March 11, 1969 W. HOFRICHTER 3,431,718

METHOD AND MACHINES FOR TWISTING TOGETHER STRANDS OF MATERIAL

Filed Feb. 11, 1965 Sheet 1 of 4

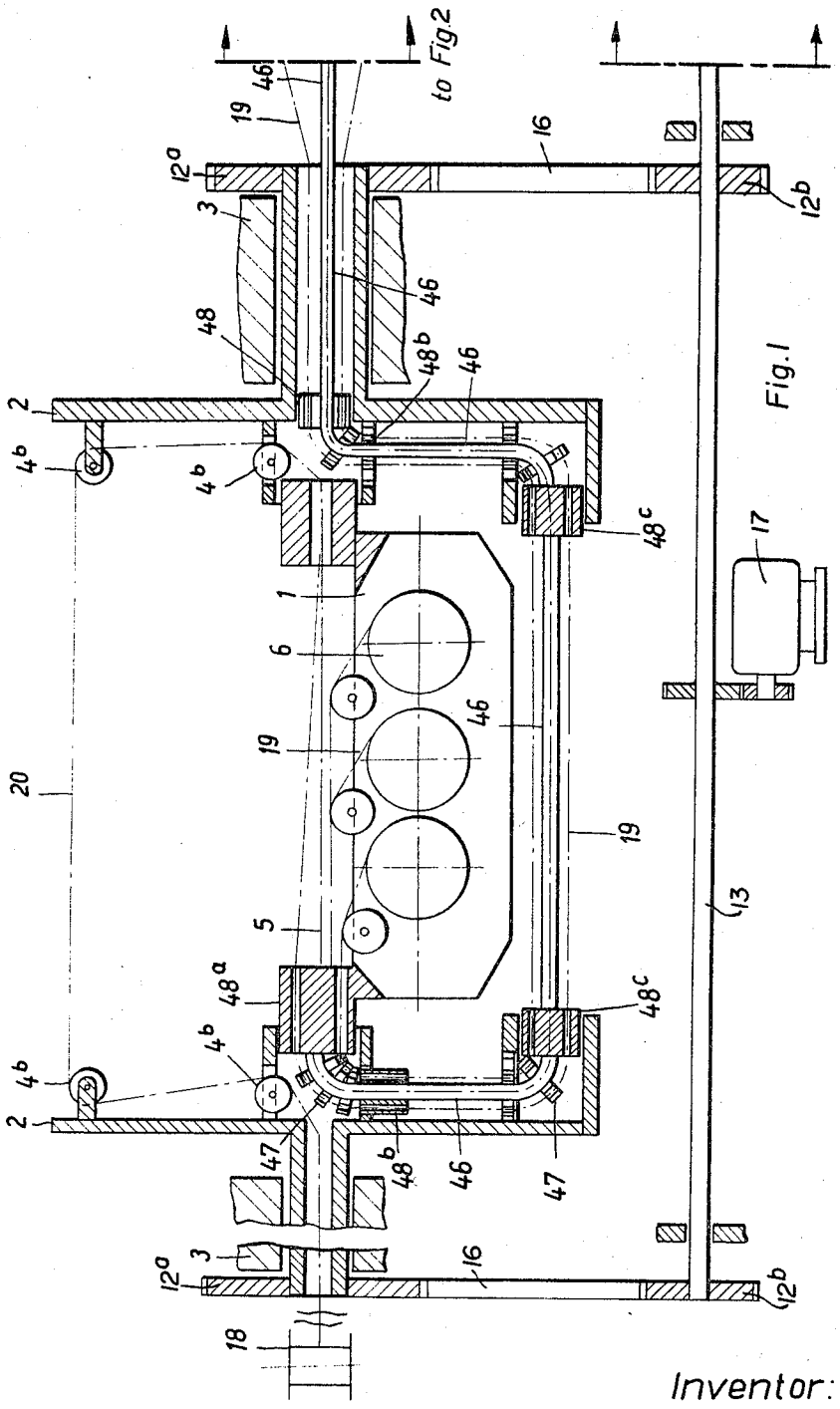


Fig.1

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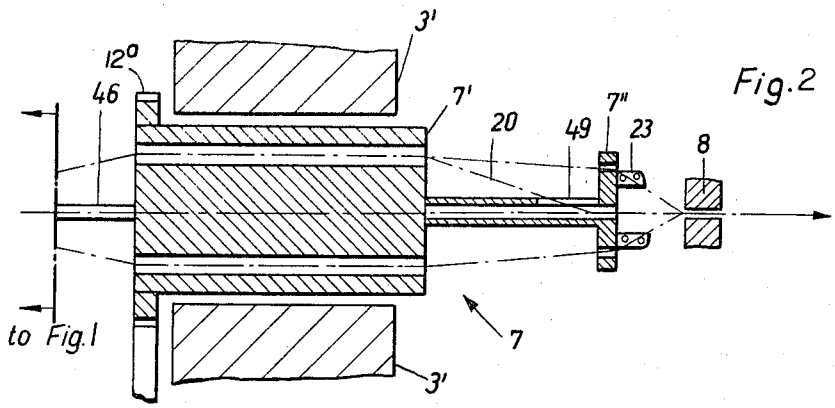


Fig.2

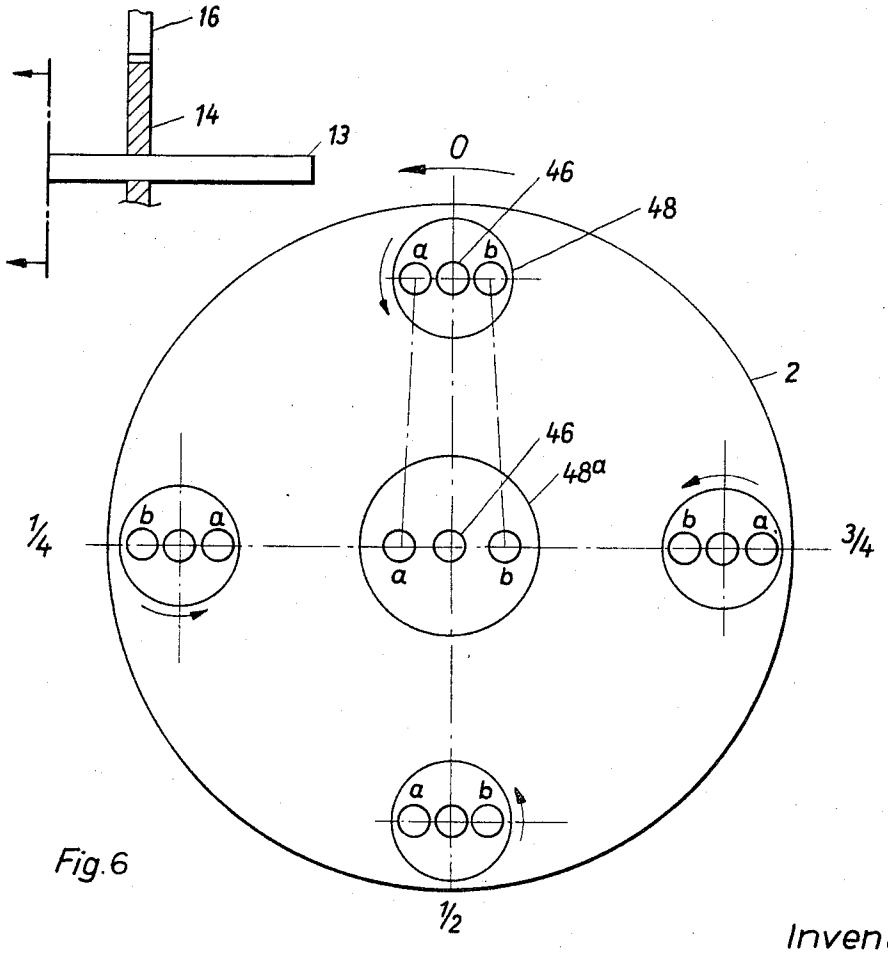


Fig.6

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METHOD AND MACHINES FOR TWISTING TOGETHER STRANDS OF MATERIAL

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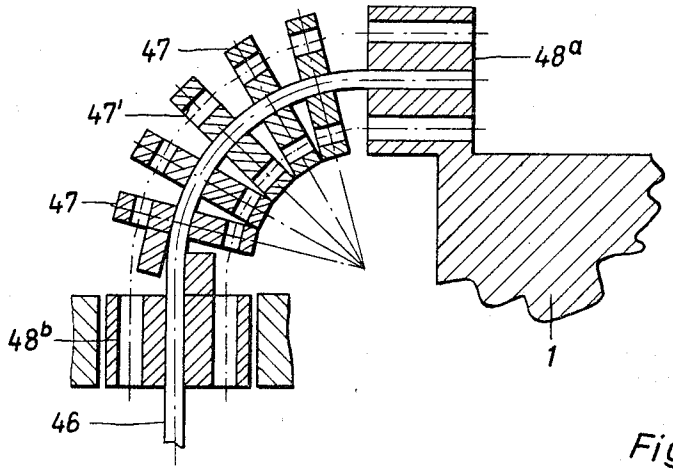


Fig. 3

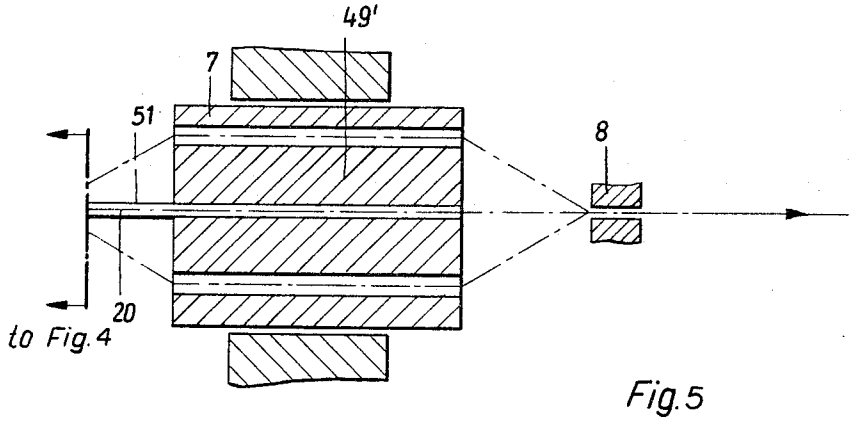


Fig. 5

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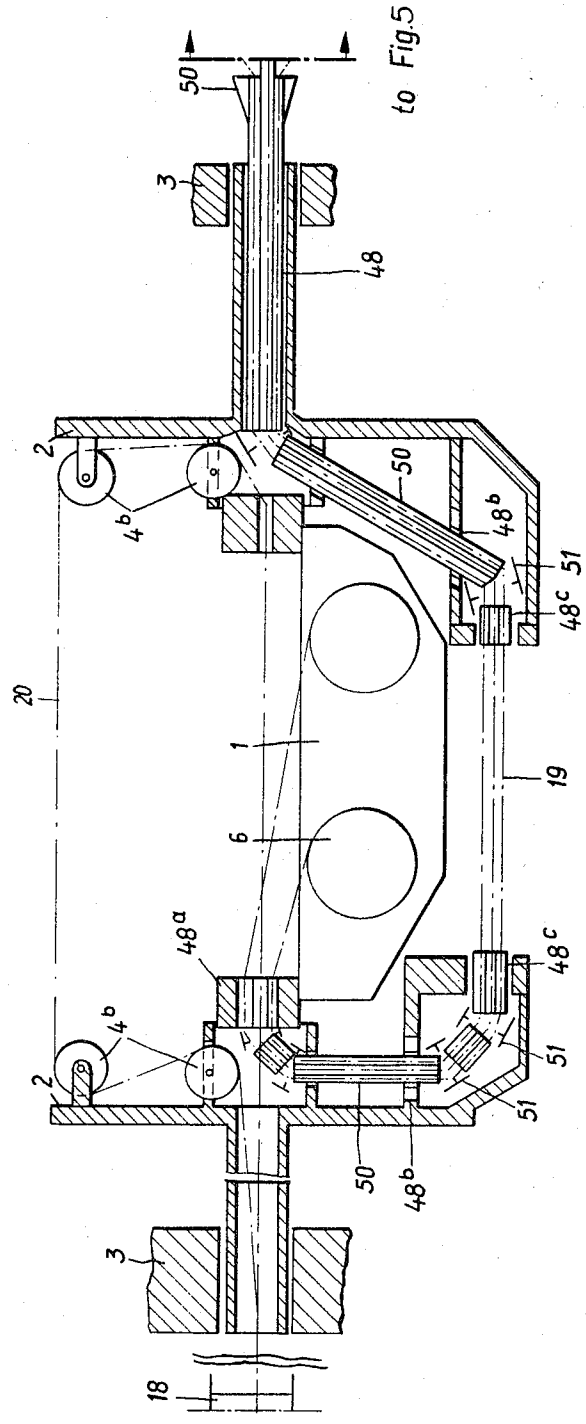


Fig.4

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3,431,718

METHOD AND MACHINES FOR TWISTING TOGETHER STRANDS OF MATERIAL

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U.S. Cl. 57—59 6 Claims
Int. Cl. D01h 7/02; D07b 3/02; D02g

ABSTRACT OF THE DISCLOSURE

Strands of material are led from a stationary real carrier in a reverse axial direction, then rotated and twisted as a group with a reel carrier support and finally led in the forward axial direction into a twisting head rotating with the same rotational sense as the carrier support, but at twice its rotational speed. The strands exiting from the twisting head enter a compression die where twisting of the strands is accomplished. The strands experience no intertwisting and no net intratwisting in their passage from the reel carrier to the compression die.

The present invention relates to methods for twisting together strands of material to form cords, cables, ropes and the like, and to a machine for carrying out these methods.

The prior methods and machines for twisting together strands of material are each useful for the production of cords or ropes from groups of materials having a particular tensile strength and elasticity, e.g., for iron, copper, brass, and plastics material on one hand or steel, hard iron wire, bronze or the like on the other hand, which corresponding to their properties and intended uses advantageously allow different production methods to be employed. Thus, for example, the production of wire cords or wire cables must be carried out in a twist and tension-free manner on high speed twisting machines and is not possible without the use of complicated auxiliary devices, while the production of cords or ropes from wires or strands of comparatively weak and inelastic materials is preferably effected by twisting on different twisting machines, so that satisfactory production using different materials involves an extremely high expenditure on machinery.

Previously proposed high speed twisting machines mostly operate with reels which are each supported in a separate, stationary reel carrier. A member formed of tubes or rods rotates around these reel carriers, so that machine lengths corresponding to the reel spacings, large weights and driving power and long reel assembly times and machine setting up times are necessary, and also accurate balancing of the large rotating masses and numerous bearings for tube members and reel carriers are required, which give rise to a high level of noise and constant supervision, maintenance and repair are necessary.

The output of the previously proposed high speed twisting machines is limited by the speed of rotation which can be reached with these machines. With these machines, for each machine rotation the strands can be twisted through only one twist. The rate of rotation of these previously proposed machines, owing to the effect of forces of inertia on the machine construction, in general amounts at the maximum to about 2800 rotations per minute, which determines the speed of twisting of the machine.

It is an object of the present invention to provide a novel and improved method for twisting together strands of material which allows the production of cables, cordage, ropes and the like of any material, independently of the tensile strength and elasticity of the material, on a single machine having a small length and a low weight and being of simple construction, and operating with low driving and supervision costs and without interruptions and maintenance.

It is a further object of the present invention to provide a method of twisting together strands and a high speed twisting machine for carrying out the method by which the speed of twisting and thus the productivity of the machine, when operating on materials of comparatively high tensile strength and elasticity with a corresponding speed of machine rotation, can be substantially greater than was previously possible, construction and operation costs of the high speed twisting machine being low.

Further objects, features and advantages of the present invention will be readily apparent to those skilled in the art from the following description of examples thereof given by way of explanation and not limitation and illustrated in the accompanying drawings, wherein:

FIG. 1 shows a schematic illustration of parts of an embodiment of the high speed twisting machine according to the invention;

FIG. 2 shows further parts which are joined to the machine parts of FIG. 1 as shown by arrows in FIGS. 1 and 2;

FIG. 3 shows a partial view, with parts broken away, of a detail of the machine shown in FIG. 1, on a larger scale for clarifying the connection of the resilient shaft to the reel carrier;

FIG. 4 shows a second embodiment of the high speed twisting machine according to the invention in a schematic partial view similar to FIG. 1;

FIG. 5 shows a view, simialr to FIG. 2, of machine parts which are joined to those shown in FIG. 4 as shown by arrows; and

FIG. 6 shows a schematic illustration of the relative rotations of single wires or strands during their passage between the reel carrier and the guide carrier.

In the drawings, similar or corresponding parts are provided with the same reference numerals.

The present invention provides a method of twisting together strands of material comprising the steps of drawing a plurality of strands from supply reels, which are mounted in a common stationary reel carrier, in a direction opposite to the direction of withdrawal of the end product, guiding the strands through at least one guide unit around the exterior of the reel carrier, passing the strands in the direction of withdrawal of the end product to a twisting head and thence to a compression die, rotating the guide unit about the reel carrier, and rotating the twisting head in the same sense but at double the speed of the guide unit, the guide unit guiding the strands from the reel carrier to the twisting head individually and separately from one another.

The invention also provides a high speed twisting machine for twisting together strands of material, comprising reel carrier supports arranged to rotate synchronously about a common axis, a stationary reel carrier being mounted between the reel carrier supports, a twisting head coaxial with the common axis being rotatable about the common axis at double the speed of rotation of the reel carrier supports, a compression die being provided coaxially with the common axis, a flexible shaft extending from the stationary reel carrier to the twisting head and being mounted on the reel carrier supports for rotation therewith, one end of the flexible shaft being fixed to the stationary reel carrier and the other end of the flexible shaft being fixed to the twisting head, the ends of the flexible shaft being directed in substantially the same di-

rection, strand guide members being mounted on and fixed to the flexible shaft. Preferably, bearing members arranged on the shaft are formed with guide openings corresponding to guide passages in the strand guide members.

The invention also provides a high speed twisting machine for twisting together strands of material comprising two reel carrier supports rotatable synchronously about a common axis, a stationary reel carrier being mounted between the reel carrier supports, a twisting head coaxial with the common axis being rotatable about the axis at double the speed of rotation of the reel carrier supports, a compression die being provided coaxially with the common axis wherein a plurality of strand guide members are connected together by universal joints for guiding strands through substantially two right angles, one of the strand guide members being connected by a universal joint to the reel carrier and another of the strand guide members being spaced from the axis and being mounted on and rotatable relative to one of the carrier supports, a further strand guide member being mounted on and rotatable relative to the other reel carrier support. Preferably, the strand guide members comprise tubes having guide passages parallel to the axes of the tubes.

The high speed twisting machine illustrated in FIGS. 1 to 3 of the drawings has a reel carrier **1** which is mounted in guide carriers **2** constructed as a reel carrier supports, the reel carrier **1** being stationary with respect to the guide carriers **2**. The guide carriers or reel supports are mounted in support frames **3** and rotate in synchronism with each other. The guide carriers **2** are driven from the main drive shaft **13** through gears **12***b* secured thereon and toothed belts **16** which extend around gears **12***a* secured on stub shafts on the guide carriers **2**. The drive shaft **13** is driven by motor unit **17** and is journaled fixed relative to support frames **3**. The guide carriers **2** each have a pair of pulleys **4***b* arranged one behind the other in the direction of travel of the strands, the pulleys **4***b* being freely rotatably mounted on the guide carriers **2** and rotating therewith about the machine axis **5**. These pairs of pulleys serve to guide the core wire **20** from core wire supply spool **18** disposed outside the machine.

The twisting head **7** shown in FIG. 2 is arranged beyond the guide carriers **2** mounted in the support frames **3**, in the direction of travel of the strands, and with its axis coinciding with the machine axis **5**, the twisting head **7** being rotatably mounted in support frames **3'** and being driven from the main drive shaft **13** by a gear **14** and a toothed belt **16** in the same direction as the guide carriers but with double the speed of rotation of the guide carriers. Thus, gear **14** is provided with twice the diameter of gears **12***b*. The twisting head **7** is constructed in two parts and comprises a disc **7''** which is fixedly connected to a head main part **7'** by a hollow shaft and which can be provided with strand holders **23**. The hollow shaft carrying the disc **7''** has at its periphery an opening **49** through which core wire **20** can be led to the centre of the disc. Compression die **8** is arranged beyond the head **7** and the twisted strands extend from the compression die **8**, if required by way of a stress-relieving device, to a take-up reel (not shown). A stress-relieving device may be required if undesirable internal stresses are present in the resulting rope of twisted strands. Such stresses arise due to the twisting of the strands together and the passage through the compression die. These stresses act to urge an untwisting of the rope, should the rope be cut. They are usually not of such size that they actually cause an untwisting, but do result in a lowering of the tightness of the twisting. The functioning of the stress relieving device is to give the rope an excess twist in the same twist direction used to twist the individual strands together. Following this, the rope is led back into its normal twisted condition. Such treatment relieves the internal stresses.

A flexible shaft 46 extends from a sub shaft 48*a* on the reel carrier **1** at the axis **5** of the machine and after bending through 90° is supported in a bearing **48***b* and after a further bend through 90° is supported in a further bearing **48***c* on the left-hand guide carrier **2**. The shaft **46** then extends substantially parallel to the axis **5** of the machine to the right-hand guide carrier **2** at the draw-off side of the machine, at which it is likewise supported in bearings **48***c*, **48***b* and **48**. From the bearing **48**, the flexible shaft extends to the head part **7'** of the twisting head **7**, with which it is rigidly connected. These bearings being secured to the shaft **46**, have strand openings. Corresponding openings are provided in perforated discs **47**, which are arranged in the vicinity of the bends in the flexible shaft **46** for guiding the separate strands **19** from the supply spools, and are fixed on the shaft **46**. The arrangement and construction of the perforated discs **47** and of the bearings **48** can be seen from FIG. **3**. The perforated discs **47** and the bearings **48**, **48***a*, **48***b* and **48***c* are provided with a plurality of guide openings **47'** so that ropes, cables and the like having different numbers of strands can be produced without replacing these guide members and bearings.

Strands **19** drawn from the supply reels **6** extend separately into the guide openings in stub shaft **48***a*, into guide openings **47'** in the perforated discs **47** and the guide openings in the bearings **48**, **48***a*, **48***b* and **48***c* parallel to the shaft to the twisting head **7** and then to the compression die **8** without the individual strands being twisted. On rotation of the reel carrier supports or guide carriers **2**, the flexible shaft **46** carries out a rotation about its own axis corresponding to that of the separate strands guided along the flexible shaft **46**. Owing to the bending of the flexible shaft **46**, this shaft is rotated about its own axis at a speed which, at the bearing **48**, is double that of the rotation of the right-hand reel carrier support **2**. This rate of rotation corresponds to the rate of rotation of the twisting head **7**, with which the shaft **46** is rigidly connected. The rotational movement of the twisting head **7** thus cancels out the rotational movement of the shaft **46**. The movements of the shaft **46** can be seen from FIG. 6, which schematically illustrates the relative movements of the bearing **48***a* and the bearing **48** in one rotation of the guide carrier **2**. As can be seen from this drawing, the shaft **46** carries out between these two bearings a double rotation on rotation of the guide carrier, this double rotation being canceled out by the rotation of the twisting head **7**. Two strand guide openings are indicated by *a* and *b* as reference guide openings.

In the construction of the high speed twisting machine shown in FIGS. 4 and 5, instead of the flexible shaft **46**, guide members **50** are provided which are connected together by universal pivot connection elements **51**, which are only illustrative schematically. The first guide member **50** in the direction of travel of the strands **19** from the reels is universally pivotably connected with the stub shaft **48***a*, while between the twisting head **7** and the guide member **50** next to the twisting head **7** a connection is formed only by the individual strands **19**. The last guide member **50** in the direction of travel of the strands can however also be rigidly connected with the twisting head **7**. In the same manner, between the guide elements **50** supported in the bearings **48***c*, a connection is provided only by the strands **19**, but a rigid connection element can also be employed here.

The travel of the strands is the same in both these machines, it is therefore not considered necessary to describe this again. As is evident from the drawings and what has been said above, there is no intertwisting of the strands in their passage from the reel carrier to the compression die. Furthermore, the net amount of intratwisting of the strands in this passage is zero. Here, a distinction is made between intertwisting nad intratwisting, where intertwisting means a twisting of strands together, while intratwisting refers to the twisting of individual strands. The guide members **50** preferably com-

prise tubular members with a number of axial passages corresponding to different strand types.

The core wire **20** is fed in, as shown in FIGS. 1 and 2 and in FIGS. 4 and 5, from core wire supply reel **18** in the direction of withdrawal of the end product through the hub of the left-hand guide carrier **2**, is deflected twice by the pair of pulleys **4***b*, and after rotating about the reel carrier **1** is guided along the axis **5** in the direction opposite to the direction of withdrawal of the end product, whereupon the core wire **20** is guided together with one of the strands **19** drawn from the spool **6** and passes therewith to the twisting head. In the machine construction illustrated in FIGS. 1 and 2, the core wire **20** after passing through the twisting head main part **7'** is separated from the corresponding strand **19** and fed through the opening **49** to the centre of the twisting disc **7''** from which it extends centrally into the compression die **8**. In the construction shown in FIGS. 4 and 5, the passage of the core wire is the same as that in the machine shown in FIGS. 1 and 2 as far as the passage of the core wire into the stub shaft **48***a* of the reel carrier **1**, but from here it passes in the centres of the guide members **50** by itself and centrally into the twisting head **7**. After passing the twisting head **7** it travels centrally into the compression die **8**.

Since the rotational drive for FIGURES 4 and 5 is the same as that for FIGURES 1 and 2, it is not illustrated again.

The invention is not limited to the embodiments described and illustrated. Modifications are possible within the scope of the protection of the subject matter of the invention. Thus, it is for example conceivable to construct the carrier for the twisting head and the untensioning device so that they are movable transversely of the machine axis to allow the mechanism to be adapted for use with different materials in a short time and with little work.

I claim:

1. A high speed twisting machine for twisting together strands of material, comprising first and second reel carriers supports, means for rotating said reel carrier supports synchronously about a common machine axis, a stationary reel carrier mounted between said reel carrier for supplying separate strands, a twisting head coaxial with said common machine axis, means for rotating said twisting head about said axis in the same direction as, but at twice the speed of rotation of, said reel carrier supports, a compression die having its axis coincident with said axis, and guide means, cooperating with said reel carrier supports, to guide strands from said reel carrier, without intertwisting of the strands and without a net amount of intratwisting of the strands, to said compression die.

2. A high speed twisting machine as claimed in claim **1**, said guide means comprising a flexible shaft extending from said reel carrier to said twisting head, one end of said flexible shaft being fixedly connected to said reel carrier and the other end of said flexible shaft being fixedly connected to said twisting head, said flexible shaft being rotatably mounted on said guide carriers, the ends of the flexible shaft being directed in substantially the same direction, and strand guide discs mounted on and fixedly connected to said flexible shaft for rotation with said flexible shaft.

3. A high speed twisting machine as claimed in claim **2**, said guide discs formed with guide openings, said guide means further comprising bearing means mounted on and fixedly connected with said flexible shaft, said bearing means having guide passages aligned with said guide openings.

4. A high speed twisting machine as claimed in claim **1**, said guide means comprising separate, universally connected strand guide members rotatable on said carrier supports about the axes of said guide members, one of said guide members being disposed adjacent the reel carrier and universally connected thereto the directional path of said strands through said guide members being substantially as follows: withdrawal from said reel carrier substantially along said axis and away from said twisting head, thence radially outwardly of said axis, past said carrier, radially inwardly towards said axis, thence along said axis into said twisting head.

5. A high speed twisting machine as claimed in claim **4**, wherein said guide members comprise tubes formed with a number of borings parallel to their axes.

6. A method of twisting together strands of material comprising the steps of:

(a) drawing a plurality of strands in a group in a first axial direction without rotating the group;

(b) passing the group out of the first direction into a second direction on the axis of the first direction and opposite to the first direction;

(c) revolving that portion of the group passing into the second direction from the first direction, about said axis without intertwisting the strands;

(d) rotating that portion of the group moving in the second direction, about said axis at a rotational velocity of the same rotational sense of step (c) and twice the velocity of revolution in step (c); and

(e) compressing the group and preventing its rotation about said axis, while maintaining its movement in the second direction.

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