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Sarracino

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[54] **DOUBLE-TWIST STRANDING OR CABLING MACHINE**

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[52] **U.S. Cl.** **57/58.52,** 57/58.65, 57/58.7

[51] **Int. Cl.** **D07b 3/10**

[58] **Field of Search** 57/58.49, 58.52, 58.54, 57/58.55, 58.57, 58.65, 58.67, 58.68, 58.7, 58.87

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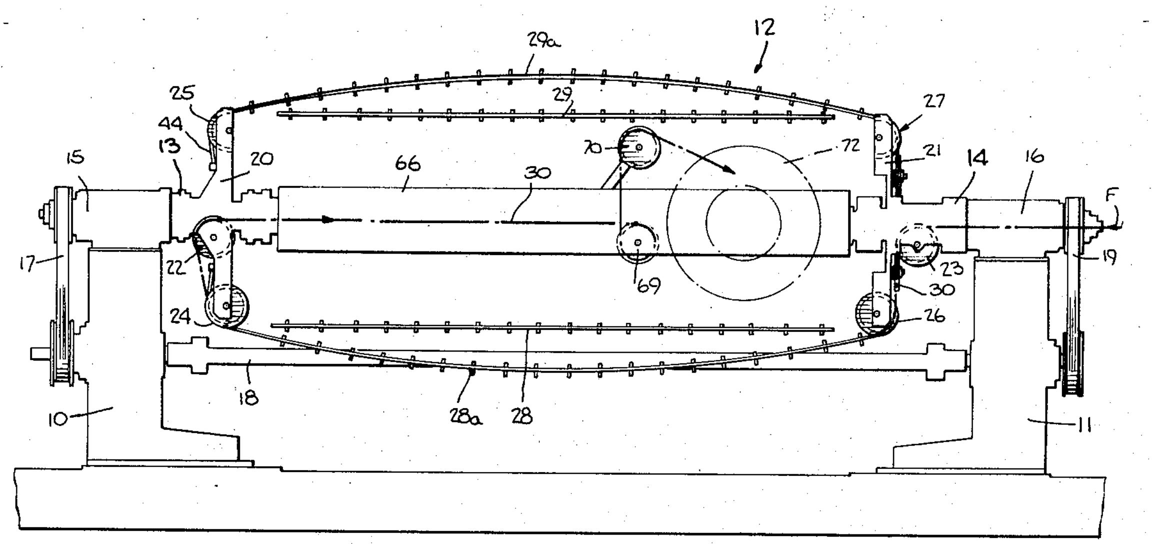
Attorney, Agent, or Firm—Brooks Haidt & Haffner

[57] **ABSTRACT**

A double-twist stranding or cabling machine in which wires to be twisted pass through a hollow shaft to a pulley on a rotating arm to be twisted, then over a flexible transfer track to a second arm to be returned to a central take-up reel on a rocking cradle while being twisted again. The flexible transfer tracks can be formed by steel ropes which are pulley mounted and spring tensioned to extend from a flat state to a curved state during operation of the machine. This flexibility of the tracks avoids the undesirable bending stresses which affect prior art transfer tracks or arcs, which are relatively rigid and inflexible.

8 Claims, 3 Drawing Figures



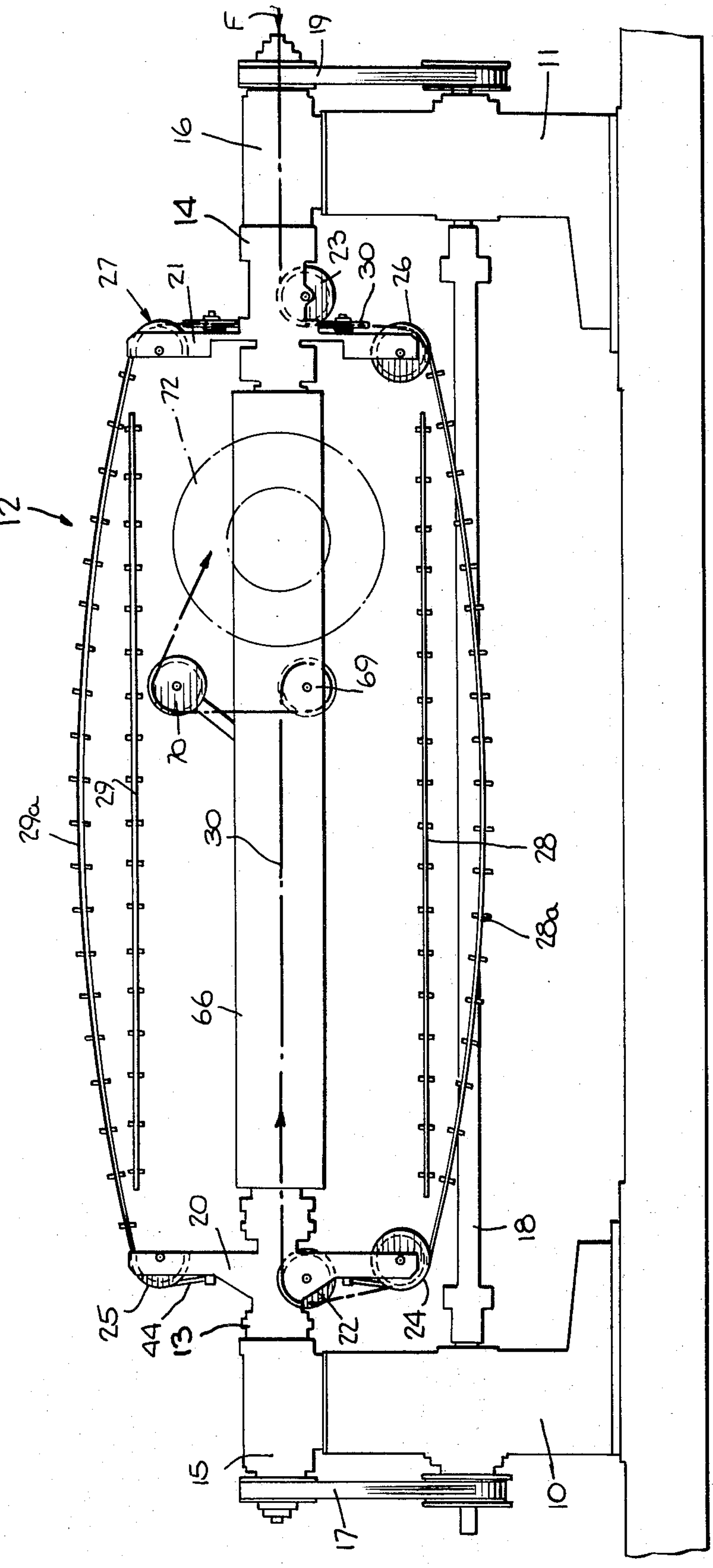

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Fig. 1.

Fig. 3.

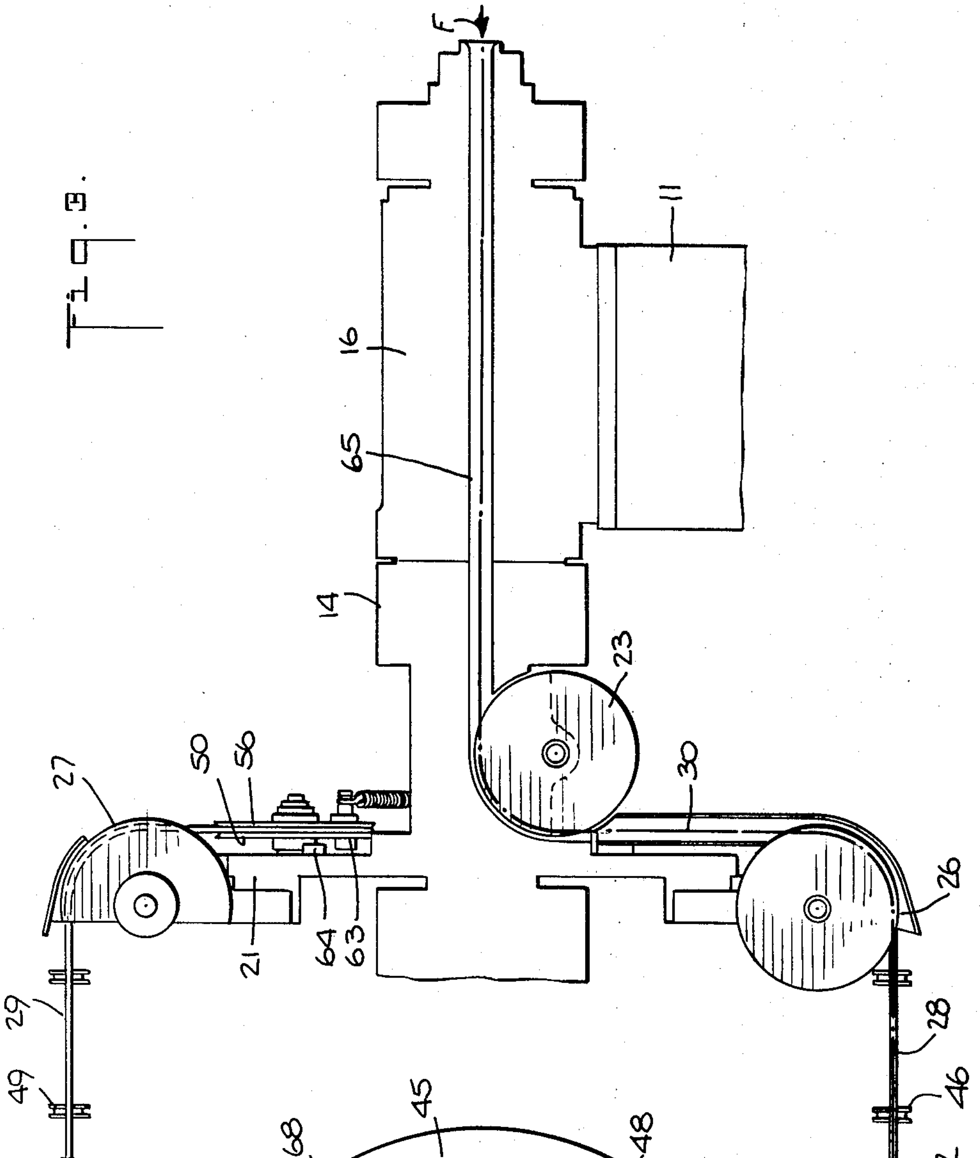
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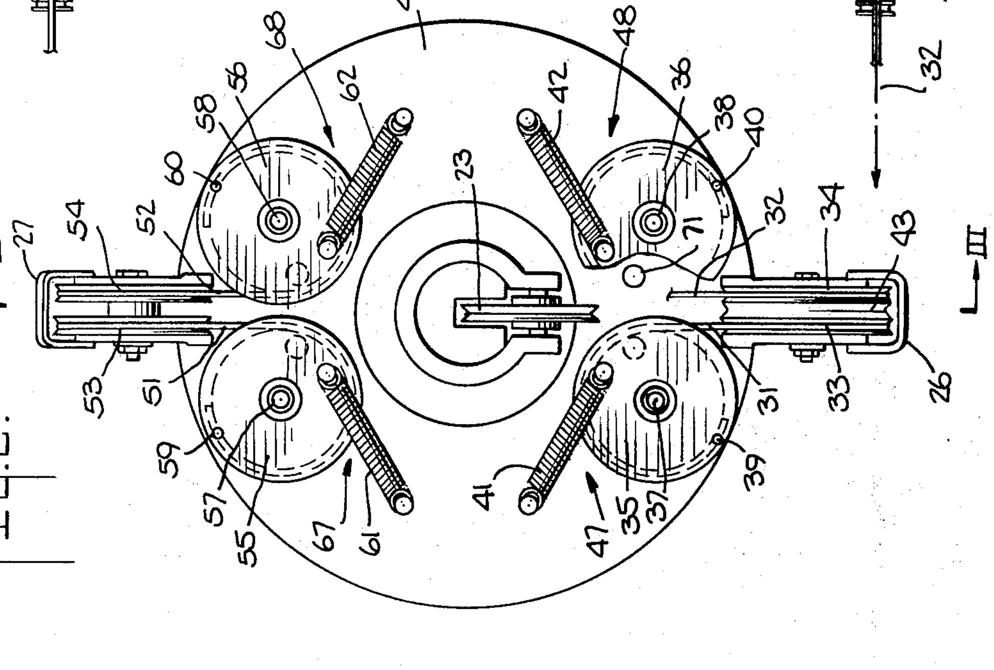
Fig. 2.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DOUBLE-TWIST STRANDING OR CABLING MACHINE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an improved double-twist stranding or cabling machine. More particularly the machine of the invention is especially, but not exclusively, suitable for stranding individual bare wires to obtain cords or strands as well as for twisting or stranding insulated wires for the manufacture of telephone or power cables.

2. Description of the Prior Art

The most advanced double-twist stranding machines heretofore used have employed a twisting unit having a pair of aligned shafts, one of which shafts is hollow. Each of the aligned shafts of prior art twisting units carries an arm element arranged perpendicularly to, and keyed to, the shaft. These arms can be shaped as cones or discs and are in spaced opposed positions, and tracks extend between the opposed arms for the transfer of wire from one arm to the other. The two shaft and arm assemblies rotate about the same axis at a synchronized speed.

The wires to be stranded pass through a central cavity of the hollow rotating shaft and are conveyed towards wire-guiding means situated on the arm near the place where they emerge from the cavity in the shaft; at this point they are dragged into rotation along with the rotating arm, and are thus subjected to a first twist. From the point at which the wires are first twisted, the wires are guided by appropriate means to a transfer track which brings the wires which have already been subjected to the first twist towards the facing surface of the opposite arm where, by means of guiding means secured to this second arm and symmetrical to those of the first arm, the wires are brought again to the axis of the twisting unit to be subjected to a second twist and to be returned to rectilinear motion. Then the wires are collected on a drum. Prior art machines of the above described type are called "inner take-up" machines.

Stranding machines of a so-called "outer take-up" type are also known in which the wires to be stranded follow a similar path, but in the reverse direction, from inside to outside the machine to be taken up outside the positions of the arms as opposed to inside as in the "inner take-up" type of machine.

Generally, the transfer tracks for transferring the wire from one arm to the other are formed as "arcs." In most cases, there are two such arcs, symmetrically arranged with respect to the longitudinal axis of the machine, which axis is also the axis of rotation of the twisting unit. In general, the arcs of prior art twisting units have a curved shape approximating a parabola, designed to comply with the requirement that the unit occupy the minimum space and also intended to generate acceptable stresses on the various components of the machine during operation. Arcs of various types are known; among those widely used are arcs made of synthetic resin, tubes and rods made of steel, metal plates and so on.

The above described generally parabolic configuration does not, however, avoid the generation of bending stresses in the arc during operation along with the unavoidable tension stresses. Such bending stresses on

the generally inflexible arcs of the prior art can sometimes cause the arcs to break.

In order to ensure perfect reliability of a generally inflexible arc of the type described it would be necessary to form the arc with a geometrical configuration able to eliminate any bending stress under the action of centrifugal forces, so that the only effective stress would be that due to tension. Such a bending-stress-free configuration is difficult to achieve in practice, since centrifugal forces acting on the arc in operation would have to be considered, and such forces are not uniform but, being directly proportional to the rotation radius, vary from point to point along the arc.

The present invention aims at obviating the above indicated disadvantages by providing tracks for the transfer of the wires which are perfectly flexible and which, in operation, spontaneously take on the configuration required by the centrifugal forces involved, and therefore operate under tension alone.

SUMMARY OF THE INVENTION

The present invention relates to a double-twist stranding or cabling machine of the type in which the twisting unit comprises at least a pair of shafts, at least one of which shafts is hollow. The shafts are aligned and each shaft carries an element shaped as a disc or arm perpendicular to and keyed to the shaft. The disc-shaped elements or arms are spaced apart from one another, in an opposed face-to-face relationship and are connected by at least one pair of transfer tracks for the wire to be twisted. There are preferably two such transfer tracks, symmetrically situated with respect to the axis of the twisting unit. Means for transferring and guiding the wire are provided on the shafts and on the disc-shaped elements or arms. Each of the transfer tracks comprises at least one flexible element which is able, under normal working conditions, to take on a configuration proportional at any point to the centrifugal forces involved. Each transfer track has elastic means for recovering and limiting its own elongation.

The invention will be more fully understood by consideration of the following detailed description of a preferred embodiment of the invention, especially when read in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The figures of the attached sheets of drawings represent by way of non-limiting example an embodiment of the invention; more precisely:

FIG. 1 is a diagrammatical view of a preferred embodiment of the stranding or cabling machine according to the invention;

FIG. 2 represents an external view of the disc-shaped element or arm of the twisting unit of the machine shown in **FIG. 1**;

FIG. 3 is a view in section, taken along line III—III of **FIG. 2**, and looking in the direction of the arrow, of the disc-shaped element or arm of the twisting unit of the machine shown in **FIG. 1**.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

The stranding or cabling machine illustrated in **FIG. 1** is of the "inner take-up" type and comprises supports **10** and **11**, carrying a twisting unit generally indicated by the reference numeral **12**. The twisting unit **12** comprises two mutually aligned, rotatable shafts 13 and 14. The shafts 13 and 14 are seated respectively in seats 15 and 16 and are arranged to be driven by a driving system including a belt 17 for driving the shaft 13, a transmission shaft 18, and a belt 19 for driving the shaft 14. Both belts 17 and 19 are operatively connected to the transmission shaft 18 to synchronize the speed of the two shafts 13 and 14.

Each of the shafts 13 and 14 carries an arm, keyed to the shaft for rotation therewith. In the preferred embodiment shown in the drawing, the arms 20 and 21 of the shafts 13 and 14 respectively are formed as disc-shaped elements hereinafter referred to as "discs," but the arms could be conically or otherwise shaped elements extending generally perpendicular to the axis of rotation of the shaft.

Each of the shafts 13 and 14 also carries, mounted in proximity to its disc 20 or 21, a wire deflecting pulley 22 or 23, respectively. Groups of pulleys 24, 25 and 26, 27 are mounted on the discs 20, 21, respectively, just within the periphery of the discs 20, 21 and in proximity to the ends of respective transfer tracks 28 and 29. The straight line configurations of the tracks indicated by the dashed lines 28 and 29 show the tracks in rest position. The curved configurations of the tracks 28 and 29 shown in solid lines at 28a and 29a indicate the elongation of said transfer tracks in response to centrifugal force during operation under normal working conditions.

In the embodiment of the stranding-cabling machine of the invention shown in the drawing, the track 28 behaves in operation as a true transfer track for carrying wires 30, which have been subjected to a first twist. The other track 29 serves only to counterbalance the track 28 during operation, and carries no wire. The track 28 comprises two wire cables or steel ropes 31 and 32 but could alternatively have but a single rope. The ropes 31 and 32 are stretched between the disc-shaped element 20 and the element 21 and are carried by the races of lateral pulleys of the pulley groups 24 and 26. FIG. 2 of the drawing shows only the lateral pulleys 33 and 34 of the pulley group 26, but it will be understood that the arrangement of the pulleys of group 24 at the disc 20 can be similar. The rope 31 is carried by the race of pulley 33 and the rope 32 is carried by the race of pulley 31. One end of each of the ropes 31, 32 can be secured directly to the outer face 44 of disc 20 and the other end of each rope 31, 32 engages the outer face 45 of disc 21 as shown in FIG. 2, through an elastic extension and recovery mechanism for each rope, namely the mechanism 47 for rope 31 and the mechanism 48 for rope 32.

The extension and recovery mechanisms 47 and 48 for the steel ropes 31 and 32 of the transfer track 28 allow the steel ropes to be extended to a limited decree to take on a curved configuration under tension in response to centrifugal forces resulting from rotation of the twisting unit 12 and also provide for recovery, i.e., shortening and straightening of the transfer track 28 from the extended operating position (28a of FIG. 1) when the centrifugal forces decrease.

The recovery mechanism 48 is a mirror symmetrical image of the mechanism 47, so the mechanism 47 will be described with odd reference numbers and even reference numbers in parentheses will refer to similar elements of the recovery unit 48.

The extension and recovery mechanism 47 (48) comprises a race pulley 35 (36) pivoted about its center 37 (38). The rope 31 (32), whose terminal portion is secured in said race, is locked in place at its end by a clamp 39 (40) with which the pulley 35 (36) is provided. A helical spring 41 (42), secured at one end to pulley 35 (36) at a point arcuately spaced from the clamp 39 (40), and at its other end to the outer face 45 of disc 21, keeps rope 31 (32) under tension.

An abutment means (not shown in FIG. 2) is provided on the face of pulley 35 (36) which is directed towards disc 21, to engage a corresponding stop (only stop 71 being shown in FIG. 2 beneath the broken-away portion of the pulley 36) provided on the outer face 45 of disc 21. This stop is arranged at a perdetermined position in order to limit the extent of travel of pulley 35 (36) and the corresponding elongation of spring 41 (42) in response to the effect of centrifugal force on the track 28 when the twisting unit 12 is operative.

In the illustrated stranding or cabling machine, the track 29 is provided only for the purpose of counterbalancing track 28 during operation. Like the track 28, track 29 comprises two steel ropes 51 and 52 which, stretched between the disc-shaped elements 20 and 21, pass in the races of the two pulleys forming each of the pulley groups 25 and 27 (FIG. 2 shows pulleys 53 and 54 of group 27, respectively, for ropes 51 and 52), so that one end of each rope can be secured directly to the outer face 44 of disc 20 and the other end of each rope engages the outer face 45 of disc 21 through an elastic recovery mechanism for each rope, namely mechanism 67 for rope 51 and mechanism 68 for rope 52. As shown in the drawing the mechanisms 67 and 68 are similar to the mechanisms 47 and 48 described above and a similar reference numeral convention is followed.

Each recovery mechanism 67 (68) of track 29 thus comprises, as in the case of track 28, a race pulley 55 (56) pivoted at its center 57 (58). The rope 51 (52), whose terminal portion is carried in said race, is locked at its end to the pulley 55 (56) by the clamp 59 (60) with which pulley 55 (56) is provided. A helical spring 61 (62), secured at one end to pulley 55 (56) and at the other end to the outer face 45 of disc 21, keeps rope 51 (52) under tension.

An abutment means provided on the face of pulley 55 (56) which is directed towards disc 21 is able to engage a corresponding stop provided on the outer face 45 of disc 21, to limit to a pre-established extent the travel of pulley 55 (56) and the elongation of spring 61 (62) under the effect of centrifugal force when the twisting unit 12 is operative. FIG. 3 shows only abutment means 63 provided on face 50 of pulley 56, for engaging stop 64, but it will be understood that similar abutment means and stops are provided for the other pulleys 35, 36 and 55.

In a modified embodiment of the invention the ropes 31 and 32, 51 and 52 could also be provided with recovery mechanisms at the other disc 20 for extension and recovery of the ropes at the outer faces 44 and 45 of both discs 20 and 21.

The extension and recovery mechanisms 47, 48, 67, 68 can, of course, be different from those of the currently preferred embodiment described above. In a further modification of the invention, each of said extension and recovery mechanisms can, for instance, comprise a slider slidable in appropriate guides, the slider being connected at one end to a helical spring, the other end of which spring is secured to the outer face of the corresponding disc. The travel of the slider can be limited by an upper stop, with the length of the rope constituting the lower limit for the slider's travel.

Each pulley group **25** and **27** comprises only two pulleys, for example, pulleys **53** and **54** of group **27**, but the pulley groups **24** and **26** comprise three pulleys, namely two lateral pulleys, e.g., the pulleys **33** and **34** of group **26**, by which the two ropes **31** and **32** are deflected, as well as an intermediate pulley, shown at **43** in group **26**. The intermediate pulley **43** serves as a guide for the wire **30** to be twisted and is located between the pulleys **33** and **34**. All three pulleys **33, 34** and **43** could be on a common shaft.

Bushes **46** are provided around the track **28** at appropriately spaced positions to serve as a guide for the wires **30**. The bushes **46** also act as spacing elements to keep constant the distance between the ropes **31** and **32**. Analogous spacing elements **49** are provided around the track **29**. If necessary, said bushes **46**, and for symmetry also the bushes **49**, could be replaced by a flexible hose, appropriately connected to the ropes.

The hollow shaft **14** has a cylindrical cavity **65** coaxial with the shaft **14**. The wire-engaging circumferential surface of the deflecting pulley **23** is aligned with the cavity **65** to receive wire approaching the pulley **23** through the cavity **65**. The disc **20** is also provided with a cylindrical cavity therethrough (not shown) aligned with the wire receiving surface of the deflecting pulley **22**.

Between disc **20** and disc **21** there is a rocking cradle **66**, schematically shown in FIG. **1**, upon which are mounted a take-up reel **72** for twisted wire and deflecting pulleys **69** and **70**. In a stranding or cabling machine of the "outer take-up" type otherwise corresponding to the inner take-up machine of the preferred embodiment shown in the drawing, the cradle **66** would house the wire supplying reels instead of the take-up reel.

Operation

The wires **30** to be twisted or stranded are arranged, while the machine is in rest condition, by unwinding them from supply reels (not illustrated) disposed outside the twisting unit **12**. The wires are caused to advance in the direction of the arrow F in FIG. **1** along a path through the central cavity **65** of the shaft **14** to the deflecting pulley **23**, over the pulley **43**, through bushes **46**, over the intermediate pulley of the pulley group **24**, over the deflecting pulley **22**, through the cylindrical cavity of the disc **20**, over the pulleys **69**, pulley **70**, and are then anchored to reel **72**.

When the twisting unit **12** is in rest condition, namely when the centrifugal force is not acting and therefore the machine is at a standstill, the tracks **28** and **29** are stretched flat under tension, since the springs **41, 42** and **61, 62** respectively belonging to the recovery mechanisms **47, 48** and **67, 68**, recover any excess portion of the ropes by which the length of the ropes forming the tracks exceeds the distance between discs **20** and **21**.

When the twisting unit is started, and while its rotation speed is progressively increasing, the springs **41, 42** and **61, 62** of the elastic recovery mechanisms **47, 48** and **67, 68** elongate gradually, so that the tracks **28** and **29** continuously change their configuration in response to the increase of the centrifugal forces. This extension of the tracks stops when the pulleys **35, 36** and **55, 56**, forming part of the recovery mechanisms have rotated to a point at which the abutment means provided on the pulleys is brought into contact with the stop provided on the discs. At this moment, the ropes have reached a configuration **28*a*, 29*a***, which remains constant as long as the machine works under normal service conditions.

When the twisting unit **12** is operating, the wires **30**, which advance with a translatory motion only through the cylindrical cavity **65** of the hollow shaft **14**, are subjected to a first twist at the pulley **23**, where they are compelled to twisting movement by the rotational motion transmitted to the pulley **23** by the rotating shaft **14**.

The wires, simply stranded in this way, pass on to the pulley **43** and, through the bushes **46** of track **28**, are conveyed to the intermediate pulley of group **24** and then to the deflecting pulley **22**. After passing over the pulley **22** the wires **30** pass through the cylindrical cavity through disc **20** and are wound up on the winding drum or reel **72** mounted on the cradle **66**. Since the cradle **66** and take-up reel **72** do not take part in the rotation of the twisting unit **13**, the wires are subjected to a second twist between the pulley **22** and the pulley **69**.

A remarkable advantage afforded by the above illustrated twisting unit resides in the fact that, because the tracks **28** and **29** are perfectly flexible, the configuration **28**a and **29**a taken spontaneously during the operation is just that required by the centrifugal forces evolved by rotation. The only stresses generated in the steel ropes constituting the transfer tracks are mere tension stresses which can be easily calculated, and consequently any possibility of ruptures or other damage is eliminated.

Numerous obvious modifications in the structure, parts and operation of the invention will obviously suggest themselves to those skilled in the art and such modifications are within the spirit and scope of this invention.

What is claimed is:

1. In a wire stranding machine having a twisting unit comprising a pair of twisting means rotatable about a predetermined axis for receiving and twisting a plurality of wires, said twisting means being spaced from each other in the direction of said axis, and means for supplying said wires to and receiving stranded wires from said pair of twisting means, the combination therewith of at least a pair of flexible track means extending between said twisting means, one of said track means being disposed to guide said wires from one of said twisting means to the other thereof and being disposed at one side of and in spaced relation to said axis and the other of said track means being disposed at the opposite side and in spaced relation to said axis, means for securing one end of each of said tracks at one end to one of said twisting means, means for securing the opposite end of each of said tracks to the other of said twisting means for rotation of said tracks around said axis, said tracks being free intermediate their ends to move outwardly with respect to said axis under the centrifugal forces to which they are subjected during said rotation thereof, and elastic means urging said tracks inwardly and toward said axis and limiting the outward movement of said tracks.

2. A wire stranding machine as set forth in claim 1, wherein at least one of said tracks comprises a pair of metal ropes in side-by-side relation and further comprising means for guiding said wires along said ropes and for maintaining said ropes in spaced relation to each other.

3. A wire stranding machine as set forth in claim 2, wherein said last-mentioned means comprises a plurality of bushes extending around each of said ropes, said bushes being spaced lengthwise of said ropes and having openings therethrough for receiving said wires.

4. A wire stranding machine as set forth in claim 1, wherein said elastic means comprises at one end of each track means, a tension applying member movably mounted on one of said twisting means and means for securing the track means to said member, an elastic member acting between said tension applying member and said one twisting means to urge said tension applying member in a first direction which tends to elongate the track means and stop means for limiting movement of said tension applying member in a second opposite direction.

5. A wire stranding machine as set forth in claim 4, wherein said tension applying member comprises a pulley rotatably mounted on the twisting means and having a race receiving the track means, said elastic member is spring means acting between the twisting means and said pulley to urge said pulley to rotate in a direction which tends to elongate the track means and said stop means comprises an abutment on said pulley engageable with a portion of the twisting means.

6. A wire stranding machine as set forth in claim 1, wherein said twisting means comprises a pair of rotatable shafts mounted with their axes co-axial with said axis and spaced from each other in the direction of said axis, at least one of said shafts having an opening therein at least a portion of which extends axially thereof for feeding said wires therethrough and outwardly thereof, first guide means mounted on said one shaft and spaced outwardly from said axis for receiving said wires from said opening and supplying said wires to one end of one of said track means, said first guide means being rotatable around said axis by said one shaft, second guide means mounted on the other of said shafts and spaced outwardly from said axis for receiving said wires from the other end of said last-mentioned one of said track means, said second guide means being rotatable around said axis by said other shaft and further comprising means for receiving said wires from said second guide means.

7. A wire stranding machine as set forth in claim 6, wherein at least one of said tracks comprises a pair of metal ropes in side-by-side relation and further comprising means for guiding said wires along said ropes and for maintaining said ropes in spaced relation to each other.

8. A wire stranding machine as set forth in claim 7, wherein said elastic means comprises a tension applying member movably mounted on one of said shafts for rotation therewith, means for securing the ends of said ropes nearer said one shaft to said member, spring means acting on said member in a direction which tends to elongate said ropes and stop means for limiting movement of said member in the opposite direction.

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