April 2, 1935. A. ROHS 1,996,689

METHOD OF AND APPARATUS FOR MANUFACTURING ROPES FROM NONCIRCULAR WIRES

Filed May 9, 1931 3 Sheets-Sheet 1

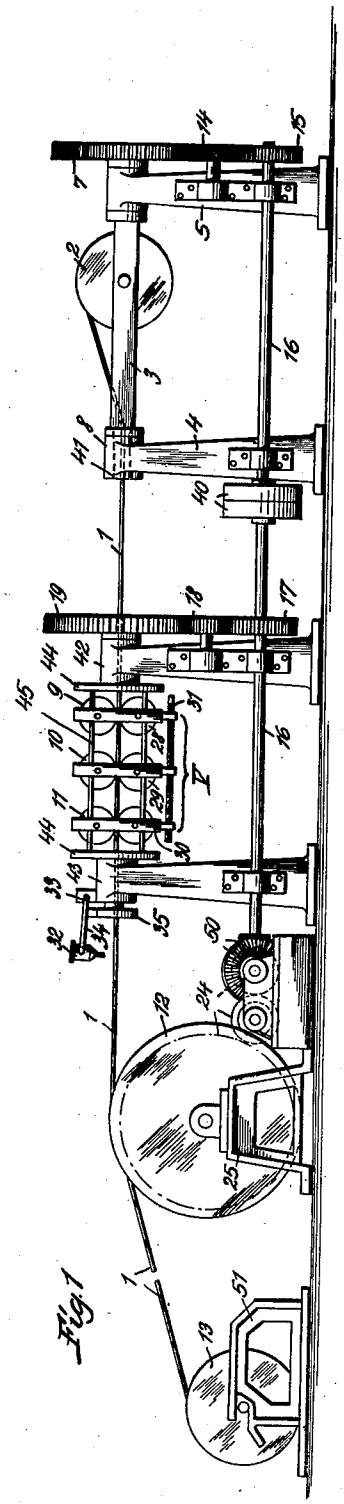

Fig. 1

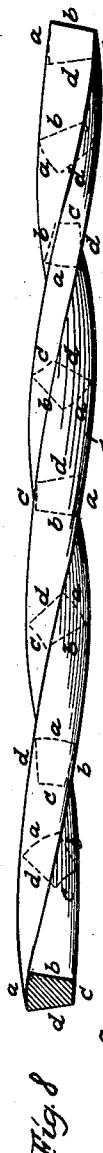

Fig. 8

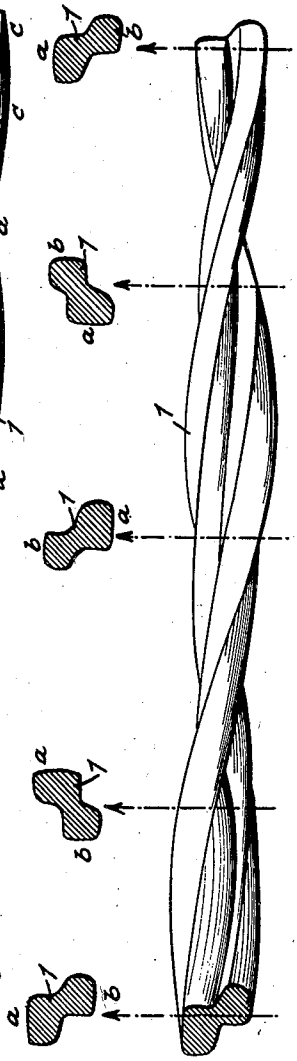

Fig. 9

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METHOD OF AND APPARATUS FOR MANUFACTURING ROPES FROM NONCIRCULAR WIRES

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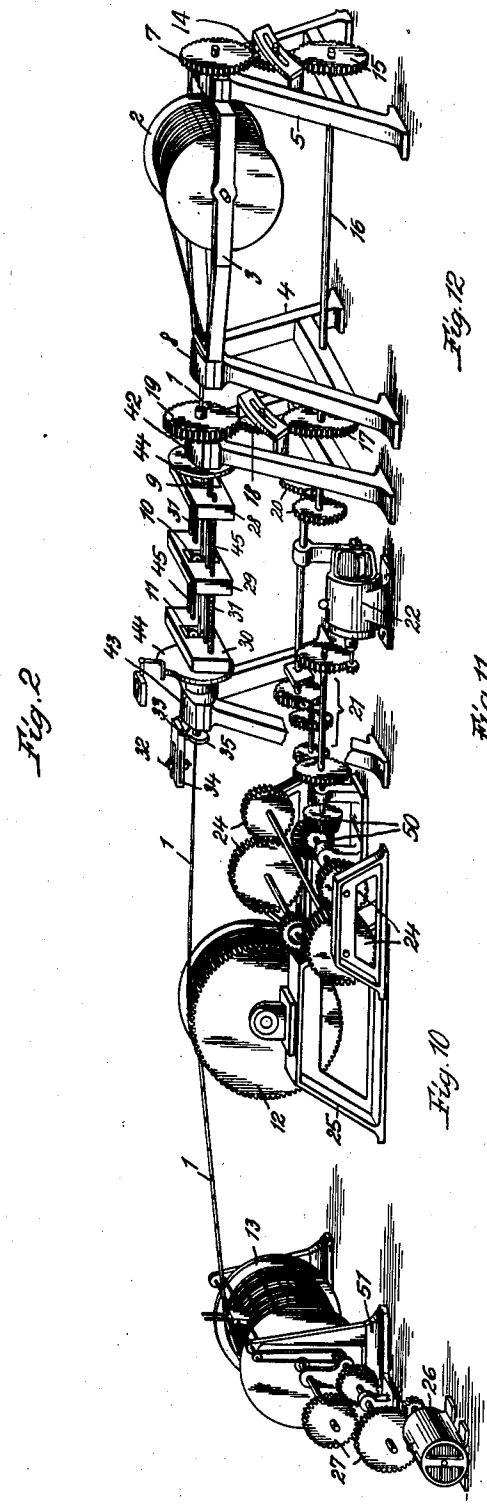

Fig. 2

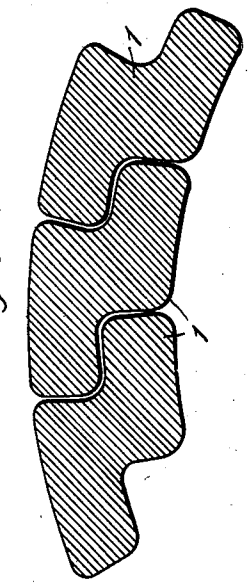

Fig. 12

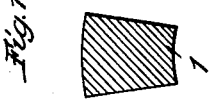

Fig. 11

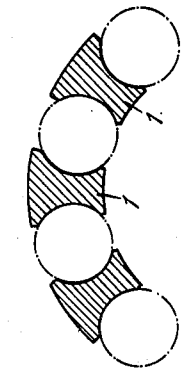

Fig. 10

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METHOD OF AND APPARATUS FOR MANUFACTURING ROPES FROM NONCIRCULAR WIRES

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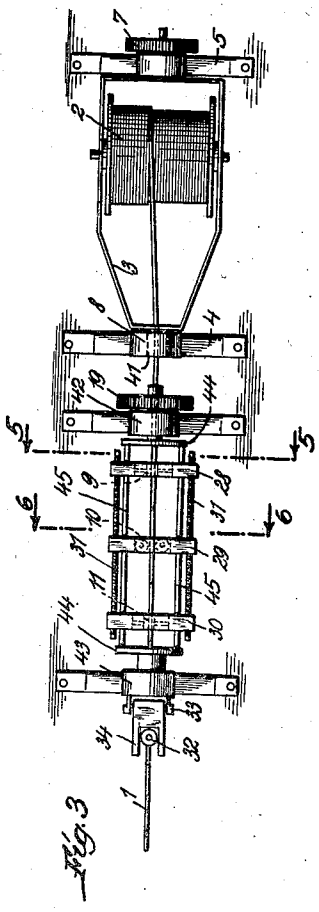

Fig. 3

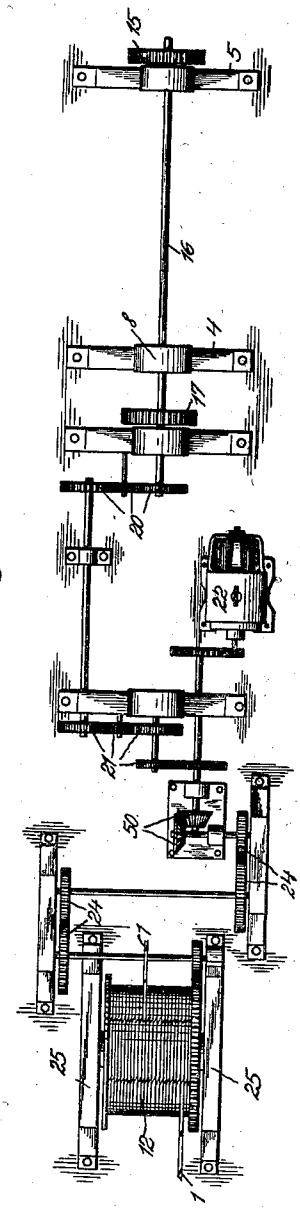

Fig. 4

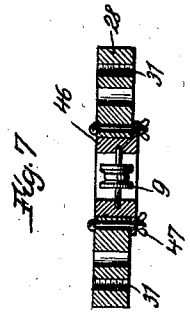

Fig. 7

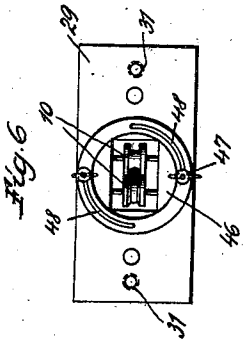

Fig. 6

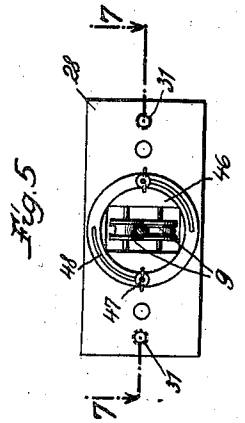

Fig. 5

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UNITED STATES PATENT OFFICE

1,996,689

METHOD OF AND APPARATUS FOR MANUFACTURING ROPES FROM NONCIRCULAR WIRES

Adolf Rohs, Kladno, Czechoslovakia

Application May 9, 1931, Serial No. 536,260
In Germany March 9, 1931

9 Claims. (Cl. 117—16)

My invention relates to improvements in the method of and apparatus for manufacturing ropes from non-circular wires.

In the making into rope of non-circular, i. e. profiled wires, the so-called back-rotation device of the rope machine employed has hitherto always had to be put out of action, in order to ensure that the same surface of the non-circular wire always lay on the outside or the inside. The consequence thereof is, however, that the non-circular wire is twisted 360° about its own axis with every rotation of the rope-making machine. On account of this twisting there are present in the non-circular wires large stresses (torsion stresses). As the non-circular wire to be employed usually consists of a material of very high strength, these stresses have a very unfavourable influence on the quality of the finished rope, because they have the tendency to untwist the separate rope layers and thus loosen the rope structure. Apart from the great difficulties which arise from the displacing of ropes made in that way, these large stresses frequently lead to such ropes becoming unsuitable for use.

One of the objects of the improvements is to provide a method in which the back-rotation devices of modern rope-making machines and the advantages obtained thereby are retained and the above disadvantage avoided, so that the manufacture of ropes consisting entirely or partly of non-circular wires is made possible on such rope-making machines. With this object in view, the non-circular wires which are to be made into rope are, before they are made into rope, i. e. before they are manufactured into a rope in the rope-making machine, subjected to treatment by twisting so that they can be employed in a rope-making machine with back-rotation.

For the purpose of explaining the invention several examples embodying the same have been shown in the accompanying drawings, in which the same letters of reference have been used in all the views to indicate corresponding parts. In said drawings,

Fig. 1 is an elevation of the machine for twisting the wire and winding the same on a reel from which it is taken for being twisted into a rope on a rope-making machine,

Fig. 2 is a perspective view showing a modification of the machine shown in Fig. 1,

Fig. 3 is a top plan view of the right hand part of Fig. 2,

Fig. 4 is a plan view of Fig. 2 with the twisting device and supply roller and its frame removed,

Figs. 5 and 6 are sectional elevations taken respectively on the lines 5—5 and 6—6 of Fig. 3,

Fig. 7 is a sectional plan view taken on the line 7—7 of Fig. 5,

Fig. 8 is an elevation showing a part of a wire twisted by means of the machine shown in either one of Figs. 1 or 2,

Fig. 9 is a similar elevation showing a wire of a different cross-section and the successive cross-sections thereof,

Fig. 10 is a detail sectional view showing a part of a rope composed of wires which are circular in cross-section and wires which are irregular in cross-section,

Fig. 11 is a cross-section on an enlarged scale of the wire shown in Fig. 8, and

Fig. 12 is a detail sectional view similar to the one illustrated in Fig. 10 and showing a part of the rope made from wires of Z-shaped cross-section.

As has been stated above, my improved method comprises the step of preparing the wires from which the rope is to be made, and the step of making the rope from such wires. The last-named step may be carried out in a manner known in the art and on a rope-making machine comprising back rotation devices. As such machines are known in the art I deem it not necessary to describe the same, and it is sufficient only to describe the step of the method and the machine for preliminarily twisting the wire.

In the example shown in Fig. 1 the machine comprises a supply roller 2, a twisting device V, a draw-off wheel 12 mounted on uprights 25, and a winding-up drum or reel 13 mounted on uprights 51.

The supply reel 2, carrying non-circular wire 1 supplied by the wire factory, is mounted in a yoke 3 which is rotatably mounted in uprights 4 and 5, and which is adapted to be rotated through the intermediary of gear wheels 14 and 15 from a main driving shaft 16, the said shaft receiving power by means of a belt gearing comprising pulleys 40 mounted on the shaft. The left hand trunnion 41 of the yoke 3 is formed with an axial bore, and through the said bore the wire 1 is passed to the twisting device V.

The said twisting device is mounted on uprights 42 and 43, and it comprises a frame composed of end plates 44 connected with each other by longitudinal bars 45, and blocks 28, 29 and 30 mounted thereon. In the said blocks 28, 29 and 30 rollers or dies 9, 10 and 11 are mounted, which dies or rollers are formed with grooves corresponding to the cross-sectional form of the wire to be treated. Preferably the blocks 28, 29 and 30

and the rollers carried thereby are adapted to be set different distances away from each other according to the twist to be imparted to the wire 1. As shown the said blocks are connected with each other by a screw-threaded spindle 31 the screw-threads of which have right hand and left hand pitch. Further, the angular relationship of the successive rollers or dies may be variable. As shown in Figs. 5 to 7, the rollers are mounted in disks 46 disposed in circular holes of the blocks, and adapted to be fixed in the desired positions by means of clamping screws 47 engaging in circumferential slots 48 of the flanges of the disks.

Normally the middle pair of rollers 10 into which the wire 1 is led after running through the pair of rollers 9, is displaced through 180° with respect to the pair of rollers 9, as is shown in Figs. 5 and 6. The non-circular wire 1, therefore, on account of its introduction into the pair of rollers 10, is compelled to acquire a twist of 180°. The same occurs as a result of its introduction into the pair of rollers 11 which in turn, with respect to the pair of rollers 10, is displaced through 180° (therefore with respect to the first pair of rollers 9, through 360°).

Instead of the displacement of the pairs of rollers themselves, the grooves in the pairs of rollers corresponding to the wire cross-section could also, of course, be displaced with respect to one another through the aforesaid angles.

The displacement of the pairs of rollers 9, 10, 11 with respect to one another is only stated as 180° by way of example. Any other angular relationship can, however, be employed for the generation of one and the same helical winding. The regulation is then brought about by merely changing the distance of the pairs of rollers from one another, as this displacement, of course, always bears a certain relationship to the angular relationship of the pairs of rollers, if a helical twist of definite pitch is to be generated in the wire.

In the construction shown in Fig. 1 the frame 44 is adapted to be rotated from the shaft 16 through the intermediary of gear wheels 17, 18 and 19. The whole twisting device V therefore, revolves together with the yoke 3 containing the non-circular wire to be twisted, and it will be understood that the gear wheels 17, 18, 19 and 14, 15, 7 may be exchanged for varying the rate of the rotary movement.

The drum 12 is likewise rotated from the shaft 16 through the intermediary of bevel gear wheels 50 and spur gears 24. For the driving of the winding-up drum 13 a motor 26 and gearing 27 may be provided, which will be described hereafter with reference to Fig. 2.

In the operation of the machine the wire taken from the supply roller 2 is passed through the bore of the trunnion 41, a bore of the right hand trunnion of the frame 44 and the successive rollers or dies 9, 10, 11, whereupon it is trained in several windings on the drum 12 and wound on the drum 13. By being positively conveyed through the grooves provided in the pairs of rollers 9, 10, 11 a twist is imparted to the wire by the pairs of rollers, and the wire receives, on account of the passage through the rotating twisting device with the simultaneous rotation of the yoke 3 which is positively connected with this device, a twist of 360°; the wire is, therefore, twisted into the form of an exact helix.

In the modification shown in Figs. 2 to 4 the construction of the operative parts is the same as has been described with reference to Fig. 1, and the same letters of reference have been used to indicate corresponding parts. However, the mechanism for driving the said parts is different.

As shown in the said figures the shaft 16 is driven through the intermediary of interchangeable transmission wheels 20, 21 from an electromotor 22. Further, the said motor drives, through the aforesaid bevel wheels 50 and change gears 24, the draw-off wheel 12. For the driving of the winding-up drum 13 the motor 26 is provided which rotates the drum through an intermediate gear 27. As a result of the arrangement of the different transmission gears and change-wheels, the number of revolutions of the yoke 3 and the twisting device V on the one hand, and the draw-off wheel 12 as well as the winding-up drum 13 on the other hand, can be exactly regulated or can be made to differ from one another.

The non-circular wire leaves the twisting device V in the form of an exact helix of the desired pitch. The wire so treated still possesses, however, a very high back-springing force, and therefore the tendency to spring back again into the original flat form. This back-springing force would, as above mentioned, be detrimental to the quality of the rope. The back-springing force frequently amounts to 30 per cent of the rotation of the wire, i. e. a non-circular wire twisted about its axis to 360° springs back again by about 120°. The amount of this back-rotation depends naturally on the form and the rigidity of the material from which the non-circular wire is manufactured. In order to remove this back-springing force of the wire helix made by twisting, the length of the wire section drawn through the twisting device by the draw-off wheel 12 in one rotation of the twisting device V (i. e., therefore the draw-off speed of the drawing-off wheel) is chosen greater than the length of twist generated on account of the positioning of the pairs of rollers 9 and 11. The difference between the drawing-off length and the length of twist which latter is necessarily fixed by the separation of the pairs of rollers 9 and 11, is different according to the material of the wire and can be easily ascertained by experiment. With a correctly chosen relationship between the separation of the pairs of rollers and the drawing-off length for one rotation of the twisting device, the finished helix of non-circular wire is nearly free from stress which would harmfully affect the finished rope. By the use of the change wheels illustrated in Fig. 2, in the drive of the twisting device and the yoke 3, it is possible to regulate exactly the number of rotations of this device and of the yoke 3 on one hand as well as of the draw-off wheel 12 on the other, and therefore the pitch of the helix of the now stress-free wire of non-circular cross-section, so that the pre-twisted non-circular wire 1 wound on the receiving drum 13 can, in contradistinction to all previously usual methods, be made without further ado into a rope without stress in a rope-making machine with a back rotation device. By employing a rope-making machine with a regulatable back-rotation device, it is also possible to balance out small differences in the helix pitch imparted to the wire by the pre-twisting device by adjusting the back-rotation device of the rope-making machine so that the drums carrying the pre-twisted non-circular wire turn backwards or forwards by a certain amount at every rotation of the rope-making machine.

A further essential advantage of the method according to the invention is that non-circular

wires can be pre-twisted for stock independently of the work of the rope-making machine. Such prepared, stock non-circular wires can, therefore, at any time be employed in one of the usual rope-making machines.

The harmful stress in the pre-twisted wire can, of course, be removed by a second passage through the above described twisting device, as with a suitable placing of the rollers or dies **9**, **10**, **11**, the number of revolutions of the yoke **3** is either allowed to lag behind the number of revolutions of the twisting device V by a corresponding amount, or the drawing-off speed of the draw-off wheel **12** is increased.

It is further advantageous to impart to the wires during the making into rope a stress opposed to the harmful stress because this stress prevents an undoing of the rope layers of the finished rope.

In order now to impart to the wires in the rope, pre-twisted in the above manner, such a stress opposed to the harmful stress, the nearly stress-free wire, which is wound on the roping or supply drum **13** after passing through the twisting device is, in the making into rope by the use of the displaceable back-rotation device of the rope-making machine, so far untwisted in the direction opposed to its spiral line, as the rigidity of the material requires and appears desirable; in this connection, however, it is to be noticed that after this untwisting the pitch of the spiral line of the twisted wire corresponds exactly to the length which is necessary for the intended length of twist of the finished rope.

This stress opposed to the harmful stress which has previously been generated with round wires in the rope-making machine itself can, however, be imparted to the non-circular wires in the winding apparatus during the pre-winding by corresponding positioning of the rollers or dies and corresponding adapting of the drawing-off speed of the drawing-off wheel.

Furthermore, it is possible to impart the additional stress to the pre-twisted wire by the above mentioned second passage of the wire through the twisting device with a suitable positioning of this device.

In order to facilitate the control of the uniformity of the pitch of the pre-twisted wire the twisting device V supports a device which automatically marks every twist on the wire. This marking must, if the wires to be made into the rope are uniformly pre-twisted, form, in the making of the rope, each time annular markings round the circumference of the rope, whose mutual distance corresponds to the twist length of the rope. If, during the rope-making, the marking of one wire compared with the marking of the other wires leads or lags, it is thus immediately to be seen that the pitch of the spiral line generated in the twisting device of the appropriate wire is not correct. By forward or back-rotation of the supply bobbin in the rope-making machine carrying the appropriate wire, the defect can immediately be compensated for.

In the form of construction illustrated in the drawings, the marking arrangement consists of a colour container **32** which is fixed on a lever **34** rotatable round a pivot **33**. A control cam **35** rotating with the twisting device V and coacting with the lever **34** lifts and lets fall the colour vessel **32** at equal intervals which correspond each time to a twisting step of the wire **1**, so that the twisted wire receives its marking by the colour flowing out from the point of the colour container.

In Fig. 8 I have shown a wire of segmental cross-section, which has been twisted into the desired form for making the rope therefrom. In the figure the successive cross-sections imparted to the wire have been indicated in dotted lines, and for more conveniently following the change in the positions of the cross-sections, the marginal lines thereof have received the characters *a, b, c, d*. Fig. 11 shows the cross-section of the wire illustrated in Fig. 8 on an enlarged scale.

In Figs. 9 I have illustrated a wire of substantially Z-shaped cross-section, and the successive cross-sections thereof, corresponding marginal lines having received the characters *a'* and *b'*.

In Fig. 10 I have shown a part of a rope composed of wires which are circular in cross-section and wires **1** which are substantially trapezoidal in cross-section, the side faces of the said wires being curved to accommodate the wires of circular cross-section. For more clearly showing the said wires the wires of circular cross-section have been shown in broken lines.

Fig. 12 shows a part of a rope made from wires of the construction shown in Fig. 9.

In the above application and in the claims the term "pitch" is used to indicate the lineal distance along or parallel to the axis between corresponding points upon the twist.

I claim:

1. An apparatus for twisting wire, comprising a die adapted to grip the wire, means for supplying the wire to said die, means for drawing the wire through said die, means for rotating said drawing means and die relatively to each other, and means operative whenever said die and drawing means have been rotated relatively to each other through equal angles for producing a mark on said wire.

2. An apparatus for twisting wire, comprising a die adapted to grip the wire, means for supplying the wire to said die, means for drawing the wire through said die, means for rotating said drawing means and die relatively to each other, and a rockable marking device adapted to produce a mark on the wire and comprising a cam taking part in the relative rotary movement of said die and drawing means for throwing said marking device into operation.

3. The method of forming ropes from non-circular wires comprising axially pre-twisting individual non-circular wires separately outside the laying-up machine and then forming said pre-twisted wires into a rope so that the same surface of each wire may always be disposed outside.

4. The method of forming ropes from solid non-circular wires comprising pre-twisting the individual solid non-circular wires separately outside the laying-up machine and then assembling said pre-twisted wires into a rope so that the same surface of each wire may always be disposed outside.

5. The method of forming ropes from pre-twisted non-circular wires comprising pre-twisting individual non-circular wires with a pitch shorter than the pitch said wires will occupy in the finished rope and then assembling said pre-twisted wires into a rope.

6. The method of forming ropes from solid non-circular wires comprising pre-twisting said non-circular wires individually with a pitch shorter than the pitch of said twisted wires in the finished

rope, then allowing said wires to spring back into stress-free position with a pitch substantially the same as in the finished rope and then assembling said wires into a rope.

7. The method of forming ropes from non-circular wires comprising twisting said wires in a twisting device, adjusting the amount of pitch of the twist by the speed of the passage of said wires through said twisting device, allowing said wires to back-spring to torsionless condition and then assembling said wires in a rope so that the same surface of each wire may be disposed on the outside.

8. The method of forming ropes from pre-twisted non-circular wires comprising pre-twisting individual non-circular wires with a pitch shorter than the pitch said wires will occupy in the finished rope and then forming said wires into a rope while lengthening said shorter pitch of said wires to the required roping pitch whereby a rope is formed in which the individual strands grip one another.

9. An apparatus for pre-twisting non-circular wires to be combined into a rope or the like comprising a supply drum for the wire, means for rotating said supply drum, a plurality of dies arranged in alignment, means for rotating said dies at the same speed as said supply drum, drawing means for said wire so that the length of wire drawn off in one rotation of the said dies is longer than the distance between the external dies, a marking device for acting upon the wire coming over said twisting device and means controlling said marking device comprising a cam rotating with the twisting device so that the wire is provided with a distinguishing mark upon each turn thereof.

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