

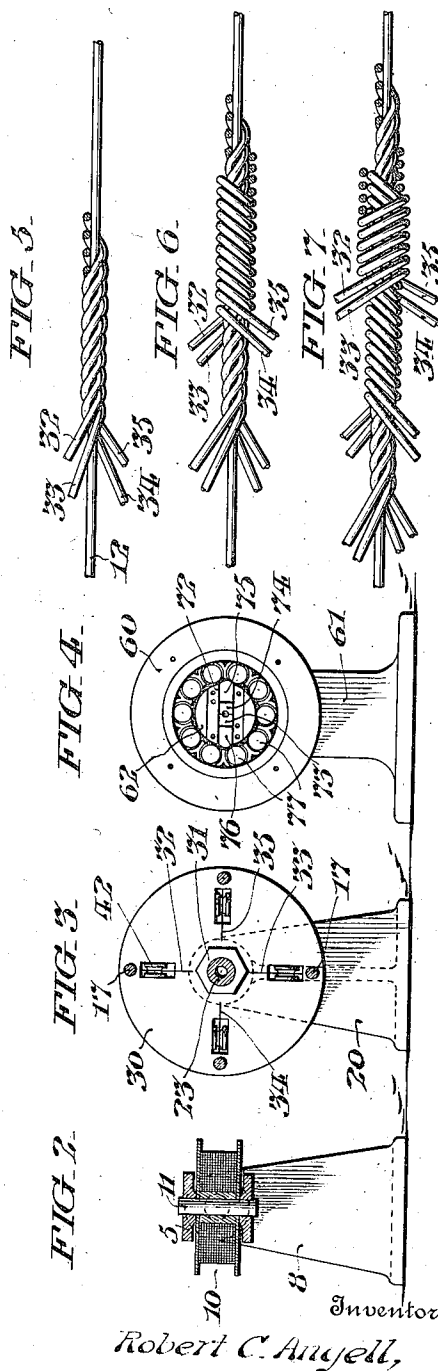
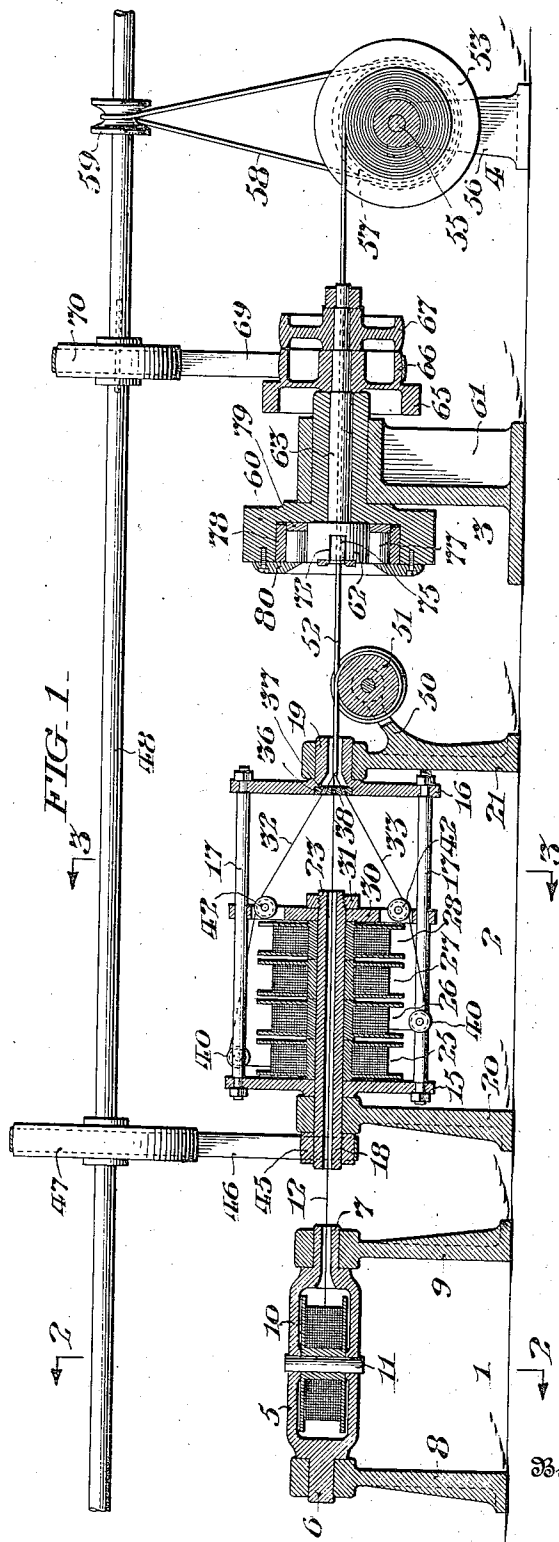
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FLEXIBLE SHAFTING AND METHOD OF PRODUCING SAME

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FLEXIBLE SHAFTING AND METHOD OF
PRODUCING SAME

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My invention relates particularly to that class of mechanism or machines that are adapted to produce cables or ropes formed of a plurality of strands twisted or wound together, and is especially directed to mechanism wherein a plurality of strands of wire are helically coiled around a mandrel or stranded core to form a cable which may be employed as a driving shaft for connecting movable elements for synchronous actuation.

In the production of flexible cable or shaft formed of a plurality of layers of wire or strip material superposed in coiled relation one upon the other, there are considerable stresses inherent in the fabricated product, due to the tension effected by bending of the individual strands in coiling them about the mandrel, which tend to produce torsional stresses, and which effect undue internal friction when such cable is rotated about its axis in flexed or curved condition, and furthermore, there is a tendency of this fabricated product when released to uncoil and to twist itself into a tangled mass. Owing to the inherent stresses effected by the tension of the individual strands of such cable, it has heretofore been impractical to produce cable which is sufficiently free from internal friction as to be successfully employed as a driving shaft, except in such limited lengths as to require the constant attention of an attendant.

The principal objects of my invention are to provide in flexible cable or shaft producing mechanism, means tending to so beat, hammer, bend or otherwise treat as by swaging the fabricated cable or shaft as to reduce the inherent stresses incident to the tension effected by the laying on of the previously wound strands, whereby such inert flexible shaft, substantially free from internal friction or inherent stresses, and embodying the desired flexibility, may be produced in what may be termed continuous length, or shaft that may be taken up by spooling or reeling mechanism as fabricated. By "inert flexible shaft" is meant a shaft which is free from the inherent stresses and also free from the tendency to unwind or uncoil, when cut at any point along its length.

Other objects of my invention are to provide flexible cable or shaft producing mechanism with means, adjacent to the strand laying mechanism, tending to retard the twisting action of the fabricated product due to winding the strands on the core.

Specifically stated, the form of my invention, as hereinafter described, comprises a strand bobbin carrier or winding mechanism, disposed be-

tween a core spool carrier or payout mechanism, and a takeup or spooling mechanism, and comprehends swaging mechanism interposed between said strand bobbin carrier or winding mechanism and said takeup or spooling mechanism, and includes means connected to actuate said mechanisms in such coordinated sequence as to effect the production of continuous inert shafting, or shafting that will not twist and tangle when cut in lengths or otherwise released or taken from the takeup spool.

My invention also includes all the various novel features of construction and arrangement as hereinafter more definitely specified.

In the accompanying drawing, Figure 1 is a vertical longitudinal sectional view of a machine constructed and assembled in accordance with my invention; Fig. 2 is a transverse vertical sectional view of the machine shown in Fig. 1, taken through the payout mechanism on the line 2—2 in Fig. 1; Fig. 3 is a transverse vertical sectional view of said machine taken through the strand-feeding and winding mechanism on the line 3—3 in said figure; Fig. 4 is a front elevational view of the swaging mechanism showing the face plate removed for convenience of illustration; Fig. 5 is a side elevational view of a short length of fabricated structure forming the shaft and showing the first layer of strands coiled upon the core; Fig. 6 is a side elevational view of a section of said shaft showing the second layer of strands coiled thereon; and Fig. 7 is a side elevational view of a section of said shaft showing the third layer of strands coiled thereon.

In said figures, the machine may preferably be composed of separate units cooperatively connected and comprising a mandrel-dispensing or core payout carrier 1, the strand-feeding and winding or laying-on mechanism 2, the swaging mechanism 3 arranged to beat, hammer or bend the fabricated cable or shaft in a direction transverse to its axis, and the takeup or spooling mechanism 4.

The core dispensing carrier has the flier-frame 5 provided with trunnions 6 and 7 rotatably mounted in the standards 8 and 9 and having the mandrel or core-carrying spool 10, which is mounted to rotate in the flier-frame 5 on the shaft 11 whose axis extends transverse to the axis of rotation of said flier-frame 5, and which is arranged to pay out the mandrel or core 12 guided through the hollow trunnion 7.

The strand-feeding and winding mechanism comprises the strand bobbin frame having its end

walls comprising the disks 15 and 16 connected by the spacing bars 17, and respectively having hollow trunnions 18 and 19 mounted for rotation in the standards 20 and 21, the trunnion 18 being extended inwardly to form the hollow stud 23 upon which the bobbins 25, 26, 27 and 28 may be rotatably mounted and removably held in position thereon by the disk 30, which is retained on the stud 23 by the retaining nut 31.

Said bobbins 25, 26, 27 and 28 are respectively arranged to deliver strands 32, 33, 34 and 35 to the strand-twisting die 36 suitably mounted in the disk 16 and having therein suitable apertures 37 through which said strands are arranged to pass, and the aperture 38 for the core 12, which is directed through the hollow trunnion 18, hollow stud 23 and hollow trunnion 19, and about which said strands 32, 33, 34 and 35 are coiled by rotation of the strand bobbin frame and its die 36. The strands 32, 33, 34 and 35 are respectively directed to the die 36 by passing over suitable guide rollers or pulleys 40, preferably carried by the spacing bars 17, and over the guide rollers or pulleys 42, which may be conveniently carried by the disk 30.

The rotation of the strand bobbin frame may be conveniently effected by the pulley 45 which is mounted on the trunnion 18 and connected by the driving-belt 46 with the pulley 47 on the counter-shaft 48, the pulley 47 being of greater diameter than the pulley 45, so as to rotate the strand bobbin frame at a comparatively high rate of speed.

As shown in Fig. 1, the standard 21 is provided with the bracket 50 which carries the grooved idler pulley 51, around which is wrapped the fabricated cable or shaft 52 which is arranged to be progressed longitudinally by the takeup reel 53. Said takeup reel has the shaft 55 mounted on the standards 56 and is provided with the pulley 57 connected by the belt 58 with the pulley 59 on the counter-shaft 48. The takeup structure thus described is designed to take up the shaft as fabricated and is merely a typical form of takeup mechanism, which may be modified to vary the tension exerted on said fabricated shaft, as is indicated in my prior Patent No. 1,671,951, granted May 29, 1928.

The swaging mechanism 3, through which the fabricated shafting is caused to pass, is interposed between the strand-feeding and winding mechanism 2 and the takeup or spooling mechanism 4, and comprises the housing 60 which is mounted in stationary relation in the supporting standard 61. Within the housing 60 is mounted for rotation the swaging head 62 having the hollow bearing stem 63 journaled in the housing 60 and provided with the balance wheel 65 and the tight and loose pulleys 66 and 67 respectively, the tight pulley 66 being connected by the belt 69 with the driving pulley 70 on the shaft 48, to which it may be connected for axial movement so as to shift the belt 69 to the loose pulley 67 in any well known manner when it is desired to stop the action of the swaging mechanism.

The swaging head 62 is provided with the transverse slot 72 in which is mounted the opposed swaging dies 73 and 74 cooperatively associated with the hammer blocks 75 and 76, which have their outer ends rounded to engage the annular series of rollers 77, which are backed by the race rings 78 and 79 and retained by the face plate 80, the latter being removed from the illustration in Fig. 4 for convenience of illustration.

Obviously, the rotation of the swaging head 62

causes the hammers to drive the swaging dies against the fabricated shaft as it passes through the swaging mechanism, which action is effective to cause the crossed strands of the different layers of strands in the fabricated product to so indent each other at the point of intersection as to leave sufficient clearance space to relieve the tension of the superposed strand upon its underlying strand, so that when the shaft is rotated in flexed condition the strands will not tend to bind upon each other, and said strands will not tend to effect twisting or kinking of the fabricated shaft when cut in lengths or otherwise released.

The various stages of construction of the fabricated rope or cable are depicted by the enlarged illustrations shown in Figs. 5, 6 and 7. The first layer of strands 32, 33, 34 and 35 are laid side by side in coiled relation about the core or mandrel 12, as shown in Fig. 5; the second layer of strands being laid upon the first layer in oppositely directed coiled relation, as shown in Fig. 6; and the third layer of strands being coiled in crossed relation on the second layer, as shown in Fig. 7; whereby the composite cable or shaft is formed by layers of four strands disposed side by side, it being understood, however, that the machine may be adapted to form a cable or shaft by fabricating the layers of one or more strands, and said cable or shaft may be formed of as many layers as may be deemed practical.

Although I have shown and described the idler pulley 51 disposed adjacent to the strand-feeding and winding mechanism 2, which tends to retard the twisting action of the fabricated product due to winding of the strands on the core, it may be desirable under some conditions to dispense with said idler pulley 51 and permit the twisting action to be distributed throughout the fabricated shaft through the swaging mechanism.

My invention is advantageous in that such distortion of the strands of the fabricated shafting is effected by the swaging action of the swaging mechanism so as to produce sufficient clearance between the relatively crossed strands of the different layers, whether it be by indentation of the strands or by slight elongation thereof, to relieve the tension which tends to cause the fabricated shafting to twist or bend upon itself and cause it to tangle.

I do not desire to limit my invention to the precise details of construction and arrangement as herein set forth, as it is obvious that various modifications may be made therein without departing from the essential features of my invention as defined in the appended claims.

Having thus described my invention, I claim:

1. The step in the method of making such flexible shafting as is formed with a core surrounded by a helix which consists in applying blows to the peripheral surface of the shafting of a force only just sufficient to properly stretch the outer layer of material of the turns so as to overcome the inherent tendency of the turns to unwind.

2. The step in the making of such flexible shafting as is formed with a core surrounded by a helix which consists in applying hammer blows to the circumferential surface along its entire length of a force sufficient to set the turns of the helix but insufficient to cause material distortion of the surface configuration.

3. The step in the method of making such flexible shafting as is formed with a core sur-

rounded by a helix which consists in applying blows to the peripheral surface of the shafting of a force only just sufficient to so stretch the outer layer as will destroy the inherent tendency of the coils to unwind.

4. The step in the method of making such flexible shafting as is formed with a core surrounded by a helix which consists in applying blows to the peripheral surface of the shafting of a force only just sufficient to properly stretch the material of the helices so as to overcome the inherent tendency of the helices to unwind and permit the insertion of the end cut from a continuous length of shafting into the conventional tips.

5. The step in the making of such flexible shafting as is formed with a core surrounded with a helix which consists in applying blows to the peripheral surface of the shafting of a force only just sufficient to properly set the turns of the helix so as to overcome the tendency of the helices to unwind and permit the insertion of the end cut from a continuous length of shafting into the conventional tips.

6. The step in the method of making such flexible shafting as is formed with a core surrounded by helices which consists in applying blows to the peripheral surface of the shafting of a force only just sufficient to properly stretch the material of the helices so as to render the shafting inert and free from its inherent stresses so as to overcome the inherent tendency of the helices to unwind when cut at any point.

7. The step in the method of making such flexible shafting as is formed with a core surrounded by helices which consists in applying blows to the peripheral surface of the shafting of a force only just sufficient to render the shafting inert and thereby to relieve the inherent torsional stresses and internal friction.

8. The step in the method of making continuous lengths of flexible shafting having a core and a helical covering, which comprises applying blows of sufficient intensity to the peripheral surface of the shafting to permanently stretch and set the helices of the covering against the tendency to unwind when the shafting is subsequently cut into short lengths.

9. The step in the method of making continuous lengths of flexible shafting having a core and a helical covering, which comprises applying blows of sufficient intensity to the peripheral surface of the shafting to permanently stretch

and set the helices, and at the same time to provide relief from friction between the helices.

10. The method of producing continuous flexible shafting, which comprises winding helices about a travelling core member; and thereupon continuously tapping the peripheral surface of the shafting with blows of ample intensity to permanently set the helices against the tendency to unwind subsequently, and at the same time to provide relief from friction between the helices.

11. The method of continuously producing flexible shafting, which comprises winding helices of wire in superposed relation about a travelling core member; and, after application of the last helix, continuously tapping the peripheral surface of the shafting with blows of ample intensity to permanently set the helices against the tendency to unwind subsequently, with provision at the same time for relief from friction between the helices.

12. The step in the method of making such flexible shafting as is formed with a core surrounded by a helix which consists in applying blows to the peripheral surface of the shafting of a force sufficient to relieve the internal pressure contact of the wires due to the inherent stresses of the shaft as fabricated.

13. As an article of manufacture, a flexible shafting made by the method defined in claim 12 as indicated by the swaging blows on the peripheral surface thereof.

14. As an article of manufacture, flexible shafting having a core surrounded by a helix of wires and having on the circumferential surface of said shafting the marks of light swaging blows extending longitudinally of the shafting, the surface configuration of said shafting being free from material distortion, and said shafting free from the torsional stresses and internal friction due to the stresses inherent in the fabricated product.

15. As an article of manufacture, flexible shafting having a core surrounded by a helix of wires and having on the circumferential surface of said shafting the marks of light swaging blows extending longitudinally of the shafting, the surface configuration of said shafting being free from material distortion, and said shafting free, when cut at any point, from the tendency to untwist by reason of the inherent stresses incident to the fabrication of said shafting.

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