Oct. 6, 1953 H. C. UHLIG 2,654,211

APPARATUS FOR AND METHOD OF CABLING THREADS

Original Filed Nov. 10, 1948 3 Sheets-Sheet 1

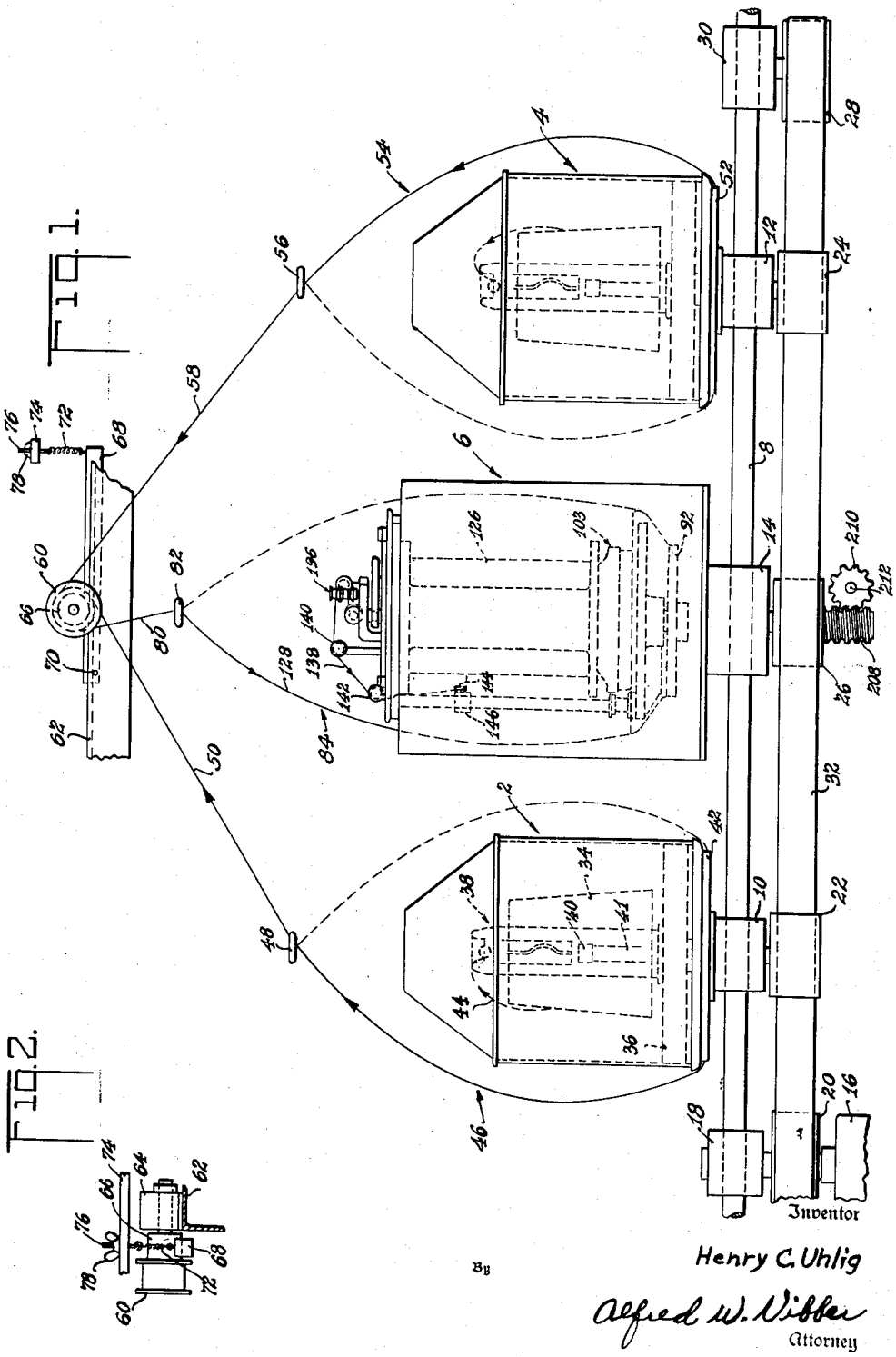


Fig. 1.



Fig. 2.

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FIG. 3.

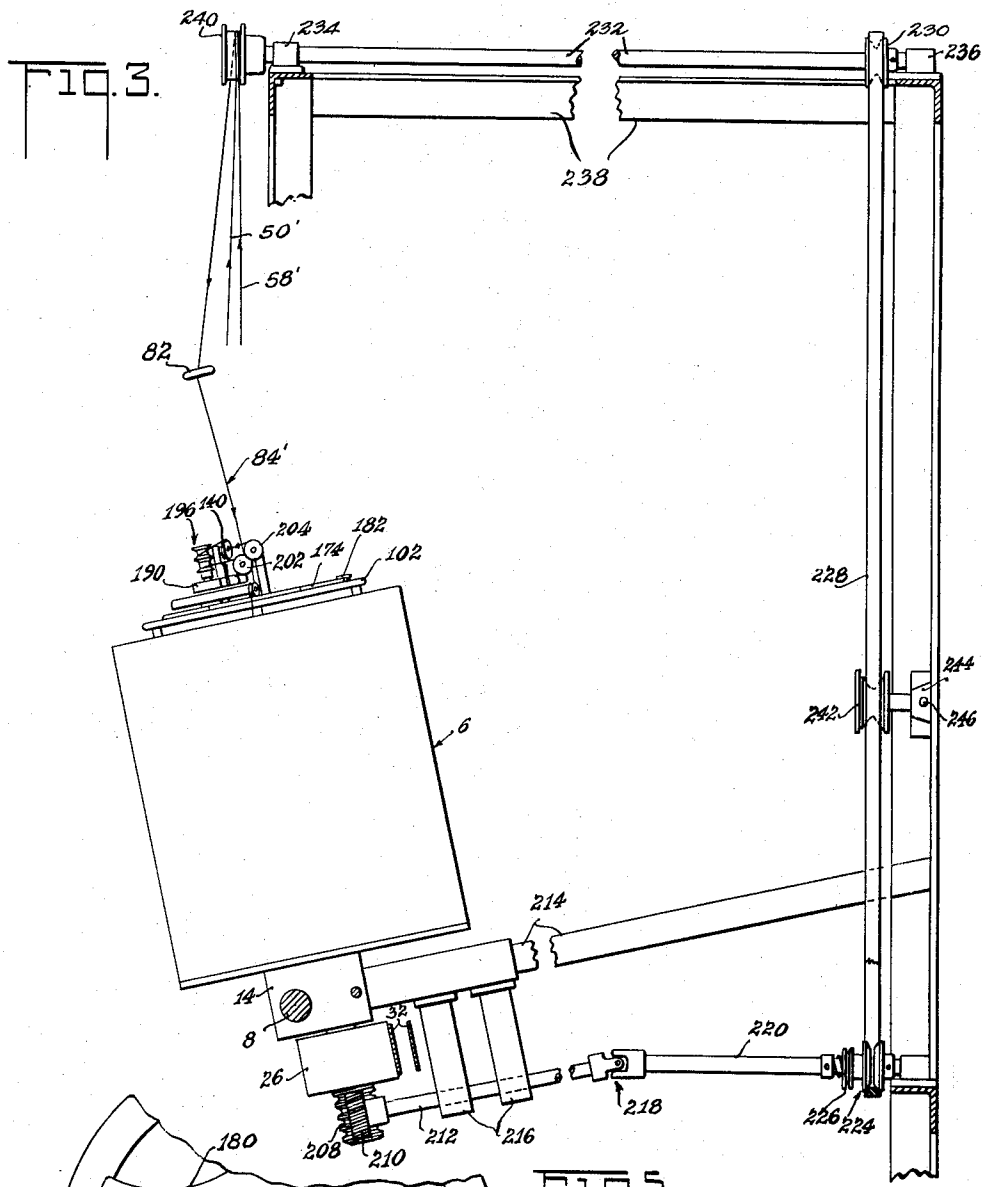
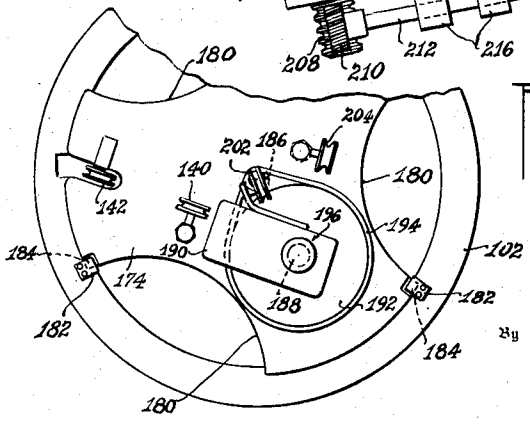



FIG. 5.




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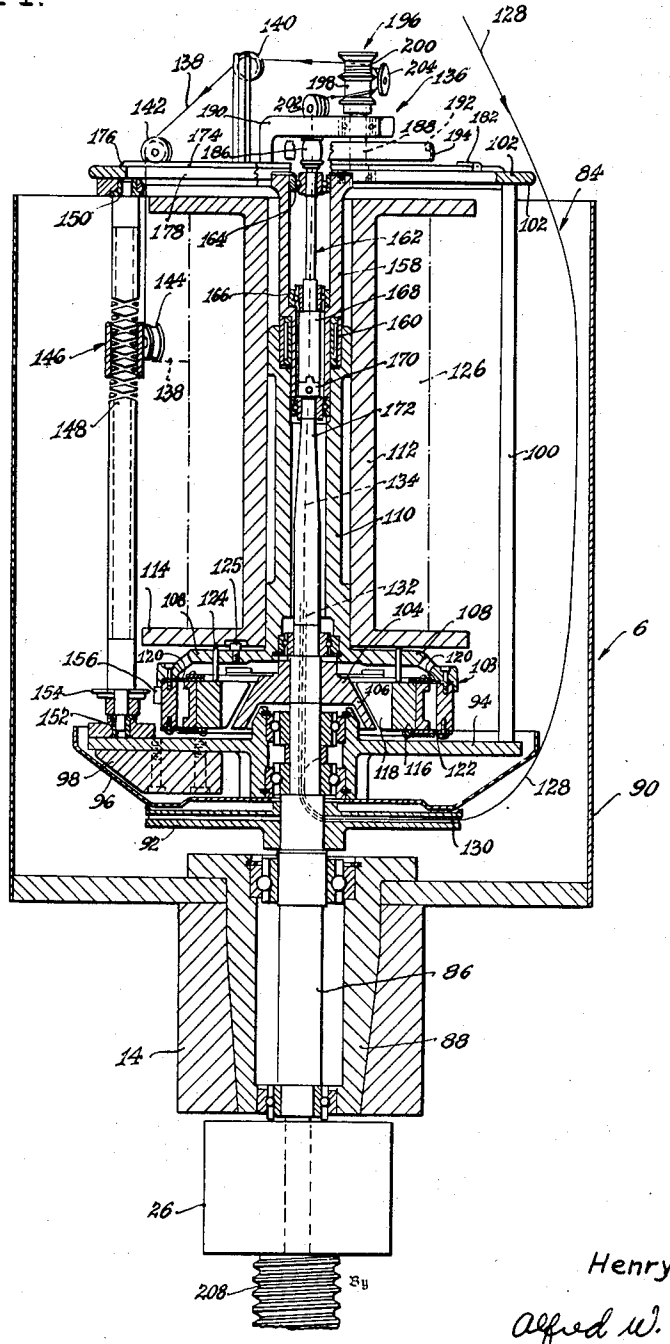
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APPARATUS FOR AND METHOD OF CABLING THREADS

Original Filed Nov. 10, 1948 3 Sheets-Sheet 3

Fig. 4.




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Patented Oct. 6, 1953

2,654,211

# UNITED STATES PATENT OFFICE

2,654,211

## APPARATUS FOR AND METHOD OF CABLING THREADS

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Original application November 10, 1948, Serial No. 59,392. Divided and this application November 15, 1949, Serial No. 127,380

13 Claims. (Cl. 57—58.55)

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This invention relates to apparatus for cabling elongated, flexible materials, such as threads, to form cords, to apparatus including such cabling device as an element thereof for forming cords from yarns in one continuous operation, and to a method of forming cords by continuously twisting yarns and then cabling together the threads thus formed to form cords.

This application is a division of application Serial No. 59,392, filed November 10, 1948, by Bogdanffy, Mitchell and Uhlig, and bearing the same title as the instant application.

The invention has among its objects the provision of an improved cabling spindle of the type creating and maintaining a balloon in the material leading thereto, the spindle being of such construction that the material entering and passing through it is under complete control both in the balloon leading to the cabling spindle and in the portion of its travel in which it is wound.

The invention has as a further object the provision of a novel combination of a cabling device, of the type above indicated, with yarn twisting spindles of the type creating and maintaining balloons in which the rate of withdrawal of yarn from the latter spindles is governed by the cabling spindle, the exactness of control of the material in the cabling spindle creating a desired balance of tensional forces in the material throughout the system.

Yet another object of the invention lies in the provision of a method of forming cord from yarns in one continuous operation with the material traveling continuously, wherein the forces acting on the material throughout the various operations are governed primarily during the cabling operation, whereby predetermined desired tension conditions throughout all the operations, including the yarn twisting, the cabling of the resulting threads, and the reeling of the resulting cord, are attained.

These and further objects of the invention will be more readily apparent in the following descriptions of preferred embodiments of the apparatus and the method of the invention.

In the drawings appended hereto and forming a part of the specification:

Figure 1 is a fragmentary, somewhat schematic, view of the general combination of apparatus of the first described embodiment of the invention, such embodiment employing a retarded thread gathering capstan, the view being taken in elevation from a plane parallel to the axes of the yarn twisting and thread cabling spindles;

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Figure 2 is a fragmentary view in end elevation of the thread gathering capstan and its retarding mechanism employed in such first embodiment;

Figure 3 is a fragmentary view in end elevation of a second embodiment of the apparatus of the invention employing a driven thread gathering and forwarding capstan;

Figure 4 is a view in axial section through the cabling spindle of the invention, such spindle being employed in both embodiments of the general combination of apparatus in accordance with the invention, and

Figure 5 is a fragmentary view in plan of the cabling spindle shown in Figure 4.

The combination of yarn twisting spindles of the type creating and maintaining balloons in the delivered thread with a cabling spindle of the type creating and maintaining a balloon in the gathered cords delivered thereto is disclosed and claimed in my Patent No. 2,487,837, issued November 15, 1949, and entitled "Method of and Apparatus for Twisting Yarn." The apparatus and method of the present invention represent improvements in the general combination, the cabling spindle, and the method of forming cords of my said patent, in that the present invention permits closer control of the cord at the cabling spindle and separates the control of the cabling spindle balloon from the control of the reeling tension. The present invention not only improves the operation of the cabling spindle itself, but also improves the operation of the combination of elements of the apparatus as a whole, since control of the yarns delivered from the yarn twisting spindles is exercised by the cabling spindle, wholly in the first described embodiment and partially in the second.

The general combination of apparatus disclosed, that is, the yarn twisting spindles in combination with the cabling spindle to which they deliver the threads which they produce, is capable of use to advantage, as will be explained, in the formation of cords formed from a plurality of yarns in one continuous operation in which the yarns, threads, and resulting cord travel continuously. Such cords are useful, for example, as the reinforcing elements in V belts and in automobile tires, rayon being a typical material for forming the cords for such latter use. It is to be understood that the apparatus and method of the invention may be employed in making cords from yarns composed of various fibers including the synthetic continuous filaments such as those of rayon or nylon, and also yarns made of natural

fibers such as cotton. The method and apparatus of the invention may also be used advantageously in forming cords from fine wire. Thus the words "yarn," "thread" and "cord," as used in the present specification and claims, are broadly construed to include the above materials, although the invention will be particularly described in its first embodiment with the twisting of rayon yarn, and in its second embodiment with the twisting of yarn made of cotton fibers, to form cords.

It is also to be understood that the invention includes the novel cabling spindle per se, as well as the combination of it with the yarn twisting spindles and other attendant mechanisms. The cabling spindle of the invention obviously may be used to advantage in cabling and reeling threads from other sources than those of the yarn twisting spindles of the general combination.

In the drawings, as above explained, Figures 1 and 2 show the general combination of the apparatus in the embodiment thereof adapted for the formation of cords from yarns of synthetic fibers such as rayon. In Figure 3 there is shown a second embodiment of the general combination which is particularly useful in the treatment of yarns formed of cotton and the like. The cabling spindle, shown generally in Figures 1 and 3 and more specifically in Figures 4 and 5, is substantially the same as that shown and described in both embodiments of the general combination.

Considering first the general combination of the first embodiment, there is shown in Figure 1 a first yarn twisting spindle 2 and a second yarn twisting spindle 4, there being a cabling spindle 6 positioned equidistant therebetween, the axes of all such spindles lying in the same plane. The spindles are supported in a frame of which only fragments are shown, the direct support for the spindles being the horizontal rod 8 which extends longitudinally of the frame. Secured to rod 8 is the supporting member 10 for spindle 2, the supporting member 12 for spindle 4, and the supporting member 14 for spindle 6. Also suspended on rod 8 is the supporting member 18 from which the electric motor 16 is hung. Motor 16 has on its driving shaft the pulley 20 which is connected to the driving pulley 22 of spindle 2, the driving pulley 24 of spindle 4, and the driving pulley 26 of spindle 6 by means of the belt 32, such belt being supported at its end remote from the motor by means of the idler pulley 28 depending from supporting member 30. Belt 32 has the two runs thereof on the opposite sides of pulleys 22 and 24, and has both runs on the rear side of pulley 26, as shown in Figure 3, so that spindles 2 and 4 are driven in the same direction and spindle 6 in the opposite direction, all in timed relation to each other.

Spindles 2 and 4 are generally shown as being of the type shown in Figure 1 of the application of Agresti et al., Serial No. 52,994, filed October 6, 1948, now Patent No. 2,492,778, entitled "Yarn Twisting Apparatus and Method." It is to be understood, however, that other twisting spindles, although preferably of the 2 for 1 type, which create and maintain balloons in the delivered material, may be substituted in the general combination of the apparatus for those shown at 2 and 4.

Spindle 2 includes the cake or package 34 of rayon yarn supported on package support 36, member 36 being floatingly mounted on the driven shaft of the spindle so as to be maintained substantially in one angular position. Yarn 44,



which is of the "flat yarn" type, that is, it has a rectangular cross section with the width materially exceeding the thickness, is fed from the package 34 through the yarn tensioning and twist barrier device, generally designated 38, whence it issues into the driven twisting guide 40 on the driven shaft 41 of the spindle. The first twisted yarn then passes downwardly through an axial passage (not shown) in shaft 41, and thence outwardly through a radial passage, not shown, in disc 42, the disc being keyed for rotation with shaft 41. Yarn issuing from the passage in disc 42 passes upwardly to the guiding eye 48 positioned axially of and above the spindle, as shown. The yarn so treated by spindle 2 is given a first twist in that portion of its travel below device 38 and above the twisting guide 40 and a second twist in that portion of its travel from the outer end of the passage in disc 42 to the guiding eye 48. By reason of the high speed of rotation of the disc 42 the thread issuing therefrom, designated 50, is thrown into a balloon 45 about the spindle.

Spindle 4 has parts similar to those of spindle 2 and the yarn treated thereby is subjected to the same steps. The balloon in the thread 58 issuing from the spindle and in the zone between twisting disc 52 of spindle 4 and eye 56 axially thereabove is designated 54. When pulleys 22 and 24 are of the same diameter, when the yarns at the two spindles 2 and 4 are substantially identical, and when the tensions imposed upon the yarns at each of the spindles are likewise substantially identical, threads 50 and 58 will be subjected to substantially the same tension as they travel upwardly beyond their respective guiding eyes.

Threads 50 and 58 are gathered, in the first described embodiment of the apparatus, by the gathering capstan 60, which is positioned above and substantially equidistant from the upper ends of the balloons created and maintained by each of the yarn twisting spindles. Because, as it will later appear, when the apparatus is treating materials such as rayon the tension in the balloon of the cord entering the cabling spindle exceeds the sum of the tensions in the threads issuing from the yarn twisting spindles, the thread gathering capstan 60 is retarded. In this embodiment, capstan 60, more clearly shown in Figure 2, is mounted on the horizontal top frame member 62 through the medium of the pillow block 64. The capstan has non-rotatably attached thereto a brake drum 66 with which the brake lever 68 cooperates. Lever 68 is pivotally connected to frame member 62 by the pivot pin 70, the brake drum engaging portion of the lever being maintained in contact with the brake drum by means of an adjustable brake lever operating mechanism. Such mechanism includes the support 74 which may conveniently be a part of the machine frame, a rod 76 having a threaded upper end which extends through a hole in member 74, a wing nut 78 screwed upon the upper end of rod 76, and a coil spring 72 connected to the outer end of the brake lever 68 and the bottom of rod 76, as shown. The force with which the brake lever engages the brake drum and thus the amount of retardation of capstan 60 may readily be varied by adjusting the position of rod 76 and thus the tension on spring 72 by means of nut 78. The braking mechanism is adjusted so that, under constant speed conditions, the tension in the balloon in the cord entering the cabling spindle equals the sum of the tensions in the threads issuing from the spindles 2 and 4 and gathered at

the capstan plus the retardation upon such threads imposed by capstan 60.

Threads 50 and 58, which are gathered at the capstan 60 into generally parallel relationship, are led around the capstan in that condition two or three times and then are directed downwardly through the guiding eye 82 which is positioned axially above the cabling spindle 6. The gathered and substantially parallel threads, as yet untwisted on each other, are designated 80 in that portion of their travel above eye 82. From eye 82 the gathered threads are fed downwardly into a radial passage in the driven twisting disc 92 at the bottom of spindle 6. The gathered threads are given a first twist in the balloon 84 between eye 82 and disc 92, the thus first twisted cord being designated 128.

The structure of the cabling spindle 6 employed in both embodiments of the general combination of the apparatus will be more clearly understood by a consideration of Figure 4. The spindle 6 includes the driven shaft 86 which is positioned, as are the driven shafts of spindles 2 and 4, at a small angle to the vertical as, for instance, 12°, as indicated in Figure 3. Such angularity of position of the spindle shafts has the function of maintaining the bobbin supports of the yarn twisting spindles and the cord laying mechanism supporting cage of the cabling spindle in substantially one angular position. Shaft 86 is supported at its lower end in bearings in the sleeve member 88, such sleeve member being supported in the member 14 previously described. Supported on member 14, as shown, is a spindle encircling closure member 90, which confines the balloon 84 and prevents it from becoming entangled with balloons 46 and 54 before the device has reached steady operating condition.

The improved cabling spindle of the invention is illustrated in that embodiment thereof providing means whereby the threads entering it and passing therethrough are given a 2 for 1 twist on each other before they are reeled upon the bobbin carried thereby. The improvement in the cabling spindle of the invention resides in the provision of means engaging the cord, in that portion of its travel in the spindle from the entering end of the radial passage in the twisting disc to the cord laying device, for positively forwarding the cord, such means being positively driven in synchronism with the driven shaft of the spindle. As a result of such construction, the power necessary for pulling the cord inwardly from the bottom of its balloon is supplied by the means at the spindle positively engaging and forwarding the cord, the slip driving connection such as a variable magnetic clutch, which is preferably employed between the driven shaft of the spindle and the bobbin support, being relied upon only to impel the cord from such last named means to the cord laying device and to wind it upon the bobbin. As a result of such construction the slip driving connection no longer performs both the functions of pulling the cord from the balloon and of reeling it and thus more accurate control is possible of both the cord balloon and of the reeling operation.

The structure of the preferred illustrative embodiment of the cabling spindle shown in Figure 4 at the bottom portion thereof immediately above sleeve 88, and also the traversing cord laying device of the spindle are substantially similar to those described in the application of Agresti, Serial No. 15,394, filed March 17, 1948, now Patent No. 2,534,495, and entitled "Constant Tension



Elongated Material Handling Mechanism." It is to be understood, however, that the improvement in the cabling spindle of the invention may be used to advantage in spindles having other types of bobbin driving mechanisms and cord laying devices. Such spindle includes the twisting disc 92 keyed on shaft 86 immediately above sleeve 88, a cage supporting flange 94 floatingly mounted on shaft 86, and an upwardly dished guard 96 non-rotatably affixed to the bottom of flange 94. A weight 98 eccentrically secured to the bottom of flange 94 maintains such flange and the cage structure carried thereby in substantially one angular position. The cage is formed by a plurality of spaced upstanding rods 100, positioned around the edge of flange 94 and parallel to shaft 86. A ring 102 is secured to the tops of rods 100. Such cage structure forms the support for the traversing cord laying mechanism and for the auxiliary cord driving capstan presently to be described.

Connection between shaft 86 and the bobbin support is effected by means of the magnetic slip clutch generally designated 103. Such clutch includes a rotor member 104 keyed to shaft 86, such rotor member being made of magnetic material such as soft iron, and having a depending skirt 106, the outer face of the skirt lying on the frustum of a cone. The bobbin support consists of a flange 108 and an upstanding central tubular portion 110 both made of non-magnetic material, such bobbin support being floatingly mounted on the upper end of shaft 86. The bobbin core 112, in this instance, is cylindrical, such core having a transverse bottom flange 114, the bobbin core also being made of non-magnetic material. The bobbin core is slidingly received over portion 110 of the bobbin support, the weight of the bobbin core and of the cord 126 wound thereon being sustained by the three non-magnetic pins 124 slidingly mounted in flange 108. The bobbin core is keyed for rotation with the bobbin support by the driving connection generally designated 125.

The bottom ends of pins 124 rest upon the upper surface of the outer rotor member 116 of the magnetic clutch. Member 116, which is a strong permanent magnet, is provided with a plurality of radially directed poles 118, the inner faces of which lie on the frustum of a cone the elements of which are parallel to those of the skirt 106. The outer magnetic clutch member 116 is supported from the outer edge of flange 108 through the medium of the upper and lower non-magnetic annular springs 120 and 122, respectively. As increasing pressure is imposed upon pins 124 as a consequence to the building up of cord upon the bobbin core, magnetic clutch part 116 is depressed and thus the air gap between parts 106 and 116 is decreased. The angles of the cones on which the confronting faces of parts 106 and 116 of the clutch lie, and the characteristics of spring members 120 and 122 are so chosen that the torque transmitted through the magnetic clutch varies substantially directly with the increase in weight of the bobbin core and the material wound thereon, whereby yarn is wound upon the bobbin under a substantially constant tension, when the bobbin core is cylindrical, regardless of the instantaneous diameter of the reel on which it is wound.

The cord 128 is withdrawn from the balloon 84 of the cabling spindle through passage 130 in twisting disc 92 from which it travels upwardly in the axial passage 132 in the upper end of shaft 86. The cord in such latter portion of its travel is designated 134. In the described embodiment, the means at the spindle positively engaging and

forwarding the cord, generally designated 136, takes the form of an auxiliary capstan 196 supported at the upper end of the cage structure and positively driven from the upper end of shaft 86. The finally twisted cord 138, after emergence from its path axially of shaft 86 and after its engagement by the auxiliary capstan 196, which will be more particularly described hereafter, is led around guide sheave 140 down around the further guide sheave 142 to the cord laying and guiding sheave 144 on the traversing cord laying mechanism, generally designated 146. From sheave 144 the cord 138 is laid upon the bobbin.

As above indicated, the traversing cord laying device 146 is similar to that shown and described in the Agresti application. Such device includes the driven double worm 148, supported for rotation in the upper bearing 150 at the upper end of the cage and in the lower bearing 152 on flange 94. Worm 148 is rotated intermittently in timed relation with the rotation of the bobbin support, and thus of the bobbin, by means including a ratchet wheel 154 keyed to worm 148 and a single lobe cam 156 positioned on the lower edge of flange 108, the cam cooperating with a ratchet operating lever (not shown) supported on flange 94, to rotate ratchet wheel 154 at each passage of the cam lobe by the ratchet lever.

The auxiliary capstan device 196 includes a sleeve member 158, the bottom end of which is reduced in diameter and telescopes within the needle bearing 160 positioned in a counterbore in the upper end of part 110 of the bobbin support. Sleeve 158 furnishes support for the auxiliary hollow driven shaft 162, such shaft being supported at the top in bearing 164 in the sleeve 158 and at the bottom in bearing 166. The bottom end of the hollow driven shaft 162 is enlarged at 168, the lower end of such enlargement having on the edges of its sidewalls slots complementary to the projections on the sidewalls of the male clutch part 170, part 170 being affixed on the upper end 172 of the driven shaft 86. Sleeve 158 and shaft 162 are attached to the supporting plate 174 so as to be removable as a unit from the spindle with the plate. Plate 174 has an overhanging rim 176 and an inwardly projecting body 178 of such dimensions that the body fits within ring 102 and the rim overlies the ring. As shown in Figure 5, plate 174 has three openings 180 around its edge. The leading outer edges 184 of the plate adjoining the openings 180 are tapered in thickness so that the plate may be temporarily locked in place by positioning it on the ring 102 and then turning it counterclockwise (in Figure 5) so that the edges 184 frictionally engage the inwardly projecting portions of clips 182 affixed to ring 102.

Above plate 174 shaft 162 is provided with a small pulley 186. Spaced from shaft 162, as more clearly indicated in Figure 5, and journaled in plate 174 and the overarm 190 attached to plate 174, is the capstan shaft 188, which is positioned parallel to shafts 86 and 162. A large pulley 192 is keyed on shaft 188 between the plate and overarm. Connection between pulleys 186 and 192 is afforded by belt 194, so that the capstan shaft is driven at reduced speed but in synchronism with shaft 86. Shaft 188 carries, keyed thereto at its upper end, a capstan 196 having a first, bottom step 198, and a second, top step 200. Cord traveling upward through the axial passage in the upper end of shaft 86 and through hollow shaft 162 passes over the guide sheave 202, affixed to plate 174, and onto the first step 198 of the capstan. The cord passes around such first step several times, and is then led to the transfer sheave 204, supported on plate 174, from which it passes to the second step 200 of the capstan. After passing around such second step several times, the cord is led to guide sheaves 140 and 142, both supported on plate 174 as shown, and thence to the sheave 144 of the cord laying device, as previously described.



When the apparatus is used for making cords of materials such as rayon, the primary purpose of the auxiliary capstan is positively to engage the cord to furnish the power necessary to withdraw it from the balloon of the cabling spindle. It also functions as the governor of both the twisting and cabling operations, since the peripheral speed of the auxiliary capstan bears a definite, predetermined, relation to the speeds of rotation of the yarn twisting spindles and to the speed of rotation of the twisting disc of the twisting spindle. In a typical auxiliary capstan for use with materials such as rayon, the upper step 200 of the capstan will exceed the bottom step 198 thereof in diameter by one-half percent. Each step of the capstan is preferably tapered to increase in diameter in an upward direction, a typical included angle of taper, in this example, being 4°. As a result of such construction, the cord is very firmly gripped and is also slightly stretched, thereby giving it a substantially permanent lay.

The apparatus of the first described embodiment may, with slight modification, be adapted for the more efficient forming of cords from yarns of materials such as cotton. Because, in some cases, it is desired that one device be used in the treating of both materials such as rayon and those such as cotton, there is shown in the embodiment of Figure 1 a driving connection from spindle 6 consisting of the worm 208 positioned on the bottom of the driven shaft of the spindle and the worm gears 210, supported on shaft 212, meshing therewith. When the apparatus is employed with a retarded gathering capstan 60 the driving connection on shaft 212 beyond gear 210 is disconnected at the universal joint 218 (Figure 3). However, when materials such as cotton are treated, it is desirable that the gathering capstan shall be driven. Figure 3 shows the apparatus of the second embodiment, such apparatus being identical with that above described except for the substitution of a positively driven gathering capstan 240 and the driving mechanism therefor, for the retarded capstan 60.

In Figure 3 the cabling spindle 6 and the parts thereof are identical with those shown in Figures 1 and 4 and thus are designated by the same reference characters. The threads, however, formed by twisting spindles as in the first embodiment, are designated 50' and 58', such threads being gathered at the driven capstan 240 from which they are fed downwardly into the balloon 84' of the cabling spindle. With threads formed of material such as cotton the sum of the tensions therein, as they are fed from their individual twisting spindles, exceeds the tension in the balloon of the cabling spindle. It is therefore necessary, in order to secure balanced conditions throughout the system with balloons of the desired character at both the yarn twisting and cabling spindles, to drive the gathering capstan. In Figure 3 such drive is provided from the shaft 212, such shaft being supported by members 216 depending from the transverse frame member 214.

The drive includes the universal joint 218, the cross shaft 220, the V belt 228 running over pulleys 224 and 230, and the upper cross shaft 232 journaled in pillow blocks 234 and 236. In order to vary the peripheral speed of capstan 240 a change speed driving mechanism is employed between shafts 220 and 232. In the embodiment shown, such speed change mechanism is provided by means of the split pulley 224, one part of which is shiftable relative to the other, to vary the effective diameter of the pulley, by means of conventional mechanism, including the shifting flange shown at 226, the groove of which is engaged by an adjustably positioned yoke, not shown. In order to maintain belt 228 in the desired taut condition there is provided an adjustable belt tightening idler pulley 242 which engages one reach of the belt, pulley 242 being adjustable transversely of the run of the belt by reason of its mounting on the slide 244, which is adjustable horizontally by the worm 246.

The change speed driving connection between shafts 220 and 232 is adjusted, in the described manner, so that under steady running conditions the balloons in the threads delivered from the individual twisting spindles and the balloon 84' leading to the cabling spindle have the desired spans. Under such conditions the tension in balloon 84' plus the tension imposed upon threads 58' and 58' by driven capstan 240 equals the sum of the tensions in the balloons of the individual yarn twisting spindles. The auxiliary cord engaging capstan 196, in this embodiment as in the first, permits separation of the controls of the balloon 84' and of the reeling operation.

When the apparatus of the second embodiment is employed in treating material such as cotton the auxiliary capstan 196 may be modified as to its capstan step dimensions so that such capstan performs the further step of substantially normalizing the cabled thread and therefore reducing subsequent length variations therein. A typical auxiliary capstan for such purpose has both the upper and lower steps tapered, as in the first described embodiment, with an included angle of 4°, for example, but the upper step exceeds the lower step in diameter by three or four percent. In this embodiment, therefore, in the passage of the cord from the lower to the upper step, the cord is subjected to substantial tension in the reaches thereof from the bottom step 198 of the capstan to the sheave 204, and from such sheave to the upper step 200 of the capstan.

Whereas I have described and illustrated preferred embodiments of the apparatus for and method of cabling threads in accordance with my invention, it is to be understood that such embodiments are illustrative only. The invention is capable of considerable variations as to details, and accordingly it is defined by the scope of the following claims.

I claim as new the following:

1. Apparatus for twisting and reeling elongated flexible material such as cord, which comprises a rotary driven spindle shaft, a bobbin support mounted on the spindle shaft, a driving connection between the spindle shaft and the bobbin support, a cord guide supporting structure spaced radially of the bobbin support, a twisting disc mounted on the spindle shaft for rotation therewith, the spindle shaft having an axial passage therein, the twisting disc having a substantially radial passage therethrough and connecting with the passage in the spindle shaft, the cord guide supporting structure having a cord guiding and loading device thereon, driven means on the apparatus for engaging the cord in its passage through the apparatus, at a location between the outer end of the radial passage in the twisting disc and the cord guiding and loading device, said last named means substantially positively forwarding the cord, and means for driving said last named means in synchronism with the spindle shaft.

2. Apparatus for twisting and reeling elongated flexible material such as cord, which comprises a rotary driven spindle shaft having an outer end, a bobbin support mounted on the outer end of the spindle shaft, a slip driving connection between the spindle shaft and the bobbin support, a cord guide supporting structure spaced radially of the bobbin support, a twisting disc mounted on the spindle shaft, for rotation therewith, the spindle shaft having an axial passage therein in its outer end, the twisting disc having a substantially radial passage therethrough and connecting with the passage in the spindle shaft, the cord guide supporting structure having a cord guiding and loading device thereon, driven means on the apparatus for engaging the cord, in its passage through the apparatus, at a location between the outer end of the radial passage in the twisting disc and the cord guiding and loading device, said last named means substantially positively forwarding the cord, and means for driving said last named means in synchronism with the spindle shaft, whereby cord fed from a point spaced from the outer end of the spindle shaft and coaxial therewith, through the passageways in the twisting disc and the spindle shaft, to the guiding and loading device on the cord guide supporting structure, and thence to the bobbin, is given a double twist when the spindle shaft is rotated and the cord is wound on the bobbin.

3. Apparatus for twisting and reeling elongated flexible material such as cord, which comprises a rotary driven spindle shaft having an outer end, a bobbin support mounted on the outer end of such spindle shaft, a slip driving connection between the spindle shaft and the bobbin support, a cord guide supporting structure spaced radially of the bobbin support, and floatingly mounted on the spindle shaft so as to be maintained in a relatively stationary position, means for maintaining the cord guide supporting structure in such position, a twisting disc mounted on the spindle shaft inwardly of the outer end of the spindle shaft for rotation therewith, the spindle shaft having an axial passage in its outer end, the twisting disc having a substantially radial passage therethrough and connecting with the passage in the spindle shaft, the cord guide supporting structure having a cord guiding and loading device thereon, a capstan mounted on the apparatus for engaging and for substantially positively forwarding the cord in its passage through the apparatus, at a location between the outer end of the radial passage in the twisting disc and the cord guiding and loading device, and means for driving the capstan from the spindle shaft in synchronism therewith, whereby cord fed from a point spaced from the outer end of the spindle shaft and coaxial therewith through the passageways in the twisting disc, the spindle shaft, around the capstan, to the guiding and loading device, in that order, and thence to the bobbin, is given a double twist when the spindle shaft is rotated and the cord is wound on the bobbin.

4. Apparatus for twisting and reeling elongated flexible material such as cord, which comprises a rotary driven spindle shaft having an outer end,

a bobbin support mounted on the outer end of such spindle shaft, a slip driving connection between the spindle shaft and the bobbin support, a cord guide supporting structure spaced radially of the bobbin support and floatingly mounted on the spindle shaft so as to be maintained in a relatively stationary position, means for maintaining the cord guide supporting structure in such position, a twisting disc mounted on the spindle shaft inwardly of the outer end of the spindle shaft for rotation therewith, the spindle shaft having an axial passage in its outer end, the twisting disc having a substantially radial passage therethrough and connecting with the passage in the spindle shaft, the cord guide supporting structure having a cord guiding and loading device thereon, a capstan mounted on the apparatus beyond the outer end of the spindle shaft for engaging and for substantially positively forwarding the cord in its passage from the spindle shaft, and means for driving the capstan from the spindle shaft in synchronism therewith, whereby cord fed from a point spaced from the outer end of the spindle shaft and coaxial therewith through the passageways in the twisting disc, the spindle shaft, around the capstan, to the guide and loading device, and thence to the bobbin, in that order, is given a double twist when the spindle shaft is rotated and the cord is wound on the bobbin.

5. Apparatus for twisting and reeling elongated flexible material such as cord, which comprises a rotary driven spindle shaft having a free end, a bobbin support mounted on the free end of such spindle shaft, a slip driving connection between the spindle shaft and the bobbin support, a cord guide supporting structure spaced radially of the bobbin support and floatingly mounted on the spindle shaft so as to be maintained in a relatively stationary position, means for maintaining the cord guide supporting structure in such position, a twisting disc mounted on the spindle shaft inwardly of the free end of the spindle shaft for rotation therewith, the spindle shaft having an axial passage in its free end, the twisting disc having a substantially radial passage therethrough and connecting with the passage in the spindle shaft, the cord guide supporting structure having a cord guiding and loading device thereon, a capstan mounted on the cord guide supporting structure beyond the free end of the spindle shaft for engaging and for substantially positively forwarding the cord in its passage from the spindle shaft, and means for driving the capstan from the spindle shaft in synchronism therewith, whereby cord fed from a point spaced from the free end of the spindle shaft and coaxial therewith through the passageways in the twisting disc, the spindle shaft, around the capstan, to the guiding and loading device, and thence to the bobbin, in that order, is given a double twist when the spindle shaft is rotated and the cord is wound on the bobbin.

6. Apparatus for twisting and reeling elongated flexible material such as cord, which comprises a rotary driven spindle shaft having a free end, a bobbin support mounted on the free end of such spindle shaft, a slip driving connection between the spindle shaft and the bobbin support, such slip driving connection comprising a magnet attached to one of the group of elements consisting of the spindle shaft and bobbin support and a rotor attached to the other element of such group, the magnet and rotor being located in spaced relationship so as to induce electric current in the rotor upon relative motion between the spindle shaft and the bobbin support, a cord guide supporting structure spaced radially of the bobbin support, a twisting disc mounted on the spindle shaft for rotation therewith, the spindle shaft having an axial passage in its free end, the twisting disc having a substantially radial passage therethrough and connecting with the passage in the spindle shaft, the cord guide supporting structure having a cord guiding and loading device thereon, driven means on the apparatus for engaging the cord, in its passage through the apparatus, at a location between the outer end of the radial passage in the twisting disc and the cord guiding and loading device, said last named means substantially positively forwarding the cord, and means for driving said last named means in synchronism with the spindle shaft, whereby cord fed from a point spaced from the free end of the spindle shaft and coaxial therewith through the passageways in the twisting disc and the spindle shaft, to the guiding and loading device on the cord guide supporting structure, and thence to the bobbin, is given a double twist when the spindle shaft is rotated and the cord is wound on the bobbin.

7. Apparatus for twisting and reeling elongated flexible material such as cord, which comprises a rotary driven spindle shaft having an outer, free end, a bobbin support mounted on the free end of such spindle shaft, a slip driving connection between the spindle shaft and the bobbin support, a thread guide supporting cage surrounding the bobbin support and floatingly mounted on the spindle shaft so as to be maintained in a relatively stationary position, means for maintaining the cage structure in such position, a twisting device mounted on the spindle shaft, the twisting device including a twisting disc mounted inwardly of the free end of the spindle shaft and of the cage structure for rotation with the spindle shaft, the spindle shaft having an axial passage in its free end, the twisting disc having a substantially radial passage therethrough connected with the passage in the spindle shaft, the cage having a cord guiding and loading device thereon, the cake having a supporting structure located thereon, the supporting structure spanning the spindle shaft beyond the free end of the spindle shaft, a capstan rotatably carried by said supporting structure, a driving means between the spindle shaft and the capstan, whereby the capstan is driven in synchronism with the spindle shaft, the capstan having a cord engaging step thereon, means for guiding the cord issuing from the spindle shaft to and around the capstan step, and means for guiding the cord from the capstan step to the cord guiding and loading device, whereby cord fed from a point spaced from the free end of the spindle shaft and coaxial therewith through the passageways in the twisting disc and the spindle shaft, around the capstan step as recited, to the guiding and loading device, and thence to the bobbin, in that order, is given a double twist when the spindle shaft is rotated and the cord is wound on the bobbin.

8. Apparatus for twisting and reeling elongated flexible material such as cord, which comprises a rotary driven spindle shaft, having an outer, free end, a bobbin support mounted on the free end of such spindle shaft, a slip driving connection between the spindle shaft and the bobbin support, a thread guide supporting cage surrounding the bobbin support and floatingly mounted on

the spindle shaft so as to be maintained in a relatively stationary position, means for maintaining the cage structure in such position, a twisting device mounted on the spindle shaft, the twisting device including a twisting disc mounted inwardly of the free end of the spindle shaft and of the cage structure for rotation with the spindle shaft, the spindle shaft having an axial passage in its free end, the twisting disc having a substantially radial passage therethrough connected with the passage in the spindle shaft, the cage having a cord guiding and loading device thereon, the cage having a supporting structure located thereon, the supporting structure spanning the spindle shaft beyond the free end of the spindle shaft, a capstan rotatably carried by said supporting structure, driving means between the spindle shaft and the capstan, whereby the capstan is driven in synchronism with the spindle shaft, the capstan having at least two axially spaced cord engaging steps thereon, one such step somewhat exceeding the other step in diameter, means for guiding the cord issuing from the spindle shaft to and around the smaller capstan step, means including a guide sheave spaced from the capstan for transferring the cord from the smaller step of the capstan to the larger step thereof, and means for guiding the cord from the larger capstan step to the cord guiding and loading device, whereby cord fed from a point spaced from the free end of the spindle shaft and coaxial therewith through the passageways in the twisting disc and the spindle shaft, around the capstan steps as recited, to the guiding and loading device, and thence to the bobbin, in that order, is given a double twist when the spindle shaft is rotated and the cord is wound on the bobbin.

9. An apparatus for forming stranded cord from a plurality of threads comprising a plurality of sources of threads, means for gathering the threads fed from their sources, the last named means including a sheave, thread from each source being led under substantially equal tension to and around the sheave, a cabling device of the type creating, and receiving material from, a balloon for twisting together the threads to form a cord, said cabling device comprising a rotary driven spindle shaft having a free end spaced from the sheave, the sheave lying at least generally on the projected axis of the spindle shaft, a bobbin support mounted on the free end of such spindle shaft, a slip driving connection between the spindle shaft and the bobbin support, a cord guide supporting structure spaced radially of the bobbin support, a twisting disc mounted on the spindle shaft for rotation therewith, the spindle shaft having an axial passage in its free end, the twisting disc having a substantially radial passage therethrough and connecting with the passage in the spindle shaft, the cord guide supporting structure having a cord guiding and loading device thereon, driven means on the apparatus for engaging the cord, in its passage through the cabling device, at a location between the outer end of the radial passage in the twisting disc and the cord guiding and loading device, said last named means substantially positively forwarding the cord, and means for driving said last named means in synchronism with the spindle shaft, whereby cord fed from the sheave, through the balloon of the cabling device and thence through the passageways in the twisting disc and the spindle shaft, to the guiding and loading device on the cord guide supporting structure, and thence to the bobbin, is given a double twist when the spindle shaft is rotated and the cord is wound on the bobbin.

10. An apparatus for forming stranded cord from a plurality of yarns in one continuous operation, comprising a plurality of similar twisting spindles each incorporating its source of yarn supply, the spindles being of the type which delivers the twisted thread therefrom in a balloon, means incorporated in each twisting spindle for imposing a predetermined back tension on the yarn, the axis of each such balloon generally coinciding with the axis of its spindle, the axes of the twisting spindles being generally parallel, means for gathering the threads from the twisting spindles, the last named means including a sheave, thread from each twisting spindle being led under tension from its balloon substantially directly to and around the sheave, such sheave being located beyond the outer end of each of the balloons from the twisting spindles and being spaced at substantially equal distances from the axes of the spindles, a cabling device of the type creating, and receiving material from, a balloon for twisting together the thus forwarded threads to form a cord, said cabling device comprising a rotary driven spindle shaft having a free end spaced from the sheave, the sheave lying at least generally on the projected axis of the spindle shaft, a bobbin support mounted on the free end of such spindle shaft, a slip driving connection between the spindle shaft and the bobbin support, a cord guide supporting structure spaced radially of the bobbin support, a twisting disc mounted on the spindle shaft for rotation therewith, the spindle shaft having an axial passage in its free end, the twisting disc having a substantially radial passage therethrough and connecting with the passage in the spindle shaft, the cord guide supporting structure having a cord guiding and loading device thereon, driven means on the apparatus for engaging the cord, in its passage through the cabling device, at a location between the outer end of the radial passage in the twisting disc and the cord guiding and loading device, said last named means substantially positively forwarding the cord, and means for driving said last named means in synchronism with the spindle shaft, whereby cord fed from the sheave, through the balloon of the cabling device and thence through the passageways in the twisting disc and the spindle shaft, to the guiding and loading device on the cord guide supporting structure, and thence to the bobbin, is given a double twist when the spindle shaft is rotated and the cord is wound on the bobbin.

11. The method of forming stranded cord from a plurality of yarns in one continuous operation comprising the following steps in the order named: feeding each of a plurality of yarns in the direction of its length from its separate source of supply, imposing a predetermined back tension on each such yarn, forming a balloon in each such yarn and separately twisting the yarns to form threads, gathering such threads into generally parallel relationship at a point beyond the balloon in each, forwarding such threads in such generally parallel relationship, twisting the thus fed gathered threads together to form a cord, during the last named twisting step forming a balloon in the cord, positively withdrawing the twisted cord from the last named balloon at a rate synchronized with the rate of twisting of the threads together, and yieldingly coiling such cord, the first twisting, the gathering, and

the second twisting steps being performed with the material continuously in motion.

12. Apparatus for twisting and reeling an elongated flexible material such as a textile cord, which comprises a rotary driven spindle shaft, a cord guide, a bobbin support and a support for said cord guide mounted on said spindle shaft for rotation about the spindle shaft axis independently of said spindle shaft and of each other, said spindle shaft and one of said supports having a driving action between them, means for holding the other of said supports from rotation about the spindle shaft axis, a twisting disc mounted on the spindle shaft for rotation therewith, the spindle shaft having an axial passage therein, the twisting disc having a substantially radial passage therethrough and connecting with the passage in the spindle shaft, and a cord feeding element engaging with the cord leaving one of said passages for feeding the cord along and through said passages.

13. Apparatus for twisting and reeling elongated flexible material, such as a textile cord, which comprises a spindle shaft, means mounting said spindle shaft for rotation about its axis, with one end of the spindle shaft unsupported and projecting beyond said means, a cord guide, a bobbin support and a support for said cord guide mounted on said projecting end of the spindle shaft for relative rotation thereon independently of said spindle shaft and of each other, said spindle shaft and one of said supports having a slip driving action between them, means for holding the other of said supports from rotation about the spindle shaft axis, a twisting element mounted on said projecting end of said spindle shaft between said bobbin support and said spindle shaft mounting means, for rotation with the spindle shaft, the spindle shaft having an axial passage therein from its unsupported end past said bobbin support, and said twisting element having a substantially radial passage connecting with the inner end of said spindle shaft passage and open at its outer end, a cord feeding device carried by said guide support disposed adjacent the projecting end of said spindle shaft, and engaging any cord leaving the projecting end of the spindle shaft to pull the cord through said passages in succession, said cord feeding device having a drive connection from said spindle shaft, and operable upon relative rotation between the spindle shaft and said guide support.

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