April 19, 1938. H. S. KEATING 2,114,496

METHOD OF AND APPARATUS FOR COMBINING STRANDS

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FIG. 1

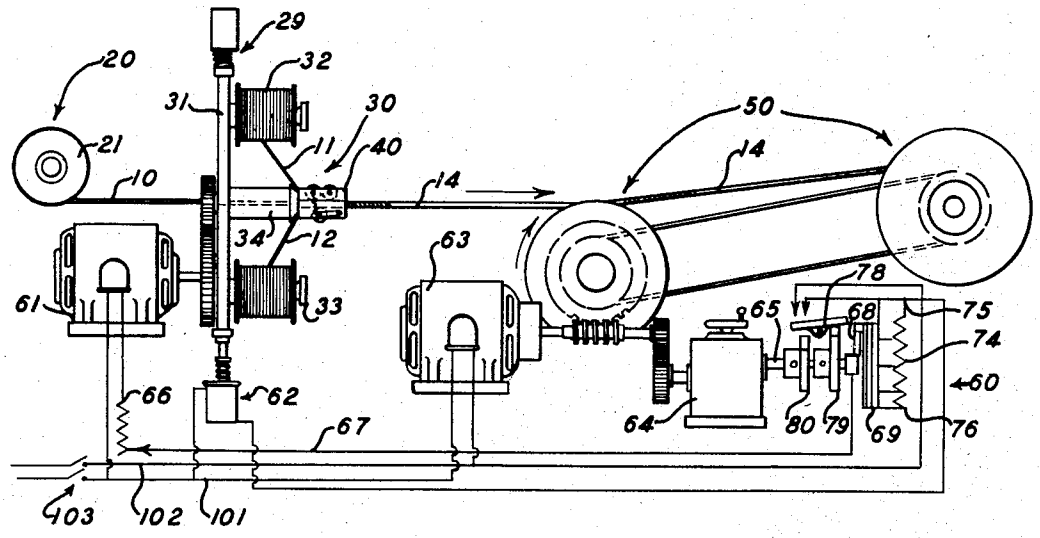


FIG. 2

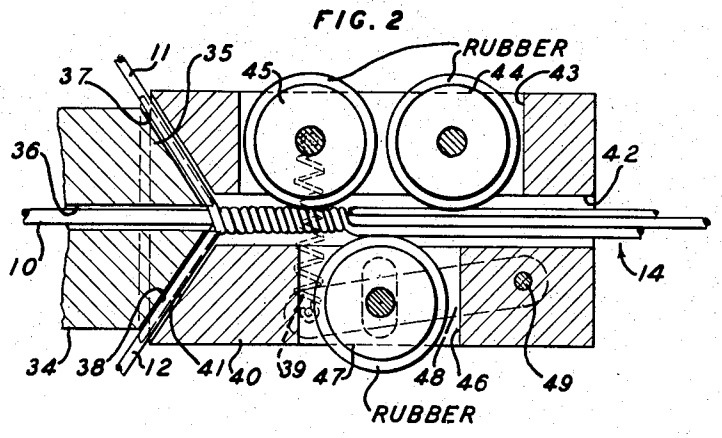


FIG. 3

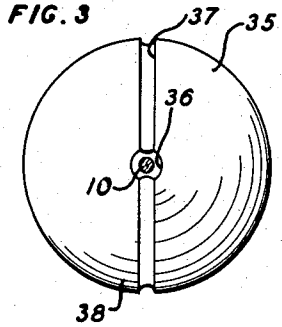
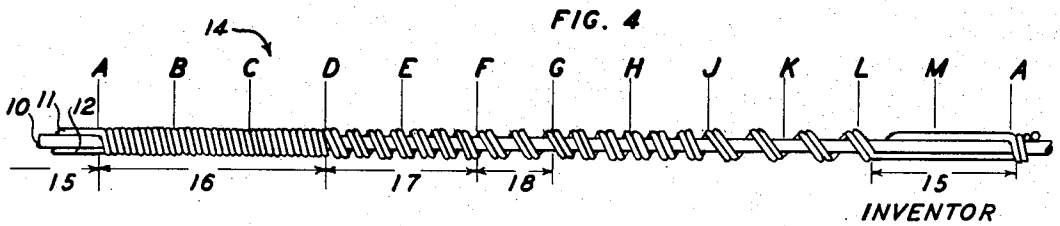


FIG. 4



INVENTOR
H. S. KEATING

BY

E R Nowlan

ATTORNEY

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METHOD OF AND APPARATUS FOR COMBINING STRANDS

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FIG. 6

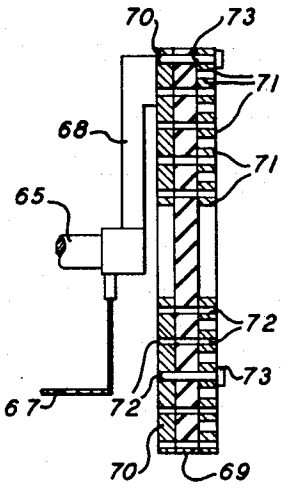


FIG. 5

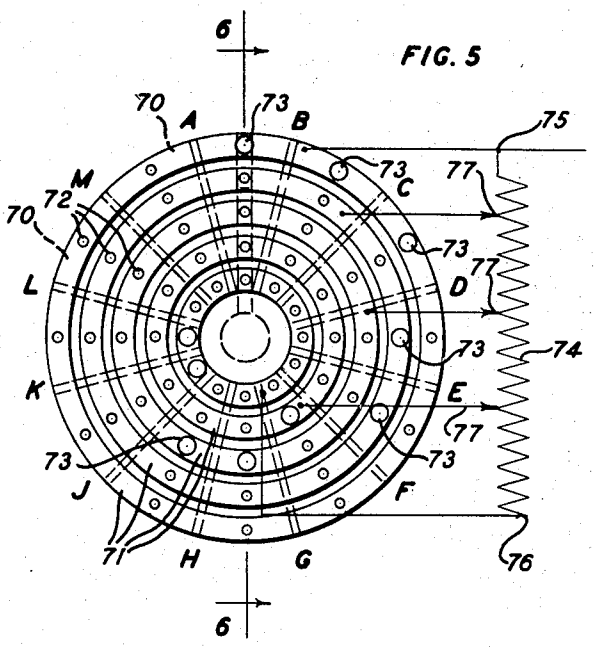


FIG. 7

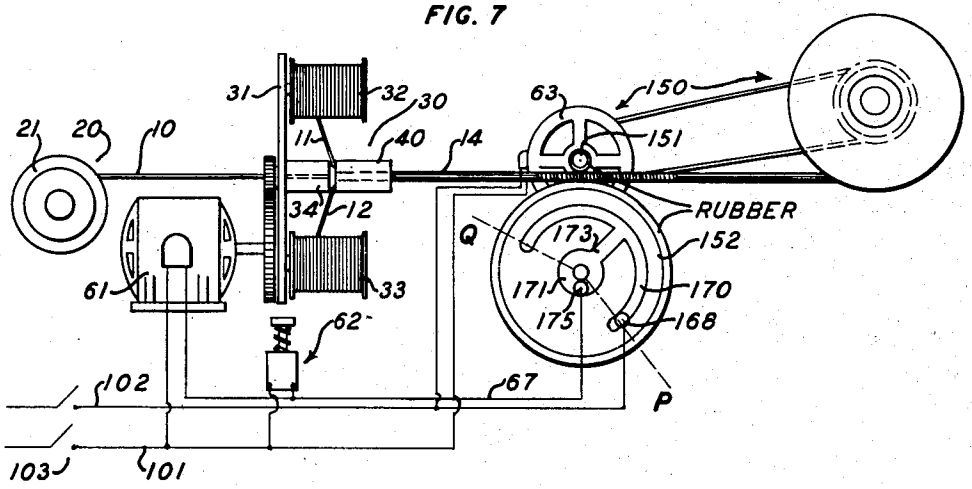
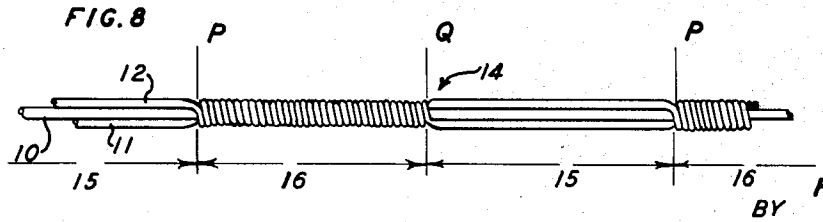


FIG. 8



INVENTOR
H. S. KEATING
BY
E. R. Nowlen
ATTORNEY

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UNITED STATES PATENT OFFICE

2,114,496

METHOD OF AND APPARATUS FOR COMBINING STRANDS

Herbert S. Keating, North Plainfield, N. J., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application July 9, 1936, Serial No. 89,814

27 Claims. (Cl. 117—34)

This invention relates to a method of and apparatus for combining strands and more particularly to a method of and apparatus for intertwisting strands with predetermined cyclic variations of lay.

In the manufacture of electric cables, especially such as are used in the communications arts, it may in some cases be desirable to adjust the capacitance relation or properties of individual strands with respect to other individual strands. This is accomplished in some instances by connecting to the pair of the strands in question a length of a pair of tightly coiled mutually insulated strands. One method of manufacturing such capacitance balancing units, as they may be called, is to intertwist two appropriate strands in such fashion that they are twisted together, with a non-conductive core strand, with a very short pitch of lay in a close double helix for a predetermined distance and then for another predetermined distance with a very long or practically no twist. The closely twisted portions may then be cut apart at some point between for use.

An object of the present invention is to provide a method of and an apparatus for intertwisting two or more strands with or without a core strand in such fashion as to produce a repeated sequence of two or more portions having lays of different pitch.

With the above and other objects in view one embodiment of the invention comprises means to advance longitudinally a plurality of strands and rotary means to intertwist the strands in combination with means to cyclically vary in predeterminable fashion the ratio of the linear speed of longitudinal advance of the strands to the angular speed of the rotary twisting means.

Other objects and features of the invention will appear from the following detailed description of one embodiment thereof taken in connection with the accompanying drawings in which the same reference numerals are appended to identical parts in the several figures and in which

Fig. 1 is a diagrammatic representation of an apparatus constructed in accordance with the invention;

Fig. 2 is an enlarged view in central longitudinal section of the compacting device;

Fig. 3 is an end view of the rotary member thereof;

Fig. 4 is a view of one product of the apparatus of Fig. 1;

Fig. 5 is a right hand side enlarged elevation of the commutator of the apparatus of Fig. 1;

Fig. 6 is a sectional view thereof on the line 6—6 of Fig. 5;

Fig. 7 is a view similar to Fig. 1 of a modified form of apparatus, and

Fig. 8 is a view of a product of the apparatus of Fig. 7.

The apparatus disclosed in Fig. 1 comprises a core supply 20, a rotatable conductor supply and twisting unit 30, a capstan and take-up unit 50, and a driving and speed control unit 60.

The core supply device 20 may be any approved and well known means to support a spool or reel 21 having a supply of a core strand 10 wound thereon. The device itself is not shown in detail as many such are well known in the art.

The unit 30 comprises a disk shaped base 31 mounted in any suitable fashion, not shown, to be rotatable about its axis. Two conductor strand supply reels 32 and 33 are mounted on the base 31 to be rotatable thereon and to revolve therewith about the axis thereof. These reels carry supplies of insulated conductor strands 11 and 12 respectively, which are combined by the apparatus into a compound strand 14 in which the strands 11 and 12 are twisted together about the substantially straight strand 10. A cylindrical male twisting member 34 having a conical head 35 and an axial bore 36 is mounted rigidly and coaxially on the base 31 which has a central aperture to communicate with the bore 36. The conical outer face of the head 35 is also formed with a pair of radial grooves 37 and 38. The strand 10 passes through the bore 36 and is met at the apex of the head 35 by the strands 11 and 12 which lie in the grooves 37 and 38 respectively. A drag device 29, of any appropriate construction, acts to retard rotation of the disk 31.

A generally cylindrical or prismatic female twisting member 40 is rigidly and immovably supported by any appropriate means not shown to be coaxial with the member 34 and to receive the conical head 35 in a correspondingly conical recess 41 formed in its end. An axial bore 42 in the member 40 forms in effect an extension of the bore 36 and permits passage to the compound strand 14. A recess or radial slot 43 formed in one side of the member 40 communicates with the bore 42 and houses a pair of fixedly positioned, rubber covered, rotatable rolls 44 and 45. Opposite the slot 43 is a corresponding slot 46 housing a third rubber covered roll 47 rotatably mounted on a lever 48 pivoted at 49 to let the roll 47 be movable toward and from the rolls 44 and 45, and urged toward them by a spring 39. These

rolls grip the compound strand between them to prevent it from rotating under the twisting effect at the apex of the head 35.

The capstan and take-up unit 50 may be of any well known and approved construction.

The drive and control unit 60 comprises a series wound D. C. motor 61 to drive the twisting unit 30, a solenoid actuated brake device 62 to stop the twisting unit, a constant speed motor 63 to drive the capstan at invariant speed and thus to advance the core strand 10 and its associated conductor strands 11 and 12 at constant linear speed through the apparatus, an adjustable reduction gear 64 driven by the motor 63 and driving a control shaft 65.

The motor 63 is connected directly across the main input power lines 101 and 102 and thus runs continuously so long as the main control switch 103 is closed. One terminal of the motor 61 is directly conected to the line 101. The other is connected through an adjustable rheostat 66 and a wire 67 to a contact arm 68 mounted on and rotatable with the shaft 65. Opposite the contact arm 68 and coaxial therewith is a stationary disk 69 (Figs. 5 and 6) of insulating material having secured to the face thereof next to the contact arm a plurality (here twelve) of segmental metallic contacts 70, insulated from each other by the plate 69 and by air gaps. The end of the arm 68 is formed to wipe over the segments 70 as the shaft 65 turns.

On the other face of the disk 69 is a concentric plurality (here five) of metallic rings 71. Holes 72 are bored along the central radius of each segment 70 through each segment and each ring. A metallic pin 73 may be thrust into the appropriate one of these holes to connect any given segment with any given ring, and by using a plurality of pins 73 the segments and rings may be interconnected in any desired manner. A resistance 74 has one end 75 connected to the outermost ring 71 and its other end 76 connected to the innermost ring 71. Sliding contacts 77, two less in number than the number of rings 71 are connected in sequence respectively to the intermediate rings 71 between the innermost and outermost rings 71.

The terminal 75 is also connected through the solenoid 62 to the line 101, and to one side of a tilting switch 78 the other side of which is directly connected to the line 102. The switch 78 is positively operated to open and to close respectively by cams 79 and 80 adjustably mounted on the shaft 65.

Assuming now that the machine is in the general position shown in Fig. 1, let the main switch 103 be closed. The motor 63 then drives the capstan and take-up 50 at constant speed propelling the strand 14 at constant linear speed thereof to the right. The switch 78 being open current can pass neither to the motor 61 nor through the solenoid of the brake 62. The disk 31 therefore is not now driven by the motor 61 and is additionally held stationary by the brake 62. Hence a length of the strands 10, 11 and 12 is drawn from the member 40 in an untwisted state as shown at 15 in Fig. 4.

The cam 79 releases the switch 78 which is now closed by the cam 80. Current then flows from the line 102 to the terminal 75 and thence through the switch 78 to energize the solenoid of the brake 62 and back to the line 101. Hence the brake releases the disk 31. At the same time current flows from the terminal 75 into the resistance 74 and thence to the several rings 71. Various pins 73 being in the positions shown in Figs. 5 and 6, current will pass from the outermost ring 71 into the segments 70 indicated at A—B, B—C and C—D, and from segment A—B into the contact or commutator arm 68, whence it flows via wire 67 and rheostat 66 to motor 61 and so to the line 101. The motor 61 thereupon begins to drive the disk 31 at a constant and relatively high rate of speed against the action of the drag 29, and so causes the conductors 11 and 12 to twist about the core 10 into the relation shown in Fig. 4 at 16. The speed of the motor 61 at this time is not affected by the resistance 74 but is fixed by the adjustable rheostat 66 at a value which in connection with the constant speed of the motor 63 driving the unit 50 will produce the extremely short pitch of twist shown at 16.

This state of affairs will continue while the contact arm 68 sweeps over the three segments 70 from A to D. The next two segments 70 from D to E and from E to F are connected by pins 73 to the second ring 71 from the outside and not to any other ring. This causes current to pass from terminal 75 through the first section of the resistance 74 and the first sliding contact 77 to the second ring 71 and thence to the D—F segments 70 and so to the motor 61. The resistance thus cut into the motor circuit causes the latter to slacken speed and to allow the twisting device to slow a trifle under the effect of the drag 29.

Since the speed of longitudinal advance of the strands remains unchanged as the motor 63 is not affected, the result is that the next length of strand 14 will show a somewhat longer pitch, as indicated at 17 in Fig. 4, until the contact arm 68 leaves the E—F segment 70.

The F—G segment 70 is connected by a pin 73 to the next to the last ring 71 and hence while the contact arm sweeps over this segment 70, the first three sections of the resistance 74 are cut into the twisting head motor circuit and the twisting speed correspondingly reduced to produce a relatively long pitch section 18 of strand.

In analogous fashion the sections from G to L in Fig. 4 are produced as the contact arm sweeps over the segments 70 from G to L in Fig. 5. Segments 70 from L to M and M to A are not connected to any ring 71, hence while the contact arm 68 sweeps over these segments no current can pass to the motor 61 and an untwisted section 15 of strand is produced, after which the entire cycle of operations is automatically repeated until the main switch 103 is opened.

For the above mode of operation, the cams 79 and 80 are set to open and close the switch 78 as the contact arm 68 enters segment 70 from L to M and leaves segment 70 from M to A, so that for this mode of operation the switch is supererogatory. However to produce the product shown in Fig. 8, pins 73 may be inserted to connect all the segments 70 with one and the same one of the rings 71. The apparatus will then produce a strand having alternating twisted and parallel portions, the relative lengths depending on the adjustment of the cams 79 and 80 and the pitch of the twisted portions depending upon which ring 71 is connected to the segments 70.

A similar result may be accomplished by removing the cams 79 and 80, locking the switch 78 closed, and then connecting an appropriate number of the segments 70 all to the appropriate ring 71.

By removing the cams 79 and 80, locking the switch 78 closed and interconnecting all the seg-

ments appropriately with the rings, a product may be produced analogous to that shown in Fig. 4 but without any parallel portion.

It will be noticed in Fig. 4 that in the open lay parts of the strand 14 from D to L, the two strands 11 and 12 lie closely abutted together with a spiral open space between the turns of the double helix thus formed, and this in spite of the fact that the twisting or serving head 35 leads the cover strands 11 and 12 to the core strand 10 from symmetrically opposite sides of the latter. Because of the inherent variability of material things, the supplies 32 and 33 will differ in the resistance which they offer to permitting the cover strands 11 and 12 to be drawn off. Hence the opposed tensions of the strands 11 and 12 on the strand 10 at the twisting point between the outlet of the bore 36 and the entrance to the bore 42 will be slightly unequal in practice and the actual twisting point will be drawn a trifle out of line (either up or down in Fig. 2 according as the tension of strand 11 is a little greater or less than that of strand 12). Because of this fact, the two strands 11 and 12 are served on the core 10 as shown instead of dividing the longitudinal space along the core 10 evenly between them.

For the manufacture of capacitance balancing units it may be an advantage to have the two conductors thus closely juxtaposed throughout their coiled length. However, if for other purposes it be desired to distribute the turns of the conductors along the core with equal interspaces, this may obviously be accomplished by making the bore 42 of such diameter, particularly at the entrance of the bore, as to fit the strand 14 so closely as not to permit any displacement of the winding point. Then the conductor strands 11 and 12 will be served on the core strand 10 in a symmetrical fashion to form equi-spaced coils.

In any event the successful operation of the apparatus disclosed is materially enhanced by the close and accurate control of the several strands, both individually and collectively, immediately before, at, and immediately behind the winding point, exercised by the members 35 and 41, the grooves 37 and 38, the bores 36 and 42, and the rolls 45 and 47. Such control exercised by such or equivalent apparatus appears to be an important auxiliary to the general procedure and apparatus.

Furthermore, if the supplies 32 and 33 be mounted on the disk 31 side by side instead of diametrically opposite, and if the grooves 37 and 38 be positioned correspondingly near together instead of diametrically opposite, the close apposition of the turns of the two cover strands 11 and 12 on the core strand 10 with interspaces between the twin turns will be positively enforced. Also more than two supplies may be mounted on the disk 31, symmetrically or unsymmetrically spaced therearound, and a corresponding number of guide grooves (such as 37 and 38) may be made in the head 35; and thus any reasonable number of cover strands may be served on the core strand with their respective turns distributed along the core strand in any desired predetermined fashion.

The apparatus shown in Fig. 7 is a simpler form adapted to produce only the type of product shown in Fig. 8. Here the units 20 and 30 are the same as before. The capstan and take-up unit 150 has the same function as the unit 50, but the capstan is here shown as a pair of rubber faced rolls or sheaves 151 and 152, the roll 151 being driven by the motor 63, and the two rolls pressing the strand 14 between them to draw it along. The unit 50 might however be equally well substituted for the unit 150.

On the side of the sheave 152 and insulated therefrom in any suitable manner is rigidly mounted a partial slip ring 170 and a complete slip ring 171 connected by a conductor 173. A stationarily supported brush 168 is connected to the line 102 and wipes over the ring 170. A similar brush 175 wipes over the ring 171 and is connected by a wire 67 to one terminal of the solenoid of the brake 62 and to one terminal of the motor 61. The other terminals of the brake solenoid and of the motor 61 are connected to the line 101. The motor 63, as before, is connected directly to the lines 101 and 102.

With the parts in the position shown in Fig. 7, if the main switch 103 be closed, the motor 63 starts at once to draw the strand 14 along toward the right at constant linear speed and to rotate the rings 170 and 171 clockwise. Current flows from the line 102 via brush 168, ring 170, conductor 173, ring 171 and wire 67 to the solenoid of the brake 62 and to the motor 61, and thence to the line 101. The solenoid being thus energized causes the brake to release the disk to be driven by the motor 61. This state of affairs corresponds to one of the points P in Fig. 8 and continues until the whole of the partial ring 170 has passed under the brush 168, during which time the twisted portion 16 of the product shown in Fig. 8 beginning at the particular point P is produced. The trailing end of the partial ring 170 corresponds to the point Q of Fig. 8. At this time the circuits of the brake solenoid and of the motor 61 are broken by the ring 170 leaving the brush 168. The motor 61 and twisting unit 30 are stopped by the brake 62, and this state of affairs continues until the leading end of the ring 170 again reaches the brush 168. During this interval an untwisted or parallel portion 15 of the strand 14 is produced. The above process then repeats itself cyclically as long as the switch 103 is closed.

It will be clear from the above disclosures that importantly characteristic features of the invention are the controlled variation of the ratio of the speed of the linear advance of the strand 14 to the angular speed of the unit 30 and in particular the arrangement and method in which the linear speed of the strands is held constant while the angular speed of the twisting is cyclically varied.

The above disclosed embodiments of the invention are illustrative only and may be modified and departed from in many ways without departing from the spirit and scope of the invention as pointed out in and limited only by the appended claims.

What is claimed is:

1. A method of combining strands which comprises the steps of advancing a plurality of strands longitudinally at constant linear speed, and intertwisting the strands together, while varying the angular speed of twisting whereby the pitch of twist of the intertwisted strands may be varied from a short pitch to a pitch of substantially any magnitude.

2. A method of combining strands which comprises the steps of advancing a plurality of strands longitudinally at constant linear speed, and intertwisting the strands together, while

cyclically varying the angular speed of twisting whereby the pitch of twist of the intertwisted strands may be cyclically varied from a short pitch to a pitch of substantially any magnitude.

3. In a strand handling apparatus, means to advance a plurality of strands longitudinally at constant linear speed, and rotary means to intertwist the strands together, in combination with means to vary the angular speed of the twisting means whereby the pitch of twist of the intertwisted strands may be varied from a short pitch to a pitch of substantially any magnitude.

4. In a strand handling apparatus, means to advance a plurality of strands longitudinally at constant linear speed, and rotary means to intertwist the strands together, in combination with means to cyclically vary the angular speed of the twisting means whereby the pitch of twist of the intertwisted strands may be cyclically varied from a short pitch to a pitch of substantially any magnitude.

5. In a strand handling apparatus, a stationary core supply, a rotatable support, a strand supply mounted on the support to be revolved thereby, a twisting member mounted on the support to be rotated thereby to twist a strand drawn from the strand supply about a core drawn from the core supply, a product advancing means to advance the combined core and strand, a constant speed motor to drive the advancing means, a motor to drive the support, and a commutator device to vary the speed of the support driving motor.

6. In a strand handling apparatus, a stationary core supply, a rotatable support, a strand supply mounted on the support to be revolved thereby, a twisting member mounted on the support to be rotated thereby to twist a strand drawn from the strand supply about a core drawn from the core supply, a product advancing means to advance the combined core and strand, a constant speed motor to drive the advancing means, a motor to drive the support, and a commutator device to cyclically vary the speed of the support driving motor.

7. In a strand handling apparatus, a stationary core supply, a rotatable support, a strand supply mounted on the support to be revolved thereby, a twisting member mounted on the support to be rotated thereby to twist a strand drawn from the strand supply about a core drawn from the core supply, a product advancing means to advance the combined core and strand, a constant speed motor to drive the advancing means, a motor to drive the support, and a commutator device driven by the constant speed motor to vary the speed of the support driving motor.

8. In a strand handling apparatus, a stationary core supply, a rotatable support, a strand supply mounted on the support to be revolved thereby, a twisting member mounted on the support to be rotated thereby to twist a strand drawn from the strand supply about a core drawn from the core supply, a product advancing means to advance the combined core and strand, a constant speed motor to drive the advancing means, a motor to drive the support, and a commutator device driven by the constant speed motor to cyclically vary the speed of the support driving motor.

9. In a strand handling apparatus, a stationary core supply, a rotatable support, a strand supply mounted on the support to be revolved thereby, a twisting member mounted on the support to be rotated thereby to twist a strand drawn from the strand supply about a core drawn from the core supply, a product advancing means to advance the combined core and strand, a constant speed motor to drive the advancing means, a motor to drive the support, a commutator device driven by the constant speed motor to vary the speed of the support driving motor, and an adjustable-speed transmission device between the constant speed motor and the commutator device.

10. A method of combining strands which comprises the steps of advancing a core strand longitudinally past a winding point, leading a plurality of cover strands to the core strand at the winding point, revolving the cover strands about the core strand to be wound thereon, and controlling lateral displacement of the winding point to control the relative distribution of the cover strands on the core strand.

11. A method of combining strands which comprises the steps of advancing a core strand longitudinally past a winding point, leading a plurality of cover strands to the core strand at the winding point, revolving the cover strands about the core strand to be wound thereon, varying the ratio of the linear speed of the core strand to the angular speed of the cover strands at the winding point to vary the lay of the cover strands on the core strand, and controlling lateral displacement of the winding point to control the relative distribution of the cover strands on the core strand.

12. A method of combining strands which comprises the steps of advancing a core strand longitudinally past a winding point at constant linear speed, leading a plurality of cover strands to the core strand at the winding point, revolving the cover strands about the core strand to be wound thereon, varying the angular speed of the cover strands to vary the lay of the cover strands on the core strand, and controlling lateral displacement of the winding point to control the relative distribution of the cover strands on the core strand.

13. In a strand handling apparatus having means to advance a plurality of strands longitudinally, and means to intertwist the strands together, in combination with means to vary the ratio of the linear speed of advance of the strands to the angular speed of the twisting means, a twisting device comprising a member having a working face thereon and formed with a cover strand guiding groove in the working face and with a core strand guiding bore intersecting the working face, and a second member having a working face thereon complementary to the first named working face to retain in place a cover strand positioned in the said groove and the second member also being formed with a bore positioned coaxially with the first named bore to receive a combined core strand and cover strand, one of the two members being rotatable relatively to the other about the common axis of their two bores to serve the cover strand on the core strand.

14. In a strand handling apparatus having means to advance a plurality of strands longitudinally, and means to intertwist the strands together, in combination with means to vary the ratio of the linear speed of advance of the strands to the angular speed of the twisting means, a twisting device comprising a member having a working face thereon and formed with a cover strand guiding groove in the working face and with a core strand guiding bore intersecting the working face, and a second member having a working face thereon complementary to the first named working face to retain in place

a cover strand positioned in the said groove and the second member also being formed with a bore positioned coaxially with the first named bore to receive a combined core strand and cover strand, the first named member being rotatable relatively to the second member about the common axis of their bores to serve the cover strand on the core strand.

15. In a strand handling apparatus having means to advance a plurality of strands longitudinally, and means to intertwist the strands together, in combination with means to vary the ratio of the linear speed of advance of the strands to the angular speed of the twisting means, a twisting device comprising a member having a working face thereon and formed with a cover strand guiding groove in the working face and with a core strand guiding bore intersecting the working face, and a second member having a working face thereon complementary to the first named working face to retain in place a cover strand positioned in the said groove and the second member also being formed with a bore positioned coaxially with the first named bore to receive a combined core strand and cover stand, one of the two members being rotatable relatively to the other about the common axis of their two bores to serve the cover strand on the core strand, and the bore of the second member being substantially of the same diameter as the served core to prevent lateral displacement of the winding point.

16. In a strand handling apparatus having means to advance a plurality of strands longitudinally, and means to intertwist the strands together, in combination with means to vary the ratio of the linear speed of advance of the strands to the angular speed of the twisting means, a twisting device comprising a member having a working face thereon and formed with a cover strand guiding groove in the working face and with a core strand guiding bore intersecting the working face, and a second member having a working face thereon complementary to the first named working face to retain in place a cover strand positioned in the said groove and the second member also being formed with a bore positioned coaxially with the first named bore to receive a combined core strand and cover strand, one of the two members being rotatable relatively to the other about the common axis of their two bores to serve the cover strand on the core strand, and the bore of the second member being substantially larger than the diameter of the served core whereby the winding point may be laterally displaced.

17. In a strand handling apparatus a serving head comprising a member having a working face thereon and formed with a cover strand guiding groove in the working face and with a core strand guiding bore intersecting the working face, a second member having a working face thereon complementary to the first named working face to retain in place a cover strand positioned in the said groove and the second member also being formed with a bore positioned coaxially with the first named bore to receive a combined core strand and cover strand, and means within the second member to prevent rotation of the served core relative to the second member, the first named member being rotatable relatively to the second member about the common axis of their bores to serve the cover strand on the core strand.

18. In a strand handling apparatus a serving head comprising a rotatable member having a convex conical head formed with a strand guide groove therein and having an axial bore coaxial with the conical surface, and a fixed member having a concave conical surface complementary to the said conical head and juxtaposed thereto to retain a strand positioned in the said groove therein and having an axial bore coaxial with the concave conical surface and with the first named bore.

19. In a strand handling apparatus a serving head comprising a rotatable member having a convex conical head formed with a strand guide groove therein and having an axial bore coaxial with the conical surface, a fixed member having a concave conical surface complementary to the said conical head and juxtaposed thereto to retain a strand positioned in the said groove therein and having an axial bore coaxial with the concave conical surface and with the first named bore, and means in the bore of the fixed member to prevent rotation relative to the fixed member of a strand passing through the bore of the fixed member.

20. In a strand handling apparatus, means to advance a plurality of strands longitudinally, rotary means to intertwist the strands together, means to drive the advancing means at constant speed, means independent of said driving means to drive the intertwisting means, and means to vary the speed of the last named driving means.

21. In a strand handling apparatus, means to advance a plurality of strands longitudinally, rotary means to intertwist the strands together, means to drive the advancing means at constant speed, means independent of said driving means to drive the intertwisting means, and means to vary the speed of the last named driving means without affecting the speed of the first named driving means.

22. In a strand handling apparatus, a stationary core supply, a rotatable support, a strand supply mounted on the support to be revolved thereby, a twisting member mounted on the support to be rotated thereby to twist a strand drawn from the strand supply about a core drawn from the core supply, a product advancing means to advance the combined core and strand, a constant speed means to drive the advancing means, means to drive the support, and means to vary the speed of the support driving means.

23. In a strand handling apparatus, a stationary core supply, a rotatable support, a strand supply mounted on the support to be revolved thereby, a twisting member mounted on the support to be rotated thereby to twist a strand drawn from the strand supply about a core drawn from the core supply, a product advancing means to advance the combined core and strand, a constant speed motor to drive the advancing means, a motor to drive the support, and a device to vary the speed of the support driving motor.

24. In a strand handling apparatus, a rotatable support, a plurality of strand supplies mounted on the support to be revolved thereby, a twisting member mounted on the support to be rotated thereby to intertwist strands together drawn from the plurality of supplies, a product advancing means to advance the intertwisted strands, a constant speed means to drive the advancing means, means independent of said driving means to drive the support, and means to vary the speed of the support driving means.

25. In a strand handling apparatus, a rotatable support, a plurality of strand supplies mounted on the support to be revolved thereby, a twist-

ing member mounted on the support to be rotated thereby to intertwist strands together drawn from the plurality of supplies, a product advancing means to advance the intertwisted strands, a constant speed means to drive the advancing means, means independent of said driving means to drive the support, and means to cyclically vary the speed of the support driving means.

26. In a strand handling apparatus, a core strand supply, a plurality of cover strand supplies, means to lead the cover strands to the core strand at a winding point, means to revolve the core strands about the cover strand to be wound thereon, means to advance the combined strands from the winding point, and means to control lateral displacement of the strands at the winding point for controlling the relative distribution of the cover strands on the core strand.

27. In a strand handling apparatus, a core strand supply, a plurality of cover strand supplies, means to lead the cover strands to the core strand at a winding point, means to revolve the core strands about the cover strand to be wound thereon, means to advance the combined strands at constant linear speed from the winding point, means to vary the angular speed of the cover strands about the core strand to vary the lay of the cover strands on the core strand, and means to control lateral displacement of the strands at the winding point for controlling the relative distribution of the cover strands on the core strand.

HERBERT S. KEATING.