July 20, 1926. 1,592,909

F. H. SLEEPER

MACHINE FOR WINDING STRANDED FORMS

Filed Jan. 8, 1923 3 Sheets-Sheet 1

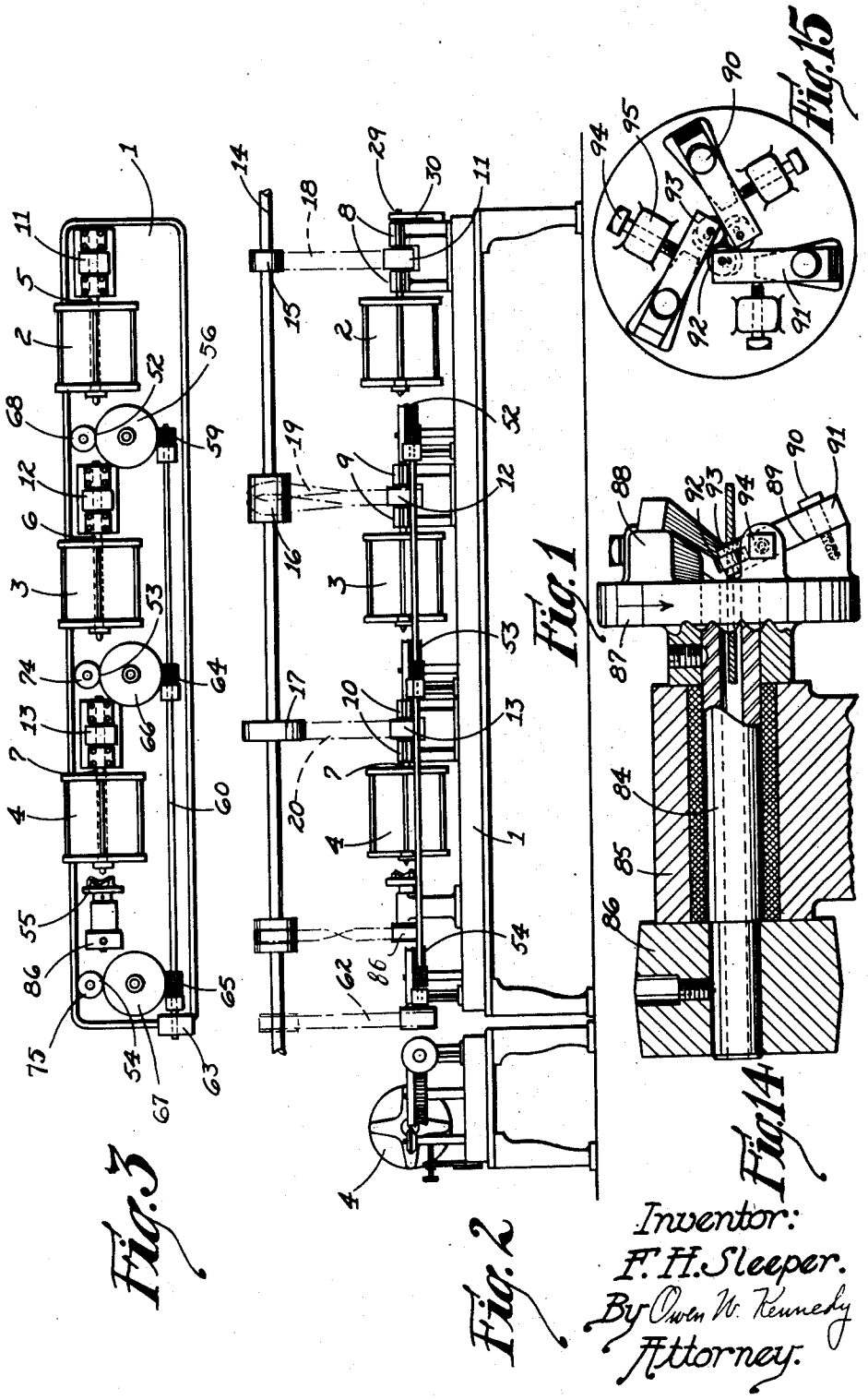


Fig. 3

Fig. 2

Fig. 1

Fig. 15

Fig. 14

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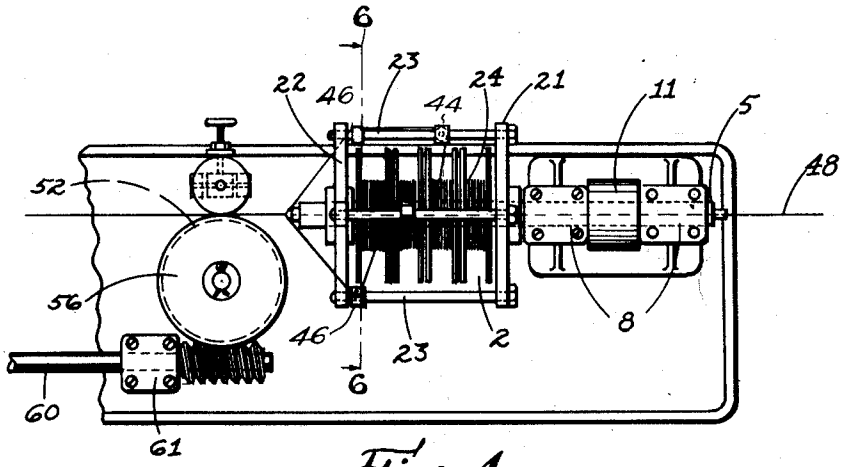


Fig. 4

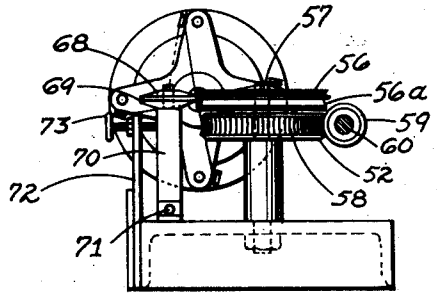


Fig. 5

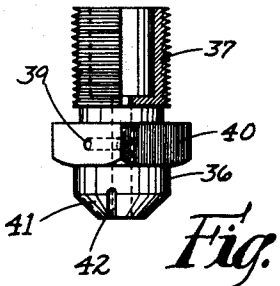


Fig. 7

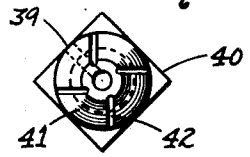


Fig. 8

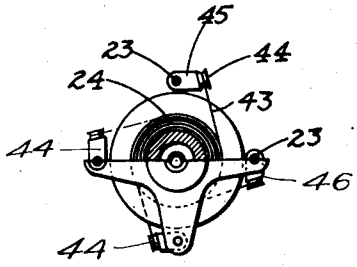


Fig. 6

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MACHINE FOR WINDING STRANDED FORMS

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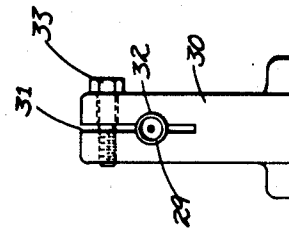
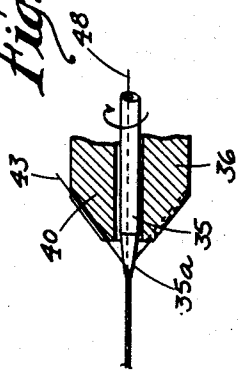
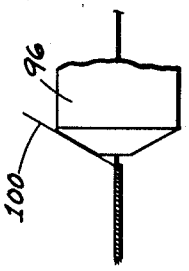


Fig. 11





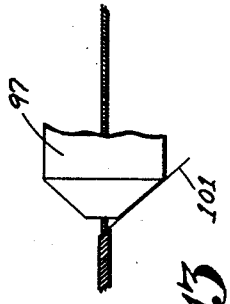
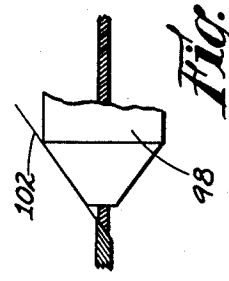
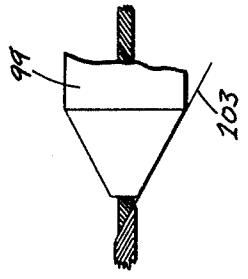


Fig. 13





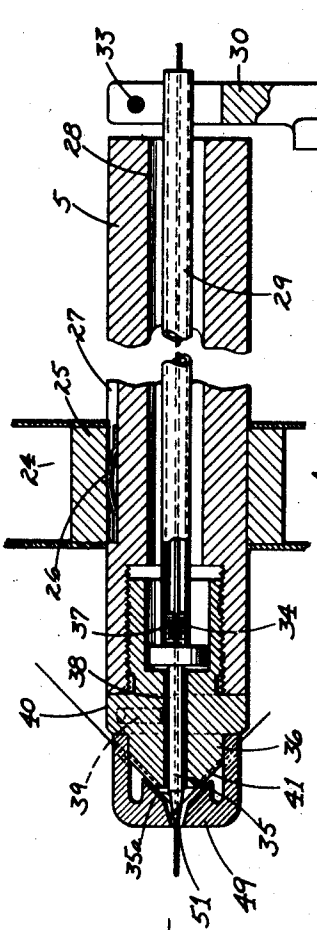


Fig. 9

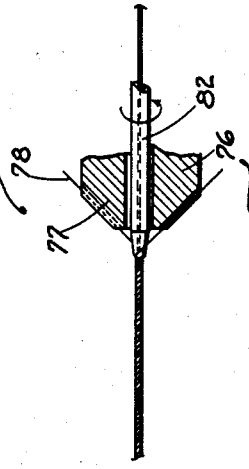


Fig. 12

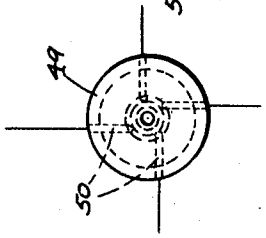
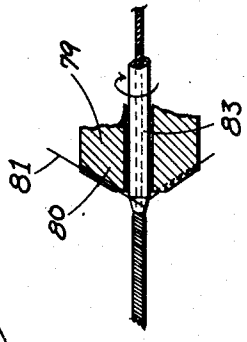


Fig. 10



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Patented July 20, 1926. 1,592,909

UNITED STATES PATENT OFFICE.

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MACHINE FOR WINDING STRANDED FORMS.

Application filed January 8, 1923. Serial No. 611,332.

My invention relates to a machine for the production of standard forms, such as flexible shafting, cable, and the like, which forms are characterized by a number of layers of separate strands wound upon a suitable core. The object of my invention is to provide an improved machine for the continuous production of stranded forms comprising any desired number of layers of strands.

In the manufacture of stranded forms, it has been heretofore customary to employ a machine for winding a single layer of strands upon a suitable core of the desired length, after which it has been necessary to run the partially completed product through the machine each time that it is desired to wind another layer of strands thereon. Such a machine is shown in my copending patent application, Serial No. 483,265, filed July 8, 1921, from a consideration of which, it will be apparent that the production of a cable comprising several layers of strands, involves a very considerable amount of time, in addition to the time consumed by the actual running of the machine, owing to the fact that the cable reels must be handled every time that it is desired to wind a new layer of strands, and furthermore considerable changes must be made in the machine itself when the strands in the new layer have a diameter and pitch different from that of the preceding layer, as is usually the case.

According to the present invention I propose to provide an improved machine of the class described, that is adapted to continuously produce, at one operation, complete stranded forms having a number of different layers of strands. My improved machine is believed to embody a new principle of operation, and furthermore, is adapted to wind stranded forms at a rate of production heretofore impossible of attainment with prior machines. The above and other advantageous features of my machine will hereinafter more fully appear, reference being had to the accompanying drawings in which—

Fig. 1 is a view in side elevation of a machine embodying my invention.

Fig. 2 is an end view of the machine shown in Fig. 1.

Fig. 3 is a plan view of the machine shown in Fig. 1.

Fig. 4 is an enlarged detailed view, showing a portion of the machine shown in Fig. 3.

Fig. 5 is an end view of the parts shown in Fig. 4.

Fig. 6 is a transverse sectional view along the line 6—6 of Fig. 4.

Fig. 7 is an enlarged plan view of a winding nose removed from the machine.

Fig. 8 is a view in front elevation of the nose shown in Fig. 7.

Fig. 9 is an enlarged longitudinal sectional view through one of the flier shafts.

Fig. 10 is an end view of the parts shown in Fig. 9.

Fig. 11 is an end view of the guide tube clamps shown in Fig. 9.

Fig. 12 is a diagrammatic view illustrating the continuous production of a stranded form.

Fig. 13 is a diagrammatic view illustrating a modification of my machine.

Fig. 14 is a longitudinal sectional view showing the cable compressing device on an enlarged scale.

Fig. 15 is an end view of the parts shown in Fig. 14.

Like reference characters refer to like parts in the different figures.

Referring first to Figs. 1, 2 and 3, the machine generally comprises an elevated table 1, upon which is mounted a plurality of fliers 2, 3 and 4. The fliers 2, 3 and 4 are carried for independent rotation by shafts 5, 6 and 7 respectively, all of which are in axial alinement. The shafts 5, 6 and 7 are rotatably supported in pairs of bearings 8, 9 and 10, respectively, and the shafts are adapted to be driven independently from any suitable source or sources of power.

For purposes of illustration, I have shown the shafts 5, 6 and 7 provided with pulleys 11, 12 and 13, respectively, mounted between the shaft bearings, whereby the several shafts may be driven from a line shaft 14 extending parallel to the common axis of rotation of the shafts 5, 6 and 7. Pulleys 15, 16 and 17 are mounted on the shaft 14 and are connected to the pulleys 11, 12 and 13 by means of belts 18, 19 and 20. The

pulleys 15, 16 and 17 are shown as being of different diameters, and one of the belts 19 is shown as being crossed, whereby the shafts 5, 6 and 7 may be driven at different speeds, and in different directions of rotation, for a purpose to be hereinafter described.

The several fliers 2, 3 and 4 are substantially identical in construction, and for the sake of brevity, only the first flier 2 will be described herein in detail. As best shown in Fig. 4, the flier 2 consists of a plate 21 mounted on the shaft 5, and a radial armed spider 22 spaced from the plate 21 on the shaft 5, and connected thereto by means of rods 23. A number of reels 24, here shown as four in number, are loosely mounted on the shaft 5 between the plate 21 and the spider 22. As best shown in Fig. 9, the hub 25 on each reel 24 is adapted to be engaged on its internal surface by a resilient finger 26 retained within a longitudinal slot 27 provided in the shaft 5, the several fingers 26 providing frictional resistance to the turning movement of the several reels 24 on the shaft 5, for a purpose to be hereinafter described.

Still referring to Fig. 9, the shaft 5 has a longitudinal opening 28 extending therethrough, through which extends a guide tube 29. The guide tube 29 is supported at one end of the shaft by means of an arm 30 extending upwardly from the base of the bearing 8, see Fig. 1. As best shown in Fig. 11, the arm 30 is provided at its top with a slot 31 and notches 32 for receiving the tube 29. A set screw 33 is provided, whereby the opposed portions of the arm 30, on either side of the slot 31, may be drawn together in order to securely clamp the guide tube 29 in position. The other end of the guide tube 29 is threaded, as indicated at 34, to receive the end of a nozzle 35 which extends into a winding nose 36. The winding nose 36 has a threaded portion 37 which is received within a threaded countersunk portion of the opening 28 in the shaft 5, whereby the nose 36 is adapted to turn with the shaft 5. An opening 38 in the nose 36, through which the nozzle 35 extends, is slightly greater in diameter than the nozzle 35, so that the nose 36 is adapted to turn about the nozzle 35 which is held fast by the tube 29. In order to reduce the friction between the nose 36 and the nozzle 35, a passage 39 is provided in an angular tool receiving portion 40 of the nose 36, whereby the bearing surfaces may be lubricated. As best shown in Fig. 7, the nose 36 further comprises a conical portion 41 and a plurality of radial grooves 42, corresponding in number to the number of reels 24, are provided in the conical portion 41 for receiving wires from the several reels 24.

Referring now to Figs. 4, 5 and 6, each wire 43 extends from its reel 24 over a pulley 44, rotatably mounted on a support 45 carried by one of the rods 23. As best shown in Fig. 6, the axis of rotation of the pulley 44 is inclined so that the wire 43 may be taken off of the reel 24 tangentially. From the pulleys 44 the wires 43 pass over pulleys 46, which are rotatably mounted on supports 47 carried by the rods 23, in such a manner that the pulleys 46 are in substantial alinement with the radial grooves 42. Two pulleys 44 and 46 are provided for leading the wire from each one of the reels 24, with the exception of the one nearest to the nose 36, for which only one pulley 46 is provided.

The grooves 42 are thus adapted to lead the wires 43 radially inwardly to the longitudinal axis of the guide tube 29, through which passes the core 48 upon which it is desired to wind the first layer of strands. When the nose 36 is rotated about the tube 29 and the core 48, it is obvious from a consideration of Fig. 9 that the several wires 43 will be wound either directly on the core 48, or on the tapered end of the nozzle 35, depending upon the position of the end of the nozzle 35 with respect to the cone portion 41. For purposes of illustration, the nozzle 35 is shown as projecting slightly beyond the cone portion 41, so that the wires will be wound on the nozzle 35 at a point closely adjacent to the core 48, for a purpose to be hereinafter described. In order to confine the wires 43 at the point of winding, a cup-shaped cap 49 is mounted on the nose 36, and is provided with slots 50 for the reception of the wires 43. The cap 49 is provided with a conical opening 51 of such size as to receive the projecting end of the nozzle 35, and to permit the passage therethrough of the core 48, with the first layer of strands wound thereon.

Referring now to Figs. 1 and 3, as the core 48, with a layer of strands 43 wound thereon, passes from the first flier 2, the cable thus formed is passed through a take up device 52, from which it passes to the next flier 3, which is adapted to wind a second layer of strands thereon. A second take up device 53 is interposed between the flier 3 and the flier 4, and a third take up device 54 is arranged to take the cable after a third layer of strands has been wound thereon and after it has been acted upon by a compressing device 55, to be described later. As the fliers 2, 3 and 4 are substantially the same in general construction, with the exception of certain differences which will be hereinafter pointed out, and as the several take up devices 52, 53 and 54 are also substantially the same in general construction, with the exception of certain differences which will be hereinafter pointed out, it is obvious that the number of fliers and the number of take up devices may be

increased or decreased at will, in order to produce cable or shafting having the desired number of layers of strands.

Referring now to Figs. 4 and 5, the take up device 52 comprises a circular disk or wheel 56, having a peripheral groove 56ª for receiving the cable with the first layer of strands thereon. The disk 56 is rotatably mounted on a stud 57, and is secured to a worm wheel 58 in mesh with a worm 59 mounted on a shaft 60, supported above the table 1 in a bearing 61. The shaft 60 is adapted to be driven from a suitable source of power by means of a belt 62 and pulley 63, or other similar power transmitting device, as shown in Fig. 3. The shaft 60 has also mounted thereon worms 64 and 65, which are adapted to drive disks 66 and 67 of the take up devices 53 and 54 respectively. The disk 66 is provided with a peripheral groove, slightly larger than the groove 56ª on the disk 56, and the disk 67 is provided with a peripheral groove larger than the other grooves so as to accommodate the increased diameter of the cable as it is formed.

The take up device 52 also comprises a disk 68 provided with a peripheral groove 69, the disk 68 being rotatably mounted on an arm 70 pivoted at 71. The arm 70 is held in the direction of the disk 56 by means of a resilient member 72 carrying an adjustable stop 73, the end of which is in engagement with the arm 70. The disk 68 is thus adapted to maintain the cable in the groove 56ª at substantially the point of tangency of the cable to the disk 56, the pressure exerted by the disk 68 being adjustable by means of the stop 73. Similar pressure disks 74 and 75 are provided to coact with the take up disks 66 and 67.

From a consideration of Fig. 3, it is apparent that as the cable emerges from each of the fliers 2, 3 and 4, and passes between the respective pairs of disks 56 and 68, 66 and 74, and 67 and 75, it will have imparted thereto a uniform longitudinal movement, by reason of the fact that the several disks 56, 66 and 67, are driven at the same speed from a common shaft 60. It is also apparent that as the several fliers 2, 3 and 4 are rotated about the longitudinal axis of the moving cable, successive layers of strands will be wound thereon. In order to take care of the increased diameter of the cable after each winding, the several fliers are driven at different speeds, as indicated, so that the amounts of material wound by different fliers on a given length of cable, within a given time interval, will vary directly in accordance with the speeds of the fliers. In order to further vary the amounts of material wound within a given space, the angular pitch of the strands wound by different fliers may be varied inversely to the speed of rotation of the fliers, and to this end the inclination of the conical portions of the several winding noses may be made different.

Referring now to Fig. 12, there is shown diagrammatically, the arrangement of the several winding noses carried by the fliers 2, 3 and 4. As previously described, the winding nose 36 of the flier 2 is provided with a conical portion 41, the inclination of which determines the pitch of the wires 43 as they are wound on the core 48 by rotation of the flier 2. The flier 3 is provided with a winding nose 76 having a conical portion 77 which makes a steeper angle with its axis of rotation than does the conical portion 41, so that the second layer of wires 78 will be wound on the first layer with a steeper pitch than that of the first layer. As previously mentioned, the flier 3 is adapted to be rotated at a greater speed than the flier 2 and in the opposite direction of rotation, as indicated by the arrows, whereby the second layer of wires will be wound with a pitch opposite to that of the first layer. The last flier 4 is provided with a winding nose 79 having a conical portion 80, the angle inclination of which is even greater than that of the nose 76. Consequently, rotation of the flier 4 will cause a third layer of wires 81 to be wound on the second layer at a still steeper pitch than that of the second layer. The flier 4 is rotated at a speed greater than that of the flier 3, and in the same direction of rotation as the flier 2.

The nozzle 35 of the flier 2 projects beyond the end of the winding nose 36, so that the wires 43 are wound partly on the tapered end portion 35ª of the nozzle 35, and then slide off of the nozzle on to the core 48 as the latter is moved through the nozzle by the take up device 52. The nozzle portion 35ª serves to support the wires 43 as they approach the core 48, so that each convolution is partly formed on the nozzle before passing onto the core, consequently the strands will not be wound as tightly as they would if wound directly on the core 48. The amount that the nozzle projects beyond the nose 36 may be regulated by moving the tube 29 in the clamping arm 30. The flier 3 is similarly provided with a nozzle 82 projecting beyond the nose 76, and the flier 4 is provided with a nozzle 83 projecting beyond the nose 79. The amount that the nozzle 82 projects beyond the nose 76 is less than the amount that the nozzle 35 projects beyond the nose 36, and the projection of the nozzle 83 is still less on account of the steeper pitch of the wires 81. Obviously, the nozzles 82 and 83 are capable of longitudinal adjustment within the fliers, in the same manner as the nozzle 35, so that the degree of tightness of each layer may be closely regulated.

Referring now to Figs. 14 and 15, there is shown on an enlarged scale the compressing device 55 for acting on the cable as it emerges from the last flier 4. The device 55 consists of a hollow shaft 84 rotatably supported in a bearing 85 extending above the table 1, with its longitudinal axis coinciding with the axes of rotation of the several fliers 2, 3 and 4. A pulley 86 is secured to the shaft 84 whereby it may be driven from a suitable source of power in a direction of rotation opposite to that of the last flier 4, for a purpose to be hereinafter described.

The shaft has mounted thereon a head 87 having a plurality of projections 88 arranged around the center thereof, through which the cable is adapted to pass. The face 89 of each projection 88 is inclined with respect to the head 87, and a block 90 is pivotally mounted on each projection by means of a pin 91. The end of each block 90 is slotted to receive a roll 92 adapted to rotate on a pin 93. As clearly shown in Fig. 15, the several axes of rotation of the rolls 92 make different angles with the line of movement of the cable as it is drawn through the head 87 by the take up device 54. The several rolls 92 are adapted to be pressed into engagement with the completed cable by means of studs 94, each in threaded engagement with a lug 95 on the head 87, with its end pressing against the corresponding block 90. Obviously the studs 94 allow considerable adjustment of the rolls 92 with respect to the cable.

As the head 87 is rotated in a direction opposite to that of the last flier 4, the rolls 92 engage the surface thereof and tend to compress or size the cable. By reason of the pressure exerted by the rolls, the individual wires in the strands forming the several layers of the cable are slightly flattened at the points of contact one upon the other, thereby materially increasing the flexibility of the cable as a whole.

From the foregoing it is apparent that by my invention I have provided an improved machine that is adapted to continuously produce, at one operation, stranded forms having a number of different layers of strands wound thereon, at any desired pitch. When operating my machine, the core upon which it is desired to form the cable, is fed in at one end, and the completed cable having the desired number of layers of strands thereon, emerges from the other end of the machine, the cable having been formed continuously without any interruptions or intermediate handling. It is obvious that cable of great length may be produced by my machine, the only limitation in the length of the cable being the amount of wire that can be conveniently carried by the reels of the fliers.

While I have shown my machine as being adapted for the formation of a cable in which the pitch of the strands in the successive layers increases, it is obvious that my machine is in no way limited to this particular mode of operation, and that it is equally as well adapted for the production of stranded forms in a reverse manner. For example, I have shown diagrammatically in Fig. 13, a modification of the arrangement shown in Fig. 12, wherein the first winding nose 96 is a relatively steep pitch. While the successive winding noses 97, 98 and 99 are each of less pitch than the winding nose 96. In a machine embodying this arrangement, it is obvious that the flier carrying the nose 96 must be driven at the highest speed, while the flier carrying the nose 99, must be driven at the lowest speed. A machine embodying the principles illustrated in Fig. 13, would be particularly well adapted for the production of stranded electric cable, in which the diameter of the first layer of wires 100 would be considerably less than the last layer of wires 103. When producing winding cable of this sort, it is obvious that the greater weight of cable carried by the last flier would be rotated at the lowest speed, thereby reducing the centrifugal effect, due to the weight of the wire 103.

I claim:—

1. In a machine of the class described, a rotatable hollow shaft, a stationary hollow shaft inside said rotatable hollow shaft, a hollow mandrel carried by said stationary shaft, a coiling head carried by said rotatable shaft, and a plurality of wire carrying reels coaxial with said rotatable shaft to supply wire to said head.

2. In a machine of the class described, a rotatable hollow shaft, a stationary hollow mandrel inside said shaft, a coiling head carried by said shaft, and a flyer structure comprising a plurality of reels carried by said shaft and coaxial therewith.

3. In a machine of the class described, a rotatable hollow shaft, a stationary hollow mandrel inside said shaft, a coiling head carried by said shaft, a plurality of reels carried by said shaft and coaxial therewith, and frictional means to cause said reels to rotate with said shaft, but allowing slight rotation of said reels relative to said shaft for the withdrawal of wire therefrom.

4. In a machine of the class described, a rotatable hollow shaft, a stationary hollow mandrel inside said shaft, a coiling head carried by said shaft, and a flyer structure comprising a plurality of reels carried by said shaft and coaxial therewith, frictional means to cause said reels to rotate with said shaft, but allowing slight rotation of said reels relative to said shaft for the withdrawal of wire therefrom, and flier arms extending radially from said shaft and carrying rods spaced around said reels.

5. In a machine of the class described, a

rotatable hollow shaft, a stationary hollow mandrel inside said shaft, a coiling head carried by said shaft, a plurality of reels carried by said shaft and coaxial therewith, frictional means to cause said reels to rotate with said shaft, but allowing slight rotation of said reels relative to said shaft for the wthdrawal of wire therefrom, and guiding means spaced around the periphery of said reels to carry wire from said reels to said head.

6. A machine of the class described, comprising a plurality of fliers rotatable about a common axis, a plurality of take up devices located between said fliers, means for driving said fliers at different speeds, and means for driving said take up devices in unison at the same speed.

7. A machine of the class described, comprising means for supporting a core, a flier rotatable about said core for winding a layer of strands thereon, a second rotatable flier for winding a second layer of strands upon the first layer, and a device for delivering the core with the first wound layer thereon to the second flier.

8. A machine of the class described, comprising means of procuring the longitudinal movement of a core, means for winding a layer of strands on said core, and rollers revolving about said core for compressing the strands after winding.

9. A machine of the class described, comprising means for procuring the longitudinal movement of a core, means for winding a layer of strands on said core, and adjustable means revolving about said core for compressing the strands after winding.

10. A machine of the class described, comprising means for procuring the longitudinal movement of a core, means for winding a layer of comparatively rigid strands on said core, and rollers skewed to said core for flattening the said layer of strands after winding.

11. In a machine of the class described, a rotatable hollow shaft, means on one end of said shaft to coil wire about a central core, a plurality of wire carrying reels coaxial with said shaft, and members detachably secured to said shaft for axially positioning said reels on said shaft between them.

12. In a machine of the class described, a rotatable hollow shaft, means on one end of said shaft to coil wire about a central core, a plurality of wire carrying reels coaxial with said shaft, members detachably secured to said shaft for axially positioning said reels on said shaft between them, and frictional means causing said reels to rotate with said shaft but allowing slight rotation of said reels relative to said shaft for withdrawal of said wire.

13. In a machine of the class described, a rotatable hollow shaft, means on one end of said shaft to coil wire about a central core, a plurality of wire carrying reels coaxial with said shaft, a plate secured to said shaft at one end, and a removable spider detachably secured to said plate by rods for axially positioning said reels on said shaft between said plate and spider.

14. In a machine of the class described, a rotatable hollow shaft, means on one end of said shaft to coil wire about a central core, a plurality of wire carrying reels coaxial with said shaft, a plate secured to said shaft at one end, a removable spider detachably secured to said plate by rods with said reels positioned therebetween, and guide pulleys mounted on said rods for leading wire from said reels.

15. In a machine of the class described, a rotatable hollow element, a stationary hollow element inside said rotatable hollow element, wire carrying means carried by said rotatable hollow element, a hollow conical member carried by said rotatable hollow element, and grooves in said conical member to lead wire to the tip of said stationary hollow element.

16. In a machine of the class described, a rotatable hollow element, a stationary hollow element inside said rotatable hollow element, wire carrying means carried by said rotatable hollow element, a hollow conical member carried by said rotatable hollow element, grooves in said conical member to lead wire to the tip of said stationary hollow element, and a detachable cap covering said conical member.

17. In a machine of the class described, a rotatable hollow element, a stationary hollow element inside said rotatable hollow element, wire carrying means carried by said rotatable hollow element, a hollow conical member carried by said rotatable hollow element, grooves in said conical member to lead wire to the tip of said stationary hollow element, a detachable cap covering said conical member, and grooves in said cap to constrain the wire to wind at a given point.

Dated this 29th day of December, 1922.

FRANK H. SLEEPER.