Nov. 17, 1931. J. E. BOYNTON 1,831,945

FORMING TUBES

Original Filed June 13, 1924 2 Sheets-Sheet 1

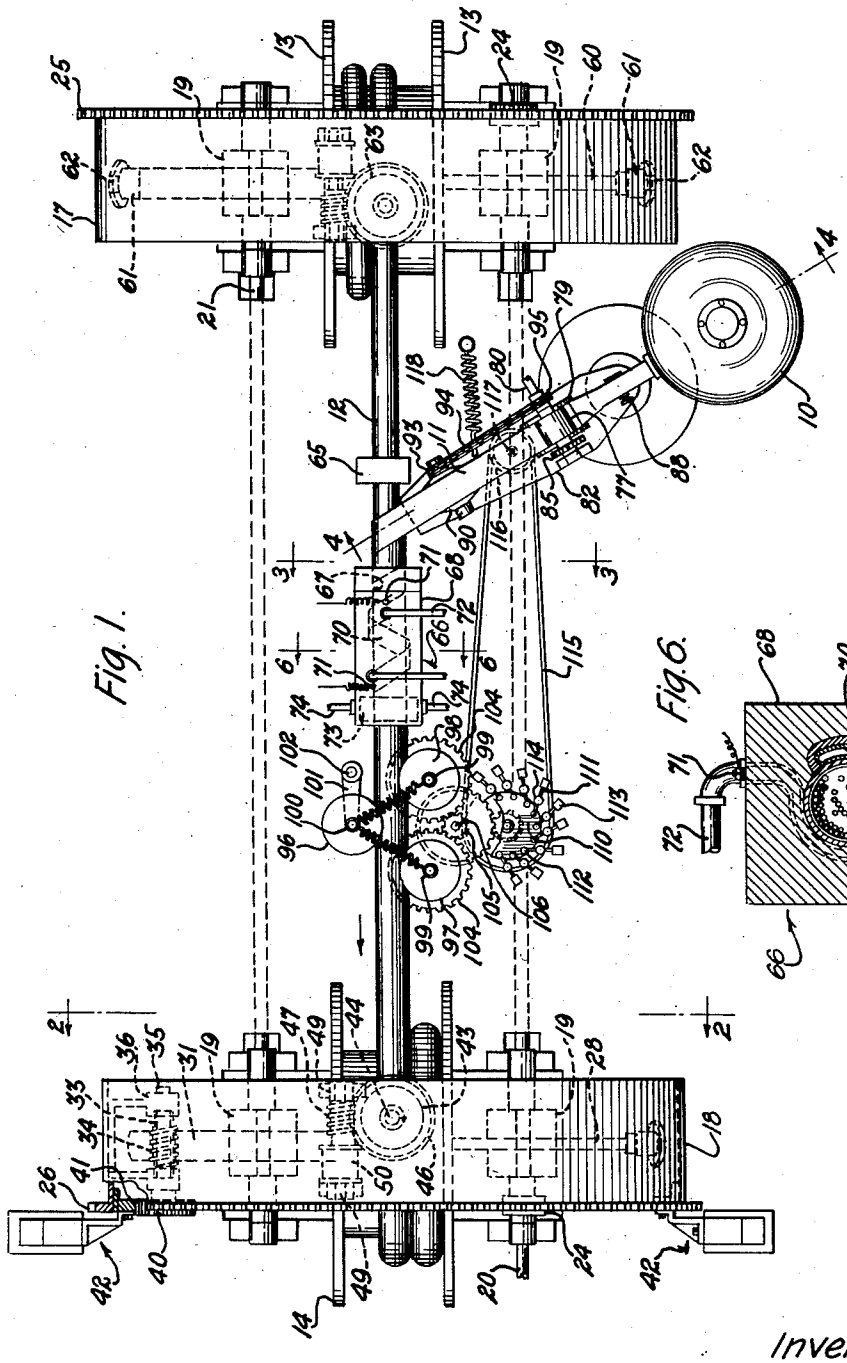

Fig. 1.

Fig. 6.

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Fig. 2.

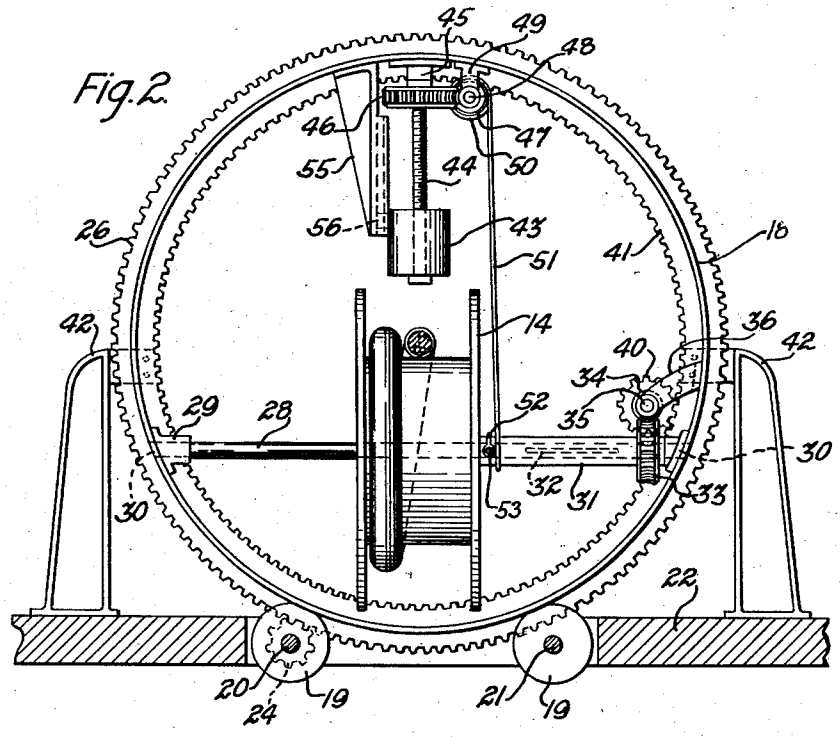


Fig. 5.

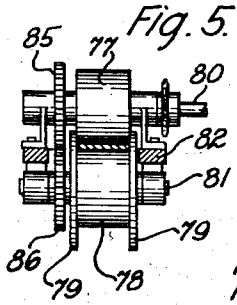


Fig. 3.

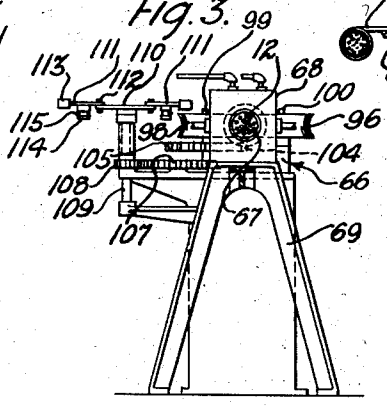
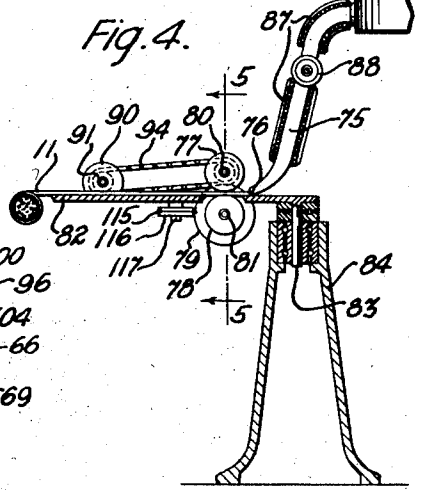


Fig. 4.



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UNITED STATES PATENT OFFICE

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FORMING TUBES

Original application filed June 13, 1924, Serial No. 719,817. Divided and this application filed May 24, 1928, Serial No. 280,329. Renewed September 2, 1931.

This invention relates to a method of and means for forming a tube, particularly to a method of and means for sheathing a core with moldable matter, and is a division of my co-pending application, Serial No. 719,817, filed June 13, 1924.

The invention is particularly adapted to be employed in the sheathing of cable cores. Heretofore, it has been the almost universal practice to apply the metallic sheath to a cable core by means of a hydraulic extrusion press having a cylinder adapted to hold a quantity of the metal to be extruded. This metal is delivered to the cylinder in the fused state and must be permitted to cool before the press is set in operation. After the metal has been extruded, the ram of the press must be backed out of the cylinder so that the cylinder may be refilled. The period of activity of the press is invariably less than the period of preparation therefor. The general efficiency of the method is less than 50% of that of a method which is substantially continuous in its nature and not limited to the capacity of a hydraulic cylinder or the like.

An object of the invention is to provide a method and apparatus whereby tubing can be manufactured at a comparatively low cost.

Another object of the invention is to provide a method of and apparatus for forming tubing without the use of high pressures.

Still another object of the invention is to form a metallic tube continuously.

One embodiment of the invention is adapted to sheath a cable core and comprises means for carrying a supply reel and a take-up reel bodily around an axis of rotation so that a cable core which is being withdrawn from the supply reel by the take-up reel may wrap a metallic ribbon around itself as it passes to the take-up reel, the metallic ribbon being molded contemporaneously and being fused into an imperforate covering for the core as it passes to the take-up reel.

The objects of the invention are more clearly set forth in the following detailed description, reference being had to the accompanying drawings, wherein

Fig. 1 is a plan view of apparatus embodying the invention;

Fig. 2 is a transverse sectional view thereof taken on line 2—2 of Fig. 1 looking in the direction indicated by the arrows;

Fig. 3 is a transverse sectional view thereof taken on line 3—3 of Fig. 1 looking in the direction indicated by the arrows;

Fig. 4 is a longitudinal sectional view of the holding apparatus taken on line 4—4 of Fig. 1 looking in the direction indicated by the arrows;

Fig. 5 is a vertical sectional view taken on line 5—5 of Fig. 4 looking in the direction indicated by the arrows, and

Fig. 6 is a transverse sectional view taken on line 6—6 of Fig. 1 looking in the direction indicated by the arrows.

It is believed that a complete understanding of the improved method will be procured from a description of the apparatus by means of which the method may be practiced.

Referring to the drawings, wherein like characters designate like parts throughout the several views, the reference character 10 designates a receptacle for holding a supply of metal in a fused state from which a metallic element in ribbon form as indicated at 11 is molded. The receptacle 10 may be heated by any suitable means (not shown). The metallic ribbon 11 is supplied to a cable core 12 which is drawn from a supply reel 13 by a take-up reel 14, means being interposed between the reels for forming the metallic ribbon into an imperforate sheath for the core. The supply reel 13 and the take-up reel 14 are carried by annular members 17 and 18, respectively. The annular members 17 and 18 are coaxially arranged in spaced relation and are supported upon a plurality of rollers 19 which permit the annular members to be rotated about a common axis. The rollers 19 are rotatably journaled upon a plurality of shafts 20 and 21 which are in turn rotatably journaled in a bed or floor 22 upon which the apparatus rests. A plurality of pinions 24 rigidly secured upon the shaft 20 mesh with gears 25 and 26 formed integrally with the annular members 17 and 18, respectively. The shaft 20 may be ro-

tated by any suitable means (not shown) and will in turn rotate the annular members 17 and 18 in unison through the medium of the pinions 24 and the gears 25 and 26.

Referring now to Fig. 2, the take-up reel 14 is mounted upon a shaft 28 and is constrained to rotate therewith. The shaft 28 is rotatably journaled in a plurality of tubular brackets 29 secured to the annular member 18, the annular member 18 being provided with apertures 30 which permit the shaft to be withdrawn from the annular member when the reel 14 is to be replaced. A sleeve 31 splined upon the shaft 28 by means of a feathered key 32 has an integral worm gear 33 meshing with a worm 34 rigidly secured to a shaft 35 which is rotatably journaled in a bearing bracket 36 rigidly secured to the annular member 18. A pinion 40 keyed to the shaft 35 meshes with a stationary internal gear 41 which is carried by a plurality of uprights 42. It is obvious that rotation of the annular member 18 is accompanied by rotation of the shaft 28 through the medium of the worm gear 33, the worm 34, the pinion 40 and the gear 41. The arrangement is such that the take-up reel 14 will draw the cable core 12 from the supply reel 13 and wind the cable core around itself.

The take-up reel 14 is counter-balanced by a weight 43 threaded upon a rod 44 which is rotatably journaled in a bearing 45 rigidly secured to the inner surface of the annular member 18. A worm gear 46 fastened to the rod 44 meshes with a worm 47 secured to a shaft 48, the shaft 48 being journaled in a plurality of bearings 49 secured to the annular member 18. A drum 50 secured to the shaft 48 has one end of a cord 51 secured thereto, the other end of the cord 51 being provided with an eye 52 adapted to be positioned upon a pin 53 projecting from the sleeve 31. During rotation of the annular member 18 the sleeve 31 will, of course, withdraw the cord 51 from the drum and thus rotate the drum together with a shaft 48 and the worm 47. The motion of the worm 48 is imparted to the worm gear 46 which causes the rod 44 to displace the weight 43 along the rod in a direction away from the axis of rotation from the annular members 17 and 18, the weight 43 being held against rotation around the axis of the rod 44 by a bracket 55 which engages a lug 56 projecting from the weight. The purpose of this construction is to compensate for the weight added to the take-up reel 14 when the cable core is drawn from the supply reel 13 and wound upon the take-up reel 14. During this operation, the weight 43 will draw away from the axis of rotation of the annular members 17 and 18 at a rate of speed which is proportional to the rate of speed with which the cable core is wound upon the take-up reel. To restore the weight 43 to its initial position and at the same time to rewind the cord 51 upon the drum 50, the operator need only remove the eye 52 from the pin 53 and then rotate the drum 50 in a counter-clockwise direction (Fig. 2).

The supply reel 13 is mounted upon a shaft 60 rotatably journaled in tubular bearings 61 secured upon the inner surface of the annular member 17, the annular member 17 being provided with apertures 62 which permit the shaft 60 to be removed from the annular member when the supply reel 13 is to be replaced. A weight 63, substantially identical to the aforementioned weight 43, is adapted to be displaced with respect to the common axis of the annular members 17 and 18 by means of mechanism which is substantially identical with the mechanism for displacing the weight 43. However, in this instance the arrangement is such that the weight 63 approaches the axis of rotation as the cable core 12 is withdrawn from the supply reel 13.

It is readily understood that if a supply reel 13 and a take-up reel 14 are mounted in the annular members 17 and 18, respectively, the apparatus may be operated to have the take-up reel 14 withdraw the cable core 12 from the supply reel and the cable core will be rotated around a common axis of the annular members. This enables the cable core to wrap around itself material which is supplied to it. In this embodiment of the invention the cable core 12 will wrap the metallic ribbon 11 around itself, the arrangement of the apparatus being such that the metallic ribbon 11 is applied in a plurality of helices around the core.

As shown in Fig. 1 the cable core 12 is preferably led through a guide 65 when it leaves the supply reel 13, the guide being adapted to bring a section of the cable core into a position wherein its longitudinal axis coincides with the axis of rotation of the annular members 17 and 18. The metallic ribbon 11 is supplied to the core directly after it has been drawn through the guide 65.

A heating unit 66 is disposed intermediate the annular member 18 and the point at which the metallic ribbon 11 is supplied to the cable core. The heating unit 66 is provided with an annular passage 67 through which the core and its covering of metallic ribbon are advanced on their way to the take-up reel. The heating unit 66 comprises a block 68 mounted upon a frame 69. A tubular resistor 70 in helical form is disposed in the block 68 and forms a portion of the wall of the passage 67. The resistor 70 is insulated from the block 68 and has its ends connected to a pair of binding posts 71 projecting from the upper surface of the block 68. The binding posts 71 provide means whereby the resistor 70 may be connected to any suitable source of electrical energy and heated to a temperature which will be sufficient to fuse the metallic

ribbon 11 when it comes in close proximity to the resistor. The lead of the helical resistor 70 is substantially equal to the lead of the helices of metallic ribbon 11 applied to the cable core. The apparatus is so arranged that the contiguous edges of each two adjacent helices of the metallic ribbon will move along the inner surface of the resistor, which surface is sufficiently wide to cause the edge portions of the metallic ribbon to fuse but is preferably too narrow to fuse the entire width of the metallic ribbon as if the entire width of the ribbon is fused the concentricity of the ribbon relative to the core may be destroyed. A plurality of pipes 72 connect the resistor 70 to any suitable source (not shown) of cooling fluid so that a cooling fluid may be passed through the resistor to lower its temperature quickly if the operator so desires. The left hand end (Fig. 1) of the block 68 is provided with an annular chamber 73 which is connected by means of a plurality of pipes 74 to a suitable supply (not shown) of cooling fluid. It is apparent that the portions of the metallic ribbon 11 which are fused as the ribbon is drawn past the resistor 70 will be solidified by the cooling fluid in the annular chamber 73 and the metallic ribbon will become an imperforate sheath for the core.

The means for forming the metallic ribbon 11 from the fused metal in the receptacle 10 comprises a spout 75 through which the fused metal may gravitate to the discharge orifice 76 of the spout 75 (Fig. 4). The discharge orifice 76 is of a shape substantially conforming to the shape it is desired to impart to the metallic ribbon 11. The fused metal is held at a temperature which permits it to solidify as it flows from the orifice 76, and in the preferred embodiment of the invention is received between a plurality of rolls 77 and 78 when it leaves the orifice. The roll 78 is provided with end flanges 79 which fit snugly against the end surfaces of the roll 77.

As shown in Fig. 5 the rolls 77 and 78 mounted upon a plurality of shafts 80 and 81, respectively, the shafts 80 and 81 being rotatably journaled upon a guide or table 82 which has one of its ends rigidly secured to a vertically disposed shaft 83 rotatably journaled in the upper end of a bearing member 84. The shaft 80 is driven by any suitable means (not shown) and is provided with a gear 85 meshing with a gear 86 rigidly secured to a shaft 81. The rolls 77 and 78 are spaced apart a distance which is substantially equal to the thickness of the metallic ribbon 11 and the length of the roll 77 is substantially equal to the width of the metallic ribbon. Therefore, the rolls 77 and 78 tend to gauge the thickness and width of the ribbon, particularly so when the fused matter tends to pile up as it leaves the spout 75. It is obvious that the rolls would withdraw the metallic ribbon from the spout 75 should the fused metal in the spout solidify just before it reaches the orifice 76. A plurality of heating units, 87 disposed around the spout 75 provide means for keeping the metal in a fused state as it passes through the spout, the flow of fused metal through the spout being controlled by a valve 88.

A pair of rotary blades or knives 90 are provided for trimming the edges of the metallic ribbon 11 directly before it is applied to the cable core. One purpose of this construction is to prepare unoxidized surfaces upon the metallic ribbon so that adjacent helices of the ribbon may be effectively fused together as they pass the resistor 70. The rotary knives 90 are secured to a shaft 91 rotatably journaled upon the free end of the guide or table 82. A sprocket 93 keyed around the shaft 91 meshes with a sprocket chain 94 which in turn meshes with a sprocket 95 rigidly secured to the shaft 80.

To compensate for the increasing speed at which the core is advanced when the sheathed core piles up on the take-up reel 14, means is provided for swinging the guide or table 82 around the axis of the shaft 83 so as to deliver the metallic ribbon 11 to the core 12 at an angle corresponding to the speed of the core. This means comprises a plurality of grooved rollers 96, 97 and 98 adapted to engage the sheath of core as it leaves the heating unit 66. The grooved rollers 97 and 98 are rotatably journaled upon a plurality of shafts 99 projecting from the frame 69, and the grooved roller 96 is rotatably journaled upon a pin 100 carried on the free end of a lever 101 pivotally mounted on the frame 69 by a pin 102. A plurality of helical springs 103 urge the grooved roller 96 toward the rollers 97 and 98 and so cause the sheathed core which passes between the rollers to drive the rollers 97 and 98. One end of each spring 103 is secured to the pin 100 and the other end thereof is secured to one of the shafts 99. Each of the rollers 97 and 98 has a gear 104 formed integrally therewith and adapted to mesh with a pinion 105 journaled upon a pin 106 projecting from the frame 69. A gear 107 mounted upon the pin 106 and constrained to rotate with the pinion 105 meshes with a pinion, 108, the pinion 108 being rigidly secured on a shaft 109 which is rotatably journaled in the frame 69.

As shown in Fig. 3 the shaft 109 has a disc 110 secured to it on its upper end. A plurality of levers 111 are pivotally secured to the disc 110 by means of a plurality of pins 112, the axes of the pins 112 being equidistantly spaced from each other and from the axis of the shaft 109. Each lever 111 is provided with a weight 113 at its outer end and with a grooved pin 114 intermediate its ends. A belt 115 is trained over the pins 114 and over a sheave

116 journaled on a pin 117 projecting from the under surface of the guide or table 82. It will be readily understood that when the disc 110 is rotated, the centrifugal force generated by the weights 113 on the levers 111 tends to bring the levers 111 into radial positions with respect to the axis of the shaft 109 and thus tends to move the grooved pins 114 away from the axis. Therefore, any increase in speed in the disc 110 will be accompanied by a tightening of the belt 115 which will then swing the guide or table 82 in a counter-clockwise direction (Fig. 1) against the action of a tension spring 118. If there is a decrease in speed in the disc 110, the guide or table 82 will be angularly displaced in a clockwise direction (Fig. 1) by the tension spring 118.

In the operation of the apparatus, the supply reel 13 carrying a supply of cable core 12 is mounted in the annular member 17 and an empty take-up reel 14 being mounted in the annular member 18. The cable core 12 is then threaded through the guide 65, the heating unit 66 and between the grooved rollers 96, 97 and 98. The forward end of the cable core is then secured to the take-up reel 14 or a short piece of steel cable or the like is utilized to secure the end of the cable core to the take-up reel. The valve 88 is then opened and the metallic ribbon 11 issuing from the spout 75 is applied to the cable core. After the operator has arranged the first few wraps of the metallic ribbon 11 around the cable core and has threaded the wrapped section of the core through the heating unit 66 and the grooved rollers 96, 97 and 98, the apparatus is set in operation. This, of course, includes the act of closing the circuit for the resistor 70 which fuses the convolutions of the metallic ribbon 11 to each other. The cooling fluid admitted to the annular chamber 73 in the block 68 serves to solidify the fused metal before it is drawn from the block. Should it be necessary at any time to stop the apparatus, it is preferable that a cooling fluid be admitted to the resistor 70 by way of the pipes 72 so that that portion of the metallic ribbon 11 which is in contact with the resistor will not remain in a fused state and so heat an adjacent portion of the ribbon that it flows out of the block 68. Of course the circuit for the resistor 70 is opened when the apparatus is brought to a full stop.

As the receptacle 10 may be refilled during the operation of the apparatus whenever it becomes necessary to do so, the efficiency of the apparatus greatly exceeds that of an hydraulic extruding press. The method embodying the invention is continuous with respect to any given length of cable core which may be placed in the apparatus.

What is claimed is:

1. A method of sheathing a core, which method consists in forming a metallic ribbon, contemporaneously causing relative movement between the ribbon and a core whereby the ribbon is wound around the core, and in contemporaneously fusing portions of the ribbon to each other.

2. A method of sheathing a core, which method consists in forming a metallic ribbon, contemporaneously causing relative movement between the ribbon and a core whereby the ribbon is wound around the core, contemporaneously fusing portions of the ribbon to each other, and in contemporaneously subjecting the fused portions to a cooling fluid.

3. A method of sheathing a core, which method consists in preparing unoxidized surfaces upon a metallic element, winding the element around the core, and in fusing adjacent convolutions of the winding to each other.

4. A method of continuously sheathing a core, which method consists in applying a metallic element to a core in such manner that the element forms a plurality of helices around the core, and in fusing portions of the helices.

5. A method of continuously sheathing a core, which method consists in wrapping a metallic element around a core, and in contemporaneously fusing portions of the element.

6. In metal working apparatus, means for rotating a core in strand form around its longitudinal axis, means for serving a strand of metal to the core, and means for fusing portions of the strand to secure it in place upon the core.

7. In metal working apparatus, means for preparing a plurality of unoxidized edges on a metallic element in ribbon form, means for winding the metallic element into a plurality of helices around a core with the unoxidized edges in opposed relation, and means for fusing adjacent helices to each other.

8. In metal working apparatus, the combination with means for molding a metallic element, of means for contemporaneously winding the metallic element around a core, and means for fusing one convolution of the winding to another convolution thereof.

9. The combination with means for supplying material to a traveling core, of means controlled by the speed of the core for controlling the angle at which the material is supplied to the core.

10. In apparatus for sheathing a core, means for advancing the core, means for rotating the core around its longitudinal axis, means for supplying a strand of material to the core, and means responsive to the speed at which the core is advanced for controlling the angle at which the strand is supplied to the core.

11. The combination with means for advancing a core, of means for applying a sheath to the core, means for trimming the sheath as it is applied to the core, and means responsive to the speed at which the core is advanced for bringing the last mentioned means into a plurality of adjusted positions with respect to the core.

12. In metal working apparatus, means for forming a metallic element into a plurality of helices, a heating unit in helical form for fusing the helices of the metallic element to each other, and means for advancing the helices of the metallic element through the helix of the heating unit.

13. A method of sheathing a traveling core, which method consists in wrapping a metallic covering on the traveling core, and in fusing portions of the covering.

14. In metal working apparatus, means for advancing a core, means for serving a strand of metal to the core, and means for fusing portions of the strand to secure it in place on the core.

15. A method of sheathing a core, which method consists in preparing unoxidized surfaces upon a metallic element, contemporaneously winding the element around the core, and in contemporaneously fusing adjacent convolutions of the windings to each other.

16. In metal working apparatus, means for rotating a core in strand form around its longitudinal axis, means for advancing the core, means for serving a strand of metal to the core to form helical wrappings thereon, and means for welding the wrappings to each other.

17. In metal working apparatus, knives for preparing a plurality of unoxidized edges on a metallic element in ribbon form, means for serving the metallic element to a core to form a plurality of helices around the core with the unoxidized edges in opposed relation, and means for fusing adjacent helices to each other.

18. The combination with means for wrapping material around a core, of means controlled by the first mentioned means for controlling the angle at which the material is applied to the core.

19. The combination with means for supplying material to a core, of means for contemporaneously advancing the core, and means controlled by the last mentioned means for controlling the angle at which the material is supplied to the core.

20. In apparatus for sheathing a core, means for advancing the core, means for rotating the core around its longitudinal axis, means for distributing a strand of material in a plurality of helices around the core, and means responsive to the speed at which the core is advanced for regulating the angle at which the strand is applied to the core.

21. In apparatus for sheathing a core, means for advancing the core, means for rotating the core around its longitudinal axis, means for supplying a metallic element to the core in such manner that the core winds the element around itself, and means responsive to the speed at which the core is advanced for controlling the angle at which the strand is supplied to the core.

22. In apparatus for sheathing a core, a rotatable carrier, means mounted on the carrier for advancing the core along its longitudinal axis, means for supplying a sheath to the core, and means responsive to the speed at which the core is advanced for controlling the angle at which the sheath is delivered to the core.

23. The combination with means for advancing a core, of means for applying a sheath to the core, a knife for trimming the sheath, and means responsive to the speed at which the core is advanced for bringing the knife into a plurality of adjusted positions with respect to the core.

24. The combination with means for advancing a core, of means for applying a sheath to the core and comprising means for guiding the sheath to the core, means carried by the guiding means for removing oxide from the sheath, and means responsive to the speed at which the core is advanced for controlling the angle at which the guiding means supply the sheath to the core.

25. In metal working apparatus, means for forming a metallic element into a pluralitv of helices, a heating unit in helical form for fusing the helices of the metallic element to each other, and means for advancing the helices of the metallic element through the heating unit and for rotating the helices of the metallic element around the longitudinal axis of the heating unit.

In witness whereof, I hereunto subscribe my name this 11th day of May, A. D., 1928.

JOHN EDSON BOYNTON.