

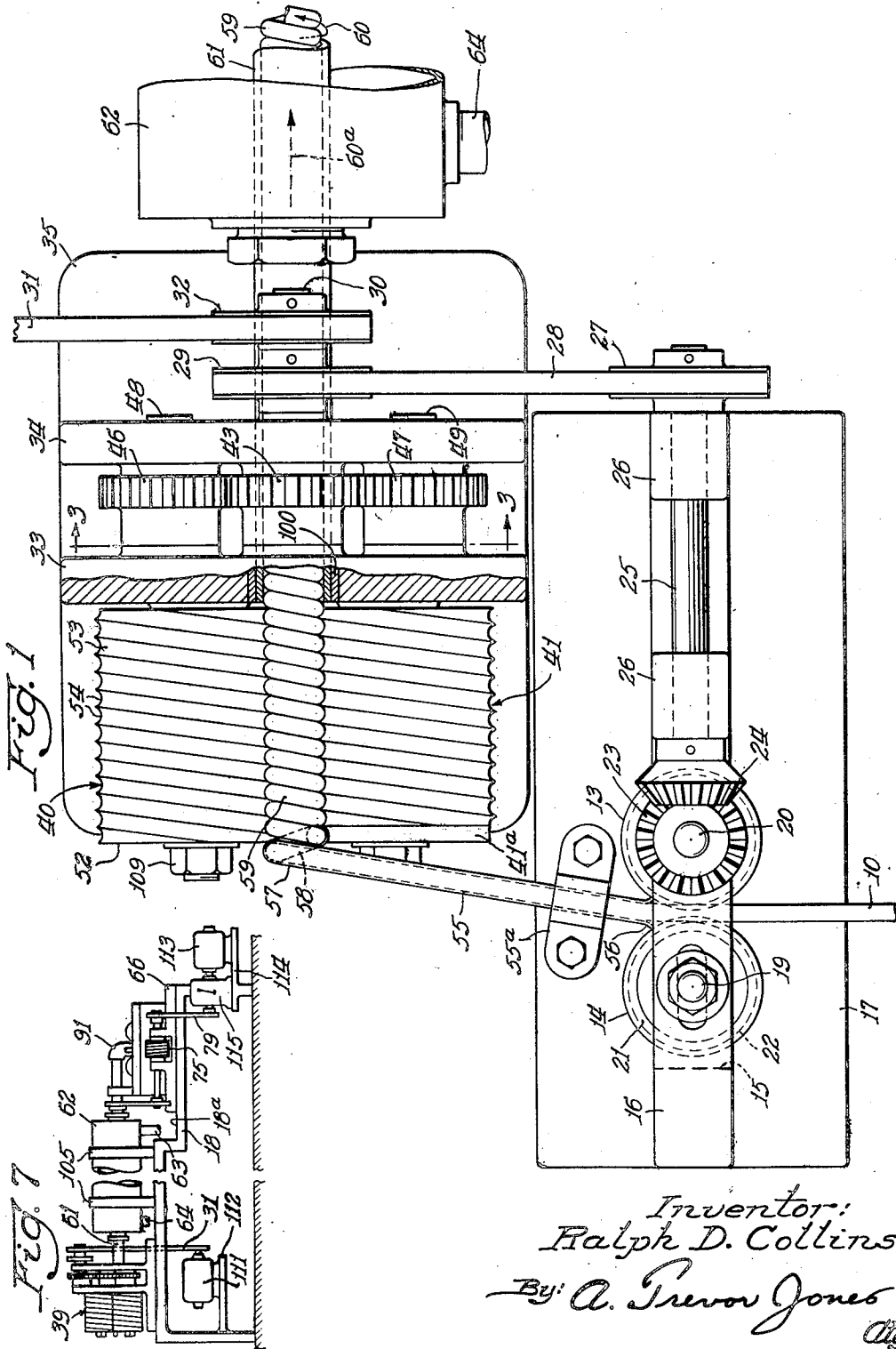
Oct. 10, 1950

R. D. COLLINS
CONTINUOUS METHOD AND APPARATUS FOR
MAKING COILED STRUCTURES

2,525,285

Filed Feb. 23, 1946

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

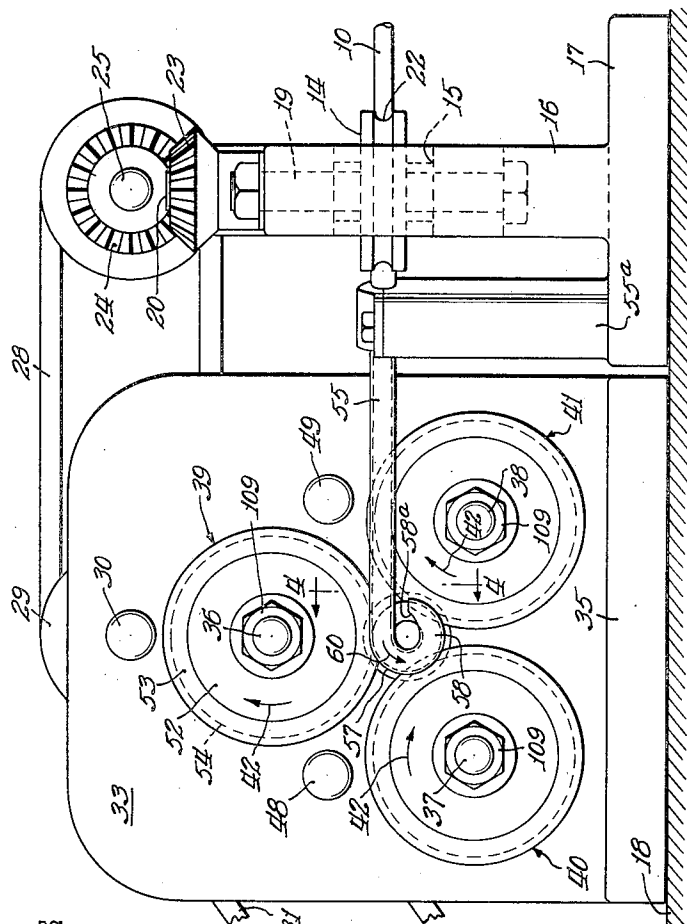


Fig. 2

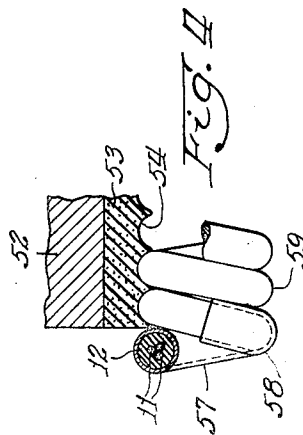


Fig. 4

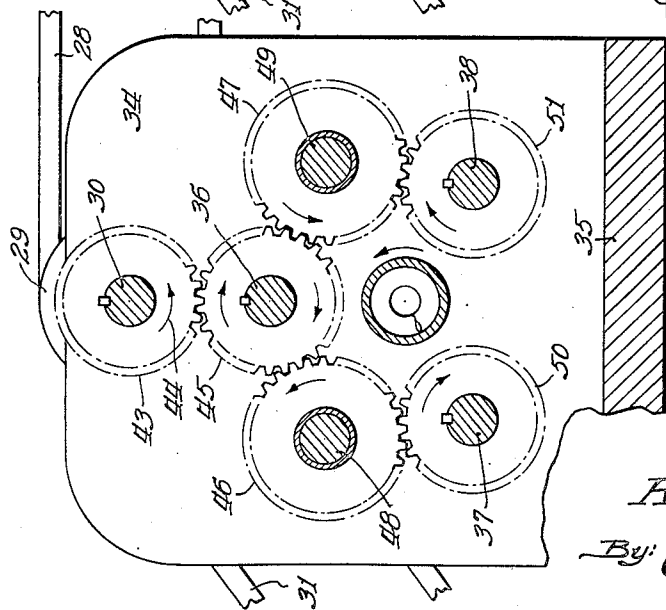


Fig. 3

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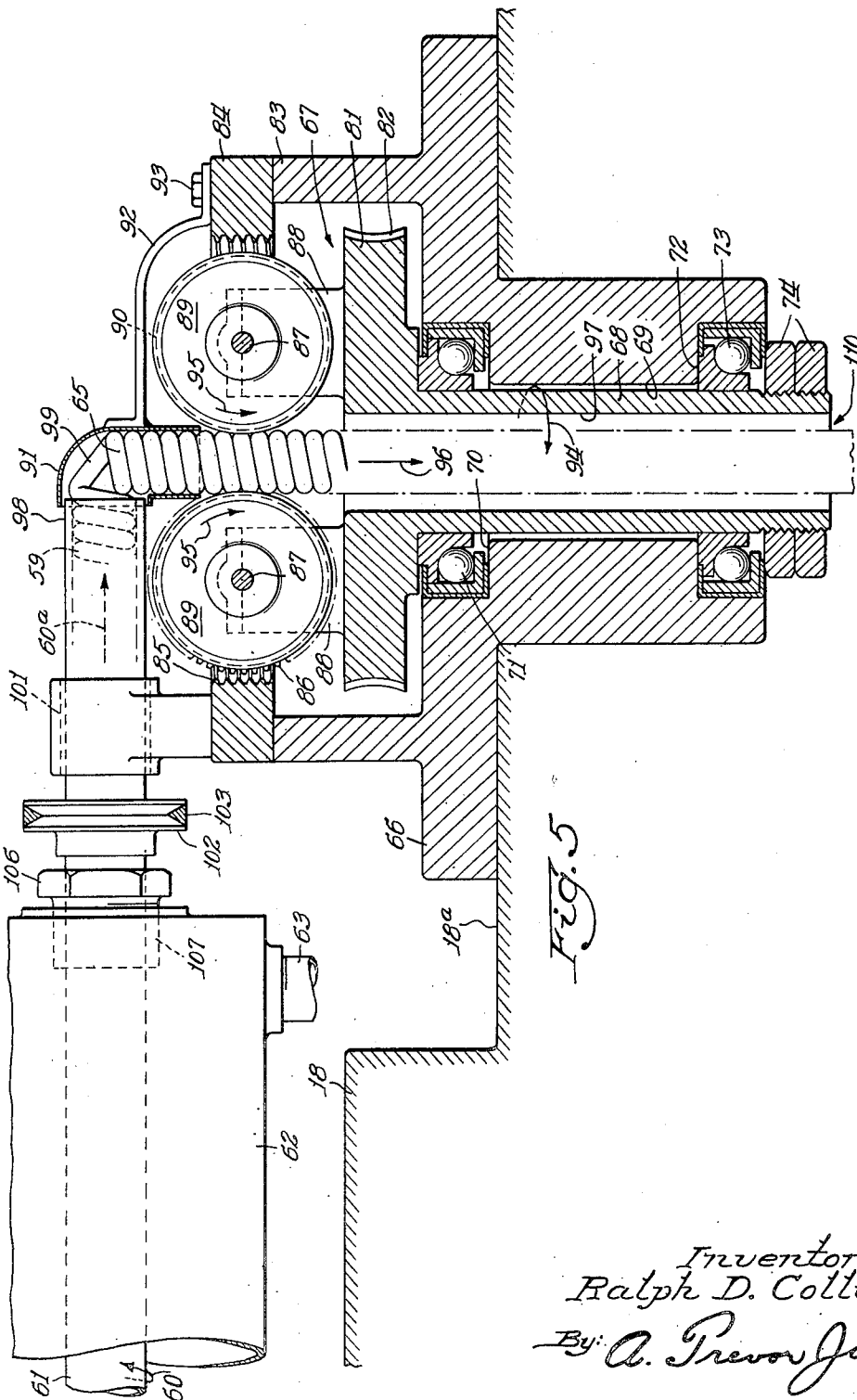
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4 Sheets-Sheet 3



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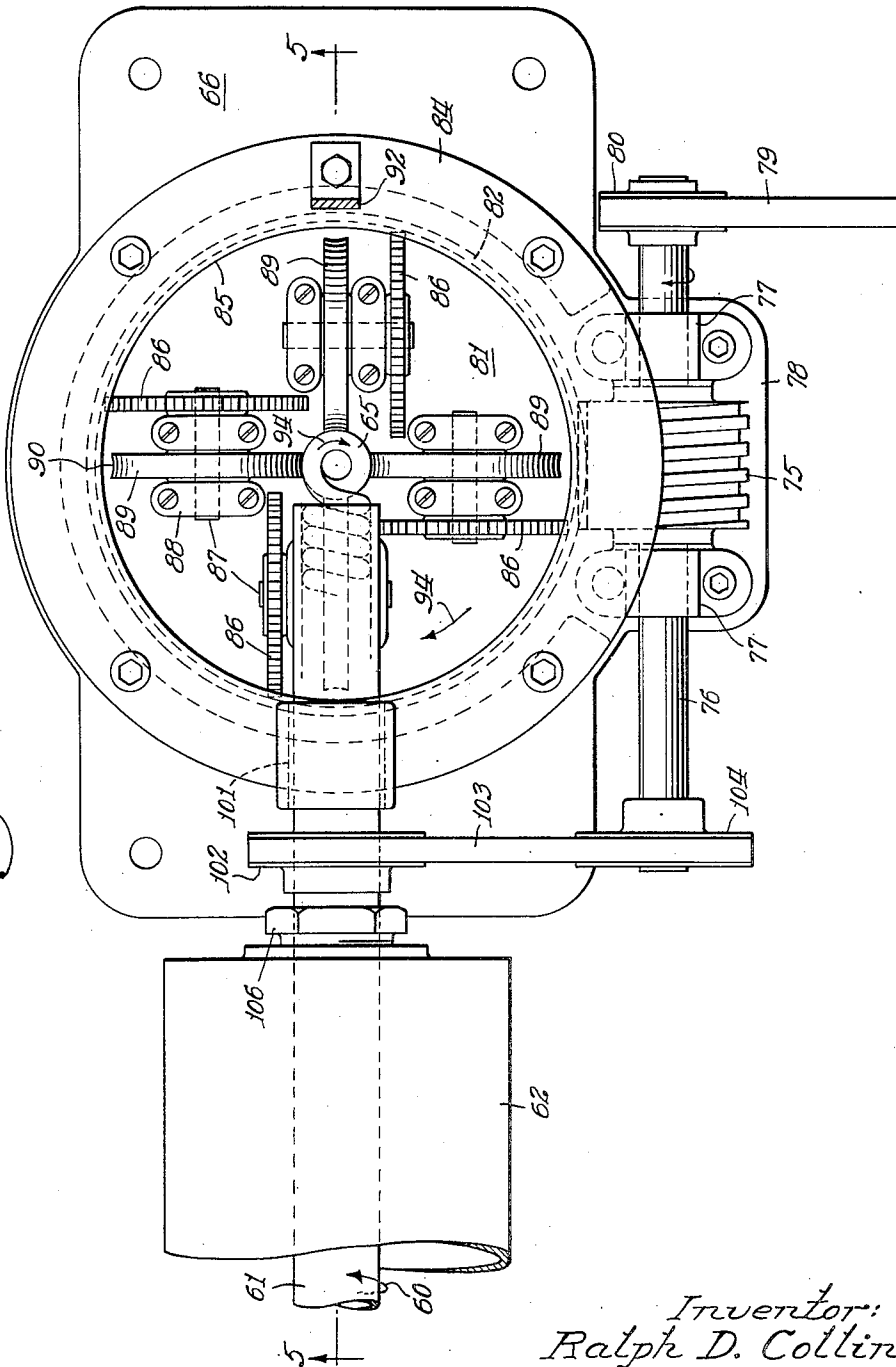
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Fig. 6



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UNITED STATES PATENT OFFICE

2,525,285

CONTINUOUS METHOD AND APPARATUS
FOR MAKING COILED STRUCTURES

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Application February 23, 1946, Serial No. 649,682

10 Claims. (Cl. 18—19)

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This invention relates to a continuous method and apparatus for making coiled structures embodying a material which is vulcanizable or of thermo-setting plastic and more particularly retractile or spring-like helical cord, which may, in one form, be embodied in an elastic coil cable to serve as an extension cord for electrical connection purposes, and commonly including one or more, generally three, wire conductors individually insulated and twisted together to cable form after which a uniform sheath or coating of initially soft, vulcanizable rubber-like substance is extruded onto the cable to form an elastic casing therefor.

It is well known that such cables with their casing of the elastomer initially incompletely vulcanized have been heretofore coiled on a mandrel and then subjected to heat treatment, while still on the mandrel, to cure or set the elastomer and produce a coiled structure of great elasticity, resiliency and extensibility, which is highly useful for electrical conductors for many purposes such as extension cords for flat irons, telephone receivers, and the like. Furthermore, in accordance with Campbell Patent No. 2,173,096, the resilience and retractability of the cord may be enhanced by reversing or inverting the direction of pitch of the helix or turns of the coil after the cable has been vulcanized in coil form.

Heretofore, it has not been possible to produce such a cable continuously, for one reason because it has been considered necessary to coil the cable on a mandrel and then leave it on the mandrel while it is being vulcanized. This has meant that the cables have been coiled in individual, predetermined lengths, each on an individual mandrel, and then conveyed to the oven or heat treating location and vulcanized with each individual cable still on its individual mandrel, and then these removed from the oven, after which each cable has been individually removed from its mandrel and individually reversed or inverted. This procedure has been laborious, time consuming and costly, as well as subjecting the cable while still in its more or less plastic condition to the vicissitudes of manual handling during which the cable is in danger of being accidentally marked. Moreover, the coiling of the somewhat plastic cable on the mandrel is in itself frequently a cause of marking the cable to the extent of a flattening of the inner peripheries of the coils by the metal mandrel, which flattening detracts from the appearance of the cord.

The present invention aims to eliminate the necessity for producing the cables individually

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and for manual handling of the cable between the time the vulcanizable sheath is extruded upon the conductors and the time the completely coiled and reversed cable is cut into appropriate cord lengths as desired, this being accomplished, as here disclosed, by the use of a method and the employment of an apparatus for practicing the method which is markedly simple and yet highly novel and efficient.

The accomplishment of the foregoing, and other subsidiary objects and advantages, will be apparent and the invention will be readily understood by reference to the following detailed description, taken together with the accompanying drawings, of illustrative apparatus for practicing the invention and illustrative method steps involved therein, and in which drawings:

Figure 1 is a plan view showing the entrance end of an apparatus constructed in accordance with the present invention;

Figure 2 is an end elevational view of the structure of Figure 1, looking at the left-hand end thereof;

Figure 3 is a somewhat similar view but being a cross-section taken on the line 3—3 of Figure 1;

Figure 4 is a fragmentary detail section taken on the line 4—4 of Figure 2;

Figure 5 is an elevational view of the exit end of the apparatus, parts being shown in section taken on the line 5—5 of Figure 6;

Figure 6 is a plan view of parts shown in section in Figure 5, other parts being omitted for clearness of description; and

Figure 7 is a reduced somewhat schematic view of the general apparatus and illustrating its advantageous unitary character.

Referring in detail to the illustrative apparatus shown in the drawings, the numeral 10 indicates a cable which may embody a thermo-setting plastic, or specifically as in this instance, a vulcanizable material such as the present invention is intended to deal with. This cable may include (see Fig. 4) one or more wires 11 which has been coated with or upon which has been extruded a sheath 12 of a synthetic elastomer such as one of the rubber substitutes readily available. The cable 10 may be taken directly from the usual extrusion machine, which forms no part of the present invention, and therefore need not be here shown.

When the operation of the present apparatus is started up, the leading end of the coated conductor or cable 10 may be manually threaded between the feed wheels 13 and 14, which are suitably rotatably mounted in a transverse opening

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15 in the upright 16 of a pedestal 17, which may be suitably mounted on a table or other support 18 (Fig. 2) and located adjacent the extruder from which the cord 10 emerges. The feed wheel 14 is mounted on the pintle 19 so as to rotate freely while the feed roller 13 is mounted on the pintle 20, both of which pintles are vertically arranged in parallel in the opening 15 and spaced apart so that the wheels 13 and 14 just pass the cord 10 therebetween in gripping arrangement. The feed wheels are desirably faced with rubber as at 21 and their peripheries slightly concaved as at 22.

The shaft 20 for the feed roller 13 has a bevel gear 23 at its upper end which meshes with a bevel gear 24 on the end of a right-angularly related shaft 25 rotatable in bearings 26 on the upright 16. The shaft 25 is here shown driven by any suitable means, such as, in this instance, a pulley 27 upon which is entrained a belt 28 which passes over another pulley 29 keyed on the countershaft 30. The latter may be driven as by a belt 31 passing over a pulley 32 (keyed to the countershaft 30) and entrained with the output shaft of a motor or other suitable propulsion means.

The countershaft 30 is rotatable in bearings including a pair of upright parallel bearing blocks 33 and 34, which rise from a base 35, also suitably carried on the support 18 adjacent the feed wheel bearing base 17. The bearing blocks 33 and 34 also provide bearings for the stub shafts 36, 37 and 38 of a system of peripheral, and, as here shown, triangularly related pressure coiling rollers 39, 40 and 41. These pressure coiling rollers are all simultaneously rotated, in the same direction of rotation as indicated by the arrows 42 (Fig. 2) by a system of spur gearing best seen in Figure 3, and including a gear 43 on the countershaft 30 which rotates in the direction of the arrow 44 opposite to that of the arrow 42. The gear 43, by means of a gear 45 on the stub shaft 36, drives the coiling roller 39 directly, and, through the gear 45 which meshes with a pair of idler gears 46 and 47 carried on stub shafts 48 and 49, respectively, also rotatable in the bearing blocks 33 and 34, drives the coiling rollers 40 and 41. That is to say, the idler 46 meshes with a gear 50 on the stub shaft 37 of the coiling roller 40, and the idler gear 47 meshes with a gear 51 on the stub shaft 38 of the coiling roller 41.

In accordance with the present invention, as best seen in Figures 1 and 4, the coiling rollers 39, 40 and 41, each has a drum-like body 52 which is elongated axially and which on its periphery has a facing 53 of cushion-like material such as rubber, leather, or soft fiber. In this facing is formed a spiral groove 54, extending from one end of the roller to the other. This groove 54 describes a helix, the turns of which in this case are in the form of a left-hand screw thread, so to speak.

The stub shafts 36, 37 and 38 are spaced apart so that their axes define an equilateral triangle and so that a circle tangent to the peripheries of all three of these coiling rollers 39, 40 and 41 also defines a similar smaller enclosed imaginary equilateral triangle. A circle tangent to all three rollers at the bottom of the groove 54 of each, is the same as the external diameter of a coiled cable to be formed from the cord 10, as best seen in Figures 2 and 4.

Reverting to the cable 10, after this has been threaded between the feed wheels 13 and 14, it is entered into a conduit-like guide 55, carried by

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a bracket 55a mounted on the base 17 between the upright 16 for the feed wheels and the base 35 for the coiling rollers. The guide 55 is supported in cantilever fashion on the bracket 55a so that its proximal end is adjacent and somewhat between the bight of the feed wheels 13 and 14. Here, as at 56, the guide may be flared slightly to facilitate the entry of the cable 10 thereinto. The bracket 55a is slightly oblique to the base 17 so as to point the distal end 57 of the guide 55 toward the bight of the coiling rollers 39, 40 and 41, and, in order to give the cable 10 a preliminary turn in the direction in which it is to be coiled by the coiling rollers, the distal end 57 of the conduit-shape guide 55 has a ram's horn termination 58, which is in effect a continuation in the guide of the helical groove 54 and so as to start the coiling of the cord 10 into the form of a helix 59. The ram's horn termination 58 of the guide is desirably broken away at its inner side as at 58a so as not to bind the cable as the latter is drawn through it, and the thread of the groove 54 on the coiling roller 41 may terminate short of the entrance end thereof, as at 41a, to allow the guide termination 58 to clear it.

It will be understood that the feed wheels 13 and 14, which turn say at the same peripheral speed as the coiling rollers 39, 40 and 41, propel the cable through the guide 55 and into the bight of the coiling rollers. As the cable emerges from the guide 55, it is already predisposed in coiled form, but with a tendency, by reason of the fact that the cable has some resilience, to expand radially of the helix which it describes. This tendency to expand brings the cable into engagement with all three of the coiling rollers 39, 40 and 41, and, since these are all rotating in the same direction and have the rubber-like grooved faces, pressure is exerted on the cable urging it to coil form as at 59, by reason of a wrist or twist movement which is given to the cable, by a frictional grip thereon.

This wrist action on the periphery of the cable not only rotates the cable bodily in the direction of the arrow 60 (which is opposite to the direction of rotation of the coiling rollers, indicated by the arrows 42) but also, by reason of the spiral or helical formation of the groove 54, moves the cord bodily axially and inwardly of the coiling rollers, or to the right as seen in Figure 1, at 60a. Thus the helix 59 is produced continuously so long as the cable is fed continuously from the extruder. The propelling action of the feed wheels 13 and 14 co-operates with the propelling action of the coiling rollers 39, 40 and 41 to keep the cable moving continuously.

Assuming that the diameter of the coiling roller has a ratio of three, to one for the diameter of the cable helix 59, the helix 59 will rotate approximately three times as fast as the coiling rollers, and, accommodate this faster rotation of the cable helix, the thread-like groove 54 of the coiling rollers may be so-called triple thread, which is to say that there are three separate but intercalated threads on each coiling roller.

Arranged centrally of the coiling rollers 39, 40 and 41 and aligned with the cable helix 59 is a smooth bore tube 61, which receives the cable helix as it is formed and as it leaves the coiling rollers, moving to the right in Figure 1. The bearing blocks 33 and 34 provide a suitable support for the adjacent end of the tube 61, which maintains the cable helix 59 in helical shape as previously formed while permitting the helix to con-

tinue to travel to the right, frictionally through the tube 61. The resilience of the coiled cable 59 keeps it in contact with the interior of the tube 61 while the tube keeps it in coiled form.

While so traveling, and further in accordance with the present invention, the cable is desirably vulcanized to set it in the helical form, (Fig. 7), while feeding it through a vulcanizing device.

Any suitable heating means may be employed for raising the temperature of the cable as it passes through the tube 61. For example, as here shown, the tube 61, for a portion of its length, may be jacketed by a steam pipe 62 through which steam may be passed as by an inlet 63 and outlet 64. Any other suitable heating means might be employed such as infra-red lamps, electrical induction, or electrostatic means.

Next, as the coated conductor is removed from the vulcanizing device, and still further in accordance with the present invention, the coated conductor or cable is unwound and reversely coiled, and in this instance as the cable helix 59 emerges from the vulcanizing treatment, it is continuously reversed or inverted to reverse the direction of the pitch of the helix from that shown at 59 to that shown at 65, where the cable helix now has a right-hand turn or right-hand screw thread appearance instead of a left-hand turn or a left-hand screw thread appearance, as it was coiled at 59 by the coiling rollers 39, 40 and 41. To accomplish this automatic and continuous inversion of the pitch of the helix, the mechanism next described is provided, (Figs. 5 and 6).

Mounted on the same common support 15 but on a stepped-down portion 18a thereof, is a turret block 66. The turret block 66 is stationary on the support portion 18a, but mounts a revolving planetary device. This planetary device comprises a rotary member 67 which has a sleeve 68 that turns in the central bore 69 of the turret block 66. The bore 69 is counterbored at one end as at 70, to provide a space for a ball-bearing device 71, and at its other end as at 72, to provide space for another ball-bearing device 73. Lock-nuts 74 at the lower end of the sleeve 68 prevent axial movement of the rotary member 67 in the turret block 66 while the member is still freely rotatable therein, by means, in this instance, of a worm 75 carried on a worm shaft 76 in bearings 77 on a lateral extension 78 of the turret block 66.

The worm shaft 76 may be driven by a belt 79 entrained on a pulley 80 fixed on the worm shaft and the belt being entrained also with the output shaft of a motor or other driving means. At its upper end, the rotary member 67 has formed integrally therewith a disc portion which provides a relatively large gear wheel 81, the teeth 82 of which engage the worm 75, the gear 81 thus providing a worm wheel for a worm gear mechanism comprising the worm 75 and worm wheel 81. About the worm wheel 81, the turret block 66 assumes the form of a cylindrical housing 83, and, at its upper end, the housing 83 has fixed thereto, concentrically therewith, a gear ring 84, the inner periphery of which is cut to provide an internal worm 85.

Meshing with the internal worm 85 are four horizontally axled smaller worm gears 86. Each of the worm gears 86 is axled as at 87 on a pair of brackets 88 which are upstanding from and carried by the upper surface of the rotary member 67. Between the pair of brackets 88 for each worm gear 86, is a cable gripping and propulsion wheel 89. The peripheries of the cable gripping and propulsion wheels 89 are concaved

as at 90. The gears 86 and the gripping and propulsion wheels 89 are arranged successively at right angles about the axis of the rotary member 67, and a distance apart so that a circle coincident with all of their peripheries simultaneously will be tangent with their concavities, as seen in Figure 6, and of the same diameter as the overall diameter of the cable helix 65, or, preferably, just slightly smaller so as to have good frictional gripping contact therewith.

As the cable tends to define a right angle between its portion which forms a left-hand helix as at 59, and its portion which forms a right-hand helix as at 65, the axis of the rotary member 67 is desirably at right angles to the axis of the tube 61, and, to accommodate this bend in the axis of the cable, helix itself, an elbow guide or funnel 91 is carried as by an arm 92, secured by a screw 93 to the gear ring 84 so as to overhang the bight of the gripping and propulsion wheels 89 and lead the coiled cord thereinto.

Since it is desired to invert the pitch of the helix, the rotary member 67 turns in the direction of the arrow 94 (Fig. 5), and all of the four axes 87 of the propulsion wheels 89 will be rotated bodily in the same direction, which in turn is a direction so as to twist the cable helix to give it a right-hand screw thread, as indicated at 65. At the same time, by reason of the direction of the threads of the internal worm 85, each of the propulsion wheels 89 will be rotated individually on its individual axle 87 in the direction of the arrow 95, so that the inner or adjacent peripheries of all of these propulsion wheels 89 will be moving downwardly. The propulsion wheels 89 thus have a composite motion which is both rotative of the coiled cable and axial thereof. Thus the coiled cable is not only rotated bodily in the direction of the arrow 94, but is also moved longitudinally in the direction of the arrow 96, downwardly through the axial passageway provided by the hollow tube-like interior 97 of the sleeve 68 of the rotary member 67.

As previously explained, the coiled cable moves continuously both rotatively in the direction of the arrow 94, and longitudinally in the direction of the arrow 96 through the tube 61. If the interior of the tube be smooth and well polished, the slight friction between the moving helix and the internal surface of the tube, even if the tube be stationary, would not prevent smooth progress of the cable through the tube, but, to reduce this friction, it might be desirable, at least in some instances, to rotate the tube 61 in the same direction as the cable helix 59, namely, in the direction of the arrow 90. In this case, the end 98 of the tube 61 would rotate in the funnel guide 91 (Fig. 5), the latter being stationary. This may be accomplished by making the tube rotatable in its bearing bushings 100 at one end of the tube, and 101 at the other end. The tube may have fixed thereon a pulley 102 on which is entrained a belt 103 entrained also on a pulley 104 fixed on the worm shaft 76 of the worm 75, and driven by the belt 79, to rotate the tube as well.

The steam jacket 62 may be supported on the support 18 as by legs and straps 105 (Fig. 7) and the tube 61, when rotatable as described, may pass through the ends thereof by bushings 106 which may include conventional fluid sealing devices 107, preventing exit of the steam thereof while still permitting the tube to revolve in the bushings, (Fig. 5).

It will be understood that as the leading end

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of the cable helix 59 enters the elbow guide 91 at the start of operation for say a day's run, the coiled cable will enter the bight of the gripping and propulsion wheels 89 with a few of the turns of the helix initially unreversed and in the direction shown at 59, rather than that of the inverted form at 65, but, as the coiled cable continues to move into the bight of the propulsion wheels 89, the twisting and pushing action of the reversing mechanism of which these propulsion wheels 89 are a part, immediately unwinds the cable from the form of the helix 59 and rewinds it to the form of the helix 65, the change in direction of pitch of the turns of the helical occurring as at 99, coincident with the bend in the elbow guide 91, and forming a relatively straight portion of cable at this point which may be longer or shorter to suit the operation of the mechanism.

As indicated in Figure 7, the motor 111 may be mounted at one end of the support 18 on a shelf 112 thereof, for driving the belt 31 for the coiling mechanism. At the other end, the motor 113 may be similarly mounted on a shelf 114 for driving the belt 79 for the reversing mechanism. In the case of the motor 113, this is desirably provided with an adjustable speed changing device 115, so that the speed of the reversing mechanism may be adjusted with reference to the coiling mechanism. At the start of operation, it may well be desirable to run the reversing mechanism slightly faster than the coiling mechanism to facilitate the rewinding of the initial coils at the start of operation and to bring the point of change (99) of pitch of the helix to the desired location, and then adjust the reversing mechanism to run at the same speed as the coiling mechanism.

The rollers 39, 40 and 41 may be removable, as by nuts 109, to replace them with rollers of different diameter for varying the diametrical size of the coiled structure to be formed, the other expedients being similarly varied.

At the exit end of the apparatus, as at 110 of the rotary member 67, the coiled cable is withdrawn from the apparatus as a finished product, coiled, vulcanized and inverted, leaving only the subsequent operation of cutting the continuously formed helix into appropriate cord lengths as desired, with which cutting the present invention is not particularly concerned, and which therefore need not be described, since any suitable cutting means may be employed for the latter purpose.

When a cord or cable is here referred to it is intended to be understood to include similar coiled structures in resilient helical form.

Manifestly, the invention is not intended to be limited to details of construction of the apparatus or the steps of procedure hereinbefore described for purposes of exemplification of the invention. Furthermore, it is to be understood that it is not considered essential that all features of the invention be employed conjointly in every instance, since at times various combinations or subcombinations of apparatus or steps of operation may be advantageously used in some aspects of the invention. Such changes may be made as fall within the scope of the appended claims without departing therefrom.

The invention having been described, what is here claimed is:

1. Apparatus for making retractile coiled cord embodying a vulcanizable material which comprises, means for coiling the cord into a helix, said means including three drum-like pressure

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rollers having triangularly related axes and for receiving the cord therebetween while rotating simultaneously in the same direction, said rollers being arranged to rotate and move the cord forward as the helix is formed therein, a smooth bore tube for receiving the helix as formed and passing the helix therethrough, means for rotating the tube in the direction of rotation of the helix, means for applying heat to the cord as it moves forward in helical form, and means for continuously inverting the helix as it leaves said tube, said last mentioned means including a plurality of rollers adapted to rotate about said helix on a common axis and also to rotate individually on angularly related axes.

2. Apparatus for making retractile coiled cord embodying a vulcanizable material which comprises, means for coiling the cord into a helix, said means including three pressure rollers having triangularly related axes and for receiving the cord therebetween while rotating simultaneously, said rollers being arranged to move the cord forward as the helix is formed therein, a smooth bore tube for receiving the helix as formed and passing the helix therethrough, means for applying heat to the cord as it moves forward in helical form, and means for continuously inverting the helix as it leaves said tube, said last mentioned means including a plurality of rollers adapted to rotate about said helix on a common axis and also to rotate individually on angularly related axes.

3. The continuous method of forming a retractile helix from thermo-setting plastic strand material which comprises, continuously withdrawing a strand of plastic material from a source of supply, coiling the strand to form a helix, continuously pushing the helix along a support, heating the helix while so supported to set the helix, withdrawing the helix from the support, and reversing the direction of pitch of the helix to enhance the retractibility as it is withdrawn from the support, the coiling and reversing respectively being done by gripping the periphery of the helix in each step.

4. Apparatus for making coiled cord embodying a vulcanizable material which comprises rotatable means for coiling the cord into a helix and for continuously moving the cord forward bodily on the axis of the helix as formed, said rotatable means being arranged about and adapted to grip the periphery of the helix, heat applying means for continuously vulcanizing the vulcanizable material of the cord as the helix is formed and moved forwardly, and rotatable reversing means also adapted to grip the periphery of the helix to invert the direction of pitch of the helix.

5. Apparatus for making coiled cord embodying a vulcanizable material, which comprises, rotatable means for coiling the cord into a helix while continuously moving the cord forward bodily on the axis of the helix as formed, heat applying means for continuously vulcanizing the vulcanizable material of the cord as the helix is formed and moved forwardly, and rotatable reversing means rotatable on an axis transverse to the first mentioned axis and adapted to rotate the helix in the direction opposite to its initial rotation.

6. Apparatus for making coiled structures, comprising a stationary block, a rotary member mounted for rotation therein and having an axial passageway therethrough, a worm wheel having a radially extending face and disposed on

said rotary member and rigid therewith, bearings carried by the face of said wheel, a plurality of planetary rollers mounted on parallel axes on each side of and in a plane perpendicular to the axis of the rotary member, a relatively small worm gear keyed to and coaxial with each planetary roller, an internal worm in the block meshing with the relatively small worm gears and stationary with respect to said rotary member, and means for rotating said worm wheel said means including a rotatable worm carried by said block and meshing with said worm wheel, said block also carrying a member for guiding a cable into the bight of said planetary rollers.

7. Apparatus for making coiled structures, comprising, a stationary block, a rotary member mounted for rotation therein and having an axial passageway therethrough, a worm wheel having a radially extending face and rigid with said rotary member, bearings carried by the face of said wheel, a plurality of planetary rollers mounted on parallel axes on each side of and in a plane perpendicular to the axis of the rotary member, a relatively small worm gear keyed to and co-axial with each planetary roller, an internal worm in the block meshing with the relatively small worm gears and stationary with respect to said rotary member, and a rotatable worm meshing with said first mentioned worm wheel for rotating said rotary member, there being four of said planetary rollers, said planetary rollers being successively right-angularly arranged about the axis of said rotary member, and the planetary rollers being grooved to conform arcuately to the overall diameter of the coiled structure passing therethrough.

8. Apparatus for making retractile coiled cord embodying a vulcanizable material, comprising rotatable mechanism for coiling the cord into a helix while continuously moving the cord forward bodily on the axis of the helix as formed, a heat applicator including a steam chamber for vulcanizing the material, means for supporting the helix in said chamber while the helix is continuously moved therethrough and out of the chamber, the chamber being closed at each end except where the cord passes into the chamber and out of the chamber to inhibit escape of steam therefrom, and a rotatable element engaging the helix after it emerges from the chamber for continuously reversing its direction of pitch to enhance its retractibility.

9. In the continuous manufacture of retractile

cords from a conductor coated with a vulcanizable material, the steps of feeding said coated conductor into one end of a vulcanizing chamber, causing said conductor to assume the form of a helix in said vulcanizing chamber, and causing the convolutions of said helix to advance from one end of said vulcanizing chamber to the other, unwinding and removing said coated conductor from said other end of the vulcanizing chamber by causing the same to advance in a tangential direction with respect to said helix said steps being simultaneously performed on different portions of the same conductor, and the conductor being continuously advanced so that a given portion thereof is subjected to said steps in succession, and vulcanizing said conductor while in helical form by subjecting the separate convolutions thereof to the action of a vulcanizing medium as they are advanced.

10. In the continuous manufacture of retractile cords from a conductor coated with a vulcanizable material, the steps of, feeding said coated conductor through a vulcanizing device while said conductor is in the form of a helix, causing the convolutions of said helix to advance from one end of said vulcanizing device to the other, vulcanizing said conductor while in helical form by subjecting the convolutions thereof to the action of a vulcanizing medium as they are advanced through the vulcanizing device, removing said coated conductor from the vulcanizing device while unwinding the helix, and reversely coiling the conductor to enhance its resilience, said steps being simultaneously performed on different portions of the same conductor and the conductor being continuously advanced so that a given portion thereof is subjected to said steps in succession.

RALPH D. COLLINS.

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