March 22, 1960 G. E. HENNING 2,929,574

APPARATUS FOR DISTRIBUTING FILAMENTARY MATERIAL INTO COIL FORM

Filed May 18, 1955 5 Sheets-Sheet 1

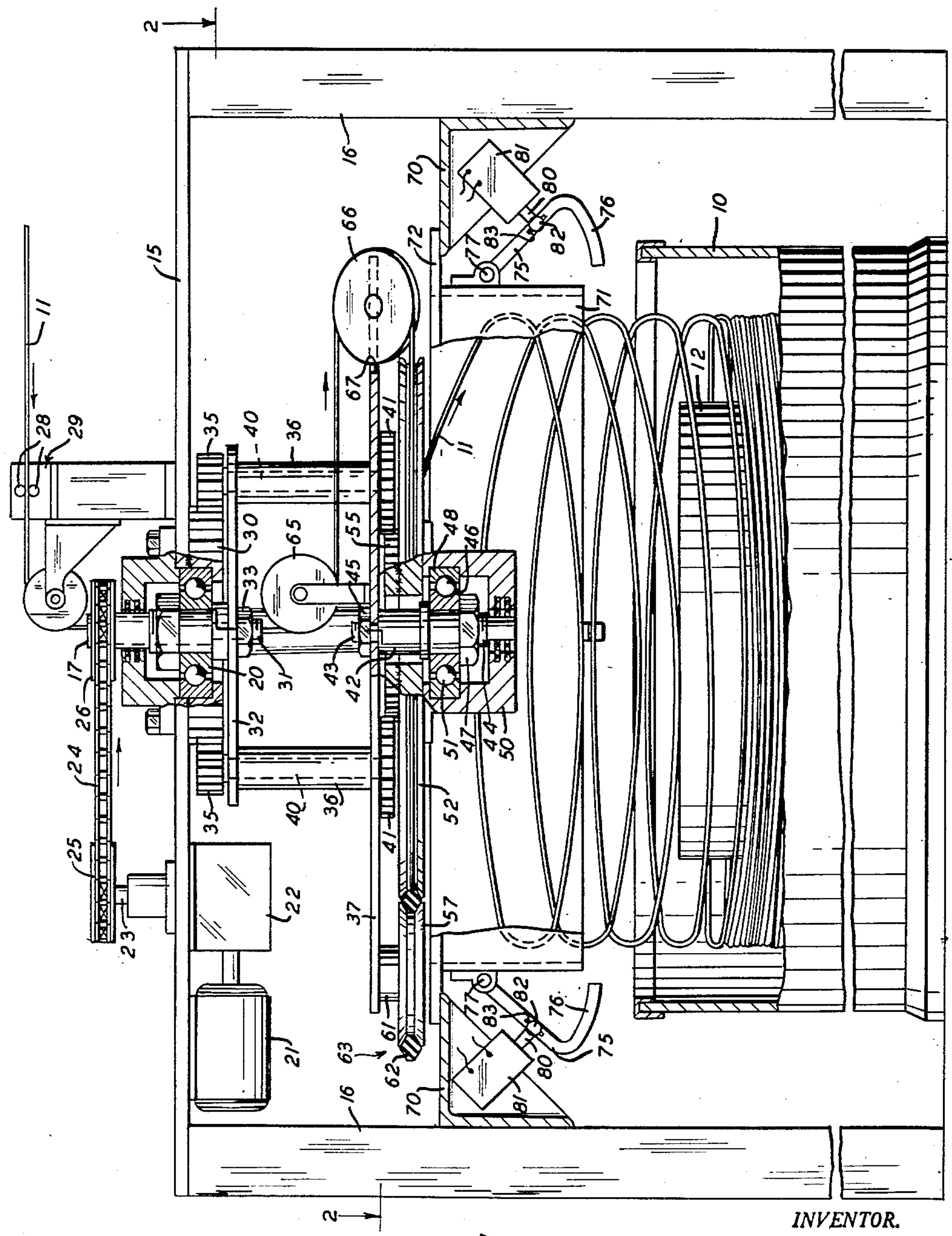

FIG. 1

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APPARATUS FOR DISTRIBUTING FILAMENTARY MATERIAL INTO COIL FORM

Filed May 18, 1955 5 Sheets-Sheet 2

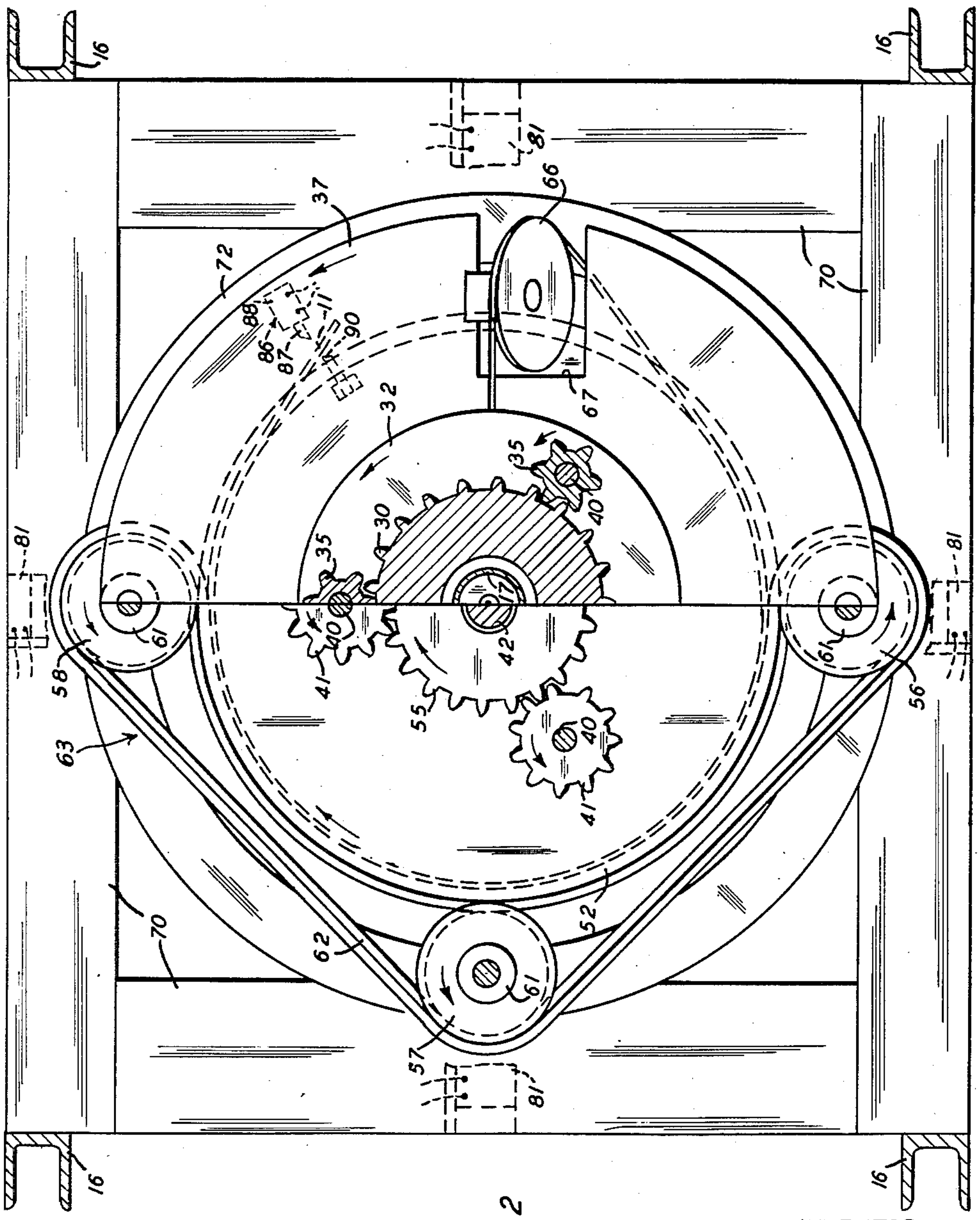

FIG. 2

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APPARATUS FOR DISTRIBUTING FILAMENTARY MATERIAL INTO COIL FORM

Filed May 18, 1955 5 Sheets-Sheet 3

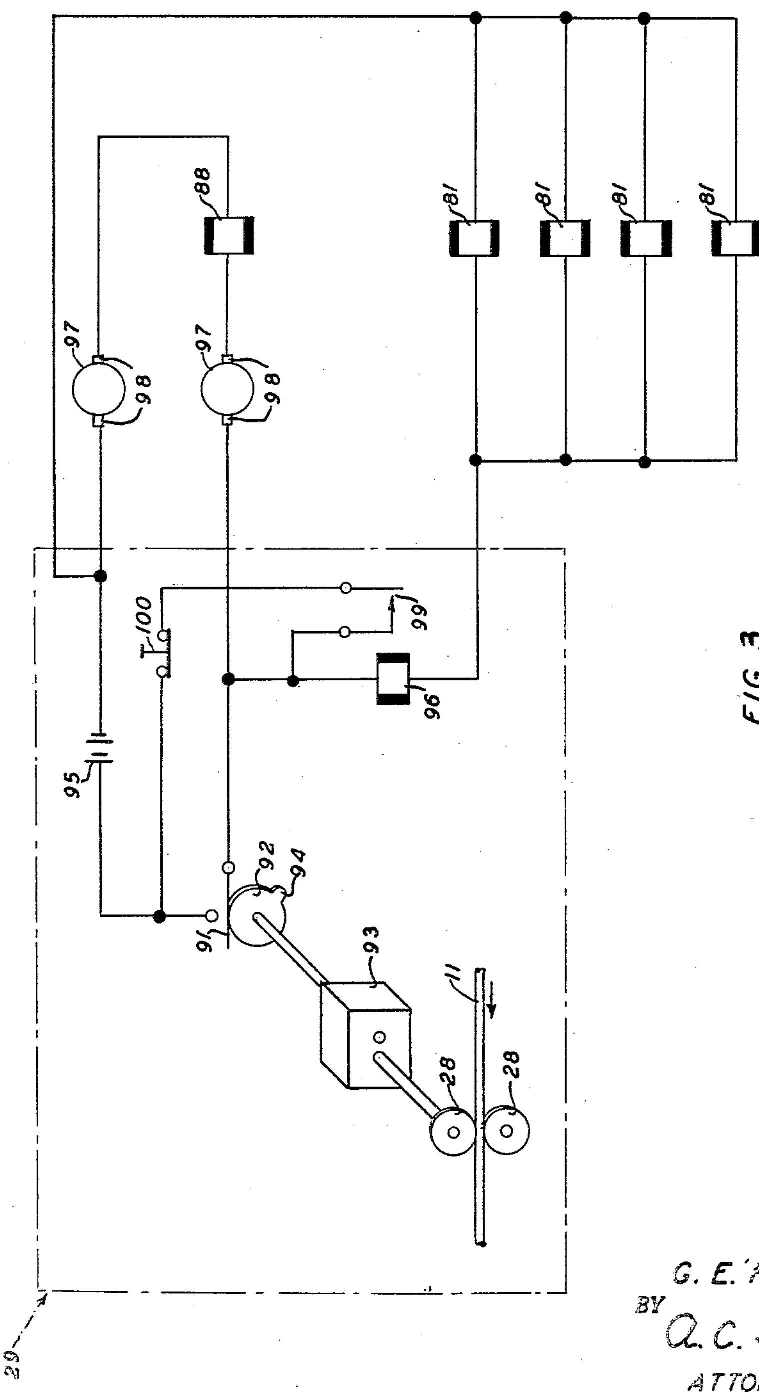

FIG 3

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APPARATUS FOR DISTRIBUTING FILAMENTARY MATERIAL INTO COIL FORM

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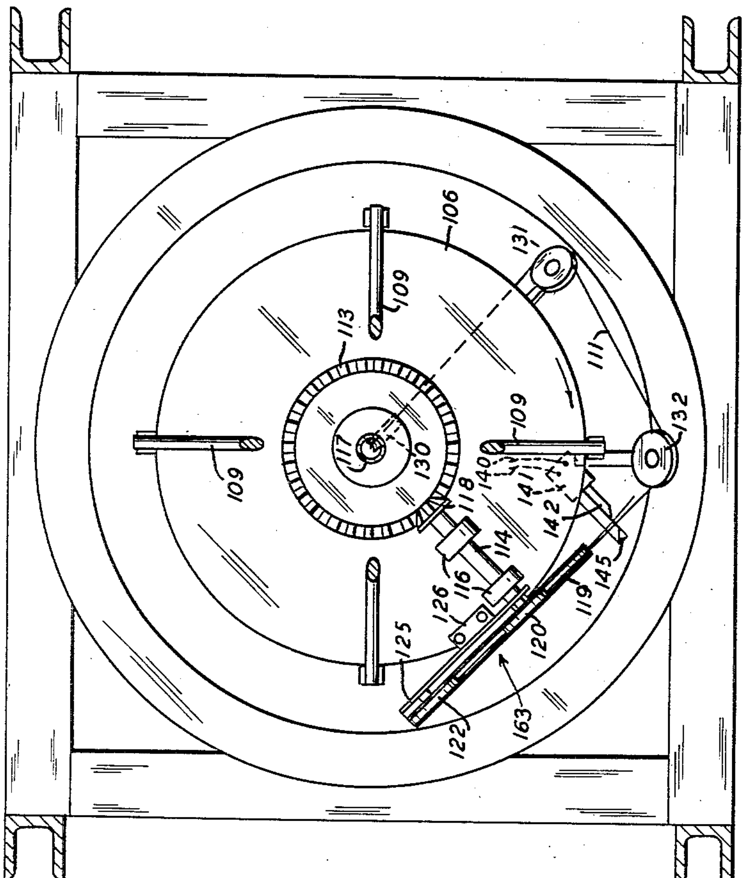

FIG.6

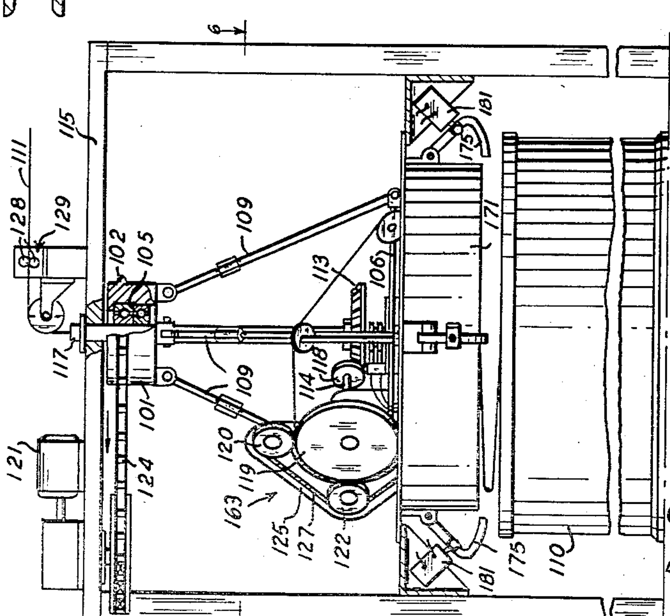

FIG.4

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APPARATUS FOR DISTRIBUTING FILAMENTARY
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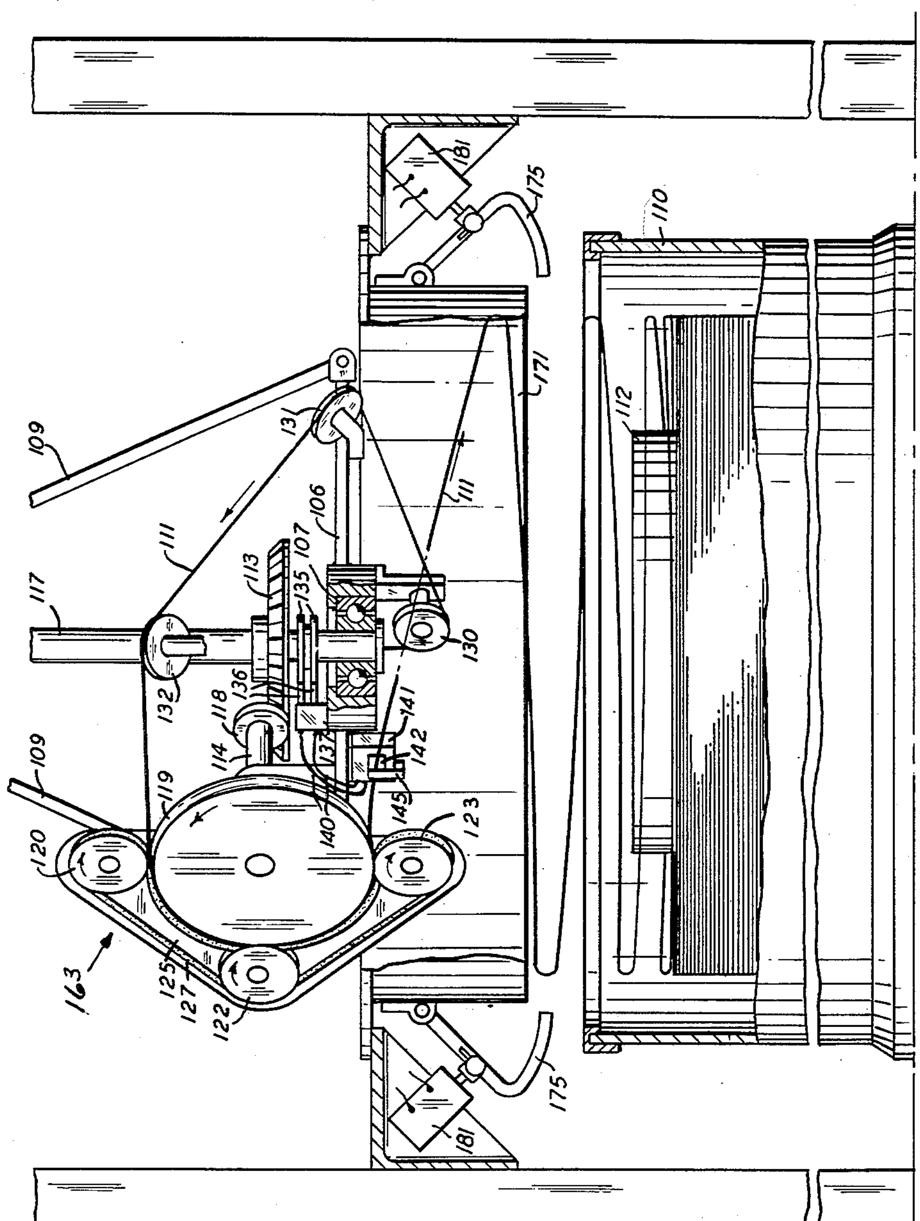

FIG.5

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United States Patent Office 2,929,574 Patented Mar. 22, 1960

2,929,574

APPARATUS FOR DISTRIBUTING FILAMENTARY MATERIAL INTO COIL FORM

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Application May 18, 1955, Serial No. 509,209

10 Claims. (Cl. 242—82)

This invention relates to apparatus for distributing filamentary material into the form of a coil, and more particularly to apparatus for distributing wire into stationary receivers in a coil.

In the past, after electrically-conductive wires have had some operation performed thereon, such as a wire-drawing or an insulation-covering operation, the wires usually have been wound on a rotatably mounted reel. Metal drums, in which the wire is coiled have been used in some instances. Recently it became desirable to use sturdy fiber containers in which to coil wire. Such containers have advantages due to their being light in weight and easy to handle. They provide protection for the wire during shipment, and the wire can be withdrawn therefrom readily.

Various apparatus have been developed to feed wire into these fiber containers, and, as far as is known, each apparatus required that the containers be rotated continuously in order to distribute the wire within the container. Continuous rotation of the containers has obvious disadvantages in that such rotation must be synchronized with the wire feeding means, and the container must be designed to stand up under high revolving speeds. Another disadvantage is that separate capstans must be used for drawing the wire through the apparatus that is performing the operation thereon, and for feeding the wire to the revolving container.

It is an object of this invention to provide new and improved apparatus for distributing filamentary material into the form of a coil.

It is another object of the present invention to provide new and improved apparatus for distributing wire into stationary receivers in a coil.

It is a further object of this invention to provide new and improved apparatus for distributing wire, wherein a capstan that draws the wire through apparatus performing some operation on the wire also is used to distribute the wire into a stationary container in a coil.

Still another object of the invention is to provide apparatus for continuously distributing a predetermined amount of filamentary material into each of a succession of containers in coil form.

An apparatus, illustrating certain features of the invention, may include means for continuously feeding a length of filamentary material into space. Means are provided for revolving at least those portions of the feeding means which are last to contact the material about the axis of a coil to be formed in the direction opposite to that in which the material is being fed so that the material is distributed along a descending helical path to form a coil.

The advancing means may comprise a belt-type capstan including a rotary capstan wheel engaging the material, a plurality of sheaves spaced around the capstan wheel, and an endless belt wound around the sheaves and engaging the peripheral surface of the capstan wheel. The belt holds the material in driving contact with the capstan wheel over an arc on the periphery thereof, so that the

material is fed by the rotation of the capstan wheel. According to one embodiment of the invention, the sheaves are revolved around the periphery of the capstan wheel in the direction opposite to that in which the capstan is rotating in order to enable distribution in coil form. According to a second embodiment of the invention, the entire belt-type capstan unit is revolved about an external axis, which is coincident with the axis of the coil to be formed.

Preferably, the speed of revolution is substantially the same as the speed at which the material is being fed. An open-topped container may be mounted beneath the capstan to collect the material in coil form. According to other features of the invention, cutting means are mounted adjacent to the point where the material leaves the capstan and accumulating means are positioned between the capstan and the container. With this arrangement, when it is desired to change over from a first container to another after a predetermined amount of the material has been collected in the first container, the cutting means are actuated to sever the material and the accumulating means are operated to collect succeeding portions of the material in coil form. Then, the first container is removed from material-receiving position and the other container is substituted therefor, whereupon the accumulating means are released to permit the acculated coil to drop into the second container.

Other objects and advantages of the invention will become apparent by reference to the following detailed description of specific embodiments thereof, and the accompanying drawings, in which:

Fig. 1 is a front elevation, partially in section, showing one embodiment of the invention;

Fig. 2 is a horizontal section taken along line 2—2 of Fig. 1;

Fig. 3 is a diagrammatic view of a metering apparatus and an associated electrical circuit for controlling the operation of the embodiment of the invention shown in Figs. 1 and 2;

Fig. 4 is a front elevation, partially in section, of a second embodiment of the invention;

Fig. 5 is an enlarged, fragmentary view, partially in section, of a portion of the apparatus shown in Fig. 4, and

Fig. 6 is an enlarged, horizontal section taken along line 6—6 of Fig. 4.

First embodiment

Referring to the drawings, and more particularly to the embodiment shown in Figs. 1, 2 and 3, a container **10** is provided to receive a wire **11**, which is to be coiled within the container **10** around a cylindrical core **12** at the center of the container. The container **10** may be made of fibrous material, but any suitable material may be used in its construction. The container **10** is shown in its correct wire-receiving position below a platform **15** supported by a plurality of vertical channel irons **16—16**. A vertical, hollow shaft **17** is rotatably mounted by a bearing **20** at the center of the platform **15**, and the wire **11** is passed therethrough. The shaft **17** is rotated by a motor **21**, through a gear box **22**, an output shaft **23** extending from the gear box and a chain **24**, which engages a sprocket **25** on the output shaft **23** and a sprocket **26** on the hollow shaft **17**.

The wire **11** passes through a pair of metering rollers **28—28** of a metering device, designated generally by the numeral **29**, and then is directed downwardly through the hollow shaft **17**. The metering device **29** is a conventional one of the type shown diagrammatically in Fig. 3, wherein a cam-operated switch **91** is closed after a predetermined length of wire has passed through the rollers **28—28**.

A stationary ring gear 30 is secured fixedly to the lower side of the platform 15 by any suitable means, such as welding. The ring gear 30 is adjacent to the lower end of the hollow shaft 17, which end terminates with a reduced, hollow, and threaded stub 31. A circular plate 32 is secured to the stub 31 by a nut 33.

A plurality of spur gears 35—35 are mounted rotatably upon the upper side of the plate 32, and mesh with the ring gear 30. A plurality of sleeves 36—36 depend from the plate 32 and are secured thereto by welding, for example. The lower ends of the sleeves 36—36 are secured, by welding or other suitable means, to a circular plate 37. Rotatably mounted within the sleeves 36—36 are a plurality of shafts 40—40 secured at their upper ends to the spur gears 35—35. A plurality of spur gears 41—41 are secured to the lower ends of the shafts 40—40, whereby rotation of the upper spur gears 35—35 will cause rotation of the lower spur gears 41—41.

A rod 42, which has reduced and threaded ends 43 and 44 is secured to the plate 37 by a nut 45 engaging the end 43. An inner ball bearing race 46 is secured near the lower end 44 of the rod 42 by a nut 47, and is designed to cooperate with an outer ball bearing race 48, which is secured within a cylindrical member 50 to retain ball bearings 51—51 disposed therebetween. The cylindrical member 50 is secured by welding, for example, to a grooved capstan wheel 52. A ring gear 55 is secured, by suitable means such as welding, to the upper side of the capstan wheel 52, and is designed to mesh with the spur gears 41—41. Consequently, any rotation imparted to the ring gear 55 by the spur gears 41—41 is also imparted to the capstan wheel 52.

A plurality of sheaves 56, 57 and 58 (Fig. 2) are secured rotatably to the circular plate 37 by suitable bearings 61—61, and are mounted adjacent to the periphery of the capstan wheel 52. An endless idler belt 62 is wound around the sheaves 56, 57 and 58, with one side thereof engaging the grooved capstan wheel 52. The capstan wheel 52, the belt 62, and the sheaves 56, 57 and 58, considered together as a single structural unit, constitute a belt-type capstan designated generally by the numeral 63, which capstan is the means for advancing or feeding the wire 10.

In using the apparatus, the wire 11 to be coiled is fed through the center of the hollow shaft 17. A sheave 65 is mounted rotatably on the upper side of the plate 37, and is designed to receive the wire 11 after it passes through the hollow shaft 17 and to direct the wire to a second sheave 66. The sheave 66 is secured rotatably within a notch 67 formed in the plate 37, and is designed to receive the wire 11 from the sheave 65 and to direct the wire toward the grooved capstan wheel 52. The wire 11 will be held in driving contact with the capstan wheel 52 by the belt 62 over the whole of a continuous arc extending about 180° along the periphery of the capstan wheel 52.

A plurality of horizontal angle irons 70—70 are secured to the vertical channel irons 16—16. A cylindrical shell like deflecting member 71 having a flange 72 around the upper end thereof is fixedly secured to the angle irons 70—70. When a container 10 is in its wire-receiving position, the lower end of the deflecting member 71 is spaced a predetermined distance above the upper end of the container. A plurality of rods 75—75, having curved lower ends 76—76, are pivotally secured to the deflecting member by pins 77—77.

An armature 80 of a solenoid 81 is connected to each rod 75 by a pin 82, which is secured to the end of each armature 80 and passes through a slot 83 in each rod. When the solenoids 81—81 are de-energized, the rods 75—75 are positioned substantially as shown in Fig. 1. When the solenoids 81—81 are energized by applying a voltage of predetermined magnitude thereto, the rods 75—75 are forced downwardly by the armatures 80—80 so that curved lower ends 76—76 of the rods project into the space between the deflecting member 71 and the container 10.

As seen in Fig. 3, the energizing coils of the four solenoids 81—81 shown in Fig. 2 are connected to the circuit within the metering device 29 so that when the cam-operated switch 91 therein closes, due to a predetermined length of wire 11 having passed through the rollers 28—28, an energizing voltage of predetermined magnitude is applied across the coils. The metering device 29 includes a cam 92 driven through a suitable speed reducing mechanism 93 in predetermined synchronism with the metering rollers 28—28 so that an apex 94 of the cam 92 operates to close momentarily the switch 91 whenever the predetermined amount of the wire 11 has passed the metering rollers 28—28. When the switch 91 is so closed, a voltage is applied from a source 95, through a latching relay 96 to energize simultaneously each of the four solenoids 81—81 to operate the pivoted rods 75—75.

A cutting mechanism 86 (Fig. 2) is secured to the lower side of the plate 37 for rotation therewith. The cutting mechanism 86 has a movable blade 87, which may be energized by a solenoid 88 to cooperate with a fixed blade 90 secured to the lower side of the plate 37 to sever the wire 11. Since the solenoid 88 is necessarily mounted for rotation, suitable contact rings 97—97 and brushes 98—98 of conventional design, seen in the circuit diagram of Fig. 3, are provided to supply an energizing voltage thereto. Two of the brushes 98—98 are connected in series with the cam-operated switch 91 across the voltage source 95 within the metering apparatus 29, which energizes the solenoids 81—81 so that the solenoids 81—81 and 88 are energized simultaneously after a predetermined length of wire 11 has passed through the rollers 28—28.

Operation of first embodiment

After some prior operation has been performed thereon, the wire 11 to be coiled in the container 10 by the belt-type capstan 63 is passed through the rollers 28—28 and down through the hollow shaft 17. The wire is then passed around the sheaves 65 and 66 and between the belt 62 and the grooved capstan wheel 52, near the sheave 56, as described hereinbefore. Assume that the motor 21, when energized, will rotate the shaft 17 in a counterclockwise direction, as viewed in Fig. 2. The plate 32 then will be rotated in a counterclockwise direction, and will carry the upper spur gears 35—35 in a counterclockwise path around the ring gear 30. The upper spur gears 35—35 will consequently rotate about their own axes, on the shafts 40—40, in a counterclockwise direction, and similar rotation will be imparted to the lower spur gears 41—41, attached to the lower ends of the shafts 40—40. Since the lower plate 37 is rigidly connected by the sleeves 36—36 to the rotating upper plate 32, and since the sheaves 56, 57 and 58 are connected by the bearings 61—61 to the lower plate 37, the sheaves will be revolved in a counterclockwise direction around the axis of the plate 37 and adjacent to the periphery of the capstan wheel 52. The idler belt 62, which is held against the periphery of the capstan wheel 52 by the sheaves 56, 57 and 58, will revolve also around the capstan wheel 52 in a counterclockwise direction, since the belt 62 is carried by these three sheaves. Similarly, the guide sheaves 65 and 66 and the cutting apparatus 86, being carried by the plate 37, will revolve in a counterclockwise direction about the same axis so that the wire 11 will always be fed to the belt-type capstan 63 near the revolving sheave 56 and so that the cutting apparatus 86 will always be positioned near the wire-discharge point adjacent to the sheave 58.

When the gear ratio between the upper, fixed ring gear 30 and the upper spur gears 35—35 is greater than the gear ratio between the lower, rotatably-mounted ring gear 55 and the lower spur gears 41—41, rotation will be imparted to the lower ring gear 55 in a clockwise direction. Since the capstan wheel **52** is secured to the lower ring gear **55**, rotation in a clockwise direction will be imparted to the capstan wheel **52**. Consequently, the wire **11**, being pressed against the grooved capstan wheel **52** by the belt **62**, will be pulled around a continuous arc on the periphery of the capstan wheel **52** in a clockwise direction.

Thus, the wire **11** is discharged into space in a generally clockwise direction, as viewed in Fig. 2, by the belt-type capstan **63** due to the clockwise rotation of the capstan wheel **52**. As seen in Fig. 2, the wire **11** leaves the capstan **63** near the point of tangency between the sheave **58** and the capstan wheel **52**, where the belt **62** ceases to contact the wire **11**. As previously mentioned, the sheaves **56**, **57** and **58** and the belt **62** revolve, as a unit, in a counterclockwise direction about the axis of the plate **37**, which axis is coincident with the axis of the coil to be formed in the container **10**, as illustrated in Fig. 1. Therefore, the point where the wire **11** leaves the belt-type capstan **63**, near the point of tangency between the sheave **58** and the capstan wheel **52**, is revolved about the axis of the coil to be formed in the opposite direction to that in which the wire **11** is being advanced by the capstan **63**. Stated otherwise, those portions of the belt-type capstan **63** which are last to contact the wire **11** are revolved about the axis of the coil to be formed in the opposite direction to that in which the wire is discharged. With this arrangement, the wire **11** is continuously distributed along a descending helical path to form a coil in the container **10**.

Preferably the gear ratio between the upper ring gear **30** and the spur gears **35—35** is 4:1 and that between the lower ring gear **55** and the spur gears **41—41** is 2:1. With this arrangement, the wire **11** will be fed by the belt-type capstan **63** at exactly the same rate that the sheaves **56**, **57** and **58** are revolving around the periphery of the capstan **52**. Hence, the wire **11** will be distributed into the container **10** in a helical path having a radius substantially equal to the radius of the capstan wheel **52**. Centrifugal force will tend to increase this radius, but the deflecting member **71**, which has a smaller diameter than that of the container **10**, serves to direct the wire **11** in a path between the inner wall of the container **10** and the core **12**. The wire **11** will be fed around the core **12**, will fall into the container **10** and build up a coil thereof within the container to any desired height.

The amount of wire **11** being coiled within the container **10** is determined by the metering device **29**. When a predetermined amount of wire has passed through the metering rollers **28—28** and has been coiled in the container **10**, the switch **91** within the metering device **29** is closed to apply energizing voltages across the solenoids **81—81** and **88**. As seen in Fig. 3, the solenoid **88** is energized as the apex **94** of the cam **92** momentarily closes the switch **91** to complete a circuit from the voltage source **95**, through the now-closed, cam-operated switch **91**, through one brush **98**, one contact ring **97** and a second brush **98**, thence through the coil of the solenoid **88**, and back through a third brush **98**, the other contact ring **97**, and the last brush **98** to the source **95**. Energizing the solenoid **88** causes the blade **87** to move toward the fixed blade **90** and to sever the wire **11** as it travels in a path between the blades. The solenoid **88** that energizes the cutting mechanism **86** must be of a type that swiftly actuates the movable blade **87** to sever the wire **11** and quickly de-energizes to withdraw the blade **87** from the path of the continuously moving wire **11**.

At the same time, the metering apparatus **29** energizes the solenoids **81—81** to place the curved ends **76—76** of the rods **75—75** into the space between the cylindrical shell **71** and the upper end of the container **10**. As seen in Fig. 3, the solenoids **81—81** are likewise energized upon momentary closure of the switch **91** by the apex **94** of the cam **92**, as an operating circuit is completed from the source **95**, through the now-closed, cam-operated switch **91**, through the coil of the latching relay **96**, to the four solenoids **81—81** in parallel, and back to the source **95**. Upon energization by the momentary closure of the cam-operated switch **91**, the relay **96** latches in through closure of its contact **99**, establishing a holding circuit to maintain energization of the relay **96**, and thus the solenoids **81—81**, through a normally-closed, manually-operated, reset switch **100**. In this manner, the solenoids **81—81** will remain energized and their associated accumulating rods **75—75** will remain pivoted into their wire accumulating positions for as long as desired, even though the switch **91** reopens due to travel of the apex **94** of the cam **92** past the point of operation of the switch **91** as more wire is distributed.

The capstan wheel **52** will continue to rotate and feed the severed leading end and the following increments of the wire **11** toward the position where the container **10** rests. However, the wire being fed by the capstan wheel **52**, instead of going into the container **10**, is caught and supported by the curved ends **76—76** of the rods **75—75** until the filled container can be removed from its wire-receiving position beneath the cylindrical shell **71** and an empty container can be replaced therefor. When an empty container is so placed, the holding circuit energizing the solenoids **81—81** is de-energized manually by opening the reset switch **100**, and the rods **75—75** return to their normal positions, as shown in Fig. 1. The coils of wire **11** that have accumulated on the curved ends **76—76** fall by gravity to the bottom of the empty container **10** and the wire is coiled therein to any predetermined height as before.

Second embodiment

The distributor shown in Figs. 4 to 6, inclusive, is designed to coil a wire **111** into a container **110** of the type described in reference to the preferred embodiment of Figs. 1 and 2. In a similar manner, a cylindrical core **112** is preferably provided in the center of the container **110**, and a deflecting member **171** is positioned thereabove. A structure to catch and support the wire while changing containers, similar to that used in the preferred embodiment, also is positioned above the container in like manner, the corresponding pivoted rods being designated by the numerals **175—175** and the operating solenoids by the numerals **181—181** in Figs. 4 and 5.

Referring to Figs. 4 and 5, instead of rotatably mounting a hollow shaft like the shaft **17** of Figs. 1 and 2 to a platform **115** supporting the distributor-driving mechanism, a vertical, hollow shaft **117** is fixedly secured thereto, through which the wire **111** is passed. A supporting ring **101** having a sprocket **102** around the periphery thereof is rotatably mounted on the fixed shaft **117** by a suitable bearing **105**. The supporting ring **101** is rotated by a motor **121** through a chain **124** that engages the sprocket **102**. A circular plate **106** is rotatably mounted about the fixed shaft **117** by a suitable bearing **107** and is further supported by a plurality of adjustable rods **109—109** that are connected between the supporting ring **101** and the plate **106**.

Referring to Figs. 5 and 6, a beveled sun gear **113** is secured to the fixed shaft **117**. A horizontal shaft **114** is rotatably mounted within suitable bearings **116—116** secured to the plate **106**. A beveled gear **118**, which meshes with the fixed sun gear **113**, is secured to one end of the shaft **114**, and a grooved capstan wheel **119** is secured to the other end of the shaft **114** for rotation therewith. A plurality of sheaves **120**, **122** and **123** are rotatably secured to a plate **125**, attached to the plate **106** by a bracket **126**, and are mounted adjacent to the periphery of the capstan wheel **119**. An endless idler belt **127** is passed around the sheaves **120**, **122** and **123** and is guided within the groove in the capstan wheel **119** over a long, continuous arc on the periphery thereof. The capstan wheel **119**, the belt **127**, and the sheaves **120**, **122** and **123**, considered together as a unit, constitute a belt-type capstan designated generally by the numeral 163 for advancing the wire 111. The capstan 163 is generally similar to the capstan 63 described in the first embodiment of the invention, except that the means for revolving the wire-discharge point about the axis of the coil to be formed are different. A plurality of sheaves 130, 131 and 132 are positioned, respectively, below, on the side of and above the plate 106, and are designed to receive the wire 111 after it passes through the hollow shaft 117, and to direct it between the belt 127 and the capstan wheel 119.

Two conductive rings 135—135 are mounted on the fixed shaft 117 and cooperate with two brushes 136—136 which are secured to a brush holder 137 attached to the rotating plate 106. A pair of lead wires 140—140 are connected from the brushes 136—136 to a solenoid 141, which is attached to the lower side of the plate 106 and which energizes a movable cutting blade 142. The movable blade 142 cooperates with a fixed blade 145 to sever the wire 111 at a predetermined point and is actuated by a metering device, designated generally by the numeral 129 (Fig. 4).

The wire 111 is passed between a pair of metering rollers 128—128 which are rotatably secured to the metering apparatus 129 and which cause a switch (similar to the cam-operated switch 91 shown in Fig. 3) therein to close. Closing of the switch energizes a circuit similar to the circuit shown in Fig. 3 which applies a voltage to the solenoid 141 to sever the wire 111, and which energizes simultaneously the solenoids 181—181 to pivot the rods 175—175 to catch and support the wire 111 while the container 110 is being replaced, as described hereinbefore with reference to the embodiment of Figs. 1, 2 and 3. The operation of the metering device 129 and associated circuitry is substantially identical with that shown in Fig. 3 respecting the metering device 29 of the first embodiment of the invention.

Operation of second embodiment

The wire 111, after having had some prior operation performed thereon, is passed through the rollers 128—128, down through the fixed hollow shaft 117, brought around the sheaves 130, 131 and 132, and passed between the belt 127 and the groove in the capstan wheel 119. The wire is held within the groove in the capstan wheel 119 by the belt 127 and is pulled around the periphery of the capstan wheel 119 from a point near the sheave 120, past the sheave 122 and emerges from its position between the belt 127 and the groove in the capstan wheel 119 at a point near the sheave 123. The cutting blades 142 and 145 are on opposite sides of the path of the wire 111 near this exit point.

To distribute wire within the container, the motor 121 is energized to rotate the supporting ring 101, and, hence, the plate 106 which is directly connected thereto by the rods 109—109. Assuming that the plate 106 is rotated in a clockwise direction, as viewed in Fig. 6, the entire belt-type capstan 163 carried thereby will be revolved about the axis of the fixed shaft 117, which axis is coincident with the axis of coiling as illustrated in Figs. 4 and 5. Thus, the shaft 114 will be revolved about an axis coincidental with the axis of the fixed shaft 117 in a clockwise direction, so that the beveled gear 118 which is attached to the inner end of the shaft 114 is rotated in a counterclockwise direction, as viewed in Fig. 5. Rotation in a counterclockwise direction is, therefore, imparted to the capstan wheel 119. The wire 111 will be fed by the belt-type capstan 163 into the container 110, and, since the entire belt-type capstan 163 is revolving about the axis coincidental with the shaft 117 in the direction opposite to that in which the wire 111 is being fed thereby, the wire 111 will be fed in a helical path around the cylindrical core 112 in the center of the container 110.

The rate at which the wire 111 is fed must equal the belt-type rate at which the capstan 163 is revolving about the axis of the shaft 117, in order that coils of wire be correctly formed in the container 110. The attainment of these rates is merely a matter of design and depends upon the relative sizes of the gear 113, the gear 118 and the capstan wheel 119, and the length of the shaft 114. The distance from the axis of the shaft 117 to the point near the sheave 123 where the wire 111 emerges from its position between the belt 127 and the groove in the capstan wheel 119 should be substantially the mean radius between the inside radius of the container 110 and that of the cylindrical core 112 in the center thereof.

After a predetermined amount of wire has been fed through the metering rollers 128—128, the metering apparatus 129 is actuated thereby to apply a voltage across the rings 135—135. This voltage is applied through circuitry similar to that shown in Fig. 3 across the brushes 136—136 to energize the solenoid 141 and cause the movable cutting blade 142 to cooperate with the fixed blade 145 and sever the wire 111. At the same time, the solenoids 181—181 are actuated to pivot the rods 175—175 to catch and support the wire 111 to accumulate the coiled wire 111 until an empty container 110 can be replaced for the filled one, as described hereinbefore with reference to the embodiment shown in Figs. 1, 2 and 3.

Thus, it will be seen that two different means have been provided for revolving the point where the material leaves the capstan about the axis of the coil to be formed in the opposite direction to that in which the material is being advanced: (1) in the first embodiment, by revolving the sheaves about the rotating capstan wheel in the opposite direction; and (2) in the second embodiment, by revolving the entire belt-type capstan about an external axis coincident with the axis of the coil, while rotating the capstan wheel to feed the material.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of this invention. Numerous other arrangements may be devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. Apparatus for distributing a filamentary material of indefinite length uniformly into a container, which comprises a capstan for continuously advancing a length of such a material, means for causing those portions of the capstan which are last to contact the material to revolve about a given axis so that the material advanced by the capstan is simultaneously distributed along a circular path within the container, cutting means positioned adjacent to the point where the material leaves the capstan for severing the material, a deflecting member secured between the capstan and the upper end of the container for directing the wire into the container, a plurality of rods having curved ends secured pivotally to the deflecting member, and means for actuating the cutting means and for actuating the rods to place the curved ends thereof in the path of the material to accumulate the material.

2. Apparatus for distributing a filamentary material of indefinite length uniformly into a container in the form of a coil, which comprises a rotary capstan wheel, gripper belt means for holding the material against the capstan wheel and over an arc on the periphery thereof so that material is positively advanced by the rotation of the capstan wheel, means for revolving the gripper belt means about the capstan wheel in the direction opposite to that in which the capstan wheel is rotating so that the material is distributed into the container in coil form, cutting means secured rotatably near the point where the material leaves the capstan wheel, accumulating means secured above said container and designed to be placed thereover, and means to actuate the cutting means and the accumulating means when a predetermined amount of material has been coiled within the container.

3. Apparatus for distributing filamentary material into the form of a coil, which comprises a platform, a fixed ring gear secured to the platform, a hollow shaft through which the material is passed rotatably secured to the plat-

form, a first plate attached to one end of the shaft and rotatable therewith, a first plurality of gears rotatably mounted on the first plate and designed to mesh with the fixed ring gear, a second plate spaced from and secured to the first plate, a second plurality of gears rotatably secured to the second plate and driven by the first plurality of gears, a second ring gear mounted rotatably with respect to the second plate and designed to mesh with the second plurality of gears and to be driven thereby, a capstan wheel secured to the rotatable ring gear, a plurality of sheaves secured rotatably to the second plate and adjacent to the periphery of the capstan wheel, a belt wound endlessly around the sheaves and running against the material on the peripheral surface of the capstan wheel for holding the material in driving contact therewith over the whole of a continuous arc on the periphery thereof, and means for rotating the hollow shaft for causing the material to be fed by the capstan wheel and for revolving the sheaves about the capstan wheel.

4. Apparatus for distributing filamentary material into the form of a coil, which comprises a base, a ring gear secured to the base, a capstan wheel mounted rotatably on the base for advancing the material, a planetary gear secured to the capstan wheel and designed to mesh with the ring gear, and means for driving the planetary gear around the ring gear, whereby the material advanced by the capstan wheel is simultaneously distributed along a circular path.

5. Apparatus for distributing filamentary material into the form of a coil, which comprises a platform, a fixed ring gear fixedly secured to and depending from the platform, a plate secured rotatably to said platform, a capstan wheel secured rotatably to the plate, a shaft mounted rotatably upon the plate and attached to the wheel at one end thereof, a planetary gear secured to the other end of the shaft and designed to mesh with the ring gear, and means for rotating the plate to cause the wheel to advance the material and to revolve the capstan wheel about the axis of the ring gear.

6. Apparatus for distributing a filamentary material of indefinite length uniformly into a container in the form of a coil, which comprises a material-advancing means including a capstan wheel, a plurality of sheaves secured rotatably adjacent to the periphery of the capstan wheel, and a gripper belt wound endlessly around said sheaves and against the periphery of the capstan wheel to hold the material against the capstan wheel so that the material is positively advanced thereby, means to revolve the material-advancing means about the axis of the coil to be formed in the container, cutting means secured to the revolving means and in the path of the material near the point where the material leaves the capstan wheel, a deflecting member secured between the material-advancing means and the upper end of the container, accumulating means movably secured to the deflecting member and normally out of the path of the coiled material, and means actuated by the material for energizing the cutting means to sever the material and for energizing the accumulating means to place the accumulating means into the path of the material.

7. Apparatus for distributing filamentary material into the form of a coil, which comprises a platform, a hollow shaft through which the material is passed secured to the platform, a ring gear secured to the hollow shaft, a plate mounted rotatably with respect to the hollow shaft, a second shaft secured to the plate for rotation thereon, a planetary gear secured to one end of the second shaft and designed to mesh with the ring gear, a capstan wheel secured to the other end of the second shaft, a plurality of sheaves secured to the plate for rotation about their axes and adjacent to the periphery of the capstan wheel, a belt wound endlessly around the sheaves and in contact with the peripheral surface of the capstan wheel, means for directing the material between the belt and the periphery of the capstan wheel after the material passes through the hollow shaft, and means for revolving the capstan wheel and the sheaves about the axis of the hollow shaft.

8. Apparatus for continuously distributing a predetermined amount of filamentary material into each of a succession of containers in coil form, which comprises a capstan for continuously advancing a length of the material, means for causing at least those portions of the capstan which are last to contact the material to revolve about a given axis so that the material advanced by the capstan is continuously distributed in a descending helical path into coil form in a first container positioned stationarily beneath said capstan in a material-receiving position, cutting means positioned adjacent to the point where the material leaves the capstan, accumulating means positioned between said capstan and the first container, means for actuating said cutting means and said accumulating means when a predetermined amount of the material has been distributed into the first container, whereby said cutting means sever the advancing material and succeeding portions thereof are accumulated in coil form by said accumulating means, so that the first container may be removed and a second container placed in material-receiving position, and means for deactuating said accumulating means to permit the accumlated coil to drop into the second container, whereupon further portions of the filamentary material may be coiled therein.

9. A belt-type capstan for distributing filamentary material into the form of a coil, which comprises a rotatable capstan wheel engaging the material, gripper belt means for holding the material against the capstan wheel over an arc on the periphery thereof so that the material is fed into space upon rotation of the capstan wheel, means for rotating the capstan wheel to feed the material, and means for revolving at least portions of the belt-type capstan about the axis of the coil to be formed in such a manner that the last point of contact between the gripper belt means and the capstan wheel revolves about that axis in the direction opposite to that in which the material is being fed and at substantially the same speed that the material is being fed, so that the material is distributed along a descending helical path to form a coil.

10. A belt-type capstan for distributing filamentary material into the form of a coil, which comprises a rotatable capstan wheel engaging the material, a plurality of sheaves mounted in spaced relationship to each other near the capstan wheel for rotation about their individual axes, an endless belt wound around the sheaves and engaging the peripheral surface of the capstan wheel for holding the material in driving contact with the capstan wheel over an arc on the periphery thereof, means for rotating the capstan wheel to feed the material, and means for revolving the sheaves around the periphery of the capstan wheel in the direction opposite to that in which the capstan is rotating so that the material is distributed along a descending helical path to form a coil.

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