April 3, 1951 W. L. AMES 2,547,356

APPARATUS FOR MAKING RETRACTILE CORDAGE CONTINUOUSLY

Filed Oct. 23, 1947 3 Sheets-Sheet 1



FIG. 3

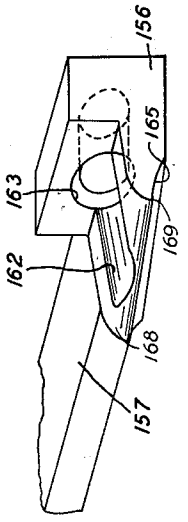


FIG. 6

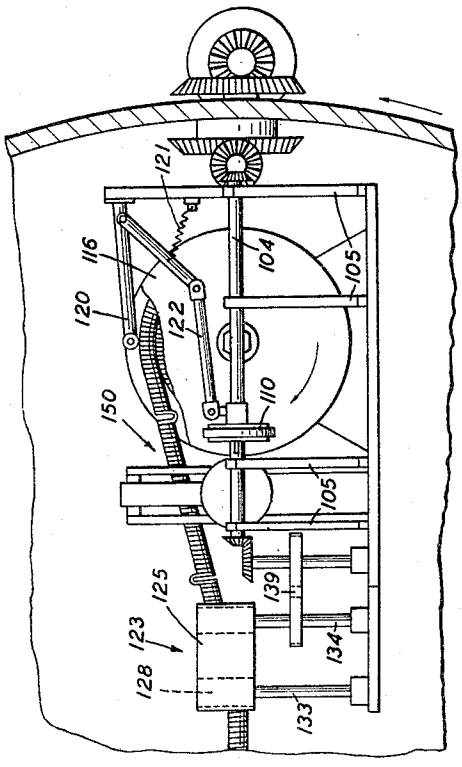


FIG. 5

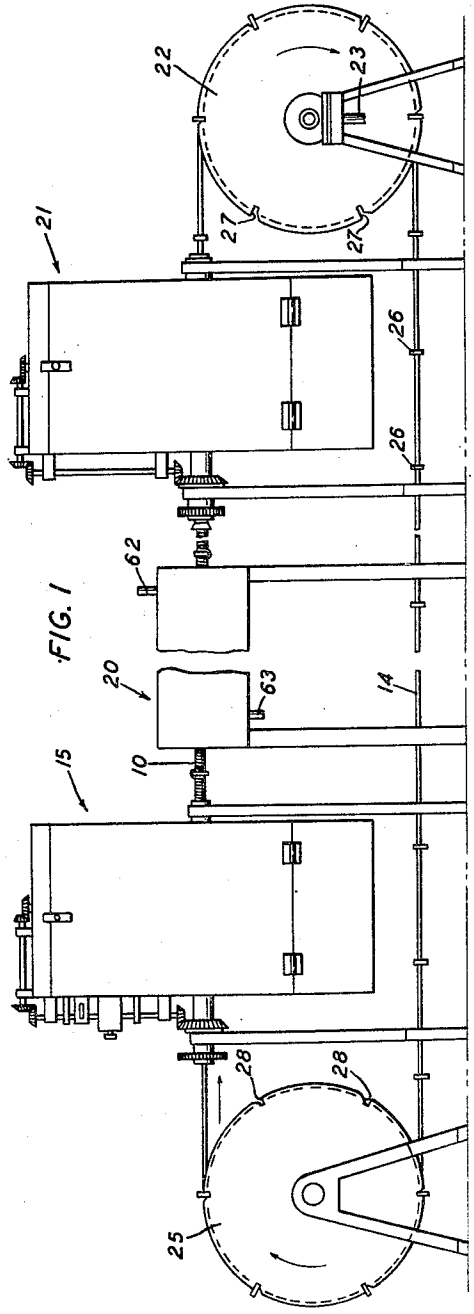


FIG. 1

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APPARATUS FOR MAKING RETRACTILE CORDAGE CONTINUOUSLY

Filed Oct. 23, 1947 3 Sheets-Sheet 2

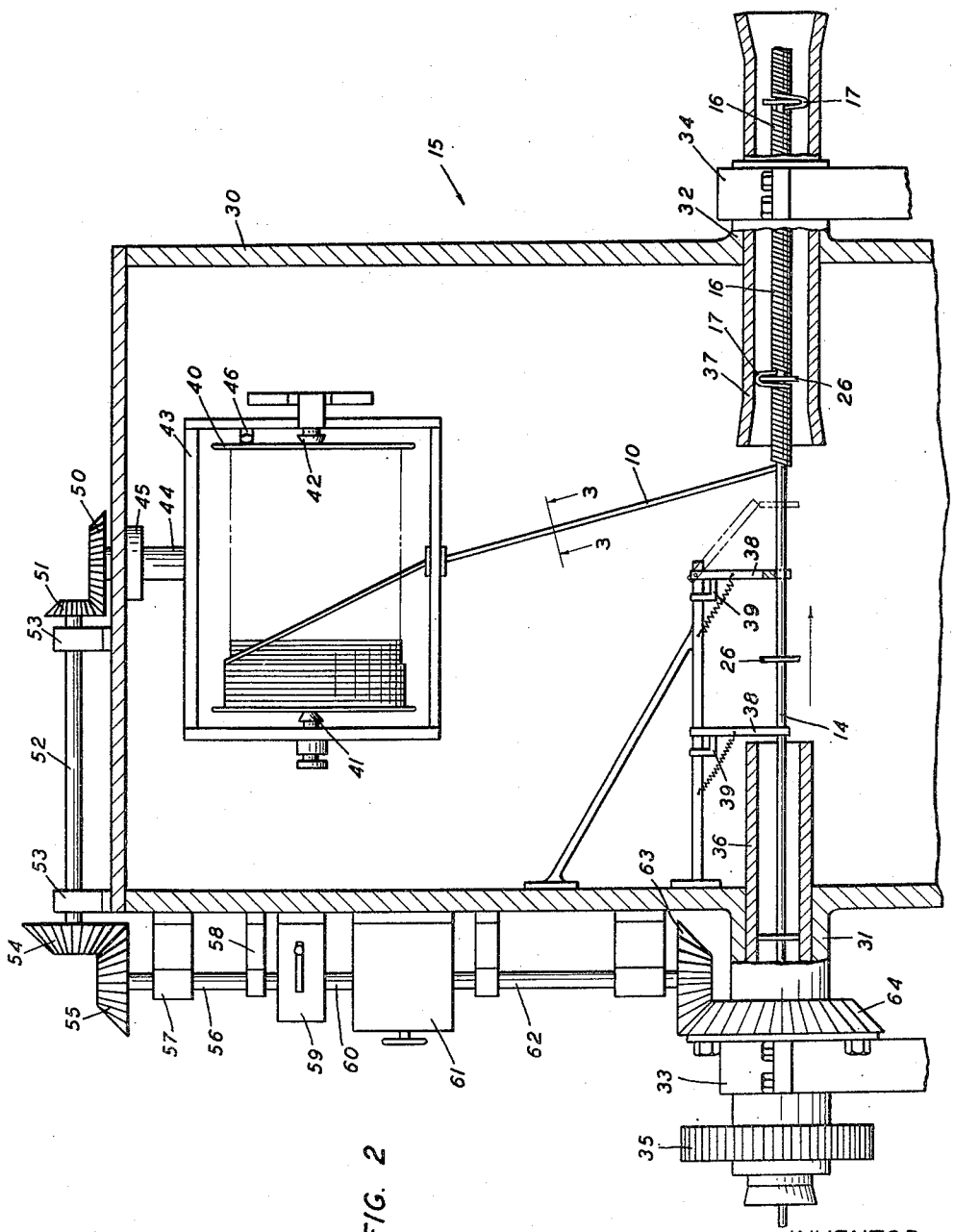


FIG. 2

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APPARATUS FOR MAKING RETRACTILE CORDAGE CONTINUOUSLY

Filed Oct. 23, 1947 3 Sheets-Sheet 3

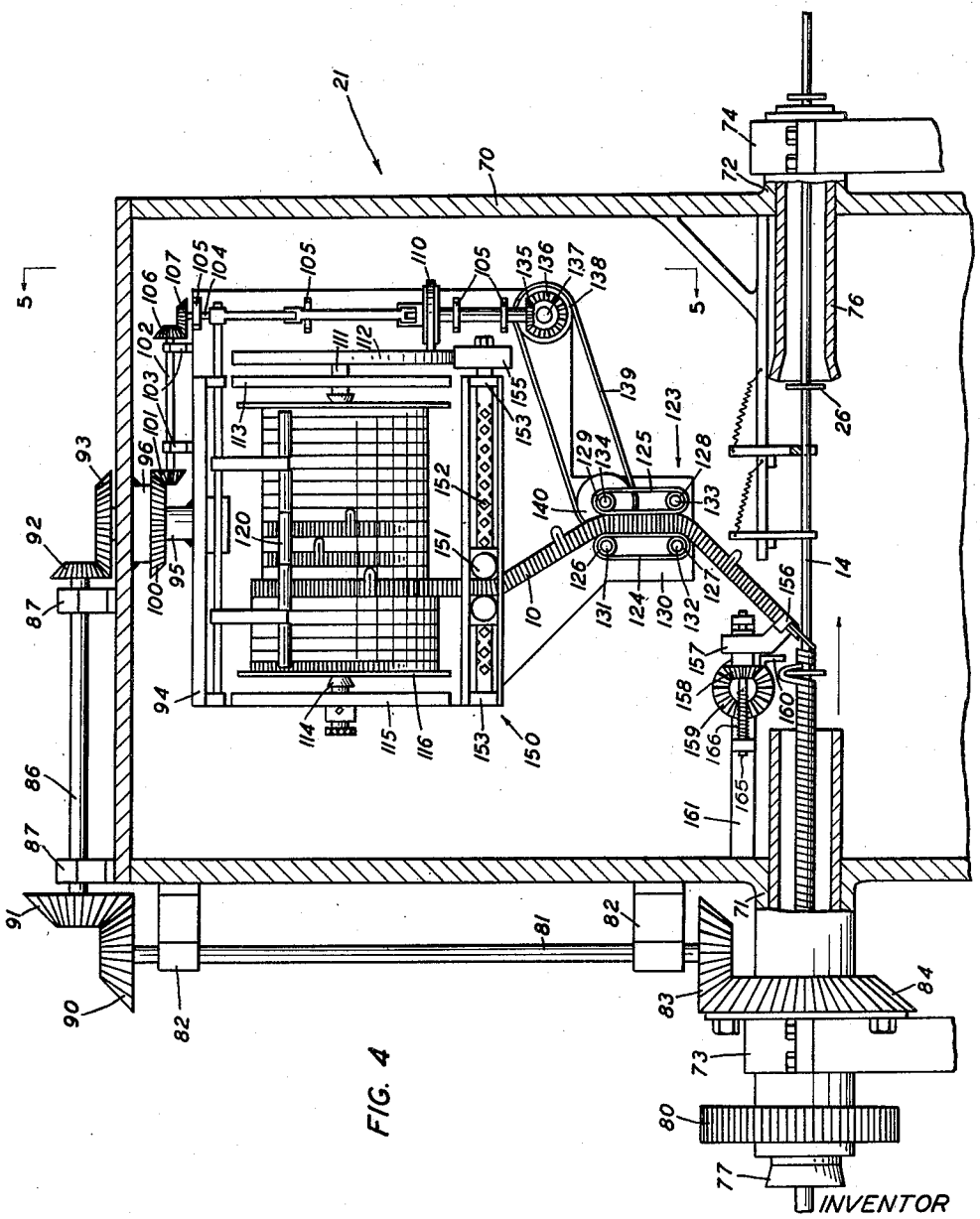


FIG. 4

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UNITED STATES PATENT OFFICE

2,547,356

APPARATUS FOR MAKING RETRACTILE CORDAGE CONTINUOUSLY

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Application October 23, 1947, Serial No. 781,734

13 Claims. (Cl. 18—19)

1

This invention relates to apparatus for making retractile cordage continuously.

In the past, retractile electrical cords of a type having plastic elements therein have been made by winding the intermediate portions of the individual cord lengths between the end portions thereof into helices upon relatively short mandrels and heating the individual cords mounted on the mandrels to soften the plastic elements of the portions of the cords in helical forms so that these intermediate portions of the elements are set in such helical forms when they are cooled and the end portions are set substantially straight, or by winding long lengths of such cordage continuously upon a rigid mandrel and pushing the cordage along the mandrel as it is wound therein. Obviously, the method of winding the cord lengths on short mandrels to form individual cords requires much manual handling of the cord lengths and the mandrels. When the cordage is wound continuously upon a mandrel and is set in the form of a continuous helix and cut into cord lengths, the end portions of such cord lengths must be straightened for the normal uses of such cords.

An object of the invention is to provide new and improved apparatus for making retractile cordage continuously.

Another object of the invention is to provide apparatus for continuously forming continuous cordage in a series of interconnected cord-length helices on a mandrel, for setting the cordage in such form and for continuously unwinding the cordage from the mandrel after the cordage has been set in such form.

An apparatus illustrating certain features of the invention, and by means of which methods embodying features of the invention may be practiced, may include means for forming continuous cordage into a series of helices, and means for forming portions of such cordage between adjacent ones of the helices substantially straight.

A complete understanding of the invention may be obtained from the following detailed description of an apparatus forming a specific embodiment thereof, when read in conjunction with the appended drawings, in which:

Fig. 1 is a fragmentary, front elevation of an apparatus forming one embodiment of the invention;

Fig. 2 is an enlarged, fragmentary vertical section of a portion of the apparatus;

Fig. 3 is an enlarged, vertical section taken along line 3—3 of Fig. 2;

2

Fig. 4 is an enlarged, vertical section of another portion of the apparatus;

Fig. 5 is an enlarged, fragmentary, vertical section taken along line 5—5 of Fig. 4, and

Fig. 6 is an enlarged, fragmentary, perspective view of a cordage prying shoe forming a portion of the apparatus.

Referring now in detail to the drawings, cordage 10 includes a plurality of conductors 11—11 (Fig. 3) having insulating coverings 12—12 thereon and a jacket 13 enclosing the covered conductors 11—11. The jacket 13 is composed of a compound including rubber, synthetic rubber-like material or other material which may be set in any particular shape by heating the material and then cooling it. The coverings 12—12 also may be made of a material which may be set by heating and cooling it. The cordage 10 is served upon an endless, flexible mandrel 14 by a coiler 15 in the form of sharply curved helices 16—16 separated by slightly curved helices 17—17 as the mandrel 14 is advanced continuously at a predetermined rate of speed through the coiler 15. The mandrel 14 is advanced through the coiler 15, then through a heating oven 20 and finally through an uncoiler 21 by a grooved sprocket 22 driven by a shaft 23.

The oven 20 heats the jacket 13 and the insulating coverings 12—12 (Fig. 3) of the helically coiled cordage 10. This softens the jacket 13 so that it sets in the form which it occupies on the mandrel 14 (Fig. 1) to form retractile cordage as it cools between the oven and the uncoiler 21. The uncoiler 21 then uncoils the retractile cordage from the mandrel 14, which is advanced around the sprocket 22 to and around a grooved guide sprocket 25 and back to the coiler 15. The general features of the coiler, the oven, the uncoiler and the mandrel are disclosed and claimed in copending application Serial No. 781,735 filed October 23, 1947, by T. K. Cox for "Methods of and Apparatus for Continuously Making Retractile Cordage."

Straightening discs 26—26 are fixed to the flexible mandrel 14 at points thereon equal distances apart. The discs 26—26 mesh with notches 27—27 in the sprocket 22 and notches 28—28 in the sprocket 25. The straightening discs have a much larger diameter than that of the mandrel 14 so that each portion of the cordage extending from one side of one of the discs to the other side thereof has two substantially straight portions. These substantially straight portions form end portions of cords cut from the continuous cordage.

The coiler 15 includes a frame 30 (Fig. 2) having aligned hollow arbors 31 and 32, which are mounted rotatably in bearings 33 and 34, respectively. Non-rotating bell-mouthed guide sleeves 36 and 37 extending through arbors 31 and 32, respectively, facilitate entrance of the discs 26—26 into the guide sleeves. The internal diameter of the major portion of the sleeve 36 is slightly greater than that of the discs so that the discs may slide therethrough. The internal diameter of the major portion of the sleeve 37 is slightly greater than the sum of the diameter of the discs plus the diameter of the cordage 10. Spring-pressed, forked guides 38—38 carried by and revolved with the frame 30 hold the mandrel against lateral deflection as the cordage is wound thereon.

The guides 38—38 are urged against stops 39—39. As one of the discs 26—26 is advanced against one of the forked guides, the disc pivots that guide out of its path. After the disc clears the spring-pressed guide, the guide springs back against the mandrel 14. The guides 38—38 are spaced sufficiently far apart to permit the discs to move only one of the guides from the mandrel at any time. However, each of the guides 38—38 is spaced sufficiently close to the point of application of the cordage to the mandrel to prevent the pull of the cordage on the mandrel from deflecting the mandrel laterally.

A gear 35 fastened rigidly to the arbor 31 and driven from a suitable source of power (not shown) serves to rotate the frame 30 around the flexible mandrel 14 and over the straightening discs 26—26, which are advanced through the sleeves 36 and 37 and past the guides 38—38. A supply of the cordage 10 is carried by a supply reel 40 mounted on the frame 30, and the cordage withdrawn from the reel 40 is served helically around the moving mandrel. The cordage is wound in close, small-diameter helices upon the portions of the mandrel 14 between the discs 26—26 and is wound over each of the discs 26—26 in two substantially straight portions.

The reel 40 is mounted rotatably by arbors 41 and 42 carried by a frame 43, which is secured to and rotated by a shaft 44 projecting therefrom. A leaf spring brake 46 tensions the carriage somewhat so that the cordage is served tightly upon the mandrel 14 and over the straightening discs 26—26. The shaft 44 is mounted rotatably in a thrust bearing 45 carried by the housing 30, and a bevelled gear 50 is keyed thereto. The gear 50 is driven through a bevelled gear 51, a shaft 52 mounted on bearings 53—53 carried by the housing 30, a bevelled gear 54 and a bevelled gear 55. The bevelled gear 55 is driven through a shaft 56 mounted rotatably in bearings 57 and 58 carried by the housing 30, a reversible differential 59, a shaft 60, a suitable adjustable gear box 61, a shaft 62, a bevelled gear 63 and a fixed bevelled gear 64. This revolves the reel 40 around an axis perpendicular to the axis of the flexible mandrel 14 so that the cordage 10 is twisted about its longitudinal axis as it is formed into the helices on the mandrel.

This twisting increases the closeness with which the individual turns of continuous cordage are placed on the flexible mandrel 14. The reel 40 is rotated around the axis of the shaft 44 at a predetermined rate with respect to the rate of revolution of the reel 40 around the flexible mandrel 14 due to the above-described gear train. Hence, the twist per turn of the helices formed upon the flexible mandrel is uniform regardless of the rate of revolution of the housing 30. This

twist tends to make the helices tighter than they would be otherwise. If it should be desired to make the helices looser, the direction in which the reel would be rotated around the axis of the shaft 44 would be reversed.

The cordage 10 coiled into a series of helices travels with the mandrel 14 into and through the oven 20, which heats the jacket 13 and the coverings 12—12 of insulating material to soften them in the form which they occupy in the helices in which the cordage is coiled. The oven 20 is heated by steam from a steam pipe 62 and the exhausted steam is led therefrom by a drain pipe 63 leading to a steam trap (not shown). The oven softens the jacket and the coverings sufficiently to relieve the strain therein so that the jacket and the coverings set in the forms they occupy in the series of helices when they are cooled.

The coiled cordage and the mandrel 14 pass from the oven 20 to and into the uncoiler 21 (Fig. 4) and the jacket 13 and coverings 12—12 cool sufficiently to set before they reach the uncoiler. The uncoiler includes a frame 70 having hollow arbors 71 and 72 projecting therefrom and mounted rotatably in bearings 73 and 74, respectively. Non-rotating guide sleeves 76 and 77 extend through the hollow arbors 72 and 71, respectively, and are identical in construction and function with the guide sleeves 36 and 37 (Fig. 2), respectively.

A gear 80 (Fig. 4) fastened to the arbor 71 is driven by suitable means (not shown) in synchronization with the gear 35 (Fig. 2) to rotate the frame 70 around the axis of the mandrel 14 at the same rate and in the same direction as that at which the frame 30 is rotated thereabout. A shaft 81 is mounted in bearings 82—82 carried by the frame 70, and the shaft 81 has a bevelled gear 83 keyed thereto, which meshes with a stationary bevelled gear 84, and, as the frame 70 is revolved about the mandrel, the gears 83 and 84 cause the shaft 81, to rotate. Rotation of the shaft 81 rotates a shaft 86 mounted in bearings 87—87, which are carried on the periphery of the frame 70, through bevelled gears 90 and 91. A bevelled gear 92 secured to the shaft 86 rotates a bevelled gear 93 to rotate a reel-supporting frame 94 carried by a shaft 95 to which the bevelled gear 93 is keyed. The shaft 95 is rotatably mounted in a radial and thrust bearing 96 secured to the frame 70.

A bevelled gear 100 is rigidly secured to the bearing 96 so that, as the reel-supporting frame 94 is rotated, a bevelled gear 101, which is keyed to a shaft 102 supported rotatably in bearings 103—103 carried by the reel-supporting frame 94, is rotated. This rotates, through bevelled gears 106 and 107, a shaft 104 supported by bearings 105—105. The shaft 104 rotates a driving disc 110 splined thereto, which drives a reel-supporting arbor 111 through a driven disc 112. The reel-supporting arbor 111 is mounted rotatably and is held against longitudinal movement by a support 113 caried by the frame 94, and, with an adjustable arbor 114 carried by a support 115, serves to hold a takeup reel 116.

When the arbor 111 is rotated through the discs 110 and 112, it rotates the takeup reel 116 in a clockwise direction, as viewed in Fig. 5, to wind the coiled cordage 10 upon the takeup reel. A feeler 120 (Fig. 5) biased against the cordage on the reel 116 by a tension spring 121 controls the position of the disc 110 through a linkage 122 in accordance with the amount of the cordage 10 which has been wound upon the takeup reel so

that the speed of rotation of the takeup reel 116 is always just sufficient to prevent slack between the takeup reel and a cordage feeder 123.

The cordage feeder 123 includes a pair of presser belts 124 and 125 (Fig. 4). The presser belt 124 is mounted on idler pulleys 126 and 127, while the presser belt 125 is mounted upon an idler pulley 128 and a drive pulley 129. The pulleys 126, 127, 128 and 129 are mounted upon shafts 131, 132, 133 and 134, respectively, secured to a tongue 130 formed on the frame 94. The shaft 134 is driven in synchronization with the reel 116 by the shaft 104 through bevelled gears 135 and 136, a shaft 137, a drive pulley 138, a belt 139 and a driven pulley 140 secured to the shaft 134. The feeder 123 advances the coiled cordage 10 to the takeup reel at a uniform rate of speed, which rate is the same as that at which the coiled cordage 10 is uncoiled from the mandrel 14.

A distributor 150 positioned between the reel 116 and the feeder 123 includes a guide fork 151, which is reciprocated adjacent to the reel 116 by a double thread screw 152 mounted rotatably in bearings 153—153 carried by the reel supporting frame 94. The screw 152 is rotated in synchronization with the variable rate of rotation of the reel 116 by a friction disc 155 keyed to the screw 152 and bearing against the periphery of the disc 112 so that the cordage is distributed upon the takeup reel 116 uniformly.

A shoe 156 carried on an arm 157 gently pries the cordage 10 away from the mandrel 14 as the shoe is revolved around the mandrel 14 with the frame 70. The arm 157 is secured rigidly to a bevelled gear 158 meshing with a bevelled gear 159 fixed to a feeler 160. The gears 158 and 159 are mounted on and are revolved with the frame 70 by a suitable mount 161 secured to the frame 70. The gear 158 is rigidly secured to a shaft 165 carried on the mount 161, and a torsion spring 166 tends to rotate the shaft 165 so as to bias the arm 157 and, in consequence, the shoe 156 toward the mandrel 14. Normally, the spring-biased arm 157 holds the shoe 156 lightly against the mandrel 14 but as one of the straightening discs 26—26 approaches the shoe, that disc strikes the feeler 160 and moves the feeler 160 out of its path. The movement of the feeler 160 turns the shoe 156 through the gears 158 and 159 against the force of the torsion spring 166 and out of the path of the disc, which is advanced therepast. As the disc clears the shoe 156, the disc moves out of contact with the feeler 160 and the shoe is moved back into engagement with the mandrel 14 by the torsion spring 166.

The cordage 10 is temporarily straightened slightly as it is gently pried from the mandrel 14 and passes through a guide passage 162 (Fig. 6) and a guide ring 163 formed in the shoe 156, after which the tightly coiled portions of the cordage recoil into tight helices. The shoe 156 is provided with a concave portion 165, which normally rests on the mandrel 14. The concave portion 165 of the shoe 156 joins an adjacent curved surface 168 to form a wedge-like edge 169. Since the frame 70 is rotated about the mandrel 14 and the shoe 156 is carried by the frame 70, the shoe 156 is rotated about the mandrel 14 as the mandrel is advanced therepast. As a result of the longitudinal movement of the mandrel 14 and the rotation of the shoe 156 about the moving mandrel, the wedge-like edge 169 is forced between the mandrel and the successive advancing convolutions of the helically wound cordage 10, and the cordage is thereby pried away from the mandrel.

As the cordage is unwound from the mandrel 14, the unwinding tends to twist the cordage at the rate of one turn per revolution of the reel 116 around the mandrel 114. This twist is immediately removed from the coiled cordage by the revolution of the reel 116 and the cordage feeder 123 by the shaft 95, which untwists the cordage at the rate of a single turn per revolution of the reel 116 so that the uncoiling operation does not affect the axial twist of the helically coiled cordage.

Operation

In the operation of the apparatus described hereinabove, the flexible mandrel 14 carrying the straightening discs 26—26 (Fig. 1) is advanced continuously at a uniform rate of speed through the coiler 15, the oven 20 and the uncoiler 21. The coiler 15 coils the cordage 10 into a series of close helices upon the portions of flexible mandrel 14 between the discs 26—26 and applies any desired twist to the cordage to form a loose helix or a tight helix whichever is wanted. The coiler applies the cordage to each of the discs 26—26 in two substantially straight portions.

The oven 20 softens the plastic elements of the cordage in the forms in the helices and straight portions, and the plastic elements cool to set in those forms. The uncoiler 21 is continuously rotated around the mandrel 14 in a counterclockwise direction, as viewed in Fig. 5. As the uncoiler 21 is rotated, the shoe 156 is revolved around the mandrel and the wedge-like edge 169 of the shoe gently pries and wedges the cordage 10 from the mandrel and discs 26—26, temporarily and partially straightening the cordage as it does so. The guide ring 163 holds the cordage in the passage 162 as the cordage is pried away from the mandrel and is forced through the passage 162 and the guide 163 by the shoe 156. The cordage reassumes its set shape as it passes through the shoe 156, and is advanced toward the take-up reel 116 by the feeder 123 at the same rate at which it is uncoiled from the mandrel 14.

The portion of the cordage uncoiled from the mandrel 14 is rotated around its own axis by the feeder 123 as the feeder is revolved by the supporting frame 94 so as to take out any twist imparted to the coiled cordage by uncoiling it from the flexible mandrel 14. The distributor 150 distributes the cordage in close turns upon the take-up reel 116 in synchronization with the rate at which the reel 116 is rotated, which rate is varied under the control of the feeler 120 to keep the rate at which the take-up reel 116 coils the cordage thereon the same as that at which the cordage is fed thereto by the feeder 123. The feeder advances the cordage towards the take-up reel 116 at the same rate at which it is uncoiled from the mandrel 114 so that there is only sufficient tension upon the coiled portion of the cordage between the feeder and the reel 116 to support the weight of that portion of the cordage.

The above-described method and apparatus serve to automatically and continuously coil, set and take-up cordage in the form of a series of helices separated by straight portions at a high rate of speed. Hence, individual retractile cords having straight end portions may be formed merely by cutting the portions of the cordage which cross over the discs. The apparatus is variable to control the "pull" of cords made from helically coiled cordage. The method and the

apparatus serve to uncoil temporarily cordage and take it up in recoiled form with all the twist effect inherently imparted to the cordage from the uncoiling operation taken out of the cordage.

What is claimed is:

1. An apparatus for making retractile cordage, which comprises a generally cylindrical, elongated mandrel having a plurality of disc-like protuberances spaced at equal intervals along a substantial length thereof, means for coiling cordage helically upon the mandrel at a predetermined rate of speed, means for actuating the cordage coiling means, and means for advancing the mandrel and the disc-like protuberances through the cordage coiling means at a predetermined rate of speed, whereby cordage coiled upon the mandrel by the coiling means is formed on the mandrel in a series of helical portions spaced apart by short, substantially straight portions.

2. An apparatus for making continuous retractile cordage, which comprises an endless mandrel having a predetermined diameter, a plurality of discs mounted on the mandrel at equally spaced points thereon which discs are larger in diameter than the mandrel, a serving head for applying cordage to the mandrel, means for rotating the serving head about the mandrel to coil cordage carried thereby helically upon the mandrel, and means for advancing the mandrel and the discs through the serving head.

3. An apparatus for making continuous retractile cordage, which comprises an endless, flexible mandrel having a predetermined diameter, a plurality of discs mounted on the mandrel at equally spaced points which discs are larger in diameter than the mandrel, a serving head for applying cordage to the mandrel, means for rotating the serving head about the mandrel to coil the cordage helically upon the mandrel, and means for engaging the discs to advance the mandrel and the discs through the serving head.

4. An apparatus for making retractile cordage, which comprises an elongated mandrel having a predetermined diameter, a plurality of discs having a diameter substantially larger than that of the mandrel mounted on the mandrel coaxially therewith at spaced points therealong, a serving head for serving cordage on the mandrel, means for advancing the mandrel and the discs through the serving head at a uniform rate of speed, and means for revolving the serving head around the mandrel and the discs at a uniform rate of speed, whereby cordage coiled upon the mandrel and the discs by the serving head is formed into a series of helices on the portions of the mandrel between the discs and substantially straight portions between the helices at the points where the discs are located.

5. An apparatus for making continuous retractile cordage, which comprises an endless, flexible mandrel, means for continuously advancing the mandrel along a predetermined path, a plurality of discs carried by the mandrel coaxially with respect to the mandrel at spaced points therealong, a serving head for continuously serving cordage upon the mandrel and the discs carried thereby, whereby the cordage is coiled into a series of helices separated substantially by straight portions, means for rotating the serving head, means surrounding a portion of said path of cordage served by the serving head on the mandrel and the discs, and means revolvable around the mandrel for continuously

unwinding the cordage from the mandrel and the discs.

6. An apparatus for making continuous retractile cordage from cordage including an element of plastic material, which comprises an elongated mandrel, a plurality of discs having a diameter substantially larger than that of the mandrel carried by the mandrel at equally spaced points thereon, means for advancing the mandrel and the discs along a predetermined path, a serving head, means for rotating the serving head about the mandrel and the discs to serve such cordage thereon, means positioned along said path for heating cordage so served, a take-up reel, means for revolving the take-up reel around the path to unwind the cordage from the mandrel and the discs, a shoe revolvable with the take-up reel for prying the cordage from the mandrel, means for urging the shoe toward the mandrel, and means operable by one of the discs as that disc approaches the shoe for moving the shoe against the action of the shoe-urging means out of the path of the disc.

7. An apparatus for making continuous retractile cordage from cordage including an element made of plastic material, which comprises an elongated mandrel, a plurality of discs of greater diameter than the mandrel positioned on the mandrel at equally spaced points therealong, means for advancing the mandrel and the discs along a predetermined path, a serving head, means for rotating the serving head about the path of the mandrel to serve such cordage helically on the mandrel and over the discs, means positioned along said path for heating cordage so served, a take-up reel, means for revolving the take-up reel around the path to unwind the cordage from the mandrel and the discs, a pivoted arm revolvable with the take-up reel, a shoe carried by the arm for prying the cordage from the mandrel, means for urging the arm toward the mandrel, and means operable by one of the discs as that disc approaches the shoe for moving the arm against the action of the arm-urging means to move the shoe out of the path of the disc.

8. An apparatus for making continuous retractile cordage, which comprises an elongated mandrel having a predetermined diameter, a plurality of discs having a diameter substantially larger than that of the mandrel and fastened to the mandrel at points along the mandrel spaced equal predetermined distances apart, a serving head for serving cordage upon the mandrel and the discs, means for advancing the mandrel and the discs through the serving head at a uniform rate of speed, and means for revolving the serving head around the mandrel and the discs at a uniform rate of speed.

9. An apparatus for making continuous retractile cordage, which comprises an elongated mandrel, a plurality of washers mounted coaxially on the mandrel at points spaced equidistantly on the mandrel, means for advancing the mandrel and the washers along a predetermined path at a uniform rate of speed, means rotatable about said path for serving cordage upon the mandrel and the washers and means for rotating the cordage serving means.

10. An apparatus for making continuous retractile cordage, which comprises an elongated mandrel, a plurality of washers carried by the mandrel at points spaced equidistantly therealong, means for advancing the mandrel and the washers along a predetermined path, a serv-

ing head rotatable about said path for coiling cordage upon the mandrel and the washer, means for rotating the serving head, and a retractible guide carried by the serving head for normally engaging the mandrel but permitting the discs to be advanced therepast.

11. An apparatus for making continuous retractile cordage, which comprises an elongated mandrel, a plurality of washers carried by the mandrel at points spaced equidistantly therealong, means for advancing the mandrel along a predetermined path, a serving head rotatable about a portion of said path for serving cordage on the mandrel means for rotating the serving head and the washers, and a pair of escapement guides carried by the serving head for engaging the mandrel to prevent lateral deflection thereof and movable out of engagement with the mandrel by the washers, said guides being spaced along the path of the mandrel sufficiently far apart to permit only one of the guides to be moved by a washer away from the mandrel at any instant.

12. An apparatus for making continuous retractile cordage, which comprises an elongated mandrel, a plurality of discs carried by the mandrel at points spaced equidistantly therealong, a serving head for serving cordage on the mandrel and the washers, means for rotating the serving head means for advancing the mandrel through the serving head, a forked guide carried pivotally by the serving head, and means for urging the guide into engagement with the mandrel and for permitting one of the discs to move the guide away from the mandrel.

13. An apparatus for making retractile cordage, which comprises a generally cylindrical, elongated mandrel having a plurality of disc-like protuberances spaced at equal intervals along a substantial length thereof, a serving head revolvable about the mandrel for simultaneously twisting cordage longitudinally and coiling the cordage helically upon the mandrel, means for revolving the serving head, and means for advancing the mandrel and the disc-like protuberances through the serving head, whereby longitudinally twisted cordage is coiled upon the mandrel in the form of a series of helical portions spaced apart by short, substantially straight portions.

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