March 22, 1960 W. S. GEORGE 2,929,179

STRAND CURLING METHOD AND APPARATUS

Filed Feb. 24, 1959

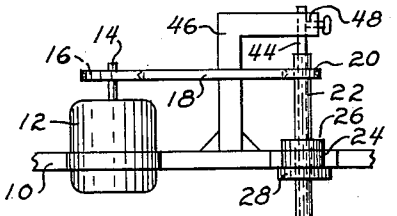

Fig. 1

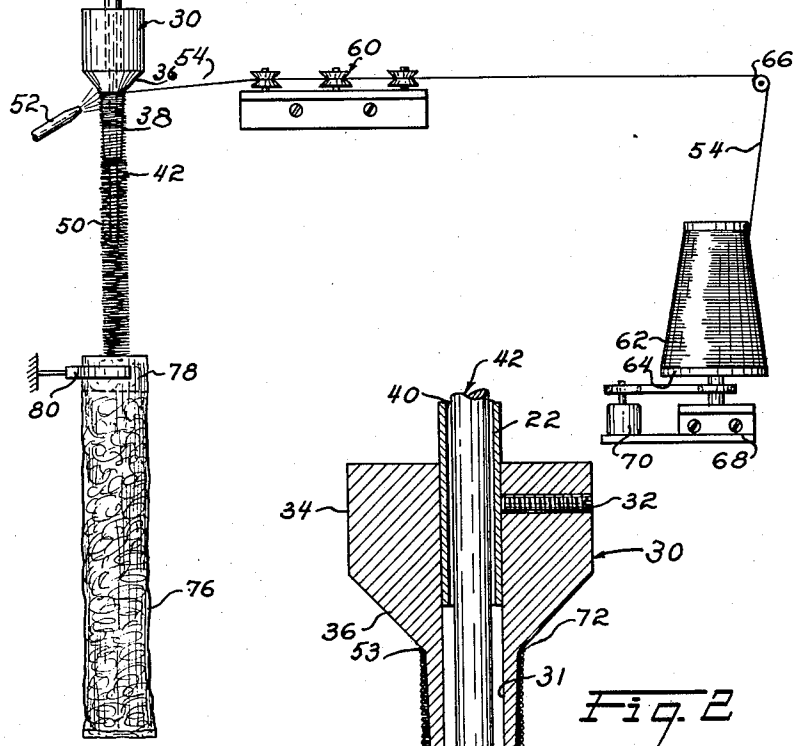

Fig. 2

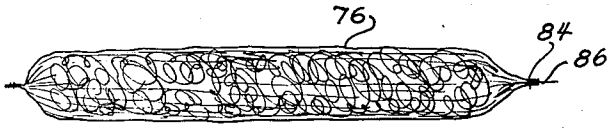

Fig. 3

INVENTOR

WILLARD S. GEORGE

BY Scrivener & Parker

ATTORNEYS

United States Patent Office 2,929,179 Patented Mar. 22, 1960

2,929,179

STRAND CURLING METHOD AND APPARATUS

Willard S. George, Severna Park, Md.

Application February 24, 1959, Serial No. 795,055

10 Claims. (Cl. 53—21)

This invention relates to an apparatus and method for continuoupsly curling thermoplastic strand material and to a method of packaging curled strand material.

Strand material of either the monofilament thermoplastic or multi-thread variety is usually manufactured in straight lengths and packaged by being wrapped upon itself to form a frustoconical package from which the strand may be stripped for use or further processing. The uses of the strand material are numerous and some uses, such as in the doll wig-making industry, require a continuous supply of pre-curled strand material for use with high speed power driven wig-making machines. Supplying precurled strand material for industrial use has been a problem and heretofore the prior art has resorted to the process of wrapping by machine several layers of strand material on small elongated spools and then conveying the spools along a heated path so that when the material is later removed from the spool it partakes of a series of helical curls substantially corresponding in diameter to the diameter of the convolutions of the material when wrapped on the spools.

There are several disadvantages to the above process, one of which is the excessive time required to set up, remove and replace the large number of spools required for use with the spool winding machines. Another is the fairly slow rate at which the spools must be moved along the heated path to insure heat penetration to the innermost layers of the material on the spool. A further disadvantage is the relatively small amount of strand material that can be accommodated on a single spool which requires frequent interruption of a machine such as a wig-making machine for replacing and rethreading of the strand material.

The broad object of the present invention, therefore, is to overcome all the disadvantages of the prior art methods of producing curled thermoplastic strand material.

A more specific object of the invention is to provide a method and apparatus for continuously and rapidly curling normally straight thermoplastic strand material without any practical limitation on the quantity curled during a single operation.

A still further object of the invention is to provide a method and apparatus for curling thermoplastic strand material which is readily adapted to the producing of curls of various sizes.

A still further object of the invention is the provision of a method and apparatus for continuously producing curled strand material and packaging the same in a novel manner not contemplated heretofore in the prior art.

A still further object of the invention is to provide a novel method of packaging curled strand material which does not involve a wrapping or winding process in any way with the method permitting rapid, continuous, unsnarled and kink-free removal of the curled strand material from the package.

Other objects of their attendant advantages will become

apparent as the following detailed description is read in conjunction with the accompanying drawings wherein:

Fig. 1 is a somewhat diagrammatic view illustrating the method of the invention being carried out on apparatus constructed in accordance with the invention;

Fig. 2 is an enlarged detailed cross sectional view of a portion of the aparatus of the invention; and

Fig. 3 is a side elevational view of a package of precurled strand material.

Referring now to the drawings, Fig. 1 illustrates the apparatus of the invention as comprising a support **10** rigidly fixed to any suitable supporting structure (not shown) and carrying an electric driving motor **12** having a stub shaft **14** provided with a drive pulley **16** operatively connected by way of a drive belt **18** to a driven pulley **20** rigidly connected to an elongated rotatable hollow shaft **22** which extends vertically downwardly through suitable bearing means **24** carried in the support **10**. The shaft **22** may be provided with vertically spaced collars **26**, **28** on opposite sides of the support to prevent vertical movement of the shaft through the bearing.

Fixed to the lower end of the rod is a mandrel **30** having an axial bore **31** therethrough with the mandrel being fixed to the shaft **22** in any convenient manner as by a set screw **32** illustrated in Fig. 2. The mandrel is constructed of smooth dense material, preferably polished metal and as illustrated in Fig. 2 it comprises an enlarged upper portion **34**, a relatively steep inwardly and downwardly extending frusto-conical shoulder portion **36** and relatively elongated slightly inwardly tapering lower extension **38**. As previously mentioned, the shaft **22** is hollow to provide a bore **40** of sufficient size to receive an elongated central rod **42** whose upper end **44** extends above the shaft **22** and is clamped in a bracket **46** by any suitable means such as the wing bolt **48** shown. The lower end **50** of the rod **42** extends considerably below the bottom edge of the mandrel for purposes that will become apparent hereinafter. A steam jet or other heat source **52** is provided to project a heating medium against the mandrel, preferably at the juncture **53** of the shoulder **36** with the tapered portion **38** since it is at this point that the strand material **54** is led onto the mandrel from a conventional tensioning device **60** which is located slightly above the juncture **53** so that the strand material leads downwardly at a slight angle to the juncture as is illustrated.

The strand material is supplied from a coil or supply roll **62** which is seated on a support **64** preferably mounted considerably below the tensioning device so that the strand material may be stripped off the supply roll axially and led over a suitable guide **66** to the tensioning device **60**. The roll support **64** may, if desired, be rotatably mounted on a base member **68** and a suitable electric motor **70** may be provided to rotate the support **64**, and hence the supply roll, in either direction to impart a twist to the strand as it is stripped off the supply.

In use, the free end of the strand material is first wrapped manually around the mandrel at the juncture **53** with a sufficient number of convolutions to insure that it will not initially slip when the mandrel is rotated. Thereafter steam or other heating medium is applied to the mandrel from the jet **52**, or by any other suitable means, to insure that the mandrel is thoroughly heated particularly in the region of the juncture **53** before the curling operation commences. After the mandrel has been heated, the motor **12** is started to rotate the mandrel at a relatively high rate of speed so that the strand material is wrapped around the mandrel. As the strand is initially drawn onto the mandrel at the juncture **53** of the shoulder with the tapered portion, the convolutions may initially, because of the downward angle of

the strand 54, endeavor to ride slightly up the outer surface of the shoulder 36, as indicated at 72 in Fig. 2, but the steepness of the shoulder is such that each oncoming convolution is prevented from riding up and instead, is forced by the shoulder to slip down and around the juncture 53 and displace therefrom in a downward direction the preceding convolution so that this and all other preceding convolutions 73 move downwardly with respect to the elongated tapered portion 38 of the mandrel. The diameter of each convolution is determined by the diameter of the juncture 53 and, as observed in Fig. 3, as the convolutions 73 move downwardly, the distance between the internal circumference of the convolutions and the outer surface of the extension increases because of the latter's inward taper. Thus the extension acts essentially as a guide and inasmuch as the lower convolutions 73 do not actually engage the extension, these convolutions, as they progress downwardly, rotate about a vertical axis at a steadily decreasing rate as they approach the lower end of the mandrel. If there is no further guiding of the convolutions as they feed off of the mandrel, there is a tendency for the curled strand material to back twist upon itself to form a snarl. Once snarled, the material may then wrap itself in a tangled mass around the extension causing considerable wastage before the apparatus can be stopped. I have discovered that this difficulty can be entirely eliminated by feeding the convolutions from the mandrel end directly onto or around the projecting lower end 50 of the rod 42. The use of the stationary rod for preventing back-twisted snarls is an important part of the invention and enables the continuous curling of yarn by a mandrel as above described without any stoppage whatsoever because of snarling.

The strand material continues to feed down the rod 42 and from the free end thereof it drops under the force of gravity into a stationary receptacle. I have discovered that when the convolutions are initially guided, as by the free end of the rod 42, so that the convolutions fall in horizontal disposition, no further guide means of any kind are required to direct the strand material into the receptacle. The convolutions as they are caught in the receptacle merely pile up upon themselves in no fixed pattern and it is possible later to withdraw the curled material from the receptacle at any desired rate, up to thousands of feet per minute, without any snarling whatever. I have found that receptacles comprising elongated plastic bags made of cellophane or the like provide excellent economical receptacles and in the drawings I illustrate such a receptacle 76 which is supported in axial alignment below the stationary rod 50. For filling purposes, a suitable rigid collar 78 is inserted into the mouth of the bag and an ordinary spring clamp 80 fixed to any suitable support, embraces the bag and clamps it to the collar.

As the curled strand material is fed into the bag it piles up upon itself and entirely fills the bag. When the the bag is filled, the strand material is cut above the bag, and the filled bag with its collar is removed from the clamp and rapidly replaced by another. With the end of the strand extending outwardly of the mouth of the bag, the collar is removed and if desired, the mouth of the bag may be heat sealed closed as indicated at 84 in Fig. 3 with the free end 86 of the strand material caught and sealed between the faces of the opposing end flaps. Thus when the bag is opened at the place of intended use, the projecting free end 86 of the strand material is readily available to the operator so that the strand material may be quickly pulled out of the bag and threaded on to a machine, such as a wig-making machine, without time being wasted fishing for the strand end.

From the foregoing it will be apparent that I have provided a method and apparatus for curling thermoplastic strand material continuously and at a rapid rate with none of the limitations of the prior art. Any size receptacle can be used and curls of any desired mean diameter can be provided by the apparatus by merely exchanging one mandrel with another of a different size. If desired, the strand material, before being curled, may have a twist imparted thereto merely by rotating the supply coil support 64 as previously explained. The means for heating the strand as it is drawn onto the mandrel may comprise any of a variety of devices such as infrared lamps though I have found steam jets to be entirely satisfactory. It has been mentioned in foregoing paragraphs that the curled strand material is particularly suited for use on high speed doll wig-making machines. This is by no means a limitation on the uses of the curled strand material since it will be apparent to those skilled in the art that there are a variety of uses of such material in the textile industry. The strand material can be monofilament or multifilament and I have found that the apparatus performs with excellent results on a strand composed of nine co-extensive filaments of "Saran" (trade name). Any thermoplastic filament or any strand material capable of having a curl set therein under the influence of heat can be utilized.

It will also be apparent to those skilled in the art that the apparatus described herein is exemplary only and that it is susceptible of a variety of modifications without however, departing from the scope and spirit of the appended claims.

What is claimed is:

1. A continuous method of curling normally straight thermoplastic strand material which comprises winding said strand material on a vertically disposed mandrel having a steep frusto-conical shoulder and an elongated tapering downwardly sloping portion integral with the small end of said shoulder, rotating said mandrel, guiding said strand material onto said mandrel so that initially the strand material is wound around said mandrel adjacent the junction of said shoulder with said tapering portion and so that said shoulder continuously causes the convolutions of strand material to be displaced downwardly along and eventually off the end of said tapering portion by succeeding convolutions wound onto said mandrel, continuously heating said mandrel as the strand material is fed thereon so as to set a continuous helical curl in said strand material, and thereafter engaging the convolutions of the curled strand material as they feed off the end of said mandrel by a fixed rod coaxial with said mandrel so as to prevent said curled material from back twisting.

2. The method of curling and packaging continuous lengths of normally srtaight thermoplastic strand material comprising the steps of winding said strand material under tension onto a vertically disposed mandrel having a downwardly and inwardly steep frusto-conical shoulder at its upper end and a downwardly and inwardly tapering elongated portion integral with said shoulder, guiding the path of movement of said strand material so that it is fed onto said mandrel at the juncture of said shoulder and said tapering portion, heating said mandrel and said strand as the latter is fed onto said mandrel so as to impart a curl into said material with the convolutions thereof being moved by said shoulder downwardly around and then off of said tapering portion by the continuous feeding of said material to said juncture, collecting the convolutions fed off of said tapering portion onto a stationary rod coaxial with said mandrel, allowing the convolutions to be pushed along said rod by oncoming convolutions until said convolutions are pushed over an end of said rod, and then permitting the convolutions to fall by gravity into a packaging receptacle.

3. Apparatus for curling normally straight thermoplastic strand material comprising a vertically disposed mandrel having a steep frusto-conical shoulder and an elongated tapering extension integrally connected to the small

end of said shoulder, means for rotating said mandrel, means for guilding strand material to the juncture of said shoulder and said extension from a point above said juncture so that said strand material moves theretoward at a downward angle with respect to a horizontal plane through said juncture, and means for heating said strand material as it is wound on to said juncture to impart a curl therein as it is wound around said juncture by the rotation of said mandrel.

4. Apparatus for curling normally straight strand of thermoplastic material comprising a vertically disposed mandrel having a steep frusto-conical shoulder and an elongated tapering extension integrally connected to the small end of said shoulder and having an axial bore extending through said shoulder and extension, means for rotatably supporting said mandrel for rotation about its vertical axis, a stationary rod projecting through said bore and terminating a substantial distance below said extension, means for guiding said strand material from a source of supply to the juncture of said shoulder and said extension so that the initial convolution of said material is wound around said juncture and thereafter caused by said shoulder to slip downwardly with respect thereto and displace in a downward direction convolutions previously wound around said juncture, means for heating said strand material as it is wound onto said mandrel so as to set continuous helical curls in said material, and means for rotating said mandrel.

5. The apparatus of claim 4 wherein said guiding means is disposed above said juncture so that said material moves toward said juncture at a downward angle with respect to a horizontal plane through said juncture.

6. The apparatus of claim 4 including in addition means for tensioning said strand material as it is wound on said mandrel.

7. The apparatus of claim 4 wherein the means rotatably supporting said mandrel comprises a hollow shaft having one end projecting partly into the upper end of said bore for removable connection with said mandrel, means for rotatably supporting the opposite end of said shaft, and means for operatively connecting said shaft and said driving means, said stationary rod extending coaxially through said hollow shaft.

8. A continuous method of packing normally straight strand material capable of having a curl set therein under the influence of heat which comprises continuously winding said strand material on a vertically disposed rotating mandrel having a steep frusto-conical shoulder and an elongated tapering extension integral with the small end of said shoulder, guiding said strand material onto said mandrel so that initially the strand material is wound around said mandrel at the juncture of said shoulder and said extension whereby said shoulder continuously causes each convolution to be displaced downwardly along and eventually off the end of said extension by succeeding convolutions wound on said juncture, continuously heating said strand material as it is wound on

said juncture to impart a curl therein, preventing back twisting of said curled material as the convolutions thereof feed off the end of said extension by engaging said convolutions on a stationary rod co-axial with said mandrel, allowing said convolutions to freely fall under the influence of gravity from said rod with the convolutions of said strand material lying disposed horizontally during their free fall, catching the freely falling convolutions in an elongated package suspended in the path of said falling convolutions, and allowing the convolutions to pile one upon the other in no pre-determined pattern in said package until the latter is filled.

9. The method of curling a continuous length of normally straight thermoplastic strand material comprising the steps of winding said strand material onto a mandrel having a steep frusto-conical shoulder and an elongated tapering portion integrally connected to the small end of said shoulder, rotating said mandrel, heating said mandrel to set a continuous helical curl in said material as it is wound on said mandrel, guiding said strand material so that it is initially fed onto the mandrel adjacent the juncture of said shoulder and said tapering portion so that said shoulder acts on the oncoming convolutions of strand material to cause them to move in the direction of said extension and displace therealong convolutions previously wound on said mandrel.

10. Apparatus for curling normally straight strand of thermoplastic material comprising a mandrel having a steep frusto-conical shoulder and an elongated extension integrally connected to the small end of said shoulder and having an axial bore extending through said shoulder and extension, means for rotatably supporting said mandrel for rotation about its longitudinal axis, a stationary rod projecting through said bore and terminating a substantial distance below said extension, means for guiding said strand material from a source of supply to the juncture of said shoulder and said extension so that the initial convolution of said material is wound around said juncture and thereafter caused by said shoulder to slip downwardly with respect thereto and displace in a downward direction convolutions previously wound around said juncture, means for heating said strand material as it is wound onto said mandrel so as to set continuous helical curls in said material, and means for rotating said mandrel.

References Cited in the file of this patent

UNITED STATES PATENTS

670,540	Flower	Mar. 26, 1901
1,689,093	Wolle	Oct. 23, 1928
2,629,564	Bell	Feb. 24, 1953
2,683,500	Goodloe	July 13, 1954
2,696,034	Swartz	Dec. 7, 1954
2,797,529	Mohr et al.	July 2, 1957
2,847,171	Keesee	Aug. 12, 1958
2,849,194	Henning	Aug. 26, 1958