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METHOD AND APPARATUS FOR MAKING YARN IN A CONTINUOUS HELICAL SPIRAL

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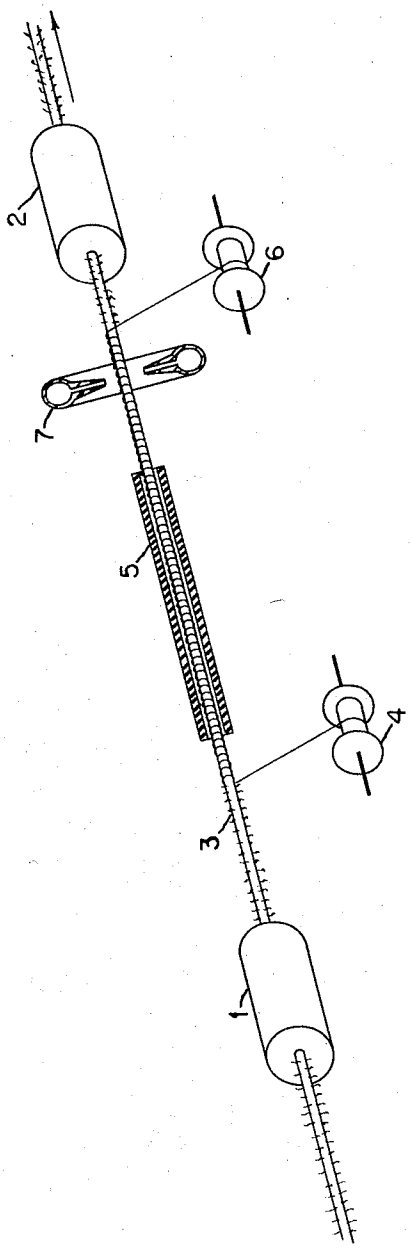

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METHOD AND APPARATUS FOR MAKING YARN IN A CONTINUOUS HELICAL SPIRAL

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This invention relates to the production of helical spiral yarn, and has for its object methods and means for producing such yarn.

Heretofore many methods have been employed for making spiral yarn, principally based on twisting and setting into a shape. The methods of prior art have had the disadvantages of being relatively complex and slow in operation.

The present invention has for its object a very simple continuous type of process and equipment for producing the yarn in question.

An object of the invention is the new method of making helical spiral yarn monofilaments or strands. Another object is the system of combination of means, or equipment for effecting this production.

Further objects will become apparent as the following detailed description of my invention proceeds.

In accordance with my invention, I wind the yarn to be helicized (whereby I mean formed into a helical spiral yarn) onto a revolving shaft, which at the same time is moving in a longitudinal direction. Thus the yarn is formed into a helical coil around this revolving shaft. The longitudinal motion of the shaft then brings the shaft with a coil of yarn wound thereon, through a heated zone which is maintained at a temperature sufficient to cancel the elastic memory of the yarn, but not high enough to soften the shaft or degrade its function as a rotating shaft. After having its memory canceled, the yarn by further travel of the shaft is moved out of the heated zone and there has an opportunity to cool, which cooling may be accelerated by separate cooling means. At this point the yarn is removed from the shaft and taken off on a separate receiving means. The novelty of this invention lies in the means of providing the rotating shaft of a twistable nature, and it functions because of the fact that, on cooling, the yarn acquires a new elastic memory in the helical form which it has at the moment of cooling through the deformation temperature. Thus, even if it is taken off in a straight line from the shaft, it will subsequently return to its coiled structure just the same as the coiled metal spring returns to the coiled shape after it has been pulled out straight. The points at which the yarn is wound onto and removed from the rotating shaft remain stationary with respect to a fixed reference. In this fashion the fiber is continuously, conveniently, dependably and rapidly transformed from a straight shape to a helical wound shape.

This process is explained in further detail in the following example, reference being made to FIGURE 1 which is a diagrammatic perspective presentation of one embodiment of the invention.

When shaft 3, which should be flexible and preferably also twistable like, for example, a yarn or a monofilament or a ribbon dependent on the shape of helix it is desirable to impart, is moved under some tension in the direction parallel to the axes and through two twisters (1 and 2), which function as a means of imparting the rotating motion to the shaft at the same time as it is being moved forward in the direction from 1 to 2 by other means not shown, the yarn to be helicized is fed onto this revolving shaft from a supply means 4 and is then wound helically around said shaft by a combination of the revolving motion of the shaft and the forward motion of the shaft.

This forward motion carries the helix thus formed to a heating zone 5 in which a temperature is maintained sufficient to release elastic memory of the fiber whereupon it comes to a cooling zone which may be augmented by separate cooling means 7. At this point the yarn is pulled off the revolving shaft down to a receiving means 6. Inasmuch as in cooling at 7 causes the elastic memory of the yarn to be implanted at the point where it is helically coiled, it will now always, due to its elastic memory, return to a coiled shape even if it is pulled out straight in the operation of pulling it off the shaft.

For example, in the present operation the shaft is 500 denier Dacron yarn, the yarn to be helicized is 20 denier nylon yarn, the temperature of the heating zone 5 is 225° C. and the shaft speed is 82,000 r.p.m. with a forward linear speed of 300 feet/min. While these parameters are used in this particular application, it will be within the knowledge of a skilled operator to adjust rotational speeds, temperatures and tensions so as to optimize the performance of the equipment for any particular yarn.

Where relatively high temperature yarns are employed, I prefer to use a loop of metal wire as the shaft. For polyethylene yarn, a polypropylene shaft is usable. A polyamide yarn, of which "Teflon" made by the Du Pont Company is an example, is suitable for many types of operation, where relatively high distortion temperatures are a controlling factor in the yarn to be helicized.

The invention is not restricted to any one particular plastic or combination of plastics. It is also possible to helicize fibers which comprise cross linking agents and thus will become cross linked when they pass through the heating zone, thereby contributing further to the setting action which takes place in cooling.

An advantage of the present invention is its potential high rate of production. Twisters to impart a revolving motion to the yarn can run at speeds as high as 100,000 r.p.m. and higher. The rotating fiber shaft having a speed of 300,000 r.p.m. and a diameter of 1/32 of an inch has a peripheral speed of 100 yards/min. Yarn wound onto such a shaft would therefore be supplied at the same rate of 100 yards/min. and somewhat in excess of this due to the linear velocity of the rotating shaft. For texturized yarns, this is a high production speed, and one which could be further increased.

This invention is applicable to all forms of thermoplastic yarns, strands or monofilaments such as filaments of acrylonitrile, nylons, polyurethane fibers, polystyrene fibers, polyethylene fibers, polypropylene fibers, polyvinyl chloride, polyvinylidine chloride and the corresponding fluoride fibers, "Silicone" fibers, "Teflon" fibers and so forth. The only limitation is that the fibers helicized must be capable of losing their elastic memory at a temperature which is still tolerated by the shaft material. Inasmuch as the shaft material can be metal, such as stainless steel or even tungsten, all thermoplastic fibers can be treated according to this process. It is seen that the invention is broad in scope and is not to be limited excepting by the claims in which it is my intention to cover all novelty inherent in the invention as broadly as possible in view of prior art.

Having thus disclosed my invention, I claim:

1. The method of making a continuous helical spiral yarn which comprises the steps of winding the yarn to be helicized around a revolving strand of twistable material, which moves in a direction of its longitudinal axis through a heating zone maintaining a temperature in the heating zone adequate to imparting a permanent set to said yarn, and removing it from said strand to a receiving means at a point located beyond the said heating zone.

2. The method of producing a continuous helical spiral yarn which comprises the steps of winding the yarn to be helicized around a flexible revolving shaft, by means of

the said revolving action of said shaft, while continuously moving the said shaft with the yarn wound thereon through heating zone, to cancel the elastic memory of said yarn, allowing it to cool so as to give it a memory of the helical form, and stripping it from the said revolving shaft.

3. Apparatus for producing helical spiral yarn, said means comprising a continuously revolving shaft which continuously moves in its longitudinal direction; means for imparting the said motions to the said shaft; means for supplying to the said shaft a yarn to be wound thereon by following the said revolving motion of the said shaft; means for annihilating the elastic memory of the said fiber; and means for stripping the said fiber from the said shaft.

4. Apparatus as claimed in claim 3, the said continuously revolving shaft being a closed loop.

5. Apparatus as claimed in claim 3, the said continuously revolving shaft being a flexible strand.

6. Apparatus as claimed in claim 3, the said continuously revolving shaft being monofilament of a polymer,

having a distortion temperature higher than the distortion temperature of the yarn being helicized.

7. Apparatus as claimed in claim 3, the said continuously revolving shaft being of metal.

References Cited

UNITED STATES PATENTS

2,878,514	3/1959	Nichols et al.	
2,881,504	4/1959	Billion.	
2,980,959	4/1961	Genovese.	
2,987,869	6/1961	Klein	57—34
3,050,819	8/1962	Allman et al.	57—34 XR
3,091,908	6/1963	Carruthers	57—157 XR
3,147,578	9/1964	Calizzano	57—34
3,178,795	4/1965	Warthen	57—34 XR

FOREIGN PATENTS

952,509	3/1964	Great Britain.

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