

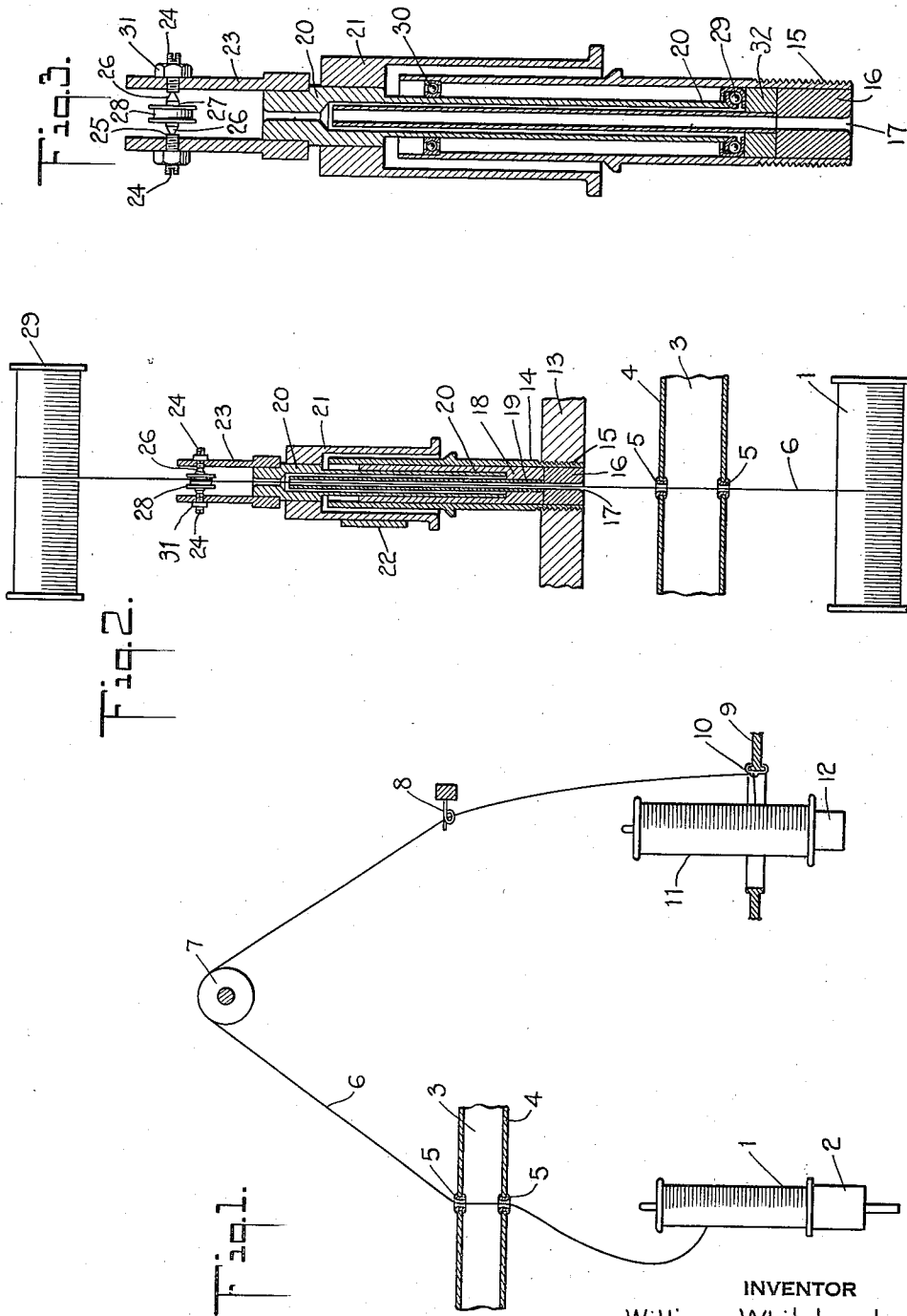
Aug. 10, 1937.

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2,089,239

APPARATUS FOR THE TREATMENT OF ARTIFICIAL TEXTILE MATERIALS

Filed Dec. 19, 1934



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## UNITED STATES PATENT OFFICE

2,089,239

APPARATUS FOR THE TREATMENT OF  
ARTIFICIAL TEXTILE MATERIALSWilliam Whitehead, Cumberland, Md., assignor  
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Application December 19, 1934, Serial No. 758,281

## 5 Claims. (Cl. 117-2)

This invention relates to the production of textile materials and in particular to the production of filaments, yarns and fabrics made of or containing filaments of organic derivatives of cellulose having modified characteristics and properties not found in normal filaments of organic derivatives of cellulose.

An object of this invention is the economic and expeditious production of artificial textile materials that have a hand that is woolly, springy and bulky. Another object of this invention is a device for imparting these modified properties and characteristics to normally straight, non-woolly filaments. Other objects of the invention will appear from the following detailed description.

In the drawing are shown devices, forming a part of this invention, for modifying the characteristics of artificial filaments that contain a more or less thermoplastic base material. In the various figures like reference numerals refer to the same or similar elements. In the drawing:

Fig. 1 is a diagrammatic view of a device for imparting a permanent distortion in artificial filaments.

Fig. 2 is a front view partially in section of a part of a device for imparting a permanent distortion in artificial filaments.

Fig. 3 is a front view partially in section of a part of a device showing a modification of the rotating element from that shown in Fig. 2.

Prior to my present invention, yarns produced from organic derivatives of cellulose and like thermoplastic materials when fabricated have not produced, without special preparation, a woolly, springy and bulky hand and appearance either in the yarn or when woven, knitted or otherwise fabricated by the normal fabricating processes of weaving, knitting and like processes. In the present invention of placing a suitable twist in yarn while in a plasticized condition and after the twist is set therein and then untwisting the yarn such that the filaments are distorted and under a strain, yarns may be produced which have the desirable properties above mentioned and further, the yarns impart the properties of being woolly, springy and bulky to the hand to fabrics produced therefrom, with other certain advantages which will appear later in this specification.

By employing this invention, fabrics may be produced by knitting, weaving or other means of fabrication that have a much more than normal springy handle, higher bulk, peculiarly soft touch and wool-like properties, apparently because the

distortions imparted to the filaments by the twisting and untwisting process render it impossible to bring the filaments in a flat and intimate contact which naturally follows fabrication of yarns which have not been processed according to the process of this invention. The fabricating processes as well as the finishing processes such as scouring, dyeing, ironing, etc. do not materially rob the treated distorted yarn of its wool-like and other properties.

Fabrics made according to this invention have, among other distinct properties, a very high heat insulating property which is highly desirable, particularly in light weight clothing. This property may be attributed to the fact that such fabrics comprise a great many air cells between the distorted filaments since the overall thickness of the fabric is greater for a given weight than normally prepared fabrics. Garments produced from such yarns may be modified in finishing processes to produce many different effects, for instance, the fabric may be "napped" to produce a hairy finish, or may be given a hard calendering to give a flat, more glossy finish. These fabrics, due to their insulating properties and variety of finishes, are exceptionally suited for use as underwear but they are also very suitable for outerwear.

In circular knitting of yarns, produced by this invention, numerous benefits may be observed. For example, such yarns knit with substantially no stitch distortion. Where the degree of distortion in the yarn is high, that is, the amount of twist which has been imparted and then taken out of the yarn is high, such as, for example 30 to 35 turns per inch or more, the circular knitting because of this torsional distortion of the yarn is improved. The fabric being taken away from the needles spirals, that is, instead of having the wales of the fabric running straight to the take-up roll or other device taking up the fabric as it is formed, the wales may spiral around giving an appearance to the fabric similar to Milanese fabric which is a warp knit fabric in which the warp moves constantly across the beds of needles.

Circular knit fabrics of plain stitch normally "ladder" very easily, but when produced according to this invention, either wholly or partially of filaments of organic derivatives of cellulose, are substantially ladder-proof, requiring great effort to cause any laddering at all. Thus, the torsional distortion of the yarn, coupled with the lofty and springy nature of the yarn results

in a gripping of the yarn in the sinker and needle loops in the fabric.

In accordance with my invention, I produce yarns, filaments and/or fibers and textile materials made from the same by producing in the filaments that contain a thermoplastic material a torsional distortion by inserting in such a yarn, preferably while plasticized by heat, a twist of any suitable number of turns per inch and then removing at least part of the twist from the yarn after it is unplasticized. Further, according to this invention, I produce a device for imparting torsional distortion to yarns containing thermoplastic materials.

This invention is applicable to the production of yarns, filaments, fibers, etc. formed of or containing thermoplastic materials, for example, those containing organic derivatives of cellulose such as the organic esters of cellulose, the cellulose ethers and/or mixed ester-ethers of cellulose. Examples of organic esters of cellulose are cellulose acetate, cellulose formate, cellulose propionate and cellulose butyrate, while examples of cellulose ethers are methyl cellulose, ethyl cellulose and benzyl cellulose. By this invention yarns or filaments containing such thermoplastic materials may be produced having a torsional distortion. Under the terms yarns or filaments are included, threads, assemblies or bundles of a number of substantially continuous filaments which may be in parallel relationship or which may be twisted together, artificial bristles, short lengths of staple fibers or yarns spun from such staple fibers.

The yarns or filaments may contain besides the thermoplastic base material effect materials and/or modifying agents under which terms are included any material that imparts to the yarns toughness, hardness, softness, pliability, color, opacity or transparency, hand and like properties. Examples of effect material and/or modifying agents are pigments, filling materials, dyes or lakes, fire retardants, plasticizers, sizes and lubricants. The yarns need not be formed wholly of thermoplastic materials but may contain also some fibers or filaments or threads of other materials such as cotton, artificial silk, wool, silk, linen, regenerated cellulose, etc.

The distortion may be placed in the yarn or filaments by imparting a suitable amount of twist to the yarns, setting the twist and then untwisting the yarns. A certain amount of distortion takes place in the first twisting operation and a large proportion of this remains after untwisting, producing a yarn in which the filaments in the yarn cannot be caused to touch and remain in contact along their lengths with each other except with extremely high tension. Such yarns are preferably plastic during the twisting operation and set between the twisting operation and the second twisting or untwisting operation. The yarns or that part of them that is thermoplastic may be made plastic or conditioned such that the twist may be set in same by any suitable means, such as by steaming, etc. The yarn may be set also during twisting by passing the yarn through heated vapors, solvent vapors, contacting the yarn with water, preferably hot, or contacting the yarn with swelling agents or restricted solvents. It is not essential that all the twist be taken out of the yarn as the nature, bulk, etc. of the yarn may be varied according to the twist originally placed in the yarn and the amount residual after the complete processing.

A particularly economical method of carrying out the invention is to insert the twist and take it out in one operation. This may be effected, for example, by the device shown in Fig. 1 of the drawing. In this device the yarn is twisted by the upward ballooning method, with or without a flyer, floating ring or other twist trapping device as the yarn is pulled from the source of supply, passed through steam or like plasticizing atmosphere, and thence the yarn is carried around a power driven feed roller. The yarn then passes to the take-up twisting spindle which operates on the ring and traveler principle. Obviously, the relative speeds of the devices may be governed such that the final yarn has twist of either hand or direction.

In the drawing is shown a device and its modifications also forming a part of this invention. With particular reference to Fig. 1 there is shown a two stage device for imparting torsional distortion to yarns or filaments. A suitable supply of yarn 1 such as a spool or bobbin of yarn of twisted filaments or of substantially untwisted filaments may be provided. The supply of yarn may be placed upon a power driven spindle 2. A steam chamber 3 may be provided above the spindle and may comprise a pipe 4 adapted to contain steam or other heated medium and having polished eyes 5 acting as guides for the yarn 6. A stationary or rotating guide 7 may be provided to direct the yarn to the take-up package. The yarn 6 may be spiralled once or more times around the guide 7 to prevent a change of degree of twist from running either forward or back from this point. A guide 8 for controlling the balloon of the yarn may be provided. A plate 9 having a ring and flyer attachment 10 may be provided for reverse twisting the yarn and directing its winding upon a take-up package 11 mounted upon a power driven spindle 12.

In operation the yarn is drawn from the package 1 and twisted to any desired degree of twist just prior to and concurrently with being plasticized by passage through the plasticizing chamber 3. From here the yarn is drawn over the guide member 7 and through the balloon guide 8 during which time the yarn has cooled and become unplasticized. The yarn is then untwisted and wound upon the take-up package. Any types of twisting devices may be employed in place of those shown for example cap twisting devices. Any ratio of speeds between the spindles 2 and 12 may be employed such that more or less twist may be taken out by the device at 12 than was placed in the yarn by the device at 2.

In Fig. 2 is shown a device that is particularly adapted to forming a torsional distortion in yarns as it untwists exactly the same amount as it twists. It comprises a supporting member 13 which may or may not be a part of the heated chamber 3. Inserted in or otherwise fastened to the base member 13 is a tube 14 shown held in place by screw threads 15. A guide member 16 containing a passageway 17 for the yarn may be provided in the lower end of the tube 14. Resting on or made integral with the guide member 16 is a bearing member 18 containing a guide 19 for the yarn. Riding in the bearing member 18 may be a rotating hollow cylinder 20 fastened to or formed integral to a larger hollow cylinder 21 that acts as a pulley for a belt 22 or other source of power to cause rotation. Mounted upon the top of member 20 may be an attachment 23 comprising a hollow member. Mounted in the attachment 23 may be two registering screws 24.

having a dented or cupped inner end 25 for receiving the bearing point 26 of a shaft 27. The shaft 27 may have mounted thereon a grooved roller 28 about which the yarn 6 is adapted to be spiralled one or more times. A power driven take-up package 29 may be provided to draw the yarn through the device and to package it.

In operation the yarn 6 from a suitable source of supply 1 is threaded through the heated chamber 3 and through the member 16, 19 and 20 and spiralled about the roller 28 then attached to the take-up package 29. By means of the belt 22 the parts 23, 20 and 21 are caused to rotate at any suitable speed, for instance, from 600 to 15,000 or more revolutions per minute, thus imparting twist to the yarn ascending to the roller 28 and untwisting the yarn as it ascends from roller 28 to the take-up package. By regulating the speed of rotation of the shaft 27 and the speed of the take-up, any desired amount of twist may be placed in the yarn and then taken out, leaving the torsional stress or distortion in the yarn. To obtain a particular wool-like effect it is preferable to employ as low feed and take-up tensions as possible. Preferably, just sufficient tension to stop the twist from running back onto the feed package and keep the yarn fairly straight so that the high twist imposed distorts the yarn. It is also preferable, at the same time, to keep the take-up tension as low as possible otherwise a part of the distortion imposed may be straightened out whilst the yarn is not entirely set.

Fig. 3 is a modified form of device from that shown in Fig. 2 and differs in that a plurality of ball-bearings 30, upon which the rotating parts 20, 21 and 23 turn are provided to reduce friction on the moving parts. The lower race may be supported on a bearing support 32 which replaces the bearing member 18 of the device shown in Fig. 2.

Lock nuts 31 may be provided for holding the screws 24 in proper adjustment. Other details may be supplied without departing from the spirit of the invention. Obviously, other elements may be used in place of the roller 28 as a turning point for the yarn in respect to the twist which is inserted either side of the rotating spindle. Another effective means is to use a small rod rotating in a plane at right angles to the path of the thread or yarn and positioned similarly to the roller 28. This rod may be drilled at right angles, preferably about the center, and the thread or yarn to be treated threaded through this. Alternatively, a series of rods slightly staggered in position may be employed or any other suitable means that will trap the opposite twists in the yarn on their respective sides of the twisting device or spindle. Any suitable number of these units may be driven by a single belt and formed into a bank having from 1 to 200 or more spindles on either side.

This invention may be conducted in conjunction with plying with normal yarns or yarns similarly treated to produce highly desirable effects for certain definite purposes.

If it is desired to produce a hairy product, this may be effected by a process in which the yarns are stretched to break a part of the filaments composing the same. Alternatively, the yarn may be caused to contact with rough abrading surfaces. Thus, the wheel or roller 28 or the drilled guide rod, if the same be used in place of the roller, may be offset to one side of center of the rotating elements, so that the yarn does not turn approximately on its axis but is caused to

rotate around a circle of desired size. In this circular path of the yarn may be controllably positioned a point or abrading surface so that the yarn in striking this has part of the filaments cut or broken producing a hairiness of the yarn in conjunction with the woolly, springy and bulky appearance and other properties.

The yarn so formed, alone or in conjunction with normal or other yarns of organic derivatives of cellulose or yarns of regenerated cellulose, wool, silk, etc., may be woven, circular knitted, warp knitted, knotted, netted or otherwise processed to fabrics and textile materials. Where it is desired to employ a high amount of wooliness which is obtained by a high amount of inserted and withdrawn twist in such a manner to leave a high torsional distortion in the yarn, and it is desired that the fabric should not spiral around on leaving the needles of a circular knitting machine, this wooliness may be obtained and the spiraling of the fabric is entirely prevented by using two or more plies in the yarn and plying the yarn so that torsional distortion of one ply balances the torsional distortion of the other ply. Alternatively, such yarns need not be plied; instead a multiple feeding knitting machine may be employed, feeding one course or number of adjacent courses of a yarn distorted to tend to spiral the fabric in one direction and then the next course or number of adjacent courses may be distorted to tend to spiral the fabric in the opposite direction. Where two or more adjacent courses tend to spiral the fabric in one direction and the next two or more adjacent courses tend to spiral the fabric in the opposite direction, a pattern effect results.

As illustrations and not as limitations the following examples are given:

#### Example I

An acetone soluble cellulose acetate yarn is threaded on the device shown in Fig. 2. A steam pressure about  $\frac{1}{2}$  lb. pressure is maintained in the jacket 3 which contains 10 to 20% moisture. The member 23 may be caused to rotate at 10,000 revolutions per minute and the take-up speed is maintained at a speed such that 35 turns per inch is inserted and taken out. The yarn so produced is circular knit into fabric giving 45 wales and 45 courses to the fabric. The fabric so obtained is springy and woolly and the wales spiral around the fabric at a uniform pitch. The fabric is highly resistant to laddering, has high insulating properties and is highly desirable for underwear in that underwear manufactured therefrom is soft and extremely comfortable and elastic to wear. This fabric may also be used for outerwear and other textile articles.

#### Example II

An acetone soluble cellulose acetate yarn is passed through the device shown in Fig. 2 inserting 44 turns left hand twist and taking them out. Another lot of the same yarn is passed through the device shown in Fig. 2 inserting 44 turns right hand twist and taking them out. These two yarns having opposite direction of torsional distortion are plied together with a twist of about 4 turns per inch. The yarns are woven as both warp and weft with a tabby weave. The fabric is scoured and dyed and is found to be of a springy and woolly hand.

The yarn having a torsional distortion may be

plied also with one or more yarns containing a true or false twist in place of another yarn containing torsional distortion.

### Example III

5 Scoured wool preferably of half blood grade is blended with cellulose acetate yarn of approximately 2 denier per filament in proportions of 30 parts by weight of wool to 70 parts by weight of cellulose acetate fibers by normal blending machines employed in the staple trades. A yarn of about 22 woolen cut is produced therefrom on a normal woolen card followed by mule or ring spinning to produce the yarn. This yarn is treated in the device shown in Fig. 2 such that 15 18 turns per inch are inserted and taken out of the yarn. The yarn so produced has a lofty and springy hand and fabrics derived therefrom have a woolly nature and elasticity.

20 It is to be understood that the foregoing detailed description and drawing are merely given by way of illustration and many alterations may be made therein without departing from the spirit of my invention.

25 Having described my invention what I desire to secure by Letters Patent is:

1. A device for applying a torsional distortion to thermoplastic yarns comprising means for plasticizing the yarn, means for imparting twist to an increment of said yarn and removing twist from another increment of said yarn including a rotating trap for said twist and a take-up device for pulling the yarn through the twist inserting means.

35 2. A device for applying a torsional distortion to thermoplastic yarns comprising means for plasticizing the yarn, means for imparting twist to an increment of said yarn and removing twist from another increment of said yarn including a trap adapted to rotate on a plane substantially normal to the yarn and to trap the twist of said

yarn and a take-up device for pulling the yarn through the twist inserting means.

3. A device for applying a torsional distortion to thermoplastic yarns comprising means for plasticizing the yarn, means for imparting twist to an increment of said yarn and removing twist from another increment of said yarn including a stationary cylindrical member and a second cylindrical member surrounding part of the first cylindrical member and adapted to rotate, said second cylindrical member carrying a trap adapted to trap the twist of said yarn, and a take-up device for pulling the yarn through the twist inserting means.

4. A device for applying a torsional distortion to thermoplastic yarns comprising means for plasticizing the yarn, means for imparting twist to an increment of said yarn and removing twist from another increment of said yarn and a take-up device for pulling the yarn through the twist inserting means, said twist inserting means including a stationary inner cylinder member and a rotatable outer cylinder member, said outer cylinder member carrying a roller journaled on an axis normal to the cylinder about which roller the thread is adapted to be spiralled.

5. A device for applying a torsional distortion to thermoplastic yarns comprising means for plasticizing the yarn, means for imparting twist to an increment of said yarn and removing twist from another increment of said yarn and, take-up device for pulling the yarn through the twist inserting means, said twist inserting means including a stationary inner cylinder member and a rotatable outer cylinder member, said outer cylinder member carrying a roller journaled on an axis normal to the cylinder about which roller the thread is adapted to be spiralled, and bearing members separating the inner cylinder from the outer cylinder.

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