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DRAWING AND CRIMPING OF SYNTHETIC FILAMENTS AND YARNS

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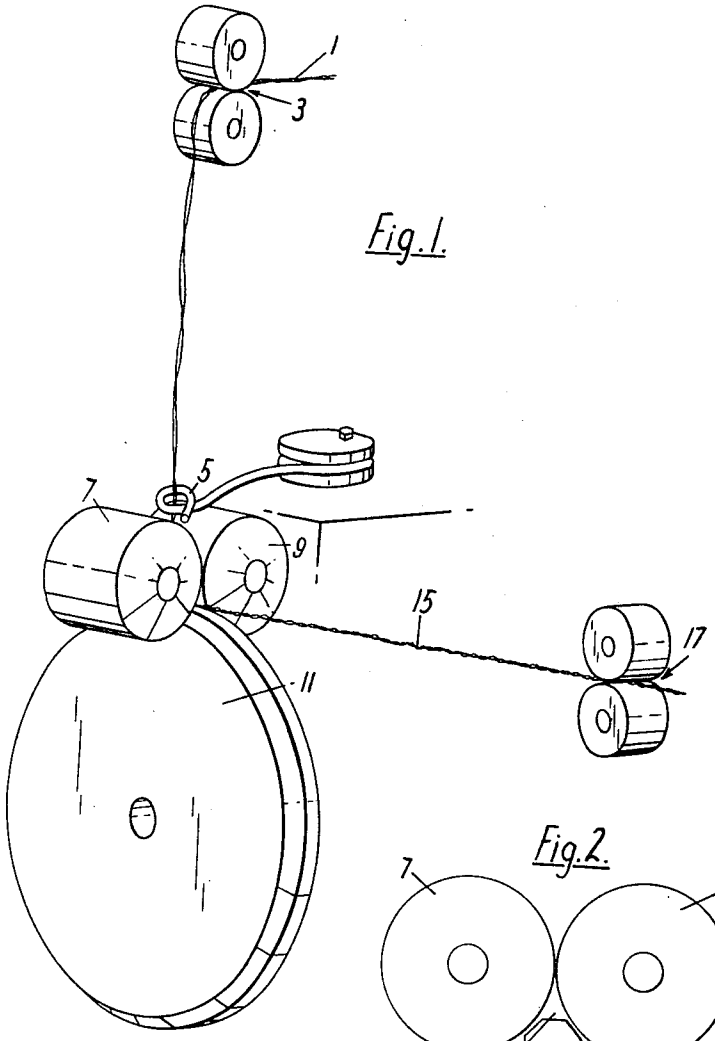

Fig. 1.

Fig. 2.

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DRAWING AND CRIMPING OF SYNTHETIC FILAMENTS AND YARNS

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This invention concerns improvements in or relating to the drawing and crimping of synthetic filaments and yarns.

Synthetic filaments are melt-spun or solution-spun through orifices in a spinneret, and then normally they are wound-up on cylinders to provide supply packages for subsequent processing steps, such as that of drawing.

Drawing, or stretching, of synthetic filaments is carried out in order to increase their tenacity by reason of molecular orientation. Normally, in the case of filaments of polyamide, polyester and polyacrylonitrile for instance, such drawing is carried out between two sets of rolls, the second set of which rotates at a peripheral speed several times (according to the desired draw ratio) that of the first set. Heat may or may not be applied to the filaments between the sets of rolls, to assist in drawing and in localising the point of draw.

Synthetic filaments or yarns are also nowadays often submitted to a bulking treatment, as by edge-crimping, stuffer-box crimping, twist-crimping or air-turbulence bulking. Generally speaking, it is necessary for the filaments or yarns to be heated concurrently with the bulking treatment in order that the deforming effect shall be sufficiently pronounced and in order that some degree of permanence shall be imparted to the deformed state of the filaments or yarns.

It has previously been proposed in British patent specification No. 852,579 to combine drawing with a bulking treatment in the form of false-twist crimping. In that process, no heat sufficient to cause setting is applied.

I have now discovered that a very convenient alternative method of combined drawing and bulking yarns of synthetic continuous filaments consists in forwarding such a yarn in undrawn state at a predetermined rate to the nip rolls of a stuffer-box crimper which nip rolls are rotated at a peripheral speed at least twice the linear speed at which the yarn is forwarded thereto so as to draw it, the conditions of the process being such that the heat engendered in the yarn by drawing and immediately subsequent crimping is sufficient to set the crimp imparted to the yarn without damaging it.

By "set" I mean that the crimp shall be of sufficient durability at least to withstand the mechanical effects of any subsequent processing of the yarns; and normally the set will be equivalent to a standard setting treatment in steam. By "yarn" I wish to incorporate all monofilamentary and multifilamentary structures of a textile nature.

In order that the conditions of the process shall lead to the engendering of only sufficient heat, it may be necessary to interpose a friction device, such as a snubbing-pin, to locate the point of draw between the forwarding means and the nip rolls, i.e. upstream of the latter, around or through which device the yarns are wrapped or laced to ensure that some of the heat of drawing is dissipated before they arrive at the nip rolls. Again, although no minimum values for them have to be prescribed for the process, variables such as the amount of moisture on and in the filaments or yarns and their rate of drawing, will have an effect on the amount of heat engendered. Naturally, the greatest effect is produced by the degree of drawing to which the yarns are subjected; the higher the

draw ratio achieved, the greater the amount of heat engendered. The nearer the point-of-draw is located to the nip of the nip rolls, the greater and more immediate is the heating effect within the crimper.

The preferred stuffer-box crimper for use in the process of the invention, because of the simple, controlled nature of its arrangements for discharging the crimped filaments or yarns, is one which, besides the nip rolls, consists solely of a driven discharge wheel whose axis is at right angles to the axes of the nip rolls and whose periphery is presented closely into the nip of the nip rolls and on the discharge side thereof. In such a stuffer-box, as described in British patent specification No. 873,368, the rate of discharge of the crimped yarn is controllable in correlation with the rate of feed so that the frequency of crimp in the yarn can be selected and be maintained uniform. As the nip rolls are, in effect, being employed as draw rolls, it is essential that their action on the filaments or yarns shall be uniform both as to their speed and as to the pressure they exert against one another. Such pressure, e.g. 30 pounds for 1040 denier multifilament nylon yarn, can be made adjustable in known manner. Although some slip between the rolls may occur, such will be acceptable if it occurs uniformly.

Drawing may take place according to the invention either whilst the filaments or yarns are being continuously forwarded from the spinning machine or as a separate operation from spinning.

One embodiment of the invention will now be described with reference to the accompanying drawings, in which

FIGURE 1 is a perspective view of apparatus according to the embodiment; and

FIGURE 2 is a diagrammatic sectional view of the stuffer-box crimper of FIGURE 1.

In the embodiment, undrawn multi-filament yarn 1 of e.g. polyhexamethylene adipamide is positively withdrawn by feed rolls 3 from a spinning cylinder package (not shown). The yarn is led through a pigtail guide 5 positioned a few inches above the nip of the nip rolls 7, 9 of a stuffer-box crimper of the above-mentioned preferred type. The nip rolls of the crimper are of stainless steel and are 1 inch in diameter. Nip rolls 7, 9 rotate at a peripheral speed several times that of feed rolls 3, depending upon the desired draw ratio. The discharge wheel 11, whose periphery fits into the underside of the nip to define a stuffing zone 13 (FIG. 2) is a brass disc of 4 inches diameter, and it is 1/16 inch in width. Both the nip rolls and the discharge wheel are driven by means not shown; and the rate of drive of the discharge wheel is considerably lower than that of the nip rolls, to account for the shortening of the yarn in adopting its crimped form at 15. Such crimped yarn is withdrawn by rolls 17.

In such an embodiment, 1040 denier/15 denier per filament yarns of polyhexamethylene adipamide, the filaments of which had a trilobal cross-section, have successfully been drawn to a draw ratio of 4 and crimped at 500 feet per minute, such being the peripheral rate of the nip rolls. Similarly, 420 denier/6 denier per filament yarns of polyhexamethylene adipamide, again with trilobal cross-section filaments, have been drawn to a draw ratio in excess of 4 and crimped at 250 feet per minute. In the former case, the yarns were suitable for use as the pile of tufted carpets; and in the latter case, the yarns were suitable for knitted underwear.

What I claim is:

1. A process for drawing and bulking yarns of synthetic continuous filaments, consisting of the steps of

(*a*) forwarding an undrawn yarn of synthetic continuous filaments at a predetermined linear rate to the nip rolls of a stuffer-box crimper;

(*b*) rotating said nip rolls at a predetermined peripheral rate at least twice as great as said linear rate;
(*c*) drawing said yarn by the nip of said rolls;
(*d*) immediately thereafter crimping said drawn yarn within said crimper;
(*e*) retaining said yarn in crimped form within said crimper whilst the crimps are set by the heat engendered by said drawing and crimping;
(*f*) and discharging the crimped, crimp-set yarn from said crimper at a linear rate less than said peripheral rate.

2. A process for drawing and bulking yarns of synthetic continuous filaments, consisting of the steps of
(*a*) forwarding an undrawn yarn of synthetic continuous filaments at a predetermined linear rate to the nip rolls of a stuffer-box crimper;
(*b*) rotating said nip rolls at a predetermined peripheral rate at least twice as great as said linear rate;
(*c*) locating the point of draw at a friction means positioned up-stream of the nip rolls;
(*d*) drawing said yarn by the nip of said rolls;
(*e*) immediately thereafter crimping said drawn yarn within said crimper;
(*f*) retaining said yarn in crimped form within said crimper whilst the crimps are set by the heat engendered by said drawing and crimping;
(*g*) and discharging the crimped, crimp-set yarn from said crimper at a linear rate less than said peripheral rate.

3. A process for drawing and bulking yarns of synthetic continuous filaments, consisting of the steps of
(*a*) forwarding an undrawn yarn of synthetic continuous filaments at a predetermined linear rate to the nip rolls of a stuffer-box crimper;
(*b*) rotating said nip rolls at a peripheral rate at least twice as great as said linear rate;
(*c*) drawing said yarn by the nip of said rolls;
(*d*) immediately thereafter crimping said drawn yarn within said crimper;
(*e*) retaining said yarn in crimped form within said crimper whilst the crimps are set by the heat engendered by said drawing and crimping;
(*f*) discharging the crimped, crimp-set yarn from said crimper at a linear rate less than said peripheral rate;
(*g*) and controlling said linear rate of discharge to maintain the frequency of crimp uniform.

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