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FALSE TWIST DEVICE FOR CURLING THERMOPLASTIC YARN

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Fig. 1.

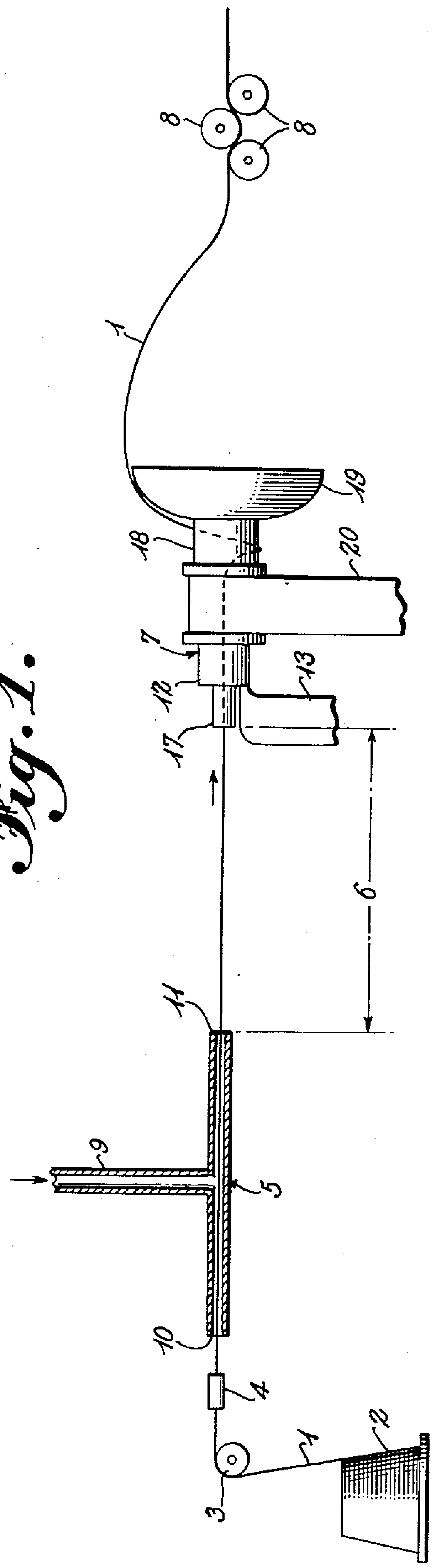
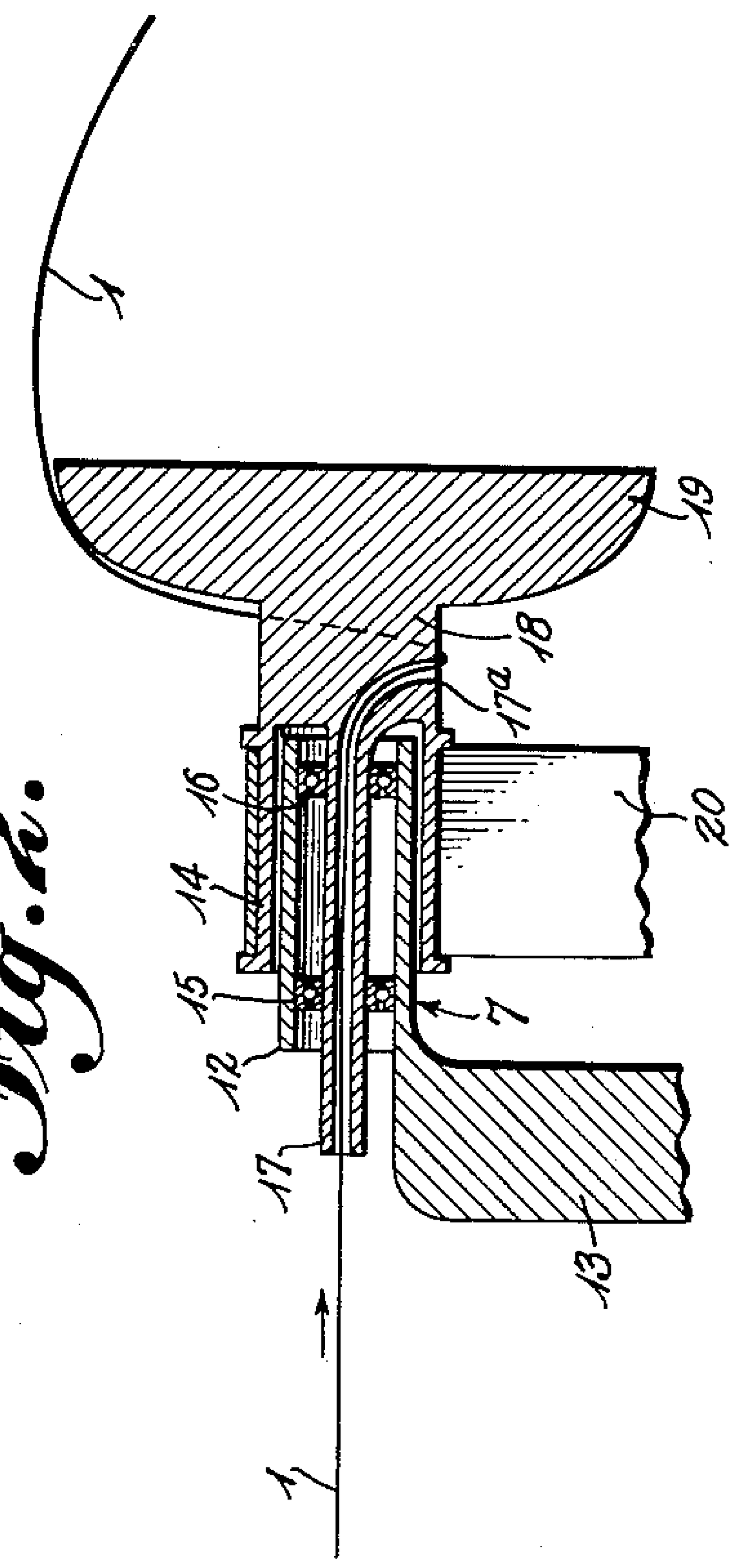


Fig. 2.



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FALSE TWIST DEVICE FOR CURLING THERMOPLASTIC YARN

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1 Claim. (Cl. 57—34)

This invention relates to a method and apparatus for the production of curled yarns or threads from thermoplastic materials and more particularly to a method and apparatus for the continuous production of curled untwisted multi-filament thermoplastic yarns.

In the production of curled yarns or threads from parallel filament yarns of the thermoplastic type it has been heretofore customary to soften the yarn with a swelling agent such as caustic alkali, a zinc chloride solution, xylene, phenol, chlorohydrin or the like, to twist the yarn while it is soft, to fix curl as with a steam treatment or with formaldehyde or by drying, and to untwist the fixed product. These operations have resulted in the production of satisfactory curled products but the cost is high due to the fact that the process is discontinuous and quite slow.

In an effort to mitigate the foregoing disadvantages, false twisters were introduced so that a separate untwisting step could be avoided. However, the simple twisting tube proved to be unreliable and special false twisters were designed. Even these specially designed false twisters offer a good deal of friction to the tender threads and they tend to impose too much stretch.

It is therefore an object of this invention to overcome the foregoing disadvantages and to provide a method and apparatus for the economical, continuous production of curled thermoplastic yarn of high quality.

According to the present invention it is proposed that smooth, straight, thermoplastic yarns be false twisted and drawn at a uniform speed successively through a heating zone and a cooling zone with maintenance of low but uniform tension during heating and cooling whereby no softening or fixing agents are required.

Other objects and advantages of this invention will be apparent upon consideration of the following detailed description of a preferred embodiment thereof in conjunction with the annexed drawings wherein;

Figure 1 is a schematic view of the entire apparatus employed in imparting curl to thermoplastic yarn according to the present invention; and

Figure 2 is a view in section to an enlarged scale of the false twisting device employed as a part of the assembly of Figure 1.

Referring now to the drawings in greater detail the numeral **1** indicates the thermoplastic yarn. It is withdrawn from a package **2** over a guide roller **3** and through a thread brake **4** or other friction-imparting device. The propulsion of the thread is accomplished entirely by a triple roller draw-off device **8** which is shown at the right extremity of Figure 1. After leaving the thread brake **4** the yarn **1** passes through a heating tube **5**, a cooling zone **6** and a false twisting device **7**.

Hot air is supplied to the heating tube **5** through a conduit **9** and this air, being centrally supplied, issues from the ends **10** and **11** of the tube **5**. The yarn **1** issuing from the end **11** of the tube **5** passes through a cooling zone **6** during which it is exposed to the cooling effect of atmospheric air. It then enters a tube or rotatable spindle **17** of the false twisting device **7** from which it issues laterally at point **17a** for ballooning out over a buffer disc or yarn storage wheel **18** on which a balloon forming discharge disc **19** is mounted.

From the foregoing it will be apparent that between the drag imparting device or thread brake **4** and the point **17a** of the false twisting device **7**, the yarn **1** is in a twisted condition, while between the point **17a** and the draw-off device **8** the yarn is untwisted. The draw-off device **8** lies on the extended axis of false twisting device **7**, and is remote therefrom, as shown in Figure 1.

The false twisting device **7** comprises a fixed supporting arm **13** having a sleeve **12** integral therewith. Bearings **15** and **16** support the spindle **17** for rotation within the sleeve **12**. The spindle **17**, storage wheel **18** and discharge disc or body **19** are integral and are provided with a sheave **14** which overlies the sleeve **12** and which receives a driving belt **20** by which the false twisting device is rotated.

An appreciation of the use of the present invention can be had upon consideration of the following examples:

Example I

A polyamide thread of 60 denier and consisting of 10 filaments was treated. This thread was produced by polymerization of caprolactam and spinning of the molten polyamide.

Hot air was fed into the tube **5** which had a length of 140 cm., so that in the tube the temperature was 160° C. The air zone **6** had a length of 100 cm. The speed of the false twisting device was 20,000 r.p.m. The triple roller device took off the thread at a speed of 5.6 m. per minute. The thread brake **4** was so adjusted that the tension of the thread **1** before the hollow spindle **17** of the twisting device amounted to 2.5 g.

Example II

A polyamide thread, made according to Example I, had a denier of 50 and consisted of 10 filaments. The heating tube had a length of 250 cm., while the temperature in the tube amounted to 170° C. In the air cooling zone which had a length of 90 cm. a blower was placed, which was provided with a slot from which atmospheric air was blown from below against the passing thread. The speed of the twisting device amounted to 50,000 r.p.m. and the triple roller device made the thread travel at a speed of 12.5 m. per minute, the thread tension before the twisting device being adjusted at 5 g.

In the same way threads from polyvinyl chloride and from polyethylene glycol terephthalate were curled with a favorable result, the temperature being 80° C. in the case of polyvinyl chloride, and 170° C. in the case of polyethylene glycol terephthalate.

While the examples refer to polycaprolactam, polyvinyl chloride and polyethylene glycol terephthalate, the invention is generally applicable to thermoplastic threads from synthetic polymerization and polycondensation products including also polyethlene, polyacrylonitrile, polyamide, polyesters or corresponding copolymers.

It is important to observe that in the present invention the heating and cooling of the yarns are both accomplished before the detwisting begins. In this regard it has been found that if detwisting commences before cooling is complete the stability or fixation of the curl is somewhat impaired. It is a remarkable advantage of the present invention that hot air applied through the conduit **9** at temperatures considerably exceeding 100° C. causes no appreciable damage to textile threads, even those produced from oxygen-sensitive polymers. In the case of polyamide threads, such as nylon, air temperatures of 140–170° C. are possible. For polyvinyl chloride threads, lower temperatures, for instance between 70 and 85° C., may be used and for threads from polyesters, such as polyethylene glycol terephthalate higher temperatures are recommended, for instance temperatures between 145 and 175° C.

In order to prevent the damage which results from feeding hot thread to the false twisting device, the path of the cooling zone **6** is quite long, it being necessary that the cooling take place before the twist is relieved. The length of the cooling zone **6** can be somewhat reduced if cool air is supplied, or if the air is circulated as by a fan or the like. It has been found, however, that a free air path without forced circulation is entirely satisfactory if it is long enough.

It has been discovered that it is desirable to heat the thread practically without tension and for that reason thread brake **4** is employed immediately ahead of the heating zone. As a thread brake, one preferably uses a disc brake or pressure shoe brake which increases the tension additively according to the formula

$$P=P_0+2\mu N (N=\text{normal pressure})$$

In the formula P represents the tension in the thread leaving the tensioning device. P_0 equals the tension of the thread before it has been tensioned in the thread brake. μ is the coefficient of friction and N, of course, is the load of the brake. It is also desirable that the supply device be one which does not impose too much tension on the thread and to draw overhead from a cone-type package as illustrated in Figure 1 is satisfactory. In order to avoid an agglutination of the filaments and to obtain a good open curling it has been found to be of importance to keep the thread portion being twisted and situated between the thread brake and the false twisting device at the slightest possible uniform tension. It is also desirable to propel the thread at a uniform speed by means of a conveyor mechanism situated beyond the said air treatment zones.

Tests have shown that particularly good results are achieved if one uses a tension on the thread in the said air treatment zones not exceeding about 6 g. per 100 denier.

It has further been found that the design and the operation of the false twisting device greatly influence the properties of the products obtained. It appears that those false twisting devices are most satisfactory which do not increase the tension towards the side of the cooling and heating zones and at the same time open up the curled thread towards the opposite side. Both effects may be obtained by using the false twisting devices in which the thread enters the twisting device without ballooning but is delivered in a ballooning manner towards the discharge end, i.e., towards the side of the conveyor device arranged after the twisting device.

In the path between false twisting device and conveyor device the cooled thread loses its twist and is then led further on by the conveyor mechanism whereupon the thread can be delivered to a collecting device.

The twisted thread which loses its twist after the false twisting device but before reaching the conveyor mechanism now keeps the twist fixed in the cooling zone in the form of curling. However, the detwisting of the thread causes bends and crinkles giving the thread a tendency to twirl which later on shows its effect.

These false twisting devices may be very well balanced, may have small dimensions, and, as an almost ideal rotating body, they require little power. With these devices it is possible to obtain, without appreciable difficulties, speeds of 20,000–60,000 r.p.m. while using a belt or rope drive so that one may obtain with the whole device rather high drawing off speeds and consequently high capacity. The thread conveyor device placed after

the twisting device is preferably a triple roller with a detachable upper roller in order to facilitate threading in.

Finally, the confined space for heating the thread may be made suitable for treating an entire sheet of threads lying in one plane and being twisted, the threads being conducted transversely through the said confined space and the hot air being supplied normally thereto in the longitudinal direction. In that case the inlet and outlet openings for the threads in the defining walls of confined space may be small.

The heating tubes for single threads as well as the heating tunnels for complete sheets of threads may be provided with detachable portions thus permitting easy threading in.

The heating path is not only dependent on the temperature of the air but also on the nature of the thread, the denier, and the speed of the thread.

The thread produced according to the present invention shows a stable twist curling under atmospheric influences. Due to the tendency to enclose air pockets it is possible to produce fabrics therefrom which have good insulating properties. The threads are extraordinarily elastic so that they can be stretched out to four times their length. This elasticity manifests itself also in knit and woven fabrics made from these threads. It is also possible to give these fabrics a thermal aftertreatment without unfavorably affecting them provided the temperature of this aftertreatment does not exceed the temperature used when fixing the twist.

What is claimed is:

In a thermoplastic yarn curling apparatus including a false twist device for imparting temporary twist to yarn passing therethrough and a heater for setting the false twist in the temporarily twisted yarn, the improvement residing in the false twist device which comprises a rotatable spindle, a cylindrical yarn storage wheel formed integral with said rotatable spindle, a discharge disk formed integral with said yarn storage wheel, means defining a longitudinal yarn passageway in said rotatable spindle, means defining a connecting passageway between the outer surface of said yarn storage wheel and said longitudinal passageway, means for imparting rotation to said spindle and to yarn passing therethrough, and means remote from said discharge disk and lying on the extended axis of said rotatable spindle for withdrawing thermoplastic yarn through said longitudinal passageway, through said connecting passageway, at least partially around said yarn storage wheel, over said discharge dish and laterally outwardly away from said rotatable spindle, said yarn ballooning between said yarn storage wheel and said withdrawing means and being twisted by said rotatable spindle in a first direction on the entrance side thereof while being twisted in a second direction equal to but opposite from said first direction on the discharge side thereof.

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