Sept. 1, 1964 J. W. I. HEIJNIS 3,146,512

CRIMPING APPARATUS

Filed May 24, 1961

FIG. 1

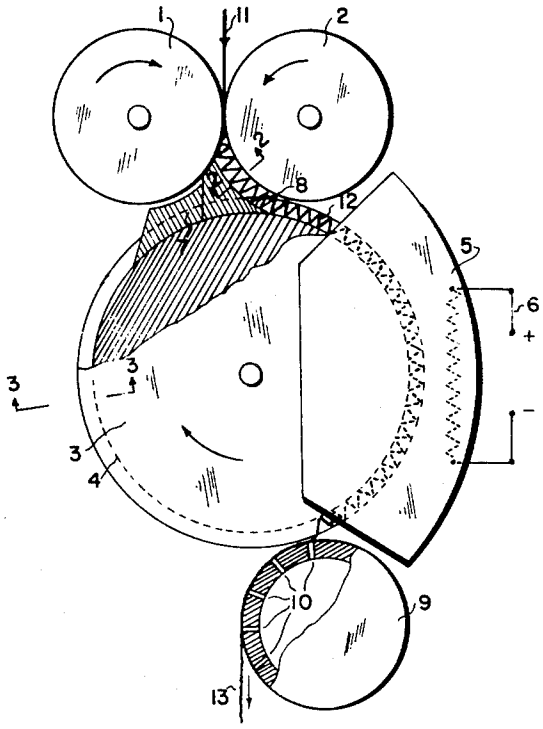

FIG. 2

FIG. 3

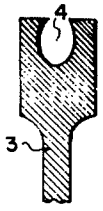

FIG. 6

FIG. 4

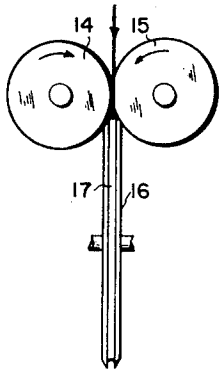

FIG. 5

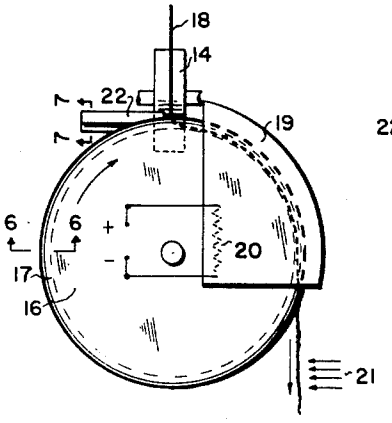

FIG. 7

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United States Patent Office 3,146,512 Patented Sept. 1, 1964

3,146,512

CRIMPING APPARATUS

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Filed May 24, 1961, Ser. No. 112,283
Claims priority, application Netherlands May 30, 1960
4 Claims. (Cl. 28—1)

This invention relates generally to the crimping of yarns or threads and more particularly to the transporting of yarns, threads, slivers, or the like into and through a stuffer box wherein they are stuffed to form a wad of yarn and in this condition subjected to a setting treatment before being withdrawn therefrom.

Such a method is generally known in the art and is used for producing novelty crimped yarn. The yarns, which may or may not be softened by chemical agents or by heating, are stuffed in a zig-zag form against a wad by rotating rolls. Both thermoplastic and non-thermoplastic yarns may be processed by this invention. The softening of non-thermoplastic yarns may be carried out by means of softening agents, whereas thermoplastic yarns can also be softened merely by heating. Setting of the softened yarn may be accomplished by cooling means.

The yarns may be set in zig-zag form in various ways, e.g. by expelling the softening agent with the aid of heat, by continuing the polymerization of the material of the yarns, or, in the case of thermoplastic yarns, by means of a purely thermal treatment, in which the form of the crimped yarn is stabilized by successively heating and cooling. After the yarn has been crimped in this manner, it is withdrawn from the stuffer box and wound into a package.

The form and the degree of crimping may be influenced, inter alia, by the ratio of the feed rate to the discharge rate of the yarn to and from the stuffer box, by the manner of setting, and by the extent to which the initial yarn has been softened. It has now been found that in order to obtain a well-crimped and uniform yarn great precision of the apparatus and a particularly accurate control of the process are required. These factors render the known apparatus costly and the method extremely difficult and expensive to operate.

An object of the present invention is to provide a yarn crimping system not having the aforesaid difficulties.

Another object of this invention is to provide a yarn crimping system requiring less precise construction and control.

Still another object of the present invention is to provide a yarn crimping method and apparatus which operates to produce high quality material with low initial investment and maintenance costs.

Yet another object of this invention is to provide a high speed yarn crimping method and apparatus which utilizes at least one wall of the crimping or stuffing chamber to facilitate yarn transport.

A further object of the present invention is to provide an economical system for separating and disentangling individual layers of crimped yarn from the main body or wad produced during crimping.

These and other objects will become apparent to those skilled in this art upon study of the following detailed explanation of preferred embodiments.

Controlling of the known methods of crimping is difficult because the speed of the yarn wad in the stuffer box is dependent upon and must be adjusted in connection with a great number of factors mentioned supra. These factors may all vary and thereby influence the speed of the yarn wad to different extents. Such variable conditions may be overcome, however, in the practice of this invention.

In accordance with the present invention, at least one of the known stuffer box walls is altered to accommodate and permit wall movement in the direction of, and at speeds corresponding with, travel of the wad formed by crimping yarn. Movement of the wall or walls, of course, affects speed of the yarn wad and, as a result of this, the yarn wad speed tends to adapt to or coincide with wall speed. A source of air pressure combined with separator surface facilitate removal of yarn layers from the wad.

If the entire surface area of the moving wall or walls and the frictional forces between these walls and the yarn wad are sufficiently great, then the speed of the yarn wad can be determined entirely by the speed of the moving walls. The effect of this is that movement of the yarn wad as well as yarn crimp becomes extremely uniform. Moreover, the fineness of the crimp may be varied simply by changing the speed of the yarn wad. The yarn wad speed can be adapted to the speed of the moving walls in a simple manner if, according to the invention, the stuffer box is open along one or more elongated sides, and if over this length the other side walls are moved in the direction of travel of the yarn wad.

According to this method, the yarn in the yarn wad remains firmly packed throughout the system. Consequently, a little more effort is required to disentangle or disengage yarn from this wad after the setting treatment without pulling along parts of the wad per se. It has been found that this difficulty can be solved in a simple way if the crimped yarn is wrapped around and withdrawn from the stuffer box across a separator body while a current of air is passed along the yarn. In this way, loops that may be present are removed from the yarn; moreover, the unwinding tension of the crimped yarn can be varied with the degree of wrap. The air current blows the yarn completely loose and also ensures a sufficient cooling. This makes it possible, particularly in the case of thermoplastic fibers, to achieve hardening and consequently final setting of the fibers during the crimping operation.

The apparatus of this invention comprises stuffing rollers with an accessory driving system, a stuffer box connected to the rollers and provided with a setting device and a discharge member. In the disclosed embodiments, the rollers are arranged with parallel axes and rotate in contact with each other. The continuously movable stuffer box wall or walls are also provided with a driving mechanism, although the drives per se have been omitted for the sake of clarity.

It is conceivable that the movable walls form part of one or more endless belts. This construction, however, has been found difficult to realize in practice. An excellent solution is obtained, on the other hand, if a transport wheel provided with a circumferential groove is used as at least one of the movable side walls of the stuffer box. It should be remarked that the open side of the groove may be covered up by a stationary deflector member. This member and the wheel groove should fit together accurately, so that yarn entanglement between the wheel and stationary member is prevented. Also conceivable, of course, is a cover in the form of a member moving along with the groove, e.g. a circular steel strip.

Surprisingly, however, it has now been found that the stuffer box can also be operated without this cover or deflector member and without pressing of the yarn wad out of the groove. This can be achieved through utilization of a circumferential groove in the wheel which enlarges inwardly from the circumference. It has been found that the yarn wad is wedged so tightly between the side walls of the groove that is not forced out during travel through the box.

In the first embodiment of this invention, the wheel axis is arranged parallel to the roller axes with the outer

circumference of the wheel touching the roller and rotating in an opposite direction during operation. A scraper blade fits within the circumferential groove and lies adjacent to the rollers up to a short distance from the point of contact between said rollers. The scraper is also provided with a groove which, together with the roller touching the wheel, forms a channel running from the point of contact between the rollers into the circumferential groove of the wheel. Yarn is first pressed into the groove of the scraper by the rollers and from there it is guided into the circumferential groove of the wheel by the roller overlying the scraper groove.

With another embodiment of the apparatus according to this invention, the wheel axis is arranged parallel to the plane through the roller axes, or perpendicular to these axes, with the periphery extending into the wedge-shaped space between the rollers. A stop fits entirely within the circumferential groove on one side of the wheel and lies adjacent to the surfaces of the rollers in the wedge-shaped space, thereby closing this side and preventing passage of yarn into that portion of the wheel groove. With this embodiment, the yarn is pressed by the rollers directly into the circumferential groove of the wheel which transports the yarn wad thus formed in a transverse direction.

In order to stabilize crimp imparted to the yarn, the yarn wad must be successively heated and cooled. The heating may be carried out by heating the wheel in its entirety, although it is preferred that an electric heating device enclosing a part of the peripheral rim of the wheel be provided.

As has been described in the preceding text, the yarn is preferably withdrawn from the stuffer box across a curved body while a current of air is passed along the yarn. With an apparatus according to this invention, this can be accomplished in a simple manner by providing a tube in the yarn path immediately following the heater. Yarn can be withdrawn from the circumferential groove of the wheel over the tube and the latter may be connected with pressure or suction openings to an air pump. The air pump is not shown, but may be of any known type.

The present invention will now be elucidated with reference to the accompanying drawings, wherein

FIGURE 1 is an elevation view, partly in section, of a stuffer box crimper embodying features described above;

FIGURE 2 represents, on an enlarged scale, a cross section of the scraper member taken along the line 2—2 of FIGURE 1;

FIGURE 3 represents, on an enlarged scale, a cross sectional view of the grooved transport wheel taken along the line 3—3 in FIGURE 1;

FIGURE 4 is an elevational view of a modified stuffer box crimper constructed in accordance with this invention;

FIGURE 5 is a side view of the modified device, with one roller omitted;

FIGURE 6 is an enlarged detail, in section, taken along the line 6—6 of FIGURE 5, and

FIGURE 7 is a sectional view, on an enlarged scale, of a detail taken along line 7—7 of FIGURE 5.

In FIGURE 1, two stuffing rolls or rollers are indicated by the reference numerals 1 and 2, which rolls are rotated in the direction of the arrow by suitable means, not shown. Placed under the rolls 1 and 2 is a yarn transport wheel 3 having an axis which runs parallel to the axes of the rolls 1 and 2, and which also rotates in the direction of the arrow, but at a circumferential speed lower than that of the rollers.

The circumferential rim or periphery of the wheel 3 lies closely adjacent to the circumference of roller 2 as shown, and is provided with a circumferential groove 4. The rollers 1 and 2, and the wheel 3, are rotated by any suitable driving mechanism (not shown), which mechanism should cause the rolls 1 and 2 to rotate in opposite directions and at equal speeds greater than that of the wheel 3. Located around part of the rim of the wheel 3,

on the roll 2 side thereof, is a heating device 5 which may be heated electrically by a circuit 6, represented diagrammatically. The heating device 5 may be so constructed that the yarn is heated either directly or indirectly.

The space between the rolls 1 and 2 and the wheel 3 is substantially filled by a scraper 7. The scraper base fits within the groove 4 of wheel 3 and rests against the roller 2 over a length about a quarter of the circular arc. Adjacent roller 2 the scraper 7 is provided with a groove 8 (see FIGURE 2) which connects with the circumferential groove 4 of the wheel 3. The groove 4 as shown is open on one side although it may, if desired, be partly covered as mentioned earlier.

Located on the other side of the heating device 5 is a separator tube 9 with radially directed openings 10. The tube 9 is connected to a compressed air line (not shown) such that air may be blown out through the openings 10. A multifilament yarn 11 on the basis of a polyamide, for example, is pre-heated in a known way not indicated in the figure. Thus slightly softened, the yarn 11 is transported downwardly by means of the rolls 1 and 2 into the groove 8 of the scraper 7. In this groove 8, a yarn wad 12 forms which extends into the groove 4 of the wheel 3 and is contained therein to a point beyond the heating device 5.

Since the wheel 3 moves at a lower speed than does the initial yarn 11, this yarn is folded and stuffed into a wad 12 after it leaves the rolls 1 and 2. The nature of the crimp formed by stuffing may be influenced by the speed of the wad, which speed in turn is determined by adjustment of the wheel 3. In the groove 4, the yarn wad 12 passes the aforesaid heating device 5. In passing said device, the yarn is heated to such a degree that tensions produced therein during stuffing are fully relaxed and the crimp effect is produced.

Before collecting the crimped yarn 13 onto a winding device (not shown), it is first withdrawn from the yarn wad 12 along the tube 9. Large loops and entanglements are thereby removed, but at the same time the yarn 13 is rapidly cooled. The openings 10 are provided very near the spot where the crimped yarn 13 is passed along the tube 9. This results in an intensive cooling of both yarn 13 and the tube wall. With a somewhat different embodiment of the apparatus, the tube 9 can be made to rotate around its axis. This affords an additional opportunity to vary the unwinding tension of the crimped yarn 13 as desired.

The groove 8 of scraper 7, shown more clearly in FIGURE 2, is formed by two parallel flat side walls which, in cross section, are interconnected by a circular bottom. The groove 4 (see FIGURE 3) is formed by two parts of conical surfaces which are also inter-connected, in cross section, by a circular bottom. Consequently, the form of this groove is such that it expands from the open side inwardly. The side walls contain a yarn wad in this groove against forceful displacement.

A variant embodiment including critical features of the apparatus described above is shown in FIGURES 4 and 5, which are diagrams of a front and a side view, respectively. As in the first embodiment, two rolls 14 and 15 and a wheel 16 are provided. By means of a driving device (not shown), the rolls 14 and 15 may be moved in the direction according to the arrows in FIGURE 4. Likewise, the wheel 16 may be driven in the direction according to the arrows shown in FIGURE 5 by means of a driving device (not shown) with an adjustable speed. For the sake of clarity of the drawing, the roll 15 has been omitted from FIGURE 5.

The wheel 16 is arranged with its axis parallel to the plane through the axes of rotation of the rolls 14 and 15 and perpendicular to those rolls in such a way that the rim thereof extends into the wedge-shaped space between rolls 14 and 15. In order that said rim may extend deeply into this wedge-shaped space, it is bevelled on both sides, as shown in FIGURE 4. Each side is so

bevelled that it can be adapted to the curvature of the surfaces of the rolls **14** and **15**. Moreover, the rim of the wheel **16** is provided with a groove **17**, which also expands from the open side inwardly in a manner corresponding to grove **4**, discussed earlier, as shown in FIGURE 6.

Rolls **14** and **15** pass or feed yarn **18** directly into the groove **17**, in which it forms a wad. This wad of yarn is transported slowly in a transverse direction by the wheel **16**, during which it is heated by a heating device **19** having an electric current circuit **20**. Heating is carried out in a way analogous to that used in the crimping system according to FIGURE 1. The same applies to the cooling of the crimped yarn, as diagrammatically indicated at **21**. In order to prevent pressing of the yarn wad about wheel **16** in a path opposite to the direction of rotation, a stop **22** has been placed between the rolls **14** and **15** and the wheel. Said stop is shaped so as to provide the best possible means of preventing yarn from feeding in the wrong direction, especially during thread-up. FIGURE 7 shows a side view of this stop on an enlarged scale.

The crimped yarn may be wound in any conventional manner. By preference, this is done while keeping the yarn at a low tension, for instance, by means of a cross winder, having a winding speed controlled in a known way by tension of the yarn to be wound. Other take-ups, of course, may be used. Moreover, the present invention is useful for crimp-setting any of the known thermoplastic yarns, nylon or others.

Inasmuch as various modifications will become apparent to those skilled in this art, it is intended that the scope of this invention be limited only to the extent set forth in the following claims.

What is claimed is:

1. Apparatus for crimping thermoplastic yarn comprising a pair of mutually opposed, cooperating stuffing rollers for feeding yarn, an elongated stuffing box for receiving yarn from said stuffing rollers and for forming the same into a wad, means for heating said wad of yarn to set crimps formed therein, and at least one rotatable yarn transport wheel having a circumferential groove forming

at least one wall of said stuffing box for transporting said wad through said heating device, said circumferential groove in cross section enlarging toward the center of said transport wheel to prevent release of said wad during transport.

2. Apparatus for crimping yarn comprising a pair of cooperating stuffing rollers rotatable in opposite directions to feed yarn therebetween, a stuffing box for receiving yarn from said stuffing rollers and to form the same into a ward, means for heating said wad of yarn to relieve tension and to set crimp formed therein, at least one yarn transport wheel having a circumferential groove surrounding said wad and forming at least one wall of said stuffing box for transporting the wad through said heater, said circumferential groove in cross section enlarging toward the center of said transport wheel to prevent release of said wad during transport, a separator tube for receiving the wad of yarn from said stuffing box under which individual layers of crimped yarn may be passed upon removal from said wad, and means providing a supply of air under pressure through said separator tube onto said crimped yarn to prevent entanglements, to remove loops, and to cool the yarn.

3. Apparatus for crimping yarn as set forth in claim 2 and further including a scraper blade engaging within a portion of said circumferential groove and extending to said stuffing rollers to divert yarn into said stuffing box.

4. Apparatus for crimping yarn as set forth in claim 3 wherein said scraper blade includes means defining a yarn receiving groove in alignment with the circumferential groove on said yarn transport wheel.

References Cited in the file of this patent

UNITED STATES PATENTS

2,812,569	Lawson et al.	Nov. 12, 1957
2,974,392	Timbie	Mar. 14, 1961
3,023,481	Scragg	Mar. 6, 1962

FOREIGN PATENTS

219,688	Australia	Jan. 14, 1959
535,340	Italy	Nov. 10, 1955