

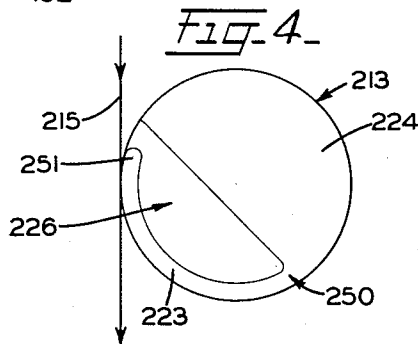
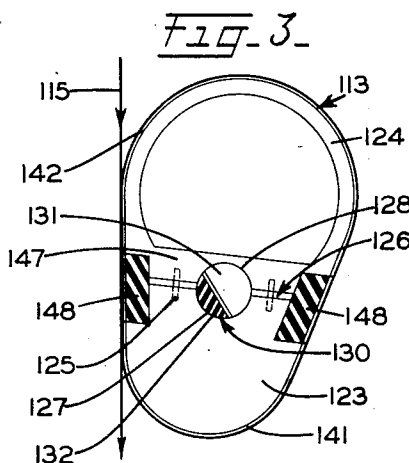
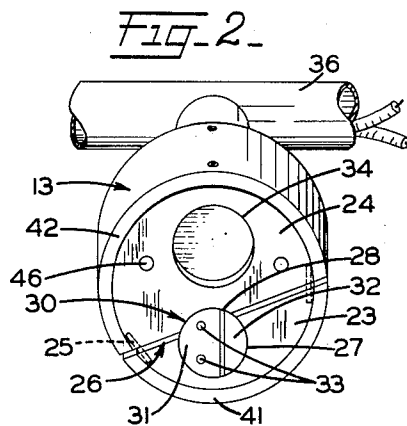
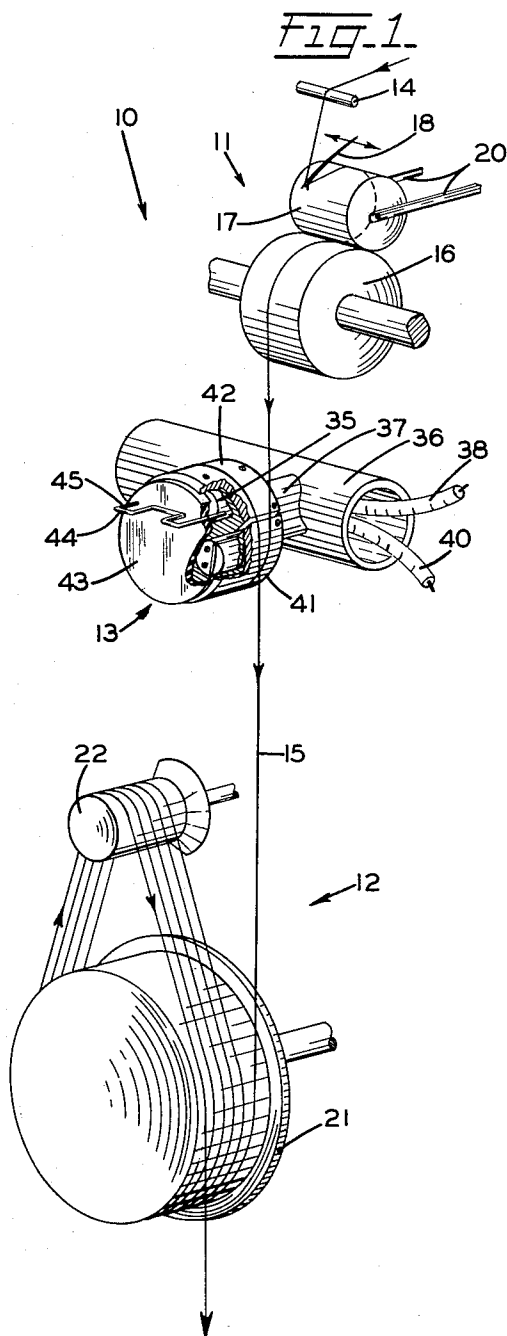
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J. A. K. BOERMA ET AL

2,993,260

DIFFERENTIALLY HEATED DRAW PIN

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2,993,260

DIFFERENTIALLY HEATED DRAW PIN

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This invention relates generally to the drawing of thread from synthetic linear polycondensation products and more particularly to an apparatus for the two-stage drawing of thread formed from high polymeric polymethylene terephthalates.

In the drawing of thread formed from synthetic linear polycondensation products it has been suggested to feed the same at a substantially constant rate of speed from a supply source to and around a heated drawing pin and then to a thread discharge mechanism. The discharge mechanism, or drawing roller, is driven at a greater peripheral speed than the feed or supply roller, which produces the desired drawing effect or thread elongation. After drawing, the thread may be collected in package form with or without twist, depending on the particular product desired.

In order to obtain optimum drawing results, it has also been suggested to provide means for additionally heating the thread during passage through the drawing zone. Such an operation, which heretofore has been accomplished by guiding the thread from the heated drawing pin over either a flat or curved heated plate as shown, for example, in U.S. Patent No. 2,533,013, dated December 5, 1950, produces a drawn thread having a higher strength, lower elongation and a lower shrinkage than drawn thread produced under similar conditions but without additional heating.

Although the two-stage heating described in the aforesaid patent results in a thread having improved qualities, the manner by which this improved result is obtained has certain disadvantages leaving much to be desired. The mounting of an auxiliary heating means or plate between the drawing pin and the drawing roller necessarily increases the overall height of the drawing machine. It can be seen, therefore, that conventional drawing machines having provision for only one-stage heating cannot be modified in the manner suggested to perform the two-stage heating function by simple reconstruction but, on the contrary, must be substantially rebuilt in order to provide the additional space requirements.

Moreover, mounting of the heated drawing pin and auxiliary heating plate separate one from the other is undesirable from the standpoint of heat economy, since two heaters must be provided in order to obtain the desired effect. Additionally, the heat transfer between a running thread and a flat or curved plate is relatively low, particularly if there is vibration in the thread.

An object of this invention, therefore, is to provide an apparatus for drawing thread not having the disadvantages of known systems.

A further object of the present invention is to provide an apparatus for the hot-drawing of thread which may be adapted to existing drawing machines without substantial change of the latter.

Another object of this invention is to provide a process and apparatus for drawing thread according to the two-stage heating process which requires no additional source of heat.

Still another object of the present invention is to provide a single drawing pin for accomplishing two-stage heating of thread during passage through a drawing zone.

Another object of this invention is to provide means

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for rapidly adjusting the temperature differential between two sections of a single drawing pin.

An additional object of this invention is to provide an apparatus for drawing thread according to the two-stage heating process which permits high heat transfer between the thread and the heating means.

A specific object of the present invention is to provide an apparatus for producing drawn thread having high strength, low elongation and low shrinkage, from synthetic linear polycondensation products.

Other objects and advantages will become apparent to those skilled in this art upon study of the following detailed disclosure.

The foregoing objects may be accomplished in accordance with the present invention by supplying thread at a substantially constant rate of speed to a single drawing pin divided into two circumferential sections which are separated by a longitudinal slot, the first of said sections being maintained at a temperature of between 80 and 120° C. and the second of said sections being maintained at a temperature of between 120 and 200° C., by passing the thread around the complementary curved surfaces of the drawing pin initially into contact with the first section and immediately thereafter into contact with the second section, and by withdrawing the thread from the latter section at a speed in excess of that at which it is supplied to the first section.

The heating mechanism according to this invention, for example, may comprise two separate heating elements of different capacity, one for each section of the single drawing pin. These elements may consist of electric resistances or, if desired, flow channels through which a heating liquid or vapor may be passed. It is also possible to mount radiating elements of different capacity opposite the respective section of the drawing pin.

It is preferred, however, to utilize a single source or element for heating both of the aforesaid sections. The thread discharging or second section of the drawing pin may be heated directly and the thread receiving or first section may be indirectly heated from the second section, this resulting in satisfactory operation since the former section should be maintained at a lower temperature than the latter. This may be accomplished by connecting the heating element or source directly to the second section of the pin and by providing insulation between the first and second sections. The insulation will prevent the passage of some heat from the second section to the first section with the result, of course, that the temperature in the first section will remain lower than the temperature of the heating element.

When utilizing a unitary drawing pin formed from heat conducting material and having a diameter of, for example, 6 cm., a substantial temperature differential is obtained between the thread receiving section and the thread discharging section if the heating element is mounted directly adjacent the surface of the discharging section, inside or outside of the drawing pin, since, as a consequence of the mounting, the heating element is remote from the thread receiving section.

In order to obtain an even greater temperature differential, it is preferred that the drawing pin be divided into two circumferential sections which are separated by a longitudinal slot and that a layer of air or other material having a heat conductivity lower than that of the drawing pin be maintained within this slot. This partially insulates one section from the other. The desired degree of heat transfer may be obtained by providing a localized connection of heat conducting material bridging the space between the two sections.

The separation between and partial insulation of the two sections may be obtained in a simple manner, for example, by providing a slot longitudinally of the draw-

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ing pin and extending chordwise therethrough from one periphery substantially to the opposite side thereof. The heat transfer from one section to the other will occur along and through the remaining or uncut portion of the pin, which operates as a heat conducting zone. It is also possible, however, to separate the drawing pin completely, in a longitudinal direction, into two sections as explained above and then to interconnect these sections with rods of heat conducting material, the remainder of the space between sections being filled with insulating material.

It is also preferred that means be provided for readily adjusting the temperature differential between the two sections. This may be accomplished if the heat conducting rod described above, which interconnects the two sections, is rotatably mounted longitudinally of the drawing pin and formed from a lamination of heat insulating and heat conducting material. By rotating this rod, the proportion of conducting material and insulating material interconnecting the two sections may be varied as the angle of the boundary surface between the two materials changes with respect to a plane surface of the slot formed in the drawing pin. The interconnecting rod therefore operates as a valve to control the flow of heat from the second section to the first.

Three specific embodiments of the present invention will now be discussed in connection with the accompanying drawings, wherein

FIGURE 1 is a perspective view of a drawing machine modified according to one embodiment of this invention and showing the drawing pin partially in section;

FIGURE 2 is a perspective front view of the drawing pin shown in FIGURE 1 with the cover plate removed;

FIGURE 3 is a sectional view, in elevation, of a modified drawing pin; and

FIGURE 4 is an elevational view of the third embodiment of this invention.

The drawing machine indicated generally by reference numeral 10 in FIGURE 1 comprises thread supply means 11, thread discharge means 12 and drawing pin 13. Thread supply means 11 comprises a thread brake 14 over which thread 15 is supplied from a supply spool (not shown), a feed roller 16 which is positively driven at a substantially constant rate of speed by means not shown, an idler or pressure roller 17 and a thread traverse mechanism 18. Thread 15 is passed from the thread brake through the guide of traverse mechanism 18, approximately 180° around pressure roller 17 and onto the feed roller. Pressure roller 17 is pivotally supported by arms 20 and urges the thread into contact with feed roller 16. The surface of pressure roller 17 may be formed from cork or other elastic material to insure against thread slippage. Traverse mechanism 18 is reciprocated in the direction of the arrows by means not shown in order to distribute wear on the pressure and feed rollers.

Thread discharge means 12 comprises drawing roller 21 which is positively driven, by means also not shown, and idler roller 22. Drawing roller 21 is rotated at a peripheral speed greater than that of feed roller 16 and thereby stretches the thread 15. The difference in speed between rollers 16 and 21 is of course determined for the particular thread to be treated and the amount of stretch to be imparted thereto. Thread 15 is wrapped a number of turns around rollers 21 and 22, as shown in the drawing, in order to prevent slippage. The axis of idler roller 22 is skewed with respect to the axis of drawing roller 21, which maintains adjacent convolutions of thread spaced or separated one from the other. From the discharge means, the thread may be fed to a ring twisting machine, twisted and collected in the desired package form, or to a winder type take-up if twist is not desired. The thread supply and discharge means described hereinabove may be conventional and, except to the extent that they contribute to the overall combination shown, form no part of the present invention.

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Disposed within the drawing zone, and in the path of thread traveling between feed roller 16 and drawing roller 21, is the novel drawing pin 13 described briefly hereinabove. This drawing pin is non-rotatably mounted at the same position on a conventional drawing machine as the customary draw rod shown, for example, in aforesaid U.S. Patent No. 2,533,013, and thread 15 is wrapped one turn therearound.

Drawing pin 13 comprises a first or thread receiving section 23 and a second or thread discharging section 24 (see FIGURE 2), each of which is formed from any suitable material having a high coefficient of heat conductivity. As can be seen in the drawings, each of these sections is substantially semi-cylindrical having a curved peripheral portion and a flat face, and the surface of thread receiving section 23 is circumferentially spaced from the surface of thread discharging section 24. The two sections are complementary and together substantially form a cylindrical structure when the flat face of one is positioned next to the flat face of the other. These faces are maintained in spaced relationship by means of dowels 25 and together define a longitudinal slot or insulation zone 26. Segment shaped recesses 27, 28 are formed in the flat faces of sections 23, 24, respectively. As shown, these recesses are opposed one from the other, with each beginning at the surface of the flat face and extending toward the curved periphery. The recesses 27, 28 together form a bearing surface within which interconnecting rod 30 may be rotatably positioned. The rod 30 is made up from any suitable material 31 having a high coefficient of heat conductivity and any suitable material 32 having a very low coefficient of heat conductivity, or insulating properties. The two portions 31, 32 of rod 30 also are complementary and together form a cylindrical structure comparable in size and shape to the opening formed by opposed recesses 27, 28.

Interconnecting rod 30 is provided with sockets 33 into which the lugs of a wrench may be inserted for purposes of rotational adjustment. In the position shown (see FIGURE 2, for example), portion 31 of the rod forms a conducting interconnection bridging the insulation zone 26 between sections 23 and 24 of the drawing pin. Conversely, if the rod is rotated until the longitudinal axis of zone 26 is parallel to or coincident with the boundary surface of the flat faces on sections 23, 24, the conducting connection between these two sections will be broken. It can be seen that rotation of the rod 30 with respect to the flat faces of sections 23 and 24 will vary the conduction zone, or the degree of conduction afforded by portion 31, and consequently, adjust the temperature differential between the two sections.

A longitudinal bore 34 is provided in the section 24 of drawing pin 13. Electric heating element 35 is mounted within the bore 34 (see FIGURE 1) and is connected to tube 36 by means of a hollow support 37. The tube 36 is fixed to the front side (not shown) of the drawing machine 10. It can be seen from this arrangement that heating element 35 supports the drawing pin 13 and that the heating element, in turn, is fixed to the drawing machine, which localizes the drawing pin with respect to the drawing machine. Heating element 35 is energized through conductors 38, 40, which are placed inside the tube 36, from any suitable source of current (also not shown).

The sections 23, 24 of drawing pin 13 are covered with mantles 41, 42, respectively, of chrome-plated steel. These mantles are separated one from the other as shown in order to prevent undesired heat conductivity. To preclude excess radiation of heat from heating element 35 and the two sections of drawing pin 13, an asbestos cover plate 43 is removably attached to the front side of the drawing pin. This plate may be secured in position by U-shaped bracket 44, the legs 45 of which fit into suitable openings 46 (see FIGURE 2) in the second section 24. Asbestos plate 43 has been omitted from FIGURE 2 in

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order that the interior of the drawing pin may be illustrated more clearly.

In the operation of the device described hereinabove, that portion of traveling thread 15 supplied by feed roller 16 first engages and moves along the outer curved surface of mantle 41 on thread receiving section 23, as indicated by arrows in FIGURE 1. With interconnecting rod 30 in the position shown by FIGURE 2, the heat transfer from section 24 to section 23 is not at a maximum value. Immediately after leaving the surface of mantle 41, the thread comes into contact with the outer curved surface of mantle 42 on thread discharge section 24. This section is maintained at a temperature substantially equal to the temperature of heating element 35, which is appreciably greater than the temperature of section 23 because of the intermediate heat conductivity position of interconnecting rod 30. The thread discharges from the surface of mantle 42 at a point on the periphery thereof near that point where the thread first engages the mantle 41. Mantles 41 and 42, which form a substantially cylindrical structure, define a convex path about which the thread is wrapped during drawing. This curved path restricts the position of that portion of the filament at which drawing occurs. The drawing point, in other words, tends to be restricted to and generally occurs along that portion of thread contacting the drawing pin while passing through the convex path defined by the outer curved surface of the mantles.

In a practical embodiment of the process of this invention, and employing the apparatus described immediately supra, an undrawn polyethylene terephthalate thread having 36 filaments and a titre of 28.1 tex (approximately 253 denier) was supplied by feed roller 16 at a velocity of 95 meters per minute from a supply spool, and thereafter fed to drawing pin 13. The drawing pin had an external diameter of 6 cm. with the thread receiving section 23 occupying 140° and the thread discharging section 24 occupying substantially the remaining 220° of the convex path. Drawing roller 21 was rotated at a peripheral speed of 375 meters per minute and the thread 15 was drawn by a multiplication factor of approximately 3.95. The mantle 42 of drawing pin 13 was heated at a temperature of 145° C. and the mantle 41 was maintained at a temperature of 95° C. by appropriate adjustment of interconnecting rod 30.

The drawn thread produced in the manner described above had a strength of 570 grams per 11.1 tex (or 570 grams per 100 denier) with an elongation of 14 percent. When using the conventional heated drawing pin and auxiliary heated plate between the drawing pin and the drawing roller, thread having a strength of about 580 grams per 100 denier with an elongation of approximately 13 percent is obtained. The small differences in these figures (less than 2 percent at a maximum) illustrate that there is substantially no loss in thread properties as a result of using the novel process and apparatus described herein.

In the embodiment according to FIGURE 3 of the drawings, which illustrates only the drawing pin in cross section, parts corresponding to the above described drawing pin have similar reference numerals with the prefix "1" added thereto. In this embodiment, the second or thread discharge section 124 of drawing pin 113 is hollow in order that a liquid or vaporous heating medium may be used rather than the electrical heating element described hereinabove. Discharge section 124 is provided with a lower wall 147 in which recess 128 may be formed for purposes previously described.

The first or thread receiving section 123 is formed in substantially the same manner as section 23 but is of a slightly different shape, having a greater surface area along the curved portion thereof. A recess 127 is formed in the flat face of section 123 and opposes recess 128. These two recesses together form a bearing surface for interconnecting rod 130 and dowels 125 secure the two

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sections together. The section 123, which has a smaller radius than the section 124 and which occupies an arc of approximately 180° as compared to the 140° arc of section 23, is provided with a chrome-plated steel mantle 141.

Thread discharge section 124 is provided with chrome-plate steel mantle 142. In either of these two modifications described, the mantles may be formed unitarily with the body proper of the respective sections, if desired. The portions 131 and 132 of interconnecting rod 130 are formed from material having good heat conductivity properties and insulating properties, respectively, as described in connection with the first embodiment. Asbestos strips 148 are provided along the periphery of the drawing pin in an overlapping relationship with respect to insulation zone 126 in order to prevent heat loss due to radiation. Thread 115 is wrapped one turn around pin 113 and thereby through the convex path defined by mantles 141, 142 in the manner shown.

In FIGURE 4, which shows a third embodiment of the drawing pin described above, parts corresponding to those of the first embodiment are identified by like reference numerals with the prefix "2" added thereto. Although the relative temperature between first section 223 and second section 224 of drawing pin 213 shown in this figure cannot be independently adjusted in the manner described in connection with the first two embodiments, this pin obviously is more economical to produce and has utility in connection with certain applications. For example, once the most desirable temperature differential has been determined for a given thread, as by experiment, a drawing pin may be designed to produce that particular differential. This may be accomplished as follows. The first and second sections may be formed in a unitary manner as shown, with an insulation zone 226 separating the two sections and allowing only limited contact therebetween, as at conduction zone 250.

The end 251 of section 223 opposite from the zone 250 is spaced from section 224 and therefore receives heat only by conduction through the said zone 250. The width of zone 250 of course determines the degree of heat conducted from section 224 to section 223. Thread discharge section 224 may be heated electrically or by a liquid of vaporous medium, it being understood that suitable cavities must be formed in this section to accommodate the heating element selected. As a result of the cantilever manner in which first section 223 is supported it will be apparent that a certain amount of heat loss due to radiation will occur as heat is conducted from the zone 250 to the unsupported end 251. In view of this, it will be obvious that the drawing pin 213 should be designed so that the average temperature of the section 223 will correspond satisfactorily to the temperature at which second section 224 is maintained. Since the temperature of section 223 is not the same throughout, the pin should be threaded up in such a manner that thread 215 initially contacts the unsupported (and therefore coldest) end 251, as shown in the drawing. In this embodiment, as in the others described, the thread is discharged from the drawing pin after a single winding through the convex path defined, in this particular instance by sections 223, 224.

It has been found that the disadvantage of known drawing processes, described earlier in this specification, are obviated upon utilization of a single drawing pin having the thread discharging portion thereof heated at a temperature greater than that of the thread receiving portion. Moreover, it has been found that thread produced in this manner has substantially the same properties as when produced under more unfavorable operating conditions.

It is preferred, when drawing thread formed from polyethylene terephthalate, that the discharge section of the drawing pin be heated at a temperature of from 120 to 200° C., and particularly between 135 and 150° C., and that the thread receiving section be maintained at a temperature between 80 and 120° C., especially between 90 and 100° C.

Although the drawing apparatuses described herein are primarily intended for use in drawing threads consisting of polymethylene terephthalates, they may also find application in the drawing of threads consisting of other linear polycondensation products, such as polyamines and polyurethanes. Moreover, other embodiments employing the principles disclosed herein will become apparent to those skilled in this art. Accordingly, 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 producing drawn thread formed from synthetic linear polycondensation products comprising a non-rotatably mounted drawing pin having circumferentially spaced thread receiving and thread discharging sections, means for supplying thread at a substantially constant rate of speed to said pin, means for withdrawing said thread from said pin at a higher rate of speed, and means for maintaining a higher temperature in said thread discharging section than in said thread receiving section.

2. Apparatus as set forth in claim 1 wherein the temperature in said thread discharging section is maintained between 120° and 200° C. and the temperature in said thread receiving section is maintained between 80° and 120° C.

3. Apparatus for producing drawn thread formed from synthetic linear polycondensation products comprising a non-rotatably mounted drawing pin having a first thread receiving section and a second thread discharge section circumferentially spaced from said first section, means for supplying thread at a substantially constant rate of speed to said first section, means for withdrawing said thread from said second section at a higher rate of speed, means for heating said second section directly, and means for heating said first section indirectly by conduction from said second section.

4. Apparatus as set forth in claim 3 wherein said second section is heated at a temperature between 120° and 200° C. and wherein said first section is heated at a temperature between 80° and 120° C.

5. Apparatus for producing drawn thread formed from synthetic linear polycondensation products comprising a non-rotatably mounted drawing pin having first and second curved sections formed from material having a high coefficient of heat conductivity, said sections being circumferentially spaced one from the other, means for supplying thread at a substantially constant rate of speed to the first section of said drawing pin, means for withdrawing said thread at a higher rate of speed from the second section of said drawing pin, means for directly heating said second section at a temperature between 135° and 155° C., and means for indirectly heating said first section at a temperature between 90° and 100° C. by conduction from said second section.

6. Apparatus for producing drawn thread formed from synthetic linear polycondensation products comprising a non-rotatably mounted drawing pin having a curved thread receiving section and a circumferentially displaced and curved thread discharge section, means for supplying

thread at a substantially constant rate of speed to said thread receiving section, means for withdrawing said thread from said discharge section at a higher rate of speed, means for maintaining said thread discharge section at a higher temperature than that of said thread receiving section, and means for adjusting the temperature differential between said sections.

7. Apparatus for producing drawn thread formed from synthetic linear polycondensation products comprising a non-rotatably mounted drawing pin having first and second sections formed from material having a high coefficient of heat conductivity, said first and second sections being circumferentially spaced one from the other and defining therebetween an insulation zone, means for supplying thread at a substantially constant rate of speed to the first of said sections, means for withdrawing said thread from said second section at a higher rate of speed, a rod bridging said insulation zone and interconnecting said first and second sections whereby heat may be conducted from one section to the other, and means for heating one of said sections.

8. Apparatus as set forth in claim 7 wherein said rod comprises a portion formed from material having a high coefficient of heat conductivity and a portion formed from material having a low coefficient of heat conductivity whereby the degree of conduction afforded by said rod may be adjusted, and wherein means are provided for rotatably supporting said rod by said first and second sections.

9. In an apparatus for producing drawn thread having high strength, low elongation and low shrinkage including feed rollers for supplying thread formed from synthetic linear polycondensation products at a substantially constant rate of speed and drawing rollers driven at a peripheral speed in excess of the speed of said feed rollers, the improvement comprising a drawing pin having a first section for receiving thread supplied by said feed rollers and a second section for discharging said thread to said drawing rollers, each of said sections having a curved thread-contacting portion and a flat face portion, said face portions cooperating to define therebetween a longitudinal slot for insulating said first and second sections, means defining opposed recesses in the face portions of said sections, an interconnecting rod having a conducting portion and an insulating portion rotatably supported within said opposed recesses whereby the degree of conduction between said sections may be adjusted, and means for heating one of said sections.

10. Apparatus as set forth in claim 9 wherein said second section is heated directly at a temperature between 120° and 200° C. and said first section is heated indirectly by conduction through said interconnecting rod at a temperature between 80° and 120° C.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

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July 25, 1961

Jan Albert Kornelus Boerma et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, between lines 7 and 8, insert -- Claims priority, application Netherlands Feb. 28, 1957 --; column 1, line 51, for "auxiliarly" read -- auxiliary --.

Signed and sealed this 28th day of November 1961.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

DAVID L. LADD

Commissioner of Patents

USCOMM-DC

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