

Sept. 13, 1955

R. P. PIPEROUX ET AL
BAND SPINNING APPARATUS

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2 Sheets-Sheet 1

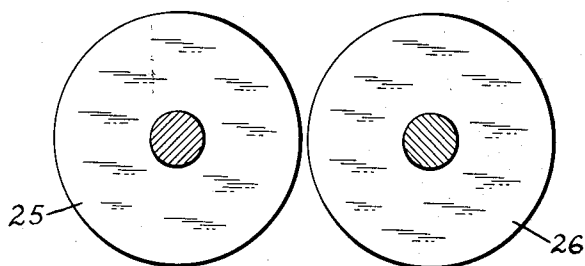


FIG. 1.

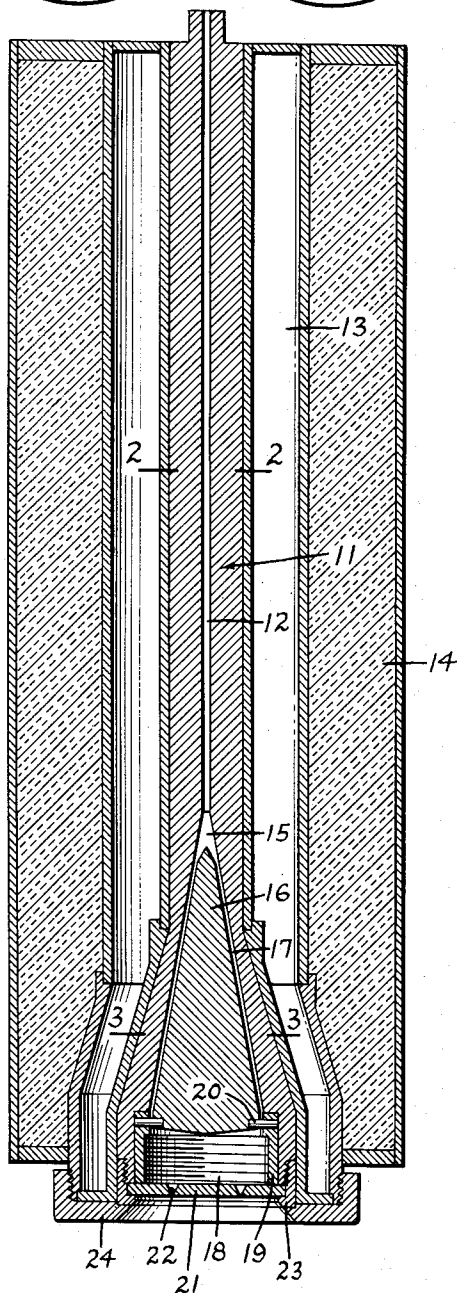


FIG. 2.

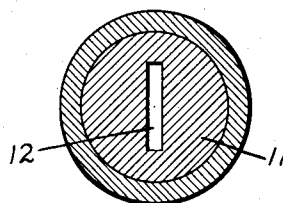
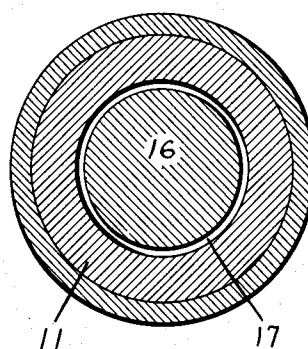


FIG. 3.



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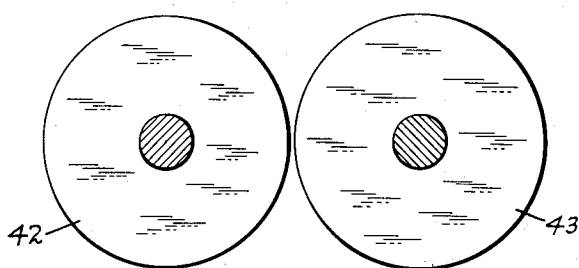


FIG. 4.

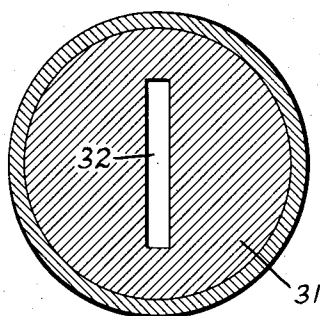
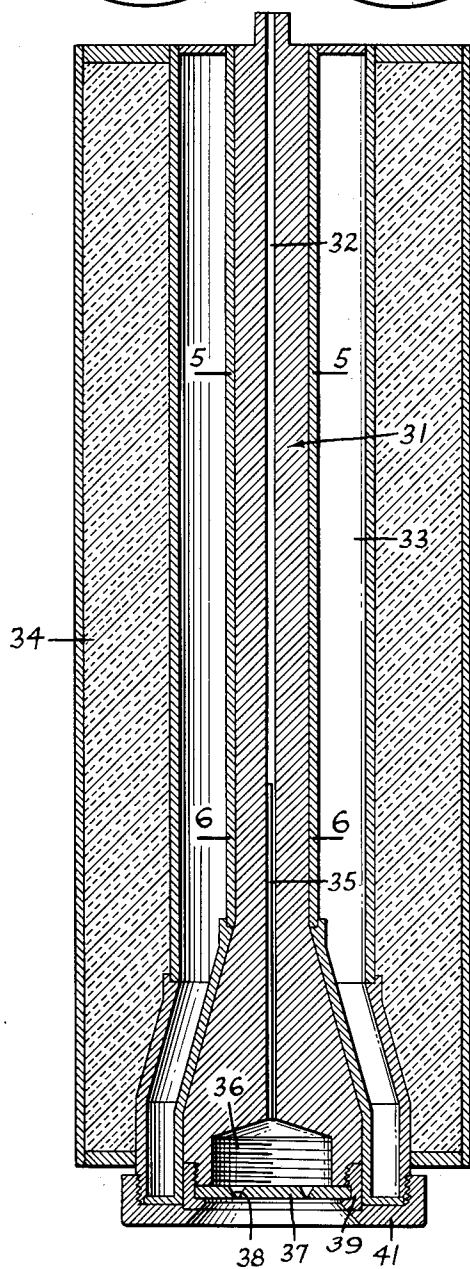


FIG. 5.

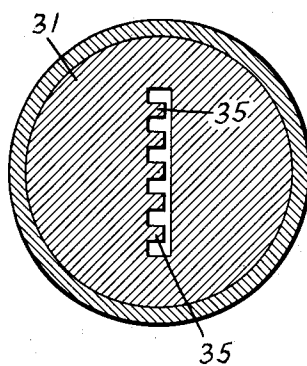


FIG. 6.

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BAND SPINNING APPARATUS

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1 Claim. (Cl. 18—8)

This invention relates to the preparation of filamentary materials and relates more particularly to an improved apparatus for the preparation of filamentary materials by the band spinning process.

In the preparation of filamentary materials such as yarns, filaments, bristle, straw, ribbon and the like by the band spinning process, a band of filament-forming material is entered at a constant rate by suitable feed means into a heated melting tube having a passageway extending therethrough and leading to a spinning jet containing at least one spinning orifice, the entrance portion of the passageway being of such size and shape as approximately to fit the band. The filament-forming material melts and is brought to the proper temperature for spinning as it traverses the passageway of the melting tube to the spinning jet, and the molten filament-forming material is forced through the spinning orifice by the pressure developed by the incoming band, which acts as a continually renewed piston. Among the filament-forming materials that may be spun in this manner are, for example, the polycarboxyamides, polysulfonamides, polysulfones, polyurethanes and polytriazoles.

As the band of filament-forming material enters the passageway leading to the spinning jet, melting will begin at the surface of said band and will progress gradually toward the center thereof. Since the heat conductivity of the molten filament-forming material is quite low, a considerable period of time will be required to effect the complete melting of the band and to bring the melted filament-forming material uniformly to the proper temperature for spinning. If the filament-forming material reaching the spinning jet contains any unmelted material, or if the temperature thereof is non-uniform, there will be produced undesirable variations in the denier of the filamentary material and the continuity of the spinning may be interrupted. In addition, when the band feed rate is high, the unmelted portion of the band will become extremely long and jamming of the band and interruption of the continuity of the spinning may occur if the unmelted portion of the band approaches or reaches the spinning jet.

It is an important object of this invention to provide a novel apparatus for the production of filamentary material by the band spinning process which will be free from the foregoing and other disadvantages and which will be especially simple in construction and efficient in operation.

A further object of this invention is to provide an apparatus for the production of filamentary material by the band spinning process in which the filament-forming material will reach the spinning jet free from unmelted material and at a substantially uniform temperature.

Other objects of this invention, together with certain details of construction and combinations of parts, will be apparent from the following detailed description and claim.

According to the present invention, the aforementioned difficulties previously encountered in the production of filamentary materials by the band spinning process are

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substantially eliminated by providing means operatively connected to the melting tube for increasing the heat transfer surface per unit length of the melting tube in contact with the filament-forming material along a length of the passageway adjacent to the discharge end of the melting tube to such an extent that it is greater than the heat transfer surface per unit length of the melting tube in contact with the filament-forming material along the remainder of the passageway. Advantageously, the heat transfer surface per unit length of the melting tube is increased along at least about 25% and preferably at least about 50% of the length of the passageway, and the heat transfer surface per unit length of the melting tube along this length is increased by an average factor of at least about 100% and preferably at least about 500% over the heat transfer surface along an equal length of the remainder of said passageway. The means employed for increasing the heat transfer surface per unit length of the melting tube may advantageously also act to reduce the thickness of at least a portion of the filament-forming material in contact with said heating surface further to insure that all of the filament-forming material is melted and is brought uniformly to the proper temperature for spinning.

In addition, means, which will be heated simultaneously with the melting tube, are positioned in the path of the band of filament-forming material so that if the length of the unmelted portion of said band becomes excessive, as pointed out above, the tip of the band will contact said means and be brought rapidly to the melting temperature. Preferably, this means is positioned at a point spaced from about 25 to 50% of the total length of the melting tube away from the discharge end of the melting tube. A single means may serve both to increase the heat transfer surface per unit length of the melting tube and to melt the unmelted tip of the band of filament-forming material if the length of the unmelted portion of said band becomes excessive.

The means for increasing the heat transfer surface per unit length of the melting tube may be integral with or separate from the melting tube. The passageway through the melting tube may have a uniform cross-sectional area throughout its length or it may be contoured to cooperate with the means operatively connected thereto to obtain the desired increase in the heat transfer surface.

Preferred embodiments of this invention are shown in the accompanying drawings wherein

Fig. 1 is a longitudinal cross-sectional view of one form of band spinning apparatus,

Figs. 2 and 3 are transverse cross-sectional views, on an enlarged scale, taken along the lines 2—2 and 3—3, respectively, in Fig. 1 of the drawings,

Fig. 4 is a longitudinal cross-sectional view of another form of band spinning apparatus, and

Figs. 5 and 6 are transverse cross-sectional views, on an enlarged scale, taken along the lines 5—5 and 6—6, respectively, in Fig. 4 of the drawings.

Referring now to Figs. 1 to 3 of the drawings wherein one embodiment of this invention is illustrated, the reference numeral 11 designates generally an elongated melting tube having a passageway 12 of rectangular cross-section extending longitudinally thereof. The melting tube 11 is enclosed within a jacket 13 through which a heating medium is passed to raise the temperature of the melting tube 11, and the whole assembly is lagged with a layer of insulation 14.

Toward the discharge end of the melting tube 11, the passageway 12 opens into a chamber 15 having a longitudinal conical cross-section. Positioned within the chamber 15 is a conical member 16 having a taper substantially equal to the taper of the wall of the chamber 15, which conical member 16 is spaced from the wall of said

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chamber and forms therewith a restricted annular passageway 17 of gradually increasing circumference. The annular passageway 17 opens into a cylindrical chamber 18 formed by a ring 19 to which the conical member 16 is fastened by means of pins 20 and in which there may be positioned means, such as a plurality of screens, or a bed of sand, to filter solid particles from the melted filament-forming material. A spinning jet 21 having spinning orifices 22 therein is releasably secured over the discharge end of the chamber 18 by means of a retaining ring 23 in threaded engagement with the melting tube 11. A retaining ring 24 in threaded engagement with the jacket 13 serves to bind the melting tube 11 and jacket 13 in operative relationship.

To feed a rectangular band of filament-forming material (not shown) having a cross-section approximately equal to the cross-section of the passageway 12 through said passageway at a constant rate, there is provided a pair of feed rollers 25 and 26, at least one of which is positively driven by any suitable means (not shown). As the band traverses the passageway 12, the filament-forming material will gradually melt. If the band does not melt completely before entering the chamber 15, the tip of the unmelted material will strike the conical member 16 and will be raised rapidly to the melting temperature. The melted filament-forming material, together with any unmelted particles of said material therein, will then flow through the restricted annular passageway 17, wherein, owing to the increased surface available for heat transfer and the reduced thickness of said material in said annular passageway, the melting of said filament-forming material will be completed and all of the melted material will be brought uniformly to the proper temperature for spinning. From the annular passageway 17, the melted filament-forming material will flow into and through the chamber 18 and then through the spinning orifices 22 to produce filamentary materials of uniform denier.

Referring now to Figs. 4 to 6 of the drawings, wherein another embodiment of this invention is illustrated, the reference numeral 31 designates generally an elongated melting tube having a passageway 32 of rectangular cross-section extending longitudinally thereof. The melting tube 31 is positioned within a jacket 33 through which a heating medium is passed to raise the temperature of the melting tube 31, and the whole assembly is lagged with a layer of insulation 34.

Toward the discharge end of the melting tube 31 one wall of the passageway 32 is provided with a number of longitudinal ridges 35 integral with the melting tube 31 and extending into said passageway almost into contact with the other wall of said passageway. The discharge end of the passageway 32 opens into a cylindrical chamber 36 in which there may be positioned means, such as a plurality of screens or a bed of sand, to filter solid particles from the molten filament-forming material. A spinning jet 37 having spinning orifices 38 therein is releasably secured over the discharge end of the chamber 36 by means of a retaining ring 39 in threaded engagement with

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the melting tube 31. A retaining ring 41 in threaded engagement with the jacket 33 serves to hold the melting tube 31 and the jacket 33 in operative relationship.

To feed a rectangular band of filament-forming material (not shown) having a cross-section approximately equal to the cross-section of the passageway 32 through said passageway at a constant rate, there is provided a pair of feed rolls 42 and 43, at least one of which is positively driven by any suitable means (not shown). As the band traverses the passageway 32, the filament-forming material will gradually melt. If the band does not melt completely before reaching the ridges 35, the tip of the unmelted material will strike said ridges and will be raised rapidly to the melting temperature. The melted filament-forming material, together with any unmelted particles of said material therein, will then flow between the ridges 35, wherein, owing to the increased surface available for heat transfer, the melting of said filament-forming material will be completed and all of the melted material will be brought uniformly to the proper temperature for spinning. From the passageway 32, the melted filament-forming material will flow into and through the chamber 36 and then through the spinning orifices 38 to produce filamentary materials of uniform denier.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made therein without departing from the spirit of our invention.

Having described our invention, what we desire to secure by Letters Patent is:

In an apparatus for the preparation of filamentary materials by the band spinning process, rolls for feeding a band of filament-forming material, a melting tube having a passageway extending therethrough adapted to receive said band from said rolls, a jacket for the passage of heating fluid, extending the length of said tube, for uniformly heating said tube to melt the filament-forming material, and a plurality of ridges extending longitudinally of the passageway in the lower portion thereof adjacent to the discharge end of the melting tube for increasing the heat transfer surface per unit length of the melting tube in contact with the filament-forming material by at least 100% as compared with the heat transfer surface per unit length in the remainder of said tube whereby all of the filament-forming material will be melted and will be brought uniformly to the proper temperature for spinning.

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