Dec. 30, 1969 A. K. SARIAN 3,487,144

APPARATUS AND METHOD FOR COOLING EXTRUDED MOLTEN FILAMENTS

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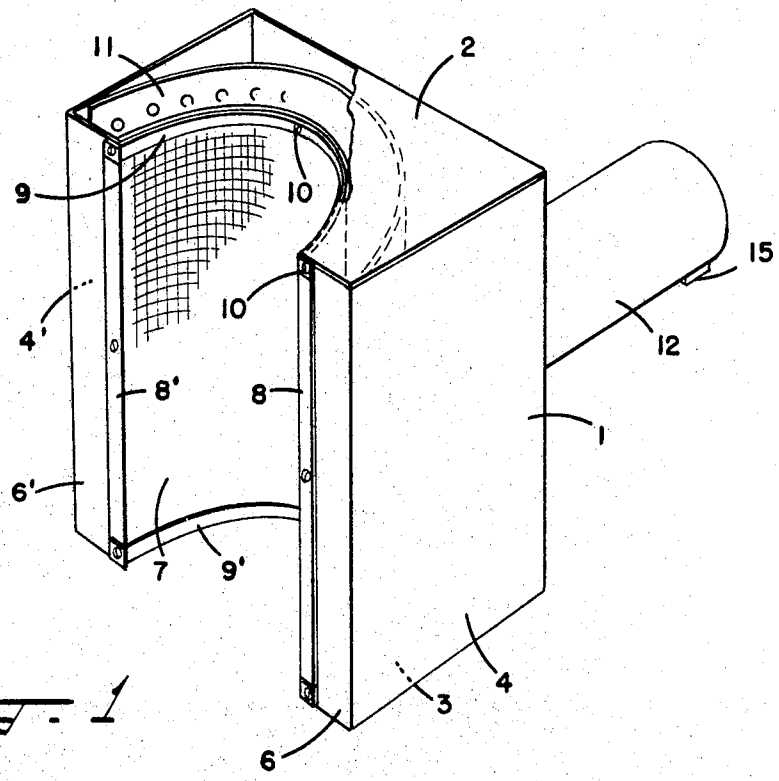

Fig. 1

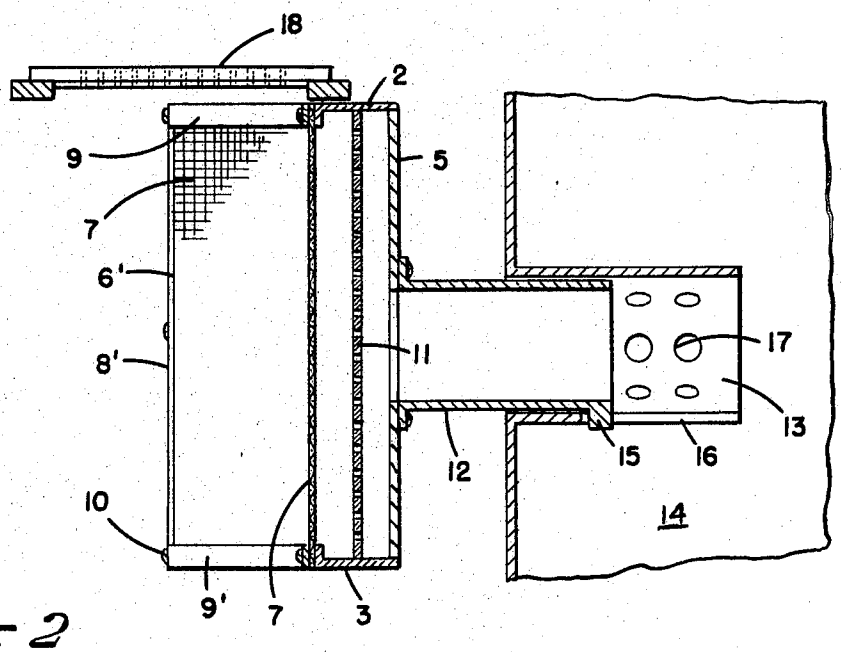

Fig. 2

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3,487,144

APPARATUS AND METHOD FOR COOLING EXTRUDED MOLTEN FILAMENTS

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U.S. Cl. 264—237 7 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus and method for cooling extruded molten polymeric filaments including a concave foraminous front wall adapted to partially encompass molten filaments emanating from a substantially circular spinneret assembly, are disclosed herein.

A number of devices have been proposed and used to quench or cool molten polymeric filaments as they pass from the spinneret. Several of these quenching devices have been specifically designed to reduce non-uniformity in the individual filaments being spun. For example, U.S. Patent No. 2,252,684, discloses a quenching apparatus which completely surrounds the spun filaments and projects a cooling gaseous medium from all directions onto the molten filaments. The gaseous medium is then forced downwardly co-current with the filaments. U.S. Patent No. 3,067,458 discloses an improvement over U.S. Patent No. 2,252,684, by the additional requirement of a horizontal flow of a gaseous medium across the filaments below the cylindrical quenching device. This addition was made to reduce the effect of air turbulence in the cylindrical quench. U.S. Patent No. 3,299,469 is an improvement over both U.S. Patents Nos. 2,252,684 and 3,067,458, and provides a central cylindrical baffle extending down from the spinneret and into the cylindrical quenching chamber. This is designed to help eliminate air turbulence in the center of the filament bundle. Other quenching devices wherein air current is directed horizontally in a straight path across the filaments are known, such as U.S. Patent No. 2,273,105. U.S. Patent No. 3,280,424 appears to be an improvement in this type of device wherein the shape of the spinneret is substantially rectangular and the side walls of the quench chamber are adapted to be fixedly positioned with respect to the molten filaments.

It is a primary object of the present invention to provide an apparatus for cooling a plurality of extruded molten polymer filaments whereby said filaments will have improved uniformity, particularly dye uniformity.

It is another object of this invention to provide a relatively simple but effective apparatus for cooling a plurality of extruded molten polymer filaments, which apparatus partially surrounds said filaments and is adjustable with respect thereto.

These and other objects are accomplished in accordance with this invention which is an apparatus for cooling molten polymeric filaments extruded from a substantially circular spinneret assembly comprising walls defining an enclosure adapted to receive a cooling gaseous medium, said walls including a front wall having a longitudinally concave foraminous surface extending into said enclosure, the walls of said enclosure having edges substantially coextensive with the edges of said concave surface, and said enclosure having inlet means for a supply of said gaseous medium.

The apparatus is more particularly disclosed in the accompanying drawing in which:

FIGURE 1 is a perspective view, partially broken at one end wall, of an embodiment of the apparatus of this invention; and

FIGURE 2 is a side view, partially in perspective and partially in section, of the apparatus of this invention in association with a circular spinneret assembly.

In FIGS. 1 and 2, the enclosure **1**, for the quenching apparatus, is defined by end walls **2** and **3** (**3** not visible in FIG. 1), side walls **4** and **4'** (**4'** not visible in drawing), back wall **5** (**5** shown in FIG. 2), and a front wall comprising front side sections **6** and **6'** and a longitudinal concave foraminous surface **7** extending into the enclosure. The foraminous surface **7** is advantageously held in place by longitudinal strips **8** and **8'** and concave strips **9** and **9'** fastened with screws **10**. The foraminous surface may be wire screen, perforated sheet metal, a combination of both or any other air distributing foraminous surface common to this art. Between the front wall and back wall of enclosure **1**, a curved perforated wall **11** is mounted to provide a more even distribution of air or other cooling gas from a supply inlet **12**.

As shown in FIG. 2, the tubular gas inlet **12** extends from back wall **5** and is adapted for telescopic cooperation with a slightly larger tube **13** which extends into a conventional plenum chamber designated **14**. Gas inlet tube **12** has a key **15** attached to the underside of its end portion which is designed to keep the quenching apparatus properly oriented by slideable engagement with slot **16** of tube **13**. Tube **13** contains orifices **17** to facilitate gas flow into inlet **12**.

While the above arrangement for supplying the cooling gas to the quench apparatus is particularly disclosed, other means may be employed in place thereof. For example, the gas inlet supply may be connected to the bottom or back with appropriate baffles employed therein to distribute the cooling gas in the manner desired. The quench device may also be mounted to slide up and down relative to the spinneret.

The quenching apparatus is designed to be capable of being positioned as close up to the face of the circular spinneret assembly **18** as possible, as shown in FIG. 2, in order to solidify the filaments more quickly. The semi-circular foraminous surface of the quenching apparatus produces a semi-radial horizontal flow of cooling gas across the filaments without a corresponding concurrent flow of the gaseous medium with the extruded filaments thus substantially obviating the type of turbulence which occurs when using a completely cylindrical quenching apparatus wherein the gas currents meet at the center of the filament stream.

The apparatus of this invention, while effectively and substantialy uniformly quenching the extruded molten filaments, also permits easier access to the face of the spinneret for cleaning and lacing and may be moved away from the filament flow without becoming littered with molten polymer. It combines the features of cylindrical quenching devices and straight wall quenching devices, thus providing advantages over both.

It has already been stated that the device of this invention does not produce the type of air turbulence developed in a cylindrical quench. It may also be stated that this invention shows advantageous quenching results over straight wall quenching, such as shown in U.S. Patent No. 2,273,105, particuplarly where the quenching means is not close up to the spinneret face.

Polyethylene terephthalate resin having an intrinsic viscosity of about 0.6, as determined from a solution of the resin in a solvent mixture of 60 wt. percent phenol—40 wt. percent tetrachloroethane at 30° C., was manufactured into two different 70 denier, 34 filament yarns usng two separate procedures, A and B, employing the same spinning and drawing conditions, but different quenching devices for cooling the melt extruded filament emanating from the spinneret. In procedure A, the quench

device had a foraminous air distributing surface 7 inches wide and 30 inches long, positioned in front of a plenum chamber about 5 inches behind the center of the molten filaments and about 5 inches below the face of the spinneret. In procedure B, the quench device of the present invention, essentialy as depicted in the accompanying drawing, was employed in place of the quench device of procedure A. The device was about 18 inches long and the foraminous surface was about 2 inches from the center of the molten filaments. The device was placed close to the face of the spinneret, similar to the showing in FIG. 2 of the drawing.

The quench air had a velocity in both procedures A and B, as measured within about ½ inch from the outer face of each foraminous surface, of 40–50 feet per minute.

The unevenness or non-uniformity of the yarns was measured following the general procedures of ASTMD–1425, "Method of Test for Uneveness of Textile Strands," using an instrument of the type which measures directly the properties of the yarn which change the capacity of a condenser when the yarn pases between its plates. The lower the value found in this test procedure, the more uniform is the filament product.

Dye uniformity or Barré ratings were made visually by three trained individulas independently, and the results averaged. The ratings are made on the yarn knitted into a sleeve. Barré ratings are assigned arbitrary numbers ranging from 1 to 5 with increments of 0.25. The higher the Barré rating, the more uniform the product.

The following results were obtained in the non-uniformity and Barré test procedures:

	Yarns	
	Procedure A	Procedure B
Non-uniformity value	2.31	1.24
Dye uniformity (Barré)	4.25	4.75

The above results are significant particularly from the viewpoint of bringing the uniformity of the polyester yarn up to or surpassing those commercially available.

The quenching device of this invention prefrably operates with quench air, or other coling gas, velocity of from about 30 up to about 100 feet per minnute. The lower velocities are preferred for lower denier yarn, while the higher velocities are preferably used for higher denier yarn.

Various changes and modifications may be made practicing this invention without departing from the spirit and scope thereof, and therefore, it is not to be limited except as defined in the appended claims.

I claim:

1. The method comprising extruding a plurality of molten synthetic polymer filaments downwardly from a substantially circular spinneret assembly and cooling said molten filaments by directing a coling gaseous medium horizontally and radially inwardly across said filaments over an arc of about 180°.

2. The method of claim **1** wherein the cooling gaseous medium is caused to flow across the filaments as they leave the spinneret assembly.

3. In combination with a device for extruding molten synthetic polymer filaments including a substantially circular spinneret assembly, an apparatus for cooling said molten filaments comprising walls defining an enclosure adapted to recive a cooling gaseous medium, said walls including a front wall having a longitudinally concave foraminous surface extending into said enclosure, said enclosure walls having edges substantially coextensive with the edges of said concave surface, and said enclosure having inlet means for a supply of said cooling gaseous medium.

4. The cooling apparatus of claim **3** wherein said concave foraminous surface is substantially semi-circular.

5. The cooling apparatus of claim **3** wherein said enclosure includes end walls, side walls and a back wall.

6. The cooling apparatus of claim **5** wherein the enclosure contains gas distributing means between the front and back walls.

7. The cooling apparatus of claim **5** wherein the inlet gas supply means is a conduit associated with said back wall which is adapted to telescopically cooperate with another conduit associated with a gas supply source whereby the cooling apparatus may be horizontally adjustably positioned with respect to the spinneret assembly.

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JULIUS FROME, Primary Examiner

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U.S. Cl. X.R.

18—8; 264—176

(5/65)

CERTIFICATE OF CORRECTION

Patent No. 3,487,144 Dated December 30, 1969

Inventor(s) Arlen K. Sarian

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 2, line 61, "particuplarly" should be --particularly--; line 68, "usng" should be --using--. Col. 3, line 6, "essentialy should be --essentially--; line 18 "uneveness" should be --unevenness--; line 21, "pases" should be --passes--; line 25, "individulas" should be --individuals--; line 43, "prefrably" should be --preferably--; line 44, "coling" should be --cooling-- line 45, "minnute" should be --minute--. Col. 4, line 7, "coling" should be --cooling--; line 17, "recive" should be --receive--.

SIGNED AND
SEALED
JUN 9 1970

(SEAL)
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