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SPINNING CHIMNEY

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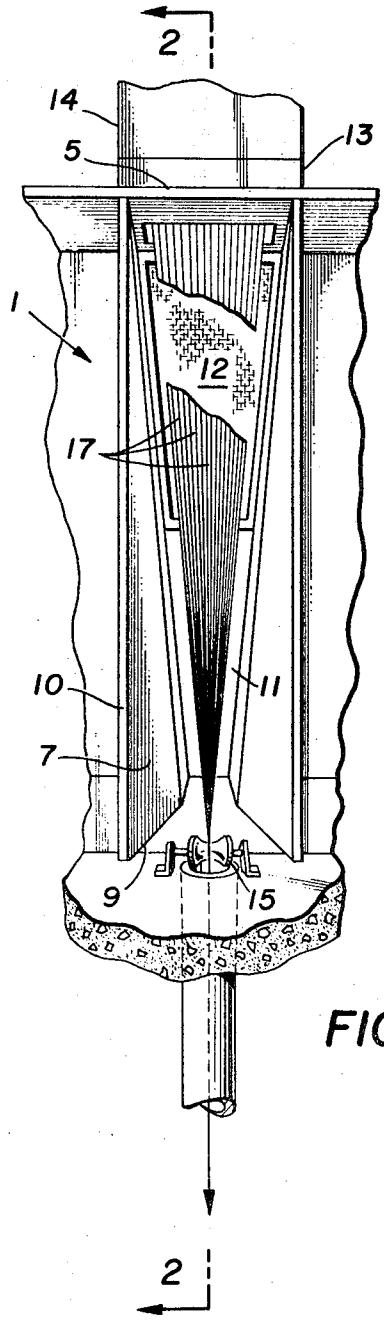


FIG. 1.

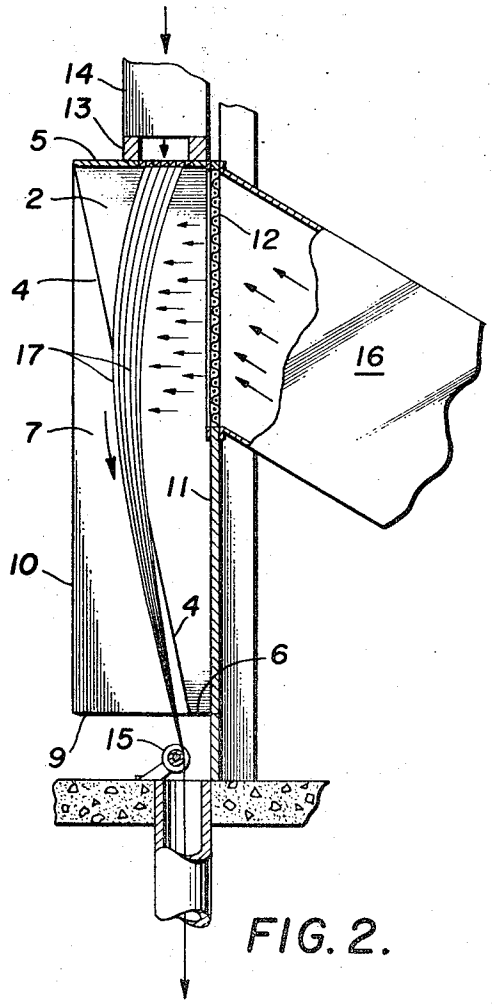


FIG. 2.

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SPINNING CHIMNEY

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ABSTRACT OF THE DISCLOSURE

A spinning chimney to be used for the quenching of molten polymeric filaments, said chimney having sides and a back with the sides comprising converging walls which conform to the path of filaments from the spinneret to the convergence guide and diverging wings which communicate with the leading edges of the walls, and a plenum chamber associated with the upper portion of the back of the chimney for directing the flow of air over the filaments.

BACKGROUND OF THE INVENTION

(1) Field of the invention

This invention relates to the production of synthetic filaments, yarns, ribbons and the like from fiber-forming polymers. More specifically, this invention deals with improvements in the apparatus employed in cooling the molten structures extruded from a spinneret.

(2) Description of the prior art

In practice, melt-spun filaments are extruded from a spinneret and enter a spinning chimney or quenching chamber where they are subjected to a cross-current flow of a quenching medium.

Heretofore, a number of different spinning chimneys have been known and all have suffered from various insufficiencies; being inadequate on the whole. Some have suffered because of the uneconomical volume of air or quenching medium required to attain the desired result. Others have suffered in that much of the air used is wasted; never reaching the filaments. Still others have suffered in that they are cumbersome while yet others are structurally uneconomical and/or unsuitable.

One of the most important disadvantages of some of the prior art spinning chimneys is the quality of filaments produced therewith; being poorer on the whole.

SUMMARY OF THE INVENTION

Accordingly, the above disadvantages are overcome and the quenching of molten polymeric filaments is accomplished through the use of a spinning chimney having a back and sides with said sides comprising (1) converging walls which conform to the path of filaments from the spinneret to the convergence guide, and (2) diverging wings which communicate with the leading edges of the walls. The quenching fluid is directed into the chimney and over the filaments through the back of the chimney which is foraminous over a part of its upper half.

Therefore, an object of this invention is the overall improvement of such properties as the denier uniformity, tenacity and dyeability of the spun filaments.

Another object of the invention is to provide a spinning chimney in which there is a more efficient use of the quenching medium.

These and other objects and advantages will become more readily apparent when considered in conjunction with the remainder of the specification and accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a spinning chimney made in accordance with the teachings of this invention and shown in association with a spin pack, a convergence guide, and a plenum chamber.

FIG. 2 is a vertical sectional view taken substantially along lines 2—2 of FIG. 1 showing the spinning chimney, plenum chamber, convergence guide, and spin pack.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment as shown in FIG. 1 and FIG. 2 includes generally a plenum chamber **16**, a spin pack **14** including a spinneret, a face plate **13** which is used to protect the spinneret face, a convergent spinning chimney generally denoted by reference numeral **1**, and a convergence guide **15**. The plenum chamber **16** has imperforate top, bottom, and side walls, as well as a front distribution plate **12** which is suitably perforated. Spinning chimney **1** has sides made up of walls **2**, through which a plurality of filaments **17** travel directly from spin pack **14** to convergence guide **15**. In the embodiment shown, walls **2** extend perpendicularly from back **11** for a distance with the terminus thereof forming leading edges **4** which communicate at an angle with divergent wings **7** which can be integral therewith.

As shown, walls **2** are substantially trapezoidal in shape with the parallel sides being the tops and bottoms thereof. Wings **7** are substantially right-triangular in shape with the hypotenuses thereof communicating with the leading edges **4** of walls **2** which are secured in place by any suitable means. The upper portion, or a major part of the upper half, of the back of chimney **1** is occupied by distribution plate **12** and the lower portion of the back is either open or occupied by plate **11**.

Depending upon the length of the chimney to be used, a greater area of the back of the chimney may be required in order to attain the desired flow and distribution of the quenching medium. In other words, for shorter chimneys, a major portion of the back can be foraminous, or open to accommodate a distribution plate.

It would also be possible to integrate distribution plate **12** into the chimney structure and adapt it for attachment to the remainder of the plenum chamber in covering relationship to an appropriate aperture. In either event, a quenching medium, usually air, flows under pressure through the foraminous plate **12** into chimney **1** for cross-current flow through filaments **17**.

While the walls and wings are preferably planar and meet at an angle being less than 180°, this is not to say that they may not be arcuate; meeting at an angle of more or less than 180°. If the arcuate wings and walls met at 180°, a continuous arcuate surface would be formed.

As is apparent from FIG. 1, the trapezoidal-shaped walls **2** converge toward the bottom of chimney **1** in such a manner as to conform to the flow of filaments **17** from spin pack **14** to convergence guide **15**; walls **2** being closely adjacent to the paths of travel of the outermost filaments.

Usually, the illustrated apparatus is physically located above its associated windup area and the filaments **17** pass downwardly thereto. In some prior art instances, when the apparatus is placed in operation, a bundle of filaments is forced downwardly through a transfer tube to the windup area by compressed air. Once the individual filaments and the bundle as a whole are running properly through the tube, they are separated and located on a convergence guide. Another possibility is to apply a vacuum to the bottom of the transfer tube and draw the filaments out through a flexible hose suitably con-

nected to a fan and filter system. The hose can be used to draw off the filaments to a waste-collecting system while the individual filaments are being strung-up.

It is easily appreciated that the structure of the instant chimney allows for an operator to manually throw the filaments through the bottom of the chimney for stringing-up in the windup area below, thus eliminating expensive tubes and vacuum devices. The structure of the chimney is such that the filaments are funneled or guided through the bottom when thrown.

In normal operation, the quenching medium flows cross-current through the filaments **17** at sufficient velocity as in a conventional rectangular chimney. However, there is a more efficient use of the medium since the reduction in the cross-sectional area of the flow path through the chimney permits a reduction in total air flow while maintaining the same flow velocity.

Uniformity of air flow velocity transverse to the chimney, as shown by the arrows in FIG. 2, is dramatically improved giving rise to spectacular improvements in the physical properties of the filaments spun in addition to a substantial reduction in quenching medium requirements.

Tests were conducted during the spinning of polyester fiber (polyethylene terephthalate) wherein the polymer throughput was 88 p.p.h. (pounds per hour). When a rectangular chimney was used having an air flow of 1000 c.f.m. (cubic feet per minute) at 20° C., filaments were produced having a denier coefficient of variation of 20 percent as determined from photomicrographs of fiber cross-sections. Fibers spun through the chimney of this invention with an air flow of 500 c.f.m. had a denier coefficient of variation of 14 percent. At an air flow of 50 c.f.m. through a rectangular chimney, only very marginal quenching was effected as evidenced by unquenched filaments which periodically broke and blew out of the chimney, whereas with the chimney of this invention spinning was continuous and satisfactory, and the marginal rate was 350 c.f.m. at 20° C.

As shown by the arrows in FIG. 2, the quenching medium flaws into the chimney through foraminous plate **12**, and exits through the front of the chimney and between wings **7**. With a trapezoidally-shaped chimney, free space for extraneous wasteful air current in the front portion of the chimney is minimized thus forcing a major portion of the medium to flow cross-current to the filament bundle. In a rectangular chimney, there is a relatively large amount of wasteful space available for extraneous flow around the sides of the bundle. Smoke pattern tests have shown the flow in these side areas of a rectangular chimney to be productive of a considerable amount of turbulence. Reduction of this turbulence is believed to be in part responsible for the improved quality of filaments spun through a trapezoidal chimney.

It is believed that the wings function to keep any stray air currents which exist within the room from affecting the bundle of filaments as they pass through the chimney. Convection and other currents could possibly change or hinder the uniform flow of filaments.

Another theory which may explain the successful operation of the chimney of this invention is that turbulence is present with air or fluid flowing past any edge and by having wings on the leading edges of the walls, an edge which would create noticeable turbulence would be displaced further from the bundle of filaments.

A definite advantage, though not affecting the quality of the filaments or operation of the chimney, is that there is less likelihood of the operator sustaining injury when the yarn or bundle is thrown through the bottom to the windup area below.

Although specific reference has been made to the use of the polyester, it is apparent that the improvements disclosed herein are equally applicable to the melt-spinning of any organic fiber-forming composition. In this and other respects, it is accordingly intended that the present invention should be limited only by the scope of the appended claims.

We claim:

1. A spinning chimney characterized in having a back and sides, said sides comprising walls which converge from top to bottom, and which extend from the back of the chimney for a distance, the terminus thereof forming leading edges which communicate at an angle with diverging wings.

2. A spinning chimney according to claim **1** wherein the wings are planar.

3. A spinning chimney according to claim **1** wherein the walls are planar.

4. A spinning chimney according to claim **1** wherein the walls extend perpendicularly from the back of the chimney.

5. A spinning chimney according to claim **1** wherein the walls are substantially trapezoidal in shape with the tops and bottoms thereof forming the parallel sides.

6. A spinning chimney according to claim **1** wherein the wings are substantially right-triangular in shape with the hypotenuses thereof conforming to the leading edges of the walls.

7. A spinning chimney according to claim **1** wherein the back of the chimney is foraminous over part of its upper half.

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