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3,071,810

CASTING WHEEL

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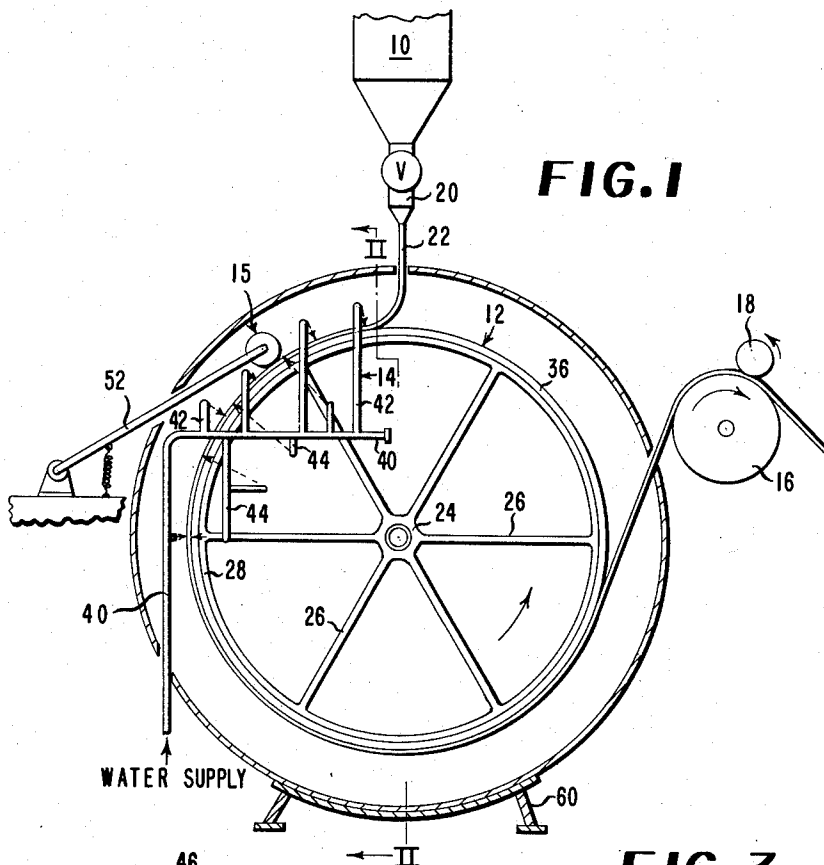
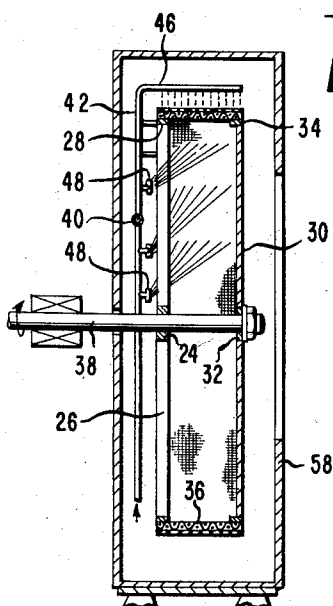


FIG. 3

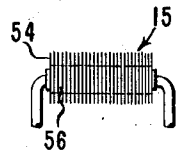


FIG. 4



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This invention relates generally to the production of fiber-forming polymers and is directed more particularly to an apparatus useful in the cooling of freshly extruded molten structures.

A process for producing polymer ribbons suitable for conversion into flake has been disclosed by Graves in U.S. Patent No. 2,289,774. After drying, blending and other preparatory steps, such flake is usually fed into the hopper of a melt-spinning apparatus. One of the major difficulties involved in these known procedures has been the length of time required for casting the extruded ribbon. In this respect, it has also been recognized that a faster casting cycle would lead to the production of polymer having a more uniform thermal history and generally improved quality.

The most important object of the present invention is to provide an apparatus with which the elapsed time of the casting cycle is reduced so as to decrease the over-all processing time and improve the quality of the polymer.

A further important object of the invention is the provision of an apparatus in which the cooling step is accomplished by vaporization of the coolant on both sides of an extruded ribbon as the latter is advanced away from the point of extrusion.

It is another objective of the present invention to increase the surface-to-volume ratio of the cast ribbon and thereby effect more uniform and efficient cooling through its entire cross section.

With these and other objects in view, the apparatus of the invention comprises generally an extrusion head which discharges a ribbon of molten polymer to a casting wheel having a foraminous surface on which a length of the ribbon is supported as it advances away from the extrusion head. Roller means are provided for pressing the ribbon against the foraminous surface and a spray assembly is located adjacent the wheel with nozzles directed at both the under and outer sides of the foraminous surface.

Additional objects will become apparent in the specification which follows wherein reference is made to the accompanying drawing in which:

FIGURE 1 is a side elevational view, partially in section, of an apparatus made in accordance with the teachings of the present invention;

FIG. 2 is a vertical sectional view taken on line II—II of FIG. 1; and

FIGS. 3 and 4 are detail views of the roller assembly shown in FIG. 1.

The melt extrusion apparatus embodiment chosen for illustration includes as components thereof an autoclave 10, a casting wheel 12, a spray assembly 14, a roller assembly 15, and a pair of stripper rollers 16, 18. The autoclave 10 is provided with a valved and slotted head 20 from which a ribbon 22 of molten polymer is extruded under pressure.

One side of the wheel 12 consists of a hub 24 and a plurality of spokes 26 which are attached at their extremities to a rim 28. The other side of the wheel is closed by an imperforate sidewall 30 which has a centrally located apertured reinforcement 32 and is attached at its periphery to a second rim 34. A strip 36 of foraminous material is coextensive in width with the wheel 12 and attached to the rims 28, 34. The strip 36 may be made, for example, of heavy duty square weave wire

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cloth or screen. For molten nylon, an 8-mesh screen material is suitable. Wheel 12 is rotated in the direction indicated by the arrow in FIG. 1 by a driven shaft 38 which passes through hub 24 and reinforcement 32. Shaft 38 is joined to hub 24 by suitable key means (not shown).

Spray assembly 14 includes a manifold 40 from which a plurality of conduits 42, 44 lead to the several nozzle devices. Conduits 42 each communicate with a perforated straight length 46 which is spaced outwardly from and generally parallel to the screen 36. Conduits 44 lead to a plurality of spray heads or nozzles 48 each of which is located adjacent the path of travel of spokes 26 and directed inwardly toward screen 36, as shown in FIG. 2.

The roller assembly 15 is mounted on a cross bar extending between a pair of pivotally mounted arms 52 which are spring-biased in the direction of wheel 12. As shown in FIGS. 3 and 4, the roller assembly 15 includes a plurality of discs 54 which are relatively rotatable and held spaced apart by spacers 56. A central perforation in each disc 54 is larger in diameter than the cross bar on which the discs and spacers are mounted.

In operation, the polymer-forming reaction takes place in autoclave 10 and ribbon 22 passes directly from extrusion head 20 to the surface of wheel 12 where a suitable non-solvent coolant is applied to both sides of the ribbon by the radially directed curtain sprays emanating from nozzles 46, 48. After the molten polymer has started to cool and as the ribbon is advanced on wheel 12, the discs of spring-biased roller assembly 15 press the polymer more intimately into the screen 36 and also corrugate the outer side of ribbon 22. Simultaneously, the inside of the ribbon is deformed or roughened by its engagement with screen 36. The term "roughened" as used herein is intended to be descriptive of the permanent deformation which results when the underside of ribbon 22 becomes partially embedded in screen 36 during the casting operation. The extent of this deformation is increased and enhanced by the action of roller assembly 15 which, as mentioned previously, also functions to corrugate or roughen the outer side of the ribbon. In this manner, the surface-to-volume ratio of ribbon 22 is increased substantially. This increase permits a corresponding increase in the effectiveness of the spray applied to the ribbon. The cooling rate is further enhanced by the fact that the underside of the ribbon is cooled by vaporization of the coolant rather than by conduction through an imperforate sheet. Ribbon 22 stays on wheel 12 for less than a complete revolution and is withdrawn by the stripper rolls 16, 18 for further processing in the manner disclosed by Graves.

Wheel 12 and spray assembly 14 are enclosed by a shroud 58 which is attached to the saddle of a suitable support 60.

In the illustrated embodiment, there is but one roller assembly 15. It is apparent that, under different circumstances, it may be desirable to have a plurality of such assemblies or to vary its construction. For example, the discs 54 and spacers 56 could be replaced with a rotatably mounted, screen covered drum in which the screen is of the same or different mesh as that which is used on wheel 12.

The improvements over the process of Graves involve the steps of deforming or roughening both sides of an extruded molten structure and simultaneously cooling both sides by vaporization. The incorporation of these features into the Graves process facilitates a more rapid and uniform cooling of the ribbon as it is cast.

The apparatus disclosed herein has special utility in the production of fiber-forming polymers since they not only permit a reduction in the elapsed time of the casting cycle but also result in a narrower distribution of the

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flake chip sizes. Thus, there are less fine and coarse flakes and the cutter may be adjusted so as to increase the average flake size with no reduction in quality. The improvements with respect to the duration of the casting cycle can be attributed to the fact that both sides of the extruded ribbon are cooled by vaporization rather than by conduction and to the fact the roughening of the under and outer sides of the ribbon produces an appreciable increase in its surface-to-volume ratio.

It is apparent that many changes and modifications may be made in the disclosed apparatus for casting molten polymers without departing from the spirit of the present invention which is therefore intended to be limited only by the scope of the appended claims.

I claim:

1. A melt extrusion apparatus comprising: an extrusion head through which molten material is extruded in the form of a ribbon; a casting wheel having an open mesh peripheral surface on which a length of the ribbon is supported as it advances away from said head; roller means engaging said ribbon in said length and pressing it against said surface; and a spray assembly located adjacent said wheel, said assembly including nozzle means directed at both sides of said supported length.

2. In a melt extrusion apparatus including an extrusion head through which molten material is extruded in

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the form of a ribbon: a rotatably driven casting wheel having a ribbon-advancing strip of screen material attached thereto at its periphery; and a spray assembly located adjacent said wheel, said assembly including nozzle means directed at the inner and outer sides of said strip in the length thereof over which said ribbon is advanced.

3. The melt extrusion apparatus of claim 2 wherein said wheel has an imperforate sidewall, a hub spaced from said wall, and a plurality of spokes extending radially from the hub, said strip is attached to the periphery of said wall and to the extremity of each spoke, and said nozzle means directed at the inner side of said strip comprises a plurality of radially spaced spray heads located adjacent said spokes on the opposite side thereof from said sidewall, said heads being positioned and adapted to discharge toward the length of said strip over which the ribbon is advanced.

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