

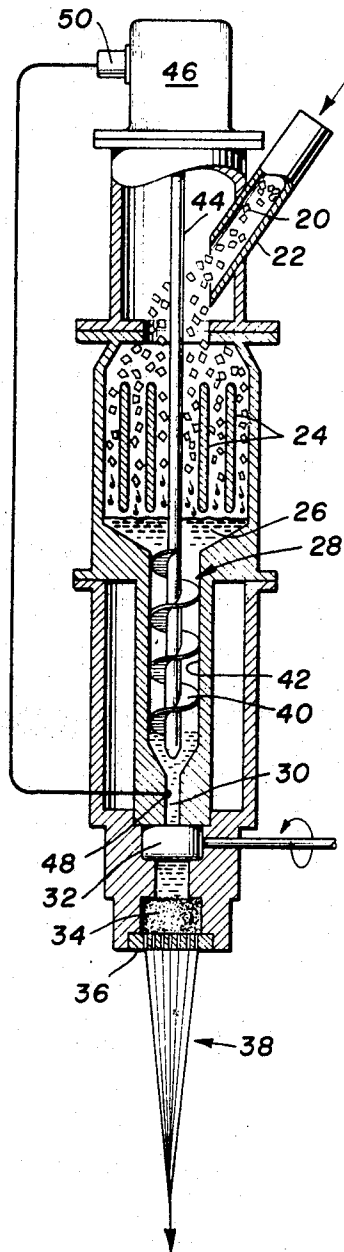
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POLYMER MELT SCREW PUMP FOR FIBER SPINNING

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3,474,773 POLYMER MELT SCREW PUMP FOR FIBER SPINNING

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5 Claims

ABSTRACT OF THE DISCLOSURE

Production of low luster yarn is avoided by controlling the temperature of the molten polymer just prior to extrusion. A viscosity-type pump is submerged in the melt pool for supplying molten polymer under pressure to the inlet of one or more metering pumps. The outputs of the metering pumps are extruded through spinnerets. The temperature of the pressurized polymer (at a point after the viscosity pump and before the spinneret) is sensed and used to control the speed of the viscosity pump, to maintain the sensed temperature within a desired range. The viscosity-type pump is selected to convert a large amount of its mechanical energy to heat.

The present invention relates to melt spinning wherein the temperature of the molten polymer is controlled just prior to extrusion. More particularly, the polymer temperature is controlled by varying the amount of heat added to the polymer by mechanical working.

In conventional melt spinning apparatus, as typified by U.S. Patent 2,278,875 to Graves, solid polymer is melted by heat exchange surfaces, and falls as molten polymer to a reservoir. The polymer is then fed under pressure by an upper or distribution pump to the inlet of a metering pump, the output of which is extruded through a spinneret to form filaments. After such a unit has been in service for a period of time, deposits build up on the heat exchange surfaces and decrease the transfer of heat to the polymer. Accordingly, the temperature of the polymer being extruded gradually falls. For nylon 66, the normal and preferred temperature just prior to extrusion is about 275 to 290° C. When the polymer temperature drops below about 270° C. just before extrusion through the spinneret orifice, "low luster" yarn usually results. Low luster yarn is characterized by lowered tenacity and elongation-at-break, variable dye receptivity, and other undesirable physical properties. A principal cause of low luster yarn can be avoided by avoiding the reduction in temperature of the molten polymer just prior to spinning.

It has been discovered that the polymer temperature can be maintained substantially constant for longer periods of time by replacing the gear-type distribution pump disclosed in the above noted Graves patent with a viscosity-type pump, and controlling the speed of the viscosity pump in accordance with the temperature of the pressurized polymer just before extrusion.

Accordingly, a primary object of the invention is to provide an improved process and apparatus for extruding molten polymer.

A further object is to provide a process and apparatus of the above character wherein the temperature of the polymer is controlled just prior to extrusion.

A further object is to provide a process and apparatus of the above character wherein the temperature control is achieved by varying the mechanical work performed on the polymer.

A further object is to provide a process and apparatus of the above character using a viscosity-type pump for supplying molten polymer under pressure to the metering

pump and for adding the necessary auxiliary heat to the polymer.

Other objects will in part be obvious, and will in part be set forth in the accompanying description with reference to the single figure, which is a vertical sectional view of the preferred embodiment of the invention.

Referring generally to the figure, polymer chips 20 are fed through a hopper 22 to conventional heated grids 24. The melted polymer falls to melt pool 26 beneath grids 24. Distribution pump 28, submerged in the molten polymer, supplies melted polymer under pressure through distribution passage 30 to the inlet of metering pump 32. The metered output stream from metering pump 32 is fed through a conventional filter media such as sand pack 34, and is extruded through spinneret 36 to form filaments 38. Filaments 38 may be conventionally quenched and collected by means not shown. According to the invention, distribution pump 28 is of the viscosity type as opposed to a positive displacement type such as a gear pump, and serves the additional function of adding heat by mechanically working the polymer.

The preferred form of distribution pump includes helix 40 rotatably received within cylindrical housing 42. Helix 40 is driven by means of shaft 44 from variable speed motor 46. A pump of this construction depends upon the viscosity of the fluid for its pumping action, and provides intensive viscous shearing of the polymer. Pump 28 accordingly can efficiently impart substantial amounts of auxiliary heat to the molten polymer. In addition, the shearing action within pump 28 aids in thoroughly mixing the polymer and disperses polymeric aggregates.

A thermocouple 48 or equivalent means senses the polymer temperature downstream from pump 28 and at some point before the spinneret, for example in the distribution passage as illustrated, and sends back a signal to motor speed control 50 for controlling the speed of helix 40 so as to maintain the temperature of the pressurized polymer within a predetermined range.

As the melt capacity and temperature decreases with age of the unit, a compensating amount of heat is added by increasing the speed of helix 40. It is not necessary that the temperature be maintained absolutely constant. For nylon 66 melting at about 262° C., an initial temperature in the melt pool with a new unit might be about 282° C. As the temperature in the melt pool gradually decreases, the distribution pump can be gradually speeded up to keep the temperature downstream from the distribution pump above 270° C., and preferably above 275° C. The increase in the speed of motor 46 can be chosen to compensate for the increasing viscosity at lower temperatures and the higher pressures resulting from increased pump speed, to maintain substantially constant pressure supplied to the inlet of metering pump 32.

What is claimed is:

1. In polymer melting apparatus including heat transfer surfaces for melting solid polymer, a reservoir for receiving molten polymer, and a distribution passage for conducting said molten polymer from said reservoir to at least one metering pump, the improvement comprising:

- (a) a viscosity pump for supplying said molten polymer under pressure to said distribution passage;
- (b) means for sensing the temperature of said molten polymer in said distribution passage; and
- (c) control means, controlling the speed of said viscosity pump in response to said sensed temperature, for maintaining said sensed temperature within a given range of temperatures.

2. The apparatus defined in claim 1, wherein said viscosity pump includes a helical screw submerged in said molten polymer.

3. A method of operating a polymer melting apparatus including a reservoir for molten polymer and a viscosity

pump for feeding said molten polymer through a distribution passage to at least one metering pump, said method comprising:

- (a) sensing the temperature of said molten polymer in said distribution passage; and
- (b) maintaining said sensed temperature within a given range by controlling the speed of said viscosity pump.

4. The method defined in claim 3, wherein said polymer is nylon 66.

5. The method defined in claim 3, wherein said given range is between 270° and 290° C.

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