Aug. 11, 1970 J. G. SIMS 3,523,827

SPINNERET RECONDITIONING

Filed May 6, 1968

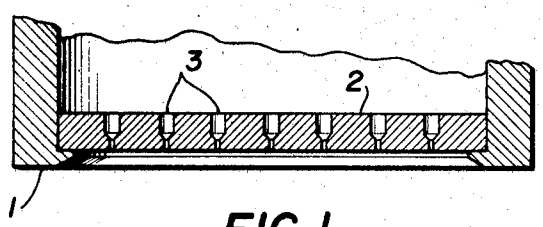


FIG. 1.

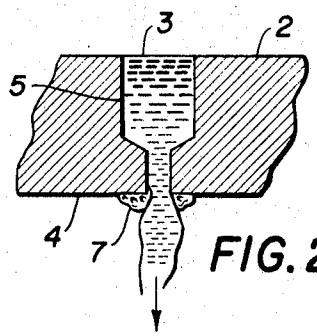


FIG. 2.

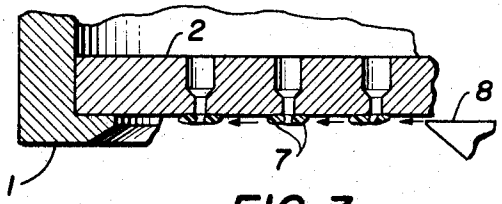


FIG. 3.

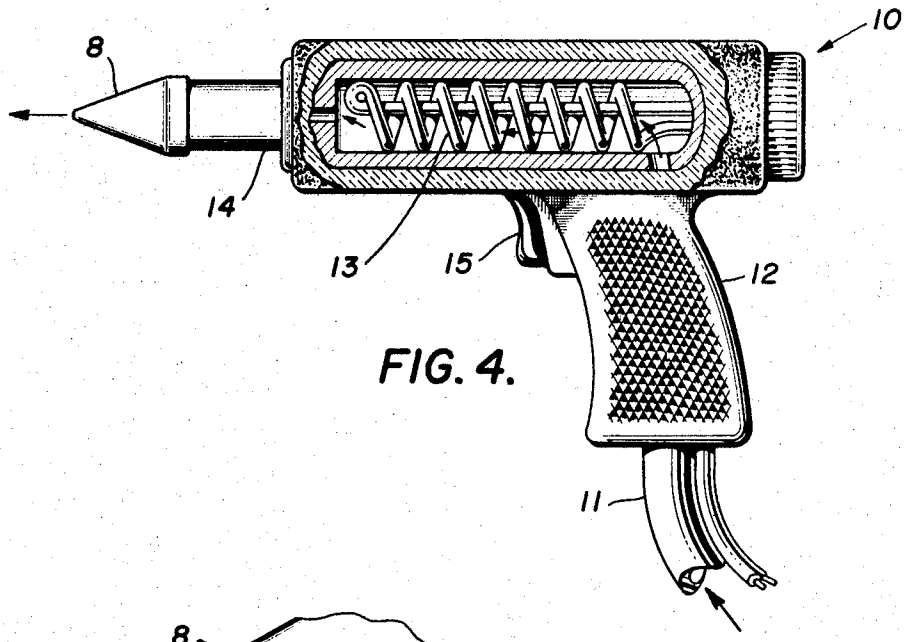


FIG. 4.

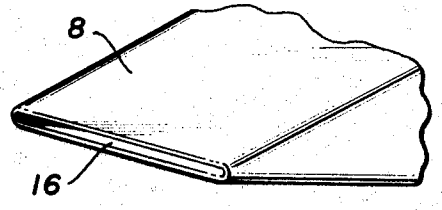


FIG. 5.

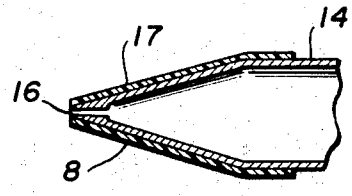


FIG. 6.

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SPINNERET RECONDITIONING

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ABSTRACT OF THE DISCLOSURE

Process for treating the extrusion face of a spinneret used in melt spinning thermoplastic filaments to remove materials deposited near the periphery of the orifices in the spinneret during spinning. The process includes establishing a planar stream of hot fluid, moving the stream at a speed of at least one-quarter of sonic velocity, and directing the stream against the face of the spinneret in a direction generally parallel thereto. This procedure disengages and casts away the deposited materials.

BACKGROUND OF THE INVENTION

In normal melt spinning operations to produce man-made filaments from synthetic thermoplastic polymers, the polymeric material is heated to a flowable molten condition and is forced under pressure through small orifices in a steel plate called a spinneret. Tiny streams of polymer emerge from the extrusion face of the spinneret and fall downwardly through a chamber wherein a cool gas contacts the streams to solidify the same into filaments, after which they are subjected to various treatments prior to conversion into textile articles. As the polymer is extruded a well-known phenomenon occurs: Decomposition products of the synthetic thermoplastic materials build up around the periphery of the orifices to the extent that these products obstruct the desired normal flow of the molten polymer through and from the spinneret. This disruption of the spinning process occurs at regular or irregular intervals, depending on many factors. To minimize the problem without undertaking the arduous and expensive task of removing the spinneret for a complete cleaning, the practice has been to wipe the extrusion face of the spinneret with a metal scraping tool. To extend the time between required spinneret wipings a film of silicone fluid or like material is placed on the face of the spinneret. The use of the scraping tool has many drawbacks. Danger always exists that irreparable damage can be done to the spinneret by the operator in wiping the spinneret with the metal tool. In addition, a satisfactory removal of all the accretions built up around the orifices of the spinneret is extremely difficult owing to the normal positioning of the spinnerets in the spinning machine which makes certain portions of the spinneret inaccessible or difficulty accessible to the use of the tool.

SUMMARY OF THE INVENTION

A method is provided for reconditioning a spinneret used in melt spinning filaments in place in a spinning machine. This is accomplished by establishing a planar stream of hot fluid moving with a velocity of at least one-quarter sonic velocity, directing this planar stream against the face of the spinneret in a direction generally parallel thereto to disengage and cast away polymeric stalacitite-like incrustations formed on the spinneret face during melt spinning. Preferably the fluid is air heated to a temperature of 260–320° C., but other common gases are also suitable, such as nitrogen, carbon dioxide, and argon, etc.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a cross-sectional view of a spinneret located in the spinneret block of a conventional melt-spinning machine;

FIG. 2 is a cross-sectional view showing the flow of molten polymer through an orifice in a spinneret;

FIG. 3 is a view in cross-section showing fluid laminate forming means in position for reconditioning the extrusion face of a spinneret;

FIG. 4 is an elevational view of a fluid laminate forming means used in the method of the present invention;

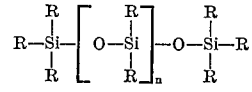
FIG. 5 illustrates the nozzle discharge portion of the means shown in the preceding figure; and

FIG. 6 is a cross-sectional view of the preferred nozzle end portion.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 there is shown a part of a standard spinning block **1** adapted for holding in spinning position a spinneret **2** which is normally a steel plate of sufficient thickness to withstand the required extrusion pressure. Molten polymer such as nylons, polyesters, polyurethanes and polyolefins and other melting material is forced through the small openings provided by orifices **3**.

In FIG. 2 one orifice is larger scale is shown illustrating the path normally taken by the polymer as it passes through the orifice to its exit on the extrusion face side **4** of the spinneret **2**. The orifice often has a counterbore section **5** and a smaller capillary extrusion section. Incrustations **7** normally build up around the periphery of the orifice as spinning is extended over a period of time. As indicated above, before spinning is normally commenced a liquid material which is for all practical purposes nonwettable to the extruding polymer is applied to the spinneret face by means of a spray device. Liquids more commonly used are the polyoxyanosiloxanes having the general formula



in which R is an alkyl group, an aryl group, an alkaryl group or aralkyl group and where n is an integer greater than 1. The polyalkylsiloxanes, such as polymethylsiloxanes should have a viscosity of 50–1000 centistokes at a temperature of 25° C. Low molecular weight polyfluoro-hydrocarbon liquids may also be used for initial coating of the spinneret. Prior to the present invention when incrustations built up to an undesirable degree, the operator would drag the edge of a wiping stick across the face of the spinneret several times. When this operation is performed properly the jets of polymer again extrude straight and freely for a period of time until another wiping of the spinneret is necessary.

In FIG. 3 the incrustations **7** formed on the spinneret **2** are wiped by directing a high-velocity jet of heated gas issuing from nozzle head **8** across the face of the spinneret. Degraded polymer accumulations are blasted away by the scavenging action of the gas stream. The present process accordingly does not-require the normal scraping with a solid surface or straight-edge. Hence there is virtually no risk of damage to the face of the spinneret.

It is preferable to spread the gas out into a relatively broad thin planar stream by means of a slit-type gas nozzle or a row of small holes arranged in a straight line. The thin high-velocity gas jet constitutes a dynamic "knife edge" that cuts through the accumulations on the spinneret face and through the extended streams if employed while melt spinning of filaments is taking place. The form of the apparatus needed to provide the broad thin jet of fluid may vary considerably, depending upon a particular spinning machine arrangement, the spinneret

size and shape and other factors. A permanently mounted installation, not illustrated herein, intended for use with a limited number of adjacent spinning positions is very convenient, a gas heater inside a fixed gas duct may suitably preheat the gas.

A preferred form is a portable unit **10** with pistol grip as illustrated herein in FIGS. 4–6. The unit is connected to a conveniently located pressurized gas source through a flexible conduit **11**. The gas flows through the stock **12** of unit and across heating unit **13** to maintain the temperature thereof as desired. The unit and especially the barrel portion **14** is insulated to minimize heat loss. Trigger **15** controls an electrical switch to the heater and the flow of gas from the source to the nozzle end **8** where the compressed gas escapes to recondition the face of the spinneret.

FIG. 5 shows the preferred long narrow slit **16** at the nozzle end of unit **10**.

The important feature of the air nozzle apparatus is in its delivery of a thin jet of high-velocity gas. The nozzle end **8** of the unit may lightly contact the spinneret face to direct the gas into the plane of the spinneret and should be made of material softer than the spinneret. One of the more convenient expedients is to simply coat the solid contacting nozzle end 8 with a layer of plastic. As shown in FIG. 6 end **8** is coated with a thin layer of high-melting plastic **17**; e.g., a 0.005–0.008 inch thick coating of "Teflon," a well-known product of the Du Pont Co.

It is usually sufficient to permit the gas to flow freely to the atmosphere a few seconds before beginning the spinneret reconditioning. This insures that the gas and nozzle parts are up to temperature. More elaborate indicators may be used, such as a temperature sensor mounted upstream of the nozzle in the gas stream that actuates a signal light to indicate that the gas is up to the minimum set temperature.

For most effective spinneret reconditioning the gas velocity at the jet should be at least 25% of sonic velocity at the existing conditions of the gas, and higher velocities are desirable. This is the velocity at the immediate exit of the nozzle and for a distance of about ⅛ inch beyond the end of the nozzle. The gas rapidly expands and the velocity correspondingly drops very rapidly at any appreciable distance from the nozzle.

The gas in the jet is preheated to a temperature within a few degrees of the temperature of the spinneret at operating conditions, preferably at a temperature higher than that of the spinneret. The exact gas temperature is not highly critical, but a cold jet of gas is to be avoided to prevent unnecessary and undesirable cooling of the spinneret. The highest practical temperature is preferred because the polymer and deposited material are made more tractable by contact with hotter gases. For the commonly melt-spun polymers, such as polyamides, polyolefins, and polyesters, a gas temperature in the range

of 260°–320° C. is highly satisfactory with the upper range of temperature preferred; i.e., 290–320° C. The heat capacity of gases is so low and the amount of gas normally required is so small that the spinneret face temperature will not be changed appreciably even if the gas temperature differs from spinneret temperature ±35° C.

The gas-jet method of the invention is especially useful with two types of spinnerets that cannot be satisfactorily reconditioned in place by the wiping procedure of the prior art: In spinnerets made by one particular method the metal surrounding each orifice outlet is upset to form a slight plateau or pimple-like zone; such spinnerets cannot be cleaned consistently with a normal wiping tool without either damaging the edges of the orifice or smearing a film of polymer over the face of the spinneret. In another recent process modification, the area surrounding each orifice is relieved or recessed such that the orifice outlet is below the general plane of the spinneret face and is therefore physically inaccessible to the scraping action of a normal wiping tool.

There are numerous other advantages associated with the use of the present invention. The method hereinabove described provides a more efficient and versatile in place spinneret reconditioning and substantially reduces the likelihood of damaging the spinneret face during the wiping operation.

I claim:

1. A method of reconditioning a melt spinning spinneret in place in a spinning machine comprising establishing a laminate stream of hot fluid moving at least one-quarter of sonic velocity, directing said laminate stream against the face of the spinneret in a direction generally parallel thereto to disengage and cast away polymeric stalactite-like incrustations formed on the spinneret face during melt spinning.

2. The process of claim **1** wherein the fluid is air.

3. The process of claim **2** wherein the fluid has a temperature of ±35° C. of the temperature of the spinneret.

4. The process of claim **1** wherein the fluid is air having a temperature of 260°–320° C.

5. The process of claim **1** wherein the fluid is air having a temperature of 290–320° C.

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U.S. Cl. X.R.

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