United States Patent

[11] 3,619,433

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Continuation of application Ser. No. 641,598, May 26, 1967, now abandoned.

[54] METHOD FOR DETERMINING FILAMENT DENIER OF FILAMENTS SPUN FROM A SPINNING PACK

2 Claims, 2 Drawing Figs.

[52] U.S. Cl. ..... 264/40, 18/8 SF, 264/176 F
[51] Int. Cl. D01d 1/08, D01d 5/10, F04b 13/00, G01d 1/06
[50] Field of Search 264/176

[56] References Cited
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ABSTRACT: A method for determining the minimum acceptable average filament denier of filaments being extruded from a spinning pack supplied with polymer at a constant metered rate by a meter pump driven by a constant speed electric motor. The power input to the motor which has been correlated to average filament denier is continuously detected by a wattmeter that supplies a signal to a device for signalling the occurrence of power input corresponding to minimum acceptable average filament denier.

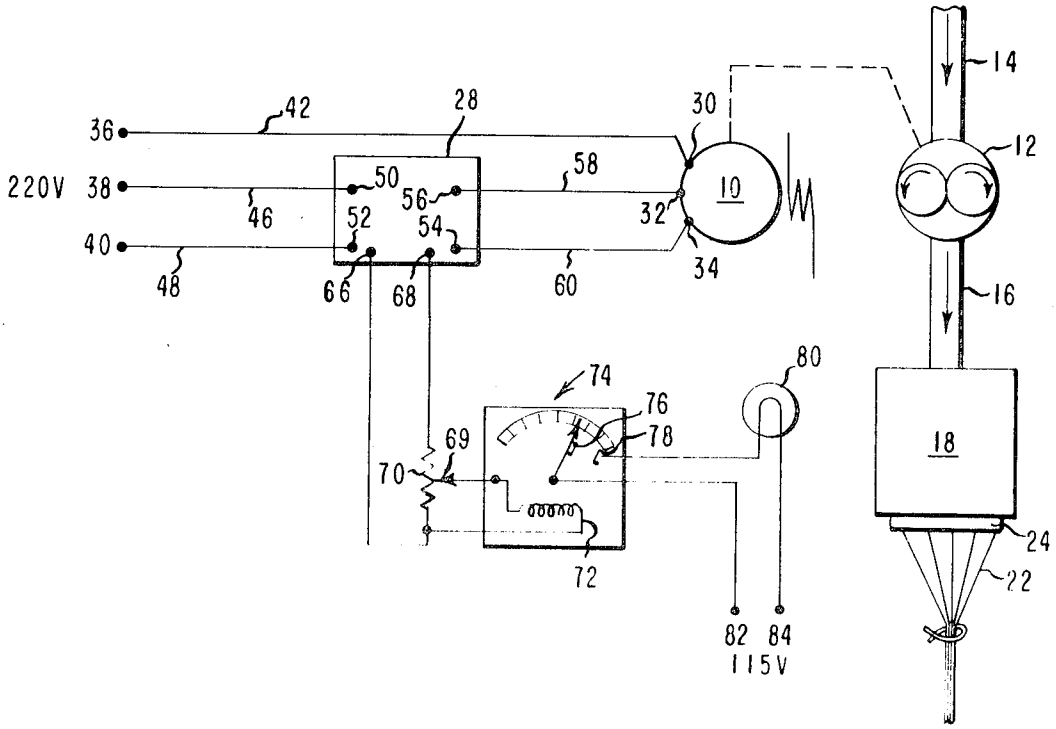


FIG. 1

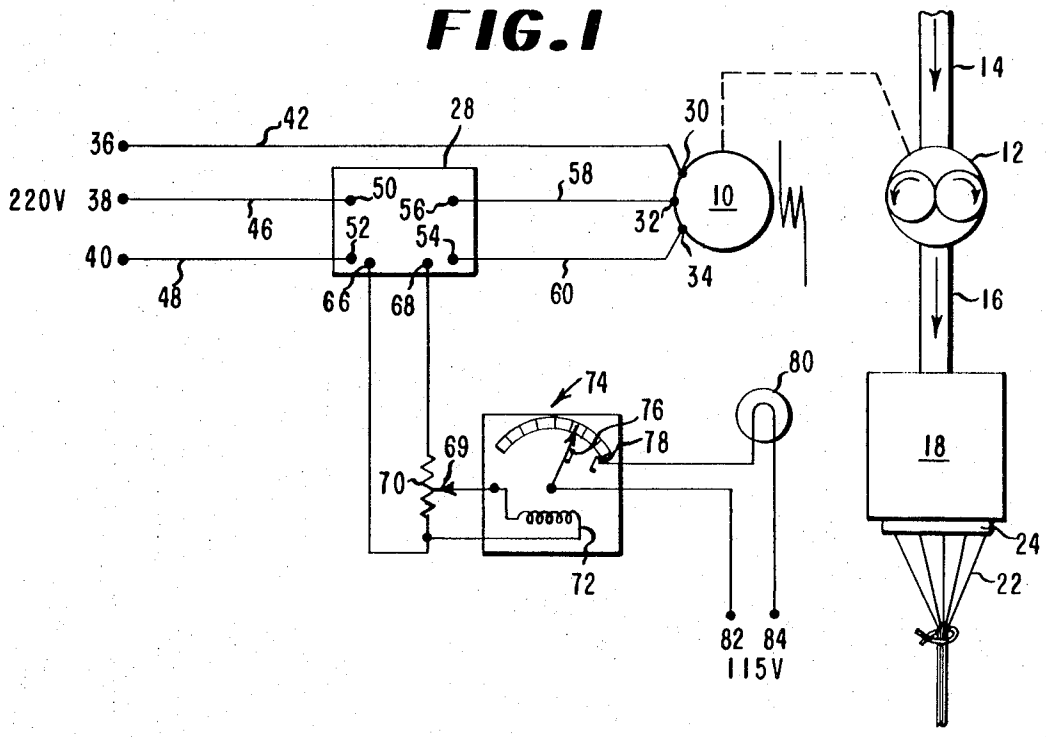
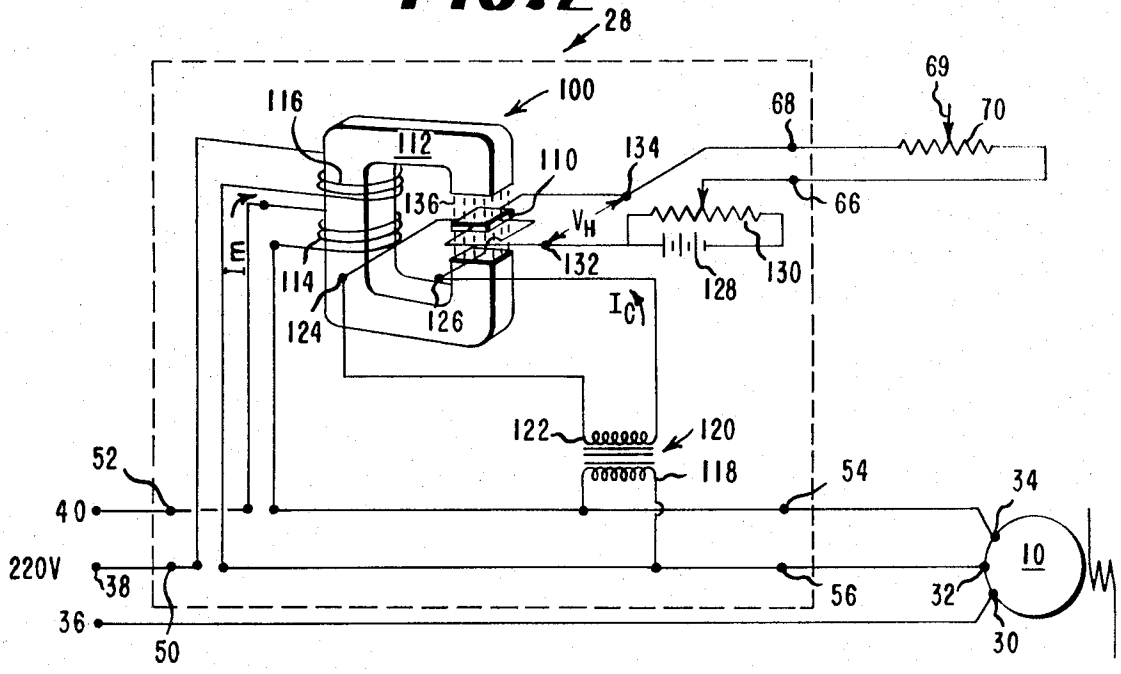


FIG. 2



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METHOD FOR DETERMINING FILAMENT DENIER OF FILAMENTS SPUN FROM A SPINNING PACK

CROSS REFERENCE TO RELATE APPLICATION

This application is a continuation of my earlier copending application Ser. No. 641,598, filed May 26, 1967, and now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to the extrusion of molten polymer to form filaments and more particularly to an improved apparatus for the production and continuous monitoring of the quality of the filaments so prepared.

In melt spinning of polymers it is well known that the molten polymer must be filtered and sheared to attain more uniformly spun products. Metal screens and/or a bed of granular material of various sizes, e.g., sand, are interposed between the meter pump and the spinneret orifices to prevent incompletely fused polymer, foreign matter, aggregates of delustering materials, and the like, from reaching the spinneret and obstructing the small passages in the spinneret plate. As the spinning progresses the metering pump must generate a higher and higher pressure in order to continue to force the required metered flow of molten polymer through the pack assembly.

Precision gear pumps are generally used for metering the molten polymer to the pack assembly. Pump slippage is very small under normal conditions but when the back pressure becomes high, the slippage becomes large enough to cause the average denier of the spun filaments to fall below the minimum acceptable level. However, this is not detected until the yarn is inspected and tested. Frequently, considerable time elapses between the initiation of low denier spinning and its detection. During this period, low quality yarn is produced.

The obvious correction is to install a clean pack. To prevent the spinning of low denier yarns all the packs in a spinning machine are changed early based on previous experience with the poorest performing pack. This is costly in labor and lost production since spinning must be stopped to change the packs when many of the packs could be used considerably longer.

Pressure sensors have been used experimentally to determined the buildup of pack pressure and indicate the need for a pack change. They must be able to stand the high temperatures of the molten polymer. However, they are too costly and unreliable to be used in a plurality of spinning positions on a multipositioned spinning machine on a long-term basis.

The need exists for a simple inexpensive route for determining exactly when a pack should be changed to prevent spinning low denier yarns, thus greatly reducing the costly inefficiency of premature pack changes.

SUMMARY OF THE INVENTION

The main objective of this invention is to provide an improved method for sensing minimum acceptable average filament denier due to high spinning pack pressure and signalling the need for a pack change.

This objective is accomplished in a melt-spinning system consisting of a spinning pack assembly supplied with molten polymer by a metering pump driven by an electrical motor, by a method which includes the steps of continuously sensing the power input to the motor which has been correlated to average denier, indicating the average filament denier and signalling the occurrence of the minimum acceptable average denier either visually, audibly or both. A synchronous motor is used to drive the meter pump and the power input to the motor which has been correlated to average filament denier is sensed by a wattmeter. A means for indicating average filament denier is connected to the wattmeter and actuates an audible and/or visual alarm to signal the occurrence of minimum acceptable average denier.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic diagram of the apparatus involved in this invention.

FIG. 2 is a detailed schematic of the wattmeter of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a synchronous motor **10** drives metering pump **12**. The metering pump **12** is a gear pump that forces the molten polymer, supplied through duct **14**, at the desired metered rate through duct **16** to the pack assembly **18**. Filaments **22** are formed by having the molten polymer forced through the spinneret **24** attached to the lower portion of the pack assembly **18**. Three-phase 220V power is supplied to terminals 36, 38 and 40. Appropriate on-off switching, not shown, is used to control this supplied power. Line **42** connects one phase of this power from terminal **36** to terminal **30** of motor **10**. Line **46** connects the second phase of power from input terminal **38** to terminal **50** of wattmeter **28**. In a similar manner line **48** connects terminals **40** and **52**. These latter two phases of power are connected to motor **10** by lines **58** and **60** between terminals **54** and **34**, and **56** and **32** respectively. Connected across the output terminals **66** and **68** of wattmeter **28** is a variable resistance **70**. Coil **72** of a meter relay **74** is connected to the adjustable arm **69** and one end of variable resistance **70**. Single-phase 115V power is supplied to terminals **82** and **84** which are connected to the contacts **76**, **78** of meter relay **74**. In series with the contacts is an alarm light **80**.

In FIG. 2 wattmeter **28** is shown connected to the 3-phase 220V source supplying power to motor **10**. Numeral **100** generally designates a Hall effect device which includes a Hall plate **110** disposed within the gap of an iron core **112**. Coils **114**, **116** are placed around core **112** and each is connected in series with one phase of the 220V supply to provide magnetizing currents I_m that are in phase with line current. The primary winding **118** of transformer **120** is connected across one phase of the 220V supply with the secondary winding **122** being connected to terminals **124**, **126** of Hall plate **110** to provide a control current I_c that is proportional to and in phase with line voltage. DC supply **128** is a bias voltage paralleled by potentiometer **130** and connected in series with Hall plate terminal **132** and output terminal **66** to provide an incremental adjustment to the output of the Hall plate at output terminals **66**, **68**. This arrangement is commonly known as biasing or zero suppression circuitry.

It is well known that when a current I_c flows in a Hall effect device and a magnetic field **136** is applied at right angles to the current flow, an electrical potential known as Hall voltage (V_H) is generated which is perpendicular to both the direction of the current flow (I_c) and the magnetic field. This potential appears at the midpoints of the lateral faces of plate **110** at which points electrodes **132**, **134** have been connected. This potential is developed across variable resistor **70** and indicated by meter relay **74** (FIG. 1).

In operation the electrical loading on motor **10** is sensed by wattmeter **28** and indicated on meter relay **74** e.g. model 202 manufactured by Assembly Products Inc. When a new pack assembly **18** is installed, this electrical loading will be nominal. As the filter picks up the foreign material, etc., creating increasing back pressure the power input to motor **10** increases as the pump continues to force a constant supply of molten material through the pack assembly. At some point in time the back pressure of the pack assembly **18** will be such as to cause slippage in metering pump **12** and the desired amount of molten polymer will not be forced through spinneret **24** to form filaments **22**. The filaments thus will have insufficient material and will be of low denier or small size. This is not acceptable. The magnitude of the pack pressure that will cause this will depend upon many factors such as the precision of metering pump **12**, and the viscosity and composition of the polymer being spun.

Meter relay **74** is calibrated to correspond with spun yarn denier by deniering the yarn over a period of time until the denier fall below average and then setting contacts **76, 78** to close just prior to reaching the low denier condition i.e. minimum acceptable average denier. In the melt spinning of nylon experience has shown that power input to meter pump motor **10** correlates both with pressure developed in pack **18** and the denier of yarn **22** and the electrical loading on the motor is an accurate indication of yarn denier. The closing of contacts **76, 78** will energize alarm light **80**. This alarm can be a visible light or an audible signal such as a bell or klaxon which signals the operator that it is time to change the pack in order to avoid the production of low denier yarns.

In a series of runs useful spinning pack life was extended without the incidence of low denier. Production of low denier spun yarn is readily detectable by monitoring the electrical loading on the meter pump motor.

With the recent commercialization of small compact Hall Effect power sensor e.g. Hall Effect wattmeter model HX5501 manufactured by F. W. Bell, it has become feasible to mount a power sensor **28** on each motor in a multipositioned spinning machine. Such a wattmeter was the used embodiment of the above-noted spinning runs. It is, of course, obvious that a single alarm indicator can be used for each spinning position or the output from all of the power sensors on a spinning machine may be fed to a single recorder with a control point which would sound a single alarm. In that case the operator would look at the recorder to determine which spinning position required a pack change.

Variable resistor **70** is used to adjust the span of the signal from the power sensor **28** which is fed to meter relay **74**, so that small differences between motors and power sensors as well as the production of different deniers may be adjusted to provide a uniform level of detection among spinning positions.

It also should be noted that alternative to meter relay **74** solid state equipment is readily adaptable for indicating changes in the output of the wattmeter **28** and initiating actuation of an alarm or a control apparatus such as a yarn cutdown device.

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

What is claimed is:

1. The method of determining minimum acceptable average denier of filaments being extruded from a spinning pack wherein pressurized molten polymer is supplied to the pack at a constant metered rate by means of a metering pump driven by a constant speed electric motor said method comprising the steps of:

a. continuously detecting the power input to the motor; and

b. signalling the occurrence of said power input corresponding to minimum acceptable average filament denier.

2. The method of determining average denier of filaments being extruded from a spinning pack wherein pressurized molten polymer supplied to the pack at a constant metered rate by means of a metering pump driven by a constant speed electric motor said method comprising the steps of:

a. continuously detecting the power input to the motor;

b. indicating the power input corresponding to average filament denier; and

c. signalling the occurrence of said power input corresponding to minimum acceptable average filament denier.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,619,433 Dated November 9, 1971

Inventor(s) William Thomas Windley

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

Column 4, lines 13-31 replace claims 1 and 2 with the following claim:

1. The method of determining minimum acceptable average denier of filaments being extruded from a spinning pack wherein pressurized molten polymer is supplied to the pack at a constant metered rate by means of a metering pump driven by a constant speed electric motor and wherein power input to the motor is an indication of yarn denier said method comprising the steps of:

a) continuously detecting the power input to the motor;

b) generating electrical signals proportional to the power input to the motor; and

c) feeding said signals to a means for detecting and signalling the occurrence of said power input corresponding to minimum acceptable average filament denier for actuation thereof.

On the title page, "2 Claims" should read -- 1 Claim --.

Signed and sealed this 9th day of May 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents