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APPARATUS FOR PRODUCING UNIFORM CONTINUOUS FIBERS

Original Filed Aug. 2, 1962

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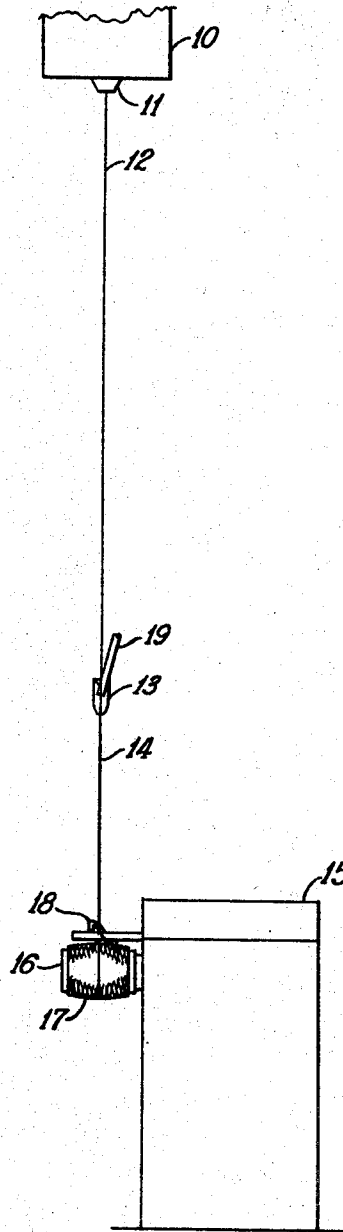


Fig. 1

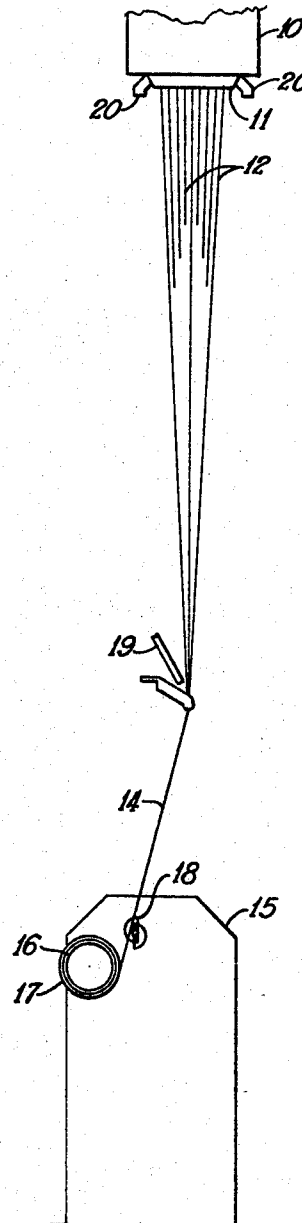


Fig. 2

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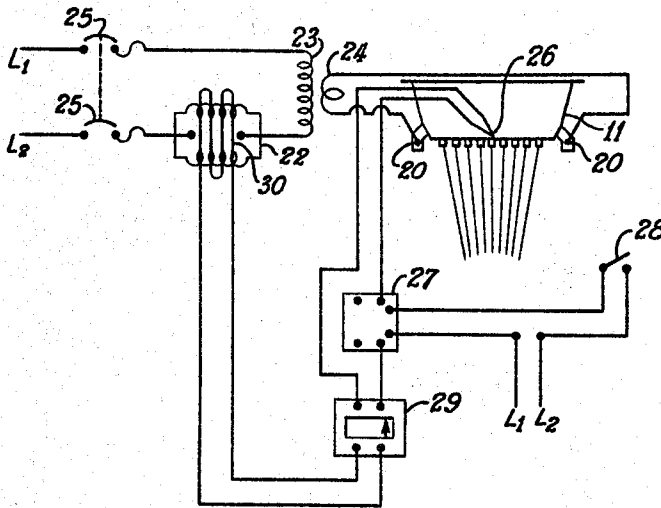


Fig. 3

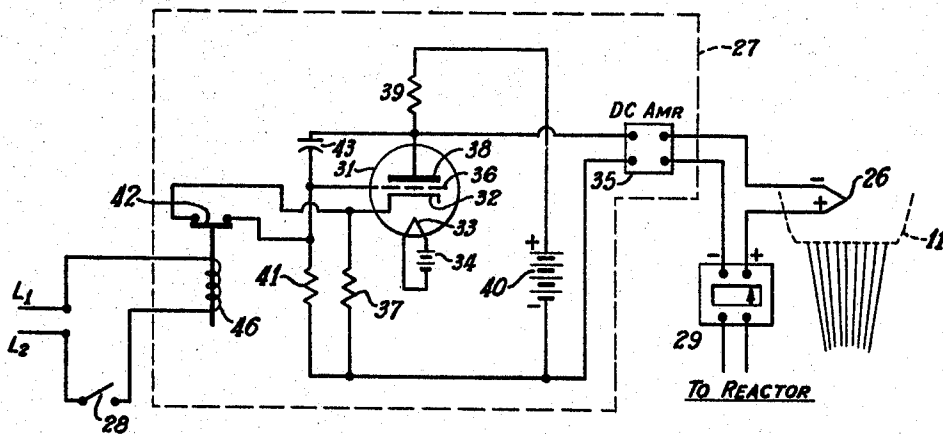


Fig. 4

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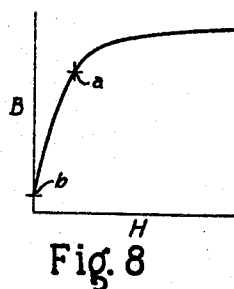
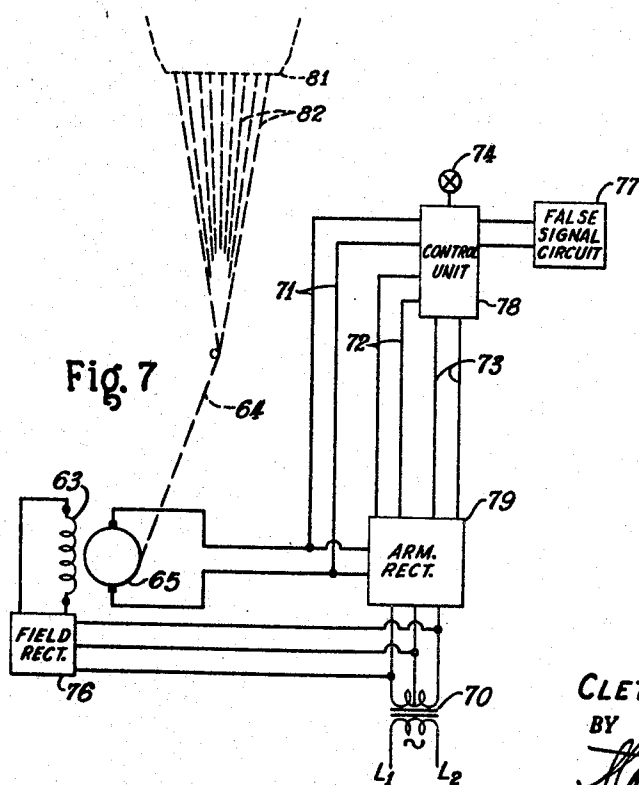
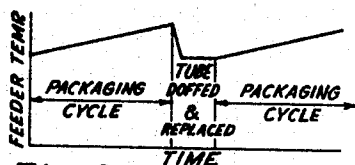
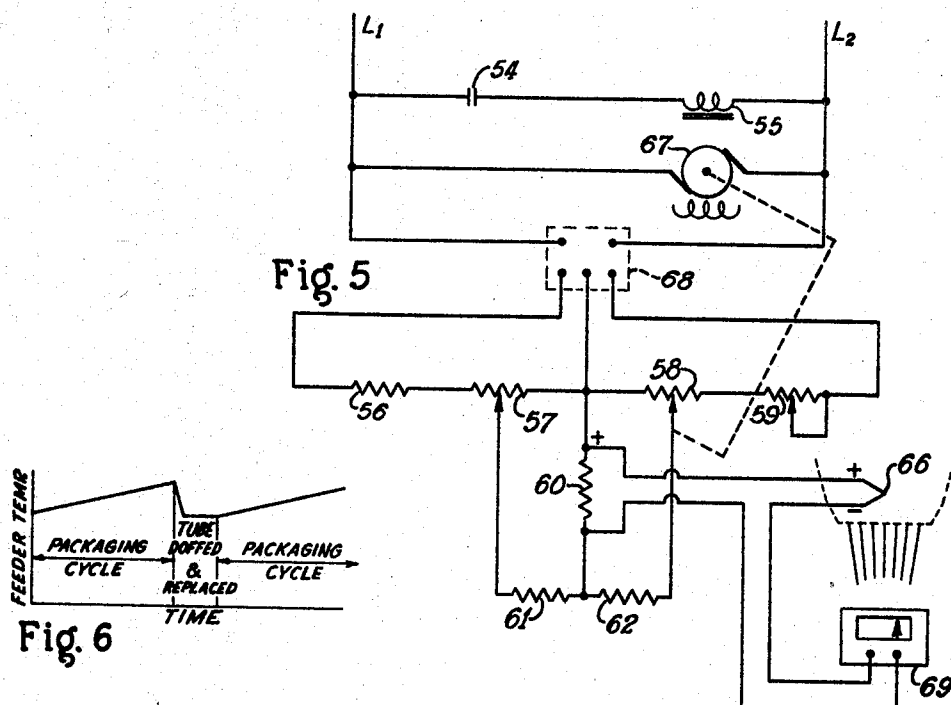
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4 Sheets-Sheet 3



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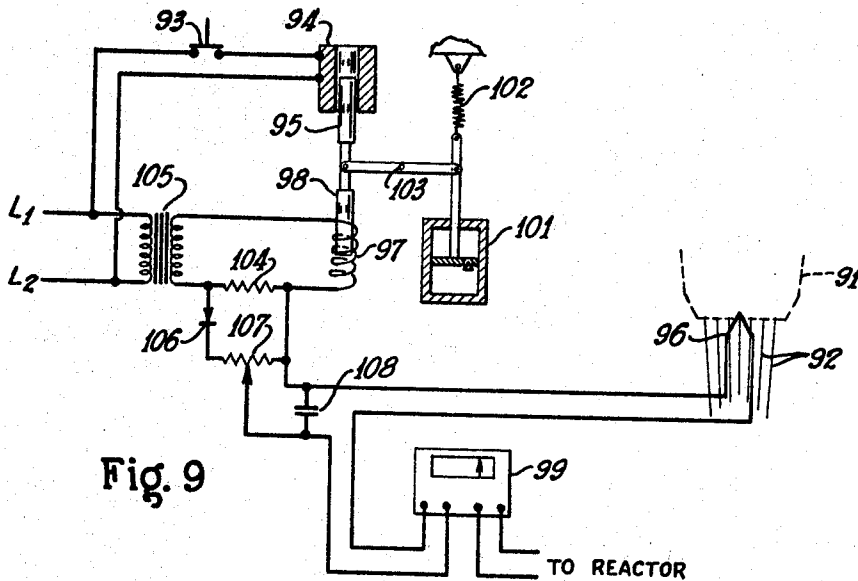
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APPARATUS FOR PRODUCING UNIFORM
CONTINUOUS FIBERS

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Original application Aug. 2, 1962, Ser. No. 214,218, now Patent No. 3,126,268, dated Mar. 24, 1964. Divided and this application Dec. 19, 1962, Ser. No. 245,838

The portion of the term of the patent subsequent to Mar. 24, 1981, has been dedicated to the Public
8 Claims. (Cl. 65—1)

This application is a division of my copending application Serial No. 214,218, filed August 2, 1962, now Patent 3,126,268 issued on March 24, 1964, which in turn is a continuation-in-part of my application, Serial No. 489,588, filed February 21, 1955, now abandoned.

This invention is related to the production of continuous fibers of thermoplastic materials and more particularly to improvements in means for producing such fibers where the forming process entails mechanical attenuation of the fibers from streams of the heated thermoplastic material.

It is well known that thermoplastic materials such as glass can be drawn into continuous fibers by attenuation of streams flowing from a feeder associated with a molten body of the material. The flowing material is attenuated in this process into individual fibers which are usually gathered into a strand under the influence of pulling forces exerted by a winder which collects the strand into a package. The strand in such instances is usually wound on a collection tube mounted on a rotating collet of the winder and may be collected at linear speeds in the order of 15,000 to 20,000 feet per minute or more.

In manufacturing fibers in this manner the goal has been to produce fibers which are closely similar in diameter and individual fibers of uniform diameter throughout their length. If production of fibers of such uniformity could be attained, the strand yardage per pound of glass supplied from the feeder would be consistently uniform and much would be done to promote consumer reliance upon product quality when strand or fiber diameters are specified.

On collection of strand into a package, however, a gradual buildup of the package occurs in the usual packaging cycle of approximately 15 to 30 minutes, such that for a given speed of the collection tube, the linear speed of attenuation is in effect gradually and uniformly increased to a maximum linear speed toward the end of the packaging cycle. In other words, at the start of a packaging cycle, the linear speed of attenuation of the fiber from the feeder is determined by the outer diameter of the bare collection tube, but as buildup of the package occurs, the speed of attenuation instead becomes dependent upon the outer diameter of the top layers of strand in the package. When viewed on an over-all basis, the linear speed of attenuation increases gradually from a minimum at the beginning of a packaging cycle to a maximum at the end of a packaging cycle when the package is completed. Under fixed conditions of temperature of the glass supplied from the feeder, the diameter of fibers collected into the strand being wound is correspondingly undesirably diminished because of this increase in speed. Consequently, the yardage per unit weight of glass being collected also varies dependent upon whether it is collected at the beginning or the end of the package.

It is therefore a principal object of the present invention to provide an improved means for mechanically attenuating continuous fibers from thermoplastic materials wherein the resulting fibers are more consistently uniform in diameter along their complete length, and in which the

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yardage per pound of strand packaged is consistently uniform.

It is a further object of the invention to provide apparatus for attenuating continuous fibers of thermoplastic materials in which uniformity in physical dimensions may be imparted thereto without requiring modification of the basic forming processes.

It is still another object of the invention to provide means for improving the process of forming glass fibers to provide more uniform quality without requiring undue added operational care.

It has been discovered according to the present invention that when one of the fiber-forming factors such as the temperature of the thermoplastic material emitted from the feeder is programmed or varied at a patterned rate matched to the variation in linear speed of attenuation, that the fiber diameter can be maintained more exactly uniform regardless of the variation in speed of attenuation. Fiber-forming factors which can be varied to accomplish such uniformity include glass temperature and winding speed. Of the factors which may be varied to produce uniform fibers, however, it is preferred to vary the temperature of the thermoplastic material during attenuation because of the greater ease of adaptability of such variation to programmed operation with conventional fiber-forming processes. Such variation in temperature is effected in the present disclosure by controlling current flow through a resistance-heated feeder. In other words, as package buildup of strand occurs and a corresponding increase in the speed of attenuation results, the temperature of the feeder associated with the attenuating means can be gradually increased by causing the current flow through the resistance-heated feeder to increase at a matched rate to produce fibers of uniform diameter throughout their length.

A feature of the invention is its adaptability to existing processes to permit production of fibers of highly uniform quality with a small investment in additional equipment and practically no additional operational care.

Another feature of the invention is the large size packages which it allows to be produced in forming operations with attendant reductions in handling costs.

Other objects and features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, as to its manner of construction together with other objects and advantages, may best be understood by reference to the accompanying drawings, in which:

FIGURE 1 shows a general layout of apparatus for producing continuous glass fibers;

FIGURE 2 is a front elevational view of the general layout of apparatus shown in FIGURE 1;

FIGURE 3 is a partially schematic and diagrammatic illustration of a circuit which may be used for control of the electrical current supplied to the feeder of the apparatus of FIGURES 1 and 2;

FIGURE 4 is a detailed schematic drawing of an electronic programming circuit for use with feeder control circuits such as shown in FIGURE 3;

FIGURE 5 is a schematic illustration of still another programming circuit for control of current flow through a feeder;

FIGURE 6 illustrates in graphic form the feeder temperature-time characteristic obtainable by use of control circuits such as those of FIGURES 4 and 5;

FIGURE 7 shows another circuit arrangement whereby fibers attenuated from a feeder are maintained uniform in diameter by gradual modification of the rotary speed of the packaging unit;

FIGURE 8 illustrates a typical B-H curve for magnetic material such as may be embodied in a saturable-core reactor; and

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FIGURE 9 is a schematic illustration of still another programming circuit utilizing inductive principles for control of current flow through a feeder.

Although the invention is herein exemplified by reference to glass fiber production, it will be apparent in view of the disclosure that it has application to production of fibers of other materials as well.

Turning to the drawings in greater detail, the general layout of strand forming and winding apparatus of FIGURES 1 and 2 includes a source of molten glass, such as a melting unit 10, having an associated electrical feeder or bushing 11 from which streams of molten glass flow. The feeder has a plurality of aligned orifices of small dimension which form the streams from which filaments or fibers 12 are then drawn. The feeder is made of high-temperature conducting material such as platinum and is provided with terminals 20 at opposite ends thereof across which a potential is applied to supply current of magnitude sufficient to heat it as to the desired attenuating temperature for the glass.

The force of withdrawal of fibers 12 from the material emerging from the feeder 11 is provided by winding apparatus such as a collet-type winder 15 which winds the strand 14 formed of the fibers 12 onto a collection or packaging tube 16 in the form of a generally cylindrical package 17. The fibers 12 are gathered together by a size-applying gathering member 13 at a point intermediate the packaging tube 16 and the feeder 11. Sizing fluid is supplied to the gathering member 13 from an external source, not shown, through a tube 19 disposed above the gathering member. After formation, the strand 14 is caused to traverse the collection tube 16 by a spiral-wire type traverse 18 of the winder 15. A thermocouple 26 is arranged to make contact with one side of the feeder to generate a temperature signal to be supplied to the automatic controls as described hereinafter.

FIGURE 3 shows an electrical power circuit and associated controls for supply of energy to heat the feeder 11. Broadly, the power circuit includes a saturable-core reactor 22 in series with a power transformer for the feeder. The feeder is connected by way of its terminals 20 across the secondary winding 24 of the power transformer while the primary of the transformer is connected serially with the saturable reactor 22. The series circuit is connected to a suitable power line source L1, L2 such, for example, as a 440-volt, 60-cycle line through contacts 25 of a line circuit breaker and over a pair of suitably fuse-protected circuit leads.

Current-regulating controls for the power circuit may be provided by a conventional-type temperature-sensing and regulating unit 29 such as a unit of the type well known to the instrument trade as a Wheelco unit which can be arranged to operate in conjunction with the temperature-sensing thermocouple 26. This unit operates to sense the temperature of the feeder by way of the thermocouple and to indicate the temperature signal at a meter provided with means for presetting the temperature desired. As the temperature signal fed to the unit varies from a preset value, the unit functions to supply a corrected signal to the power circuit by way of the saturable reactor to establish the current flow for the temperature desired. According to the present invention, however, the regulating unit not only receives the signal from the thermocouple 26 but also an auxiliary signal corresponding in effect to a false temperature signal supplied by unit 27 as described hereinafter.

The saturable-core reactor 22 has an associated direct current winding 30 which when energized builds up the flux concentration in the reactor in characteristic manner illustrated by the B-H curve of FIGURE 8. Energy for the D.C. winding 30 is supplied from the temperature-regulating unit 29. When the flux concentration in the saturable-core reactor 22 is high on the B-H curve, such as at point (a) just below the knee of the curve, the inductive reactance of the reactor is at a minimum and the

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current supplied to the transformer by way of its primary is correspondingly at a maximum. When, however, the direct current flow in the winding 30 is somewhat smaller, such that the flux concentration in the reactor dwells in the region of point (b) considerably below the knee of the curve, the inductive reactance of the reactor is more appreciable and the current flow in the transformer primary is accordingly lower. Thus, the amount of direct current flowing in the winding 30 determines the magnitude of the reactance in series with the transformer and consequently determines the amount of electrical energy supplied to establish the temperature of feeder 11.

As indicated previously, it has been found that by causing a gradual increase in the temperature of the feeder as increases in speed of attenuation of fibers occur permits production of fibers of uniform diameter throughout each packaging cycle for each package wound. That is, as the speed of attenuation increases due to package buildup, a gradual increase in temperature of the feeder at a matched rate, results in establishment of compensating variations in the attenuation factors to permit production of fibers uniform in diameter within a very close tolerance. On viewing the operation more fundamentally, it appears that the progressive increase in temperature of the glass in actuality causes the glass to flow more freely from the feeder. Thus, more molten material is made available as the speed of attenuation increases to maintain the diameter of the glass fibers uniform.

FIGURE 6 illustrates graphically the ramp or slope function, or in still other words, the stepped manner by which the feeder temperature may be varied with respect to time to effectively provide fiber uniformity throughout the packaging cycle. Each step of temperature variation is matched to a packaging cycle. At the beginning of the cycle, the feeder temperature is at a minimum while during the cycle it is gradually increased to a maximum which will compensate for the increased speed due to buildup at the end of the cycle.

While the package is being doffed, and another collection tube is being installed on the collet, the temperature of the feeder is reduced to its initial value at the beginning of the cycle preparatory to start of another packaging cycle. It has been found that this reduction in temperature can be effected in a period of very short duration by cutting back on current flow through the feeder. Because of the high temperature differential between the feeder and the surrounding atmosphere, the period required to effect temperature reduction is a matter of mere seconds and is sufficiently rapid not to be a retardant to start-up of a subsequent packaging cycle. In other words, the reduction in temperature can be effected with time to spare in the period usually required to effect removal of a completed package and reinstallation of a new collection tube.

By way of example, in one installation a 15° F. increase in feeder temperature from a temperature of 2300° F. in a 20-minute cycle maintained fiber uniformity within a 1% tolerance, whereas previous to providing a matched temperature variation with package buildup, a 7% tolerance was the closest that could be attained.

The gradual buildup of temperature can be accomplished by supplying a false temperature signal to the regulating unit 29 from the unit 27 along with the temperature signal supplied thereto by the thermocouple 26. The unit 27 is connected to the regulating unit 29 in series with the thermocouple and is arranged to oppose the thermocouple signal as it increases, to falsely indicate to the unit 29 that the temperature of the feeder is gradually diminishing. That is, the regulator unit receives a false temperature signal which causes it to allow the current flow through the feeder to gradually increase and consequently effect a gradual increase in temperature of the feeder.

More than one type of circuit arrangement might be

adopted to provide this false signal. Thus, the circuit arrangements set forth herein are intended to be an example of the means by which such signals can be provided rather than being limiting.

In FIGURE 4 the exemplary circuit is a vacuum tube circuit which prolongs the charge characteristics of a resistance-capacitor circuit to provide a ramp-function or gradually increasing direct current signal arranged to oppose the thermocouple signal. The ramp-function signal is initiated responsive to closure of a switch 28 which is suitably associated with the winding apparatus for actuation when the winder begins a package winding cycle. The switch may be conveniently associated with the winder traverse mechanism to operate in this manner. A solenoid relay 46 connected across a power source L1-L2 through the switch 28 has a pair of normally closed contacts 42 in the vacuum tube circuit which initiate development of the ramp function.

As indicated, the circuit is in general a resistance-capacitance circuit in which a condenser 43 has a charge built up therein under the influence of a "B" battery 40 through a load resistance 39 and grid bias resistance 41. The grid resistance 41 and a cathode resistance 37 are connected in parallel when the contacts 42 which bridge the grid and cathode are in their normally closed position. The vacuum tube 31 is a triode having a plate 38 which is connected directly to the load resistance 39 as well as to a direct current output amplifier 35. The cathode 32 is connected to the biasing resistance 37 which in turn is connected to the negative side of the battery 40 while the heater 33 is suitably energized as by a filament battery 34. The grid 36 is connected to the negative potential side of the condenser which corresponds to the same potential as that of the cathode when the contacts 42 are in normally closed position. Since the grid thus has a zero bias voltage when the contacts 42 are closed, the tube functions in a sense as a diode and has its maximum current flow therethrough. The voltage drop across the tube, and correspondingly across the condenser, is therefore at its lowest value.

Upon opening of the contacts 42 responsive to closure of the switch 28, the cathode and grid are connected independently to their bias resistances 37 and 41, respectively. The grid potential, however, is initially dependent on the low charge on the condenser until the condenser can build up a charge through the grid bias resistance 41. The current flow is accordingly at a high initial value but gradually diminishes as the condenser charge builds up. Correspondingly, the voltage drop across the tube starts out at a low value and gradually builds up dependent upon the rate at which the condenser is charged.

Thus, the D.C. amplifier 35, having one side of its input connected directly to the plate 38 and having its other input side connected directly to the negative side of the battery 40, is supplied with a gradually increasing signal upon closure of the switch 28, which signal in turn may be supplied to the D.C. amplifier for amplification before introduction into the circuit of thermocouple 26. The magnitude of components of the circuit are selected so that the period of charge of the condenser 43 is sufficiently long that a packaging cycle can be completed within the linear portion of the charge characteristic of the condenser. The effective R.C. time constant of the circuit can be extended in this manner to periods as long as several hours and thus can be designed to provide a substantially straight line signal characteristic for the smaller periods corresponding to the usual packaging cycles. Although the vacuum tube in the circuit described is a triode, it will be recognized that the circuit may be readily modified to incorporate tetrode or pentode tubes for different linearity characteristics if desired.

The switch 28 can be readily arranged to be opened automatically and the winding apparatus stopped automatically when the package is built to full size such as may be determined by winding for a given period, thereby

causing the contacts 42 to return to their normally closed condition. The resistances 37 and 41 are thereupon again connected in common with the grid to reset the circuit for charge of the condenser 43. The circuit arrangement is such that the discharge period is sufficiently short that more than enough time exists during the doffing period to permit complete recharge of the condenser and return of the feeder temperature to the temperature value desired before start of a subsequent packaging cycle.

FIGURE 5 illustrates another arrangement by which a gradually increasing signal can be introduced into the thermocouple circuit. This arrangement includes a variable resistance 58 driven by a clock-type motor 67 which gradually modifies the resistance during each packaging cycle to provide a gradually increasing voltage signal. This signal is supplied to a load resistance 60 connected in the thermocouple circuit to introduce a false temperature signal therein for receipt by the temperature-regulating unit 69.

More specifically, energy for the false signal circuit is supplied over suitable power lines L1 and L2 of an alternating current source to a converter unit 68 which in turn provides a constant D.C. reference voltage for the false signal circuit. A pair of contacts 54 mechanically associated with the traverse mechanism of the winder of FIGURES 1 and 2 are arranged to close and operate a clutch 55 when the winder is in operation. The clutch mechanically connects the continuously running clock motor 67 to the shaft of the potentiometer 58 which varies the magnitude of the signal introduced into the thermocouple circuit.

The direct current portion of the circuit consists in general of a tapped voltage divider branch including a pair of series-connected resistances 56 and 57 on one side of the tap and resistances 58 and 59 on the other side. Variable voltage selector taps are associated with the resistances 57 and 58, respectively, and have a pair of series-connected resistances 61 and 62 connected therebetween. The resistance 60 is connected between the tap point between the resistances 57 and 58 and a point between the resistances 61 and 62. It is from the resistance 60 that the false signal voltage is introduced into the thermocouple circuit. The variable tap of the resistance 58 on being driven by the motor 67 gradually increases the voltage signal applied across the resistance 60. The mechanical arrangement of the variable voltage selector arm for the resistance 58 is such that it begins at one end of the resistance 58 and sweeps slowly thereacross during the packaging cycle, and then drops back to the beginning of the resistance upon completion of a package preparatory to start of a subsequent step of the false signal.

The resistance 59 is arranged to be manually variable to enable adjustment for the slope of the false signal with respect to time. In other words, the variability of resistance 59 permits adjustment of the rate of increase of the signal supplied at the resistance 60, thereby permitting a match of the stepped temperature rise of the feeder with the rate of buildup of packages. A manually variable tap is additionally provided for the resistance 57 to permit preselection of the feeder temperature at the beginning of the packaging cycle.

While the invention is described above principally in connection with circuits for straight-line programming of the feeder temperature, it is contemplated that the feeder temperature may also be modified on a nonlinear basis when desired. Thus, the nonlinearities in the rate of attenuation such as may be caused by odd shaped packages or unusual paths taken by the strand to effect winding of packages can be matched by corresponding nonlinear feeder temperature variations to attenuate fibers of uniform diameter.

FIGURE 7 shows another arrangement adapted to providing uniform fiber diameters by attenuation of a plurality of fibers 82 at a constant linear speed from a feeder 81. The constant speed of attenuation is obtained in this

instance by programming the speed of the winder motor 65 in accordance with the rate of buildup of the package being wound on the winder. The motor 65 is a conventional electronically controlled D.C. motor such as is commercially available with feedback circuits to operate at constant speed for a range of load conditions. The motor and controls are connected to a suitable power source such as an alternating current source through a power transformer 70 connected across lines L1 and L2.

The motor armature receives its energy from an armature rectifier 79 connected to the transformer 70 while the D.C. field 63 of the motor receives energy from a separate rectifier 76 which is also connected to the transformer 70. The voltage and current supplied to the armature is regulated through the armature rectifier 79 by a control unit 78 which receives a speed feedback signal from the motor over leads 71 and a current feedback signal from the rectifier 79 over leads 72. The main control signals are transmitted to the motor over a pair of leads 73 through the rectifier 79. The unit 78 includes an amplifier and grid circuit as well as an error circuit to assimilate the feedback signal for maintenance of the desired constant speed of the motor. The speed of the motor may be adjusted by a manually adjustable potentiometer 74 which sets the uniform speed at which the motor is to operate.

The electronic controls contained in unit 78 in the present instance, however, are arranged to receive a false speed variation signal from a unit 77 similar to the unit 27 in FIGURE 4. That is, the unit 77 is arranged provide a signal to the electronic circuits of the control unit 78 to falsely indicate that the motor is gradually increasing in speed and thus cause the control circuits to gradually reduce the speed of rotation of the motor 65 as package buildup occurs. The linear speed of attenuation of the strand 64 can thereby be made uniform throughout the packaging cycle to correspondingly produce fibers 82 of uniform diameter throughout the packaging cycle.

It will be noted that in addition to varying feeder temperature or winder speed independently of each other, that both these variables may also be modified simultaneously in complementary relationship to produce fiber uniformity. Additionally, these factors may also be varied in sequence one at a time during a given cycle for purposes such as extension of the cycle over a longer period without requirement of large variation of either factor from a given value. In still other instances, the fibers may be controllably varied in diameter along their length by causing periodic variations in feeder temperature or variations in speed of attenuation. In the latter instance, the variations in diameter may be cyclically varied over short sections of the continuous fibers by selection of a package shape, such as a rectangular or pentagonal package, which when rotated at a constant rate will effect variations in the rate of attenuation within short intervals. Fibers of varying diameter can be gathered to provide strands which vary in cross-sectional dimension along their length and to permit production of yarns of corresponding dimensional variation. The fibers of varying diameters may also be arranged to have their sections of similar diameter staggered to reapproach uniformity in the strands and yarns while still taking advantage of fiber diameter variations.

FIGURE 9 is still another circuit arrangement by which a gradually increasing ramp-function signal can be produced for introduction into a control circuit for modification of the condition monitored by the control circuit. In this arrangement a variable inductance is utilized as the variable timing element for programming the signal fed to the regulating unit 99.

A solenoid 94 energized by A.C. supplied over lines L1 and L2 and through a pushbutton switch 93, draws up the solenoid armature 95 and simultaneously withdraws a core or slug 98 from within an inductance coil

97, while at the same time tensioning a biasing spring 102 and pushing against a pneumatic dash-pot 101, both of which are mechanically associated with the slug 98 through a pivoted lever arm 103 to cause a gradual withdrawal of the slug. When the armature 95 completely withdraws the slug 98 from the coil, a maximum signal is introduced into the thermocouple circuit. This is accomplished by first rectifying the A.C. energy supplied from the transformer 105 which is rectified through a suitable rectifier 106, and then supplying the rectified signal into the thermocouple circuit by way of a potentiometer 107. A resistance 104 bridges the rectifier and potentiometer to provide an A.C. path through the inductance 97. A capacitance 108 bridging the potentiometer output smoothens the rectified signal to make it more compatible with the signal corresponding to temperature of the feeder 91 supplied from thermocouple 96.

When the pushbutton 93 is actuated, the solenoid 94 is energized and gradually withdraws the core 98 from the coil 97 as regulated by the dash-pot 101, which is provided with suitable adjustment to permit extension of the withdrawal period over the time desired. The gradual withdrawal of the core from the inductance 97 gradually decreases the inductive reactance in the potentiometer input circuit and accordingly, increases the voltage at the output leads of the input potentiometer in the thermocouple circuit. The potentiometer signal gradually builds up and when combined with the thermocouple signal, it indicates to the regulating unit 99 that a gradual change in current in the feeder circuit should be made. The variable inductance thus produces a ramp-function temperature variation to produce uniform diameter fibers 92 similar to the programming signals produced by the circuit arrangements shown in FIGURES 4 and 5. Upon completion of the package buildup cycle, the solenoid is arranged to be de-energized, and the spring 102 which is gradually built up in tension during the period of withdrawal of the core 98, now acts to reset the dash-pot 101 and at the same time reinsert the core 98 into the coil 97 for start of another packaging cycle.

Thus, while I have shown certain particular forms of my invention, it will be understood that I do not wish to be limited thereto since many modifications may be made within the concepts of the invention, and I, therefore, contemplate by the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

I claim:

1. Fiber producing apparatus comprising in combination means supplying a plurality of streams of molten fiber-forming material, a winder collet for attenuating said streams into continuous fibers and for collecting said fibers into a package, a gathering device between said feeder and winder for grouping said fibers into a strand before being wound into said package, an electrically energizable motor arranged to rotationally drive said collet, motor power control means regulating the power supplied to said motor and consequently the speed of said motor, speed sensing means arranged to supply signals corresponding to the speed of said motor, said motor speed control means being arranged to receive and regulate the power supplied to said motor according to requirements for a preselected constant speed, and electrical timing means arranged to supply preselected programmed auxiliary signals matched to the rate of build-up of said package, said control means being arranged to receive and modify the regulation by said speed signals according to said auxiliary signals to maintain constant the rate of attenuation of said streams.

2. Fiber producing apparatus comprising in combination means supplying a plurality of streams of molten fiber-forming material, a winder collet for attenuating said streams into continuous fibers and for collecting said fibers into a package, an electrically energizable motor

arranged to rotationally drive said collet, a motor speed control circuit for regulating the power supplied to said motor, speed sensing means arranged to supply signals corresponding to the speed of said motor to regulate the power supplied to said motor, said motor speed control means being arranged to receive and regulate the power supplied to said motor according to requirements for a preselected constant speed, and electrical timing means arranged to supply preselected programmed auxiliary signals matched to the rate of build-up of said package, said control circuit being arranged to receive and modify the regulation by said speed signals according to said auxiliary signals to maintain substantially constant the rate of attenuation of said streams.

3. The fiber producing apparatus of claim 2 wherein the electrical timing means is a capacitance timing means for supplying programmed auxiliary signals.

4. The fiber producing apparatus of claim 2 wherein the electrical timing means is a driven variable resistance means for supply of programmed auxiliary signals.

5. The fiber producing apparatus of claim 2 wherein the electrical timing means is a variable inductance timing means for supplying programmed auxiliary signals.

6. Fiber producing apparatus comprising in combination means supplying a plurality of streams of molten fiber forming material, a winder collet for attenuating said streams into continuous fibers and for collecting said fibers into a package, an electrically energizable motor arranged to drive said collet, motor speed control means regulating the power supplied to said motor, speed sensing means for measuring the speed of said motor and for supply of control signals proportional to said speed measurement, preselectable control means arranged to receive said control signals to regulate the power supplied to said motor to maintain its speed at a preset level, and means for supplying preselected auxiliary signals opposing said control signals to provide false speed control signals for said control means, said control means being arranged to be governed by said false signals in regulating power supplied to said motor to vary the angular speed of said collet inverse matched relation to the general rate of build-up in diameter of the package collected thereon.

7. Fiber producing apparatus comprising in combination means supplying a plurality of streams of molten fiber-forming material, a winder collet for attenuating said streams into continuous fibers, and for collecting said fibers into a package, a gathering device between said feeder and winder for grouping said fibers into a strand before being wound into said package, an electrically

energizable motor arranged to rotationally drive said collet, motor speed control means regulating the power supplied to said motor, speed sensing means arranged to supply signals to said control means corresponding to the speed of said motor to regulate the power supplied to said motor for a substantially constant speed, means for supplying an auxiliary signal to said control means opposing said speed signals to falsely indicate to the control means the occurrence of a variation in motor speed, and means for programming said auxiliary signal means according to a predetermined program to effect a gradual variations in the angular speed of said collet according to a pattern matched inversely to the general rate of build-up in diameter of said package during collection of said strand.

8. Fiber producing apparatus comprising in combination means supplying a plurality of streams of molten fiber-forming material, a winder collet for attenuating said streams into continuous fibers and for collecting said fibers into a package, a gathering device between said feeder and winder for grouping said fibers into a strand before being wound into said package, an electrically energizable motor arranged to rotationally drive said collet, motor speed control means regulating the power supplied to said motor, speed sensing means arranged to supply signals to said control means corresponding to the speed of said motor to regulate the power supplied to said motor for a substantially constant speed, and means for supplying preselected programmed auxiliary signals in opposition to the signals from said speed sensing means to provide false speed signals for regulation of the power to speed said motor, said auxiliary signal means being patterned to provide false signals such as to effect variation of the speed of the motor at a rate matched inversely to the general rate of build-up in package diameter.

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