

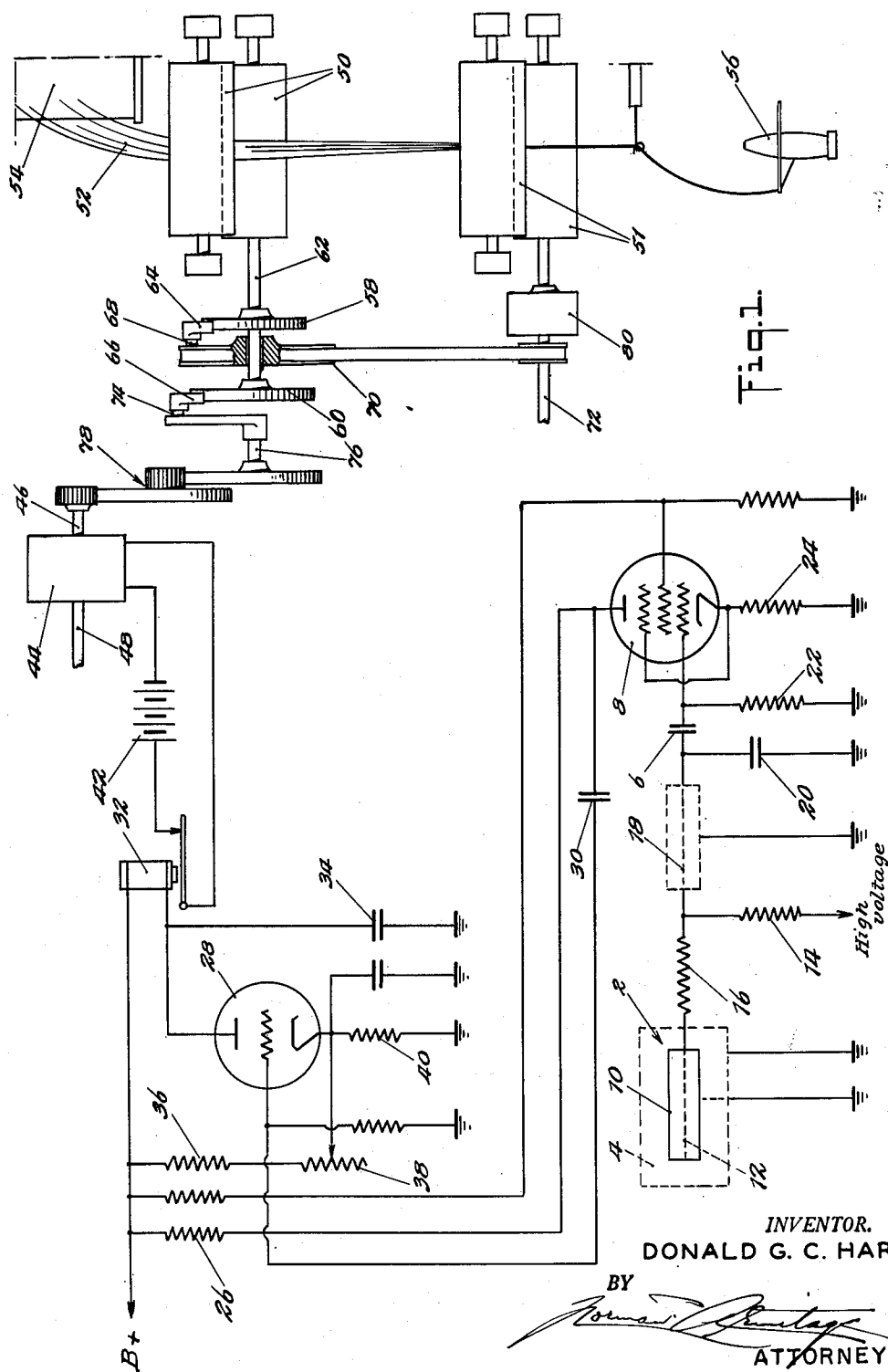
Dec. 23, 1952

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METHOD AND MEANS FOR PRODUCING
AND UTILIZING CONTROL SIGNALS

2,622,282

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3 Sheets-Sheet 1



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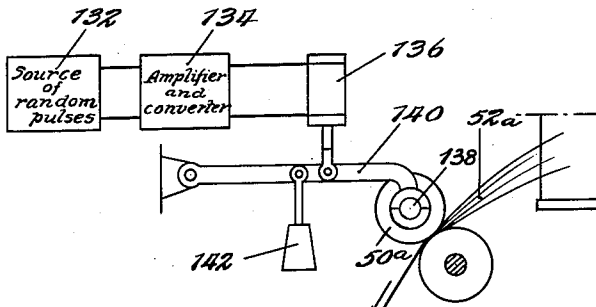


Fig. 4.

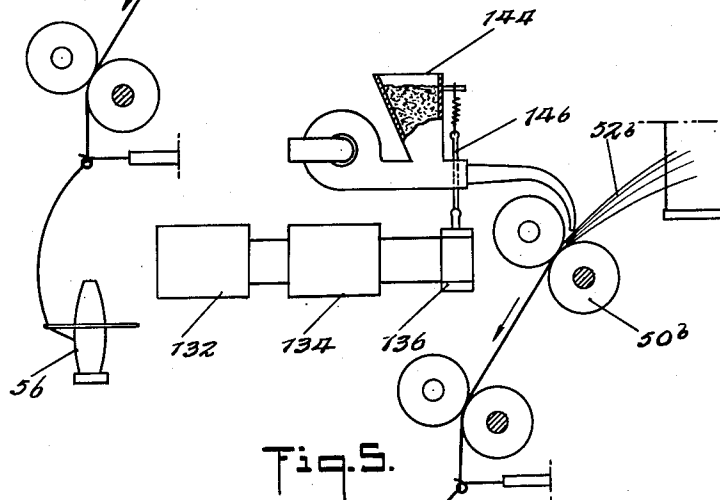


Fig. 5.

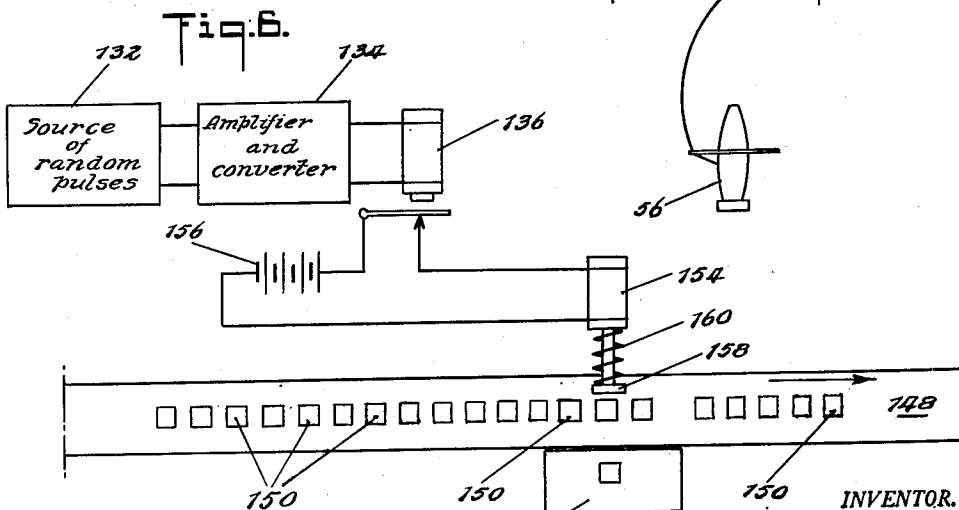


Fig. 6.

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METHOD AND MEANS FOR PRODUCING AND UTILIZING CONTROL SIGNALS

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The present invention comprises a novel type of control system which, although particularly adapted for use in the production of yarn having novel characteristics, is of more general application, as it may be advantageously employed wherever variation, control or actuation of an element after unpredictable lengths of intervals is desired. As applied to the manufacture of yarn, whether from natural fibers or from artificial filaments, the invention comprises a method of, and means for, producing yarn having slubs, that is relatively short stretches of increased diameter, at truly random intervals therein.

The deliberate injection of slubs into yarn, as heretofore practiced, has resulted either in a yarn having slubs at regular intervals therein or in one having slubs separated in accordance with a predetermined sequence of intervals. In either case the repetitive spacing of the slubs in the yarn results in a discernible pattern in fabric woven from the yarn. When, however, slubs are injected into yarn after truly random lengths of intervals, there is no discernible pattern in the yarn or fabric woven therefrom, and the fabric has a novel and interesting appearance.

The general object of the invention is thus to provide a method and means for controlling, or actuating, an element, for example an element of a slub injecting mechanism, after unpredictable lengths of intervals.

Another object of the invention is to provide relatively simple and stable apparatus for production of randomly occurring control signals.

A specific object of the invention is to provide a method of, and means for, producing yarn having slubs truly randomly spaced therein.

Other objects of the invention will become apparent as the description proceeds.

In accordance with the invention the various objects thereof are obtained by utilizing inherently random, that is, statistically variable, phenomena such as the reception of rays from radioactive material, or the incidence of cosmic rays, or random current fluctuations, or noise, in thermionic tubes, for creation of random pulses, and by providing apparatus for converting such pulses, as by amplification or integration, into appropriate randomly occurring control signals suitable for control or actuation of an element.

For an understanding of the invention and of specific systems embodying the same, reference may be had to the accompanying drawings of which:

Fig. 1 is a diagram of a control system representing a specific embodiment of the invention

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and utilizing randomly occurring control signals initiated by cosmic or other radiation for control of injection of slubs into yarn;

Fig. 2 is a diagram illustrating an arrangement for obtaining a controllable average rate of randomly occurring control signals initiated by cosmic rays;

Fig. 3 is a circuit diagram of a system utilizing random current fluctuation in a gas filled tube as a source of random pulses for conversion into randomly occurring control signals;

Figs. 4 and 5 are diagrams of alternative types of slub injection mechanisms controlled in accordance with the invention; and

Fig. 6 is a diagram illustrating the control system of the invention applied to the selection of samples for inspection.

In the embodiment of the invention illustrated in Fig. 1, advantage is taken of the inherently random nature of cosmic or similar radiation for creation of control signals for actuation of a slub injection mechanism. A counter tube 2 of suitable dimensions is shielded by a lead sheath 4 and has its high voltage terminal connected through a condenser 6 with the control grid of a pentode 8 so as to bias the pentode to cut off when the counter passes current. The counter 2 is preferably of the type known as the Geiger-Müller counter tube and comprises a grounded and air tight cylindrical member 10 containing argon or other inert gas at low pressure and a wire electrode 12 extending along the axis of the cylinder 10 and suitably insulated therefrom. High positive potential from any suitable source (not shown) is applied to the electrode 12 through a high resistance 14 and a resistor 16. The junction of resistors 14 and 16 is connected through a shielded lead 18 and the condenser 6 with the grid of tube 8. A pulse lengthening condenser 20 is connected between ground and the lead 18, and biasing resistors 22 and 24 are provided for the grid and cathode respectively of tube 8. The plate of tube 8 is connected to a source of positive potential, indicated as B+, through a resistor 26 and to the control grid of a triode 28 through a condenser 30. The plate of triode 28 is connected to B+ through the winding of a relay 32 and to ground through a condenser 34. The cathode of tube 28 is operated at positive potential, as shown, through resistors 36, 38 and 40 connected in series across the source of potential; the cathode of tube 28 being connected to the junction of resistors 38 and 40. In the particular embodiment of the invention illustrated in Fig. 1, relay 32, over a

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front contact, controls an intermediate circuit including a source 42 of direct current and an electromagnetic clutch 44. Clutch 44, when energized, couples a shaft 46 to a drive shaft 48 and such coupling results in a reduction of the draft of a yarn spinning mechanism.

The yarn spinning mechanism is diagrammatically illustrated as comprising a pair of feed rolls 50, a pair of draft rolls 51, and a conventional ring spinner 56. The rolls 50 draw roving 52 from one or a plurality of supply reels 54 and feed it into the ratch defined by the two pairs of rolls, where it is drafted by the rapid rotation of the draft rolls 51. The drafted fibers, upon emission from the draft rolls, are spun into yarn by the ring spinner 56. As is well known, the diameter of yarn spun from any roving on a given spinning mechanism may be varied by varying the draft of the mechanism, that is, by varying the ratio of the peripheral speed of the draft rolls to that of the feed rolls; decrease in draft resulting in increase in yarn diameter. Thus, by temporary increase in feed roll speed in response to energization of the magnetic clutch 44, slubs may be injected into the yarn.

In Fig. 1 such increase in feed roll speed is obtained through the use of a pair of overriding clutches, indicated diagrammatically as comprising ratchet wheels 58 and 60 on the shaft 62 of the driven feed roll and their respective driving pawls 64 and 66. Pawl 64 is mounted on an arm 68 integral with a pulley 70. The pulley 70 is rotatably mounted on the shaft 62 and belt driven from the main drive shaft 72 of the spinning mechanism. Pawl 66 is carried by an arm 74 secured to a shaft 76 for rotation therewith; shaft 76 being coupled, through suitable multiplication gearing 78, with shaft 46. The draft rolls 51 are driven from drive shaft 72 through multiplication gearing indicated diagrammatically at 80.

The operation of the system of Fig. 1 will now be described. When cosmic or other radiation penetrates the counter tube 2 and ionizes the gas therein, a transient discharge occurs between electrode 12 and the grounded cylinder 10. The grid of pentode 8 is swung sufficiently negative by the transient current to cause deenergization of the tube. This deenergization of tube 8 causes a sudden rise in potential of the grid of tube 23 with consequent energization of that tube and of relay 32. Energization of relay 32 closes the circuit of the magnetic clutch 44 which thereupon couples shaft 46 to the drive shaft 48. During the period of energization of the magnetic clutch 44, ratchet wheel 60 will be driven through its pawl 66 and its rate of rotation will be greater than that of pulley 70. Consequently the teeth of ratchet wheel 58 will slide under the pawl 64 and the rate of rotation of shaft 62 will be increased. The resulting increased rate of rotation of the feed rolls and consequent reduction in draft will cause a slub to be injected into the yarn, the length of which will depend upon the duration of the control pulse and the diameter of which will depend upon the rate of rotation of the shaft 48.

Thus, with the above described arrangement, pulses resulting from random discharge of the counter tube 2 are converted by amplification into signals suitable for actuation of slub injecting mechanism, the control signals, in the case of the system of Fig. 1, controlling the circuit of the magnetic clutch, operation of which results in injection of a slub.

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The optimum dimensions of the counter tube 2 and of the lead sheath 4 will depend upon the radiation to which it is to be exposed and upon the desired average frequency of discharge of the counter, which in turn depends largely upon the mechanism to be controlled. In the case of slub injection, the desired average frequency will depend upon the rate of yarn production of the spinning mechanism. As the rate of emission per unit weight, and the penetrating powers of the radiations of radioactive materials are known, as is also the average frequency of incidence of cosmic rays, suitable dimensions of the counter for any desired average number of pulses may be readily calculated. Preferably the counter tube 2 of Fig. 1 is dimensioned for actuation by cosmic rays as, when advantage is taken of cosmic rays, the use of relatively expensive radioactive materials is avoided. The circuit of Fig. 1 with a cosmic ray actuated and properly shielded counter tube of about six inches in length and having a diameter of one and one-quarter inches has been found to operate particularly satisfactorily to produce control pulses at an average rate suitable for random slub injection.

With the particular system of Fig. 1, the average rate of production of control signals can be increased or decreased by substitution of a counter tube of larger or smaller surface area, respectively, for the counter tube 2. A system wherein adjustment of the average rate of production of control signals may be made without substitution or replacement of elements is disclosed in Fig. 2, to which reference may now be had. In this embodiment of the invention control signals are produced when two counter tubes are discharged by cosmic rays coincidentally; the two counters being mounted so that they may be moved relatively to each other for increase or decrease, as desired, of the average rate of coincidental discharges.

The two counter tubes, which are indicated in Fig. 2 at 2a and 2b, are carried in bracket arms 82 and 84. Arm 82 and arm 84 are respectively mounted as by screws 82' and 84' on upright supports 86 and 88. The outer cylindrical electrodes 10a and 10b of the counter tubes 2a and 2b, respectively, are grounded, as indicated, and the wire electrodes 12a and 12b thereof are connected through individual conventional quenching circuits to a conventional coincident circuit for production of control signals.

The quenching circuits for tubes 2a and 2b, each of which passes a negative pulse to the coincident circuit each time the associated counter tube discharges and also quenches the discharge, are alike and hence only one need be specifically described. The quenching circuit associated with counter tube 2a comprises a pentode 93a, the control grid of which is connected to the wire electrode 12a of the counter and the anode of which is connected to a source of high positive potential indicated as V, a resistor 92a connected between the control grid and cathode of tube 93a, a resistor 94a connected between the cathode and ground and a condenser 96a connected between the cathode of the tube and the coincident circuit now to be described. This circuit comprises a pair of pentodes 98a and 98b the plates of which are connected together and to one end of a high resistance 100, the other end of which is connected to the positive terminal of a source 102 of high voltage. The cathodes of tubes 98a and 98b are grounded and the control grids are connected to ground through resistors

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104a and 104b respectively and to the condensers 96a and 96b respectively of the quenching circuits. The screen grids of the tubes are supplied with a positive potential through a lead 106 tapped to an intermediate point of the source 102.

In Fig. 2 the circuit upon which are impressed the positive pulses transmitted by the coincident circuit is shown as identical with that part of the circuit of Fig. 1 upon which the positive pulses transmitted by the tube 8 are impressed and the elements thereof are indicated by the same reference numbers as used to identify like elements of the circuit of Fig. 1. The circuit comprises the tube 28 with its control grid connected through the condenser 30 with the anodes of tubes 98a and 98b, and the relay 32 in the plate circuit of the tube 28 for energization when the tube passes current as a result of the delivery of a positive pulse to the control grid.

With the system of Fig. 2, as the control grid of tube 90a has no fixed bias, the tube normally passes current and hence the counter tube 2a is substantially in parallel with the resistance 94a. Thus the potential of the wire electrode 12a is substantially that impressed on the plate of tube 90a. When a cosmic ray penetrates the counter tube, the counter discharges and a negative pulse is transmitted to the control grid of tube 98a through condenser 96a. The discharge of the counter tube results in a drop in potential of the control grid of tube 90a which cuts off the current through the tube 90a and quenches the discharge current. The circuit then returns to normal. Similarly, when counter tube 2b discharges as the result of cosmic ray penetration, a negative pulse is transmitted through condenser 96b to the control grid of tube 98b and the discharge of the counter tube is quenched by the transient blocking of tube 90b. Both tubes 98a and 98b of the coincident circuit normally pass current. When one or the other only is blocked, due to reception of a negative pulse from its respective counter tube, there is substantially no change in the flow of current through the high resistance 100 as the other tube still introduces substantially no resistance into the circuit. When negative pulses arrive simultaneously, however, both tubes 98a and 98b become blocked, introducing a high resistance in series with the resistance 100 and substantially reducing the current therethrough. A positive pulse is thus transmitted through condenser 30 to the control grid of tube 28 causing energization of that tube and operation of relay 32. Relay 32, which is thus energized only when cosmic rays coincidentally penetrate tubes 2a and 2b, may be used for controlling the random injection of slubs into yarn, as shown in Fig. 1 or as hereinafter described in connection with Figs. 5 and 6, or for random selection of samples for inspection, as hereinafter described in connection with Fig. 7, or for control or actuation of any element where truly random effects are desired, that is, where a sequence of events, separated by periods of unpredictable duration, is desired.

With the circuit of Fig. 2, the average rate of production of control signals, that is, the average number of times the relay 32 is energized over a given period, will depend upon the size of the counter tubes 2a and 2b and upon their relative location. As only cosmic rays which pass through both tubes create a control signal, the greater the projection of one on the other, the higher the average rate of production of control

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signals. Thus, by moving the standards 86 and 88 carrying the tubes 2a and 2b toward or away from each other, the average rate of production of control signals may be adjusted over a wide range without substitution of counter tubes of different dimensions.

The provision of two relatively movable counter tubes of Fig. 2 together with the coincident circuit thus provides a control system for actuation by cosmic rays that is readily adjusted for production of any desired average rate of control signals. Moreover, when coincidental discharges only are utilized, as in Fig. 2, shielding of the counter tubes to prevent discharge by gamma radiation from possible radioactive materials in the neighborhood of the counter is not necessary as the possibility of coincidental discharge by gamma radiation is too remote to affect appreciably the functioning of the system.

In the circuit of Fig. 3 to which reference may now be had, random control pulses for operation of slub injecting or other mechanisms are obtained by amplification and integration of potential changes resulting from random fluctuations of the current through a gas filled tube. The gas filled tube, which may be, for example, an 884, is indicated at 108 with the grid thereof connected to the cathode through a resistor 110 and the plate thereof connected to B+ through a resistor 112. Voltage changes across the tube, after amplification in voltage and power amplifiers 114 and 116 respectively and rectification in a rectifier 118, build up a charge on a condenser 120. When a sufficient charge is accumulated by the condenser 120, a second gas filled tube 122, the plate of which is connected to the positive side of condenser 120, is triggered. A relay 124 in the cathode circuit of tube 122 controls, through a front contact, energization of a double triode gas tube 126, the elements of which are connected in push pull relation for energization from a suitable source (not shown) of low frequency alternating current, relay 124, when energized, reducing the negative potential on the grids of tube 126 and thereby permitting energization of the tube. The low frequency alternating potential for the plates of tube 126 is provided by a transformer 128, the primary of which is connected to the source and secondary of which is connected across the plates of the tube. A relay 130 is connected between the mid-point of the transformer secondary and ground so as to be energized whenever tube 126 is energized as the result of discharge of condenser 120. Relay 130, like relay 32 of Figs. 1 and 2, is thus energized at random intervals as a result of random control signals derived from a source of inherently random phenomena. In the case of Fig. 3, the control signals are derived by amplification and integration, whereas in Fig. 1 the signals are derived by amplification only and in Fig. 2 by amplification and selection.

In the particular embodiment of the invention illustrated in Fig. 1, slubs are injected into the yarn by change of draft of a spinning mechanism effected by means including magnetic and overriding clutches. Change of the draft of a spinning or drafting mechanism for random injection of slubs under control of a randomly energized device could be readily effected by other means than those illustrated in Fig. 1 and slubs could be injected without change of draft. Fig. 4 illustrates a slub injection mechanism which operates to change the draft by varying the pres-

sure exerted on the roving by the feed rolls, and Fig. 5 illustrates a slub injection mechanism which operates without change of draft.

In Fig. 4, unit 132 is intended to represent a source of random pulses. It may include one or more counter tubes actuated by cosmic or other radiation as described in connection with Figs. 1 and 2, or it may include a thermionic tube, such as tube 108 of Fig. 3, or it may include any other source of inherently random phenomena that is susceptible of detection and means for transforming such phenomena into pulses for conversion into control signals. For example, unit 132 may include an electronic tube having a heated filament and means for measuring variations in that part of the electron flow from the surface of the filament that passes through a small fixed orifice, or the unit 132 may include non-electrical inherently random phenomena and detecting means therefor. In general, any statistically variable source, that is one wherein there are a great number of independently variable elements which are individually unpredictable but collectively stable, such as the sources heretofore discussed, may be used for creation of control signals, provided means are provided for detecting the variations of the individual elements. Unit 134 in Fig. 4 represents any suitable amplifying, converting or selecting means for the pulses originating in unit 132, as for example the coincident circuit and amplifier of Fig. 2, or the integrating circuit of Fig. 3, or it may include one or more conventional "scale of two" circuits for amplifying and transmitting only every second, fourth, eighth or the like pulse. An electromagnetic device 136 is connected to unit 134 to be energized in response to the control signals delivered thereby. In Fig. 4 the shaft 138 of the idler feed roll 50a of a drafting mechanism is shown mounted in bearings carried on the end of a pivoted arm 140. Pressure between the feed rolls is provided by a weight 142. Reduction of the pressure permits slippage of fibers of the roving 52a between the feed rolls and consequent reduction of draft. The electromagnet 136, when energized in response to the control signals from unit 134, opposes the action of the weight 142 and thus reduces the pressure between the feed rolls and causes injection of a slub into the yarn.

Instead of decreasing the draft by reduction of feed roll pressure, as in Fig. 4, or by increase of the peripheral speed of the feed rolls, as in Fig. 1, the draft could be decreased by decrease of the peripheral speed of the draft rolls or by change of ratch length; a sudden decrease in ratch length causing injection of a slub.

In Fig. 5 in which slubs are injected without change of draft, and in response to energization of electromagnet 136 loose fibers or lint, from a receptacle 144 are blown on to the roving 52b at the nips of the feed rolls 50b of a drafting mechanism when a gate 145 is opened, gate 146 being suitably spring biased to closed position and being opened upon energization of the randomly energized electromagnet 136. The loose fibers or lint so deposited on the roving results in a wad or slub in the produced yarn.

The alternative types of slub injecting mechanisms above described in connection with Figs. 1, 4 and 5 have been indicated as associated with drafting and spinning mechanisms. Obviously, however, they are equally applicable to direct tow-to-yarn machines wherein the tow is stretch-

ments are simultaneously drafted. Also the randomly actuated relays of Figs. 1 to 5 could be readily arranged for control of mechanisms for injecting slubs into continuous filament yarn during production thereof, as will be readily apparent to those skilled in the art. In a co-pending application of the present applicant, Ser. No. 735,457, filed March 18, 1947, to which reference may be had, various additional arrangements for varying the diameter of both discontinuous and continuous yarn are disclosed and such arrangements could be readily adapted for random injection of slubs into yarn in accordance with the present invention.

As heretofore indicated the randomly occurring control signals produced in accordance with the invention, while particularly suited for production of yarn having slubs unpredictably spaced therein, may be advantageously employed for other purposes. An example of a specific use of the control system of the present invention in other than the textile industry is illustrated diagrammatically in Fig. 6. In this embodiment of the invention the control system is utilized to select the inspection articles on a conveyor. In Fig. 6 the travelling conveyor which is indicated at 148 and which is moved longitudinally at a constant rate by any suitable means (not shown), carries articles, indicated by the reference number 150, past the inspector's desk or table 152. Across the conveyor from the table 152 is an electromagnetic device 154 which is normally energized from a source 156 through a circuit including a back contact of the control signal responsive relay 136. Electromagnet 154 when energized, holds a plunger 158 against the action of a compression spring 160 out of the path of travel of articles 150. When the electromagnet 154 is deenergized as a result of energization of relay 136 the plunger 158 under the action of the spring 160 moves transversely of the conveyor and pushes an article 150 on to the inspector's table 152. Relay 136, as described in connection with Fig. 4 is randomly energized by control signals transmitted from unit 134 connected to the source 132 of random pulses. Thus, by the system of Fig. 6, sampling or selection for inspection of mass produced articles is made independent of the human element.

From the foregoing description of the invention and of specific embodiments thereof, it will be apparent that the invention, broadly speaking, comprises both a method and a means for obtaining and utilizing truly random control signals for initiation of a series of events separated by unpredictable lengths of intervals of time. The "events," in the case of control of slub injecting mechanisms, are the injection of slubs into yarn after unpredictable lengths of intervals, and the invention, therefore, provides a novel method and means for producing a yarn having truly randomly spaced slubs therein. In each embodiment of the invention, inherently random phenomena are converted into a series of control pulses or signals which are separated by periods of random duration. A wide variety of mechanisms could be employed for injection of slubs into yarn in response to the randomly occurring control signals, as heretofore indicated and as will be apparent to those skilled in the art. The choice of slub injecting mechanism will depend upon the type of yarn being produced, that is, whether the yarn is continuous filament yarn or yarn of staple fibers, upon the type of spinning appa-

ratus to be controlled and upon the normal rate of yarn production.

Although the invention has been described with reference to the random injection of slubs into yarn and to the random selection of articles for inspection, obviously the method and means of the invention could be advantageously employed for purposes other than those specifically described. For example, novel non-repetitive printing effects on fabrics, or on wall coverings or other surfaces, could be obtained in accordance with the invention by control of a printing element in response to random control signals, or the random control signals could be used to provide erratic and unpredictable movement of a target in a shooting gallery or unpredictable direction of projection or of time of release of the targets in trap shooting. Other applications of the invention to fields wherein random variations of a characteristic of an article or an erratic sequence of events may be desired will occur to those skilled in the art.

Obviously various changes, both in the described method of the invention and in the specific means illustrated and described herein, could be made without departing from the spirit of the invention. For example, although in the normal practice of the invention the randomly occurring control signals would be utilized concurrently with their production, as described in connection with each of the illustrated embodiments, their use may be delayed if desired, either for predetermined periods, as by inclusion of delay circuits, or for indefinite periods as by inclusion of recording and reproducing means in the system. Also, although in each of the illustrated embodiments of the invention, but one mechanism has been indicated as controlled by the sequence of control signals, obviously any number of mechanisms could be simultaneously controlled in response to the same signals. Another variation of the system that is obviously within the scope of the invention would be to utilize the random control signals to deactivate, rather than to activate; an element. In other words, the "events" separated by periods of unpredictable duration would become short periods of inactivity separated by periods of activity of random duration. Other variations within the scope of the appended claims will occur to those skilled in the art.

I claim:

1. A method of operating a mechanism for continuous production of a novelty article which comprises utilizing the reception of radiation to obtain a plurality of random pulses, initiating a control signal upon occurrence of a pulse, substantially simultaneously initiating a discharge of a storage device, maintaining the control signal for the period of discharge of the storage device and causing the operation of the mechanism to depart from normal in response to the control signals whereby the parts of the article produced during occurrence of control signals will differ from the parts produced during normal operation of the mechanism.

2. The method according to claim 1 wherein cosmic rays are utilized to obtain the pulses.

3. The method according to claim 2 wherein the pulses are converted into control signals by transmission and amplification of coincident pulses.

4. The method of producing a novelty yarn

which comprises utilizing the reception of radiation to obtain a plurality of random pulses, converting the pulses into a series of control signals separated by intervals of random duration and injecting slubs into yarn in response to the control signals.

5. The method of producing a novelty yarn which comprises controlling mechanism for injecting slubs into yarn in response to control signals initiated by cosmic rays.

6. Apparatus for producing yarn having slubs therein at random intervals comprising in combination, a source of inherently random electrical pulses, means for amplifying and converting pulses originating in said source into a series of randomly occurring control signals, a yarn spinning mechanism and means associated therewith and responsive to said control signals for injecting slubs into yarn spun by said mechanism.

7. Apparatus for producing a novelty yarn comprising in combination, means actuated by random radiation for creating a plurality of random pulses, means for converting the created pulses into a series of control signals separated by intervals of random duration, mechanism for injecting slubs into yarn, and means for controlling said mechanism in response to the control signals.

8. The combination according to claim 7 wherein said first mentioned means is adapted for actuation by cosmic rays.

9. The method according to claim 4 wherein the randomly occurring pulses are converted into a sequence of control signals by initiating a control signal upon occurrence of a pulse, substantially simultaneously initiating a discharge of a storage device and maintaining the control signal for the period of discharge of the storage device.

10. Apparatus for producing novelty yarn comprising in combination, a source of random electrical pulses, means for converting pulses from said source into a series of control signals separated by intervals of random duration, mechanism for injecting slubs into yarn, and means for controlling said mechanism in response to the control signals.

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