

June 17, 1969

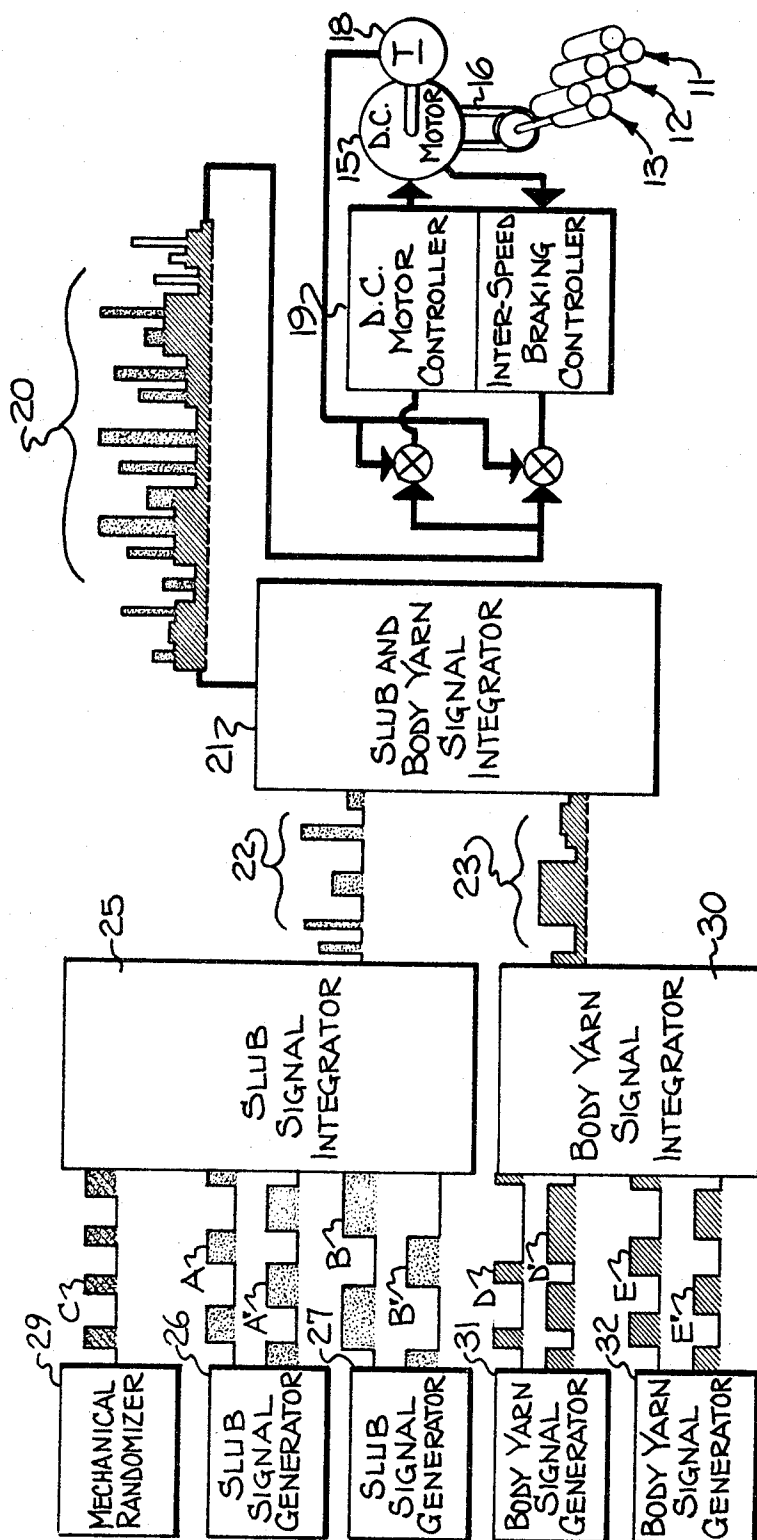
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3,449,899

VARIABLE COUNT AND SLUBBING APPARATUS AND METHOD

Filed March 1, 1968

Sheet 1 of 7



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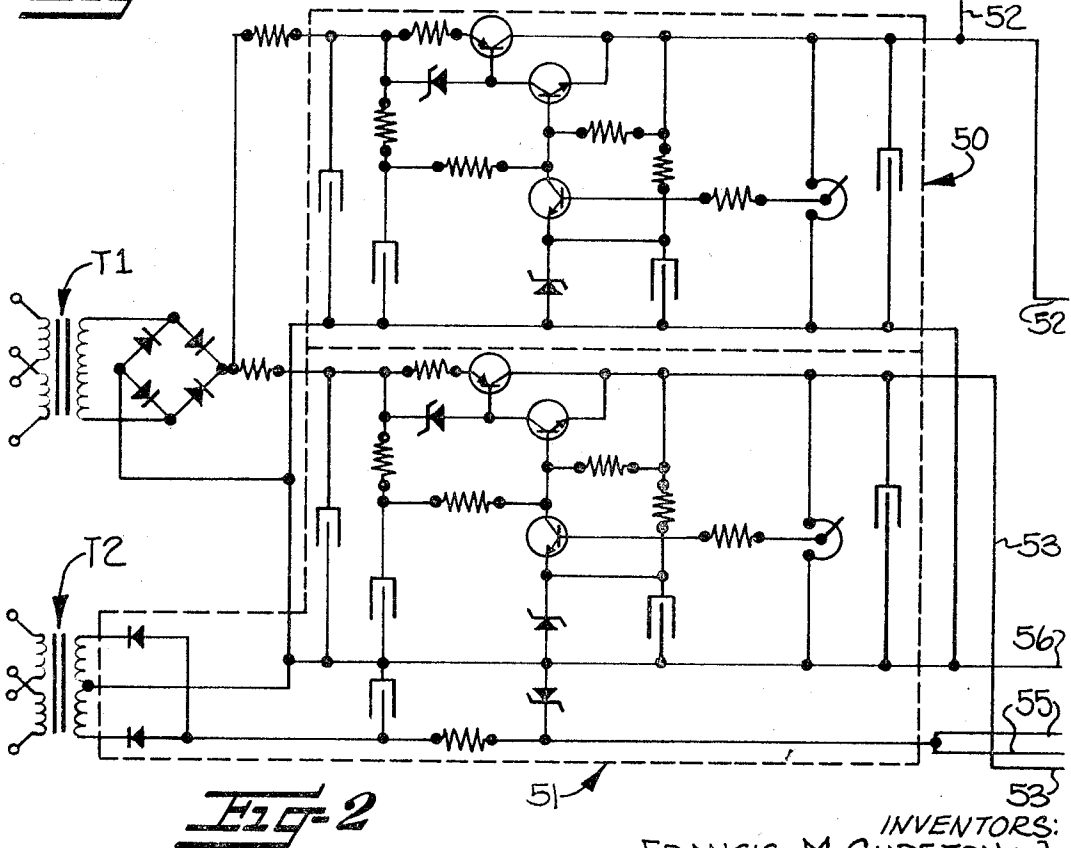
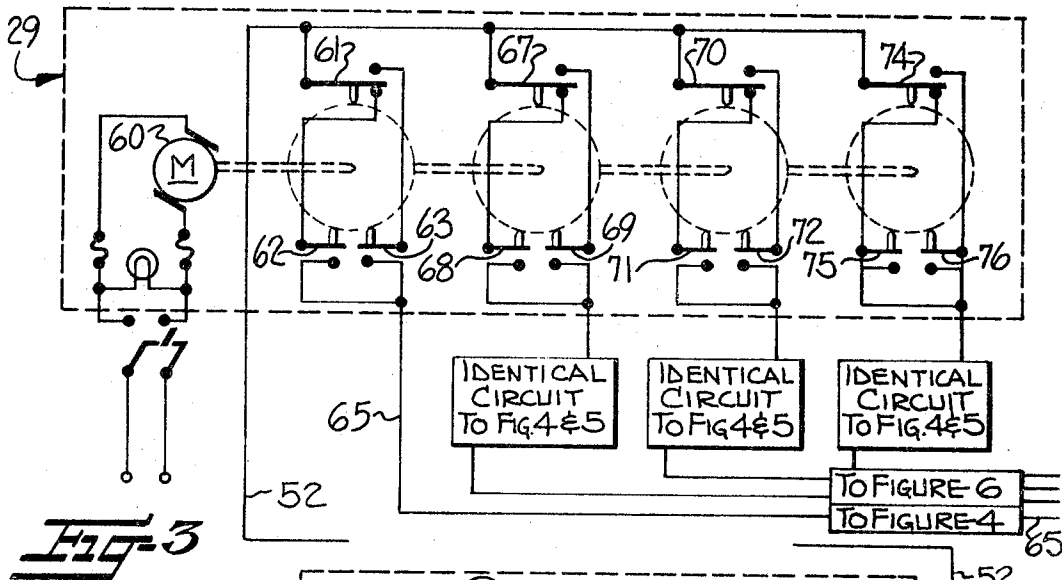
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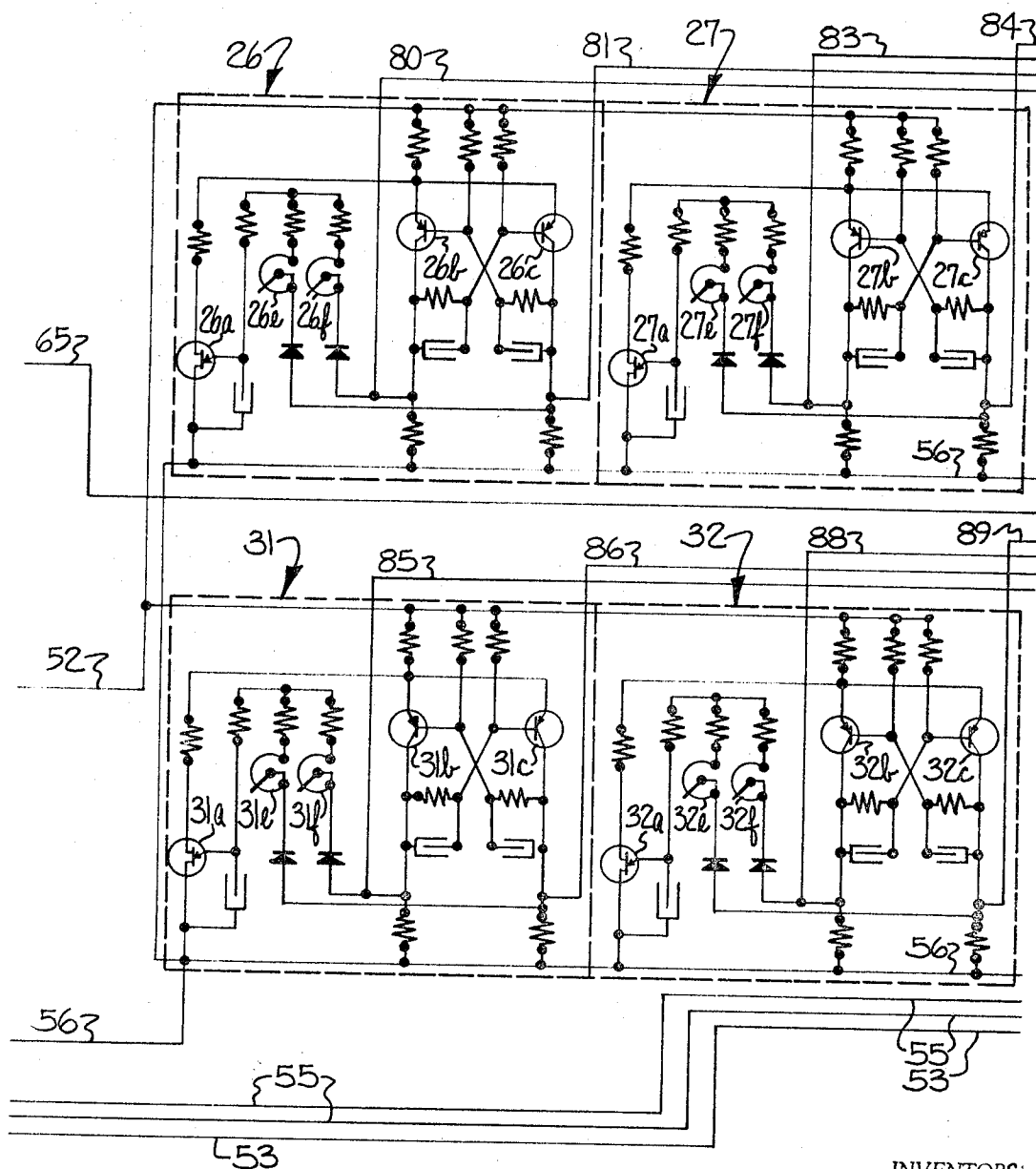


FIG-4

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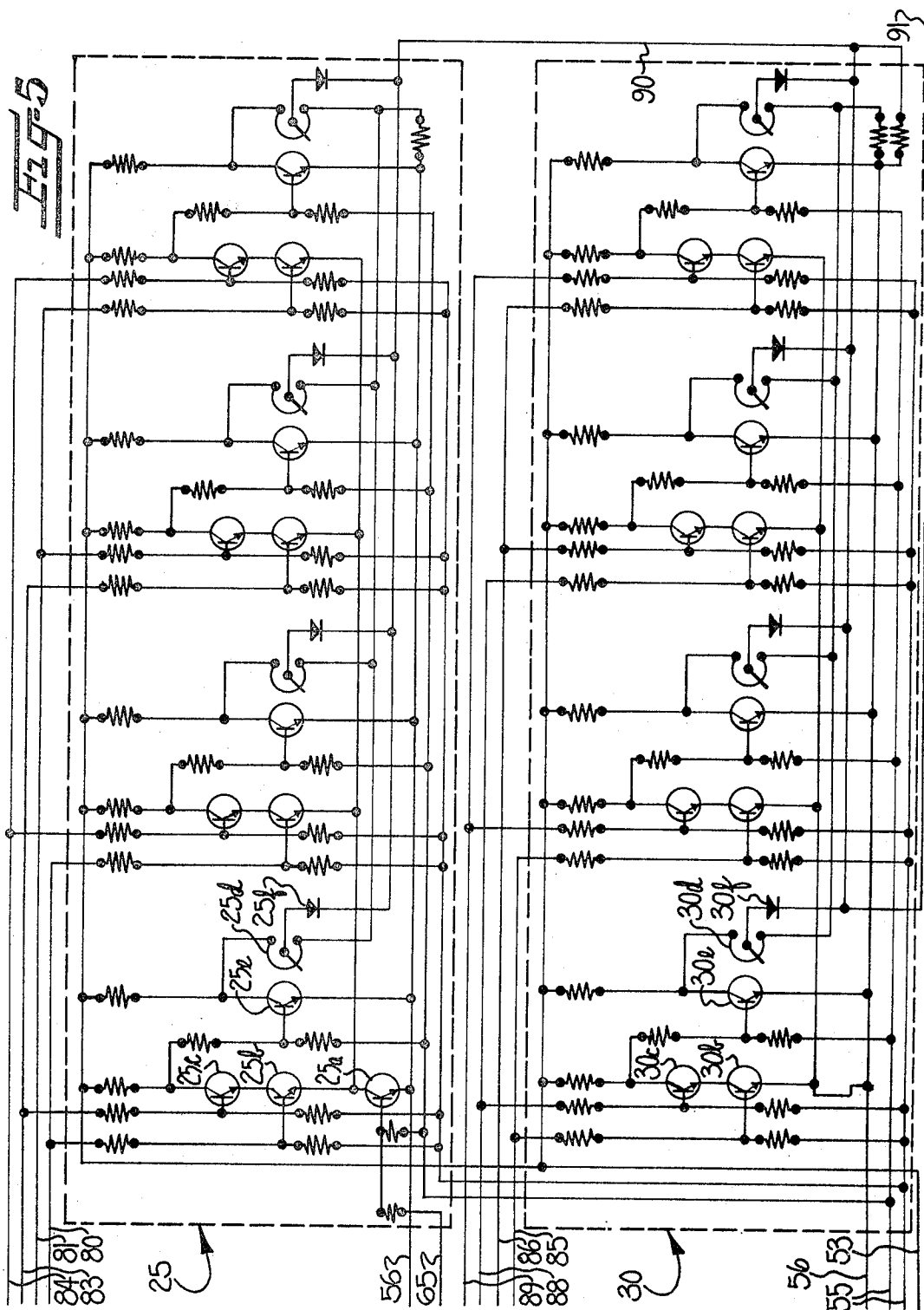
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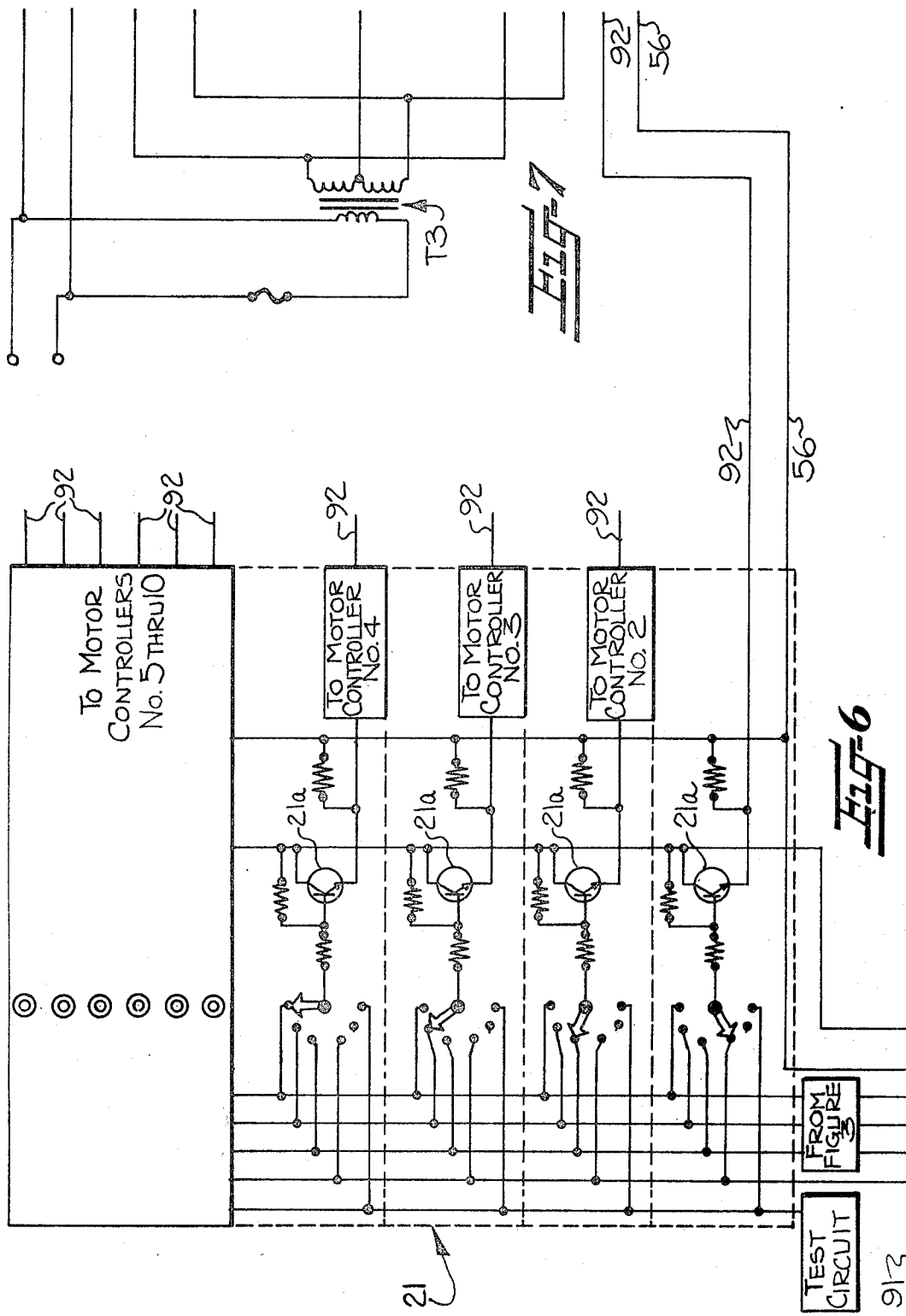
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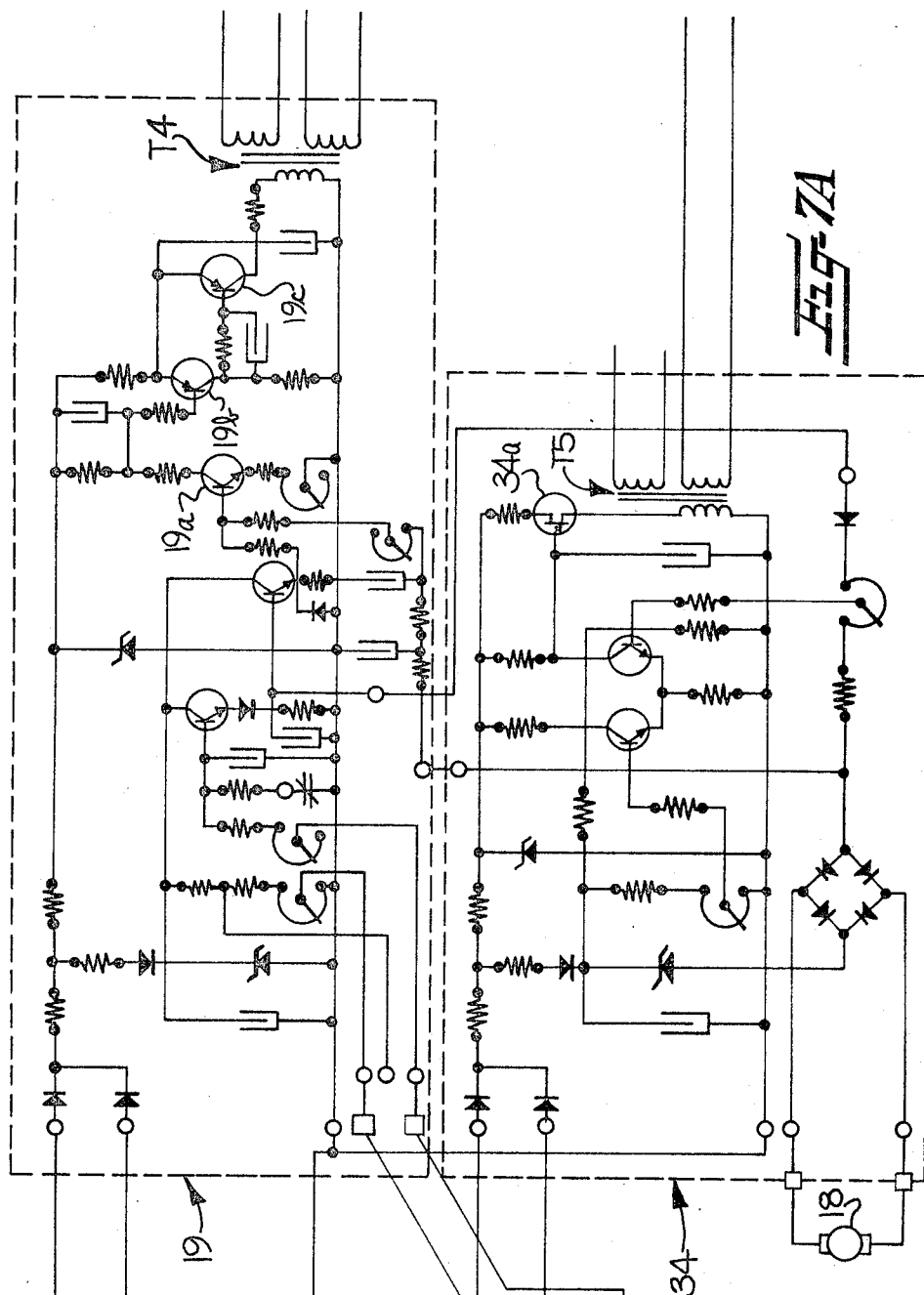
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Sheet 6 of 7



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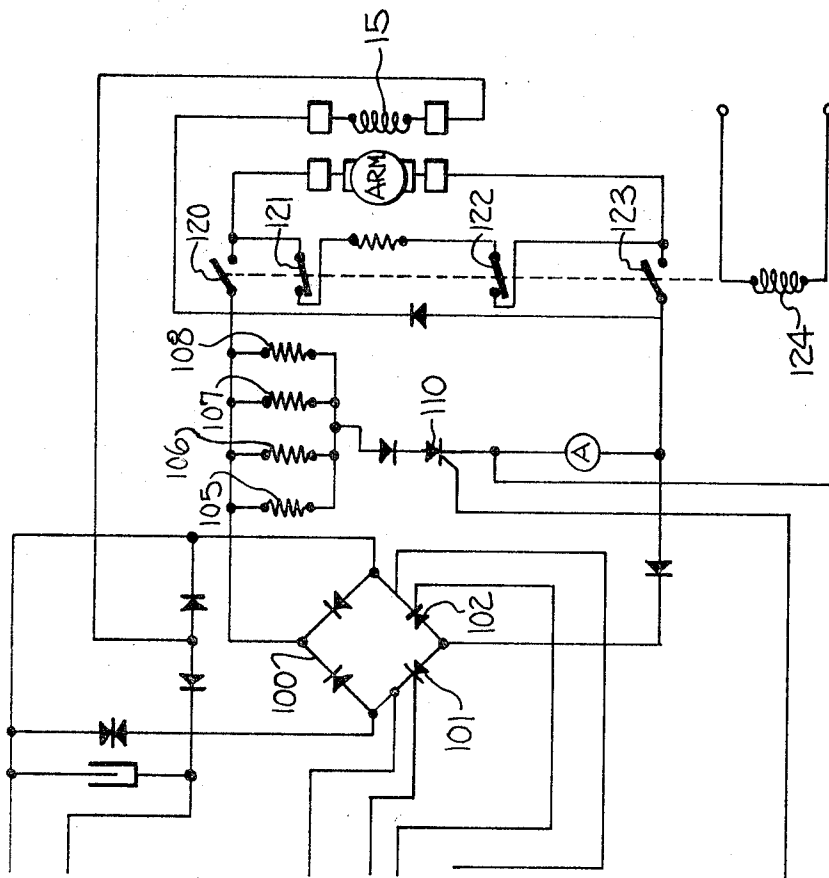


FIG-8

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3,449,899

VARIABLE COUNT AND SLUBBING APPARATUS AND METHOD

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ABSTRACT OF THE DISCLOSURE

An apparatus and method for the production of novelty yarns wherein the characteristics of the yarn vary in a random nature such as, for example, a slub yarn wherein slubs of randomly varying size and length are spaced at random intervals along a base yarn of randomly varying count.

Certain desirable effects, such as novel visual appearances and characteristics of hand, may be achieved in a woven fabric or other end textile product by the use of novelty yarn, such as slub yarn having a varying diameter or thick and thin portions along the length thereof. A fabric constructed with such yarn may have more of an appearance of being manufactured by hand and is, in any event, preferably characterized by a random distribution of the yarn size variations or slubs which impart the novel appearance and hand to the fabric.

In most instances, a repeating pattern of the slubs across the surface of the fabric is undesirable as detracting from the other desirable qualities being sought. In particular, the more uniform the distribution of the slubs along the length of a novelty yarn and the shorter the length of the yarn in which this distribution repeats, the higher the likelihood that a repeating pattern of distribution of effects in the fabric will appear.

With this problem particularly in mind, the methods and apparatus heretofore available for and used in the production of novelty yarns have attempted to attain randomization of yarn characteristics. While some progress has been made in this direction, the full potential of the novelty effects sought has not been realized, principally due to certain limitations in the apparatus and methods used.

In particular, the apparatus used typically utilizes drafting instrumentalities to form the novelty yarn with at least front and rear spaced apart sets of drafting instrumentalities being driven at different speeds to effect the drafting action. Usually, the rear set of drafting instrumentalities is driven at a uniform speed by the front set of drafting instrumentalities during formation of the base yarn by a suitable operative connection therebetween. In order to create a thickened portion or slub in the yarn, an over-running clutch is employed in the operative connection between the rear and front sets of drafting instrumentalities and a secondary drive means is provided to overspeed the rear set relative to the normal speed of rotation thereof and thereby form the thickened portion or slub. A novelty yarn of the type produced in such an apparatus thus has a base yarn of uniform diameter or count and slubs of uniform diameter but varying length interspersed along the length of the novelty yarn.

In methods involving the use of such apparatus, a wide variety of steps have been suggested for controlling the secondary drive means to overspeed the rear rolls, including such variations as the use of complicated gear trains and randomized signals controlling such gear trains, including one such apparatus which utilizes cosmic radiation sensing means to provide the randomized signal. As to the

use of gear trains or other similar complicated drive means, a difficulty arises in that the variations obtained are not truly random, but will be found to repeat in a predetermined pattern should a sufficient interval of production be studied. Thus, the danger of a repeating pattern in the end textile product is quite significant. While the use of cosmic radiation sensing means, or other means for detecting truly random physical events, is more capable of avoiding such a repeating pattern, such methods as heretofore proposed have still been limited by the apparatus used to the realization of less than the full potential of effects to be gained by variations in yarn diameter.

With the foregoing particularly in mind, it is an object of the present invention to provide an apparatus and method for the production of novelty yarns wherein the potential effects to be gained from yarn size variations are more fully realized so that the appearance of a repeating pattern in fabric formed therefrom is avoided.

In realizing this object of the present invention, random variations of the basic yarn count are introduced at the same time that random variations in slub diameter and length are obtained. In particular, the apparatus of this invention comprises controllable variable speed drive means operatively connected to a rear set of drafting instrumentalities to drive the same entirely independently of an as-
therefrom, to control the feed of a textile strand into the drafting zone defined between the sets of drafting instrumentalities entirely independently of the speed at which the front set of drafting instrumentalities delivers the drafted yarn therefrom. The method contemplated by the present invention comprises the steps of generating a randomly varying signal and applying the signal to control the speed of a rear set of drafting instrumentalities entirely independently of the speed of a front set of drafting instrumentalities spaced therefrom.

Thus, a more specific object of this invention is to provide, in conjunction with a textile spinning frame for drafting fibrous textile strands passing therethrough, a method of and means for driving a rear set of drafting instrumentalities at randomly varying rates to randomly vary the base count and slub characteristics of a textile yarn being delivered from the spinning frame. In realizing this object of the present invention, means are provided for generating randomly varying signals and a control means is operatively connected to the signal generating means for combining a plurality of randomly varying signals to create a drive signal of randomly varying magnitude. Such drive signal is then applied to a controllable variable speed drive means, to drive the rear set of drafting instrumentalities entirely independently of the front set and result in the delivery by the front set of drafting instrumentalities of a yarn having randomly varying count and slub characteristics.

Yet another more detailed object of the present invention is the provision of an apparatus and method wherein a plurality of inversely varying signals and an intermittent signal are generated and the signals are then combined to create two randomly varying signals, one of which is a continuous, randomly varying signal and the other is an interrupted, randomly varying signal. The two randomly varying signals are then combined to create a single drive signal of varying magnitude wherein the magnitude of the drive signal is determined by the greater of the magnitudes of the continuous, randomly varying signal and the interrupted, randomly varying signal. The rotational speed of a rear set of instrumentalities is then controlled in accordance with the resulting drive signal.

While in most instances it is undesirable to have a repeating pattern of variations in yarn count or slubs across the surface of a fabric, there are certain specific instances in which it is desired that changes in the count

of a yarn be preprogrammed in a determinable pattern, in order to obtain a pattern across the surface of a fabric constructed with such yarn and thus simplify the manufacturing process for the fabric. Heretofore, certain arrangements have been provided which were capable of producing a preprogrammed patterned yarn of this general type, but the range of adjustment and hence of variations in the preprogrammed pattern were severely limited. Also, these arrangements had only limited application since they were incapable of producing the randomization of yarn characteristics desired in most instances.

The apparatus of the present invention, as briefly discussed above, is not only capable of obtaining the randomization of yarn characteristic desired in most instances, but may be adjusted through a much wider range than heretofore possible, so that patterned yarns of a wide range of preprogrammed characteristics may be produced thereby. Thus, there is provided an apparatus and method of producing novelty yarns of random or preprogrammed patterned characteristics.

Some of the objects and advantages of the invention having been stated, others will appear as the description proceeds, when taken in connection with the accompanying drawings, in which:

FIGURE 1 is a schematic representation of an apparatus contemplated by the present invention;

FIGURES 2 through 8, taken together, are a circuit diagram of an operating embodiment of an apparatus as schematically represented in FIGURE 1 and wherein

FIGURE 2 is a circuit diagram of a power supply means for providing electrical current to certain signal generators which form portions of the apparatus schematically illustrated in FIGURE 1;

FIGURE 3 is a circuit diagram of a mechanical randomizer which forms a portion of the apparatus schematically illustrated in FIGURE 1;

FIGURE 4 is a circuit diagram of certain signal generators which form portions of the apparatus schematically represented in FIGURE 1;

FIGURE 5 is a circuit diagram of certain signal integrating means which form a portion of the apparatus schematically illustrated in FIGURE 1;

FIGURE 6 is partly a circuit diagram and partly a schematic illustration of a selection means for facilitating production of a plurality of varying types of yarn on a single spinning frame; and

FIGURES 7, 7a and 8, taken together, are a circuit diagram of a motor speed control means forming a portion of the apparatus schematically illustrated in FIGURE 1.

Drafting instrumentalities and drive means

Referring now more particularly to the drawings, the schematic representation of FIGURE 1 includes block diagram representations of certain portions of an apparatus as contemplated by the present invention and illustrates also a plurality of spaced apart sets of drafting instrumentalities, represented as the roll sets 11, 12 and 13, defining drafting zones therebetween. The roll sets 11, 12 and 13 represent the front, intermediate and rear drafting instrumentalities of a conventional spinning frame, with the front set 11 delivering a textile strand material or yarn to the spindle of the spinning frame and the rear set 13 feeding textile strand material, such as roving, into the drafting zones to be drafted. The intermediate set of drafting instrumentalities 12 may be present or omitted as found desirable for each particular installation. The front set of drafting instrumentalities 11 preferably is driven in a conventional manner as widely known in the construction of spinning frames.

In accordance with the present invention, a controllable variable speed drive means is connected to the rear set of drafting instrumentalities 13 independently of the front set 11 for driving the rear set 13 independently thereof. The controllable variable speed drive means preferably comprises a direct current electrical motor 15, operatively in-

terconnected with the rear set 13 of drafting instrumentalities by means of any suitable connection, such as a driving belt 16. Also operatively connected to the shaft of the variable speed motor 15 is a tachometer generator 18, the function of which will be brought out more fully hereinafter.

As herein used, reference to driving the rear set of drafting instrumentalities independently of the front set is not intended to convey that the relative speeds of rotation are not correlated, for such correlation is necessary if desirable predictability is to be obtained as to the yarn produced. It is intended that the drive means provided for the front and rear sets of instrumentalities be separate and that the rotative speed of the front set not necessarily be changed. However, for correlation of twist and draft, it may be desirable to also control the front drafting instrumentalities' speed in relation to the control of the rear drafting instrumentalities' speed.

General description of control system

The speed of the electrical motor 15 is controlled by a DC motor controller 19, to which is applied a drive signal 20 of randomly varying magnitude (represented by a signal envelope designated at 20 in FIGURE 1) so as to result in varying speed being imparted to the rear set 13 of drafting instrumentalities. The drive signal 20 is created by a slub and body yarn signal integrator 21 which receives first and second randomly varying signals 22 and 23 (respectively represented by signal envelopes also designated 22 and 23) and combines them to create the drive signal 20. One of the randomly varying signals is discontinuous or interrupted, such as signal 22, and is produced by a slub signal integrator 25 which receives a plurality of signals (variously represented by signal envelopes A, A', B, B' and C) generated by first and second slub signal generators 26 and 27 and by a mechanical randomizer 29. The other randomly varying signal 23 is generated in a somewhat similar manner by a body yarn signal integrator 30 receiving pairs of signals (represented as D, D', E and E') generated by first and second body yarn signal generators 31 and 32.

Turning from a general description with reference to a schematic diagram as given above to a specific operating embodiment of the present invention, the circuit diagrams of FIGURES 2 through 8 disclose the details of an operating embodiment of the present invention which functions to control the rear sets of drafting instrumentalities in a plurality of zones of a spinning frame or spinning frames, as for example ten zones. In a normal application, each such zone is two sides of a spinning frame.

Mechanical randomizer

In order to produce an interrupted signal for controlling the passage of other signals as generally discussed above, or gating such signals, the operating embodiment of the present invention includes a mechanical randomizer (FIGURE 3) corresponding to an identified by the same reference as the mechanical randomizer 29 of FIGURE 1. Suitable elements for the mechanical randomizer 29 include an appropriate electrical motor 60 which may be operatively connected to a source of line voltage such as 110 volts through appropriate switch means and fuses, as is generally known. Fixed to the drive shaft of the motor 60, for rotation therewith, are a plurality of randomizer discs (indicated in phantom lines in FIGURE 3). Operatively associated with each of the randomizer discs are a plurality of electrical switches, such as microswitches, which are operated by projections or cam fingers carried by the respective discs. Preferably, the cam fingers are displaceable about the discs, and cooperate with the positioning of the switches about the discs to cause completion of an electrical circuit and passage of an electrical signal in a pattern which approximates a random sequence of signals. The intermittent signal thus developed by the mechanical randomizer 29 is applied to a slub signal integrator as pointed out more fully hereinafter with reference

to the discussion of the circuits of FIGURE 5. At the present point, it is sufficient to note that the intermittent voltage signal resulting from actuation of three switches 61, 62 and 63 appears on a conductor 65. Other intermittent voltage signals resulting from actuation of sets of switches 67, 68 and 69; 71, 72; and 74, 75 and 76 are applied to circuits identical to those of FIGURES 4 and 5 in the same manner as will be described hereinafter, to produce signals applied to a selection and integration device as illustrated in FIGURE 6. The interrelationships of these elements of the operating embodiment of the present invention will become more clear hereinafter.

Power supplies

Electrical current to be modulated to generate the various pairs of inverse signals is derived from a pair of regulated voltage supplies, each enclosed within dash lines in FIGURE 2 and respectively identified as 50 and 51. Unregulated direct current is tapped from the secondary winding of a transformer T1 through a rectifier bridge and is regulated by a network of resistors, capacitors, diodes and transistors of a type which is generally known for regulating direct current supplies. An unregulated voltage supply of predetermined potential, such as 10-volts, and a common ground are provided by the secondary winding of a second transformer T2. The first regulated power supply 50 applies a regulated direct current of predetermined potential, such as 25-volts, to a conductor 52, which is operatively connected to a plurality of signal generators (FIGURE 4) corresponding to and identified by the same numerals as the signal generators 26, 27, 31 and 32 (FIGURE 1) for modulation of the current to produce pairs of inversely varying signals such as those represented in FIGURE 1 as the signals A and inverse A; B and inverse B; D and inverse D; and E and inverse E. Direct current from the second regulated power supply 51 is supplied at a predetermined potential, such as 25 volts, through a conductor 53 to integrator circuits (FIGURE 5) corresponding to and identified by the same numerals as the slub signal integrator 25 and the body yarn signal integrator 30 (of FIGURE 1). Additionally unregulated direct current is supplied through a conductor 55, to be applied to the integrator circuits (FIGURE 5). A common ground for return is provided by a conductor 56.

Signal generators

Circuit details of the signal generators 26, 27, 31 and 32 as included in the operating embodiment of the present invention are as shown in FIGURE 4. The four circuits there illustrated as enclosed within dash lines and identified by the reference numerals 26, 27, 31 and 32 are all substantially identical, being hybrid timing circuits arranged as unsymmetrical multivibrators wherein a unijunction transistor is used in conjunction with a pair of conventional PNP transistors for timing the changes in conductive state of such transistors. By way of illustration, the signal generator enclosed within dash lines and identified as the first slub signal generator 26 includes a unijunction transistor 26a which operates as a timing control over the changes in conductive state of a flip-flop circuit using a pair of PNP transistors 26b and 26c. Through the use of a pair of potentiometers 26e and 26f, isolated from each other by diodes, the time intervals between successive changes in conductive state may thus be independently determined and may differ by a substantial amount if so desired. A pair of electrical conductors 80 and 81 are operatively connected in the collector circuits of the flip-flop transistors 26b and 26c, to serve as outputs from the signal generator 26 and carry a pair of inverse signals such as are represented by the signal envelopes A and inverse A in FIGURE 1.

In a similar manner, the signal generators enclosed within dash lines identified as the second slub signal generator 27 and the first and second body yarn signal generators 31 and 32 include circuit components identi-

fied by designations corresponding to those used with reference to the first slub signal generator 26 and similarly modulate electrical current derived from the power supply 50 to cause pairs of inverse signals to appear on respective sets of conductors. On the conductors 83 and 84, signals identified as B and inverse B appear. On conductors 85 and 86, operatively connected to the first body yarn signal generator 31, appear the signal D and inverse D. Finally, the operative connection of conductors 88 and 89 with the second body yarn signal generator 32 conducts therefrom the signals E and inverse E.

Slub signal and body yarn signal integrators

The pairs of signals present on the conductors 80 and 81; 83 and 84; 85 and 86; 88 and 89 are combined by signal integrators corresponding to and identified by the same reference characters as the integrators 25 and 30 of FIGURE 1. Circuits appropriate for such integrators are shown in FIGURE 5, enclosed with dash lines and identified as the slub signal integrator 25 and the body yarn signal integrator 30. The principal distinction between the two signal integrators is the presence, in the slub signal integrator 25, of a gating transistor 25a to the base of which the conductor 65 is operatively connected for application of the intermittent signal from the mechanical randomizer 29. The gating transistor 25a in the slub signal integrator 25 controls the output from that integrator in such a manner that an output signal appears from the integrator only during such time that a signal is applied to the gating transistor through the conductor 65.

Each of the signal integrators is built up from a plurality of basic circuits which comprise an "and" gate formed by two transistors directly coupled by emitter to collector connection, such as the transistors 25b and 25c in the basic circuit to the far left of the integrator 25 in FIGURE 5, and an integrating circuit with signal pick-off through a potentiometer, such as the potentiometer 25d in the same basic circuit. By means of these basic building blocks of circuitry, one signal from each pair of inversely varying signals is combined with a signal from another pair of inversely varying signals, to ultimately create a single randomly varying signal. As a particular example, the signal A carried by the conductor 80 is combined, by the basic circuit including the transistors 25b and 25c and the potentiometer 25d, with the signal B carried by the conductor 83. Each of these signals is applied to the base of one of the two transistors 25b and 25c, included in the "and" gate of the basic circuit, and, in the simultaneous presence of both signals, a signal is passed through an integrating transistor 25e to be picked off through the potentiometer 25d, passed by a screening diode 25f, and be presented as a component of an output signal from the slub signal integrator 25. At the same time, other pairs of the conductors 80 and 81, 83 and 84 are operatively connected to the bases of transistors in the "and" gates of three additional basic circuit blocks in the slub signal integrator 25, to similarly produce integrated signals resulting from combining of signals from the inversely varying pairs. The integrated signals resulting from the combining of the signals from the inversely varying pairs generated in the first and second slub signal generators 26 and 27 are combined and, on gating by the intermittent signal carried by the conductor 65 from the mechanical randomizer 29, appear as a randomly varying, interrupted signal on a conductor 90, corresponding to the slub signal 22 in the schematic representation of FIGURE 1.

In a manner similar to the operation of the slub signal integrator 25, the two pairs of inversely varying signals carried by the conductors 85 and 86, and 88 and 89 are applied to the bases of transistors forming "and" gates in the four basic building block circuits including in the body yarn signal integrator 30 (lower half of FIGURE 5). On combining of the signals resulting from the integration of the "and" gate signals, an uninterrupted or

continuous body yarn signal appears on a conductor 91 as an output from the body yarn signal integrator 30. By virtue of interconnection of the conductor 90 with the conductor 91, and through the output of the body yarn signal integrator 30, the interrupted or discontinuous slub signal is superimposed on the continuous body yarn signal, and the two signals are thus simultaneously present on the conductor 91.

Parallel circuitry

To this point, the discussion of the operating embodiment of this invention has had reference to the use of one section of the mechanical randomizer 29 and a corresponding number of slub and body yarn signal generators and integrators as needed to produce a single signal on the conductor 91. It is to be understood that, in the operating embodiment, the circuits illustrated in FIGURES 4 and 5 are duplicated, as shown by the blocks included in FIGURE 3, in order to produce a plurality of random signals useful in controlling the speed of a rear set of drafting instrumentalities, illustrated as four such signals in the drawings. Due to the independent operation of the parallel channels of circuitry, and the possibility of independent adjustment of the potentiometers which function as signal determining components in certain of these circuits, it is thus possible to generate, in the operating embodiment of the present invention, four signals which vary randomly as to magnitude, duration, sequence, and variations in magnitude of voltage. While the particular embodiment which is presently operating produces four such signals, this number of signals results largely from the particular circuit component selections made in assembling the circuitry and the limits of practical operation imposed by those design choices. It is specifically recognized that other component selections are within the skill of a technically competent engineer once an understanding of this invention has been gained, and that such design choices will determine the practical limits of operation of the circuitry. The four signals generated in the operating embodiment are applied to the four conductors illustrated in FIGURE 6 and identified respectively as conductor 91 and as originating from FIGURE 3.

Slub and body yarn signal integrator

In order to create the randomly varying drive signal for governing the speed of the rear set of drafting instrumentalities, the slub signal and body yarn signal generated as discussed above the combined and integrated together so that the magnitude of the drive signal thus created is determined by the greater instantaneous magnitude of the two signals thus applied. In particular, a slub and body yarn signal integrator corresponding in function to that one included in the schematic diagram of FIGURE 1 is enclosed within a dash line in FIGURE 6 and identified by reference character 21. This signal integrator includes a five-portion switch to permit selection of a signal from any of the four sets of signal generators and integrators described immediately above or a signal to be applied from a test circuit as indicated in block form in FIGURE 6. The signal selected by positioning of the switch is applied to a signal amplifier and integrator using a single transistor 21a, to create a randomly varying drive signal which is applied to a conductor 92, operatively connected to a motor controller as described more fully hereinafter. In the operating embodiment, nine additional slub and body yarn signal integrators are provided, three of which are shown by circuit diagrams in FIGURE 6 and six of which are incorporated within a single block diagram. By employing this number of slub and body yarn signal integrators and a corresponding number of motor controllers as described more fully hereinafter, a total of ten DC drive motors such as the motor 15 of FIGURE 1 may be controlled. In similarity to the manner in which four drive signals result as discussed above, the use of ten slub and body yarn integrators and ten motor controllers flows largely

from component selections made as the circuitry of the operating embodiment was assembled and may vary should components capable of handling heavier or lighter loads be chosen. In view of the conventional practice of interconnecting the rear sets of drafting instrumentalities on one side of a spinning frame so that the same are driven in a common manner, the illustrated operating embodiment would thus be accommodated to use with a total of ten spinning frames.

Motor and interspeed braking controllers

In order to produce the desired yarns by varying the rate at which textile strands are supplied to the drafting zone in accordance with the fluctuation of the drive signal 20, the operating embodiment controls the speed of an electric motor corresponding to the DC motor 15 in response to the random variations of the drive signal 20 as presented across the conductors 92 and 56. Specific circuitry for performing this function is illustrated in FIGURES 7, 7 and 8 wherein the circuitry of a solid state motor controller and an interspeed braking controller, functionally corresponding to those schematically represented in FIGURE 1, are identified by the reference characters 19 and 34 and included, in part, within dash lines. Operating current for the controller circuitry and the motor 15 is obtained through suitable connection to a source of line current such as 110 volts, with the line current being applied to the primary winding of a transformer T3 and to two terminals of a Wheatstone bridge circuit 100 (FIGURE 8). Current derived from the secondary winding of the transformer T3 and the drive signal 20 present across the conductors 92 and 56 (between FIGURES 6 and 7) are applied to the controller circuitry including the circuits 19 and 34. In addition, a tachometer generator identified by reference character 18 is connected into the circuitry of the interspeed braking controller 34 through a bridge arrangements of diodes, in order to assure that a signal derived from the generator is applied to the circuitry with a proper polarity so that the circuits will function in the desired manner.

In following the fluctuations of the drive signal 20, the line current applied to the Wheatstone bridge circuit 100 is rectified and supplied to the armature of the motor 15. Due to the inclusion in the bridge 100 of a pair of controller rectifiers 101 and 102, the effective voltage supplied from the bridge circuit 100 to the motor 15 may readily be controlled, as described more fully hereinafter. Upon an indication for a rapid increase in the speed of the motor 15, or an indication to maintain the motor speed constant at an attained rate, the voltage supplied from the bridge circuit quickly adjusts to the necessary level, and the characteristics of the motor assure a prompt response. However, due to the inertia of the motor itself and of the rotating parts driven thereby, the motor 15 does not so readily follow the drive signal 20 upon the signal calling for a rapid decrease in the voltage applied to the motor from the bridge circuit 100. Instead, the fly wheel effect of the motor and the parts driven thereby tends to cause the rate of which textile stands are supplied to the drafting zone to smoothly but slowly decrease.

In order to permit obtaining the desired characteristics for the textile yarns produced, by assuring that the speed of the motor 15 follows fluctuations of the drive signal 20 calling for a decrease in driven speed as well as those fluctuations calling for an increase in speed, the interspeed braking controller functions to impose a load on the armature of the motor 15 at any time that comparison of the signal originating from the tachometer generator 18 with the drive signal 20 indicates that the shaft speed of the motor 15 is above that required by the drive signal 20. In particular, the Wheatstone bridge circuit 100 is shunted by a circuit including a plurality of load resistors 105, 106, 107, 108 and a controlled

rectifier 110. Upon firing of the controlled rectifier 110 to a conductive state (as discussed more fully hereinafter), the resistors 105-108 are electrically connected as a load across the armature of the motor 15, causing the motor to operate as a generator for sufficient length of time to extract from the rotating elements of the spinning frame sufficient energy to reduce the momentum thereof to such a level that the shaft speed of the motor reaches the desired speed indicated by the drive signal 20.

Turning now in greater detail to the operation of the controllers 19 and 34, each of the controllers includes an output transformer, respectively identified as transformers T4 and T5. The pulse of the circuitry included within the dash lines is to apply pulse trains of particular types to the primary windings of the transformers T4 and T5, depending upon a comparison between the drive signal present across the conductors 92 and 56 and the shaft speed signal generated by the tachometer generator 18. By interconnection of the circuitry of the two controllers 19 and 34, a train of pulses is generated by a Schmidt trigger circuit connected with the primary of the transformer T4, to apply to the pair of controlled rectifiers 101 and 102 in the bridge 100 (FIGURE 8) a train of pulses which is determined by a summing of the incoming drive signal 20 and the tachometer generator 18 signal at the base of a transistor 19a controlling two Schmidt trigger transistors 19b and 19c. The controlled rectifier 110 in the bridge shunting circuit is controlled by a train of pulses originated by a unijunction transistor 34a which is electrically connected to the primary of transformer T5, due to the connection of the controlled rectifier 110 to the secondary winding of the transformer T5. When a comparison of the incoming drive signal 20 with the signal from the tachometer generator 18 indicates that the shaft speed of the motor 15 is above that called for by the drive signal 20, the generation of pulses by the Schmidt trigger using transistors 19b and 19c stops, while the unijunction transistor 34a creates a train of pulses causing conduction of the controlled rectifier 110.

In addition to the circuitry described heretofore, a plurality of relay contacts are provided to control the connection of the armature of the motor 15 with the controllers 19 and 34. The plurality of relay contacts 120, 121, 122 and 123 are controlled by a relay coil 124 which preferably is electrically connected with the starter of the main motor driving the spinning frame with which the DC motor 15 is used. Thus, in the event that the spinning frame itself is stopped, the motor 15 is disconnected from the control circuitry provided in accordance with the present invention, to assure that the motor 15 is not driven during periods of time that the spinning frame is not in use.

Preprogrammed operation

In the circuitry arrangements and methods of operation as described to this point, the pairs of signals which are selected and combined are directed particularly toward an end result drive signal having randomly changing characteristics. In those instances where a patterned variation of yarn characteristics is desired, it has been discovered that the apparatus and method of the present invention are adaptable to the formation of such yarn. In particular, the potentiometers 26e and 26f and 27e and 27f which control the characteristics of the pairs of inverse signals A, A', B and B' may be adjusted so that no slub signal is generated. Then, the pairing of the inverse signals D, D', E and E' originating with the body yarn signal generators 31 and 32 may be selected in such a manner, by adjustment of the potentiometers corresponding to the potentiometer 30d and by interconnection of the conductors 85 and 86, 88 and 89 with the "and" gates in the body yarn signal integrator 30 (lower half of FIGURE 5), to obtain a continuous body yarn signal which alternates between predetermined signal magnitude levels with a predetermined pattern in relation to time. In order that the patterns thus obtained are repeatable and the apparatus may be programmed for the production of a de-

sired yarn, the potentiometers used in the circuits described in more detail above are of the type that may be returned at will to particular settings.

We claim:

1. In a spinning frame having at least front and rear spaced apart sets of drafting instrumentalities for drafting fibrous textile strands passing therethrough, said front set normally being driven at a predetermined rotative speed and said rear set normally being driven at a slower relative speed than said front set for feeding the textile strand into the drafting zone at a slower rate than it is delivered, the improvement which comprises means connected to said rear set of drafting instrumentalities for driving the same at randomly varying rates to randomly vary the count of the strand being delivered from said drafting instrumentalities and comprising:

(a) controllable variable speed drive means connected to said rear set of drafting instrumentalities independently of said front set for driving the rear set independently of said front set,

(b) means for generating first and second randomly varying signals, and

(c) control means operatively connected to said signal generating means (b) for receiving the first and second signals therefrom and combining the same to create a drive signal of randomly varying magnitude and operatively connected to said drive means (a) for varying the speed at which said rear set of drafting instrumentalities are driven in response to the magnitude of the drive signal.

2. The combination of claim 1 wherein said signal generating means (b) comprises means for generating a plurality of signals each varying in a predetermined manner and an interrupted signal and gate means for receiving the varying and interrupted signals and for combining each of said varying signals with another signal varying in a different manner to generate at least two randomly varying signals and for controlling the passage of one of the randomly varying signals with the interrupted signal to generate an intermittently varying signal as the aforementioned second signal, the other of the at least two randomly varying signals being present as the aforementioned first signal.

3. The combination of claim 1 wherein said signal generating means (b) includes a plurality of first signal sources each originating a pair of inversely varying signals and a first signal integrating means operatively connected to said first signal sources for integrating the plurality of pairs of signals originating from said first signal sources into a single continuous signal to thereby generate the aforementioned first signal.

4. The combination of claim 1 wherein said signal generating means (b) includes a plurality of second signal sources, at least two of said second signal sources each originating a pair of inversely varying signals and another of said second signal sources originating an interrupted signal, and a second signal integrating means operatively connected to said second signal sources for integrating the plurality of pairs of signals originating from said at least two signal sources into a single signal and including a gate means actuated by the interrupted signal and controlling the passage of the single signal to thereby generate a discontinuous signal as the aforementioned second signal.

5. In a spinning frame having at least front and rear spaced apart sets of drafting instrumentalities for drafting fibrous textile strands passing therethrough, said front set normally being driven at a predetermined rotative speed and said rear set normally being driven at a slower relative speed than said front set for feeding the textile strand into the drafting zone at a slower rate than it is delivered, the improvement which comprises means connected to said rear set of drafting instrumentalities for driving the same at randomly varying rates to randomly vary the count

of the strand being delivered from said drafting instrumentalities and comprising:

(a) controllable variable speed drive means connected to said rear set of drafting instrumentalities independently of said front set for driving the rear set independently of said front set.

(b) means for generating a continuous first voltage signal and a discontinuous second voltage signal and

(c) control means operatively connected to said signal generating means (b) for receiving the first and second signals therefrom and combining the same to create a drive voltage signal having an instantaneous magnitude determined by the greater of the instantaneous magnitudes of the first and second signals and operatively connected to said drive means (a) for varying the speed at which said rear set of drafting instrumentalities are driven in response to the magnitude of the drive signal.

6. The combination of claim 5 wherein said signal generating means (b) includes a plurality of first signal source means each originating a voltage signal which varies in a predetermined manner as to duration, spacing and sequence of voltage peaks and a first signal integrating means operatively connected to said first signal source means for integrating the plurality of varying signals originating from said first signal source means into a single signal to thereby generate the aforementioned continuous first signal.

7. The combination of claim 5 wherein said signal generating means (b) includes a plurality of second signal source means, certain of said second signal source means each originating a voltage signal which varies in a predetermined manner as to duration, spacing and sequence of voltage peaks and another of said second signal source means originating an interrupted signal, and a second signal integrating means operatively connected to said second signal source means for integrating the signals originating from said certain signal source means into a single signal and including a gate means actuated by the interrupted signal and controlling the passage of the single signal to thereby generate the aforementioned discontinuous second signal.

8. In a spinning frame having at least front and rear spaced apart sets of drafting instrumentalities for drafting fibrous textile strands passing therethrough, said front set normally being driven at a predetermined rotative speed and said rear set normally being driven at a slower relative speed than said front set for feeding the textile strand into the drafting zone at a slower rate than it is delivered, the improvement which comprises means connected to said rear set of drafting instrumentalities for driving the same at randomly varying rates to randomly vary the count of the strand being delivered from said drafting instrumentalities and comprising:

(a) controllable variable speed drive means connected to said rear set of drafting instrumentalities independently of said front set for driving the rear set independently of said front set,

(b) means for generating a plurality of pairs of inversely varying voltage signals and an interrupted voltage signal,

(c) means operatively connected to said signal generating means (b) for receiving signals therefrom and for combining a signal of each pair of inverse signals with a signal of another pair to create at least two randomly varying voltage signals and for gating one of the randomly varying signals with the interrupted signal to create an intermittently varying voltage signal, and

(d) control means operatively connected to said means (c) for receiving the randomly varying and intermittently varying voltage signals therefrom and combining the same to create a drive voltage signal of varying magnitude and operatively connected to said drive means (a) for varying the speed at which said

rear set of drafting instrumentalities are driven in response to the magnitude of the drive signal.

9. The combination of claim 8 wherein said signal generating means (b) includes a plurality of multivibrator circuits, each of said circuits generating one of said pairs of inversely varying signals and comprising a pair of alternately conducting circuit elements and means for controllably timing the alternation in conductive state of said circuit elements.

10. The combination of claim 8 wherein said signal generating means (b) includes a randomizer generating said interrupted signal and comprising a rotatively driven cam member and a plurality of electrically interconnected switches engaged thereby for completing an electrically conductive path at random time intervals.

11. The combination of claim 8 wherein said drive means (a) includes a voltage responsive electrical motor and said control means (c) modulates voltage applied to said motor and includes means responsive to the operating speed of the motor for imposing a load thereon in the event the operating speed thereof exceeds that indicated by said drive signal so as to facilitate fluctuation of such speed in response to variations in magnitude of the drive signal.

12. In a spinning frame having at least front and rear spaced apart sets of drafting instrumentalities for drafting fibrous textile strands passing therethrough, said front set normally being driven at a predetermined rotative speed and said rear set normally being driven at a slower relative speed than said front set for feeding the textile strand into the drafting zone at a slower rate than it is delivered, the improvement which comprises means connected to said rear set of drafting instrumentalities for driving the same at preprogrammed varying rates to vary the count of the strand being delivered from the drafting instrumentalities in accordance with a predetermined pattern and comprising:

(a) controllable variable speed drive means connected to said rear set of drafting instrumentalities independently of said front set for driving the rear set independently of said front set,

(b) means for generating a plurality of pairs of inversely varying voltage signals,

(c) means operatively connected to said signal generating means (b) for receiving signals therefrom and for combining a first signal of each pair of inverse signals with a first signal of another pair and for combining the second signals of the respective pairs of inverse signals to create a voltage signal varying intermittently in a predetermined manner and,

(d) control means operatively connected to said means (c) for receiving the intermittently varying voltage signal therefrom and for creating a drive signal of varying magnitude and operatively connected to the drive means (a) for varying the speed at which the rear set of drafting instrumentalities are driven in response to the magnitude of the drive signal.

13. A method of producing a novelty yarn on a spinning frame having at least front and rear spaced apart sets of drafting instrumentalities for drafting fibrous textile strands passing therethrough and wherein said front set is normally driven at a predetermined rotative speed for delivering the textile strands, the method comprising the steps of:

generating first and second randomly varying signals, combining the first and second signals to create a driving signal of randomly varying magnitude, and driving the rear set of drafting instrumentalities independently of the front set thereof and at varying speeds in response to the varying magnitude of the drive signal so that the rear set of drafting instrumentalities feeds the textile strands into a drafting zone between the front and rear sets at randomly varying rates to randomly vary the count of the strands being delivered therefrom.

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14. A method according to claim 13 wherein the step of generating signals includes modulating electrical currents to generate voltage signals as the aforementioned first and second signals.

15. A method according to claim 14 wherein the step of generating signals includes generating a plurality of pairs of inversely varying signals and integrating together a signal of each pair of inversely varying signals with a signal of another pair of such signals.

16. A method according to claim 13 wherein the step of generating first and second signals includes generating a continuous voltage signal as the aforementioned first signal and generating a discontinuous voltage signal as the aforementioned second signal.

17. A method of producing a novelty yarn on a spinning frame having at least front and rear spaced apart sets of drafting instrumentalities for drafting fibrous textile strands passing therethrough and wherein said front set is normally driven at a predetermined rotative speed for delivering the textile strands, the method comprising the steps of:

generating a plurality of pairs of inversely varying voltage signals,

generating an interrupted voltage signal,

combining a signal of each pair of inversely varying signals with a signal of another pair of such signals to create at least two randomly varying voltage signals,

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controlling transmission of one of the randomly varying signals with the interrupted signal to create an intermittently varying voltage signal,

combining the intermittently varying signal with another of the randomly varying signals to create a drive voltage signal of varying magnitude, and

driving the rear set of drafting instrumentalities independently of the front set thereof and at varying speeds in response to the varying magnitude of the drive signal so that the rear set of drafting instrumentalities feeds the textile strands into a drafting zone between the front and rear sets at randomly varying rates to randomly vary the count of the strands being delivered therefrom.

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JOHN PETRAKES, *Primary Examiner*.

U.S. Cl. X.R.

57—91, 156; 19—238

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,449,899

June 17, 1969

Francis M. Cureton et al.

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

Column 1, line 28, "event." should read -- event, --; line
"fromation" should read -- formation --. Column 2, line 25,
"as-" should read -- associated front set of drafting instrument
ities spaced --. Column 3, line 12, "it" should read -- is --.
Column 4, line 46, "rears" should read -- rear --; line 56, "an"
should read -- and --; line 62, "drive" should read -- driven --
line 65, "rondomizer" should read -- randomizer --. Column 5, li
6, before "71" insert -- 70 --; line 73, "lanes" should read --
lines --. Column 6, line 72, "including" should read -- included
--. Column 7, line 47, "the" should read -- are --; line 55,
"five-portion" should read -- five-position --. Column 8, line 1
after "7", second occurrence, insert -- a --; line 51, "he"
should read -- the --. Column 9, line 13, "purse" should read --
purpose --; line 75, before "programmed" insert -- pre- --. Colu
11, line 6, "set." should read -- set, --. Column 12, line 7,
"alternatively" should read -- alternately --.

Signed and sealed this 10th day of March 1970.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

WILLIAM E. SCHUYLER,
Commissioner of Paten