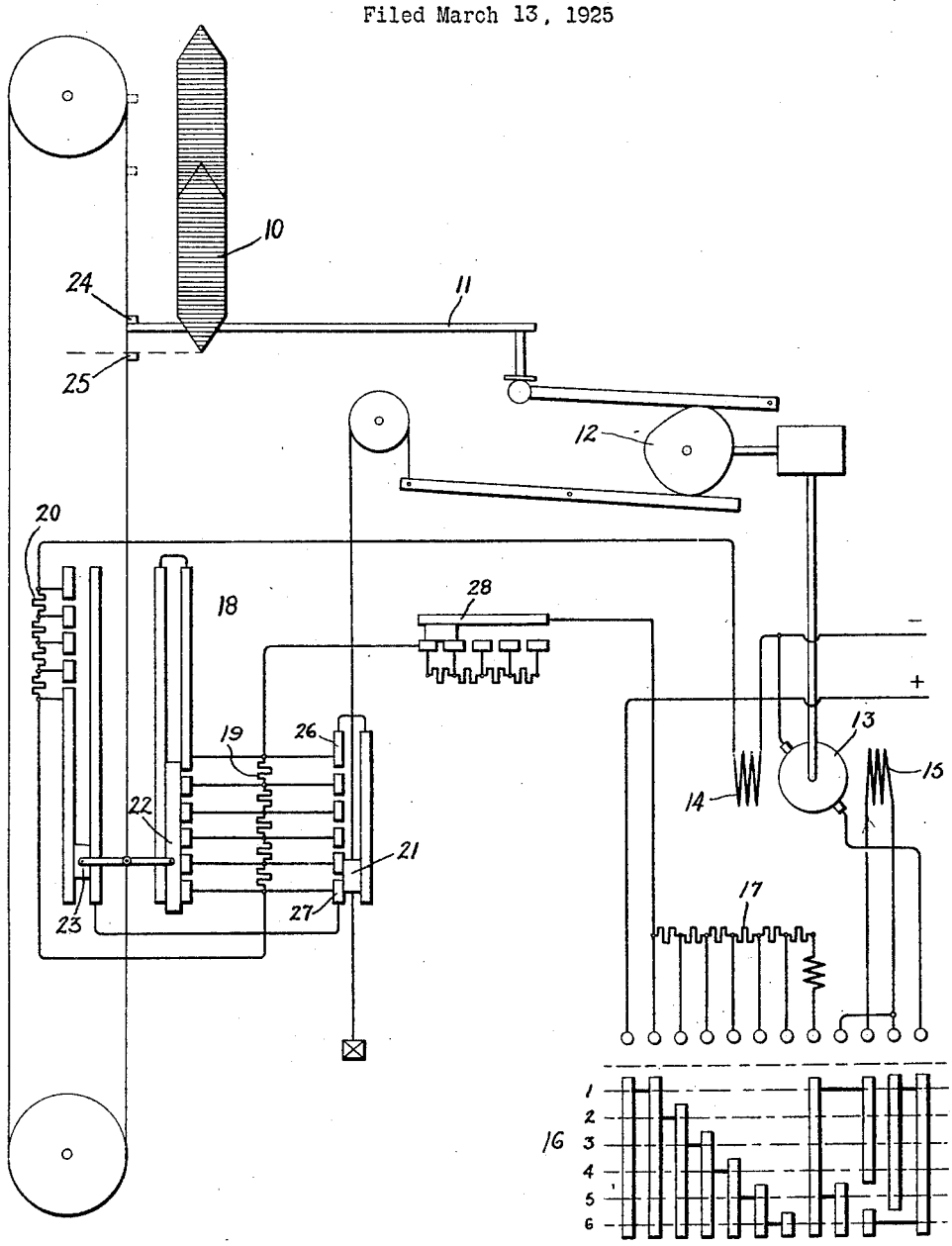
Feb. 7, 1928. 1,658,652

R. REGNAULT

CONTROL SYSTEM FOR MOTOR DRIVEN SPINNING FRAMES

Filed March 13, 1925



Inventor:
René Regnault:
by Alexander S. Lunt
His Attorney.

Patented Feb. 7, 1928. 1,658,652

UNITED STATES PATENT OFFICE.

RENÉ REGNAULT, OF LILLE, FRANCE, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

CONTROL SYSTEM FOR MOTOR-DRIVEN SPINNING FRAMES.

Application filed March 13, 1925, Serial No. 15,330, and in France April 18, 1924.

This invention relates to control systems for motor driven textile machinery such as spinning frames and the like, and has for its object the provision of improved means for controlling the speed of the driving motor in accordance with the movement of the ring rail of the spinning machine so as to maintain the tension of the yarn substantially constant.

The yarn spun on ring spinning frames generally is wound on bobbins or tubes in conical layers with the threads slightly crossed in order to enable unwinding to take place easily without entanglement. To this end, the yarn is guided up and down along the rotating spindles by the ring rail which performs a reciprocating up and down motion. At the beginning of the spinning, a conical base must be wound on the bare tube or bobbin unless the bobbin itself is formed with a conical base. On the top of this base, a cop is then built up with the layers of thread normally arranged in conical shape. This requires that the ring rail be raised or advanced by the thickness of one layer after each up and down reciprocating motion. In the ordinary form of ring spinning frame, this is accomplished by means of the builder or copping motion frame which is reciprocated by an eccentric cam or copping plate and a ratchet wheel which is moved forward one step at each reciprocation of the frame and is arranged to raise or advance the ring rail upon the completion of each layer.

It is well known that in the operation of continuous ring spinning frames of the above character, the yarn tension varies inversely with the height of the ring rail above the lowest position and inversely with the particular diameter in the layer upon which the yarn is being wound. Hence, in order that the thread may be smoothly wound in regular layers in a conical bobbin, it is necessary to correct the variations in tension due to both the change in direction of the pull of the thread upon the traveler or ring as well as for the variation due to the gradual decrease in length of the balloon thread as the bobbin is built up from "starting" until "doffing".

While heretofore it has been proposed to vary the speed of both alternating current and direct current driving motors of spinning frames in widely different ways, however, none of the systems of control with which I am familiar have been of a nature to insure variations in the speed of the spinning frames periodically and synchronously with the definite variations in the tension of the yarn in a practical and simple manner when applied to control a direct current motor operated spinning frame.

Although not necessarily limited thereto, the present invention is particularly applicable to the control of spinning machinery in which each spinning frame is driven by an electric motor of the adjustable speed direct current type.

Ordinarily, after starting a shunt wound direct current motor driven spinning frame in the unheated condition there will be a gradual increase in the operating speed of the spinning frame due on the one hand to the heating of the field windings of the driving motor and on the other hand to the decrease in power required to drive the spinning frame after it is once set into operation. Moreover, to maintain constant tension on the yarn, the proper operating speed of the driving motor continuously varies during the different phases of winding the bobbin and depends primarily upon the following factors:—first, the nature of the thread being manufactured; second, the location of the thread layer in the bobbin as determined by the level or height of the ring rail; and third, the position of the particular spire or turn in the layer.

The present invention provides a novel form of controlling means which is well adapted for controlling direct current motor driven spinning frames or the like whereby the proper operating speed may be obtained under all of the varying phases of operation just enumerated. To insure against speed variations due to heating of the field winding of direct current motors, field magnets having windings of ample current carrying and heat dissipating capacity are provided, and if desired a differential connected series winding may be provided to compensate for the variations of speed resulting from variations in the load imposed upon the driving motor. In carrying the present invention into effect in a preferred form, a novel form of circuit controlling switch mechanism is operatively connected to the regulating gear of the spinning frame and the switch mechanism is arranged to control

speed controlling resistors connected in circuit with the driving motor in such manner that the motor speed is successively increased and decreased between progressively variable limits according to the particular requirements of the various phases of operation of the spinning frame. The preferred form of controlling switch mechanism for the driving motor comprises a pair of independently operable circuit controlling members, one of which is arranged to control a short circuit around successive sections of a speed controlling resistor for the driving motor in accordance with the rise and fall of the ring rail of the spinning machine and the other of which is arranged to independently control a short circuit around successive sections of the same speed controlling resistor in accordance with the advance of the ring rail of the spinning machine. In this way, a progressively increasing number of sections of the speed controlling resistor are placed under the control of the first circuit controlling member as the bobbin is built up and consequently the motor speed is varied between progressively variable limits.

For a better understanding of my invention, reference is had to the following description taken in connection with the accompanying drawing in which the single figure diagrammatically illustrates a direct current motor driven spinning frame control system embodying my invention for the purpose of explaining the principles thereof.

Referring to the drawing, it will be seen that I have illustrated only such parts of the spinning frame as seem essential for the disclosure of my invention since spinning frames are old and well known and my invention does not depend in any way on the particular construction of the spinning machine. However, in the drawing it will be seen that 10 represents the cop or bobbin into which the thread is wound under the control of the usual form of ring traveller which is mounted upon the ring rail carriage 11. The ring rail carriage 11 is mechanically connected to be oscillated up and down by the eccentric or copping plate 12 and it will be understood that the ring rail carriage 11 is periodically advanced relatively to the bobbin 10 after the completion of each layer by any of the well known forms of spinning frame mechanisms.

The spinning frame driving motor 13 is shown as of the direct current compound wound type having a shunt field winding 14 and a series field winding 15 and is mechanically connected through suitable gearing to drive the operating mechanism of the ring rail 11 as well as to rotate the bobbin 10 at high speed. A starting controller 16 which may be of the drum type illustrated is provided for controlling the connection of the series winding 15 in the armature circuit of motor 13 as well as for controlling the motor starting resistor 17 as will be more fully described in connection with th operation of the control system embodying my invention.

In order to control the operating speed of motor 13, in accordance with my invention the circuit controlling mechanism 18 is provided for regulating the speed controlling resistors 19 and 20 which are connected in circuit with the shunt field winding 14 of the motor 13. In the preferred form illustrated in the drawing, the circuit controlling mechanism 18 comprises essentially the sliding circuit controlling devices 21, 22 and 23. It will be observed that the circuit controlling device 21 is electrically connected to control a short circuit around successive sections of the speed controlling resistor 19 and is mechanically connected through a suitable weighted cord, pulley, and lever mechanism to be actuated by the eccentric 12 responsively to the rise and fall of the ring rail carriage 11. Furthermore, it will be observed that the circuit controlling devices 22 and 23 are mechanically connected to be simultaneously operated in accordance with the advance of the ring rail carriage 11 through the agency of a suitable cord and pulley operating mechanism as indicated in the drawing. As shown, the cord of the operating mechanism is provided with a pair of adjustable stops 24 and 25 which are disposed in the path of travel of the ring rail carriage 11.

The manner in which the independently movable circuit controlling devices 21 and 22 cooperate to jointly control the speed regulating resistor 19 as well as the manner in which the circuit controlling device 23 operates to control the speed controlling resistor 20 will better be understood from the following description of the operation of the spinning frame control system illustrated in the drawing.

With the direct current supply lines, indicated as plus and minus in the drawing, energized from a suitable source, motor 13 may be started and accelerated to normal operating speed by operation of the controller 16 through its successive controlling positions 1 to 6 indicated in the drawing. In this way, the series winding 15 is initially connected to act cumulatively with the shunt field winding 14 in order to increase the torque of motor 13 during the starting period in which the successive sections of the starting resistance 17 are short circuited by the controller 16. It will be observed, however, that in the sixth or full speed running position of controller 16, the series winding 15 is connected differentially with the shunt field winding 14 to compensate for variations in the load imposed upon the motor.

With the operating parts of the circuit controlling switch mechanism 18 in their respective positions in which they are shown in the drawing, the resistor 19 is entirely short circuited by the circuit controller 22 while the resistor 20 is inserted in the shunt field circuit of driving motor 13. Under these conditions the motor speed is regulated by means of the manually operated rheostat 28 to the proper value for the winding of the yarn upon the bobbin 10 in the initial or bunch stage. The subsequent operation of the automatic motor speed control arrangement is as follows:—When a filling winding is being wound upon the bobbin 10, the ring rail carriage 11 is oscillated only a slight degree by the eccentric or copying plate 12 during the formation of the bunch upon the lower end of bobbin 10. During this operation the movement of the ring rail carriage 11 is not sufficient to engage with the stop 24 and, consequently, the circuit controlling member 22 as well as the circuit controlling member 23 remain in the position in which they are shown in the drawing. It will be understood, however, that the circuit controlling member 21 is oscillated between the stationary contacts 26 and 27 cooperating therewith responsively to the oscillation of the ring rail carriage 11.

After the completion of the winding of the bunch, the advance of the ring rail carriage 11 is started by means of suitable mechanism which is not shown in the drawing. At the same time the oscillation of the ring rail carriage 11 by the eccentric 12 continues thus producing a combined back and forth motion of the ring rail carriage 11 with the limits of motion gradually advancing as the bobbin is built up. During this phase of winding of the yarn upon the bobbin 10, the current controlling device 18 becomes effective to control the speed of motor 10 so as to maintain a substantially constant tension upon the yarn as it is wound upon the bobbin. As the limits of oscillation of the ring rail carriage 11 advances, the stop 24 is engaged by the ring rail carriage 11 so as to correspondingly raise the slide of circuit controlling device 22 and thereby remove the short circuit around successive sections of the speed controlling resistor 19. In this way, first one, then two, and then progressively increasing numbers of the sections of resistor 19 are placed under the control of the oscillating slide of circuit controlling device 21. Thus, when the successive layers of yarn are wound upon the bobbin 10, the speed of driving motor 13 is automatically increased when the layer is wound upon the full diameter of the bobbin and is automatically decreased when the thread is wound upon the inner diameter of the bobbin and the limits between which the speed of motor 13 is varied are progressively increased correspondingly with the advance of the ring rail 11. This progressive variation of motor speed continues throughout the building up of the bobbin 10.

When the point of the bobbin is formed, the ring rail carriage 11 has advanced the stops 24 and 25 sufficiently to bring the slide of circuit controlling device 23 into the position required to short circuit the successive sections of auxiliary speed controlling resistor 20. This serves to vary the energizing current of the shunt field winding 14 of the motor so as to gradually decrease the limits within which the speed is varied by the slide of circuit controlling device 21 to compensate for the decreased length of the balloon thread.

When the bobbin is complete, the slides of circuit controlling devices 22 and 23 are brought back to the initial position in which they are shown in the drawing, upon the lowering of the ring rail carriage 11 preparatory to subsequent winding of additional bobbins in the manner previously described.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention together with the apparatus which I now consider to represent the best embodiment thereof, but I would have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new, and desire to secure by Letters Patent of the United States, is:—

1. In a motor control system for spinning machines and the like, the combination of an electric motor for driving the machine, a speed controlling resistor in circuit with the motor, a pair of independently operable circuit controlling devices each connected to separately control a short circuit around successive sections of said resistor, and means operatively connecting the motor with said devices to operate the same to successively insert and remove a progressively increasing number of sections of the said resistors in the motor circuit and thereby successively vary the motor speed between progressively variable limits.

2. In a motor control system for spinning machines and the like, the combination of an electric motor for driving the machine, a speed controlling resistor in circuit with the motor, a pair of independently operable circuit controlling devices, each connected to separately control a short circuit around successive sections of said resistor and means operatively connecting the motor with one of said devices to operate the same to open and close the short circuit around the said successive sections of said resistor in a predetermined sequence and means operatively connecting the motor with the other of said devices to operate the same to open the short

circuit around the said successive sections of said resistor in a different sequence whereby the motor speed is successively varied between progressively variable limits.

3. In a motor control system for spinning machines and the like, the combination of an electric motor for driving the machine, a speed controlling resistor in circuit with the motor, a circuit controlling device operatively connected with the motor to be operated thereby and arranged to periodically establish and interrupt a short circuit around successive sections of said resistor during the operation of the motor, and a second circuit controlling device operatively connected with the motor to be operated thereby and arranged to successively interrupt an independent short circuit around the said successive sections of said resistor to permit said first device to successively insert and remove a progressively increasing number of the said sections of said resistor in the motor circuit and thereby successively vary the motor speed between progressively variable limits.

In witness whereof, I have hereunto set my hand.

RENÉ REGNAULT.