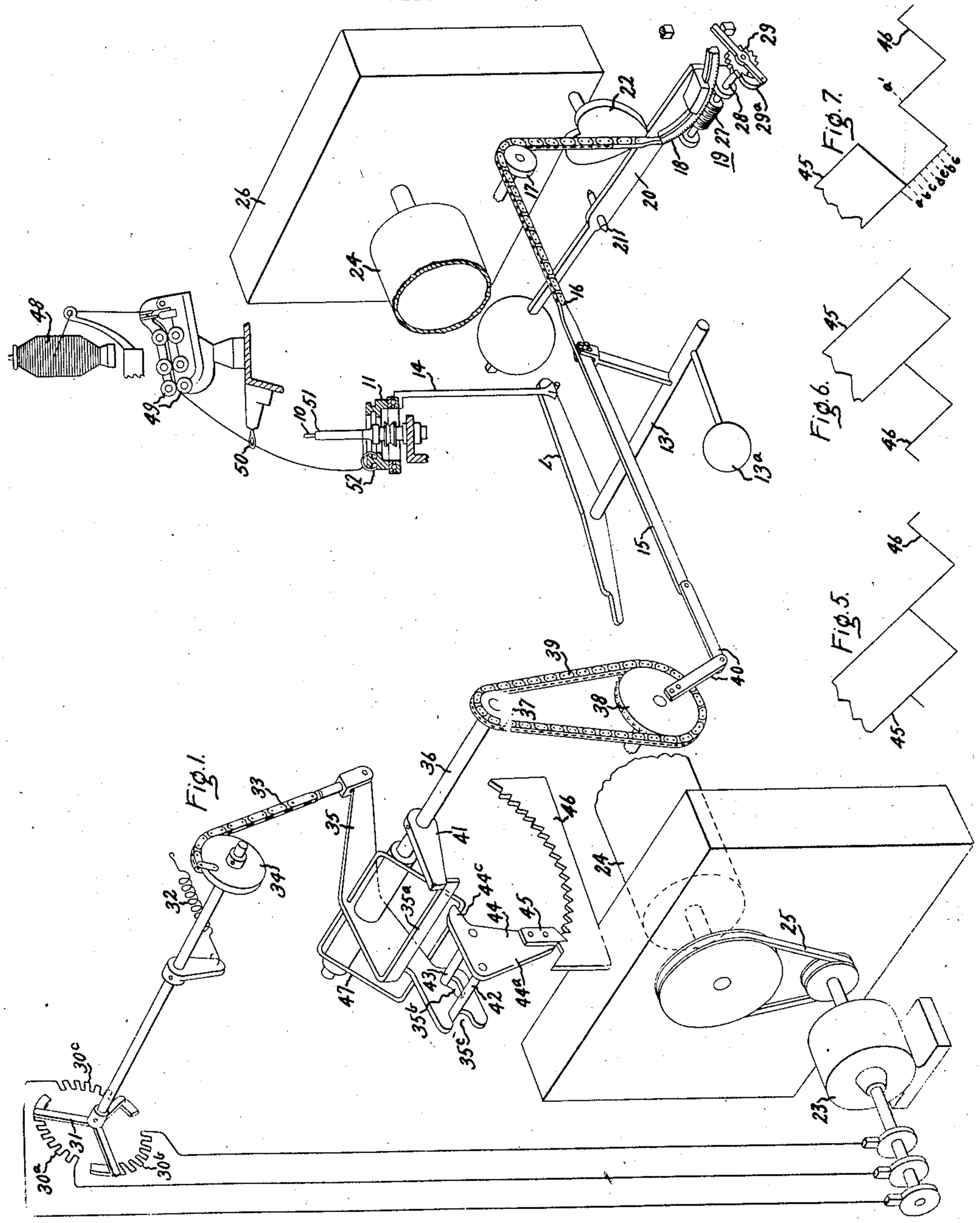
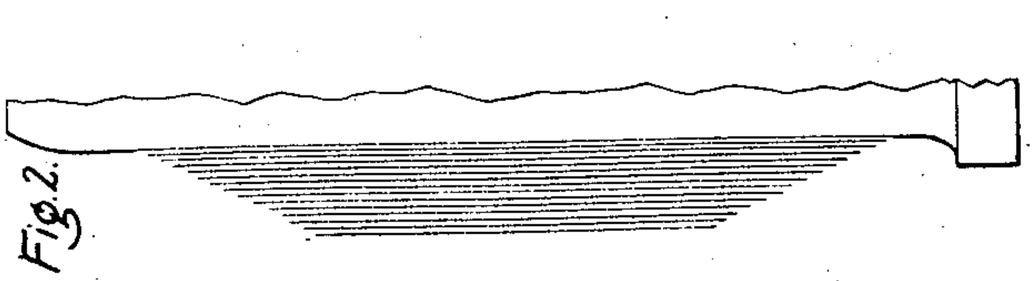
March 7, 1944. J. EATON 2,343,648

CONTROL SYSTEM

Filed Nov. 2, 1942 2 Sheets-Sheet 1





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2 Sheets-Sheet 2

Fig. 3.

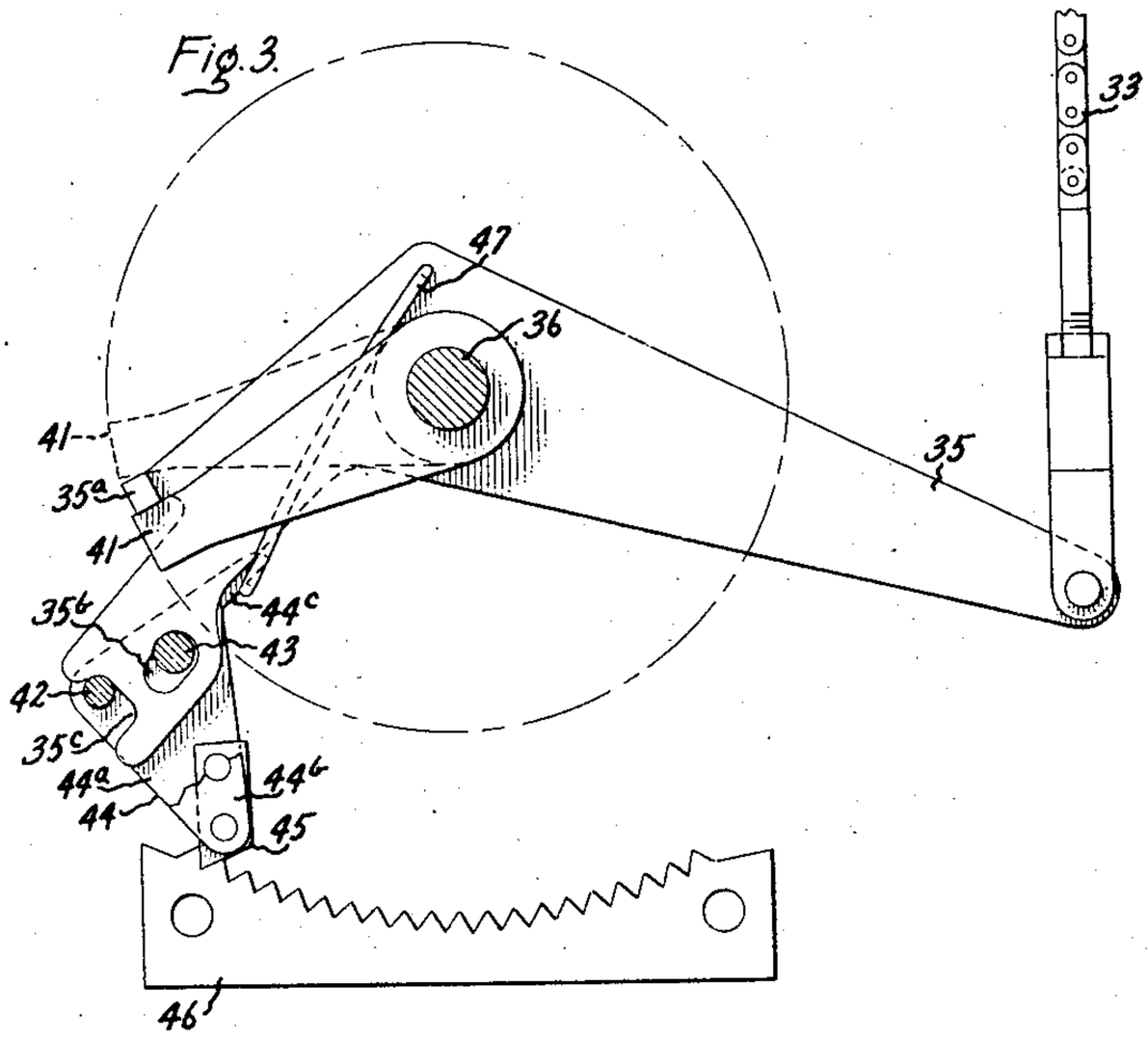
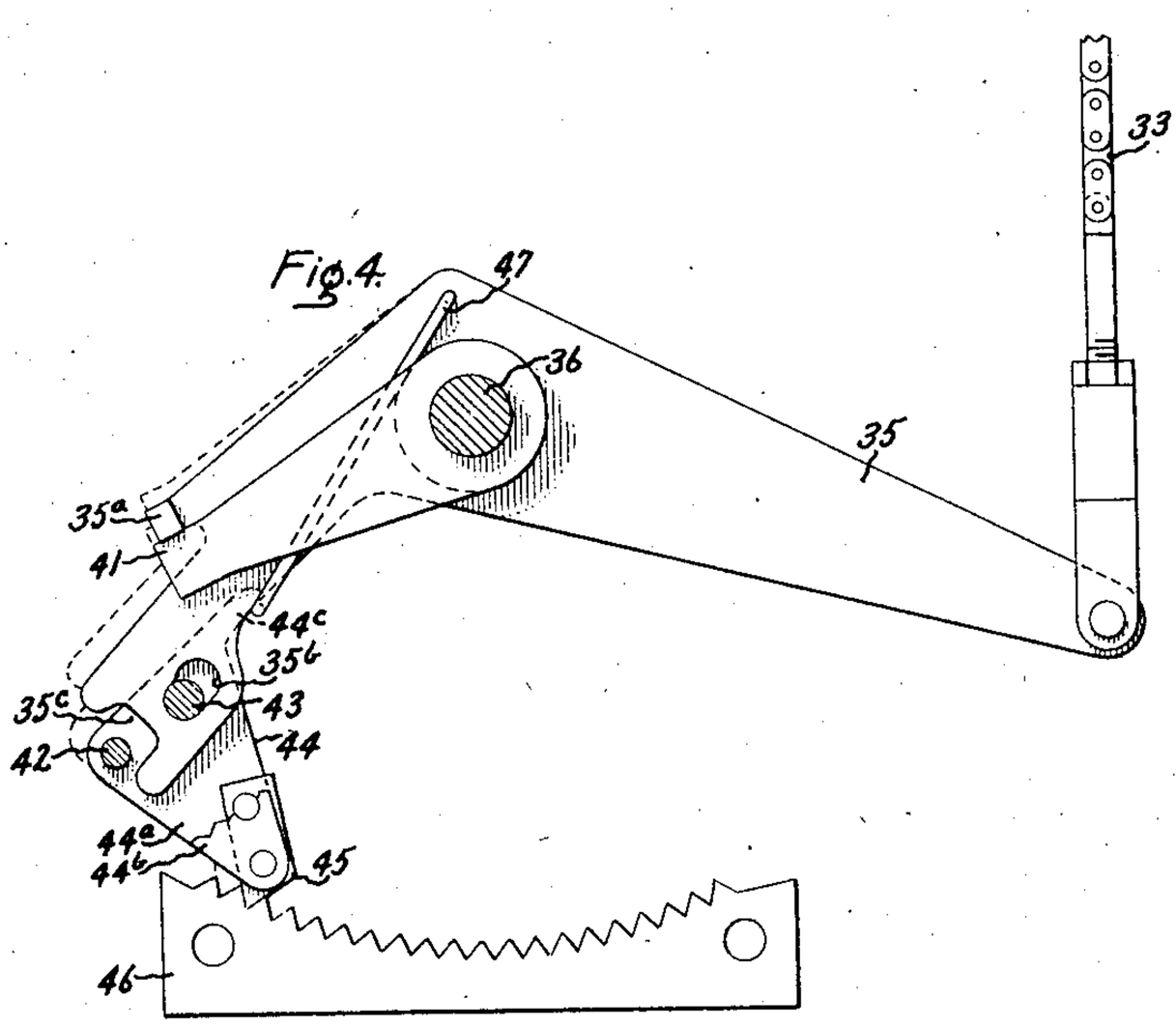


Fig. 4.



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2,343,648

CONTROL SYSTEM

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Application November 2, 1942, Serial No. 464,220

4 Claims. (Cl. 57—94)

This invention relates to the control of textile machinery such as spinning frames and the like, and it has for an object the provision of a simple, reliable and improved means for varying 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.

A ring spinning frame is provided with a mechanism known as a builder mechanism for reciprocating the ring rail in such a manner as to build the bobbin according to one of a number of known bobbin winds. This builder mechanism is usually built in the frame at one end thereof which is referred to as the "head" end. For reasons pertaining to the manufacture, operation and convenience for repair of spinning frames, the driving motor is usually mounted at the opposite or "foot" end of the frame. Heretofore, in variable speed spinning frames, it has been found necessary to mount the controller or device for varying the speed of the motor at the end of the frame to provide for its actuation by the builder mechanism with a minimum installation expenditure.

A modern spinning frame may be 40 feet or more in length. Thus, with the rheostat mounted at one end of the frame and the motor at the other, a cable containing three large size copper conductors extending the full length of the frame has been required to connect the rheostat with the slip rings of the motor. The elimination of these long lengths of expensive cable results in a very substantial saving.

Accordingly, a further object of this invention is the provision of suitable means for actuating the speed control device in response to movement derived from the movement of the ring rail or its actuating member at the foot end of the frame so that the speed controlling device can be mounted at the end of the frame at which the motor is mounted, with consequent elimination of expensive cable extending the full length of the frame.

More specifically, the invention relates to spinning frames in which the yarn is wound on the bobbin in the form of a warp wind. This invention is a modification of the invention disclosed and claimed in U. S. Patent 2,303,112, and assigned to the same assignee as the assignee of the present invention.

In warp wind, at the beginning of the spinning and winding process, the builder arm slowly moves the ring rail up and down from a point at the bottom of the bobbin to a predetermined point at the top of the bobbin. The rate of speed of traverse is uniform in each direction. This is determined by the shape of the builder cam which effects the movement of the builder arm. In the case of warp wind, it is known as a heart-shaped cam or an even throw cam. As each successive traverse of the ring rail is made, the effective length of the builder arm is shortened, thereby making the length of each successive traverse shorter.

It is, therefore an object of the invention to provide means at the motor end of the frame which is responsive to reciprocation of the member which reciprocates the ring rail of a spinning frame for warp wind, to vary the speed of the motor which drives the spinning frame in accordance with increasing diameter of the bobbin.

In carrying the invention into effect in one form thereof, a rheostat is provided at the motor end of the frame for varying the speed of the motor. A ratcheting device is provided which has a pawl member which advances from each position on a cooperating toothed member only in response to a plurality of reciprocations of the ring rail actuating member, i. e. the wave shaft. Means responsive to each advance of the pawl are provided for actuating the rheostat to increase the speed of the motor with increasing diameter of the bobbin and maintaining the speed of the motor constant throughout each traverse of the ring rail.

For a better and more complete understanding of the invention, reference should now be had to the following specification and to the accompanying drawings, in which Fig. 1 is a simple, diagrammatical illustration of an embodiment of the invention in perspective; Fig. 2 is a diagrammatic view in section of a warp wound bobbin; Figs. 3 and 4 are views in elevation of details of the invention; and Figs. 5, 6 and 7 are diagrammatic views which illustrate the positions and movements of the pawl of the speed controlling ratcheting device in advancing from one position to another on the toothed member.

Referring now to the drawings, only the essential parts of the spinning frame directly cooperating with the speed varying means are shown. In the machine illustrated, the spindle 10 is fixed in position, while the ring rail 11 is oscillated axially of the spindle as the winding operation progresses. As far as is known, all present-day commercial spinning frames have this relative arrangement of spindle and ring rails, but obviously this arrangement might be reversed with the ring rail stationary and the spindle given a corresponding movement. Consequently, any ref-

erence in this specification or in the annexed claims to movement of the ring rail is to be understood as a relative movement of the ring rail and spindle.

For the purpose of simplifying the drawings, the ring rail is shown as being operated in a conventional manner by means of a lever 12 mounted on a cross shaft 13. The lever 12 is connected to the lower end of a lifter rod 14, the upper end of which is secured to the ring rail. The cross shaft 13 carries a weight 13*a* which tends to rotate the cross shaft in a direction to raise the ring rail, and the lever 12 is moved against the force of the weight by means of a member 15 which extends lengthwise of the spinning frame from one end thereof to the other. This member is usually referred to as the wave shaft. One end of the wave shaft 15 is connected to one end of a chain 16 which passes over a pulley 17 to the end of an arcuate-shaped short rack 18 to which it is attached by suitable fastening means. This arcuate-shaped rack comprises one element of the builder mechanism which is indicated generally by the reference character 19. This builder mechanism is of a well-known commercial type and comprises a builder arm 20 pivoted at 21 and mounted to be engaged by a builder cam 22.

The spindle 10 and the builder mechanism are both driven by suitable driving means illustrated as an alternating current induction motor 23 of the wound rotor type. As illustrated, the motor 23 is mounted at the foot end of the machine which is the opposite end from that at which the builder mechanism is located. The motor drives a large cylinder 24 through a belt connection 25, and the spindles are driven from the drive cylinder 24 by means of tapes (not shown). The builder cam at the head end of the machine is driven from the cylinder 24 by means of gearing in the end casing 26.

In order to provide for the necessary shortening of the amplitude of reciprocation of the wave shaft 15 to produce the necessary progressive shortening of the traverse of the ring rail, means are provided for shortening the effective length of the builder arm 20. This is accomplished by means of a worm gear 27 which engages the teeth of the arcuate-shaped rack 18. This worm 27 is mounted on a worm shaft 28 which is rotatably journaled in bearings on the builder arm 20 and provided with a ratchet wheel 29 arranged to cooperate with a pawl 29*a* to move the rack 18 inwardly a predetermined amount each time that the builder arm 20 is oscillated about its pivot 21. Thus, it is seen that the builder arm constitutes an element of the machine which oscillates in accordance with the relative oscillatory movement between the ring rail and the spindle, and that the rack 18 which is moved inward one step each time that a forward and return layer is wound on the spindle, constitutes an element of the machine which is progressively movable in accordance with the increasing diameter of the bobbin. Consequently, the wave shaft 15 which is mounted for longitudinal movement, reciprocates once for each rotation of the builder cam and effects a raising and lowering of the ring rail for each reciprocation.

The principal function of the builder mechanism is to decrease the effective length of the builder arm each time that the builder arm oscillates, thereby progressively to change both the limits of relative oscillatory movements and the amplitude of this movement and thereby progressively to change the limits and amplitude of traverse of the ring rail.

The speed of the motor 23 is controlled by means of a rheostat having resistors 30*a*, 30*b*, and 30*c* connected in the secondary circuit of the motor together with a rotatable contact member 31 having three arms for varying the effective amount of the resistors. A spring 32 serves to bias the contact member 31 to the high speed position in which the entire amount of resistance of each of the resistors 30*a*, 30*b* and 30*c* is short circuited and is adapted to be operated from that position in a clockwise direction as viewed in the drawings by means of a chain 33, one end of which is secured to a drum 34 and the other end of which is secured to the extremity of a crank arm 35 which is loosely mounted on the shaft 36 for rotation on the shaft as a pivot. The shaft 36 is connected by means of sprockets 37 and 38 and a connecting chain 39 and a crank mechanism 40 to the wave shaft 15. The ratio of the chain and the sprocket gearing 37, 38, and 39 is so chosen that a radial arm 41 which is secured to the shaft 36 will be rotated forward and backward through a suitable angle, e. g., approximately 360 degrees for the first complete reciprocation of the wave shaft, and thus for the first complete relative oscillation of the ring rail and spindle. At the end which is opposite to the point of attachment of the chain 33, the crank arm 35 is bent at right angles to the plane of rotation of the crank to form a projection 35*a* which is in a position to be struck by the rotating arm 41 as the arm 41 nears the limit of its rotation in a clockwise direction. This end of the crank arm 35 is provided with a slot 35*b* and a recess 35*c* which receive the pins 42 and 43 of a triangular shaped pawl carrying member 44. This triangular shaped pawl carrying member 44 comprises two plates 44*a* and 44*b* which are separated from each other to receive the pawl 45 to which they are attached by suitable fastening means. The front plate 44*b* is omitted in Fig. 1 and in Figs. 3 and 4, it is shown broken away to reveal the details of the pin and slot connections of the pawl carrying member 44 to the end of the crank arm 35.

The spring 32 places the chain 33 under tension and this tension tends to rotate the crank 35 in a counterclockwise direction, thereby to force the pawl 45 into engagement with the stationary arcuate-shaped toothed member 46. For the purpose of lifting the pawl 45 out of engagement with the toothed member 46 when the tension of the spring 32 is relieved, the crank arm 35 is provided with a spring 47 which is attached to the crank arm 35 and is flexed about the hub of the crank arm 35 and at its opposite end, the spring 47 bears against a projection 44*c* of the pawl carrying member 44, thereby biasing the pawl carrying member in a counterclockwise direction about the pin 43. However, the force of the spring 47 is insufficient to lift the pawl 45 out of engagement with the toothed member 46 against the tension of spring 32 until the arm 41 on clockwise movement strikes the projection 35*a* of the crank and relieves the pressure against the pawl carrying member 44.

With the foregoing understanding of the elements and their organization in the system, the operation of the system itself will readily be understood from the following detailed description.

The roving yarn is led from the roving spool 48 through the usual draft rollers 49, and thence

through the wire guide eye 58 to the bobbin 51. When the bobbin is empty and the ring rail is at the bottom of its traverse, the pawl 45, the movable contact member 31 of the rheostat, will occupy the positions in which they are illustrated in Figs. 1 and 3. Since the rheostat contact arm 31 is in the low speed position, the spinning frame will be driven at low speed at this initial stage of the operation. The rotation of the builder cam 22 allows the weight 13*a* to raise the ring rail to wind the first layer on the empty bobbin. During this first traverse of the ring rail, the wave shaft 15 is moved to the left by the downward counterclockwise rotation of the weight 13*a*, and this movement of the wave shaft causes the crank mechanism 40 to rotate the drive sprocket 38 and through the chain 39 the driven sprocket 37 and the shaft 36 to which the driven sprocket 37 is fixed.

The rotation of the shaft 36 rotates the radial arm 41 from the dotted position illustrated in Fig. 3 in a clockwise direction until, when the ring rail reaches a point near the upper extremity of its travel, the radial arm 41 strikes the projection 35*a* of the crank arm 35. As the ring rail continues its upward traverse toward its extreme upper limit, the radial arm 41, now bearing against the crank arm 35, rotates the crank 35 in a clockwise direction thereby applying a downward pull to the chain 33 and rotating the drum 34 and the contact arm 31 of the rheostat in a clockwise direction. As illustrated, the contacts of the rheostat at the low speed point are elongated so that the movable contact arm 31 does not open the circuit of the secondary winding of the motor 23 while the ring rail is completing its upward traverse.

The relative positions of the parts of the ratcheting mechanism at the instant that the radial arm strikes the projection 35*a* of the crank 35 is illustrated in Fig. 3 and the position of the pawl 45 in the first tooth at this instant is illustrated in the enlarged view in Fig. 5. As the ring rail continues its upward traverse, the radial arm 41 continues in a clockwise direction from the position shown in Fig. 3. At this point the radial arm 41 in engaging the crank 35 removes the pressure of the spring 32 from the pawl 45 and consequently, the spring 47 which is biased about the hub of the crank 35 rotates the pawl carrier 44 in a counterclockwise direction about the pin 43 as a pivot until the lower crossbar of the spring 47 engages the arm of the crank 35 which carries the pawl carrier 44. This rotation of the pawl carrier lifts the pawl out of the first tooth. The pawl carrier then drops in the slot 35*b* from the position illustrated in Fig. 3 to the position illustrated in Fig. 4 with the pawl 45 in the second tooth. The relationship of the pawl 45 and the teeth of the rack member 46 is illustrated in the enlarged view in Fig. 5 which shows the pawl 45 bearing against the second tooth. As the ring rail approaches its upper limit, the radial arm 41 continues to move the crank 35 in a clockwise direction and this carries the pawl 45 out of the second tooth and back into the first tooth. At the limit of the upward traverse of the ring rail, the pawl 45 comes to rest in the first tooth in the position indicated by the dotted line *a* as illustrated in Fig. 7.

At this point in the operation the builder cam 22 has reached the position in which its high point engages the builder arm 20. As the rotation of the builder cam continues the wave shaft 15 begins to move to the right to initiate the downward traverse of the ring rail 11. The movement of the wave shaft to the right rotates the radial arm 41 in a counterclockwise direction and allows the tension of the spring 32 to pull upward on the chain 33 and rotate the crank 35 in a counterclockwise direction to seat the pawl 45 in its original position against the first tooth as illustrated in Fig. 5. Since the pawl 45 is seated against the first tooth, the spring 32 cannot rotate the rheostat arm 31 beyond its low speed position and consequently, the speed of the motor 23 remains at the lowest speed value as the downward traverse of the ring rail proceeds.

Also during the first complete traverse of the ring rail, the pawl 29*a* advances the ratchet wheel 29 one step and thereby moves the arcuate-shaped rack 18 inward and thereby shortens the effective length of the builder arm 20. As a result of the decrease of the effective length of the builder arm, the ring rail does not return to its initial position and consequently, the second layer on the bobbin ends at a point above the bottom of the first layer. As a result, the beginning of a taper will be formed at the lower end of the bobbin and, since the effective length of the builder arm 20 has been shortened, the next upward traverse of the ring rail will be correspondingly shortened so that the beginning of a taper will also be wound at the top of the bobbin. This condition is illustrated diagrammatically in Fig. 2.

The operation of the apparatus during the second upward traverse of the ring rail is the same as that described for the first upward traverse with the exception that when the pawl 45 is pulled away from the second tooth after the radial arm 41 strikes the projection 35*a* of the crank, the pawl 45 does not come to rest at the position indicated by the dotted line *a* in Fig. 7 as it did at the end of the first upward traverse, but instead, comes to rest at a somewhat lower point indicated by the dotted line *b* in Fig. 6, owing to the shortened traverse of the wave shaft 15 which results from the shortened effective length of the builder arm 20.

The upward and downward traverses of continuously decreasing amplitude of the ring rail continue with the pawl 45 stopping at progressively lower positions when it is withdrawn from the second tooth to the first tooth at the end of the upward traverse of the ring rail as indicated by the dotted lines *c*, *d*, *e*, *f*, and *g* in Fig. 7.

On the next upward traverse of the ring rail the reciprocation of the wave shaft 15 will have been shortened to such an extent by the progressive shortening of the effective length of the builder arm that the pawl 45 will not be withdrawn from the tooth 2 at the upper limit of ring rail traverse, but instead, will come to rest in the second tooth in the position indicated by the dotted line *a'* in Fig. 7. Then when the next downward traverse of the ring rail begins, the pawl 45 will be forced by the spring 32 to seat against the second tooth in the position indicated in Figs. 4 and 6. As a result, the spring 32 can rotate the contact arm 31 of the rheostat an amount corresponding to one tooth on the arcuate-shaped tooth member 46, thereby to increase the speed of the motor 23 to a value corresponding to the diameter of the yarn wound on the bobbin after the number of traverses of the ring rail required to advance the pawl 45 one tooth on the arcuate-shaped member 46.

As the winding operation progresses, the foregoing operation is repeated until at full bobbin,

the pawl 45 is advanced to the last tooth at the right-hand end of the arcuate-shaped member 46 and the spring 35 has rotated the contact arm 31 of the rheostat to a position in which all of the resistance of the resistors 30*a*, 30*b*, and 30*c* is short circuited and the frame driving motor 23 is driving the spinning frame at maximum speed.

From the foregoing, it will be seen that as the winding progresses from empty bobbin to full bobbin, the limits of movement of the wave shaft 15 and the limits of traverse of the ring rail are progressively changed and their amplitude progressively shortened. It will also be noted that the ratcheting mechanism responds to advance the pawl 45 one tooth of the arcuate shaped member in response to a plurality of traverses of the ring rail. This makes it possible to construct the rheostat with a much lesser number of speed points than the number of layers of yarn which are wound on the bobbin.

Although in accordance with the provisions of the patent statutes, this invention is described as embodied in concrete form and the principle thereof has been described together with the best mode in which it is now contemplated applying that principle, it will be understood that the apparatus shown and described is merely illustrative and that the invention is not limited thereto, since alterations and modifications will readily suggest themselves to persons skilled in the art without departing from the true spirit of this invention or from the scope of the annexed claims.

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

1. A control system for a ring spinning machine comprising an electric driving motor at one end of said machine, a member extending lengthwise of the machine for effecting relative oscillation of the ring rail and spindle, a builder mechanism at the opposite end of the frame for reciprocating said member between progressively varying limits of travel, a rheostat mounted at said one end of said frame with said motor for controlling the speed of said motor, meahs for varying the speed of said motor in accordance with the progressively increasing diameter of the bobbin comprising mechanical connections between said reciprocating member and said rheostat including a pawl and tooth device responsive to a plurality of reciprocations of said member for advancing said pawl one tooth, and means controlled by the advance of said pawls for varying said rheostat.

2. A control system for a ring spinning machine comprising an electric motor at one end of the machine, a member extending lengthwise of the machine mounted for reciprocating movement to effect relative oscillation of the ring rail and spindle, a builder mechanism at the opposite end of the machine for reciprocating said member through progressively decreasing amplitudes between progressively changing limits, a rheostat mounted at said one end of said machine for controlling the speed of said motor, and means for progressively increasing the speed of said motor in accordance with the progressively increasing diameter of the bobbin comprising mechanical connections between said reciprocating member and said rheostat including a ratcheting mechanism having a pawl and means responsive to a plurality of reciprocations of said reciprocating member for advancing said pawl one tooth on said ratcheting mechanism and means responsive to said advance of said pawl for varying said rheostat.

3. A control system for a ring spinning machine comprising an electric motor at one end of the machine, a member extending lengthwise of the machine mounted for reciprocating movement to effect relative oscillation of the ring rail and spindle, a builder mechanism at the opposite end of the machine for reciprocating said member through progressively decreasing amplitudes between progressively changing limits, a rheostat mounted at said one end of said machine for controlling the speed of said motor, and means for progressively increasing the speed of said motor in accordance with the progressively increasing diameter of the bobbin comprising mechanical connections between said reciprocating member and said rheostat including a mechanism comprising a stationary arcuate-shaped member provided with a plurality of teeth, a movable pawl cooperating with said member, means actuated by said reciprocating member for advancing said pawl only in response to a plurality of reciprocations of progressively diminishing amplitude and means responsive to said advance of said pawl for varying said rheostat.

4. A control system for a ring spinning machine having an electric driving motor at one end of the machine, a member extending longitudinally of the machine mounted for reciprocating movement and connected to effect relative reciprocating movement of the ring rail and spindle, a builder mechanism at the opposite end of the machine for reciprocating said member at progressively decreasing amplitude between progressively changing limits of travel, a rheostat mounted at the motor end of said frame for controlling the speed of said motor, means for varying the speed of said motor in accordance with the progressively increasing diameter of the bobbin comprising a ratcheting device having a member provided with a plurality of teeth, a rotatably mounted arm, and a pawl having a pin and slot connection to said arm, a mechanical connection between said arm and said rheostat and a first spring biasing said rheostat to the low speed position and biasing said arm to force said pawl into engagement with said toothed member, a rotatably mounted member driven by said reciprocating member for engaging said arm to oppose the bias of said spring, and a second spring mounted on said arm for releasing said pawl from engagement with said toothed member and moving said pawl to a new position on said toothed member thereby to permit said first spring to move said rheostat to increase the speed of said motor.

JOHN EATON.