318-135 CROSS REFERENCE SERIAL NO.

Dec. 13, 1960 A. EDELMAN ET AL 2,964,260

TRAVERSE MECHANISM

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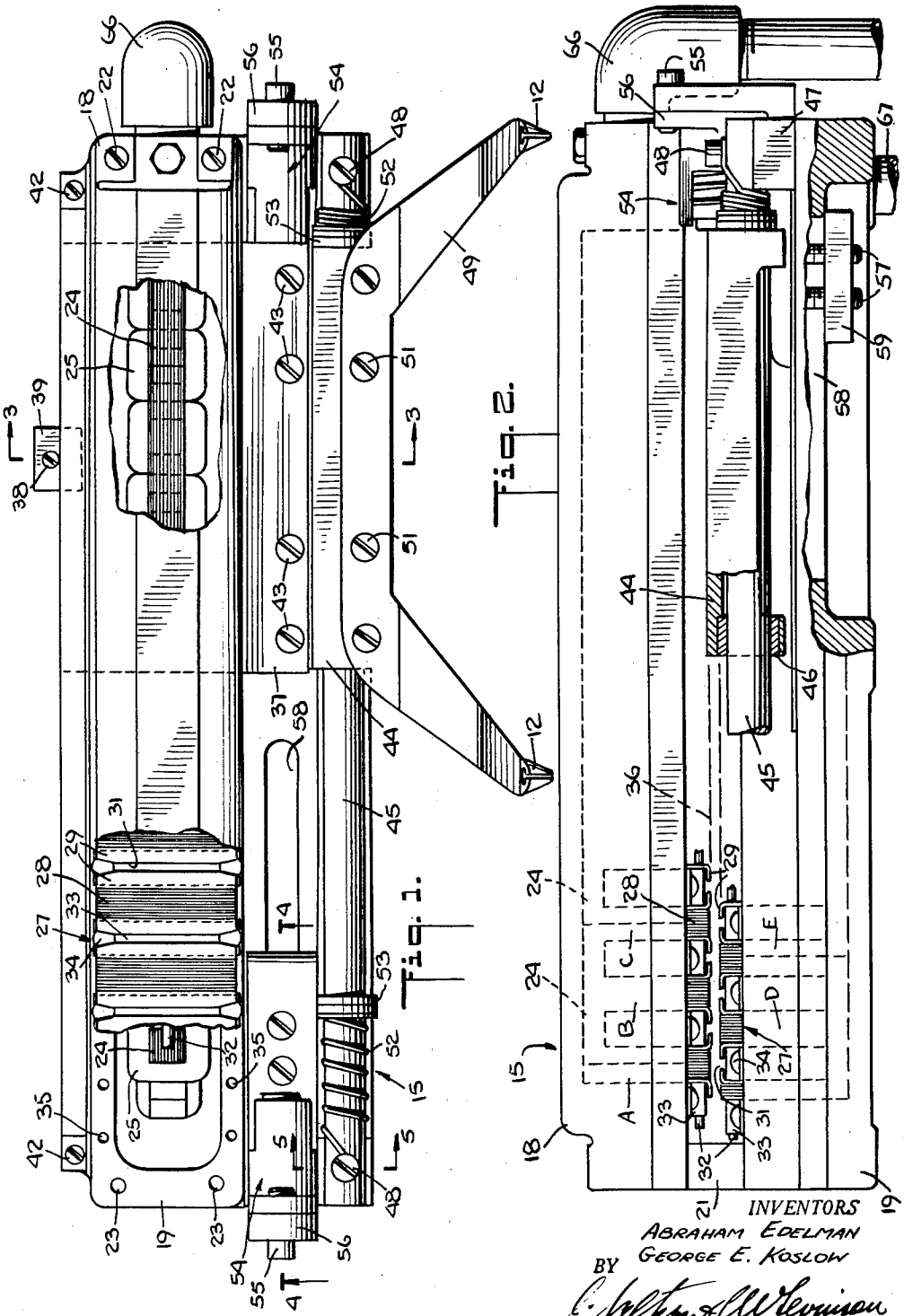


Fig. 1.

Fig. 2.

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Fig. 3.

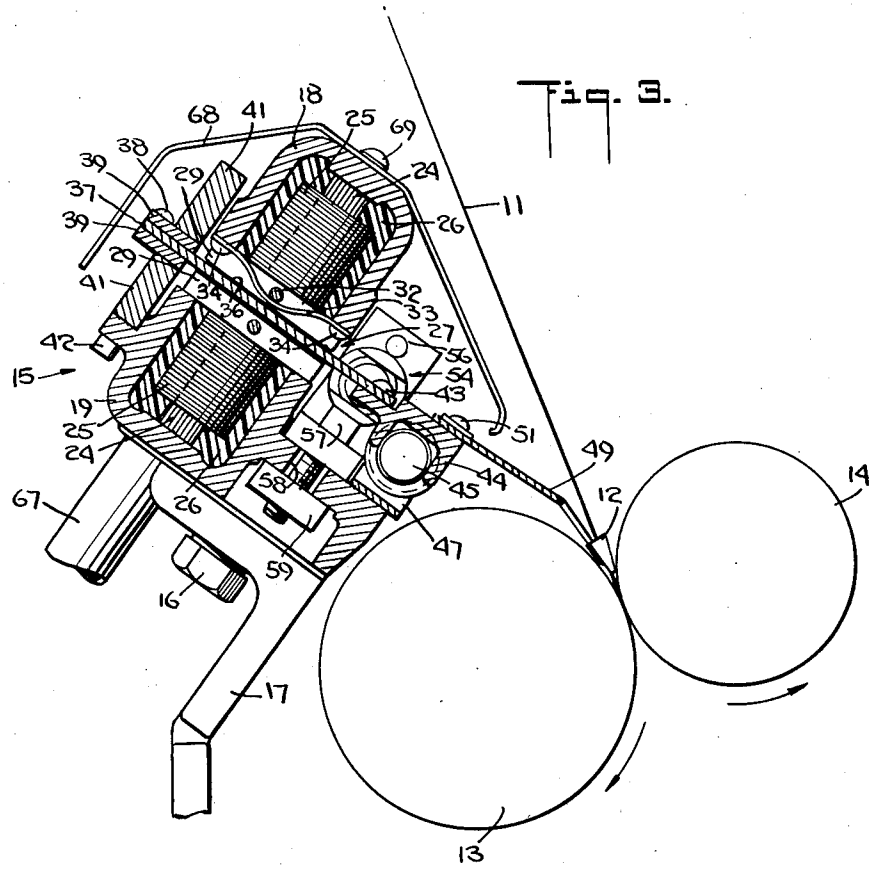
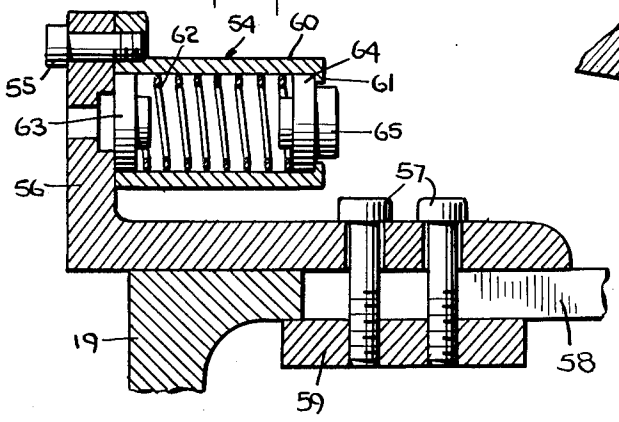


Fig. 4.



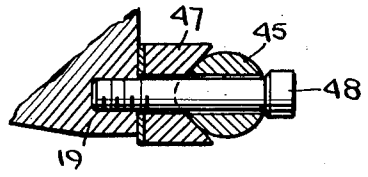


Fig. 5.

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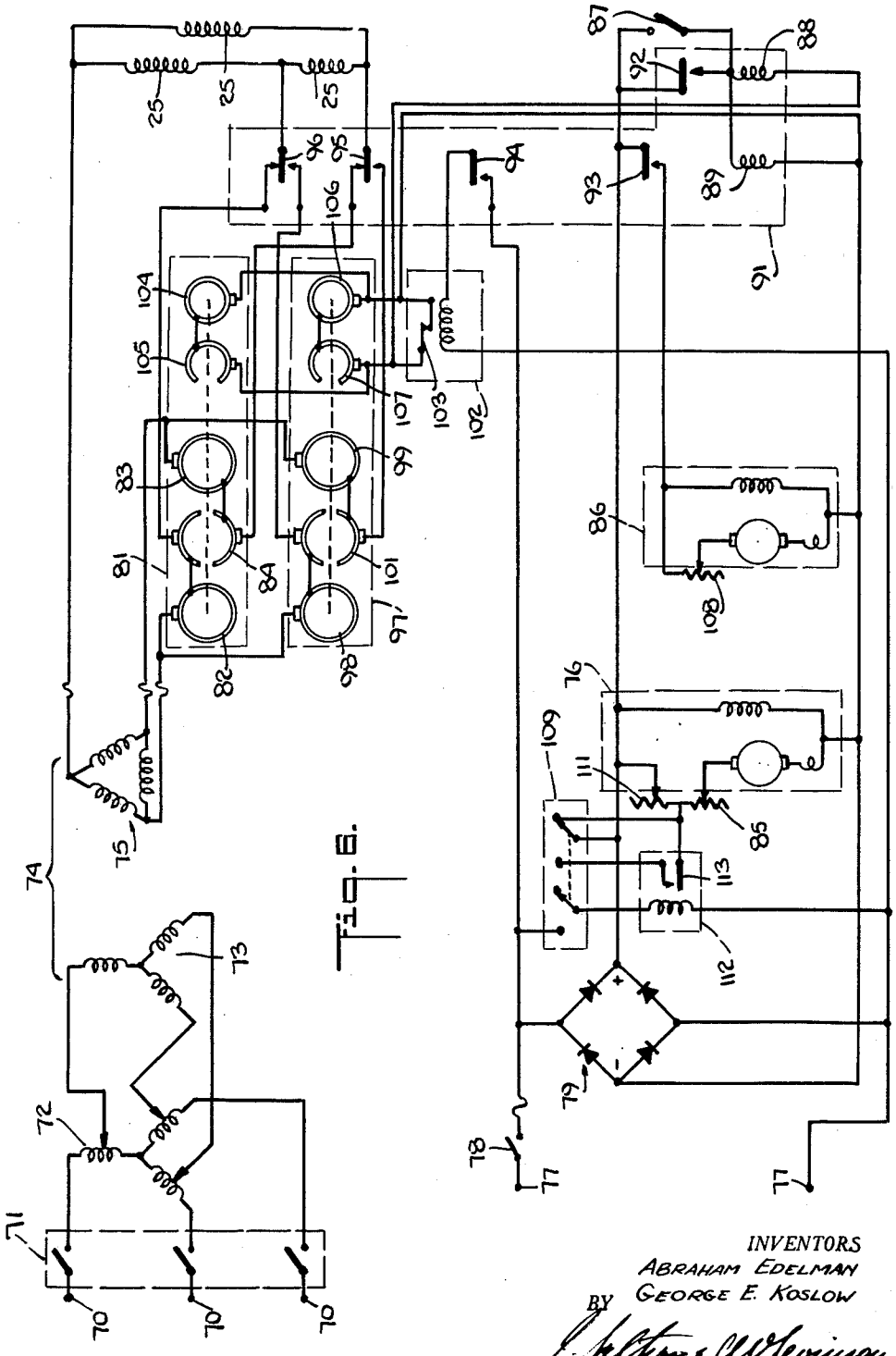


Fig. 6.

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TRAVERSE MECHANISM

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9 Claims. (Cl. 242—158)

This invention relates to a traverse mechanism and relates more particularly to a high speed traverse mechanism for a yarn winding machine.

Traverse mechanisms of many types have been developed for guiding filamentary material, which may be a textile yarn or the like, onto a take-up package. Mechanically actuated traverse mechanisms are quite satisfactory at relatively low traverse speeds and rates. However, as the traverse speed, the linear speed of the traverse element, or the traverse rate, the frequency at which the traverse element is reversed, increase, mechanical traverse mechanisms are no longer satisfactory owing to their high power requirements and the rapid wear that occurs at such speeds or rates. To overcome these difficulties, there have been developed pneumatically and electromagnetically actuated traverse mechanisms that can be operated at higher traverse speeds and rates than are feasible with conventional mechanically actuated traverse mechanisms. However, these prior pneumatically and electrically actuated traverse mechanisms suffer from a number of drawbacks, including a lack of flexibility as to operating speed, an inability to control the delivery of power to the traverse element throughout the entire length of its stroke and poor operating characteristics when the traverse path exceeds a given length.

It is an important object of this invention to provide a traverse mechanism which will be free from the foregoing and other difficulties.

A further object of this invention is to provide a high speed traverse mechanism actuated by a linear polyphase motor.

Other objects of this invention, together with certain details of construction and combinations of parts, will be apparent from the following detailed description and claims.

According to the present invention there is provided a traverse mechanism for a yarn winding machine comprising a linear polyphase motor to the armature of which there is secured a yarn guide. The polyphase motor includes a plurality of coils that are linearly disposed and are connected to a polyphase power supply in such a manner that the said coils will produce a moving magnetic field in which the armature is positioned and by which it is moved. Connected to said armature is the guide through which filamentary material is drawn whereby the movement of the armature will act to move the filamentary material through its traverse stroke. Means are also provided for periodically reversing the connections to said coils whereby the direction of movement of the magnetic field will be reversed, causing the armature and the guide connected thereto to move in the opposite direction.

While the foregoing arrangement permits high traverse speeds and rates to be achieved, even better results can be obtained if there are provided means at each end of the traverse stroke for converting the kinetic energy of movement of the armature and the parts connected thereto into potential energy and delivering said energy

back to the armature as it starts moving in the opposite direction. Such means, may, for example, comprise a spring positioned in the path of and adapted to be compressed by the armature. In this way the amount of energy that must be supplied to the armature is held at a minimum and the efficiency of operation is increased significantly.

It is not feasible to start the apparatus of this invention at the desired speed owing to the inertia of the armature. Accordingly, there are provided auxiliary starting means for reversing the direction of movement of the magnetic field at a slow rate at the outset and for increasing this rate gradually until the armature is moving at the desired speed. Once this has occurred, such auxiliary starting means may be disconnected from the apparatus.

A preferred embodiment of this invention is shown in the accompanying drawings wherein

Fig. 1 is a plan view of the traverse mechanism itself with certain parts broken away,

Fig. 2 is a front elevation of the traverse mechanism itself with certain parts broken away,

Fig. 3 is a cross-sectional view of the traverse mechanism taken along the line 3—3 in Fig. 1 in the direction of the arrows, and showing in addition the position of the traverse mechanism in a yarn winding machine,

Fig. 4 is a detail cross-sectional view taken along the line 4—4 in Fig. 1 in the direction of the arrows,

Fig. 5 is a detail cross-sectional view taken along the line 5—5 in Fig. 1 in the direction of the arrows, and

Fig. 6 is a circuit diagram of the electrical connections of the traverse mechanism.

Referring now to the drawings, the reference numeral **11** in Fig. 3 designates a yarn which is drawn from any suitable source such as a spinning metier (not shown) and directed by means of a yarn guide **12** onto a take-up roll **14** which is driven at a constant peripheral speed by means of a feed roll **13** in frictional contact therewith. The yarn guide **12** is reciprocated to form on the take-up roll **14** a yarn package having the desired wind by means of a traverse mechanism, indicated generally by reference numeral **15**, which traverse mechanism is fastened by bolts **16** to the frame **17** of the winding machine.

The traverse mechanism **15** comprises an upper housing **18** and a lower housing **19** that are spaced from one another by means of separators **21** positioned between the ends thereof. The upper housing **18**, the lower housing **19** and the separators **21** are held together as a unit by means of screws **22** that extend through the upper housing and the separators into threaded engagement with apertures **23** in the lower housing. There are positioned in the upper housing **18** and in the lower housing **19** a plurality of E-shaped laminations **24** around the legs of which are coils **25**, and the whole is impregnated with a suitable potting compound **26**. Secured to the legs of the laminations **24** are pole pieces, indicated generally by reference numeral **27**, comprising a plurality of bundles of laminations **28**, Figs. 1 and 2, extending at right angles to the laminations **24** and positioned to abut the legs of the said laminations **24**. Pole faces **29** positioned between the bundles of laminations **28** define a plurality of gaps **31**. The laminations **28** and the pole faces **29** are held in place by means of rods **32** that extend through apertures in said members, while the rods **32** are themselves held in place by pole clamps **33** that engage the said rods and have screws **34** extending through the ends thereof into threaded apertures **35** in the housing **18** and **19**.

As shown most clearly in Fig. 2 of the drawings, the pole pieces **27** positioned in the upper housing **18** are spaced from the pole pieces **27** positioned in the lower housing **19** and the said pole pieces define between them a narrow elongated passageway **36**. Also, as shown in

Fig. 2 of the drawings, the pole pieces 27 are so positioned in the upper housing 18 that each of said pole pieces is midway between a pair of pole pieces 27 in the lower housing 19. In this way, there is attained between the said pole pieces a strong magnetic field in the passageway 36. Positioned in the passageway 36 is an armature comprising a generally rectangular aluminum slider plate 37 to the upper edge of which there is secured, by means of screws 38, a pair of flat bearing blocks 39 that are supported slideably between elongated bearing members 41 fastened to the lower housing 19 with screws 42. To the lower edge of the slider plate 37 there is fastened, by means of screws 43, a slider 44 that is mounted for longitudinal movement on a rod 45. The ends of the slider 44 are equipped with bushings 46 that engage the rod 45 so as to minimize friction therebetween. To support the rod 45, there are provided V-blocks 47, Fig. 5, that are held in place by means of bolts 48 that extend through the rod 45 and the V-blocks 47 into threaded engagement with the lower housing 19. A yarn guide holder 49 is fastened, by means of screws 51, to the slider 44 and carries at its ends two yarn guides 12, Fig. 1. It is to be understood that the number of yarn guides 12 may be greater or less than that specifically shown, depending on the spacing between successive yarns, the desired speed and rate of traverse, and the like. Encircling the ends of the rod 45 are weak springs 52, one end of each of which is engaged under the bolt 48, and the other end of each of which abuts an oil-saturated felt washer 53 mounted slideably on the rod 45. The washers 53 are adapted to be engaged by the slider 44 towards the end of its traverse stroke thereby compressing the spring 52. The spring 52 will expand when the slider 44 begins to move in the opposite direction and will move for a certain distance past its point of rest, thereby applying a film of oil to the rod 45 and effectively lubricating the said rod.

There are provided at each end of the traverse stroke bumpers, indicated generally by reference numeral 54, that are fastened by means of screws 55 to brackets 56 clamped in place by bolts 57 extending through a slot 58 in the lower housing 19 and entering into threaded engagement with straps 59. The bumpers 54 each comprise a tubular housing 60 having at one end thereof an inwardly extending flange 61. Positioned in the housing 60 is a spring 62 one end of which bears against a washer 63 that abuts the bracket 56 and the other end of which abuts against a washer 64 that abuts the flange 61. The washer 64 is provided with a projection 65 that extends through the opening formed by the flange 61. The bumpers 54 are positioned so that the edge of the slider plate 37 will strike one of the projections 65 at each end of the traverse stroke. The impact of the slider plate 37 will compress the spring 62 whereby the kinetic energy of motion of the slider plate 37 and the parts connected thereto will be converted into potential energy in the compressed spring. The spring 62 will then expand moving the slider plate 37 in the opposite direction and providing a considerable portion of the energy needed to start the said slider plate through its traverse stroke. In this way, the amount of energy that must be supplied to the slider plate 37 is held to a minimum and the speed and rate of traverse may be raised to high levels without running into difficulty. The springs 62, as pointed out above, are so designed that they will absorb as potential energy of compression substantially all the kinetic energy of motion of the slider plate 37 and will tend to bring said slider plate to a halt. However, if complete reliance were placed on the springs 62 to halt the slider plate 37, the precise point at which the said slider plate would halt would vary depending upon the speed with which the slider plate 37 is moving under any given set of conditions. This would result in an undesirable change in the length of the traverse stroke. To avoid such difficulty, the spring 62 is so designed that the impact of the slider plate 37 will compress the spring 62 until the slider plate 37 strikes the end of the housing 60 itself which will, of course, stop the movement of the slider plate 37 at a fixed point. In this way, the length of the traverse stroke will be fixed. By changing the position of the bumpers 54 the length of the traverse stroke can be altered at will.

The traverse mechanism is equipped with conduits 66 and 67 through which the electrical wiring for the coils 25 is brought to the upper housing 18 and the lower housing 19, respectively.

To guard against accidental contact with the moving parts of the traverse mechanism, there is provided a shield 68, Fig. 3, that is fastened to the upper housing 18 by means of screws 69.

The electrical circuit of the traverse mechanism is shown in detail in Fig. 6 of the drawings and comprises terminals 70 to which three-phase alternating current is supplied. Connected to the terminals 70 through a switch 71 is a three-phase autotransformer 72, the output of which is connected to the primary winding 73 of a transformer 74 having a secondary winding 75 that is connected to the coils 25 through a switching circuit that will be described in greater detail below. The coils 25 are connected to the transformer 74 in such a manner that a moving magnetic field will be created in the passageway 36 and will provide the necessary force to urge the slider plate 37 from one end to the other end of its traverse stroke. For example, the coils 25 are so connected to the transformer 74 that the first coil in the upper housing 18, Fig. 2, designated A, is connected to phase 1, the second coil, designated B, is connected to phase 2, and the third coil, designated C, is connected to phase 3. This cycle of connections is repeated for all the remaining coils 25 in the upper housing 18. The coils 25 in the lower housing 19 are connected to the transformer 74 in a similar cyclic manner. To obtain a magnetic flux of maximum intensity, the coils 25 in the lower housing 19 are connected to the transformer 74 in such a manner that each coil in said lower housing is connected to a phase other than that to which are connected the coils 25 in the upper housing 18 between which it is located. That is, coil D is connected to phase 3, coil E is connected to phase 1, etc. In addition, the connections to the coils 25 are made in such a manner that the magnetic fluxes will tend to reinforce one another. For example, when the magnetic flux is coming out from coils A and B, it should be going in on coil D, etc.

The moving magnetic field produced by the coils 25 will drive the slider plate 37 which acts as the armature, and all the elements connected thereto from one end to the other end of the traverse stroke. To reverse the direction in which the magnetic field produced by the coils 25 moves, there is provided a switching circuit comprising a compound wound motor 76 to which direct current is supplied from alternating current terminals 77 through a switch 78 and a rectifier bridge 79. The motor 76 drives a commutator section 81 that includes a slip ring 82 connected to one terminal of the output of transformer 74, and a slip ring 83 connected to another terminal of the output of the said transformer. The commutator section 81 also includes a commutator 84 having two equal sections, one of which is connected to the slip ring 82 and the other of which is connected to the slip ring 84. The output from the commutator 84 is connected to the coils 25. As shown in Fig. 6 of the drawings, one terminal of the output of the transformer 74 is connected directly to the coils 25, whereas the remaining two output terminals of the transformer 74 are connected to the coils 25 through the commutator 84 so that such connections are periodically reversed. When such reversal occurs, the direction of movement of the magnetic field produced by the coils 25 will also reverse and drive the slider plate 37 in the opposite direction. The frequency with which such reversal takes place may be regulated by adjusting the rheostat 85 to bring the motor 76 to the desired speed. In addition, the transformer 72 may

be adjusted to regulate the voltage applied to the coils 25 so that the strength of the magnetic fields produced by said coils and the forces acting on the slider plate 37 and the speed with which such plate moves may be varied. It has been found that the most reliable operation is secured when the adjustments are made in such a manner that the slider plate 37 reaches the end of its traverse stroke and is beginning to move in the opposite direction under the urging of the spring 62 before the connections to the coils 25 are reversed. With this arrangement there is no tendency for stalling to occur even when excessive loads are applied momentarily to the traverse mechanism.

While the traverse mechanism will operate successfully in the manner described above, once it has been started, it will not start of its own accord owing to the inability of the moving parts going in one direction to come up to operating speed before the commutator 84 reverses the direction of movement of the magnetic field. A separate circuit is accordingly provided to start the traverse mechanism. The starting circuit comprises a compound wound motor 86 which is connected to the rectifier bridge 79 through a circuit including a starting button 87 which when closed completes the circuit from the rectifier bridge 79 and energizes holding coil 88 and coil 89 of a relay 91. When holding coil 88 is energized, it closes a quick-operating holding contact 92 connected in parallel with the starting button 87 so that current will continue to flow through coils 88 and 89 even after the said starting button is released. Coil 89, when energized, closes contacts 93 and 94, and moves contacts 95 and 96 from an up to a down position. Closing of contact 93 completes the circuit from the rectifier bridge 79 to the starting motor 86 so that said motor will begin to turn, driving a commutator section 97 to which it is connected. The commutator section 97 is identical to and is connected in parallel to the commutator section 81. Thus, the commutator section 97 includes slip rings 98 and 99 that are connected in parallel to the slip rings 82 and 83, and also includes a commutator 101 having two equal sections one of which is connected to the slip ring 98 and the other of which is connected to the slip ring 99. The output of the commutator 101 is connected to the lower points of contacts 95 and 96 so that when the relay 91 is energized and the said contacts are in their down position, current is supplied to the coils 25 through the commutator section 97.

The starting motor 86 is so designed that it will come up to speed slowly. As a result, the direction of motion of the magnetic field produced by the coils 25 will, at the outset, change at a slow frequency thereby permitting the slider plate 37 to come up to operating speed gradually. When the slider plate 37 has reached operating speed, control of the supply of current to the coils 25 is shifted from the starting motor 86 to the motor 76. To effect such changeover automatically, there is provided a time delay relay 102 having a normally closed contact 103 that is connected in series with the holding coil 88. The relay 102 is energized simultaneously with the starting motor 86 by the closing of the contact 94. After a sufficient period has elapsed, the relay 102 will open the contact 103 and hold the same open as long as the contact 94 remains closed. When the control of current to the coils 25 is switched from the starting motor 86 to the motor 76, care must be taken that at such time the commutator section 81 will supply current to the said coils having the same phase relationship as that which has been supplied by the commutator section 97, otherwise the movement of the slider plate 37 may stop. To insure that such phase relationship will exist, there is provided in the commutator section 81 a slip ring 104 that is connected to a commutator 105 having a single opening therein. The slip ring 104 and the commutator 105 are connected in parallel with the contact 103. There is also provided in the commutator section 97, a slip ring 106 connected to a commutator 107 having a single opening therein. The slip ring 106 and the commutator 107 are also connected in parallel with the contact 103. When the contact 103 opens, current will continue to flow through the coil 88 until the commutator sections 81 and 97 come into alignment as shown in the drawings, at which time the phase connections to said commutator sections will be identical. Then, the connections through the commutators 105 and 107 will be opened simultaneously, de-energizing the coil 88 of the relay 91 whereby the contact 92 will release quickly cutting off the current to the coil 89 and thereby opening the contacts 93 and 94, and moving the contacts 95 and 96 to the down position. This will interrupt supply of current to the starting motor 86 and the relay 102, and will shift the control of the flow of current to the coils 25 to the motor 76. It is to be noted that with the arrangement of the commutator sections 81 and 97 shown in the drawings, such shifting of control will occur at the time that no current is flowing through either of the commutator sections to the said coils. To avoid the possibility that the traverse mechanism will stop at the time the control is shifted from the starting motor 86 to the motor 76, the full speed of the starting motor 86 is set, by means of the rheostat 111, at a level somewhat higher than that of the motor 76. This difference in speed insures that the commutator sections 81 and 97 will not remain out of synchronism for an extended time. It also insures that, if the speed of the slider plate 37 drops momentarily during the shifting over, it will not drop so low that continued operation will be impossible.

One of the difficulties encountered in the winding of filamentary materials into packages is known as ribboning and occurs when the geometry of the winding operation is such that successive turns of the filamentary material are positioned substantially on top of one another to form a ridge or ribbon. A package containing such a ribbon exhibits a tendency for the yarn windings to shift relative to one another. Such a package is also difficult to unwind at a high speed. To prevent such ribboning, optional means are provided for varying the speed of the motor 76 from time to time so as to change the geometry of the winding operation and displace the successive turns of the winding from one another. Such speed changing means includes a double-pole double-throw switch 109 which is shown in a position where no change in speed is effected. However, when the switch is thrown to the left, it will connect in series with the rheostat 85 the rheostat 111. It will also energize a timer 112 that closes and opens a contact 113 at any desired rate, which contact 113 is connected to short out the rheostat 111 when closed. When the contact 113 is closed the motor 76 and the slider plate 37 will operate at a speed determined by the rheostat 85. On the other hand, when the contact 113 is open, the motor 76 and the slider plate 37 will operate at a lower speed.

To operate the traverse mechanism, the switches 71 and 78 are closed. This will supply power to the coils 25 and the motor 76 whereby the said motor will come up to speed, but the slider plate 37 will not move. Then, the starting button is closed momentarily whereby the starting circuit will bring the slider plate 37 up to speed and will cut off, leaving the traverse mechanism operating at the proper speed.

While the drawings show only a single traverse mechanism connected to the electrical circuit, it should be understood that normally a number of such mechanisms will be connected in parallel. In such case, suitable switch means may be provided for connecting one traverse mechanism at a time to the starting motor 86 so that said traverse mechanisms may be started up independently, or so that one of the traverse mechanisms may be started up while the others are operating. For ex-

ample, the coils **25** of a second traverse mechanism may be connected to a double-pole double-throw switch that is wired in parallel to the contacts **95** and **96**.

While each of the coils **25** may be identical, it may also be desirable to use different coils at different points along the traverse path. In this way, the supply of energy to the slider plate **37** may be varied from point to point so that the speed of said plate may be adjusted in any desired manner. The same effect may be attained, for example, by inserting resistances in series with selected coils **25**.

It is to be understood that the foregoing detailed description is merely given by way of illustration and that many variations may be made therein without departing from the spirit of our invention.

Having described our invention, what we desire to secure by Letters Patent is:

1. In a winding machine, a traverse mechanism comprising means for producing a moving magnetic field, an armature positioned in said field for movement thereby, means for reversing the direction of movement of the magnetic field continuously and repeatedly so as to reverse the direction of movement of the armature, means positioned in the path of movement of the armature for converting the kinetic energy of motion of the armature moving in one direction into potential energy and for returning said potential energy to the armature to move it in the oppostie direction, said means for reversing the direction of movement of the magnetic field acting to reverse the direction of movement of said field after the direction of movement of the armature has been reversed by said energy converting means, and guide means for a filamentary material connected to said armature.

2. A reciprocating mechanism comprising means for producing a moving magnetic field, an armature positioned in said magnetic field for movement thereby, control means for reversing the direction of movement of the magnetic field at a predetermined rate so as to reverse the direction of movement of said armature at said rate, and starting means to reverse the direction of movement of the magnetic field initially at a lower rate than said predetermined rate and to increase gradually said rate.

3. A reciprocating mechanism comprising means for producing a moving magnetic field, an armature positioned in said magnetic field for movement thereby, control means for reversing the direction of movement of the magnetic field at a predetermined rate so as to reverse the direction of movement of said armature at said rate, starting means to reverse the direction of movement of the magnetic field initially at a lower rate than said predetermined rate and to increase gradually said rate until it is greater than said predetermined rate, and means for shifting the reversal of said magnetic field from said starting means to said control means.

4. A reciprocating mechanism comprising a plurality of linearly disposed coils adapted to produce a moving magnetic field, an armature positioned in said field for movement thereby, switching means for reversing the connections to said coils to reverse the direction of movement of the magnetic field at a predetermined rate so as to reverse the direction of movement of the armature at said rate, and auxiliary switching means for starting to reverse the connections to said coils to reverse the direction of movement of the magnetic field initially at a lower rate than said predetermined rate and to increase gradually said rate.

5. A reciprocating mechanism comprising a plurality of linearly disposed coils adapted to produce a moving magnetic field, an armature positioned in said field for movement thereby, switching means for reversing the connections to said coils to reverse the direction of movement of the magnetic field at a predetermined rate so as to reverse the direction of movement of the armature at said rate, auxiliary switching means for starting to reverse the connections to said coils to reverse the direction of movement of the magnetic field initially at a lower rate than said predetermined rate and to increase gradually said rate until it is greater than said predetermined rate, and means for shifting the reversal of said magnetic field from said auxiliary switching means to said first-mentioned switching means when said means are in phase with one another.

6. A reciprocating mechanism comprising a plurality of linearly disposed coils adapted to produce a moving magnetic field, an armature positioned in said field for movement thereby, switching means for reversing the connections to said coils to reverse the direction of movement of the magnetic field at a predetermined rate so as to reverse the direction of movement of the armature at said rate, auxiliary switching means for starting to reverse the connections to said coils to reverse the direction of movement of the magnetic field initially at a lower rate than said predetermined rate and to increase gradually said rate until it is greater than said predetermined rate, means for shifting the reversal of said magnetic field from said auxiliary switching means to said first-mentioned switching means when said means are in phase with one another, and springs positioned in the path of movement of the armature and adapted to be struck thereby for converting the kinetic energy of motion of the armature in one direction into potential energy of compression and for returning said potential energy to the armature to move it in the opposite direction, said switching means acting to reverse the direction of movement of the magnetic field after the direction of movement of the armature has been reversed by the springs.

7. A reciprocating mechanism comprising a plurality of linearly disposed coils adapted to produce a moving magnetic field, an armature positioned in said field for movement thereby, switching means for reversing the connections to said coils to reverse the direction of movement of the magnetic field at a predetermined rate so as to reverse the direction of movement of the armature at said rate, means for varying the rate at which such reversal takes place, auxiliary switching means for starting to reverse the connections to said coils to reverse the direction of movement of the magnetic field initially at a lower rate than said predetermined rate and to increase gradually said rate until it is greater than said predetermined rate, means for shifting the reversal of said magnetic field from said auxiliary switching means to said first-mentioned switching means when said means are in phase with one another, springs positioned in the path of movement of the armature and adapted to be struck thereby for converting the kinetic energy of motion of the armature in one direction into potential energy of compression and for returning said potential energy to the armature to move it in the opposite direction, said switching means acting to reverse the direction of movement of the magnetic field after the direction of movement of the armature has been reversed by the springs, and stops positioned in the path of movement of the armature and adapted to be struck thereby for stopping the movement of the armature at a definite position.

8. A mechanism for producing reciprocating motion comprising means for producing a moving magnetic field, an armature positioned in said field for movement thereby, means for reversing the direction of movement of the magnetic field so as to reverse the direction of movement of the armature, and means positioned in the path of movement of the armature for converting the kinetic energy of motion of the armature moving in one direction into potential energy and for returning said potential energy to the armature to move it in the opposite direction, said means for reversing the direction of movement of the magnetic field acting to reverse the direction of movement of said field after the direction of movement

of the armature has been reversed by said energy converting means.

9. A mechanism for producing reciprocating motion comprising means for producing a moving magnetic field including a plurality of pole-pieces in opposed, staggered relation, an armature positioned in said field for movement thereby, means for reversing the direction of movement of the magnetic field so as to reverse the direction of movement of the armature, and means positioned in the path of movement of the armature for converting the kinetic energy of motion of the armature moving in one direction into potential energy and for returning said potential energy to the armature to move it in the opposite direction, said means for reversing the direction of movement of the magnetic field acting to reverse the direction of movement of said field after the direction

of movement of the armature has been reversed by said energy converting means.

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