Sept. 2, 1930. L. E. TOPHAM 1,774,737

DRIVING AND STOPPING MECHANISM

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Fig. 1

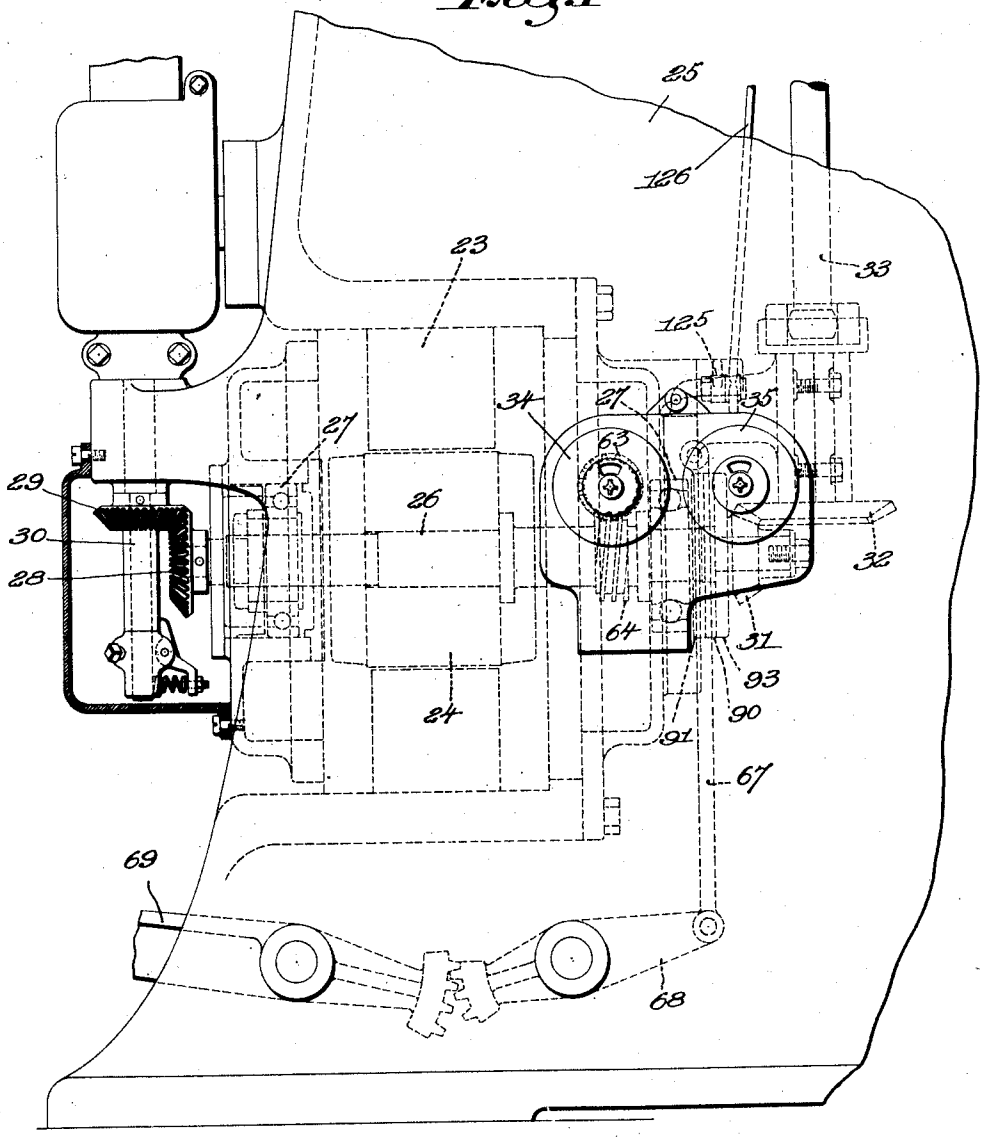
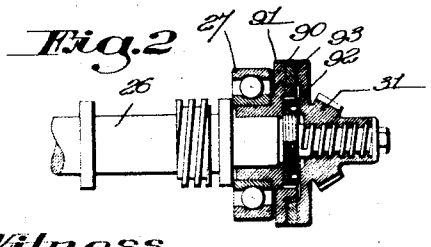


Fig. 2



Witness
Frederick J. Grumbach.

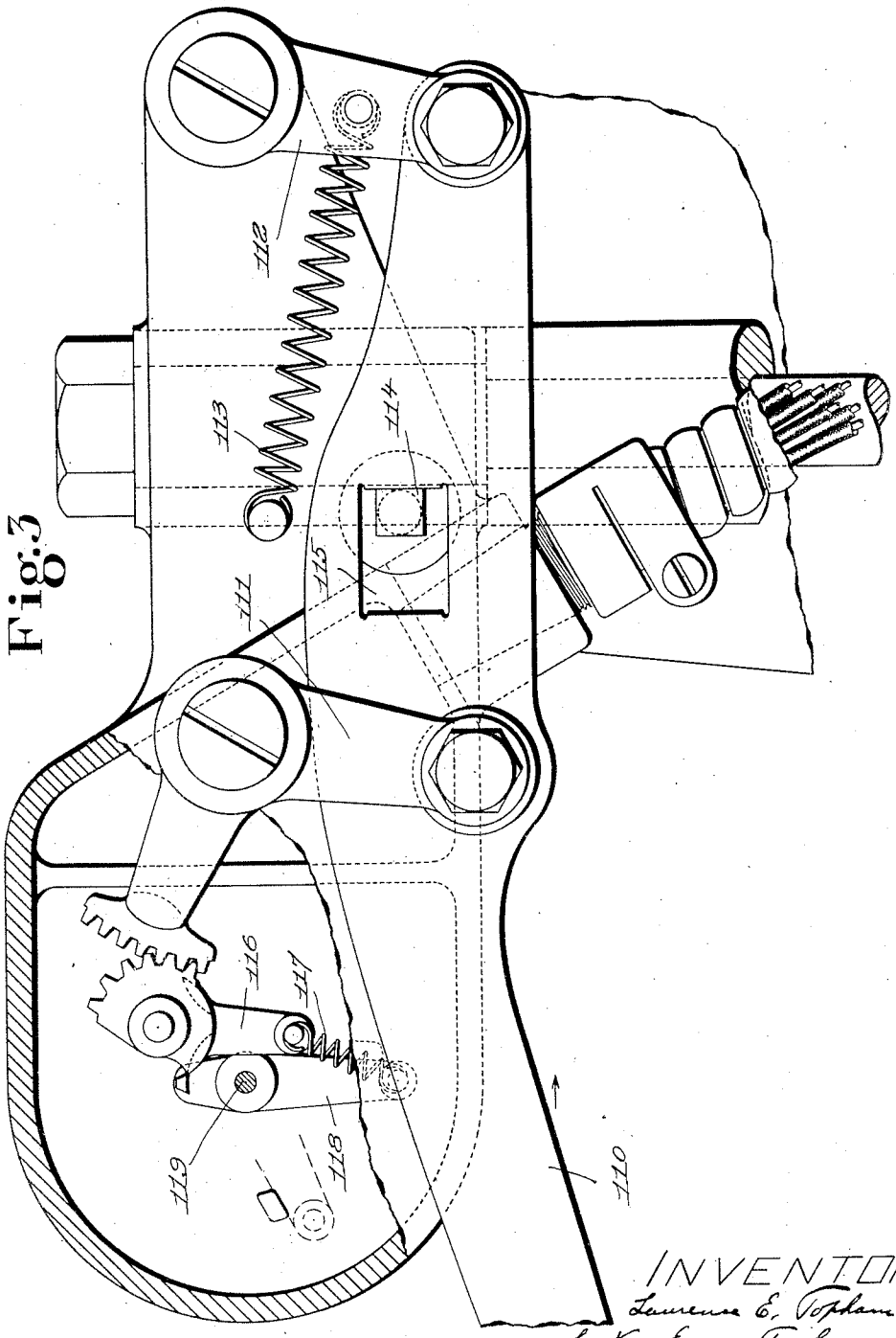
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DRIVING AND STOPPING MECHANISM

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Fig.3



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DRIVING AND STOPPING MECHANISM

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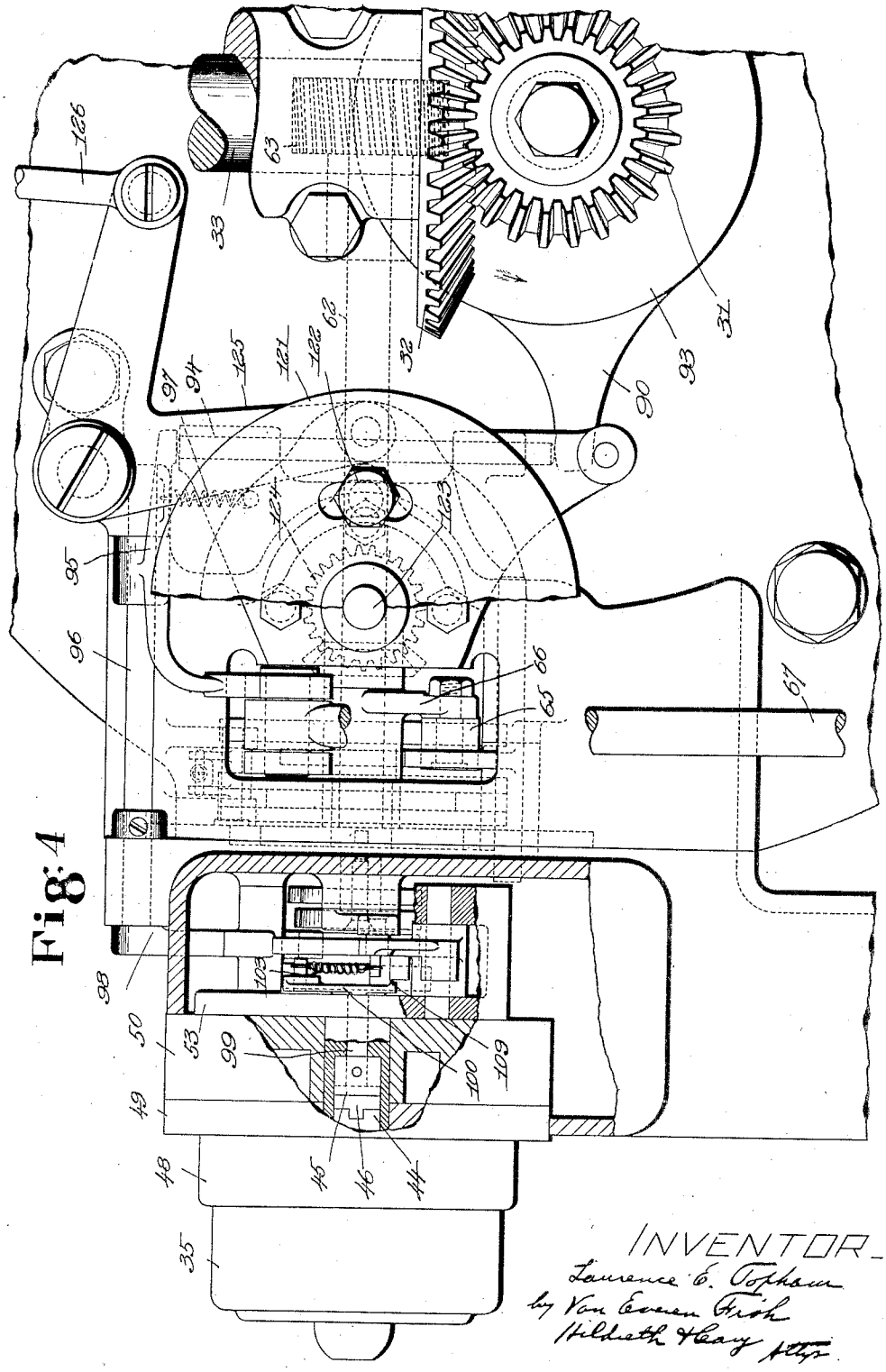


Fig. 4

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Sept. 2, 1930. L. E. TOPHAM 1,774,737

DRIVING AND STOPPING MECHANISM

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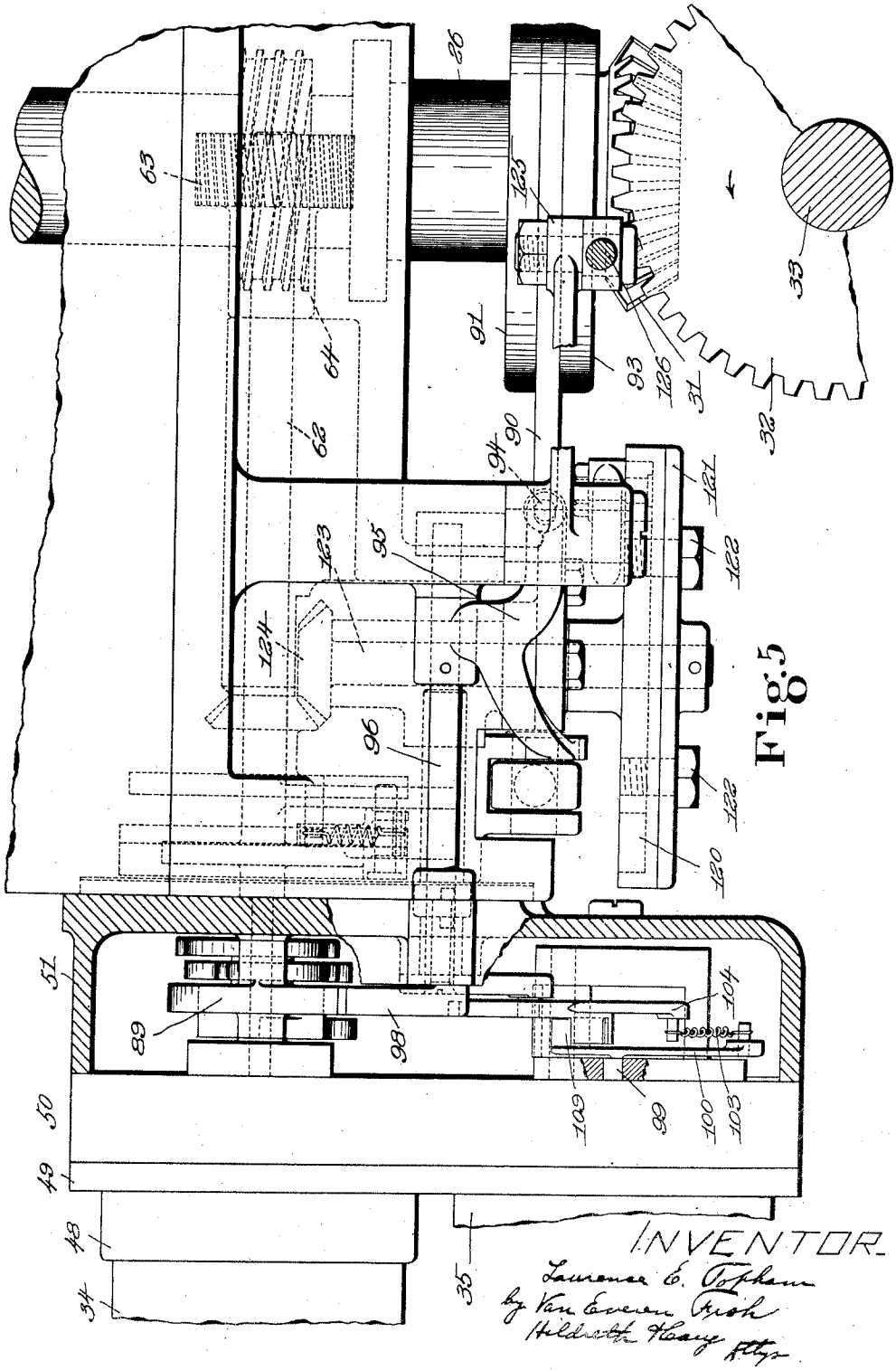


Fig. 5

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DRIVING AND STOPPING MECHANISM

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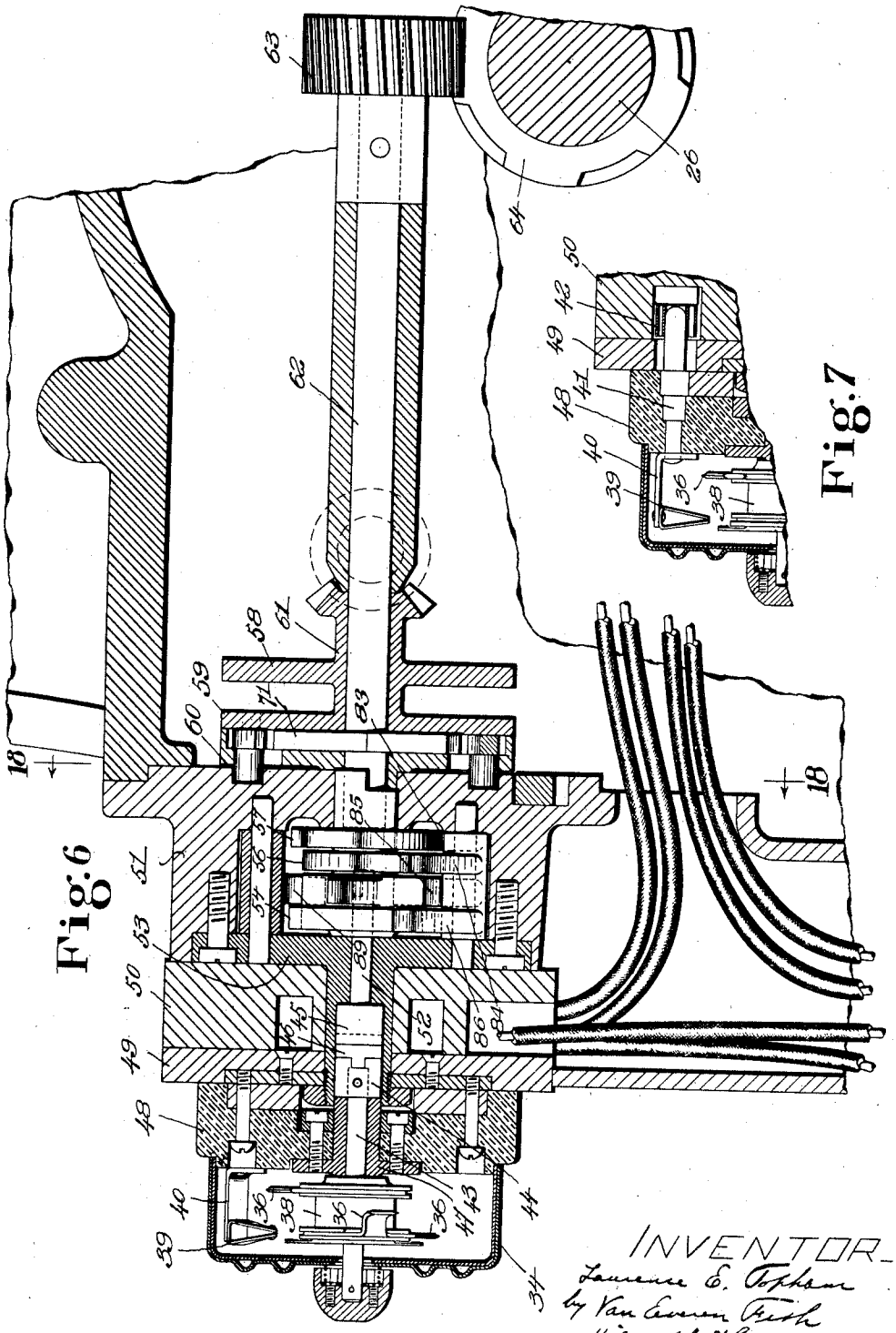


Fig. 6

Fig. 7

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Sept. 2, 1930. L. E. TOPHAM 1,774,737

DRIVING AND STOPPING MECHANISM

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Fig. 8

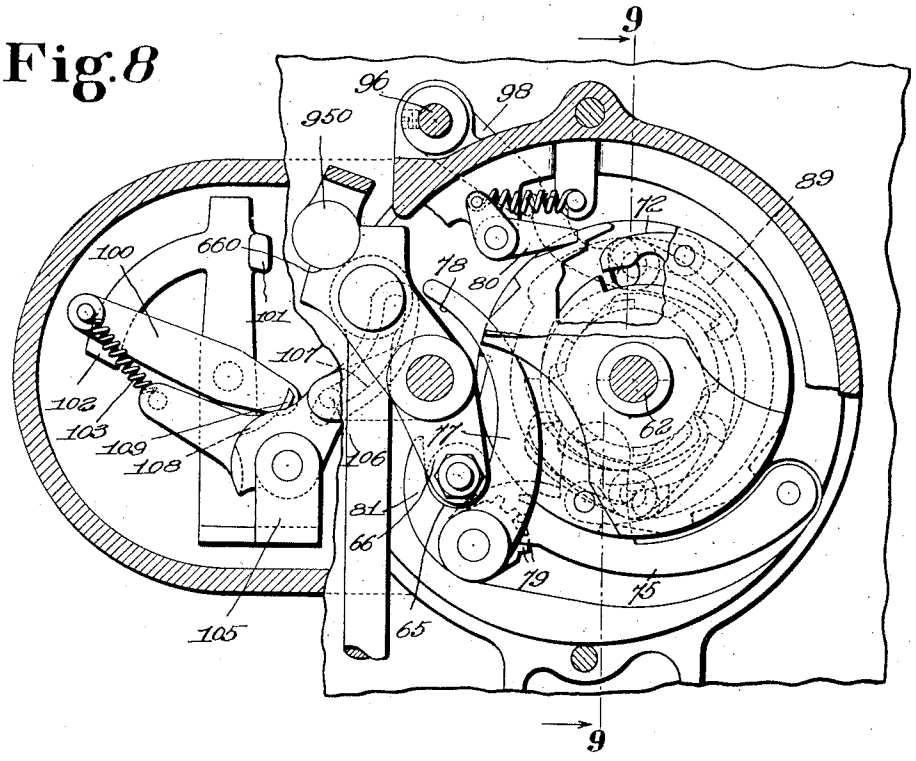
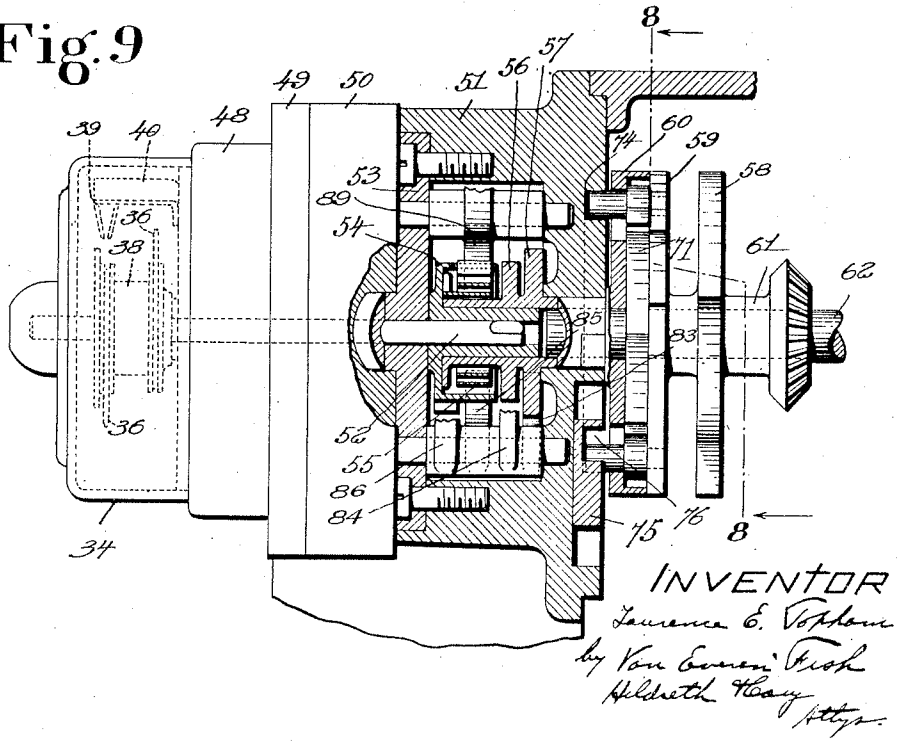


Fig. 9



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DRIVING AND STOPPING MECHANISM

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Fig. 11

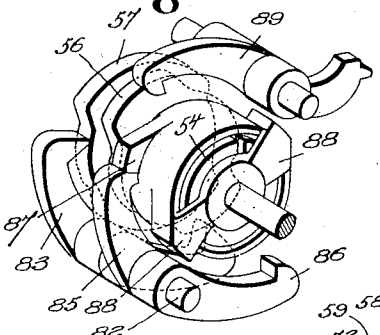


Fig. 10

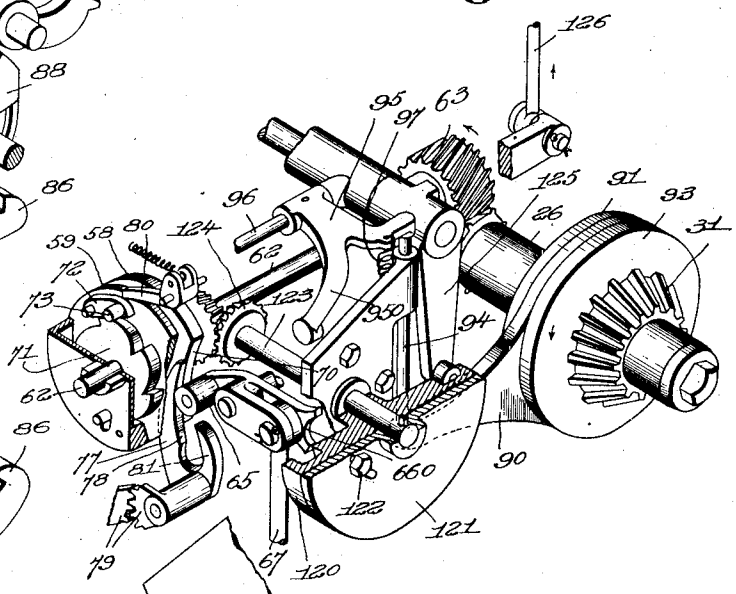


Fig. 12

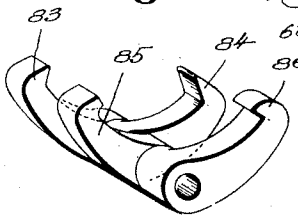


Fig. 13

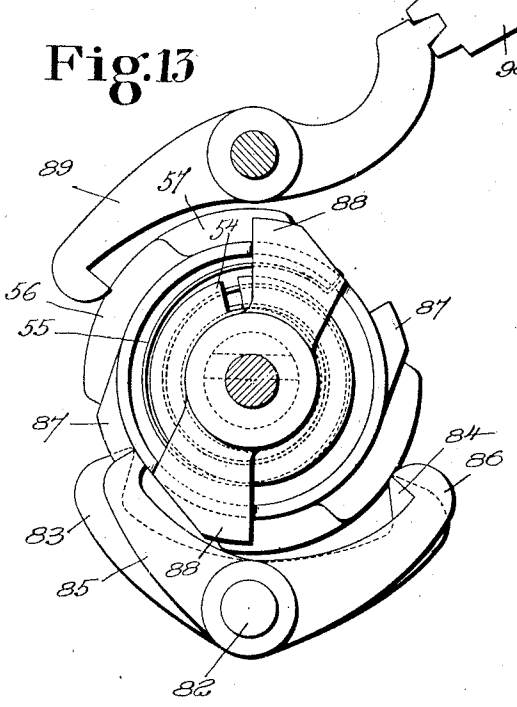
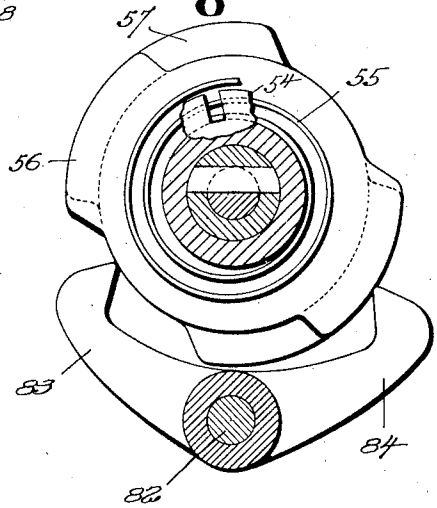


Fig. 14



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Sept. 2, 1930. L. E. TOPHAM 1,774,737

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Fig. 15

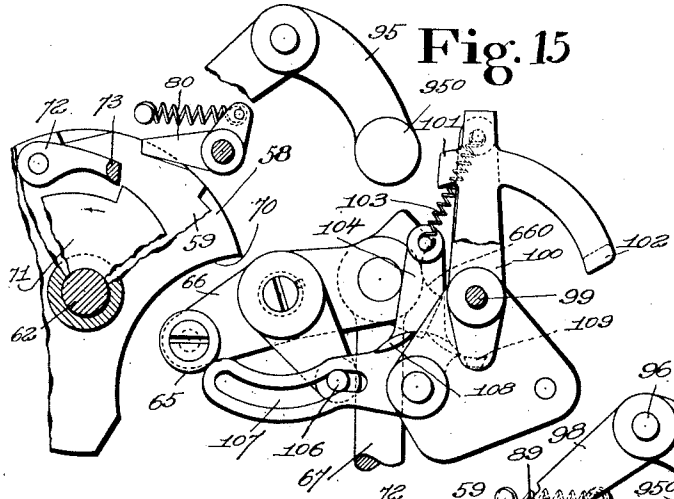


Fig. 16

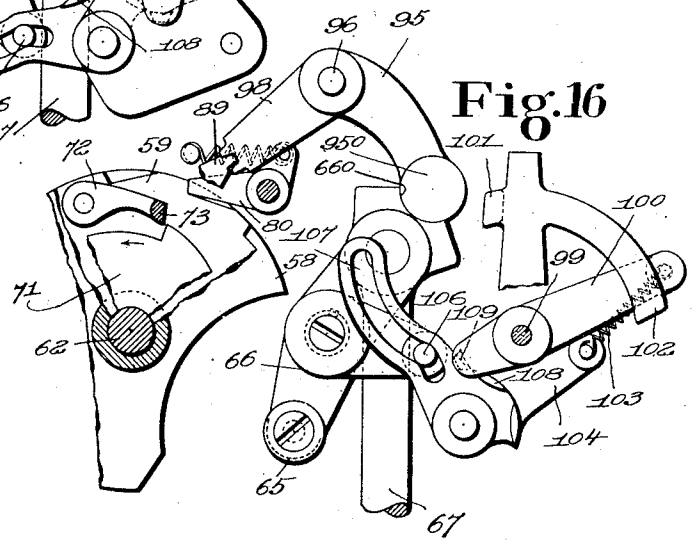
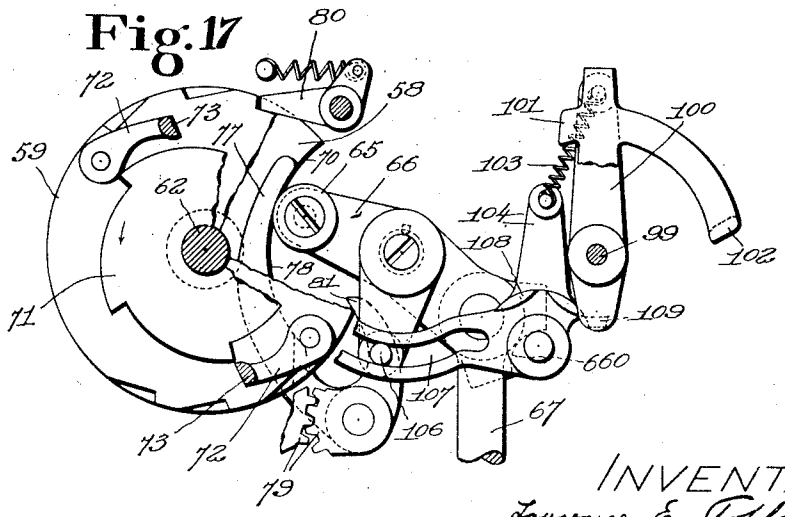


Fig. 17



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Fig. 19

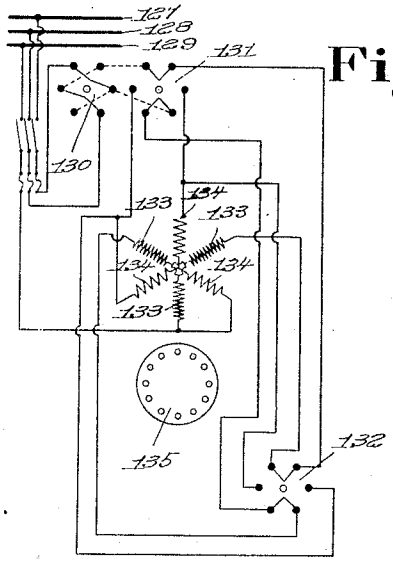


Fig. 18

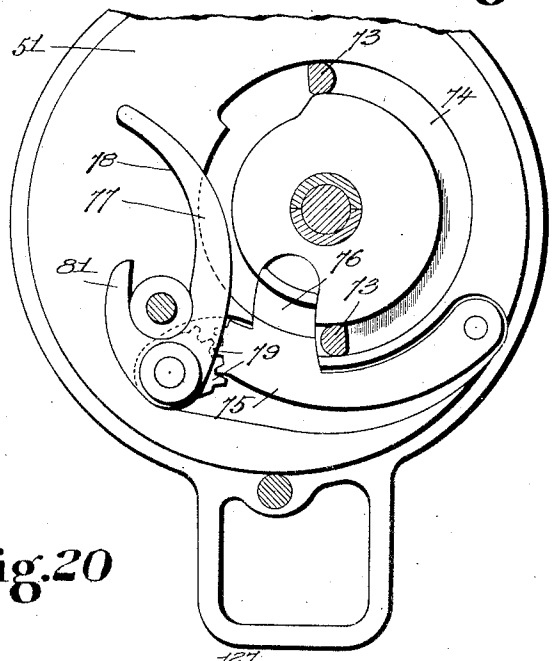


Fig. 20

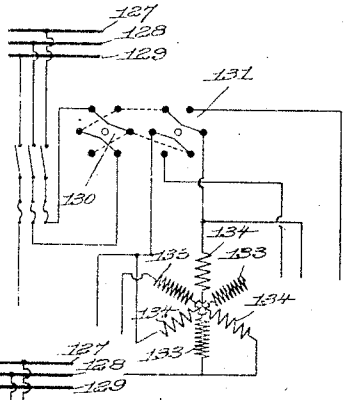


Fig. 22

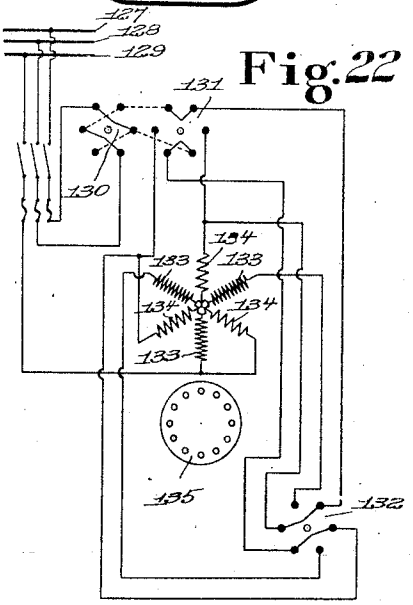
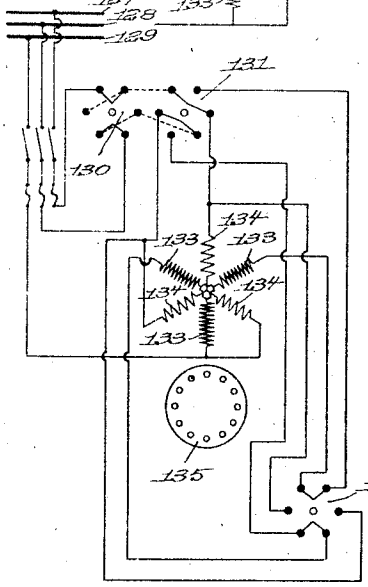


Fig. 21



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Patented Sept. 2, 1930 1,774,737

UNITED STATES PATENT OFFICE

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DRIVING AND STOPPING MECHANISM

Application filed September 24, 1925. Serial No. 58,352.

The present invention relates to driving and stopping mechanism adapted for use on machines which it is necessary or desirable to stop at a certain or substantially certain point in a cycle of operations, or at a certain or substantially certain angular position of the main shaft or one of the other shafts of the machine. The invention is intended primarily for use on wax thread shoe sewing machines but is well adapted for use on other types of machines.

The object of the invention is to provide a shoe sewing or other machine with a driving and stopping mechanism of extreme simplicity of construction by which the machine can be stopped as above indicated in a certain and reliable manner and without appreciable shock or jar.

With the above object in view the invention contemplates utilizing in a driving and stopping mechanism the braking effect or drag produced on the armature or rotor of an electric motor when the conditions in the motor are changed so as to alter its electro-dynamic torque. As herein shown the invention is embodied in an apparatus in which an electric motor of any suitable type is directly connected to drive the machine which is to be driven and stopped, means being provided whereby the dynamic torque of the motor can be reversed in timed relation to the operation of the machine and thereafter the current supply of the motor cut off at, or approximately at, the instant the motor comes to rest. Although not necessary to the embodiment of the broader features of the invention, means are preferably provided whereby the speed of the motor may be reduced from normal high speed to a comparatively low speed before the electro-dynamic torque is reversed, and also preferably the speed changing means and the torque reversing means are arranged and controlled so that the dynamic torque can be reversed only after a predetermined amount or period of low speed conditions. The current supply of the motor and the varying conditions in the motor may conveniently be controlled by suitable switches, and where it is desired to cause the motor to run at a low speed before stopping, a separate high and low speed switch is preferably provided, which switch may be operated and controlled in such a manner that the low speed position is utilized only in stopping and no shift from low to high is required in starting.

The present invention is applicable either to machines in which the stopping is initiated automatically or is under the control of the operator. It is herein shown as embodied in a shoe sewing machine in which a treadle is provided by which the operator can start and stop the machine at will. This treadle when depressed actuates a switch or switches to cause the motor to run at high speed, and when released throws into operation mechanism driven from a shaft rotated by the motor, which mechanism actuates the switch in timed relation to the shaft to reverse the electro-dynamic torque of the motor. This causes the motor to stop with the shaft in a predetermined angular position at which instant the current supply is cut off by any suitable means. As herein shown, this result is conveniently accomplished by an actuation of the switch by the motor as it starts to reverse.

In addition to the features above indicated, the present invention also consists in certain constructions, arrangements and combinations of parts hereinafter described and claimed.

A driving and stopping mechanism embodying the several features of the present invention is illustrated in the accompanying drawings applied to a shoe sewing machine of the McKay type. In the drawings, Fig. 1 is a view in side elevation of the base of the machine with the driving and stopping mechanism located therein; Fig. 2 is a detail view in side elevation partly in section of one end of the armature or rotor shaft illustrating particularly the friction device through which the supply switch of the motor is opened as the armature starts to rotate in a reverse direction; Fig. 3 is a detail inside elevation on a larger scale than Fig. 1 of a knee lever controlled switch on the column of the machine by which the speed of the motor can be changed from high to low during the continued operation of the machine; Fig. 4 is a view in elevation of the driving and stopping

mechanism looking towards the left of Fig. 1 with a portion of the casing of the high and low stopping switch mechanism broken away to show underlying parts; Fig. 5 is a plan view of the mechanism illustrated in Fig. 4 with a portion of the casing enclosing the switches broken away; Fig. 6 is a view in sectional elevation of the driving and stopping mechanism taken on a vertical plane passing through the axis of the forward, reverse and off switch; Fig. 7 is a detail sectional view illustrating the construction of certain of the switch connections; Fig. 8 is a sectional view taken on a vertical plane at right angles to the plane of Fig. 6 and approximately on the line 8—8 of Fig. 9; Fig. 9 is a detail sectional view taken approximately on the line 9—9 of Fig. 8; Fig. 10 is a detail perspective view of some of the principal moving parts of the driving and stopping mechanism; Fig. 11 is a detail perspective view of a portion of the forward, reverse and off switch mechanism; Fig. 12 is a detail perspective view of the combined pallet and detent for controlling the snap member of the forward, reverse and off switch; Fig. 13 is a detail sectional view taken at right angles to the axis of the forward, reverse and off switch illustrating the same parts which are shown in Fig. 11; Fig. 14 is a view similar to Fig. 13 but taken on a different plane showing particularly the spring connection between the operating member and the snap member of the forward, reverse and off switch; Figs. 15, 16 and 17 are detail views illustrating particularly the manner in which the high and low switch and the forward, reverse and off switch are actuated and controlled from the foot treadle of the machine, Fig. 15 showing the position of the parts with the treadle half way down, Fig. 16 showing the position of the parts with the treadle released and the machine stopped, and Fig. 17 the position of the parts with the treadle completely depressed and the machine running in a forward direction at high speed; Fig. 18 is a detail sectional view taken substantially on the line 18—18 of Fig. 6; and Figs. 19, 20, 21 and 22 are diagrammatic views illustrating the circuit connections which may be employed with a two-speed, three-phase induction motor, Fig. 19 indicating the position of the various switches when the motor is running forward at high speed, Fig. 20 the position of the switches while the motor is running forward at low speed before stopping, Fig. 21 the position of the switches after the electro-dynamic torque of the motor has been reversed, and Fig. 22 the position of the switches when the motor is running forward at low speed during the continued operation of the machine.

In the construction illustrated in the drawings, see particularly Fig. 1, the driving and stopping mechanism of the machine comprises an electric motor, the field of which is indicated at 23 and the armature at 24, the said motor being supported and enclosed in the lower portion of the machine column 25. The armature shaft 26 is supported near each end by a roller bearing 27 and is arranged in a horizontal position so that at one end it may be connected directly by means of bevel gears 28 and 29 to a vertical shaft 30 through which the usual devices in the horn of the machine are actuated, and at the other end may be connected directly by bevel gears 31 and 32 to a vertical shaft 33 through which the cam shaft in the head of the machine is operated.

It will be evident that the speed of the machine at all times will depend upon the speed of the motor and that control of the starting, driving and stopping of the machine can be attained by controlling the motor. For the control of the motor in starting and stopping, a switch is provided which is controlled partly from the starting treadle of the machine and partly from a shaft driven from the motor shaft. This switch may conveniently be termed the "forward, reverse and off switch." Also in the arrangement illustrated in the drawings, a starting and stopping high and low speed switch is provided which is controlled wholly from the treadle. The switch blades and contacts of these switches are inclosed in switch covers indicated at 34 and 35 in Fig. 1. The switch blades and contacts of the switches are similar in construction, each switch comprising a series of blades as indicated at 36 in Figs. 6 and 7 mounted upon a drum 38 and arranged to cooperate with spring contact plates 39. The blades 36 are suitably cross-connected and the contact plates 39 are connected to the leading-in wires of the motor. As illustrated, the contact plates 39 are mounted upon angle plates 40 carried by posts or studs 41, the rear ends of which are arranged to engage sockets 42 carried by the leading-in wires. The drum 38 of each switch is secured to a shaft 43, the inner end of which is provided with a slotted block 44 by which it is coupled to a block 45 on a shaft in axial alignment with the shaft 43 through an intermediate block 46. For convenience of assembly and to render the parts so far described readily accessible, the shaft 43 is journaled in a flanged sleeve 47 secured to a block 48 of insulating material, to which block the angle plates 40 carrying the contact plates 39 are secured and which block is removably secured to a plate 49, see particularly Fig. 6. The plate 49 forms a support for the blocks 48 of both switches and is secured to a block 50 recessed to receive the leading-in wires, as indicated in Figs. 6 and 7, and removably secured to a block 51 which in turn is secured to the column of the machine.

As so far described, the two switches are the same in construction. To enable the for-

ward, reverse and off switch, which is the switch illustrated in Fig. 6, to be actuated from the starting treadle of the machine and also from the armature of the motor, the shaft, indicated at 52, which is in axial alignment with the drum carrying the switch blades, is mounted in a flanged sleeve 53 secured to the block 51 and extends into the hub of one member 54 of a switch actuating mechanism mounted in a chamber formed in the block 51, the end of the shaft being flattened, as indicated in Figs. 9 and 14, and being engaged by a cross key so that the shaft turns with the member 54. The switch actuating mechanism is constructed to give the switch drum a snap action, and for convenience the member 54 of the actuating mechanism, since it moves with the switch drum, may be termed the "snap member" of the switch actuating mechanism. This snap member is connected by a spiral spring 55, see Figs. 9, 13 and 14, to an operating member which, for convenience of assembly, is made in two parts, one part consisting of a sleeve provided with cam disks 56 and 57 mounted on the hub of the member 54 and in a bearing in the block 51. The other part of the operating member comprises a series of disks 58, 59 and 60, see Figs. 6, 9 and 10, the disks 58 and 59 being integral with a sleeve 61 mounted to rotate loosely on a shaft 62, and the disk 60 being rigidly connected at its periphery with the disk 59 and provided with a hub journaled on the shaft 62 and in the block 51 and being formed with clutch projections to engage corresponding projections on the hub of the other part of the operating member. The shaft 62 is journaled in the machine frame and also has a bearing at its outer end in the sleeve carrying the cam disks 56 and 57, as best shown in Fig. 9. At its inner end the shaft 62 is provided with a spiral gear 63 which engages a spiral gear 64 on the armature shaft 26 so that while the motor is running the shaft 62 is driven continuously in timed relation to the armature of the motor and to the shafts of the sewing machine in the arrangement shown the shaft 62 making one complete revolution during five complete revolutions of the cam shaft of the sewing machine. The operating member of the switch, comprising the disks 58, 59 and 60 and the cam disks 56 and 57, is arranged to be operated either by the starting treadle of the machine or by the shaft 62, the movement of the operating member by the treadle causing a movement of the switch to forward position, and a movement of the operating member from the shaft 62 causing a movement of the switch from forward position to reverse position. This movement of the operating member of the switch by the shaft 62 also stores sufficient power in the spring 55 to enable the switch to be moved to off position as the armature of the motor stops and starts to reverse, as will be hereinafter described. In thus operating the switch from off position to forward, reverse and off position, the operating member makes one-half of a revolution.

The operating member of the forward, reverse and off switch is actuated from the starting treadle of the machine by connections including a roll 65 (see Figs. 8, 10, 15, 16 and 17) on one arm of a three-arm lever 66. Another arm of this lever 66 is connected by a rod 67 to a lever 68 in the base of the machine column, the forward end of which is connected by intermeshing gear segments to the rear end of the lever 69 carrying the starting treadle, the arrangement of these connections being such that a depression of the foot treadle depresses the rod 67 and swings the arm of the lever 66 carrying the roll 65 upwardly. The normal position of the parts when the machine is at rest is indicated in Fig. 16. Upon the depression of the treadle, as the roll 65 rises from the position indicated in Fig. 16, first to the position indicated in Fig. 15, and finally to the position indicated in Fig. 17, the roll 65 engages one of two diametrically disposed concave surfaces 70 formed on the disk 58 of the operating member of the forward, reverse and off switch and moves the member sufficiently to cause a movement of the switch to forward position through the connections between the operating and snap members of the switch hereinafter described.

The connections for actuating the operating member of the forward, reverse and off switch from the shaft 62 in stopping the machine comprise a ratchet wheel 71 (see Figs. 6, 8, 9, 10, 15, 16 and 17) fast on the shaft 62 and two pawls 72 mounted on the disk 59 of the operating member in position to engage the ratchet wheel. The ratchet wheel is located between the disks 59 and 60 of the operating member of the switch, and each pawl is provided with a lateral projection 73 at its free end which extends through a radial slot in the disk 60 and engages a cam groove 74 formed in the stationary block 51 (see Figs. 6, 9 and 18). While the machine is stopped the pawls 72 are held out of engagement with the ratchet 71 by the action of the cam groove 74 on the projections 73 of the pawls, as indicated in Figs. 16 and 18. A lever 75 (see Figs. 8, 9 and 18) is pivotally mounted in a recess in the stationary block 51 and is provided with a groove 76 adapted to form a continuation of the cam groove 74. In starting the machine, the lever 75 is depressed so as to bring the groove 76 into register with the outer portion of the cam groove 74 so as to receive the projection 73 of the lower pawl, as illustrated in Fig. 18, when the operating member of the forward, reverse and off switch is moved by the starting treadle into the position indicated in Fig.

17, as has been hereinbefore described. This movement of the lever 75 is produced by the roll 65 before the operating member of the switch is actuated, a lever arm 77 being provided pivotally mounted on the block 51 and having a curved surface 78 arranged to be engaged by the roll 65 and so shaped that the lever is actuated before the roll moves the operating member sufficiently to actuate the switch. The movement of the lever 77 is transmitted to the lever 75 through intermeshing gear segments 79 formed on the free end of the lever 75 and on the hub of the lever 77. While the machine is running, the pawls 72 are held out of engagement with the ratchet wheel 71, as indicated in Fig. 17, the projection 73 of the upper pawl engaging the high portion of the cam 74 and the projection 73 of the lower pawl being engaged by the groove 76 of the lever 75, which at this time is in its depressed position.

In stopping the machine, the foot treadle is allowed to rise, which, through the connections hereinbefore described, causes the three-arm lever 66 with the roll 65 to move from the position indicated in Fig. 17 to that indicated in Fig. 16. During this movement of the roll 65, the operating member of the forward, reverse and off switch is held from backward movement by means of a retaining pawl 80 which engages one of a series of ratchet teeth formed on the disk 59. As the roll 65 approaches its lowest position, it engages an arm 81 of the lever 77 and actuates the lever so as to raise the lever 75 into the position indicated in Fig. 18. This brings the lower pawl 72 into engagement with the ratchet wheel 71 and positions the groove 76 in the lever in alignment with the low portion of the cam groove 74. The ratchet wheel 71 rotates with the motor driven shaft 62, as has been described, and as soon as a tooth of the ratchet wheel engages the pawl, the operating member of the switch will be turned with the ratchet wheel and shaft. This movement of the operating member of the switch will carry the projection 73 of the lower pawl into the low portion of the cam groove 74, and the movement of the operating member of the switch will continue until the lower pawl reaches the high portion of the cam, at which time the ratchet wheel will be released by the pawl and the rotation of the operating member of the switch will cease. The operating member of the switch will thus have made a half revolution, the parts being in the positions indicated in Fig. 18, with the exception that the two pawls have changed places.

The snap member of the forward, reverse and off switch is actuated and controlled from the operating member through the coiled spring 55 hereinbefore referred to and by a combined pallet and detent illustrated separately in Fig. 12, which is actuated by the cam disks 56 and 57 of the operating member and which engages stop shoulders formed on the snap member. The combined pallet and detent is mounted to oscillate upon a fixed pivot 82 and is formed with cam engaging arms 83 and 84 extending on opposite sides of the pivot and with stop arms 85 and 86 substantially parallel with the arms 83 and 84. The arm 83 is arranged to engage the cam disk 57 of the operating member of the switch, and the arm 84 is arranged to engage the cam disk 56. These cam disks are so shaped, as clearly shown in Figs. 11, 13 and 14, that the combined pallet and detent is oscillated as the operating member of the switch is rotated and is positively controlled at all times. The stop arm 85 of the combined pallet and detent is arranged to engage one of a pair of stop shoulders formed on lugs 87 projecting from the periphery of the snap member of the switch at substantially diametric points, and the stop arm 86 is arranged to engage stop shoulders formed on projections 88 projecting from the snap member at substantially diametric points and located approximately 60° in advance of the projections 87.

When the machine is at rest, the parts are in the position illustrated in Figs. 11, 13 and 14 with the stop arm 85 in engagement with one of the lugs 87. To start the machine, the foot treadle is depressed and the operating member of the switch is moved in a counter-clockwise direction, as viewed in Figs. 13 and 14, by the engagement of the roll 65 with one of the surfaces 70 on the disk 58 of the operating member, as has hereinbefore been described. This movement of the operating member is sufficient to tension the spring 55 and oscillate the pallet and detent member to move the stop arm 85 out of engagement with the projection 87 and allow the snap member of the switch to rotate until one of the projections 88 engages the stop arm 86. In this position of the snap member of the switch the switch is in forward position. To stop the machine, the foot treadle is allowed to rise and the operating member of the switch is rotated from the motor driven shaft 62 in the manner hereinbefore described. The operating member of the switch is rotated in a counter-clockwise direction and acts to tension the spring 55 and then oscillate the pallet and detent member to move the stop arm 86 out of engagement with the projection 88. This allows the snap member of the switch to again rotate in a counter-clockwise direction, a viewed in Figs. 13 and 14. If the movement of the snap member of the switch were otherwise unrestrained this snap member would move until one of the projections 87 on the snap member engaged the stop arm 85. In order to stop the switch in reverse position a detent lever 89 is provided which is adapted to engage one of the projections

87 and stop the switch member before said projection engages the stop arm 85. The switch remains in this position until the motor and the shaft driven thereby stop, at which instance the detent lever 89 is actuated to release the snap member of the switch which immediately moves to the off position in which position one of the projections 87 is in engagement with the stop arm 85. In each of its movements to forward, reverse and off position the snap member of the switch moves through approximately 60°.

In the construction illustrated in the drawings (see Figs. 2, 4, 10, 11 and 13), the movement of the motor armature as it starts to reverse is utilized to actuate the detent lever 89 to release the forward, reverse and off switch to permit it to move from reverse to off position. To this end an arm 90 is mounted upon the armature shaft 26 between a flange 91 secured to the shaft by a lock nut 92 and a flange 93 formed on the hub of the bevel gear 31. The flanges 91 and 93 provide friction surfaces to engage the adjacent surfaces of the arm 90 and move the arm in a direction to raise its free end, as viewed in Fig. 10, when the direction of rotation of the armature shaft 26 reverses. The bevel gear 31 has a screw-threaded engagement with the armature shaft which permits a slight movement of the gear longitudinally of the shaft. This longitudinal movement of the gear 31 causes the arm 90 to be freed from the frictional engagement with the disks 91 and 93 while the armature shaft is rotating in a forward direction, but causes the arm to be firmly gripped when the armature shaft reverses its rotation. The free end of the arm 90 engages the lower end of a sliding rod 94, the upper end of which engages an arm 95 fast on a rock shaft 96, a spring 97 being provided to hold the arm 95 in contact with the rod 94. To the rock shaft 96 is secured an arm 98 having a rack tooth connection with one end of the detent lever 89.

To prevent injury to the parts in case the starting treadle is depressed while the current of the motor is cut off for any reason and while the detent lever 89 is holding the snap member of the forward, reverse and off switch in reverse position, a safety device in the form of connections between the starting treadle and the detent lever 89 is provided so that the detent lever is actuated to release the switch during the first portion of the downward movement of the treadle rod 67. These connections (see particularly Figs. 10 and 16) comprise an extension 950 of the arm 95, the rounded end of which is arranged to rest in a recess 660 in the arm of the lever 66 to which the treadle rod 67 is connected. With this construction, as the treadle rod 67 starts downwardly from the position indicated in Fig. 16, the arm 95 is raised sufficiently to actuate the detent lever 89 so as to release the forward, reverse and off switch and permit it to move to off position in case it is being held in reverse position by the detent lever.

The starting and stopping, high and low speed switch is actuated from the foot treadle through connections which are best shown in Figs. 15, 16 and 17. In these figures, 99 indicates a shaft which is in alignment with the shaft on which the blade carrying drum of the switch is secured, the connection between the shafts being the same as that between the shafts 43 and 52 of the forward, reverse and off switch. This shaft 99 is also shown in Figs. 4 and 5. To the shaft 99 is secured an arm 100 mounted to move between limiting stops 101 and 102. When the arm 100 is in contact with the stop 101 the switch is in high speed position, and when the arm is in contact with the stop 102 the switch is in low speed position. In order to give the switch a snap action, the outer end of the arm 100 is connected by a spring 103 to the outer arm of a bell crank lever 104 pivotally mounted in a fixed bracket 105 (see Figs. 4 and 8). This bell crank lever 104 is operated from the rod 67 of the treadle mechanism by a pin 106 projecting from the third arm of the treadle actuated lever 66 into a curved slot 107 in the inner end of the bell crank lever. While the machine is at rest the parts have the position indicated in Fig. 16 in which the outer arm of the bell crank 104 is nearly horizontal and the pull of the spring 103 is at the right of the shaft 99. As the treadle rod 67 is depressed from the position indicated in Fig. 16, first to that indicated in Fig. 15 and then to that indicated in Fig. 17, the outer arm of the bell crank 104 is swung into a substantially vertical position so that the pull of the spring 103 is at the left of the shaft 99. This will give a quick snap action to the arm 100 and move the switch from low to high position. To restrain the movement of the arm 100 until the spring 103 has passed well beyond the shaft 99, cooperating locking projections 108 and 109 are provided on the bell crank 104 and on the inner end of the arm 100. It will be noted that the arm 100 is moved from low to high speed position in starting the machine before the forward, reverse and off switch is moved to the forward position. With this arrangement, making and breaking the supply circuit twice in starting the machine is avoided, since the high and low speed switch is in high position when the supply circuit is finally completed by moving the forward, reverse and off switch to forward position. In stopping the machine, however, the arm 100 is moved from high speed to low speed position, as indicated in Fig. 15, before the forward, reverse and off switch is moved first from forward to reverse position and then to off position.

In addition to the switches hereinbefore described, the machine illustrated in the drawings may be provided with what may conveniently be termed "a running high and low speed switch". This switch may be used while the machine continues in operation to change the speed of the motor from high to low and back to high as may be desired. The mechanism for actuating this switch is illustrated in Fig. 3 and comprises a lever, or arm, 110 mounted on the column of the machine with its forward end in position to be engaged by the knee of the operator. As shown in Fig. 3, this lever is mounted upon the machine column by means of parallel arms 111 and 112. The arm 112 is acted upon by a spring 113 which tends to move the knee lever to the left and retain it in the position indicated in the figure. The movement of the lever in this direction is limited by a stationary stop lug, 114 projecting through a slot 115 in the lever. This stop lug and slot also serve as a means for limiting the movement of the lever against the force of the spring 113 by the operator. The arm 111 is provided with an upward and forward extension which has a toothed engagement with the hub of a switch operating arm 116. This arm is connected by a spring 117 to the outer end of an arm 118 secured to the shaft 119 of the switch, the construction, arrangement and operation of these parts being the same as the corresponding parts of the mechanism for actuating the starting and stopping, high and low switch hereinbefore described.

In stopping certain types of machines, it is desirable to perform some special operation on the work, or to cause certain parts of the machine to move in a different manner or to a different position than during a normal cycle of operations of the machine. In the machine illustrated in the drawings, mechanism for accomplishing such a result is provided which is normally inoperative, or out of operation, and which is thrown into operation, or actuated, as the machine is stopped. As illustrated (see Figs. 4, 5 and 10), this mechanism comprises a cam disk 120 secured so as to be capable of angular adjustment to a disk 121 by means of bolts 122 passing through slots in the disk. The disk 121 is secured to a shaft 123 provided at its inner end with a bevel gear 124 meshing with a corresponding gear on the sleeve 61 of the forward, reverse and off switch. The cam disk 120 is provided with a cam groove engaging a roll at the lower end of the vertical arm of a bell crank 125. The horizontal arm of the bell crank 125 is connected to the lower end of a rod 126 which extends upwardly to the head of the machine and which may be connected to perform any desired operation as the machine stops, as for instance the raising of the presser foot.

The circuit connections, which may conveniently be used when the electric motor is of the two-speed, three-phase induction type, are indicated in Figs. 19, 20, 21 and 22 and will be readily understood from an inspection of these figures. The line wires are indicated at 127, 128 and 129. The forward, reverse and off switch is indicated at 130, the stopping and starting, high and low speed switch at 131, and the high and low running switch at 132. The high speed windings of the motor are indicated at 133 and the low speed windings at 134. The armature of the motor is indicated at 135. As will be obvious from an inspection of the figures, when the three switches are in the position indicated in Fig. 19, the current passes through the three switches to the high speed windings of the motor so that the armature is caused to rotate at high speed in a counter-clockwise direction, when the switches 130 and 131 are in the position indicated in Fig. 20, regardless of the position of the switch 132, the current will be supplied to the motor so as to cause the armature to rotate in a forward direction at low speed; when the three switches are in the position indicated in Fig. 21, current will be supplied to the motor so as to cause the armature to tend to rotate in a reverse direction at low speed; and when the switches are in the position indicated in Fig. 22, the current will pass through the switch 132 to the motor so as to cause the armature to rotate in a forward direction at low speed.

The operation of the driving and stopping mechanism illustrated in the drawings has been indicated in the preceding description of the construction and arrangement of the parts, but may be briefly summarized as follows: When the machine is at rest the forward, reverse and off switch and the starting and stopping, high and low speed switch are in the positions indicated in Fig. 16. As the treadle rod 67 is depressed, the arm 100 of the high and low speed switch is swung from the low position to the high position indicated in Fig. 15. Further depression of the treadle rod 67 swings the roll 65 into contact with the disk 58 of the operating member of the forward, reverse and off switch and moves the member to shift the switch from off to forward position. The operation of the mechanism for actuating and controlling the snap member of the forward, reverse and off switch from the operating member, illustrated in Figs. 11, 12, 13 and 14, has been fully set forth in the preceding description and need not be again described. The parts remain in the position indicated in Fig. 17 so long as the machine is running. To change from high to low speed while the machine continues in operation, the knee treadle 110, illustrated in Fig. 3, may be actuated by the operator to shift the running high and low speed switch from high to low position.

In stopping the machine, the treadle rod 67 is moved from its low position indicated in Fig. 17 to its high position indicated in Fig. 16. As the treadle rod nears its upper position, the starting and stopping, high and low speed switch is moved to low speed position, the arm 100 moving to the position indicated in Fig. 16. Thereafter the roll 65 rocks the lever 77 so as to move the lever 75 upwardly into the position indicated in Fig. 18. This carries the lower pawl 72 (see Fig. 17) upwardly into the path of the ratchet wheel 71, which ratchet wheel is constantly driven from the armature shaft of the motor through the shaft 62 to which the ratchet wheel is secured. It is to be noted that the movement of the operating member of the forward, reverse and off switch to forward position in starting the machine moves the projection 73 of the lower pawl 72 into the groove 76 of the lever 75 so that the upward movement of the lever 75 can operate to move the pawl into engagement with the ratchet wheel. The pawl 72 on the operating member of the forward, reverse and off switch being engaged by the ratchet wheel 71, the switch member is operated to move the switch from forward to reverse position, the snap member of the switch being stopped in reverse position by the detent lever 89 (see Fig. 13), as has hereinbefore been described. The ratchet wheel 71 is rotated in timed relation to the armature shaft of the motor and to the shafts of the machine driven by the armature shaft. Consequently the forward, reverse and off switch is moved to reverse position in timed relation to the armature shaft and to the shafts driven thereby, and this movement, as will be obvious, takes place only after at least a predetermined period of low speed conditions. In other words, the high and low speed switch is moved to low position before a tooth of the ratchet wheel engages the pawl 72, and thereafter a certain angular movement of the ratchet wheel 71 is required before the forward, reverse and off switch is shifted to reverse position.

The nature and scope of the invention having been indicated and a specific embodiment of the invention having been described, what is claimed is:

1. A driving and stopping mechanism for a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor, a shaft driven by the motor, connected to and rotating in timed relation to the cam shaft, means for supplying current to the motor, means actuated in timed relation to the angular position of the shaft and to said cycle of operations for changing the conditions in the motor so as to alter its electro-dynamic torque at a predetermined point in the revolution of the shaft and in said cycle of operations, and means acting automatically thereafter to cut off the current supply.

2. A driving and stopping mechanism for a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor, a shaft driven by the motor connected to and rotating in timed relation to the cam shaft, means for supplying current to the motor, means actuated by the shaft and acting when thrown into operation to change the conditions in the motor so as to reverse its electro-dynamic torque at a predetermined point in the revolution of the shaft and in said cycle of operations, and means acting automatically thereafter to cut off the current supply.

3. A driving and stopping mechanism for stopping a shaft in a predetermined angular position having, in combination, an electric motor, means for supplying current thereto to drive the motor in the same direction between stops, a shaft driven by the motor, means for changing the conditions in the motor to cause it to run at a high or a low speed, means actuated in timed relation to the angular position of the shaft and after at least a predetermined period of low speed conditions to change the conditions in the motor so as to reverse its electro-dynamic torque at a predetermined point in the revolution of the shaft, and means acting automatically thereafter to cut off the current supply.

4. A driving and stopping mechanism for stopping a shaft in a predetermined angular position having, in combination, an electric motor, means for supplying current thereto to drive the motor in the same direction between stops, a shaft driven by the motor, means for changing the conditions in the motor to cause it to run at a high or a low speed, means actuated in timed relation to the angular position of the shaft and after the change to low speed conditions to change the conditions in the motor so as to reverse its electro-dynamic torque at a predetermined point in the revolution of the shaft, and means acting automatically thereafter to cut off the current supply.

5. A driving and stopping mechanism for stopping a shaft in a predetermined angular position having, in combination, an electric motor, a shaft driven thereby, means for supplying current to the motor, means under the control of the operator for changing the conditions in the motor so as to reverse its electro-dynamic torque at a predetermined point in the revolution of the shaft, and means acting automatically thereafter to cut off the current supply.

6. A driving and stopping mechanism for

a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor, a shaft driven by the motor connected to and rotating in timed relation to the cam shaft, means for supplying current to the motor, including a switch, normally inoperative mechanism driven from the shaft for actuating the switch to change the conditions in the motor so as to reverse its electro-dynamic torque in timed relation to the angular position of the shaft, and to said cycle of operations, and means for rendering said mechanism operative.

7. A driving and stopping mechanism for a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor, a shaft driven by the motor, connected to and rotating in timed relation to the cam shaft, means for supplying current to the motor, means actuated in timed relation to the angular position of the shaft and to said cycle of operations to change the conditions in the motor so as to reverse its electro-dynamic torque, and means operating on the reversal of the motor to cut off the current supply.

8. A driving and stopping mechanism for a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor, a shaft driven by the motor, connected to and rotating in timed relation to the cam shaft, means for supplying current to the motor including a switch, means operating in timed relation to the shaft and to said cycle of operations, for actuating the switch to reverse the electro-dynamic torque of the motor, and means operating on the reversal of the motor for actuating the switch to cut off the current supply.

9. A driving and stopping mechanism having, in combination, an electric motor, a shaft driven thereby, means for supplying current to the motor, treadle operated means for changing the conditions in the motor to reduce its speed from high to low, means controlled from the treadle and acting in timed relation to the shaft after at least a predetermined amount of low speed to change the conditions in the motor so as to reverse its electro-dynamic torque, and means acting automatically thereafter to cut off the current supply.

10. A driving and stopping mechanism having, in combination, an electric motor, a shaft driven thereby, means for supplying current to the motor including a forward, reverse and off switch, means operating in timed relation to the rotation of the shaft for moving the switch from forward to reverse position, a detent for holding the switch in reverse position, a spring to move the switch from reverse to off position when released by the detent, and means operating as the motor stops for actuating the detent to release the switch.

11. A driving and stopping mechanism having, in combination, an electric motor, a shaft driven thereby, means for supplying current to the motor including a forward, reverse and off switch, means operating in timed relation to the rotation of the shaft for moving the switch from forward to reverse position, a detent for holding the switch in reverse position, a spring to move the switch from reverse to off position when released by the detent, means operating as the motor stops for actuating the detent to release the switch, and means actuated by the reverse rotation of the motor for actuating the detent to release the switch.

12. A driving and stopping mechanism having, in combination, an electric motor, a shaft driven thereby, means for supplying current to the motor including a forward, reverse and off switch and a high and low speed switch, a treadle and suitable connections for actuating the high and low speed switch, connections from the treadle to the forward, reverse and off switch for moving said switch from off to forward position in starting, mechanism actuated by the shaft and controlled from the treadle for moving the forward, reverse and off switch from forward to reverse position in stopping, and means controlled by the reversal of the rotation of the motor for moving the forward, reverse and off switch from reverse to off position.

13. A driving and stopping mechanism having, in combination, an electric motor, a shaft driven thereby, means for supplying current to the motor comprising a high and low speed switch and a forward, reverse and off switch, means operating in starting the machine to move the high and low switch to high position and thereafter the forward, reverse and off switch from off to forward position, and means operating in stopping to move the high and low switch to low position and thereafter the forward, reverse and off switch from forward to reverse position and finally to off position.

14. A driving and stopping mechanism having, in combination, an electric motor comprising an armature shaft, machine shafts driven by the armature shaft, a shaft separate from the machine shafts driven by the armature shaft, means for supplying current to the motor including a switch, normally inoperative mechanism driven from said separate shaft for actuating the switch to

change the conditions in the motor so as to reverse its electro-dynamic torque in timed relation to the angular position of said separate shaft, means for rendering said mechanism operative, and means acting automatically thereafter to cut off the current supply.

15. A driving and stopping mechanism having, in combination, an electric motor, a shaft driven thereby, means for supplying current to the motor comprising a high and low speed switch and a forward, reverse and off switch, a treadle and suitable connections for actuating the high and low speed switch, connections from the treadle to the forward, reverse and off switch for moving said switch from off to forward position in starting after the high and low speed switch has been moved to high position, means controlled by the treadle in stopping for moving the forward, reverse and off switch from forward to reverse position after the high and low speed switch has been moved to low speed position, and means for finally moving the forward, reverse and off switch from reverse to off position.

16. A driving and stopping mechanism having, in combination, an electric motor, a shaft driven thereby, means for supplying current to the motor including a forward, reverse and off switch and a high and low speed switch, a treadle and suitable connections for actuating the high and low speed switch, connections from the treadle to the forward, reverse and off switch for moving said switch from off to forward position in starting after the high and low speed switch has been moved to high position, mechanism actuated by the shaft and controlled from the treadle for moving the forward, reverse and off switch from forward to reverse position in stopping after the high and low speed switch has been moved from high to low speed position, and means for finally moving the forward, reverse and off switch from reverse to off position.

17. A driving and stopping mechanism having, in combination, an electric motor, a shaft driven thereby, means for supplying current to the motor including a switch, normally inoperative mechanism driven from the shaft for actuating the switch to change the conditions in the motor so as to reverse its electro-dynamic torque in timed relation to the angular position of the shaft, normally inoperative mechanism for performing an operation in the machine to which the driving and stopping mechanism is applied as the machine stops, and means for rendering said mechanisms operative.

18. A driving and stopping mechanism having, in combination, an electric motor, a shaft driven thereby, means for supplying current to the motor including a switch, normally inoperative mechanism driven from the shaft for actuating the switch to change the conditions in the motor so as to reverse its electro-dynamic torque in timed relation to the angular position of the shaft, connections from the switch actuating mechanism for performing an operation in the machine to which the driving and stopping mechanism is applied, and means for rendering said mechanism operative.

19. A driving and stopping mechanism having, in combination, an electric motor, a shaft driven thereby, means for supplying current to the motor including a high and low speed switch operable to change the speed of the motor while the motor continues in operation, a forward and reverse switch to control the conditions in the motor in stopping, means actuated in timed relation to the rotation of the shaft in stopping for moving the forward and reverse switch from forward to reverse position, and means acting automatically thereafter to cut off the current supply.

20. A driving and stopping mechanism for a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor directly connected to the cam shaft so as to control said cam shaft while being driven and stopped, a shaft driven by the motor connected to and rotating in timed relation to the cam shaft, means for supplying current to the motor, and means for stopping the shaft in a substantially predetermined angular position and at a predetermined point in a cycle of operations, comprising means actuated in timed relation to the angular position of the shaft and to said cycle of operations for changing the conditions in the motor so as to alter its electro-dynamic torque at a predetermined point in the revolution of the shaft.

21. A driving and stopping mechanism for a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor directly connected to the cam shaft so as to control said cam shaft while being driven and stopped, and means for stopping the shaft in a predetermined angular position and at a predetermined point in a cycle of operations comprising means actuated at a substantially predetermined point in the rotation of the shaft and in a cycle of operations for cutting off the current supply of the motor.

22. A driving and stopping mechanism for a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor directly connected to the cam shaft so as

to control said cam shaft while being driven and stopped, a shaft driven by the motor connected to and rotating in timed relation to the cam shaft, means for supplying current to the motor, and means for stopping the shaft during any revolution in a substantially predetermined angular position and at a substantially predetermined point in the cycle of operations comprising means under the control of the operator and actuated in timed relation to the angular position of the shaft and to the cycle of operations for changing the conditions in the motor so as to alter its electro-dynamic torque.

23. A drivnng and stopping mechanism for a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor directly connected to the cam shaft so as to control said cam shaft while being driven and stopped, a shaft driven by the motor connected to and rotating in timed relation to the cam shaft, means for supplying current to the motor, and means for stopping the shaft during any revolution in a predetermined angular position and at a predetermined point in the cycle of operations comprising means under the control of the operator and actuated at a substantially predetermined point in the rotation of the shaft and in the cycle of operations for cutting off the current supply of the motor.

24. A driving and stopping mechanism for a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor, a shaft driven by the motor connected to and rotating in timed relation to the cam shaft, means for supplying current to the motor, and means actuated in timed relation to the rotation cycle of the shaft and in the said cycle of operations for reversing the electro-dynamic torque of the motor at a predetermined point in the revolution of the shaft and in the cycle of operations to brake the machine to which the driving and stopping mechanism is attached.

25. A driving and stopping mechanism for a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor, a shaft driven by the motor connected to and rotating in timed relation to the cam shaft, means for supplying current to the motor, and means actuated by the shaft and acting when thrown into operation to reverse the electro-dynamic torque of the motor at a predetermined point in the revolution of the shaft and in the cycle of operations to brake the machine to which the driving and stopping mechanism is attached.

26. A driving and stopping mechanism for a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor, a shaft driven by the motor, connected to and rotating in timed relation to the cam shaft, means for supplying current to the motor, means actuated by the shaft and acting when thrown into operation to reverse the electro-dynamic torque of the motor at a predetermined point in the revolution of the shaft and in the cycle of operations to brake the machine to which the driving and stopping mechanism is attached, and means for rendering said means operative.

27. A driving and stopping mechanism for a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor, a shaft driven by the motor, connected to and rotating in timed relation to the cam shaft, means for supplying current to the motor, and means for changing the conditions in the motor to alter its electro-dynamic torque and for thereafter stopping the shaft in a predetermined angular position and at a predetermined point in the cycle of operations.

28. A driving and stopping mechanism for a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor, a shaft driven by the motor connected to and rotating in timed relation to the cam shaft, means for supplying current to the motor, means for changing the conditions in the motor to cause it to run at a reduced speed, and means for thereafter stopping the shaft in a predetermined angular position and at a predetermined point in the cycle of operations.

29. A driving and stopping mechanism for a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor, a shaft driven by the motor connected to and rotating in timed relation to the cam shaft, means for changing the conditions in the motor to cause the motor to run at a reduced speed, and means operative after at least a predetermined amount of reduced speed to stop the shaft in a predetermined angular position and at a predetermined point in the cycle of operations.

30. A driving and stopping mechanism for

a machine comprising cooperating moving parts and a cam shaft for actuating said parts to perform a regularly recurring cycle of operations during each revolution of the cam shaft having, in combination, an electric motor, a shaft driven by the motor connected to and rotating in timed relation to the cam shaft, means for supplying current to the motor, and means actuated in timed relation to the rotation of the shaft for changing the electro-dynamic torque of the motor at a predetermined point in the revolution of the shaft and at a predetermined point in the cycle of operations to brake the machine to which the driving and stopping mechanism is attached.

In testimony whereof I have signed my name to this specification.

LAURENCE E. TOPHAM.