

Oct. 5, 1948.

A. PALMER ET AL

2,450,484

LETOFF FOR LOOMS

Filed May 10, 1945

2 Sheets-Sheet 2

FIG. 3

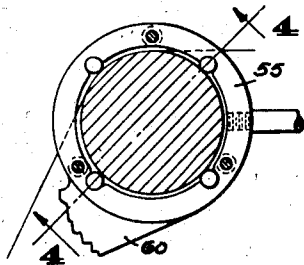


FIG. 4

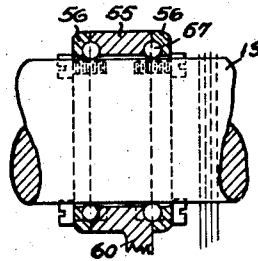


FIG. 5

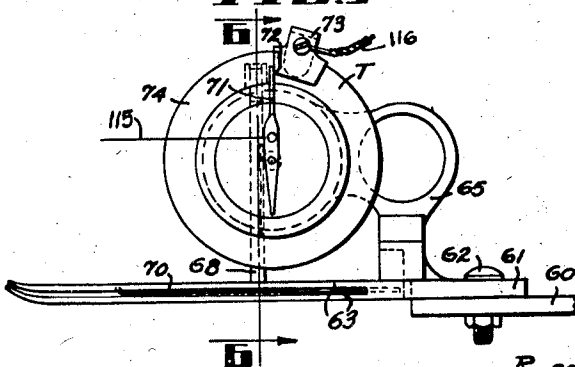
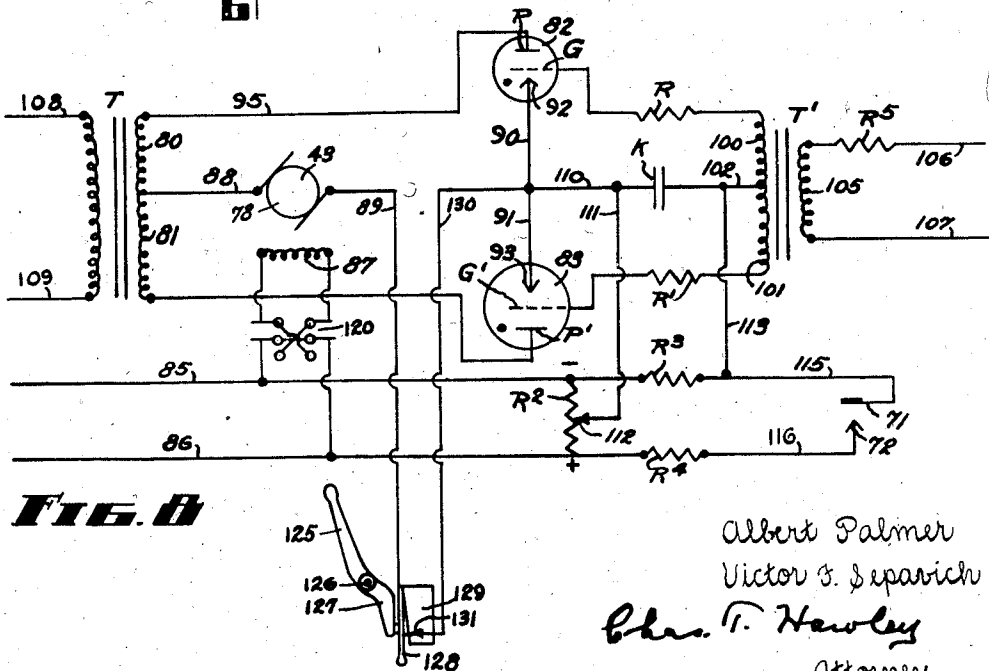
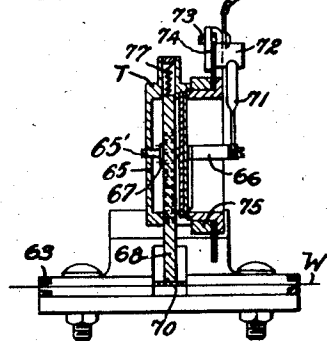


FIG. 6



Albert Palmer
Victor S. Sparich
Chas. T. Hawley
Attorney.

UNITED STATES PATENT OFFICE

2,450,484

LETOFF FOR LOOMS

Albert Palmer and Victor F. Sepavich, Worcester, Mass., assignors to Crompton & Knowles Loom Works, Worcester, Mass., a corporation of Massachusetts

Application May 10, 1945, Serial No. 592,986

26 Claims. (Cl. 139—110)

1

This invention relates to improvements in loom letoffs and it is the general object of the invention to provide means controlled by the warp tension for turning the warp beam.

There is a tendency in the textile industry to utilize warp beams of ever increasing diameter for the purpose of holding larger supplies of warp. As the diameter of these beams increase their weight interferes with proper letting off of the warp when conventional types of letoff mechanisms are employed. Ordinarily the force for moving the warp beam is transmitted through the warp threads, but as the inertia of the beam increases an amount of force required for turning the beam is more than can properly be transmitted through the warp. It is an important object of the present invention to provide means for applying a continuous rotary force to the beam control in such a way that the rate of application of the force can be altered to meet the conditions of the warp.

It is another object of the invention to provide a constantly running motor driven unit connected to the warp beam and subject to speed variations controlled by indications derived from the warp tension in such a way that when the tension is low the unit will operate at a slow speed, but when the tension is high the unit will operate faster to pay off warp from the beam.

It is a still further object of the invention to control the speed of the motor forming part of the aforesaid unit by means of an electronic circuit wherein fluctuations in the control grid potential are derived from variations in warp tension.

With these and other objects in view which will appear as the description proceeds, our invention resides in the combination and arrangement of parts hereinafter described and set forth.

In the accompanying drawings, wherein a convenient embodiment of our invention is set forth, Fig. 1 is a side elevation of the rear part of the loom having the invention applied thereto.

Fig. 2 is a rear elevation looking in the direction of arrow 2, Fig. 1.

Fig. 3 is an enlarged vertical detailed section on line 3—3 of Fig. 2.

Fig. 4 is a section on line 4—4 of Fig. 3.

Fig. 5 is a view looking in the direction of arrow 5, Fig. 1, showing the electronic circuit controlling gauge which is responsive to variations in warp tension.

Fig. 6 is a vertical section on line 6—6 of Fig. 5.

Fig. 7 is a vertical section through the driving gear of the reduction unit showing the type of

2

friction drive which may conveniently be used with the invention, and

Fig. 8 is a diagrammatic view showing the electric circuits employed for controlling the motor.

Referring to Figs. 1 and 2, there is shown a loom frame 10 to which are attached upper and lower rearwardly extending stands 11 and 12, respectively. A whip roll 13 is mounted on the upper end of an arm 14 pivoted as at 15 to the stand 11. A spring 16 may be employed to hold the arm normally and rearwardly or to the left as viewed in Fig. 1. A stop 17 on the bottom of arm 14 engages a shoulder 18 on the stand 11 to limit rearward movement of arm 14 and the whip roll. Forward movement of the whip roll is limited by an adjusting screw 19 mounted on stand 11 for engagement with the front part of arm 14. The warp W derived from the beam B passes over the whip roll and then forwardly to harness frames and other weaving instrumentalities not shown. The whip roll 13 is capable of a limited back and forth motion determined by the stops 18 and 19 but tends normally to be in the rear position shown in Fig. 1. At the time of beatup or when the harnesses are wide open forward tension in the warp may move the whip roll to the right as viewed in Fig. 1.

The stand 12 is provided with a bearing 25 through which extends a gudgeon 26 projecting laterally from the head 27 of the warp beam. The gudgeon is mounted for free rotation in its bearing and is the means for supporting the adjacent end of the beam. It will be understood that suitable supports are provided for the opposite end of the warp beam and whip roll and that during the loom operation consumption of the warp requires rotation of the beam B in the direction of arrow a, Fig. 1. When the beam is of a large diameter and is full of warp it weighs a good many hundred pounds and a considerable amount of force must be applied to it to turn it on its bearings.

The matter thus far described except as noted hereinafter forms no part of the present invention and may be made as usual.

In carrying the invention into effect there are provided a gear reducer unit R, a motor unit M, a control unit C responsive to variations in warp tension, and the electric circuits shown in Fig. 8.

The gudgeon 26 has secured thereto a gear 30 meshing with a second gear 31 mounted on a low turning shaft 32 of the gear reducer R. As shown in Fig. 7 the gear 31 has a web 34 held frictionally between plates or disks 35 and 36. The plate 35 has a hub 37 secured to shaft 32 and the plates 35 are held in frictional engagement with the web

by bolts 38. Ordinarily the plates are so set as to transmit an operating force from shaft 32 to gear 31 for the purpose of turning the gear 30, but if for any reason the shaft 32 should be held against rotation the gear 31 can slip with respect to it. The unit R is mounted on a support 40 located on the floor at one side of the warp beam but held in fixed position with respect to the loom frame as at 41. A small bracket 42 extending upwardly from the support 40 has mounted thereon a fractional horse power motor 43 the shaft 44 of which is connected by coupling 45 to the fast turning input shaft 46 of the reducer unit R.

The mechanism in the reducer is not set forth in detail herein but operates in such a manner that when shaft 46 is turned by operation of the motor 43 the output shaft 32 will turn at a slow rate. The mechanism within the reducer includes a worm gear 47 and a worm 48 meshing therewith and it is because of the worm that the type of drive for gear 31 shown in Fig. 7 is used.

The control unit C is mounted on the whip roll or at least held in such a position that it can respond to variations in warp tension without moving forwardly with the warp. As shown herein a shell 55 having end plates 56 houses ball bearings 57 which engage the whip roll 13. By means of the ball bearings the whip roll can turn with respect to the shell 55, although this is not an essential feature inasmuch as rotation of the whip roll with respect to its supporting arm 14 may be prevented if desired as by a set screw 58. A counterweight 59 secured to shell 55 keeps the unit C in balance so that the pressure reading will be accurate.

The shell 55 has extending downwardly therefrom an arm 60 on which is mounted a gauge or warp tension meter T. This gauge has a foot 61 secured as at 62 to the arm 60. Parallel spaced fingers 63 extend from the base 61 and are adapted to have a small section of warp pass between them as suggested in Figs. 5 and 6. An upright 65 supports the gauge and affords support as at 65' for a small shaft 66 mounted for rotation on the upright and having secured thereto a small pinion 67. This pinion meshes with a rack rod 68 guided as indicated in Fig. 6 with respect to the upright 65 and having the lower end thereof provided with a pressure detecting foot 70 which normally engages the warp threads extending between the fingers 63. The tension meter T of itself forms no part of the invention except as it closes a contact as will be described. Reference may be had to patent to Payne No. 1,817,203 after which the meter T is patterned.

The end of shaft 66 opposite the pinion has secured thereto and insulated therefrom a contact sweep arm 71 which rotates with shaft 66 and is adapted for engagement with an electric contact 72 clamped as at 73 to the insulated rim 74 held as at 75 on the upright 65. A light spring 77 guided in upright 65 tends to lower the detecting foot 70 but this tendency is resisted by the tension of the warp W in engagement with the detector foot. The contact 72 can be set at any desired angular position around the disk 74 so that engagement between the arm 71 and the contact 72 may be effected for any selected vertical position of the detector foot 70 with respect to the controller C.

Fig. 8 shows diagrammatically a form of circuit which has been used with the invention disclosed herein. The transformer T has its secondary divided into two windings 80 and 81 each capable of giving current at a sufficiently high voltage to operate the armature 78 of the motor 43. Two electronic tubes 82 and 83 are employed and a

direct current supply furnished by wires 85 and 86 feeds the shunt field 87 of the motor 43. A center tap 88 between the secondary windings 80 and 81 leads to one side of the armature, while a wire 89 leading from the other side of the armature is connected by switch unit 120 to wire 130 connected by wires 90 and 91 to the cathodes 92 and 93, respectively, of the tubes 82 and 83. Ordinarily, a small unidirectional pulsating current flows from secondary winding 80 over wire 95 to plate P of tube 82 and across to the cathode 92 and thence by wires 96 and 130, unit 120 and wire 89 to the armature of the motor and back by the center tap 88 to the winding 80. In a similar manner the winding 81 establishes a circuit through the tube 83 and the motor armature. The two tubes act to rectify the alternating current so that a unidirectional current can flow through the tubes to the armature causing the latter to turn normally at a slow rate. The conditions which permit this flow of current will now be described.

A second transformer T' has secondary windings 100 and 101 connected to a center tap 102. Since the tubes 82 and 83 are gas filled it is desirable that they be protected against excess current and for this purpose resistances R and R' are used.

Bridged across the direct current wires 85 and 86 is a variable resistance R2 which serves as a control for the initial or normal speed of the motor. Resistances R3 and R4 are relatively high, resistance R4 in one instance in which the invention has been used being about one quarter megohm and resistance R3 being about one half of resistance R4. The lower right hand part of Fig. 8 represents diagrammatically the swinging contact arm 71 and the adjustable but normally stationary contact 72 shown in more detail in Figs. 5 and 6.

The primary 105 of transformer T' is supplied with power by wires 106 and 107 which are connected to the same source as are wires 108 and 109 connected to the primary of transformer T. A resistance R5 is connected in wire 106 in series with the primary 105 and cooperates with the inductance of primary 105 to create a 90° phase displacement of the secondaries 100 and 101 with respect to the power lines 106 and 107 and also transformer T the secondaries of which are connected to plates P and P' of the tubes 82 and 83.

The normal bias of grid G is determined by the following circuit: secondary 100, resistance R, grid G, cathode 92, wires 90, 110 and 111, sliding contact 112 for resistance R2, the upper part of resistance R2, wire 85, resistance R3, wire 113, and center tap 102 back to the secondary 100. In this circuit the upper part of resistance R2 imposes a direct current component on the secondary alternating current component derived from winding 100, and this direct current component is reckoned from a potential level below the zero potential level of the line alternating current supplied by wires 106 and 107. The combination of the direct and secondary alternating components provides a resultant alternating current. When the positive secondary alternation is added to the direct current it provides a positive wave for the resultant current the maximum potential of which will ordinarily be above the zero potential of the line alternating current, and when the alternation is negative it subtracts from the direct current component to produce a negative resultant wave below the zero potential of the line alternating

current level. The zero level or axis of the resultant wave is therefore below the zero level or axis of the line alternating current, but this resultant wave axis can be raised and lowered relatively to the line alternating current axis by changing the location of sliding contact 112.

The amount of current which can flow through grid G for the normal operation of the motor will be dependent upon the extent to which the positive resultant wave rises above the axis of the line alternating current. Contact 112 will ordinarily be set so that this positive resultant wave will be above the line alternating current zero of the plate P sufficiently to provide the current needed to drive the motor at its normal speed, but current flowing through tube 82 can be increased by raising the axis of the resultant wave so that more of the positive part of the resultant wave will be above the axis of the line alternating current at the plate. The raising of the resultant wave axis is effected by closure of the contacts 71 and 72, as will be described.

That part of resistance R2 between wire 85 and sliding contact 112 determines the average potential of grid G. Sliding contact 112 can be set to give grid G any desired potential to permit a smooth variation in current passing through tube 82 from zero to maximum. Under normal conditions contact 112 will be set so that the potential of grid G will allow enough current to flow through armature 78 to allow the motor to run at a constant speed which is somewhat less than that required to turn the warp beam fast enough to supply warp as the latter is consumed. The contacts 71 and 72 are of course out of engagement with each other under these normal conditions.

As weaving continues tension in the warp will increase due to consumption of the warp and swinging arm 71 will ultimately engage contact 72 and establish the following grid circuit: secondary 100, protective resistance R, grid G, cathode 92, wires 90, 110 and 111, sliding contact 112, lower part of resistance R2, wire 86, resistance R4, wire 116, contacts 72 and 71, wires 115 and 113 to center tap 102 and back to secondary 100. In this last circuit it will be noted that resistance R3 is bypassed and the resistance R4 is substituted for it. The effect of substituting the lower part of resistance R2 and resistance R4 for resistance R3 and the upper part of resistances R2 is to raise the aforesaid axis of the resultant wave, thereby raising the positive part of the resultant wave to higher level relatively to the line alternating current or plate axis than existed previously. More current therefore flows through the tube 82 to the armature 78 and motor speed is increased. The motor will run at its increased speed until it has caused the warp beam to unwind enough warp to offset the previously increased warp tension, whereupon arm 71 will move away from contact 72 and the normal grid bias circuit will be reestablished.

Similar conditions exist for grid G' of tube 83 and during closure of contacts 71 and 72 the two tubes act to supply a unidirectional current at a value above the normal current for operation of the motor.

Fig. 8 shows a condenser K between wire 110 and center tap 102. Warp tension temporarily increases at beat-up and again when the harnesses are wide open. When the loom is running at high speeds, therefore, there will be several temporary or periodic increases in warp tension each second. The effect of the condenser is to

smooth out the impulses which may result from closure of contacts 71 and 72 due to these periodic tension increases. As a result, the grids respond to the integrating effect which the condenser has on these periodic impulses rather than to each individual impulse, and the motor has a smoother operation. Without the condenser the motor response would be instantaneous, which might shorten the life of the motor.

The period during which the aforesaid integration of impulses occurs may be varied by changing the size of condenser K. The rate at which the condenser is charged is determined by resistances R3 and R4 and the rectified grid current as determined by the upper part of resistance R2. The condenser is charged through resistance R4 and discharges at a slower rate through resistance R3.

If for any reason warp should become too slack, necessitating reversal of motor 43, reversing switch 120 can be thrown to reverse the field.

Another feature of the invention relates to provision for stopping the motor 43 whenever the loom is stopped. It will be apparent that if the motor 43 should continue to run after the loom had been stopped due to warp or filling fault, the warp could continue to unwind and create a condition which would require attention from the weaver when the loom was restarted. In order to take care of this condition we establish a control between the motor circuit and some part of the loom, such as the shipper handle, which changes its position when the loom is stopped.

Referring particularly to Fig. 8, there is shown a shipper handle 125 which may be pivoted as at 126 and have a depending arm 127 for engagement with the switch blade 128 of a switch unit 129 held in fixed position. When the loom is running the shipper handle 125 will be in its extreme left hand or running position as viewed in Fig. 8, but when the loom stops the shipper handle will be moved to the right to its stopping position. Wires 89 and 130 which are in the armature circuit are connected respectively to the blade 128 and an electrode 131 carried by the switch unit 129. Blade 128 is so placed that when the shipper handle is in running position it will cause blade 128 to engage the electrode 131 and thereby connect the armature 78 to the cathodes 92 and 93. When the shipper handle moves to stopping position, however, the blade 128 moves away from the electrode 131 and interrupts the armature circuit, whereupon the motor stops.

From the foregoing it will be seen that we have provided a loom letoff employing a motor which runs continuously and normally at a rate too slow to supply sufficient warp for the weaving operation, together with means to increase the speed of the motor above its normal minimum rate to turn the warp beam sufficiently to maintain uniform tension. It will also be seen that the control for the motor is an electronic circuit which responds to diminution in warp tension without regard to the position of the whip roll. Furthermore, it will be seen that the position of the sliding contact 112 determines the normal minimum current which flows through the armature and that a variation in armature speed can be obtained throughout a wide range for normal operation due to the fact that the grids of the tubes are out of phase with their corresponding tube plates by 90°. It will also be noted that when the contact is closed at the controller C the potential of the grid is altered due to a

change in the axis of the resultant wave relatively to the line or plate alternating current which results when resistance R4 is substituted for resistance R3 in the grid potential circuit. In this connection it will also be seen that the resistance R2 has two parts, one above contact 112 which contributes to the determination of the grid potential under normal motor speed conditions and the other part of which is below contact 112 and contributes to the increase in motor speed when the contact is closed at the controller C. Also, the condenser K has the effect of integrating and smoothing out impulses derived from the controller C when periodic increases of warp tension occur due to beat-up and harness opening. The condenser K affects the potential of the grids in such a way as to give smoother control for the armature current than would be possible if the condenser were omitted. It will also be seen that the switch unit 123 interrupts the circuit to the armature 43 whenever the shipper handle is in stopping position, thereby preventing running of the motor whenever the loom is stopped.

Having thus described our invention it will be seen that changes and modifications may be made therein by those skilled in the art without departing from the spirit and scope of the invention and we do not wish to be limited to the details herein disclosed, but what we claim is:

1. In a letoff mechanism for a loom having a beam which turns to supply warp the tension of which increases when the beam turns too slowly to supply the warp needed for the weaving operation, a motor operatively connected to the beam to cause turning of the beam to supply warp when the motor is running, electric means causing the motor to run continuously during loom operation but normally at a rate insufficient to enable the beam to supply the warp needed for the weaving operation, and means responsive to increased tension in the warp causing the motor to run faster than the normal speed thereof to enable the beam to supply the warp needed for the weaving operation.

2. In a letoff mechanism for a loom having a beam which turns to supply warp the tension of which increases when the beam turns too slowly to supply the warp needed for the weaving operation, a motor operatively connected to the beam to cause turning of the beam to supply warp when the motor is running, electric circuit means capable of causing the motor to turn at varying rates of speed and normally causing the motor to turn at a rate too slow to enable the beam to supply the warp needed for the weaving operation when the warp tension is below a given point, and a controller for said electric circuit means operative when the warp tension reaches said given point to increase the speed of the motor to enable the beam to supply warp at a faster rate.

3. In a letoff mechanism for a loom having a beam which turns to supply warp the tension of which increases when the beam turns too slowly to supply the warp needed for the weaving operation, a motor operatively connected to the beam to cause turning of the beam to supply warp when the motor is running, electric means capable of driving the motor at different speeds and normally operative to drive the motor at a speed insufficient to enable the beam to supply warp at the rate needed for the weaving operation, and a controller for said electric means responsive to changes in warp tension and causing the electric means to increase the speed of the motor when

the warp tension increases to a given point to thereby increase the rate at which the beam supplies warp.

4. In a letoff mechanism for a loom having a warp beam supplying warp the tension of which increases when the beam turns at a given rate insufficient to supply the amount of the warp needed for the weaving operation, an electric motor operatively connected to the beam to cause turning of the latter when the motor is running, electric circuit means including the motor and normally operative to cause the motor to turn the beam at said given rate, tension means responsive to increases in tension in the warp and having a contact which is closed when a given degree of tension occurs in the warp, and electric controller means including said contact and connected to said electric circuit means and effective to cause the latter to turn the motor at an increased speed when said contact is closed.

5. In a letoff mechanism for a loom having a warp beam which turns to supply warp the tension of which increases when the beam turns too slowly to supply the warp needed for the weaving operation, an electric motor operatively connected to the beam to cause turning of the latter when the motor is running, electric circuit means normally causing the motor to turn at a given minimum rate too slow to cause the beam to supply sufficient warp for the weaving operation, tension means connected directly to the warp and effective to close an electric contact when the warp tension increases to a given point, and electric control means including said contact and electrically connected to said electric circuit means causing the latter to turn the motor at a rate above said given minimum rate when said contact is closed.

6. In a letoff mechanism for a loom having a beam which turns to supply warp the tension of which increases when the beam turns too slowly to supply the warp needed for the weaving operation, a motor operatively connected to the beam to cause turning of the beam to supply warp when the motor is running, an electronic tube including a grid, electric circuit means including the tube and motor, primary electric controller means for the grid operative under normal conditions to maintain the grid in such electric condition as to permit an amount of current to flow in said electric circuit means sufficient only to cause the motor to turn the warp beam at too slow a rate to supply the warp required for weaving, an indicator responsive to warp tension and closing a contact when the warp tension increases to a given point, and secondary electric controller means including the contact and grid and operative when the contact is closed to alter the electric condition of the grid so that more current flows through said tube with resultant increase in the rate of turning of the motor.

7. In a letoff mechanism for a loom having a beam which turns to supply warp the tension of which increases when the beam turns too slowly to supply the warp needed for the weaving operation, a motor operatively connected to the beam to cause turning of the beam to supply warp when the motor is running, an electronic tube including a grid, electric circuit means including the tube and motor tending normally to cause enough current to flow through the tube and motor to run the latter at a speed high enough to cause the beam to supply sufficient warp for weaving, electric controller means connected to the grid and normally operative to maintain the grid in

such electric condition as to permit only that amount of current to flow through the tube which will cause turning of the motor at a rate too slow to enable the beam to supply the warp required for weaving, a tension indicator which closes an electric contact when the warp tension increases to a given point, and additional electric controller means connected to the grid and operative upon closure of said contact to change the electric condition of the grid in such manner that the grid permits more current to flow through the tube and motor to increase the speed of the latter.

8. In a letoff mechanism for a loom having a beam which turns to supply warp the tension of which increases when the beam turns too slowly to supply the warp needed for the weaving operation, a motor operatively connected to the beam to cause turning of the beam to supply warp when the motor is running, an electronic tube including a grid, electric circuit means including a grid and motor tending normally to turn the motor at a speed sufficiently high to cause the beam to supply the warp required in the weaving operation, electric control means for the grid normally maintaining an electric condition on the grid by which the latter permits only enough electric current to flow through the tube and motor to operate the latter at a relatively low speed insufficient to enable the beam to supply the warp needed for the weaving operation, and additional electric control means for the grid responsive to changes in warp tension and operative upon increase of tension in the warp to a given point to change the electric condition of the grid so that an increased amount of current passes through the tube and motor to increase the speed of the latter.

9. In a letoff mechanism for a loom having a beam which turns to supply warp the tension of which increases when the beam turns too slowly to supply the warp needed for the weaving operation, a motor operatively connected to the beam to cause turning of the beam to supply warp when the motor is running, means normally operative when the warp tension is below a given degree causing the motor to turn the beam at a rate insufficient to supply the warp needed for the weaving operation, and other means under control of the warp and operative when the warp tension increases to said given degree to cause the motor to run faster and turn the beam at an increased rate.

10. In a letoff mechanism for a loom having a warp beam which turns to supply warp the tension of which increases when the beam turns at too slow a rate to supply the warp needed for the weaving operation, an electric motor having an armature the rate of rotation of which increases as the current flowing therethrough increases, driving connections between the armature and the beam causing the latter to turn when the armature turns, an electronic tube having a grid, a source of electric current, electric circuit means including said source, tube and armature and tending normally to turn the armature at a relatively high rate of speed sufficient to enable the beam to supply the warp needed for weaving, a primary control for the grid normally operative to maintain the latter at such electric condition as will enable only enough current to flow through said circuit means to turn the armature at a relatively low rate too slow to enable the beam to supply the warp required for the weaving operation, and a secondary controller

for said grid operative when the warp tension increases to a given point to alter the electric condition of the grid so that the latter permits a larger current to flow through said electric circuit means to turn said motor at said relatively high speed.

11. In a letoff mechanism for a loom having a warp beam which rotates to supply warp the tension of which increases when the beam turns too slowly to supply the warp needed for the weaving operation, a direct current motor having a field coil and an armature, driving connections between the armature and the beam causing the latter to turn when the armature turns, a source of direct current connected to the field coil, a source of alternating current, an electronic tube having a grid, electric circuit means including said source of alternating current, motor and tube, the latter permitting current to flow therethrough in only one direction so that unidirectional current flows through the armature, an electric resistance connected across said source of direct current, control means for the grid including a part of said resistance and normally effective to maintain said grid at such electric condition that said grid permits only an amount of current to pass through the tube and armature which will turn the latter at a rate too slow to enable the beam to supply the warp required for the weaving operation, and other control means for the grid including another part of said resistance and rendered operative upon increase of tension of the warp to a given point to alter the electric condition of the grid in such manner that the grid enables increased unidirectional current to flow from said source of alternating current through the armature to increase the speed of the latter sufficiently to enable the beam to supply the warp needed for the weaving operation.

12. In a letoff mechanism for a loom having a warp beam which turns to supply warp the tension of which increases when the beam turns too slowly to supply the warp needed for the weaving operation, a direct current motor having a field coil and an armature, driving connections between the armature and the beam causing rotation of the latter when the armature rotates, a source of direct current for the field coil, a source of alternating current, an electronic tube which permits current to pass therethrough in one direction only, electric circuit means including said source of alternating current, said tube and said armature tending normally to turn the latter at a relatively high rate of speed sufficient to enable the beam to supply the warp needed for weaving, a grid forming part of said tube, a resistance connected across said source of direct current, two other resistances, grid control circuit means including said source of alternating current, one of said other resistances, a part of said one resistance, and the grid normally operative to maintain the latter at such electric condition as will enable only enough current to flow from said alternating current source through said tube to the armature to turn the latter at a relatively low rate too slow to enable the beam to supply warp at the rate needed for the weaving operation, and other control circuit means for the grid including said other resistance and the other part of said one resistance, said source of alternating current and grid operative upon increase of warp tension to a given point to alter the electric condition of the grid so that the latter enables said circuit means to cause increased current to

11

flow through said tube and armature for the purpose of increasing the speed of the latter and the rate at which said beam supplies warp.

13. In a letoff mechanism for a loom having a warp beam which turns to supply warp the tension of which increases when the beam turns too slowly to supply enough warp for the weaving operation, a direct current motor having a field coil and an armature operatively connected to the beam to turn the latter when the armature turns, a source of direct current for the field coil, a source of alternating current, an electronic tube permitting current to pass therethrough in one direction only, electric circuit means including the source of alternating current, tube and armature tending normally to operate the latter at a relatively high speed sufficient to enable the beam to supply the warp needed for weaving, a grid forming part of the tube, a primary circuit for the grid including said source of alternating current, means in said primary circuit to superimpose a part of the voltage of said source of direct current upon the current from said source of alternating current to create such an electric condition on the grid as will permit the latter to enable only enough current to flow through said tube to turn the armature at a relatively slow rate insufficient to enable the beam to supply the warp required for the weaving operation when the warp tension is below a given point, and a secondary control circuit for the grid operative when the warp tension increases to a given point to change the amount of direct current voltage derived from the source of direct current and imposed upon the voltage derived from the source of alternating current to alter the electric condition of the grid in such manner that the grid enables an increased amount of current to flow from said source of alternating current through the armature for the purpose of increasing the speed of the latter.

14. In a letoff mechanism for a loom having a rotatable beam supplying warp the tension of which increases when the beam turns too slowly to supply sufficient warp for the weaving operation, an electric motor operatively connected to the beam to cause turning of the latter when the motor runs, an electric contact closed when warp tension increases to a given point, an electronic tube, a source of electric power, motor circuit means including the tube, source and motor tending normally to cause the motor to run at a high enough rate to turn the beam fast enough to supply sufficient warp for the weaving operation, a grid forming part of the tube, electric resistance means, grid circuit means including said source and a part of said resistance means normally maintaining the grid at such electric condition as to enable current to flow into said motor circuit means to cause continuous operation of the motor at a rate too slow to enable the beam to supply the warp needed for the weaving operation, a second grid circuit means including said grid, source, the other part of said resistance means, and said contact, said second grid circuit being closed when said contact is closed and effective to alter the electric condition of the grid so that the latter permits increased current to flow through the tube and said motor circuit means to increase the speed of the motor, and a condenser connected in parallel with said contact and said other part of the resistance means.

15. In letoff mechanism for a loom having a beam which rotates to supply warp the tension of which increases when the beam turns too slowly to supply warp needed for the weaving operation,

12

an electric motor operatively connected to the beam to turn the latter when the motor runs, a source of electric power, an electronic tube including a grid, motor circuit means including said source, tube and motor tending normally to cause the motor to turn fast enough to enable the beam to supply the warp needed for the weaving operation, an electric contact closed whenever the warp tension increases to a given point, grid circuit means normally maintaining the grid at such electric condition as will permit current to flow through said motor circuit means to cause continuous operation of the motor at a rate too slow to enable the beam to supply the warp needed for the weaving operation, connections between said electric contact and said grid circuit means producing an effect which alters the electric condition of the grid whenever said contact is closed to enable more current to flow through the tube and said motor circuit means to increase the speed of the motor, and condenser means in parallel with said contact and connected to said grid circuit means and causing an averaging of several successive effects caused by closure of said contact to prevent sudden changes in said grid circuit upon closure of said contact.

16. In a letoff mechanism for a loom having a part which is in one position when the loom is operating and is in another position when the loom is stopped, a warp beam which turns to supply warp for the weaving operation, an electric motor operatively connected to the beam and causing the latter to turn when the motor runs, a switch under control of said part, and electric means including the motor and switch operative to cause continuous running of the motor to cause turning of the beam whenever the loom is operating and said part is in said one position and closes said switch, said electric means being incapable of causing the motor to run when the loom is stopped and said switch is open due to the fact that said part is in said other position.

17. In a letoff mechanism for a loom having a beam which turns to deliver warp for the weaving process, an electric motor operatively connected to the beam to cause turning thereof to deliver warp when the motor is running, electronic tube means including control grid means, electric circuit means including the tube means and motor normally tending to cause an electric change in the motor to effect delivery of warp by the beam at a given rate, and grid control means responsive to changes in warp tension normally enabling the grid means to prevent the electric circuit means from causing said change in the motor to effect delivery of warp at said rate, said grid control means effective when the warp attains a given tension to alter the grid means in such manner as to permit said electric circuit means to effect said change in the motor to cause delivery of warp at said rate.

18. In a letoff mechanism for a loom having a beam which turns to deliver warp for the weaving process, an electric motor operatively connected to the beam to cause turning thereof to deliver warp when the motor is running, electric circuit means including an electronic tube tending to run the motor at a rate sufficient to relieve excess warp tension and to deliver the warp needed for the weaving process, a grid in said tube controlling said electric circuit means, and grid circuit means causing the grid to prevent the electric circuit means from running the motor at said rate when the warp tension is less than said excess tension but causing the grid to enable the

electric circuit means to run the motor at said rate when the warp attains said excess tension.

19. In a letoff mechanism for a loom having a beam which turns to deliver warp for the weaving process, an electric motor operatively connected to the beam to cause turning thereof during loom operation to deliver warp when the motor is running, electric circuit means including an electronic tube normally tending to run the motor at a rate sufficient to relieve excess warp tension and to deliver the warp needed for the weaving process, a grid in said tube controlling said electric circuit means, grid circuit means causing the grid to prevent the electric circuit means from running the motor at said rate when the warp tension is less than said excess tension but causing the grid to enable the electric circuit means to run the motor at said rate when the warp attains said excess tension, and means to prevent said electric circuit means from causing said motor to run when loom operation is stopped.

20. In letoff mechanism for a loom having a warp beam operatively connected to an electric motor which when running turns the beam to deliver warp for the weaving operation, a contact capable of assuming two conditions in one of which the contact is open and in the other of which the contact is closed, said contact being under control of the warp and being in one condition thereof when the tension of the warp is less than a given maximum and being in the other condition thereof when the warp attains said given maximum, motor operating electric circuit means including electronic tube means normally tending to cause the motor to run at a rate sufficient to relieve said maximum tension, controlling grid means for the tube means, and grid circuit means controlled by said contact and effective when the latter is in said one condition thereof to enable the grid means to prevent said motor operating electric circuit means from causing the motor to run at said rate and effective when said contact is in the other condition thereof to alter said grid means to enable said motor operating electric circuit means to cause the motor to run at said rate.

21. In letoff mechanism for a loom having a warp beam delivering warp which attains a given maximum tension during loom operation, an electric motor which when running turns the beam to deliver warp, said motor being of the shunt wound type and having an excited field and an armature, armature controlling electric circuit means including an electronic tube normally tending to turn the motor at a rate sufficient to reduce said maximum warp tension, a control grid in said electronic tube, and grid circuit means controlled by the warp tension and effective when said tension is less than said maximum to enable the grid to prevent the armature circuit means from causing said motor to run at said rate, said grid circuit means being effective when the warp attains said maximum tension to alter the electric condition of the grid in such manner as to enable said armature circuit means to energize the armature in such manner as to cause the motor to run at said rate.

22. In letoff mechanism for a loom having a warp beam delivering warp which attains a given maximum tension during loom operation, an electric motor which when running turns the beam to deliver warp, said motor being of the direct current shunt wound type having a field coil which is constantly energized during loom operation and having an armature independent of the field,

a transformer having a secondary provided with a center tap and constituting a source of alternating current, a pair of electronic gas containing tubes having plates one of which is connected to one end of said secondary and the other of which is connected to the other end of said secondary, electric circuit means including said tubes, secondary and armature and connected to said center tap and normally tending to cause the motor to run at a rate sufficient to reduce said maximum warp tension, a control grid for each tube, and grid controlling circuit means under control of the warp tension and effective when the warp tension is less than said maximum to enable the grids to prevent said electric circuit means from running the motor at said rate, said grid controlling circuit means being effective when the warp attains said maximum tension to alter the electric condition of said grids to enable said electric circuit means to cause said motor to run at said rate.

23. In a letoff mechanism for a loom having a beam which turns to deliver warp for the weaving process, an electric motor operatively connected to the beam to cause turning thereof to deliver warp when the motor is running, electronic tube means including control grid means, a source of alternating current, electric circuit means including said source, the tube means and motor normally tending to cause an electric change in the motor to effect delivery of warp by the beam at a given rate, a second source delivering alternating current out of phase with the alternating current of the first named source, and grid control means including said second source responsive to changes in warp tension normally enabling the grid means to prevent the electric circuit means from causing said change in the motor to effect delivery of warp at said rate, said grid controlling means effective when the warp attains a given tension to alter the grid means in such manner as to permit said electric circuit means to effect said change in the motor to cause delivery of warp at said rate.

24. In letoff mechanism for a loom having a beam which turns to deliver warp for the weaving process, an electric motor operatively connected to the beam to cause turning thereof to deliver warp when the motor is running, electric circuit means including an electronic tube tending to run the motor at a rate sufficient to relieve excess warp tension and to deliver the warp needed for the weaving process, a grid in said tube controlling said electric circuit means, grid circuit means causing the grid to prevent the electric circuit means from running the motor at said rate when the warp tension is less than said excess tension but causing the grid to enable the electric circuit means to run the motor at said rate when the warp attains said excess tension, and electric means to reverse the direction of turning of the motor.

25. In a letoff mechanism for a loom having a beam which turns to deliver warp for the weaving process, an electric motor having a field and an armature and operatively connected to the beam to cause turning thereof to deliver warp when the motor is running, electric circuit means including an electronic tube tending to run the motor at a rate sufficient to relieve excess warp tension and to deliver the warp needed for the weaving process, a grid in said tube controlling said electric circuit means, grid circuit means causing the grid to prevent the electric circuit means from running the motor at said rate when the warp tension is less than said excess tension

but causing the grid to enable the electric circuit means to run the motor at said rate when the warp attains said excess tension, and electric switch means to reverse the field of the motor.

26. In letoff mechanism for a loom having a warp beam delivering warp which attains a given maximum tension during loom operation, a shunt wound type electric motor having a field and an armature effective when the loom is running normally to turn the beam to deliver warp, electric means to reverse the field to cause reverse running of the motor, armature controlling electric circuit means including an electronic tube normally tending to turn the motor at a rate sufficient to reduce said maximum warp tension, a control grid in said electronic tube, and grid circuit means controlled by the warp tension and effective when said tension is less than said maximum to enable the grid to prevent the armature circuit means from causing said motor to run at said rate, said grid circuit means being effective when the warp attains said maximum tension to alter the electric condition of the grid in such manner as to enable said armature circuit

means to energize the armature in such manner as to cause the motor to run at said rate.

ALBERT PALMER,
VICTOR F. SEPAVICH.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
807,721	Carver	Dec. 19, 1905
1,369,457	Meyer	Feb. 22, 1921
1,655,036	Alexanderson	Jan. 3, 1928
2,143,200	Madden	Jan. 10, 1939
2,227,355	Lawson	Dec. 31, 1940
2,227,356	Lawson	Dec. 31, 1940
2,236,086	Conover	Mar. 25, 1941
2,248,880	Lawson	July 8, 1941
2,334,058	Bassist	Nov. 9, 1943
2,340,889	Klumpp	Feb. 8, 1944
2,421,539	Clarke	June 3, 1947
2,430,022	Lambach	Nov. 4, 1947
2,430,639	Jacques	Nov. 11, 1947