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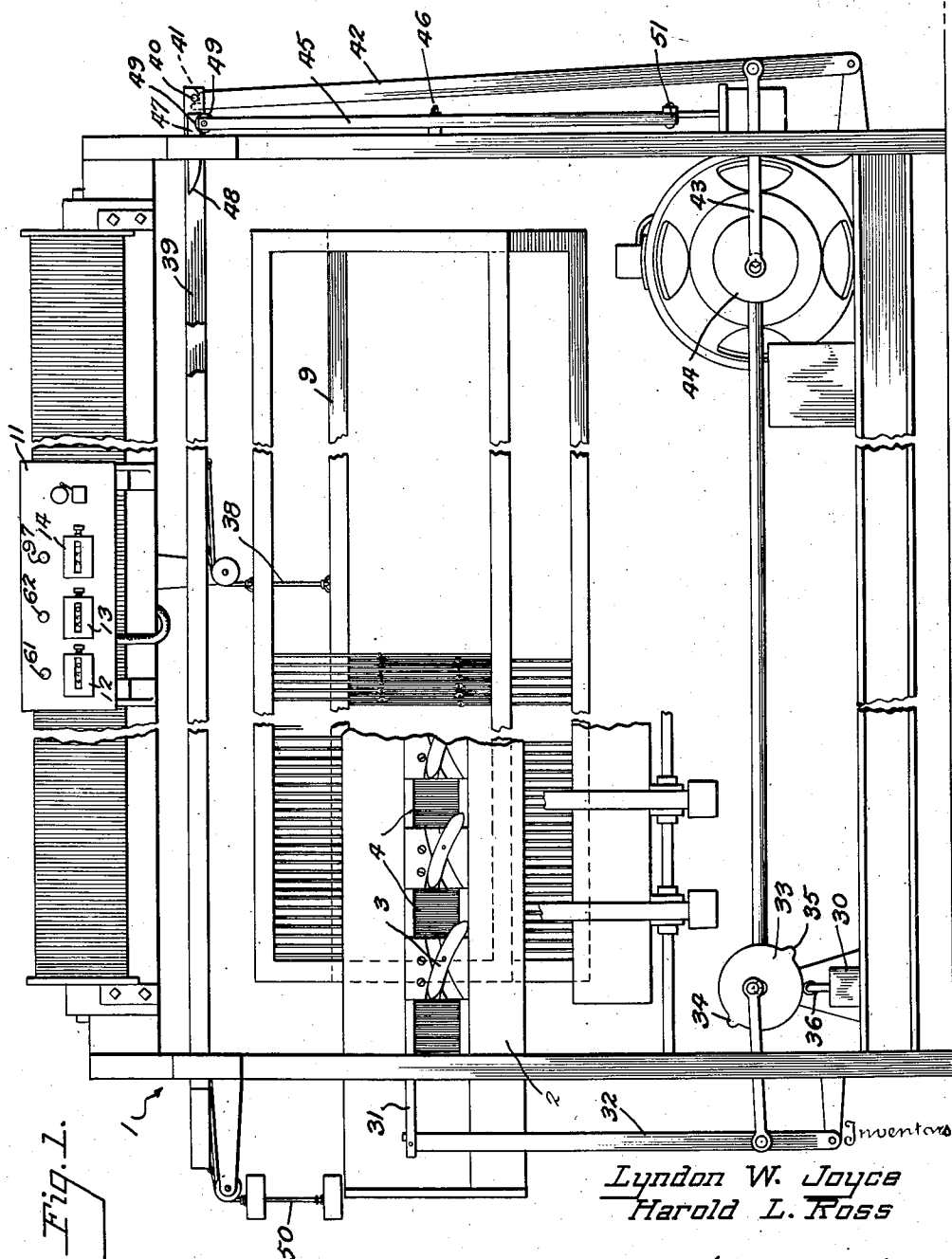
L. W. JOYCE ET AL.

2,131,706

CONTROL SYSTEM FOR LOOMS

Filed Oct. 25, 1937

5 Sheets--Sheet 1



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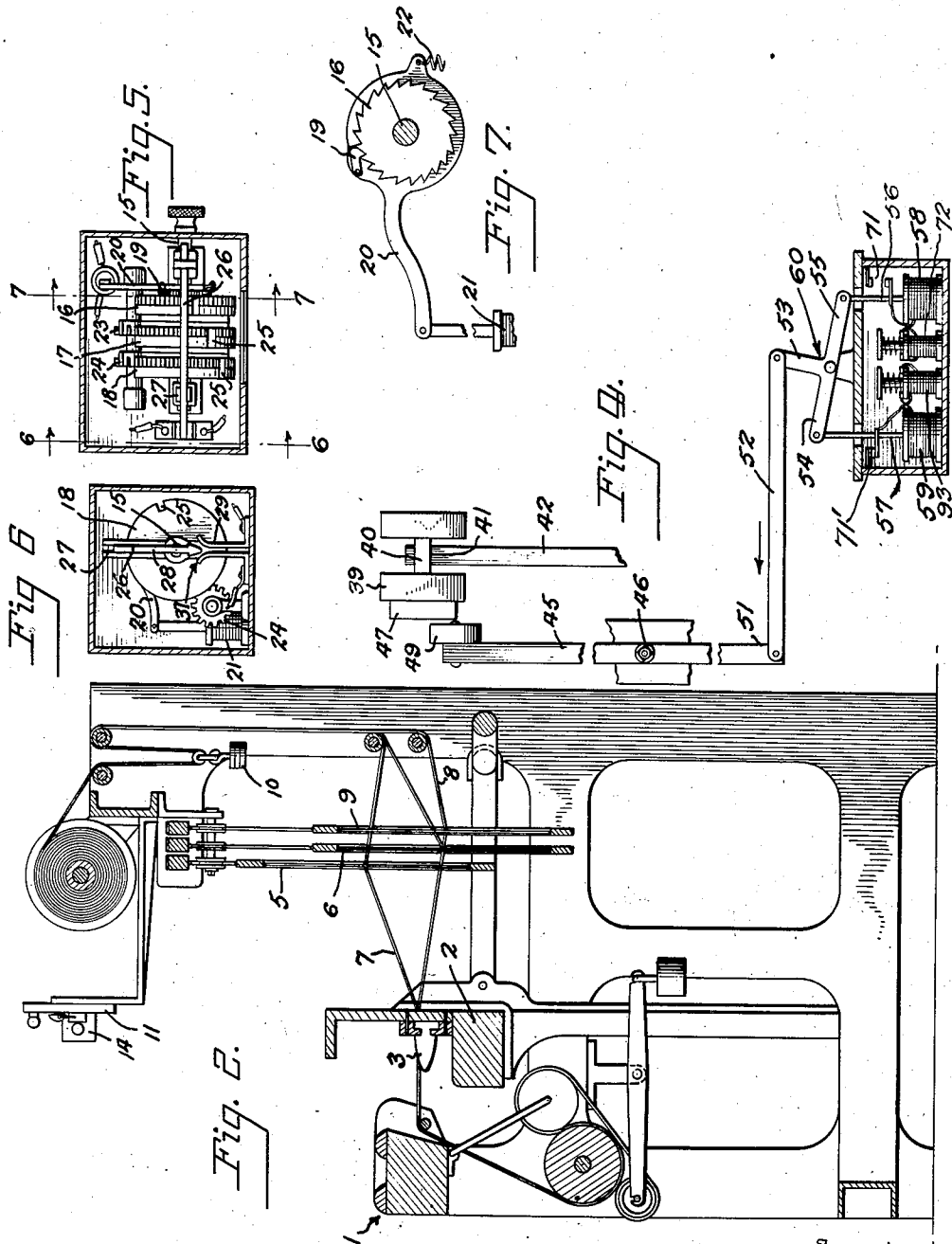
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5 Sheets-Sheet 2



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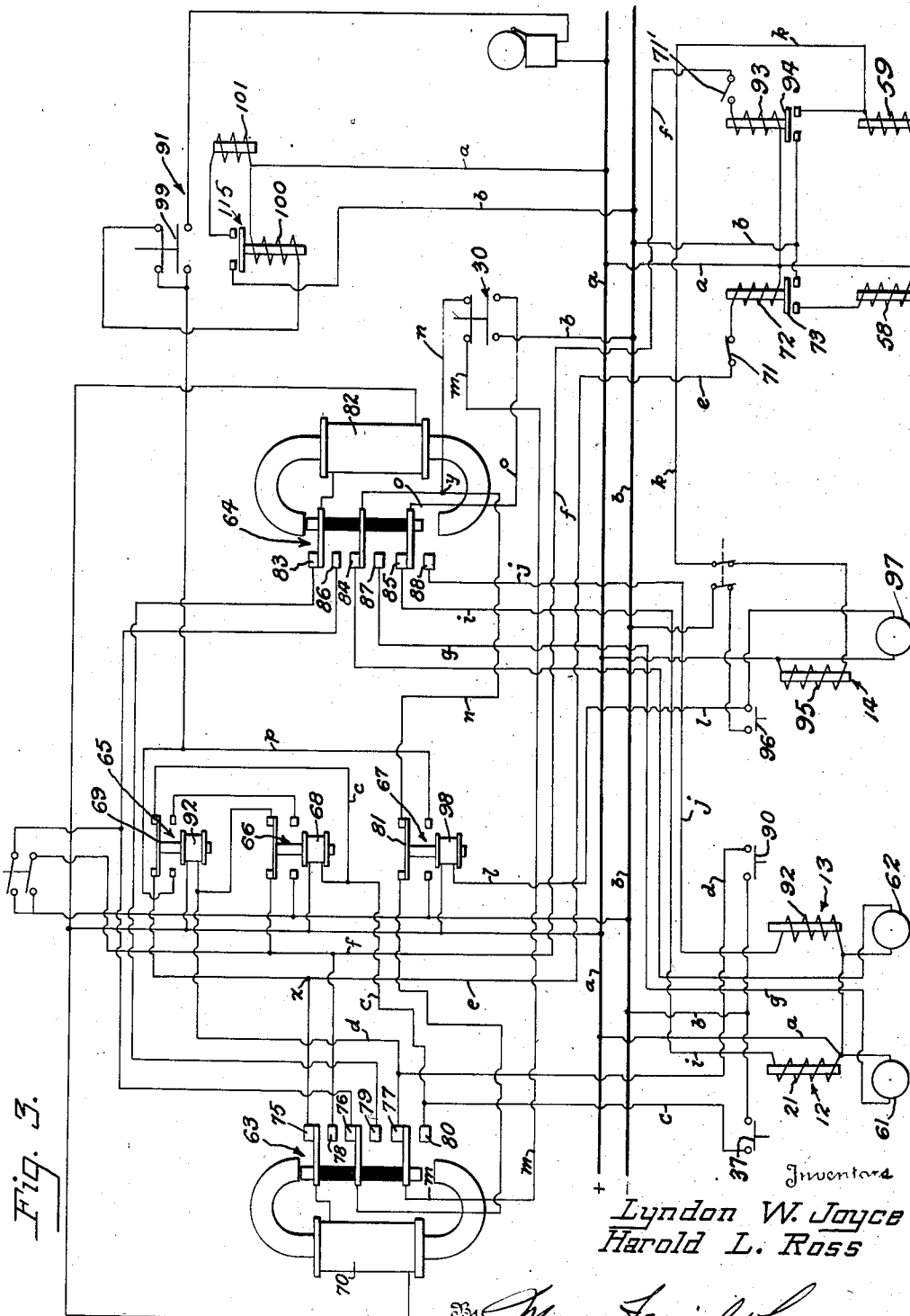
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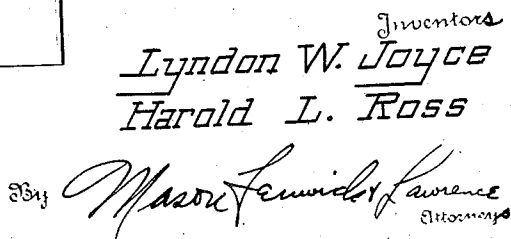
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5 Sheets-Sheet 4



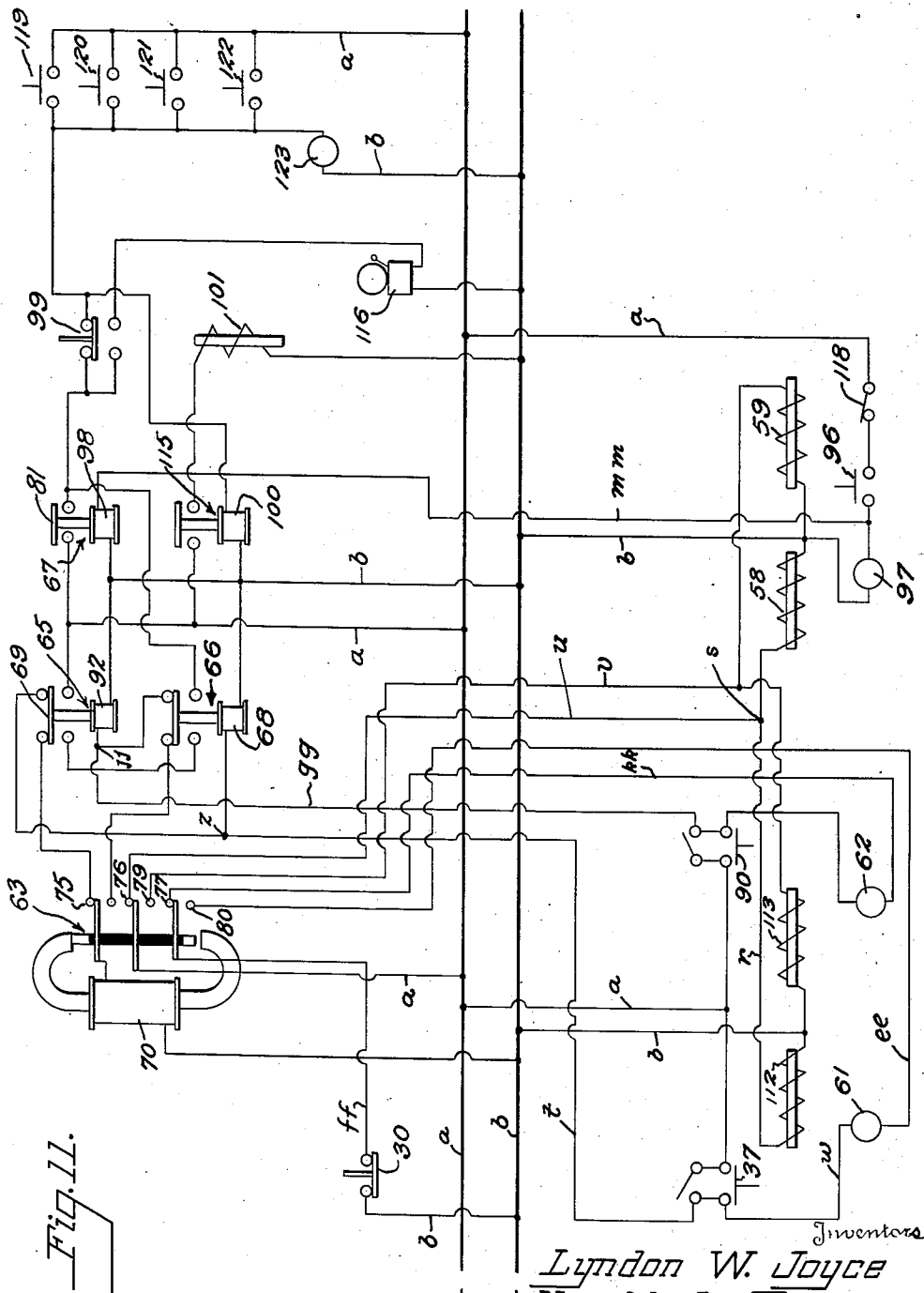
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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,131,706

CONTROL SYSTEM FOR LOOMS

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14 Claims. (Cl. 139—1)

This invention relates to the electrical control of the operative sequences of a loom, for causing it automatically to periodically and alternately vary the character of the weaving, and at the will of the operator, to change the duration of the periods of operation which determine the linear extent of the variations.

In the exemplary embodiment of the invention as described and illustrated in this application for patent, the loom produces the variations in the character of the weaving through the instrumentality of a normal warp and an auxiliary warp, the latter being brought alternately into and out of the weaving plane of the normal warp and held in either position for a period of weaving determined by the number of weft courses or picks required to produce a section of one kind or pattern of weaving.

One of the objects of the invention is to control the duration of the active and inactive periods of the auxiliary warp electrically by alternately actuated switches respectively controlled by counting devices, one concerned with counting the picks when both the normal and auxiliary warps are engaged in the weaving, the other when the normal warp only is so engaged, the counting devices being settable to respond, after the execution of any number of determined picks, to close one or the other of said switches thereby actuating mechanism for shifting the auxiliary warp from one position to the other with respect to the normal warp.

It is obvious that any number of picks may be made of one style of weaving up to and into the thousands if desired, which would be impractical in view of its unwieldiness with the use of a card chain control system.

Another object of the invention is the provision of an electrical system including the switches which are associated with the respective pick-counting devices, including relays suitably arranged to respond to the closing of either of the pick-counting device switches for establishing electrical paths that will cause an immediate operation of the other pick-counting device and the eventual re-operation of the first pick-counting device after the second pick-counting device has completed its determined number of counts and closed the switch which it actuates.

A further object of the invention is to provide in the electrical system as described above, circuit arrangement which will flash a signal after one of the pick-counting devices has fulfilled its counting of the determined number of picks, and while the other is counting, indicating that

the first pick-counting device is awaiting to be set either to the same or a different number of picks according to the desire of the operator, in readiness for the resumption of its phase in the cycle of operation of the loom.

Still another object of the invention is the provision of a cycle counter and a stop motion element for the loom, electrically controlled so that the cycle counter counts once for each complete alternation of said warp-shifting mechanism, until the predetermined number of cycles for which it was set has been realized, at the end of which period, a switch mechanically actuated by said cycle counter closes cutting off the motive power of the loom and simultaneously operating a signal indicating the source of the interruption.

In the present exemplary embodiment of the invention, the fabric is cut into units, each comprising two integral sections, one of each type of weaving in consequence of which the cycle counter is useful as a production counter and will be hereinafter referred to as such throughout the specification and claims.

Other objects of the invention will appear as the preferred and practical embodiment thereof proceeds.

In the drawings which accompany and form a part of the specification and throughout the several figures of which the same characters of reference have been employed to designate identical parts:

Figure 1 is a front elevation of a loom with an electrical control, combined according to the principles of the present invention;

Figure 2 is a cross section through the loom;

Figure 3 is a layout, largely diagrammatic of the electrical system through which the operative sequences of the loom are controlled;

Figure 4 is a view in detail of the means for bringing the auxiliary warp into and out of operative position with respect to the normal warp;

Figure 5 is a plan view of a pick counter;

Figure 6 is a cross section taken along the line 6—6 of Figure 5;

Figure 7 is a cross section taken along the line 7—7 of Figure 5.

Figure 8 is a plan view somewhat diagrammatic of a modified form of the invention in which the pick counters are mechanically actuated and electrically shifted;

Figure 9 is a section taken along the line 9—9 of Figure 8;

Figure 10 is a view in elevation partly in section showing a variant of the invention in which

the production counter is mechanically actuated; and

Figure 11 is a diagram of a simplified electrical system made possible by the substitution of mechanical functions indicated in Figures 8 to 10, inclusive, for the corresponding electrical functions described in connection with the first disclosed embodiment of the invention.

Referring now in detail to the several figures and first adverting to the loom 1 as illustrated in Figures 1 and 2, this is basically a narrow fabric loom having the breast beam 2, which carries a plurality of simultaneously actuated oscillating shuttles 3, the spaces between which shuttles are obstructed by grids 4 of vertical rods or wires for beating up the fabric. The normal warp 7, it will be understood, is separated into a plurality of portions, the threads of which pass through the spaces between the wires of the respective grids. In Figure 2, it will be observed that the threads of the normal warp are separated by two oppositely vertically reciprocating harness frames 5 and 6.

Insofar as the loom has been sketchily described, up to this point, it is conventional and old. The present invention provides an auxiliary warp 8 carried by a harness auxiliary frame 9 and adapted to be brought into or moved out of operative relation to the normal warp by the vertical reciprocatory movements of the auxiliary frame. Figure 2 shows the auxiliary warp 8 in its lowermost position and it will be understood that the frame 9 rises to the height of the frame 5 in the position shown in Figure 2, carrying the auxiliary warp up to the plane of the warp threads of the frame 5.

Let it be assumed for the purpose of the present description that the normal warp threads are of cotton while the auxiliary warp is of strands of covered rubber yarn maintained under tension by means such as the weight 10. When the auxiliary warp is out, the woven web is altogether of cotton. When the auxiliary warp is in, the webbing is elastic. The product of the loom therefore is a narrow webbing having integrally woven sections of inelastic and elastic material.

It is contemplated in connection with the present invention that the inelastic and elastic sections will be of considerable length, each involving several hundred weft courses or picks and that the webbing will be made in continuous strips having alternate inelastic and elastic sections. It is conceivable that such webbing could be made through a chain card pattern, but it will be obvious to those skilled in the art that in order to reproduce several picks of different type of weaving would require an inordinate number of cards. The present invention proposes to control the making of the alternate different sections by pick-counting devices, themselves electrically or mechanically actuated and which in turn electrically effect the sequences of operation of the loom. It also proposes the provision of means for varying the number of picks in the alternately different sections at will, and during the operation of the loom.

Before proceeding with the description of the controlling instrumentalities and the electrical system appurtenant thereto, it may be stated that the type of loom and the nature of the fabric as specifically described has been chosen in order to present the invention in the simplest possible manner, it being understood that a larger number of auxiliary warps may be employed, the material may be of wide instead of narrow fabric,

and the auxiliary warp may be of other thread than covered rubber, and still be within the purview of the invention as claimed.

Referring to Figure 1, a panel 11 is observed on which are mounted pick-counting devices 12 and 13 and a counter 14 which at the present moment may be ignored. The counting device 12 counts the picks or weft courses that are made when only the normal warp is in weaving position while the counting device 13 counts the picks made while the auxiliary or rubber warp is in weaving position in conjunction with the normal warp. No invention insofar as the structure of the counting devices per se, is attributed to the present invention. The counting devices 12 and 13 may both be alike and have the structural elements shown in Figures 5, 6 and 7, or their equivalents. In these figures, the shaft 15 is shown having frictionally or loosely mounted thereupon, and in frictional contact, a plurality of disks 16, 17 and 18, one for each digit. There may be three or more disks according to the capacity of the counting devices. In the present illustration, there are three and the capacity of the counting device would be 999. The units disk 16 is actuated by means such as the pawl 19 on an arm 20 which is actuated by a solenoid 21 and retracted by a spring 22. The other disks are temporarily held against rotation by the conventional gears 23 and 24 with interrupted teeth and when the units disk has made a complete revolution it picks up the tens disk 17 and carries it a distance equal to the value of one ten whereupon the hundreds disk is again locked until the units disk make another revolution. In the same manner the hundreds disk 18 is picked up and rotated.

Each of the disks has a transverse slot 25 and when the disks are all in zero position the three slots 25 are in alignment. A rod 26 rests lightly across the peripheral faces of the disks as illustrated in Figure 6, said rod being maintained parallel to the axis of the shaft 15 by suitable means such as the bifurcated post 27 between the limbs of which the rod 26 can reciprocate. On one end of the rod is a switch contact 28 adapted to close with a complementary switch contact 29, the two constituting the switch 31. The rod 26 cannot fall so as to close the switch contacts 28 and 29 while it rests upon the peripheral faces of the disks 16, 17 and 18, but when the disks are in alignment, that is to say, in zero position, the rod drops into the aligned slots 25 closing the switch contacts.

The solenoid 21 which transmits the mechanical counting impulses to the pick-counting device is in circuit with a switch 30, see Figure 1, which closes once with each passage of the shuttles. Figure 1 shows that the shuttle-actuating rack bar 31 is reciprocated back and forth by a pitman 32 on a crank wheel 33 which has cam projections 34 and 35 making contact with the plunger 36 which is connected to the movable member of the pick switch 30. The counting devices shown are of the type which may be set to indicate the determined number of picks that are to be woven and will work back to zero, so that when the zero position is reached a length of fabric has been woven that has been determined by the setting of the pick-counting device.

Supposing for example that the pick-counting device 12 which counts the number of picks for only the normal warp is set for 640 as shown in Figure 1, it will go back one digit for each passage of the shuttle until zero is reached whereupon the rod 26 will fall, closing the switch 31. This

immediately brings the auxiliary warp into operative position with respect to the normal warp. It does so through the following train of mechanism: Figure 1 shows that the frame 9 which carries the auxiliary warp 8 is raised and lowered through means such as the cable 38 attached to the horizontally reciprocating bar 39, the end of which has a pin 40 which rests in a rabbet 41 in the upper end of the reciprocating pitman 42. The said pitman constantly oscillates by means of an arm 43 on a crank 44 which rotates once for every complete back and forth passage of the shuttles. Since the frame 9 is active only when the auxiliary warp is in operative position, means are provided for throwing the bar 39 out of engagement with the pitman 42 when it is desired that the frame 9 shall be inactive and for throwing it into operative engagement with the pitman 42 when it is desired to incorporate the auxiliary warp into the weaving. The connecting and disconnecting means comprises a swinging lever 45 pivotally mounted at an intermediate point 46 on the frame of the loom and oscillatable in a plane at right angles to the direction of reciprocation of the bar 39. On its front the bar 39 has a cam 47 which is less than the length of the amplitude of reciprocation of the bar 39 having a pointed end 48. The upper end of the lever 45 has an anti-friction roller 49, the height of the roller being such that when the bar 39 is in the position shown in Figure 1, retracted to its fullest extent through the weight 50, the roller 49 is in front of the cam above the level of the lower face thereof, but out of contact therewith, the pin 40 being then seated in the rabbet 41. The bar 39 under these conditions is reciprocated by the pitman 42 and synchronously therewith.

The lower end 51 of the lever 45 is connected by means such as the link 52 with the middle arm 53 of a double bell crank lever 60 having lateral arms 54 and 55. To each of these lateral arms is pivotally connected an armature 56 and 57 respectively attracted by the respective solenoids 58 and 59. In the position of the parts shown in Figure 4, both the normal warp and the auxiliary warp are involved in the weaving. The switch 37 of the pick-counting device 13 is in circuit with the winding of the solenoid 58 so that when the switch 37 closes at the completion of the number of picks for which the pick-counting device 13 was set, the solenoid 58 is energized, pulling down the armature 57 and rocking the double rocking lever to the opposite position, throwing the link 52 backwards in the direction of the arrow and pushing the roller 49 into contact with the cam 47. When the bar 39 is reciprocated to the right as viewed in Figure 1, the switch 37 closes and the action described takes place so that cam 47 rides on the roller 49 and disengages the pin from the rabbet 41, breaking the connection between the bar 39 and the pitman 42 so that the bar no longer reciprocates, but remains inactive in its extreme leftward position until the double rocking lever is again reversed. When this next reversal takes place which will be after the counting device 12 has returned to zero position and the normal warp section of the fabric has been woven, the solenoid 58 which is closed by the switch 37 of the pick-counting device 12 has been energized and the double rocking lever again tilted to the position illustrated in Figure 4.

Immediately after the shift has been made in the operation of the loom from the section of fabric in which only the normal warp was employed to that section in which the auxiliary

warp was incorporated, the pick-counting device 12 associated with the weaving of the normal warp section is ready for resetting and may be set any time during the operation of the pick-counting device 13. In order to attract the attention of the operator to the fact that the pick-counting device should be reset, a pilot lamp 61 is provided which flashes with each movement of the breast beam during the entire time that the pick-counting device 13 is in operation, or as much of said time as elapses up to the point at which the pick-counting device 12 is reset. Likewise, the pick-counting device 13 which is associated with the incorporation of the auxiliary warp into the weaving has the pilot light 62 which flashes during the operation of the pick-counting device 12 indicating that the pick-counting device 13 needs resetting.

At this time it becomes necessary to refer to the electrical diagram of Figure 3 in which the pick-counting devices 12 and 13 are shown near the bottom left hand end of the sheet, and in which the pick switch 30 has an armature which oscillates between lower and upper pairs of contacts. While the weaving is being done with the normal warp only, the solenoid 21 which actuates the pick-counting device 12 is energized each time the pick switch armature closes the lower pair of contacts.

Before attempting to trace the various circuits involved in the functioning of the electrical control system, attention is directed to the impulse switches 63 and 64 alternately actuated, each having an armature making simultaneous engagement with contacts of each of three pairs of contacts, and alternately with the other contacts of said pairs.

There are also three relays 65, 66 and 67 which accomplish essential shifts in the circuit paths, the relays 65 and 66 being concerned with the shift from one of the controlling pick-counting devices to the other, and the relay 67 being associated with the production counter 14 and the stop motion assembly, consisting of the switches 99 and 115 and the solenoid 101.

Assuming now that the normal warp only is being woven, the current which actuates the pick-counting device 12 may be traced from the line wire *a* through solenoid 21, wire *i*, contact 85 of the lowermost armature of impulse switch 64, wire *o*, armature of pick switch to line wire *b*. This circuit is opened and closed once for every pick, and the pick-counting device 12 is actuated accordingly.

When the determined number of picks has been made, the closing of the switch 37 has established the following circuits: From line wire *b* through switch 37, wire *c*, through coil of relay 66, (this shifting the armature of said relay from upper to lower circuit closing position). At the same time the current passes by way of the wire *c* through the armature of relay 65, the point *x*, contact 75, through upper armature of impulse switch 63, energizing the coil 70 of said impulse switch, immediately causing all three armatures to close with the contacts 78, 79 and 80 and to break with the contacts 75, 76 and 77. At the same time also, current passes from point *x* through wire *e*, through the mechanically closed switch 71, and solenoid 72 of the relay switch 73 which in turn closes a circuit by way of the line wires *a* and *b* through the coil 58 which actuates the rocking bell crank lever 69 of the shifter.

All the above functions have transpired during

the single instant of closure of the pick switch 30.

On the very next closing movement the pick switch 30 opens lower contact and upon closing upper contact, current passes from the line wire *b*, switch 37, wire *c*, contact 80, wire *m*, pick switch 30 (upper position), wire *n* to point *y*, then through armature of relay 67 (in upper position) through the middle armature of impulse switch 63 in its lower position, contact 79, to upper armature of impulse switch 64, energizing the solenoid 82, throwing all of the armatures of impulse switch 64 to their lower positions, then passing through the middle armature of impulse switch 64, through contact 87, wire *g* to indicator lamp 61.

The moving of the lowermost armature of the impulse switch 64 to its lower position prepares the path for the passage of the current to the solenoid of the pick-counting device 13, so that on the next downward closing movement of the pick switch, the current passes from line wire *b*, through armature of pick switch 30, wire *o*, contact 88, wire *j*, through solenoid 92 of the pick-counting device 13 to line wire *a*.

Now the pick-counting device 13 begins to count and every time the pick switch breaks with the upper pick switch contacts, the lamp 61 associated with the pick-counting device 12 blinks.

The operator may reset the pick-counting device 12 at any time while this lamp is flashing. Resetting of said pick-counting device opens the mechanically operated switch 37. This breaks the circuit through the coil of relay 66 which has been holding down the armature of said relay, and breaks the circuit of the signal lamp 61, permanently extinguishing it. The lamp 61 is lighted by the closing of the following circuit: Line *b*, the switch 37, wires *c*, contact 80, wire *m*, upper contact 30, wire *n*, point *y*, contact 87, wire *g*, to lamp 61 to line *a*. When the predetermined number of picks involving the auxiliary warp have been reached on the pick-counting device 13, the switch 90 is closed mechanically. This completes a circuit which may be traced from line wire *b*, switch 90, wire *d*, solenoid 92 of relay 65, causing the armature of said relay to break its upper contacts and close its down contacts. The current passes also through the armature of relay 66 in its upper position, to contact 78 of impulse switch 63, passing through the upper armature of said impulse switch which is then in its down position, energizing the solenoid 70 of said impulse switch, reversing the position of all the armatures of said switch. At the same time, the circuit passes by way of wire *f* through the mechanically closed switch 71' of the shifter energizing the solenoid 93, causing the relay armature 94 to close the circuit which includes the line wires *a* and *b*, through the shifter solenoid rocking the bell crank lever 60 in the opposite direction, cutting out the auxiliary warp from the weaving.

A wire *k* tapped into the circuit of the shifter solenoid carries current to the solenoid 95 of the production counter 14, which solenoid is grounded to the line wire *a*. This registers one count on the production counter every time the solenoid 59 is energized. Since the production counter operates solely in response to the solenoid 59, it registers only once for a complete unit of weaving.

When the production counter has reached the

limit to which it is set, it automatically stops the loom. This it does by mechanically closing the switch 96 in the same or similar manner to that of the pick-counting devices 12 and 13. Closing the switch 96 establishes a circuit from the line wire *b* through switch 96, lamp 97, to line wire *a*. At the same time current passes from the line wire *b*, switch 96, wire *l* to solenoid 98 of relay 67. This shifts the relay armature closing the circuit from line wire *b* through the lower contacts of relay 67, through wire *p*, through the normally closed contacts of the limit switch 99 energizing relay coil 100, closing a circuit including the line wires *a* and *b* through the stop motion solenoid 101 which operates a shifter rod or other means not shown to disengage clutch of the motor which operates the loom, thus stopping the loom.

Should the switch 37 be closed by reason of counter 12 completing its number of pick counts and not being reset, it holds contacts of relay 66 in lower position energizing the solenoid 68, through the following circuit: Wire *b*, switch 37, wire *c*, solenoid 68, wire *a*. If the switch 90 closes before switch 37 is opened manually by resetting the counter 12, a circuit is closed through line *b*, switch 90, wire *d*, solenoid 92 of the relay 65, line *a*. Thus relays 65 and 66 are both in lower position and the circuit is closed through line *b*, lower contact of relay 66, lower contact 65, wire *p*, switch 99, relay 115, solenoid 101, to the line *a*, thus stopping the loom. The pilot lamp 61 remains lighted and no shifting takes place. Upon resetting the counter 12, switch 37 opens, allowing the relay 66 to rise closing the circuit which actuates the armature of the switch 63, shifting contact of the switch 64 and sets the loom for operation of the counter 12.

In a narrow fabric loom such as that illustrated in the present application, since a number of units are simultaneously woven the production counter is pre-set to a number which is the quotient of the number of units desired to be made divided by the number of units which are made simultaneously, and the loom will automatically stop just as soon as the desired number of units has been woven, at the same time flashing a continuous signal to the effect that the weaving has been completed and the loom is at a standstill. The invention is of course not limited to the weaving of narrow fabrics.

In that form of the invention illustrated in the group of Figures 8 to 11, inclusive, the counting function of both pick counters and the production counter is performed by means entirely mechanical. The numeral 102 represents a shaft in the loom-driving mechanism suitably geared to a cam shaft 103 which operates the pick counters. The shaft 103 has a flat portion 104 forming a guide for an axially movable sleeve 108.

The sleeve carries a cam 105, see particularly Figure 9, having a curved tread 106 and an abrupt shoulder 107. The pick counter (12 or 13) has an arm 109 carrying an anti-friction roller 110 which rides on the tread 106 of the cam and by means of which the arm 109 is elevated. The arm may be associated with a pawl and ratchet movement such as that shown in Figure 7. When the roller falls from the shoulder 107, the arm descends causing the pawl to pull the mechanism through an angle causing the registration of one unit. The cam 105 is shown as being arranged to alternately serve

either pick counters 12 or 13. This is accomplished by sliding the sleeve until the cam underlies either of the arms 109 or 109' associated with the respective pick counters.

5 The sliding movement is accomplished by the reciprocation of an armature between two alternately energized solenoids 112 and 113. These solenoids do not find their functional counterpart in the form of the invention described in

10 Figures 1 to 7, inclusive.
Referring to the electrical diagram of Figure 11, those parts which bear the same reference characters as in Figure 3 are the same and do not need to be re-described.

15 It being understood that pick counter 12 is now counting the picks mechanically, a circuit is already closed through the cam shifting solenoid 112, the circuit path being from the line b, solenoid 112, wire r to point s, thence to contact 76 of impulse switch 63, the armatures of which are then in the upper position to the line a. The solenoid 112 is holding the cam in operative relation to the arm 109 of the pick counter 12.

20 At the same time a circuit is closed through the solenoid 58 of the shifter lever 60, the circuit path being from line b through solenoid 58 to point s to contact 76 to line wire a. This holds the auxiliary warp frame in action.

25 When the pick counter 12 has counted the full number of picks for which it was set, the mechanical switch 37 closes. This makes a circuit which actuates the impulse switch 63, dropping the armatures of said impulse switch to their lower contact positions. This action breaks the circuit through solenoid 112 of the pick counter 12 and the shifter solenoid 58 and closes a circuit through the solenoid 113 which shifts the cam to the pick counter 13; and also closes the circuit through the shifter solenoid 59 moving the auxiliary warp frame out of operative position. These circuits may be traced as follows: upon closing of the mechanical switch 37, current passes from line a through switch 37, wire t, upper contacts bridged by armatures 69 of relay 65, contact 75 of impulse switch 63 to solenoid 70 of said switch, energizing the latter and throwing down the three armatures of said impulse switch. The middle armature shifts from contact 75 to contact 79 breaking the circuits previously described, through solenoids 112 and 58 and closing the following circuits, from line b through solenoid 113, wire v, contact 79 to line a; also from line b, through solenoid 59, wire v, contact 79, to line a.

30 Closing of the switch 37 has also established a circuit from line a, switch 37, wire t, to the point z to the solenoid 68 of relay 66 pulling the armature of said relay down to lower contact position, thence to line b. This position of the armature of relay 66 will be useful in the event that one neglects timely resetting of the pick counter 12.

35 Simultaneously with the circuit shifts just described, closure of the mechanical switch 37 has established a circuit through the lamp 61 as follows: from line a, through switch 37, wire w, lamp 61, wire ee, contact 80 of impulse switch through wire ff, pick switch 39 to line b. Inasmuch as the pick switch is opening for each pick count, the lamp 61 of pick counter 12 blinks while the pick counter 13 is operating, indicating that the pick counter 12 needs resetting.

40 When the pick counter 13 has counted its quota of picks, the mechanical switch 99 closes, and, assuming that the switch 37 has been mechanically opened by resetting the pick counter 12, the

armatures of the impulse switch 63 will move to the upper contact positions, circuits through solenoids 113 and 59 will be opened and circuits through solenoids 112 and 58 will be again closed. The circuit through lamp 61 was broken when the switch 37 was opened in the resetting of the pick counter 12 and the circuit through lamp 62 which is associated with pick counter 13 will be established when the counting functions are shifted from pick counter 13 to pick counter 12. The circuits established by the closing of the mechanical switch 90 are as follows: from line a through mechanical switch 90, wire gg, solenoid 92 of relay 65, pulling the armature down bridging the lower contacts. Simultaneously, a circuit passes by way of wire gg to the point jj and through the upper contacts bridged by the armature of relay 66, (assuming that the switch 37 has been reset and the previously closed circuit through the solenoid 68 of relay 66 has been opened), the current then passing to contact 76 of the impulse switch 63 energizing solenoid 70, said impulse switch lifting all of the armatures of said switch to their upper contact position. At the same time another circuit is closed from line b through the solenoid 112, wire u to contact 76 to line a. A circuit is also closed from line b, to solenoid 58 to point s, to contact 76, to line a. At the same time a circuit is closed from line a through switch 90, lamp 62, wire kk, contact 77, pick switch 39 to line b. Thus lamp 62 will blink while the pick counter is operating, until the pick counter 13 is reset, which resetting operation opens the switch 90.

35 Should the switch 37 remain closed by reason of the pick counter 12 completing its number of pick counts without being reset, it holds the armature of relay 66 in its low contact position. If the switch 90 closes before the switch 37 is opened manually by resetting the pick counter 12, a circuit is closed through line a, lower contacts of relay 65, lower contacts of relay 66, limit switch 99, solenoid 130 of relay 115, to line b. This pulls down the armature of relay 115, closing a circuit from line a through armature of relay 115 through solenoid 101 of stop motion switch and to line b. Under such a condition, that is, where both of the mechanical switches 37 and 90 are closed which means that both pick counters have operated to the limit of their setting without either having been reset, the loom stops. A bell 116 is shown in circuit with a limit switch 99 so that if desired, the limit switch can be manually pushed to its low contact position in which the aforementioned functions will be performed and in addition an alarm will ring indicating that the loom has ceased operating.

45 Reverting once again to the mechanical group, Figures 8 to 10, inclusive, the production counter is seen at 117 supported by a stationary frame member and having its arm 109 with anti-friction roller 110 engaging the lever 45 which oscillates with the rocking lever 60 of the shifter mechanism. Since it is assumed that the inner works of the production counter are similar to those illustrated in Figures 5, 6 and 7 in connection with the pick counters, it is obvious that the production counter operates once only on each complete oscillation of the shifter mechanism. This is as it should be, for one unit of production is considered to be one section of inelastic webbing and the adjacent section of elastic webbing.

50 Referring now to the electrical diagram, Figure 11, the switch 96 closes mechanically when the

production counter reaches the limit of counts for which it was set. When this switch closes a circuit is closed from line *a* through switch 96, wire *mm*, to solenoid 98 of relay 67, to line *b*.
 5 Energization of the solenoid 98 pulls down the armature 81 of the relay 67 closing a circuit through which current flows by way of the line *a*, armature 81, limit switch 99, solenoid 100 of relay 115, to line *b*. This pulls down the arma-
 10 ture of the relay 115 closing contacts which establish a circuit from line *a* through armature of the relay 115, through stop motion solenoid 101 to line *b*. This stops the loom. Closing of the switch 96 also establishes a circuit from line *a*,
 15 through switch 96, lamp 97, to line *b*. Thus a visual indication is given that the loom has stopped moving which continues until an attendant takes notice and opens a switch 118.

From time to time in the operation of a loom, a warp thread may break or run out, necessitating stopping of the loom until the thread can be replaced or tied, and if the discontinuity of the yarn is not immediately noticed, the weaving may run on, producing an imperfection.

25 The present invention as illustrated in Figure 11 provides for automatic stopping of the loom upon breaking of the thread. In the electrical diagram, four switches are shown, 119, 120, 121 and 122 in parallel between the lines *a* and *b*.
 30 Each of these switches serves an entire loom, being held open by any desired mechanical means which releases when the yarn in the warp on the loom breaks, permitting the switch to close. Closing of any one of the switches produces a
 35 current through line *a*, the closed switch, the solenoid 100 of the relay 115, closing the circuit which includes the stop motion solenoid 101 of the loom. A lamp 123 is in shunt between the line *b* and one side of the switch circuit which glows when
 40 any one of the switches 119 to 122, inclusive, is closed.

The controlling of the lengths of the differentiated fabric sections by means of pick-counting devices provides an efficient and flexible controlling mechanism, permitting a great number
 45 of picks to be made in each section, avoiding bulky card chains and like expedients, and giving the operator the opportunity throughout the weaving to vary to any extent desired the lengths of
 50 the sections.

For the sake of simplicity the invention has been described in connection with a loom which weaves alternate differentiating sections. It is to be understood however that the principle of the
 55 invention can be carried out with a greater number of pick-counting devices than two for the continuous weaving of fabric in which the repeated unit consists of more than two sections.

While we have in the above description defined what we believe to be preferred and practical relationships in the arrangement and cooperation of the members of the control system, it will be understood to those skilled in the art that various
 60 changes in the arrangement and disposition of the physical instrumentalities are within the contemplation of the invention as the exigencies of future use may prescribe.

What we claim is:

70 1. In a loom of that type which weaves a continuous length of fabric with alternate sections, one incorporating a main warp only and the other the main warp and an auxiliary warp, main and auxiliary warp harnesses, the latter being alterna-
 75 tively shiftable to bring the auxiliary warp into

and out of the weaving plane of the main warp, alternately operating counting devices, respectively controlling the number of picks to be made in each section, actuating means therefor syn-
 5 chronized with the movements of the shuttle of the loom for registering the number of picks on one or the other of said counting devices, said counting devices being settable to predetermine the number of picks to be laid in each section, and means actuated by one pick-counting device
 10 when the number of picks for which it was set has been made, for shifting the operative connection of said counting device actuating means to the other counting device, and shifting the auxiliary warp harness into or out of operative rela-
 15 tion to the main warp harness.

2. In a loom of that type which weaves a continuous length of fabric with alternate sections, one incorporating a main warp only and the other the main warp together with an auxiliary
 20 warp, main and auxiliary warp harnesses, the latter being shiftable into and out of the weaving plane of the main warp, alternatively operating counting devices respectively controlling the number of picks to be made in each section,
 25 means actuating said counting devices responsive to the movements of the shuttle of the loom, said counting devices being settable to predetermine the number of picks to be laid in each section, a switch for each counting device closed thereby
 30 when the predetermined number of picks has been registered by said counting devices, said switches each closing the circuit which actuates the other counting device, an instrumentality for throwing said auxiliary warp harness into and out of op-
 35 erative position, circuits alternately closed by the closing of said pick-counting device switches for actuating said instrumentality to shift said auxiliary warp harness alternately into and out of
 40 operative position.

3. In a loom of that type which weaves a continuous length of fabric with alternate sections, one incorporating a main warp only and the other the main warp together with an auxiliary
 45 warp, main and auxiliary warp harnesses, the latter being shiftable into and out of the weaving plane of the main warp, alternatively operating counting devices, respectively controlling the number of picks to be made in each section,
 50 means actuating said counting devices responsive to the movements of the shuttle of the loom, said counting devices being settable to predetermine the number of picks to be laid in each section, a signal for each counting device indicating when
 55 it is out of operation, a switch for each counting device closed thereby when the predetermined number of picks has been registered by the respective counting devices, said switches each closing the circuit which actuates the other count-
 60 ing device, an instrumentality for throwing said auxiliary warp harness into and out of operative position, circuits alternately closed by the closing of said pick-counting device switches for actuating said instrumentality to shift said auxiliary
 65 warp harness alternately into and out of operative position, circuits closed by the respective switches putting out of action the counting device with which the switch is associated and putting the other counting device into action, and
 70 operating the signal of the non-operating counting device, indicating that it is in condition to be reset.

4. In a loom of that type which weaves a continuous length of fabric with alternate sections, 75

one incorporating a main warp only and the other the main warp together with an auxiliary warp, main and auxiliary warp harnesses, the latter being shiftable into and out of the weaving plane of the main warp, alternatively operating counting devices respectively controlling the number of picks to be made in each section, solenoids for actuating said counting devices, a pick switch opening and closing synchronously with the movements of the shuttle of the loom, interposed in common in the circuits of said solenoids, said counting devices being setttable to predetermine the number of picks to be laid in each section, a switch associated with each counting device, closed thereby when the predetermined number of picks has been registered by said counting device, said switches each closing the circuit which actuates the other counting device, an instrumentality for throwing said auxiliary warp harness into and out of operative position, and circuits closed by the closing of the switches associated with said counting devices for actuating said instrumentality to shift said auxiliary warp harness alternately into and out of operative position.

5. In a loom of that type which weaves a continuous length of fabric with alternate sections, one incorporating a main warp only and the other the main warp together with an auxiliary warp, main and auxiliary warp harnesses, the latter being shiftable into and out of the weaving plane of the main warp, alternatively operating counting devices respectively controlling the number of picks to be made in each section, solenoids for actuating said counting devices, a pick switch opening and closing synchronously with the movements of the shuttle of the loom, interposed in common in the circuits of said solenoids, said counting devices being setttable to predetermine the number of picks to be laid in each section, a switch associated with each counting device closed thereby when the predetermined number of picks has been registered by said counting device, said switches each closing the circuit which actuates the other counting device, auxiliary warp harness operating mechanism, comprising an arm moving synchronously with the shuttle of the loom, a bar connected to said auxiliary warp harness detachably engaged by said arm and moved thereby during the operative periods of said auxiliary warp harness, a shifter, including a solenoid rocked armature, means moved by said armature for tripping said bar out of engagement with said arm and permitting its return to position of engagement with said arm according to the position of said armature, and circuits alternatively closed by the closing of the switches associated with said counting devices for actuating said armature.

6. In a loom of that type which weaves a continuous length of fabric with alternate sections, one incorporating a main warp only and the other the main warp together with an auxiliary warp, main and auxiliary warp harnesses, the latter being shiftable into and out of the weaving plane of the main warp, alternatively operating counting devices respectively controlling the number of picks to be made in each section, solenoids for actuating said counting devices, a pick switch opening and closing synchronously with the movements of the shuttle of the loom, interposed in common in the circuits of said solenoids, said counting devices being setttable to predetermine the number of picks to be laid in each section,

a switch associated with each counting device closed thereby when the predetermined number of picks has been registered by said counting device, said switches each closing the circuit which actuates the other counting device, auxiliary warp harness operating mechanism, comprising an arm oscillating synchronously with the shuttle of the loom, a bar connected to said auxiliary warp harness detachably engaged by said arm and reciprocated thereby during the operative periods of said auxiliary warp harness, a cam on said bar, a shifter including a solenoid rocked armature, means moved by said armature into and out of the path of said cam for alternatively lifting said bar out of engagement with said arm, and permitting its return to position of engagement with said arm according to the position of said armature, and circuits alternatively closed by the closing of the switches as associated with the switches of said counting devices for actuating said armature.

7. In a loom of that type which weaves a continuous length of fabric with alternate sections, one incorporating a main warp only and the other the main warp together with an auxiliary warp, main and auxiliary warp harnesses, the latter being shiftable into and out of the weaving plane of the main warp, alternatively operating counting devices respectively controlling the number of picks to be made in each section, solenoids for actuating said counting devices, a signal for each counting device adapted to be activated during the periods of inactivity of the counting device with which it is associated, a pick switch having a movable member moving synchronously with the movements of the shuttle of the loom between opposite contacts, said pick switch when in one closed position being interposed in common in the circuits of said solenoids, and in the other closed position in common in the circuits of said signals, said counting devices being setttable to predetermine the number of picks to be laid in each section, a switch associated with each counting device and closed thereby when the predetermined number of picks has been registered by said counting device, said switches each closing the circuit which actuates the other counting device and the circuit which actuates the signal of its own counting device, auxiliary warp harness operating mechanism comprising an arm oscillating synchronously with the shuttle of the loom, a bar connected to said auxiliary warp harness detachably engaged by said arm and reciprocated thereby during the operative periods of said auxiliary warp harness, a shifter including a rocking lever, alternatively actuated solenoids for rocking said lever in opposite directions, a cam on said bar, and means moved by said rocking lever to positions of engagement or disengagement with said cam for lifting said bar out of engagement with said arm or returning it to engagement therewith, and circuits alternatively closed by the closing of the switches associated with the counting devices for actuating the solenoids.

8. In a loom of that type which weaves a continuous length of fabric with alternate sections, one incorporating a main warp only and the other the main warp together with an auxiliary warp, main and auxiliary warp harnesses, the latter being shiftable into and out of the weaving plane of the main warp, alternatively operating counting devices respectively controlling the number of picks to be made in each section, solenoids for actuating said counting devices, a signal for

each counting device adapted to be activated during the periods of inactivity of the counting device with which it is associated, to indicate that the counting device is ready to be reset, a pick switch having a movable member moving synchronously with the movements of the shuttle of the loom between opposite contacts, said pick switch when in one closed position being interposed in common in the circuits of said solenoids, and in the other closed position in common in the circuits of said signals, said counting devices being settable to predetermine the number of picks to be laid in each section, a switch associated with each counting device and mechanically closed thereby when the predetermined number of picks has been registered by said counting device, said switches each closing the circuit which actuates the other counting device and the circuit which actuates the signal of its own counting device, auxiliary warp harness operating mechanism comprising an arm oscillating synchronously with the shuttle of the loom, a bar connected to said auxiliary warp harness detachably engaged by said arm and reciprocated thereby during the operative periods of said auxiliary warp harness, a shifter including a rocking lever, alternatively actuated solenoids for rocking said lever in opposite directions, a cam on said bar, and means moved by said rocking lever to positions of engagement or disengagement with said cam for lifting said bar out of engagement with said arm or returning it to engagement therewith, and circuits alternatively closed by the closing of the switches associated with the counting devices for actuating the solenoids, the resetting of either of the counting device switches opening the signal circuit of the corresponding counting device.

9. In a loom of that type which weaves a continuous length of fabric with alternate sections, one incorporating a main warp only and the other the main warp together with an auxiliary warp, main and auxiliary warp harnesses, the latter being shiftable into and out of the weaving plane of the main warp, alternatively operating counting devices respectively controlling the number of picks to be made in each section, solenoids for actuating said counting devices, a pick switch opening and closing synchronously with the movements of the shuttle of the loom, interposed in common in the circuits of said solenoids, said counting devices being settable to predetermine the number of picks to be laid in each section, a switch associated with each counting device and closed thereby when the predetermined number of picks has been registered by said counting device, said switches each closing the circuits which actuates the other counting device, auxiliary warp harness operating mechanism comprising an arm oscillating synchronously with the shuttle of the loom, a bar connected to said auxiliary warp harness detachably engaged by said arm and reciprocated thereby during the operative periods of said auxiliary warp harness, a shifter including a rocking lever, alternatively actuated solenoids for rocking said lever in opposite directions, relay switches closing circuits for energizing said solenoids, a cam on said bar, and means moved by said rocking lever to positions of engagement or disengagement with said cam for lifting said bar out of engagement therewith, and circuits alternatively closed by the closing of the switches associated with the counting devices for actuating one or the other of said shifter solenoids, said lever when rocked, mechanically opening the relay switch of the circuit of the solenoid which rocked it, and mechanically closing the relay switch of the circuit of the solenoid which shall next rock it, the resetting of either of the counting device switches opening the signal circuit of the corresponding counting device.

associated with the counting devices for actuating one or the other of said relay switches for causing the energization of one or the other of said shifter solenoids, said lever when rocked mechanically, opening the relay switch of the circuit of the solenoid which rocked it, and mechanically closing the relay switch of the circuit of the solenoid which shall next rock it.

10. In a loom of that type which weaves a continuous length of fabric with alternate sections, one incorporating a main warp only and the other the main warp together with an auxiliary warp, main and auxiliary warp harnesses, the latter being shiftable into and out of the weaving plane of the main warp, alternatively operating counting devices respectively controlling the number of picks to be made in each section, solenoids for actuating said counting devices, a signal for each counting device adapted to be activated during the periods of inactivity of the counting device with which it is associated to indicate that the counting device is ready to be reset, a pick switch having a movable member moving synchronously with the movements of the shuttle of the loom, between opposite contacts, said pick switch when in one closed position being interposed in common in the circuits of said solenoids, and in the other closed position in common with the circuits of said signals, said counting device being settable to predetermine the number of picks to be laid in each section, a switch associated with each counting device and mechanically closed thereby when the predetermined number of picks has been registered by said counting device, said switches each closing the circuit which actuates the other counting device and the circuit which actuates the signal of its own counting device, auxiliary warp harness operating mechanism comprising an arm oscillating synchronously with the shuttle of the loom, a bar connected to said auxiliary warp harness detachably engaged by said arm and reciprocated thereby during the operative periods of said auxiliary warp harness, a shifter including a rocking lever, alternatively actuated solenoids for rocking said lever in opposite directions, relay switches closing circuits for energizing said solenoids, a cam on said bar, and means moved by said rocking lever to positions of engagement or disengagement with said cam for lifting said bar out of engagement with said arm or returning it to engagement therewith, and circuits alternatively closed by the closing of the switches associated with the counting devices for actuating one or the other of the relay switches for causing the energization of one or the other of said shifter solenoids, said lever when rocked, mechanically opening the relay switch of the circuit of the solenoid which rocked it, and mechanically closing the relay switch of the circuit of the solenoid which shall next rock it, the resetting of either of the counting device switches opening the signal circuit of the corresponding counting device.

11. In a loom of that type which weaves a continuous length of fabric with alternate sections, one incorporating a main warp only and the other the main warp and an auxiliary warp, main and auxiliary warp harnesses, the latter being alternatively shiftable to bring the auxiliary warp into and out of the weaving plane of the main warp, alternately operating pick-counting devices, respectively controlling the number of picks to be made in each section, actu-

ating means therefor synchronized with the movements of the shuttle of the loom for registering the number of picks on one or the other of said pick-counting devices, said pick-counting devices being settable to predetermine the number of picks to be laid in each section, means actuated by one pick-counting device when the number of picks for which it was set has been made, for shifting the operative connection of said pick-counting device actuating means to the other pick-counting device, and shifting the auxiliary warp harness into or out of operative relation to the main warp harness, a production counter for counting the units of weaving produced in the interval between the beginning of successive operating periods of said auxiliary warp harness, actuating means for said production counter in circuit with the switch of one only of said pick-counting devices for registering in said production counter the number of closures of said switch, said production counter being settable for any predetermined number of units, and means actuated by said production counter for stopping the loom when said production counter has registered the number of units for which it was set.

12. In a loom of that type which weaves a continuous length of fabric with alternate sections, one incorporating a main warp only and the other the main warp and an auxiliary warp, main and auxiliary warp harnesses, the latter being alternately shiftable to bring the auxiliary warp into and out of the weaving plane of the main warp, alternately operating pick-counting devices respectively controlling the number of picks to be made in each section, actuating means therefor synchronized with the movements of the shuttle of the loom for registering the number of picks on one or the other of said pick-counting devices, said pick-counting devices being settable to predetermine the number of picks to be laid in each section, means actuated by one pick-counting device when the number of picks for which it has been set has been made for shifting the operative connection of said pick-counting device actuating means to the other pick-counting device, and shifting the auxiliary warp harness into or out of operative relation to the main warp harness, a production counter for counting the units of weaving produced in the interval between the beginning of successive operating periods of said auxiliary harness, a solenoid for actuating said production counter in circuit with the switch of one only of said pick-counting devices for registering in said production counter the number of closures of said switch, said production counter being settable for any predetermined number of units, means for stopping the loom, and a switch in circuit with said means and mechanically closed by said production counter upon reaching the predetermined number of counts, for stopping the loom.

13. In a loom of that type which weaves a continuous length of fabric with alternate sections, one incorporating a main warp only and the other the main warp together with an auxiliary warp, main and auxiliary warp harnesses, the latter being shiftable into and out of the weaving plane of the main warp, alternately operating pick-counting devices respectively controlling the number of picks to be made in each section, solenoids for actuating said pick-counting devices, a signal for each pick-counting device adapted to be activated during the periods of inactivity of the pick-counting device with which

it is associated, to indicate that the said pick-counting device is ready to be reset, a pick switch having a movable member moving synchronously with the movements of the shuttle of the loom between opposite contacts, said pick switch when in one closed position being interposed in common in the circuits of said solenoids, and in the other closed position in common in the circuits of said signals, said pick-counting devices being settable to predetermine the number of picks to be laid in each section, a switch associated with each pick-counting device and mechanically closed thereby when the predetermined number of picks has been registered on said pick-counting device, said switches each closing the circuit which actuates the other pick-counting device and the circuit which actuates the signal on its own pick-counting device, auxiliary warp harness operating mechanism comprising an arm oscillating synchronously with the shuttle of the loom, a bar connected to said auxiliary warp harness detachably engaged by said arm and reciprocated thereby during the operative periods of said auxiliary warp harness, a shifter including a rocking lever, alternatively actuated solenoids for rocking said lever in opposite directions, a cam on said bar, means moved by said rocking lever to positions of engagement or disengagement with said cam for lifting said bar out of engagement with said arm or returning it to engagement therewith, circuits alternately closed by the closing of the switches associated with the pick-counting devices for actuating the solenoids, the resetting of either of the pick-counting device switches opening the signal circuit of the corresponding pick-counting device, a production counter for counting the units of weaving produced in the interval between the beginning of successive operating periods of said auxiliary warp harness, a solenoid for actuating said production counter in circuit with the switch of one only of said pick-counting devices for registering in said production counter the number of closures of said switch, said production counter being settable for any predetermined number of units, a signal for said production counter, loom stopping means, and a switch in circuit with said loom stopping means and said signal, said switch being mechanically closed by said production counter upon reaching the predetermined number of units for which it was set, for stopping said loom and activating said signal.

14. In a loom of that type which weaves a continuous length of fabric with alternate sections, one incorporating a main warp only, and the other the main warp and an auxiliary warp, main and auxiliary warp harness, the latter being alternately shiftable to bring the auxiliary warp into and out of the weaving plane of the main warp, alternately operating counting devices respectively controlling the number of picks to be made in each section, means actuating said counting devices responsive to the movements of the shuttle of the loom, said counting devices being settable to predetermine the number of picks to be laid in each section, a switch for each counting device closed thereby when the predetermined number of picks has been registered by the respective counting devices, said switches each closing a circuit which actuates the other counting device, an instrumentality for throwing said auxiliary warp harness into and out of operative position, circuits alternately closed by the closing of said pick-counting device switches for actuating said instrumentality to shift said auxiliary warp harness alternately into and out of opera-

tive position, circuits closed by the respective switches putting out of action the counting device with which the switch is associated and putting the other counting device into action, and a circuit including an electrically actuated loom stop motion established when the switches of said

pick-counting devices are in closed position at the same time, which occurs when both pick counters have reached their limit of count without one having been reset for stopping said loom.

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