Feb. 19, 1952 D. W. HOWE, JR., ET AL 2,586,335

PROTECTION FOR LOOMS

Filed March 12, 1949 3 Sheets-Sheet 1

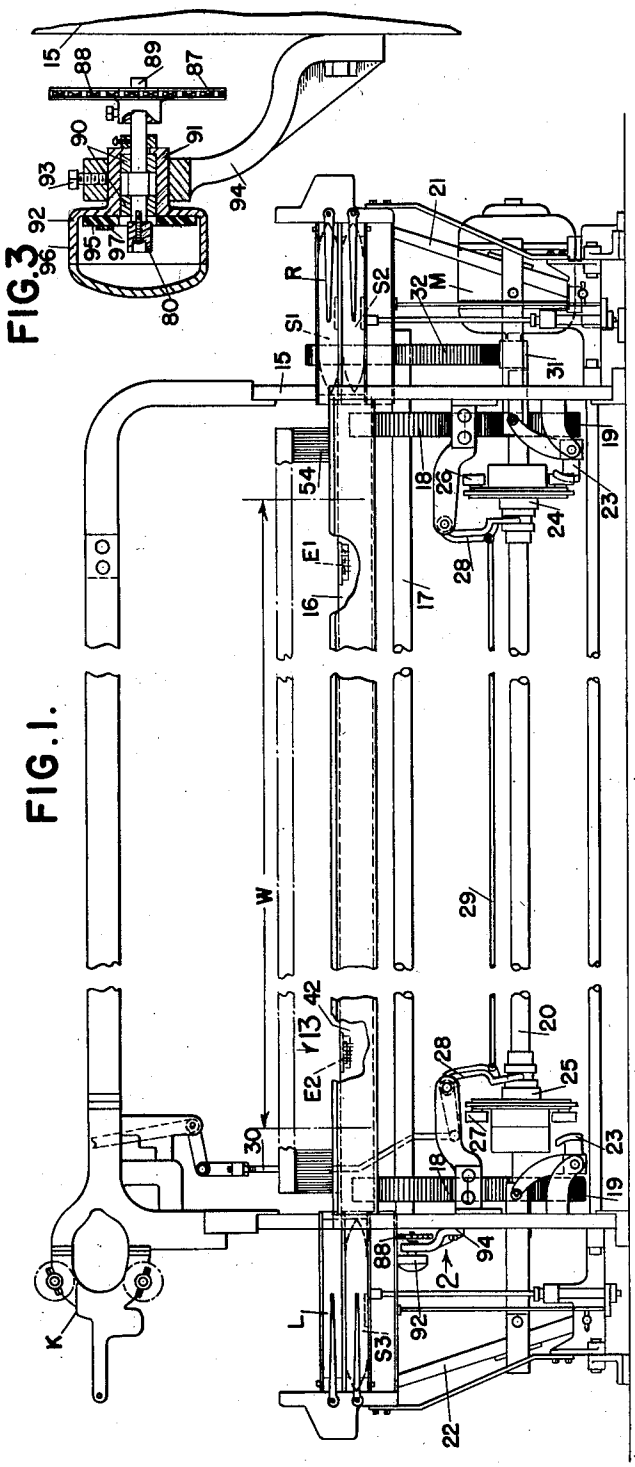


FIG. 1.

FIG. 3

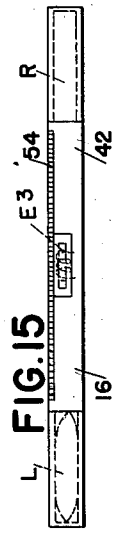


FIG. 15

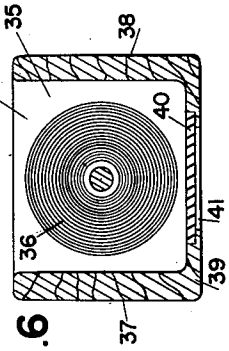


FIG. 6

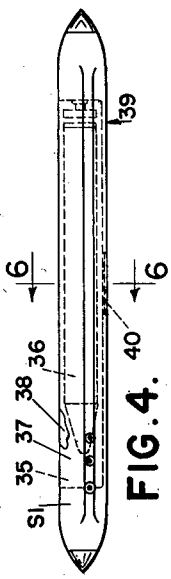


FIG. 4.

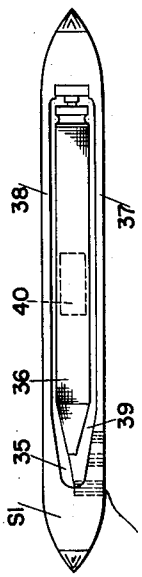


FIG. 5

INVENTORS,
DONALD W. HOWE JR.
VICTOR F. SEPAVICH

Chas. F. Hawley

ATTORNEY.

Feb. 19, 1952 D. W. HOWE, JR., ET AL 2,586,335

PROTECTION FOR LOOMS

Filed March 12, 1949 3 Sheets-Sheet 2

FIG.8

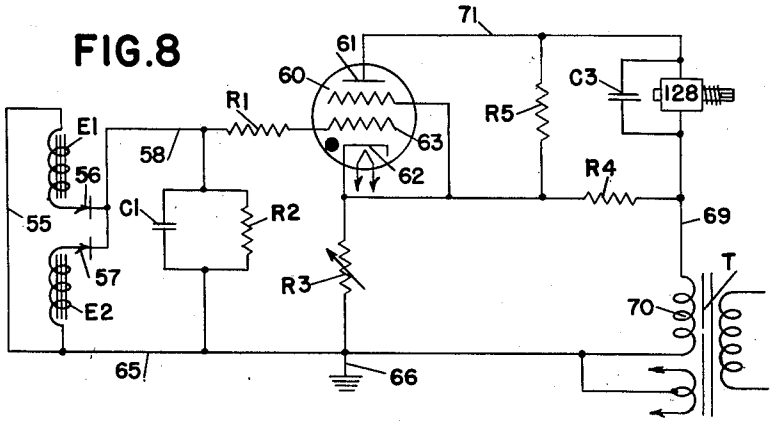
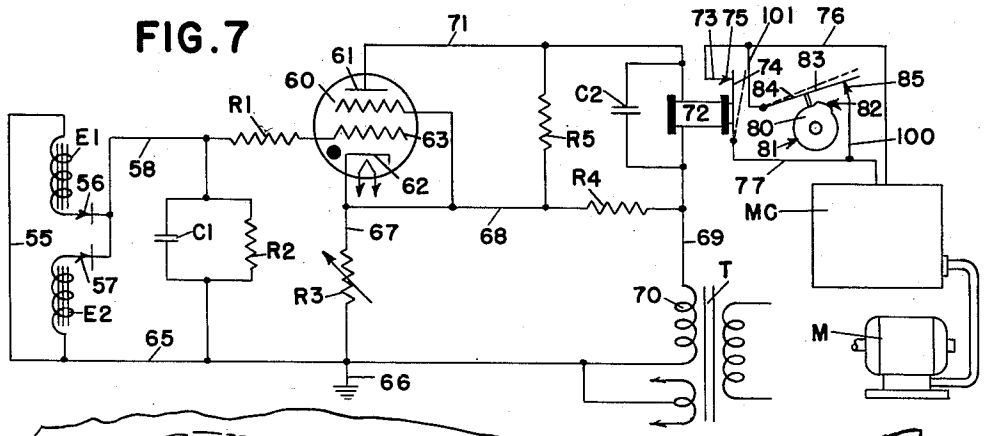


FIG.7



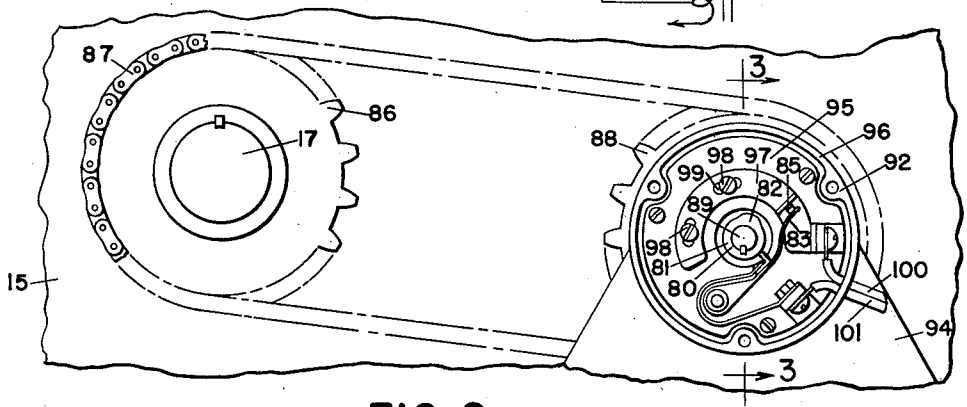


FIG.2

INVENTORS
DONALD W. HOWE JR.
VICTOR F. SEPAVICH
Chas. T. Hawley
ATTORNEY

Feb. 19, 1952 D. W. HOWE, JR., ET AL 2,586,335

PROTECTION FOR LOOMS

Filed March 12, 1949 3 Sheets-Sheet 3

FIG.9

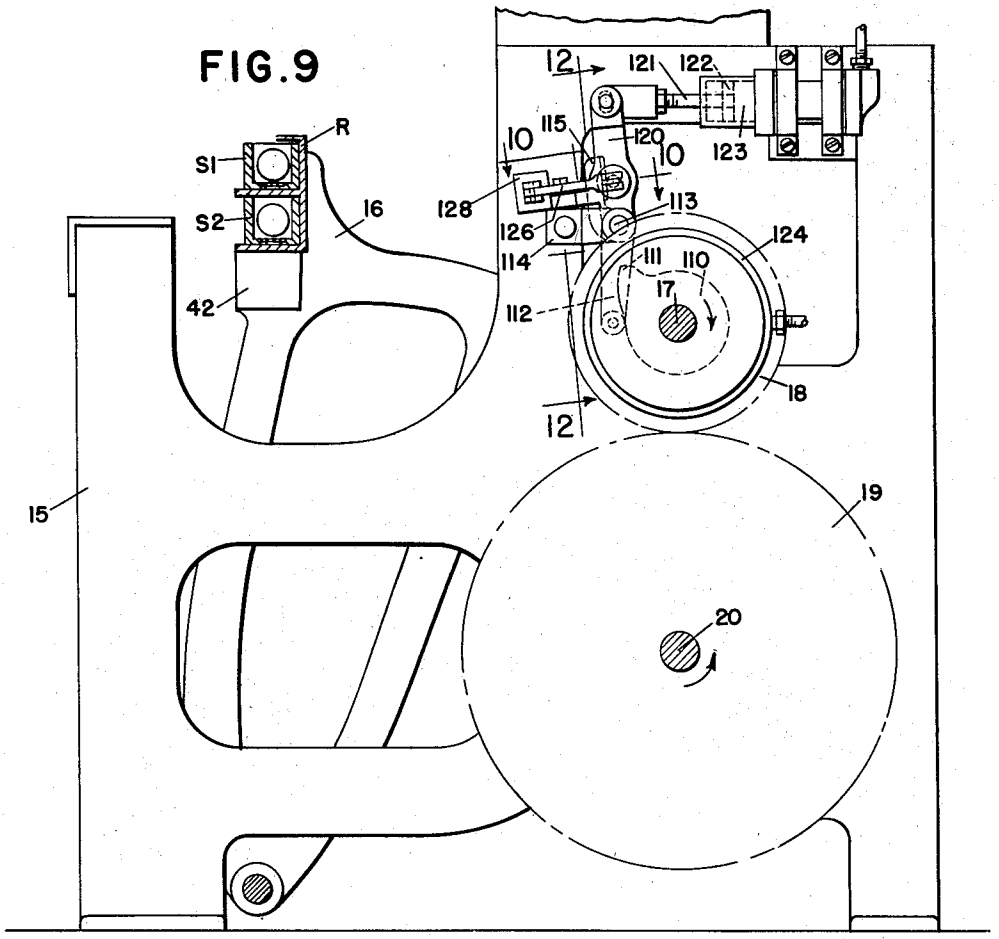


FIG.11

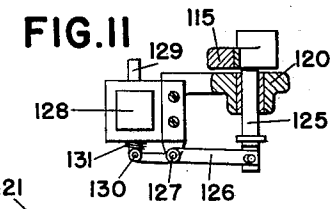


FIG.13

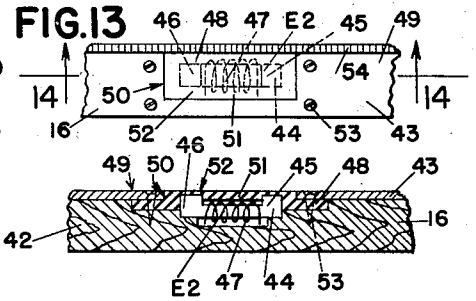
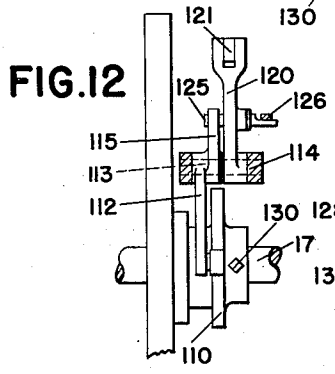


FIG.14

FIG.12



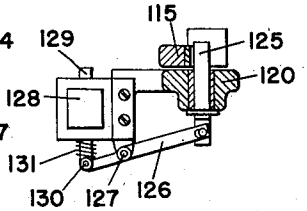


FIG.10

INVENTORS
DONALD W. HOWE JR.
VICTOR F. SEPAVICH

Chas. T. Hawley

ATTORNEY

Patented Feb. 19, 1952 2,586,335

UNITED STATES PATENT OFFICE

2,586,335

PROTECTION FOR LOOMS

Donald W. Howe, Jr., Ware, and Victor F. Sepavich, Worcester, Mass., assignors to Crompton & Knowles Loom Works, Worcester, Mass., a corporation of Massachusetts

Application March 12, 1949, Serial No. 81,164

26 Claims. (Cl. 139—341)

1

This invention relates to improvements in electric protection means to stop a loom if the shuttle while in flight fails to reach a given point along the lay at a given time in the loom cycle due to the fact that the shuttle is not running properly.

Loom lays are customarily provided with a protector rod having secured to it daggers normally positioned to engage bunters at least one of which is connected to the loom stopping mechanism. The protector rod has fingers which engage the shuttle binders and if the shuttle is running properly it enters a shuttle box in time to rock the protector rod and depress the daggers before they can engage the bunters. If the shuttle fails to enter the shuttle box on time the daggers remain in stopping position and strike the bunters to effect stoppage of the loom. Such mechanisms act to stop the lay very abruptly and are likely to break some part of the loom. Stopping of the loom is necessarily abrupt due to the short time elapsing between proper boxing of the shuttle and the point in the loom cycle where a shuttle in the shed would break the warp.

It is an important object of the present invention to provide means by which proper running of the shuttle can be determined before it reaches the shuttle box, thereby allowing more time for stopping of the loom. This means may include two parts which due to relative motion cooperate to produce an electric change in at least one of them. One of these parts is on the lay and the other is on the shuttle, and when the shuttle is running correctly the two parts cooperate to generate an electric impulse which is utilized to cause energization of an electric circuit at a given time in the loom cycle which will permit continued loom operation. If the shuttle is running slow, however, the impulse will be generated after said given time and—too late to effect energization of the electric circuit at the required time, and loom controlling means will stop the loom. The part on the lay may take the form of a coil surrounding a permanent magnet and the part on the shuttle may be a body of metal which when passing over the coil will alter the magnetic field in such a manner as to induce an electric potential or impulse in the coil. The energy for developing this potential or impulse is derived from the shuttle, or more properly, the picking mechanism which propels the shuttle.

The lay may be provided with one coil, in which event it will be located centrally of the length of the lay, or the lay may be provided with

2

two coils spaced along its length and located on opposite sides of the longitudinal center of the lay. When two coils are used a single flight of the shuttle will generate two electric impulses the first of which occurs too early to affect the loom controlling means, but the second impulse derived from the other coil will normally occur at a time when the loom controlling means would stop the loom unless prevented from doing so.

The generated impulse controls the grid of an electronic tube in circuit with a stopping means controlling electromagnetic device. Normally the latter will be deenergized at the aforesaid given time in the loom cycle due to the normal electric condition of the grid. When the impulse occurs it changes the electric condition of the grid so that electric current can flow through the tube to energize the electromagnetic device. If the impulse occurs on time the loom controlling means, which may be either electric or mechanical, will be prevented from stopping the loom, but if the impulse is generated too late, or is not generated due to stoppage of the shuttle in the warp shed, the electromagnetic device will not be energized by the time the stopping means normally acts, and the loom will be stopped.

With this general object in view, and other objects which will appear as the description proceeds, the invention resides in the combination and arrangements of parts hereinafter described and claimed.

In the accompanying drawings, wherein three forms of the invention are set forth,

Fig. 1 is a front elevation of a loom having the preferred form of the invention applied thereto,

Fig. 2 is an enlarged detailed side elevation looking in the direction of arrow **2**, Fig. 1, the cover of the loom driven switch being removed,

Fig. 3 is a vertical section on a reduced scale on line **3—3**, Fig. 2,

Fig. 4 is a front elevation of a shuttle used with the invention,

Fig. 5 is a plan view of the shuttle shown in Fig. 4,

Fig. 6 is an enlarged transverse vertical section on line **6—6**, Fig. 4,

Fig. 7 is a diagrammatic view showing a form of electric circuit which can be used with the preferred form of the invention,

Fig. 8 is a view similar to Fig. 7, but showing a circuit which can be utilized with the first modified form of the invention,

Fig. 9 is a side elevation of part of a loom showing the lever mechanism and solenoid used in the first modified form of the invention,

Fig. 10 is a horizontal section on line 10—10, Fig. 9, showing the parts in normal position,

Fig. 11 is similar to Fig. 10, but showing the parts in the positions they occupy when the shuttle is running properly,

Fig. 12 is a vertical section on line 12—12, Fig. 9,

Fig. 13 is an enlarged plan of part of the lay and one of the coils, looking in the direction of arrow 13, Fig. 1,

Fig. 14 is a vertical section on line 14—14, Fig. 13, and

Fig. 15 is a diagrammatic plan for a loom lay showing the second modification of the invention in which only one coil on the lay is used.

Referring particularly to Fig. 1, loom frame 15 is provided with a lay 16 which swings backwardly and forwardly during loom operation. The loom has a top shaft 17 provided with gears 18 meshing with gears 19 on the bottom shaft 20. The lay is provided with right and left gangs, R and L, respectively, of shuttle boxes which are shifted relatively to the lay by known mechanism not shown but operated by a head mechanism designated as K. Right and left picker sticks 21 and 22, respectively, are each operated by picking mechanism including a cam 23. Sleeves 24 and 25 slidable on but rotating with the bottom shaft are provided with picking rolls 26 and 27, respectively. The sleeves are operatively connected to levers 28 which are connected by a rod 29, and a positioning rod 30 operated by mechanism K moves the sleeves lengthwise of shaft 20 so that only one picking roll 26 or 27 at a time will be able to engage a cam 23.

During loom operation the picker sticks will be given operative picking motions determined by the positions of the sleeves 24 and 25. The loom shown in Fig. 1 is of the pick and pick type employing three shuttles S1, S2 and S3. Whenever a picker stick operates it will propel one of the shuttles from the associated shuttle box gang across the lay 16 toward the other shuttle box gang. The warp shed of the loom will generally occupy some such space as that indicated at W in Fig. 1.

The loom is driven by a motor M which has a pinion 31 meshing with a motor gear 32 secured to the top shaft 17. Whenever the motor is running the loom will be in operation, and whenever the motor is stopped, as will be set forth more particularly hereinafter, the loom will be stopped.

The matter thus far described sets forth a type of loom on which the invention can be used, but it is to be understod that the invention is not limited in its use to this particular type of loom.

In carrying the invention into effect means are provided by which the shuttle gives an electrical indication when it arrives at a given point along the length of the lay between the shuttle boxes R and L. If the shuttle is running properly the indication will be given in time to prevent loom stoppage, but if the shuttle is running slow the indication will be given too late to prevent loom stoppage. The shuttles are all equipped with means which assist in giving the indication, and a description for one of them will suffice.

As shown in Fig. 4, where shuttle S1 is set forth, the shuttle has a bobbin compartment 35 containing a weft carrier, such as a bobbin 36. The shuttle body is made of non-magnetic material, such as wood, and has front and back walls 37 and 38 and a floor or bottom 39. Mounted on the underside of the shuttle is an elongated metallic plate 40 extending lengthwise of the shuttle. This plate is below the bobbin 36 and close to the bottom surface of the shuttle but spaced slightly thereabove, as shown at 41, Fig. 6. This plate which is held in place either by cementing or by a close fit, or in any other convenient manner, is located preferably centrally of the length of the shuttle as indicated in Fig. 5 and is made of a magnetizable substance or material which will conduct magnetic lines of force. For this purpose the plate may be made of ferrous metal, such soft steel or iron. As shown herein the plate will normally be demagnetized, but it is within the spirit of the invention to have plate 40 a permanent magnet if desired. Only one plate 40 located centrally of the shuttle is shown, but the invention is not limited to a single plate thus placed.

The lay includes a lay beam 42, which may be made of wood, to the top of which a race plate 43 is secured. The race plate may be made of wood or metal, preferably steel, and extends between the shuttle boxes at each end of the lay. The lay has mounted thereon between the shuttle gangs R and G two spaced electric induction units E1 and E2, preferably but not necessarily under the warp shed. Both of these units are alike and made as shown in Figs. 13 and 14, wherein unit E2 is shown in detail. The units E1 and E2 are preferably equally spaced from their corresponding shuttle box gangs.

The unit E2 includes a permanent magnet 44 having poles 45 and 46 and a coil of wire 47 which is wound around the magnet. Magnet 44 is secured to a support 48 made of non-magnetic material, such as a plastic, and has its poles slightly below the top 49 of the race plate, see Fig. 14. The race plate has a slot 50 therein into which the upper part 51 of the support fits. The top surface 52 of the part 51 is preferably aligned with the top surface of the race plate to form a substantially continuous top surface for the lay. Slot 50 is large enough so that no part of the race plate is near the poles of the magnet, see Fig. 13, hence if the race plate is made of steel it will not be close enough to the magnet to provide a path for the magnetic lines of force of the poles. Support 48 is secured as at 53 to the lay beam. The center to center distance between poles 45 and 46 is substantially equal to the length of plate 40, although this is not an essential relation. The poles 45 and 46 are also spaced from the reed 54 which is usually made of flat sheet steel dents.

The coils of the two units E1 and E2 may be connected as shown diagrammatically in Fig. 7, a side of each coil being connected to a wire 55 and the other side of each coil being connected to a single wave rectifier. As shown in Fig. 7, rectifiers 56 and 57 are provided for coils E1 and E2, respectively. These rectifiers are so arranged that they permit only positive electric current to flow from the coils to a wire 58 which is connected to both rectifiers.

As shown in Fig. 7 the electric circuit used with the preferred form of the invention includes an electronic power tube 60 having a plate 61, a cathode 62, and a control grid 63. The latter is connected through a protective resistance R1 to wire 58.

Wire 55 is connected to a wire 65 grounded at 66, and a small condenser C1 and a second resistance R2 are connected in parallel across wires 58 and 65 on that side of resistance R1 opposite to

the tube 60. One side of a preferably variable resistance R3 is connected to wire 65, while its other side is connected to cathode 62 by wire 67. A wire 68 connects wire 67 to one side of a resistance R4 the other side of which is connected by wire 69 to a secondary 70 of a transfermer T. The secondary supplies relatively high voltage alternating current and is connected to wire 65, and tends normally to cause electric current to flow through tube 60. Resistance R4 is considerably higher than resistance R3, and the cathode is kept at a voltage slightly above ground.

Plate 61 is connected by wire 71 to a normally deenergized relay 72 controlling a switch 73 having a blade or contactor 74 and a stationary contact 75. Relay 72 is also connected to wire 69 and is in parallel with a relatively large electric condenser C2. Switch 73 is connected by wires 76 and 77 to a motor control unit MC not shown in detail but indicated diagrammatically in Fig. 7.

A rotary switch cam 80 has a relatively long dwell 81 and a short cam point 82 for operation of blade 83 of a switch 84 having a stationary contact 85. Blade 83 is connected to wire 76, while contact 85 is connected to wire 77, so that switches 73 and 84 are parallel and each is able to control the electrical apparatus within the motor controller MC. One or the other of these switches must be closed to enable the controller MC to maintain motor M in operation. Cam 80 and switch 84 constitute loom controlling means which normally attempts to stop the loom every pick at a time when the shuttle should be over one or the other of the controlling unit E1 or E2, depending upon the direction of travel.

The cam 80 and switch 84 may be arranged as shown in Fig. 2, wherein the top or crank shaft 17, which may be considered a member moving regularly during loom operation, is shown as having keyed thereto a sprocket wheel 86 around which is trained a chain 87. The chain is trained around a second sprocket wheel 88 secured to a stub shaft 89, see Fig. 3, to which cam 80 is secured. Wheels 86 and 88 are the same size, hence cam 80 turns in unison with the top shaft 17.

Shaft 89 turns in two aligned bushings 90 driven into the shell 91 of an adjusting member 92. A set screw 93 holds the angular setting of member 92 relatively to a stand 94 fixed to the loom frame. A disk 95 of insulation material is fastened within the enlarged cup 96 of member 92 and supports an arcuate contact plate 97, see Fig. 2, held to the disk in angularly adjusted position by screws 98 passing through slots 99 in plate 97 and tapped into the disk. The previously described contact 85 is carried by the contact plate 97, and switch blade 83 is also mounted on disk 95. Wire 100 connects contact 85 to wire 77, and wire 101 connects the switch blade 83 to wire 76.

Set screw 93 permits angular adjustment of switch 84 with respect to the cam 80 to vary the time of opening of the switch with respect to the loom cycle. The structure shown at the right of Fig. 2, and in Fig. 3, is given merely as an example of a circularly adjustable switch the time of opening of which can be adjusted relatively to the loom cycle.

During loom operation switch 84 will be closed for the greater part of each one pick cycle of the loom, but will be opened by cam point 82 when the metallic plate on the running shuttle should pass over one or the other of the induction units E1 and E2, depending upon the direction of motion of the shuttle. Opening of switch 84 would normally cause the motor control MC to stop the motor M, but if switch 73 is closed at this time control MC will remain in normal condition and the motor will continue to run and drive the loom. If, on the other hand, switch 73 is not closed at this time control MC stops the motor.

Assuming that the shuttle has been picked from gang R by the picking mechanism at the right end of the loom and is moving to the left it will pass over the induction unit E1 while switch 84 is still closed due to the dwell 81 of cam 80 and the electric potential developed in unit E1 will change grid 63 so that current can flow through the tube, but this will have no effect, since switch 84 is closed at this time. As the shuttle continues to move it will pass over the second induction unit E2 and will generate a single cycle of alternating current in the coil. It will be noted that the picking mechanism supplies the energy necessary to generate the electric potential or impulse in the units E1 and E2. The rectifier 57 will block out the negative alternation of this cycle but will permit the positive alternation to be impressed on the grid 63 through the resistance R1 and at the same time will charge the small condenser C1. As soon as the shuttle has passed the unit E2 the condenser C1 will start to discharge through resistance R2 and in doing so will hold the grid 63 in the positive condition relatively to the cathode 62. The grid will be held at this potential long enough so that current can pass through the electronic tube 60, whereupon the secondary 70 will be able not only to energize the relay 72 but also charge condenser C2 which is larger than condenser C1. When the potential of the plate 61 changes from positive to negative the condenser C2 will discharge through the relay 72 and in this way the latter can be kept energized for a period corresponding to the period of opening of switch 84. If the shuttle is running on time relay 72 will close switch 73 during the time that switch 84 is open, and there will be no change in the control MC, and the loom will continue to run.

If the shuttle is running late and does not pass over unit E2 until after switch 84 is open, then both switches 73 and 84 will momentarily be open and the circuit through wires 76 and 77 will be open and control MC will cause stoppage of motor M. This stoppage may be effected by any of the commercial devices which are available for this purpose, these devices of themselves forming no part of the present invention. The control MC may if desired include electrical apparatus for plugging the alternating current motor M with direct current.

On return of the shuttle to the right, Fig. 1, the same conditions will exist as those already described, except that the controlling electric potential will be generated in induction unit E1. If the shuttle is on time relay 72 will close switch 73 as before and the loom will continue in operation.

The adjustment of switch 84 relative to the cam member 80 will permit some variation in the time of opening of switch 84 by cam point 82 with respect to the loom cycle so that adjustments may be made to compensate for different shuttle speeds for which the picking mechanism may be set.

When two coils are used as set forth in Fig. 7 the rectifiers 56 and 57 will not only act to block out the negative alternations generated in the

units E1 and E2, but will also prevent each unit from discharging through the other unit and the full energy developed in each unit can therefore be utilized for the grid and charging of condenser C1.

In the first modified form of the invention the electric switch 84 and cam 80 are dispensed with and in their place is used a mechanically operating device which tends normally to stop the loom at a given point in the loom cycle, as is customary in protection devices, but the mechanism will be prevented from effecting loom stoppage if the shuttle is on time and generates an electric potential at the correct point in the loom cycle.

Referring to Fig. 9, the top shaft 17 of the loom has secured thereto a cam 110 having a point 111 which periodically rocks an actuator lever 112. The latter is pivoted on a stud 113 fixed on a stand 114 held in stationary position on the loom frame. The upper part of lever 112 has an arm 115 which as viewed in Fig. 9 has a periodically recurring movement to the right which occurs at the time in each one pick cycle of the loom when the shuttle should pass over the induction unit which is relied upon for controlling the grid of tube 60.

A knock-off or stopping lever 120 also pivoted on stud 113 has the upper end thereof operatively connected by a rod 121 to the piston 122 of a hydraulic cylinder 123 which is appropriately connected to a hydraulic brake 124 for the loom. Mounted on lever 120 is an element shown as a plunger 125, see Fig. 10, slidable on the lever and normally in the path of lever arm 115. This plunger is operatively connected to a small lever 126 moving about a pivot 127 fixed with respect to lever 120. A solenoid 128 also mounted on lever 120 has a core 129 connected as at 130 to lever 126. A compression spring 131 interposed between the solenoid and lever 126 holds the latter normally in the position shown in Fig. 10 with the element or plunger 125 in stopping position in front of lever arm 115. When the solenoid 128 is energized the plunger 125 is moved out of the path of lever arm 115 and the latter has an idle motion. If, on the other hand, the plunger 125 is still in the path of lever arm 115 when the latter has its periodic rocking, which occurs every pick of the loom, then hydraulic pressures are developed within the cylinder 123 and the loom is stopped by brake 124. Cam 110, lever arm 115, plunger 125, and lever 120 and parts operated by it are loom controlling means tending at regularly recurring one pick intervals to stop the loom.

The circuit for controlling the solenoid 128 may be substantially the same as that already described for the preferred form of the invention except for slight modifications. This circuit, shown in Fig. 8, is similar to the greater part of the circuit shown in Fig. 7. The solenoid 128 takes the place of the relay 72, and electric condenser C3, having preferably a somewhat larger capacity than C2, is in parallel with the solenoid.

From the description already given it is believed that the operation of the modified form will be understood. Lever arm 115 will rock at the time the shuttle should pass over the controlling induction unit E1 or E2, and if the shuttle is on time it will induce a potential which will change the electric condition of grid 63 to permit current to flow through the tube 60 and solenoid 128 and cause the latter to move the plunger 125 out of the path of lever arm 115 just before the latter starts on a working stroke. At the same time the condenser C3 will be charged to keep the solenoid 128 in a continued state of energization for a short interval after the tube ceases to fire. One purpose for this continued energization is to prevent spring 131 from forcing the end of plunger 125 against the lever arm 115 and thereby avoid wear. It is understood of course that the essential function of the electric circuit will have been performed if the shuttle is on time and plunger 125 has been moved to a non-stopping position, such as shown in Fig. 11, just before cam point 111 rocks lever 112.

While solenoid 128 has been shown as being directly energized by current flowing through the tube 60 it will be within the spirit of the invention if the solenoid is replaced by a relay similar to relay 72 and a switch controlled by this relay will close a circuit through the solenoid. This will introduce an additional electrical step which may involve a slight additional time delay between the passage of the shuttle over one or the other of the units E1 or E2 and removal of plunger 125 from the path of lever arm 115, but an adjustment can be made in the setting of cam 110 to take account of this very slight delay. Cam 110 is adjustable angularly on shaft 17 by means of set screw 130, hence the time of rocking of lever 112 can be varied relatively to the loom cycle.

In the second modification of the invention a single unit E3 is located on the lay midway between the shuttle box gangs, or the ends of the race plate. When a single unit is used as shown in Fig. 15 the switch 84 will be adjusted relatively to the cam 80 to open earlier in the loom cycle than is the case when two units are used. Also, an adjustment of cam 110 will be necessary to rock lever arm 115 earlier. From this it will be seen that the single coil E3 can be used with either the preferred or the first modified form of the invention.

In operation it is found that the invention set forth hereinbefore initiates the loom stopping impulse earlier than is possible with the usual protection and more time is therefore provided for dissipating the energy of the moving parts of the loom. Induction units E1 and E2 are spaced a substantial distance from the shuttle boxes adjacent to them and the length of time required for the shuttle to travel from these units to their respective boxes represents a gain in time which is available for stopping the loom beyond that now possible with the usual mechanical protection.

While the various parts of the electric circuits shown in Figs. 7 and 8 are subject to some variation a few specific values found to be satisfactory will be mentioned. The lay carried coils may generate from 5 to 15 volts, condensers C1 and C2 can be, respectively, 0.25 and 16 microfarads, resistance R1 may have a value of 1.57 megohms, while the resistance R2 can be one megohm. The resistance R3 is variable up to 100 ohms, while the resistance R4 may be 10,000 ohms. The relay 72 may have a resistance of 3300 ohms and the resistance R5, which is a tube load resistance, had a value of 4000 ohms. The secondary 70 supplied a potential of 175 volts. The motor M operated with three phase alternating current and the unit MC of commercial form impressed direct current on the motor to stop the loom. These values are illustrative of those which have been found satisfactory, but the invention is not limited to them.

From the foregoing it will be seen that the invention sets forth electronically controlled loom protection mechanism including cooperating parts on the lay and shuttle which generate an electric potential at some point along the lay, and if desired under the warp shed, before the shuttle is boxed, and this potential is utilized to control the grid of an electronic tube which is normally prevented from firing by the normal condition of the grid. The electric potential thus generated alters the grid so that the tube can fire and pass current for the energization of an electromagnetic device. If this energization occurs during the period that switch 84 is open in the preferred form of the invention, or just before lever arm 115 rocks on a working stroke in the modified form of the invention, the loom will continue to run. If, however, the shuttle is running slow the electric potential which it generates will come too late in the loom cycle and the switch 84 of the preferred form of the invention will be open simultaneously with switch 73 and unit MC will stop the loom. In the first modified form of the invention these conditions result in an energization of solenoid 128 too late to move the plunger 125 out of the path of lever arm 115 and as a result the hydraulic cylinder 123 and brake 124 will act to stop the loom. The invention is not limited to the particular means for inducing electric current by a flight of the shuttle, such as shown hereinbefore, since it will be sufficient if passage of the shuttle over a coil or unit on the lay will generate an electric impulse which will change the electric condition of the grid 63. The energy for creating the electric impulse is derived from the shuttle which in turn derives its energy from the picking mechanism. Furthermore, the invention is not necessarily limited to the two units E1 and E2, since a single unit located centrally along the length of the lay with appropriate early adjustment either of cams 80 or 110 will suffice. The timing of the opening of switch 84 can be accomplished by any desired form of adjustable switch, cam or the like, and the mechanism shown for instance in Fig. 2 for accomplishing this result is to be considered merely as illustrative. The invention further provides a lay with a unit in which an electric impulse can be generated by the passage of the magnetizable body on the shuttle.

Having thus described the invention it will be seen that changes and modifications of the foregoing specific disclosure may be made without departing from the spirit and scope of the invention.

We claim:

1. In protection means for a loom having a shuttle which is picked across a lay, an electric induction unit on the lay including a coil, a body on the shuttle capable of inducing an electric potential in the coil when the body passes the unit, electric circuit means including an electromagnetic device and an electronic tube containing a grid electrically connected to the coil and normally preventing firing of the tube, the shuttle when passing the induction unit generating an electric potential in the coil which effects a change in the electric condition of the grid to enable current to flow through the tube to energize the electromagnetic device, and loom controlling means effective to stop the loom upon failure of the electromagnetic device to be energized at a given time in the loom cycle due to failure of the body on the shuttle to pass said unit at said given time.

2. In protection means for a loom having a shuttle which when running properly passes a given point along the lay at a given time in the loom cycle, electric induction means having a part on the lay at said given point and having another part on the shuttle, said induction means effective to generate an electric potential when said other part on the shuttle passes said part on the lay, electric circuit means including an electromagnetic device and an electronic tube having a control grid electrically connected to said electric induction means and normally preventing flow of electric current through the tube and electromagnetic device, said grid having the electric condition thereof changed when said electric potential is generated to enable electric current to flow through the tube to energize said electromagnetic device, and loom controlling means effective to stop the loom upon failure of the electromagnetic device to be energized at said given time in the loom cycle.

3. In protection means for a loom having a shuttle which when running properly passes a given point along the lay under the warp shed at a given time in the loom cycle, electric induction means having a part on the lay at said given point and having another part on the shuttle effective to generate an electric potential when said other part on the shuttle moves in the warp shed and passes said part on the lay, electric circuit means including an electromagnetic device and an electronic tube having a control grid electrically connected to said electric induction means and normally preventing flow of electric current through the tube and device, said grid having the electric condition thereof changed when said electric potential is generated to enable current to flow through the tube to energize said device, and loom controlling means effective to stop the loom upon failure of the device to be energized at said given time in the loom cycle.

4. In protection means for a loom having a shuttle which is picked across a lay, an electric induction unit on the lay including a coil around a permanent magnet, a body of metal on the shuttle capable of inducting an electric potential in the coil when the shuttle passes said unit, an electronic tube including a grid which normally is in such electric condition as to prevent flow of electric current through the tube normally tending to cause electric current to flow through the tube and device and effective to energize the device when current can flow through said tube, electric connections between the coil and grid changing the electric condition of the latter to enable current to flow through the tube when said electric potential is generated in said coil, and loom controlling means stopping the loom if the device fails to be energized at a given time in the loom cycle.

5. In protection means for a loom having a shuttle which when running properly from one shuttle box to another shuttle box on the lay passes a given point along the lay between the shuttle boxes at a given time in the loom cycle, electric induction means partly on the lay at said given point and partly on the shuttle generating an electric potential when the shuttle passes said given point, an electromagnetic device, stopping means effective to stop the loom if the device fails to be energized at said given time in the loom cycle, and electric means energizing said device at said time if said electric potential is

generated at said time in the loom cycle, said electric means including an electronic tube the grid of which has the electric condition thereof altered by said generated electric potential.

6. In protecting means for a loom having a shuttle which travels over the race plate of a lay, an electric induction unit supported by the lay including a coil below the top of the race plate, a ferrous body on the shuttle effective when passing the unit to generate an electric potential therein, loom stopping means normally acting to stop the loom at a given time in the loom cycle, and electric controlling means for the stopping means including an electromagnetic device and an electronic tube electrically connected to said coil and effective to prevent the stopping means from stopping the loom if said electric potential is generated by passage of said ferrous body over said coil at said time in the loom cycle.

7. In protecting means for a loom having a shuttle which travels across a lay, a ferrous body on the bottom of the shuttle, a unit on the lay including a coil capable of generating an electric potential when said ferrous body passes over the unit while the shuttle is moving across the lay, a normally deenergized electromagnetic device, loom controlling means dependent upon energization of the device at a given time in the loom cycle to enable the loom to continue running, said controlling means stopping the loom if the device fails to be energized at said given time, and electric means effective to energize said electromagnetic device when said electric potential is generated in said coil, said body on the shuttle if passing the coil at said time in the loom cycle effecting energization of the device by said electric means with resultant continued operation of the loom, and said electromagnetic device remaining deenergized if said body fails to generate said electric potential in the coil at said time in the loom cycle with resultant stoppage of the loom by said controlling means.

8. In protector means for a loom having a lay provided with a shuttle box at each end thereof and a shuttle which is picked back and forth across the lay from one box to the other box, a body of ferrous metal on the shuttle, a unit on the lay including an electric coil located along the lay at a point centrally of said boxes, said shuttle when passing over the coil causing the generation in the latter of an electric potential, loom controlling means capable either of stopping the loom at a given time in the loom cycle or permitting continued loom operation, and electric means controlling the loom controlling means dependent upon generation of said electric potential and effective to cause the loom controlling means to stop the loom if said electric potential fails to be generated at a given time in the loom cycle, said electric means enabling the loom controlling means to permit continued running of the loom if said electric potential is generated at said given time.

9. In protection means for a loom having a shuttle which is picked across a lay, a member moving regularly during loom operation, regularly acting means moving in timed relation with said member normally tending to stop the loom at a given point in the loom cycle, means to adjust the time relation of the regularly acting means relatively to said member, an electromagnetic device effective when energized at said point in the loom cycle to prevent said regularly acting means from stopping the loom, cooperating electric induction means partly on the shuttle and partly on the lay including a coil on the lay effective to generate an electric potential when the shuttle passes the coil, and electric circuit means including the electromagnetic device and an electronic tube the grid of which normally prevents electric current from flowing through the tube to energize the electromagnetic device, said grid being electrically connected to the coil and being changed electrically to permit electric current to pass through the tube to energize the electromagnetic device when said electric potential is generated in the coil, the shuttle if running on time causing generation of said electric potential at said given point in the loom cycle, and the shuttle if running slow failing to cause generation of said electric potential with resultant failure of energization of the electromagnetic device at said given point in the loom cycle, whereupon said regularly acting means effects loom stoppage.

10. In protection means for a loom having a shaft which rotates during loom operation in time with picking mechanism which picks a shuttle across a lay, a cam on said shaft, an actuator lever rocked each pick of the loom by said cam at a given time in the cycle of the loom, loom stopping means including an element normally in the path of said actuator lever but movable relatively to said path and effective when in said path and moved at said time by the actuator lever to stop the loom, an electromagnetic device effective when energized to move said element out of the path of the actuator lever, an electric induction unit on the lay including a coil, a magnetizable body on the shuttle which when passing the coil generates an electric potential therein, electric circuit means including the electromagnetic device and an electronic tube effective when electric current can pass through the tube to energize the electromagnetic device, and a control grid in said tube electrically connected to the coil and normally preventing current from passing through the tube but altered electrically to enable current to pass through the tube with resultant energization of the electromagnetic device when said electric potential is generated in said coil, the shuttle if running on time effecting generation of said electric potential and energization of the device to move said member out of said path prior to rocking of the lever at said time in the loom cycle, the shuttle if running late failing to effect generation of said electric potential at said time in the loom cycle, whereupon said element remains in said path and is moved by said actuator lever to effect loom stoppage.

11. In a lay for a loom having stopping means controlled by an electric impulse, the lay comprising a beam, a race plate on the beam made of magnetizable material and formed with an opening therein, and an electric impulse generating unit on the lay including a magnet in said opening spaced from the race plate and a coil wrapped around the magnet, said unit effective to generate said electric impulse when a magnetizable body passes the unit.

12. In a loom lay and shuttle for a loom having stopping means controlled by an electric impulse, an electric impulse generating unit on the lay including a permanent magnet having two poles spaced along the length of the lay and a coil around the magnet, and a magnetizable body on the shuttle having a length measured lengthwise

of the lay equal substantially to the center to center distance between said poles, said body when passing over the magnet generating said electric impulse in said coil.

13. In protection means for a loom having a shuttle which is picked across a lay, an electric induction unit on the lay including a coil, a body on the shuttle capable of inducing an electric potential in the coil when the body passes over the unit, a source of alternating electric current, an electronic power tube, an electromagnetic device, loom stopping means controlled by the device effective to stop the loom if the device fails to be energized by the time a given point is reached in the loom cycle but ineffective to stop the loom if said device is energized by said time, electric circuit means including said source, tube and device effective when electric current can pass through the tube to energize the device, a control grid in the tube normally preventing current from passing through said tube, and electric means including said coil and an electric condenser electrically connected to said grid and effective when said electric impulse is generated to charge said condenser so that the side thereof connected to the grid shall be positively charged, said condenser being effective after said electric impulse has been generated to maintain the grid in such electric condition as to permit electric current to flow through said tube to energize said device.

14. In protection means for a loom having a lay with a shuttle box at each end thereof and a shuttle which is picked across the lay from either shuttle box toward the other shuttle box, two spaced electric impulse generating units on the lay between the shuttle boxes, each unit including a coil, a body of magnetizable material on the shuttle effective when passing over said units to generate electric impulses in said coils, electric loom controlling means including an electronic tube having a control grid normally preventing electric current from flowing through the tube, said loom controlling means effecting loom stoppage if the grid prevents flow of electric current through the tube at a given point in the loom cycle, the shuttle when picked from either shuttle box and when running on time passing both units and generating an electric impulse in each coil and the impulse of the second coil to be passed by the shuttle being generated in time to change the electric condition of said grid to enable current to flow through said tube at said given time.

15. In protection means for a loom having a shuttle which is picked across a lay, an electric induction unit on the lay including a coil around a permanent magnet having poles spaced lengthwise of the lay, a body of metal on the shuttle of a length equal substantially to the center to center distance between said poles and capable of inducing an electric potential in the coil when passing said unit, an electronic tube including a grid which normally is in such electric condition as to prevent flow of electric current through the tube, an electromagnetic device, electric circuit means normally tending to cause electric current to flow through the tube and device and effective to energize the device when current can flow through said tube, electric connections between the coil and grid changing the electric condition of the latter to enable current to flow through the tube when said electric potential is generated in said coil, and loom controlling means stopping the loom if the device fails to be energized at a given time in the loom cycle.

16. In protection means for a loom having a shuttle which when running properly passes a given point along the lay at a given time in the loom cycle, electric induction means having a part on the lay at said given point and having another part of the shuttle effective to generate an electric impulse having positive and negative waves when said other part passes the part on the lay, electric circuit means including an electromagnetic device and an electronic tube having a control grid which normally prevents electric current from flowing through said tube and device, electric connections between said part on the lay and said grid including a rectifier which allows the positive wave only of said electric impulse to be impressed on said grid, said grid having the electric condition thereof altered when the positive wave of said impulse is impressed on the grid to enable current to flow through said tube and energize said device, and loom controlling means effective to stop the loom upon failure of the device to be energized at said given time in the loom cycle.

17. In protection means for a loom having a shuttle which when running properly in one direction passes a given point along the lay at a given time in the loom cycle and when running properly in the opposite direction passes a second given point along the lay at said given time in the loom cycle, two spaced electric induction units on the lay each including a coil, one unit being located at said given point and the other unit being located at said second point, means on the shuttle effective to generate an electric impulse having positive and negative waves in each coil as the shuttle travels along the lay either in said one direction or in said opposite direction, electric circuit means including an electromagnetic device and an electronic power tube having a control grid which normally prevents electric current from flowing through the tube and device, electric connections between each coil and said grid electrically connecting said coils and including rectifier means which allows the positive waves only of said electric impulses to be impressed on the grid and also prevents the impulse of each coil from passing through the other coil, said grid having the electric condition thereof altered when the positive waves of said impulses are impressed on the grid to permit electric current to flow through said tube and device to energize the latter, and loom controlling means effective to stop the loom upon failure of the device to be energized at said given time in the loom cycle.

18. In protection means for a loom having picking mechanism to propel a shuttle across a lay, loom controlling means tending to stop the loom at a given time in the loom cycle, electromagnetic means effective when energized at said given time to prevent said controlling means from stopping the loom, electric circuit means including said electromagnetic means and an electronic tube normally preventing electric current from flowing through said circuit means and electromagnetic means but effective when receiving an electric impulse to permit current to flow through the tube and circuit means to energize the electromagnetic means, and electric impulse generating means having cooperating parts one of which is on the shuttle and the other of which is on the lay effective to generate said impulse by energy derived from the picking mechanism when

said part on the shuttle passes said part on the lay.

19. In protecting means for a loom having a shuttle picked back and forth across the lay and when running properly in one direction passes a given point on the lay at a given time in the loom cycle and when running properly in the opposite direction passes a second point along the lay at said given time, two spaced electric induction units on the lay each including a magnet and a coil, one unit being located at said given point and the other unit being located at said second point, means on the shuttle effective to generate an electric impulse having positive and negative waves in each coil as the shuttle travels along the lay, either in said one direction or in said opposite direction, electric circuit means including an electromagnetic device and an electronic power tube having a control grid which normally prevents electric current from flowing through the tube and device, electric connections between each coil and said grid electrically connecting said coils and including rectifier means which allows the positive wave only of said electric impulses to be impressed on the grid and also prevent the impulse of each coil from passing through the other coil, said grid having the electric condition thereof altered when the positive waves of said impulses are impressed on the grid to permit electric current to flow through said tube and device to energize the latter, and loom controlling means effective to stop the loom upon failure of the device to be energized at said given time in the loom cycle.

20. In electric protection means for a loom having a shuttle which when running properly passes a given point along the lay at a given time in the loom cycle, an electric relay, electric loom stopping means controlled by the relay and effective to stop the loom upon failure of the relay to be energized for a period starting at said given time in the loom cycle, electric circuit means including said relay, an electronic tube having a grid, and a condenser and resistance, said condenser and resistance connected so that the condenser can discharge through the resistance, and electric means actuated by the shuttle when the latter passes said given point to effect energization of said circuit means to alter the electric condition of the grid of the tube and cause the tube to fire to energize the relay and also charge said condenser, and the condenser discharging through said resistance after the shuttle passes said given point and the circuit means due to discharge of the condenser maintaining the grid in condition to cause continued firing of the tube during said period.

21. In electric protection means for a loom having a shuttle which when running properly passes a given point along the lay at a given time in the loom cycle, an electric induction unit on the lay including a coil, a body on the shuttle capable of inducing an electric potential in the coil when the body passes over said unit due to motion of the shuttle along the lay, an electronic tube including a grid, an electromagnetic device, loom stopping means controlled by the device effective to stop the loom if the device fails to be energized for a period starting at said given time in the loom cycle but ineffective to stop the loom if the device is energized during said period, an electric condenser and a resistance connected so that the condenser can discharge through the resistance, and electric circuit means including the electromagnetic device, electronic tube and grid, condenser and resistance and said induction unit, said electric circuit means effective when the shuttle reaches said given point at said given time to change the potential of the grid and cause the tube to fire and energize the electromagnetic device and charge the condenser, the condenser discharging through the resistance after the shuttle passes said given point and said circuit means due to said discharge of the condenser maintaining the potential of the grid changed to cause continued firing of the tube.

22. In electric protection means for a loom having a shuttle which when running properly passes a given point along the lay at a given time in the loom cycle, an electric relay, electric loom stopping means effective to stop the loom if the relay fails to be energized for a period starting at said time in the loom cycle, an electric condenser, and electric circuit means including said electric relay and condenser and controlled by the shuttle and caused by the latter when the same passes said given point to cause charging of the condenser and energization of said relay, the condenser discharging through said relay after the shuttle passes said given point to keep the relay energized for said period.

23. In electric protection means for a loom having a warp shed and means to pick a shuttle through the warp shed, electronic means for stopping the loom controlled by an electric impulse generated when the shuttle is in the warp shed by cooperation of electric and magnetic elements one of which is outside the warp shed intermediate the sides of the warp shed and the other of which is on the shuttle.

24. In electric protection means for a loom in which the path of flight of a shuttle passes through a warp shed, a normally open loom controlling electric circuit which when closed at a given time in the loom cycle effects continued loom operation, electric means controlling said electric circuit located at a point along that part of the path of flight of the shuttle in the warp shed caused to effect closure of said electric circuit by the shuttle when the latter is in the warp shed and passes said point, and means effective to stop the loom upon failure of the shuttle to reach said point by said given time in the cycle of the loom.

25. In protection means for a loom operating with warp threads which are separated into different planes to define a warp shed through which a shuttle passes to lay weft in the warp shed when traveling across the lay, means creating a magnetic field extending across at least one of said planes into the warp shed, a magnetizable body so located on the shuttle as to pass through said magnetic field as the shuttle passes through the warp shed, and electric means operating incident to movement of said magnetizable body through said magnetic field controlling loom operation and effecting loom stoppage upon failure of said magnetizable body to pass through said magnetic field at a given time in the loom cycle.

26. In protection means for a loom operating with warp threads which define a warp shed, an element moving along a path within the warp shed during introduction of weft into the warp shed, a second element outside the warp shed adjacent to said path, each element including magnetic material, one of said elements having the magnetic condition thereof altered when the

first named element while in the warp shed passes the second element during introduction of weft into the warp shed, and electric circuit means controlling loom operation and dependent upon said change in the magnetic field at a given time in the cycle of the loom to effect continued running of the loom.

DONALD W. HOWE, JR.
VICTOR F. SEPAVICH.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,179,338	Lindegren	Nov. 7, 1939
2,482,943	Sepavich	Sept. 27, 1949