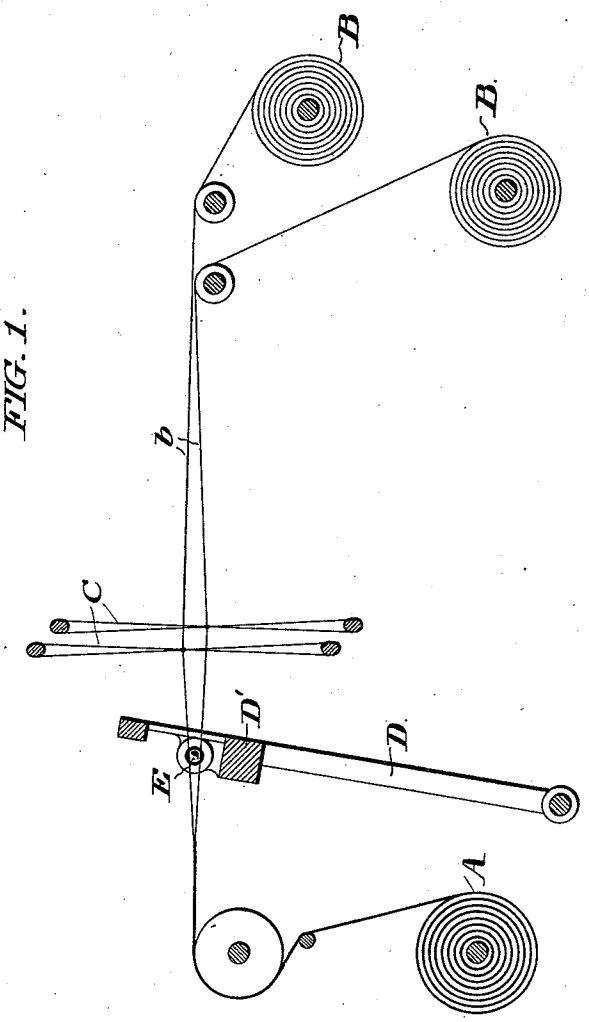
(No Model.) 5 Sheets—Sheet 1.

E. GATES.

MAGNETIC SHUTTLE MOTION FOR LOOMS.

No. 565,449. Patented Aug. 11, 1896.

FIG. 1.



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WITNESSES:

A. E. Page

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(No Model.) 5 Sheets—Sheet 2.

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MAGNETIC SHUTTLE MOTION FOR LOOMS.

No. 565,449. Patented Aug. 11, 1896.

FIG. 2.

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MAGNETIC SHUTTLE MOTION FOR LOOMS.

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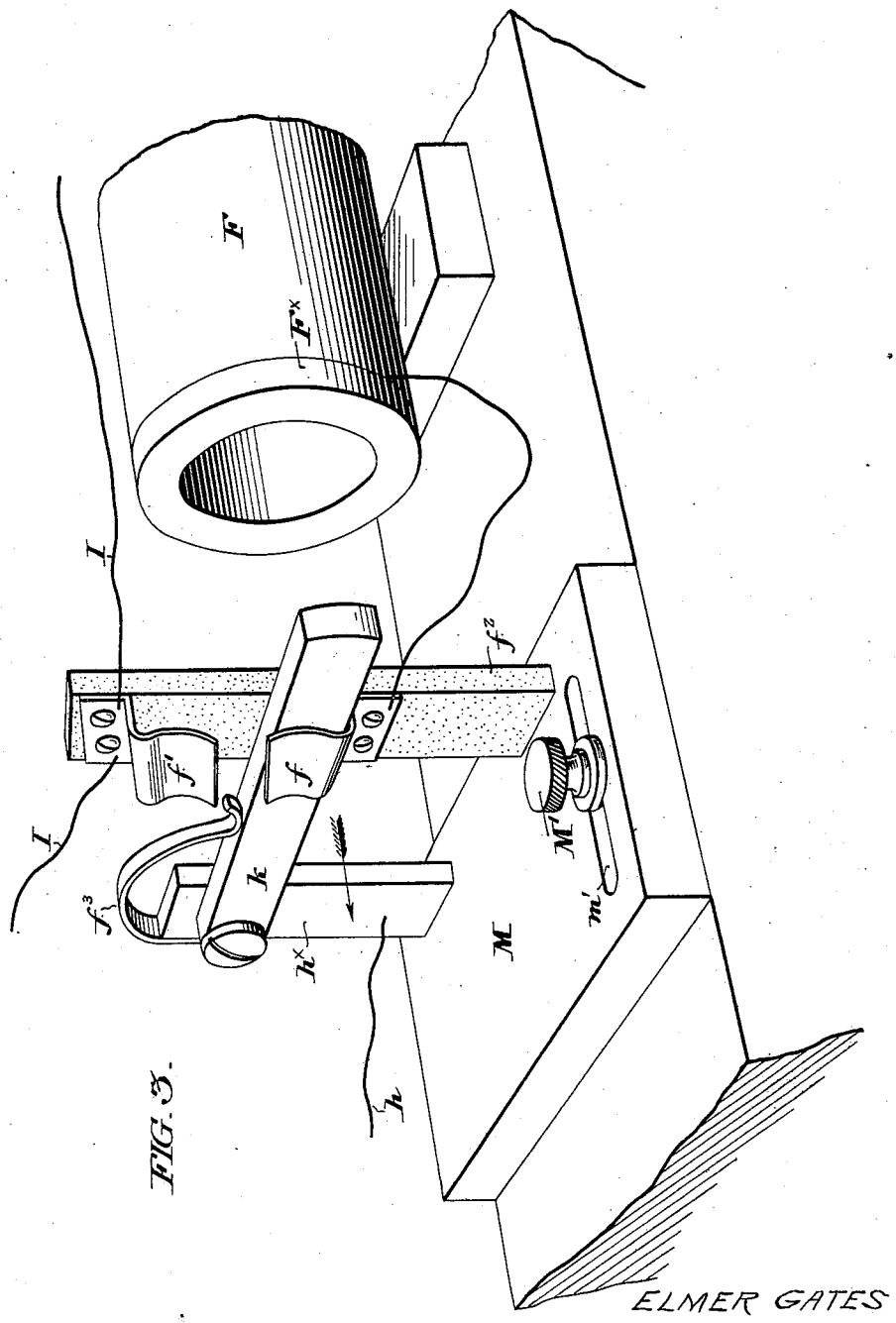

FIG. 3.

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(No Model.) 5 Sheets—Sheet 4.

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MAGNETIC SHUTTLE MOTION FOR LOOMS.

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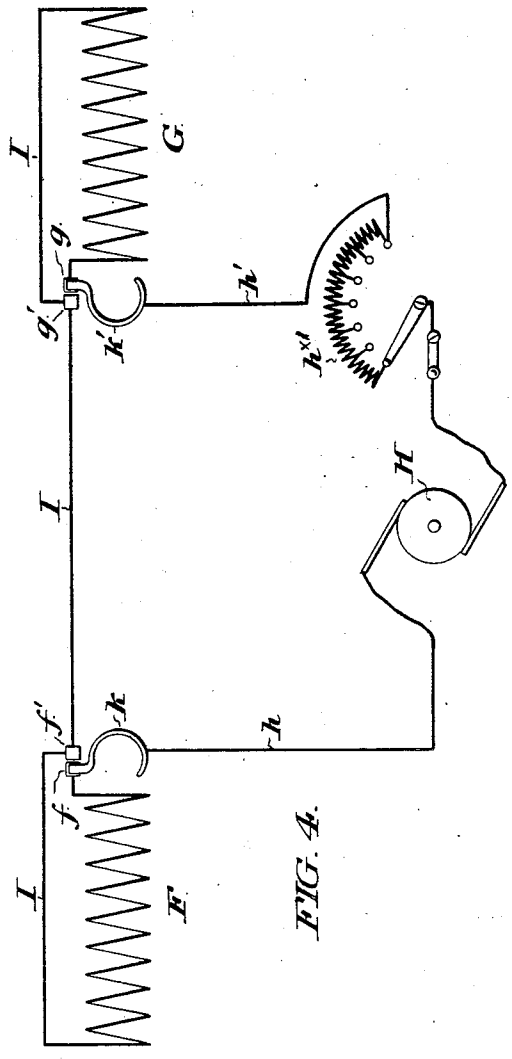

FIG. 4.

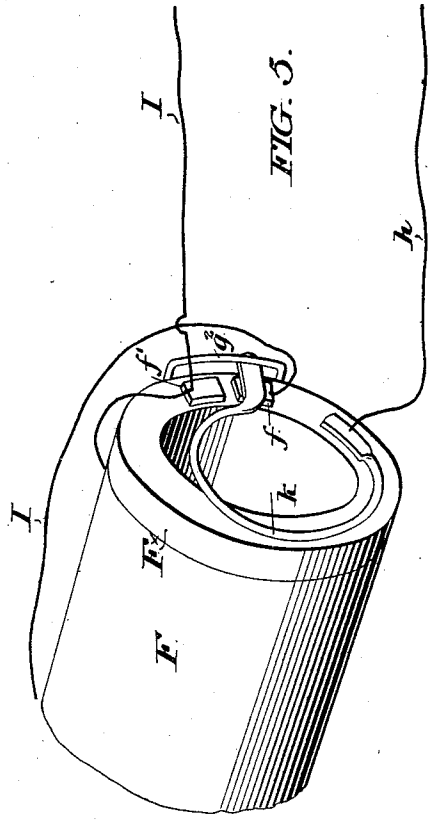

FIG. 5.

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(No Model.) 5 Sheets—Sheet 5.

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MAGNETIC SHUTTLE MOTION FOR LOOMS.

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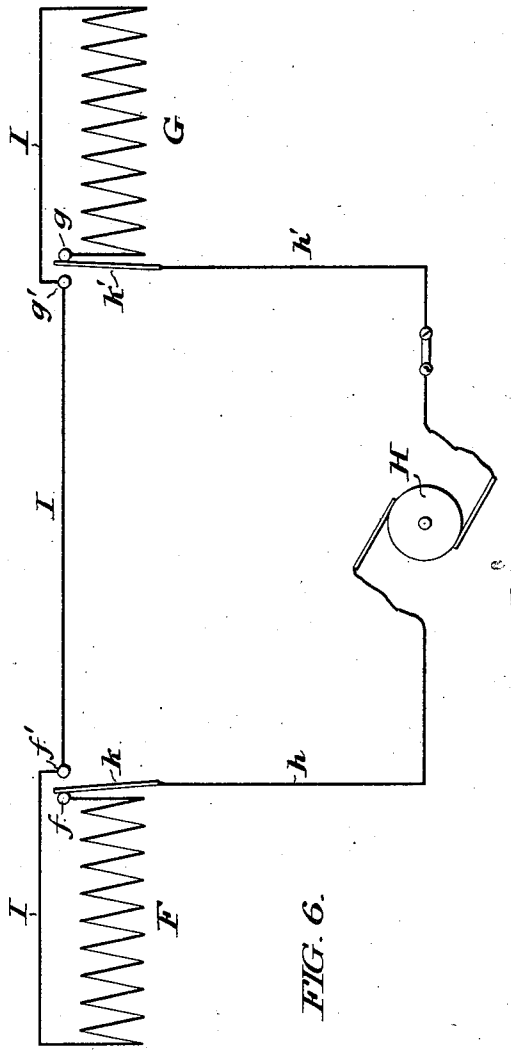

FIG. 6.

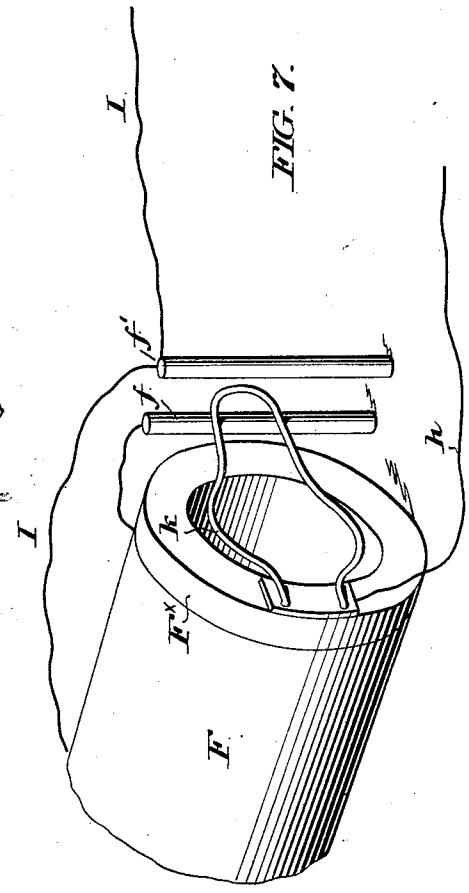

FIG. 7.

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UNITED STATES PATENT OFFICE.

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MAGNETIC SHUTTLE-MOTION FOR LOOMS.

SPECIFICATION forming part of Letters Patent No. 565,449, dated August 11, 1896.

Application filed August 5, 1895. Serial No. 558,304. (No model.)

To all whom it may concern:

Be it known, that I, ELMER GATES, a citizen of the United States, residing in the City and County of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Magnetic Shuttle Motions for Looms, of which the following is a specification:—

My invention relates to the shuttle throwing mechanism of a loom, and it is its object to substitute for the ordinary mechanical devices heretofore employed for the purpose of throwing the shuttle, electrically actuated devices of the general character hereinafter set forth.

In the accompanying drawings I show, and herein I describe, a good form of a convenient embodiment of my invention, the particular subject-matter claimed as novel being hereinafter definitely specified.

In the drawings,

Figure 1 is a view in side elevation of the cloth roller, warp beams, and threads, a pair of heddles, a lay, and a shuttle shown as resting upon the shuttle race bar, the parts mentioned being all of the parts of an ordinary loom that I deem it necessary to illustrate in explanation of my invention, which is applicable in connection with looms of any ordinary or usual construction.

Figure 2 is a diagrammatic view of a pair of coils or solenoids supposed mounted at the respective sides of a loom, and of a shuttle supposed in transit from one to the other of said solenoids.

Figure 3 is a view in perspective of a form of automatic switch which I prefer to employ.

Figure 4 is a diagrammatic view of solenoids, dynamo, circuit wires, and switches, employed in connection with the solenoids.

Figure 5 is a view in perspective of a switch of a character diagrammatically illustrated in Figure 4.

Figure 6 is a diagrammatic view of solenoids, dynamo, circuit wires, and switches, employed in connection with the solenoids.

Figure 7 is a view in perspective of a switch of a character diagrammatically illustrated in Figure 6.

Similar letters of reference indicate corresponding parts.

In the accompanying drawings,

A is a cloth roller; B B the warp beams; *b* the warp threads; C the heddle frames; D the lay carrying the shuttle race bar, D'; and E is the shuttle.

F G are a pair of solenoids or coils preferably mounted respectively upon hollow non-conducting spools, $F^{\times}$ $G^{\times}$, situated respectively at opposite sides of the loom beyond the respective extremities of the shuttle race and in approximately axial alinement with each other, being respectively inclined somewhat from the horizontal to approximate the trajectory of the shuttle which is projected from one to the other as hereinafter set forth.

Each of the coils, F and G, is in circuit with a dynamo or other suitable source of energy and the shuttle, E, is formed or provided with a mass of magnetizable metal, but is otherwise of ordinary construction.

As is well known, if a core is placed within the interior of a solenoid, as for instance that designated, F, and the circuit which includes said solenoid be closed, the influence of the coil acting upon said core will tend to draw said core into a position in which its magnetic center coincides with the magnetic center of the solenoid, and if when the core is in the position represented in dotted lines in Figure 2, in which its magnetic center Y—Y is to the left of and not in coincidence with the magnetic center X—X of the coil, the circuit is closed, the core will be drawn to a position in which its center coincides with the magnetic center of the core, and drawn so swiftly the the momentum of the core will carry it beyond the magnetic center of the coil on the right, and said core will then rebound, so to speak, to or almost to its original position, and will continue to reciprocate until it finally comes to rest in a position in which the line Y—Y coincides with the line X—X.

I have discovered that if when the core is in a position further to the left than that shown in dotted lines in Figure 2, and the circuit is first closed to propel the core to the right, and then opened, the initial impulse imparted to the core will occasion its projecting from the coil with a force determined by the strength of the current in the coil and the position of the core in the coil, F, at the moment when the circuit controlling said

solenoid was opened and the current thus turned off.

If a second coil or solenoid be placed in line with the first named, the core thus projected from the coil, F, will, by the force of the impulse thus given to it, be carried to the interior of said second solenoid, and the said second solenoid being supposed energized, the core will, under the influence of the said coil which tends to bring the core to rest with its magnetic center in coincidence with its own center, be arrested in its movement just after the magnetic center of the core passes the magnetic center of the solenoid, and cause to rebound so as to speak to the left.

If, however, in the return of the core to the left, the current is at the proper moment turned off from the second solenoid, the impulse given to propel said core to the left will serve to carry the core back to the coil, F, assumed to have been, in the meantime, placed again in circuit, so that it serves to receive and arrest the progress of the core, and to again project it to the right in the manner described, and so on.

Broadly stated my invention comprehends the provision of a pair of coils or solenoids situated respectively at the respective ends of the shuttle race, and of a shuttle formed as a core,—and the utilization of this principle of operation of the coils or solenoids for the reciprocation of the shuttle to and fro across the loom.

The turning on and off of the currents which control the coils may be effected in any desired manner, but I prefer to provide means by which the current shall be automatically controlled by a moving member of the machine and preferably by the shuttle itself, and in Figures 3 to 7 inclusive I have illustrated different arrangements whereby the switching of the current is automatically effected by the shuttle.

H is a dynamo or electric generator and, *h*, *h'*, are line conductors shown as leading therefrom, one of said wires being in Figure 4 shown as provided with a resistance coil, $h'^{\times}$, by which the strength of the current may be controlled.

The coils, F, G, are respectively provided at their inner ends with terminals, *f*, *g*, and are connected in series by the line wire, I, which is in the vicinity of the respective terminals, *f*, *g*, provided with terminals, *f'*, *g'*, and the conductors, *h*, *h'*, leading from the electric generator are provided with switch tongues, *k*, *k'*, normally respectively in contact with the respective terminals, *f*, *g*, with the result that the coils, F, G, are normally in curcuit.

The switch tongues employed may be of any preferred construction and arrangement.

In Figure 7, the switch tongue, assumed to be that designated, *k*, and of which that designated, *k'*, is a counterpart, is shown as consisting of a **U**-shaped loop of wire, the extremities of which are attached to a plate in circuit with the wire, *h*, mounted on the end of the spool, and the free rounded end of which loop extends between the terminals, *f*, *f'*, but normally rests against the terminal, *f*.

The side members of the said loop of wire are spread apart intermediate of their length a distance which is slightly less than the greatest diameter of the core or shuttle, but said loop is sufficiently resilient to permit of the passage of the shuttle between said members.

As will be understood, assuming the shuttle mounted in said solenoid, F, and given an impulse to the right in the manner described, its end will when the shuttle reaches a predetermined position, protrude from the coil between the sides of the **U**-shaped loop forming the switch tongue and force said switch away from the terminal, *f*, and into contact with the terminal, *f'*, with the result (see Figures 4 and 6) of throwing the coil, F, out of circuit, and thereby, as explained, enabling the shuttle to be carried by the force of its impulse out between the side members of the switch, across the loom, and to the interior of the coil, G.

As soon as the shuttle leaves the coil, F, the switch, *k*, automatically reassumes its normal set, in contact with the terminal, *f*, to throw the coil, F, again in circuit.

The coil, G, being provided with a switch which is, as explained, the counterpart of that described with relation to the coil, F, the shuttle will, in entering said coil, pass between the side members of said switch without altering the arrangement of the circuit, and, said coil being normally in circuit, the travel of the shuttle will be arrested by the magnetic action of the coil and said shuttle will be returned to the left with the result that it will encounter the switch, *k'*, of the coil, G, and throw said coil out of circuit and thereupon continue its travel back to the coil, F.

In the arrangement shown in Figure 5 the terminals, *f*, *f'*, are shown as conducting blocks mounted upon the end of the non-conducting spool, and the switch, *k*, itself is shown as a **C**-shaped spring one end of which, in circuit with the wire, *h*, is secured to the end of the spool, while a portion of its body extends across the end of the spool, in the path of the shuttle, and its free extremity rests normally upon the terminal, *f*.

The shuttle in its passage through the spool passes beneath the switch, *k*, extending across the bore of the spool, and deflects it upwardly and into contact with the terminal, *f'*, with the result of cutting out the coil, F, in the manner described.

The free end of the switch, *k*, in this arrangement is of a breadth greater than the distance between the terminals, *f*, *f'*, so that the switch, in its movement, does not leave one terminal until after it has made contact with the other, and thereby the breaking of

the circuit and the consequent sparking is avoided.

g^2, is a yoke of wire which serves as a guide to maintain the free end of the switch in operative position.

In the arrangement shown in Figure 3, the switch tongue, k, is shown as a latch bar pivotally mounted as to one end upon an upright member of conducting material, $h^\times$, with which the wire, h, is in circuit.

The terminals, f, f', are shown as latch-receiving plates, mounted some little distance apart upon an upright, f^2, of non-conducting material, and the latch is shown as normally resting upon the lower of said terminals, f, being normally held in contact therewith by the force of gravity, assisted, if desired, by a small spring, f^3, connected with the upright, $h^\times$, and bearing upon the switch bar.

The switch or latch bar, k, is in the construction of Figure 3, arranged at such height and in such relation to the adjacent coil that in the operation of the loom the shuttle will pass beneath the said bar and in passing elevate it into contact with the terminal, f', with the result hereinbefore described, of cutting out of circuit the coil F.

The uprights, $h^\times$, f', are conveniently mounted upon the supporting block, M, provided with a longitudinal slot, m', through which a thumb screw, M', passes into engagement with the permanent framework of the loom, with the result, as will be obvious, that the switch may be set in any desired position of adjustment with relation to the coil.

Having thus described my invention, I claim:—

1. In a loom, a shuttle formed as an armature, and means for throwing said shuttle, consisting of, a pair of coils or solenoids mounted at the respective ends of the shuttle race, an electric generator in circuit with said coils or solenoids, switches adapted to be opened to throw said coils out of circuit and placed in the path said shuttle so as to be operated by it,—substantially as set forth.

2. In a loom, a shuttle formed as an armature, and means for throwing said shuttle, consisting of, a pair of coils situated in substantial axial alinement at the respective ends of the shuttle race, an electric generator, circuit wires leading from said coils to the electric generator and provided with switches normally closed, one located in proximity to each coil, and each adapted when open to throw the adjacent coil out of circuit, said switches being arranged in the path of said shuttle so as to be operated by it,—substantially as set forth.

3. In a loom, a shuttle formed as an armature, and means for throwing said shuttle, consisting of, a pair of solenoids, an electric generator, said coils being connected in series, line wires leading from the electric generator to the respective solenoids, switches mounted in connection with the respective line wires and each adapted to make contact alternately with the adjacent coil to place said coil in circuit or with the wire connecting the two coils to cut said coil out of circuit, said switches being normally in position to maintain said coils in circuit and placed in the path of said shuttle so as to be operated by it,—substantially as set forth.

4. In a loom, a shuttle formed as an armature, and means for throwing said shuttle, consisting of,—a pair of solenoids located at opposite sides of the loom and connected in series,—an electric generator,—line wires leading from said generator to the vicinity of the respective solenoids,—a switch adapted to connect the first line wire alternately with the coil of the first solenoid and the conductor connecting the two solenoids,—and a switch adapted to connect the second line wire alternately with the coil of the second solenoid and the conductor connecting the two solenoids,—substantially as set forth.

5. In a loom, a shuttle formed as an armature, and means for throwing said shuttle, consisting of,—a pair of solenoids located at opposite sides of the loom and connected in series,—an electric generator,—line wires leading from said generator to the vicinity of the respective solenoids,—a switch adapted to connect the first line wire alternately with the coil of the first solenoid and the conductor connecting the two solenoids,—and a switch adapted to connect the second line wire alternately with the coil of the second solenoid and the conductor connecting the two solenoids,—said switches being mounted in the path of so as to be thrown by a moving part of the loom,—substantially as set forth.

6. In a loom, a shuttle formed as an armature, and means for throwing said shuttle, consisting of,—a pair of solenoids located at opposite sides of the loom and connected in series,—an electric generator,—line wires leading from said generator to the vicinity of the respective solenoids,—a switch adapted to connect the first line wire alternately with the coil of the first solenoid and the conductor connecting the two solenoids,—and a switch adapted to connect the second line wire alternately with the coil of the second solenoid and the conductor connecting the two solenoids,—said switches being mounted in the path of said shuttle so as to be operated by it,—substantially as set forth.

7. In a loom, in combination, a pair of solenoids mounted on hollow spools located at opposite sides of the loom,—an electric generator,—line wires leading from the generator to the vicinity of the respective solenoids, and each of which is in circuit with a conducting pivotal latch bar extending across the mouth or bore of the adjacent spool, the free or front ends of which latch bars normally rest in plates or sockets which constitute the terminals of the respective coils or solenoids,—a pair of plates or sockets, independent of the plates or sockets first named, located respectively a short distance from

said respective sockets first named, and adapted to be encountered by the latch bar when said bar is moved away from said plates or sockets first named,—and a conductor by which the two solenoids are connected in series, said conductor being connected with both of the second named plates or sockets,—and a shuttle, formed as an armature, which, in its travel, passes beneath said latch bars and elevates them into contact respectively with the second named plates or sockets,—substantially as set forth.

In testimony that I claim the foregoing as my invention, I have hereunto signed my name this 9th day of July, A. D. 1895.

ELMER GATES.

In the presence of—
F. NORMAN DIXON,
A. E. PAIGE.