W. ROUTLEDGE.

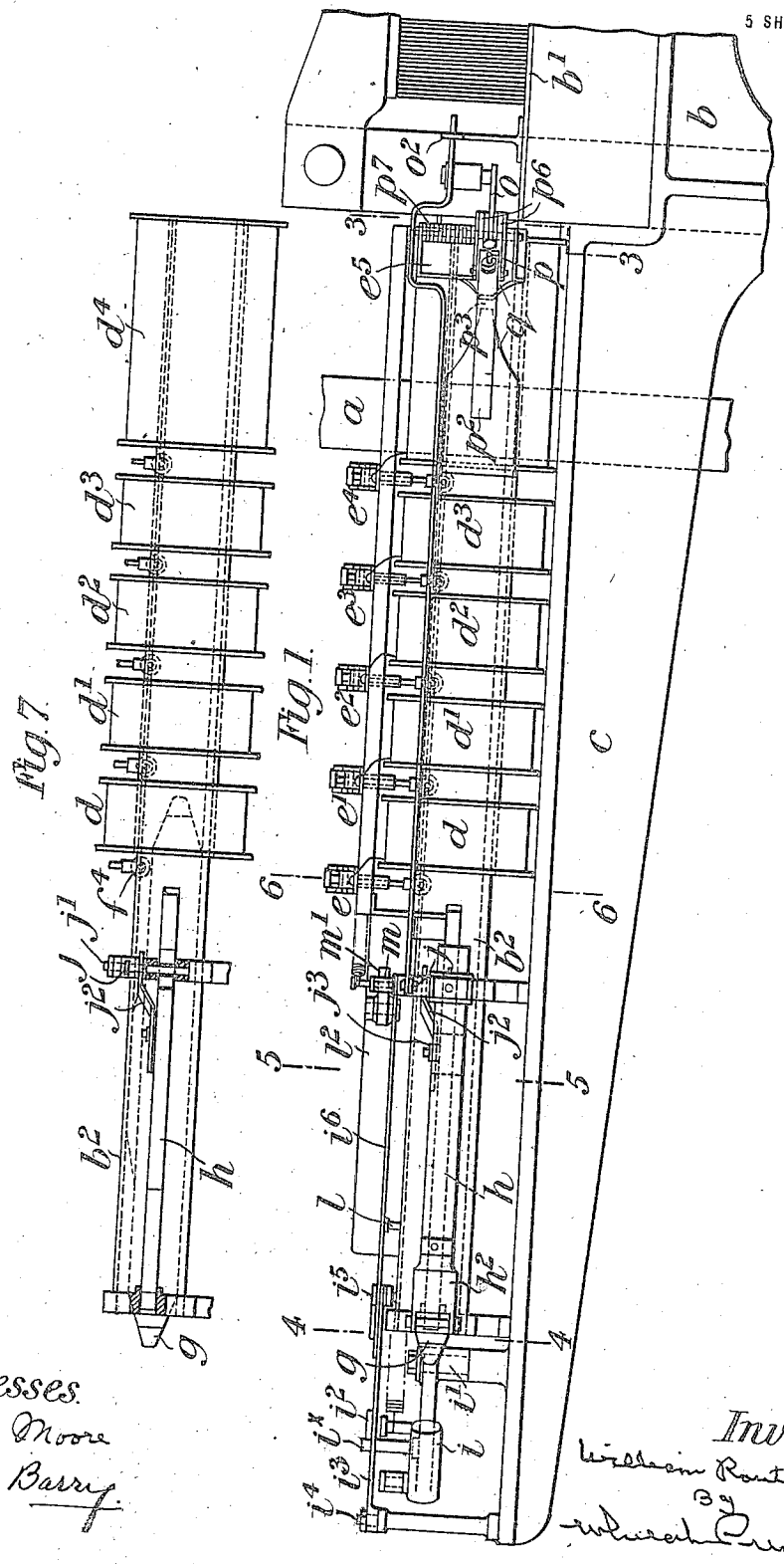
MAGNETIC SHUTTLE MOTION.

APPLICATION FILED DEC. 28, 1916.

1,302,437.

Patented Apr. 29, 1919.

5 SHEETS—SHEET 1.



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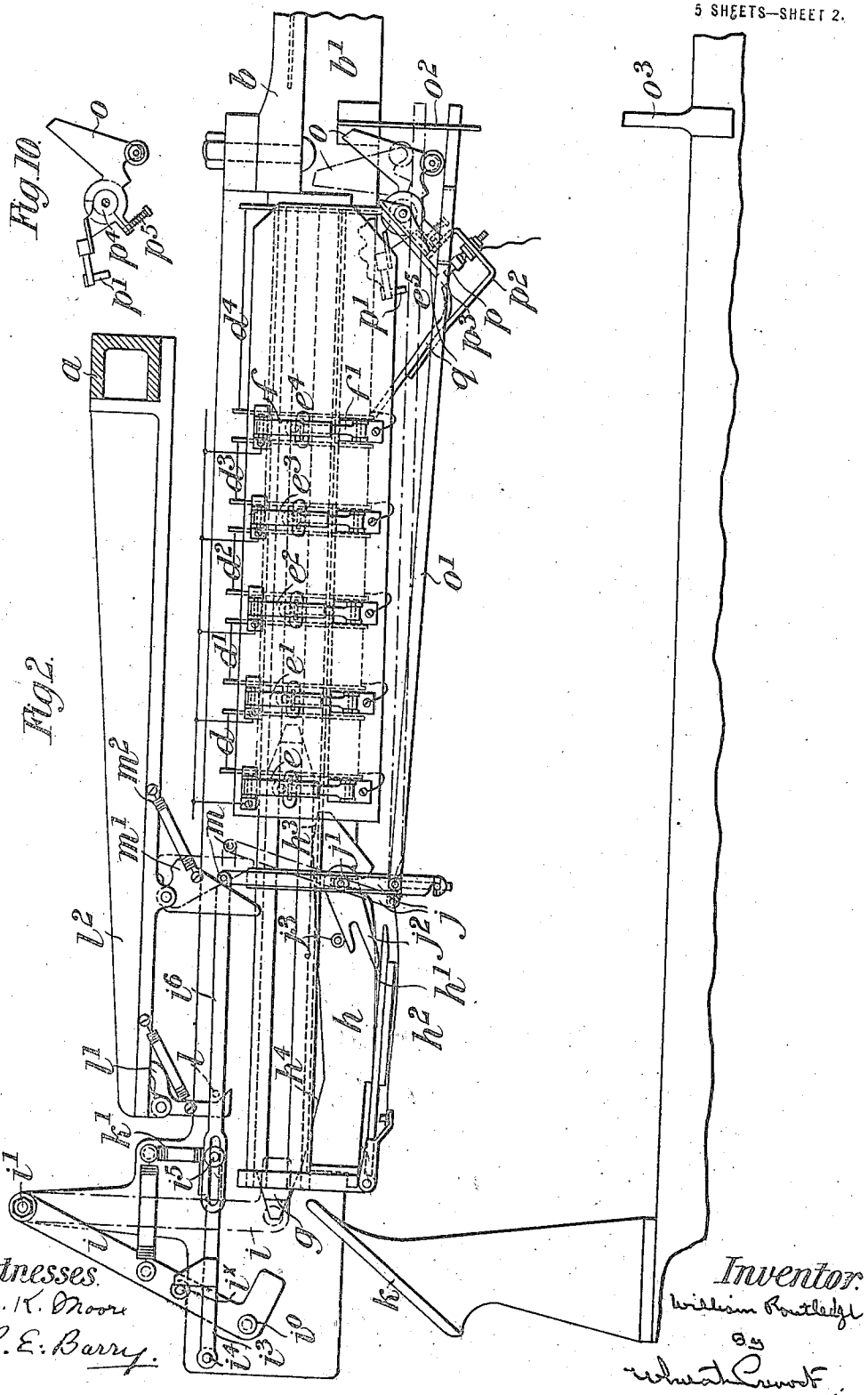
5 SHEETS—SHEET 2.

Fig 10.

Fig 2.



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5 SHEETS—SHEET 3.

Fig. 3.

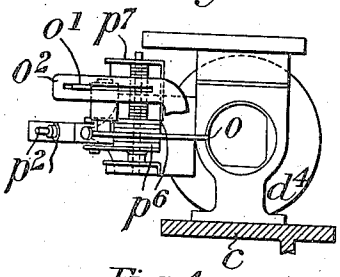


Fig. 4.

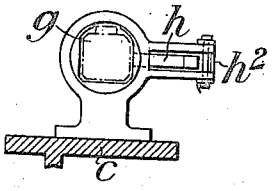


Fig. 5.

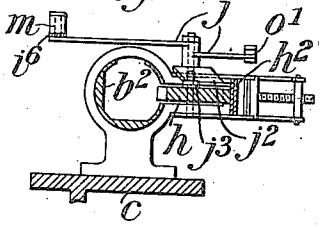


Fig. 6.

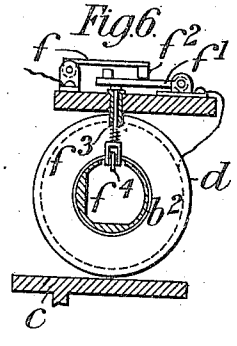


Fig. 16.

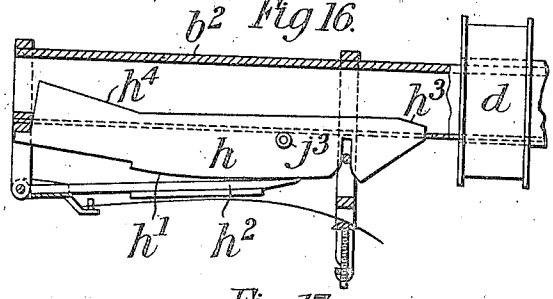


Fig. 17.

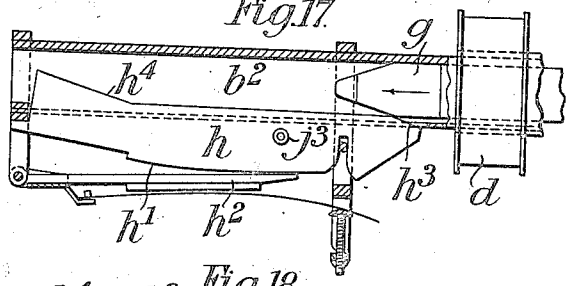


Fig. 18.

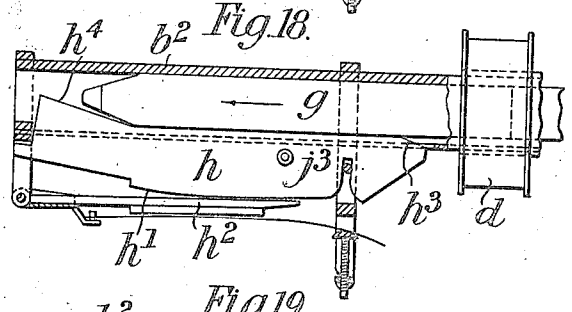


Fig. 19.

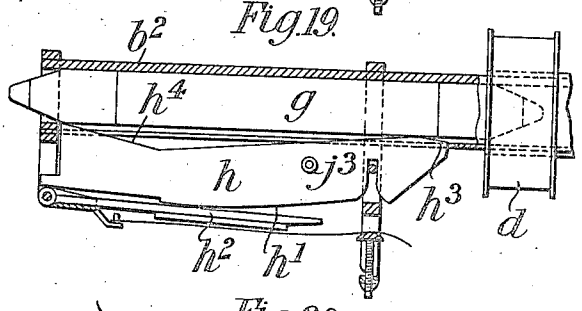
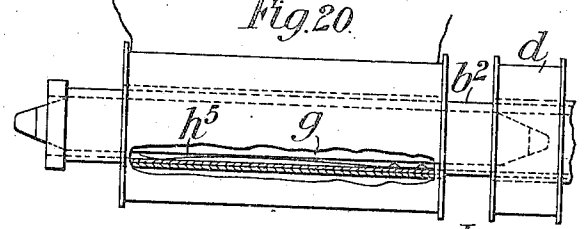


Fig. 20.



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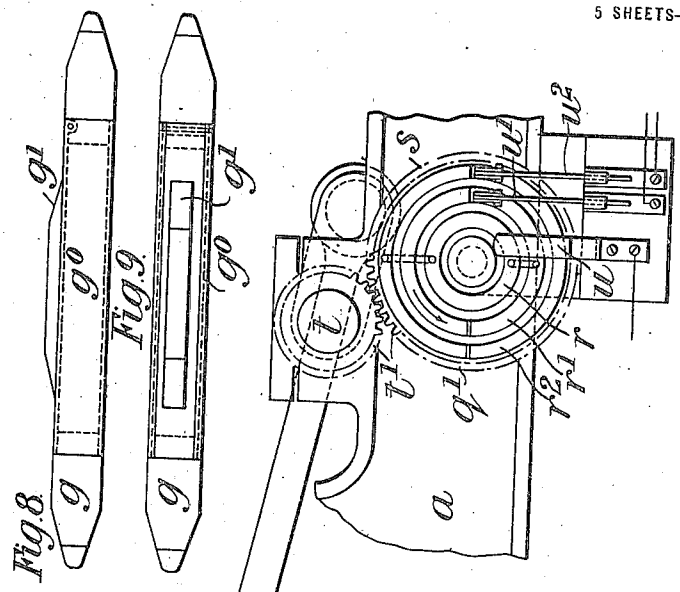
5 SHEETS—SHEET 4.



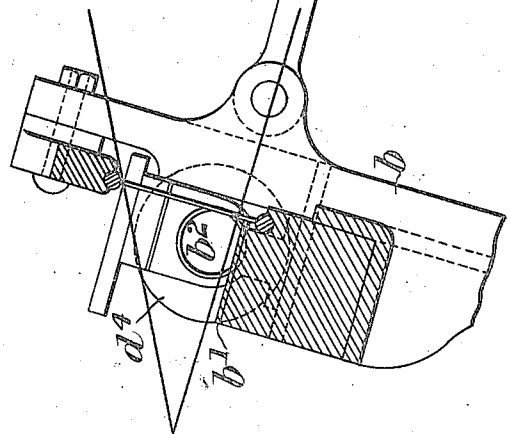
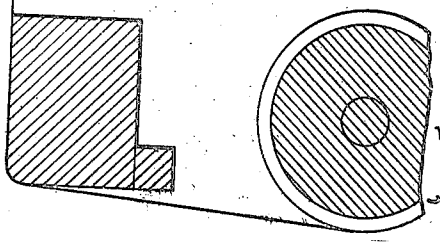


Fig.11.



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5 SHEETS—SHEET 5.

Fig. 12.

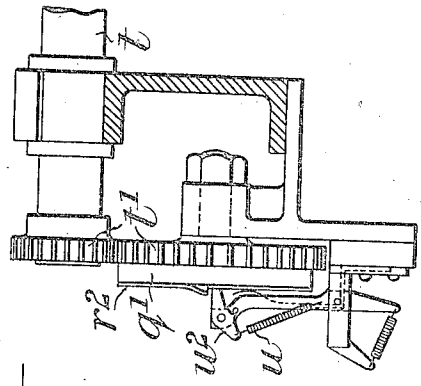


Fig. 13.

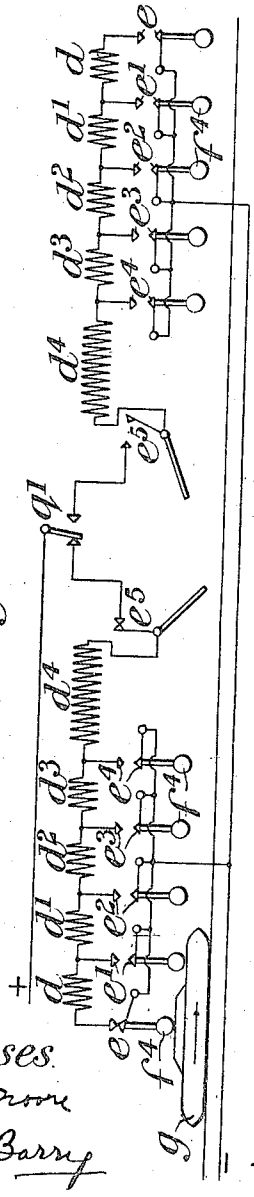


Fig. 14.

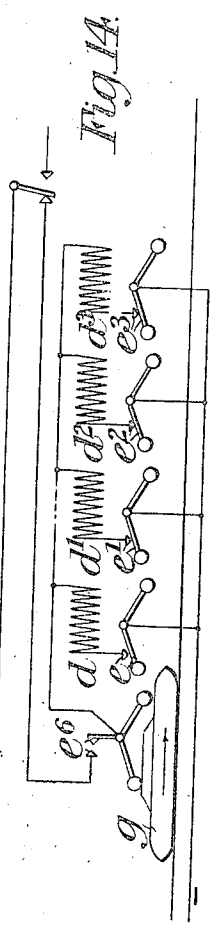
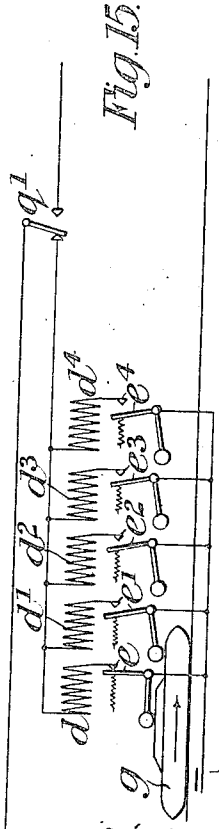


Fig. 15.



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WILLIAM ROUTLEDGE, OF MIDDLESEX, ENGLAND.

MAGNETIC SHUTTLE-MOTION.

1,302,437. Specification of Letters Patent. Patented Apr. 29, 1919.

Application filed December 28, 1916. Serial No. 139,267.

To all whom it may concern:

Be it known that I, WILLIAM ROUTLEDGE, a subject of the King of Great Britain, residing at 4 Laurel Bank, Hoop Lane, Golders Green, Middlesex, England, have invented new and useful Improvements in or Relating to Magnetic Shuttle-Motions, of which the following is a specification.

This invention relates to improvements in electro-magnetic shuttle throwing gear for weaving looms.

Electro-magnetic picking motions are known in which the shuttle is influenced by electro-magnets successively put into and out of an electric circuit and over which the shuttle is drawn. Also picking motions have been proposed in which a single solenoid is mounted at each end of the shuttle race in conjunction with which the shuttle acts as a core, the cutting of the solenoids out of the electric circuit being controlled by switches under the action of the shuttle, and the arrangement being such that the shuttle is, at each end of the race, projected along the race to the other end by being drawn into the solenoid which is then cut out of circuit so as to leave the shuttle free to move under the momentum thus acquired.

Now, according to this invention use is made of a multiple solenoid at each end of the shuttle race, the individual sections of each solenoid being combined with switching gear operated by the shuttle in such a manner that as the shuttle travels through the solenoid the active field of the latter is maintained in front of the shuttle so that a pull is imparted to, and maintained upon it to project it along the race.

In the accompanying drawings:—

Figure 1 is a front elevation of the left hand side of a portion of a weaving loom provided with the improvements, and

Fig. 2 is a plan of the same.

Figs. 3, 4, 5 and 6 are respectively sections on the lines 3—3, 4—4, 5—5 and 6—6 of Fig. 1.

Fig 7 is an elevation of the solenoid shown in Figs. 1 and 2 detached.

Figs. 8 and 9 are respectively a side view and a plan of the shuttle.

Fig 10 is a plan of a detail.

Fig. 11 is a sectional side view showing the slay or reed, the winding-on beam and the shaft for oscillating the slay.

Fig. 12 is a view at right angles to Fig. 11.

Fig. 13 is a diagram illustrating the electric circuits.

Fig. 14 is a similar view to Fig. 13 illustrating a modified arrangement of the circuits, and

Fig. 15 is a similar view illustrating a further modified arrangement of the circuits.

Figs. 16, 17, 18 and 19 are sectional plan views illustrating the shuttle checking mechanism employed in connection with the invention.

Fig. 20 is a similar view to the latter figures illustrating a modification.

a indicates the frame of a portion of a loom to which the invention is applied and b the slay carrying the shuttle race b^1. c indicates one of two brackets arranged on opposite sides of the slay and upon which the sectional solenoids are carried. Each solenoid surrounds a tube b^2 which forms a continuation of the race b^1 at either end thereof.

In the drawings the solenoid is represented as comprising five sections, d, d^1, d^2, d^3, d^4, respectively, the sections d, d^1, d^2, d^3 being shown as of equal length while the section d^4 is made of greater length for a purpose hereinafter mentioned.

In the arrangement shown in the drawings each section of the solenoid has arranged in connection with it switches e, e^1, e^2, e^3, e^4 corresponding respectively with the several sections d, d^1, d^2, d^3, d^4.

Each switch is represented as being composed of two pivoted arms f, f^1 Fig. 6, which bear one against the other, the arm f being provided with a spring at its pivot and with a piece of insulating material f^2 for normally retaining the arms out of contact while the other arm f^1 is designed to make electrical contact with the arm f. The arm f^1 has in connection with it a spring plunger f^3 one end of which projects within the tube b^2 into the path of the shuttle and carries a roller f^4 so that as the shuttle travels through the solenoid it will act against the said roller and press back the plunger to place the arms f, f^1 in contact.

g is the shuttle shown detached in Figs. 8 and 9, and formed with a tubular metal

body g^0 which is square in cross section the tubes b^2 being formed with a flat back and bottom for the shuttle to bear against when being propelled. The shuttle is provided with capped wooden ends in the well known manner and the metal body has upon it a cam strip g^1 formed on the lid of the shuttle which strip during the traverse of the shuttle operates the rollers f^4 of the switches e—e^4. It will be understood, that the position of the switches e—e^4 with relation to the shuttle must be such that when the shuttle has received its maximum pull into one solenoid section the current shall be cut off from this section so that there shall be no counteracting effect upon the shuttle in the next section.

It will be noticed that the section d^4 of the solenoid which effects the final propelling action on the shuttle is made of considerably greater length than the other sections d—d^3 of the solenoid and furthermore that as the latter sections are cut out and the resistance in the circuit correspondingly reduced that an increased magnetic effect will take place in the section d^4 so that the shuttle will leave the solenoid under a considerable impulse to throw it across the slay. An appreciable resistance will also remain in the circuit. One or more of the small sections may be wound to a considerably higher resistance than the others, say d or d, d^1, the object of this being to reduce the current at first contact. By the time the high resistance coils are dropped out the shuttle has time to attain considerable speed and the induction effect of the moving iron then prevents any further abnormal rise of current. The section d^4 in addition to being provided with the switch e^4 as before referred to has arranged in conjunction with it another switch e^5 which is arranged in such a position with relation to the switch e^4 that it will break the circuit at the moment when the shuttle reaches the point of greatest attraction and so prevent any counteracting effect upon the shuttle as hereinbefore stated.

The shuttle having left one solenoid travels through the opposite solenoid where its motion is arrested by a check h. This check, which is illustrated in Figs. 16 to 19, comprises a block which normally projects within the tube b^2 into the path of the shuttle beyond the end of the solenoid as shown in Fig. 16, the said block having its front surface h^1 curved so that it will roll against a spring-arm h^2, while the back surface of the check-block is formed with inclines h^3, h^4 at its ends. The first impact of the shuttle is upon the surface h^3 of the check, the result of which is that the said check rolls on the arm h^2, as shown in Fig. 17. As the shuttle advances, the point of contact between the block h and the spring-arm h^2 will advance nearer the fulcrum of the arm so that the pressure of the block will be increased. Such point of contact gradually advances nearer to the said fulcrum until the advancing point of the shuttle rides along the incline h^4 and forces the block h still more forcibly against the arm, as shown in Fig. 19 and which is the position of rest of the shuttle this position being also indicated in Fig. 2.

Instead of the check block above described a solenoid may be employed into which the shuttle enters as shown in Fig. 20, and to avoid any to and fro action of the shuttle when in the solenoid a spring clip h^5 may be used which will bear friction-wise against the shuttle.

As the shuttle itself controls the current fed to the solenoid the position of the shuttle before throwing must be clear of the contacts or switch levers. There is, therefore, provided a lever arm or similar device worked from some moving part of the loom to push the shuttle into the contact making position at the right moment. Further, in order to relieve the solenoid of the duty of overcoming the inertia of the shuttle the lever device may be so arranged that it gives to the shuttle a "flying" start.

This starting is advantageously effected by the following means which are arranged in conjunction with the outer extremity of each solenoid. These means comprise a spring hammer i pivoted at i^1 to the slay and held against the pull of its spring in the position shown in Fig. 2, by a stop-lug i^2 on an arm i^3 pivoted at i^4 to the slay, the said lug acting against a pin i^x on the hammer. This arm i^4 is jointed at i^5 to the slotted end of a link i^6, the other end of which is jointed to one end of a double ended lever j having a pivot j^1, the said pivot also carrying an arm j^2 which bears on one side against the outer end of the arm h^2 and at the other side against a roller j^3 on the check-block h. The hammer i is provided with a roller i^0 which, when the slay is swung toward the front of the loom to beat up the weft, makes contact with an inclined surface k fixed on the framing of the loom so that the hammer is forced from the position indicated by the dotted lines in Fig. 2, to that indicated by the full lines, the pin i^x being caused to ride over the lug i^2, the latter yielding against the pull of a spring k^1 connected to the outer end of the arm i^3. In order to trip or release the hammer i from the lug i^2 to strike and start the shuttle the link i^6 is provided with a pin l on its underside, which on the backward movement of the slay, will come into contact with a spring stop l^1 pivoted to a bracket l^2 carried on the frame a, the said link and consequently the

arm i^3 being forced back against the pull of the spring k^1.

To enable the shuttle to be free of the grip of the check h before being operated upon by the hammer i, the arm j is provided with a roller m designed, when the slay is swung forward to beat up the weft, to allow a spring cam-piece m^1, pivoted to the bracket l^2, and which is shown bearing against the said roller by the pull of a spring m^2, to swing from the position shown in the full lines in the said figure to the position shown in the dotted lines so that, when the slay again moves rearward, the said roller will come into contact with the left hand edge of the said cam-piece and will be moved together with the upper end of the lever j to the left so that the arm j^2 by acting upon the arm h^2 relieves the pressure of the latter against the block h. The normal position of the arm j is indicated by the dotted lines in Fig. 2, the position in full lines being that which the said arm assumes when the shuttle is in the position shown, the check block h through the medium of the roller j^3 having moved the arm j^2 into the position shown.

The cut-out switch e^5, which is operated by the shuttle g as the latter leaves the solenoid section d^4, is left in position in which it will not impede the return of the shuttle and this necessitates the resetting of the arm o of the said switch after the shuttle has been returned. This resetting is effected during the next forward movement of the slay after the return of the shuttle through the medium of an arm o^1 pivoted to one end of the lever j and carried in a slot in a guide o^2 at its outer end, so as to project slightly in the path of a stop o^3 carried on the frame at the front of the loom. It will thus be seen that as the slay swings forward the arm o^1 will impinge against the stop o^3 and be moved from the full line position to that shown in dotted lines in Fig. 2, whereby the arm o is also moved from the full line position to that shown by dotted lines into the path of the shuttle.

The electrical contacts p, p^1 of the switch e^5 are respectively carried on a fixed support p^2 in proximity to a gap p^3 in a spark blow-out hereinafter described and upon a disk p^4 carried within the hub of the lever o. The parts p^4 and o are adapted to move in one direction only with relation to one another and are normally held together by means of a spring p^5, Fig. 10. With this arrangement when the arm o is reset, as hereinbefore described, the said lever and disk p^4 will be moved together until the contact p^1 presses against the contact p, the slightly further movement of the arm o necessary for resetting will compress the spring p^5 so that the contacts p, p^1 are under spring pressure and so make a good contact. Friction washers p^6 are arranged above and below the disk p^4 and hub of the lever o, as shown in Fig. 3, a spring p^7 arranged around the pivot of the switch being employed for pressing them together. This friction device prevents the spring p^5 reacting to relieve pressure on the contacts p, p^1 after the stop o^3 has ceased to act upon the arm o.

q, q are the iron magnetic poles on the outside of the solenoid d^4 and between the ends of which is formed the gap p^3 in which the contacts p, p^1 are arranged and which act as a blow-out. It will thus be seen that the magnetic field of the solenoid is used for the purpose, the return being by way of the said poles. To reinforce the magnetism the iron may be wound.

q^1, Figs. 11 and 12, is the selector switch for placing the solenoid at either end of the shuttle race in condition to receive current alternately and is employed to obviate the disadvantage which would result if both solenoids were in condition to receive current simultaneously as in the latter case, in the event of the shuttle being thrown short and lodging within one of the sections of a solenoid, it would be prematurely returned and probably damage the warps. This switch comprises three concentric metallic rings r, r^1, r^2, carried on a disk s driven from the shaft t, which oscillates the slay gear wheels t^1 so proportioned that the said disk rotates once for two oscillations of the slay. The inner ring r has a spring brush or contact u in rubbing contact with it the said brush being connected to the source of current while the two outer rings r^1, r^2 are divided in equal parts and insulated from each other as indicated, these rings r^1, r^2 having respectively spring contacts u^1, u^2 in rubbing contact with them and which contacts serve to supply current to the two solenoids. As shown in Fig. 11, it will be seen that the ring r is in electrical connection with the lower half of the ring r^1 and with the upper half of the ring r^2 so that the current supplied to the brush u will alternately be supplied to the contacts u^1, u^2.

In the operation of the loom assume the shuttle to have just been received from the side of the loom, not shown, and to be in the position indicated in Figs. 2 and 19, the other parts of the mechanism being also in the positions shown in Fig. 2. If now the slay be moved forward to beat up the weft the cam-piece m^1 will be allowed to assume the dotted line position and the arm o^1 will come into contact with the stop o^3 and reset the arm o in the path of the shuttle as hereinbefore described at the same time closing

the contacts p, p^1 of the switch e^5. On the return of the slay to the position shown, the roller m will ride against the left edge of the cam piece m^1 to actuate the arm j^2 to relieve the grip of the block h upon the shuttle as hereinbefore described and the pin l upon the link i^6 will come into contact with the stop l^1 so that the said link will be deflected and operate the arm i^3 to trip and release the hammer i which, under the influence of its spring, will strike the rear end of the shuttle and start it on its journey to the opposite side of the loom. The shuttle will then come into contact with and raise the roller f^4 of the switch e the contacts of which will then be closed and allow the current to flow through all of the sections of the solenoid and cause the section d to attract the shuttle, the selector switch having just previously been operated to direct the current to the left sectional solenoid. The shuttle then operates each switch in turn and is successively attracted by each solenoid section and then comes into contact with the arm o which it deflects separating the contacts p, p^1 so as to prevent any action of the solenoid upon the shuttle as the latter is leaving it, the shuttle then passing through the shed and the other solenoid to a position corresponding with that shown in Fig. 2. The slay will now again be moved forward to beat up the weft with the result that the lever j will be moved, when clear of the cam-piece m^1, to the dotted line position by the action of the spring arm h^2 upon the arm j^2 the block h being at the same time moved by the said spring arm to the position shown in Fig. 16 ready to receive the shuttle on the next throw. The movement of the lever j to the dotted line position will also move the arm o^1 toward the left so that it no longer projects in the path of the stop o^3, hence the latter cannot act to reset the arm o to cause the arm to form an obstruction to the shuttle. The forward movement of the slay also causes the incline k to reset the hammer to the full line position. On the backward movement of the slay to the position shown in Fig. 2 the shuttle will be returned by the mechanism at the other side of the loom, the shuttle again assuming the position shown in the said figure, moving the lever j through the medium of the block h to the full line position so that the cam-piece m^1 is also moved in the full line position and the arm o^1 again projected in the path of the stop o^3.

Instead of arranging the sections of the solenoids in series as hereinbefore described they may be arranged in parallel; this is indicated in Fig. 14, each solenoid switch being controlled by two rollers f^4 and an additional switch e^6 is employed also having two rollers. On the outward journey the said switch will first be closed by the shuttle and remain closed so as to feed current to all the solenoid sections while the other switches will be opened to cut out the solenoid sections in turn. On the return of the shuttle the switches of the solenoid sections will be closed and the switch e^6 opened. No electrical effect will result from this as the current is cut off by the selector switch.

Instead of the solenoid sections being all in the circuit simultaneously and cut out as required as previously described they may be arranged to be successively cut in and out by the passage of the shuttle. This arrangement is shown clearly in Fig. 15 and will require no further description.

It is to be understood that the invention is not limited to the arrangements hereinbefore described as it will be obvious that the construction of the switches and other elements of the apparatus may be varied to produce the desired results. Also it will be understood that the switches instead of being arranged so that they only cut out the solenoid sections successively during the traverse of the shuttle, can be adapted to cut in the section in front of the shuttle successively and to cut out the sections which the shuttle has passed.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In a loom, the combination with an oscillating slay provided with a shuttle race and shuttle, of electrically operated means for throwing said shuttle, a hammer pivotally connected to said slay, a spring for moving said hammer toward the shuttle race for starting said shuttle, a roller provided on said hammer adapted to engage an inclined surface on the loom frame when the slay is moved forward for moving said hammer away from the race, a pin provided on the hammer, an arm pivotally connected to the slay and carrying a latch which engages the hammer pin to normally prevent the hammer from moving toward said race, a link having a slotted end pivotally connected to the free end of the arm, and a pin carried by said link adapted to be engaged by a stop on the loom frame when the slay is moved rearwardly for swinging the arm and link forwardly to release the catch and permit the spring to move the hammer toward the race.

2. In a loom, the combination with a slay provided with a shuttle race and shuttle, of electrically operated means for throwing said shuttle across the shuttle race, a switch at each end of the race operated by the shuttle when the shuttle is moving toward the race, a brake at each end of the slay for ar-

resting the movement of the shuttle, means for releasing the brakes to permit the shuttle to freely leave the same, mechanical means for starting the shuttle toward the race, stops provided on the loom frame, and switch closing means connected to said brakes adapted to be engaged by said stop when the slay is moved forward and the shuttle is engaged by a brake.

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