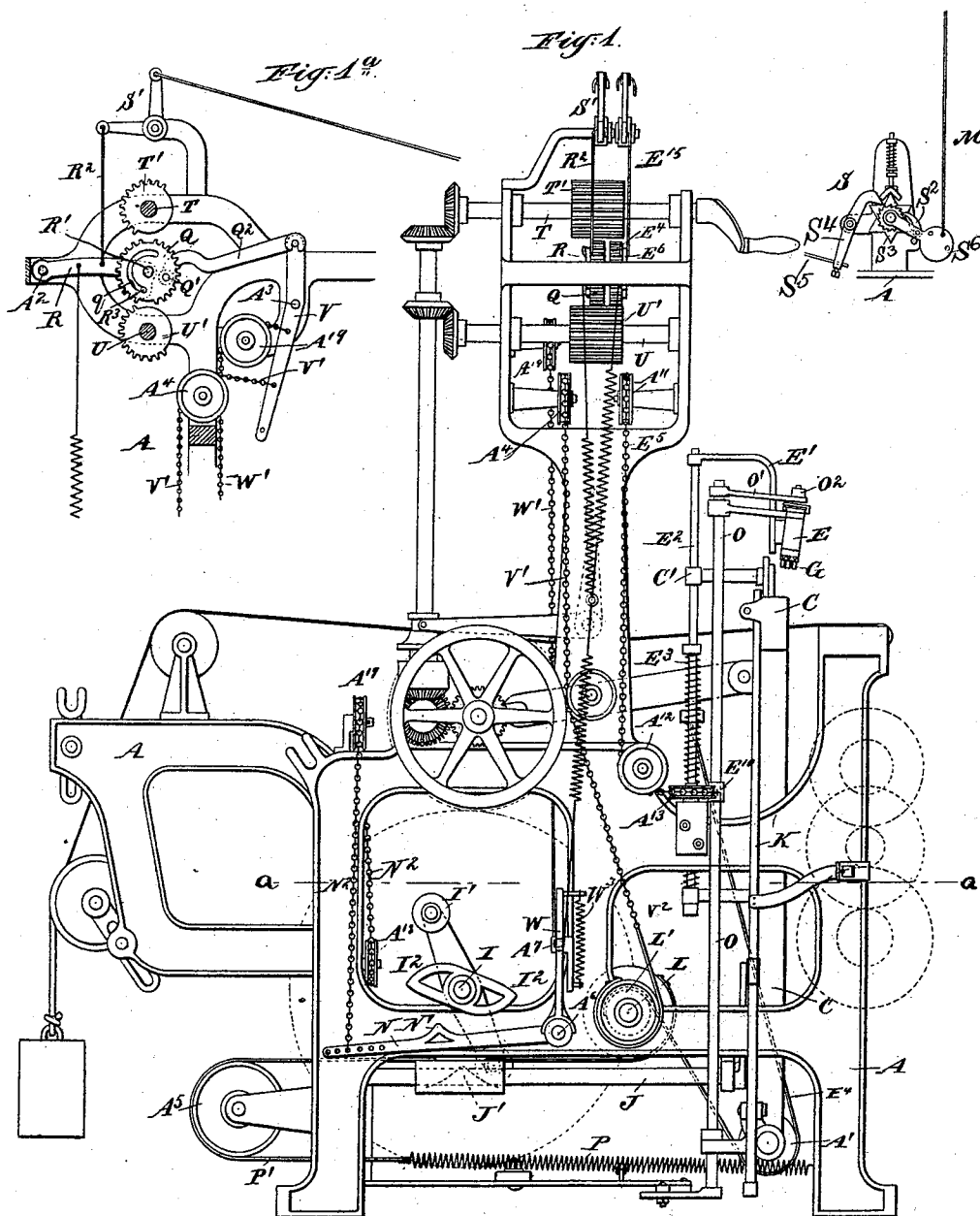


4 Sheets—Sheet 1.

No. 499,399.

Patented June 13, 1893.



*Witnesses:*

Charles R. Searle.  
Alice L. Markland.

*Inventors:*

James Smith  
John D. Minchin  
by their attorney  
James D. Gray

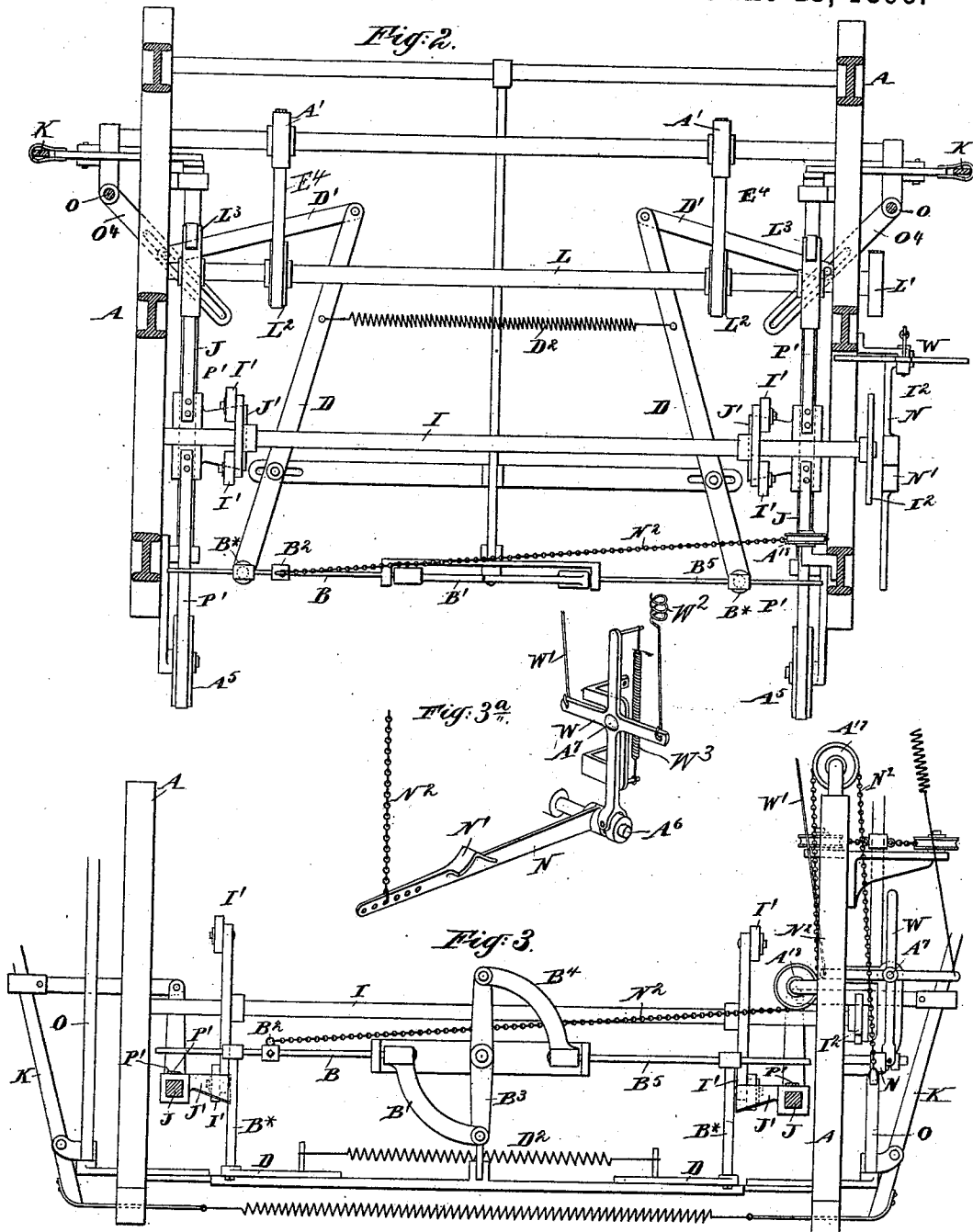
(No Model.)

4 Sheets—Sheet 2.

T. SMITH & J. J. MINCHIN.  
SWIVEL LOOM.

No. 499,399.

Patented June 13, 1893.



Witnesses:

Charles R. Searle.  
Alice C. Markland

Inventors:

Thomas Smith  
John J. Minchin  
by their attorney  
James S. Searle

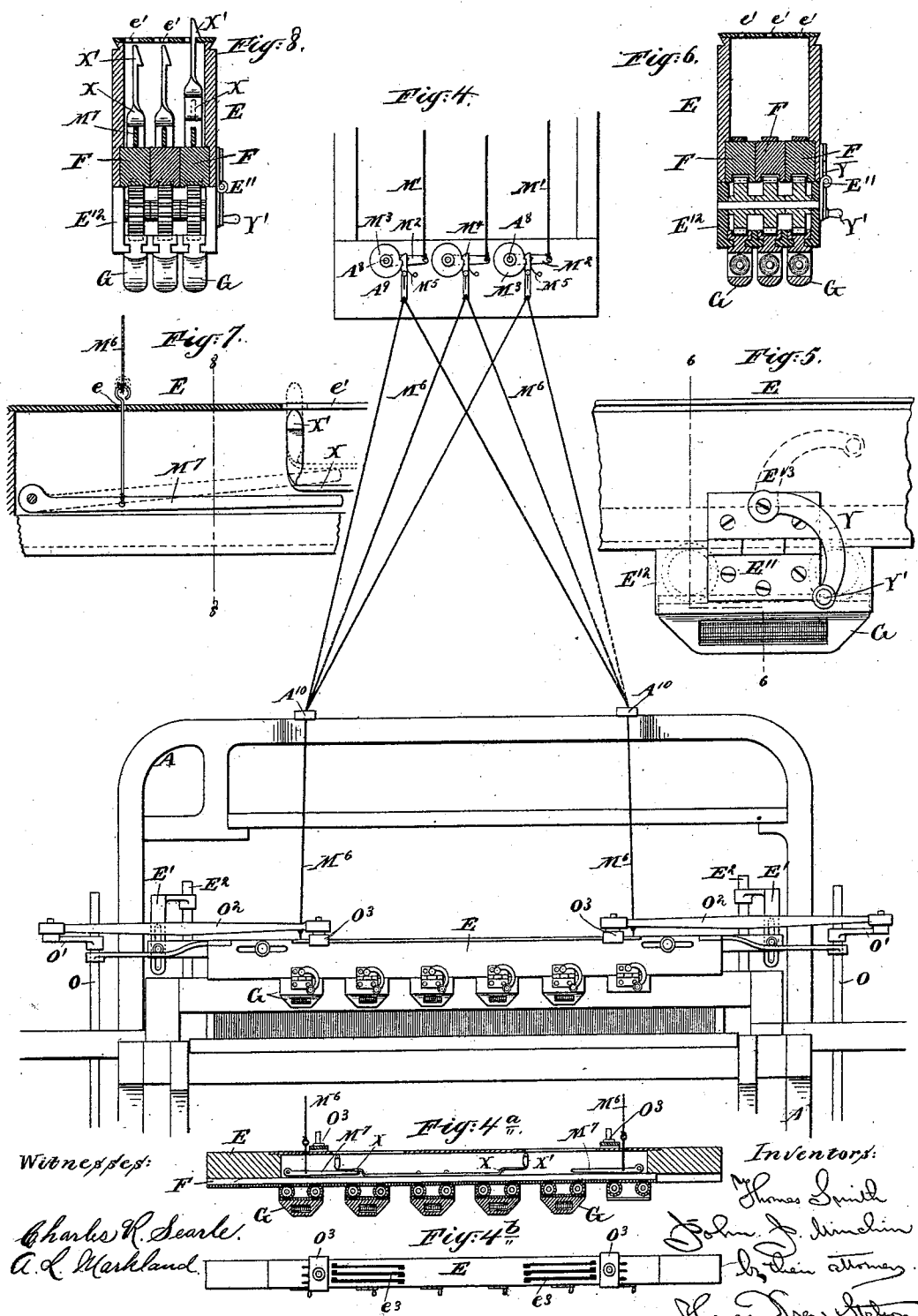
(No Model.)

4 Sheets—Sheet 3.

T. SMITH & J. J. MINCHIN.  
SWIVEL LOOM.

No. 499,399.

Patented June 13, 1893.

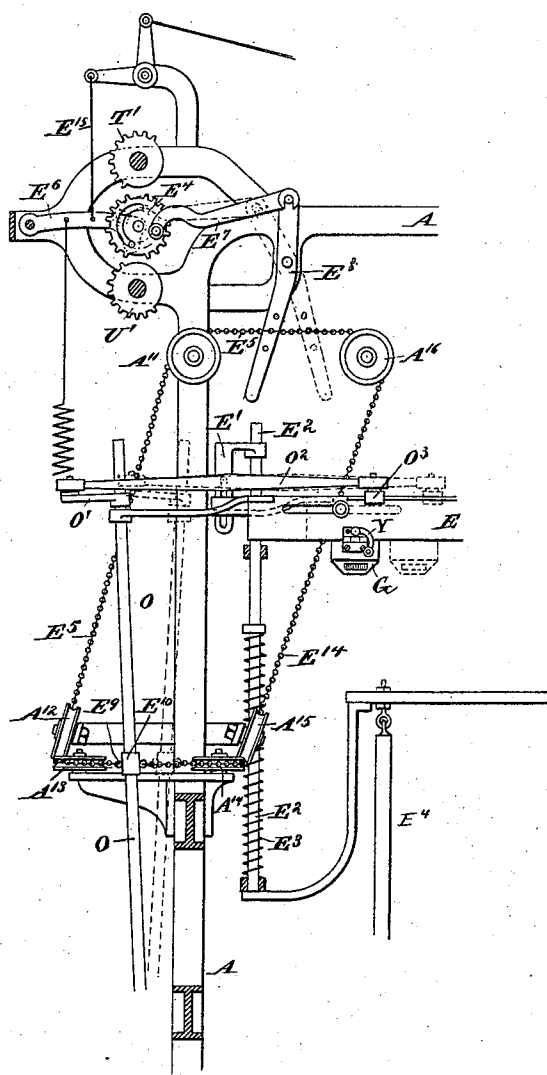


4 Sheets—Sheet 4.

No. 499,399.

Patented June 13, 1893.

*Fig: 9.*



Witnesses:  
Charles R. Searle.  
Alice L. Markland.

*Inventors:*

Mr Thomas Smith  
 John F. Lindlin  
 by their attorneys  
 Mr Thomas Drew Nelson

# UNITED STATES PATENT OFFICE.

THOMAS SMITH AND JOHN J. MINCHIN, OF PATERSON, NEW JERSEY,  
ASSIGNORS TO HESS, GOLDSMITH & CO., OF NEW YORK, N. Y.

## SWIVEL-LOOM.

SPECIFICATION forming part of Letters Patent No. 499,399, dated June 13, 1893.

Application filed December 17, 1891. Serial No. 415,348. (No model.)

### *To all whom it may concern:*

Be it known that we, THOMAS SMITH and JOHN J. MINCHIN, both residing at Paterson, in the county of Passaic and State of New Jersey, have invented a certain new and useful Improvement in Swivel-Looms, of which the following is a specification.

Our improvement is applicable to all looms in which swivel weaving is wrought in combination with ground weaving so as to produce figures. We have made our experiments with fine silk goods, using box shuttles and various complications, but we will, for clearness, describe the invention as using but a single ground shuttle. What is here termed "swivel" weaving operates by a set or several sets of small shuttles carrying yarns of any desired color or quality for the figures, which swivel-shuttles are guided in ways, and impelled backward and forward by a set of gear-wheels operated in the lay. This is well adapted for weaving narrow goods, as ribbons and tapes, a number being woven side by side a proper distance apart. Such weaving has also been long employed to put in small isolated figures of different colors in wide fabrics, the swivel shuttles being worked intermittently in relation to the larger shuttle which weaves the ground. The combination of perforated cards and accompanying mechanism, known as a jacquard, is used to determine the position of the figures by raising only the required warps at the opening of each shed. Mechanism is provided which holds these swivel shuttles out of use and lifts them out of the way at the periods when the full sheds are opened and the ground shuttle is thrown quite across for ground weaving, and which arrests the action of the ground shuttle and brings the swivel shuttles into play at the other periods which occur at successive intervals during the weaving of each figure when the limited sheds are opened, each composed of only a few yarns of the warp. The mechanism thus far described has been long known, as also provisions for operating by the jacquard to determine the intervals during which each kind of weaving shall proceed. But these latter have involved disadvantages, one of which has been a necessity for making idle picks under some conditions

and the loss of valuable time. Our invention overcomes these and gives the advantage that we may at each period of swivel weaving put in any required number of swivel yarns, and at each interval of ground weaving put in any number of ground yarns, the numbers in either case being odd or even, the loom changing its condition promptly from ground weaving to swivel weaving and back again without losing a pick.

We have also improved the provisions for calling up different colors in the swivel weaving. It has long been common to call up different colors in swivel weaving by means of the jacquard operating through complicated connections. We have discovered that it can be done by direct connection by cords from a proper head to dogs and catches arranged in the rack, giving the cords sufficient slack to allow the vibrations of the lay. We have also devised an improvement in the catches, by making them integral with the several levers or dogs which connect to the several rack-bars, allowing the parts to be made with less complication, and to require less space. A greater number of colors can be wrought by the swivel weaving, or with any given number, as the three shown, the parts may be stronger and simpler and the shed will be less crowded. We lock and unlock each shuttle-holder by a curved lever at the front which is easy of access, and takes up less width than the usual provisions for attaining these ends.

The accompanying drawings form a part of this specification and represent what we consider the best means of carrying out the invention.

Figure 1 is a side elevation showing the principal portions of the loom. Fig. 1<sup>a</sup> is a vertical section through the upper portion, technically the head. It is on the line *a-a* in Fig. 1, with certain portions removed. A portion of this figure, representing an ordinary monkey-head, is shown on the right of Fig. 1, it being understood that the wire or other suitable connection extends across. Fig. 2 is a horizontal section on the line 2-2 in Fig. 1. Fig. 3 is a rear elevation of a portion partly in vertical section. Fig. 3<sup>a</sup> is a perspective view of a portion. Fig. 4 is a

front view on the same scale as Figs. 1, 2 and 3, showing certain portions. Fig. 4<sup>a</sup> is a vertical section through the swivel shuttle rack. Fig. 4<sup>b</sup> is a plan view of the rack. Figs. 5 to 8 exhibit portions on a larger scale. Fig. 5 is a front elevation. Fig. 6 is a vertical section on the line 6—6 in Fig. 5. Fig. 7 is a front elevation partly in vertical section. Fig. 8 is a vertical section on the line 8—8 in Fig. 7; and Fig. 9 is a vertical section and partial side elevation of a portion showing more fully the mechanism for effecting the swivel weaving.

Similar letters of reference indicate corresponding parts in all the figures where they appear.

A is the fixed framework, which may be of cast iron or other suitable material.

The loom is equipped with the necessary parts only partially shown, including the let-off and take-up mechanism, the jacquard, the ordinary harnesses, a ground shuttle and its driving mechanism, and a set of swivel shuttles and driving mechanism therefor.

C is the lay operated in the ordinary manner and with the ordinary effect, having a ground shuttle thrown across when required in the ordinary manner.

E is the rack carried on the lay C, having provisions for carrying and operating three independent series of swivel shuttles G, carrying a different color in each series, and equipped for being raised out of position for work during any required time while the ground shuttle is working, and being lowered into position to allow the required series of shuttles to traverse the limited sheds during the rapidly succeeding short periods when required to effect the swivel weaving in producing the figures.

I is the cam-shaft, geared to make, as usual, one revolution for every two beats of the lay, and carrying at a sufficient distance within the frame on each side the usual rollers I', I', supported on rigidly attached arms adapted to actuate the proper mechanism to throw the ground shuttle alternately in opposite directions as follows: J is one of a pair of longitudinal shafts supported in fixed bearings, adapted to be smartly rocked at the proper time by the rollers I' acting alternately upon a shoe J' which is mounted on a squared portion of the shaft J with liberty to be moved endwise thereon. The connections of the rocker shafts J to their respective picker-staffs, and the action of the latter, as also the arrangement of boxes, &c., not shown, for exchanging the ground shuttles when more than one are used, may be of any ordinary character. When a shoe J' is in the position shown, it is acted on by the respective rollers I', and rocks the shaft J, and operates the corresponding picker-staff K, which performs its usual functions of throwing the ground shuttle. There are two of these pairs of rollers I', I', and two shafts J, each with its shoe, one near each side of the loom, arranged the

one to work the picker-staff on one side of the loom and throw the ground shuttle one way, and the other to work the corresponding parts on the other side of the loom to throw the ground shuttle in the opposite direction. Both these work at the same time, but only that one is effective which finds the shuttle on its side of the loom. The other strikes idly, but returns in time to let the shuttle be received. Thus the ground-weaving mechanism is ready to stop and resume work at any moment. When a period arrives for the production of the figures, this portion of the mechanism is intermittently arrested by a movement of the shoes J' endwise on their shafts J so far as to be out of the paths of the rollers I'. During the time while the figures are being wrought by the swivel weaving there are interwoven with the several short throws of swivel yarns, ground yarns which are put in by the ground shuttle and extend continuously across from one edge of the fabric to the other. To do this, the shoes J' require each time to be restored to their working position, and then immediately afterward moved again into the idle position. After the completion of that series of figures there occurs a period during which the fabric is woven plain; for this both the shoes J' are allowed to remain continuously in their working positions.

The rack E is lowered into position and raised again out of position for work by means of two vertical rods E<sup>2</sup> mounted in guide-eyes C' carried on the lay C, and connected to the rack by rigid arms E'. These rods are raised by the action of springs E<sup>3</sup>, each of which is spiral and encircles its rod E<sup>2</sup> and abuts at the bottom on the framing and acts under a collar on the rod E<sup>2</sup> and thereby lifts or tends to lift it. The rods E<sup>2</sup> are lowered at the proper intervals by being pulled down by straps E<sup>4</sup> one for each rod which pass under idle or guide pulleys A', and thence extend upward and are wound upon pulleys I<sup>2</sup> upon the shaft L see Figs. 1 and 9. The parts which thus put the swivel shuttles in and out of position for work, and also further parts which throw the swivel shuttles when they are required to work, are operated by a head-motion constructed as follows:—A mutilated gear-wheel Q is mounted on a pivot R' fixed on a lever R turning on a fixed center A<sup>2</sup>, and is raised and lowered at the proper intervals with gentle force by a wire or other connection R<sup>2</sup> leading from a bell-crank lever S' operated by a monkey-head S controlled by the jacquard in an ordinary and long-approved manner. When the lever R is lifted, it brings the mutilated gear-wheel Q into engagement with a mutilated gear-wheel T' carried on a constantly revolving shaft T supported in fixed bearings, and the partial gears engage for a sufficient period to give the wheel Q a half revolution. The mutilated gear is so arranged that after completing a half revolution the wheel T' may revolve for any required

period without effect. When, on the contrary, the lever R is lowered by the action of the monkey-head relaxing the wire R<sup>2</sup>, the wheel Q is presented to a mutilated gear-wheel U' on the shaft U, revolved in the opposite direction. The engagement of this lower mutilated gear promptly and strongly revolves the wheel Q a half revolution back to its original position, and then again releases it. The gear-wheels T' and U' are made extra wide so as to actuate another wheel independently raised and lowered, as will appear farther on.

Q' is a pin carried on one face of the wheel Q and connecting by a link Q<sup>2</sup> with a lever V turning on a fixed pivot A<sup>3</sup> and connected to a chain V' which runs over a pulley A<sup>4</sup> and extending downward by a connected strap V<sup>2</sup> forming an extension is wound partially around a pulley L' on the shaft L. A curved aperture *q* in the wheel Q receives a stop R<sup>3</sup> fixed in the lever R, and controls the revolution so that the wheel Q will never be turned by momentum, or otherwise, beyond the required half of a revolution, except that a slight excess is allowed to carry the pin Q' past the line of centers and insure that the wheel shall not be revolved accidentally in either direction by any force received through the link Q<sup>2</sup>.

P is a contractile spring at each side of the loom, adapted to exert a long and sufficiently powerful action in opposition to the tension of the chain V'. It connects to the fixed framing and to a strap P' which runs around an idle pulley A<sup>5</sup>, and connects to the shoe J'. A continuation of each strap P' leads from the proper shoe J' to the periphery of a pulley L<sup>3</sup> on the shaft L, and is wound thereon. Whenever the head-motion relaxes the chain V', each spring P asserts itself and contracts, drawing the corresponding shoe J' into position for action, and by the same movement partially revolves the shaft L and relaxes the straps E<sup>4</sup>, allowing the rack E to rise into the idle position. Thus conditioned, two pairs of the rollers I' will act each on its proper shoe J' and vigorously rock the shafts J with the effect to throw the ground shuttle across from either side to the other of the fabric, and put in a proper pick to effect the ground weaving. When, on the contrary, the head-motion, controlled by the Jacquard string M through a proper monkey-head S pulls on the chain V', it revolves the shaft L in the opposite direction, with the effect to extend the springs P and move the shoes J' out of the path of the rollers I', leaving the ground shuttle for the time being idle. The same movement also draws down the strap E<sup>4</sup>, and consequently the rack E, and by proper connections partially turns the shafts O, O, and thereby traverses the swivel shuttles through their respective narrow sheds from right to left, or from left to right, as the case may be. These connections are shown in Figs. 2 and 3 and will be described farther on.

It may be well to explain that what we term

a monkey-head is a device intermediate between the jacquard and the head-motion, which enables the changes of condition of the head-motion to be produced by simply pulling and relaxing the string M, (see Fig. 1<sup>a</sup>.) One pull on the string M, by the jacquard, lifts the weighted lever S<sup>6</sup> in the monkey-head, and by the pawl S<sup>2</sup> shown engaging in the click shown, turns the star-shaped wheel S<sup>3</sup> a twelfth of a revolution. This presents one of the points instead of one of the recesses in the star-shaped wheel to the upright lever S<sup>4</sup> shown, and by its connecting wire S<sup>5</sup> (interrupted in the figure by a portion of Fig. 1, but which will be readily understood as extending across) turns the upper arm of the bell-crank lever S', to the right and raises the lever R, in the head motion. This has the effect to change the condition of the head-motion, and to move the link Q<sup>2</sup> and its connected lever V, strongly from one extreme position to the opposite. The next pull on the string M, by the jacquard lifts the weighted lever in the monkey-head to exactly the same extent, and drops it in exactly the same manner as before, and by the pawl again turns the star-shaped wheel a twelfth of a revolution. This movement unlike the previous movement presents a recess to the upright lever, and the V-shaped point in the latter is allowed to drop into such recess. This allows the upright arm of the bell-crank lever S', to move to the left, and the lever R in the head-motion to drop, with the effect to change the head-motion and its connections back again to their previous condition and position. Thus the monkey-head is a simple and efficient means for transforming successive similar actions of the jacquard into alternate changes of condition of the head-motion. The shafts O, O, extend up and down, one in each side of the lay, and are subject to a variety of motions. Each, by means of an arm O', link O<sup>2</sup> and slide O<sup>3</sup>, which latter embraces a slight widening on the top of the rack, (see Figs. 1, 4, 4<sup>b</sup>, 6, 8, and 9,) and thus is guided to traverse right and left on the top of the rack, is ready to push any one of the rack-bars F and throw the corresponding series of swivel shuttles G to the right or to the left, as the case may be, and thereby put in by each shuttle the required short length of swivel yarn of the proper color. This motion is effected by the cams I<sup>2</sup> carried on the shaft I, engaging with a projection N' on a loose lever N mounted on the stud A<sup>6</sup> with liberty to be moved sidewise thereon, so as to be carried out of the path of the cams I<sup>2</sup>, and stand unaffected during the period while the ground weaving is being performed, and be moved into position to be struck by the cams I<sup>2</sup> and thereby to partially revolve the shafts O in the proper direction at the required periods when the swivel weaving is to be effected. The lever N effects this movement through the chain N<sup>2</sup> which leads up over an idler A<sup>17</sup>, thence under an idler A<sup>18</sup> and thence nearly horizontally across the loom

(see Fig. 3) and connects to an eye  $B^2$  on the slide B guided in the stationary framing to slide transversely, and is provided with an arm  $B'$  which communicates motion through a rocking lever  $B^3$  to the corresponding opposite slide  $B^5$  having a similar arm  $B^4$  similarly connected to the lever  $B^3$ , so that the two slides B and  $B^5$  move simultaneously toward and from each other as the lever N sinks and rises.

Each slide B and  $B^5$  has a rigid arm  $B^*$  extending downward (see Fig. 3), and engaging with a horizontal lever D (see Fig. 2), which extends obliquely forward, and its forward end is connected by a link  $D'$  to a horizontal arm  $O^4$  on the corresponding shaft O. The forward portions of the levers D are urged gently together by a spring  $D^2$ .

The movement of the lever N into and out of position for action is effected by a cross-shaped lever W turning on a center  $A^1$ , and operated by a chain or connection  $W'$  leading from a horizontal arm of the lever W over a pulley  $A^{19}$  to connected lever V. It is operated by the head-motion. The return movement is induced by a contractile spring  $W^2$  connecting the opposite arm to the fixed framing. Certainty of complete movement is increased by a contractile spring  $W^3$ , which we term a tumbling spring, extending downward from the upper arm of the lever and attached to the fixed framing below. It follows that when the lever N with its projection  $N'$  is in the position shown in Figs. 2, 3 and  $3^a$ , the swivel shuttles will remain idle, but when by the action of the chain  $V'$  and lever W, the lever N carrying the projection  $N'$  is shifted inward into the working position, it will be acted on twice in each revolution of the shaft I by the cams  $I^2$ , and the swivel-shuttles G will be thrown. During the rapidly succeeding periods of swivel weaving in producing a given figure, the swivel yarns thus interwoven for short distances between the ground yarns may be all of the same color, or the colors may be varied by the working of any one of the three series of swivel shuttles, the other two remaining for the time being out of use.

The rack E carries three series of five swivel shuttles G, each series carrying quills of a different color, any one of which can be "called up" by the jacquard and wrought into the fabric at the points required. It being understood that the jacquard by old and familiar mechanism properly opens the sheds to produce the required figures, our mechanism drops the rack into position and works the swivel shuttles alternating with the ground weaving, either alternate picks, or with any number of picks of ground weaving followed by any number of picks of swivel weaving, the change from either condition to the other being effected after any number of picks without losing a pick. We attach importance to this quality. During the intervals between the weaving of the figures the rack is elevated, and all the provisions for swivel weaving are

out of use, the ground weaving proceeding in the ordinary manner, weaving twilled, plain or in any other variety which may be required. When the period arrives at which the figures are to be introduced by the swivel weaving, the ground weaving is suspended, and the rack dropped into position for work, and all the five swivel shuttles G in one series, that carry the required color, say red, are traversed each across its narrow shed in the ordinary and long-approved manner. These swivel shuttles may be returned, and, if required, may be traversed any number of times to make any number of picks of swivel weaving before another pick of ground weaving. Ordinarily, there will be but one pick of the swivel weaving thus put in. Then the rack is lifted, and the swivel shuttles and their operating mechanism are thrown out of use, and the ground weaving resumed, the large ground shuttle being thrown across the whole breadth of the fabric in the usual manner in either direction, from left to right or from right to left, until one pick or any number of picks of ground weaving is effected. Then the swivel shuttles are again lowered into use and all the swivel shuttles carrying the same or another color, as the design may require, are traversed through their respective sheds and the whole are again lifted. These changes of color are effected by the three cords  $M'$ , (see Fig. 4,) leading from the jacquard, acting each on an independent lever  $M^2$  mounted on fixed studs  $A^8$ , and carrying notched wheels  $M^3$ , which engage with hooks  $M^4$  loosely supported by pins  $A^9$ , urged into engagement by springs  $M^5$ , but arranged to be promptly dropped as soon as lifted above a certain height, and having attached divergent strings  $M^6$ , which extend through eyes  $A^{10}$ , in the framing, and thence down by wire extensions, each with a proper amount of slack, through one of the holes  $e$  in the upper face of the rack E (see Fig. 7), and connect each to a lever  $M^7$  which turns on a center carried in the rack, and engages under a spring-dog in the form of an elastic strut or spring-dog X fixed on the corresponding rack-bar F. The free end of each dog X is turned up and formed into a catch  $X'$  integral therewith. The three slots  $e'$ , side by side, are each of a proper length to allow the required movement of the rack-bar to throw the corresponding series of swivel shuttles, and is widened at each end. When a certain color is to be called up, the jacquard pulls on the proper string  $M'$  and lifts the attached lever  $M^2$ , and by the strings  $M^6$  lifts the connected levers  $M^7$ , and these lift the proper spring-dogs X, and each engages on the top of the rack by its catch  $X'$  integral therewith (see Fig. 8). The form of the wheel  $M^3$  and of the hook  $M^4$  causes the latter to be instantly released, and allows the levers  $M^7$  to fall, but the spring-dog X remains for the time being protruding above the top of the rack E. The lever  $M^7$  on each side, the right and the left, for each series of swivel shut-



ties, is thus lifted and held momentarily, but only one is effective in lifting and suspending by its catch  $X'$  the corresponding dog. The latter is struck by the slide  $O^3$  and forced to move laterally, carrying with it the rack-bar  $F$  to which it is attached; and correspondingly turning the gear-wheels and moving the series of swivel shuttles  $G$  to which it is connected. This effects the proper throw of the swivel shuttles which have the desired color, and puts the corresponding yarn into the figure. As soon as the movement is completed, each spring-dog  $X$ , by reason of its head or catch  $X'$  having reached the wide place at the proper end of its slot  $e'$ , drops down again into its ineffective position, where it remains until again called up.

In order to set the several figures to alternate with each other, as is usual in figured goods, the rack and its attachments require to be shifted to the right or left between each operation to an extent equal to half the distance between the center of each figure and the next in a series. This has usually been done by hand, and is liable to be neglected. Our invention relieves the attendant from any such duty, and performs the shifting automatically. This is effected by a second partial gear-wheel  $E^4$  (see Figs. 1 and 9), mounted between the wide gear-wheels  $T'$  and  $U'$ , before described, with provisions for raising and lowering it independently of the adjacent partial gear-wheel  $Q$ . There is a lever  $E^6$  corresponding to the lever  $R$ , on which this wheel  $E^4$  is mounted, and there are similar provisions for raising and lowering it by the jacquard. There is a link  $E^7$  similar to the link  $Q^2$ , and a lever  $E^8$  similar to the lever  $V$ , which it operates. Such lever  $E^8$  operates a chain  $E^5$  which runs over an idle pulley or idler  $A^{11}$ , mounted on a fixed pivot (see Fig. 1), and being led under an idler  $A^{12}$  and thence around a horizontal idler  $A^{13}$ , is attached to an eye  $E^9$  on a sleeve  $E^{10}$  which is fitted on one of the shafts  $O$ , which extends up and down in the lay and swings therewith. Another chain  $E^{14}$ , which will be readily understood, extends in line with this from an eye on the opposite side of the sleeve  $E^{10}$ , and running around a horizontal idler  $A^{14}$ , and thence under a vertical idler  $A^{15}$ , runs up and over a vertical idler  $A^{16}$  and connects to the same lever  $E^6$ . This mechanism is controlled by the jacquard through the wire  $E^{15}$  which lifts the wheel  $E^4$  at the proper time into engagement with the wide wheel  $T'$  and causes the wheel  $E^4$  to make a half revolution in one direction, pulling on the chain  $E^5$  and shifting the rack  $E$  to the left. Later, when a set of figures have been completed and the loom is performing the ground weaving alone, and the swivel work is idle, the jacquard working through a proper monkey-head, (not shown,) similar to the one described, relaxes the string or wire  $E^{15}$  and allows the wheel  $E^4$  to be moved downward by its gravity and the tension of the spring  $E^3$ . This brings the par-

tial gear-wheel  $E^4$  into engagement with the wide gear-wheel  $U'$ , and causes it to perform a half revolution in the reverse direction, or to the right. Each half revolution actuating the chain  $E^5$ , and exerting force in the proper direction to the right or left, as the case may be, shifts the upper end of the approximately upright shaft  $O$ , and consequently the connected rack  $E$ , with the opposite shaft  $O$ , and all the mechanism carried on the rack to the right or left to the proper extent, and holds it in its new position until it is again shifted back, and so on.

It is common in swivel weaving to hinge the shuttle-holders  $E^{12}$  to the rack  $E$  in the required positions, and to turn each on its proper hinge when it is desired to disconnect its shuttle, or shuttles, and the corresponding driving-gear from the rack-bar, or rack-bars  $F$ , which are mounted in the rack. We do the same.

$E^{11}$  are the hinges (see Figs. 4, 6 and 8).

$Y$  is a thin curved lever, one for each shuttle-holder  $E^{12}$ , having a handle  $Y'$  by which it may be conveniently turned on its center  $E^{13}$  fixed on the rack  $E$ . When any shuttle-holder is properly equipped with shuttles  $G$ , each carrying the proper color, and is turned into position shown ready for work, the lever  $Y$  is turned downward into the position shown, and pressing with force against the front face of the shuttle-holder  $E^{12}$ , holds it firmly in position. When, on the contrary, it is desired to displace the shuttle-holder, the attendant touches the handle  $Y'$  and raises the lever  $Y$  into the position shown in dotted lines in Fig. 5. Then the shuttle-holder can be turned on its hinge  $E^{11}$ , which movement brings its gear-wheels out of connection with the rack-bar, and one or more of its contained shuttles may be removed and supplied with fresh quills, or otherwise attended to. On returning the parts to place, taking care to properly adjust the shuttles, the ordinary gear-wheels in the shuttle-holder  $E^{12}$  again engage with their proper rack-bar  $F$ , and the depression of the lever  $Y$  holds it firmly in such position during the working period. The curvature of each lever  $Y$  allows for the protuberance of the bead or swell along the axis of the hinge  $E^{11}$ .

It will be observed that our mode of raising and lowering the rack with its attached swivel shuttles and their driving mechanism allows us to hold the rack down during any number of picks with the swivel shuttles. This avoids much destructive wear of the parts and enables us to drive the loom faster while making two or other number of swivel picks in succession than with the ordinary method of raising and lowering the rack between each of such picks.

We claim as our invention—

1. In a loom for combined ground and swivel weaving, swivel-shuttle mechanism and operating means therefor, consisting of the constantly revolving cam  $I^2$  and the shifting lever

N, adapted to connect and disconnect the same, so as to cause the swivel-shuttles to work at any pick and to stop at any pick controlled by the jacquard, in combination with  
 5 ground-shuttle mechanism, consisting of the picker-sticks K, connected rocking shafts J, endwise movable shoes J', springs P, straps P', pulleys L', L<sup>3</sup>, and connection V', operated by a jacquard, adapted to cause the ground-shuttle to work at any pick and to stop at any pick, all arranged for joint operation substantially as herein specified.

2. In a loom for combined ground and swivel weaving, swivel-shuttle mechanism and operating means therefor, consisting of the constantly revolving cam I<sup>2</sup> and the shifting lever N, adapted to connect and disconnect the same, and a connection W' operated by a head-motion for inducing the changes at the  
 20 desired periods, so as to cause the swivel-shuttles to work at any pick and to stop at any pick, controlled by the jacquard, in combination with each other and with ground-shuttle mechanism, consisting of the picker-sticks K, connected rocking-shafts J, endwise movable shoes J', springs P, straps P', pulleys L', L<sup>3</sup>, and connection V', controlled by the jacquard, adapted to cause the ground-shuttle to work at any pick and to stop at any pick,  
 30 pick, all substantially as herein specified.

3. In a loom for combined ground and swivel weaving, swivel-shuttle mechanism and operating means therefor, consisting of the constantly revolving cam I<sup>2</sup> and the shifting lever N, adapted to connect and disconnect the same, and a connection W' operated by a head-motion, and a monkey-head S and connections thereto, arranged as shown so as to cause the swivel-shuttles to work at any pick and to stop at any pick, controlled by the jacquard, in combination with each other, and with ground-shuttle mechanism, consisting of the picker-sticks K, connected rocking-shafts J, endwise movable shoes J', springs P and straps P', pulleys L', L<sup>3</sup>, and connection V', controlled by the jacquard, adapted to work at any pick and to stop at any pick, all arranged for joint operation substantially as herein specified.

4. In a loom, swivel shuttle mechanism, operating means as the cam I<sup>2</sup> therefor, an easily moved shifting device as the lever N adapted to connect the same and cause such shuttles to work at any pick, and the actuating lever W arranged to be shifted at any pick by a connection from a jacquard and spring W<sup>3</sup> adapted to insure the completeness of the shifting motion, in combination with each other and with ground shuttle mechanism  
 60 adapted to work at any pick, all substantially as herein specified.

5. In a loom, swivel shuttle mechanism, operating means as the cam I<sup>2</sup> therefor, and an easily moved shifting device, as the lever N adapted to connect the same and cause such shuttles to work at any pick, in combination

with each other and with the ground shuttle mechanism adapted to work at any pick, and with a head motion, a lever V actuated by such head motion, and two separate flexible  
 70 connections V' and W' actuated thereby, one controlling the ground shuttle mechanism and the raising of the rack, and the other controlling the traversing of the swivel shuttles, all arranged for joint operation substantially as  
 75 herein specified.

6. In a loom for combined ground and swivel weaving, ground shuttle mechanism adapted to work in either direction at any pick of the loom and to stop at any pick, in combination  
 80 with swivel shuttle mechanism, arranged to work the series of swivel shuttles in proper direction at any pick of the loom and to stop at any pick, and with the constantly revolving cam I<sup>2</sup>, and with the lever N capable of  
 85 being shifted laterally, and the lever W and tumbling spring W<sup>3</sup>, the connection W' from the head motion, and the spring W<sup>2</sup> for effecting the return movement, all arranged for joint operation substantially as herein specified.  
 90

7. In a loom for combined ground and swivel weaving, the constantly rotating partial gear-wheels T' and U', and the partial gear-wheel Q mounted between them, in combination  
 95 with each other and with connections from a jacquard for raising and lowering the wheel Q, and with the link Q<sup>2</sup>, lever V and chain V', and suitable guiding pulleys or idlers for the latter, the shaft L, pulleys L', L<sup>3</sup>, the picker-sticks K, connected rocker shafts J, endwise movable shoes J' on the latter, and springs P and straps P', operated by said pulleys L<sup>3</sup>, all arranged for joint operation substantially as herein specified.  
 105

8. In a loom for combined ground and swivel weaving, the constantly rotating partial gear-wheels T' and U', and the partial gear-wheel Q mounted between them, in combination  
 110 with each other and with connections from a jacquard for raising and lowering the wheel Q, and with the link Q<sup>2</sup> lever V and chain V', and suitable guiding pulleys or idlers for the latter, the shaft L, pulleys L', L<sup>2</sup>, straps leading from the latter, rack E arranged to be  
 115 drawn down by such straps, and springs E<sup>3</sup> to raise the rack when the straps are relaxed, all arranged for joint operation substantially as herein specified.

9. In a loom for combined ground and swivel  
 120 weaving, the constantly rotating partial gear-wheels T' and U', and the partial gear-wheel Q mounted between them, in combination with each other and with connections from a jacquard for raising and lowering the wheel  
 125 Q, and with the link Q<sup>2</sup>, lever V and chain V', and suitable guiding pulleys or idlers for the latter, shaft L and pulleys L', L<sup>2</sup>, L<sup>3</sup>, thereon, the rack E and springs E<sup>3</sup> adapted to be drawn down by straps from the pulleys L<sup>2</sup>,  
 130 and the picker-sticks K, connected rocking shafts J, endwise movable shoes J' on the lat-

ter, springs P and straps P' operated by said pulleys L<sup>3</sup>, all arranged for joint operation as herein specified.

10. In a loom for combined ground and swivel weaving, the means shown for shifting the rack and its accompanying mechanism to the right and left at the required intervals, the same consisting of the rack, a head motion controlled by the jacquard, and chains E<sup>5</sup>, E<sup>14</sup>, operated thereby at the required intervals, in combination with each other and with the shaft O, extending up and down and capable both of being partially revolved and being inclined in different directions, connected the upper end with the rack and the lower end with the arm O<sup>4</sup> carried in fixed bearings, and the upper end being shifted to the right and left with the rack, all arranged for joint operation as herein specified.

11. In a loom for combined ground and swivel weaving, the cam I<sup>2</sup>, lever N, chain N<sup>2</sup> connected thereto, slides B and B<sup>5</sup>, with their arms B' and B<sup>4</sup>, lever B<sup>3</sup>, connecting said arms, levers D, links D', attached to said levers, shafts O, arms O', O<sup>4</sup>, thereon, links O<sup>2</sup>, and slides O<sup>3</sup> reciprocated by said links, rack-bars F, and swivel shuttles G, in combination with each other, and with the cross-shaped lever W, head-motion, and connection W' from the latter to said lever, all arranged to serve by making the cam I<sup>2</sup> alternately operative and inoperative so as to work the swivel-shuttles at the required periods, as herein specified.

12. In a loom for combined ground and swivel weaving, the cam I<sup>2</sup>, lever N, chain N<sup>2</sup>, slides B, B<sup>5</sup>, horizontally moving levers D, D', and spring D<sup>2</sup>, links D', D', actuated by the said levers, shafts O, O', having arms O<sup>4</sup>, O<sup>4</sup>, near their lower ends, and arms O', O', near their upper ends, slides O<sup>3</sup>, links O<sup>2</sup> connecting them, rack-bars F and swivel shuttles G, all combined and arranged to serve as herein specified.

13. In a loom having more than one series of swivel shuttles adapted to carry different colors, independent connections M' from the jacquard to each through levers M<sup>2</sup>, wheels M<sup>3</sup>, having offsets, as shown, carried thereby, turning on studs A<sup>8</sup>, and the hooks M<sup>4</sup>, springs M<sup>5</sup> engaging such hooks with the offsets in said wheels, and the rack-bars F, cords M<sup>6</sup> leading from such hooks, and the lever M<sup>7</sup> and spring-dogs X, connected to such rack-bars, all combined and arranged to serve substantially as herein specified.

14. In a loom for combined ground and swivel weaving, the lever M<sup>2</sup>, the attached wheel M<sup>3</sup>, having an offset or notch, as shown, the hooks M<sup>4</sup> free to be raised and lowered, and also to be moved to a slight extent laterally, the spring M<sup>5</sup> urging such hook into engagement with the notch in said wheel, and the connection M' allowing the wheel to be partially turned by the jacquard, and the cords M<sup>6</sup>, rack-bar F, rack E, two levers M<sup>7</sup>, mounted in said racks and arranged reversely relatively to each other and connected to said

cords, and the spring-dogs X, attached to the said rack-bar F, all combined and arranged to serve substantially as herein specified.

15. In a loom, having two or more rack-bars and a corresponding series of swivel shuttles adapted to carry different colors and to be introduced as required, the elastic struts or spring-dogs X attached to the several rack-bars, each adapted to yield laterally and having a catch X' made integral therewith, arranged to serve substantially as herein specified.

16. In a loom, having more than one series of swivel shuttles adapted to carry different colors, the series of shuttle-holders E<sup>12</sup>, each having a hinge E<sup>11</sup> at the front, in combination with the curved levers Y, turning on centers E<sup>13</sup>, one for each shuttle-holder, arranged at the front of the rack, and adapted to serve as herein specified.

17. In a loom for combined ground and swivel weaving, the rack E, two slides O<sup>3</sup>, moving simultaneously toward and from each other, a series of rack-bars F, and corresponding series of swivel shuttles G, operated thereby, two spring dogs connected to each rack-bar, adapted to be independently moved into the path of the slides, and a connection from the jacquard to such dogs adapted to effect such movements at the required periods, all combined and arranged to serve substantially as herein specified.

18. In a loom for combined ground and swivel weaving, the rack E, two slides O<sup>3</sup>, moving simultaneously toward and from each other, a series of rack-bars F, and corresponding series of swivel shuttles G, operated thereby, two spring-dogs connected to each rack-bar, adapted to be independently moved into the path of the slides, a connection from the jacquard to such dogs adapted to effect such movement at the required periods, and two levers M<sup>7</sup>, for each rack-bar, adapted to lift the required spring-dog at the proper end of the rack, and the means e', for receiving and holding each spring-dog for the required movement after such adjustment by the jacquard, all combined and arranged for joint operation substantially as herein specified.

19. In a loom for combined ground and swivel shuttle weaving, the combination of ground and swivel shuttle operating mechanism, a drive shaft, a head motion, controlling means for said head motion such as a jacquard, connections between the head motion and drive shaft to operate the former at any pick, and controlling connections between the head motion and ground and swivel shuttle operating mechanism, whereby the weaving from ground to swivel shuttle weaving and the reverse may be changed at any pick, substantially as described.

20. In a loom for combined ground and swivel shuttle weaving, the combination of ground and swivel shuttle operating mechanism, a head motion comprising oppositely moving parts or gears, a vibrator, controlling

means as a jacquard connected with said vibrator for making the same engage one or the other of said oppositely moving parts at any pick, and controlling connections between  
5 said vibrator and the ground and swivel shuttle operating mechanism, whereby the weaving from ground to swivel and the reverse may be changed at any pick as desired, substantially as described.

In testimony that we claim the invention to above set forth we affix our signatures in presence of two witnesses.

THOMAS SMITH.  
JOHN J. MINCHIN.

Witnesses:

GEORGE B. SENIOR,  
SYLVESTER F. WILEY.