2 Sheets—Sheet 1.

P. L. SLAYTON.

CIRCULAR LOOM FOR WEAVING HATS, &c.

No. 41,466. Patented Feb. 2, 1864.

Fig: 1.

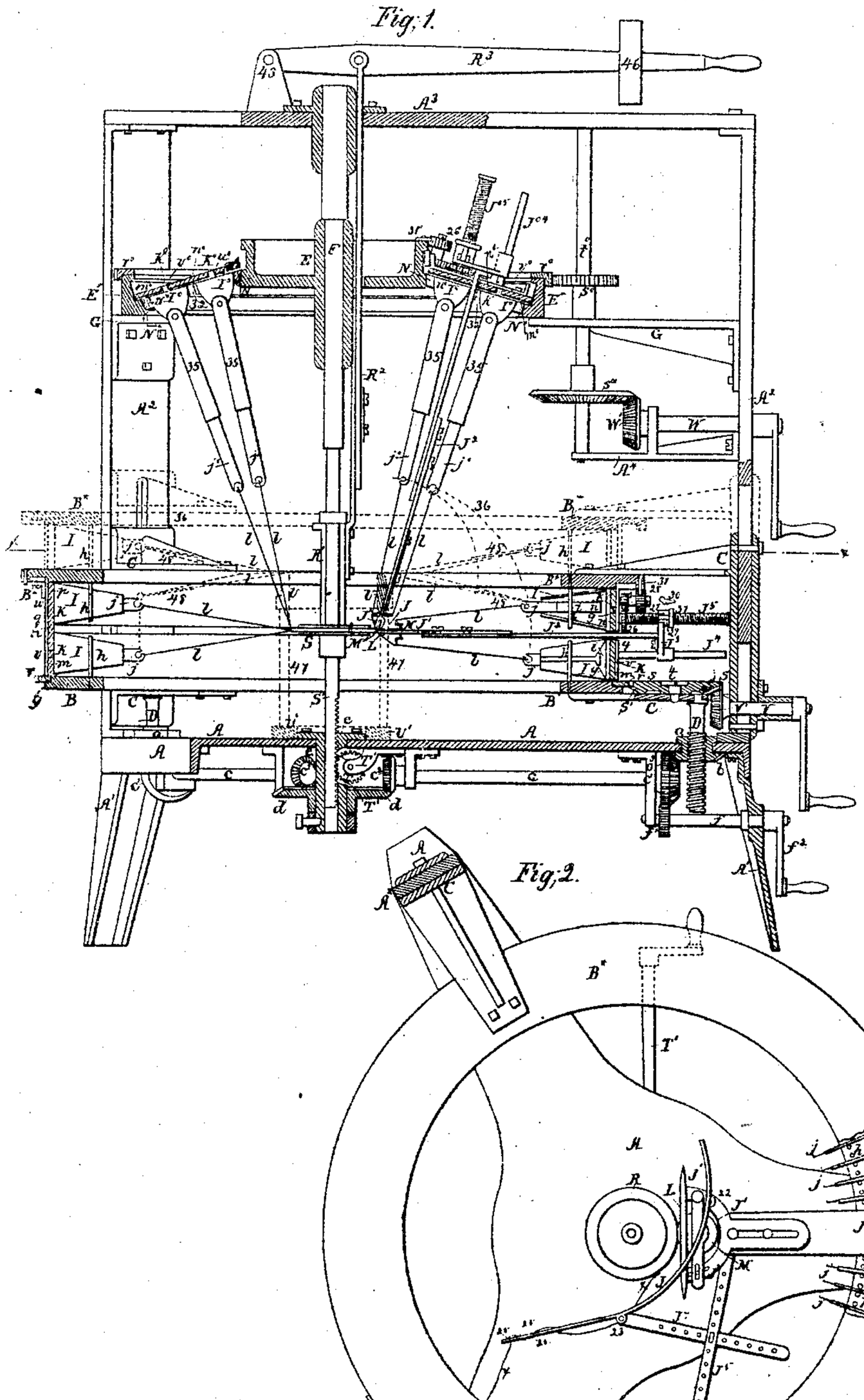
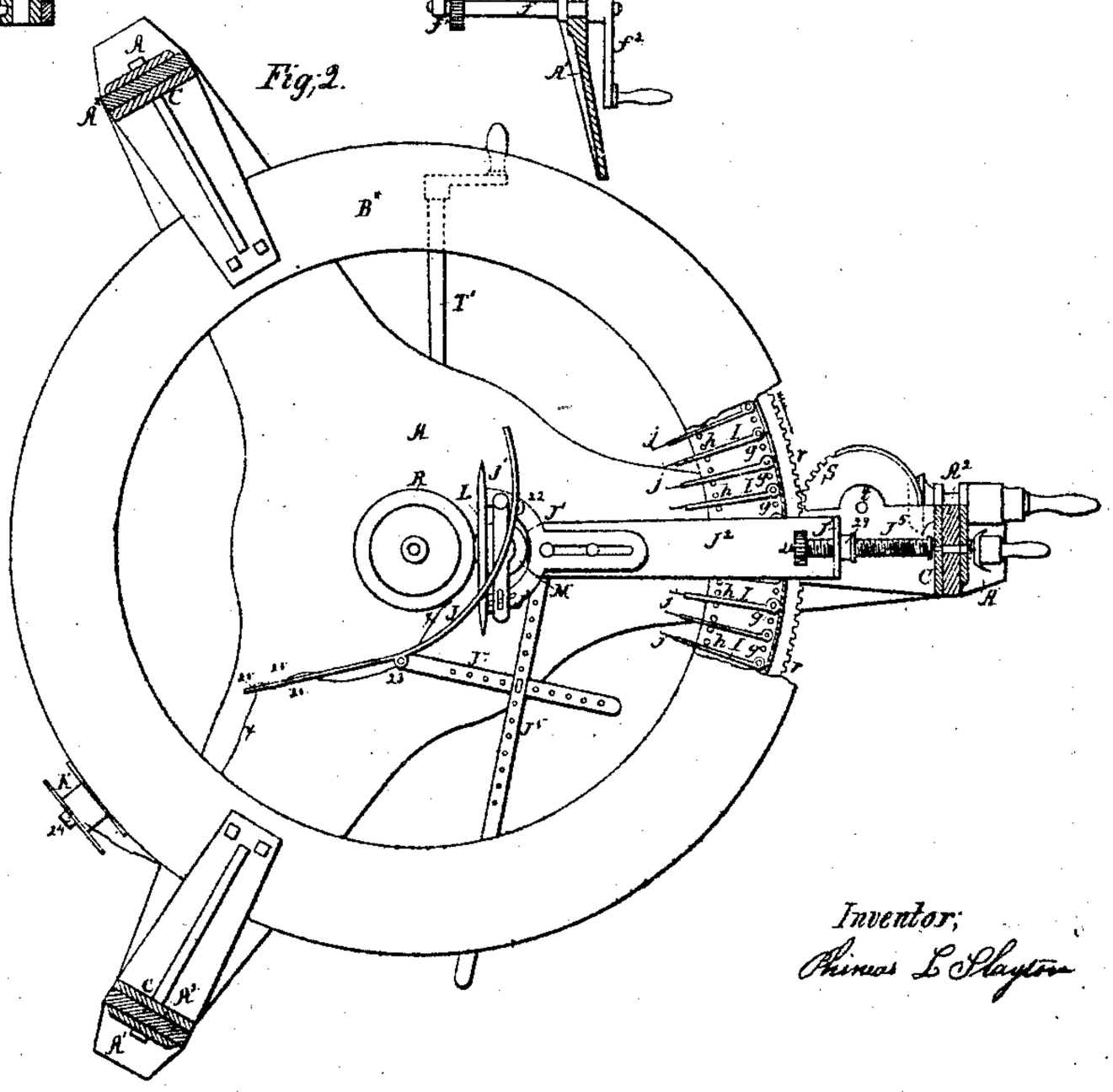


Fig: 2.



Witnesses;
Thos. H. Douglas
Geo. W. Reed

Inventor;
Phineas L. Slayton

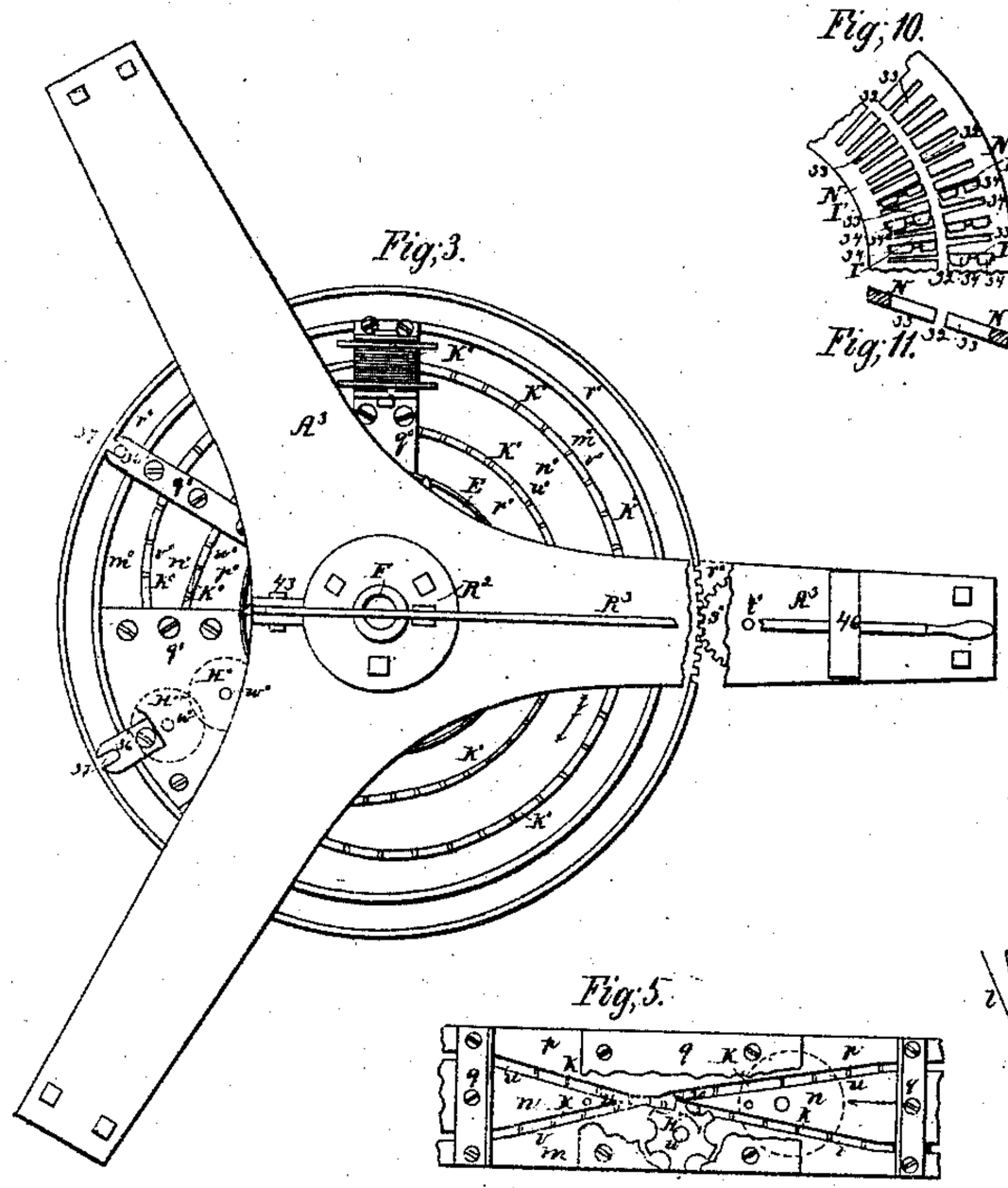
2 Sheets—Sheet 2.

P. L. SLAYTON.

CIRCULAR LOOM FOR WEAVING HATS, &c.

No. 41,466. Patented Feb. 2, 1864.

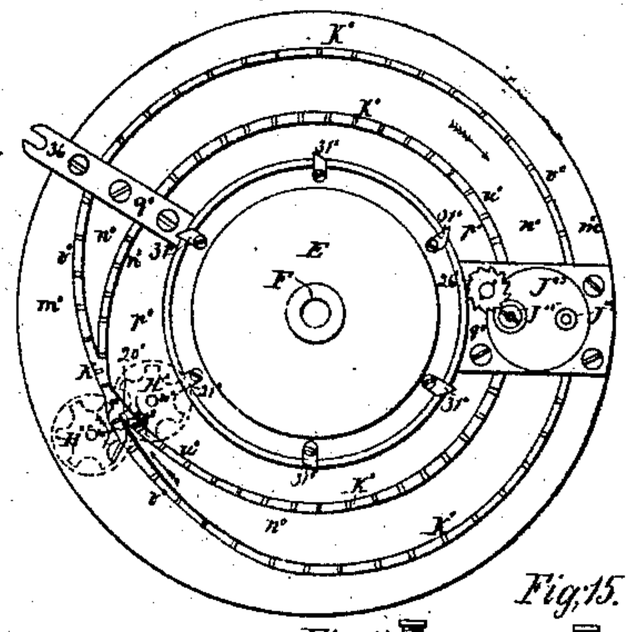
Fig; 3.



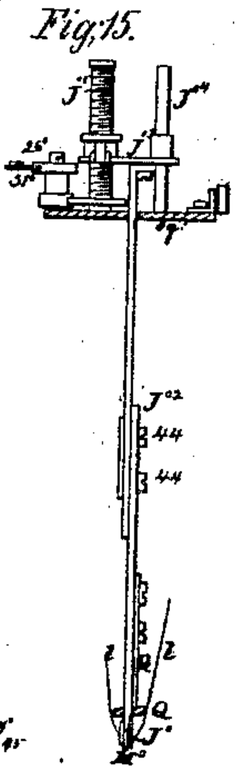
Fig; 10.

Fig; 11.

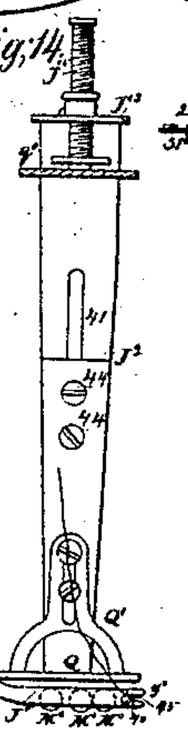
Fig; 4.



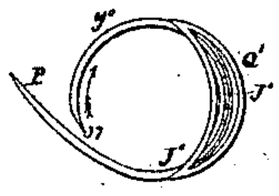
Fig; 15.



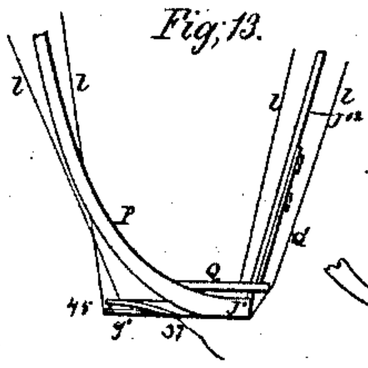
Fig; 14.



Fig; 12.

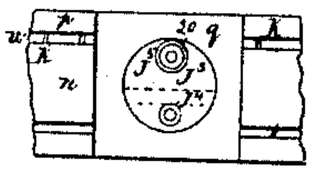


Fig; 13.

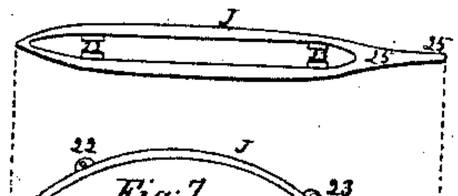


Fig; 5.

Fig; 6.

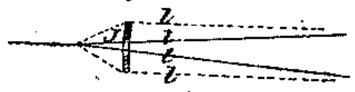


Fig; 8.



Fig; 7.

Fig; 9.



Witnesses:
Thos. J. Douglas
Geo. W. Reed

Inventor;
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UNITED STATES PATENT OFFICE.

PHINEAS LEESON SLAYTON, OF NEW YORK, N. Y., ASSIGNOR TO CORNS. S. MITCHELL, OF SAME PLACE.

IMPROVEMENT IN CIRCULAR LOOMS FOR WEAVING HATS, &c.

Specification forming part of Letters Patent No. **41,466,** dated February 2, 1864.

To all whom it may concern:

Be it known that I, PHINEAS L. SLAYTON, of the city, county, and State of New York, have invented certain new and useful Improvements in Circular Looms for Weaving Hats and other Articles; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a central vertical section of a loom constructed according to my invention. Fig. 2 is a horizontal section of the same in the plane indicated by the line *x x* in Fig. 1. Fig. 3 is a plan of the upper part of the machine. Figs. 4 to 16, inclusive, are views of the details of the machine, which will be hereinafter explained.

Similar letters of reference indicate corresponding parts in the several figures.

This invention consists principally in the employment in a circular loom of two separate and distinct sets of weaving mechanism, one set being arranged for weaving flat or nearly flat work—such as the top of the crown and brim of a hat—and the other set for weaving in a cylindrical form or form approximating thereto—as for the side of the crown of a hat—and the two sets being so arranged relatively to each other that the warp in a partly-woven piece of work can be transferred from one set to the other to change the form of the work at pleasure without disturbing or moving the portion already woven.

It also consists in making that set of weaving mechanism by which the weaving of the flat portions of a piece of work—as the top of the crown and brim of a hat—is performed, movable in a direction relatively to the other set parallel with the axis of the machine about which the weaving is performed, instead of radially thereto, whereby it is enabled to be brought to the most favorable position for weaving each of those portions, and the necessity of shifting the woven part of the hat or other article at any stage of the operation is avoided; also, in certain means of holding the partly-woven hat or other article in place while transferring the warp from one set of weaving mechanism to the other; also, in a certain novel device employed in combination with the mechanism for weaving the side of the crown of the hat or the cylindrical or hollow portion of any other article to regulate the size thereof; also, in certain improved means of operating what may be termed the "warp-carriers," which carry the warp in a circular loom to produce the opening and crossing of the shed, and, further, in certain improvements in the apparatus or devices for depositing and pressing up the weft in the warp.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation for the manufacture of hats.

A is a horizontal bed-plate, supported on three feet, A' A' A', and supporting three uprights, A^2 A^2 A^2, which are connected at their upper ends by a plate, A^3. These parts constitute the main framing of the loom.

B B* are two stationary horizontal flat rings or annular plates, arranged one above another in the center of the main framing, at a suitable distance apart to provide for the attachment or support of all the mechanism for weaving the top crown and brim of a hat. The internal diameter of these rings requires to be considerably greater than the length of the warp strands or threads, which length is sufficient for the said strands to extend across the top crown, twice down the side crown, and twice across the brim, besides providing for the shortening which takes place in weaving, and allowing for their attachment to the warp-carriers. The said rings B and B* are secured firmly to slides C C C, which are so attached to the uprights A^2 A^2 A^2 as to be capable of being elevated or depressed, the said slides and rings or annular plates combined forming an independent vertically-movable frame. This frame is supported by means of screws D D, of which there is one attached to each slide C, the mode of attachment being such that the screw cannot turn on its axis. These screws are fitted to nuts *a*, which are fitted to turn freely in bearings provided for them in the bed-plate A, and the said nuts are furnished under the bed-plate with bevel-gears *b*, gearing with similar bevel-gears, *c'*, on the outer ends of three horizontal shafts, *c c*, which are arranged radially to the center of the bed-plate in suitable fixed bearings, and which are furnished at their inner ends with similar bevel-gears, c^2 c^2, all of which gear with a bevel-gear, *d*,

which is fitted to turn freely on a stationary hollow upright shaft, *e*, which is secured in the center of the bed-plate. One of the shafts *c c* is furnished with a spur-gear, c^3, which gears with a spur-gear, *f'*, on a horizontal shaft, *f*, arranged in suitable bearings below the said shaft *c*, and this shaft is furnished with a hand-crank, f^2, by the turning of which all the shafts *c c* are caused to turn simultaneously at the same speed, and transmit rotary motion to the nuts *a a*, which are thus caused to raise or lower the screws D D equally, and so raise or lower the frame B B* C C C, according to the direction in which the crank is turned. The object of this raising and lowering of the frame which supports or has attached to it the mechanism for weaving the top of the crown and brim is to bring the said mechanism as nearly as possible to the level of the work in weaving both of these portions of the hat, it being desirable not to move the hat from the time of its commencement till the weaving has been completed.

The frame which carries the mechanism for weaving the side of the crown or upright portion of the hat is stationary. It is composed of a central circular plate, E, and surrounding ring E*, arranged in the upper part of the main frame concentric with the rings B B*. The plate E is secured firmly to and supported by a fixed central upright shaft, F, which is secured in the top plate, A^3, of the main framing. The ring E is secured firmly to and supported by brackets G G, which are bolted to the uprights A^2 A^2 A^2 of the main framing.

Having now described the whole of the framing and mere supporting parts of the loom, I will proceed to describe the mechanism for weaving the top of the crown and brim of the hat, and afterward that for weaving the side of the crown.

Each of the rings B B* has firmly secured in it two concentric circular series of upright pins, *g g* and *h h*, those in the lower ring, B, projecting above the upper surface of the said ring, and those in the upper ring, B*, projecting downward from the lower surface of the said ring. The several pins are of equal length, and spaces are left between the two upper and lower series for the passage of the weft and the arm of the shuttle carrier, as will be hereinafter explained. The number of pins in each of the four (two upper and two lower) series is equal to the greatest number of threads or strands to be employed in the warp. The pins in each series are equidistant, and each pin in either series is directly opposite to or in line with a pin of the opposite series. Those of the two inner series, *h h*, are arranged opposite the spaces between those of the two outer series, *g g*. The two outer series serve to attach the warp-carriers I I and the two inner series to guide the same carriers, as shown in Fig. 2, where part of the upper stationary ring, B*, is represented as broken away. The warp-carriers consist simply of flat cases, made of tin plate or other sheet metal, having just sufficient space between their sides for the reception and working of flat springs *i i*, made of india-rubber or other material, and having sockets at their outer or back ends to fit easily to the pins *g g*, the depth of the said sockets being not greater than the length of the said pins, and the depth of the cases diminishing toward the inner or front ends in taper form, as shown in Fig. 1. Each of the said carriers has formed upon the back of its socket a projecting tooth or lug, *k*, which is acted upon to produce the operation of the said carriers, as hereinafter described. The springs *i i* have their back ends attached securely to the back parts of the carriers, and are furnished with thin flat hooks *j j* at their front ends for the attachment of the strands *l l* of the warp, which extend from the hook *j* of one carrier across the center of the loom to the hook *j* of the opposite carrier, the attachment being made by loops formed in the ends of the strands, or by loops, rings, or hooks secured thereto. The object of the springs is to hold the warp sufficiently tight or with a sufficient tension upon it for weaving and to allow the ends to yield sufficiently to compensate for the shortening which is consequent upon the corrugation produced in weaving. The opening and crossing of the shed—that is to say, the bringing of the several strands of the warp into a condition for the weft to pass over some and under others, and the closing of the said strands over the weft—is effected by the movements of the warp-carriers from the upper to the lower pins, *g g*, and vice versa, the order of the operation of the said carriers depending on the kind of weaving—plain, tweel, or otherwise—to be produced; but for plain weaving one is elevated and the next depressed all the way round, those which are depressed in one revolution requiring to be elevated in the next, and hence an odd number of carriers being required. The example of my invention represented has the devices for operating the warp-carriers constructed and arranged for plain weaving. These devices are partly represented in Fig. 1 and partly in Figs. 5 and 6, which are outside views, taken on opposite sides of the rings B B*, which, for the sake of distinction, I will call "stationary rings," they being stationary during the operation of weaving. The above-mentioned devices consist of three rotating metal rings or bands, *m n p*, encircling the carriers between the rings B B* and a toothed wheel, H, arranged in the lower ring, *m*.

The three rotating rings *m n p* are all connected together by plates *q q* outside, and the lower one, *m*, has secured to it a ring, *r*, which is toothed all round its outer edge to gear with and receive rotary motion from a spur-gear, *s*, which turns on a fixed stud, *t*, secured in one of the slides C C. The rings *m n p* are at such distances apart that there are spaces or channels, *u* and *v*, between them just wide enough for the reception of the teeth or lugs *k* on the

backs of the warp-carriers. The upper and lower rings, *m* and *p*, extend entirely round the warp-carriers, but the middle one, *n*, has an opening, as shown at 20 21 in Fig. 5. The several rings are so formed that the channels *u* and *v* are horizontal and parallel with the faces of the stationary rings B B*, except for a short distance on each side of the opening 20 21, where they are inclined so that the upper and lower channels meet in the said opening, and form, for a short distance only, a single channel, as shown in Fig. 5, the middle ring, *n*, terminating in two sharp points, 20 and 21, at the meeting of the channels. The lugs *k k* of the warp carriers being received in the channels *u* and *v*, the said carriers are caused to rise and fall, when in each revolution of the rings *m n p* with the toothed ring *r* the inclined portions of the channels pass the said lugs, and the said carriers are held up or down on the higher or lower pins, *g g*, the remaining greater portion of the revolution during which they are in the straight or horizontal portions of the channels. The revolution of the rings *m n p r* is in the direction of the arrow shown on the ring *n* in Figs. 2 and 5. By the passage of the lugs down or up either channel *u* or *v* into the single channel, the warp-carriers are brought to a position midway between the two rings B B* and midway between the positions they occupy when the shed is open; and before the point 20 arrives at any warp-carrier in the rotation of the rings, the carrier, if it is to be raised up above the opening between the two series of pins *g g* for the weft to pass under it must be lifted high enough to pass over the said point 20, otherwise it will be caused by gravitation to descend the lower channel, *v*, below the opening between the two series of pins *g g* for the weft to pass over it. The lifting of the carriers is effected by the toothed wheel H, before referred to. This wheel has teeth and notches something like a cog-wheel and is arranged in an opening in the lower ring, *m*, where it turns freely on a pin, *w*, which attaches it to one of the connecting-plates *q q*, the axis of the said pin being almost directly under the point 20, and at such distance from the said point that the tops of its teeth will pass just above the said point in their revolution. The teeth and notches in the said wheel are so spaced that two of the lugs *k k* on the carriers might rest on two of the teeth while the lug of an intervening carrier would be in the intervening notch of the wheel. The said wheel is caused to turn on its axis in the direction indicated by the arrow marked on it in Fig. 5, by the pressure of its teeth against the lugs of alternate carriers as the said wheel revolves with the rings, and its teeth are thus brought under the lugs of the intervening carriers and caused to lift them over the point 20 and into the upper groove, *u*, but the lugs which enter the notches of the said wheel are carried into the lower groove, *v*, so that as the rings continue their rotation they raise every second carrier and depress the intervening ones.

J is what may be termed the "shuttle," by which the weft or filling is deposited in the warp while the latter is attached to and operated by the carriers I I. This consists of a long, curved, pointed, and slotted piece of sheet metal. (Shown in Figs. 1 and 2, and represented detached in Figs. 7 and 8, of which 7 is a top view and 8 an outside face view.) This shuttle is connected at 22, near its heel, with a fork-shaped yoke, J′, which is attached to a flat bar, J^2, which may be termed the "shuttle-carrier." This bar J^2 passes through the spaces between the two upper and the two lower series of pins, and through a slot in the ring *n*, and its outer end is secured rigidly to a head, J^3, Figs. 1, 2, and 6, which is fitted to slide on a rigid guide-rod, J^4, secured to one of the plates *q*, before mentioned, and standing out radially to the rings *m n p*. The said head is also made with a hollow socket, 29, for the passage through it of a hollow screw, J^5, which is fitted to turn freely but prevented from moving longitudinally upon a pin which is secured rigidly in the same plate *q* above and parallel with J^4. The socket 29 is also fitted with a threaded tongue, 30, which is secured in place by a ring, 31, slipped over it, and thereby made to serve as a nut to the screw J^5. By turning the screw J^5 the shuttle-carrier J^2 is moved in or out toward and from the center of the loom, as will be presently more fully explained. The shuttle-carrier is further attached to the rotating rings *m n p*, that it may rotate and cause the shuttle to revolve with them, by means of a brace, J^6, which is arranged nearly at a right angle to it, and which passes between the upper and lower pins, *g g* and *h h*, and through a slot in the ring *n*, and is secured outside of the said ring by any convenient means. The shuttle is also attached at 23 to a brace, J^7, which is connected by a movable connection with the brace J^6. By means of its various connections the shuttle is enabled to be adjusted to bring its point as near as may be desired to the warp-carriers and the broad part near its heel as near as may be desired to the center of the loom. The shuttle does not contain the filling or weft, but that is supplied from a spool, K, arranged to rotate on a pin, 24, carried by one of the plates *q q*, and from this spool the filling *x* passes through a hole in the plate *n* and between the upper and lower pins, *g g* and *h h*, to the shuttle, near the point of which there are a number of eyes, 25 25, (see Fig. 2,) through one or more of which the filling is passed, according to the degree of friction and tension required to be produced upon it, and from these eyes the filling passes to the weaving-point. The shuttle, besides depositing the filling in the warp, assists in drawing the warp tightly over it after the shed has been crossed and so pressing up the filling. This is done by bringing the broad part of the shuttle as near as practicable to the

center of the loom, so that in passing between the raised and depressed strands of warp it may pull them farther apart, as shown in dotted lines *l l* in the diagram, Fig. 9, the bold lines *l l* in the same figure representing the direction the strands assume when the shuttle is not between them or not so near to the center of the loom. By thus drawing apart the warp-strands the filling deposited in the previous revolution of the shuttle and over which the warp has been crossed is forced up closer toward the center of the loom and against the body of the work. In order that the wide part of the shuttle, which effects the above result, may be always at the same distance from and as near as practicable to the weaving-line, it is obvious that it should move outward from the center of the loom as the weaving from the center outward progresses, and to effect this movement automatically the screw J^5 has secured to it close to the plate *q* a spur-gear, 26, which gears with a pinion, 27, turning on a stud attached to the same plate *q*, and this pinion has secured to it a ratchet wheel, 28, which is turned one or more teeth at every revolution of the rings *m n p*, the shuttles, and their attachments, by coming in contact with and passing a number of fixed pawls or pins k^0, secured in the upper stationary ring, E*. From four to eight of these pawls or pins are used, according to the quality of the work.

The yoke J′ also carries a presser, L, attached to its ends, for pressing up the work, the pressure of the shuttle, as before described, not being of itself sufficient. This presser consists of a piece of metal of round form in its transverse section, straight longitudinally, and tapered at the ends. This presses in between the crossed strands of the warp closer to the inserted filling than the shuttle. There is also attached to the said yoke a thin roller, M, the edge of which presses in still closer to the filling, and so presses against the crossed strands quite close to the inserted filling, and thereby presses up the filling quite close to the body of the work and makes the work quite close. This roller rotates by the friction of its edge against the work. The presser L and roller M, being both connected by the yoke J′ with the shuttle-carrier J^2, are moved outward along with the wide part of the shuttle as the latter is moved out by the action of the screw J^5.

The mechanism for weaving the top of the crown and brim having been now described, I will proceed to describe the mechanism for weaving the side of the crown, all of which is supported by the stationary plate E and ring E*, before described. This mechanism only differs from that first mentioned as much as is rendered necessary or advisable by the necessary difference in its arrangement.

Between and concentric with the plate E and ring E* there are arranged two stationary annular and radially-slotted plates, N N*, Figs. 4, 10, and 11, in which the upper warp-carriers, I^0 I^0, work in substantially the same manner as the lower warp-carriers, I I, work upon and between the pins *g g* and *h h*. These plates are made in the form of hollow frustums of a very low cone. The plate N is secured to the plate E, and the plate N* to the ring E*. There is a narrow annular space between the two, as shown at 32 in Figs. 1, 10, and 11, for the passage of the weft and of the shuttle-carrier. The radial slots 33 33 in the said plates are best shown in Figs. 10 and 11, the former of which is a top view and the latter a vertical section of portions of the said plates, which are for the most part concealed in the other figures of the drawings. The slots in each correspond in number with the greatest number of strands to be used in weaving the side of the crown of the hat. They are equidistant, and those of each plate are directly opposite to or in line with those of the other, so that the warp-carriers I^0 I^0 may pass freely from one plate into the other. These warp-carriers differ somewhat from the lower set. They are each composed of a taper plate of a thickness to work easily in the slots 33 33, having its greatest width a little less than the length of the slots and having one or more shoulders, 34 34, (see Fig. 10,) at its upper end to support it on the plates N N*. This plate I^0 has attached to it a tube, 35, to receive the shank of the hook j^0, and a spring which attaches the said hook to the carrier. These hooks and springs are substantially like those *j* and *i* of the lower warp carriers, and the said hooks are so situated that after the crown of a hat has been woven the ends of the warps may be transferred by hand to them from the lower hooks by a movement such as indicated by red dotted lines 36 36 in Fig. 1.

The movements of the warp-carriers I^0 I^0 from the plate N into the plate N*, and vice versa, to produce the opening and crossing of the sheds, are produced by three revolving rings, m^0 n^0 p^0, and two toothed wheels, H^0 and H^{0*}. These, allowing for their being conical, to conform to the plates N N*, instead of cylindrical, are substantially like the rings *m n p* of the lower set of weaving mechanism, and the two wheels are precisely like the wheel H, the two being necessary, as gravitation does not aid their action, as is the case with H. Fig. 4 is a top view of these rings and wheels and their attachments. The three rings m^0 n^0 p^0 are arranged above N N*, and are connected together by plates q^0 q^0, substantially like *q q*, and also connected by forks 36 36 and pins 37^0 37^0, with a ring, r^0, which is fitted to turn on the top of the ring E*. This ring r^0 is toothed all round to gear with and receive rotary motion from a spur-gear, s^0, which is fast on a vertical shaft, t^0, which is arranged in a bearing, A^4, secured to one of the standards A^2. The channels u^0 v^0 between the rings m^0 n^0 p^0, (shown in Figs. 4 and 5,) are substantially like the channels *u*

v^0 between the rings $m\ n\ p$, and the said channels receive lugs $k^0\ k^0$, provided on the backs of the carriers $I^0\ I^0$, so that by the rotation of the said rings $m^0\ n^0\ p^0$ in the same direction as $m\ n\ p$ the said lugs may be acted upon to produce the movements of the said carriers in the slots 33 and 33 toward and from the center of the loom, by which the opening and crossing of the sheds of the warp is produced. The two wheels $H^0\ H^{0*}$ are arranged one in an opening in the plate m^0 and the other in an opening in the plate p^0, the pins $w^0\ w^0$, upon which the said wheels rotate and which secure them to said plates, being so arranged at equal distances from the point 20^0 of the ring n^0 that the tips or ends of their teeth will enter very slightly into the spaces between the teeth of the other one. One of the said wheels is caused to rotate upon its axis by the entrance into its notches of the lug k^0 of every second carrier I^0, and the other one is caused to rotate on its axis by the entrance into its notches of the intervening carriers, each rotating in the direction of the arrow marked on it in Fig. 4, and the tops of the teeth of each coming in contact with the lugs $k^0\ k^0$, which are received in the notches of the other, and so carrying the said lugs over the point 20 of the plate n^0, the wheel H^{0*} transferring over the inner side of the said point and into the inner or upper channel, u^0, the lugs which have previously been in the channel u^0, and the wheel H^0 transferring over the outer side of the said point and into the channel u^0 the lugs which have previously been in the channel u^0, and thus causing the rotation of the plates $m^0\ n^0\ p^0$ to produce a proper shedding of the warp.

$J^0\ y^0$, Figs. 12, 13, 14, 15, is the shuttle by which the weft or filling is deposited in the warp while the latter is attached to and operated by the carriers $I^0\ I^0$. This is in the form of a nearly complete ring, as shown in the plan view, Fig. 12, a portion, y^0, of which, terminating in a point, as shown at 39, is attached to the other portion, J^0, by a screw, 40, to permit of its detachment while the brim of the hat is being woven. The portion J^0 is secured permanently to a flat bar, J^{02}, which I term the "shuttle-carrier," which passes through the annular space 32, between the plates N N*, and through a slot in the plate n^0 and one of the plates q^0, and is furnished above the plate with a head, J^{03}, precisely like the head J^3 of the lower shuttle-carrier, J^2. The said bar J^{02} is made in two pieces, united rigidly by screws 44 44, shown in the face and side views, Figs. 14 and 15, passing through a slot, 41, in the upper part, which allows the lower part to be raised up with the part J^0 of the shuttle to bring the latter out of the way in weaving the sides of the crown and the brim. The filling or weft is supplied from a spool, K^0, (see Fig. 3,) arranged above and attached to one of the plates q^0, and it passes down through a hole in the plate n^0, and through the annular space 32, before mentioned, to the shuttle, and is received in a groove, 45, in the outer periphery of the part y^0 thereof, coming out at the point or tail 39, whence it is deposited in the warp. This shuttle is also steadied by a brace, P, which runs up in a spiral direction from the front of the shuttle and passes through the annular space 32 and through a slot in the plate n^0, the said slot being just large enough to allow it to slide freely through as the shuttle-carrier and the shuttle are raised in the process of weaving the side of the crown from the top toward the brim, the hat being woven in an inverted position with the crown downward. The head of the shuttle-carrier is guided by a rod, J^{04}, precisely like J^4, before described in connection with the lower shuttle carrier, and operated by a screw, J^{05}, attached to the plate q^0, and operating in the same manner and by similar means to the screw J^5 of the lower shuttle-carrier, the ratchet-wheel 26^0, through which the said screw J^{05} is operated, being actuated by stationary pawls 31^0, secured to the stationary ring, the teeth of the said ratchet-wheel being brought into contact with the said pawls as the said wheel revolves with the rings $m^0\ n^0\ p^0$. The portion y^0 of the shuttle, besides depositing the filling in the warp, serves the purpose of gathering the warp in and regulating the circumference of the side of the crown of the hat, the exterior of which will be just the size of the inner circle of the shuttle. Were it not for the shuttle being so extended by the piece y^0, the inclination of the warps would cause the side of the crown to be woven in a conical form, and the weaving to be looser as the circumference is increased. The reason for the inclination of the warp, (which is visible in Fig. 1,) is that in order to get into the upper set of weaving mechanism a sufficient number of warp-carriers I^0 the said carriers have to be arranged in a circle of much greater diameter than the circle in which the weaving is performed. The point or tail 39 is depressed, in order that it may deposit the filling as close as possible to the previous crossing of the warp. The crossing of the warp takes place over the said portion y^0 of the shuttle, which, being thin and tapered to the point or tail 39, slips out easily from the crossed shed and leaves the filling secured by the closing of the shed. The pressing up of the filling is effected by a crescent-shaped piece, Q, which is attached rigidly by a forked yoke, Q′, to the shuttle-carrier J^{02}, the said piece operating on the warps substantially like the broad part of the lower shuttle, J, to draw it tightly over the filling. The shuttle J^0, has also rollers $M^0\ M^0$ (see Fig. 14 and 15) attached to it to act in the same manner as the rollers M, applied in the lower weaving mechanism. This shuttle and the devices for pressing in its filling all require to be changed for weaving hats of different sizes, as their curvature must conform to the size of the hat.

R and S, Figs. 1 and 2, are two circular

clamping plates for clamping the top of the crown of the hat, and thus holding it in place, both while the warps are being transferred from one set of warp-carriers to the other and during the weaving of the side of the crown of the hat. The upper one, P, of these plates is of the circumference intended for the top of the crown of the hat, and is attached to a sleeve, R′, which is fitted to slide freely up and down on the lower part of the stationary center shaft, F, and connected by a rod, R^2, with a lever, R^3, arranged to work on a fixed fulcrum, 43, above the top plate, A^3, and this lever is furnished with one or more movable weights, 46, to load it as much as may be desirable. The lower plate, S, may be smaller than R. It is made with a centrally-bored socket, which is fitted to turn freely on the top of a shaft, S′, which is fitted to slide freely up and down in line with F through the fixed hollow upright shaft *e*, before mentioned, which is arranged in the center of the bed-plate A. This sliding shaft is made with a toothed rack, as shown in Fig. 1, to gear with a pinion, T, on a horizontal shaft, T′, arranged in suitable fixed bearings below the bed-plate A. The shaft T′ is furnished with a hand-crank, by which to turn it and the pinion for raising and lowering the shaft S′.

U (shown in Fig. 1 in red color) is a removable ring of a circumference just large enough to receive within it the side of the crown or upright portion of the hat, and it is attached by means of two or more upright rods, 47 47, to a ring, U′, which is made flat to rest upon the bed-plate A. The purpose of the ring U is to support the side of the crown of the hat and prevent it from being stretched or pulled out of shape in weaving the brim, and thus preserve the circular form of the brim, the said ring being supported at such a height that its upper edge is just even with the termination of the side of the crown where it joins the brim.

V, Fig. 1, is the shaft for driving the lower set of weaving mechanism, arranged horizontally in suitable bearings attached to one of the standards A^2, and furnished with a bevel-gear V′, which gears into a bevel-gear, *s*′, attached to the spur-gear *s*, hereinbefore referred to. This shaft may be driven by any convenient motive power, and its bevel-gear V′, giving motion to the gears *s*′ and *s*, causes the latter to give rotary motion to the toothed ring *r*, which carries with it all the rotating parts of the lower set of mechanism.

W, Fig. 1, is the shaft for driving the upper set of weaving mechanism, arranged horizontally in suitable bearings attached to or formed in one of the uprights A^2 and the bracket A^4. This shaft is furnished with a bevel-gear W′, which gears with a bevel-gear, $s^{0\prime}$, on the upright shaft t^0, hereinbefore mentioned. The shaft W may be driven by the same power as the shaft V by simply changing the belt or gearing and its bevel-gear W′, giving rotary motion to the bevel gear $s^{0\prime}$, and shaft t^0 causes the gear s^0 to give rotary motion to the toothed ring r^0, which carries with it all of the rotating parts of the upper set of weaving mechanism. The object in using an odd number of warps when every alternate thread is to be raised, after the manner of plain weaving, is so that in each revolution when the upper half of the warp changes to the lower, and vice versa, the thread of filling while carried in a continous rotation in one direction may pass each particular warp-thread on the side opposite to that on which it passed before.

The operation of weaving a hat in this loom is as follows: The movable frame B B* C C C, containing the lower set of weaving mechanism, having been brought to its lowest position by means of the screws D D, and the plate R having been raised and the plate S lowered to leave an open space in the center of the said frame, a suitable odd number of warp strands or threads, generally about from one-tenth to one-sixth of the whole number required to form the hat, are stretched diametrically across the frame, and their ends secured at equal distances apart to the hooks of the warp-carriers. The filling yarn or thread is then brought from the spool K, as hereinbefore described, to and through the eyes 25 25 of the shuttle J, and its end brought to the center of the loom. Power is then applied to the shaft V, and the lower set of weaving mechanism, being thereby set in motion, commences the weaving of the hat at the center of the top of the crown, and at each revolution of the said mechanism one pick or course of weft or filling is inserted into the open warp, the warp crossed over it, and the weft or filling pressed up, and as this operation proceeds the screw J^5 gradually draws the shuttle and the pressing-up devices farther from the center of the loom, as required by the increasing diameter of the web. As the web increases in diameter new strands or threads of warp are introduced from time to time by securing their ends to the warp-carriers situated at equal distances between those occupied by the previously-inserted strands, and in this way the required degree of closeness of texture is obtained in the crown of the hat. When a circular web a little larger than the crown of the hat has been thus woven, the shaft V is stopped, the plate S is raised up in contact with the part so woven by means of the pinion T, and suitably secured and the plate R is lowered upon it and held down by the application of the weight or weights 46 to the lever R. The web, being now clamped between the plates R S, is held securely against displacement while the warp strands or threads are detached from the hooks *j j* of the lower set of weft-carriers, I I, and transferred to the hooks $j^0 j^0$ of the upper set, I^0 I^0, by a movement by hand, as indicated by the dotted lines 36 36 in Fig. 1, and in so doing the margin of the web already woven is turned up over the edges of the plate R. The shuttle J^0 y^0 is,

and its respective pressing-up devices are, then inserted, adjusted, and secured in the loom, and the upper set of weaving mechanism is set in motion by power applied to the shaft W, and the weaving proceeds in an upward direction to produce the side of the crown of the hat, which is of cylindrical or an approximate form, the shuttle and pressing-up devices being drawn upward by the screw J^{05} as the weaving proceeds. When the side of the crown has been woven to the required depth, which is rather greater than the intended height of the crown, the shaft W is stopped, the upper shuttle and its respective pressing-up devices taken out, and the ring U put in, as shown in red outline in Fig. 1. This ring may be attached to the shaft S′, so as to be adjustable, and the plate S may be dispensed with altogether. The frame B B* C C C is next raised up by the screws D D to bring the space between the upper and lower series of pins, *g g h h*, on a level with the edge of the web as produced by the last course of weft, and the warp strands or threads are disconnected from the hooks j^0 j^0 and connected again with the hooks *j j*, but owing to so much of the strands having been taken up in weaving the side of the crown, the strands themselves are not long enough to reach and connect directly with the said hooks, and the springs to which the hooks are attached could not without injury be stretched sufficiently for such direct connection. I therefore connect with each end of each strand a strap, loop, hook, or other suitable device, 48, (shown in red color in Fig. 1,) of a length equal to the height of the crown, and attach these devices to the hooks *j j*. The edge of the web is then drawn over the thin upper edge of the ring U, and on the shaft V being again set in motion the lower set of weaving mechanism is again set in operation, and the weaving of the brim commences. This part of the process is substantially like that of weaving the top of the crown, and additional strands are inserted from time to time as the diameter of the web increases, the shuttle J and its respective pressing-up devices all moving outward in proportion to such increase of diameter. The hat is kept in place during this part of the process by means of the plate R and ring U. When the brim is of sufficient size, the shaft is stopped, the plate R raised out of the hat, the warp-strands disconnected from their carriers, and the weft cut or broken, and the hat is then removed from the loom. I prefer to weave the brim rather larger than is required and to finish it afterward by turning in the edge all round and stitching it down.

Having now fully described the nature, construction, and operation of my invention, I will proceed to state what I claim as new and desire to secure by Letters Patent—

1. The employment, in a circular loom of two separate and distinct sets of weaving mechanism—one suitable for weaving in a flat or nearly flat form, as required for the top of the crown and brim of a hat, and the other suitable for weaving in a cylindrical or hollow form, as required for the side of the crown of a hat—and the two so constructed and arranged that the warp may be transferred from one set to the other to change the form of the weaving, substantially as herein specified.

2. In a circular loom having two separate and distinct sets of weaving mechanism, such as above specified, making one set movable or adjustable relatively to the other in a direction parallel with the axis of the loom, substantially as and for the purpose herein specified.

3. The combination of the plate R and forming-shuttle J^0 y^0, applied and operating in a circular loom, substantially as and for the purpose herein specified.

4. The ring U, employed in combination with a plate, R, or its equivalent, to hold and secure the vertical part of the crown after the latter has been formed by the shuttle j^0 y^0, substantially as and for the purpose herein set forth.

5. The combination, in a circular loom, of a series of revolving rings, *m n p* or m^0 n^0 p^0, or their equivalents, and an attached toothed or notched wheel, H, or pair of toothed or notched wheels H^0 H^{0*}, to separate a series of warp-carriers, the whole operating substantially as and for the purpose herein specified.

6. The shuttle J^0 y^0, constructed substantially as herein described, in the form of a nearly complete ring, whereby it is made to serve the two purposes of depositing the filling in the warp in weaving the side of the crown of the hat and of gathering in the warp and regulating the size of the side of the crown of the hat, substantially as herein set forth.

7. The employment, in a circular loom, of wheels or rollers so applied as to press up the filling in the warp by means of rolling-friction, when used in combination with a presser-bar, L, substantially as herein specified.

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Witnesses:

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