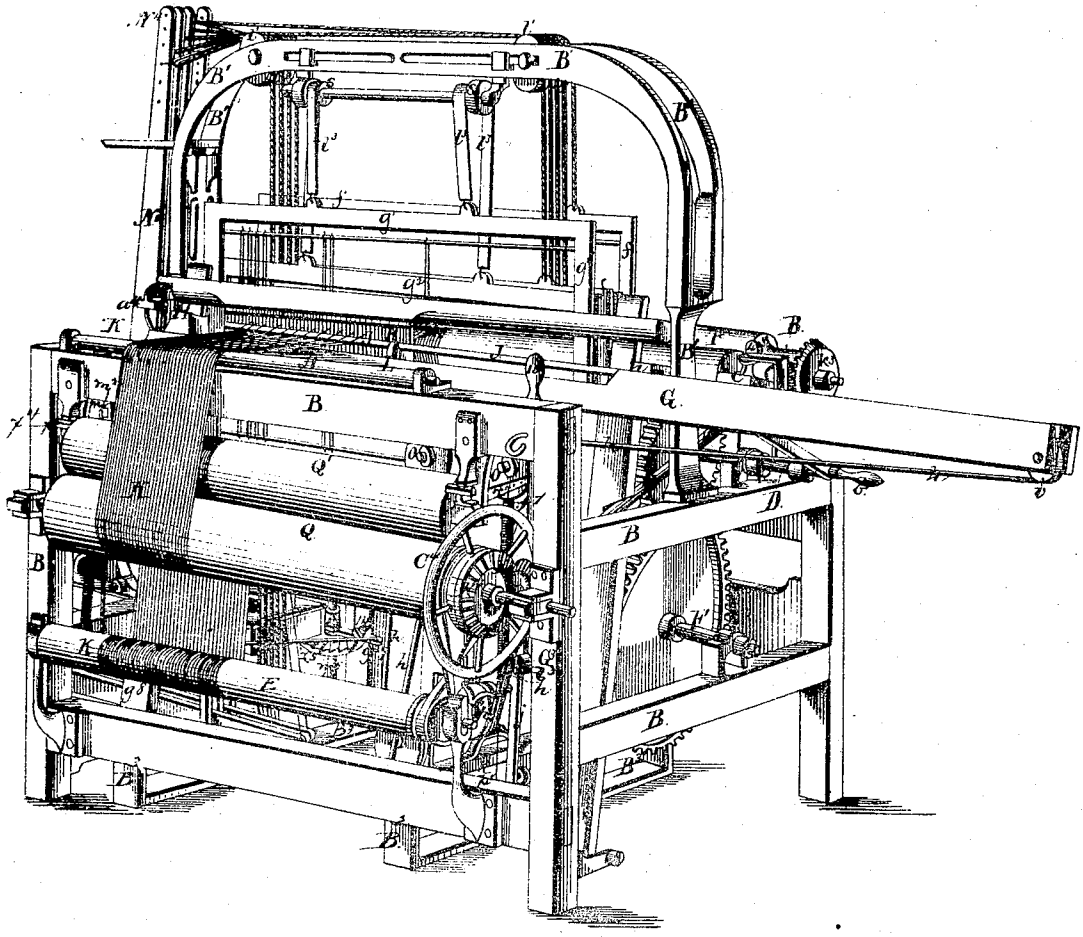
9 Plates—Plate 1.

I. LINDSLEY.

LOOM FOR WEAVING HAIR CLOTH.

No. 45,107. Patented Nov. 15, 1864.

Fig. 1.



Witnesses:

Isaac A Bonnell

George L Phillips.

Inventor.

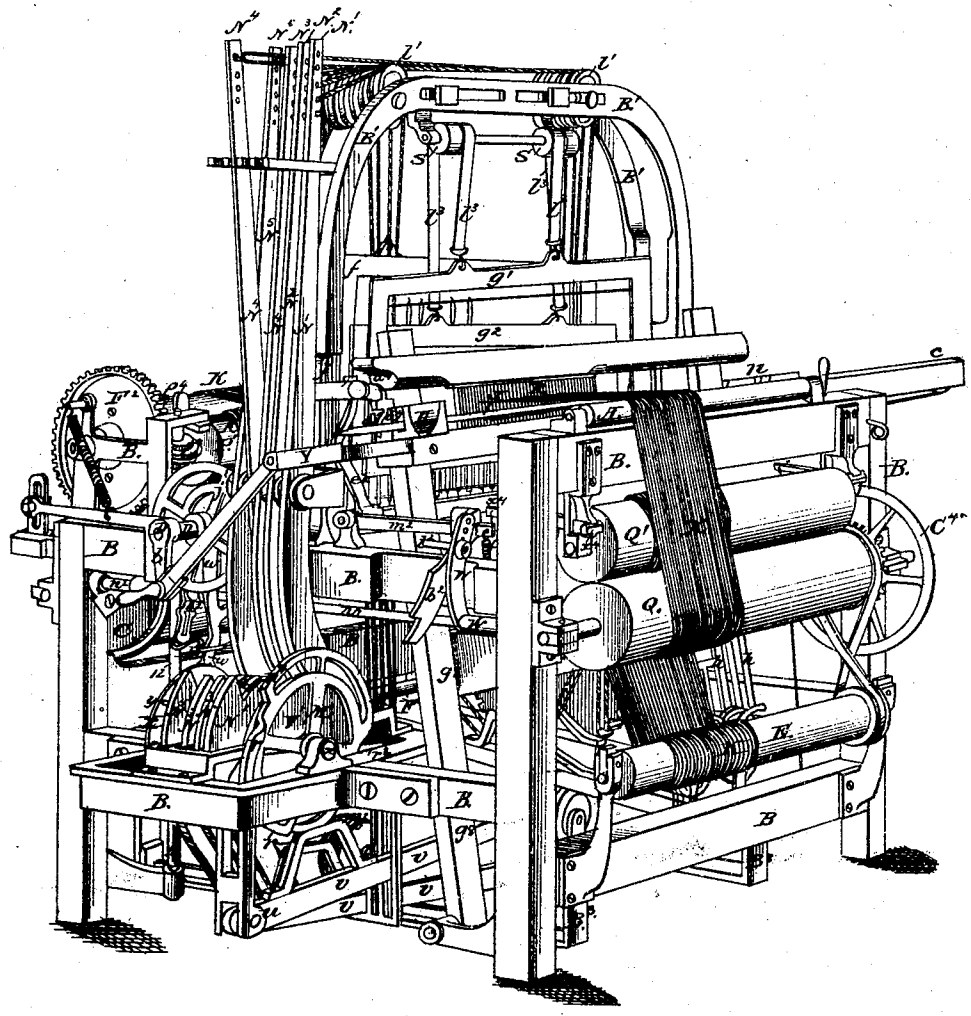
Isaac Lindsley

I. LINDSLEY.

LOOM FOR WEAVING HAIR CLOTH.

No. 45,107. Patented Nov. 15, 1864.

Fig. 1.



Witnesses:
Isaac A Brunell
George G. Phillips

Inventor:
Isaac Lindsley

9 Plates—Plate 3.

I. LINDSLEY.

LOOM FOR WEAVING HAIR CLOTH.

No. 45,107. Patented Nov. 15, 1864.

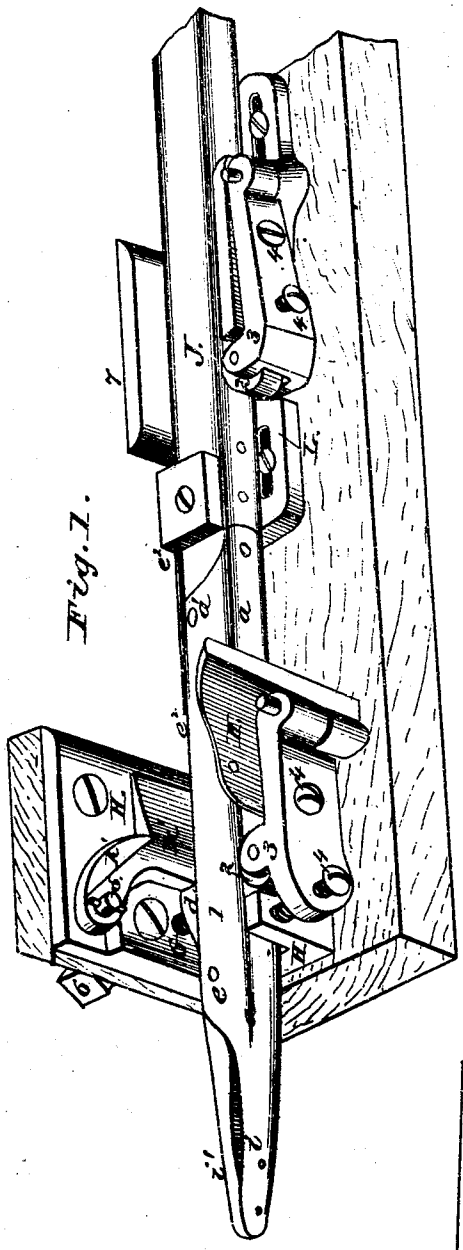


Fig. 1.

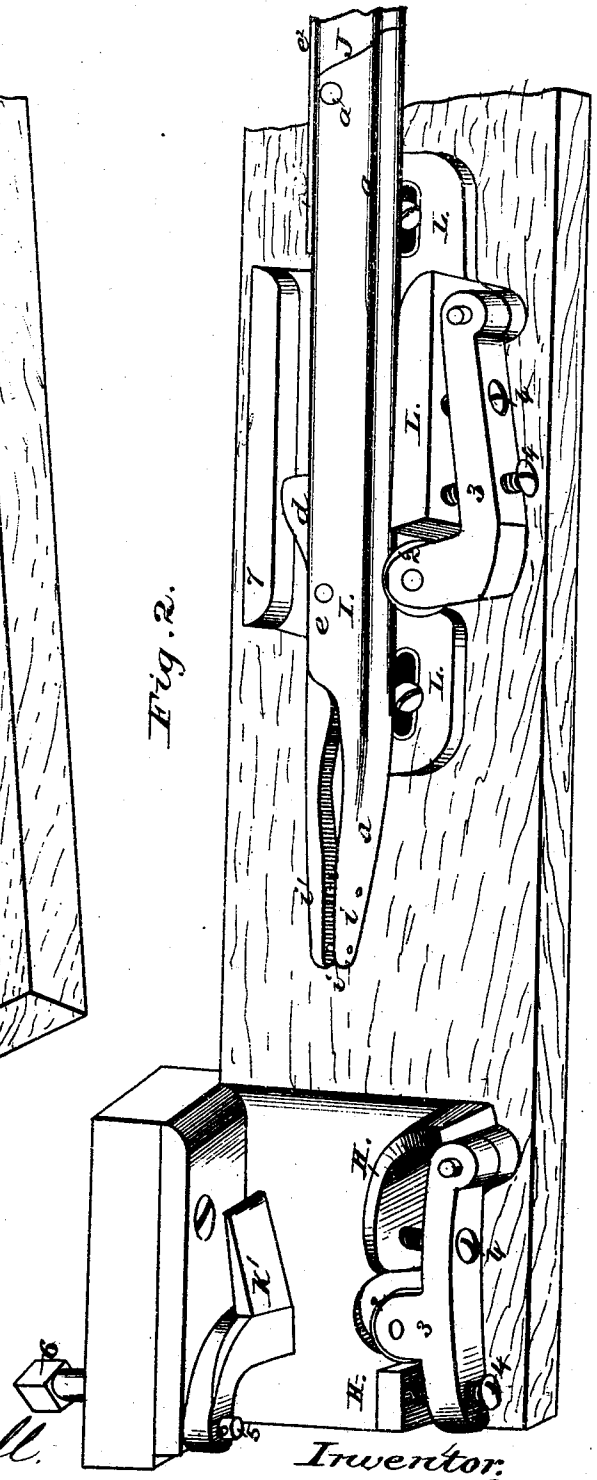


Fig. 2.

Witnesses:

Isaac A. Bonnell.

George G. Phillips

Inventor:

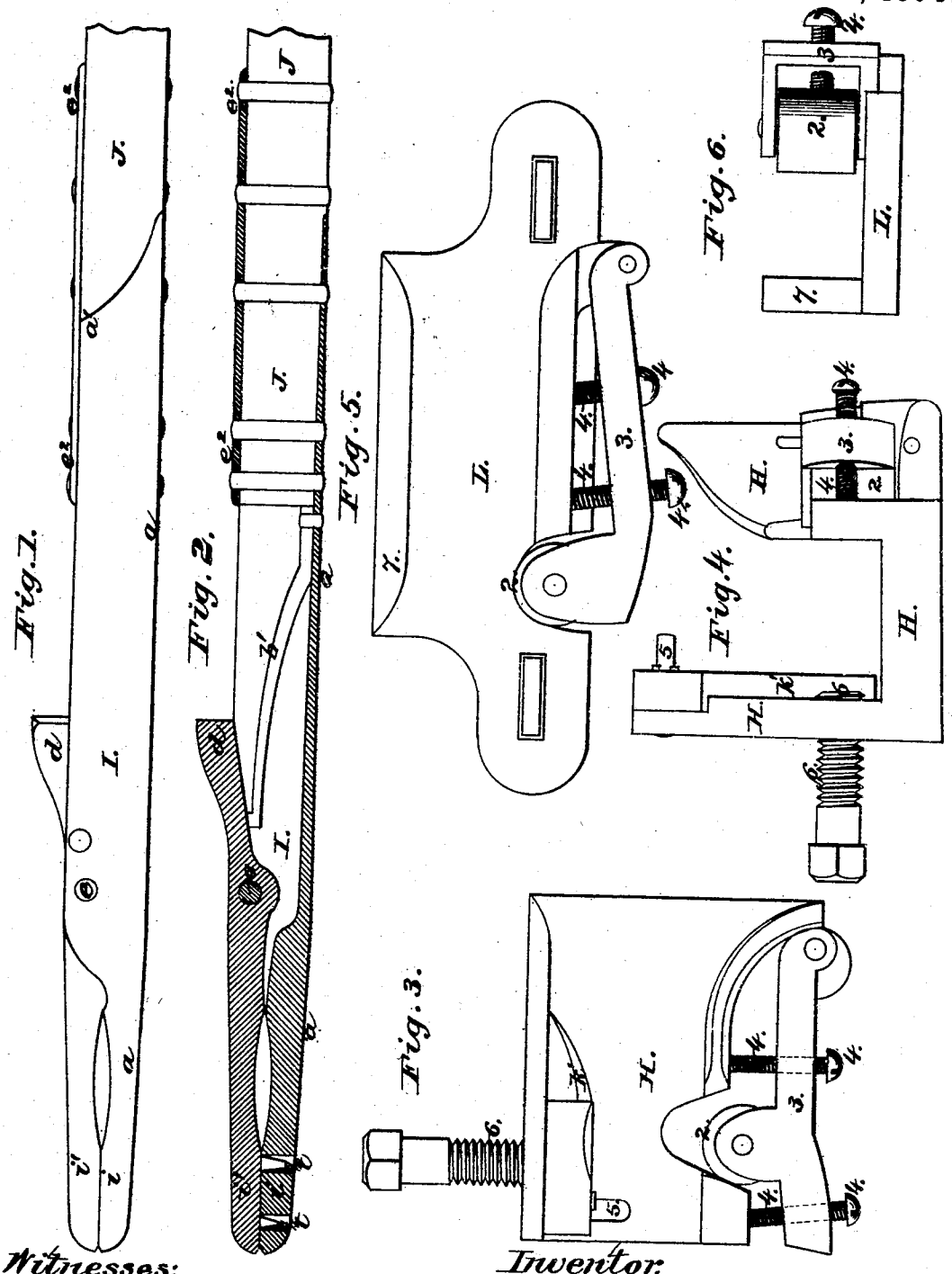
Isaac Lindsley

9 Plates—Plate 4.

I. LINDSLEY.

LOOM FOR WEAVING HAIR CLOTH.

No. 45,107. Patented Nov. 15, 1864.



Witnesses:

Isaac A. Bonnell.

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Isaac Lindsley

9 Plates—Plate 5.

I. LINDSLEY.

LOOM FOR WEAVING HAIR CLOTH.

No. 45,107. Patented Nov. 15, 1864.

Fig. 1.

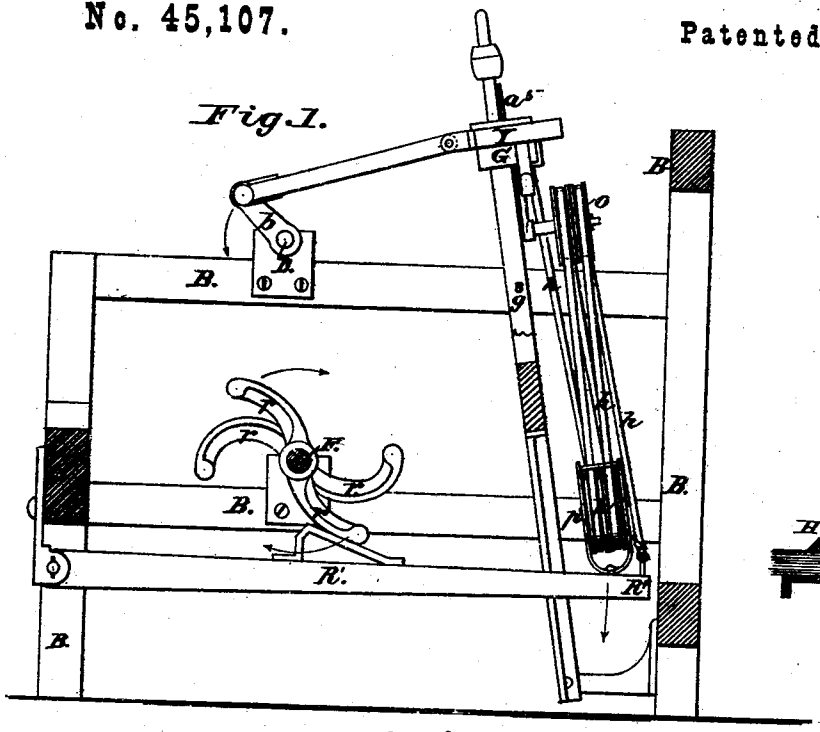


Fig. 3.

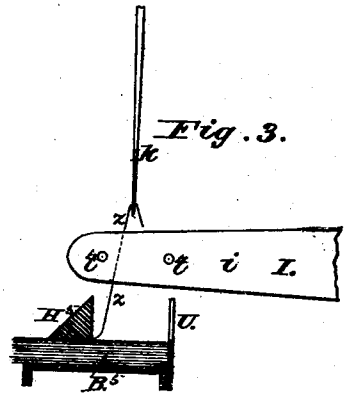
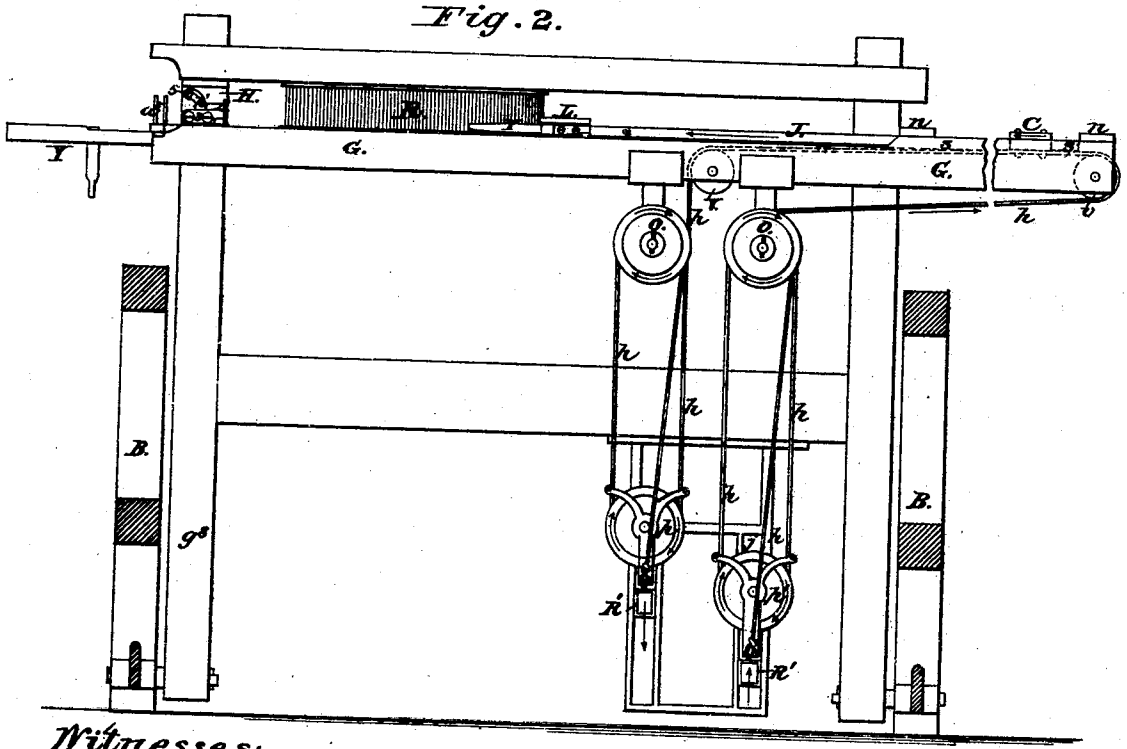


Fig. 2.



Witnesses:

Isaac A. Brinnell.

George G. Phillips.

Inventor.

Isaac Lindsley

9 Plates—Plate 6.

I. LINDSLEY.

LOOM FOR WEAVING HAIR CLOTH.

No. 45,107. Patented Nov. 15, 1864.

Fig. 5.

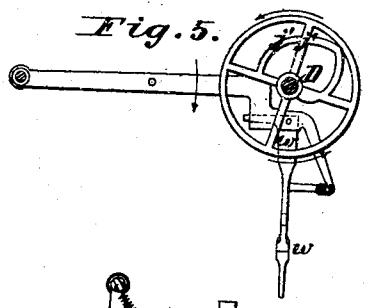


Fig. 1.

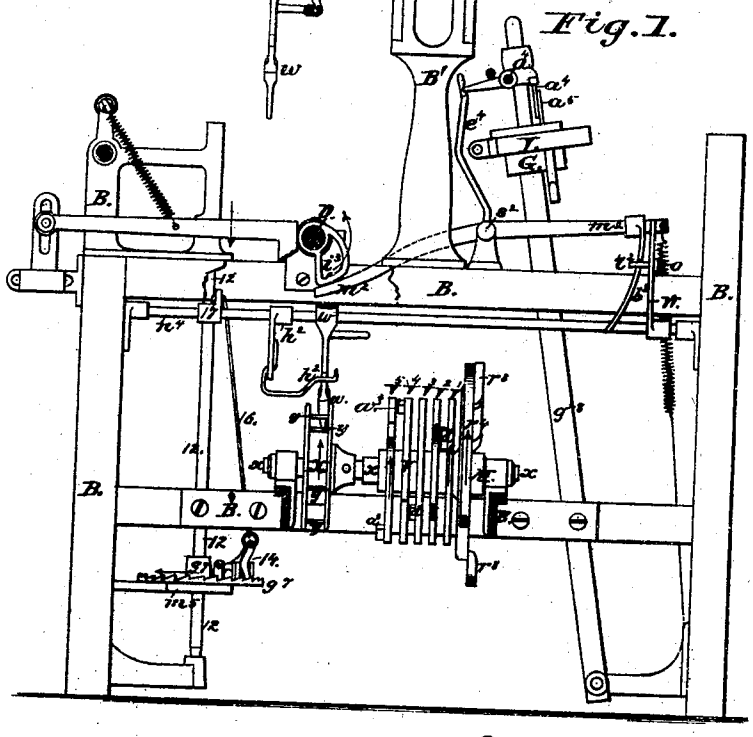


Fig. 6.

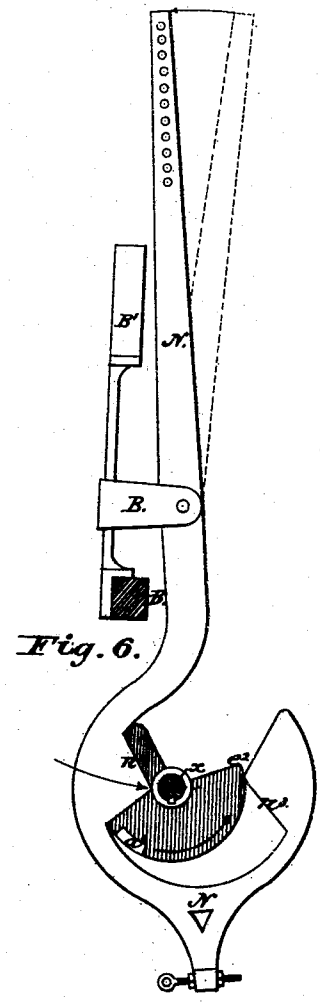


Fig. 3.

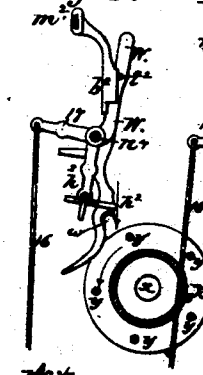


Fig. 4.

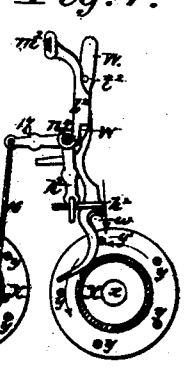
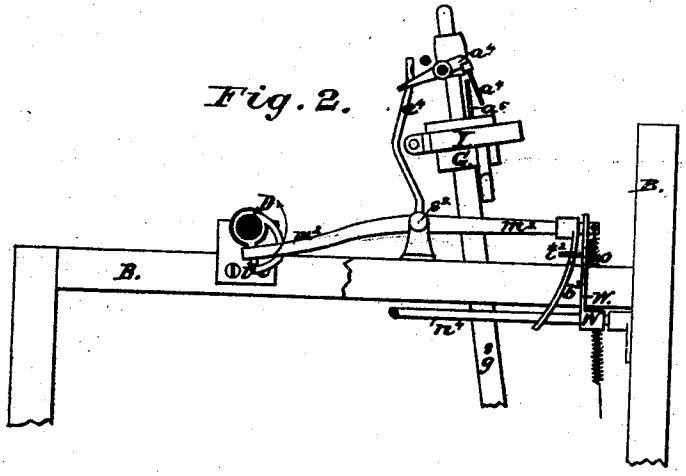


Fig. 2.



Witnesses:

Isaac A. Bonnell.
George G. Phillips

Inventor:

Isaac Lindsley

I. LINDSLEY.

LOOM FOR WEAVING HAIR CLOTH.

No. 45,107. Patented Nov. 15, 1864.

Fig. 1.

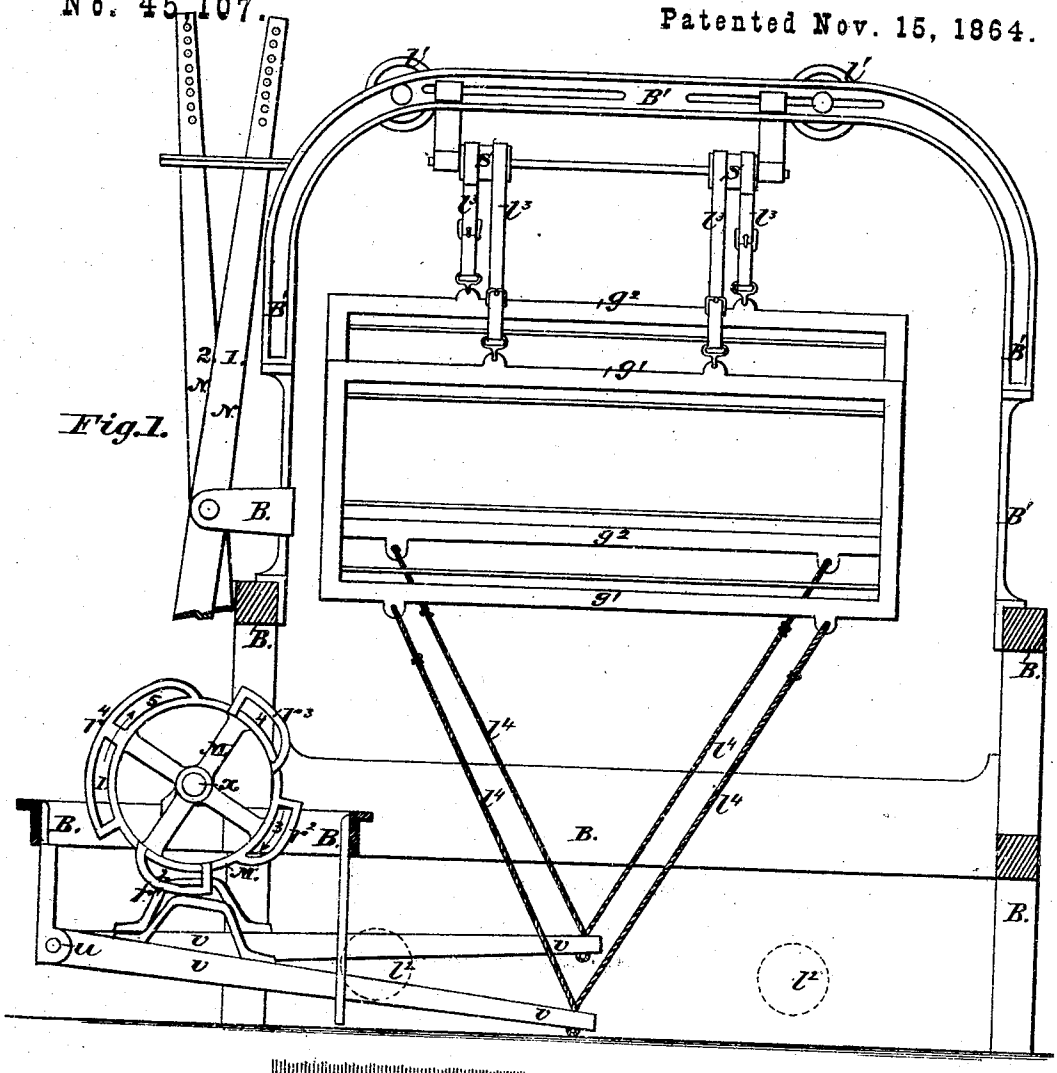
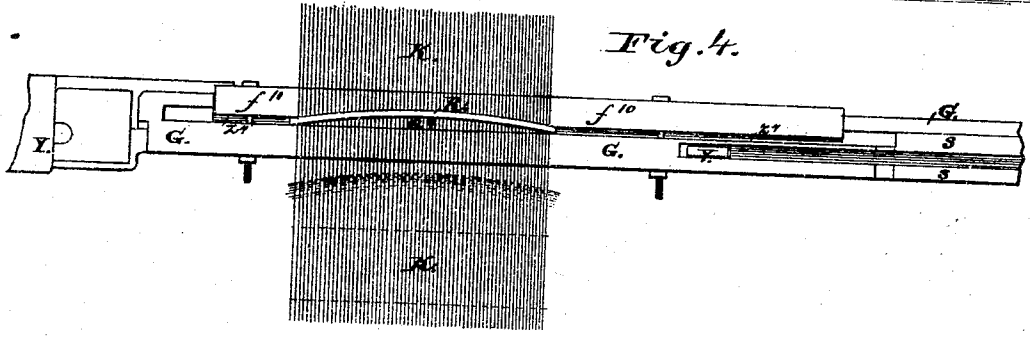


Fig. 4.



Attest:

Isaac A Bonnell
George G Phillips

Inventor.

Isaac Lindsley

9 Plates—Plate 8.

I. LINDSLEY.

LOOM FOR WEAVING HAIR CLOTH.

No. 45,107. Patented Nov. 15, 1864.

Fig. 3.

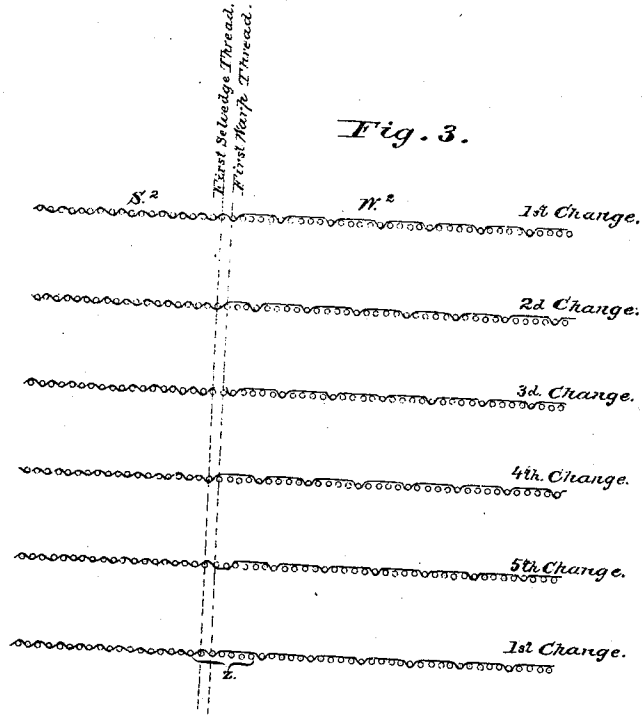
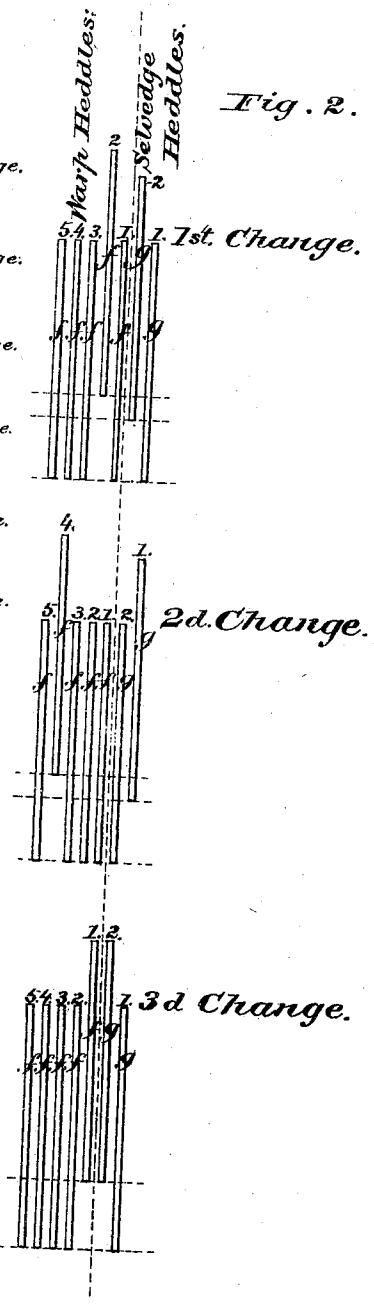


Fig. 2.



Witnesses:

Isaac A. Pennell

George G. Phillips

Inventor.

Isaac Lindsley

9 Plates—Plate 9.

I. LINDSLEY.

LOOM FOR WEAVING HAIR CLOTH.

No. 45,107. Patented Nov. 15, 1864.

Fig. 1.

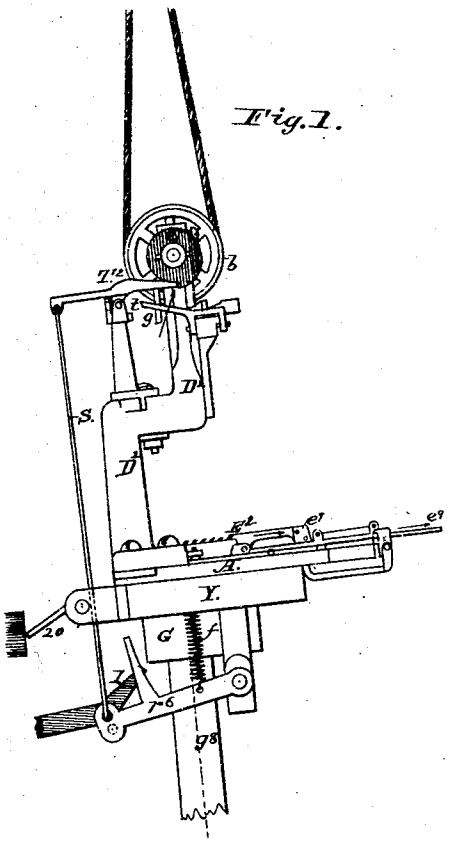
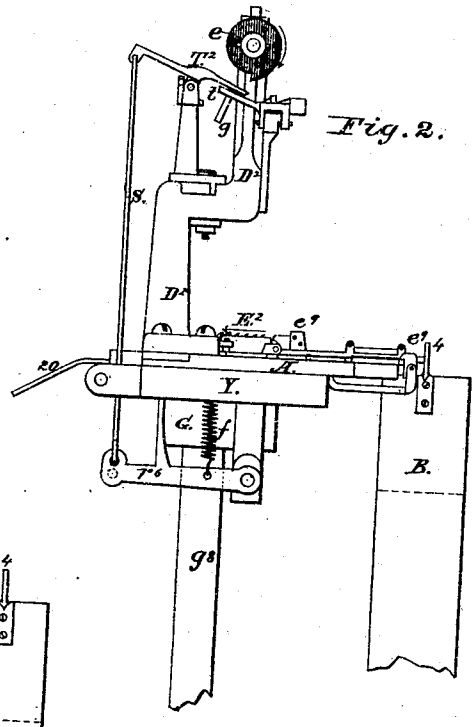


Fig. 2.



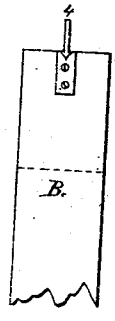


Fig. 3.

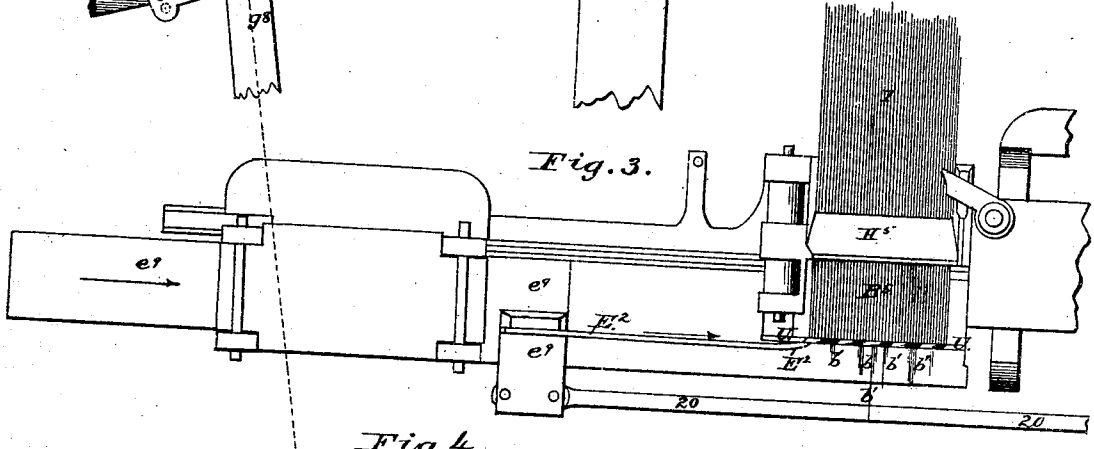
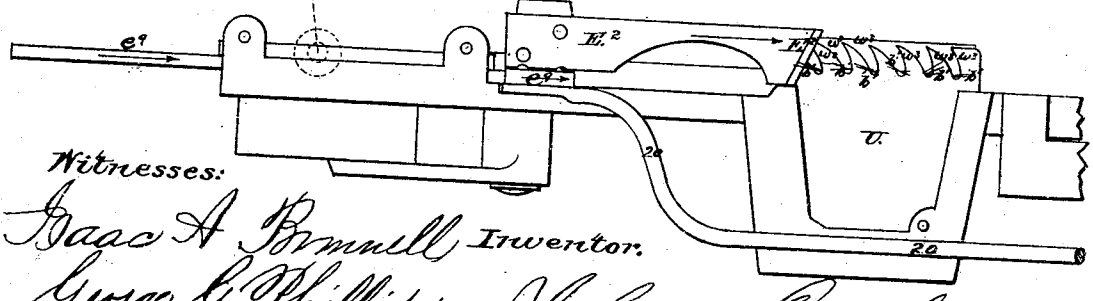


Fig. 4.



Witnesses:

George G Phillips

Isaac A Brunell Inventor.

Isaac Lindsley

UNITED STATES PATENT OFFICE.

ISAAC LINDSLEY, OF NORTH PROVIDENCE, RHODE ISLAND.

IMPROVEMENT IN LOOMS FOR WEAVING HAIR CLOTH.

Specification forming part of Letters Patent No. **45,107**, dated November 15, 1864.

To all whom it may concern:

Be it known that I, ISAAC LINDSLEY, of North Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful improvements in power-looms for weaving hair-cloth and fabrics, in which the weft is inserted in separate lengths of material instead of a continuous yarn or thread; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings and the letters of reference marked thereon, making part of this specification.

The invention hereinafter described presupposes the existence of an automatic mechanical device or "serving apparatus" which will select a single hair or length of weft from a bunch or mass during a single beat of the lathe, and hold it in the proper position to be seized by the nipper or device used to insert the same in the open shed of the warp with a sufficient degree of certainty and precision to enable the operation of weaving to continue uninterruptedly. Several of the improvements constituting this invention, however, are equally serviceable in case the separate hair or length of weft is selected and presented in the requisite position by the human hand. As a suitable and efficient serving apparatus for thus selecting and presenting the selected hair or length of the weft to the nipper or other device used to insert the same in the warp, I purpose using that described and set forth in the schedule attached to Letters Patent of the United States No. 1,630, (32,634,) granted to me, the said ISAAC LINDSLEY, June 25, 1861, as being the best device known to me for that purpose; but any other efficient device may be used instead thereof in connection with the improvements herein described.

My present invention embraces the following features of improvement:

First, the construction and method of operating the nipper or device used to insert the lengths of weft in the warp in order to insure the certain seizure of the hair without severing, crushing, or otherwise injuring the same, and also in the means employed to reciprocate the said nipper or other device performing its functions in the open sheds of the warp, to avoid undue momentum arising from its rapid movement to and fro. To accomplish the first of these results, the selecting or serving mechanism is so arranged in relation to the nipper and to the mass of hair or weft, which is suitably held in position to be operated upon by them, that when the end of the hair has been selected from the mass by the means before mentioned, or its equivalent, and deflected and held aside from the mass and directly across the path of the nipper, the nipper shall grasp the same between the selecting-instrument and the mass while thus held, so that the wefts will be presented to the nipper with certainty in the same position successively. In connection with this, I form one jaw of the nipper with two projecting pegs, or their equivalent, which enter the opposite jaw thereof in closing, and between which the weft is seized and inclosed beyond the probability of escape. It has been found in practice that if the jaws of the nipper are closed suddenly upon the hair with force the hair is liable to be crushed and severed, and for the purpose of avoiding this difficulty the nipper is first closed sufficiently to encompass and secure the hair, and at the commencement of the retreating movement of the nipper the jaws are made to close gently upon the hair with sufficient firmness to hold it and draw it from the mass into the shed. And for the accomplishment of the latter-mentioned result I make use of a tough yet light wooden nipper-staff, which is made to slide to and fro in suitable guides formed in the lathe-beam by means of a strap or band passing over a system of fixed and movable pulleys, the latter of which, with the two ends of the said strap or band, being attached to the loose ends of the treadle-levers, which are operated by revolving cams in the usual way.

The second feature of my improvement relates to the mode of working the heddles or harness, by means of which the changes of the sheds are made within a short portion of the time required for the cycle of operations of the loom, for the purpose of giving the nipper and other parts connected therewith ample time and space to perform their respective functions during the single beat of the the, and also to controlling the changes of the heddles or harness by the supply of weft; and it consists in giving to the cam-shaft which works the heddles or harness an intermittent revo-

lution, with a rest between the changes of the sheds, by means of a ratchet, or its equivalent, having as many teeth or pins as there are picks in working the round of the figure, and a pawl, or its equivalent, which will move the ratchet one tooth or pin at each beat of the lathe, which pawl is controlled in its operation upon the ratchet by the supply of weft to the shed, so that if the weft is not supplied to the shed the pawl fails to act upon the ratchet, and the heddles or harness remains unchanged until the weft is duly supplied, when the pawl acts and turns the cam-shaft and opens a new shed for the next shot of weft.

The third feature of my improvement relates to the manner of operating the heddles or harness which forms the selvage in connection with the heddles or harness that forms the body of the cloth to prevent the formation of an overshot of weft of undue length where the body and selvage join at a certain period in the round of changes of the heddles or harness; and it consists in so arranging the cams that operate the selvage heddles or harness, in combination with the cams that operate the heddles that form the body of the cloth, that at each round of the figure the selvage shed will be held open during two picks and receive two shots of weft.

The fourth feature of my improvement relates to the mechanism for letting off or delivering the warps and taking up the woven cloth as it is produced; and it consists in so combining a positive "take-up" and a positive "let-off" (by which I mean devices that take up and deliver a uniform measured length of the warp at each beat of the lathe) with the mechanism that actuates the same that when the weft fails to be supplied to the shed their operation will be arrested until the weft is duly supplied.

The fifth feature of my improvement relates to the manner of arranging the reed so as to compensate for or counteract certain difficulties in weaving hair-cloth that I will mention. The weft-hairs being moistened when they are woven, which moistens the warps in same degree, and the selvage being of a different texture from the body of the goods, the unequal shrinkage of those parts in drying is liable to leave the weft lying in a curved direction across the web, instead of straight. This part of my invention therefore consists in giving a curve or form to the reed so as to place the weft in the cloth with a curvature just sufficient to counteract the effect of the unequal shrinkage mentioned.

The sixth feature of my improvement relates to the operation of the automatic serving apparatus used to select the separate lengths of hair or weft and present the same to the nipper, by which they are drawn into the shed, and its purpose is to arrest the operation of the serving mechanism, to prevent the nipper, as it advances to seize the hair, from coming in contact with the said mechanism and injuring it; and it consists in combining with the serving mechanism a detent or stop so arranged as to work in concert with the nipper and arrest the operation of the serving mechanism in a position out of the way of the nipper when it advances to seize the hair, and to release the serving mechanism as soon as the selected hair is drawn out of the bunch.

The seventh feature of my improvement consists in the employment of a suitable clipping device, to clip the straggling ends of the bunch of hair or other weft to prevent said ends from interfering with the operation of the contiguous parts of the machine.

To enable others skilled in the art to make and use my invention, I will proceed to describe the construction and operation of the same by means of the accompanying drawings, in which—

Plate I: Figures 1 and 2 are perspective views of the said hair-cloth loom, showing the general arrangement of the parts.

Plate II: Figs. 1 and 2 are perspective views of the said machine, showing the general arrangement of the parts at the reverse end of the same.

Plate III: Fig. 1 is a perspective view of the said nipper and the devices by which it is opened and closed at the proper time, showing the nipper in the position of seizing the hair. Fig. 2 is a perspective view of the same nipper and devices, showing the former in the position of releasing the hair after having drawn it into the warp.

Plate IV: Fig. 1 is a full-size plan of said nipper. Fig. 2 is a longitudinal section of the same, showing fully its construction. Fig. 3 is a full-size plan of the device which opens and closes the said nipper in the act of seizing the hair. Fig. 4 is an end elevation of the same. Fig. 5 is a full-size plan of the device which opens the nipper in the act of releasing the hair when it has been drawn into the warp. Fig. 6 is an end elevation of the same.

Plate V: Fig. 1 is an end elevation of the frame of the machine and of those parts which impart the reciprocating movement to the nipper for the insertion of the weft in the warp. Fig. 2 is a front elevation of the same. Fig. 3 represents the nipper in the act of seizing the selected hair as it is deflected and held by the lance *k* for that purpose.

Plate VI: Fig. 1 is an end elevation of the frame of the machine and of those parts which operate and control the action of the several sets of heddles or harness. Figs. 2, 3, 4, 5, and 6 are details, which are referred to as the description proceeds.

Plate VII: Fig. 1 is a front elevation of the frame and those parts of the machine which operate and control the selvage warps. Figs 2 and 3 are details illustrating the successive changes of the several sets of heddles or harness. Fig. 4 is a plan of a portion of the lathe and of the curved reed R therein.

Plate VIII: Fig. 1 is an end elevation of the frame of the machine and of the let-off

and take-up devices, their connections, and the means by which the same are operated. Fig. 2 is an elevation of the reverse end of the same parts and their connections.

Plate IX: Figs. 1 and 2 represent the device used to arrest the operation of the lance or device used to select the hair or weft from a mass at the proper time, as hereinafter specified. Figs. 3 and 4 represent the device used to trim or clip off the projecting ends of the bunch or mass of hair which may be partially drawn therefrom by the repeated action of the lance *k*, or from any other cause.

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

In the said drawings, B is the frame of the loom, B′ being the arch from which the several sets of heddles or harness f' f^2 f^3 f^4 f^5 g' g^2 are suspended, as shown in Plates I, II, and VII.

G is the lathe, which receives its vibrating movement from the crank *b b* on each end of the main shaft D.

F is the cam-shaft, which is driven with a speed of one revolution to two revolutions of the main shaft by means of the gears on each, Plate II.

C is the yarn-beam, E the cloth-beam all of which parts are of the usual construction.

I will now proceed to describe the nipper I. (Fully shown in Plates III, IV, and V.) Said nipper is constructed, as shown in Figs. 1 and 2 of Plate IV, with two tapering jaws, *i i′*, one of which, *i′*, is movable on the pivot *e* by the projection *d* thereon, sliding against an inclined surface against the force of the spring *b′*, Plate IV, Fig. 2. The other jaw is rigid, and its shank surrounds and is firmly secured to the wooden nipper-staff J; and it will be perceived that the side of the shank at *a* is rounded, and that the end thereof is curved obliquely, as shown, and let into the wood, and that the corner at *a′* is covered and protected by a plate, e^2, which construction has been especially devised for the purpose of preventing the wood from wearing away next to the metal shank, from the continuous rapid movements of the nipper between the open sheds of the warp, and to prevent the nipper from catching and breaking the warps in its passage through them. In the movable jaw *i′* two pegs, *t t*, are inserted about half an inch asunder, which pegs enter two cavities in the rigid-jaw *i′*, as shown. These pegs serve to prevent the selected hair or weft from escaping after the nipper closes in the act of seizing the same, as will presently be explained.

H and L are the nipper-boxes, which operate and control the movable-jaw of the nipper. The former, H, consists of a cast-iron shell, Plates III and IV, having arranged upon one side a friction-roller, 2, in a swing-arm, 3, and adjusted to give the requisite opening to the nipper by the two set-screws 4. Upon the opposite side of said shell is arranged a swinging wedge, *k′*, upon the stud 5, and a set-screw, 6, protruding through from the outside of the shell, with its point next to the head of the said wedge. The office of said wedge is to depress the projection *d* to open the nipper in the act of seizing the hair, and the office of the protruding point of said set-screw is to arrest the complete closing of the nipper, and thereby prevent the crushing of the hair thus seized. The nipper-box L serves to open the nipper and release the hair after drawing it fully through the open shed; and to this end it is provided with a friction-roller, 2, arranged and adjusted in like manner with that just described, and a stationary wedge, 7, forming one side of said box. These nipper-boxes are situated on the bed of the lathe in the pathway traversed by the nipper, as shown in Plate V, Fig. 2, in the proper position with respect to the warp to admit and insure the performance of their respective functions.

The lathe G extends over the frame upon the right-hand side to a sufficient length to accommodate the requisite length of the nipper-staff, Plate V, Fig. 2, and is formed with longitudinal guides *s s*, between which the nipper-staff slides to and fro, the sliding movement being limited by the block *c* on the nipper-staff striking against the stops *n n* on the said guides. The traversing movement of the nipper-staff is effected by means of the strap *h*, which is attached to the under side of and directly beneath the block *c*, and extends in opposite directions longitudinally, passing over the wheels *v v* in the under side of the lathe, thence over the two sets of fixed pulleys *o o′* and movable pulleys *p p′*, the latter of which, together with the two ends of said strap, being attached to the ends of the treadle-levers R′ R′, swinging vertically in guides *j* upon a fulcrum on the opposite side of the frame by motion derived from the revolving cams *r r* on the cam-shaft F, Plate V, Fig. 1.

There are two fixed pulleys *o* and three fixed pulleys *o′* and two each of the movable pulleys *p p′*; and it will be seen that by means of this arrangement of fixed and movable pulleys the extent of motion of the two treadle-levers is multiplied when transmitted through the strap *h* to the nipper-staff, without creating any excessive momentum beyond the resistance of the friction produced by the sliding nipper-staff, and otherwise to suppress and control, and it is this peculiarity of the mechanism which renders it important and valuable as a means for operating the nipper-staff in power-looms for weaving hair-cloth; and it should be here stated that it is found to be important in practice that the nipper-staff should be as light as possible, and that everything calculated to create undue momentum in the nipper-staff should be avoided.

Having thus described the construction and arrangement of the nipper and the appliances for operating and controlling the same, its operation is as follows: When the nipper is in the position shown in Plate V, Fig. 2, the hair is released by the opening of the jaws of the nipper, as shown in Plate III, Fig. 2, and

by a continued revolution of the cam-shaft F, Plate V, Fig. 1, in the direction indicated by arrows the cam *r* depresses the treadle-lever R′, and, through the medium of the strap *h* and pulleys *o* and *p*, transmits motion to the nipper, carrying it through the open shed of the warp and into the nipper-box H, when the projection *d* on the movable jaw slides against the inclined surface of the swinging wedge *k′*, thereby causing the said jaw to open and receive the selected hair *z* when deflected from the bunch B^5 and presented by the lance or selecting-instrument *k*, in the manner shown in Fig. 3, between the pegs *t t*, and to grasp the selected hair *z* between the selecting-instrument and the points of its deflection from the bunch, as shown. The projection *d* then slides from the head of the wedge *k′* and strikes immediately against the point of the set-screw 6, which is so adjusted as to permit the movable jaw to inclose the hair without actually pressing it, when the nipper recedes, and in so doing the projection *d* slides off the point of the set-screw, thereby causing the nipper to seize the hair firmly. The wedge *k* then swings aside, and the hair thus seized is drawn into the warp until the projection *d* meets and is depressed by the wedge 7, which opens the nipper and releases the hair, when it is beaten up by the reed in the usual way.

It is obvious that if the nippers should be closed upon the hair violently with the full force of the spring that shuts the movable jaw the hair would be crushed and severed; and it is for the purpose of avoiding this casualty that the nipper is first closed sufficiently to encompass and secure the hair within its grasp, and with the retreating movement of the nipper the restraint before imposed upon the spring which closes the nipper is removed, which permits the hair to be gently and yet firmly seized and drawn into the warp

Although nippers of various constructions have been heretofore tried for the purpose of weaving detached wefts, I am not aware that a similar mode of operation has ever before been employed to render the nipper effective, and this mode is therefore claimed as one feature of improvement in my invention.

I will next proceed to describe that part of my invention which relates to the method of operating and controlling the action of the heddles or harness, in doing which reference will be had to Plates I, II, VI, and VII, in which f^1 f^2 f^3 f^4 f^5, g' g^2 are the heddles or harness. The latter, g' g^2, being the selvage heddles, are more particularly described under another head.

Hair-cloth is commonly woven with five sheds, and there are five heddles, each of which opens a distinct shed in regular succession. These heddles are operated by the levers N' N^2 N^3 N^4 N^5, swinging on the common fulcrum-pin 9, and the cams V' V^2 V^3 V^4 V^5, being connected with both ends of the said levers by suitable bands passing over the pulleys l' l' in the arch B′ above and corresponding pulleys, l^2 l^2, attached to the cross-pieces B^3 B^3, beneath the heddles, as shown in Plate I, Figs. 1 and 2. The levers N and cams V are formed as shown in Plate VI, Fig. 6, and the cams are arranged on the cam-shaft *x*, as shown in Fig. 1. Each cam has a projection, a^3, on one side of its periphery, which, in revolving in the direction indicated by the arrow, slides against the inclined surface n^2 of the lever N, and swings the upper end of the same to the position shown in dotted lines to raise one leaf of the heddles; and the rounded corner of the cam at l^2 slides against the inclined surface n^3 of the lever N, and returns the opposite end of the same to the position in which it is shown. The said cams are arranged on the cam-shaft *x* with respect to each other in the order required for opening the sheds in their proper order, and the action of each cam to impart the requisite movement to its lever is produced by one-fifth of a revolution of the cam-shaft *x*.

The arrangement of cams and levers above described by themselves form no part of my invention, the same having been previously used in looms for weaving woolen and other fabrics, but in every instance within my knowledge the cam-shaft *x* has been revolved continuously, and although this mode of revolving the said cams is without objection in looms using a continuous weft inserted with each to and fro movement of a shuttle, it is unsuitable as a means for operating the same cams in hair-cloth looms, wherein two movements of the nipper or device which performs the functions of a shuttle are necessary for the insertion of one length of weft, in consequence of which it is especially necessary to open and close the successive sheds with at least twice the rapidity required in using a shuttle and a continuous weft. To accomplish this purpose I employ a cam, *j′* on the main shaft D as the source of motion, which, with about one-third of a revolution, imparts a sufficient reciprocating movement to a swinging pawl, *w*, Figs. 1, 3, 4, 5, Plate VI, engaging with one of five pins, *y y*, &c., of the ratchet-wheel X on the cam-shaft *x*, to turn said shaft and cams one-fifth of a revolution, and thereby open the successive sheds of the warp with one-third of a revolution of the main shaft D, and one-third of a full beat of the lathe, or in one-sixth of the time occupied by the arrangement heretofore used for the purpose, supposing the gears which drive the cam-shaft *x* to be of equal size.

The operation of the heddles f' f^2 f^3 f^4 f^5 is controlled in a manner to make the opening of each succeeding shed dependent on the seizure and insertion of a weft in the preceding one by means of the "drop-wire" a^4, which engages with the upright arm e^4 on the lever m^2, vibrating on the stud s^2 with a positive movement from the cam i^3 on the main shaft, to raise and depress a wedge, b^2, at its oppo-

site end, the incline surface of which, sliding against the stud t^2 in the arm W of the rocking shaft n^4, imparts thereto a sufficient rocking movement to cause the arm h^2 to withdraw the pawl w from engaging with the pins y y, &c., when the said wedge is raised, as shown in Fig. 3, Plate VI) and to allow the said pawl to engage with the pins y y, &c., when the said wedge is depressed, as shown in Figs. 2 and 4. The first condition of the said drop-wire a^4, arm e^4, lever m^2, cam i^3, wedge b^2, arms W and h^2 on the rocking shaft, and the pawl w being fully shown in Plate VI, Fig. 1, and Plate I, Fig. 2, the relative position of the wedge b^2 and latter-mentioned parts with the pins and ratchet-wheel being fully shown in Fig. 3, in which it will be seen that the fall of the drop-wire a^4 into the position shown in Fig. 1 causes the pointed end of its lever to catch the end of the arm e^4 of the lever m^2, when it is released by the cam i^3, and returns by the action of the spring o, in consequence of which the wedge is held in the position shown in Fig. 3, swinging the rocking arms W and h^2 into the position shown, the latter withdrawing the pawl w from engaging with the pin y', thus causing the ratchet-wheel X and cams V V, &c., to remain wholly disconnected from the source of motion by which the same are actuated, and the heddles remain at rest and unchanged.

The second condition of the drop-wire a^4 and its connections, which results from the seizure and drawing of the weft into the open shed, is fully shown in Plate I, Fig. 1, and Plate VI, Figs. 2 and 4. In this case the drawing of the weft past the wire a^5 causes the weft to trip and lift the drop-wire a^4 with the return beat of the lathe, thereby preventing the end of the drop-wire lever from catching the end of the arm e^4, which instead falls under the projection on the end of said arm, as shown, thereby allowing the said arm to swing forward, the wedge b^2 to fall, as shown in Fig. 4, the arms W and h^2 to swing into the position shown, and the pawl w to engage with the pin y', whereby a connection is effected between the cam j' (the source of motion) and the ratchet-wheel X and cams V V, &c., which operate the heddles.

I will next proceed to describe the parts which operate the selvage-warps, the same being fully illustrated by Figs. 1, 2, and 3 of Plate VII.

In Figs. 1 and 2, g' g^2 are the selvage-heddles, which are suspended by suitable bands, l^2 l^2, from the opposite sides of the rolls S S, so that when one of the said heddles, g^2, is elevated, the other, g', is depressed in the usual way. The heddles are connected by suitable bands, l^4 l^4, to the levers v v, swinging on the common fulcrum u, by motion imparted from the cams r' r^2 r^3 r^4 of the cam-wheel M on the cam-shaft x, which depress the levers v v and their respective heddles alternately, as shown in the several changes of the diagram, Fig. 2, thereby forming the selvage of plain cloth, which has the effect to bind the ends of the weft more closely and firmly than in the body of the fabric, which is required in hair-cloth and similar fabrics to give permanence and stability to the goods, and to fasten the same by when used for upholstery purposes.

The difference between the length of the selvage-loops S^2 and those of the body of the cloth W^2 is fully shown in Fig. 3, in which the loops of hair are represented by black lines, and the divided threads of the warp are represented in red lines; and it will be perceived that in the selvage the hair passes over one warp-thread and under the next, while the hair or weft in the body of the cloth passes over four warp-threads and under one thread, then over four other threads, and so on, a different combination of four warp-threads being bound in one loop with each of the five changes produced by the heddles. In repeating these changes, owing to the difference in the number of threads forming the short loops of the selvage and the long loops of the body of the fabric, the weft inserted with the first of the series of changes combines six warp-threads instead of four in one loop next to the selvage, thereby forming a loop of excessive length, and giving an uneven and imperfect appearance to the fabric, to avoid which is the object of this feature of improvement in my invention; and although I am aware that hair-cloth has heretofore been woven in hand-looms without this imperfection by means of a peculiar mounting of the harness and working of the heddles, I am not aware that by any automatic or self-operating means the said imperfection has been avoided. This desirable result is accomplished by the arrangement of the cams r' r^2 r^3 r^4 in the following manner:

The cam-wheel M makes one-fifth of a revolution with each intermittent rotation of the cam-shaft x, as above explained, and the cams r' r^2 r^3 r^4 each occupy a position one-fifth of the circumference asunder. The cam r^4 occupies a space equal to that of two of the other cams and the intervening space, and is, in fact, two cams united in one, so that there are actually five cams, which I will distinguish by the figures 1 2 3 4 5 in red, which produce the successive changes of the selvage-heddles in the order represented in Fig. 2 with reference to the other heddles, and as represented in Fig. 3 with reference to the succeeding sheds of the warp, to wit: Cam 1 (red) produces the first change of the selvage-heddles, as shown in Fig. 2, and the hair or weft is inserted in the shed, as shown in the first change, Fig. 3; cam 2 produces the second change, as represented; cam 3, the third change; cam 4, the fourth change, and cam 5 the fifth change, and last of the series. With the next rotating movement of the cam-wheel M the first change is repeated; but as cam 5 and cam 1 constitute one cam, r^4, instead of opening the alternate selvage-shed, no change takes place, and a second

hair is inserted therein, as shown by the diagrams of the two first changes in Fig. 3. If, on the contrary, the alternates selvage-shed was opened with the repetition of the first change, the first selvage-thread would be one of the upper warps, the weft would be inserted beneath it, and the adjoining loop, *z*, in the body of the cloth would contain six threads instead of four, and thus create the imperfection above described. As a self-operating means, therefore, for operating and controling the selvge-threads and the warp, the arrangement of the cams r' r^2 r^3 r^4, or the equivalent thereof, to effect this purpose forms one feature of improvement in my invention.

I will next proceed to describe that feature of improvement which relates to the combination and arrangement of the let-off and take-up mechanisms and the devices that actuate the same, in doing which reference will be had to Plates II and VIII. In these plates, C is the yarn-beam, P P′ are the pressure-rollers of the let-off A is the breast-beam, Q Q′ are the pressure-rollers of the take-up, and E is the cloth-beam. The warp K passes from the yarn beam C around and between the let-off rollers P P′, thence in the direction indicated by the arrows through the heddles and reed and over the breast-beam A, thence around and between the take-up rollers Q Q′, and is finally wound upon the cloth-beam E. The said warp is pinched between the let-off rollers by means of the set-screw 3 in the upper end of the lever 4, in which the roller P has a bearing at each end, as shown in Fig. 2 of the said plates. The cloth K is also punched between the take-up rollers Q Q by means of the lever x^4 and the force of the spring f^7 applied to the end thereof, which is exerted on the bearing at each end of the roller Q′, as shown. In addition to this, the warp and cloth are so wrapped around the said roller that any revolution thereof imparts to the warp a corresponding progressive movement. The two rollers P and Q are connected and made to revolve simultaneously in the same direction with an equal speed by means of two equal pairs of bevel-gears, k^3 k^4, and the cross-shaft 10, extending at right angles with the axis of said rollers at one end thereof.

The circumference of the take-up roller Q exceeds that of the let-off roller P about three-sixteenths of an inch, to compensate for the stretching or yielding of the warp produced by the repeated beating of the lathe, and the surface of said take-up roller is coated with coarse emery or sand, to render its action positive upon the cloth. The two mechanisms being connected by the cross-shaft 10, as above described, they are both revolved with an equal intermittent movement in the same direction by means of the actuating device, consisting of the worm-gear F^2 on the shaft of the let-off roller P, and the worm i^4 on the upright shaft 12, the ratchet-wheel m^5, and the pawl 14, the latter moving with the swinging arm g^7, which is connected by the rod x^5 to the sword g^8 of the lathe, the source of motion, as shown; and the several parts of the actuating device being thus arranged with each beat of the lathe, the pawl 14 turns the wheel m^5 and its shaft 12 to the extent of one tooth (there being generally from twenty-eight to thirty-six teeth in said wheel, according to the number of wefts put into an inch of the cloth) thereby giving to the worm and worm-gear, a slight yet sufficient rotary movement to cause the warp to progress in its passage to the cloth-beam E, a suitable distance to provide for the insertion of each succeeding length of weft; but if the supply of weft to the sheds should be interrupted for one or more beats of the lathe, the uniform progress of the let off and take up, as before described, would produce an open or slack place in the goods at the point where the supply of weft failed. To prevent this result, the pawl 14 is connected by the rod 16 to the arm 17 upon the rocking shaft n^4, the operations of which are controlled by the weft stop-motion, as before described, so that when the weft fails to be supplied to the shed the turning of the shaft n^4 to arrest the operation of the heddles or harness also raises the pawl 14 from the ratchet-wheel m^5 and arrests the operation of the let-off and the take-up, until by the proper supply of weft, as before described, the movement of the shaft n^4 is reversed and the pawl 14 is lowered upon the ratchet-wheel m^5, and its regular operation is resumed. By this means it will be seen that, dependent upon the failure or the supply of weft, all the operations of the warps are simultaneously and automatically suspended or resumed, which mode of operation also constitutes one feature of improvement in my invention.

To provide for a disconnection of the take-up rollers from the let-off rollers for removing the woven fabric from the loom, or for any other purpose, I form one bearing of the cross-shaft 10 in the lever 15, which swings on the stud t^3 on the frame, and is held in the position necessary for the meshing of the two bevel-gears k^4 by means of the pin O^5, passing through the frame. The take-up rollers may be revolved by hand by means of the hand-wheel O^4, and their revolutions are transmitted to the cloth-beam E by means of the crossed belt or band passing around said beam and the roller P, as shown in Plates I and II, Fig. 2, to wind the cloth as it is woven or unwind the same, when desired.

I will next proceed to describe that feature of improvement which relates to the shaping of the reed or sley to counteract the effects of shrinkage by the drying of the web after it is woven, in doing which reference will be had to Plate II, Fig. 2, and Plate VII, Fig. 4.

In the selvage of hair-cloth the hair is of necessity bound more closely and rigidly than in the body of the fabric, and the hair which

is previously moistened to prepare it for weaving becames dry after it is woven, in doing which the web is liable to shrink in the direction of its length so as to draw the hair in the body of the cloth into the form of an irregular arc or curve, greatly to the injury of the appearance and usefulness of the goods, the concave side of the curve being next to the reed, and it is the object of this feature of my invention to avoid this difficulty, to accomplish which I curve the reed R in, as nearly as possible, the form in which the lengths of weft are curved by the shrinkage, as before explained, except that the reed is curved in the opposite direction, as shown in Plate II, Fig. 2, and Plate VII, Fig. 4, by which means the moist hair or weft is inserted and beat up in the form of a curve, so that by the shrinkage, which would otherwise curve the weft, it is left straight and at right angles with the warp. The reed is held in the requisite curved position by means of a former, e^9, of wood, placed between the reed and the straight edge of the groove z^4 in the lathe and the binder f^{10}, which is set up against the reed by means of the two bolts therein, as shown.

I will next proceed to describe that feature of improvement which relates to the means employed to arrest the operation of the instrument used to select the lengths of hair or other weft from a mass when the nipper advances to seize it, the same being sufficiently illustrated by Figs. 1 and 2 of Plate IX. In said figures, A is a metal plate, which is secured to a metal plate, Y, extending from the left end of the lathe-beam G, as shown in the several figures. A stand, D^2, is fastened upon the metal plate A, in the upper part of which are formed suitable bearings for the shaft *a*, which is revolved by means of the grooved pulley *b* and a band thereon connecting with another pulley suitably arranged on some revolving part of the machine. The shaft *a* imparts a vertical reciprocating movement to the instrument, which selects the lengths of weft from the bunch at the proper time, as hereinbefore related, and to provide for the failure of the said instrument to select a hair or length of weft in its first effort to do so the movement is repeated until a hair is selected. Should this movement, however, continue after the nipper advances to seize the hair, the nipper would be liable to strike against the lance and break it and its appendages. To prevent this casualty, I arrange on the stand D^2 a lever or pawl, T^2, which is thrown up into an engagement with the notched disk *e* on the shaft *a* by means of the rod *s* and lever r^6, which hangs upon the lathe, the outer end of which is depressed by passing beneath the stationary incline 1 when the lathe swings back, as is shown in Fig. 1, thereby arresting the further revolution of the shaft *a* and holding the selecting-instrument up out of the way until the nipper completes its stroke and is withdrawn. The pawl T^2 is disengaged from the shaft *a* by means of the finger *g*, which is embraced by the forked piece *t*, which has a sliding movement parallel to the axis of the shaft *a* imparted to it by a stationary incline upon the frame, against which the sliding rod or bar *o*, that carries the forked piece *t*, impinges as the lathe swings forward, as is shown in Fig. 2, or by any other suitable device, by which means the pawl T^2 is pushed aside from the notch of the disk, when the spring *f* restores the lever r^6 and the pawl T^2 to the position shown in Fig. 2. In practice I have operated this stop by connecting it with the stop of the serving-instrument, constructed substantially as described in the aforesaid Letters Patent No. 1,630, and have effected the disengagement of the pawl T^2 by mounting the forked piece *t* upon the sliding rod marked *o* in Fig. 6 of the drawings of said patent the movement of which suffices for both purposes. This stop, arranged to operate substantially in the manner specified, is necessary for the successful co-operation of the selecting-instrument and nipper when arranged as before described, and is therefore claimed as one feature of improvement in my invention.

I will next proceed to describe that feature of improvement which relates to the means employed to trim off the straggling ends of hair which are partially drawn from the bunch or mass by reason of the repeated selections made therefrom, in doing which I shall refer to Figs. 1, 2, 3, and 4 of Plate IX. In Fig. 3 of said plate, B^5 is the end of the bunch of hair or weft, the same being confined beneath the clasp H^5, and b' b' represent straggling hairs which have been partially drawn out by the other hair which has been drawn from the bunch by the nipper. Those straggling ends of hair protrude through the spaces between the series of cutting-blades w^3 of the plate U, and they are clipped off by means of the sliding blade E^2 on the sliding plate e^9, the extreme end of which strikes against the post 4 on the frame B, Fig. 2, with the forward stroke of the lathe, and slides the blade E^2 past the hooked edges of the blade w^3, thereby cutting off the protruding ends of the hairs. The sliding blade is returned with the next backward stroke of the lathe by means of the rod 20, secured to the said sliding plate, the end of which strikes against the some convenient part of the frame of the machine, and slides the plate and blade E^2 back preparatory to repeating its cutting-stroke, as shown in Fig. 1. This device prevents the straggling ends of the weft from being accidentally caught between the jaws of the nipper and from embarrassing the action of the more delicate selecting mechanism, and is therefore important, and is claimed as one feature of improvement in my invention.

Having thus described my invention, I would not be understood as restricting myself to the particular construction and arrangement herein set forth and described, as I claim all modifications in which the same mode of operation is performed by equivalent means.

I claim—

1. So combining and arranging the selecting or serving instrument and the nipper and the mass of weft presented thereto, as described, that the end of the weft that has been selected will be deflected and held aside from the mass directly across the path of the nipper, which is thus enabled to seize the weft between the selecting-instrument and the mass, substantially as described.

2. The employment of two projecting pegs, or their equivalent, in the jaws of the nipper, substantially as described, to effect the purpose specified.

3. The mode of operation, substantially as specified, by which the nipper is first closed sufficiently to encompass and secure the hair or weft, and at the commencement of its retreating movement the jaws are made to close gently upon the hair or weft with sufficient force to hold the same and draw it from the mass into the open shed, substantially as described.

4. The employment of two sets of fixed and movable pulleys, *o o' p p'*, or their equivalent, in combination with the treadle-levers R' R' and a suitable strap or band connecting with the nipper-staff, substantially as described, for the purpose specified.

5. Giving to the cam-shaft, or its equivalent, that works the heddles or harness an intermittent rotation at each change of the shed by means of a ratchet and pawl or other suitable devices, whose operation upon the cam-shaft is made to depend upon the supply of weft to the shed.

6. The arrangement of the cams r' r^2 r^3 r^4, or their equivalent, which operate the selvage heddles or harness, substantially as and to effect the purpose specified.

7. Combining a positive take-up and a positive let-off with the devices that actuate the same, so that when the weft fails to be supplied to the shed their operation will be arrested and will be resumed when the weft is duly supplied.

8. I do not claim the use of a waved reed for giving a permanent waved form to the weft; but I do claim placing the weft in the cloth by means of the curved reed or otherwise in such a position as will counteract the effect of the unequal shrinkage of the parts, substantially as described.

9. Combining with the automatic serving mechanism a detent or stop, so arranged as to work in concert with the nipper and arrest the operation of the serving mechanism when in a position to be out of the way of the nipper as it advances to seize the weft, and to release the serving mechanism after the nipper has retired, substantially as described.

10. In combination with the mechanism which supplies the weft to the nipper, or its equivalent, the employment of a clipping or shearing device, substantially in the manner and for the purpose described.

ISAAC LINDSLEY.

Witnesses:
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