Sheet 1,
4 Sheets.

A. Babbett.

Loom for Weaving Figured Fabrics.

No. 7,714. Patented Oct. 8, 1850.

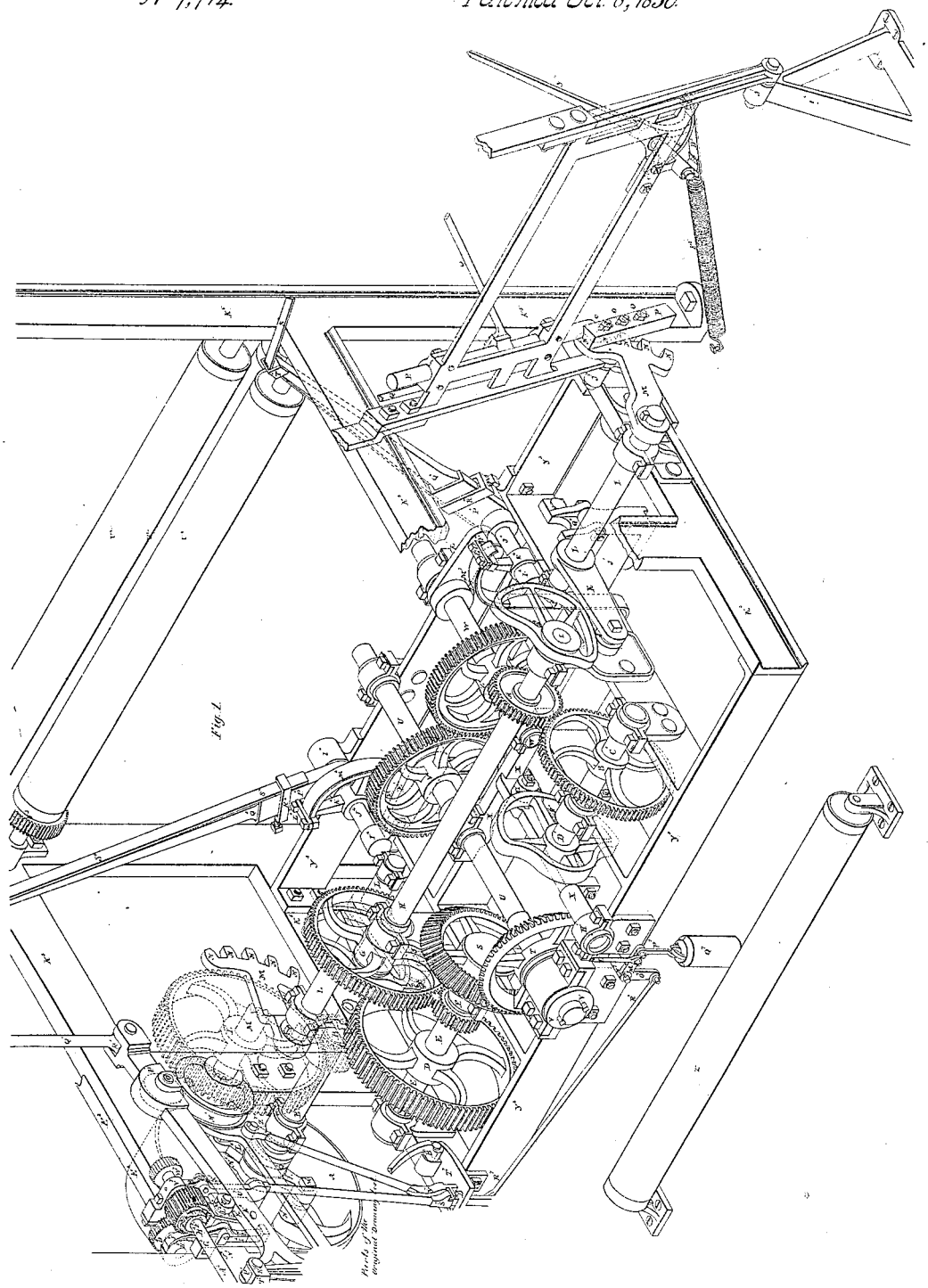


Fig. 1.

Witnesses
[illegible]

Inventor
[illegible]

Sheet 2,
4 Sheets.

A. Babbett.

Loom for Weaving Figured Fabrics.

No. 7,714. Patented Oct. 8, 1850.

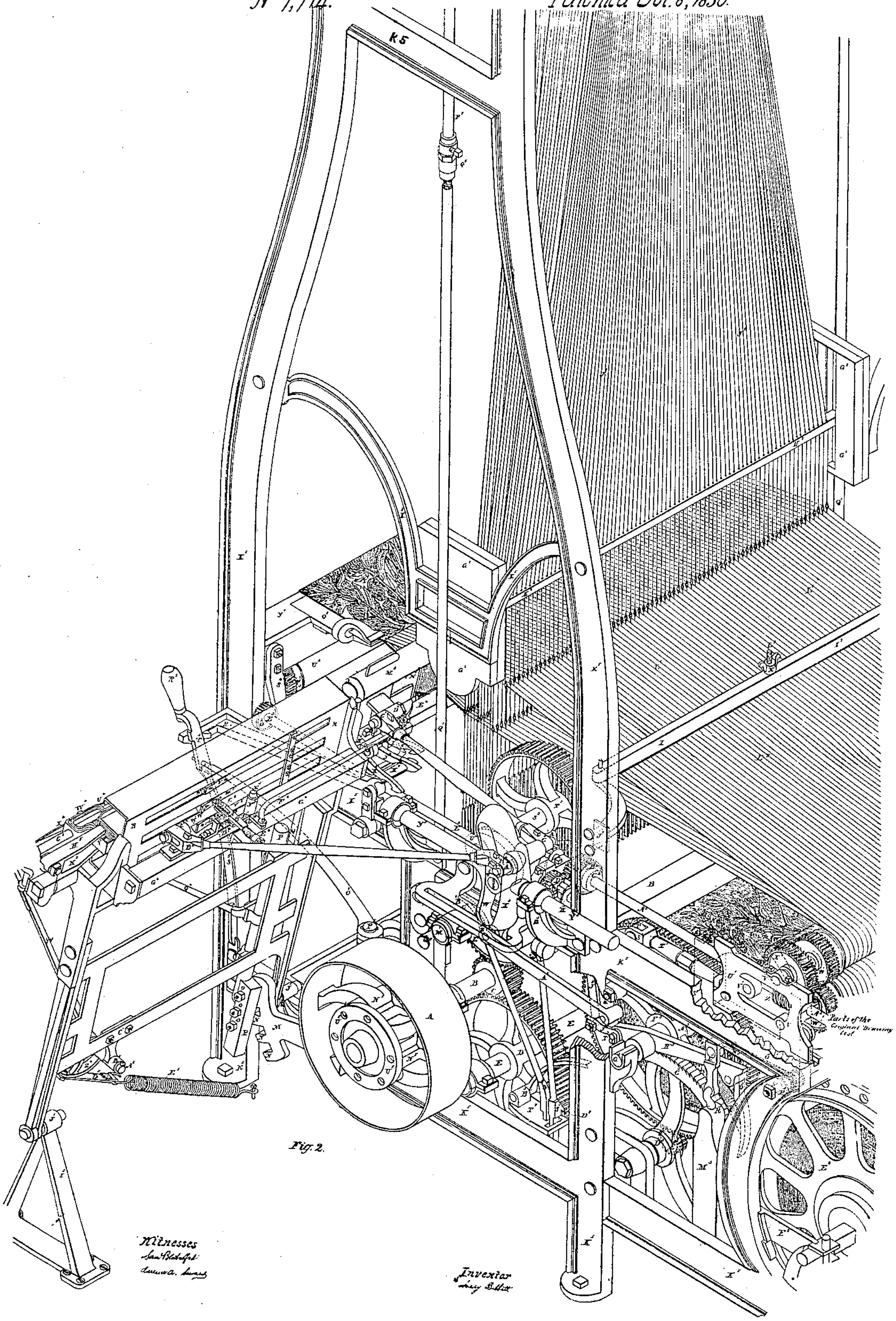


Fig. 2.

Witnesses

Inventor

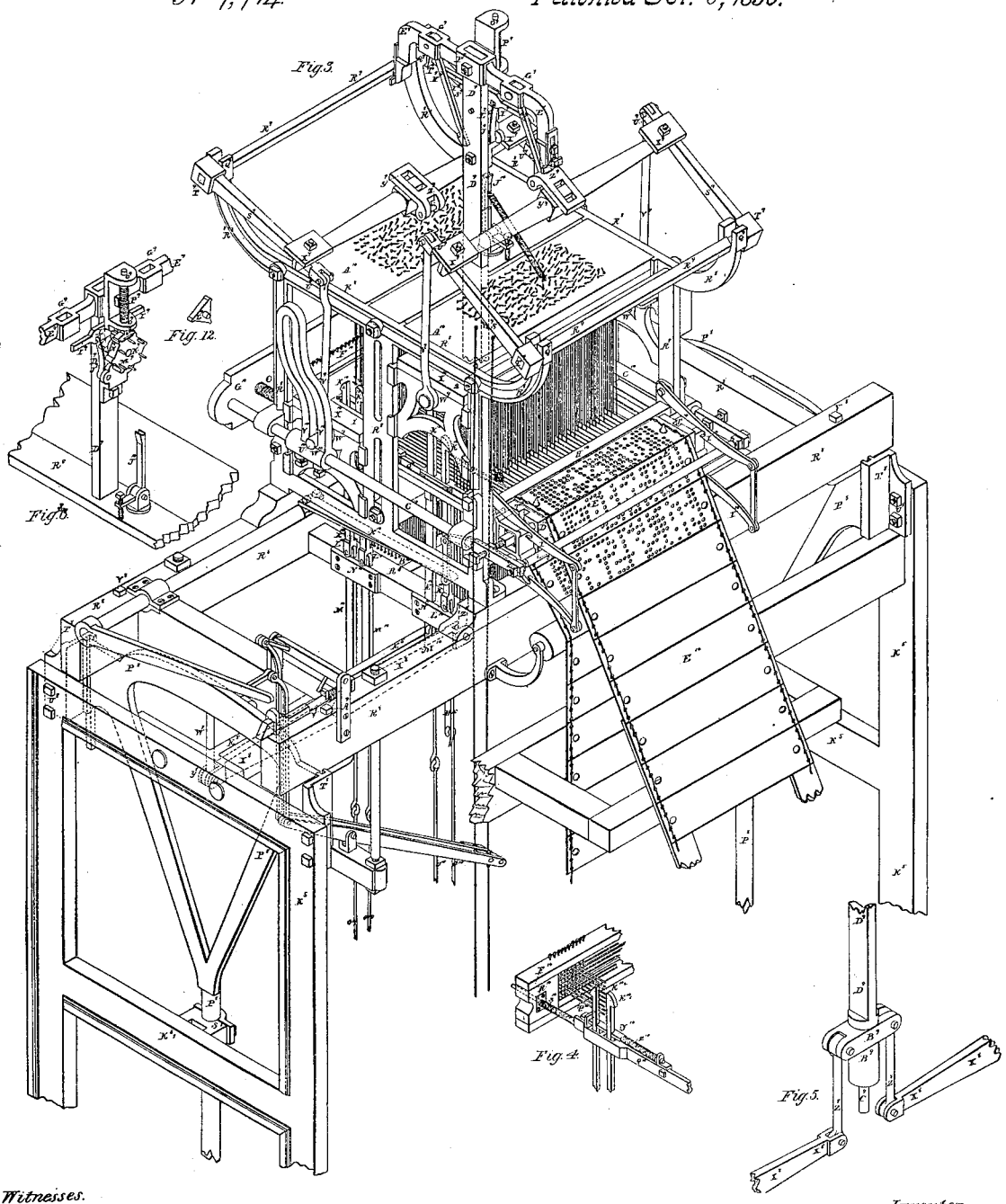
N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

Sheet 3,
4 Sheets.

A. Babbett.

Loom for Weaving Figured Fabrics.

No. 7,714. Patented Oct. 8, 1850.



Witnesses.
Lewis Stadtfeld
Daniel A. Lucas

Inventor.
Amy Babbett

Sheet 4,
4 Sheets.

A. Babbett.

Loom for Weaving Figured Fabrics.

No. 7,714. Patented Oct. 8, 1850.

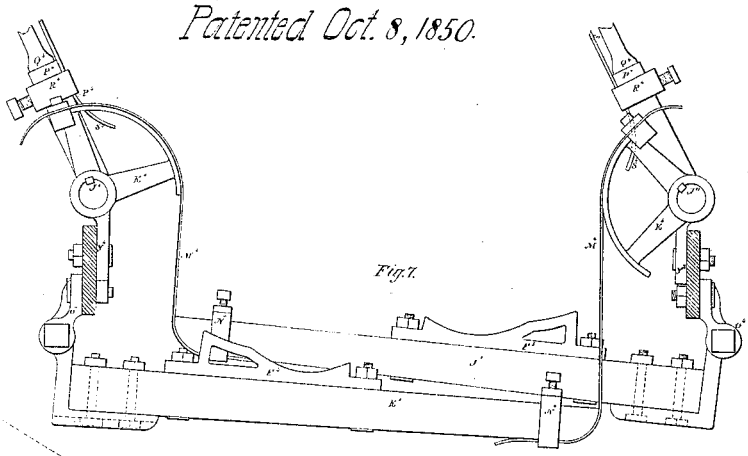


Fig. 7.

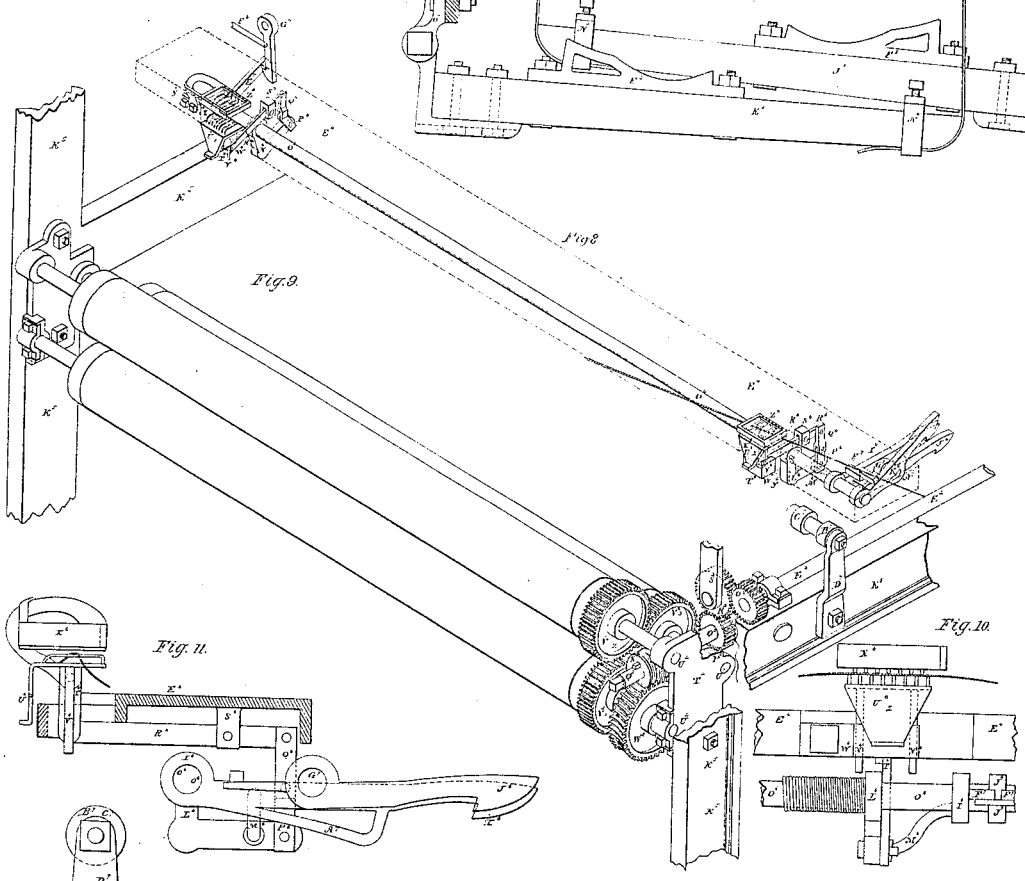


Fig. 8

Fig. 9.

Fig. 11.

Fig. 10.

Witnesses.
Chas. Babcock
Edward C. Simmons

Inventor.
Henry Babbett

UNITED STATES PATENT OFFICE.

AVERY BABBETT, OF AUBURN, NEW YORK.

IMPROVEMENT IN LOOMS.

Specification forming part of Letters Patent No. 7,714, dated October 8, 1850.

To all whom it may concern:

Be it known that I, AVERY BABBETT, of Auburn, in the county of Cayuga and State of New York, have invented certain new and useful Improvements in Looms for Weaving Carpets and other Fabrics; 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, which are referred to in and form a part of such description.

I will in the first place describe the material parts of the loom into which I have introduced my improvements, and with these improvements introduced as the same are found in the entire loom when in working order.

The accompanying drawings contained on four sheets, and numbered from Figures 1 to 12, both inclusive, and lettered to correspond where they show corresponding parts, represent, taken together, the entire loom, into which I have introduced my improvements and comprehend those improvements.

Fig. 1 represents the lower part of the loom—that is, the part nearest to the driving-pulley with the upper frame-work and all the upper part of the loom removed. Fig. 2 represents the side elevation of the loom with the accompanying parts, and shows the location of the parts. It includes the loom in elevation up to the cross-rail of the frame shown at the bottom of Fig. 3. Fig. 3 represents the top parts of the loom, including the pattern-cards, Jacquard machine, &c. Fig. 4 represents a part of the back board with a part of one of the journal-needles and parts of two of the journal-hooks. Fig. 5 represents the lower end of the vertical slide that raises the draft-boards. Fig. 6 shows the upper end and fixtures of the same slide. Fig. 7 shows the relative position of the treadle and picker-sticks. Fig. 8 shows the race-board of the lay in dotted lines with the thread-protector underneath in all its parts. Fig. 9 shows the take-up rolls with the parts of the frame in connection removed so as to show the mode of operation of the rolls. Figs. 10 and 11 are oleographic projections of the thread-protector, Fig. 10 in a front view, and Fig. 11 in an end view. Fig. 12 is the triangular cam which regulates the working of the draft-boards.

First. The first part of my invention relates to the working of the series of shuttle-boxes. I work the entire series by means of motion communicated to it through and from a single rotating shaft, which revolves with a speed equal to one-half or less than one-half, but never greater than one-half, of the speed with which the shaft that moves the lay revolves, the shaft that works the shuttle-boxes varying in speed according to the kind of goods required to be made.

In Figs. 1 and 2, A is the driving-pulley. B B is the driving-shaft running through the driving-pulley and through the loom from side to side. C is a pinion on the driving-shaft B B, working into the wheel D on the shaft E E.

In Fig. 1, on the shaft E E is the pinion F, working into the wheel G on the shaft H, on which shaft are two cams, each marked I. Each of these cams works a pulley J, attached to an arm K. Each of these arms is keyed fast to a shaft L L. To each of these shafts is also keyed fast an arm M, with five fingers or projections N N N N N on the end, one of which arms and fingers is also shown in Fig. 2. Between the fingers N N N N N work small pulleys secured to studs, one pulley between every two fingers and one pulley to each stud. Three of these studs on one side of the loom are shown in Fig. 1 marked O O O, and three of them on the other side of the loom are shown in Fig. 2 marked O O O. These six studs are screwed fast to two slides, three studs to each slide. One of these slides on one side of the loom is shown in Fig. 1 marked P P, and the other on the other side of the loom is shown in Fig. 2 marked P P, the number of pulleys being always the same as the number of shuttle-boxes on either side of the loom. Attached to each of the two slides P P P P are two arms. Two of these arms on one side of the loom are shown in Fig. 1 each marked Q and two of them on the other side of the loom are shown in Fig. 2 each marked Q. These four arms are secured to the ends of two series of shuttle-boxes, one series on each side of the loom, (one series being shown in Fig. 2 marked R R,) one arm being secured to each end of each series.

In Fig. 1 it will be seen that as rotary motion is given to the shaft H by the pinion F and the wheel G, the two cams I I on each end of the shaft H will as it revolves depress the ends of the two arms K K, to which are attached the two pulleys J J, one pulley to each

arm. The two shafts L L will thus be turned and the finger ends N N N N N N N N N N of the two arms M M will be carried upward and carry up with them the two slides P P P P and the entire series of shuttle-boxes R R, Fig. 2, on both sides of the loom. The weight of the entire series of shuttle-boxes and of the two slides P P P P will always keep the two pulleys J J in close contact with the two cams I I. The shaft H must revolve with a speed equal to one-half or less than one-half, but never greater than one-half, of the speed with which the shaft S^3, Fig. 2, hereinafter described, that moves the lay revolves. In making plain two-ply goods the shaft H revolves with a speed equal to one-half of the speed with which the shaft S^3, Fig. 2, revolves. In making plain three-ply goods the shaft H revolves with a speed equal to one-third of the speed with which the shaft S^3, Fig. 2, revolves. In making shot about three-ply goods the shaft H revolves with a speed equal to one-sixth of the speed with which the shaft S^3, Fig. 2, revolves. In making shot about two-ply goods the shaft H revolves with a speed equal to one-fourth of the speed with which the shaft S^3, Fig. 2, revolves. These different rates of speed require corresponding variations in the shapes of the cam I I and D′, hereinafter mentioned.

Second. The next part of my invention relates to the throwing of the shuttles and to the regulation of their throwing. I throw the shuttles by means of motion communicated to them through and from either one rotating shaft or two rotating shafts (and, if two, parallel to each other and revolving in opposite directions with equal velocities) revolving with a speed equal to that with which the shaft that moves the lay revolves; and I regulate the throwing of the shuttles, as required, by the kind of goods to be made by causing either the one rotating shaft or the two rotating shafts to slide so that the shuttles shall be driven regularly from either side, as required.

In Fig. 1 on the shaft E E is a miter beveled wheel S, working into another miter beveled wheel T of the same size. Through the wheel T is the shaft U U, which by means of the two feathers V V is prevented from turning in the wheel, while the shaft U U slides in the wheel in the direction of its length. The shaft U U is coupled to the shaft W W by the cross-head X X X. Keyed to the shaft U U is a wheel Y, which works into the wheel Z. The wheel Z is keyed fast to the shaft W W.

In Fig. 1 on the shaft H is a pinion A′, working into the wheel B′. The wheel B′ is keyed to the shaft C′. On the shaft C′ is a cam D′. Keyed to the shafts U U and W W are the two wipers E′ E′, one on each shaft. At the end of each of these wipers E′ E′ is a pulley F′. It will be readily seen that when rotating motion is communicated to the driving-shaft B it is communicated thence to the shafts E E, H, and C′, successively, and produces a rotating motion in the cam D′ against the pulley G′, Fig. 1, which is secured to the cross-head X X X. This causes the cross-head X X X to slide in the box H′, Fig. 1, which as it slides causes the shafts U U and W W to slide with it. Under the cross-head X X X is a horizontal spiral spring I′, Fig. 1, which keeps the pulley G′ steadily in contact with the cam D′ as the cross-head X X X slides.

In Fig. 1, as rotary motion is given to the shafts U U and W W, as before indicated, and as sliding motion is given to the same shaft by the cam D′, it will be readily seen that the pulleys F′ F′ on the wipers E′ E′ will be thrown upon the treadle J′ K′, Fig. 7, so as to depress them, one wiper acting on one treadle and the other on the other.

In Fig. 1, I^4 I^4 I^4 I^4 are four boxes. Between these four boxes are two shafts J^4 J^4, one shaft in each pair of boxes. On each of these shafts is a quarter-circle or quadrant K^4 K^4. Each of these quarter-circles or quadrants K^4 K^4 has two arms. At the upper extremity of each of the quadrants K^4 K^4 are two bolts and an iron strap at L^4 L^4, for the purpose of securing the two leather straps M^4 M^4. These leather straps M^4 M^4 extend downward, and are attached to the ends of the treadles J^4 K^4, Fig. 7, one strap to one end of each treadle by the iron straps and bolt N^4 N^4, Fig. 7, one on each treadle. The box O^4 holding the treadle J′ is shown in Figs. 1 and 7, and the end of the treadle J′, opposite to the end where the leather strap M^4 is attached, is shown in Fig. 1 at J′.

In Fig. 1 on the shafts J^4 J^4 are keyed the sockets P^4 P^4, holding the picker-sticks Q^4 Q^4. R^4 R^4 are iron straps and bolts securing the two picker-strings S^4 S^4 S^4 S^4 to the sockets P^4 P^4, one picker-string to each socket. The picker-strings S^4 S^4 S^4 S^4 extend upward and over the ends of the picker-sticks Q^4 Q^4 in the manner shown at the point T^4 and extend both ways along the front side of the series of shuttle-boxes R R, Fig. 2, and are shown again at the point U^4, Fig. 2, between the picker V^4, Fig. 2, and the series of shuttle-boxes R R, Fig. 2, and are attached to the picker V^4, Fig. 2, by the bolt W^4, Fig. 2. In Fig. 2 the bolt W^4 also secures a leather strap X^4, attached to the small picker-stick Y^4. This picker-stick Y^4 runs downward, and is inserted in a socket projecting upward from the quadrant Z^4. This quadrant Z^4 is placed upon a pin A^5 held by the box B^5. The box B^5 is secured to the lower rail of the framework of the lay by two bolts at C^5. D^5 is a leather strap, one end of which is attached to the quadrant Z^4 and the other end to the spiral spring at E^5. It will be seen, therefore, that when the wipers E′ E′, Fig. 1, depress the treadles J′ K′, Fig. 7, by passing over the curved pieces F^5 F^5, Fig. 7, placed upon the upper side of the treadle J′ K′, Fig. 7, one on each, the shafts J^4 J^4, Fig. 1, will be turned inward by means of the leather straps M^4 M^4, Fig.

1, passing over the quadrant K^4, Fig. 1, and will carry with them and turn inward the picker-sticks Q^4 Q^4, Fig. 1, by that means drawing the pickers V^4, Fig. 2, along the picker-rod G^5, Fig. 2, to the opposite end of the series of shuttle-boxes R R, Fig. 2, and causing the shuttle to be driven out of the shuttle-box, after which, by means of the leather strap X^4, Fig. 2, attached to the small picker-stick Y^4, Fig. 2, and the spiral spring E^5, Fig. 2, and the leather strap D^5, Fig. 2, the picker V^4, Fig. 2, is immediately returned to its original place outside of the series of shuttle-boxes R R, Fig. 2, between the two fingers H^5 H^5, Fig. 2. On the opposite side of the loom the picker V^4, the bolt W^4, the leather strap X^4, the picker-stick Y^4, the quadrant Z^4, the pin A^5, the box B^5, the two bolts at C^5, the leather strap D^5, the spiral spring E^5, the picker-rod G^5, and the two fingers H^5 H^5, as the same are shown in Fig. 2, are reproduced in exactly like mechanism. In Fig. 1, instead of the two shafts U U and W W, there may be a single shaft performing the office of the two shafts. If there are two shafts, they must be parallel to each other and must revolve in opposite directions with equal velocities. The velocity of the revolution of the shaft, if one, and of each of the two shafts, if two, must be equal to the velocity with which the shaft S^3, Fig. 2, revolves. The sliding in the manner described of the shaft, if one, and of the two shafts, if two, causes the shuttles to be driven regularly from either side of the loom, as required, and regulates their throwing as required by the kind of goods to be made.

Third. The next part of my invention relates to the positive taking up of the cloth. I take it up by means of friction-rolls, which have a regular and positive motion and around which the cloth moves, and I combine with those rolls a compensating-lever, which operates so as to drive the cloth-beam more slowly as the roll of cloth on it increases in diameter.

In Fig. 1, L′ is a wheel, (shown by dotted lines,) the lower edge of which is shown in Fig. 2. In Figs. 1 and 2 this wheel works into the pinion C on the driving-shaft B B, and is keyed to the shaft M′, which runs through from side to side of the loom. The shafts B B and M′ are both represented in Fig. 1 as broken off, but they are continued through in fact to the opposite side of the loom. The shaft B B has on its opposite end at a like position with the pinion C a pinion exactly like the pinion C, and the shaft M′ has on its opposite end at a like position with the wheel L′ a wheel exactly like the wheel L′.

In Fig. 1, on the shaft M′ is a cam N′. On the opposite end of the same shaft M′, and in a like position with the cam N′, is a cam exactly like the cam N′. The cam N′ works a pulley O′ directly over it. (Shown by dotted lines.) This is a friction-pulley and has its bearings in the lower side of the lever P′ P′ P′. Upon the other side of the loom, and in a like position with the pulley O′, is a friction-pulley exactly like the pulley O′ and having its bearings in the lower side of a lever exactly like the lever P′ P′ P′, and in a like position with that lever. The lever P′ P′ P′ is shown in Fig. 2 at P′.

In Fig. 2 parts of two vertical rods Q′ Q′ are shown. A part of one of them is shown in Fig. 1. In Fig. 1 the rod Q′ is connected with one end of the lever P′ P′ P′ in the joint R′. In Fig. 1 the other end of the lever P′ P′ P′ is placed upon a stud *a*, secured to the side of the loom, and there is a like stud upon the other side of the loom to which the lever that has been mentioned as like the lever P′ P′ P′ is secured. The stud *a* is shown in Fig. 2. The rod Q′, Fig. 2, that is not shown in Fig. 1, is connected with the other lever that has been mentioned as like the lever P′ P′ P′ in a joint exactly like the joint R′.

In Fig. 1 on the wheel B^2 is a click, a dog F^2, and a spring G^2, to hold the dog F^2 onto the ratchet C^2. On the end of the shaft E^2 E^2 is a ratchet H^2. This ratchet H^2 is also shown in Fig. 2.

In Fig. 1, I^2 is a vertical slide, to which is attached a dog J^2 J^2. To the vertical slide I^2 is also attached a stud K^2. From the stud K^2 projects a pin L^2, which carries a pulley M^2. N^2 is a spring holding the dog J^2 J^2 onto the ratchet H^2. In Fig. 2 the shaft E^2 E^2 is extended on toward the front part of the loom, onto the end of which shaft E^2 E^2 near the front post of the loom is keyed a wheel O^2. This wheel O^2 is shown in Fig. 9, as is also the front end of the shaft E^2 E^2.

In Fig. 9, P^2 is a wheel of the same size as the wheel O^2, and is keyed to the shaft Q^2 Q^2. R^2 is an intermediate gear between the wheel P^2 and the wheel O^2 and is secured to the stud S^2. The top of the stud S^2 is shown in Fig. 2 bolted to the breast-beam Y′.

In Fig. 9, T^2 is a box leveling the three front take-up rolls U^2 U^2 U^2. $V^2 1$ $V^2 2$ $V^2 3$ are gears on the rolls U^2 U^2 U^2, one on each. The gear $V^2 2$ works into the gear $V^2 3$, and the gear $V^2 3$ works into the gear $V^2 1$. W^2 is a worm-wheel keyed to the shaft of the roll U^2, on which is the gear $V^2 1$, the top of which roll is driven outward by the worm X^2 on the shaft Q^2 Q^2, the worm X^2 working into the worm-wheel W^2. The roll V^2, on which is the gear $V^2 3$ and the gear $V^2 3$ are also shown in Fig. 2, and the three rolls U^2 U^2 U^2 and the gear $V^2 3$ are shown in Fig. 1.

In Fig. 1 it will be readily seen that as rotary motion is given by the wheel L′ to the shaft M′, the shaft M′ carrying with it the cam N′, on which rolls the pulley O′ in the lower side of the lever P′ P′ P′, a vertical motion is given to the pulley end of the lever P′ P′ P′. As vertical motion is given to the lever P′ P′ P′ it operates the vertical slide I^2 by means of the pulley M^2, the vertical slide

I^2 carrying with it the dog J^2 J^2, which works into the ratchet H^2, which is keyed onto the back end of the shaft E^2 E^2.

In Fig. 1, after the cloth leaves the take-up rolls U^2 U^2 U^2, it passes down to the floor under a roll not shown in any of the drawings, but like the roll Z^2, hereinafter described, under the frame-work Y^2 Y^2 Y^2 Y^2, under the roll Z^2, and onto the cloth-beam shown at A^3 in Fig. 2. In Fig. 1, B^3 is the lower end of a stationary dog that holds the ratchet-wheel C^3 in Fig. 2. The whole of the dog B^3 is shown in Fig. 2.

In Fig. 2 the ratchet-wheel C^3 is keyed upon the thimble D^3, one end of which thimble D^3 is a pinion E^3 working into the large toothed wheel F^3, which wheel F^3 is keyed fast to the shaft G^3 of the cloth-beam A^3. On the shaft G^3 is a lever H^3, in one end of which is placed a stud I^3. Spanning this stud I^3 is a forked piece J^3 J^3, coming down from the lever P′ P′ P′, Fig. 1, attached to it at the farther end of the stud K^3, Fig. 1, and worked by it with a vertical motion.

In Fig. 2, on the opposite side of the shaft G^3, and on the lever H^3, is a slide L^3, to which is attached a weight M^3. On the upper end of the slide L^3 is a hook N^3, to which is attached a cord o^3, running around a spool P^3. The hook N^3, the cord o^3, and the spool P^3 are represented in dotted lines. The other end of the cord o^3 is not shown, but the cord o^3 passes around the spool P^3 and is fastened to an upright piece attached with a joint to the floor below, the upper end of which upright piece works against the cloth on the cloth-beam as it winds on, and as the cloth-beam fills up carries out the slide L^3 and keeps it opposite the extreme periphery of the cylinder formed by the cloth on the cloth-beam A^3. Q^3 is the upper end of a dog, the lower end of which is represented in dotted lines. This dog Q^3 works the ratchet C^3. R^3 is a spiral spring holding the dog Q^3 against the ratchet C^3.

From the foregoing description it is obvious that in consequence of the compensating movement of the slide L^3 on the lever H^3 the cloth must be wound upon the cloth-beam A^3 with a uniform tension whether the roll of cloth on the cloth-beam A^3 be larger or smaller. The machinery thus described for taking up the cloth produces a positive take-up. The three take-up rolls are covered with cloth and are properly friction-rolls. The cloth passes under the upper front roll, then backward and around the middle roll, and then forward and over the lower roll, and then down to the roll before mentioned that is like the roll Z^2, Fig. 1.

Fourth. The next part of my invention consists of a positive let-off motion, whereby I effect a regular and uniform delivery from the yarn-beam of a certain and invariably-equal length of yarn at each regular and uniform delivery.

In Fig. 2 three rolls V′ V′ V′ have each of them one bearing in the slide U′, and they have each of them another bearing in the slide on the opposite side of the loom, which is hereinafter mentioned as like the slide U′. The gears W′1 W′2 W′3 are on the let-off rolls V′ V′ V′, one on each. The gear W′2 works into the gear W′3, and the gear W′3 works into the gear W′1. X′ is a worm-wheel keyed to the shaft of the roll on which is the gear W′2, the top of which roll is driven in the direction of the breast-beam Y′ by the worm Z′ on the shaft A^2, the worm Z′ working into the worm-wheel X′. The shaft A^2 is boxed onto the slide U′ at $A^2$1 and slides with it. On the opposite end of the shaft A^2 is a wheel B^2 and a ratchet C^2. The end of the shaft A^2, the wheel B^2, and the ratchet C^2 are also shown in Fig. 1.

In Figs. 1 and 2 the wheel B^2 is loose on the shaft A^2 and runs in gear with the wheel D^2 on the shaft E^2 E^2. As the wheels D^2, Fig. 1, and B^2, Fig. 1, run together and are equal to each other in number of teeth, the shaft E^2 E^2, Fig. 1, and the shaft A^2, Fig. 1, will have the same amount of motion, and as the worm-wheel W^2, Fig. 9, and the worm-wheel X′, Fig. 2, are equal to each other in all respects, and as the worm Z′, Fig. 2, and the worm X^2, Fig. 9, are equal to each other in all respects, the front take-up rolls U^2 U^2 U^2, Fig. 9, and the let-off rolls V′ V′ V′, Fig. 2, will have the same amount of motion, all six of the rolls being of the same diameter.

The machinery thus described for letting off the yarn produces a positive let-off, and that and the positive take-up before described operate together as one piece of machinery. The positive let-off produces a regular and uniform delivery from the yarn-beam of a certain and invariably equal length of yarn at each regular and uniform delivery. The three let-off rolls are covered with cloth and are properly friction-rolls. The yarn passes from the yarn-beam over the lower back roll, then around the middle forward roll, and then backward around and over the upper back roll to which the worm-wheel X′, Fig. 2, is secured. The yarn is drawn off from the yarn-beam by the friction of the yarn on the rolls and not by the pressure of the rolls against each other, there being no other means of rotating the yarn-beam so as to let off the yarn except the pulling of the yarn through the rolls as the loom works it up.

Fifth. The next part of my invention consists in preventing the opening and closing of the shed from producing an increased or diminished strain upon the warp-threads. This I effect by the regular and positive advance of the let-off rolls toward the harness through an invariably equal distance at every opening of the shed, and by their return through the same distance at every closing of the shed, as hereinafter described.

In Figs. 1 and 2 the pitman T′ terminates at one end at the upper extremity of the lever P′ P′ P′ in a joint S′. At the other end it is connected with the slide U′, Fig. 2, in a

joint like the joint S′. Upon the opposite side of the loom and in a like position with the pitman T′ is a pitman exactly like the pitman T′, terminating at one end at the upper extremity of the lever which has been mentioned as like the lever P′ P′ P′, and in a joint which is in a like position with the joint S′ and exactly like it, and connected at the other end with a slide in a like position with and exactly like the slide U′ in a joint like the joint S′. It will be seen that as vertical motion is given to the pulley end of the lever P′ P′ P′, Fig. 1, it will communicate a horizontal sliding motion to the slide U′, Fig. 2, which slide will carry with it the rolls V′ V′ V′, Fig. 2.

In Fig. 2, by means of the motion of the slide U′ and of the machinery connected with it I produce a regular and positive advance of the let-off rolls toward the harness through an invariably equal distance at every opening of the shed and their return through the same distance at every closing of the shed, and thus the opening and closing of the shed are prevented from producing an increased or diminished strain upon the wash-threads.

Sixth. The next part of my invention relates to the working of the lay to beat up the cloth. I work it by means of slides and connecting-rods or pitmen, as hereinafter described. The peculiar feature of my slide is that it is worked by means of a combination of machinery, consisting of a shaft, a crank, a crank-pin, a pulley, and a slot. The motion of the slide is communicated to the lay by means of connecting rods or pitmen, which are attached to the frame-work of the lay and are so arranged as to brace the frame-work of the lay.

In Fig. 2 the shaft S^3 has keyed to it a wheel T^3 of the same size as each of the wheels D and L′. The wheel T^3 is immediately above the wheel L′ (shown in dotted lines in Fig. 1) and works into it. The shaft S^3 runs through the loom from side to side, and on the opposite end of the shaft S^3 and at a like position with the wheel T^3 is a wheel exactly like the wheel T^3, and working into the wheel which has been described as on the shaft M′ and as exactly like the wheel L′. On the extreme end of the shaft S^3 is a curved arm U^3, represented in dotted lines, and carrying a pulley V^3 attached to the arm U^3. On the opposite end of the shaft S^3 and at a like position with the arm U^3 is a curved arm exactly like the arm U^3, and carrying a pulley which is at a like position with and exactly like the pulley V^3, and is attached to the arm which has been described as like the arm U^3. The pulley V^3, for which, however, a crank-pin on the curved arm U^3 may be substituted, works into the curve or slot W^3. The curved piece X^3 has two shafts Y^3 Y^3 projecting out from it, one on each side. The curved piece X^3 and the shafts Y^3 Y^3 are supported by and slide in the boxes Z^3 Z^3. Attached to the curved piece X^3, and running through it and projecting from it on both sides, is a pin or stud A^4 A^4. On the ends of the stud A^4 A^4, one on each end, are placed two pitmen B^4 B^4 and C^4 C^4, one on each side of the curved piece X^3, C^4 C^4 being a straight one running directly from the inside of the curved piece X^3 to a stand D^4, bolted to the race-board E^4 of the lay, and B^4 B^4 being in the form of and acting as a brace and running from the outer side of the curved piece X^3 to a stand F^4 bolted to the frame-work G^4 G^4 of the lay. The race-board E^4 of the lay is secured to the frame-work G^4 G^4 of the lay at H^4. On the opposite side of the loom the curve or slot W^3 the curved piece X^3, the shafts Y^3 Y^3, the boxes Z^3 Z^3, the pin or stud A^4 A^4, the pitmen B^4 B^4 and C^4 C^4, the stand D^4, the race-board E^4 of the lay, the stand F^4, the frame-work G^4 G^4 of the lay, and the point H^4 are reproduced in exactly like mechanism. The axes of the two shafts Y^3 Y^3 and the axis of the shaft S^3 are in the same horizontal plane, the one at right angles to the other. The axes of the two shafts Y^3 Y^3 are in the same vertical plane and in the same horizontal plane with each other. It is apparent therefore that when rotary motion is given to the shafts S^3, a sliding motion will be produced in the direction of the lengths of the shafts Y^3 Y^3, which as they slide will carry with them the curved piece X^3 and the pitmen B^4 B^4 and C^4 C^4 and cause the race-board E^4 of the lay and the frame G^4 G^4 of the lay to vibrate for the purpose of beating up the cloth.

In Fig. 2, I^5 is a stand secured to the floor and holding the frame-work of the lay. J^5 J^5 are joints in which the frame-work of the lay vibrates. K^5, wherever found in any of the figures, represents the frame-work of the loom. This frame-work is represented as broken off and removed in several places the better to exhibit the machinery.

Seventh. The next part of my invention relates to the throwing of the loom out of gear. I cause it to throw itself out of gear whenever a shuttle fails to go into its proper box at the proper time, and also whenever the connection formed by any weft-thread between its shuttle and the cloth is not maintained during the whole time of the passage of that shuttle through the warp-threads, and this I effect by the operation of hooks attached to the bed of the lay, as hereinafter described. In the arrangement for stopping the loom when the connection of the weft-thread is broken the hooks are combined with wires or prongs for the reception of the weft-thread, as hereinafter described, and are operated by the passage of the shuttle into the shuttle-box, as hereinafter described.

In Fig. 1, behind the driving-pulley A and upon the driving-shaft B is a slide L^5 L^5, having two pins M^5 M^5 projecting from it and running through the tubes N^5 N^5 in the center of the driving-pulley A, one through each tube. The tubes N^5 N^5 are also shown in Fig. 2. This slide L^5 L^5, Fig. 1, is worked in

the direction of the length of the driving-shaft B, Figs. 1 and 2, by the lever O^5, Fig. 2, secured to the stud P^5, Fig. 2, the lower end of the lever O^5, Fig. 2, being inserted in the crease Q^5, Fig. 1, and the upper end extending upward and being inserted in and running through the spring S^5 S^5, Fig. 2, below the handle R^5, Fig. 2. As the handle R^5, Fig. 2, attached to the spring S^5 S^5, Fig. 2, is pulled inward toward the frame-work K^5 of the loom, and as the spring S^5 S^5, Fig. 2, is hitched onto the catch T^5, Fig. 2, the pins M^5 M^5, Fig. 1, projecting from the slide L^5 L^5, Fig. 1, and running through the tubes N^5 N^5, Figs. 1 and 2, in the center of the driving-pulley A, Figs. 1 and 2, pass into the holes which are shown in the plate U^5 U^5, Fig. 2, keyed onto the driving-shaft B, Figs. 1 and 2, by which means a connection is formed between the driving-pulley A, Figs. 1 and 2, and the driving-shaft B, Figs. 1 and 2. The driving-pulley A, Figs. 1 and 2, and the slide L^5 L^5, Fig. 1, are loose on the shaft B, Figs. 1 and 2.

In Fig. 2, on the back side of the series of shuttle-boxes R R are flat steel springs V^5 V^5 V^5, turning outward from each of the shuttle-boxes. Screwed onto the inner sides of the springs V^5 V^5 V^5 are the pieces W^5 W^5 W^5, one on each. As the shuttle comes into the shuttle-box it crowds against the piece W^5 and forces the spring V^5 outward, as represented in the drawings, and is therefore held steady by it and prevented from rebounding. On the frame-work G^4 G^4 of the lay is secured an upright stud X^5. On the stud X^5 is placed a hollow cylinder Y^5, having two arms Z^5 Z^5 projecting from it. Above and across one of the arms Z^5 Z^5 is placed a slide A^6, which is secured to the arm by a pin A^6. At one end of the slide A^6 is a piece B^6, connected to the slide A^6 by the joint C^6. The two spiral springs D^6 D^6, one projecting out onto and pressing against the upper side of the piece B^6 and the other projecting out onto and pressing against the lower side of the piece B^6, are designed to keep the piece B^6 in its place, its place being as represented in the drawings. The other end of the slide A^6 runs through the stand E^6 at E^6. The stand E^6 is bolted to the frame-work G^4 G^4 of the lay. To the other of the arms Z^5 Z^5 is secured a rod F^6. The rod F^6 is continued on and works against the hook G^6. The hook G^6 is secured to the under side of the stand D^4 by a nut and bolt, and is kept against the end of the rod E^6 by the spiral spring H^6 immediately under it. The hook G^6 and the rod F^6 on the opposite side of the loom, and which are alike on both sides of the loom, are shown in Fig. 8.

In Fig. 2, from underneath the race-board E^4 of the lay project three hooks I^6 J^6 K^6. These hooks are also shown in Fig. 8. In Fig. 8 the hook I^6 is secured fast to the crooked arm L^6 by the rod M^6. The hook K^6 and the crooked arm N^6 are keyed fast to the shaft O^6 O^6. On the ends of the two crooked arms L^6 and N^6 are secured two studs P^6 P^6, one on each arm. The two studs P^6 P^6 terminate each in a joint at its upper end with the two studs Q^6 Q^6 secured to the two levers R^6 R^6, one stud to each lever. The two fulcrums S^6 S^6, one to each of the two levers R^6 R^6, are secured to the under side of the race-board E^4 E^4 of the lay. On the opposite ends of the two levers R^6 R^6 are two joints, one to each lever, connecting the two levers R^6 R^6, with two upright connections T^6 T^6, one connection to each lever. The upper ends of the two pieces T^6 T^6 are secured to the plates U^61 U^62 by two joints, one to each plate. Extending down from underneath the two plates U^61 U^62 are four pins V^6 V^6, two on each plate. The four pins V^6 V^6 are guided so that they may slide in a vertical direction by two stands W^6 W^6, one stand to each pair of pins. In the upper side of the two plates U^61 U^62 sixteen wires are inserted, eight in each plate, bent in the manner shown in the drawings. X^6 X^6 are two small frame-works immediately above the two plates U^61 U^62, one above each plate, secured to the front of the race-board E^4 of the lay at Y^6 Y^6, each by two bolts. Underneath the two frame-works X^6 X^6 are eighteen wires, nine under each, (only four of which are shown in the drawings,) coming down the thickness of the wire below the front sides and ends of the two frame-works X^6 X^6, and running parallel with their lower edges and turned up and riveted through the cross-bars Z^6 Z^6, nine through each cross-bar. The hooks I^6 and J^6, the crooked arm L^6, the rod M^6, the upright piece T^6, the plate U^62, the frame-work X^6, and the shaft O^6 O^6 are shown in Figs. 10 and 11. The two pins V^6 V^6 and the stand W^6 are shown in Fig. 10. The stud P^6, the stud Q^6, the lever R^6, the fulcrum S^6, and the pin V^6 are shown in Fig. 11. Figs. 10 and 11 are drawn full size.

It will be obvious in Fig. 8 from the foregoing description that as the race-board E^4 of the lay is carried forward for the purpose of beating up the weft-thread the two hooks I^6 and K^6 having each of them a curved swell on its lower surface, which curved swell on K^6 is shown at A^7 will, as they pass forward and over the two pulleys B^7 and C^7, one over each pulley, (which pulleys B^7 and C^7 are secured to the stud D^7,) be thrown upward into the position in which the hook K^6 is represented in Fig. 8. Thus by the action of the hook K^6 the shaft O^6 O^6 will be turned so that in consequence of the connection before described of the shaft O^6 O^6 with the plate U^61 the plate U^61 will be dropped to the position in which it is represented in Fig. 8, and be held there by the hook G^6, and the lever E^7, which lever E^7 is keyed fast to the shaft O^6, the hook I^6 being loose on the shaft O^6 O^6, and being connected by means of the rod M^6 with the crooked arm L^6, which crooked arm L^6 is also loose on the shaft O^6 O^6, will, whenever it is thrown up by passing over the pulley C^7, have the same effect on the plate U^62 that the hook K^6 has on the plate U^61, and the plate

$U^6 2$, when dropped to a like position with that in which the plate $U^6 1$ is represented in Fig. 8, will be held down in consequence of the hook G^6, Fig. 2, catching, as the hook I^6, Figs. 2 and 8, rises, a projection on the side of the hook I^6, Figs. 2 and 8, and holding firmly the hook I^6, Figs. 2 and 8.

In Fig. 8 the two hooks I^6 and K^6 have two pieces F^7 F^7 secured to them at their tops, one to each. The hook J^6 has its bearing at G^7, and extends backward under the two pieces F^7 F^7, and as the two hooks I^6 K^6 are always up when the lay recedes, the two pieces F^7 F^7 will be raised from the back end of the hook J^6, so that the hook end of the hook J^6 will fall downward, and in case the shuttle as it is thrown does not go into the box on the opposite side of the loom neither of the two hooks I^6 K^6 will be dropped down, and the hook end of the hook J^6 will not be raised. Consequently, as the lay returns forward, the hook J^6 will catch the slide T^5 H^7 H^7, Fig. 2, and the spring $S^5 S^5$, Fig. 2, will be let go and the loom be thrown out of gear. The piece F^7 is shown in Fig. 10. The curved snell A^7, the two pulleys B^7 C^7, the shed D^7, and the bearing at G^7 are shown in Fig. 11.

In Fig. 2, as the shuttle is thrown from the left-hand side of the loom to the right, carrying the thread with it, as shown in Fig. 8, and goes into one of the series of shuttle-boxes R R on the right-hand side of the loom, one of the springs V^5 V^5 V^5 is crowded outward and carries with it the slide A^6, which is secured to the arm Z^5, by which means a sliding motion is given to the rod F^6 in the direction of its length, which crowds off the hook G^6 and lets the hook end of the hook I^6 drop downward, causing the plate $U^6 2$, Fig. 8, to pass upward and catch the thread between the wires in it and the wires in the frame-work X^6, Fig. 8, above it, in which case the hook I^6 as it drops raises the hook end of the hook J^6 to a level with it and just above the slide T^5 H^7 H^7, so that the hooks I^6 J^6 pass over the slide T^5 H^7 H^7, and the loom works on.

In Fig. 8, as the shuttle is thrown from the right-hand side of the loom to the left into one of the series of shuttle-boxes on the left-hand side, there being the same number of shuttle-boxes on each side and like machinery on the left-hand side with that represented on the right-hand side in Fig. 2 as in connection with the series of shuttle-boxes R R, a sliding motion is produced in the rod F^6, the end of which is shown, so that the hook G^6 is crowded off and the lever E^7 is let go, causing the hook K^6 to drop and the slide U^6 1 to rise and catch the thread between the wires on it and the wires on the frame-work X^6, and as the hook end of the hook K^6 drops it raises the hook end of the hook J^6 to a level with and just above the slide T^5 H^7 H^7, Fig. 2, so that the hooks J^6 K^6 pass over the slide T^5 H^7 H^7, Fig. 2, and the loom works on. It is worthy of remark here that the hook end of he hook J^6 is always down when the lay recedes, and is always ready to catch the slide $T^5 H^7 H^7$, Fig. 2, and will catch it unless taken up by one of the hooks I^6 K^6 as they drop downward.

In Fig. 8, whenever the weft-thread breaks or is exhausted from the bobbin in the shuttle, so that it is not present between the slides $U^6 1$ $U^6 2$, respectively, and the frame-works X^6 X^6, respectively, the wires on the plates $U^6 1$ $U^6 2$ pass up between the wires on the frame-works X^6 X^6, and by them thus enabling the hook end of the hooks $I^6 K^6$ to pass farther downward and catch the slide T^5 H^7 H^7, Fig. 2, and as the lay passes forward the loom is thrown out of gear, as before represented. Thus it will be readily seen that from whichever side of the loom and in whatever order the shuttles are thrown, the hooks I^6 K^6 J^6 are always ready to perform their offices.

My thread-protector is constructed with wires, but may be constructed with prongs. The principle on which I construct it and the machinery connected with it is to place the wires or prongs between which the weft-thread lies sufficiently near together to be sensitive to the presence of the finest thread and to multiply the number of wires or prongs and bring them closer together as the fineness of the weft-thread increases. It will also be seen that it is the passage of the shuttle into the shuttle-box that works the machinery which throws the loom out of gear when the weft-thread is not found between the wires of the thread-protector at the proper time.

The parts of the loom immediately in connection with the treadles which are shown in Fig. 1 are also shown in Fig. 7, and are lettered in Fig. 7 to correspond with their lettering in Fig. 1

Eighth. The next part of my invention consists of a conditional let-off, whereby yarn is let off from the yarn-beam in consequence of there being an improper strain on the warp-thread, and whereby such letting off of yarn ceases whenever the proper strain on the warp-threads is restored.

In Fig. 2, I^7 I^7 is a rod lying across the loom immediately above the warp and resting lightly upon the warp. One end of the rod I^7 I^7 is shown resting upon a curved piece J^7, bolted to the frame-work K^5 of the loom at J^7. The other end of the rod I^7 I^7 rests upon a like curved piece on the opposite side of the loom, bolted in a like manner to the frame-work of the loom on the opposite side. Resting upon the top of the rod I^7 I^7 is a nut K^7. The nut K^7 is screwed onto the top of a rod L^7, which passes through the rod I^7 I^7. The rod L^7 passes down through the warp and is curved, so that it passes on clear of the cloth-beam A^3. The lower end of the rod L^7 is shown at L^7, Fig. 1. In Fig. 1 the rod L^7 is attached to an arm M^7. The arm M^7 is secured to a stud N^7 at N^7. On the stud N^7 and connected with and at right angles to the arm M^7 is an arm O^7, extending downward. On the arm M^7 is

suspended a hook P^7, holding a weight Q^7. Secured to the lower end of the arm O^7 is a rod R^7 R^7, extending to and connected with a vertical slide S^7. The vertical slide S^7 extends upward through a slot in the plate T^7, and has a hook extending downward from it at S^7. The vertical slide S^7 is connected with the vertical slide U^7 at U^7. To the vertical slide U^7 at V^7 is attached a dog V^7, which works into the ratchet W^7. The ratchet W^7 is keyed fast to the shaft A^2. X^7 is a spring holding the dog V^7 against the ratchet W^7. The top of the dog V^7 is shown on the farther side of the ratchet W^7. Close to the vertical slide S^7 is another vertical slide Y^7, which passes upward through the plate T^7, and is secured by a bolt Z^7 to the lever A^8. The lever A^8 works upon a stud secured to the frame K^5 of the loom at A^8. The lever A^8 is also shown in Fig. 2, where it will be seen that as it goes forward it curves upward and passes over a vertical stud B^8, the vertical stud B^8 being secured to a ring C^8, which is secured to the shaft M′. The parts just described, as in Fig. 2, are shown in dotted lines under the curved piece X^3.

Now it will be seen in Fig. 2 that as rotary motion is given to the shaft M′ the vertical stud B^8, being secured to it, will revolve with it and give a vertical motion to the curved end of the lever A^8. The vertical slide Y^7, (seen more distinctly in Fig. 1,) being attached to the lever A^8 at Z^7, will have a vertical sliding motion.

In Fig. 1, as the rod I^7 I^7, Fig. 2, is raised it will, from its connection with the vertical slide S^7, bring the vertical slide S^7 forward over the beveled stud D^8, which is secured to the vertical slide Y^7. As the vertical slide Y^7 has a vertical motion, it will carry up the vertical slide S^7 and operate the dog V^7, attached to the vertical slide U^7 and working into the ratchet W^7. The ratchet W^7 being keyed to the shaft A^2 and the wheel B^2 being loose on the shaft A^2, as before represented, the shaft A^2 will be at liberty to turn. The click or dog F^2, secured to the wheel B^2 and held down to the ratchet C^2 by the spring G^2, will always prevent the wheel B^2 from turning on the shaft A^2 when the wheel B^2 is driven by the wheel D^2, the ratchet C^2 being keyed fast to shaft A^2.

In Fig. 2 the nut K^7 may be adjusted by screwing it. It is in practice so adjusted that with the ordinary tension which the warp-threads have in weaving they will not affect the rod I^7 I^7, although they are in contact with it; but if the tension of the warp-threads is increased they will raise the rod I^7 I^7, and thus, by means of the machinery which has just been described, there is provided a conditional movement for the three let-off rolls. V′ V′ V′, Fig. 2, in addition to their positive movement before described, by which conditional movement sufficient yarn, and no more, will be let off from the yarn-beam to restore their given strain to the warp-threads.

In Fig. 2, E^8 is one head of the yarn-beam resting on the box F^8. G^8 G^8 G^8 G^8 are two pieces secured to the frame-work K^5 of the loom, one piece on each side, to which pieces are secured on the inside vertical guides for the harness-journals, one of which harness-journals is shown at H^8 H^8. L^8 L^8 L^8 represent the warp-threads going through the harness J^8 J^8 J^8. K^8 is the cloth on the cloth-beam. J^8 is the cloth passing over the breast-beam Y′. M^8 is a roll holding the upper edge of the reed N^8. O^8 is a temple.

Ninth. The next part of my invention relates to the working of the draft-boards. I work the draft-boards or combs when they are used by forming and breaking the connection between the draft-boards or combs and the machinery that works them by means of the two hooks H^9 H^9, as hereinafter described; and in connection with the movement hereinafter described of the Jacquard machine to which the harness is attached I use for the purpose of moving the draft-boards in correspondence with the movement of the part of the jacquard to which the harness is attached the combination of machinery hereinafter described, consisting of the two jacks X^8 X^8 X^8 X^8, the two rods Z^8 Z^8, the slide B^9 B^9 and the pin C^9.

In Fig. 2, on the upper ends of the rods Q′ Q′ and between them and the two triangular slides P^8 P^8 P^8 P^8 P^8 P^8, Fig. 3, the lower end of one of which triangular slides is shown in Fig. 2 at P^8, are two nuts, only one of which is shown in Fig. 2, (marked Q^8,) there being one nut Q^8 on the upper end of each rod Q′, and each triangular slide P^8 P^8 P^8, Fig. 3. Each nut Q^8 has in the lower end of it a screw between it and the rod Q′ and in the upper end of it a socket and set-screw, so that as the nuts Q^8 are turned on the lower ends of the triangular slides P^8 P^8 P^8 P^8 P^8 P^8, Fig. 3, those triangular slides will be raised or lowered, carrying with them the frame-work R^8, Fig. 3, of the Jacquard machine above them, which rests upon them and is bolted to them by two bolts on each side of the loom, as shown at V^8 V^8, Fig. 3, and thus by the turning of the nuts Q^8 the height of the harness will be adjusted. In Fig. 3, R^8, wherever found, represents the frame-work of the Jacquard machine. On the cross-rail K⁵1, Figs. 2 and 3, of the frame-work K^5 of the loom opposite K⁵1, Fig. 3, is a box S^8, Fig. 3, which serves as a guide for the lower end of the triangular slide P^8 P^8 P^8, Fig. 3. In Fig. 3, on the upper end of the triangular slide P^8 P^8 P^8 are two boxes T^8 T^8, which serve as guides for the upper end of the triangular slide P^8 P^8 P^8, and are bolted to the frame-work K^5 of the loom at U^8. On the triangular slide P^8 P^8 P^8, secured to its inner upper extremity, is a joint holding the upper end of the connecting-rod W^8, the lower end of which rod W^8 is fastened to one end of a rocking-beam or jack X^8 X^8 at Y^8. The opposite end of the jack X^8 X^8 has at-

tached to it a rod the lower end of which is shown at Z^8, and which is like the rod W^8. The jack X^8 X^8 is shown in dotted lines, and is secured at A^9 to the frame-work K^5 of the loom. On the opposite side of the loom the boxes S^8, the two boxes T^8 T^8, the two bolts V^8 V^8, the connecting-rod W^8, the rocking beam or jack X^8 X^8, and the rod Z^8 are reproduced in exactly like mechanism. One box T^8 and one bolt V^8 on the opposide side of the loom are shown.

In Fig. 5 the two rocking beams X^8 X^8 X^8 X^8 are partly shown with their inner ends attached to the two rods Z^8 Z^8, one to each. The upper ends of the rods Z^8 Z^8 are secured each by a joint to the slide B^9 B^9. The slide B^9 B^9 is placed upon a pin C^9, which projects downward from the vertical slide D^9 D^9, represented as broken off at the upper end. The upper end of the vertical slide D^9 D^9 is also represented in Figs. 3 and 6.

In Fig. 3, on the upper end of the vertical slide D^9 D^9 is a cross-head E^9 E^9, turning downward at E^9 and secured to the vertical slide D^9 D^9 by the bolt F^9 in the center of the cross-head E^9 E^9.

In Fig. 6 the vertical slide D^9 D^9, a part of the cross-head E^9 E^9, and a part of the horizontal piece I^9 I^9 are shown turned around, so as to present the opposite side of them from that shown in Fig. 3.

In Fig. 3 G^9 G^9 are two joints, one on each side of the center of the cross-head E^9 E^9, in which the upper ends of the two hooks H^9 H^9 work, one hook in each joint. The two hooks H^9 H^9 are connected together by a horizontal piece I^9 I^9, which is attached to them at H^9 H^9. Into the under edge of the horizontal piece I^9 I^9 are inserted two springs, one of which is shown at J^9. The other spring is like the spring J^9 and in like position with it. The spring J^9, which is shown in Fig. 3, is also shown in Fig. 6. Between the two springs J^9, and secured to the shaft K^9, Fig. 6, is a triangular cam L^9, one point of which is shown in Figs. 3 and 6 projecting against the spring J^9. The triangular cam L is fully shown in Fig. 12.

In Fig. 6, between the cam L^9 and the hexagon M^9 or wheel with six points and six projecting pins is a box N^9, holding the shaft K^9. The shaft K^9 is secured at its opposite end to the vertical slide D^9 D^9. O^9 O^9 is a vertical slide with a cross-piece on the bottom pressed down onto the wheel M^9 by the spiral spring P^9, for the purpose of holding the points of the cam L^9 steadily against the springs J^9 when required.

In Fig. 3 the two upper rails R^8 R^8 R^8 R^8 of the frame-work of the Jacquard machine extend outward, and at R^81 R^81 R^81 R^81 curve upward. On the ends of the two upper rails R^8 R^8 R^8 R^8 are four boxes Q^9 Q^9 Q^9 Q^9, one on each end. The shafts R^9 R^9 are carried by the four boxes Q^9 Q^9 Q^9 Q^9, one shaft by each pair of boxes. On the outside of the boxes Q^9 Q^9 Q^9 Q^9 are four arms S^9 S^9 S^9 S^9, keyed to the ends of the two shafts R^9 R^9 at T^9 T^9 T^9 T^9, one arm on each end of each of the two shafts. On the opposite ends of the four arms S^9 S^9 S^9 S^9 are four joints U^9 U^9 U^9 U^9, one joint on the opposite end of each arm connecting with the four arms S^9 S^9 S^9 S^9 four rods, one rod with each arm, three of which rods are shown marked V^9 V^9 V^9, and the fourth of which is exactly like each of those that are shown. These four rods are secured to four slides, as shown at W^9 W^9 W^9, one rod to each slide, three of which slides are shown marked W^9 W^9 W^9, and the fourth of which is exactly like each of those that are shown. Secured to the four arms S^9 S^9 S^9 S^9 at X^9 X^9 X^9 X^9 are two cross-pieces X^9 X^9 X^9 X^9, one cross-piece to each pair of arms. To the centers of the two cross-pieces X^9 X^9 X^9 X^9, at Y^9 Y^9, are bolted two curved pieces Y^9 Y^9, one curved piece to the center of each cross-piece. In the inner ends of the two curved pieces Y^9 Y^9 are two slots or openings Z^9 Z^9, one slot in the inner end of each curved piece. In these two slots Z^9 Z^9 are inserted two pins running through from side to side, one pair to each slot.

From the description before given it will have been seen that vertical motion is given to the two vertical rods Q′ Q′, Fig. 2, by the two levers P′ P′ P′, Fig. 2. The amount of that vertical motion is in each of the rods Q′ Q′, Fig. 2, equal or nearly equal to one-half of the opening of the shed of the warp-threads. As then in Fig. 3 vertical motion is given to the two vertical rods Q′ Q′, Fig. 2, it is communicated to the two triangular slides P^8 P^8 P^8, which as they move carry with them the whole frame-work R^8 of the Jacquard machine and also the two knot-boards A^{10} A^{10}, two tail-boards, the end of one of which is shown at B^{10}, the two slides C^{10} C^{10}, the cylinder or prism D^{10}, over which the pattern-cards run, all the upper part of the pattern-cards E^{10} E^{10} E^{10}, the back board F^{10}, the sliding back board G^{10}, the needle-board, of which the upper edge is shown at H^{10}, and the four cylinder-hooks J^{10} J^{10} J^{10} J^{10}, and, in short, all the parts that ordinarily constitute a Jacquard machine. It will thus be seen that by the connection of the upper parts of the two triangular slides P^8 P^8 P^8 with the two rocking-beams or jacks X^8 X^8 X^8 X^8 the vertical slide D^9 (the lower end of which and its connection with the two rocking-beams X^8 X^8 X^8 X^8 are shown in Fig. 5) will slide downward at the same time that the two triangular slides P^8 P^8 P^8 slide upward and will, as it slides downward, carry down the two of the four slides W^9 W^9 W^9, that are shown in Fig. 3 as drawn up. As the vertical slide D^9 D^9 comes down, carrying down with it the wheel M^9, Fig. 6, one of the six projecting horizontal pins on the wheel M^9, Fig. 6, will come in contact with the vertical stud J^{10}, Fig. 6, which will cause the wheel M^9, Fig. 6, to turn, thereby throwing one of the points of the triangular cam L^{10}, Figs. 6 and 12, against that one of the two springs J^9 which

is not shown in Figs. 3 and 6, whereby that one of the two hooks H^9 H^9 which is shown in Fig. 3 as hooked into the slot Z^9, will let go its hold and the horizontal piece I^9 I^9 be carried across, so that the hook end of the other one of the two hooks H^9 H^9 will hook onto the slot Z^9, which is shown in Fig. 3 as below it, this last-named slot Z^9 being at that instant brought up by the motion of the Jacquard machine to a level with the hook F^9 that is on the same side with it; then as the Jacquard machine goes downward again the draft-board that was before down will be drawn up. This mode of working the draft-boards is equally applicable to the working of combs where they are used instead of draft-boards. My mode of working the draft-boards may be used with two Jacquard machines instead of one, and in that case the hooks H^9 H^9, of which there will be four, will still be worked in correspondence with the working of the draft-boards.

Tenth. The next part of my invention relates to the movement of the Jacquard machine. I attach the harness to the knot-boards, (or to their equivalent, being a part of the Jacquard machine,) as hereinafter described, and I then move the part of the jacquard to which the harness is attached regularly and statedly in correspondence with the beating up of the lay, so as to aid in opening and closing the shed, as hereinafter described; and the harness, the moving parts of the Jacquard and their connections with the lower part of the loom are so arranged that when the loom is to be thrown out of gear the weight of the harness and of these parts and connections opposes the greatest possible resistance to the momentum of the loom. The whole of that weight rests on the two levers P′ P′ P′, Fig. 1, and through these levers and the two pulleys O′, Fig. 1, on the two cams N, Fig. 1. When the lay is back, (at which time, if at all, the loom is to be thrown out of gear,) that weight rests on the parts of the two cams N′, Fig. 1, that are nearest to the shaft M′, Fig. 1, and therefore opposes the greatest possible resistance to the momentum of the loom. I also use as a part of the Jacquard machine and for the purpose of permitting the draft-boards to come down without crowding out the cylinder or prism the combination of machinery hereinafter described, consisting of the two slides Y^{10}, the two springs Z^{10}, and the two needles Q^{10}.

In Fig. 3, $K^{10}2$ K^{10} $K^{10}1$ K^{10} K^{10} K^{10} K^{10} K^{10} are four hooks on the Jacquard machine, each of which has a joint at its lower end. Three of the joints are shown at L^{10} L^{10} L^{10}. The fourth joint is like each of the other three. Attached to the four joints L^{10} L^{10} L^{10} are four pieces M^{10} M^{10} M^{10} M^{10}, one piece to each joint, which extend downward through the frame-work of the Jacquard machine, as shown at N^{10} N^{10}. Attached to the four pieces M^{10} M^{10} M^{10} M^{10} are four wires O^{10} O^{10} O^{10} O^{10}, one wire to each piece, extending downward and attached to the harness-journals, one of which is shown at H^8 H^8, Fig. 2, one wire to each harness-journal. On the opposite side of the Jacquard machine the four hooks $K^{10}2$ K^{10} $K^{10}1$ K^{10} K^{10} K^{10} K^{10}, the four joints L^{10} L^{10} L^{10}, the four pieces M^{10} M^{10} M^{10} M^{10}, and the four wires O^{10} O^{10} O^{10} O^{10} are reproduced in exactly like mechanism.

In Fig. 4, F^{10} represents the back board holding the back ends of the wire needles, a few of which are shown projecting from it at P^{10}. $K^{10}1$ $K^{10}2$ are the upper ends of the two hooks, which are marked $K^{10}1$ K^{10} $K^{10}2$ K^{10} in Fig. 3. Q^{10} is part of a needle or slide, which operates on the four hooks $K^{10}2$ K^{10} $K^{10}1$ K^{10} K^{10} K^{10} K^{10}, Fig. 3, and is inserted into and runs through the back-board F^{10} at R^{10}. The needle Q^{10} is worked forward by the spiral spring S^{10} on its back end and backward by the cylinder or prism D^{10} at its front end. On the opposite side of the Jacquard machine the needle or slide Q^{10} and the spiral spring S^{10} are reproduced in exactly like mechanism.

In Fig. 3, T^{10} T^{10} are two slots in the upper side of the cylinder or prism D^{10} D^{10}. Directly opposite the slots T^{10} T^{10} are two other slots exactly like them. Projecting at W^9 from the slide W^9 is a pin U^{10}, which passes between two curved pieces V^{10} V^{10}, that are joined together at the top and terminate at the bottom in a hub W^{10}, which is screwed fast to the sliding rod C^{10}, which carries the cylinder or prism D^{10}. On the opposite side of the Jacquard machine the pin U^{10}, the two curved pieces V^{10} V^{10}, and the hub W^{10} are reproduced in exactly like mechanism. The four slides W^9 W^9 W^9 carry the two draft-boards $X^{10}1$ $X^{10}2$, one slide being fastened to each end of each draft-board.

From the foregoing description it will be seen in Fig. 3 that whenever either of the two sides of the cylinder or prism D^{10} which contain the four slots T^{10} T^{10} is turned toward the needle-board H^{10} the springs S^{10}, Fig. 4, will crowd the ends of the two slides or needles Q^{10} forward, each into one of the two slots T^{10} T^{10} which are nearest to the needle-board H^{10}. At the same time the hook ends of the eight hooks $K^{10}2$ K^{10} $K^{10}1$ K^{10} K^{10} K^{10} K^{10} K^{10} will be moved forward toward the cylinder or prism D^{10} by the movement of the slides or needles Q^{10}. As the draft-board $X^{10}1$ is raised the two slides C^{10} C^{10}, carrying the cylinder or prism D^{10}, will, by the action of the two pins U^{10} between the four curved pieces V^{10} V^{10}, move the cylinder or prism D^{10} outward. As the cylinder or prism D^{10} moves outward, two of the four cylinder-hooks I^{10} I^{10} I^{10} I^{10} come in contact with the cylinder or prism D^{10} during its passage outward and cause it to turn one square, and thus bring next to the needle-board H^{10} and into action another of the pattern-cards. After the cylinder or prism D^{10} has been turned in this way the two needles or slides Q^{10}, Fig. 4, will, by means of the two springs S^{10}, Fig. 4, pass forward through the needle-board

H^{10} and out of it on its outward side and remain forward, and as the cylinder or prism D^{10} returns at the same time that the draft-board $X^{10}1$ comes down the ends of the two needles or slides Q^{10} will pass into the two slots T^{10} T^{10}, which are next to the needle-board H^{10}, one needle into each slot. As the cylinder or prism D^{10} returns at the same time that the draft-board $X^{10}1$ comes down, the draft-board $X^{10}1$ will come onto the inclined parts of the two hooks, one on each side of the Jacquard machine, of which $K^{10}1$, Figs. 3 and 4, represents one, and in its progress downward will crowd back the two needles or slides Q^{10}, and cause the springs S^{10} to yield until the top parts of the two last-named hooks pass up through and come onto the top of the draft-board $X^{10}1$. As the draft-board $X^{10}1$ is raised again, the same effects will be produced of carrying outward and turning the cylinder or prism D^{10}, and as the draft-board $X^{10}1$ comes down, and the cylinder or prism D^{10} is returned at the same time, the side of the cylinder or prism D^{10} that has no slots in it, being returned against the needle-board H^{10}, the needles or slides Q^{10} will be carried backward against the springs S^{10}, Fig. 4, one against each spring, and held there by the cylinder or prism D^{10}. The draft-board $X^{10}1$ coming onto the inclined parts of the two hooks, one on each side of the Jacquard machine, of which $K^{10}2$, Figs. 3 and 4, represents one, would be prevented from coming down (because the two slides or needles Q^{10} will be held firmly backward by the cylinder or prism D^{10} coming against the forward ends) were it not for two slides, both alike and in like position, one on each side of the loom, one of which is shown in Fig. 4, (marked Y^{10},) and two spiral springs, both alike and in a like position, one on each side of the loom, one of which is shown in Fig. 4, (marked Z^{10},) there being one slide and one spiral spring to each of the needles Q^{10}. In Fig. 4 the upper ends of the four hooks $K^{10}1$ $K^{10}2$ pass through the edges of the two slides Y^{10}, two hooks through each slide, and by that means operate the two slides Y^{10}, thus enabling the two hooks $K^{10}2$ as the draft-board $X^{10}1$, Fig. 3, comes down onto the inclined parts of the two hooks $K^{10}2$ to pass backward without disturbing the needles or slides Q^{10}. The two hooks $K^{10}2$ as they pass backward will carry with them the two slides Y^{10}, whereby the draft-board $X^{10}1$, Fig. 3, will pass entirely down, after which the springs Z^{10} will throw the hook parts of the two hooks $K^{10}2$ over the top of the draft-board $X^{10}1$, Fig. 3, so that in its next upward movement the draft-board $X^{10}1$ will carry up with it the two hooks $K^{10}2$.

The support which I give to my Jacquard machine by means of the two triangular slides P^8 P^8 P^8 P^8 P^8 P^8, thus distributing the points of bearing, is rendered necessary by the fact that the Jacquard machine moves. I have represented the whole of the Jacquard machine, including its frame-work, as moving; but the essence of my invention consists in this, that in connection with the movement of the draft-boards I move the knot-boards (or their equivalent, being a part of the Jacquard machine) to which the harness is attached. My moving Jacquard machine may be used in connection with any of the known modes of tying up the harness of a loom.

Wherever in this specification I have used the term "wheel" simply without qualifying it in any way, I intend a toothed wheel. The several drawings herein referred to, and numbered from 1 to 12, both inclusive, are all of them, with the exception of Figs. 10 and 11, drawn to a scale of four inches to a foot. Figs. 10 and 11 are drawn full size.

Having thus described all the parts of the loom in which my improvements are introduced which it is necessary to describe in order to show these improvements, and having also fully described my improvements, what I claim to have invented, and desire to secure by Letters Patent, is as follows:

1. The arrangement of the machinery for throwing the shuttles, as herein described, in connection with the arrangement of the machinery for raising and lowering the shuttle-boxes, the devices thus arranged occupying the under part of the loom-frame and being more simple, compact, and convenient than other arrangements heretofore in use for the same purpose.

2. The winding of the cloth round the beam with uniform tension by increasing the leverage of the tension-weight M^3 in proportion as the diameter of the roll of cloth is increased, substantially as herein described.

3. In combination with a positive let-off, the use of a conditional let-off constructed substantially as herein described, whereby when there is an excess of strain on the warp-threads an increased quantity of yarn is delivered from the yarn-beam, such conditional increased delivery of the yarn ceasing whenever the proper strain on the warp-thread is restored.

4. The preventing the opening and closing of the shed from producing an increased or diminished strain upon the warp-threads by means of the regular and positive advance of the let-off rolls toward the harness through an invariably equal distance at every opening of the shed and by their return through the same distance at every closing of the shed, substantially as described.

5. The causing the loom to throw itself out of gear whenever a shuttle fails to go into its proper box at the proper time and whenever the connection formed by any weft-thread between its shuttle and the cloth is not maintained during the whole time of the passage of that shuttle through the warp-threads by the operation of hooks combined with each other and attached to the bed of the lay, substantially as described, the hooks being in the latter case combined with wires or prongs for the reception of the weft-thread, substan-

tially as described, and operated by the passage of the shuttle into the shuttle-box, substantially as described.

6. Forming and breaking in any required order the connection between the draft-boards, respectively, and the machinery that works them by means substantially such as are herein described, this method of working the draft-boards admitting of a more simple, compact, and convenient arrangement of the machinery than others before used to attain the same end.

7. The combination of a rising and falling Jacquard frame with the draft-boards, substantially as herein set forth, whereby the depression of the frame will be simultaneous with the elevation of a part of the draft-boards and the elevation of the frame with the depression of a part, the one in this manner aiding in working and equipoising the other.

8. Elevating and depressing the harness and draft-boards by the simultaneous elevation or depression of all the knot-boards for the purpose of opening the sheds in looms for weaving figured fabrics when these knot-boards are arranged above the draft-boards, as herein described.

9. In connection with the movement of the part of the jacquard to which the harness is attached, substantially as described, the arrangement of the harness and of the moving parts of the jacquard and of their connections with the lower part of the loom, substantially as described, in such manner that at the time when the loom is to be thrown out of gear the weight of the harness and of those parts and connections shall oppose the greatest possible resistance to the momentum of the looms.

10. The use, as a part of the Jacquard machine, of the combination of machinery hereinbefore described, and shown in Fig. 4 of the accompanying drawings, such combination consisting of the two slides Y^{10}, the two springs Z^{10}, and the two needles Q^{10}, constructed substantially as described and operating so as to permit the draft-board to come down without crowding out the cylinder or prism, substantially as described.

AVERY BABBETT.

Witnesses:
SAML. BLATCHFORD,
CLARENCE A. SEWARD.