(No Model.) 6 Sheets—Sheet 1.

T. HARRISON.

LOOM.

No. 440,591. Patented Nov. 11, 1890.

FIG. 1a

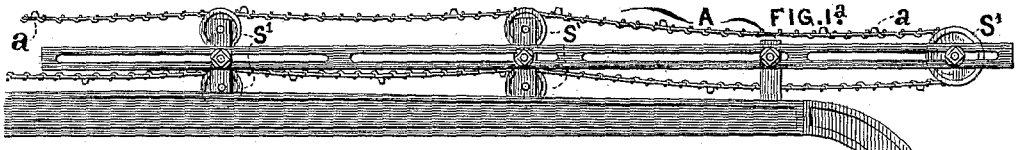
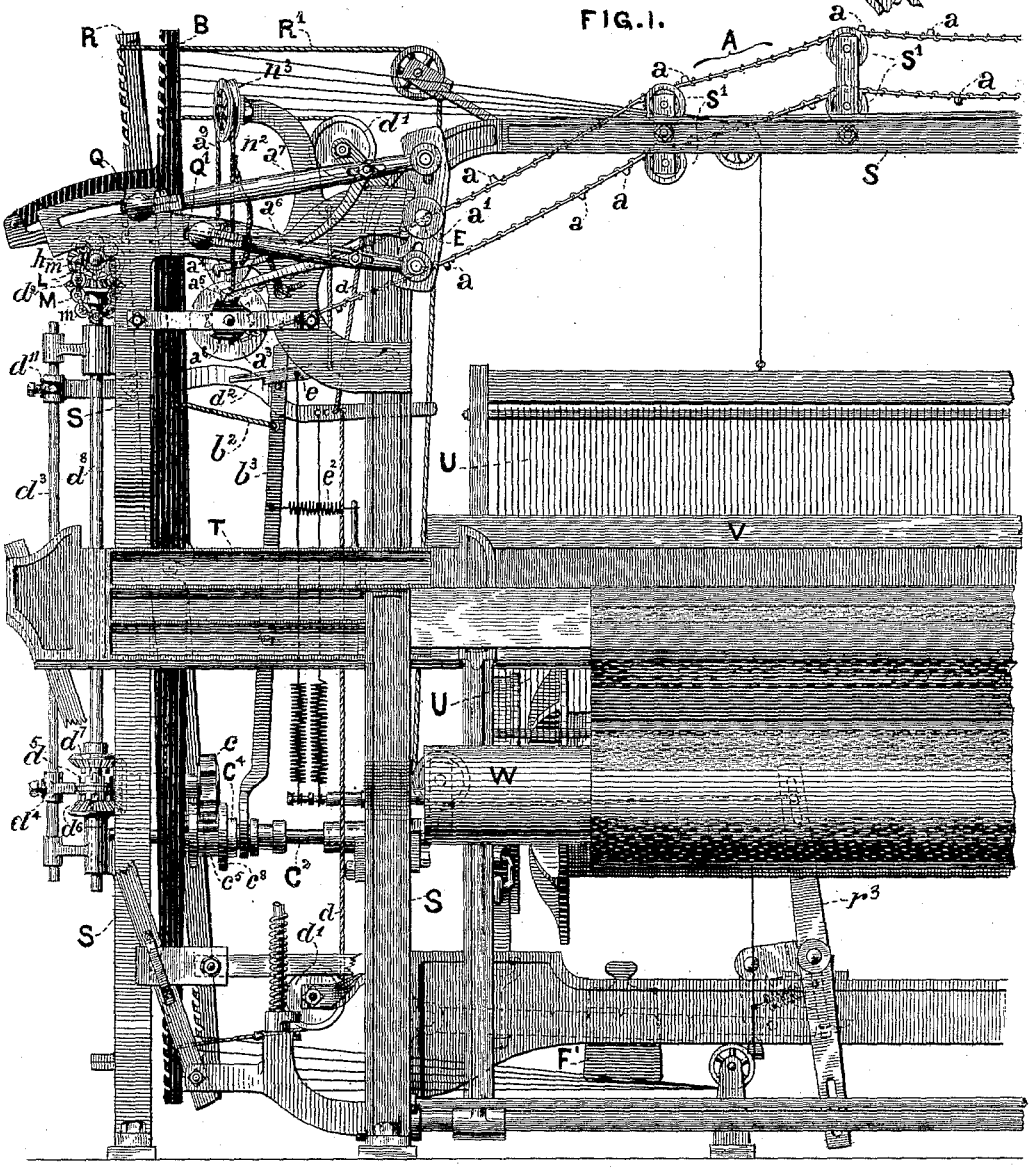


FIG. 1.



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(No Model.) 6 Sheets—Sheet 2.

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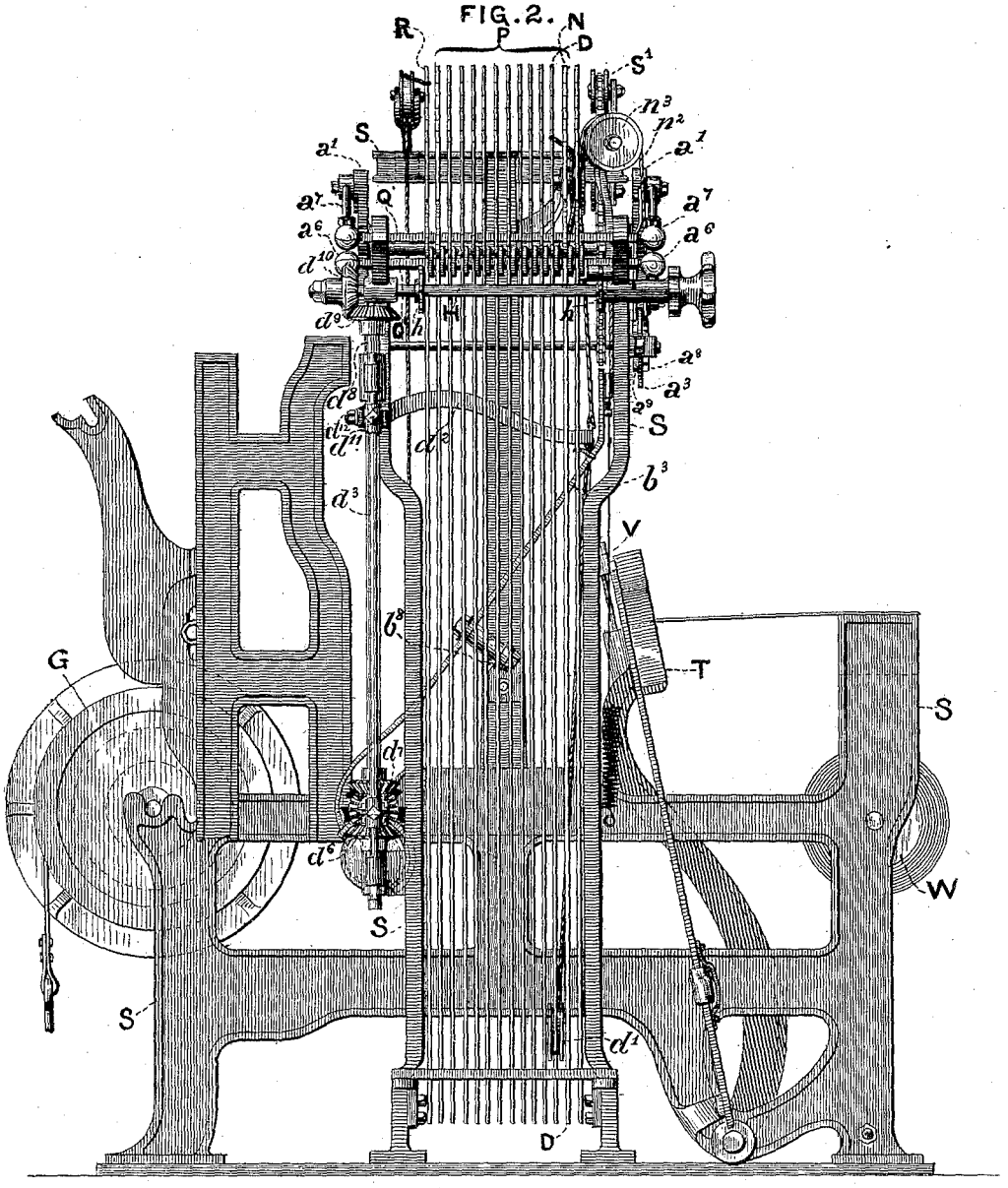
LOOM.

No. 440,591. Patented Nov. 11, 1890.

FIG. 2.



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T. HARRISON.

LOOM.

No. 440,591. Patented Nov. 11, 1890.

FIG. 3.

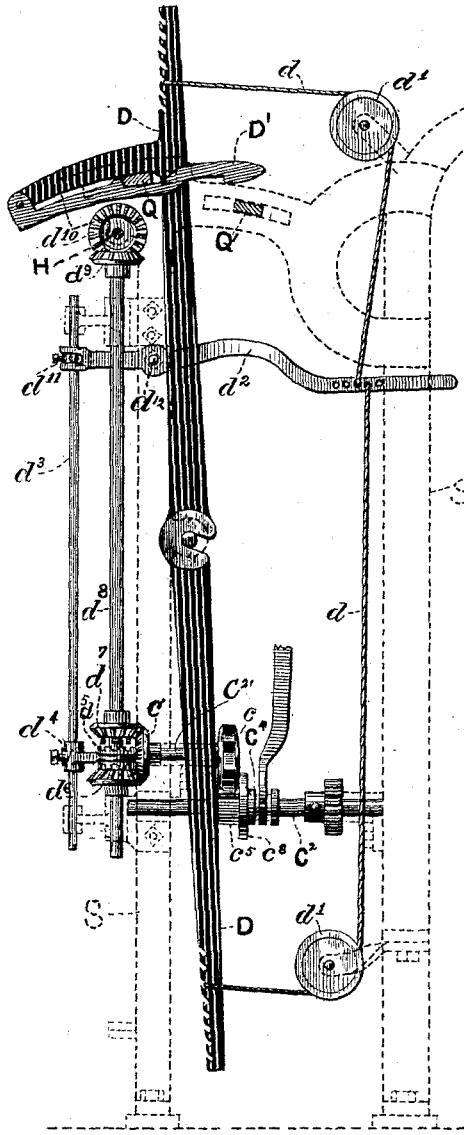
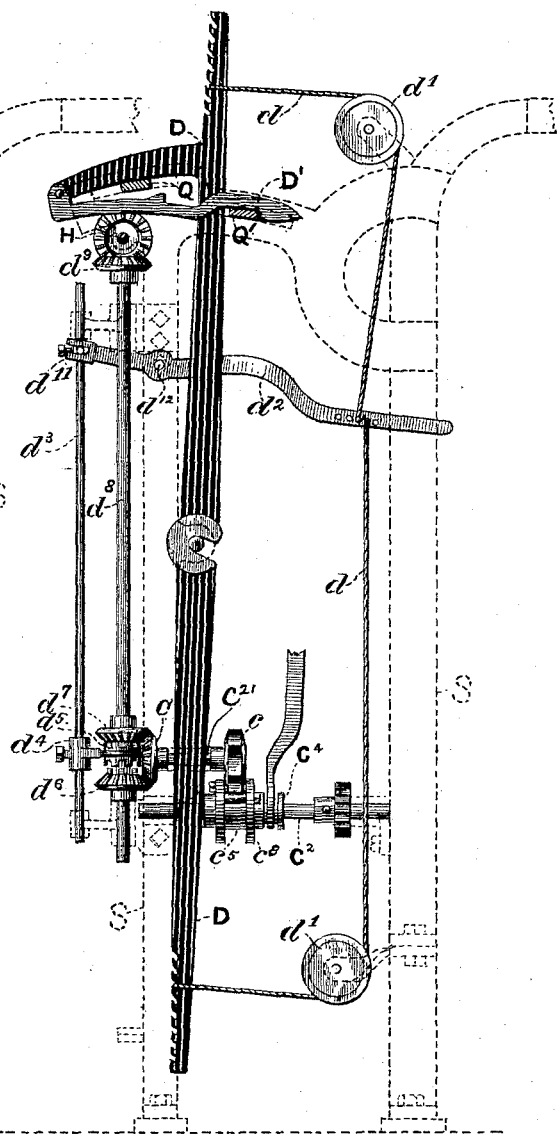


FIG. 4.



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(No Model.)

6 Sheets—Sheet 4.

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No. 440,591. Patented Nov. 11, 1890.

FIG. 5.

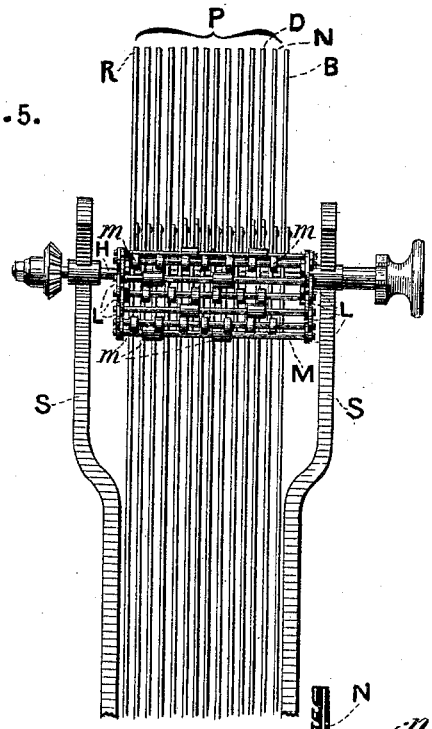


FIG. 6.

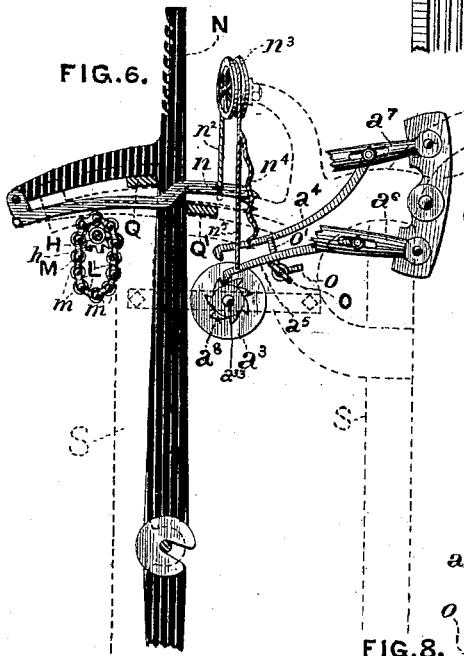


FIG. 7.

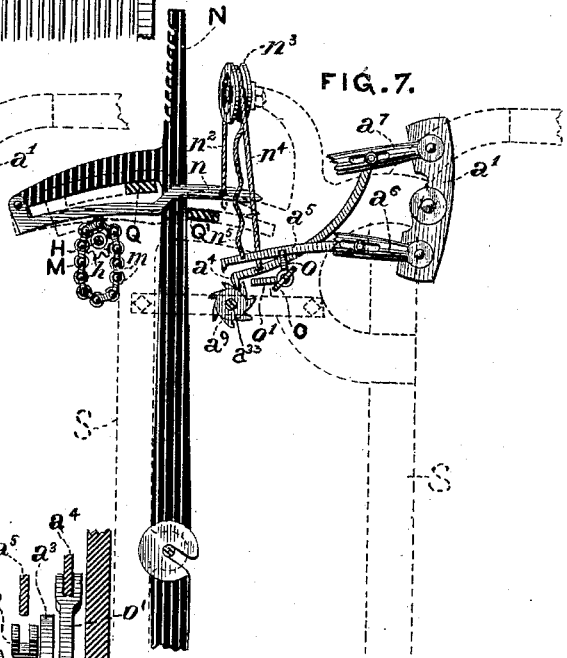
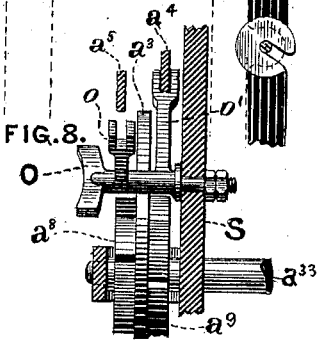


FIG. 8.



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(No Model.)

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LOOM.

No. 440,591. Patented Nov. 11, 1890.

FIG. 9.

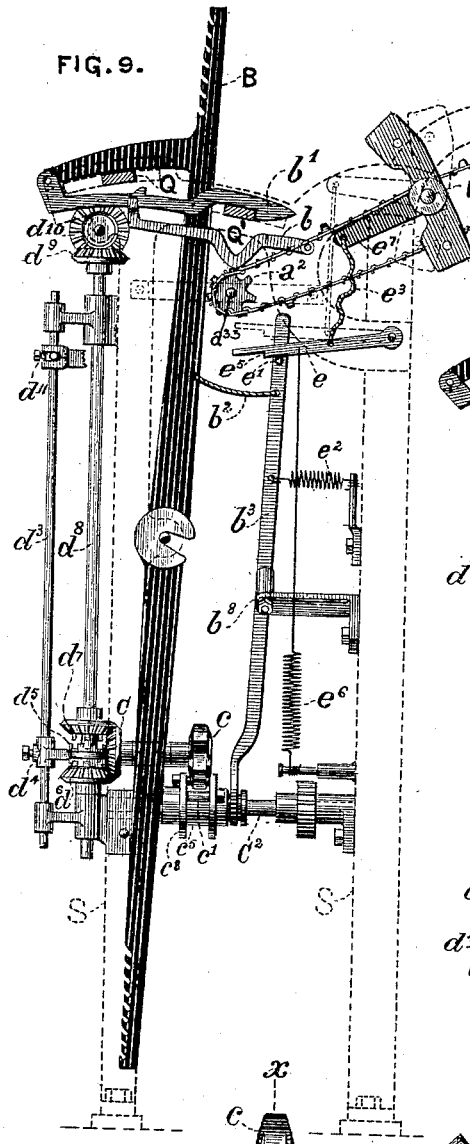


FIG. 10.

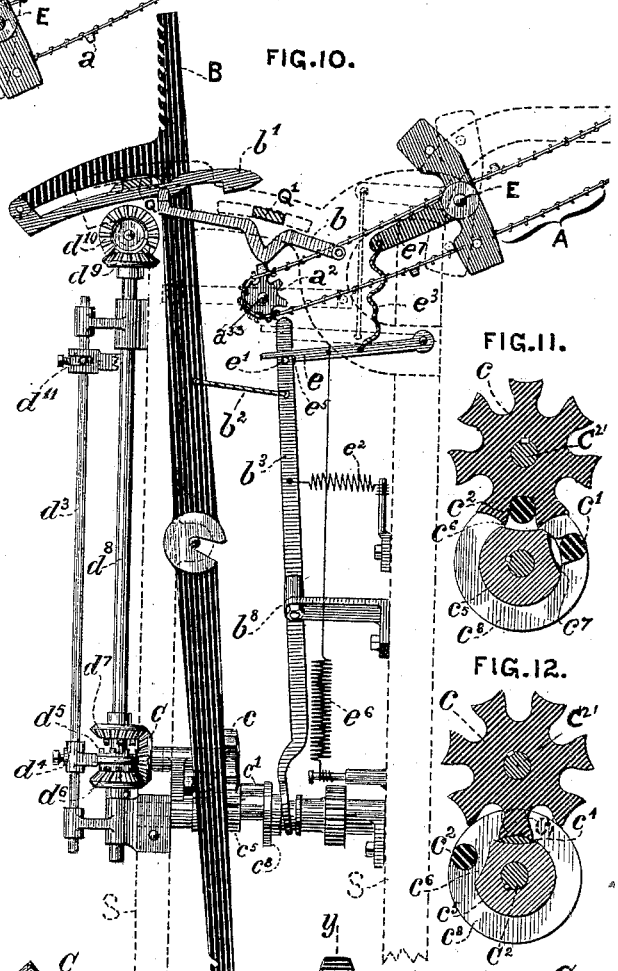


FIG. 11.

FIG. 12.

FIG. 13.

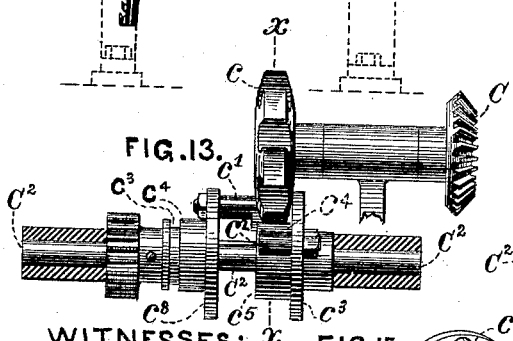


FIG. 14.

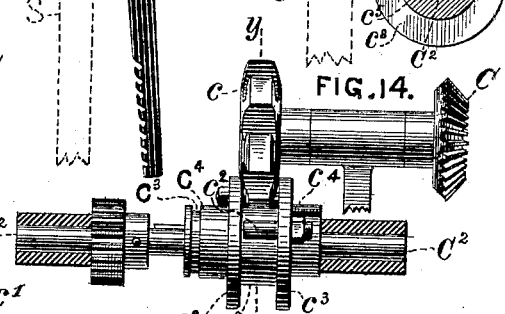
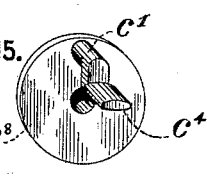


FIG. 15.



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(No Model.) 6 Sheets—Sheet 6.

T. HARRISON.

LOOM.

No. 440,591. Patented Nov. 11, 1890.

FIG. 16.

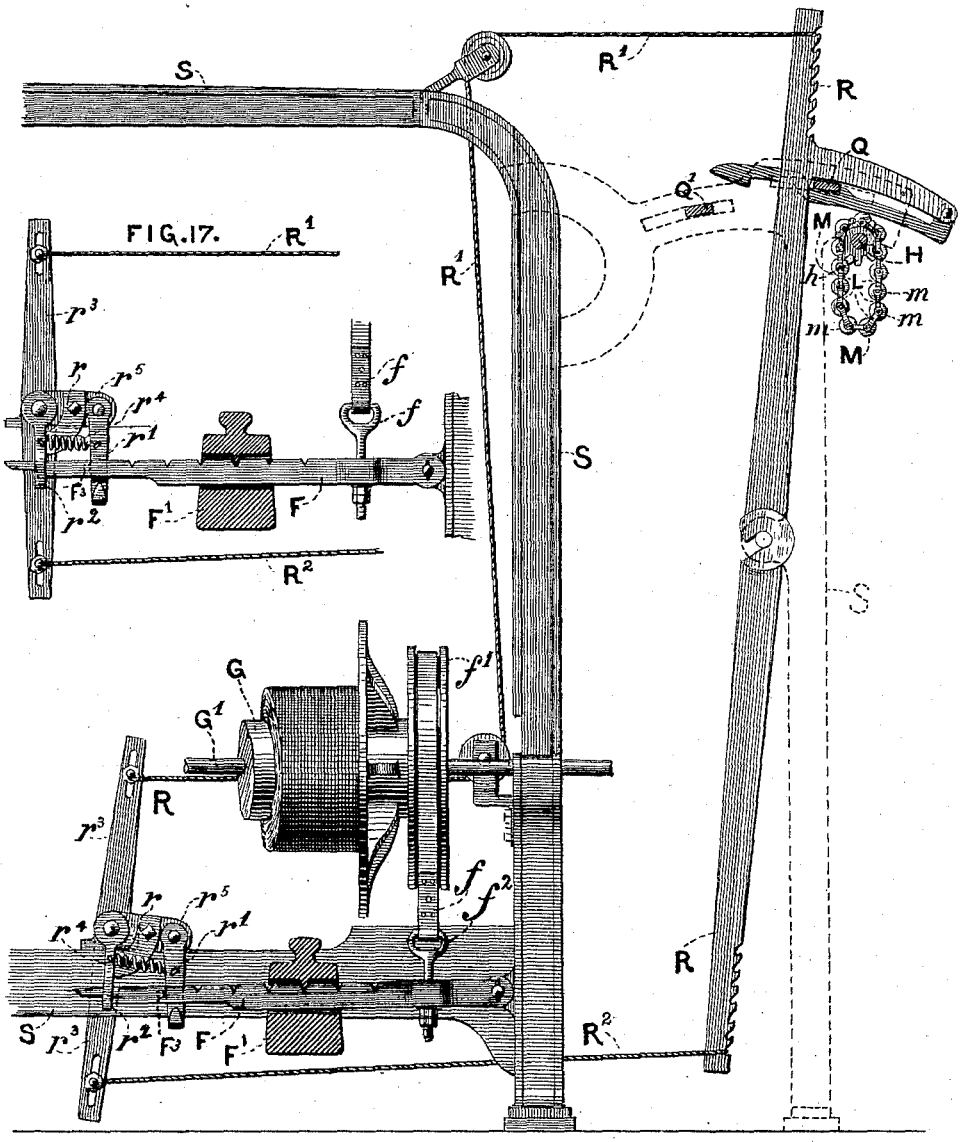

FIG. 17.

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UNITED STATES PATENT OFFICE.

THOMAS HARRISON, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO SCHEPPERS BROTHERS, OF SAME PLACE.

LOOM.

SPECIFICATION forming part of Letters Patent No. 440,591, dated November 11, 1890.

Application filed March 24, 1887. Serial No. 232,234. (No model.)

To all whom it may concern:

Be it known that I, THOMAS HARRISON, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Looms, whereof the following is a specification, reference being had to the accompanying drawings.

My improvements are intended for use upon that class of looms which are known as "multi-harness or chain looms," wherein the harness-levers are thrown into operation by means of rolls (or "risers" and "sinkers") whose contact raises the "hooks" of the levers, which levers are adapted when so raised to engage with the lever-operating mechanism. As is well known, these rolls are arranged upon transverse rods connected by links in the form of an endless chain, the structure being termed the "harness-chain" and passing over sprocket-wheels. The movement of this chain brings the rolls successively into play beneath the lever-hooks. The pattern which can be thus produced is necessarily limited by the number of transverse rods in the chain, since, of course, starting from any givem rod, the pattern must repeat whenever by the round-and-round movement of the chain this same rod recurs in operation. Owing to the weight and cumbrousness of the chains thus built up it is not practicable, with the mechanism of this character heretofore in use, to produce a pattern of very great length, since there are practical limits to the number of links or rods which can be successfully employed.

My invention is intended to produce with a harness-chain of moderate length a pattern much longer than the ordinary round-and-round movement of such a chain could give, and the underlying principle of my invention is as follows:

Instead of deriving the harness-lever movements from successive rods in the chain, the chain-cylinder is rotated sufficiently to move the chain forward two rods at each pick of the loom. Obviously the lever movements will then be derived from the rolls upon alternate rods, the intermediate rods being skipped. Of course if such a system were continuously kept up (the intermediate rods being inoperative) the capacity of the chain would be exhausted in just half the time of the ordinary system; but if the movements of the chain-cylinder be controlled so that for a time it shall move the chain forward two rods at each pick, and then for a single pick move one rod, and then again resume its two-rod movement, it will be seen that those rods which had before been skipped would now become the operative ones, and the former operative ones would now be skipped. Of course if this set of pairs or groups of rods were continuously operative their limit would also soon be reached, just as in the case of their alternates; but if the movements of the chain-cylinder are susceptible of repeated variations by a series of regular or irregular movements the rods of either group can be made temporarily operative, or the rods can be caused to alternate directly for a time and then by pairs, so that by using two groups of harness-chain rods and varying the manner of their use the limit of the pattern is only fixed by the recurrence of the series of movements of the chain-cylinder itself. If these varied movements of the chain-cylinder be produced automatically by a secondary endless chain having groupings of rolls or projections upon it, which cause the variations of the movement of the chain, it is only when this second endless chain has made a complete round-and-round movement that the series of modifications in the movement of the primary pattern-chain will be complete. Moreover, since the motion of the primary pattern-chain can be reversed in the well-known manner, such reversal (accompanied by a corresponding reversal of the secondary chain) will bring about a further range of possible variations in the pattern.

The invention may therefore broadly be defined as consisting in an endless pattern-chain whose units are arranged to form two series, the individuals which constitute one series alternating with those of the other, actuating mechanism normally moving said chain a distance equal to two units, and devices whereby the normal movement of said chain may be modified so as to throw either series into operation for any desired period.

The best method known to me of modifying the movements of the pattern-chain cylinder is the use of a secondary endless chain having at intervals projections or balls adapted to operate upon a member of the harness-lever group. The lever acted upon controls a shifting-crank, which forms part of the driving system of the pattern-chain cylinder, and which when in one position causes said cylinder to advance more than one rod of the pattern-chain, but in the other position limits the advance to one rod. To economize the movement of the secondary chain, I prefer not to drive it continuously, but to advance it only at intervals, and for this purpose I control its actuating device by another member of the harness-lever group, which is thrown into play by a set of rolls on the primary pattern-chain itself.

The following specification describes an embodiment of the invention in a "Crompton" loom with a reversible harness-chain, the harness-levers being actuated, for instance, in the manner described in Letters Patent of the United States, No. 51,928, dated January 9, 1866.

In the drawings, Figure 1 represents a partial front view of the said loom, Fig. 1ª being a continuation of the upper portion of the frame thereof. Fig. 2 is an end view of the loom with the primary pattern-chain removed to show the parts beneath. Figs. 3 and 4 are side views of the mechanism by which the primary pattern-chain cylinder is driven, certain portions of the automatic reversing mechanism being also shown in two different positions. Fig. 5 is a view of the primary pattern-chain as seen from the end of the loom, showing, also, some of the adjacent parts. Figs. 6 and 7 are detail views of the pawl-and-ratchet devices which actuate the secondary pattern-chain, showing the positions of the parts in both the regular and reversed running of the chain. Fig. 8 is a detail view, on an enlarged scale, of the device whereby either or both of the pawls may be thrown out of action. Figs. 9 and 10 are side views of the first harness-lever, which controls the motion of the primary pattern-chain cylinder, showing the same in two different positions and showing, also, a portion of the secondary pattern-chain by which its movements are controlled, and the shifting-crank mechanism which is actuated by said movements. Figs. 11, 12, 13, 14, and 15 are detail views, on an enlarged scale, of the shifting-crank mechanism and the gear upon which the same operates, Fig. 12 being a vertical section on the line $x\,x$ of Fig. 13, and Fig. 11 being a similar section upon the line $y\,y$ of Fig. 14. Figs. 16 and 17 are partial rear views of the loom, showing the details of the tension device connected with the let-off, and the harness-lever, by which the tension is automatically controlled.

The frame of the loom is represented at S, the lathe at T, the reed at V, the heddles at U, the fabric-beam at W, and the warp-beam at G. No detailed description of these parts is deemed necessary, and their position is simply indicated to show their relation to the parts which embody my invention.

P represents the group of harness-levers driven in the ordinary way by means of oscillating cross-heads Q Q′.

M, Fig. 5, represents the primary pattern-chain, built up in the usual way by the placing of rolls m, m, &c., at proper intervals on transverse rods carried by the end links L.

H is the chain-cylinder having sprocket-wheels h, which engage with the rods of the primary pattern-chain. Said chain-cylinder is mounted in horizontal bearings beneath the hinged hooks of the harness-levers, and it is driven by means of the bevel-gears d^9 d^{10}, the former of which is mounted upon a vertical shaft d^8, supported in suitable bearings upon a portion of the frame S. Near the bottom of the shaft d^8 are two opposing bevel-gears d^6 d^7, which run loosely thereon and engage with a bevel-gear C, mounted upon a horizontal shaft c^{21}. A double clutch-collar d^5, (see Figs. 3 and 4,) sliding on a feather on the shaft d^8, can be shifted by the vertical movement of a rod d^3, so as to engage with either one of the bevel-gears d^6 d^7 and thus couple it to the shaft d^8. As the gears d^6 d^7 are opposing, the engagement of one (while the other runs free) will cause the shaft d^8 to rotate in one direction, and the engagement of the other reverses the motion of said shaft. This reversing double clutch, the details of which are well understood, need not be further described. The shifting of said clutch is effected by means of a horizontal lever d^2, having a pivoted connection at d^{11} to the vertically-movable rod d^3, to which the clutch is rigidly attached at d^4. Said lever d^2 vibrates upon a pivot fixed to the frame S at d^{12}, and is connected by means of cords d passing over pulleys d' d' with the harness-lever D, having a pivoted hook D′, which when raised by one of the rolls upon the primary pattern engages with the vibrating cross-head Q, so as to throw the lever D outward. The movement of the lever D, thus effected, actuates the lever d^2, and the clutch mechanism is thereby actuated so as to reverse the motion of the vertical shaft d^8, and consequently of the chain-cylinder H. The lever d^2, and, consequently the clutch d^5, are returned to their former position in a similar manner by the hook D′ being allowed to fall by the harness-chain, when it engages with the other vibrating cross-head Q′, which draws the harness-lever D inward, and consequently the lever d^2 and clutch d^5, to their previous position. The details of this reversing mechanism have been described at this point because they are so closely associated with the driving mechanism of the chain-cylinder H that they must be understood in order to comprehend the control of the latter.

The bevel-gear C, which drives the shaft d^8, is mounted upon the end of a horizontal

shaft c^{21}, which carries at its other end a gear-wheel c. (See Figs. 11 to 15.) The teeth of this gear-wheel c have the peculiar shape shown in the sectional views, in order that it may be driven intermittingly by means of wrist-pins c' c^2, and that during the intervals of operation the wheel will be locked by the contact between the concave end of the tooth and the opposing surface of the cylinder c^5, which rotates continuously with the shaft C^2, which is driven from the main driving-shaft of the loom. The pin c^2 is mounted upon a disk c^3, rigidly attached to the shaft C^2 and to the cylinder C^5. The said cylinder has a concavity c^6 immediately beneath the pin c^2, and also another concavity c^7 adjacent thereto, (see Fig. 11,) in order to permit the passage of the teeth upon the gear c when said gear is rotated by the pins. The pin c^2 is always in position to engage at each rotation with the gear c and move it forward a distance equal to one tooth, and the movement of one tooth upon said gear c, when transmitted by means of the gear C, the gear upon the vertical shaft d^8 engaged thereby, and the said vertical shaft to the chain-cylinder H, would advance the latter the distance of one rod in the primary pattern-chain.

In order to advance the gear c a distance equal to two teeth (and the primary pattern-chain two rods) I provide another pin c', which is mounted upon a disk c^8, attached to a cylindrical sliding hub C^4, rotating with the feathered shaft C^2 and movable longitudinally thereon. Said pin, as shown clearly in Fig. 15, carries at its outer end a projecting segment c^4, which corresponds exactly on its inner surface with the concavity c^7 of the cylinder c^5, and on its upper side with the periphery of the same. The disk c^8 being movable upon the shaft C^2 toward and from said cylinder c^5, it will be seen that in one position (shown in Figs. 12 and 13) the pin c^2 will be clear of the gear c; but the projecting segment c^4 will fill up the concavity c^7 in the face of the cylinder c^5, and thus preserve the continuity of its locking-surface. When, however, the disk c^8 is shifted toward the cylinder c^5, the pin c^2, as shown in Figs. 11 and 14, comes into position to engage with a tooth upon the gear c, while the projecting segment c^4 is pushed through an opening of the disk c^3 beyond the cylinder c^5, and an open space c^7 for the passage of the tooth is thus left beneath the pin c' similar to that which permanently exists beneath the pin c^2.

When both the pins c' and c^2 are operative, as shown in Figs. 1, 9, 11, and 14, the gear c^4 will be advanced two teeth, and during the remainder of the revolution of the shaft C^2 said gear c will be positively locked by means of the cylinder c^5. Thus through the intermediate gearing the chain-cylinder H will be rotated sufficiently to advance two rods of the primary pattern-chain; but when by the withdrawal of the pin c' and the substitution therefor of the segment c^4 only one pin is operative, as shown in Figs. 10, 12, and 13, the primary pattern will be advanced only one rod. Such is the actual driving mechanism of the chain-cylinder H, and such are the movements which produce the groupings of the operative rods upon the primary pattern-chain. The method of controlling these movements by means of a secondary chain will now be described.

Returning to the main view of Fig. 1, A represents the secondary pattern-chain running upon a suitable system of friction-rollers S', mounted upon the frame S. This chain may be of very light build, and therefore of considerable length, and it is provided at suitable intervals with projecting studs or balls a, which are the operative portions, and which are analogous therefore to the rolls or risers upon the primary pattern-chain. The secondary pattern-chain is actuated by a sprocket-wheel a^2, (see Figs. 9 and 10,) mounted upon a shaft a^{33}, which is provided with two ratchet-wheels a^8 a^9, Figs. 1, 6, 7, and 8, whose teeth are in opposite directions, so that by means of the proper pawls a^4 a^5 the sprocket-wheel can be rotated in either direction. The details of this pawl-and-ratchet mechanism are shown in Figs. 6, 7, and 8. At the ends of the oscillating cross-heads Q and Q', respectively, I attach (see Fig. 1 and 2) connecting-rods a^7 a^7 a^6 a^6, which are journaled upon wrist-pins carried by the rocking head a'. The pawls a^4 and a^5 are pivoted, respectively, to the rods a^7 and a^6 nearest to the front of the loom, and are in different planes, as shown in Fig. 8, so as to engage with their respective ratchets, which are separated by a disk a^3. Beneath the pawls are two rests o and o', arranged at right angles to one another upon a turn-key O. The rest o is beneath the pawl a^5 and the rest o' is beneath the pawl a^4. Consequently when said turn-key is turned by hand the said rests will rotate accordingly, and as the pawls are in their respective planes of rotation the rests can be made to throw either or both of the pawls out of contact with their respective ratchets.

In Fig. 6 the pawl at a^4 is inoperative, being supported by its rest o', while in Fig. 7 the pawl a^5 is inoperative, being supported upon its rest o.

The pawls a^4 a^5 are suspended by cords n^4 and n^5, respectively, which are both attached to a cord n^2 passing over a pulley n^3.

The cord n^2 is attached to a vertically-movable finger or latch n, which for convenience I attach to a member N of the harness-lever group in the same manner as the hooks of the other members of this group are attached, so that it is capable of receiving a vertical movement from a set of rollers on the primary pattern-chain H. The latch or finger n is, however, different from the hooks of the other levers in that it has no studs or projections to engage with the vibrating cross-head, and is therefore not af-

fected by their movement. Consequently the lever N, to which the latch n is attached, is not an operative part, but is merely utilized as a convenient means of support for the finger n, so as to bring the latter under the influence of the primary pattern-chain.

The length of the cords n^2 n^4 n^5 is such that when the finger n is in its normal position the pawls are held clear of their respective ratchets, and it is only when said finger n has been raised by one of the rolls of the primary pattern-chain coming beneath it that the pawl which is in operation can descend and engage with its ratchet. Fig. 6 shows the finger n thus raised and the pawl a^5 engaging with its ratchet, the other pawl a^4 being thrown out of operation by means of its rest, and its cord n^4 consequently hanging loose. The converse is shown in Fig. 7, where the pawl a^5 is raised upon its rest o and the other pawl a^4 is operative. It will thus be seen that although both pawls move at each reciprocation of the cross-heads Q Q′ one of them is always rendered inoperative by the interposition of its rest, and the other is only permitted to operate when lowered by the rising of the finger n upon a roll on the primary pattern-chain. Thus the rotation of the sprocket-wheel a^3, which carries the secondary pattern-chain, only occurs at desired intervals, and hence the movement of the chain is greatly economized.

The manner in which the secondary pattern-chain controls the driving mechanism of the primary pattern-chain cylinder will now be described by reference to Figs. 9 and 10. Resting upon the secondary pattern-chain A at a point adjacent to its sprocket-wheel a^5 is a bent lever b, whose free end engages beneath the hook b' upon the first harness-lever B. The normal position of the lever b and hook b' is shown in Fig. 9, where the lever is resting upon the flat portion of the secondary chain, and the hook b' is at such a point that the cross-head Q rides clear of it. When, however, one of the studs or balls a upon the secondary pattern-chain comes beneath the downward bend of the lever b it raises said lever, and with it the hook b', so that the latter will now engage with the cross-head Q, which then throws the upper end of the harness-lever B outward or toward the left. This motion of the harness-lever is communicated by means of the cord b^2 to the diagonally-placed lever b^3, pivoted at b^8 on a projection or stand upon the frame S. The lower end of the lever b^3 is bifurcated, so as to fit in a groove C^3, formed in the cylinder C^4, to which the disk c^8 is secured. As before stated, this cylinder and disk which carry the second wrist-pin c' are capable of longitudinal movement upon the shaft C^2, so that the movement of the diagonal lever b^3 will shift said wrist-pin toward or from the gear-wheel c. The effect of such shifting of the pin has before been described. Thus by suitable distribution of the balls a upon the secondary pattern-chain the shifting movement of the lever can be effected at any desired intervals. The return of the shifting-lever b^3 to its normal position is effected by means of a spring e^2; but as it is not desirable that the said return movement should commence immediately with the return movement of the harness-lever B, I provide a stop device which retards it in the following manner: Near the upper end of the lever b^3 is a transverse pin e', upon which rests a pivoted finger e, having a shoulder e^5 a short distance from its end. Said finger e is drawn downward by the spring e^6, so as to always rest upon the pin e'. A cord e^3 connects the finger e with an arm e^7, mounted upon the rock-shaft E of the rocking head. The shaft E is rocked in the manner described in Letters Patent No. 51,928, above referred to, from the main driving-shaft of the loom, the connecting mechanism not being shown in the drawings, oscillating the cross-heads Q Q′ at each vibration; but the length of the string e^3 is such that it hangs loose during a greater part of the rocking movement and only pulls upon the finger e for a brief interval toward the close of said movement.

Referring now to Fig. 9, it will be seen that the shifting-lever b^3 is in its normal position and the finger e is resting upon the pin e' clear of the shoulder e^5. When, however, the shifting-lever is thrown to the left, (see Fig. 10,) the pin e' moves beyond said shoulder, whereupon the spring e^6 draws the finger e downward, so that when by the return movement of the harness-lever B the spring e^2 would tend to draw the shifting-lever back into position it is prevented from so doing by the contact between the shoulder e^5 and the pin e'. When, however, the return movement of the cross-head Q is nearly complete, the arm e^7 has risen sufficiently to tighten the cord e^3, as shown in dotted lines, and during a last fraction of the said return movement the finger e is raised by the cord, so that the shoulder e^5 clears the pin e', whereupon the shifting-lever b^3 is quickly drawn back into its normal position by means of the spring e^2. The retardation of the return is necessary to prevent the pin c' from being reinserted at a wrong moment between the teeth of the gear-wheel c.

It will be observed in the foregoing description that the secondary pattern-chain has been arranged to act upon the harness-lever hook b' by an intermediate lever b. This method is selected because it facilitates the application of said chain to existing looms of the Crompton type. The same is true of the driving mechanism of the pawl and ratchet which actuates the secondary pattern-chain. Obviously, however, these details can be modified and the necessary movements taken from or imparted to other elements of the loom without altering the principle of the invention, so that I do not limit my claim to this particular embodiment.

To accommodate the tension upon the warps

to the varying requirements of the pattern, I provide the device shown in Figs. 16 and 17, where G represents the let-off beam, upon whose shaft G′ is mounted a flanged pulley f', around which passes a leather friction-belt or drag f. This belt is fastened to an eye f^2, attached to the lever F, carrying the weight F′, which causes the tension upon the warps. To take off the tension, it is of course only necessary to raise this lever F, and this I accomplish in the following manner: Upon a portion of the frame S, adjacent to the free end of lever F, I mount a lever r^3, turning upon a horizontal axis and having a laterally-projecting arm r^5. Said arm r^5 carries at its outer end a pendent hook r', which engages beneath the lever F. A link r^2, pivoted upon the axis of the lever r^3, receives the end of the weighted lever F, which has a shoulder on its under side, as indicated in the drawings. A segment r is rigidly attached to the arm r^5, and the lower end of the said segment is in contact with the link r^2, which is drawn toward it by means of a spring r^4, attached to the hook r'. At the upper and lower ends of the vertical lever r^3 cords R′ R² are attached, which run, respectively, to the upper and lower ends of the harness-lever R, which is controlled in the ordinary way by the primary pattern-chain. When the parts are in their normal position, as shown in Fig. 17, the tension-lever F rests solidly upon the link r^2, and thus the let-off is without tension. When, however, by the action of a roll upon the primary pattern-chain n, the harness-lever R is thrown into operation, the cord R′ draws the upper end of the vertical lever r^3 to the right, (see Fig. 16,) whereupon the movement of the arm r^5 and segment r pushes the link r^2 toward the left, so that it slips past the shoulder on the end of the tension-lever F, and as said lever is no longer supported by the link the weight is thrown upon the friction-belt f, thus applying the tension to the warps. When the return movement of the harness-lever R occurs, the cord R² draws the lower end of the vertical lever r^3 to the right. This raises the arm r^5 so that the hook r' engages beneath the tension-lever F and lifts it, whereupon the spring r^4 draws the freely-suspended link r^2 toward said hook, the movement of the latter being prevented by the pin F³ projecting from the rear of the tension-lever F. As soon as the upward movement of the lever F is completed the link r^2 clears the shoulder upon the end of said lever, and is brought beneath the lower surface of the lever so as to again solidly support it. Thus by the arrangement of any number of rolls upon the primary pattern-chain the tension upon the let-off device may be perfectly controlled.

As before stated, the foregoing specification describes the most convenient embodiment now known to me in my invention in connection with a Crompton loom; but I do not wish to be understood as limiting my claims to that particular embodiment, since obviously the means for producing the variations in the movement of the pattern-chain cylinder, can be greatly varied without effecting the principle of my invention. In using the words "secondary pattern-chain," therefore, I do not wish to be understood as limiting myself to the particular separate chain which I have described, for the essence of the invention lies in the arrangement of the primary pattern-chain members in two series, so that the individuals of one alternate with those of the other, and, provided the chain-actuating mechanism be capable of properly varying the periods of operation of the respective groups, the mechanical construction of such mechanism is not important.

Having thus described my invention, I claim—

1. The combination of a primary pattern-chain having its units arranged in two series, the individuals of the one series alternating with the individuals of the other, a chain-carrier, actuating-gearing for said carrier, a rotating shaft, a pair of normally-operative actuating-pins carried by said shaft, each of which pins is adapted to move said gearing a distance corresponding with one unit of the chain, but one of which pins is capable of being shifted out of engagement with said gearing, a shifting-lever connected with said movable pin, actuating mechanism, substantially as set forth, for said shifting-lever, and a secondary pattern-chain controlling the operative periods of said shifting-lever, substantially as set forth.

2. The combination, with the pattern-chain cylinder, the gear c, and the system of shafting and gearing communicating therefrom to the pattern-chain cylinder, of a disk having a pin c^2 permanently in operative engagement with said gearing, a movable disk having a pin c', a rotating shaft carrying said disks, and shifting mechanism whereby said disk carrying the pin c' may be moved longitudinally on said shaft, whereby at a single revolution thereof the said gear c may be advanced either one or two teeth, substantially as set forth.

3. The combination, with the stop-gear c, of the shaft C², disk c^3, pin c^2, permanently engaged with said stop-gear, shifting-disk c^8, having a pin c', the cylinder c^5, having concavities corresponding with the arcs of rotation of said pins, respectively, and a segment c^4, carried by the shifting-pin and of such size and shape as to fill the concavity which corresponds with said pin and maintain the surface of the cylinder when said shifting-pin is thrown out of play, whereby the gear c, though capable of advancement at each revolution of the pins either one or two teeth, is positively locked during the whole interval between its advances.

4. The combination, with the gear c and the shaft C², disk c^8, longitudinally movable thereon, and pin c', carried by said disk, of the

shifting-lever b^3, having a positive actuating device for moving it in one direction and a spring e^2 for effecting its return, the stop-finger engaging with said shifting-lever upon the conclusion of its positive movement, the releasing device connected with said finger, and actuating mechanism for said releasing device, substantially as set forth, whereby the movement of the releasing device is delayed until the rotation of the shifting-pin beyond the range of contact with the gear c.

5. The combination, with the primary pattern-chain, its cylinder, and actuating mechanism, substantially as set forth, for said cylinder, of a movable pin adapted to engage operatively with said actuating mechanism, shifting mechanism, substantially as set forth, for said pin, a harness-lever connected with said shifting mechanism, actuating mechanism, substantially as set forth, for said harness-lever, a movable hook connected with said harness-lever, a secondary pattern-chain, and a lever resting thereon and supporting said hook, substantially as set forth.

6. The combination, with the secondary pattern-chain and its sprocket-wheel a^2, of the opposing ratchets a^8 and a^9, mounted upon the sprocket-wheel shaft, the pawls a^4 and a^5, engaging, respectively, with said ratchets, the connecting-rods a^7 and a^6, carrying said pawls, respectively, the rocking-head a', by which said rods are oscillated, and the rests o and o', whereby either of said pawls may be thrown out of operation, the whole operating substantially in the manner set forth, whereby the movement of the secondary pattern-chain in either direction may be effected by the movement of the rocking-head.

7. The combination, with the weighted tension-lever F, having a shoulder near its free end, of the lever r^3, arm r^5, hook r', link r^2, segment r, and spring r^4, the harness-lever R, connected with said lever r^3, and actuating mechanism, substantially as set forth, for said harness-lever, the whole operating substantially in the manner and for the purposes set forth.

THOMAS HARRISON.

Witnesses:
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