No. 652,105. Patented June 19, 1900.

H. I. HARRIMAN.

LOOM.

(Application filed Apr. 5, 1900.)

(No Model.)

3 Sheets—Sheet 1.

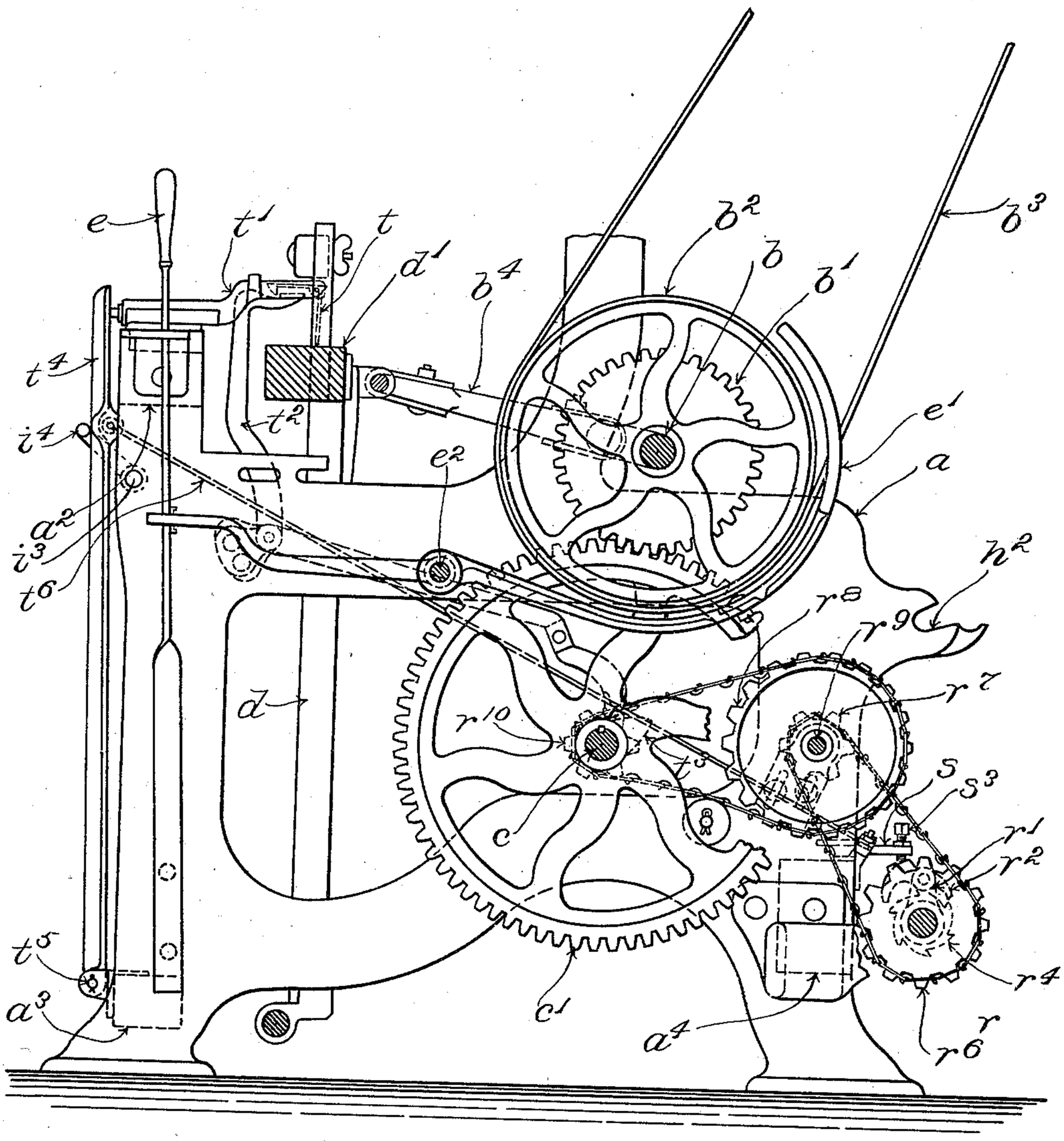

Fig. 1.

Witnesses:
Lolpine Hall Rice
Oscar F. Hill.

Inventor:
Henry I. Harriman
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3 Sheets—Sheet 2.

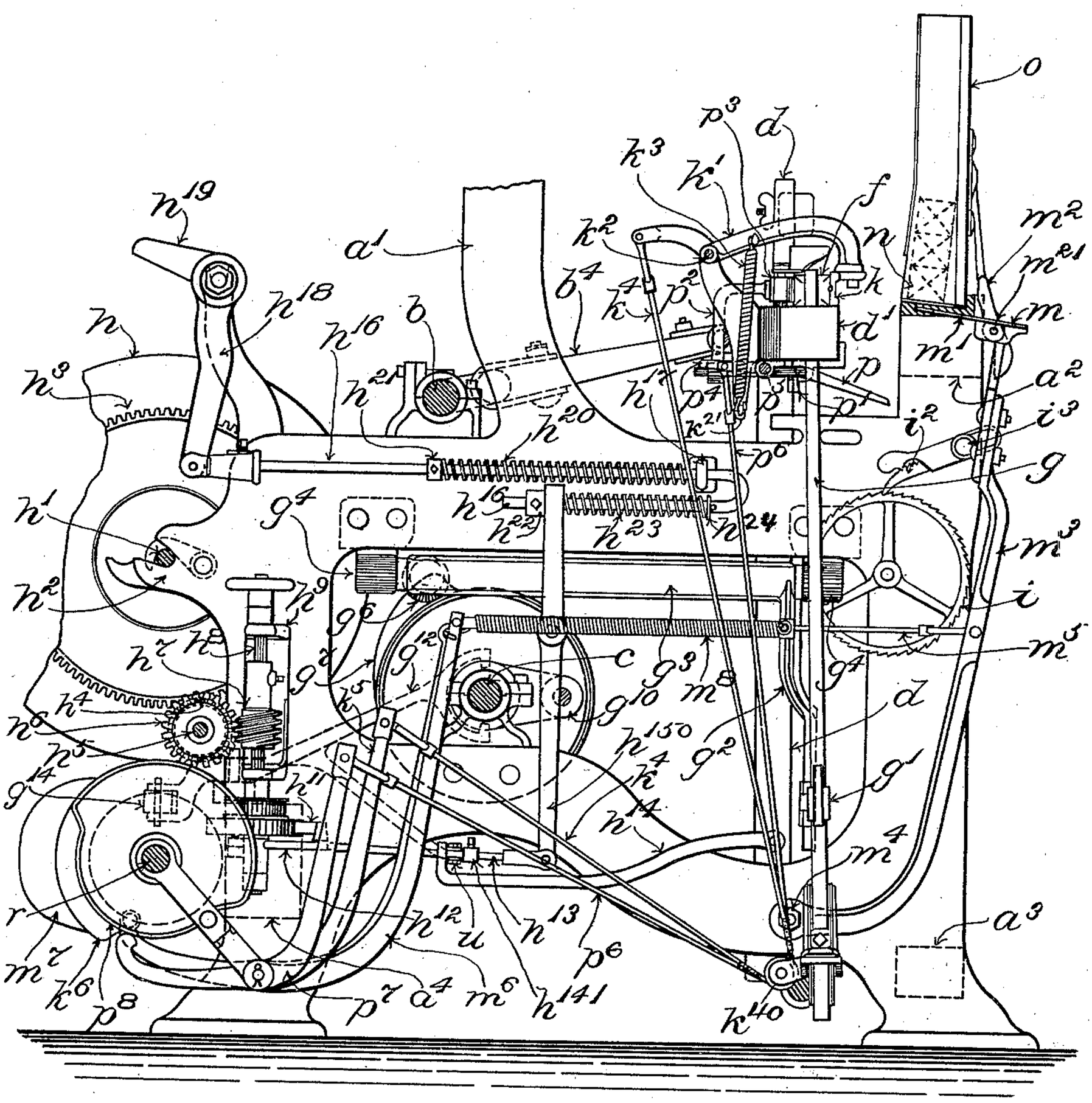

Fig. 2.

Witnesses:
Lothrop Hall & Rice
Oscar F. Hill

Inventor:
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3 Sheets—Sheet 3.

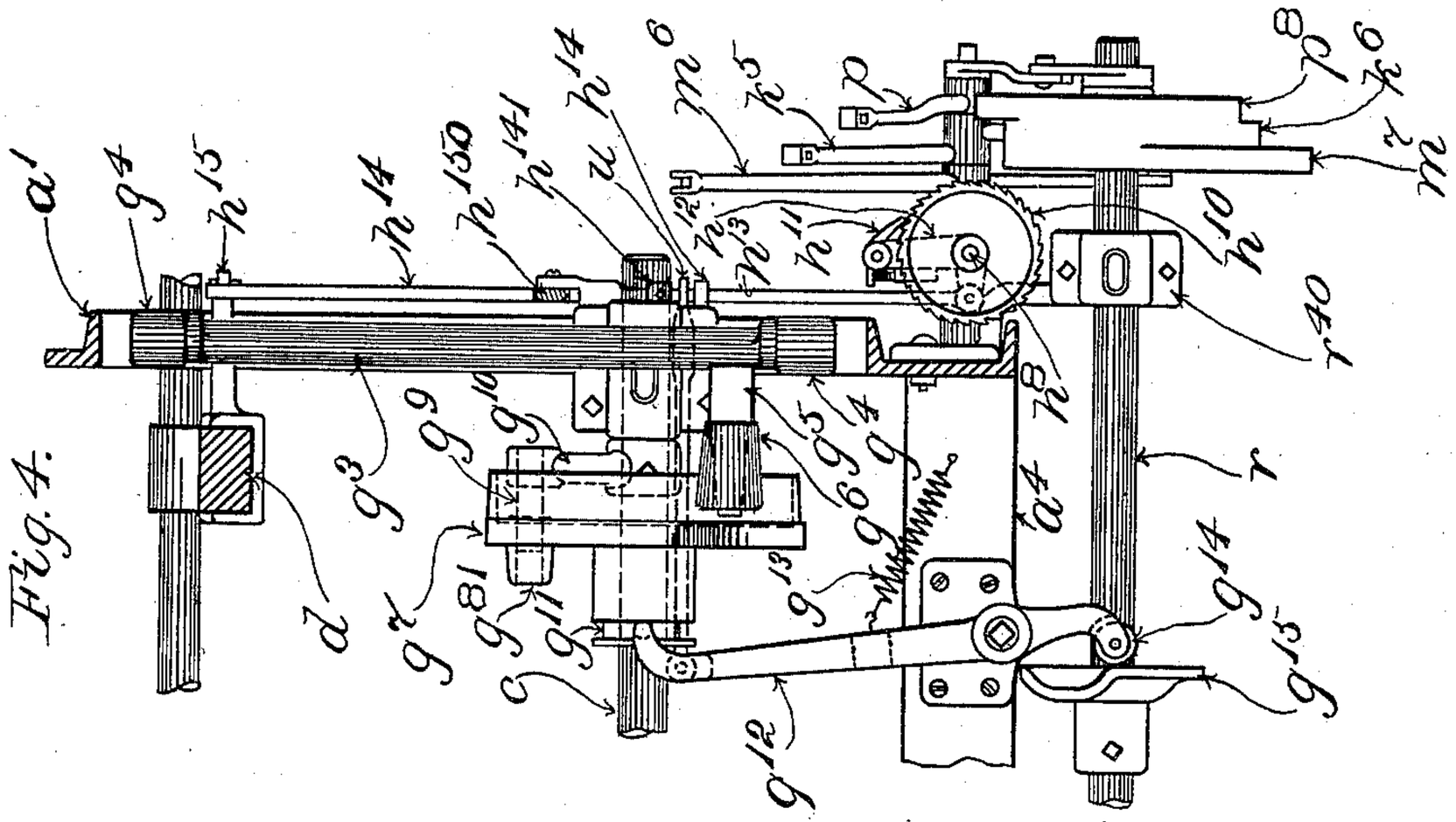

Fig. 4.

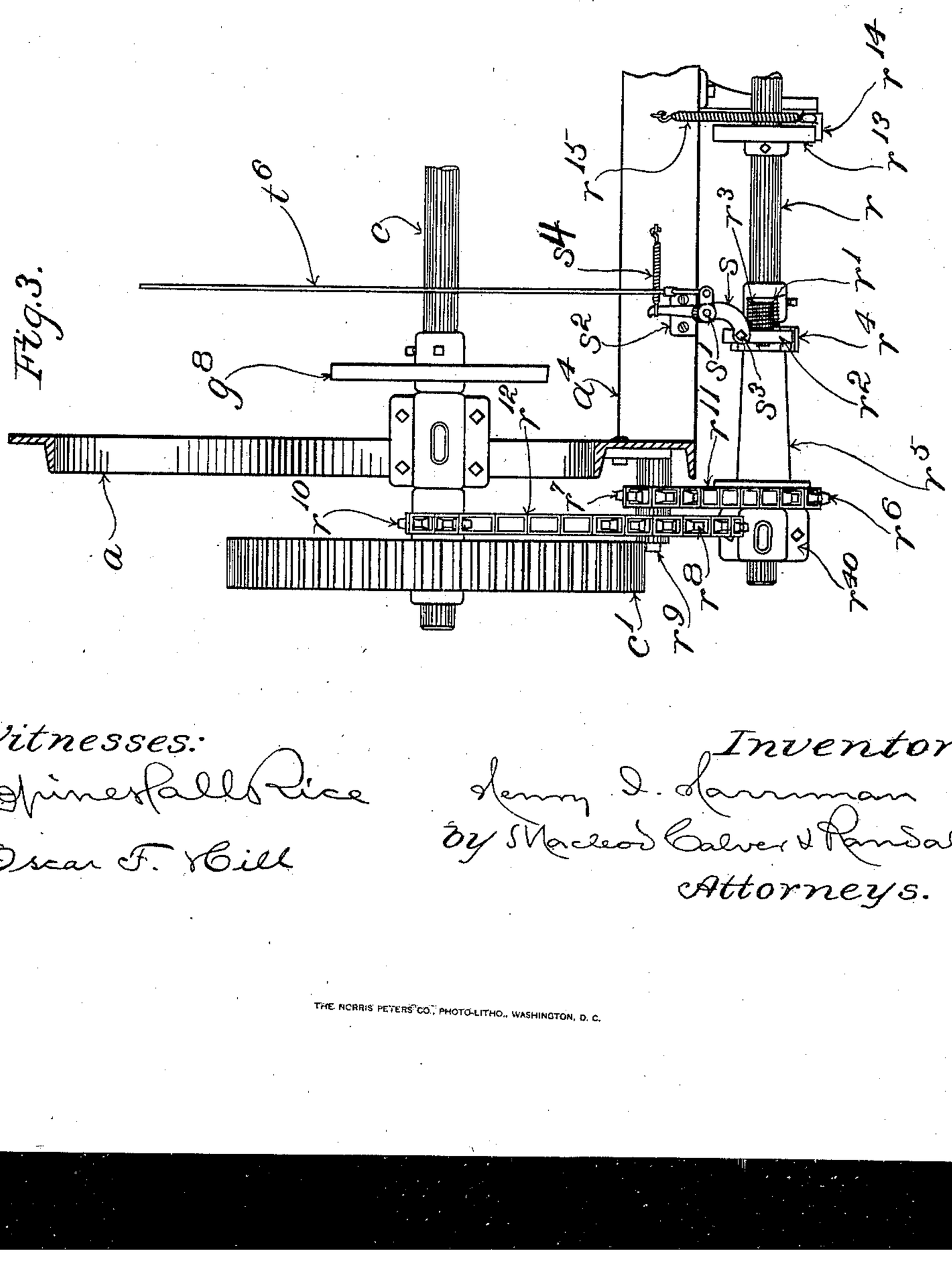

Fig. 3.

Witnesses:
Lepine Hall Rice
Oscar F. Hill

Inventor:
Henry I. Harriman
by Macleod Calver & Ramsdell
Attorneys.

UNITED STATES PATENT OFFICE.

HENRY I. HARRIMAN, OF NEW YORK, N. Y.

LOOM.

SPECIFICATION forming part of Letters Patent No. 652,105, dated June 19, 1900.

Application filed April 5, 1900. Serial No. 11,567. (No model.)

To all whom it may concern:

Be it known that I, HENRY I. HARRIMAN, a citizen of the United States, residing at New York, in the county of New York, State of New York, have invented a certain new and useful Improvement in Looms, of which the following is a specification, reference being had therein to the accompanying drawings.

The invention has relation to looms of that class in which replenishment of the working weft-supply is effected automatically by the mechanism of the loom when necessity arises therefor—as, for example, on exhaustion of the supply of weft or filling that is carried by the working shuttle on the lay, or on exhaustion thereof to a predetermined extent or on loss of continuity of such weft or filling, the action of the replenishing instrumentalities being brought about or instituted through the agency of suitable forms of weft-indicator mechanism.

The main object of my invention is to produce an automatic weft-replenishing loom in which the operations that are incident to replenishment shall be performed without the suddenness and shock that are characteristic of many of the forms of weft-replenishing looms heretofore devised and also without arrest of the loom or modification of the driving thereof.

In this invention when the weft-indicator mechanism acts to indicate that the working weft-supply is in the predetermined condition calling for replenishment thereof the picking is arrested, the letting-off of the warps and the taking-up of the woven cloth are arrested, and then, while the loom continues to run at normal unabated speed, the operations essential to weft replenishment are caused to be performed in the required order, these operations being divided up among a considerable number of revolutions of the crank-shaft of the loom and reciprocations of the lay—that is to say, through more than two revolutions of the crank-shaft and reciprocations of the lay—in order that precipitate and harsh action, with all its attendant liability to disarrangement, breakage, &c., may be avoided.

The invention is intended to be carried into effect with the aid of various types and forms of weft-replenishing instrumentalities and weft-indicator mechanisms. For convenience I have chosen to present the invention herein as embodied in a loom containing weft-replenishing instrumentalities which act to replace the working shuttle on the lay by a fresh or reserve shuttle, and also containing weft-indicator mechanism acting on breakage or exhaustion of the weft carried by the said working shuttle. Other forms and types of the said instrumentalities and mechanism may be employed in practice in some instances, and it will be understood, therefore, that the invention is not limited in all instances to the exact mechanism or means herein shown for accomplishing the desired results, for, as will be obvious to those skilled in the art, the results aimed at might without departure from the broad invention be automatically accomplished by the employment of forms of mechanical devices other than those herein shown.

I will now proceed to describe the selected embodiment of my invention with the aid of the accompanying drawings, in which—

Figure 1 is an elevation of the driving end of a loom containing the embodiment aforesaid of my invention. Fig. 2 is an elevation of the change end thereof. Fig. 3 is a partial plan of the said driving end, with the change-shaft in its normal position of rest. Fig. 4 is a partial plan of the said change end, with the picking-tappet in inoperative position and the let-off arrested, as during the rotation of the change-shaft.

Having reference to the said drawings, a a' designate the opposite end frames of the loom; a^2, the breast-beam; a^3, the front girth, and a^4 the rear girths.

b is the crank-shaft, and c the cam-shaft. b' c' are intermeshing gears on the said shafts, by means of which motion is communicated from one thereof to the other.

b^2 is a band-pulley on the crank-shaft, and b^3 is a driving-band passing around the said band-pulley for the purpose of operating the loom.

b^4 b^4 are the pitmen connecting the crank-shaft with the lay d.

d' is the lay-beam.

e, Fig. 1, is the usual shipper-handle, and e' the shipper-fork operated therefrom and controlling the driving-band b^3, the said ship-

per-fork being mounted on a stud e^2 with capacity to slide lengthwise of the latter, the said stud extending outwardly from end frame a.

The working shuttle on the lay is designated f in Fig. 2. For the purpose of operating the same I have shown at the change end of the loom (see Figs. 2 and 4) a picker-stick g, a lug-strap g', connecting the said picker-stick with an arm g^2 on the picking rock-shaft g^3, the said rock-shaft, bearings g^4 g^4, which are applied to the end frame a' and in which the said rock-shaft is mounted, an arm g^5 on said rock-shaft g^3, a bowl g^6 on the said arm, and a picking-tappet g^7, mounted on the cam-shaft c and rotating in unison therewith. Only the picking-tapet g^8 of the picking mechanism at the opposite end of the loom is shown, (see Fig. 3;) but the rest of such mechanism would correspond substantially with that which has thus far been described as pertaining to the change end of the loom.

The arrest of the picking preferably is provided for by throwing the picking mechanism out of action at the change end of the loom, although it may be accomplished in other ways. Herein the picking-tappet g^7 at the change end of the loom is made movable in a direction lengthwise of the cam-shaft c, and thereby placed in and out of working relations with the bowl g^6 on the arm g^5 of the picking rock-shaft g^3. The said tappet is sleeved on the cam-shaft c, and through the body thereof is formed a hole g^{81}, receiving a pin g^9, projecting transversely from an arm g^{10}, fast on the cam-shaft c. Thereby the picking-tappet g^7 is compelled to rotate in unison with the cam-shaft c, while capable of being shifted lengthwise of the latter. For the purpose of enabling this shift to be effected automatically the hub of the picking-tappet is grooved, as at g^{11}, to be engaged by the fork of a shifter-lever g^{12}, and a spring g^{13} is arranged to act on the lever g^{12} with a tendency to hold the picking-tappet in normal or working relations with the bowl g^6. A roller g^{14}, carried by the lever g^{12}, bears against the rotatable cam g^{15}, and by means of the said cam and spring the shifts of the picking-tappet g^7, which place it in and out of working relation with the bowl g^{14}, are occasioned.

Fig. 4 of the drawings shows the picking-tappet in the position thereof which places the noses thereof out of working relations with the bowl g^6. In said figure the bowl is shown resting upon a continuous concentric portion thereof which is equal in diameter to those portions of the tappet which intervene between the picking-noses. Consequently in the return shift of the picking-tappet back into normal working position one or the other of the said intervening portions will slip unobstructedly beneath the end of the bowl g^6.

h is the warp-beam, (see Fig. 2,) its journals h' being received in bearings h^2 h^2, which are provided therefor on the end frames a a'. For the purpose of delivering the warps from the said warp-beam as required in the weaving I have illustrated a well-known form of let-off mechanism combined with the said warp-beam h. Thus the warp-beam h is equipped with the usual gear h^3, which latter is arranged to mesh with the small gear or pinion h^4 on the shaft h^5, the said shaft being suitably mounted in a bearing on end frame a' and being furnished with the worm-gear h^6, which is engaged by the worm h^7 on the upright shaft h^8. The shaft h^8 is mounted in bearings h^9 on the end frame a' and furnished with the ratchet-wheel h^{10}. A pawl h^{11} engages with the said ratchet-wheel, the said pawl being pivoted to a swinging pawl-carrier h^{12} and the latter having jointed thereto the rod h^{13}, extending forwardly in the loom.

h^{14} designates a rod which at its front end is connected with a projection h^{15}, carried by the lay, (see Fig. 4,) the rear end of said rod h^{14} having a hole therethrough to enable it to be threaded on the rod h^{13}. The rod h^{14} is utilized for transmitting movement from the lay to the rod h^{13}, pawl-carrier h^{12}, and pawl h^{11} in order to rotate the shaft h^8 and the warp-beam.

In order that the unwinding of the warps may proceed at a rate conforming to the needs of the loom, the rod h^{13} is connected, as usual, with the lower arm of a lever h^{150}. Through a hole in the upper arm of this lever h^{150} passes a rearwardly-extending portion of the rod h^{16}, the forward portion of the said rod being fitted to a guide h^{17} on the end frame a', while the rear end of the said rod is connected with the arm h^{18} of the usual whip-roll h^{19}. h^{20} is a spring on the said rod h^{16} acting between the bearing h^{17} and a collar h^{21} on the rod h^{16}, with a tendency to force the rod rearwardly and press the whip-roll h^{19} upwardly in opposition to the strain on the warp-threads.

h^{22} is a collar on the rod h^{16} at the rear side of the lever h^{150}, and h^{23} is a spring on the rod h^{16} between the said lever and a fixed stop at h^{24} on the rod. Through the devices described the extent of the strokes of the pawl-carrier and pawl is controlled in the usual manner, it being understood that at each forward movement of the lay the pawl-carrier and pawl are advanced by the rods h^{13} h^{14} from the position which has been given them by means of the whip-roll, &c., thus occasioning the necessary delivery of warps from the warp-beam.

For the purpose of arresting the delivery of the warp-threads from the warp-beam I interpose between the rear end of rod h^{14} and a stop-collar h^{141}, fast on rod h^{13}, a movable filling-in piece u, shown slotted to fit upon the said rod h^{13}. When said filling-in piece is in its normal position, with its full width interposed between the end of rod h^{14} and the stop-collar h^{141}, each time the lay beats forward, drawing the rod h^{14} with it, the said rod carries the filling-in piece forward against the stop-collar and moves forward the rod h^{13}, thus transmitting to the pawl-carrier h^{12} and pawl h^{11} movement to actuate ratchet-wheel

h^{10} and rotate warp-beam h, so as to unwind a certain length of the warps. When the filling-in piece is in its retracted position, (shown in Fig. 4,) the rod h^{14} moves idly back and forth without transmitting movement to rod h^{13}, and thereby the delivery of warps is suspended.

For the purpose of operating the filling-in piece u automatically it is connected with shifter-lever g^{12}, as shown in Fig. 4, and thereby when the latter is moved to shift the picking-tappet g^7 into inoperative position the filling-in piece is withdrawn, while when the shifter-lever g^2 is moved to restore the picking-tappet to its operative position the filling-in piece is moved back again, so as to place its thicker portion between rod h^{14} and stop-collar h^{141}.

The ratchet-wheel of the take-up mechanism is shown at i and its retaining-pawl at i^2, the latter being mounted on one end of a shaft i^3. When the weft-indicator mechanism calls the weft-replenishing instrumentalities into action, it also occasions a partial rotation of said shaft i^3, thereby lifting the said retaining-pawl, and thereby arresting the take-up of the woven cloth. One means of rocking the said shaft is explained hereinafter.

As indicated hereinbefore, I have presented the invention herein as embodied in a loom containing weft-replenishing instrumentalities which act to replace the working shuttle f on the lay by a fresh or reserve shuttle. In effecting the change the spent or failed working shuttle first is discharged from the lay and then a reserve shuttle is transferred into working position on the latter. The discharge is provided for herein by opening the shuttle-box at the change end of the loom, so as to permit the spent or failed shuttle to escape therefrom, and to then enable the fresh or reserve shuttle which is to be substituted therefor to be transferred to the lay from a suitable hopper or magazine. For the purpose of enabling the said shuttle-box to be opened for the discharge of the spent or failed shuttle and the introduction of the fresh or reserve shuttle the front k of the said shuttle-box is made movable by being applied to the forward portion of an overarching rocker k', which last is pivoted at k^2 on a bracket k^{21}, extending rearwardly from the lay-beam d'. A spring k^3 acts upon the said rocker with a tendency to hold the same depressed in the position which places the shuttle-box front k in its normal position. (Represented in Fig. 2.) One end of said spring is connected with a forwardly-projecting arm of the rocker k', while the other end of the spring is connected with a downwardly-extending part of the bracket k^{21}. For the purpose of enabling the rocker k' and shuttle-box front k to be operated at the proper times a connection k^4 extends from the rearwardly-projecting arm of the said rocker around a direction-changing sheave or pulley at k^{40} to a lever k^5, working in connection with a rotatable cam k^6.

For the purpose of effecting the transfer of a fresh or reserve shuttle to the lay after the spent or failed working shuttle has been ejected from the latter an injector m is provided, the same being arranged to take a reserve shuttle from a supply n, contained in a hopper o, located at the change end of the breast-beam, and carry the same rearward to the lay. The said injector is provided with rearwardly-projecting fingers m', which are adapted to extend beneath the bottom shuttle n in the hopper or magazine o and to support the said bottom shuttle as it is being carried rearwardly to the lay; also, with upwardly-projecting fingers m^2, which in the movement of the injector rearward in the loom engage with the said bottom shuttle, so as to carry it along with the injector. These fingers are pivoted at m^{21} in order that they may yield when in the forward movement of the injector they come in contact with the shuttle which has dropped into the bottom position in the hopper or magazine. The injector is mounted on an arm m^3, which is pivoted at m^4. A connection m^5 extends from the said arm m^3 to a lever m^6, working in connection with a rotatable cam m^7. The said connection m^5 includes a spring m^8, and is thereby made yielding, so as to enable it to give when the injector in being drawn rearwardly in the loom brings up against the lay and also so as to enable the injector to partake of the movements of the lay back and forth during the time while the injector-operating devices are acting to draw the same rearwardly in the loom.

In a loom embodying the present invention the lay beats up one or more times during the performance of the replenishing operations, while the shuttle-box front k is occupying its withdrawn position. The protector mechanism would act during this time if provision were not made for preventing such action until after the introduction of the fresh or reserve shuttle into the shuttle-box at the change end of the loom and the return of the shuttle-box front to its normal position. Such provision is made as follows: The dagger pertaining to the protector mechanism is shown at p and the protector-shaft mounted on the lay and carrying the said dagger is shown at p'. (See Fig. 2.) One of the usual protector-fingers carried by the said protector-shaft is shown at p^2, Fig. 2, and at p^3 is shown the swell or binder pertaining to the shuttle-box at the change end of the loom and with which the said protector-finger p^2 coöperates. The devices for raising the dagger p and holding it uplifted above the usual frog (not shown) until after the shuttle-box front has been lowered comprise the rocker p^4, pivoted at p^5 on the lay-beam p', the connection p^6, joined to the said rocker, the lever p^7, with which the said connection also is joined, and the rotatable cam p^8, acting against the said lever p^7.

For their convenient support and actuation the cams p^8, k^6, m^7, and g^{15} are mounted on the shaft r, this last being mounted in suitable bearings r^{40} r^{40}, which are provided therefor at the rear of the loom, the said shaft being termed by me the "change-shaft." The said cams normally are maintained ineffective to operate the devices which have been described and are rendered effective under the dictation of the weft-indicator mechanism. To this end in the present mechanism the change-shaft r is arranged to stand normally still or at rest—that is, during the regular working of the loom—and is caused to begin its rotation when the condition of the working weft-supply is such as to call for replenishment of the latter. As a convenient means of driving the said change-shaft r, I provide an arm r', which is fast on the said change-shaft, Figs. 1 and 3, a pawl or dog r^2, which is pivoted to the said arm and acted on by a spring r^3, which tends to depress its engaging end, a ratchet-wheel r^4, made fast to a sleeve r^5, which surrounds the change-shaft r and is arranged to rotate freely thereon, a sprocket-wheel r^6 on the said sleeve r^5, a sprocket-pinion r^7 and sprocket-gear r^8, fast to each other and mounted to turn together on a fixed stud r^9, projecting from the end frame a, a sprocket-pinion r^{10}, fast to one of the loom-shafts, herein the cam-shaft c, a sprocket-chain r^{11}, connecting the sprocket-gear r^6 with the sprocket-pinion r^7, and a sprocket-chain r^{12}, connecting the sprocket-gear r^8 with the sprocket-pinion r^{10}. Through the sprocket-gearing described the sleeve r^5 is driven from the cam-shaft c at a speed bearing a predetermined ratio to that of the said cam-shaft. The change-shaft r stands normally at rest in a predetermined position which is secured and maintained by means of a disk r^{13} on the change-shaft r, having in its periphery a notch which is entered by a projection on a locking-lever r^{14}, the said lever being held up to its work by a spring r^{15}. (See Fig. 3.)

Under the ordinary working conditions of the loom the pawl or dog r^2 is held from engaging with the ratchet-wheel r^4 by a controller s, herein constituted by a lever that is pivoted at s' on a bracket s^2, carried by the rear girth a^4. The said controller s is furnished with a projection s^3, herein constituted by a screw for convenience in making adjustment when desired, which is adapted to remain normally in contact with the tail of the pawl or dog r^2, as in Figs. 1 and 3, and thereby keep the engaging end of the said pawl or dog from moving into the path of rotation of the teeth of the ratchet-wheel r^4. Spring s^4 holds the controller in its said normal position. (Shown in Figs. 1 and 3.)

The controller s is under the control of the weft-indicator mechanism and is arranged to be operated at the proper time to release the said pawl or dog r^2, and thereby enable the said pawl or dog to become engaged with the ratchet-wheel r^4, and thus bring the replenishing instrumentalities into action. The illustrated form of weft-indicator mechanism comprises a weft-fork t, a slide t' on which said weft-fork is pivoted, a gooseneck t^2 to coöperate in the usual manner with the said weft-fork, a cam t^3, mounted on the cam-shaft c and serving to actuate the said gooseneck, an arm t^4, arranged to be actuated by the said slide t', the said arm being pivoted at t^5 to a bracket on the front girth a^3 and a connection t^6, extending from the said arm t^4 to the controller s.

The shaft i^3 extends across the front of the loom and is furnished with an arm i^4, having a projection extending across in front of arm t^4. When said arm is moved forward, it acts against the said projection to move the arm and rock the shaft i^3, thereby raising the retaining-pawl of the take-up mechanism and arresting the take-up of the woven cloth.

The number of teeth on ratchet r^4 corresponds with the ratio between the speed of the cam-shaft c and that of sleeve r^5. In the present instance the sprocket-gearing is proportioned to rotate the said lever at one-sixth the speed of the cam-shaft. Consequently the said ratchet-wheel is furnished with six teeth in order to secure the required timing in the operation of the change-shaft and the parts which are actuated therefrom with relation to that of the usual mechanism of the loom.

When the loom is at work, breakage or failure of the weft is followed by engagement of the gooseneck t^2 with the tail of the weft-fork t, and this causes the weft-fork slide t' to be advanced and arm t^4 to be pushed forward. The forward movement communicated thus to the arm t^4 causes the shaft i^3 to be rocked, so as to raise the retaining-pawl i^3 and arrest the taking up of the woven cloth, as already explained. Movement also is transmitted from arm t^4 through connection t^6 to controller s, and this withdraws the latter from its normal position. (Shown in Figs. 1 and 3.) The withdrawal of the controller frees the pawl or dog r^2, and the latter immediately moves into position to become engaged by a tooth of ratchet-wheel r^4. Thus the change-shaft r is started and the various parts and instrumentalities under the operative control thereof are brought into play in the predetermined order. The change-shaft having been set in motion the cam g^{15} comes into operation first, and it actuates the shifter-lever g^{12} to arrest the picking from the change end of the loom and also arrest the letting off of the warps. The timing is such as to assure that the last pick of the shuttle shall be from the driving end of the loom to the change end thereof. Cam p^8 acts to lift dagger p, so that during subsequent beats of the lay, while the shuttle-box front k is withdrawn, the said dagger shall be held above the frog and prevented from engaging therewith. The cam k^6 acts next to move the rocker k' and withdraw the shuttle-box front k. This withdrawal of the shuttle-box front affords opportunity for the escape of the shuttle from

the open shuttle-box at the change end of the loom as the lay beats to and fro. The cam m^7 acts to draw the injector rearwardly toward the lay, so as to transfer a reserve shuttle n to the latter and place it in the unoccupied open shuttle-box, the injector being held pressed a short time against the lay, the spring n^8 allowing the injector to partake of the movements of the lay back and forth. While the injector continues pressed against the lay, keeping the freshly-transferred shuttle in place in the open shuttle-box, the cam k^6 causes the rocker k' to be operated to move the shuttle-box front k back into its normal position, whereupon cam m^7 occasions the withdrawal of the injector m and the return of the latter to its normal position. (Shown in Fig. 2.) The front k having been closed back in position the protector devices are freed and then the picking mechanism at the change end of the loom is rendered operative again. In practice I have timed the parts so as to hold the shuttle-box front k lifted for substantially three revolutions of the crank-shaft before the injector acts, in order to afford ample opportunity for the escape of the spent or failed shuttle from the lay, and also keep the said front lifted during two more revolutions thereof in order to afford ample opportunity for making the transfer of a reserve shuttle to the lay. The first pick with the freshly-transferred shuttle from the change end of the loom to the driving end of the latter is made before the change-shaft r completes its revolution in order to place the weft of the said shuttle in position to act against the weft-fork t. If such weft were not thus placed in position to act against the weft-fork just before the completion of such revolution, the engagement of the gooseneck t^2 with the tail of the weft-fork in the forward beat of the gooseneck, which occurs at about such time, would cause slide t' and arm t^4 to be forced forward, as before, with the result that controller s would be shifted into its inoperative position once more and the change-shaft would be caused to continue in revolution.

In my present invention the action of the weft-indicator mechanism, which institutes the operations that are incident to replenishment, has no effect on the driving arrangements of the loom, the said operations being performed while the loom continues to run at normal unabated speed and without arrest or modification of the driving thereof.

What I claim is—

1. In a loom, in combination, loom-driving mechanism, picking mechanism, weft-indicator mechanism, weft-replenishing instrumentalities, and actuating mechanism called into action by said weft-indicator mechanism to suspend the picking until fresh weft has been supplied, and to extend the replenishing operations throughout a plurality of reciprocations of the lay while the driving of the loom is continued at normal unabated speed.

2. In a loom, in combination, loom-driving mechanism, picking mechanism, take-up mechanism for the woven cloth, weft-indicator mechanism, means under the control of the weft-indicator mechanism to arrest the taking-up action, weft-replenishing instrumentalities, and actuating mechanism called into action by said weft-indicator mechanism to suspend the picking until fresh weft has been supplied, and to extend the replenishing operations throughout a plurality of reciprocations of the lay while the driving of the loom is continued at normal unabated speed.

3. In a loom, in combination, loom-driving mechanism, mechanism for feeding warp, weft-indicator mechanism, weft-replenishing instrumentalities, and actuating mechanism called into action by said weft-indicator mechanism, to arrest the feeding of the warp until the weft has been replenished, and to extend the replenishing operations throughout a plurality of reciprocations of the lay.

4. In a loom, in combination, loom-driving mechanism, mechanism for feeding warp, weft-indicator mechanism, weft-replenishing instrumentalities, and actuating mechanism called into action by said weft-indicator mechanism to arrest the feeding of the warp until the weft has been replenished, and to extend the replenishing operations throughout a plurality of reciprocations of the lay while the driving of the loom is continued at normal unabated speed.

5. In a loom, in combination, loom-driving mechanism, picking mechanism, mechanism for feeding warp, weft-indicator mechanism, weft-replenishing instrumentalities, and actuating mechanism called into action by said weft-indicator mechanism to suspend the picking and arrest the feeding of the warp until fresh weft has been supplied, and to extend the replenishing operations throughout a plurality of reciprocations of the lay while the driving of the loom is continued at normal unabated speed.

6. In a loom, in combination, loom-driving mechanism, picking mechanism, let-off and take-up mechanism, weft-indicator mechanism, weft-replenishing instrumentalities, and mechanism under control of said weft-indicator mechanism, to suspend the picking and arrest the letting off and taking up until fresh weft has been supplied, and to extend the replenishing operations throughout a plurality of reciprocations of the lay.

7. In a loom, in combination, loom-driving mechanism, protector mechanism, weft-indicator mechanism, weft-replenishing instrumentalities, and actuating mechanism called into action by said weft-indicator mechanism independently, to extend the replenishing operations throughout a plurality of reciprocations of the lay while the driving of the loom is continued at normal unabated speed, and maintain the said protector mechanism inoperative until the replenishment has been effected.

8. In a weft-replenishing loom, in combination, loom-driving mechanism, the lay, weft-indicator mechanism, weft-replenishing instrumentalities including a movable shuttle-box side on the lay and an injector to transfer a reserve shuttle to the lay, and actuating mechanism called into action by the said weft-indicator mechanism to withdraw said shuttle-box side for a plurality of reciprocations of the lay to permit the shuttle on the lay to be discharged and a fresh one substituted and then restore the side to normal position, and to cause the injector to advance to the lay and partake of the movement thereof while holding a shuttle on the lay until the shuttle-box front is closed upon such shuttle while the driving of the loom is continued at normal unabated speed.

9. In a weft-replenishing loom, in combination, loom-driving mechanism, the lay, protector mechanism, weft-indicator mechanism, weft-replenishing instrumentalities including a movable shuttle-box side on the lay and an injector to transfer a reserve shuttle to the lay, and actuating mechanism called into action by the said weft-indicator mechanism to render the protector mechanism inoperative until after a change of shuttles has been effected, to withdraw said shuttle-box side for a plurality of reciprocations of the lay to permit the shuttle on the lay to be discharged and a fresh one substituted and then restore the side to normal position, and to cause the injector to advance to the lay and partake of the movement thereof while holding a shuttle on the lay until the shuttle-box front is closed upon such shuttle, while the driving of the loom is continued at normal unabated speed.

10. In a weft-replenishing loom, in combination, loom-driving mechanism, the lay, picking mechanism, weft-indicator mechanism, weft-replenishing instrumentalities including a movable shuttle-box side on the lay and an injector to transfer a reserve shuttle to the lay, and actuating mechanism called into action by the said weft-indicator mechanism to arrest the picking until after a change of shuttles has been effected to withdraw said shuttle-box side for a plurality of reciprocations of the lay to permit the shuttle on the lay to be discharged and a fresh one substituted and then restore the side to normal position, and to cause the injector to advance to the lay and partake of the movement thereof while holding a shuttle on the lay until the shuttle-box front is closed upon such shuttle, while the driving of the loom is continued at normal unabated speed.

11. In a weft-replenishing loom, in combination, loom-driving mechanism, the lay, protector mechanism, picking mechanism, weft-indicator mechanism, weft-replenishing instrumentalities including a movable shuttle-box side on the lay and an injector to transfer a reserve shuttle to the lay, and actuating mechanism called into action by the said weft-indicator mechanism to render the protector mechanism inoperative and arrest the picking until after a change of shuttles has been effected, to withdraw said shuttle-box side for a plurality of reciprocations of the lay to permit the shuttle on the lay to be discharged and a fresh one substituted and then restore the side to normal position, and to cause the injector to advance to the lay and partake of the movement thereof while holding a shuttle on the lay until the shuttle-box front is closed upon such shuttle, while the driving of the loom is continued at normal unabated speed.

12. In a weft-replenishing loom, in combination, loom-driving mechanism, the lay, protector mechanism, picking mechanism, let-off and take-up mechanism, weft-indicator mechanism, weft-replenishing instrumentalities including a movable shuttle-box side on the lay and an injector to transfer a reserve shuttle to the lay, and actuating mechanism called into action by the said weft-indicator mechanism to render the said protector mechanism inoperative and arrest the picking, letting off and taking up until after a change of shuttles has been effected, to withdraw said shuttle-box side for a plurality of reciprocations of the lay to permit the shuttle on the lay to be discharged and a fresh one substituted and then restore the side to normal position, and to cause the injector to advance to the lay and partake of the movement thereof while holding a shuttle on the lay until the shuttle-box front is closed upon such shuttle, while the driving of the loom is continued at normal unabated speed.

13. In a weft-replenishing loom, in combination, weft-indicator mechanism, one of the rotating shafts of the looms, weft-replenishing instrumentalities, the change-shaft in operative control of the said instrumentalities, the arm fast on said change-shaft provided with a pawl or dog, the sleeve loose on the said change-shaft provided with the toothed wheel, means to drive said sleeve from the said rotating shaft at a reduced rate of speed, and the controller for the said pawl or dog in operative connection with the said weft-indicator mechanism.

14. In a weft-replenishing loom, in combination, weft-indicator mechanism, one of the rotating shafts of the loom, the change-shaft, means under control of the weft-indicator mechanism to rotate the said change-shaft from the said shaft of the loom, picking mechanism including a picking-tappet that is movable from operative to inoperative position and vice versa, a cam on the change-shaft and means operated by said cam to shift the said picking-tappet, replenishing instrumentalities, and cams on the change-shaft in operative control of the said instrumentalities.

15. In a weft-replenishing loom, in combination, weft-indicator mechanism, the change-shaft, means under the control of the said mechanism to rotate the said change-shaft, let-off mechanism and means to operate the

same, a cam on said change-shaft in operative control of the working of said let-off mechanism, and weft-replenishing instrumentalities under the operative control of the said change-shaft.

16. In a weft-replenishing loom, in combination, weft-indicator mechanism, the change-shaft, means under the control of the said mechanism to rotate the said change-shaft, let-off mechanism and means to operate the same, the filling-in piece by which the working of said let-off mechanism is controlled, a cam on said change-shaft in operative connection with said filling-in piece, and weft-replenishing instrumentalities under the operative control of the said change-shaft.

In testimony whereof I affix my signature in presence of two witnesses.

HENRY I. HARRIMAN.

Witnesses:

FRANK B. MILLIKEN,

LEPINE HALL RICE.