

No. 626,834.

Patented June 13, 1899.

H. I. HARRIMAN.

LOOM.

(Application filed Feb. 28, 1899.)

9 Sheets—Sheet 1.

(No Model.)

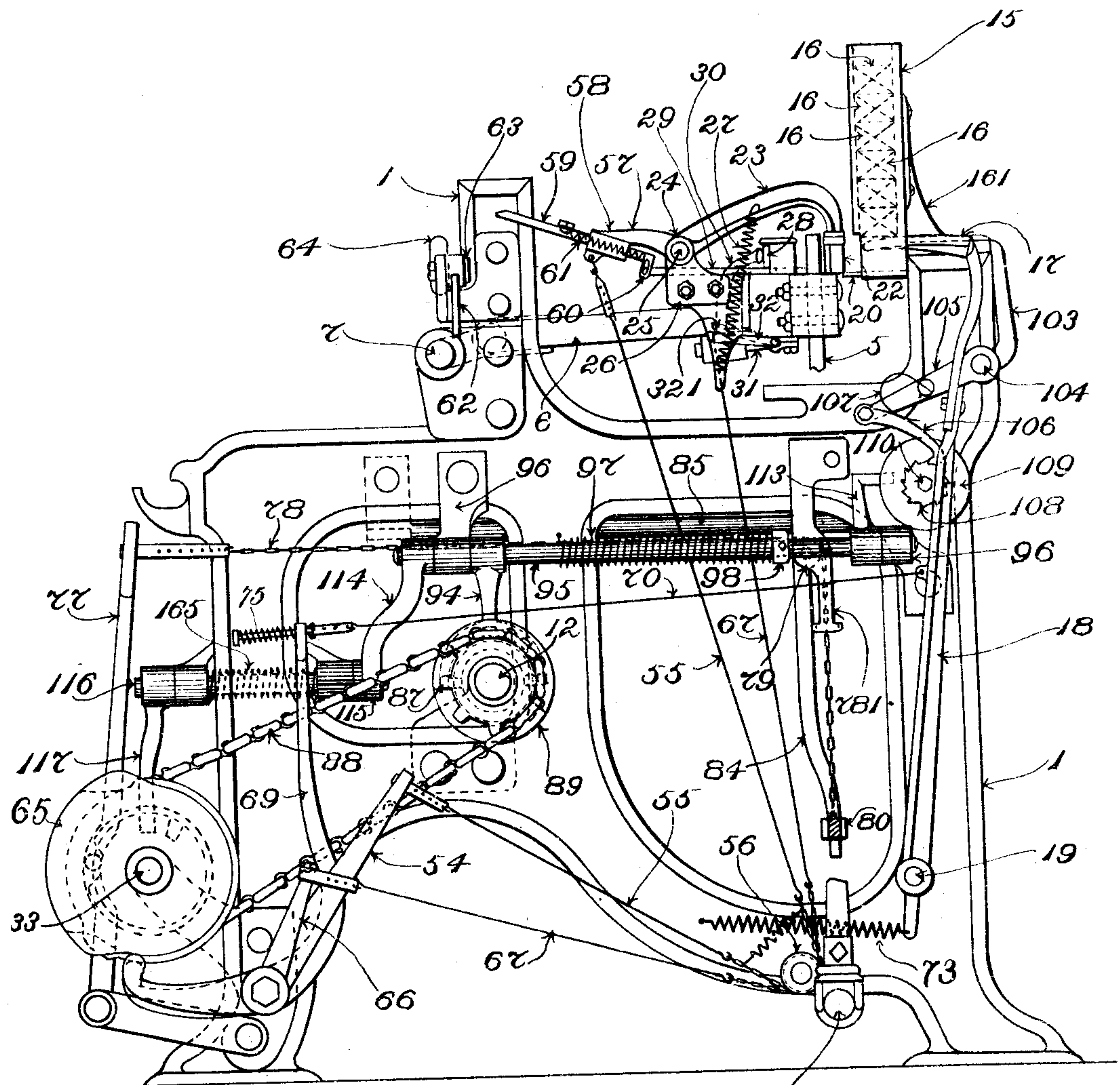


Fig. 1.

Witnesses:

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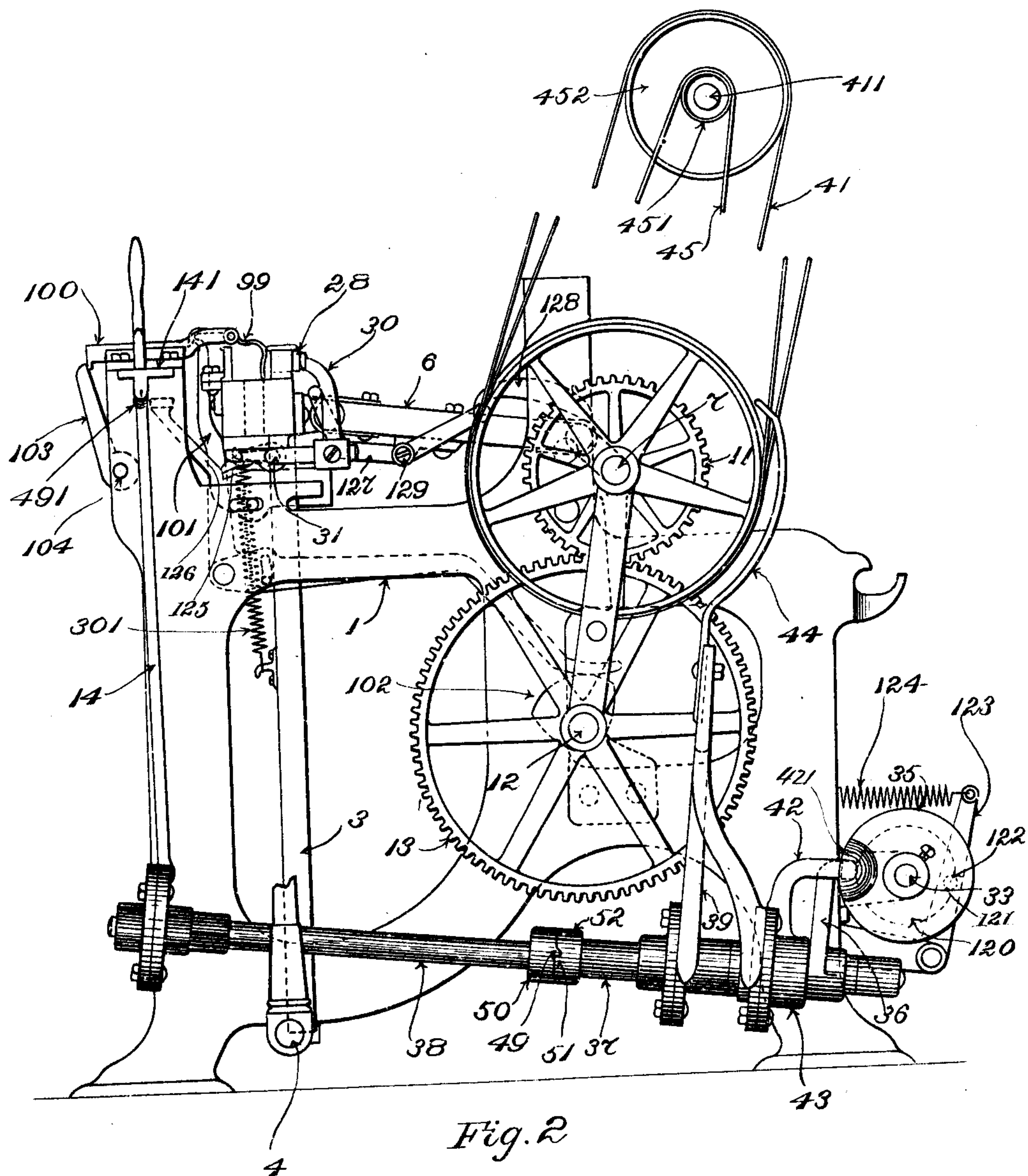


Fig. 2

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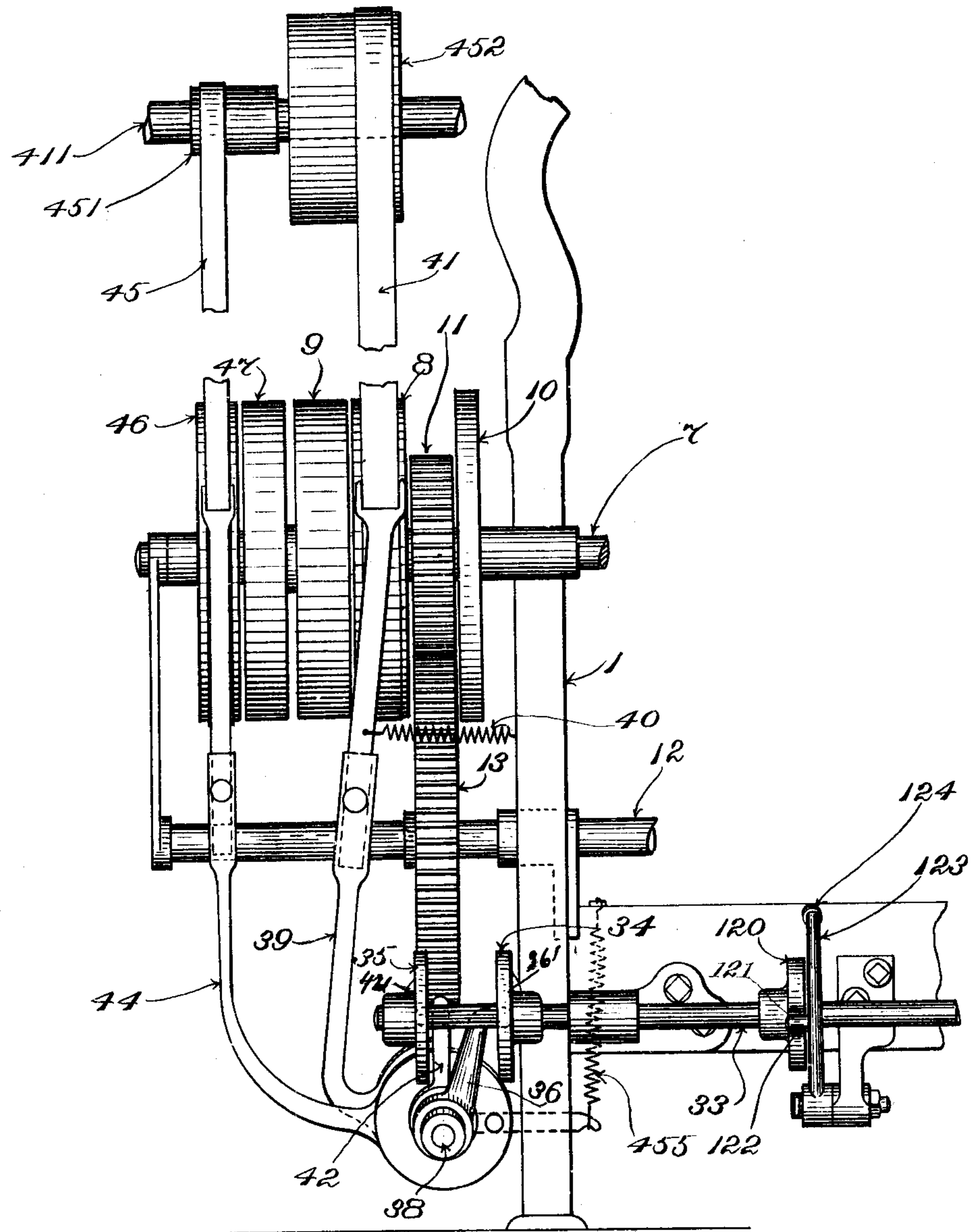


Fig. 3.

Witnesses

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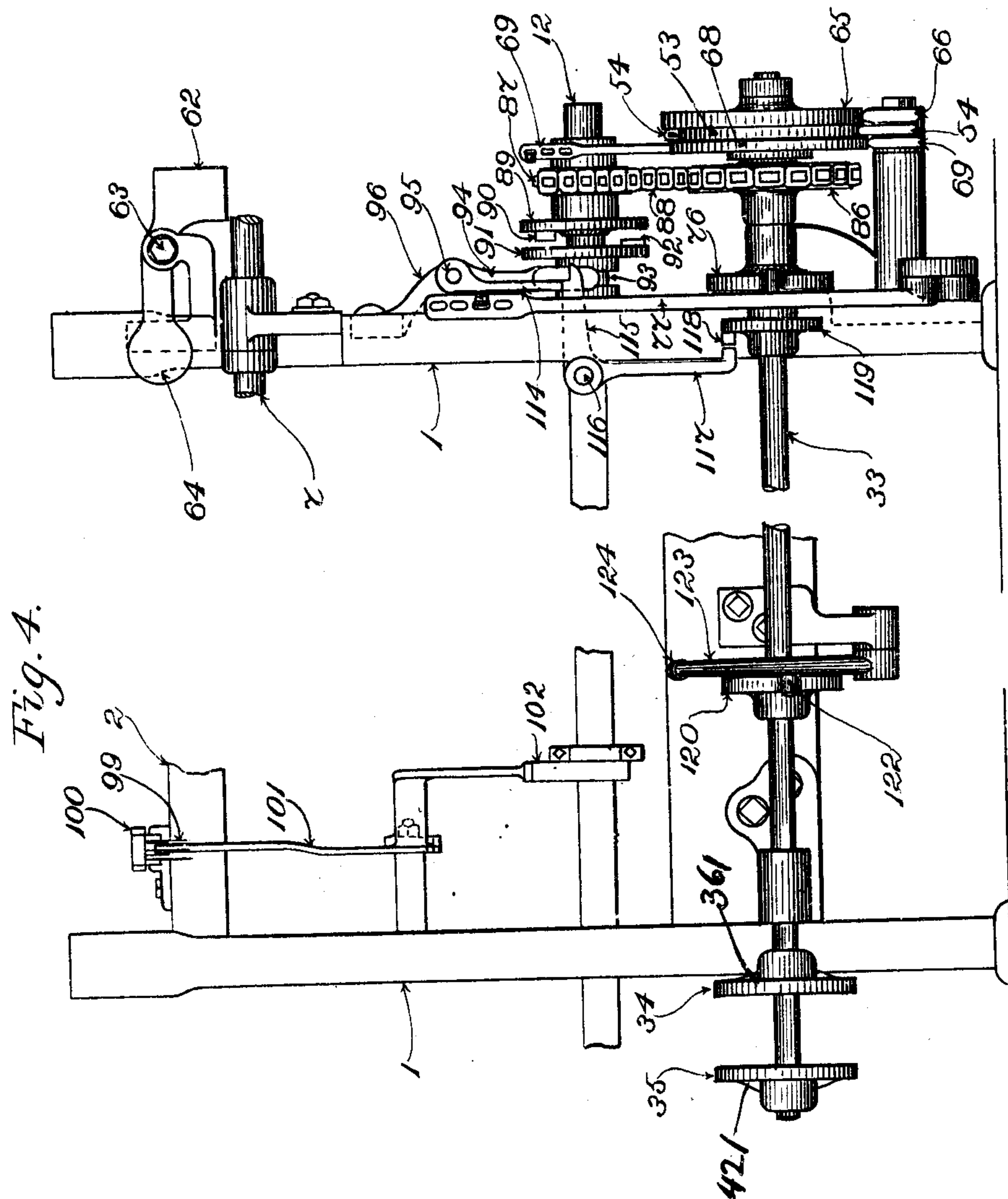
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9 Sheets—Sheet 4.

(No Model.)



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9 Sheets—Sheet 5.

(No Model.)

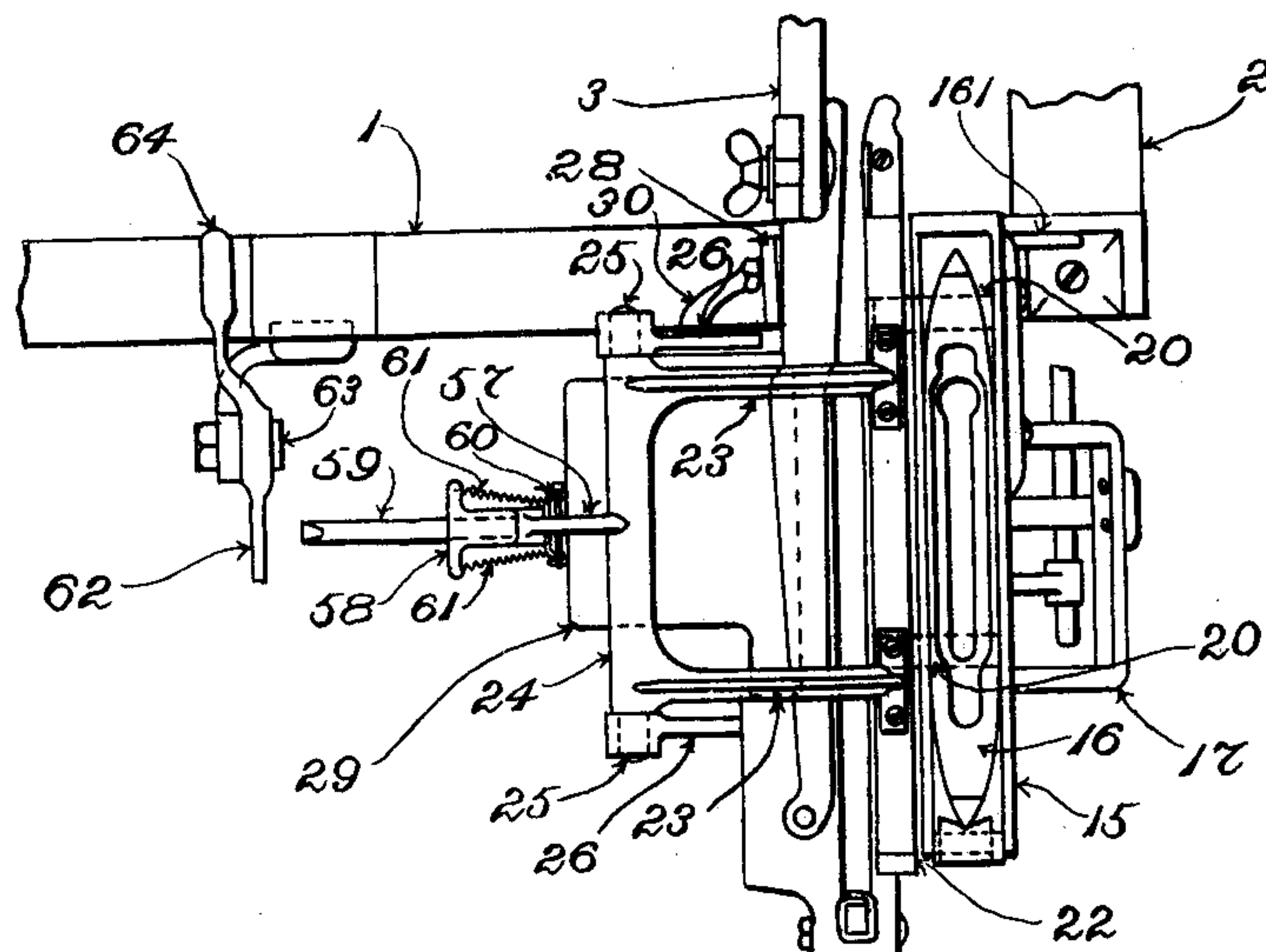


Fig. 5.

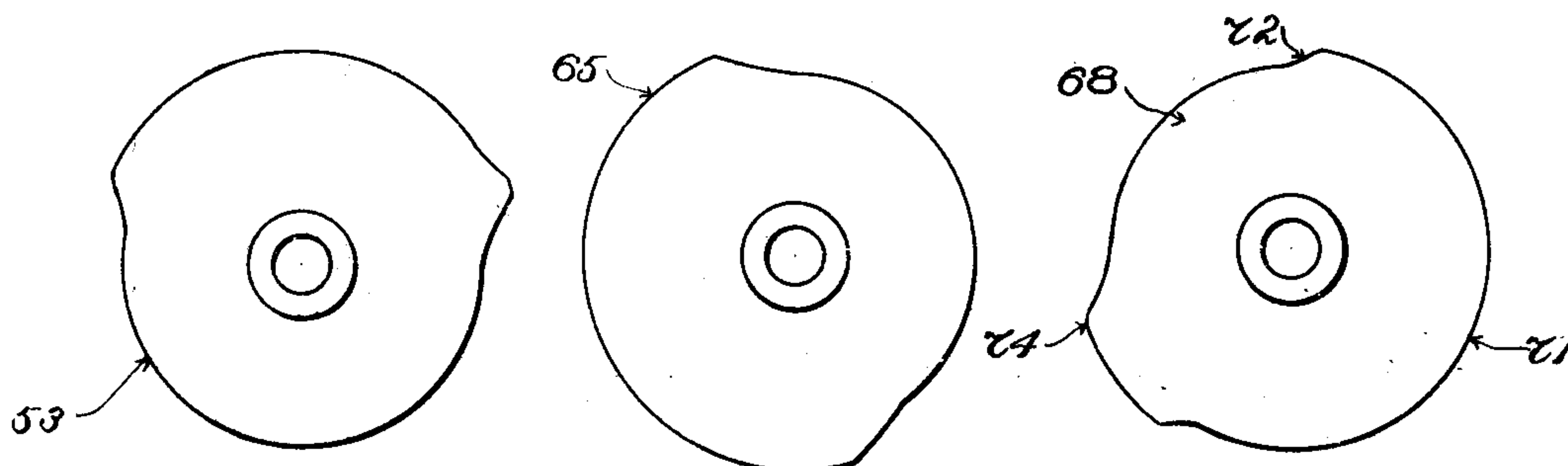


Fig. 6.

Fig. 7.

Fig. 8.

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9 Sheets—Sheet 6.

(No Model.)

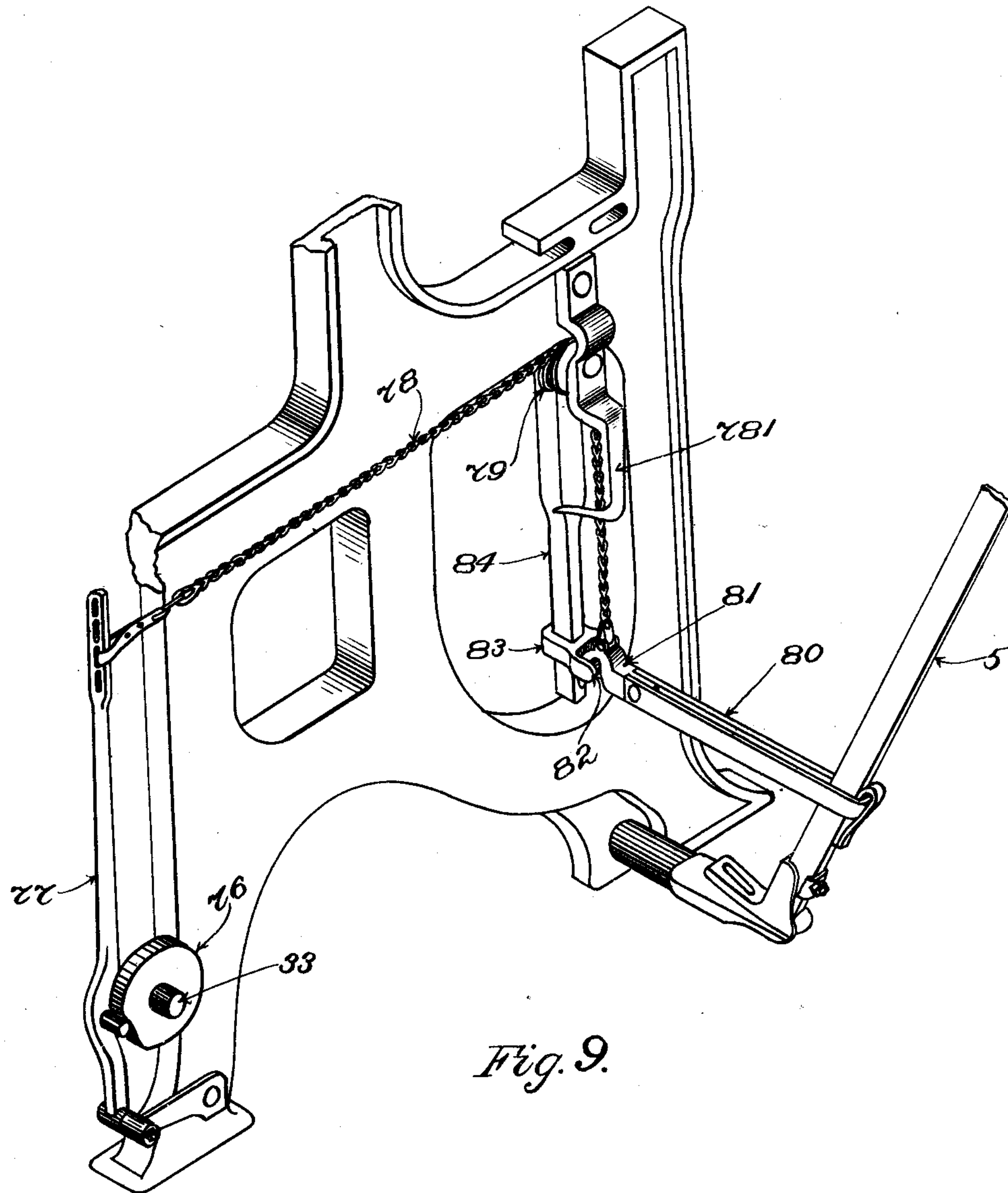


Fig. 9.

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**No. 626,834.**

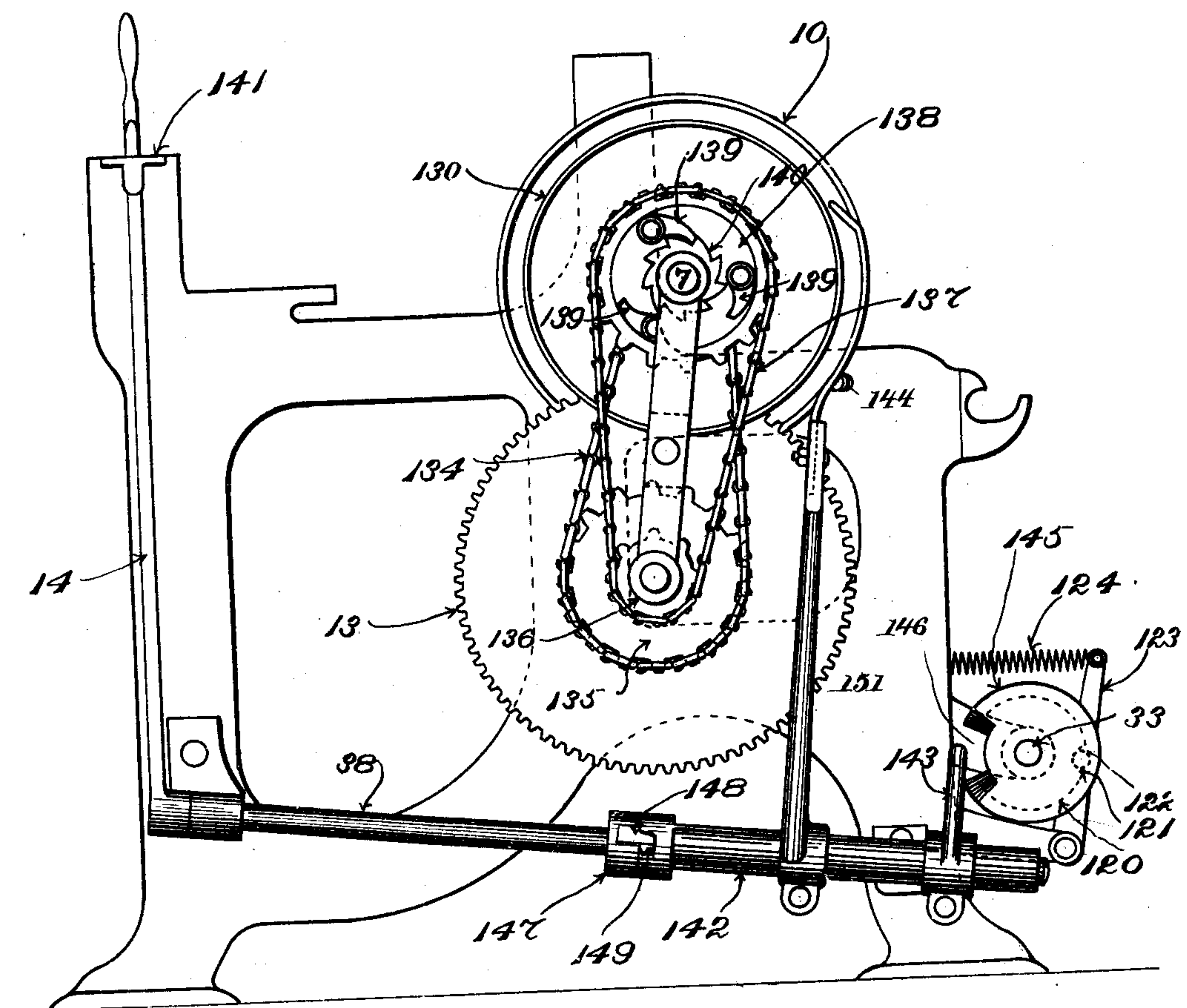
**Patented June 13, 1899.**

H. I. HARRIMAN.  
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(Application filed Feb. 28, 1899.)

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(No Model.)



*Fig. 10.*

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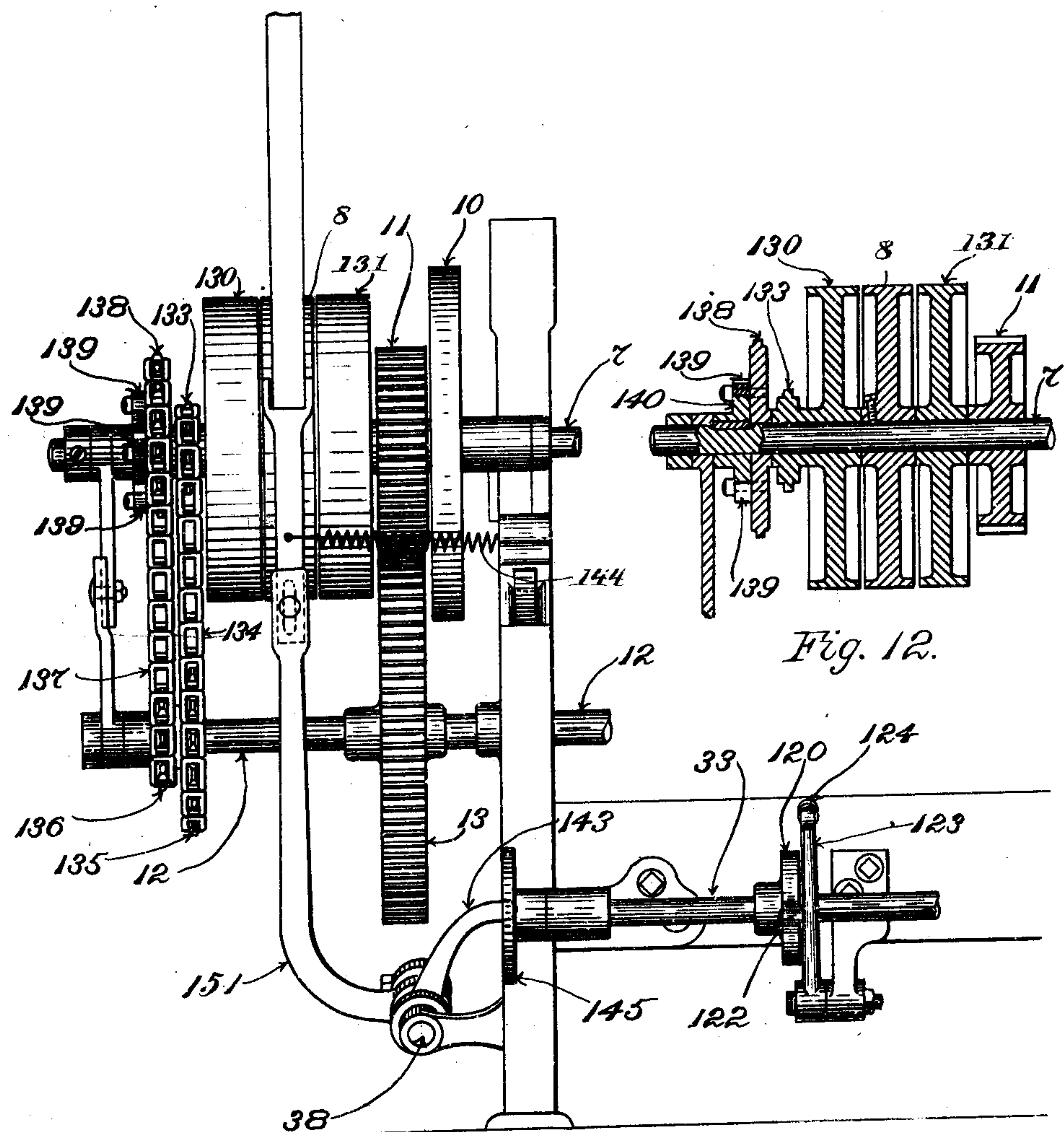
**Patented June 13, 1899.**

**H. I. HARRIMAN.  
LOOM.**

(Application filed Feb. 28, 1899.)

(No Model.)

**9 Sheets—Sheet 8.**



*Fig. 11.*

*Witnesses:*

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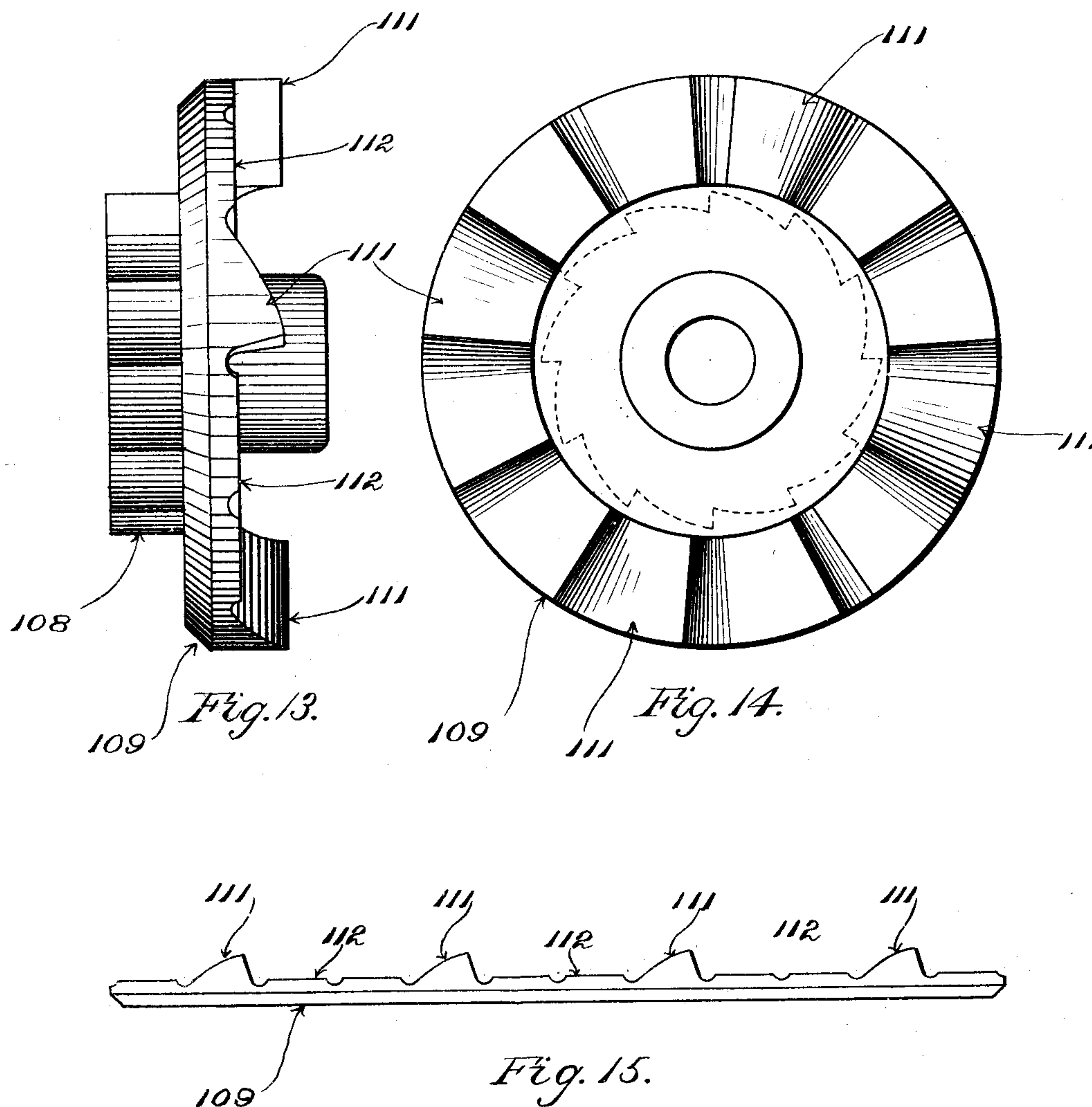
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9 Sheets—Sheet 9.



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# UNITED STATES PATENT OFFICE.

HENRY I. HARRIMAN, OF NEW YORK, N. Y., ASSIGNOR TO THE UNIVERSAL LOOM COMPANY, OF READVILLE, MASSACHUSETTS.

## LOOM.

SPECIFICATION forming part of Letters Patent No. 626,834, dated June 13, 1899.

Application filed February 28, 1899. Serial No. 707,155. (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 and State of New York, have invented certain new and useful Improvements 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 weft or filling that is being incorporated into the web or fabric being woven is effected automatically by the mechanism of the loom when necessity arises therefor—as, for example, on complete or practically complete exhaustion of the supply of weft or filling that is carried by the working shuttle or on loss of continuity of such weft or filling—the action of the replenishing mechanism being brought about or instituted by suitable forms of weft-indicator mechanism. In some forms of the said looms the replenishment is effected by making a change of shuttles, the spent or failed working shuttle being retired or discharged and a fresh or reserve shuttle being introduced into working position in the loom, this latter shuttle having its supply of weft or filling in proper condition to continue the weaving. In other cases the working shuttle has not been retired or discharged, but devices have been employed by means of which the filling-carrier in such shuttle, such filling-carrier having the form of a bobbin, a spindle, or a cop-case, has been ejected from the said shuttle and a fresh or reserve filling-carrier has been inserted into the shuttle, the latter being of a self-threading character, so as to provide for an immediate resumption of the introduction of weft or filling into the web or fabric being woven. In the looms of the said class now generally known the replenishing mechanism has been suddenly thrown into action and the operations that are incident to the replenishment have been performed with the loom running at its usual full or regular working speed. This mode of operation has the serious drawback that it occasions a considerable shock to the loom and throws sudden and great strain upon the parts which are involved in effecting the de-

sired result. The necessity for eventing the said shock and strain from becoming excessive and causing injury, breakage, or derangement of the working parts compels the loom to be run at a regular working speed somewhat below what otherwise would be attainable, and hence lessens the productiveness and value of the loom. By way of making clear the reason for this necessity it may be stated, for example, that in a loom in which the automatic weft replenishment is effected by making a change of shuttle quite complicated mechanism is required to be employed and quite a series of mechanical actions is required to occur—as, for instance, the releasing or opening of the shuttle-box swell or binder, the removal by lifting or otherwise of the front of the shuttle-box, the ejecting of the exhausted or failed shuttle, the inserting of the new shuttle, &c. These actions follow one another in quick succession. They must be timed properly and very accurately with relation to one another and to the general working of the loom and must occur with exact and unvarying precision. Hence when the shuttle-changing mechanism is suddenly called into play and is required to perform its various functions at the full speed of the loom the stress exerted on such mechanism and on the loom is both sudden and great and is exceedingly liable to occasion derangement and breakage or failure to operate correctly. The same is essentially true also of looms in which a change of filling-carrier is caused to occur. Herein the number of actions that is required to be performed is somewhat less than when the shuttle itself is changed; but even greater delicacy and accuracy or precision in working are indispensable. An imperative requirement in connection with looms in which the filling-carrier is changed in the shuttle is that the shuttle must be positioned with exactness in the shuttle-box on the lay, otherwise the filling-carrier cannot be changed. In addition after the change the filling must be threaded properly into the shuttle while the loom continues in operation. Delicacy becomes the predominant feature of a loom in which the filling-carrier is changed. It is very difficult to get the shuttle to position



itself exactly right in the shuttle-box. Rebound thereof is very likely to occur. A change of the speed of a loom to the extent of a few picks per minute, even such as might be due to a defect in the engine or its running or to the slight increase in the speed of the engine which results from the throwing out of operation of other machinery in the mill, will cause the shuttle to rebound, although the parts of the loom previously were arranged to work in a manner to provide against rebound at the normal speed of the loom. This results in the shuttle not being properly positioned in the shuttle-box at the time when a change of filling-carrier should take place. Should now the filling-changing mechanism act with its usual instantaneous suddenness, it either would fail to do so properly or derangement or breakage would result. In short, automatic weft-replenishing mechanism is a very delicate mechanism both to build and to keep in running order, and the difficulties are very much increased by causing the same suddenly to start into the performance of its multiple functions, as well as complete such performance, at the full working speed of the loom to which it is applied. Practical experience with looms constructed and equipped to effect automatically replenishment of the weft or filling has demonstrated that in order to guard against failure in operation or derangement, accident, and breakage a slower rate of speed than otherwise would be possible must be adopted for such looms.

Certain main objects of the present invention are to provide for facilitating in general the operations by which the replenishment of weft is effectuated, whether that be by change of shuttle or by change of filling-carrier, to eliminate all shock and strain incident to bringing the replenishing mechanism into action and during the performance of its various operations, to diminish or eliminate the liability to derangement and to breakage resulting therefrom, and to enable the productiveness of the loom to be increased, if desired, by an increase in the speed at which the loom normally is run. These objects in general are attained in accordance with the present invention by providing means under the control of the devices which institute the action of the replenishing mechanism, whereby when the change of weft or filling is required to occur the driving of the loom first is modified to occasion a dwell in the regular working of the loom, the devices hereinafter described operating to reduce the speed of the loom below that normally maintained during the regular working of the loom to a rate at which the operation of the replenishing mechanism conveniently and safely may be caused to take place, and whereby, further, the reduction of the speed of the loom is maintained and the picking of the shuttle is arrested during several revolutions of the crank-shaft, so as to afford ample opportunity for the replenishment to be effect-

ed. By modifying the driving of the loom before the weft-replenishing devices are brought into action, I relieve the shock that is incident to bringing the replenishing mechanism into action while the loom is running at full speed and also the strain that is incident to the performance of its functions, as well as the tendency to accident, derangement, and breakage. The reduction of the speed of the loom for several revolutions of the crank-shaft, with accompanying arrest of the picking, and the greater amount of time thereby allowed for the performance of such functions also tend to the attainment of these results.

My invention enables the loom to be run at a rate of speed considerably higher between changes of weft or filling than has been found practicable heretofore in the case of looms now generally known having weft-replenishing mechanism applied thereto, thereby adding considerably to the productiveness of the loom.

Other objects of the invention and various additional improvements are disclosed in the course of the following description.

Figure 1 of the accompanying drawings is a left-hand end elevation of parts of an ordinary loom having applied thereto embodiments of the various features of my present invention, the end shown being herein the change end or supply end. Fig. 2 is a right-hand end elevation thereof. Fig. 3 is a view in rear elevation of the parts which are shown in Fig. 2. Fig. 4 is a view in rear elevation of the parts which are shown in Fig. 1, it showing also the opposite end of the change-shaft and certain parts at the corresponding end of the loom. Fig. 5 is a plan of certain of the parts which are shown in Fig. 1. Figs. 6, 7, and 8 show certain of the change-cams. Fig. 9 is an isometric showing chiefly the picking devices at the change end or supply end of loom. Fig. 10 is an end elevation showing a modification of the driving mechanism and speed-changing devices. Fig. 11 is a view thereof in rear elevation. Fig. 12 is a view in central vertical section of one end of the crank-shaft and the parts which are mounted thereon in Figs. 10 and 11. Fig. 13 is an elevation of the cam-disk detached. Fig. 14 is a face view thereof. Fig. 15 is a development of its periphery on a somewhat smaller scale.

1 1 designate the end frames of the loom, 2 the breast-beam, and 3 the lay.

4 4 are the journals of the lay; and 5, Figs. 1 and 9, one of the picker-sticks.

6 6 are the lay pitmen or connecting-rods.

7 is the crank-shaft.

8, Fig. 3, is the usual fast band-pulley thereon; 9, the usual loose band-pulley thereon; 10, the brake or balance wheel thereon; 11, the pinion thereon; 12, the cam-shaft, and 13 the gear thereon, which is in mesh with the pinion 11 on the crank-shaft.

14, Fig. 2, designates the shipper-handle,



and 141 the usual slotted plate, in which the upper portion of the said shipper-handle works.

In the drawings I have illustrated devices which effect replenishment of the weft or filling by making a change of shuttles, although it is to be borne in mind that the main features of the invention are equally applicable to other forms and arrangements of replenishing mechanism, and in some cases I contemplate the use of such other forms and arrangements. Usually the weft replenishment will be effected by transfer from a holder for a reserve supply—as, for example, a holder for reserve shuttles. Thus 15 designates a hopper or magazine for a supply of reserve shuttles, the ends of a number of such shuttles being indicated in dotted lines at 16 16, Fig. 1. This hopper preferably is mounted independently of the lay, it being herein shown carried by a fixed support 161 on the breast-beam at the change end or supply end of the loom.

17 is an injector or pusher for transferring at the proper time a shuttle from the said hopper over into the shuttle-box on the corresponding end of the lay. The said injector is represented as having an arm 18, by means of which it is supported from a pivot at 19 upon the corresponding end frame of the loom. The transfer of a shuttle from the hopper to the said shuttle-box takes place when the lay is in a forward position near the breast-beam.

20 20 are bridging-pieces, which project from the bottom of the hopper 15, so as to facilitate the movement of the shuttle from the hopper to the shuttle-box.

22 designates the front wall of the shuttle-box at the supply end or change end of the loom. It is made movable vertically, so as to permit it to be withdrawn from in front of the spent or failed shuttle in the shuttle-box, whereby to permit of the escape or ejection of the said spent or failed shuttle from the shuttle-box and also to permit a reserve shuttle to be transferred from the hopper 15 into the empty or vacant shuttle-box by the action of the injector 17. Herein the said front wall 22 is shown carried by the forwardly-extended arms 23 23 of a rocker 24, which is pivoted at 25 to supports 26, which extend rearwardly from the lay. A spring 27 acts to hold the rocker 24 and front wall 22 of the shuttle-box in their normal or working position.

28 28, Figs. 1, 2, and 5, designate the usual swells or binders, which are located at the rear of the shuttle-boxes.

30 30 designate the usual protector-fingers, the same being mounted upon arms at the ends of the usual protector-shaft 31.

301, Fig. 2, is the usual spring, which acts upon the protector-shaft.

32 designates a small rocker which is mounted upon the lay at the under side of the lay-beam and at the change end of the loom, it having an arm 321 in engagement with the

adjacent protector-finger, whereby when said rocker is moved as hereinafter described it acts to take the pressure of the protector-fingers off the swells or binders, and thereby facilitates the movement of the front 22 of the shuttle-box at the change end of the loom and the entrance of the fresh shuttle into the said shuttle-box under the action of the injector 17.

29 designates an ejector for pushing the spent or failed shuttle out of the shuttle-box at the supply end or change end of the loom after the movable shuttle-box front 22 has been moved out of the way, so as to permit of the escape of the said shuttle. This ejector 29 is in the form of a plate working beneath the lower edge of the swell or binder 28 at the change end of the loom without interfering with the action of the latter. The ejector is held from rising out of proper position by the said swell or binder above the same.

The hopper, injector, movable shuttle-box front, ejector, and rocker for relieving the pressure upon the swell or binder constitute the characteristic and essential parts, which are most immediately involved in the operations by which a change of shuttles is effected in the particular form of change or weft-replenishing mechanism which is presented in this case. They are combined, through instrumentalities which will presently be explained, with a shaft 33 or its equivalent, hereinafter known as the "change-shaft" and by means of which the working of such parts is occasioned or controlled. This change-shaft 33 is conveniently mounted in the loom. Herein it is shown carried by bearings at the rear of the loom. It normally stands stationary and inoperative, the various working parts of the change or weft-replenishing mechanism remaining also in their normal inoperative positions. At the proper time, however, this change-shaft is caused to begin to rotate, and thereby brings into action the aforesaid working parts of the change or weft-replenishing mechanism. The rotation of the change-shaft is initiated or begun under the dictation of mechanism by which the condition of the weft or filling being introduced into the web or fabric being woven is indicated. So far as this indicator mechanism is concerned it should be understood that while for convenience I have shown herein a simple form of weft-fork mechanism acting on the breakage or failure of the weft or filling being woven in, yet in practice any suitable adaptation of any of the other known forms or types of mechanism for indicating the condition of the weft or filling which is being introduced by the working shuttle may be employed without departure from the spirit of the invention. This normally stationary change-shaft 33 has combined therewith a shipper or shifter mechanism by means of which the driving of the loom is controlled. Thus, having reference more particularly to Figs. 2, 3, and 4 of the drawings, at the end of the loom



which is opposite to that at which the change or replenishing mechanism is located the change-shaft 33 has fast thereon two cams 34 and 35. The cam 34 acts in connection with an arm 36, which is fast on the rear end of a sleeve 37, the said sleeve being fitted to turn independently upon a rock-shaft 38, extending from front to rear of the loom at the right-hand end thereof—that is to say, at the end which is shown in Fig. 2 of the drawings. The forward end of this rock-shaft has the shipper-handle 14 made fast thereto. The said sleeve carries the belt-shifter 39. A spring 40, which is connected with the said belt-shifter and with a fixed part of the loom-frame, acts with a tendency to draw the belt-shifter 39 into its position in Fig. 3, where it operates to hold the driving-band 41 upon the fast driving-band pulley 8. The driving-band 41 serves to drive the loom during the regular working thereof. The cam 35 acts in connection with an arm 42, which is connected with the hub 43 of a second belt-shifter 44. The said hub 43 is fitted or sleeved loosely upon the exterior of sleeve 37, and a spring 455, connected with the said hub and also with some fixed point, acts with a tendency to hold the belt-shifter 44 in the position, which is shown in Fig. 3, thereby keeping the driving-band 45, which passes through the fork of the said belt-shifter, on the loose band-pulley 46 on crank-shaft 7. Alongside the loose band-pulley 46 a band-pulley 47 is made fast on the crank-shaft 7. It is intended that driving-bands 41 and 45 shall both be driven from a suitable counter-shaft, as 411, Figs. 2 and 3, but driving-band 45 much slower than driving-band 41—as, for example, in consequence of applying the former to a pulley 451 on said counter-shaft that is considerably less in diameter than the adjoining pulley 452, to which driving-band 41 is applied. During the regular running of the loom the driving-band 41 will be caused to pass around fast band-pulley 8 and driving-band 45 around loose band-pulley 46. Consequently the loom will be caused to work at the required high rate of speed.

It may here be explained that should it be desired to stop the loom at any time during the regular running of the loom this may be effected by dislodging the shipper-handle 14 from the usual holding-notch in the plate 141, whereupon the strong spring 491, which is connected with the shipper-handle, will rotate rock-shaft 38, the clutch-tooth 49 on the collar 50, fast on the said rock-shaft, engaging with a shoulder 51 on a collar 52, fast with sleeve 37, and turning the sleeve with its belt-shifter 39, so as to shift driving-band 41 onto the loose pulley 9, the resistance offered by spring 40 being overcome by the greater strength of spring 49. During the regular running of the loom the ends of arms 36 and 42 are caused by the action of springs 40 and 455 to occupy positions in the lateral depressions 361 and 421, respectively, on the

sides of cams 34 and 35. When shaft 33 is started to rotate at the dictation of the weft or filling detector or indicator mechanism, as referred to above, cam 34 acts then to move belt-shifter 39, so as to shift driving-band 41 from fast band-pulley 8 onto loose band-pulley 9, thereby taking off the regular driving power. Cam 35 also acts to move belt-shifter 44, so as to shift the slow-speed driving-band 45 from loose band-pulley 46 onto fast band-pulley 47. As the said slow-speed driving-band 45 passes onto fast band-pulley 47 it acts at first to retard the latter in its rotation and thereby to brake the loom, so as quickly to overcome the momentum of the loom and bring the speed thereof down to the desired low rate. While the loom is being driven at a low rate of speed by means of the driving-band 45 passing around the fast band-pulley 47, the change or replenishment of weft or filling is caused to occur in consequence of the continued rotation of change-shaft 33.

One of the first actions occasioned by the rotation of the change-shaft is the arrest of the picking of the shuttle. This may be effected in various ways. I have found the following means of accomplishing the same efficacious, (see particularly Figs. 1, 4, and 9 of the drawings:) A cam 76 on the change-shaft 33 acts upon a lever 77, the latter having attached thereto one end of a connection 78, which is made flexible in whole or in part, so as to enable it to pass around a direction-changing pulley or sheave 79, from which last the said connection extends downward and is attached to the lug-strap 80 at the change end or supply end of the loom. The inner end of the lug-strap is furnished with a hook, as 81, which engages with a pin or cross-bar 82 on a block 83, which is attached to the arm 84 of the picking rock-shaft 85. When lever 77 is acted upon by cam 76, which occurs promptly after change-shaft 33 begins its rotation, the said hook 81 is lifted off the pin or cross-bar 82, and thereafter the said picking rock-shaft moves without transmitting motion to the picker-staff 5 on the change end or supply end of the loom until after the replenishment of weft or filling has been completed, whereupon the hook 81 is dropped into engagement with the pin or cross-bar 82 again. In order to prevent swinging movements of the lug-strap and flexible connection 78, which might interfere with the proper reengagement of hook 81 with the cross-bar 82, I provide a fixed guide 78 for the said flexible connection, the same being located between sheave 79 and the lug-strap and being constituted by an arm attached to the loom-frame and having a forked inwardly-extending lower end, between the branches of which the connection 78 extends.

In order to permit of the ejection of the spent or failed shuttle from the shuttle-box and the injection of a fresh or reserve shuttle I raise the shuttle-box front 22 out of the way. To effect this, the said change-shaft has mounted thereon at the change end of the loom



a cam 53, (shown separately in Fig. 6,) which acts upon one arm of the bell-crank 54, the latter having connected with the extremity of its other arm one end of a connection 55, which is made flexible in whole or in part to facilitate passing around a direction-changing pulley or sheave 56, which last is pivoted closely adjacent to the axis on which the lay rocks. The other end of the connection 55 is attached to the rearwardly-extending arm 57 of the rocker 24, and when the cam 53 begins to move the said bell-crank 54 the rocker 24 is turned, depressing the rear arm 57 thereof and raising the front arms 23 23, together with the shuttle-box front 22.

The ejection of the spent or failed shuttle from the shuttle-box on the lay may be effected in various ways. Herein a guide 58, with which arm 57 of the rocker is provided, receives a bolt or slide 59, which latter at its front end 60 is loosely jointed to the rear end of the ejector 29, as by means of a slot-and-pin connection on the order of that which is shown in Fig. 1. By means of a spring or springs 61, connected with bolt or slide 59 and with fixed portions of arm 57 of the rocker, the slide and ejector are held normally in their rearward position, the ejector being then withdrawn from the interior of the shuttle-box. The depression of the rear arm 57 of rocker 24 brings the rear portion of the bolt or slide 59 down into line with a stop 62, that is applied to a fixed portion of the loom-frame 1. Consequently as the lay goes rearward the bolt or slide encounters the said stop, and thereby during the remaining portion of the rearward movement of the lay the said bolt or slide and the connected ejector are held from further rearward movement, the result being that the spent or failed shuttle is pushed out of the shuttle-box and falls forward off the lay-beam. As the lay advances toward the breast-beam again the ejector 29 is drawn backwardly out of the shuttle-box by the spring or springs 61. In order to guard against breakage in case in its descent the rear end of the bolt or slide 59 should come down on top of the stop 62, the said stop is made capable of yielding to downward pressure by being mounted on a pivot, as 63, it being weighted, as at 64, or otherwise acted upon with yielding force to hold it in the normal working position thereof.

It is desirable that in order to facilitate the operations which are incident to effecting the discharge or retirement of the spent or failed shuttle and the injection of a fresh one the pressure of the swells or binders should be reduced. To this end another cam (designated 65 and shown separately in Fig. 7) is mounted upon the change-shaft 33. It acts upon one arm of a bell-crank 66, to the upper arm of which is connected one end of a connection 67, the latter being made flexible in whole or in part to enable it to pass around a direction-changing sheave or pulley at 56 and having its other end connected with the rocker

32. By this means at the proper time—namely, just before the shuttle-box front 22 is raised—the said rocker is operated to relieve the pressure on the swells or binders 28 28, and this action is maintained until after the shuttle-box front has been dropped in order that no obstruction may be offered to the entrance of the fresh shuttle, which is to be transferred from the hopper 15. This operation of rocker 32 acts, moreover, to hold the dagger 125 of the protector mechanism elevated during the advance of the lay which follows the ejection of the spent or failed shuttle, so as to prevent the knocking off of the loom.

For the purpose of operating the injector I employ herein mechanism as follows: A third cam (designated 68 and shown separately in Fig. 8) is mounted on change-shaft 33. It acts on one arm of a bell-crank 69, the other arm of the said bell-crank being united by a connection 70 with the arm 18 of the injector 17. By this means the transfer of a reserve shuttle from hopper 15 to the empty or vacant shuttle-box is effected. The cam 68 has a concentric portion 71, extending around a considerable portion of the circumference thereof and acting to maintain the injector normally in an intermediate position, (see Fig. 1,) with the rear portion thereof within the hopper and extending beneath the bottom shuttle of the stack of reserve shuttles in hopper 15, so as to support the said bottom shuttle in an elevated position, whereby it will be held above the opening in the rear side of the hopper at the lower end of the latter, and thereby will be prevented from being caused by the jar of the loom to project or fall out through said opening into the way of the lay. The said cam 68 has also a drop, as at 72, which permits the injector to be carried forward or toward the right in Fig. 1, as by the action of a spring 73, so as to withdraw the injector from beneath the shuttle or shuttles in the hopper and permit the bottom one thereof to fall into position in line with the opening in the rear side of the hopper and with the injector. The projection or rise 74 on the said cam 68 causes the advance of the injector to inject or push a reserve shuttle into the shuttle-box from the hopper. A spring 75 is interposed between bell-crank 69 and arm 18, and the throw of the projection or rise 74 of cam 68 is sufficiently great to occasion an excess of movement of the bell-crank, so that, the injector having been moved to place a reserve shuttle in the shuttle-box on the lay and being held pressed against the shuttle as it lies in the shuttle-box, the tension of the spring 75 operates to cause the injector to follow the lay rearwardly a short distance, still pressing against the shuttle and holding it in place, until the shuttle-box front 22 is lowered onto the upper surface of the injector, after which the lay will separate from the injector and the shuttle-box front will drop off the latter and down into its regular operative position.



The purpose of this is to insure that the shuttle-box front shall be partially down in front of the newly-introduced shuttle before the pressure of the injector is taken off the front of the shuttle. After this the injector will resume its position in Fig. 1.

The change-shaft 33 is arranged to be moved progressively until the operations incident to weft replenishment have been performed. Preferably it is operated by direct connections with one of the rotating shafts of the loom. Herein for convenience I operate the change-shaft from the cam-shaft 12. Between the change-shaft and the shaft which acts as the driver I provide a train of driving connections which normally is broken or disconnected, so as to leave the change-shaft normally in a state of rest, provision being made, however, for establishing driving relations when it is required that movement of the change-shaft should be occasioned. In the present case the said train comprises a series of motion-transmitting devices and a clutch which normally stands open, so that the change-shaft remains at rest and inoperative; the said clutch, it being known hereinafter as the "change-clutch," having combined therewith means to shift the same under the dictation of the weft-indicator mechanism in order to set the change-shaft at work. The said driving connections herein will be understood to be only one of the arrangements that may be adopted. They comprise a sprocket-wheel 86, that is fast upon the change-shaft, a sprocket-wheel 87, loose upon the cam-shaft, and a sprocket-chain 88, passing around and connecting the said two sprocket-wheels. Fast with sprocket-wheel 87 is a disk 89, provided with a single lateral clutch-tooth 90 or the like engaging portion. Feathered upon the cam-shaft is a second disk 91, provided with a tooth 92 or its equivalent for cooperating with the tooth 90 of disk 89. The hub of this disk 91 has a groove 93, receiving the shipper-arm 94 on the change rock-shaft 95, the latter extending from front to rear of the loom at the change end or supply end thereof and being supported in bearings 96 96, which are attached to the corresponding end frame. A spring 97, here shown as surrounding the change rock-shaft 95 and as having one end thereof made fast to a fixed part of the loom-frame and the other to a collar 98, secured upon the said rock-shaft, operates to hold the rock-shaft normally in the position which keeps the members of the change-clutch on the cam-shaft open or separated from each other. This change rock-shaft 95 is under the control of the weft-indicator mechanism and is intended to be rocked in opposition to the action of the spring 97 through the operation of the said weft-indicator mechanism when occasion requires, so as to throw the said clutch members into engagement with each other, and thereby cause the change-shaft to be rotated. Herein by way of illustration of the relations, &c., of the weft-in-

dicator mechanism to the other parts and by way of making clear the proper mode of operation I have illustrated a familiar form of devices of that class which detect the breakage or discontinuance of the weft which is being introduced into the successive sheds. Herein, therefore, 99, Figs. 2 and 4, designates an ordinary weft-fork; 100, its movable stand or slide; 101, the gooseneck or weft-hammer; 102, the cam on the cam-shaft 12, by means of which to operate the said gooseneck or weft-hammer; 103, the arm which extends up in front of the said movable stand or slide for the weft-fork, and 104 the rod or rock-shaft on which the said arm is mounted. These parts are all of well-known character, arrangement, and working. From the indicator rock-shaft 104 movement is to be transmitted to the change rock-shaft 95 in order to cause the same to close the clutch upon the cam-shaft. This may be accomplished in various ways. Herein I have presented a special contrivance for the purpose, which I have contrived with the end in view of attaining certain results, which will be explained. Thus upon the end of the indicator rock-shaft 104 I mount an arm 105, Fig. 1, it carrying a pawl 106. The latter is pressed by a spring 107 into engagement with the teeth of a ratchet-wheel 108, (see also Figs. 13 and 14,) the latter being fast with a disk 109 and the ratchet-wheel and disk being mounted to turn upon a stud or pin 110, projecting from the loom-frame. One face of the disk (see also Fig. 15) is furnished with a number of lateral cam projections 111 111, separated from one another by intervening spaces 112 112. An arm 113 is made fast upon the forward end of the change rock-shaft 95, the said arm having a projection which is caused to bear against the said face of the cam-disk by the action of the spring 97, which has been described as connected with the said change rock-shaft. The disk normally stands with one of the spaces 112 thereof receiving the projection on arm 113 and with one of the cam projections 111 thereof in readiness to act against arm 113 to turn the change rock-shaft 95 and close the change-clutch at the next advance of the disk 109. When now the indicator rock-shaft 104 is rocked, the pawl 106 will be operated to advance the said disk one step, causing the said projection 111 to press arm 113 laterally and turn the rock-shaft 95, thereby closing the change-clutch. For the purpose of holding the change-clutch closed until the change-shaft 33 has completed one revolution the change rock-shaft 95 is furnished with an arm 114, and after the turning of the said rock-shaft, as described above, this arm is engaged by a catch 115 on a short rock-shaft 116. This rock-shaft 116 is operated to throw the catch up into engagement with arm 114 by means of spring 115. It carries also a depending arm 117. When the change-shaft 33 has about completed its revolution, a lat-



erally-projecting tappet 118 on a disk 119, fast on the change-shaft, (see also Fig. 4,) presses against arm 117, and by partially turning the rock-shaft 116 against the tension of the spring 165 disengages catch 115 from arm 114 of the change rock-shaft, allowing the latter to be restored to its normal position by the action of its spring 97, which causes the change-clutch to be opened. For the purpose of stopping the change-shaft 33 in a definite position after the opening of the change-clutch a stop-disk 120 is secured thereto, the said disk having in its periphery a notch, as 121, to receive a stud or pin 122, carried by a locking arm or lever 123, the said lever being acted upon by a spring 124, which causes the stud or pin to bear against the periphery of the stop-disk and to enter the said notch when the latter presents itself, in order thereby to hold the change-shaft from further rotation. In consequence of the fact that the weft-indicator mechanism is actuated at a definite point in the revolution of the cam-shaft, while the change-shaft is stopped always in a definite position, thereby causing the loose sprocket-wheel 87 and connected clutch member to stop also, with the tooth 90 in a given position, and of the further fact that each clutch member is provided with but a single tooth, it is evident that the change-shaft will always be started when the lay is at a definite point in its movement.

In order to afford ample opportunity for the performance of the various operations which are incidental to the replenishment of the working weft-supply and secure the desired ease and safety of action in effecting replenishment, the actuating mechanism for the replenishing instrumentalities is constructed and combined in the manner described elsewhere herein to extend the operations of the said replenishing instrumentalities throughout a greater number of revolutions of the crank-shaft of the loom than two. It will be apparent from what has preceded herein that during this time certain of the usual working members of the loom will continue in motion, among them being included the weft-indicating devices. Inasmuch as the weft-indicating devices act at every other revolution of the crank-shaft, it will follow, from the fact that no weft or filling is being introduced during the working of the replenishing instrumentalities, that the said devices will rock the rock-shaft 104 several times before the normal working of the loom is resumed, each movement of the said rock-shaft serving to advance the cam-disk 109 one step. The low spaces 112 112 between the cam projections 111 111 of the cam-disk 109 accordingly are respectively of an extent which is proportionate to the number of revolutions of the crank-shaft before the change-shaft has completed its revolution in order to provide for these idle actions of the weft-indicator devices. So long as one of the said low spaces 112 is presented to the arm 113 of the change rock-shaft

95 the spring 97 is free to act to return the said rock-shaft to its normal position and open the change-clutch as soon as the catch 15 is disengaged from the arm 114 on the rock-shaft 95. I term the cam-disk 109 a "device for intermitting the action of the weft-indicating devices upon the change rock-shaft."

One aim of the present invention is to provide means for causing the first pick of weft after the replenishment of the working weft-supply to be introduced into a predetermined shed in the warps in order to obviate as far as possible breaks in the weave of the fabric being produced. To this end the instrumentalities of my improved loom are contrived and combined to introduce the first pick of fresh weft into a reopening of that shed in the round or cycle of shed formations which was deficient in its supply of weft or filling at the time of the detecting action of the weft-indicating devices which brought about the weft replenishment. In the illustrated embodiment of the invention the weft-indicating devices act to feel for the weft after each pick of the working shuttle from the change end of the loom to the driving end thereof, and should the weft or filling be absent from in front of the weft-fork at such time the said devices bring about the change in the running of the loom, the arrest of the picking, and the replenishment of the working weft-supply through the agency of the various instrumentalities which have been described. The shed for which the weft-indicating devices act in order to occasion the working just described may be termed the "first" shed of a given cycle or round of shed formations. In accordance with the invention the revolution of the change-shaft and the action of the instrumentalities connected therewith for controlling the driving, the picking, and the weft replenishing are timed to keep the loom running at slow speed with the picking arrested, the replenishment of the working weft-supply being effected, meanwhile, for a plurality of shed formations, beginning the count with the said first or deficient shed and to restore the full speed of the loom and restart the picking in season to cause the first pick of the fresh weft to be laid into a reopening of the said first shed. Thereby the picking is suspended at time of replenishment for a plurality of rounds of picking (each round comprising a pick from change end of the loom to driving end thereof and a pick back to change end) and restarted at the end of a round or cycle of shed formations or a multiple of such round or cycle greater than two shed formations, counting from a deficient shed, to introduce the first pick of fresh weft into a reopening of the predetermined shed.

The embodiment of the invention which is illustrated in the drawings has been designed with especial reference to the employment of either two, three, or six harnesses, the parts being constructed and combined to restart the picking and the normal working of the



loom after a suspension of the picking, including the sixth shed formation. As will be obvious, when six harnesses are employed the operation of the described embodiment of the invention will cause a suspension of the picking for just one round or cycle of shed formations. When either two or three harnesses are employed in connection with the said embodiment, it will be obvious that the resumption of weaving will be effected after a number of shed formations corresponding with a multiple of the number of harnesses in use. The seventh shed is a repetition of the first, with which the count is begun, whether two, three, or six harnesses be employed, and consequently in cases where the deficiency of weft occurs in the said first shed the weaving will be resumed by the pick through the seventh shed without any break in the continuity of the weave of the fabric being produced.

In the present case in order to secure the resumption of the normal working of the loom in season for the seventh pick the change-shaft is driven from the cam-shaft at half the speed of the latter, thereby causing the change-shaft to make one revolution to four revolutions of the crank-shaft. The goose-neck engages with the weft-fork and acts to move the weft-fork slide forward in the loom at about the time of the second pick of the failed shuttle. The next four picks are occupied by the working of the replenishing devices, the loom being changed to slow speed and the picking arrested, as above described, after which the normal working is instituted again in season for the seventh pick, as explained.

The operation of recovering the deficient shed—i. e., the shed which is lacking in its supply of weft or filling—is known in the art as "pick-finding." The devices of the present case which cooperate in the recovery of the required shed—that is, in providing for the introduction of the first pick of fresh weft into the predetermined shed—may be termed for the purposes of this case "pick-finding instrumentalities."

When using more than three harnesses, except where six harnesses are employed, I contemplate sometimes varying the relative speed at which the change-shaft is driven through change in the driving connections in order to secure the desired results—that is to say, in order to restart the picking at the end of a round or cycle of shed formations or a multiple of such round or cycle. I prefer, however, to retain in the loom the same driving connections and continue to drive the change-shaft at the same relative speed as in the present case and to secure the required number of shed formations prior to the resumption of weaving, beginning the count with a deficient shed, by permitting the weft-indicating devices to act idly one or more times before the change-clutch is closed. This may be effected by simply increasing the extent of the spaces 112 112 between the projections 111 111 on the

cam-disk 100, so as to permit the said cam-disk to be advanced one or more steps before one of the said projections is brought against the arm 113 of the change rock-shaft 95. This will permit movement of the loom at regular speed for two or more revolutions of the crank-shaft after the action of the weft-indicating devices before the speed of the loom is reduced, &c.

The rotation of the change-shaft begins before the spent or failed shuttle has completed its return from the end of the loom at which in the present case the weft-fork is located to the change end or supply end. It is conceivable that the said shuttle may fail to complete such return and may be trapped in the shed. If such is the case, the trapping of the shuttle will happen after the change-shaft has started to rotate. In order to provide against such a contingency, the cams 34 and 35, which effect the transfer of the driving-bands, are set or timed so that the said bands shall not be shifted or transferred until after the loom has passed the bottom center succeeding the action of the weft-fork. In other words, the belt-shifters 39 and 44 will not be moved until after the lay in its forward movement has carried the dagger 125 beyond the engaging portion of the frog 126. Consequently should the shuttle have been trapped in the shed on its return to the change end or supply end the dagger will engage with the frog and knock off the loom before the rotation of the change-shaft has progressed far enough to cause the shifter-cams 34 35 to actuate the belt-shifters.

The loom will be provided in practice with a number of shuttles which are intended to come successively into use, as many as from four to six reserve shuttles sometimes being placed in the hopper 15 at one time. (See Fig. 1.) It is very difficult or practically impossible to get shuttles which all size up exactly alike, and while in use different shuttles wear differently, so that their thickness is found to vary from time to time. Different sizes of shuttles will fit differently in the shuttle-box, and consequently will not enter or be retained therein exactly the same. Consequently in the course of the working of the loom the latter is likely to slam off frequently owing to the rebounding of a shuttle which is not held tightly enough by the pressure of the swell or binder. Furthermore, when a reserve shuttle is introduced into the shuttle-box at the change end or supply end of the loom it is of necessity placed somewhat in advance of the picker. It will be remembered, moreover, that the picker commonly has a hole of some depth worn in its striking-face by contact with the tip of the shuttle. Thus in making the first pick with the freshly-supplied shuttle the picker will travel an inch or so before it encounters the shuttle, and this will result in giving a less effective driving blow than usual. To offset this loss in efficiency, it is necessary to set the picking mechanism to act with enough power



to drive the shuttle into the opposite box from the position which is taken by such shuttle when applied by the injector. Thus it is evident that during the normal working of the loom the shuttle is driven with slightly more force than necessary. This means that the swells or binders must be set to act with greater force in order to prevent rebound of the shuttle; but this involves greater rack and strain on the loom in picking and a greater liability to break picker-sticks and other parts.

In accordance with one part of my present invention I provide means for permitting the swells or binders to be set to act with sufficient force to counteract all variations in the sizes of the shuttles, whereby tendency of a small shuttle to rebound shall be overcome, and also for permitting the shuttle to be picked with proper force to meet all requirements, while relieving the rack and strain incident to picking with increased power. To these ends I combine with the protector devices a means of operating the same to permit the full pressure of the swells or binders to exert itself as the shuttle enters a box and to remove or relieve the greater portion of the pressure at the time when the pick takes place. Thus on one of the pitmen or connecting-rods 6 I pivot a lever 127, (see Fig. 2,) one arm of which engages with the adjacent protector-finger 30. The other arm of the said lever by the swing of the said connecting-rod in the rearward movement of the lay is caused to bear against a cam, as 128, fixed upon the loom-frame. Thereby the said lever is turned upon its pivot 129 on the said connecting-rod and caused to take the pressure of the protector-fingers off the swells or binders by rocking the protector-shaft just prior to the pick, after which the pressure is allowed to act again before the entrance of the shuttle into the opposite box. This enables me to exert an excess of pressure on the swells or binders and an excess of power on the picker-sticks without fear of racking the loom in the action of picking or causing breakage, and this is especially necessary in a loom having a hopper or magazine receiving a plurality of shuttles which vary in size and weight.

A modification of the speed-reducing devices is shown in Figs. 10 and 11. In these figures I mount upon the crank-shaft 7, at opposite sides of the usual fast band-pulley 8, two band-pulleys 130 and 131, respectively. The band-pulley 131 is an ordinary loose or idle pulley. The band-pulley 130 is also free to turn loosely on the crank-shaft, it having fast therewith a sprocket-wheel 133. Around the said sprocket-wheel 133 and also around a larger sprocket-wheel 135, loose on cam-shaft 12, a sprocket-chain 134 passes. Fast with sprocket-wheel 135 is a smaller sprocket-wheel 136, around which and a large sprocket-wheel 138, mounted loosely on the crank-shaft 7, a sprocket-chain 137 passes. To the said

loose sprocket-wheel 138 a series of gravitating dogs or pawls 139 139 is pivoted, the same being adapted for engagement with the teeth of a ratchet-wheel 140, which is fast upon the crank-shaft. 151 designates a single belt-shifter which is affixed to a sleeve 142, mounted loosely on the shaft 38 of the shipper-handle, the said sleeve having affixed thereto an arm, as 143, which is borne by a spring 144 toward a cam-disk 145, mounted upon change-shaft 33. While the change-shaft is at rest during the normal working of the loom, the action of spring 144 causes the end of the arm 145 to stand in a notch or depression 146 in the said cam-disk and the belt-shifter 151 holds the driving-band on the fast band-pulley 8. During this time the loom is being driven at its normal high-running speed, and ratchet-wheel 140 turns freely within the series of dogs or pawls 139 139, the sprocket-wheel 138, by which such dogs or pawls are carried, remaining stationary meanwhile. When the change-shaft begins to rotate, the cam-disk 145 operates to move the belt-shifter 151, so as to transfer the driving-band onto the band-pulley 130, whereupon the arrangement of sprocket-wheels and sprocket-chains will be thrown into operation, the result of which will be that sprocket-wheel 138, with its series of dogs or pawls 139 139, will be set to turning slowly in the direction in which the crank-shaft is revolving. So long as the momentum of the loom continues to turn ratchet-wheel 140 at a higher rate of speed than the sprocket-wheel 138 the teeth of the ratchet-wheel 140 will simply pass the said dogs or pawls; but as the speed of the loom slackens, so that the crank-shaft tends to turn more slowly than the sprocket-wheel 138, then the said dogs or pawls will take hold of the said teeth and act as drivers to continue the revolution of the crank-shaft and the working of the loom, but at a predetermined low rate of speed. The collar 147, fast on shaft 38, is provided with projecting finger 148 to be engaged by the shoulder or projection 149 on the forward end of the sleeve. So long as the shipper-handle 14 remains seated in its holding-notch in plate 141 at the end of the breast-beam, the said notch being in this embodiment of the invention at the outer end of the slot in said plate instead of at the inner end of such slot, as in the case of the embodiment first described, the spring 144 is prevented from carrying the belt-shifter 151 inward beyond the position thereof which places the driving-band on the fast-pulley 8. When, however, the shipper-handle is disengaged from its holding-notch aforesaid, the said spring is permitted to turn both the sleeve and the shaft 38 inwardly until belt-shifter 151 places the driving-band upon the loose or idle band-pulley 131, and thereby deprives the loom of its driving-power, the end of arm 143 passing at this time farther through the notch or opening 146 of the cam-disk 145.

I claim as my invention—



1. In a loom, weft-replenishing mechanism, driving mechanism to drive the loom at a high speed for regular working and also at a definite reduced rate of speed during replenishment, and weft-indicator devices controlling the working of the said mechanisms, all combined and operating to reduce the speed of the loom to the said definite lower rate for the performance of the operations incident to replenishment and to restore the speed to the normal rate of running after such operations have been performed.

2. In a loom, weft-replenishing mechanism comprising essentially a holder for a reserve supply and means to effect replenishment by transfer therefrom, driving mechanism to drive the loom at a high speed for regular working and at a reduced speed during replenishment, and weft-indicator devices controlling the working of the said mechanisms, combined and operating to reduce the speed of the loom for the performance of the operations incident to replenishment and to restore the normal high speed after such performance.

3. In a loom, the lay, weft-replenishing mechanism comprising essentially a holder for a reserve supply independent of the lay and means to feed from the said holder to the lay, driving mechanism to drive the loom at a high speed for regular working and at a reduced speed during replenishment, and weft-indicator devices controlling the working of the said mechanisms, combined and operating to reduce the speed of the loom for the performance of the operations incident to replenishment and to restore the normal high speed after such performance.

4. In a loom, the lay, weft-replenishing mechanism comprising essentially a holder for reserve shuttles independent of the lay and means for replacing the spent or failed shuttle on the lay by a reserve shuttle from the said holder, driving mechanism to drive the loom at a high speed for regular working and at a reduced speed during replenishment, and weft-indicator devices controlling the working of the said mechanisms, combined and operating to reduce the speed of the loom for the performance of the operations incident to replenishment and to restore the normal high speed after such performance.

5. In a loom, in combination, weft-replenishing mechanism, driving mechanism having separate fast and slow speed transmitting devices both making positive connection with the driving shaft of the loom, a shifter device to control the action of said driving mechanism, weft-indicator devices, and means under the control of the said weft-indicator devices to actuate the said shifter device and the weft-replenishing mechanism, the said means acting to cause the shifter device to be moved to restart the loom under normal working conditions after the operation of the weft-replenishing mechanism.

6. In a loom, in combination, weft-replen-

ishing mechanism, comprising essentially a holder for a reserve supply and means to effect replenishment by transfer therefrom, loom-driving mechanism having a shifter device to control the action thereof, weft-indicator devices, and means under the control of the said weft-indicator devices for causing the said shifter device to be actuated to occasion a dwell in the regular working of the loom, the weft-replenishing mechanism to perform its operations, and the shifter device to be moved to restart the loom under normal working conditions after such performance, substantially as described.

7. In a loom, in combination, the lay, weft-replenishing mechanism comprising essentially a holder for a reserve supply independent of the lay and means to feed therefrom to the lay, loom-driving mechanism having a shifter device to control the action thereof, weft-indicator devices, and means under the control of the said weft-indicator devices for causing the said shifter device to be actuated to occasion a dwell in the regular working of the loom, the weft-replenishing mechanism to perform its operations, and the shifter device to be moved to restart the loom under normal working conditions after such performance, substantially as described.

8. In a loom, in combination, the lay, weft-replenishing mechanism comprising essentially a holder for reserve shuttles independent of the lay and means providing for replacing the spent or failed shuttle on the lay by one from the said holder, loom-driving mechanism having a shifter device to control the action thereof, weft-indicator devices, and means under the control of the said weft-indicator devices for causing the said shifter device to be actuated to occasion a dwell in the regular working of the loom, the weft-replenishing mechanism to perform its operations, and the shifter device to be moved to restart the loom under normal working conditions after such performance, substantially as described.

9. In a loom, in combination, loom-driving mechanism having a shifter device to control the action thereof, picking mechanism, weft-replenishing mechanism, weft-indicator devices, and means under the control of the weft-indicator devices for causing the said shifter device to be actuated to occasion a dwell in the regular working of the loom, the weft-replenishing mechanism to perform its operations, the picking of the shuttle to be arrested during such performance, and the shifter device to be moved to restart the loom under normal working conditions after such performance, substantially as described.

10. In a loom, in combination, loom-driving mechanism having a shifter device to control the action thereof, picking mechanism, weft-replenishing mechanism comprising essentially a holder for a reserve supply and means to effect replenishment by transfer therefrom, weft-indicator devices, and means un-



der the control of the weft-indicator devices for causing the said shifter device to be actuated to occasion a dwell in the regular working of the loom, the weft-replenishing mechanism to perform its operations, the picking of the shuttle to be arrested during such performance, and the shifter device to be moved to restart the loom under normal working conditions after such performance, substantially as described.

11. In a loom, in combination, loom-driving mechanism having a shifter device to control the action thereof, picking mechanism, weft-replenishing mechanism comprising essentially a holder for a reserve supply independent of the lay, and means to feed therefrom to the lay, weft-indicator devices, and means under the control of the weft-indicator devices for causing the said shifter device to be actuated to occasion a dwell in the regular working of the loom, the weft-replenishing mechanism to perform its operations, the picking of the shuttle to be arrested during such performance, and the shifter device to be moved to restart the loom under normal working conditions after such performance, substantially as described.

12. In a loom, in combination, loom-driving mechanism having a shifter device to control the action thereof, picking mechanism, weft-replenishing mechanism comprising essentially a holder for reserve shuttles independent of the lay and means providing for replacing the spent or failed shuttle on the lay by one from the said holder, weft-indicator devices, and means under the control of the weft-indicator devices for causing the said shifter device to be actuated to occasion a dwell in the regular working of the loom, the weft-replenishing mechanism to perform its operations, the picking of the shuttle to be arrested during such performance, and the shifter device to be moved to restart the loom under normal working conditions, after such performance, substantially as described.

13. In a loom, in combination, weft-replenishing mechanism, driving mechanism to drive the loom at a high speed for regular working and at a reduced speed during replenishment, picking mechanism, weft-indicator devices, and means under the control thereof for causing the speed of the loom to be reduced for the performance of the operations incident to replenishment, the picking of the shuttle to be arrested during such performance, and the replenishment to be effected, and for restarting the loom under normal working conditions and speed after such performance.

14. In a loom, in combination, weft-replenishing mechanism comprising essentially a holder for a reserve supply and means to effect replenishment by transfer therefrom, driving mechanism to drive the loom at a high speed for regular working and at a reduced speed during replenishment, picking mechanism, weft-indicator devices, and means un-

der the control thereof for causing the speed of the loom to be reduced for the performance of the operations incident to replenishment, the picking of the shuttle to be arrested during such performance, and the replenishment to be effected, and for restarting the loom under normal working conditions and speed after such performance.

15. In a loom, in combination, the lay, weft-replenishing mechanism comprising essentially a holder for a reserve supply independent of the lay and means to feed therefrom to the lay, driving mechanism to drive the loom at a high speed for regular working and at a reduced speed during replenishment, picking mechanism, weft-indicator devices, and means under the control thereof for causing the speed of the loom to be reduced for the performance of the operations incident to replenishment, the picking of the shuttle to be arrested during such performance, and the replenishment to be effected, and for restarting the loom under normal working conditions and speed after such performance.

16. In a loom, in combination, the lay, weft-replenishing mechanism comprising essentially a holder for reserve shuttles independent of the lay and means providing for replacing the spent or failed shuttle on the lay by one from the said holder, driving mechanism to drive the loom at a high speed for regular working and at a reduced speed during replenishment, picking mechanism, weft-indicator devices, and means under the control thereof for causing the speed of the loom to be reduced for the performance of the operations incident to replenishment, the picking of the shuttle to be arrested during the said replenishment and the latter to be effected and for restarting the loom under normal working conditions and speed after such performance.

17. In a loom, in combination, weft-replenishing mechanism, driving mechanism to drive the loom at a high speed for regular working, and also at a definite reduced rate of speed during replenishment, picking mechanism, weft-indicator devices, and means under the control thereof for causing the speed of the loom to be reduced for the performance of the operations incident to replenishment, the picking of the shuttle to be arrested during such performance, and the replenishment to be effected, and for restarting the loom under normal working conditions and speed after such performance.

18. In a loom, in combination, weft-replenishing mechanism comprising essentially a holder for a reserve supply and means to effect replenishment by transfer therefrom, driving mechanism to drive the loom at a high speed for regular working and also at a definite reduced rate of speed during replenishment, picking mechanism, weft-indicator devices and means under the control thereof for causing the speed of the loom to be reduced for the performance of the operations



incident to replenishment, the picking of the shuttle to be arrested during such performance, and the replenishment to be effected, and for restarting the loom under normal working conditions and speed after such performance.

19. In a loom, in combination, the lay, weft-replenishing mechanism comprising essentially a holder for a reserve supply independent of the lay and means to feed therefrom to the lay, driving mechanism to drive the loom at a high speed for regular working and also at a definite reduced rate of speed during replenishment, picking mechanism, weft-indicator devices, and means under the control thereof for causing the speed of the loom to be reduced for the performance of the operations incident to replenishment, the picking of the shuttle to be arrested during such performance, and the replenishment to be effected, and for restarting the loom under normal working conditions and speed after such performance.

20. In a loom, in combination, the lay, weft-replenishing mechanism comprising essentially a holder for reserve shuttles independent of the lay and means providing for replacing the spent or failed shuttle on the lay by one from the said holder, driving mechanism to drive the loom at a high speed for regular working and also at a definite reduced rate of speed during replenishment, picking mechanism, weft-indicator devices, and means under the control thereof for causing the speed of the loom to be reduced for the performance of the operations incident to replenishment, the picking of the shuttle to be arrested during the said replacing, and the replenishment to be effected, and for restarting the loom under normal working conditions and speed after such performance.

21. In a loom, in combination, weft-indicating devices, a change-shaft, means for rotating the change-shaft under the control of the said weft-indicating devices, weft-replenishing mechanism operated from the said change-shaft, and driving means for the loom having a shifter device to control the action thereof, the said shifter device being itself controlled from the change-shaft, substantially as described.

22. In a loom, in combination, driving means therefor having a shifter device to control the action of such means, weft-indicating devices, a change-shaft, means for rotating the change-shaft under the control of the said weft-indicating devices, weft-replenishing mechanism having its operation occasioned by the said change-shaft and comprising essentially a holder for a reserve supply and means to effect replenishment by transfer therefrom, and means for operating the said shifter device from the change-shaft, substantially as described.

23. In a loom, in combination, driving means therefor having a shifter device to control the action of such means, weft-indicating devices,

a change-shaft, means for rotating the change-shaft under the control of the weft-indicating devices, weft-replenishing mechanism having its operation occasioned by the said change-shaft and comprising essentially a holder for a reserve supply independent of the lay and means to feed therefrom to the lay, and means for operating the said shifter device from the change-shaft, substantially as described.

24. In a loom, in combination, driving means therefor having a shifter device to control the action of such means, weft-indicating devices, a change-shaft, means for rotating the change-shaft under the control of the weft-indicating devices, weft-replenishing mechanism having its operation occasioned by the said change-shaft and comprising essentially a holder for reserve shuttles independent of the lay and means providing for replacing the spent or failed shuttle on the lay by one from the said holder, and means for operating the said shifter device from the change-shaft, substantially as described.

25. In a loom, in combination, weft-indicating devices, a change-shaft, means for operating the said change-shaft under the control of the said weft-indicating devices, driving mechanism to drive the loom at a high speed for regular working and also at a reduced rate of speed during replenishment, shifter devices controlled by the said change-shaft to effect the changes of speed, and weft-replenishing mechanism operated from the said change-shaft.

26. In a loom, in combination, weft-indicating devices, a change-shaft, means for operating the said change-shaft under the control of the said weft-indicating devices, driving mechanism to drive the loom at a high speed for regular working and also at a reduced rate of speed during replenishment, shifter devices controlled by the said change-shaft to effect the changes of speed, picking mechanism, means operated by the change-shaft to discontinue and restart the picking, and replenishing mechanism operatively connected with the said change-shaft.

27. In a loom, in combination, weft-indicating devices, a change-shaft, means for rotating the said change-shaft under the control of the said weft-indicating devices, driving mechanism to drive the loom at a high speed for regular working and also at a reduced rate of speed during replenishment, shifter devices operated by the said change-shaft to effect the changes of speed, picking mechanism, means operated by the change-shaft to discontinue the picking prior to the replenishment and restart it subsequently thereto, and weft-replenishing mechanism comprising essentially a holder for a reserve supply and means operatively connected with the change-shaft to effect replenishment by transfer from the said holder.

28. In a loom, in combination, the lay, weft-indicating devices, a change-shaft, means for rotating the said change-shaft under the con-



5 control of the said weft-indicating devices, driving mechanism to drive the loom at a high speed for regular working and also at a reduced rate of speed during replenishment, shifter devices operated by the said change-shaft to effect the changes of speed, picking mechanism, means operated by the said change-shaft to discontinue the picking prior to the replenishment and restart it subsequently thereto, and weft-replenishing mechanism comprising essentially a holder for reserve shuttles independent of the lay, and means operatively connected with the said change-shaft for effecting replenishment by replacing a spent or failed shuttle on the lay by a reserve shuttle from the said holder.

20 29. In a loom, in combination, weft-indicating devices, the change-shaft, means for rotating the same under the control of the said weft-indicating devices, the holder for shuttles, the lay and its shuttle-box, and means operated from the said change-shaft for opening the shuttle-box to permit the ejection of the spent or failed shuttle and the transfer of a reserve shuttle from the holder, and also for effecting such ejection and transfer, substantially as described.

30 30. In a loom, in combination, weft-indicating devices, the change-shaft, means for rotating the same under the control of the said weft-indicating devices, the holder for shuttles, the lay and its shuttle-box, the swell or binder, means operated from the said change-shaft for relieving the pressure of the protector-finger on the swell or binder, for opening the shuttle-box to permit the ejection of the spent or failed shuttle and the transfer of a reserve shuttle from the holder, and also for effecting such ejection and transfer, substantially as described.

31 31. In a loom, in combination, weft-replenishing devices comprising a holder for a reserve supply independent of the lay and means of transferring from the said holder to the lay, and actuating mechanism for the replenishing devices extending the operations of the said devices throughout a predetermined number of revolutions greater than two of the crank-shaft of the loom.

50 32. In a loom, in combination, weft-replenishing mechanism, picking mechanism, and actuating mechanism extending the operations of the replenishing mechanism throughout more than two revolutions of the crank-shaft of the loom, and suspending the picking during the performance of such operations.

60 33. The combination with the lay, its movable shuttle-box front, the rocker pivotally supported on the lay and having the said front connected therewith, means to move the said rocker, and the ejector, of the bolt or slide connected with the said ejector and moving with the said rocker, and the stop with which the said bolt or slide engages in the movement of the lay in order to effect the action of the ejector.

34. The combination with the lay, its mov-

able shuttle-box front, the rocker pivotally supported on the lay and having the said front connected therewith, means to move the said rocker, and the ejector, of the bolt or slide connected with the ejector and moving with the said rocker, the stop with which the said bolt or slide engages in the movement of the lay in order to effect the action of the ejector, and the spring or springs for effecting the return movement of the ejector.

35. The combination with the lay, its movable shuttle-box front, the rocker pivotally supported on the lay and having the said front connected therewith, means to move the said rocker, and the ejector, of the bolt or slide connected with the said ejector and moving with the said rocker, and the pivoted stop with which the said bolt or slide engages in the movement of the lay in order to effect the action of the ejector.

36. The combination with the lay, the movable shuttle-box front, the rocker pivotally supported on the lay and having the said front connected therewith, a rotatable shaft, a cam thereon, and a lever operated by the said cam, and connected to the said rocker for operating the latter, substantially as described.

37. The combination with the lay, of the ejector working in the shuttle-box on the lay, the change-shaft, and operating devices for the ejector controlled by the change-shaft, substantially as described.

38. The combination with the lay, the movable shuttle-box front, the rocker pivotally supported on the lay and having the said front connected therewith, the swell or binder, the protector-shaft and its finger, the rocker mounted on the lay and acting in connection therewith, a rotatable shaft, cams thereon, levers operated by the said cams, and connections from the said levers to the said rockers for operating the latter, substantially as described.

39. The combination with the lay, its movable shuttle-box front, the rocker pivotally supported on the lay and having the said front connected therewith, the ejector, the bolt or slide connected with the said ejector and moving with the said rocker, the stop with which the said bolt or slide engages in the movement of the lay in order to effect the action of the ejector, the swell or binder, the protector-shaft and its finger, the rocker mounted on the lay and acting in connection therewith, a rotatable shaft, cams thereon, levers operated by the said cams, and connections from the said levers to the said rockers for operating the latter.

40. In combination, the lay, a hopper, an injector for injecting from the said hopper into the shuttle-box on the lay, the change-shaft, means to operate the injector under the control of said change-shaft, means to operate the change-shaft, and weft-indicator mechanism controlling the working of the change-shaft, substantially as described.

41. The combination with the lay, its mov-



able shuttle-box front, and means to operate the latter, of the injector, a rotatable shaft, and means to move the injector to transfer a shuttle to the lay, the said means comprising  
 5 a cam on said shaft, a lever operated by the said cam, and a connection between the said lever and injector including a spring, the said cam being constructed to occasion an excess of movement of the said lever and thereby  
 10 strain the spring to cause the injector to follow the lay rearwardly while pressing against the shuttle and holding it in place until the shuttle-box front is lowered.

42. The combination with the hopper having the discharge-opening at the lower end thereof, of the injector, and operating means therefor whereby the injector is caused to stand normally during the regular working of the loom in an intermediate position supporting the contents of the hopper above the  
 20 said opening, and on being set in action is retracted to permit such contents to descend and then is advanced to transfer or inject from the hopper to the lay, it being afterward  
 25 returned to the said intermediate position.

43. In combination, the lay, an ejector to discharge the spent or failed shuttle from the shuttle-box on the lay, a hopper for reserve shuttles, an injector for transferring or injecting from the said hopper into the shuttle-box, the change-shaft, means to operate the  
 30 ejector and injector under the control of the change-shaft, means to operate the change-shaft, and weft-indicator mechanism controlling the working of the change-shaft, substantially as described.

44. The combination with the hopper having an opening at the bottom thereof for the escape of shuttles, of the injector, the spring  
 40 acting with a tendency to draw the same forward, a rotatable shaft, a cam thereon, and a lever operated by the said cam and connected with the injector, the said cam having a portion thereof acting against the said lever constructed to hold the injector normally  
 45 in an intermediate position supporting the shuttles in the hopper, and also having a drop which permits the injector to be drawn forward by the spring out from under the shuttles in the hopper.

45. In a loom, the combination with one of the rotating shafts thereof, of the change-shaft, driving connections between said shafts embracing the change-clutch, a clutch-shipper, weft-indicating devices, means for operating the said clutch-shipper from the said weft-indicating devices to occasion the working of the change-shaft, and weft-replenishing devices under the operative control of the  
 60 said change-shaft.

46. In a loom, the combination with one of the rotating shafts thereof, of the change-shaft, driving connections between the said shafts embracing the change-clutch, a clutch-shipper, weft-indicating devices, means for operating the said clutch-shipper from the said weft-indicating devices to occasion the

working of the change-shaft, weft-replenishing devices under the operative control of the change-shaft, and means under the control  
 70 of the change-shaft to occasion the unshipping of the change-clutch when the change-shaft has completed the required rotation.

47. In a loom, the combination with one of the rotating shafts thereof, of the change-shaft, devices for driving the latter from the former embracing a normally open change-clutch, a clutch-shipper, weft-indicating devices, means for operating the said clutch-shipper from the said weft-indicating devices  
 80 to occasion the working of the change-shaft, weft-replenishing devices under the operative control of the said change-shaft, a catch to retain the change-clutch in the closed condition which it is caused to assume by the operation of the weft-indicating devices, and means to free the said catch and allow the change-clutch to become disengaged after the desired rotation of the change-shaft has occurred.

48. In a loom, the combination with the cam-shaft, of the change-shaft, devices to drive the latter from the former embracing the normally open change-clutch, the change-rock-shaft to ship and unship the said change-clutch, weft-indicating devices in operative connection with the said rock-shaft, the movable catch for locking the change rock-shaft to hold the change-clutch in closed condition after the operation of the weft-indicating devices, the cam carried by the said change-shaft and operating to disengage the said catch to permit the opening of the change-clutch, and weft-replenishing devices operated from the said change-shaft.

49. In a loom, the combination with the cam-shaft, the change-shaft, driving connections between the said shafts embracing the change-clutch, and weft-replenishing mechanism operated by the said change-shaft, of weft-indicating devices, a pawl actuated at each movement of the weft-indicating devices, a cam operated by the said pawl, and the clutch-shipper operated by the said cam.

50. In a loom, in combination, the cam-shaft, the change-clutch thereon, the change-shaft, driving connections between the said change-shaft and the loose member of the said change-clutch, weft-replenishing mechanism operated by the said change-shaft, weft-indicating devices, a pawl actuated at each movement of the weft-indicating devices, a cam-disk operated by the said pawl and having cam projections, a clutch-shipper having an arm thereof engaged by the said cam projections to actuate the clutch-shipper, a spring acting on the said clutch-shipper, a catch engaging with the said clutch-shipper to retain the change-clutch closed, and a cam carried by the change-shaft to disengage the said catch for the purpose of allowing the change-clutch to be opened.

51. In a loom, in combination, weft-indicating devices, the picking-arm, the picker-



stick, the lug-strap having separable connection with one of the parts which it connects, and means actuated under the control of the weft-indicating devices to determine the transmission of power by the lug-strap.

52. In a loom, the combination with the picking-arm 84, of the picker-stick, the lug-strap having the hook for engagement with a pin or the like carried by the said picking-arm, and means to disengage the said hook from the said pin at certain times in the working of the loom.

53. In a loom, the combination with the picking-arm, and means to operate the same, of the picker-stick, the lug-strap having a separable connection with the said picking-arm, a rotating shaft of the loom, and operating connections between the said shaft and lug-strap to determine the times of the actuation of the lug-strap by the picking-arm.

54. In a loom, the combination with the picking-arm, and means to operate the same, of the picker-stick, the lug-strap having a separable connection with the said picking-arm, the change-shaft, a cam thereon, a lever operated by the said cam, and a connection between the said lever and the lug-strap, whereby the times of the actuation of the picker-stick are determined.

55. In a loom, in combination, the picking-arm, the picker-stick, the lug-strap in separable engagement with one of the said parts, the flexible connection joined to the said lug-strap and extending upwardly therefrom, means acting through the said connection to determine the times for the transmission of power through the said lug-strap, and the guide for restraining the said connection from vibration adjacent the lug-strap.

56. In a loom, the combination with the lay, its shuttle-boxes, the swells or binders thereof, the pressure devices acting against said swells or binders, the picking mechanism, a hopper receiving a plurality of shuttles, and devices by which the said shuttles successively are transferred to the lay, of devices whereby the pressure on the swells or binders is removed prior to the pick and restored before the shuttle completes its flight.

57. In a loom, the combination with the lay, its shuttle-boxes, the swells or binders thereof, the protector-shaft and its fingers acting against the said swells or binders, the lay-pitman or connecting-rod, the lever 127 pivoted thereupon, the cam 128 on a fixed part of the loom and engaged by the said lever in the working of the loom, and the picking mechanism, whereby the pressure upon the swells or binders is removed prior to each pick and restored before the shuttle completes its flight.

58. In a loom, the combination with the lay, its shuttle-boxes, the swells or binders thereof, the protector-shaft and its fingers acting

against the said swells or binders, the lay-pitman or connecting-rod, the lever 127 pivoted thereupon, the cam 128 engaged by the said lever in the working of the loom, picking mechanism, a hopper receiving a plurality of shuttles, and devices by which said shuttles successively are transferred to the lay.

59. In a loom, in combination, weft-indicating devices operative when the condition of the working weft-supply necessitates replenishment thereof, a change-shaft, instrumentalities under the control of said devices to operate the said change-shaft, weft-replenishing instrumentalities under the operative control of the said change-shaft, picking mechanism, and instrumentalities under the control of the change-shaft operative to suspend the picking at the time of effective replenishment.

60. In a loom, in combination, fast and slow speed driving mechanism, weft-replenishing instrumentalities, weft-indicating devices operative when the condition of the working weft-supply necessitates replenishment thereof, instrumentalities under the control of such devices operative to reduce the speed of the loom for the action of the said weft-replenishing mechanism and to occasion such action while the loom is running at its reduced speed, and pick-finding instrumentalities operative to cause the first pick of fresh weft to be laid in the predetermined shed.

61. In a loom, in combination, weft-replenishing instrumentalities, controlling and actuating means therefor operative when the condition of the working weft-supply necessitates replenishment thereof, picking mechanism, and instrumentalities operative to suspend the picking at time of replenishment and subsequently restart the same in season to introduce the first pick of fresh weft into a re-opening of a predetermined shed after a multiple of rounds or cycles of shed formations, counting from a deficient shed.

62. In a loom, in combination, weft-replenishing instrumentalities, controlling and actuating means therefor operative when the condition of the working weft-supply necessitates replenishment thereof, picking mechanism, and instrumentalities operative to suspend the picking at time of replenishment and restart the same at the end of a round or cycle of shed formations or a multiple of such round or cycle, greater than two shed formations, counting from a deficient shed, to introduce the first pick of fresh weft into a re-opening of the predetermined shed.

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

HENRY I. HARRIMAN.

Witnesses:

CHAS. F. RANDALL,  
OSCAR F. HILL.



It is hereby certified that in Letters Patent No. 626,834, granted June 13, 1899, upon the application of Henry I. Harriman, of New York, N. Y., for an improvement in "Looms," an error appears in the printed specification requiring correction as follows: In line 81, page 15, the word "effective" should read *effecting*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 4th day of July, A. D., 1899.

[SEAL.]

WEBSTER DAVIS.

*Assistant Secretary of the Interior*

Countersigned:

C. H. DUELL,

*Commissioner of Patents.*