W. R. BURROWS.

LOOM.

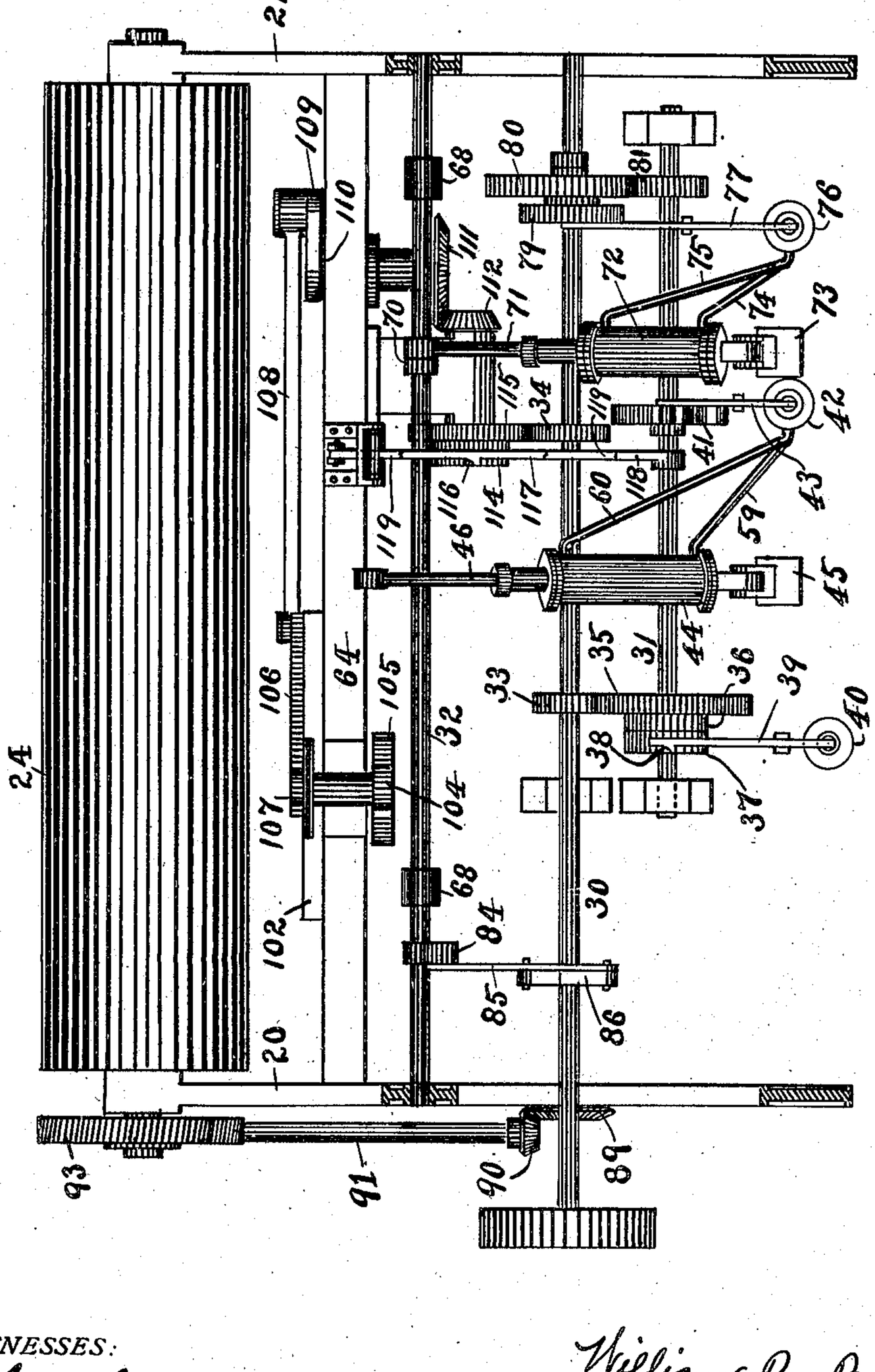
APPLICATION FILED JUNE 21, 1906.

924,142.

Patented June 8, 1909.

6 SHEETS—SHEET 1.

Fig. 1.



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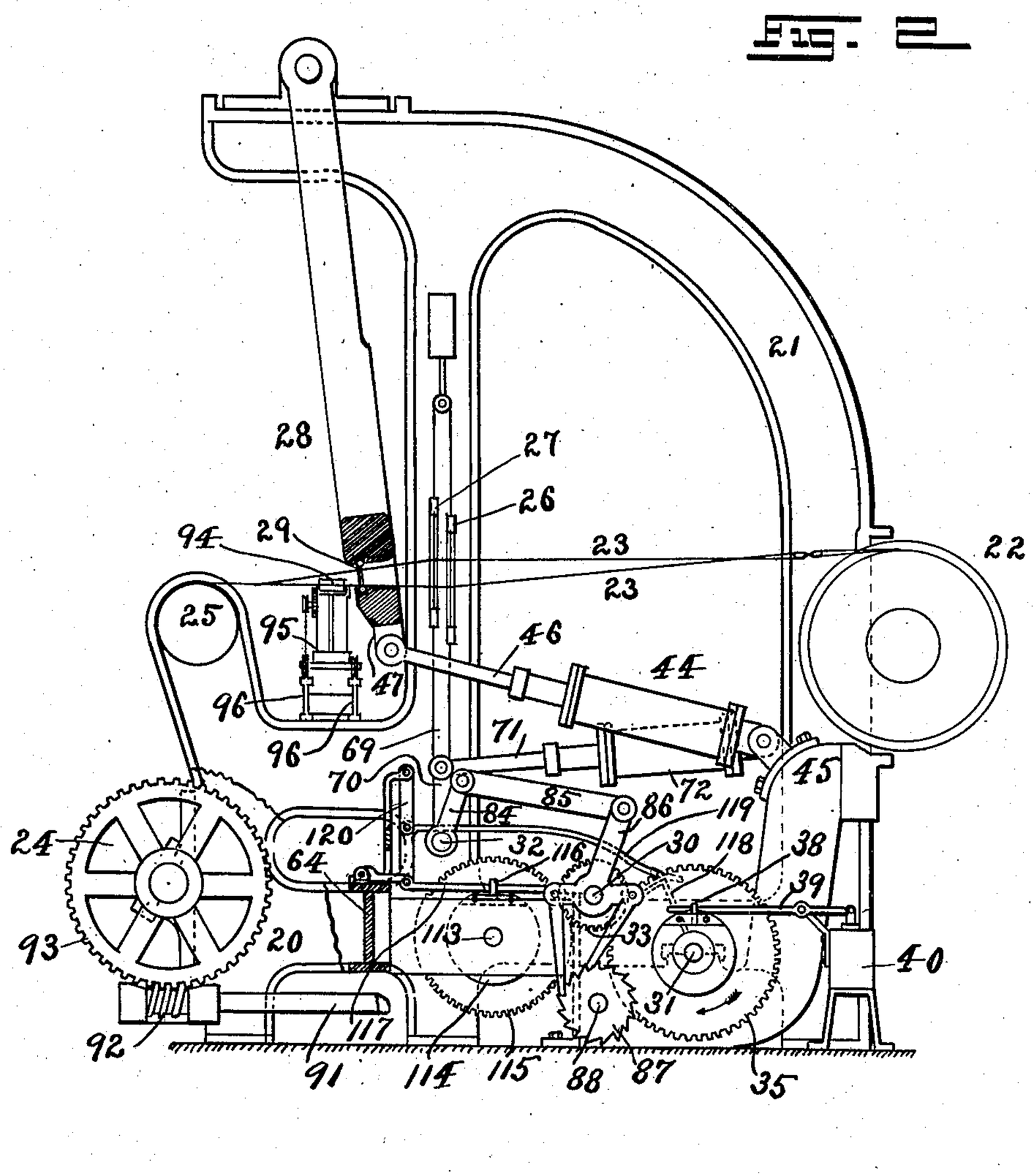
6 SHEETS—SHEET 2.

Fig. 2



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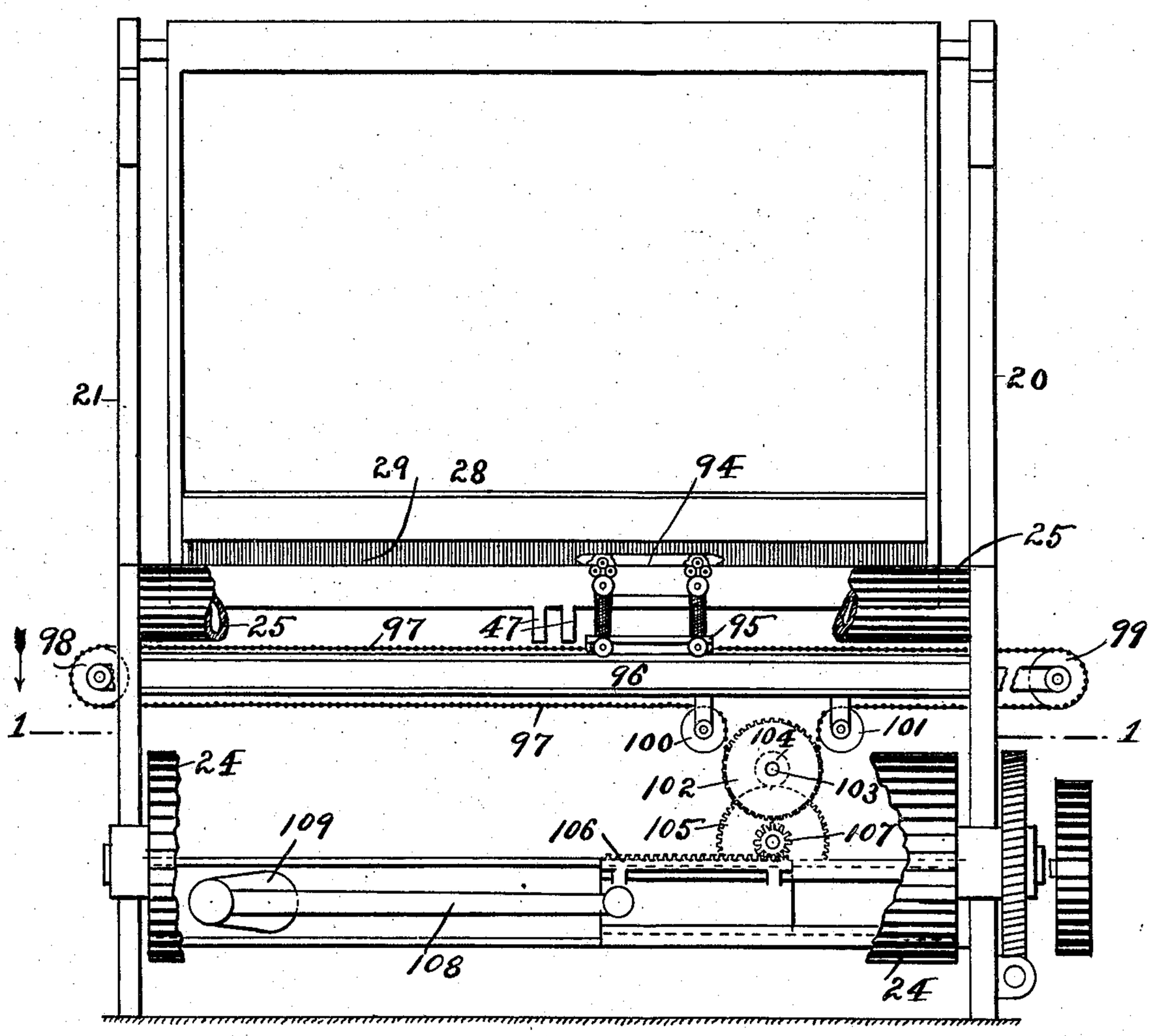
6 SHEETS—SHEET 3.

Fig. 3



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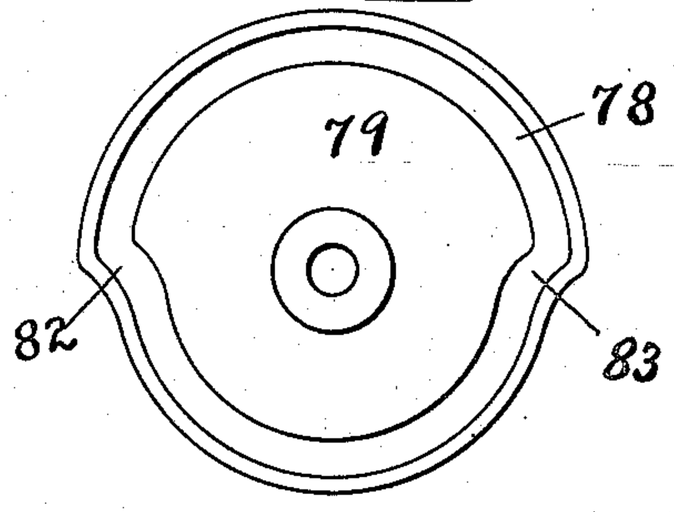
6 SHEETS—SHEET 4.

Fig. 6



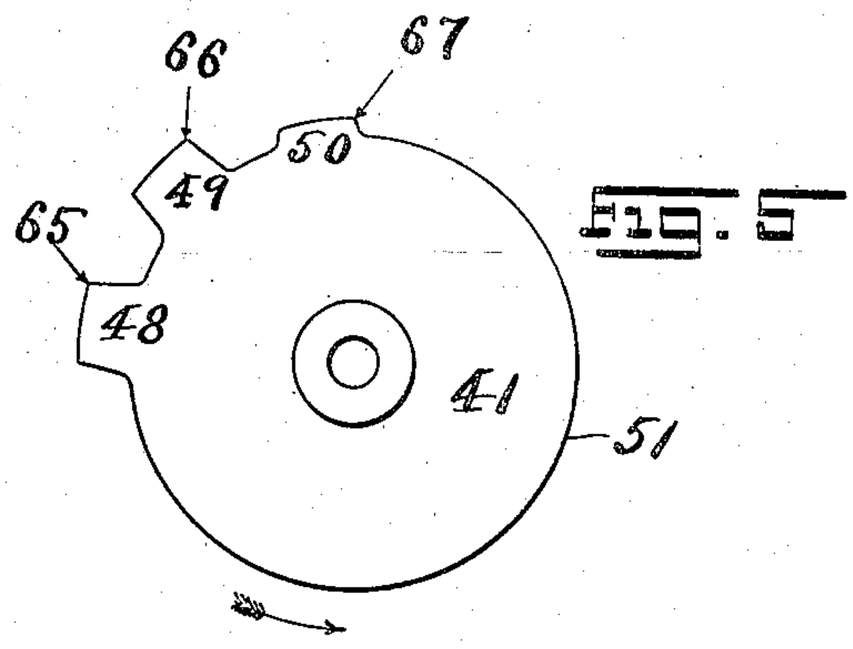


Fig. 5

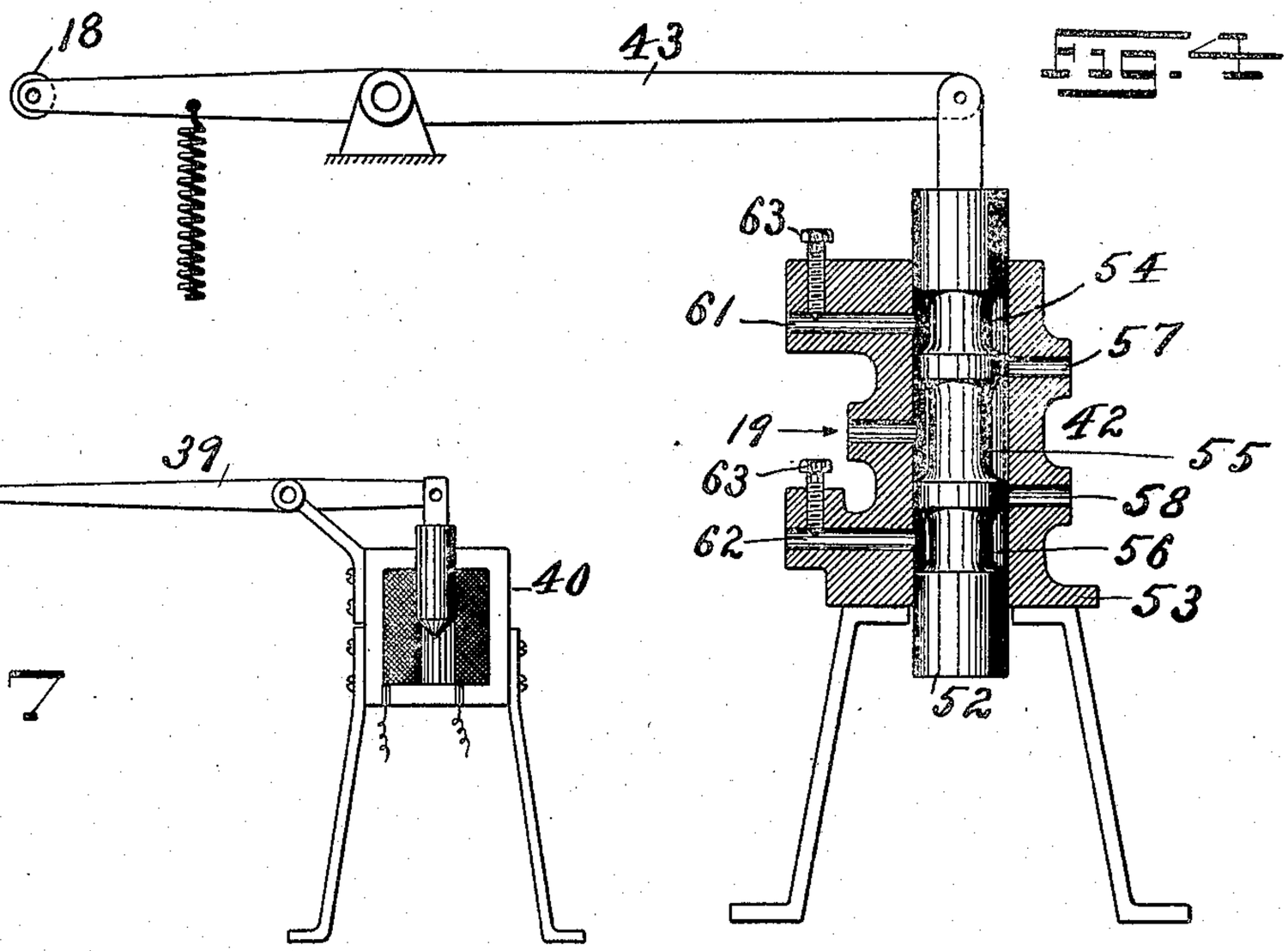


Fig. 4

Fig. 7

Witnesses;
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6 SHEETS—SHEET 5.

Fig. 8

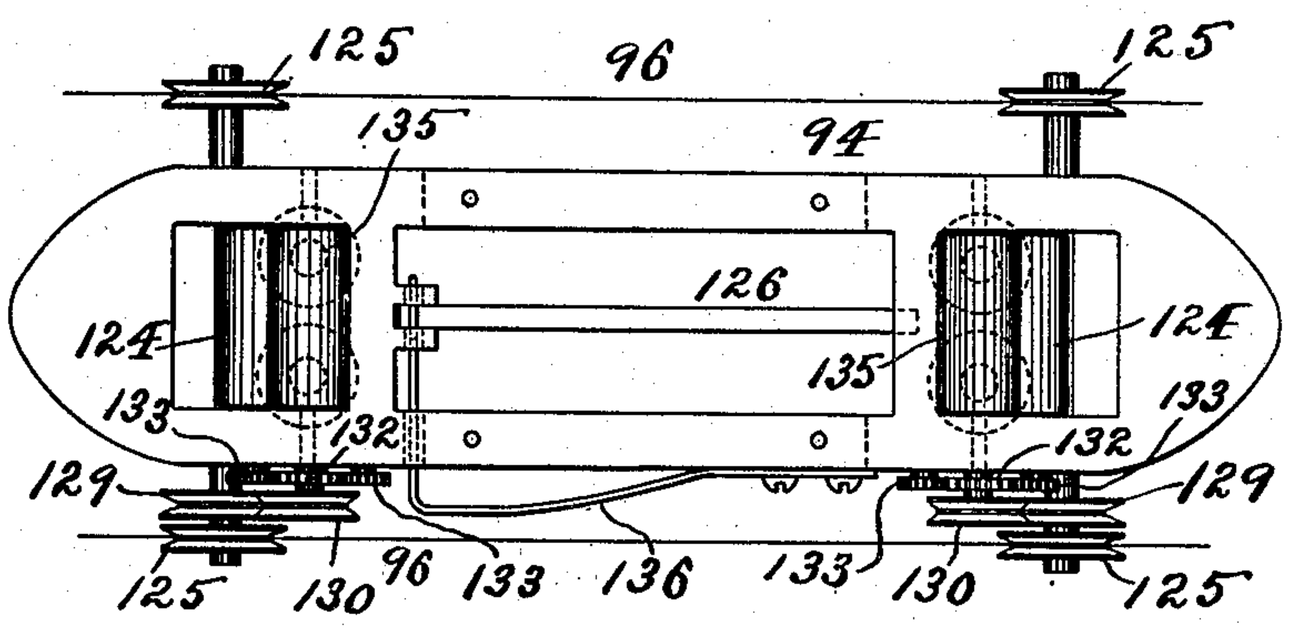
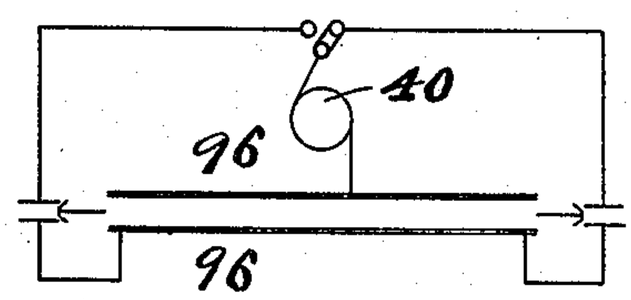


Fig. 10



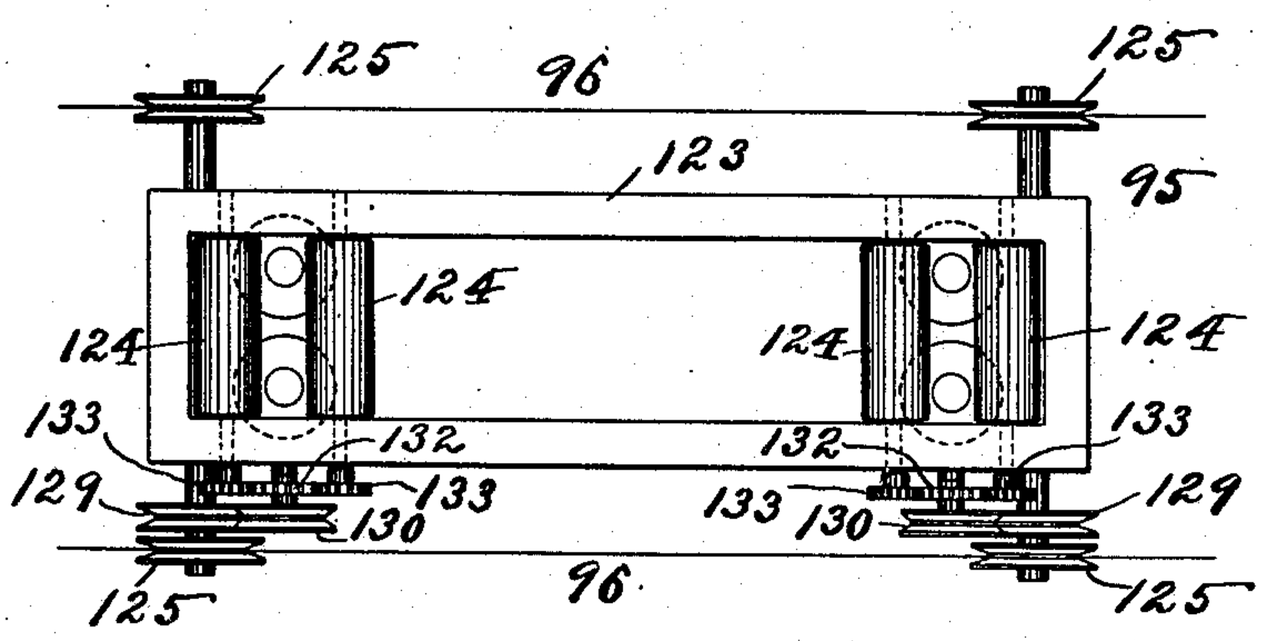


Fig. 9

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6 SHEETS—SHEET 6.

25

Fig. 12

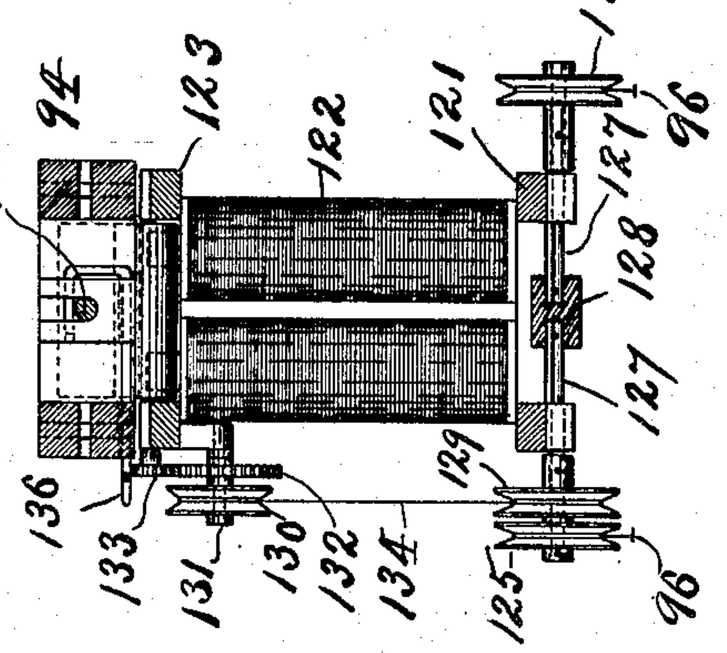


Fig. 11

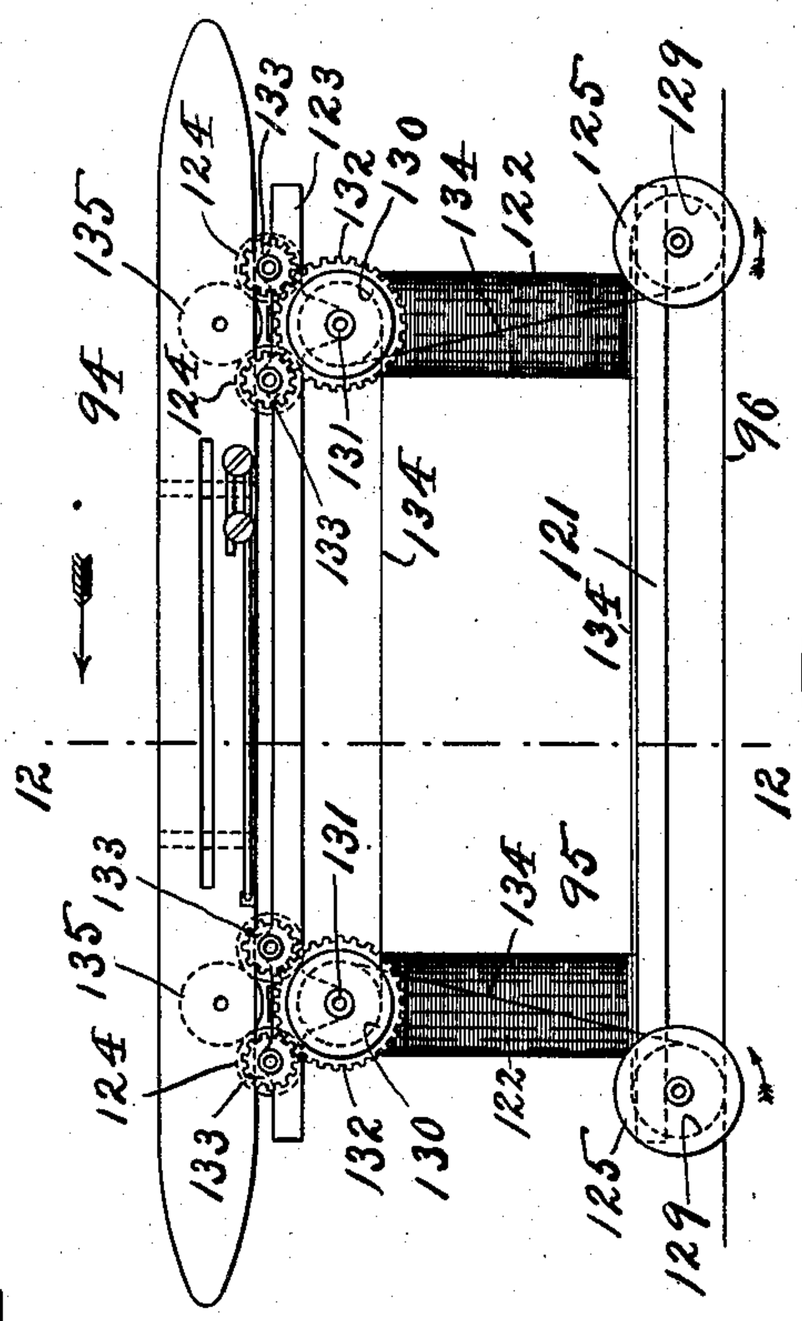


Fig. 15

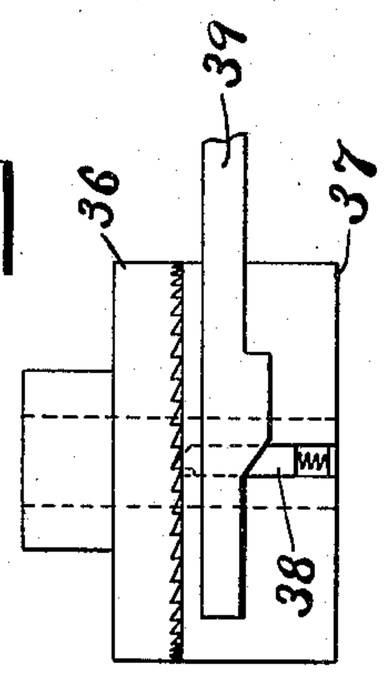


Fig. 13

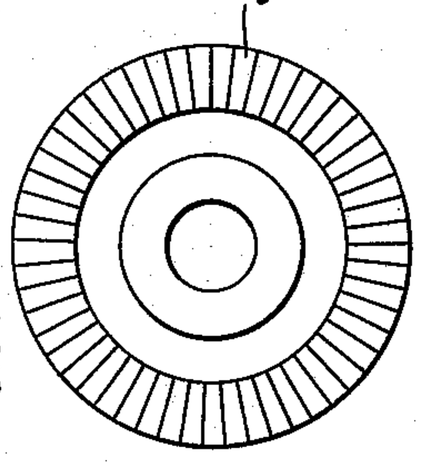
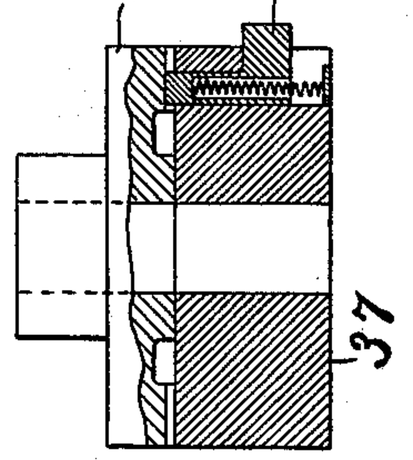


Fig. 14



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UNITED STATES PATENT OFFICE.

WILLIAM R. BURROWS, OF NEWARK, NEW JERSEY.

LOOM.

No. 924,142. Specification of Letters Patent. Patented June 8, 1909.

Application filed June 21, 1906. Serial No. 322,663.

To all whom it may concern:

Be it known that I, WILLIAM R. BURROWS, a citizen of the United States, and a resident of Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Looms, of which the following is a specification.

The invention relates to improvements in looms; and it consists in the novel features, arrangements and combinations of parts hereinafter described, and particularly pointed out in the claims.

I present my invention in this application as embodying certain improvements in the loom made the subject of Letters Patent No. 779,025 granted January 3, 1905 to William R. Burrows. I retain in the present loom many of the features characterizing the loom described in the said Patent 779,025, the novel features of the present loom, aside from details of construction and arrangement to be hereinafter pointed out, residing in pneumatic mechanism designed and provided by me for operating the lay, heddles, and cloth beam and also in a novel construction of carriage for effecting the travel of the shuttle back and forth along its usual path, said carriage carrying electro-magnets and mounted on track rails which are electric conductors. The entire loom in its capability to operate is placed under the control of an electro-magnet which must be energized before the loom can start into operation and be reënergized prior to each successive action of the operative parts of the loom, the circuit through this magnet being broken by the movement of the heddles just before the shuttle starts on its movement and reëstablished by the shuttle on the latter reaching the end of its line of travel. In the absence of the circuit being thus reëstablished by the shuttle the controlling electro-magnet will not become reënergized and the loom will come to a stop.

The features of my present invention involve no change in the electric circuits or in the employment of the control electro-magnet, and hence in the drawings forming a part of this application I indicate only so much of the electric features as may be necessary to an understanding of the special features constituting my present invention.

In accordance with my invention I place the lay-beam and heddles under pneumatic control and actuate them in both their movements by means of compressed air. In respect of the lay-beam I provide a special air valve and controlling cam therefor by which the lay-beam during the operation of the loom, is first driven forwardly against the work, then withdrawn a slight distance and then given a second forward blow, after which said beam is caused to recede to its initial position, the compressed air effecting the two blows of the lay-beam against the work and then operating to force the lay-beam to its initial position and maintain it at such position. The compressed air features connected with the heddles cause them to change between the two blows delivered by the lay-beam against the work at each operative action of the loom.

The carriage carrying the electro-magnets for effecting the travel of the shuttle embodies certain novel features, hereinafter described, for enabling it to effectually compel the proper movement of the shuttle and enable the latter to travel directly upon the warp wires without the interposition of a race between the lower surface of said wires and the upper ends of said magnets.

The invention will be fully understood from the detailed description hereinafter presented, reference being had to the accompanying drawings, in which:

Figure 1 is a top view, partly in section, of a loom constructed in accordance with and embodying the invention, the section being on the horizontal line 1—1 of Fig. 3; Fig. 2 is an end view, partly broken away and partly in section, of same taken from the left hand end of Fig. 1, which is the right hand end of the machine when the latter is viewed from the front thereof; Fig. 3 is a front elevation, partly broken away, of the loom; Fig. 4 is an enlarged detached vertical section through the air valve for controlling the admission of air to and its exhaust from the air cylinder whose piston-rod controls the movement of the lay-beam frame; Fig. 5 is an enlarged detached side elevation, of the cam for controlling the movement of the valve shown in Fig. 4 and effecting the two beats of the lay-beam frame during each operative action of the loom; Fig. 6 is an enlarged side elevation of the cam for controlling the air valve mechanism by which the heddles are caused to reverse between each of the two beats of the lay-beam frame; Fig. 7 is an enlarged vertical section through the control electro-magnet for the entire

loom; Fig. 8 is an enlarged detached view of the shuttle and the carriage for moving the same; Fig. 9 is a top view of the carriage, with the shuttle removed therefrom; Fig. 10 is a diagrammatic view of the electric circuits employed in the loom, these being the same as the electric circuits shown in the aforesaid Letters Patent numbered 779,025; Fig. 11 is an enlarged detached side elevation of the shuttle and the carriage for moving the same; Fig. 12 is a transverse section of same on the dotted line 12—12 of Fig. 11; Fig. 13 is a detached face view of one of the pin-clutch members constituting a part of the operative mechanism of the loom; Fig. 14 is a top view, partly broken away and partly in section, of one of the pin-clutches of the loom, this pin-clutch being of ordinary construction, and Fig. 15 is a top view of same with one portion of a lever arm thereon, the clutch shown in Figs. 13, 14 and 15 substantially corresponding with the pin-clutches disclosed in the aforesaid Letters Patent numbered 779,025 and not claimed herein.

In the drawings, 20 designates the right hand side frame of the loom, looking at the front of the latter, 21 the left hand side frame thereof, 22 the warp-beam, from which the warp wires or threads 23 unwind, 24 the cloth-beam, upon which the finished cloth is wound, 25 the breast-beam, 26 the rear heddle, 27 the front heddle, and 28 the pivotally hung lay-beam frame carrying the reed 29, all of the features just enumerated being in themselves of well known construction and relative arrangement and requiring no special description herein.

30 designates the main power shaft, 31 a rear auxiliary shaft, and 32 a front auxiliary or rock-shaft, from which the heddles are operated and the cloth beam 24 receives its intermittent take up motion.

Upon the shaft 30 are rigidly secured the gear wheels 33, 34, (Figs. 1 and 2), the former of which is in mesh with a gear wheel 35 which is loosely mounted upon the shaft 31 and is rigid with one member 36 (Fig. 14) of a pin-clutch whose other member 37 is rigid on said shaft 31 and carries a pin 38 adapted at the proper time to lock the members 37, 36 together and thus enable the gear wheel 35 to impart its movement to the shaft 31 and parts carried thereby. The shaft 30 and gear-wheels 33, 35 have a constant rotation but impart no motion to the shaft 31 except when the two clutch members 36, 37 are locked together by the pin 38, and these members are normally free of each other because of the presence of the front cam end of the pivoted arm 39 (Fig. 1) against the head of the pin 38. When the front end of the arm 39 is turned upwardly the pin 38 snaps into a socket in the clutch member 36 and thereby the two clutch members 36, 37 become locked together and the motion of the gear wheel 35 is communicated to the shaft 31. The arm 39 is controlled in its movement by the electro-magnet 40, which is the control-magnet for the loom and corresponds with the control-magnet (numbered 41) described in my aforesaid Letters Patent. When the magnet 40 is energized it draws down the rear end of the arm 39 and turns the front end thereof upwardly to free the same from the pin 38, and thereupon the clutch members 36, 37, gear wheel 35 and shaft 31 start in rotation and the pin 38 is carried with the said members. Before the clutch members 36, 37 and shaft 31 perform a complete rotation the magnet 40 becomes deënergized and the front end of the arm 39 descends to its lower position upon the clutch member 37 where its cam surface will lie in the path of the clutch pin 38 and effect the withdrawal of same from the clutch member 36, thereby at the end of each rotation of the shaft 31 cutting off the power from it.

The control-magnet 40, arm 39 and clutch members 36, 37 with their pin 38 correspond with like features fully described in my aforesaid Letters Patent and therefore require no further description here, except that attention may be called to the fact that said electro-magnet 40 must be energized before the loom can start into operation and be reënergized prior to each successive action of the operative parts of the loom, the circuit through this magnet being broken by the movement of the heddles just before the shuttle starts on its movement and reëstablished by the shuttle on the latter reaching the end of its line of travel, as fully described in my aforesaid Letters Patent. The electro-magnet 40 is of the plunger-type (Fig. 7) and of usual commercial construction.

I will first describe the means operable from and during each rotation of the shaft 31 for imparting motion to the lay-beam frame 28, and these means (shown in Fig. 1) comprise a cam 41 (Fig. 5) rigid on said shaft 31, an air-valve 42 (Fig. 4) located near said cam, a lever-arm 43 connected with said valve and engaging said cam, an air-cylinder 44 pivotally mounted at its rear end upon a support 45 and supplied with air through said valve 42, and a piston-rod 46 extending from said cylinder and pivotally secured at its front end between ears 47 (Figs. 2 and 3) provided on the lay-beam frame.

The cam 41 is preferably formed with three projecting portions 48, 49, 50 (Fig. 5) arranged near together and an extended uniform peripheral portion 51, and this cam while rotating carries its periphery against the front end of the valve-arm 43 to control the position of the plunger 52 within its

casing 53, said plunger and casing constituting the valve designated generally hereinbefore as 42. The plunger 52 closely fits within the cylindrical casing 53 and is formed with three annular chambers or grooves 54, 55, 56; and said casing is formed with an inlet 19 for compressed air or other motive fluid leading to the middle chamber 55, two outlets 57, 58 respectively connected by pipes 59, 60 with the opposite ends of the air-cylinder 44, and two exhaust outlets 61, 62 equipped with regulating screws 63. The front end of the valve arm 43 carries a roller 18 (Fig. 4) which is retained against the cam 41 by means of a coiled spring secured at its upper end to said arm and at its lower end to the floor.

While the uniform portion 51 of the cam 41 is moving against the roller 18 the valve arm 43 will be at rest holding the plunger 52 in such position that the compressed air may flow from the inlet 19 through the chamber 55, outlet 57 and pipe 60 into the front end of the cylinder 44, for the purpose of positively holding the lay-beam in its extreme rear position, the air within the rear end of said cylinder 44 being at such time permitted to exhaust through the pipe 59, port 58, chamber 56 and outlet 62.

When the cam 41 carries its projection 48 against the roller 18 at the front end of the valve-arm 43 it depresses the rear end of said arm and thereby moves the plunger 52 downwardly to a sufficient extent to connect (through the annular chamber 55) the inlet 19 with the outlet 58 and pipe 59 leading to the rear end of the cylinder 44, thus admitting the compressed air to said end of said cylinder, with the result that the air will drive the piston-rod 46 and lay-beam 28 frontwardly and effect the first blow of the reeds against the work, this blow taking place when the end 65 of the protection 48 reaches the valve-arm 43. Immediately upon the striking of this first full blow of the lay-beam, the heddles begin to change, and the cam 41 carries its projection 48 from the valve-arm 43, whereupon the roller 18 on the front end of said arm drops in between the projections 48, 49 of said cam and the plunger 52 is elevated to momentarily cut off the motive fluid from the pipe 59 and direct it into the pipe 60, whereby the lay-beam is caused to recede a short distance from the work, and thereupon the projection 49 on the cam 41 engages the valve-arm 43 and depresses the plunger 52 to again admit the motive fluid to the rear end of the cylinder 44 and permit the exhaust from the front end of same. By the time the end 66 of the projection 49 reaches the valve-arm 43 the heddles will have completed their change action and the lay-beam will have been given its second blow or second division of its double beat against the work, and thereupon the roller 18 on the end of the valve-arm 43 will fall into the recess between the projections 49, 50 of the cam 41 and cause said valve-arm 43 to raise the plunger 52 to a point at which the inlet 19 of the valve-casing 53 is placed in communication, through the annular chamber 55, with the outlet 57 and pipe 60 leading to the front end of the cylinder 44, and at which the pipe 59 and outlet 58 are placed in communication, through the annular chamber 56, with the exhaust 62, under which condition the motive fluid will pass into the front end of the cylinder 44 and drive the piston rod 46 and lay-beam rearwardly toward their initial position and the fluid within said cylinder in rear of the piston may escape through the pipe 59, annular chamber 56 and exhaust 62. Just prior to the piston rod 46 and lay-beam reaching their initial at rest position the projection 50 of the cam 41 will act upon the valve-arm 43 and depress the plunger 52 sufficiently to nearly cut off the exhaust through the pipe 59 and port 58 and nearly cut off the admission of the air to the pipe 60, thereby trapping a sufficient quantity of air in the rear end of the cylinder 44 to afford a cushion for the piston therein as it completes its rear stroke. When the end 67 of the projection 50 reaches the arm 43 the lay-beam will be substantially in its extreme rear position. When the projection 50 on the cam 41 leaves the valve-arm 43, the roller 18 of the latter will pass to the uniform surface 51 of the cam 41 and said arm will elevate the plunger 52 to reëstablish free admission of air to the front end of the cylinder 44 and a free exhaust from the rear end of same, so that the compressed air may firmly hold the lay in its extreme rear position, until the projection 48 on the cam 41 again reaches and acts upon the valve-arm 43, when the operation above described will be repeated. During the travel of the surface 51 of the cam 41 against the valve-arm 43 the shuttle of the loom performs its travel. When the projection 48 of the cam 41 again reaches and acts upon the arm 43, the plunger 52 is depressed as before to place the inlet 19 into communication with the outlet 58 and pipe 59 leading to the rear end of the cylinder 44, and at this time the compressed air which had been acting within said cylinder at the front of the piston to hold the lay-beam at rest in its rear position, exhausts through the pipe 60, port 57, annular chamber 54 and escape port 61.

The cylinder 44 with its piston rod connected with the lay-beam, coöperating with the air valve 42 and cam 41, automatically effects, by means of compressed air, the movement of the lay-beam in both directions, the imparting to said beam of a double-beat against the work, the formation of an air-cushion for the piston and beam

on their return movement to their initial at rest position and the positive retention of the lay-beam in its rear position until the proper time has arrived for said beam to again go forward.

The heddles 26, 27 which are of usual construction and operation change their position in the usual manner between the two outward beats of the lay-beam, and these heddles are moved to change by the rocking motion of the rock-shaft 32 (Fig. 1) which has thereon band-wheels 68 which receive the lower bands 69 (Fig. 2) of said heddles. The shaft 32 has upon it a rigid crank-arm 70 (Figs. 1 and 2) to whose upper end is pivotally secured the front end of the piston-rod 71 extending from an air-cylinder 72 which is pivotally mounted at its rear end upon a suitable support 73. The air cylinder 72 and piston-rod 71 are provided for imparting a rocking motion to the shaft 32 for changing the heddles, and said cylinder and rod correspond exactly with the cylinder 44 and rod 46 provided for the lay-beam. The cylinder 72 is provided with air supply pipes 74, 75 (Fig. 1) leading to its respective ends from an air-valve 76 corresponding with the air-valve 42 shown in detail in Figs. 1 and 4, and the plunger of which valve is provided with a pivoted arm 77 whose front end is confined within the groove 78 of a cam 79 (Fig. 6) loosely mounted on the power shaft 30 and connected with a gear-wheel 80 which is also loosely mounted on said shaft 30. The cam 79 receives its motion from the driving shaft 31 through the pinion wheel 81 on said shaft and the said gear wheel 80, and said cam by the contour of its groove 78, controls, through the arm 77, the air-valve 76 and regulates the admission of air to the respective ends of the cylinder 72. When air is admitted to the rear end of the cylinder 72 it drives the piston rod 71 forwardly to rock the shaft 32 in one direction and make one change of the heddles, and when air is admitted to the front end of the cylinder 72 it drives the piston rod 71 rearwardly to rock the shaft 32 in the opposite direction and reverse the heddles. The cam 79 moves the valve-arm 77 to change the direction of the flow of the compressed air from one end to the other of the cylinder 72 when the front end of said arm 77 is being acted upon by the inclined portions 82, 83 of said cam (Fig. 6). The means for moving the heddles thus comprise the rock-shaft 32, crank-arm 70, piston-rod 71, cylinder 72, air-valve 76, valve-arm 77, and cam 79. The rock-shaft 32, operated in both directions and held in its at rest positions by compressed-air, also actuates (through intermediate mechanism) the cloth-beam 24 to wind up the cloth as formed. Upon the shaft 32 is a rigid crank-arm 84 (Figs. 1 and 2) to which is pivoted the front end of a link 85, whose rear end is pivoted to a rocking frame 86 loosely mounted upon the shaft 30 as a bearing. The frame 86 carries two pawls, as shown in Fig 2, in engagement with a ratchet wheel 87, said pawls both engaging the same side of said wheel so as to drive the same on both movements of said frame when the latter is rocked due to the rocking of the shaft 32 by means of the piston rod 71. The ratchet wheel 87 is on a short shaft 88 located below the shaft 30, and on this short shaft 88, near the side frame 20 (Fig. 1), is secured a bevel-gear wheel 89 which is in mesh with a pinion wheel 90 rigid on the rear end of a shaft 91 carrying on its front end the worm 92 (Fig. 2) in engagement with the worm-wheel 93 carried by the shaft of the cloth-beam, the latter receiving its motion through this train of gearing from the ratchet wheel 87. I thus provide one air cylinder (44) for operating the lay-beam, and one air-cylinder 72 for operating both the heddles and the cloth-beam 24.

The carriage for effecting the travel of the shuttle 94 is numbered 95 and is mounted on metal track-rails 96. The details of the shuttle and its carriage will be described hereinafter. The platform of the carriage 95 has secured to its ends the ends of a propelling sprocket chain 97 (Fig. 3) which extends over idler wheels 98, 99, 100, 101 and a driving sprocket wheel 102 which is mounted on a short shaft 103 carrying on its rear end a pinion wheel 104 (Figs. 1 and 3), which derives its motion from a gear wheel 105 and imparts the same to the driving sprocket wheel 102 for the purpose of causing said chain to travel first in one direction and then in the other and effecting the due movement of the carriage 95.

The gear wheel 105 receives its reverse rotary movements from a reciprocatory rack-bar 106 which engages a pinion 107 on the shaft of said wheel 105, and this bar 106 receives its movements from a pitman rod 108 connected with a crank-arm 109 carried on the front end of a short shaft 110 (Fig. 1) upon whose rear end is a bevel-gear wheel 111 in mesh with a bevel-gear pinion 112 which is rigid on a shaft 113 (Fig. 2) with a pin-clutch member 114 (Fig. 1) whose other member 115 is free on said shaft and in the form of a gear wheel which is in constant mesh with the gear wheel 34 which is rigid on the power shaft 30. The gear wheel 115 runs constantly but does not communicate its motion to the shaft 113, gear wheels 112, 111, crank 109, pitman rod 108 and rack-bar 106 for operating the carriage 95 except when the pin 116 of the clutch member 114 (Fig. 1) is permitted to engage the gear wheel 115 and thereby lock said wheel to the shaft 113. The pin 116 is controlled as to its position in a usual manner by a cam pro-

jection on the side of an arm 117 which initially prevents said pin 116 from engaging the gear-wheel 115 and which is adapted to be elevated clear of said pin by a tappet arm 118 secured on the driving shaft 31 in position to temporarily engage and elevate the rear end of an arm 119 (Fig. 2) which has a front downwardly extending arm pivoted to said arm 117 and adapted to lift or turn said arm 117 upwardly to a sufficient extent to free its cam edge from said pin 116. The arm 119 is in the form of a bell-crank lever and is pivotally hung from a link 120 which is pivotally suspended from a rigid bracket, as shown in Fig. 2. The front end of the arm 117 is pivotally held in an eye secured to the rigid beam 64. The link 120 and front vertical member of the arm 119 constitute toggles which firmly hold the arm 117 down upon the clutch member 114 except when the tappet arm 118 acts against said arm 119 to move the toggles out of line and elevate said arm 117.

During each rotation of the driving shaft 31, the tappet arm 118, acting through the arm 119, temporarily elevates the clutch arm 117 to free the pin 116 and allow it to lock the gear wheel 115 to the clutch member 114 for the purpose of effecting the travel of the carriage 95 and shuttle 94 in one direction, and as the said tappet arm passes from the arm 119 the latter and the arm 117 descend to their former position and said arm 117 effects the withdrawal of the pin 116 from the gear wheel 115 at the end of each rotation of said clutch member 114 and gear wheel 115 together.

Having described the means for moving the carriage 95 back and forth I will refer to the detailed construction of said carriage and the shuttle to be moved by it. The carriage 95 comprises a bed 121, electromagnets 122 mounted upon the end portions of said bed and an open frame 123 supported upon said electro-magnets and having journaled between its sides the rollers 124, which I make of brass and two of which, properly separated, are at each end of said frame 123, as shown in Fig. 9. The carriage 95 is mounted upon grooved wheels 125 which are adapted to the track rails 96 and the axles 127 of which wheels are in two parts connected together at their center by an insulating coupling 128 (Fig. 12), which prevents the direct passage of the current through said axles, this being desirable in the arrangement shown because the track rails 96 are electric conductors, corresponding with the arrangement and construction disclosed in my aforesaid Letters Patent Number 779,025. Upon the axles 127 at one side of the carriage 95 I provide pulley wheels 129, and upon the same side of the carriage I provide the upper frame 123 with corresponding pulley wheels 130, which are mounted upon short studs or shafts 131 supported from said frame 123. Upon the short shafts or studs 131 are secured gear wheels 132, which are in mesh with pinion wheels 133 secured upon the shafts of the rollers 124. Upon the pulley wheels 129, 130 I place a continuous thin cord or cable 134, which is set in motion by the pulley wheels 129 during the travel of the carriage 95 and imparts motion to the pulley wheels 130, whereby the gear wheels 132 are caused to rotate and impart motion to the pinion wheels 133 and carriage rollers 124, the latter rotating in an opposite direction to that of the track wheels 125 and having a movement of substantially the same rapidity as said track wheels. The carriage therefore comprises the bed 121, track wheels 125, electro-magnets 122, upper frame 123, and rollers 124, with means for transmitting motion from the track wheels 125 to said rollers 124, the latter rotating reversely to the motion of the track wheels and being arranged in pairs to afford supports for the shuttle. The rollers 124 are disposed at opposite sides of the poles of the electro magnets 122, as shown in Fig. 9.

The shuttle 94 comprises an open frame having a central removable bobbin rod 126 and end supporting rollers 135 which are set within openings formed in the shuttle frame as shown in Fig. 8 and extend transversely thereof. The rollers 135 are preferably of iron covered with a soft material adapted to move upon the warp wires without injuring them. The rollers 135 may be of iron, with a thin coating of rubber. The rollers 135, when the shuttle is placed upon the carriage 95 rests upon and between the carriage rollers 124, as shown in Figs. 8 and 11, and during the travel of the carriage and shuttle, the shuttle rollers 135 rotate in the same direction and with substantially the same speed as the track wheels 125 for the carriage, said rollers 135 deriving their movement by their contact with the warp wires and from the rollers 124. In the employment of the loom the carriage 95 is below the warp wires, with its rollers 124 close up to said wires, and the shuttle 94 travels upon the warp wires, the rollers 135 moving directly upon the wires and being supported by the rollers 124 of said carriage. The shuttle is caused to travel with the carriage by reason of the magnetic force exerted against the same by the electro-magnets 122.

In the present construction, as in the construction shown in my aforesaid Patent 779,025, the electro magnets of the carriage 95 are energized for the purpose of compelling the shuttle 94 to follow it, and the special features of the present invention so far as they pertain to the carriage and shuttle, reside in providing the carriage with the rollers 124 to receive and support the shuttle

rollers 135 and also in the means provided for imparting motion to said rollers 124.

The rod 126 for holding the bobbin enters a socket at one end portion of the shuttle and at its other end is held down within a slot by the upper bent portion of a wire spring 136, as shown in Figs. 8 and 12, but since the present invention is not confined to the rod 126 and spring 136 these features require no special description and are not claimed herein.

It is believed that the operation of the loom will be fully understood from the foregoing description without further detailed explanation. I may however call attention to the fact that the lay-beam and other parts of the loom are entirely automatic in their operation, requiring no manual attention whatever and being timed and controlled wholly from the main power shaft, and that since the lay-beam, heddles and cloth-beam are operated by compressed air there is but little strain on the power shaft 30.

The electric circuits are indicated in Fig. 10 and since these are precisely the same circuits described in detail in my aforesaid Patent 779,025 they require no further explanation.

I regard it of special importance that the movements of the lay, heddles, cloth-beam and shuttle are timed and controlled automatically, the attendants having no manual work to perform with respect to keeping the loom in operation or actuating any of its parts. The lay is held in its rear position during the travel of the shuttle, and it at the proper time moves forwardly to deliver its blow without requiring any attention on the part of the attendants, the movements of the lay in both directions being automatically timed and controlled. I also regard it of special importance that the lay delivers its blow under the force of compressed air acting against it, since by means of the air the lay is caused to give, as I believe from actual experience, a more efficient blow and enabled to produce better cloth than has been possible heretofore. The lay, under the pressure of the fluid, starts forward slowly and gains force until it strikes the blow.

The provision of the shuttle having rollers to travel upon the warp wires and a carriage for effecting the movement of said shuttle and having rollers close up against the lower surface of said wires to coöperate with the carriage-rollers and rotating reversely thereto, affords highly efficient results, said structure being capable of operating with entire success without injury to the wires or danger of being caught and held thereby.

I do not confine my invention to details of form, arrangement or construction.

The features disclosed herein in presenting an operative loom and illustrating the best means known to me for utilizing my invention and not permissible of being claimed herein, are to be made the subjects of separate applications for Letters Patent.

What I claim as my invention and desire to secure by Letters-Patent, is:—

1. In a loom, a lay-motion comprising a fluid-pressure device for moving the lay against the cloth, and automatic means for causing the lay, under such pressure, to perform a full beat and then a short beat, one blow being delivered before the heddles change and the other thereafter, combined with automatic means for changing the heddles, and means for effecting the coöperative action of the lay and heddles; substantially as set forth.

2. In a loom, a lay-motion comprising a fluid-pressure cylinder having its piston rod connected with the lay, valve mechanism controlling the admission of the fluid to and its exhaust from the respective ends of said cylinder, and a cam on a driven shaft of the loom for setting said valve mechanism and automatically timing and controlling the operation of the lay for causing the lay, under fluid pressure, to perform a full beat and then a short beat, one blow being delivered before the heddles change and the other thereafter, combined with automatic means for changing the heddles, and means for effecting the coöperative action of the lay and heddles; substantially as set forth.

3. In a loom, a lay-motion comprising a fluid-pressure cylinder having its piston rod connected with the lay, valve mechanism controlling the admission of the fluid to and its exhaust from the respective ends of said cylinder, and means operated from a driven shaft of the loom for setting said valve mechanism and automatically timing and controlling the operation of the lay, said means first setting said valve mechanism to admit the fluid to one end of said cylinder and open the exhaust from the other end thereof for effecting a full forward throw of the lay, then reversing said valve mechanism momentarily to effect a limited receding movement of the lay, then re-setting said valve mechanism to effect a further forward throw of the lay and then again reversing said valve mechanism to effect the return of the lay to its rear position, combined with automatic means for changing the heddles, and means for effecting the coöperative action of the lay and heddles; substantially as set forth.

4. In a loom, a lay-motion comprising a fluid-pressure cylinder having its piston rod connected with the lay, valve mechanism controlling the admission of the fluid to and its exhaust from the respective ends of said cylinder, and a cam on a driven shaft of the loom for setting said valve mechanism and automatically timing and controlling the operation of the lay, said cam first setting said

valve mechanism to admit the fluid to one end of said cylinder and open the exhaust from the other end thereof for effecting a full forward throw of the lay, then reversing said valve mechanism momentarily to effect a limited receding movement of the lay, then resetting said valve mechanism to effect a further forward throw of the lay and then again reversing said valve mechanism to effect the return of the lay to its rear position, combined with automatic means for changing the heddles, and means for effecting the coöperative action of the lay and heddles; substantially as set forth.

5. In a loom, a lay-motion comprising a fluid-pressure cylinder having its piston rod connected with the lay, valve mechanism for controlling the admission of the fluid to the respective ends of said cylinder for moving the lay forwardly and backwardly, and a cam on a driven shaft for setting said valve mechanism and automatically timing and controlling the operation of the lay, said cam having an acting surface adapting it to operate the valve mechanism to cause the lay to make a forward throw and then a second forward throw after the heddles change and then to return to and remain at its rear position until the shuttle performs its travel, combined with automatic means for changing the heddles, automatic means for effecting the movement of the shuttle, and means for effecting the coöperative action of the lay, heddles and shuttle; substantially as set forth.

6. In a loom, a lay-motion comprising a fluid pressure cylinder having its piston rod connected with the lay, valve mechanism for controlling the admission of the fluid to the respective ends of said cylinder for moving the lay forwardly and backwardly, and a cam on a driven shaft for setting said valve mechanism and automatically timing and controlling the operation of the lay, said cam having an acting surface adapting it to operate the valve mechanism to cause the lay to make a double beat and then to return to and remain a proper time at its rear position and on the rearward movement of the lay to choke off the admission to and exhaust from said cylinder for a limited period to create a cushion in said cylinder, combined with automatic means for changing the heddles, automatic means for effecting the movement of the shuttle, and means for effecting the coöperative action of the lay, heddles and shuttle; substantially as set forth.

7. In a loom, a pivotally hung lay, a pivotally mounted fluid pressure cylinder, a piston and piston rod therefor, the latter at its outer end being pivotally connected with the lay, and valve mechanism for controlling the admission of the fluid to said cylinder for moving the lay under fluid pressure against the cloth, with a full beat and then a short beat, one blow being delivered before the heddles change and the other thereafter, combined with automatic means for changing the heddles, automatic means for effecting the movement of the shuttle, and means for effecting the coöperative action of the lay, heddles and shuttle; substantially as set forth.

8. In a loom, a pivotally hung lay, a pivotally mounted fluid pressure cylinder, a piston and piston rod therefor, the latter at its outer end being pivotally connected with the lay, and valve mechanism for controlling the admisison of the fluid to the respective ends of said cylinder for moving the lay under fluid pressure against the cloth with a double beat and then return to and be maintained at its rear position, one full blow of the beat being delivered before the heddles change and the short blow thereafter, combined with automatic means for changing the heddles, automatic means for effecting the movement of the shuttle, and means for effecting the coöperative action of the lay, heddles and shuttle; substantially as set forth.

9. In a loom, a pivotally hung lay, a pivotally mounted fluid pressure cylinder, a piston and piston rod therefor, the latter at its outer end being pivotally connected with the lay, valve mechanism for controlling the admission of the fluid to and its exhaust from said cylinder, and automatic means for controlling the operation of said valve mechanism to compel the lay under fluid pressure to move forwardly against the cloth before and after the heddles change and then return to its initial rear position, combined with automatic means for changing the heddles, automatic means for effecting the movement of the shuttle, and means for effecting the cooperative action of the lay, heddles and shuttle; substantially as set forth.

10. In a loom, in combination, a lay-motion comprising a fluid-pressure cylinder having its piston-rod connected with the lay for driving the same under fluid-pressure against the cloth, with a double beat, one full blow being delivered before the heddles change and the short blow thereafter, heddles, a fluid pressure cylinder having its piston rod operatively connected with the heddles for changing the same, a cloth-beam, mechanism operable from said last-mentioned piston-rod for actuating the cloth beam, valve mechanisms for said cylinders for controlling the admission of the fluid thereto, and means for timing said valve mechanisms and piston rods for securing the coöperative action of the lay, heddles and cloth beam in the weaving of the cloth; substantially as set forth.

11. In a loom, in combination, a power shaft, a lay, a fluid-pressure cylinder having its piston rod connected with the lay for

moving the same against the cloth, with a double beat, one full blow being delivered before the heddles change and the short blow thereafter, valve mechanism for said cylinder, means operable from said shaft for actuating said valve mechanism, heddles, a cloth beam, a fluid-pressure cylinder having its piston rod operatively connected with said heddles and cloth beam for actuating them, valve mechanism for said cylinder, and means operable from said shaft for setting said valve mechanism in coöperative relation with the valve mechanism of the lay-cylinder; substantially as set forth.

12. In combination, in a loom, a power shaft, a lay, means operable from said shaft for moving the lay and causing the same to make a double beat against the cloth, with a double beat, one full blow being delivered before the heddles change and the short blow thereafter, heddles, a fluid-pressure cylinder having its piston rod operatively connected with the heddles for changing the same, valve mechanism operable from said shaft for controlling the movement of the heddles with relation to the movement of the lay; substantially as set forth.

Signed at New York city, in the county of New York and State of New York this 18th day of June A. D. 1906.

WILLIAM R. BURROWS.

Witnesses:

CHAS C. GILL,

HERMAN GUSTOW.