W. R. BURROWS.

LOOM.

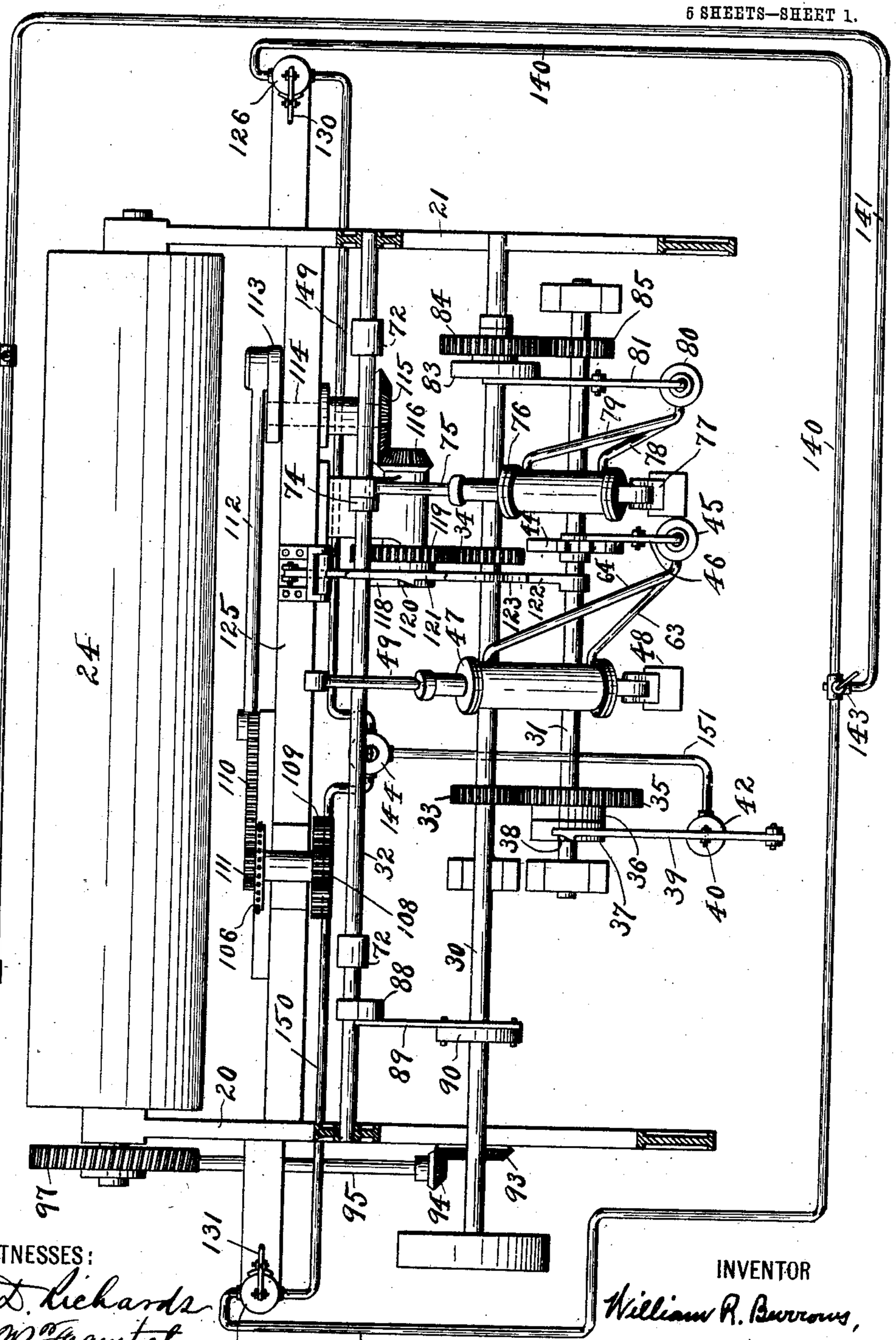
APPLICATION FILED OCT. 8, 1906. RENEWED NOV. 18, 1908.

924,886.

Patented June 15, 1909.

6 SHEETS—SHEET 1.

FIG. 1.



WITNESSES:

Geo. D. Richards

F. H. P. Frantzel

INVENTOR

William R. Burrows,

BY Chas. C. Gill

ATTORNEY

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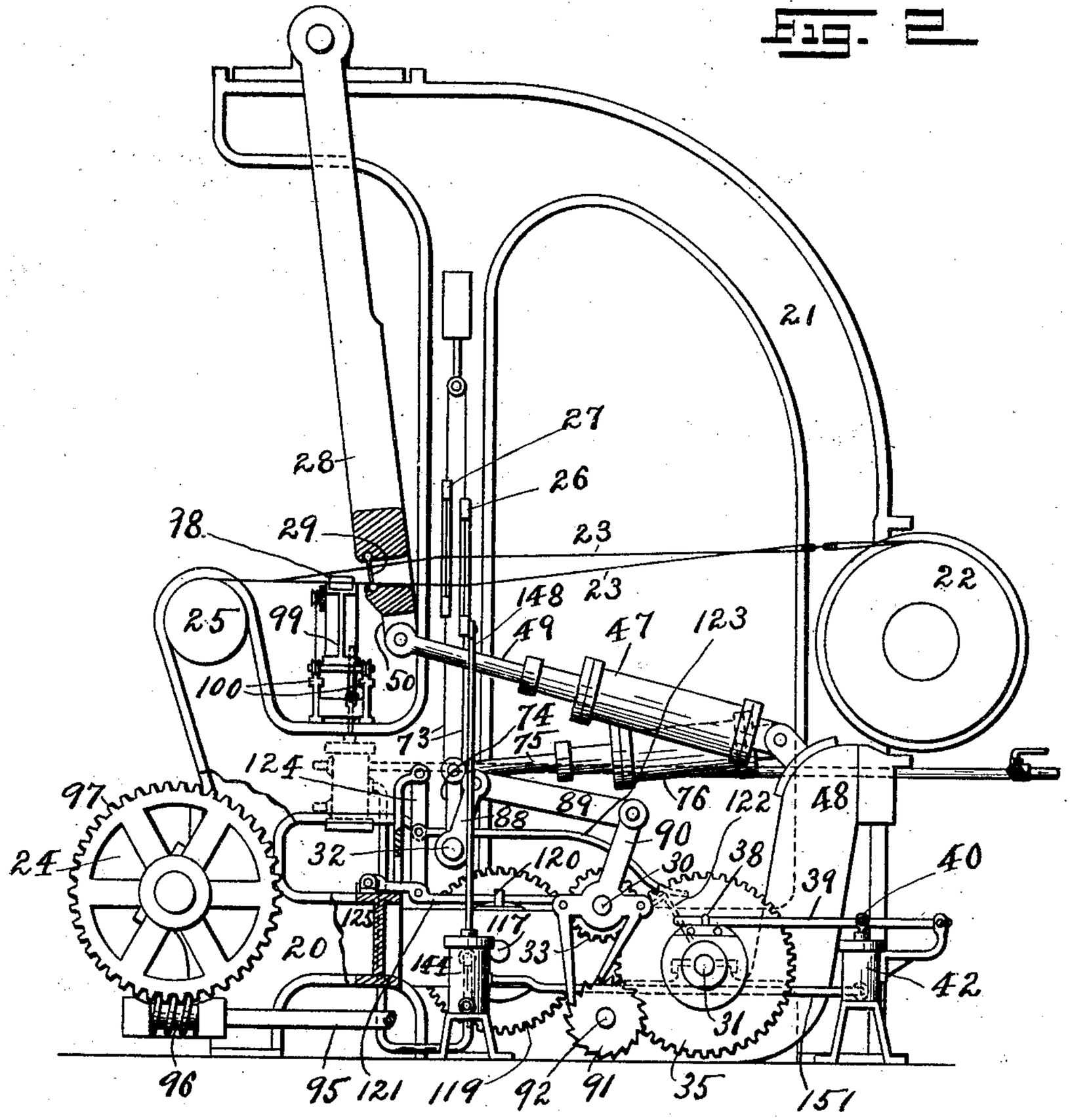
5 SHEETS—SHEET 2.

Fig. 2



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Geo. L. Richards

F. H. W. Brantzel

INVENTOR

William R. Burrows,

BY

Chas. C. Gill

ATTORNEY

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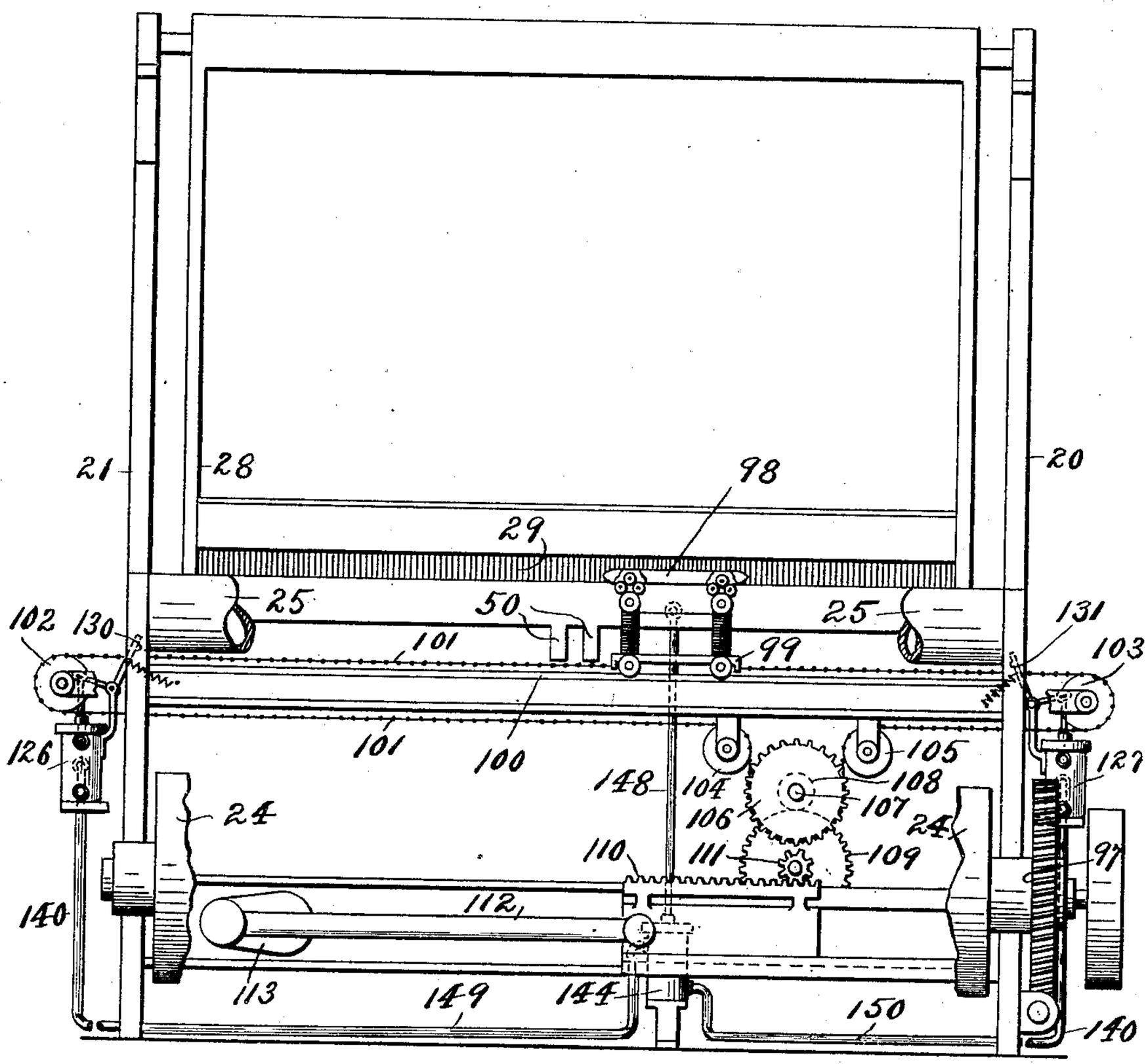
5 SHEETS—SHEET 3.

Fig. 3



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INVENTOR

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5 SHEETS—SHEET 4.

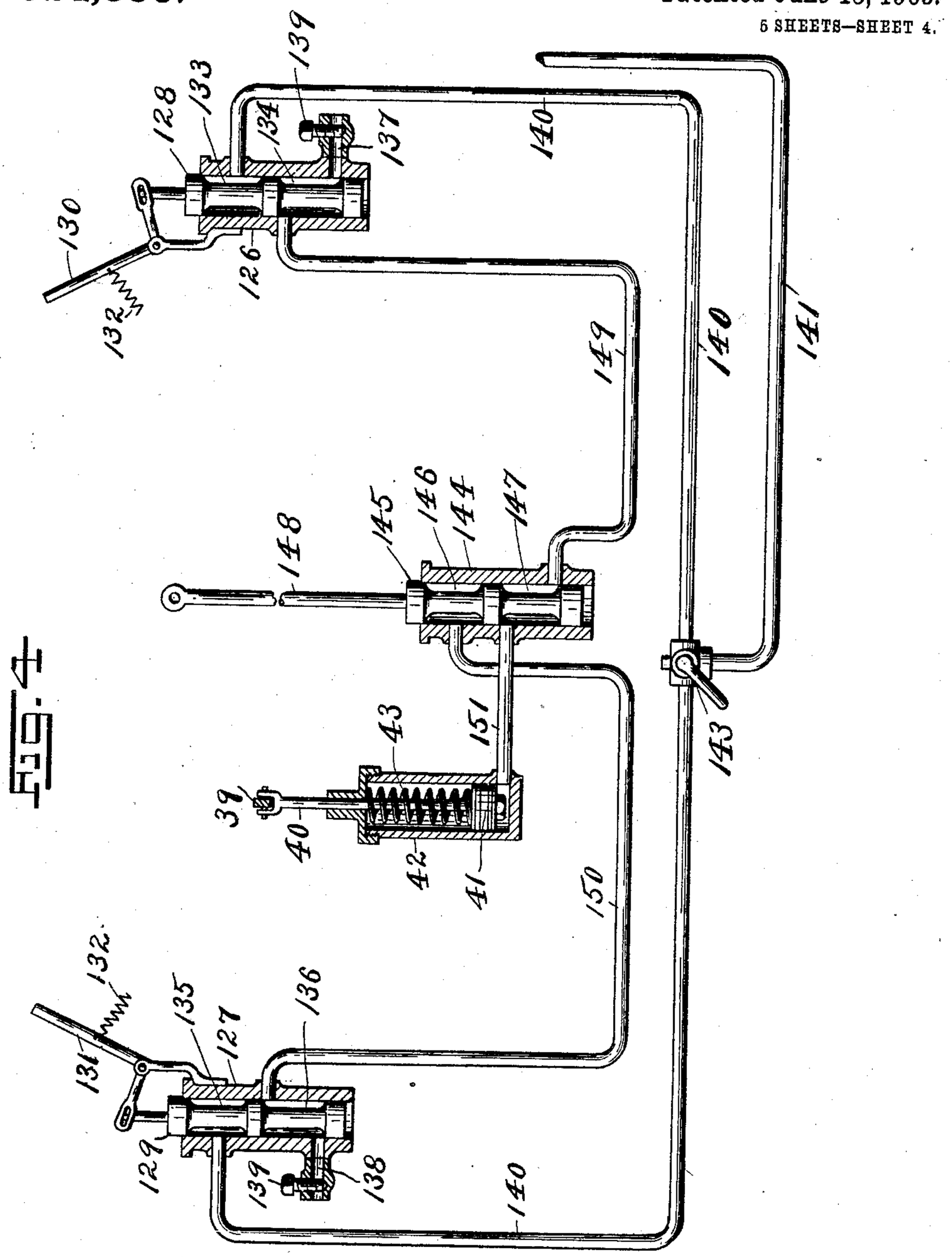

FIG. 4.

WITNESSES:

Geo. D. Richards

F. H. P. Frantzel.

INVENTOR

William R. Burrows

BY

Chas. C. Gill

ATTORNEY

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5 SHEETS—SHEET 5.

Fig. 7

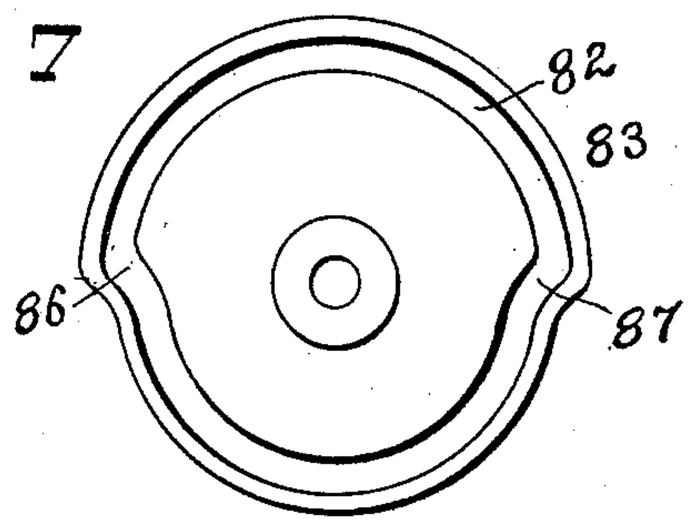


Fig. 6

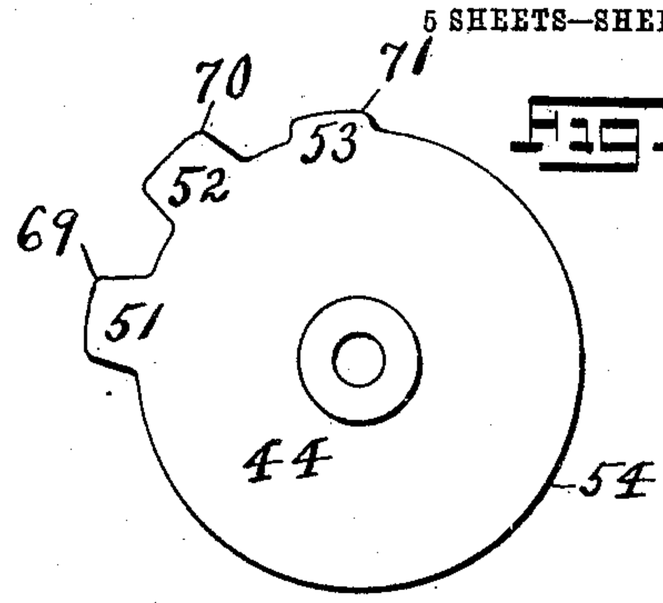


Fig. 5

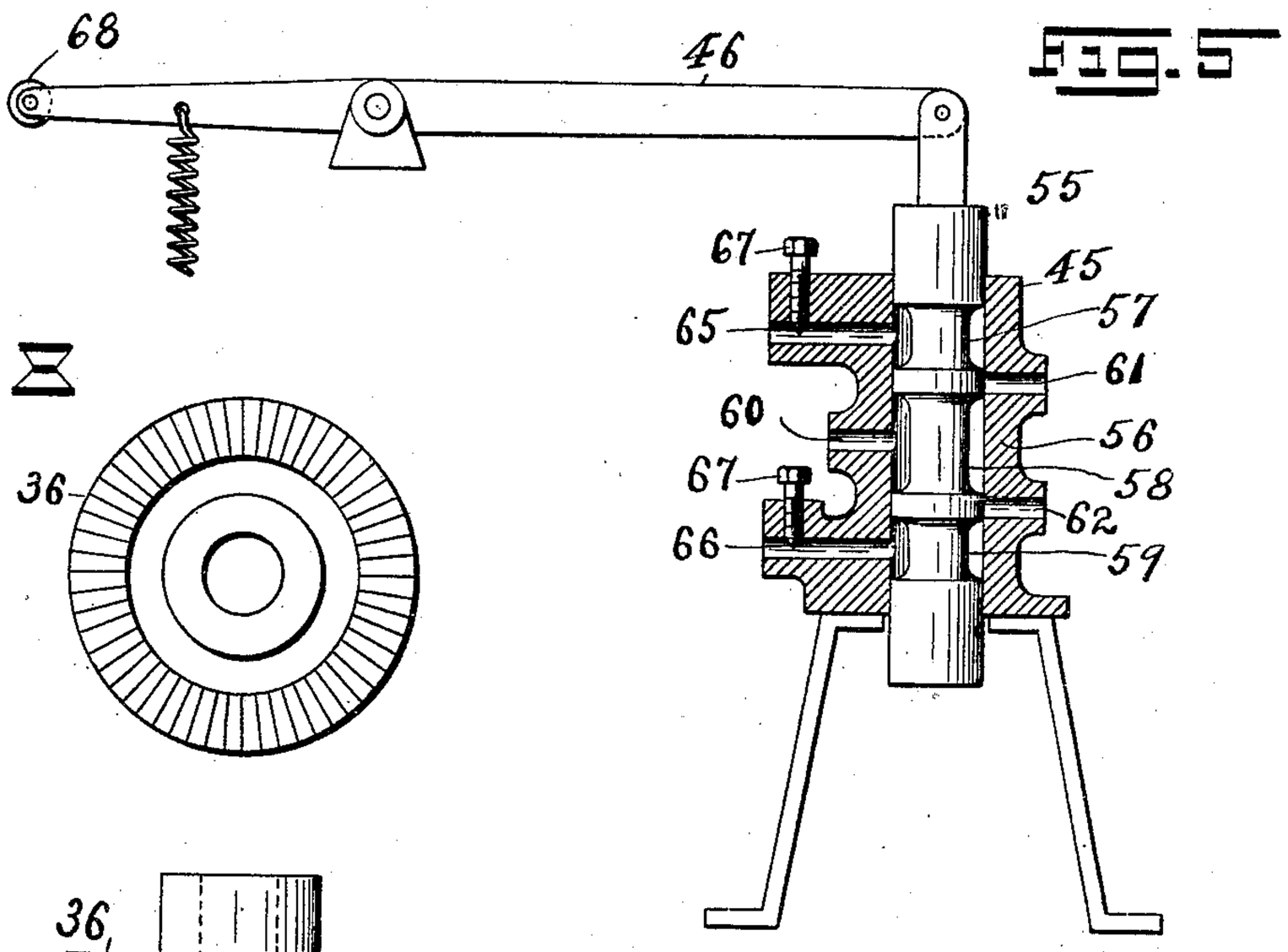


Fig. 8

Fig. 9

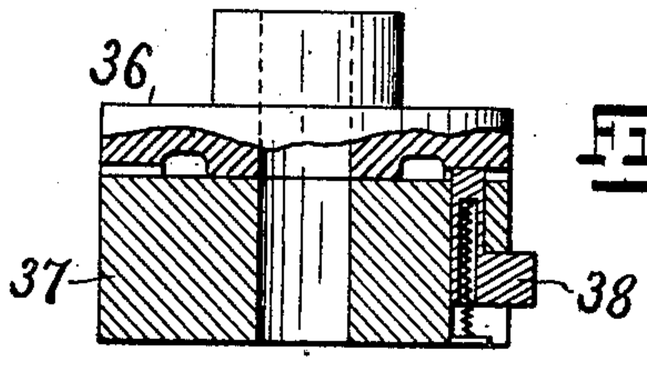
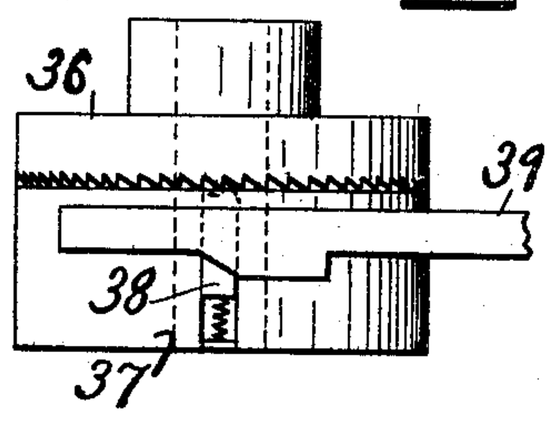


Fig. 10



WITNESSES:

Geo. D. Richards

F. H. W. Trautfel

INVENTOR

William R. Burrows,

BY Chas. C. Gill

ATTORNEY

UNITED STATES PATENT OFFICE.

WILLIAM R. BURROWS, OF NEWARK, NEW JERSEY.

LOOM.

No. 924,886. Specification of Letters Patent. Patented June 15, 1909.

Application filed October 8, 1906, Serial No. 337,974. Renewed November 18, 1908. Serial No. 463,315.

To all whom it may concern:

Be it known that I, WILLIAM R. BURROWS, a citizen of the United States, and 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 illustrate my invention in this application as embodied in a loom for weaving wire cloth of the character required for use in paper making machines, this wire cloth being of very fine mesh and requiring the utmost uniformity throughout its entire extent.

The loom illustrated in the drawings presents some well known features, these being the warp-beam, breast-beam, cloth-beam, lay-beam frame and heddles, all of which perform their usual duties in the customary manner. The loom illustrated in the drawings also presents certain features not claimed herein but made the subject of an application, Serial No. 322,663 filed by me on June 21, 1906 for Letters Patent for improvements in looms, said drawings presenting the present invention as embodied in the loom illustrated and described in the said application.

My present invention pertains more particularly to novel features whereby the operation of the loom is rendered automatic and placed under pneumatic control, the entire loom in its capability to operate being under the control of suitable compressed-air mechanism operable from the shuttle-carriage or other movable part of the loom at the end of each operative action of the latter and adapted when thus operated to insure the transmission of power from the main driving shaft to the other operative parts of the loom and the continuing of the loom in operation and when not thus operated to prevent such transmission of power from said shaft to the other parts of the loom, thereby causing the loom to cease its operation automatically and avoiding the consequences which might ensue if the loom continued in operation while, for instance, the shuttle due to accident or otherwise, remained within the shed.

The features constituting my present invention are adapted to insure the automatic stoppage of the loom at the end of any rotation of the main power shaft in the event that the shuttle has failed to perform its complete movement during such rotation.

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 horizontal section, of a loom constructed in accordance with and embodying the invention; 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 a diagrammatic view, partly in section, of the pneumatic apparatus controlling the operation of the loom and embodying the present invention; Fig. 5 is an enlarged detached vertical section through the air-valve for controlling the admission of air to and its exit from the air-cylinder whose piston-rod controls the movement of the lay-beam frame; Fig. 6 is an enlarged detached side elevation of the cam for controlling the movement of the valve shown in Fig. 5 and effecting the two beats of the lay-beam frame during each operative action of the loom; Fig. 7 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. 8 is a detached face view of one of the pin-clutch members constituting a part of the operative mechanism of the loom; Fig. 9 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. 10 is a top view of same with a portion of a lever-arm thereon, the clutch shown in Figs. 8, 9 and 10 substantially corresponding with the pin-clutches disclosed in the aforesaid application and also in Letters Patent No. 779,025 granted January 3, 1905 to William R. Burrows.

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

lay-beam frame carrying a 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 (Figs. 1 and 9) 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 (Figs. 1 and 10) 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 actuating plunger rod 40 whose lower end carries a piston 41 within a cylinder 42, within which and pressing upon the said piston is confined the coiled spring 43. The spring 43 acts to normally keep the arm 39 (which is pivotally mounted at its outer end) down upon the clutch-member 37 in position for the head of the pin 38 to, if necessary, ride against the same upon the shaft 31 approaching the end of each rotation so that said pin may be moved outwardly from the other clutch-member 36 and cut off the power of the shaft 30 from the shaft 31.

In the proper operation of the loom and when it is unnecessary to bring the loom to a stop, pneumatic pressure is exerted against the lower side of the piston 41 at the end of each rotation of the shaft 31 for the purpose of moving the rod 40 upwardly and thereby causing the inner end of the lever-arm 39 to become elevated from the clutch member 37, thereby preventing the pin 38 from being withdrawn from the clutch member 36 by said arm and continuing the shaft 31 in motion. At the end of each operative action of the loom the shuttle-carriage operates to actuate the valve mechanism for admitting compressed air to the cylinder 42 for the purpose of effecting the elevation of the lever arm 39 from the clutch member 37, and in the absence of said carriage or other selected part actuating said mechanism, which would happen if the shuttle became arrested within the shed or failed to perform its complete movement, the lever arm 39 would remain upon the clutch member 37 in position to be acted against by the clutch-pin 38 and effect the stoppage of the loom. The shaft 31 may stop at the end of any of its rotations, because at the end of each of its rotations the clutch-pin 38 will pass into engagement with the inclined edge of the lever arm 39 unless the latter is elevated by pneumatic pressure from the path of said pin. At each rotation of the shaft 31, in the correct operation of the loom, the arm 39 is elevated from the clutch-member 37 but is only held in its upward position for a brief period, after which said arm is returned to the clutch-member 37 by the spring 43 in position to effect the stoppage of the shaft 31 in the event that some accident should occur and that by reason thereof the pneumatic pressure should not be applied to the cylinder 43 for the purpose of elevating said arm 39.

The means for applying and controlling the pneumatic pressure whereby the loom may be continued in operation in the absence of accident and stopped in case of accident at the end of any rotation of the shaft 31, is illustrated more clearly in Figs. 1 and 4, but since this mechanism is set in motion and in part controlled by the general mechanism of the loom, I will, before specifically describing the same and its operation, briefly describe the general operative parts of the loom.

The general operative parts of the loom other than the pneumatic means illustrated in Fig. 4 for controlling the operation of the loom, are substantially identical with the features fully described in my aforesaid application No. 322,633 and hence it will not be necessary to here enter into a minute description of the same.

The means operable from and during each rotation of the shaft 31 for imparting motion to the lay-beam frame 28, comprise a cam 44 (Figs. 1 and 6) rigid on said shaft 31, an air-valve 45 (Fig. 5) located near said cam, a lever-arm 46 connected with said valve and engaging said cam, an air-cylinder 47 pivotally mounted at its rear end upon a support 48 and supplied with air through said valve 45, and a piston-rod 49 extending from said cylinder and pivotally secured at its front end between ears 50 (Figs. 2 and 3) provided on the lay-beam frame.

The cam 44 is preferably formed with three projecting portions 51, 52, 53 (Fig. 6) arranged near together and an extended uniform peripheral portion 54, and this cam

while rotating carries its periphery against the front end of the valve-arm 46 to control the position of the plunger 55 within its casing 56, said plunger and casing constituting the valve designated generally hereinbefore as 45. The plunger 55 closely fits within the cylindrical casing 56 (Fig. 5) and is formed with three annular chambers or grooves 57, 58, 59; and said casing is formed with an inlet 60 for compressed air or other motive fluid leading to the middle chamber 56, two outlets 61, 62 respectively connected by pipes 64, 63 with the opposite ends of the air-cylinder 47, and two exhaust outlets 56, 66 equipped with regulating screws 67. The front end of the valve arm 46 carries a roller 68 (Fig. 5) which is retained against the cam 44 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 54 of the cam 44 is moving against the roller 68 the valve arm 46 will be at rest holding the plunger 55 in such position that the compressed air may flow from the inlet 60 through the chamber 57, outlet 61 and pipe 64 into the front end of the cylinder 47, for the purpose of positively holding the lay-beam in its extreme rear position, the air within the rear end of said cylinder 47 being at such time permitted to exhaust through the pipe 63, port 62, chamber 59 and outlet 66.

When the cam 44 carries its projection 51 against the roller 68 at the front end of the valve-arm 46 it depresses the rear end of said arm and thereby moves the plunger 55 downwardly to a sufficient extent to connect (through the annular chamber 58) the inlet 60 with the outlet 62 and pipe 63 leading to the rear end of the cylinder 47, thus admitting the compressed air to said end of said cylinder, with the result that the air will drive the piston-rod 49 and lay-beam 28 frontwardly and effect the first blow of the reeds against the work, this blow taking place when the end 69 of the projection 51 reaches the valve-arm 46. Immediately upon the striking of this first full blow of the lay-beam, the heddles begin to change, and the cam 44 carries its projection 51 from the valve-arm 46, whereupon the roller 68 on said arm drops in between the projections 51, 52 of said cam and the plunger 55 is elevated to momentarily cut off the motive fluid from the pipe 63 and direct it into the pipe 64, whereby the lay-beam is caused to recede a short distance from the work, and thereupon the projection 52 on the cam 44 engages the arm 46 and depresses the plunger 55 to again admit the motive fluid to the rear end of the cylinder 47 and permit the exhaust from the front end of same. By the time the end 70 of the projection 52 reaches the valve-arm 46 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 68 on the end of the valve-arm 46 will fall into the recess between the projections 52, 53 of the cam 44 and cause said valve-arm 46 to raise the plunger 55 to a point at which the inlet 60 of the valve-casing 56 is placed in communication, through the annular chamber 58, with the outlet 61 and pipe 64 leading to the front end of the cylinder 47, and at which the pipe 63 and outlet 62 are placed in communication, through the annular chamber 59, with the exhaust 66, under which condition the motive fluid will pass into the front end of the cylinder 47 and drive the piston rod 47 and lay-beam rearwardly toward their initial position and the fluid within said cylinder in rear of the piston may escape through the pipe 63, annular chamber 59 and exhaust 66. Just prior to the piston rod 49 and lay-beam reaching their initial at rest position the projection 53 of the cam 44 will act upon the valve-arm 46 and depress the plunger 55 sufficiently to nearly cut off the exhaust through the pipe 63 and nearly cut off the admission of the air to the pipe 64, thereby trapping a sufficient quantity of air in the rear end of the cylinder 47 to afford a cushion for the piston therein as it completes its rear stroke.

When the end 71 of the projection 53 reaches the arm 46 the lay-beam will be substantially in its extreme rear position. When the projection 53 on the cam 44 leaves the valve-arm 46, the roller 68 of the latter will pass to the uniform surface 54 of the cam and said arm will elevate the plunger 55 to reëstablish free admission of air to the front end of the cylinder 47 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 51 on the cam 44 again reaches and acts upon the valve-arm 46, when the operation above described will be repeated. During the travel of the surface 54 of the cam 44 against the valve-arm 46 the shuttle of the loom performs its travel.

When the projection 51 of the cam 44 again reaches and acts upon the arm 46, the plunger 55 is depressed as before to place the inlet 60 into communication with the outlet 62 and pipe 63 leading to the rear end of the cylinder 47, 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 64, port 61, annular chamber 57 and escape port 65.

The cylinder 47 with its piston rod connected with the lay-beam, coöperating with the air valve 45 and cam 44, 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 72 which receive the lower bands 73 (Fig. 2) of said heddles. The shaft 32 has upon it a rigid crank-arm 74 (Figs. 1 and 2) to whose upper end is pivotally secured the front end of a piston-rod 75 of an air-cylinder 76 which is pivotally mounted in its rear end upon a suitable support 77. The air cylinder 76 and piston-rod 75 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 47 and rod 49 provided for the lay-beam. The cylinder 76 is provided with air supply pipes 78, 79, (Fig. 1) leading to its respective ends from an air-valve 80 corresponding with the air-valve 45 shown in Figs. 1 and 5, and the plunger of which valve is provided with a pivoted arm 81 whose front end is confined within the groove 82 of a cam 83 (Fig. 7) loosely mounted on the power shaft 30 and connected with a gear-wheel 84 which is also on said shaft 30. The cam 83 receives its motion from the driving shaft 31 through the pinion wheel 85 on said shaft and the said gear wheel 84, and said cam by the contour of its groove 82, controls, through the arm 81, the air-valve 80 and regulates the admission of air to the respective ends of the cylinder 76. When air is admitted to the rear end of the cylinder 76 it drives the piston rod 75 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 76 it drives the piston rod 75 rearwardly to rock the shaft 32 in the opposite direction and reverse the heddles. The cam 83 moves the valve-arm 81 to change the direction of the flow of the compressed air from one end to the other of the cylinder 76 when the front end of said arm 81 is being acted upon by the inclined portions 86, 87 of said cam (Fig. 7).

The means for moving the heddles thus comprise the rock-shaft 32, crank-arm 74, piston-rod 75, cylinder 76, air-valve 80, valve-arm 81 and cam 83. 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 88 (Figs. 1 and 2) to which is pivoted the front end of a link 89, whose rear end is pivoted to a rocking frame 90 loosely mounted upon the shaft 30 as a bearing. The frame 90 carries two pawls, as shown in Fig. 2, in engagement with a ratchet wheel 91, 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 75. The ratchet wheel 91 is on a short shaft 92 located below the shaft 30, and on this short shaft 92, near the side frame 20 (Fig. 1), is secured a bevel-gear wheel 93 which is in mesh with a pinion wheel 94 rigid on the rear end of a shaft 95 carrying on its front end the worm 96 (Fig. 2) in engagement with the worm-wheel 97 carried by the shaft of the cloth-beam, the latter receiving its motion through this train of gearing from the ratchet wheel 91. I thus provide one air cylinder (47) for operating the lay-beam, and one air-cylinder 76 for operating both the heddles and the cloth-beam 24.

The electro-magnetic carriage for effecting the travel of the shuttle 98 is numbered 99 and is mounted on metal track-rails 100. The details of the shuttle and its carriage are unimportant in respect of this application and are described in full in my aforesaid application No. 322,663. A further example of an electro-magnetic carriage for moving the shuttle is described in detail in my aforesaid patent No. 779,025. The platform of the carriage 99 has secured to its ends the ends of a propelling sprocket chain 101 (Fig. 3) which extends over wheels 102, 103, 104, 105 and a driving sprocket wheel 106 which is mounted on a short shaft 107 carrying on its rear end a pinion wheel 108 (Fig. 1), which derives its motion from a gear wheel 109 and imparts the same to the driving sprocket wheel 106 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 99. The gear wheel 109 receives its reverse rotary movements from a reciprocatory rack-bar 110 which engages a pinion 111 on the shaft of said wheel 109, and this bar 110 receives its movements from a pitman rod 112 connected with a crank-arm 113 carried on the front end of a short shaft 114 (Fig. 1) upon whose rear end is a bevel-gear wheel 115 in mesh with a bevel-gear pinion 116 which is rigid on a shaft 117 (Fig. 2) with a pin-clutch member 118 (Fig. 1) whose other member 119 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 119 runs constantly but does not communicate its

motion to the shaft 117, gear wheels 116, 115, crank 113, pitman rod 112 and rack-bar 110 for operating the carriage 99 except when the pin 120 of the clutch member 118 (Fig. 1) is permitted to engage the gear wheel 119 and thereby lock said wheel to the shaft 117. The pin 120 is controlled as to its position in a usual manner by a cam projection on the side of an arm 121 which initially prevents said pin from engaging the gear-wheel 119 and which is adapted to be elevated clear of said pin by a tappet arm 122 secured on the driving shaft 31 in position to temporarily engage and elevate the rear end of an arm 123 (Fig. 2) which has a front downwardly extending arm pivoted to said arm 121 and adapted to lift or turn said arm 121 upwardly to a sufficient extent to free its cam edge from said pin 120. The arm 123 is in the form of a bell-crank lever and is pivotally hung from a link 124 which is pivotally suspended from a rigid bracket, as shown in Fig. 2. The front end of the arm 121 is pivotally held in an eye secured to the rigid beam 125. The link 124 and front vertical member of the arm 123 constitute toggles which firmly hold the arm 121 down upon the clutch member 118 except when the tappet arm 122 acts against said arm 123 to move the toggles out of line and elevate said arm 121.

During each rotation of the driving shaft 31, the tappet arm 122, acting through the arm 123, temporarily elevates the clutch arm 121 to free the pin 120 and allow it to lock the gear wheel 119 to the clutch member 118 for the purpose of effecting the travel of the carriage 99 and shuttle 98 in one direction, and as the said tappet arm passes from the arm 123 the latter and the arm 121 descend to their former position and said arm 121 effects the withdrawal of the pin 120 from the gear wheel 119 at the end of each rotation of said clutch member 118 and gear wheel 119 together.

It is believed that the construction and operation of all of the features of the loom with the exception of those more particularly constituting the present invention, will be fully understood from the foregoing description without further detailed explanation, and I may therefore proceed to a description of the means for applying and controlling the pneumatic pressure whereby the loom may be continued in operation in the absence of accident or stop in case of accident, at the end of any rotation of the shaft 31, said means being more clearly illustrated in Figs. 1 and 4 and having been in part described hereinbefore in referring to the features connected with the air cylinder 42, clutch members 36, 37 and lever arm 39.

In accordance with the present invention I utilize the shuttle carriage 99 at the ends of its movements, for actuating air-valves to admit air to the lower end of the cylinder 42 for effecting the elevation of the arm 39 from the clutch member 37, and I utilize the movements of the heddles for effecting the release of the compressed air from the cylinder 42 so that the piston 41 may move to its initial position under the force of the spring 43 and return the arm 39 to the clutch member 37 preparatory to stopping the loom at the end of any rotation of the shaft 31 should that be necessary by reason of the shuttle not having performed its movement or having been caught in the shed, such stoppage of the loom preventing the lay-beam from being driven forwardly.

At each end of the loom I provide an air-cylinder or cylindrical air-valve casing, the one at the right being numbered 126 and that at the left 127 (looking at Fig. 4), and these cylinders 126, 127 are equipped with plunger-valves 128, 129 respectively which are adapted to be operated by means of bell-crank levers 130, 131 respectively. The levers 130, 131 are normally held in their at rest position by means of coiled springs 132, and they stand in the path of the shuttle carriage 99, which upon reaching the ends of its line of travel will move against and operate said levers to shift the valves within the cylinders 126, 127. The air valve 128 is formed with annular chambers 133 and 134, and the air valve 129 is formed with similar annular chambers 135 and 136, and the cylinders 126, 127 are provided with exhaust outlets 137 and 138 respectively equipped with regulating screw-valves 139 of customary character. The upper annular chambers 133, 135 formed within the cylinders 126, 127 are connected together by a pipe 140 which is connected with a pipe 141 leading from any suitable source of compressed air and preferably extending along the front of the loom, as shown in Fig. 1, where it is provided with manually operable valves 142 by which the weavers may open or close said pipe 141, thereby admitting or cutting off the compressed air from the pipe 140 connected with the air cylinders 126, 127. At the point of connection of the pipe 141 with the pipe 140 there may also be provided a valve 143 for cutting off the air from the pipe 140. When the air valves 128, 129 are in their normal at rest position shown in Fig. 4, the compressed air from the pipe 140 will fill the annular chambers 133, 135, but perform no duty, the compressed air not being permitted to act except when the bell-crank levers 130, 131 are alternately moved to lower the valves 128, 129 respectively within the casings 126, 127.

At an intermediate point I provide an air-valve casing 144 containing a plunger valve 145 having annular chambers 146, 147 and connected by a vertical rod 148 with the rear heddle 26, said valve 145 being operable by

the heddles during their change action. The lower portion of the valve casing 144 is connected by a pipe 149 with the cylinder 126, and the upper portion of the said casing 144 is connected by a pipe 150 with the cylinder 127. The cylinder 42 is connected by a pipe 151 with the valve casing 144 at a point intermediate the connection therewith of the pipes 149, 150.

The position of the piston 41 and rod 40 governs the relation of the arm 39 with respect to the clutch member 37; the position of the valve 145 determines whether compressed air may flow through the pipe 149 or pipe 150 and pipe 151 to the lower end of the cylinder 42 or exhaust therefrom through the same; the position of the valve 128 determines whether the supply pipe 140 shall be placed in communication with the pipe 149 for permitting the flow of the air to the lower end of the cylinder 42 or the pipe 149 shall be placed in communication with the outlet 137 for permitting the exhaust of the air from the cylinder 42 through said pipe 149, and the position of the valve 129 determines whether the supply pipe 140 shall be placed in communication with the pipe 150 for permitting the air to flow to the lower end of the cylinder 42 or said pipe 150 shall be placed in communication with the outlet 138 for permitting the exhaust from the lower end of the cylinder 42 through said pipe 150. The valve 145 is operated by the heddles and the valves 128, 129 are alternately operated, in one direction, by the shuttle-carriage.

It may be assumed in the position of the parts shown in Fig. 4, that the rear heddle has moved upwardly and moved the valve 145 to the position shown and that the shuttle carriage is traveling toward the right. In this condition, the air has been permitted to exhaust from the lower end of the cylinder 42 through the pipe 151, chamber 147, pipe 149, chamber 134 and outlet 137, and the arm 39 has descended upon the clutch-member 37 preparatory to stopping the loom at the end of the rotation of the shaft 31 should that be necessary. The shuttle-carriage will on approaching the end of its movement toward the right, looking at Fig. 4, pass into contact with and turn outwardly the bell-crank lever 130 and thereby depress the valve 128 so as to place the annular chamber 133 of said valve into communication with the pipe 149, this having the effect of placing the air-pipe 140 into communication with said pipe 149 and permitting the compressed air to flow into the annular chamber 147 of the valve casing 144 and thence through the pipe 151 into the lower end of the cylinder 42, wherein said air will operate to elevate the piston 41 and rod 40 and raise the lever-arm 39 from the clutch member 37, thus assuring a continuance of the rotation of the driving shaft 31, the operation of the lay-beam and the change of the heddles between the two beats of said beam. This change of the heddles effects the lowering of the valve 145 to cut off the pipe 149 from communication with the pipe 151 and cylinder 42 and permits the exhaust from said cylinder through the pipe 151, chamber 146, pipe 150 chamber 136 and outlet 138, and thereupon the piston 41 will be moved downwardly and the arm 39 will again descend upon the clutch-member 37.

Upon the succeeding movement of the shuttle-carriage toward the left, looking at Fig. 4, said carriage will recede from the bell-crank lever 130 and travel toward the bell-crank lever 131. Upon the shuttle-carriage leaving the lever 130 the spring 132 connected therewith will restore said lever and the valve 128 to their initial position shown in Fig. 4, thus cutting off communication of the pipe 140 with the pipe 149 and placing the outer end of pipe 149 into communication with the annular exhaust chamber 134; and upon the carriage striking the lever 131 the latter will be turned outwardly and move the valve 129 downwardly, so that the compressed air may then flow from the pipe 140 through the annular chamber 135, pipe 150, annular chamber 146 and pipe 151 into the cylinder 42 for elevating the arm 39 from the clutch member 37, thus again assuring a continuance of the rotation of the shaft 31, the operation of the lay-beam and the change of the heddles between the two beats of said beam. This change of the heddles effects the raising of the valve 145 to cut off the pipe 150 from communication with the pipe 151 and cylinder 42 and permits the exhaust from said cylinder through the said pipe 151, chamber 147, pipe 149, chamber 134 and outlet 137, whereupon the shuttle-carriage will travel toward the right as before and the operation above described be repeated.

If for any reason the shuttle-carriage should not on its movements reach the bell-crank levers 130, 131, the arm 39 will remain upon the clutch-member 37 and effect the stoppage of the loom at the end of the rotation of the shaft 31. In the absence of accident and upon the shuttle-carriage reaching the end of its movement, said carriage will move the bell-crank lever and valve to place the air supply pipe into communication with the lower end of the cylinder 42 for elevating the arm 39 from the clutch-member 37 and continuing the loom in operation. The entire loom in its capability to continue in operation is thus placed under pneumatic control, the fluid pressure being admitted to the cylinder 42 only upon the shuttle successfully reaching the end of its stroke.

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

1. A power-loom having warp and cloth beams, a lay-beam, a shuttle, power mechanism and a driving-shaft, combined with means for automatically stopping said shaft at the end of each of its rotations, and fluid-pressure means to be actuated upon the shuttle reaching the end of its line of travel for continuing the loom in operation; substantially as set forth.

2. A power-loom having warp and cloth beams, a lay-beam, a shuttle, a power-driven carriage for moving said shuttle along its path, power mechanism and a driving-shaft, combined with means for automatically stopping said shaft at the end of each of its rotations, and fluid-pressure means to be actuated upon said carriage and shuttle reaching the end of their line of travel for continuing the loom in operation; substantially as set forth.

3. A power-loom having warp and cloth beams, a lay-beam, a shuttle, power mechanism and a driving shaft, combined with means for automatically stopping said shaft at the end of each of its rotations, means in operative connection with the heddles for assuring the application, on the change-action of said heddles, of said automatic means to position to stop said shaft, and fluid-pressure means to be actuated upon the shuttle reaching the end of its line of travel for rendering said automatic means inoperative and continuing the loom in operation; substantially as set forth.

4. A power loom having warp and cloth beams, a lay-beam, a shuttle, a power shaft, a driving-shaft, clutch members respectively connected with said shafts, and means for locking said members together so that the power may actuate said driving shaft, combined with an unlocking device adapted to automatically free said members from each other and thereby stop said shaft at the end of each of its rotations, and fluid-pressure means to be actuated upon the shuttle reaching the end of its line of travel for continuing the loom in operation; substantially as set forth.

5. A power-loom having warp and cloth beams, a lay-beam, a shuttle, a power shaft, a driving-shaft, clutch members respectively connected with said shafts, and means for locking said members together so that the power may actuate said driving shaft, combined with an unlocking device adapted to automatically free said members from each other and thereby stop said shaft at the end of each of its rotations, a spring for moving said unlocking device to its operative position upon the change-action of the heddles, and fluid-pressure means operable upon the shuttle reaching the end of its line of travel for moving said device to its inoperative position and thereby continuing the loom in operation; substantially as set forth.

6. A power-loom having warp and cloth beams, a lay-beam, a shuttle, a power shaft, a driving-shaft, clutch members respectively connected with said shafts, and means for locking said members together so that the power may actuate said driving shaft, combined with an unlocking device adapted to automatically free said members from each other and thereby stop said shaft at the end of each of its rotations, means under the control of an operative part of the loom for automatically moving said unlocking device to its operative position, and fluid-pressure means operable upon the shuttle reaching the end of its line of travel for moving said device to its inoperative position and thereby continuing the loom in operation; substantially as set forth.

7. A power-loom having warp and cloth beams, a lay-beam, a shuttle, a power shaft, a driving-shaft, clutch members respectively connected with said shafts, and means for locking said members together so that the power may actuate said driving shaft, combined with an unlocking device adapted to automatically free said members from each other and thereby stop said shaft at the end of each of its rotations, an air-cylinder 42 having a piston and piston-rod connected with said unlocking device for moving the same, air-valves at the ends of the path of the shuttle, a pipe for supplying compressed air to said valves, air-connections leading from said valves to said cylinder, and means for alternately moving said valves upon the shuttle reaching the ends of its path for admitting air from said supply pipe to said cylinder for actuating said piston-rod to move said unlocking device to its inoperative position and permit the loom to continue in operation; substantially as set forth.

8. A power-loom having warp and cloth beams, a lay-beam, a shuttle, a power shaft, a driving-shaft, clutch members respectively connected with said shafts, and means for locking said members together so that the power may actuate said driving shaft, combined with an unlocking device adapted to automatically free said members from each other and thereby stop said shaft at the end of each of its rotations, an air-cylinder 42 having a piston and piston-rod connected with said unlocking device for moving the same, air-valves at the ends of the path of the shuttle, a pipe for supplying compressed air to said valves, air-connections leading from said valves to said cylinder, means under the control of an operative part of the loom for effecting the exhaust of the air from said cylinder and the movement of said unlocking device to its operative position preparatory to the movement of the shuttle and means for alternately moving said valves upon the shuttle reaching the ends of its path for admitting air from said

supply pipe to said cylinder for actuating said piston-rod to move said unlocking device to its inoperative position and permit the loom to continue in operation; substantially as set forth.

9. A power-loom having warp and cloth beams, a lay-beam, a shuttle, a power shaft, a driving-shaft, clutch members respectively connected with said shafts, and means for locking said members together so that the power may actuate said driving shaft, combined with an unlocking device adapted to automatically free said members from each other and thereby stop said shaft at the end of each of its rotations, an air-cylinder 42 having a piston and piston-rod connected with said unlocking-device for moving the same, a valve casing 144 containing a valve 145 forming chambers 146, 147 in said casing, a rod connecting said valve with the heddle, valve-casings 126, 127 at the ends of the path of the shuttle having exhaust ports and containing valves 128, 129 respectively forming chambers 133, 134 in the casing 126 and chambers 135, 136 in said casing 127, a supply pipe for compressed air leading to the said chambers 133, 135, an air-pipe 149 leading from the casing 126 to said chamber 147, an air-pipe 150 leading from said casing 127 to said chamber 146, an air-pipe 151 leading from said casing 144 to said cylinder 42, and means for alternately operating said valves 128, 129 upon the shuttle reaching the ends of its path for effecting the admission of the air to said cylinder and actuating the piston and rod therein to move said unlocking-device to its inoperative position for continuing the loom in operation, said valve 145 directing the air to said cylinder and permitting the air to exhaust therefrom in accordance with its position; substantially as set forth.

Signed at New York city, in the county of New York and State of New York this 6th day of October A. D. 1906.

WILLIAM R. BURROWS.

Witnesses:
CHAS. C. GILL,
ARTHUR MARION.