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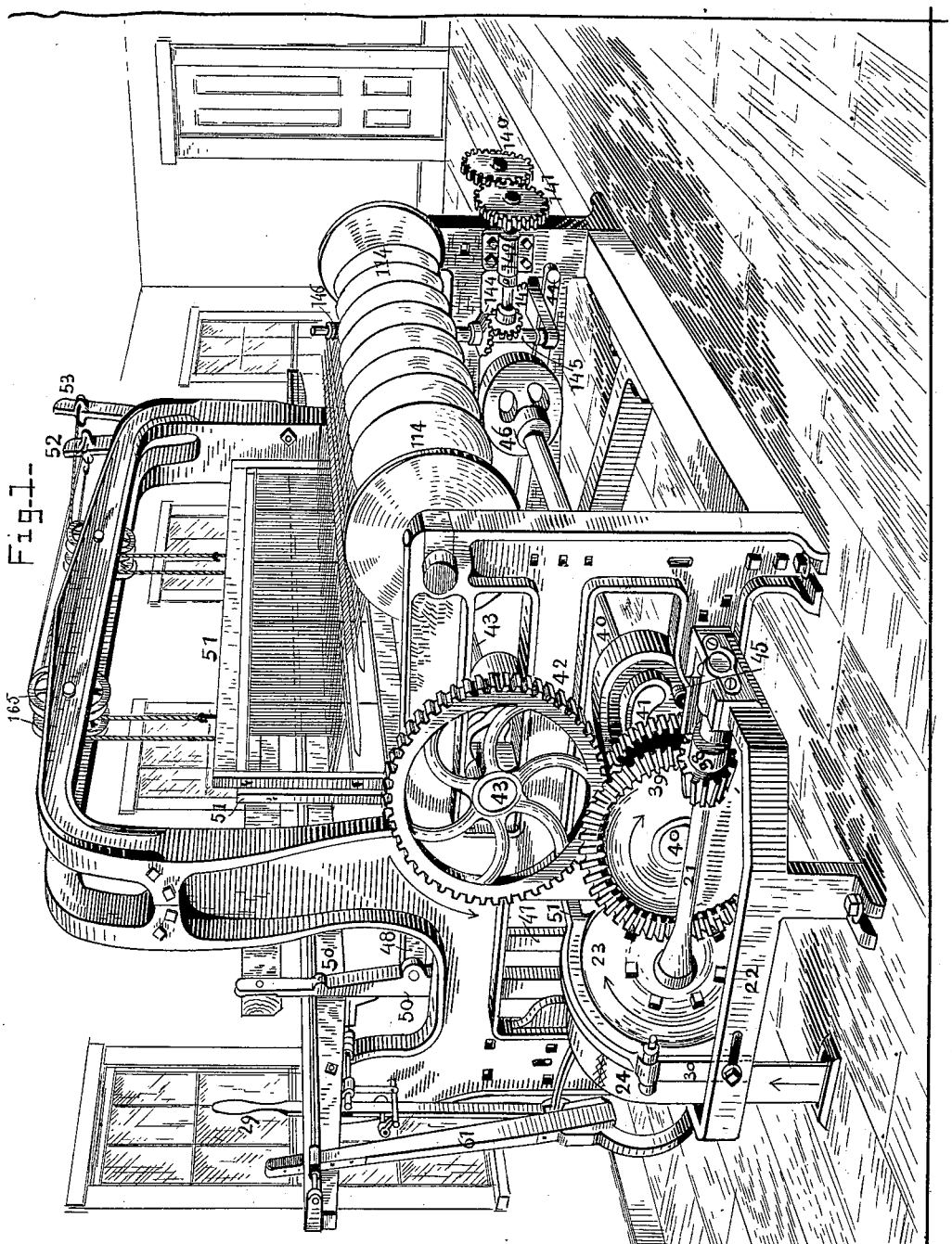
S. T. & W. S. THOMAS.

LOOM.

No. 386,506. Patented July 24, 1888.

Fig. 1.



Witnesses.
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per Eugene Humphrey
their Atty.

(No Model.) 12 Sheets—Sheet 2.

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LOOM.

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Fig-3-

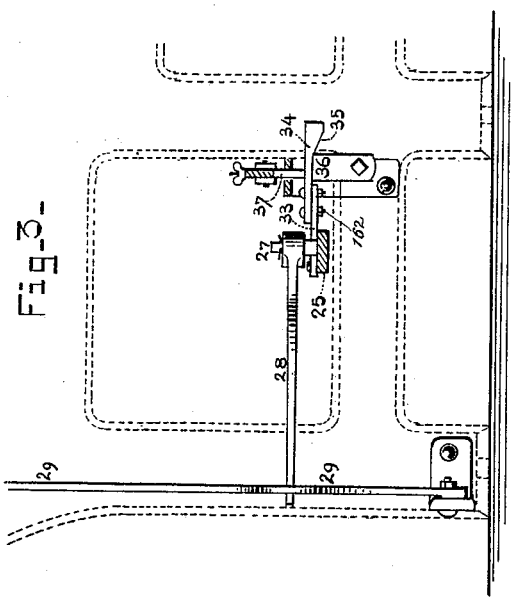


Fig-4-

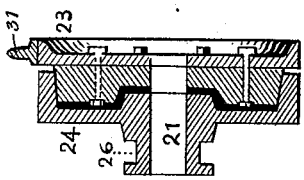
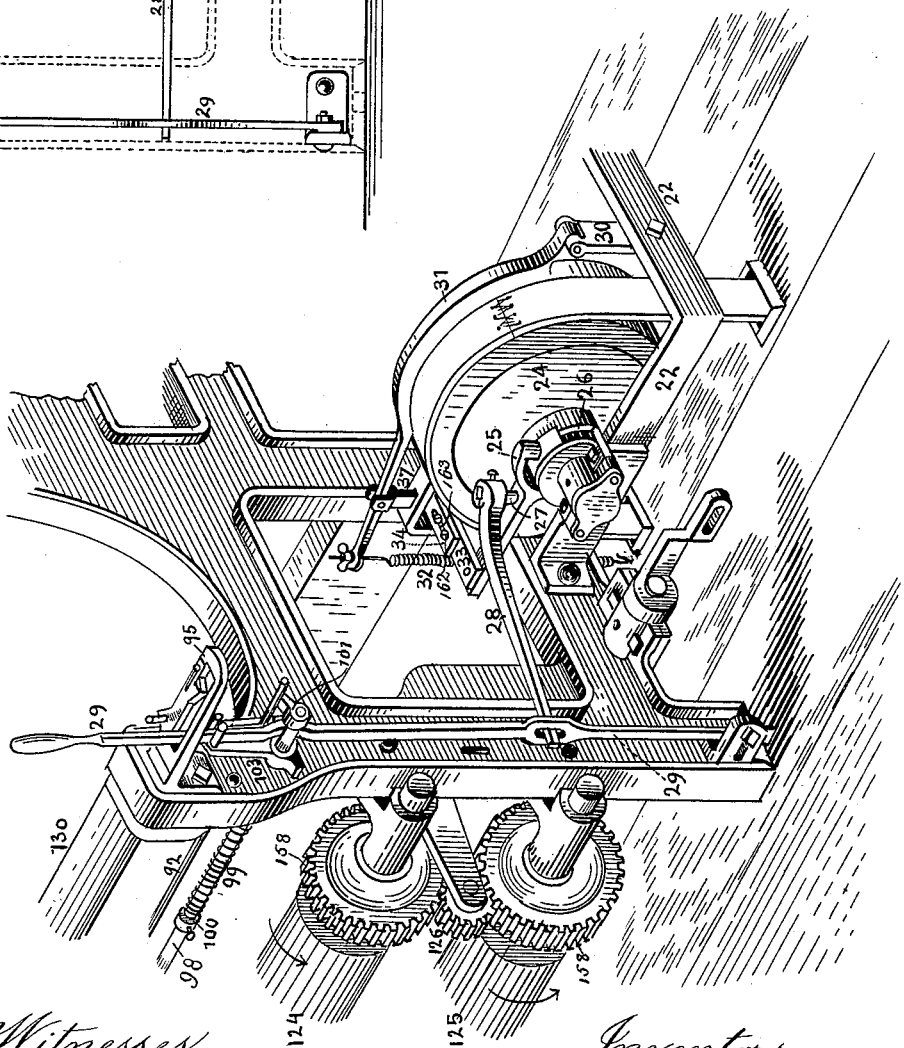


Fig-2-



Witnesses.
Samuel D. Keller,
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their Attorney

(No Model.) 12 Sheets—Sheet 3.

S. T. & W. S. THOMAS.

LOOM.

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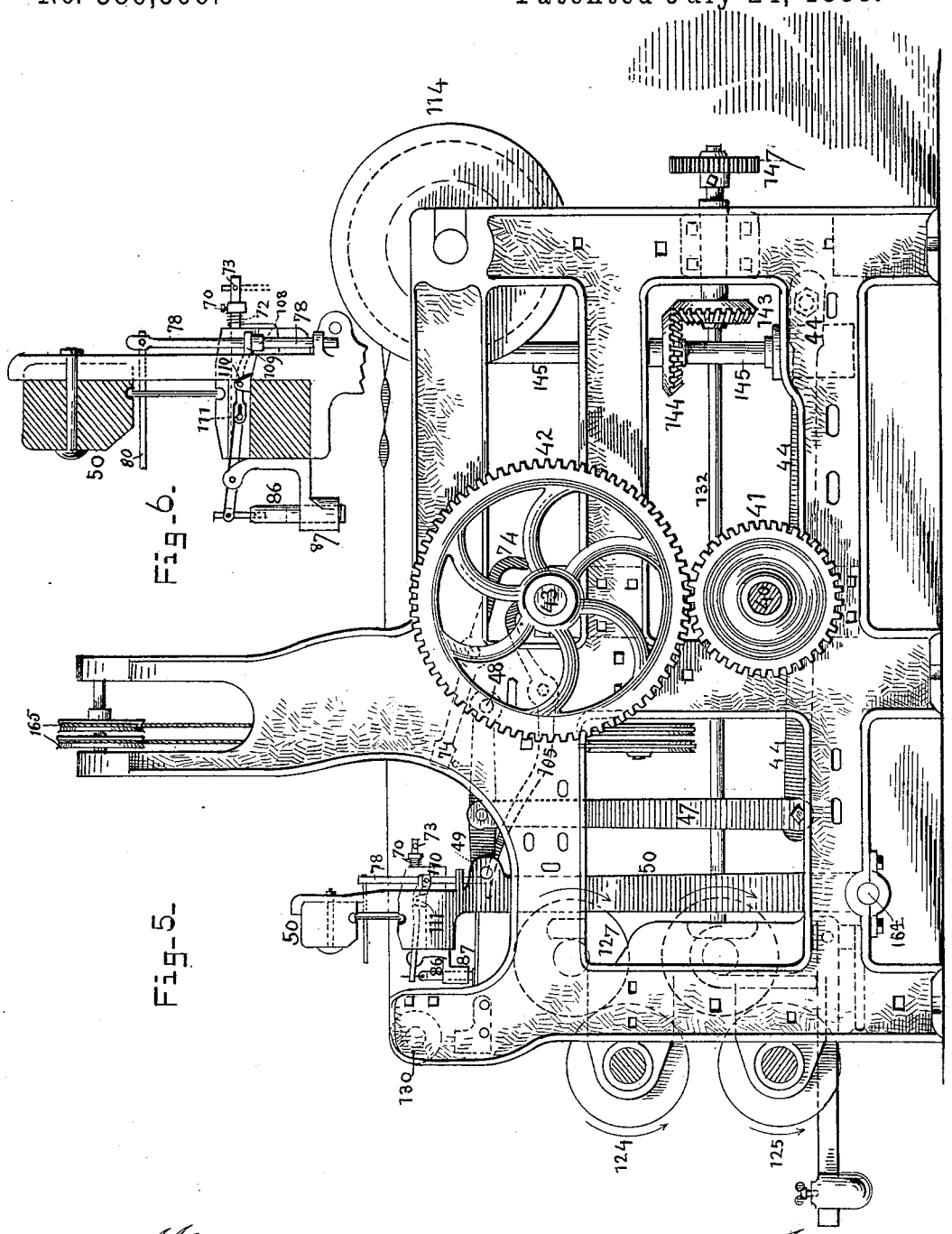

Fig. 6.

Fig. 5.

Witnesses.
Samuel D. Kelly
William H. McGinty.

Inventors.
Samuel T. Thomas.
Winfield S. Thomas.
per Eugene Humphrey.
their Atty.

(No Model.) 12 Sheets—Sheet 4.

S. T. & W. S. THOMAS.

LOOM.

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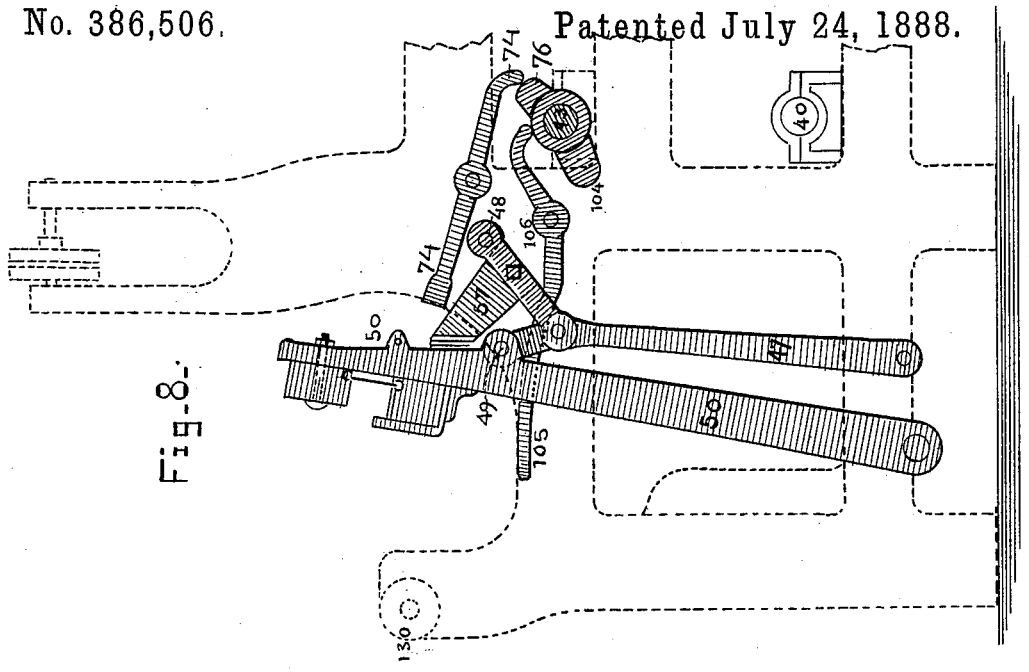

Fig. 8.

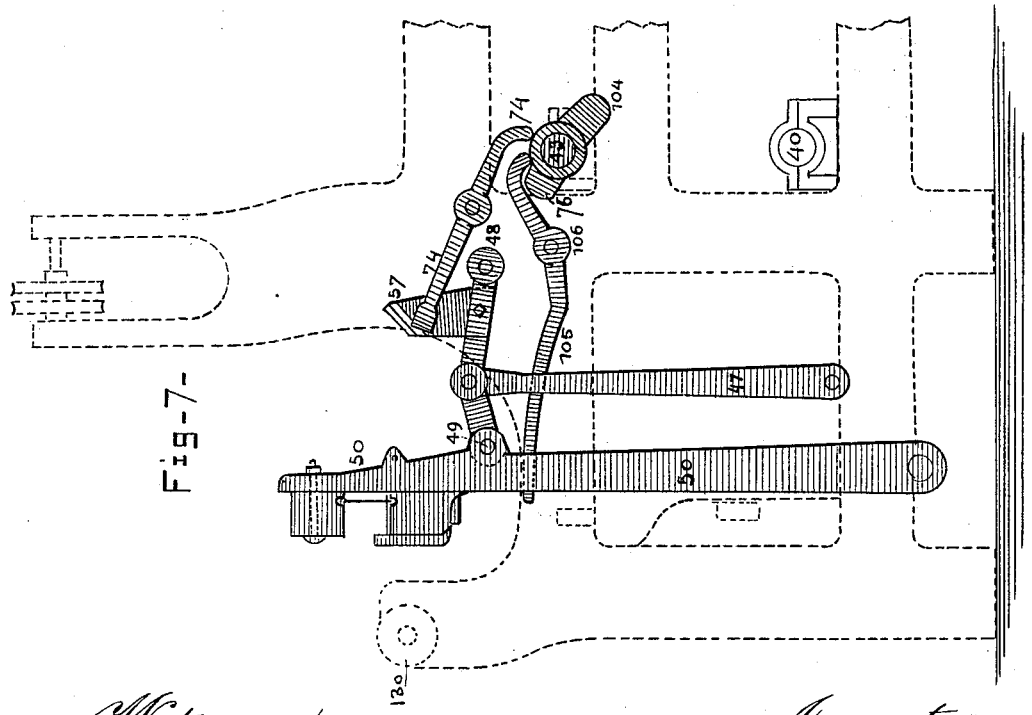

Fig. 7.

Witnesses:
Samuel D. Kelley.
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Samuel T. Thomas.
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per Eugene Z. Humphrey.
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(No Model.) 12 Sheets—Sheet 5.

S. T. & W. S. THOMAS.

LOOM.

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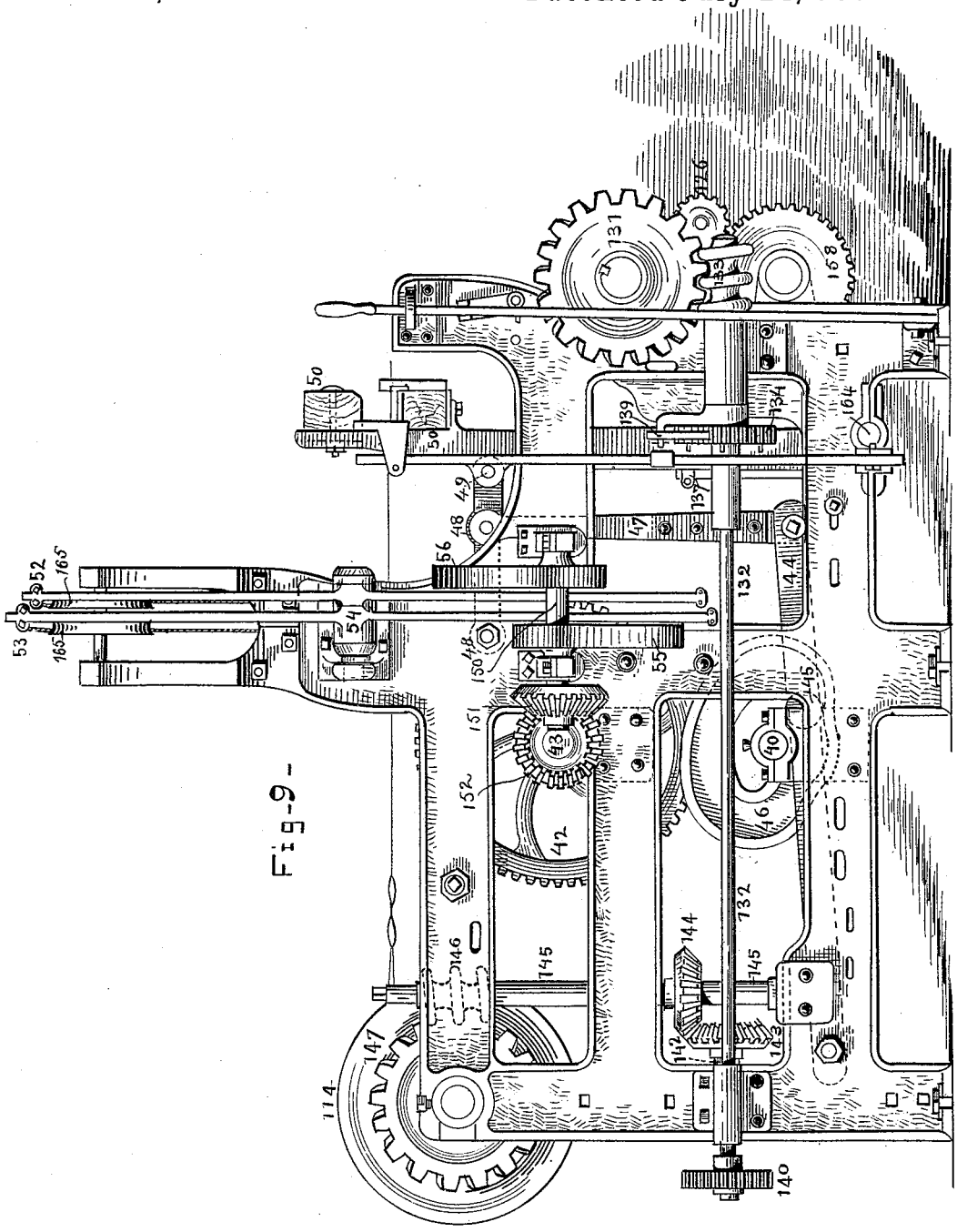

Fig. 9.

Witnesses.
Samuel D. Kelley,
William H. McGinty.

Inventors.
Samuel T. Thomas.
Winfield S. Thomas.
per Eugene Humphrey.
their Atty.

N. PETERS, Photo-Lithographer, Washington, D. C.

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S. T. & W. S. THOMAS.

LOOM.

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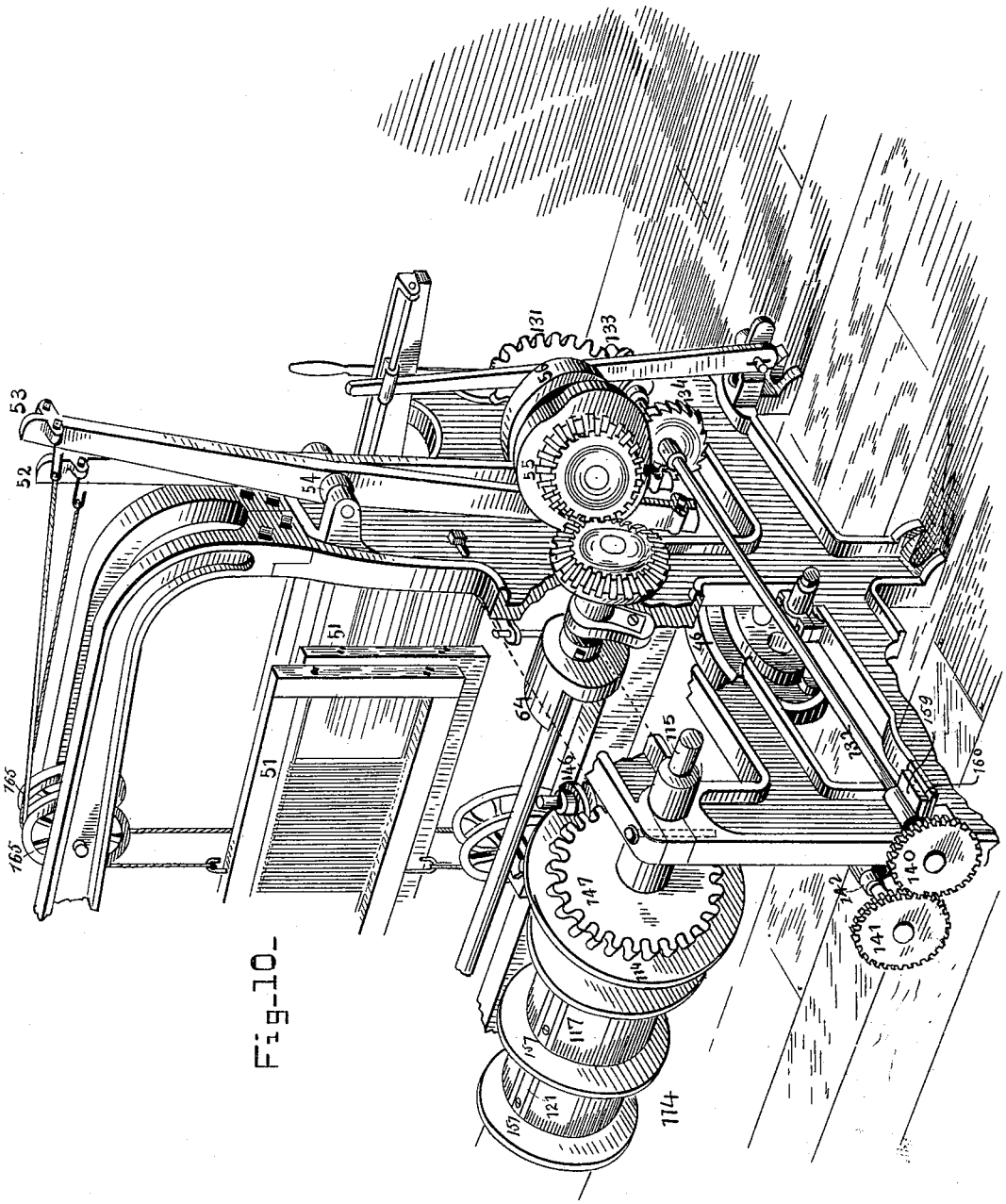

Fig-10-

Witnesses.
Samuel D. Kelley.
William H. McEnulty.

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Samuel T. Thomas.
Winfield S. Thomas.
per Eugene F. Wemphrey.
their Atty.

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S. T. & W. S. THOMAS.

LOOM.

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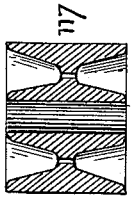

Fig. 15.

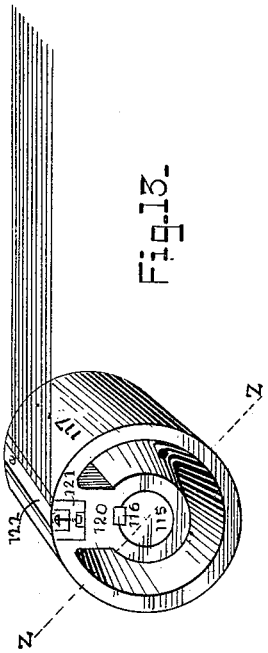

Fig. 13.

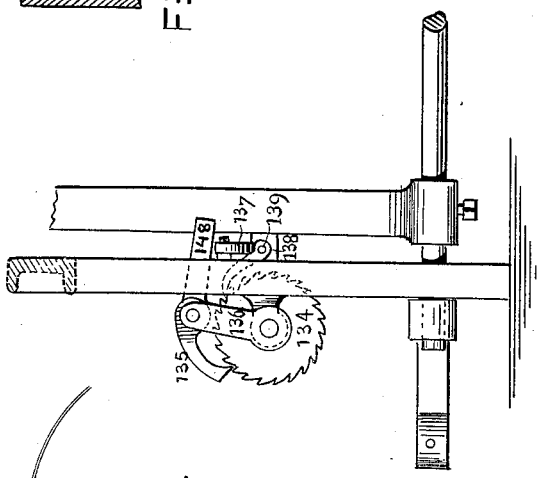

Fig. 12.

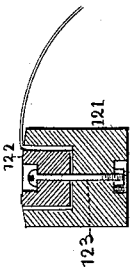

Fig. 14.

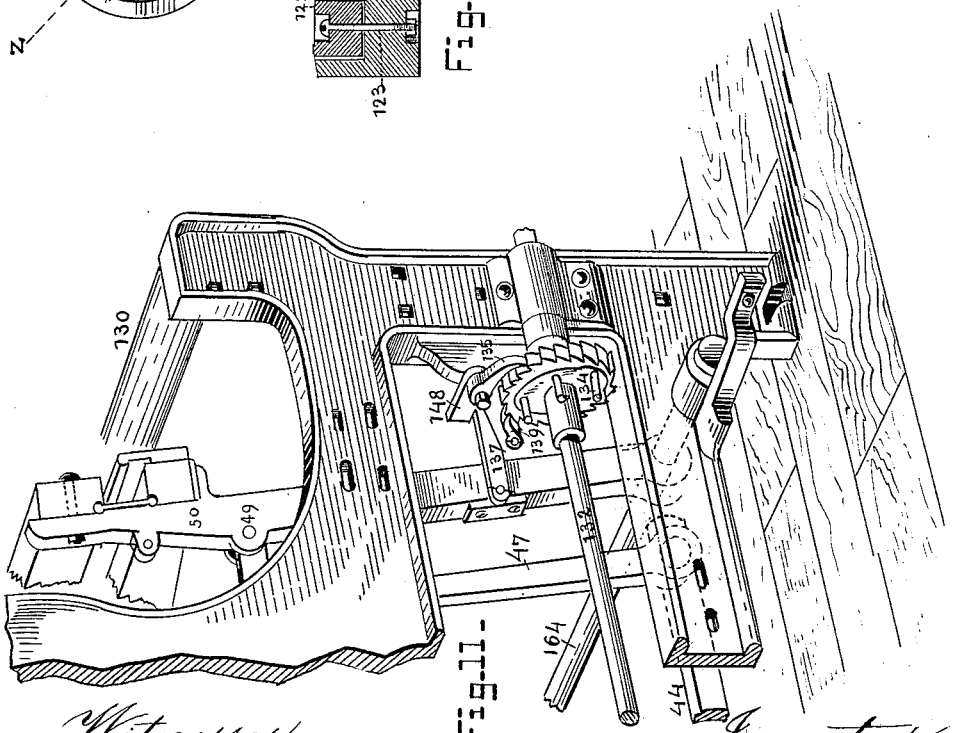

Fig. 11.

Witnesses.
Samuel D. Kelley.
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(No Model.) 12 Sheets—Sheet 8.

S. T. & W. S. THOMAS.

LOOM.

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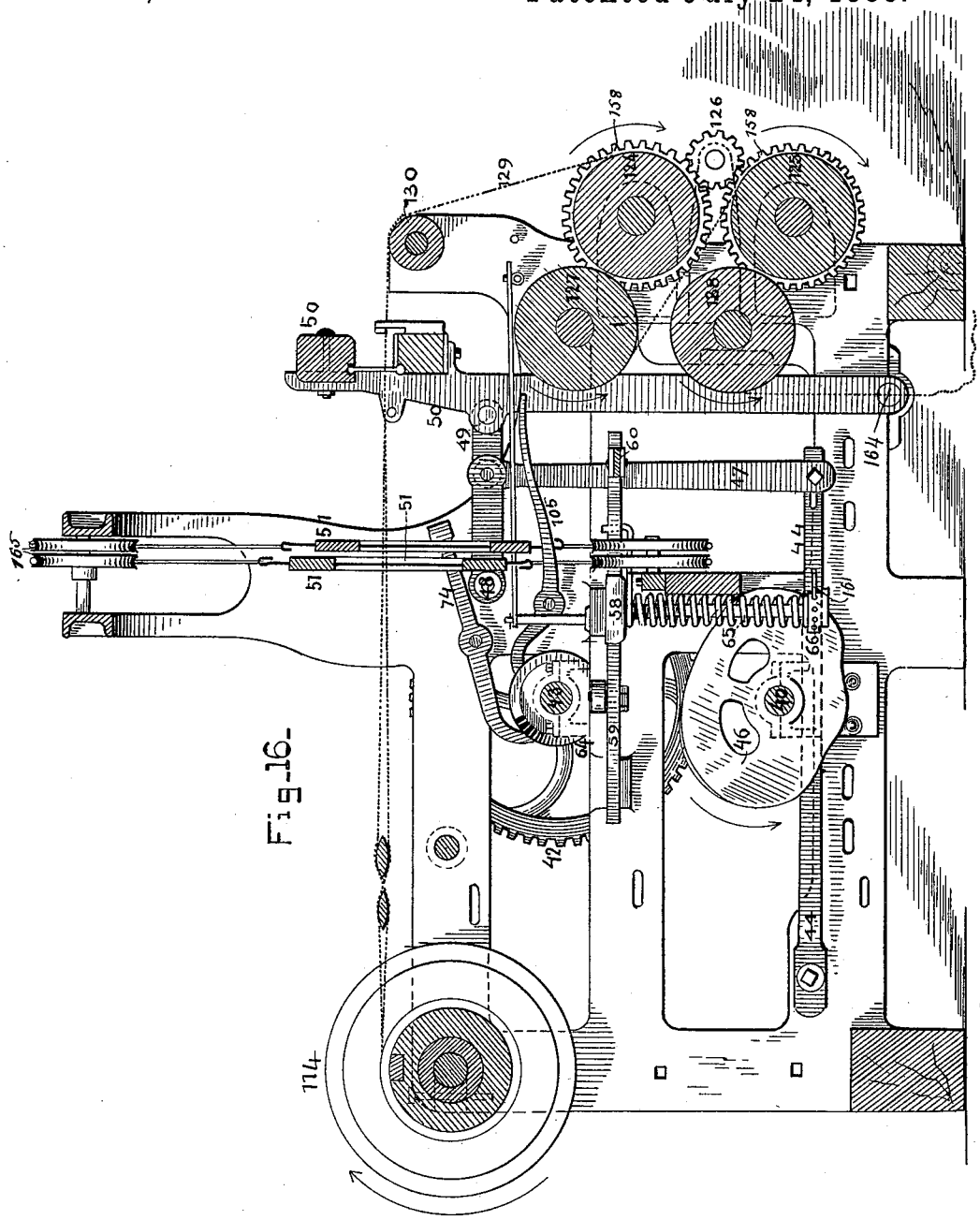

Fig. 16.

Witnesses:
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(No Model.) 12 Sheets—Sheet 9.

S. T. & W. S. THOMAS.

LOOM.

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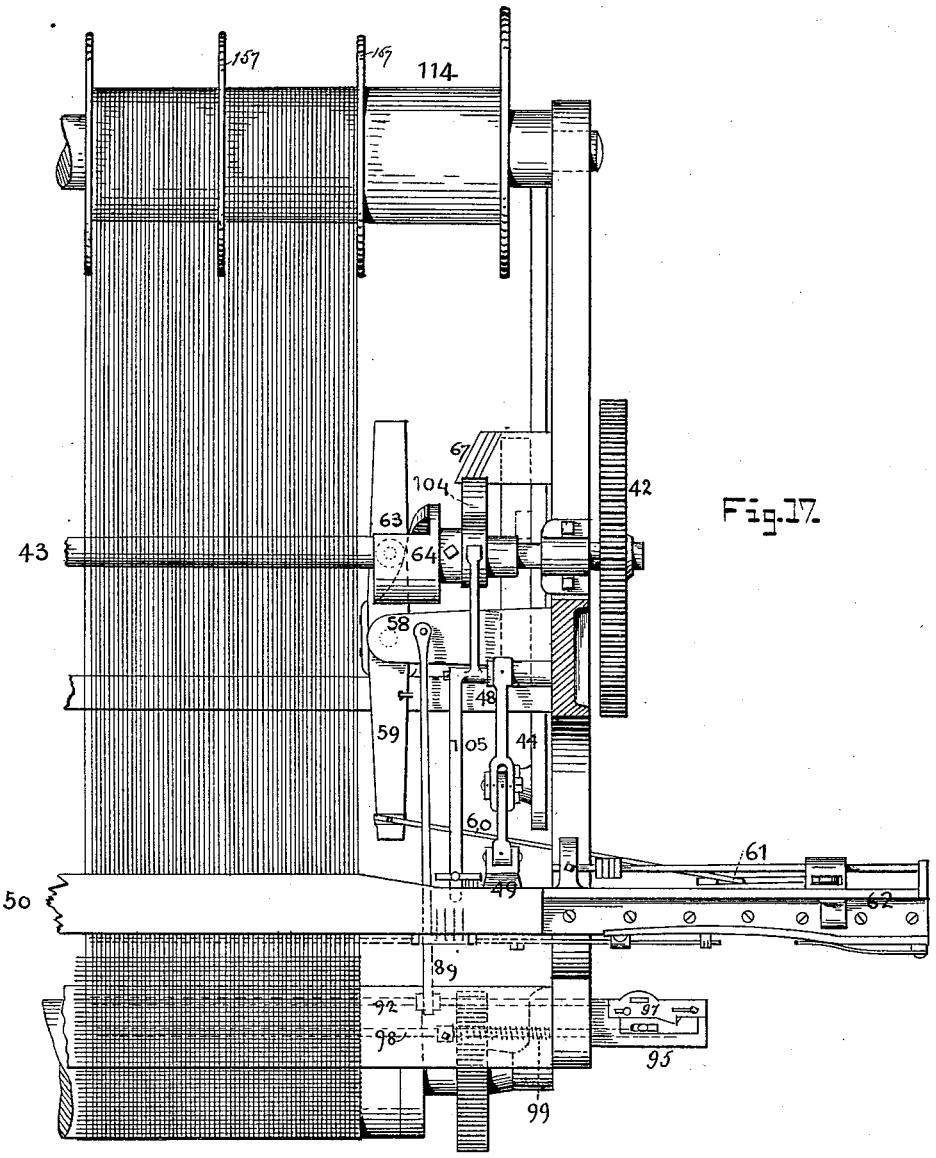

Fig. 17.

Witnesses:
Samuel D. Kelley.
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(No Model.) 12 Sheets—Sheet 10.

S. T. & W. S. THOMAS.

LOOM.

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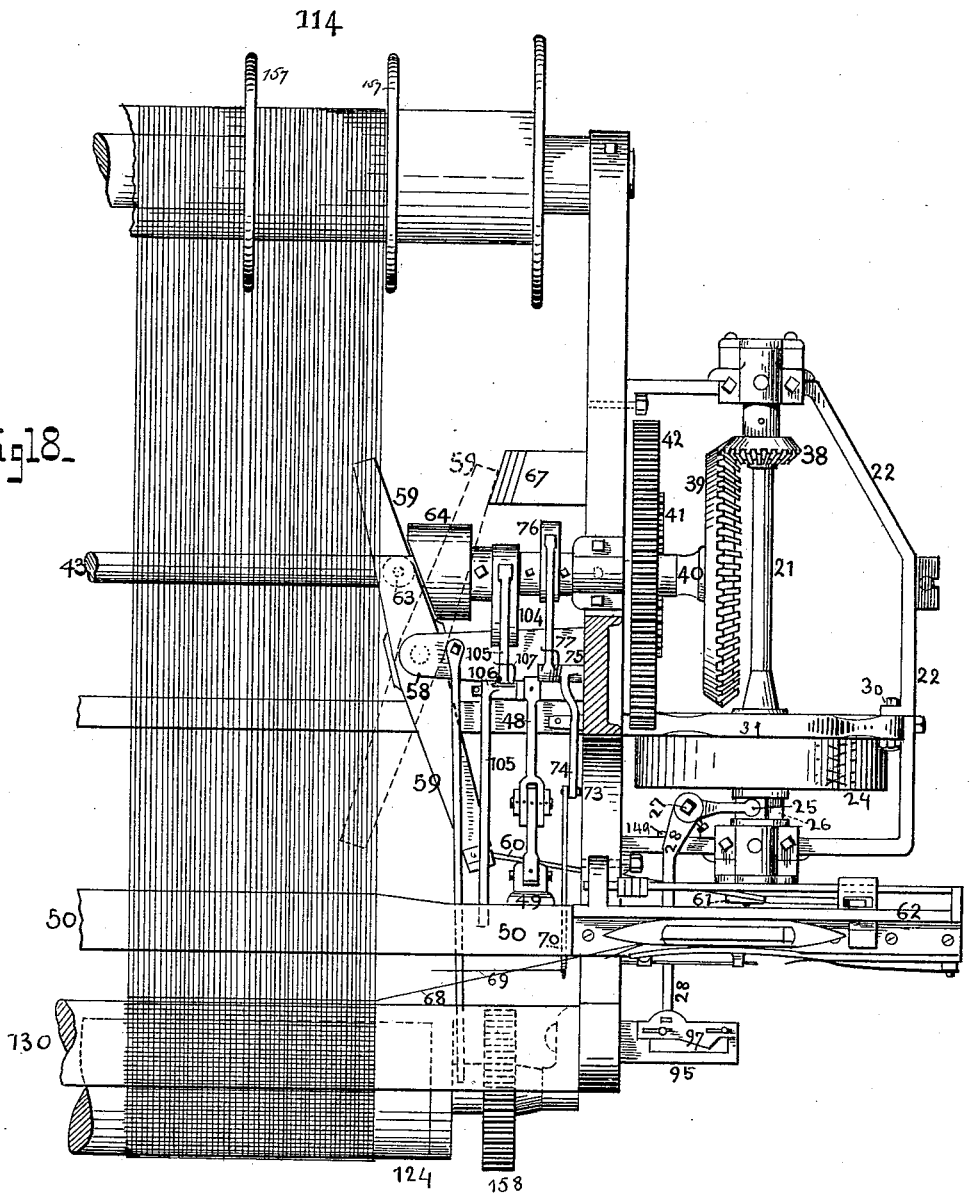
Fig 18.



Witnesses.

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(No Model.) 12 Sheets—Sheet 11.

S. T. & W. S. THOMAS.

LOOM.

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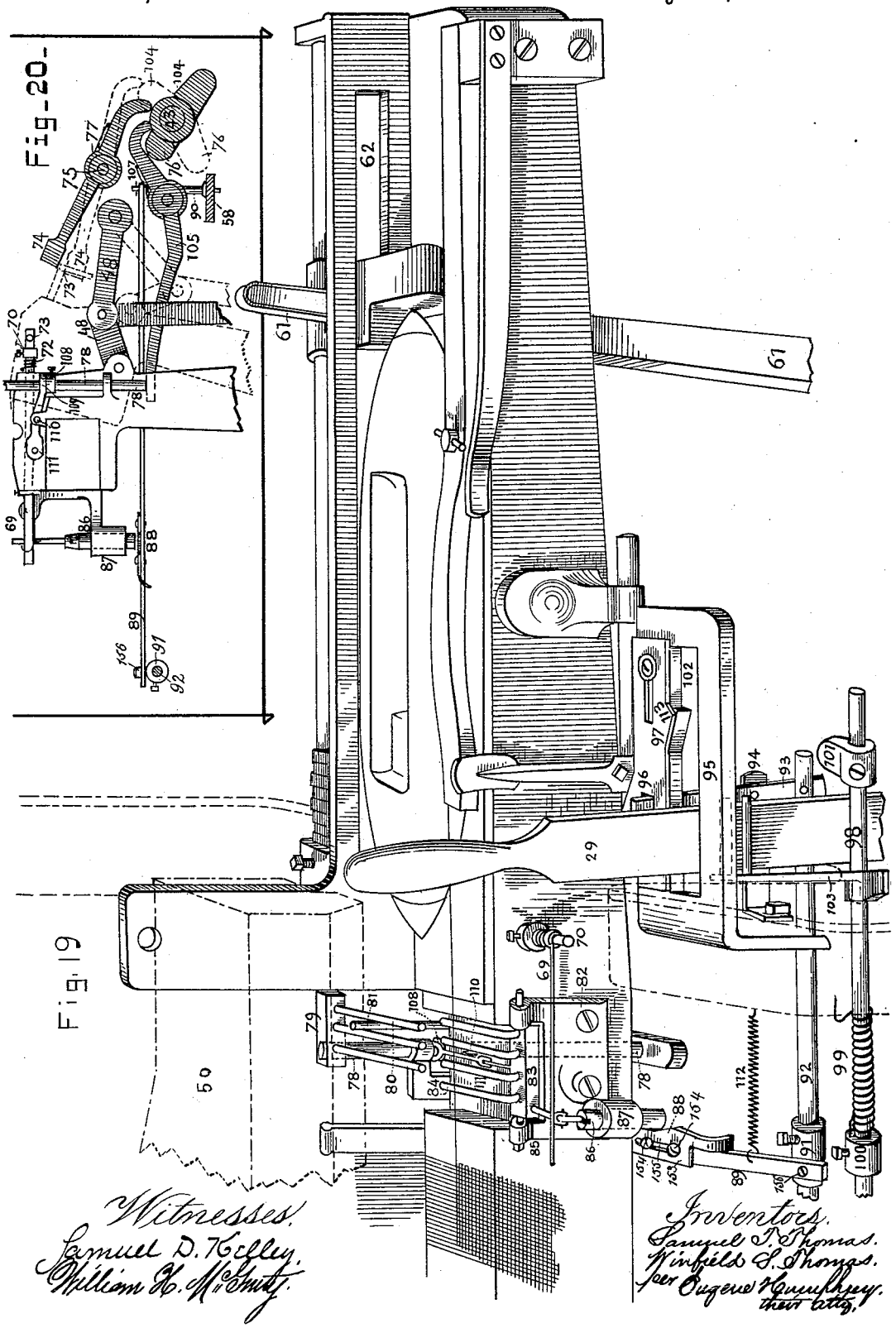

Witnesses.
Samuel D. Kelley.
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their attys.

(No Model.) 12 Sheets—Sheet 12.

S. T. & W. S. THOMAS.

LOOM.

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Fig. 21.

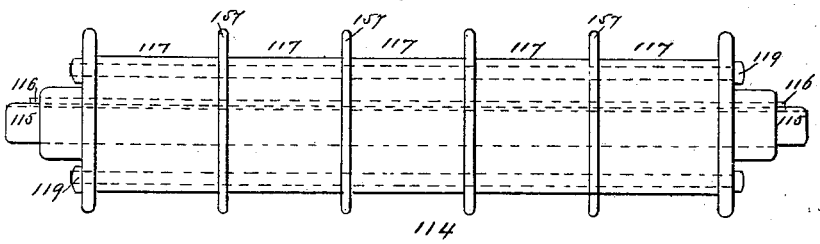


Fig. 22.

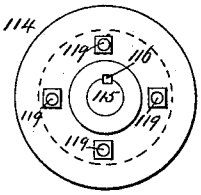


Fig. 23.

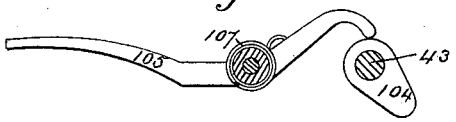


Fig. 25.

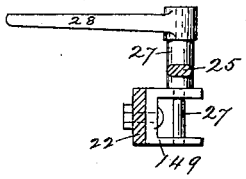


Fig. 24.

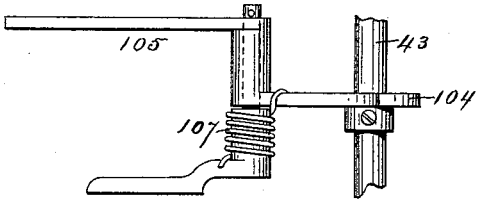


Fig. 26.

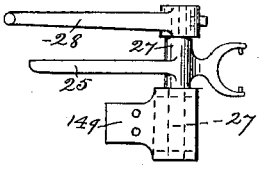


Fig. 27.

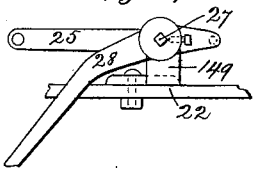


Fig. 28.

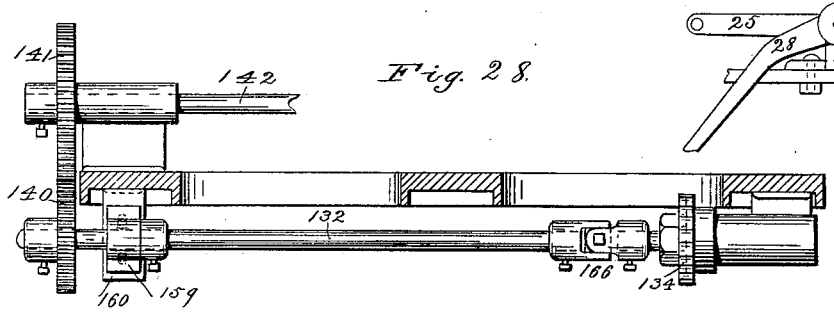
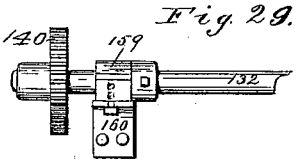


Fig. 29.



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C. E. Doyle.

Inventors:
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Winfield S. Thomas,
by Henry Calvert
Asso. Atty.

UNITED STATES PATENT OFFICE.

SAMUEL T. THOMAS AND WINFIELD S. THOMAS, OF BOSTON, MASSACHUSETTS, ASSIGNORS TO THE AMERICAN METALLIC FABRIC COMPANY, OF PORTLAND, MAINE.

LOOM.

SPECIFICATION forming part of Letters Patent No. 386,506, dated July 24, 1888.

Application filed February 28, 1884. Serial No. 122,270. (No model.)

To all whom it may concern:

Be it known that we, SAMUEL T. THOMAS and WINFIELD S. THOMAS, of Boston, in the county of Suffolk and State of Massachusetts, have invented a new and useful Improvement in Looms, which will, in connection with the accompanying drawings, be hereinafter fully described, and specifically defined in the appended claims.

The object of our invention is to provide an improved loom which, though more especially intended for weaving wire fabrics, is also adapted for other purposes.

The several features of our invention will first be described, and then summarized in the claims at the end of this specification.

In the accompanying drawings, Figure 1 is a perspective view of a loom embodying our invention. Fig. 2 is a perspective view of a portion of our loom, showing the friction-driving devices, the brake and shipper mechanisms, and adjacent parts. Fig. 3 is a detached sectional elevation showing the shipper-lever in connection with the clutch-pulley lever and devices for relieving the brake. Fig. 4 is a section through the axis of the friction-clutch pulley and the pulley or wheel upon which it acts to drive the loom. Fig. 5 is a sectional end elevation with the driving mechanism shown in Fig. 1 removed and intended to represent the arrangement of the take-up rolls, but more particularly the stop-motion devices. Fig. 6 is a detached view of the stop-motion devices. Figs. 7 and 8 are detail views of the lay, a portion of its operating mechanism, and some adjacent parts, the devices being shown in different positions in the two views, and the frame of the loom being represented by dotted lines. Fig. 9 is an elevation of the end of the loom opposite that shown in previous views, and in which the take-up and let-off devices, the harness-cams and levers, and the cam and lever for operating the lay through the toggle-joint connection are clearly shown, the lay being shown in its extreme forward position. Fig. 10 is a perspective of the end of the loom shown in Fig. 9, taken from a standpoint to the left of said figure, and shown with the frame broken away in places to more clearly exhibit certain parts. Fig. 11 is a detached perspective of a portion of the devices shown in Fig. 10, illustrating more clearly the ratchet mechanism for actuating the take-up and let-off by means of devices attached to and operated by the lay. Fig. 12 is a side view showing a portion of the devices represented in Fig. 11, as seen from the right of the latter figure. Fig. 13 is a perspective view of a section of our warp-beam, showing the means for securing the warp thereto. Fig. 14 is a vertical section of the clamp shown as inserted in the beam in Fig. 13. Fig. 15 is a section through the beam, as on line *z z*, Fig. 13. Fig. 16 is a sectional elevation in a central vertical plane as viewed from the same standpoint as in Fig. 9, but showing the inner side of the frame at the opposite end of the loom with the devices thereto attached, the levers and cam for actuating the lay, the lever, cam, and spring for throwing the shuttle, a part of the kink-preventing and stop-motion devices, and the arrangement of the take-up rolls. Fig. 17 is a top view or plan of the right-hand portion of the loom, showing the lay in its forward position and the other parts in their proper relative positions. Fig. 18 is a plan like Fig. 17, but showing the lay back, the shuttle in the right-hand box and ready to leave, its actuating-lever being on the point of being released by its cam to the action of its counteracting torsion-spring, and the weft-thread being shown as extending from the selvage across the kink-preventing device to the shuttle in the box. Fig. 19 is an enlarged detached perspective of the right-hand portion of the lay, the shuttle-box, the stop-motion devices attached to the lay, the shipper-lever, and the shipper-lever locking and detaching devices. Fig. 20 is a detached side elevation of a portion of the lay and a part of the stop-motion devices thereto attached, the kink-preventing device, the levers for actuating the lay, the kink-preventing device, and the stop-motion, the lay being also represented in broken lines in its back position, and the relative positions of

the other parts are similarly represented corresponding to such changed position of the lay. Fig. 21 is a side view of our warp-beam, and Fig. 22 is an end view thereof. Figs. 23 and 24 are detail views of the lever for actuating the raddles and the operating mechanism for said lever. Figs. 25, 26, and 27 are detail views of the clutch-lever and adjacent parts. Figs. 28 and 29 are detail views showing the shaft from which the take-up and let-off mechanisms are operated, the adjustable box for said shaft, and adjacent parts.

The loom thus illustrated is designed for broad heavy weaving, and requires a stiff and substantial frame, which may be constructed in the well-known manner. Upon a shaft, 21, journaled in bearings mounted in a supplemental frame, 22, Figs. 1, 2, is fixed a friction-wheel, 23, which is or may be of ordinary construction. There is also upon the same shaft a friction-clutch pulley, 24, having a lineal as well as rotary movement on said shaft, and being constructed and arranged, as shown in Fig. 4, to drive wheel 23 by frictional contact therewith. Power is applied to the loom to operate the same through a belt which turns the clutch-pulley 24. This pulley is forced into and out of contact with the friction-wheel 23 by means of a forked clutch-lever, 25, having pins which work in a groove, 26, in a hub formed on the pulley, as shown, (Figs. 2, 4,) said lever being formed with a vertical shaft or bar, 27, which is squared at its upper end to receive lever 28, and arranged to be thereby rocked about its axis, and to thus impart the requisite lineal movement of the clutch-pulley on its shaft to make and break contact with the friction-wheel, said lever 28 being secured to the top of the shaft 27, as shown, and extending toward the front of the loom it passes through a slot in the shipper-lever 29, by which it is actuated by the hand of the operator to stop and start the loom in the well-known manner. Shaft 27 is sustained by a bracket, 149, secured to the supplemental frame 22. (See Figs. 25, 26, and 27.)

Pivoted to a bar, 30, secured to frame 22, Fig. 2, is a curved brake-lever, 31, which bears upon wheel 23, when required to stop the same, with a pressure equal to the contractile force of a spring, 32, which is adjustably secured to the end of the lever, as shown. To relieve wheel 23 from the pressure of the brake when starting the loom, a horizontal bar, 33, is pivoted to the rear end of the clutch-lever 25, and to bar 33 another bar, 34, is adjustably connected by bolts 162, passing through a slot, 163, (see Fig. 2,) near one end, while at its opposite end (more clearly shown in Fig. 3) it is formed with a downward incline, 35. When the clutch-lever 25 is rocked to force the driving-pulley into and out of contact with the friction-wheel, as before described, the bars 33 and 34, connected, as stated, with the rear end of the clutch-lever, will be moved horizontally, according to the movement of the clutch-lever. If that movement is such as to set the loom in motion, then the movement of the bars will be in the direction to cause said incline 35 to ride upon the projecting shoulder 36, formed or secured upon the frame, thus raising the bar to the extent of the depth of the incline. A vertical bar, 37, is secured at its upper end to the brake-lever, while its lower end is in close proximity to the upper side of bar 34, so close that when said incline by a horizontal movement of the bar, as stated, causes the bar to rise upon shoulder 36 it comes in contact with the end of rod 37 and raises it also, thereby carrying the brake-lever up against the resistance of its spring and relieving the wheel 23 from its pressure, and when the movement of the clutch-lever is such as to stop the loom there will be a retractive movement of the parts just described, and spring 32 will instantly apply the brake to the friction-wheel, causing it to stop promptly. Upon shaft 21 there is also fixed a small bevel-gear, 38, Fig. 1, which meshes into a large gear, 39, secured upon shaft 40, which extends horizontally from side to side of the loom, and is the main driving-shaft, carrying the cams which, through lever-connections, operate and time the movement of the lay, and also carrying the gear 41, which meshes into a larger gear, 42, fixed on the end of an upper shaft, 43, which also extends from side to side of the loom, operating the shuttle-driving mechanism and other devices and transmitting movement to the harness mechanism.

Pivoted to the frame, on either end of the loom, is a lever, 44, Figs. 5, 9, 16, which carries a roll, 45, that works in a groove in a cam, 46, fixed on the lower shaft, 40. The forward end of this lever is jointed to a vertical arm, 47, Figs. 5, 9, and 16, which at its upper end is connected with a toggle-joint, one branch of which is pivotally bolted to the frame at 48, and the other to the lay at 49, and it is through these devices that the lay is moved and timed in its movements, as will be described. The lay 50 is supported upon a horizontal shaft, 164, in the lower portion of the loom-frame, and so as to rock thereon in the usual manner. The harness 51, Fig. 10, is suspended by hooks secured above and below in cords which pass over pulleys 165, as shown, and connect with both the upper and lower ends of the harness-lever 52 53, which are pivoted to the side of the frame at 54, and are actuated and timed in their movements by the cams 55 56, carried by shaft 150, said shaft being provided with a beveled gear, 151, meshing with a similar gear, 152, on shaft 43.

When the loom is in practical operation, the movements of the lay and its time of action and rest relatively to the harness and shuttle movements are as follows: Supposing the shuttle to have just made its flight and entered the box, leaving a thread or "pick" of filling properly in the warp, the shed remains open, while cams 46, acting on levers 44, move arms 47 upward, carrying the toggle-joints and lay

from the position shown in Fig. 8 into the position shown in Fig. 9, at which point the lay will give the requisite blow to the filling and beat it into its proper place in the warp. The toggle-joints will still move upward into the position shown in Fig. 7, thus slightly retracting the lay, and will then commence to move downward to the position shown in Fig. 9. During the upward movement from this last position and return to it again the harness closes and opens the shed, crossing the warp over the last pick of weft, and as the toggle-joints in their descent come into a straight line again, as in Fig. 9, they cause the lay to give a second blow to the filling after the warp has been so crossed over it, as is desirable in some kinds of weaving. This double beating move of the lay results from the construction of the cams 46 and the connections by which the toggles 49 are operated from said cams, the latter being so formed as to lift or throw the centers of the toggles above or beyond a straight line between their ends at the extreme upward movement of the arms 47, as above described. The arms of the toggle-joints are further drawn downward till they reach the position shown in Fig. 8, when the lay is at its extreme backward position and drawn into contact with and is supported steadily upon a cushioned rest, 57, secured to the back arms of the toggle-joints, and remains so at rest during the flight of the shuttle.

The means employed for throwing the shuttle with a uniform velocity are as follows: Upon each end of the loom is pivoted in a bracket, 58, extending inward from the frame, Figs. 17, 18, a lever, 59, which lever at its front end is attached by a strap, 60, to the usual picker-staff, 61, which is connected with the shuttle-box 62 and arranged to throw the shuttle therefrom in the well-known manner. Toward its rear end lever 59 carries a roll, 63, which bears against a cam, 64, secured upon and rotated by shaft 43. A spiral spring, 65, is coiled about a vertical shaft beneath this lever, and at its upper end is attached to the forward portion of the lever, as shown, while at its lower end it is attached to a winding-wheel, 66, provided with peripheral holes or sockets, into which bars, as 161, are inserted, as shown, to secure and wind the spring about its central shaft to the requisite degree to produce sufficient reactionary force therefrom to throw the shuttle with the velocity required. This force is exerted when the lever 59 is turned on its pivot by cam 64, as from the position shown in dotted lines in Fig. 18 to the position shown in solid lines in said figure, (or from the position shown in Fig. 17 to that shown in Fig. 18,) against the said force of spring 65, and then suddenly released from the incline on said cam to return its roll by a direct line to the lowest part thereof, thus bringing the rear end suddenly into the position in which it rests against the buffer 67, extending inward from the loom-frame. The lever, being so acted upon by the cam in one direction and by the torsional force of the spring in the opposite direction, imparts through its connection with the picker-staff the required force to the shuttle to throw it with the requisite velocity to the opposite shuttle-box, and this force is adjustable by means of the winding-wheel 66, through which more or less torsional strain may be put upon the spring.

To avoid kinking in the weft-thread and consequent damage to the woven fabric, which sometimes occurs in hard-twisted filling and in metallic threads in that part of the weft which extends from the selvage to the shuttle in the box when it is slackened as the shuttle leaves the box, we employ the following devices: When the lay is at rest on its extreme backward throw, as has been described, the filling 68, Fig. 18, will extend from the selvage of the woven fabric to the shuttle in the box, as shown, and this being the position from which the shuttle is thrown, when it starts out of the box it will slacken the weft-thread between it and the selvage until it has entered the shed far enough to draw the thread into the warp. If the thread is inclined to kink, it will do so when thus slackened. To prevent this we secure an elastic arm, 69, to a rod or rock-shaft, 70, Figs. 18, 19, extending through the lay. This arm is composed of a wire which lies horizontally under the line of filling as it extends from the selvage to the shuttle in the box, as shown. To make it sufficiently elastic, it is coiled at its connection with rod 70. The rod to which it is attached is arranged to make a partial revolution in the lay, being, when not acted on for that purpose, held by the torsional force of a spring, 72, attached to it and the lay, so as to keep the wire arm 69 in the horizontal position shown and described. In the rear end of rod 70 there is a pin, 73, projecting therefrom in a plane parallel to arm 69. Upon this pin a lever, 74, acts to give rod 70 a quarter-turn when required. This lever 74 is pivoted to a stud, 75, and its rear end rests upon a cam, 76, secured to shaft 43, Fig. 20. The end of the lever is kept in contact with the cam by a coiled spring, 77. Cam 76 is so formed and its movement so timed relative to the flight of the shuttle that it raises the end of lever 74 in contact therewith just as the shuttle commences to move out of the box, or slightly in advance of such movement, and thereby forces the forward end of the lever down upon pin 73, and turns rod 70 so as to raise arm 69 into contact with the filling, such movement keeping pace with the flight of the shuttle, or so that the filling is looped over the arm 69, and is thereby kept straight between it and the selvage and the shuttle until the shuttle has progressed far enough to release the filling by springing the arm down sufficiently to allow the thread to be drawn therefrom into the warp free from kinks. The arm 69 is sufficiently stiff to maintain the requisite tension upon the filling to prevent its kinking, but not stiff enough to overcome the shuttle-tension upon the thread,

and thus to retard the velocity of the shuttle; and said arm returns, by action of the cam and springs, to its horizontal position again before the shuttle returns to the box from which it was last shot. Each end of the lay is provided with such a device for preventing kinks in the filling. Upon each end of the lay are devices which are constructed and arranged to operate in connection with other devices, as a weft-stop motion, whereby the action of the loom is arrested whenever the weft fails to reach across the warp, such stopping of the loom taking place just as the lay commences to move forward from its extreme back position and before the harness mechanism moves to close the shed.

The construction and mode of operation of these devices are as follows: On the back side of the lay are secured two bearings or guides, in which a vertical rod, 78, Figs. 19, 20, moves up and down. To the top of this rod is fastened a block, 79, in which a number of small horizontal rods or fingers, 80, are secured, and which project forward and across and above the shuttle-race, constituting what we term a "raddle," Fig. 19. A guide-pin, 81, keeps this raddle from lateral movement about the axis of its rod 78. Upon the front of the lay, opposite the device just described, is secured a bracket, 82, in which is pivoted, as shown, a block, 83, carrying a number of small rods or fingers, 84, constituting another raddle, which projects backward below and across the shuttle-race in a recess in the lay, as shown, and having its fingers arranged beneath the spaces between the fingers of the upper raddle, 79 80, so that the upper fingers may pass down between the lower ones without coming in contact therewith. From the pivotal block of this lower raddle there projects an arm, 85, which is jointed to and upholds a pin, 86, which is supported laterally by and moves vertically in a bearing, 87, formed on said bracket. This pin projects below the lay far enough to come in contact with an incline, 88, on the edge of a plate, 153, adjustably attached by screws 154, passing through a slot, 155, in said plate, Fig. 19, to a horizontal bar, 89, which is pivoted at its rear end to a standard, 90, upon a bracket, 58, Figs. 16, 20, and at its front end is pivotally secured by a screw or pin, 156, to a sleeve, 91, Fig. 19, fastened to a rod, 92. This rod connects with the lower end of a lever, 93, which is pivoted to an arm extending out from the frame of the loom at 94, and the upper end of which works in a slot in the back side of the shipper-bracket 95 at 96 to actuate a detaching slide, 97, arranged to move upon the top of said bracket to dislodge the shipper-lever, as will be more fully explained. The shipper-lever 29 works in the slotted bracket 95, and a rod, 98, extends through the loom-frame, having secured upon it a spring, 99, one end of which rests against the frame and the other against a sleeve, 100, secured to the rod by a set-screw. The spring is also secured to said sleeve and frame, so that it cannot turn freely upon said rod. Upon the outer end of the rod is secured a collar, 101, having a projection toward the lay. Against the projection on this collar the shipper-lever 29 is pressed when starting the loom, and is carried against the resistance of spring 99 until it is interlocked with notch 102 in its bracket. Spring 99, being secured from turning freely on rod 98, as stated, is arranged to be wound about said rod by the turning of the same, to produce a torsional action in said spring. This torsional force of the spring is utilized to keep the shipper-lever 29 in the notch 102, by means of a short lever, 103, Fig. 2, secured to said rod 98, and at its upper end being provided with a projecting pin, which bears against the front side of the shipper-lever with the torsional force of said spring 99. There are two ways in which pin 86 is raised out of range of incline 88, as the lay rocks backward and forward, carrying said pin—one by means of a cam, 104, Figs. 7, 8, 20, upon shaft 43, which operates a lever, 105, pivoted at 106, and kept in contact with said cam by a coiled spring, 107, Figs. 23, 24, while its forward end extends under rod 78 and serves to raise said rod when required. Upon the rod is a collar, 108, (see Fig. 6,) which, when the rod rises, comes in contact with one end of a lever, 109, which is pivoted at 110, and at 111 is jointed to a rod or arm extending from raddle 83, and thereby said raddle is rocked so as to raise its arm 85 and the pin 86, connected therewith. This means of raising the pin is operative every time the shuttle is in the box at the opposite end of the lay. The other way of operating the lower raddle and raising its pin 86 is by the falling of the upper raddle, consisting of block 79 and its rods or fingers 80, when lever 105 moves downward away from rod 78 and allows it with its said attachments to fall by gravitation. This movement takes place just as the shuttle is entering the box and has passed out of range of the falling raddle, when, if the weft-thread lies across the lower raddle, as shown in Fig. 19, the fingers of the falling upper raddle will bear upon the weft, and thus will form a connection with the fingers of the lower raddle, and thereby as the upper one moves down, bearing upon the intervening weft, its weight will tilt the lower one, and consequently raise its pin 86 out of range of the incline 88, while the lay moves forward to beat said weft-thread into its proper place in the warp and will not stop the loom; but if said weft-thread does not follow the shuttle, as it should, and is not across the fingers of the lower raddle when the shuttle enters the box and the upper raddle falls, then the fingers of the upper raddle will pass down between the fingers of the lower raddle without contact therewith, and consequently without tilting the same and raising pin 86, which pin will in that case, when the lay moves forward, strike incline 88 at the commencement of such forward movement of the lay, and

will thereby move its bar 89 laterally against the resistance of spring 112 and impart lineal movement in the same direction to rod 92, which will rock the vertical lever 93 and cause the upper end thereof to move slide 97 in the opposite direction, driving its incline 113 against the shipper-lever, thereby forcing said lever out of its retaining-notch 102, when spring 99 by its expansive force will immediately carry the shipper into the position shown in Figs. 2 and 19 in bracket 95, and this movement of the shipper will disconnect the friction-clutch or belt-pulley from the friction-wheel, and at the same time release the brake, allowing it to be sprung upon the wheel 23, as hereinbefore described, and thus the motion of the loom will be immediately stopped before the lay has beaten against the filling or the shuttle or harness have moved from their positions.

The warp beam or roll, which as an entirety is designated 114, consists of a shaft, 115, Figs. 13, 21, and 22, provided with a key, 116, which, together with the shaft, extends across the loom, the shaft being suitably mounted in journal-boxes in the frame thereof. The warp-beam proper is composed of a number of iron sections, 117, which may be provided with flanges 157, said sections being fitted to the central shaft and its key and secured together lineally by four rods, 119, passing through the same parallel to the central shaft and between that and the surface about which the warp is wound, said sections being clamped between the heads formed upon one end of said rods and nuts threaded upon the opposite ends. These sections each have a groove, 120, planed in them, and when so secured upon the central shaft they are arranged so that their several grooves are in line and form a continuous groove the entire length of the beam.

Into the groove in each section is fitted a wooden block, 121, which is also grooved in a similar manner and provided with a wooden clamping-piece, 122, fitted to said groove so as to leave the requisite space for the ends of the warp-thread to pass around the same and to be securely clamped between the two by means of screw-bolts 123, passed through and into the same, as shown in Fig. 14.

The warp-roll may be when preferred made in one entire piece, grooved and provided with a clamp, as described, instead of in sections, as shown and described, our invention in this particular being confined to the means for securing the warp by means of a clamping device inserted and secured in a groove in the beam. The clamp being properly fitted to the groove in the beam, the winding of the warp about the same will secure it in position.

We will now describe our improved take-up mechanism and mechanism combined therewith to let off uniformly with the take-up or variably therefrom.

Upon the front of the loom are journaled, in brackets extending outward from the frame, two take-up rolls, 124 and 125, Fig. 16. These rolls are provided at one end, on the right, with gears 158, connected by an intermediate gear, 126. Resting against roll 124 is another roll, 127, and against roll 125 rests a similar roll, 128, these rolls 127 128 being journaled in bearings in the loom-frame or in suitable brackets attached thereto. These four rolls, which may be made of wood or metal, are of uniform diameters, and the two first are positively actuated by gearing, while the other two are moved by frictional contact with those that are geared. The woven fabric 129 passes over a small roll, 130, journaled in the frame at the front of the loom and around roll 124, thence around roll 127, being pinched between these two rolls next to and around roll 125, thence up between this roll and roll 128, and over the latter to the place of delivery, all as indicated in said Fig. 16. Roll 125 is provided with a gear which has a less number of teeth (two less in this case) than there are in the gear on roll 124, and roll 124 being the driving-roll there is consequently a slightly faster movement imparted to roll 125, which produces a strain upon the fabric between that roll and roll 127. This strain, in conjunction with the pressure which the fabric receives in passing between the meeting faces of the rolls, produces a finishing effect upon the fabric analogous to calendering, whereby the surface of the goods is leveled under a uniform tension and the appearance of the same greatly improved, and in some cases of fabrics woven for special purposes—as, for instance, metallic fabrics—the quality of the goods is thereby improved. We do not, however, herein claim the method of finishing wire fabrics just described, as this feature of our invention is embraced by our application, Serial No. 261,557, filed January 21, 1888.

We provide the take-up roll 124 with a worm-wheel, 131, Fig. 9, on the left or opposite end from that to which the gears already referred to are attached, and the number of teeth in said wheel corresponds to the number of inches around the circumference of the roll. A shaft, 132, is mounted in suitable bearings on the side of the loom, and upon its front end is secured a screw or worm, 133, which engages the teeth of the worm-wheel 131, and one revolution of said worm moves said wheel to the extent of one tooth, which is equivalent to the extent of one circumferential inch of the roll to which the wheel is attached.

The shaft 132 is turned by means of a ratchet, 134, secured thereon, which is actuated by a pawl, 135, Figs. 11 and 12, which pawl is pivoted to an angle-lever, 136, journaled on said shaft adjacent to the ratchet, and having an arm, 148, extending into the path of the lay. Upon the side or "sword" of the lay is pivoted a bar, 137, the under side of which is inclined and rests on a projection, 138, on the inside of the loom-frame and extends under arm 148. As the lay moves forward to beat in the filling, the forward end of bar 137 slides under the arm 148 in close proximity thereto,

and as the lay advances its incline slides upon projection 138, causing the bar to rise into contact with arm 148, carrying that up also, and thereby turning lever 136 on shaft 132, together with its pawl, which engages the ratchet-teeth, and thus the ratchet is moved to the extent of one tooth, and as the whole number of teeth in the ratchet represents one revolution of the worm, and one revolution of the worm represents one tooth of the wheel and one inch of the circumference of the roll, and as each movement of the lay in beating up the picks moves the ratchet one tooth, therefore each tooth of the ratchet represents one pick, and as many teeth as there are in the ratchet so many picks will there be to the inch in the woven fabric to a mathematical exactness.

To vary the number of picks of weft in an inch of the woven fabric one or more, it is only necessary to change the ratchet for one containing the number of teeth corresponding to the exact number of picks required. This is a result which is not obtainable by means of the usual changes of gearing heretofore employed to vary the take-up in looms, and enables a manufacturer to regulate the quality of his goods to a degree of nicety and certainty, and with an advantage heretofore unattained by take-up devices. When the lay has thus caused a movement of ratchet 134, and has moved backward again, withdrawing bar 137, then the projecting arm 148 of pawl-lever 136 will fall by its gravity, and thereby retract pawl 135 to the requisite extent. A detent-pawl, 139, pivoted to the frame and engaging the teeth of the ratchet, prevents a reaction of the ratchet-wheel when its actuating-pawl is so retracted.

In connection with the take-up devices just described we employ, when desirable, a positive let-off, which is actuated simultaneously with the take-up, and by the same means above described. We extend the shaft 132 and support such extension in a journal-box on the rear of the frame, Figs. 9, 10, and upon that end of the shaft we place a gear, 140. This gear meshes into another gear, 141, secured upon the outer end of a short shaft, 142, journaled in bearings on the inner side of the frame and carrying at its forward end a bevel-gear, 143. This gear meshes into another bevel-gear, 144, of the same size, secured to a vertical shaft, 145, which is also supported in suitable bearings upon the inner side of the frame. This vertical shaft carries at its upper end a worm, 146, like that shown on the take-up end of shaft 132, and worm 146 works in a worm-wheel, 147, secured to the warp-roll, and being like the worm-wheel on the take-up roll. The ratchet actuated by the lay to turn shaft 132 to operate the take-up devices, as described, also operates simultaneously therewith the let-off or warp-roll 114, through the mechanism just described, and to the same extent that the take-up roll is turned if gears 140 and 141 are equal; but when it is desirable that more warp should be let off than is taken up by the direct action of the cloth or take-up rolls to compensate for the deflection of the warp-threads by the filling when interwoven therewith in the fabric, then gear 141 may be made with a less number of teeth than gear 140; or if it should be desirable to retard the warp, then a gear with a greater number of teeth than are contained in gear 141 may be substituted therefor to work with gear 140, an adjustable journal-box, 159, constructed in any well-known and suitable manner being provided to accommodate the variable gears to each other. As herein shown, this journal-box is secured to a bracket, 160, Figs. 28 and 29, attached to the loom-frame, and to adapt the shaft 132 for a considerable adjustment said shaft may, if desired, be provided with a joint, 166, as shown in Fig. 28. By this method of constructing and arranging the let-off devices any practical degree of variation, either faster or slower, of the warp-roll from the take-up roll may be had to suit the requirements of the fabric being woven, and to compensate for the variations in the quantity of warp upon the roll as the weaving progresses. In ductile metallic warps, where it may be desirable to retain the ductility of the threads in the woven fabric to a greater or less degree, such an arrangement of positive and differential take-up and let-off is adapted to secure the most perfect results.

We claim as our invention—

1. The combination, with the lay 50, of the toggle, the rest 57, the cam 46, its operating mechanism, and connections between the said cam and toggle, whereby the lay will be brought against said rest and there held during the flight of the shuttle, as set forth.

2. The combination, with the lay and the shuttle and their actuating mechanisms, of the rock-shaft 70, provided with an arm, 69, having a yielding connection with said shaft, and thus adapted to move independently thereof, and mechanism for rocking said shaft, whereby the weft will be prevented from kinking when it is slackened as the shuttle starts forward to pass through the shed, substantially as set forth.

3. The combination, with the loom-frame and the lay, of the rock-shaft 70, provided with yielding arm 69, torsional spring 72, pin 73, lever 74, pivoted to said frame and arranged to act on said pin, shaft 43, cam 76, and spring 77, for holding said lever in contact with said cam, substantially as set forth.

4. The combination, with the lay, of the vertically-movable raddle 79 80, means for operating the same, the pivoted raddle 83 84, having arm 85, the vertically-movable pin 86, connected to said arm, the lever 89, provided with an incline adapted to be engaged by said pin when the latter is depressed at the commencement of the forward movement of the lay, a shipper-lever for stopping and starting the loom, and connections between said shipper-lever and the lever 89, whereby when the

weft is absent the loom will be stopped at the commencement of the forward movement of the lay, substantially as set forth.

5. The combination, with the lay, of the pivoted raddle 83 84, the pin 86, upheld thereby, the vertically-movable raddle 79 80, its operating-rod 78, having a projection, as collar 108, a lever operated by said collar, and connections between said lever and said pivoted raddle, whereby the latter will be tilted to lift the pin 86 when the vertically-movable raddle is lifted, substantially as set forth.

6. The combination, with the lay, of the vertical shaft 78, raddle 79 80, collar 108, secured to said shaft, lever 109, arranged to be engaged at one end by said collar, raddle 83 84, connected with said lever, pin 86, lever 105, the loom-frame to which said lever is pivoted, cam 104, spring 107, and shaft 43, whereby when said shaft 78 and raddle 79 80 are moved upward the raddle 83 84 will be tilted, substantially as set forth.

7. The combination, with the lay and the vertically-movable pin 86, supported thereby, and means for operating the said pin, of the lever 89, provided with an adjustable plate having an incline, 88, rod 92, connected with said lever, lever 93, slide 97, having an inclined projection, shipper-lever 29, and bracket 95, adapted to operate substantially as set forth.

8. The combination, with the movable slide 97, means for operating the same, the shipper-lever 29, and bracket 95, having a retaining-notch for said lever, of the longitudinally-movable rod 98, provided with torsional and retracting spring 99, and collar 101, having a projection, an arm or lever, 103, attached to said rod and adapted to engage said shipper-lever, whereby when said slide is moved the said shipper-lever will be disengaged from its retaining-notch and moved to effect the stopping of the loom, substantially as set forth.

9. The combination, with the loom-frame and driving-shaft 21, supported thereby, of the friction-clutch and driving-pulley 23 24, the clutch-lever 25, the arm or lever 28, the shipper-lever 29, the brake-lever 31, its spring 32, a sliding bar connected with said clutch-lever and provided with an incline, and a vertical bar, 37, whereby when the said shipper-lever is moved in the proper direction the parts forming the driving-clutch will be disconnected and the brake be simultaneously applied, substantially as set forth.

10. The combination, with a warp-roll provided with a longitudinal groove, of a grooved block or beam fitted in said groove, a clamping-bar adapted to be inserted in the groove of said block or beam, and attaching devices, as screw-bolts 123, for securing said clamping-bar in place, substantially as set forth.

11. The combination, with the rolls 124 and 125, differentially geared, as described, and means for operating said rolls, of the intermediate pinion, 126, and the friction-rolls 127 and 128, whereby the woven fabric as it is taken up in the process of weaving is passed over and between said rolls and pressed and subjected to a uniform strain, thereby leveling and finishing the surface of the web, substantially as set forth.

12. The combination, with a pair of take-up rolls and their operating worm-gear wheel, of a shaft provided with a worm and a ratchet-wheel, a warp or let-off roll provided with worm-gear wheel, a second shaft carrying a worm, connections between said shafts, a pawl-carrier and pawl for operating said ratchet-wheel, the lay, and a device moving with the latter for imparting motion to said pawl-carrier, whereby said take-up and let-off rolls will be intermittingly and simultaneously operated from the lay, substantially as set forth.

13. The combination, with the take-up roll, of the shaft 132 and mechanism for rotating the same, connections for rotating said roll from said shaft, a gear-wheel, 140, on said shaft, a gear-wheel, 141, having a number of teeth different from the number of the wheel 140, a warp or let-off roll, and a train of gearing between the latter and the said gear-wheel 141, whereby the said take-up and let-off mechanisms may be simultaneously but differentially operated, substantially as set forth.

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