(6 Sheets). Sheet 1.

S. D. Paul.
Spinning Mule.

No. 43,333. Patented Jun. 28, 1864.

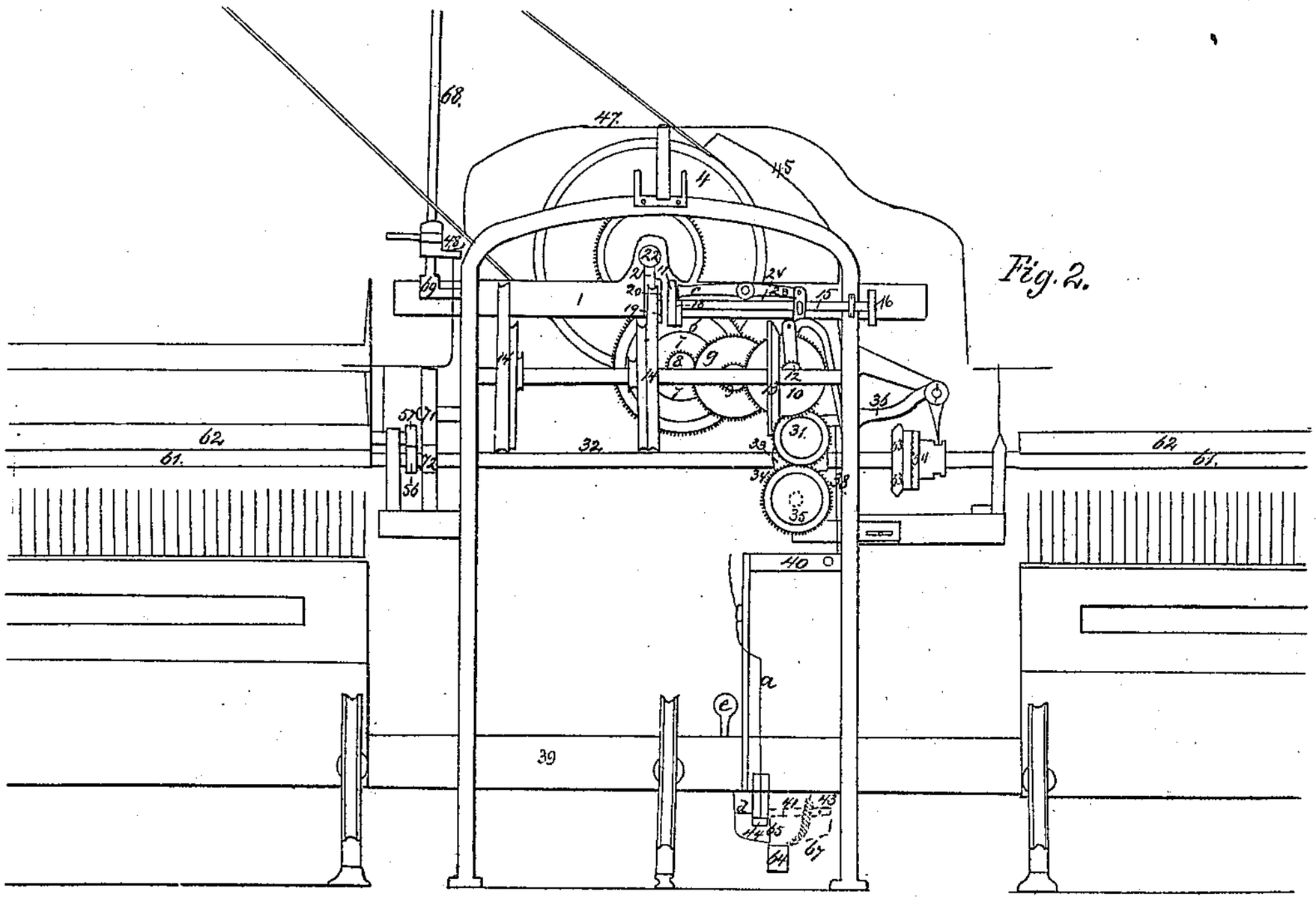


Fig. 2.

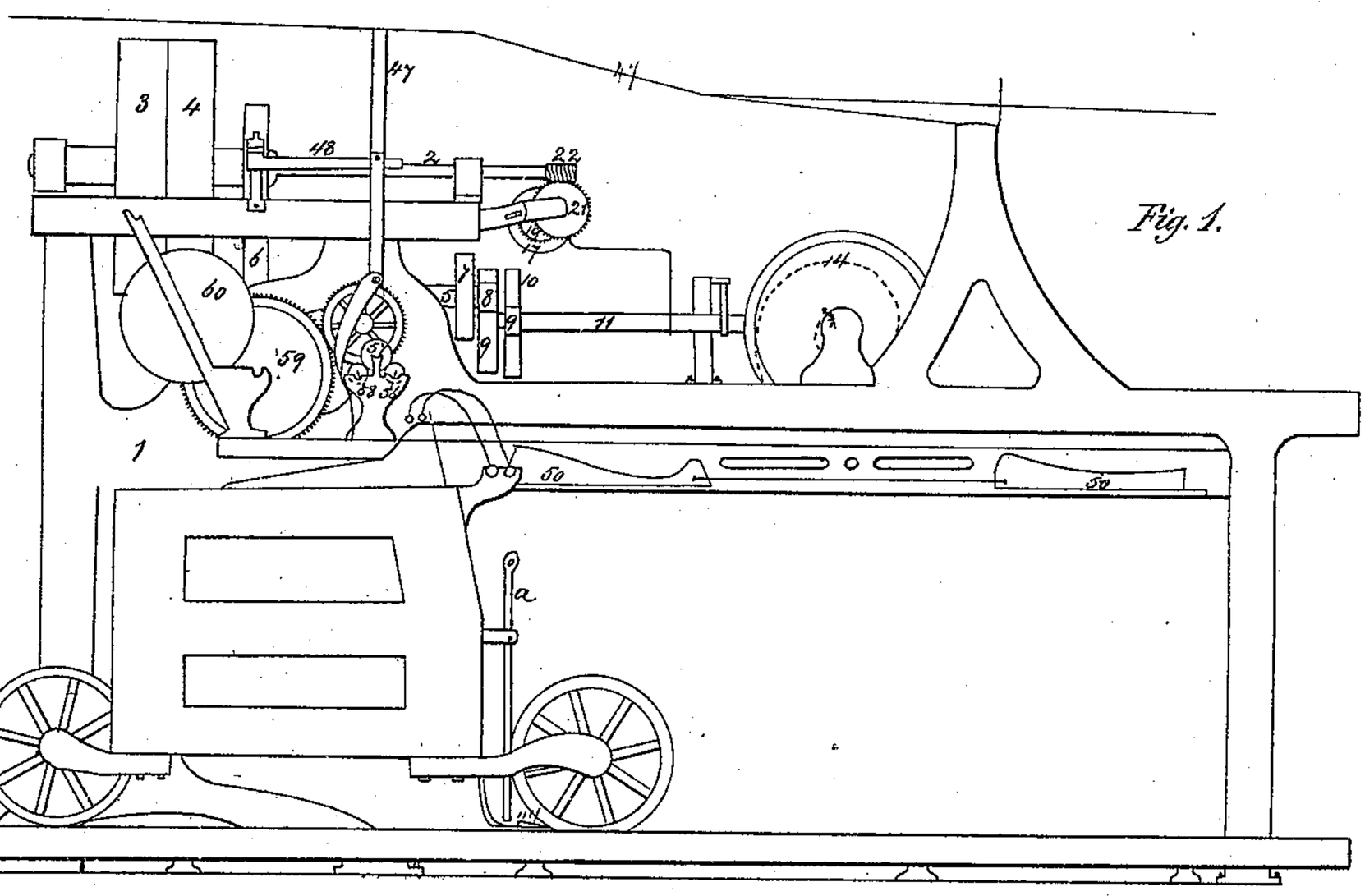


Fig. 1.

Witnesses.

James C. Barker
James L. Barker.

Inventor.

Seth D. Paul

(6 Sheets) Sheet II.

S. D. Paul.
Spinning Mule.

No. 43,333. Patented Jun. 28, 1864.

Fig. 4.

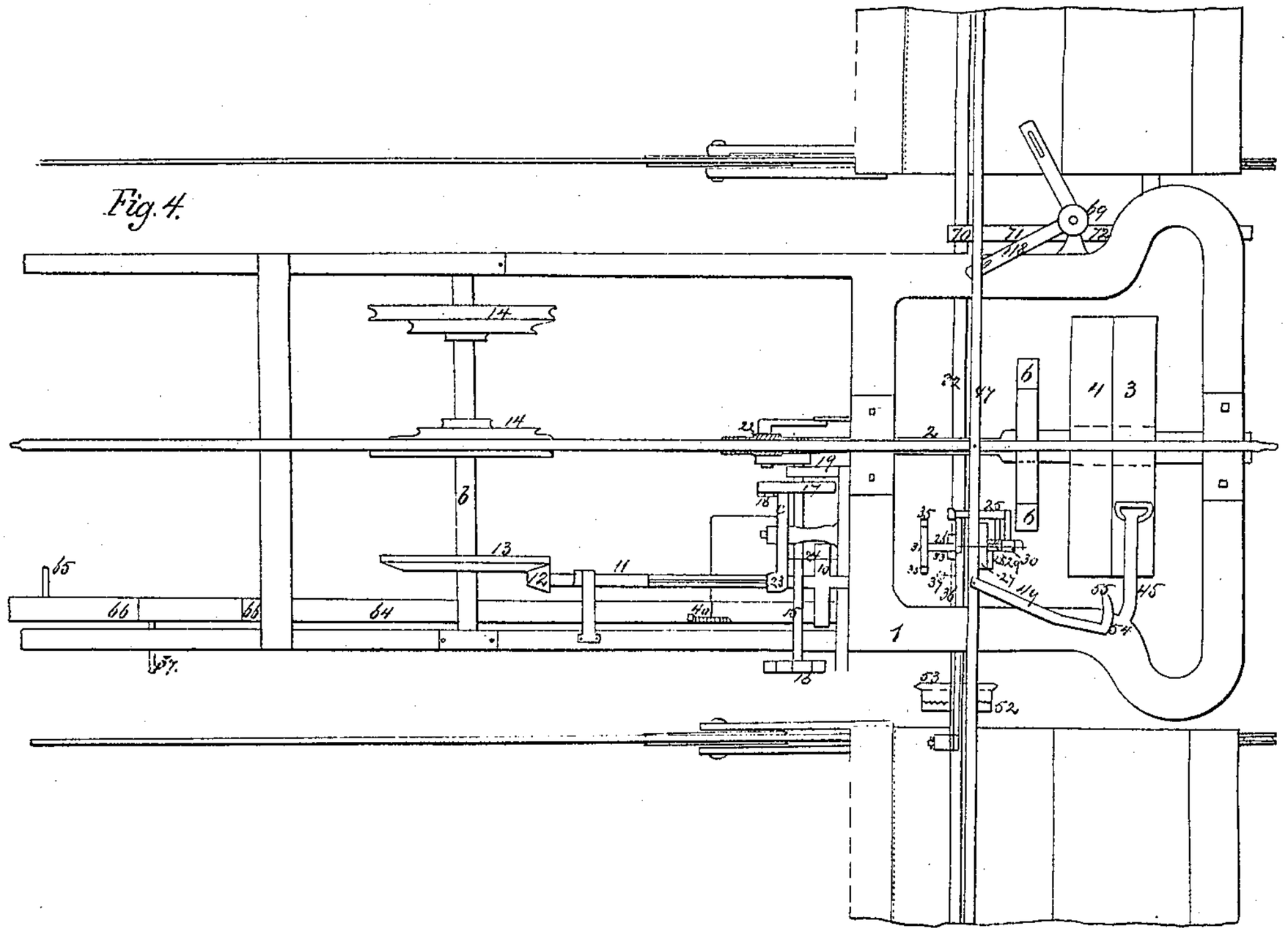
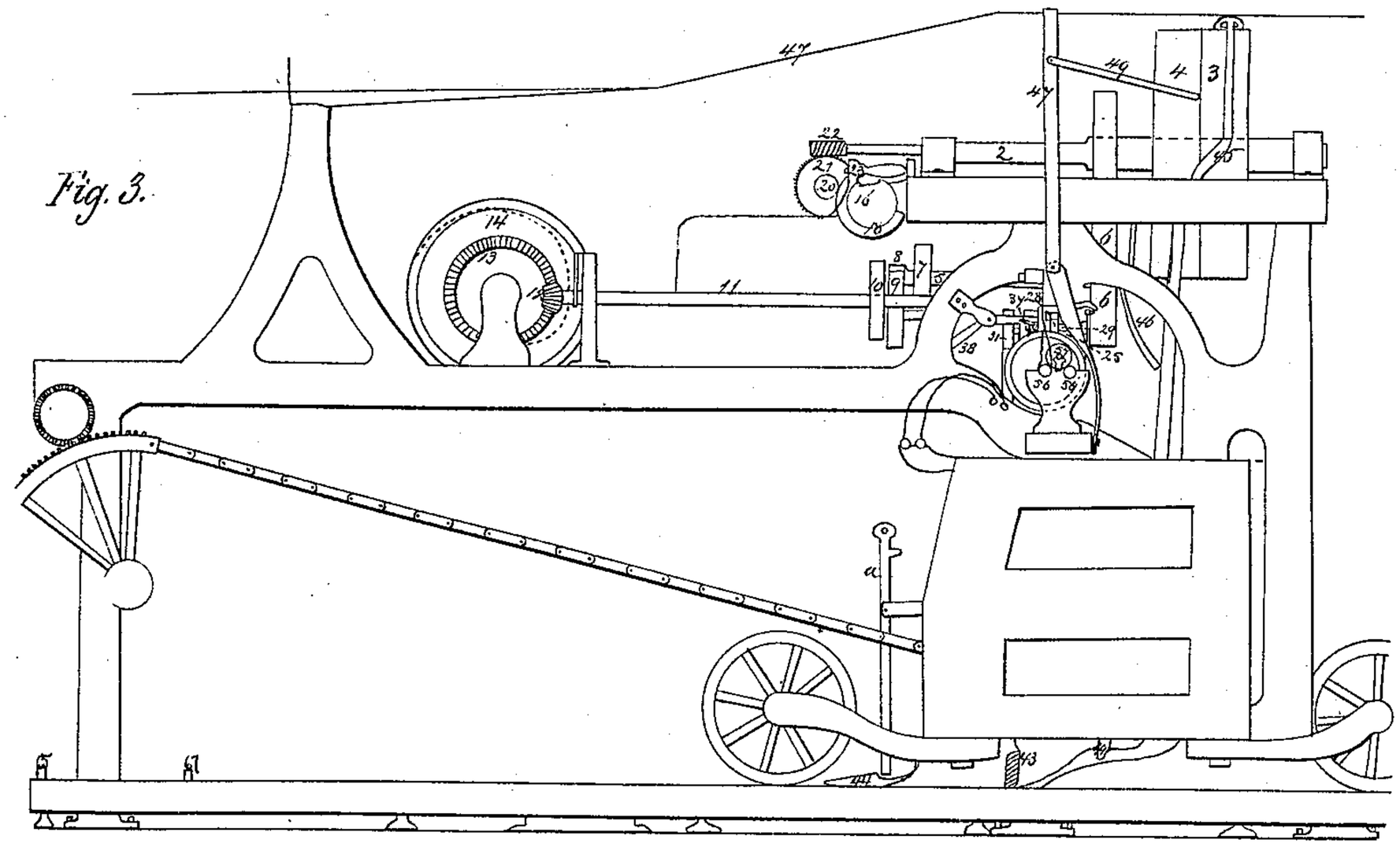


Fig. 3.



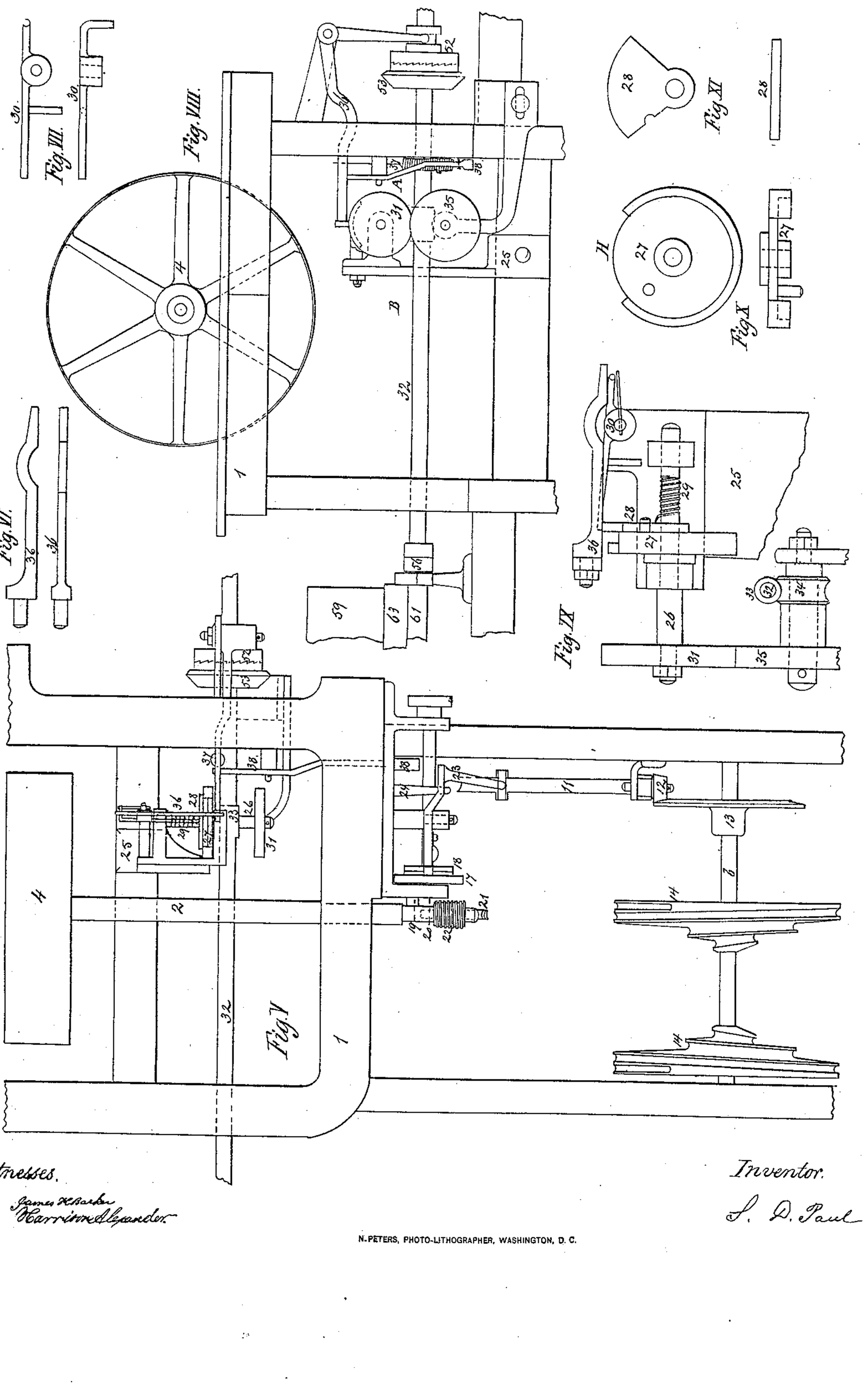
Witnesses
James H. Barker
James L. Barker.

Inventor.
Seth. D. Paul

(6 Sheets) Sheet III

S. D. Paul.
Spinning Mule.

No. 43,333. Patented Jun. 28, 1864.



Witnesses.

James Dabbs
Harrison Alexander.

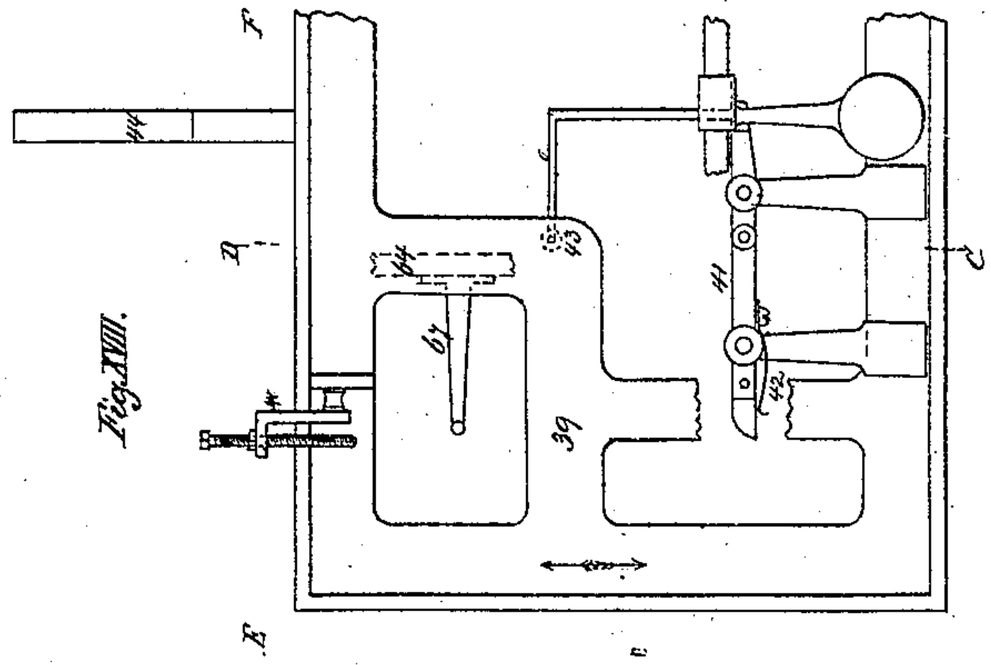
Inventor.

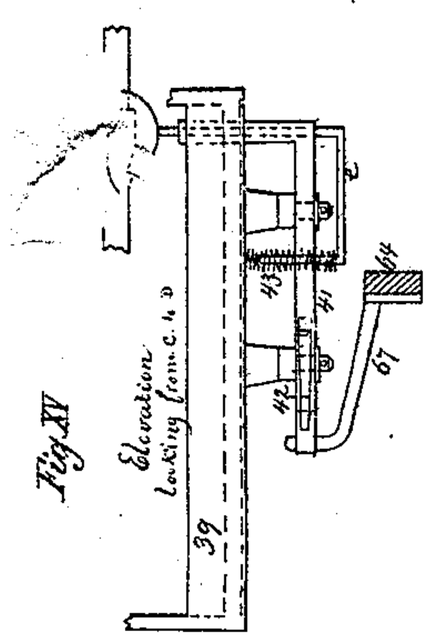
S. D. Paul

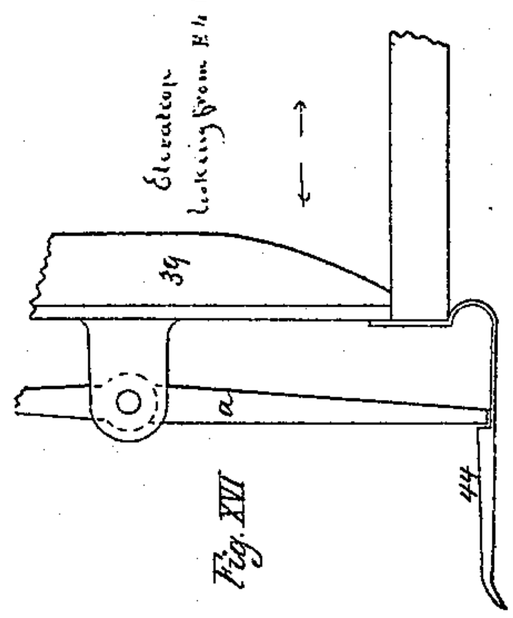
(6 Sheets) Sheet IV.

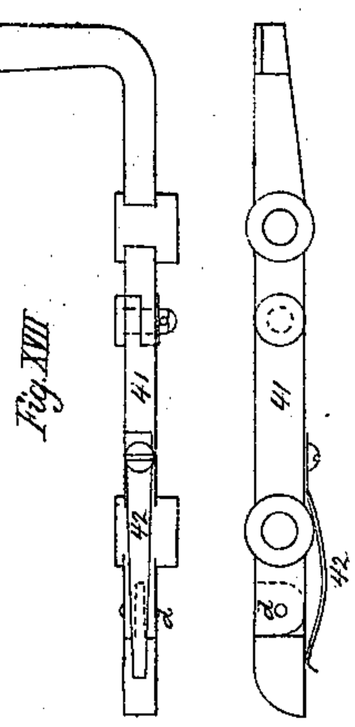
S. D. Paul.
Spinning Mule.

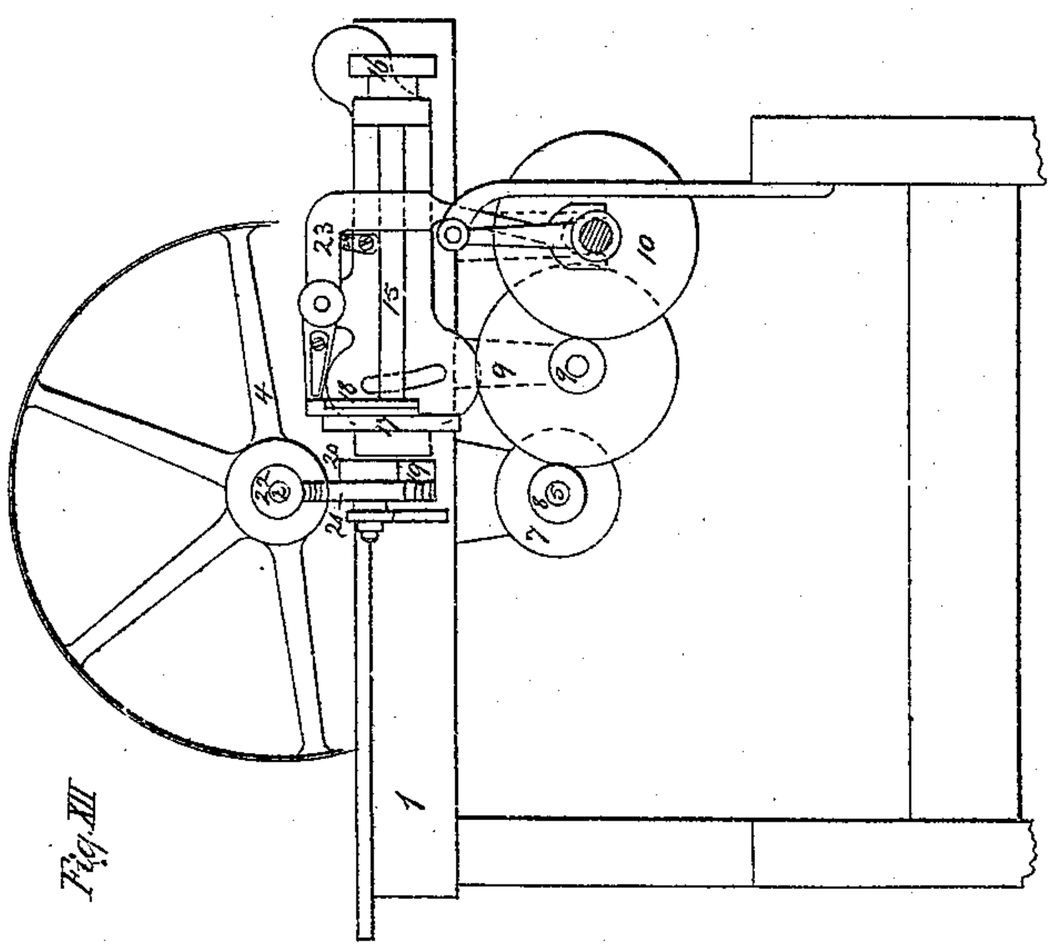
No. 43,333. Patented Jun. 28, 1864.

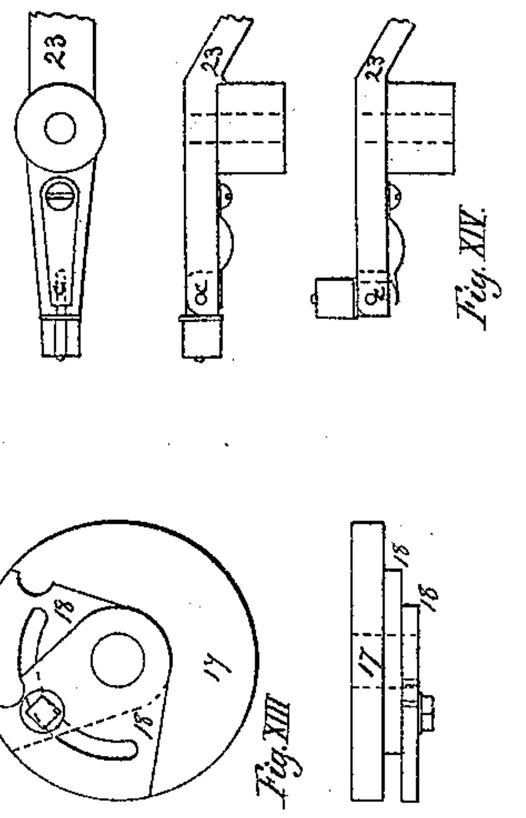












Witnesses.
James H Barker
Harrison Alexander

Inventor.
S. D. Paul

(6 Sheets) Sheet V.

S. D. Paul.
Spinning Mule.

No. 43,333. Patented Jun. 28, 1864.

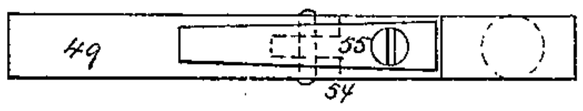


Fig. XIX.

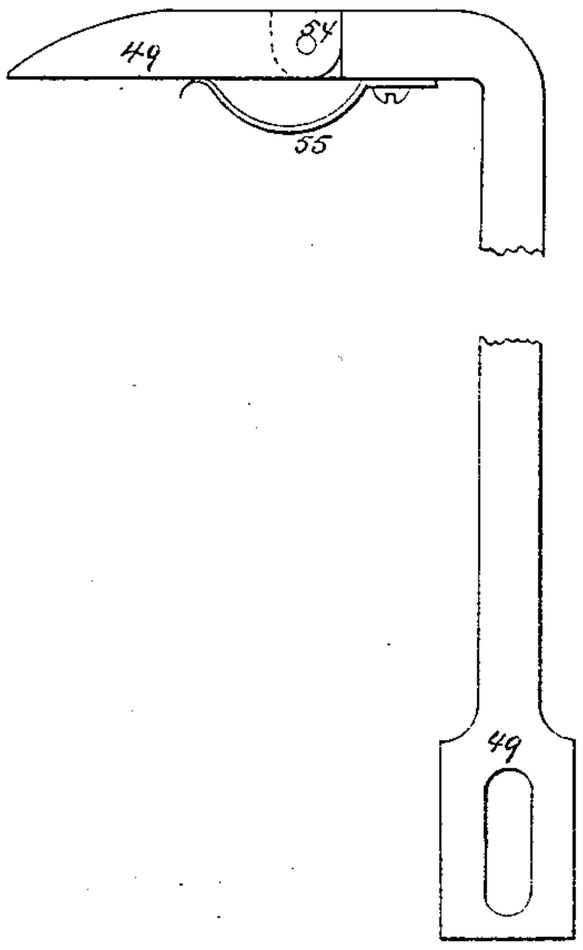
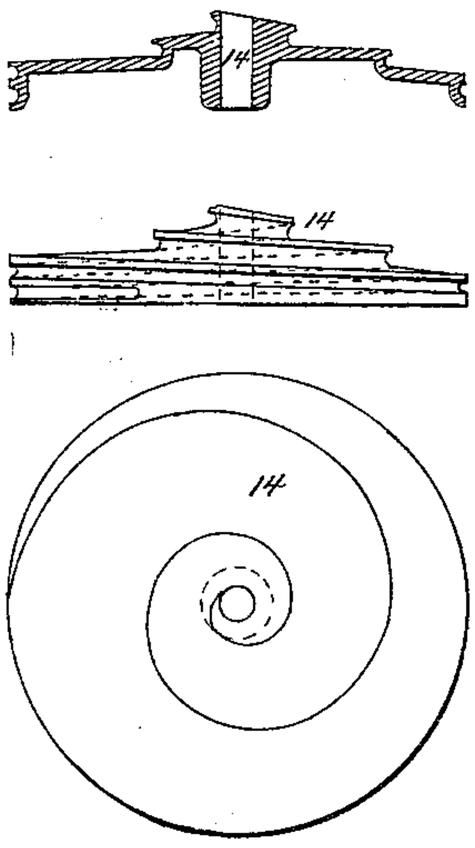


Fig. XX.



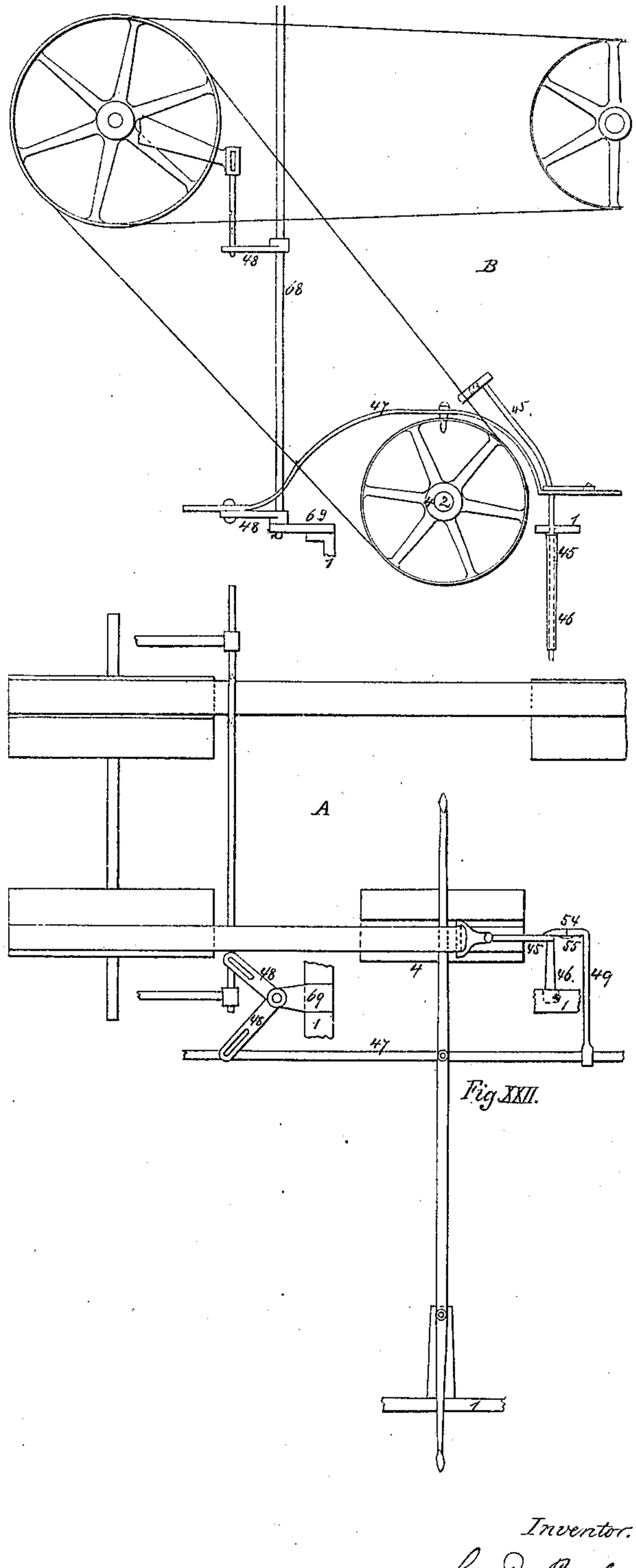


Fig XXII.

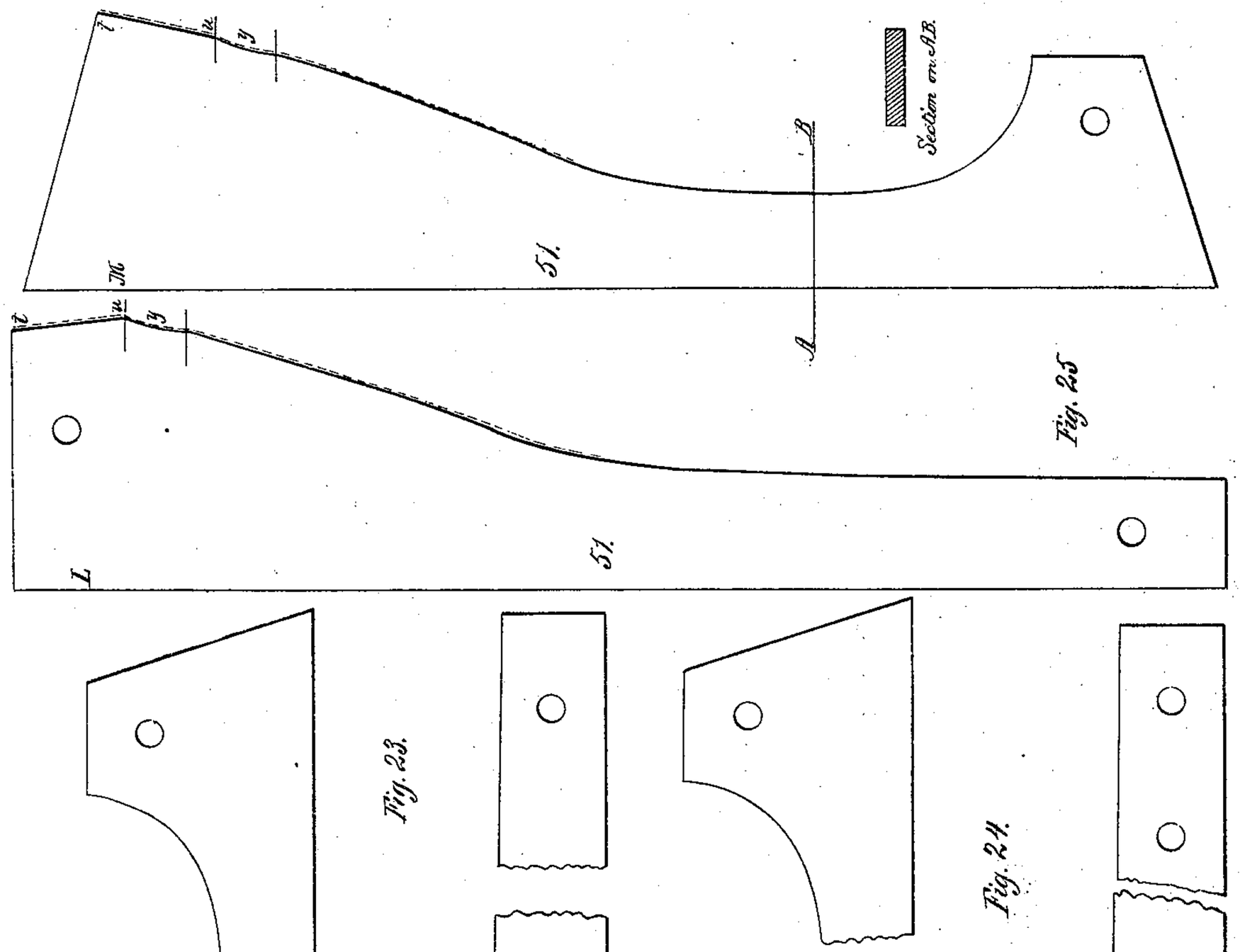
Witnesses.
James K. Barker
Harrison Alexander

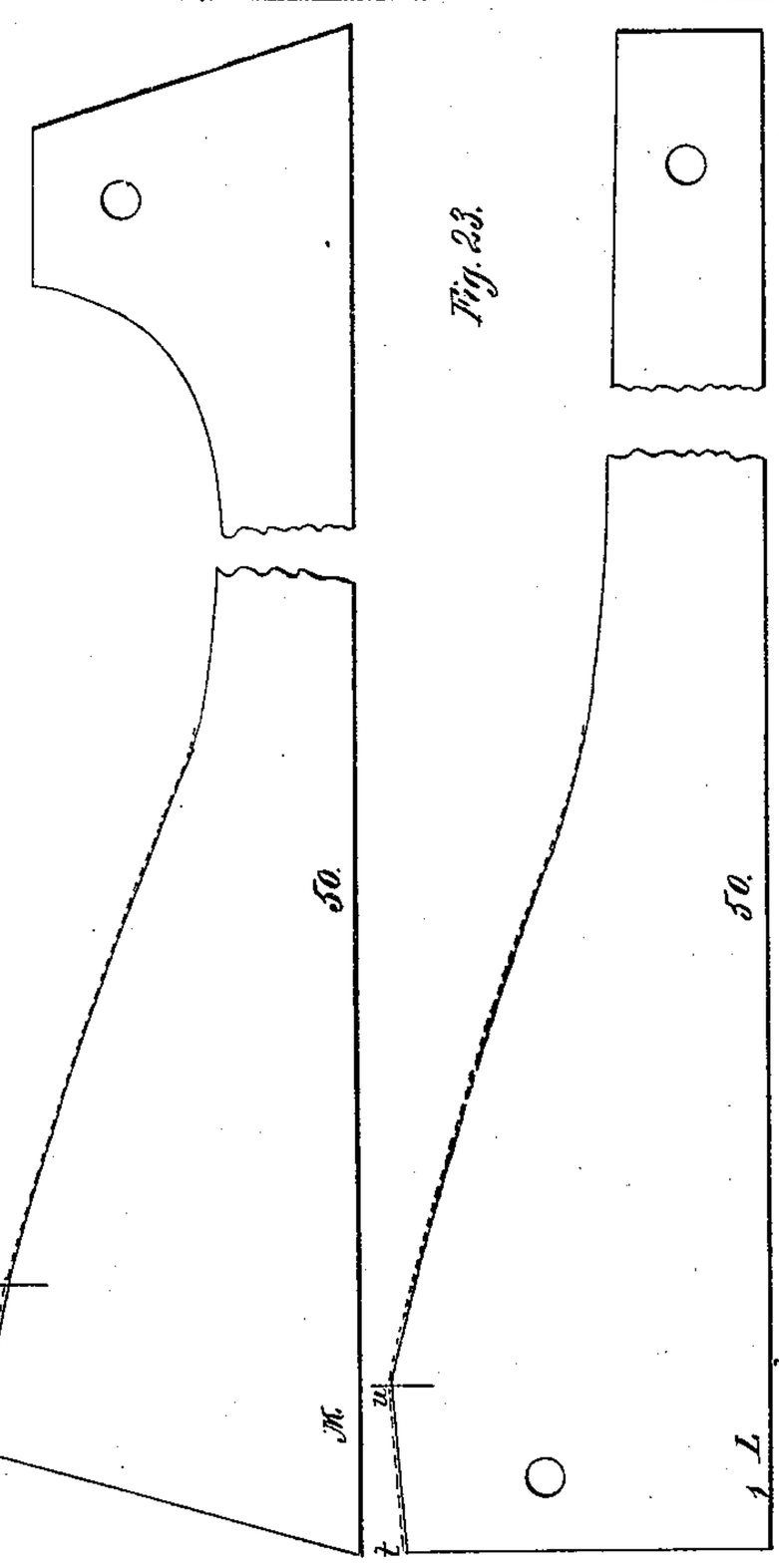
Inventor.
S. D. Paul

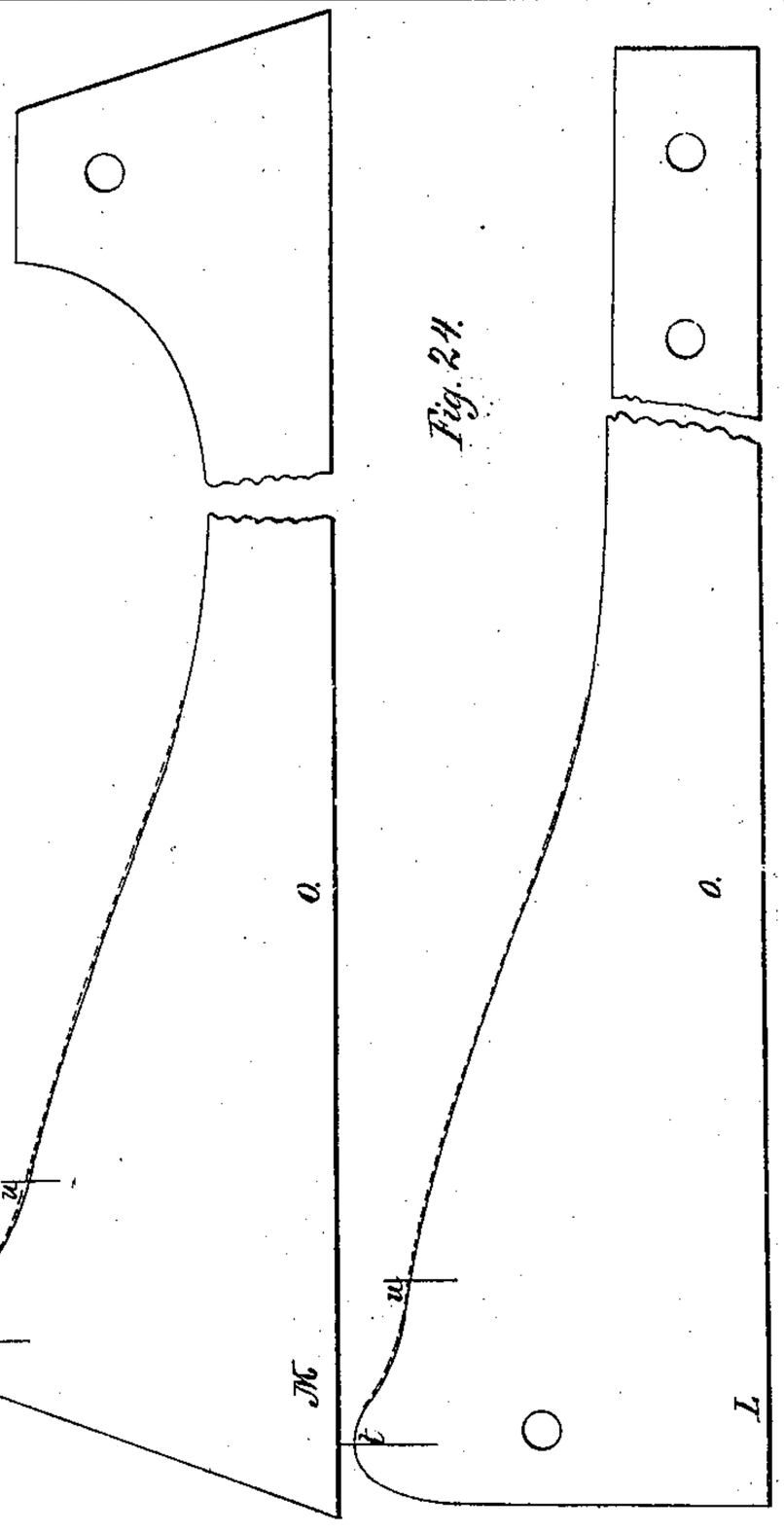
(6 Sheets) Sheet VI.

S. D. Paul.
Spinning Mule.

No. 43,333. Patented Jun. 28, 1864.







Witnesses.
James H. Baker
Harrison Alexander

Inventor.
S. D. Paul

UNITED STATES PATENT OFFICE.

SETH D. PAUL, OF LAWRENCE, MASSACHUSETTS.

IMPROVEMENT IN MULES FOR SPINNING WOOLEN YARN.

Specification forming part of Letters Patent No. **43,333**, dated June 28, 1864.

To all whom it may concern:

Be it known that I, SETH D. PAUL, of Lawrence in the county of Essex and State of Massachusetts, have invented an Improvement in Machines for Spinning Woolen Yarn; and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, making a part of this specification.

My machine for spinning wool is in many respects similar to the Sharp and Roberts' mule and other machines used for spinning cotton, but differs from them, so far as relates to the result to be attained, in this—viz., that in my machine the peculiar motions that are required for drawing and twisting wool into yard or thread and giving the requisite form to the cap or bobbin, and which have heretofore been done upon a "jack" operated by hand, are now done on my machine by self-acting mechanism, and in a much more perfect manner than they can be done with the hand-machines.

The successive movements of the self-acting mule for spinning cotton are well known, and in order that the main features of difference between this machine and my woolen self-acting mule may be understood, I will first describe the various motions that are requisite for producing woolen yarn, but without referring in detail to the special mechanism or parts of the machine by which these motions are effected. The roving or prepared sliver of wool is wound upon bobbins or spools, from which it passes between two rollers, and thence to the spindles, which are of the usual form, and placed in the same position as in the cotton-mule. First, the carriage begins to recede from the rollers and goes about half the length of its traverse at a uniform and rapid rate. Its speed then decreases to the end of its traverse, the spindles being in uniform motion during the whole extent of the traverse of the carriage and putting the twist into the yarn. The carriage then runs back from two to four inches the spindles still turning and the twist going on. The rollers that deliver the sliver that is to be spun start when the carriage does and stops when the carriage is about half-way out. As the carriage keeps on while no more of the sliver is delivered from the rollers, the consequence is that the yarn is drawn and its size reduced from the time that the rollers stop until the carriage reaches the end of its traverse. The carriage then runs back the two to four inches as above mentioned, this backward motion being equivalent to the amount of shortening of the yarn consequent upon its being twisted, the result being that the yarn is thus equalized and made of uniform size throughout. The next motion is the "backing off," which consists in the reversal of the motion of the spindles, and dropping the "copping" or "faller" wire, for the purpose of running the yarn down to the proper position for winding it upon the cop or bobbin. The reversal of the spindles continues only during the time of this operation of backing off. The carriage now runs back, the spindles turning the same direction as when it was running out. While the carriage is running back the speed of the spindles is varied according to the required shape and size of the cop or bobbin. The carriage starts to go back with a slow motion, increases in speed until it is about half-way back, and then decreases during the remainder of its traverse, until it reaches the point whence it started, the spindles being now at their nearest point to the front roller and ready for the next outward stretch.

Having thus described in general terms the movements requisite for spinning woolen yarn, and their relative order and succession, I will now describe the details of mechanical construction by which I spin woolen yarn by automatic machinery instead of hand-labor, as previously done upon the common jack.

The drawings are comprised in six sheets, (marked from A to F,) and the references relate to the same parts in all of the figures.

The colors in the drawings are not relied upon for absolute reference, but are intended to assist in showing the old and new parts, the new being represented in dark color, the old in wood color, and such parts as are not new in themselves, but are new in this combination, in red.

Sheet A, Figure I, is a side elevation of the mule-head. Sheet A, Fig. II is an end elevation of the mule head; Sheet B, Fig. III, side of mule-head opposite Fig. I; Sheet B, Fig. IV, plan of mule-head and adjacent parts; Sheet C, Fig. V, clutch-box, scrolls, rim-shaft, and

roller coupling-shaft; Sheet C, Fig. VI, clutch-box lever; Sheet C, Fig. VII, lever to stop roller-cam latch; Sheet C, Fig. VIII, clutch-box and lever and roller "stop-motion;" Sheet C, Fig. IX, roller-cam, coupling-shaft, worm-gears, and lever; Sheet C, Fig. X, roller-cam; Sheet C, Fig. XI, roller-cam latch; Sheet D, Fig. XII, elevation of twist-shaft, swing-lever, and connections; Sheet D, Fig. XIII, twist-shaft plate and cams; Sheet D, Fig. XIV, lever to work short "swing-shaft;" Sheet D, Fig. XV, elevation of latch spring carrier-movements; Sheet D, Fig. XVI, backing off relieving lever and spring; Sheet D, Fig. XVII, carrier-lever; Sheet D, Fig. XVIII, ratchet-spring carrier and connections; Sheet E, Fig. XIX, jointed arm of shipper; Sheet E, Fig. XX, scrolls on drawing-out scroll-shaft; Sheet E, Fig. XXI, side view of shipper and other attachments; Sheet E, Fig. XXII, plan of shipper with pulleys and belts; Sheet F, Fig. XXIII, filling-bobbin shaper; Sheet F, Fig. XXIV, shapers heretofore used; Sheet F, Fig. XXV, warp-bobbin shaper.

The roller-cam shaft 26, Sheet B, Fig. IV, is driven by the gear connecting with worm 33 on the roller coupling-shaft 32. When the mule starts, the clutch-box lever 36 rests on the roller-cam latch 28, Fig. XI. The cam turns with the shaft 26. As the latch comes round, it strikes the lever 30 and is stopped by it. The cam continues to revolve until the slot or opening in it reaches the lever 36. The lever 36 is then thrown into this opening by the spring 37, opens the clutch-box 52, and stops the rollers; also, at the same time the lever 36 strikes the lever 30, and relieves the latch 28, which is thrown back by the spring 29 against the lever 36. This occurs when the carriage is about half-way out, but can be varied by changing the draft gear 35 and substituting a gear having a different number of teeth. The carriage continues out, and when it returns the set-screw in stand 40 strikes the lower end of the lever 38, which causes the lever 36 to rise, and throws in the clutch-box 52, at the same time the latch 28 comes back to its first position, as also the lever 30. The object of the latch 28 is to support the lever 36 while the opening H of the cam is under it. After the carriage is out it usually runs in a little while twisting. This is effected by the swing-shaft 11, which gears into the bevel gear 13 on the scroll-shaft *b*. This swing-shaft is driven from pinion 8 on the short going-in shaft connected by the gears 9, 9^2, and 10. The swing-shaft is thrown in or out of gear by the lever 23. This lever is operated by the cams 18 18.

The object of having two cams with slots, instead of one, is for the purpose of closing them up or spreading them, in order to make the traverse of the cam longer or shorter as the yarn requires to be more or less twisted. These cams are set so that the lever 23 will drop and throw out the swing-shaft at the same time that the finger on the cam-shaft passes through the opening in the twist-shaft cam 16.

The object of the joints in the lever 23 is, in case any accident to the mule causes the twist-shaft to run the reverse way, to allow the cams 18 18 to swing open the end of the lever and pass around, thereby preventing the throwing in of the gear of the swing-shaft or breaking the gears.

The common mule, when spinning cotton, "backs off" when it is out to the extreme end of the stretch, the lower end of the relieving-lever *a* being relieved when the floor-lever 64 drop.

In spinning wool, when the carriage is running in while twisting, the relieving-lever *a*, of course, passes away from the stud 65, and would have nothing to act upon. The spring-latch 44 is designed to remedy this difficulty. When the carriage runs out, the lower end of the lever *a* strikes the stud 65 and is carried back over the latch 44, which springs up and holds the lever *a*, and remains so until the mule backs off, when the floor-lever drops, and the latch 44 is struck by the stud 65 and relieves the lever *a*. When the carriage is running in while twisting, the "winding-on" ratchet is liable to fall into gear when it stops to back off, thereby preventing the backing-off motion of the mule. To obviate this difficulty, I have put on the lever 41 and the spiral spring 43. The object of the joint *d* is, that when the carriage is running out and the end of the lever 41 strikes the arm 67 it will open and pass by without operating the lever. The spring 42 throws the end of the lever back to its former position. When the carriage returns, the lever 41 strikes the arm 67 just before the mule is ready to back off, which causes the lever to act on the ratchet spring carrier *e*, and throws the ratchet up from the gear and allow the mule to back off. The spiral spring 43 serves the double purpose of holding down the end of the carrier *e* from the frame 39, so as to allow the action of the lever 41; and also when the mule is backed off and the floor-lever 64 drops and relieves the lever 41, it reacts on the carrier *e*, and throws the ratchet in gear. The shipper 47 47 extends the whole length of the carriage, and also the whole length of the mule-head—at right angles—in order that the mule may be stopped by the attendant while standing at any point in the whole length of the mule, or at the front or the back of the head. The shipper arm or attachment 49 operates on the upright shipper 45 for the driving-belt in such a manner that if the belt is shipped before the carriage gets in, at any time after it is far enough in to run entirely in the carriage will stop close up to the rollers, and the spindles will stop precisely at the same point each time, whether the belt is shipped at precisely the same point of the traverse of the carriage or not. This cannot be done by any shipper heretofore used, and

is a very important improvement, as it gives an opportunity to piece up the broken ends of yarn before the rollers begin to move. This makes the threads of uniform size, which would not be the case if the carriage did not stop at the nearest point to the rollers. When the counter-belt is shipped off, the shipper attachment 49 shuts by the upright shipper 45 on the back side and holds it fast, thus preventing it from shipping the driving-belt from the loose pulley 4 to the tight pulley 3. When the mule-carriage "strikes in" or reaches the end of its traverse nearest to the rollers, this attachment 49 acts as described, and the force of the driving-belt and momentum of the counter-pulley, whether it be greater or less, is expended upon the loose pulley 4 without affecting any of the motions of the carriage, the spindles, or the rollers.

I will now state the object of the joint 54 in the shipper attachment 49. When the counter-belt is shipped at the same time or just before the driving-belt is shipped from the tight pulley 3 to the loose pulley 4, the attachment would shut past the front side of the upright shipper 45, and would prevent the free action of the parts. With this flexible joint 54 it yields to the pressure of the shipper 45 in one direction, while in the other it is inflexible. The action of the spring 55 brings the part 49 back to its first position.

The scrolls 14 14 are used for giving motion to the carriage, as they draw it out (by means of a rope of suitable size and strength running in the grooves) they take it out about half-way at a uniform speed, and then the speed decreases regularly until the carriage is quite out. This decrease of speed is necessary to the proper drawing of the wool when spinning, it being also necessary that the twisting and drawing should go on simultaneously. The scrolls act counter to each other, each scroll having a band connected with the carriage, and the scroll represented at the right side in Fig. V lets off the band as fast as the scroll at the left side takes it up, and the opposite. By letting out one band and taking up the other the position of the scrolls relative to the draw or stretch of the mule is changed, thereby adapting the speed of the carriage to different kinds of wool and varying numbers or fineness of yarn. These scrolls are the same (that is, they give the same rate of decrease of speed) as the scroll in common use on jacks, for what is called "first spinning," differing from the scroll used for "second spinning" in this, that it gives a much greater rate of decrease of speed to the carriage.

The shapers (see Sheet F) are curved pieces of iron or steel which slide on the copping-rail frame, being in the same position as in the common self-acting mule. The curvature given to the upper edge of the shapers determines the form of the cop or bobbin. They are used in pairs.

In Figs. 23, 24, and 25, L represents the front shapers, and M the back shapers.

The shapers marked O O, Fig. 24, are used in the position shown in the drawings, and produce a cop that is tapered or conical at both of its ends, being the shape commonly used on the mule for spinning cotton.

Shapers of my improved form are shown at Figs. 23, 50 50. The principal difference between them and those marked O O, is found at that part of the edge marked in red line between the points *t* and *u*.

In the front shaper, Figs. 23, 25, L, (the red edge being up,) the part from *t* to *u* is a straight line and ascending. In the back shaper, M, from *t* to *u* is a straight line and descending. This difference is for the purpose of filling a bobbin which has a square head at the base, by building out the bobbin to the full size close to the head, the result being that a wooden bobbin of the form used on the ring or the dead-spindle frame is made square at the bottom instead of being conical at the lower end, as heretofore made. It is not necessary that the lines from *t* to *u* should be of the precise angle or form represented in the drawings, what I consider as new being this, that the front shaper has the lines from *t* to *u* straight and ascending, and in the back shaper straight and descending, as herein stated, and for the purpose specified.

The shapers in Fig. 25, marked 51 51, are the same as sharpers 50 50, Fig. 23, with the exception of the curve at the points *y y*. These shapers are intended for building the bobbin out close to the head, the same as is done by 50 50, and to the full size of the head, and then the curves or depressions *y y* cause the yarn to be built out and up, on a curve, to the size desired, thus forming a bobbin larger in diameter at and near the center of its length than it is at the head or lower end.

I claim as an improvement—

1. In the roller-motion, the use or combination of roller-cam 27, latch 28, latch-spring 29, lever 30, the connecting-gears and worm-gears, spring 37, levers 36 and 38, and stand 40, or their equivalents, operating substantially as described.

2. The apparatus for running the carriage in while twisting, consisting of the combination of pinion 8, gears 9. 9^2 10, swing-shaft 11, gears 12, 13, scroll 14, plate 17, cams 18 18, gear and pinions 19 20 21, lever 23, spring 24, and joint *d*, or their equivalent, substantially as described.

3. The combination of lever 41, spring 42, spring 43, and arm 67, or their equivalents, for throwing up the winding-on ratchet from the gear and allowing the mule to back off.

4. The shipper 47, running the whole length of the mule, and also at right angles across

the length of the mule-head, substantially as described.

5. The attachment 49 to shipper 47, with its joint and spring 54, operating substantially as described.

6. The combination of the spring-latch 44 with the backing-off relieving-lever, substantially as described.

7. The shapers 50 50, as described, and for the purpose specified.

8. The shapers 51 51, as described, and for the purpose specified.

9. The combination of the scroll 14 14, or its equivalent, with the roller-cam latch and spring, which govern the motion of the rollers.

SETH D. PAUL. [L. S.]

In presence of—
L. BEACH,
JAS. C. STANLY.