Sheet 1-5 Sheets.

S. D. Paul.

Spinning Mule.

No. 53,036. Patented Mar. 6, 1866.

Fig. 2.

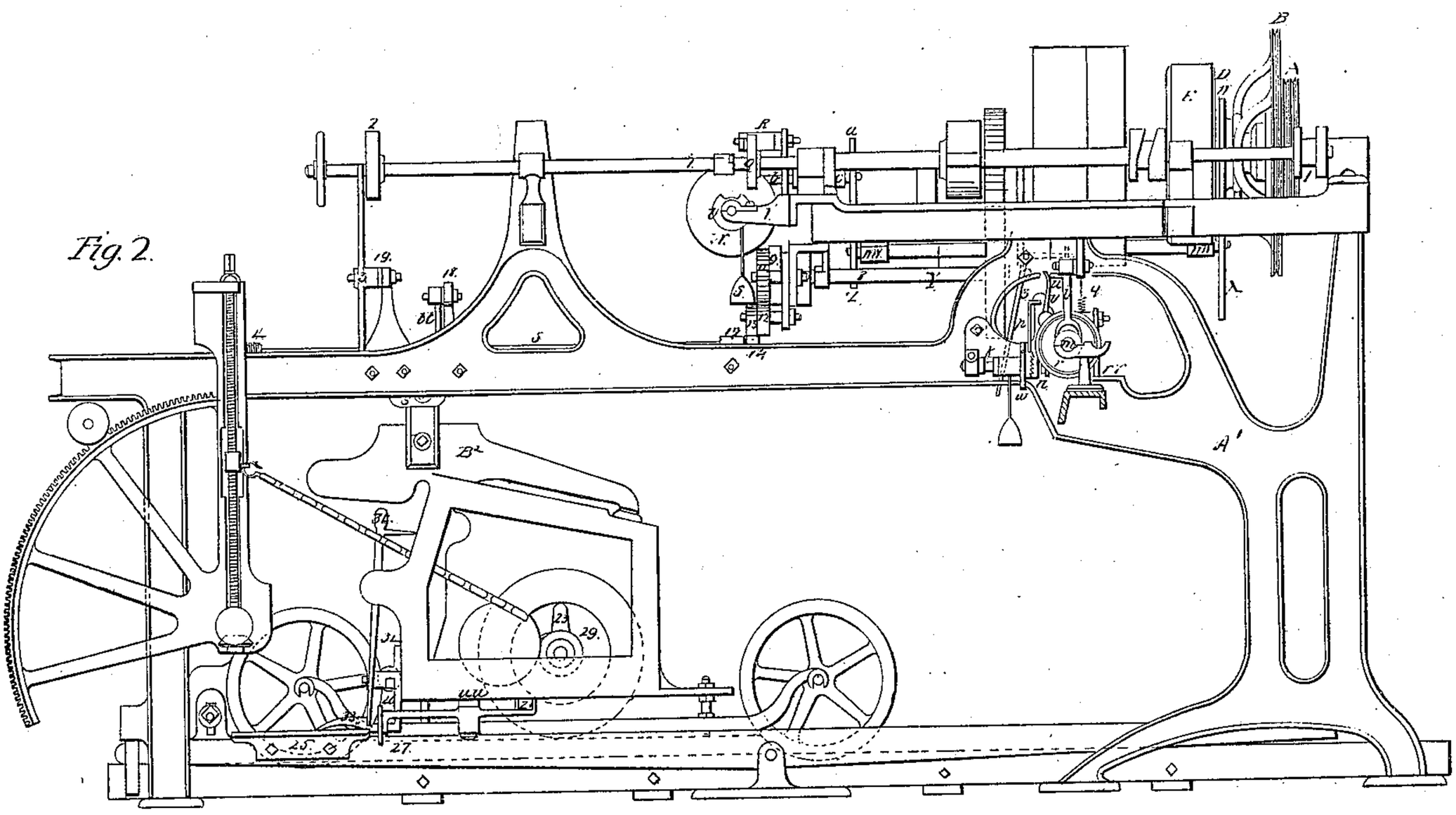
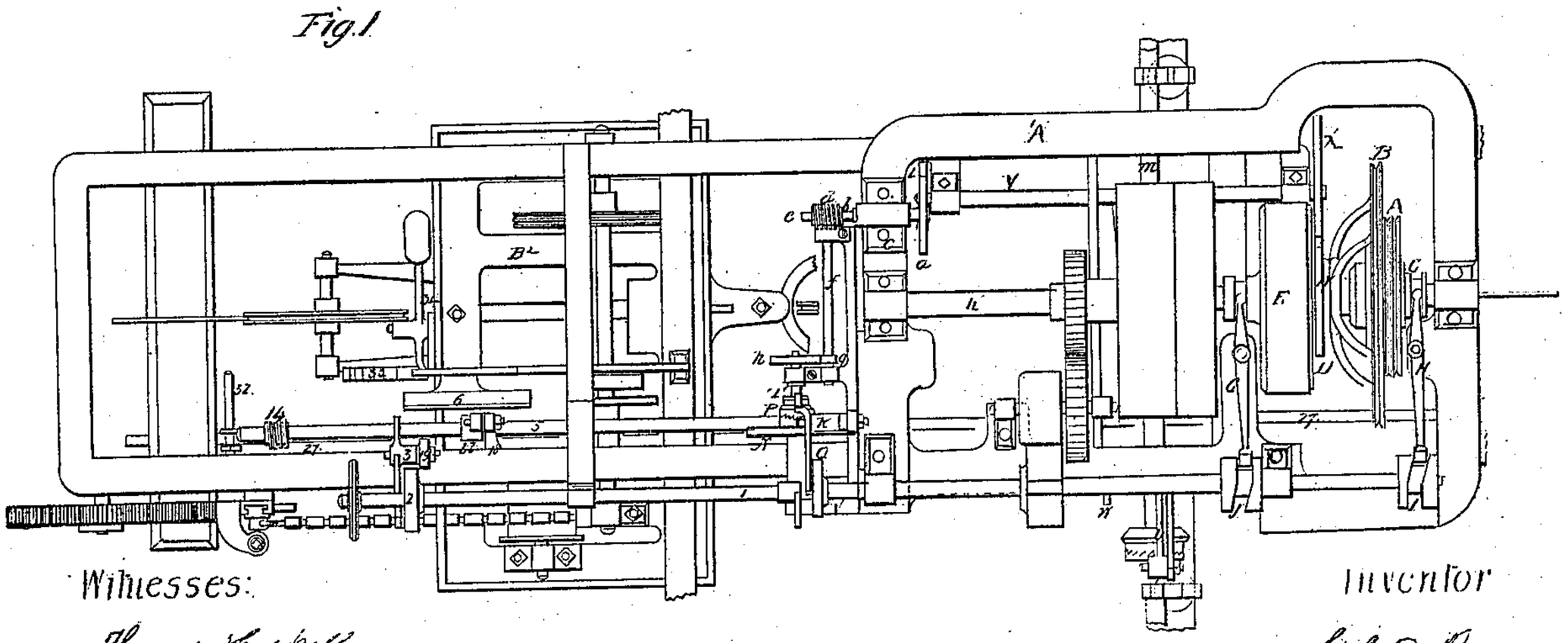


Fig. 1



Witnesses:

Thomas Haskell

June 6 Wing

Inventor

Seth D Paul

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Sheet 2 - 5 Sheets.

S. D. Paul.

Spinning Mule.

No. 53,036. Patented Mar. 6, 1866.

Fig. 6.

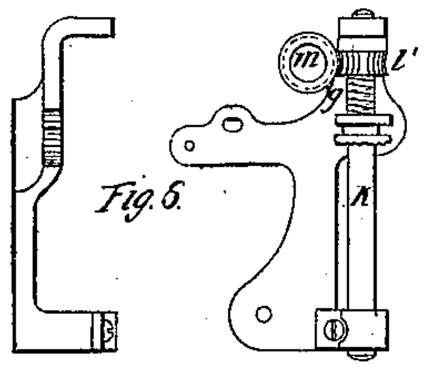


Fig. 1. Fig. 2.

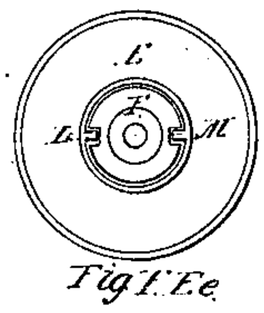
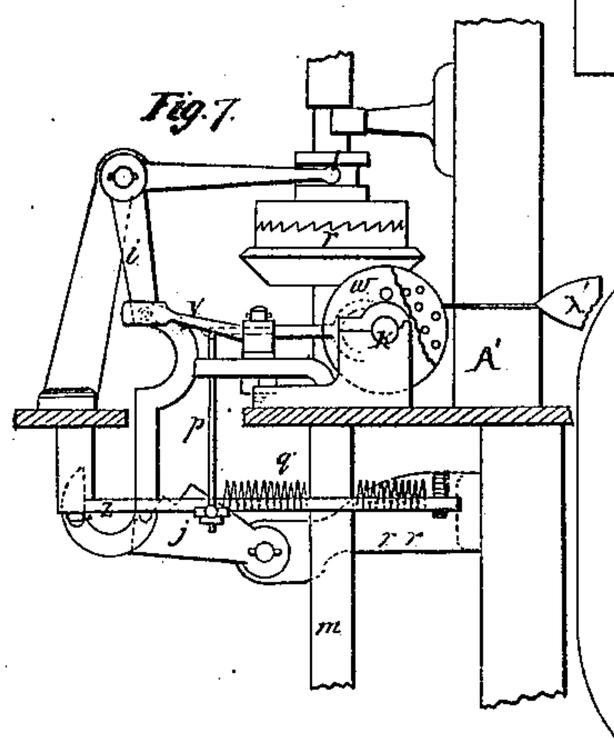


Fig. 4.

Fig. 7.



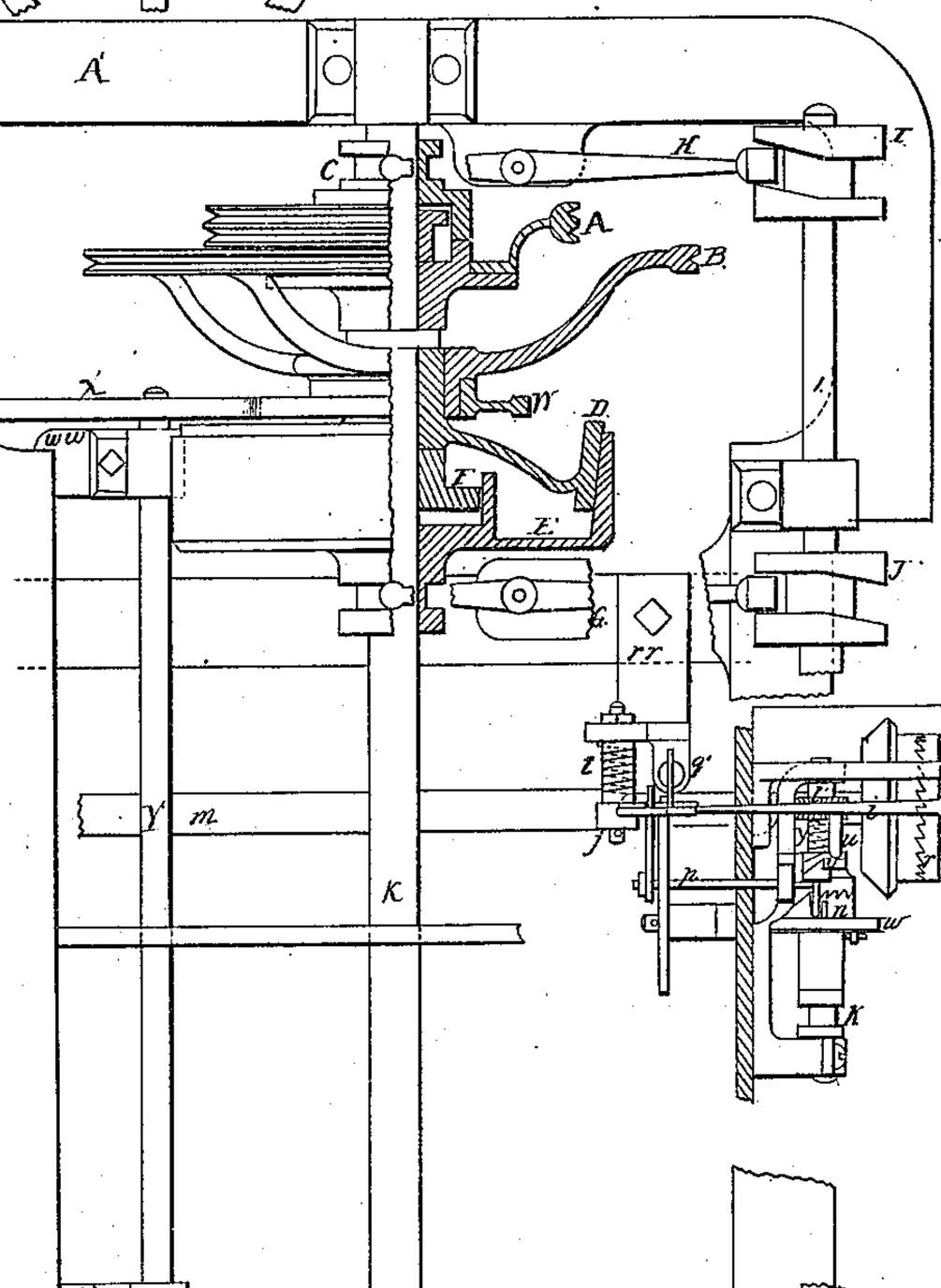
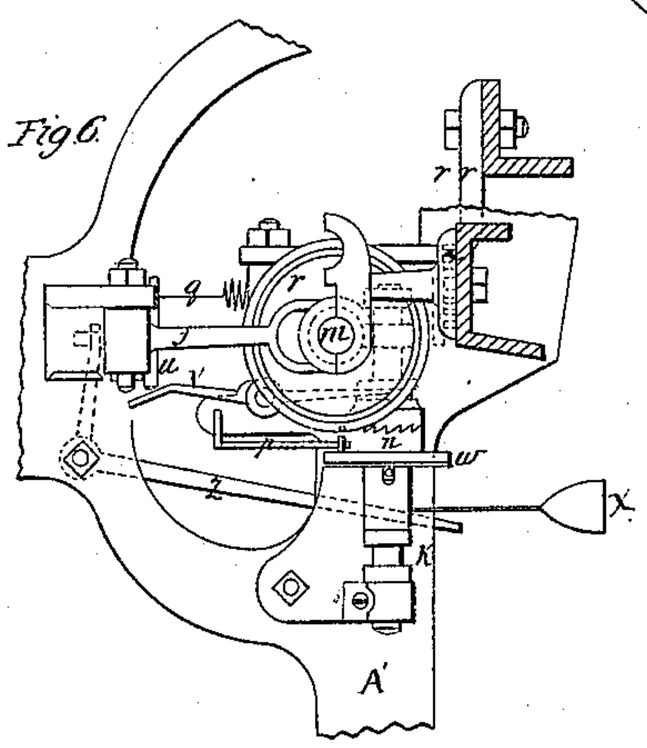


Fig. 6.



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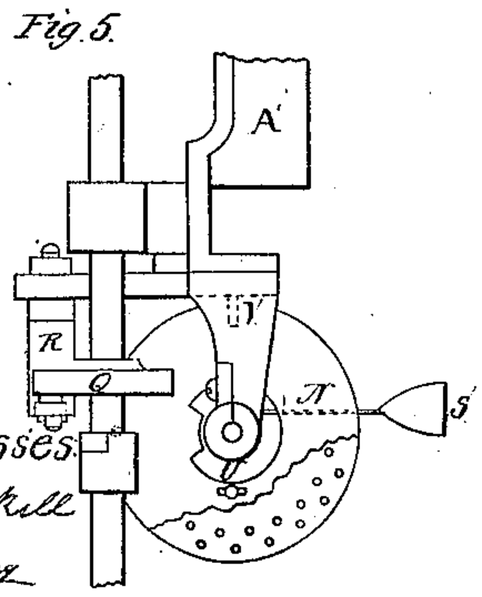

Witnesses:
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Fig. 3.

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S. D. Paul.

Spinning Mule.

Sheet 3 - 5 Sheets.

No. 53,036.

Patented Mar. 6, 1866.

Fig. 12

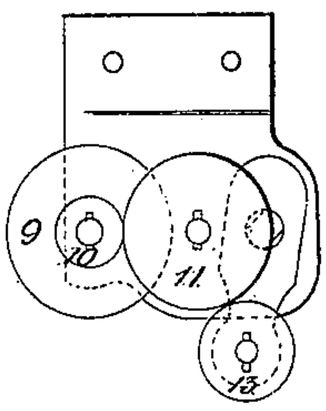
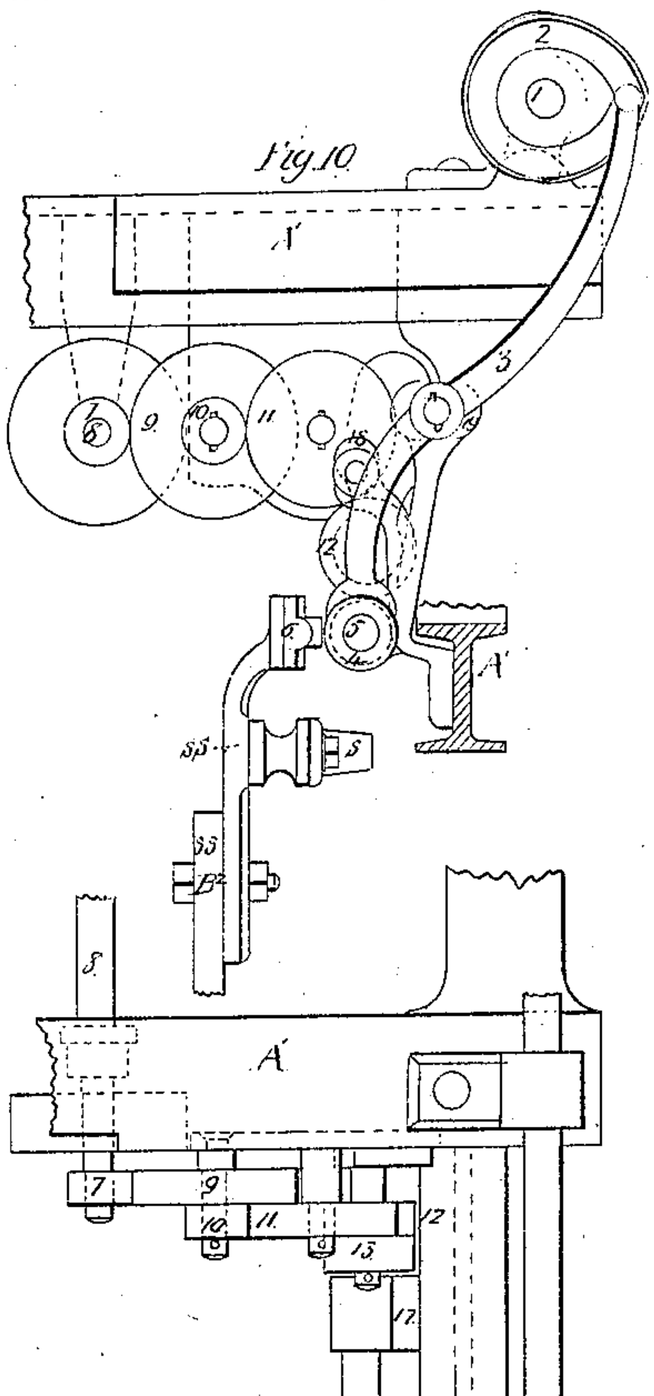


Fig. 10



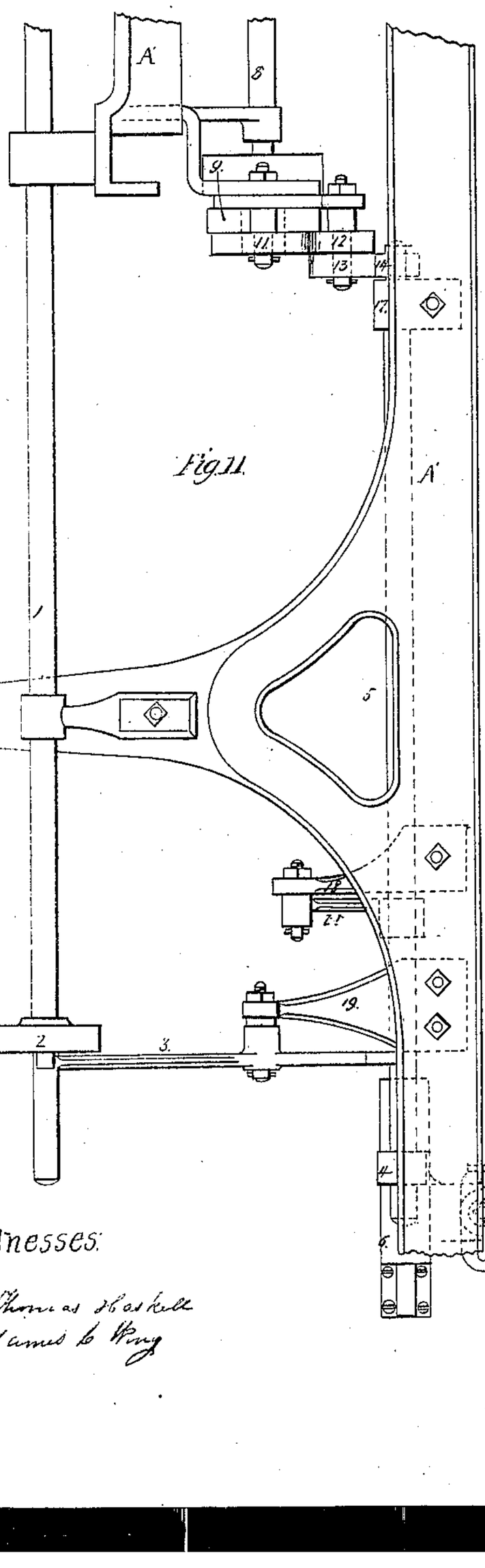


Fig. 11

Fig. 9

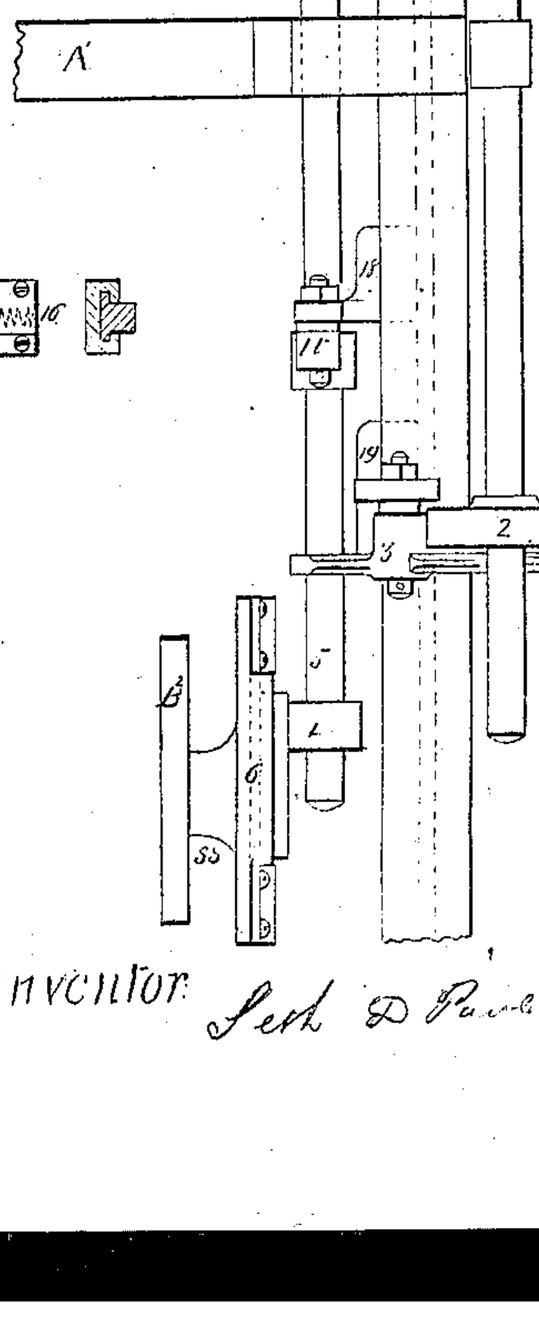
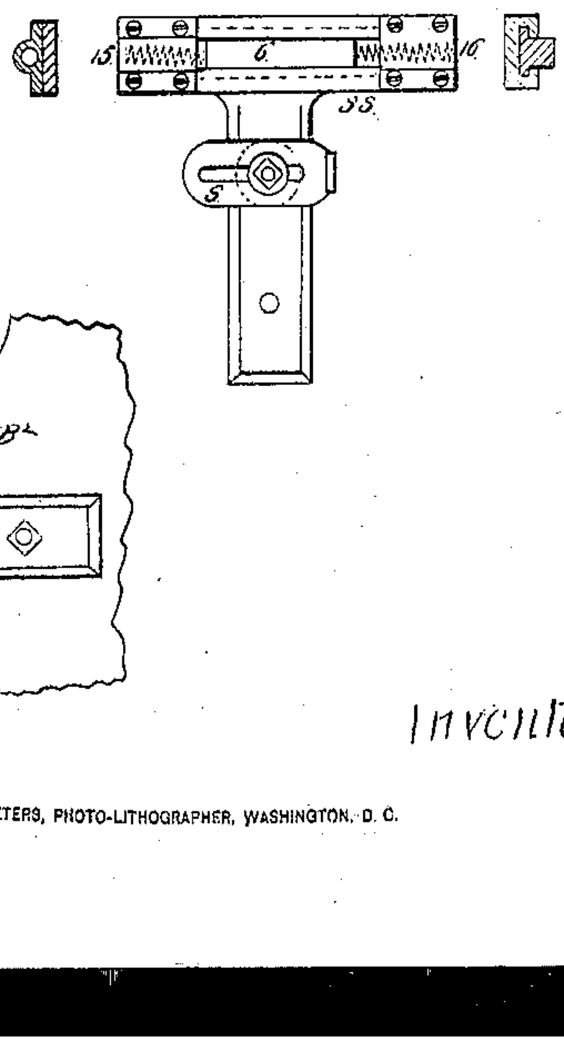


Fig. 13



Witnesses:

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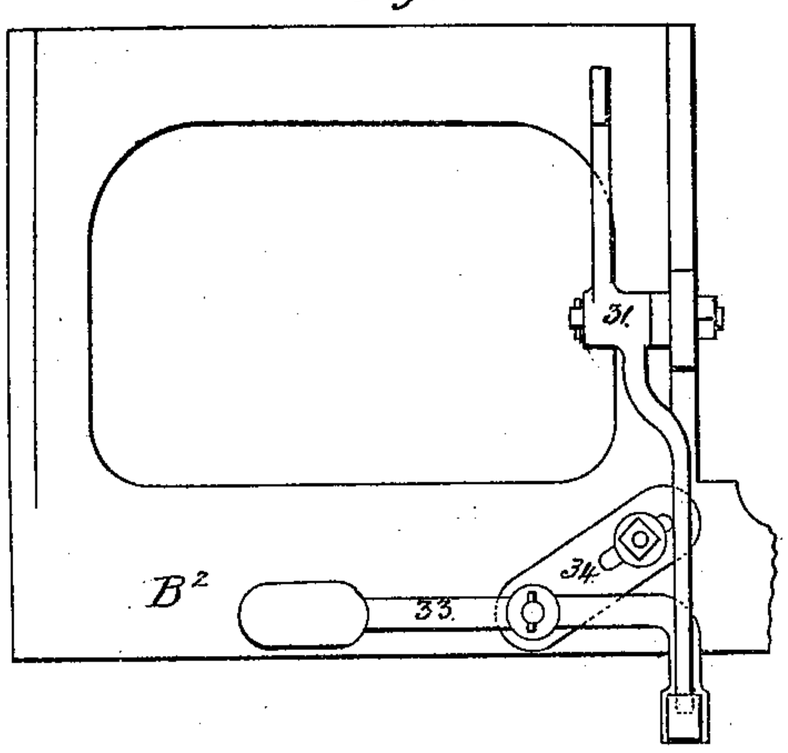
Sheet 4 - 5 Sheets.

S. D. Paul.

Spinning Mule.

No. 53,036. Patented Mar. 6, 1866.

Fig. 16



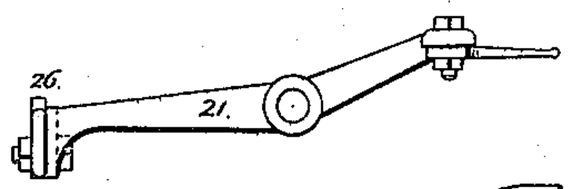


Fig. 17.

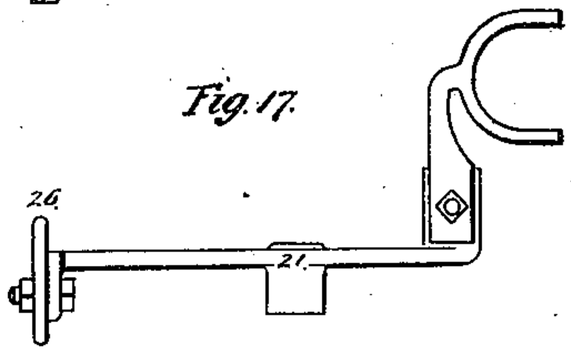


Fig. 18.

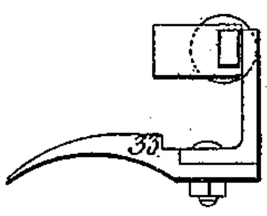
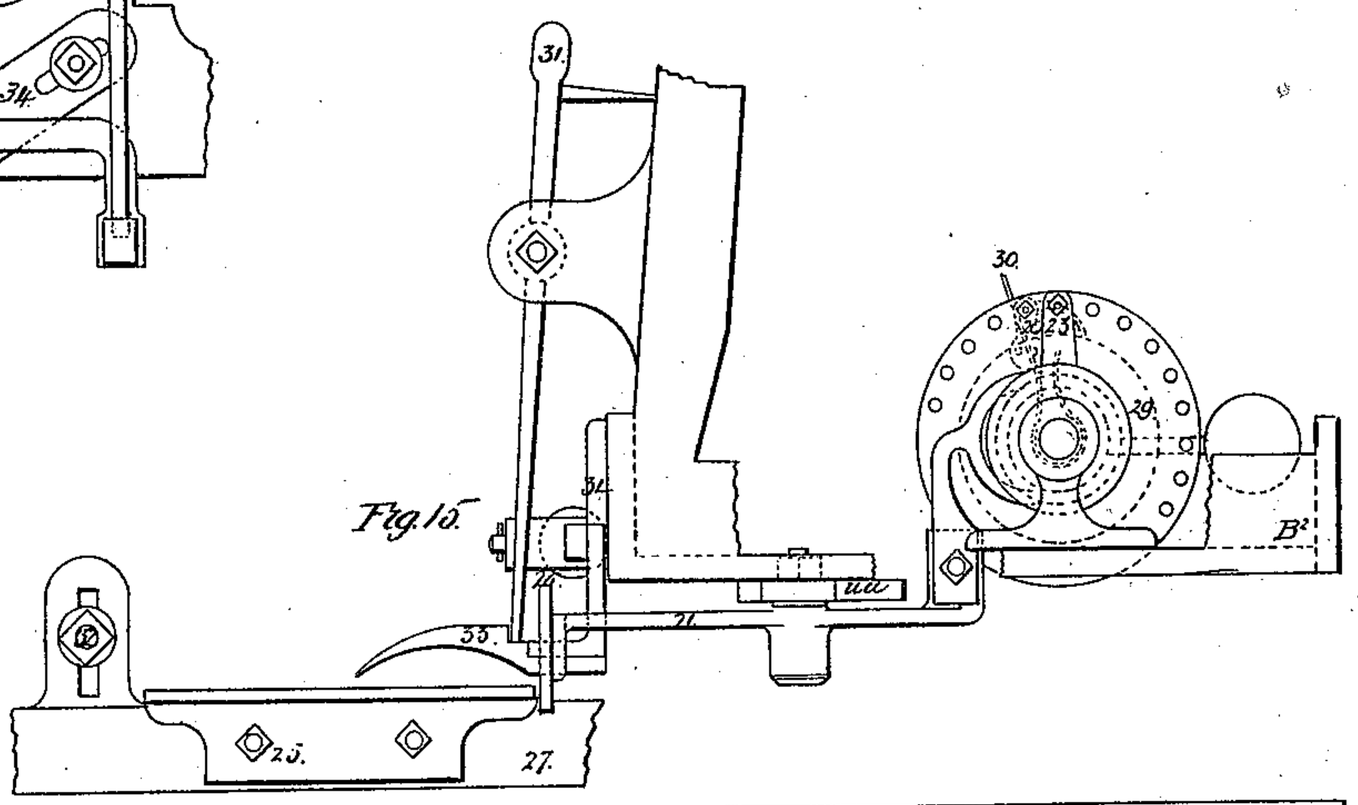


Fig. 15.



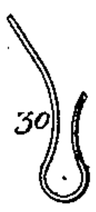
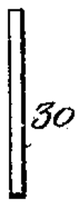


Fig. 19.



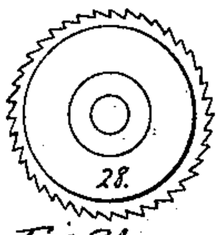


Fig. 21.

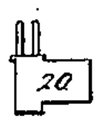
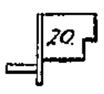


Fig. 20.



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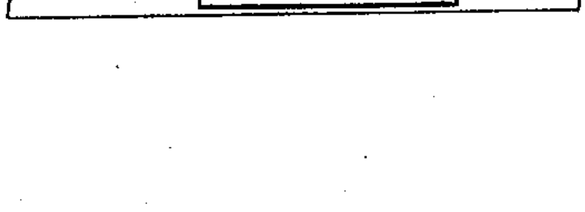


Fig. 14.

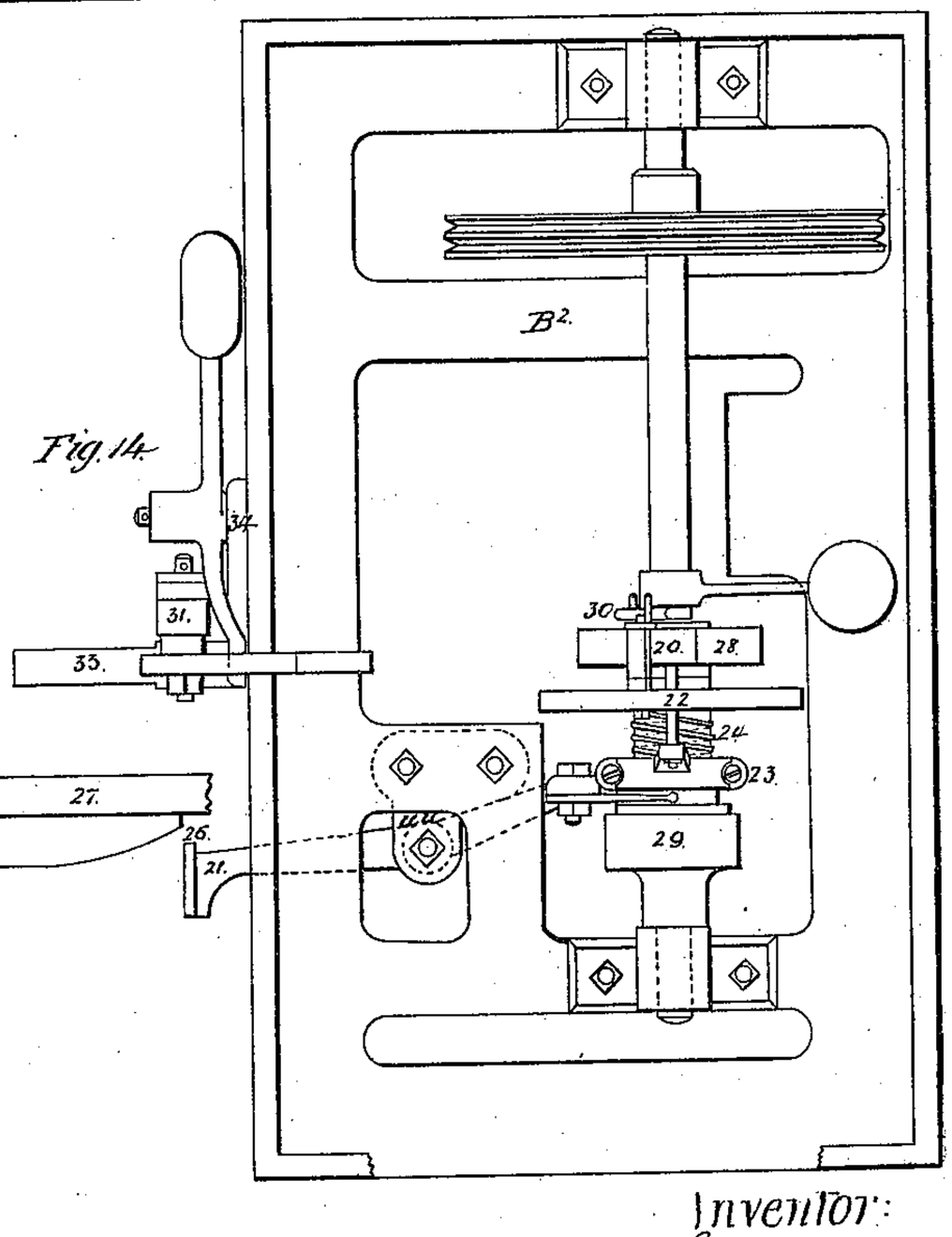
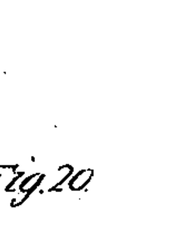


Fig. 23.



Witnesses:

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Inventor:
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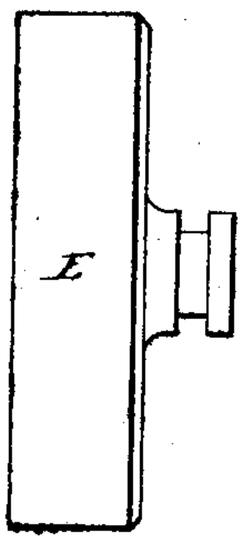
Sheet 5-5 Sheets.

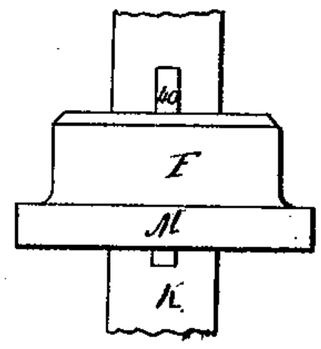
S. D. Paul.

Spinning Mule.

No. 53,036. Patented Mar. 6, 1866.

Fig. 28.





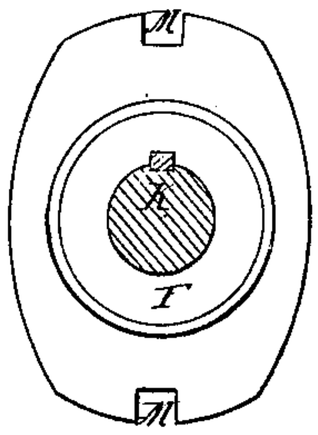


Fig. 26.

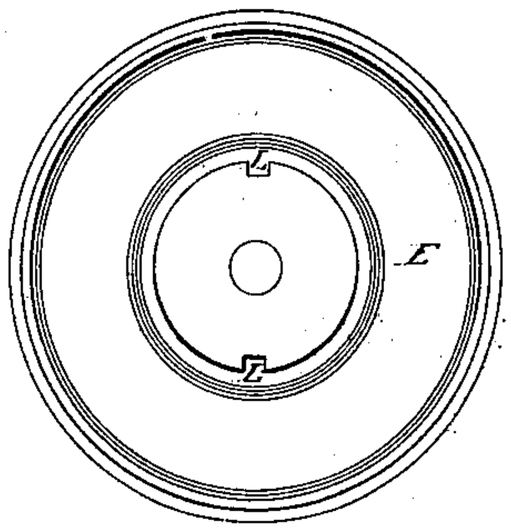


Fig. 25.

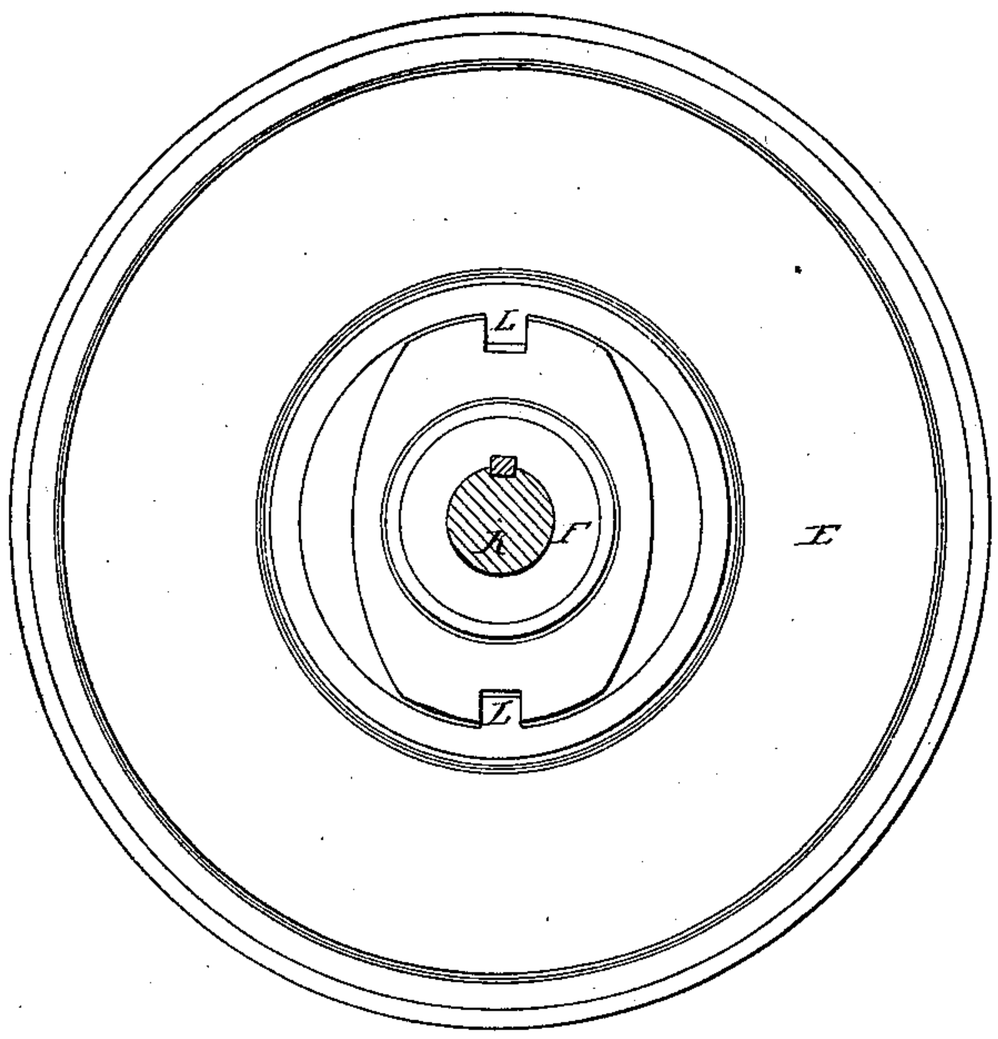
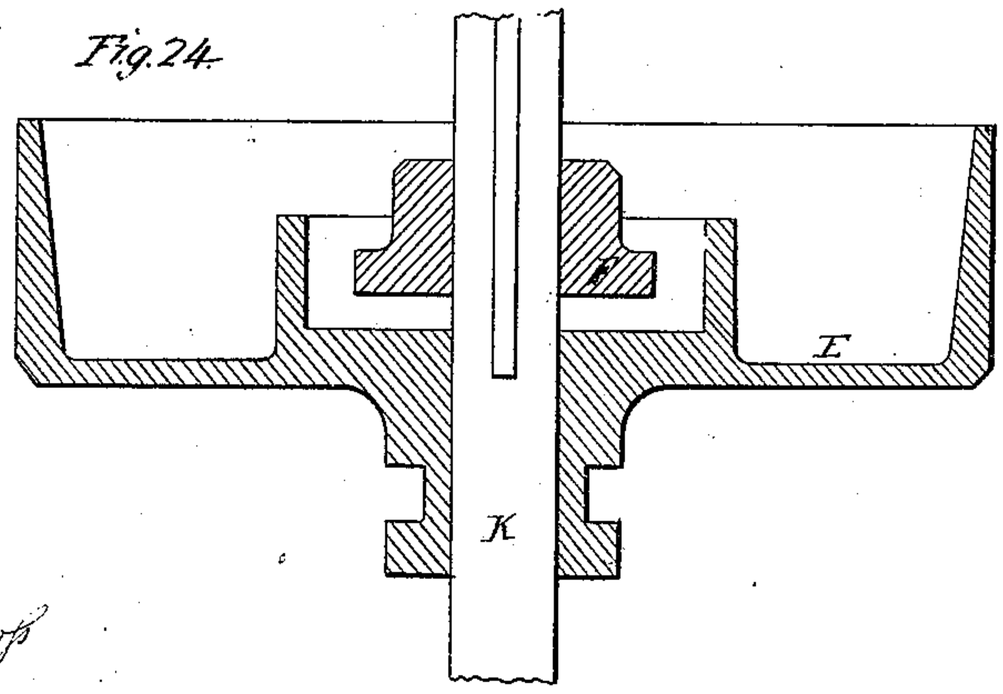


Fig. 24.



Witnesses:

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Edmund B. Mearns

Inventor

Seth. D. Paul

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UNITED STATES PATENT OFFICE.

SETH D. PAUL, OF LAWRENCE, MASSACHUSETTS.

IMPROVEMENT IN MULES FOR SPINNING.

Specification forming part of Letters Patent No. **53,036,** dated March 6, 1866.

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 new and useful Improvements in a Machine for Spinning Woolen Yarn; and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the annexed drawings, making a part of this specification.

My machine for spinning wool is in many respects similar to the Sharp and Roberts mule for spinning cotton, but differs from it so far as the peculiar motions required for spinning woolen yarn differ from those required for spinning cotton yarn.

The successive movements of the self-acting mule for spinning cotton are well known; and in order that the main features of the difference between this machine and my self-acting woolen-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 condition of the wool when prepared for spinning is in roving or prepared sliver wound upon spools. These spools are placed upon drums back of the rollers on the mule. The roving passes from the spools between the rollers and thence to the spindles, which are in the usual position in the carriage. First, the carriage begins to recede from the rollers and goes about one-half of its traverse at a uniform and rapid rate. Its speed then decreases to the end of the traverse. The spindles run at a uniform rate of speed during the whole length of the traverse of the carriage, putting the twist into the yarn. The carriage then runs back from one 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 stop when the carriage is about half-way out. As the carriage keeps on after the rolls stop and no more sliver is delivered, 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 from one to four inches, as above mentioned, this backward motion being equivalent to the amount of the shortening of the yarn consequent upon its being twisted. The next motion is the backing off, which consists in the reversal of the motion of the spindles and dropping the coppin or fuller-wire, for the purpose of running the yarn down to the proper position for winding it upon the bobbin. The reversal of the motion of the spindles continues only during this operation of backing off. The carriage now runs back, the spindles turning the same way they did when it was coming out.

When the carriage is running back the speed of the spindles is varied according to the required shape and size of the bobbin. The carriage starts to go back with a slow motion, and increases in speed until it is about half-way back, and then decreases 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 obtain these motions.

The drawings are comprised in four sheets, marked from A to D. To assist in distinguishing the old from the new parts I have colored the new a light red.

The references relate to the same parts in all of the figures.

Sheet A: Figure I, is a plan of mule-head; Fig. II, elevation of mule-head.

Sheet B: Fig. III, plan of part of mule-head, showing roller-motion, twist-motion, and motion for increasing speed of spindles; Fig. IV, elevation of Fig. III; Fig. V, end elevation of twist-motion; Fig. VI, side elevation of roller-motion; Fig. VII, front elevation of roller-motion; Fig. VIII, plan and elevation of stand for roller-motion; Fig. F E^e, friction-pulley and disk.

Sheet C: Fig. IX, plan of taking-in motion; Fig. X, end elevation of Fig. IX; Fig. XI, side elevation of Fig. IXI; Fig. XII, stands and gears for taking-in motion; Fig. XIII, stand with rack or gear with springs for taking-in motion.

Sheet D: Fig. XIV, plan of part of the carriage, showing ratchet-motion and relieving-lever latch; Fig. XV, side elevation of Fig. XIV; Fig. XVI, front elevation of relieving-lever latch and portion of carriage; Fig. XVII, forked lever for ratchet-motion; Fig. XVIII,

end elevation of relieving-lever latch; Fig. XIX, spring to work ratchet; Fig. XX, ratchet; Fig. XXI, ratchet-wheel or gear; Fig. XXII, ratchet-plate and gear for driving the same; Fig. XXIII, movable collar and arm with finger attached to slide under the ratchet. Fig. XXIV is a section of friction-pulley E and disk F, and showing a portion of shaft, K; Fig. XXV, elevation of friction-pulley E and disk F, showing shaft K and key 40, and also the projection L on friction-pulley E by means of which the disk F drives the pulley E; Fig. XXVI, plan and elevation, showing disk F as made fast to shaft K by key 40; Fig. XXVII, end elevation of pulley E, showing projections L; Fig. XXVIII, side elevation of pulley E.

A′ is frame to mule-head. B^2 is the carriage.

Motion to increase the speed of spindles.—Most woolen yarn requires considerable twist after the carriage is out to the end of the stretch or transverse. It has been found that the spindles can be run at a higher speed after the carriage is out than they can while it is coming out, thereby getting the required amount of twist in a shorter time, which is an advantage. To obtain this increased speed of spindles I make use of the following machinery: small band-pulley A, large band-pulley B, clutch-box C, cone-wheel D, friction-pulley E, disk F, forked lever G, forked lever H, cam I, and cam J. The disk F is keyed to the shaft K. The friction-pulley E slides loose on the shaft K, but is carried with it by means of the projection L in the pulley E sliding in the slot M in disk F, as shown in Fig. F E^e. The same band runs on both pulleys A and B. The large band-pulley B is keyed to the cone-wheel D and runs loose on the shaft K. The small band-pulley A also runs loose on the shaft K.

When the mule is ready to start the clutch-box C is in, and the small band-pulley A runs with the shaft K, driving the spindles. At the same time the friction-pulley E is out, and the large band-pulley B runs loose on the shaft K and follows the band as driven by small pulley A.

When the carriage gets out to the end of the stretch the cam-shaft 1 makes a quarter-revolution, and cam I, operating the lever H, throws out the clutch C, leaving the small pulley A to run loose on the shaft K. At the same time friction-pulley E is thrown in by the operation of the cam J on the lever G and drives the large band-pulley B, which now drives the spindles at a higher speed, and the small band-pulley A follows the band as driven by the large pulley B. This increased speed of the spindles continues until the yarn is sufficiently twisted. Then the cam-shaft 1 makes another quarter-turn and the mule backs off. Then the cam-shaft makes another quarter-turn and friction-pulley E is thrown out. When the carriage arrives in at the starting-point the cam-shaft 1 makes another quarter-turn and the clutch-box C is thrown in.

Twist-motion.—In this motion I use the following parts: twist-plate N, pin O, clutch P, cam Q, lever R, weight S, shaft T, comb U, stand V, pin V^2, finger V^3.

When the mule starts out the pin O rests on pin V^2. The clutch P is in and drives the pin-plate N and comb U. When the carriage arrives out at the end of its traverse the cam-shaft 1 makes a quarter-revolution and the finger V^3 strikes the comb U, which prevents the cam-shaft from turning farther. The yarn continues to twist until the opening in comb U reaches the finger V^3. The cam-shaft 1 then makes a quarter-revolution, the finger V^3 passing through the opening in the comb. The cam Q operates the lever R and throws out the clutch P. The pin-plate N is then carried back by the weight S until the pin O strikes the pin V^2—its first position. When the carriage returns in to the starting-point again the cam-shaft 1 makes a quarter-revolution, and the clutch P is thrown in.

There are holes drilled through the plate N, at equal distance from each other, in a circle near the outside of the plate.

To change the amount of twist it is only necessary to change the pin O from one hole to another in plate N, thus varying its amount of traverse, and consequently varying the amount of twist in the same proportion. This is a simple and convenient way of changing the twist. It saves time and labor, and also a large list of change-gears which were necessary in the old method of changing.

Mode of connecting twist-motion with large band-pulley.—To connect twist-motion with large band-pulley B, I use the following parts: gear W, gear X, shaft Y, gear Z, gear *a*, shaft *b*, stand *c*, worm *d*, gear *e*, shaft *f*, gear *g*, gear *h*. The object of making this connection so as to drive twist-motion from the large band-pulley is to always secure with certainty the same amount of twist with pin *o* in any given hole in plate N.

w w w w are stands to support shaft Y.

Roller-motion.—When the mule starts the clutch-box lever *i* rests upon the latch *j*. The shaft *k* is driven by the worm *l* on the roller coupling-shaft *m*. The clutch-box *n* is now in, and the pin *o* in plate *w* is carried around and strikes the rod *p*, which is connected with latch *j*, and pushes the latch from under the lever *i*. The lever *i* is then thrown down by the spring *g*, throwing out the roller-clutch box *r*, thus stopping the rolls. This occurs when the carriage is about half-way out, but can be varied by changing the pin *o* from one hole to another in plate *w*. There are holes in the plate *w* for that purpose, the same as in twist-plate, as described. This is a very convenient way of changing or varying the time of stopping the rolls, thus varying the amount of roving or sliver delivered, and consequently making the yarn coarser or finer. The carriage continues out after the rolls stop, and when it returns the stand *s*, Sheet C, Fig. XI, and Sheet A, Fig. II, strikes the lever *z*, causing it to raise

the lever *i*, and throws in the roller clutch-box *r*. At the same time the latch *j* is thrown back under the lever *i* by the spring *t*. When the lever *i* is thrown down to stop the rolls the finger *u* strikes the lever *v* and throws out the clutch *n*, and the pin-plate *w* is brought back to its first position by the weight *x*.

When the carriage returns and the lever *i* is raised, it relieves the lever *v*, and the clutch *n* is thrown in again by the spring *y*.

r r is a stand to support latch *j*.

Taking-in motion.—After the carriage arrives at the end of its traverse it usually runs in a little while the yarn is being twisted. The distance which the mule thus runs in varies from one to four inches, according to the amount of twist put in the yarn. This running in is effected as follows: When the carriage strikes out at the end of the stretch the cam-shaft 1 makes a quarter-turn, and by means of the cam 2, operating the lever 3, the worm 4 on shaft 5 is thrown into the rack or gear 6 in stand *s s*, which is attached to carriage B^2. The worm runs in the rack as long as the yarn is being twisted; consequently the carriage is drawn in slowly until the twist is all in; then the cam-shaft 1 makes a quarter-turn and the worm 4 is thrown out of the rack 6. The shaft 5 is driven by the pinion 7 on the short going-in shaft 8, connected by the train of gears 9, 10, 11, 12, 13, and 14. The rack 6 slides in the stand *s s* about half an inch.

The object of the spring 15 is to allow the worm 4 to gear in the rack easily. The spring 16 is to keep the rack in such a position in the stand that it will have to slide a little distance in the stand before it will begin to move the carriage up. This gives the yarn a chance to twist a little before the carriage begins to move, in which is better than to have it move in immediately after it strikes out.

Stands 17 18 19 support shaft 5. *t t* is a swinging arm connecting shaft 5 to stand 18.

Ratchet-motion.—When the carriage is running in while the yarn is being twisted the winding-on ratchet 20 is liable to fall into gear and prevent the backing-off motion of the mule. To obviate this I make use of the lever 21, finger 22, (attached to collar 23,) spring 24, stand 25, and adjustable plate 26. In the collar 23 is a groove to receive the forked end of lever 21. When the carriage runs out the adjustable plate 26, which is attached to front end of lever 21, strikes the curved edge of stand 25, which throws the finger 22 under the ratchet 20, making it impossible for the ratchet to fall in gear until the mule backs off. When the mule backs off the floor-lever 27 drops and relieves the lever 21, and the finger 22 is thrown is out from under the ratchet 20 by the spring 24, so as to allow the ratchet to go into gear.

28 is a ratchet-gear. 29 is a ratchet-plate with gear attached. 30 is a spring to work the ratchet. *u u* is a stand to support lever 21.

Relieving-lever latch.—When spinning cotton the mule backs off when it is out at the extreme of the stretch. The lower end of relieving-lever 31 acts on stud 32, and is relieved when the floor-lever 27 drops. In spinning wool, when the carriage is running in while the yarn is twisting, the relieving-lever, which is attached to carriage B^2, would, of course, pass away from the stud 32 and would have nothing to act upon. The catch 33 is designed to supply this deficiency. When the carriage runs out the end of the relieving-lever 31 strikes the stud 32 and is carried back over the catch 33, which is thrown up by the excess of weight on the opposite end and holds the relieving-lever until the mule backs off. When the mule backs off the floor-lever 27 drops and the stud 32 strikes the catch 33 and relieves the lever 31.

34 is a stand to support the relieving-lever latch.

I claim—

1. Pulley A, pulley B, clutch-box C, cone-wheel D, friction-pulley E, disk F, lever G, lever H, cam I, and cam J, or their equivalents, arranged and operating substantially as described.

2. Twist-plate N, pin O, clutch P, cam Q, lever R, or their equivalents, arranged and operating substantially as described.

3. The arrangement of gear W, gear X, shaft Y, gear Z, gear *a*, shaft *b*, stand *c*, worm *d*, gear *e*, shaft *f*, gear *g*, and gear *h*, or their equivalents, substantially as described, and for the purpose specified.

4. Lever *i*, latch *j*, shaft *k*, worm *l*, clutch-box *n*, pin *o*, plate *w*, or their equivalents, arranged and operating substantially as described.

5. Cam 2, lever 3, worm 4, shaft 5, and rack 6, or their equivalents, arranged and operating substantially as described.

6. Lever 21, finger 22, and stand or plate 25, or their equivalents, arranged and operating substantially as described.

7. The combination of latch 33 with relieving-lever 31, constructed and operating substantially as described, and for the purpose specified.

SETH D. PAUL.

Witnesses:

GEO. O. CROSS,

EMERY G. MESERVE.