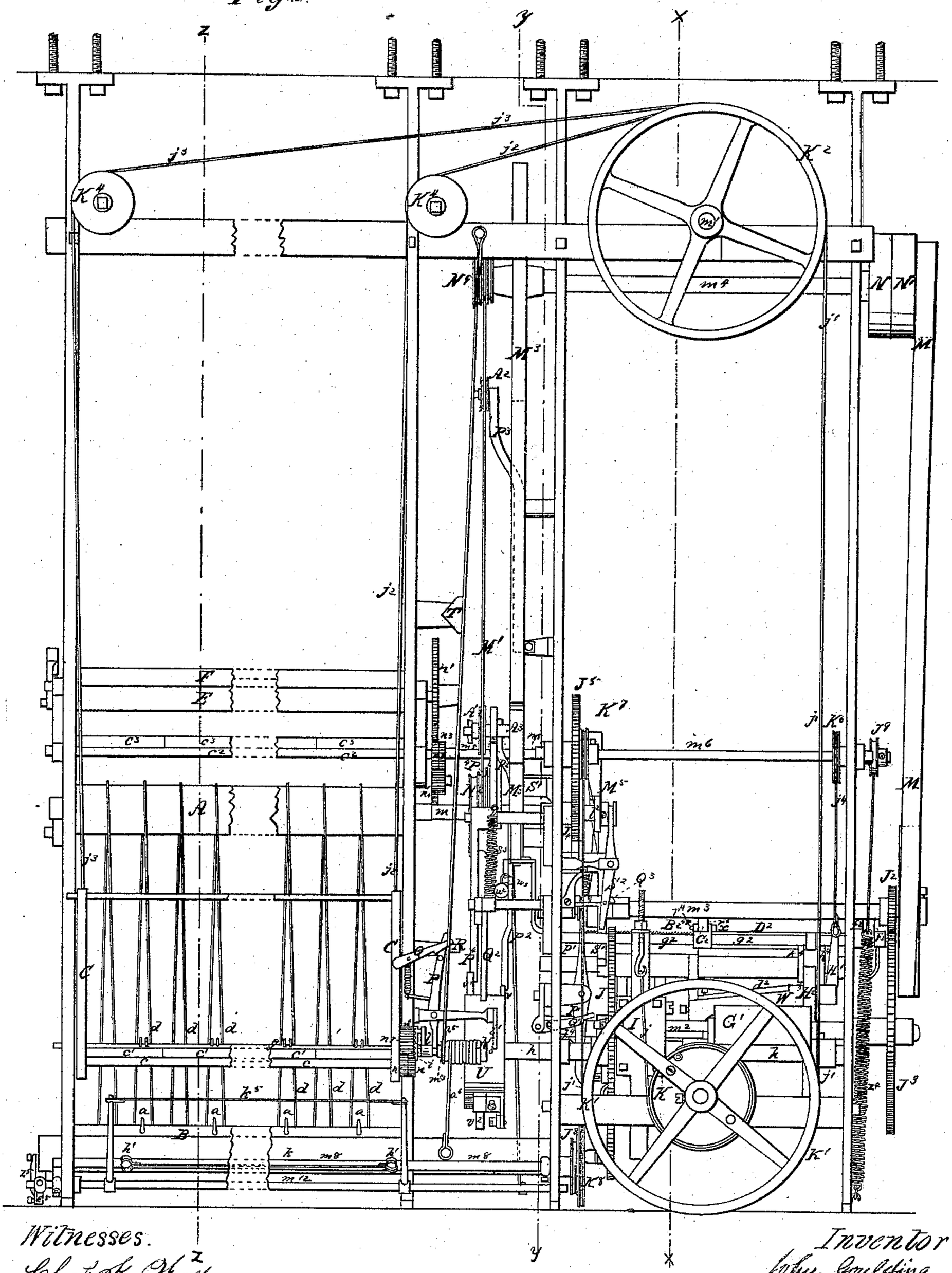
Sheet 1- 5 Sheets.

J. Goulding.
Mule and Jack.

No. 56,922. Patented Aug. 7, 1866.

Fig: 1.



Witnesses.
Chas. K. Walker
W. L. Bennett

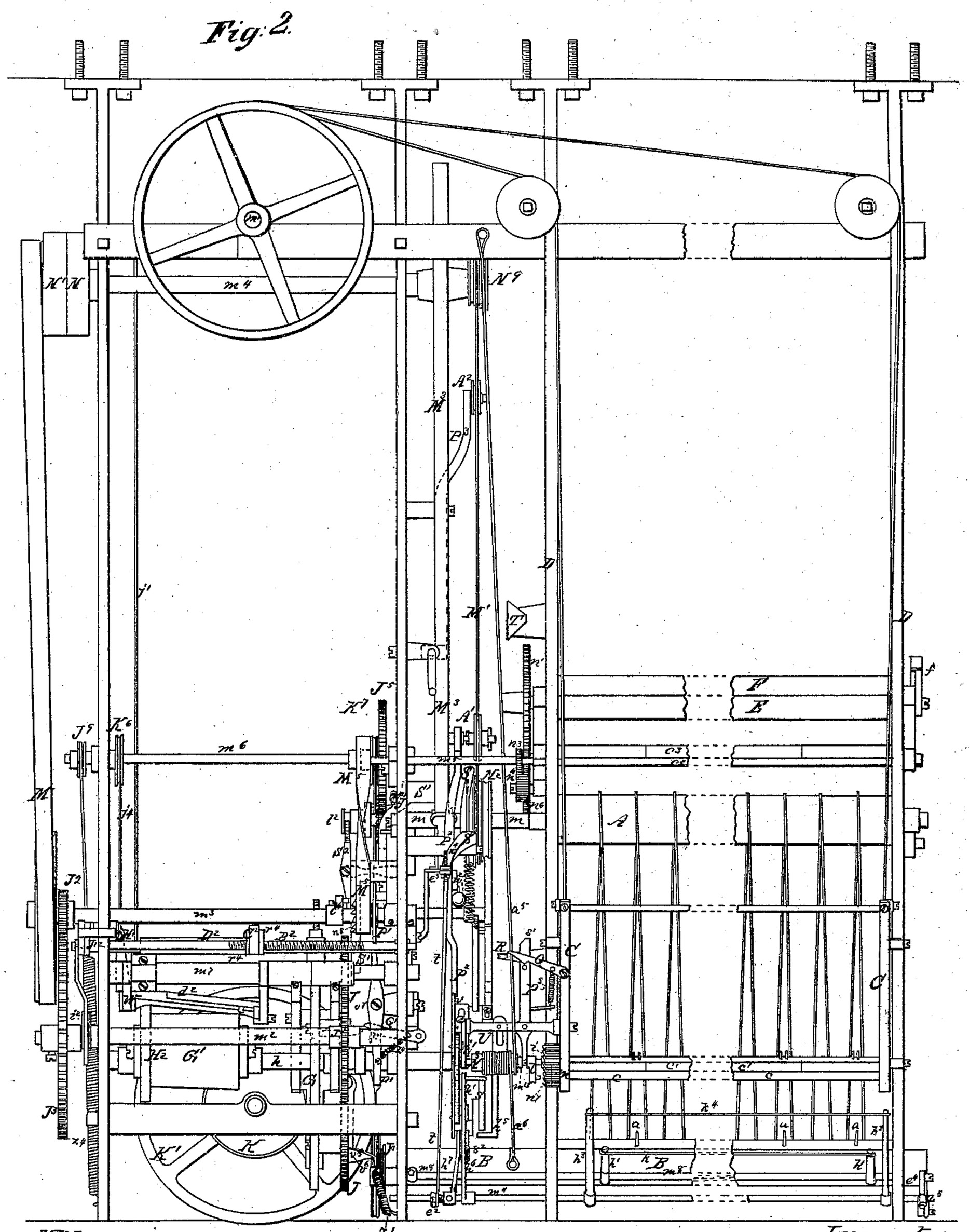
Inventor
John. Goulding
by his Attorney
C. L. Pennick

Sheet 2 - 5 Sheets.

J. Goulding.
Mule and Jack.

No. 56,922. Patented Aug. 7, 1866.

Fig. 2.



Witnesses

Chas. K. Walker
W. L. Bennett

Inventor
John Goulding
by his attorney
E. S. Renwick

Sheet 3-5, Sheets.

J. Goulding.
Mule and Jack.

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Fig. 3.

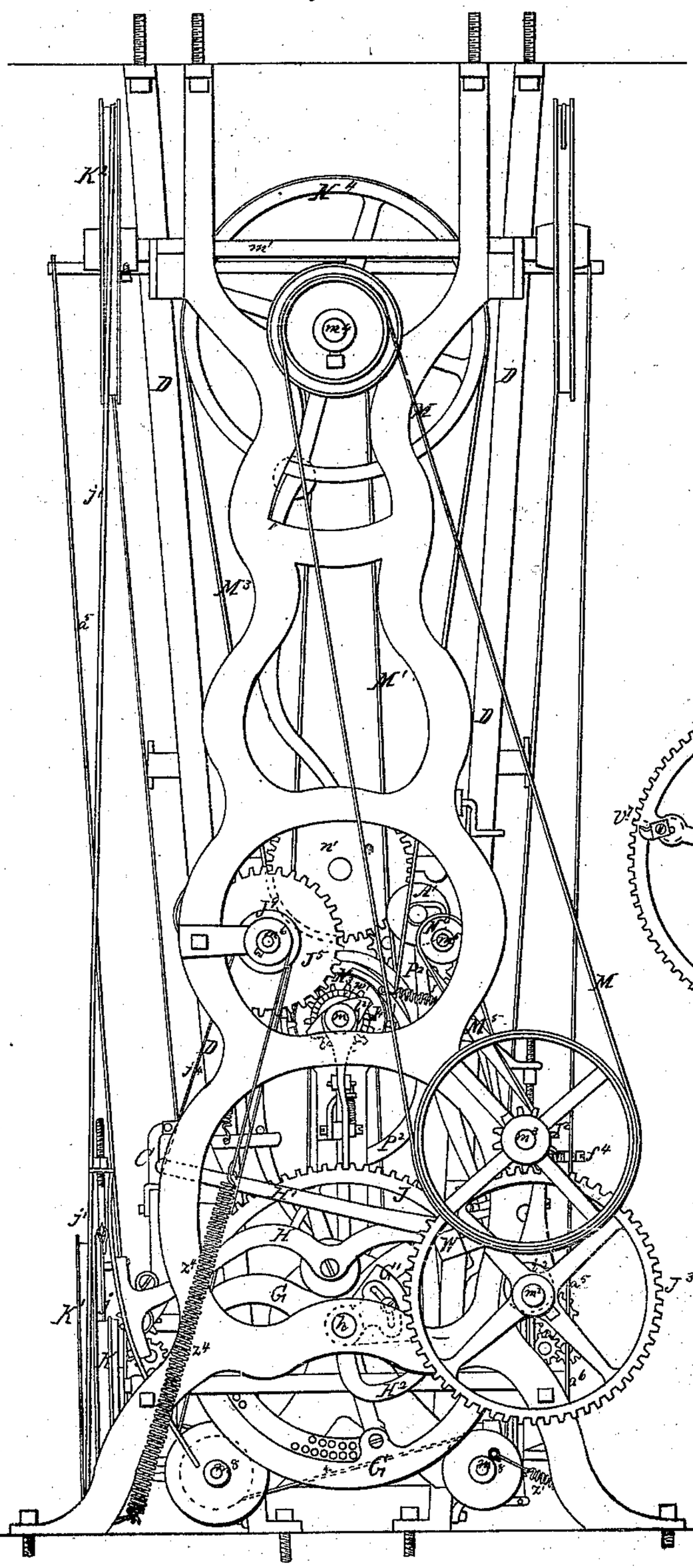


Fig. 7.

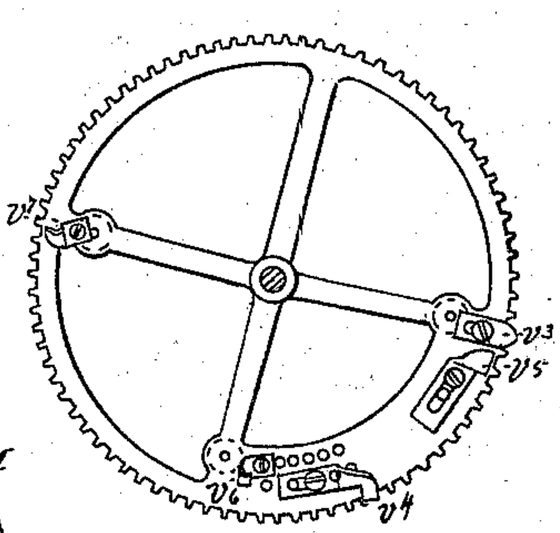


Fig. 11.

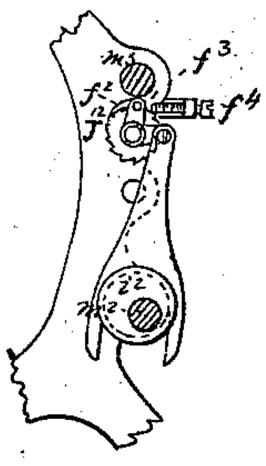
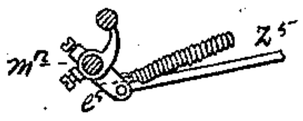


Fig. 8.



Witnesses

Chas. K. Walker

W. L. Bennett.

Inventor

John Goulding

by his attorney

E. S. Renwick

Sheet 4 - 5 Sheets.

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Mule and Jack.

No. 56,922. Patented Aug. 7, 1866.

Fig: 4.

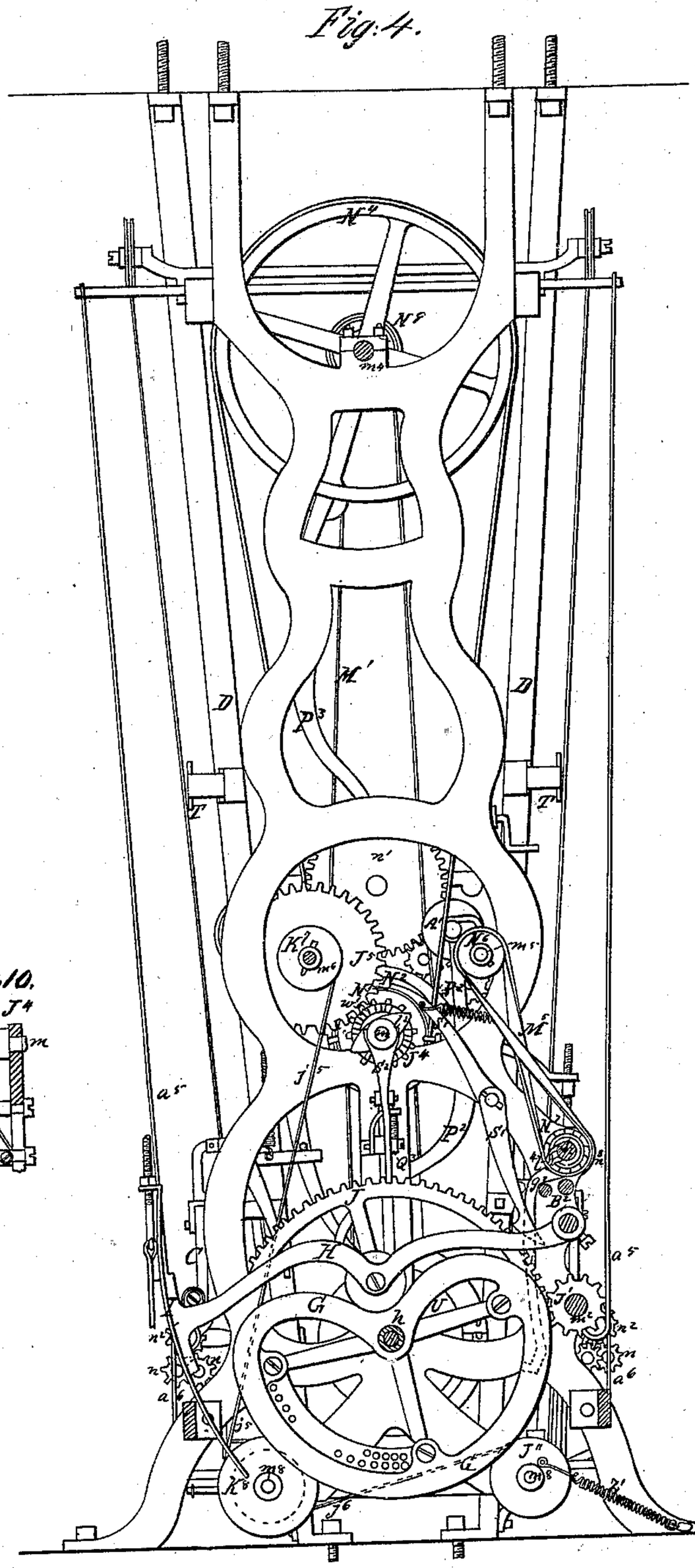


Fig: 10.

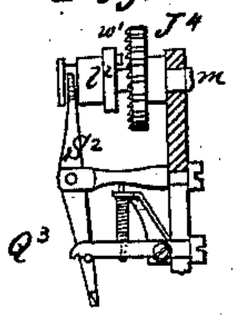
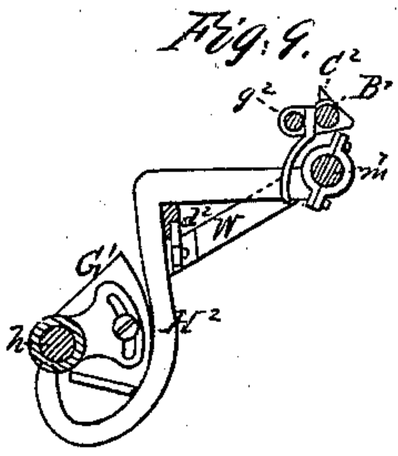


Fig: 9.



Witnesses

Chas. K. Walker

W. L. Bennem.

Inventor

John Goulding

by his attorney

E. S. Renwick.

Sheet 5-5 Sheets.

J. Goulding.
Mule and Jack.

No. 56,922. Patented Aug. 7, 1866.

Fig. 5.

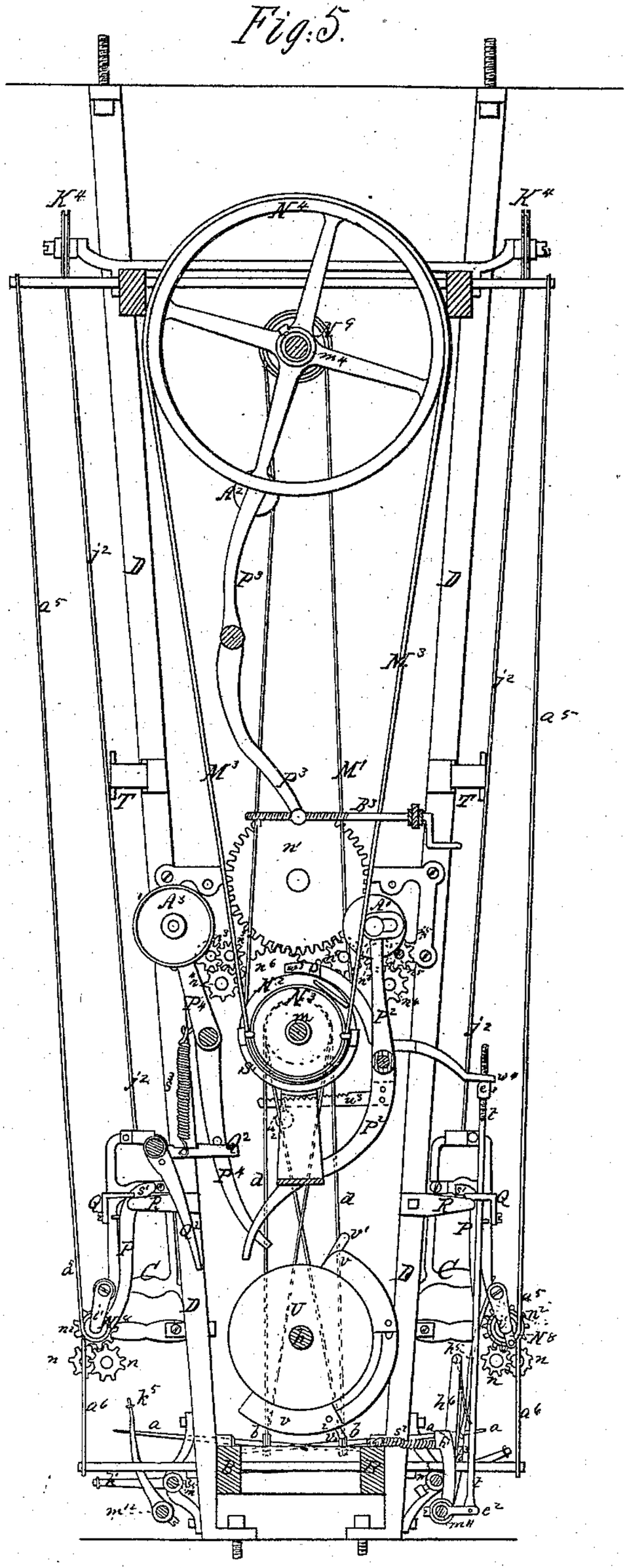
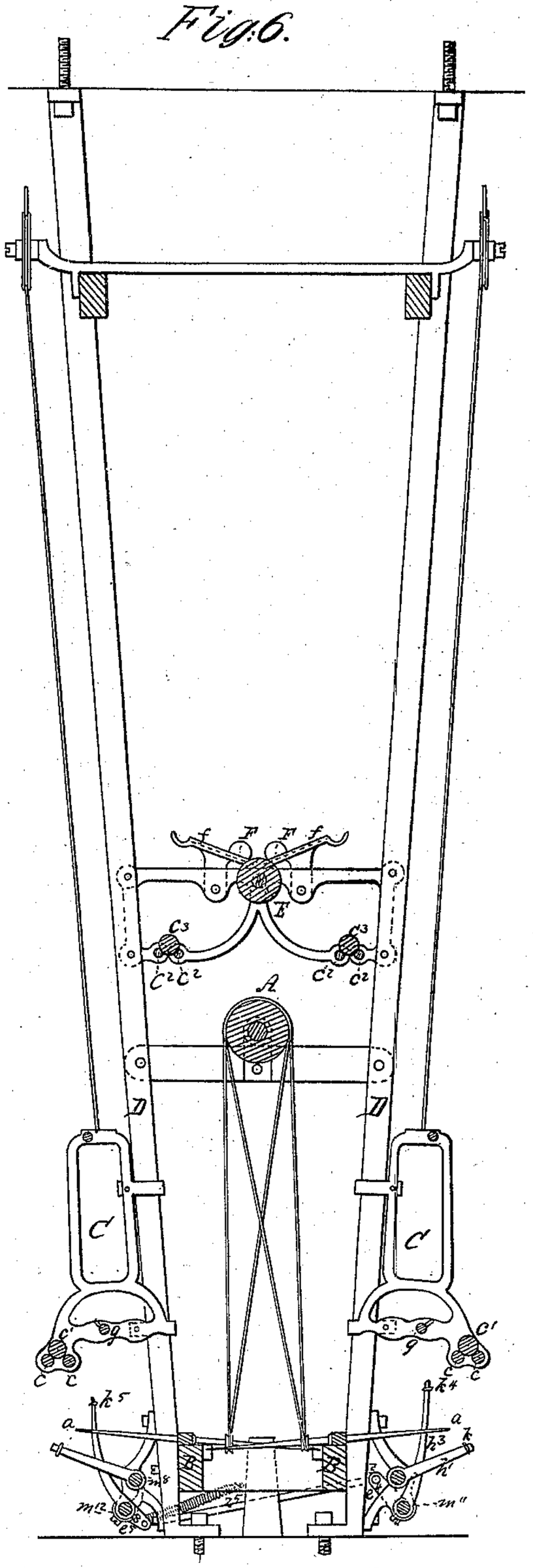


Fig. 6.



Witnesses
Chas. K. Walker
W. L. Bennett

Inventor
John Goulding
by his Attorney
E. G. Rennie

UNITED STATES PATENT OFFICE.

JOHN GOULDING, OF WORCESTER, MASSACHUSETTS.

IMPROVEMENT IN SPINNING MULES AND JACKS.

Specification forming part of Letters Patent No. **56,922**, dated August 7, 1866.

To all whom it may concern:

Be it known that I, JOHN GOULDING, of the city and county of Worcester, and State of Massachusetts, have invented certain new and useful Improvements in Jacks and Mules for Spinning Yarns; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, in which—

Figure 1 represents a front elevation of the principal parts of a jack embodying my invention. Fig. 2 represents a rear elevation of the same. Fig. 3 represents an end elevation of the same. Fig. 4 represents a vertical transverse section of the same at the line *x x* of Fig. 1. Fig. 5 represents a similar section at the line *y y* of Fig. 1. Fig. 6 represents a similar section at the line *z z* of Fig. 1. Fig. 7 represents a view of the side of the wheel J opposite that seen in Fig. 4; and Figs. 8, 9, 10, and 11 represent views of detached parts of the mechanism, denoted by the same letters as the corresponding parts in the preceding drawings.

The invention which constitutes the subject-matter of this patent relates to those spinning-machines known as "jacks" and "mules," in which the stretching and winding of the yarns are effected alternately and intermittently.

The object of the present invention is to simplify the construction and lessen the cost of such machines, particularly that described by me in a previous patent, dated the 2d day of May, 1865.

The special object of the first part of the invention is to permit the bobbins or spools from which the rovings are supplied for spinning to remain stationary while the jaws that determine the delivery of the rovings for spinning travel toward and from the spindles. This part of the invention consists of the combination of a carriage and jaws for the rovings with a stationary turning-spool support, so that, although the jaws move toward and from the spindles, the spools of rovings may remain stationary while turning against the stationary turning-spool support.

The special object of the second part of the invention is to determine the delivery of rovings from a stationary spool or bobbin used in connection with traveling jaws. This part of the invention consists of the combination of a stationary set of jaws and stationary turning-spool support with a traveling set of jaws mounted upon a carriage, so that the weight of the rovings extending from the spool at the stationary turning-spool support to the traveling roller-jaws upon the carriage is not permitted to affect the unwinding of the rovings from the spool.

The special object of the third part of the invention is to operate the traveling jaws of the machine by a more simple mechanism than has heretofore been used for that purpose; and it consists of the combination of the traveling carriage of the roller-jaws for delivering and holding rovings, and the shaft upon the carriage which imparts motion to the instrumentalities carried by it with ropes extended in the direction in which the carriage is moved, so that the shaft which drives the roller-jaws is caused to turn by ropes during the movement of the carriage.

The special object of the fourth part of the invention is to provide a simple means of regulating the tightness or hardness with which the yarn is wound in cops upon the spindles; and it consists of the combination of the drum, or its equivalent, for imparting motion to the spindles with an endless rope and grooved pulleys, for transmitting motion to it during the winding of the yarn, and a tightening-pulley for said rope controlled by an adjustable weight or its equivalent, so that the pressure of the tightening-pulley upon the rope may be varied by adjusting the weight or its equivalent, and consequently the rope may be permitted to slip less or more upon its pulleys and drive the spindles at greater or less speed during winding, as required to vary the degree of tightness with which the yarns are wound.

The special object of the fifth part of the invention is to compensate variations in the length of the endless rope used for transmitting motion to the spindles during winding; and it consists of the combination of the members of the last preceding combination with a second adjustable tightening-pulley, which may be adjusted as required to compensate variations in the length of the endless rope.

The special object of the sixth part of the invention is to regulate the speed of the spindles during the winding of the yarns, so that the yarns may be wound with an equable strain upon them. This part of the invention

consists of the combination of a regulating-wire and friction-brake with the drum or other member of the mechanism for driving the spindles, so that the speed at which the spindles are permitted to revolve during winding is regulated by the tension of the yarns extending from the spindles to the jaws of the machine and operating upon the regulating-wire.

The special object of the seventh part of the invention is to provide a simple means of imparting a rapid motion to the spindles during the stretching and hard-twisting of the yarns, and of stopping the operation of the spindles by such means. This part of my invention consists of the combination of the drum for driving the spindles with an endless belt and pulleys for imparting a rapid motion to them, and with a tightening-pulley controlled by cams, for putting said mechanism into and out of action at the required times.

The special object of the eighth part of the invention is to prevent a loss of time after the hard-twisting is completed and before backing off is commenced by reason of the momentum of the parts of the machine still continuing to turn the spindles in a forward direction. This part of my invention consists of the combination of the drum for imparting motion to the spindles with a friction-brake operated by a cam in such manner as to check the motion of the spindles previous to backing off.

The special object of the ninth part of the invention is to permit the variable mechanism that regulates the backing off or winding of the yarns to be reset rapidly after one set of cops is spun and before a new set is commenced. This part of my invention consists of the combination of the arm of the backing-off or winding mechanism and the screw that shifts it with a section-nut that may be easily disengaged and re-engaged with said screw.

All of the improvements are embodied in the machine represented in the accompanying drawings. In this machine there are two series of prostrate spindles, (but a few of which, *a a a*, are represented in the drawings,) which are arranged in two rows, with their ends pointing in opposite directions, and are supported in suitable bearings in two rails, B B, near the floor of the room in which the machine is operated; and each spindle is fitted with a whirl, *b*, to receive the cord *d*, by which the rotary motion is imparted to it from a drum, A. The spindles of each row are arranged in sets or gangs of about twenty each, as in the horizontal machines in common use, and a drum is used for each two adjacent sets of the two rows. All these drums are mounted upon one shaft, *m*, which extends through the center of the machine, is supported at intervals by bearings, and is operated in turn by each one of three trains of driving mechanism, hereinafter described, one for impelling the drums, and consequently the prostrate spindles which they operate upon, at a suitable speed during the delivery of the lengths of roving to be spun and during the winding of the yarn, the second train for impelling the spindles at the proper speed during the stretching of the rovings and until they are twisted to the requisite hardness, and the third for turning the spindles backward, so that they may "back off" the yarn extending from the cops of thread to the points of the spindles.

A carriage, C, composed mainly of two end frames connected by cross-bars, is arranged to move up and down above each set or row of prostrate spindles, so that it alternately recedes from them and approaches them. Each carriage is guided in its movement by two upright guides, D D, which, for better security, are connected at their upper and lower ends with the floors of the factory. The carriage holds the jaws which deliver and hold the rovings during spinning. These jaws consist of two rollers, *c c*, which are turned to deliver rovings, and the loose rollers *c' c'*, which lie upon the rovings, press them in contact with the turning-rollers *c c*, and gripe them by pressure so that the rovings are clamped fast when the rollers *c c* cease to turn. The spool F, or long bobbin upon which the rovings to be spun by each set of spindles are wound, and from which they are unwound intermittently as required for the operation of the machine, is supported against a stationary turning-spool support consisting of a cylinder or drum, E, whose shaft turns in bearings in the stationary frame of the machine, so that the spool is turned to unwind the rovings by frictional contact. The same cylinder is employed to unwind the rovings for the two adjacent sets of spindles pointing in opposite directions, and each spool of each set is retained in its proper positions against the cylinder E by a pair of inclined guides, *f f*, against which the end gudgeons of the spool bear. The rovings pass from each spool to a stationary set of roller-jaws, which, like those upon the carriage, consist of a pair of rollers, c^2 c^2, (which are turned to deliver the rovings passing over their barrels,) and a set of loose rollers, c^3 c^3, which press the rovings in contact with the turning rollers c^2 c^2, and gripe them by pressure, so that the rovings are clamped or held when the rollers cease to turn.

The carriage is drawn upward from the prostrate spindles, and is permitted to descend by gravity, so as to approach the prostrate spindles, by means of a cam, G, secured to a revolving shaft, *h*, and operating upon the carriage through the following mechanism: The cam operates directly upon a friction-wheel secured to an arm, H, whose end is provided with a segment, I, which is connected with a steel band, *j*, wound upon a pulley-wheel, K. The pulley-wheel K is secured to a transverse shaft, to which a second pulley-wheel, K', of larger size, is secured, and this second pulley-wheel is connected with a steel band, *j'*, which is wound upon a pulley-wheel, K^2, secured to a counter-shaft, *m'*, above. This pulley is also connected with the two end frames of the car-

riage C by means of two steel bands, j^2 j^3, which pass over pulleys K^4 K^4, so that the upward movement of the arm H by the cam G draws off the band j from the pulley-wheel K, and thereby causes it and the larger pulley-wheel K′ to turn, and the turning of this pulley-wheel draws the band j' from the pulley-wheel of the counter-shaft m', and, causing it to turn, effects the winding up of the bands j^2 j^3 and the consequent rise of the carriage C. When, on the other hand, the cam in its revolution permits the arm H to descend, the weight of the carriage causes it to descend and turn the pulley-wheels and shaft in the opposite direction, and the speed at which the carriage descends is regulated by the form of the cam G.

In order that the power required to operate the machine may be equalized, the weight of the carriage and its appurtenances should be counterbalanced in part by a counter-weight suspended from a band wound upon a pulley-wheel secured to the counter-shaft m'.

The cam G is secured to a shaft, h, to which a cog-wheel, J, is also secured. This cog-wheel engages with a pinion, J′, on a shaft, m^2, which is driven from a shaft, m^3, by means of a pinion, J^2, and cog-wheel J^3. The shaft m^3 is fitted with a belt-pulley, which receives a belt, M, leading from a belt-pulley secured to the driving-shaft m^4 of the machine, and the driving-shaft is fitted with a fast pulley, N, and with a loose pulley, N′, to one or other of which the driving-belt is applied, according as the machine is to run or to remain at rest.

In order that the turning-spool support and the stationary rotary jaws appertaining to each set of rovings may be turned to deliver rovings for spinning, the ends of their respective shafts are extended through the frame that supports them and are provided with cog-wheels n^3 n^3. These cog-wheels are connected by intermediate cog-wheels, n^4 n^5 n^6 n', the last of which, n', is secured to the shaft of the turning-spool support E, and one of the shafts m^5 of one of the roller-jaws is extended sufficiently to support a pulley, N^6, in a proper position to receive a twisted belt, M^5, leading from a pulley, N^7, on the shaft m^3, so that when the said pulley N^7 is turned with the shaft m^3 it imparts motion to the shaft of one of the roller-jaws c^2, and that motion is transmitted to the turning-spool support or cylinder E, and to the other rotary jaws by means of the cog-wheels n' n^3 n^4 n^5 n^6, which connect the whole set together. As the rovings are to be unwound and delivered for spinning at intervals, the pulley N^7 is not fixed to the shaft m^3, but its hub is fitted to turn freely thereon, and it is connected with the shaft and disconnected therefrom, as the delivery of rovings is to proceed or stop, by means of a clutch. To this end a clutch-wheel, n^8, is secured to the pulley N^7, and an arm, l^4, carrying a tooth, is secured to the shaft m^3, facing the clutch-wheel. The hub of the pulley is constructed to slide along the shaft m^3 toward and from the tooth of the clutch-arm l^4, and its hub has a groove formed in it, to which the forked arm of a shifting-lever, P′, is applied. This lever is pivoted to the frame of the machine, and is moved alternately in opposite directions by means of a spring, z^4, and a cam, v^6, secured to the face of the cog-wheel J in a position to act upon the longer arm of the lever. The spring causes the lever to push the pulley N^7 along the shaft m^3 until one of the teeth of the clutch-wheel n^8 is engaged with the tooth of the arm l^4, whereupon the turning-spool support E and the stationary roller-jaws c^2 c^3 are caused to revolve and deliver rovings. The cam v^6 moves the lever P′ in the opposite direction, and causes it to push the pulley N^7 away from the clutch-arm l^4, thereby disconnecting the pulley from the shaft m^3 and stopping the movement of the roller-jaws c^2 c^3 and turning-spool support E. When the pulley is thus disconnected it is held in that condition by a spring-latch, Q′, which engages with a pin projecting from the side of the lever P′, and prevents the spring z^4 from moving it until the latch is disengaged by means of a second cam, v^7, secured to the cog-wheel J in the proper position relatively to the carriage-cam G to start the turning-spool support and roller-jaws delivering rovings.

In order that the rotary jaws that are mounted upon each carriage may be turned to deliver the rovings for spinning, the ends of their respective shafts are extended through one of the end frames of the carriage, and are provided with cog-wheels n n, which are connected by means of an intermediate or connecting cog-wheel, n^2, so that the roller-jaws turn together. The cog-wheel n^2 is pivoted upon a tubular stud, i, secured to the frame of the carriage, and its outer side is provided with a clutch-wheel, n^7. A bayonet-clutch, l, is secured to a shaft, m^{13}, which is arranged to turn and slide longitudinally in the stud i and in a bracket, i', which forms the outer bearing of this clutch-shaft, so as to engage with and disengage from the teeth of the clutch-wheel n^7. This clutch-shaft is caused to turn so as to impart motion to the roller-jaws by the rise of the carriage in the following manner: A drum, N^8, is secured to the clutch-shaft, and two ropes, a^5 a^6, are made fast to the drum. One of the ropes, a^5, is extended directly to one of the upper rails of the frame of the machine, and is made fast to a bracket projecting therefrom. The other rope, a^6, is wound around the barrel of the drum, and its end is secured to a bracket projecting from one of the lower rails, B, of the frame. Hence when the carriage is drawn upward the coiled rope, unwinding, pulls the clutch-shaft around in the direction required to turn the roller-jaws for the delivery of rovings, and at the same time effects the coiling up of other rope, a^5, upon the barrel, while during the descent of the carriage these operations of the two ropes are reversed.

In order that the clutch-tooth may be engaged with the clutch-wheel, the carriage C is provided with a clutch or shifting lever, P, which is pivoted to a bracket and has its lower

arm forked to engage in a groove in the barrel of the clutch-shaft m^{13}. This shifting-lever is fitted with a spring, *s*, which causes it to engage the clutch-tooth in the clutch-wheel whenever this operation is permitted, so that the roller-jaws are then caused to turn with the clutch-shaft. When, on the other hand, the clutch-tooth is disengaged by moving the shifting-lever antagonistically to the spring, the roller-jaws of the carriage cease to turn.

As rovings are delivered for spinning during the rising of the carriage for a certain period preliminary to the stretching, the clutch-tooth is engaged with the clutch-wheel when the carriage is in the lowest position, and remains so engaged until the carriage has moved the required distance to extend the lengths of rovings to be spun between the roller-jaws and the spindles, after which the clutch-tooth is withdrawn from the clutch-wheel n^7, thereby disconnecting the gearing from the clutch-shaft and stopping the turning of the roller-jaws *c c'*. In order to so withdraw the clutch-tooth the upper end of the shifting-lever is provided with a projection, *s'*, which, by the upward movement of the carriage, is brought in contact with an inclined plane, T. Hence, as the carriage rises, the shifting-lever is caused to turn on its pivot by the action of the inclined plane upon its upper end, and its fork disengages the clutch-tooth. In order to hold the tooth so disengaged during the remainder of the upward movement of the carriage and during the descent, a latch, Q, is provided, to engage with a pin projecting from the shifting-lever and prevent its movement until the latch is disengaged at the end of the descending movement of the carriage by a stop, R, upon which it strikes as the carriage approaches its lowest position, whereupon the clutch-tooth is permitted again to be engaged by its spring *s*. As the turning of the roller-jaws ceases when the clutch is disengaged by the action of the inclined plane T, the position of this instrument determines the length of the rovings delivered by the jaws for spinning. Hence, by setting this instrument nearer to or farther from the spindles, the length of the rovings delivered is proportionally shortened or lengthened, and as the rovings are stretched during the entire remainder of the upward movement of the carriage the amount of stretch is correspondingly increased or diminished.

The stationary roller-jaws c^2 c^3 are arranged at a position midway between the uppermost and lowermost positions of the carriage, so that if they be turned to deliver the same length of rovings as the jaws of the carriage the slack between them and the carriage-jaws will be sufficient to permit the carriage to rise to its highest position without straining the rovings unduly. Consequently the cam v^6, which determines the stopping of the revolution of the stationary jaws and turning-spool support, may be set upon the wheel J in such a position relatively to the cam G that moves the carriage as to stop the movement of the spool-support and stationary jaws at the same time as the shifting-lever P of the carriage-jaws *c c'* is moved by the inclined plane T. The rovings passing to the roller-jaws of each carriage are guided to their proper positions opposite the spindles by which they are to be spun by means of guide-pins secured to a guide-rail, *g*, that is mounted upon the carriage.

In order that the spindles may be turned with the proper speeds at the proper times in the operation of spinning, the drum A, as before stated, is operated upon by three trains of mechanism. For this purpose the drum-shaft is provided with a belt-pulley, N^3, a grooved pulley, N^2, and with a cog-wheel, J^4, the last of which is fitted to turn freely upon it, while the first two are rigidly secured to it. The grooved pulley N^2 constitutes the last member of the train of mechanism for impelling the spindles at the speed required for winding the yarn upon them, and also for turning them during the delivery of rovings prior to the stretching. It is driven by an endless rope, M', which receives motion from a corresponding grooved pulley, N^9, secured to the driving-shaft m^4 of the machine, so that the two pulleys and the endless rope constitute in this example the train of mechanism that transmits motion from the driving-shaft to the drum-shaft. As the slow twisting of the roving during its delivery should be capable of variation to adapt it to the quality of rovings, each grooved pulley N^2 N^9 has three grades of grooves of varying diameter, so that any one of three different speeds may be imparted to the spindles, according to the grades to which the rope M' is applied. The endless rope is of such length, when it is applied to the pulleys, that it is too slack to impart motion from the grooved pulley N^9 on the driving-shaft to the other grooved pulley, N^2, and the drum A, unless it be tightened by a tightening-pulley, A', which is secured to the upper end of a lever, P^2, that is pivoted to the frame of the machine and is caused to bear against the rope by a weight, w^2, acting upon a horizontal arm, w^3, which projects from the lever, P^2. This tightening-pulley A' is made use of to make the rope stop driving the drum A and drive it at the proper time. For this purpose a cam-hub, U, is secured to the cam-shaft *h*, and a cam, *v*, is secured to the hub in the proper position relatively to the cam G to act upon the lower end of the tightening-lever P^2 and withdraw the pulley from the rope at the time the rope is to stop driving the drum A, which is when the delivery of rovings is stopped.

The cam is provided with a concentric grade extending a sufficient distance around the cam-hub to maintain the tightening-pulley out of contact with the endless rope during the stretching and tight-twisting of the yarns and the backing off. The hinder end of the grade is in the proper position relatively to the cam

G to release the lever P^2 and permit the tightening-pulley to be borne by the weight u^2 against the endless rope when the winding of the yarns is to commence, so that the rope then drives the drum A and the spindles, and continues to drive them until the cam withdraws the tightening-pulley 'A'.

The extremities of the cam v are made adjustable, so that they may be adjusted to effect the tightening of the rope and the slackening of it at the proper times.

It is desirable that the speed of winding should be capable of adjustment, so that the yarns may be wound more or less tightly, as desired. This is effected in the machine by permitting the rope M' to slip a regulated quantity during its action. To this end the tightening-lever w^3 is provided with a series of notches and the weight u^2 is placed in one or another of said notches, so as to act with greater or less leverage on the tightening-pulley and cause it to permit the rope to slip less or more, according as the yarns are to be wound more or less tightly.

As the endless rope is made of hemp by preference, on account of the facility with which it will slip upon the pulleys when the strain exerted by the tightening-pulley is relaxed, it is affected by the greater or less dryness of the weather, becoming shortened in damp weather. As this variation in length, if not compensated, would affect the speed of the spindles, an adjustable tightening-pulley, A^2, is provided to compensate the changes produced by changes in the weather. This tightening-pulley is pivoted to one arm of a lever, P^3, whose opposite arm is controlled by a screw, B^3, so that by turning said screw the endless rope may be tightened or slackened as required.

The speed of the spindles when driven by the rope may be uniform during the delivery of rovings; but during the winding up of the yarn it must vary, according to the greater or less diameter of the cop at the place where the yarn is guided by the faller. This variation in speed is provided for by using a rope which will slip upon the pulleys N^2 N^9 in case the resistance to the turning of the pulley N^2 is excessive, and the speed is regulated by the strain upon the yarn, which is made to act upon a friction-brake, which retards the movement of the drum N^2 and spindles wherever the strain begins to increase beyond the proper limit by reason of too rapid winding. A friction-brake, S, is therefore arranged to press upon the pulley N^2, the brake having the form of a lever, (which is pivoted to the frame of the machine,) with its shoe end w^3 adjacent to the rim of the grooved pulley N^2, and its shank w^4 projecting horizontally and perforated to admit the upper end of a standard, t, that projects upward from the arm e^2 of a rock-shaft, m^{11}, beneath, and is fitted beneath the shank w^4 of the brake-lever with a collar, e^3. This rock-shaft m^{11} extends the entire length of the row of spindles, being supported in bearings secured to the frame of the machine, and it is provided with arms h^3, between which the regulating-wire k^4 is stretched a little above the points of the spindles. During spinning the yarns extend from the points of the spindles in the usual manner, but during winding the yarns are borne toward the butts of the spindles by the faller k, and consequently are borne against the regulating-wire k^4. The pressure of the yarns thus tends to move the regulating-wire and rock the shaft m^{11}, and thereby cause the friction-brake S to press upon the pulley N^2 with greater force, thus retarding its movement by the rope M', (which then slips upon the pulley,) and consequently diminishing the speed of the drum A and spindles. On the other hand, if the yarns are being wound too slowly, the strain of the yarns upon the regulating-wire is relaxed. Consequently the pressure of the friction-brake is relieved somewhat, and the rope is permitted to drive the pulley N^2, drum A, and spindles at a quicker rate of speed.

As there are two rows of spindles in the machine represented in the drawings, each row is provided with a separate regulating-wire, k^4 and k^5, and the rock-shafts m^{11} m^{12} of these two wires are connected by a link, z^5, pivoted to crank-arms e^4 e^5, secured to the rock-shafts, so that either regulating-wire will operate the brake mechanism. As the diameter of the spindles is small, but little force will turn them when the yarns are guided by the faller to the points of the cops of yarn at the close of the winding of each stretch of yarn, and consequently the brake S must then be applied with considerable force in order to retard the revolution of the spindles sufficiently.

As the yarns might be unduly strained if all the force required for this purpose were thrown upon them, mechanism is provided to apply extra pressure to the friction-brake at that time. To this end an arm, h^5, with a horizontal finger at its end, is projected downward from one of the carriages C, and an arm, h^6, is projected upward from the rock-shaft m^{11} of the regulating-wire k^4. This latter arm is provided with an inclined spring, s', arranged in the proper position to be borne upon by the finger of the carriage-arm h^5 during the latter part of the descent of the carriage. Consequently at that time the rock-shaft arm h^6 is pressed backward, and additional pressure is applied through it to the friction-brake. The spring s' of the arm h^6 is so short that when the carriage descends to its lowest point the finger of the carriage-arm passes below its end, and permits that end to spring forward and relieve the pressure on the friction-brake; then, when the carriage reascends, the finger of the carriage-arm is carried upward behind the spring s'. As the upper end of this spring is inclined inward sufficiently to be within the range of the finger of the carriage-arm in its descent, it is struck by that finger in its ascent with the carriage; but the rock-shaft arm is then permitted to yield to the pressure of the finger

by the following construction: The hub of the arm h^6 is fitted loosely upon the rock-shaft m^{11} by the side of a second arm, h^7, which is secured thereto. The end of this second arm laps in behind the first arm, h^6, so that when the latter is borne backward by the pressure of the finger of the carriage-arm the pressure is transmitted through the second arm, h^7, to the rock-shaft m^{11}. When, on the other hand, the arm h^6 is borne forward by the pressure of the finger rising behind it, it turns forward on the rock-shaft without imparting motion thereto. When the finger, in its ascent, has passed by the arm h^6 the latter is restored to its position by a spring, s^2.

In order that the brake mechanism may be adjusted, the upper end of the standard t is formed into a screw, and the collar e^3 has the form of a nut, so that it may be set in any required position by screwing it up or down upon the standard.

The pulley N^3 upon the drum-shaft m constitutes the last member of the train of mechanism for driving the spindles at the uniform rapid speed required to twist the rovings during stretching and subsequently until the required hardness of twist is attained preliminary to winding. It is driven directly from the driving-shaft m^4 by means of an endless belt, M^3, which encircles a corresponding pulley, N^4, secured to the driving-shaft, so that the two pulleys N^3 N^4 and the endless belt M^3 constitute the train of mechanism for transmitting motion from the driving-shaft to the drum-shaft m during stretching and hard-twisting.

In order that the connection of the drum-shaft with this mechanism may be made and broken at the proper times, the endless belt is of such length that when it is applied to the pulleys it hangs slack, so as then to impart no motion to the pulley N^3 on the drum-shaft, and a tightening-pulley, A^3, is provided to tighten it and cause it to operate, or to slack it and permit it to cease from driving the drum-shaft. This tightening-pulley is secured to the upper end of a lever, P^4, which is pivoted to the frame of the machine with its lower end near the barrel of the cam-hub U. The cam-hub is provided with an adjustable cam or tappet, v', set in the proper position relatively to the cam G to move the tightening-lever P^4 at the required time sufficiently to make the tightening-pulley tighten the belt M^3, and a spring-hook latch, Q^2, is pivoted to the frame in a position to catch upon a projection of the tightening-lever and hold it in the position in which it is so placed. A second adjustable cam or tappet, v^2, is secured to the cam-hub in the proper position relatively to the cam G to detach the spring-latch Q^2 at the time when the hard-twisting is completed and the yarns are to be backed off the spindles preliminary to winding.

The detachment of the latch Q^2 releases the tightening-lever P^4 and tightening-pulley A^3, and permits the latter to be pulled back from the belt M^3 by means of a spring, s^3, thereby breaking the connection between the drum-shaft and the train of mechanism of which the belt forms a member.

As the drum-shaft and spindles are to be turned backward—that is, in directions the reverse of those in which they are turned during winding—immediately after the hard twisting is completed, and as, in order to avoid loss of time, the forward movement of the drum and spindles should be stopped quickly previous to their backward movement, a friction-brake, S', is provided to press upon the pulley N^3 and stop its movement as rapidly as possible after the tightening-pulley A^3 is released. This brake S' has the form of a lever, and is pivoted to the frame of the machine with its shoe over the pulley N^3 and its shank within the range of a cam, v^3, secured to the face of the cog-wheel J in the proper angular position relatively to the cam G to bear the brake-shoe for a short period upon the pulley N^3 as soon as the tightening-pulley A^3 is released, and thereby stop the motion of the drum-shaft and spindles quickly.

The cog-wheel J^4 constitutes the last member of the train of mechanism for turning the spindles backward to cause them to back off from the yarn previous to winding. Its teeth engage with those of a cog-wheel, J^5, which is secured to a rock-shaft, m^6, and this shaft has a pulley-wheel, K^6, secured to it, upon which a band, j^4, is wound. One end of the band is secured to an arm, H', which projects from a rock-frame, W, that is arranged to rock upon the shaft m^7. This rock-frame is provided with a second arm, H^2, whose end projects within the range of a cam, G', secured to the shaft h, so that as the said shaft revolves the cam G', acting through the arms H^2 H', band j^4, pulley-wheel K^6, and cog-wheel J^5, imparts motion to the cog-wheel J^4, running on the shaft m of the drum A, which drives the spindles.

The cog-wheel J^4 is arranged to turn loosely upon the drum-shaft m, which is connected with and disconnected from the cog-wheel J^4 and the train of mechanism of which it forms part, in the following manner: One side of the cog-wheel J^4 is provided with a ring of clutch-teeth, w', and a clutch-slide, l^2, is fitted to slide upon the drum-shaft m toward and from the clutch-teeth, this slide being connected with a drum-shaft, so as to turn with it, by means of a feather upon the shaft sliding in a longitudinal groove in the hub of the slide. The slide is operated by a clutch-lever, S^2, which is pivoted to the frame of the machine, its upper end being forked to run in a groove formed in the clutch-slide, and its lower end projecting downward within the the range of a cam, v^4, secured to the adjacent side of the cog-wheel J. This cam is set in the proper position relatively to the cam G to act upon the clutch-lever and engage the tooth of the clutch-slide with the clutch-teeth upon the cog-wheel J at the time backing off is to commence, and a spring-latch, Q^3, is provided

to hold the clutch-lever in the position in which it is placed by the cam. The reverse movement of the spindles, or backing off, then continues until a second cam, v^5, also secured to the wheel J, moves the clutch-lever in the direction required to disengage the clutch-slide from the clutch-teeth of the cog-wheel, and leaves it held by the spring-latch Q^3 in its disengaged position. The second cam, v^5, is of course set in such a position relatively to the cam v as to effect the disengagement and stop the backing off before the winding of the yarn is commenced.

In order that the yarns may be shifted from the ends of the spindles to the cops during winding, and may be extended to the ends of the spindles during twisting, a special wire faller, k, is provided for each row of spindles of the machine. Each faller is stretched between and supported by arms h' h', which projects from a rock-shaft, m^8. The two rock-shafts of the two rows of spindles are connected so as to operate simultaneously by means of a band, j^6, whose ends are wound upon and secured to two pulleys, J^8 J^{11}, made fast to the faller rock-shafts m^8 m^8, and, as the faller and backing-off mechanism should operate at the same time, the faller is connected with and operated by the train of backing-off mechanism terminating in the cog-wheel J^4. The connection is made by means of a band, j^5, whose ends are wound upon and secured to two pulley-wheels, K^8 K^7, the one secured to the rock-shaft of one of the fallers and the other secured to the rock-shaft m^6, so that when the latter is moved, as before described, by the action of the cam G′ upon the arm H^2, the faller is raised to shift the yarns from the ends of the spindles to the cops. When, on the other hand, the cam G′ passes by the arm H^2, the faller is rocked downward to shift the yarns to the ends of the spindles by a spring, z', operating upon the hub of the pulley J^{11} of one of the faller rock-shafts m^8, and the return movement of the train of backing-off mechanism is effected by means of a spring, z^4, operating upon a pulley, J^9, secured to the shaft m^6.

As the position of the conical ends of the cops of yarn on the spindles is gradually changed from their butts toward their points by the progressive accumulation of yarn, the range of motion of the faller and the amount of backing off performed by the spindles must be correspondingly varied. In order that this may be done automatically, the arm H^2 is not fixed to the rock-frame W, but is constructed to move along it, and the part d^2 of the frame, which forms the support on which the arm rests, is inclined to the axis on which the frame rocks, so that as the arm H^2 is moved along the support d^2 from right to left its end is progressively lowered or moved farther from the axis of the cam G′. Hence the cam moves it a less distance, and consequently the movement of the faller and the backing off are progressively lessened. In order that the cam may commence to act upon the arm H^2 at the proper time, notwithstanding this change in the position of the end of the arm, the cam is skewed longitudinally so that its forward face is more advanced as the end of the arm H^2 is farther withdrawn from its axis. The movement of the arm H^2 along its support on the rock-frame W is effected automatically by means of a screw, B^2, turning in a section of a nut, C^2, secured to a slide, D^2, which traverses on a guide-rod, g^2, and is connected with the arm H^2 by two pins, h^4. The head of the screw passes through the adjacent frame of the machine and is fitted with collars, which prevent it from moving endwise. It also projects beyond the frame, and its projecting end is fitted with a ratchet-wheel, J^{12}, which is acted upon by a reciprocating finger, f^2. This finger is pivoted to the upper arm of a bell-crank, f^3, which is arranged to oscillate upon the projecting head of the screw. The horizontal arm of the bell-crank has a hanger pivoted to it, whose end is forked to embrace an eccentric, i^2, secured to the shaft m^2, so that every revolution of this shaft moves the bell-crank and causes its finger to push round the screw the amount of one tooth of the ratchet-wheel J^{12}. The return movement of the finger f^2, as the eccentric revolves, is effected by the weight of the hanger, and the distance to which the finger can move is limited by an adjustable stop, f^4, secured to the frame of the machine.

When the cops have been fully formed and removed the winding will be recommenced upon the butts of the spindles, and therefore the arm H^2 must be shifted back to the end of the cam G′, from which it was moved by the screw B^2. In order to facilitate this shifting, the nut C^2 is a section of a circular nut, and has a shank which is pivoted to a pair of cheeks, r^4, projecting from the slide D^2, so that it can be turned out of engagement with the thread of the screw B^2, to permit the slide and arm H^2 to be moved by hand. When the arm has thus been moved to its proper position for commencing winding at the butts of the spindles, the section-nut C^2 is re-engaged with the screw, and is held there by a pin, x, inserted through holes in the cheeks and the body of the section-nut.

Counter-fallers have not been applied to the machine represented in the drawings, but if required one may be applied for each row of spindles, in the manner described in my preceding patent of May 2, 1865, care being taken that it is not permitted to interfere with the regulating-wire.

The teeth of some of the cog-wheels of the machine represented in the accompanying drawings are drawn of larger proportionate sizes than they would be in a working machine, as the dimensions of the drawings are so small that it would be difficult to represent the cog-teeth of their proper relative sizes. This difference, however, is not a matter of importance,

as the dimensions of the cog-teeth of the gearing of jacks and mules are well understood by the builders of machines.

The relative speeds of the spindles during the delivery of rovings, stretching, spinning, backing off, and winding may be the same as the speeds of the spindles in the horizontal jacks and mules, and, as these are well known to builders of such machines, it is not deemed necessary to state them.

The carriage-cam G is of such form that it causes the carriages C C to rise at the speed at which the carriage of a horizontal jack or mule is withdrawn from the jaws when the rovings are delivered and stretched. The cam is also of such form that, after the stretching is completed by the rise of the carriage to its highest point, the carriage is permitted to descend slowly during the continued twisting of the yarns, to compensate their shortening by twisting preliminary to backing off and winding. The cam is also so formed that the carriage is permitted to descend during the winding with the proper speed, which may be the same as that at which the carriage of a horizontal jack or mule is moved toward the jaws during winding.

The machine thus described is an upright jack suited to the spinning of woolen yarns from continuous rovings produced by carding machinery and wound upon long bobbins or spools. An upright mule for extending rovings by drawing-rollers previous to stretching and twisting them may be constructed according to the aforesaid invention by mounting the successive pairs of drawing-rollers, together with the gearing for imparting to them the requisite speeds, upon the rising and falling carriages. In this case the rovings delivered from the bobbins or spools will be drawn by the successive action of rollers before being delivered for stretching and twisting, and the last pair of drawing-rollers may act as the jaws whence the rovings pass to the spindles.

Having thus described a machine which embodies all parts of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, in a spinning-machine, of the following instrumentalities, viz: the carriage and jaws for the rovings and the stationary turning-spool support, substantially as set forth.

2. The combination, in a spinning-machine, of the following instrumentalities, viz: the stationary jaws, stationary turning-spool support, traveling jaws, and carriage, substantially as set forth.

3. The combination, in a spindle-machine, of the following instrumentalities, viz: the traveling carriage, the shaft thereof, and ropes for turning the said shaft, substantially as set forth.

4. The combination, in a spinning-machine, of the following instrumentalities, viz: the drum for imparting motion to the spindles, pulleys, endless rope, tightening-pulley, and adjustable weight, substantially as set forth.

5. The combination, in a spinning-machine, of the following instrumentalities, viz: the drum for imparting motion to the spindles, pulleys, endless rope, tightening-pulley, adjustable weight, and second tightening-pulley, substantially as set forth.

6. The combination, in a spinning-machine, of the following instrumentalities, viz: the regulating-wire, friction-brake, and drum for imparting motion to the spindles, substantially as set forth.

7. The combination, in a spinning-machine, of the following instrumentalities, viz: the drum for imparting motion to the spindles, pulleys, endless belt, tightening-pulley, and cams, substantially as set forth.

8. The combination, in a spinning-machine, of the following instrumentalities, viz: the drum for imparting motion to the spindles, friction-brake, and cam, substantially as set forth.

9. The combination, in a spinning-machine, of the following instrumentalities, viz: the arm of the backing-off mechanism, shifting-screw, and section-nut, substantially as set forth.

In witness whereof I have hereunto set my hand this 14th day of September, 1865.

JOHN GOULDING.

Witnesses:

F. A. MAKEPEACE,

J. HENRY HILL.