4 Sheets--Sheet 1.

E. WRIGHT.

Self-Acting Spinning-Mules.

No. 148,397. Patented March 10, 1874.

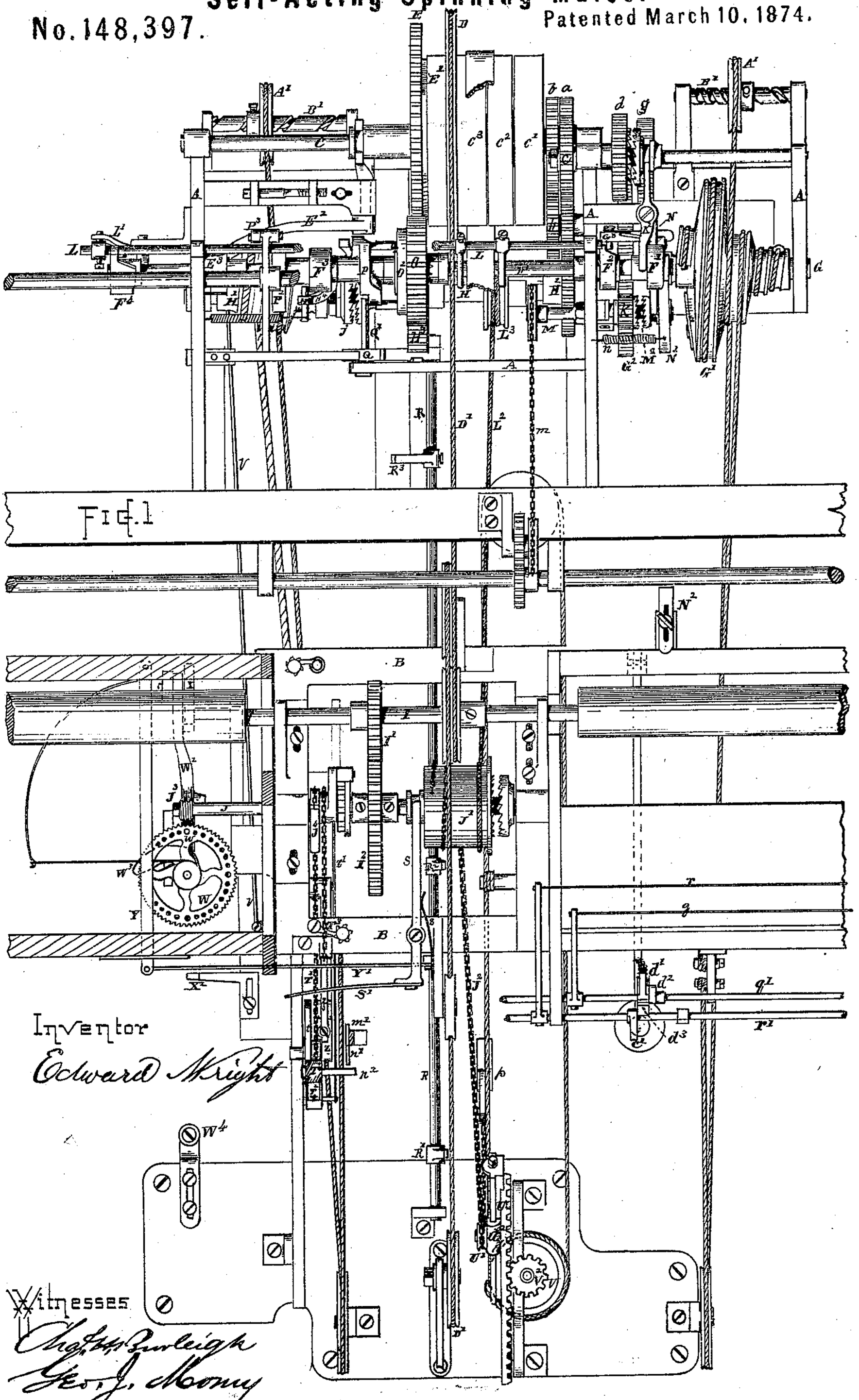

FIG. 1

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4 Sheets--Sheet 2.

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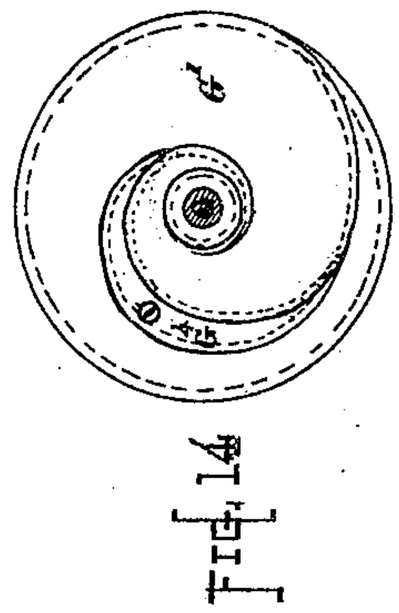

FIG. 14

FIG. 2

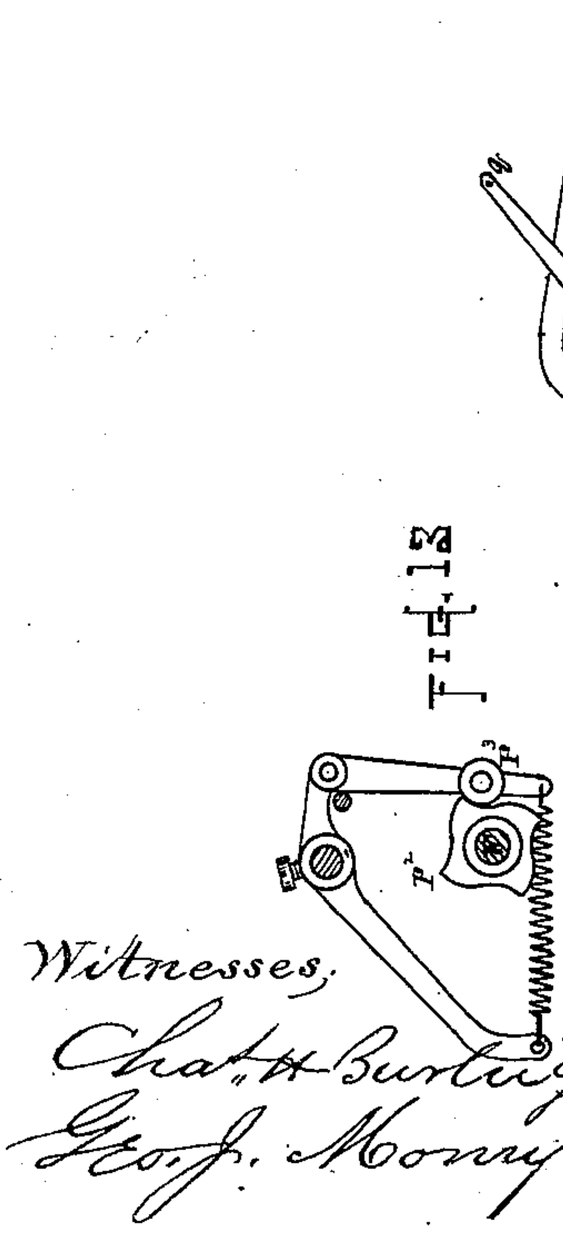

FIG. 13

Witnesses,
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Geo. J. Mooney

Inventor;
Edward Wright

4 Sheets--Sheet 3.

E. WRIGHT.

Self-Acting Spinning-Mules.

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FIG. 3

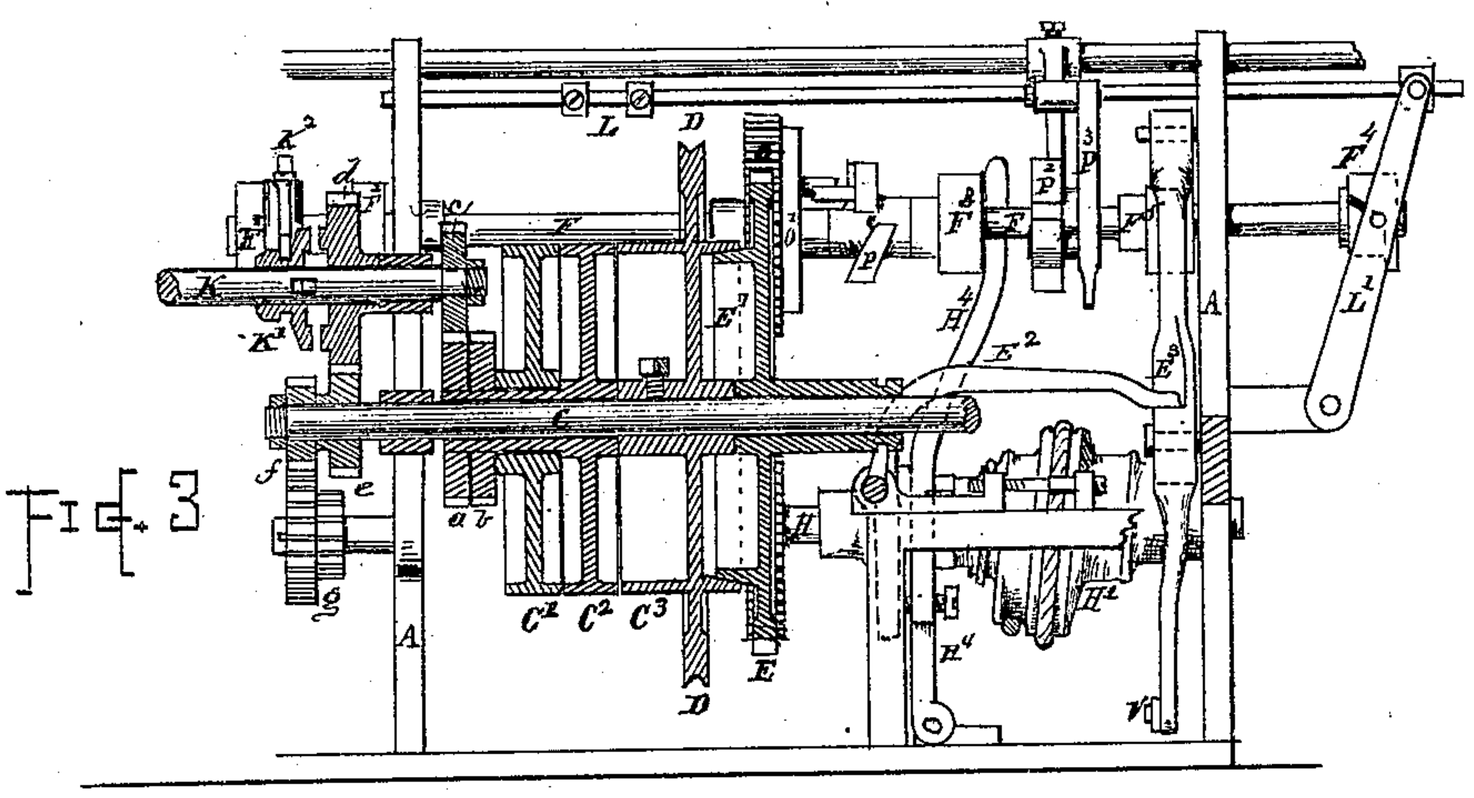


FIG. 4

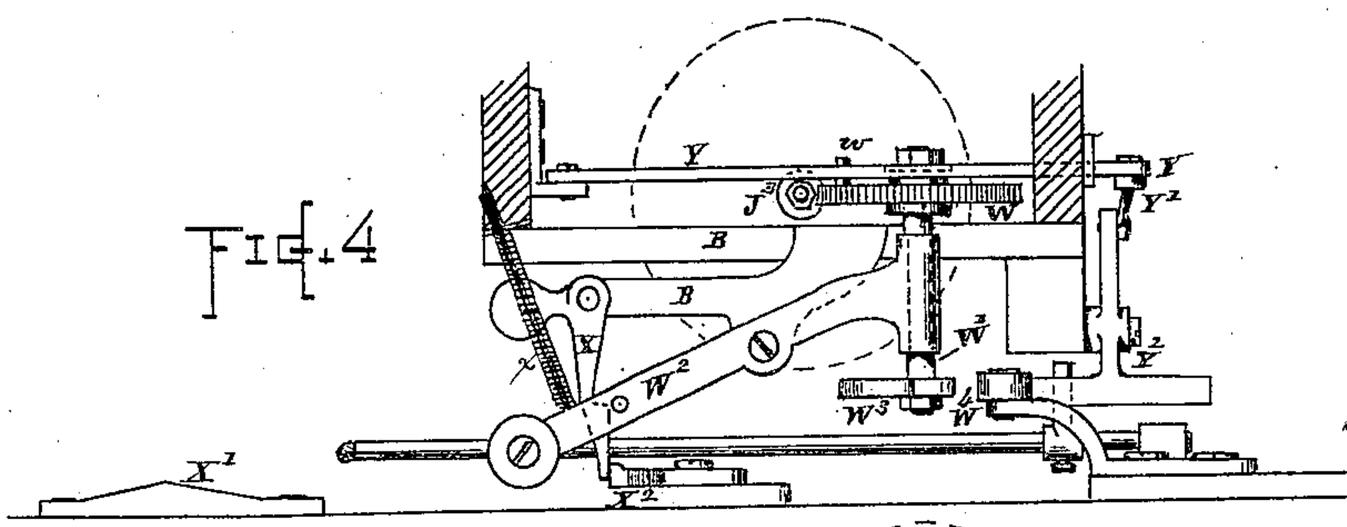


FIG. 5

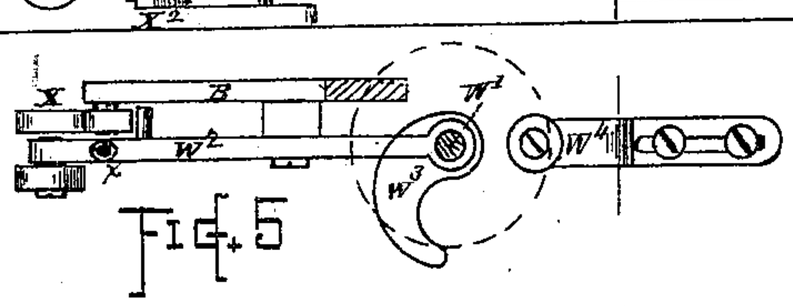


FIG. 7

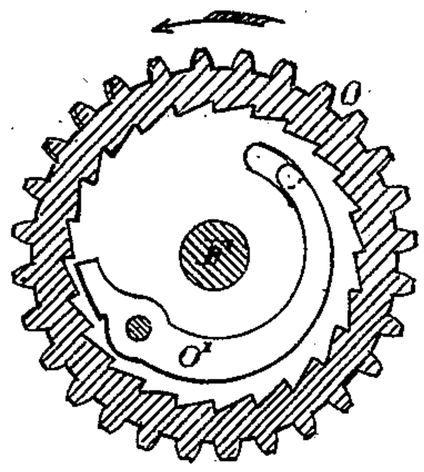


FIG. 8

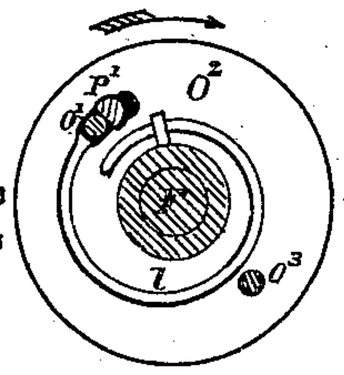


FIG. 9

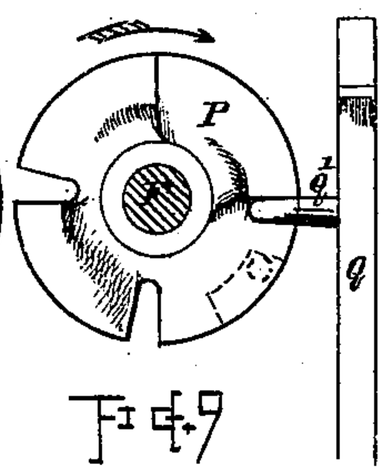
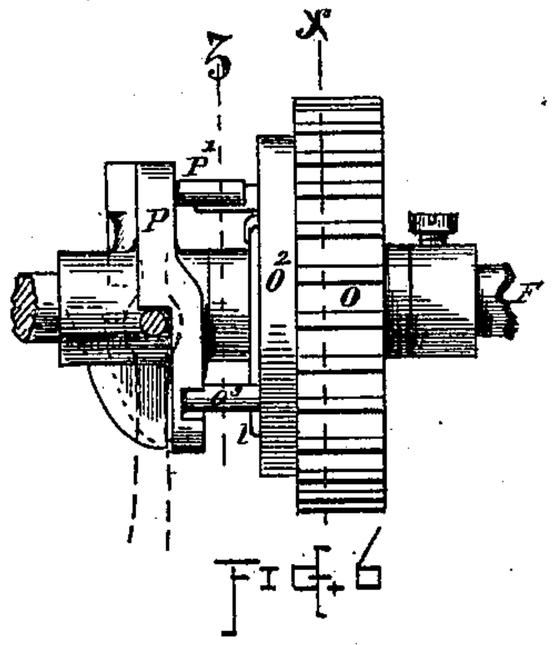


FIG. 6



Witnesses

Chas. Burleigh

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Edward Wright

4 Sheets--Sheet 4.

E. WRIGHT.

Self-Acting Spinning-Mules.

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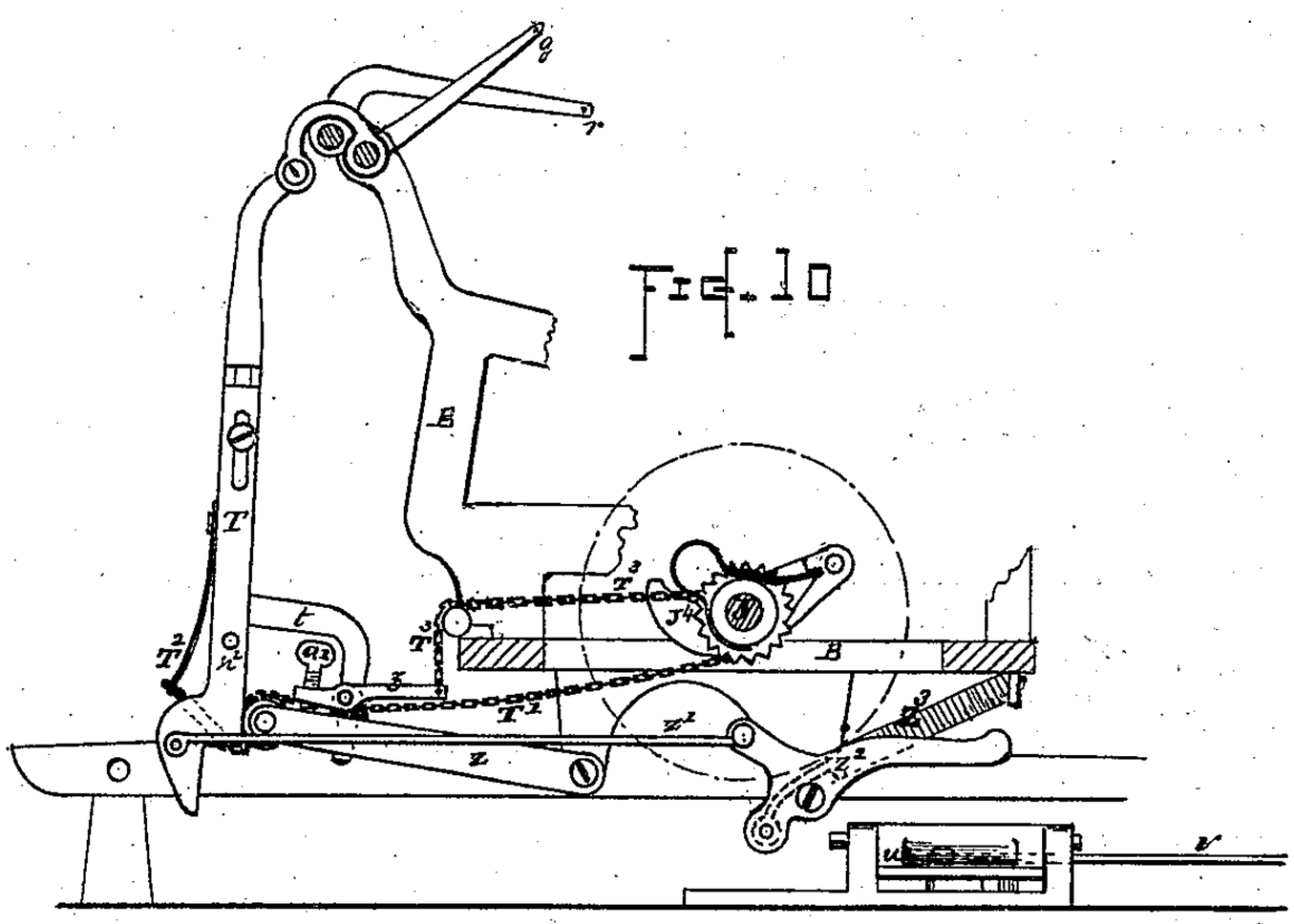

Fig. 10

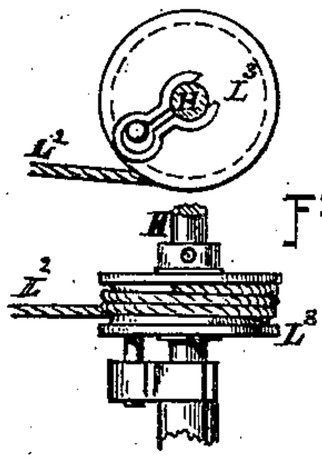

Fig. 12

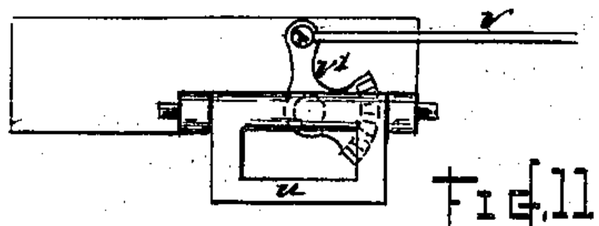

Fig. 11

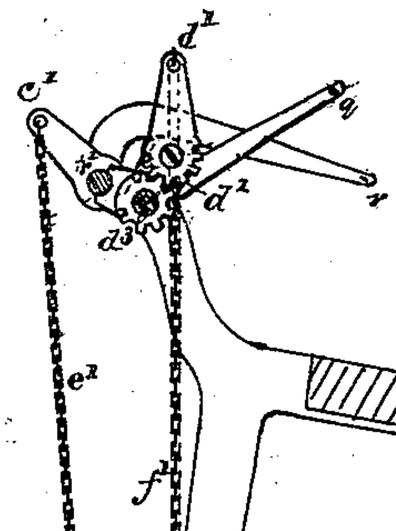

Fig. 15

Witnesses

Chas. H. Burleigh

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Inventor

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UNITED STATES PATENT OFFICE.

EDWARD WRIGHT, OF WORCESTER, MASSACHUSETTS, ASSIGNOR TO RODNEY A. M. JOHNSON AND JOSEPH M. BASSETT, OF SAME PLACE.

IMPROVEMENT IN SELF-ACTING SPINNING-MULES.

Specification forming part of Letters Patent No. **148,397**, dated March 10, 1874; application filed December 11, 1873.

To all whom it may concern:

Be it known that I, EDWARD WRIGHT, of the city and county of Worcester, and Commonwealth of Massachusetts, have invented certain new and useful Improvements in Self-Acting Mules for Spinning; 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 which form a part of this specification, and in which—

Figure 1 represents a plan view of the central or working portion of my improved self-acting mule. (Some portions are shown in the drawing as in section, and others as broken away, to more fully reveal the parts beneath.) Fig. 2 represents a side view of the working mechanism of the mule. Fig. 3 represents a central longitudinal section through the driving-pulleys and speed-accelerating gears, showing a rear view of the cam-shaft and some other portions of the mechanism. Fig. 4 represents a side view of the twist-wheel mechanism. Fig. 5 represents a plan view of the easing-off cam and some parts of the twist-wheel mechanism. Figs. 6, 7, 8, and 9 represent, on a somewhat larger scale, detail views of the cam-shaft escapement mechanism, Figs. 7 and 8 being sectional views taken, respectively, at lines *x* and *z* of Fig. 6, and Fig. 9 a side view of the escape-wheel. Fig. 10 represents a detail view of the faller-locking mechanism and back-off regulating device. Fig. 11 shows a plan view of the pedal device for working the rod, which acts upon and stops the operation of the backing-off mechanism. Fig. 12 represents a side and plan view of the pulley and friction device for turning the winding-drum and taking up the slack of the quadrant-chain. Fig. 13 represents a side view of the star-wheel and pressure-arm for holding the cam-shaft from backward movement. Fig. 14 represents a side view of the draft-scroll, showing the auxiliary section or extension secured in position thereon. Fig. 15 represents a side view of the faller-rod weight-fingers.

The object of my present invention is the improvement of the self-acting mule or spinning-machine, with a view to render said machine more rapid and efficient in its operation than those heretofore in use, and capable of nicer and more accurate adjustment of parts to the particular requirements of the stock to be worked, so that the machine will give more satisfactory and uniform results with stocks of different grades. Also, to provide a machine of less complicated construction, and one capable of being operated by persons having but little experience.

The first part of my invention relates to the combination, with the cam-shaft and the mechanism for moving the roving-rolls, of peculiarly-constructed clutch-operating levers and an adjustable tripping-lug for throwing the end of the levers from their cam, as hereinafter fully described.

The second part of my invention relates to the manner of arranging the cam-shaft of the mule-head, in relation to the main shaft and the backing-off devices thereon, that the gear by which the cam-shaft is operated will mesh directly with the back-off gear on the main shaft without the introduction of intermediate gears, thus simplifying and compacting the mule-head mechanism.

The third part of my invention relates to the combination of a peculiar escapement-wheel with the cam-shaft, escape-lever, and rocker-rod, for stopping the movement of said shaft; and, also, to the mechanism employed with said escapement-wheel for locking said cam-shaft to its operating-gear when the positions of the cams are to be changed, and releasing the gear when the shaft and cams have accomplished the required change.

The fourth part of my invention relates to the combination, with the winding-shaft on the carriage, of the twist-wheel mechanism for regulating the amount of twist imparted to the yarn, together with the devices for setting the twist-wheel into and out of action, and for changing the movement of the carriage and backing-off mechanism.

The fifth part relates to the employment, with the winding-drum and its clutch, of an actuating-lever, having a spring-arm, operated for throwing the clutch into mesh by the faller-lock mechanism when the latter is drawn up onto the cop-builder arm, preparatory to running in the carriage, as hereinafter described.

The sixth part relates to the combination, with the faller-lock mechanism, of a relieving-

spring, for preventing shock to the parts when the faller-lock is drawn up onto the cop-builder arm by the faller locking-chain, as hereinafter described.

The seventh part relates to the combination, with the faller-locking scroll, of a regulating chain and lever, made adjustable by means of a thumb-screw, for governing and regulating the amount of backward movement imparted to the spindles when backing off, as hereinafter described.

The eighth part relates to the combination, with the shaft of the return-scroll, of a roll or pulley working on said shaft by friction, and provided with a cord extending to and attached to the winding-drum, for the purpose of winding the quadrant-chain upon said drum as the carriage moves out.

The ninth part relates to the combination, with the draft-scroll, of interchangeable auxiliary curved sections or extensions for increasing or changing the size and shape of said scroll when required, and thereby regulating the movement of the carriage to suit the requirements of the stock operated upon.

Other minor features of my invention will be readily understood from the detailed description of the construction and operation of the several parts of the machine.

In the drawings, the parts marked A represent the frame of the mule-head or stationary portion of the machine, and B indicates the frame of the carriage. C indicates the main driving-shaft, upon which are supported the pulleys C^1 C^2 C^3 for the driving-belt, together with the main rim D and backing-off gear E. F indicates the cam-shaft, upon which are placed the escapement-wheel and the several cams, by means of which the different portions of the machine are at the proper time thrown into and out of action, as will be more fully explained hereafter. G indicates the shaft of the draft-scroll G^1, for running the carriage B outward, and H denotes the shaft of the return-scroll H^1, whereby the carriage is drawn inward, said scrolls being connected with the carriage-frame B by means of chains or ropes in the usual manner. I denotes the cylinder-shaft of the carriage from which the spindles are operated. (The spindles and spindle-bands, being of ordinary and well-known construction, are not shown in the drawings.) Shaft I is operated by the rim-band D^1 from the main rim D. J indicates the winding-shaft; J^1, the winding-drum, arranged upon said shaft with a suitable connecting-clutch, and J^2, the winding or quadrant chain for operating the mechanism when the carriage moves inward, and winding the yarn upon the spindles or bobbins. The loose pulley C^1 is arranged to turn upon the hub of the winding-pulley C^2, and said winding-pulley C^2 is loose upon the main shaft C, while the driving-pulley C^3 and main rim D are rigidly secured to and turn with the shaft C. (See Fig. 3.) The hub of the winding-pulley C^2 extends through and beyond the hub of the pulley C^1, and has firmly keyed to its end two gears, *a* *b*, one of which gears, *a*, meshes with and operates a smaller gear or pinion, *c*, fixed to the end of a counter-shaft, K, arranged, in this instance, parallel with the main shaft C, as indicated. Said counter-shaft K has a loose gear, *d*, that meshes with a pinion, *e*, keyed to the driving-shaft C. The gear *d* is joined for action to the counter-shaft K by means of a clutch, K^1, called the speed-clutch, which clutch is operated by a lever, K^2, working on the inner side of the double cam F^1 on the cam-shaft F. When the gear *d* is clutched with the counter-shaft K the winding-pulley C^2 serves as a driving-pulley, and the motion of the driving-belt on said pulley C^2 is transmitted to the main shaft C through the train of gears and pinions *a c d e*, consequently the speed of said main shaft with the main rim D and parts operated therefrom, is at such time accelerated or much greater than it is when the gear *d* is out of clutch, and the shaft and main rim D are operated directly by the driving-belt running on the pulley C^3, the amount of acceleration being proportional to the difference in size between the gears *a d* and the pinions *c e*. This accelerating mechanism is for the purpose of increasing the speed of the spindles after the roving has been run out and during the operation of twisting the yarn, thus increasing the working capacity of the mule. The gear *d* and pinion *e* are made interchangeable with others of different proportions, and by changing said gears the mechanism can be adapted to the requirements of the work, and the degree of acceleration of speed adjusted to suit the particular quality of stock to be operated upon.

The accelerating speed-gears and their counter-shaft may be arranged in different position from that shown, and bevel-gears can be used and the counter-shaft set at an angle to the main shaft, if desired, but I prefer the construction shown.

It will be observed that by constructing and arranging the accelerating mechanism substantially as herein set forth, viz., employing a counter-shaft and train of gears and pinions from one of the driving-belt pulleys to the shaft upon which said pulleys are supported, I obtain the accelerated movement of the spindles with the use of a single main rim and rim-band, and also with but a single driving-belt, which belt runs at a uniform speed. Also, that the mechanism is simple and compact, and can be readily adjusted to impart the proper degree of acceleration.

The shaft C is provided with a pinion, *f*, by means of which, in connection with suittable intermediate gears or pinions *g*, motion is transmitted to the gear G^2 on the shaft G of the outward draft-scroll G^1, and by means of the gear *b*, with proper intermediate gears and pinions *h*, motion is transmitted to the gear H^2 of the return scroll-shaft H. A gear, H^3, keyed to shaft H, meshes with and operates the backing-off gear E, which

latter is supported and turns loosely upon the main shaft C. The gear E is, while backing the spindles, connected for action to the main rim D by a friction-clutch, E^1, the friction-rim being moved into and out of clutch by the lever E^2 in connection with the vertical sliding lever E^3 and cam F^5 on the cam-shaft F. The outward draft-scroll G^1 is put into and out of action by means of a suitable clutch worked by a lever, G^3, from the cam F^2 on the cam-shaft F. The lever G^3 of the draft-scroll clutch and the lever K^2 of the speed-clutch are both held to their respective cams, and actuated to throw their respective clutches into mesh by the same spring *i*, which is made in shear form, and is strained from one of said levers to the other, so as to forward the ends of the levers and lock the clutches when the cams F^1 and F^2 are in such position that their depressed portions coincide with the bearing-points of the levers, and when the straight or raised portion of the cams act upon the levers the spring *i* is compressed, the clutches opened, and their teeth securely held apart during the time that the respective portions of the mechanism are out of action. The return-scroll H^1 is clutched to its shaft H for action by the clutch *j*, actuated by a lever, H^4, from the cam F^3 on the cam-shaft F; and the shipper L, by which the driving-belt is shifted on the several pulleys C^1 C^2 C^3, is actuated by the cam F^4 in connection with the lever L^1, suitable springs being employed with both levers for pressing them against the working sides of their cams. The lever H^4 of the scroll-clutch is held back by an arm from the lever E^2 of the backing-off mechanism, so that the scroll H^1 cannot commence action until the backing-off friction-cone E^1 is released. The chain *m* for operating the roving-rolls is arranged from the chain-wheel M, as indicated. This wheel M is fixed upon a short shaft, M^1, properly supported on the frame A, and provided with a small pinion, *k*, loose upon the shaft M^1, and meshing with the gear G^2 of the draft-scroll. A suitable clutch, M^2, is arranged upon the shaft M^1 for locking the gear and shaft to each other for action to set the roving-rolls in motion at the proper time for running off the desired length of roving for a stretch. The clutch M^2 is thrown in and out by a swinging arm or lever, N, having a curved lever, N^1, attached to its side, as shown, said arm and lever being actuated by the outer side of the double cam F^1 of the cam-shaft, and also by the lug N^2 on the rear side of the carriage B and spring *n*, strained between the lever N^1 and frame A. The swinging arm N is pivoted at its rear end to a projecting portion of the frame A, while its forward forked end fits into the groove around the hub of the clutch M^2, so that any movement of the arm N will impart a corresponding movement to the clutch. The lever N^1 is pivoted to the side of the arm N, and its forward end is formed quite heavy, or weighted, so that its preponderance will tend to hold it at its lowest position, except when raised by the lug N^2. The lever is provided with a pin or stop-lug, which rests upon the arm N and prevents its end from falling too low. The lever N^1 also has a small projection or heel, which runs against the cam F^1 and receives the motion imparted by said cam when in operation. The side of the cam is so formed that the teeth of the clutch M^2 will be held out of mesh, except for a short space where the cam is cut away, and at which space the cam permits the spring *n* to swing the arm N inward and lock the clutch-teeth, causing the roving-rolls to operate. The position of the depressed part of the cam F^1 is so adjusted that in the operation of the machine, the cam-stops, with the projection or heel of the lever N^1 quite near the shoulder or depressed portion of the cam, so that by any further movement of the cam, or by raising the forward end of the lever N^1, the heel of the lever will be freed from the raised part of the cam and the clutch M^2 locked by the force of the spring *n*.

It will thus be seen that, with this arrangement of parts, the roving-rolls can be set into action either by the revolution of the cam-shaft F or by raising the forward end of the lever N^1 by means of the lug N^2 on the rear of the carriage. When by the latter, the roving-rolls commence to turn before the carriage starts to run out, thereby slackening the roving, so that there will be no liability of breaking the strands by the movement of the carriage as it starts. This greatly facilitates the operation of spinning very short stock. The lug N^2 is made adjustable with a suitable thumb-screw, so that the parts can be adjusted to run off or slack the roving to a greater or less extent in advance of the carriage movement, thus adapting the mechanism to the particular quality of stock used. The cam-shaft F is operated by a gear, O, which meshes directly with and receives its motion from the backing-off gear E. Said cam-shaft F is regulated in its changes by a peculiarly-constructed escapement mechanism, and is governed by the rocker-rod R and escape-lever Q, the rocker-rod R being actuated by different portions of the carriage mechanism acting upon the fingers R^1 R^2 R^3 at the proper intervals, and the lever Q being moved by said rod R in the usual manner. The gear O and escapement-wheel P are shown in detail by Figs. 6, 7, 8, and 9 of the drawings. The gear O is loose upon the shaft F, being held in position by suitable collars. Said gear O is formed hollow, and is provided with a series of ratchet-teeth on its inner rim, (see Fig. 7,) while within said gear works a curved pawl, O^1, which is pivoted to a plate or disk, O^2, arranged at the side of the gear and firmly keyed to the shaft F. The tail of the curved pawl O^1 is made to project through a slot in the plate O^2, and a spring, *l*, is arranged at the outer side of said plate, to press forward the tail of the pawl and cause its head to engage with the ratchet-teeth on the interior of the gear-rim. The tail of the pawl also engages with a pin or lug, P^1, fixed on the side of the escapement-wheel P, which lug or pin acts upon the pawl in opposition to

the spring *l*. The escapement-wheel P is loose on the shaft F, and is held from revolving thereon by two lugs or shoulders, which embrace a stud or projection, O^3, on the side of the disk O^2, in such a manner that the wheel P will be allowed a limited rotary movement independent of the shaft F, said movement being just sufficient to permit the tail of the pawl O^1 to move back and forth in the slot of the disk O^2. The wheel P is made with four lateral offsets or shoulders at its circumference, to engage the pin Q^1 of the escape-lever Q, which pin has a lateral movement when the lever Q is moved by the rocker-rod R. A star-wheel, P^2, is arranged upon the cam-shaft F, and a spring-arm, P^3, having a roll at its end, is arranged for pressing against said wheel P^2 in such a manner as to prevent any backward movement of shaft F, thus obviating the liability of said shaft being turned back by the pressure of the spring *l* or any vibration of the pawl O^1. The operation of the cam-shaft is governed by the rocker-rod R when the latter is oscillated by the action of the carriage mechanism upon its various fingers, and is substantially as follows: The lever Q swings the pin Q^1 from in front of the shoulder or notch of the escape-wheel P, which latter, being thereby released, is thrown forward by the pressure of the spring *l* acting against the tail of the pawl O^1 and pin P^1. The pawl O^1 is caused by such movement to engage with the teeth of the ratchet within the gear O, and said gear O revolves the cam-shaft F until the next succeeding stop-notch of the escapement-wheel P strikes the pin Q^1 of the escape-lever, when the tail of the pawl O^1 is pressed back by the pin P^1 and the head of said pawl disengaged from the ratchet, thus preventing further movement of the shaft F until the escape-lever Q is again moved to release the wheel P. The limited movement of the escape-wheel on the shaft F is sufficient to impart to the tail of the pawl a sudden shock when its movement is checked by the pin O^1, so as to overcome the friction caused by the pressure of the head of the pawl against the ratchet-tooth, and thereby insure its perfect action. The escape-mechanism is arranged for moving the shaft F a quarter revolution at each change, and, as the changes occur, the different cams upon the shaft act to set in motion, at the proper time, the several portions of the mule mechanism.

The winding-shaft J of the carriage is connected for operation with the cylinder-shaft I, by means of gears I^1 and I^2. The winding-drum J^1 is provided with a suitable clutch for locking it to the shaft J, and said parts are operated by means of a lever, S, pivoted on the frame B and having a spring-arm, S^1, arranged at its end to be acted upon by a projection or bow-shaped arm, *t*, on the faller-lock T, which projection strikes the spring-arm S^1 and throws the winding-drum clutch into mesh as the faller-lock T moves up onto the roll of the cop-builder arm preparatory to running in the carriage. In the present instance the drum J^1 is arranged to slide on the shaft J with the movement of the lever S, one-half of the clutch being formed on the end of the drum and the other half keyed to the shaft, as indicated. This construction obviates the necessity of using splines, which are liable to become worn and loose, after a little use, by the constant wear of the sliding parts. The clutch-teeth are unlocked when the pressure is removed from the spring-arm S^1 by means of a spring, *s*, which acts against the side of the lever S.

The quadrant-chain or winding-chain J^2 has one of its ends attached to the drum J^1, and from thence it extends to the arm of the quadrant U, where it passes around a small roll or pulley, U^1, attached to nut U^2 of the quadrant-arm screw, while its opposite end is secured to a chain-stay, *p*, fixed to the floor or bed, as indicated. The chain-stay *p* is so made that the end of the chain can be secured at different positions, at a greater or less height from the floor, and the length of the chain J^2 thereby adjusted. By combining the pulley U^1 with the quadrant-arm and arranging the chain in the manner shown the quantity of chain taken up or let out by a given movement of the quadrant-arm will be about double that taken up or let out with the parts of ordinary construction, and consequently the quadrant can be made smaller, and will occupy less space.

The quadrant is operated by a cord from the carriage-frame, working around a pulley, V, keyed directly to the lower end of the vertical shaft V^1, with no intermediate mechanism, and the shaft V^1 moves the arm by a gear, V^2, at its upper extremity, as indicated. The chain J^2 is wound upon the drum J^1, while the carriage moves out by means of a cord, L^2, extending from said drum to a roll or pulley, L^3, supported upon the shaft H, the pulley L^3 being provided with a friction device, which, working on said shaft H, imparts to said pulley sufficient force to wind the chain, but permits the pulley to slip on the shaft when the slack has been taken up and the chain drawn taut. This device is simple in its construction, operates with facility, and can be adjusted to draw upon the chain with greater or less force by increasing or diminishing the friction. W indicates the twist-wheel, which I arrange beneath the carriage, as shown. Said wheel W is supported in a horizontal position, and is fixed to the upper end of a short upright shaft, W^1, working in a bearing at the end of a lever, W^2, which latter is pivoted to a projecting portion of the frame B, in such manner as to permit a limited upward and downward movement of the ends of the lever, sufficient to move the teeth of the twist-wheel W into and out of mesh with the worm-screw J^3 on the end of the winding-shaft J, and by means of which the twist-wheel W is revolved. A latch-piece, X is arranged for holding up the rear end of the lever W^2 during the time the carriage is running in and out. Said latch X is pivoted to the frame B, and is weighted, so that its lower end will swing forward and lock onto a

pin or lug at the side of the lever W^2, when the lever is raised by the wheel at its lower end passing over the inclined block X^1 as the carriage runs inward. The latch X is thrown off from the pin to release the lever W^2, and set the twist-wheel into action, by means of an adjustable lug, X^2, secured to the floor or bed of the machine, and a suitable spring, *x*, is combined with lever W^2 to insure the quick and sure movement of the parts, and to hold the wheel W up to its working screw or worm J^3. The rim of the twist-wheel W is perforated with a series of holes, in one of which the index-pin *w* is placed. This pin *w* strikes the arm Y as the wheel revolves, and, by pressing back said arm, operates the devices, by which the twisting is stopped and the backing-off mechanism set in motion. A cam, W^3, is fitted to the lower end of the twist-wheel shaft W^1. This cam runs against a friction-wheel on a suitable bearing-piece or stud, W^4, and thereby causes the carriage to move slowly inward, to compensate for the shortening of the yarn as it become twisted. The bearing-piece W^4 is secured to the floor or bed of the machine, and is made adjustable. The cam W^3 is made interchangeable with others of different form or size, and by these changes and adjustments the slow inward movement of the carriage is accurately regulated to the requirement of the work. The twist-wheel W is provided with a cord and spring by which it is revolved back to its original position after the pin *w* has pressed back the arm Y, and its teeth have been thrown out gear with its operating-screw J^3. The amount of twist to which the yarn is subjected is regulated and governed by the position of the index-pin *w* in the rim of the wheel W. The arm Y is connected by a rod, Y^1, to an upright lever, Y^2, which swings against the finger R^1 of the rocker-rod R, and thereby actuates the escapement-lever Q, and permits the cam-shaft F to revolve, at which movement the cam F^4 causes the partial shipment of the driving-belt to the pulley C^1, so that it will bear but slightly upon pulley C^2, and will slip upon said pulley C^2 should any accident occur to impede the progress of the carriage as it moves inward when winding the yarn. At the same time the cam F^5 raises the vertical slide-lever E^3, and this in turn, acting upon the lever E^2, forces in the friction-clutch E^1, and by thus locking the gear E to the main rim D sets the backing-off mechanism in operation. The backward movement of the winding-shaft J causes the faller-locking chain T^1 to be wound upon the scroll J^4, (see Fig. 10,) and the faller-lock T is thereby drawn up onto the roll of the cop-builder arm Z, to bring the fallers *q* and *r* into proper position for guiding the yarn while winding upon the spindles or bobbins. Motion is transmitted at the same time by the rod Z^1 to the tripping-finger Z^2, and said finger is thrown down upon the pedal *u*, which latter in turn actuates the rod *v* to move the vertical slide-lever E^3 from the cam F^5, thereby relieving the friction-cone E^1 of the backing-off gear E, and stopping the backward movement of the spindles. The chain T^1 passes through an opening in the lower part of the faller-lock T, and is attached to the end of a spring, T^2, which is secured, at its upper end, to the outer side of the faller-lock, as shown. This spring T^2 relieves the chain T^1 from sudden shock when the lower end of the faller-lock strikes the cop-builder arm-roll, and the chain becomes taut, thus preventing liability of breaking said chain or the other parts of the mechanism. To throw the faller-lock off from the roll of the cop-builder arm Z I employ a swinging faller trip-arm, m^1, extending downward from the rod of the counter-faller to which its upper end is attached. At the side of the arm m^1 there is fitted an adjustable inclined piece, n^1, which engages with a pin or lug, n^2, on the side of the faller-lock T, and bears said faller-lock from the roll when the lower end of the tripper-arm m^1 is swung outward by striking against a lug or pin, m^2, secured to the floor as the carriage moves up to the head. The lug m^2 can be adjusted to throw the faller-lock from the roll at the desired instant, while, by the inclined piece n^1, I provide for the difference of time at which the fallers require to be released when winding the yarn at the lower and upper ends of the bobbins. I arrange a regulating-chain, T^3, from the hub of the faller-locking scroll J^4 to the cop-builder arm Z, one end of said chain being attached to the hub of the said scroll, while the other passes over a suitable guide, and is secured to the rear end of a small lever, *z*, pivoted on the cop-builder arm, as illustrated. The front end of said lever *z* is provided with a thumb-screw, a^1, by means of which the lever can be adjusted to lengthen or shorten the chain T^3, and thus regulate the extent of backward motion imparted to the spindles, by causing the scroll J^4 to commence its action on the chain T^1 at an earlier or later instant, when backing off. The tripping piece or finger Z^2 is made substantially in the form shown, and is provided with a spring, Z^3, strained from the carriage-frame to the heel of the tripper, to which its end is secured, the parts being relatively arranged in such manner that the spring will move past the fulcrum or pivot center when the tripper Z^2 is operated, and will hold the finger in both raised or depressed position, so that said spring Z^3 not only serves to retain the tripper raised, and to throw it forcibly down upon the pedal *u*, when required, but also through the rods acts upon the faller-lock T, and serves to bear its lower end away from the roll, and leave the cop-builder arm free when the faller-lock is down, while, when the faller-lock T is drawn up for winding, this spring Z^3 prevents it from sliding from the roll. The pedal *u* (see Fig. 11) rocks on a horizontal axis, and is furnished with gear-teeth which mesh with corresponding teeth on a bell-crank lever, v^1, to which the end of the rod *v* is connected, so that when the pedal *u* is pressed down by the tripper-finger Z^2 the

rod *v* will be drawn forward, which movement swings the vertical slide-lever E^3 from the cam F^5, and the latter operates the backing-off friction-cone in the manner before described. The cords or ropes which extend from the scrolls to the front part of the carriage are carried by scroll-rope guides arranged as shown. The guide consists of a pulley, A^1, working upon a screw-shaft in the manner somewhat similar to a nut, in the present instance, by means of a screw-pin in the hub of the pulley, which traverses in the thread or helical groove of the shaft B^1. The thread or helical groove is made variable or of irregular pitch to conform to the pitch of the scroll, so that the pulley will move along the shaft with a movement corresponding to the lateral movement of the rope running onto or off from the scroll, thereby keeping the relative position of the cord or rope at nearly a right angle to the axis of the scroll.

The guides may be made with the pulleys fixed to the shafts, and the screw-thread of said shaft arranged to work in the bearings, so that both pulleys and shafts will act to produce the required variable lateral movement; but I prefer the construction herein shown.

At the side of the draft-scroll G^1 I arrange an auxiliary section or extension piece, G^4, for continuing the rapid movement of the carriage, when required, to any portion of the stretch or outward run. The section G^4 is made with a flange to match the flange of the scroll, and its ends are beveled off or made thin to fit close to the surface of the scroll, and produce no practical irregularity at their junction with the scroll-face. The section G^4 is held to the side of the scroll by a screw or bolts readily accessible, so that it can conveniently be removed when required, and said section is made to be interchangeable with others of varying form and size, so that by using different sections or the plain scroll the movement of the carriage can be adapted to different grades or qualities of stock.

It will be observed that, by the use of the auxiliary sections for producing the variation of movement required for different qualities of stock I obviate the necessity of taking out the scroll-shaft and changing the entire scroll, as is the usual practice. Consequently the time and labor required for accomplishing the change are greatly reduced, as it requires from one to two hours to change the entire scroll; whereas the auxiliary sections can be changed in a few minutes.

In Fig. 15 are shown the faller-rod-weight fingers, which are arranged as follows: The tension-weights are supported upon an arm or lever, in the usual manner, and connected to the fingers c^1 d^1 by means of the chains e^1 f^1, as indicated. The weight-finger c^1 of the counter-faller *r* is of ordinary form, and is keyed to the rod r^1, while the finger d^1 of the winding-faller is pivoted to a short arm, d^2, and said arm is keyed to the rod q^1. A segment-gear is formed on the end of the finger d^1, which meshes with a corresponding segment-gear, d^3, supported on the rod q^1, and held from turning thereon by a lug, which engages with the rod r^1, or by some other suitable device. When the winding-faller *q* is operated by the faller-lock T the finger d^1 moves down with a quick movement and throws the entire weight upon the finger c^1, causing the counter-faller to act in taking up the slack of the yarn, and when the faller *q* is raised the finger d^1 supports the entire weight and permits the counter-faller *r* to drop down out of the way; and it will be observed that by the quick movement of the finger d^1 the weight is transferred to act upon the counter-faller *r* immediately as the winding-faller *q* commences to move, and is not relieved therefrom until the fallers have ceased to act upon the yarn; hence there is no delay in the operation of the counter-faller or irregularity of winding the yarn.

Having described my improved self-acting mule or spinning-machine, what I claim therein as new and of my invention, and desire to secure by Letters Patent, is—

1. The combination, with the winding-pulley C^2 and main shaft C, of the gears *a d*, pinions *c e*, counter-shaft K, clutch K^1, and clutch-operating lever K^2, for the purpose of increasing the speed of the spindles while twisting, substantially as set forth.

2. The combination, with the cam-shaft F, carriage-frame B, and clutch M^2, which locks for action the roving-roll mechanism, of the clutch-operating levers N N^1, cam F^1, and adjustable tripping-lug N^2, substantially as and for the purposes set forth.

3. The combination and relative arrangement in a mule-head of the cam-shaft F, the main shaft C, and the backing-off devices, whereby the cam-shaft gear O meshes directly with and is operated by the backing-off gear E of the main shaft, substantially as set forth.

4. The combination, with the cam-shaft F and escapement-lever Q of the escape-wheel P, constructed substantially as described, and having lateral offsets or shoulders at its circumference to engage the pin Q^1, substantially as set forth.

5. The combination, with the cam-shaft F and its operating gear O, provided with a series of ratchet-teeth, of the curved pawl O^1, disk O^2, escape-wheel P, and spring *l*, constructed and operating substantially as and for the purposes set forth.

6. The combination, with the winding-shaft J, of the worm-screw J^3, twist-wheel W, lever-support W^2, weighted latch X, inclined block X^1, and tripping-lug X^2, substantially as and for the purposes set forth.

7. The combination, with the twist-wheel W and rocker-rod R, of the arm Y, connecting-rod Y^1, and lever Y^2, substantially as and for the purposes set forth.

8. The combination, with the winding-drum J^1 and faller-lock T, of the lever S, spring-arm

S^1, and actuating-arm *t*, substantially as and for the purpose set forth.

9. The combination, with the faller-lock T, and its locking-chain T^1, of a relieving-spring, T^2, substantially as shown and described.

10. The combination, with the faller-locking scroll J^4, and cop-builder arm Z, of the regulating-chain T^3, adjusting-lever *z*, and thumb-screw a^1, substantially as and for the purpose set forth.

11. The combination, with the winding-drum J^1 and return scroll-shaft H, of the friction pulley or roll L^3, and rope L^2, for winding the quadrant-chain upon the drum, substantially as set forth.

12. The combination, with the draft-scroll G^1, of the auxiliary section or extension piece G^4, for changing the form of the scroll, substantially as set forth, and for the purpose stated.

13. The combination, with the winding-faller rod q^1 and weight-chain f^1, of the geared finger d^1, pivoted to the arm d^1, and stationary gear-segment, d^3, substantially as and for the purpose set forth.

14. The combination, with the faller-lock T, of the rod Z^1, tripping-finger Z^2, and spring Z^3, arranged to move past the pivot-center, and to hold the parts in either raised or depressed position, substantially as set forth.

15. The combination, with the faller-lock T, of the faller trip-arm m^1, inclined adjusting-piece n^1, and pin n^2, substantially as shown and described.

EDWARD WRIGHT.

Witnesses:
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