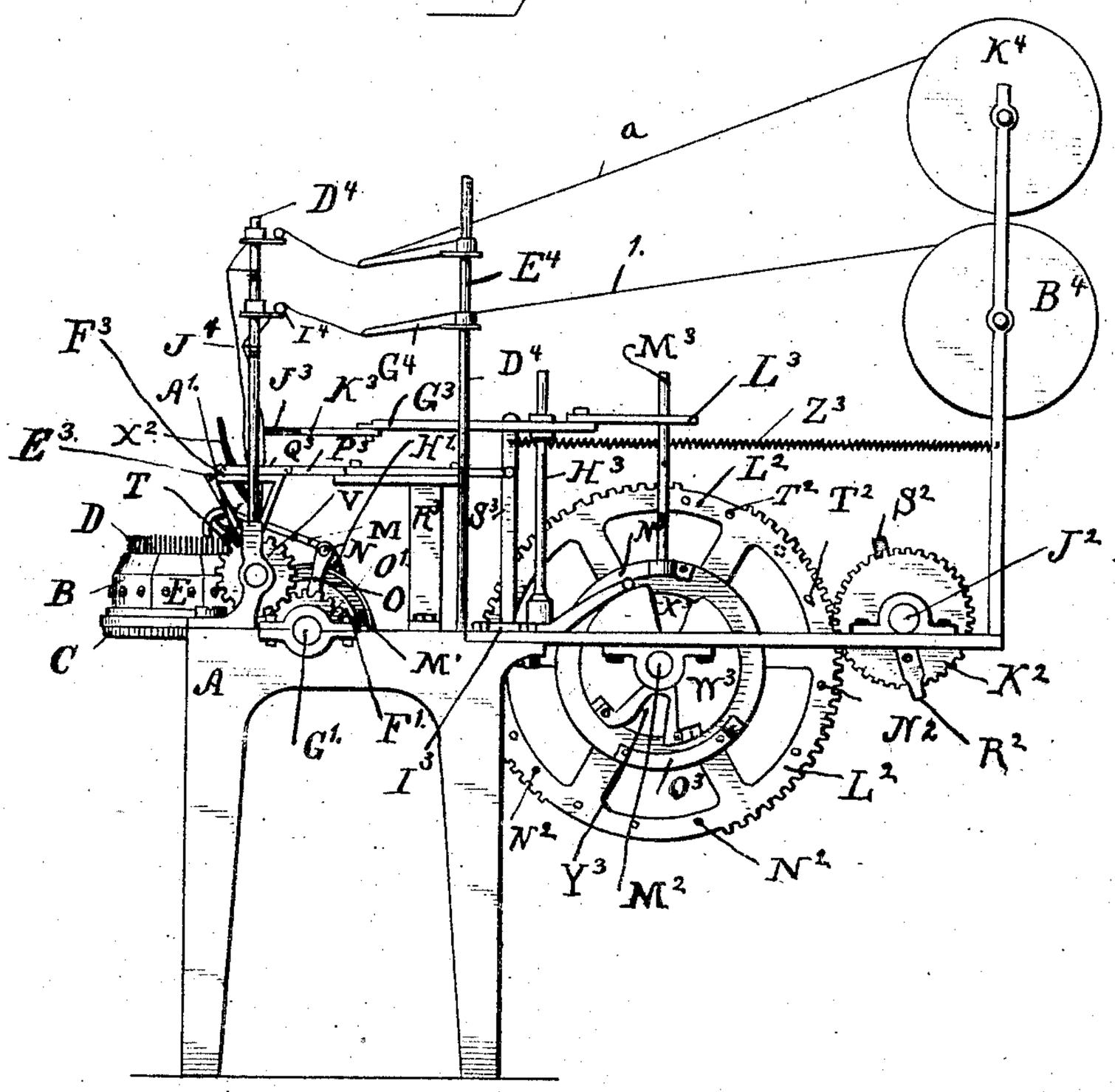
(No Model.) 19 Sheets—Sheet 1.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

Fig. 1.



WITNESSES:

John Dolley Jr

F. N. Dixon.

John Adams

INVENTOR

By his Attorneys

W. C. Strawbridge

Donald Taylor

(No Model.)

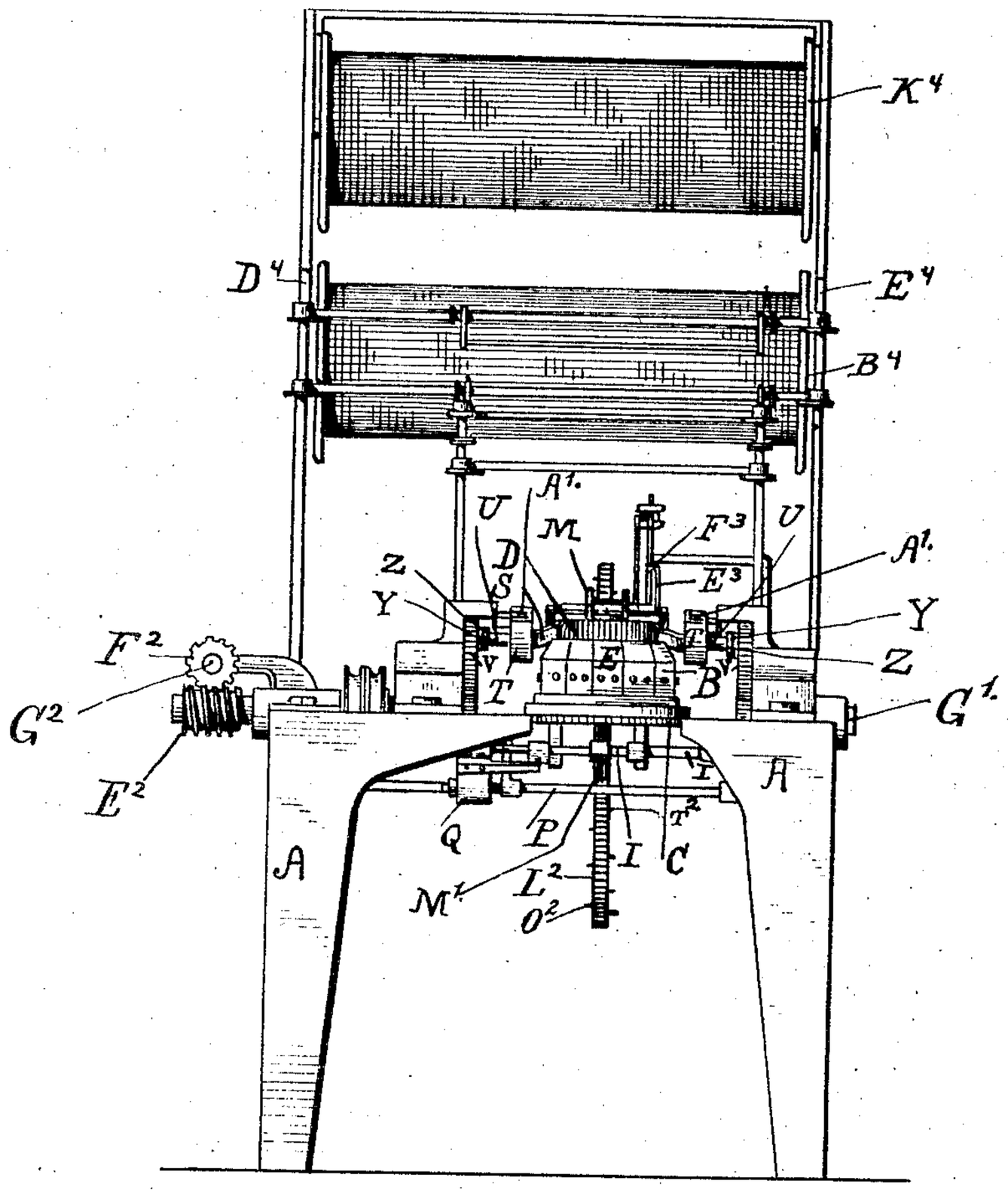
19 Sheets—Sheet 2.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

Fig. 2.



WITNESSES:

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W. C. Crawford &

Bonsall Taylor

(No Model.)

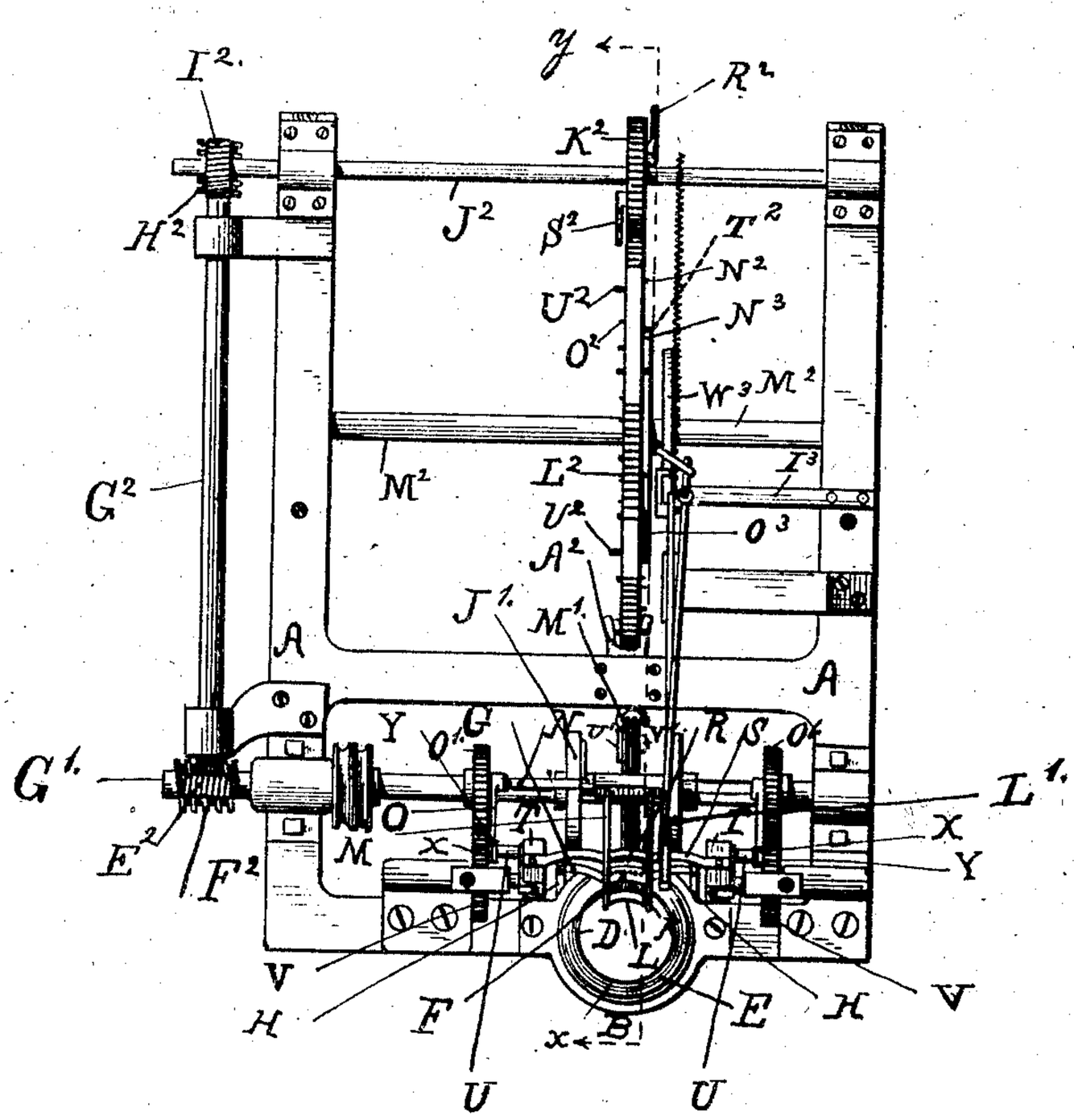
19 Sheets—Sheet 3.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

Fig. 3.



WITNESSES:

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Donald Taylor

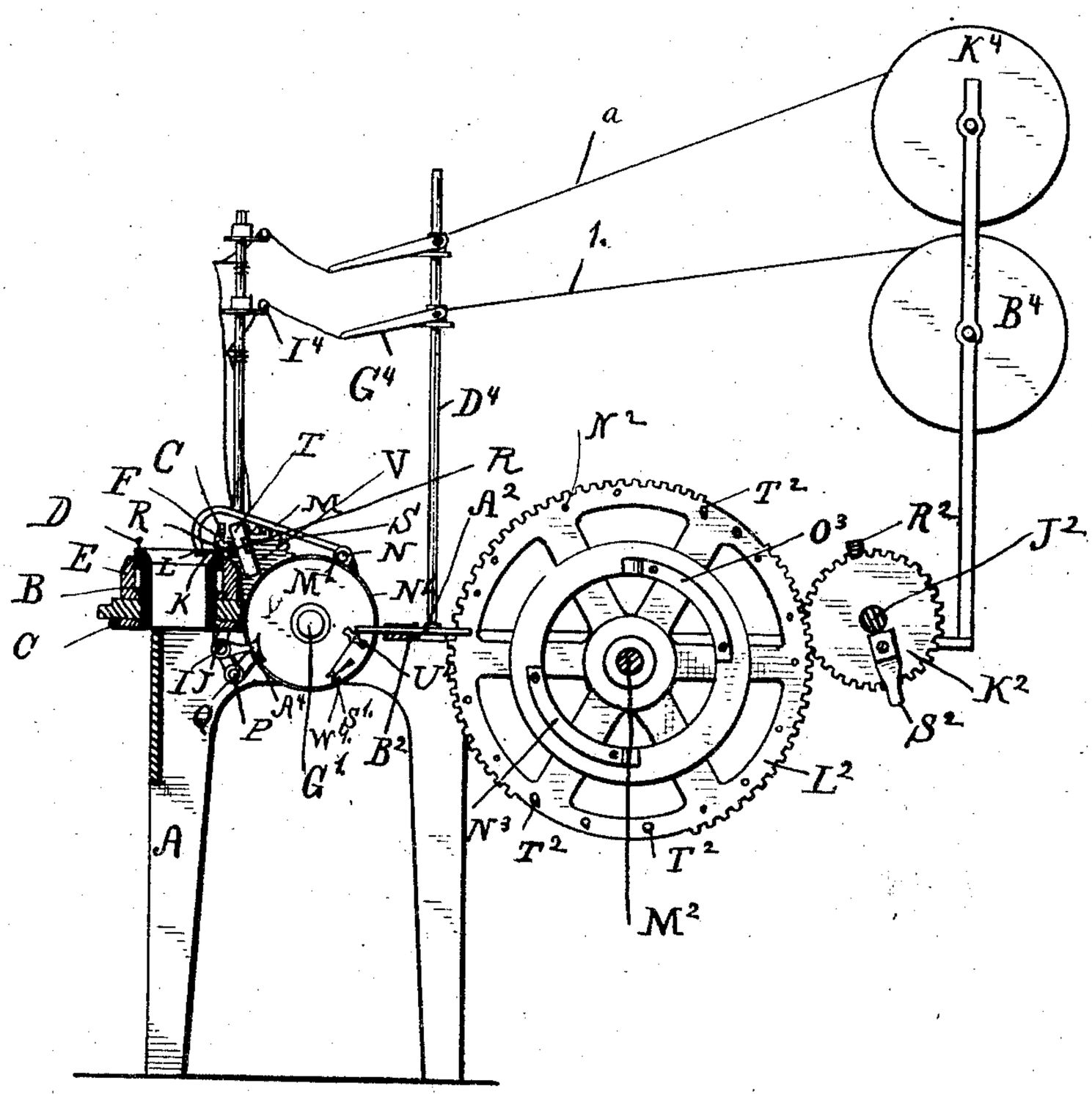
(No Model.) 19 Sheets—Sheet 4.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

Fig. 4.



WITNESSES:

John Jolley Jr

F. N. Dixon

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By his Attorneys

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(No Model.)

J. ADAMS.

19 Sheets—Sheet 5.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

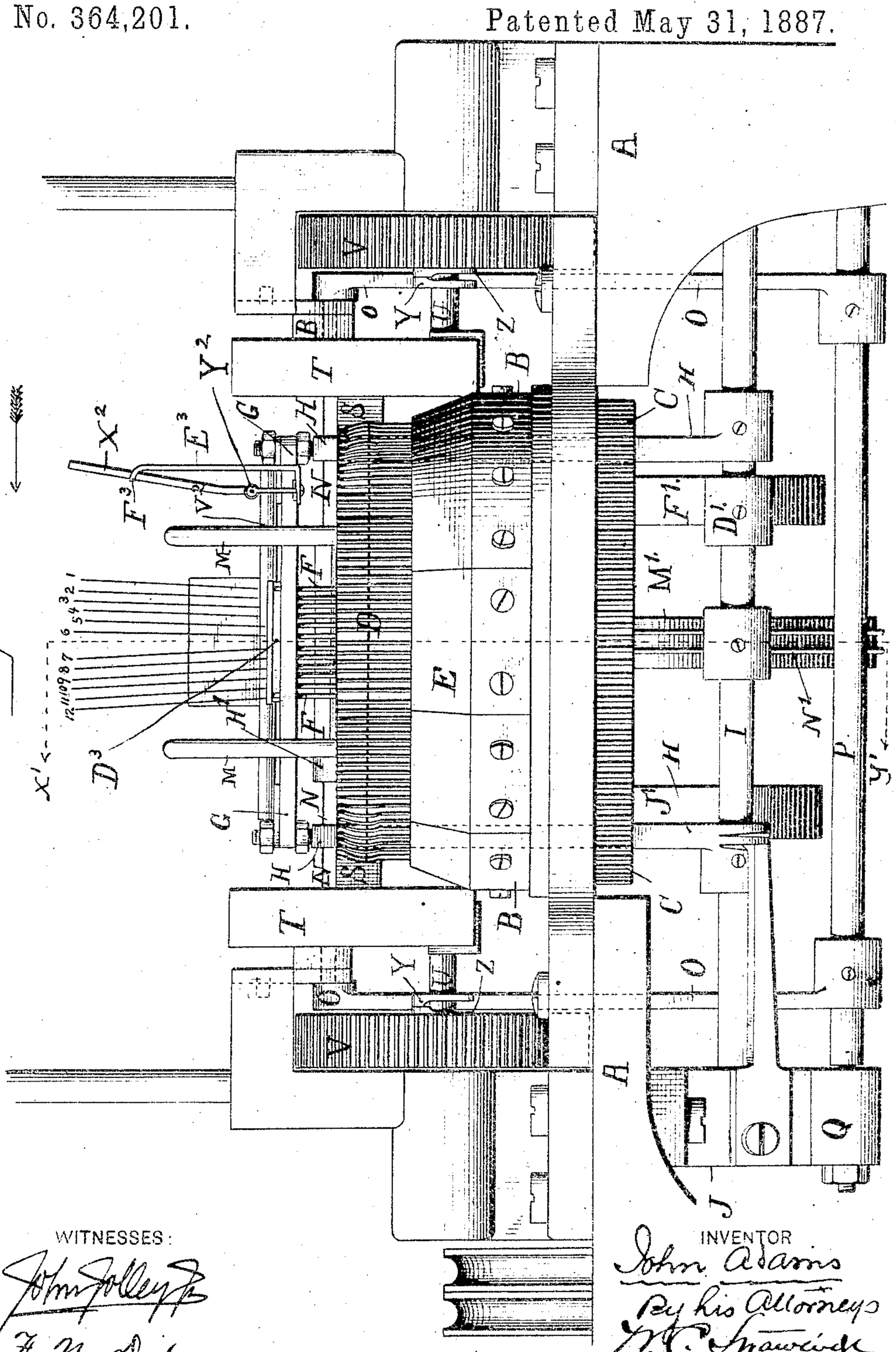

Fig. 5.

WITNESSES:

John Tolley Jr

F. N. Dixon

INVENTOR

John Adams

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H. C. Hazard

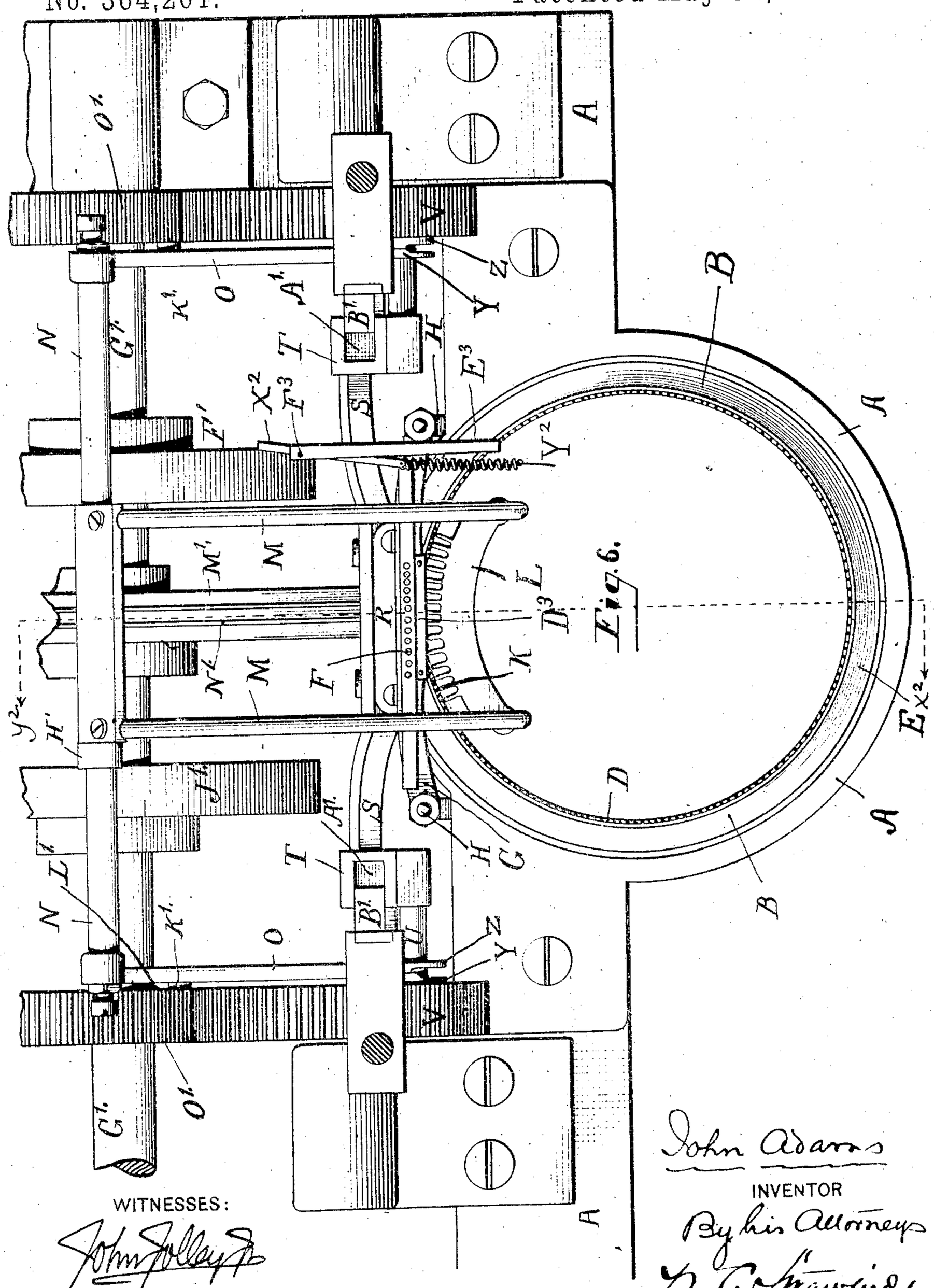
Donsall Taylor

(No Model.) 19 Sheets—Sheet 6.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.



WITNESSES:

John Tolley Jr

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INVENTOR

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(No Model.)

19 Sheets—Sheet 7.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

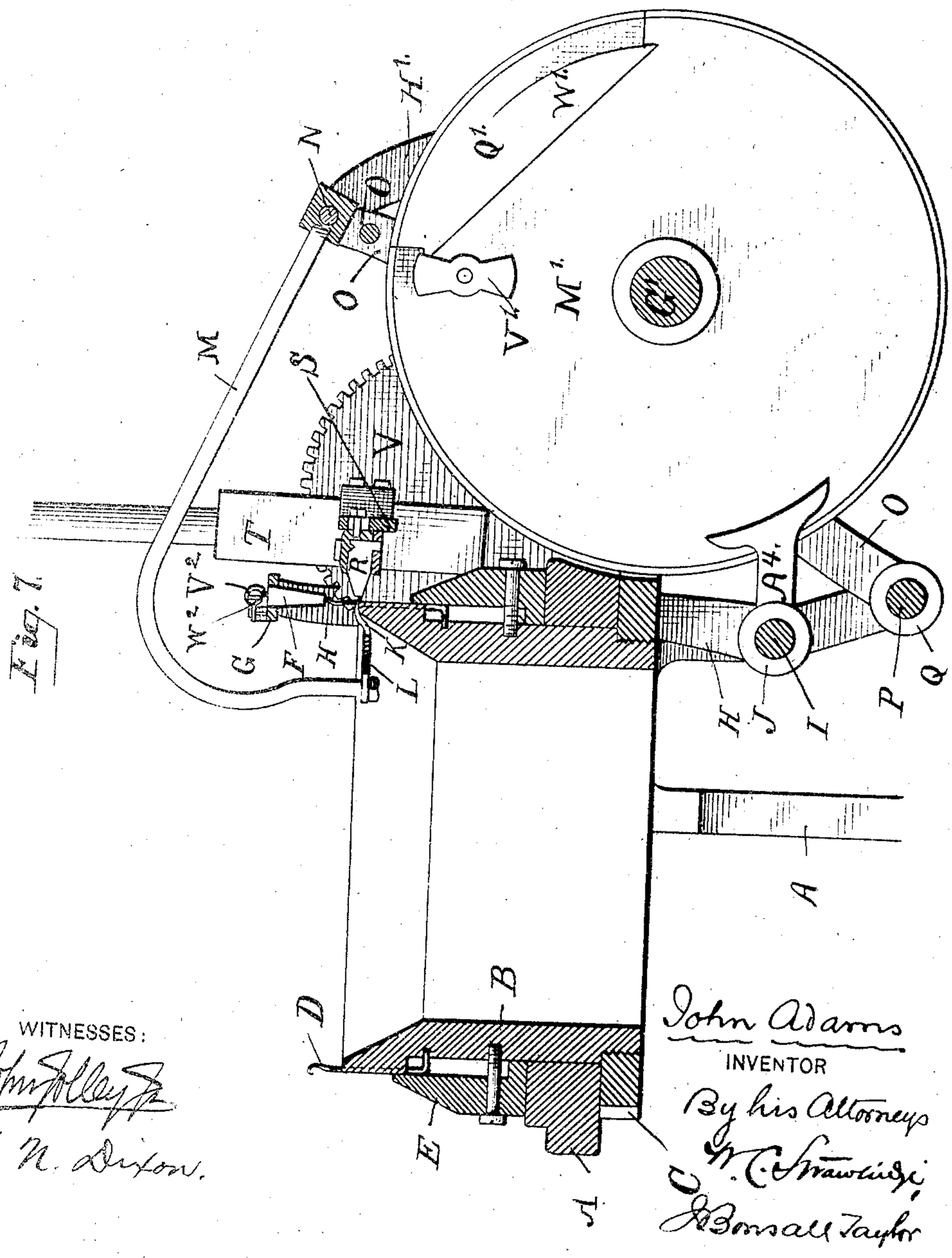

Fig. 7.

WITNESSES:

John F. Alley Jr.

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INVENTOR

By his Attorneys

W. C. Strawbridge,

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J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

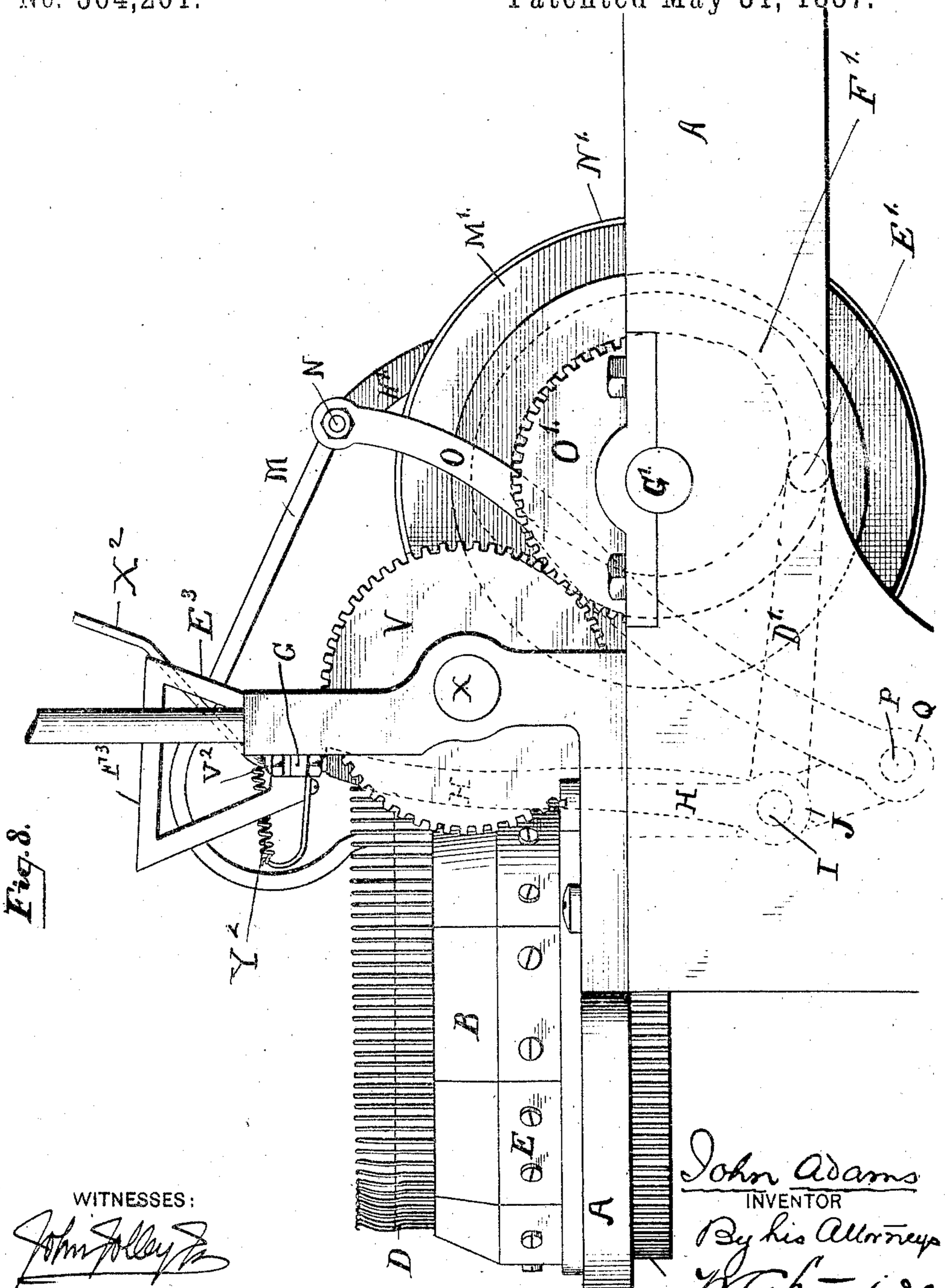

Fig. 8.

WITNESSES:

John Talley Jr

F. N. Dixon,

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By his Attorneys
J. C. Strawbridge,
J. Bonsall Taylor

(No Model.) 19 Sheets—Sheet 9.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

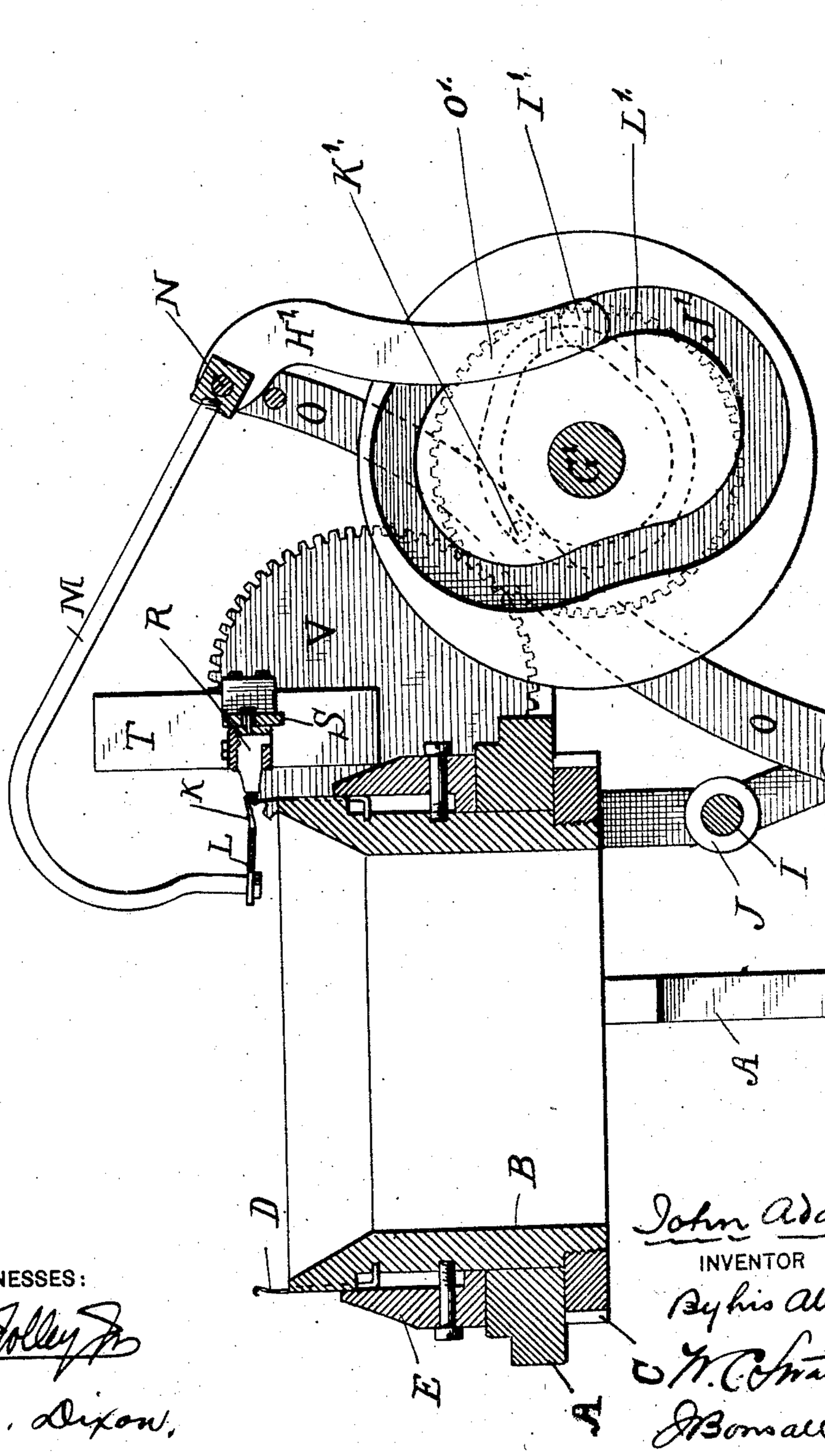

Fig. 9.

WITNESSES:

John Jolley Jr

F. N. Dixon.

John Adams
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By his Attorneys
C. C. Shawkey Jr
J. Bonsall Taylor

(No Model.) 19 Sheets—Sheet 10.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

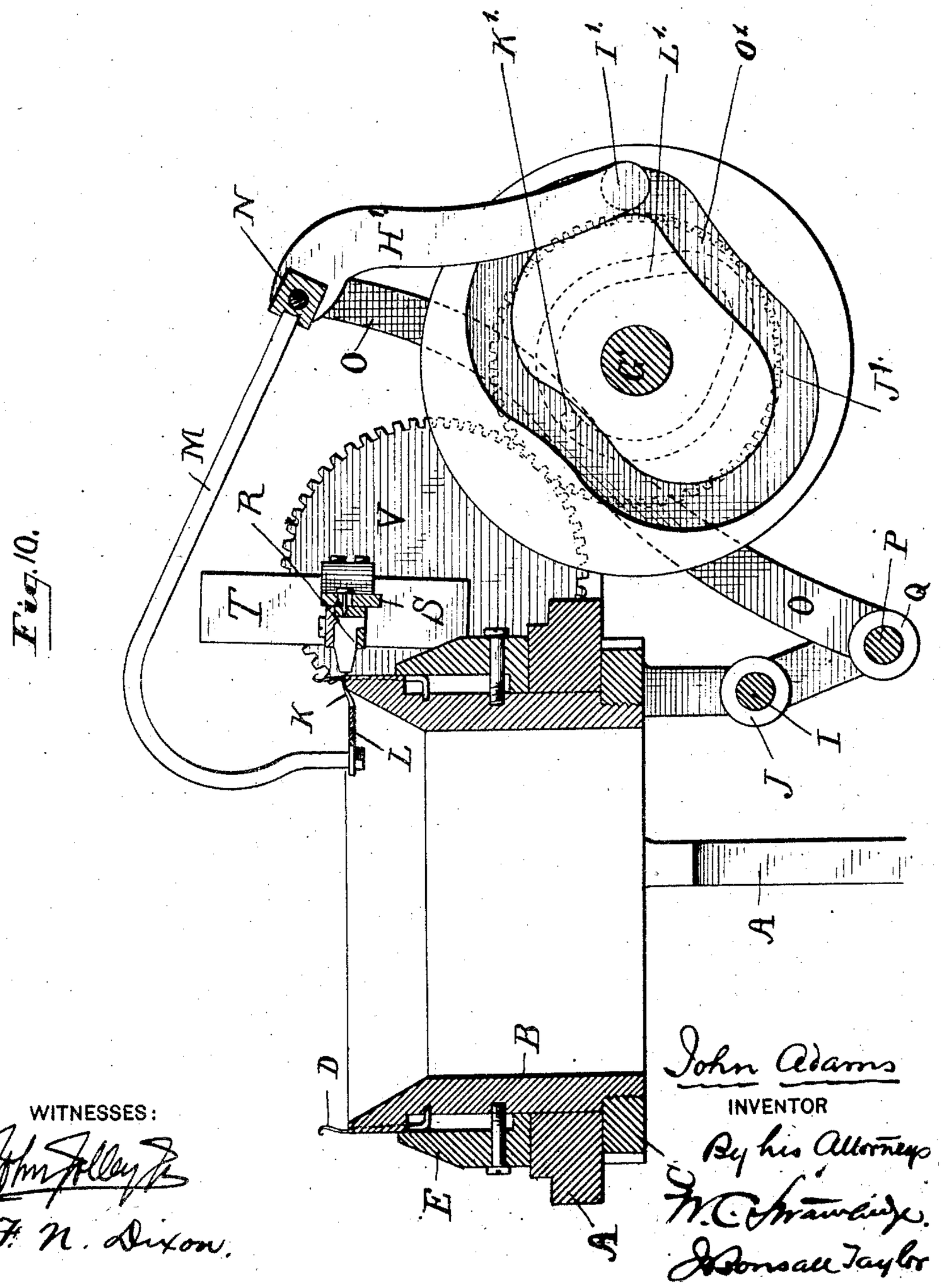


Fig. 10.

WITNESSES:

John Adams

F. N. Dixon.

John Adams

INVENTOR

By his Attorneys

W. C. Strawbridge.

Donsall Taylor

(No Model.) 19 Sheets—Sheet 11.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

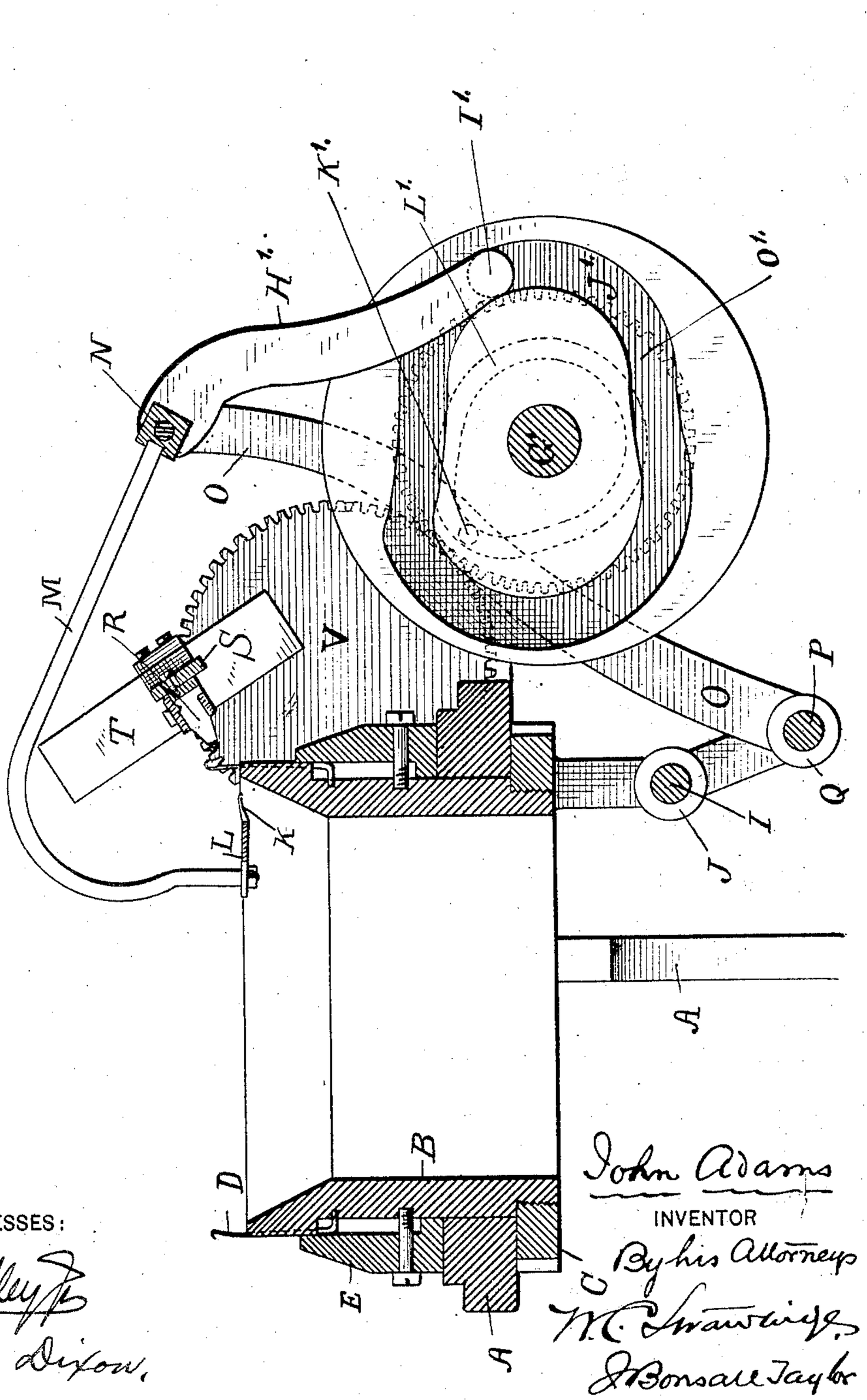


Fig. 11.

WITNESSES:

John Dolley Jr

F. N. Dixon,

John Adams

INVENTOR

By his Attorneys

W. C. Strawbridge

J. Bonsall Taylor

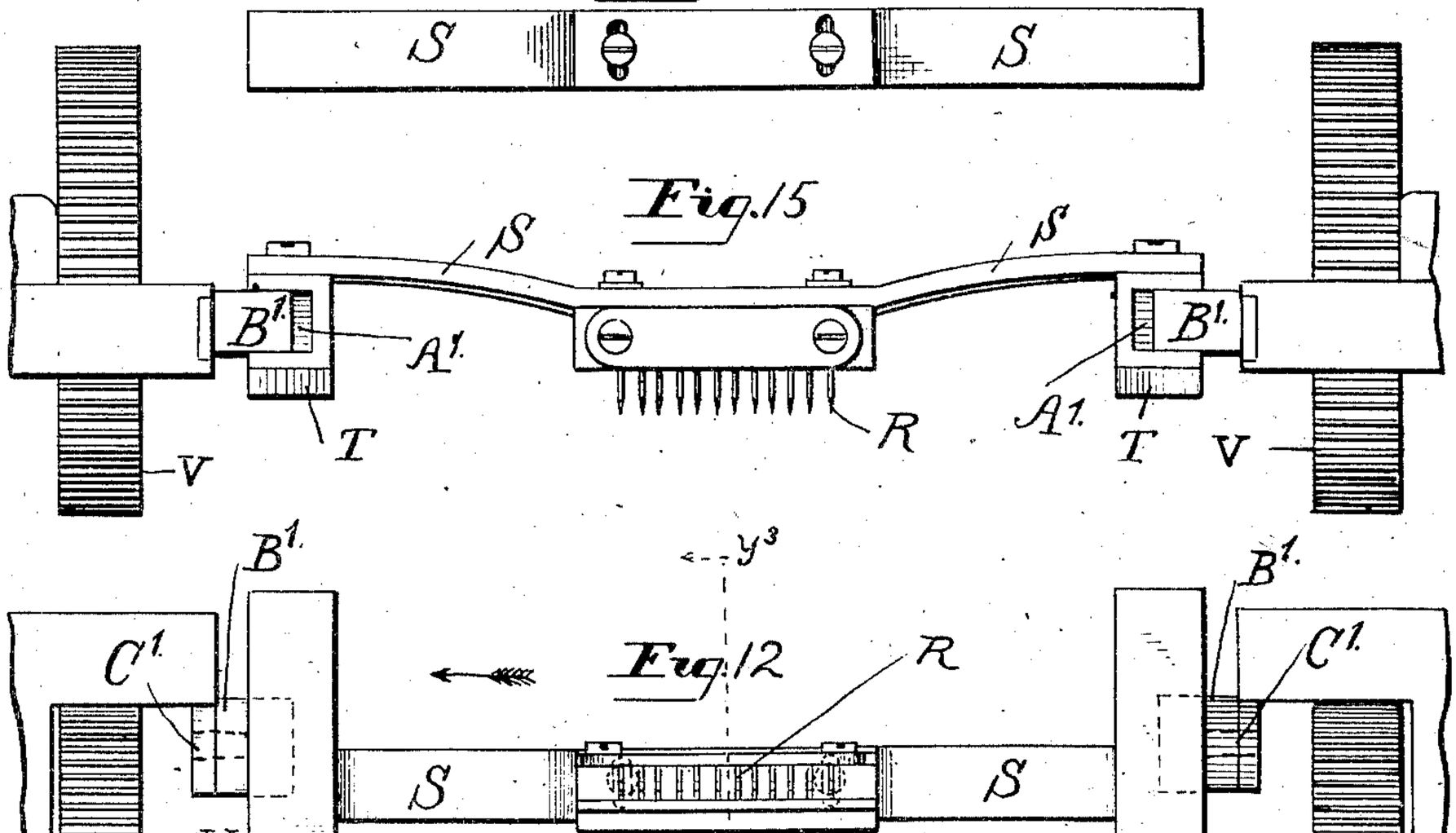
(No Model.) 19 Sheets—Sheet 12.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

Fig. 16.



WITNESSES:

John Adams

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J. Bonsall Taylor

F. N. Dixon.

(No Model.) 19 Sheets—Sheet 13.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

Fig. 22.

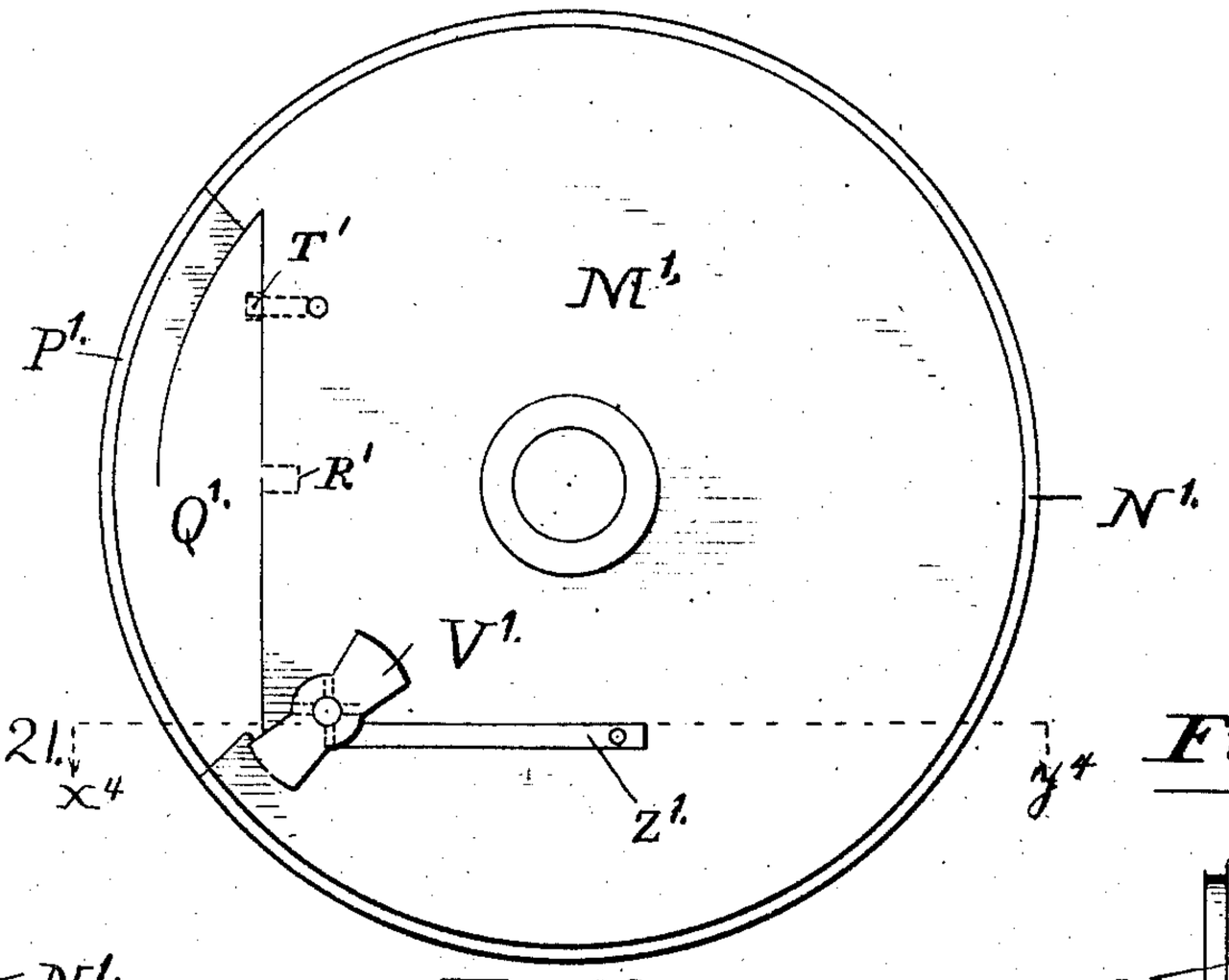


Fig. 21.

Fig. 20.

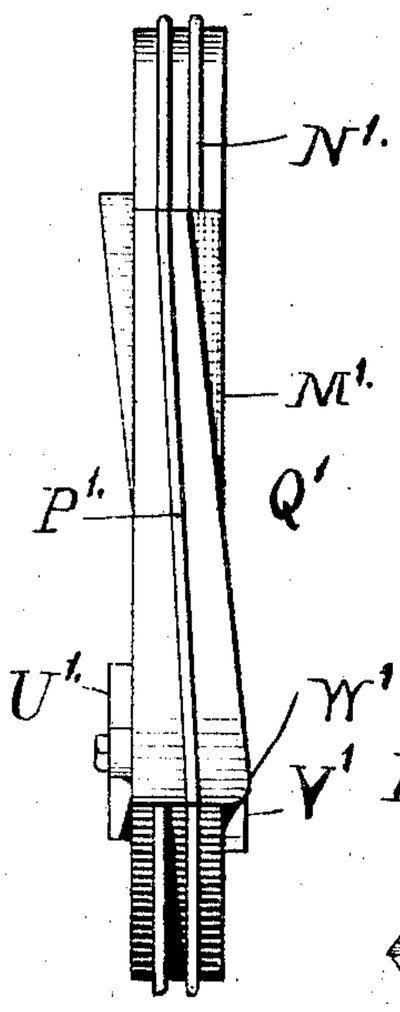


Fig. 23.

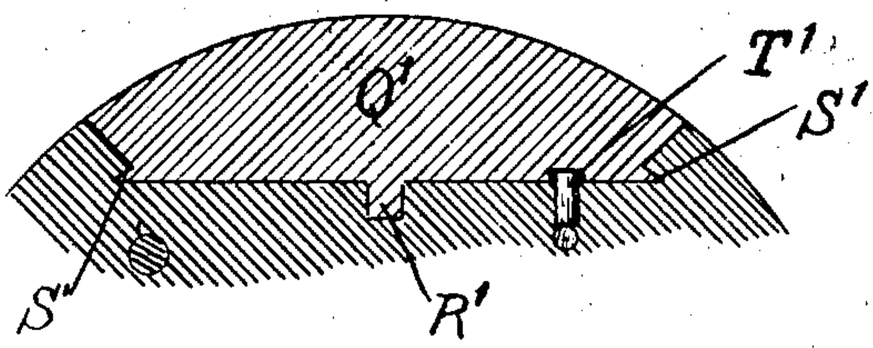
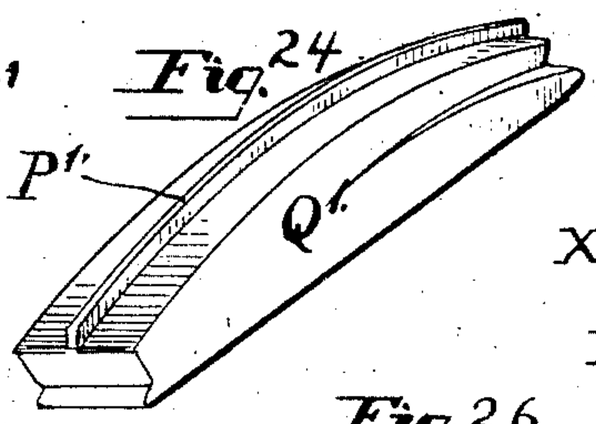


Fig. 24



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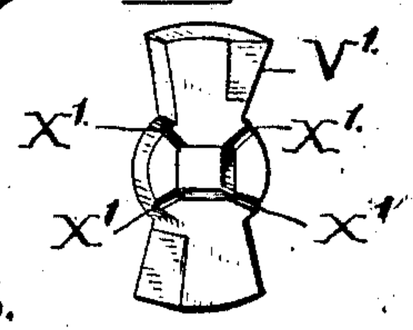

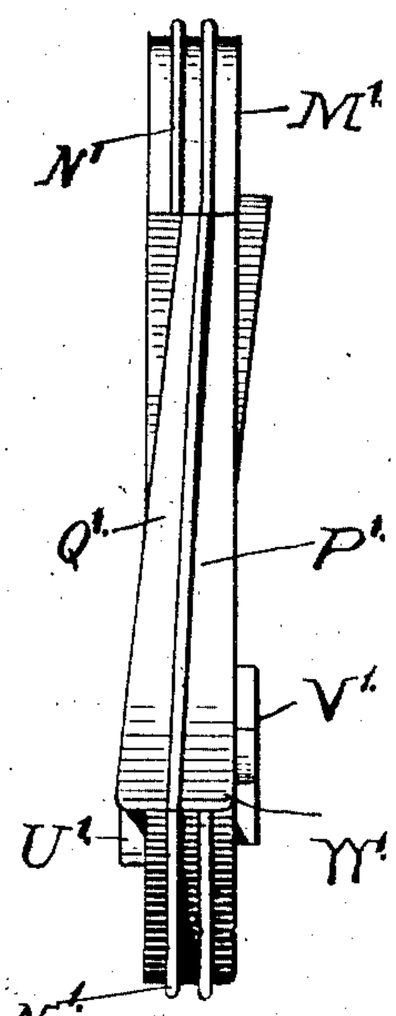

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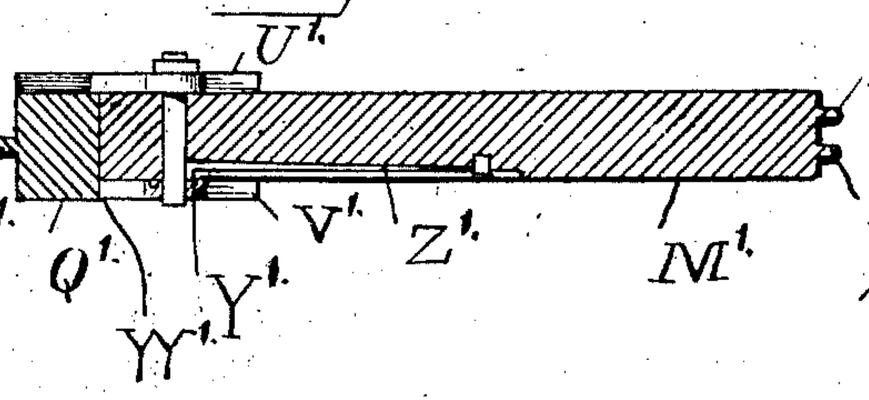

WITNESSES:

John Wesley Hall

F. N. Dixon.

John Adams
INVENTOR
By his Attys
W. C. Strawbridge
Bonsall Taylor

(No Model.) 19 Sheets—Sheet 14.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

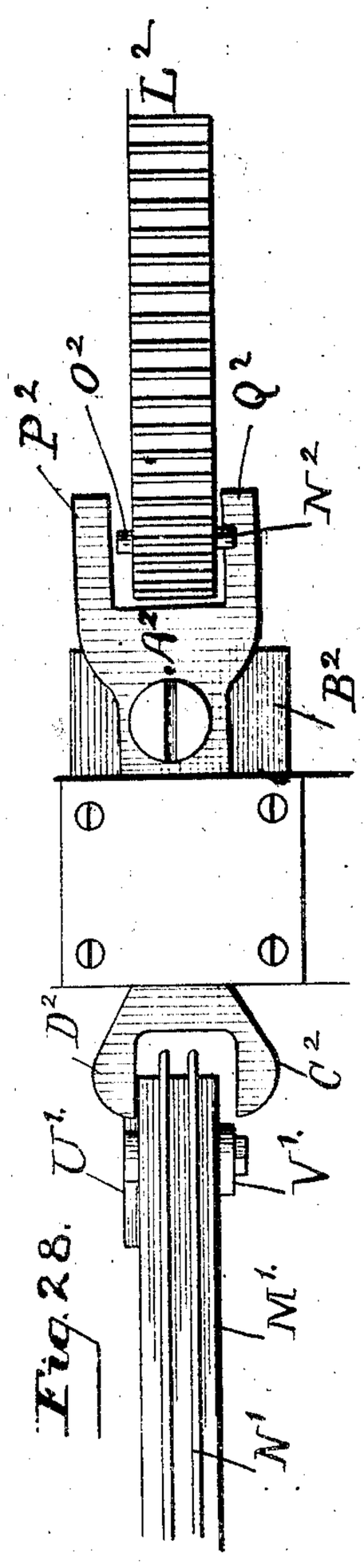

Fig. 28.

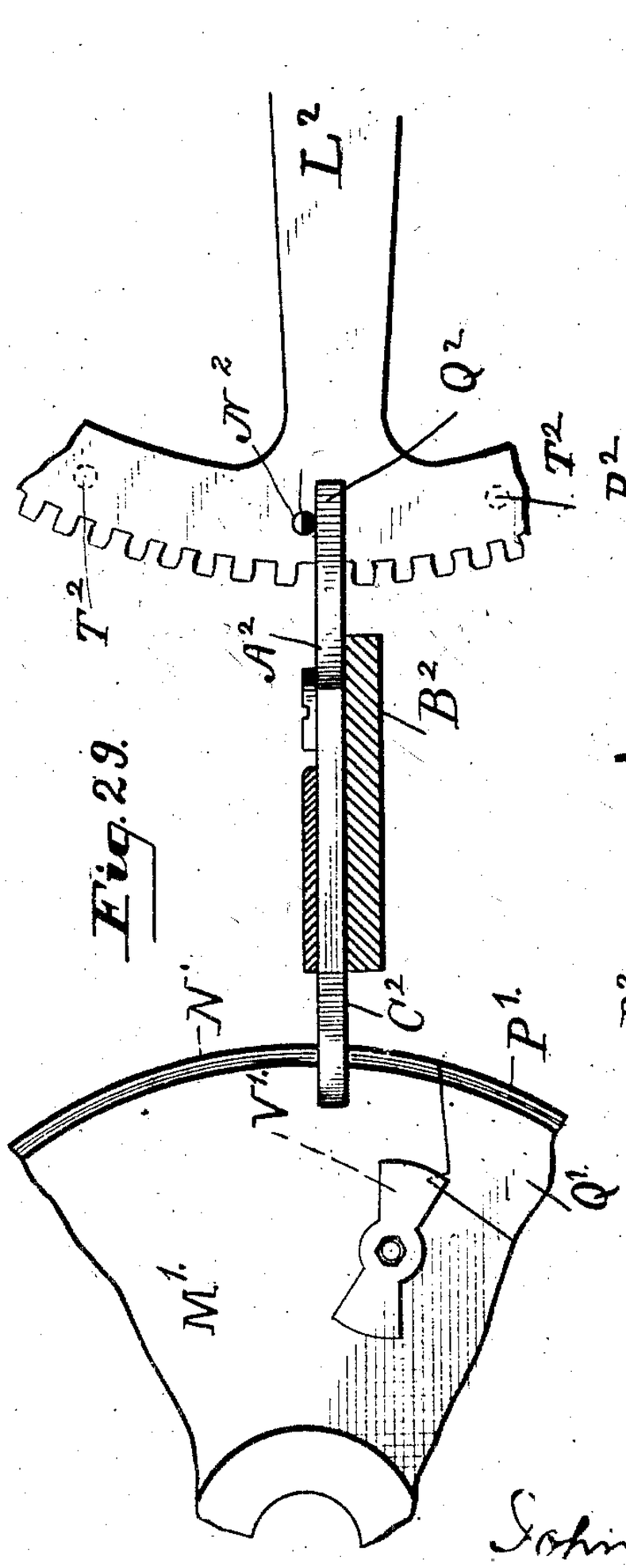

Fig. 29.

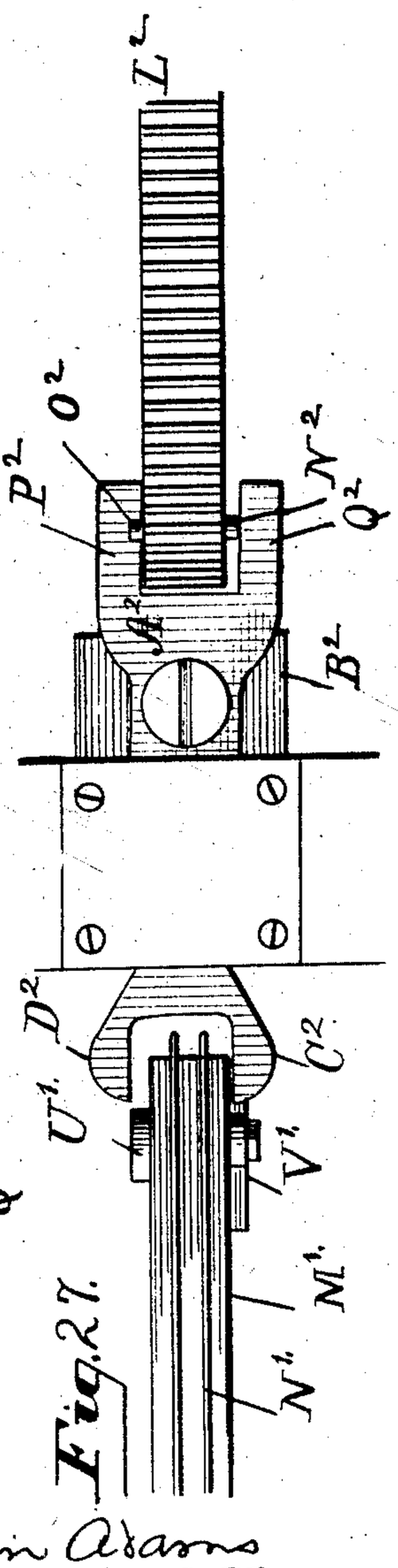

Fig. 27.

WITNESSES:

John Adams

INVENTOR

F. N. Dixon.

By his Attorneys,

W. C. Strawbridge,

H. Bonsall Taylor

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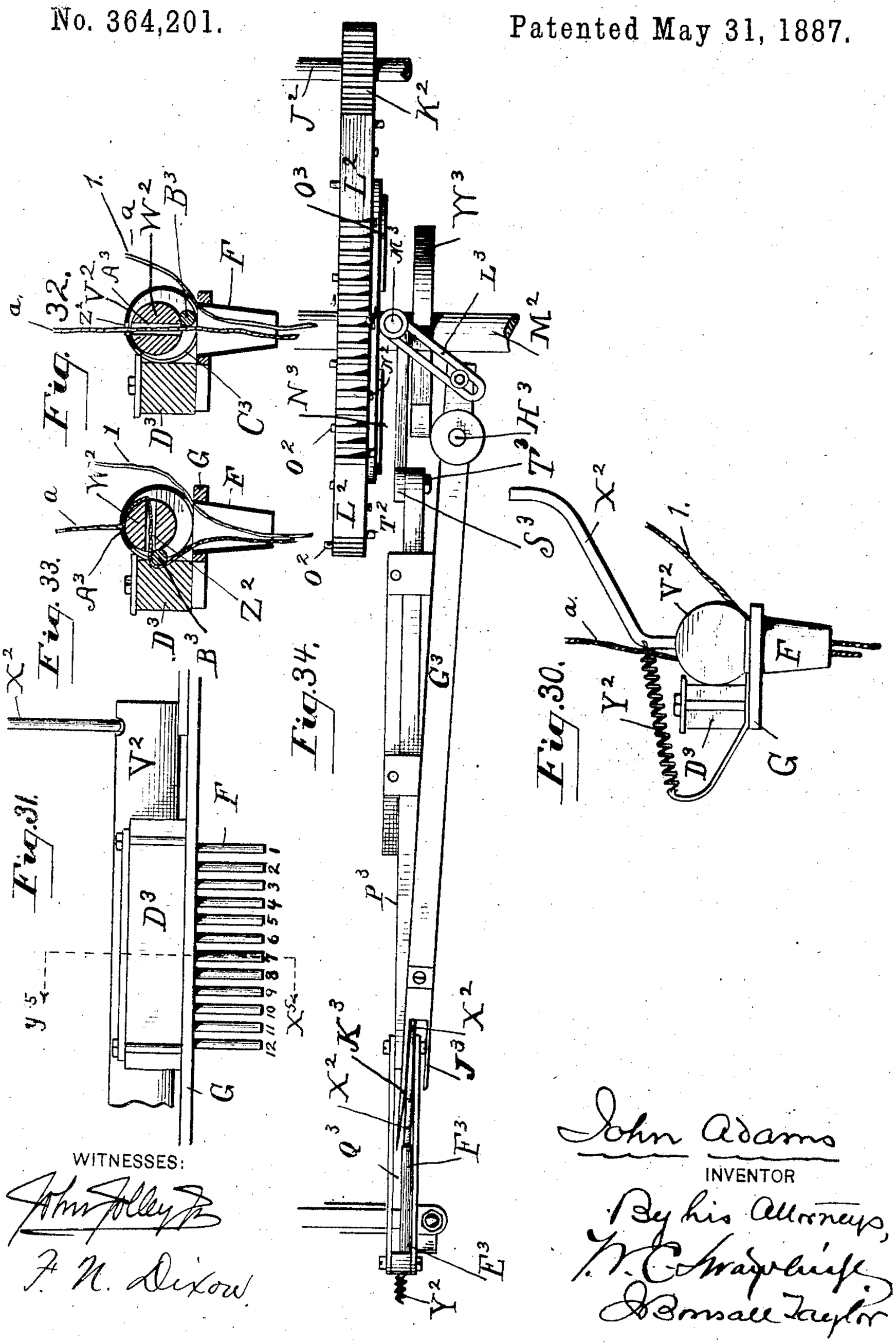
J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.



John Adams
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By his Attorneys,
W. Schaffield
Bonsall Taylor

(No Model.) J. ADAMS. 19 Sheets—Sheet 16.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

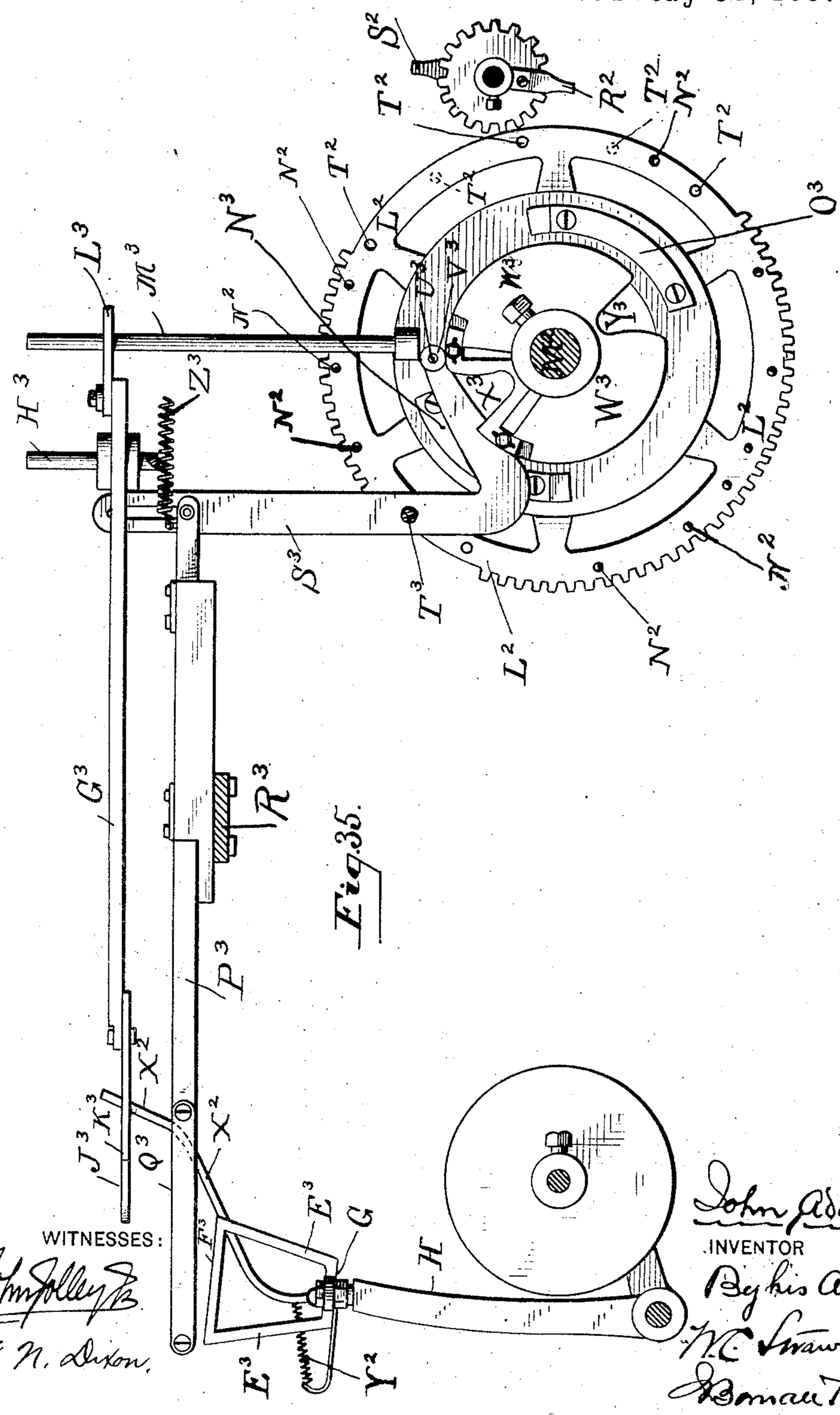

Fig. 35.

WITNESSES:

F. N. Dixon.

John Adams
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By his Atty
W. C. Strawbridge
Bonnell Tag

(No Model.) 19 Sheets—Sheet 17.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201 Patented May 31, 1887.

Fig. 36.

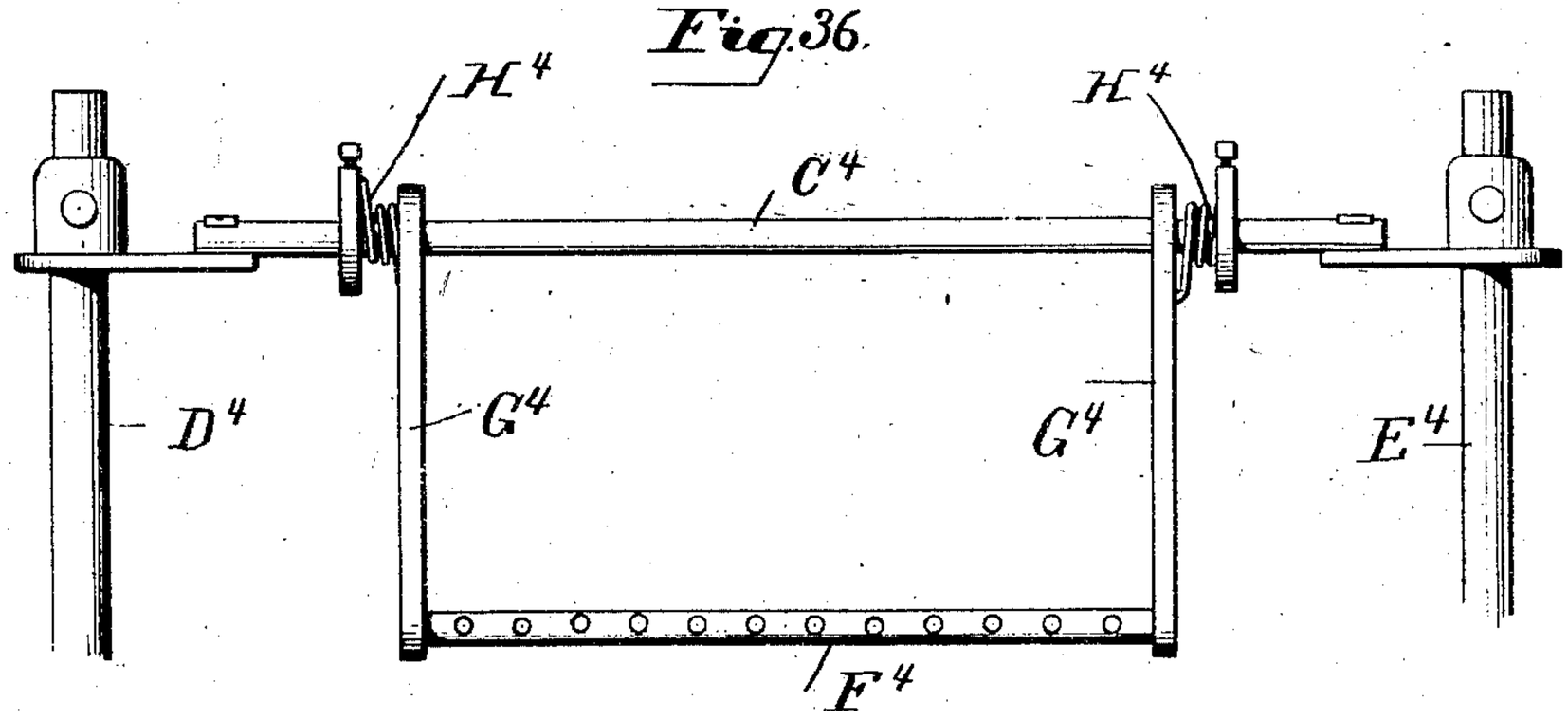


Fig. 37.

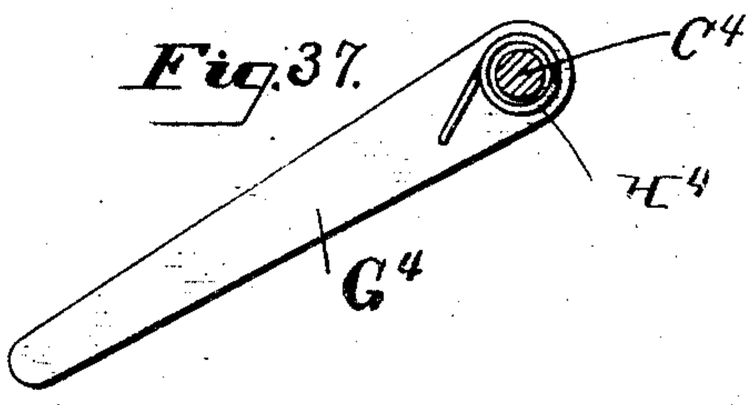
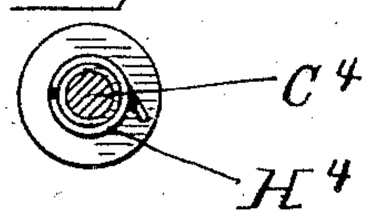


Fig. 38.



WITNESSES:

John Tolley Jr

F. N. Dixon.

John Adams

INVENTOR

By his Attorneys

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Bonsall Taylor

(No Model.)

19 Sheets—Sheet 18.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

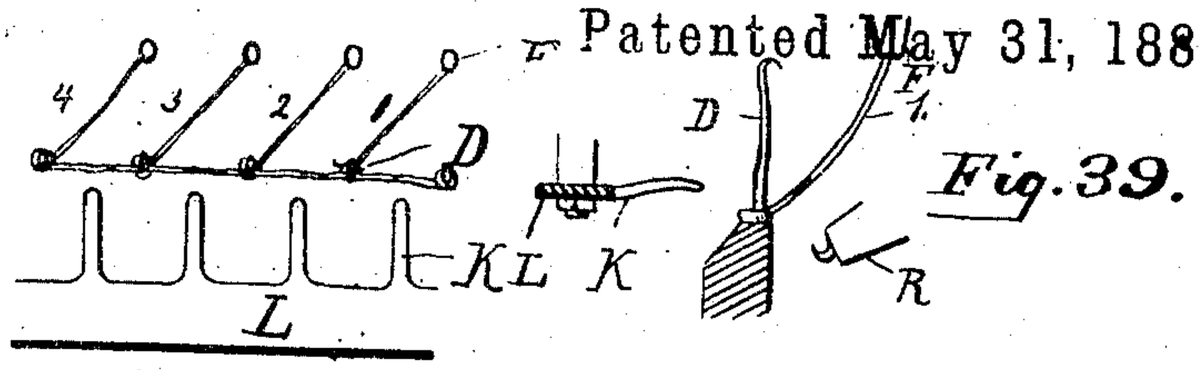


Fig. 39.

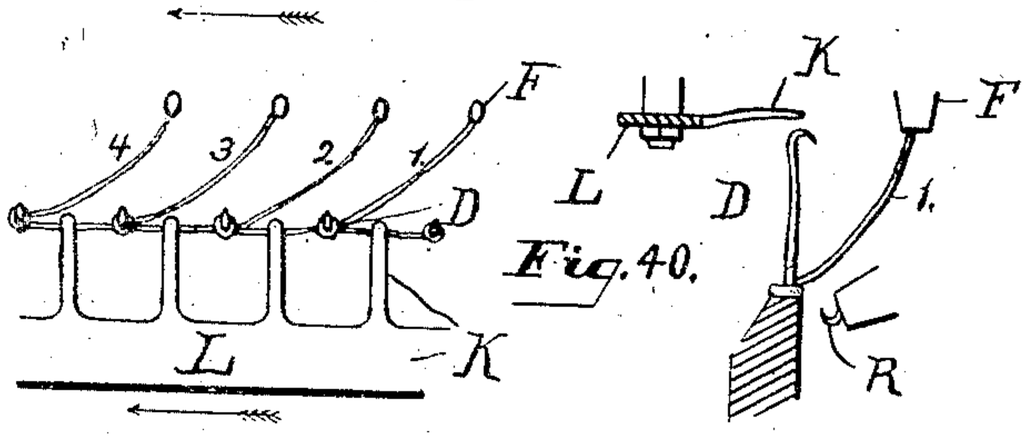


Fig. 40.

Fig. 41.

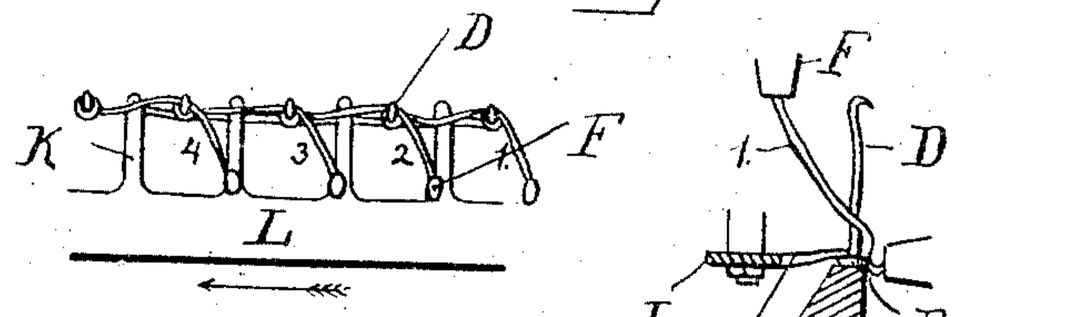


Fig. 42.

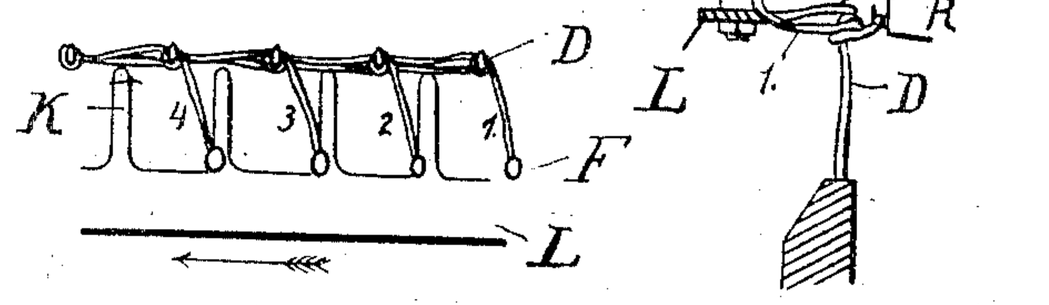
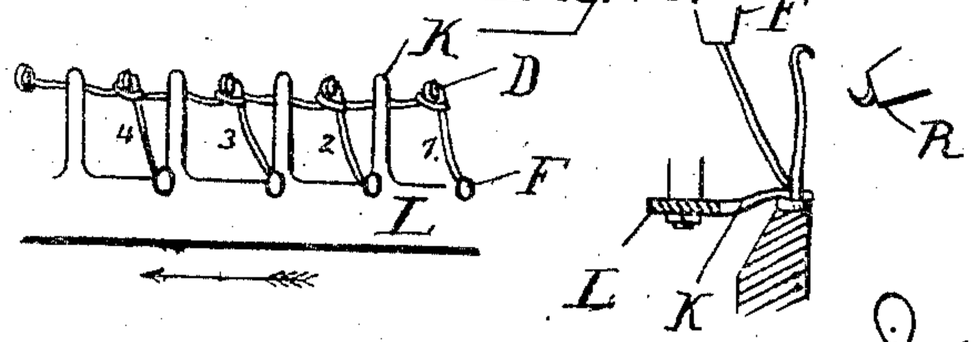


Fig. 43.



WITNESSES:

John Tolley Jr

F. N. Dixon.

John Adams

INVENTOR

By his Attorneys

W. C. Strawbridge

Donald Taylor

(No Model.)

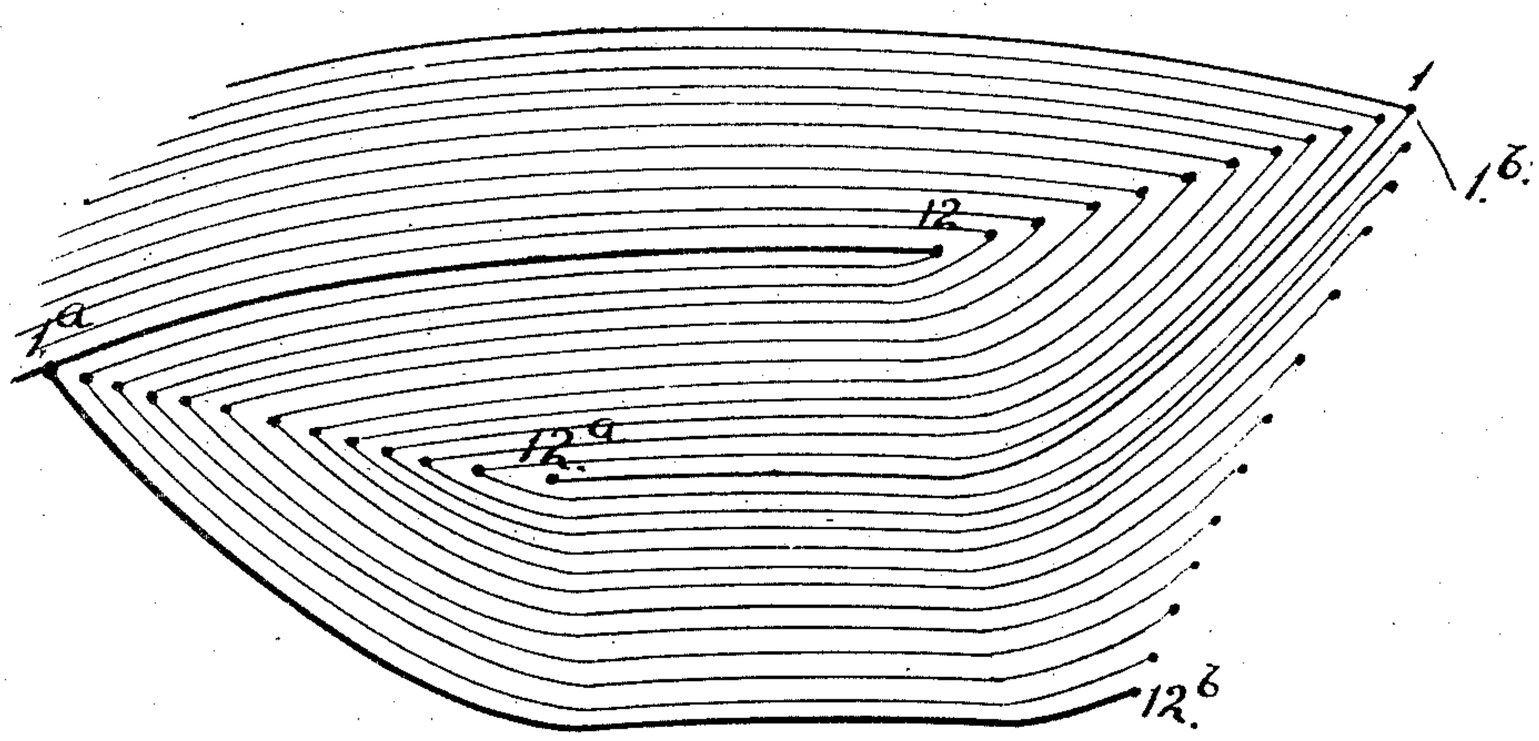
19 Sheets—Sheet 19.

J. ADAMS.

CIRCULAR KNITTING MACHINE.

No. 364,201. Patented May 31, 1887.

Fig. 44.



WITNESSES:

John Adams

INVENTOR

By his Attorneys

Wm. C. Strawbridge

Donald Taylor

UNITED STATES PATENT OFFICE.

JOHN ADAMS, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO JOHN J. GLAZIER, WILLIAM H. GLAZIER, AND GEORGE R. REPPLIER, OF SAME PLACE.

CIRCULAR-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 364,201, dated May 31, 1887.

Application filed July 16, 1886. Serial No. 208,174. (No model.)

To all whom it may concern:

Be it known that I, JOHN ADAMS, a citizen of the United States, residing in the City and County of Philadelphia, and State of Pennsylvania, have invented an Improvement in Circular Knitting Machines, of which the following is a specification.

My invention relates to that class of knitting machines in which stationary needles, mounted in a revoluble needle cylinder, are employed, and in which, in the operation of knitting, a thread is wrapped around a needle upon which a loop has previously been formed, which said previously formed loop is, by loop-hooks, raised upon said needle and upset over its upper extremity, with the result that said loop is cast off the needle and forms one of the loops of the upper line of loops of the knitted fabric, and with the further result that a new loop is at the same time formed upon the needle.

The object of my invention is to provide, in a knitting machine of the class mentioned, means for automatically causing, at predetermined times and for predetermined periods, a reversal or change of direction of revolution of the needle cylinder in the operation of knitting the heel and toe of a stocking, and its further object is to provide means whereby a double thickness of fabric may be knitted to form the heel and toe portions of a stocking, and it consists as hereinafter described and particularly claimed.

A good form of a convenient embodiment of my invention is represented in the accompanying drawings, in which—

Figure 1 is a side elevation of a circular knitting machine embodying my invention. Fig. 2 is a front elevation of the devices shown in Fig. 1. Fig. 3 is a plan view of part of the machine. Fig. 4 is an elevation, partly in section, upon the line x—y of Fig. 3. Fig. 5 is an enlarged front elevation of the machine. Fig. 6 is an enlarged top plan view of the forward part of the machine. Fig. 7 is an elevation, partly in section, on the line x'—y' of Fig. 5, sight being taken in the direction of the arrow on said last named figure. Fig. 8 is an enlarged side elevation of the parts of the machine shown in Fig. 5, sight being taken in the direction of the arrow on said last named figure. Figs. 9, 10, and 11 are elevations, partly in section, upon the line x^2—y^2 of Fig. 6, the operative parts of the machine depicted in said figures being shown in the relative positions occupied by them at successive points of the operation of the machine in knitting a stocking. Fig. 12 is a detail front elevation of the loop hooks, their supporting yoke, and a part of the mechanism by which they are operated. Figs. 13 and 14 are detail side elevations, partly in section, of parts of the devices shown in Fig. 12. Fig. 15 is a top plan view of the devices shown in Fig. 12. Fig. 16 is a back view of the loop hook yoke. Fig. 17 is a perspective view of the loop hooks and their containing block. Fig. 18 is a side elevation, partly in section, upon the line x^3—y^3 of Fig. 12, sight being taken in the direction of the arrow on said last named figure. Fig. 19 is a front elevation, partly in section, of part of the devices shown in Fig. 12. Figs. 20 and 21 are front elevations of the worm wheel by which the needle cylinder is operated, and of its switch, said switch, in said figures, being shown in reverse positions. Fig. 22 is a side elevation of the worm wheel shown in Fig. 20. Fig. 23 is a sectional elevation of part of the worm wheel shown in Fig. 22. Fig. 24 is a perspective view of the worm wheel switch. Fig. 25 is a perspective view of one of the turn buckles by which the worm wheel switch is unlocked, shifted and locked. Fig. 26 is a sectional plan view upon the line x^4—y^4 of Fig. 22. Figs. 27 and 28 are top plan views of part of the worm wheel, of the shifting lever by which the worm wheel switch is operated, and of the devices by which the shifting lever is actuated. Fig. 29 is an elevation, partly in section, of the devices shown in Figs. 27 and 28. Fig. 30 is a side elevation of one of the thread-guides and of the brakes or devices by which an auxiliary set of threads are fed to or cut off from the needles. Fig. 31 is a front elevation of the devices shown in Fig. 30. Figs. 32 and 33 are sectional end elevations upon the line x^5—y^5 of Fig. 31, the operative parts being shown in different positions. Fig. 34 is

a top plan view of part of the devices which operate to actuate the thread brake of Figs. 32 and 33. Fig. 35 is a longitudinal elevation of the devices shown in Fig. 34. Fig. 36 is a top plan view of the thread tension device. Figs. 37 and 38 are detail end elevations, partly in section, of part of the devices shown in Fig. 36. Figs. 39, 40, 41, 42, and 43 are respectively detail plan and end elevational views, partly in section, of the thread, thread-guides, needles, depressor hooks and loop hooks in the relative positions occupied by said parts at successive points of the operation of the machine in knitting. Fig. 44 is a plan view of a fabric made by the machine hereinafter described and exhibiting the principle of forming a heel or toe portion of a stocking on said machine.

In the drawings, A is the main frame of the machine, which may be supported in any convenient manner. Upon this main frame is mounted a revoluble needle-cylinder B, which, at its lower outer periphery is provided with a gear wheel C adapted to gear into and to be actuated by a worm wheel. This needle-cylinder is provided with hooked needles D which are secured thereto by clamping blocks E and set screws.

F are vertical tubular thread-guides mounted in and supported by a horizontal thread guide yoke G, which, at its ends, is supported upon the upper extremities of two vertical reciprocating arms H, which, at their lower extremities, are attached to a rock shaft I pivotally supported at its extremities in bearings J in the main frame.

K are what I term depresser-hooks, the plate L forming the back of which is connected to and supported by arms M, each of which, at one of its extremities, is attached to said plate, and, at its other extremity, is attached to a horizontal rock-shaft N which is supported in bearings in the upper ends of two vertical oscillating standards O. The standards O, at their lower extremities, are attached to and supported upon a horizontal rock-shaft P, which, at its respective ends, is pivotally supported in bearings Q in brackets depending from the main frame.

R are what I term loop-hooks. These hooks are mounted in a block attached to and supported by a horizontal loop-hook yoke or plate S, which, at each of its extremities, is attached to a grooved cross-head T, said block, in the construction shown in said figure, being provided with grooves or seats to receive the rear ends of the loop hooks and with a plate or cap, secured by screws, to retain said loop hooks in said seats. These cross-heads are, at each of their lower ends, provided with spindles U which are rigidly attached to said cross-heads, and, at their outer ends, journaled in bearings W in the sides of the gear-wheels V, said wheels being supported upon journals X whose bearings are in brackets sprung from the main frame. The spindles U are each provided with eccentric cams Y, corresponding cams Z being attached to the gear wheels V respectively. The construction of these cams Y Z is such that the gear wheels V, at each revolution, cause said cams to shift or reciprocate the cross-heads, and their attached loop-hook yoke, backward and forward in the line of the axes of the spindles, to which said cross heads are attached. The grooves A' of the cross-heads T embrace blocks B', which are pivotally mounted upon studs C' which at their outer extremities are attached to brackets sprung from the main frame.

To the rock-shaft I is attached an arm or lever D' which, at its outer extremity, is provided with a stud E' which takes into and is operated by a cam F' mounted upon and actuated by the main shaft G'. To the rock-shaft N is attached a lever H' the lower extremity of which is provided with a stud I' which takes into and is operated by a cam J' mounted upon and operated by the main shaft G'. The standards O are provided with studs K', which take into and are operated by cam-grooves L' in wheels O* mounted upon the main shaft G'. Upon the main shaft G' is mounted a worm wheel M' provided with a worm N' which gears into and actuates the gear wheel C of the needle-cylinder B.

In the machine shown in the drawings a series of twelve threads and thread-guides are shown as employed; each of these threads is, in the formation of fabric, simultaneously operated upon by one of a series of twelve needles, so that in the operation of said machine twelve lines of loops of fabric are simultaneously produced.

Revolution being given to the main shaft G' the mode of operation of the parts of the machine hereinbefore described in the formation of a tube or cylinder of plain knitted fabric is as follows: Assuming the threads employed in knitting to be terminated in loops upon the needles respectively corresponding to said threads, and assuming the main shaft of the machine to have been revolved to a point at which the thread-guides have been moved forward of the needles to the position F, the loop-hooks to have been moved forward and downward to the position R, and the depresser-hooks to have been moved upward and backward to the position K, all as shown in Fig. 39, then further revolution of the main shaft causes the further elevation of the depresser-hooks to the position K, an intermittent revolution of the needle cylinder in the direction of the arrow, and the further elevation of the loop-hooks to the position R, all as shown in Fig. 40. At this point further revolution of the main shaft causes the depression of the depresser-hooks to the position K, further elevation of the loop-hooks to the position R, and a backward movement of the thread-guides to the position F, all as shown in Fig. 41, with the result that the threads 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12, are wrapped around the needles D, the pre-

viously formed loops upon said needles being held down by the depresser-hooks K until the loop hooks R have risen sufficiently high to engage with said loops. Further revolution of the main shaft now causes the thread-guides to move to a position F still further back of the needles, and the depresser-hooks and loop-hooks to rise to the positions K and R, all as shown in Fig. 42, with the result that the loops previously formed upon the needles are elevated to that point at which a further revolution of the main shaft causes the loop-hooks R to upset said loops over the tops of the needles. Further revolution of the main shaft causes the loop-hooks to move forwardly and downwardly to the position R, and the depresser-hooks to move downwardly to the position K and the thread-guides to move forward to the position F, all as shown in Fig. 43, with the result that the newly formed loops upon the needles are, by the depresser-hooks K, depressed to the lower ends of the needles, and, in the further revolution of the main shaft, the thread-guides F, loop-hooks R, and depresser-hooks K, are moved to the positions shown in Fig. 39, from which positions the parts are again caused to operate, in the manner just explained, for the formation of loops upon the needles next successively presented to the threads. The reciprocation of the thread-guides F backward and forward across the line of needles to the positions shown in Figs. 39 to 43, as above explained, is occasioned by the oscillation of the rock-shaft I through the instrumentality of the lever D', stud E', and cam F', the shape of which cam is so fashioned as to insure the placing of the thread-guides F in a position in front of the line of needles just prior to each intermittent revolution of the needle-cylinder, and in a position behind said line of needles immediately after said intermittent revolution of the needle cylinder.

The horizontal and vertical movements of the depresser-hooks K are respectively occasioned by the cams L' and J' through the respective instrumentalities of the studs K' and oscillating standards O, and of the stud I' and lever H'. The movements of the loop-hooks R will be understood by assuming said hooks to be in a position of rest with their points in contact with the front faces of the needles which lie opposite to them, as shown in Fig. 10, in which position the cross-heads T will be vertical, and the cross-head spindles U will lie in a horizontal plane through the center of the gear wheel V, and upon that side of the center of said gear wheel which is toward the needle cylinder. Revolution being given to the main shaft G' the gear wheels V are, by the gear wheels O' on the main shaft, caused to revolve and to occasion a vertical movement of the cross-head spindles U, cross-heads T, and loop-hooks R. This vertical movement of the cross-heads T causes them to slide upwardly on the blocks B' and to carry the points of the loop-hooks to a position as high as and in contact with the tops of the needles. Further revolution of the gear wheels V revolves the spindles U around the axes of said gear wheels to a position in a vertical plane through the center of said wheels, which movement of said spindles causes the cross-heads T to turn upon the studs C' the lower ends of the cross-heads moving in a direction away from the needle-cylinder and the upper ends of said cross-heads in a direction toward the needle-cylinder, with the result that the loop-hooks are carried above and over the upper ends of the needles in a direction toward the center of the needle-cylinder, the loops on the needles being thereby thrown off the needles, as has hereinbefore been explained. In the revolution of the spindles U, around the axes of the gear wheels V, from the position of rest in which they were assumed to be to said position in a vertical plane through the centers of said gear wheels, the cams Y Z operate to shift the spindles U longitudinally in their bearings in the gear wheels V, which bearings are sufficiently deep to permit of the longitudinal reciprocation of said spindles therein, with the result that the points of the loop-hooks R, after they have thrown off or upset the loops from the needles, are in a position inside the line of needles and opposite the spaces between the vertical needles, so that, in the subsequent movement of the loop-hooks away from the needle-cylinder, they move between the needles without coming into contact with them. Further revolution of the gear wheels V causes the spindles U to move from their positions in a vertical plane through the centers of said gear wheels, and in a direction away from the needle cylinder, to the original positions in which they were assumed as at rest, viz: to positions in a horizontal plane through the center of the wheels V and at the side of the centers thereof toward the needle cylinder. This movement of the spindles U causes the cross-heads T to slide upon the blocks B' in a direction away from the needle cylinder, and further causes said cross-heads to revolve upon the studs C' and the lower ends of said cross-heads to move in a direction toward the needle-cylinder, by which the points of the loop-hooks R are brought into positions in contact with the front faces of the needles, or into the original positions occupied by them.

The movements of the needle-cylinder, thread guides, depresser-hooks, and loop-hooks being effected, as described, the operations of these parts in respect to each other are so timed, that they shall successively occupy the relative positions shown in Figs. 39 to 43, as hereinbefore explained.

In the operation of the machine, as above explained, the needle-cylinder is caused to revolve intermittently, each revolution being through an arc equal to the distance between two adjacent needles, each needle of the line of needles being successively presented to the threads 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12,

the loop forming operation being effected between each two of said intermittent revolutions of the needle cylinder. The worm on the worm wheel M′ is divided into two parts, one part, N′, of which lies in a plane at right angles to the main shaft G′ upon which said worm wheel is mounted, the other part P′ being in a plane at an angle to said shaft. From this construction it results that revolution of the needle cylinder is only occasioned during the time in which the part P′ of the worm is in gear with the gear wheel C. The part P′ of the worm is formed upon the periphery of a switch or segmental part Q′ of the worm wheel M′. This switch Q′ is, at its base and intermediately of its length, by a pin R′, the axis of which is radial to the worm wheel M′, pivoted to said worm wheel so as to be capable of oscillatory adjustment on said pivot. This switch is retained in pivotal connection with the worm wheel M′ by lips S′ which take into, and which are adapted to slide within, corresponding seats in said wheel. The oscillatory movement of this switch is limited by a pin T′, the head of which takes into a curved slot of suitable length the radius of which slot is the distance from said pin to the pivot upon which the switch oscillates. A shifting of the switch Q′, from one side to the other, occasions the shifting of the part P′ of the worm into or out of contact with the ends of the branches of the part N′, so that the direction of revolution of the needle-cylinder is controlled by the direction in which the switch Q′ and the part P′ of the worm is set.

Just before each reversal of the needle-cylinder the thread-guides F are, when they are in front of the line of needles, longitudinally shifted a distance equal to the distance between two adjacent needles, to properly present the threads to the needles when the needle-cylinder is revolved in a reverse direction. This shifting of the thread-guides is occasioned by the projecting part W′ of the switch Q′ coming into contact with one or the other fork of a forked stud A′ attached to the longitudinal shifting rock shaft I upon which the standards H, which support the thread guide yoke, are mounted. The worm wheel M′ is, upon either side, provided with, what I term, turn buckles U′ V′, which are mounted upon the same spindle and with their longitudinal axes at right angles to each other.

The forward end of the switch Q′, or that end which lies in the direction in which the worm wheel M′ revolves, is, as shown at W′ of a thickness greater than the thickness of the worm wheel M′, so that the end of said switch projects upon the side of the worm wheel toward which the switch has been shifted. At each quarter revolution of the turn buckles U′ V′, the switch is shifted by the contact of one of the turn-buckles with the end of the switch which at the time lies beyond the plane of the worm wheel M′, as for example by the contact of the turn-buckle V′ with the projection W′. In the operation of shifting the switch, the turn-buckle, which at the time operates as the switching device, is caused to stop at a point at which one of its ends overlaps the side surface of the switch and thus to lock it in its shifted position. At this point the opposite turn-buckle is out of contact with the surface of the switch. One of the turn-buckles is provided with grooves or seats X′ to receive the head Y′ of a spring Z′ to lock said buckles in position after the switch has been shifted.

The operation of giving a quarter revolution to the turn-buckles to shift the switch is effected by a horizontal shifting lever A^2, which, intermediately of its length, is pivoted to a cross bar B^2 of the main frame. This lever is, at its forward extremity, provided with two forks C^2 D^2 so that, when it is shifted horizontally from side to side, said forks, in the revolution of the worm wheel M′, are caused to alternately come into contact with the ends of the turn-buckles U′ V′.

The mechanism employed by me to shift the lever A^2 is of the following construction:

The main shaft G′ is, at one end, provided with a worm E^2 which gears into and operates a worm wheel F^2 upon the end of a longitudinal shaft G^2, which, at its ends, is supported in bearings attached to the main frame. The rear end of the shaft G^2 is provided with a worm H^2 which gears into and operates a worm wheel I^2 upon the end of a transverse shaft J^2 which is supported in bearings at the rear of the main frame. The shaft J^2 is, intermediately of its length, provided with a gear wheel K^2 the teeth of which mesh with the teeth upon the periphery of a shifting wheel L^2 mounted upon the transverse shaft M^2, which, at its ends, is journalled in bearings in the main frame. The shifting wheel L^2 is, upon either side, provided with bevel-ended pins N^2 O^2, which, in the revolution of said shifting wheel L^2, alternately come into contact with the bevelled inside edge of one or the other of the forks P^2 Q^2 which form the rear end of the shifting lever A^2, with the result that the shifting lever is forced in a direction toward the side of the machine corresponding to the side of the wheel upon which the pin operating said shifting lever is located.

It will be obvious that the number of shifting pins N^2 O^2, their location upon the shifting wheel L^2, the size of said shifting-wheel L^2, and the speed at which it is geared to run, may all be so regulated as to cause the reversal of direction of revolution of the needle cylinder at such times and for such periods of time as may be desired and as may be proper in the knitting of stockings of different and predetermined sizes.

In the drawings the shifting-wheel L^2 is shown as unprovided at parts of its periphery with teeth, Figs. 3 and 4. The object of this construction is to permit said wheel, during the operation of the machine in knitting the

tubular parts of the leg and foot of a stocking, to remain at rest sufficiently long to allow the needle cylinder to revolve in one direction, without reversal, to knit said parts, a result which would not be obtained should a shifting wheel be employed with teeth upon its entire periphery, unless said wheel were of such a size as to, for many reasons, render it inconvenient for use.

In connection with the shifting wheel L^2 I provide radial arms R^2 S^2 attached to the transverse shaft J^2, and pins T^2 U^2 on either side of the shifting wheel L^2 and opposite those parts of the periphery of said wheel which are unprovided with teeth. The location of said pins and the length of said arms is such that the arms are adapted to come into contact with the pins and revolve the shifting wheel at such times and for such distances as are required in knitting stockings having leg and foot portions of predetermined lengths.

The construction and mode of operation of the devices employed by me to feed an auxiliary set of threads to the needles, during the operation of knitting the heel and toe portions of a stocking, is as follows:

A horizontal tubular casing V^2 is mounted upon the top of the thread-guide yoke G, and within this casing is mounted a revoluble rod W^2 provided at one extremity with an oscillating lever X^2 to which is attached one end of a spring Y^2, the other end of said spring being attached to a projecting arm sprung from the thread-guide yoke. The casing V^2 and rod W^2 are each respectively provided with a series of twelve thread-feed-holes Z^2 A^3, the holes of one series registering with the holes of the other when the feed holes in the rod are in a vertical position. The action of the spring Y^2, when it is permitted to act upon the lever X^2, is to keep the holes of one series in register with those of the other. Through the thread-feed holes Z^2 A^3 an auxiliary set of threads *a* is fed to the thread-guides F where they come into frictional contact with the threads of the primary set and are thereby carried forward to the needles, so that a thread of one series is, with a thread of the other series, presented to each of the needles as a single thread, with the result that a fabric of double thickness is knitted.

The rod W^2 is, upon one side, provided with a longitudinal rib or projection, B^3, which, through a longitudinal slot C^3 in the casing V^2, is, upon the rod W^2 being revolved by means of the oscillation of the lever X^2, revolved forward into contact with a yielding buffer D^3 which is formed of rubber or other suitable material and which is supported upon the top of the thread guide yoke G. In this position of the rod W^2, the auxiliary threads *a* are clamped against the surface of the buffer D^3, as shown in Fig. 33, by which said threads will, by the revolution of the needle cylinder, be broken at a point between the lower ends of the thread guides and the tops of the needles, with the result that the operation of knitting fabric of a single thickness, by the employment of a single set or series of threads, will be resumed.

As is above explained, the action of the spring Y^2, when the lever X^2 is free to be operated thereby, causes the feed-holes in the rod W^2 to register with the corresponding feed-holes in the casing V^2.

Erected from and supported upon the thread-guide yoke G is a lever-bracket or keeper E^3 having a flanged edge F^3 which acts to retain the lever X^2 thereunder, as shown in Figs. 5, 6, 8, 34, and 35, when the rod W^2 has been revolved to the position shown in Fig. 33, and the threads of the auxiliary set been clamped against the buffer D^3.

The devices by which the lever X^2 is released from the flange or keeper F^3 and again thrown back into position under said flange are of the following construction: A horizontal lever G^3 is pivotally mounted upon a standard H^3 sprung from a bracket I^3 upon the main frame. The forward end of this lever is provided with forks J^3 K^3 which embrace the upper end of the lever X^2 when it is in position under the flange F^3 as shown in Fig. 8. When the rear end of the lever G^3 is thrown in a direction away from the shifting wheel L^2 the fork J^3 comes into contact with the upper end of the lever X^2 and throws it from under and out of contact with the flange F^3. The spring Y^2 operates to draw the lever X^2 in a direction toward the front of the machine and to thereby revolve the rod W^2 and cause the feed holes therein to register with the feed holes in the casing in which it is mounted. To the rear end of the lever G^3 is attached an adjustable arm L^3, provided with a depending rod M^3 the lower end of which is adapted, in the revolution of the shifting-wheel L^2, to come into contact with and ride upon cam plates N^3 O^3 mounted upon one of the faces of said shifting-wheel, with the result that the rear end of said shifting-lever G^3 is thrown in a direction away from the shifting-wheel L^2, and the fork J^3 caused to throw the lever X^2 away from and out of contact with the flange F^3 of the bracket E^3. The lengths of said cam plates N^3 and O^3 respectively, are made to correspond to the times during which two sets of threads are to be fed to the needles.

The devices by which the lever X^2 is again shifted and locked beneath the flange F^3 to throw the auxiliary set of threads out of contact with the needles are of the following construction: A horizontal rod, P^3, having at its forward extremity a slot Q^3, is mounted in a horizontal way or bearing in a bracket R^3 sprung from the main frame, so that the upper end of the lever X^2 is embraced by said slot. The rod P^3, at its other end, is pivotally attached to the upper end of a vertical lever S^3, which, intermediately of its length, is pivotally supported upon a horizontal stud T^3 sprung

from a bracket on the main frame. The lower arm of the lever S^3 is bent upwardly, or into a V-shape, and is, at its end, provided with a stud U^3, and a friction roller V^3 adapted to roll upon the periphery of a cam wheel W^3 mounted upon the shaft M^2. This cam wheel is provided with two radial slots X^3 Y^3 into which, when said slots are revolved into positions respectively opposite the stud U^3, said stud is caused to fall by reason of the upper arm of the lever S^6 being shifted by the spring Z^3, the sliding rod P^3 being thereby backwardly shifted so that the front wall of its slot Q^3 is caused to engage with the arm of the lever X^2 and pull it backward under and into contact with the flange F^3 of the bracket E^3, by which operation the auxiliary set of threads are clamped against the buffer D^3. At this point further revolution of the cam wheel W^3 elevates the stud U^3 until it again rides upon the periphery of said cam wheel. The primary set of threads employed in knitting are wound upon a horizontal spool E^4 journaled in bearings in the main frame; the threads, (see Figs. 36, 37, and 38,) before reaching the thread guides F, are subjected to the action of a tension device consisting of a horizontal rod C^4 mounted upon standards D^4 E^4 sprung from the main frame, and a swinging frame, having a horizontal bar F^4 provided with as many holes as there are threads employed, said bar F^4, at its ends, being attached to arms G^4 which are pivoted to the rod C^4.

H^4 are spiral springs each of which is, at one end, attached to the rod C^4, and, at the other extremity, to the arms G^4 in such manner as to control the downward movement of the tension bar F^4.

The primary threads 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12, after passing through the holes in the tension bar F^4, are passed over a horizontal bar I^4 which is supported at its extremities upon standards sprung from the main frame, and are further passed over a horizontal wire J^4 also supported by standards sprung from the main frame, so that the threads are vertically conducted to the thread guides. The set of auxiliary threads are mounted, and are passed to the thread guides, in the same manner as the primary threads.

The method of forming the heels and toes of stockings, upon a machine of the construction hereinbefore described, is represented in Fig. 44. A series of twelve needles is shown as employed, and the position of each of the needles of said series, at the point at which the first reversal of the machine occurred, is represented from 1 to 12. The needles are shown as having been operated to the positions 1^a to 12^a, and again, in a reverse direction, to the positions 1^b to 12^b.

It will be understood that the number of reversals of the needle cylinder, the intervals at which they occur, and the number of gores, as well as the length of each gore, may all be regulated according to the size and shape of the heel and toe to be produced.

Having thus described my invention, I claim:—

1. In a circular knitting machine, in combination, a revoluble needle-provided cylinder equipped with gearing, a worm wheel provided with a worm and with a worm switch and adapted to gear into the gearing of said cylinder, a horizontal lever intermediately of its length pivoted to the main frame and provided at one end with devices for shifting the worm switch and at the other end with forks, and a shifting wheel provided upon each of its faces with pins or projections adapted, in the revolution of said wheel, to alternately come into contact with the inside edges of said forks and shift the lever, as and for the purpose specified.

2. In combination, a revoluble needle-provided cylinder equipped with a gear wheel, a main driving shaft provided with a worm wheel and with a worm wheel switch, a horizontal lever pivotally mounted upon the main frame and provided at one end with devices adapted to be brought into contact with and to operate said worm-wheel switch and at the other end with forks, a shifting wheel provided upon its sides with pins or projections adapted, in the revolution of said wheel, to come into contact with the inside edges of said forks and shift said lever, and gearing between said main driving shaft and said shifting wheel, as and for the purpose specified.

3. In a circular knitting machine, a horizontal lever intermediately of its length pivotally mounted upon the main frame, adapted to operate the worm-switch of the needle-cylinder-actuating worm-wheel, and provided at one end with forks, in combination with a shifting wheel having pins or projections upon its faces at such distances apart and so located as to, in the revolution of said shifting wheel, come into contact with the forks of said lever and reciprocate said lever, as and for the purpose specified.

4. The combination with a needle provided cylinder, of thread guides, a rotatable rod formed with passages for a set of auxiliary threads and having a rib B or its equivalent, a stationary or fixed clamp member, and means, substantially as described, for rotating said bar to cause said rib to press said auxiliary threads against the fixed clamp member, whereby the auxiliary threads may be either permitted to move freely through the guides, or be clamped to prevent their passage through the guides and thereby occasion the breaking of said threads at points between the clamping device and the needles, substantially as and for the purposes set forth.

5. In a circular knitting machine, in combination, a revoluble needle-provided cylinder, reciprocating thread guides, a brake adapted to be operated to permit the passage of the threads through said guides and also to clamp or hold said threads and prevent their passage through said guides, a brake-lever connected with said brake and adapted

to operate it, a keeper to hold said brake lever when the brake is locked, a spring to hold said brake lever when the brake is unlocked, a device substantially as described for automatically, in the operation of the machine, throwing said brake lever out of contact with said keeper, and a device substantially as described for automatically, in the operation of said machine, drawing said brake lever into contact with said keeper, as and for the purpose specified.

6. In a circular knitting machine, in combination, a revoluble needle-provided cylinder, reciprocating thread guides, a brake adapted to be operated both to permit the passage of threads through said guides and also to clamp or hold said threads and prevent their passage through said guides, a brake-lever connected with said brake and adapted to operate it, a keeper to hold said brake lever when the brake is locked, a spring to hold said brake-lever when the brake is unlocked, a horizontal lever pivotally supported upon the main frame, adapted at its forward end to be brought into contact with said brake lever, and adapted at its rear end to, at predetermined times and for predetermined periods, come into and be in contact with projections upon the side of a revolving shifting-wheel, and a revoluble shifting wheel to oscillate said brake lever and throw it out of contact with its keeper, as specified.

7. In a circular knitting machine, in combination, a revoluble needle-provided cylinder, reciprocating thread guides, a brake adapted to be operated both to permit the passage of threads through said guides and to clamp or hold said threads and prevent their passage through said guides, a brake lever connected with said brake and adapted to operate it, a keeper to hold said brake lever when the brake is locked, a spring to hold said brake lever when the brake is unlocked, a horizontal sliding rod mounted upon the main frame, and, at its forward extremity, connected with said brake lever, a vertical lever pivotally mounted upon the main frame and having one arm pivotally connected with said sliding rod, a cam wheel provided with radial slots, adapted to be revolved in the operation of the machine, and adapted to support upon its periphery the extremity of the other arm of said vertical lever, and a spring connected with said vertical lever, as and for the purpose specified.

8. In a circular knitting machine, in combination, a revoluble shaft supported in bearings in the main frame, a shifting lever, a shifting wheel mounted on said shaft and provided upon its face with a series of pins for operating said lever, and also provided as to portions of its periphery with gearing, and as to those portions of its periphery which are not provided with gearing, upon its side faces provided with a series of pins, a revoluble shaft mounted in bearings in the main frame, adapted to be revolved in the operation of the machine, provided with a gear wheel meshing into the gearing on the periphery of said shifting wheel, and provided with radial arms adapted to come into contact with pins upon the faces of said shifting wheel and cause its revolution, as and for the purpose specified.

9. In a circular knitting machine, in combination, a worm wheel M provided with a switch Q' and with turn buckles U' V', a shifting lever A^2, and a shifting wheel L^2 provided with pins N^2, as and for the purpose specified.

10. In a circular knitting machine, in combination, thread guides F, a thread brake consisting of a casing V^2 provided with thread feed-holes Z^2 and with a longitudinal slot C^3, a revoluble rod or brake W^2 provided with a rib or projection B^3 and with thread holes A^3, a lever X^2, a sliding rod P^3, a spring controlled lever S^3, and a radially slotted cam wheel W^3, as and for the purpose specified.

In testimony whereof I have hereunto signed my name this second day of July A. D., 1886

JOHN ADAMS

In the presence of
WM. C STRAWBRIDGE,
J BONSALL TAYLOR.