

(No Model.)

6 Sheets—Sheet 1.

E. MORRIS.

MACHINE FOR INSERTING THREADS INTO WOVEN FABRICS.

No. 549,737.

Patented Nov. 12, 1895.

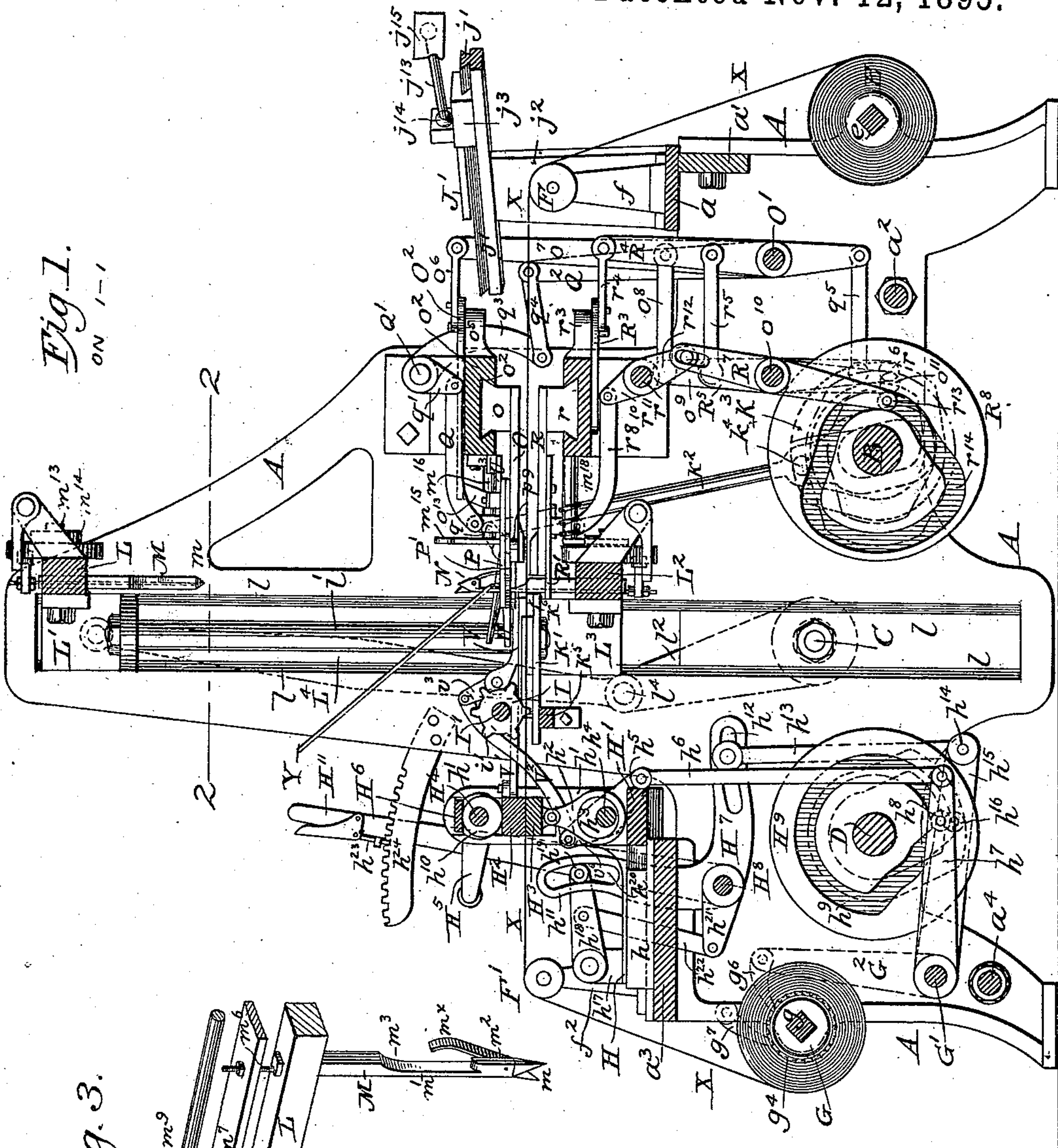


Fig. 1.
ON 1-1

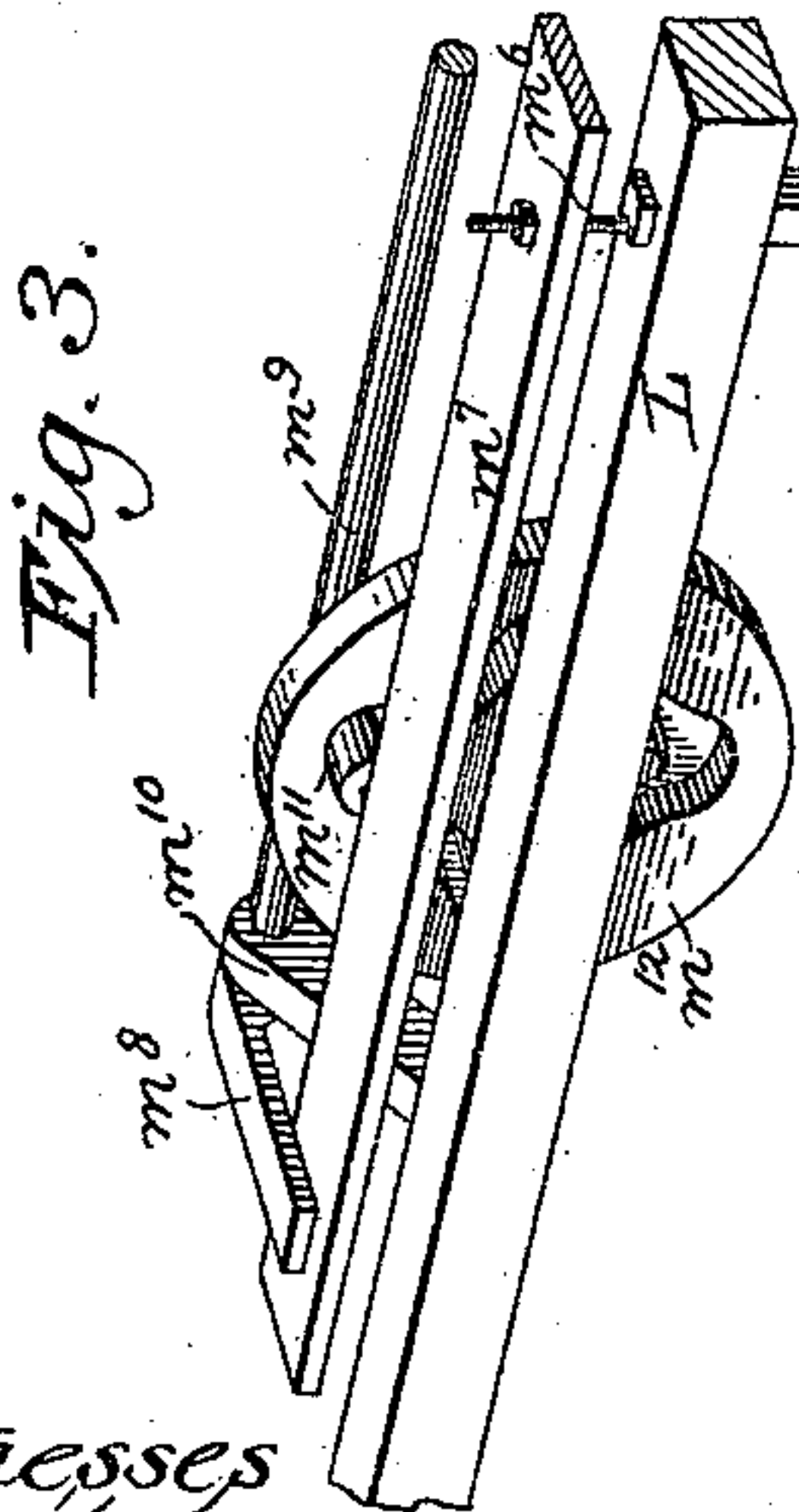
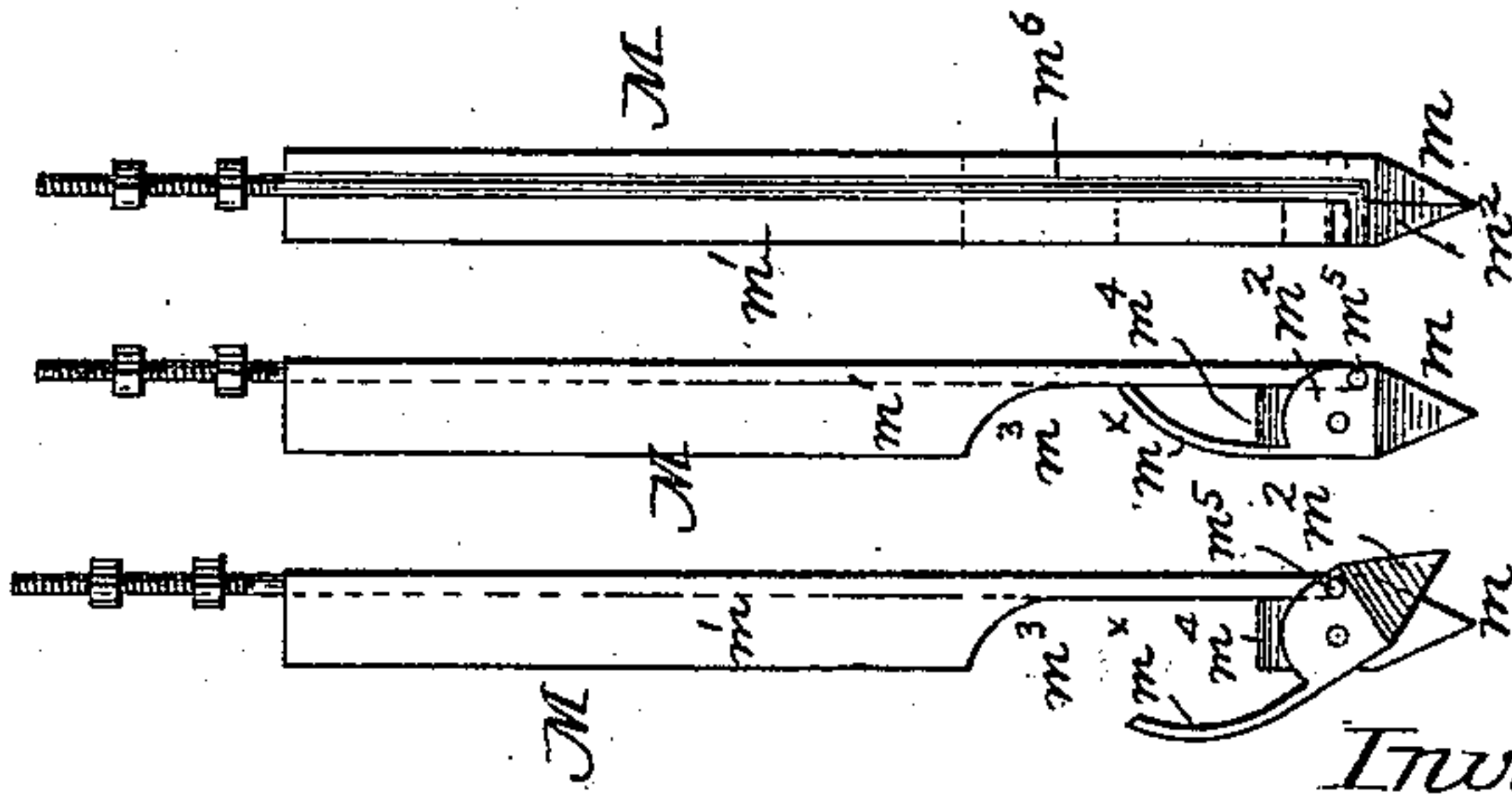


Fig. 3.



Inventor:

EDMUND MORRIS
by his attorneys

Baldwin Davidson & Night.

Witnesses

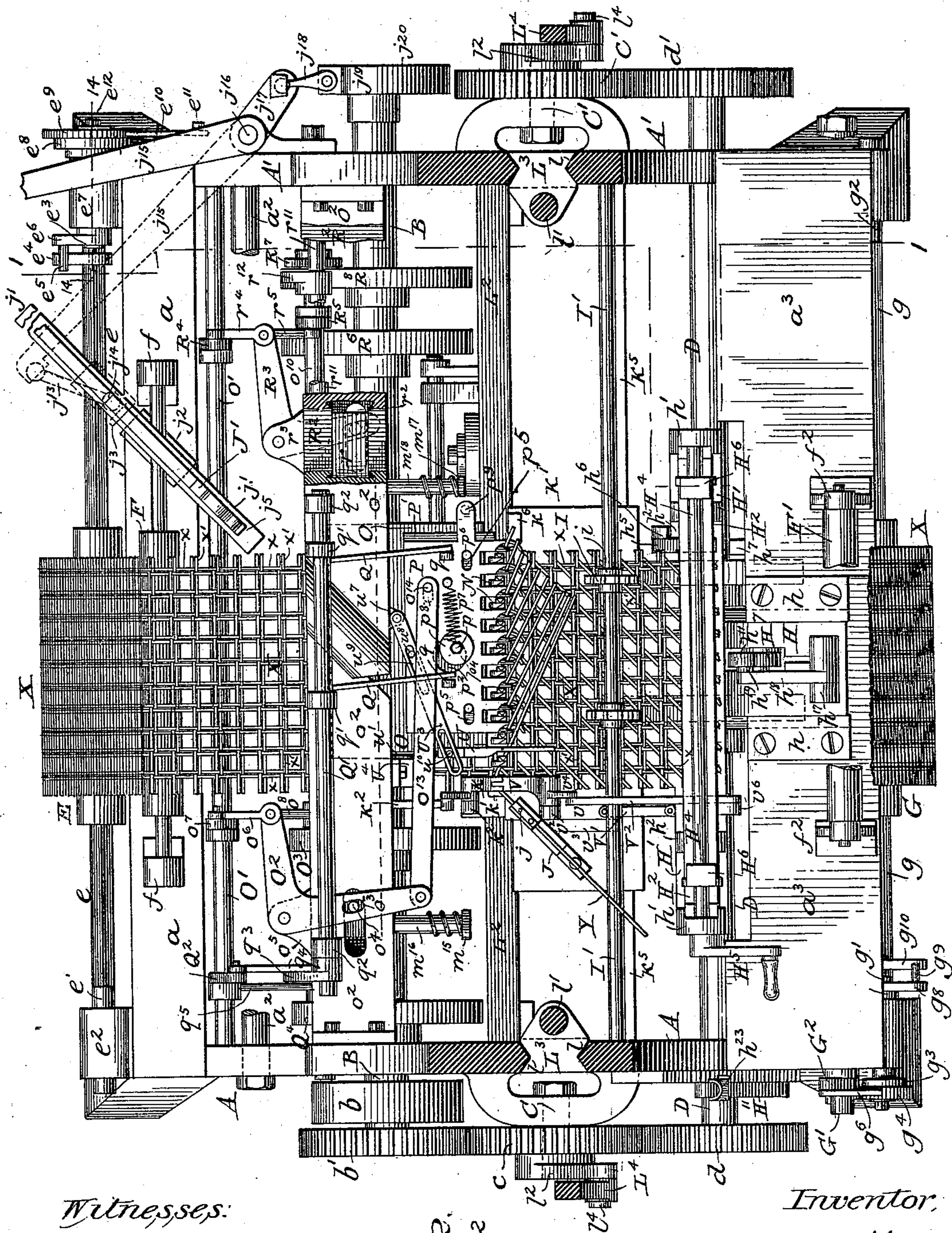
~~Edmund P. Hollingsworth~~
W. W. Hollingsworth

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Witnesses:

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W. W. Hollingsworth

Fig. 2.
ON 2-2

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Puldon, Davidson & Wight

(No Model.)

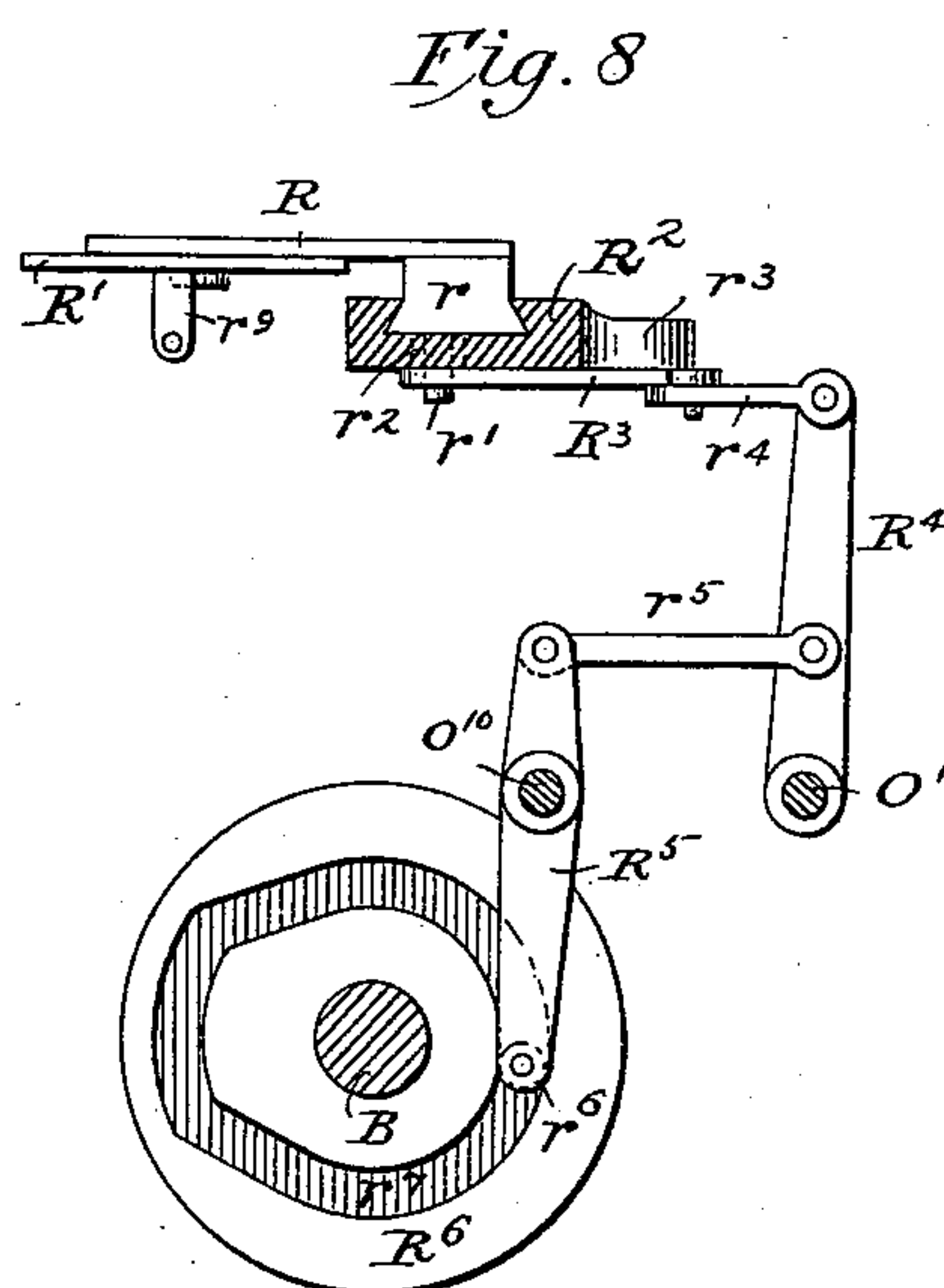
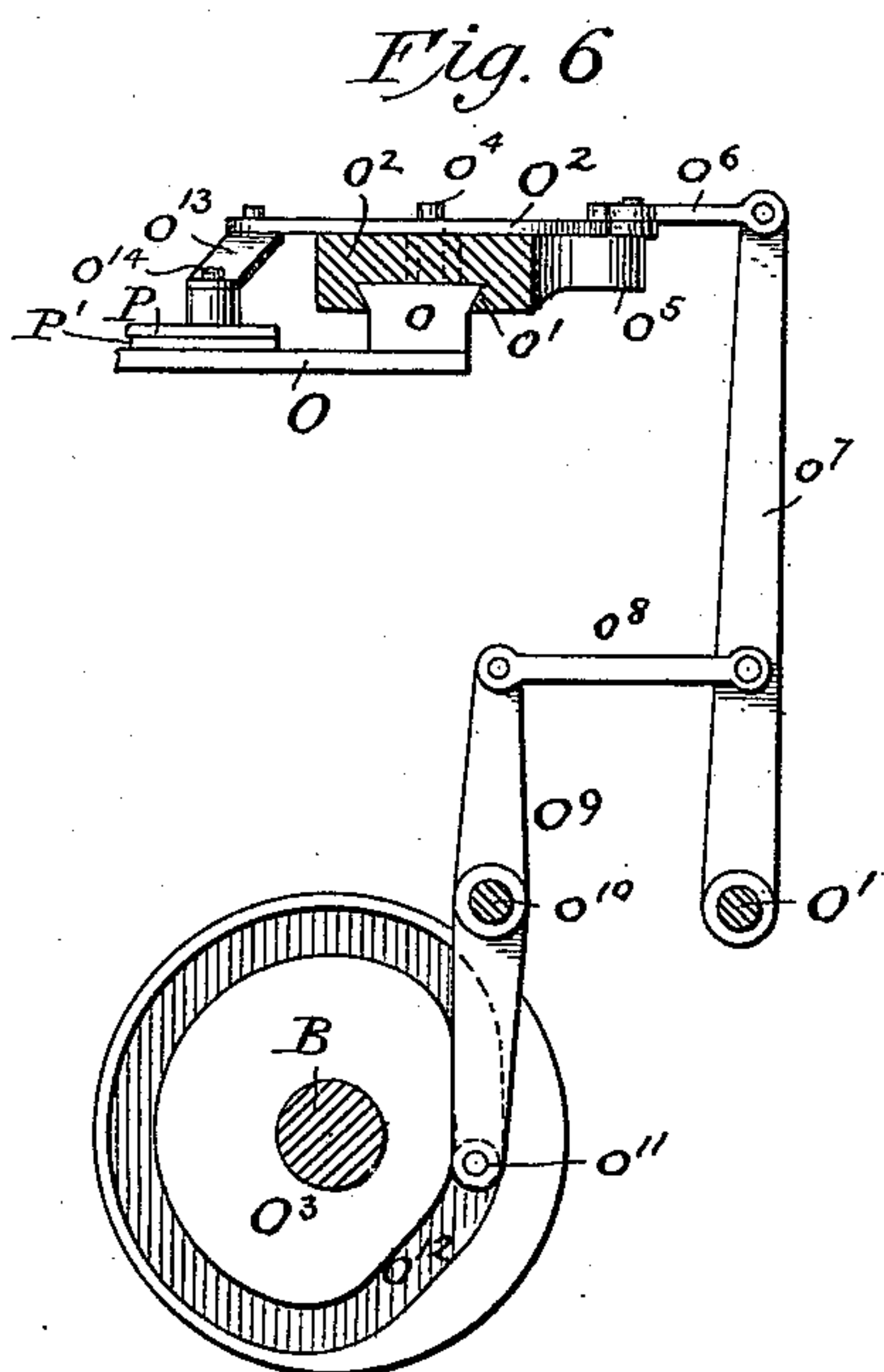
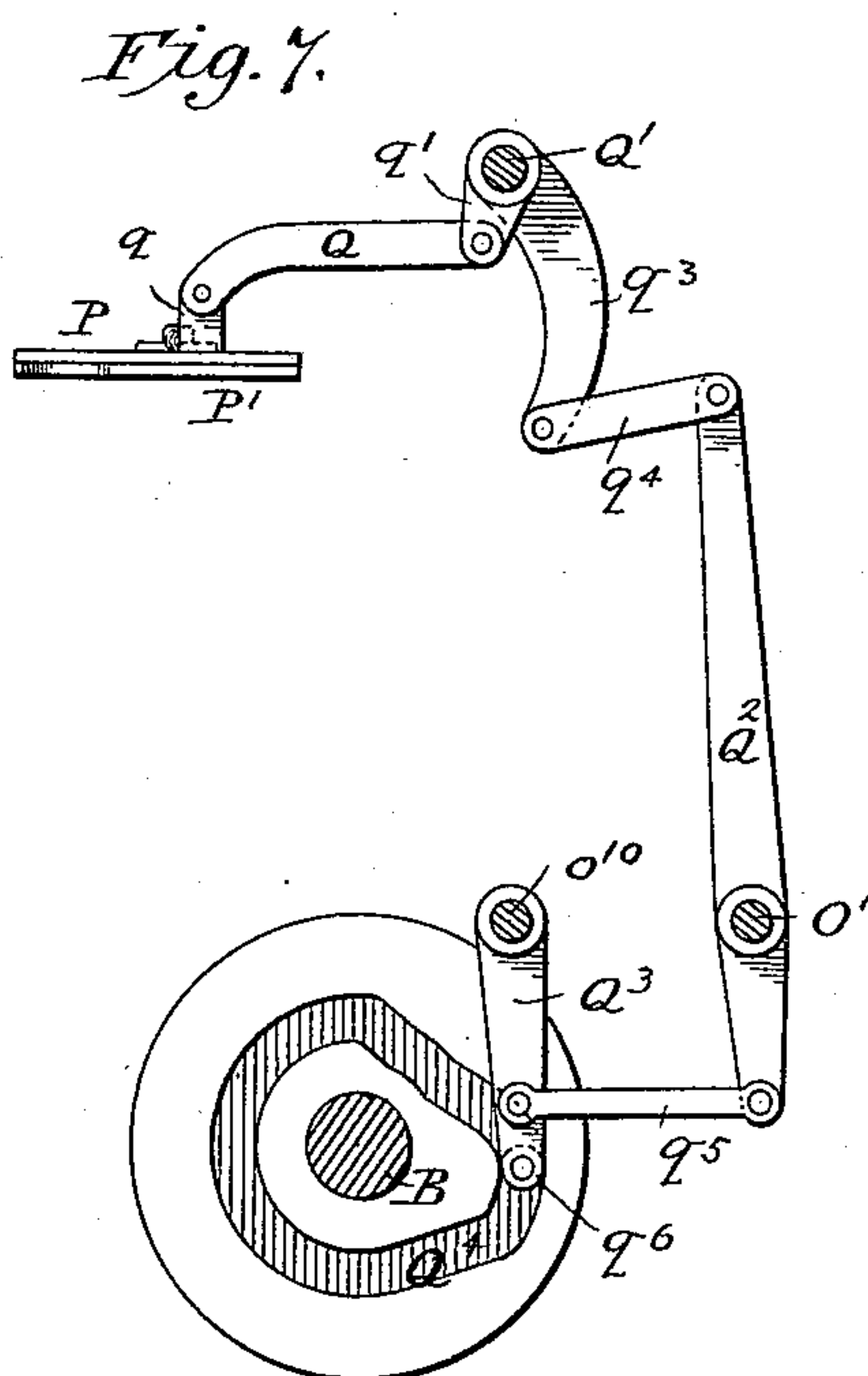
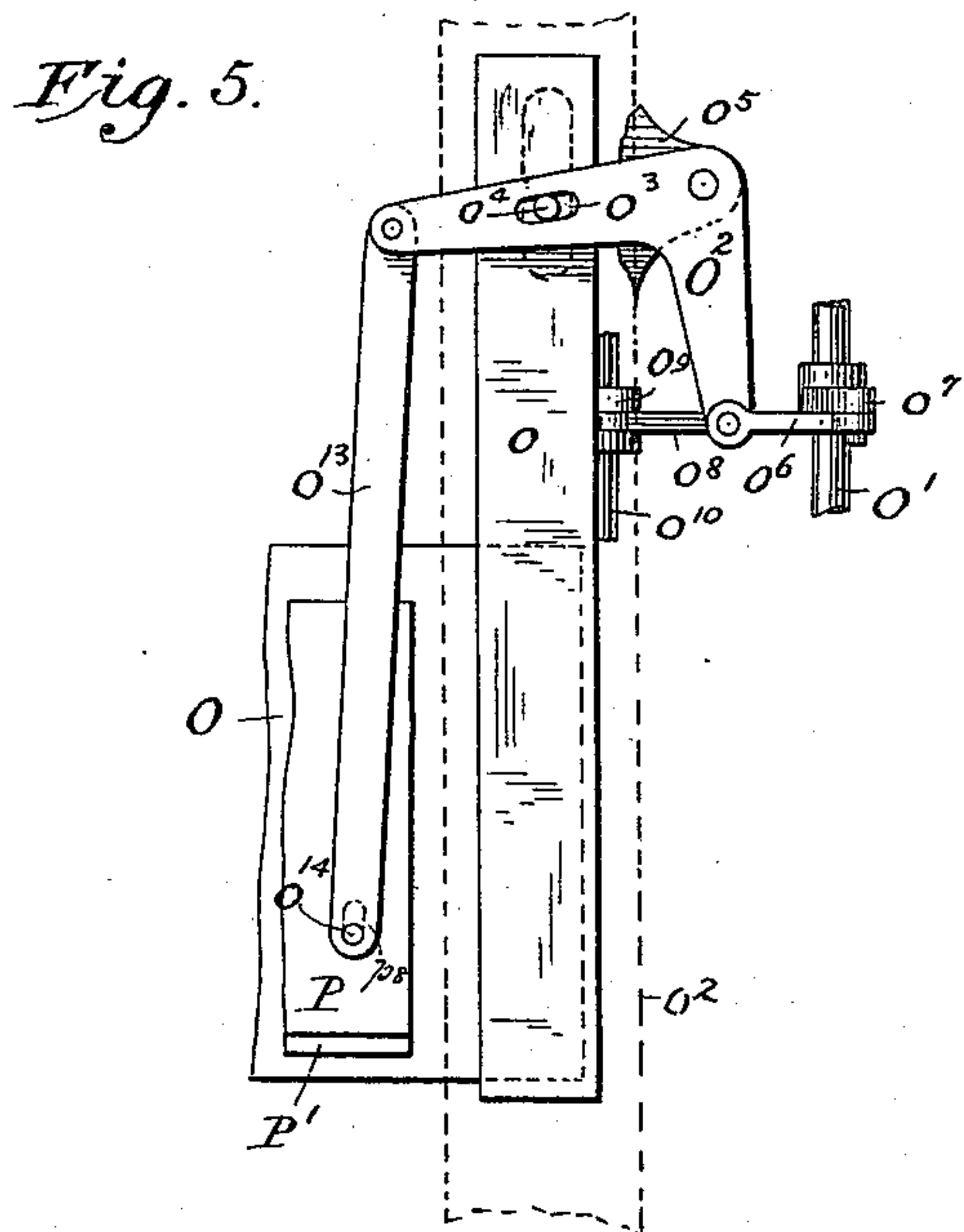
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(No Model.)

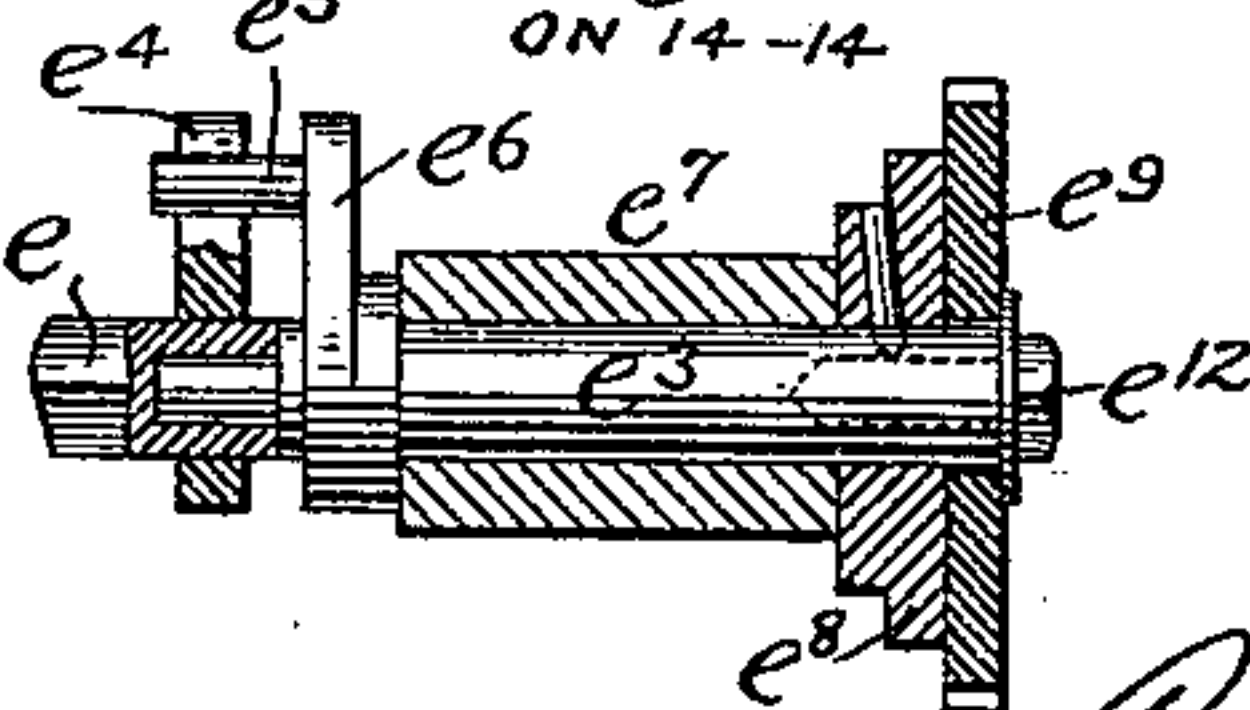
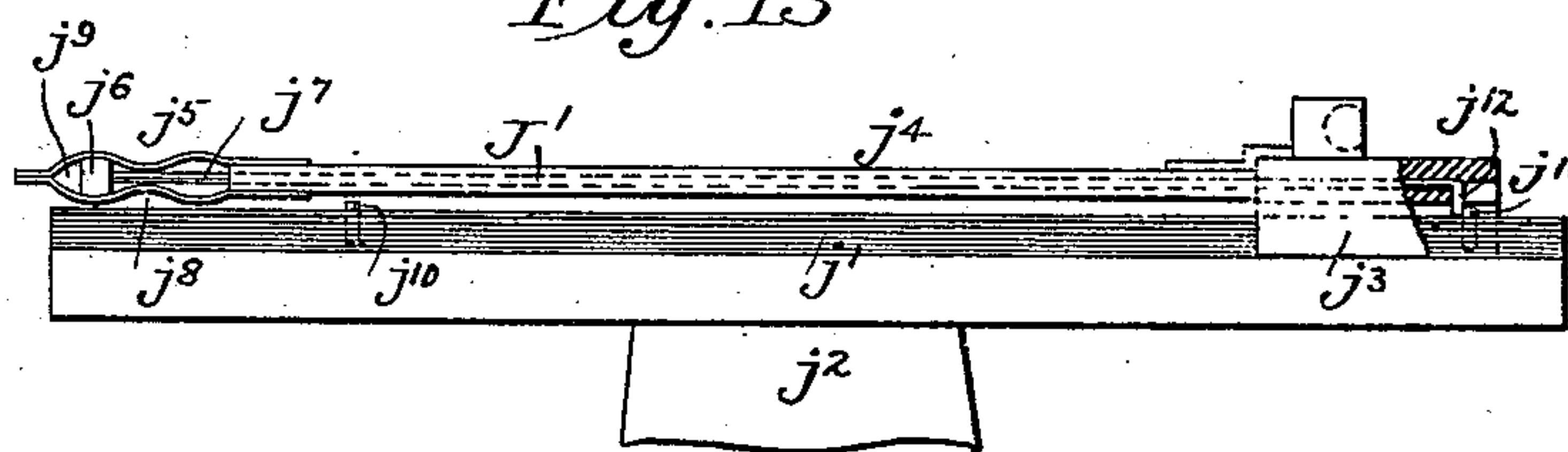
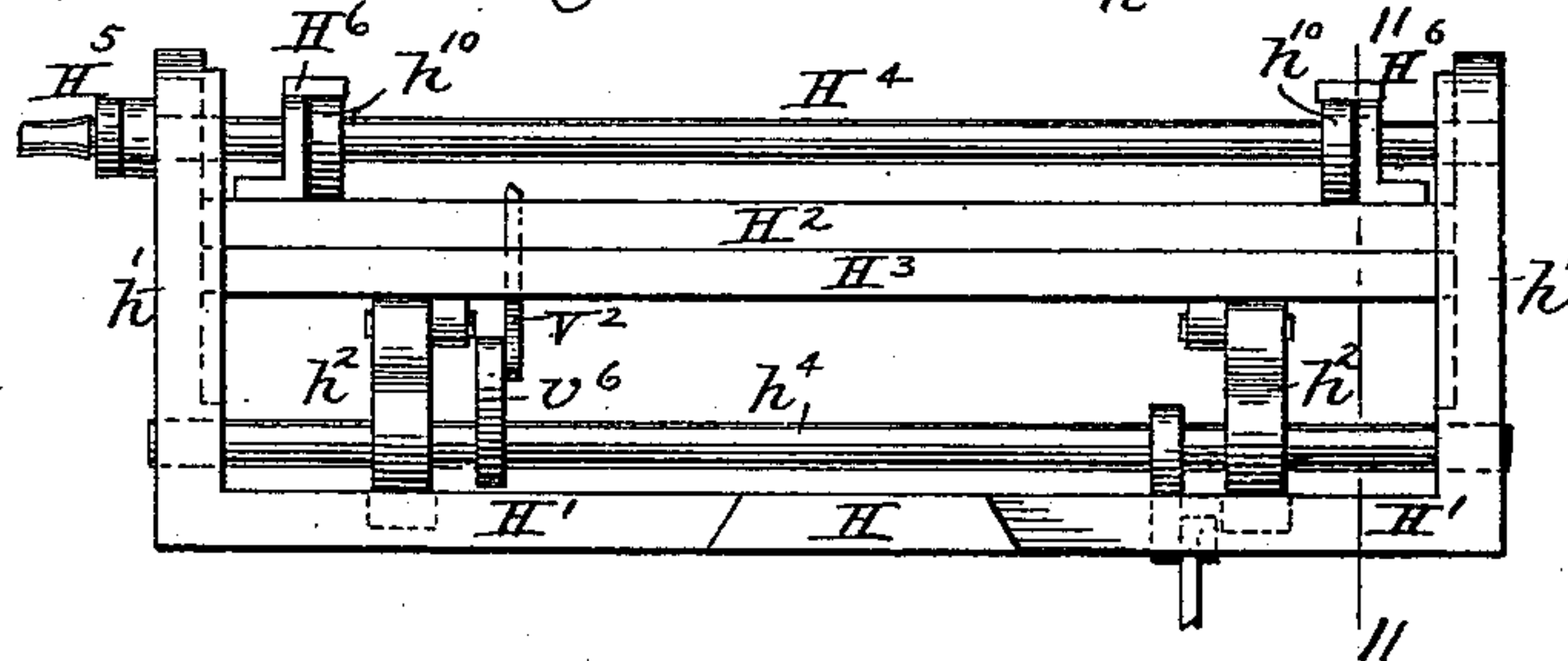
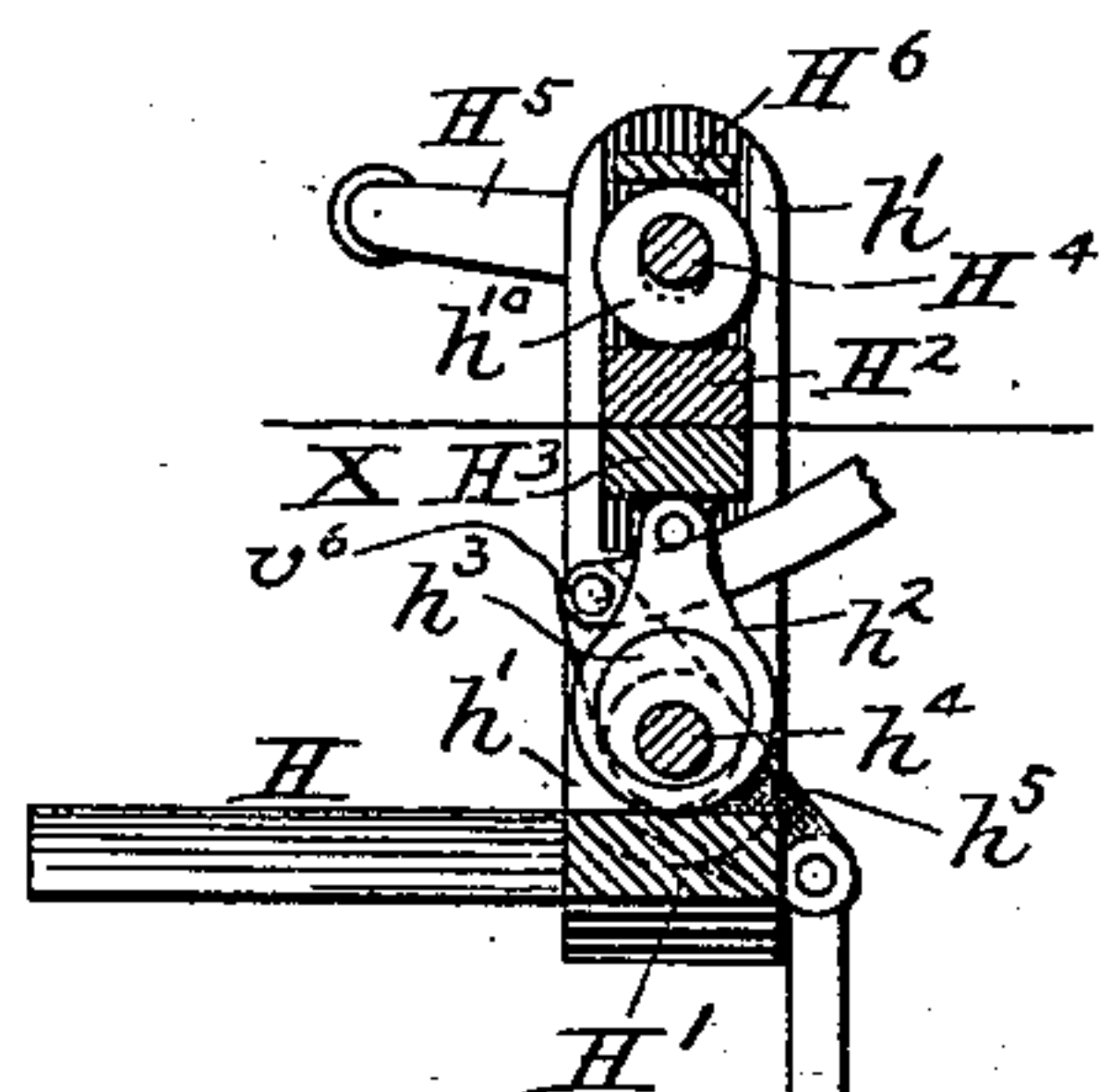
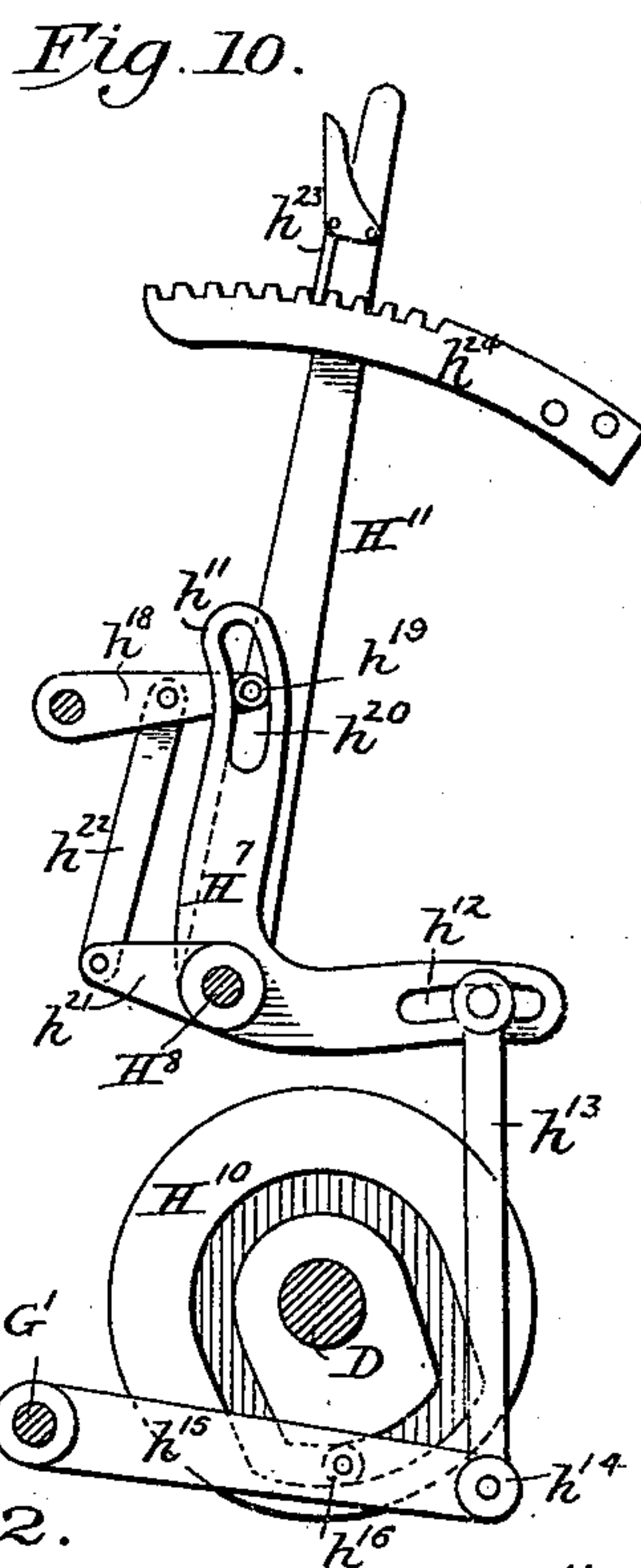
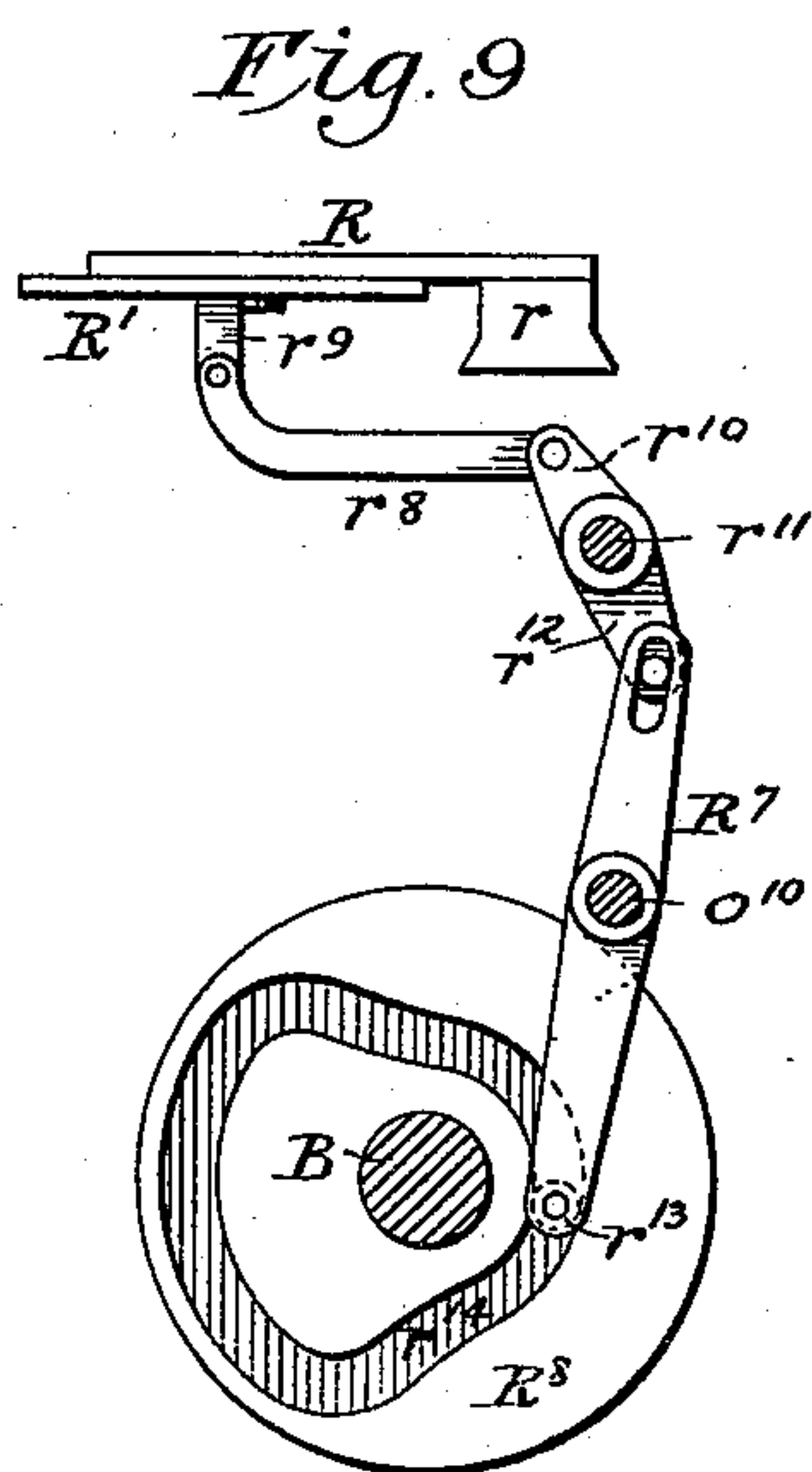
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(No Model.)

6 Sheets—Sheet 5.

E. MORRIS.

MACHINE FOR INSERTING THREADS INTO WOVEN FABRICS.

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Fig. 15

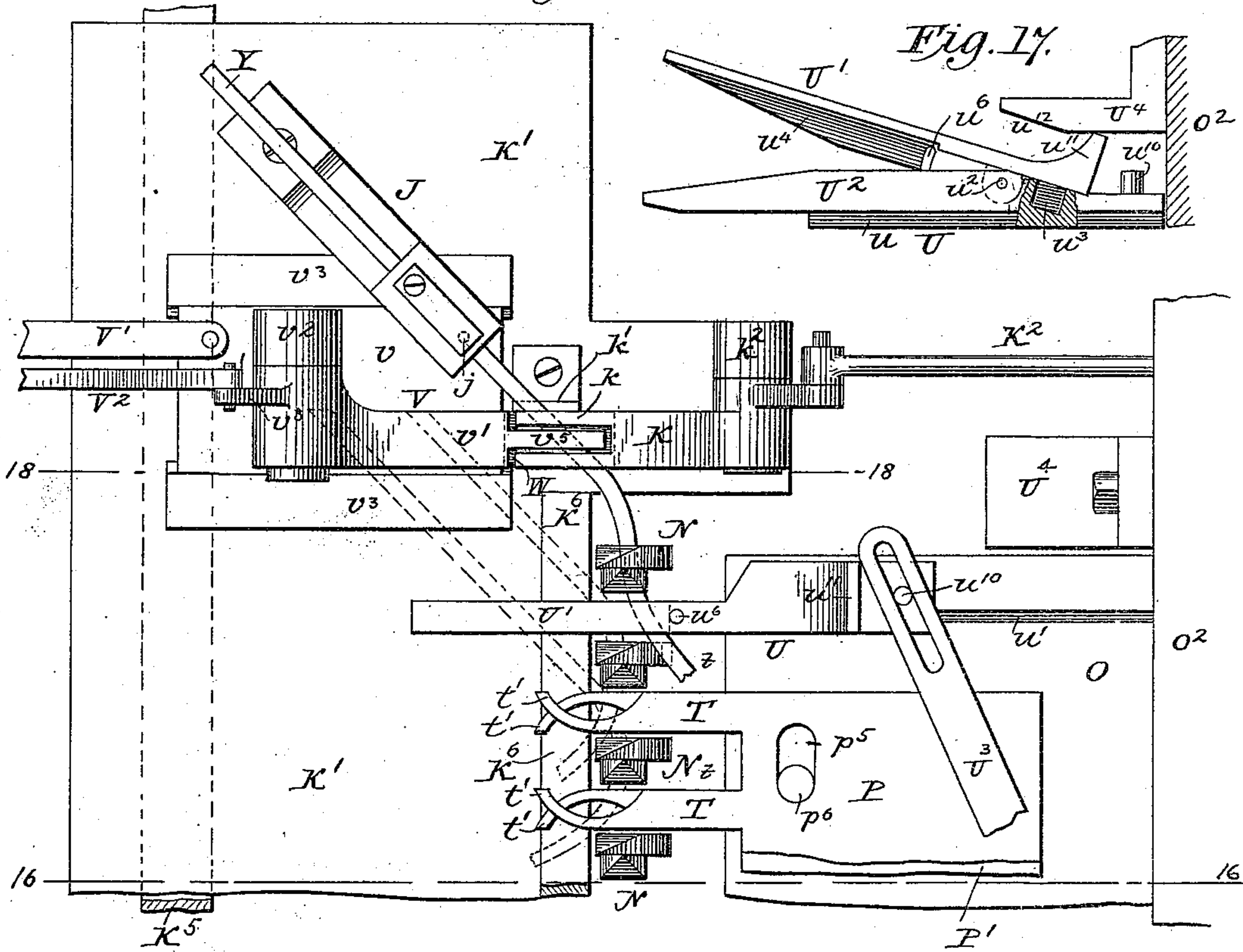


Fig. 17

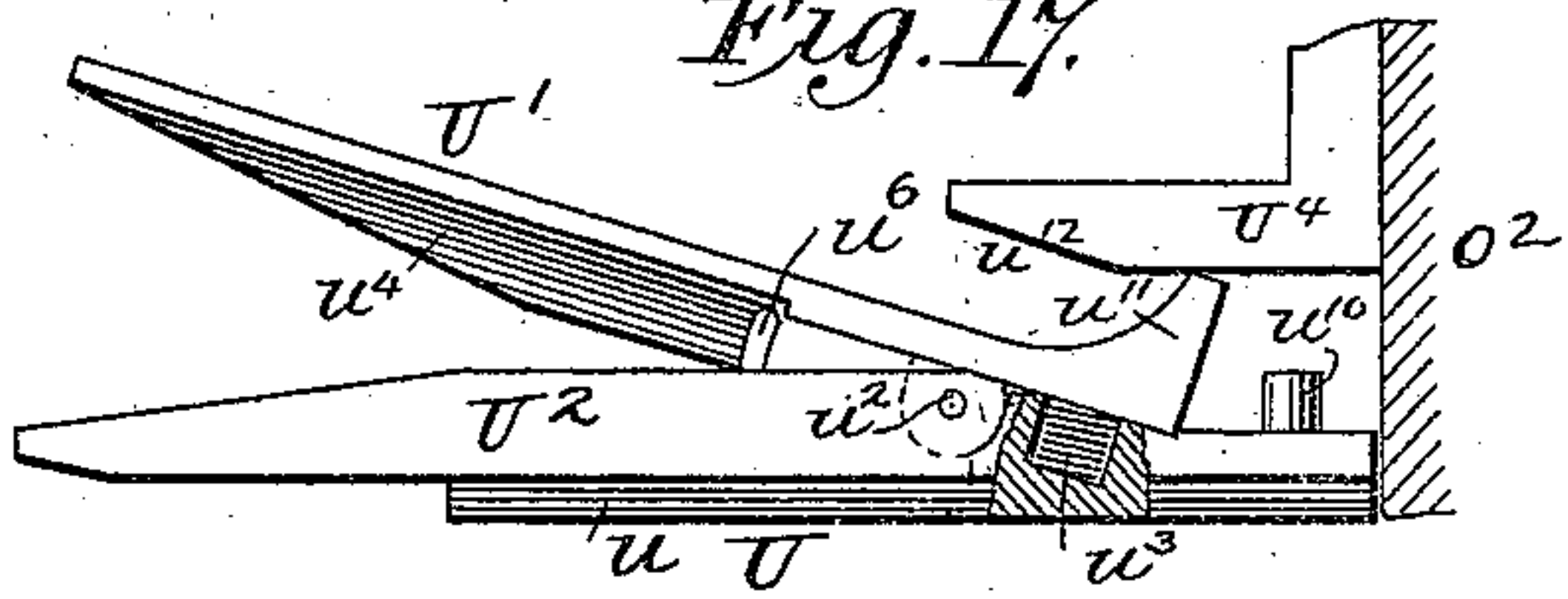


Fig. 16

ON 16-16

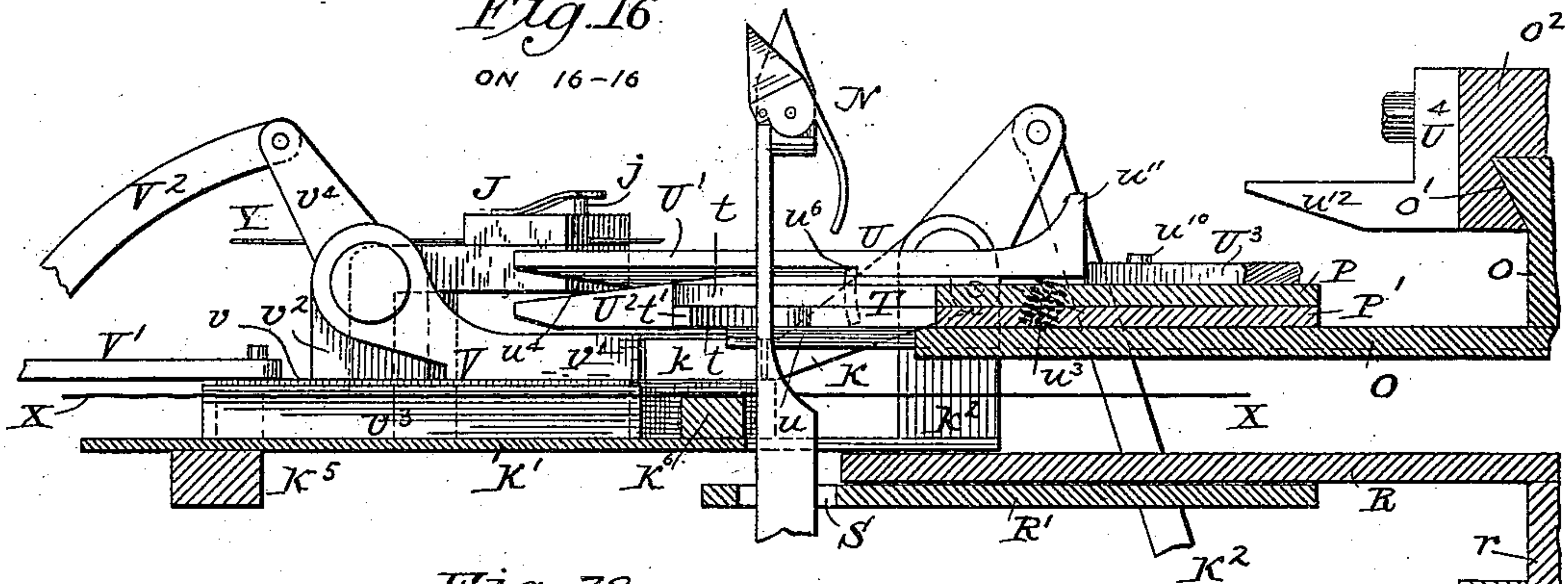
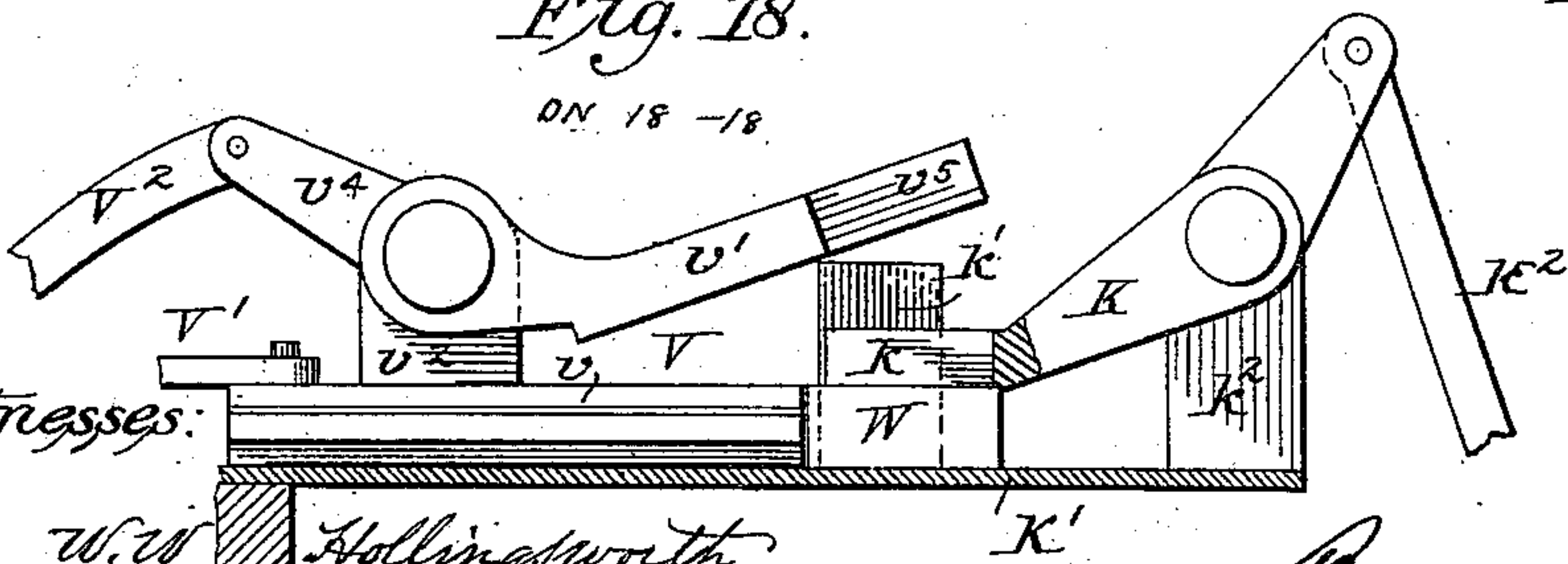


Fig. 18

ON 18-18



Witnesses:

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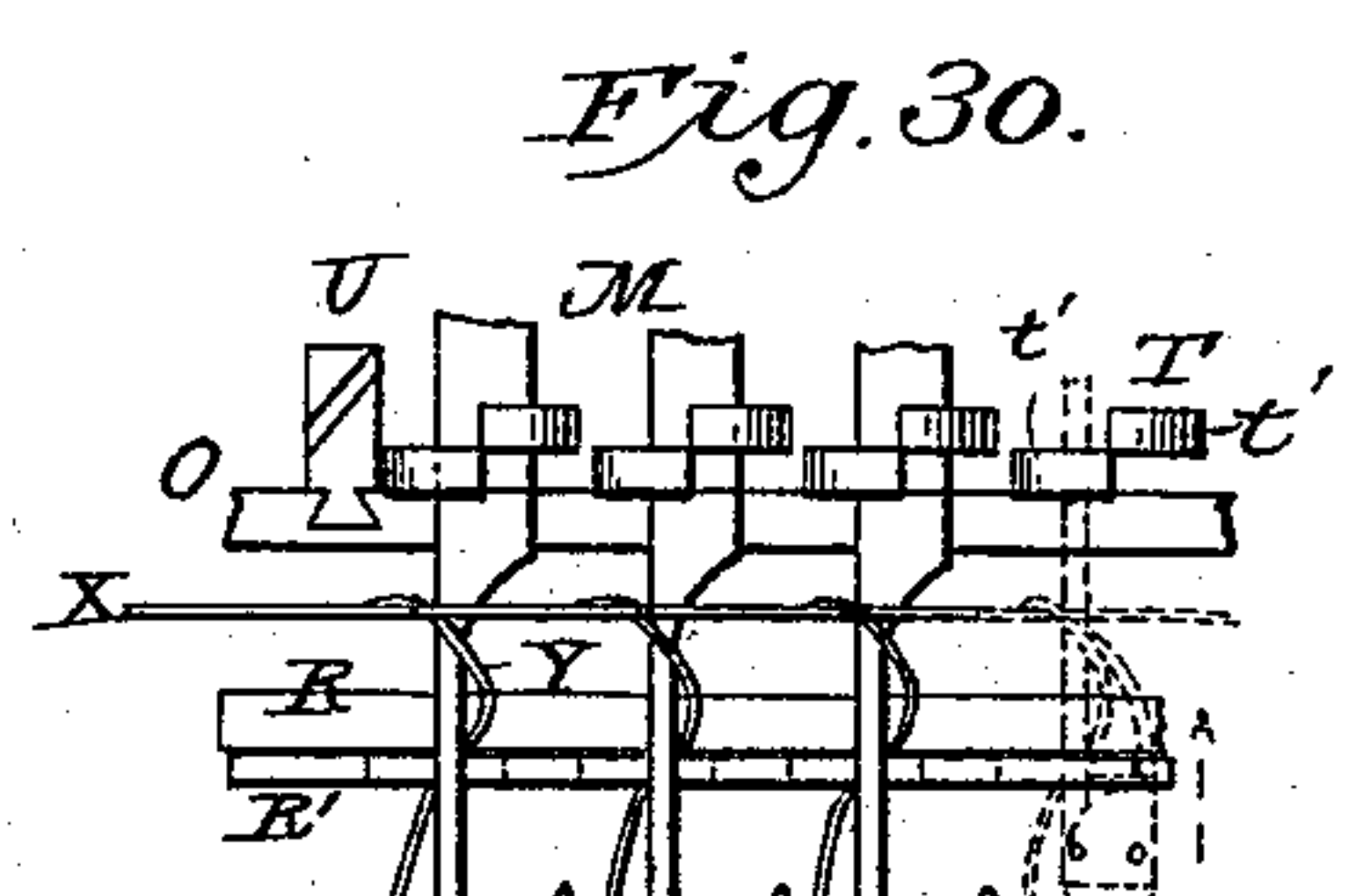
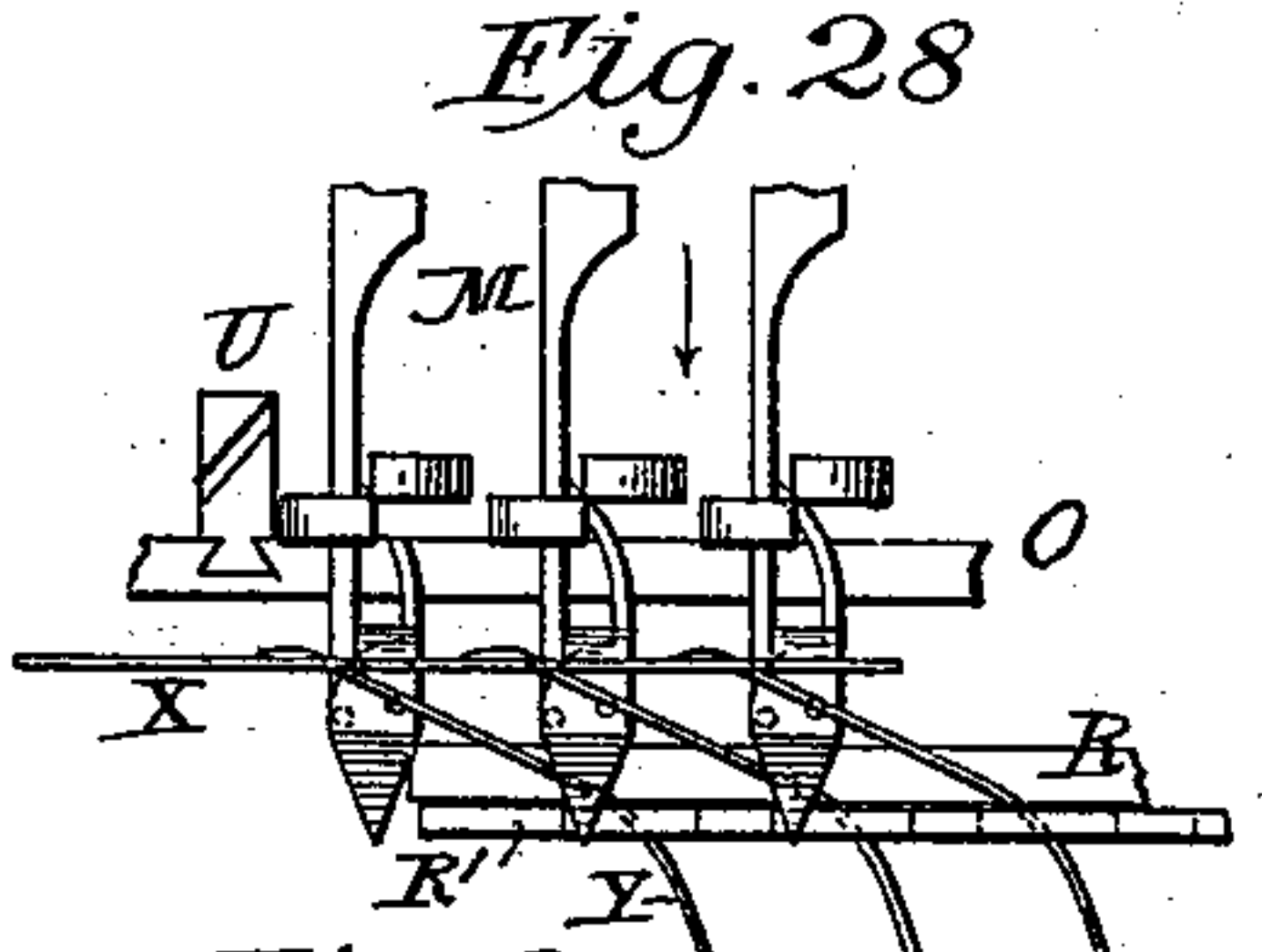
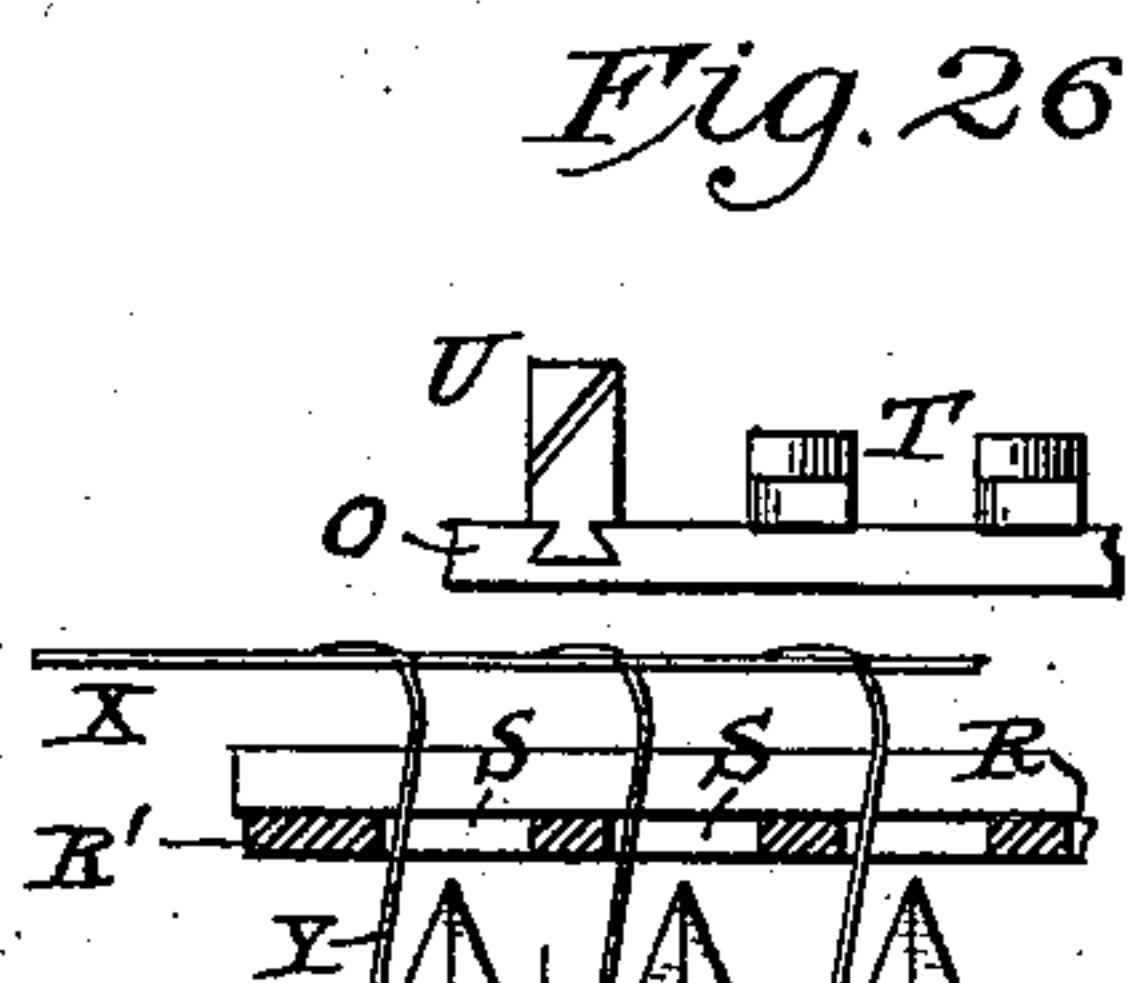
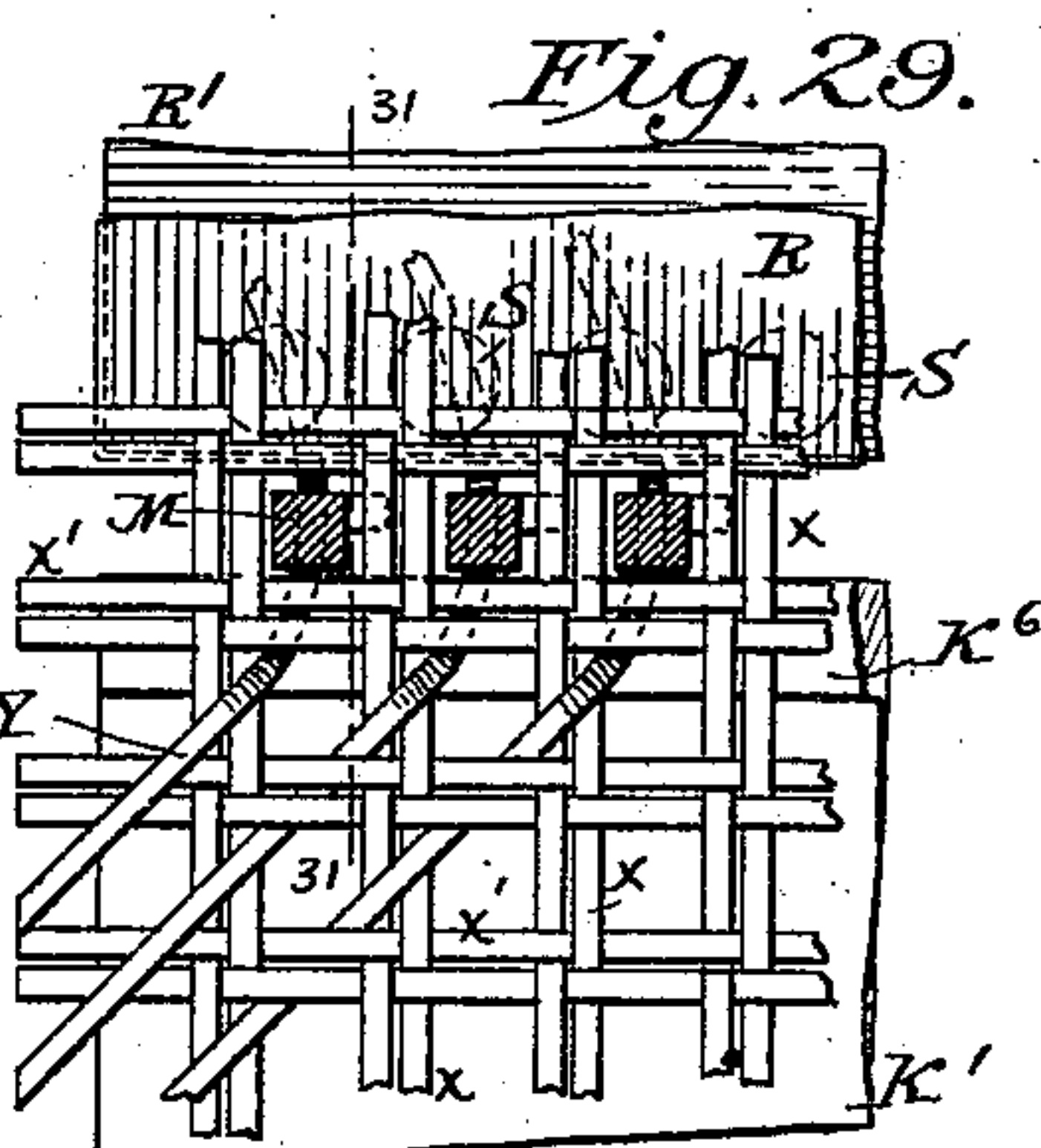
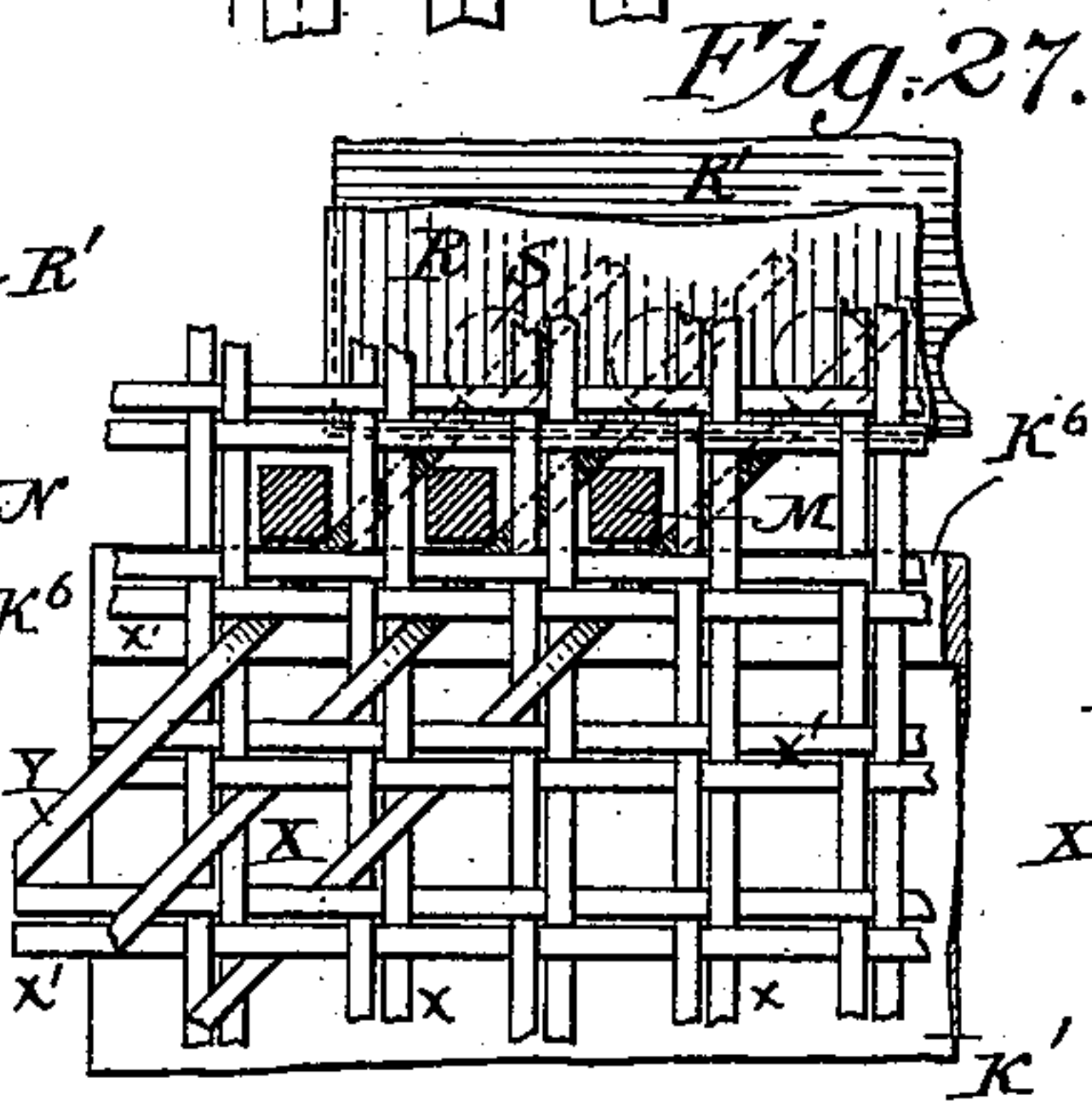
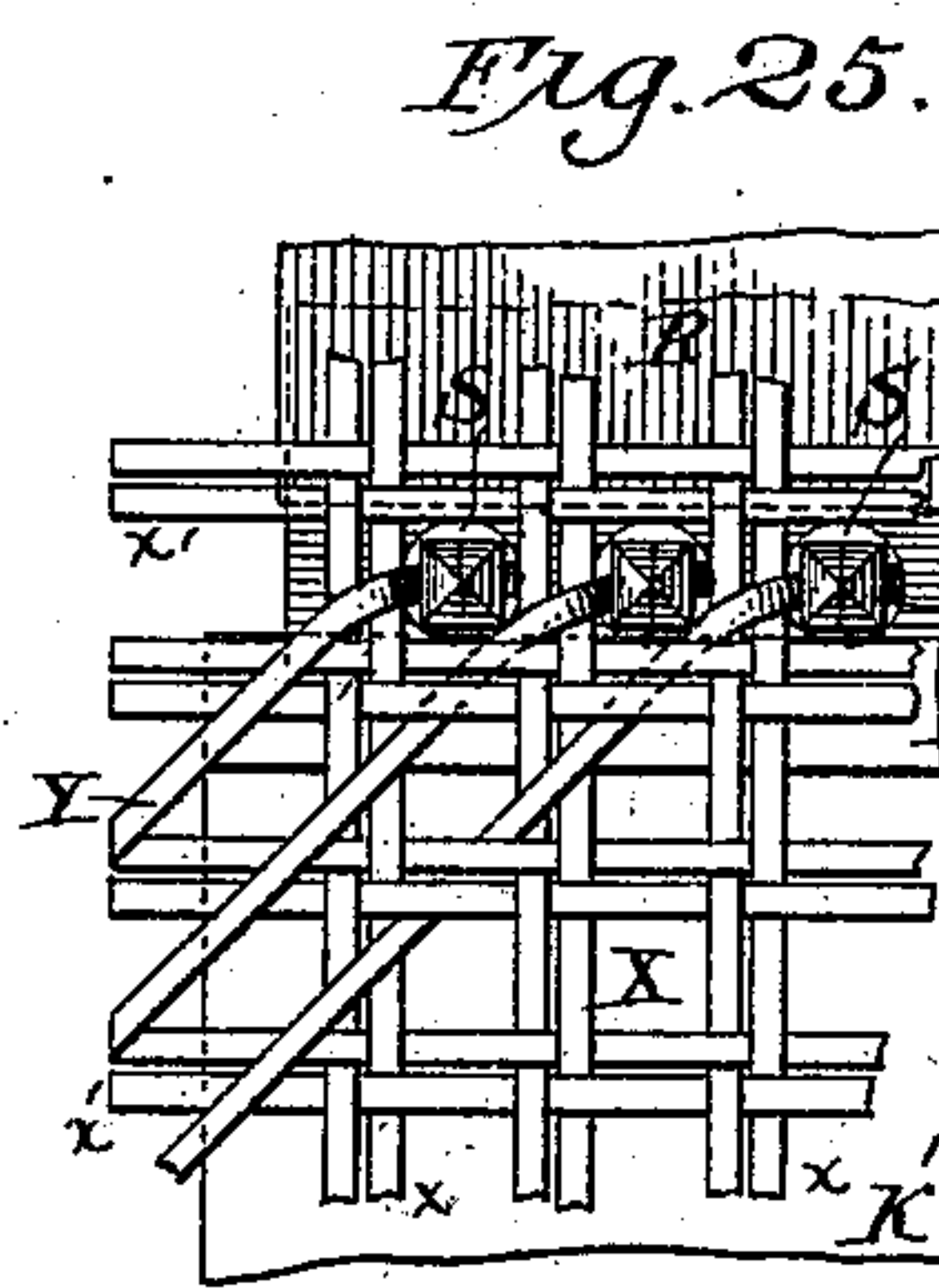
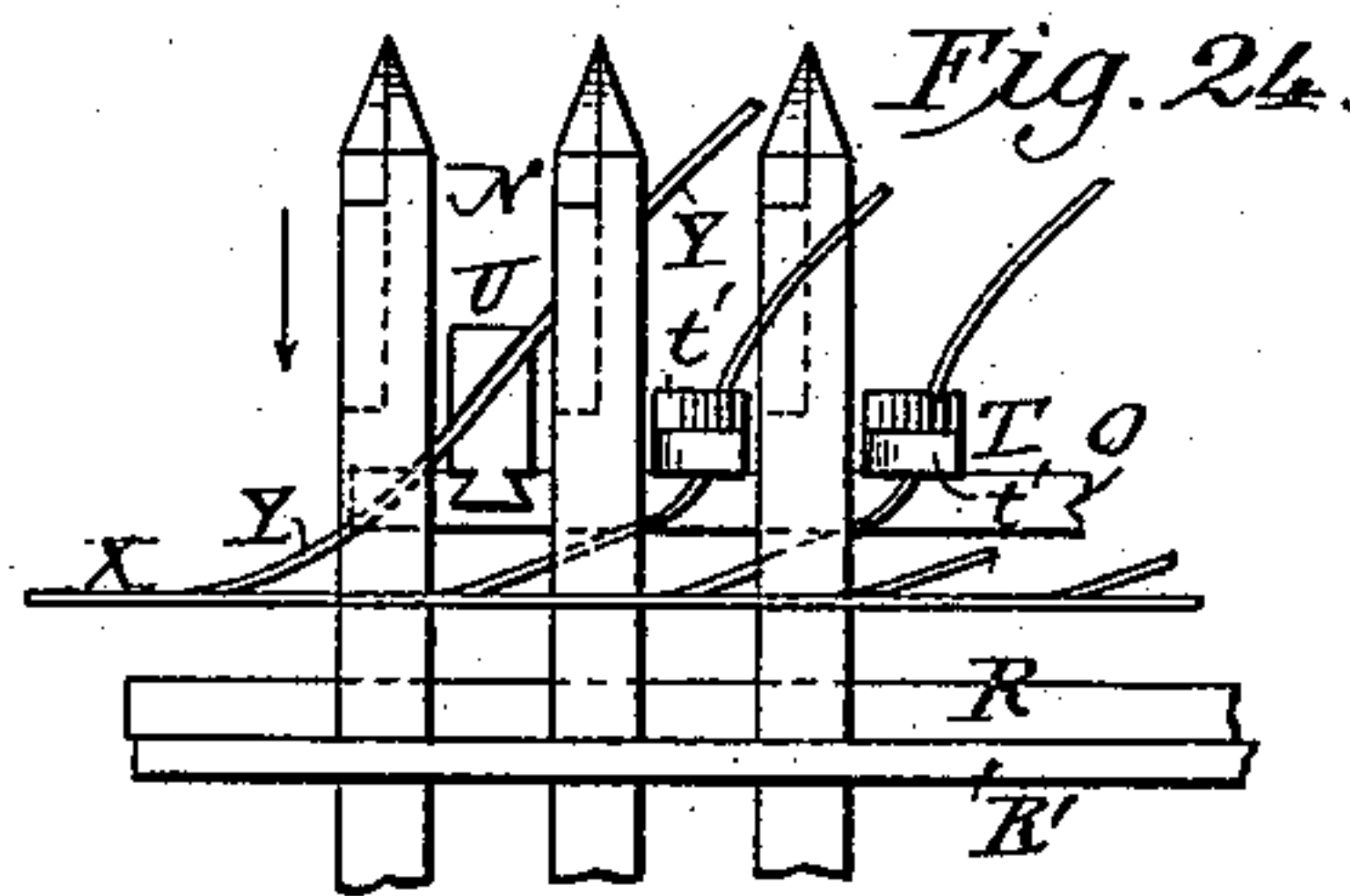
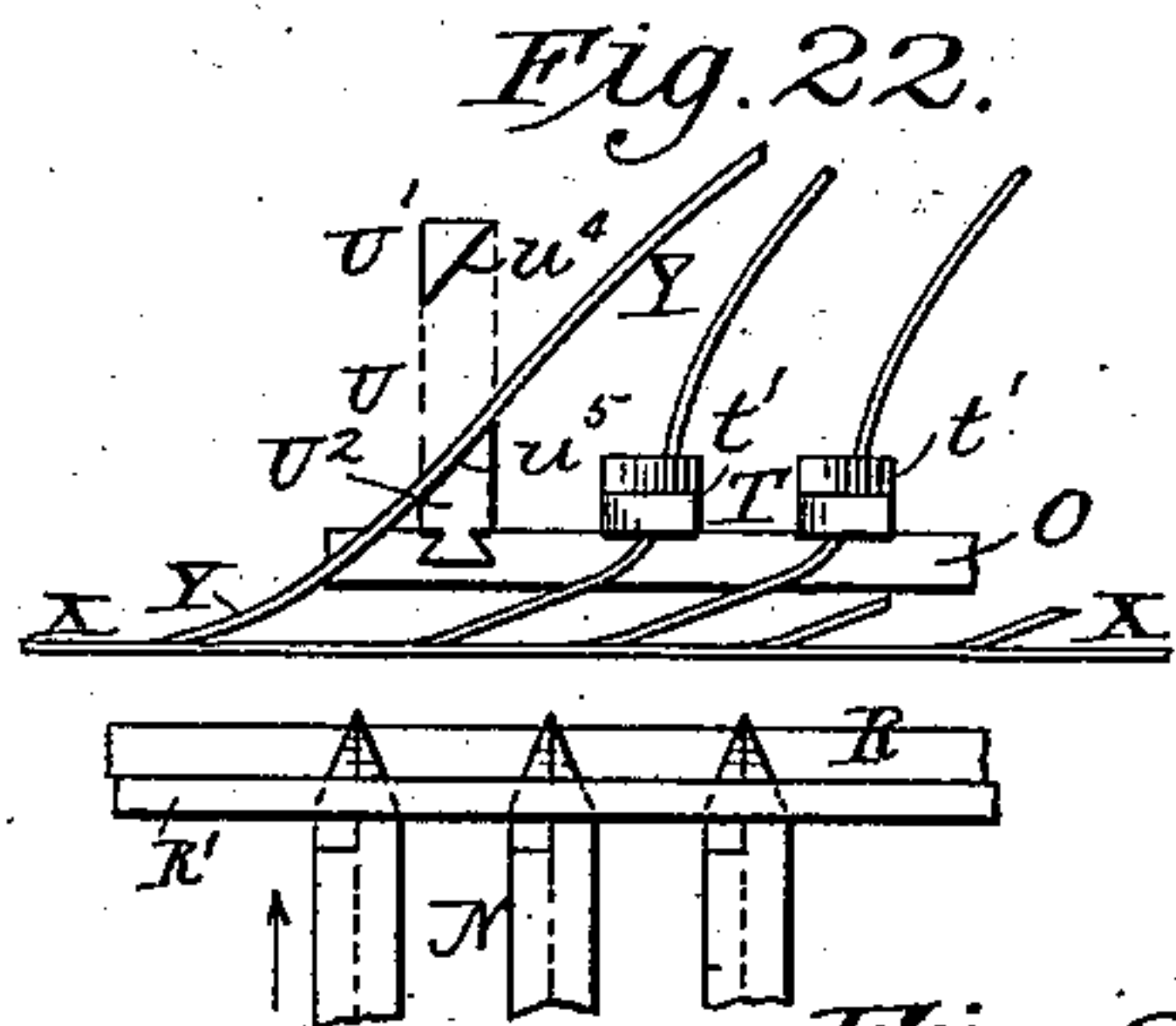
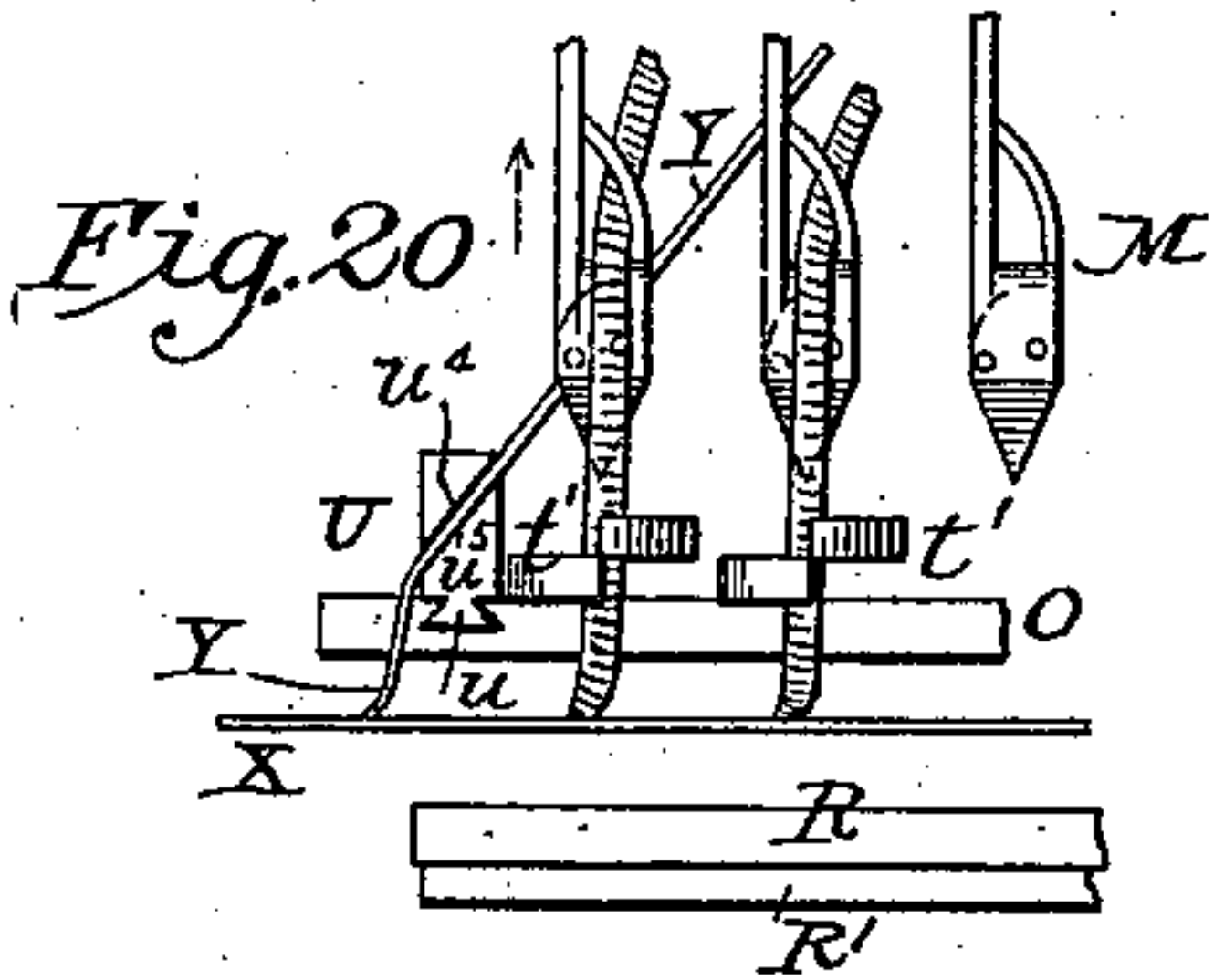
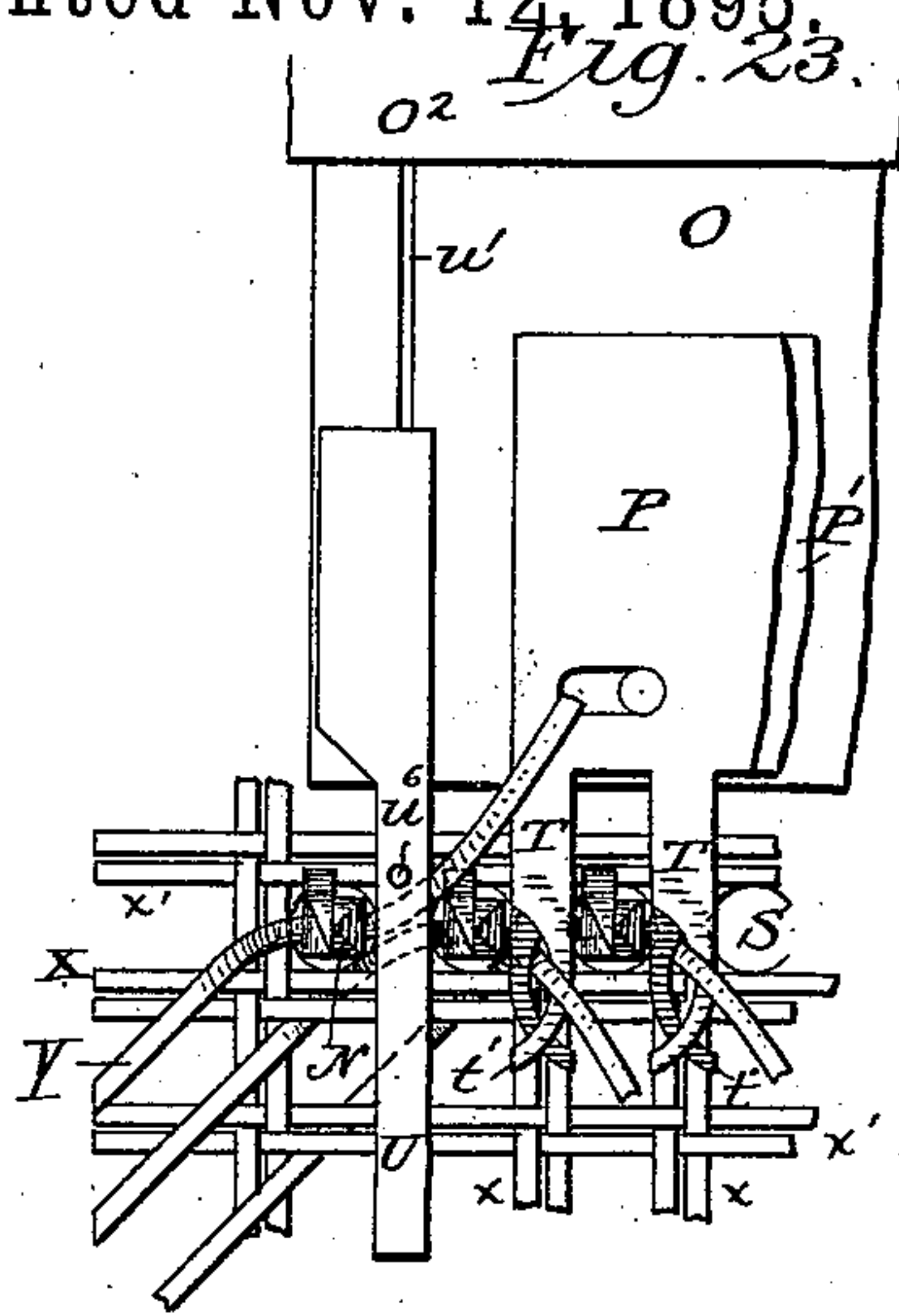
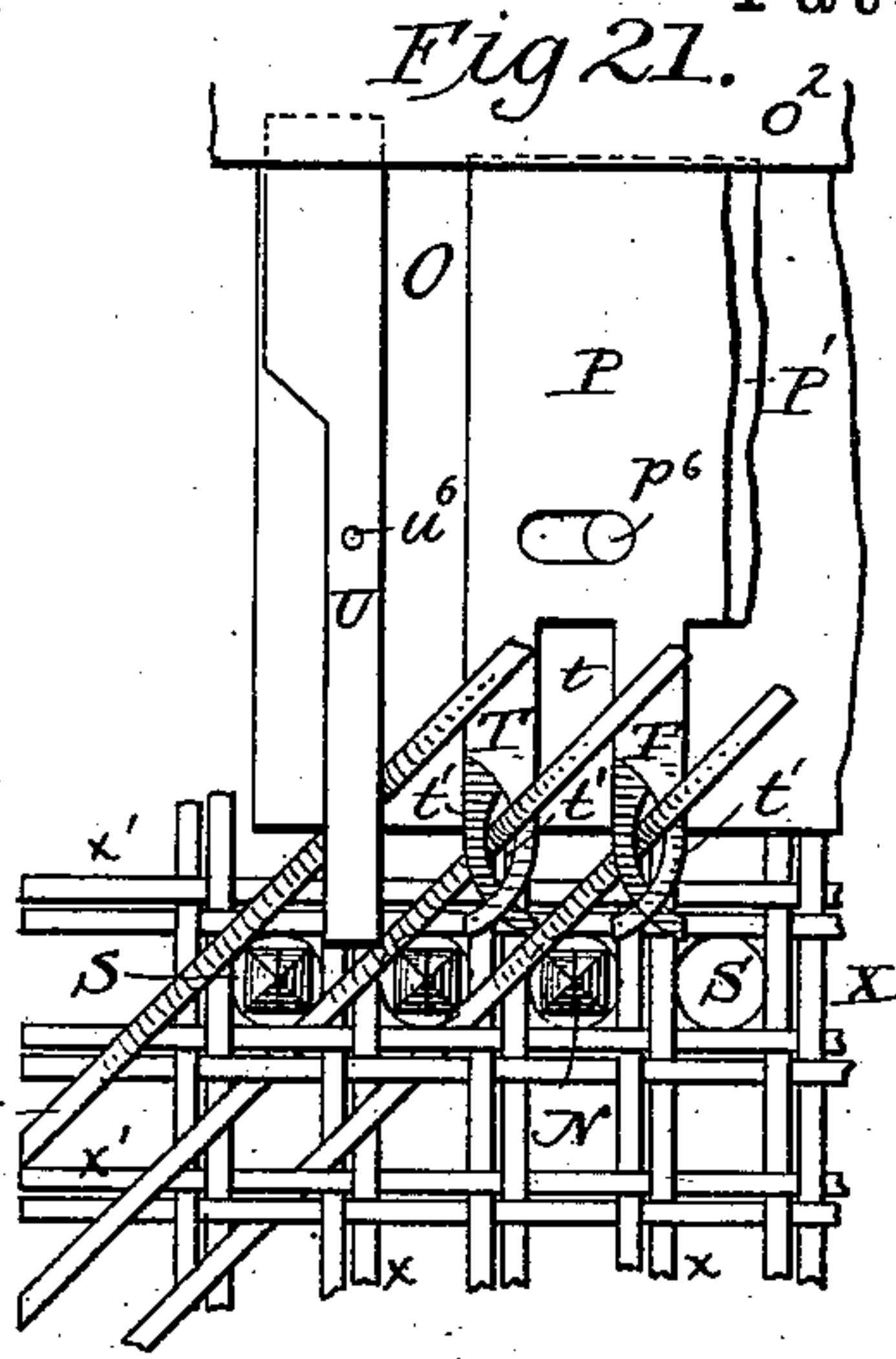
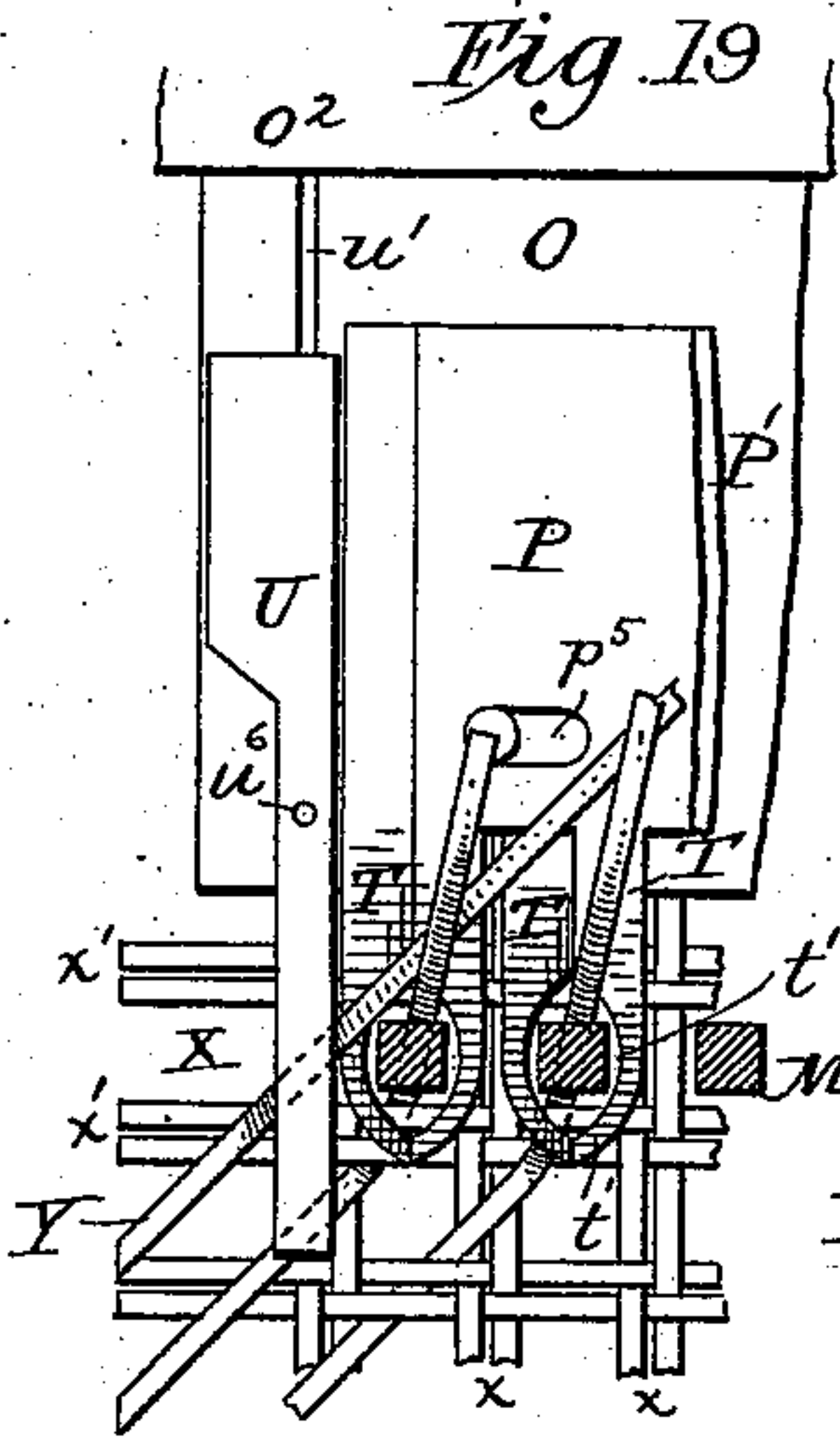
6 Sheets—Sheet 6.

E. MORRIS.

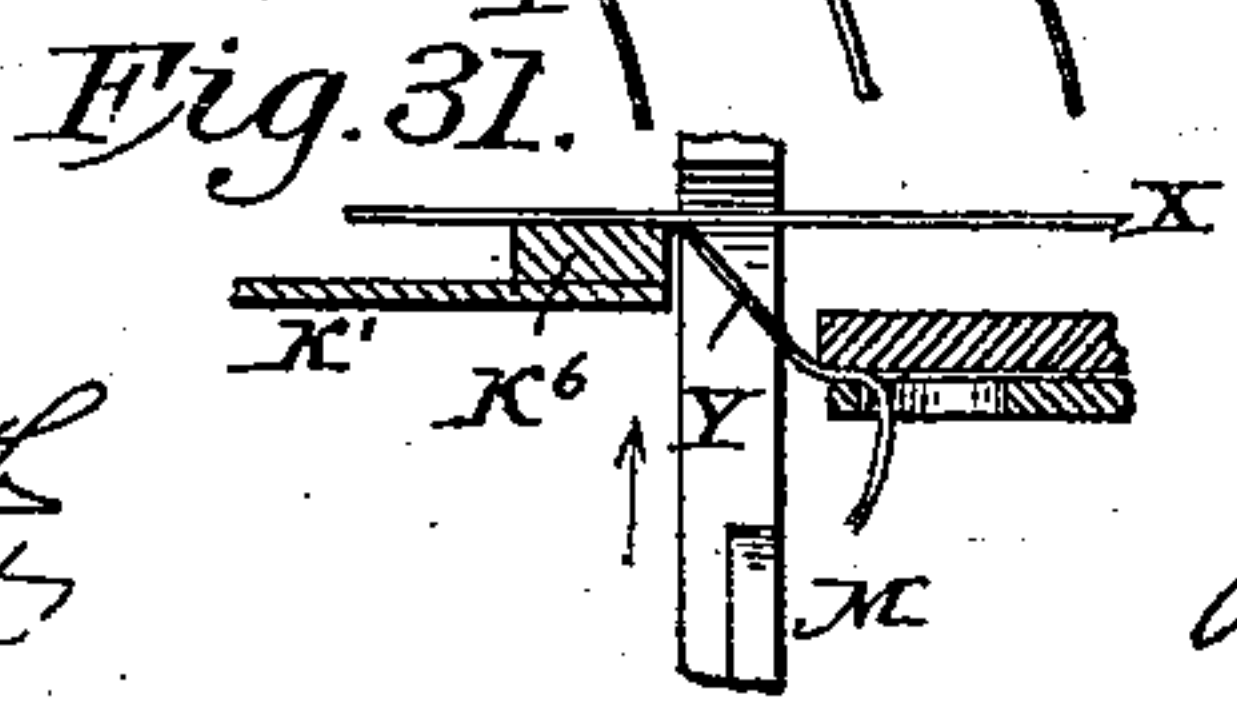
MACHINE FOR INSERTING THREADS INTO WOVEN FABRICS.

No. 549,737.

Patented Nov. 12, 1895.



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W. W. Hollingsworth



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UNITED STATES PATENT OFFICE.

EDMUND MORRIS, OF MICHIGAN CITY, INDIANA, ASSIGNOR TO FORD,
JOHNSON & CO., OF SAME PLACE.

MACHINE FOR INSERTING THREADS INTO WOVEN FABRICS.

SPECIFICATION forming part of Letters Patent No. 549,737, dated November 12, 1895.

Application filed April 15, 1895. Serial No. 545,813. (No model.)

To all whom it may concern:

Be it known that I, EDMUND MORRIS, a citizen of the United States, residing at Michigan City, in the county of La Porte and State of Indiana, have invented certain new and useful Improvements in Machines for Inserting Threads into Woven Fabrics, of which the following is a specification.

My invention relates particularly to machines for inserting threads or strands of cane diagonally into previously-formed open-mesh cane fabric composed of warp and weft threads arranged in pairs. Such fabric with two sets of diagonal threads interwoven and arranged at right angles to each other is commonly used in the manufacture of the backs and seats of chairs and settees. Two types of machines have heretofore been commonly employed for this purpose: first, those employing a crossing-needle which is rotated and at the same time passed diagonally across the fabric, over the warps and under the wefts, so as to open a diagonal channel from edge to edge of the fabric for the shaft of the needle, into which channel a cane-thread is drawn when the needle is retracted; second, those employing dies or separators which act upon the warp and weft threads in the fabric to bend them, and thus open a diagonal passage through which a non-rotary needle is reciprocated to lay an additional diagonal thread.

My Patents Nos. 534,343 and 534,344, dated February 19, 1895, show machines for inserting diagonal threads into cane-cloth differing from the two types of machines above mentioned; but as those machines have not been extensively used, they need be only thus referred to.

The machine forming the subject-matter of my present invention differs, essentially, in its mode of operation, as well as in its construction, from any of the machines above mentioned, and more nearly resembles in operation the old and more natural method of inserting the diagonal threads by hand.

I employ devices which pull each strand successively through each of the meshes in a diagonal row across the previously-formed fabric, over the warps and under the wefts, without bending or abrading the warps and wefts or putting them under tension or in

any way subjecting them to injury. Several diagonal threads are operated upon simultaneously, the arrangement being such that at each operation of the mechanism a thread is drawn through a mesh in each longitudinal row of meshes in the fabric, thereby in effect interweaving a thread diagonally entirely across the fabric in the same time that is required to operate one set of devices to pull a single thread through a single mesh.

The fabric composed of warp and weft threads woven in the usual manner is led from a supply-roll at the rear end of the machine, over suitable guides and between devices for inserting the diagonal threads, to a take-up roll which is actuated to wind the completed fabric as it is step by step advanced by the feeding devices. On each side of the horizontal plane of the fabric I arrange a series of devices which I call "pullers," that engage with threads supplied to them by "threaders" and interweave them with the warp and weft threads by pulling the additional threads over the warps and under the wefts and through the meshes in a diagonal direction across the fabric as it is step by step advanced. The pullers are in the form of hooks with pivoted jaws or latches that open and close at intervals to receive and release the threads, and the threaders are constructed to so manipulate the threads as to move them at proper times into the path of the hooks and effect their engagement therewith when the latches are open. The thread to be woven diagonally is drawn through a guide by a diagonally-arranged picker that lays the thread in a clamp called a "pincher," which as it closes severs the thread into proper lengths, and additional clamping devices are also employed for holding the diagonal threads after having been released by the pincher. While thus clamped, the threads are seized by the threaders and presented to the pullers that interweave them with the cloth, the free end of each thread growing shorter and shorter until it is finally entirely interwoven.

The accompanying drawings show my improvements embodied in the best way now known to me. Some of said improvements may, however, be used without the others

and in machines differing to some extent in their details of construction from that herein shown. Unless otherwise indicated, the parts are of usual approved construction. That end
 5 of the machine at which the take-up roll is arranged I call the "front," the opposite the "rear." That side of the machine to the right of one facing the front I call the "right," the opposite the "left."

10 Figure 1 shows a longitudinal section on the line 1 1 of Fig. 2 through a machine embodying my improvements. Fig. 2 shows a transverse section on the line 2 2 of Fig. 1, most of the mechanism, however, being shown in plan and
 15 a few of the parts being broken away to better illustrate details. Fig. 3 shows a detail view in perspective of part of the mechanism for opening and closing the jaws of the pullers. Fig. 4 shows on an enlarged scale one of the
 20 pullers in different positions. Fig. 5 shows a detail view of part of the mechanism for operating the upper threader-plates to give them a transverse movement. Fig. 6 is a view of the same mechanism, showing the connections with the operating-cam. Fig. 7 is a
 25 view of the mechanism for giving a longitudinal back-and-forth movement to the upper threader-plates. Fig. 8 shows the mechanism for giving a transverse movement to the lower threader-plate. Fig. 9 shows the mechanism
 30 for giving a longitudinal back-and-forth movement to the lower threader-plate. Fig. 10 shows part of the mechanism for giving a back-and-forth movement to the cloth-feed clamp and also the devices for adjusting the
 35 feed. Fig. 11 shows a vertical section on the line 11 11 of Fig. 12 of the cloth-feed clamp and also its connections with the operating-cam. Fig. 12 shows a front elevation of the cloth-feed clamp. Fig. 13 is a detail view of
 40 the picker. Fig. 14 is a detail view in section on line 14 14 of Fig. 2 of the devices used for supporting the shaft of the feed-roll or the take-up roll and for imparting a tension
 45 thereto. Fig. 15 is a view on an enlarged scale, showing in plan the pincher, the clamp, some of the pullers of the lower set, and some of the threaders above the cloth. Fig. 16 shows a vertical section on the line 16 16 of
 50 Fig. 15. Fig. 17 is a detail view of the first threader and the bracket by means of which it is opened. Fig. 18 is a section on the line 18 18 of Fig. 15, showing particularly the construction of the pincher and the clamp. Figs.
 55 19 to 31, inclusive, are diagrams showing the different positions of the threaders and pullers and the threads operated upon by them at different stages of the operation. Fig. 19 is a plan showing the position of the thread-
 60 ers and threads at the time that the upper pullers are operating to draw the threads up through the meshes of the cloth. Fig. 20 shows a front elevation of the threaders, pullers, and threads in the position indicated in Fig.
 65 19. Fig. 21 is a plan showing the position of the various parts at the time when the lower series of pullers is projected upwardly

through the cloth. Fig. 22 shows a front elevation of the same. Fig. 23 is a plan showing the position of the threaders and pullers
 70 and the threads at the time when the threads are inserted by the threaders into the jaws of the lower series of pullers. Fig. 24 is a front elevation of the same. Fig. 25 is a plan showing the position of the lower threaders
 75 at the time that the lower set of pullers draws the threads down over the warps through the lower threader-plates. Fig. 26 shows a front elevation of the same. Fig. 27 is a plan showing the position of the mechanism at the time
 80 that the upper series of pullers is projected downwardly through the cloth. Fig. 28 shows a front elevation of the same. Fig. 29 shows the position of the pullers, threaders, and threads at the time that the threads are moved
 85 by the lower threaders into the open jaws of the upper series of pullers. Fig. 30 shows a front elevation of the same. Fig. 31 is a detail view showing particularly the position of the thread when the threaders and pullers are
 90 in the position shown in Figs. 29 and 30.

The main frame for supporting all of the mechanism employed is shown as consisting of two upright similarly-formed parallel cast-
 95 ings A A' on opposite sides of the machine, firmly connected together at their rear ends by plates a a' and a bar a^2 and at their front ends connected by a plate a^3 and bar a^4 . The castings are formed, as shown in Fig. 1, with
 100 projections which extend upwardly above the plane of the plates a a^3 , each side casting being provided on its inner side with a groove or raceway extending vertically from top to bottom of the frame and constituting guides
 105 for the transverse bars that carry the pullers, as will be hereinafter explained.

The main driving-shaft B carries a belt-pulley b , extends transversely across the machine, and is journaled in bearings in the
 110 lower portion of the side castings A A'. A spur-wheel b' on the left-hand end of the main shaft B gears with a cog c on the short shaft C, the cog c in turn gearing with a cog d on a shaft D, which extends transversely
 115 across the machine and is journaled in bearings in the lower portion thereof. On the right-hand end of the shaft D there is another cog d' , which meshes with a cog c' on a short shaft C'. These shafts thus geared together are provided with means for actuat-
 120 ing the mechanism hereinafter described for effecting the various operations incident to inserting additional threads into the fabric fed through the machine.

The open-mesh cane-cloth X, composed of
 125 warps x and wefts x' , arranged in pairs, as usual, is supplied from a roller E at the rear end of the machine, and it is led upwardly therefrom over supporting guide-rollers F F', and thence downwardly to a take-up roller
 130 G. The roller E is mounted on a square shaft e , supported at its left-hand end by the projecting tip of a short shaft e' , journaled in a bracket e^2 of the main frame, and at its right-

hand end by the projecting tip of the short shaft e^3 , journaled in a bracket e^7 , projecting rearwardly from the main frame.

In order to produce a suitable tension on the roll of cane-cloth, I secure to the shaft e an arm e^4 , which engages with a pin e^5 , projecting from an arm e^6 on the shaft e^3 , at the outer end of which is a disk e^8 , which is rigidly secured to the shaft and has frictional contact with the smooth side of a ratchet-wheel e^9 , loosely mounted on the shaft and engaged by a pawl e^{10} , pivoted on a pin e^{11} , fixed to the main frame. The pressure between the disk e^8 and ratchet e^9 may be regulated by a headed screw e^{12} , adjustable in the end of the shaft e^3 . The guide-roller F is mounted in bearings on two standards f , secured to the horizontal plate a , and the guide-roller F' is mounted in bearings in standards f^2 , mounted on the plate a^3 at the front end of the machine.

The take-up-roll G is mounted upon a square shaft g , supported upon projecting tips formed on the ends of a driving-shaft g' and an opposite shaft g^2 . Upon that portion of the shaft g' which is outside of the main frame I secure a friction-disk g^3 and arrange alongside of it a ratchet-wheel g^4 . An arm g^5 on the shaft g' is provided with a pin g^6 , engaging with an arm g^{10} on the shaft g . The ratchet is revolved at intervals by means of a pawl g^6 , pivoted to the upper end of a lever G^2 , rigidly secured to the shaft G' . This shaft is oscillated, as will be hereinafter described, and effects the rotation of the roller G step by step. The reverse movement of the roller G is prevented by a detent g^7 .

The cloth is fed forward step by step by means of devices which alternately clamp and release the cloth and which have a longitudinal movement back and forth. On the cross-plate a^3 is mounted a frame-plate H , which is adapted to move back and forth longitudinally of the machine between guide-plates h . The plate H has secured to it at its rear end a transverse bar H' , which extends laterally in both directions from the rear end of the plate H , and at opposite ends has upwardly-extending standards h' , that are formed with guides for the upper and lower clamp-bars H^2 H^3 , one of which is arranged above the cloth X and the other arranged below it. The lower clamp-bar H^3 is pivotally connected on its lower side with two eccentric-straps h^2 , that extend around eccentrics h^3 on a horizontal shaft h^4 , mounted in bearings in the lower ends of the uprights h' . An arm h^5 is rigidly secured to the shaft h^4 and is connected by a rod h^6 with the end of a lever h^7 , pivoted on the shaft G' . The lever h^7 carries a roller h^8 , that enters a cam-groove h^9 in a cam H^9 , mounted on the shaft D . As the shaft rotates, the lever h^7 is oscillated and an up-and-down movement is given to the lower clamp-bar H^3 . The upper clamp-bar is normally stationary—that is, it is not reciprocated up and down, as is the lower clamp-bar—but it may be adjusted by means of cams h^{10} on a shaft H^4 , mounted in bearings

in the uprights h' above the clamp-bars. The shaft H^4 is provided with a handle H^5 , by means of which the cams h^{10} may be turned to depress the upper clamp-bar, which, as shown, is provided with arms H^6 , through which the shaft H^4 extends and which extend over the top of the cams h^{10} and bear upon them, the arrangement being such that by turning or adjusting the handle H^5 the upper clamp-bar may be raised or lowered, as desired, and held in any adjusted position.

The frame-plate H is slotted longitudinally to permit the passage of the vertically-extending arm h^{11} of a bell-crank lever H^7 , which is loosely mounted on a shaft H^8 , that extends across the machine and is journaled in bearings in the frame thereof. The lower rearwardly-projecting portion of the bell-crank lever is slotted at h^{12} and is adjustably connected with a rod h^{13} , the lower end of which is connected at h^{14} with a lever h^{15} , rigidly secured to the shaft G' . This lever h^{15} carries a roller h^{16} , working in a cam H^{10} on the shaft D . On the front end of the plate H is secured a short standard h^{17} , to which is pivotally connected an arm h^{18} , the rear end of which is provided with a laterally-projecting arm carrying a roller h^{19} , extending into a curved slot h^{20} in the upper end of the bell-crank lever above the frame-plate H . As the bell-crank lever is oscillated by means of its connections with the lever h^{15} , an oscillating back-and-forth movement is given to the plate H and consequently to the clamp-bars, the arrangement being such that the forward movement is effected after the clamp-bars are compressed upon the fabric X . When the bars have reached the limit of their forward movement, the lower clamp-bar is lowered, thus releasing its grasp upon the fabric, and when the clamp-bars retreat the fabric is loose between them. At the end of the backward movement of the clamp-bars the devices are operated to again compress the clamps upon the fabric, so that on their forward movement they may draw the fabric forward another step.

In order to vary the longitudinal or back-and-forth movement of the clamp-bars while the machine is in operation to adjust the feed, I secure an arm h^{21} to the shaft H^8 and connect the arm h^{21} by a link h^{22} with the arm h^{18} . On the outer end of the shaft H^8 , I secure an upright lever H^{11} , provided with a detent h^{23} , engaging a curved rack h^{24} , projecting from the frame of the machine. By this arrangement the shaft H^8 may be turned in either direction and held, and by means of the link h^{22} adjust the position of the roller h^{19} in the slot h^{20} , thus varying the throw of the frame which carries the clamp-bars.

The mechanism for clamping and feeding forward the fabric is nicely adjusted and co-operates with the take-up mechanism, so that the fabric as fast as fed forward is wound up on the roller G , but is not pulled forward past the clamps by this roller.

It will be understood that it is of great importance that the step-by-step forward movement of the fabric should be accurately adjusted in order that the fabric may be fed one mesh at a time to receive the devices for inserting diagonal threads into them and in such manner that these devices will not abut against or abrade the warp and weft threads which bound the meshes. The feed mechanism which I have just described does the work accurately and may be nicely adjusted by the adjusting devices above referred to.

In order to prevent sidewise movement of the fabric, I provide two or more toothed wheels I, mounted on a shaft I', extending across the machine above the fabric and journaled in bearings in the side castings. These wheels I are free to revolve about the shaft I', and their lengthwise movement on the shaft is prevented by collars *i* on opposite sides of the wheels. The teeth *i'* of the wheels are accurately shaped and spaced so that they shall pass through the meshes of the fabric, the wheels being rotated by the fabric itself as it is advanced.

The additional thread Y to be inserted is fed from any suitable source of supply through a guide J, provided with a short spring-pressed pin *j*, from which a short end of the thread always projects. The guide J is arranged in line with a diagonally-arranged picker J', which may be of usual construction. As shown, it is constructed and operated as follows: A dovetailed slide-bar *j'*, mounted on a standard *j''*, rising from the frame-plate *a*, supports a picker-block *j'''*, carrying a horizontally-arranged rod *j''''*, at one end of which are secured spring-jaws *j'''''*, operated by a block *j''''''* between them. The block *j''''''* is secured to a rod *j'''''''*, adapted to reciprocate in the hollow rod *j''''''''* to move the block past the inwardly-curved portions *j'''''''''* of the jaws into the enlarged portions *j''''''''''* thereof, thus quickly opening the jaws and allowing them to at once close. The rod *j'''''''''* is operated at the end of the forward movement of the picker and also at the end of its backward movement by pins *j''''''''''* *j'''''''''''*, that project upwardly from the slide-bar *j'* and alternately engage with a downwardly-projecting lug *j''''''''''* on the end of the rod *j'''''''''*. A reciprocating motion is imparted to the picker by a link *j'''''''''''*, connected by a ball-and-socket joint *j''''''''''''* with the picker-block, and in like manner connected at its opposite end to the end of an oscillating lever *j'''''''''''*, secured to an upright shaft *j''''''''''*, which carries an arm *j'''''''''''*, connected by a link *j''''''''''''* with an eccentric-strap *j'''''''''''*, encircling an eccentric *j''''''''''''* on the main driving-shaft B. After the picker has moved forward and engaged with a thread at the guide J it retreats and lays the thread below the jaw *k* of a pincher K, which when it descends clamps the thread upon a block W, and also moves it against a knife or cutter *k'*, that severs the thread to be interwoven in the fabric from the remaining portion thereof. The jaw *k* is pivoted to a

bracket *k''*, projecting from a frame-plate K', mounted on a cross-bar K⁵, and is operated by a rod K², extending downwardly, embracing the driving-shaft B, and carrying a roller *k''''*, entering a groove in a cam K³ on the driving-shaft. A bar K⁶ on the front edge of the plate K' under the fabric is employed to prevent the diagonal thread from twisting when acted on by the lower threader-plate. The additional thread to be interwoven is held by the pincher until taken by the devices which interweave it with the fabric, and which I will now proceed to describe.

A bar L, which I call the "puller-carrying" bar, extends transversely across the machine above the fabric and is secured to blocks L', mounted to move vertically in the guides or raceways *l*, hereinbefore referred to. A similar puller-carrying bar L² extends across the machine below the fabric X, and is likewise provided with guide-blocks L³, which are adapted to reciprocate vertically in the raceways *l*. Upright rods *l'* are secured to the guide-blocks L' and L³, rigidly connect them together, and cause them to reciprocate simultaneously in the same direction when they are actuated.

In order to give a vertical reciprocating movement to the puller-carrying bars, I secure to the short shafts C C' arms *l''*, which are adapted to rotate around with the shafts, and which are joined at *l'''* to pitman-rods L⁴, connected to the upper blocks L'. The arrangement is such that the puller-carrying bars L L² are moved vertically toward and from the fabric X in such manner as to alternately pass the pullers, hereinafter described, in opposite directions through the meshes of the fabric. The pullers are shown in detail in Fig. 4. The upper pullers M are arranged in a transverse row across the plane of the fabric X in the puller-carrying bar L. The pullers of the upper row or series are all of the same size and construction and have their lower ends *m* in the same horizontal plane. As shown in Fig. 4, each puller is formed with a square or rectangular shank *m'*, secured at its upper end to the puller-carrying bar L and at its lower end *m* tapered. On one side the lower end of the puller is cut away to receive a pivoted jaw *m''*, the point or lower end of which is tapered to correspond with the tapered end of the body of the puller. The lower end of the puller is also provided with a recess *m'''* to receive the thread to be interwoven in the fabric, and the lower surface of the recess is rounded to form a seat *m''''* for the thread. The jaw *m''* is provided with an arm *m''''*, which extends over the top of the seat *m''''* when the jaw is closed and prevents the thread from escaping at that time. The jaw is connected at *m''''''* with a rod *m'''''''*, which extends vertically through a groove or recess in the shank of the puller and is connected at its upper end with a cross-bar *m''''''''*. By reciprocating the bar *m''''''''* vertically the jaw *m''* may be opened and closed. All of the pull-

ers in the upper series are constructed in this way, and all of their rods m^6 are connected with the cross-bar m^7 . This bar is carried by arms m^8 , mounted on a shaft m^9 , that is in turn mounted in brackets m^{10} , projecting rearwardly from the puller-carrying bar L. The cross-bar m^7 carries a stud m^{11} , which projects into a groove in a cam m^{12} , mounted on a shaft m^{13} , projecting rearwardly from the puller-carrying bar L. This shaft also carries a ratchet-wheel m^{14} , which when it is actuated causes the cam to be turned to reciprocate the rods m^6 at proper times, and thus open and close the jaws of the pullers. The ratchet-wheel m^{14} is operated by a spring-pawl m^{15} , pivoted on a rod m^{16} , projecting from the main frame. This pawl is so located as to operate the jaws to both open and close them while the hooked ends of the pullers are beneath the fabric and before they return through the meshes thereof. The lower set of pullers is similarly constructed and similarly operated, the operating-pawl m^{17} being mounted on a bar m^{18} below the plane of the fabric and being constructed to actuate the ratchet of the operating-cam to open and close the lower series of hooks N after they have been projected through the meshes of the cloth and while they are on the upper side thereof.

The jaws of the upper series of pullers M open toward the right of the machine, while the jaws of the lower pullers N open toward the rear. Each puller in the lower series is arranged directly under a puller in the upper series and the number of pullers in each series corresponds with the number of pairs of warps in the fabric over which the additional threads are to be drawn.

Each additional thread to be interwoven in the fabric is supplied by the picker to a device which I call the "first threader," which presents it to the first puller of the lower series of pullers and it is in turn fed to the other pullers by other independently-operated threaders arranged on opposite sides of the fabric.

The threaders on the upper side of the fabric are all mounted on a plate O, secured to and projecting forwardly from a bar o , having a dovetailed connection with a correspondingly-formed groove o' in a bar o^2 , arranged transversely across the machine at its rear end and bolted to the side castings A A'. A reciprocating transverse movement is given to the bar o and to the plate O, carried thereby, by a bell-crank lever O^2 , which is slotted at o^3 to receive a pin o^4 , carried by the bar o . The lever O^2 is pivoted on a bracket o^5 , projecting from the bar o^2 , and is connected by a link o^6 with the upper end of a lever o^7 , pivoted on a cross-shaft O' , and connected by a link o^8 with the upper end of a lever o^9 , pivoted on a cross-shaft o^{10} and carrying on its lower end a roller o^{11} , working in a groove o^{12} in a cam O^3 on the main driving-shaft B. By this mechanism a transverse movement is

given to the threader-carrying plate O and the threaders carried thereby, and these threaders also have an independent transverse movement and also a longitudinal movement, as will be hereinafter described.

The threader-plates P P', are mounted on the plate O and are held in engagement therewith by a bolt p , which extends through holes p^2 in the threader-plates, and carries at its upper end a spring-cap p^4 . The upper plate P is slotted at p^5 , and through these slots extend pins p^6 , secured to the lower plate P', thus permitting the upper plate to have a somewhat greater transverse movement on the plate O than the lower plate. A spring p^7 , secured to the top of the bolt p and to the upper threader-plate P, pulls this plate to the left, but permits the plate P to have the transverse movement independently of the plate P', above referred to. A lug p^9 , projecting downwardly from an arm on the plate P, is adapted to strike against the edge of the plate O, and thereby limit the transverse movement to the left of the upper threader-plate.

To the front end of the bell-crank lever O^2 is pivotally connected a link o^{13} , in turn connected to a pin o^{14} , projecting upwardly from the lower plate P' through a slot p^8 in the upper plate P. By this mechanism the threaders, in addition to being moved transversely by the plate O, are also given an independent transverse movement over the plate. A longitudinal movement over the plate O is imparted to the threader-plates by the parallel rods Q, connected at their front ends to lugs q , projecting upwardly from the plate P, and connected at their rear ends to arms q' , projecting downwardly from an oscillating shaft Q' , mounted in standards q^2 on the bar o^2 . A curved arm q^3 , extending rearwardly and downwardly from the shaft Q' , is connected by a link q^4 with the upper end of a lever Q^2 , pivoted on the shaft O' and connected by a link q^5 with a lever Q^3 , pivoted on the shaft o^{10} and carrying on its lower end a roller q^6 , working in a groove in a cam Q^4 on the main driving-shaft B. The plates P P' are connected in the manner above described by pins p^6 , secured to the lower plate, and the transverse slots p^5 in the upper plate, so that they move together longitudinally of the machine, having no independent movement in this direction, the diameter of the pins p^6 being approximately equal to the width of the slots p^5 , and the connections between the rods Q and the threader-plates are loose enough to allow the latter to move transversely, as before described.

Below the fabric is another threader, which moves independently of the upper threaders. A plate R, secured to a bar r , supports another plate R', that is adapted to reciprocate longitudinally of the machine on the plate R and transversely with said plate. The bar r has a dovetailed sliding connection with a slide-bar R^2 , arranged transversely below the fabric and bolted to the frame-castings A A'.

A pin r' on the bar r extends through a slot r^2 in the cross-bar R^2 into the slotted end of a bell-crank lever R^3 , pivoted to a bracket r^3 on the slide-bar R^2 , its opposite end being connected by a link r^4 with the upper end of a lever R^4 , pivoted on the shaft O' and connected by a link r^5 with a lever R^5 on the shaft o^{10} , and carrying at its lower end a roller r^6 , working in a groove r^7 in a cam R^6 on the main driving-shaft B.

The plate R' is reciprocated longitudinally on the plate R by means of links r^8 , pivotally connected to lugs r^9 , projecting downwardly from the plate R' , and at their rear ends connected to arms r^{10} , projecting from a shaft r^{11} , mounted in suitable bearings below the bar R^2 . The shaft r^{11} is connected by an arm and pin r^{12} with the slotted end of a lever R^7 , mounted on the shaft o^{10} and carrying at its lower end a roller r^{13} , working in a groove r^{14} in a cam R^8 on the main driving-shaft B. The plate R' is connected to the plate R by pins extending through slots which guide it as it is moved back and forth.

All of the cams for operating the threaders are, it will be observed, mounted on the main driving-shaft, and the connections are such as to cause the threaders to move harmoniously and to co-operate with the pullers to insert the diagonal threads in the fabric. The lower threader-plate R' at its front edge is formed with a transverse series of holes S , corresponding in number to the number of pullers in each row. The holes are of sufficient size to allow the pullers to reciprocate through them while carrying threads.

Each plate $P P'$ has at its front end a series of forwardly-projecting teeth T , separated by recesses or spaces t , the sides of the front ends of the teeth being cut away to form curved fingers t' . The recesses on the teeth of the upper plate are on the left-hand side thereof. Those on the teeth of the lower plate are formed on the opposite side, so that when the plates are in one position (see Fig. 2 or Fig. 23) the fingers shall overlap and form oblong narrow openings, but when in another position form between them wide nearly-circular openings, as shown in Fig. 19, large enough to permit the pullers to reciprocate through them. When the fingers overlap, each pair may be projected forward without danger of having the pullers come in contact with them, and the oblong openings are such as to hold the free ends of the threads out of the path of the pullers to the right of them.

The device U , which I call the "first threader," is mounted on the plate O and is adapted to reciprocate longitudinally thereon. It has a dovetailed rib u , fitting a correspondingly-formed groove u' in the top of the plate O , and is provided with two jaws $U' U^2$, the rib u being formed on the lower jaw, and this jaw has only a back-and-forth movement on the plate O . The upper jaw is pivoted to the lower jaw at u^2 , and a spring u^3 in rear of the pivot normally closes the jaws. The inner

faces of the jaws are inclined or beveled at $u^4 u^5$, so as to form an inclined opening between them when the jaws are closed, as indicated in Fig. 22. This space or opening is of such size as to hold the diagonal thread in such manner as to prevent it from twisting or turning, but permit the thread to be withdrawn from between the jaws when operated upon by a puller, and the diagonal arrangement of the opening holds the thread out of the path of the open jaws of the puller to the right of the thread. A curved pin u^6 projects downwardly from the upper jaw into a recess in the lower jaw in front of the pivot u^2 and prevents the thread from passing too far back in the jaws, being so located as to hold the thread at the proper time in such a position as to cause the first puller of the lower series of pullers to engage with the thread and pull it downwardly over a pair of warps at the left-hand edge of the fabric. A reciprocating longitudinal movement is given to the first threader by a lever U^3 , pivoted to a bracket u^7 on the cross-bar o^2 behind the upper threader-plates. The lever is connected with the plate P by a pin u^8 on the plate extending through a slot at u^9 in the lever, and at its slotted forward end it is connected with the rear end of the lower jaw U^2 of the first threader by a pin u^{10} , which extends through the slot in the lever. The lever U^3 being arranged diagonally with reference to the transverse movement of the threader-plates $P P'$ and their supporting-plate O and the lever being connected with the threader-plate P and with the first threader by a slot-and-pin connection, a short back-and-forth movement will be given to the first threader when the threader-plates move transversely on the supporting-plate O and a greater longitudinal movement will be given to the first threader when the supporting-plate O is moved transversely. The connections between the first threader and its operating-lever and between this lever and the threader-plates are such as to permit the threader-plates to move transversely without giving a transverse movement to the first threader, which, however, is moved transversely with the supporting-plate O .

The jaws of the first threader U are narrow and can be reciprocated back and forth between adjacent pullers, the arrangement being such that the jaws are always closed when the first threader is moved forward; but when the first threader is moved to the left and is drawn rearwardly by the lever U^3 the upwardly-projecting rear end u^{11} of the upper jaw rides under the inclined under surface u^{12} of a bracket U^4 , secured to the transverse bar o^2 . When the first threader is thus moved to the left and to the rear and its jaws are opened, the picker is moved forward through its jaws and is operated to grasp the end of the diagonal thread Y to be inserted, which thread at this time projects a short distance from the guide J , the jaws of the picker being opened

and closed, as hereinbefore described, at this time to grasp the end of the thread and to draw it diagonally across the fabric as the picker is retracted. After the picker has receded the first threader is shifted, the jaws closed, and the thread Y is held between them, and when thus held is presented to the first puller of the lower series of pullers. After the thread has thus been laid in the first threader the pincher K is operated to grasp the end of the thread Y, at the same time operating the knife or cutter k' to sever a strand of proper length. The pincher is constructed to hold the thread Y while it is being operated upon by the first puller in the lower series of pullers; but after it is thus operated upon by the puller the fabric is fed forward and other devices are employed for holding the said thread, and also other threads immediately succeeding it, while they are being partially interwoven and until they are held tightly enough to prevent them from being pulled through the fabric in the wrong direction.

As will be more clearly hereinafter described, the pullers operate upon the threads Y to pull them over the warps and under the wefts through the meshes of the fabric while it is being fed forward, so that these threads are woven in a diagonal direction entirely across the cloth, growing shorter and shorter until they are entirely interwoven. To do this it is necessary that the threads at their left-hand ends shall not be pulled through the meshes; but they must be held positively. After the threads have been partially interwoven they will be sufficiently held by being tied to the fabric itself; but at first they must be held by devices especially constructed for that purpose.

The pincher K, as above described, holds the thread while it is being operated upon by the first puller in the lower series of pullers. In order to hold the threads after the cloth has been fed forward step by step a distance corresponding to one or more meshes, I employ a clamp V, consisting, primarily, of a base-plate v and a jaw v' , pivoted to a standard v^2 on the base-plate and having at its rear end a tongue v^5 , adapted to pass between the tines of the bifurcated front end of the pincher. The plate v is adapted to reciprocate longitudinally in guide-plates v^3 on the plate K' , and is operated by a link V' , connected with the upper clamp-bar of the feed mechanism in such manner that the clamp V is moved back and forth coincidently with and to the same extent as the feed mechanism. The upper member v' of the clamp is opened and closed by a rod V^2 , pivoted to a lug v^4 on the rear end of the jaw v' and connected at its front end with an arm v^6 on the shaft h^4 of the feed mechanism, the arrangement being such that the jaw v' is opened and closed coincidently with the opening and closing of the clamp-bars.

While the threads Y are being inserted through the first few meshes of the fabric

they will be grasped by the clamp V and held at their left-hand ends and until they have been partially interwoven. Afterward the threads pass the clamps, and other threads drawn by the picker and severed by the cutter are held for a short time in the clamp for a similar purpose.

All the mechanism has thus been fully described and the operation of some of the parts has been indicated.

The feeding forward of the fabric into which the additional threads are to be inserted has been fully described and is easily understood. As the fabric is thus fed forward step by step, the picker is reciprocated across the top of the fabric to draw threads Y across the upper threader-plates. The picker as it moves forward passes through the open jaws of the first threader and through or past the open pincher K, the clamp V being withdrawn from the path of the picker and the first threader being in the position indicated in Figs. 17 and 21. When the picker has receded, the pincher descends, operates the cutter, and in connection with the block W grasps the thread Y near its severed end and holds it while being drawn through the fabric by the first puller in the lower series of pullers.

Referring now to the diagrams Figs. 19 to 31, inclusive, I will describe in detail the operation of weaving the additional threads into the cloth. For convenience reference is first made to Fig. 21, wherein the first threader is shown in its retracted position open and the thread Y is assumed to have been just laid by the picker. The threader-plates P P' are moved to the right and retracted, and the fingers $t' t'$ are overlapped and are arranged behind the plane of the pullers, and the threads are held up in an inclined direction, as indicated in Fig. 22. This figure also indicates some of the lower pullers as just rising to pass through the cloth. After they have passed through the cloth the first threader and the threader-plates P P' are projected forward to lay the threads in the jaws of the lower pullers, as indicated in Figs. 23 and 24, which then descend, the pincher K grasping the thread Y, which passes through the first threader. The lower pullers as they were projected upwardly passed through the holes S in the lower threader-plate R', and on their descent, of course, returned through these holes, drawing the diagonal threads with them. Figs. 25 and 26 show how the threads are drawn downwardly through the holes S in the lower threader-plate by the pullers N. As soon as the threads are thus drawn through the holes S, the fabric is fed forward one step and the plate R' is moved backwardly under the plate R, the plates R and R' at the same time being moved to the right, as indicated in Fig. 27, the threads being held between the front edges of the plates R R', as indicated in Fig. 31. This will carry the threads to the right of the vertical planes of the corresponding pullers of the upper set. The up-

per threaders are then moved from the position shown in Fig. 23 to the position shown in Fig. 19, the plate P being moved relatively to the plate P', so that the fingers spread apart and form openings through which the upper pullers may pass. At the same time a slight backward movement is given to the first threader, as well as to the threader-plates. When the threaders are in this position, the upper pullers descend in the manner indicated in Fig. 28. After they have thus descended to the position shown in Fig. 30 the plates R R' are moved to the left, as indicated in Fig. 29, causing the threads to be moved into the open jaws of the upper pullers. Then the jaws are closed by the mechanism heretofore described, and the upper pullers rise through the openings between the fingers, as indicated in Figs. 19 and 20. After they have thus risen and have drawn the diagonal threads under the wefts the first threader and upper threaders are moved into the position shown in Fig. 21, when a new thread is laid by the picker in the jaws of the open first threader. Then the lower set of pullers is projected upwardly through the cloth and then the first threader and the threader-plates P P' are projected forwardly, as indicated in Fig. 23, laying the diagonal threads in the jaws of the lower pullers N, which pull them over the warps and down through the lower threader in the manner heretofore indicated. The operation continues in the same way, the first thread introduced being supplied by the first threader to the first puller of the lower series of pullers. This draws it down through a mesh and over the first pair of warps at the edge of the fabric. The fabric is then fed forward and the lower threader transfers the thread to the first puller of the upper series of pullers, which draws it under the weft and up through the next mesh. The thread is then taken from the first puller of the upper series by the threader-plates and is transferred to the second puller of the lower series, and in like manner the thread is supplied by a threader to a puller of one series and then from the puller of that series to a puller of the other series, until it is entirely interwoven, while the cloth is being fed forward. The threaders and pullers are so arranged as to prevent the threads from twisting or turning, their glazed sides always being uppermost. The bar K⁶ on the front of the plate K' co-operates with the lower threaders, as indicated in Fig. 31, to prevent the twisting of the threads. The clamp V is during these operations actuated correspondingly with the actuation of the feed-clamps to hold the threads while being pulled through the first few meshes in the manner before indicated.

At first the operation of interweaving the diagonal threads is slow. I do not mean by this that the parts do not operate rapidly; but I mean that each thread is necessarily moved back and forth a number of times through the meshes of the cloth, over the

warps and under the wefts, before it is interwoven; but the operation grows faster and faster, as after a while a number of threads are operated upon corresponding with the number of warps in the fabric, and in a fabric which has ten warp-threads or ten pairs of warps ten additional threads are drawn over the ten warps and under the wefts at each operation of the machine, thus in effect interweaving a single thread entirely across the fabric at one operation of the mechanism and as a result giving the machine a capacity for great speed.

The drawings show the machine organized to insert one set of diagonal threads. To insert the other set, the fabric may be reversed or turned over and run through the machine and operated upon in precisely the same way as it was operated to insert the first set of diagonals.

I claim as my invention—

1. The combination with means for supporting an open-mesh fabric, of a series of pullers adapted to reciprocate toward and from the face of the fabric to draw an additional thread successively through its meshes, threaders for supplying a thread to the pullers and means for actuating the pullers and threaders.

2. The combination with means for supporting an open-mesh fabric, of a series of pullers adapted to reciprocate through the meshes of the previously woven fabric, and threaders for supplying additional threads to the pullers to be interwoven diagonally in the fabric.

3. The combination with means for supporting an open-mesh fabric, of pullers arranged on opposite sides of the fabric and adapted to reciprocate toward and from the previously woven fabric to draw additional threads back and forth through the meshes thereof, and threaders for supplying threads to the pullers.

4. The combination of the upper and lower series of pullers, means for reciprocating the pullers through the meshes of a fabric arranged between them, means for supplying an additional thread to a puller of one series, and means for transferring the thread after it has been drawn through the fabric from said puller to a puller of the other series to be drawn in an opposite direction through the fabric, substantially as described.

5. The combination with means for supporting an open-mesh fabric, of a series of pullers adapted to reciprocate toward and from the face of the fabric to draw additional threads back and forth through the meshes thereof, threaders for supplying threads to the pullers, and mechanism for advancing the fabric step by step during the operation of the threaders and pullers, the combination being and operating substantially as described to interweave additional threads diagonally with the warp and weft threads.

6. The combination with means for sup-

porting an open-mesh fabric, of pullers having hooked ends and adapted to reciprocate toward and from the previously formed fabric to draw an additional thread successively
5 through its meshes, and threaders for supplying a thread to the hooked ends of the pullers.

7. The combination with means for supporting an open-mesh fabric, of pullers having hooked ends provided with opening and closing
10 jaws and adapted to reciprocate through the meshes of the previously formed fabric to draw additional threads back and forth through the meshes thereof, and threaders for supplying threads to the hooked ends of
15 the pullers when the jaws are open.

8. The combination with means for supporting an open-mesh fabric, of pullers having hooked ends and opening and closing
20 jaws, rods for opening and closing the jaws, means for operating the rods, mechanism for reciprocating the pullers toward and from the fabric to draw additional threads through the meshes thereof, and threaders for supplying threads to the pullers.

9. The combination with means for supporting an open-mesh fabric, of pullers arranged on opposite sides of the fabric, and adapted to reciprocate toward and from the
30 fabric to draw additional threads through the meshes thereof, transverse bars above and below the fabric to which the pullers are secured, rods connecting the two bars, means for reciprocating the puller-carrying bars together toward and from the fabric, and threaders
35 for supplying threads to the pullers.

10. The puller herein described for drawing an additional thread through the meshes of an open-mesh fabric, having a side recess near its tapered end, provided with a seat for
40 the thread and also provided with a pivoted jaw adapted to close one side of the recess adjacent to a seat for the thread, and an operating rod connected with the jaw and extending to the opposite end of the puller.

11. The combination with means for supporting a fabric, of a picker, means for operating it to draw a thread from a supply to be interwoven with the fabric, a pincher for grasping the thread drawn by the picker, pullers
50 adapted to reciprocate toward and from the fabric to draw the additional thread through its meshes, and threaders for presenting the thread to the pullers.

12. The combination with means for supporting a fabric, of a picker, means for operating it to draw a thread from a supply to be interwoven with the fabric, a pincher for grasping the thread drawn by the picker, a knife for severing the portion of thread drawn by
60 the picker from the other portion thereof, pullers adapted to reciprocate toward and from the fabric to draw the additional thread through its meshes, and threaders for presenting the thread to the pullers.

13. The combination with means for supporting a fabric, of a picker, means for operating it to draw a thread from a supply to be in-

terwoven with the fabric, a pincher for grasping the thread drawn by the picker, a knife for severing the portion of thread drawn by
70 the picker from the other portion thereof, pullers adapted to reciprocate toward and from the fabric to draw the additional thread through its meshes, threaders for presenting the thread to the pullers and a clamp for holding
75 partially interwoven threads.

14. The combination with means for supporting an open-mesh fabric, of pullers adapted to reciprocate toward and from the fabric to draw additional threads through the meshes
80 thereof, threaders for supplying threads to the pullers, the clamp having the upper and lower opening and closing clamp bars and provided with mechanism for moving them back and forth to advance the fabric through the
85 machine, a picker, means for operating it to draw a thread from a supply to be interwoven with the fabric, a pincher for grasping the thread drawn by the picker, a thread-clamp for holding partially interwoven threads, and
90 connections between the thread-clamp, and the operating mechanism of the cloth-feed-clamp, whereby the thread-clamp is operated coincidentally with the cloth-feed-clamp.

15. The combination with means for supporting an open-mesh fabric, of a picker provided with mechanism for operating it to draw a thread from a supply to be interwoven with the fabric, a pincher having an arm pivoted on a fixed axis and provided with mechanism for oscillating it, a knife or cutter operated by the pincher, a thread clamp having
100 a member pivoted to move vertically, a supporting plate for the pivoted member of the clamp, means for oscillating said pivoted member, means for reciprocating the supporting plate toward and from the pincher, and mechanism for weaving into the fabric the threads drawn by the picker and held by the pincher and clamp.
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16. The combination with means for supporting an open-mesh fabric, of the upper and lower series of pullers adapted to reciprocate toward and from the fabric and to draw additional threads through the meshes thereof,
115 of the first threader adapted to receive an additional thread, and to present it to the first puller of one of the series of pullers, independently movable threaders adapted to present the thread to the other pullers and
120 mechanism for actuating the pullers and threaders.

17. The combination with means for supporting an open-mesh fabric, of the upper and lower series of pullers adapted to reciprocate
125 toward and from the fabric, and to draw additional threads through the meshes thereof, the first threader having opening and closing jaws beveled or inclined on their adjacent inner walls, and adapted to receive an additional thread and to present it to the first
130 puller of one of the series of pullers, means for reciprocating the first threader longitudinally of the machine and also transversely

thereto, and independently movable threaders adapted to present the thread to the other pullers.

18. The combination with means for supporting an open-mesh fabric, of the upper and lower series of pullers adapted to reciprocate toward and from the fabric and to draw additional threads through the meshes thereof, the first threader adapted to receive an additional thread and to present it to the first puller of one of the series of pullers, independently movable threaders adapted to present the thread to the other pullers, and a clamp for grasping the thread while being operated upon by the first few pullers.

19. The combination with means for supporting an open-mesh fabric, of the pullers adapted to reciprocate toward and from the fabric, to draw additional threads through the meshes thereof, the toothed, recessed, independently movable threader-plates, means for moving the threader-plates both longitudinally of the machine and also transversely thereto, and means for supplying additional threads to the threaders.

20. The combination with means for supporting an open-mesh fabric, of the pullers adapted to reciprocate through the meshes of the fabric to draw additional threads there-through, the toothed, recessed, independently movable threader-plates, means for moving the threader-plates both longitudinally of the machine and transversely thereto, and means for advancing the fabric step by step, the combination being and operating substantially as described to interweave additional threads diagonally with the warp and weft threads.

21. The combination with means for supporting an open-mesh fabric, of the pullers adapted to reciprocate through the meshes of the fabric and draw additional threads there-through, the toothed, recessed threader-plates, means for moving the threader-plates both longitudinally of the machine and also transversely thereto, means for advancing the fabric past the pullers step by step, the first threader adapted to present the additional thread to the first puller, and means for actuating the first threader independently of the other threaders.

22. The combination with means for supporting an open-mesh fabric, of the upper and lower series of pullers on opposite sides of the fabric, and adapted to reciprocate through the meshes thereof, the threaders above the fabric consisting of independently movable, toothed, recessed plates adapted to reciprocate back and forth past the vertical plane of the pullers, and also transversely relatively thereto, the threader plate below the plane of the fabric adapted to reciprocate both longitudinally of the machine and transversely thereto, mechanism for actuating the pullers and threaders, means for feeding the fabric step by step, and means for supplying thread to the threaders.

23. The combination with means for supporting an open-mesh fabric, of the pullers having hooked ends provided with pivoted jaws and arranged on opposite sides of the fabric, means for reciprocating the pullers through the meshes of the fabric and for opening and closing their jaws, the first threader for supplying thread to the first hook of one of the series, the toothed, recessed threader-plates arranged one above the other and adapted to reciprocate transversely of the machine independently of each other, a supporting plate on which the threader plates are mounted and which also supports the first threader, means for reciprocating the supporting plate to move the threader plates and the first threader together transversely of the machine, means for reciprocating the threader-plates together longitudinally of the machine, and mechanism for giving an independent, longitudinal movement to the first threader.

24. The combination with means for supporting a fabric, of the opening and closing clamp bars, means for actuating them to open and close, a lever for imparting a longitudinal movement to the clamp bars to feed the fabric forward, and an arm connecting the clamp bars with the operating lever and having adjusting devices, whereby the longitudinal movement of the clamp bars may be varied while the machine is in operation.

25. The combination with means for supporting a fabric, of the clamp bars, means for opening and closing them to clamp or release the fabric, a frame on which the clamp-bars are supported, a lever for giving a longitudinal movement to the clamp-bars, means for actuating the lever, an arm pivotally connected with the frame of the clamp bars and having an adjustable connection with the lever and devices for adjusting the connection between the arm and the lever whereby the longitudinal movement of the clamp bars may be varied while the machine is in operation.

26. The combination with means for supporting a fabric, of the clamp bars, means for opening and closing them to grasp or release the fabric, a frame on which the clamp bars are mounted, a bell-crank lever, means for oscillating it, an arm pivoted to the frame of the clamp bars, and connected at its opposite end with a slot in one arm of the bell-crank lever, an arm on the shaft of the bell-crank lever connected by a link with the arm which is pivoted to the frame of the clamp bars, and a hand lever for turning the shaft of the bell-crank lever for adjusting the position of the pivoted arm, whereby the longitudinal movement of the clamps may be varied while the machine is in operation.

In testimony whereof I have hereunto subscribed my name.

EDMUND MORRIS.

Witnesses:

ARTHUR N. GITTINGS,
HENRY B. MORRIS.