

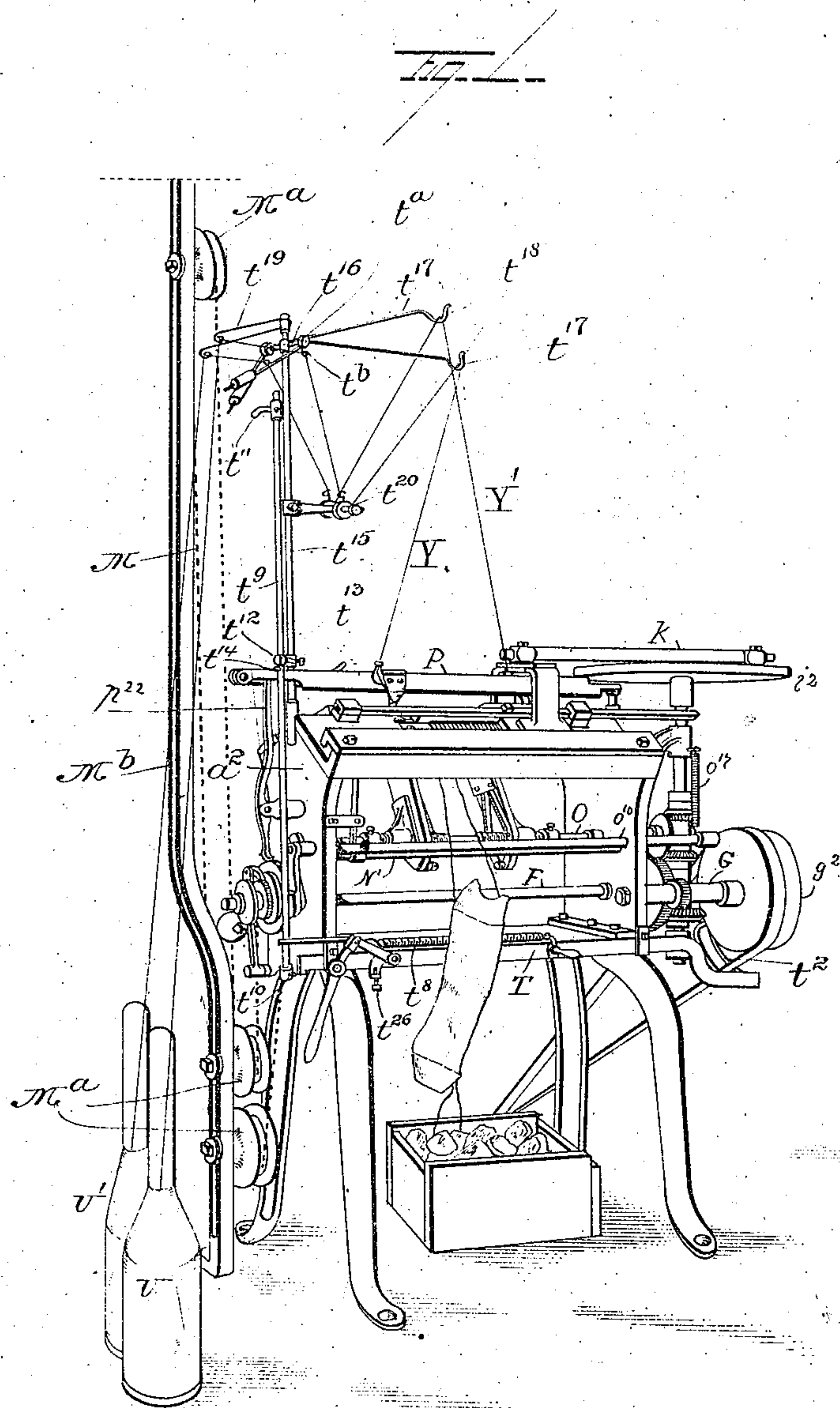
(No Model.)

13 Sheets—Sheet 1.

J. BENNOR.
STRAIGHT KNITTING MACHINE.

No. 440,389.

Patented Nov. 11, 1890.



WITNESSES:

WITNESSES:
John Nolan,
James C. Hogan

INVENTOR

INVENTOR
Joseph Pennock
BY
Joshua Pusey
ATTORNEY.

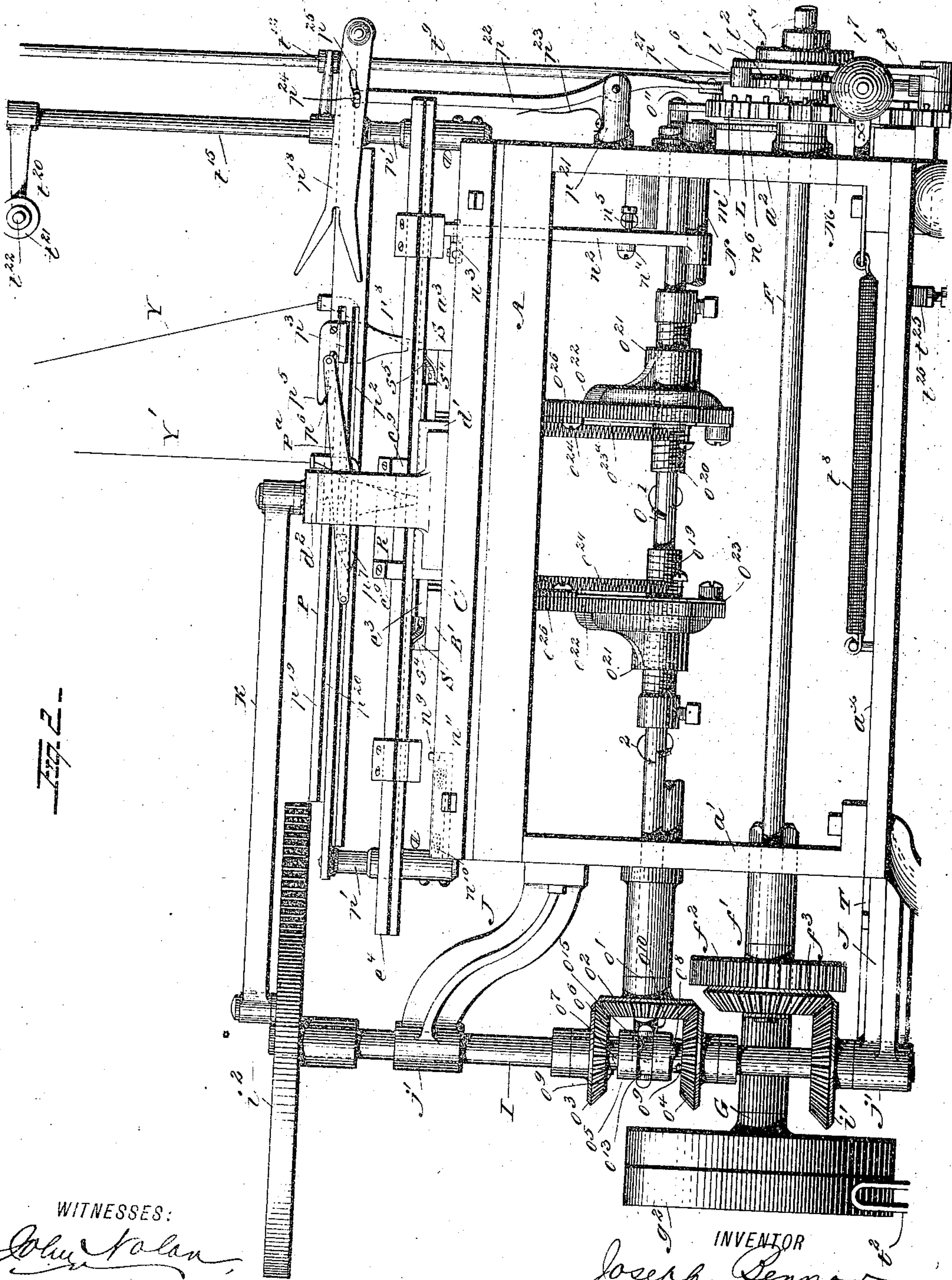
(No Model.)

13 Sheets—Sheet 2.

J. BENNOR.
STRAIGHT KNITTING MACHINE.

No. 440,389.

Patented Nov. 11, 1890.



WITNESSES:

Blue Volan,
James & Osgan

INVENTOR

INVENTOR
Joseph Pennor
BY Joshua Pusey

ATTORNEY

(No Model.)

13 Sheets—Sheet 3.

J. BENNOR.
STRAIGHT KNITTING MACHINE.

No. 440,389.

Patented Nov. 11, 1890.

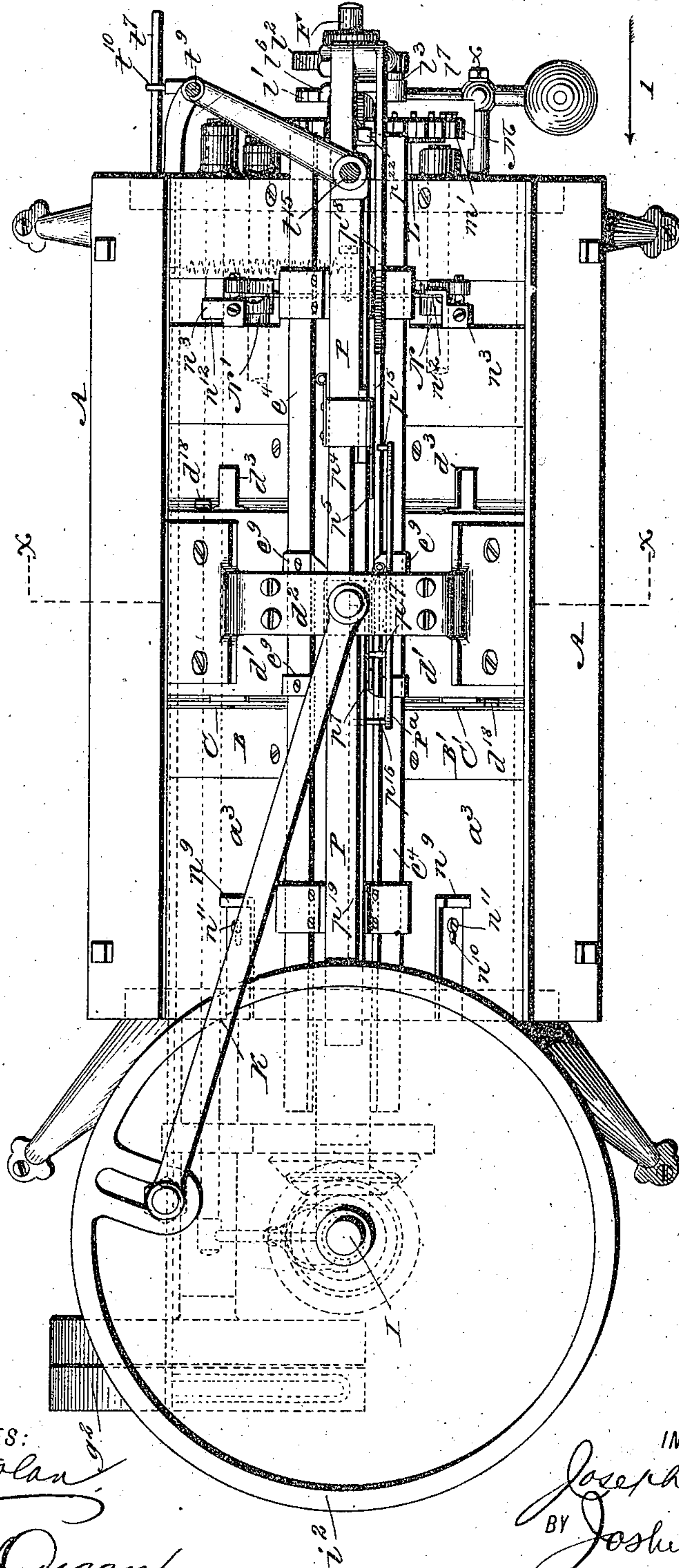


Fig. 3.

WITNESSES:

John Nolan
James O'Ryan

INVENTOR

Joseph Bennor
BY *Joshua Pusey*
ATTORNEY

No. Model.)

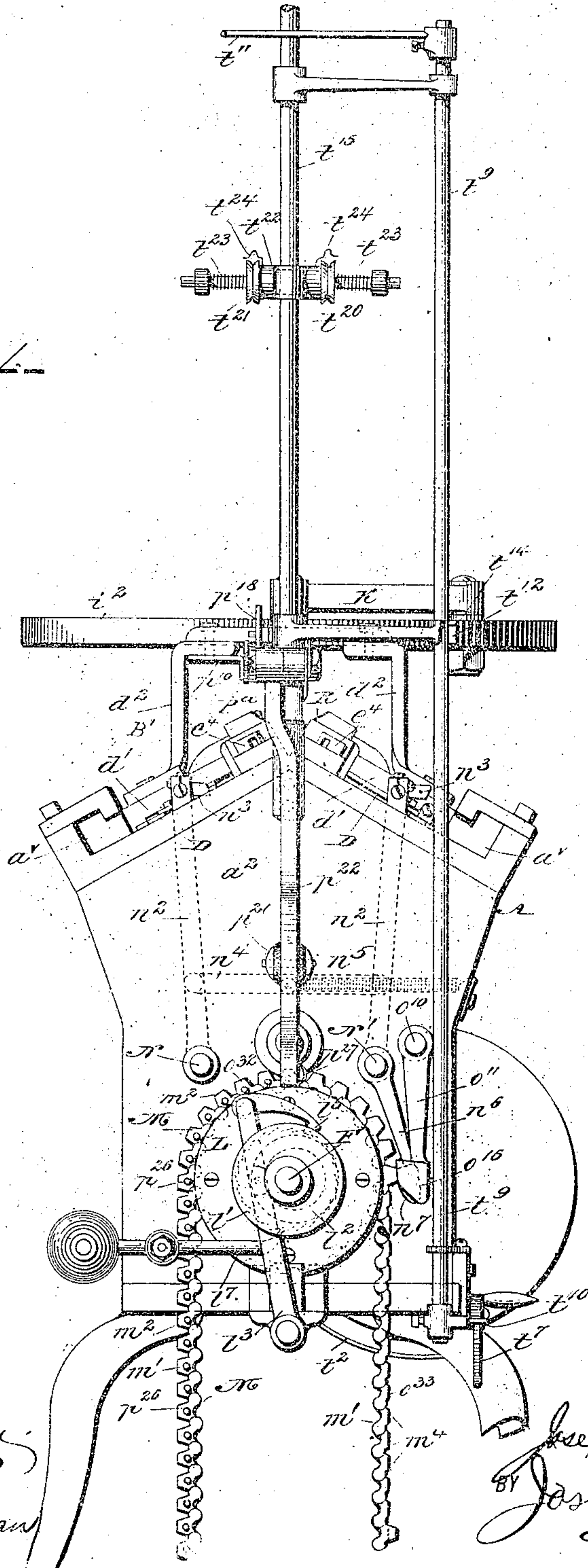
13 Sheets—Sheet 4.

J. BENNOR.
STRAIGHT KNITTING MACHINE.

No. 440,389.

Patented Nov. 11, 1890.

Fig. 4.



WITNESSES:

Blair Tolson
James Dugan

INVENTOR

Joseph Bennor
BY *Joshua Pusey*
ATTORNEY

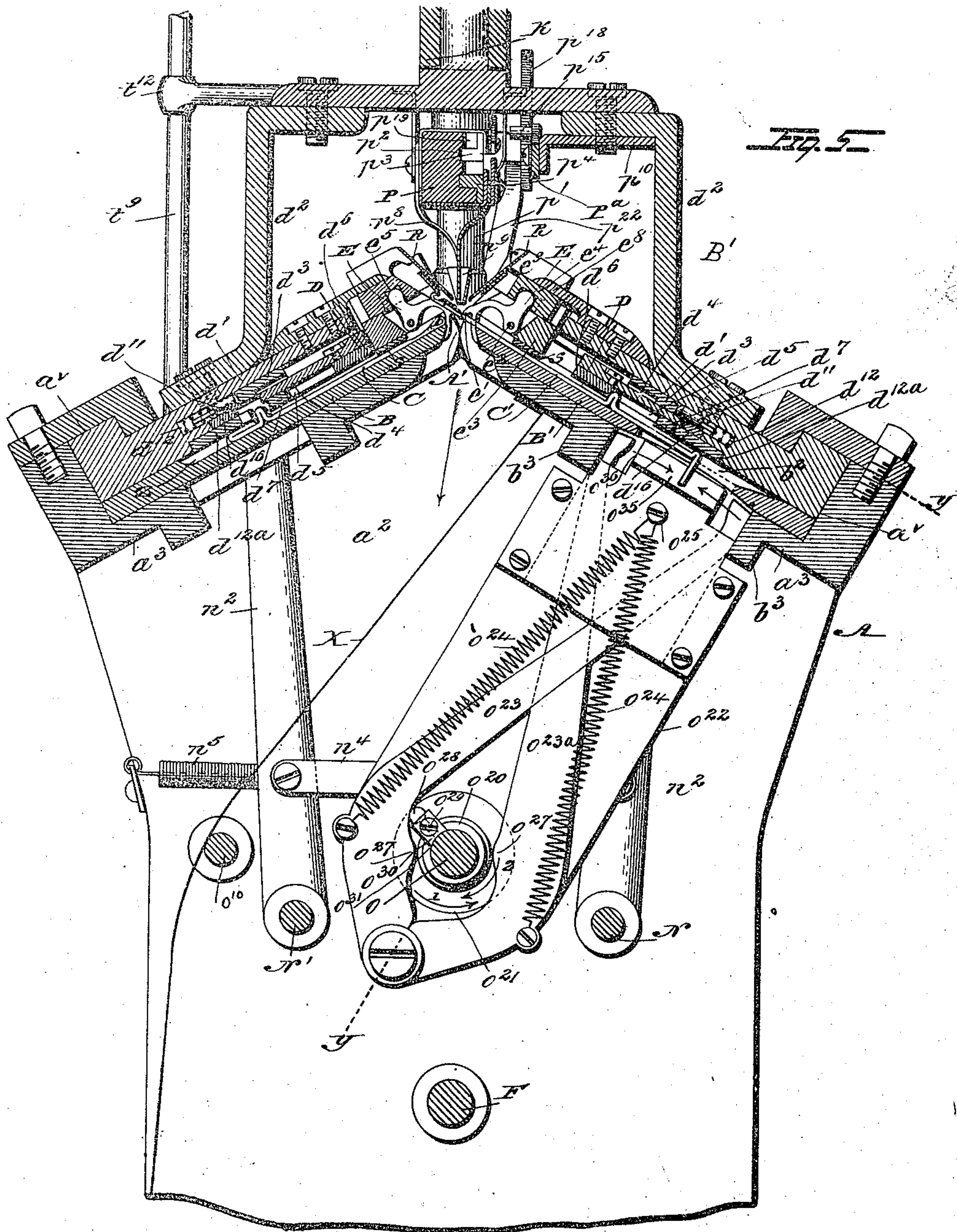
(No Model.)

13 Sheets—Sheet 5.

J. BENNOR.
STRAIGHT KNITTING MACHINE.

No. 440,389.

Patented Nov. 11, 1890.



WITNESSES:

John Tolson
James Dugan

INVENTOR

Joseph Bennor
BY *Joshua Pusy*

ATTORNEY

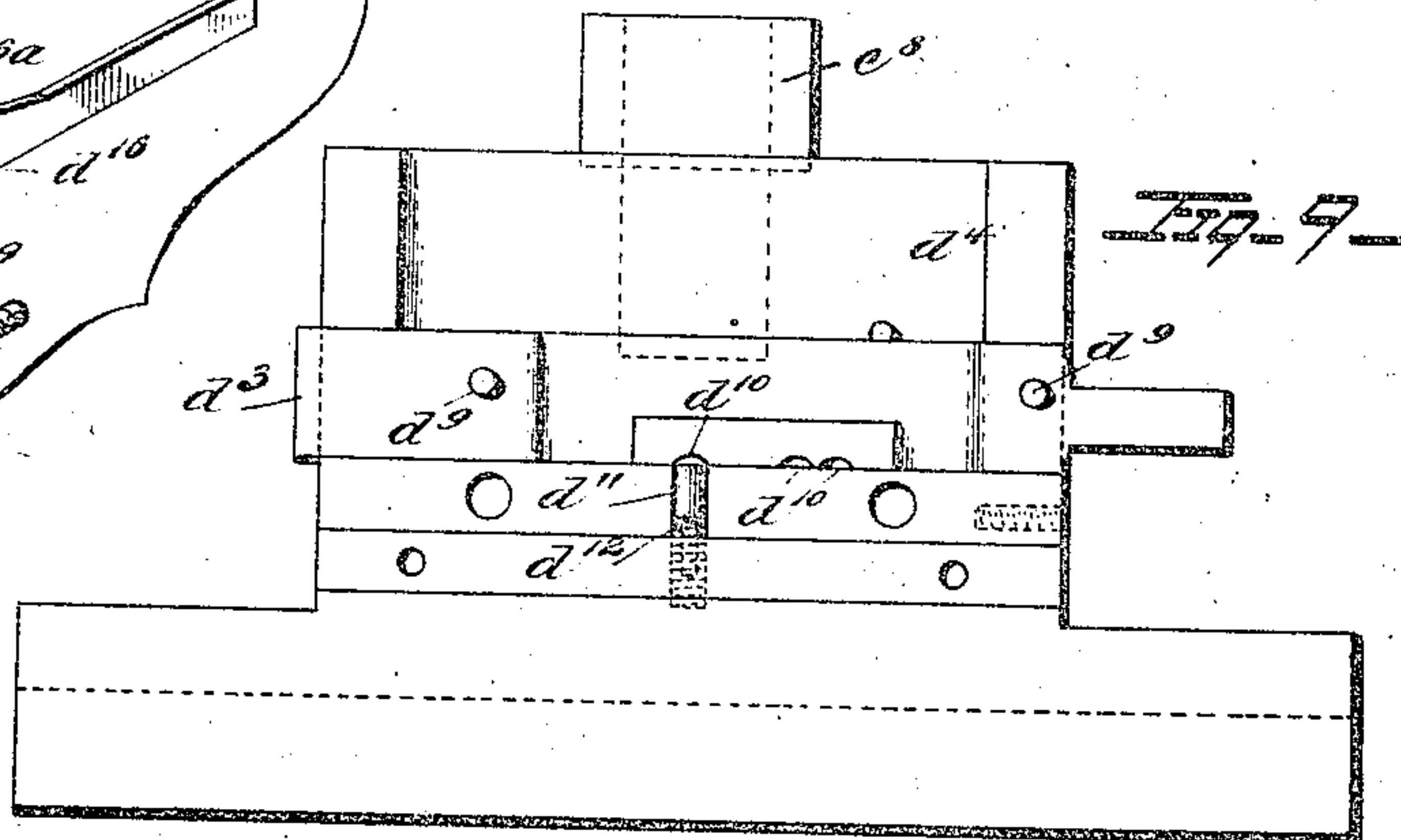
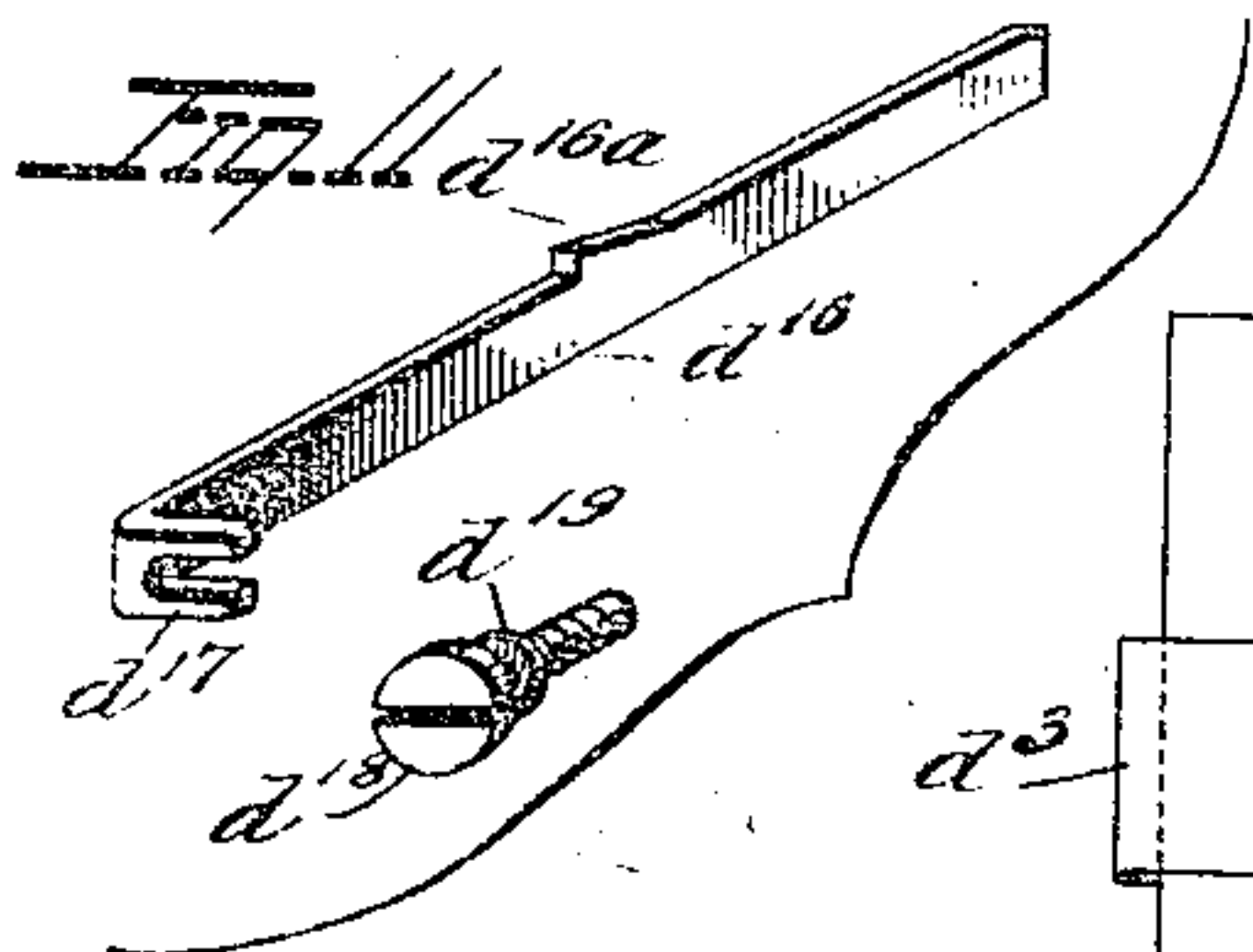
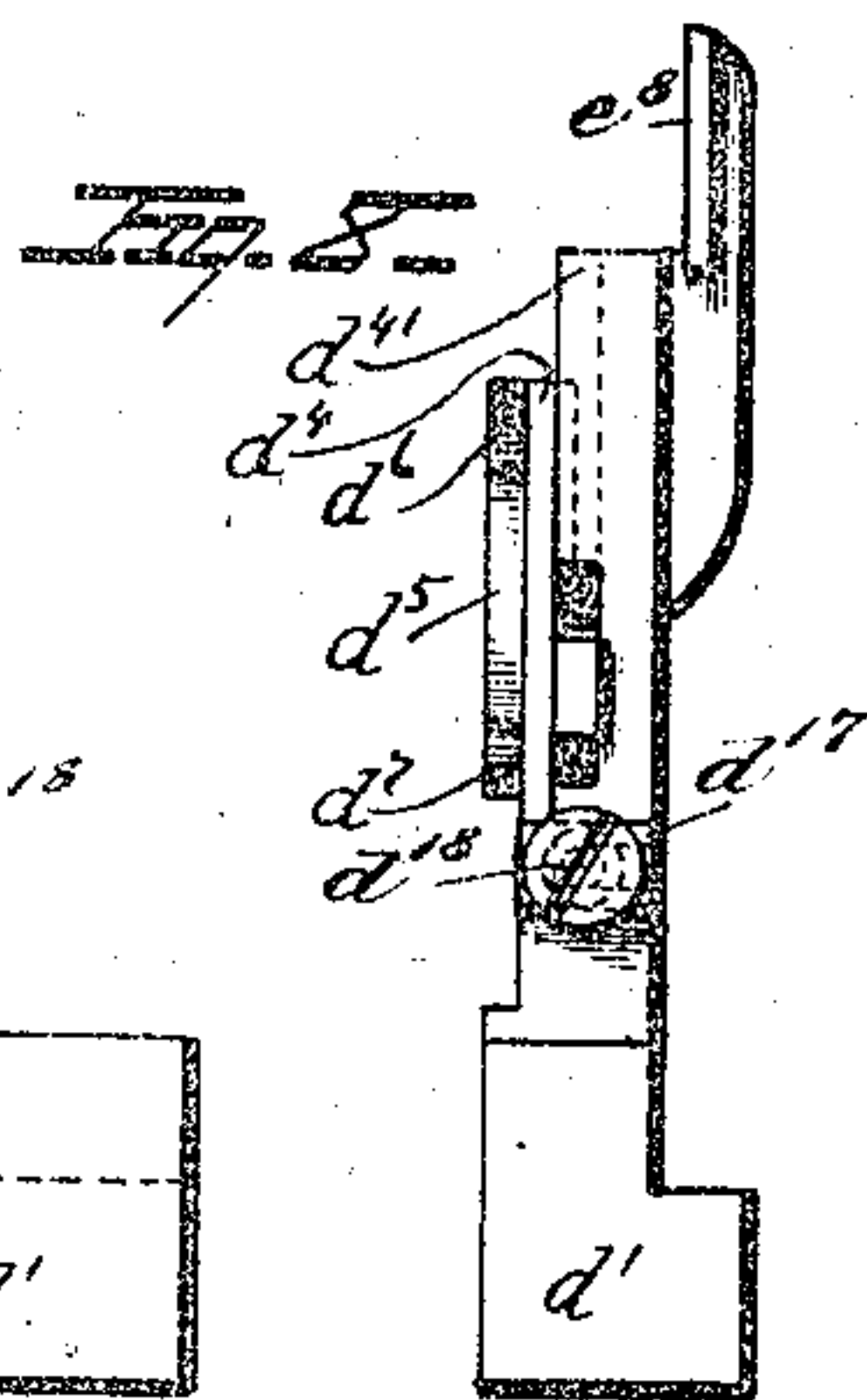
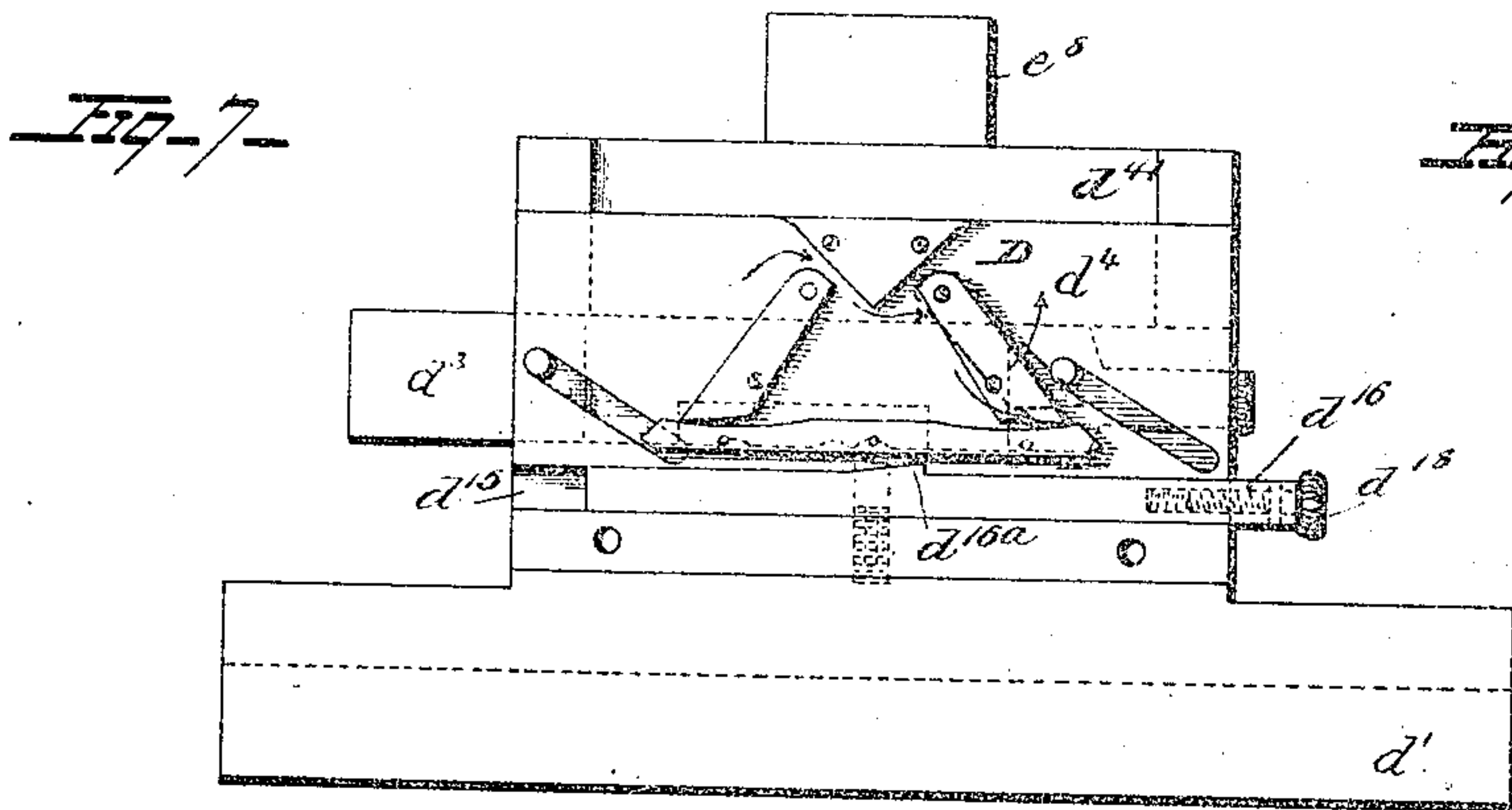
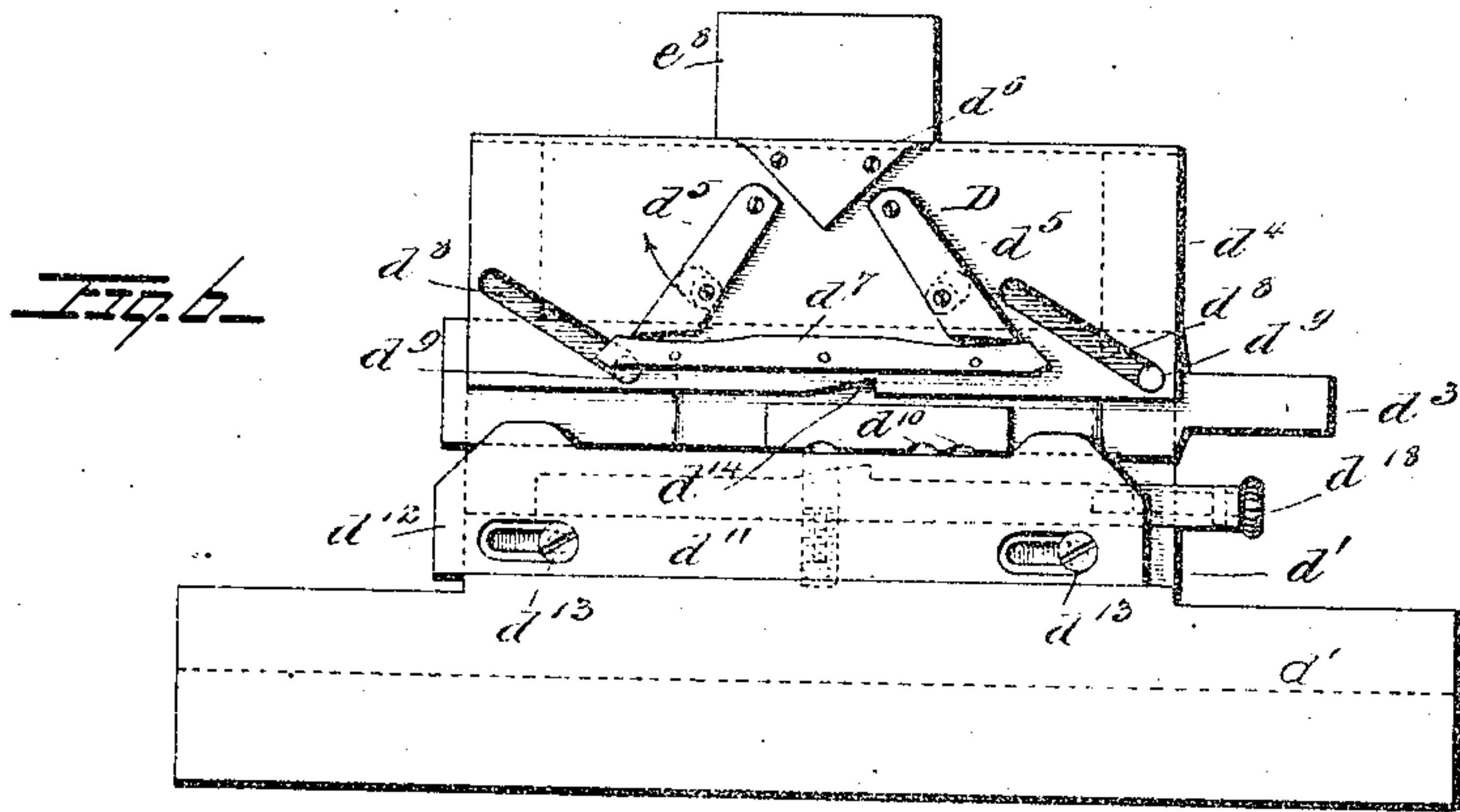
(No Model.)

13 Sheets—Sheet 6.

J. BENNOR.
STRAIGHT KNITTING MACHINE.

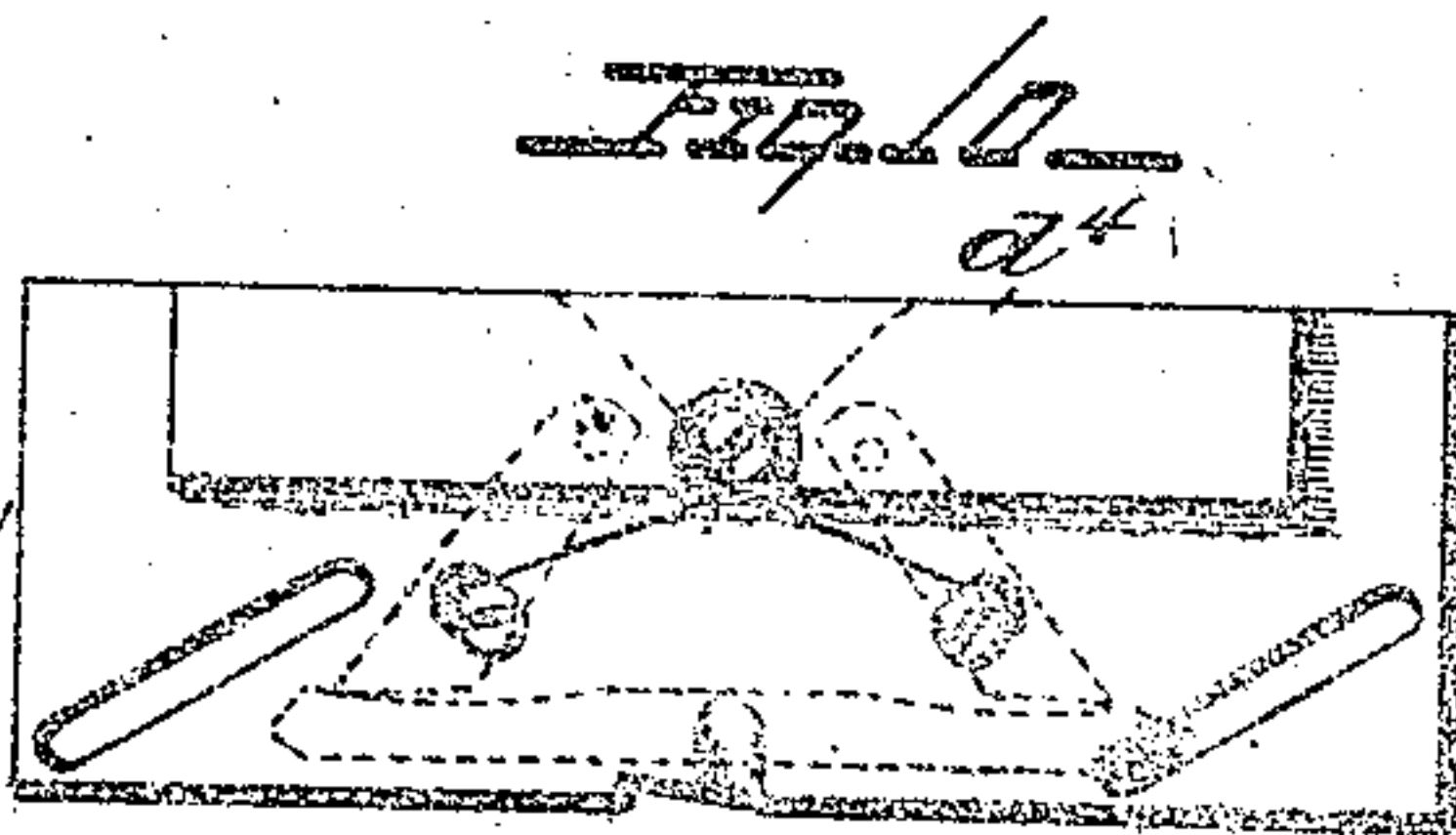
No. 440,389.

Patented Nov. 11, 1890.



WITNESSES:

WITNESSES:
John Nolan
 James Regan



INVENTOR

INVENTOR
Joseph Pennor,
BY
Joshua Pussey,
ATTORNEY

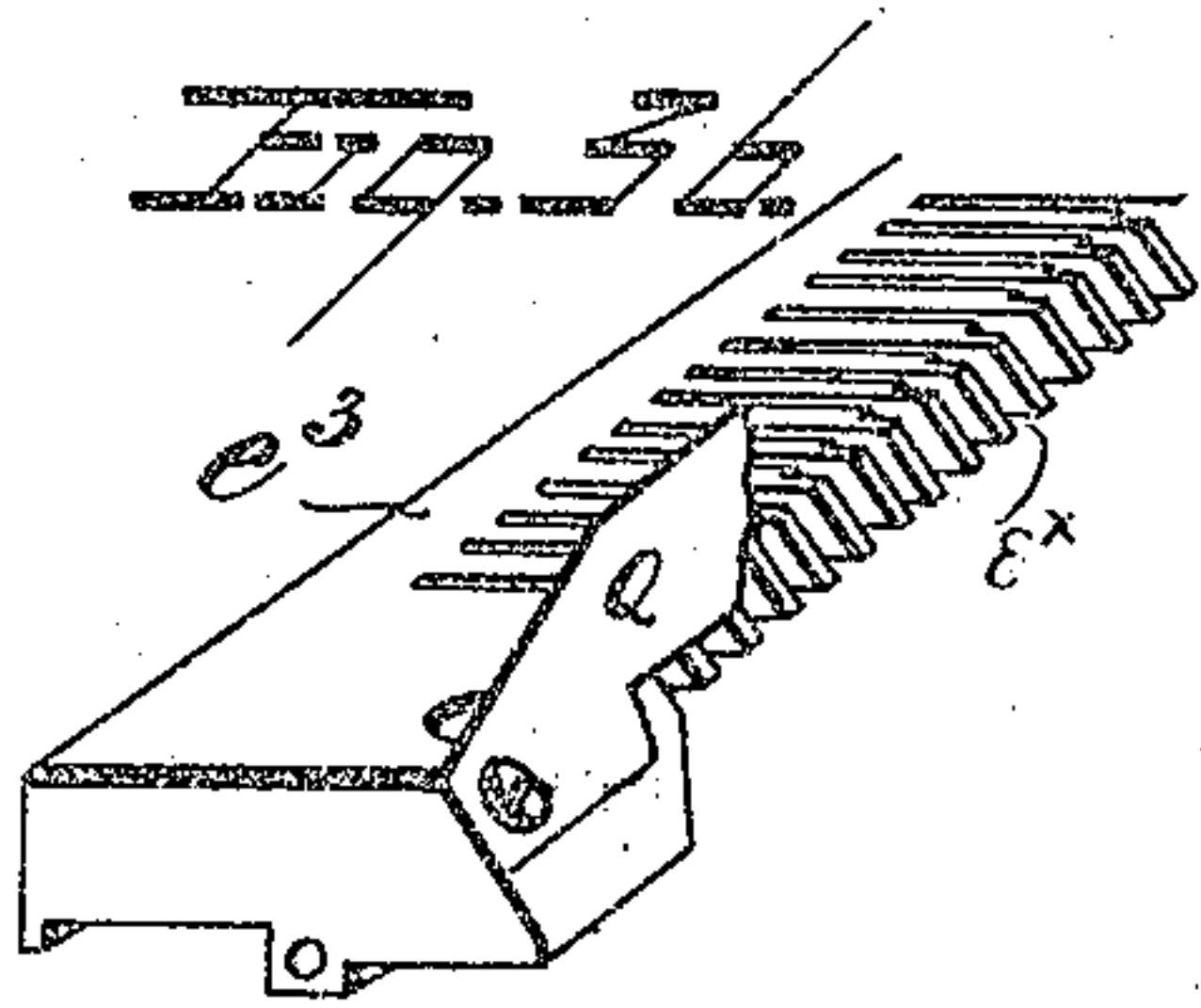
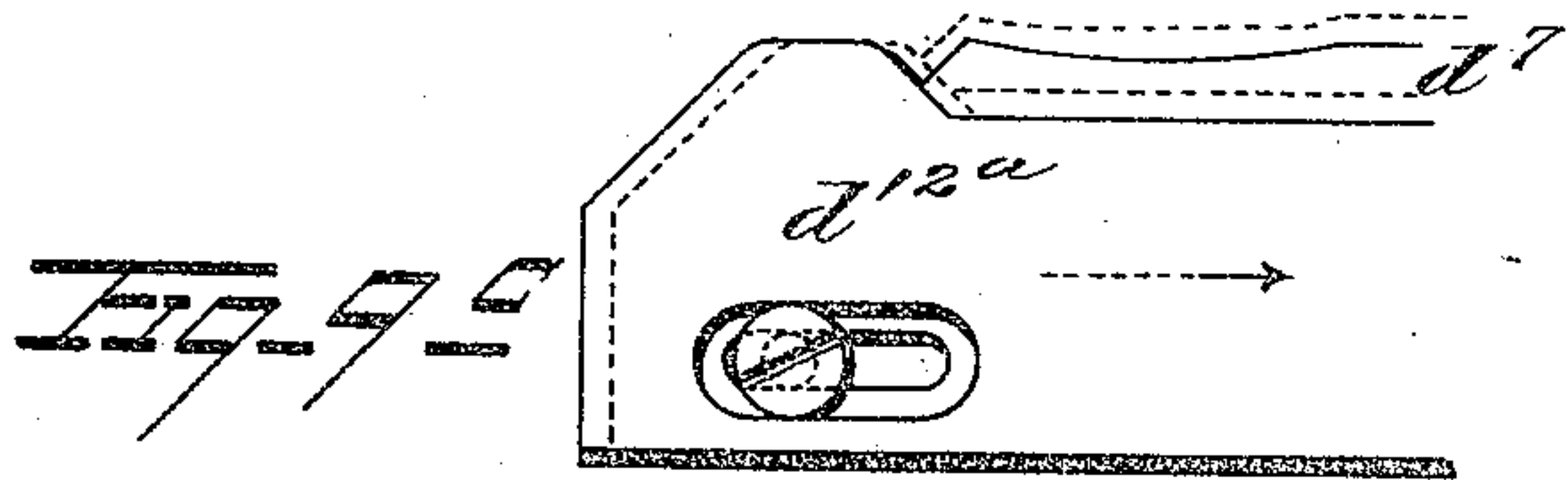
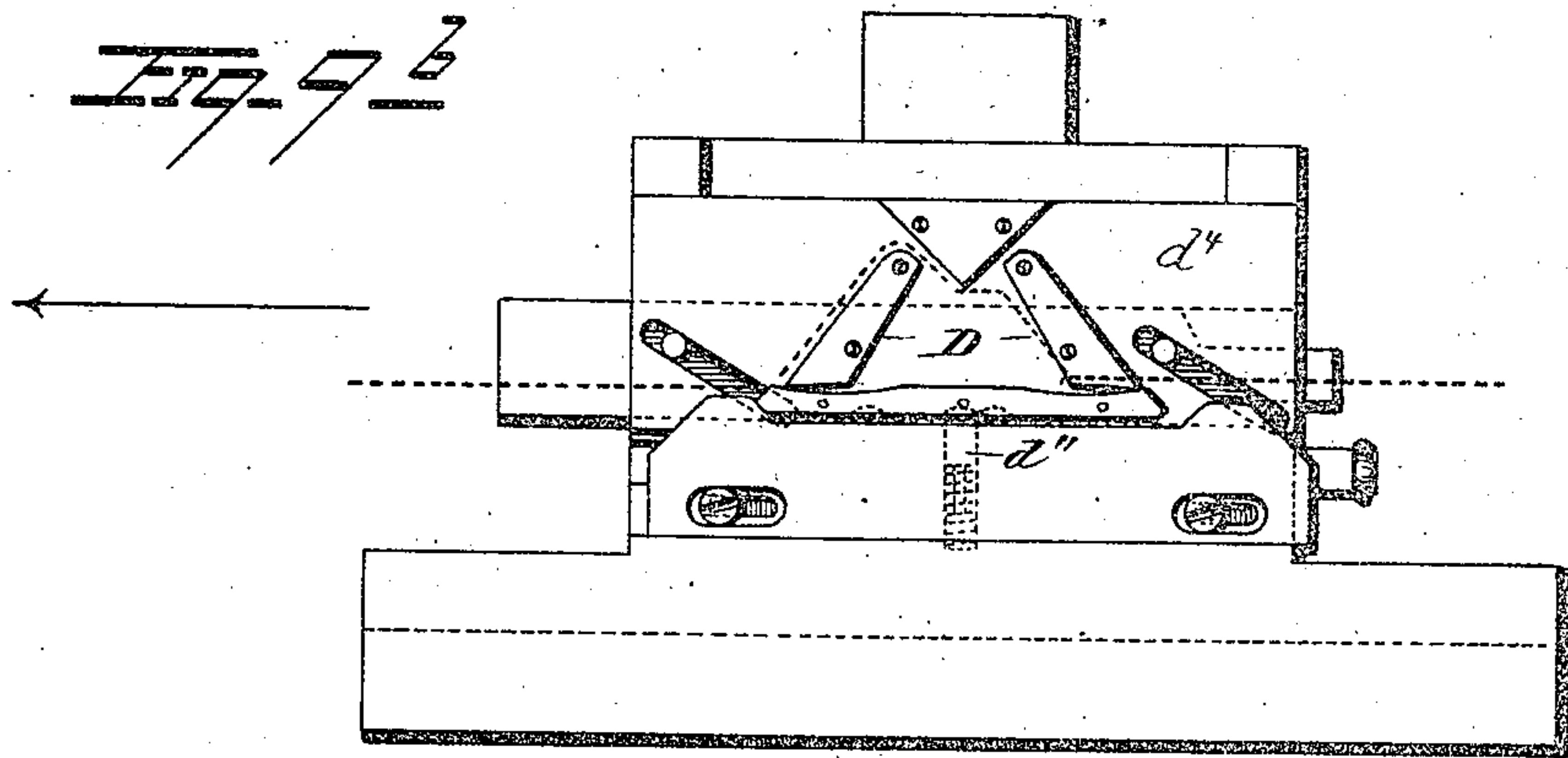
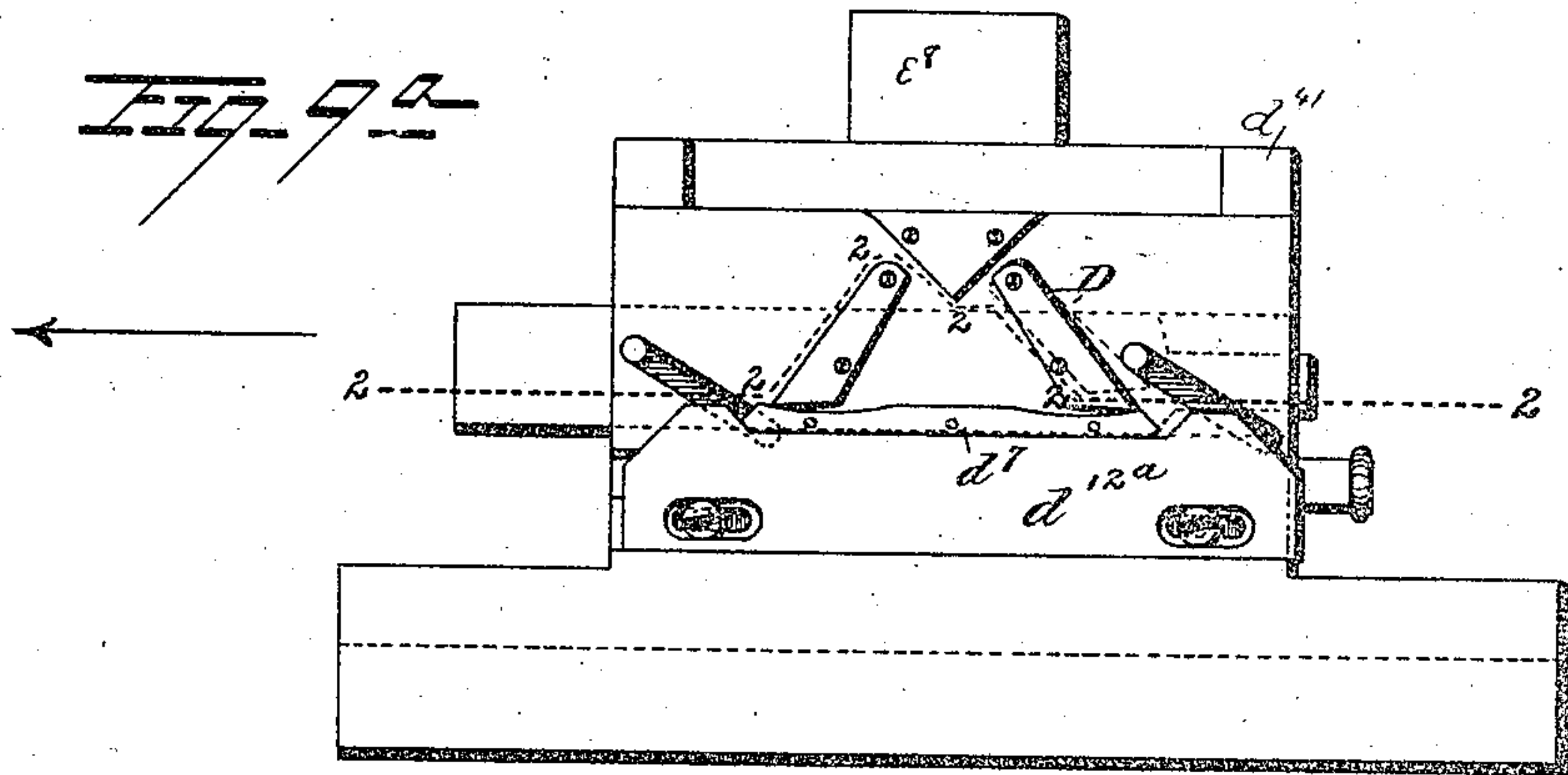
Two Model.)

13 Sheets—Sheet 7.

J. BENNOR.
STRAIGHT KNITTING MACHINE.

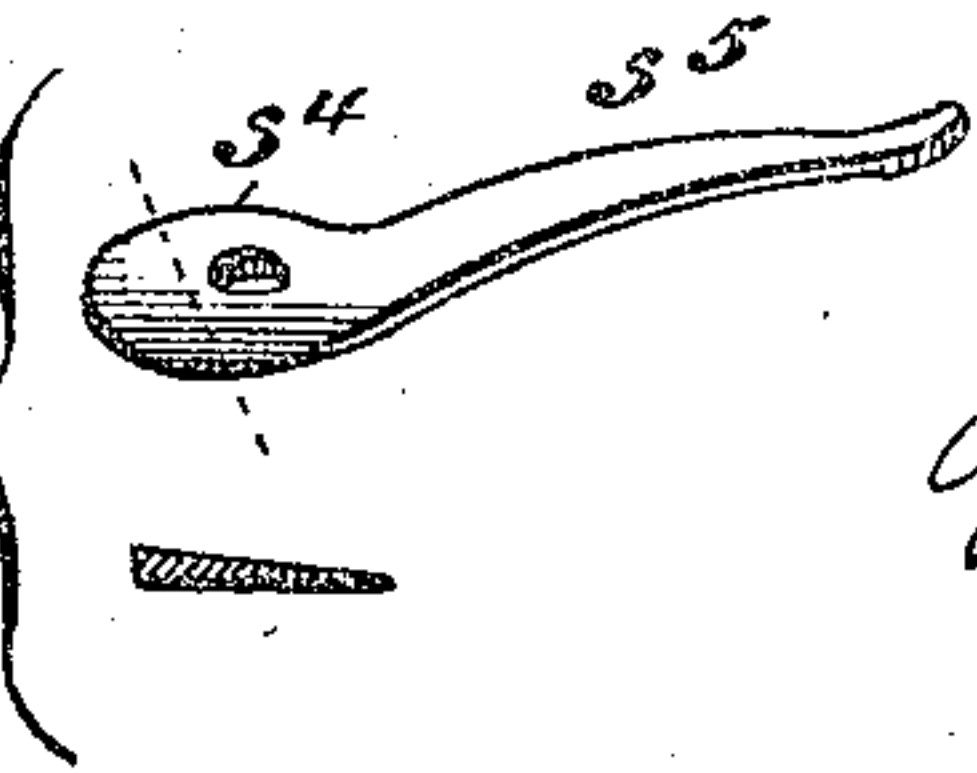
No. 440,389.

Patented Nov. 11, 1890.



Witnesses:

Blue Nolan
J.C. Dugan



Inventor

Inventor
Joseph Bennett,
per Joshua Pusey,
attorney

(No Model.)

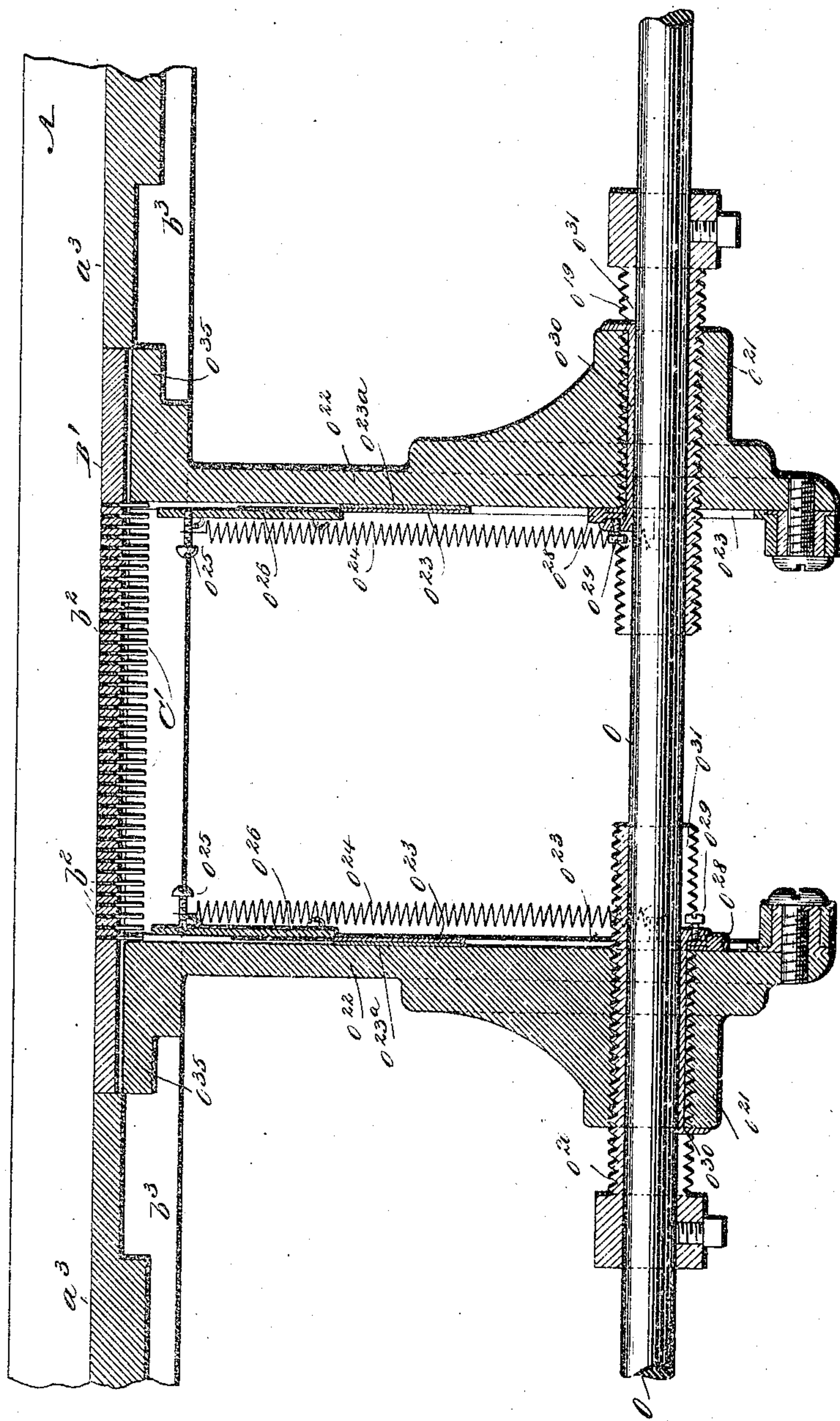
13 Sheets—Sheet 8.

J. BENNOR.
STRAIGHT KNITTING MACHINE.

No. 440,389.

Patented Nov. 11, 1890.

Fig. 12



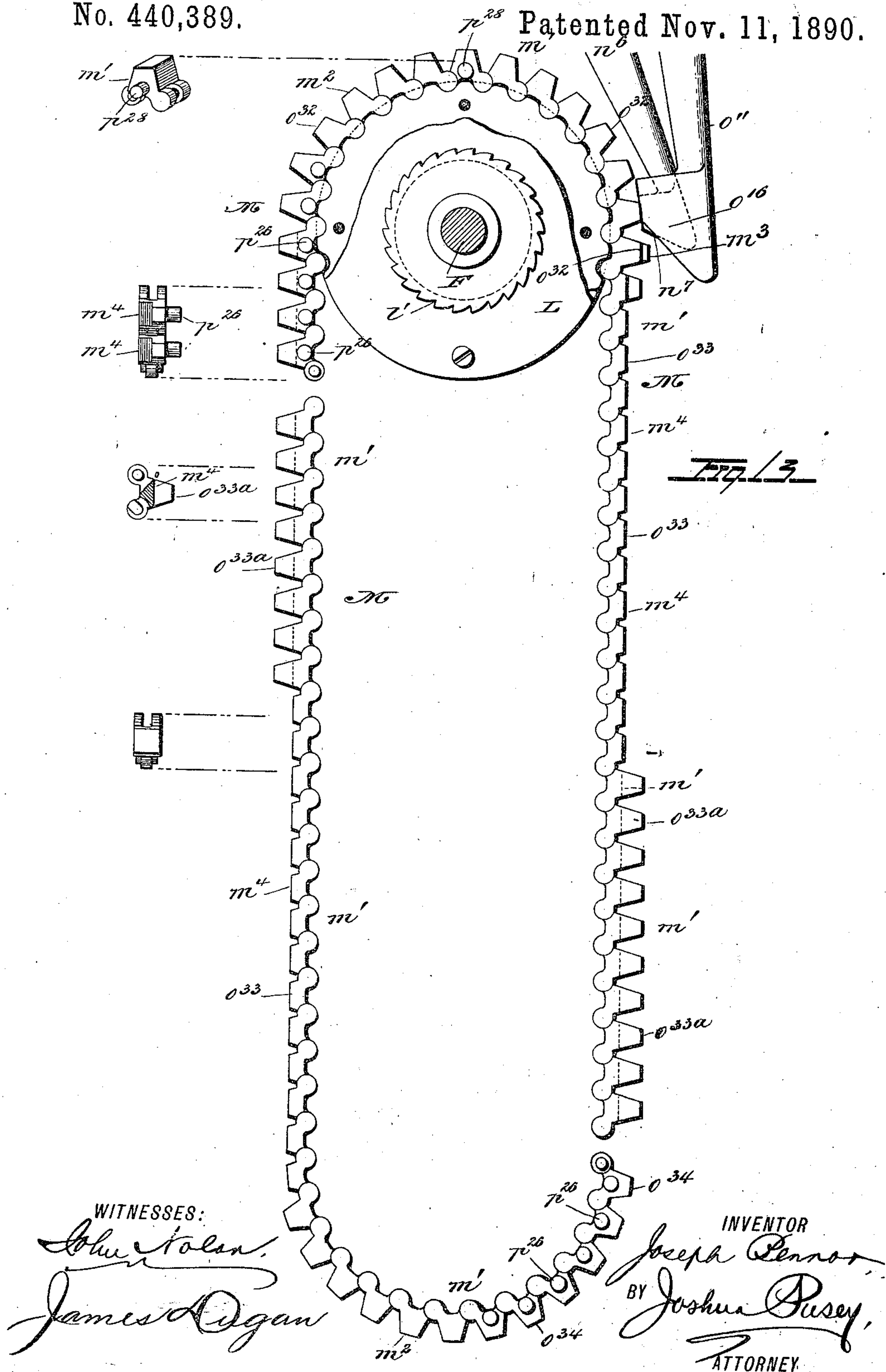
(No Model.)

13 Sheets—Sheet 9.

J. BENNOR.
STRAIGHT KNITTING MACHINE.

No. 440,389.

Patented Nov. 11, 1890.



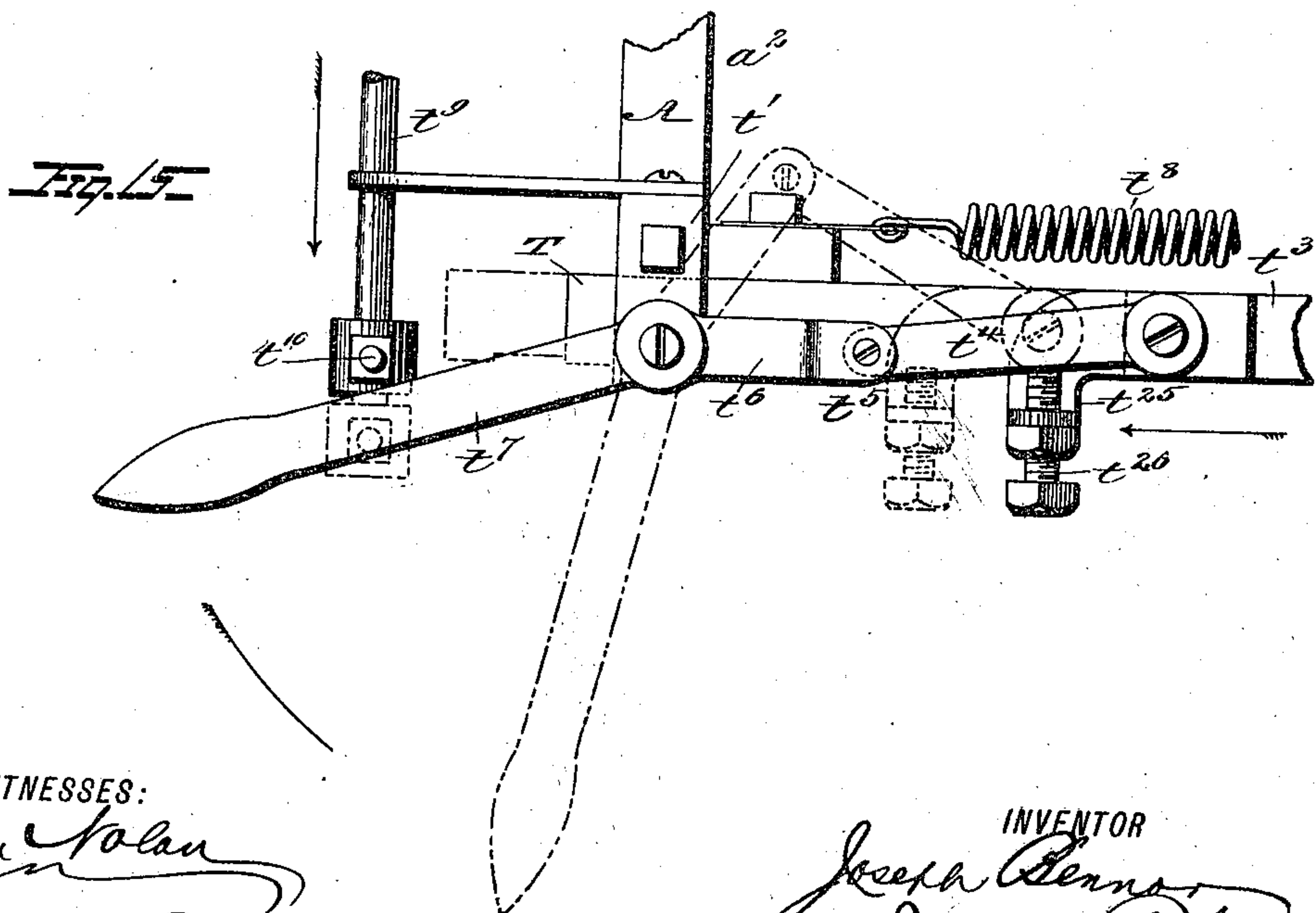
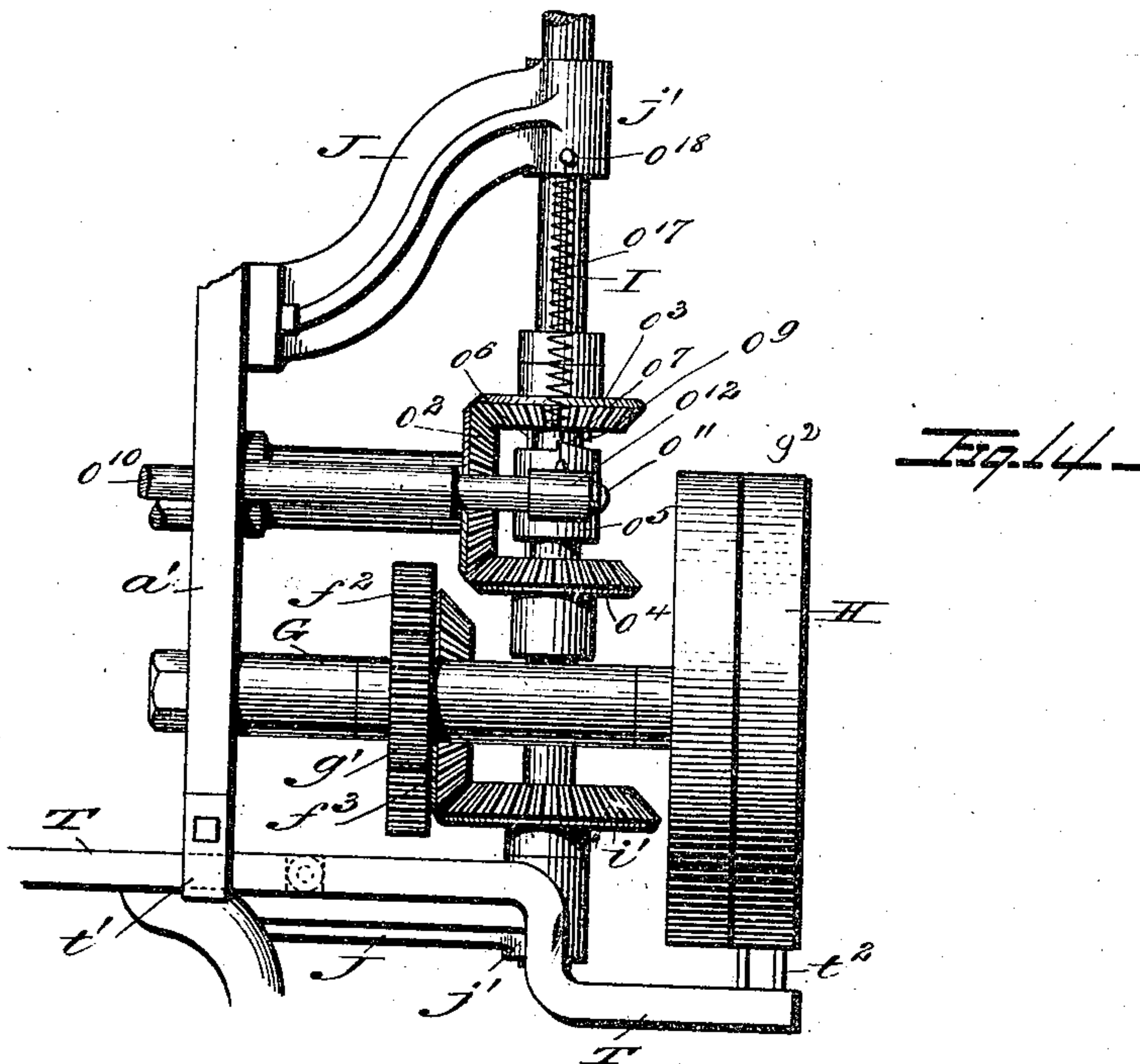
(No Model.)

13 Sheets—Sheet 10.

J. BENNOR.
STRAIGHT KNITTING MACHINE.

No. 440,389.

Patented Nov. 11, 1890.



WITNESSES:

John Nolan
James Dugan

INVENTOR

Joseph Bennor
BY *Joshua Pusey*
ATTORNEY

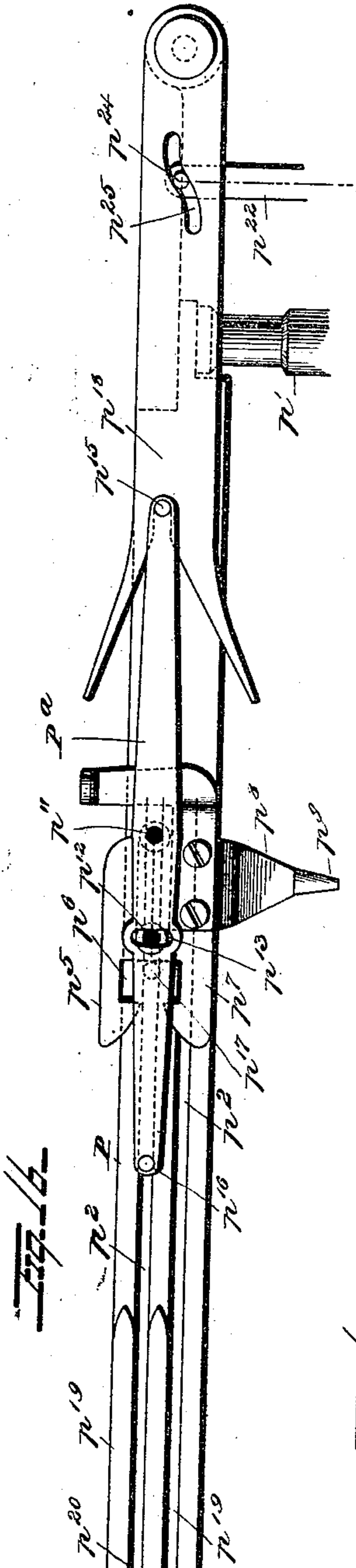
(No Model.)

13 Sheets—Sheet 11.

J. BENNOR.
STRAIGHT KNITTING MACHINE.

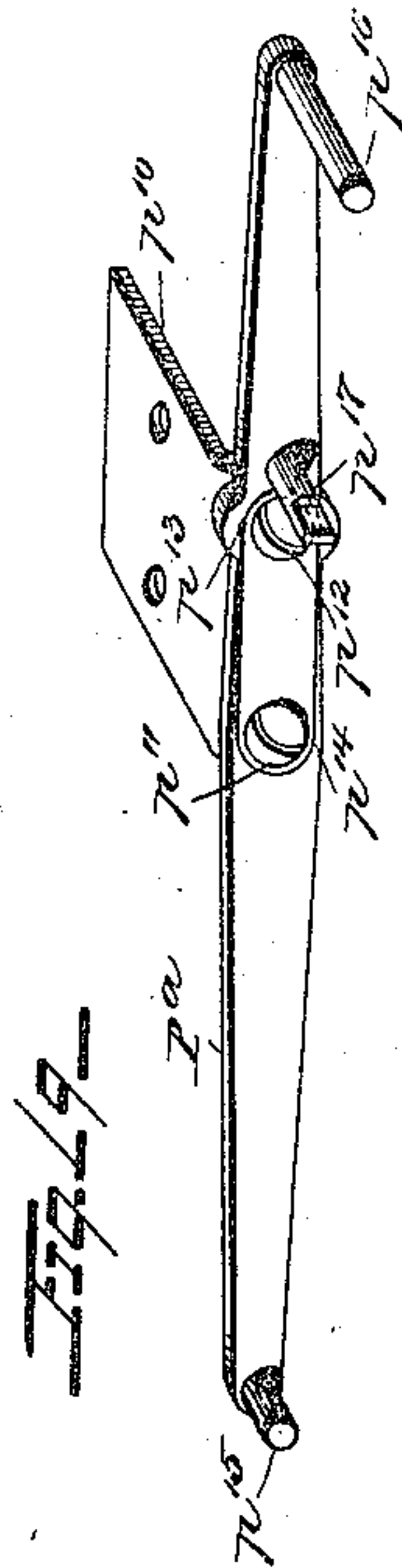
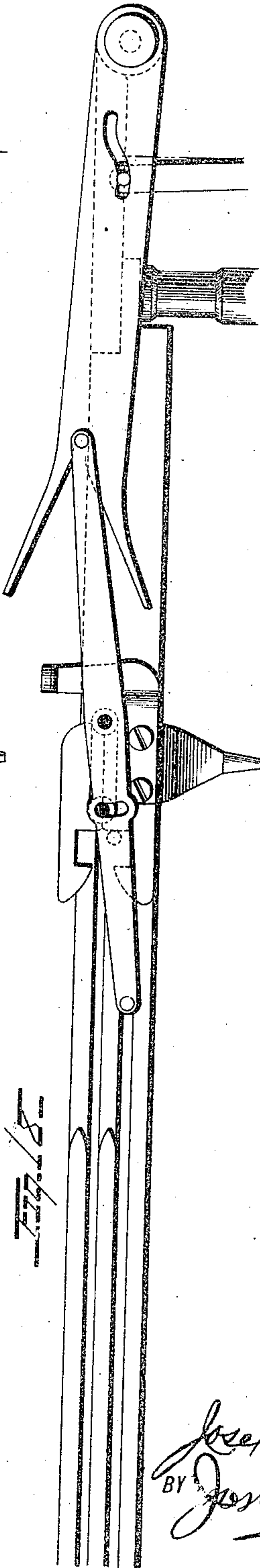
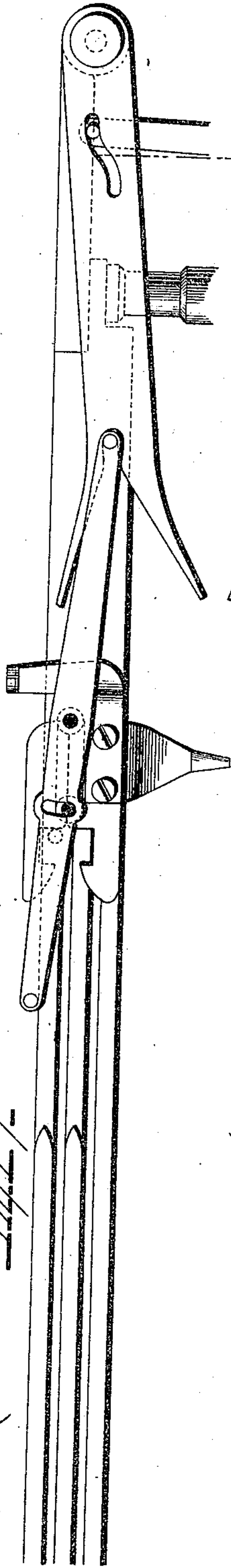
No. 440,389.

Patented Nov. 11, 1890.



WITNESSES:

John Tolson
James H. Dugan



INVENTOR

Joseph Bennor
BY *Joshua Pusey*

ATTORNEY

(No Model.)

13 Sheets—Sheet 12.

J. BENNOR.
STRAIGHT KNITTING MACHINE.

No. 440,389.

Patented Nov. 11, 1890.

Fig. 20.

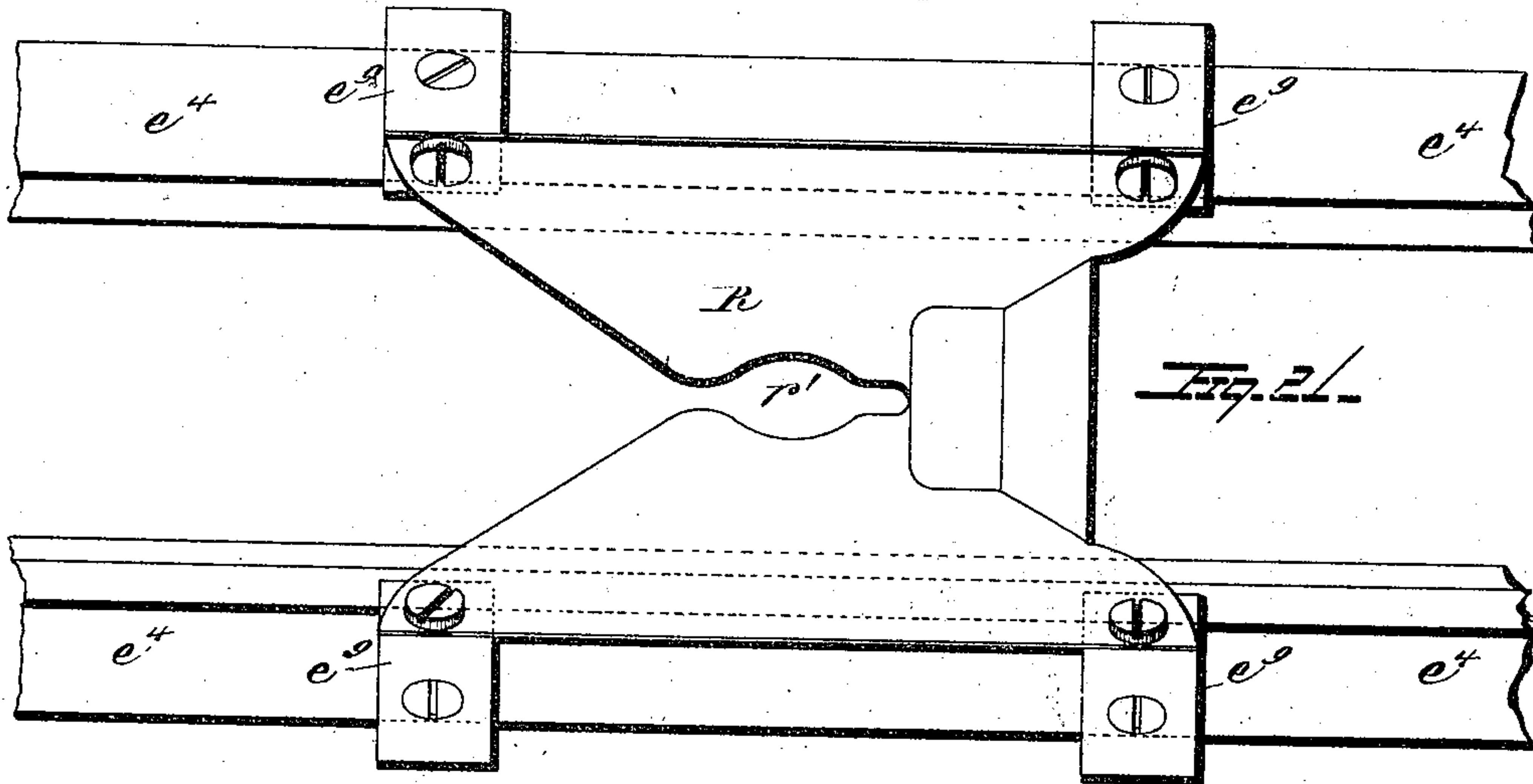
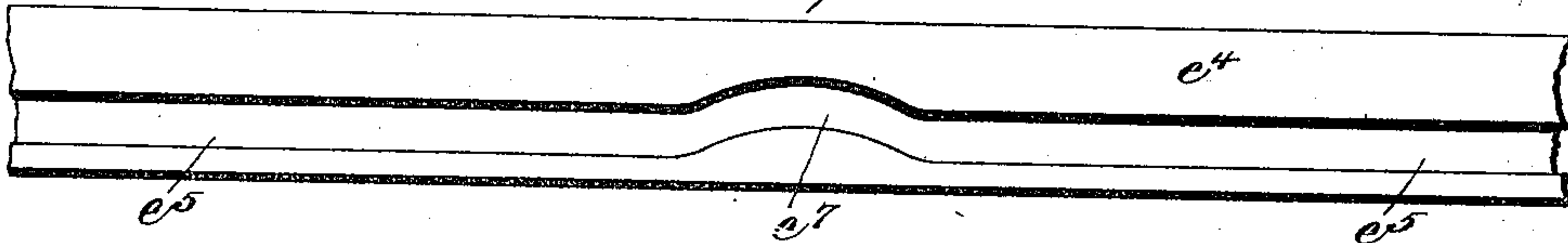


Fig. 21.

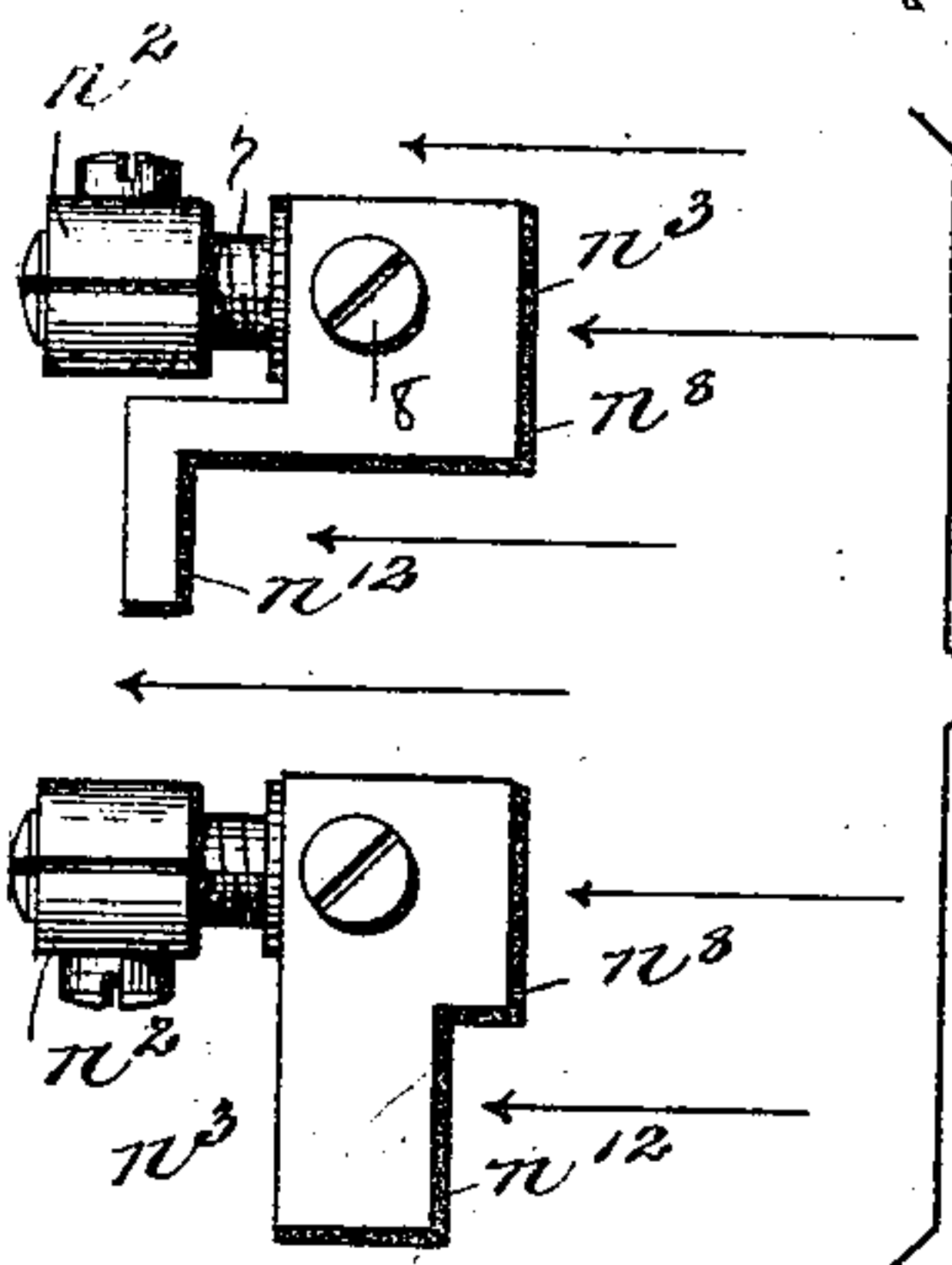


Fig. 22.

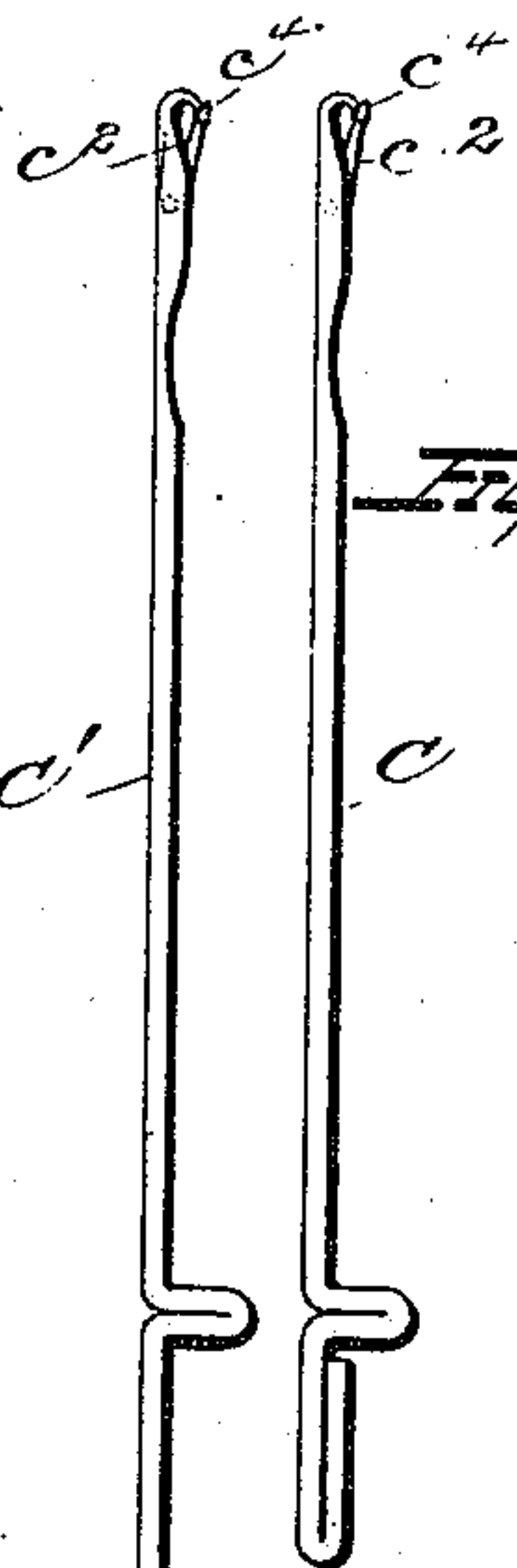


Fig. 25.

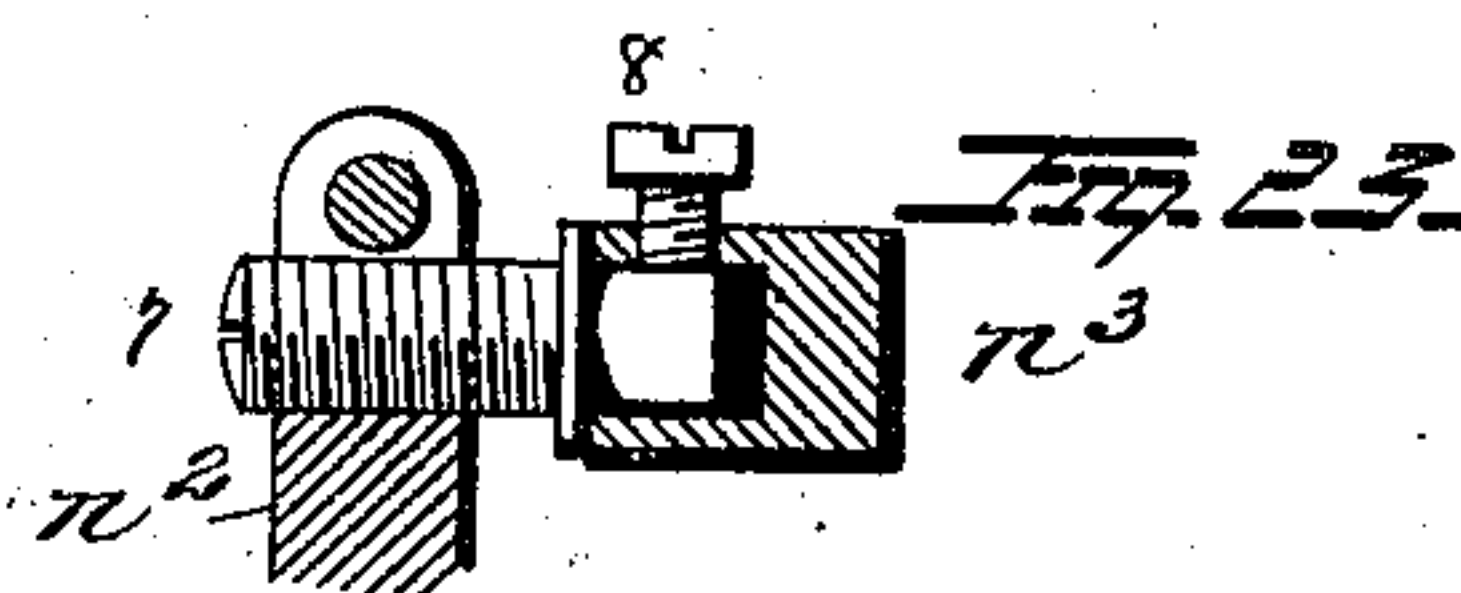


Fig. 23.

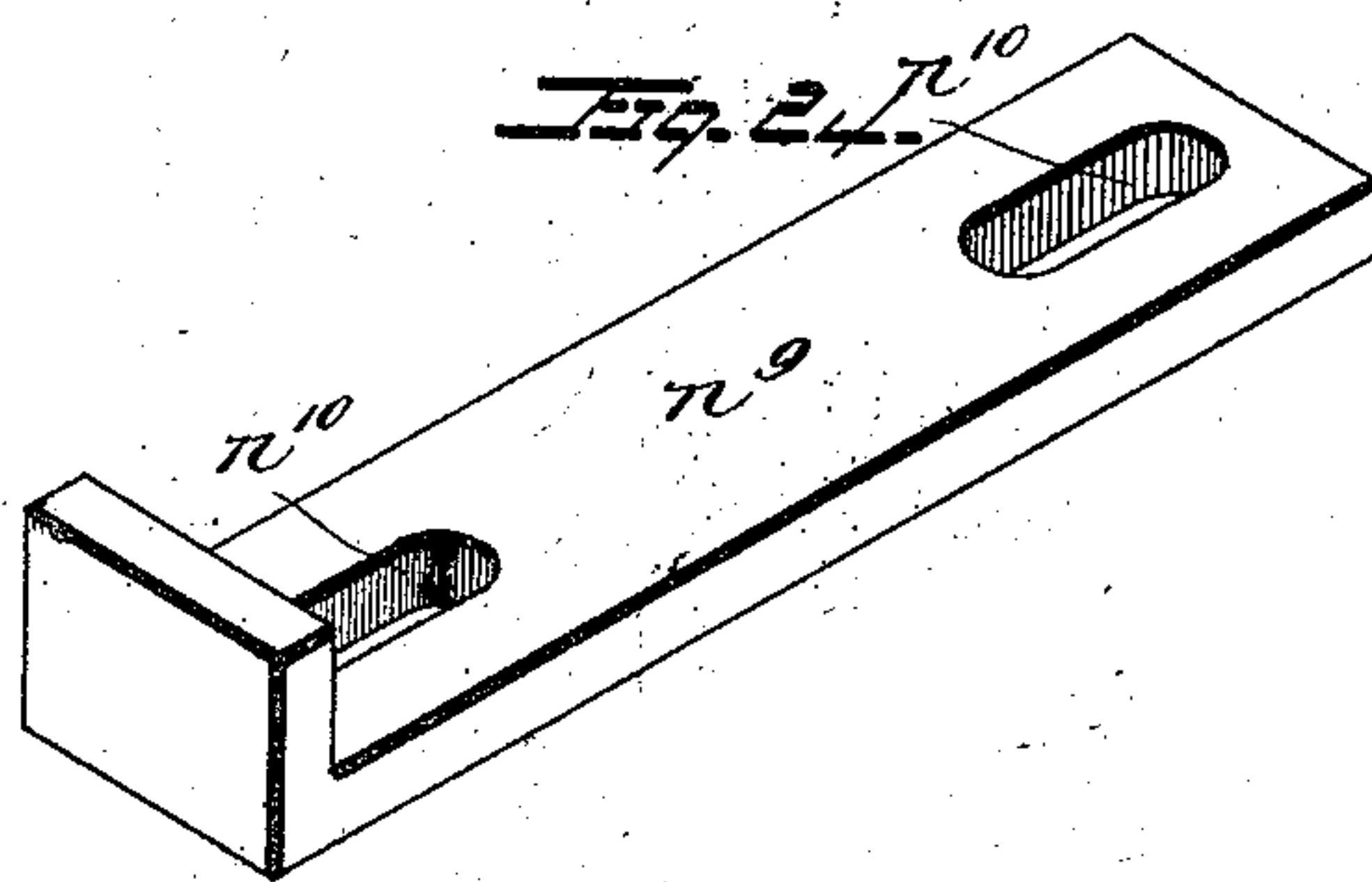


Fig. 24.

WITNESSES:

John Valan
James Dugan

INVENTOR

Joseph Bennor
BY *Joshua Pussey*
ATTORNEY

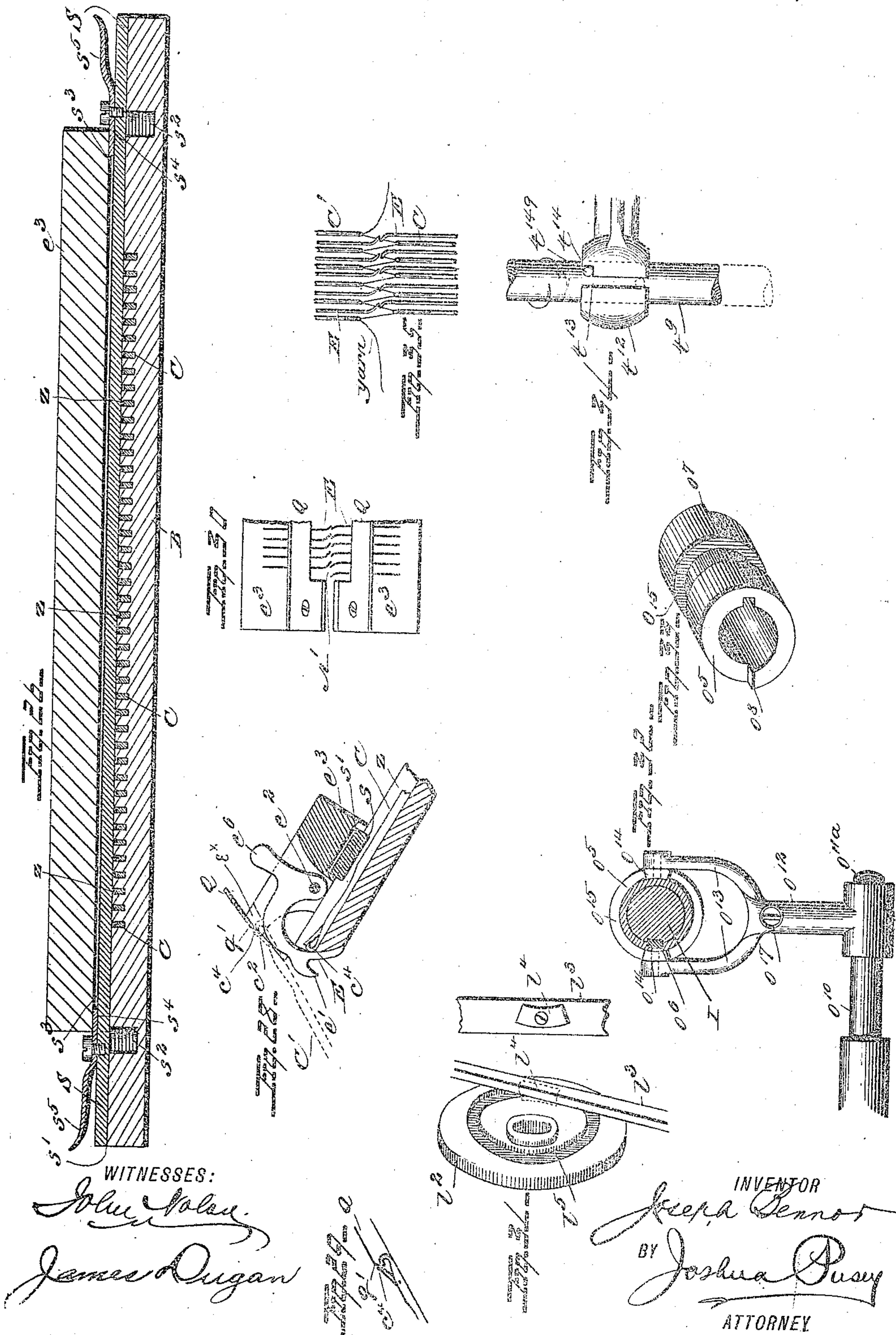
(No Model.)

13 Sheets—Sheet 13.

J. BENNOR.
STRAIGHT KNITTING MACHINE.

No. 440,389.

Patented Nov. 11, 1890.



UNITED STATES PATENT OFFICE.

JOSEPH BENNOR, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO POWELL
& BROTHER, OF SAME PLACE.

STRAIGHT-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 440,389, dated November 11, 1890.

Application filed June 21, 1889. Serial No. 315,132. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH BENNOR, a citizen of the United States, residing at the city and county of Philadelphia, and State of Pennsylvania, have invented certain new and useful Improvements in Straight-Knitting Machines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, of which—

Figure 1, Sheet 1, is a general perspective view of my machine as in actual use, the belt having been thrown from the fly to the loose pulley, and the pattern-chain represented by the dotted lines. Fig. 2, Sheet 2, is a side elevation of the working parts of the machine, the take-up levers and immediate adjuncts not shown. Fig. 3, Sheet 3, is a plan of the same. Fig. 4, Sheet 4, is an end elevation looking in the direction of the arrow marked 1, Fig. 3. Fig. 5, Sheet 5, is a transverse vertical section, enlarged, as on the line *xx*, Fig. 3. Fig. 6, Sheet 6, is an elevation of one set of needle-operating cams and immediate connections, the cams being in their up or disengaged position. Fig. 7 is a like elevation, the cams being in their down or engaged position and the safety-cam removed. Fig. 8 is an end view of the same. Fig. 9 is an elevation of the cam-frame, the notched slide-bar and the spring-controlled locking-pin being shown therein. Fig. 9^a, Sheet 7, is a view similar to Fig. 7, showing the "safety-cam" in position. Fig. 9^b is a view showing the cams in the intermediate position. Fig. 9^c is an enlarged view of one end of the safety-cam and the adjacent end of the needle-controlling bar, the full lines showing their relative positions when the knitting-cams are down and the dotted lines showing their positions when the cams are in the intermediate position. Fig. 10, Sheet 6, is a rear elevation of the sliding cam-plate. Fig. 11 is a view of the cam-regulating bar and its adjusting-screw detached. Fig. 12, Sheet 8, is a longitudinal section through the needle-bed B', the needle-throwing fingers, screw-shaft, &c., as on the line *yy*, Fig. 5. Fig. 13, Sheet 9, is a broken elevation of the pattern-chain, the sprocket-wheel, its ratchet, and the rock-arms. Fig. 14, Sheet 10, is a front elevation of the gearing, the clutch

devices, and adjuncts. Fig. 15 is a like elevation of the toggle-lever, the adjacent end of the shifter-bar, the drop-rod, and connections, the full lines showing the position of the parts when the machine is in operation and the dotted lines showing their position when the machine is stopped. Fig. 16, Sheet 11, is a side elevation of one end of the yarn-carrier-supporting bar, showing the yarn-carriers thereon, the sliding rocking-lever, the cam slotted arm for actuating the same, and the lever for controlling said arm, the parts being in their neutral or inactive position—that is, the rocking-lever disengaged from both carriers. Fig. 17 is a like elevation showing the position of the several parts when the rocking lever is engaged with the upper carrier. Fig. 18 is a like elevation when the rocking lever is engaged with the lower carrier. Fig. 19 is a separate view of the sliding rocking lever with the plate to which it is pivoted, showing the projecting pins and the spring-washer. Fig. 20, Sheet 12, is a bottom view of a part of a sinker-actuating bar. Fig. 21 is a plan of the latch-controller and the adjacent parts of the sinker-actuating bar, showing the studs or shoulders *e'* on the latter. Fig. 22 is a like view of the shifting-blocks and their supporting-arms, the arrows indicating their different positions relative to the central cam-sliding bar. Fig. 23 is a vertical section through one of said blocks and the upper end of its supporting-arm. Fig. 24 is a view of the fixed end stop or block detached. Fig. 25 is a view of the needles used in the machine. Fig. 26, Sheet 13, is a vertical section through the sinker-frame and the needle-bed, being designed more especially to show the construction of the needle-retaining bar and adjuncts. Fig. 27, Sheet 7, is a separate view of the cam-lever for operating said bar, showing, also, a section taken through the dotted line on the wedge-shaped cam. Fig. 28, Sheet 13, is a transverse section through one of the sinker-frames, the adjacent needle-bed, the latch-opener, and the needle-retaining bar, a sinker and needle being shown in place, and a needle about to be unlatched by the latch-opener being shown in dotted lines. Fig. 29

shows a modification of the latch-opener. Fig. 30 is a plan of one end of the sinker-frames, showing the latch-openers and sinkers. Fig. 31 shows the pawl-arm-actuating cam and a part of said arm. Fig. 32 is a horizontal section through the clutch-sleeve and its shaft, showing the engaged bifurcated arm and its rock-shaft. Fig. 33 is a perspective view of said clutch-sleeve detached. Fig. 34 is a view of a part of the studded drop-rod and its slotted supporting-box. Fig. 35 is a view of the ends, a number of the needle-hooks, and the interposed sinkers, showing their relative positions and the position of the yarn when both sets of needles are simultaneously retracted at the outset of the knitting operation. Fig. 36, Sheet 7, is a view of one end of one of the sinker, latch-opener, and needle-hook supporting frames.

This invention has reference more particularly to that class of knitting-machines sometimes termed "straight-row" machines, wherein are employed two opposite parallel rows or sets of needles which are so relatively actuated by suitable mechanism as to knit automatically a continuous series of whole and complete socks or other hosiery of uniform or variable color.

To improve the construction of these machines in such manner that their operation will be positive and uniform and better and more perfect results than heretofore thereby secured is the primary object of the invention.

It consists, first, in the general construction and arrangement of the mechanism for controlling and actuating the reciprocating needle-cams at various stages of the work; secondly, in the special construction of said cams, whereby certain hereinafter-described results and advantages are secured; thirdly, in novel mechanism for automatically throwing the needles into and out of action during the operation of knitting the heel and toe parts of the sock; fourthly, in devices for automatically changing the color (or size, if desired) of the yarn at any prescribed point in the operation; fifthly, in devices for insuring the opening of the latches of the needles; sixthly, in a simple means for positively arresting the motion of the machine in the event of the breaking or ending of the yarn; seventhly, in a certain reciprocating device, termed the "latch-controller," for holding the latches in their open position; eighthly, in a simple means for holding the needles within their grooves; ninthly, and, finally, in the details and minor features of construction of the several parts and in their special arrangements and combinations, all as will be hereinafter fully and clearly described, and be definitely pointed out in the claims.

Referring to the annexed drawings, A represents the frame-work of the machine; B B', the oppositely-inclined needle-beds; C C', the sets of needles therein contained; D, the reciprocating needle-operating cams, whose

frames d' are connected by the yoke or saddle d^2 , and E the sinkers or loop-holders, whose fingers e' project into and play within the central longitudinal throat or slot A' , through which the knitted web descends. The relative arrangement of these parts is the same as heretofore.

F represents the main shaft of the machine, by and from which the mechanism is actuated. On one end f' of this shaft is a spur-wheel f^2 , with which gears a pinion g' , fast on an adjacent shaft or stud G. The latter is driven from some proper source of power by means of a belt H passing around a fixed pulley g^2 on said shaft or stud.

I is a vertical shaft, which is mounted near the wheel f^2 in boxes or bearings j' , that are borne in arms J, projecting from the end cheek a' of the frame-work. On the lower end of this shaft I is a bevel-gear i' , whose teeth engage with those of a similar gear f^3 on the shaft F, and on the upper end of shaft I is a crank or disk wheel i^2 , which is connected with the cam-yoke d^2 by means of a rod or pitman K. In this way the shafts F G communicate their motion to the vertical shaft, and the latter in turn imparts a reciprocating motion to the cams. The construction and operation of these cams is such that in knitting tubular work one set is active while the other set is idle, and vice versa, both sets being alternately thrown into and out of action by means of mechanism, which will be hereinafter described.

Loosely mounted on the end f^4 of shaft F is a sprocket-wheel L, which carries a ratchet l' on its outer face. Next this ratchet there is fixed on said shaft a face-cam l^2 , below which to the end head a^2 of the frame A is pivoted an arm l^3 , which latter is provided with a pivoted stud l^4 thereon that projects into and rides within the cam or eccentric groove l^5 . On the upper end of this arm is a pawl l^6 , which normally engages with the teeth of the ratchet-wheel, as shown. From this construction it will be seen that the shaft F through its cam l^2 will oscillate the arm l^3 and its pawl l^6 , and the pawl in turn will impart a step-by-step movement to the ratchet, and perforce to the sprocket-wheel L. A lower stop-pawl l^7 , which is pivoted at x on the head a^2 , normally engages the teeth of the ratchet and prevents backward motion thereof. Borne by the sprocket-wheel L is a measuring or pattern chain M, whose peculiarly-formed links m' , through intermediate mechanism engaging therewith, determine the various positions of the needles at the different stages of the operation, and the color (or size, if desired) of yarn that is supplied, as will hereinafter appear. Chain M in the present instance is supported upon pulleys M^a , Fig. 1, which are mounted in a suitable frame or upright M^b , firmly secured to the floor, adjacent to the end a^2 of the machine.

Journalled in the end heads or cheeks of the frame A, adjacent to the shaft F, are two

parallel rock-shafts N and N', upon each of which is supported an upright arm n^2 , which extends through a slot in the top plate a^3 , and carries at its upper or free end a block n^3 . In the present instance this block is fitted loosely on one end of a stud 7, which projects from the arm n^2 and is held in place by a set-screw 8, which is adapted to work in the block and bear against said stud. The other end of the latter is screw-threaded and works in the arm n^2 , so that by properly turning the stud it will be moved in or out, and the block thus be set toward or from the arm, as desired. When so set, if the block be not in proper horizontal position it may be readily loosened on the stud 7, moved to and fixed at the proper point of adjustment by properly turning the set-screw 8. (See Figs. 22 and 23.) The arms n^2 are united by a rod n^4 , and are normally held at a prescribed point by means of a retracting-spring n^5 , whose ends are respectively secured to said rod and to the near end head a^2 , as seen. The end of one of these rock-shafts (N' in the present instance) extends out beyond the head a^2 and has fixed thereon an arm n^6 , which is provided at its free end with an enlarged head n^7 , which successively rides upon the individual links of the pattern-chain during the intermittent motion thereof. It will be noticed that the blocks n^3 swing in the paths of two longitudinal slide-bars d^3 , respectively, which bars extend centrally through the cam-frames and are designed to control the position of the cams D therein contained, and consequently their action upon the needles. These cams are of the following construction: d' indicates the frames in which the cams are supported. Each frame is reciprocated on its needle-bed in the manner before stated, being guided in a channel or way a^v , formed in the side of the main frame A of the machine, as clearly shown.

d^4 is a plate which is movable, within certain limits, at right angles to the slide-bar d^3 , being guided by suitable offsets d^{41} in the under side of the frame d' . On this plate are properly disposed and secured the usual needle-actuating cams D, which in the present instance do not differ materially from those in general use, consisting, essentially, of the lateral spring or gravity controlled wing-cams d^5 and the upper depressing-cam d^6 , with the addition of the lower needle-controlling cam or bar d^7 .

In Fig. 9^a the positions of the needle-heels before, during, and after engagement with the cams D are represented by the dotted line 2 2, &c. When the cams are down or in active position, as shown in this figure, Fig. 7, and right of Fig. 5, they will engage and actuate the needles; but when the cams are up or in idle position they will in their stroke pass above the needle-heels without operating the same—that is to say, the line of the needle-heels will be just below that of the lower edge of bar d^7 , and the needles therefore remain quiescent. (See left of Fig. 5, and

also Fig. 6.) The ends of this bar d^7 are pointed or beveled on both sides, as seen, in order to deflect the needle-heels upon contact therewith above or below the same. The plate d^4 is provided with inclined slots d^8 , into which project from the slide-bar d^3 studs or pins d^9 . Obviously the movement to and fro of the slide-bar will force its projecting studs against the sides of the slots in the cam-plate and thereupon raise or lower the latter and its cams, positively throwing said cams into and out of action with the heels of the needles at each complete reciprocation of the bar. During the process of knitting the foot or leg of the sock the head of the rock-shaft arm n^6 rides upon the medium faces m^2 of the pattern-chain links and in this way maintains the steps n^8 of the swinging blocks n^3 in line with the ends of the respective bars d^3 of the sets of cams. Now it will be apparent that when these cams have traversed the needle-beds the ends of their said bars d^3 will strike against the steps n^8 and be pushed back thereby, thus throwing one set of cams into idle position and the other set into active position. These opposite positions of the two sets of cams, which are identical in construction, arise from the fact that the cams are disposed on the opposite needle-beds, which disposition of course reverses the adjacent ends of the two sets. Although the cams and frames on the opposite needle-beds are identical in construction, the bars d^3 have the projecting portion (shown at the right in Fig. 6 of the drawings) at opposite ends, the same being necessary in order that when in place on the needle-beds said projecting portions shall appear at the same ends of the cam-frames, as shown in Fig. 3.

In order that the cams shall alternately be thrown into and out of action at each reciprocation thereof, I secure near the end of the frame A, opposite to that where the blocks n^3 are arranged, but in line with the latter, fixed stops n^9 , against which the ends of the bars d^3 strike with the result mentioned. These stops are adjustable, as required, the screw-holes n^{10} therein, through which the screws n^{11} pass, being elongated, as seen.

As is well known, in knitting-machines of the class to which my invention relates the knitting commences at the top of the toe-pouch, proceeds downward and upward, knitting the pouch complete, and then forming the foot, the heel, and the leg of the sock in regular order, at the conclusion of which operation another sock is likewise started and a similar operation repeated, and so on in continuous succession. At the outset of this operation both sets of needles are thrown upward and the yarn is conducted thereto, the needles seize the yarn and retreat with the same, (see Fig. 35,) and after forming a round of stitches one set of cams is thrown out of action and the other set proceeds with the knitting, as will hereinafter appear. In order, therefore, to throw both cams simultane-

ously into action, so as concertedly to actuate both sets of needles, as described, in beginning the stocking an offset or depression n^{12} is formed in one side of each of the blocks n^3 , and the face m^3 of one of the chain-links is made slightly higher than those preceding. Thus when the head of the arm n^6 engages with the face m^3 said arm, as also the arms n^2 , with which the blocks are connected, will be moved laterally, thereupon bringing the offset portions n^{12} of the blocks in line with the ends of the respective bars d^3 . When these ends strike the offsets, the bars will be pushed inward thereby a distance only sufficient to throw both sets of cams into active position—that is to say, the cam-plates d^4 will not be moved so far as to permit the needle-controlling cams d^7 to pass over the heels of the needles. (See Fig. 9^b.) When both sets of cams have been thrown into this intermediate position, they will simultaneously act upon the needles. In the first stroke of the cams the two sets of needles will be actuated in concert, their hooks while receding engaging the yarn delivered thereto and drawing it into a zigzag line, as seen in Fig. 35. The yarn is merely caught on the hooks, no stitches whatever having been formed. As the cams reach the end of the first stroke, the leading ends of the slide-bars d^3 will abut against the stops n^9 and be pushed inward, thus throwing one set of cams into the down or active position and the other set into the up or idle position. In the return-stroke of the cams one set of needles will be acted upon, thereby knitting a straight row of stitches. Meanwhile the chain will be moved a distance of one link, and the face of the following link being of the same height as the medium faces m^2 the blocks n^3 , when the head of arm n^6 drops upon said link, will be returned to their former position—that is to say, the steps n^8 will be in line with the ends of the slide-bars d^3 . Upon the latter striking the steps n^8 the positions of the two sets of cams will be reversed—i. e., the idle set will be thrown into action and the other or active set will be thrown out of action, whereupon during the next stroke of the cams a row of stitches will be formed by the opposite set of needles, thus making a complete round of stitches. As the cams reach the end of this last-mentioned stroke, the leading ends of the slide-bars will strike the fixed stops n^9 , and the positions of the cams will thereupon be reversed—that is, those which traverse the bed B' will become active, while those on the other bed will be idle. The active set of cams now operates the needles in bed B' , knitting to and fro thereon, while the other set remains idle. During every stroke of the active cams a needle at each side of the bed is thrown up out of action without dropping the stitch from its hook, so as to narrow or contract the portion of the toe-pouch being formed, as will be hereinafter fully explained. That the cams will retain these relative positions for a prescribed

period I provide the pattern-chain with a series of links with low faces m^4 , which series immediately succeeds the medium-faced link last referred to. When the head n^7 rides upon these low faces m^4 , its arm n^6 , together with the arms n^2 , will be moved backward, so as to throw the blocks n^3 wholly out of the paths of the slide-bars. Thus the cams will remain in the active and idle positions aforesaid. After a sufficient number of needles have been withdrawn they are automatically returned into engagement with the cams in regular order—that is, one at each side of the bed B' during every stroke of the cams, which returning of the needles causes the completion of the pouch; or, in other words, a gradually-widened portion is formed, which corresponds with the gradually contracted or narrowed first-formed portion, and is connected therewith during each stroke of the cams by the return of the upthrown needles, as will be readily understood by one conversant with the operation of this class of machinery. When all the upthrown needles have been retracted and the pouch is thereupon complete, another series of medium-faced links is brought below the head n^7 , thus throwing the steps n^8 of the swinging blocks into the paths of the bars d^3 , as before stated, whereupon the cams will be alternately thrown into active and idle position and proceed with the knitting of the tubular foot portion of the sock. The number of links in this series will determine the length of the foot portion, and following the same is another series of low-faced links, which govern the formation of the heel portion of the sock. When the head of arm n^6 rides upon these low-faced links, all the parts will assume the same positions and operate in the same manner as hereinbefore described with regard to the knitting of the pouch, the needles being thrown into and out of action in like manner. Upon completion of the heel another series of medium-faced chain-links are brought below the head of arm n^6 , and the mechanism is again thrown into the tube-knitting position, whereupon the leg portion of the sock is made. The number of these links last mentioned prescribe the length of the leg—the more links the longer the leg. When the latter has been formed, the yarn-conductor will cease to deliver yarn to the needles until the second reciprocation of the cams, as will be hereinafter described. The stitches will thus be cast off the needles, and the sock will fall therefrom down through the throat of the machine, as illustrated in Fig. 1. In this second reciprocation of the cams, they having again been thrown into the intermediate position, both sets of needles will thereby be simultaneously actuated, the yarn will be fed to and caught by the needles, and the foregoing-described operation will be repeated, and in like manner in continuous succession whole and complete socks will be knit by and cast from the needles. It will be ob-

vious that the zigzag line into which the yarn is drawn by the cams at the outstart of the operation will form on one side of the toe-pouch a row of connected M-loops. As it is desirable that these loops be as tight, and therefore as indistinct as possible, the knitting-cams are thrown into the intermediate position above described. When the cams are in this position, less throw will be given thereby to the needles than if both sets of cams were in full active position. In the former case less yarn will be drawn by the needles than in the latter case, and of course the loops formed by the yarn will be correspondingly tighter or smaller. The difference in the depths of the offsets n^{12} in the blocks n^3 , as shown in Figs. 3 and 22, arises from the fact that to throw the up or idle cams into the intermediate position it requires a greater movement of the slide-bar than it does to throw the down or active cams into this position. Therefore the offset against which strikes the bar of the idle set is of less depth than the other offset.

As a simple and effective means by which the cams may be securely retained in the three above-specified positions which they are caused to assume, I provide the under edge of each bar d^3 with a corresponding number of sockets d^{10} at proper points therein, with which sockets is adapted successively to engage a strong spring-controlled pin d^{11} , that plays in a lower recess d^{12} in the cam-frame.

In Figs. 6, 7, and 9^b, the knitting-cams are shown in the up, down, and intermediate positions, respectively, in each instance being locked in position by the pin d^{11} engaging with the proper notch in the slide-bar d^3 .

To guard against any possibility of the heels of the needles passing below the cam-bar d^7 while both sets of cams are in simultaneous action, I provide below said bar a slide-plate d^{12a} , Figs. 6, 9^a, 9^b, and 9^c, which I term a "safety-cam." Its ends project upward and are oppositely beveled or inclined, as shown, and it is provided with longitudinal slots therein, through which loosely pass the screws d^{13} , that connect it to the cam-frame. This plate bears upon the face of the needle-bed, and at each stroke of the cams its inclined end is carried by the frictional contact into proper position with respect to the inclined end of the cam-bar, so as to close the intervening gap which would otherwise remain.

The function of the safety-cam will be more readily understood by reference to Figs. 9^a, 9^b, and 9^c. If it were stationary, there would of course be a gap between the up-projecting end of the same and the adjacent end of the bar d^7 when the cams are in the intermediate position. This is clearly represented by the dotted lines in Fig. 9^c. When in this intermediate position, the cams must engage the needle-heels and not pass idly over the same. Therefore the moving of the

up-projecting end of the safety-cam to and against the leading end of the bar d^7 obviates all liability of the needle-heels dropping accidentally down between the said ends and being passed over by the bar d^7 instead of being acted upon by the knitting-cams. The purpose of the outer bevels on the up-projecting ends of the safety-cam is to deflect the needles upward should the leading end of said cam during the reciprocation of the knitting-cams strike a needle-heel which shall have dropped below the line of the retracted needle-heels, and the purpose of the inner bevels on the said up-projecting ends is to deflect above the top thereof any needle-heels which shall have dropped down upon the upper edge of the safety-cam during the passage of the bar d^7 over the same—that is, while the knitting-cams are inactive. These inner bevels also assist the safety-cam to move readily to the position shown in Fig. 9^c upon the lower beveled end of the bar d^7 striking the opposed inner bevel on the safety-cam when the cam-supporting plate is depressed—i. e., when the knitting-cams are thrown from the idle into the active position. I state in this connection that when the bar d^7 passes above the heels of the idle needles the latter are thereby prevented from jumping and catching the yarn.

That the position of the cams may be readily changed at will, so as to vary the throw of the needles and thus cause tight or loose stitches to be produced thereby, I provide the under side of the movable cam-supporting plate d^4 with an inclined notch or recess d^{14} , and below said plate, in a space d^{15} , I adjustably secure a bar d^{16} , which is provided at a point thereon, in line with said notch or recess, with a correspondingly-inclined tooth or projection d^{16a} . By moving this bar inward the tooth thereon will limit the downward movement of the cam-plate and its cams, and thus of course lessen the throw of the needles, causing them to form comparatively small and tight stitches, and, again, by moving the bar backward an opposite effect will be produced. A very convenient and simple way by which this bar may be quickly adjusted, as occasion may require, is shown in Sheet 6 of the drawings. It consists in providing one end of the bar with an upturned slotted lug d^{17} , through which passes a set-screw d^{18} , working in the end of the frame d^7 . As this screw is provided with an inner flange or projection d^{19} , it will be obvious that by properly turning the screw the bar may be moved in or out, at pleasure.

When the stitch-regulating bar d^{16} is adjusted as above described, the range of movement of the slide-bar d^3 , when acting to depress the cam-plate d^4 , should be correspondingly altered—that is to say, if the bar d^{16} be set so as to lessen the downward throw of the cam-plate the fixed stop n^2 on the needle-bed B' and the swinging stop n^3 on the bed B will be moved longitudinally outward a

proper distance, while, on the other hand, if the bar d^{16} be set so as to permit an increased downward throw of the cam-plate said stops will be moved inward. These stops are adjustable, as above mentioned.

In order that certain needles shall be automatically and successively thrown out of and into action, so as to narrow and widen the web during the formation of the toe-pouch and the heel of the sock, I have devised the following novel mechanism: O is a shaft which is journaled in the end heads a' a^2 of the frame A. The end o' of this shaft extends beyond the adjacent head a' , and has secured thereto a bevel-gear o^2 , which engages with two similar gears o^3 o^4 , that are oppositely but loosely mounted on the vertical shaft I, hereinbefore referred to. On this latter shaft, between the gears o^3 and o^4 , there is interposed a vertically-movable sleeve o^5 , which is secured against independent lateral movement and guided in its vertical movement by means of a spline o^6 , projecting thereinto from the shaft I. This sleeve or "clutch member," as it may be termed, is provided with projections or teeth o^7 and o^8 on its upper and lower ends, respectively, and the opposite faces of the gears are provided with studs o^9 , with which said teeth are adapted to engage successively, as and for the purpose hereinafter described. Journaled in the end heads a' a^2 , adjacent to the rock-shaft N' is another similar shaft o^{10} , whose ends project beyond said heads. The end o^{11a} has fixed thereon an inwardly-extending arm o^{12} , whose forward end is bifurcated, as seen, the limbs o^{13} thereof being provided with pivot-blocks o^{14} , which register with a circumferential groove o^{15} in the sleeve o^5 . On the opposite end of shaft o^{10} is secured a depending arm o^{11} , which is similar to the arm n^6 on the adjacent rock-shaft N', being likewise provided with a head o^{16} , which is adapted to ride upon the faces of the pattern-chain links just aside of the head n^7 . Head o^{16} is normally held against the chain by means of a strong retracting-spring o^{17} , Fig. 1, which is secured to the forked arm o^{12} and to a pin o^{18} , that projects from the upper journal-box j' of the vertical shaft I. Fixed on the shaft O, in line with the sides of the series of needle-grooves b^2 , are two oppositely-pitched screws o^{19} and o^{20} , and on these screws are mounted correspondingly-threaded nuts or followers o^{21} . The latter are provided with inclined broad-faced arms o^{22} , which extend up to and between two guide-ribs b^3 , Fig. 5, that are formed on the under side of the top plate a^3 just below the needle-bed B', which bed carries the set of needles C' that knit the toe and heel of the sock. On the inner face of each of these arms, immediately below the screw, are pivoted two curved fingers o^{23} and o^{23a} , which normally cross each other, as shown, in a manner somewhat similar to the legs of a pair of inside calipers, being held in this position in the present instance by means of retracting-

springs o^{24} , whose ends are connected to the sides of the fingers and to a screw o^{25} , projecting from the face of the arm. (See Figs. 5 and 12.) The free ends of these fingers extend up to or nearly to the lower side of the needle-bed, the grooves therein being cut entirely through the bed at a point between the opposite edges of these said ends, as seen. The lower side of this open slotted section of the bed is concave, in order to provide a free path in which the fingers o^{23} o^{23a} may swing on their common fulcrum. The upper ends of these fingers are secured against lateral displacement by means of a plate o^{26} , which is screwed or otherwise fixed to the side of the arm o^{22} . The needles C', which are contained within the slotted bed B', differ from those in the other or plain, grooved bed B in so far that their (C') lower ends are elongated and bent downward—that is, in a direction opposite to the heels of the needles. When the needles C' are in their grooves, these bends project down through the respective open slots. The pivoted fingers are provided with enlargements o^{27} on their inner edges at points directly opposite the axis of the shaft O. These enlargements project into the paths traversed by radial studs o^{28} , which are detachably secured by screws o^{29} to the inner ends of splines o^{30} , adapted to travel within longitudinal grooves o^{31} in the screws o^{19} o^{20} .

From the above-described construction it will be seen that when the shaft O is rotated in one direction—to wit, in that of the arrow 2, Figs. 2 and 5—the screws o^{19} o^{20} thereon will move their respective nuts, with their pivoted fingers, toward each other, the studs o^{28} in their rotation impinging against the enlargements o^{27} on the fingers o^{23} and throwing upward the free ends of the latter. These ends will bear against the downward bends of the adjacent needles and carry the same, with the loops thereon, out of action with the cams. The springs o^{24} will return said fingers to their first position for a succeeding operation on the next adjacent needles, and so on until the predetermined number of needles—thirteen, for instance—has been thrown up at each end of the row, whereupon the shaft O is rotated in the reverse direction, so that the other fingers o^{23a} will be likewise actuated, in order successively to return the needles to their active position. The pitch of the screw-threads is equal to the distance between the centers of the two needles of each pair of needles, and the parts are so timed that when the up-throwing fingers o^{23} are in action with the needles the other or down-throwing fingers o^{23a} will be moved in the spaces between the two needles, upon the stud o^{28} , while at one-half of its rotation striking the enlargements on said down-throwing fingers, and the converse. The action of the shaft O at the different stages—viz., the starting, reversing, and stopping thereof—is governed by the pattern-chain M. When the head o^{16} of the rock-shaft arm o^{11} is riding upon the faces o^{32} of the pattern-chain links,

the sleeve o^5 will be held in a neutral position; but when the faces o^{33} of the following links are brought below said head by the cam-actuated pawl-and-ratchet mechanism afore-
 5 said, the spring o^{17} will force the head o^{16} down upon the faces o^{33} , and thus draw the sleeve o^5 up against the under side of the gear o^3 , whereupon the tooth o^7 on said sleeve in its rotation will engage with the stud on the under
 10 side of the upper bevel-gear and impart motion to the latter, and consequently to the shaft O, turning it in the direction of the arrow marked 2. After shaft O has made a suitable number of revolutions in this direc-
 15 tion another series of links with raised faces o^{33a} is brought in the same manner as the preceding links into engagement with the head of arm o^{11} , thus forcing out the latter against the stress of the spring o^{17} , which ac-
 20 tion disengages the sleeve from the gear o^3 and engages its lower tooth o^8 with the stud o^9 on the lower gear o^4 , thereby imparting motion to the latter and turning the shaft in the direction indicated by arrow 1. After the
 25 function of the shaft in this reverse movement has been performed a series of links with medium faces o^{34} is brought into engagement with the head of arm o^{11} , and the sleeve is thereby returned to its first or neutral po-
 30 sition, the shaft O thereupon remaining idle, as will be readily understood by any skilled mechanic. It is to be remembered that the gears o^3 and o^4 are normally loose on the vertical shaft I. It will be observed that an out-
 35 wardly-projecting plate o^{35} is formed at the top of each of the arms o^{22} . As the nut is moved forward during the rotation of shaft O, the upper edge o^{36} of this plate will pass
 40 under the bends of the up thrown needles, and thus prevent the latter from prematurely dropping down into action with the cams.

It is desirable that the toe and heel of the sock shall differ in color from the foot and leg portions thereof. This necessitates the
 45 use of two kinds of yarn, which must successively be thrown into and out of action with the needles at certain stages of the operation. To effect this changing of the yarns, I provide devices of the following description:
 50 P represents a bar, Figs. 2 and 5, which is mounted longitudinally above the center or apex of the machine, being supported by fixed end posts p^1 . This bar is furnished on one side thereof with parallel guideways p^2 , in
 55 which are adapted to travel slide-blocks p^3 p^4 , respectively. The upper block is provided with a forwardly-inclined finger p^5 , which is notched or recessed at p^6 on its under side, and the lower block p^4 is provided with an op-
 60 positely notched and inclined finger p^7 . Each of these blocks carries a yarn-conductor p^8 , whose eye p^9 is adapted to move in close proximity to the needle-hooks in the usual manner.

65 On the bottom of that side of the yoke d^2 adjacent to the grooved side of the bar P is secured a plate p^{10} , Fig. 5, to which a lever P^a

is centrally pivoted, as at p^{11} . To prevent voluntary movement of this lever, a screw p^{12} is passed through a guide-slot p^{13} therein into
 70 the plate p^{10} , and a spring-washer p^{14} is interposed between the pivot and guide screws, as seen most clearly in Fig. 19. The inner side of the lever P^a is provided at suitable points
 75 thereon with three projecting pins—to wit, one p^{15} at its leading end, one p^{16} at its opposite end, and one p^{17} near the pin p^{16} . It will be apparent that the act of moving up or
 80 down the leading end of the lever when the yoke d^2 is at the limit of its forward stroke will engage the pin p^{17} with the recess p^6 in
 85 one of the fingers p^5 p^7 , and the lever will depart with the connected yarn-carrier, remaining in engagement with the latter until the end of the lever is oppositely moved. As a
 90 means to engage this lever with one or the other of the yarn-carriers, or wholly to disengage it therefrom, as desired, I pivot on the end of the bar P a lateral arm p^{18} , whose in-
 95 ner end has a V-shaped opening therein. By properly moving this arm either leg of the V will be brought into the path of the pin p^{15}
 100 on the leading end of the lever, which pin will impinge against the opposed inclined edge of the V-leg, and, as the case may be, be guided
 105 up or down thereby, thus correspondingly actuating the end of the lever and throwing the pin p^{17} into or out of engagement with the
 110 yarn-carrier fingers—that is to say, if the pin be engaged with one yarn-carrier it will be disengaged therefrom and be engaged with
 115 the other carrier, or be entirely disengaged from both carriers, according to the position of the lever.

In order to retain the lever engaged with
 105 one or the other of the yarn-carriers, or wholly disengaged therefrom, as occasion may require, I provide the face of the bar P with
 110 lateral ribs or projections p^{19} , whose forward ends are beveled or pointed, as seen. These ribs are above and below the horizontal plane
 115 of the pivotal point p^{11} of the lever P^a , so that when the latter is in its neutral position—i. e., disengaged from both fingers—the lever-pin
 120 p^{16} will be guided in the channel p^{20} between the ribs, and thus the lever be positively held in the neutral position, and when the lever is
 125 in engagement with one or the other of the yarn-carriers said pin will accordingly be guided above the upper rib or below the lower
 130 rib with like effect. To actuate this lever automatically, as and under the circumstances stated, I pivot on a stud p^{21} , Fig. 2, that projects from the end a^2 of the main frame A, whereat the chain-wheel is located, a lever p^{22} ,
 135 whose lower end is normally held in contact with the outer side of the chain-links by means of a spring p^{23} , preferably flat, which is so
 140 secured to the stud p^{21} as to bear against and throw outward the upper arm of the lever. The top of said arm has a laterally-projecting
 145 pin p^{24} thereon, which pin enters a cam-slot p^{25} near the pivoted end of the bifurcated arm p^{18} . The shape of this cam-slot is such that

when the upper end of the lever is vertical, right, or left oblique, the arm p^{18} will be thrown into the relative positions above mentioned, so as to actuate the lever P^a in order to engage its pin p^{17} with one or the other of the yarn-carriers, or wholly to disengage it therefrom, as clearly shown in Sheet 10 of the drawings. When the lower end of the lever p^{22} is bearing against the plane sides of the chain-links, the bifurcated arm p^{18} and reciprocating lever P^a will occupy the relative positions shown in Fig. 17—that is to say, the pin p^{17} will be engaged with the notched finger p^5 of the upper yarn-carrier, the yarn Y, Fig. 1, conducted thereby, being white, colored, or party-colored, as desired.

As a means to throw the parts into the position shown in Fig. 18—that is, so that the pin p^{17} will be disengaged from the upper carrier and engaged with the finger p^7 of the lower carrier, whose yarn Y', Fig. 1, may be colored or party-colored, as required, I provide certain of the chain-links at proper points in the chain with lateral studs p^{26} , and the lower end of the lever p^{22} in the path of these studs I equip with a curved or beveled flange p^{27} , so that during the movement of the chain, as above mentioned, the studs p^{26} will be drawn under said flange and the latter will ride upon the studs, thus actuating the parts as stated.

As it is necessary that the yarn be not carried at the completion of one sock before another is commenced, I provide the proper link m' with a short stud p^{28} , so that when the end p^{27} of lever p^{22} is raised by and upon said stud the parts will be thrown into the position shown in Fig 16—i. e., the lever P^a will be neutral or out of engagement with both yarn-carriers. The cams will make one reciprocation without the yarn being caught by the needle-hooks, and the sock will thus drop down through the throat A'.

In the next movement of the cams all the needles will be thrown up, as hereinbefore stated, and the yarn will be grasped thereby and the aforementioned operation of knitting the sock repeated.

By relatively arranging the studded and plane links any prescribed part or parts of the sock may be varied in color, as desired, and by lessening or increasing the number of links in each series the length of the leg and foot and the contraction of the toe and heel parts may be correspondingly altered.

Instead of the yarn-carriers conducting different-colored yarns to the needles, as described, different grades or sizes of yarn may be so conducted.

E represents the loop-holders or "sinker," so-called. They are substantially the same as heretofore in construction, arrangement, and operation, being pivoted at e^2 in slotted frames e^3 , that are secured one on each side of the throat A', wherein the stitches are formed. There is one sinker for each needle, said sinker being provided with a hooked point or finger e' , which is adapted to engage

the loop immediately upon its formation by the needles and to hold down said loop until another round of loops is formed, whereupon the operation is repeated, each sinker likewise working in its regular order. Each row of sinkers is operated by a sliding grooved bar e^4 , into the groove e^5 of which extend lugs e^6 , that project from the sinkers. This groove is provided with an offset or cam portion e^7 therein, which throws the sinkers into and out of engagement with the loops when the bar is reciprocated. A lug or arm e^8 projects from the cam-frame d' up between two studs or shoulders e^9 , that are formed or secured on the top of the slide-bar e^4 , so that when the cam-frames are reciprocated the slide-bars will be correspondingly actuated thereby. The distance between the studs or shoulders e^9 is greater than the width of the arm e^8 , so that at each return-stroke of the cams there will be a slight interval or lost motion before the bar e^4 is actuated, the object being to properly time the operation of the sinkers.

To insure the opening of the latches c^2 of the needles when the latter are thrown up by the cams, I secure on the opposite faces of the slotted sinker-frames, at a slightly greater angle or incline than the needles, thin metal plates Q, whose lower edges q' are beveled and so disposed that the under sides of the latch-heads c^4 will impinge against the same, and thus the latches be positively opened thereby. By inclining the plates as just described the needles will be free therefrom after their hooks have passed the edges of the plates. Were it not for this increased inclination of the plates—that is, if they were at the same angle as the needles—if the hook of one needle should happen to be slightly larger or coarser than the others it would upon passing below the plate raise the latter and thus throw its forward edge out of line with the latch-heads. Even though in such case the degree of elevation would be or might be very slight indeed, still if the edge be ever so slightly above the lower point of the latch-heads the purpose of the plate will be defeated. As the needles are thrown upward successively by the knitting-cams, their hooks will singly engage the opposed edge of the plate, the latches will be thrown open thereby, and the hooks with the open latches will pass freely under the plate, so that if one hook shall be coarser than its fellows it will not interfere with the action of the plate on the latter. It will be understood that the plate is elastic or yielding, for if it were rigid when a coarse hook-needle struck the edge thereof the hook would be bent or broken.

Although it is essential that the edge of plate Q be not above the line of latch-heads, such edge may, however, be below that line, and, in fact, in practice I prefer so to make the latter, for the reason that the action of the edge upon the latch-heads will be more positive, owing to its yielding contact with the needle-hooks, not only when the parts are

first assembled, but after long operation of the machine when the guideways e^x for the needles in the frames e^3 and the grooves z b^2 in the needle-beds $B B'$, respectively, have become worn slightly, and would otherwise bring the base of the latch-heads below the line of the working-edge of the plate. The latter, being elastic and, perforce, self-adjusting, will automatically engage the latches of the needles under the conditions just stated. It will be noticed that the advancing needle-hooks mount the guideways in the frames e^3 just before contact with said edge. Thus their action against the plate Q will be firm and direct and the liability of bending of the hooks materially obviated. (See Figs. 5, 28, and 36.) I make the latch-heads c^4 more decided or prominent than heretofore, in order still further to insure their proper engagement with the plates.

It will be obvious that when the latch-opening plates are mounted upon the frames e^3 , as above described, each of said plates will be supported wholly throughout its length. Thus very thin elastic plates may be used. If such plates were not supported in this manner, they would be apt to sag, and it might therefore be necessary to use stiff unyielding plates, which are defective in practice, as aforementioned.

Instead of inclining the plates more than the needles, as explained, I sometimes incline the plates similarly with the needles and give the lower edges q' a bend or set, as seen in Fig. 29, thus attaining the same end—that is to say, the working-edges q' of the plates will be lower than the under sides of the latter, whereby the needle-hooks will be free after they have passed said edges.

In order to retain the latches at the proper time in the open positions described, I secure to the sliding bars e^4 a V-shaped frame R , which I term the "latch-controller." Its lower edge or apex, which is open, as seen, extends down near to the needles, so that the lower inclined sides will pass over the latches when they are thrown open. This frame R will not only keep the latches open, but its forward edges will fully open any latches that may not have been completely thrown back by the plates Q . At a point where the sinkers are actuated the latch-controller is cut away, as at r' , in order that the sinkers shall have free play and that the needle-latches shall there be allowed to close.

To hold the needles down in their grooves $b^2 z$, yet permit the former to be readily removed and replaced, as required, I form in each needle-bed just below its sinker-frame e^3 a longitudinal groove s' , in which snugly fits a narrow strip or plate S , against whose under side, near each end thereof, bears a small compression-spring s^3 , Fig. 26. A recess s^2 is formed in the under side of the frame e^3 just above the strip S , and near each end of the latter is pivoted a small wedge-shaped cam s^4 , which is provided with an upwardly-

projecting arm s' . By properly turning the arms s^5 at each end of the strip their cams s^4 will be moved into the adjacent ends of the recess s^2 , and the strip will thus be forced against the action of the springs into the groove s' and hold the needles in place. By re-turning the arms of the cams the strips will be released and the springs will raise the same, whereupon a broken needle or needles may be readily removed and another or others inserted in lieu thereof.

The final feature of my invention resides in a certain mechanism for stopping the machine in the event of the yarn breaking or ending. This mechanism is of the following construction: T designates a sliding bar or rod, Figs. 1, 2, and 15, which is guided in brackets t' on one edge of the bed-plate a^x . On that end of the bar which is near to the pulleys is secured a curved shifter-frame t^2 , through which one side of the belt extends. On the opposite end t^3 of the bar is secured one arm t^4 of a toggle-lever t^5 , its other arm t^6 being secured to the fixed bracket t' and provided with an outward extension t^7 . It will be seen that by sliding this bar the shifter thereon will throw the belt off the loose onto the fixed pulley, and the converse. A retracting-spring t^8 , which is secured to the bar T and to the end of the frame A , operates normally to engage the belt with the loose pulley. When the shifter is in such position as to hold the belt upon the fixed pulley, the toggle-lever will be down or below its center; but when the extension t^7 is forced downward the toggle t^5 will draw the bar with its shifter inward, thus transferring the belt onto the loose pulley. On the end of the frame, adjacent to the extension t^7 , is mounted a rod t^9 , which is movable longitudinally within certain limits. The lower end of this rod has a pin or stud t^{10} thereon, which projects above the extension, and the upper end of the rod is provided with an inwardly-extending arm t^{11} . The middle box t^{12} , Fig. 34, through which the rod extends, has a vertical slot t^{13} therein, and in the top of this slot is an offset t^{14} . The rod t^9 is provided with a lateral stud t^{14a} , which registers with the slot and is guided therein. When the machine is in operation, the pin t^{10} is held out of contact with the toggle-extension t^7 by reason of the stud on the rod t^9 being engaged with the offset t^{14} , and thus keeping the rod raised; but when the stud is disengaged from the offset, the rod will drop, and the pin t^{10} on the lower end thereof will strike the toggle-extension, and thus, through the devices described, arrest the motion of the machine. Fixed on the end of the frame A , adjacent to the rod t^9 , is another rod t^{15} , near whose upper end is a cross-piece t^{16} , on which are pivoted two take-up levers t^{17} , their outer arms being weighted, as seen, their inner arms being provided with eyes or hooks t^{18} , and their hubs t^{19} supporting hooks t^{20} . The upper end of this rod, just above the levers t^{17} ,

is also provided with two outwardly-extending arms t^{19} , whose free ends are looped, as shown in Fig. 1. Some distance below these levers is fixed an ordinary tension device t^{20} , consisting of two pairs of disks t^{21} , loosely mounted on a transverse bar t^{22} , the disks of each pair being held together by means of spiral springs t^{23} and provided with adjacent guide-hooks t^{24} . The yarns Y Y' are passed from their respective bobbins U U' up through the looped arms t^{19} , thence through the hooks t^{24} , thence down over the hooks t^{24} and between the tension-disks, thence over the hooks on the ends of the take-up levers t^{17} , and thence to the yarn-carriers, as most clearly shown in Fig. 1. It will be obvious that the tension upon the yarns during the working of the machine will pull down the inner ends of the take-up levers, thus holding their weighted ends upward; but if one or both of the yarns should happen to break or suddenly end at any time the tension will be removed from the inner end of the lever or levers, whereupon its or their weighted arm or arms will drop against the projecting arm t^{11} on the upper end of the sliding rod t^9 and, turning the latter, will release its stud from the offset t^{14} , with the result above set forth. Adjacent to the toggle-lever is a bracket t^{25} , which carries a vertical screw t^{26} , whose function is to limit or adjust the downward throw of the toggle. X, Fig. 5, is simply a curved plate, which is secured to the under side of the needle-bed B so as to cover the mechanism below the throat A' and act as a guide to direct the work from the machine.

Having thus described my invention, I claim as new and wish to secure by Letters Patent—

1. In a knitting-machine of the class recited, the combination, with the needle-bed, its needles, and the cam-frame, of the slide-plate transversely movable within said frame, the needle-actuating cams mounted upon the slide-plate, the longitudinal slide-bar, and provisions whereby it is connected with said plate and adapted to reciprocate the same to throw the cams into or out of action, substantially as described.

2. In a knitting-machine of the class recited, the combination, with the needle-bed, the needles therein contained, and the cam-frame, of the transverse slide-plate arranged within said frame, carrying thereon the needle-actuating cams and provided with the inclined face-slots, and the longitudinal slide-bar having studs which engage with said slots, substantially as described.

3. In a knitting-machine of the class recited, the combination, with the needle-bed, the needles therein contained, and the cam-frame, of the transverse slide-plate arranged within said frame and carrying the needle-actuating cams, the longitudinal slide-bar provided with the edge notches or recesses, provisions whereby said bar is connected with the slide-plate and adapted to reciprocate the same to

throw the cams into or out of action, and the spring-controlled locking-pin adapted to engage with said notches or recesses successively, substantially as described.

4. In a knitting-machine of the class recited, the combination, with the needle-bed, the needles therein contained, and the cam-frame, of the transverse slide-plate arranged within said frame and carrying the needle-actuating cams, the longitudinal slide-bar, provisions whereby it is operatively connected with said plate and adapted to reciprocate the same, so as to throw the cams into or out of action with the needles, the cam-regulating bar, the inclined tooth and notch arranged with opposite relation to each other in said regulating-bar and slide-plate, and the screw for adjustably securing said regulating-bar in position, substantially as described.

5. In a knitting-machine, the combination, with the cam-frame, the notched slide-plate therein contained, and the needle-actuating cams supported upon said plate, of the adjustable toothed bar disposed in the path of said slide-plate, and the adjusting-screws, substantially as described.

6. The combination, in a knitting-machine, with the cam-frame, the notched slide-plate therein contained, and the needle-actuating cams supported upon said plate, of the movable toothed bar provided with the slotted end lug, and the flanged set-screw engaging said slotted lug and working in the cam-frame, substantially as described.

7. In a knitting-machine of the class recited, the combination, with the cam-frame, the slide-plate therein, the longitudinal slide-bar, provisions whereby said plate and bar are operatively connected, and the needle-actuating cams supported upon said slide-plate, of the needle-controlling cam d^7 , supported below said cams, substantially as described.

8. In a knitting-machine of the class recited, the combination, with the cam-frame, the slide-plate therein contained, the longitudinal slide-bar, provisions whereby said plate and bar are operatively connected, and the needle-actuating cams and needle-controlling cam-bar supported upon said plate, of the sliding safety-cam loosely secured to the cam-frame below said slide-plate, substantially as described.

9. In a knitting-machine of the class recited, the combination, with the needle-bed, the needles therein contained, the reciprocating cam-frame, the mechanism for reciprocating the latter, the sliding needle-cam-supporting plate within said frame, the slide-bar, and provisions whereby it is operatively connected with said plate, of the fixed end stop, the laterally-movable end stop or block, the rock-arm supporting said block, the rock-shaft, the arm on the extremity of the latter, the measuring device, such as the described chain, with which said latter arm engages, and by which it is actuated, and means,

and for permitting it to drop under the circumstances stated, the spring t^8 , the toggle-lever provided with the extension adjacent to said pin or stud, and the shifter-bar connected with said toggle-lever and provided with the shifter-frame, together with the fast and loose pulleys, substantially as described.

30. In a knitting-machine, the combination, with the reciprocating yarn-carrier, of the take-up lever having its outer arm weighted and its inner arm hooked or looped, the vertically-movable rod provided with the laterally-projecting arm at a point thereon below and adjacent to said weighted arm and provided with a stud or pin at its lower end, the bearing t^{12} , with means for supporting the rod t^9 and for permitting it to drop under the circumstances stated, the spring t^8 , the toggle-lever provided with the extension adjacent to said pin or stud, the shifter-bar connected with said toggle-lever and provided with the shifter-frame, the set-screw t^{16} , and its bracket, substantially as specified.

31. In a knitting-machine of the class recited, the combination of the cam-frame, the slide-plate transversely movable therein and provided with the inclined face-slots, the slide-bar having studs which engage with said slots, the needle-actuating cams mounted upon the slide-plate, and the spring-controlled pin adapted to lock the slide-bar in positions of longitudinal adjustment, substantially as described.

32. In a knitting-machine of the class recited, the combination of the cam-frame, the slide-plate transversely movable therein and provided with the inclined face-slots, the notched or recessed slide-bar having studs which engage with said slots, the needle-actuating cams mounted upon the slide-plates, and the spring-controlled locking-pin disposed within the cam-frame and adapted to bear against the notched or recessed edge of said slide-bar, substantially as described.

33. In a knitting-machine of the class recited, the combination, with the needle-bed, the needles therein contained, the reciprocating cam-frame, the needle-actuating cams therein supported, the slide-bar and provisions whereby it is operatively connected with said cams, of the laterally-movable end stop or block, the rock-arm adapted to support said block, the rock-shaft, the arm on the extremity of the latter, the measuring device, such as the described chain, with which said latter arm engages and by which it is actuated, and means, such as the cam and pawl-and-ratchet mechanism, adapted to operate said measuring device, together with the opposite end stop, as u^9 , substantially as described.

34. In a knitting-machine of the class recited, the combination, with the needle-bed, the needles therein contained, the reciprocating cam-frame, the needle-actuating cams therein supported, the slide-bar and provisions whereby it is operatively connected with

said cams, of the fixed end stop, the movable end stop or block provided with the offset therein, the rock-shaft adapted to support said block, the rock-shaft, the arm on the extremity of the latter, the measuring device, such as the described chain, with which said latter arm engages and by which it is actuated, and means, such as the cam and pawl-and-ratchet mechanism, adapted to operate said measuring device, substantially as described.

35. In a knitting-machine of the class recited, the combination, with the needle-bed provided with the open needle-grooves, the needles therein contained, and the reciprocating needle-actuating cams, of the shaft O, the right and left hand screws thereon, the nuts on said screws, the fingers pivoted on said nuts and adapted to engage and actuate the needles, the longitudinally movable and rotatable studs on said shaft adapted to actuate said fingers, substantially as described, means, such as the springs o^{21} , adapted to return said fingers to their normal position, clutch mechanism, such as the described gear devices, the interposed sliding sleeve, the rock-shaft o^{10} , connected with said sleeve, the end arm on said rock-shaft, and the pattern-chain, for starting, reversing, or stopping said shaft O, substantially as described.

36. In a knitting-machine of the class recited, the combination, with the needle-bed, the needles therein contained, and the reciprocating needle-actuating cams, of the shaft O, the right and left hand screws thereon, the nuts on said screws, the fingers pivoted on said nuts and adapted to engage and actuate the needles, the longitudinally movable and rotatable studs on said shaft adapted to actuate said fingers, substantially as described, means, such as the springs o^{21} , adapted to return said fingers to their normal position, clutch mechanism, such as the described gear devices, the interposed sliding sleeve, the rock-shaft o^{10} , connected with said sleeve, the end arm on said rock-shaft, and the pattern-chain, for starting, reversing, or stopping said shaft O, substantially as described.

37. In a knitting-machine of the class recited, the combination, with the needle-beds, the needles therein contained, the reciprocating needle-actuating cams, and the connecting-yoke, of the longitudinal guide-bar provided with the parallel ribs p^{19} , the yarn-carrier mounted on said bar and provided with the oppositely-notched fingers, the rocking lever pivotally connected with said yoke and provided with the projecting studs p^{15} p^{17} , the arm p^{18} , pivoted on said bar and provided with the shaped end and with the cam-slot p^{25} , the pattern-chain provided with the plain and stud links, and the lever engaging with said links and cam-slot, substantially as described.

38. The combination, in a knitting-machine, with the needle-bed, the latch-needles therein contained, and the needle-actuating cams, of

the thin elastic or self-adjusting latch-opening plate disposed in the path of the needles, and the frame e^3 , upon which said plate is supported throughout its length, substantially as specified.

39. In a knitting-machine, the combination, with the cam-frame, the slide-plate therein, the longitudinal slide-bar, provisions whereby said plate and bar are operatively connected, the needle-actuating cams, and the needle-controlling cam supported upon said plate, of the sliding safety-cam mounted upon the cam-frame below said slide-plate and provided with beveled-up projecting ends, substantially as described.

40. The combination, in a knitting-machine, with the needle-bed, the latch-needles therein contained, and the needle-actuating cams, of the latch-opening plate disposed in the path of the needles and having its working-edge lower than the under side of the plate, together with the frame e^3 , provided with the guideways e^x , upon which the needle-hooks are supported, as and for the purpose specified, substantially as described.

41. In a knitting-machine, the combination,

with the needle-bed, the needles, and the needle-actuating cams, of the shaft, as O, the right and left hand screws thereon, the nuts or followers on said screws, the fingers connected with said nuts or followers, and provisions whereby said fingers are operated to throw the needles into or out of action, substantially as described.

42. In a knitting-machine, the combination, with the needle-bed provided with open needle-grooves, the needles having downward bends or extensions which project through said grooves, and the needle-actuating cams, of the shaft, as O, the right and left hand screws thereon, the nuts or followers on said screws, the fingers connected with said nuts or followers, and provisions whereby said fingers are operated to throw the needles into or out of action, substantially as described.

In testimony whereof I have hereunto affixed my signature this 24th day of May, A. D. 1889.

JOSEPH BENNOR.

Witnesses:

JOHN NOLAN,
GEO. W. REED.

the lever engaging with said links and arm, for automatically throwing said rocking lever into and out of engagement with the yarn-carrier, substantially as described.

18. In a knitting-machine, the combination, with the needle-beds, the needles therein contained, the needle-actuating cams, and the yoke connecting the same, of the longitudinal guide-bar, the yarn-carrier adapted to travel thereon, the plate secured to said yoke, the rocking lever pivoted on said plate, the spring-washer, and mechanism, such as the plain and studded links, the pivoted arm, and the lever engaging with said links and arm, for automatically throwing said rocking lever into and out of engagement with the yarn-carrier, substantially as described.

19. In a knitting-machine of the class recited, the combination, with the needle-beds, the needles therein contained, and the reciprocating needle-actuating cams, of the longitudinal guide-bar, the yarn-carriers adapted to slide thereon, the pivoted rocking lever adapted to move in concert with said cams, and mechanism, such as the plain and studded pattern-chain links and the intermediate lever and pivoted bifurcated arm, for automatically engaging said rocking lever with one yarn-carrier and disengaging it from the other yarn-carrier, substantially as described.

20. In a knitting-machine of the class recited, the combination, with the needle-beds, the needles therein contained, the reciprocating needle-actuating cams, and the yoke connecting the same, of the longitudinal guide-bar, the yarn-carrier adapted to slide thereon and provided with the notched finger, the rocking lever pivotally connected with said yoke and provided with the projecting studs p^{15} p^{17} , the pivoted arm provided with the beveled or inclined inner end and with the cam-slot, the pattern-chain provided with the plain and studded links, and the lever engaging with said links and cam-slot, substantially as and for the purpose set forth.

21. In a knitting-machine of the class recited, the combination, with the needle-beds, the needles therein contained, the reciprocating needle-actuating cams, and the yoke connecting the same, of the longitudinal guide-bar, the yarn-carriers mounted thereon and provided with the oppositely-notched fingers, the rocking lever pivotally connected with said yoke and provided with the projecting studs p^{15} p^{17} , the arm p^{18} , pivoted on said bar and provided with the V-shaped end and with the cam-slot p^{25} , the pattern-chain provided with the series of studs p^{26} and the stud p^{28} , and the lever engaging with said links and cam-slot, substantially as described.

22. In a knitting-machine of the class recited, the combination, with the needle-beds, the needles therein contained, the reciprocating needle-actuating cams, and the connecting-yoke, of the longitudinal guide-bar provided with the rib p^{10} , the yarn-carrier mounted on said bar and provided with the

notched finger, the rocking lever pivotally connected with said yoke and provided with the projecting studs p^{15} p^{16} p^{17} , the arm p^{18} , pivoted on said bar and provided with the beveled or inclined inner end and with the cam-slot, the pattern-chain provided with the plain and studded links, and the lever engaging with said links and cam-slot, substantially as and for the purpose set forth.

23. In a knitting-machine of the class recited, the combination, with the needle-bed, the latch-needles therein contained, the needle-actuating cams and their frames, of the sliding bars actuated by said frames and the V-shaped latch-controlling plate secured to said bars substantially as described.

24. In a knitting-machine of the class recited, the combination, with the needle-bed, the latch-needles therein contained, the needle-actuating cams, and their supporting-frames, of the sliding bars actuated by said frames, and the V-shaped latch-controlling plate provided with the opening r' therein and secured to said bars, substantially as described.

25. In a knitting-machine of the class recited, the combination of the needle-bed, the latch-needles therein contained, the needle-actuating cams and their frames, the sinker-frames, the sinkers therein contained, the sliding grooved bars engaging with said sinkers, and the latch-controller composed of the V-shaped plate secured to said sliding bars and adapted to move in concert with the latter, substantially as described.

26. In a knitting-machine of the class recited, the combination, with the needle-bed, the needles therein contained, and the recessed frame or block, as e^2 , of the bar or strip S and the end lever cams s^4 s^5 thereon, substantially as described.

27. In a knitting-machine of the class recited, the combination, with the needle-bed, the needles therein contained, and the recessed frame or block e^2 , of the bar or strip S, the end lever cams s^4 s^5 , and the springs s^2 , substantially as described.

28. In a knitting-machine, the combination, with the yarn-carrier, of the take-up lever through which the yarn passes, the shifter-bar provided with the toggle-joint and the belt-shifter frame, the drop-rod between said lever and bar, provisions for supporting said rod and for permitting it to drop and thereupon to release the toggle-joint, and means, such as a spring, for actuating said toggle-joint, together with the fast and loose pulleys, substantially as described.

29. In a knitting-machine, the combination, with the reciprocating yarn-carrier, of the take-up lever having its outer arm weighted and its inner arm hooked or looped, the vertically-movable rod provided with the laterally-projecting arm at a point thereon below and adjacent to said weighted arm and provided with a stud or pin at its lower end, the bearing t^{12} , with means for supporting the rod