

No. 686,070.

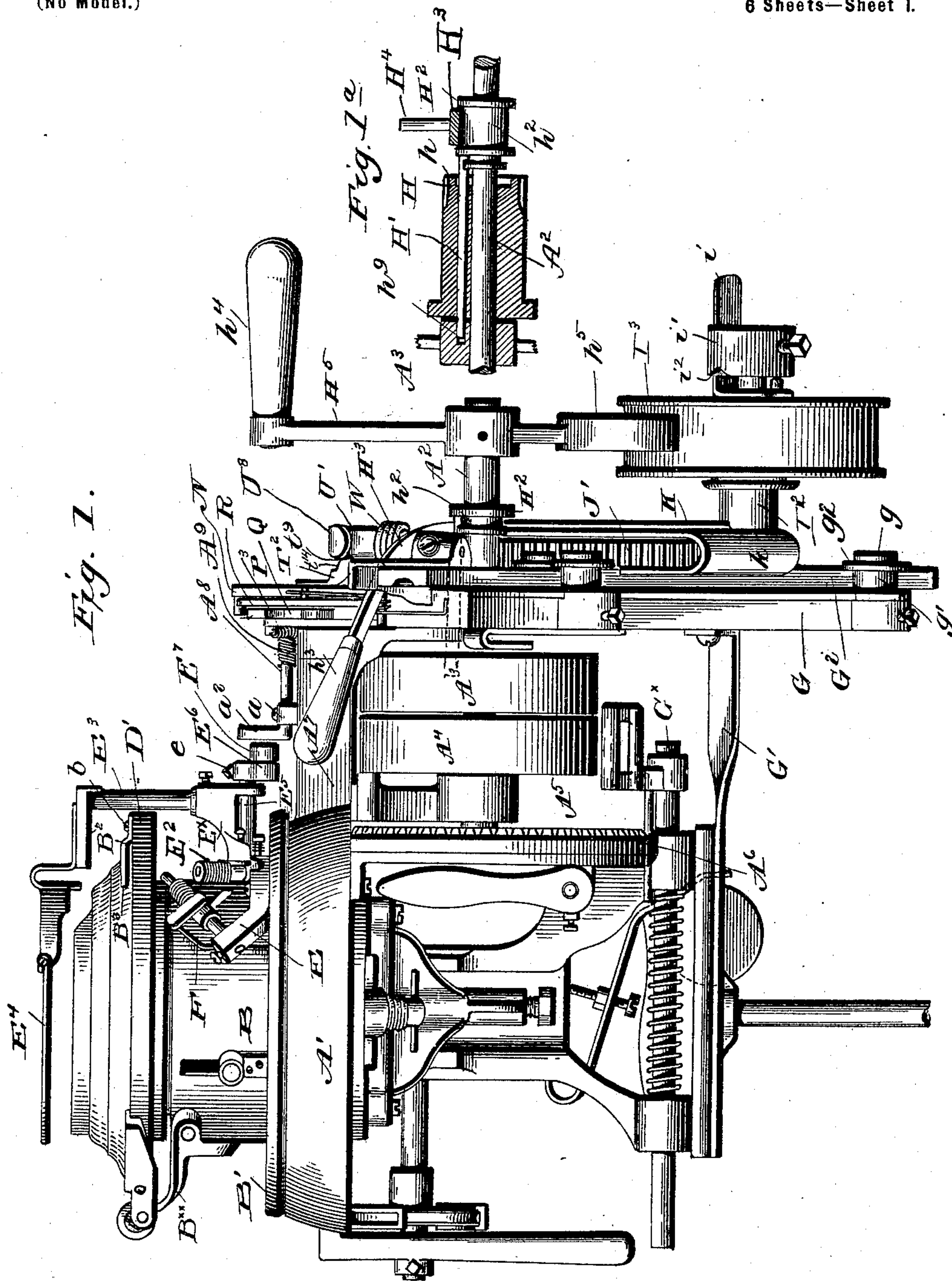
Patented Nov. 5, 1901.

E. A. HIRNER.
KNITTING MACHINE.

(Application filed Aug. 29, 1895.)

(No Model.)

6 Sheets—Sheet 1.



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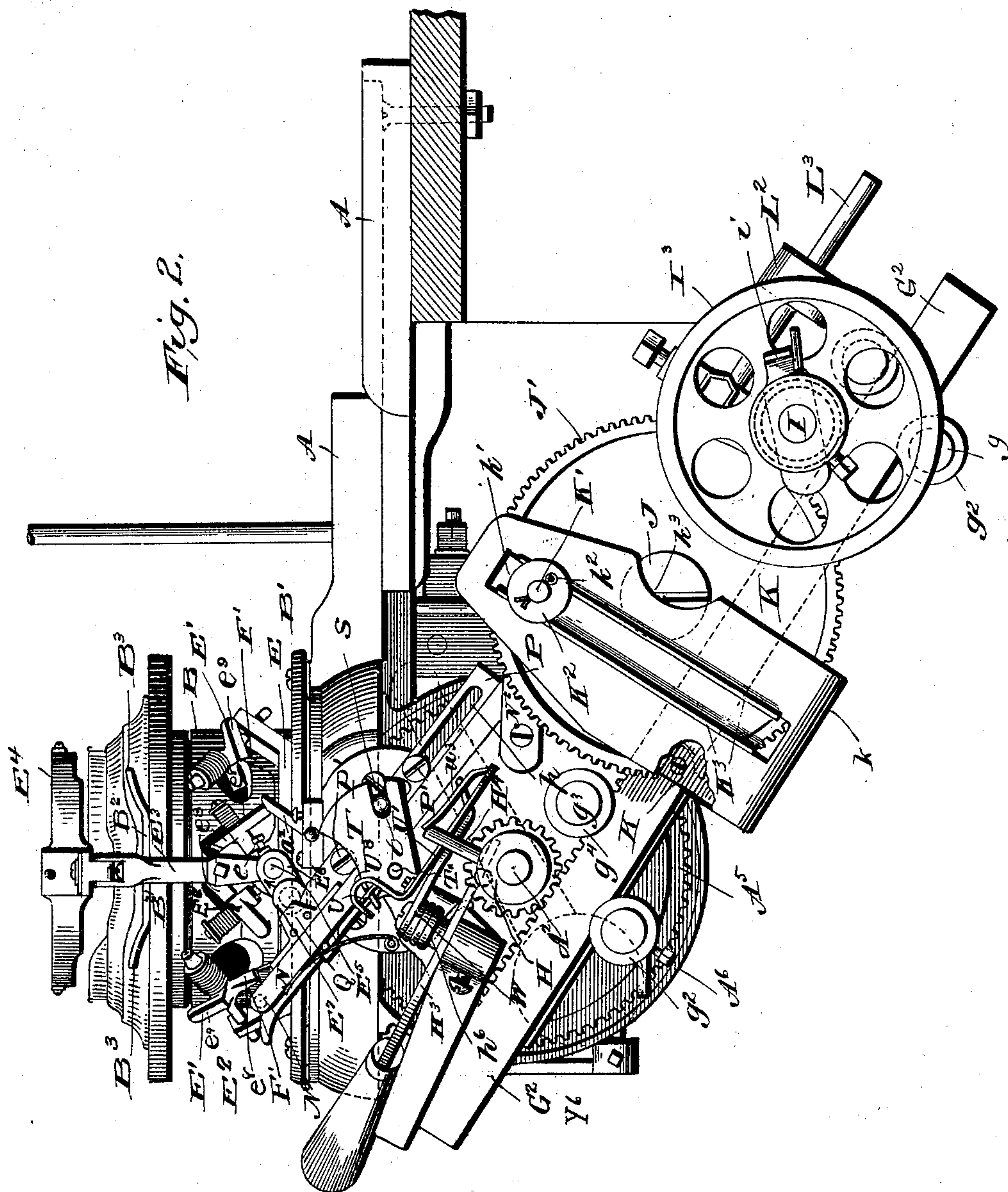
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6 Sheets—Sheet 2.



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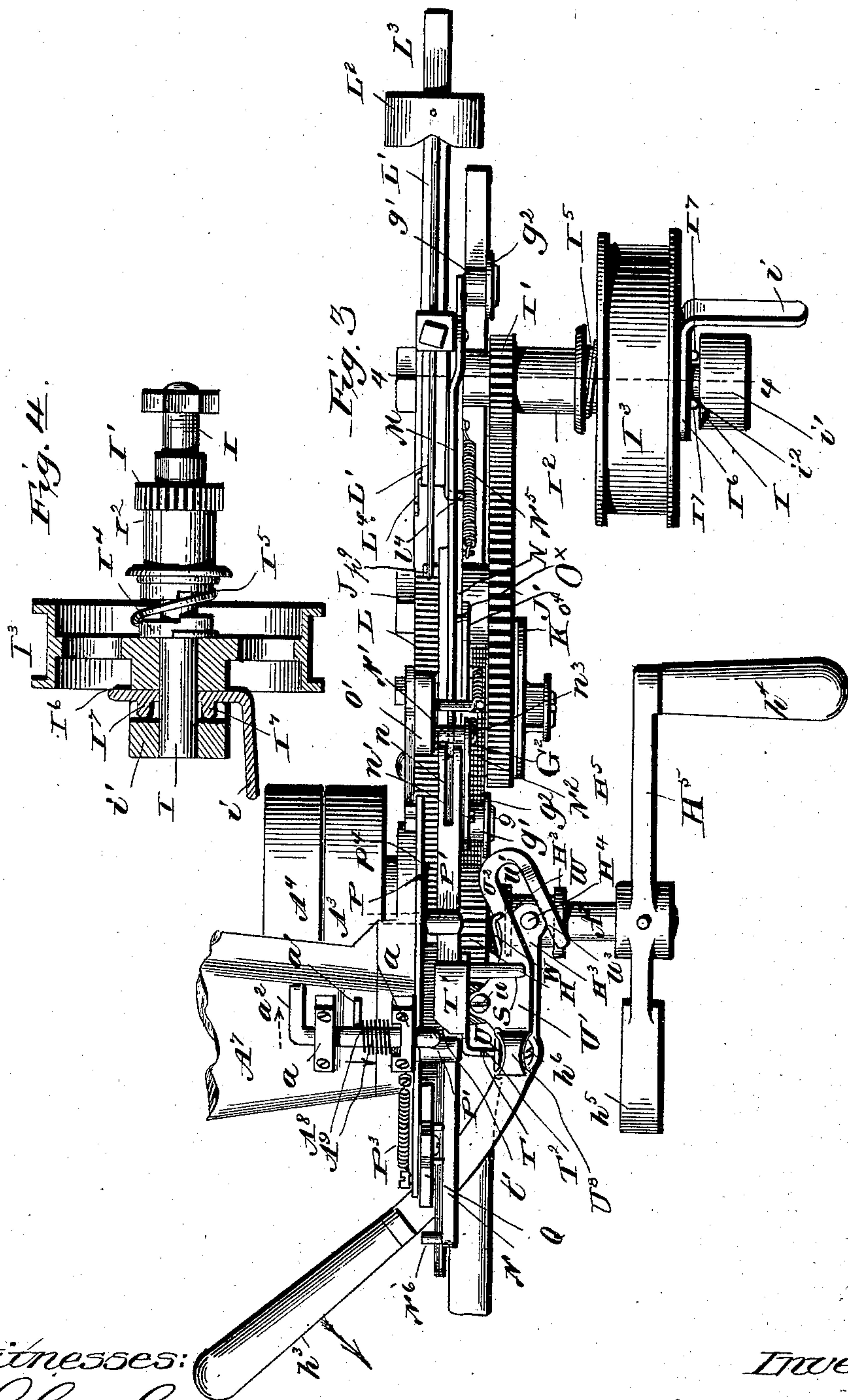
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6 Sheets—Sheet 3.



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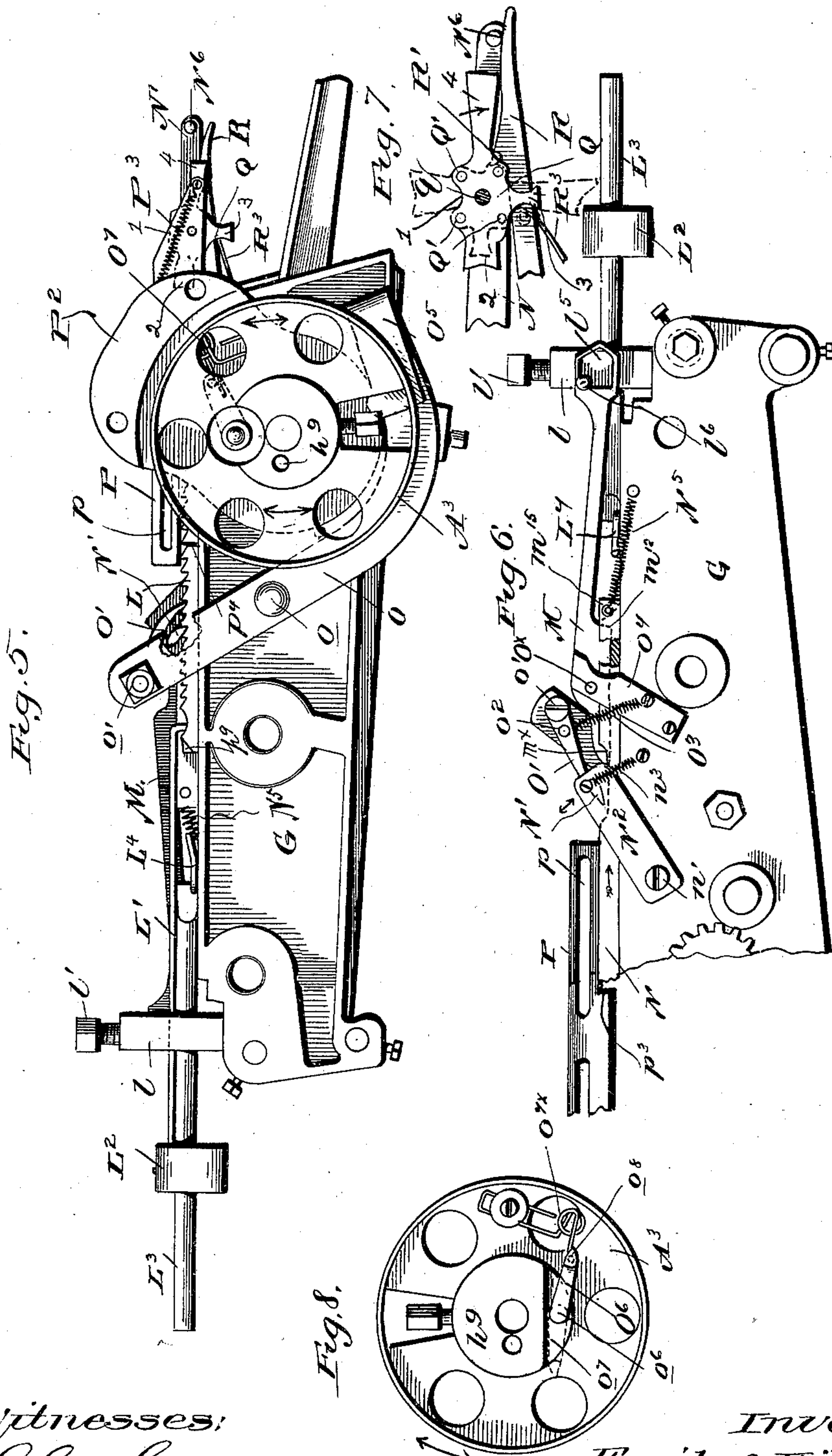
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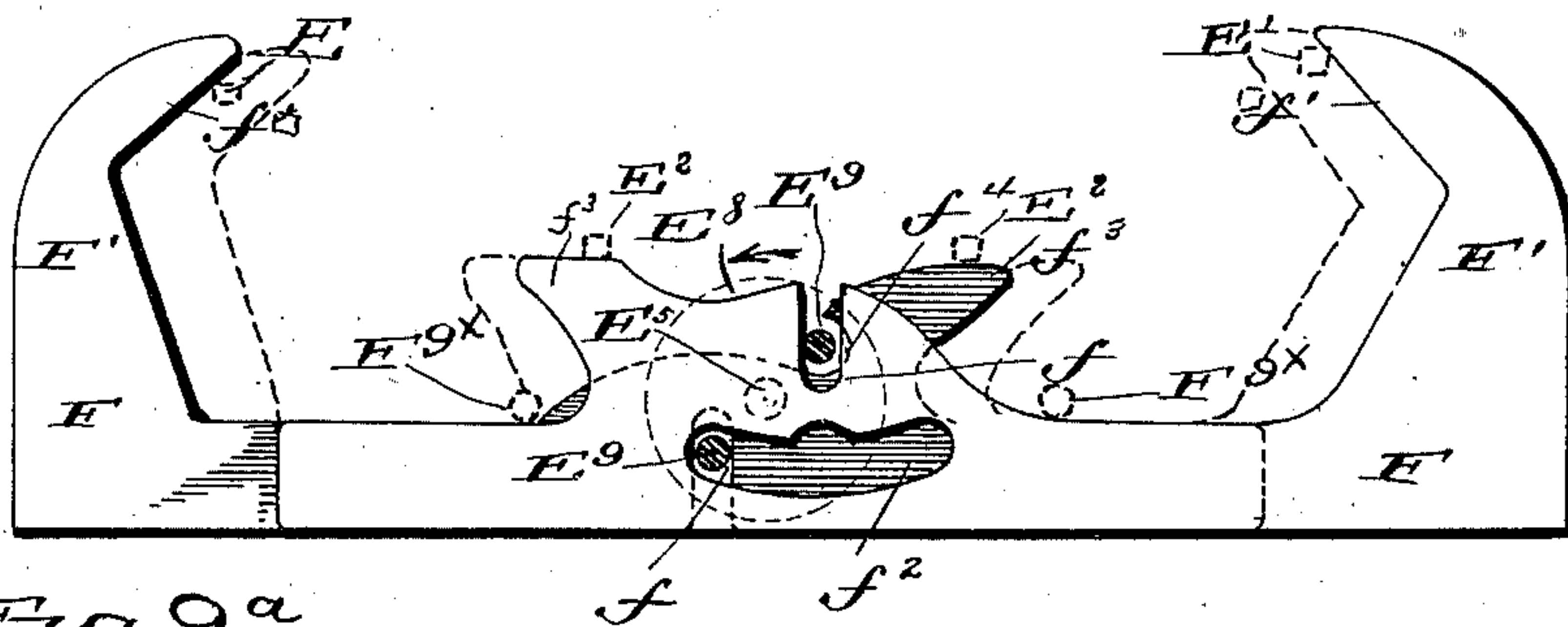
E. A. HIRNER.
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(No Model.)

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Fig. 9.



B  Fig. 9.^a

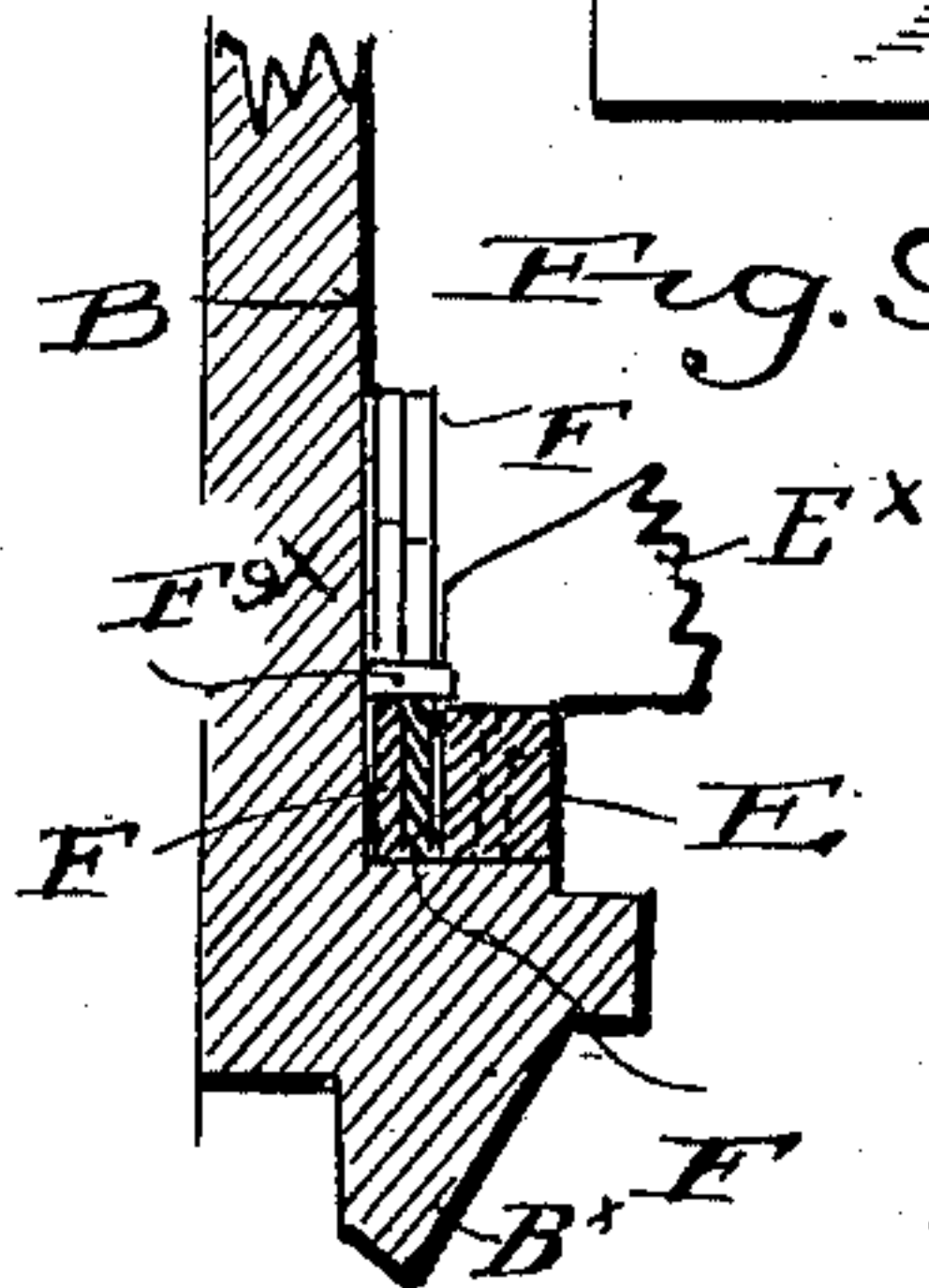


Fig. 10.

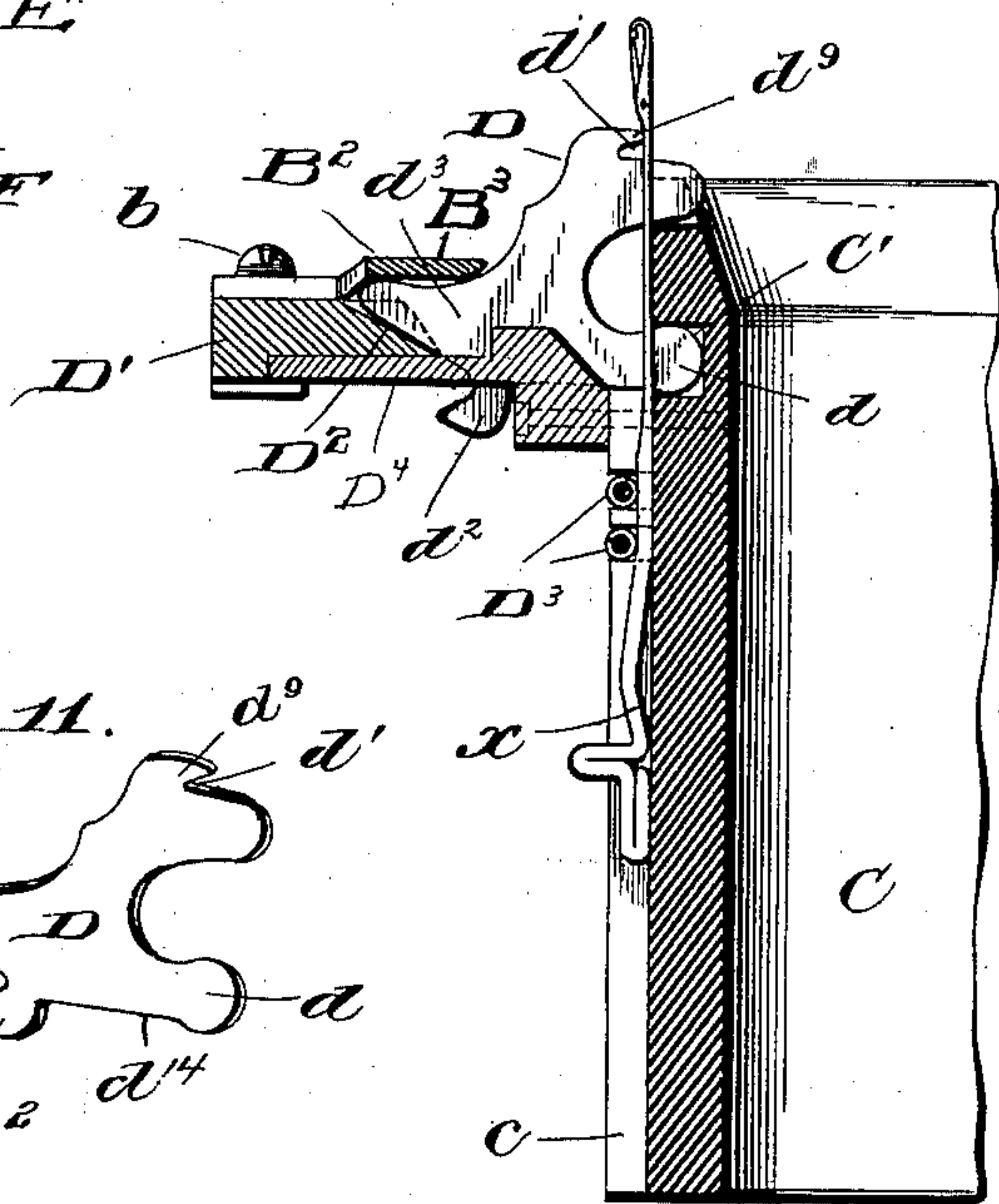
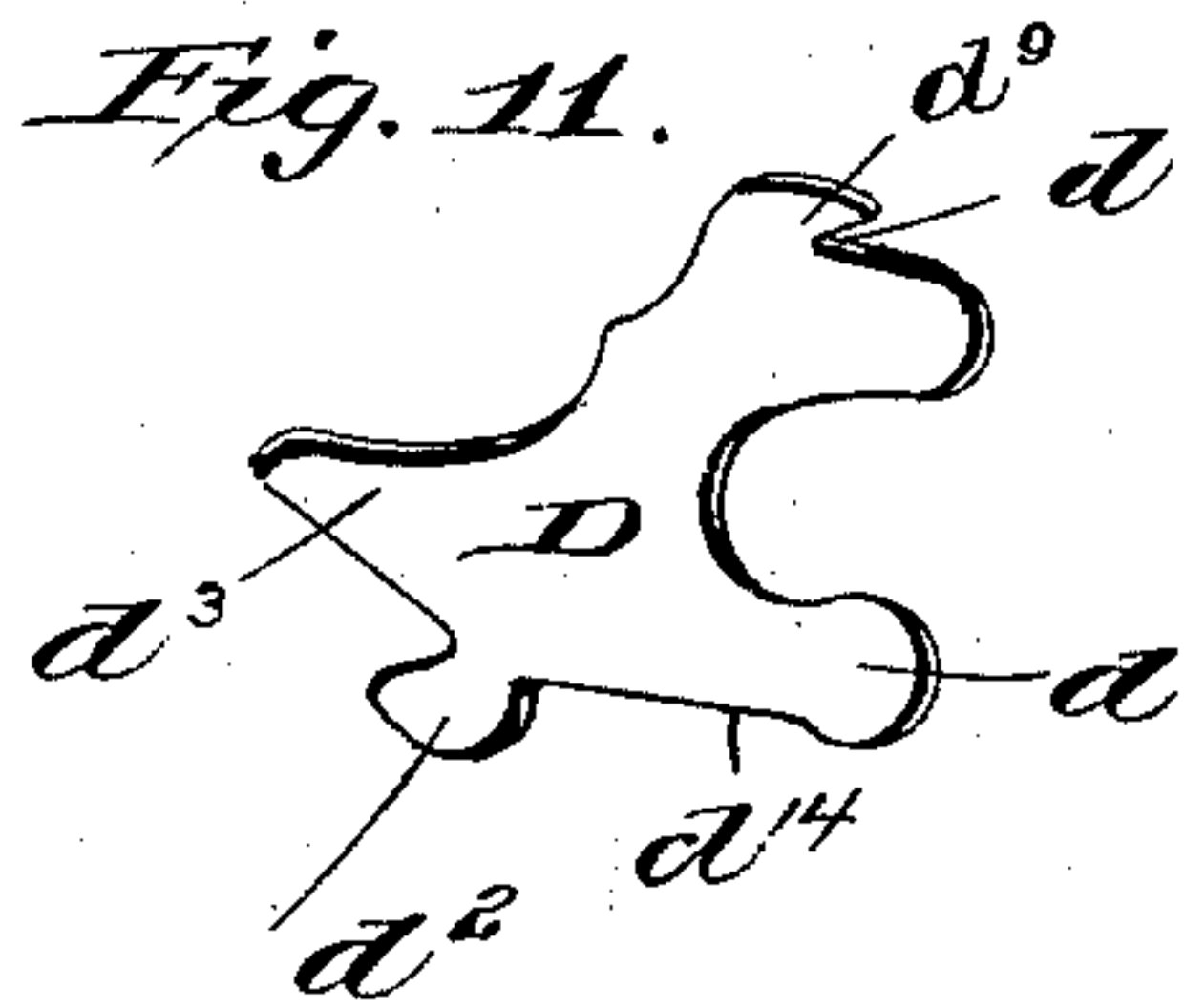


Fig. 11.



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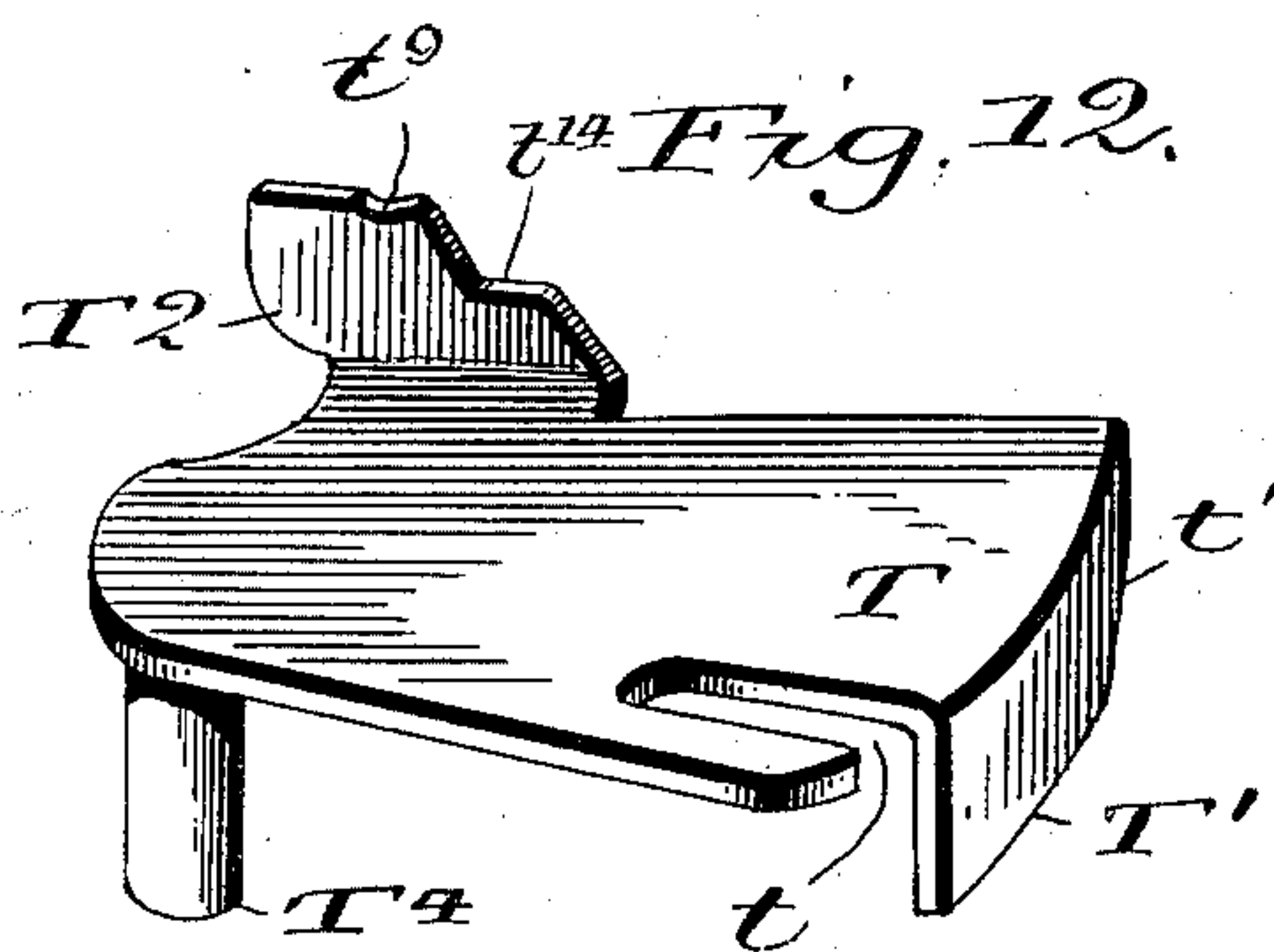
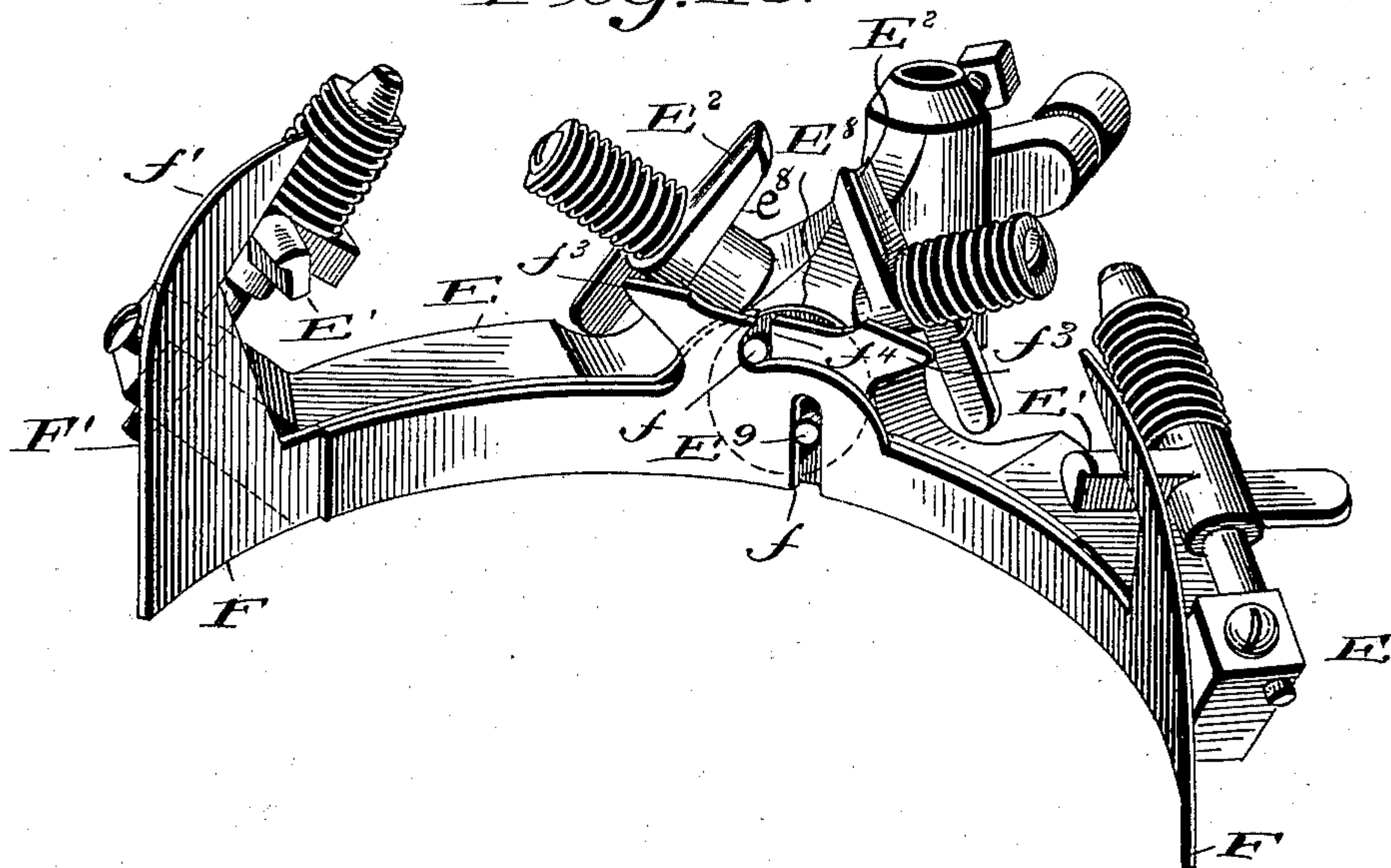
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(No Model.)

6 Sheets—Sheet 6.

Fig. 13.



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UNITED STATES PATENT OFFICE.

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KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 686,070, dated November 5, 1901.

Application filed August 29, 1895. Serial No. 560,925. (No model.)

To all whom it may concern:

Be it known that I, EMIL A. HIRNER, a citizen of the United States, residing at Allentown, in the county of Lehigh, State of Pennsylvania, have invented certain new and useful Improvements in Knitting-Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to circular-knitting machines; and among the objects and advantages sought and secured by the invention are the provision of means for throwing into and out of operation push-up and pull-down or picking cams—that is, the cams employed in narrowing and widening, respectively, when making, for example, the heel and the toe of a stocking; to automatically accomplish the control of said cams as just described; to provide means for reciprocating a cam-cylinder during said work, and means for stopping said reciprocation when said work is completed.

The invention is clearly illustrated in the accompanying drawings, which, with the letters of reference marked thereon, form a part of this specification, and in which—

Figure 1 is a front elevation of a machine embodying my present invention. Fig. 1^a is a detail, partly in section and partly in elevation, showing the means for connecting and disconnecting a pinion, hereinafter described, and the fast pulley. Fig. 2 is a side elevation of the machine, the crank H⁵ being removed. Fig. 3 is a plan (with the knitting-cylinder removed) of the means employed for controlling the push-up and pull-down cams and for connecting and disconnecting the fast pulley. Fig. 4 is a section on the line 4-4 of Fig. 3. Fig. 5 is a detail in side elevation looking at the inner face of the plate carrying the mechanism shown in Fig. 3. Fig. 6 is an elevation of a portion of the same plate looking upon the opposite or outer side. Fig. 7 is a detail, on a larger scale, of the pawl seen at the upper right hand of Fig. 5. Fig. 8 is an elevation of one side of pulley A³, seen in Fig. 5, looking at the opposite face thereof from that shown in said figure. Fig. 9 is a view of the shiftable cam-plates detached from the cam-cylinder. Fig. 9^a is a section

through the cam-cylinder, showing the manner of mounting the cam-plates employed for changing the push-up and pull-down cams. Fig. 10 is a vertical sectional detail through the needle-cylinder. Fig. 11 is a perspective of one of the presser-bits removed. Fig. 12 is a detail of the cam-plate T, and Fig. 13 is a perspective of the shifting plates and the push-up and pull-down cams.

Like letters of reference indicate like parts throughout the several figures of the drawings.

There being portions of a knitting-machine which do not constitute a part of my invention and portions which have no direct relation thereto, I have shown only such parts of a knitting-machine as are necessary to a proper understanding and operation of my invention, and such parts of a knitting-machine as are not shown and parts shown and not particularly described and parts which may be substituted for those shown may be of any well-known construction.

Referring to Figs. 1 and 2, A designates the base of the machine, designed to be secured in a desired position in any of the known ways and which in its circular portion A' is provided with an annular groove (not shown) in which is mounted the cam-cylinder B in the usual manner, the retaining-ring B' being detachably secured in position by screws in the usual way.

A² is the main driving-shaft, carrying fast and loose pulleys A³ and A⁴, respectively, and upon the inner end of this shaft is a beveled gear A⁵, adapted to mesh with a toothed rim or ring B^x, Fig. 9^a, on the lower end of the cam-cylinder B to rotate and oscillate or reciprocate the cam-cylinder in the usual manner.

C, Fig. 10, is the needle-cylinder, having the vertical grooves c for the needles x of known construction and mode of operation. Near its upper end this cylinder is provided with an annular groove C' for the reception of the heels of the presser-bits or "hold-downs" D, as seen in Fig. 10. These presser-bits have each a rounded heel d, which fits in the said groove C' and on which the bit works as a fulcrum, and each bit has also a

horizontal bearing portion d^{14} between the heel and the tail d^2 , hereinafter described. It will thus be seen that the pivotal point is located within the outer surface of the needle-cylinder. This is important, for by thus
 5 locating the pivot the presser-bits are thrown in and out by means hereinafter described in a very slightly curved line or arc between the needles, and the yarn is received in the
 10 notch d' thereof, so as to hold the loop or stitch down when the needle rises, thus avoiding the use of a weight. As the stitch is drawn the presser-bits move forward toward the center of the cylinder, and in so doing
 15 carry inward from the hook the work, and as the needle rises in the loop or stitch the finger d^9 above the notch d' prevents the fabric from rising any farther, and thus holds the work down, it being understood that the
 20 presser-bits are at first held back while the needles are descending. The presser-bit is formed with a hook-shaped tail d^2 , which is designed to work in a slot in and hook or take bearing against the undersurface of the ring
 25 D' , (which is driven by an arm B^{\times} , Fig. 1, on the cam-cylinder,) and the extension d^3 thereof is adapted to bear against the inclined inner face of a depression D^2 in said ring D' , as seen in Fig. 10. Hooking the tail
 30 d^2 under the ring D^4 , which is secured to the needle-cylinder, retains the bit in place without other holding means.

D^3 represents the annular springs, located in grooves in the outer periphery of the needle-cylinder and operate in the usual manner
 35 to retain the needles in their places.

B^2 is a plate secured to the ring D' in any suitable manner, as by screws b , and the opposite ends of this plate are provided with
 40 the oppositely upwardly inclined arms or extensions B^3 , which pass over the extensions d^3 of the presser-bits, and as the cam-cylinder is revolved these arms ride over the said extensions of the presser-bits, and thus de-
 45 press them on their pivot and withdraw the finger portion and notch d' thereof away from the needles, the movement being in substantially a very slightly curved line in and
 50 out from between the needles and back between the same, the extensions B^3 of the plate B^2 bearing upon the upper face of the extensions d^3 of the presser-bits and the latter having a bearing upon the inclined surface
 55 D^2 , which surface is restricted to the locality under plate B^2 , which locality is adjacent to the stitch-cams of the cam-cylinder, so as to produce coaction of the needles and
 60 presser-bits at the time that stitches are formed, while the bits are in a series extending completely around the needle-cylinder. The said bits must follow the prescribed path in their movement as the plate B^2 and ring
 65 D' are moved around by the arm B^{\times} .

The cam-cylinder is provided with push-up and pull-down cams, designed to operate in the manner fully explained in my Patent No. 471,220, dated March 22, 1892.

Integral with the support E of the partially-rotatable and slidingly-mounted pull-down cams E' and push-up cams E^2 is a
 70 bracket E^{\times} , (see Figs. 1, 2, and 9^a,) in which is detachably mounted the standard E^3 , carrying the guard-ring E^4 , of usual construction, and mounted in this bracket is a horizontal shaft E^5 , upon the outer end of which
 75 is an arm E^6 , held thereon detachably and adjustably, as by a set-screw e , and mounted on a stud projecting from the free end of this arm is a roller E^7 . Upon the inner end of this shaft is carried a disk E^8 , (indicated in
 80 its proper position in front of plates F in Fig. 9 by dotted lines,) and projecting from diametrically opposite points on the inner face of this disk are the pins E^9 , which are located in slots f of the plates F , which are
 85 curved to conform to the contour of the cam-cylinder and mounted in any suitable manner to slide thereupon, with their horizontal portions overlapping each other. Each of these plates is formed with an upward extension
 90 F' , terminating in the inwardly-directed portions, the under faces f' being inclined. The outer plate F has a curved slot f^2 for the passage of a pin E^9 into the vertical slot f of the inner plate and for the movement of said
 95 pin in a direction opposite to that of the outer plate F when the disk E^8 is partially rotated. The outer plate F is moved by the other pin E^9 of the disk, resting in a vertical slot f therein, similar to the slot f of the inner
 100 plate, and as said pin projects inwardly slightly more than the thickness of the outer plate the inner plate is given a curved upper edge at f^4 to permit said pin E^9 to move in a direction opposite to that of the inner plate.
 105 By this construction oscillations of the disk produce opposite direction of movement in each plate. The upper faces of the extensions f^3 are cam-shaped and are designed to engage the portions e^8 at a point inside of their
 110 pivots (see Fig. 2) of the inner or push-up cams E^2 (which portions e^8 are those which project into and through the opening in the cylinder to cooperate with the needles) to lift them out of operative position or permit
 115 their springs to return them when not lifted by said extensions f^3 . The inclines f' cooperate with the pull-down cams in the same manner. The thumb-pieces of said cams are designed for the operation of the cams by
 120 hand when desired to throw them into or out of operative position. In the operation of the machine when the roller E^7 , Fig. 1, contacts with the arm a^2 , which will soon be described, and the arm E^6 is moved it rotates
 125 the disk E^8 , and through the engagement of the pins with the inner ends of the plates the latter are moved simultaneously toward or from each other. In this manner the widening and narrowing cams are brought into and
 130 out of use at desired times. As shown in Fig. 9, the plates F are in position which they assume for widening the work—that is, the pull-down cams are in use. When the

disk E^8 is moved in the direction of the arrow indicated in Fig. 9, the plates are moved toward each other (see dotted lines in Fig. 9) by reason of the pins E^9 engaging in the slots f of said plates, and the portions f' of said plates are drawn toward each other, thus drawing down out of operation the pull-down cams E^1 and allowing the push-up cams E^2 to be brought by their springs into operative position for raising the needles. When the disk is moved in the opposite direction, the plates F are moved from each other, the push-up cams are thrown back into position, (indicated in Fig. 9,) and the pull-down cams are thrown into position through the openings in the vertical portion of the cam-cylinder provided therefor, and the parts are again in the position for widening. It will be understood that each plate F controls one push-up and one pull-down cam and that the push-up and pull-down cams operated by each plate are disposed upon opposite sides of the pivot of the disk, as clearly seen in Fig. 9, so that the said cams are operated in pairs of like cams. For example, plate F , right of Fig. 9, when moved to the left pulls down out of the cam-cylinder pull-down cam E^1 at the right of Fig. 9 and allows push-up cam E^2 on edge f^3 of the same (outer) plate to enter the cam-cylinder. The same action takes place with the other plate F on the other cams, and thus a pair of push-up cams are put into operation. In Fig. 13 push-up cams E are shown as locked in an outer inoperative position when they are uninfluenced by the edges f^3 of plates F . They are constructed to be put into and released from such position by hand.

As thus far described there are the principal elements of a knitting-machine provided with the push-up and pull-down cams employed for widening and narrowing the work, which cams and their operation are fully and clearly described in my Patent No. 471,220, hereinbefore mentioned. There also are thus far described shifting plates for throwing into and out of operation said cams and means for operating the shifting plates. It now remains to describe the means employed for operating the plate-shifting disk.

The beveled gear A^5 is located in a curved depending chamber A^6 on the frame A , Fig. 1, and the fast and loose pulleys $A^3 A^4$ are located beneath the horizontal extension A^7 of said frame. On the upper face of this extension A^7 is mounted to slide a bolt A^8 , the outer end of which is rounded, as seen best in Fig. 3, and this bolt is mounted to slide in suitable bearings or guides a on the said extension, and around this bolt is a spring A^9 , one end of which is connected in any suitable manner to the outer guide or bracket a , while its other end is connected with a laterally-projecting lug or stud a' , extending from the bolt between its guides or bearings. The inner end of the bolt is extended at right angles to its length, as seen at a^2 , and the upper face thereof is slightly rounded or beveled, as seen best

in Fig. 2. This right-angled extension or arm a^2 of the bolt is adapted to be thrown into the path of the roller E^7 , Fig. 1, carried by the arm E^6 , as will be hereinafter described. The spring A^9 acts to force the bolt A^8 outward—i. e., in the direction of the arrow in Fig. 3—the said spring being stretched as the bolt is forced in the opposite direction by the engagement of the cam portion t' of the plate T therewith. This spring is also, as before noted, connected to the pin or lug a' , so as normally to keep the arm a^2 of said bolt in an upward right inclined position, as seen in Fig. 2, the direction being indicated by the dotted arrow in Fig. 3. The plate T is shown detached in Fig. 12, and it comprises a cam-like flange T' , projecting inwardly from its body portion and at the top, and another flange T^2 , projecting outwardly at the bottom and having notches t^9 and t^{14} in its edge. A slot t is made in the plate for the reception of the pin S , carried by the bar N , and the plate is movably supported by its pivot T^4 , which is seated in the plate G , above and at right angles to the pivot u of the plate U' . (See Fig. 2.)

The cam-plate T is operated as follows: When the slide P is moved upward by rack-bar L , so that the plate Q , hereinafter described, engages the pin N^6 on the bar N , the latter is caused to move, whereby the pin S , projecting therefrom into slot t of the plate T , moves the plate T on its pivot and its cam-flange T' engages the rounded end of the bolt A^8 and forces the same inward and its arm a^2 into the path of the roller E^7 , which arm a^2 trips arm E^6 , turns disk E^8 , and shifts plates E . By means hereinafter described plate T is moved to allow bolt A^8 to be moved outwardly by the spring A^9 .

As thus far described it will be seen that the shifting plates F will remain inactive during a number of reciprocations of the cam-cylinder in the operations of narrowing until the progressive movement of the rack-bar L has forced plate Q against the pin N^6 on bar N , thus moving bar N with the rack-bar L , which continues its step-by-step movement, (by means hereinafter described,) and the result is that the arm a^2 of bolt A^8 is projected into the path of rock-arm E^6 on shaft E^5 , secured to the disk E^8 , which, being actuated by the rock-arm, shifts the plates F away from each other and they throw into operative position the pull-down cams and out of operative position the push-up cams, putting the former in position for the work of widening. By "reciprocation" of the cam-cylinder is meant that it makes one practically complete rotation in one direction and a second practically complete rotation in an opposite direction when driven by pinion H , pulley I^3 , and intermediate devices to be described. The reversal of direction of rotation of the cam-cylinder is occasioned by reversal movements of rack-bar G^2 to be described. It will be understood that the plates F are shifted toward

each other by lowering arm E⁶ by hand before reciprocating knitting begins, thereby throwing the narrowing or push-up cams into operative position, and they remain there until the widening or pull-down cams are thrown into position, as just described.

Any suitable form of belt-shifting mechanism may be employed. One form has been herein shown; but as this constitutes no part of the present invention a description thereof is not deemed necessary. It is described in detail in my Patent No. 522,438, dated December 31, 1895, to which reference may be had for a further understanding thereof, if necessary.

F^{9x}, Fig. 9^a, represents studs or projections extending laterally from the cam-cylinder B and engaging over the upper faces of the plates F to prevent vertical movement thereof. G is a plate supported from the frame A and may be reinforced at its lower edge by the lateral brace G', extending from the bracket which supports the belt-shifter G^x, as seen best in Fig. 1. Projecting laterally from the lower edge of this plate and near each end are studs g, carrying rollers g', having flanges g², which serve to support and guide the sliding rack-bar G², as seen best in Fig. 2. A similar roller g³, having a flange g⁴, is located on a stud projecting from the said plate above the rack-bar.

H is a pinion loosely mounted on the driving-shaft A², meshing with the rack-bar G², and this pinion has an opening h, (see Fig. 1^a,) in which is located a pin H', having at its outer end a notch engaging a rib on the collar H², mounted to slide on the shaft A² and having a groove h², in which works the end of the shifting lever H³, the said end lying in the groove, so that the collar may slide upon and revolve with the shaft to which it is secured by a spline in the usual manner. Projecting upward from this shifting lever is a pin H⁴, (seen best in Figs. 2 and 3,) the object of which is to move the cam-plate U' (when the handle h³ is moved in the direction of the arrow in Fig. 3) so as to swing its end (at the left of its pivot) away from the notched flange T² of the plate T. This allows the plate T to be swung on its pivot, (through the medium of pin S, bar N, and spring N⁵,) the pin pressing against the plate in slot t, Fig. 2, so that the roller U, Fig. 2, which is carried by the bend U³ of the plate U', will engage the notch t⁹, Fig. 12, of the flange T², as also seen in Fig. 2, and lock the plate U', when during its movement and that of the lever the clutch-pin H' has been carried into engagement with the pulley A³. This results in connecting the pinion H and the rack-bar with belt-pulley A³ and in reciprocating the cam-cylinder by power, as will be presently described. Normally the pin H' rests out of engagement with the fast pulley A³; but when it is desired to have the pinion H actuate the pulley and its shaft to reciprocate the cam-cylinder the handle of lever H³

is thrown outward, thus moving the sliding collar inward and forcing the pin H' into opening h⁹ in the hub of the pulley A³ and pin H' beneath wall w³ and into the slot of plate U'.

On the outer end of the shaft A² is fastened a crank H⁵, having a handle h⁴, and, if desired, weighted at the other end, as seen at h⁵. This handle is for the purpose of operating the machine by hand when the belt is on the idler and it becomes necessary to rotate the cam-cylinder. The shifting lever h³ is pivotally mounted between its ends, as at h⁶, on a stud projecting from the plate G, as shown best in Fig. 2.

The means employed to reciprocate the cam-cylinder in the work of widening and narrowing will now be described.

Mounted in the lower end of the plate G is a shaft I, carrying a pinion I', which has one member I² of a clutch. (See Figs. 3 and 4.) I³ is a band-pulley loosely mounted on said shaft and carrying the other member I⁴ of the clutch. I⁵ is a spring embracing the shaft and the parts of the clutch, it being engaged at one end with one part of the clutch and at the other end to the other part. These clutch members are normally separated by the spring I⁵, so that the pulley does not normally engage and turn the member I² and pinion I'.

I⁶ is an arm turning upon the shaft I and carrying upon its outer face two diametrically oppositely disposed pins, studs, or projections I⁷. One end of this arm is extended at right angles to its length and substantially parallel with the shaft to form a handle i, by which the same may be moved, if desired. Fast upon the outer end of this shaft is a collar or nut i', having upon its inner face two oppositely-disposed substantially V-shaped notches i², Figs. 1 and 3. Normally the spring forces the pulley and the arm I⁶ outward, and the projections or pins I⁷ fit in these notches. When it is desired to engage the clutch members so that the pulley will turn the pinion I', the arm or handle i is moved in either direction, when the pins or projections I⁷, which are rounded or beveled on their free ends, ride up the inclines of the notches, and thus force the arm and the pulley inward, so that the clutch members are engaged and are thus held by reason of the bearing of the pins or projections upon the inner face of the collar i', as will be readily understood.

J is a stud projecting from the plate G, and loose on this stud is a large gear-wheel J', which meshes with the pinion I' on the shaft I.

K is a plate secured to the sliding rack-bar G², as seen in Fig. 2, by screws, the plate being seated in a recess in the said bar, so as to be flush therewith, and this plate is bent, as seen at k, to pass under the gear J' and up the outer side thereof and is provided with a slot k', in which works a crank-pin K', projecting from the outer face of the gear J'. A washer K², of vulcanized fiber or any other

suitable material, is secured upon this crank-pin in any suitable manner, as by a cotter k^2 , passed through an opening in the outer end of the pin, and this washer rides upon the vertical ribs K^3 at opposite sides of the slot, while the crank-pin itself works between the walls of said slot and between the ribs. When the clutch members $I^2 I^4$ are in engagement and motion is conveyed by belt (not shown) to the pulley I^3 , the pinion I' is rotated, and by reason of its engagement with the gear J' the latter is revolved, and a reciprocatory motion is imparted to the rack-bar G^2 , which oscillates the pinion H , the shaft A^2 , the beveled gear A^5 , and the cam-cylinder, whereby opposite movements of bar G^2 produce opposite rotations or reciprocations of the cam-cylinder in widening and narrowing. When the clutch members are not engaged, as seen in Fig. 4, the pulley I^3 may be rotated without imparting motion to the said parts for the reason that the pinion I' is not revolved. One edge of the plate K is cut away, as shown at k^3 , so as to allow of the full required movement of said plate without striking the shaft I or the member of the clutch thereof.

Arranged to slide upon the upper edge of the plate G is a rack L , having a shoulder or inclined portion p^9 , as seen best in Fig. 5, and to which rack is connected in any suitable manner one end of the rod L' , the other end of which is connected to the weight L^2 , which is mounted to slide upon an arm or rod L^3 , which is adjustably mounted in the bracket l , rising from the lower end of the plate G and provided with a set-screw l' , as seen best in Figs. 5 and 6, by which the said rod may be adjusted up or down to put to use more or less teeth of the rack-bar L , as occasion may require. It is apparent that the rod L' and wire L^4 act as a stop to further downward movement of rack-bar L and if set farther to the right, Fig. 5, would leave a less number of teeth to be operated by pawl O' to move the bar to its extreme upward travel. In the upper end of this rod L^3 is a substantially U-shaped wire L^4 , one arm of which is extended laterally, as seen at l^4 , Fig. 3, beneath the plate M , having a shoulder m^{12} , Fig. 6, and the lower end of which plate is provided with an opening l^5 for receiving a stud or pin l^6 , projecting from the bracket l . The other end of this plate works in a slot n in the upper face of the bar N , as seen in Fig. 3, having an end wall to contact with projection m^{12} of plate M , and the upper edge of this end of the plate M is beveled, as seen at m^x , Fig. 6, and extends beneath the detent N' , which is carried by an arm N^2 , pivotally mounted, as at n' , on the side of the plate G , and a spring n^3 is provided for the purpose of normally holding this detent down in engagement with the rack L . Pivoted on the opposite side of the plate G at o , Fig. 5, is an arm O , and on the upper end of this arm is pivotally mounted at o' a pawl O' , caused by spring o^3 to yieldingly engage with the rack

L , the pawl O' passing over the detent N' , as seen clearly in Fig. 5. This detent N' serves to normally engage the rack-bar L and prevent motion thereof under the influence of its weight L^2 ; but when the plate M is moved by contact of weight L^2 , raised by the rack-bar L , its inclined portion lifts the detent N' and pawl O' out of engagement with the rack-bar, which is then free to be carried downward to the end of its movement by the weight. As the rack-bar L is brought down by the weight L^2 the bevel p^9 at the lower end of the rack-bar takes under the wire L^4 and raises it so that its arm beneath plate M lifts it out of the shoulder or recess, Fig. 6, when by gravity or the stress of the pawl-springs the plate is returned to its lower position ready to be again forced upward by contact of weight L^2 with its lower end.

Projecting from the pawl O' is an arm or stud o^2 , Fig. 6, to which is attached a spring the other end of which is connected to some fixed part, as to the arm or bracket O^4 on the plate G . This bracket carries a pin O^x , which projects above bar N to keep it in contact with plate G . The other end of this arm O is bent back upon itself, as seen at O^5 , to give a bearing for a tappet O^6 , Fig. 8, pivotally mounted, as at o^6 , on the hub of the fixed pulley A^3 , the tappet being located in a recess o^{7x} in said hub and having a lateral projection o^8 at the free end. The pivot of this tappet is encircled by a coiled spring (not shown) to keep it normally in the position shown in Figs. 5 and 8. A yielding resistance, as a spring O^{7x} , is provided on the pulley for the purpose of cushioning this tappet after it strikes and leaves the end O^5 of pawl-lever O . This occurs only when the pulley A^3 is rotating in one direction—that is, when the tappet depresses the end O^5 of the lever O —the coiled spring allowing the tappet to pass over the end O^5 without operating the pawl-lever when the pulley is rotating in the other direction. Suppose the pulley to be moving with its top traveling in the direction toward the pivot O of the lever O^5 . Then the end of tappet O^6 would slide along the lever O^5 until it came to the angle between the arm of the said lever and the rounded projection on the end thereof. Then on further movement of the pulley the tappet would be turned on its pivot and as it turned would increase the radial distance from the center of the pulley to the outer end of the tappet, and hence lower the lever, being finally released therefrom after being turned into substantially the position indicated in dotted lines in Fig. 8. On the return movement the tappet would simply wipe past the projection on the lever. When the belt is thrown from the fast pulley A^3 onto the loose pulley A^4 and the machine is operated by another belt on the pulley I^3 , this tappet engages the portion O^5 of said lever O , and thus moves the same on its pivot, causing the pawl O' to engage the rack L and move the same one tooth at each alternate

reciprocation of the rack-bar and of the cam-cylinder.

P is a slide having slots p , by which it is mounted upon the pins or studs P' , projecting from the depending portion P^2 at the outer end of the horizontal part A^7 of the frame, and which pins extend over the bar N. To the rear end of this bar is attached a spring N^5 , the other end of which is attached to the plate G.

P^3 is a spring connected at one end to the slide P and at the other end to some fixed part, as the portion P^2 of the frame, as seen in Figs. 3 and 5.

The upper end of the bar N carries a laterally-projecting pin N^6 , as seen in Figs. 3 and 5, and on the upper end of the slide P is loosely pivoted the plate or pawl Q on a pivot q , and having its arms, of which there are four, 1 2 3 4, of different lengths, and having also four projecting pins Q' , as seen most clearly in Fig. 7.

R is a latch pivoted at its lower end on a stud projecting from the plate G, and its outer end is beveled, as seen in Fig. 7, while said outer end is provided with a notch or shoulder R' , as is seen also in said Fig. 7, to engage one or the other of the pins Q' on the plate Q as the parts are reciprocated. The dotted lines in Fig. 7 show the position of the plate Q after it has been turned by the notch R' . A spring R^3 is provided for the purpose of normally holding this latch R up, the same being depressed by the pins Q' and returned to its normal position by said spring as soon as the pins have passed out of the path thereof.

S is a stud or pin projecting laterally from the bar N and works through a slot t in the plate T, which is pivotally mounted, as at T^4 , Fig. 2, on the plate G and has at its upper end the overlapping cam-flange T' , the upper edge or end of which is beveled, as seen at t' in Fig. 3. This flange is designed to act as a cam upon the sliding bolt A^8 . This plate T has projecting therefrom at its lower end a lateral portion T^2 , having notches, Figs. 3 and 9, which portion extends beneath and is adapted to be engaged by the roller U, carried by the plate U' . This plate is pivotally mounted, as at u , on an extension of the plate G, and the lower end is curved in substantially U form, as seen at U^2 , forming a slot u' , one wall of which is resilient and curved or bent upwardly, as seen at u^3 in Fig. 2. The upwardly-projecting pin H^4 on the shifting lever H^3 is designed to engage this bent spring portion u^3 and to pass beneath the same and into the slot u' when the shifting lever is moved in the direction of the arrow to throw the pin H' into the hole in the hub of the fast pulley A^3 to produce reciprocation of the cam-cylinder and to pass out of said slot when the pin H^4 is entirely disconnected from fast pulley A^3 , and this without bringing the plate U' outwardly, the wall u^3 being in this case raised by hand. A

stout spring W is provided, which is wrapped around the pivot of the shifting lever, with one end extending back of the plate U, as seen in Figs. 2 and 3, and serving to normally keep the said plate outward.

The plate U' is in its nature a latch under spring tension and held in that condition by the plate T, which is moved upward by pin S on bar N to at the proper time release said latch in order that it, being under tension of spring W, shall automatically by action on pin H^4 operate lever H^3 to withdraw pin H' from pulley A^3 and stop the reciprocation of the cam-cylinder. When it is desired to stop such reciprocation before the bar N has reached a point to do it automatically, it may be done by hand, provided the wall u^3 be raised by hand slightly to allow pin H^4 to pass beneath it. When this has been done and the pin H^4 stands outside of and in front of wall u^3 , as seen in Fig. 2, the lever h^3 may be moved in the direction of arrow, Fig. 3, and pin H^4 will automatically lift wall u^3 and enter the slot, where it is shown to be in Fig. 3, whereupon the reciprocation is resumed and continued until the rack-bar L and the connections described bring bar N and its pin S to a position to automatically stop the reciprocation, as before described.

The slide P is provided upon its under side with a shoulder p^3 , Fig. 6, which is in line with and adapted to be engaged by a shoulder or offset p^4 , Fig. 3, on the rack-bar L, so that when the latter has traveled a predetermined distance this shoulder engaging the shoulder p^3 on the slide P will move the same with it to the limit of its movement. As it is thus moved the plate or pawl Q, carried by plate P, is moved on its pivot by the engagement of one of the pins Q' with the notch R' of the latch R, as will be best understood by reference to Fig. 7.

The plate or pawl Q, with its four arms 1, 2, 3, and 4, of different lengths, is designed for use in making the ordinary toe and large heel. In the position in which they are shown in Fig. 7 the toe has been completed and the parts are in position to be moved, so as to make the heel of a subsequent stocking, the first movement being to carry arm 4 around by hook R' on a pin Q' and bring arm 1 in line with pin N^6 , it being understood that the two arms 1 and 2 are for the heel, while the other two arms 3 and 4 are for the toe, and that each of these pairs of arms is used separately and independently—that is, while the heel is being made the arms 3 and 4 are completely out of use and vice versa. While the cylinder is being reciprocated and the rack-bar L is being moved up its shoulder p^4 comes first into contact with the shoulder p^3 of the slide P, upon which the plate or pawl Q is mounted for rotary movement, and after moving farther the hook R' of the latch R engages the pin Q' between the arms 3 and 4, and in the further movement of the slide the plate or pawl Q is turned on its pivot in the direc-

tion of the arrow indicated in Fig. 7, bringing the arm 1 into position to next engage the pin N^6 on the outer end of the bar N. Slide P is then moved ahead until the arm 1 engages said pin N^6 , and this contact moves the bar N up, and by means of the devices seen in Fig. 6, including the weight L^2 , hereinbefore described, the plate M is forced upward until the tapered end m^x of the said plate engages the detent N' and lifts it from engagement with the rack, and this detent in turn engaging beneath the pawl O' also disengages the same from the rack, thereby releasing the rack, which drops by weight L^2 into its normal or starting position, and in so doing the shoulder or tapered portion p^9 of the rack-bar engages beneath the longitudinal portion l^4 of the wire L^4 , which being beneath the plate M lifts its shoulder m^{12} from the lower end wall of the slot n of bar N (see Fig. 6) to insure the return of the detent N' and pawl O' into position to engage the rack. This completes the operation of narrowing to make the first half of the heel. Let it be remembered that the push-up cams have been in use during this operation of narrowing and that the rock-arm E^6 has been in a depressed position and, further, that the rack-bar (and its adjuncts) has reached the highest point in its step-by-step movement, so as to force the bolt inward to bring its arm a^2 in contact with arm E^6 and move it from a depressed position to a lifted position, thus actuating the disk which moves the plates F, whereby the pull-down cams are now in position to do their work in the subsequent reciprocations of the cam-cylinder while widening to complete the heel. The machine is then reciprocated as before. The second upward movement of the rack-bar causes, through the medium of the devices hereinbefore described in connection with the movement of the plate Q, a second rotary movement thereof upon its pivot, so that the arm 2 thereof comes into operative relation with the pin N^6 on the bar N by contact of hook R with one of the pins Q' of the plate Q, thereby throwing out the sliding collar H^2 and withdrawing the pin H from its engagement with the hub of the pulley A^3 , discontinuing the reciprocating motion, and the heel is completed. Now the machine is stopped, and all the needles of the cylinder are by hand put in position to make the foot. The machine being thus shifted for circular work, the foot portion, excepting the toe, is completed in the usual manner—that is, by complete rotation of the cam-cylinder. In making the toe one-half of the needles are raised by hand into the idle track and the roller E^7 is first thrown down, bringing the push-up cams into operative position for narrowing, and the operation requires the same reciprocation of the cam-cylinder as in making the heel, except that the arms 3 and 4 of the plate Q are brought into operation one after the other in the manner described instead of the arms 1 and 2. It will be understood that the dif-

ference in length of the arms of the plate Q necessitates a corresponding difference in the distance traversed by the slide P and the rack-bar L, and consequently a difference in the number of reciprocations and of needles employed and stitches formed before the said arms are brought into contact with the pin N^6 to throw pin H^4 out of pulley A^3 and stop reciprocating the cam-cylinder. The rack-bar L is moved one tooth by pawl O' at each reciprocation (double half-rotation) of the cam-cylinder. For instance, supposing that the slide P and the arm 1 of said plate Q traverse a distance sufficient to permit reciprocation to rack twenty-seven needles, the arm 2 being longer, the distance traversed by slide P will be less and a less number of needles will be racked or thrown out of use—say twenty-five on each side of the whole number (eighty)—in narrowing or racked or thrown into use in widening—that is, one will be thrown in at each side at each half-rotation of the cam-cylinder in widening and one thrown out at each side in narrowing. At each reciprocation (double half-rotation) a still less number of the twenty-seven needles on each side will remain for use until sufficient are racked out and the narrowing at the heel completed. So, also, in making the toe the arm 3 is shorter than the arm 4, and the distance traversed by said plate is therefore increased, and a greater number of needles—say twenty-three—are racked when arm 3 is used than when the arm 4 is used. The latter being of greater length than the arm 3 racks off less needles—say twenty-one—although, of course, the arms could be so varied in length as to bring about a greater difference in the number of needles thrown out of employment before reciprocation is automatically stopped. By “racking” is meant throwing the needles into and out of working position in the work of widening or narrowing. It will be understood that the plate Q is held in any of its four positions by reason of the disposition of the pins Q' upon opposite sides of the pivot and their riding contact on the upper edge of the catch R, so that the reverse movement of the slide P does not affect or rotate the plate Q.

The operation of knitting a complete stocking by the means hereinbefore particularly described may be stated in general terms as follows, assuming the plain knitting has progressed to a completion of the leg portion and that the heel is to be formed: One-half of the needles are thrown up into the idle track of the cam-cylinder. The main belt is shifted to the idle pulley A^4 . Lever h^3 is thrown out to couple pinion H with fast pulley A^3 . Rock-arm E^6 is thrown down to the position shown in Figs. 1 and 2, thereby reciprocating plates F F toward each other and permitting the push-up cams to project through the cam-cylinder into the plane of the path of the heels of the needles and drawing downwardly out of the cam-cylinder the pull-down cams,

thus preparing the cams for narrowing the fabric to form the first half of the heel. Now the clutch-lever z , Fig. 3, is thrown to connect belt-pulley I^3 with pinion I' , whereby power is conveyed and motion imparted to the cylinder-reciprocating means and picking-cam-controlling plates $F F$. The reciprocations are continued until the pawl Q of plate P has contacted with pin N^6 of bar N and moved said bar until pin S forces plate T against bolt A^8 , the arm a^2 of which is thereby moved into contact with rock-arm E^6 , causing it to move upwardly and rotate disk E^8 , and this moves plates F away from each other, withdrawing the push-up cams and inserting the pull-down cams. The above-mentioned movement of plate T releases plate U' , so that spring W disconnects pinion H and fast pulley A^3 , so that reciprocation of the cam-cylinder ceases automatically. It is customary for one operator to have charge of several machines, and this automatic stoppage of narrowing when a desired predetermined number of needles have been racked is of course of material value. The picking-cams having been thrown into position for widening, the operator now throws lever h^3 , as before, and connects pinion H with fast pulley A^3 , and reciprocation of the cam-cylinder again takes place and continues until automatically stopped, as just described. All the needles are now by hand or, it may be, by special devices run down to the working track, and the foot is formed by plain knitting, as usual. Then the picking-cams are set for narrowing at the toe and the power applied to pulley I^3 to reciprocate the cam-cylinder, as above described in narrowing at the heel.

It is to be understood that the operation of the needles aside from the novel devices for controlling them in making the heel and toe of a stocking is the same both as to the number thrown out of use by hand or otherwise, the number remaining in use, the increase and decrease of those in use at each side of the series of needles at each reciprocation of the cam-cylinder during the operations of widening and narrowing as has been long known in the art and as in substance fully described in United States Patents No. 350,466, dated October 5, 1886, No. 172,940, dated February 1, 1876, and in my patent No. 471,220, hereinbefore mentioned, in which the specific picking-cams herein employed are fully shown and described. Reference to these patents is made to avoid unnecessary prolixity of description of what is old.

From the description given it will be seen that the knitting-machine provided with my improvements is capable of automatically performing the work of knitting a complete stocking, including the formation of the heel and toe thereof, and that by the relative lengths of the arms of the plate or pawl Q an ordinary or large heel may be formed by controlling the duration or the reciprocation and

of the operative of the pull-down and push-up or picking cams. Furthermore, the invention is readily adaptable to machines of known construction, and it is apparent that certain combinations hereinafter claimed may be utilized for controlling duration of reciprocation without the employment of the simultaneously-operating picking-cam-controlling devices, and vice versa. Other modifications and details of construction may be employed without departing from the gist of the invention or sacrificing any of its advantages.

Parts of a knitting-machine, including the presser-bits and some of their coacting devices herein shown and in part described, are not herein claimed, as they are made the subject-matter of a divisional application, Serial No. 40,801, filed December 22, 1900.

What is claimed is—

1. The combination with a cam-cylinder and its needle-picking cams, of oppositely-disposed plates slidingly mounted on the said cylinder and located to operate directly on said cams; substantially as specified.
2. The combination with a cam-cylinder and its needle-picking cams, of oppositely-disposed slotted overlapping plates slidingly mounted on the said cylinder, and a disk provided with pins constructed to actuate said plates; substantially as specified.
3. The combination with a cylinder and its needle-picking cams, of oppositely-disposed plates mounted to slide on the outer face of said cylinder and having notches, and a disk carried by a rotatable shaft and having pins adapted to engage said notches; substantially as specified.
4. The combination with a cam-cylinder and its needle-picking cams, of oppositely-disposed plates having inclined cam-contacting portions and notches, mounted on said cylinder, a rotatable shaft, and a disk on the inner end thereof provided with pins engaging said notches to actuate the plates; substantially as specified.
5. The combination with a cam-cylinder and its needle-picking cams, of oppositely-disposed plates having inclined cam-contacting portions and notches, a rotatable shaft, a disk on the inner end thereof provided with pins engaging said notches to actuate the plates, and an arm on the outer end of said shaft for giving motion to said shaft; substantially as specified.
6. The combination with a cam-cylinder and its needle-picking cams, of oppositely-disposed plates having cam-contacting portions and notches, mounted on said cylinder, a rotatable shaft, a disk on the inner end thereof provided with pins engaging said notches to actuate the plates, an arm on the outer end of said shaft, and a shaft-operating device adapted to be moved into and out of the path of said arm; substantially as specified.
7. The combination with a cam-cylinder

and its needle-picking cams; of oppositely-disposed plates having cam-contacting portions mounted on said cylinder, a rotatable shaft, a disk on the inner end thereof provided with pins engaging, so as to actuate, the plates, an arm on the outer end of said shaft carrying a roller, and a sliding bolt having an arm adapted to be engaged by said roller, said bolt being spring-actuated and having a rounded outer end; substantially as specified.

8. The combination with a cam-cylinder and its needle-picking cams mounted to slide, to partially rotate and to work through openings in the cylinder, of oppositely-disposed plates having inclined portions and notches, a shaft mounted in an extension on the support of said cams, and a disk carried by said shaft and having pins adapted to actuate said plates; substantially as specified.

9. The combination with a cam-cylinder and the needle-picking cams adapted to operate through openings therein, of slidingly-mounted oppositely-disposed plates having portions moving in the plane of and to actuate said cams, and a shaft operatively connected with and adapted to actuate said plates; substantially as specified.

10. In a knitting-machine of the class described, the combination with the plate G and the rack-bar mounted to slide on the upper edge thereof, the cam-cylinder, the cams, and the needles, of a pawl engaging said rack-bar, a curved pivoted arm carrying said pawl, the main drive-shaft, a fast pulley thereon provided with a tappet for actuating said arm to cause the pawl to move the rack-bar, and connections controlled by the rack-bar for rendering the needles operative and non-operative; substantially as specified.

11. The combination with a main drive-shaft of a knitting-machine and the pulley fast thereon, of a pinion loose on said shaft, a collar slidingly mounted on said shaft and carrying a pin adapted to pass through the pinion and engage an opening in the hub of the pulley, means for rotating said pulley in opposite directions, a shifting lever pivotally mounted between its ends and having a portion engaging said sliding collar to throw the pin into engagement with the hub of the fast pulley and carrying an upwardly-projecting pin, a spring-actuated pivoted plate having a substantially U-shaped portion with a spring-jaw, and means for locking and unlocking said plate; substantially as specified.

12. In a knitting-machine of the class described, the combination with the plate G and the rack-bar mounted to slide upon the upper edge thereof, the cam-cylinder, the cam, and the needles, of a pawl adapted to engage said rack-bar, a pivoted arm carrying said pawl, means on the fast pulley of the main drive-shaft adapted to actuate said pivoted arm, and connections controlled by the rack-bar for rendering needles operative and non-operative; substantially as specified.

13. In a knitting-machine of the class described, the combination with the plate G and the rack-bar mounted to slide on the upper edge thereof, the cam-cylinder, the cam, and the needles, of a pawl engaging said rack-bar, a curved pivoted arm carrying said pawl, a main drive-shaft, a fast pulley thereon provided with a tappet for actuating said arm to cause the pawl to move the rack-bar, a weighted rod connected with the lower end of said rack-bar, and connections for rendering needles operative and non-operative; substantially as specified.

14. In a knitting-machine of the class described, the combination with the plate G and the rack-bar mounted to slide on the upper edge thereof, the cam-cylinder, the cam, and the needles, of a pawl engaging said rack-bar, a curved pivoted arm carrying said pawl, a main drive-shaft, a fast pulley thereon provided with a tappet for actuating said arm to cause the pawl to move the rack-bar, a weighted rod connected with the lower end of said rack-bar, the sliding plate M, a pivoted pawl-lifting device, and connections controlled by the rack-bar for rendering needles operative and non-operative; substantially as specified.

15. In a knitting-machine of the class described, the combination with the plate G and the rack-bar mounted to slide on the upper edge thereof, the cam-cylinder, the cam, and the needles, of a weighted rod connected with said rack-bar, a pawl engaging the rack-bar, a curved arm pivoted on the plate and carrying the pawl and having its other end bent laterally, a main drive-shaft, a fast pulley thereon, a tappet on said pulley to engage the bent end of said arm, and connections controlled by the rack-bar for rendering needles operative and non-operative; substantially as specified.

16. In a knitting-machine of the class described, the combination with the plate G and the rack-bar mounted on the upper edge thereof, of a weighted rod connected with said rack-bar, the cam-cylinder, the cam, and the needles, a pawl engaging the rack-bar, a curved arm pivoted on the plate and carrying the pawl and having its other end bent laterally, a main drive-shaft, a fast pulley thereon, a tappet on said pulley to engage the bent end of said arm, a cushioning device for said tappet, and connections controlled by the rack-bar for rendering needles operative and non-operative; substantially as specified.

17. In a knitting-machine of the class described, the combination with the plate G and the rack-bar mounted to slide on the upper edge thereof, the cam-cylinder, the cam, and needles, of a weighted rod connected with said rack-bar, a pawl engaging the rack-bar, a curved arm pivoted on the plate and carrying the pawl and having its other end bent laterally, a main drive-shaft, a fast pulley thereon, a tappet on said pulley to engage the bent end of said arm, a cushioning de-

vice for said tappet, and a sliding plate actuated by said rack-bar and having means for rendering the needles operative and non-operative; substantially as specified.

5 18. In a knitting-machine of the class described, the combination with the plate G and the rack-bar mounted to slide on the upper edge thereof, the cam-cylinder, the cam and needles, of a weighted rod connected with
10 said rack-bar, a pawl engaging the rack-bar, a curved arm pivoted on the plate and carrying the pawl and having its other end bent laterally, a main drive-shaft, a fast pulley thereon, a tappet on said pulley to engage
15 the bent end of said arm, a cushioning device for said tappet, a sliding plate actuated by said rack-bar, a plate pivoted on the sliding plate and having portions of different lengths, and connections controlled by the rack-bar
20 for rendering the needles operative and non-operative; substantially as specified.

19. In a knitting-machine of the class described, the combination with the plate G and the rack-bar mounted to slide upon the upper
25 edge thereof, the cam-cylinder, the cam and the needles, of a weighted rod connected with said rack-bar, a pawl engaging the rack-bar, a curved arm pivoted on the plate and carrying the pawl and having its other end bent
30 laterally, a main drive-shaft, a fast pulley thereon, a tappet on said pulley to engage the bent end of said arm, a cushioning device for said tappet, a sliding plate actuated by said rack-bar, a plate pivoted on the sliding
35 plate and having portions of different lengths, lateral pins, a pivoted spring-actuated notched arm located beneath said pins, and connections controlled by the rack-bar for rendering the needles operative and non-operative;
40 substantially as specified.

20. In a knitting-machine, the combination with the cam and needle cylinders and with the main driving-shaft and its fast pulley, of a pinion loosely mounted on said shaft, means
45 for connecting and automatically disconnecting said pinion and fast pulley, a rack-bar meshing with said pinion, and means independent of the main shaft for reciprocating said rack-bar; substantially as specified.

50 21. In a knitting-machine, the combination with the cam and needle cylinders and with the main driving-shaft and its fast pulley, of a pinion loosely mounted on said shaft, means for connecting and disconnecting said pinion
55 and fast pulley, a rack-bar meshing with said pinion, a gear having a wrist-pin, a slotted plate embracing said pin and secured to said rack-bar, a pinion meshing with said gear, a belt-pulley independent from the main shaft
60 of the machine, and means for automatically disconnecting the loose pinion from the fast pulley on the main shaft after a predetermined number of reciprocations of said rack-bar.

65 22. In a knitting-machine, the combination with the cam and needle cylinders and main driving-pulley thereof having a pivoted tap-

pet thereon, of a tappet-lever and cam-cylinder-reciprocating means, comprising a rack-bar and a pinion separably connected with
70 said driving-pulley, a pawl-and-rack mechanism operated by said tappet and carrying devices for terminating the reciprocation of the cam-cylinder; substantially as specified.

23. In a knitting-machine, the combination
75 with the needle and cam cylinders thereof, of picking-cams, means comprising overlapping plates for throwing the same in pairs into and out of operative position with relation to the needles, means for reciprocating
80 the overlapping plates, cam-cylinder-reciprocating means operated from an independent shaft and a pawl-and-rack mechanism cooperatively arranged to throw picking-cams out of operation and to simultaneously stop the
85 reciprocation of the cam-cylinders; substantially as specified.

24. The combination of a plate, the rack-bar mounted to slide on the upper edge thereof, the cam-cylinder, the needles and the cams,
90 the pawl engaging the rack-bar, means for supporting and actuating said pawl, a rod connected to the rack-bar and carrying a weight, an arm pivoted on the plate and carrying a transverse pawl extending under the first-
95 mentioned pawl, a sliding plate having a beveled end extended under said pawl, devices actuated by the rack-bar for causing the movement of said plate to automatically release the first-mentioned pawl from engagement
100 with the rack-bar, and controlled by the rack-bar connections for rendering the needles operative and non-operative; substantially as specified.

25. The combination of the plate, the rack-
105 bar mounted to slide on the upper edge thereof, the cam-cylinder, the needles and the cams, the pawl engaging the rack-bar, means for supporting and actuating said pawl, the rod connected to the rack-bar and carrying a
110 weight, the arm pivoted on the plate and carrying a transverse pawl extending under the first-mentioned pawl, a sliding plate having a beveled end extended under said pawl, means for the automatic movement of said
115 plate to automatically release the pawl from engagement with the rack-bar, a sliding plate arranged in the path of the rack-bar and carrying at its upper end a pivoted plate with portions of different lengths, and connections
120 controlled by the rack-bar for rendering the needles operative and non-operative; substantially as specified.

26. The combination of the plate, the rack-
125 bar mounted to slide on the upper edge thereof, the cam-cylinder, the needles and the cams, the pawl engaging the rack-bar, means for supporting and actuating said pawl, the rod connected to the rack-bar and carrying a
130 weight, the arm pivoted on the plate and carrying a transverse pawl extending under the first-mentioned pawl, a sliding plate having a beveled end extended under said pawl, means for automatic movement of said plate

to automatically release the pawl from engagement with the rack-bar, a sliding plate mounted in the path of the rack-bar and carrying at its upper portion a pivoted plate with 5 portions of different lengths and with laterally-projecting pins, a spring-actuated pivoted notched arm arranged beneath said pins, and connections controlled by the rack-bar for rendering needles operative and non-op- 10 erative; substantially as specified.

27. In a knitting-machine, the combination with the frame-plate and the shifting-lever, the cam-cylinder, the cams, cam-controlling devices and the needles, of a rock-arm for operating the cam-controlling devices, a sliding 15 bolt for operating the arm, and a pivoted plate having a flange for operating said sliding bolt and having a notch, a sliding bar having a pin entering said notch, means for actuating said sliding bar, and connections 20 for operating the shifting lever by means of the pivoted notched plate; substantially as specified.

28. The combination with the frame-plate 25 and the pivoted shifting lever, the cam-cylinder, the cams and the needles, of a pivoted plate having a notch, a sliding bar having a pin engaging said notch, said pivoted plate having a lateral flange, a spring-actuated sliding bolt adapted to be engaged thereby, and 30 connections between said bolt and said cams for rendering needles operative and non-operative; substantially as specified.

29. The combination with the frame-plate 35 G and the pivoted shifting lever, the cam-cylinder, the cams and the needles, of a pivoted plate having a notch, and a sliding bar having a pin engaging said notch, said pivoted plate having a lateral flange, a spring-actuated 40 sliding bolt adapted to be engaged by said pivoted plate, a pivoted arm adapted to be actuated by the movement of the shifting lever and to engage said pivoted plate, and connections between said bolt and said cams 45 for rendering needles operative and non-operative; substantially as specified.

30. The combination with the plate G and the pivoted shifting lever, the cam-cylinder, the cams and the needles, of a pivoted plate 50 having a notch, a sliding bar having a pin engaging said notch, said pivoted plate having a lateral flange, a spring-actuated sliding bolt adapted to be engaged by said pivoted plate, a pivoted arm adapted to be actuated by the 55 movement of the shifting lever and to engage said pivoted plate, a spring on the pivot of the shifting lever engaging the arm, and connections controlled by said plate for rendering needles operative and non-operative; sub- 60 stantially as specified.

31. The combination with the cam-cylinder, the cams, the needles and the spring-actuated sliding bolt having a rounded end, of the plate G supported from the frame, the plate 65 T mounted thereon for pivotal movement and having a lateral flange with a tapered end adapted to engage the rounded end of the

bolt, means for throwing the same into and out of engagement with said bolt, and connections controlled by said plate for rendering 70 needles operative and non-operative; substantially as specified.

32. The combination with the cam-cylinder, the cams, the needles and the spring-actuated sliding bolt having a rounded end, of the 75 plate G supported upon the frame, the plate T mounted thereon for pivotal movement and having a lateral flange with a tapered end adapted to engage the rounded end of the bolt, a pivoted arm having a roller engaging 80 a notch in said plate T and connections controlled by said plate for rendering needles operative and non-operative; substantially as specified.

33. The combination with the cam-cylinder, 85 the cams, the needles and the spring-actuated sliding bolt having a rounded end, of the plate G supported from the frame, the plate T mounted thereon for pivotal movement and having a lateral flange with a tapered end 90 adapted to engage the rounded end of the bolt, a pivoted arm having a roller engaging a notch in said plate, a shifting lever engaging said arm, and connections controlled by 95 said plate for rendering needles operative and non-operative; substantially as specified.

34. The combination with a knitting-machine having means for reciprocating the cam-cylinder thereof, of a pivoted tappet mounted 100 on the driving-pulley, a lever projecting into the path of the tappet, and connections between the lever and the cylinder-reciprocating means for terminating the reciprocation of said cylinder; substantially as specified.

35. The combination with a knitting-machine 105 having means for reciprocating the cam-cylinder thereof, of a tappet and a cushioning-spring mounted on the driving-pulley, and connecting devices for terminating the reciprocative movements of said cylinder, 110 which devices are gradually brought into action by said tappet and a cooperating pawl and rack-bar; substantially as specified.

36. The combination with a knitting-machine, of cylinder-reciprocating means, 115 devices for causing said means to act and means for automatically terminating said action comprising a lever and a pivoted tappet, the latter mounted upon the fixed pulley of the machine; substantially as specified. 120

37. The combination with a knitting-machine having means for reciprocating its cam-cylinder, of means for terminating said reciprocation involving a pawl, lever a rack-bar and a tappet for said lever which tappet is 125 mounted on the driving-pulley of the machine and constructed and arranged to operate on said lever in the movement of said pulley in one direction and to inoperatively pass over said lever in an opposite movement of said 130 pulley; substantially as specified.

38. The combination with a knitting-machine, of a supporting-plate secured to the frame of the machine, a rack-bar mounted on

said supporting-plate, means for operating said rack-bar, a slidable plate arranged in the path of the rack-bar and adapted to contact with devices for controlling the operation of the machine, whereby the said slidable plate remains for a time inactive and is gradually brought into operative position; substantially as specified.

39. The combination with a supporting-plate secured to the frame of a knitting-machine, of a rotary pawl having a plurality of arms of varied length mounted on a slidable plate having a shoulder, a rack-bar sliding on said supporting-plate and having an offset to engage the shoulder of the slidable plate, and means for intermittently moving the rack-bar whereby said pawl may be brought into action at different predetermined periods; substantially as specified.

40. The combination with the plate supported from the frame of the machine and the plate mounted to slide thereon and having a shoulder, of a rack-bar sliding on said plate and having an offset to engage the shoulder of the sliding plate, means for feeding said rack-bar step by step, and connections controlled by the rack-bar for rendering needles operative and non-operative; substantially as specified.

41. The combination with the plate supported from the frame of the machine and the plate mounted to slide thereon and having a shoulder, of a rack-bar sliding on said plate and having an offset to engage the shoulder of the sliding plate, means for feeding said rack-bar step by step, means for automatically returning it to its normal position, and connections controlled by the rack-bar for rendering needles operative and non-operative; substantially as specified.

42. The combination with the main shaft of a knitting-machine, of cylinder-reciprocating devices comprising a support, a driving-pulley and a pinion on said main shaft, a belt-pulley and pinion, a gear and rack-bar mounted on said support, and an automatically separable connection between said pulley and pinion; substantially as specified.

43. The combination with the main shaft of a knitting-machine, of cylinder-reciprocating devices comprising a pinion mounted on said shaft, means for operatively connecting and automatically disconnecting said pinion, a rack-bar meshing with said pinion, and means for reciprocating said rack-bar operative independently of the said main shaft; substantially as specified.

44. The combination with a knitting-machine and its cylinder-reciprocating devices and with the means for terminating their action, of a plate or pawl having arms of differing lengths connected and arranged to act at different periods during the reciprocation of the cylinder upon the said means for terminating its reciprocation; substantially as specified.

45. The combination with a knitting-ma-

chine, of a cylinder-reciprocating mechanism temporarily coupled to the main shaft of the machine, means for automatically uncoupling the same, a plate or pawl having arms of differing lengths, and means operatively connected with the main shaft for moving said plate or pawl into action, and uncoupling devices actuated by said plate or pawl; substantially as specified.

46. The combination with a cam-cylinder having openings, of a support mounted on and to move with the cam-cylinder, picking-cams mounted on the support with movements into and out of the openings in the cam-cylinder, a pair of plates mounted on, conforming to the curvature of the cam-cylinder, located between it and the support and movable toward and from each other in a path across the cams, and means for moving the plates; substantially as specified.

47. In a knitting-machine having picking-cam-operating mechanism and a device for intermittently controlling said mechanism, the combination with said device, of a rack-bar, means for moving said bar step by step in one direction, and means for moving said bar continuously to its starting-point in an opposite direction; substantially as specified.

48. In a knitting-machine having picking-cam-operating mechanism and a device for intermittently controlling said mechanism, the combination with said device, of a rack-bar, means for moving said bar intermittently in one direction, a weight for moving said bar to its starting-point, and an adjustably-supported rod carrying said weight and located in the path of said rack-bar; substantially as specified.

49. In a knitting-machine having picking-cam-operating mechanism and a device for intermittently controlling said mechanism, the combination with said device, of a rack-bar, a pawl for moving said bar in one direction, a weight for moving said rack-bar in the opposite direction, a rod in line with said rack-bar and having a lever, and a plate in the path of said weight for lifting said pawl; substantially as specified.

50. In a knitting-machine having picking-cam-operating mechanism and a device for intermittently controlling said mechanism, the combination with said device, of a rack-bar, a pawl for moving said bar in one direction, a weight for moving said rack-bar in the opposite direction, a rod in line with said rack-bar and having a lever, a plate in the path of said weight for lifting said pawl, and a detent beneath said pawl and in the path of said plate; substantially as specified.

51. In a knitting-machine having picking-cams and devices for intermittently throwing them into and out of operation comprising a cam-plate, the combination of a rod and a rack-bar arranged parallel with each other, and means for conveying motion from the rack-bar to the rod and from the rod to the cam-plate; substantially as specified.

52. In a knitting-machine having picking-cams and devices for intermittently throwing them into and out of operation comprising a cam-plate, the combination of a rod and a rack-bar arranged parallel with each other, and means for conveying motion from the rack-bar to the rod at different points in the travel of the rack-bar; substantially as specified.
53. In a knitting-machine having picking-cams and devices for intermittently throwing them into and out of operation comprising a cam-plate, the combination of a rod and a rack-bar arranged parallel with each other, means for conveying motion from the rack-bar to the rod at different points in the travel of the rack-bar, and means carried by the rod to actuate the cam-plate in one direction; substantially as specified.
54. In a knitting-machine having picking-cams and devices for intermittently throwing them into and out of operation comprising a cam-plate, the combination of a rod and a rack-bar arranged parallel with each other, and means for conveying motion from the rack-bar to the rod automatically at different points in the travel of the rack-bar; substantially as specified.
55. In a knitting-machine having picking-cams and devices for intermittently throwing them into and out of operation comprising a cam-plate, the combination of a rod and a rack-bar arranged parallel with each other, and means for conveying motion from the rack-bar to the rod consisting of a movable plate carrying a multiple-armed pawl either arm of which may be used; substantially as specified.
56. In a knitting-machine having picking-cams and devices for intermittently throwing them into and out of operation comprising a cam-plate, the combination of a rod and a rack-bar arranged parallel with each other, means for conveying motion from the rack-bar to the rod consisting of a movable plate carrying a multiple-armed pawl, either arm of which may be used, and means for automatically and successively bringing said arms into use; substantially as specified.
57. In a knitting-machine having picking-cams and devices comprising overlapping plates for intermittently throwing them in pairs into and out of operation comprising a cam-plate, the combination of a rod and a rack-bar arranged parallel with each other, means for conveying motion from the rack-bar to the rod consisting of a movable plate carrying a multiple-armed pawl having pins, means for automatically and successively bringing said arms into use consisting of a spring-seated latch; substantially as specified.
58. In a knitting-machine and in combination with the needle and cam cylinders thereof, means for reciprocating the cam-cylinder, and means for determining the number of

such reciprocations comprising an adjustable pawl-and-rack mechanism operated by the main shaft of the machine; substantially as specified.

59. In a knitting-machine and in combination with the needle and cam cylinders and picking-cams thereof, means for selecting and throwing out of operation said picking-cams means for reciprocating the cam-cylinder, and an adjustable pawl-and-rack mechanism for determining the number of such reciprocations and the stoppage of the operation of the picking-cams; substantially as specified.

60. In a knitting-machine and in combination with the needle and cam cylinders and picking-cams thereof, a pinion-and-rack mechanism driven from an independent shaft to cause reciprocation of the cam-cylinder, and an adjustable pawl-and-rack mechanism driven from the main shaft and for determining the number of such reciprocations; substantially as specified.

61. In a knitting-machine and in combination with the needle and cam cylinders and main shaft and fast pulley thereof, of an independent power-applying shaft and cam-cylinder-reciprocating mechanism detachably coupled with said main shaft and a step-by-step moving mechanism operated from said main shaft and constructed, arranged and adapted to disconnect said reciprocating mechanism operatively from the main shaft; substantially as specified.

62. In a knitting-machine and in combination with the needle and cam cylinders, picking-cams, main shaft and fast pulley thereof, of an independent power-applying shaft and cam-cylinder-reciprocating mechanism detachably coupled with said main shaft and a step-by-step moving mechanism operated from said main shaft and constructed, connected, arranged and adapted to disconnect said reciprocating mechanism operatively from the main shaft and to render inoperative the said picking-cams; substantially as specified.

63. In a knitting-machine having picking-cams and devices for intermittently throwing them into and out of operation comprising a cam-plate and means for reciprocating the cam-cylinder comprising a coupling-pin and its operating-lever, the combination with said cam-plate and lever, of a pivoted spring-pressed latch-plate for automatically disconnecting the cylinder-reciprocating mechanism; substantially as specified.

64. In a knitting-machine and in combination with its fast driving-pulley, a tappet pivotally mounted in a recess in one end of the hub of said pulley at one side of the center thereof, and a cushioning-spring fixed on said pulley in the path of the free end of the tappet; substantially as specified.

65. In a knitting-machine and in combination with its fast driving-pulley, a tappet pivotally mounted in a recess in the end of the

hub of said pulley at one side of the center thereof, in combination with a rack-bar, pawl and pawl-arm, the latter projecting into the path of the tappet, whereby motion is conveyed from the fixed pulley to a rack-bar during the reciprocation of the cylinder; substantially as specified.

In testimony whereof I affix my signature in presence of two witnesses.

EMIL A. HIRNER.

Witnesses:

WM. H. JACOBS,
EMILIE E. SPAHN.