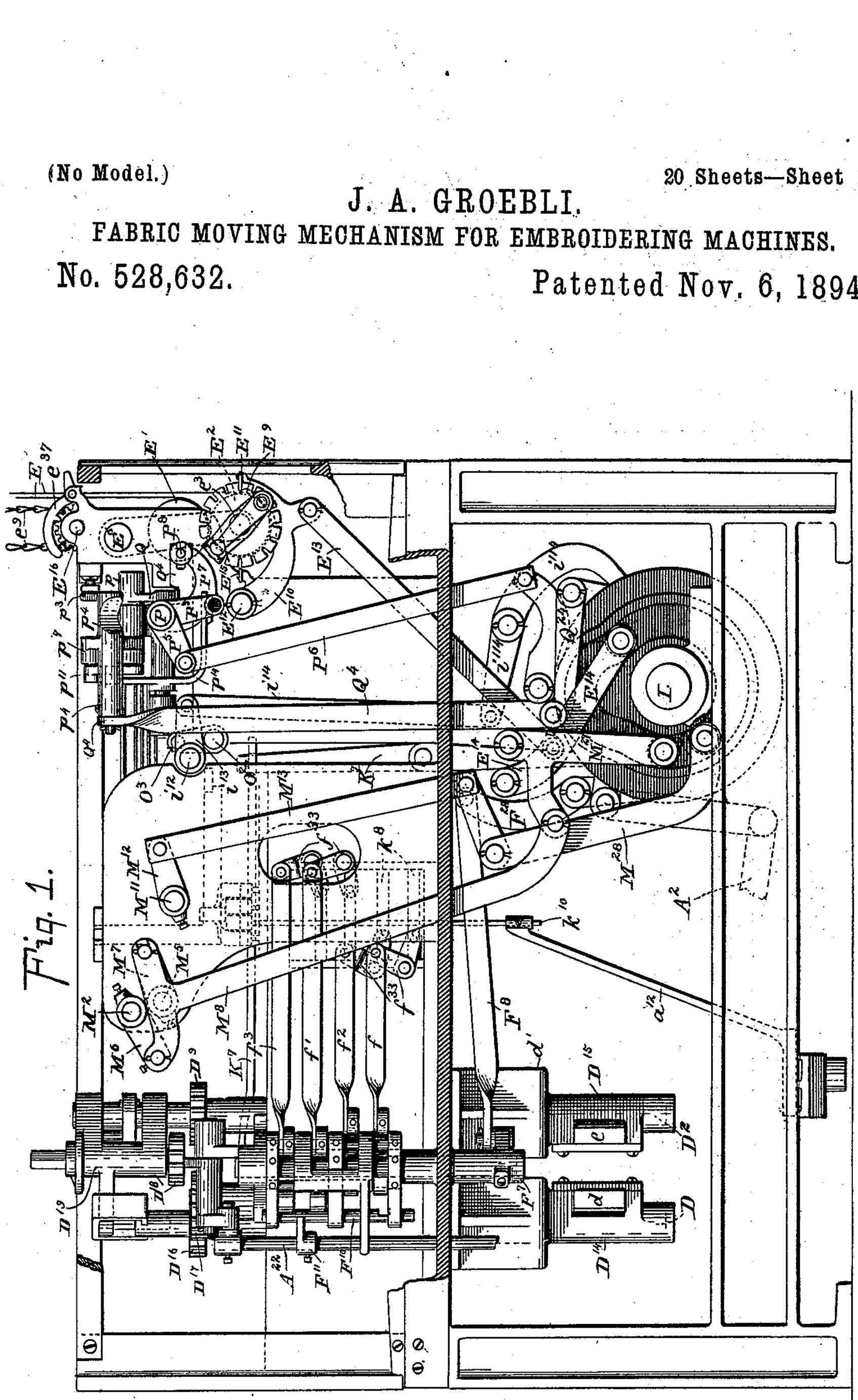
(No Model.) 20 Sheets—Sheet 1.

J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

Fig. 1.



WITNESSES:

Ph. B. Stephens.
L. F. H. Wachsschlager.

INVENTOR

Joseph A. Groebli,
BY Briesen & Knauth

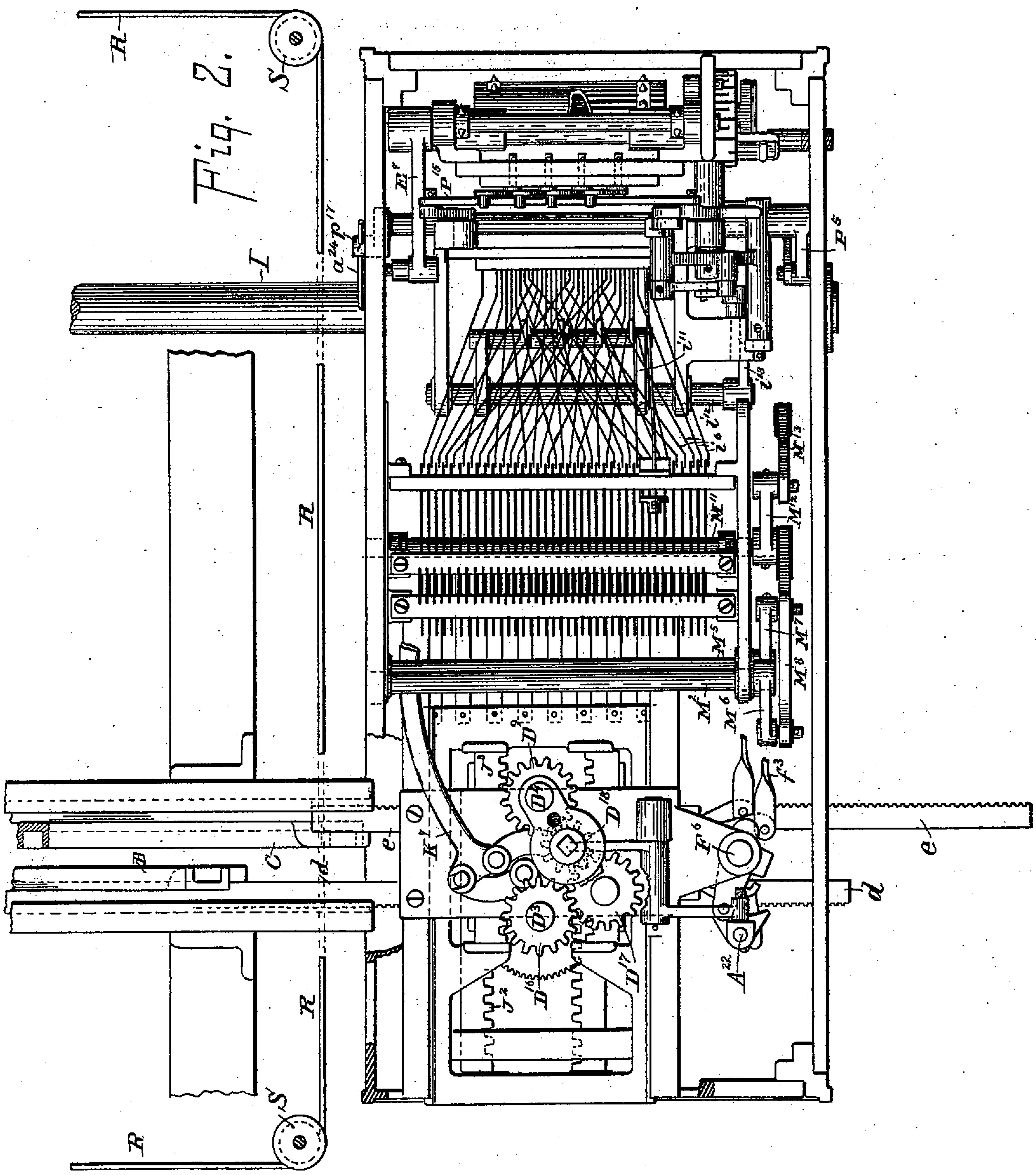
ATTORNEYS.

(No Model.) 20 Sheets—Sheet 2.

J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.



WITNESSES:

R. B. Shepherd.
L. M. Wachschlager.

INVENTOR

Joseph A. Groebli,
BY Briesen & Knauth
ATTORNEYS.

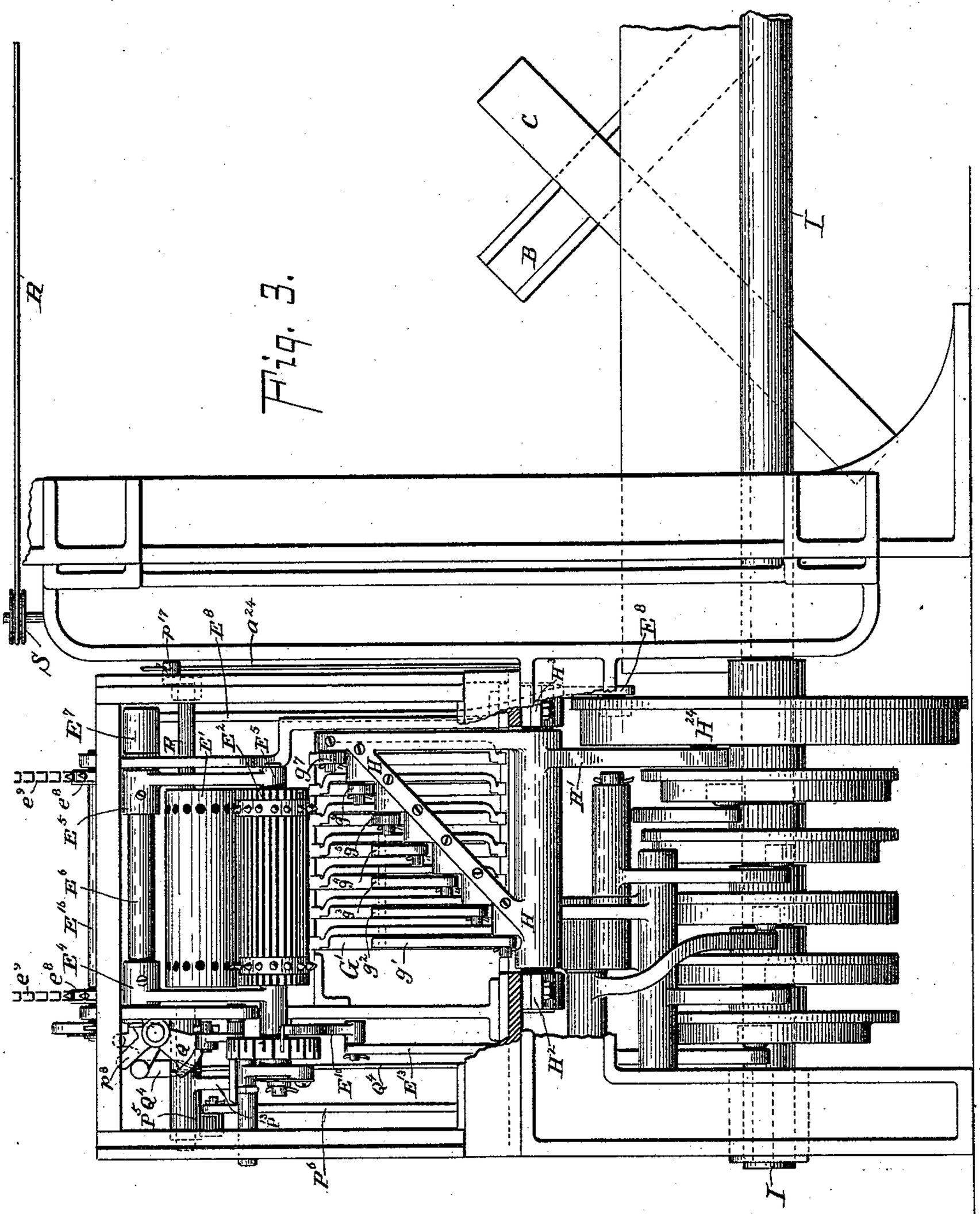
(No Model.) 20 Sheets—Sheet 3.

J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

Fig. 3.



WITNESSES:

R. B. Shepherd.

L. M. Hackschlager.

INVENTOR

Joseph A. Groebli,

BY Briesen & Knauth

ATTORNEYS.

(No Model.) 20 Sheets—Sheet 4.

J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

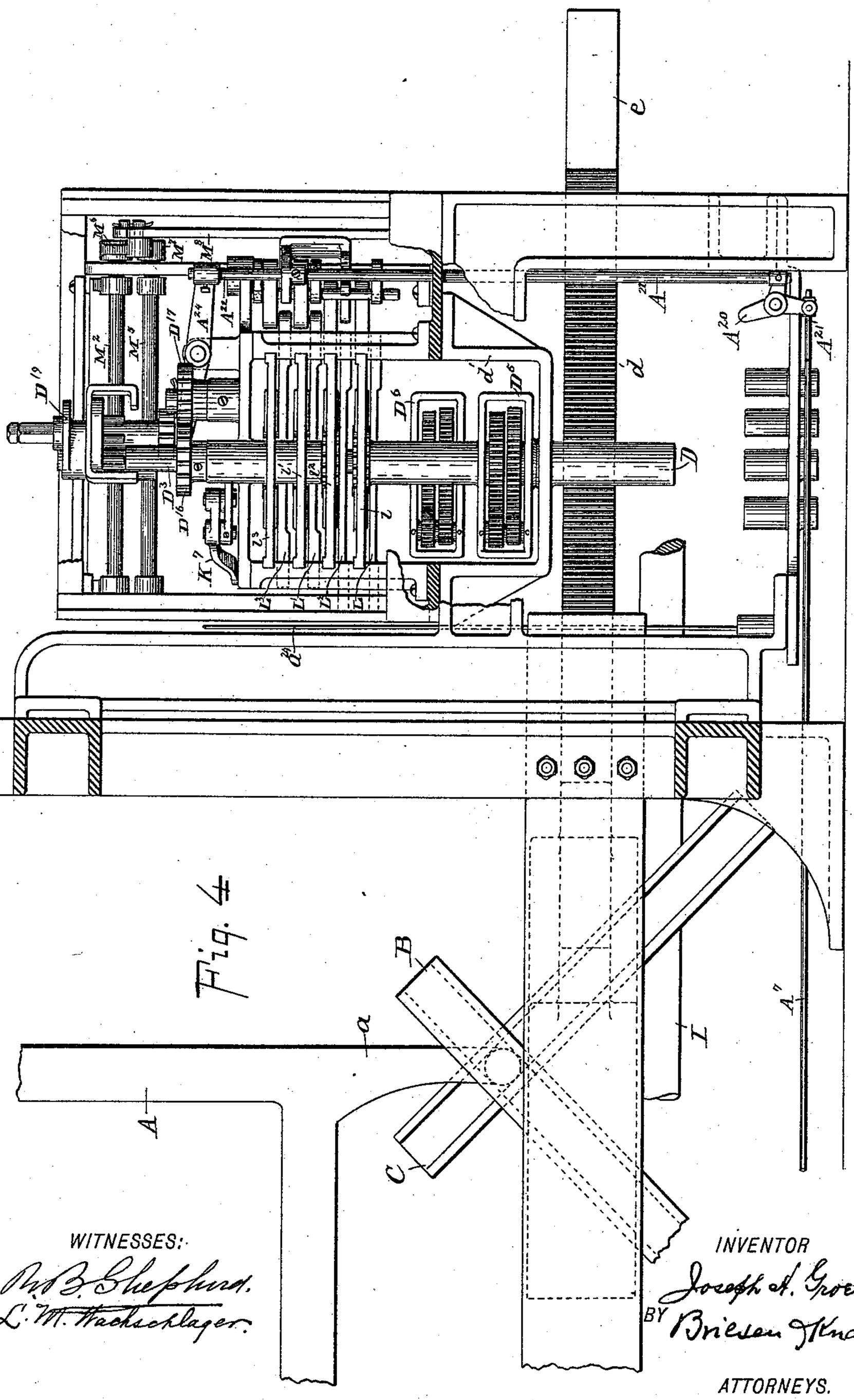


Fig. 4.

WITNESSES:
Robt B. Shepherd.
L. M. Hachschlager.

INVENTOR
Joseph A. Groebli,
BY Briesen & Knauth
ATTORNEYS.

(No Model.) 20 Sheets—Sheet 5.

J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

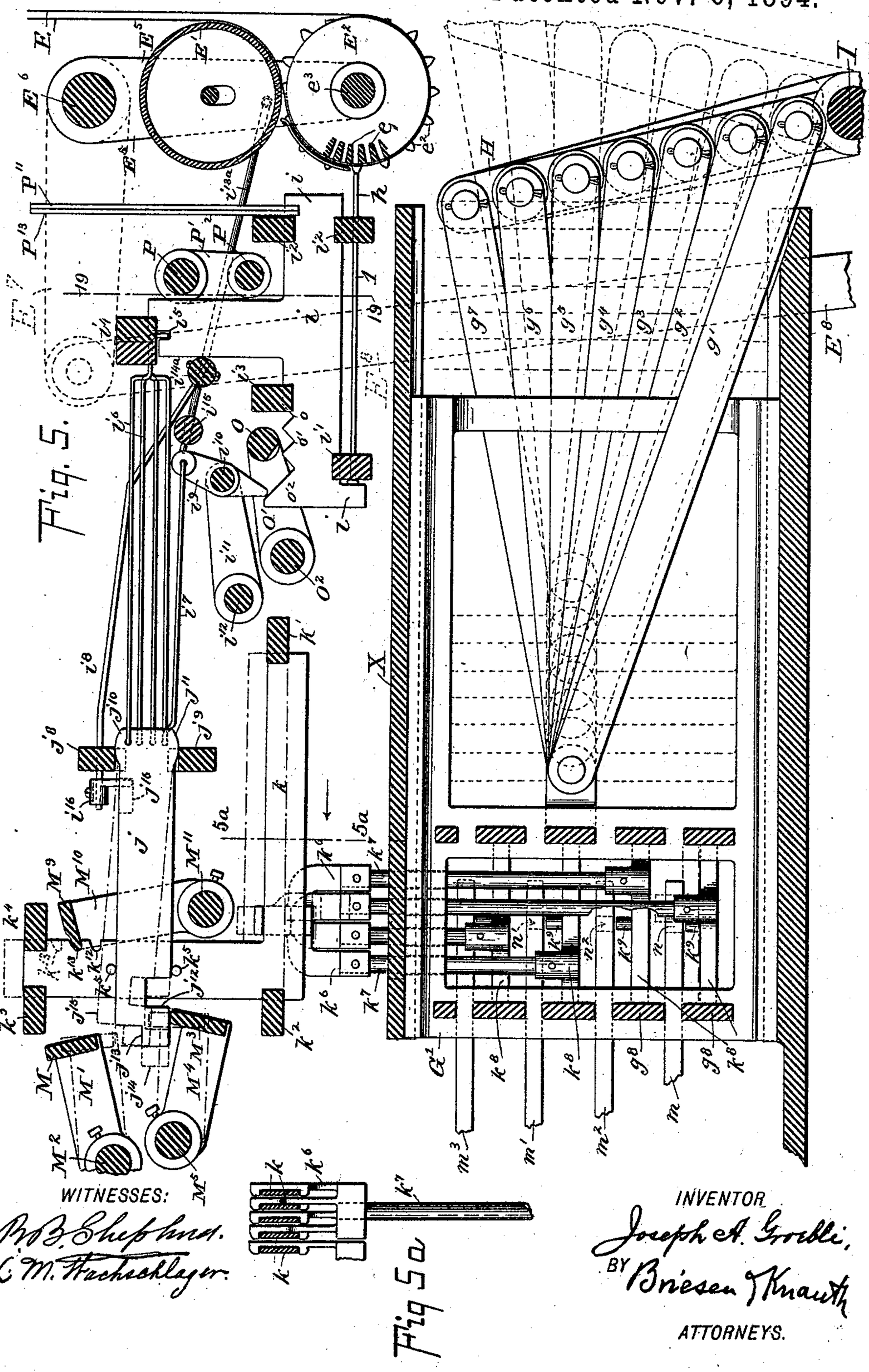


Fig. 5.

Fig. 5a.

WITNESSES:

R. B. Stephens.

L. M. Fischeklager.

INVENTOR

Joseph A. Groebli,

BY Briesen & Knauth

ATTORNEYS.

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J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

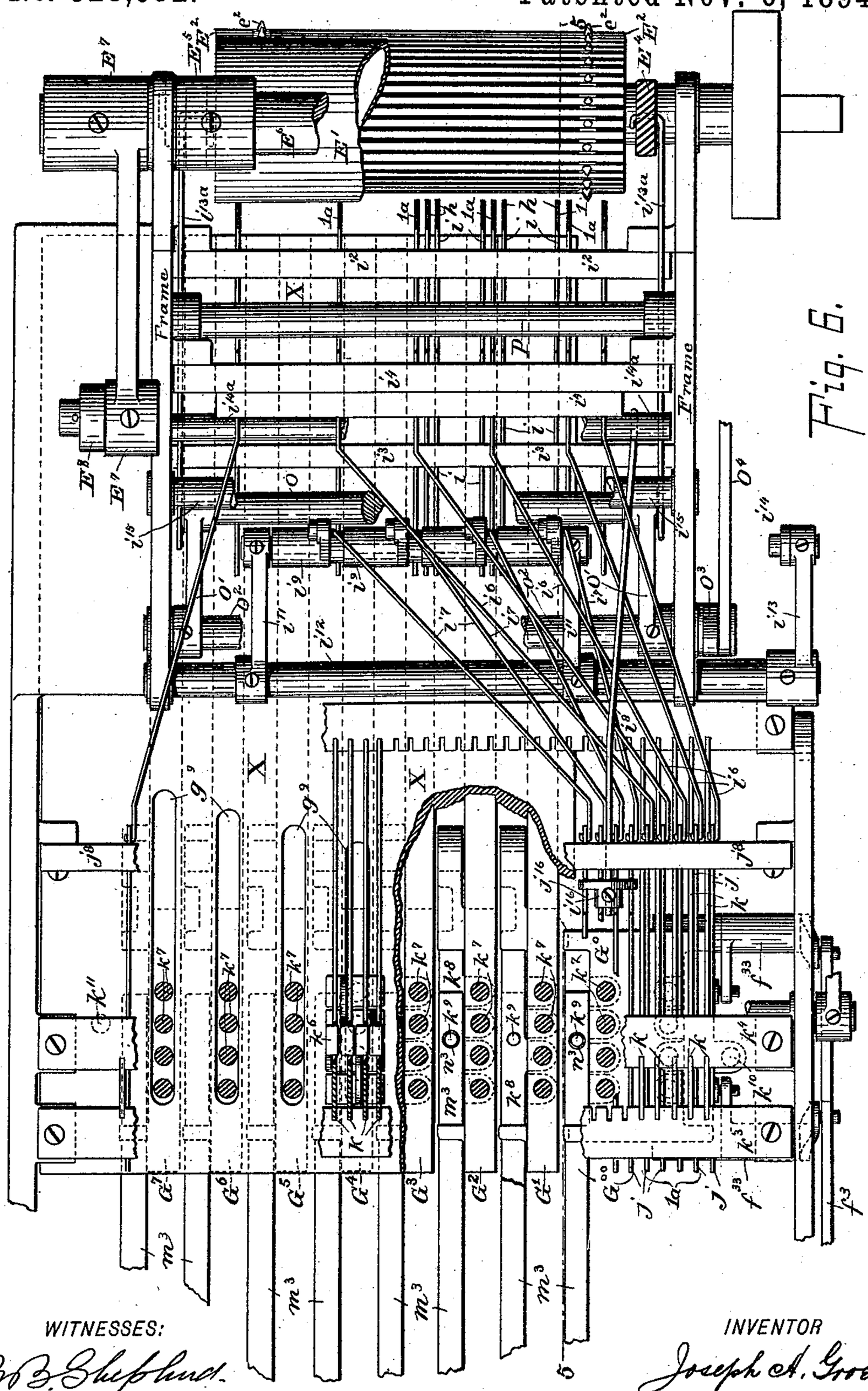


FIG. 6.

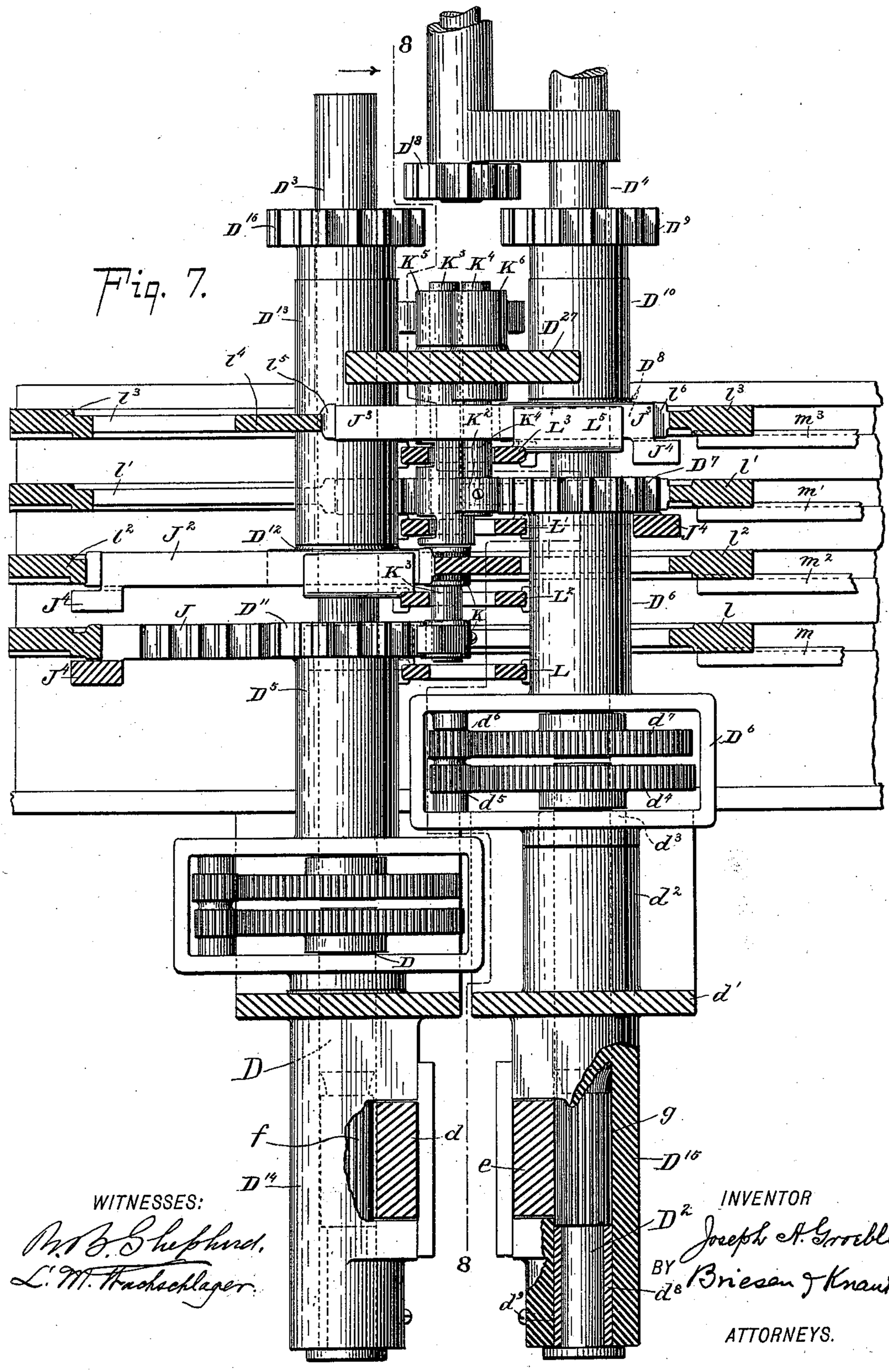
(No Model.) 20 Sheets—Sheet 7.

J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

Fig. 7.



WITNESSES:

W. B. Shepherd.

L. M. Trachsclager.

INVENTOR

Joseph A. Groebli,

BY Briesen & Knauth

ATTORNEYS.

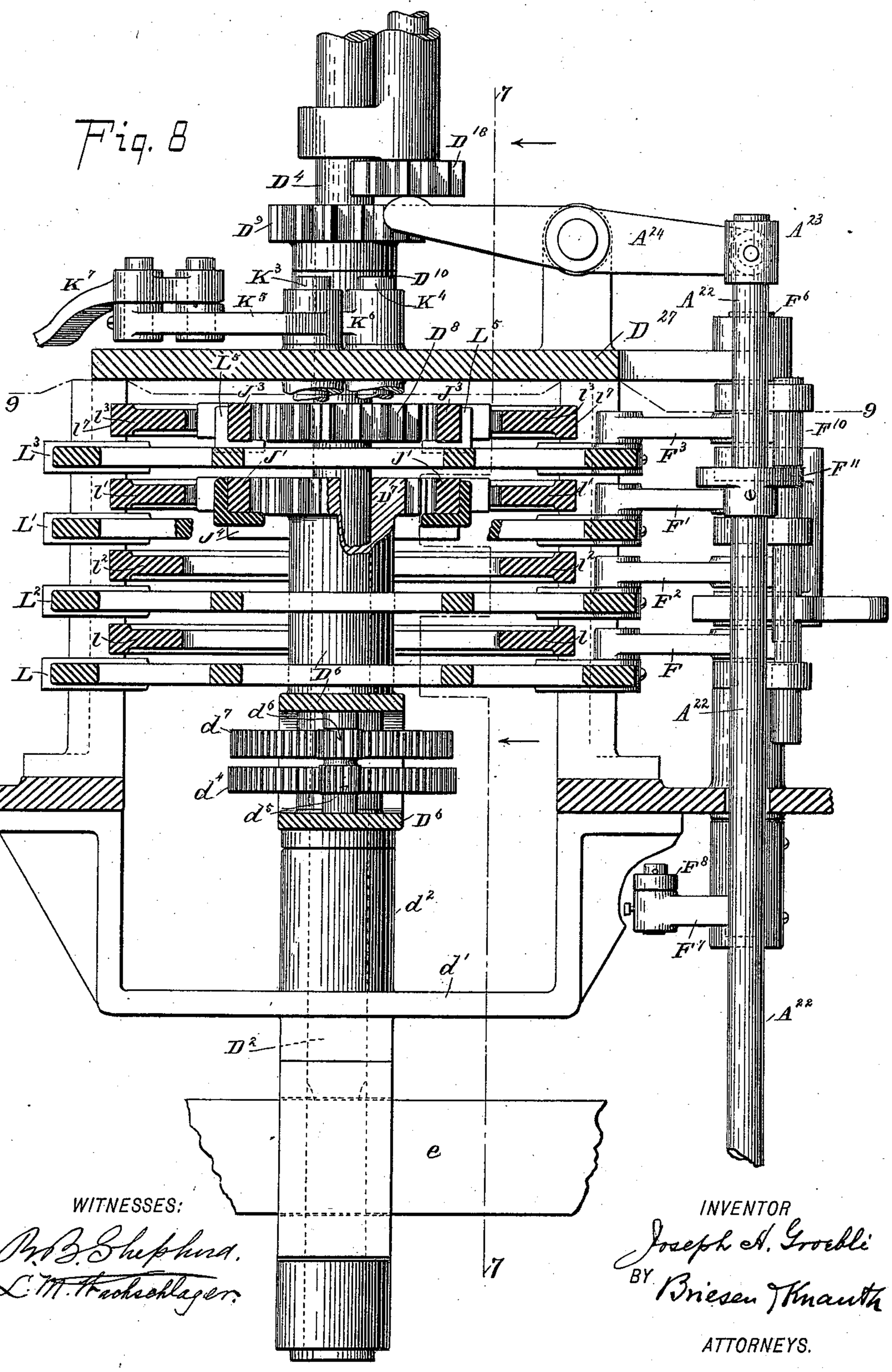
(No Model.) 20 Sheets—Sheet 8.

J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

Fig. 8



WITNESSES:

Robt. B. Shepherd.

L. M. Hochschlager.

INVENTOR

Joseph A. Groebli

BY Briesen & Knauth

ATTORNEYS.

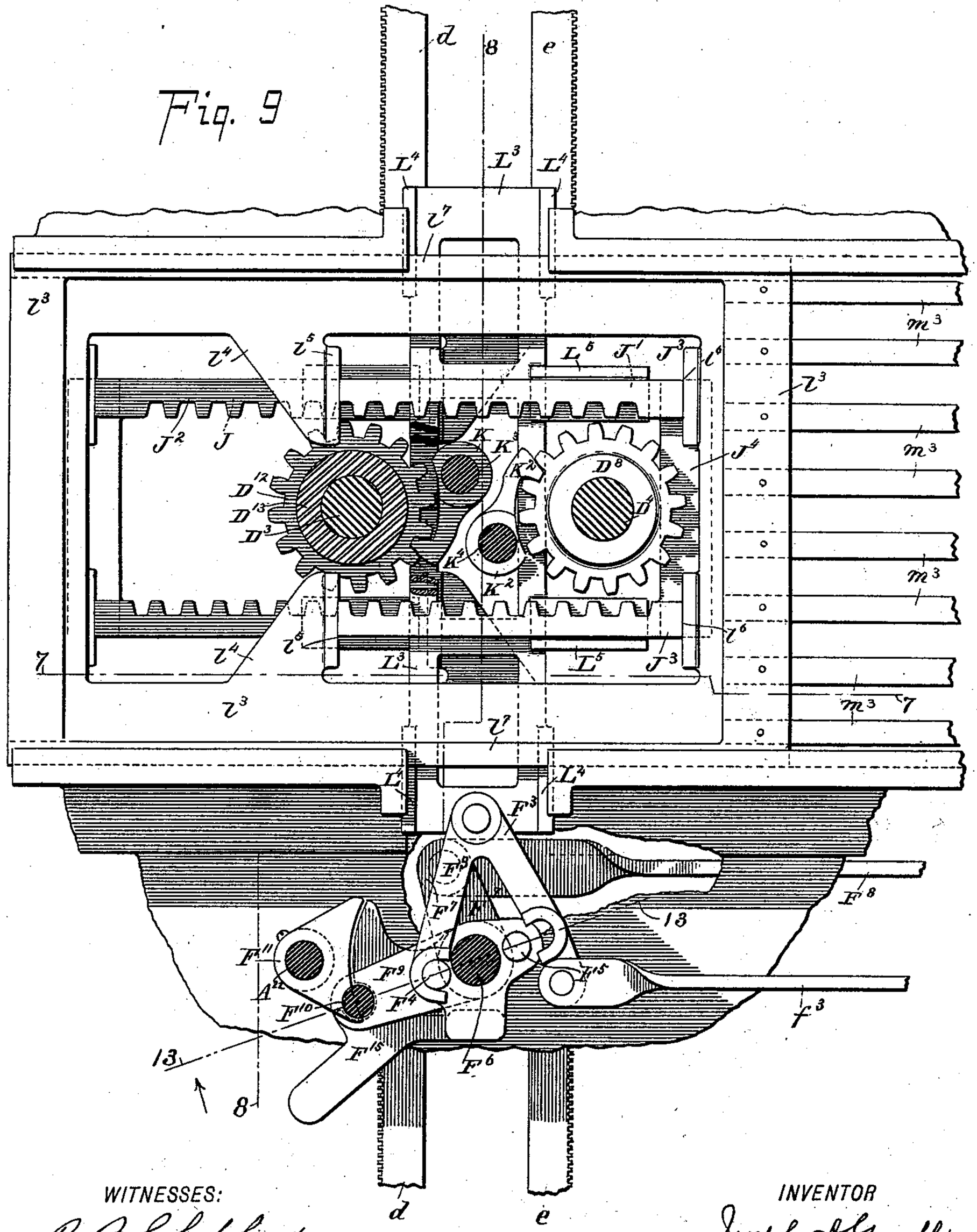
(No Model.) 20 Sheets—Sheet 9.

J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

Fig. 9



WITNESSES:

R. B. Shepherd.

L. M. Hachschlager.

INVENTOR

Joseph A. Groebli,

BY Briesen & Knauth

ATTORNEYS.

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J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

Fig. 12.

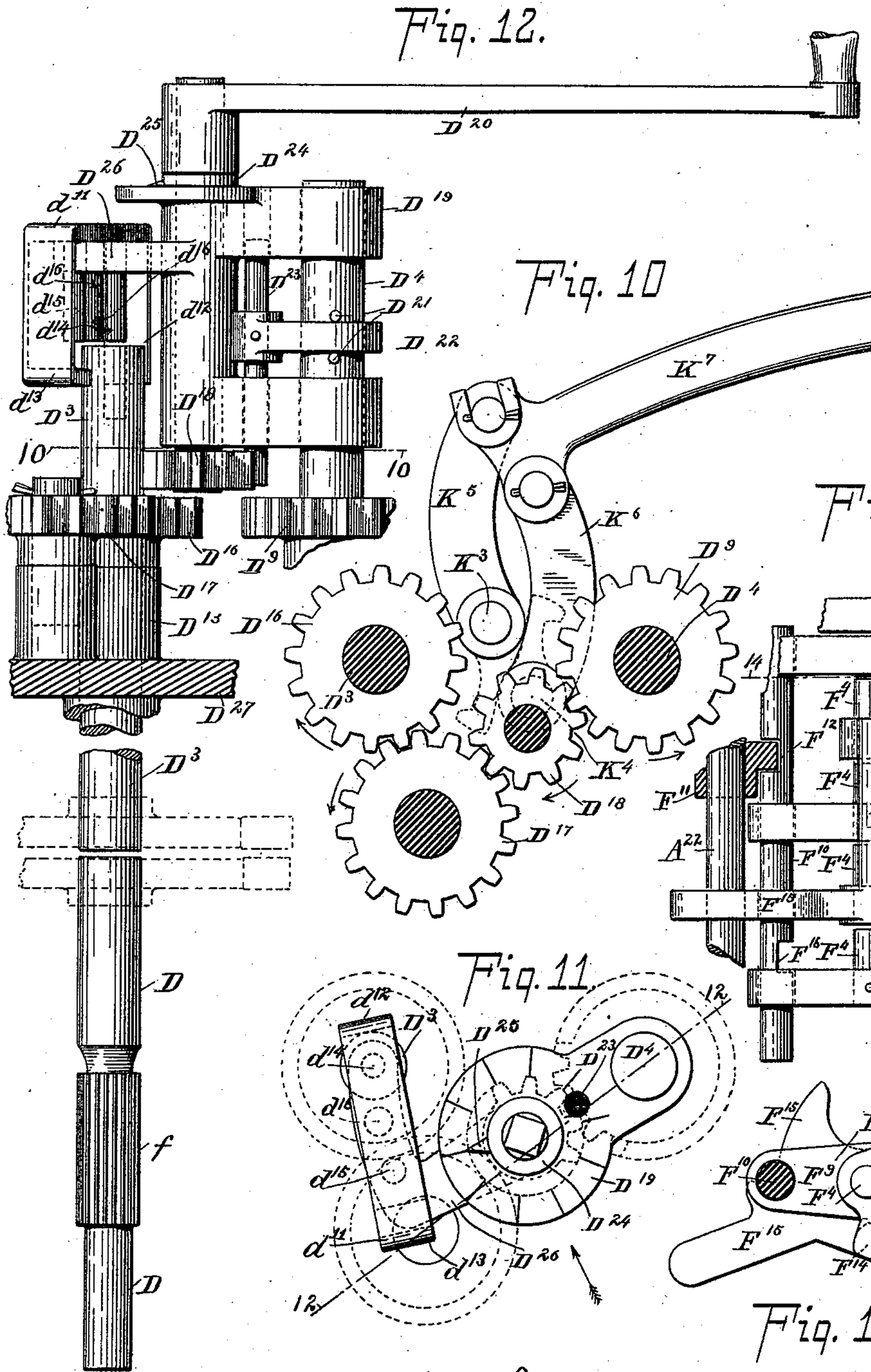


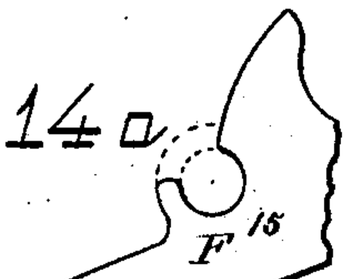
Fig. 10

Fig. 13.

Fig. 11

Fig. 14.

Fig. 14a.



WITNESSES:

A. B. Shepherd.

L. M. Trachsellager.

INVENTOR

Joseph A. Groebli,

BY Briesen & Knauth

ATTORNEYS.

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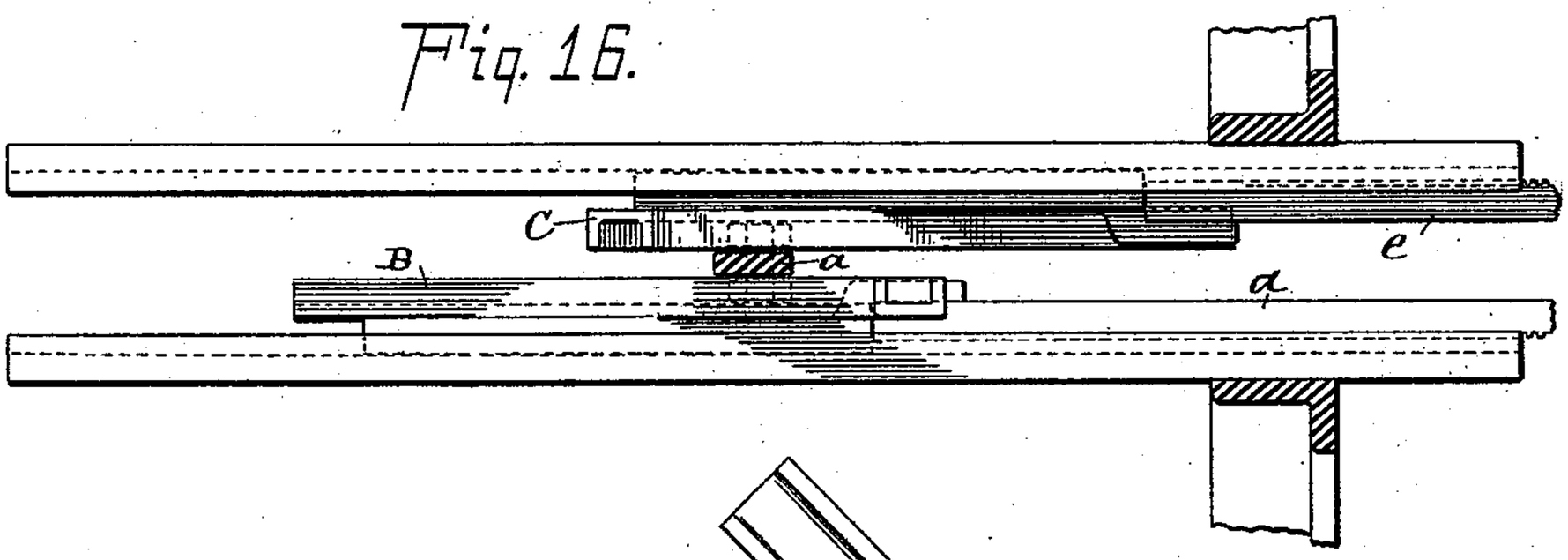
J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

Fig. 16.



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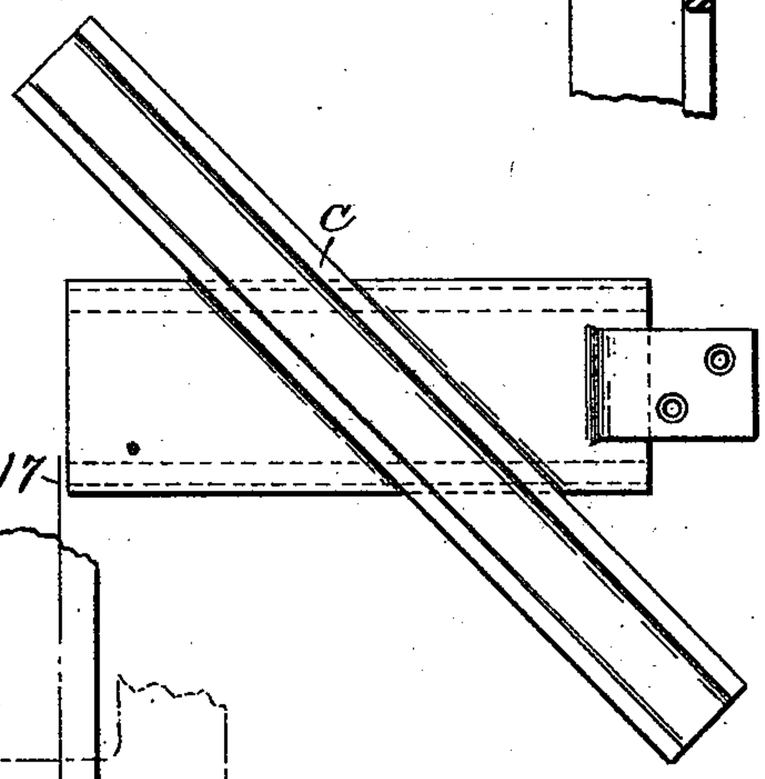

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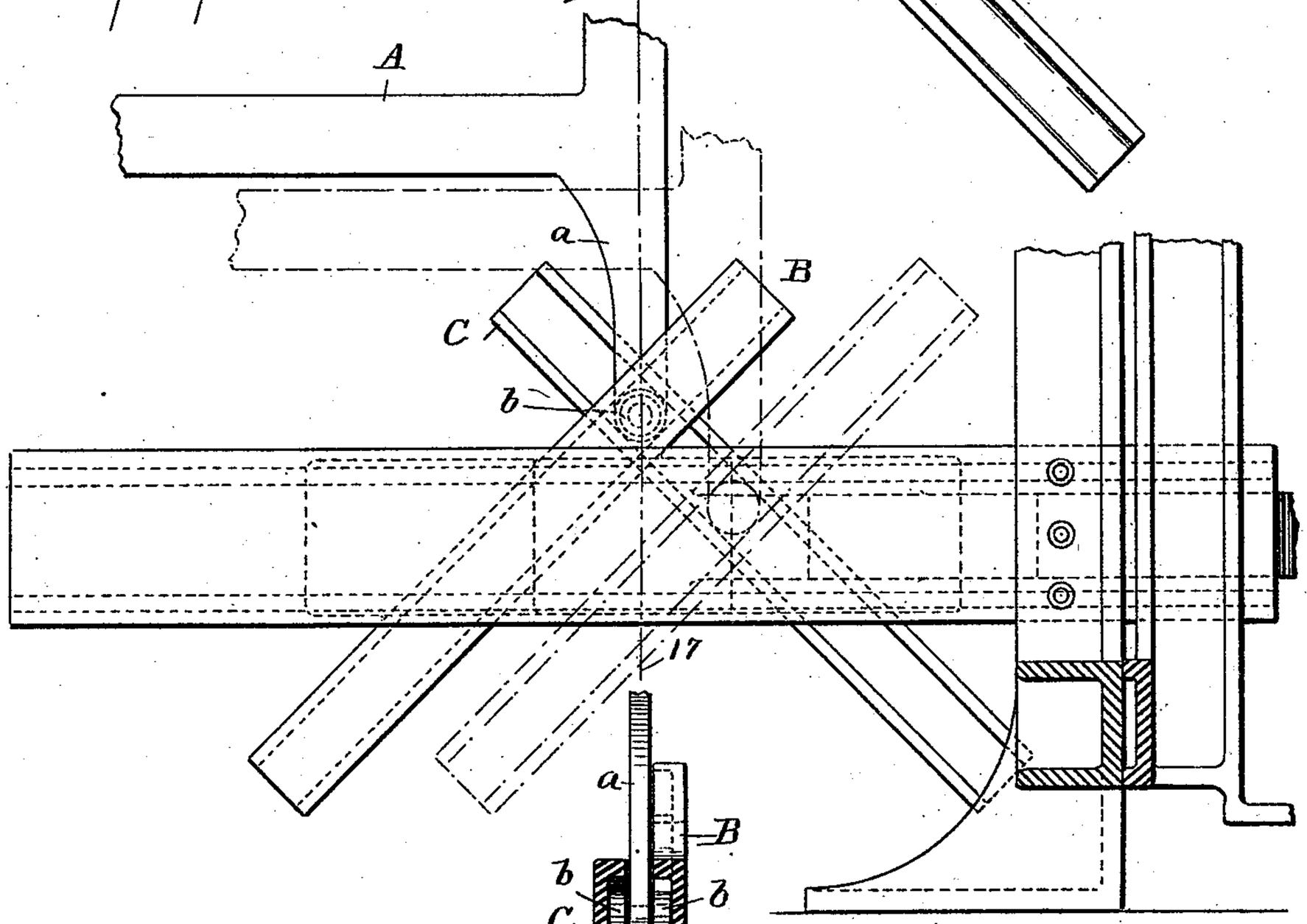
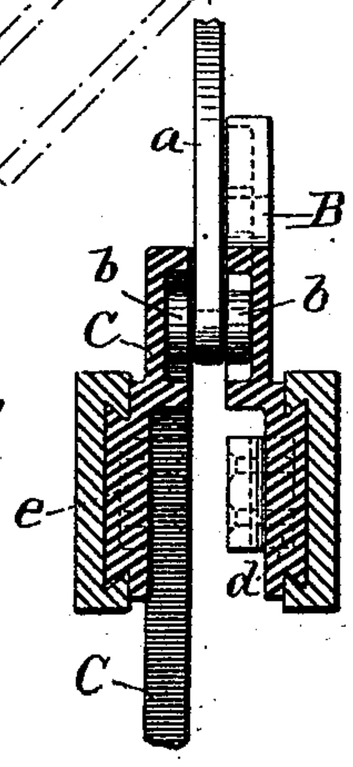


Fig. 17.



WITNESSES:

Ryb. Shepherd.

L. M. Hackethal.

INVENTOR

Joseph A. Groebli,

BY Briesen & Knauth

ATTORNEYS.

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J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

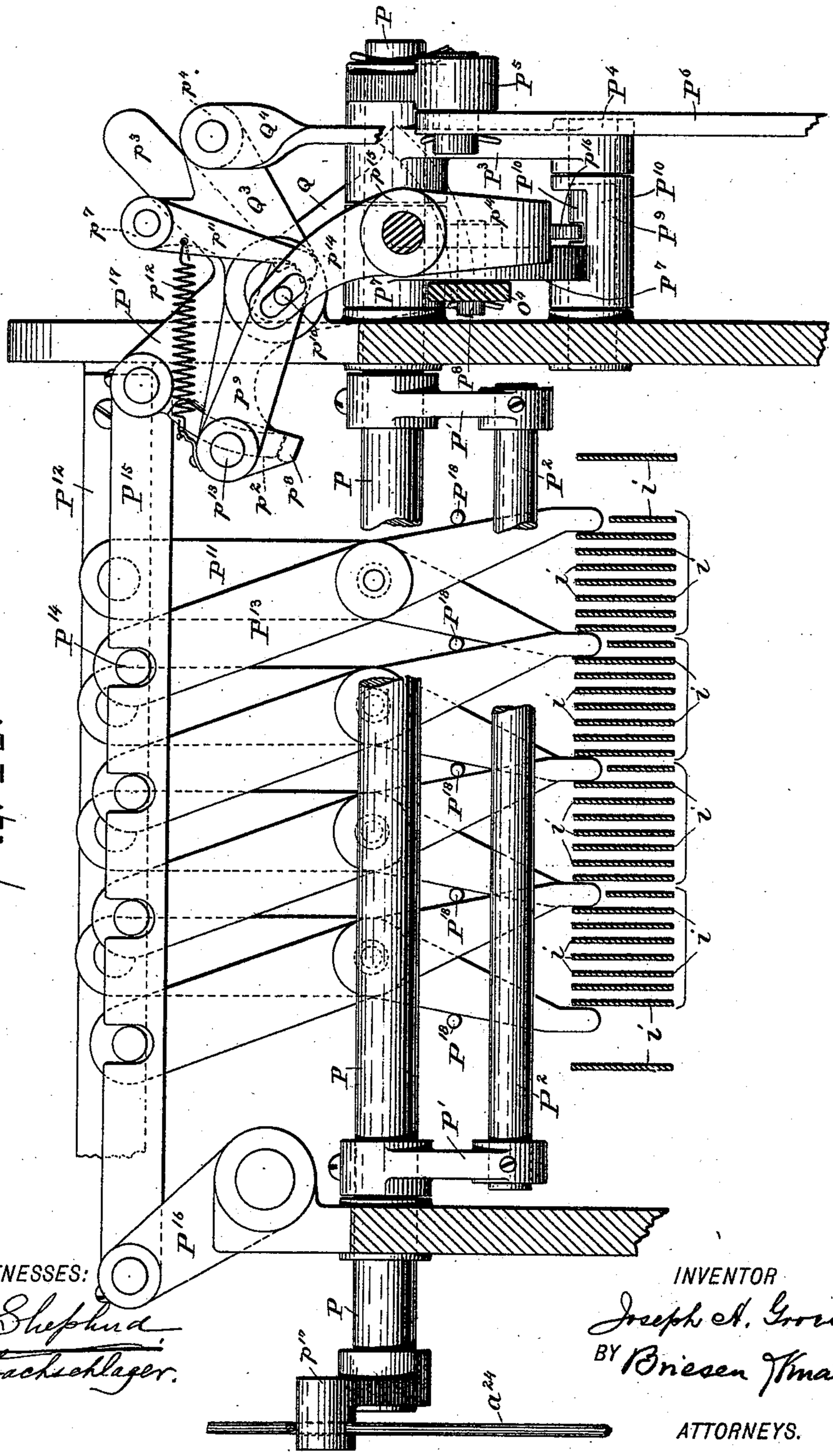


Fig. 19.

WITNESSES:

A. B. Shepherd

L. M. Hachschlager.

INVENTOR

Joseph A. Groebli,

BY Briesen & Knauth

ATTORNEYS.

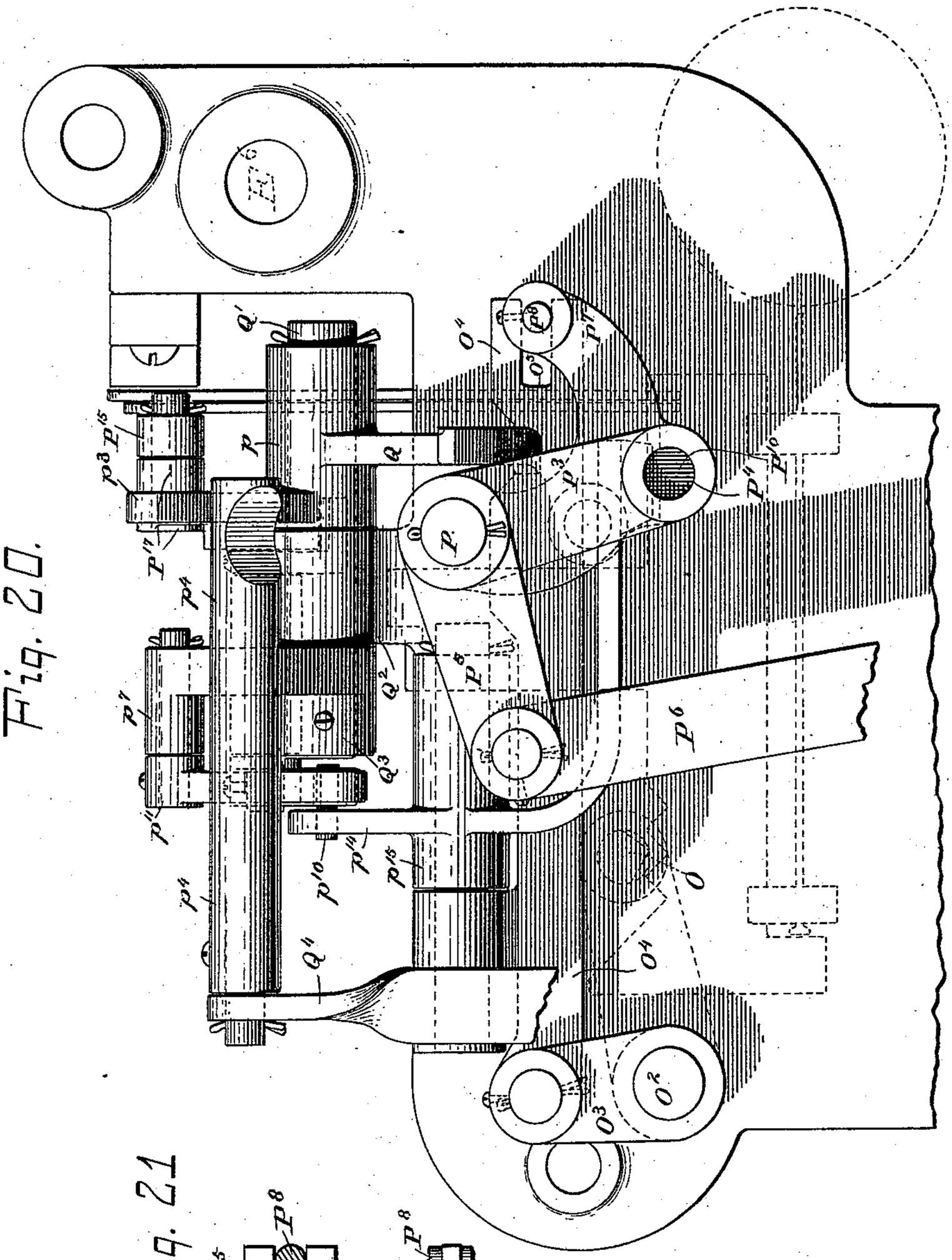
(No Model.) 20 Sheets—Sheet 13.

J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

Fig. 20.



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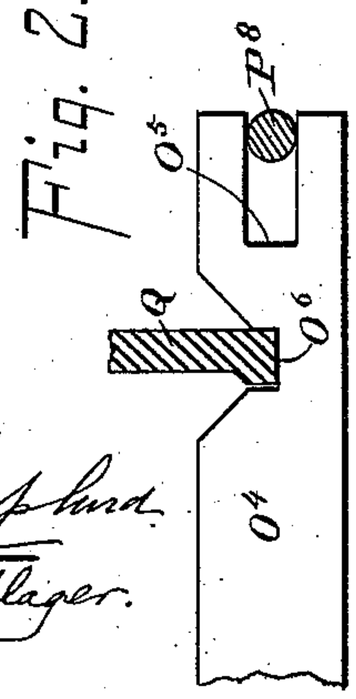

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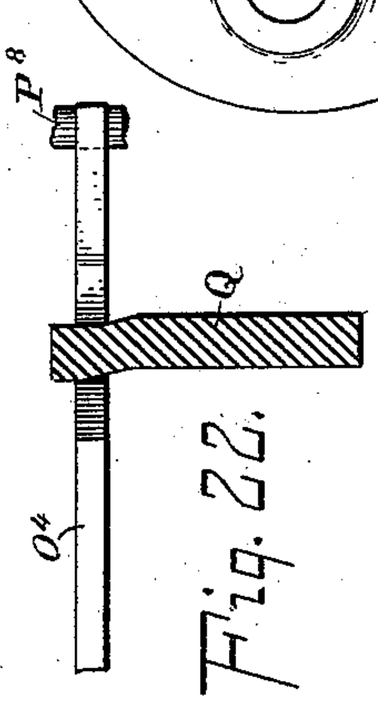

WITNESSES:
R. B. Shepherd
L. M. Fachschlager.

INVENTOR
Joseph A. Groebli,
BY Briesen & Knauth
ATTORNEYS.

(No Model.) 20 Sheets—Sheet 14.

J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

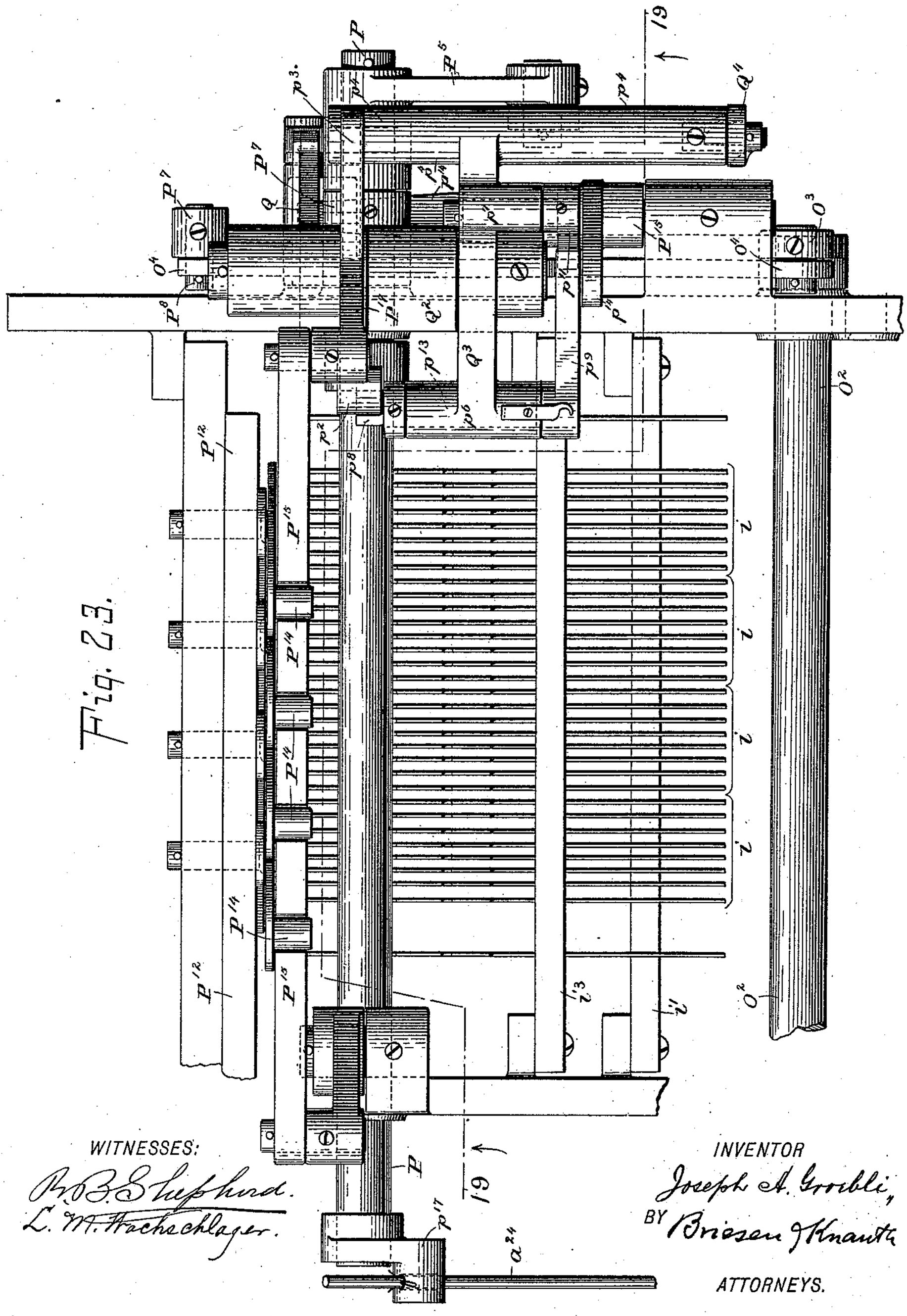

Fig. 23.

WITNESSES:

R. B. Stephens.

L. M. Fischschlager.

INVENTOR

Joseph A. Groebli,

BY Briesen & Knauth

ATTORNEYS.

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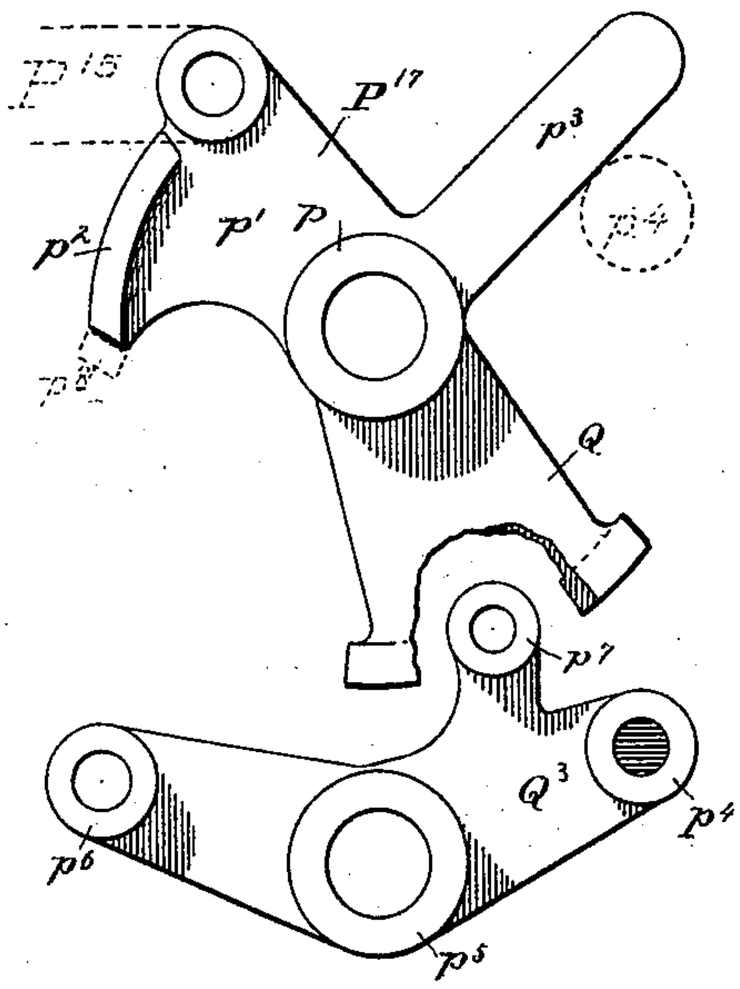
J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

Fig. 24.



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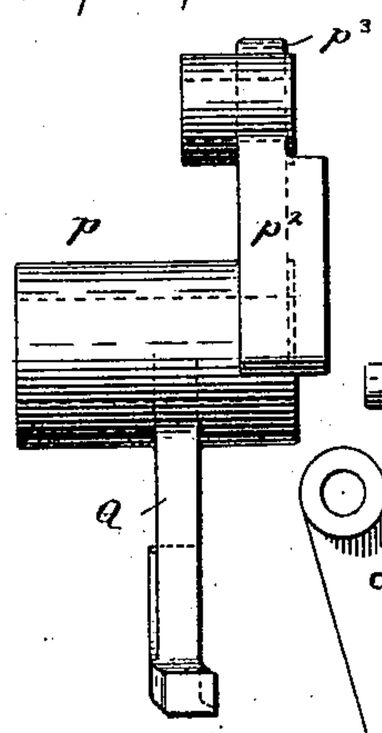

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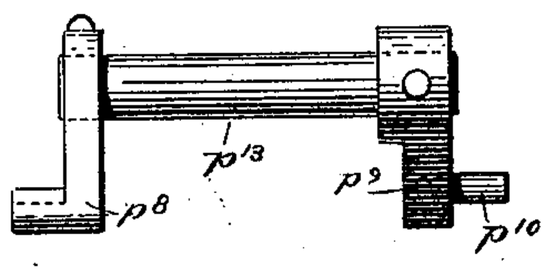

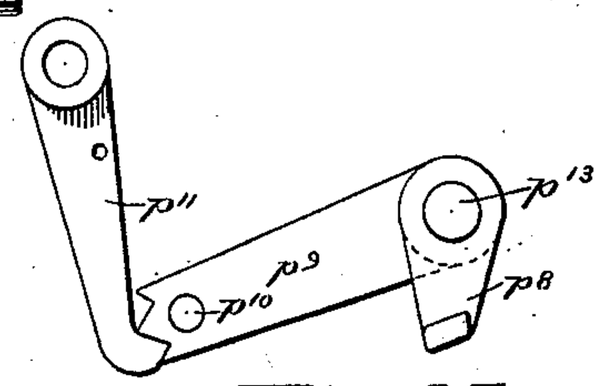

Fig. 27.

Fig. 28.

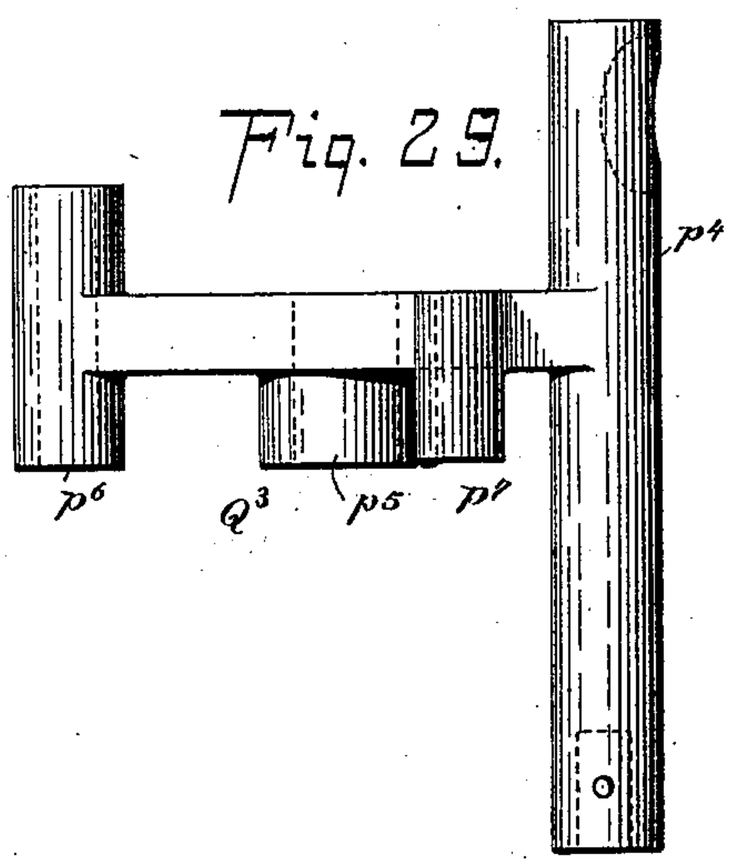

Fig. 29.

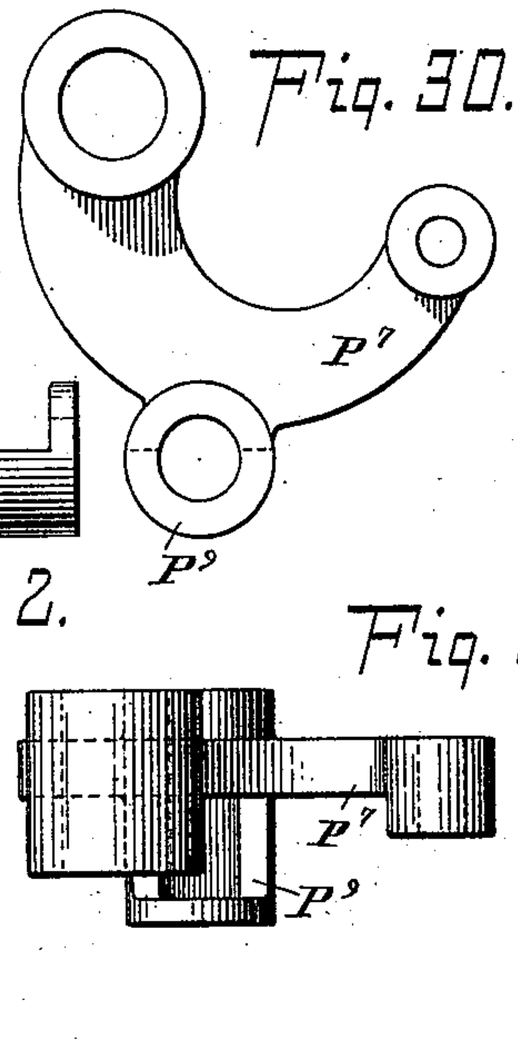

Fig. 30.

Fig. 32.

Fig. 31.

WITNESSES:

R. B. Shepherd.
L. M. Hackethaler.

INVENTOR

Joseph A. Groebli,
BY Briesen & Knauth
ATTORNEYS.

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J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

Fig. 33.

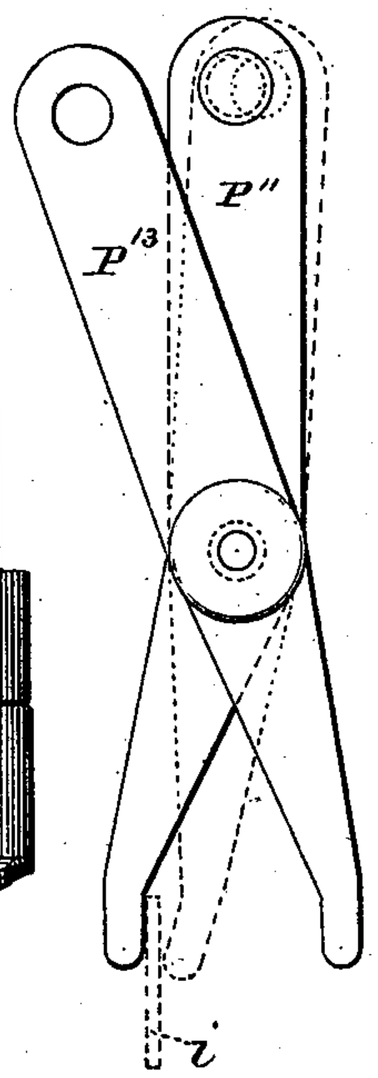


Fig. 34.

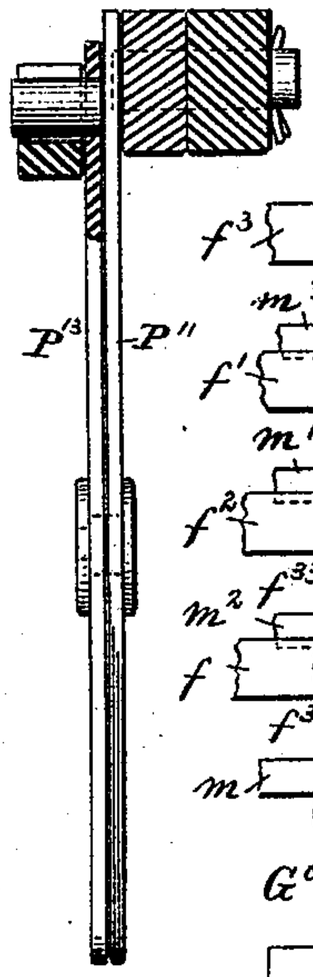


Fig. 46

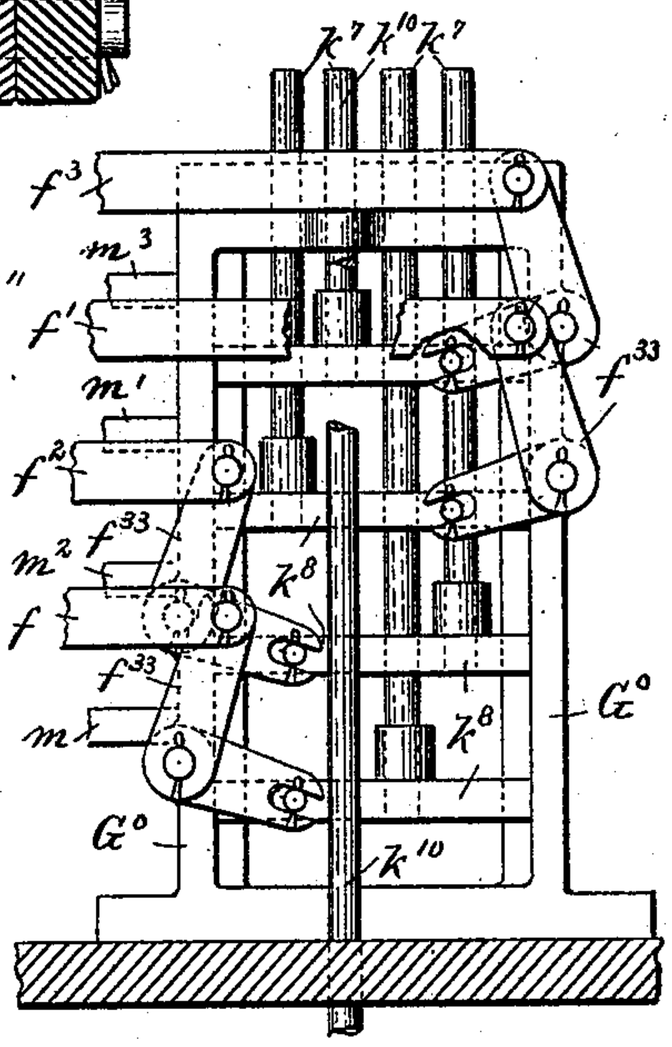


Fig. 47.

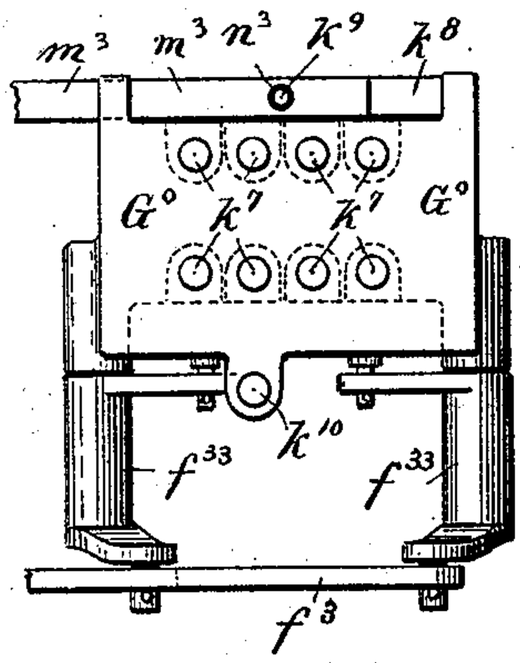


Fig. 45.

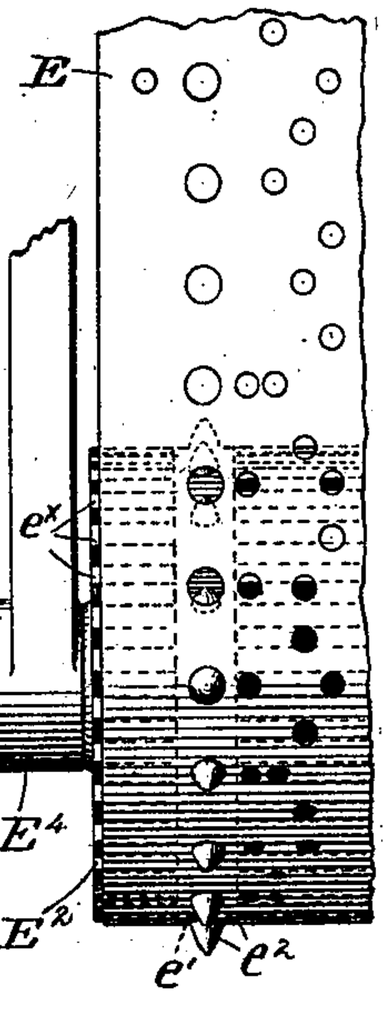
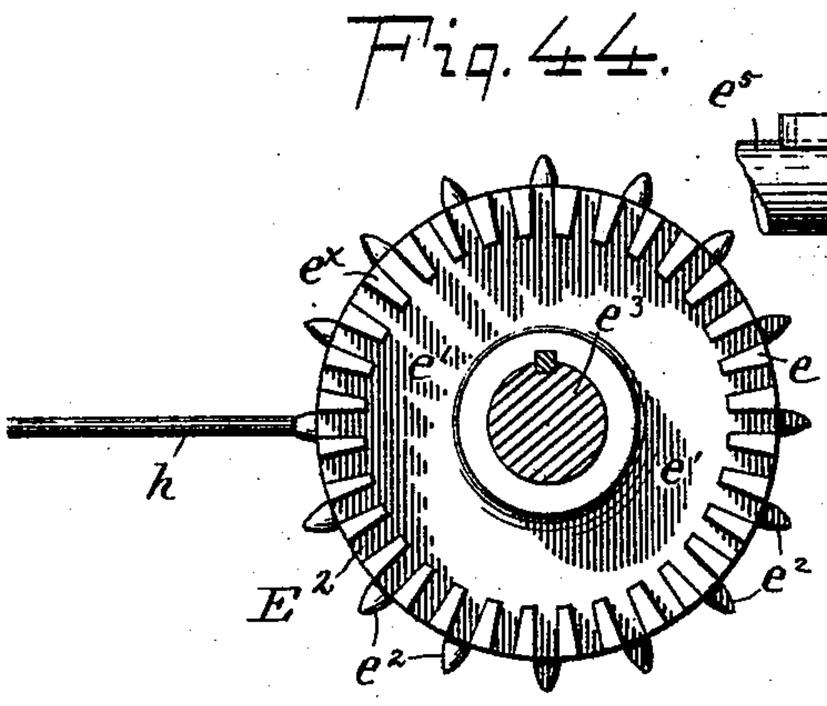


Fig. 44.



WITNESSES:

Chas. B. Shepherd.

L. M. Hochheimer.

INVENTOR

Joseph A. Groebli,

BY Briesen & Knauth

ATTORNEYS.

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J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

Fig. 35.

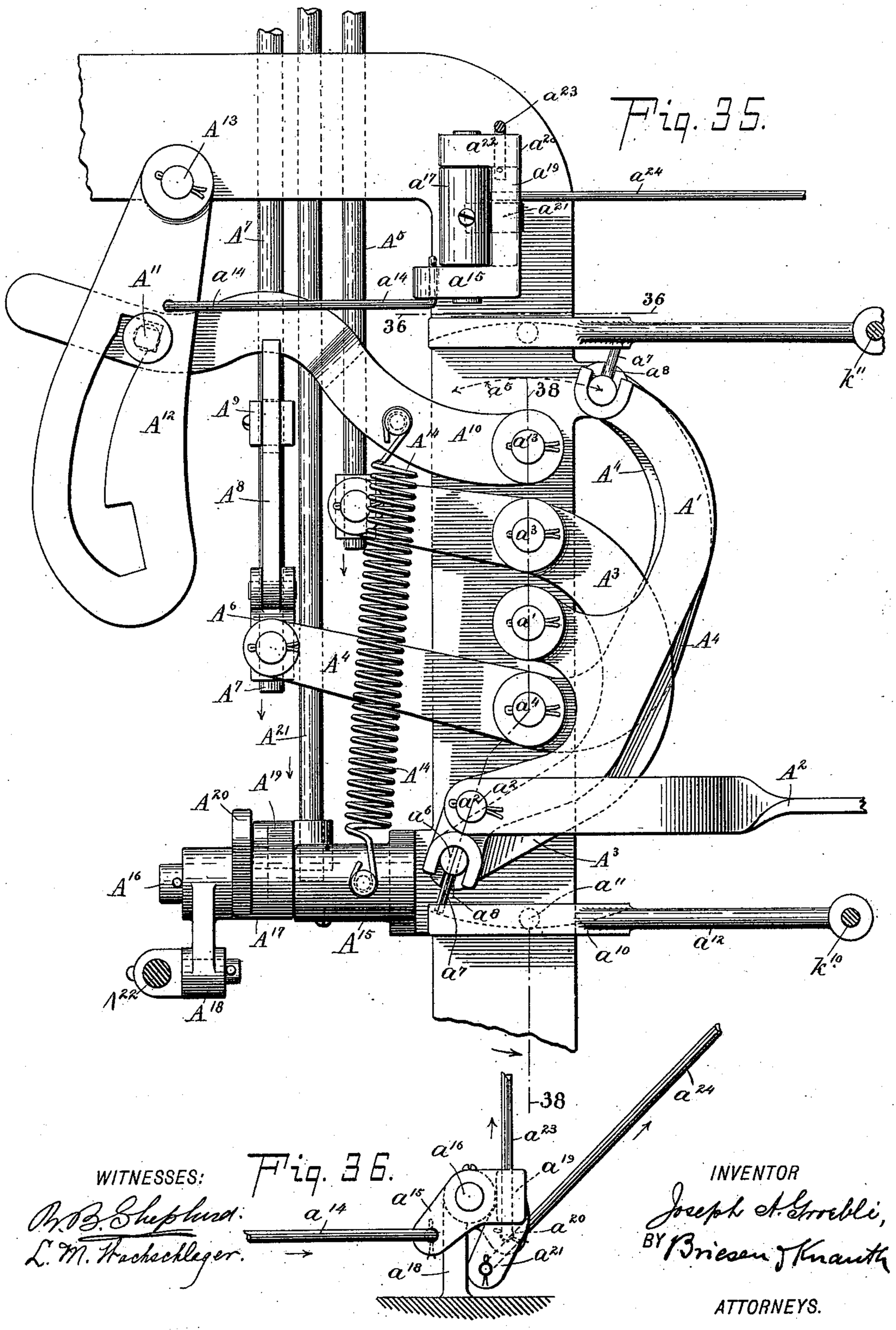


Fig. 36.

WITNESSES:
A. B. Shepherd.
L. M. Hachschleger.

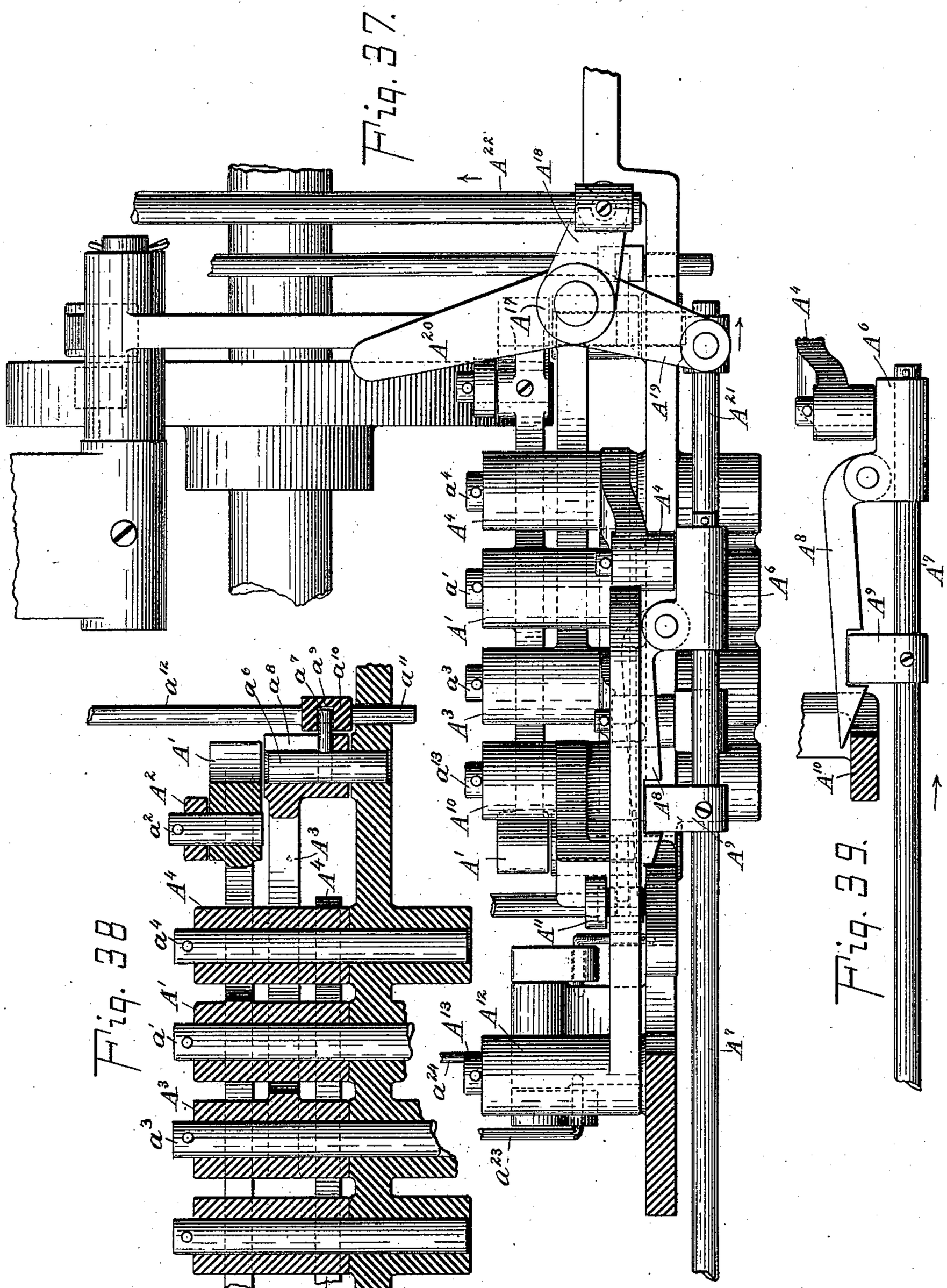
INVENTOR
Joseph A. Groebli,
BY Briesen & Knauth
ATTORNEYS.

(No Model.) 20 Sheets—Sheet 18.

J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.



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J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

Fig. 40.

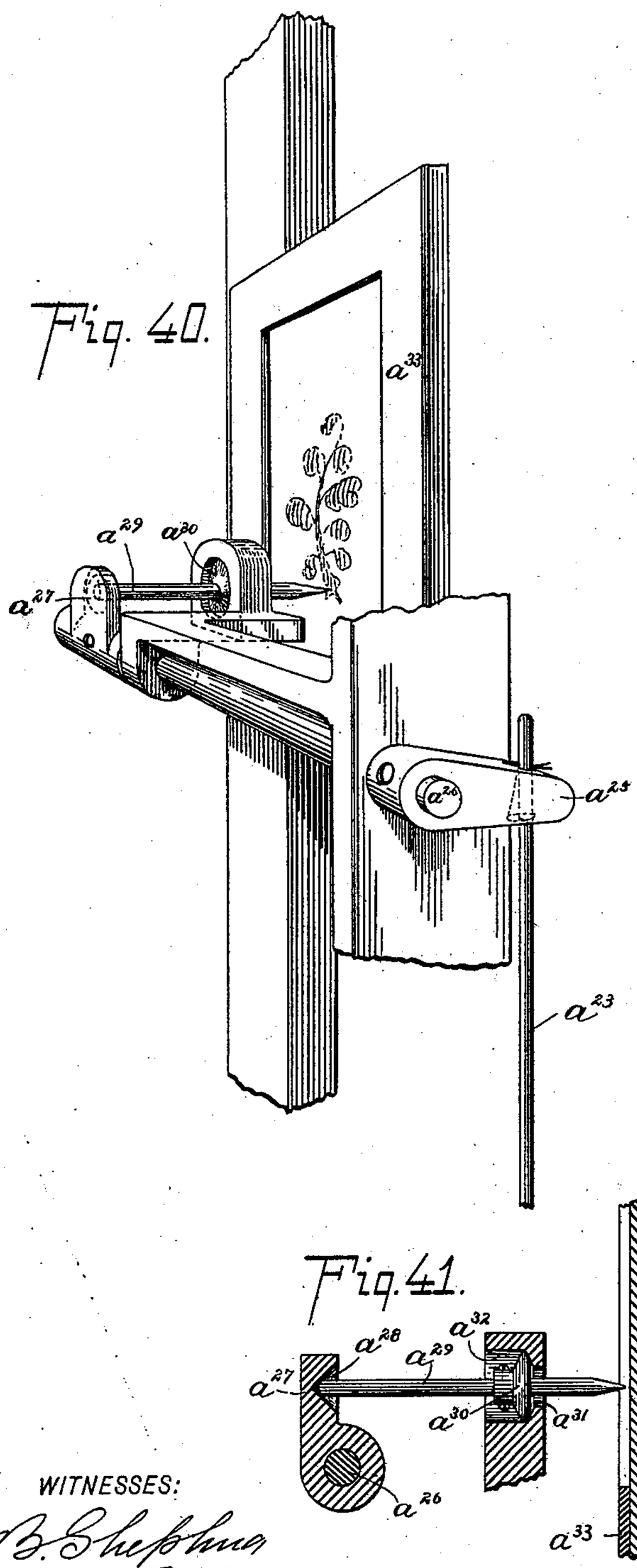
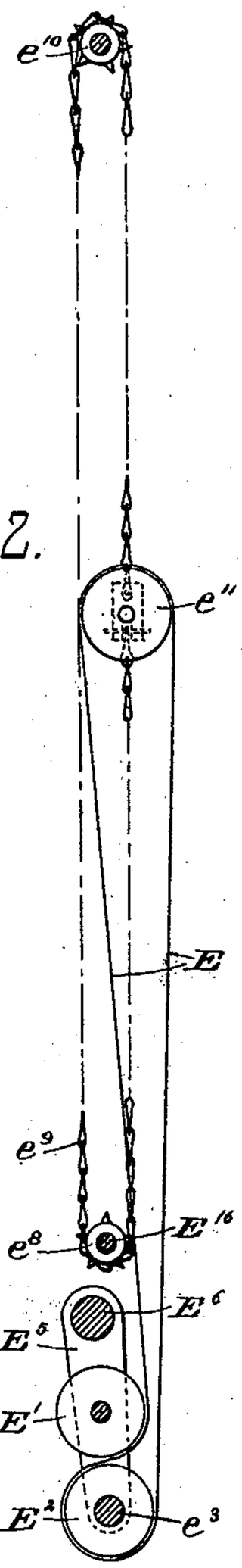


Fig. 41.

Fig. 42.



WITNESSES:

W. B. Shepherd

L. M. Fachschlager

INVENTOR

Joseph A. Groebli,

BY Briesen & Knauth

ATTORNEYS.

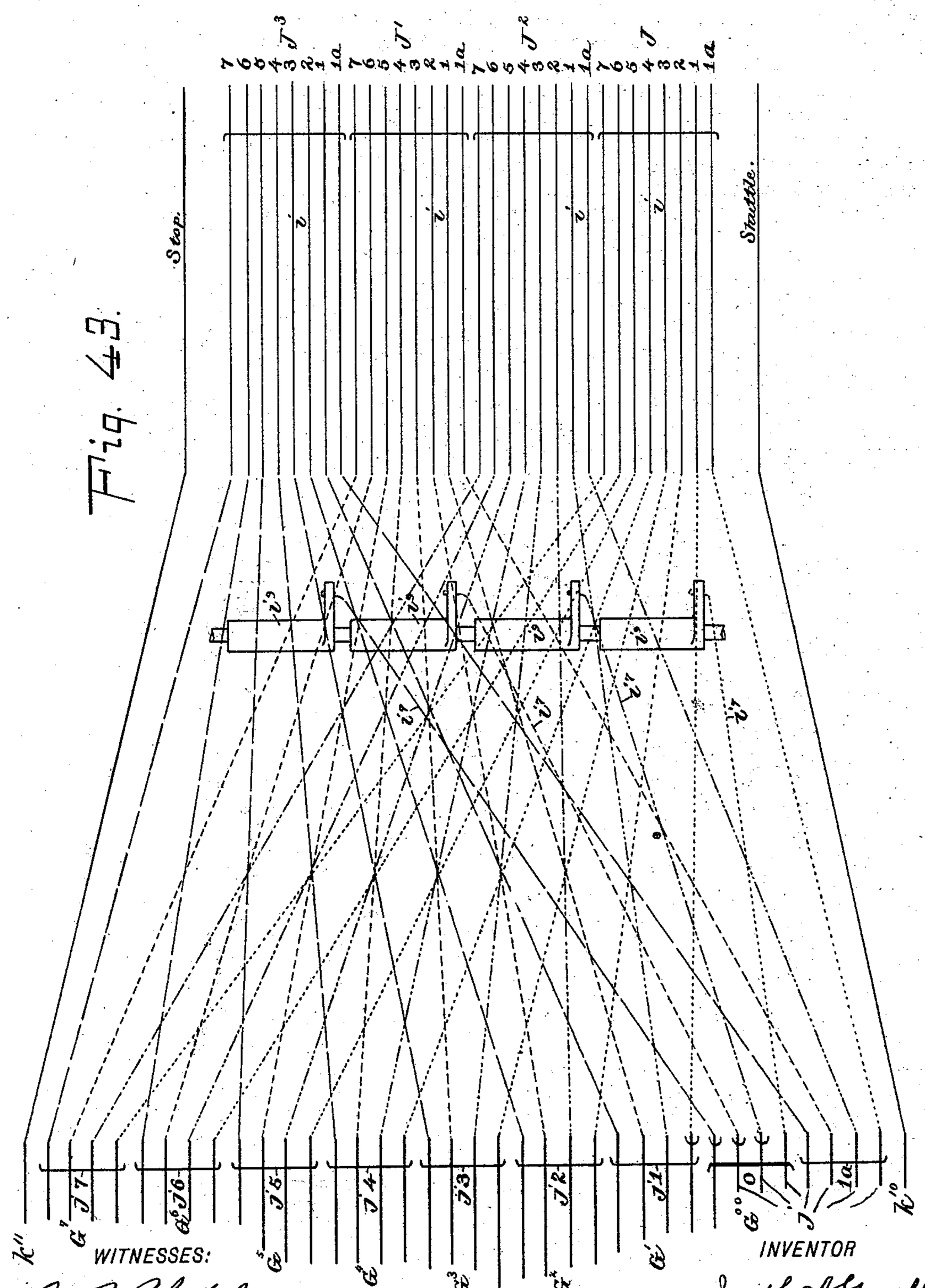
(No Model.) 20 Sheets—Sheet 20.

J. A. GROEBLI.

FABRIC MOVING MECHANISM FOR EMBROIDERING MACHINES.

No. 528,632. Patented Nov. 6, 1894.

Fig. 43.



WITNESSES:

Arthur B. Shepherd.

L. M. Hachenlager.

INVENTOR

Joseph A. Groebli,

BY Briesen & Knauth

ATTORNEYS.

UNITED STATES PATENT OFFICE.

JOSEPH ARNOLD GROEBLI, OF NEW YORK, N. Y., ASSIGNOR TO THE KURSHEEDT MANUFACTURING COMPANY, OF SAME PLACE.

FABRIC-MOVING MECHANISM FOR EMBROIDERING-MACHINES.

SPECIFICATION forming part of Letters Patent No. 528,632, dated November 6, 1894.

Application filed June 27, 1893. Serial No. 478,982. (No model.)

To all whom it may concern:

Be it known, that I, JOSEPH ARNOLD GROEBLI, residing in the city, county, and State of New York, have invented an Improved Fabric-Moving Mechanism for Embroidering-Machines, of which the following is a specification, reference being had to the accompanying drawings, forming part hereof, in which—

Figure 1, Sheet 1, is a side elevation of my mechanism. Fig. 2, Sheet 2, is a plan view of the same, showing a portion of the frame of the embroidery machine to which it is attached and the inclined slides which move the fabric frame. Fig. 3, Sheet 3, is a rear elevation of the mechanism having a portion of housing broken away for clear representation. Fig. 4, Sheet 4, is a front elevation of the same with the housing broken away as before, and showing a portion of the frame of the embroidery machine to which it is attached and a corner of the fabric frame. Fig. 5, Sheet 5, is a vertical diagrammatic section on the line 5—5 (Fig. 6, Sheet 6) drawn to a larger scale, of the rear upper part of my mechanism. Fig. 5^a is a detached sectional view on the line 5^a—5^a, Fig; 5, the direction of observation being indicated by arrow. Fig. 6, Sheet 6, shows a broken plan view exhibiting the same portion of device as Fig. 5, and drawn to same scale, with a number of parts omitted for clearer representation. Fig. 7, Sheet 7, is a detached sectional elevation drawn to a still larger scale than the three preceding figures, and taken on the lines 7—7, Fig. 9, Sheet 9, and Fig. 8, Sheet 8, direction of view being shown by arrows. Fig. 8, Sheet 8, is a detached sectional elevation of the same portion of my mechanism, drawn to same scale as the preceding figure, and all the following figures (with a few noticed exceptions) and upon a plane perpendicular to that of Fig. 7, indicated by the line 8—8 of that figure. Fig. 9, Sheet 9, is a sectional plan view on line 9—9 of Fig. 8. Fig. 10, Sheet 10, is a detached sectional plan view on line 10—10, Fig. 12, showing train of gears and locking device hereinafter described. Fig. 11, Sheet 10, is a detail plan view of the upper portion of the device illustrated further in Fig. 12. Fig. 12, Sheet 10, is a fragmental elevation of a portion of the hand operating mechanism on a vertical plane parallel to the line 12—12, Fig. 11. Fig. 13, Sheet 10, is a fragmental elevation of the rack-meshing device, on a vertical plane parallel to line 13—13, Fig. 9, Sheet 9. Another elevation of this device is shown in Fig. 8, Sheet 8. Fig. 14 is a detached plan of same shown again with its connection in plan, Fig. 9, Sheet 9. Fig. 14^a is a detail of one of the parts shown in Fig. 14. Fig. 15, Sheet 11, is a front elevation, on same scale as Fig. 1, Sheet 1, of the inclined slides, the direction of the movement of whose point of intersection is the resultant of any horizontal movements imparted to the two slides. Fig. 16, Sheet 11, is a plan view of the above inclined slides, and Fig. 17 is a section on line 17—17, Fig. 15, viewed in direction indicated by arrow. Fig. 18 is a detached elevation of one of the slides. Fig. 19, Sheet 12, is a fragmental sectional elevation on the line 19—19, Fig. 23, Sheet 14, viewed from the front, drawn to same scale as Fig. 7, Sheet 7, and which is full size. Fig. 20, Sheet 13, is full size side elevation of the same portion of my mechanism shown in Fig. 19, and also seen on a smaller scale in the right hand upper corner of Sheet 1. Fig. 21 is a fragmental vertical section through the cam Q, Fig. 20, and directly in front of the reciprocating bar, O^4. Fig. 22 is a cylindrical section developed through the working part of cam Q. Fig. 23, Sheet 14, is a plan view of that part of any mechanism illustrated in Figs. 19 and 20. Figs. 24 to 32, inclusive, Sheet 15, are full size detached views of parts shown collectively in Figs. 19 to 23 inclusive. Figs. 33 and 34, Sheet 16, are front and side elevation respectively of the shears shown in Fig. 19. Fig. 35, Sheet 17, is a plan view of the lower part of my mechanism seen in front elevation, Fig. 4. Sheet 4. Fig. 36 is a fragmental sectional elevation on line 36—36 of the preceding figure. Fig. 37, Sheet 18, is an elevation of the portion last mentioned, and Fig. 38 is a fragmental section through line 38—38 of Fig. 35, Sheet 17. Fig. 39, Sheet 18, is a detail of the latch shown in Fig. 37 on same sheet. Fig. 40, Sheet 19, is a perspective view of a precautionary device fastened to some convenient

part of the embroidery frame and connected to my mechanism by a rod as hereinafter described. Fig. 41 is an orthographic vertical section through the axis of pointer shown in the preceeding view. Fig. 42 is a diagrammatic vertical section through the card-drum on a plane perpendicular to the axis of drum, showing the manner of suspending and taking up the "slack" of the card. Fig. 43, Sheet 20, is a diagram illustrating the arrangement of Jacquard pins and slides and their connecting wires. Fig. 44, Sheet 16, is an end view of the card-drum, showing relative positions of Jacquard pins and drum. Fig. 45, Sheet 16, is a fragmental rear elevation of a part of the card-drum and its hanger, showing perforated card in position. Figs. 46 and 47, Sheet 16, are elevation and plan respectively of stationary block G^0 to be explained more fully hereinafter.

This invention relates to a new mechanism for automatically controlling the position and moving the fabric frame of embroidering machines, and consists of the new combinations and arrangements of parts that are hereinafter more fully described and pointed out in the claims.

The main object of my invention is to produce the various motions of the fabric-frame of an embroidering machine by the use of fewer pins than have hitherto been employed for this purpose. In the prior art, so far as I am aware, there has been used a separate Jacquard pin for obtaining each motion, that is to say, one pin would give, say, unit motion in a given direction; another pin two units of motion in the same direction; a third pin three units of motion in the same direction, and so on up to the desired number of motions; so therefore, if we wished to give the fabric-frame three units of motion in a certain direction, we would pick out by means of the Jacquard card the third pin. This necessitated a great number of pins, as, if it were desired to give the fabric-frame a range of one hundred units of motion in both directions, it would be necessary to have a set of one hundred pins for imparting the one hundred increments of motion in one direction, and a set of one hundred pins for giving one hundred increments of motion in the other direction. It will thus be seen that in the mechanisms of this class heretofore used a great number of pins were necessarily employed in order that many different ranges of movement might be given to the fabric-frame.

Now, by my invention, I dispense with the use of a great number of pins by arranging the fabric-frame in combination with mechanism, which enables different pins to each give different extents of motion to the fabric-frame on one and the same line, and by actuating a plurality of pins and causing these pins to add or subtract their motions, as will be more fully hereinafter set forth. For instance, suppose we have a pin that is capable, when actuated, of giving to the fabric-frame seven units of motion on a certain line in the plane of the fabric-frame, and another pin which is capable, when actuated, of giving to the fabric-frame eight units of motion on the same line as the first mentioned pin. Now, if we wish to give to the fabric-frame seven units of motion or eight units of motion on the given line, we actuate the corresponding one of these two pins, and if we wish to give fifteen units of motion, we actuate both of these pins, at the same time actuating other mechanism which will cause these two pins to add their respective movements in order to produce the fifteen units of motion on one line. Similarly, if we desire to give the fabric-frame one unit of motion on the given line, we actuate the same two pins, at the same time actuating other mechanism which will cause the said two pins to subtract their motions, giving instead of the sum as in the former case, the difference of the two motions, that is to say, one unit of motion.

Therefore, broadly speaking, the essence of my invention consists in providing a limited number of pins which will each serve to impart to the fabric-frame different degrees of motion on one and the same line, and selecting two of these pins and combining their respective movements in order to obtain a movement of the fabric-frame on the given line, which will be the resultant of the movements which would ordinarily be imparted to the fabric-frame by either of the two selected pins acting singly. It will of course be understood that I also combine with these pins mechanism for determining whether the movements shall be the sum of the respective movements imparted to the fabric-frame by the two selected pins or the difference thereof, thus further simplifying the machine.

To some extent the mechanism which I shall proceed to describe may be employed in connection with the cross-guides that are described in my Patent No. 283,707, of August 21, 1883, as will more fully appear in the later part of this specification; but my present improvement can also be employed in combination with means other than those specified in my aforesaid Letters Patent for transmitting the desired movement to the suspended embroidery-frame.

With reference to Fig. 4, Sheet 4, of the drawings, the letter A represents the fabric-frame. This frame A is intended so far as this specification is concerned, to be understood as the same structure as the frame A shown in Fig. 1 of my said Patent No. 283,707, namely, a fabric-frame properly suspended, as shown in Fig. 1 of that patent, so as to be fairly balanced and easily movable up or down, or in the direction of its length, in the plane of its suspension, and is, as is likewise shown in Fig. 1 of said patent, and as is indicated in Figs. 15 to 18 inclusive, Sheet 11, of this present application, provided with an extending arm *a*, which has friction rollers or blocks *b* that enter grooves in two guides

B and C, which are represented as crossing one another at right angles. These guides B and C, shown in Figs. 15 to 18, are the guides a^3 and b^3 of Figs. 1 and 1^a of my aforesaid Patent No. 283,707. The guide B is rigidly connected to a rack *d*, and the guide C in like manner is rigidly connected to a rack *e*, as clearly shown in Fig. 16, Sheet 11. The rack *d* engages with a pinion *f* on a vertical shaft D, and the rack *e* engages a pinion *g* on a vertical shaft D^2 (Fig. 7, Sheet 7).

The reader of this specification will have to understand that it is the object of this invention to so revolve the shafts D and D^2 by mechanism controlled by a Jacquard card E (see Fig. 1) that the suspended fabric-frame A, after each stitch shall be moved in the desired direction up or down or lengthwise in the plane of its suspension, so as to present a particular new spot in the fabric to the needles for the obtainment of the requisite design. It is, of course, not necessary here to describe the machinery for operating the needles. The needle-carrying frame, or, as we may call it, the needle-bar, is given a transverse movement after every adjustment of the fabric-frame A, so as to cause the needles to pierce the fabric at the desired place; but this invention does not concern itself with any particular mechanism for controlling the needles or actuating them, as long as it is understood by the reader that the needle-frame moves, without any longitudinal or vertical adjustment, on a certain track, whereas the fabric-frame is to be adjusted according to the Jacquard card in such manner that every new stitch shall be placed exactly where needed for the production of the design; and it is likewise of interest to understand that the invention relates mainly to machinery in which a large number of needles are used simultaneously in the same fabric that is carried by the fabric-frame for the production of Hamburg edgings or analogous multiplied embroidery of like design.

By reference to my former patent No. 283,707, it will be understood that when the inclined guides or crossing guides B and C, which are shown in Figs. 15 to 18 of this application, are properly moved, the required adjustment of the fabric-frame is obtained. They may be moved one at a time, or both together, as was described in my above mentioned patent, and consequently, with reference to the present invention, it is needful to so construct the mechanism intervening between the Jacquard card E and the shafts D, D^2 (see Fig. 1, Sheet 1), that at the proper time each shaft shall be turned in the precise direction required to the specific extent required, and that after having been moved for thus adjusting the fabric-frame, each shaft shall be locked and rendered immovable while the stitch is being produced. Inasmuch, therefore, as it will be necessary to revolve each of the shafts D D^2, or turn it once in one direction and at other times in another direction, it follows that four means of turning said two shafts must be used, namely, one for turning one shaft to the right, another for turning the same shaft to the left, a third for turning the other shaft to the right, and a fourth for turning this other shaft to the left. These four devices, in accordance with the present invention, are: two double racks, which, in manner hereinafter described, enter into engagement with the shafts D, D^2, and turn each of them in the desired direction from time to time; but, as will hereinafter more fully appear, it is also necessary to turn the shafts D, D^2, with varying speeds from time to time, and for the obtainment of these different speeds I have, in connection with certain differential gearing, which I shall also hereinafter describe, added two further double racks, one for each of said shafts D, D^2, so that with the aid of one of these racks the shaft to which it pertains may be turned less far than when brought in gear with the other of said racks, as will be more clearly described. It follows that we have four racks with the aid of which to move the two shafts D and D^2. The Jacquard card is punched with reference to the existence of these four racks. Now, it also follows that if any one of these four racks, which is thrown into action, is moved farther, it will turn its shaft D or D^2 farther than if the same rack is moved less far. For the purposes of this specification, and as a matter of convenience, I have found a division of stroke into seven parts to answer the purpose; but, of course, any other division into less or more than seven parts for the lengths of strokes might be adopted. These four double racks which are indicated in Figs. 7 and 8 of the drawings are so arranged that two of said racks, being the lower two shown in these figures and being those marked J J^2, will affect the shaft D and pinion *f*, while the other two of said racks, being those marked J′, J^3, are intended to affect the motion of the shaft D^2 and of its pinion *g*. In other words, by horizontally reciprocating either one of said racks, a corresponding degree of motion in the desired direction is imparted to the proper pinion, the arrangement being such, as will be hereinafter described, that the two double racks pertaining to the same pinion, *f* or *g*, may be moved to turn them in opposite directions, if necessary, at the same time, so as to obtain for the said pinion the difference resulting from such motion in opposite directions. All of this will be more minutely hereinafter described. I have stated introductorily the general plan of mechanism for imparting motion to the fabric frame A, but I shall now proceed to describe, starting from the Jacquard cards, how the parts are arranged, which, when affected by said Jacquard card will ultimately result in imparting to the pinions *f*, *g*, the precise extent and direction of movement prescribed by the said card.

Referring now to Fig. 5, Sheet 5, which is

a vertical section on the line 5—5, seen on Sheet 6, we notice that the Jacquard card E moving in a step-by-step motion to be explained hereinafter, passes around a portion of a guiding cylinder E′ and then around the card drum E^2. This drum is best seen in Figs. 44 and 45, Sheet 16. It consists of a number of straight bars, $e^\times$, arranged in such a manner as to form a cylinder or drum. (See Fig. 3, Sheet 3.) These bars $e^\times$ are set in notches in the periphery of two disks, e', at equal distances apart and parallel to the axis of the cylinder. The disks e' are arranged so as to divide the drum into three parts, the central being much the longer and the two extremes equal and much shorter. These dividing disks e' carry projecting spurs e^2 which mesh with certain corresponding holes in the guiding cylinder E′, as also seen in Fig. 3, Sheet 3. I have shown the cylinder E′ and drum E^2 of about the same diameter and having the same number of holes and spurs, respectively, but the relative diameters of these two parts may be in any ratio, the former merely acting as a guide to the card E, and may have any number of holes, provided their distance apart may be such as to cause them to mesh properly with the spurs e^2. The office of the spurs e^2 is to properly mesh with holes in the Jacquard card E so that the perforations in the card may always coincide with the space between the bars $e^\times$ of the drum E^2. The disks e' are secured to an axle e^3 (Fig. 44), which is rotatively hung in oscillating hangers E^4 and E^5, which are rigidly fastened to a rock-shaft E^6, best seen in the rear view, Fig. 3, Sheet 3. This shaft E^6 moves in bearings in the housings of the machine and is rocked in its said bearings by suitable mechanism. For this purpose it may carry (Fig. 6, Sheet 6) a crank E^7, which is connected by a link E^8 (Fig. 6) to a suitably formed rotating cam on main driving shaft I, Fig. 3. This cam imparts an up and down movement to the link E^8, which in turn imparts a rocking movement to shaft E^6, which in turn gives a swinging motion to the hangers E^4 and E^5, thus giving a similar swinging movement to the card drum E^2.

Referring again to Sheet 16, in Fig. 44, it will be seen that the regular radial arrangement of the bars or slats $e^\times$ of the drum E^2 produces longitudinal slots or spaces into which the Jacquard pins h can enter without friction, provided no intervening obstacle is interposed between the ends of pins and the openings in the drum. The card E is punctured with reference to these slots in the drum and to the position of the Jacquard pins h, so that pins which are to remain stationary will, on every forward stroke of the swinging drum, be freely permitted to enter the holes in the card and the slots in the drum, whereas those pins h which are to be moved will encounter an unperforated portion of the card. The inner or front ends of the pins h (Fig. 5) abut against a corresponding number of slides i which are confined in stationary guides i', i^2, i^3, i^4, which allow of a free horizontal movement in a direction perpendicular to the axis of the drum E^2. In the upper part of each slide i is a recess i^5 which engages the downwardly bent end of one of a series of wires i^6. Each wire i^6 is thus enabled to connect with one of the slides i, and is partly guided in the guide i^4. The wires i^6 connect by hooks or otherwise flexibly the slides i with an equal number of slides j, which slide in ways cut in stationary rods j^8, j^9, but so as to admit of two movements of j, one the horizontal backward and forward movement corresponding to that of the slide i, to which it is connected, and the other a vertical rotary movement of the front end of j around a movable point in its rear end, which in the present case is the center of a circle of which the two arcs j^{10} and j^{11} form a part. The front ends of the slides j are loosely held between pins k^5 which serve as guides for the front ends of these slides. These pins k^5 are fastened in pairs, one above and the other below each slide j to slides k, which are made in the shape of an L, and are confined in stationary guides k', k^2, k^3, k^4, in which are cut ways that admit of a vertical movement only. On the horizontal portion of these slides k are hung by means of jaws which loosely clasp them (see Fig. 5^a) sliding hangers k^6, to which are fastened vertical rods k^7, which in their turn are fastened to and support sliding locking bars k^8. Twenty-eight of these bars k^8 slide vertically in ways g^8 which are formed integrally with the vertical sliding frames G′, G^2, G^3, G^4, G^5, G^6, G^7, Fig. 6, Sheet 6, and which serve the double purpose of acting as ways for the sliding bars k^8 and as guides for the horizontal rods m, m', m^2, and m^3. The remaining four locking-bars k^8 connect with a fixed block G^0 hereinafter described. Referring to Sheet 7, Fig. 7, we see these same rods m, m', m^2, m^3 again fastened to horizontal sliding frames l, l', l^2, l^3, shown in vertical section in this figure. A plan view of one of these horizontal sliding frames l^3 is seen in Fig. 9, Sheet 9, this figure showing said frame l^3 as fastened to eight rods m^3, which latter form the connecting links between a corresponding number of locking-bars k^8 and said frame l^3. The other sliding frames l, l' and l^2 connect also each with a set of eight such rods, m, m', m^2 respectively. Hence there are shown four frames or slides l, l', l^2, l^3, connected to thirty-two rods m, m', m^2, m^3, and by them to thirty-two locking bars k^8, slides k and slides j. Of these thirty-two slides j, twenty-eight connect with twenty-eight Jacquard pins h, the remaining four slides j being otherwise connected as hereinafter stated.

In Fig. 6, Sheet 6, which is a broken plan view of that part of my machine shown in vertical section in Fig. 5, Sheet 5, it will be seen that there are seven vertical sliding frames G′, G^2, G^3, G^4, G^5, G^6, G^7. These cor-

respond to the seven divisions of stroke to which I have previously alluded. Each of these frames slides horizontally in well-finished ways placed above and below it as in Fig. 5. The upper of these ways are formed on a plate X which has seven slots g^9 (Fig. 6), through which the rods k^7 pass, four being in each slot. The seven slots g^9 are of varying lengths, as indicated in Fig. 6, to provide for the seven progressive movements that are to be given to the seven slides G′, G², G³, G⁴, G⁵, G⁶, G⁷. In Fig. 3, Sheet 3, we see a rear view on a smaller scale of these vertical slides G′, &c. These slides are respectively connected by links g', g^2, g^3, g^4, g^5, g^6 and g^7 to a triangular shaped bell-crank lever H, the lower arm H′ of which holds a friction roller, which works in a rotating cam, H²⁴, which is mounted upon the main shaft I. The upper arm forms a right triangle, upon the hypotenuse of which we see a series of seven steps, upon which are formed seven bearings for the rear ends of the seven before mentioned links. This crank lever H is rotatively mounted in bearings H², H³, which are hung to the main frame. The distances of the bearings upon the steps from the axis of rotation of H are in arithmetical progression from 1 to 7, the "1" representing the unit stroke before mentioned, and the other terms of the progression representing the other six strokes.

Now, returning to Fig. 5, Sheet 5, we see a side view of the upper part of the lever H showing the seven bearings on the steps and the seven links g', g^2, g^3, g^4, g^5, g^6 and g^7, which connect the lever H with the vertical frames G′ to G⁷ inclusive, only one of which, G′, is seen in this figure, because I have here shown these frames in their forward position in which their ends all lie in a vertical plane parallel to the rotating axis of the lever H.

When the lever H is moved by means of a cam to the position shown by dotted lines in Fig. 5 it will draw after it the seven vertical slides, but each slide will move through a distance equal to the chord of the arc described by its point of connection with the lever H, and will thus be brought into their respective progressive positions shown by dotted lines.

In Fig. 6, Sheet 6, it will be seen that there are eight rods marked m^3. In Fig. 5, Sheet 5, only one of these rods m^3 is shown; but it must be remembered that in this figure m^3 represents a horizontal group of eight such rods all connected to one horizontal sliding rack frame. In like manner m, m' and m^2 represent horizontal groups of eight rods each, each group being fastened to a similar horizontal frame. Thus we have four groups of eight rods each connected to four horizontal sliding rack frames, and each of these frames controls the longitudinal motion of one of the four double racks before mentioned. Referring to Fig. 9, in which are shown these rack frames l, l', l^2, l^3, the latter of which is the only one seen in full (it being the uppermost), we see inwardly projecting brackets l^4, upon which are finished ways or guides l^5. At the rear end of the frame, and opposite to l^5, are two other finished guides l^6 formed on said frame. Sliding in these ways is a double rack J³, the two sides of which are joined rigidly by a connecting bar J⁴ underneath their rear ends, which in the present case is cast integrally with the racks, and is shown in elevation in Fig. 7, Sheet 7.

The rack frame l^3 has finished edges l^7 which fit and slide in finished ways in the stationary frame only, as shown by cross-section in Fig. 8, Sheet 8. This description of the rack frame l^3 will substantially fit the other rack frames l, l' and l^2, which control respectively the movements of three other double racks J, J′ and J². The lower of these racks J and J² have their connecting bars J⁴ in front as in Fig. 7, and the brackets l^4 for these lower racks face forward instead of backward. The two upper racks J′ and J³ control the movements of the pinion g on shaft D². The two lower racks J and J² control the movement of the pinion f on shaft D.

The pinions f and g, Fig. 7, Sheet 7, are made integrally with the shafts D and D², respectively, though they may be made separately and fastened to their respective shafts. I have broken away the housings of the shaft D², exposing its pinion g.

In Fig. 8 we see a stationary bracket, d', on which is cast an upwardly projecting hub, d^2, and a downwardly projecting hub, D¹⁵. In these hubs or tubular housings the shaft D² is by preference held. I also prefer to use a bushing, d^8, driven into hub D¹⁵ and held in place by a screw, d^9, or otherwise. On the upper end of the hub d^2 is a shoulder, d^3, which forms a support for a rotating frame, D⁶, which contains in its lower part, within a yoke formed integrally therewith, a train of differential gears, d^4, d^5, d^6, d^7, to be explained hereinafter. The wheel d^4 is fastened rigidly to the upper end of the shaft D². The wheel d^7 is fastened to the lower end of a shaft, D⁴, which is aligned with the shaft D² as shown, and which is supported in a stationary hub, D¹⁰, which is carried by a cross-bar, D²⁷, of the main frame. The shafts D² and D⁴ are connected only by the train of gears d^4, d^5, d^6, d^7, in which train d^5 and d^6 are made integrally of one piece of material, or otherwise fastened rigidly together. The office of this train of gears will be more fully explained in another part of this specification.

Upon the upper part of the rotating sleeve D⁶, Fig. 8, is a spur wheel D⁷ and upon the shaft D⁴ is fastened a spur wheel D⁸ and farther up on the same shaft another spur wheel D², all as shown in Figs. 7 and 8.

The above description of the shafts D² and D⁴, with their bearings and mountings, applies similarly to the shaft D and its fellow D³. The spur wheels D⁷ and D⁸ are made to mesh with the racks J′, J³, respectively, while

on the other shaft D^3, the spur wheels D^{11} and D^{12} are made to mesh with the racks J and J^2, respectively. The sleeve D^5 corresponds to the sleeve D^6, the wheel D^{11} to the wheel D^7. The sleeve D^6 has also a yoke containing a train of gears in every particular like the sleeve and yoke D^6, with its train of gears d^4, d^5, d^6 and d^7. Hence the shafts D^3 and D^4 will, when revolved, communicate motion by these gears to the shafts D and D^2, and thereby to the racks *d* and *e*.

Referring to Fig. 9 again, we notice below the rack frame l^3 a narrower transverse frame L^3, whose office is to mesh, to shift and to unmesh the rack J^3 with and from its spur wheel D^8. This frame, which we will call a meshing bar, slides on finished edges L^4 in grooves cut in the housings. Two projecting brackets L^5, at right angles to the length of the bar, form guides and supports for the rack J^3, as clearly shown in Figs. 7, 8 and 9. Three meshing bars, L, L′, L^2, which guide and support the racks J, J′, J^2, respectively, are like the meshing bar L^3 just described, except that bars L and L^2 have the supporting brackets nearer the front, while the bars L′ and L^3 have their brackets nearer the rear.

By reference to Figs. 7 and 9, we see between the two shafts D^3 and D^4, extending downward through bearings cast to cross bar D^{27}, two smaller shafts, K^3, K^4, of unequal lengths. Upon shaft K^3, which is the longer of the two, are two pawls K, arranged to engage the two spur wheels D^{11} and D^{12}. Upon the shaft K^4 are two pawls K^2, which are arranged to engage the spur wheels D^7 and D^8. The upper ends of these shafts, K^3, K^4, see Fig. 10, Sheet 10, are provided with cranks K^5, K^6, respectively, which at their ends farthest from their respective shafts engage an actuating link K^7. This link K^7 has its rear end connected to a lever, which carries a friction roller playing in a rotatory cam, as indicated in Fig. 1. This cam is mounted upon the main shaft I, in such relation to the cam that operates the meshing bars L, L′, L^2, L^3 (hereinafter described), that whenever the racks are unmeshed the pawls engage, and vice versa.

It will be explained farther on that the racks are either all engaged or all disengaged. One or more cannot be engaged while the others are free. This is also true of the pawls, whose office is to immediately engage the spur wheels as they are disengaged from the racks, so as to hold them in proper position to be engaged without interference when necessary.

A certain train of gears, D^9, D^{16}, D^{17}, D^{18}, which I will now refer to, is to be used when the machine is at rest, and it is desired to arrange my mechanism to begin work.

It must be remembered that the object of my invention is to so move the fabric frame back and forth before the embroidery needles that the latter will make successive stitches upon the fabric such as would be made by hand by one skilled in embroidery. There must be a starting point in the figure to be worked, and in order to set the fabric frame at any desired point of the pattern a hand-operating device is necessary. This device is shown near the front of my mechanism in Fig. 2, Sheet 2, and in detail in Figs. 7, 8, 10 on Sheets 7, 8, 10 respectively and Fig. 11 on Sheet 10.

The shafts D^3 and D^4, it will be remembered, indirectly operate the racks *d* and *e* (Figs. 15 to 18, Sheet 11), which in their turn operate the inclined guides B and C, which in their turn move the fabric frame A in a direction which will be the resultant of the two motions imparted to A by B and C working separately or together. When my mechanism is driven by power applied to the main driving shaft I these two guides B and C move at the same time with any desired speed unless only one is required, in which case the mechanism which operates the idle guide is locked and immovable; but when the fabric frame is to be moved by hand through the agency of these guides it is found best to move the two guides together with the same speed, either in the same or in opposite directions. When moved in the same direction at same speed the fabric frame is moved horizontally. When moved in opposite directions at same speed the fabric frame is moved vertically. Thus by these two motions successively applied, the fabric frame may be brought to any desired position. For this purpose we provide the shafts D^3, D^4, with spur wheels D^{16}, D^9, respectively, both of same size. An idle spur, D^{17}, in the present case of the same size as D^{16} and D^9 is permanently in mesh with D^{16}. A smaller spur, D^{18}, is rotatively mounted in a bracket bearing D^{19}, which in its turn is rotatively mounted upon the upper end of the shaft D^4. (see Fig. 12, Sheet 10.) This bracket is so arranged that it may slide up and down on D^4 between certain limits. Two pins, D^{21}, driven into shaft D^4, confine a small crank, D^{22}, which carries at its smaller end a dowel pin D^{23}, which passes through a boss on D^{22}, and is held therein by a set screw. This dowel may rotate about the shaft D^4 within certain limits, but may not move vertically, since it is held by pins D^{21}.

The spur D^{18} is fastened to the lower end of a small shaft or arbor which passes vertically through the bearing D^{19}, and is held from falling by a collar D^{24}, which is either driven on the arbor or fastened by means of a set screw. The upper end of this arbor or shaft is faced off in the form of some regular prism to accommodate one end of a removable crank-handle D^{20}. Fig. 11 is a plan view of this bracket-bearing D^{19}. The collar D^{24}, which rotates with the spur D^{18}, carries a pointer D^{25}, which moves around a dial which is divided into ten (more or less) equal parts. In the present case the spur D^{18} is provided with ten teeth, while the other three, D^9, D^{16}, D^{17}, have each sixteen teeth. The axis of D^{18}

is always parallel to that of D^9, and the distance between these axes is such that the pitch cylinders of the two spurs are always tangent whether they are in or out of mesh.

The hand-driven pinion D^{18} when meshed with D^{17} and D^9, as shown in Fig. 10, and then turned in the direction indicated by the arrow, will drive the shafts D^3 and D^4 in opposite directions and with them the shafts D and D^2, thus moving the racks *d* and *e* in the same direction and away from the embroidery machine at the same rate of speed, which combined movements will cause the fabric-frame to move horizotally in the same direction and to the same extent. By turning the crank D^{20} in the other direction we will get a reverse movement of the fabric-frame.

When the hand-driven pinion D^{18} is in mesh with D^9 and D^{16}, the two latter will be driven in the same direction and consequently move the racks *d* and *e* in opposite directions at the same rate of speed, thus causing the fabric-frame to move up or down vertically, according as the crank D^{20} is turned to the right or left.

The pinion D^{18} before being lowered so as to mesh with D^9 and either of the other two pinions D^{16} or D^{17} should be so located that its teeth will slide uninterruptedly between the teeth of the other two. To accomplish this easily and surely it is necessary that in moving the bearing D^{19} about D^4 it must only move just far enough either way to bring the pitch cylinder of D^{18} to a position tangent to that of the other pinion with which it is desired to mesh it. It must be remembered that the pitch cylinders of D^{18} and D^9 are always tangent. Hence by moving D^{18} till its pitch cylinder becomes tangent to either of the other pitch cylinders, it makes its pitch cylinder tangent to the pitch cylinders of the two spurs with which it is to be meshed.

In order to prevent D^{18} from being moved too far in its arc, an arm D^{26} cast integrally with D^{19} and having a hook-shaped extremity, which in the drawings, Fig. 11, is in the form of a sector whose mean radius is the distance between the centers of D^3 and D^4, has secured to its upper surface a piece of metal d^{11} bent downward at its two ends far enough to form two stops d^{12} and d^{13} for the horizontal rotary movement of D^{19}. In Figs. 11 and 12 the stop d^{12} is seen to be in contact with D^3. In this position a pin d^{14} projecting downwardly from D^{26} is in such a position that it will slip snugly into a hole bored in the top of the shaft D^3, when D^{19} is lowered for operating. Again when D^{18} is moved so as to be in position for meshing with D^{16} and D^9 the stop d^{13} will reach contact with shaft D^3 and a downwardly projecting pin d^{15} will then be above the same hole in the top of shaft D^3. There is a third pin d^{16} larger in diameter than, and situated midway between d^{14} and d^{15}, which serves as a stop to prevent the spur D^{18} from falling into any position save those two determined by the pins d^{14} and d^{15} and the stops d^{12} and d^{13}, because the pin d^{16} will be above the shaft D^{13} and prevent the descent of the bearing D^{19}, unless one of said pins d^{14} or d^{15} arrives above said shaft. The office of the dowel pin D^{23} is to prevent the lifting of the pinion D^{18} and bracket D^{19} except when the gears D^7, D^8, D^{11}, D^{12} (Fig. 7, Sheet 7) are in proper position to be engaged by their respective double racks. This is shown by the pointer D^{25} and dial upon D^{19}. When the pointer rests upon one of the radial marks which are the same in number as the teeth of D^{18}, it is an indication that the dowel D^{23} is in position to pass between two of the teeth of D^{18}, allowing D^{18} to be raised after it has performed the desired adjustment. It is evident from the description of this hand-operating device that the shafts D^3 and D^4 can only be turned through arcs which are multiples of the arcs on the pitch circles from one tooth to another of the spur-wheels D^9 and D^{16} (which are equal). It is also evident that (referring to Fig. 9, Sheet 9), since the rack frames *l*, *l'*, l^2, l^3, all must return to a normal position (which is that shown in the figure) before the double racks can be again meshed to their respective spur-wheels, these spur-wheels must always stop in position to be meshed by the racks in the normal position. This can only be accomplished by making all the rotary movements imparted to the spurs by the racks multiples of the arcs on the pitch circles representing the distance from one tooth to another. The pattern to be embroidered, however, in nearly all cases, requires that the movements of the fabric frame shall not be restricted to multiples of any one unit of distance, but, on the contrary, requires the greatest variety of movements in any direction and to any distance. This led to the introduction of the differential gearing before mentioned so that the movements of the shafts D and D^2 in multiples of a certain unit might be divided and subdivided so that any desired distance in any desired direction might be accomplished by the fabric frame. Before describing this differential gearing, however, I will return to the rack-frames and show how they are connected to that part of the machine that is operated by the perforated card E.

Referring to Fig. 9, Sheet 9, we see that the rack-frame l^3 and likewise the other three rack-frames below it, have extending horizontally from the under rear surface eight bars m^3. In Fig. 5 these four groups of eight bars each are shown in elevation, m^3, *m'*, m^2, *m*, as passing between the lugs or ways g^8, which serve as guides and which are cast upon the vertical sliding frames G' to G^7. Each of these bars has near its rear end a hole marked in their respective groups n^3, *n'*, n^2, *n*. These holes in the normal positions shown in Fig. 5 stand immediately over pins k^9 extending upward from the locking bars k^8. Let it be borne in mind that below each group of these eight bars and below each bar

of the group is to be found one of these locking bars k^8. When one of the vertical hanging rods k^7 is lifted carrying with it its locking bar, the pin k^9 will enter the hole immediately above it, locking its particular rack-frame to the vertical sliding frame intended.

I have spoken of groups of eight bars m, m', m^2, m^3, while there are only seven vertical sliding frames, G′ to G⁷, to give the seven grades of motion before mentioned. It is as necessary to provide for holding the double racks stationary as to give them movement. Hence the first bar in each group of eight is for locking its particular rack to a locking bar which is horizontally stationary, moving vertically in ways cast upon a stationary block seen partly dotted in Fig. 6, marked G⁰. On the outer side of G⁰ will be noticed, dotted in, another group of four hanging rods with their locking bars. This group is for regulating the meshing of the racks to be explained hereinafter. It will now be evident why these vertical hanging rods k^7 are arranged in groups of four, since each rod in each group is to govern some function of, or pertaining to, one of four double racks. In addition to those nine groups of four each there will be noticed two isolated hanging rods, one at each end of the phalanx. These rods k^{10}, k^{11}, Fig. 6, have no locking bars attached, but extend downward through holes in the housings to certain mechanisms which will be explained hereinafter, and which are partly shown in Fig. 1, and more fully in Fig. 35, Sheet 17. The rod k^{10} regulates a shuttle-moving device in the embroidery machine, and k^{11} operates to stop the embroidery machine and with it my fabric moving devices.

Since the hanging rods k^7, Fig. 5, are connected through the sliding hangers k^6 with the slides k and j, it follows, that since the hanging rods are arranged in groups of four, the slides k and j will be arranged also in groups of four, and, since there are four double racks to be operated by the pins h, it follows that a division of those pins h and their slides i into four groups will be the most convenient. This scheme of grouping these pins and slides is clearly illustrated in Diagram 43, Sheet 20. The slides i are here shown divided into four groups of eight each with two extreme slides isolated from the rest and marked "Stop" and "Shuttle" because they operate the stop and shuttle mechanisms respectively before mentioned, whose actuating bars are vertical, marked k^{11} and k^{10}. I have placed near these four groups of eight (see right hand end Fig. 43), the letters J, J′, J², J³, which are the same as appertain to the four double racks. Thus by analogy we see that the first group of slides i controls the movements of rack J, the second controls rack J², the third controls rack J′, and the fourth controls rack J³. I have marked the individual slides in each group 1ª, 1, 2, 3, 4, 5, 6, 7. The four marked 1ª control the meshing of the four racks, and those marked 1 to 7 determine whether the racks shall be moved one, two, three, four, five, six, or seven units respectively. This unit of movement is the distance between the centers of any two teeth on the rack, so that in speaking of moving a rack three or more units is equivalent to saying three or more teeth (or multiples thereof). We also see that the four slides i, marked 1ª, are connected with a group of four slides j, also marked 1ª, shown in the lower left hand corner; also that the four slides i, marked 1, are connected with four slides j, marked G′; that the four slides i, marked 2, are connected with the four slides j, marked G², and so on up to slides i marked 7, and slides j marked G⁷.

The group of four slides j, marked 1ª, see Fig. 6, is immediately over four hanging rods k^7, that control the meshing of the racks. The group marked G⁰⁰, Fig. 6, is immediately over four hanging rods k^7 that lock the racks. It will be noticed from the diagram, Fig. 43, that these four slides j, forming the group marked G⁰⁰, are not connected to slides i like all the other slides j, but are connected by wires i^7 (see Figs. 5 and 6) to the upper arms of four levers i^9, which are rotatively mounted on a horizontal axle, i^{10}, which is held at its extremities in the ends of two cranks i^{11}, which are secured firmly to a rock shaft i^{12}, which is mounted in bearings in the housings or main frame, and carries on its outer end a crank i^{13}, which imparts to the rock shaft i^{12} an oscillating movement through a small arc by means of a link i^{14} (see Fig. 1), which is actuated by a bell crank i^{114}, which plays in a rotary cam on the main shaft I. The group of four slides j, marked in the diagram, Fig. 43, j', is immediately over the vertical sliding frame G′, which has a reciprocating horizontal movement of one unit, and may be connected to any one of the four double racks. Similarly the group of four sides j, marked j^2, is immediately over the vertical frame G², which has a reciprocating horizontal movement of two units, and may be connected to any one of the four double racks, and so on, throughout the other groups of four slides j, it will be seen that each group is immediately over its respective vertical slide, thus providing a means of connecting any one of the four double racks with any one of the vertical sliding frames whose horizontal movements are in arithmetical progression from 1 to 7. The slides j pertaining to group G⁰⁰, connect with locking bars k^8, which have no horizontal movement. This last-mentioned locking of the racks I have preferred not to leave to the action of the perforated card, and have not, therefore, connected those bars with the slides i and pins h, but have connected them, as explained before, to levers i^9, whose action I will explain later on in the specification.

Two notches, j^{12}, j^{13}, Fig. 5, Sheet 5, will be noticed in the slide j. Over the notch j^{13} is a bar M, which extends over all the slides j, and is held at or near its ends by two cranks M′ secured to a rock shaft M². Just touching

the under surface of j near its front end, and hence all the other slides j, is seen another bar, M^3, which is held at or near its ends by two cranks, M^4, secured to a rock shaft M^5. These rock shafts, M^2, M^5, are mounted in bearings in the housings or main frame (Fig. 2, Sheet 2), and have secured to their outer ends cranks M^6, M^7, respectively (Fig. 1, Sheet 1), which are actuated by a T-shaped link M^8, which receives a reciprocating movement in the direction of its length by a bell crank M^{27}, which plays in a rotary cam upon the main shaft I. The cranks M^6, M^7, extending in opposite directions, and actuated by the same link M^8 will impart to the shafts M^2 M^5, a rocking motion in opposite directions. Referring again to Fig. 5, this rocking motion will move toward and from each other the bars M, M^3. The extent of this movement is indicated by dotted lines.

In the upright part of k and in the rear edge will be seen two notches k^{12}, k^{13}. These are in all the slides k. Into these notches fits a locking bar M^9, which is held at or near its ends by two cranks M^{10}, which are secured to a rock shaft M^{11}, which is rotatively mounted in bearings in the housings or main frame (see Fig. 2) and carries secured to its outer ends (see Fig. 1) a crank M^{12}, which is pivoted to a link M^{13}, which receives a reciprocating movement in the direction of its length by means of a bell crank M^{28}, which plays in a rotary cam on the main shaft I.

Referring again to Fig. 5, Sheet 5, we notice on the upper edge of the front limb of slide i two V-shaped notches o, o', and another V-shaped notch which has its front incline, o^2, longer and extending higher than the others. This forms an incline near the upper part of which is seen to be nearly touching it the lower edge of the lever i^9 before mentioned. This lever is made long enough to engage all but one of the slides i of each of the four groups of eight shown in the diagram. The four slides of these groups that are not engageable by these levers are marked 1^a (in Figs. 6 and 43). The reason for omitting these four slides from engagement with the levers i^9 will be understood later. Directly over the notch o' will be seen the cross section of a rod O, which extends over all the slides i, and is shaped to fit in the notches o' and o. This rod O is for holding the slides firmly in their proper places. The rod O is held at a point near its ends by arms O', which are secured to a rock shaft O^2 which is rotatively mounted in bearings in the housings or main frames (Fig. 6), and carries, secured to its outer end, a crank O^3 (see Fig. 20, Sheet 13), which extends in an upward direction and is pivoted to a horizontal bar O^4 whose rear end is provided with a slot O^5 which slides over a pin P^8. This pin P^8 is seen to be secured in the end of a semi-circular lever P^7. This lever is secured (see Fig. 23, Sheet 14) to a shaft P, which is rotatively mounted in the housings. I will explain the office of this shaft at another place. For the present it is best to consider the semi-circular lever P^7 (Fig. 20, Sheet 13) as fastened to the housings and kept from rotating by a pin P^{10} (see Fig. 19, Sheet 12) which passes through a boss P^9 on the lower part of P^7 and into the housings. Thus, it will be seen that the rear end of the bar O^4 (Fig. 20, Sheet 13) is kept from falling and also from being lifted by a pin P^8.

A cam Q which rocks with a shaft Q', upon which it is mounted, plays in a suitable notch O^6 in the bar O^4 (Figs. 21 and 22), and, by reason of its deflected form and oscillating movement, imparts to the bar O^4 a reciprocating horizontal movement. This movement rocks the shaft O^2 (Fig. 5, Sheet 5,) thereby depressing and raising the locking bar O when required. The manner of rocking the shaft Q' is hereinafter described. Loosely pivoted at the rear ends in the swinging arms E^5 (Figs. 5 and 6) are two stout wires i^{13a}, which slide through holes in and are held from falling by the bar i^{15}, which is mounted in the housings. These wires carry a bar i^{14a}, which is secured to them. This bar is seen to be nearly tangent to the upright limb of the slides i, and being linked to the swinging arms which carry the card-drum E^2 must move with said drum. Passing through the bar i^{14a} and fastened to it at its rear end by a set screw is seen a wire i^8 (Figs. 5 and 6), which near its front portion slides through a hole in a stationary bar j^8. The front end of this wire i^8 carries a winged pawl i^{16}, which engages the four slides j of the series G^{00} in recesses j^{16} in said slides. These are the slides which operate the locking bars k^8, which slide in the fixed block G^0.

Referring to Fig. 45, Sheet 16, we see secured by a set screw to the outer end of the drum shaft e^3 a crank e^4, which has at one end a handle e^5, which is arranged to slide in the direction of the axis of drum in bearings in the crank. This handle carries a spur e^6 on its inner end, which engages radial slots e^7 in a stepping wheel E^9, which is loosely hung on the drum shaft e^3. This stepping wheel is held from rotating and is also given a step-by-step rotation by means of a lever E^{10}, Fig. 1, which carries a flat pawl E^{11} on its rear end, which engages radial slots in the wheel E^9. This semicircular lever E^{10} is rotatively mounted on a pivot E^{12} rigidly fastened to the housings, and is given an oscillating movement by a link E^{13}, which is pivoted to a lever E^{14}, whose lower end plays in a rotary cam on the shaft I. There is to the front of the stepping wheel E^9 another flat pawl E^{15}, which is secured to the housings. It will be noticed by reference to Fig. 45, Sheet 16, that this stepping wheel has as many radial slots (say thirty-two) as the number of radial slots in the card-drum, but that only half this number extend entirely through the thickness of the wheel.

Referring to Fig. 1 it will be seen that the drum E^2 is shown in its backward position

with the stepping wheel engaged by the rear pawl E^{11}. In swinging forward it will be seen that the stepping wheel will be engaged by the pawl E^{15} before E^{11} has released it. The former pawl E^{15} being fastened to the housings, prevents any possible rotation of the drum while in the forward position. The step-by-step movement is imparted as follows: As shown in Fig. 1, the stepping wheel is free from the stationary pawl E^{15} and engaged by the movable one E^{11}. This latter by means of the link E^{13} and the rotary cam before mentioned receives an upward movement about the pivot E^{12}, carrying with it about its own center the stepping wheel E^{9} a distance equal to that between one radial slot and the next. This will bring another slot opposite the pawl E^{15}, which will engage it when it swings forward releasing E^{11}. E^{11} then returns to its former position, the drum swings back, engaging the stepping wheel again with E^{11}, which is thus in position to repeat the former upward rotary movement. The "slack" in the card is cared for by another roller e^{11} of the same size as E', though it may be smaller or larger, suspended above, and over which the card is passed. This is clearly shown in Fig. 42, Sheet 19.

Above the shaft E^{6} and near to it is a parallel one considerably smaller, carrying near its ends two sprocket wheels e^{8}, which engage two sprocket chains e^{9}, which in their turn engage two other sprocket wheels e^{10}, secured in some convenient position to the ceiling above in such a manner that the chains may remain always taut. Somewhere in the length of these chains are inserted two bearings which carry a light axle on which is fastened the roller e^{11}. In Figs. 1 and 3, on Sheets 1 and 3, respectively, it will be seen that the shaft E^{16} carries near its out end a toothed wheel which engages a gravity pawl e^{37}, operated by hand, which prevents rotation of the shaft E^{16}, and consequently its sprocket wheels with their chains. Thus the roller e^{11}, Fig. 42, Sheet 19, may be raised or lowered to any position and held there by this pawl. This, it will be readily seen, provides a simple method of taking up the slack of the card.

We now understand enough of the principal parts of my mechanism to be able to follow their various actions in succession as controlled by the perforations in the Jacquard card.

The explanations of various precautionary devices which have been found desirable in connection with the proper working of my machine, and which form a part of my invention, will be reserved for another part of this specification.

Referring to Fig. 5, Sheet 5, we will suppose that there is only one perforation in the card E and that one to be opposite the end of the sliding pin h there shown, so that when the drum E^{2}, carrying the card E swings forward by means of a rocking motion imparted to the shaft E^{6} by crank E^{7} (as explained previously, and clearly understood by reference to Fig. 6), the pin h will pass through the card and into the drum, or rather the card will pass over the pin without moving it, while all the other pins, with their slides i and j will be pushed forward. It must be remembered, however, that there are four slides j (see diagram, Fig. 43) that have no corresponding pins h and slides i. Hence, these four slides j, in addition to the slide operated by the card, will be left behind. Thus we have all but five of the slides j pushed forward assuming the positions indicated by dotted lines j^{14}. The slide i shown in Fig. 5 is the same that is numbered 1 in group J in the diagram 43, Sheet 20. The slides i are then all locked firmly from further movement by the rocking of shaft O^{2}, thus depressing the locking bar O into the notches o, o', according as the sides are pushed forward or remain behind. Next the shaft i^{12} is rocked, depressing the rod i^{10}, which carries the wedge-shaped lever i^{9}. Now, since the slide i, as seen in the figure is the only one remaining behind, it is the only one that will engage one of the levers i^{9}. The wedge end of this lever will, on its descent thus be pushed backward by the incline o^{2}, thereby pushing forward the upper end of the lever, the wire i^{7} and the slide j, to which it is joined. Thus we have only four slides j standing in the normal position; all the others occupying the forward position shown by dotted line j^{14}. Next the locking bar M^{9} is withdrawn from the notches in the upright limbs of the slides k. Then the shafts M^{2} and M^{5} rocking in opposite directions, cause the bars M and M^{3} to approach each other, carrying upward the four slides j that are left behind, and not disturbing those that were pushed forward; that is to say, the upwardly moving bar M^{3} enters the notch j^{12}, of the slides j that have been moved forward, and only lifts those slides whose notches j^{12} are out of line. The extending bar M simply serves as a jaw to receive the thrust of the ascending slides, and to help M^{3} hold all the slides in position. The slides j that have been lifted carry with them the slides k, to which they are attached, together with the hangers k^{6}, the rods k^{7} and their locking bars k^{8}. In the figure the slide k, which is shown, will lift the lowest locking bar k^{8}, thereby locking the vertical sliding frame G' to the lowest rack frame, thus connecting it for the smallest (unit) movement.

By referring to the diagram, 43, it will be seen that the four slides j, &c., that have been lifted, I have caused to be marked by small semi-circles. It must be remembered that the group of slides G^{00} are intended for locking the rack frames. These slides are not operated from the card, but in a more satisfactory manner, as will now be seen.

In the case when only one perforation occurs opposite the pin marked 1 in group J that one slide remaining behind causes the first slide in group G^{00} to be pushed forward

while the other three remain behind. This is as it should be, for the card indicated that the lowest rack was to be used, and only the lowest; therefore, the lowest, and only the lowest should be free to move, all the others being locked. Again, suppose the slide marked 3 in group J′ be left behind. This will actuate the third wedge-shaped lever, thus unlocking the rack J′, while all the others will be locked. This slide marked 3 in group J′ indicates that the double rack J′ is to be moved three units. Therefore this rack is unlocked for the purpose, while all the others are locked immovable.

Those levers i^9 which regulate the unlocking of the racks, engage with but seven of the slides i in each group of eight shown in the diagram. This is because there being seven positive motions, any one of which may be connected to one rack-frame, it follows that any one of the seven slides which control this connection should also control the necessary unlocking for that particular group. Hence each lever i^9 submits to the action of seven slides i and no more. The first slide 1^a in each group is to regulate the direction in which its particular rack is to turn the pinion with which it is to be meshed. It is so arranged that when there occurs no hole in the card opposite one of those pins marked 1^a the toothed wheels D^7, D^8, D^{11}, D^{12}, will be turned in a certain direction. When the hole does occur then the rotation will be reversed. This meshing of the double racks with one side or the other of their respective pinions is accomplished in the following manner:

Referring to Figs. 8 and 9, Sheets 8 and 9, respectively, we see pivoted near the outer ends of the meshing slides L^3, &c., V-shaped links, F^3. These links have two limbs of unequal length set at an angle of about forty-five degrees and pivoted at their junction to the meshing slides. Each limb forms on its inner face a jaw, said jaws being adjusted to fit over pins F^4, F^5. There are four pairs of these pins, one pair for each meshing slide, and they are carried in four tiers on opposite sides of a vertical shaft, F^6 (see Fig. 13, Sheet 10), and are firmly fastened to four horizontal brackets at equal distances from said shaft F^6. Two of these brackets (Figs. 8 and 13, Sheets 8 and 10, respectively) are firmly secured to the shaft F^6, which rests in bearings in the housings and has secured to its lower end a crank F^7 (Fig. 8). The other two brackets move with the shaft F^6 in the same way as if they were fastened to it. This will be explained more fully in another part of this specification. The end of this crank is pivoted to a link F^8 (Figs. 8 and 9), which is itself connected to a bell crank, F^{28}, one end of which plays in a rotary cam on main shaft I (see Fig. 1), thus securing an oscillating motion to the shaft F^6 (Fig. 9), and with it and about it to the pins F^4, F^5. If the V-shaped links F^3 are all connected to the pins F^4, as in Fig. 9, they will, when the shaft F^6 is rocked by a pull on F^8, push the slides L^3, &c., and their racks over against the pinions, meshing them so as to give a rotation in a direction contrary to the movement of the hands of a watch, when the racks thus engaged are moved rearward.

To the rear limb of each of the links F^3, F^2, F′, F (see Figs. 1, 8, 46 and 47), are attached horizontal bars, f^3, f^2, f', f, respectively, which bars are pivoted to bell-crank levers f^{33}, whose bearings are in the stationary castings G^0 before mentioned (Fig. 6). The lower arms of these bell cranks are provided with slotted holes in which play horizontally projecting pins from four bars similar to the locking bars k^8 in Fig. 5 and similarly placed. These bell-cranks having their angles opposite (as in Fig. 1), do not all move alike. The two lower ones when actuated by the lifting bars k^7 will push their meshing links F^3 toward the front. The two upper ones when actuated in the same manner will pull their respective links F^3 to the rear. The normal position of these links is that indicated in Fig. 1. Now, returning to Fig. 9, we will see that if a rotation like that of the hands of a watch is desired the link F^3 must first be pushed to engage the pin F^5, after which the shaft F^6 must be rocked to move the pin F^5 away from the double rack.

Thus it will be readily understood how the perforated card may be made to control any and every movement of the fabric frame within certain limits prescribed by my mechanism.

I will now describe the actions of the train of differential gears introduced between the upper and lower parts of the rack-driven and rack-driving shafts.

Referring to Figs. 7 and 8, we see that there are two spur wheels of the same size and gearing firmly fastened to the vertical shaft D^4. The upper of these spur wheels, D^9, is for operating by hand, as before described. The lower one, D^8, is intended to be meshed with the double rack, J^3. The lower end of this shaft, D^4, has attached to it a large toothed wheel, d^7. This wheel has seventy-five teeth, which engage a pinion, d^6, which has twenty teeth. This pinion is rigidly fastened to and immediately above another pinion, d^5, on the same shaft, which has nineteen teeth. In the present case these two pinions with their spindles may all be made in one piece of metal. The lower pinion, d^5, engages a larger toothed wheel, d^4, which has seventy-six teeth and which is firmly secured to the upper end of the shaft, D^2. If the bearings of the small pinions, d^5 and d^6, are held immovable by locking the sleeve, D^6, one revolution of the shaft, D^4, will produce fifteen-sixteenths of a revolution in D^2. The bearings of these pinions are carried by the yoke and sleeve, D^6. If, now, we hold D^4 from moving and turn the yoke, D^6, through one complete revolution in the same direction which we

previously turned D^4, the shaft, D^2, will be turned through one-sixteenth of a revolution. Thus, if racks J′, J^3, are meshed with spur wheels, D^7, D^8, respectively, on the same side and at the same time, and are made to turn these spur wheels to the same extent (Fig. 7), the pinion *g* on the shaft, D^2, will be turned (fifteen-sixteenths plus one-sixteenth) to precisely the same extent. If these two racks, J′, J^3, meshed on the same side be connected to the sliding frame, G^7 (Fig. 6, Sheet 6), they will give to the pinion, *g* (Fig. 7), and rack, *e*, the greatest movement which my mechanism is capable of imparting. If they be meshed on opposite sides, thus turning their respective spur-wheels in opposite directions, they will give to the pinion *g* and rack *e* fourteen-sixteenths (fifteen-sixteenths minus one-sixteenth) of the seven units of motion. If D^7 be turned seven units in one direction and D^8 one unit in the opposite direction the result will be expressed by fifteen-sixteenths of one unit, minus one-sixteenth of seven units, leaving eight-sixteenths of one unit. Thus it will be seen that by connecting the spur wheel D^7 successively with the vertical sliding frames G′ to G^7 while D^8 is locked immovable, we will obtain successive movements of rack *e* equal to from one-sixteenth to seven-sixteenths of one unit of motion. If we connect the spur wheel D^8 successively with the vertical sliding frames G′ to G^7, while D^7 is locked immovable, we will obtain successive movements of rack *e* equal to from fifteen-sixteenths to one hundred and five sixteenths of one unit of motion. It will be readily seen, therefore, that by combining these motions either in the same or in different directions any movement from one-sixteenth to one hundred and twelve sixteenths of one unit of motion may be obtained in any direction.

Now, referring to Sheets 17 and 18, I will proceed to describe certain mechanism which further connects my fabric moving device with the embroidery machine. Fig. 35 is a plan view of the lower front portion of my device, partly seen in Fig. 4, Sheet 4. In Fig. 35 we see a bent lever A′ pivoted at *a′*, and provided at each end with an open jaw. Near one end of this lever at a^2 is pivoted a link A^2, which is partly shown dotted in Fig. 1, Sheet 1. This link is attached to a bell crank, one end of which engages a rotary cam on the main shaft I, which imparts to the lever A′ a regularly recurring oscillating movement through the arc a^5 (Fig. 35). A^3 is a curved lever pivoted at a^3, which stands still unless it be coupled with A′, as will be explained. Fig. 38, Sheet 18, is a section on line 38—38 of Fig. 35—looking in the direction of the lower arrow. We there see the lever A^3 pivoted at a^3, carrying in its outer end a loose vertically sliding coupling pin a^6, which has a dowel pin a^7 driven into it and extending through a slot a^9 of lever A^3. This vertical coupling pin a^6 is seen to extend into the frame or housing, thus holding the lever A^3 from moving. The dowel pin a^7 extends into a circular slot a^9 cut in a small block a^{10}, which has a downwardly projecting pin a^{11}, which slides in a suitable hole in the housing. This block (see Fig. 1, Sheet 1) has cast or fastened to it at an angle an upwardly projecting arm a^{12}, which carries a small boss on its upper end through which passes and is secured by a set screw the rod k^{10} before mentioned. This rod is connected to the outside slide indicated in diagram 43, so as to be operated by the Jacquard card. Returning to Fig. 38, Sheet 18, it will be remembered that the pin a^7 is capable of oscillating back and forth in a circular slot a^9. When the block a^{10} is raised by action of the card it carries with it the dowel pin a^7 and coupling pin a^6, thereby coupling the levers A′ and A^3 together at the same time loosing A^3 from the housings. Thus A^3 will be made to move with A′. In Fig. 35 the lever A^3 is shown to have an arm projecting forward beyond the pivot a^3, to the end of which arm is coupled by a swivel joint a horizontal rod A^5. The motion imparted to A^3 will, therefore, pull the rod A^5 in direction of arrow, thereby regulating a shuttle mechanism on the embroidery machine, which may be united in suitable manner to said rod. Thus the card controls the shuttle mechanism if such is required. A curved lever A^4 carries a similar combination of coupling and dowel pins operated by a similar lifting block connected to the rod k^{11}, which is connected to the other outside slide shown in the diagram, Fig. 43. This lever A^4 has an arm projecting forward beyond the pivot a^4 which carries at its end a swivel A^6. The lower part of this swivel has a bore through which freely slides the rod A^7, (Fig. 39, Sheet 18.) The swivel carries a latch A^8 which engages a stop A^9 firmly secured to the rod A^7 by a set screw. When A^4 is coupled to A′ this latch will be pulled in direction indicated by arrow (Fig. 35), carrying with it the rod A^7. This rod connects with a proper shipping lever to arrest the motion of the embroidery machine and of my mechanism. From a pivot a^{13}, extending toward the front is a double curved lever A^{10} which carries a pin A^{11} near its front end. This pin, as shown in Fig. 35, rests in a notch in a curved slot in a shoe A^{12}. This shoe is rotatively mounted on a pivot A^{13}. The lever A^{10} is connected to the housings by a spring A^{14} which tends to pull it away from the embroidery machine. Should the shoe A^{12} be pulled backward by the wire a^{14} the pin A^{11} will be released from its notch and the lever A^{10} will fly outward by action of spring A^{14} (away from embroidery machine) till it is stopped by the pin A^{11} reaching the end of its slot in the shoe. Fig. 39 is a vertical section taken immediately in front of the latch A^8. This view shows the lever A^{10} in the same position as is shown in Fig. 35. The first action of the lever A^{10} in its flying outward will be

to lift the latch A^8 from its stop A^9. Then by carrying this stop with it in its flight it will cause the rod A^7 to stop the machine in the same manner as it would be stopped by the lever A^4 as just explained. This mechanism is operated by the wire a^{14} being pulled backward, carrying with it the shoe A^{12}. This wire at its rear end is hooked through a hole in a short lever a^{15} which moves in a vertical plane about the axle a^{16} (Fig. 36). This axle is set horizontally in bearing a^{17} which is carried by an upright a^{18} cast upon the housings. The lever a^{15} is secured at right angles to a rear bar a^{19}, which has two other levers a^{20} and a^{21} secured to it and extending downward. It is also provided with a bracket a^{22}, which forms another inner bearing for this trio of levers which are joined by the bar a^{19}. The lever a^{20} has hooked into it a vertical wire a^{23}, and the lever a^{21} has hooked into it, extending upward and backward at an angle, another wire a^{24}. It is readily seen, Fig. 36, that pulling either of these wires upward in the direction of its length will operate to pull backward the wire a^{14}, thus stopping the machine. The wire a^{23} extends upward some distance (Sheet 19, Fig. 40), and passes loosely through a hole near the end of a crank a^{25}, and has a small cotter run through it above the crank, so that the crank may lift the wire a^{23}, but the wire may pass freely up through the crank without disturbing it. This crank a^{25} is secured to a shaft a^{26}, which turns in bearings at some convenient place in the housings of the embroidery machine. This shaft has secured to it a short upright crank a^{27}, which has drilled into it, near its upper end, a conical recess a^{28} (Fig. 41). In this conical recess rests one end of a rod a^{29}, the other end of which is pointed. Near the middle this rod has a disk or enlargement a^{30}. This disk presses against a flange a^{31}, near the end of a hole a^{32}, drilled into a boss on the housings of the embroidery machine, which hole has a diameter slightly greater than that of the disk a^{30}. This disk is pressed against the flange a^{31} by the crank a^{27} whose tendency is in a backward direction due to the weight of the crank a^{25} and the wire a^{23}. Near to the pointer a^{29} and in a plane perpendicular to its length moves a board upon which is drawn the pattern to be embroidered. This board is fastened to the fabric frame before mentioned and moves with it. The pattern is surrounded by a frame a^{33} whose thickness is greater than the distance of the pointer from the pattern drawing. The area inside this frame represents the surface that may be covered by the extreme movements of the fabric frame in any direction. A movement beyond these limits would cause damage and breakage. The device shown on Sheet 19, Figs. 40 and 41, is to prevent this accident, and operates as follows: Should the fabric frame be moved beyond its prescribed limits, the rear end of the pointer a^{29} will come in contact with the frame a^{33}, thereby deflecting this pointer about some point of the flange a^{31} as a fulcrum. This deflection will cause the other end of the rod to be forced out of the vortex of its conical resting place, and by pushing against the inner surface of this conical recess will press forward the crank a^{27}, thereby rocking the shaft a^{26}, and lifting the wire a^{23}, stopping the machine before any damage can be done. The other wire, a^{24}, Fig. 36, also operates to stop the machine in case of accident, as will be explained hereinafter.

When my mechanism is to be operated by hand it is necessary that some means of preventing the starting of the embroidery machine by accident should be provided. This provisional device is shown partly in Fig. 35, Sheet 17. To the housings a projecting boss A^{15} sustains a forwardly projecting pin A^{16}, upon which is rotatively mounted a bell crank A^{17}, with an outwardly projecting arm A^{18}, a downwardly projecting arm A^{19} and a third arm A^{20} projecting upward, all as in Fig. 37. The lower arm A^{19}, Fig. 37, is secured to the end of a long horizontal rod A^{21} by a swivel. The arm A^{18} is secured to a vertical rod A^{22} also by a swivel. If the arm A^{20} be pushed forward the bell crank will be turned and the rod A^{21} will move in the direction indicated by arrow away from the embroidery machine. This rod A^{21} is connected to a clutch loosening the driving pulley, or analogous interlocking device which prevents the machine from being started. The vertical rod A^{22} extends up and is connected with the hand-operating device. (See Fig. 8, Sheet 8.) At or near the top of this rod is fastened a swivel A^{23}, which in its turn is fastened to a lever A^{24}, supported upon an upright bearing upon the housings near its middle, and having its inner end resting underneath the pinion D^{18}. This is the pinion (Fig. 12, Sheet 10) which is fastened upon the shaft or arbor which carries the handle D^{20}.

Returning to Fig. 8, Sheet 8, we understand that when D^{18} is in gear with my mechanism the rod A^{22} will be lifted, thus causing the rod A^{21} to be pulled with the effect already stated of interlocking the embroidery machine.

In describing the hand operating device in the earlier part of this specification I spoke of turning the two shafts D^3 and D^4, Fig. 7, Sheet 7. It was not the place then to cloud the explanation by referring to the yoke-carrying sleeves D^5, D^6, which revolve upon the lower parts of these two shafts. The reader can now understand that when operating by hand it will be necessary that these sleeves remain stationary while the spurs D^8 and D^{12} are released from their racks.

Referring to Fig. 13, Sheet 10, we see the meshing pins F^4 and F^5 in two vertical rows of four each. We will also notice that the first and third pairs F^4, F^5, beginning from the top are secured to two shorter brackets than are the second and fourth pairs. These latter brackets F^9 together with another simi-

lar one at the top are secured firmly to shaft F^6. These extend forward beyond the meshing pins and have holes bored near their forward ends. Through these holes passes loosely a vertical sliding pin F^{10}. This pin is kept in place by a winged pawl F^{11}, secured to the vertical rod A^{22}, which pawl fits into a slot F^{12} in the pin F^{10}. The shape of this winged pawl is best seen in Fig. 9, Sheet 9. The engaging edge is in form of an arc whose center is the center of the shaft F^6. The rocking of shaft F^6 carries with it the pin F^{10}, whose notch F^{12} rests and slides upon the upper surface of the pawl F^{11}. The first and third pairs of meshing pins, F^4, F^5, counting from above, are secured to the two shorter brackets F^{13}, which are joined rigidly together by a vertical bar F^{14}. The lower bracket has cast to it a forward extension F^{15} in the form of an arc whose center is that of the shaft F^6. To the outer corner of this extension is added an arm for moving by hand. (See Figs. 14 and 14^a.) The pin F^{10} passes through this extension F^{15} and has its axis in line with the circumference of the arc. The hole through which it passes is partly cut open, as seen in Fig. 14^a. Lower down and on the other side of the pin F^{10} is another notch F^{16} similar to F^{12}. When the rod A^{22} is lifted, as stated, by the depression of the spur D^{18} of the hand operating gears, the pawl F^{11} will raise the pin F^{10} till the notch F^{16} is in line with the circular extension F^{15}. This will admit of an outward circular movement of F^{15} about the shaft F^6 by hand.

The mechanism of my invention is so arranged that while the needles of the embroidery machine are in the fabric the double racks are all released from their respective spurs, and the spurs are, as stated before, locked by their pawls; and, on the other hand, when the needles are withdrawn from the fabric the racks are meshed and the pawls are withdrawn. It must be in this latter position when the hand operating mechanism is to be used. The manipulation of this device is as follows: Referring to Fig. 4, Sheet 4, the lever arm, A^{20}, should first be pushed over toward the embroidery machine. This will operate the interlocking or arresting rod A^{21} before mentioned, and also lift the rod A^{22}. Now, referring the Fig. 8, Sheet 8, it will be seen that this rod A^{22}, by means of the pawl F^{11}, will lift the pin F^{10} and rock the lever A^{24}, thus leaving the spur D^{18} free to drop into engagement. The arm F^{15} (Fig. 9, Sheet 9) is now pulled outward, thereby unmeshing the top and third racks from their respective spurs D^8 and D^{12}, while the other two racks and spurs are in mesh, not so shown, however, in this figure. Thus the sleeves D^5 and D^6 will be held stationary, while the shafts D^3 and D^4 may be turned by hand and the fabric frame moved as desired.

If, by an accident, more than one of the vertical sliding frames G′ to G′ should be connected to the horizontal rack-frames, a destruction of various parts would be the result. I have provided against such an accident in the following manner: Fig. 19, Sheet 12, is a vertical section on the line 19—19 of Fig 5, Sheet 5, looking toward the rear; and Fig. 23, Sheet 14, is a plan view of the same portion of my mechanism. I have omitted the pins h and the guides i^2 for clearer representation. There are seven slides i in each group of eight, of which seven only one must be left behind by the action of the card drum at the time. Above each group of these seven slides, hanging vertically and straddling the group between their lower ends, will be seen a pair of shears. The rear blades, P^{11}, of these shears are rotatively hung from a rigid bar, P^{12}. The front blades, P^{13}, which are pivoted to P^{11} a little below the center, are provided with forwardly projecting pins, P^{14}, which move freely in vertical depressions in a transverse bar, P^{15}. This bar is pivoted to the ends of two parallel cranks of equal length, P^{16}, P^{17}, so that it always remains parallel to its normal position. These cranks move through an arc of sufficient length to close the lower jaws of the shears just far enough to admit the free passage of one of the slides i. See Fig. 32, Sheet 16. The hanging of the shears enables them to accommodate themselves to any position between the limits determined by fixed stop pins P^{18}. P^{17} is the active crank and P^{16} the follower. The form of P^{17} is best seen in Figs. 24 and 25, Sheet 15. Upon a hub p is cast an upwardly projecting flange p' which serves as the moving crank for the bar P^{15}, and a support for a cam p^2 which is circular and has its center in that of the hub. In the same plane as p' and at right angles thereto is an arm p^3. Projecting below the hub is a flange Q which forms the cam previously mentioned in the description of rod O^4. In Fig. 20, Sheet 13, this casting is seen mounted upon an axle Q′ upon which it rotates freely and is held on by a cotter. The arm p^3 rests upon a longitudinal bar p^4. This is shown in detail Sheet 15, Figs. 28 and 29. The bar p^4, the hub p^5, and the two bosses p^6, p^7, are all parallel and rigidly joined together by a web as shown, the whole forming a crank Q^3. The shaft Q′, Fig. 20, Sheet 13, rests in a bearing Q^2, and is firmly secured at its forward end in the hub p^5, of the crank Q^3. To the forward end of the bar p^4 is pivoted on a crank pin a link Q^4 (see Fig. 1, Sheet 1), which is connected to one end of a bell crank Q^{24}, the other end of which plays in a rotary cam on the main shaft I, which gives to the link Q^4 a reciprocating movement in direction of its length. This rocks the crank Q^3 with its shaft Q′. Underneath the cam p^2 (Fig. 19, Sheet 12) of the crank P^{17} is seen a pawl p^8. This pawl is secured to a shaft p^{13}, which passes through the longer boss p^6 upon the crank Q^3 (see Fig. 3), and carries secured to its forward end a lever p^9 notched at its outer end as seen in Figs. 26 and 27 on Sheet 15. Fitting into

these notches is a corresponding projection at the end of another lever p^{11}, which latter is secured to a small shaft which is rotatively mounted and held by a cotter in the shorter boss p^7 of the crank Q^3. A spring p^{12} between this lever and a hook on the longer boss p^6 (Fig. 23) presses the notches in the ends of these levers together, thus requiring a considerable force to separate them. This (Fig. 19, Sheet 12) keeps the pawl p^8 in position underneath the cam p^2. This pawl p^8 and the horizontal bar p^4 move in a rocking motion with the crank Q^3, and carry with them and between them the crank P^{17}, which gives a reciprocating movement to the bar P^{15}, thus closing and opening the jaws of the shears. This movement is just sufficient to close the jaws far enough to admit the passage of a single slide *i*. The shears straddle the slides *i* near their rear ends (see Fig. 5), and any slide *i* which is moved forward escapes from between the shears. Should two or more slides remain behind by accident, such as a rent in the Jacquard card, the jaws of the shears will not come near enough together, the bar P^{15} cannot complete its full motion, a sudden resistance will be offered by the cam p^2 to its pawl p^8 sufficient to push the pawl from its normal position, thus rocking the shaft p^{13} and shearing the two levers p^9 and p^{11} apart. The lever p^9 carries near its end a forwardly projecting pin p^{10}, which engages a slot near the end of an upright crank p^{14}. This crank (Fig. 20, Sheet 13) is cast to a hub p^{15} and is continued below the hub and then bent backward horizontally till it reaches just beyond the sliding pin P^{10}, previously mentioned. A downwardly projecting toe p^{16} (Fig. 19, Sheet 12) from the end of p^{14} engages permanently a slot in the pin P^{10}. The resistance opposing the closing of the shears, disengaging the pawl p^8, throws downward the lever p^9, carrying with it the crank p^{14}. This movement throws the pin P^{10} into the hole P^4 in the bell crank P^3, thus coupling the semicircular crank P^7 with P^3, and loosing it from the housings. (See Fig. 20.) This crank, P^7, will therefore move with P^3. The pin P^8 in the end of P^7 will pull downward the end of the flat bar O^4, thus releasing this bar from the cam Q. By this time the turning of shaft P upon which the semicircular crank P^7 is secured, has brought the rod P^2 against the slides *i* which have remained behind and will push them all forward. At the same time (see Fig. 23, Sheet 14) the rocking of shaft P turns a crank p^{17} secured to its inner end, pulls upward in direction of its length the wire a^{24}, thus stopping the machine (Sheet 17, Figs. 35 and 36).

It might happen that one of the pins, *h*, after passing freely through the card, will meet some obstruction in the drum, and be pushed with its slide *i* forward a part of the way. Referring to Fig. 5, the bar O descending would probably carry such slide back again by pressing into its proper notch; but, should the slide offer resistance, and remain stationary, while partly advanced, the rod O cannot complete its descent (see Fig. 20, Sheet 13) the crank O^3 with its horizontal bar O^4 will offer resistance to the cam Q and prevent it from turning. This cam is formed integrally with the crank P^{17} (see Fig. 19, Sheet 12). Any interruption to its movement will therefore interrupt those of the crank P^{17}. Thus the same result will transpire; the shaft P will be rocked, the slides pushed forward out of danger and the machine stopped. Such stoppage will call attention to the existence of a defect and give opportunity for proper repair.

My device being operated by the main shaft I of the embroidery machine must necessarily be started and stopped by the same mechanism which starts and stops the said embroidery machine. I have already explained the stopping devices.

For starting the embroidering machine and with it my mechanism, and endless cord R (see Figs. 2 and 3), passes around four, more or less, sheaves S (only two of which are shown), near the corners of the embroidery machine, said cord being secured at some convenient portion of its length to the lever or other device for shifting the driving belt to or from the driving pulley on the main shaft. This cord R, passing completely around the embroidery machine, enables the operator to start or stop the machine wherever he may be standing.

Before specifying my claims of invention, I desire to have it understood that the principles underlying the mechanism of my fabric moving device can be employed with many modifications.

I have been particular in describing the construction of the parts of my device in considerable detail, stating how certain parts are connected to others by means of set-screws, or by being cast together, and otherwise. It is evident that nevertheless by other forms of connection the same results could be accomplished. Again, I have described the particular machine which is represented in the drawings as operating with the aid of slides and jacquard pins by which four double racks are controlled in seven units of motion; or, in other words, each rack is capable of a step by step movement under the influence of the Jacquard, there being seven such steps for each rack; but instead of having this number seven, it may be eight, nine, ten, six or any other desired number. So, with regard to the differential gear, I have described the relative difference as represented by 15, while clearly the same principle may be brought into play if any other difference be selected; and in other respects my mechanism can be modified by the skilled mechanic without departing from the spirit of my invention. I therefore desire it to be particularly understood that I do not limit myself to the precise details or numbers of parts and forms of constructions shown in the drawings or described in the

specification. I have simply endeavored to clearly state one form in which my invention may be clothed. Other forms will readily occur to those who may choose to enjoy the fruits of my invention.

While I consider the above described mechanism as being but one of the many forms in which my invention may be clothed, it can, nevertheless, be construed broadly as generic mechanism, and is capable of analysis into the following elements: To begin with, we have a fabric-frame; then there is mechanism directly connected to said fabric-frame for actuating the same, that is to say, the guides, the racks *d e*, and the vertical shafts. Then there are one or more moving mechanisms, that is to say, moving racks or their equivalents, for imparting varying ranges of movement to the fabric-frame actuating mechanism. Then there is a compounding mechanism for compounding the motion imparted to the fabric-frame actuating mechanism by the moving mechanisms. This last is shown as differential gearing, but it will be understood that any suitable compounding mechanism may be used, the character of which will vary with the varying conditions of practice. Such differential gearing I have here shown as a part of the actuating mechanism of the fabric-frame, and as interposed between the moving mechanisms and the guides which directly move the fabric-frame.

It will be observed that the pinion teeth *f g* co-operate with the rack teeth *d e* to move the frame; but once the frame is in motion and it is desired to stop it, the pinions *f g* are stopped and the rack teeth engaged therewith at the instant are stopped from motion, and consequently stop the frame. Thus the pinion teeth form stoppers for co-operating with the contacting surfaces of the rack teeth to stop the motion of the frame.

In addition, I wish to say that whenever I use the term "Jacquard card" or "Jacquard mechanism," or "Jacquard drum," or "Jacquard pins *h*" in this specification, I mean to embrace by said term any pattern mechanism of analogous kind adapted to perform analogous service. A perforated Jacquard card may be used, as shown, or one having no perforations whatsoever, but instead, projections might be used, or no card at all might be used. A cylinder having projections properly applied according to the pattern desired to be produced, or, in fact, any analogous pattern regulating mechanism, is by me understood to be the equivalent of the Jacquard mechanism specified. In this sense I desire the term "jacquard" to be read in this specification.

I need not state also that in lieu of levers and cams indicated in this specification and drawings in connection with the essential parts that are to be moved, other mechanical contrivances may be used with like or substantially like effect.

I will further have it understood that throughout the specification where I use the words "on one line" I mean a single line of direction in the plane of the fabric, which line may be horizontal, vertical or inclined.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The Jacquard drum E^2 constructed of notched disks *e'* and of slats or rods $e^{\times}$ set into these notches, all arranged so that the Jacquard pins may enter the slots produced between said rods or slats $e^{\times}$, as specified.

2. The punctured card E, combined with the longitudinally slotted card-drum E^2, with mechanism substantially as described for rocking or swinging said drum and the card thereon, and with the Jacquard pins *h*, all arranged so that every pin *h* which is aligned with a perforation of the card will when said card and its card-drum E^2 are moved toward the pin pass through the hole in the card and enter the slot in the drum, substantially as and for the purpose herein shown and described.

3. The combination of the card-drum E^2, adapted to be embraced by a Jacquard card with series of sliding Jacquard pins *h h* and with double racks J, J', J^2, J^3, and with mechanism substantially as described intervening between said Jacquard pins *h* and said racks, said pins *h* being in groups, so that the pins in each group control the motion of a particular rack, the degree of motion depending upon the selection of the particular pin in the group, as and for the purpose specified.

4. The combination of the vibrating Jacquard drum E^2, adapted to be embraced by a Jacquard card, with series of Jacquard pins *h* arranged in four groups, with four double racks J, J', J^2, J^3, mechanism intervening between said Jacquard pins and said racks substantially as described, for producing longitudinal movement of said racks, and with mechanism substantially as described for transversely moving each rack by connection with one of the Jacquard pins in each of the four groups, as and for the purpose specified.

5. The combination of the Jacquard drum E^2, adapted to be embraced by a Jacquard card, with series of Jacquard pins *h* arranged in four groups, with four double racks J, J', J^2, J^3, adapted to be moved longitudinally by certain of the pins in each group, and mechanism substantially as described for moving each rack laterally by means of one of the pins in each of said four groups, and with the shafts D^3 and D^4 having pinions adapted to be thrown into engagement with either side of said double racks, as and for the purpose herein shown and described.

6. In a machine for controlling the motion of an embroidery frame, the combination of said embroidery frame with the guides B C and their racks *d e*, and pinions *f g*, with shafts D, D^2, yoked sleeves D^5, D^6, shafts D^3 and D^4, differential gearing substantially as described for connecting the shaft D^3 and the sleeve D^5; with the shaft D, differential gearing substan-

tially as described for connecting the shaft D^4 and the sleeve D^6 with the shaft D^2, double racks J, J′, J^2, J^3, for engaging with pinions on said shafts D^3, D^4, and on said sleeves D^5, D^6, respectively, Jacquard pins *h* arranged in four groups, one for each of said double racks, mechanism substantially as described for communicating motion to the said racks longitudinally and laterally by means of said Jacquard pins, and means substantially as described for moving said Jacquard pins, all as and for the purpose specified.

7. The combination of the Jacquard pins *h* *h*, arranged in series and adapted to be moved by a Jacquard card, with the slides *i* arranged in corresponding groups in alignment with said pins and adapted to be moved by said pins in one direction, and mechanism substantially as described for locking said slides *i* after motion, including those not moved, and mechanism substantially as described for returning the slides *i* and the pins *h* to their normal positions after the movements produced by the Jacquard cards have been completed and the Jacquard card carried out of the way, as and for the purpose specified.

8. The combination of the Jacquard pins *h* arranged in groups and the corresponding slides *i* which are adapted to be moved by said pins, with the series of shears P^{11}, P^{13}, and mechanism substantially as described for moving said shears and for connecting them with a stopping mechanism, all arranged so that the slides *i* which are moved by the pins *h* escape from between said shears and so that if more than one slide of a group remains unmoved the machine will be stopped, as and for the purpose specified.

9. The combination of the Jacquard slides *i* with Jacquard pins *h* adapted to push them and mechanism substantially as described, for moving series of racks, with the locking bar O, and means substantially as described for moving the same, as specified.

10. The combination of the slides *i* and the Jacquard pins for moving the same in one direction, with the Jacquard cylinder E^2 adapted to be embraced by a Jacquard card, and hangers E^5 of said cylinder, and with the cross-bar i^{14a}, and means for moving said cross-bar and hangers, all arranged so that said cross-bar will bring the slides *i* back again to their normal position after they have been moved by the Jacquard pins, as set forth.

11. The combination of the Jacquard pins *h* and means substantially as described for moving them, with the slides *i*, connecting rods i^6, slides *j*, and with the slides *k*, connected with the locking-bars k^8 and sliding-frames G′ to G^7, all arranged for operation upon racks connected with said sliding frames, as and for the purpose described.

12. The combination of the horizontally moving slides *j*, having notched ends, with means substantially as described for moving them, and with the lifting and embracing jaws M^3, M, as and for the purpose specified.

13. The combination of the horizontally moving slides *j*, and means substantially as described for moving them, with the lifting and embracing jaws M^3, M, and with the vertically movable slides *h*, controlled by said slides *j*, and with the locking bar M^9, adapted to lock said vertically sliding bars *k*, substantially as and for the purposes herein shown and described.

14. The horizontally movable slides *j* connected with the vertically movable slides *k*, and with mechanism for rocking said horizontally movable slides *j*, in addition to moving them in a horizontal direction, as and for the purpose specified.

15. The slides *k*, carrying projections k^5, combined with the horizontal slides *j* that pass between said projections, and with the sliding hangers k^6, rods k^7, and locking bars k^8, substantially as and for the purpose herein shown and described.

16. The combination of the double racks J, J′, J^2, J^3, with the horizontal sliding frames *l*, *l′*, l^2, l^3, arms *m*, *m′*, m^2, m^3, locking bars k^8, and slides G′ to G^7, and mechanism substantially as described for moving said locking bars, all arranged so that thereby any one of the slides *l*, *l′*, l^2, l^3, can be connected to any one of the slides G′ to G^7, as and for the purpose specified.

17. The combination of the slides G′ to G^7 with corresponding numbers of links g' to g^7 and with a single lever H to which all of these links are attached at varying distances from its pivots, so that each motion of the lever produces different motions of the slides G′ to G^7, as and for the purpose described.

18. The combination of the shaft D^2 with the toothed wheel d^4 mounted upon it, with the yoked sleeve D^6 carried by said shaft, said yoked sleeve having the pinions d^5 d^6, and with the shaft D^4 aligned with the shaft D^2 and carrying the toothed wheel d^7, the teeth of the wheels d^7 and d^4 being of unequal number, and the teeth of the pinions d^5 and d^6 being also unequal, said pinions meshing respectively into said toothed wheels, all arranged to produce a differential movement and a varying degree of movement in the shaft D^2 as rotary motion is imparted either to the shaft D^4 or to the sleeve D^6, or both, in the same or in opposite directions, substantially as and for the purpose herein shown and described.

19. The combination of the shaft D^2 with the shaft D^4 aligned with it, with the yoked sleeve D^6 interposed between them, the differential gear d^4, d^5, d^6, d^7 connecting said shafts with said yoked sleeve, and with the pinions D^8 and D^7 mounted respectively upon the shaft D^4 and sleeve D^6, all as and for the purpose herein shown and described.

20. The combination of the shafts D and D^2, their respective yoked sleeves D^5 and D^6 and their respective aligned shafts D^3 and D^4, with pinions on said aligned shafts and on said yoked sleeves, and with the double racks

J, J′, J², J³, adapted to mesh into said respective pinions, with the longitudinally movable slides *l*, *l′*, *l²*, *l³*, and with the laterally movable slides L, L′, L², L³, said last named two sets of slides being adapted to move the double racks longitudinally and laterally as described, and with locking pawls K, K², adapted to engage said pinions and lock the same, and means substantially as described for actuating said pawls, as and for the purpose specified.

21. The combination of the shafts D³, D⁴, and their yoked sleeves D⁵, D⁶, the differential gearing as described, and shafts D, D², with racks J, J′, J², J³, arranged for automatically turning said shafts and yoked sleeves, with the vertically movable pinion D¹⁸, idle pinion D¹⁷, toothed wheels D¹⁶ and D⁹, on shafts D³, D⁴, respectively, and means substantially as described for moving the pinion D¹⁸ into gear with the wheel D⁹, and either with the wheel D¹⁶ or the pinion D¹⁷, and for registering the same for hand adjustment, substantially as and for the purpose herein shown and described.

22. The combination of the fabric-frame of an embroidery machine with mechanism substantially as described for adjusting it automatically in a vertical and horizontal direction from a Jacquard card, and with mechanism substantially as described for setting it by hand, and locking mechanism connected to the hand operated mechanism for locking the automatic mechanism as long as the hand operated mechanism is in position for operation, as specified.

23. The combination of the vertically movable bracket D¹⁹ and its handle D²⁰, and spur wheel D¹⁸ with the carrying shaft D⁴ of said bracket, pins D²¹, crank D²², and vertical dowel-pin D²³, substantially as and for the purpose herein shown and described.

24. The combination of the vertically movable bracket D¹⁹ and its handle D²⁰, and spur wheel D¹⁸ with the carrying shaft D⁴ of said bracket, pins D²¹, crank D²², vertical dowel-pin D²³, and with the arm *d*¹¹ on said bracket, stops *d*¹², *d*¹³ on said arm, and shaft D³, substantially as described.

25. The combination of the vertically movable bracket D¹⁹ and its handle D²⁰, and spur wheel D¹⁸ with the carrying shaft D⁴ of said bracket, pins D²¹, crank D²², vertical dowel-pin D²³, with the arm *d*¹¹ on said bracket, stops *d*¹², *d*¹³ on said arm and shaft D³, and with the pins *d*¹⁴, *d*¹⁵ and *d*¹⁶ carried by said arm *d*¹¹, two of which pins are adapted to enter a socket in the upper end of the shaft D³, while the third pin *d*¹⁶ is incapable of entering said socket as and for the purpose specified.

26. The combination of the racks J, J′, J², J³, and means substantially as described for moving them, with the gear-wheels D⁷, D⁸, D¹¹, D¹² adapted to be engaged by said racks, and the shaft D⁴ carrying one of said gear-wheels, with the vertically movable hand-driven pinion D¹⁸ and pin D²³, which is adapted to enter between the teeth of the pinion D¹⁸, all arranged so that said pinion D¹⁸ will be prevented from being lifted by said pin D²³, unless the said racks are in position to be engaged to their respective gear-wheels, as and for the purpose specified.

27. The combination of the racks J, J′, J², J³, and means substantially as described for moving them, with the gear-wheels D⁷, D⁸, D¹¹, D¹², adapted to be engaged by said racks, and the shaft D⁴ carrying one of said gear-wheels, with the vertically movable hand-driven pinion D¹⁸ and pin D²³, which is adapted to enter between the teeth of the pinion D¹⁸, all arranged so that said pinion D¹⁸ will be prevented from being lifted by said pin D²³ unless the said racks are in position to be engaged to their respective gear-wheels, and with the pointer D²⁵ carried by the shaft of the pinion D¹⁸ for indicating when the said pinion is in position to be lifted, as and for the purpose specified.

28. The combination of the rack frames *l* to *l³* with the series of rods *m* to *m³*, each having a perforation, and with the locking bars *k*⁸ having pins *k*⁹ to meet said perforations, and with means substantially as described for moving said locking bars up and down, and with the slides G′ to G⁷, all as and for the purpose specified.

29. The combination of the rack frames *l* to *l³* with the series of rods *m* to *m³*, each having a perforation, and with the locking bars *k*⁸ having pins *k*⁹ to meet said perforations, and with means substantially as described for moving said locking bars up and down, and with the slides G′ to G⁷, and the stationary block G⁰, all as and for the purpose specified.

30. The combination of the embroidering frame, with racks *d e* for moving it, pinions *f g* for moving said racks, differential gearing substantially as described for moving said pinions, double racks J to J³ for controlling the motion of said differential gearing, means substantially as described for moving said double racks longitudinally and laterally from a Jacquard-card, and rod *k*¹¹ adapted to be moved by the Jacquard card, and mechanism substantially as described connected with said rod *k*¹¹ for stopping the machine, as and for the purpose described.

31. The fabric-frame of an embroidering machine combined by means substantially as described with a differential gearing, Jacquard pins controlling said differential gearing, means for connecting the Jacquard pins with the differential gearing, and a Jacquard card for selecting the pins to control the differential gearing, substantially as described.

32. The combination of a slotted Jacquard drum E² with the slotted or notched stepping-wheel E⁹, spurs *e*⁶ and pawl E¹¹, the notches of the wheel E⁹ corresponding to the slots of the drum E², as and for the purpose specified.

33. The combination of a slotted Jacquard drum E² with the slotted or notched stepping-

wheel E^9, spurs e^6 and pawl E^{11}, the notches of the wheel E^9 corresponding to the slots of the drum E^2, and with the fixed pawl E^{15}, as and for the purpose specified.

34. The combination of the lever E^{10} and means substantially as described for moving it at regular intervals and of the pawl E^{11} carried by said lever, with the notched stepping-wheel E^9, fixed pawl E^{15}, Jacquard drum E^2, and means substantially as described for swinging said Jacquard drum and said stepping-wheel, all as and for the purpose specified.

35. The combination of the shaft E^6, hangers E^5 and Jacquard drum E^2, with the sprocket-wheels e^8 and e^{10}, sprocket chains e^9 and roller e^{11}, and with the string of Jacquard cards E, as and for the purpose specified.

36. The combination of the string of Jacquard cards E and Jacquard drum E^2, with the sprocket-wheels e^8 and e^{10}, sprocket-chains e^9, roller e^{11}, and with the shaft E^{16} and gravity pawl e^{37}, as and for the purpose specified.

37. The combination of the slides or needles i, having inclined faces o^2, with the wedge-shaped levers i^9 adapted to contact with said inclined faces, and with mechanism substantially as described for moving said slides and said levers, substantially as and for the purpose described.

38. The combination of the slides i, having inclined faces o^2, double racks J to J^3, mechanism substantially as described intervening between said double racks and said slides i for communicating the motion of the slides to said racks, wedge-shaped levers i^9 adapted to contact the inclined faces o^2, and means substantially as described for unlocking the racks by said levers i^9, as specified.

39. The combination of the meshing slides L to L^3, of the double racks J to J^3, with the V-shaped links F to F^3, having jaws on their inner faces, pins F^4, F^5, shaft F^6 carrying said pins, link F^8 connected with said shaft, and means substantially as described for moving said link, all as specified.

40. The combination of the meshing slides L to L^3, of the double racks J to J^3, with the V-shaped links F^3, having jaws on their inner faces, pins F^4, F^5, shaft F^6 carrying said pins, link F^8 connected with said shaft, and means substantially as described for moving said link, and with the bars f^3, f^2, f', f, connected with the links F^3, F^2, F', F, and stationary block G^0, substantially as and for the purpose set forth.

41. The combination of the meshing slides L to L^3, of the double racks J to J^3, with the V-shaped links F to F^3, having jaws on their inner faces, pins F^4, F^5, shaft F^6 carrying said pins, link F^8 connected with said shaft, means substantially as described for moving said link, with the bars f to f^3 connected with the links F to F^3, and stationary block G^0, and with the intervening crank levers f^{33} standing in opposite directions, as and for the purpose specified.

42. The combination of the meshing slides L to L^3, of the double racks J to J^3, with the V-shaped links F to F^3, having jaws on their inner faces, pins F^4, F^5, shaft F^6 carrying said pins, link F^8 connected with said shaft, means substantially as described for moving said link, with the bars f to f^3 connected with the links F to F^3, stationary block G^0, intervening crank levers f^{33} standing in opposite directions, and with the locking-bars k^8, lifting bars k^7, and means substantially as described for moving the latter up and down, as set forth.

43. The combination of the lever A' and its link A^2, and means substantially as described for moving said link and said lever at regular intervals, with the lever A^3, coupling-pin a^6 having dowel-pin a^7, rod a^{12} and rod k^{10}, and means substantially as described for communicating motion to said rod k^{10} by the Jacquard card, all as described.

44. The combination of the lever A' and its link A^2, and means substantially as described for moving said link and said lever at regular intervals, with the lever A^3, coupling pin a^6 having dowel-pin a^7, rod a^{12} and rod k^{10}, and means substantially as described for communicating motion to said rod k^{10} by the Jacquard card, and with the rod A^5 connected to the lever A^3, substantially as and for the purpose specified.

45. The combination of the lever A' and its connecting link A^2 and means substantially as described for imparting a regular to and fro movement to said lever and said link, with the lever A^4, its coupling and dowel pins and rod k^{11} adapted to be moved by the Jacquard card, as and for the purpose specified.

46. The combination of the lever A' and its connecting link A^2, and means substantially as described for imparting a regular to and fro movement to said lever and said link, with the lever A^4, its coupling and dowel pins, and rod k^{11} adapted to be moved by the Jacquard card, and with the swivel A^6 and rod A^7, which is adapted to be connected with the shipping lever, as and for the purpose herein shown and described.

47. The combination of the lever A' and its connecting link A^2, and means substantially as described for imparting a regular to and fro movement to said lever and said link, with the lever A^4, its coupling and dowel pins, rod k^{11} adapted to be moved by the Jacquard card, swivel A^6 and rod A^7, which is adapted to be connected with the shipping lever, and with the latch A^8, lever A^{10}, spring A^{14} and slotted shoe A^{12}, as and for the purpose specified.

48. The combination of the lever A' and its connecting link A^2 and means substantially as described for imparting a regular to and fro movement to said lever and said link, with the lever A^4, its coupling and dowel-pins, rod k^{11} adapted to be moved by the Jacquard card, swivel A^6 and rod A^7 which is adapted to be connected with the shipping lever, with

the latch A^8, lever A^{10}, spring A^{14} and slotted shoe A^{12}, and with the levers a^{20} and a^{21}, and wires a^{23} and a^{24}, as and for the purpose specified.

49. The combination of the pattern-frame a^{33} with the loose pin a^{29}, crank a^{27} bearing on said pin, crank a^{25} and wire a^{23}, and mechanism substantially as described for connecting said wire a^{23} with the stopping mechanism, all arranged so that whenever the point of the pin a^{29} strikes the edge of the pattern-frame the machine will be stopped, as specified.

50. The combination of the rod A^{21} with the three-winged crank A^{17}, rod A^{22}, means substantially as described for moving said three-winged crank, clutch mechanism substantially as described connected to rod A^{21}, and hand-operating device, substantially as described connected to rod A^{22}, all as specified.

51. The combination of the hand operating pinion D^{18} with the lever A^{24} placed under said pinion and with the rod A^{22} connected with said lever, and means substantially as described for operating said rod A^{22}, as and for the purpose specified.

52. The combination of the meshing pins F^4 F^5 and their brackets F^9, and their shaft F^6, with the sliding pin F^{10}, winged pawl F^{11}, and rod A^{22}, all as and for the purpose specified.

53. The combination of the meshing pins F^4, F^5 and their brackets F^9, and their shaft F^6, with the sliding pin F^{10}, winged pawl F^{11}, and rod A^{22}, and with the brackets F^{13} and bar F^{14}, all as and for the purpose specified.

54. The shear-blades P^{11} and P^{13} combined with the slides i and with notched and movable bar P^{15}, as and for the purpose specified.

55. The shear-blades P^{11} and P^{13} combined with the slides i and with notched and movable bar P^{15}, and with the crank Q^3 and contracting or shearing-levers p^9 and p^{11}, as and for the purpose specified.

56. The shear-blades P^{11} and P^{13} combined with the slides i and with notched and movable bar P^{15}, crank Q^3, contracting or shearing levers p^9 and p^{11}, and with the pin p^{10} and crank p^{14} and sliding pin P^{10}, as and for the purpose specified.

57. The shear-blades P^{11} and P^{13} combined with the slides i and with notched and movable bar P^{15}, crank Q^3, contracting or shearing-levers p^9 and p^{11}, pin p^{10}, crank p^{14}, sliding pin P^{10}, and with the bar O^4, as described.

58. The combination of the Jacquard pins h and means substantially as described for moving them, with the slides i, bar O, crank O^3, bar O^4 and cam Q, all as and for the purpose described.

59. In a fabric-moving-mechanism for embroidering machines, the combination of a fabric-frame, a series of Jacquard pins arranged in two or more groups or sets, mechanism intervening between each of the said pins and the fabric-frame, operating when actuated, to move the fabric-frame on one and the same line, and mechanism controlled by each pin for actuating said mechanism for moving the frame, compounding mechanism substantially as described for compounding the movements imparted to the intervening mechanism by the action of two or more selected pins, so that the movement of the fabric-frame on one line is the resultant of the several motions imparted to said intervening mechanism by the several selected pins, and a Jacquard pattern for selecting one or more pins from each of the groups, substantially as and for the purposes set forth.

60. In a fabric-moving-mechanism for embroidering machines, the combination with a fabric-frame, of a guide C therefor, with a cooperating guide B for moving the frame on one line, actuating mechanism connected to said guide for moving it, a series of Jacquard pins, each of which, when connected, imparts a different degree of movement to the actuating mechanism for the guide B, compounding mechanism connected to the actuating mechanism for the guide for compounding the several motions given by the two or more selected pins, whereby the motion imparted to the guide is the resultant of the several motions given by the pins, and a Jacquard pattern for selecting two or more pins which are adapted to thus jointly effect the adjustment on one line of the fabric-frame, substantially as and for the purposes set forth.

61. In a fabric-moving-mechanism for embroidering machines, the combination with a fabric-frame, of a series of Jacquard pins, each of which, when actuated, imparts a different extent of motion to the said fabric-frame on one line, together with compounding mechanism acting to compound the motions given by the two or more selected pins, whereby the movement of the fabric-frame on one line is the resultant of the several motions given by the selected pins, and with a Jacquard drum and pattern for selecting and actuating the pins, substantially as and for the purposes set forth.

62. In a fabric-moving-mechanism for embroidering machines, the combination with a fabric-frame, of a series of Jacquard pins, each of which, when actuated, imparts a different extent of motion to the said fabric-frame on one line, together with compounding mechanism acting to compound the motions given by the two or more selected pins, whereby the movement of the fabric-frame on one line is the resultant of the several motions given by the selected pins, with another series of pins, each of which, when actuated, imparts a different degree of motion to the fabric-frame on one line at an angle to the first line, compounding mechanism acting to compound the motions given by the two or more selected pins of the last named series, whereby the movement of the fabric-frame on the last mentioned line is the resultant of the several motions given by the last mentioned series of pins, combined with pattern mechanism for selecting and actuating the pins, all arranged so that the pins

will effect, by their combined action, the extent of motion of the fabric-frame, substantially as and for the purposes specified.

63. In a fabric-moving-mechanism for embroidering machines, the combination with a fabric-frame, of a series of Jacquard pins, each of which, when actuated, imparts motion to the said fabric-frame on the same line, differing in extent only, together with compounding mechanism acting to compound the motions given by the two or more selected pins, whereby the movement of the fabric-frame on one line is the resultant of the several motions given by the selected pins, and mechanism substantially as described for determining the direction of said movement, and with a Jacquard drum and pattern for selecting and actuating the pins, substantially as and for the purposes set forth.

64. In a fabric-moving-mechanism for embroidering machines, the combination with a fabric-frame, of a series of Jacquard pins acting to impart movement to the fabric-frame on one line, with compounding mechanism substantially as described for compounding the motions given by the two or more pins, whereby the movement of the frame is the resultant of the several motions given by the two or more selected pins, and means for selecting the pins to adjust the fabric-frame, substantially as and for the purposes specified.

65. Fabric-frame of an embroidering machine, combined by means substantially as described with compounding mechanism, a swinging lever adapted to be connected with the compounding mechanism to actuate the same, and means for connecting the compounding mechanism to the lever at points at varying distances from its fulcrum, and a Jacquard card for controlling the compounding mechanism, substantially as described.

66. Fabric-frame of an embroidering machine, combined by means substantially as described with a differential gearing, a swinging lever adapted to be connected with the differential gearing to actuate the same, and means for connecting the differential gearing with the lever at points at varying distances from its fulcrum, and a Jacquard card for controlling the connections between the lever and differential gearing, substantially as described.

67. The combination of the Jacquard pins *h h* and a Jacquard card for selecting and moving the same, with the slides *i* in alignment with said pins and adapted to be moved by said pins, means for so moving said slides, and mechanism substantially as described for returning the slides *i* and the pins *h* to their normal positions, when the Jacquard card is carried out of the way, as and for the purpose specified.

68. The combination of the slides *i* arranged in groups or sets and adapted to be moved by the Jacquard pattern and means substantially as described for so moving the same, with a corresponding number of shears adapted to grasp the slides, mechanism for bringing the slides to a normal position out of the grasp of the shears when more than one slide of the group is between said shears, and mechanism substantially as described for moving said shears and causing them to grasp the slides and connecting them with the mechanism for bringing the slides to the normal position, as set forth.

69. The combination of the slides *i* adapted to be pushed by the pattern device substantially as described, and means substantially as described for so pushing the same, with the locking bar O and means substantially as described for moving the same, as specified.

70. The combination of the Jacquard pins with a pattern device adapted to move the Jacquard pins, and means substantially as described for so moving the same, and with a cross-bar i^{14a}, and means substantially as described for moving said cross-bar, together with intermediate mechanism between the cross-bar and pins for returning the pins to their normal position, all arranged so that said cross-bar will bring the pins back to their normal position after they have been moved by the pattern device, as specified.

71. The combination of the shaft D^2 with the yoked sleeve D^6 carried by said shaft, said yoked sleeve having the pinions d^5 d^6, and with the shaft D^4 aligned with the shaft D^2, all arranged to produce a differential movement and a varying degree of movement in the shaft D^2, as specified.

72. The combination of the embroidering frame with racks *d e* for moving it, pinions *f g* for moving said racks, differential gearing substantially as described for moving said pinions, double racks J to J^3 for controlling the motion of said differential gearing, and means substantially as described for moving said double racks longitudinally and laterally by Jacquard pins adapted to be moved by a Jacquard card, and means substantially as described for automatically stopping the machine, all as specified.

73. The combination of the embroidering frame with racks *d e* for moving it, pinions *f g* for moving said racks, differential gearing substantially as described for moving said pinions, double racks J to J^3 for controlling the motion of said differential gearing, and means substantially as described for moving said double racks longitudinally and laterally by Jacquard pins adapted to be moved by a Jacquard card, as specified.

74. The combination in an embroidering machine, of a fabric-frame, actuating-mechanism therefor, a plurality of moving mechanisms for imparting varying ranges of movement to the fabric-frame actuating-mechanism, to move the fabric-frame on one line, mechanism for compounding the motions imparted to the fabric-frame actuating-mechanism by the moving mechanisms, whereby the movement of the fabric-frame on one line

is the resultant of the several motions imparted to the fabric-frame actuating-mechanism by the moving mechanisms, series of Jacquard pins and mechanism connected thereto, substantially as described for selecting and connecting two or more of the moving mechanisms with the fabric-frame actuating-mechanism, and a Jacquard pattern co-operating with and selecting the pins, whereby two or more selected pins can effect by their combined action a predetermined movement of the fabric-frame, substantially as described.

75. The combination of the pattern E and the pattern holder E^2, with the sprocket-wheels e^8 and e^{10}, sprocket-chain e^9 and roller e^{11}, substantially as and for the purpose specified.

76. The combination of the meshing slides L to L^3, of the double racks J to J^3, with the V-shaped links F to F^3, having jaws on their inner faces, pins F^4 F^5, and shaft F^6 carrying said pins, all arranged substantially as specified.

77. The combination of the meshing slides L to L^3, of the double racks J to J^3, with the V-shaped links F^3 having jaws on their inner faces, pins F^4 F^5, shaft F^6 carrying said pins, bars f^3, f^2, f' and f connected with the links F^3, F^2, F', and F, and block G^0, substantially as and for the purpose specified.

78. The combination of the meshing slides L to L^3, of the double racks J to J^3, with the V-shaped links F to F^3 having jaws on their inner faces, pins F^4 F^5, shaft F^6 carrying said pins, bars f to f^3 connected with the links F to F^3, block G^0, and intervening crank levers f^{33}, as and for the purpose described.

79. The combination of the meshing slides L to L^3, of the double racks J to J^3, with the V-shaped links F to F^3 having jaws on their inner faces, pins F^4 F^5, shaft F^6 carrying said pins, bars f to f^3 connected with the links F to F^3, block G^0, intervening crank levers f^{33}, and locking bars k^8, lifting bars k^7, and means substantially as described for moving the latter up and down, as set forth.

80. In a machine of the class described, the combination of the lever A' and means substantially as described for moving said lever at regular intervals, with the lever A^3 and coupling-pin a^6, and means substantially as described for communicating motion to said coupling-pin, as specified.

81. In a machine of the class described, the combination of the lever A' and means substantially as described for imparting a regular to and fro movement to said lever, with the lever A^4, its coupling-pins adapted to be moved by the Jacquard card, as and for the purpose specified.

82. In a machine of the class described, the combination of a pattern frame with a pattern-tracer movable therein, a device for stopping the machine, and mechanism substantially as described connecting said pattern-tracer with the device for stopping the machine, all arranged so that when the pattern-tracer is moved in contact with the walls of the frame it will be deflected, thereby actuating the device for stopping the machine, as specified.

83. The shear-blades P^{11} and P^{13} combined with the slides i, and means substantially as described for moving the slides and operating the shear-blades, substantially as and for the purpose specified.

84. In fabric-moving-mechanism for embroidering machines, the combination of a plurality of double racks for moving the fabric-frame, a swinging lever having link mechanism connected thereto at varying distances from its fulcrum, means for connecting one or more of the racks to one or more of the mechanisms connected to the lever, Jacquard pins controlling the connection of the racks with the lever, and pattern mechanism for selecting and actuating the pins, and means for moving the lever, whereby varying ranges of movement may be imparted to the racks, as specified.

85. The combination in an embroidering machine of a fabric-frame, actuating-mechanism therefor, a plurality of moving mechanisms for imparting varying ranges of movement to the fabric-frame actuating-mechanism, to move the fabric-frame on one line, mechanism for compounding the motions imparted to the fabric-frame actuating-mechanism by the moving mechanisms whereby the movement of the fabric-frame on one line is the resultant of the several motions imparted to the fabric-frame actuating-mechanism by the moving mechanisms, series of Jacquard pins and mechanism connected thereto substantially as described for selecting and connecting two or more of the moving mechanisms with the fabric-frame actuating-mechanism, and a Jacquard pattern co-operating with and selecting the pins, whereby two or more selected pins can effect by their combined action a predetermined movement of the fabric-frame, and another two or more selected pins in the same manner can effect the movement of the fabric-frame on a line at an angle to the first one, and mechanism also controlled and actuated by the Jacquard pattern for determining the direction of said motions, all adapted and arranged to adjust the position of the fabric-frame for every stitch, as specified.

86. In a fabric-moving-mechanism for embroidering machines, a series of slides G' to G^7, a plurality of guides adapted to be coupled to one or more of the series of slides, coupling pieces k^8 for coupling a guide with a slide, Jacquard mechanism controlling and actuating the coupling pieces and pattern mechanism for selecting and actuating the Jacquard mechanism, all arranged so that the movement of one or more of the slides may be transmitted to one or more of the guides, substantially as described.

87. In fabric-moving-mechanism for em-

broidering machines, shaft D^4 and sleeve D^6 in combination with differential gearing and mechanism substantially as described for effecting and combining the rotations of the shaft D^4 and sleeve D^6, as specified.

88. The fabric-frame of an embroidering machine, combined by means substantially as described with a compounding mechanism, Jacquard pins actuating said compounding mechanism, means for connecting the Jacquard pins with the compounding mechanism, and a Jacquard card for selecting the pins to control the compounding mechanism, substantially as described.

89. The combination in fabric-moving mechanism for embroidering machines, of a fabric frame, pattern mechanism, and series of pins *h* in combination with suitable stoppers and with contacting surfaces connected to the fabric-frame and co-operating with the stoppers, and intervening mechanism substantially as described, by which two or more pins *h* can select by their joint action certain one or ones of the stoppers for co-operating with the contact surfaces to arrest the motion of the fabric-frame, substantially as described.

90. Fabric frame of an embroidering machine and pattern mechanism and series of pins, which can determine different extents of movement of the fabric frame all adapted and arranged with intervening mechanism and connectors k^9 substantially as described for effecting such movement so that such motion is secured in a positive manner by rigid or unyielding connections k^9, substantially as described.

91. Fabric-frame of an embroidering machine, with pattern mechanism, and a plurality of pins controlling the movement of the fabric-frame, said pins determining individually various extents of movement of the fabric-frame on one and the same line, in combination with intervening connecting and moving mechanism substantially as described, by which two or more of said pins can conjointly control the extent of movement of the fabric-frame on the one line for every stitch as specified, and with disconnecting mechanism substantially as described for disconnecting the operating mechanism from the fabric-frame actuating mechanism upon the return stroke, allowing the operating mechanism to return to its normal position leaving the fabric-frame actuating mechanism with the fabric-frame in its proper adjustment.

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