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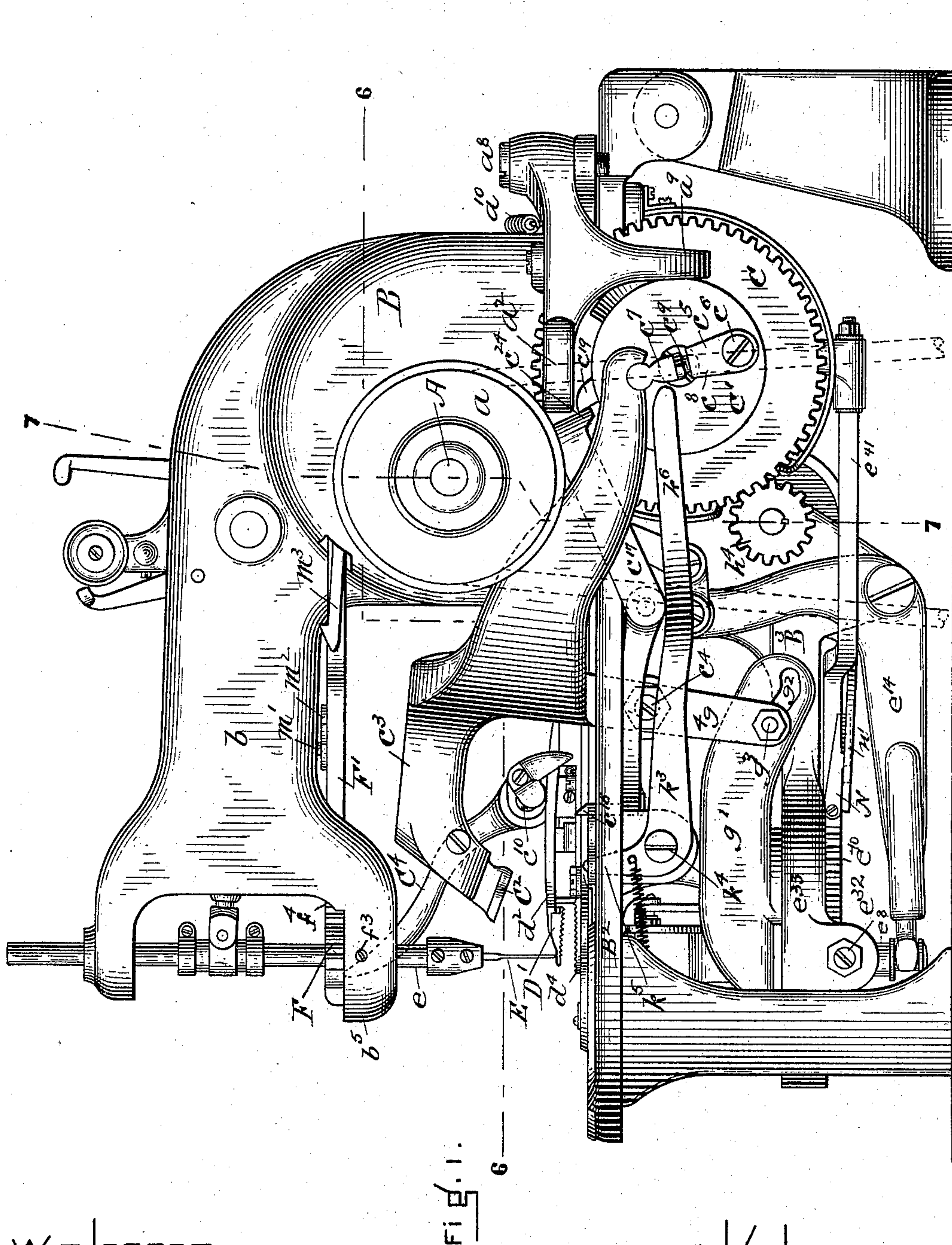
Patented Oct. 18, 1898.

C. A. DAHL.
BUTTONHOLE SEWING MACHINE.

(Application filed Feb. 1, 1897.)

(No Model.)

18 Sheets—Sheet 1.



WITNESSES

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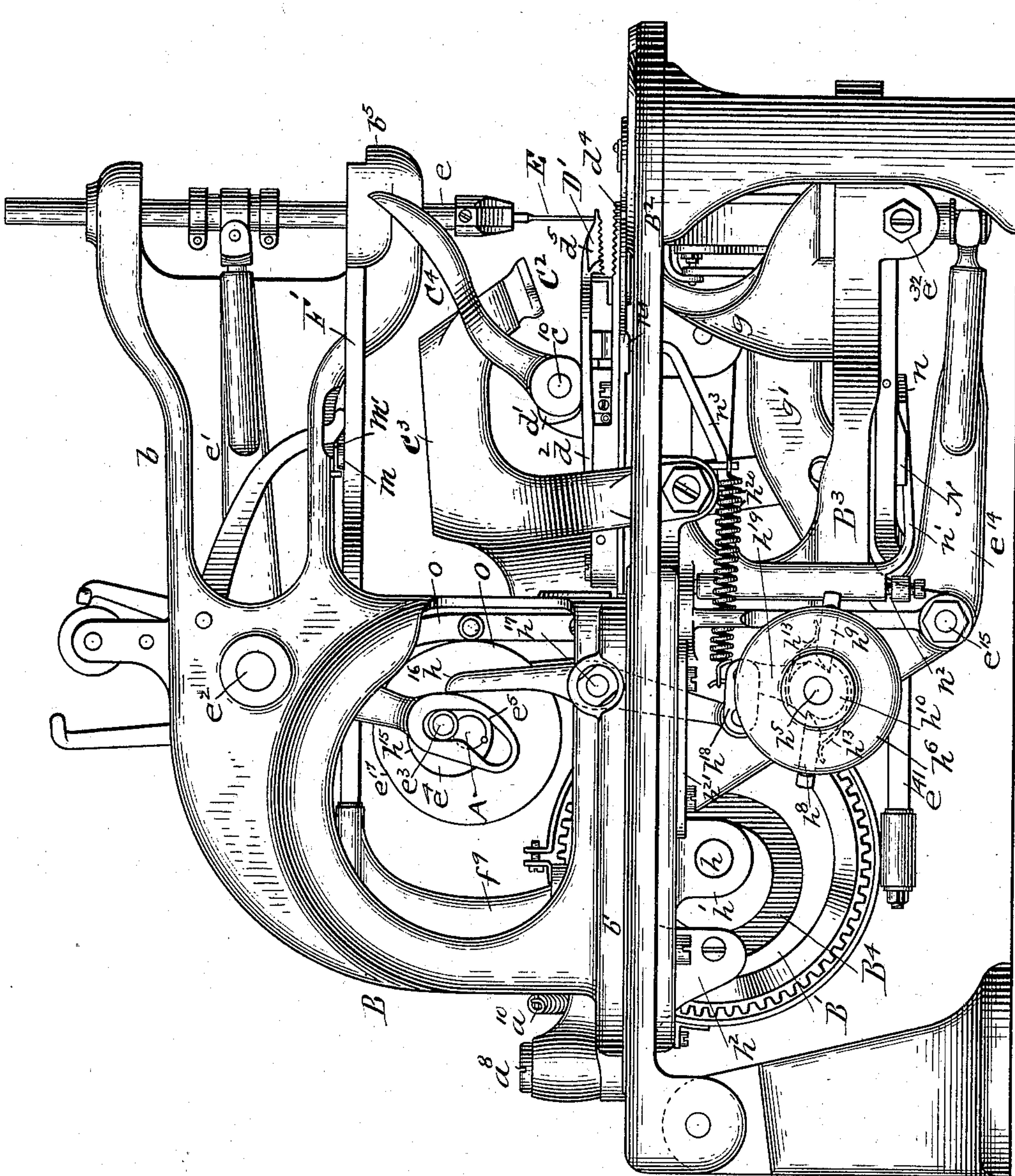
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WITNESSES

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FIG. 2.

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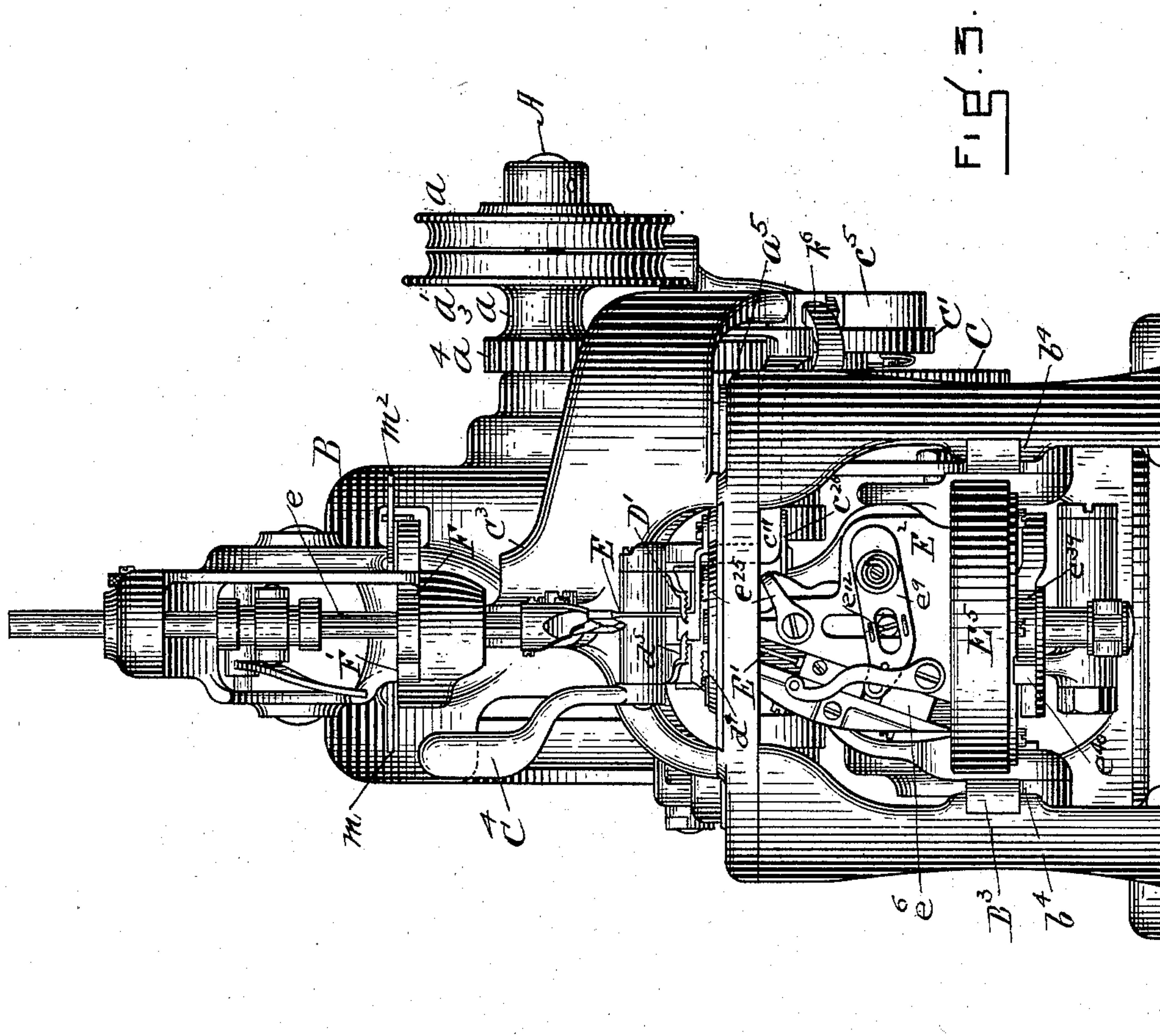
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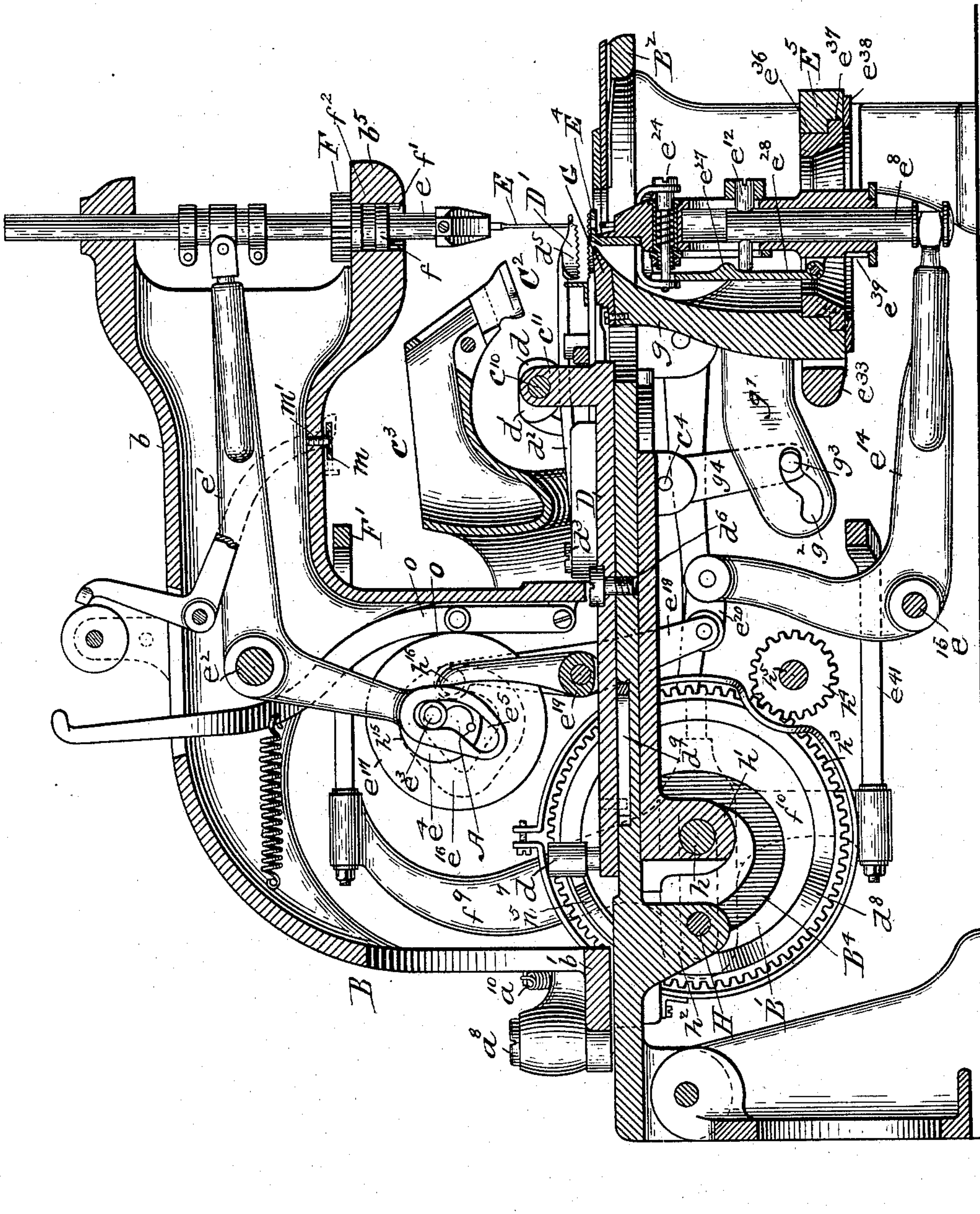
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FIG. 4

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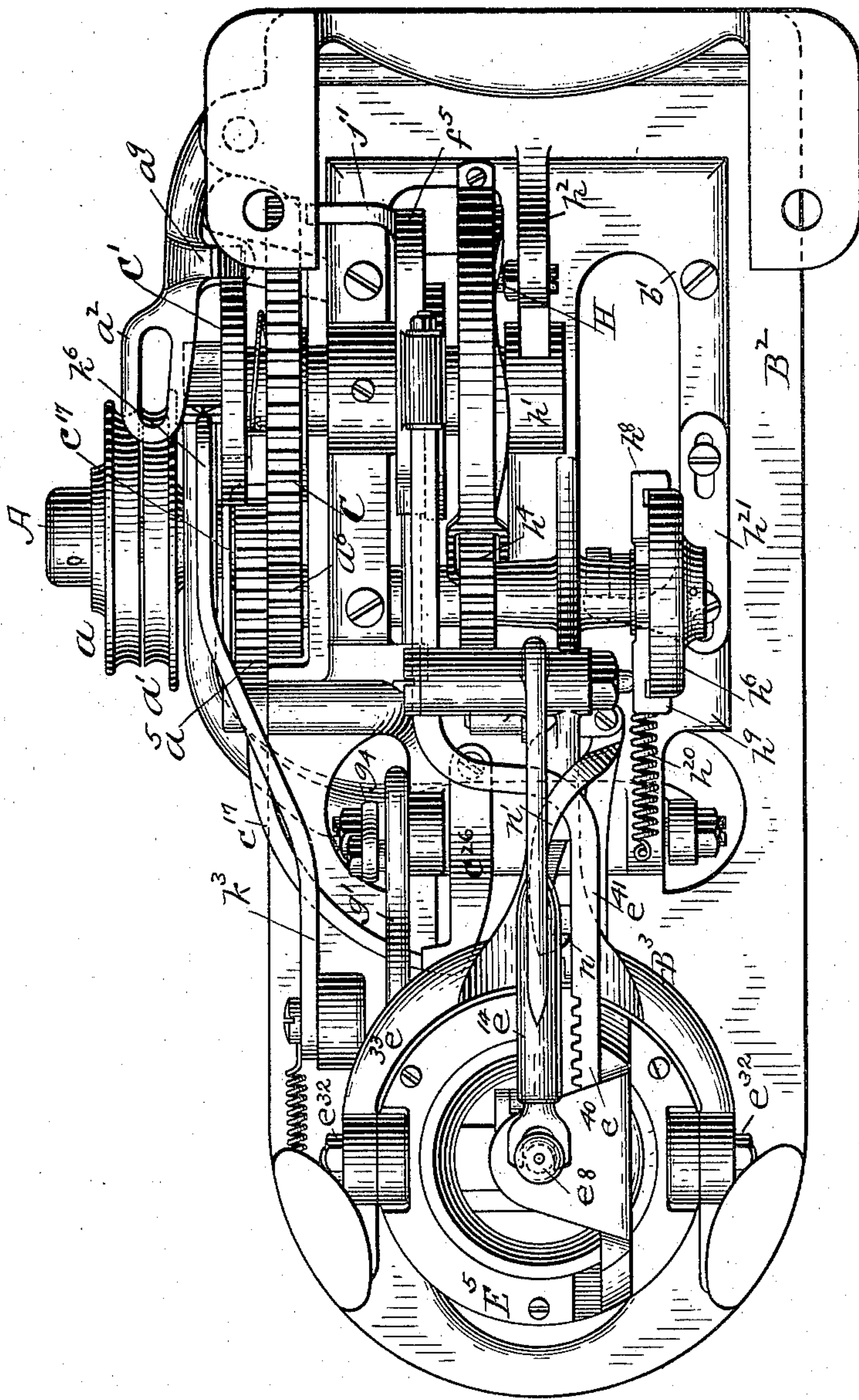
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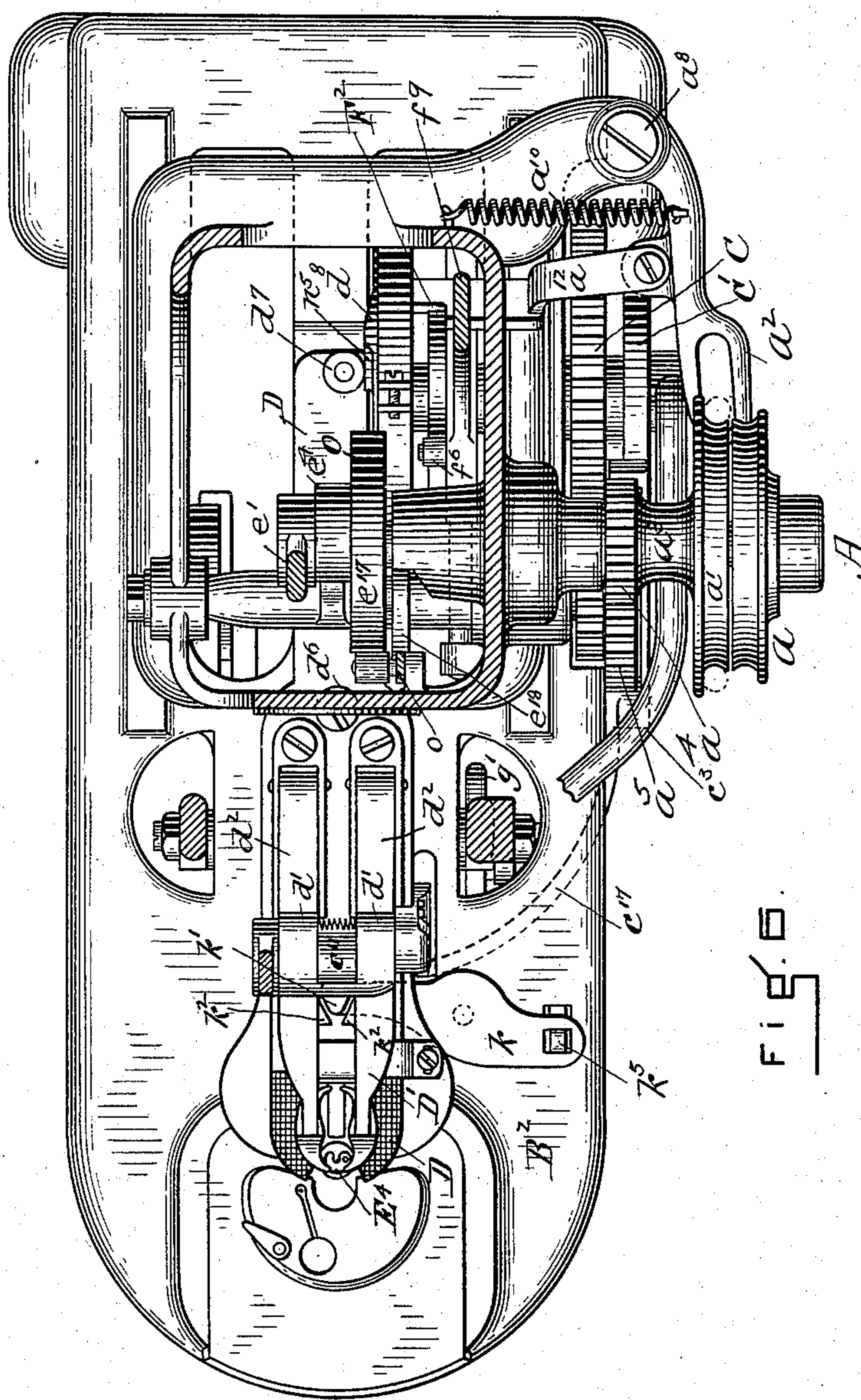
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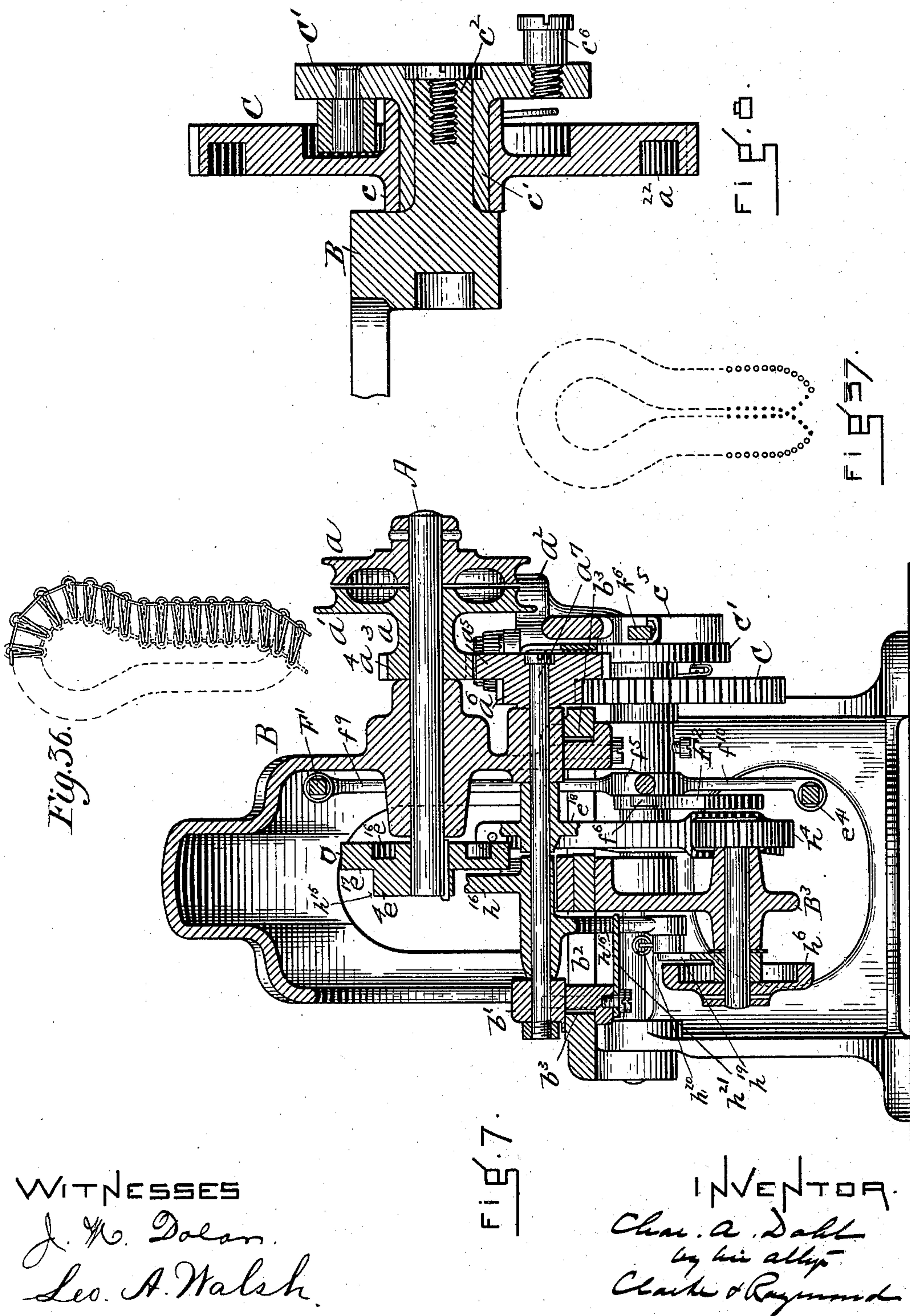
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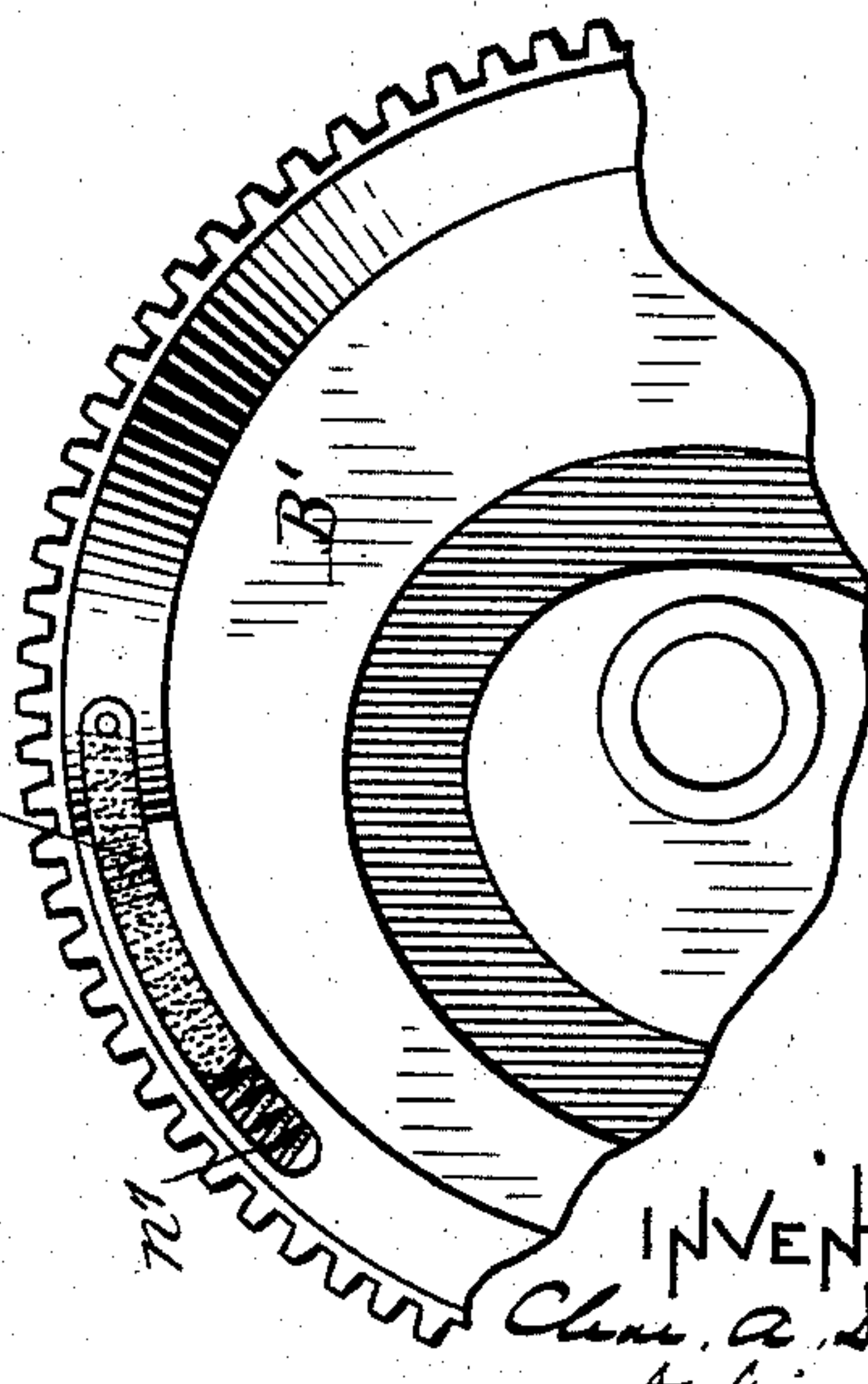
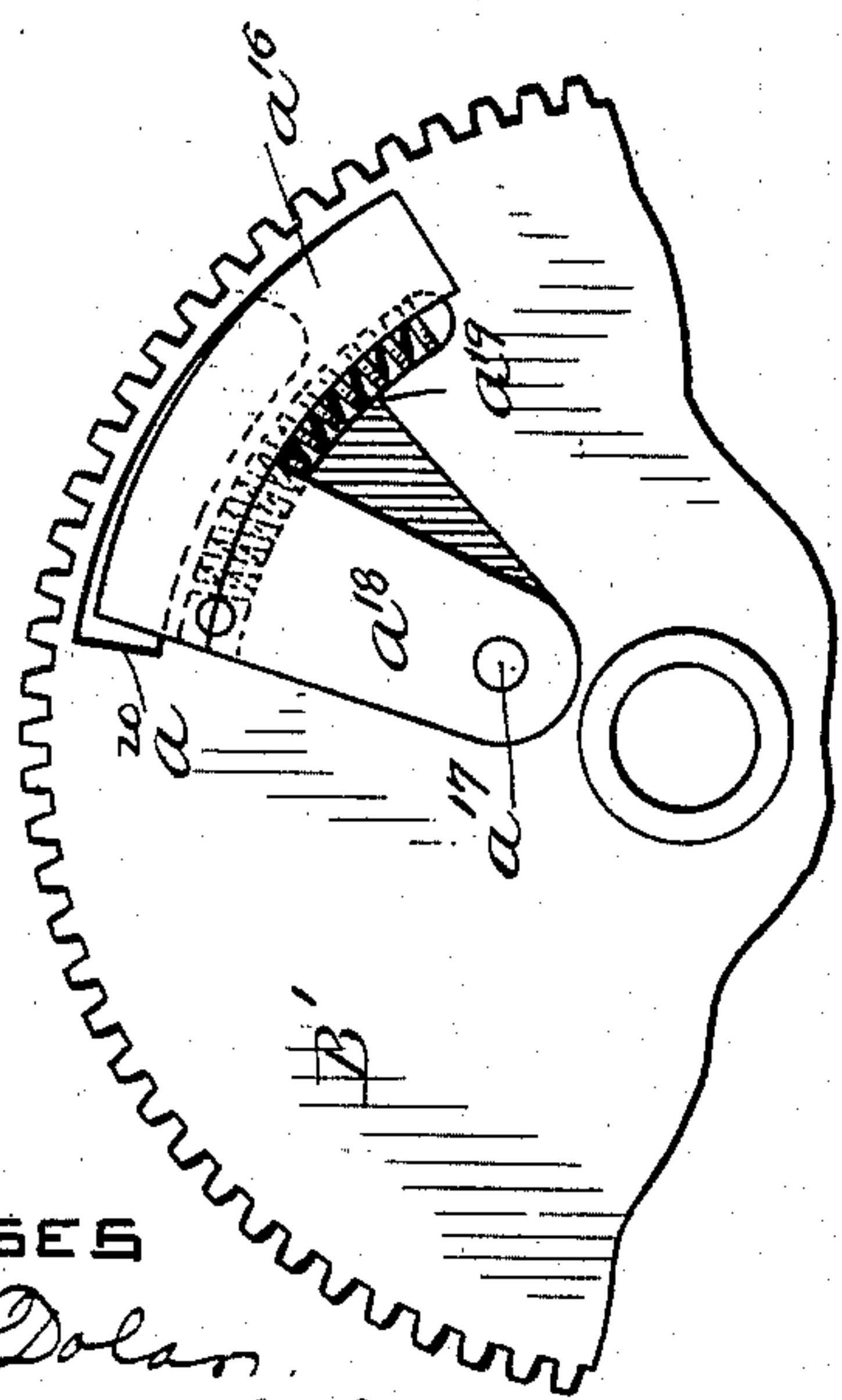
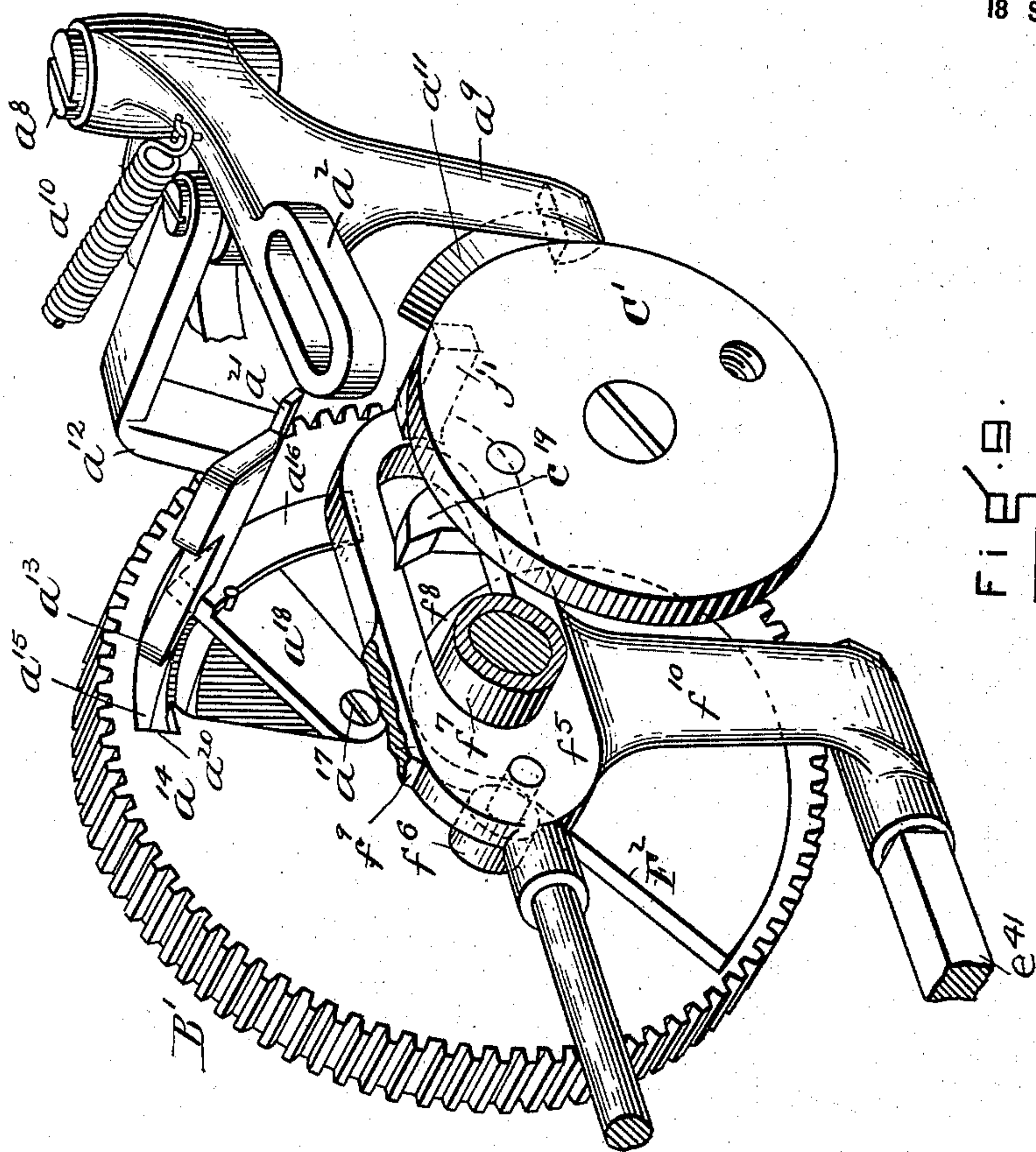
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WITNESSES

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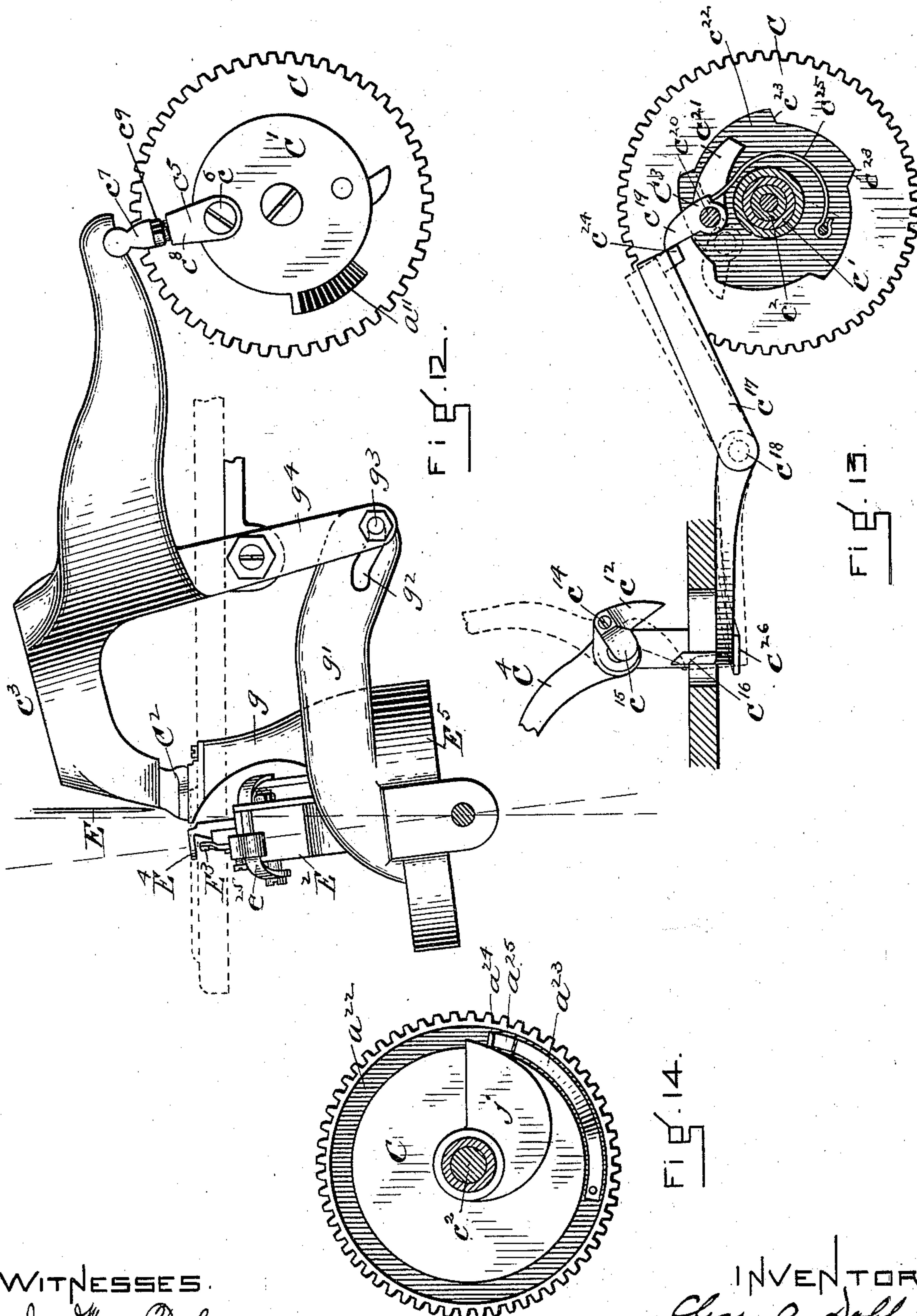
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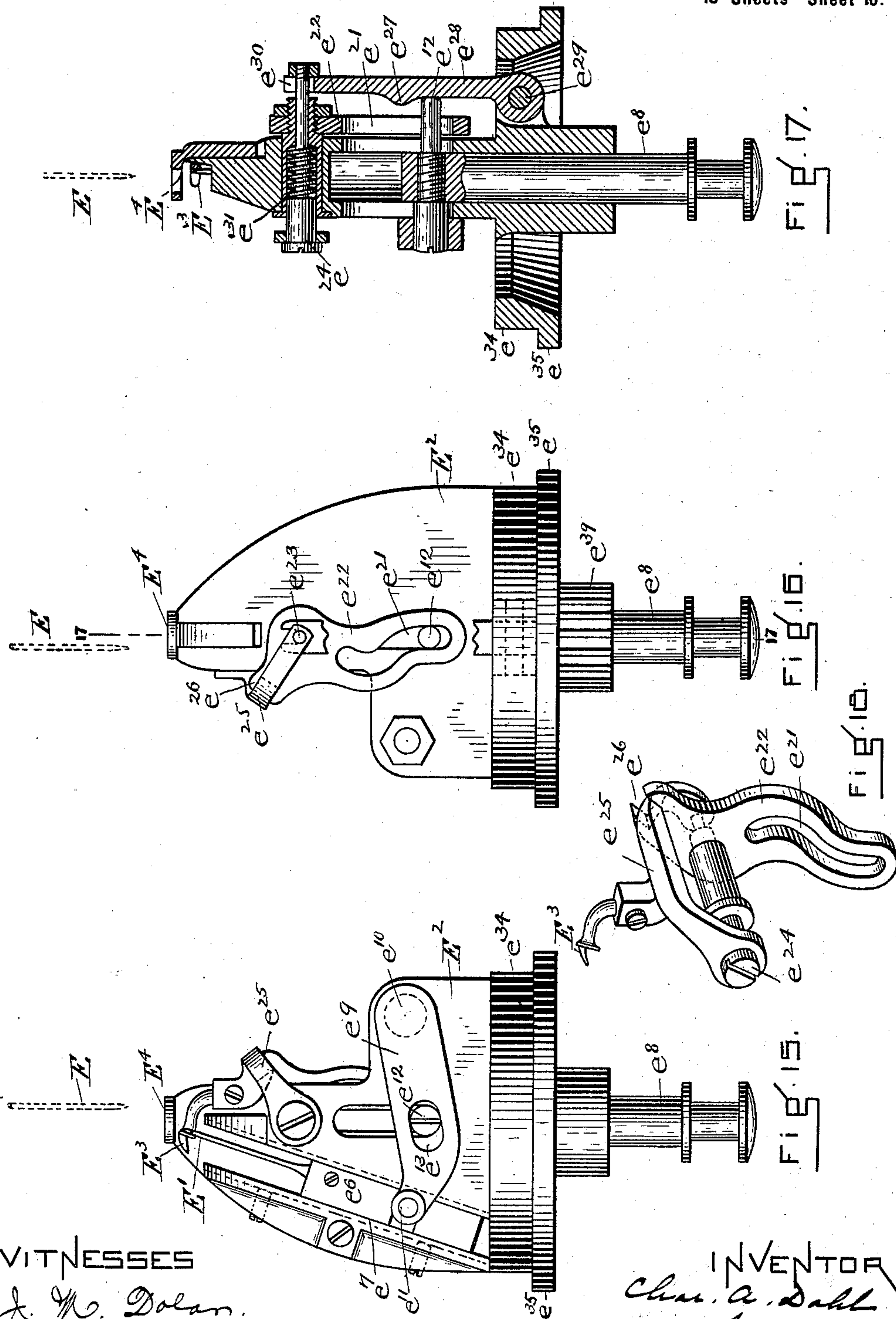
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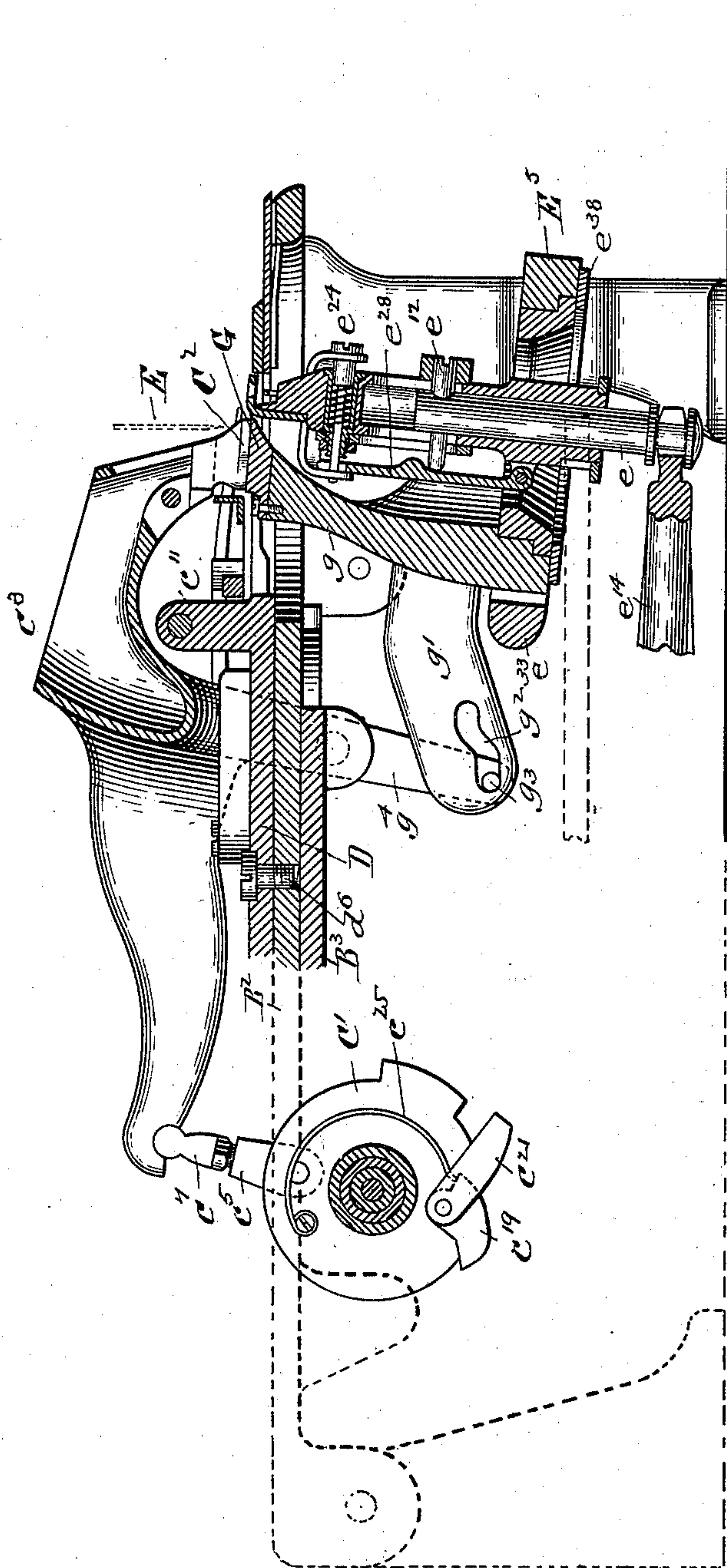


FIG. 19.

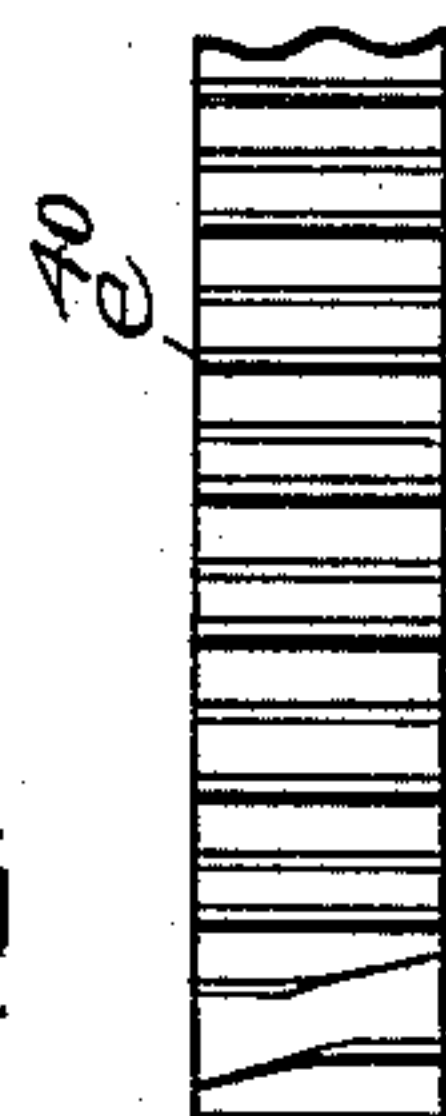


FIG. 20.

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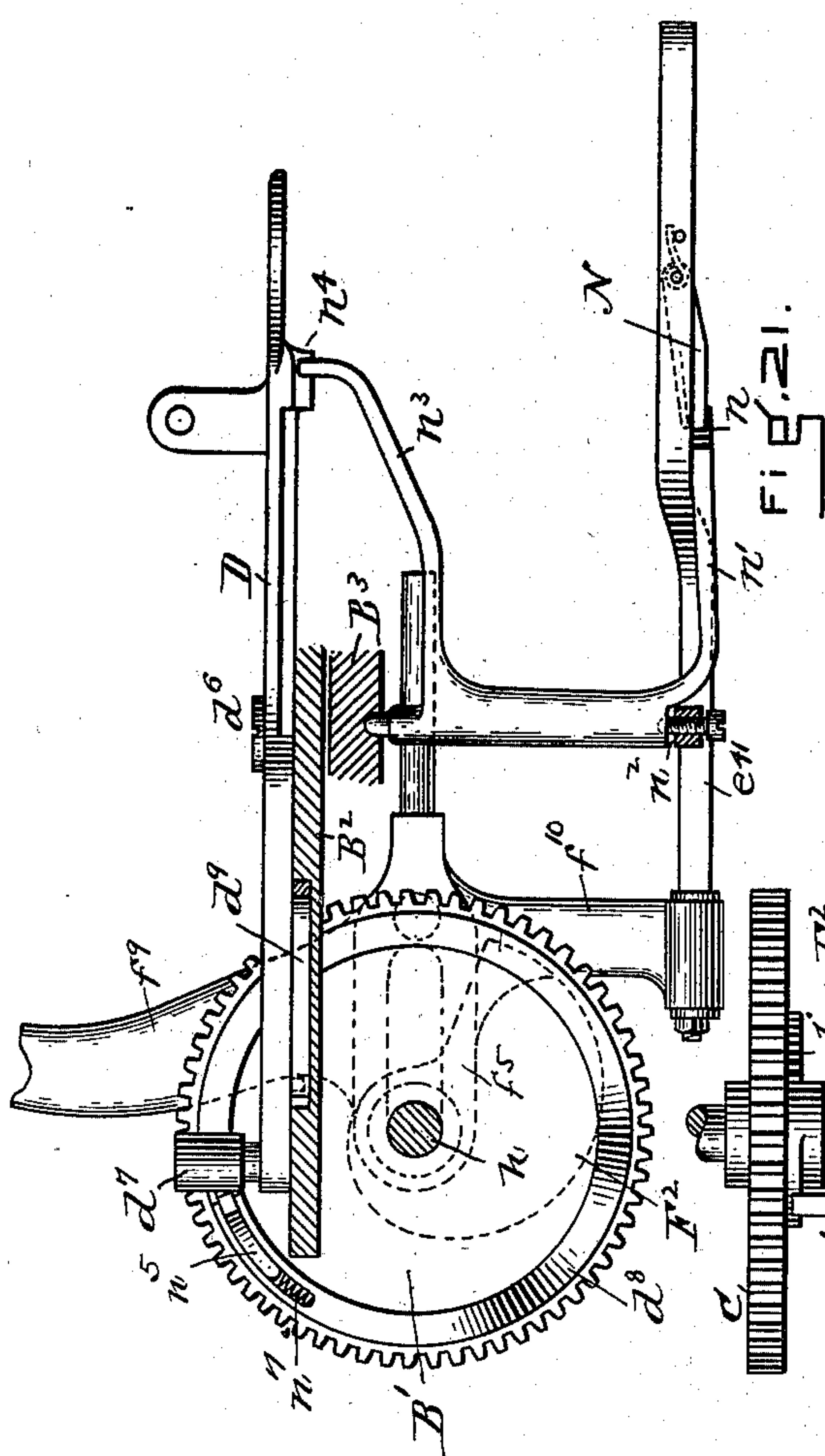


FIG. 21.

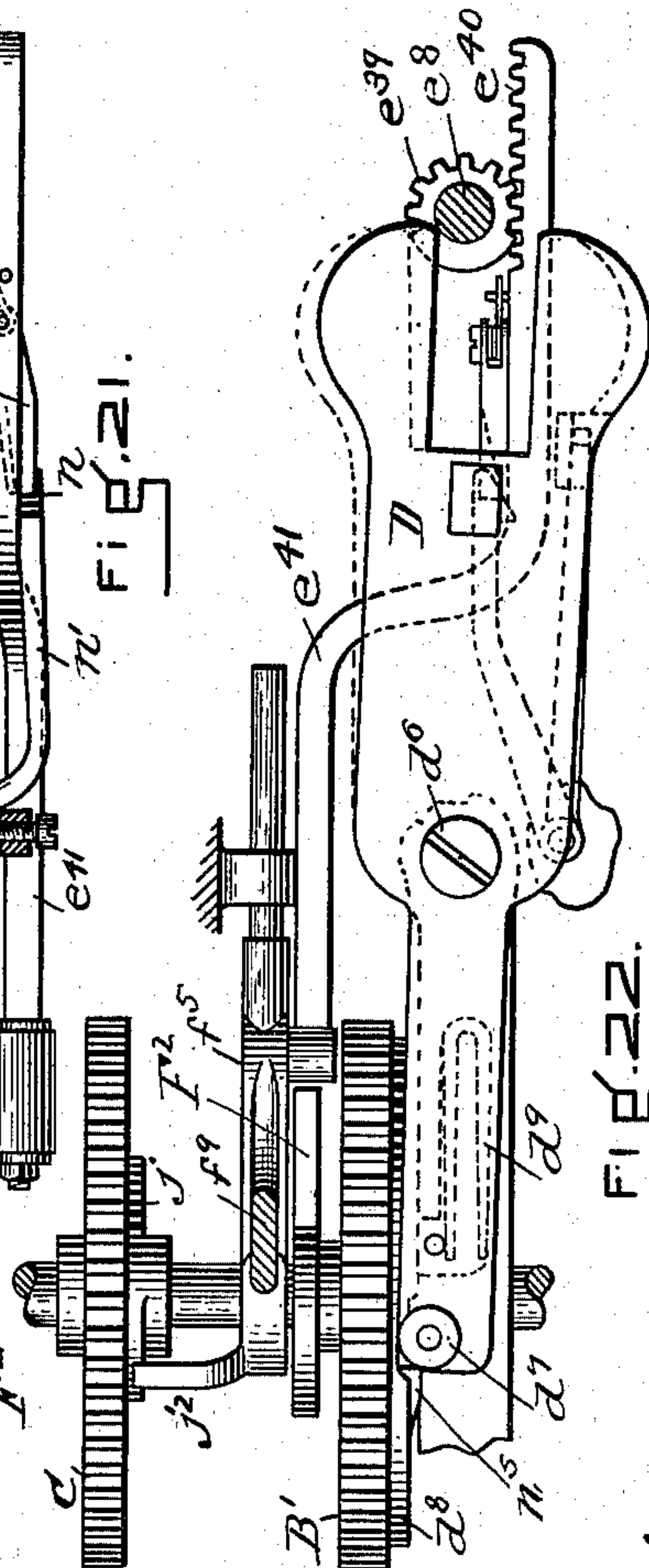


FIG. 22.

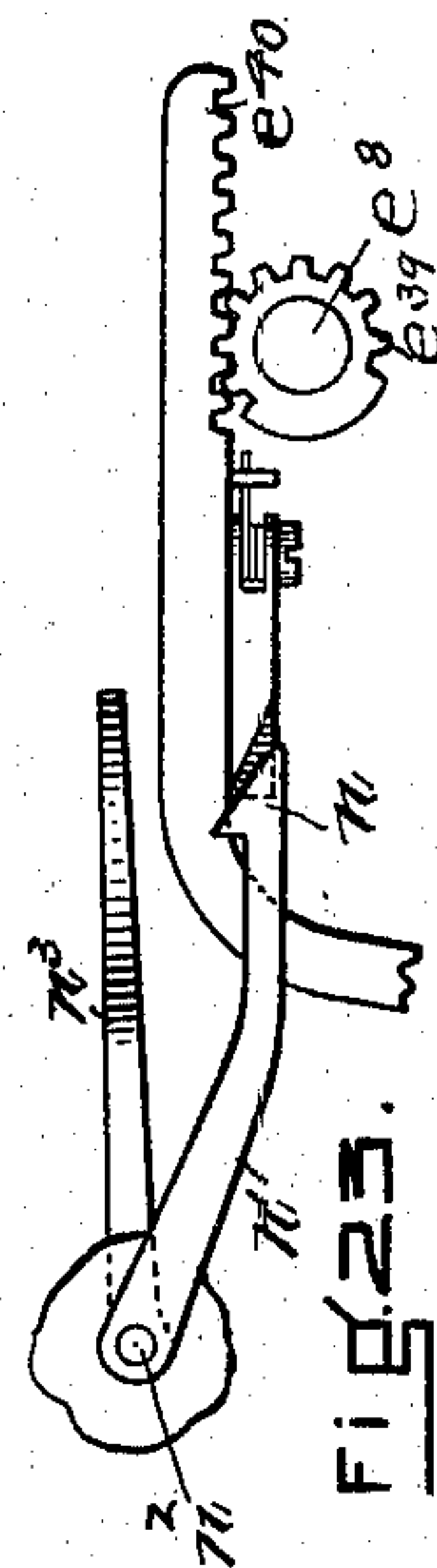


FIG. 23.

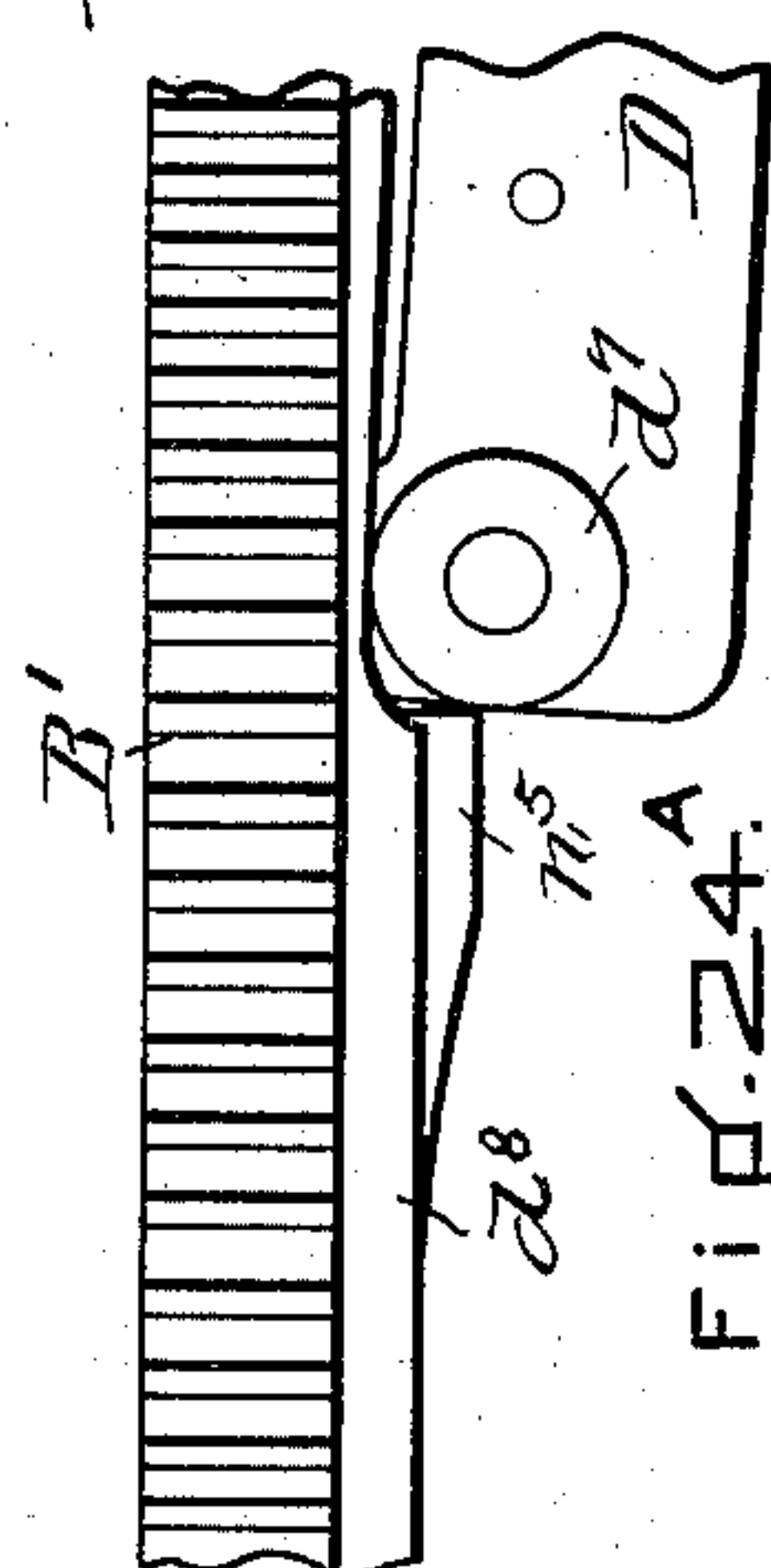


FIG. 24A.

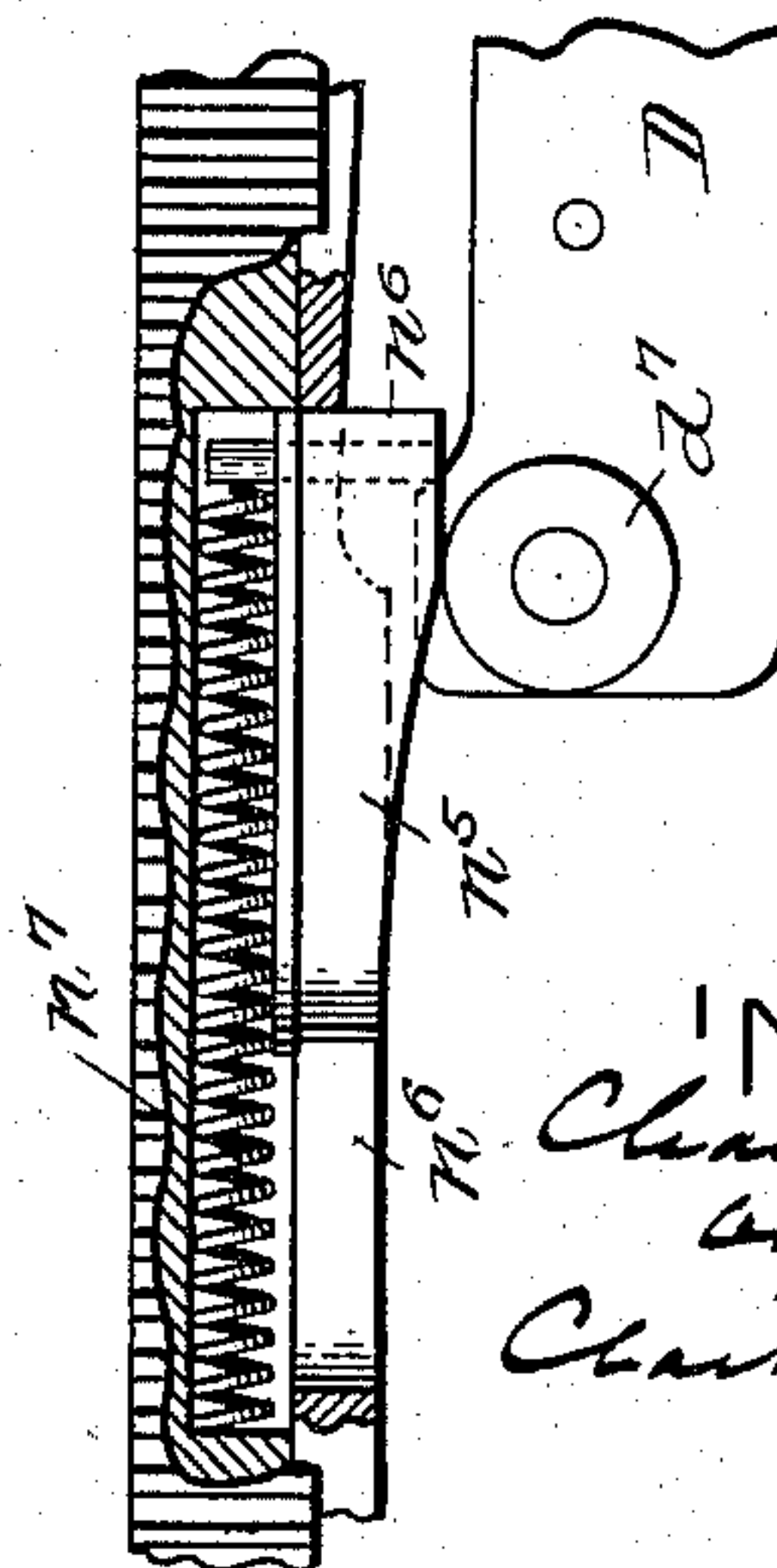


FIG. 24.

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18 Sheets—Sheet 14.

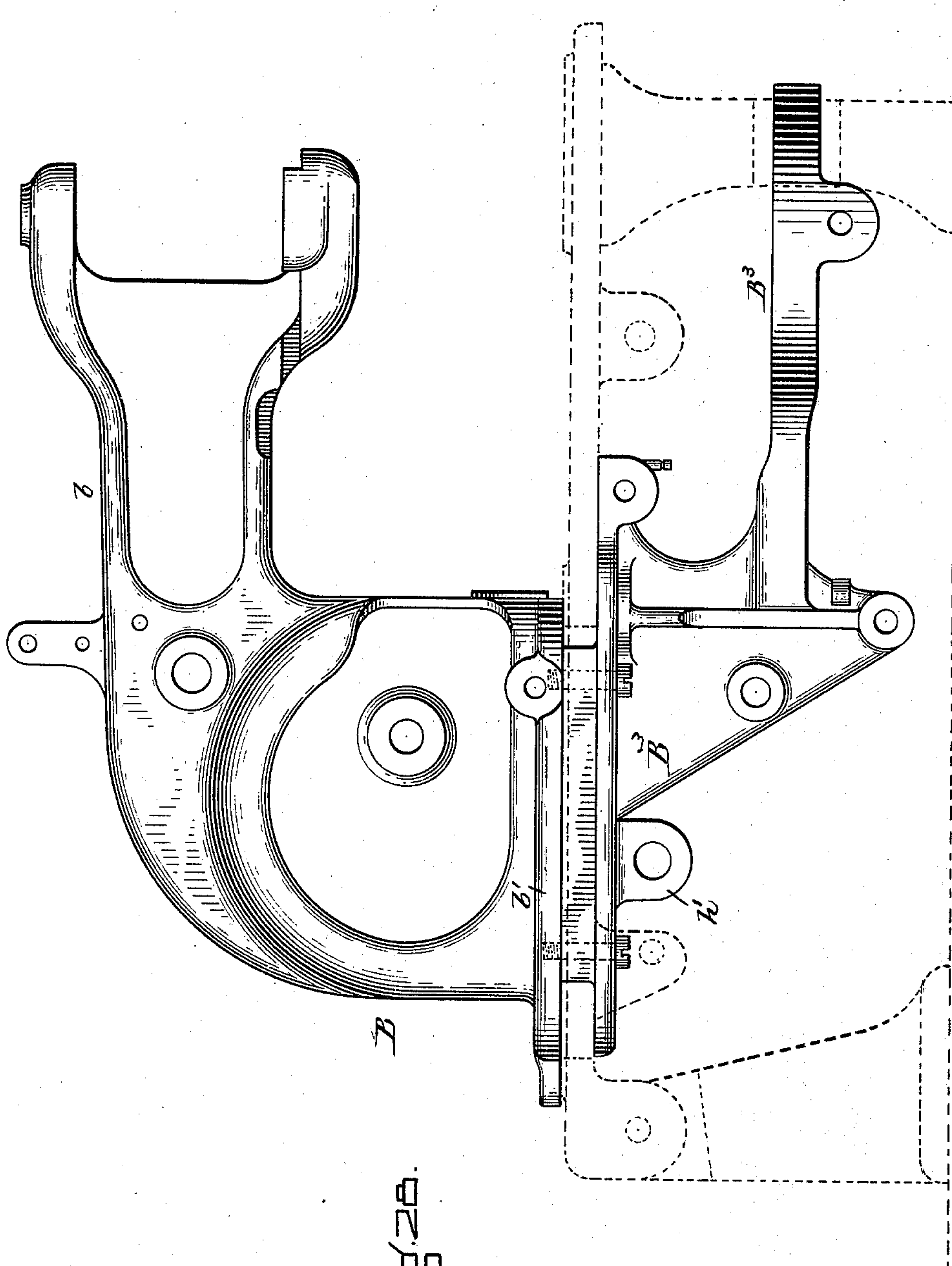


Fig. 28.

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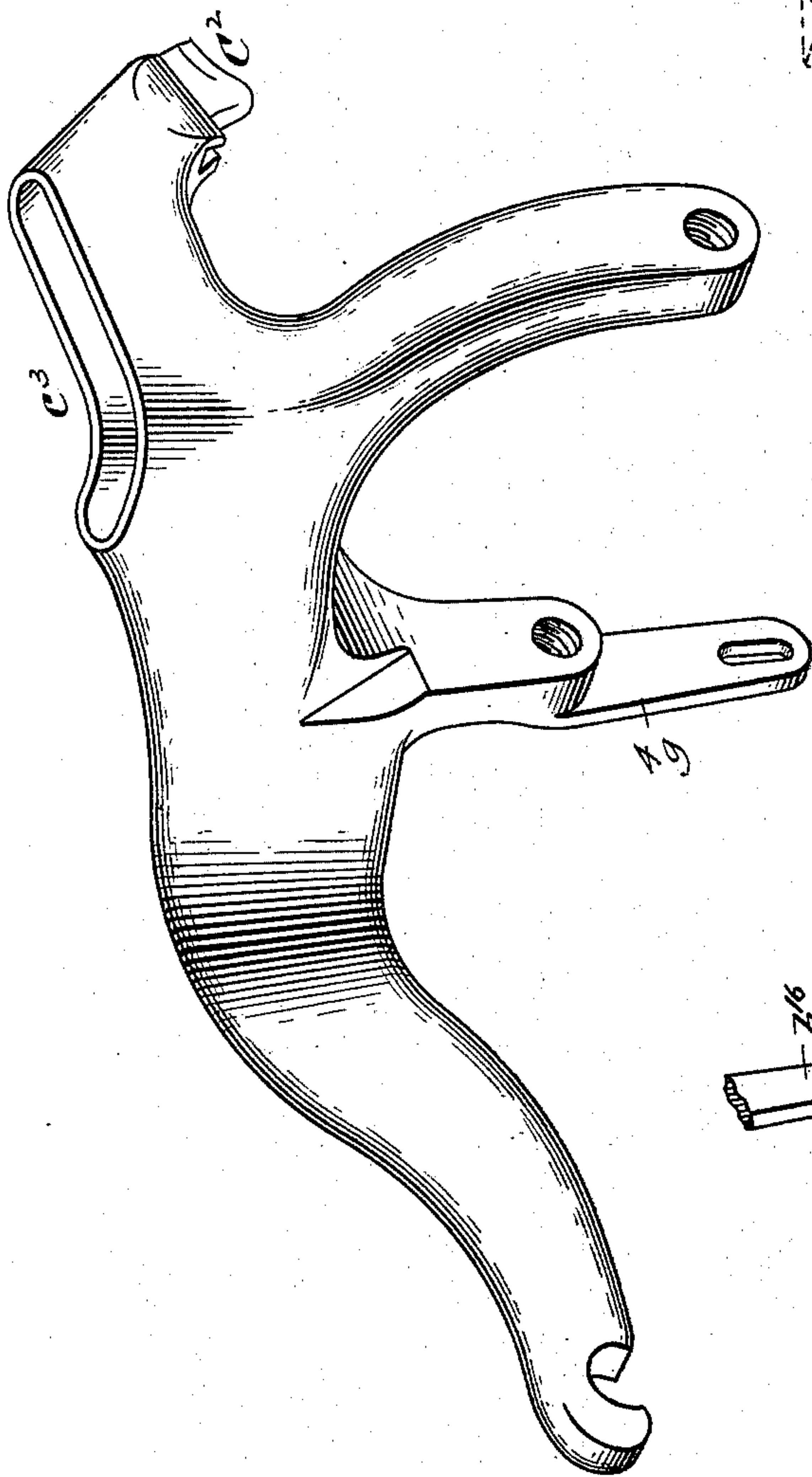


FIG. 29.

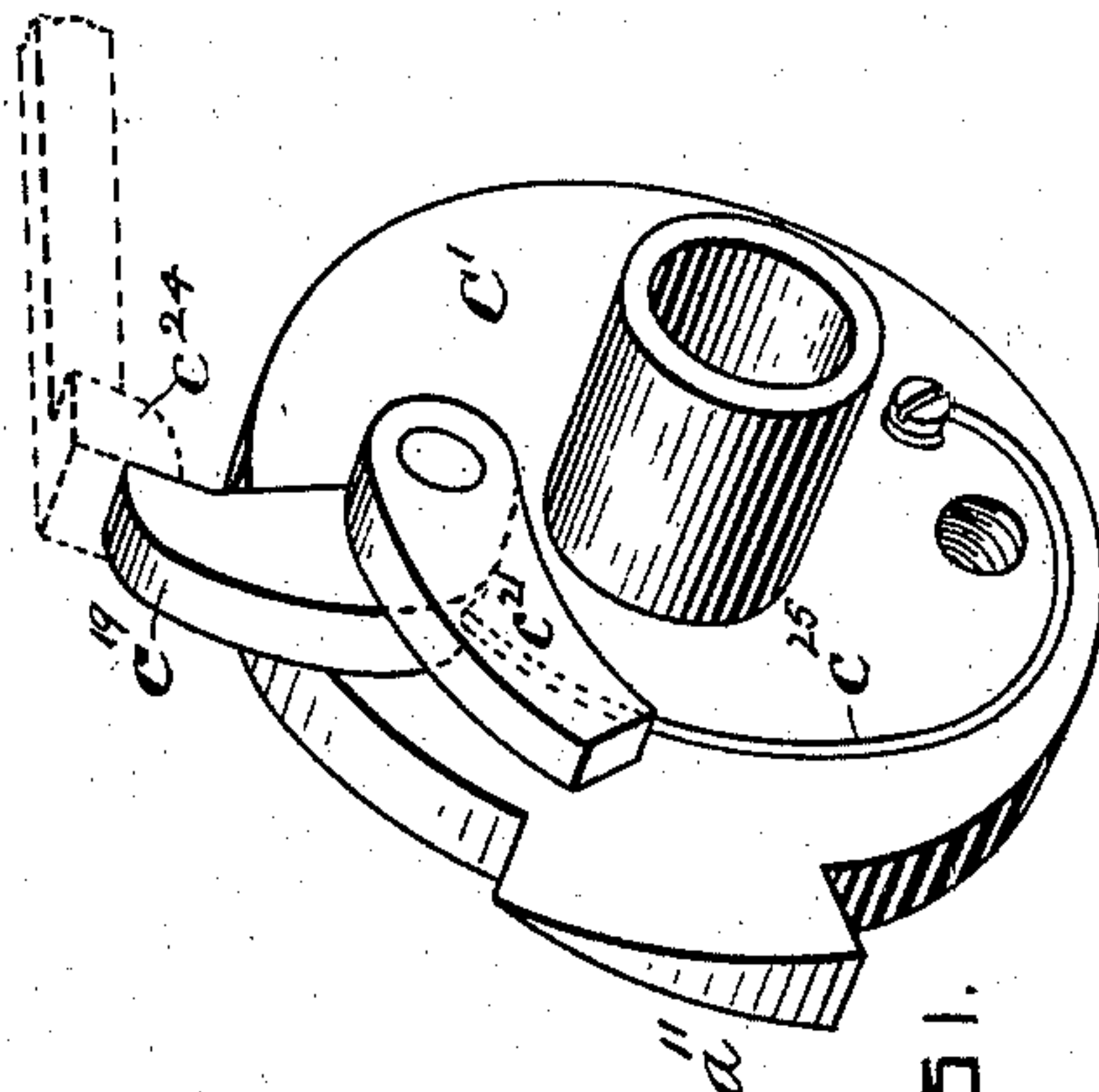


FIG. 31.

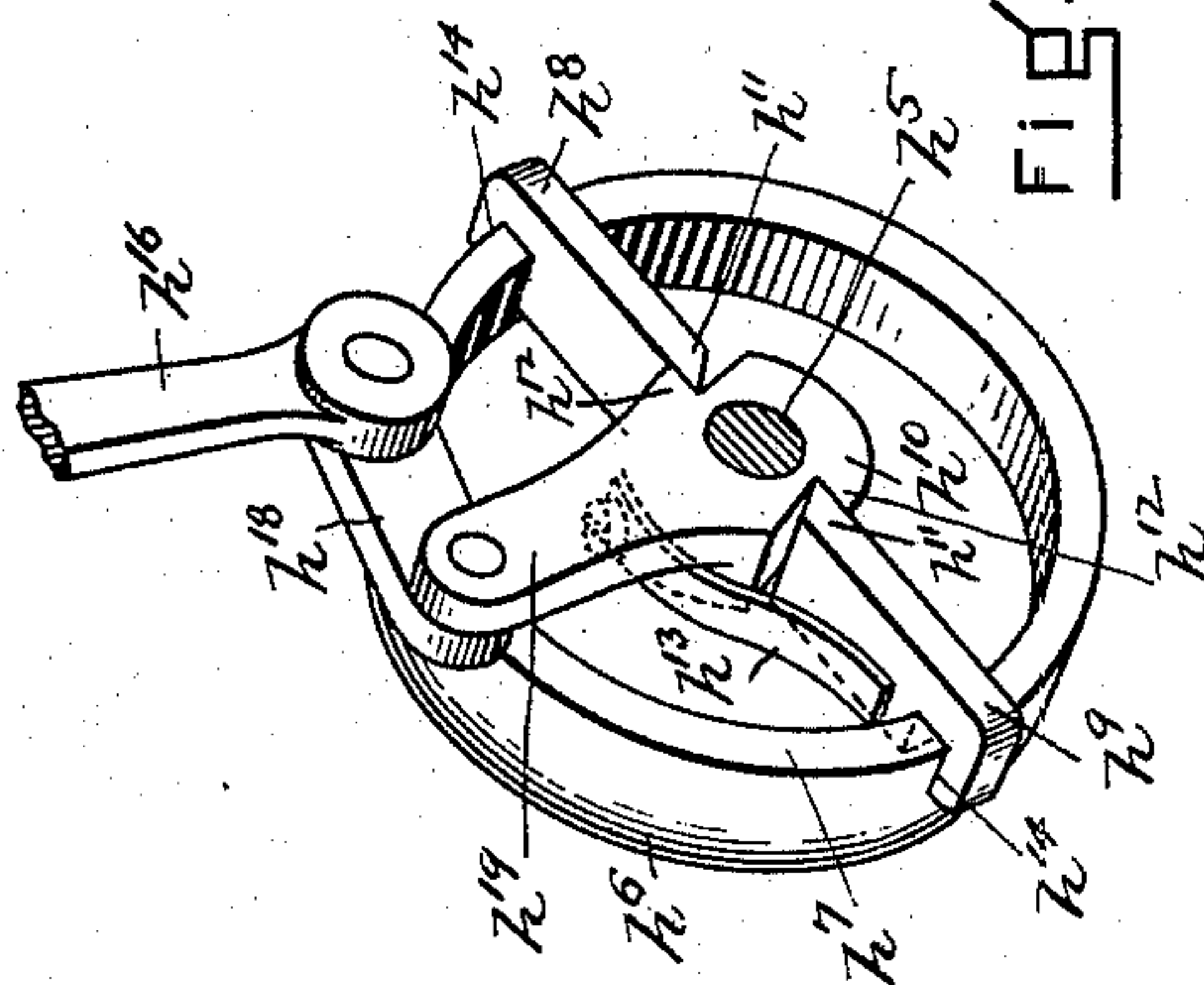


FIG. 30.

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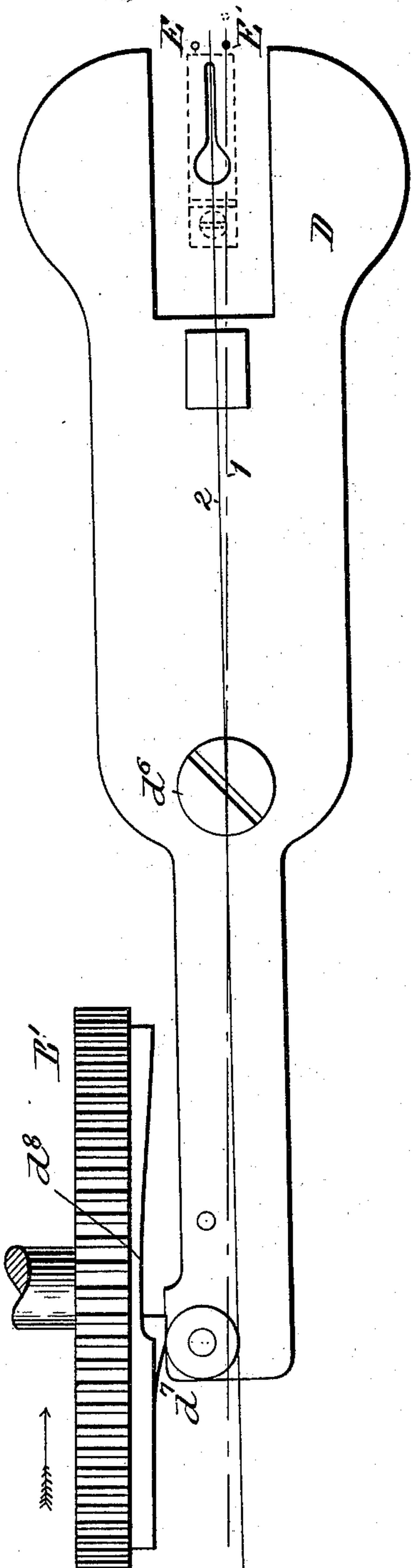


FIG. 32.

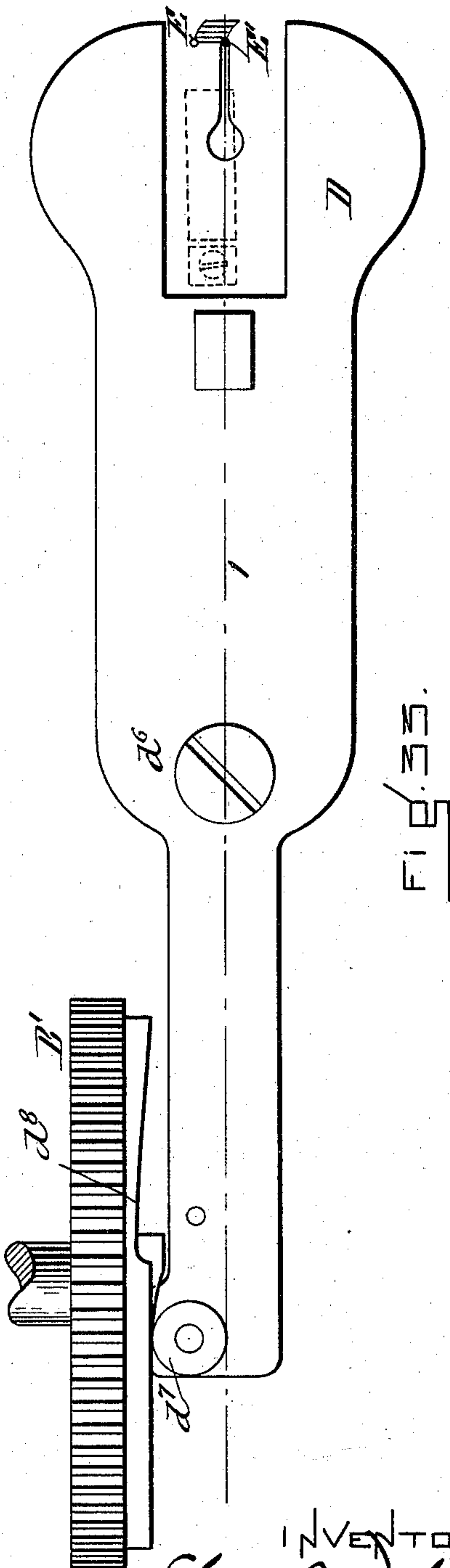


FIG. 33.

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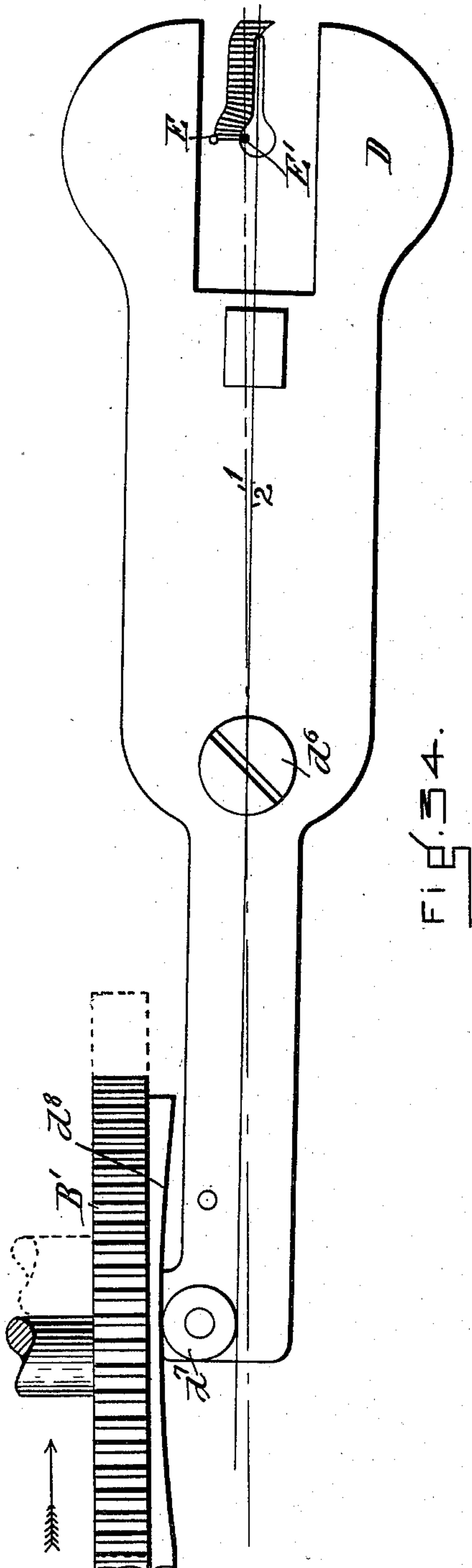


FIG. 34.

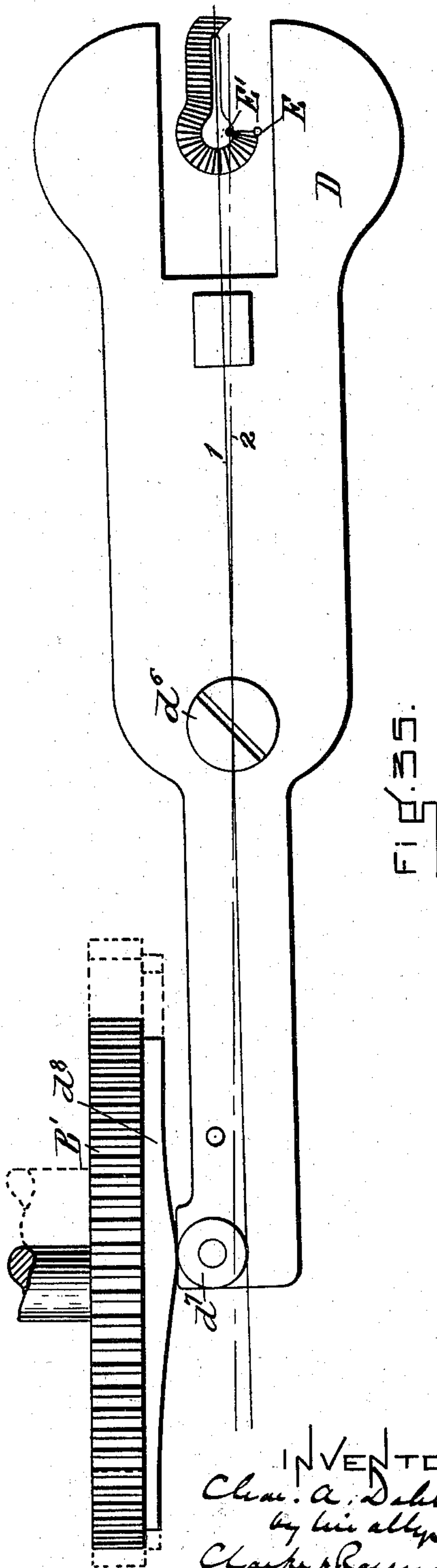


FIG. 35.

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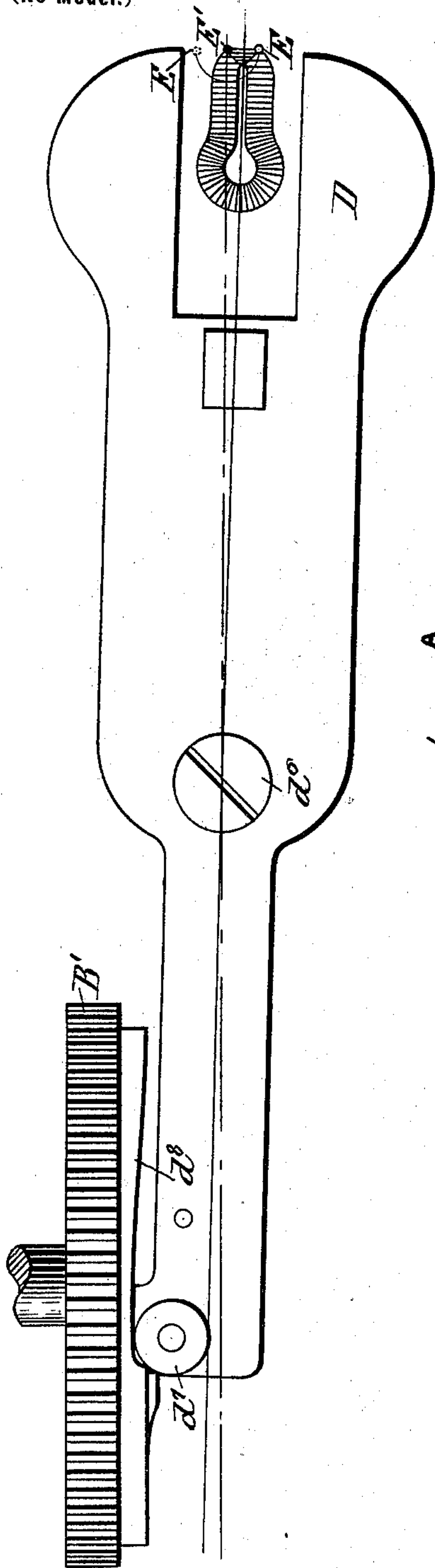


FIG. 35. A

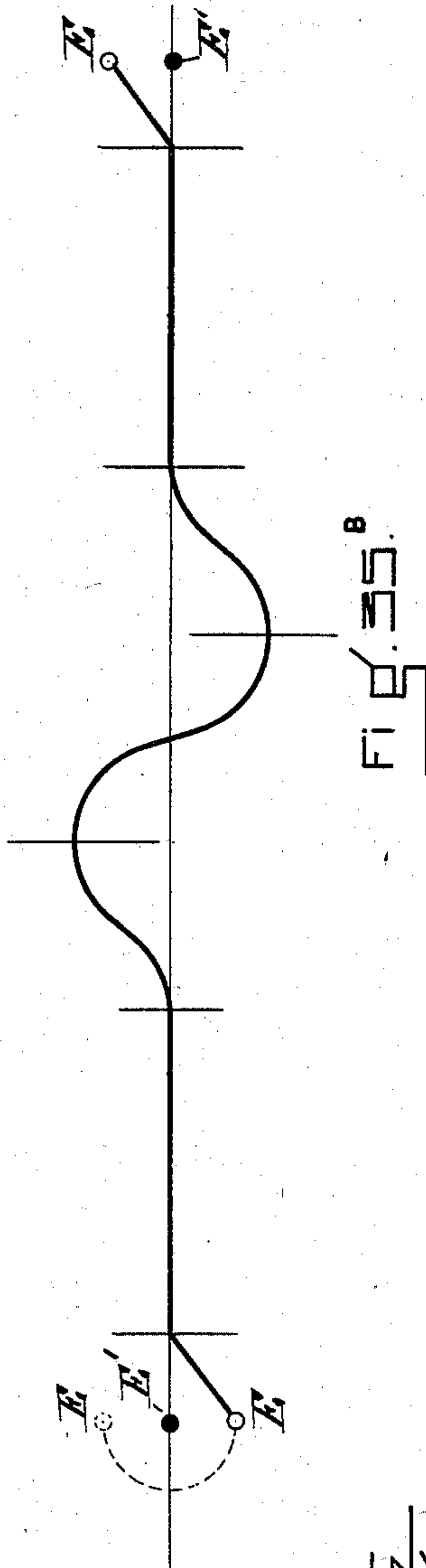


FIG. 35. B

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UNITED STATES PATENT OFFICE.

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BUTTONHOLE-SEWING MACHINE.

SPECIFICATION forming part of Letters Patent No. 612,604, dated October 18, 1898.

Application filed February 1, 1897. Serial No. 621,468. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. DAHL, a citizen of the United States, and a resident of Lynn, in the county of Essex and State of Massachusetts, have invented a new and useful Improvement in Buttonhole-Stitching Machines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification, in explaining its nature.

The invention relates to a buttonhole stitching and barring machine in which there is organized a clamp for holding the work or material in which the buttonhole is being stitched, which is mounted upon a bed and is adapted to hold the work stationary excepting during the stitching of the bar end and eye, when it is provided with a slight lateral movement first in one direction and then in a reverse direction from its median line, a traveling buttonhole-cutter and a traveling anvil which is also provided with an additional movement whereby it is brought into operative relation with the material held by the clamp and with the buttonhole-cutter and held in such relation during the cutting operation and then returned to its original position, a frame or support carrying the stitch-forming devices and buttonhole-cutting devices which is provided with an intermittent movement upon a straight line upon its support forward and back, and which presents the stitching devices to the work or material held by the clamp, and which stitching devices are turned or rotated during the stitching of the eye and returned to their original position at the end of the stitching of the buttonhole. There are also organized in the machine instrumentalities for starting the machine upon the movement of the work-clamping lever, for operating the cutting mechanism and the stitching mechanism by a single belt, for automatically shipping the belt, and for automatically connecting and disconnecting a loose wheel with the buttonhole-cutter-operating mechanism. The machine also has clamp-spreading mechanism and stitcher-returning devices and means for stitching a barring end of a peculiar character to the buttonhole.

Before I describe the construction of the machine specifically I will further describe the invention generally by giving the operation of the machine. The work or material is placed in the buttonhole-clamp and the clamping-lever moved to depress the upper members of the clamp upon the material or work, thus clamping it to the lower members thereof and at the same time starting the operation of the cutting mechanism and cutting the buttonhole by the immediate or instantaneous descent of the cutter to the cutting-anvil, which is at the same instant moved forward beneath the material to receive it, the throat, its support, and its operating devices being moved forward at the same time to make place for the anvil. The cutter and anvil are instantly withdrawn and the throat and lower needle restored to their original and operative position and the anvil to its inoperative position, and during the remainder of the operation of machine the cutter and anvil are inoperative. The work-clamp is immediately spread and the stitch-forming devices, which are in their forward position and beyond the rear end of the buttonhole, are set in operation. The work-clamps then hold the material in such position that the first two or three stitches are taken across the material beyond the end of the buttonhole and upon a diagonal advancing line, the work-clamps moving slightly laterally while the stitching-frame is being advanced and until the under needle enters the end of the buttonhole-slit. The work-clamps then hold the material stationary while the stitching devices are advanced along one side of the slit in a straight line to the beginning of the stitching of the eye, when the work-clamps are again moved laterally, first inwardly from the median line of the buttonhole, then backward and as great a distance upon the other side of the median line, and then in a reverse direction to very nearly the position which it occupied during the stitching of the first straight side, when it is held stationary during the stitching of the second side and until the end of the buttonhole-slit is reached, when it is moved diagonally to the position it occupied at the beginning of the stitch-

ing operation and which causes additional stitches to be sewed in advancing order across the material beyond the end of the button-hole-slit and over those first sewed until the last stitch taken practically covers or is in line with the first stitch taken. During the lateral movements of the clamps at the stitching of the eye the stitch-forming devices are rotated a half-revolution, the end of said half-revolution taking place at the beginning of the stitching of the last straight side, and they are held stationary during the said stitching of the last side and until after the making of the last barring-stitch, when they are released and permitted to return to their original position, as will hereinafter appear.

I will now proceed with a description of the drawings and with a detailed description of the construction and operation of the machine.

Figure 1 is a view of the machine in right side elevation. Fig. 2 is a view in left side elevation. Fig. 3 is a view in front elevation. Fig. 4 is a view in vertical central section taken lengthwise the machine. Fig. 5 is a view of the machine in plan inverted. Fig. 6 is a view in horizontal section upon the dotted line of Fig. 1. Fig. 7 is a view in vertical cross-section upon the dotted line 7 7 of Fig. 1. Fig. 8 is a detail view, in vertical section, of a portion of the mechanism for operating the cutting devices. Fig. 9 is a view in perspective of a portion of the belt-shifter and mechanism adjacent thereto. Fig. 10 is a detail view representing a part of the stopping mechanism of the stitches. Fig. 11 is a detail view of a section of the cam-wheel which operates the stitching-frame and the clamp-plate. Fig. 12 is a detail view representing the cutting mechanism. Fig. 13 is a detail view representing the starting mechanism. Fig. 14 is a view in plan of a gear or wheel, showing part of the stopping mechanism of the cutter and a cam for turning back the stitching mechanism. Fig. 15 is a view in front elevation. Fig. 16 is a view in rear elevation, and Fig. 17 is a view in vertical section, of the devices for operating the lower needle and looper. Fig. 18 is a view in perspective to further illustrate the manner of supporting and operating the looper. Fig. 19 is a view showing the relation of the buttonhole-cutter, buttonhole-anvil, upper needle, and lower section of the stitch-forming devices at the end of the cutting operation, the view being taken from the side of the machine opposite that from which Fig. 12 was taken, and showing also the anvil, its support, and lower portion of the stitch-forming devices in vertical section. Fig. 20 is a detail view, enlarged, representing a portion of the rack for turning the under section of the stitch-forming devices and especially representing the shape of the teeth of the rack, whereby the pinion on said devices may be moved slightly from a vertical axis in relation thereto. Figs. 21, 22, and 23 represent

the mechanism for transferring laterally the clamp-plate and clamps at the end of the stitching operation and while the machine is coming to rest in order that it may be restored to the position which it should occupy at the beginning of the sewing of the next buttonhole in order. Figs. 24 and 24^a are views, enlarged, of the portion of the cam-actuating clamp-plate and clamps and especially the part which is operative to transfer the clamp-plate and clamps for the purpose indicated in the description of Figs. 21, 22, and 23. Fig. 25 is a view in the form of a diagram of the said cam for providing the clamp-plate and clamps with their lateral movements. Fig. 26 is a view of the clamp-plate removed from the machine. Fig. 27 is a detail view, enlarged, of the mechanism for shifting the belt and the stop mechanism, to which reference will hereinafter be made. Fig. 28 is a view in side elevation of the frame of the machine, showing the upper or main section thereof and the lower bracket bolted thereto and also showing in dotted outline the bed upon which the frame is moved lengthwise it and the support for the front end of the bracket. Fig. 29 is a view in perspective, enlarged, of the buttonhole-cutter lever removed from the machine. Fig. 30 is a view in perspective, enlarged, of one side of the clutch for operating the frame-feeding mechanism. Fig. 31 is a view in perspective, enlarged, of the opposite side of said clutch. Figs. 32, 33, 34, 35, and 35^a are enlarged views, principally in plan, of the clamp-plate and its operating-cam for the purpose of representing the various positions of the clamp-plate from the beginning of the stitching of the buttonhole to the end of said stitching and in respect to a base-line which is the same in all the figures and which extends through the center of the pivot of said clamp-plate and the center of the lower needle, and in said views the lower needle is represented by a small solid circular section and the upper needle by a small cylindrical section. Fig. 32 represents the position of the clamp-plate and the buttonhole in respect to this base-line at the starting of the stitching of the half portion of the bar which is sewed at the first stitching operation of the machine, the clamp-plate being in the position in which it was left at the end of the operation of the machine after the stitching of the previous buttonhole and also being in the position in which the buttonhole-slit is cut by the buttonhole cutter and anvil, this position being slightly at one side of the base-line, and the buttonhole anvil and cutter are arranged to cut in a line slightly removed from the base-line and upon a slight angle thereto. Fig. 33 represents the first stitches of half the bar as having been sewed and the clamp-plate as moved from the position represented in Fig. 32 to a position in which the base-line runs through the center of the buttonhole-slit lengthwise it. Fig. 34 represents the position of the

clamp-plate in relation to the base-line at the end of the stitching of one-fourth of the eye, being the position which it occupies immediately before the stitching devices begin to turn. Fig. 35 represents the position of the clamp-plate in relation to the base-line after the stitching of three-fourths of the eye and after the turning of the stitching devices, when it will be seen that the clamp-plate is as far at one side of the base-line as it is shown upon the other side in Fig. 34. Fig. 35^A represents the position of the clamp-plate in relation to the base-line at the completion of the stitching of the last half of the bar and immediately before its transfer to the position represented in Fig. 32 and the backward rotation of the stitch-forming devices to the position shown in said figure, the said position of the upper needle when so returned and its path of movement being represented by a dotted curved line and dotted circle in Fig. 35^A. Fig. 35^B is a diagrammatic view representing the path of the cam laid out upon the base-line. Fig. 36 is a view, enlarged, of a portion of a stitched buttonhole, representing in dotted lines the course of the needles due to the movements communicated to the clamp-plate. Fig. 37 is a view, enlarged, further illustrating the course which the stitch-forming devices take because of said movement of the clamp-plate.

A is the main shaft of the machine. It is supported by the moving or traveling frame B, which carries the stitching and cutting mechanism. It has at its outer end the two belt-wheels a a' , and they are shaped and arranged so that the driving-belt may be shifted from one to the other by the belt-shifter a^2 . The belt-wheel a is fast to the main shaft A. The belt-wheel a' is loose on said shaft and has a hub a^3 , which carries a gear-wheel a^4 , and which gear-wheel a^4 is connected by means of the intermediate gears a^5 a^6 upon the stud a^7 with the gear-wheel C. (See Figs. 1, 3, and 7.) This gear-wheel C has a hub c , (see Fig. 8,) which is mounted upon the hub c' of a disk C', the said hub and disk being mounted upon a stud c^2 , cast on or otherwise attached to the traveling frame B of the machine. The office of the gear-wheel C is to operate, through the disk C', the cutter at the beginning of the operation of the machine and to revolve back by means of a cam the stitching mechanism at the end of the operation of the machine. It also serves through the said disk to spread the material-holding and slit-spreading clamps and to actuate the belt-shifter. The disk C' is connected with the buttonhole-cutter C² by means of the lever c^3 , which carries at its forward end the cutter and which is pivoted at c^4 to the traveling frame B and is connected at its rear end with the disk by a pitman c^5 , attached to the disk by a crank-pin c^6 . (See Figs. 1, 2, 3, 8, and 12.) The pitman is made adjustable as to length to adjust the cutter C² in relation to the anvil, being made in two

parts c^7 c^8 , which are connected by a right-and-left screw c^9 . (See Figs. 1 and 12.) The gear-wheel C is connected with the crank-disk C' by a clutch C³, (see Fig. 13,) and this clutch is represented as actuated by the starting-lever C⁴, which also actuates the devices for depressing the clamp-arms of the work-clamp, as will hereinafter be described.

The lever C⁴ is attached by the shaft c^{10} to a post c^{11} , rising from the clamp-plate D, (see Fig. 4,) and there is secured to the shaft to be turned by it the cam d , having a depressing and locking surface d' , which is turned against the yielding arms d^2 of the clamps D' to depress them to clamp the work and to hold them depressed. The clamp-arms are secured to the clamp-plate D at d^3 . There is attached to the end of the cam d opposite the starting-lever a tripping-pawl c^{12} . (See Fig. 13.) This pawl is pivoted at c^{14} to said cam end and has a swinging movement upon said pivot, which is limited by a suitable stop-pin. The pawl is also overbalanced by its end c^{15} , so that normally it has the position shown in full lines in Fig. 13. Upon the movement of the starting-lever C⁴ upward and backward to the position represented by the dotted outline in Fig. 13 the pawl is caused to be moved and brought into contact with the inclined end c^{16} of the rock-lever c^{17} , which is pivoted at c^{18} to the traveling frame, and by such contact moves downward the forward end of said rock-lever and lifts its rear end from engagement with the clutch pawl or finger c^{19} , the pawl c^{12} riding by the depressed incline c^{16} and passing beyond the same and then being free to ride over, upon the backward movement of the frame, the end c^{16} of the rocking lever, which is immediately returned and without then disturbing its position or operating the clutch.

The clutch pawl or lever c^{19} is pivoted by the pivot c^{20} to the crank-disk C', (see Fig. 13,) and there is also carried by the pivot a second pawl or finger c^{21} . The two pawls c^{19} c^{21} are secured together or may be made in one piece, if desired. The pawl c^{21} is held in a recess c^{22} on the face of the gear-wheel C, (see Fig. 13,) having the shoulders c^{23} , with one of which the end of the pawl c^{21} is adapted to be brought into contact when the end c^{24} of the rock-lever c^{17} has been lifted sufficiently to permit the pawl c^{19} to ride or move by it, the said movement being given to the said pawl and also to the pawl c^{21} by the spring c^{25} , which is attached to the crank-disk C' and bears against the pawl c^{19} .

To start the machine, the starting-lever C⁴ is moved forward and downward. This will cause the end c^{24} of the rock-lever c^{17} to be lifted sufficiently to disengage the clutch-pawl c^{21} , which is then immediately moved by its spring into line with and becomes engaged by one of the shoulders c^{23} of the gear-wheel C, which it should be remembered is constantly rotating while the driving-belt of the machine is on the pulley a' . The gear C is

thus connected with the crank-disk C' and serves to turn the disk one revolution, or until the clutch-pawl c^{21} is disengaged from it. The end c^{24} of the rocking lever c^{17} is immediately returned to its original position by the flat spring c^{26} , (see Fig. 5,) which is attached to the traveling frame and which bears upon the under surface of the forward end and is thereby brought into position to engage the pawl c^{19} at the end of said revolution of the crank-disk, arrest its progress, cause it to disengage the pawl c^{21} from the shoulders c^{23} , and thereby stop the rotation of the crank-disk. The rock-lever in Fig. 13 is shown in full lines as engaging the said pawl c^{19} and in dotted outline as disengaged from said pawl. The crank-disk C' also serves to operate the belt-shifter a^2 . This belt-shifter is pivoted to the traveling frame at a^8 . The belt passes through a hole formed in its outer end, and it has a downward-extending arm a^9 , which is engaged by the crank-disk. The belt-shifter is moved in an inward direction by the spring a^{10} (see Figs. 1 and 6) and in a reverse direction by a cam a^{11} on the crank-disk, the cam operating against the inner side of the said arm a^9 at its lower end. The cam a^{11} serves to move the belt-shifter outward to transfer the belt from the pulley a' to the pulley a at the end of the revolution of the crank-disk C' . This permits the gear C to be stopped and immediately starts the revolution of the main shaft A and brings into play a locking device which locks the belt-shifter in its outward position against the stress of the spring a^{10} and holds the belt upon the pulley a during the stitching operation. This locking device comprises the stitcher-frame feed-wheel B' and the arm a^{12} , (see Fig. 9,) attached to and extending inward from the belt-shifter, and the end a^{13} of which bears against the face a^{14} of the said feed-wheel B' during its entire revolution, excepting when opposite the hole a^{15} therein, which is brought into line with the end of said arm at the completion of the stitching of the buttonhole and which permits the arm to be moved inward and also the belt-shifter by its actuating-spring, and thereby permits the belt-shifter to shift the belt from the pulley a to the pulley a' . The feed-wheel B' has attached to its face a plate a^{16} , which is adapted to fill or cover said hole a^{15} and which is brought into play at the starting of the main shaft. It is pivoted to the feed-wheel at a^{17} by its arm a^{18} , and a spring a^{19} , attached to the wheel and bearing against said plate, serves to move it to the closed position represented in Fig. 10. As the feed-wheel B' approaches the end of its revolution the rear end a^{13} of the arm a^{12} comes into contact with the raised end a^{20} of said plate and moves it from the closed position represented in Fig. 10 to that represented in Fig. 9, uncovering the hole and permitting the endwise movement of the arm in relation to the wheel, the end of the arm entering the hole. Upon

the outward movement of the belt-shifter to move the belt from the pulley a' to the pulley a at the starting of the machine the plate a^{16} is immediately closed behind the end of said arm, or to the position represented in Fig. 10, the cam a^{11} moving the belt-shifter and arm outwardly sufficiently to permit this closing action of the plate. The arm a^9 is formed in the shape of a hook at its lower end, and by the spring is then closed behind the cam a^{11} , thus serving as a stop or pawl for preventing the disk from turning backward, and this slight movement brings the rear end a^{13} of the arm into contact with the outer face of the plate a^{16} .

The movement of the belt-shifter to transfer the belt from the pulley a' to the pulley a also moves the stop-pin a^{21} , which is formed on the arm a^{12} , into contact with a stop in the groove a^{22} in the inner face of the gear-wheel C , the object being to check the momentum of the said wheel after the belt has been moved from its operating-pulley a' , also to prevent it from turning when it is not being operated, and also to prevent it from being started too quickly, as will hereinafter appear. To accomplish this, there is in the groove or recess a flat spring a^{23} , the free end of which is normally held outward from the bottom of the groove and is adapted to be pressed into the groove toward its bottom, and beyond the end of this spring is a stop a^{24} . There is a space a^{25} between the end of the spring and the stop of a width to receive the stop-pin. The disk C , continuing its rotation, brings the spring into contact with the end of the stop-pin, and the spring then acts to check its rotation gradually and as a brake; but the rotation is not entirely checked until the spring has ridden by the pin and the pin brought into contact with the stop a^{24} . The gear-wheel C will then be held from revolving in one direction by the stop a^{24} and in the reverse direction by the end of the spring a^{23} . This stopping-point also bears relation to the cam for revolving back the stitching mechanism, which is attached to the gear-wheel (see Fig. 14) and which will hereinafter be described, the object being to prevent the said cam from actuating the mechanism for turning back the stitching devices until the stitching operation is finished and the needles are clear of the work.

It will be understood that when the machine is not in operation the belt is constantly running on the loose pulley a' and the loose pulley and the gear-wheel C are constantly turning, but are doing nothing, and upon the starting movement of the starting-lever the gear-wheel C engages by a clutch the crank-disk C' , and the crank-disk C' then makes one revolution, operating the cutter and also operating at the end of its revolution the belt-shifter, and the belt is then moved by the belt-shifter from the loose pulley a' to the pulley a , causing the traveling frame and stitching mechanism to be started. The belt is so

held by the belt-shifter in contact with the said pulley *a* until the buttonhole has been completely stitched, the loose pulley and the gear-wheel *C* coming to a stop and remaining stationary during the stitching operation. At the end of the stitching operation the belt-shifter shifts the belt from the pulley *a* to the pulley *a'*, and the gear *C* is again set in operation, actuating the devices for turning back the stitching mechanism to their normal position, and after so turning back the stitching devices it continues to revolve without actuating the machine, but being in readiness to immediately engage the disk *C'* upon the starting movement of the starting-lever.

The traveling frame carries all the operative mechanism of the machine, excepting the cloth-clamping plate and devices. It is given a traveling movement upon and in the bed *B*² backward and forward in a straight line. It is made in two parts—namely, the arm *b*, which is above the bed-plate and the base *b'* of which bears upon the upper surface of the bed at each side, and the lower section *B*³, which is shaped as represented in Fig. 1 and is bolted to the base *b'*. The frame is provided with the opening *b*², and the inner edges *b*³ of this opening serve as guides in connection with the section of the traveling frame between them. The lower part *B*³ extends forward below the base-plate and is supported in guideways *b*⁴ upon the inner surface of the forward legs.

E is the upper needle. It is straight and eye-pointed. It is carried at the lower end of the needle-bar *e*, which has a vertical reciprocating movement in the forward end of the arm *b*, said movement being given it by means of the bent lever *e'*, pivoted at *e*² to the arm, and a crank-pin *e*³ on the crank-disk *e*⁴ at the inner end of the main shaft *A*, the crank-pin working in a curved cam-slot *e*⁵ of peculiar shape at the lower end of the vertical part of the bent lever. (See Fig. 2.) As the crank-pin *e*³ is turned it traverses the slot *e*⁵ from one end to the other, and the cam-slot is so curved that as the pin approaches its lower end it increases the speed of the upper needle and moves it very rapidly. This is largely owing to the shape of the cam-slot, and the slot is also so shaped that while the crank is upon the upper part of its movement the needle is moved very slowly and but very little, and this gives to the upper needle the movements which it is necessary for it to have in relation to the lower needle—namely, an accelerated downward movement and retarded upward movement with a substantial period of rest in its highest position—and the mechanism for accomplishing this is very simple in construction and direct in its action. The needle-bar *e* passes through a gear *F* and reciprocates in relation to it. The gear is attached to the needle-bar by means of a fast feather or spline, which enters a groove in the bar, and it is supported by the lower horn *b*⁵ of the arm *b* and attached to it, it hav-

ing a hub *f*, which enters a hole *f'* in said horn, the said hub having a recess *f*², which receives the point of a screw *f*³, the point not bearing against it, but simply preventing it from rising from the horn. This gear *F* is engaged by the end *f*⁴ of an **S**-shaped rack-bar *F'* and a yoke *f*⁵, having a cam-roll *f*⁶, which is moved outward by a cam *F*², fastened to the feed-disk. The yoke is supported upon the hub *f*⁷ of the feed-disk *B'* and has the slot *f*⁸ to permit it to travel in relation thereto. It also has an upwardly-extending arm *f*⁹, which is connected with the inner end of the said upper **S**-shaped rack-bar *F'*. It also has a downwardly-extending arm *f*¹⁰, which is connected with a lower **S**-shaped rack-bar, which will hereinafter be referred to.

E' is the lower needle. (See Figs. 15, 16, and 17.) It is straight and is eye-pointed. It is mounted upon the upper end of a slide-block *e*⁶, mounted in an inclined slideway *e*⁷ in the rotating support *E*². It is reciprocated by means of a reciprocating bar *e*⁸, carried by said support, and a lever *e*⁹, pivoted at *e*¹⁰ and connected at *e*¹¹ with the slide *e*⁶ by a pin and cross-slot or by means of a link. The reciprocating bar is connected with the lever *e*⁹ by a pin *e*¹² and slot *e*¹³ or a link connection. The bar *e*⁸ is reciprocated by means of the bent lever *e*¹⁴, pivoted at *e*¹⁵, suitably connected at its outer end with the lower end of said arm *e*⁸ and receiving motion from a cam-groove *e*¹⁶ in the back side of a disk *e*¹⁷ on the main shaft *A*, the said groove being connected with the upper end of the bent lever *e*¹⁴ by means of a lever *e*¹⁸, pivoted at *e*¹⁹, the upper end of which carries a cam-pin, which enters the said cam-groove *e*¹⁶, and the lower end of which is connected with said lever by a link *e*²⁰. The cam-groove is constructed to give the needle an upward movement, then a slight dropping movement, then a rest, and then a renewed upward movement, and then a continuous downward movement to its lowest position.

*E*³ is the looper. (Shown in elevation in Fig. 15 and in perspective in Fig. 18.) It is moved past the upper needle to take the loop therefrom as the upper needle is lifting from its lowest position, and it carries the loop back of the under needle as the latter needle is falling, and then holds it over the under needle until the under needle has taken it, when it returns in the same path to its original position. It is moved backward and forward by means of the reciprocating pin *e*¹², which is extended through a cam-groove *e*²¹ in the cam-lever *e*²², which is pivoted at *e*²³ upon the pin *e*²⁴ and connected with the looper-holder *e*²⁵, to the upper end of which the looper is attached. The lever engages the looper-holder at *e*²⁶ by means of a recess in its end, in which the looper-holder slides, the looper-holder being attached to the end of the pivot *e*²⁴ and having a transverse or horizontal movement with said pivot in addition to the rocking movement imparted to it by the cam *e*²¹ and lever

e^{22} . The horizontal movement is given to it by the end of the pin e^{12} , which comes in contact at the desired time with a projection or cam e^{27} on a lever e^{28} , pivoted at e^{29} , the upper end of which is connected with the said pin e^{24} at e^{30} . (See Fig. 17.) As the pin e^{12} is lifted upward by the reciprocating bar e^8 its end rides upon the projection e^{27} and moves the lever outward, carrying the looper-holder with it and moving the looper transversely, the lever e^{28} and looper-holder returning to their original position after the pin has left the projection upon its upward movement, and the downward movement of the pin repeats the movements, so that the looper is caused to be moved transversely in relation to the lower needle as the looper is moved forward, and also transversely in relation to the said lower needle as it is moved backward. A coil-spring e^{31} about the pin e^{24} (see Fig. 17) is compressed by the outward movement of the lever e^{28} as the end of the pin e^{12} passes the cam e^{27} and serves to return the lever after the pin has passed said cam or bunch, the object being to keep the lever in contact with the end of the pin at all times.

E^4 is the button, in which the throat of the machine is formed, and it is attached to the upper end of the rotary support E^2 . The rotary support is mounted in a sleeve or holder E^5 . It is free to be turned forward and back in said holder or sleeve, and the holder or sleeve is pivoted upon each side at e^{32} to the forked end e^{33} of the lower section B^3 of the frame. The lower part of the rotary support E^2 has the cylindrical section e^{34} and flange e^{35} , (see Figs. 15, 16, and 17,) and its holder or sleeve E^5 has recesses of two diameters e^{36} e^{37} to receive from below the said cylindrical section and flange, and a cap-plate e^{38} , fastened to the under surface of the holder E^5 , laps upon the under surface of the rotary support. (See Fig. 4.) The said holder or support E^5 is adapted to be tilted or turned slightly upon its pivots to transfer the rotating support at its upper end and throat sufficiently to move the said upper end, the lower needle, looper, and throat out of line with the upper needle and an anvil G into the position which the button or throat had occupied in part—that is, in a position below the cutter—the forward point of the anvil being in line just back of the line of movement of the upper needle. The anvil is carried upon an arm g , (see Figs. 4 and 12,) which is integral with the said holder or sleeve E^5 and which is back of the rotary support E^2 .

Upon the starting of the machine the upper end of the support E^2 , the throat, looper, and lower needle are tilted out of operative or sewing position and the anvil moved into operative position, the parts then bearing the relation to each other represented in Fig. 12, and the cutter immediately moves downward to cut a buttonhole-slit in the material held by the clamps and upward to the original position, and the anvil and under section of the

stitching mechanism are then moved back again to their original position, (shown in Fig. 4,) in which they are held during the stitching. The stitching then immediately begins from the rear end of the buttonhole. The tilting movements are given the rotary support and anvil by means of an arm g' , preferably integral with the anvil-support, and which extends back and has in its end a cam-slot g^2 , and an arm g^4 , extending downward from the cutter-lever c^3 , which has a cam-pin g^3 on its lower end, which enters the cam-slot, (see Figs. 1, 4, and 12,) so that the crank-disk C' during its rotation not only operates the cutter-lever, but also serves to move the lower part of the stitching mechanism out of position and the anvil into position preparatory to cutting and return the said parts to their original position at the completion of the cutting operation. The cam pin and slot lock the parts in each of the two positions. The said cam-slot g^2 is made long enough to provide rests, into which the cam-pin may run to provide a rest for the anvil during the cutting and to meet the requirements caused by the adjustment of the cutter-lever. The rotary support is turned forward and backward by means of a pinion e^{39} , which preferably is integral with the rotary support and which is engaged by the rack e^{40} at the lower end of the lower S-shaped rack-bar e^{41} , the said rack-bar at its rear end being attached to the arm f^{10} of the yoke-slide f^5 above described, the upper and lower S-shaped rack-bars being thereby moved in unison in turning the upper and lower sections of the stitch-forming devices in stitching around the eye and in returning them.

The connections between the lower rack and the pinion and between the outer end of the lever e^{14} and the lower end of the reciprocating bar e^8 are so formed as to permit the tilting of the pinion and needle-bar in relation to said rack and the end of said lever, respectively, the teeth of the rack being cut away at the corners to provide play (see Fig. 20) and the end of the lever being connected with the end of the bar e^8 by means of a forked connection having curved upper and lower faces. (See Fig. 19.)

The traveling frame, stitching devices, cutter, and anvil are moved backward and forward in relation to the cloth-clamps and upon and in the bed by means of the cam-groove B^4 in the cam-wheel B' on a stud h , which is fast to the lugs h' , extending downward from the under bracket of the traveling frame. A stationary cam-pin H , fixed to the stationary lug h^2 , enters the cam-groove. Upon the turning of the cam-wheel the traveling frame is fed intermittently backward and forward and the cam-wheel moves with it. The wheel is intermittently turned to provide the frame with a step-by-step feed by means of the gear-teeth h^3 , formed in its outer edge, and a pinion h^4 on a shaft h^5 , and this shaft h^5 is intermittently turned by means of a clutch, compris-

ing a disk h^6 , fastened to its end and having a chamber upon its inner side, which forms a short rim or ring h^7 , with which the dogs h^8 h^9 engage as they are turned in one direction. These dogs are shaped as represented in Fig. 30, and each is connected with the oscillating hub h^{10} , as represented—that is, each has the inner end h^{11} , which bears against a shoulder h^{12} in the hub, and a spring h^{13} , attached to the hub, bears against each dog. Each dog has a cross-recess h^{14} at its outer end, through which the rim of the disk extends. As the hub is turned in one direction the dogs ride freely on this rim; but as the dogs are turned in the reverse direction their angle in relation to the rim is so changed that they clutch the rim and carry the disk with it. The hub is given an oscillating movement by means of the cam h^{15} on the edge of the disk e^4 on the main shaft A and a lever h^{16} , pivoted at h^{17} to the end of the long stud, which carries at its opposite end the intermediate gear a^6 . This lever is connected at its lower end by a link h^{18} with an arm or lever h^{19} , extending from the hub. The cam serves to move the lever, and consequently the hub, in one direction, and a spring h^{20} , connecting a part of the traveling frame with the end of the arm or lever h^{19} , serves to move it in the reverse direction and to maintain the upper end of the lever in contact with the cam h^{15} or the lever in contact with an adjustable stop h^{21} . This stop varies the throw of the lever, and consequently the extent of the rotation of the feed-wheel B', each reciprocation of the needle, and the degree of movement of the frame.

It is desirable to change the feed of the traveling frame according as the spacing of the stitches of the buttonhole require, and if the stop h^{21} is adjusted so as to decrease the throw of the lever the stitches of the feed of the traveling frame are shorter and the spacing of the stitches less. If it is moved in the opposite direction, the feed is coarser and the stitches are separated by spaces of greater width. It is therefore apparent that the end of the lever does not constantly bear on the cam h^{15} , the cam coming in contact with the end of the lever only for the purpose of giving it the required movement. At all other times it is separated from the cam and held by the stop. The stop is represented in the form of an angle-plate and as adjusted upon the traveling frame by means of slots and set-screws, (see Fig. 5;) but I do not confine myself to this particular means for adjusting the throw of the lever.

The feed-wheel B' is inclosed by a sheet-metal band, which acts to cover the teeth, and thereby prevent dirt from reaching them, and also as a frictional device in retarding the rotation of the wheel, so that the momentum of the feeding movement will not throw the wheel farther than is desired. The stress with which it bears upon the wheel may be varied by means of the adjusting-screw which connects its two ends. (See Fig. 4.) It is

attached by an angle-piece to the traveling frame.

The clamp-plate D is supported upon the bed-plate of the machine, and its forward end is made thin and carries the clamps D', which are of the usual character, there being two of them, each comprising a lower plate d^4 and an upper jaw d^5 , the upper jaws being at the ends of the spring-arms d^2 and moved toward the lower plates and the jaws being separable to stretch the material, the movement of one jaw and plate causing the other jaw and plate to be moved in a reverse direction. The clamps and clamp-plate do not travel back and forth. They have a lateral movement, however, in relation to the throat. This is obtained by pivoting the clamp-plate at d^6 to the bed-plate of the machine and by mounting at the rear end of said plate a cam-roll d^7 , which bears against the face of the cam d^8 on the feed-wheel B'. (See Figs. 32 and 35^B, inclusive.) This cam is so shaped as to impart to the forward end of the clamp-plate and clamps a very slight and gradual lateral movement at the beginning of the stitching of the buttonhole. (See the diagram represented in Fig. 36, also Figs. 32 and 33.) The object of this lateral movement is to cause the line of stitches to be diverted from a central position at or beyond the rear end of the buttonhole-slit to a position at one side of the buttonhole-slit at the extreme rear end. The clamp-plate and clamps then remain stationary during the backward movement of the frame and stitching devices in stitching of one side of the buttonhole and until the enlarged end of the buttonhole is reached, when the cam d^8 again moves the clamps laterally first in the same direction in which it first moved them (see Fig. 34) and then in a reverse direction until it has moved the clamps a distance just as great upon the other side of the buttonhole-slit, (see Fig. 35,) when the clamps are again moved slightly in a reverse direction and held during the stitching of the other side of the eye to or very nearly to the end of the buttonhole-slit, when they are again moved in the same direction to cause stitches to be sewed across the line of stitches first formed at the beginning of the stitching of the buttonhole, (see Fig. 35^A,) and the stitching is stopped with the clamps in the position, leaving the last stitch or two upon the same line that the first stitch or two were taken, and this provides a finished end or bar to the rear end of the buttonhole-slit, the two lines of stitching extending into each other and interlocking at said rear end. The cam d^8 being a face-cam, a spring d^9 is employed to hold the cam-roll in contact therewith. (See Fig. 4.) The cam also causes one other movement of the clamp-plates.

It will be seen that if the needles are rotated in the position in which they are at the completion of the last stitch of the stitched buttonhole, as represented by the diagram Fig. 35^A, the upper needle will be carried a por-

tion of the length of a stitch beyond the position which it should occupy for the beginning of the stitching of the next buttonhole in order, and the said cam d^8 is therefore formed to move the cam-plate laterally sufficiently to cause the clamps to be brought into the proper relation with the stitching mechanism or to the position represented in Fig. 32. This additional movement of the clamp takes place after the completion of one buttonhole and before the stitching of the next and while the buttonhole-stitching devices are being returned to their normal position, and it is accomplished by means of a dog N on the side of the lower S-shaped rack-bar, which as the rack-bar is moved backward rides against the end n of a rock-lever n' , pivoted at n^2 , and the upper arm n^3 of which engages by its end the clamp-plate at n^4 and moves it laterally sufficiently to move the cam-roll d^7 from the face of the cam when a movable section d^{10} of the cam is released, and by a spring moved back of the cam-roll and serves to maintain the cam-roll and the clamps in their new position. This spring-acting section of the cam is provided by the piece n^5 , which slides in a circular groove n^6 , contained in the said groove. It has at one end a shoulder n^6 , which is brought into contact with the roll as the same approaches the end of its revolution, and the roll serves to hold this sliding section while the cam continues to revolve; but upon the movement of the cam-roll from the cam, as above specified, this sliding section is released and by its spring n^7 moved back of the cam-roll, and when the machine is again started the cam starts on this movable cam-section and from its new position, the said sliding section acting as a part of the cam. The stitching mechanism is turned backward to its original position after the completion of the stitching of the buttonhole and after the belt has been shifted from the pulley a' to the pulley a and the gear-wheel C started.

In Figs. 32 to 35^A, inclusive, I have represented a dotted base-line extending through the center of the pivot of the clamp-plate and the lower needle. This line I have numbered 1, and I have also represented in the same figures, excepting Fig. 33, a full line numbered 2, which is the median longitudinal line of the clamp-plate. This last named always extends through the longitudinal center of the buttonhole, and the relations which these lines bear to each other represent the various positions which the clamp-plate and buttonhole being stitched bear to the base-line and the stitching mechanism at various stages in the stitching operation. In Fig. 33 I have represented by dotted outline the position of the cutter-anvil in relation to the said base-line 1 and to the clamp-plate median line 2, which is then coincident with the base-line.

As I have above explained, the gear-wheel is stopped, so that it is caused to turn from one-half to three-quarters of a revolution before the cam j , which it carries on its back

face, begins to operate the backturning mechanism. This cam is connected with the yoke by means of a cam pin or projection j' , extending from the side of yoke f^5 at the rear end, and as the cam bears upon it it moves the yoke and the S-shaped rack-bars forward by a continuous movement, turning the stitching devices backward quickly and continuously to their original position.

It will be understood that the yoke and S-shaped rack-bars are intermittently moved while the stitching is progressing, the feeding cam-wheel having a step-by-step rotation, while the returning-cam has a continuous rotation.

I have represented the clamps as automatically spread after the operation of the cutter and before the beginning of the stitching of the buttonhole by means of a lever k , attached to the stationary bed and having a projection k' at its inner end, which is adapted to bear against inclines k^2 , formed on the clamp-arms, (see Fig. 6,) and this lever is moved by a rock-lever k^3 , pivoted at k^4 and having a short arm k^5 , which engages the outer end of said lever, and a long arm k^6 , which is adapted to be moved by the pitman operating the cutting-lever and during its downstroke after it has actuated the cutter.

The clamps are automatically unclamped at the end of the stitching movement by means of a lever m , pivoted to the head b at m' and against one arm of which the starting-lever is moved in starting the machine and held by the cam which bears upon the clamp-plate. This moves the other arm m^2 of the lever forward, and as the stitching mechanism is turned this arm is engaged by a spring m^3 , carried upon the upper S-shaped rack-bar, and this engagement is maintained until after the stitching, when upon the reverse movement of the rack-bar in turning backward the stitching devices the said lever m is drawn backward, forcing the starting-lever forward and turning the cam which bears upon the clamp-arms sufficient to release them and permit them to move upward.

The momentum of the stitching mechanism is immediately checked after the transfer of the belt from the pulley a' to the pulley a largely by means of the lever o , which bears against the edge O of the cam-disk e^{17} and which is held against the same with considerable force by a spring. This lever operates a thread-tension.

It will be seen that the racks for turning the stitching mechanism are reciprocated at the desired intervals in both directions by cams, the first of which acts intermittently and the second continuously, and that the racks when not acted upon by the cams retain a stationary position because of friction. It will be noticed that the stitch-forming devices and their supporting-frame travel backward and forward upon the bed only the length of the buttonhole to be stitched, and that the frame is stationary during the action

of the buttonhole-cutting devices. This organization of the machine enables it to be constructed on simpler lines and with fewer and lighter parts and more cheaply than machines of similar character of which I have knowledge.

Having thus fully described my invention, I claim and desire to secure by Letters Patent of the United States—

10 1. In a buttonhole-stitching machine the combination of the bed-plate of the machine, a work-clamping mechanism held fixed upon the bed-plate during the stitching of each straight side of the buttonhole and laterally
15 moved upon the bed-plate during the stitching of the eye, a frame mounted upon said bed-plate movable intermittently forward and back thereon, the length of the buttonhole to be stitched, and stitch-forming de-
20 vices carried by said frame held stationary in the frame during the stitching of the sides but in a position on one side reversed from that of the other and rotated step by step substantially a half-rotation during the said
25 traversing movements of said work-clamping mechanism.

2. In a buttonhole-stitching machine, the combination of the bed-plate of the machine, a work-holding and slit-spreading clamp, a
30 buttonhole-cutter held in operative relation to the clamp at the beginning of the operation of the machine, the throat of the machine, its support, the under complemental stitch-forming devices, the cutter-anvil and
35 means for moving the throat, its support and said under complemental stitch-forming devices out of position and the cutter-anvil into position, and for reversing said movements, whereby the cutter-anvil is moved into oper-
40 ative relation with the cutter during the cutting of the buttonhole-slit and is then returned to its original or inoperative position, and the throat, its support and said under complemental stitch-forming devices re-
45 turned to their operative position, as and for the purposes set forth.

3. In a buttonhole-stitching machine, the combination of the bed-plate of the machine, a work-holding and slit-spreading clamp and
50 means for moving it laterally at the beginning and ending of the stitching of the rear end of the buttonhole in a manner to cause the stitches to cross each other at the rear end of the buttonhole, devices for also pro-
55 viding the said clamp with lateral movements during the stitching of the eye of the buttonhole, and means for holding the clamp stationary upon the bed at all other times, with a stitching-frame mounted upon the bed-
60 plate, stitch-forming devices carried by said frame and means for moving said stitching-frame with an intermittent or step-by-step feeding movement backward and forward lengthwise the frame and buttonhole and
65 means for operating the stitch-forming devices and turning them a half-rotation during the traversing or lateral movements of

said clamp in the stitching of the eye of the buttonhole, and devices for returning the stitch-forming devices to their original posi- 70
tion after the completion of the stitching of the buttonhole and the stopping of their stitching action.

4. In a buttonhole-stitching machine the combination of the bed-plate of the machine, 75
a work-holding and slit-spreading clamp, means for providing it with lateral movements during the stitching of the eye and for holding it stationary during the stitching of the straight sides of the buttonhole, with a 80
frame, stitch-forming devices mounted upon said frame, a buttonhole-cutter, an anvil for the same, means for actuating the buttonhole-cutter and moving the anvil into and out of operative position and means actuated af- 85
ter the operation of the buttonhole-cutter to move the frame and stitch-forming devices backward and forward upon the bed with a step-by-step feeding movement, and devices for actuating the stitch-forming mechanism 90
and for turning the same in one direction during the traversing movements of said clamp and in the reverse direction at the end of the stitching operation.

5. In a buttonhole-stitching machine the 95
combination of the bed-plate of the machine, a work-holding and slit-spreading clamp, a stitcher-frame, stitch-forming devices mounted upon the frame, a buttonhole-cutting jaw above the bed-plate of the machine and a 100
cutter-anvil below the bed-plate of the machine movable independently of the stitcher-frame into and out of operative relation with the cutter, and devices for actuating the cut- 105
ter-anvil, the stitcher-frame and stitching devices, as and for the purposes set forth.

6. In a buttonhole-stitching machine, the combination of the bed-plate of the machine, a work-holding and slit-spreading clamp, means for laterally moving it in respect to the 110
bed-plate at the beginning and at the ending of the action of the stitching devices and for also laterally moving it during the stitching of the eye of the buttonhole and for holding the work stationary at all other times, a 115
stitcher-frame, means for moving it lengthwise the bed-plate, stitching devices carried thereby, buttonhole-cutting devices, means for interchanging the position of a portion of the stitch-forming devices and the cutter-an- 120
vil, and devices for starting and stopping the operation of the buttonhole-cutting devices and for starting and stopping the operation of the frame-feeding mechanism and stitching devices, as and for the purposes set forth. 125

7. The combination in a buttonhole-stitching machine of an automatic buttonhole-cutting mechanism comprising a cutter, an anvil and means for temporarily substituting the anvil during the cutting operation for a por- 130
tion of the stitch-forming devices, a work-clamp for holding the work during the operation of the buttonhole-cutter, and means for moving said clamp laterally at the beginning

and at the ending of the action of the stitch-forming devices and also laterally during the stitching of the eye, a frame, stitch-forming devices mounted thereon, means for moving the frame backward and forward with a step-by-step movement, means for actuating the stitching devices and a connection between the buttonhole-cutting devices and the frame-feeding and stitch-actuating mechanism to automatically start the operation thereof at the completion of the operation of the buttonhole-cutting devices, means for automatically stopping the frame-feeding and stitch-forming mechanism, and devices for automatically returning the buttonhole-stitching mechanism and the clamp-plate laterally to their original or starting position automatically actuated upon the stopping of said frame-feeding and stitcher-actuating mechanism.

8. The combination in a buttonhole-stitching machine of the bed of the machine, a workholding and slit-spreading clamp mounted upon the bed of the machine, a buttonhole-cutting mechanism, the anvil of which is movable into and out of operative position, stitch-forming mechanism and frame, means for actuating the buttonhole-cutting mechanism, stitch-forming mechanism and frame, means for automatically spreading the clamp-plate, for moving it laterally during the stitching of the eye and for holding it stationary during the stitching of the straight sides of the buttonhole, a starting-lever connected with the work-clamps and with the buttonhole-cutting mechanism to upon its starting movement close the clamps and start said mechanism, automatic devices connecting the buttonhole-cutting mechanism with the stitching mechanism adapted to be automatically started by the buttonhole-cutting mechanism and to automatically start the buttonhole-stitching mechanism, devices for automatically stopping the action of the stitching mechanism at the completion of the stitching of the buttonhole and independent means for turning backward the stitch-forming devices, restoring the clamp-plate to its original position and automatically releasing the clamps at the stopping of the stitch-forming mechanism.

9. The combination in a buttonhole-stitching machine of the movable frame and stitching devices carried thereby, the cutter-lever c^3 pivoted to the frame and operated as specified, the anvil G, the movable anvil-support pivoted to said moving frame, its arm g' having a cam-slot g^2 of the shape specified, and an arm g^4 depending from the cutter-lever and connected with the said slot g^2 by a cam pin or roll.

10. The combination of the throat E^4 , its pivot-support and undercomplemental stitch-forming devices carried by said pivoted support, the upper stitch-forming devices and buttonhole-cutter with the anvil G, its support g and means for simultaneously moving the two supports in one direction to move the

throat and under complemental stitch-forming devices and their support out of position, and the anvil-arm and anvil into position and for holding them for an instant in such position, and to then move the said supports in a reverse direction and to hold them in said last-named position during the operation of the stitch-forming devices.

11. The combination of the bracket or arm B^3 , the sleeve or holder E^5 pivoted to said support, the arm g carried by said sleeve or holder, on the upper end of which the anvil G is mounted and the rotary support E^2 also carried by said sleeve or holder, and supporting the throat and under complemental stitch-forming devices, the upper stitch-forming devices and the buttonhole-cutter, as and for the purposes described.

12. In a buttonhole-sewing machine the combination of the bed of the machine, a frame B intermittently moved thereon forward and back, an under bracket or support B^3 attached to said frame B to be movable therewith, forward rests and guides b^4 in the legs or supports B^2 of the bed for guiding and supporting the forward end of said bracket, a saddle E^5 pivoted to the forward end of said bracket B^3 , under rotary complemental stitch-forming devices mounted on said pivoted saddle, an anvil-arm also mounted upon said saddle having an anvil at its upper end, means for tilting said saddle E^5 and for rotating said complemental stitch-forming devices, the upper stitch-forming devices and the buttonhole-cutter.

13. In a buttonhole cutting and stitching mechanism the combination of the bed-plate of the machine, a movable stitcher-frame mounted thereon having an underneath bracket or support B^3 which extends forward below the work-clamp and throat of the machine and has one or more bearing-sections at or near its front end, with the machine-frame having a stationary rest below said work-clamps and throat to receive and support said forward bearing-section of said bracket, an anvil-arm mounted upon said bracket or support B^3 to be movable therewith, and the anvil carried by said arm, the said stationary rest acting to support the forward end of said bracket, anvil-arm and anvil during the operation of the buttonhole-cutter and thereby relieve said parts from strain.

14. The combination of the wheel C having a hub c , the disk C' , mechanism for automatically engaging said disk with said wheel and for automatically disengaging said disk from said wheel at the end of one full revolution thereof, the buttonhole-cutter, its anvil, throat and under complemental stitch-forming devices connected with said disk and operated during its revolution to move the anvil into and out of position, the throat and under complemental stitching devices out of and into position and to hold the anvil stationary for an instant during the cutting op-

eration and to reciprocate the buttonhole-cutter and the upper stitch-forming devices, as and for the purposes described.

15. The combination of the wheel C, the disk C' actuating the buttonhole-cutting devices and mechanism between the said wheel and disk comprising a pawl c^{21} pivoted to the inner face of the disk C' and extending into a cavity in the outer face of the wheel C, and the end of which is adapted to be moved upon an arc in said cavity toward and from the outer edge thereof, a pawl c^{19} attached to the pawl c^{21} and adapted to extend outward from the cavity between the wheel and the disk, a spring for moving the end of the pawl c^{21} outwardly attached to the disk C', the wheel C having the cavity c^{22} and the shoulders or teeth c^{23} with which the end of the pawl c^{21} is adapted to engage, and the lever c^{17} pivoted at c^{18} having an end c^{24} which is adapted to be moved into and out of engagement with the end of the pawl c^{19} and a starting-lever preferably the lever for depressing and clamping the plates connected with said lever c^{18} to move the same to disengage the end of the lever c^{17} from the pawl c^{19} .

16. The combination of the wheel C, the disk C' connected with the buttonhole-cutting mechanism, the clutch between said wheel and disk, the clutch-actuating and stop lever c^{17} , the handle C⁴ and the trip c^{12} between it and the lever c^{17} , whereby upon the movement of the handle the lever is disengaged from the clutch, and whereby also, without restoring the handle to its original position the lever is left free to immediately resume its original or clutch-engaging position.

17. The combination in a buttonhole cutting and stitching machine of the main shaft A, the loose pulley a' thereon, the pinion a^4 connected therewith and the gear-wheel C connected with said pinion, the pulley a fast to the main shaft A, the disk C' operating the buttonhole-cutting mechanism, a clutch connecting the gear C with the disk C' adapted to permit a single rotation of the disk C' and a belt-shifter moved by the section a^{11} of the disk to shift the belt from the pulley a' to the pulley a , whereby the main shaft A is started and through it the mechanism for feeding frame B and for actuating the stitching devices.

18. The combination of the main shaft A, the pulley a fixed thereto, the loose pulley a' loose thereon and operating a wheel C, a disk C' and mechanism connecting it with the buttonhole-cutting mechanism, a clutch connecting the wheel C with the disk C' and a belt-shifter adapted to transfer the belt from the pulley a' to the pulley a upon the completion of the operation of the buttonhole-cutting mechanism and to hold it upon the pulley a during the operation of the stitch-forming devices, and to then transfer it to the pulley a' , whereby after the machine comes to rest,

it turns constantly the said pulley and the wheel C until the clutch connecting it with the disk C' is set in operation.

19. The combination of the bed of the machine, the plate D pivoted to the bed, material-holding and slit-spreading clamps carried at the forward end of said plate, a rotary face-cam and a cam-roll upon the rear end of said pivoted plate yieldingly held in contact with said cam which is constructed to move the clamp-plate laterally during the stitching of the eye of the buttonhole and to hold it stationary during the stitching of each straight side of the buttonhole.

20. The combination in a buttonhole-stitching machine of the plate D pivoted to the bed of the machine, the material-holding and slit-spreading clamps carried at the front end of said plate, the movable stitching-frame and devices upon it adapted to engage said pivoted plate and move the same laterally while they are traveling bodily with the movable frame.

21. The combination in a buttonhole-stitching machine of the bed of the machine, material-holding and slit-spreading clamps pivoted to said bed and provided with lateral movements during the stitching of the eye of the buttonhole and held stationary during the stitching of the sides of the buttonhole, whereby the work is held stationary excepting so far as it is given slight lateral movements during the stitching of the eye, a stitcher-frame movable step by step upon the bed of the machine in a straight line backward and forward, an intermittently-revolving wheel mounted upon a horizontal axis or shaft attached to said frame whereby said wheel is movable with it, a cam upon the face of said wheel connected with the clamps to move the same laterally and a cam-groove in the face of said wheel connected with the bed of the machine by a roll or pin fixed to said bed whereby the frame is moved backward and forward, as and for the purposes described.

22. The combination of the lower bar e^8 , the bent lever e^{14} pivoted at e^{15} , a cam-groove e^{16} in the back side of the rotary disk e^{17} of the main shaft connected with the upper end of the bent lever e^{14} by the lever e^{18} pivoted at e^{19} , the upper end of which carries a cam-pin which enters said cam-groove e^{16} and the lower end of which is connected with said bent lever e^{14} by a link e^{20} .

23. The combination of the needle-bar having the pinion F, the lower bar having the pinion e^{39} , the upper rack-bar F' carried by the arm b , the forward end of which engages the pinion F, the lower rack-bar e^{41} , the forward end of which engages the pinion e^{39} , the sliding yoke f^5 having the arms f^9, f^{10} to which said bars are attached, the rotary cam F² and a cam-roll f^6 carried by the yoke and held in engagement with the edge of the cam by friction, the said cam being constructed to per-

mit the rapid backward movement of the yoke and racks at the completion of the stitching operation.

24. The combination of the bed of the machine, the frame mounted thereon to be movable as specified, the cam-disk B' mounted upon the frame to travel therewith and connected with the bed and having two cams, one of which is connected with the bed and the other with the clamps, the said cam having the gear h^3 upon its outer edge, a pinion h^4 to engage said gear-teeth and means for intermittently rotating the said pinion, comprising the shaft h^5 upon which it is mounted, a clutch upon said shaft which is reciprocated by means of the lever h^{16} pivoted at h^{17} , the cam h^{15} and the spring h^{20} , all as and for the purposes described.

25. The combination in a machine of the character specified of the pulley a' , the pulley a , the belt-shifter a^2 , a spring a^{10} for moving it in one direction, a cam a^{11} for moving it in the reverse direction and means for holding the belt-shifter and releasing it at the intervals stated, comprising the wheel B' having in its face a hole a^{15} , an automatically-closing cover-plate carried by said wheel and adapted to cover said hole, and an arm extending from the belt-shifter, the end a^{13} of which is adapted upon the rotation of the wheel B' to act as a stop in holding the cover-plate while the hole is being uncovered, and which hole then permits the lateral movement of the belt-shifter, and which cover-plate upon the movement of the belt-shifter in a reverse direction is adapted to be moved past the end of said belt-shifter arm to close the hole and prevent the return of the belt-shifter.

26. The combination of the disk C' operating the cutting mechanism and connected with the wheel C as specified and having the section a^{11} for operating the belt-shifter with the belt-shifter having a hook-section to shut behind the part a^{11} of the disk C' and the said wheel C and the cutting mechanism, as and for the purposes described.

27. The combination of the belt-shifter, the pulleys a, a' , the wheel C and a latch attached to the belt-shifter and adapted to be brought into contact with a spring on the inner face of the wheel C as the belt is being shifted from the pulley a' to the pulley a and to lock said wheel from rotating between the end of said spring and a stop thereon.

28. In a buttonhole-stitching machine the combination of a cam caused to be actuated after the operation of the stitching device has ceased, the stitching mechanism and means for turning it, the clamp-plate, an intermediate connection between them and the cam whereby the said cam causes the stitch-forming devices to be turned backward and the clamp-plate to be transferred after the completion of the stitching operation.

29. The combination of the wheel C, a cam thereon connected with the mechanism for

rotating the stitch-forming devices to operate the same after the completion of the stitching operation, and a stop upon said wheel for holding the same stationary until the belt-shifter has been shifted from the pulley a to the pulley a' and in such relation to the said stitching-mechanism-returning cam as to cause said wheel C to make a portion of a revolution before the cam is brought into operation, whereby the cam is prevented from turning the stitching devices until after the needles have been removed out of the work.

30. The combination in a buttonhole cutting and stitching machine, of the main shaft A, the stitch-forming devices operated thereby, the fast pulley a and the loose pulley a' thereon, the wheel C connected with the loose pulley to be operated thereby, the disk C' connected with the wheel C by a clutch and the buttonhole-cutting devices, a belt-shifter for moving the belt from the pulley a' to the pulley a at the end of the operation of the cutting devices, and for moving the belt from the pulley a to the pulley a' at the end of the operation of the stitching devices, means substantially as described for moving the said belt-shifter, a stop for stopping the rotation of the disk C' after it has been unclutched, a stop for stopping the rotation of the wheel C upon the transfer of the belt from the pulley a' , means for releasing said last-named stop and for transferring the belt from the pulley a to the pulley a' at the completion of the operation of the buttonhole-stitching devices and whereby the said devices are stopped and a cam upon the said wheel C brought into operation after the stopping of the buttonhole-stitching devices and connected with them, whereby the stitching devices are adapted to be turned backward to their normal position, as and for the purposes described.

31. The combination of the frame B, the wheel B' having the frame-propelling cam B⁴ and a metal band inclosing the said feed-wheel and adapted to bear thereon whereby it acts as a cover to the teeth and also as a retarding device for checking the momentum of the frame at the instant the belt is shifted from its actuating-pulley.

32. In a buttonhole-stitching machine the combination of the bed-plate, the clamp-plates, a cam for moving the clamp-plates laterally after the completion of the stitching operation from the position in which they were at the end of the stitching operation to the position which they should occupy at the beginning of the stitching of the next buttonhole in order, the stitching devices and means for simultaneously turning them backward a half-revolution at the same time that the clamps are transferred, as and for the purposes set forth.

33. The combination in a buttonhole-stitching machine of the clamp-plate, a cam-roll at the rear end of the clamp-plate, a cam having a movable section held by the said cam-

roll until the clamp-plate is moved laterally to move the cam-roll from engagement with the cam, and means for then moving said movable section of the cam whereby it is returned under the cam-roll and devices for so moving the clamp-plate and cam-roll while the stitching devices are inoperative.

34. The combination of the plate D supporting the material-holding and slit-spreading clamps connected with its actuating-cam as described, the said cam having the movable cam-section, a spring for holding the end of said plate in contact with the cam, devices for moving the end of the plate from the cam to permit the interposition of the movable section of the cam between it and the end of said plates, as and for the purposes described.

35. The combination of the plate D pivoted as described and supporting the material-holding and slit-spreading clamps and a rock-lever n pivoted at n^2 having an arm n^3 , the upper end of which engages the plate D at n^4 and a dog N on the side of the lower rack-bar and which dog engages said rock-lever as the said rack-bar approaches the end of its forward movement after the operation of the stitch-forming devices.

36. In a buttonhole-stitching machine the combination of the bed-plate of the machine, a work-clamp mounted thereon, means for transferring it laterally in one direction at the beginning of the stitching of the rear end of the buttonhole and in a reverse direction at the end of the stitching of the rear end of the buttonhole, a buttonhole-stitching mechanism movable lengthwise the buttonhole, means for holding it stationary or for slightly moving it at the beginning and at the end of the stitching of the rear end of the buttonhole during the transferring movement of the work-clamp whereby the stitching of the buttonhole is begun by stitches of the same length as those used in stitching the sides and eye placed closely together in the material at the rear end of the buttonhole and in line therewith, and whereby the stitching of the buttonhole is ended by the sewing on top of the stitches first named of additional stitches of the same length as the sides and eye and a compact double-stitched bar thus formed at the rear end of the buttonhole.

37. The combination in a buttonhole-stitching machine of an upper reciprocating straight eye-pointed needle and means for reciprocating it upon a vertical plane, a lower reciprocating straight eye-pointed needle and means for reciprocating it upon a straight line from below the work-plate at an angle to the plane of movement of the upper needle and across the same, a looper below the work-plate and means for providing it with movements past the upper needle to take the loop therefrom as the upper needle is lifting from its lowest position and carry the loop back of the under needle as the latter needle is falling, and to then hold it over the under needle until the under needle has taken it and

to then return it by the same path to its original position, all as and for the purposes set forth.

38. The combination of the support E^2 , the lever e^9 , the bar e^8 connected with the lever e^9 , means for reciprocating the said bar e^8 , the inclined slideway e^7 , the slide e^6 therein, the needle E' attached thereto and a connection between the free end of the lever e^9 and the slide.

39. The combination of the support E^2 , the looper-holder pivoted to said support as described and movable laterally in relation thereto, the looper E^3 carried by said looper-holder and the lever e^{22} having the cam-slot e^{21} and lever e^{23} having the cam e^{27} , both connected with said looper-holder, one adapted to reciprocate the same and the other to provide it with lateral movement, and the reciprocating bar e^8 connected with the said cams e^{27} and e^{21} .

40. The combination of the looper-holder and the looper carried thereby, the laterally-sliding support or pin to one end of which the looper-holder is attached, the lever e^{28} connected at its free end with said pin, the cam e^{27} thereon, a reciprocating pin or bearing-piece actuated as specified to engage said cam, and the spring e^{31} to return the looper-holder and hold the lever with the cam in operative relation to the end of said pin.

41. The combination in a buttonhole-stitching machine of a clamp-plate having a lateral movement at the beginning and at the end of the stitching of the rear end of the buttonhole, means for holding it fixed during the stitching of the straight sides of the buttonhole, means for moving the clamp-plate laterally in both directions during the stitching of the eye and additional means for moving the clamp-plate transversely in a direction the reverse of that in which it is moved at the end of the stitching of the last side of the buttonhole, which movement is made after the stitching of the buttonhole is finished to restore the clamp-plate to its original position in relation to the stitching mechanism and while the latter is being rotated back to its original position, the stitching mechanism and means for imparting to it a step-by-step feeding movement and for rotating it in one direction during the stitching of the eye and in a reverse direction at the completion of the stitching of the buttonhole.

42. The combination of the reciprocating bar e^8 , a cross-pin e^{12} mounted thereon to reciprocate therewith and having an end which comes into contact with the cam upon the side of a pivoted lever, with said lever e^{28} , the said cam e^{27} thereon, the looper-holder e^{23} upon which the looper is mounted, said pin being connected with the upper end of the said lever e^{28} to be moved in one direction thereby, a spring e^{31} to move it in the reverse direction and the looper E^3 carried by said looper-holder.

43. The combination in a buttonhole cut-

ting and stitching machine of the bed-plate of the machine, the stitcher-frame and means for moving it step by step backward and forward upon said bed-plate, the stitching mechanism carried thereby, the lever C^2 mounted upon the forward end of said frame, a crank and means for providing it with a single continuous revolution, a pitman connecting the crank with said lever C^3 , an anvil beneath the bed-plate moved into and out of operative position with the cutter C^2 during the downward and upward movements of the cutter and held stationary upon the stitcher-frame out of operative relation with the cutter during the movement of the stitcher-frame, as and for the purposes set forth.

44. The combination in a buttonhole cutting and stitching machine of the bed-plate of the machine, the stitcher-frame mounted thereon, the stitching mechanism carried thereby, means for moving the frame and actuating the stitching mechanism, the cutter-lever and cutter mounted thereon, a crank-pin and means for providing it with one continuous revolution, a longitudinal adjustable pitman connecting the crank-pin with the cutter-lever, and an anvil, as and for the purposes set forth.

45. The combination in a buttonhole-stitching machine of a longitudinally-movable frame mounted upon the bed of the machine, buttonhole-stitching devices mounted thereon, buttonhole-cutting mechanism also mounted upon said frame to be movable longitudinally therewith, one section of which cutting mechanism is above the bed-plate of the machine and the other section of which is below said bed-plate, and means for moving said upper section toward and from the lower section and for moving the lower section horizontally into and out of operative relation

with the upper section, as and for the purposes set forth.

46. The combination in a buttonhole-stitching machine of the buttonhole-stitching devices comprising a bed-plate, a work-clamp laterally movable during the stitching of the eye, a stitcher-frame movable lengthwise the work-clamp and bed-plate, stitching devices carried by said stitching-frame and rotated during the stitching of the eye in one direction and at the completion of the stitching operation in a reverse direction, a buttonhole-cutter above the work-plate, a cooperating anvil below the work-plate and means for moving the lower complemental stitch-forming devices and the anvil laterally to move the said lower complemental stitch-forming devices out of their operative relation with the upper stitch-forming devices and the anvil into operative relation with the cutter and to restore them to their original positions, and devices for actuating the cutter.

47. In a buttonhole cutting and stitching machine the combination of a laterally-movable clamp with a buttonhole-cutting mechanism, the anvil and cutter of which are set to operate slightly out of line to a median line passing through the center of the fulcrum of the clamp-plate and the center of the upper needle.

48. In a buttonhole stitching and cutting machine a buttonhole-cutting mechanism the anvil and cutter of which are set slightly out of line to a median line passing through the center of the fulcrum of the clamp-plate and the center of the upper needle.

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