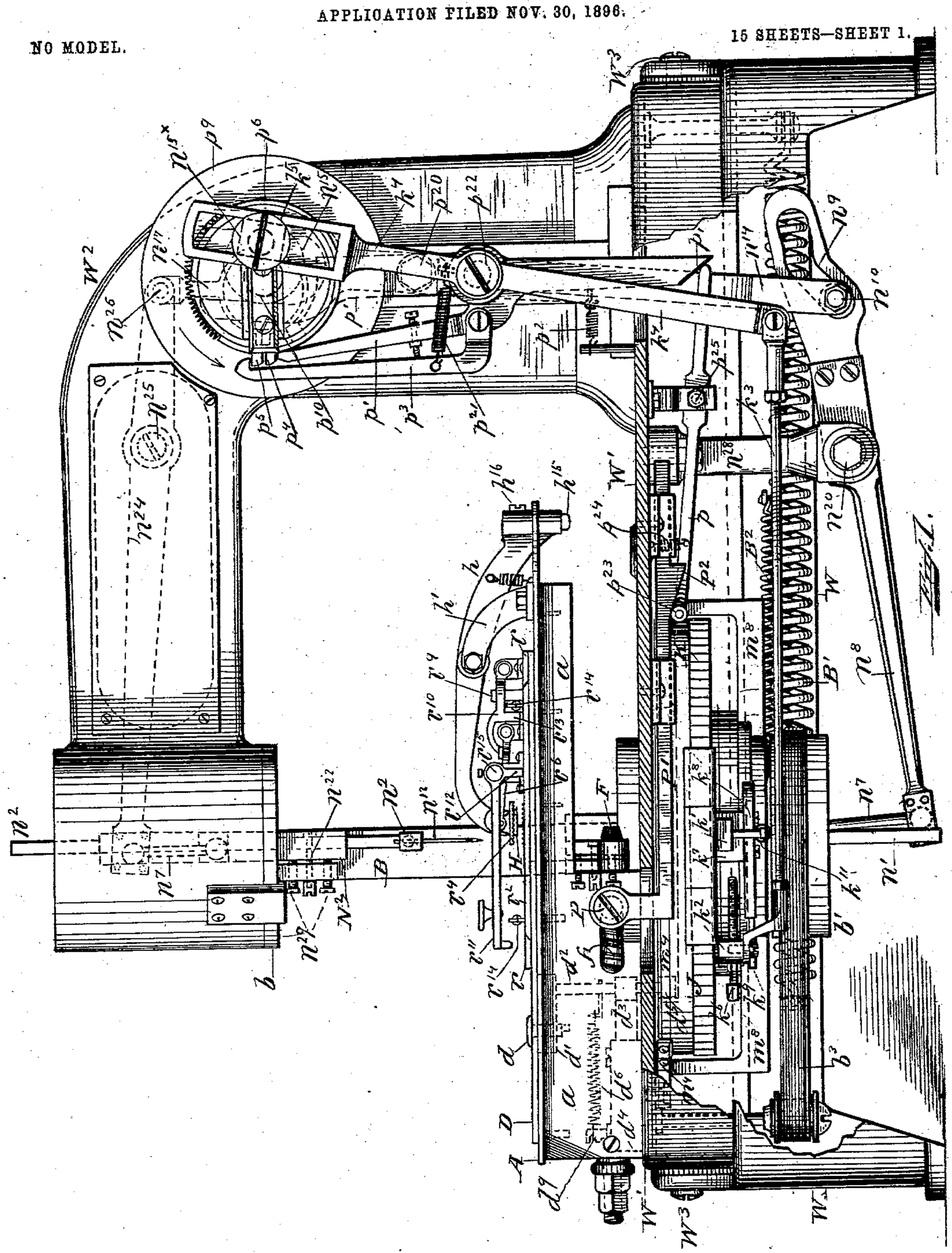
No. 740,755. PATENTED OCT. 6, 1903.

F. L. HARMON.

MACHINE FOR SEWING BUTTONHOLES.

APPLICATION FILED NOV. 30, 1896.

NO MODEL. 15 SHEETS—SHEET 1.



Witnesses:
Seth T. Thaker Jr.
N. E. Merwick Jr.

Inventor:
Frank L. Harmon.

No. 740,755. PATENTED OCT. 6, 1903.

F. L. HARMON.

MACHINE FOR SEWING BUTTONHOLES.

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NO MODEL. 15 SHEETS—SHEET 2.

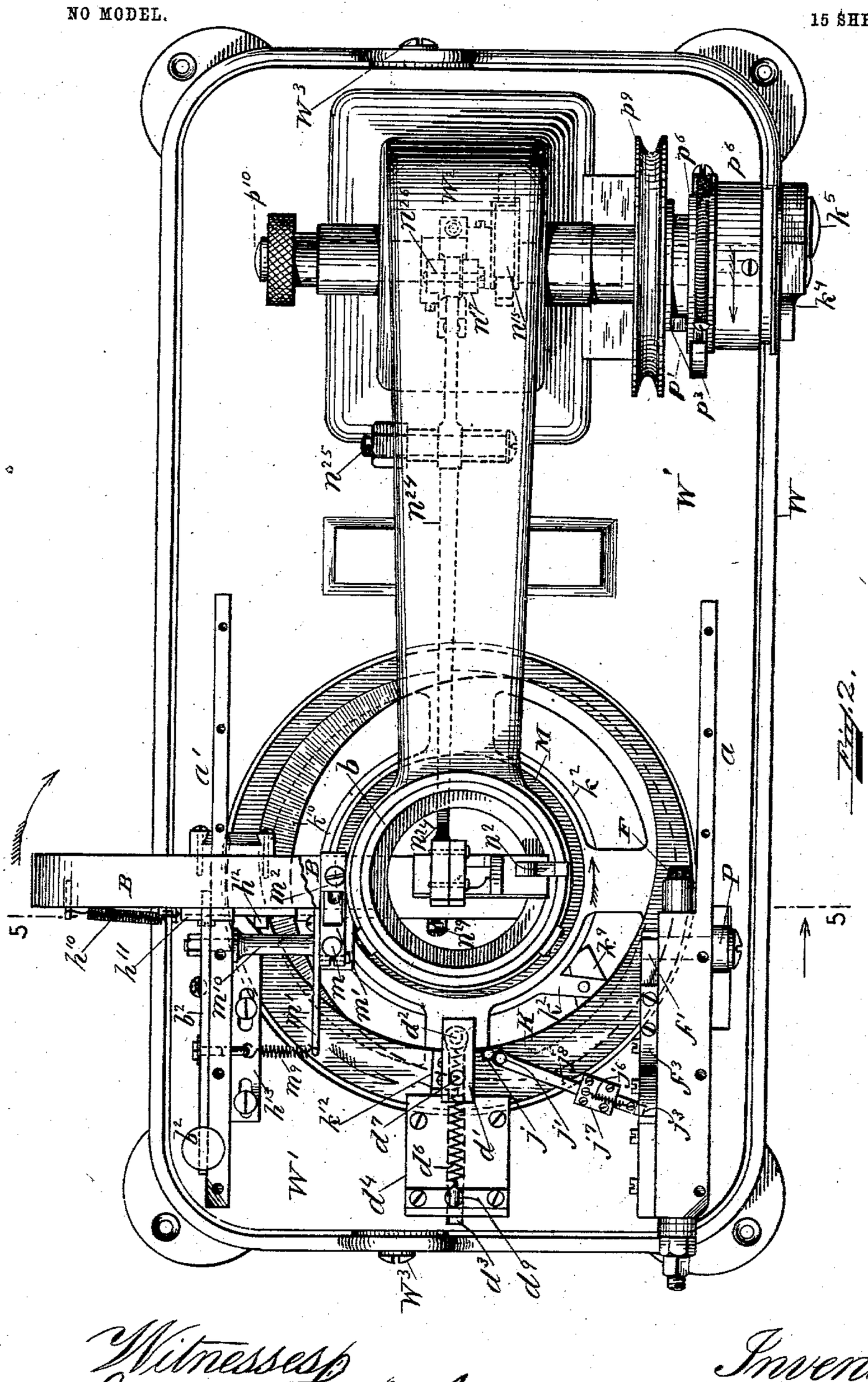

Fig. 12.

Witnesses:
Seth T. Thacher Jr.
H. C. Pennock Jr.

Inventor:
Frank L. Harmon.

No. 740,755. PATENTED OCT. 6, 1903.

F. L. HARMON.

MACHINE FOR SEWING BUTTONHOLES.

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NO MODEL. 15 SHEETS—SHEET 3.

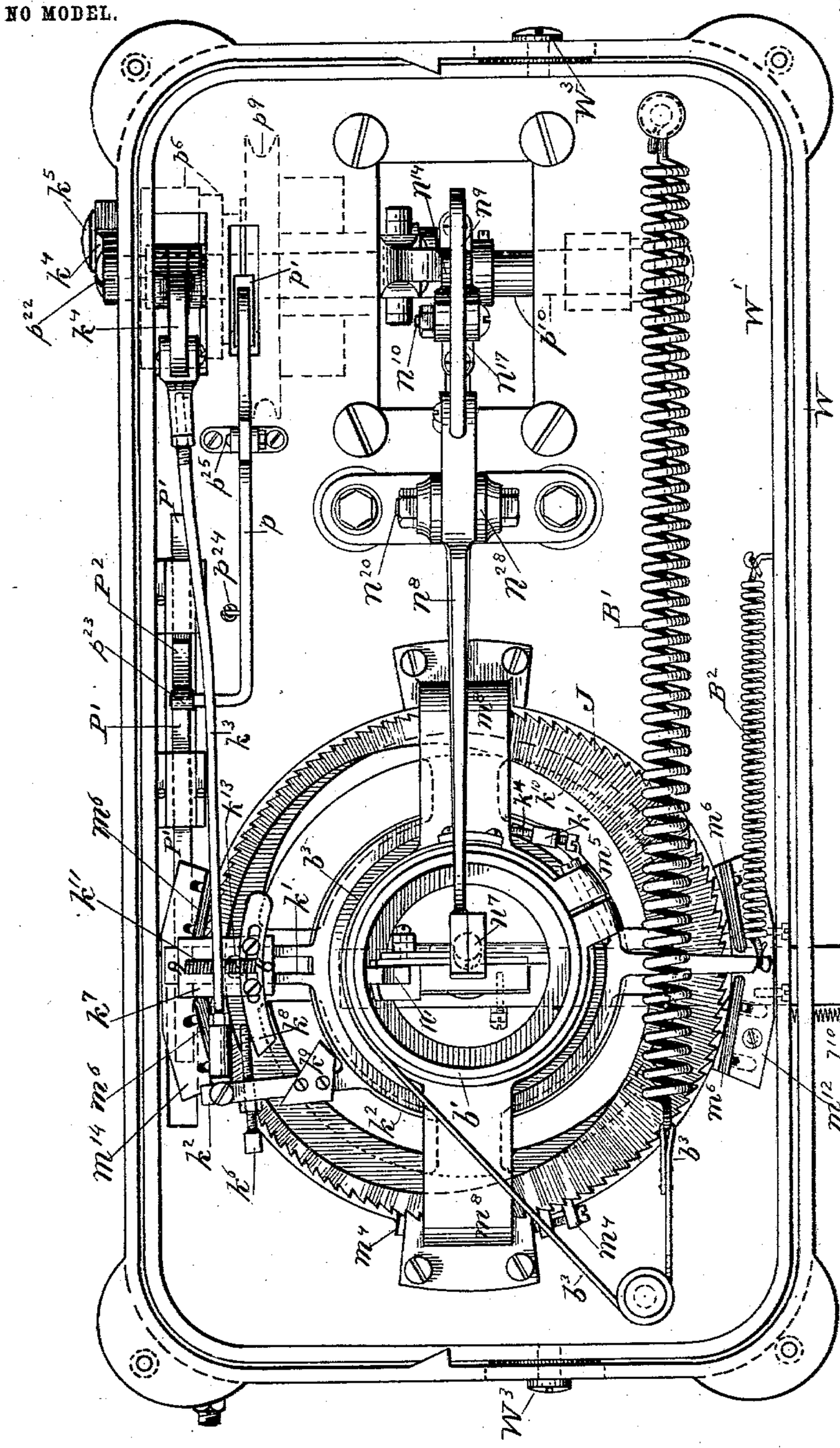


Fig. 3.

Witnesses:
Seth T. Mauhews
H. E. Kenrick Jr.

Inventor:
Frank L. Harmon.

No. 740,755. PATENTED OCT. 6, 1903.

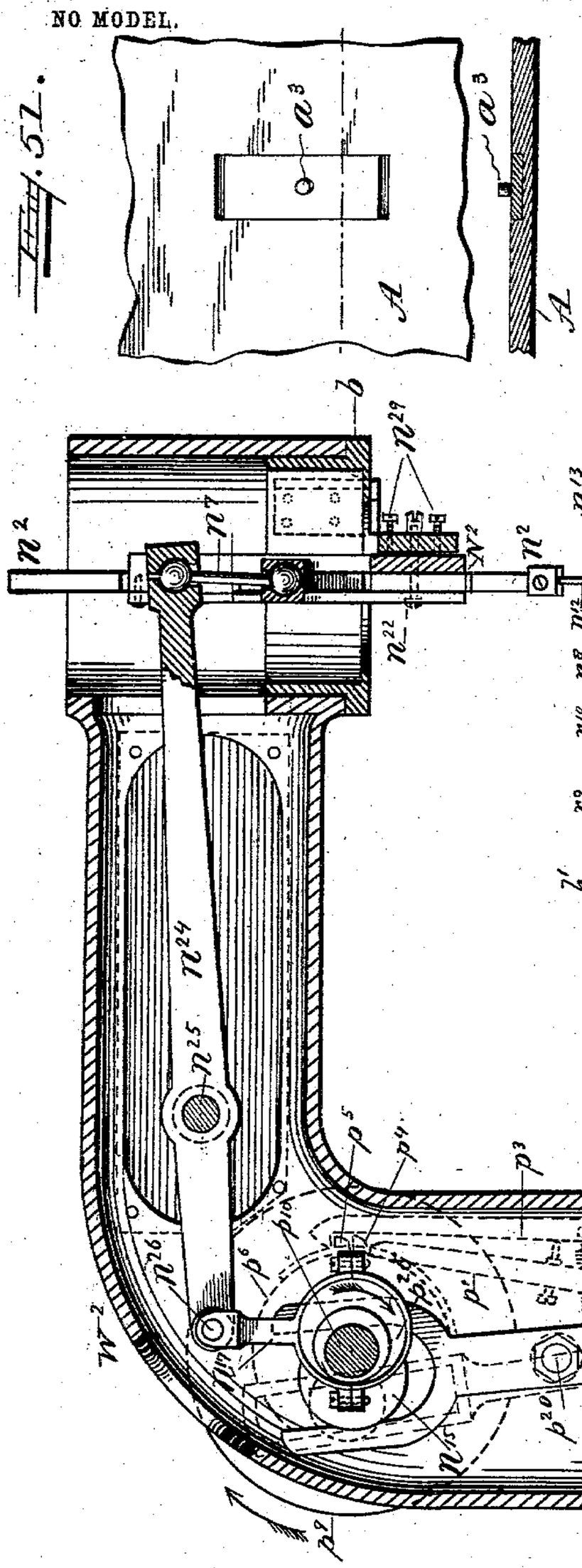
F. L. HARMON.

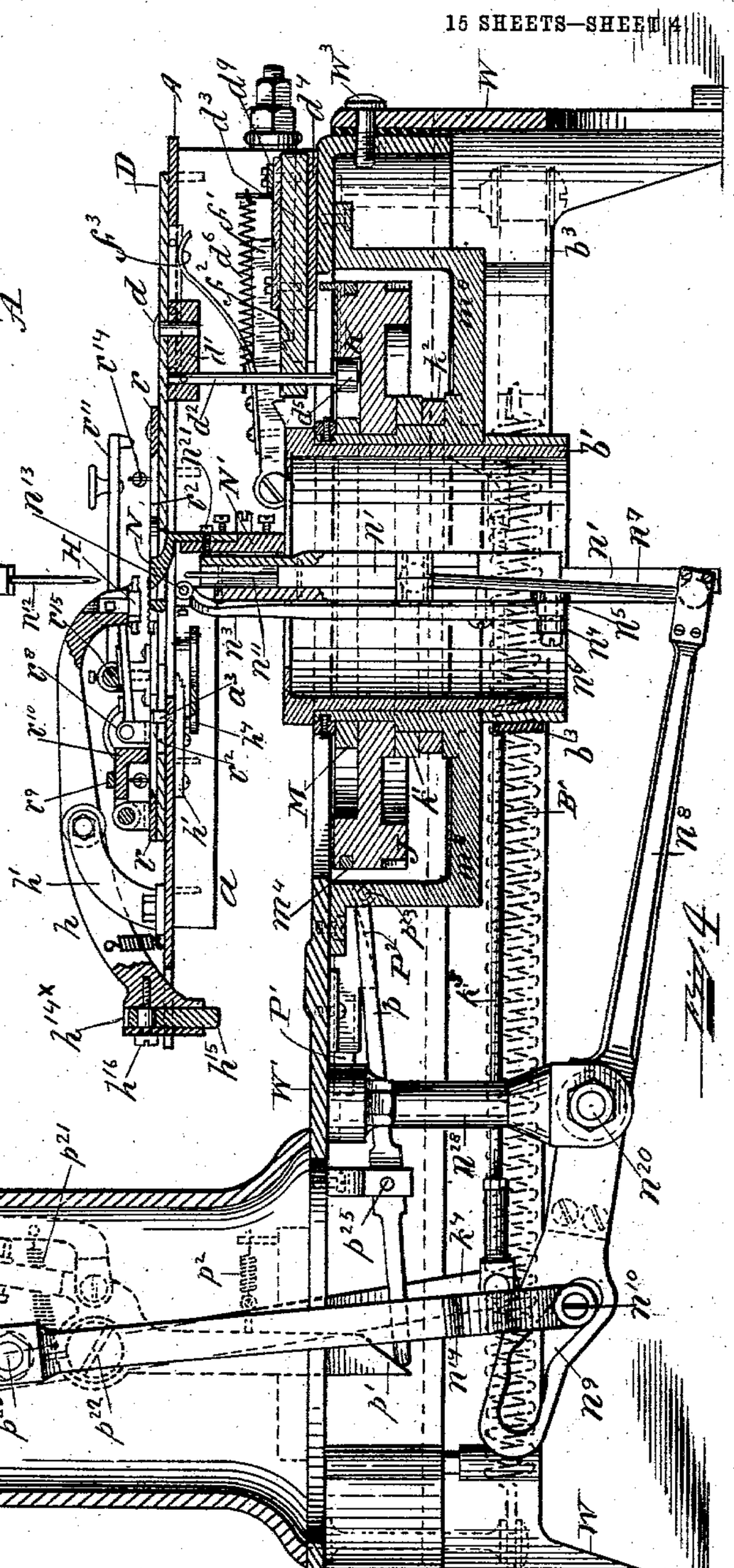
MACHINE FOR SEWING BUTTONHOLES.

APPLICATION FILED NOV. 30, 1896.

NO MODEL. 15 SHEETS—SHEET 14.

Fig. 51.





Witnesses,
Seth T. Thacher Jr.
H. C. Renick Jr.

Inventor:
Frank L. Harmon.

No. 740,755. PATENTED OCT. 6, 1903.

F. L. HARMON.

MACHINE FOR SEWING BUTTONHOLES.

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NO MODEL. 15 SHEETS—SHEET 5.

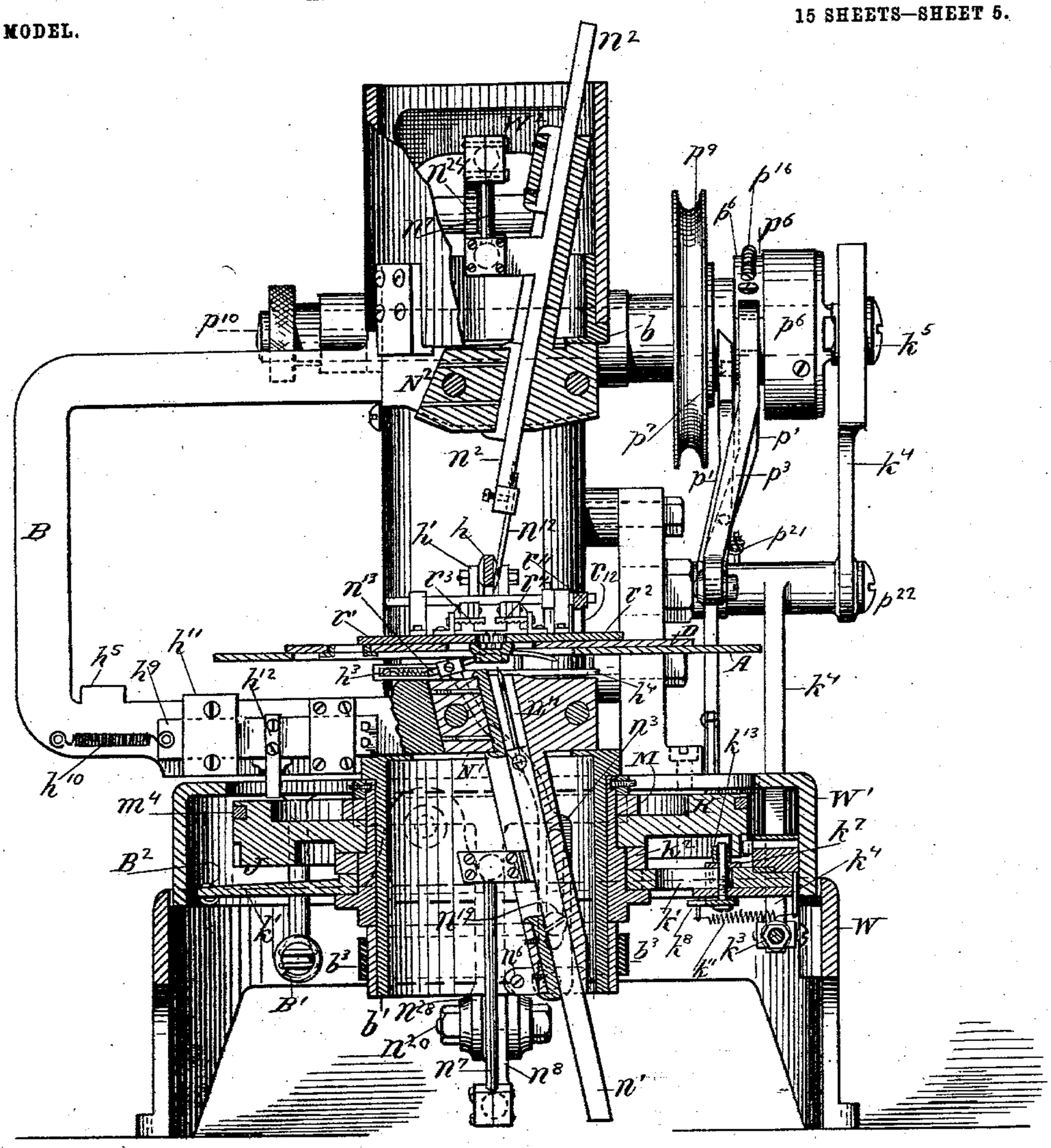

Fig. 5.

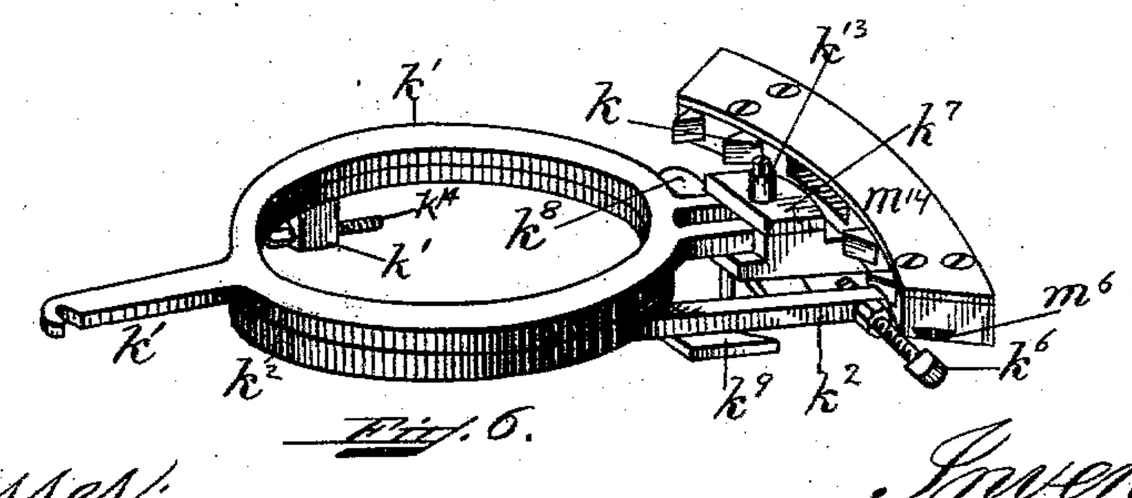

Fig. 6.

Witnesses:
Seth T. Thacher Jr.
H. E. Kinnick Jr.

Inventor:
Frank L. Harmon.

No. 740,755. PATENTED OCT. 6, 1903.

F. L. HARMON.

MACHINE FOR SEWING BUTTONHOLES.

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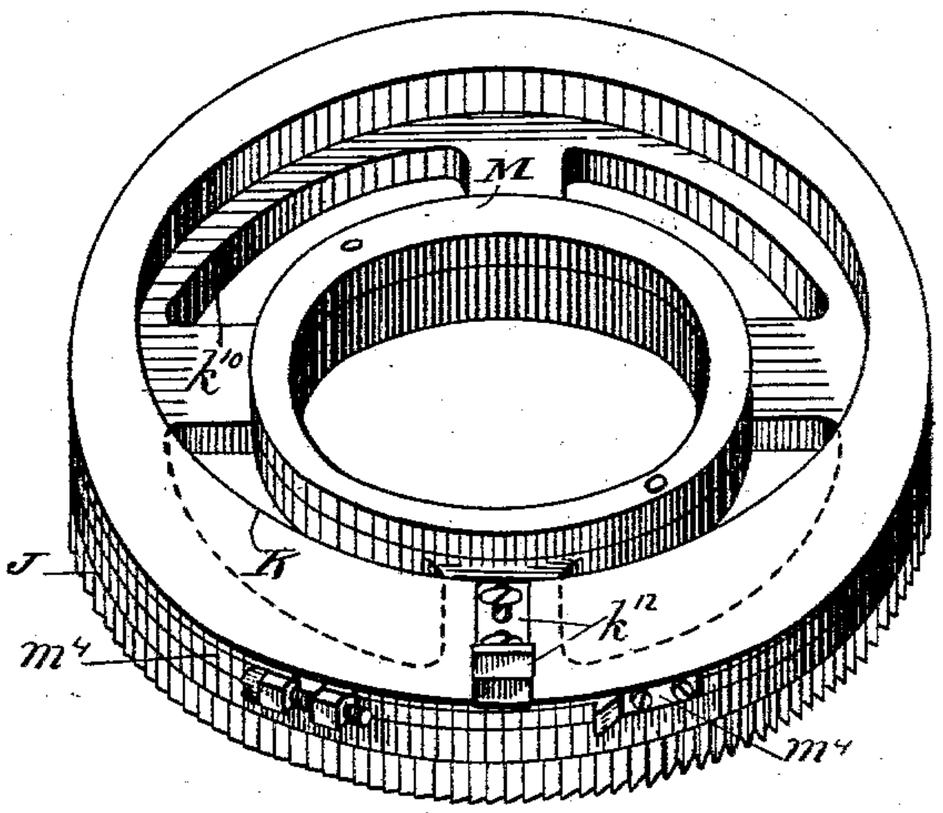
NO MODEL. 15 SHEETS—SHEET 6.



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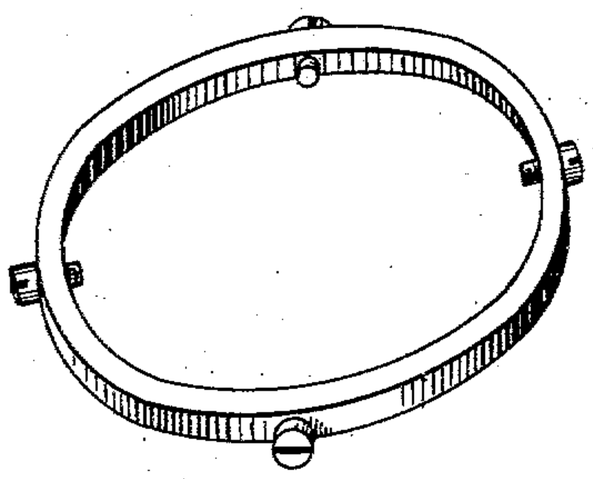

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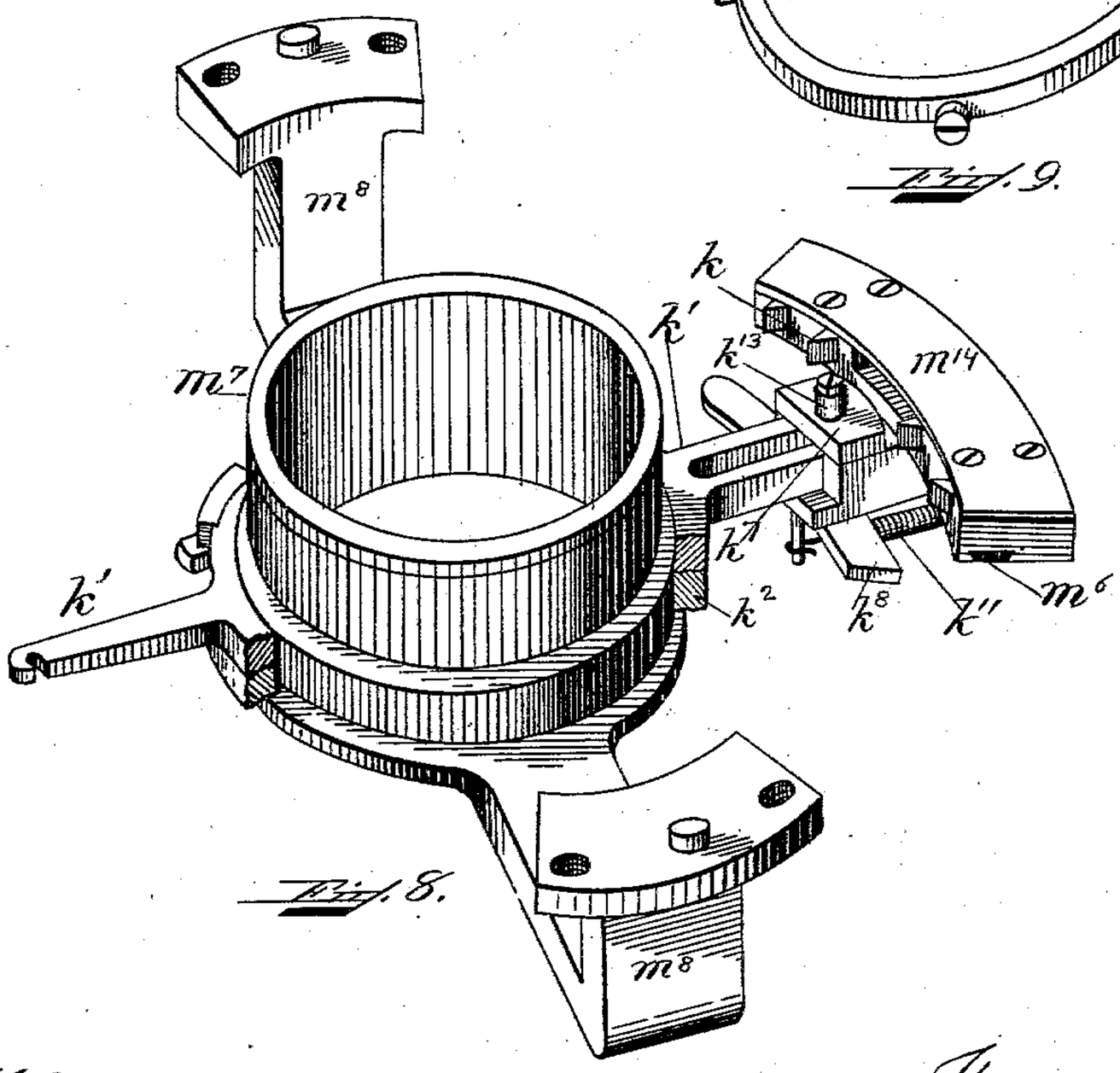


Fig. 8.

Witnesses:
Seth F. Thacker Jr
H. E. Kunick Jr

Inventor:
Frank L. Harmon.

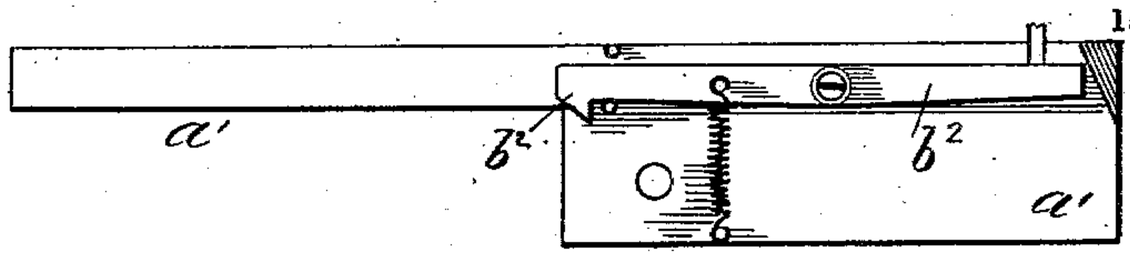
No. 740,755. PATENTED OCT. 6, 1903.

F. L. HARMON.

MACHINE FOR SEWING BUTTONHOLES.

APPLICATION FILED NOV. 30, 1896.

NO MODEL. 15 SHEETS—SHEET 7.



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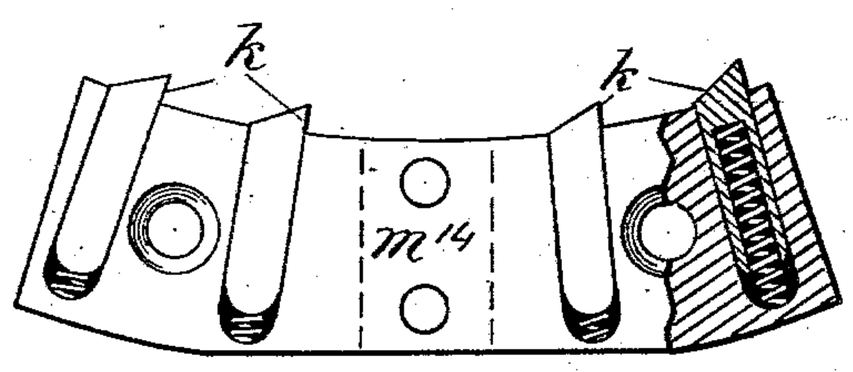
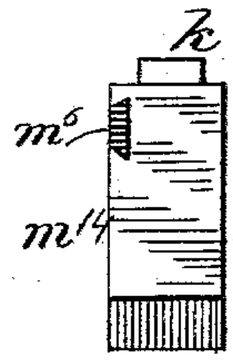


Fig. 10.



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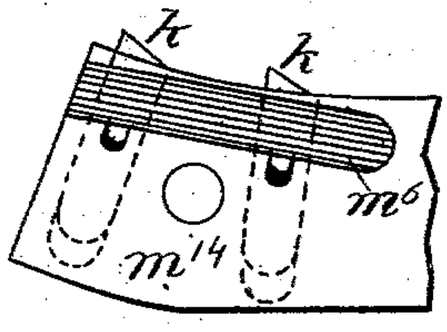

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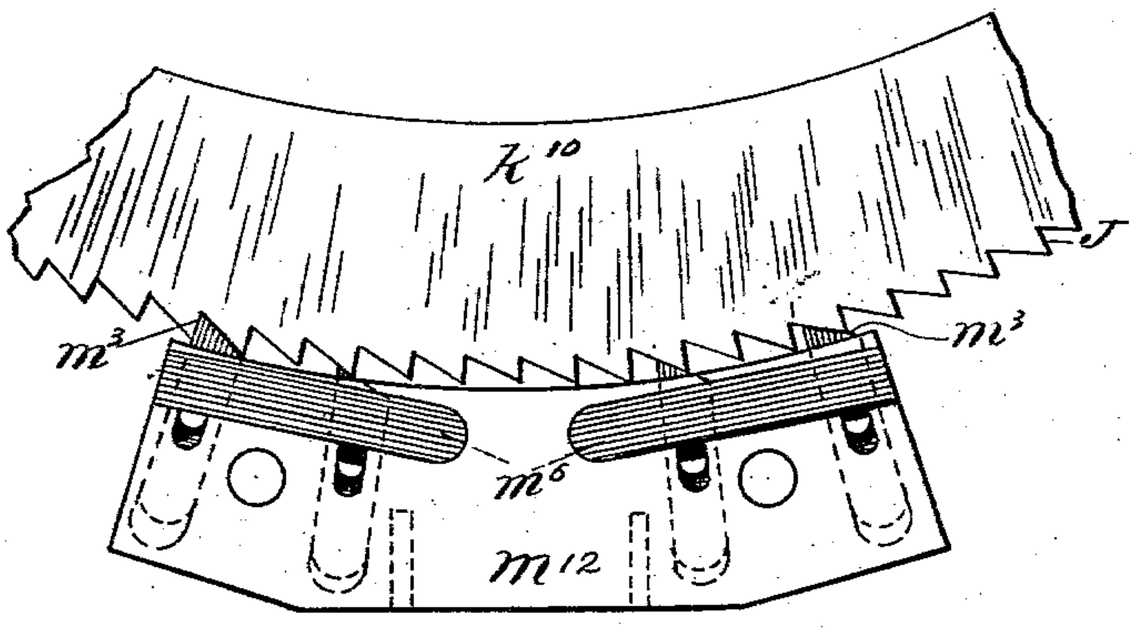

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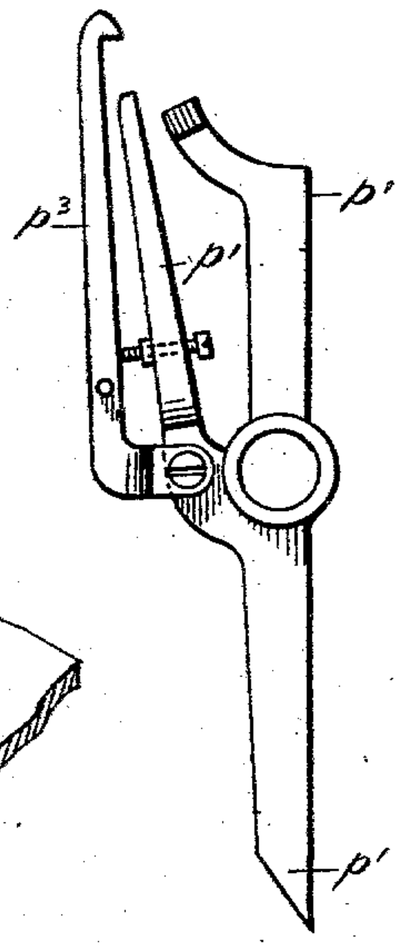

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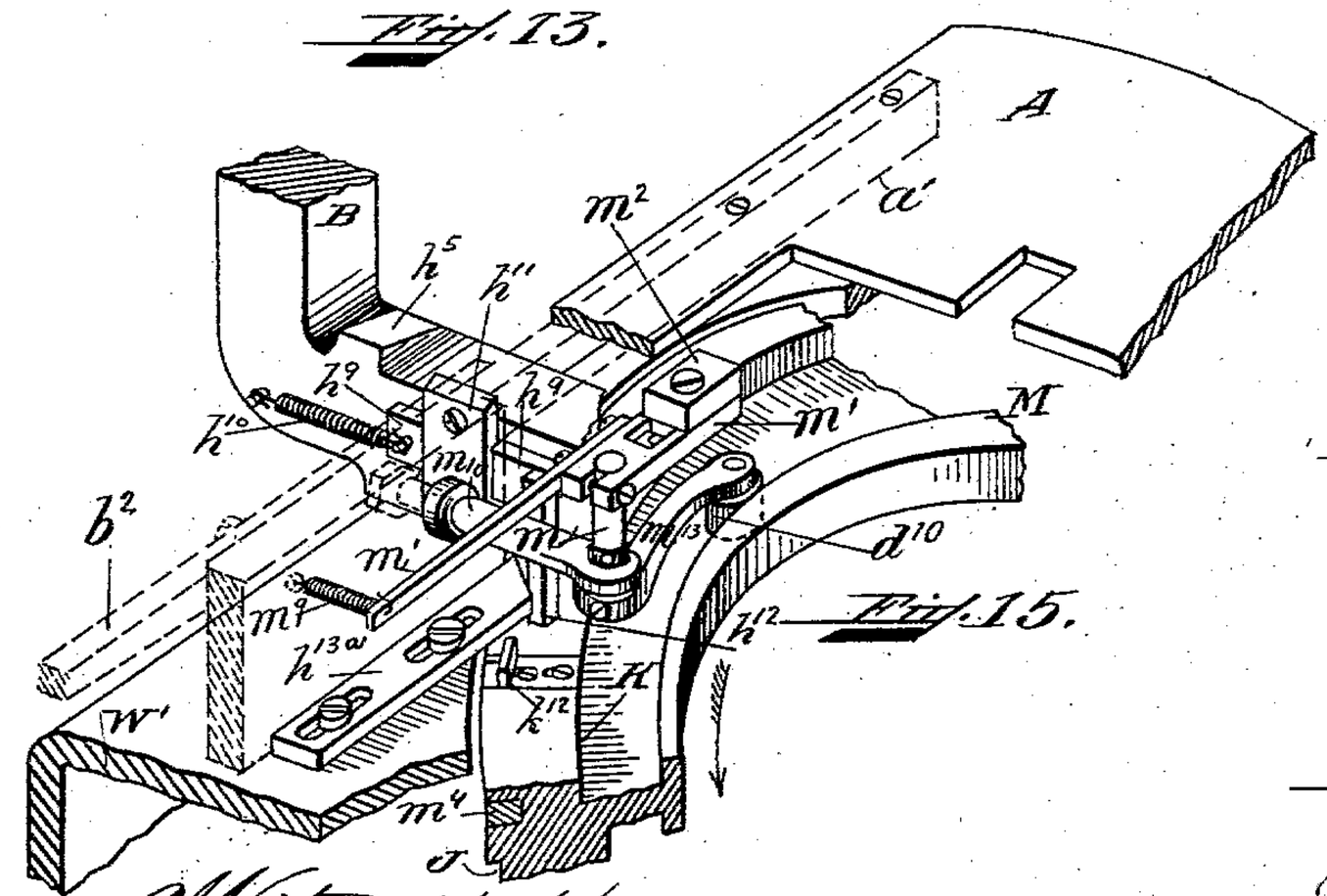

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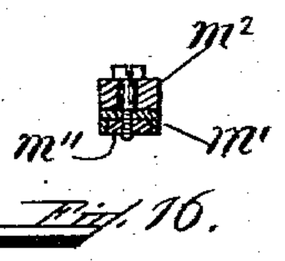

Fig. 16.

Witnesses:
Seth T. Thacher Jr.
F. E. Kenick Jr.

Inventor:
Frank L. Harmon.

No. 740,755. PATENTED OCT. 6, 1903.

F. L. HARMON.

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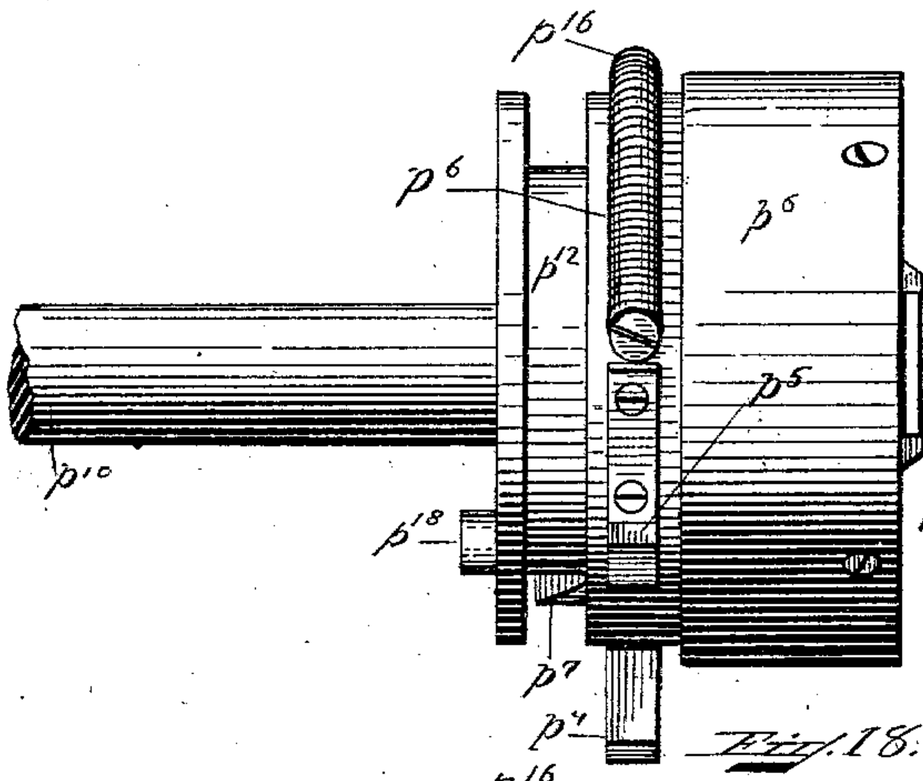
NO MODEL. 15 SHEETS—SHEET 8.



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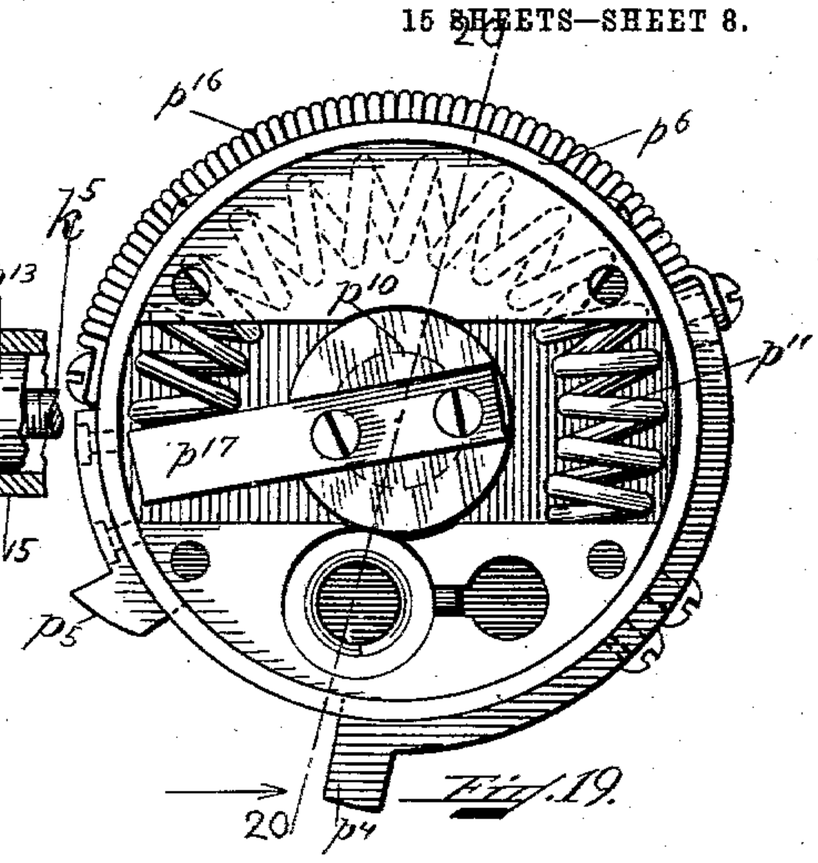

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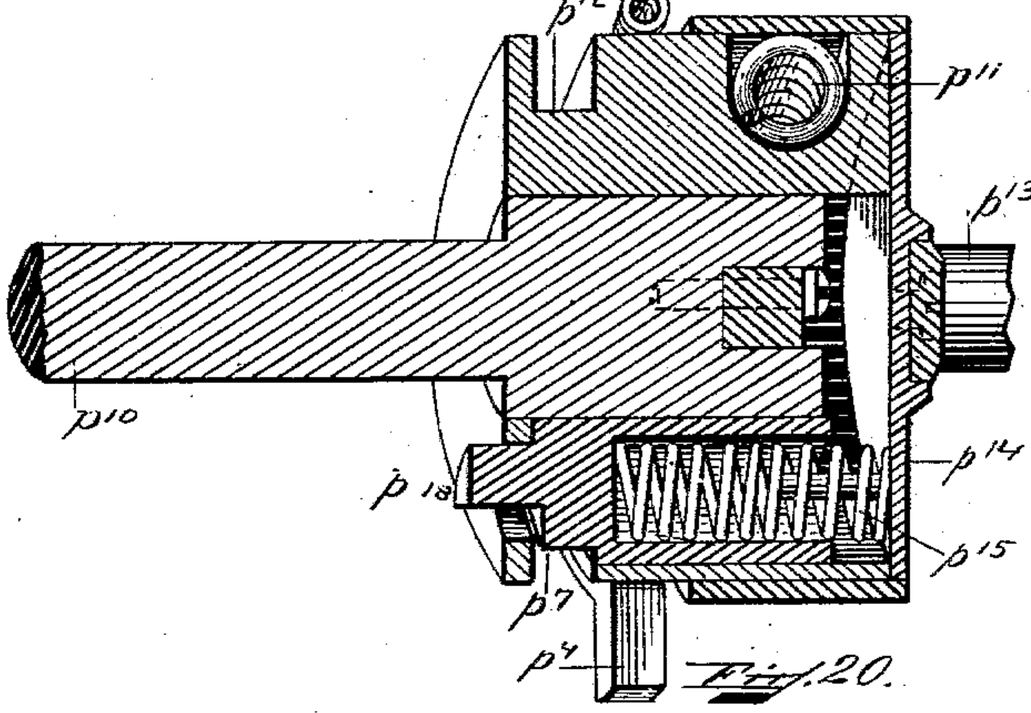

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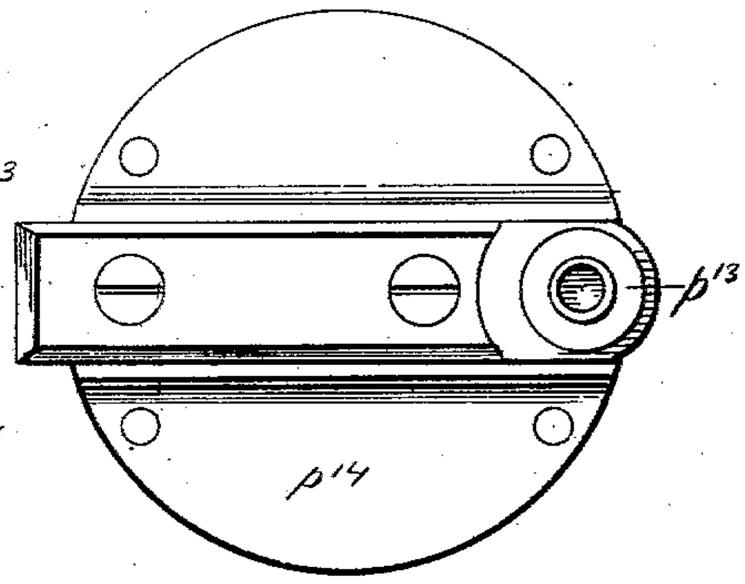

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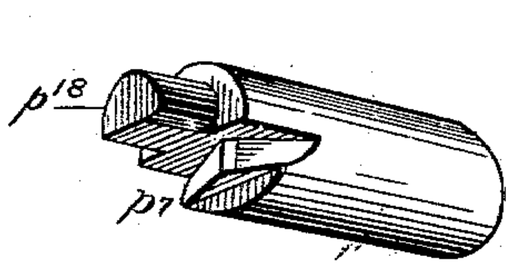

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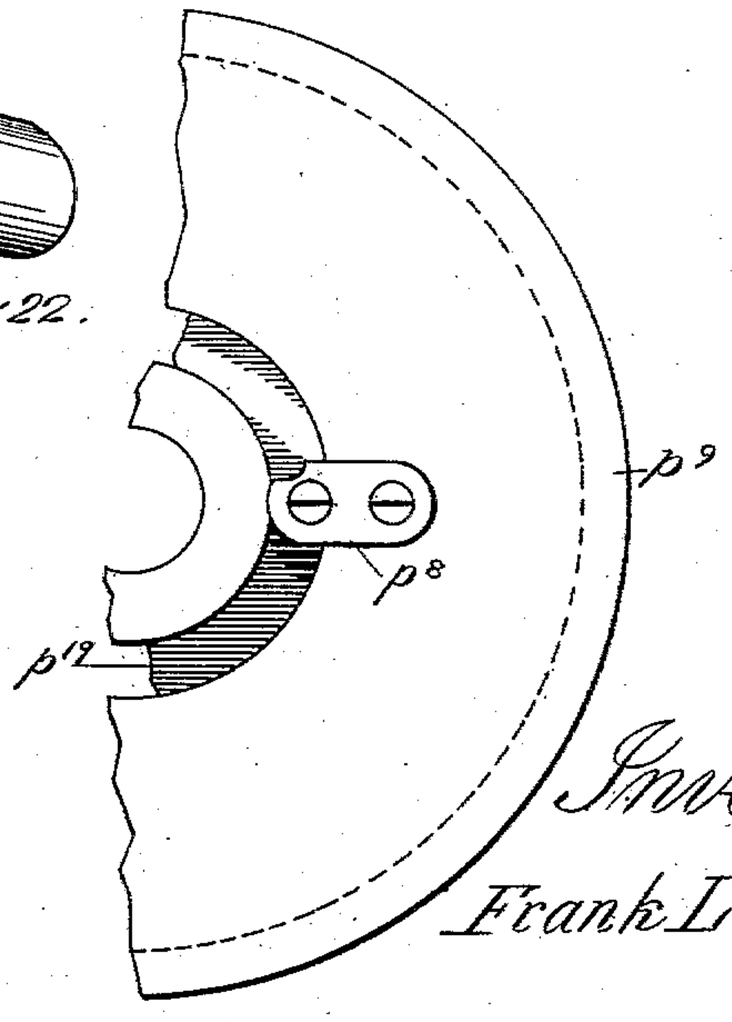

Fig. 23.

Witnesses:
Seth T. Thacher Jr.

N. E. Merwick Jr.

Inventor:
Frank L. Harmon.

No. 740,755. PATENTED OCT. 6, 1903.

F. L. HARMON.

MACHINE FOR SEWING BUTTONHOLES.

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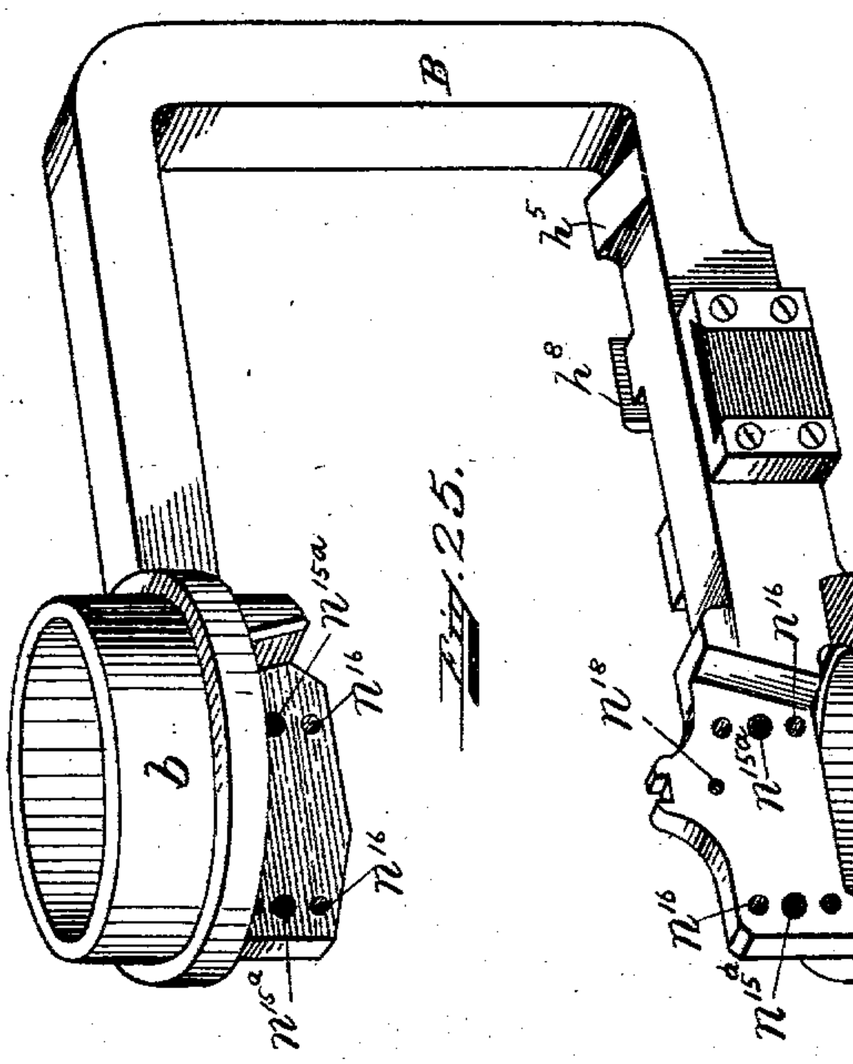
NO MODEL. 15 SHEETS—SHEET 9.



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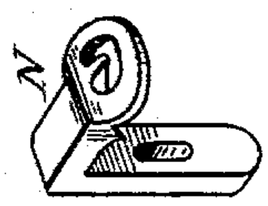
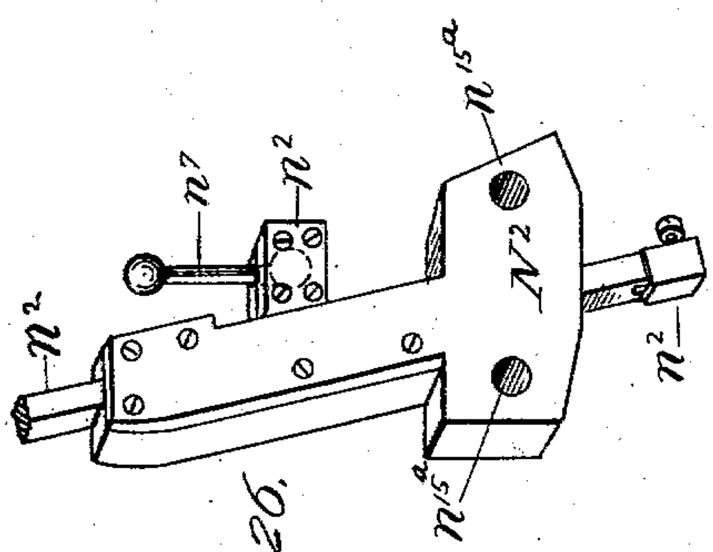


Fig. 26.

Fig. 27.



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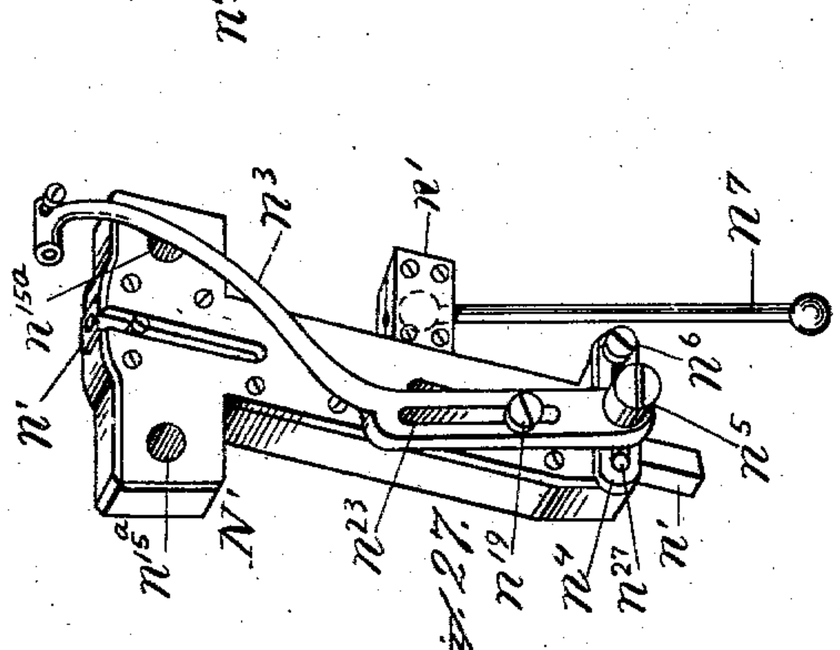

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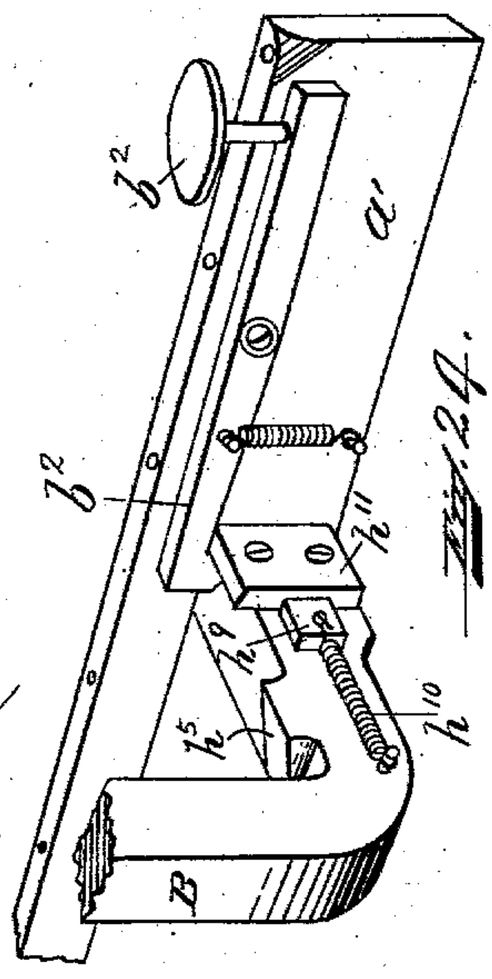


Fig. 24.

Witnesses:
Seth T. Thacher Jr.
H. A. Penick Jr.

Inventor:
Frank L. Harmon.

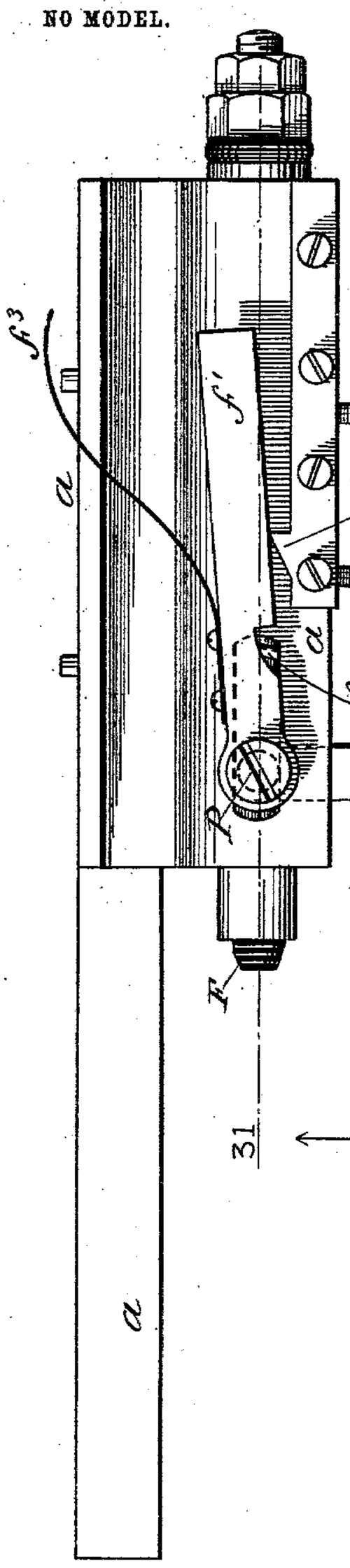
No. 740,755. PATENTED OCT. 6, 1903.

F. L. HARMON.

MACHINE FOR SEWING BUTTONHOLES.

APPLICATION FILED NOV. 30, 1896.

NO MODEL. 15 SHEETS—SHEET 10.



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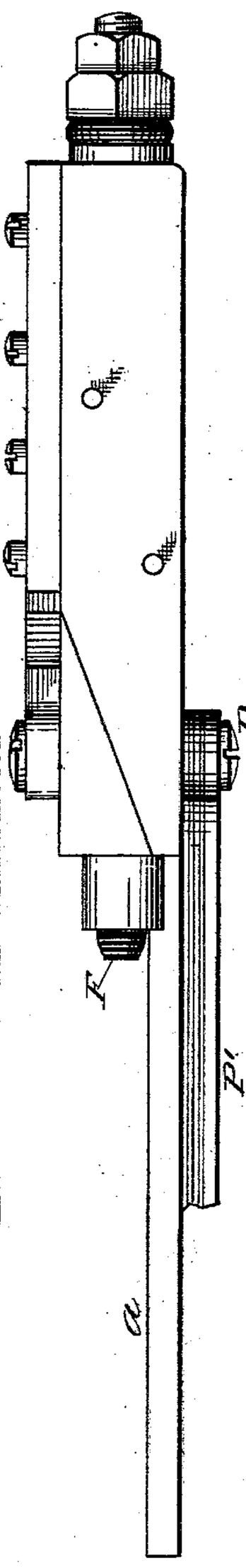

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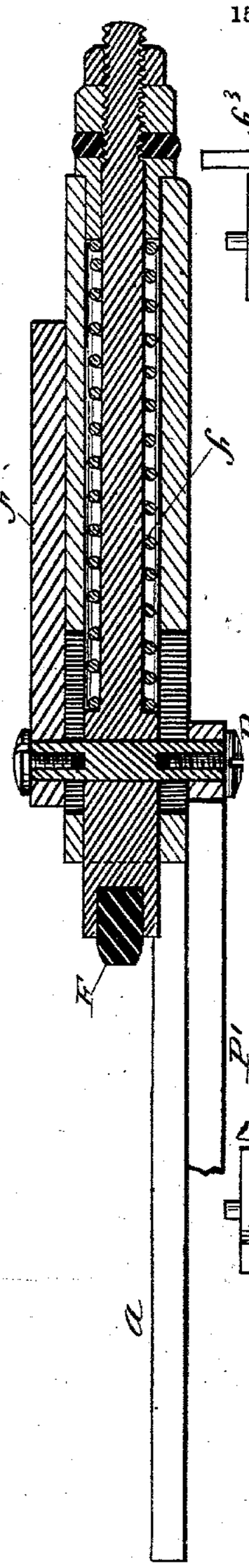

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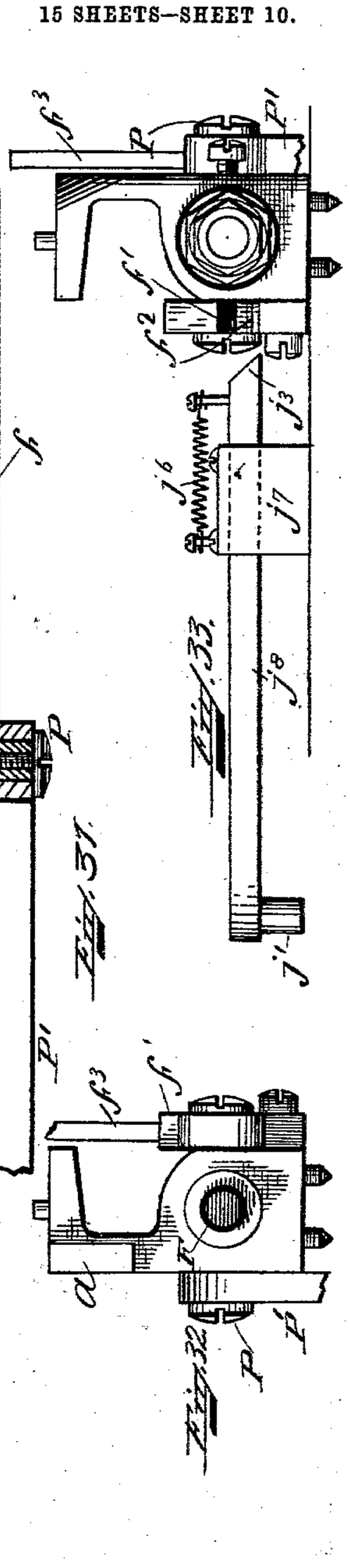

Fig. 32.

Fig. 33.

Witnesses:
Seth F. Thacher Jr.
H. E. Runick Jr

Inventor.
Frank L. Harmon.

No. 740,755. PATENTED OCT. 6, 1903.

F. L. HARMON.

MACHINE FOR SEWING BUTTONHOLES.

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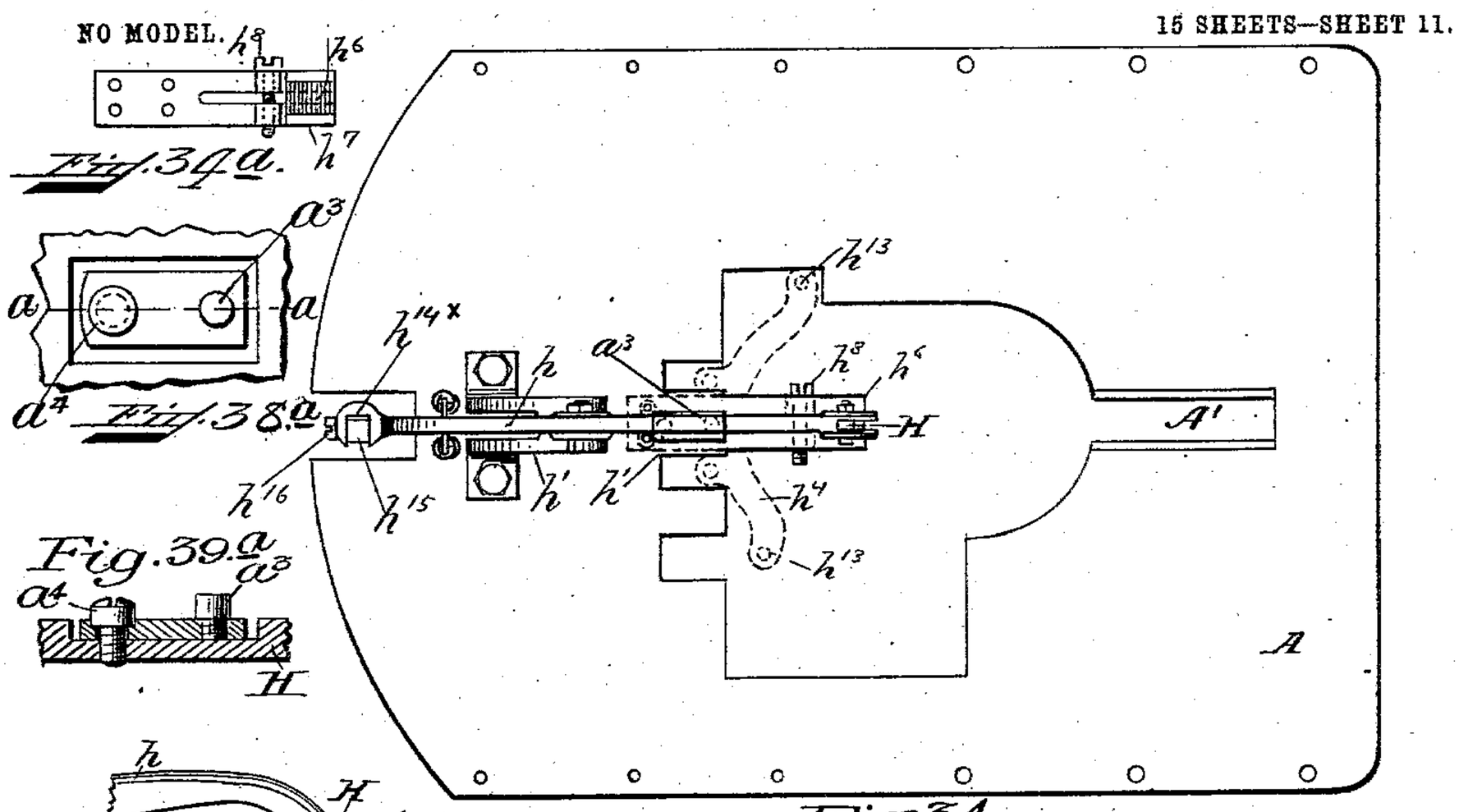
NO MODEL. 15 SHEETS—SHEET 11.



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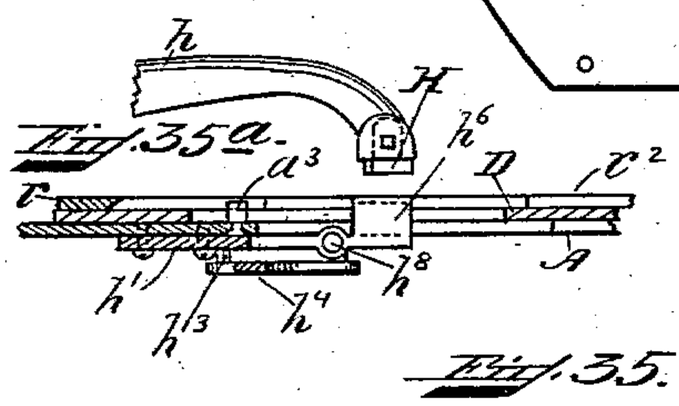

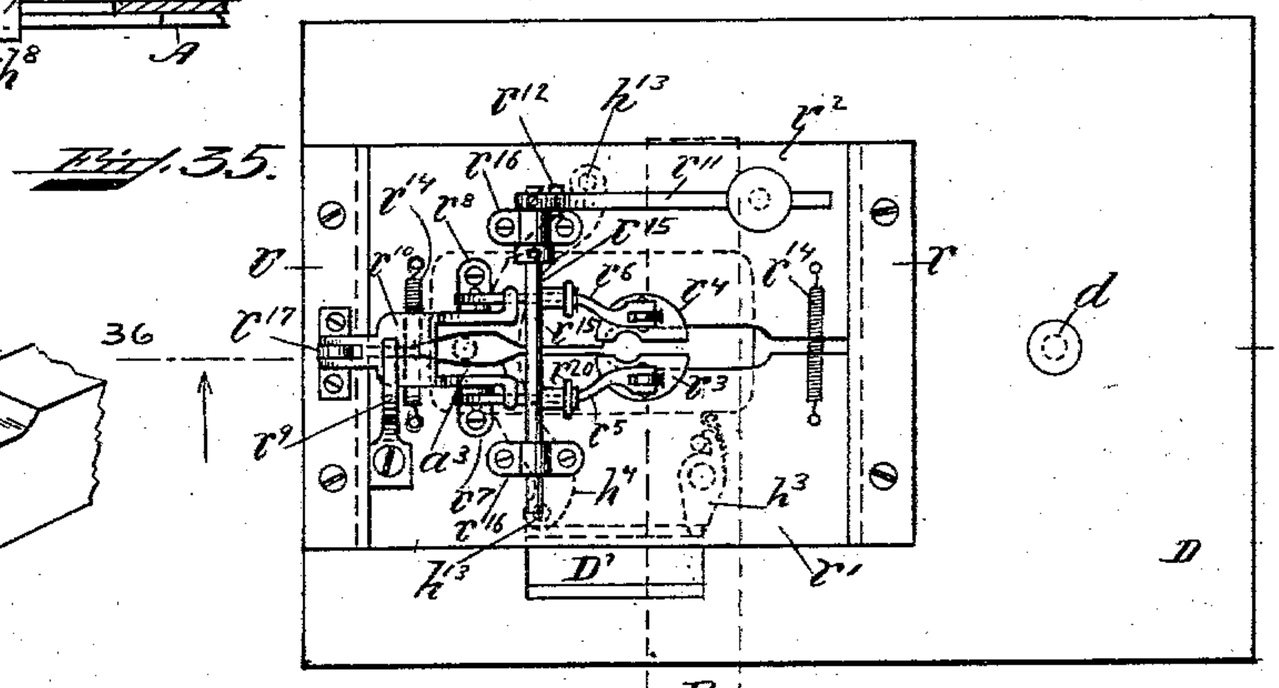

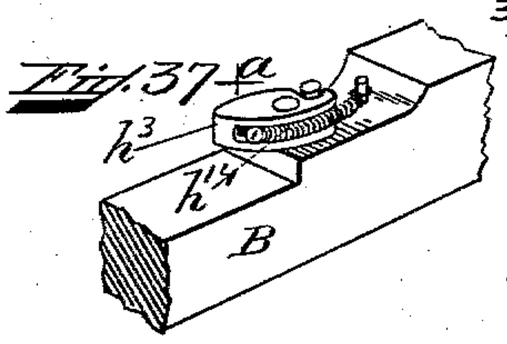

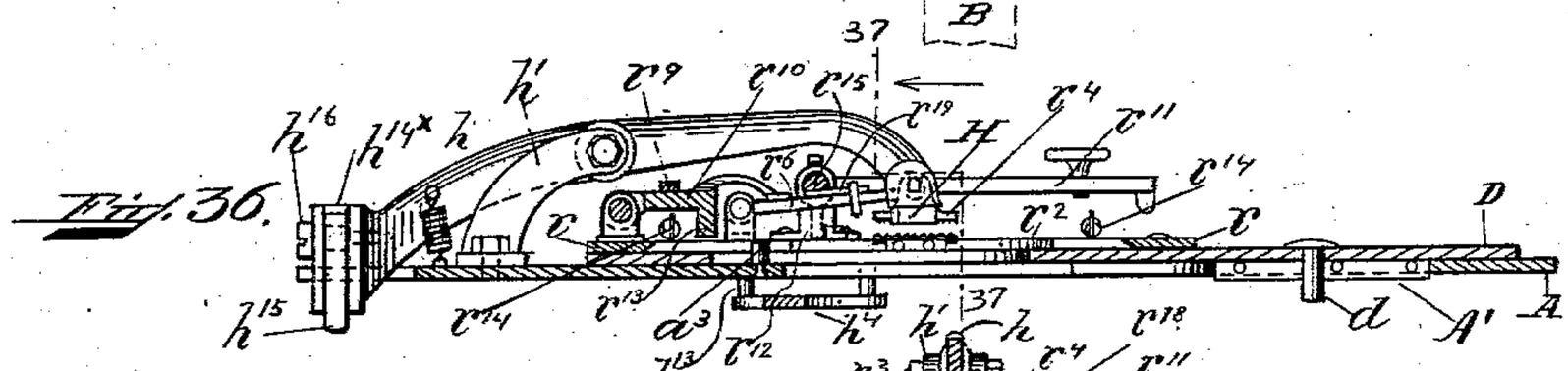

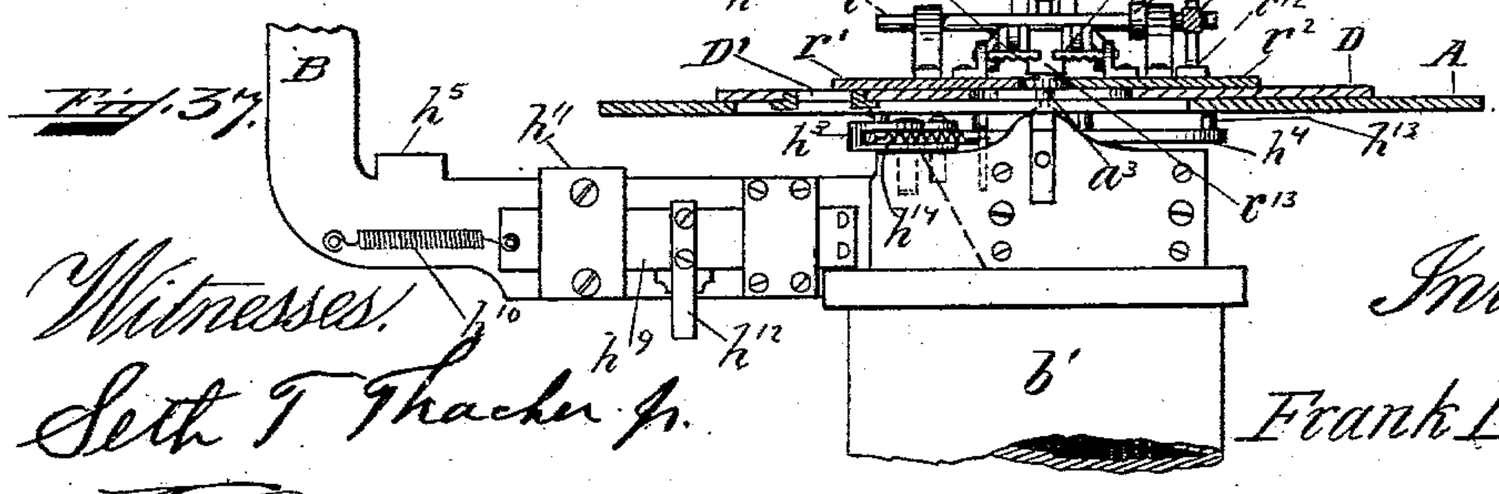

Witnesses.
Seth T. Thacher Jr.
H. E. Runnick Jr.

Inventor.
Frank L. Harmon.

No. 740,755. PATENTED OCT. 6, 1903.

F. L. HARMON.

MACHINE FOR SEWING BUTTONHOLES.

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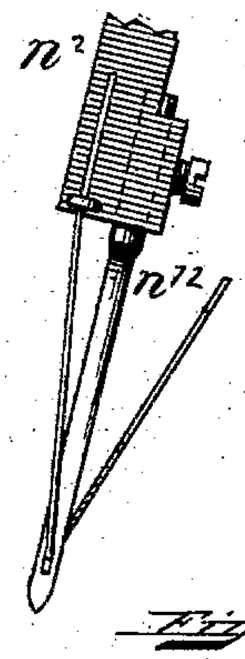

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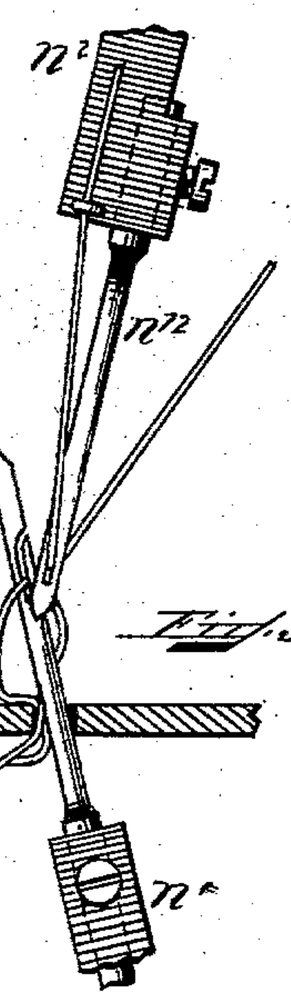

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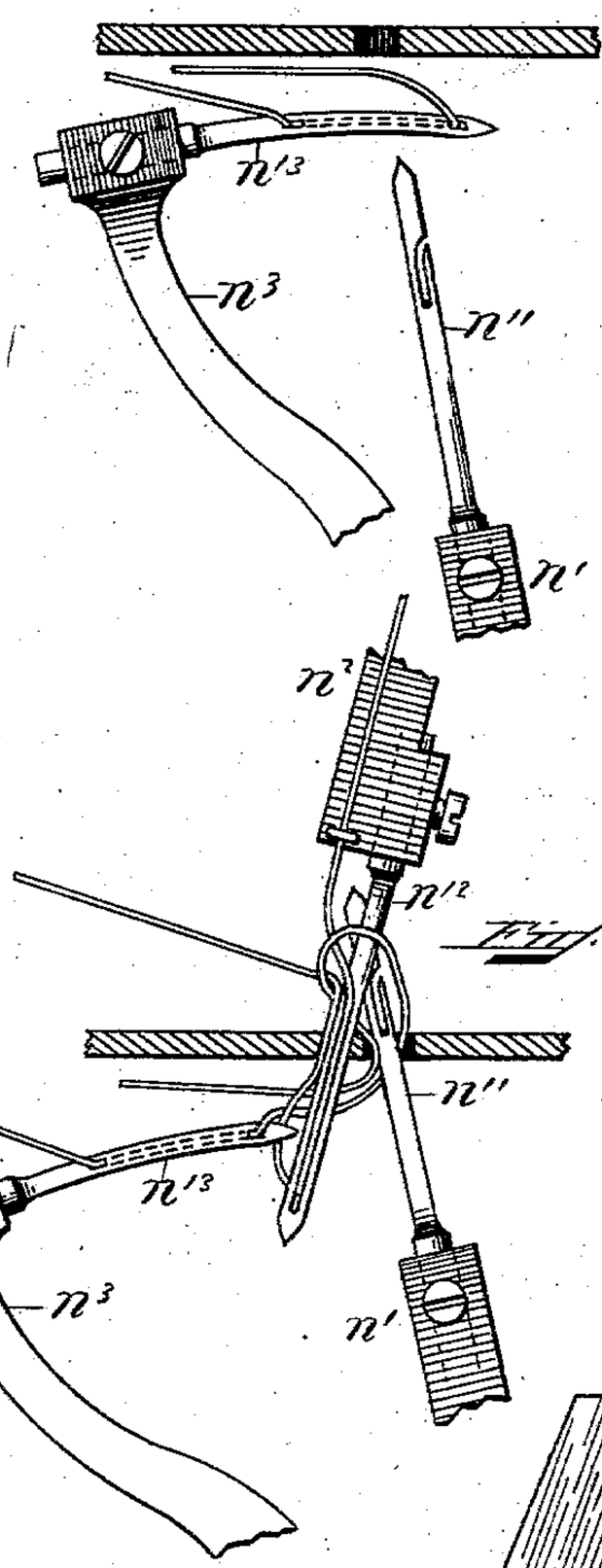

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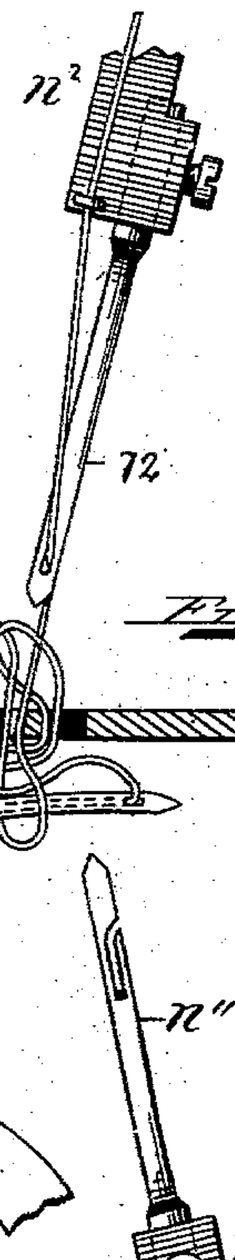

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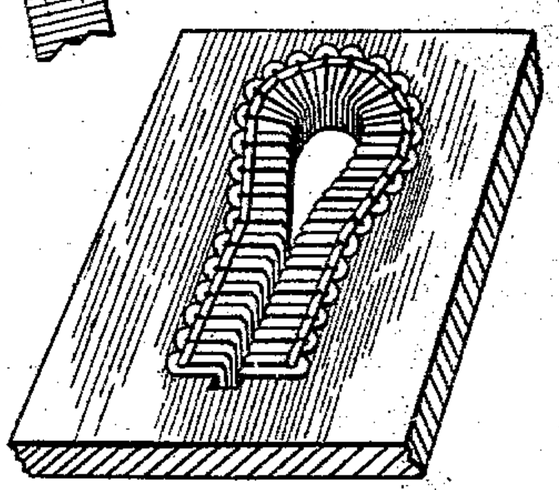


Fig. 42.

Witnesses:
Seth T. Thacher.
H. E. Kunick Jr.

Inventor:
Frank L. Harmon.

No. 740,755. PATENTED OCT. 6, 1903.

F. L. HARMON.

MACHINE FOR SEWING BUTTONHOLES.

APPLICATION FILED NOV. 30, 1896.

NO MODEL. 15 SHEETS—SHEET 13.

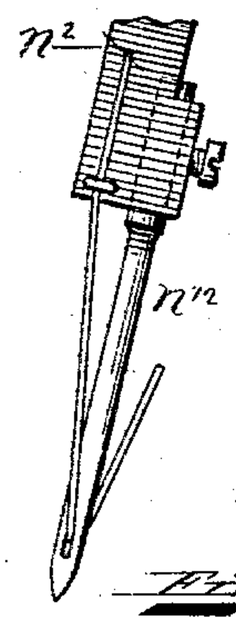
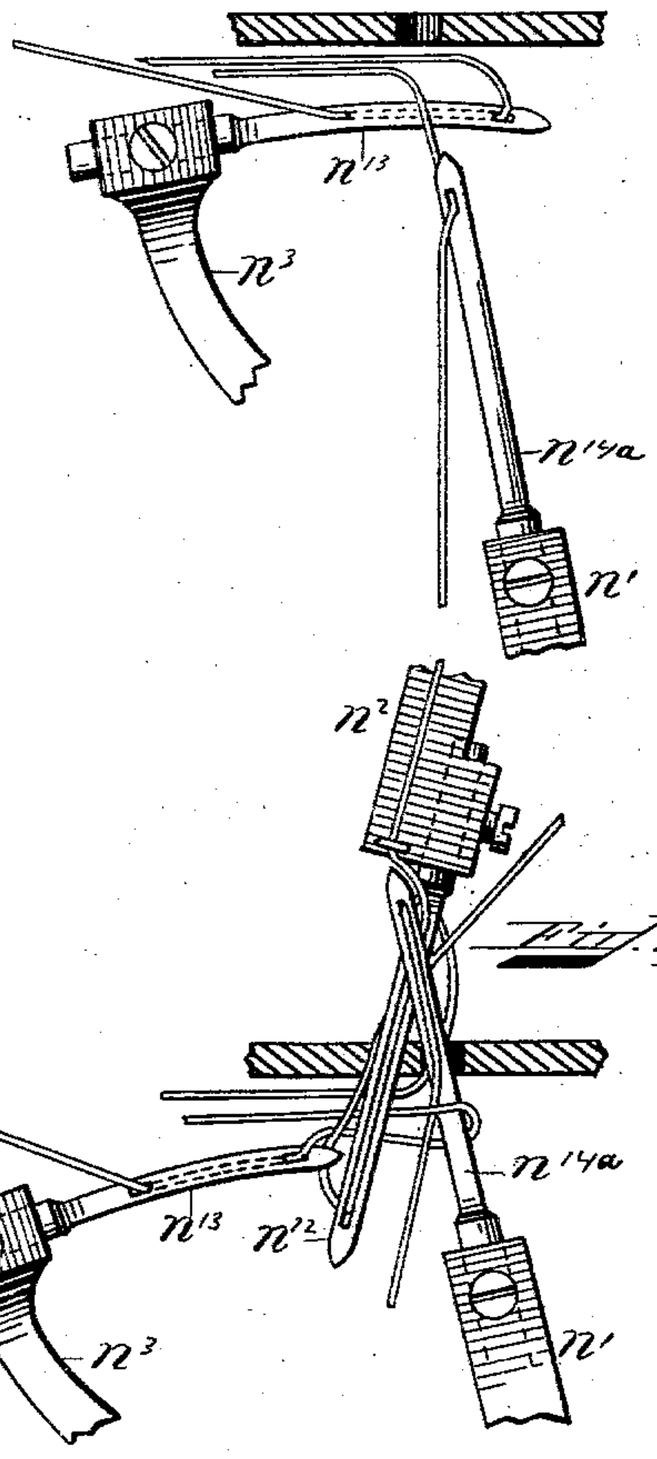


Fig. 43.

Fig. 44.



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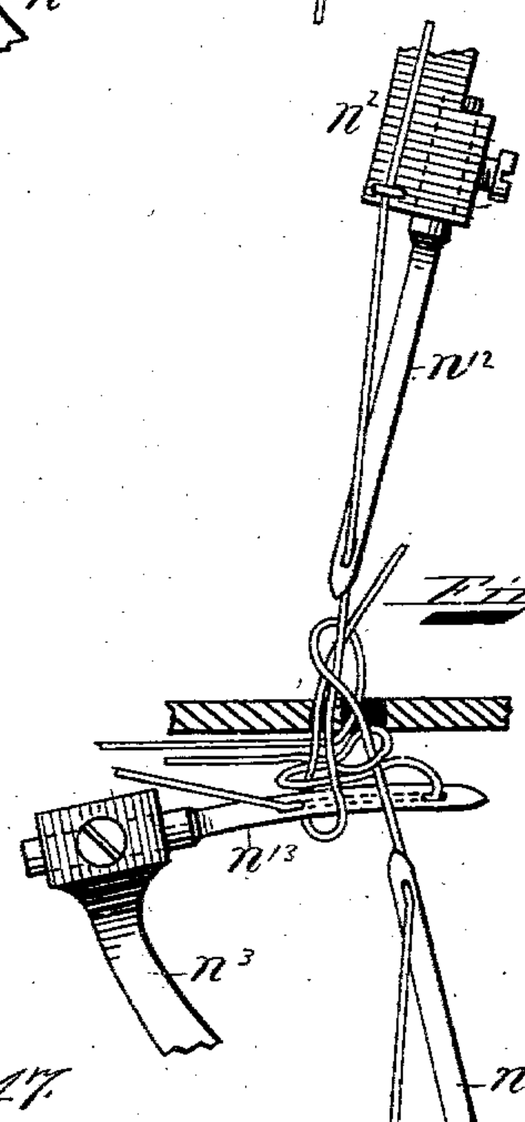
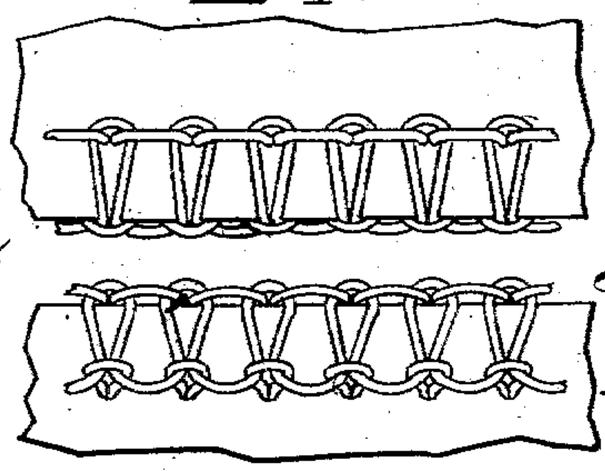


Fig. 46.

Fig. 47.



Witnesses:
Seth T. Thacher Jr.
H. E. Kennick Jr.

Inventor:
Frank L. Harmon.

No. 740,755. PATENTED OCT. 6, 1903.

F. L. HARMON.

MACHINE FOR SEWING BUTTONHOLES.

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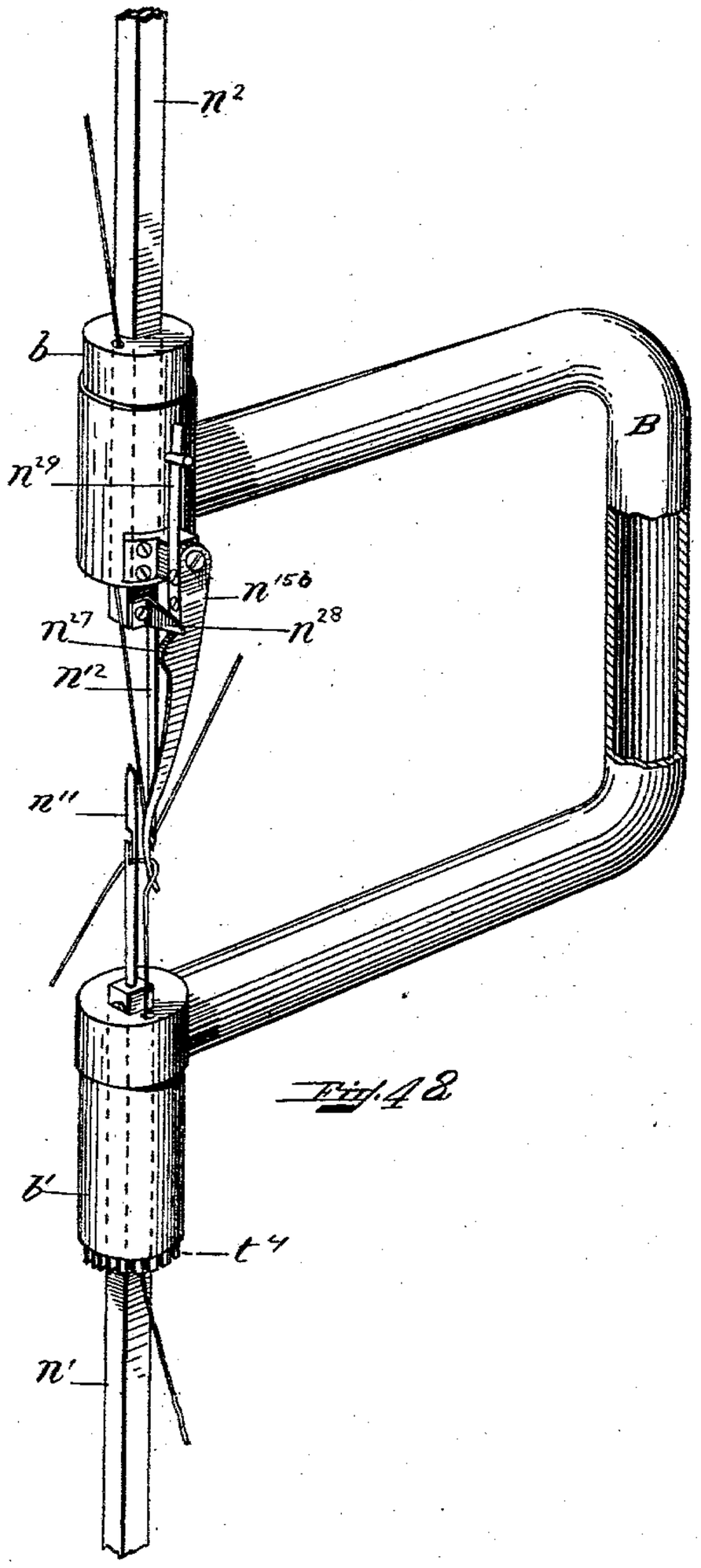

Fig. 48

Witnesses:
Seth T. Thacher Jr.
H. E. Runick Jr.

Inventor:
Frank L. Harmon

No. 740,755. PATENTED OCT. 6, 1903.

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MACHINE FOR SEWING BUTTONHOLES.

APPLICATION FILED NOV. 30, 1896.

NO MODEL. 15 SHEETS—SHEET 15.

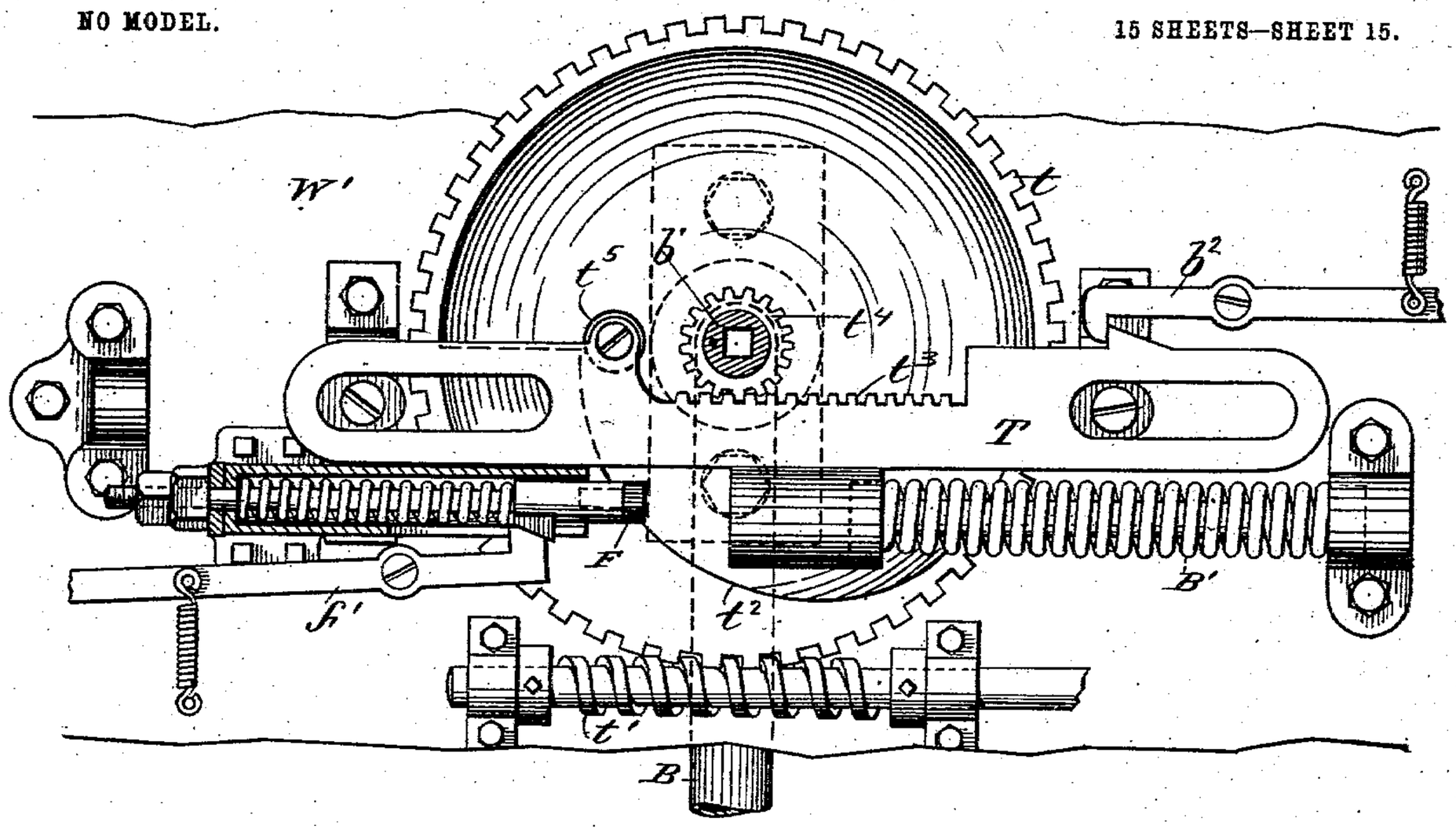

Fig. 49.

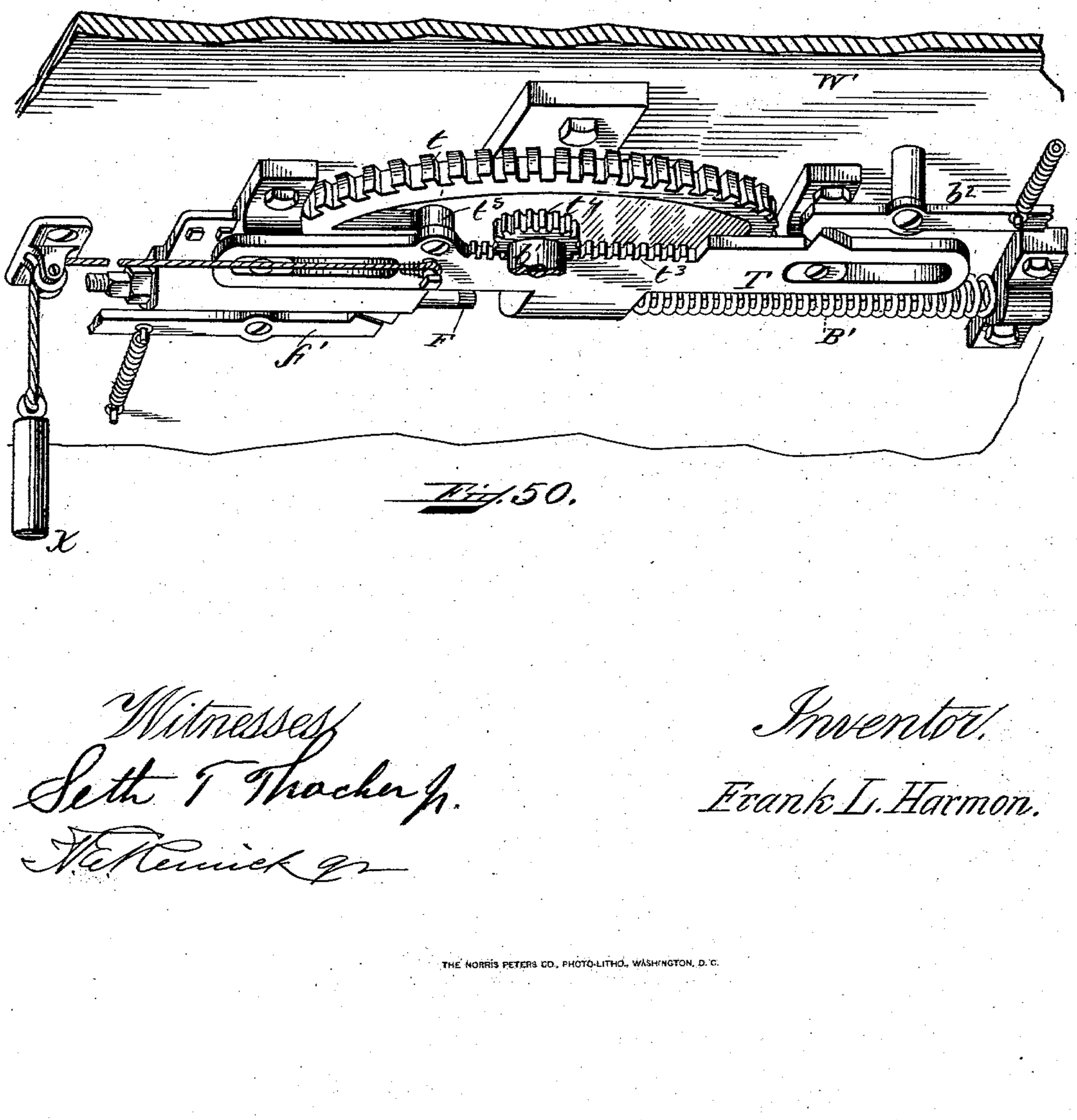

Fig. 50.

Witnesses
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No. 740,755. Patented October 6, 1903.

UNITED STATES PATENT OFFICE.

FRANK L. HARMON, OF BEVERLY, MASSACHUSETTS.

MACHINE FOR SEWING BUTTONHOLES.

SPECIFICATION forming part of Letters Patent No. 740,755, dated October 6, 1903.

Application filed November 30, 1896. Serial No. 613,906. (No model.)

To all whom it may concern:

Be it known that I, FRANK L. HARMON, of Beverly, in the county of Essex and Commonwealth of Massachusetts, have invented a new and useful Machine for Making Buttonholes, Overseaming, Embroidering, and other Purposes, of which the following is a specification, reference being had to the accompanying drawings.

This specification discloses a button-hole machine holding controlling power in store all the time between the operations of the machine, to be released to begin the automatic operation of the machine, and a device by which this power may be released, whereupon, said power turns a yoke with stitch-forming devices thereon, a half revolution at the beginning of each operation of the machine, and forces a clamp-plate with a pair of clamps thereon, with a material therein, out of its normal position against the power of a spring, and forces a button-hole cutter to cut a button-hole slit in the material, and forces the lower members of the clamps against a device, and forces said clamps apart, and spreads said button-hole slit, and a chock carried with said clamps is forced between said clamps to keep said clamps apart to keep the button-hole slit spread, and forces devices to generate and store power in a device called a buffer to be released to cause the stitch-forming devices to cease sewing after a button-hole slit is sewed, and forces devices to control and employ another power connected with the driving pulley of the machine, to start and drive mechanisms, whereupon, the sewing and the generating and storing of power is accomplished, and causes said power to force a device to release the power in store in the device called a buffer, whereupon, the power operating the mechanisms, whereupon, the sewing and the generating and storing of power is accomplished, automatically ceases operating said mechanisms, and a device is operated to instantly cause these mechanisms to cease operating, leaving controlling power in store, to be released to cause the machine to perform another operation.

I believe that I am the first to devise devices adapted to be forced by stored power released to move a material, whereupon, a button-hole slit is cut and spread; and that a machine in the operation of which two distinct powers must be employed, one power automatically generated and stored, and the other power automatically controlled, automatically employed, and automatically disemployed, by the stored power after it is released, originated wholly with me.

Therefore, one part of my invention consists in the following combination of instrumentalities, viz: an automatic power-generating and power-storing apparatus containing controlling power in store, operative devices to be operated by controlling power, a device containing main power, devices to be operated by controlling power, whereupon, the main power may be automatically controlled, employed and disemployed, operative devices to be operated by the main power, a device, whereupon, controlling power may be released by an outside agency, or otherwise, whereupon, the entire automatic action of the apparatus may be automatically controlled as follows: the action of the apparatus begun, the main power controlled and employed, the length of the time that the automatic action continues, controlled, the number of movements of the operative devices controlled, the amount of controlling power generated, controlled, the main power again controlled and disemployed, leaving a proper amount of controlling power in store.

This specification also discloses a clamp-plate and novel mechanism, whereupon, the clamp-plate is moved little by little longitudinally and is swung little by little diagonally of a button-hole slit in a material held by a pair of clamps movably mounted upon said clamp-plate, and novel devices, whereupon, a yoke is turned little by little carrying the stitch-forming devices little by little in a circular direction around the end of a button-hole while the machine is sewing.

A particular stitch is formed as follows: a loop of an upper thread above a material to be sewed is carried down through the solid material near to the button-hole slit cut therein, and a loop of an under thread beneath the material is carried through the loop of the upper thread beneath the material and up through the material or button-hole slit, and a loop of the upper thread is carried down

through the loop of the under thread above the material and down through the material; and to form this particular stitch this specification also discloses a mechanical combination comprising two old straight needles vibrated from opposite sides of a material in straight lines through the material and across each other above the material, and an old looper is vibrated on one side of the material across the straight lines in which said needles are vibrated, and novel mechanism, whereupon, said needles and looper are vibrated as aforesaid, in lines as aforesaid.

I believe that I am the first to vibrate two straight needles in straight lines across each other in the forming of this stitch expressly to engage loops of two threads by said needles above the material, and to avoid using a looper above the material, and to vibrate a looper across the straight lines in which said needles are vibrated beneath the material in the forming of this stitch expressly to engage the upper and under threads beneath the material while forming this stitch, and to vibrate the under needle in a straight line expressly to avoid damaging the under needle while passing it through a tough material in the forming of this stitch; and as the novel function of this combination comprises the thrusting of a straight under needle from beneath the material up through the material as described in the forming of this stitch, and across the straight line in which the upper needle is vibrated above the material, and the engaging of loops by said needles, and as the result of the combination is the particular stitch formed of loops of two threads as described, the novelty of the combination must reside in the novel mechanism, whereupon, said needles and looper are vibrated as aforesaid to obtain said novel functions.

Therefore, I believe that the combination of any two straight needles vibrated in straight lines as aforesaid, and any looper vibrated as aforesaid, whereupon, loops of two threads are engaged as aforesaid to avoid the use of more than one looper, and to avoid the damaging of the under needle while passing it through the material to form this particular stitch is of my invention.

The above-named new and useful characteristics, together with other new and useful characteristics of this invention will hereinafter appear, and will be fully shown in the accompanying drawings; and will be fully described hereinafter, and will be claimed in the claims appended hereto by claiming devices operated as the devices shown and described.

Fig. 1 is a side elevation of the machine which is the subject of this invention, with the stand, and bed-plate shown as if a part of each were broken away. Fig. 2 is a top plan of the same with the work-table, or stationary support, which supports a device for cutting a button-hole slit, and the clamp-plate which supports a pair of clamps, removed. Fig. 3 is a bottom plan of this machine. Fig. 4 is a longitudinal section of the same. Fig. 5 is a cross section on line 5 5 of Fig. 2. Fig. 6 is a perspective detail showing the feed-lever, and striker-lever, and the parts carried with them. Figs. 7, 8 and 9 are perspective details illustrating some of the detached parts described as follows: Fig. 7 shows a cam-disk, comprising three cam-faces and a ratchet. Fig. 8 illustrates the support for said cam-disk to rotate upon, and also shows the feed-lever and striker-lever on said support. Fig. 9 illustrates a collar to hold said cam-disk on said support. Figs. 10, 11, 12 and 13 illustrate two sets of pawls one set of which is used as a detent. Fig. 14 is a detail illustrating a device for retaining power in store hereinafter termed controlling power, because it controls the entire automatic action of the machine upon the material after it is released. Fig. 15 illustrates mechanism, whereupon, a yoke with stitch-forming devices mounted upon it is turned, and also illustrates devices, whereupon, a clamp-plate is moved sidewise. Fig. 16 shows a cross section of adjustable devices, whereupon, the clamp-plate may be caused to move sidewise at a greater or less distance so that the width of a button-hole may be changed without manually adjusting the needle toward or from a button-hole slit. Fig. 17 illustrates a part of a mechanism, hereinafter described and termed a stop-fork, whereupon, power in or connected with a clutch mechanism is automatically controlled and employed. Figs. 18, 19, 20, 21, 22 and 23 illustrate a clutch mechanism. Fig. 24 illustrates a part of the yoke and devices carried with the yoke, and devices, whereupon, controlling power is held in store in a powerful main-spring in a mechanism hereinafter termed an auxiliary mechanism to be released to control the entire automatic operation of the machine. Fig. 25 illustrates the yoke, which comprises two journals rigidly held in alinement and in relative positions with each other. Fig. 26 shows the upper needle-bar bearing with the needle-bar connected therewith. Fig. 27 shows the under needle-bar bearing with the needle-bar and looper-carrier connected therewith. Fig. 28 illustrates a throat-plate, or "button." Figs. 29, 30, 31, 32 and 33 illustrate a buffer. Fig. 34 is a plan of the top of said work-table, or stationary support, with a cutter-lever supported upon it. Fig. 34[a] is a detail illustrating a metal clamp, or adjustable socket in which a raw-hide cutter-block is shown. Fig. 35 is a top plan of a clamp-plate, with a pair of clamps movably connected therewith. Fig. 35[a] is a sectional detail in elevation from Fig. 36 to show the cutter in operative position with said raw-hide cutter-block, and to show that said adjustable socket, in which the raw-hide cutter-block is confined is fastened to said work-table, or stationary support. Fig. 36 shows a section of Fig. 35 on line 36 36, mounted upon a longitudinal section of Fig. 34. Fig. 37 shows a part of said

yoke in position with a cross section of Fig. 34, and a cross section of the devices shown in Fig. 36 on line 37 37 of Fig. 36 mounted upon said cross section of Fig. 34. By these views being so described the assembling of the devices shown in the several views is illustrated. Fig. 37ª shows a section of said yoke to illustrate a device for moving the clamp-plate and clamps between the cutter-block and cutter. Figs. 38, 39, 40 and 41 illustrate two straight needles that are vibrated in straight lines across each other, and a looper that is vibrated across the straight lines in which said straight needles are vibrated. Fig. 38ª shows a top view of a piece as broken out of the work-table, or stationary support, to show how a movable device, whereupon, a button-hole slit is spread, is movably connected with the work-table, or stationary support. Fig. 39ª shows a section of Fig. 38ª on line *a a* of said figure, to show more fully how said movable device is movably connected with said work-table, or stationary support. Fig. 42 illustrates the stitch formed with two threads. Figs. 43, 44, 45 and 46 illustrate two straight needles and a looper which are vibrated in the same lines as the other needles and looper are vibrated, but form a stitch with three threads. Fig. 47 illustrates the stitch formed with three threads by these needles and looper. Figs. 48, 49 and 50 show a modification of the machine in which my invention is embodied showing that other mechanisms and forces may be employed together without departing from the novel scheme disclosed by this invention, whereupon, one power is automatically generated and stored, and another power is automatically controlled, employed and disemployed on account of the stored power being released. Fig. 51 illustrates the mounting of the pin a^3.

Figs. 1, 2, 3 and 4 disclose the fact that the bed-plate W′ is pivoted to the stand W by the pivots W^3 so that the bed-plate may be turned up, on its pivots, to expose the machinery on the under side of it to view. The work-table, or stationary support A is supported upon the brackets *a* and *a′* fast to the bed-plate W′ so as to admit of the turning of the yoke B one hundred and eighty degrees from the position in which it is shown in the drawings, under and around the end of the work-table, or stationary support A as will be plain by Figs. 1 and 2. Fig. 2 shows a plan of the machine with the exception of the work-table, or stationary support, and the clamp-plate, which are removed. The work-table, or stationary support A is shown in Fig. 34, and is replaced in position on Fig. 2 by putting the slot or slideway A′, shown in said work-table over the block *d′*, shown in Fig. 2, and is secured to the brackets *a* and *a′* by screws so that the block *d′* may be moved longitudinally in said slot. The clamp-plate D is shown in Fig. 35, and is placed upon the work-table, or stationary support A by placing the long slot D′, shown in said clamp-plate, over the block, or adjustable device m^2, shown in Figs. 2 and 15, and placing the pivotal stud, or pin *d* shown secured in said clamp-plate into the hole d^7 in the block *d′*, thereby forming the movable axis, shown in Fig. 36. It will be observed that by this construction the movable axis and clamp-plate may be moved longitudinally of the machine by moving the block *d′* longitudinally in the slot A′ in said work-table.

Attention is called to the fact that the clamp-plate D is shown toward the left in Fig. 4, as far as it is ever carried intermittently by the feeding mechanism; but before the sewing is begun in every operation of the machine, the block *d′*, movable axis, clamp-plate, clamps and material held thereby, are thrust longitudinally of the machine by a mechanism hereinafter described, out of the position in which they are shown in the drawings in the direction which is toward the left in Fig. 4, thereby sliding the clamp-plate D upon the work-table, or stationary support and guiding said clamp-plate longitudinally by said adjustable device, or block m^2 in the long slot D′ in said clamp-plate; and the material held by said clamps is thereby carried under the cutter H so that a button-hole slit may be cut in said material; and said movable axis, clamp-plate, clamps and material held thereby, are instantly returned to their original position, or into the position shown in Fig. 4, on account of said mechanism.

The cam-disk, shown in Figs. 7 and 2, comprising three cam-faces, viz: K, M, and k^{10}, is shown rotatably mounted upon the vertical bearing, or support, shown in Fig. 8, in the manner shown in Fig. 4; and the support m^{10} is shown rigidly secured in the bracket *a′*, in Figs. 2 and 15. In Fig. 15 the stud *m* is shown movably secured in the support m^{10}. Upon said stud *m* the lever m^{13} is rigidly secured; and upon said lever m^{13} the roll d^{10} is movably secured. Upon the upper end of the stud *m* the lever *m′* is rigidly secured; and upon the lever *m′* the above described block, or adjustable device m^2, over which the long slot D′ in the clamp-plate D is placed, as above described, is adjustably secured, as, and for the purpose hereinafter described. To the lever *m′*, and the bracket *a′*, the spring m^9 is secured; and the force of said spring holds the roll d^{10} against the cam-face M, which prevents the block, or adjustable device m^2 and the clamp-plate connected therewith from being easily moved laterally as will be plain by Fig. 2.

While the roll d^{10} is thus held against the part of the cam-face M which is concentric with the center of the cam-disk, and the cam-disk, shown in Figs. 7, 2 and 4 is being moved little by little in a circular direction by devices hereinafter described, the cam-face K allows the roll d^5 upon the stud d^2 shown in Fig. 4, the slide d^3 fast to said stud and in the slideway d^4, shown also in Fig. 2, the block *d′* fast to said stud, the pin, or pivotal

stud d, pivoted in said block d' forming said movable axis, the clamp-plate D fast to said pin, or pivotal stud d, the clamps on said clamp-plate and the material held by said clamps, to be moved little by little by the force of the spring d^6 connected with the stud d^2 and a device on the slideway d^4, shown also in Fig. 2, toward the right in Fig. 4, thereby sliding the clamp-plate longitudinally upon the work-table, or stationary support and guiding said clamp-plate longitudinally of a button-hole slit in a material held in the clamps by said adjustable device, or block m^2 while one straight side of a button-hole slit is being sewed.

While one angular part of a button-hole slit is being sewed, the clamp-plate D is swung on its movable axis by the block, or adjustable device m^2 in the long slot D′ in the clamp-plate, against the stress of the spring m^9, shown in Fig. 15, little by little, diagonally of a button-hole slit, on account of a part of the cam-face M, shown in Fig. 15, which is eccentric to the center of the cam-disk, being moved little by little against the roll d^{10}, shown in Fig. 15, moving said roll and the block, or adjustable device m^2, shown in Figs. 2 and 15, which is in said long slot D′ in said clamp-plate as above described, diagonally in one direction through the connecting devices, shown in Fig. 15 between the roll d^{10} and the clamp-plate D, thereby carrying the clamps by said clamp-plate, and moving the device a^3, movably secured to the work-support A, as shown in Figs. 34, 38^a and 39^a, with said clamp-plate while said movable axis is being moved little by little as aforesaid longitudinally; and said cam-face M allows the spring m^9, shown in Fig. 15, to move said connecting devices, clamp-plate, said clamps, and said device a^3, as aforesaid in the opposite direction while the other angular part of the button-hole slit is being sewed.

While the curved parts of a button-hole slit are being sewed, said devices move the clamp-plate little by little, longitudinally, and swing the clamp-plate little by little diagonally, while the stitch-forming devices are rotated and vibrated about the curved parts of a button-hole slit, thereby carrying the clamps with said clamp-plate, and the material with said clamps.

The above described mechanism, shown in Figs. 15 and 2, between the cam-face M and the clamp-plate D, including the roll d^{10} and the block, or adjustable device m^2, is termed a connecting device in the claims appended hereto; and the above described mechanism between the cam-face K and the clamp-plate D, including the roll d^5, the block d', and the pin, or pivotal stud d, is also termed a connecting device in the claims appended hereto.

It is understood that the above described cam-disk comprising said cam-faces K and M rotatably mounted upon the vertical bearing, or support, and turned little by little, by suitable devices hereinafter described, together with the clamp-plate D and said connecting devices, whereupon, said clamp-plate D with the clamps thereon is moved as aforesaid, whereupon, a button-hole slit is sewed, and stitches are formed in straight angular and curved lines form one of the principal novel combinations of this invention, and it is claimed in the claims appended hereto.

Fig. 16 shows how the block, or adjustable device m^2, may be manually adjusted or moved on said lever m', and secured in another position on said lever. The nut m^{11} is threaded upon the screw shown in Fig. 16, and is fitted loosely into the groove in said lever m'. By tightening the screw shown in the block, or adjustable device m^2, the lever m' is clamped or gripped between said nut m^{11} and the shoulder of said screw. The block, or adjustable device m^2 will then easily turn on the body of said screw, while said screw is thus held rigidly from slipping out of its position on said lever m'. On account of these devices, shown in Fig. 16, whereupon, said block, or adjustable device m^2 is adjustably secured on said lever m', the clamp-plate D may be caused to automatically swing diagonally, more, or less, upon its movable axis, thereby carrying the clamps and the material held thereby diagonally a greater or less distance, whereupon, the width of a button-hole can be changed.

The mechanism, whereupon, said cam-disk is turned little by little, upon its vertical support, or bearing, whereupon, the clamp-plate, clamps and material are moved as above described, is described as follows:

The striker-lever k^2, and the feed-lever k', which carries the pawl-carrier m^{14} with its pawls k, are shown in Fig. 6. In Fig. 8 these levers are shown on their support m^8. To assemble these parts of the machine, the cam-disk, shown in Fig. 7, comprising three cam-faces, viz: K, M, and k^{10}, and the ratchet J, is placed upon the support m^8 so that the ratchet J is connected with the pawls k, and so that the cam-face k^{10} is placed in contact with the stud k^{13}. Then the collar, shown in Fig. 9 is placed upon the support m^8 to hold said devices upon said support; and the screws shown in said collar are inserted into the groove m^7 in the support m^8. The support m^8 is then made fast to the under side of the bed-plate W′, as is shown in Fig. 3. The lower journal b', of the yoke B, shown in Fig. 25, is placed in the hole or journal bearing in the support m^8; and the journal b is placed into the journal bearing in the end of the arm W^2. The pawls of the pawl device m^{12}, shown in Fig. 13, are used as detents to prevent backward movement of said cam-disk and the yoke B, as will be plain by Fig. 3. The pawl device m^{12} in which the pawls k operate as detents, is made fast to the bed-plate W′ by screws, as will also be plain by Fig. 3.

The connecting devices shown in Figs. 1, 3 and 6, between the main shaft and said striker-lever, whereupon, said striker-lever

is vibrated, are described as follows: The screw n^{15} is carried by the hub p^6, shown in Fig. 1. The block k^5 is carried by said screw. The lever k^4 is rocked upon its fulcrum p^{22} by the block k^5 carried in the slot in the lever k^4. The lower end of the lever k^4 is movably secured to the rod k^3; and the rod k^3 is carried back and forth by said lever k^4. The other end of said rod k^3 is movably secured to the striker-lever k^2, and by the rod k^3, the striker-lever k^2 is oscillated on its bearing m^8. Attention is called to these devices in Fig. 3 also, to show how the rod k^3 is movably secured to the striker-lever k^2; and attention is also called to Fig. 8 to show how the striker-lever k^2 is movably mounted upon its vertical support, or bearing m^8. The feed-screw k^6, shown in Figs. 1, 3 and 6, is secured to, and carried by said striker-lever k^2, and is forced against the block k^7, which block is movably secured upon said feed-lever k', and the feed-lever k' with the pawl-carrier fast thereto is moved; and the pawls in said pawl-carrier engage said ratchet, which is a part of said cam-disk, shown in Figs. 1, 3, 4 and 7, and said cam-disk is thereby moved on its vertical bearing, or support m^8, shown in Figs. 8 and 4. The spring B^2 is secured to the other end of the feed-lever k', and is also secured to a hook in the bed-plate of the machine, as will be clear by Fig. 3. When the feed-screw k^6, carried by the striker-lever k^2, strikes the block k^7, which is movably secured to the feed-lever k', and moves said feed-lever, the spring B^2 is thereby expanded; and when the striker-lever k^2 is moved back in the opposite direction, the spring B^2, secured to the other end of said feed-lever k', pulls the lever k' back to its original position, and said feed-lever is stopped in its original position, by the stop-screw k^{14}, shown in Figs. 3 and 6, carried by said feed-lever, being brought into contact with the edge of the bracket m^8, by said feed-lever, which will also be plain by Figs. 3 and 6.

By Figs. 1 and 3, it will be seen that the point of the feed-screw k^6, carried by the striker-lever k^2 is at a distance from the block k^7, which is movably secured to the feed-lever k'. The space between the point of the feed-screw k^6, which is movably secured to the striker-lever k^2 is traversed by said screw before movement is given thereby to the feed-lever. Thus it will be seen that the stroke of the striker-lever k^2 is longer than the stroke of the feed-lever k' while the straight side and angular part of a button-hole slit are being sewed. By Figs. 1 and 8, it will be seen that the block k^7, which is movably secured on the feed-lever k', is held in position by the spring k^{11}, which is secured to the pin in said block, and also to the pin in said feed-lever; and it will be remembered that the stud k^{13}, shown in Figs. 1 and 8, is shown in Fig. 3 in contact with the cam-face k^{10}, and is described in the description of the assembling of parts of the feeding mechanism as in contact with said cam-face, which at this time does not force the block k^7 to move on said feed-lever.

The devices and the action thereof, whereupon, the stroke of the feed-lever is automatically changed for causing the proper number of stitches to be put in the eye of the button-hole, are described as follows: It will be observed that the shape of the cam-face k^{10}, in Fig. 3 is such that the block k^7 upon the feed-lever must be forced inward toward the center of said cam-disk, by the cam-face acting upon the stud k^{13}, shown in the dotted lines in the block, and shown also in Fig. 8. The device m^4 shown in Figs. 4 and 7 is a friction band to prevent overthrow of the cam-disk.

Attention is called to the circular stitch-bar k^8, which is adjustably secured to the block k^7, which block is hereinabove described as being moved inward upon said feed-lever toward the center of rotation of said cam-disk at this time, by said cam-face k^{10} thereby expanding the spring k^{11}, secured to the pin in said block k^7, and to the pin in said feed-lever k'. As said circular stitch-bar is thus carried inward, it is brought nearer to the inclined block k^9, secured to the striker-lever, thereby partially taking up the space between said circular stitch-bar and the inclined block k^9 on said striker-lever k^2; and immediately the stroke of the feed-lever, which is less than the stroke of the striker-lever, is thereby automatically lengthened to, or nearly to, the stroke of the striker-lever. On account of these devices, the speed of the clamp-plate with the clamps thereon, is automatically changed to a proper speed to cooperate properly with the stitch-forming devices so that the proper number of stitches are made in the eye of a button-hole. After the circular part of the eye of the button-hole slit is sewed, said moving cam-face k^{10} allows the spring k^{11} to move the block k^7 on said feed-lever k' back to its original position and away from said inclined part of the block k^9, secured to the striker-lever k^2, whereupon, the long stroke of the feed-lever is automatically changed back to its original or short stroke, so that the proper number of stitches are made in the angular part and the other straight side of the button-hole slit. It will be observed that adjusting the feed-screw k^6, shown in Figs. 1, 3 and 6 by hand, causes the number of stitches in the sides of a button-hole slit to be changed; and adjusting the circular stitch-bar by hand, causes the number of stitches in the eye of a button-hole slit to be changed.

Movably secured to the clamp-plate D, shown in Figs. 35, 36 and 37, is a pair of clamps, described as follows: The lower clamp-members r' and r^2 are movably mounted upon said clamp-plate in the ways r. Secured to one of said lower clamp-members is the bracket r^7; and pivoted in said bracket is the upper clamp-member r^5, which members form a clamp.

Secured upon the other lower clamp-member is the bracket r^8; and pivoted to said bracket r^8 is the upper clamp-member r^6, which members form another clamp. These two clamps form a pair of clamps, the lower members of which are held by the springs r^{14} against the movable device a^3, shown in Figs. 34, 38^a and 39^a, pivotally secured to the work-table, or stationary support A, the position of which is shown in Fig. 35. Secured to one of the ways r is the bracket r^{17}; and pivoted to said bracket r^{17} is the forked lever r^{10} comprising two spring-arms, which rest upon said clamp-members, and also comprising a chock r^{13} shown in Fig. 36, to be forced between said clamps to keep them apart after said clamps are separated to spread a button-hole. The spring r^9 forces said forked lever down upon said upper clamp-members. Secured to the lower clamp-members r' and r^2 are the brackets r^{16}. The crossbar r^{15} is movably secured in said brackets r^{16}. A clamp-lever r^{11}, whereupon, the material is clamped, is fast to said crossbar r^{15} and bears against one of the brackets r^{16}. A collar is fast to the crossbar r^{15} and bears against this bracket. The other end of said crossbar is movable endwise in the other bracket r^{16}, which allows the clamps to be separated in the ways r to spread a button-hole. By pressing by hand upon the clamp-lever r^{11}, its toe r^{12} shown in Figs. 36 and 37, is moved out of its perpendicular position which when perpendicular cannot be forced by the power of the spring r^9 out of its position, whereupon, the spring r^9, acting through the spring-arms of the forked lever r^{10}, forces said upper clamp-members quickly down upon a material, between the upper and lower members of the clamps, with such force as to spring the upper clamp-members r^5 and r^6 and to spring the spring-arms of said forked lever r^{10}, and is prevented from springing the upper clamp-members and said spring-arms more, by the chock r^{13}, shown in Fig. 36, being forced against the lower members of said clamps.

The main mechanism of this machine comprises an automatic sewing mechanism, devices of which are automatically started and forced to operate upon a material, and are automatically caused to cease operating upon the material after an operation is finished; and also an automatic power-storing apparatus which is automatically started and forced to store power in an auxiliary mechanism, hereinafter described, and is automatically caused to cease storing power after a proper amount of power is stored; and a loose driving pulley which is rotated continuously whether the machine is in operation or not. The main mechanism is termed a main mechanism because without it, it would be impossible for the auxiliary mechanism to be automatically operated. The auxiliary mechanism is termed an auxiliary mechanism, because without it, devices of the main mechanism cannot be automatically started into action and automatically stopped on account of power released in the auxiliary mechanism, as is hereinafter described.

When the machine is ready to begin an operation upon the material, or in other words, to cut and sew a button-hole slit, the driving pulley p^9, shown in Figs. 1, 2, 3, 4, 5 and 23, is belted to a moving pulley by a belt and is being rapidly rotated loosely upon the main shaft p^{10}. All other parts of the machine are still, at this time, because the inclined upper end of the stop-fork, or device p', shown in Figs. 17, 1, 4 and 5, is held into the groove in the hub, or clutch-member p^6, which hub, or clutch-member and groove are shown in Figs. 18, 20 and 5, which prevents the power stored in the spring p^{15} in the clutch mechanism, shown best in Fig. 20, from forcing the pawl p^{18}, shown in Figs. 22, 20, 18 and 19, into the groove p^{19} in said loose pulley, shown best in Fig. 23.

It should be remembered that the driving pulley is rapidly rotated continuously whether the machine is operating upon the material or not; but at this time, viz: between the operations of the machine upon the material, the loose driving pulley p^9 is free to rotate loosely upon the main shaft, simply because the stop-fork p' is held in the groove in the clutch-member p^6 as is shown in the drawings, and against the shoulder p^7, of the pawl p^{18}, shown in Fig. 22, by the power of the spring p^2 shown in Fig. 1, secured to a hook fast to said stop-fork and fast to a pin in the bed-plate W', thereby holding power in store in the spring p^{15}, shown in Fig. 20, thereby preventing one clutch-member from automatically engaging the other clutch-member, or in other words, preventing the pawl p^{18} which is a part of the clutch-member p^6, from being forced by the power of said spring p^{15}, to engage the loose pulley p^9, which carries another clutch-member.

Fig. 5 shows the machine in the position in which it stands before an operator. The main spring B', shown in Figs. 1, 3 and 4, is a very powerful one, and is the main spring of the auxiliary mechanism, and is secured to the strap b^3, shown in Figs. 1 and 3, which strap is secured to the clamp m^5, which is fast to the lower journal b' of the yoke B. The yoke B is shown in Fig. 5 toward the left in the drawings, and is held latched in this position, by the latch b^2, as shown in Figs. 24 and 2, holding said main spring expanded, as is shown in Fig. 1, thereby holding power in store in said main spring.

The auxiliary mechanism comprises the latch b^2 and all of the intermediate devices to be operated by stored power released, between the power stored in the main spring B' of the auxiliary mechanism, and the power stored in the spring p^{15}, shown in Fig. 20, of the clutch mechanism, including the stop-fork p', shown in Figs. 17, 5 and 1. Or in other words, the auxiliary mechanism comprises a connecting device between the power

stored in a device of the auxiliary mechanism and the power stored in a device in the clutch mechanism, whereupon, the power is automatically released in the device in the clutch mechanism on account of the stored power released in the device in the auxiliary mechanism.

I believe that I am the first to devise, combine and employ an auxiliary mechanism with a main mechanism in the manner in which this auxiliary mechanism is herein described as employed, viz: an auxiliary mechanism containing controlling power in store between operations of the machine, to be released to control the entire automatic action of operative devices of a machine and to automatically force devices to aid to begin an operation of a machine upon a material held by a part of a machine; and to automatically force a device to begin an operation of a machine upon a material; and to force power to be generated and stored in a device in a buffer; and to automatically release power stored in a device in a clutch mechanism, whereupon, the power released in the device in the clutch mechanism automatically forces one clutch-member to engage another rotating clutch-member, thereby automatically employing a power which is distinct from the stored power released, to drive devices of a main mechanism, which comprises a sewing mechanism, and an apparatus for storing power in a device in an auxiliary mechanism; and to actuate a device to release the power stored in a device in a buffer, whereupon, that power released in the device in a buffer, automatically forces a device to automatically disengage said clutch-members after the operation of the machine is finished upon a material, and a proper amount of power is generated and stored in a device in an auxiliary mechanism, thereby leaving power stored in the device in an auxiliary mechanism for controlling an entire operation of a machine upon a material, and generating and storing power in a device in said clutch mechanism, and leaving it in store therein; but the auxiliary mechanism in this machine has all of these novel functions as will be disclosed by the drawings and the description of the action of the auxiliary mechanism with the main mechanism of this machine.

The clamp-lever r^{11} may be started into action on account of manual power, whereupon, the clamps are caused to grip the material and the latch b^2 may be also actuated on account of such power, whereupon, the power is released in the main spring B', and the auxiliary mechanism and devices of the main mechanism are started into action, which mechanisms are described by describing their action together, as follows:

The yoke is turned from the position it is shown in Fig. 1 a half revolution, and while it is being thus turned, the device h^3, shown in Figs. 37 and 37^a, upon the yoke B, strikes the curved part of the device h^4, shown in Figs. 34, 36 and 4, rigidly connected with the clamp-plate D by studs or posts h^{13}, which forces or thrusts said curved device, posts and clamp-plate toward the left in Fig. 36, and toward the right in Fig. 1, and toward the left in Fig. 4, thereby carrying the clamp-plate D, shown in Fig. 4, clamps and material, and the movable axis formed by the pin, or pivotal stud d, in a hole in the block d', shown in Fig. 4, the stud d^2 rigidly secured to said block d', the roll d^5 movably secured to said stud, toward the left against the force of the spring d^6, the space at the left of the cam roll d^5 permitting, sliding said clamp-plate upon the block, or adjustable device m^2 in the long slot D' in said clamp-plate, shown in Fig. 35, which prevents said clamp-plate from being moved diagonally, thereby carrying the material in a straight line in the clamps between the cutter H and the cutter-block h^6, shown in Figs. 34, 34^a and 35^a.

It will be observed by Fig. 34, that the curved device h^4 is so shaped that the central portion of it is concentric with the pivotal axis of said yoke B. During the time that the device h^3, shown upon the yoke B in Figs. 37 and 37^a, is passing over this concentric part of the curved device h^4, the clamp-plate and clamps are caused to stand still. During the time that said clamp-plate, clamps and material are still, the inclined surface h^5, shown on the yoke B in Fig. 25, is forced against the toe h^{15} of the pawl h^{14} pivoted by the screw h^{16} to the cutter-lever h, shown in Figs. 34, 36, 4 and 1, and the cutter-lever h is moved upon its pivot in the support h', and a button-hole slit is cut in the material by the button-hole cutter H in the end of said cutter-lever. After this inclined surface h^5 on the yoke B is passed by the toe h^{15} of the pawl h^{14} in the cutter-lever, shown in Fig. 1, the spring connected with said cutter-lever and with the stationary support A, shown in Figs. 36, 4 and 1, moves the cutter up from the material. By the shape of the curved device h^4, shown in Fig. 34, it will be seen that the upper end of this device projects farther to the right in said figure than the lower end; therefore, it will be seen that after the cutter is raised from the material, the device h^3, shown in Figs. 37 and 37^a, still acting against the curved device h^4 again moves the clamp-plate D, and the movable axis formed by said clamp-plate and block d', shown in Fig. 4, by the pin, or pivotal stud d, pivoted in said block d', toward the left in Fig. 4. This second movement of the clamp-plate toward the left in Fig. 4 forces the inclined parts of the lower members of said clamps, shown in Fig. 35, movably mounted upon said clamp-plate, against the device a^3 movably secured to the work-table, or stationary support as shown in Figs. 34, 38^a and 39^a, which device a^3 projects up through a slot in said clamp-plate, fitting said slot, and between the lower members of said clamps, the position of which is

shown in Fig. 35, with such force that said clamps are separated from each other, thereby spreading the button-hole slit cut in the material. It has been shown and described that before the clamps are separated, the lower clamp-members r' and r^2 prevent the spring r^9, shown in Fig. 35, from forcing said chock downward farther; but when said clamps are separated as aforesaid, said spring r^9 immediately forces the spring-arms of the forked lever r^{10} and the upper members r^5 and r^6 of said clamps to yield enough to force said chock r^{13} a short distance between said lower clamp-members. This chock keeps the clamps apart, and keeps the button-hole slit spread until it is sewed. Then the device h^3 leaves the device h^4 and allows the spring d^6, shown in Fig. 4, to pull the stud d^2, the block d' fast thereto, the pin, or pivotal stud d, pivoted in said block forming the movable axis, the clamp-plate D, fast to said pin, or pivotal stud, and the clamps and material, into sewing position; or in other words, one end of the button-hole slit is moved under the needles. Then the yoke B strikes the buffer-rod F, shown in Figs. 1, 2, 29, 31, 32 and 33, with such force that the buffer-rod F is forced toward the left in Fig. 1, thereby overcoming the buffer-spring f, shown in Figs. 31 and 32, thereby generating power therein, whereupon, the buffer latch spring f^3 shown in Figs. 29 and 4, instantly forces the buffer-latch f', shown also in Figs. 29 and 4, to engage the projection f^2, fast to said buffer, shown also in Figs. 29 and 4, which instantly prevents the buffer-rod F from rebounding, thereby storing power in the buffer-spring f, shown in Figs. 31, 32 and 1, to be automatically released at a proper time to cause the machine to cease operating. When the buffer-rod F is forced toward the left in Fig. 1, it takes the slide-bar P', shown in Figs. 29, 30, 31 and 1, movably secured to the buffer-rod F by the screw P, with it. As the slide-bar P' is moved toward the left in Fig. 1 in its slideways, the inclined part P^2 of said slide-bar is forced against the roll p^{23}, which forces said roll and lever p to which it is secured, downward over its pivot p^{25}, thereby moving the right-hand end of said lever p upward against the inclined end of the stop-fork p', thereby moving the stop-fork p' upon its fulcrum p^{22}, and thereby overcoming the force of the spring p^2, shown secured to a hook on said stop-fork or device, and a pin in the bed-plate W', thereby moving the upper inclined end of the stop-fork, or device p', shown best in Fig. 17, out of the groove p^{12} in the hub, or clutch-member p^6, shown in Figs. 2, 5, 18 and 20, whereupon, the power stored in the spring p^{15}, shown in Fig. 20, which is a part of said clutch mechanism, is automatically released, which instantly forces the pawl p^{18}, which is a part of the clutch mechanism, into the groove p^{19} in the rotating loose pulley p^9, shown in Fig. 23, which pawl is immediately caught by the block p^8, shown in Fig. 23, across the groove p^{19} in the loose driving pulley p^9, which at this time is described as rapidly rotating, thereby automatically forcing one clutch-member to engage another rotating clutch-member, thereby automatically controlling and employing the power connected with the loose driving pulley p^9 to start and drive a part of the main mechanism, whereupon, the cam-disk, shown in Figs. 7, 2 and 4, is turned little by little on its vertical bearing, and the movable axis, clamp-plate, clamps and material held thereby, are moved little by little longitudinally of a button-hole slit in the material, or toward the left in Fig. 1, while the stitch-forming devices are forced to form stitches, in the straight part of the button-hole slit; and the movable axis and clamp-plate D are carried little by little, longitudinally upon said stationary support A, and the clamp-plate is carried diagonally while the stitch-forming devices sew one angular part of the button-hole slit; and the stroke of the feed-lever is automatically lengthened, whereupon, the proper number of stitches are made in the circular part of the button-hole slit. Then the device or block k^{12}, shown in Figs. 7 and 15, fast to the cam-disk, is forced against the slide-bar pin h^{12}, which is fast to the slide-bar h^9, shown mounted in ways h^{11} on the yoke B, in Figs. 37 and 15, thereby turning the yoke B in its journal bearings, little by little, while the circular part of the button-hole slit is sewed. While the yoke B is being thus turned in its journal bearings the clamp m^5, clamped to the lower journal b' of said yoke B, and secured to the strap b^3, which is secured to the main spring B', winds said strap around the lower journal b' of the yoke B, thereby expanding the main spring B' of the auxiliary mechanism, and gradually generating power therein, and the device h^{14}, shown in Figs. 1, 4, 34 and 36, in the cutter-lever h, is lifted on its pivot h^{16} and the device h^3 on the yoke B, shown in Figs. 37 and 37^a, yields as it passes by the curved device h^4. While the last part of the circular portion of the button-hole slit is being sewed, the yoke B is being moved into the position in which it is shown in Fig. 1, and under the latch b^2, shown in Fig. 15. At this time the slide-bar pin h^{12}, fast to the slide-bar h^9, shown best in Figs. 37 and 15, is forced against the inclined end of the adjustable disconnecting bar h^{13}, shown secured to the bed-plate W' in Fig. 15, and also in Fig. 2, thereby moving the slide-bar pin h^{12}, and the slide-bar h^9, in the ways h^{11} against the stress of the spring h^{10}, fast to a pin in said slide-bar, and fast to a pin in the yoke B, to the right in Figs. 15 and 2, thereby disconnecting said slide-bar pin from the device, or block k^{12}, shown in Fig. 15, thereby allowing said block, or device to pass by said slide-bar pin, thereby allowing the cam-disk to move on in the direction indicated by the arrow shown to the right of Fig. 15, leaving said

yoke B, held by the latch b^2, as shown in Fig. 24, from being rotated in the reverse direction on account of the main spring B′ of the auxiliary mechanism. The yoke B is held firmly in this position while the movable axis and clamp-plate, shown in Fig. 4, formed by the pin, or pivotal stud, pivoted in the block d', are moved longitudinally, and the clamp-plate D is swung diagonally upon its axis, thereby carrying the clamps and material held thereby longitudinally and diagonally of the button-hole slit while the angular part of the other side of the button-hole slit is being sewed; and said movable axis, clamp-plate, clamps and material held thereby are moved little by little, longitudinally toward the right in Fig. 1, while the straight part of the other side of the button-hole slit is being sewed.

After the last stitch is made and the sewing of the button-hole slit is finished, the device j, fast in the cam-disk, shown in Fig. 2, is forced against the rounded end j' of the device j^8, shown in Figs. 2 and 33, movably secured in the bearing j^7, which moves the device j^8 in said bearing, and expands the spring j^6, secured to the bearing j^7 and device j^8, and forces the pointed end of the device j^8 under the buffer-latch f', shown also in Figs. 4, 29, 30, 31, 32 and 33, whereupon, the power is automatically released in the buffer-spring f, which power instantly forces the buffer-rod F shown in Fig. 1, to the right of said figure, which carries the slide-bar P′, movably secured to said buffer-rod F by the screw P, to the right in Fig. 1, and moves the inclined part P^2 of said slide-bar away from the roll p^{23}, movably secured to the lever p, whereupon, the power of the spring p^{24}, secured to the lever p and to the bed of the machine, pulls one end of the lever p on its fulcrum p^{25}, upward which forces the other end of the lever p downward away from the inclined end of the stop-fork p', and the spring p^2 secured to a hook in the stop-fork p', and a stud in the bed-plate W′ moves the stop-fork toward the left in Fig. 1, upon its fulcrum p^{22}, which forces the inclined end of the stop-fork p', shown best in Fig. 17, into the groove p^{12} in the hub, or the clutch-member p^6, shown in Figs. 18 and 19, and the inclined shoulder p^7 of the pawl p^{18}, shown in Figs. 22, 20 and 18 is struck against the inclined end of the stop-fork p', and the pawl p^{18} is quickly moved on account of the stop-fork p', to the right in Figs. 18 and 20, thereby generating power in the spring p^{15}, shown in Fig. 20, in the clutch mechanism, and disconnecting the pawl p^{18} from the loose driving pulley, thereby automatically disengaging the clutch-members, thereby automatically controlling and disemploying the power automatically controlled and employed.

Instantly after the clutch-members are thus disengaged, the movable catch p^4, movably secured to the clutch-member p^6, shown in Fig. 19, by the two screws near together in the slot, shown by the dotted lines in the catch p^4, shown in Fig. 19, is caught by the tine of the stop-fork p' which prevents said movable catch p^4 from being rotated by said clutch-member, and the momentum of the operative parts is so great that the clutch-member continues to turn, thereby expanding the spring p^{16}, secured to said movable catch p^4, and secured to a screw fast in said clutch-member, until the catch p^5, fast to the clutch-member p^6 is forced against the rounded upper end of the latch p^3, pivoted to said stop-fork as shown in Fig. 1, and forces said latch p^3 to the left in Fig. 1 against the stress of the spring p^{21}, secured to said latch and to said stop-fork, and the catch p^5, fast to said clutch-member is forced against the movable catch p^4 and is instantly caught by the latch p^3, and is held as shown in Fig. 1, from rebounding in the opposite direction to the direction indicated by the arrow, shown on the loose pulley p^9 in Fig. 1, thereby causing the sewing devices to cease operating after the last stitch is made and before another one is made, and bringing the stitch-forming devices into the position shown in Fig. 41 and as hereinabove described, and leaving power in store in the spring shown in Fig. 20, in the clutch mechanism, and power for automatically controlling the entire automatic action of operative devices of the machine, and their consequent operation upon a material, in the main spring B′ of the auxiliary mechanism. From the time that the power is released in the auxiliary mechanism to the time that the power is automatically released in the clutch mechanism and the sewing of the material is begun including the cutting, moving and spreading of the material, and the storing of power in the buffer of the auxiliary mechanism by devices of the auxiliary mechanism forced by stored power released, it is about the same time as that between the pulling of a trigger of a gun and the report.

The hub, or clutch-member p^6 is connected with the lever p^{17}, which is fast to the main shaft by the spring p^{11}, as is shown in Figs. 19 and 20. This breaks the force of the blow and acts as a cushion when one clutch-member automatically engages the other rotating clutch-member; and the spring p^{16}, shown in said Figs. 19 and 20 breaks the force of the blow of the parts forced by the momentum of the moving mechanism after said clutch-members are disengaged. Therefore, the vibrating parts of the main mechanism are started and stopped with comparatively little shock to operative parts.

I believe that I am the first to devise devices such as are hereinabove mentioned, as follows: a stationary support A and a device a^3 movably secured thereto, and a clamp-plate having a slot therein placed over said movable device a^3, a pair of clamps movably mounted upon said clamp-plate, the lower members of which have inclined surfaces adapted to be thrust against said movable

device, whereupon, a button-hole slit is spread, and to provide a long slot D′ in said clamp-plate, and a device in said slot for swinging and guiding said clamp-plate, and to connect said device with a cam-face M, whereupon, said clamp-plate may be swung diagonally of a button-hole slit, and to fasten a pin, or pivotal stud *d* in said clamp-plate and to pivot said stud to a movable device connected with a cam-face K, thereby forming a movable axis, whereupon, said clamp-plate may be moved longitudinally of a button-hole slit in a material held in the clamps, and may be swung by said device in said long slot D′ in said clamp-plate upon its movable axis thereby swinging the movable device a^3 with said clamp-plate, and, whereupon, said clamp-plate and movable device a^3 are prevented from being moved diagonally while the clamps are thrust longitudinally of a button-hole slit against said movable device a^3 to spread a button-hole, and to provide a chock connected with said clamps for keeping said clamps apart. Therefore, these novel devices are recited in the claims appended hereto.

It will be observed that the clamp-lever r^{11} shown in Fig. 35 and in several other figures is separated from the latch b^2 which holds power in store in the main spring of the auxiliary mechanism, but as it has long been the practice to connect clamps with the starting mechanism of button-hole machines, a single rod, or bar (not shown) may reach from the clamp-lever r^{11} to the latch b^2 without invention so as to release the power by the latch b^2 through said bar when the clamp-lever r^{11} is operated.

Having described how the clamp-plate and clamps are moved longitudinally and are swung diagonally of a button-hole slit in a material held by the clamps, and a novel mechanism, whereupon, this is accomplished, and how the button-hole slit is cut and spread, and novel mechanism, whereupon, this is accomplished in a unique manner, and having described how that power is held in store in the auxiliary mechanism between operations of the machine and is released, and how the auxiliary mechanism actuated by stored power released controls the main mechanism and another power therein in a unique manner so quickly that the action of the auxiliary mechanism by stored power and the action of the main mechanism by power controlled appear to be simultaneous, and how that the main mechanism aids in the automatic storing of power in the auxiliary mechanism, &c., attention is now called to a new stitch-forming mechanism comprising two straight needles which are vibrated and forced to enter the material from opposite sides of the material and pass through the material with straight forward thrusts and cross each other above the material, and a looper which is vibrated on one side of the material across the straight lines in which said needles are vibrated, whereupon, a loop of an upper thread is carried across the under needle and through a loop of an under thread above the material and through the material, and a loop of an under thread is passed through the loop of the upper thread beneath the material and up through the material, thereby employing two straight needles and one looper for the first time to engage loops of two threads as aforesaid.

The needle-bar bearings N^2 and N′, shown in Figs. 26 and 27, in which the straight needle-bars n^2 and n' are movably secured, are secured in the journals *b* and *b*′ of the yoke B, shown in Fig. 25, angular to each other as follows:

Adjusting screws are threaded in the holes n^{16} in the yoke, shown in Fig. 25, until they project through the yoke a short distance. The adjusting screws are designated by the character n^{29} in Figs. 1 and 4. Then the straight needle-bar bearing N^2, shown in Fig. 26, is secured in the bearing *b* of the yoke B, by placing said straight needle-bar bearing N^2 as it stands between the journals of said yoke, and pushing it up through the upper journal *b* of said yoke until the holes n^{15} are over the holes n^{15} in the yoke; then the straight needle-bar bearing N^2 is adjustably secured in the journal *b* of said yoke and against the points of said screws by screws n^{22}, shown in Figs. 1 and 4, placed in the holes n^{15} in the straight needle-bar bearing and threaded into the holes n^{15} in said yoke. It will be observed that the ball device n^7, shown in Fig. 26, is carried by the lever n^{24}, as will be plain by Figs. 1 4 and 5, and is connected with a socket in said straight needle-bar n^2, and forms a ball and socket connection between said straight needle-bar n^2, and said lever n^{24}, which ball and socket connection is at the pivotal axis of said yoke B, which allows said yoke to be rotated and said straight needle-bar bearing N^2 and straight needle-bar therein, to be carried by said journal in a circular direction while said straight needle-bar is vibrated through said lever and ball and socket connection. The straight needle-bar bearing N′ with the straight needle-bar n' therein, shown in Fig. 27 is adjustably secured in the journal *b*′ of said yoke, and upon the projection upon the journal *b*′ of said yoke by pushing the lower end of said straight needle-bar bearing N′ down into the hole shown in the journal *b*′ of said yoke and adjustably securing said straight needle-bar bearing in the journal of said yoke and to the projection on said journal by screws in the same manner in which the upper straight needle-bar bearing is adjustably secured in the journal *b* of said yoke B.

It will be observed that the yoke B is so devised and constructed that the threads are rendered through its journals, in practice, directly to the stitch-forming devices.

It will also be observed that the ball device n^7 carried by the lever n^8, shown in Figs. 1,

4 and 5, and connected with a socket in said straight needle-bar n', forms a ball and socket connection between said straight needle-bar n' and said lever n^8, which ball and socket connection is at the pivotal axis of said yoke, which allows said yoke to be rotated and said straight needle-bar bearing N′ and said straight needle-bar therein, to be carried by said journal in a circular direction while said straight needle-bar is vibrated in said straight needle-bar bearing through said lever and ball and socket connection.

The looper-carrier n^3 is adjustably secured upon the straight needle-bar bearing N′, shown in Fig. 27, as follows: The novel adjustable bar n^4 is movably secured to said straight needle-bar bearing by the screw n^6 and a pin n^{27} in a slot shown in said adjustable bar n^4. The looper-carrier n^3 is pivotally secured to the adjustable bar n^4 by the screw n^5. By loosening the screw n^6, the looper-carrier pivot n^5 may be manually adjusted by sliding said adjustable bar and looper-carrier secured thereto, upon the screw n^6 and the pin n^{27} and securing it in another position by the screw n^6. By this adjustment of this novel adjustable bar n^4 the looper may be timed; or in other words, may be caused to take the loop from the upper needle sooner or later. The looper-carrier is vibrated upon its pivot n^5 through the straight needle-bar n' and the connecting device or screw n^{19} rigidly secured to, and carried by said straight needle-bar, and movably connected with the slot n^{23} in the looper-carrier n^3. It will be plain that by moving the straight needle-bar up and down, that the device n^{19} rigidly secured in said needle-bar and movably connected with the slot n^{23} in the looper-carrier n^3, vibrates said looper-carrier upon its pivot n^5, thereby vibrating the looper, shown in Fig. 5, secured to the upper end of the looper-carrier n^3 across the straight lines in which the needles, shown in Fig. 5 are vibrated, thereby forming stitches in a material upon the throat-plate N, which is secured upon the top of the projection of the journal b' of the yoke B in the manner shown in Fig. 4, by the screw n^{21}, shown in Fig. 4, inserted in the hole, shown in Fig. 28.

In Fig. 5 attention is called to the straight needle-bar bearings N′ and N², which I believe are the first that ever were turned while they guide two straight needle-bars n' and n^2 in straight lines which cross each other, adjustably secured in the journals b and b' of the yoke B, which yoke I believe is the first device, whereupon, two journals are immovable independent of each other together with the needle-bars n' and n^2, which I believe are the first whereupon, two straight needles are vibrated from opposite sides of a material in straight lines through the material and across each other above the material and turned at the same time, and a looper-carrier n^3, which I believe is the first looper-carrier that was ever pivoted to a device carried in a circular direction, whereupon, a looper n^{13}, which I believe is the first looper that ever was vibrated on one side of a material across two straight lines which cross each other above the material in which two straight needles are vibrated and enter the material from opposite sides and cross each other above the material, is vibrated, and a looper-carrier, which looper-carrier I believe is the first looper-carrier that ever was vibrated by a device connected with a cam-slot in said looper-carrier and carried by a vibratory bar mounted in a bearing in a journal. I also believe that the needle-bar bearings N′ and N² are the first devices, whereupon, straight needle-bars are guided in straight lines which lines cross each other, whereupon, two straight needles are guided in straight lines from opposite sides of the material and are guided in straight lines while they pass through the material from opposite sides of the material and across each other above the material, whereupon, a loop of an under thread is carried through the material and a loop of an upper thread is carried through said loop of the under thread and down through the material, thereby engaging loops of two threads, whereupon, the stitch is formed of two threads above described and shown in Fig. 42, and I also believe that the looper-carrier is the first looper-carrier, whereupon, a looper is vibrated on one side of the material across two straight lines which cross each other above the material in which two straight needles are vibrated and enter the material from opposite sides of the material and cross each other above the material, whereupon, the stitch is formed with two threads hereinabove described and shown in Fig. 42, and I also believe that the looper-carrier n^3 is the first looper-carrier vibrated by a device connected with a cam-slot in said looper-carrier and carried up and down by a vibratory bar, and I also believe that the looper-carrier n^3 is the first looper-carrier having a cam-slot therein, and a device connected with said cam-slot and fast to and carried by a bar adapted to be moved up and down, thereby moving the device fast thereto up and down in the cam-slot in said looper-carrier, whereupon, a looper is vibrated across two straight lines which cross each other in which two straight needles are vibrated from opposite sides of the material, whereupon, the stitch hereinabove described is formed of two threads, and I believe that the looper n^{13} is the first looper that was ever moved on one side of the material across two straight lines which cross each other above the material in which two straight needles are vibrated from opposite sides of the material and cross each other above the material, whereupon, the stitch hereinabove described and shown in Fig. 42 is formed, and I also believe that I am the first to form the stitch with two threads hereinabove described and shown in Fig. 42, with two straight needles vibrated from op-

posite sides of the material through the material and across each other above the material, and a looper vibrated on one side of the material across the straight lines in which said needles are vibrated.

Attention is called to the fact that the mechanism, whereupon, said straight needles and looper are vibrated as above described forms a novel combination of devices, the function of which is the vibrating of said needles and looper as above described in such time as to engage loops of two threads as aforesaid. Attention is called to another fact that the needles and looper in themselves are considered as additional devices to the novel combination or mechanism, whereupon, they are vibrated as aforesaid. Attention is called to another fact that the needles and looper combined with the novel combination or mechanism, whereupon, they are vibrated as above described form a novel combination, the result of the operation of which is the stitch hereinabove described and shown in Fig. 42 formed with two threads.

Therefore, the novelty residing in the combination of the devices, whereupon, the stitch-forming devices, or the needles and looper are vibrated, must not be confused with the novelty residing in the combination of the stitch-forming devices, whereupon, stitches are formed as aforesaid; and the novelty residing in the combination of devices, whereupon, the stitch-forming devices are vibrated and carried in a circular direction must not be confused with either the novelty residing in the combination of devices, whereupon, the stitch-forming devices are vibrated, or the combination of the stitch-forming devices, and the novelty of each one of these separate combinations must not be confused with the novelty of all of them combined, whereupon, the stitch above described and shown in Fig. 42 is first formed by two straight needles and a looper vibrated as aforesaid.

Having shown and described the devices, whereupon, the stitch-forming devices are carried, as aforesaid, and the needle-bar bearings in which the devices, whereupon, the stitch-forming devices are movably secured, and having shown and described that said needle-bar bearings are adjustably secured in the journals of said yoke, and disclosed some of the novel features thereof, attention is now called to the description of the adjustments of said needle-bar bearings, and my reasons for devising said adjustable needle-bar bearings, and means for adjusting said needle-bar bearings in the journals of said yoke.

Against the points of the adjusting screws n^{29} in the yoke B, shown in Figs. 1 and 4, the upper needle-bar bearing N^2, shown also in Fig. 26, is adjustably secured by the screws n^{22} as above described. By manually loosening the two lower screws n^{29} and tightening the two upper screws n^{29}, shown in Fig. 4, the needle-bar bearing N^2 may be adjusted upon an angle to the axis of said journal, thereby moving the lower end of the needle-bar and the needle n^{12} toward the right in said figure, so that when the upper needle n^{12} moves down very near to the under needle n^{11} above the material to the left of the needle in Fig. 4, there will be room enough between the point of the upper needle n^{12} when it is rising from its lowest position, and the under needle n^{11} as it is falling, to admit of the passage of a looper between the upper needle and the lower needle without striking either one of the needles with said looper.

I believe that I am the first to devise a journal above a work-support, and devise an adjustable needle-bar bearing therein, and means for adjusting it upon an angle to the axis of said journal, whereupon, a straight needle is caused to pass by an under needle above the material, near to said needle upon an angle to said needle, whereupon, the point of the upper needle when at its lowest position is at a greater distance from the lower needle than it is when it passes the lower needle above the material so that a looper may pass between the upper needle near its point, as it is rising from its lowest position, and the lower needle as it is falling, without striking either one of said needles with said looper. The under needle-bar bearing N′ may be adjusted upon an angle to the axis of said journal in the same manner, thereby moving the point of the under needle toward the left in Fig. 4 to afford more room between the needles and looper. This feature is also new with me.

Therefore, the journal above said work-support, said novel needle-bar bearing secured therein as aforesaid, said needle-bar in said bearing, means for adjusting said bearing as aforesaid, combined with the ball and socket connection above described between the needle-bar n^2 and the lever n^{24} form a combination of devices which is of my invention.

Attention is now called to another adjustable feature of said needle-bar bearing above said work-support.

The screws n^{22}, shown in Figs. 1 and 4, fit loosely in the holes in the needle-bar bearing N^2, shown in Fig. 26. Therefore, the top of the needle-bar bearing N^2 may be adjusted to the right in Fig. 5, thus moving the needle-bar upon an angle to the axis of the journal, and may be secured in this position by the friction of the heads of the screws, thereby moving the needle toward the left in Fig. 5, thereby changing the gage of the buttonhole which is the distance from the buttonhole slit to the place where the material is penetrated by the upper needle. This adjustment is at right angles with the other adjustment above described. I believe that I am the first to devise a journal and to mount it in a journal bearing, and to devise an adjustable needle-bar bearing and secure it in said journal, and means for adjusting it at an angle to the axis of said journal, to adjust a needle-bar in said needle-bar bearing, and a

needle in said needle-bar upon an angle to the axis of said journal, whereupon, the gage of the button-hole slit is changed.

Having shown and described the adjustable needle-bar bearings, and fully explained the adjustments thereof, and the ball and socket connection between the needle-bar n^2 and the lever n^{24}, and also the ball and socket connection between the needle-bar n' and the lever n^8, whereupon, the needle-bar bearings may be adjusted as aforesaid, without preventing the journals of the yoke from being rotated in their bearings, attention is now called to the mechanism whereupon, the levers n^{24} and n^8 are vibrated in such a manner as to cause the needles and looper to engage loops of thread as aforesaid.

The main shaft p^{10}, shown in Fig. 4, has an eccentric p^{26} secured thereto. Upon this eccentric is the eccentric strap n^{17}. This eccentric strap is pivotally secured to the lever n^{24} by the pivot screw n^{26}; and the lever n^{24} is movably secured upon the stud, or screw n^{25}, shown rigidly secured in the arm W^2. The lever n^{24} is connected with the needle-bar n^2 as shown and described. When said shaft p^{10} is rotated, said eccentric strap, said lever and said needle-bar are vibrated. The eccentric n^{15} is also secured to said shaft p^{10}. The forked lever n^{14} is placed over said eccentric n^{15} and is pivoted upon the pivot screw p^{20}, which is also rigidly secured in the arm W^2. When said shaft is rotated, the forked lever n^{14} is vibrated over its pivot screw p^{20} by said eccentric $n^{15\times}$, thereby vibrating the lower end of the forked lever n^{14} toward the right and left in Fig. 4. Movably secured upon the lower end of the forked lever n^{14} is the roll, or device n^{10} which is inserted in the cam-slot n^9, shaped somewhat like a half of a rhombus in the lever n^8. When the forked lever is vibrated toward the right and left in Fig. 4, the device, or roll n^{10} is carried back and forth by the forked lever in said cam-slot in the lever n^8, and the lever n^8 is thereby vibrated upon its pivot screw n^{20}; and as the lever n^8 is connected with the needle-bar n' as above described, said needle-bar is vibrated as above described, and the looper-carrier n^3, shown in Fig. 27, is vibrated on account of said needle-bar, and a device fast to, and carried by said needle-bar acting upon said looper-carrier as above described; and loops of two threads are engaged as above described, forming the stitch shown in Fig. 42.

It will be observed by looking at Fig. 4, that the device n^{10} in the cam-slot n^9 in the lever n^8 being moved half of the length of the slot toward the left in Fig. 4, forces the lever n^8 to force the under needle-bar to cause the under needle to take a loop of thread from beneath the work-support, or material upward in a straight line at an angle to a vertical line and to the straight line in which the upper needle is vibrated, to the limit of its upward stroke. During this time the upper needle is caused to rise a short distance from below the limit of its upward stroke to the limit of its upward stroke, and downward a little below the limit of its upward stroke, and as the device n^{10} is moved farther toward the left from the central part of said cam-slot, it will be observed that the cam-slot n^9 is so shaped that it causes the under needle-bar and needle to fall a little to open the loop of the under thread held above the material. As the device n^{10} continues to move toward the left, the lower needle-bar and needle are caused to stand substantially still to hold the open loop substantially still above the material and below the point of the upper needle, as shown in Fig. 39, until the device n^{10} returns to the middle of the cam-slot n^9. By that time the upper needle has passed through said loop above the material, and down through the material, and started to rise, as shown in Fig. 40; and while the device n^{10} is carried from the center of the cam-slot into the position in which it is shown in Fig. 4, the under needle is forced to complete its downward stroke and the upper needle is forced to nearly finish its upward stroke; and the looper is carried across the lines in which the needles are vibrated, thereby bringing the needles and looper into the position in which they are shown in Figs. 4 and 5, viz: the under needle at the limit of its downward stroke, the upper needle nearly at the limit of its upward stroke, and the looper across the straight lines in which the straight needles are vibrated.

I believe that I am the first to devise devices, as follows:

A journal in a journal bearing above a work-support; a straight needle-bar bearing in said journal; a straight needle-bar mounted in said straight needle-bar bearing; a lever pivoted above said work-support; a ball and socket connection between said lever and said needle-bar, whereupon, said needle-bar may be vibrated through said lever and ball and socket connection while said journal is turned; a main shaft; connecting means between said main shaft and said lever, whereupon, said lever may be vibrated through said main shaft; a journal mounted in a journal bearing beneath said work-support; a straight needle-bar bearing secured in said journal; a straight needle-bar mounted in said straight needle-bar bearing; a lever pivoted beneath said work-support; a cam-slot therein; a ball and socket connection between said needle-bar and said lever; connecting means between said main shaft and said cam-slot, whereupon, said lever and said needle-bar may be vibrated on account of said main shaft, connecting devices and said cam-slot; means for rotating said main shaft, whereupon, a straight needle is forced by the needle-bar beneath the work-support to move in a straight line, and at an angle to a vertical line, and to take a loop of thread from beneath the work-support up through a button-hole slit in a material while the upper needle-

bar and needle carried thereby are raised from a short distance below the limit of their upward stroke, to the limit of their upward stroke, and downward a little below the limit of their upward stroke, and to then cause the needle-bar and needle beneath the work-support to fall enough to open the loop of the under thread above the material, and to then cause the needle-bar and needle beneath the work-support to stand substantially still, thereby holding said loop open and out over the edge of the material until the needle-bar above the work-support forces the straight needle above the work-support to carry a loop of thread down in a straight line through the open loop of the under thread and through the material, and to cause said needle to rise enough to open this loop beneath the material, and until a looper-carrier beneath the material is forced on account of said needle-bar to carry a looper into said loop beneath the material and then to force the upper needle to nearly finish its upward srtoke at the same time that the under needle finishes its downward stroke, and to force the looper to cross the straight lines in which the needles are vibrated.

It should be understood that the combination of two straight needles and looper, shown in Figs. 38, 39, 40 and 41, forms a novel combination of devices, the operation of which is as follows:

Fig. 38 shows the two straight needles n^{11} and n^{12} and the looper n^{13} in the position in which they are held when the machine is not in operation. Fig. 39 shows that a loop of the under thread is carried by the under needle n^{11} up through the material in a straight line and across the line in which the upper needle is vibrated, and is held in loop form above the material. Fig. 40 shows that the upper needle n^{12} has passed through said loop and through the material and holds a loop in loop form beneath the material. Fig. 41 shows that the looper n^{13} has passed through the loop of the upper thread beneath the material and passed across the straight lines in in which the needles are vibrated, and shows that the under needle n^{11} is at the limit of its downward stroke, and the upper needle n^{12} is nearly at the limit of its upward stroke.

It will be observed by examining Fig. 41 that the stitch shown in Fig. 42 is made by a loop of the under thread being passed up through the material, and a loop of the upper thread being passed through said loop of the under thread above the material and through the material, and a loop of the under thread being passed through a loop of the upper thread beneath the material, and then passed up through the material to be again engaged by a loop of the upper thread as aforesaid.

It will be observed that there are three stitch-forming devices used in the formation of this stitch. Two of these devices are eye pointed and carry threads, and one of said devices has a barb, or long open eye at a distance from the point of it, the opening of said barb, or long eye being at the end of the eye which is nearest to the point of this device.

It will be observed that this combination of stitch-forming devices is novel, yet the novelty in these devices is independent of the novelty residing in the construction of the devices, whereupon, these needles are vibrated as above described, and carried in a circular direction at the same time.

It will be observed that if any other stitch-forming devices be substituted for these devices, the novelty still exists in the devices for vibrating and rotating them as hereinabove described and shown in the drawings. Therefore, the stitch-forming devices, shown in Figs. 43, 44, 45 and 46, may be employed, thereby forming another combination of stitch-forming devices distinct from the first combination; and these devices may be vibrated substantially the same as the former combination of stitch-forming devices by the same machine. This combination of stitch-forming devices is distinct from the first combination of stitch-forming devices, inasmuch as there are three threads used in the formation of a stitch instead of two, and the stitch formed by this combination of stitch-forming devices and three threads is shown in Fig. 47. The relative movements of these stitch-forming devices are exactly the same as the relative movements of the stitch-forming devices in the former combination, inasmuch as two needles are vibrated across each other with straight forward positive thrusts, and the looper is vibrated across the lines in which the needles are vibrated, and the threads are engaged just the same, except there is one thread more interwoven in the stitch. The interlocking of the threads by this combination of stitch-forming devices is described as follows:

A loop of one under thread is carried by an under needle n^{14} up through a loop of another under thread carried by the looper n^{13} beneath the material, and is then carried through the material as shown in Fig. 44. Then a loop of the upper thread is carried by the upper needle n^{12} down through the loop of the under thread held above the material, and through the material, and holds a loop of the upper thread in loop form below the material. Then a loop of one under thread is carried by the looper n^{13} through the loop of the upper thread held beneath the material as is shown in Fig. 46, and a loop of another under thread carried by the needle n^{14} is carried through the loop of the other under thread and up through the material to be engaged by the upper thread. The above described combinations of stitch-forming devices must be regarded as distinct from each other, inasmuch as they form two different stitches. However, the relative movements of the devices in the two combinations are the same because two straight needles are

vibrated in straight lines from opposite sides of a material upon a work-support, and enter the material from opposite sides of the material, and cross each other on one side of the material, the lines in which the needles are vibrated forming vertical angles; and a looper is vibrated on one side of the material across the straight lines in which the needles are vibrated.

The novelty residing in each of these combinations must be determined regardless of each other; but the novelty residing in the devices, or mechanism, whereupon, the stitch-forming devices are vibrated as aforesaid, is distinct from either of the combinations of stitch-forming devices. It should be distinctly understood that any combination of devices, or mechanism, whereupon, two straight needles and a looper are vibrated as aforesaid, and carried in a circular direction as aforesaid, is of my invention.

It should be also distinctly understood that any combination of devices, or mechanism, whereupon, loops of two threads are engaged as above described forming the stitch above described by aid of two straight needles and one looper is of my invention.

It should also be understood that any combination of devices, or mechanism, comprising journals and angular needle-bar bearings therein angular to each other, whereupon, loops of two threads are engaged as aforesaid on account of two straight needles vibrated from opposite sides of the material through the material with straight forward thrusts and across each other above the material, and a looper vibrated across the two straight needles beneath the material is of my invention.

It should also be understood that a journal mounted in a journal bearing, a vibratory bar in said journal at the axis of said journal combined with suitable means for moving said bar up and down in said journal at the axis of said journal while said journal is turned, and suitable devices mounted upon said journal and the projection of said journal, whereupon, a straight under needle is vibrated in a straight line at an angle to the straight line in which an upper needle is vibrated, and a looper is vibrated across the straight line in which the under needle is vibrated, both movements being accomplished through said vibratory bar which is moved up and down in the journal at the axis of said journal, whereupon, loops of an upper and an under thread are engaged below the material in the forming of the stitch above described was first devised by me.

It should also be understood that I am the first to pivot a lever and to provide a cam-slot in said lever shaped somewhat like a half of a rhombus or diamond, and to provide connecting devices between a main shaft and said cam-slot which is shaped somewhat like a half a rhombus, and to connect said lever with a vibratory bar in a journal at the axis of said journal, whereupon, said vibratory bar is moved up and down while said journal and vibratory bar are turned in a circular direction, whereupon, a straight under needle is vibrated on account of said vibratory bar and the power applied to said vibratory bar through said lever and connecting devices between the cam-slot and the main shaft, in a straight line from beneath the material up through the material and across a straight line in which an upper needle is vibrated, and a looper is also vibrated on account of said vibratory bar and the power applied to said vibratory bar through said lever, cam-slot and connecting devices between the cam-slot and the main shaft, on one side of the material across the straight lines in which the upper and under needles are vibrated especially for the purpose of vibrating said under needle from beneath the material in a straight line up through the material so that said under needle will not be damaged while passing through said material, and to cross the straight line in which the upper needle is vibrated above the material to avoid the use of a looper above the material so quickly that the upper needle rising from a little below the limit of its upward stroke to the limit of its upward stroke and down from the limit of its upward stroke passes the under needle after the under needle is to the limit of its upward stroke, whereupon, it is possible for the upper needle to take a loop of under thread from the under needle above the material while loops of two threads are being engaged to form the stitch as aforesaid and shown in Fig. 42.

It is obvious that artisans may use various devices for generating and storing powers other than the power in a spring to be held in store in an auxiliary mechanism between operations of a machine, and may release said powers to control a main mechanism as hereinabove described, and thereby employ my invention. Therefore, I have also devised various devices to show that this may be accomplished by other forces except the power of a spring, and have shown one of these devices in a modification of the mechanism above described, shown as mounted upon the under side of the bed-plate W′ in Figs. 49 and 50 to show that the power in store in the auxiliary mechanism to control a main mechanism may be powers other than the power in a spring. The yoke B, shown in Fig. 48, shows a part of the modification shown on Figs. 49 and 50. In this modification the worm t' is used for rotating the cam t. The worm t' may be moved in a circular direction little by little by any common pawl and ratchet device, as will be plain by Figs. 49 and 50, whereupon, the cam-surface t^2 acting upon the roll t^5 movably secured to the spring bar T, forces the spring bar T to the right in Figs. 49 and 50, against the stress of the spring B′, or against the force of gravitation upon the weight x, together with the stress of the spring B′, thereby rotating the pinion t^4 fast to the lower journal b' of

the yoke B by the teeth t^3 on the spring bar T, shown in Figs. 49 and 50, thereby generating power in the spring B′, or causing the weight x to be lifted against the power of attraction, thereby carrying the yoke and stitch-forming devices a half revolution gradually while the circular part of a button-hole slit is sewed, or until the latch b^2 engages the projection upon the spring bar T as is shown in Figs. 49 and 50, thereby storing power in the spring B′, or holding the weight x lifted. After the spring bar T is thus caught by the latch b^2, the end of the cam-surface t^2 may be carried by or past the roll t^5 movably secured to the spring bar T while the last straight side of a button-hole is sewed; and this power may be held in store until substantially the time that another button-hole is begun, and may be then released by manually pressing upon the latch b^2, whereupon, the spring bar T may be quickly moved toward the left in Figs. 49 and 50 by the stored power released in the spring B′, or attraction acting upon the weight x, and the buffer rod F may be forced toward the left in Figs. 49 and 50, thereby generating power in the buffer spring upon said buffer rod F, which may be immediately stored by the buffer latch f' engaging the projection shown on the buffer rod F, and turning the yoke B a half revolution thereby carrying the stitch-forming devices a half revolution, and may operate devices as heretofore shown and described.

The operation of stitch-forming devices upon the yoke which is made of tubing, and is a part of the modification, shown in Fig. 48 is described as follows:

The loop spreader n^{15} is pivoted to the yoke B, and when the needle n^{12} is moved downward in a vertical line, the device n^{28} fast to and carried by the bar n^2 may act upon the projection n^{27} upon the loop spreader n^{15}, and may swing said loop spreader upon its pivot, and may spread a loop of an under thread above the material, carried in a vertical line from beneath the material, and hold said loop in such a position that the needle n^{12} on its downward stroke may carry a loop of the upper thread through said loop of the under thread and through the material.

It will be observed that the needles are adapted to be vibrated in vertical lines, in Fig. 48, instead of in straight lines crossing each other as heretofore shown and described. It will be also observed that the upper and under threads pass through the journals of said yoke. By comparing these vertical needles with the needles which cross each other in straight lines, hereinabove described and shown in Fig. 5, it will be observed that the applicant first devised mechanism, whereupon, two straight needles are crossed above the material in order to dispense with the loop spreader n^{15} in forming the stitch above described.

I have hereinabove described, and shown by this modification that the power of gravitation and the weight x may be used as a substitute for the spring B′, and the power therein; and it is obvious that many other devices may be employed for storing various powers to operate mechanisms as above shown and described, viz: to force devices to aid to begin an operation upon a material; to force a device to begin an operation upon a material; to force devices to generate and store powers; to force devices to automatically employ another distinct power; and devices forced by this power automatically employed to operate upon the material; and devices forced by said power automatically employed to generate and store powers; and devices forced by said power automatically employed for causing said devices for storing powers to automatically cease storing powers after a proper amount of power is stored, and for causing the device for operating upon the material to cease operating upon the material after said operation is finished, leaving powers in store as has been heretofore shown and described, so that one of these powers may be released, whereupon, the entire operation of the machine upon the material may be automatically controlled by devices operated by said power as above described.

Therefore, it should be distinctly understood that one of the principal novel combinations of this invention resides in the combinations formed by the combination of a suitable apparatus for automatically generating and storing power combined with devices to be actuated by power automatically employed and controlled as heretofore shown and described.

Having invented this complicated machine in the operation of which two distinct powers are employed, one automatically stored, and the other automatically controlled by the stored power released, whereupon, devices for moving, cutting, spreading and stitching operate so nearly simultaneously that they are blended into one sharp report, and having described the novel combinations of this invention without much regard to the parts which are old or common in other machines in such a manner that those who are skilled in the art of button-hole machine construction will doubtless allow that they can make and use the same, I claim as follows:

1. In a button-hole machine the following combination of instrumentalities, viz: an apparatus comprising a device in which power may be automatically generated, stored and held in store substantially all the time between complete operations of the machine upon the material; means, whereupon, said power may be automatically generated and stored; means, whereupon, the generating of power automatically ceases after enough power is stored; means, whereupon, said power may be released; mechanism adapted to be actuated by said power released, and

comprising means, whereupon, the material may be automatically moved; and means, whereupon, a button-hole slit may be automatically cut in the material at substantially the time said power is released.

2. In a button-hole machine the following combination of instrumentalities, viz: an apparatus comprising a device in which power may be automatically generated, stored and held in store substantially all the time between complete operations of the machine upon the material; means, whereupon, said power may be automatically generated and stored; means, whereupon, the generating of power automatically ceases after enough power is stored; means, whereupon, said power may be released; mechanism adapted to be actuated by said power released, and comprising means, whereupon, the material may be automatically moved; and means, whereupon, the button-hole slit may be automatically spread at substantially the time said power is released.

3. In a button-hole machine the following combination of instrumentalities, viz: an apparatus comprising a device in which power may be automatically generated, stored and held in store substantially all the time between complete operations of the machine upon the material; means, whereupon, said power may be automatically generated and stored; means, whereupon, the generating of power automatically ceases after enough power is stored; means, whereupon, said power may be released; mechanism adapted to be actuated by said power released, and comprising a cutter for cutting a button-hole slit in the material at substantially the time said power is released.

4. In a button-hole machine a combination like this: an auxiliary mechanism and a main mechanism; the auxiliary mechanism adapted to be actuated by power stored and released, and comprising an apparatus comprising a device in which power may be automatically generated and stored; and means, whereupon, said power may be released; and mechanism, whereupon, a button-hole slit may be moved, cut and spread; and the main mechanism adapted to be actuated by another power, and comprising means, whereupon, said power may be automatically generated and stored in said device in said auxiliary mechanism, and a sewing mechanism comprising two clutch-members; and mechanism connecting the auxiliary and main mechanisms, whereupon, the clutch-members may be automatically engaged, and the main mechanism may be automatically started at substantially the time said power is released.

5. In a button-hole machine a combination like this: an auxiliary mechanism and a main mechanism; the auxiliary mechanism adapted to be actuated by power stored and released, and comprising an apparatus comprising a device in which power may be automatically generated and stored; and means, whereupon, said power may be released; and mechanism, whereupon, a button-hole slit may be moved, cut and spread; and the main mechanism adapted to be actuated by another power, and comprising means, whereupon, said power may be automatically generated and stored in said device in said auxiliary mechanism, and a sewing mechanism, and two clutch-members, one of which is adapted to rotate continuously, whether the machine is operating upon the material or not, and the other comprising means in which power may be held in store substantially all the time between complete operations of the machine upon the material; and mechanism connecting the auxiliary and main mechanisms, whereupon, the power may be automatically released in one of said clutch-members, whereupon, one clutch-member may automatically engage the other clutch-member, whereupon, the main mechanism may be automatically started to operate the power-storing, and sewing mechanisms and for automatically generating and storing power in one of said clutch-members, and for stopping the main mechanism after the sewing is finished upon the material and enough power is stored.

6. In a button-hole machine a combination like this: an apparatus comprising a device in which power may be automatically generated, stored and held in store substantially all the time between complete operations of the machine upon the material; devices, whereupon, power may be automatically generated and stored in said device; devices, whereupon, the generating of power automatically ceases after enough power is generated and stored; a clutch-member adapted to rotate continuously whether the machine is operating upon the material or not, by a power distinct from the power in store; another clutch-member connected with a driving shaft, and adapted to be engaged by the other clutch-member; means by which the stored power may be released; means adapted to be actuated by said power released, whereupon, one clutch-member may be forced to automatically engage the other clutch-member and the driving shaft may be automatically started at substantially the time the power is released.

7. In a button-hole machine the following combination of instrumentalities, viz: a looper below a work-support; a straight under needle below the work-support; a straight upper needle above the work-support; any suitable mechanism, whereupon, the looper may be forced to cross the upper needle below the work-support, and the under needle may be forced to cross the looper below the work-support, and the upper needle may be forced to cross the under needle above the work-support.

8. In a button-hole machine the following combination of instrumentalities, viz: a straight upper needle-bar-bearing supported

above a work-support; a straight upper needle-bar therein; a straight under needle-bar-bearing supported below the work-support and at an angle to the upper needle-bar-bearing; a straight under needle-bar in the under needle-bar-bearing and at an angle to the upper needle-bar; a looper-carrier movably supported below the work-support; any suitable mechanism, whereupon, these needle-bars and looper-carrier may be vibrated, and a looper fast to the looper-carrier may be forced to cross the upper needle below the work-support, and an under needle fast to the under needle-bar may be forced to cross the looper below the work-support, and an upper needle fast to the upper needle-bar may be forced to cross the under needle above the work-support.

9. In a button-hole machine the following combination of instrumentalities, viz: a straight upper needle-bar-bearing supported above a work-support; a straight upper needle-bar therein; a straight upper needle fast to said needle-bar; a straight under-needle-bar-bearing supported below the work-support and at an angle to the upper needle-bar-bearing; a straight under needle-bar in the under needle-bar-bearing; a straight under needle fast to the under straight needle-bar and at an angle to the upper straight needle; a looper-carrier movably supported below the work-support; a looper fast to the looper-carrier; any suitable mechanism, whereupon, the needle-bars and looper-carrier may be vibrated and the looper may be forced to cross the upper needle below the work-support, and the under needle may be forced to cross the looper below the work-support, and the upper needle may be forced to cross the under needle above the work-support.

10. In a button-hole machine the following combination of instrumentalities, viz: a straight upper needle-bar-bearing supported above a work-support; a straight upper needle-bar therein; a straight under needle-bar-bearing supported below the work-support and at an angle to the upper needle-bar-bearing; a straight under needle-bar in the under needle-bar-bearing and at an angle to the upper needle-bar; a looper-carrier-pivot supported below the work-support; a looper-carrier pivoted to said looper-carrier-pivot; a device fast to and carried by the under needle-bar and connected with the looper-carrier for vibrating the looper-carrier on its pivot; any suitable mechanism, whereupon, said needle-bars may be vibrated, and a looper fast to said looper-carrier may be forced to cross the upper needle below the work-support, and an under needle fast to the under needle-bar may be forced to cross a looper fast to the looper-carrier below the work-support, and an upper needle fast to the upper needle-bar may be forced to cross the under needle above the work-support.

11. In a button-hole machine the following combination of instrumentalities, viz: a straight upper needle-bar-bearing supported above a work-support; a straight upper needle-bar therein; a straight upper needle fast to said needle-bar; a straight under needle-bar-bearing supported below the work-support and at an angle to the upper needle-bar-bearing; a straight under needle-bar in the under needle-bar-bearing; a straight under needle fast to the under needle-bar and at an angle to the upper needle; a looper-carrier-pivot supported below the work-support; a looper-carrier pivoted to said looper-carrier-pivot; a looper fast to the looper-carrier; any suitable mechanism, whereupon, the needle-bars and looper-carrier may be vibrated and the looper may be forced to cross the upper needle below the work-support, and the under needle forced to cross the looper below the work-support, and the upper needle may be forced to cross the under needle above the work-support.

12. In a button-hole machine the following combination of instrumentalities, viz: a straight upper needle-bar-bearing supported above the work-support; a straight upper needle-bar therein; a straight upper needle fast to said needle-bar; a straight under needle-bar-bearing supported below the work-support and at an angle to the upper needle-bar-bearing; a straight under needle-bar in the under needle-bar-bearing; a straight under needle fast to the under needle-bar and at an angle to the upper needle; a looper-carrier-pivot supported below the work-support; a looper-carrier pivoted to said looper-carrier-pivot; a looper fast to the looper-carrier; a device fast to the under needle-bar and connected with the looper-carrier for operating the looper-carrier; any suitable mechanism, whereupon, the needle-bars may be vibrated and the looper may be forced to cross the upper needle below the work-support, and the under needle may be forced to cross the looper below the work-support, and the upper needle may be forced to cross the under needle above the work-support.

13. In a button-hole machine the following combination of instrumentalities, viz: a straight upper needle-bar-bearing supported above the work-support; a straight upper needle-bar therein; a straight upper needle fast to said upper needle-bar; a straight under needle-bar-bearing supported below the work-support and at an angle to the upper needle-bar-bearing; a straight under needle-bar in the under needle-bar-bearing; a straight under needle fast to the under needle-bar; a looper-carrier movably secured below the work-support; a looper fast to the looper-carrier; manually adjustable means, whereupon, the length of the movement of the looper and its relative time with the needles may be changed; suitable mechanism, whereupon, the looper may be forced to cross the upper needle below the work-support, and the under needle may be forced to cross the looper below the work-support, and the upper nee-

dle may be forced to cross the under needle above the work-support.

14. In a button-hole machine the following combination of instrumentalities, viz: an adjustable needle-bar-bearing supported above a work-support; an upper needle-bar therein; an upper needle fast to said needle-bar; an adjustable under needle-bar bearing supported below the work-support; an under needle-bar therein; an under needle fast to said under needle-bar; a looper carrier movably secured below the work-support; a looper fast to the looper-carrier; manually adjustable means by which the needle-bar-bearings may be moved, whereupon, the needles fast to said needle-bars may pass through the work-support at greater angles than before the adjustment is made, and, whereupon, more space is made between the needles for the looper than there is before the adjustment is made; any suitable mechanism, whereupon, the needle-bars and said looper-carrier may be vibrated, and the looper may be forced to cross the upper needle below the work-support, and the under needle may be forced to cross the looper below the work-support, and the upper needle may be forced to cross the under needle above the work-support.

15. In a button-hole machine the following combination of instrumentalities, viz: an adjustable needle-bar-bearing supported below a work-support; a needle-bar therein; a looper-carrier movably supported below the work-support; a looper fast to the looper-carrier; manually adjustable means by which the needle-bar-bearing may be moved, whereupon, said needle may pass through the work-support at a greater angle than before the adjustment is made, and, whereupon, more space is made between the needle and looper than there is before the adjustment is made; any suitable means, whereupon, said needle-bar and looper-carrier may be vibrated.

16. In a button-hole machine the following combination of instrumentalities, viz: a needle-bar-bearing supported below a work-support; a needle-bar therein; a needle fast to said needle-bar; an adjustable looper-carrier-pivot supported below the work-support; a looper pivoted to said looper-carrier pivot; a looper fast to the looper-carrier; manually adjustable means, whereupon, said looper-carrier-pivot may be moved, and the length of movement of the looper, and the relative time of the action of the looper with the needles changed; any suitable means, whereupon, said needle-bar and said looper-carrier may be vibrated.

17. In a button-hole machine the following combination of instrumentalities, viz: a straight needle-bar-bearing above a work-support; a straight upper needle-bar therein; a straight upper needle fast to said needle-bar; a straight under needle-bar-bearing supported below the work-support; a straight under needle-bar in said under needle-bar-bearing; a straight under needle fast to the under needle-bar; a looper-carrier movably supported below the work-support; a looper fast to the looper-carrier; a pivoted lever connected with the upper needle-bar; an eccentric-strap connected with said lever; an eccentric connected with said eccentric-strap; a shaft connected with said eccentric; a pivoted cam-lever having a cam-slot shaped nearly like half a rhombus therein, and connected with the under needle-bar; a device connected with said cam-slot, and with said shaft, whereupon, the needle-bar may be forced to move up quickly, and dwell in its upper position and forced downward quickly and dwell in its lower position; any suitable means, whereupon, said shaft may be rotated.

18. In a button-hole machine the following combination of instrumentalities, viz: a needle-bar-bearing; a needle-bar therein; a needle in said needle-bar; a looper-carrier movably supported; a looper fast to the looper-carrier; a device fast to and carried by said needle-bar and connected with said looper-carrier for vibrating said looper-carrier; a pivoted cam-lever having a cam-slot therein shaped nearly like half a rhombus; any suitable means, whereupon, said cam-lever may be vibrated.

19. In a button-hole machine the following combination of instrumentalities, viz: a work-support; a journal mounted in a journal-bearing supported above said work-support; a journal mounted in a journal-bearing supported beneath said work-support; a needle-bar-bearing in each one of said journals; a needle-bar in each one of said needle-bar-bearings; a needle in each one of said needle-bars; a looper-carrier pivoted to a device fast to, and carried by one of said journals; a looper fast to said looper-carrier; a device fast to the needle-bar below said work-support, and movably connected with said looper-carrier, whereupon, said looper-carrier may be vibrated; a lever pivoted above said work-support; a ball and socket device connecting said lever and needle-bar and made in such a manner that the needle-bar may be vibrated while the journal is turned; a driving shaft rotatably supported; connecting mechanism between said driving shaft and said lever, comprising an eccentric, and an eccentric strap, whereupon, said lever may be vibrated through said driving shaft; a cam-lever pivoted below said work-support; a cam-slot therein shaped somewhat like half a rhombus; connecting mechanism between said driving shaft, and said cam-lever, and comprising an eccentric and a device to be moved back and forth in said cam-slot; a ball and socket device connecting said cam-lever and the needle-bar beneath the work-support and made in such a manner that the needle-bar may be vibrated while the journal is turned; any suitable mechanism, whereupon, the driving

shaft may be automatically started, and rotated, and any suitable means, whereupon, the driving shaft may be automatically stopped.

20. The following combination of instrumentalities, viz: a rigid yoke having two journals, and for holding them in their exact relative positions to each other; journal bearings in which said journals are mounted; a work-support between said journals; operative devices mounted upon said yoke, at, and near the axis of said yoke; any suitable mechanism, whereupon, said operative devices may be operated; and any suitable mechanism, whereupon, said yoke may be turned.

21. In a button-hole machine the following combination of instrumentalities, viz: a rigid yoke having two journals, and for holding them in their exact relative positions to each other; journal bearings in which said journals are mounted; a throat-plate upon a projection on one of said journals; a work-support between said journals; a needle-bar movably mounted on and carried by each one of said journals; a needle fast to each one of said needle-bars; a loop-carrier movably mounted on and carried by a projection on one of said journals; a looper fast to said looper-carrier; any suitable mechanism, whereupon, said needle-bars, and looper-carrier may be operated, and any suitable mechanism, whereupon, the yoke may be turned.

22. In a button-hole machine the following combination of instrumentalities, viz: a rigid yoke having two journals, and for holding them in their exact relative positions to each other; journal bearings in which said journals are mounted; thread bearings in said journals; a throat-plate secured to a projection on one of said journals; a work-support between said journals; a needle-bar mounted upon and carried by each one of said journals; a needle fast to each one of said needle-bars; a looper-carrier movably mounted upon a projection on one of said journals; a looper fast to said looper-carrier; any suitable mechanism, whereupon, the needle-bars and looper-carrier may be operated, and any suitable mechanism whereupon, the yoke may be turned.

23. In a button-hole machine the following combination of instrumentalities, viz: an eye-pointed needle above a work-support; a needle below the work-support and having a long eye open at the part of the eye which is nearest the point of the needle; a looper below the work-support; any suitable mechanism, whereupon, the looper may be forced to cross the upper needle below the work-support, and the under needle may be forced to cross the looper below the work-support, and the upper needle may be forced to cross the under needle above the work-support.

24. In a button-hole machine the following combination of instrumentalities, viz: a work-support; a journal in a journal-bearing each side of the work-support; an adjustable needle-bar-bearing in each journal; a straight needle-bar in each needle-bar-bearing; a straight needle fast to each needle-bar; an adjustable looper-carrier-pivot adjustably secured to a projection on one of said journals; a looper-carrier pivoted to the looper-carrier-pivot; a looper fast to said looper-carrier; a device fast to and carried by the needle-bar and connected with the looper-carrier for operating the looper-carrier through the needle-bar; any suitable mechanism, whereupon, the needle-bars may be vibrated; and any suitable mechanism, whereupon, said journals may be turned.

25. In a sewing-machine the following combination of instrumentalities, viz: a work support a straight eye-pointed needle above a work-support; a straight needle below the work-support and having a long eye open at that part of the eye which is nearest the point of the needle; a looper below the work-support; any suitable mechanism, whereupon, the needles and looper may be vibrated.

26. In a button-hole machine the following combination of instrumentalities, viz: a stationary support; a cam having three cam-faces and movably mounted upon a vertical bearing below said stationary support; a clamp-plate movably mounted upon said stationary support; a movable connecting device between one of said cam-faces and said clamp-plate; a pin or pivotal stud by which said clamp-plate is pivoted to a part of said movable connecting device, thereby forming a movable axis; a spring for holding the part of the movable device against the cam-face, whereupon, said clamp-plate may be moved and held in position upon said stationary support; another movable connecting device between another of said cam-faces and the clamp-plate and a part of which is connected with the cam-face and a part of which is connected with the clamp-plate; a spring for holding the part against the cam-face, whereupon, the clamp-plate may be held in position, guided and moved upon said stationary support; a movable device movably secured to the stationary support and extending up through a slot in said clamp-plate fitting said slot; a pair of clamps movably mounted upon said clamp-plate, each clamp comprising two clamp-members; springs for holding the lower clamp-members against the movable device which extends up through the slot in the clamp-plate; a cutter-block secured to a device for supporting it; a button-hole cutter; any suitable mechanism, whereupon, said movable axis, clamp-plate, and clamps, may all be carried out of their respective normal positions; and suitable mechanism, whereupon, the button-hole cutter may be actuated.

27. In a button-hole machine the following combination of instrumentalities, viz: a stationary support; a cam having three cam-faces and movably mounted upon a vertical bearing below said stationary support; a clamp-plate movably mounted upon said stationary support; a movable connecting device

between one of said cam-faces and said clamp-plate; a pin or pivotal stud by which said clamp-plate is pivoted to a part of said movable connecting device, thereby forming a movable axis; a spring for holding the part of the movable device against the cam-face, whereupon, said clamp-plate may be moved and held in position upon said stationary support; another movable connecting device between another of said cam-faces and the clamp-plate and a part of which is connected with the cam-face and a part of which is connected with the clamp-plate; a spring for holding the part against the cam-face, whereupon, the clamp-plate may be held in position, guided and moved upon said stationary support; a movable device movably secured to the stationary support and extending up through a slot in said clamp-plate fitting said slot; a pair of clamps movably mounted upon said clamp-plate, each clamp comprising two clamp-members; an inclined surface upon each lower member of each clamp, said inclined surfaces adapted to be thrust against the movable device which extends up through the slot in said clamp-plate, whereupon, the clamps may be separated; springs for holding the lower clamp-members against the movable device; a device for automatically moving said clamp-plate and movable axis out of their respective normal positions, and for forcing the inclined surfaces upon the lower clamp-members against the movable device which extends up through said slot in said clamp-plate, whereupon, the clamps are separated, thereby spreading a button-hole slit in a material held in said clamps.

28. In a button-hole machine the following combination of instrumentalities, viz: a stationary support; a cam having three cam-faces and movably mounted upon a vertical bearing below said stationary support; a clamp-plate movably mounted upon said stationary support; a movable connecting device between one of said cam-faces and said clamp-plate; a pin or pivotal stud by which said clamp-plate is pivoted to a part of said movable connecting device, thereby forming a movable axis; a spring for holding the part of the movable device against the cam-face, whereupon, said clamp-plate may be moved and held in position upon said stationary support; another movable connecting device between another of said cam-faces and the clamp-plate and a part of which is connected with the cam-face and a part of which is connected with the clamp-plate; a spring for holding the part against the cam-face, whereupon, the clamp-plate may be held in position, guided and moved upon said stationary support; a movable device movably secured to the stationary support and extending up through a slot in said clamp-plate fitting said slot; a pair of clamps movably mounted upon said clamp-plate, each clamp comprising two clamp-members; an inclined surface upon each lower member of each clamp and adapted to be thrust against the movable device which extends up through the said slot in said clamp-plate; whereupon, the clamps may be separated; springs for holding the lower clamp-members against the movable device; a device or chock movably mounted upon and carried with said clamp-plate and adapted to be forced between the lower members of said clamps after they are separated to keep them apart; a spring for forcing said chock down between the lower members of said clamps; a device for automatically moving said clamp-plate, movable axis and clamps out of their respective normal positions, thereby forcing the inclined surfaces upon the lower clamp-members against the movable device which projects up through said slot in said clamp-plate, whereupon, the clamps are separated, thereby spreading a button-hole slit in a material held in said clamps, and whereupon, said chock is forced between the lower members of said clamps to keep them apart.

29. In a button-hole machine the following combination of instrumentalities, viz: a stationary support; a cam having three cam-faces and movably mounted upon a vertical bearing below said stationary support; a clamp-plate movably mounted upon said stationary support; a movable connecting device between one of said cam-faces and said clamp-plate; a pin or pivotal stud by which said clamp-plate is pivoted to a part of said movable connecting device, thereby forming a movable axis; a spring for holding the part of the movable device against the cam-face, whereupon, said clamp-plate may be moved and held in position upon said stationary support; another movable connecting device between another of said cam-faces and the clamp-plate and a part of which is connected with the cam-face and a part of which is connected with the clamp-plate; a spring for holding the part against the cam-face, whereupon, the clamp-plate may be held in position, guided and moved upon said stationary support; a movable device movably secured to the stationary support and extending up through a slot in said clamp-plate fitting said slot; a pair of clamps movably mounted upon said clamp-plate, each clamp comprising two clamp-members, the upper clamp-members being springs, and each of the lower clamp-members having an inclined surface adapted to be thrust against the movable device which extends up through said slot in said clamp-plate; springs for holding the lower clamp-members against said movable device; a device or chock movably mounted upon and carried with said clamp-plate and adapted to be automatically forced between the lower clamp-members when they are separated to keep them apart, said chock comprising two spring arms resting upon the upper spring clamp-members; a powerful spring for pressing the spring arms of said chock down upon the upper spring clamp-members; a clamp-lever adapted to hold the upper clamp-mem-

bers in a raised position against the stress of said powerful spring by which the material is automatically clamped when said clamp-lever is manually moved out of its normal position; any suitable mechanism, whereupon said material is automatically clamped and clamp-plate and movable axis are moved out of their normal positions and the inclined surfaces of the lower clamp-members are forced against the movable device which extends up through said slot in said clamp-plate, and the clamps are separated and a button-hole slit is spread in a material held in said clamps, and said chock is automatically forced between the lower members of said clamps to keep them apart at substantially the time that the clamp-lever is manually moved out of its normal position.

30. In a button-hole machine the following combination of instrumentalities, viz: a stationary support; a cam having two cam-faces rotatably mounted upon a vertical bearing below said stationary support; a clamp-plate movably mounted upon said stationary support; a movable connecting device between one of said cam-faces and said clamp-plate; a pin, or pivotal stud by which said clamp-plate is pivoted to a part of said movable device, thereby forming a movable axis; a spring for holding a part of said movable device against one of said cam-faces, whereupon, said clamp-plate may be held in position and moved upon said stationary support; another movable connecting device between the other of said cam-faces and said clamp-plate, a part of which is movably connected with said clamp-plate, and another part of which is movably connected with the cam-face; a spring also for holding the part of this device against said cam-face, whereupon, said clamp-plate may be held in position, guided and moved upon said stationary support; a movable device movably secured upon said stationary support and extending up through a slot in said clamp-plate, fitting said slot; a suitable device for automatically moving said cam little by little upon its bearing while a button-hole slit is being sewed, whereupon, said movable axis, clamp-plate and a pair of clamps movably mounted upon said clamp-plate and a material held in said clamps are carried between the making of the stitches little by little longitudinally of a button-hole slit in said material, and said clamp-plate is swung little by little upon its movable axis, thereby swinging said movable device and carrying said clamps and material between the making of the stitches diagonally little by little of said longitudinal movement.

31. In a button-hole machine the following combination of instrumentalities, viz: a clamp-plate movably supported; a cam movably supported; an adjustable connecting device which is mechanically movable between said cam and said clamp-plate; means for moving said cam little by little, whereupon, said clamp-plate is moved in a direction which is crosswise of a button-hole slit a certain distance little by little through said adjustable device which is mechanically movable between said cam and said clamp-plate, whereupon, a button-hole of a certain width is sewed; means, whereupon, said connecting device between said cam and said clamp-plate may be manually adjusted, or moved and secured in another position, whereupon, said clamp-plate is automatically moved little by little a greater or less distance than it is moved before said device is manually adjusted, whereupon, a button-hole of a different width may be sewed.

32. In a button-hole machine the following combination of instrumentalities, viz: a stationary support; a cam having three cam-faces, rotatably mounted upon a bearing beneath said stationary support; a clamp-plate movably mounted upon said stationary support; a movable connecting device between one of said cam-faces and said clamp-plate; a pin, or pivotal stud by which said clamp-plate is pivoted to a part of said movable device, thereby forming a movable axis; a spring for holding a part of said movable device against said cam-face, whereupon, said clamp-plate is held in position and moved upon said stationary support; another movable connecting device between one of said cam-faces and said clamp-plate, a part of which is movably connected with said clamp-plate; a spring also for holding a part of this device against said cam-face, whereupon, said clamp-plate is held in position, guided and moved upon said stationary support; a suitable device for automatically moving said cam little by little upon its bearing or support, whereupon, said clamp-plate, clamps and material are moved little by little at a certain speed while the straight side and angular part of a button-hole slit are being sewed; a device connected with another of said cam-faces, whereupon, the speed of the clamp-plate is automatically changed while the circular part of a button-hole slit is being sewed.

33. In a button-hole machine the following combination of instrumentalities, viz: a stationary support; a cam having three cam-faces rotatably mounted upon a bearing beneath said stationary support; a clamp-plate movably mounted upon said stationary support; a movable connecting device between one of said cam-faces and said clamp-plate; a pin or pivotal stud by which said clamp-plate is pivoted to a part of said movable device, thereby forming a movable axis; a spring for holding a part of said movable device against the cam-face, whereupon, said clamp-plate is held in position and moved upon said stationary support; another movable connecting device between another of said cam-faces and said clamp-plate, a part of which is movably connected with said clamp-plate and a part of which is connected with said cam-face; a spring also for hold-

ing the part of this device against the cam-face, whereupon, said clamp-plate is held in position, guided and moved upon said stationary support; devices, whereupon, stitches are formed mounted upon a journal supported above said clamp-plate; devices, whereupon, stitches are formed mounted upon a journal supported beneath said clamp-plate to coöperate with the devices, whereupon, stitches are formed above said clamp-plate; suitable means for vibrating the devices, whereupon, stitches are formed; a suitable device for automatically moving said cam little by little upon its bearing or support, whereupon, said clamp-plate, clamps and material are moved little by little longitudinally and diagonally of a button-hole slit in a material held in a pair of clamps while the straight side and angular part of a button-hole slit are being sewed, and whereupon, said journals are turned while the circular part of a button-hole slit is being sewed; a device connected with another of said cam-faces, whereupon, the relative speeds of the clamp-plate and the turning stitch-forming devices are such that the proper number of stitches are made in the eye of a button-hole slit while the circular part of a button-hole slit is being sewed.

34. In a buttonhole stitching machine, the combination with workholding and stitch-forming devices, of an automatic start-and-stop-motion mechanism, and automatic means for storing up power, during the operation of stitching a buttonhole, to be utilized to release said start-and-stop-motion mechanism, to set the said stitch-forming devices in motion.

35. In a buttonhole stitching machine, the combination with work-holding and stitch-forming devices, of an automatic cutter, means for operating the same to cut the buttonholes, an automatic clamp-advancing mechanism, and automatic means for storing up power, during the operation of stitching a buttonhole, to be utilized to actuate said cutter and said clamp-advancing mechanism to cut a buttonhole and then shift or advance the clamp from cutting position to stitching position.

36. In a buttonhole stitching machine, the combination with work-holding and stitch-forming devices, of an automatic buttonhole cutter, and means for operating the same, an automatic start-and-stop-motion mechanism, and automatic means for storing up power, during the operation of stitching a buttonhole, to be utilized to actuate said cutter and to release said start-and-stop-motion mechanism to set the said stitch-forming devices in motion.

37. In a buttonhole stitching machine, the combination with work-holding and stitch-forming devices, of an automatic cutter, means for operating said cutter, an automatic clamp-advancing mechanism, an automatic start-and-stop-motion mechanism, and automatic means for storing up power, during the stitching of a buttonhole, to be utilized to actuate said cutter, shift or advance the clamp from cutting position to stitching position and then release the start-and-stop-motion mechanism to set the said stitch-forming devices into action.

38. In a sewing machine, the combination with a stitch-forming mechanism, of a start-and-stop-motion mechanism serving to arrest the operation of the stitch-forming mechanism when a group or a predetermined number of stitches has been formed, automatic means connected with the stitch-forming mechanism, for storing up power during the stitching operation, and means for releasing the stored up power while the stitch forming devices are inactive so that such stored up power may be utilized to perform an operation independently of the stitch-forming mechanism and before the latter is set in action by the said start-and-stop-motion mechanism.

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