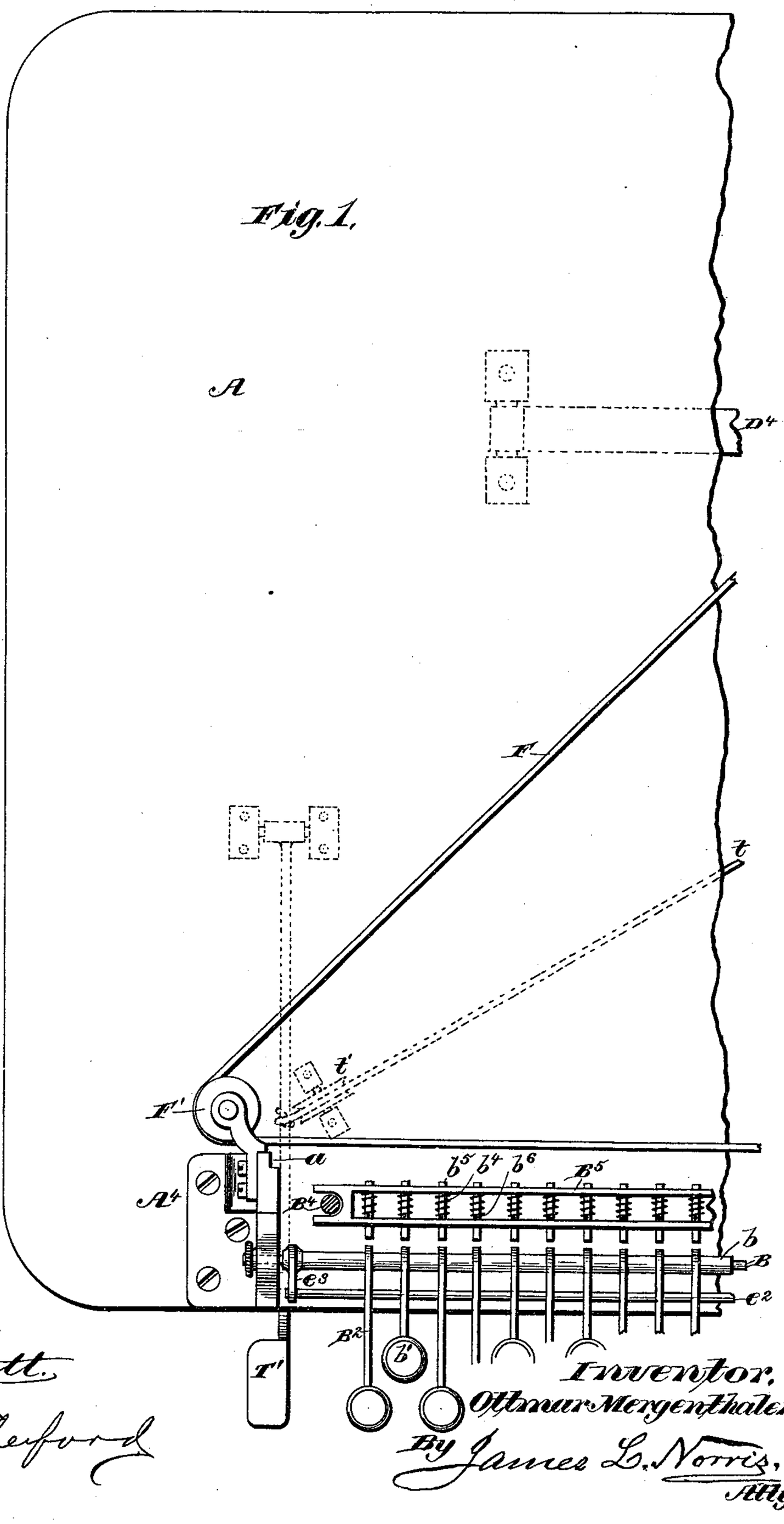
(No Model.) 7 Sheets—Sheet 1.

O. MERGENTHALER.

MACHINE FOR FORMING TYPE MATRICES.

No. 332,354. Patented Dec. 15, 1885.

Fig. 1.



Witnesses,
Robt Everett.
J. A. Rutherford

Inventor,
Ottmar Mergenthaler.
By James L. Norris,
Atty

(No Model.)

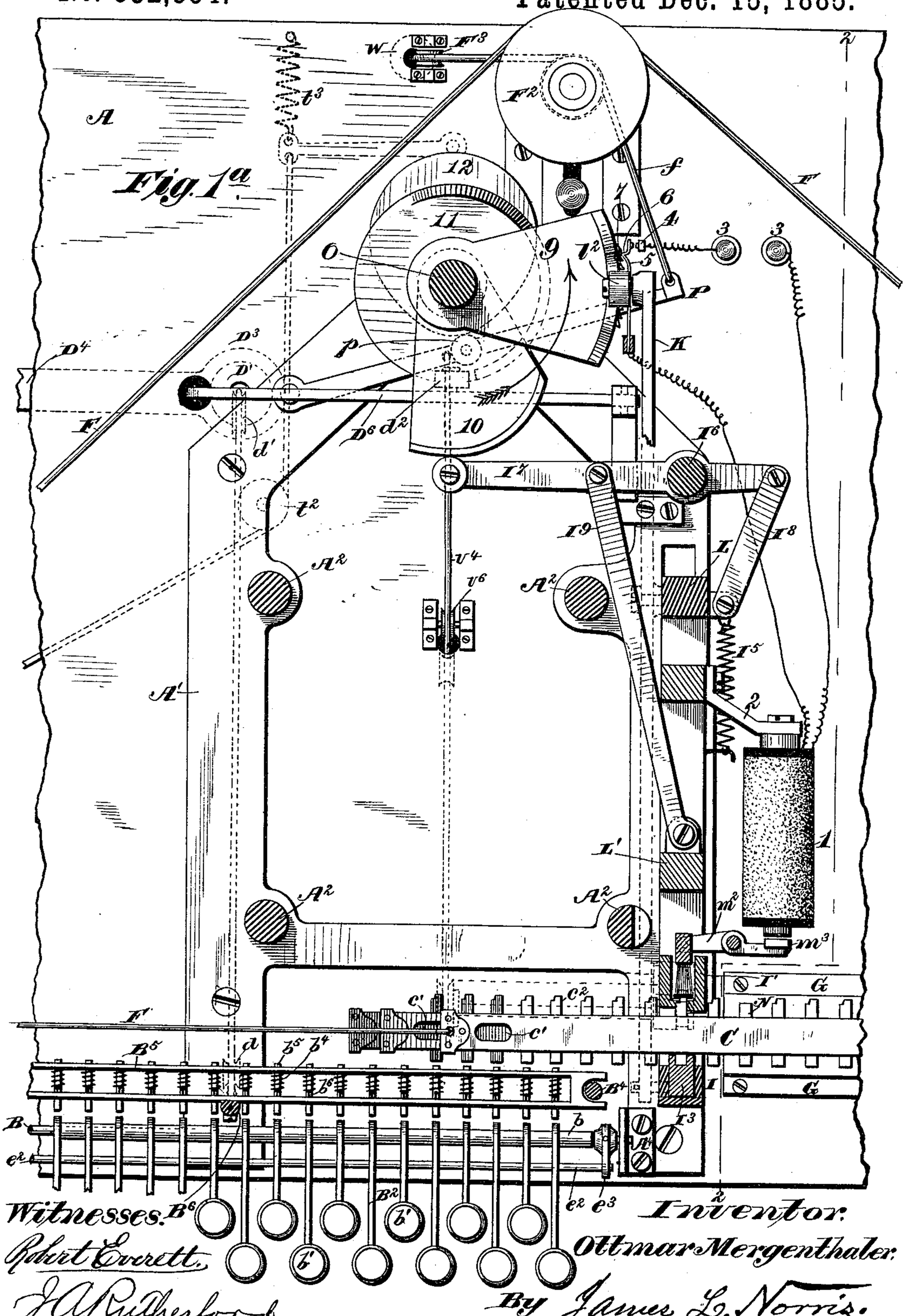
7 Sheets—Sheet 2.

O. MERGENTHALER.

MACHINE FOR FORMING TYPE MATRICES.

No. 332,354. Patented Dec. 15, 1885.

Fig. 1a.



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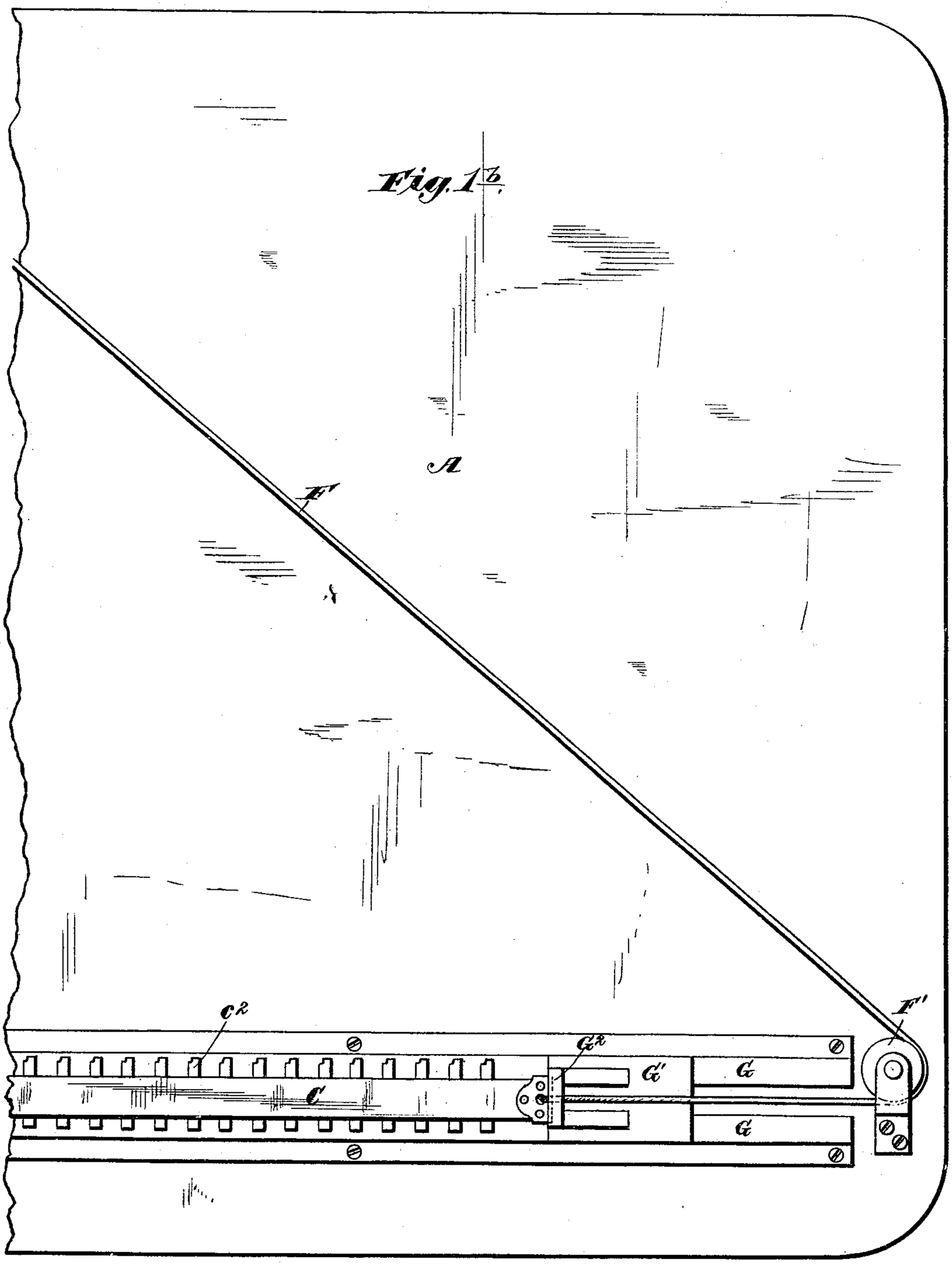
(No Model.) 7 Sheets—Sheet 3.

O. MERGENTHALER.

MACHINE FOR FORMING TYPE MATRICES.

No. 332,354. Patented Dec. 15, 1885.



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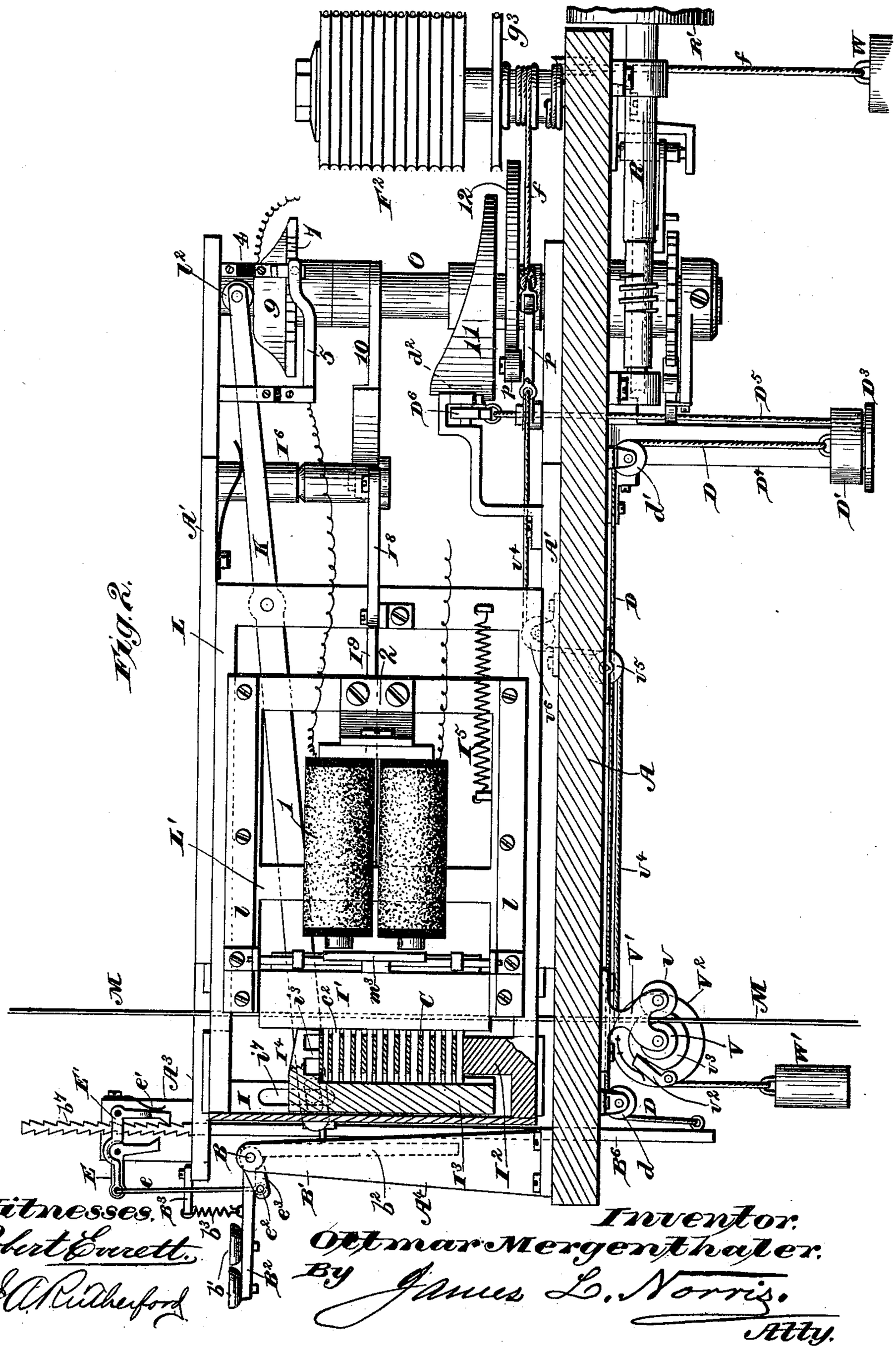
(No Model.)

7 Sheets—Sheet 4.

O. MERGENTHALER.

MACHINE FOR FORMING TYPE MATRICES.

No. 332,354. Patented Dec. 15, 1885.



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(No Model.)

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O. MERGENTHALER.

MACHINE FOR FORMING TYPE MATRICES.

No. 332,354. Patented Dec. 15, 1885.

Fig. 3.

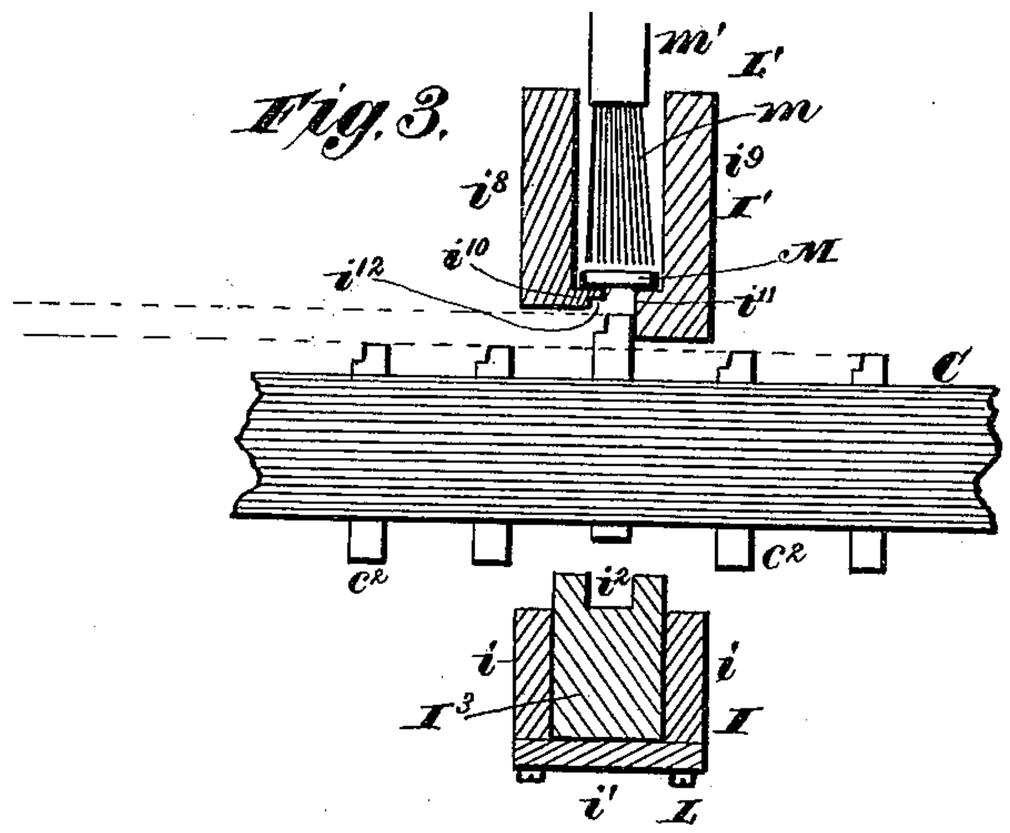


Fig. 4.

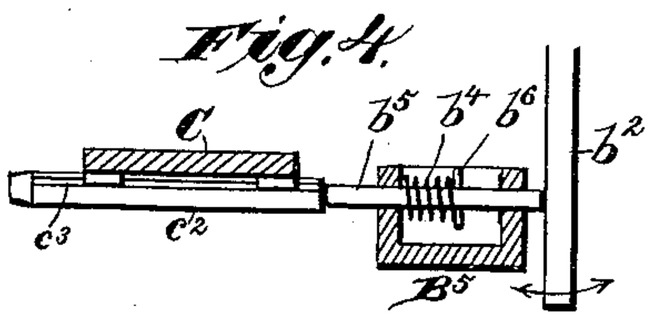


Fig. 5.

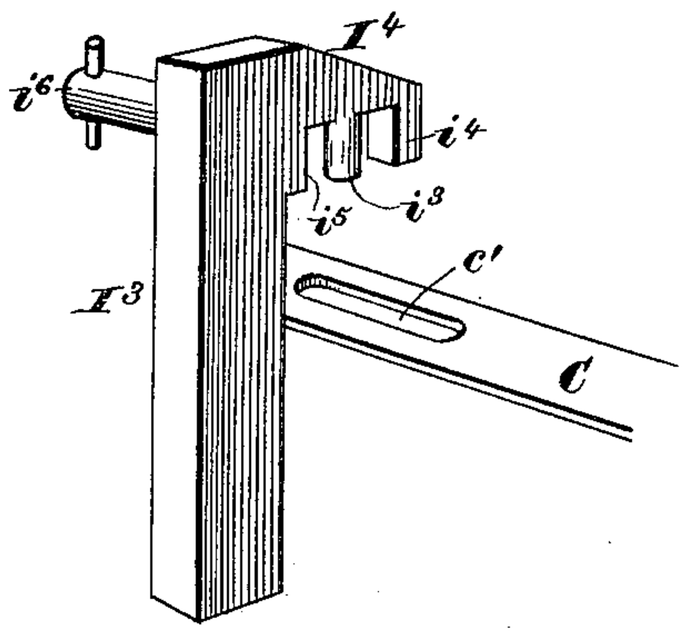


Fig. 6.

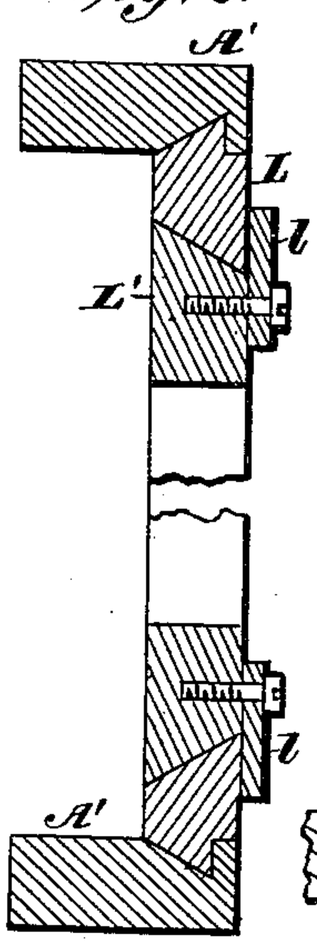


Fig. 7.

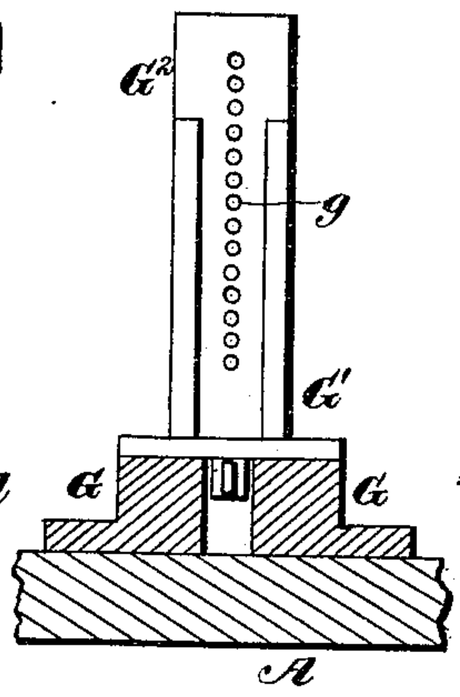
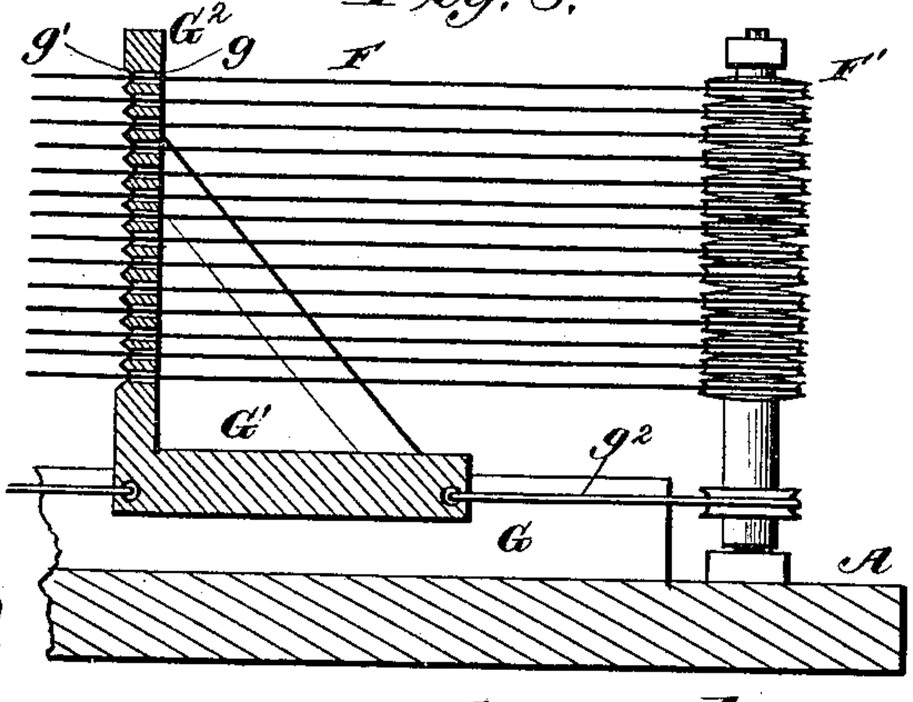


Fig. 8.



Witnesses.
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O. MERGENTHALER.

MACHINE FOR FORMING TYPE MATRICES.

No. 332,354. Patented Dec. 15, 1885.

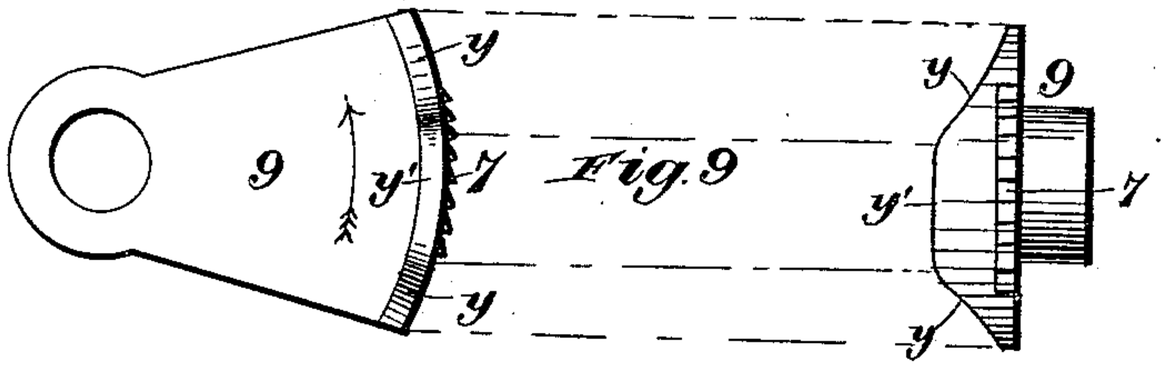

Fig. 9

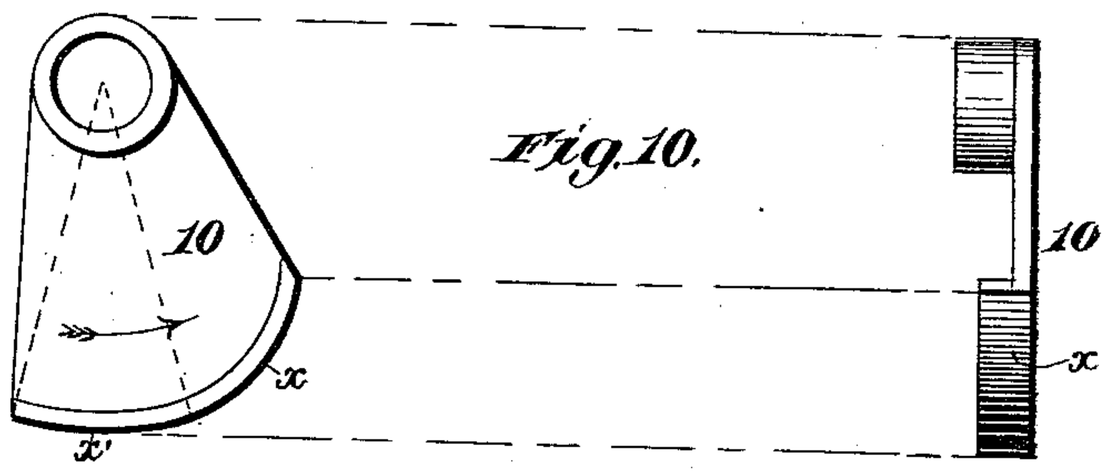

Fig. 10.

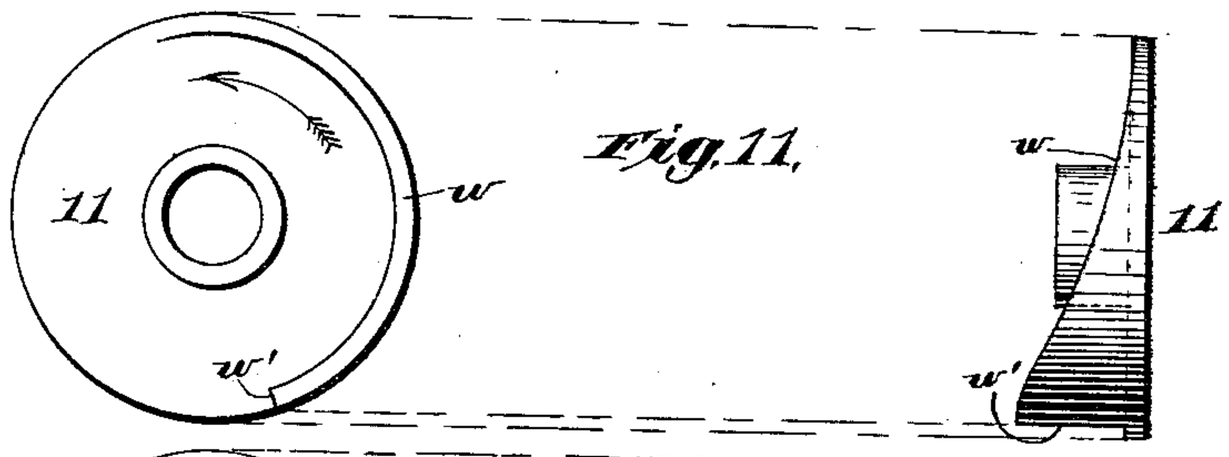

Fig. 11.

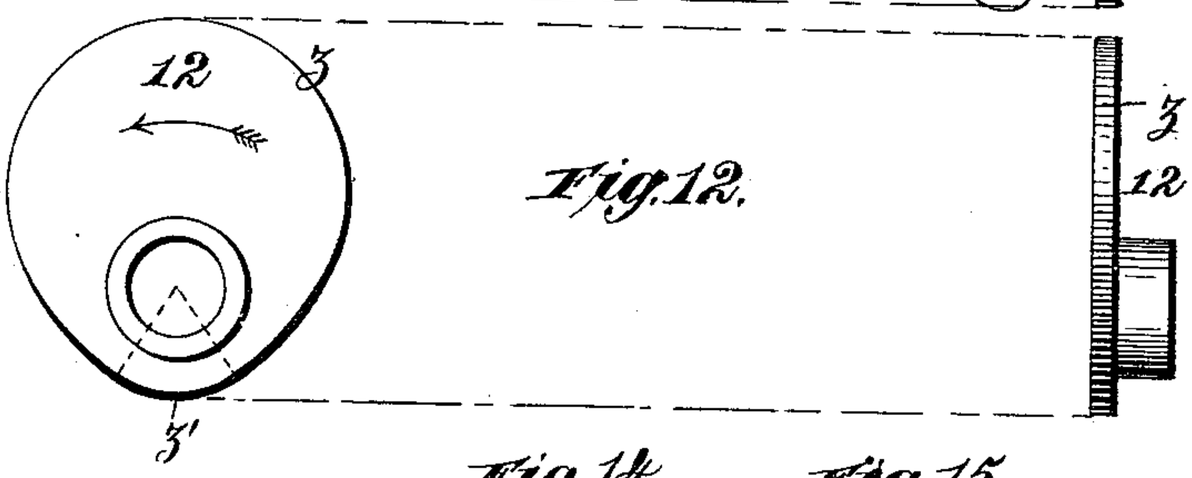

Fig. 12.

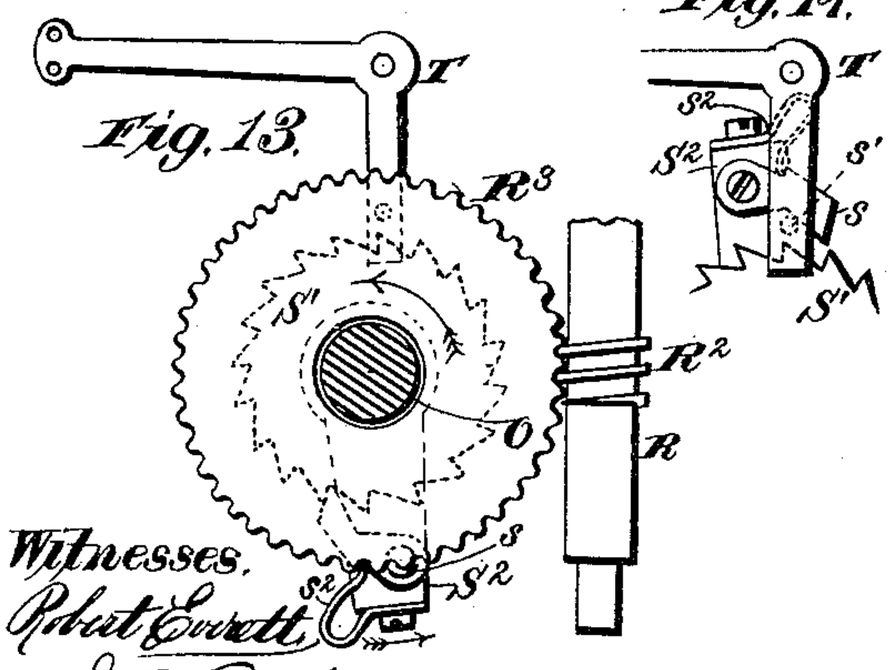

Fig. 13.

Fig. 14.

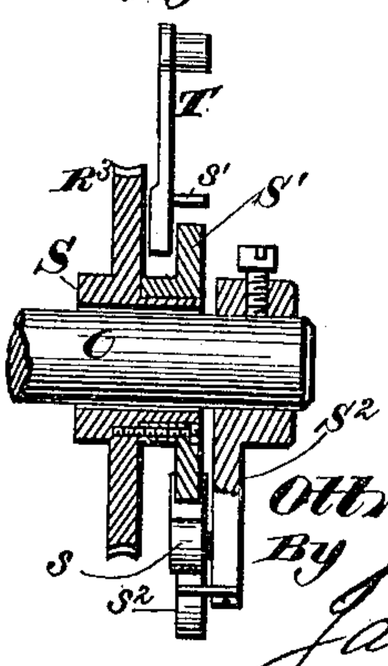

Fig. 15.

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(No Model.) 7 Sheets—Sheet 7.

O. MERGENTHALER.

MACHINE FOR FORMING TYPE MATRICES.

No. 332,354. Patented Dec. 15, 1885.

Fig. 16.

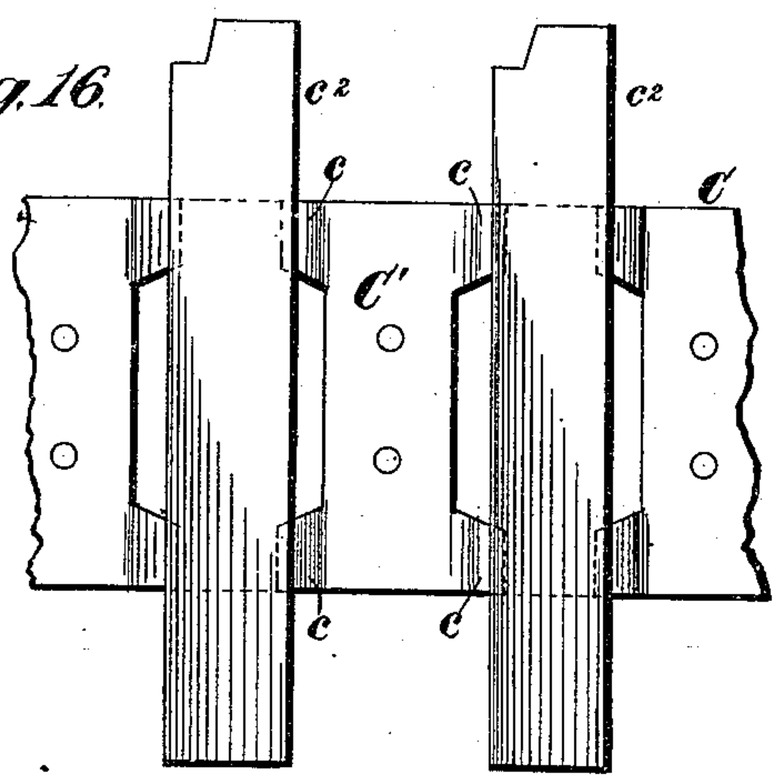


Fig. 17.

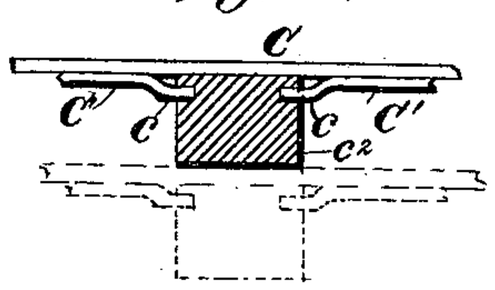


Fig. 18.

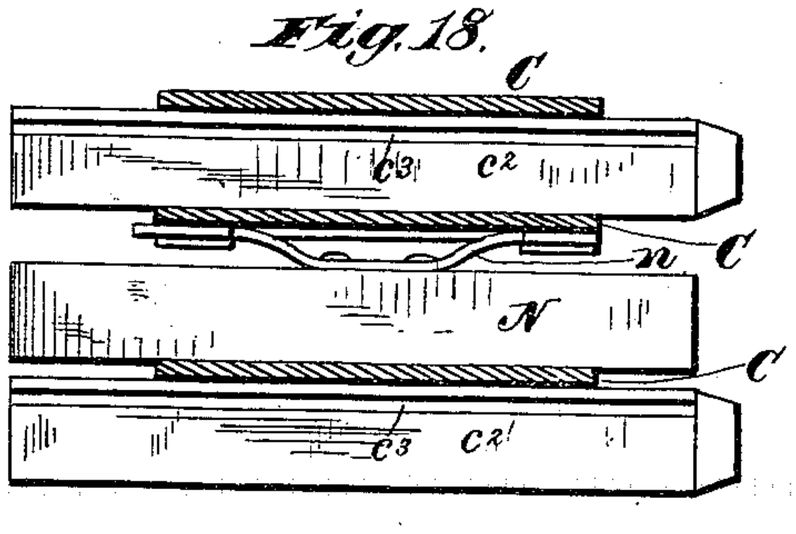


Fig. 19.

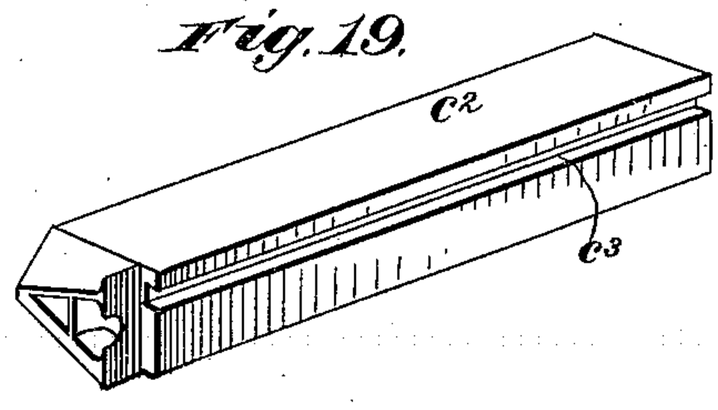


Fig. 21.

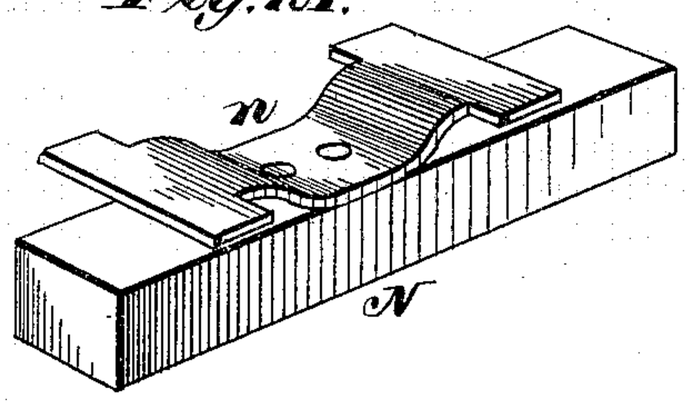
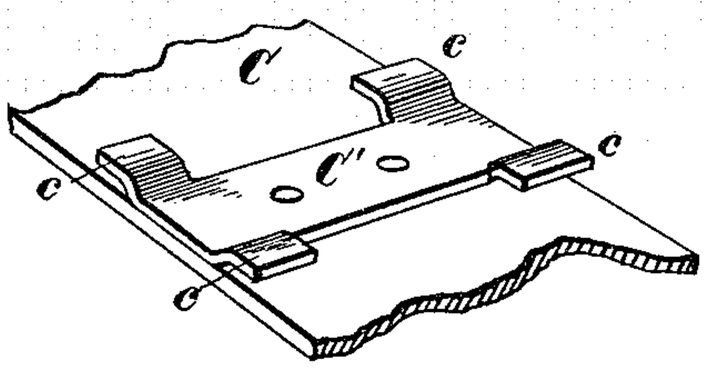


Fig. 20.



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Inventor.
Ottmar Mergenthaler.
By James L. Norris.
Atty.

UNITED STATES PATENT OFFICE.

OTTMAR MERGENTHALER, OF BALTIMORE, MARYLAND, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE NATIONAL TYPOGRAPHIC COMPANY, OF WASHINGTON, DISTRICT OF COLUMBIA.

MACHINE FOR FORMING TYPE-MATRICES.

SPECIFICATION forming part of Letters Patent No. 332,354, dated December 15, 1885.

Application filed June 27, 1883. Serial No. 99,328. (No model.)

To all whom it may concern:

Be it known that I, OTTMAR MERGENTHALER, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented new and useful Improvements in Machines for Forming Type-Matrices, of which the following is a specification.

My invention relates to those machines which are employed for producing type-impressions on a strip or strips of paper or other flexible or pliable material designed for use as a matrix for stereotypes; and it consists in an improved construction and combination of various elements, which will be hereinafter fully described, and specified in the claims.

My invention relates more particularly to the class of machines shown in an application for Letters Patent filed by me upon the 15th day of March, 1883, and has for its object to produce type-impressions upon a plastic strip by means of mechanism whereby any desired number of types may be successively selected and spaced and the entire series simultaneously impressed upon the plastic strip, instead of making a series of successive single impressions and spacing by the feed movement of the plastic strip, each impression giving a matrix representing a single line of justified matter or an integral part of said line.

My invention also has for its object to produce a single continuous impressed strip, which may be used as a matrix for a stereotype-mold, the type impressions and spacing being effected by the printing mechanism in such manner that at each action upon the plastic strip a full line or some integral part of a full line of justified matter is impressed thereon.

My invention also has for its object to provide means for automatically selecting the required type, bringing them into alignment with the strip, and after the impression is effected releasing and restoring said type to their original positiou in readiness for a new selection; also, to combine with the impressing mechanism any desired number of type-strips, each carrying a series of independent types and quadrats or spacing-blocks, said strips being adapted to shift longitudinally to bring the selected types into alignment, and mechanism for locking the latter together, the quadrats being provided with elastic connections interposed between them and the adjacent types, whereby the operation of the locking mechanism justifies the entire line by the yield of the elastic connections upon the quadrats; also, to combine with the mechanism for locking the selected types, devices for impressing the plastic strip upon the faces throughout the entire line simultaneously by rapidly-repeated impactions upon the rear face of the matrix-strip; also, to combine with the type-strips, each carrying a series of independent types and quadrats, a corresponding series of selecting-pins, which are brought opposite each type-strip successively, a series of keys which throw the pins against the types, and feeding mechanism by which the selecting-pins are between each selection brought into position to engage with the types in the strip next succeeding; also, to provide mechanism whereby after the selection of type in each type-strip is effected the whole number of type-strips are shifted, and the selected types brought into alignment with each other and with the plastic matrix-strip, and after the impression is made are again shifted to their original position, in readiness for a new selection and impression; also, to produce automatic mechanism whereby an entire line or an integral part of an entire line of matter may be set up with the proper spacings and other symbols used in printing, the selected types and space-blocks be brought into alignment, the entire line justified and locked in position to impress a plastic matrix-strip, the impression be taken, the types unlocked, and the type-carrying devices restored to a position for the next succeeding selection and impression, the type-selecting pins and the plastic strip being fed or advanced between each type-selection and line-impression, respectively.

Figures 1, 1ª, and 1ᵇ represent a top plan view of the apparatus, the parts being broken at the limits of each sheet. Fig. 2 is a transverse vertical section taken in the plane 2 2, Fig. 1ª. Fig. 3 is a horizontal section showing part of the type aligning and supporting devices with a single type-carrying

strip, the parts being enlarged for clearer illustration. Fig. 4 is a detail section enlarged, showing a single type-strip, the type-selecting pin with its support, and part of the key operating said pin. Fig. 5 is a detail perspective showing part of the type-locking devices. Fig. 6 is a vertical section illustrating the construction of the frame carrying the type-aligning and matrix-impressing mechanism. Fig. 7 is a transverse section, and Fig. 8 is a longitudinal section, showing the carrying-pulleys and the support for the cords which shift the type-strips. Fig. 9 is a face view and an edge elevation of the cam actuating the type-locking and line-justifying devices. Fig. 10 is a similar view of the cam which actuates the sliding frame carrying the type aligning and supporting devices together with the matrix-impressing mechanism. Fig. 11 is a similar view of the cam which raises the weight by which the type-selecting pins are fed over the type-strips during each selection. Fig. 12 is a similar view of the cam actuating the devices which shift the type-strips and advance the matrix-strip between each line-impression, each of the four cams illustrated in the figures last named being shown in their true relative position. Fig. 13 is a detail elevation of the worm shaft and gear by which motion is communicated from the main shaft to the cam-shaft, the ratchet and pawl and pawl-tripping devices being indicated by dotted lines. Fig. 14 is a detail of the pawl-tripping device shown in Fig. 13. Fig. 15 is a central vertical section of Fig. 13. Fig. 16 is a detail plan view of part of one of the type-strips, showing the under surface of said strip with the type connected. Fig. 17 is a central section taken longitudinally with the strip and transversely to the type in Fig. 16, the relative positions of the type-strips being indicated by dotted lines representing a second strip beneath the first. Fig. 18 is a cross-section showing the two type-strips with the type connected, the intermediate strip being represented as carrying a quadrat having elastic connection with the same. Fig. 19 is a detail perspective of a single type detached from the strip. Fig. 20 is a detail perspective of one of the strips, showing the device by which the quadrat is connected therewith. Fig. 21 is a detail perspective of a single quadrat or spacing-block with the elastic device whereby it is attached to the supporting-strip.

In Figs. 16 to 21, inclusive, the parts are enlarged for the purpose of illustration.

In order to simplify the description of my invention, I will take each part as nearly as possible in the order of its operation, and having shown the construction and pointed out the function of the devices separately I will append a sufficient description of the operation as a whole to give a clear understanding of the same.

A in the drawings indicates the foundation upon which the operative parts are supported, consisting of a flat horizontal slab of suitable dimensions. Near its center is arranged a frame, A′, having its upper and lower sections connected by the rods A^2, the lower section being securely bolted to the foundation A.

Near the front edge of the table A, upon one side of its central point, is placed a shaft, B, supported by standards B′ B′, having a height nearly equal to that of the frame A′. This shaft B carries a series of keys, B^2, arranged at equal intervals and separated by intervening sleeves *b*. Each key is provided with a finger-plate, *b*′, having an alternate arrangement, as shown in Figs. 1 and 1ª, to secure economy of space, and has a downwardly-extending arm, b^2, (see Fig. 2,) of a length somewhat greater than that of the arm carrying the finger-plate *b*′. A strip, B^3, screwed to the plate A′, serves as an attachment for a series of spiral springs, b^3, which are connected with each key, and by which the latter are normally raised, thereby throwing the downwardly-extending arm b^2 toward the rear.

Behind the shaft B are placed vertical standards or guides B^4, (shown in Figs. 1 and 1ª,) which serve to support a vertically-moving frame, B^5, formed of two parallel strips having an open notch in each end to receive the standards B^4. Between the strips of said frame are placed spiral springs b^4, surrounding pins b^5, the latter having horizontal arrangement and passing completely through both strips of the frame. One end of the springs b^4 bears against the rearward strip of the frame B^5, and the other against a detent, b^6, upon each pin b^5, whereby the latter are normally thrown toward the arm b^2 of the keys, the detents b^6 serving to limit the movement of the pins in that direction. The number of pins in the frame B^5 is equal to the whole number of keys upon the shaft B, and the pins are placed at such intervals that they are exactly opposite said keys. By operating the latter, which is done by depressing the finger-plates *b*′, the arms b^2 are thrown against the ends of pins b^5, and the latter are projected toward the rear against the tension of the springs b^4, as shown in Fig. 4, the pins sliding easily in the perforations in the parallel strips of the frame B^5.

The spring-actuated pins, operated by the keys in the manner described, are used in the selection of the type from the type-carrying strips, which are shown in Figs. 1ª and 1ᵇ, and in detail enlarged in Figs. 16, 17, and 18. Each strip C consists of a long plate of metal having a width equal to a little more than half the length of the type. Upon the under surface of each strip are secured transverse supporting-plates C′ C′, (see Figs. 16 and 17,) having nibs *c c* at each end adapted to enter grooves c^3 in the body of the type c^2, whereby the latter are supported in such manner that one side of the type lies closely against the strip C, at the same time permitting the type to slide freely transversely of the strip. Each strip is provided with a sufficient number of type to represent the entire alphabet, not only

in capitals, but in "lower case," as well as the usual punctuations, and at least one quadrat. These are arranged at equal intervals upon the strip C, the spaces between each being equal to the distance between the type-selecting pins b^5, whereby the latter when actuated by the keys are caused to strike the bottom of the type-body and project the latter slightly toward the rear of the machine. The type-strips C, each provided with its full complement of types, as already described, are arranged one upon the other, as seen in Figs. 17 and 18. Any desired number of such strips, parallel with each other, may be used, the arrangement being such that, beginning with the lower strip, a single type, mark, or quadrat may be selected from each strip in succession, the selected type reading upward. The number of type-strips used may be varied to any desired degree.

In order to effect the selection of the type in the order mentioned, the vertical arms of the keys are extended downward, as shown in Fig. 2, until their extremities are in the plane of the lower type-strip. There being a single series only of type-selecting pins b^5, the latter are so arranged as to have vertical adjustment with a step-by-step movement, each step being equal to the distance between the adjacent type-strips. This feed of the type-pins is accomplished by the means and in the manner following: The type-pin frame B^5, guided by the vertical standards B^4, is supported by a rod, B^6. (Shown in Figs. 1ª and 2.) This rod has bearings in the upper and lower plates, A′ A′, and extends above and below the same, an eye being attached to its lower end to receive a cord, D, running over sheaves d and d', and provided at its end with a weight, D′. The action of this weight tends to raise the rod B^6 vertically in its bearings, thereby carrying the type-pin strip continuously upward. The step-by-step movement is obtained by the following devices: The upper portion of the rod B^6 is toothed upon two opposite sides, the distance between any two adjacent teeth being equal to the interval between the successive type-strips, and therefore measuring the length of each step or feed movement of the type-pin strip. These teeth or serrations b^7 are so formed that those upon one side of the rod alternate with those upon the other side, their longer edges being divergent upwardly. Upon the upper plate, A′, and upon each side of the rod B^6, is mounted a standard, A^3, furnishing pivotal support for two levers, E and E′, each having the form of a bell-crank. Each lever is pivoted at its angle to the standards A^3, each having a horizontal and a vertical arm, the vertical arms being arranged one upon each side of the rod B^6 and opposite the serrated face. The vertical arms are of unequal length, the difference being equal to the interval between the successive serrations, and upon the lower end of each is formed a tooth, adapted to engage with the serrations b^7 of the rod. The latter being alternated, as already described, it will be seen that when either one of said arms is in engagement with the rod B^6 the other will be out of contact with its tooth, lying midway between the notches b^7. The upper arms of the levers E E′ extend from their pivotal points over the keys B^2 and terminate at the same point, an eye being formed in the extremity of each to receive a connecting-rod, e. A leaf-spring, e', mounted upon one of the standards A^2, bears upon the rear of the vertical arm of the lever E′, and normally retains its tooth in engagement with the serrated rod B^6, at the same time holding the horizontal arms of both levers up in the position shown in Fig. 2. The lower end of the connecting-rod e is attached to a bar, e^2, carried by links e^3 e^3, pivotally mounted upon the ends of the shaft B, the bar e^2 being arranged just beneath the keys B^2.

The operation of these parts is as follows: Let it be supposed that the type-pin series is in the plane of the lower type-strip. Having ascertained what type should be selected therefrom, the corresponding key (indicated by the type-symbol upon the finger-plate b') is operated, thereby projecting the type-pin and pushing the selected type partly out of rank with the other members of the series in which it stands. The depression of the key B^2 at the same moment draws the bar e^3 downward, thereby, through the connecting-rod e, operating the levers E and E′ simultaneously, disengaging the toothed arm of the latter from the serrated rod B^6, and at the same moment throwing the toothed arm of the lever E against the opposite side of the said rod. The latter being now free to move, rises until it is arrested by the tooth upon the lever E, at which moment the key B^2 is depressed to its lowest point. The finger of the operator being now removed, the spiral spring b^3 raises the depressed key, the leaf-spring e' throws the toothed arm of the lever E out of the notch with which it has engaged, and at the same moment pushes the toothed arm of the lever E′ back against the rod. The latter, being released by the withdrawal of the toothed lever E, again rises until it is arrested by the lever E′, the feed movement being thus accomplished by two separate steps, each being one-half the length of the required adjustment. It will readily be seen that at each depression of any one of the keys by which the selecting-pins are operated the type-pin series is advanced a single interval, bringing it into the plane of the succeeding type-strip from which the next selection is to be made. It should be noted that in practice the serrations b^7 in the rod B^6 are cut of such depth that the arm b^2 of the key will fully actuate the type-pins before the toothed lever E′ is fully withdrawn from the notch with which it engages, thereby delaying the rise of the type-pin series until the type selection is completed. Each type-strip C is supported by a strong cord, F, having its ends attached to each extremity of the strip. Near each end of the platform A is placed a sheave, F′, over which the cord passes. These

sheaves are so arranged that the cords F run in rear of and parallel with the type-pin series, and from the said sheaves F′ F′ the cords pass over a driving-roll, F^2. This roll is grooved, as shown in Fig. 2, and by operating it in one direction the cords F will shift all the type-strips until they lie directly behind the type-pins b^5. The ends of said strips abut against a shoulder, *a*, formed in the standard A^4, upon which the sheave is mounted, and are thereby brought into accurate position for the type-selection.

The mechanism whereby the strips are automatically shifted in both directions will be described hereinafter.

At the end of the platform A opposite that at which the type-pins are placed I arrange guideways G G, parallel with each other, having a narrow interval between. Upon these ways is mounted a traveling support, G′, having a central strip entering the space between the guides, and having a vertical standard, G^2, pierced at intervals with openings *g*, to receive the cords F, and having transverse channels or notches *g′* cut in its outer face and registering with each aperture *g*.

To each end of the lower portion, G′, is attached a strong cord, g^2, passing over a roll upon each of the shafts carrying the sheaves F′ F′, and over a roll, g^3, upon the shaft of the actuating-roll F^2. The function of this traveler is as follows: When the type-strips C are shifted to position behind the type-pins, the post or standard G^2 is drawn by its cord to abut against their ends, which enter the transverse channels *g′*, formed in said standard, and receive vertical support therein. The type-carrying strips C shift in the direction of their length between two vertical bars, I and I′, each forming part of two rectangular frames, L and L′, respectively, and said strips pass over a block, I^2, which forms part of the frame L.

The device last named consists of a rectangular structure set vertically in grooved ways cut longitudinally in the right side of the upper and lower plates A′, as shown in Fig. 6, said frame having a sliding movement in the direction of its length. The block I^2 rises from the lower bar of the frame L, near its forward end, and is of such height that when the type-strips are shifted in either direction its end will clear the type upon the lower strip by a short interval. The forward vertical bar of the frame L is composed of two parallel plates, *i i*, with a plate, *i′*, detachably secured to their forward edges and closing the opening between them. The space thus formed is occupied by a clamping-bar, I^3, which, by mechanism hereinafter described, has vertical movement within the space formed by the plates *i* and *i′*. This bar, which is shown in detail in Figs. 3 and 5, has a vertical rectangular channel, i^2, formed in its rear edge, said channel being of such width as to admit the bottoms of the types, and the said channeled edge projects from the block I far enough to carry the bottom of the channel i^2 a very little beyond the rear edges of the plates *i i*. The upper end of the clamping-bar I^3 is provided with a rearwardly-projecting arm, I^4, having a portion of its lower edge cut away, leaving a central depending stud, i^3, with an open space upon each side, bounded by short vertical faces i^4 and i^5, the distance between the latter being equal to the width of the type-strips C. Upon one side of the clamp-bar I^3, near its upper end, is a pin, i^6, which engages with an actuating-lever, K, presently to be described, said pin projecting through a vertical slot, i^7, in one of the plates *i*. It should be noted that the bar I, with its inclosed clamping-bar I^3, stands opposite the rear ends of the types, while the bar I′ stands in the same vertical plane opposite the faces of the types carried by the strips C. The bar I′ forms the forward vertical part of the second frame, L′, which slides within the frame L, the horizontal bars of the latter being beveled in opposite directions, while the horizontal bars of the frame L′ have outer metallic strips, *l l*, attached thereto and lapping over upon the bars of the frame L, thereby confining the former within the latter, and at the same time permitting each to slide independently. The bar I′ is composed of two vertical and parallel plates, i^8 and i^9, separated by a space about equal to the width of the matrix-strip, which is fed between them. Upon the forward edge of each plate, respectively, is an inwardly-projecting flange, i^{10} and i^{11}, forming a support for the margin of the matrix-strip M. The flange i^{11} upon the strip i^9 is considerably thicker than the flange i^{10}, and the vertical edge of the plate i^9 lies nearer the type-strips than the edge of the plate i^8, the difference being equal to the height at which the type-face stands above the type-shoulder. The distance between the inner edges of the flanges i^{10} and i^{11} is also equal to the height of the type-faces, thereby exposing only that portion of the matrix-strip upon which the types act. The outer and inner edges of the flange i^{10} are cut away, as shown at i^{12}, Fig. 3, to permit the body of the type to pass beyond the former, and allow the face of the type to project beyond the inner faces of the flanges upon which the matrix-strip rests, in order to produce the required impression upon the latter. The frames L and L′, as already described, slide, the former within grooves in the plates A′ A′, and the latter within the first-named and larger frame. Their movement, which is simultaneous, is such as to cause the bars I and I′ to approach and recede from each other alternately. Normally these bars are held at their widest interval of separation by a coiled spring, I^5, having one end fastened to the rear of the frame L and the other end to a pin upon the frame L′. They are moved toward each other by the following mechanism:

Upon the lower side of the upper plate A′ is placed a drop-bearing, I^6, upon which is pivoted a lever, I^7. To this lever, and upon opposite sides of its fulcrum, are pivoted con-

necting-rods I^8 and I^9, the former being attached to the frame L and the latter to the frame L′. The projecting end of the lever carries a friction-roll, which engages at regular intervals with a cam, 10, upon the cam-shaft O. This cam is shown in detail in Fig. 10. It has a cam-surface, *x*, by which the throw of the lever I^7 is effected, and a surface, *x′*, formed in the arc of the circle described from the axis of the cam-shaft, upon which the friction-roll rides, holding the lever motionless until the roll rides off. The action of the lever, as will be seen from Fig. 1ª, pushes the frames in opposite directions, causing the bars I and I′ to approach each other until they occupy the position shown in Fig. 1ª.

The function of the bars I and I′ is as follows: When the type-strips have been shifted to the extreme left, and when the selection of type and spacings has been completed, beginning with the lower type-strip and taking a single type or a single quadrat from each strip in succession, it becomes necessary to bring the selected type into vertical alignment with each other and opposite the matrix-strip in preparation for the impression to be made upon the latter. For this purpose the type-strips are now shifted by mechanism hereinafter described toward the right. The bars I and I′ being at this time separated by the action of the spring I^5, there is sufficient interval between them to allow the passage of all those type which, not having been acted upon by the type-pins b^5, have not been projected out of rank. The selected type, however, having been pushed out toward the bar I′, will, after passing the plate i^8, strike the plate i^9, as shown in Fig. 3, arresting the movement of the type-strip in which said type is carried, the cord F, by which the strip is moved, slipping upon the actuating-roll F^2. As the shifting of the strip continues, the selected type will be brought one after another into the same vertical line, their tops abutting against the shoulder i^{11} upon the plate i^9. At this moment the cam 10 engages with the lever I^7, drawing the bars I and I′ toward each other, the bottoms of the selected types entering the channel i^2 in the clamping-bar I^3, which is carried by the bar I, and the faces of said type entering the space between the flanges i^{10} and i^{11} until their shoulders rest in the recess i^{12} in the flange i^{10}. As the bars continue to approach, the selected types are pushed back in the type-strips until they stand in rank with the others. The bars I and I′ now halt, the position of the parts being shown in Fig. 1ª. It will be seen that the selected types are firmly supported against all movement, either in the direction of their length or transversely thereto. Simultaneously with the locking of the types within the bars I and I′ they are clamped together by the descent of the clamping-bar I^3. This bar, as already mentioned, is actuated by a lever, K, pivoted to the rear bar of the frame L, and operated by a cam, 9, upon the cam-shaft O. This cam (shown in Fig. 9) is provided with two cam-surfaces, *y y*, and a holding-surface, *y′*, and is timed to act with the cam 10. As the first cam-surface, *y*, engages with the lever K, its slotted end, which is in engagement with the pin i^6 upon the bar I^3, is thrown downward, driving the arm I^4 against the upper type-strip and forcibly compressing the type brought into vertical alignment upon one another until the friction-roll upon the lever rides upon the holding-surface *y′*. While its friction-roll l^2 is traveling thereon the type are held clamped together and locked by the bars I and I′, as already described, and during this time the impression is made upon the matrix-strip. The quadrats or spacing-blocks carried in each type-strip are of usual form, as shown at N in Fig. 21. They are mounted upon or connected with said strips by means of plates *n* of elastic metal attached longitudinally, having their ends bent upward or away from the quadrat, and with a T-head upon each end, which engages with the nibs *c c* of one of the plates C′ upon the type-strip, allowing the quadrat to hang from the strip C with an interval between the two. The object of this construction will be explained hereinafter. In the selection of the type the quadrats are thrown out by the type-pins b^5 far enough to be brought into engagement with the bar I′, their ends lying in the line of the type-shoulders.

I have already mentioned in the opening part of this specification that one object of my invention is to provide mechanism whereby a single line or an integral part of a single line of matter may be set up, spaced, and then justified before the impression is made upon the matrix-strip.

Previous to my invention it has been customary to effect the successive impressions upon the strip and cut it into lengths, which were placed in justifying-plates, and the necessary spacing being added by hand, which greatly added to the labor and time required. In every line or part of a line of matter of a given length there will be an average of space, which, while it varies somewhat, will run closely to the average. It is evident that each space may be slightly increased or lengthened, provided the change is alike throughout the line, without attracting notice or affecting the regularity and beauty of the type arrangement. In this manner by slightly increasing or decreasing each space, room may be afforded for ending the line or for breaking the last word when it runs over at the proper point. Moreover, if a single line of matter is set up and the type-impressions taken simultaneously, it happens that, as some letters are of double the thickness of others, the line may not only have to be broken in the middle of a syllable, but that, as the strip is always fed the same distance by the machine in order to leave an equal interval between the lines, this interval might not only occur in the middle of a word, but in case the line was too full to admit more than a narrow letter the line would be broken

improperly and the several lines would be of unequal length. In the present invention I avoid all these difficulties by using space-blocks having an elastic connection intermediate between it and the type-strip. In setting up, the whole number of quadrats used in a single line being known, the operator can readily determine how much additional space will be afforded by the compression of their elastic attaching devices, and, as the clamping-bar by which this compression is effected always moves to the same point, it is easily known where to break a word or terminate a line. By reference to Fig. 18 it will be seen that as the type are selected and the end of the line reached the clamping-bar I^3, being brought down, will compress the spring-plates *n* upon each quadrat alike or to the same degree. Therefore, should the line comprise more double letters than the average, the spacings will be somewhat less than the average, and vice versa. Being alike, however, throughout the whole line, the appearance is uniform, and the difference will not be distinguishable by the eye. As the clamping-bar I^3 must always compress the line to the same length, it will be seen that when a considerable number of wide letters occur in the same line the whole number of type-strips cannot be used. In setting up the line the operator will readily determine what space must be allowed for any preponderance of such letters, and will, in proportion to their number, make no selection from the upper strip, or it may be from the two upper strips, of type. In order to provide for the compression of the selected types lying in the strips beneath, I slot the end of each strip C, as shown at *c'*, Fig. 1ª, and place no type on this portion. When the strips are shifted to align the selected types, those strips from which no selection has been made will be carried to the right far enough to bring their slotted ends beneath the clamping-arm I^4. As the latter descends the stud i^5 passes down through the slots *c'* (the plain faces i^6 and i^7 lying against each edge of the strip) until said stud strikes the upper strip from which a type has been taken. In this manner the compression is effected and the type clamped without disturbing the type-strips which are not used. After the selected types are locked between the bars I and I' and the clamping-bar I^3 in the manner already described the impression is made in the plastic matrix-strip in the manner following: The types being in the position named and shown in Fig. 1ª, their faces rest against the matrix-strip M, the ends of the types entering the recess in the bar I' a distance equal to the depth of the impression to be made in the strip. Resting against the rear face of the matrix-strip throughout that portion in contact with the types is an elastic body or substance, *m*, having equal contact with every part. As shown in the drawings, this substance is in the nature of a strip of metallic wires, closely placed together and carried by a strip, *m'*, which is mounted upon bars m^2, carried by a rock-shaft pivoted in bearings carried by the frame L'. Upon an arm rigid with said shaft is mounted an armature, m^3, and directly behind the latter is an electro-magnet, 1, carried by a bracket, 2, on the frame L', and so arranged that when the types are in position to give an impression the armature is withdrawn from contact with the poles of the magnet by the matrix being pushed backward by the types and tilting the bars m^2, as seen in Fig. 1ª. The wires of the helix pass from the battery through binding-posts 3 3, one of said wires being carried to a contact, 4, where the circuit is interrupted. Opposite this contact-point is a vibratory platinum strip, 5, having a detent or projection, 6, upon its back, which engages with serrations 7 upon the cam 9. As the latter revolves the platinum strip is brought by each tooth against the contact-point 4, thereby making the circuit and vitalizing the magnet, which instantly attracts the armature m^3, causing the brush *m* to be thrown against the back of the matrix-strip, which is thereby driven against the types. This operation is repeated at each make and break of the circuit until the type have been sunk into its plastic body to the required depth. It will be seen that as the number of teeth upon the cam may be increased or diminished, the number of impactions upon the matrix may be increased or decreased, and this number being the same at each impression the intaglio letters in the matrix will be of uniform depth throughout.

Instead of the metallic brush *m*, I propose to employ any other substance or body, whether of similar construction or not. Moreover, the repeated impact upon the strip may be obtained by other than electrical devices. The impression in the matrix is made while the friction-roll l^2 of the lever K is riding upon the surface *y'* of the cam 9, the roll upon the lever I^7 running during the same period upon the arc *x'* of the cam 10. As these rolls both ride off at the same moment, the clamping-bar I^3 rises and releases the type at the same time that the bars I and I' are separated by the action of the spring I^5. The type are thereby wholly released, and the parts are in condition to permit the type-strips to be shifted back behind the type-pins for the purpose of a new selection. The shifting of the type-strips is effected in the following manner: The cords F, which carry the strips C, are operated by a roll, F^2, which is rotated in one direction by a lever, P, pivoted to the lower plate A', the free end of said lever being attached to a cord, *f*, which is coiled on the shaft of the roll F^2, is thence carried over a sheave, F^3, and attached to a weight, W. The lever P is actuated by a cam, 12, upon the cam-shaft O. This cam is shown in Fig. 12, and has a continuous cam-surface, *z*, and a surface, *z'*, in the arc of a true circle struck from the axis of the shaft. As the cam rotates in the direction of the arrow, Fig. 1ª, the cam-surface *z* engages with

a friction-roll, *p*, near the middle of the lever P, throwing the lever slowly and steadily toward the front of the machine, and rotating the roll F^2 by the cord *f*, which at the same times raises the weight W. The moment the throw of the cam is complete its motion is arrested by devices which I am about to describe, leaving the type-strips shifted into position in rear of the type-pins, where they remain until the cam-shaft is again put in motion.

R represents the main shaft of the machine, carrying a belt-pulley, R′, which is driven continuously. Upon the shaft R is a worm, F^2, meshing with a worm-gear, R^3. This gear is formed upon a sleeve, S, loose on the cam-shaft O, and upon the cam-sleeve, and rigid with it, is a ratch, S′, a space being left between the latter and the worm-gear. Upon the lower end of the cam-shaft O is rigidly mounted an arm, S^2, carrying a pawl, *s*, which locks with the ratch S′ in one direction. When the pawl is in engagement with the ratch and the latter is rotated by the worm-gear, the arm S^2 will be carried around with it and the cam-shaft O will be revolved.

T represents a bell-crank lever, which is pivoted in a bearing beneath the table A, and has such arrangement that one end lies between the worm-gear R^3 and the ratch S, a pin, *s*′, being placed thereon in such manner that it projects over the ratch and in the path of the pawl *s*. As the latter rotates in engagement with the ratch it comes into contact with the pin, which, striking the inner edge of the pawl, tips it. The movement of the arm S^2 is at once arrested, and the cam-shaft thereby stopped, the pawl remaining upon the pin *s*′, by which it is supported above the teeth of the ratch. The parts are so timed that this takes place at the moment when the type-strips C are all shifted over behind the type-pins and in position for the selection of type for the next impression. By the tripping of the pawl the revolution of the cam-shaft O is arrested at this point, and the parts remain motionless until the selection is completed, when the strips are in readiness to be shifted toward the right to bring the selected types into alignment. To effect this, the operator presses a lever, T′, at the left of the keys, downward. This lever is pivoted beneath the platform A, and has a cord, *t*, attached to it and leading over sheaves *t*′ and t^2, with its end screwed to the bell-crank lever T. Tension upon this cord by the depression of the lever T′ rocks the lever T against the force of a spring, t^3, and draws the pin *s*′ from under the pawl *s*, causing it to again engage with the ratch S′ and start the cam-shaft O. The pawl *s* is thrown down by a leaf-spring, s^2, mounted upon the end of the arm S^2, and when the pin *s*′ is withdrawn from beneath it, the lever T being restored to its original position by the spiral spring t^3, the pin *s*′ strikes the back of the pawl and aids the spring in effecting its engagement with the ratch. The cam-shaft being started, the cam 12, which is holding the lever P upon its highest cam-surface, continues its rotation and slowly restores the lever to its original position, dropping the weight W, and causing a reverse movement of the roll F^2, thereby causing the cords F to shift the type-strips to bring the selected types into alignment. As each type comes in contact with the bar I′ the strip which carries it is arrested, the cord slipping upon the roll F^2. When the friction-roll upon the lever P reaches the surface *z*′ of the cam 12, the types will have been aligned, the bars I and I′ locking them in front and rear, the clamping-bar I^3 will have been forced down, and the impressing devices will begin to act, their operation continuing during the time said friction-roll traverses the surface *z*′, after which the cams 9 and 10 will release the types, and the cam 12 will again act upon the lever P, shifting the type-strips behind the type-pins, at which moment the cam-shaft will be stopped in the manner described, and the operations already set forth will be repeated.

The matrix-strip M is fed downward between each type-impression by the following devices: Beneath the platform is a drum, V, having a channel in its periphery equal in width to the width of the impressed portion of the matrix-strip, the margin upon each side of said channel bearing upon the unimpressed borders of the strip. This drum has bearing in one arm of a forked bracket, V′, and in the other arm is journaled an idle-pulley, *v*, bearing against the rear face of the matrix-strip and giving it frictional contact with the channeled drum V. The latter is revolved by a cord-pulley, V^2, upon the same shaft, having a pawl, v^2, pivoted to it, and engaging with a notch in a disk, v^3, also upon the same shaft, and rigid therewith, as are the drum V and pulley V^2. The cord v^4, which operates the latter, is provided with a weight, W′, and is carried from the pulley over sheaves v^5 and v^6 to the lever P. As the weight W drops and the lever is drawn toward the cam-shaft O the drum V is rotated, and the strip M is fed downward a sufficient distance to present a new surface for the next impression.

I have already described the mechanism by which the type-pins are raised during the process of selecting the types. When the process is completed, it is necessary to drop them again in readiness for the next selection. This is accomplished by raising the weight D′, when the rod B^6, which carries the type-pin frame B^5, will descend by gravity as far as the slackening of the cord D will permit. The weight W is raised in the following manner: When the type-pins have been raised into the plane of the upper type-strip, the weight D′ will have dropped nearly low enough to rest upon a supporting-bracket, D^3, which has a curved arm, D^4, pivoted beneath the table A. To the bracket D^3 is attached a cord, D^5, which is carried vertically to one end of a lever, D^6, pivoted at its other end to lugs upon the table A,

and having a roll, d^2, which engages with a cam, 11, on the cam-shaft O. This cam has a cam-surface, *w*, terminating in a shoulder, *w'*. While the type-strips are being shifted into the position shown in Fig. 1ª the roll d^2 upon the lever D^6 is traveling on the rising cam-surface *w*, lifting the bracket and raising the weight D', thereby allowing the descent of the type-pin frame. At the time the impressing mechanism begins to act said roll rides off the shoulder *w'*, dropping the bracket D^3 to its lowest point, leaving the weight suspended at the point to which it has been raised.

A description of the operation of this machine as a whole would comprise a repetition of the recitals of function already given. I will therefore merely state that the first step is the selection of the types by means of the key-levers, during which the cam-shaft is arrested and the mechanism remains motionless. When the selection is complete, the operator depresses the lever T', thereby withdrawing the pin *s'* from beneath the pawl *s*, dropping the latter into engagement with the ratch S' and starting the cam-shaft. The cam 12, acting upon the lever P, shifts the strips toward the right, aligning the selected types, whereupon the cams 9 and 10 act simultaneously, actuating the locking-bars I and I' and the clamping-bar I^3. This operation being completed, the serrated border of the cam 9 makes the circuit of the magnet and effects the compression of the matrix during the time the cams 9, 10, and 12 are holding the levers K, I', and P upon their surfaces *y'*, *x'*, and *z'*, respectfully. When said levers pass off these surfaces, the types are unlocked and the strips shifted back behind the type-pins for a new type-selection. The moment they are in position therefor the cam-shaft is automatically arrested, as already described. During the shifting of the strips after each selection the cam-actuated lever P draws the cord v^4 over the pulley V^2, advancing the matrix M to receive the next impression. At the same time the cam 11 raises the lever D^6, lifting the weight D', and allowing the type-pin frame to fall to bring it into position for the next selection.

Having thus described my invention, what I claim is—

1. The combination, substantially as described, in a machine for producing type-impressions, of type-selecting devices, a series of type-carrying strips, mechanism for shifting said strips into engagement with the selecting devices and to bring the selected types into alignment, and locking-bars for supporting the latter, one of said bars having a projecting flange with which the selected types engage as the strips are shifted, arresting the motion of the latter, substantially as described.

2. The combination, with keys and the type-carrying strips arranged one above another, of intermediate type-pins carried in a frame having vertical adjustment, and mechanism, substantially as described, for moving said frame after each type-selection to bring it opposite the succeeding type-strip, substantially as described.

3. The combination, with the type-strips, of bars between which said strips pass, by which both ends of the selected type are locked, a clamping-bar moving vertically and compressing the line of selected type, and mechanism, substantially as described, whereby the locking-bars and the clamping-bar are engaged with and disengaged from the selected types, substantially as described.

4. The combination, with the selecting mechanism, of the type-strips, devices, substantially as described, for shifting said strips, locking-bars for supporting and a clamping-bar for compressing the selected types, and mechanism, substantially as described, for impressing a plastic strip upon the types.

5. The combination, with the type-strips, of movable types and quadrats arranged therein, and elastic connections intermediate between each quadrat and the strip by which it is carried, substantially as described.

6. The combination, with the type-strips having movable types and quadrats connected therewith in the manner set forth, of mechanism, substantially as described, for bringing the selected types into alignment, and a clamping-bar whereby they are compressed by the yield of the elastic connections of the quadrats into a line of a given length, substantially as described.

7. The combination, with the type-strips, of cords attached to each end, sheaves over which said cords pass to an actuating-roll, and devices, substantially as described, for rotating said roll alternately in opposite directions, substantially as described.

8. The combination, with the type-pins, of a supporting-frame, a rod carrying said frame, and provided with opposite alternately-arranged serrations at its upper part, devices, substantially as described, for raising said rod vertically, and escapement-pawls which are operated by the type-selecting keys, and which engage alternately with the serrations in the rod and limit and time its upward movement, substantially as described.

9. The combination, with the type-strips carried by cords, of the sheaves guiding and supporting said cords, and a traveling guide having a vertical post through which the cords pass, with transverse channels registering with said perforations and adapted to support one end of the strips during the process of selecting the type, substantially as described.

10. The combination, with the type-strips, of the shifting-roll, a weighted cord actuating the same, a lever operating said cord, a cam actuating said lever in both directions, and mechanism, substantially as described, for arresting the movement of said cam when it has thrown the lever in one direction.

11. The combination, with the type-carrying strips, of the locking-bars I and I', mount-

ed upon frames L and L′, sliding in opposite directions, the lever I⁷, having rods pivoted upon each side of its fulcrum and to said frames, and a cam operating said lever at stated intervals, substantially as described.

12. The combination, with the type-strips and their shifting mechanism, of the bar I′, having the plates i^8 and i^9, provided with the flanges i^{10} and i^{11}, respectively, the bar I, carrying the clamping-bar I³, having channel i^2, and mechanism, substantially as described, for operating the same, as set forth.

13. The combination, with the type-strips, of types arranged at intervals thereon, quadrats connected with each strip by an elastic plate, *n*, whereby said quadrats are suspended from each strip with a space between, and a clamping-bar adapted to compress the selected types against the tension of said elastic quadrat-connections, substantially as described.

14. The combination, with the frame L′, carrying the bar I′, within which the matrix-strip is fed, of compressing mechanism, substantially as described, acting upon the rear face of the matrix-strip by a series of impactions thereon applied to the entire surface simultaneously, substantially as described.

15. The combination, with the type-strips C, having slots *c′* in one end, of the clamping-bar I³, having arm I⁴, with downwardly-extending stud i^3, substantially as described.

16. The combination, with the type-strips C, having plates provided with nibs *c c*, attached at regular intervals, of the types c^2, having grooves c^3 in their upper and lower sides to receive said nibs, substantially as described.

17. The combination, with the block I′, of an impressing device mounted upon a lever pivoted to the frame L′, said lever having an armature, an electro-magnet having its poles arranged to attract said armature, and devices, substantially as described, for successively interrupting the current which vitalizes the magnet, substantially as described.

18. The combination, with the type-pin frame B⁵, of the rod B⁶, having serrations b^7, formed upon opposite sides and alternating with each other, the bell-crank levers E and E′, both coupled to a single connecting-rod, *e*, and having toothed ends which engage with the serrations b^7, and the rod e^2, arranged beneath the keys B², substantially as described.

19. The combination, with the vertically-adjustable type-pin frame having a supporting-rod, B⁶, of the cord D, weight D′, lifting-arm D⁴, cord D⁵, lever D⁶, and cam 11, substantially as described.

20. In combination, substantially as described and shown, of a series of type adapted to be placed in line, a series of yielding quads or spacing devices adapted for introduction between the aligned type, clamps acting against the ends of the line to confine the type between them, and mechanism, substantially as described, for approximating said clamps, whereby the line is justified or reduced in length to the predetermined limit.

21. In a machine of the type herein described, the type and their carrying devices, the yielding quads and their carrying devices, clamps acting to compress the selected and aligned type lengthwise of the line, and mechanism, substantially as described, for operating said clamps subsequent to the alignment, whereby the types and quads are left free during the process of alignment and subsequently compressed to reduce the length of the line.

22. In combination with longitudinally-movable bars, each provided with a series of transversely-movable type, clamps, as I² and I⁴, to confine the aligned type in one direction, and clamps, as I′ and I³, to confine them in a different direction.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

OTT. MERGENTHALER.

Witnesses:

JAMES L. NORRIS,

J. A. RUTHERFORD.