L. A. DISS.

MACHINE FOR MAKING DIES OR MATRICES FOR THE MANUFACTURE OF TYPE, &c.

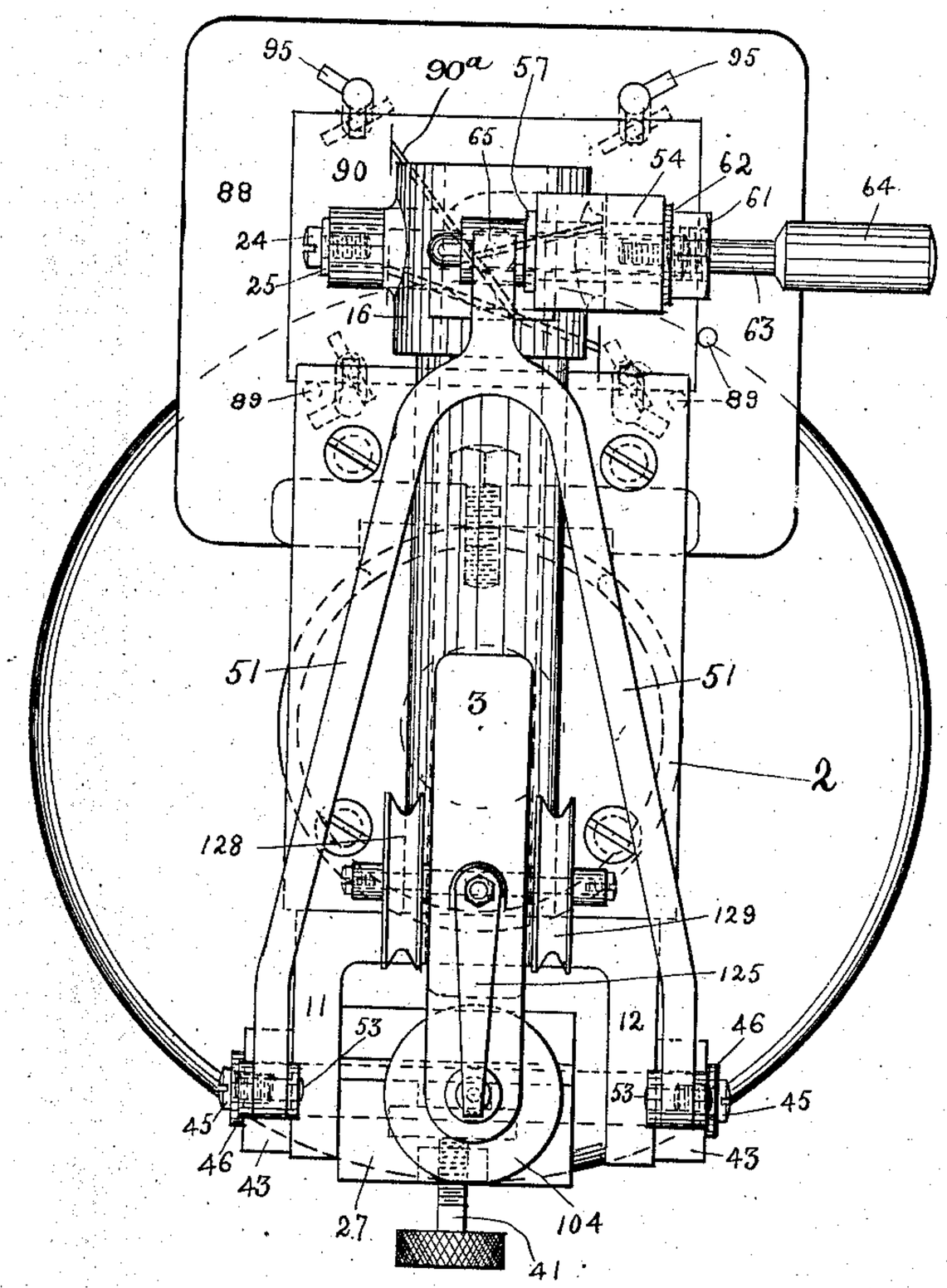
APPLICATION FILED JUNE 4, 1898.

923,252.

Patented June 1, 1909.

6 SHEETS—SHEET 1.

Fig 1.



Witnesses:
Ethel Wells.
K. V. Donovan.

Inventor.
Louis Albert Diss
by Jacob Felbel
His Attorney.

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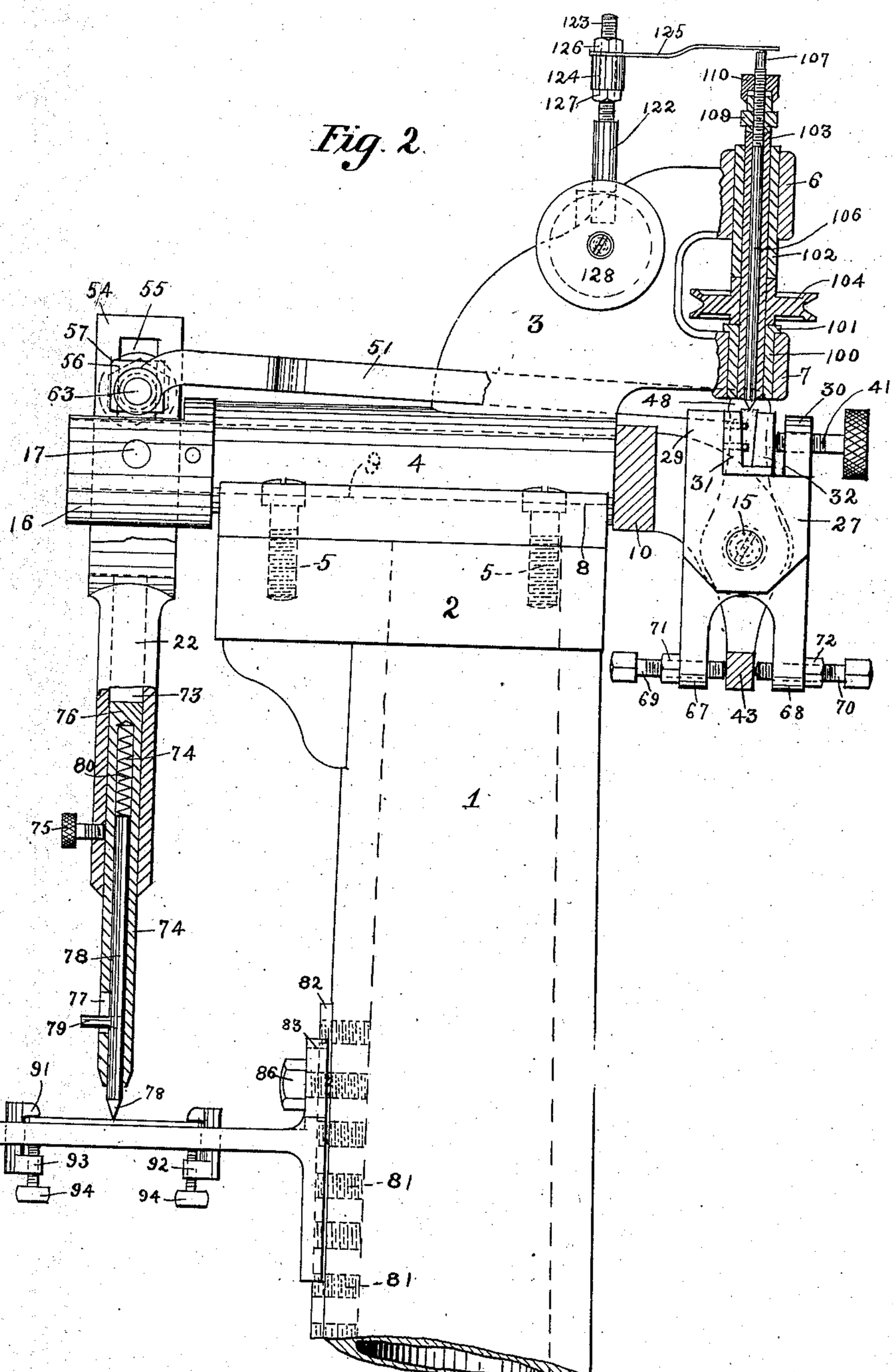
6 SHEETS—SHEET 2

Fig. 2.



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6 SHEETS—SHEET 3.

Fig. 3.

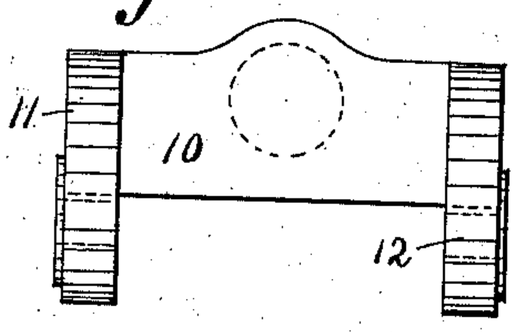

Fig. 11.

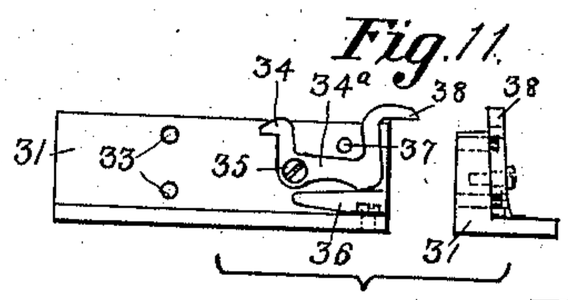

Fig. 12.

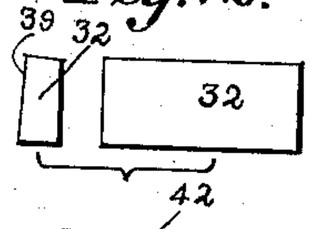

Fig. 13.

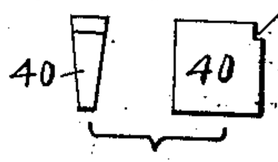

Fig. 22.

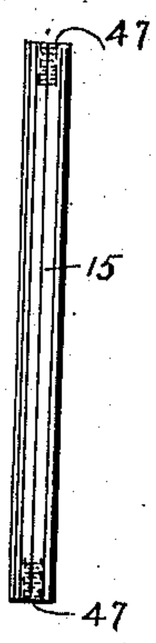

Fig. 4.

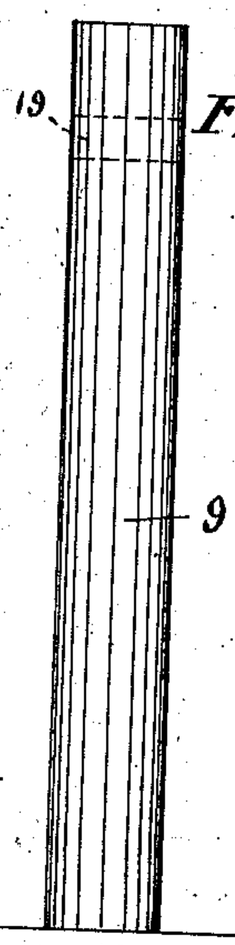

Fig. 5.

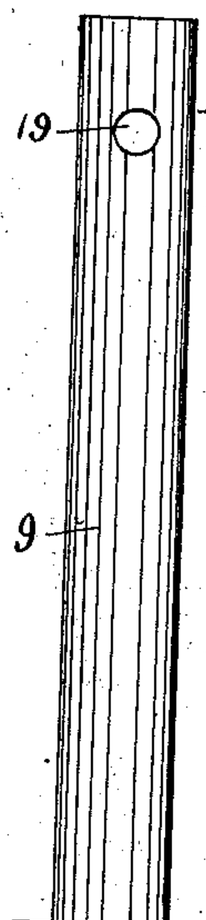

Fig. 6.

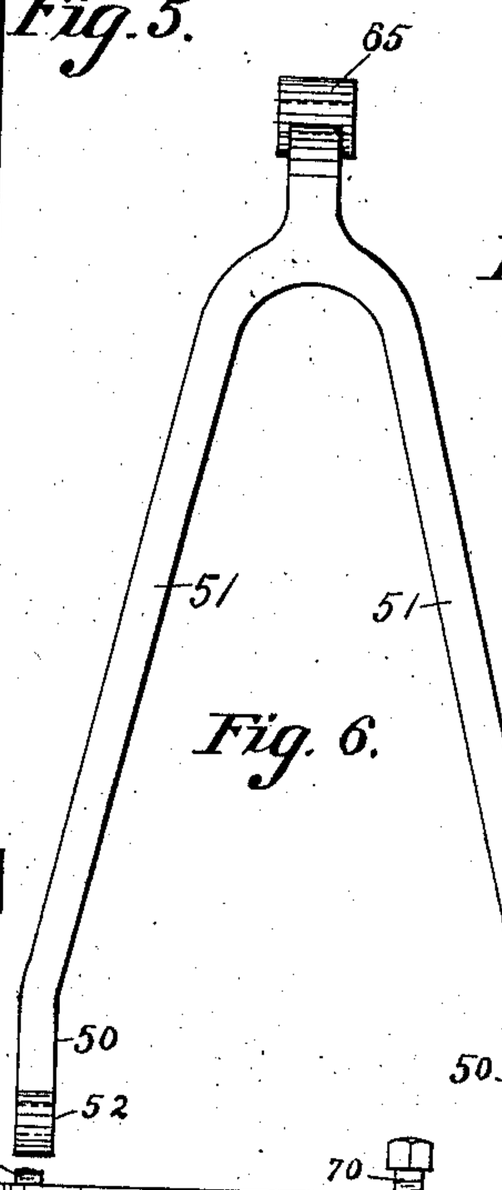

Fig. 7.

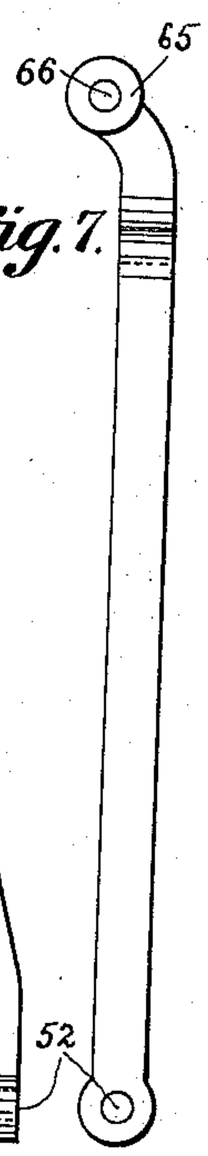

Fig. 8.

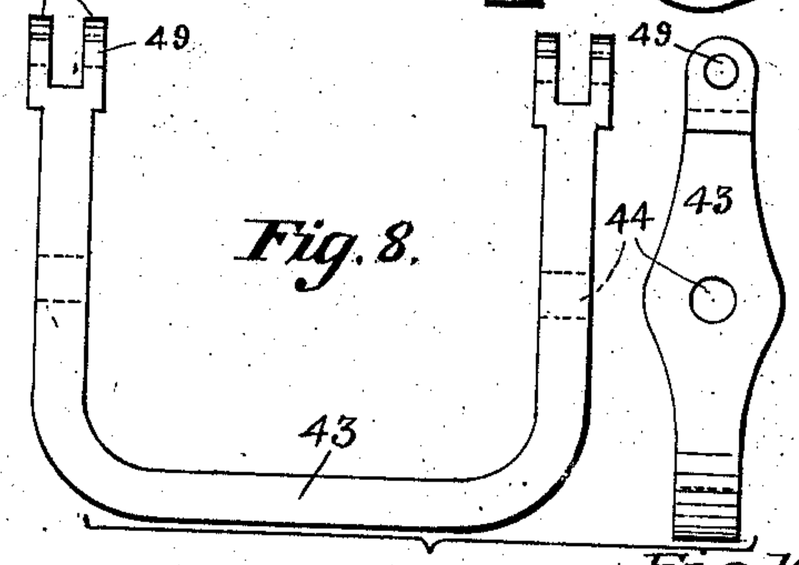

Fig. 9.

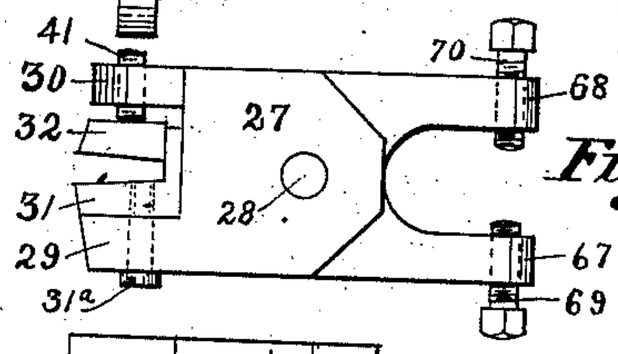

Fig. 10.

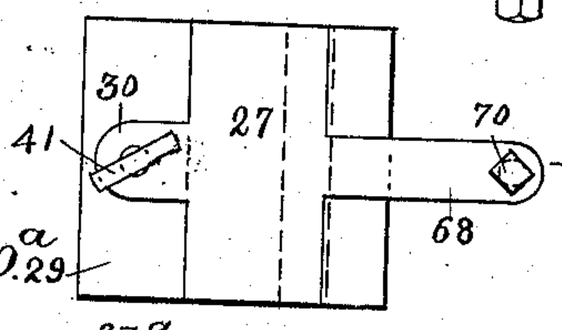

Fig. 10a.

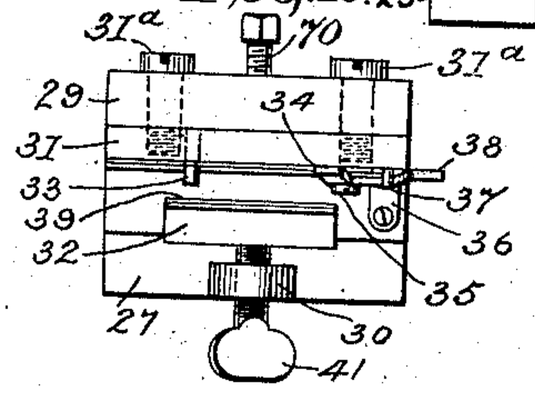

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Fig. 15.

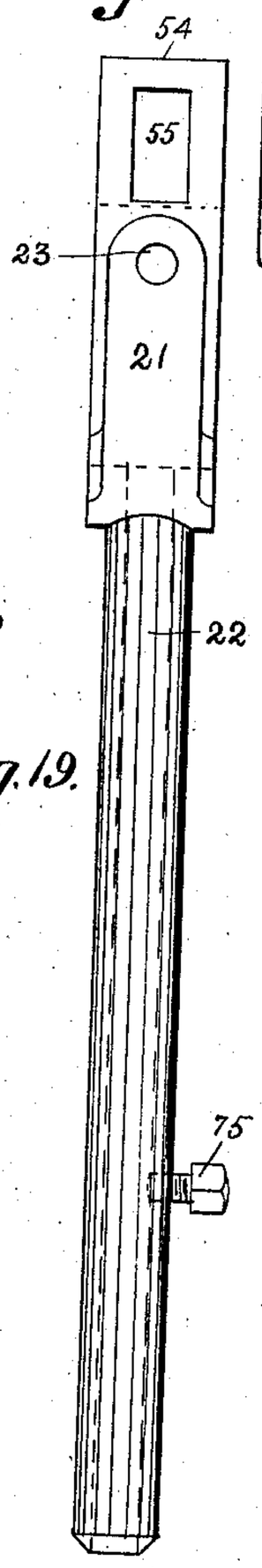


Fig. 14.

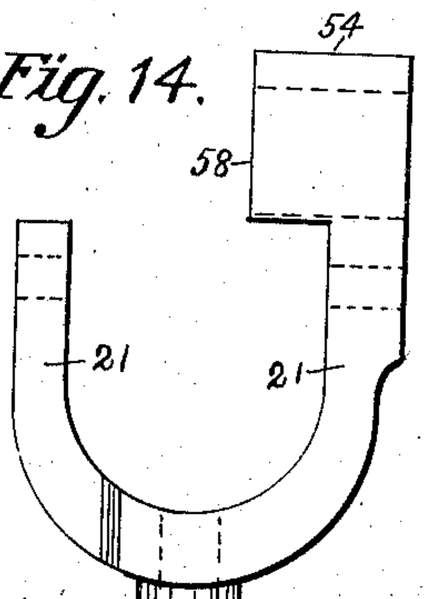


Fig. 17.

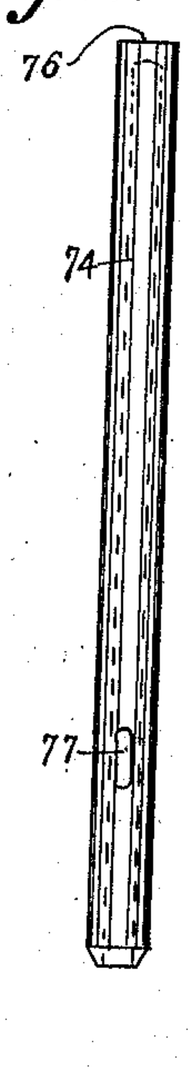


Fig. 19.

Fig. 18.

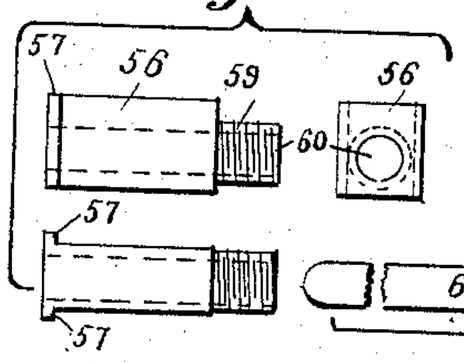
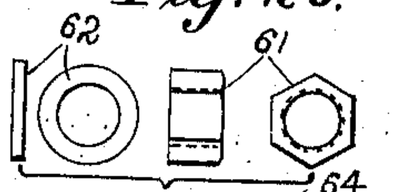


Fig. 20.



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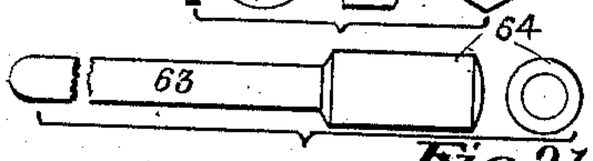


Fig. 23.

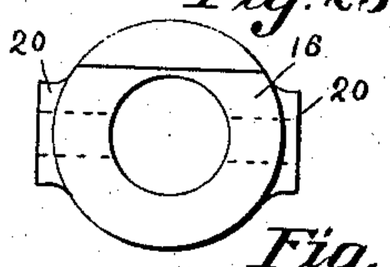


Fig. 24.

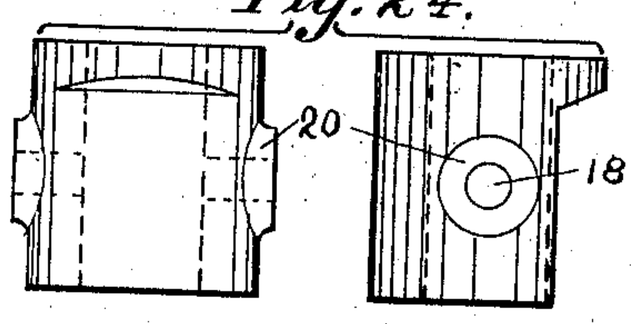


Fig. 25.

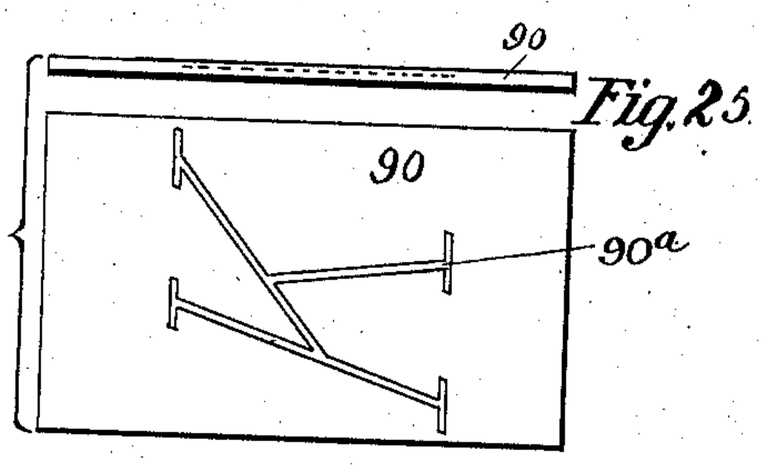


Fig. 27.

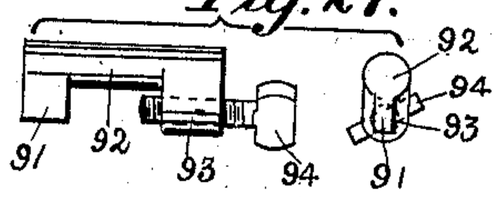


Fig. 16.

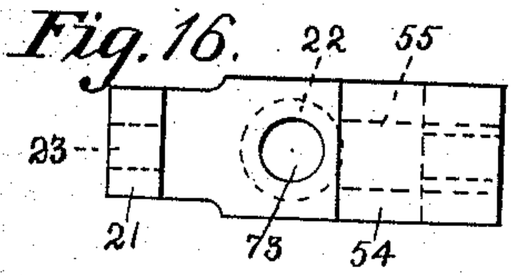
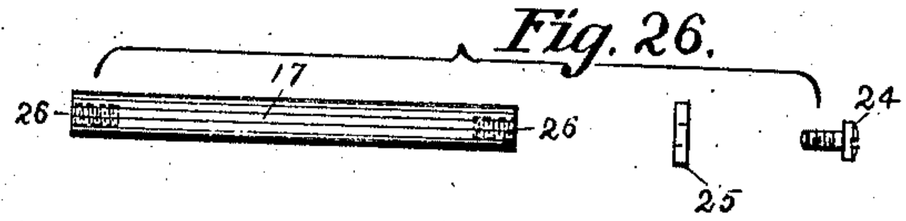


Fig. 26.



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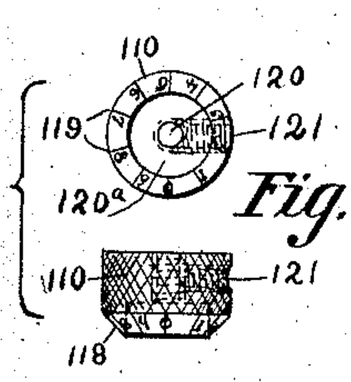


Fig. 36.

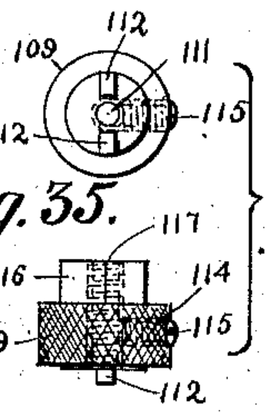


Fig. 35.

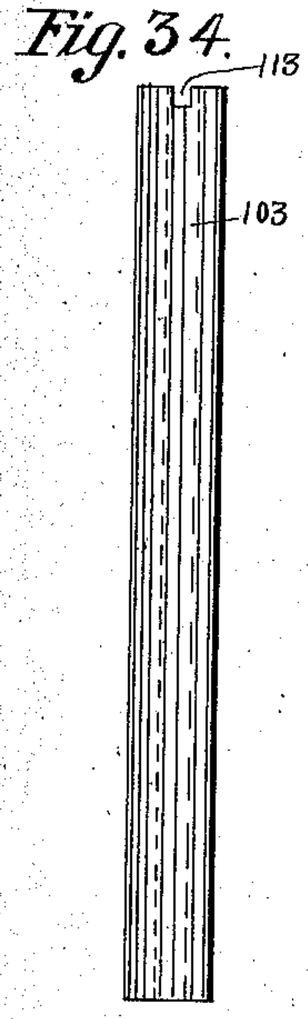


Fig. 34.

Fig. 37.

Fig. 28.

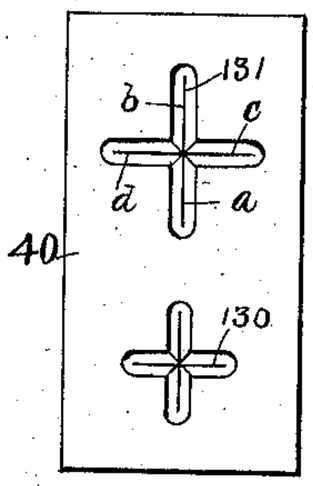
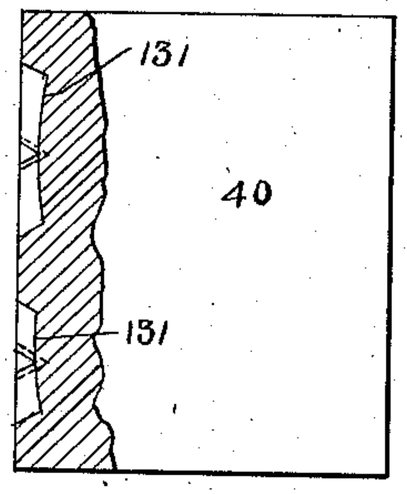


Fig. 29.



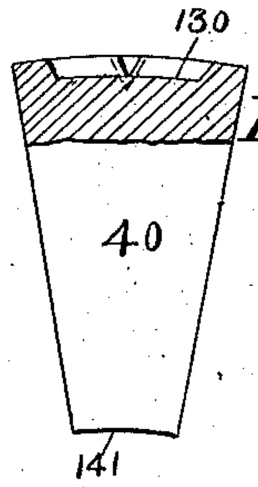


Fig. 30.

Fig. 31.

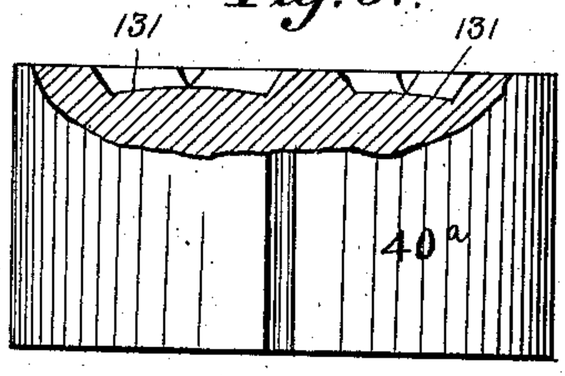


Fig. 32.

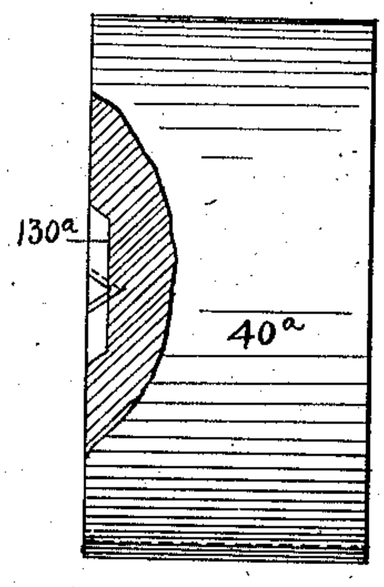
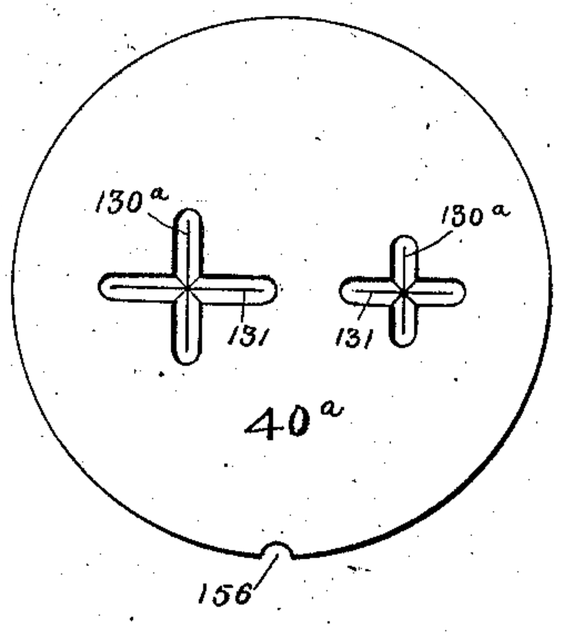


Fig. 33.



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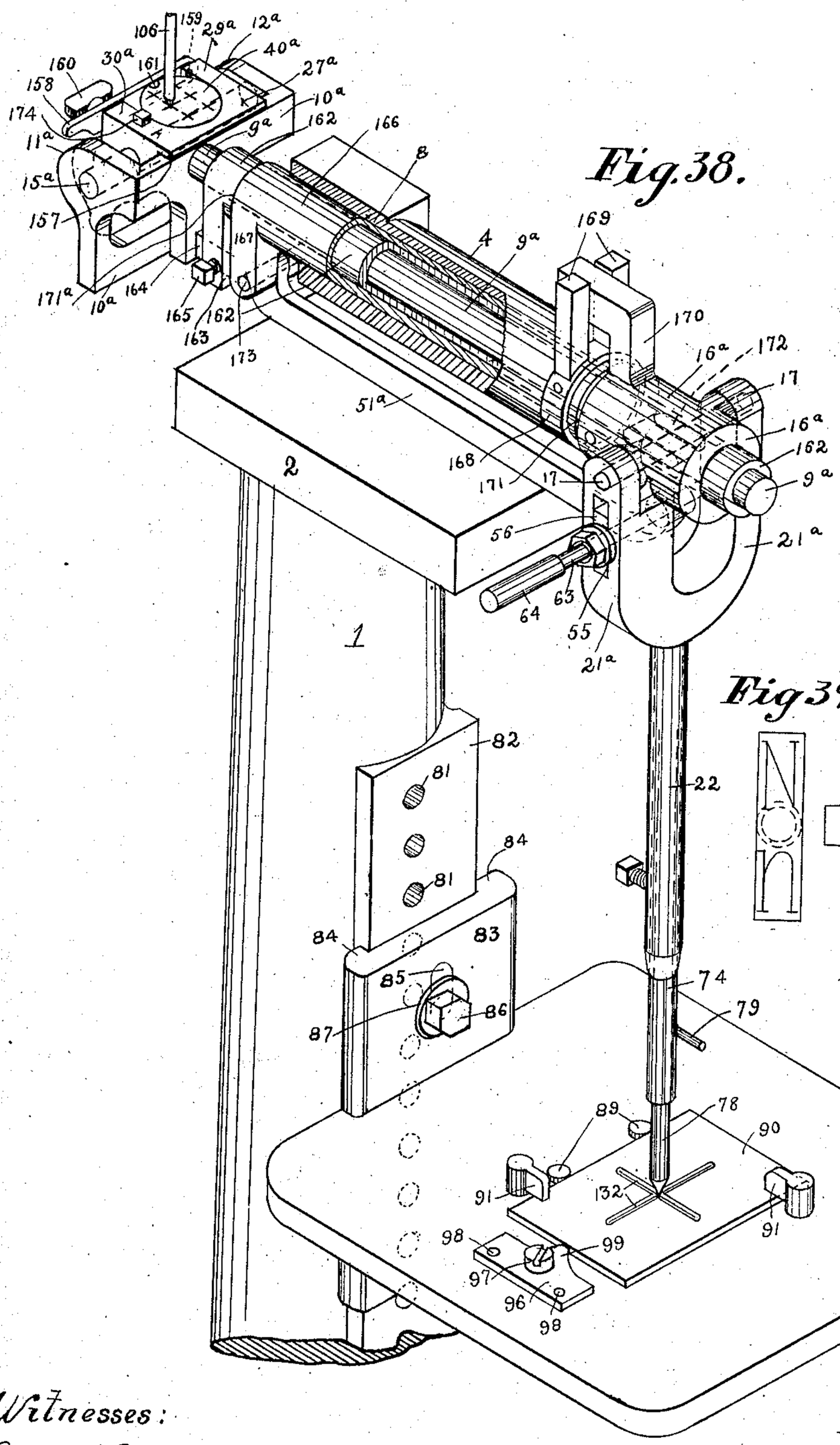

Fig. 38.

Fig. 39

Fig. 40.

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UNITED STATES PATENT OFFICE.

LOUIS ALBERT DISS, OF ILION, NEW YORK, ASSIGNOR TO WYCKOFF, SEAMANS & BENEDICT, OF ILION, NEW YORK, A CORPORATION OF NEW YORK.

MACHINE FOR MAKING DIES OR MATRICES FOR THE MANUFACTURE OF TYPE, &c.

No. 923,252. Specification of Letters Patent. Patented June 1, 1909.

Application filed June 4, 1898. Serial No. 682,542.

To all whom it may concern:

Be it known that I, LOUIS ALBERT DISS, citizen of the United States, and resident of Ilion, in the county of Herkimer and State of New York, have invented certain new and useful Improvements in Machines for Making Dies or Matrices for the Manufacture of Type for Type-Writing Machines, &c., of which the following is a specification.

The present invention relates primarily to a machine for cutting dies or matrices for type to be used in typewriting machines.

In one class of typewriting machines, a cylindrical platen is employed and the faces of the type are made to fit this cylindrical surface; that is, the faces of the type are in surfaces of single curvature, just as the surface of a cylinder is of single curvature. In another make of typewriting machines, the platen is polygonal and the faces of the type are flat or plane to fit the plane faces of the prism. The type for these classes of typewriting machines are commonly formed on a block of steel provided with a tapering shank. In some cases, the said block is provided with two (or more) type or characters, as upper and lower case letters. These type may be made by dropping or pressing, or by rolling. When the type are made by dropping or pressing, the dies or matrices must have the form (inverted) of the finished type; and the said dies, when they are to be used in the rolling process, must have their parts, which correspond to or form the faces of the type, in the surface of a sphere or outer surface of a cylindrical ring. The foregoing remarks apply only in the case where the faces of the type lie in the surface of a cylinder. If the plane-faced type are to be made by dropping or pressing the dies have their faces in planes; and if the type are to be made by rolling, then the dies must have their faces which make or form the faces of the type in the surface of a cylinder.

Types for typewriting machines are made of iron or steel, and must therefore be produced from hardened steel matrices or dies. Heretofore such dies have been made by forcing master types into soft steel and hardening the latter after the impression is made. This process is open to two objections, the first of which arises from the necessity of hardening the master type after it is shaped, since in hardening the type is somewhat deformed. The second objection arises from the necessity of forcing the master types into soft steel and of subsequently hardening the latter, since the matrix is strained by the compression and the strain is removed by the subsequent heating, so that the impressions are disturbed. Thus from two independent causes deformities exist in matrices formed by the usual process. Both of these objections are overcome by my invention of forming a type matrix by a cutting process, since practically no deformation of the characters occurs in hardening a cut matrix.

The principal object of this invention is to provide a simple and efficient machine for cutting dies or matrices from which to form types whose faces are curved to match substantially the curvature of the cylindrical writing-machine platen upon which they are intended to print.

The invention consists of certain features of construction and combinations of devices hereinafter described and more particularly pointed out in the appended claims.

The invention is illustrated in the accompanying drawings forming part of this specification in which,

Figure 1 is a plan view of a form of the invention adapted for cutting dies of double curvature. Fig. 2 is a side elevation, from the left of the machine shown in Fig. 1, some of the parts being broken away and others shown in section, to more clearly exhibit the invention. Figs. 3, 4 and 5 are respectively an end view, a top view, and a side view of the main rock-shaft and its fork. Figs. 6 and 7 are respectively plan and side views of the forked link. Fig. 8 comprises a side and an end elevation of a yoke. Figs. 9 and 10 are respectively end and side views of a vise or die-blank holder carried by the aforesaid forked-link and yoke. Fig. 10^a is a top or plan view of the blank holder shown in Figs. 9 and 10. Fig. 11 comprises two views of a removable vise-jaw and attached parts. Fig. 12 comprises a side and an end view of a second removable vise-jaw. Fig. 13 comprises a side and an end view of a die-blank. Fig. 14 is an elevation or view of the actuating lever taken at right angles to the pivot or fulcrum thereof. Fig. 15 is a similar view of the said lever in the direction of the axis or pivot thereof. Fig. 16 is a top or end view of the said actuating lever. Fig. 17 is a side view of a sleeve carried by the said actuating lever. Fig. 18 includes top, side and end

views of the figure proportioning sleeve. Fig. 19 is a side view of the figure tracing-pin and of a spring for actuating the same. Fig. 20 includes two views each of the nut and the washer for fastening the figure proportioning sleeve to the actuating lever. Fig. 21 includes side and end views of the pivot or pin for connecting the actuating lever and the forked-link. Fig. 22 is a side view of the pivot for connecting the vise and the yoke to the fork of the rock-shaft. Fig. 23 is an end elevation. Fig. 24 includes top and side views of the collar which serves to hold the rock-shaft in place and to provide bearings for the pivot of the actuating lever. Fig. 25 comprises plan and side views of a pattern or guide plate, illustrating one form of an enlarged skeleton pattern letter. Fig. 26 comprises a view of the actuating lever hinge pin screw and washer. Fig. 27 comprises two views of a guide plate or pattern clamp. Figs. 28, 29 and 30 are respectively a face view, a longitudinal section and a transverse section all on an enlarged scale, of a die made for use in the rolling process of forming type. Figs. 31, 32 and 33 are respectively a longitudinal sectional view, a transverse sectional view and a face view, all on an enlarged scale, of a die for use in the dropping or pressing process of making type. Fig. 34 is a side view of the cutter spindle. Fig. 35 comprises side and plan views of the cutter-carrier and adjuster. Fig. 36 comprises side and bottom views of a graduated sleeve for use in conjunction with the carrier for the cutter. Fig. 37 is a side view of the cutter-rod. Fig. 38 is a perspective view, partly in section, of a modification of the invention, which provides for cutting dies for making type of single curvature by the dropping or pressing process. Fig. 39 is a face view and Fig. 40 a side view of a double case type and its shank.

The same part, in the various views, will be found to be designated by the same numeral of reference.

Referring to the form of the invention shown in Figs. 1 and 2 and the figures showing details of parts shown therein, the reference 1 indicates a hollow standard or casting provided with a platform 2 at the top thereof. 3 indicates a head or standard cast in one with a horizontal bed or plate 4 which is bolted to the platform by screws 5, which pass through the plate 4 and engage threaded holes in the platform 2. The head 3 is provided with a pair of bearings 6 and 7 disposed one over the other. The plate 4 is bored horizontally at 8 to provide a bearing for a rock-shaft 9, which is formed or provided at one end with a cross head 10, and the latter at its ends is provided with curved arms 11 and 12. The arms 11 and 12 are bored at 13 and 14 to provide bearings for a shaft or pivot pin 15. After the rock-shaft 9 has been inserted in the bore 8 from the rear end thereof, it is secured against endwise motion by means of a collar 16 and a pin or shaft 17 which passes through a transverse perforation 18 in the collar and a transverse perforation 19 in the shaft. The pin or shaft 17 is of a length sufficient to project beyond bosses 20 at each side of the collar 16, to provide bearings for the forked end 21 of an actuating lever or stylus carrier 22. The prongs 21 are provided with perforations 23 in line with each other to fit over the ends of the pin or shaft 17, and the prongs, the collar, and the rock-shaft are secured together by means of screws 24 and washers 25, the said screws entering threaded holes 26 in the ends of the pivot or shaft 17.

The die-blank-holder 27 consists of a block bored transversely at 28 to receive the pivot or shaft 15, above referred to, and by which it is held between the arms or forks 11, 12, of the rock-shaft 9. The vise block or die-blank-holder 27 is made less in width than the distance separating the said arms 11 and 12, for a purpose presently to appear. The top of the vise is formed with two extensions 29 and 30 to provide a seat or bearing for the reception of the removable jaws 31 and 32. The jaw 31 is L-shaped to fit the angle between the extension 29 and the horizontal top of the block 27. The inner vertical surface of the jaw 31 makes an obtuse angle with the top of the horizontal part of the jaw 31 for a purpose presently to appear. The jaw 31 is held in position relatively to the block 27 by means of a screw 31^a. The jaw 31 is provided with a couple of pins or projections 33 on its vertical arm, and it is also provided with a die-blank-catch 34 carried by an angle lever 34^a pivoted thereto at 35 on the vertical part thereof and with a spring 36 secured to the horizontal part thereof, and pressing the lever 34^a upwardly against a stop-pin 37. The lever 34^a is bent upwardly and then horizontally, as at 38, to provide a finger piece whereby the catch 34 may be operated. The jaw 32 rests on the horizontal part of the jaw 31 and its inner or die-clamping face 39 makes an obtuse angle with the said horizontal portion of the jaw 31. The opposing or die-blank clamping surfaces of the jaws 31, 32, are thus adapted to co-act with tapering or segment-shaped die-blanks 40 to securely hold the same when the jaws are forced toward each other by means of a screw 41, which engages with a screw-threaded perforation in the extension 30 and bears against the back surface of the jaw 32, as shown in Fig. 2. Each die-blank 40 is provided with a notch or shoulder 42 for the reception of the catch 34 hereinbefore referred to. The die-blanks 40 are placed in position between the jaws of the vise by pressing down the lever 34^a, thus moving the catch 34 out of the way and then inserting the blank between the

pins 33 and the catch, with one end of the blank bearing against the pins, after which the lever 34ª is released to allow the nose or catch to snap into the notch 42. The jaw 32, which has previously been loosened is now tightened up by the screw 41 and the die-blank is thus firmly held between the jaws in all directions.

The mechanism by which the vise is moved will be described next in detail. The shaft 15, above referred to, serves to connect a yoke 43 with the arms 11 and 12, of the rock-shaft 9, as well as to connect the vise with the said arms. The yoke 43 is perforated at 44 to fit over the ends of the shaft 15 which project beyond the arms 11 and 12. Screws 45 and washers 46, the first of which engage screw-threaded holes 47 in the ends of the shaft 15, secure the said parts together, see Fig. 1 more particularly. The ends 48 of the yoke 43 are forked (see Fig. 8) and the prongs of these forks are perforated or drilled at 49 to receive the ends 50 of a forked-link 51. The ends 50 are perforated at 52 to correspond with the holes 49 and are secured to the said forked ends 48 by means of pins 53, which fit in said holes. At its other end, the said forked-link 51 is connected with the actuating-lever 22 in the following manner:—One of the prongs 21 of the lever 22 is provided with an extension 54 which overhangs the said prong inwardly as shown in Fig. 14. This extension 54 is provided with a rectangular slot 55 parallel with the axis 17 of the lever 22. The figure proportioning sleeve 56 (shown in detail in Fig. 18) is rectangular in cross section and fits the slot 55 widthwise and is slidable lengthwise thereof or up and down in said slot. At one end, the sleeve 56 is provided with shoulders 57 which co-act with the end-surface 58 of the extension 54 to prevent the sleeve from passing through the slot, and the other end of the sleeve 56 is reduced and provided with an external screw-thread 59. The sleeve 56 is bored longitudinally at 60; and this bore is parallel with the axis 17 when the sleeve is in proper position in the slot 55. The distance from the shoulders 57 to the end of the sleeve where the reduced screw-threaded portion joins it, is equal to or is slightly less than the length of the extension 54; the nut 61 on the thread 59 and washer 62 lock or hold the sleeve 56 in any position in the slot 55 to which it may be adjusted. A pin 63 provided with a head or finger piece 64 fits closely within the hole 60 of the sleeve 56 and is of a length sufficient to project beyond the same, as shown in Fig. 1. The projecting end of said pin 63 provides a pivot for the end 65 of the forked-link 51, said link being perforated at 66 to fit upon said pin. By the described means, the motion of the lever 22 about the axis 17 is communicated to the yoke 43.

The means by which the yoke 43 communicates this motion to the vise and so moves it about or with the axis 15 will now be described. The vise-block 27 is provided with two arms 67 and 68 projecting downwardly therefrom at opposite sides of the yoke 43; the arms 67 and 68 are provided with screw-threaded perforations and with adjusting screws 69 and 70 engaging said perforations and adapted to bear at their ends against opposite sides of the yoke 43, as shown in Fig. 2. Jam-nuts 71 and 72 upon the screws 69 and 70 are also provided. The screws 69 and 70 serve to adjust or vary the position of the vise-block 27 and die-blank 40 relatively to the yoke 43 and to the cutter and to secure these parts in such adjusted positions. These screws also serve in conjunction with the said yoke to secure the vise in any position along the shaft or axis 15 to which it may be adjusted.

The actuating-lever 22 is shown as being hollow or bored out at 73 to receive a sleeve 74 therein. A set-screw 75 engaging a screw-threaded hole in the lever 22 secures the sleeve 74 against displacement. The sleeve 74 is closed at its upper end 76 and is provided with a slot 77 near its lower end. A tracing-pin 78 fits within the sleeve 74 and is provided with a pin 79, which passes through the slot 77, thus limiting its motion longitudinally of the sleeve and providing a handle for lifting it. A helical spring 80 inserted in the sleeve 74 bears against the closed end 76 of the sleeve and the top of the tracing-pin, pushing the pin outwardly.

The column or standard 1 is provided with a vertical row of screw-threaded holes 81 at the front thereof, these holes being in a rectangular piece or guide 82 formed integral with or attached to the said column. A slide 83 is provided for co-action with a guide 82, said slide being formed with jaws 84 which embrace the edges of the guide. The slide 83 is provided with a vertical slot 85. A fastening screw 86 passing through the slot 85 and engaging with the corresponding hole 81 secures the slide 83 in the position to which it may be adjusted. A washer 87 beneath the head of the screw 86 may be used. A platform 88 projects horizontally from the slide 83 and is provided with three pins 89 arranged to co-act with a side and an end of a rectangular or square guiding plate or pattern carrier 90. The platform is also provided with clamping jaws 91 projecting from bars 92, as shown in Fig. 27. The bars are formed with projections 93 which are provided with screw-threaded perforations parallel with the bar. Clamping-screws 94, engaging the perforations, have their working ends in opposition to the jaws 91. The platform 88 is provided with suitably shaped openings 95 for the insertion of the clamps which are then turned to bring them over the pattern-plate 90, after which

the screws 94 are set up to draw the jaws 91 down upon the pattern carrier and hold it firmly in position. In Fig. 38 one of the pins 89 is replaced by plate 96 which is attached to the platform 88 by means of a screw 97 and dowel pins 98; a projection 99 on the plate 96 serves the functions of the pin 89.

In Fig. 25 I have shown the pattern plate 90 having the letter K formed in its surface by the pattern groove 90ª, and in Fig. 1 this same pattern plate and pattern letter are shown in position in the machine. It will be observed from an inspection of Fig. 1 that the pattern plate is so positioned in the machine that lines extending from top to bottom of the letter would be formed by the swinging of the work holder about the axis that is nearest the point of the cutter—that is to say, in the form of the machine here shown, about the fixed axis.

The mechanism for cutting the die or type will next be considered. As above stated the head 3 of the frame or casting is provided with two lugs or bearings 6 and 7 arranged one over the other. These bearings are perforated or drilled vertically and the lower bearing 7 is provided with a bushing 100 having a flange 101 at one end thereof and inserted in the bearing 7 from above. The upper bearing 6 is provided with a bushing or sleeve 102. The cutter operating spindle or sleeve 103 fits in and passes through the bushings 100 and 102, and is provided between said bushings with a pulley wheel 104 made fast to the spindle 103 by a drive fit or other suitable means. The hub of the wheel 104 at one end rests upon the bushing 100 and the bushing 102 rests upon the other end of the said hub. The cutter 105 is at one end of a rod 106, whose opposite end is reduced at 107; the main portion of the rod 106 adjoining the part 107 is screw-threaded at 108. This rod 106 fits within the sleeve or spindle 103 and is provided with an adjustable cutter suspending nut or device 109 and with a graduated sleeve 110. The nut 109 is provided with an internally threaded longitudinal perforation 111 for engagement with the threaded portion 108 of the rod 106; it is also provided with a knurled surface. At one end the nut 109 is provided with tongues 112 adapted to engage the notches 113 in the upper end of the spindle 103. The nut is provided with a transverse threaded-hole 114, which opens into or communicates with the threaded hole 111. A set screw 115 engages with said threaded hole 114 and its end bears against the threaded portion 108 of rod 106 to secure the nut 109 in any position to which it may be adjusted on the rod 106. The other end of the nut 109 is reduced in diameter at 116 and is provided with a mark or index 117 extending longitudinally thereof. The graduated sleeve 110 has a knurled cylindrical portion and a coned end 118 upon which are suitable graduations or marks 119, say ten, numbered from "0" to "9". The sleeve 110 is provided with a longitudinal threaded perforation 120 adapted to engage with the threaded portion 108 of the rod 106; it is also counter-bored at 120ª to receive the cylinder 116; it is also provided with a transverse or radial threaded hole 121. A set screw engaging with the perforation 121 and adapted to bear at its end against the threaded portion 108, securely attaches the graduated sleeve 110 to the rod 106.

The head 3 is provided with an upright rod 122 fixed thereto, whose upper end 123 is threaded, as shown; a sleeve 124 fits loosely over the threaded portion 123 and is provided with a flat or leaf-spring 125, preferably fast thereto, which is adapted to bear upon the upper end of the rod 106. A couple of nuts 126 and 127, respectively above and below the sleeve 124 allow of the adjustment of the sleeve 124 longitudinally of the screw 123 and secure the sleeve in such adjusted position. By adjusting the sleeve up or down on the rod 122, the desired amount of spring-pressure upon the upper end of rod 106 may be secured.

The function of the spring 125 is to force the point of the revolving pointed end-milling tool or cutter 106 down, before the tracing operation begins, as far as the nut 109 will allow, and thereafter to maintain the tool in that position, so that during the tracing operation the point of the tool remains at a fixed and invariable distance from the axis of shaft 9, without attention on the part of the workman. It is understood that the spring is to be made powerful enough to accomplish this purpose. The spring may be swung aside to permit the removal of one cutter and insertion of another, as hereinafter explained, and may then be swung back to working position.

The pulley 104, sleeve 103, nut 109, sleeve 110, and rod 106, are rotated by means of a cord or round belt which passes around the pulley 104 and the guide pulleys 128 and 129 at the sides of the head 3, the cord coming from overhead, and being connected with a suitable source of power.

When it is desired to adjust the cutter 105 closer to or farther from the die-blank-holder or the axis 15 of the vise 27, the spring 125 is swung aside; the set screw 115 in nut 109 is loosened, and the sleeve 110 and rod 106 are rotated together (nut 109 being held stationary the while) or nut 109 is rotated, the sleeve 110 and rod 106 being held stationary the while, in the direction which will increase or decrease the distance between the nut 109 and the point of the cutter 105, according as it is desired to lower or raise the cutter; as a guide to obtaining accurate adjustments, the mark 117 and the

graduations upon the cone 118 are provided; in such case, the turning of the rod 106 and sleeve 110 is continued until the mark 117 reaches the graduation on cone 118 which corresponds to the amount by which it is desired to vary the distance of the point of the cutter 105 from the axis 15 of the vise 27, whereupon the said set screw 115 is tightened up and spring 125 is replaced. The distances through which the point of the cutter 105 is adjusted are, relatively speaking, not large; a complete turn of the rod 106 in either direction probably covering all the adjustments that will be required after nut 109 has once been set. The effect of increasing the distance between the point of the cutter 105 and the axis 15 (and the axis of shaft 9) is to increase the radii of the working-faces of the dies formed. Conversely, decreasing the distance between the point of the cutter 105 and axis 15 (and axis 9) decreases the radii of the working-faces of the dies cut. The axis of cutter 105 and rod 106, produced, passes through the axes of shaft 9 (produced) and shaft 15. The nut 109, in conjunction with the sleeve 103, performs several functions; it forms a support or carrier for the rod 106, and with the tongues 112 and notches 113 forms a clutch for connecting sleeve 103 with rod 106; and the said nut 109 also acts as an adjustable stop for rod 106.

In Figs. 28, 29 and 30, are three views, on an enlarged scale, of matrices or dies produced by the machine shown in Figs. 1 and 2 and above described. As above pointed out, the matrices or dies shown in these figures are intended for producing type by the rolling process. It will now be seen that in cutting the die for the rolling process, it is swung on two axes which differ in their distances from the cutter; consequently the type-face of the die will be in the exterior surface of a "cylindrical ring", which by the rolling process effects a cylindrical face of the type. It will also be seen that instead of this face being in the exterior surface of a "cylindrical ring", it may be spherical which it would necessarily be if the radius of the platen and of the circle in which the type face of the die swings were equal. In which case, the two axes of the die would necessarily be at equal distances from the cutter; that is, they would intersect each other. The die-blank 40 shown in Fig. 30 is segmental or tapering and the top curved surface thereof formed before the die-cutting is begun, is concentric with the bottom or type-face forming line 130 of the die, and this face is formed or struck, so to say, on the axis of shaft 15 as a center. The curved bottom lines 131 of the dies shown in Figs. 28 and 29, produce that surface of the type which is to fit the cylindrical surface of the platen and have the same radius as the platen with which the type are to co-act; which radius is equal to the distance from the axis of shaft 9 (produced) to the point of the cutter.

Although preferable, it is not essential that the type shall be formed upon a curve having the radius of the platen in connection with which it is to be used, so long as it is so curved as to fit the platen in practice, and enable all portions thereof to bear with substantial evenness upon the platen. By reference to Figs. 39 and 40 it will be noted that the two letters upon the type of a double case typewriter are arranged one above another, so that the top of the lower letter is next the bottom of the upper letter, the space between the letters depending upon the extent of the "shift" of the writing machine platen relatively to the type. It is noted that the curves of the two letters on the type, although having equal radii, are eccentric to each other, that they would intersect if produced, and that the curve of each letter extends from top to bottom, or in other words the upright lines of each letter are formed on curves.

Owing to the fact that the point of the cutter 105 is at unequal distances from the axes of shafts 9 and 15, it results that when the die-blank is vibrated about the axis 9, it is cut in the arc of a circle lengthwise of the blank, and when the blank is vibrated about the axis 15 the blank is cut in the arc of a circle crosswise of the blank, or in an arc at right angles to the first mentioned cut; but inasmuch as the axis 9 is nearer the point of the cutter, the lengthwise arc is formed on a shorter radius than that of the crosswise arc formed on a radius equal to the distance from the point of the cutter to the axis of shaft 15. Thus the blank is cut on arcs of unequal radii considered lengthwise and crosswise of the blank, owing to the fact that the blank is swung on axes at right angles to each other. It will be understood, of course, that the blank may be swung or vibrated simultaneously on both axes to move in any desired direction and hence enables the cutter 105 to form or produce any desired figure or character, as any letter of the alphabet, numeral, punctuation or other mark, as well as the right angled cross shown for illustrative purposes.

It will be seen that I have combined a cutter and a die or work holder, one of said parts being arranged to swing on axes at right angles to each other, the relative movements of the cutter and blank holder, whereby the desired predetermined curves are obtained in the depressed or intaglio type face formed in the die, being controlled by said axes. By the above phrase "relative movements of the cutter and blank holder," I refer particularly to the automatic swinging movements about said axes which produce the desired curvature, as distinguished from

the manually-controlled or surface movements which determine the outline of the letter. By this construction the matrices are cut uniformly and automatically upon a predetermined double curvature. The operator may manipulate the tracer to vary the outlines of the letters, but not to vary the curvatures upon which the letters are cut.

The operation of the apparatus is as follows:—Assuming that it be desired to form a double-case die for the "plus" mark shown in Fig. 28, the guide or pattern plate 90 is placed upon the platform 88 against the pins 89 and stop 99, as shown in Fig. 38, and securely clamped in position by means of two or more clamps 91. The pattern 132 is preferably much larger than the corresponding die or die-figures to be formed on the blank 40; and hence the parts of the machine are proportioned to greatly reduce the die as compared with the pattern. Assuming that it is desired to form the upper or larger die (see Fig. 28) the sleeve 56 is set in say, the position shown in Fig. 2 relatively to the slot 55; also, the die-holder 27 is placed against arm 11 or in the position shown in Fig. 1 and is secured in such position in the manner above described. The die-blank 40 is secured in the vise by the screw 41 in the manner above described. The tracing-pin 78, which is movable longitudinally in sleeve 74, is placed in the position shown in Fig. 38, to wit, in the center of the cross or "plus" mark, which is formed by a couple of intersecting V-shaped grooves. The rod 106 is inserted in the spindle 103 and the spring 125 is placed over its upper end, as shown in Fig. 2, thus pressing the cutter 105 down upon the surface of the die-blank. The cutter is next rotated by means of the described mechanism, the pulley 104 and spindle 103 together with the bushing 102 being lifted slightly, if necessary, for the purpose of causing the tongues 112 to engage with the notches 113 to rotate the cutter. As soon as the cutter, under the force of spring 125, has cut its way into the die-blank as far as the nut 109 will allow it, the tracing-pin 78 is moved by means of the lever 22 along one of the four arms of the pattern 132, the point of the tracing-pin being kept in the bottom of the V-shaped groove, which it constantly fits by means of the spring 80, which moves the pin outwardly longitudinally of the lever 22. Assuming that the lever 22 is moved toward the observer in Fig. 2, the rock-shaft 9 is rotated upon its axis but the lever 22 is not moved upon or about its axis 17; it results from this that the end of the vise nearest the observer (which is the left-hand end of the vise 27 as shown in Fig. 1) swings up and the opposite end swings down; the corresponding groove cut in the die is the lower branch *a* of the upper or larger "plus" mark shown in Fig. 28. When the point of the tracing-pin 78 has reached the limit of the pattern in the direction in which it has been moved as described, the said tracing-pin 78 is moved back to its starting point, thus bringing the blank back to its first position relatively to cutter 105; and another branch of the cross or "plus" mark is begun. Let this be the branch opposite the one just formed. In this case, the tracing-pin 78 will move away from the observer in Fig. 2, and that end of the vise-block 27 next the observer in Fig. 2, which is the left-hand end of the vise in Fig. 1, will swing down and the other end up by the rotation of the rock-shaft 9; the cutter will thereupon form the upper branch *b* of the upper or larger die shown in Fig. 28. After the cut of the said upper branch is complete, the tracing-pin is brought back to the center of the pattern which, of course, brings the center of the upper die shown in Fig. 28 under the cutter and the formation of the cross groove is begun. Assuming that the tracing-pin 78 is moved to the right in Fig. 2, along the groove of the pattern, there is no rotation of the shaft 9 but the lever 22 is moved upon or about its axis 17, and, through the described connections, it moves the link 51 to the left in Fig. 2; and link 51, through the yoke 43, the arms 67 and 68 and the screws 69 and 70, turns the vise-block 27 upon its axis 15, thus causing the die-blank to move to the left in Fig. 2; the cutter 105 forms in this movement, the right-hand or lateral branch *c* of the upper die shown in Fig. 28. Upon the completion of the cutting of this branch of the die, the tracing-pin 78 is brought back to the center of the pattern and simultaneously the die-blank is moved to bring the center of the die being formed under the cutter 105. Upon moving the lever 22 to the left in Fig. 2, the tracing pin still being in the groove of the pattern 132, the link 51 is moved to the right in Fig. 2 and through the described connections swings the die-blank in the same direction; this brings about the formation of the left-hand branch *d* of the upper or larger die shown in Fig. 28.

The above described operations of the machine assume the use of but one cutter only. In practice, however, I prefer to use two or more cutters to do a given or total amount of cutting, and to take two or more "cuts" at the same piece of work, the purpose being, of course, to avoid putting an undue amount of work upon a single tool and also to obtain a fine finish by means of a tool doing as little work in the last or finishing operation as is consistent with the fine finish desired. Hence, the first cut, by means of the cutter 105 in the above described operation, would be of a depth less than the depth of the final or complete die. For the second cut, the cutter used for the first cut would be removed and a second cutter would be intro-

duced in place of the said first cutter, the second cutter being adjusted to take a deeper cut than the one first used. The said second cutter can make the finishing cut or it may merely deepen the previous cut and a third cutter, be inserted in place of the second cutter and be used to give the finishing cut. It is understood, of course, that in making each cut in the operation of forming a die the tracing-pin 78 and the same fixed pattern 132 are used.

If now it is desired to form the lower or smaller die shown in Fig. 28, it may be done from the same pattern used in forming the upper die or the last named pattern may be replaced by a smaller pattern of the "plus" mark. In case it is desired to form said smaller "plus" mark upon the same blank as a larger one, the vise-block 27 is moved from the position shown in Fig. 1 over against the arm 12 of the rock shaft 9 and there secured. In case a smaller pattern is employed to obtain the smaller die, no adjustment of the mechanism from the positions shown and described is necessary and the operation is substantially the same as above described. If, however, it is desired to obtain the smaller die from the pattern used in making the larger die shown in Fig. 28, the following adjustments are made:—The screw 86 is removed and the platform 88 is moved downward a distance such that the excursions to and fro of the tracing-pin 78 in the pattern will be reduced at the surface of the die-block in the vise to the desired extent, and the screw 86 inserted in a hole opposite the slot 85 and the platform is secured in place. The slot 85 and screw 86 allow of delicate adjustments of the height of the platform to secure the exact reduction desired. Next the set screw 75 is loosened and the sleeve 74 (of the two-part extensible actuating-lever 22 74) is slid out of the upper part 22 until the tracing-pin 78 with its point at the center of the pattern and resting on the bottom thereof is pushed inward relatively to the sleeve 74 until pin 79 has risen sufficiently far in the slot 77 to permit of free longitudinal motion of the pin, as the tracer is moved to all parts of the pattern, and the set screw 75 is then tightened up and the machine is ready. The operation of forming the said smaller "plus" mark is substantially the same as that hereinbefore described in connection with the formation of the larger "plus" mark shown in Fig. 28, the only difference being that, for the same excursions of the tracer in the pattern, the die-blank makes smaller motions than in the previously described case.

The end-milling tool or tapering cutter 105 is three sided and V-shaped or V-pointed at its lower end; that is, it is substantially an inverted, equilateral, triangular pyramid; and may come to a fine point or the point may be slightly rounded in order to avoid giving too sharp an edge to the working-faces of the type.

The lines of the finished or printing type faces produced from the matrix equal in thickness the diameter of the extreme point of the cutter. Only a skeleton outline of the type is generated in the matrix by the point of the cutter, owing to the use of a grooved skeleton pattern letter and a follower which constantly fits the groove. The letter is cut intaglio in the pattern plate, that is, in the form of a channel or groove, the tracer being positively guided by the groove throughout the entire cutting operation. As will be noticed by reference to Fig. 25, the groove or grooves in the pattern plate are parallel sided and of uniform width throughout.

To provide for the case wherein it may be desired to form dies for type whose height shall be equal but whose widths shall be different and all from one pattern, there is provision made for the increase or the reduction of the motion of the vise and die in one direction without affecting the amount of its movement or motion in the other direction. Thus it may be desired to form a set of dies for the production of a set of type for use in a machine where the movement of the carriage is $\frac{1}{10}$ of an inch for each letter space and it may also be desired to produce a set of dies for making type for use in a machine where the carriage moves a greater or a lesser distance than $\frac{1}{10}$ of an inch for each letter, without, however, making any change in the height of the letters. Provision is made for such variation by means of a sleeve 56 and the slot 55 hereinbefore described. The closer the pin 63 is to the axis 17 of the lever 22, the less is the throw of the vise about its axis 15, while by moving the slide 56 farther from the axis 17, the greater is the throw of the vise-block 27 about its axis 15. The lines of the dies, formed by the cutter when the vise moves about its axis 15, are those lines which produce the width of a character in the die. It will thus be seen that the width of the character may be varied by varying the motion of the vise about its axis 15.

The method or process of and apparatus for forming dies made in the above manner and shown in Figs. 28, 29 and 30, will be briefly described. A separate machine is used for this purpose in which a shaft is provided having on it a drum and certain disks adapted to have a number of the dies 40 mounted thereon in such a way that their engraved faces taken together form the surface of a cylinder or part of a cylinder. When these dies are thus mounted, the set of dies form in effect a cylinder having the matrix grooves engraved in its cylindrical surface. This cylinder has a radius equal to the distance of the axis 15 from the face of the die 40 when said die is mounted in the matrix

cutting machine so that the grooves 130 in the matrices have their centers in the axis of said cylinder. A set of type blanks corresponding in number with the set of dies, is mounted in a straight clamp so that the type blanks are face to face with the cylinder composed of the dies. The blanks for the types (see Figs. 39 and 40) preferably consist of T-shaped blocks 142 of soft steel. The head 142ª of each blank 142 is of prismatic shape, flat or plane on three sides and convex or rounded on the fourth side. The back of the head of the blank is the rounded part, while the face is flat and receives the impress of the die. The shank 143 is round and tapered as usual. The device in which the type blanks are mounted has a straight toothed rack which meshes with a toothed gear or pinion rigidly connected with the matrix cylinder.

In the operation of forming types the clamp containing the type blanks is reciprocated and the cylinder containing the dies is rotated, these two parts moving in unison so that each type blank is rolled against one of the dies. Means are provided for reciprocating the type blank holder and rotating or oscillating the die cylinder back and forth and for feeding one of these devices toward the other under heavy pressure. The result is that the metal of the type blanks is gradually forced into the matrix grooves in the die and this operation is continued until said metal has completely taken shape so as to fit exactly into said matrix grooves. As the grooves 130 are concentric with the cylinder and as the type blank moves in a straight line, the part of a type that is formed by one of said grooves 130, will be straight in the type. The grooves 131 on the other hand are curved longitudinally of the axis of the cylinder and the curvature of these grooves will be duplicated as at 155 in the raised type. The result is that the type as formed contains the curves 131 but has a raised surface or edge corresponding to the groove 130 except that this latter edge is straight instead of curved. The face of each type thus formed lies in the surface of a cylinder having a curvature corresponding to the curvature of the groove 131 of the matrix. It will be recalled that this groove was cut concentrically with the shaft 9 of the matrix cutting machine and cut in a radius corresponding to the radius of the typewriter platen. The types are thus formed with their faces in the surfaces of cylinders having a radius corresponding to that of the platen of a typewriter so that when the types are used in the typewriting machine they will contact nicely with the platen from top to bottom of the type. After the types are removed from their holder they may be subjected to any desired operation for the purpose of removing burs, hardening them or otherwise finishing them.

In case die-blanks wider or narrower than those shown in Figs. 1 and 2 are employed, the vise-block 27 may be adjusted accordingly about its axis 15 to bring the point of the cutter to the center of the blank.

In case blanks of a shape different from that shown in Fig. 13 are to be used, the jaw 31 is removed from the vise-block 27 and a jaw shaped to receive the new style of blank is substituted; the jaw 32 may also be replaced by another if necessary.

The modified form of the invention shown in Fig. 38 is intended for the production of dies of the character illustrated in Figs. 31, 32 and 33, in which the die-faces 131 are the same as in Figs. 28, 29 and 30 and are for the same purpose, while the die face 130ª is straight and not curved. The type are produced by dropping or pressing the type blanks and the dies one upon the other, and the final product is the same as in the rolling process just described. In the machine for producing the dies under consideration, the die-blank holder or vise has motion in two directions at right angles to each other, one of which motions is a pivotal or swinging motion and the other of which is a rectilineal motion. Those parts of the structure having the same numerals of reference as in the previous figures are the same, and have the same functions, as the parts hereinbefore described. Certain parts of the structure, such as the mechanism for driving the cutter, are omitted from Fig. 42 for the sake of clearness. The die-blanks 40ª are in the form of solid disks of metal with a longitudinal groove 156 for purposes presently to be described. The vise 27ª consists of a block of metal perforated to slide upon the rod 15ª. The rod 15ª is fixed in the arms 11ª and 12ª of the cross-head 10ª; and the cross head 10ª is fast upon the rock-shaft or stem 9ª. The vise 27ª is provided with a flange 157 which rests upon the top of the cross head 10ª. The vise is provided with two arms 29ª and 30ª, which are united by a semi-circular part adapted to form a seat for and to receive the die-blank or disk 40ª, which rests upon a flat part or seat in the vise above the shaft 15ª. A latch-piece 158, hinged to the arm 29ª at 159 and provided with a screw 160 passing therethrough and adapted to engage with a threaded hole in the arm 30ª, secures the die-blank 40ª in position. The vise 27ª is provided with a locking and registering rib 161 adapted to co-act with the groove 156 in the side of the die-blank 40ª, thus securing that the die-blank may be removed and replaced without change of position relatively to the cutter. The shaft or stem 9ª is carried within a sleeve 162 and is adapted to move lengthwise thereof. The sleeve 162 is provided with a forked head 163 and the cross head 10ª fast on the shaft 9ª is provided with a rectangular arm 164 adapted to

fit between the parallel prongs of the fork 163. The set screw 165, passing through one of the prongs of the fork, 163, is adapted to co-act with the arm 164 to secure the same immovably between the prongs 163; by these means the shaft or stem 9^a is compelled to rotate or rock with the shaft or sleeve 162 and may be adjusted, together with its attached parts, longitudinally of said sleeve. The sleeve 162 itself fits within a sleeve 166 which is journaled in the bearing 8 in the bed 4. The sleeve 166 is provided with a fork 167 inside the fork 163. At its other end the sleeve 166 is provided with a collar 168 having parallel arms or a fork 169; the said collar 168 being firmly attached to the sleeve 166. The fork 167 and collar 168 prevent the sleeve 166 from moving endwise in its bearing, as they themselves abut against the ends of bed 4. The sleeve or shaft 162 projects beyond the sleeve 166 at the front of the machine and is provided with a sleeve 16^a fast thereto, and the sleeve 16^a is provided with a bent arm 170 which fits between the prongs of the fork 169, above named; whence it results that any motion of rotation of either sleeve 162 or 166 is communicated to the other, while the sleeve 162 may slide lengthwise of the sleeve 166 to a limited extent, spaces 171 and 171^a between the collar 168 and sleeve 16^a and between forks 163 and 167 being left to provide for this endwise motion of the sleeve 162. The actuating-lever 22 is provided with prongs or forks 21^a pivoted upon the stud or shaft 17 which passes through the sleeve 16^a and through the slot 172 in the shaft 9^a. One of the arms 21^a is slotted at 55 for the reception of the figure-proportioning-sleeve 56, which is or may be similar in all respects to that hereinbefore described and may be similarly secured in place. The pin 63 in this instance provides a pivotal connection for the rod or link 51^a with lever 22; at its other end the link is pivoted to the parallel arms 167 by means of the pin 173.

The vise 27^a is provided with a set screw 174 by which it is clamped to the rod 15^a. The vise is of a length less than the distance between the inner surfaces of said arms, thus providing for its adjustment lengthwise of the said rod for the purpose of providing for upper and lower case dies in one and the same blank. The adjustments secured by the arm 164, fork 163, rod 15^a and set screws 165 and 174 provide for the formation of two or more pairs of dies in the same die block 40^a, as indicated in Fig. 38.

The operation of the modification illustrated in Fig. 38 is as follows: It being understood that the cutter rod 106 is operated in the manner hereinbefore described, and that a die-blank is in position in the vise and a guide-plate in position on the platform 88, the tracing pin 78 is placed at the center of the pattern 132 and the machine started. The cutter, under the action of spring 125 soon sinks into the die to the depth allowed by its nut 109, and then the tracing-pin 78 is moved along one of the branches of the pattern, let us say, lengthwise of the pattern. This swinging motion of the lever 22 rotates the shaft 9^a, sleeve 162, and sleeve 166 but produces no endwise motion of the sleeve 162 or shaft 9^a. The fork 169, arm 170 and the other parts secure that the rear end of the link 51^a, to wit, that end pivoted on pin 173, shall rotate about the axis of shaft 9^a in unison with the front end or that pivoted on the pin 63. The vise 27^a is rotated about the axis of the stem 9^a and the curved face 131 (see Fig. 31) is that produced by moving the tracing-pin along as described. To produce the cross cut, the tracer is brought to the center of the pattern and is then moved across the pattern, and causes the lever 22 to pivot upon the pin 63 and move sleeve 162 and the stem 9^a to the rear and then to the front; this causes the cutter to produce the cross cut or groove; the groove produced in this operation corresponds to the straight face 130^a of Fig. 32. The die, in this instance, may be formed by one, two or three cutters adjusted and used as hereinbefore described. To form the other, say upper, case letter or mark, the vise 27^a is adjusted along the rod 15^a to abut against arm 11^a and is secured in its new position, and the foregoing operations are repeated.

The method of producing enlarged or reduced dies from one and the same pattern is the same in this instance as in the preceding case or that shown in Figs. 1 and 2. The adjustment of the figure-proportioning sleeve up and down secures the same variations in the results as in the case hereinbefore described.

It is noted that the blank holder in both the cases shown has motion in the direction of the length of the shafts 9 and 9^a (and 166); in one case, this motion is a swinging motion about the shaft 15 and in the other case it is a straight or rectilinear motion. It is noted also that the axis of the cutter bar 106 (produced) intersects the axes of shafts 9, (9^a) and 15 (produced, if necessary.) It is noted further that the end milling tool or cutter 105 works under endwise pressure or has endwise support and acts or cuts by an end edge or edges and not by a peripheral or reaming cut, being in this respect very similar to twist-drills and carpenter's bits. It is also noted that the axis 15 and the axis of the cutter lie in a plane and that the axis of the shaft 15 swings about the axis of the shaft 9 and in said plane, whence it results that the angle between the (produced) axis of the cutter 105 and the axis of shaft 15 varies during the operation of the machine.

Heretofore, in producing master punches

or matrices it has been found nearly impossible to space or position the two or more characters thereon with the exactness required, and hence when placed in a writing machine at least one of the letters has usually been found to be out of line, either vertically or sidewise, or both, or perhaps canted over, rendering it necessary to file, cut, twist, bend, compress, expand and otherwise treat the type in order to get both letters in perfect alinement with the other types in the machine, and as such alterations in the type are difficult to make and require special tools and appliances, as well as the utmost skill of a trained workman, the process has proved very costly. Particularly was this the case where special types were required for an existing writing machine. Such types were made by hand, without the use of master punches or dies. By my invention this difficulty is wholly avoided, and each character in the group is positioned with the utmost accuracy without the necessity of special training or skill on the part of the workman, so that the expense of alining the types on a writing machine is materially reduced. Heretofore, in making special types having a plurality of characters thereon, the usual appliances for making duplicate type faces could not be made available, and the types were necessarily hand-engraved in a laborious manner by a skilled mechanic. To illustrate, in the ordinary "Remington" writing machine the character "#" is placed upon the same type with the figure "3", and if it should be desired to substitute a "£" mark for the former, it would be necessary to engrave by hand both the "£" and the "3" upon a single type-blank, to be placed directly in the writing machine. By my invention, a blank is placed in the blank-holder, the usual pattern for the figure "3" is placed in the pattern-holder, and the character "3" is formed upon the blank in the described manner. Then the pattern is removed, the usual pattern for "£" substituted, the blank shifted, and the character "£" formed thereon, both characters being formed in absolutely correct position upon the blank, without requiring the services of either a trained mechanic or a skilled engraver.

Of course the invention or improvement is equally well adapted for making dies for single type or characters, and many changes may be made without departing from my invention. The invention may be used for other purposes than making dies for type. I have shown my invention carried out in the form of a machine for cutting the type faces of matrices, but many of my improvements are obviously applicable to machines for cutting the type faces of master punches used in making matrices for writing machine types, especially where it is desired to properly position several characters upon a single punch. By the term "type face" I mean to include type faces whether formed intaglio in a matrix or in relief on a master punch.

It will be observed that in both forms of my machine the swinging element has not only a swinging motion upon an axis but also a motion longitudinally of said axis. The last mentioned motion is in one machine a swinging motion, whereby the horizontal lines of the types are curved, but in the other machine, it is a straight line motion, so that such horizontal lines are given a straight formation.

In the machine illustrated at Fig. 2, the point of the cutter is held at an unvarying or set distance from the main axis or shaft 9, and also in the vertical plane in which the axis 15 swings during the cutting operation. The point of the cutter works at the intersection of two vertical planes, one whereof passes through the axis 9 and the other whereof passes through the axis 15. The work holder swings with a universal joint motion which is secured by mounting a movable axis crosswise upon a fixed axis. The tracing lever is mounted upon the fixed axis and connected to the movable axis. The axes are arranged at unequal distances from the point of the cutter, the tracing lever being mounted upon the axis nearer said cutter. The face of the work lies between the point of the cutter and both of said axes. The skeleton pattern letter, which the tracer constantly fits, is so mounted in the machine that the grooves extending from the top to the bottom of the skeleton letter grooved in the matrix by the cutter, that is, the grooves extending along the vertical axis of the letter, are curved concentrically with the axis which is nearer the point of the cutter, and the grooves extending across said matrix letter are curved concentrically with the other axis. In other words the groove in the pattern letter which extends from the top to the bottom of said letter is traversed by the tracing pin 78 when it moves in a direction to and from the operator, viewing Fig. 2, and when said tracer pin moves to the right and left in said view it traverses the crosswise groove of the letter in the pattern plate. Means are provided for enabling a relative straight-line shift to be effected between the cutter and the work, so that the cutter may produce a plurality of letters upon a single blank. By means of automatically operating devices the grooves which extend in the direction of the work-shifting movement are cut on predetermined uniform convex curves. The work holder swings upon an axis 9 which extends at right angles to the direction of said work-shifting movement. The tracing lever mounted upon said axis is connected to means for effecting relative surface movements of the cutter and work

holder in a direction longitudinally of said axis 9, said movements being produced by means of the link 61, which causes the work holder to swing upon the axis 15. It will also be seen that relative movements of the cutter and the face of the work are effected in the direction of the axis of the cutter, so that grooves are cut in the work concentrically with both axes 9 and 15, or in other words, the work is tipped up and down so as to cause the cutter to penetrate more or less into the work, in order to form the letters on the desired curves.

Some of the claims are specific to the form of machine shown in Figs. 1 and 2, etc. and some of said claims are broad enough to read both on that form of the invention and on the form shown in Fig. 38. The form of the invention shown in Fig. 38 is claimed specifically in a divisional application of mine filed May 1st, 1901, Serial No. 58,274.

The process of forming typewriter types herein set forth is claimed in a divisional application, filed December 23rd, 1907, Serial No. 407,850.

What I claim as new and desire to secure by Letters-Patent, is:—

1. In a machine for cutting type forming dies, the combination of a pointed cutter and a work holder, means whereby one of said parts is mounted to swing on a fixed axis and also on a swinging axis at right angles to the fixed axis, the fixed axis being between the point of the cutter and the swinging axis, and the point of the cutter being at a fixed distance from the fixed axis and in the plane of the swinging axis during the cutting operation.

2. The combination of a pointed rotary cutter, a work holder, means whereby one of said parts is mounted to swing about two axes one of which is fixed, means for holding the point of the cutter at a fixed working distance from said fixed axis, and a tracer operatively connected to said swinging part and operative to swing it.

3. The combination of a pointed rotary cutter, a work holder, means whereby one of said parts is mounted to swing about two axes arranged at unequal distances from the point of said cutter and at right angles to each other and to the axis of said cutter, and a tracer operatively connected to said swinging part and operative to swing it about both of said axes.

4. The combination of a pointed rotary cutter, a work holder, a pivot about the axis of which said work holder is mounted to swing and the axis of which extends at right angles to the axis of the cutter, a swinging support upon which said pivot is mounted, said swinging support having a transverse axis arranged closer to the point of the cutter than said pivot, and a tracer mounted upon said swinging support and connected to means for moving the work holder about the first mentioned axis.

5. The combination of a pointed rotary cutter, and a work holder, means whereby one of said parts is being mounted to swing upon both a fixed axis and a movable axis, the axes being arranged transversely of each other, the fixed axis lying between the point of the cutter and the movable axis, and the face of the work lying between the point of the cutter and both of said axes.

6. The combination of an endwise motionless journaled shaft having a fixed axis, a matrix holder pivotally mounted upon said shaft, the axis of said pivot being at right angles to said shaft, a tapering cutter, means for holding said cutter at a fixed working distance from the said fixed axis during the cutting operation, a tracing lever operatively connected to said journaled shaft and independent connections from said tracing lever to said matrix holder.

7. The combination of a pointed rotary cutter, a work holder, means whereby said work holder is mounted to swing on two axes arranged at right angles to each other, one axis being fixed and nearer the point of the cutter than the other, means whereby the point of the cutter is always maintained in a fixed working position relatively to the fixed axis of said work holder and at the intersection of vertical planes passing through said axes, a pattern letter, a pattern tracer operatively connected to said work holder to swing it about said fixed axis, and independent connections between said work holder and said pattern tracer to swing the work holder about the other axis.

8. The combination of a rock shaft having a fixed axis, a matrix holder mounted thereon and movable so as to move the face of the matrix in the general direction of said axis, a tapering cutter, means for holding said cutter at a fixed distance from said shaft during the cutting operation, and a tracing lever operatively connected to said shaft and matrix holder.

9. The combination of a rotary pointed groove cutter, a work holder having gages, means whereby a relative shifting movement may be effected between the cutter and the work so that the cutter may produce a plurality of letters upon a single blank, a pattern holder having gages, a manually controlled pattern tracer, and automatically operating means for causing the cutter to cut grooves which extend in the direction of said shifting movement upon predetermined uniform curves.

10. The combination of an axis or shaft, a pattern tracer mounted thereon, a work-holder also mounted upon said axis or shaft and shiftable transversely thereof, and a pointed rotary cutter.

11. The combination of a rotary pointed

groove cutter, a work holder, means for enabling a relative straight-line shifting movement to be effective between the cutter and the work, so that the cutter may produce a plurality of letters upon a single blank, and means for causing the cutter to groove a letter in the work, said means including a pattern tracer and also including automatically operating devices for causing the cutter to cut the grooves which extend in the direction of said shifting movement on predetermined uniform convex curves.

12. The combination of a rotary pointed groove cutter, a work holder, means whereby the work can be shifted to different set positions so that the cutter may produce a plurality of letters upon a single blank, a pattern tracer connected to said work holder, and automatically operating means for causing the cutter to cut the grooves which extend in the direction of the work shifting movement upon uniform convex curves.

13. The combination of a rotary pointed cutter, a support, means whereby said support is mounted to swing about a fixed axis, a work-holder, means whereby said work-holder is pivotally mounted on said support to swing about an axis transverse to said fixed axis, said work holder being shiftable in a direction parallel with said swinging axis and without changing the plane of the work relatively to said fixed axis, so that the cutter may produce a plurality of letters upon a single blank, and a manually controlled tracer for swinging said work holder upon both of said axes.

14. The combination of a rotary pointed cutter having a fixed working position, a work holder, means whereby said work holder is mounted to swing upon a fixed axis, said holder being shiftable in a direction at right angles to said axis, stops for limiting the shifting movements of the holder, and a tracer for swinging said holder upon said axis, said tracer being also connected to means for moving said holder longitudinally of said axis.

15. The combination of a pointed rotary cutter, a matrix holder, a pattern plate having a grooved letter, the groove being of uniform width, a manually controlled tracer fitting said groove, means for causing the cutter to cut the grooves in the work automatically upon predetermined convex curves, and means whereby a relative adjustment of the cutter and matrix holder can be effected independently of the tracer and pattern, so that a plurality of type faces may be grooved in a single matrix on convex curves.

16. The combination of a pointed cutter, a shaft having a fixed axis, a matrix holder mounted upon said shaft and adjustable longitudinally thereon, and a manually operated tracer operatively connected to said matrix holder.

17. The combination of a pointed groove cutter, a matrix holder, means including a pattern tracer, for causing the cutter to cut a letter in the work, said means also including automatically operating devices for causing the cutter to cut grooves extending in one direction upon predetermined convex curves, and means whereby set adjustments of said matrix holder can be effected in a direction transversely of said grooves.

18. The combination of a pointed cutter, a shaft having a fixed axis, a matrix holder mounted thereon, a manually controlled pattern tracer connected to said shaft and also connected to means for causing a relative surface movement of the matrix holder and cutter in a direction longitudinally of said fixed axis, and means whereby a relative set adjustment of the cutter and matrix holder can be effected in a direction transversely of said axis.

19. The combination of a shaft, a pattern tracer mounted thereon, a work holder also mounted upon said shaft and bodily adjustable transversely thereof, a pattern holder shiftable toward and away from said shaft, and a tapering rotary cutter

20. In a die or matrix cutting machine, the combination of a revolving cutter, a blank holder, means whereby said blank holder is mounted to have a swinging movement and also to move in a direction at right angles to its swinging movement, a tracer for controlling said swinging movement, and a forked link 51 for connecting the tracer to the blank holder to control said right-angle movement thereof.

21. A machine for cutting writing machine type faces, including a tapering cutter 106 shaft 9, a manually actuated pattern tracer connected to said shaft, axis 15 mounted upon shaft 9 crosswise thereof, blank holder 27 mounted on pivot 15, and adjusting screws 70 for swinging the blank holder upon the axis 15 independently of the tracer and pattern.

22. A machine for cutting writing machine type faces, including a tapering cutter 106, shaft 9, a manually actuated pattern tracer connected to said shaft, pivot 15 mounted upon shaft 9 crosswise thereof, blank holder 27 mounted on pivot 15, adjusting screws 70 for swinging the blank holder upon the pivot 15 independently of the tracer, and means whereby the blank holder can be adjusted in a direction parallel with pivot 15.

23. In a die or matrix cutting machine, the combination of a cutter, a blank-holder, an actuating lever, and mechanism intermediate said lever and said holder for moving said holder in two directions at right angles to each other, said mechanism being connected with said lever by two pivots having parallel axes, one of said pivots being adjustable toward and from the other,

whereby the dimensions of the dies formed may be varied in one direction without varying them in the other, substantially as described.

24. In a die or matrix cutting machine, the combination of a cutter, a blank-holder, a mounting for said blank-holder comprising means to allow to said blank-holder a universal motion, an actuating lever, and two mechanisms independently connecting said lever with said holder for communicating the motions of the lever thereto, one of said mechanisms being adjustably connected to the lever in the direction of the length of the lever, whereby one dimension of the die may be varied without varying the other, substantially as described.

25. In a die or matrix cutting machine, the combination of a cutter, a journaled shaft, a blank holder movably connected to said shaft to move the face of the blank to and fro in the direction thereof and also connected to be swung with said shaft, a lever pivotally connected to said shaft so as to swing in the direction of the length of said shaft and so as to rock said shaft, positive connections between said lever and said holder for moving the holder independently of said shaft, and means for varying the distance between the pivotal connections of said lever and shaft and of said lever and said positive connections, whereby the dimensions of the die formed may be varied in one direction without varying them in the other; substantially as described.

26. In a die or matrix cutting machine, the combination of a cutter, a blank-holder, an axis or shaft forming a pivot for the holder, a second shaft at right angles to and connected with and carrying the first-named shaft, an actuating lever pivoted upon and rotating the second-named shaft, and connections between said actuating lever and said holder independent of said second shaft, whereby the movements of the lever are communicated to the blank-holder, substantially as described.

27. In a die or matrix cutting machine, the combination of a cutter, a journaled shaft, a blank holder pivotally connected to said shaft on an axis at right angles to said shaft, a lever pivotally connected to said shaft and rocking it, and a link connecting said lever and said holder for rocking said holder on said axis; substantially as described.

28. In a die or matrix cutting machine, a cutter, arranged to revolve in a fixed position, combined with a blank-holder, pivotal mountings for said blank-holder arranged to allow said blank-holder to swing on axes at right angles to each other and the axis of motion of said cutter intersecting both axes of said holder, means for affording an adjustment of said holder to different positions whereby two or more characters may be cut in a blank, and means comprising the actuating lever 22 and connections for actuating said holder, substantially as described.

29. In a die or matrix cutting machine, a blank-holder, pivotal mountings for said blank-holder arranged to allow said blank-holder to swing on axes at right angles to each other, combined with a cutter arranged to revolve in a fixed position, and having its axis intersecting both axes of motion of said holder and means, comprising the adjustable figure proportioning sleeve 56, for actuating said blank holder, substantially as described.

30. In a die or matrix cutting machine, the combination of a revoluble cutter, a blank-holder, mountings for said blank-holder arranged to allow said blank-holder to move in two directions at right angles to each other, an actuating lever 22 provided with a slot 55 extending lengthwise thereof, an endwise movable tracer 78 connected with the lever, the figure proportioning sleeve 56 in and adjustable along said slot 55, a rock shaft pivotally connected with said lever and rotated thereby, connections from said shaft to said holder for moving said holder in one direction, a link pivotally connected with the sleeve 56 and connections from said link to said holder for moving it in a direction at right angles to the direction of the motion communicated thereto by the said rock shaft, substantially as described.

31. In a die or matrix cutting machine, the combination of a cutter, a rock shaft 9 provided with a forked end, a shaft 15 borne by said forked end with its axis at right angles to shaft 9, a blank-holder having shaft 15 for an axis of motion, an actuating lever pivoted to said shaft 9 at right angles to the axis thereof and adapted to rotate the same, and connections between said actuating lever and said holder independent of the said rock shaft 9, whereby the holder is given swinging motion in two directions at right angles to each other by the universal motion of the actuating lever, substantially as described.

32. In a die or matrix cutting machine, the combination of a cutter, a rock-shaft 9 having a cross head 10 provided with arms 11 and 12, a shaft 15 borne by said arms and at right angles to the shaft 9, a blank-holder borne by the said shaft 15, a yoke also borne by the said shaft 15 and connected with the holder, an actuating lever 22 pivoted to the shaft 9 upon a pivot at right angles thereto, and a forked link pivotally connected to the said yoke and to the said actuating lever, substantially as described.

33. In a die or matrix cutting machine, the combination of a cutter, a rock shaft provided with a forked end, a second shaft at right angles to the first and borne by said forked end, a blank-holder borne by said

second named shaft, a yoke also borne by said second shaft and connected with the holder, an actuating lever connected to the first-named shaft by a pivot parallel with the second shaft, and a link pivotally connected to said yoke and to said lever, substantially as described.

34. In a die or matrix making machine, a blank-holder comprising a block provided with two extensions or standards, a jaw removably secured to one of said extensions of the block and provided with a ledge or horizontal arm and with blank-holding pins or stops and a catch, a movable jaw resting on said ledge, and a screw passing through the other of said extensions and operating said movable jaw, substantially as described.

35. In a die or matrix cutting machine, a cutter revolving in a relatively fixed position, a block provided with blank-holding devices at its upper side, a shaft or rod on which said block is pivoted, a yoke also pivoted on said shaft or rod and extending below the same, two arms or extensions on said block and at the sides of said under part of said yoke, and screws passing through said arms and bearing against said under part of said yoke, whereby the central line of the blank may be adjusted relatively to the cutter, substantially as described.

36. In a die or matrix making machine, the combination of the block 27 provided with extensions 29 and 30, the angle-jaw 31 provided with pins 33 and a spring-operated blank-catch 34, the jaw 32 movable toward and from the jaw 31, and a screw 41 for operating the jaw 32, substantially as described.

37. In a die or matrix cutting machine, the combination of a cutter revolving in a relatively fixed position, a rock shaft provided with a cross head having arms extending in the direction of said shaft, a cross shaft or rod borne by said arms, a blank-holder borne by said cross shaft or rod and adjustable along the same to provide for at least two dies in one and the same blank, and means for securing said holder in the positions to which it is adjusted, substantially as described.

38. In a die or matrix cutting machine, the combination of a cutter revolving in a relatively fixed position; a blank-holder, an extensible actuating lever, a tracer freely movable lengthwise of said lever, a pattern carrying platform adjustable toward and from the axis of motion of said lever, and mechanism intermediate said lever and said holder for giving said holder universal motion, said mechanism being connected to said lever at two points by pivots having their axes parallel to each other and one of said axes being adjustable toward and from the other, whereby dies may be formed from one and the same patterns and have their heights and widths or either of these varied, substantially as described.

39. In a machine for forming dies from which to make types to coöperate with cylindrical platens of writing machines, the combination of a pointed rotary cutter, a blank holder, mountings for one of said elements arranged to allow said element to swing on axes at right angles to each other, one of said axes being fixed and the other movable, and means for maintaining the point of the cutter while cutting the character in the blank always at a fixed distance from the fixed axis, and the distance from the point of the cutter to the movable axis being equal to the radius of the platen with which the types are to be used, a letter pattern, means for traversing the latter, and connections whereby the movements of said swinging element are controlled by said letter pattern and the cutter thus caused to produce in the blank type-faces cut on predetermined curves.

40. In a machine for cutting dies from which to form type faces on predetermined curves, the combination of a pointed cutter, and a die or work holder, a pivotal mounting for one of said parts arranged to allow to said part a swinging movement about a fixed axis, means for affording to said parts also a relative movement such that the point of the cutter and the face of the work have a relative movement longitudinally of the axis of said swinging movement, means for normally holding the work holder and the end of the cutter at unvarying distances from said axis, and means for guiding the relative motions of said parts in accordance with the outlines of type characters, substantially as shown and described.

41. In a machine for cutting matrices from which to form types having predetermined curved faces, the combination of a pointed rotary groove cutter and a work holder, means for affording to one of said parts swinging motions about non-intersecting axes at right angles to each other, one axis being fixed and the other arranged to swing, means for maintaining the point of the cutter at a fixed distance from the fixed axis and in a fixed relation to the plane in which the swinging axis swings during the cutting operation; and means for guiding the swinging motion of said swinging part in accordance with type characters.

42. In a machine for cutting dies from which to form type faces on predetermined curves, the combination of a pointed cutter, and a die or work holder, means for affording to one of said parts a swinging movement on a fixed axis and also a movement longitudinally of the axis of said swinging movement, means for maintaining the cutter unvarying in its distance from said fixed axis during the cutting operation, a pattern plate, a pattern

tracer, and means for communicating the movement of the pattern tracer to said swinging part, substantially as shown and described.

43. In a machine for cutting dies from which to form types with curved faces, the combination of a pointed rotary cutter and a blank-holder, means for affording to one of said elements swinging movements on axes arranged at right angles to each other, and one of said axes being fixed and the other swinging thereabout, means for guiding the motion of the parts to cause said cutter to cut curved grooves having the form of type characters below the surface of the blank on arcs the curvatures of which are predetermined by said axes, and means for maintaining the point of the cutter at a fixed distance from the fixed axis during the cutting operation, whereby a grooved letter may be cut below the surface of the blank upon predetermined curves.

44. In a machine for cutting dies from which to form types with curved faces, independent of a model having such face, the combination of a pointed rotary cutter and a blank-holder, means whereby one of said elements is mounted to swing on a fixed axis and to move in the direction of said axis, means for guiding the motion of the parts to cause said cutter to cut a curved groove having the outline of a type character below the surface of the blank, and means for maintaining the point of the cutter at a fixed distance from the axis about which the swinging element swings during the entire cutting operation, whereby a grooved letter may be cut below the surface of the blank upon a predetermined curve.

45. In a machine for cutting type forming dies having predetermined intaglio curved faces, the combination of a die holder, a pointed rotary cutter, means for affording to one of said parts a swinging movement about a fixed axis and also a movement longitudinally of said axis, means for causing the point of the cutter to enter the die for a given distance and for then holding the point of the cutter at an unvarying distance from the said fixed axis during the cutting operation, and means for guiding the movement of said movable part in accordance with the outline of a type character.

46. In a machine for producing writing machine type matrices, the combination of a pointed rotary cutter, a work holder, means for affording to one of said parts swinging movements about both a fixed axis and a movable axis, said axes being arranged at right angles to each other and at unequal distances from the cutter, the fixed axis lying between the point of the cutter and the movable axis and the face of the work lying between said axes and the point of the cutter, a pattern tracer, and a pattern letter so mounted in the machine that the grooves extending from the top to the bottom of the letter cut in the matrix by said tool are curved concentrically with the axis which is nearer the point of the cutter.

47. In a machine for producing writing machine type matrices, the combination of a pointed rotary cutter, a work holder, one of said parts being mounted to swing upon axes which are arranged at right angles to each other, said work holder being arranged to hold the face of the work between the point of the cutter and said axes, a pattern tracer connected to said swinging part and adapted to actuate it, and a pattern letter so mounted upon the machine that grooves extending from the top to the bottom of the letter cut in the matrix by said tool are curved concentrically with one of said axes, and grooves extending across the letter are cut concentrically with the other of said axes.

48. In a machine for producing writing machine type matrices, the combination of a pointed rotary cutter, a work holder, pivotal mountings for said work holder arranged to allow said work holder to swing upon two axes which are arranged at right angles to each other, said work holder being arranged to hold the face of the work between the point of the cutter and both of said axes, a pattern tracer connected to said work holder, and a pattern letter so mounted upon the machine that grooves extending from the top to the bottom of the letter cut in the matrix by said tool are curved concentrically with one of said axes, and grooves extending across the letter are cut concentrically with the other of said axes.

49. The combination of a rotary pointed cutter, a work holder, a pattern tracer, and means whereby a relative rectilinear shifting movement effected between the cutter and the work holder in a direction to bring a fresh part of the work into position to be operated on by the cutter without affecting the disposition of the tracer so that the cutter may produce a plurality of letters upon a single blank, means for affording to one of said cutter and work holder elements swinging movements about an axis arranged at right angles to the direction of said shifting movement, said pattern tracer being connected to said swinging part.

50. The combination of a rotary pointed cutter, a work holder, a pivot upon which said work holder swings, a pattern tracer connected with said work holder, means whereby a relative rectilinear shifting movement can be effected between the cutter and the work holder in a direction to bring a fresh part of the work into position to be operated on by the cutter without changing the disposition of the tracer, so that the cutter may produce a plurality of letters upon a single

blank, said shifting movement being at right angles to the direction of the axis of said pivot.

51. The combination of a rotary pointed cutter, a work holder, a manually controlled pattern tracer, means whereby a relative rectilinear shifting movement can be effected between said cutter and work holder without affecting the disposition of the manually controlled pattern tracer, so that the cutter may produce a plurality of letters upon a single blank, a pivotal mounting for one of said cutter and work-holder elements having its axis at right angles to the direction of said work shifting movement, means connecting said tracer to said axis and means controlled by said tracer for effecting relative movements of the cutter and work holder in a direction longitudinally of said axis.

52. The combination of a rotary pointed cutter, a work holder, a manually controlled pattern tracer, means whereby a relative shifting movement between the cutter and work holder can be effected without changing the disposition of the manually controlled pattern tracer, so that the cutter may produce a plurality of letters upon a single blank, a pivoted mounting for one of said cutter and work holder elements swinging on an axis at right angles to the direction of said shifting movement and said manually controlled pattern tracer being mounted upon said pivoted mounting; and means controlled by said tracer for effecting relative movements of the cutter and the work holder in a direction longitudinally of said axis.

53. The combination of a pointed rotary groove-cutter, a matrix-holder, means for affording to said parts a relative swinging motion, a pattern plate having a grooved letter, the groove being of uniform width, a manually-controlled tracer fitting said groove, means for preventing endwise movement of said cutter while cutting a groove in the work, and means whereby a relative adjustment of the cutter and matrix-holder can be effected independently of the tracer and pattern, so that a plurality of type faces may be cut in a single matrix.

54. The combination of a pointed groove cutter, a matrix holder, means whereby set adjustments of the matrix holder can be effected in two directions at right angles to the axis of the cutter, a pattern holder, and means, including a pattern tracer, for causing the cutter to groove a letter in the work, said means also including automatically operating devices for causing the cutter to cut grooves extending in one direction upon predetermined convex curves.

55. The combination of a rotary pointed cutter, a work-holder, means for causing the cutter to groove a letter in the work, said means including a pattern tracer and also including automatically operating devices for causing the cutter to cut upon a predetermined convex curve grooves extending in one direction, and said means including means whereby the ratio between the movements of the said tracer and the corresponding groove-cutting movements can be varied.

56. The combination of a pointed rotary cutter, a work holder, one of said parts being mounted to swing upon a fixed axis, means for holding the point of the cutter at a set distance from said axis, a manually controlled tracer connected to said swinging part, means for enabling said tracer to move said swinging part in a direction transverse to the direction of its said swinging movement, and means whereby the ratio between the motion of the tracer in one direction and the corresponding motion of said swinging part, can be varied without varying the ratio of movement in the other direction.

57. The combination of a tapering cutter, a work holder, means for providing a rectilinear, bodily relative shifting movement between the cutter and the work holder so that a plurality of letters may be cut upon a single blank, a manually controlled tracer, means whereby said tracer effects a relative motion between the cutter and the work holder, a pattern letter so fixed in the machine that the vertical axis of the type face produced from said pattern letter lies in the direction of said shifting movement, and means for varying the ratio between the movement of the pattern tracer and the corresponding letter-cutting movement.

58. The combination of a pointed groove cutter, a work holder, means for providing a rectilinear, bodily shift of the work holder so that a plurality of letters may be cut upon a single blank, a manually controlled pattern tracer operatively connected to said work holder, and means for varying the ratio between the movement of the tracer and the corresponding movement of the work holder.

59. The combination of a tapering rotary cutter, a work holder, a pattern holder, a manually controlled tracer, means for providing a relative rectilinear, bodily shift between the cutter and the work so that a plurality of letters may be cut upon a single blank, and means for varying the ratio between the movement of the tracer and the corresponding letter-cutting movement in a direction only transverse to the direction of said shift.

60. The combination of a matrix holder, a removable rotary tapering cutter, a releasable spring for pressing said cutter into the work, said spring being releasable in order to permit of the removal of the cutter, a relatively fixed stop for said cutter, a letter pattern, a tracer, and means whereby said tracer effects a relative movement between said cutter and the work.

61. A machine for cutting writing machine type matrices, comprising a tapering cutter having a fixed position, a shaft having a fixed axis, a second shaft mounted transversely thereon and movable about said axis, and a matrix holder mounted upon the second shaft and bodily adjustable to a plurality of set positions thereon.

62. A machine for cutting writing machine type matrices, comprising a pointed rotary cutter and a matrix holder, means for affording to one of said parts swinging movements on nonintersecting crossed axes to cause the depressed type faces in the matrices to be cut automatically and uniformly with a predetermined double curvature, and means for moving said swinging part to cause the point of the cutter to trace the outline of a type character.

63. A machine for cutting writing machine type matrices, comprising a pointed rotary cutter, a matrix holder, means for affording to one of said parts swinging movements on one or more axes, means for holding the other of said parts in fixed relation to one of said axes to cause the depressed type faces in the matrices to be cut automatically and uniformly with a predetermined curvature, a grooved pattern, and a pattern tracer constructed to coöperate with the groove or grooves of said pattern and to control the configuration of the cut made by the point of the cutter.

64. In a die or matrix cutting machine, a blank holder, pivotal mountings for said blank-holder arranged to swing on axes at right angles to each other to enable grooved intaglio characters to be cut on predetermined curves, combined with a pointed cutter arranged to revolve in a fixed position and having its axis at all times intersecting both axes of motion of said blank holder, said blank holder being adjustable to various set positions, whereby two or more grooved intaglio characters having the same curves may be cut in one blank, and means for swinging said blank holder in accordance with the outline of a type character.

65. The combination with a work holder for holding a matrix blank and a cutter adapted to cut a matrix groove in said blank, one of said parts being movable with relation to the other; of means for guiding said movable part to cut a groove the bottom of which corresponds to the working face of a type, which working face is concave.

66. The combination with a work holder for holding a matrix blank and a cutter adapted to cut a matrix groove in said blank, one of said parts being movable with relation to the other; of means for guiding said movable part so that a groove cut by said cutter in said matrix blank shall have its bottom lying in a geometrical surface of double curvature, and a pattern and pattern tracer for controlling the motion of said movable part.

67. The combination with a matrix blank holder, and a groove cutter adapted to cut a matrix groove in said blank; of means supporting said parts for relative swinging motion about two crossed axes at different distances from the end of said cutter; and means for controlling such swinging motion in accordance with the outline of a type character.

68. The combination with a matrix blank holder and a pointed groove cutter adapted to cut a matrix groove in the blank held by said blank holder; of means supporting said parts for relative motion such that the end of the cutter is always in a predetermined curved geometrical surface having a fixed relation to the work holder; and means for guiding such relative motion in accordance with type characters, to cause said cutter to cut in said blank a matrix groove, the bottom of which lies in said geometrical surface and has the outline of a type character.

69. The combination with a work holder for holding a matrix blank and a cutter adapted to cut a matrix groove in said blank, said parts being relatively movable, of means for controlling the relative motion of said parts to cause said cutter to cut in said blank a matrix groove the bottom of which corresponds to the working face of a type, which working face is curved.

70. In an engraving machine, a suitable frame, a pattern, a stylus coöperating with the pattern and supported to have its tip swing freely in a horizontal plane, a cutting tool, a work-holder, and supporting devices for the work-holder comprising means for causing the latter to swing on one radius when the stylus swings in one direction and on a different radius when the stylus swings in a direction transversely of the first direction.

71. In an engraving machine, a frame, a pattern, a stylus-carrier movable horizontally in any direction and operatively related to the pattern, a rotary cutting tool, a work-holder-carrier supported to swing in one plane only, a workholder pivotally mounted on the workholder-carrier to swing at right angles to said plane, and operative connections between the workholder and the stylus-carrier.

72. In a machine for cutting matrices from which to form typewriter types, the combination of a cutter and a work holder, means for affording to said cutter and work holder relative swinging motion about two crossed axes at different distances from the point of the cutter, a pattern, a pattern tracer, means whereby said pattern tracer effects the relative swinging motion between the cutter and the work holder, and means whereby the dis-

tance between said pattern and said cutter can be varied so as to vary the ratio between the size of the character on the pattern and that of the character engraved in the matrix.

73. In a machine for cutting matrices from which to form typewriter types, the combination of a work holder fo holding a matrix, a pointed rotary cutter for cutting a matrix groove in the matrix, means for limiting the motion of said cutter toward the work holder, and means for effecting a micrometer adjustment of the cutter relatively to said limiting means, said cutter being removable from and replaceable in the machine without disturbing said micrometer adjustment.

74. In a machine for cutting matrices from which to form typewriter types, the combination of a pointed cutter, a work holder, means for causing said cutter to groove letters in a matrix held by said work holder, means whereby a relative shifting movement between the matrix and said cutter can be effected so that a plurality of characters may be engraved in a single matrix, and means for guiding the relative motion of said cutter and work holder in such fashion that each of the characters engraved on the matrix will have the lines that extend from top to bottom of the character formed on predetermined convex curves, the axes of curvature of the different characters on the matrix being parallel.

75. In a machine for forming dies from which to make types to coöperate with cylindrical platens of writing machines, the combination of a pointed rotary cutter, a blank-holder, pivotal mountings for one of said elements being arranged to swing on axes at right angles to each other, one of said axes being fixed and the other movable, means for maintaining the point of the cutter while cutting the character in the blank always at a fixed distance from the fixed axis, a letter pattern, means for traversing the latter, and connections whereby the movements of said swinging element are controlled by said letter pattern and the cutter thus caused to produce in the blank type-faces cut on predetermined curves.

76. The combination of a rotary pointed cutter, a work holder, a manually controlled pattern tracer, means whereby a relative rectilinear shifting movement between said cutter and work holder can be effected without affecting the disposition of the manually controlled pattern tracer so that the cutter may produce a plurality of letters upon a single blank, and means whereby one of said cutter and work holder elements is swung by said tracer about an axis at right angles to the direction of said shifting movement.

Signed at Ilion in the county of Herkimer and State of New York, this 27th day of May, A. D. 1898.

LOUIS ALBERT DISS.

Witnesses:
LOUIS P. DISS,
RALPH W. GOUGH.