

Modern Automatic Type Making Methods

Refinement of Machine Design, Unique Methods for Determination of Accuracy of Matrix. The Microscope a Factor of Machine Installation

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The accuracy of any result, either mathematical or concrete machine construction, is only determined by the accuracy of the means by which the results have been reached, and the art of type making, in which the greatest accuracy is conceded by those who know, would perhaps be better appreciated were we to stop and

use, he did it under a microscope, and with great strain on his eyes and nerves; at any moment the tool might slip and spoil the work. With the machine, however, and with no strain whatever, experimental punches have been cut so small as to be legible only with the aid of the microscope, too small, in fact, to print.

and at the same time produce a pleasing effect. When the printed page is viewed as a whole, and conveys information to the reader without attracting attention to itself, it is ideal, and the purpose and function of the machine is to give us that result.

DEVELOPMENT OF PATTERN

When the design of the character or letter has been satisfactorily determined upon, being either submitted to the firm or originally designed by them, it is placed upon the delineating machine, as shown in Fig. 1, being drawn so large that all errors are easily seen and corrected and begins the first step in its round of reproduction.

This machine is a refined pantograph with microscope attachment. Directly beneath the focal point of the microscope is a small bed plate or holder upon which is placed the model character or letter clamped in place by means of spring fingers. The intersection point of the cross-hairs of the magnifying instrument is focused on the outline of the character and the construction of the machine allows for constant change of position of the drawing, and consequently this intersec-

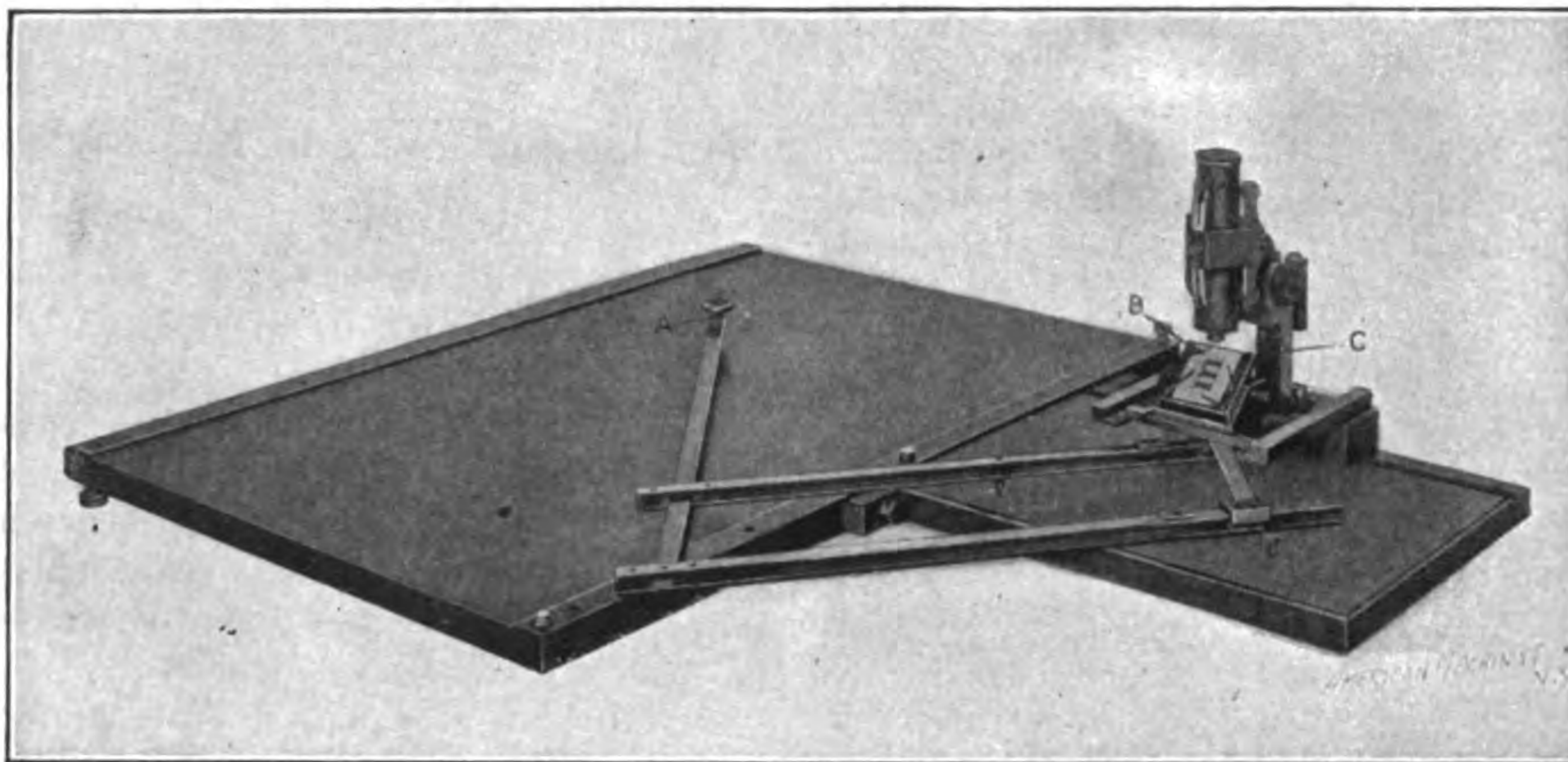


FIG. 1. DELINEATING THE CHARACTERS

A, tracing point; B, fingers for clamping character; C, bed plate showing angle possibilities.

consider the foundation upon which this concession is based, the building up step by step through the intricacies involved in the various processes that go toward making the master tools or matrices.

It is an art where the little things, measured in fractions of a thousandth of an inch are the big things as exemplified by the American Type Founders Company, of Jersey City, N. J., whose system makes each small step a refinement link in the whole chain of microscopic accuracy.

PRELIMINARY

The preliminary work is that of the artist who designs the various characters of type, but this same mind must also be capable of carrying into the machine design, the kind of art that will reproduce itself, because machines have superseded the old-fashioned method of cutting originals by hand, and have enormously increased the production of new type faces. Whereas, in the old days, it took about 18 months to bring out a new Roman face or style of letter, in seven different sizes, at present it can be done in about five weeks, the result being superior to handwork, in both accuracy and uniformity, and having a wider range, and by range I mean size.

When the old-time artist made an unusually small size of type, say, for Bible

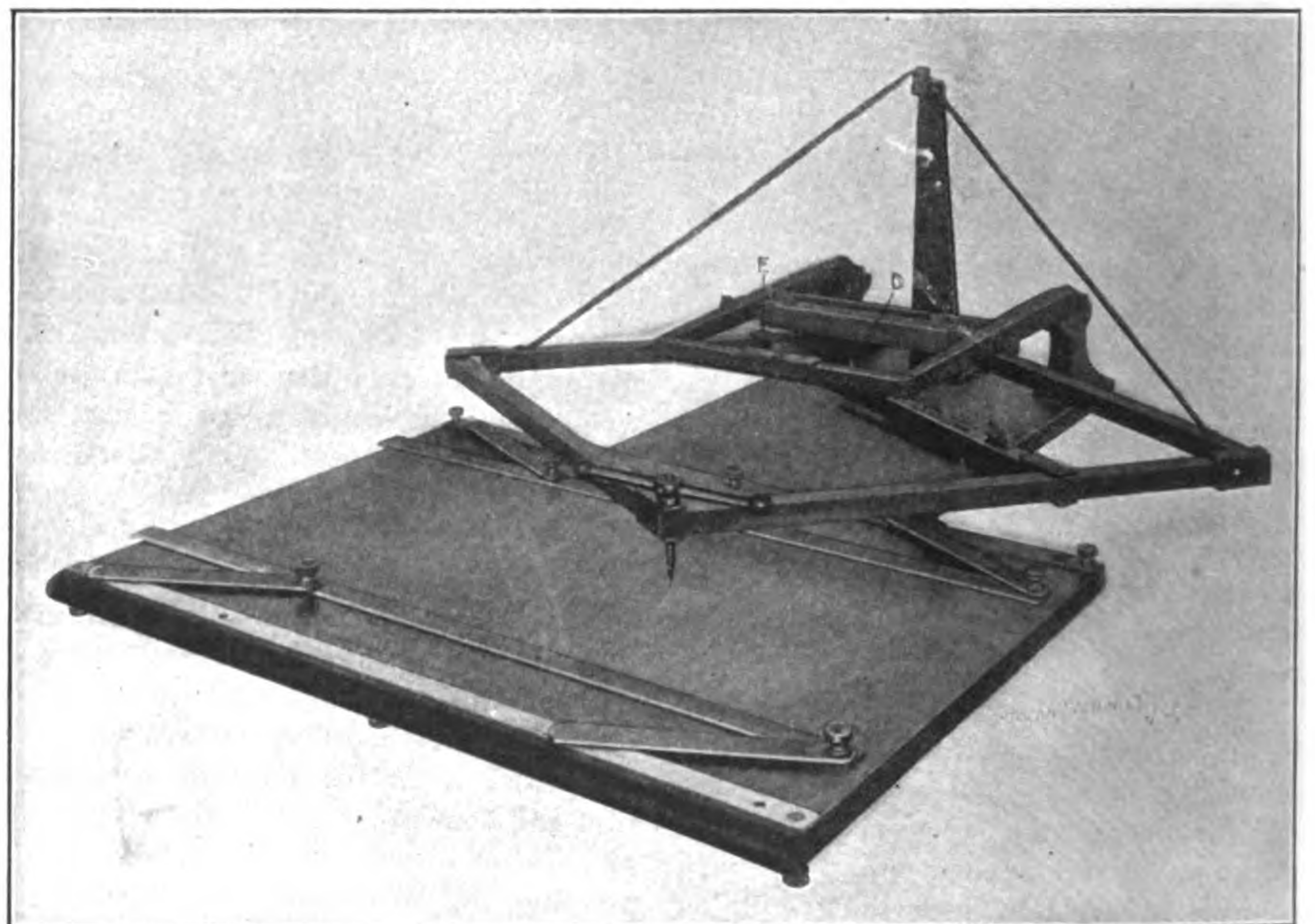


FIG. 2. DELINEATING ON WAX PLATE
D, tracing point inverted; E, frame for holding plate.

It is not, however, for the purpose of perfection that the machine is desirable, for perfection in anything is tiresome, but it is essential that the letters be proportioned and shaped in such a manner as to cause the least strain upon the eye in reading,

tion point which is made to follow the outline of the complete character and the pencil point of the extension arm of the machine reproduces the character enlarged.

The bed of the holder upon which the

original character is laid, can be swiveled to any angle, thereby changing the style of the letter to wide, narrow, back slope or italic, both the italic and back slope being produced through the combination of angles. This machine has a range of production from 0 to 96 point.

A REVERSAL OF FORM

When the original design submitted is large, the machine reproduction is backward, and reproduces it in small form by removing the microscope attachment and in its place attaching a small pencil arm which traces the outline of the letter by

nifying power required to produce the same error.

THE WAX IMPRESSION

The next step in the development of the letter toward the pattern stage is the outline in wax, which is made on a panto-

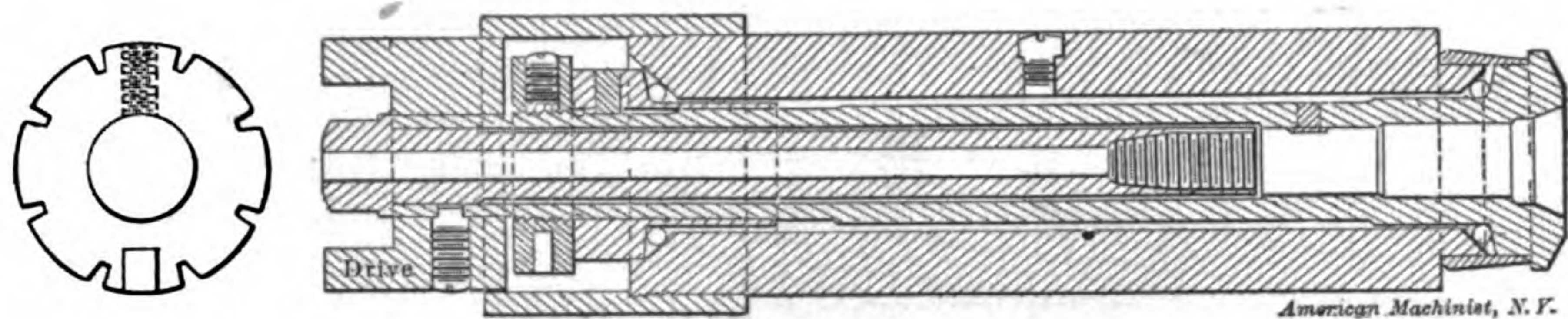


FIG. 4. CONSTRUCTION OF QUILL

able the operator to follow the movements of the needle through the varying outlines. This enlarged drawing is larger than the pattern size, so it is not only reproduced, but also reduced in this second step.

THE PATTERN

From this machine, after the ragged edges of the wax have been removed, it is electrotyped, a process which deposits in the outline sufficient metal to leave a raised character when the wax has been removed. This is "backed up" with metal, trimmed and finished similar to an ordinary electrotype plate of a page of type. This pattern is now ready for use as a model in the engraving machine.

THE ENGRAVING MACHINE—ITS CONSTRUCTION AND PRINCIPLE

In Fig. 3 is shown the next step in the

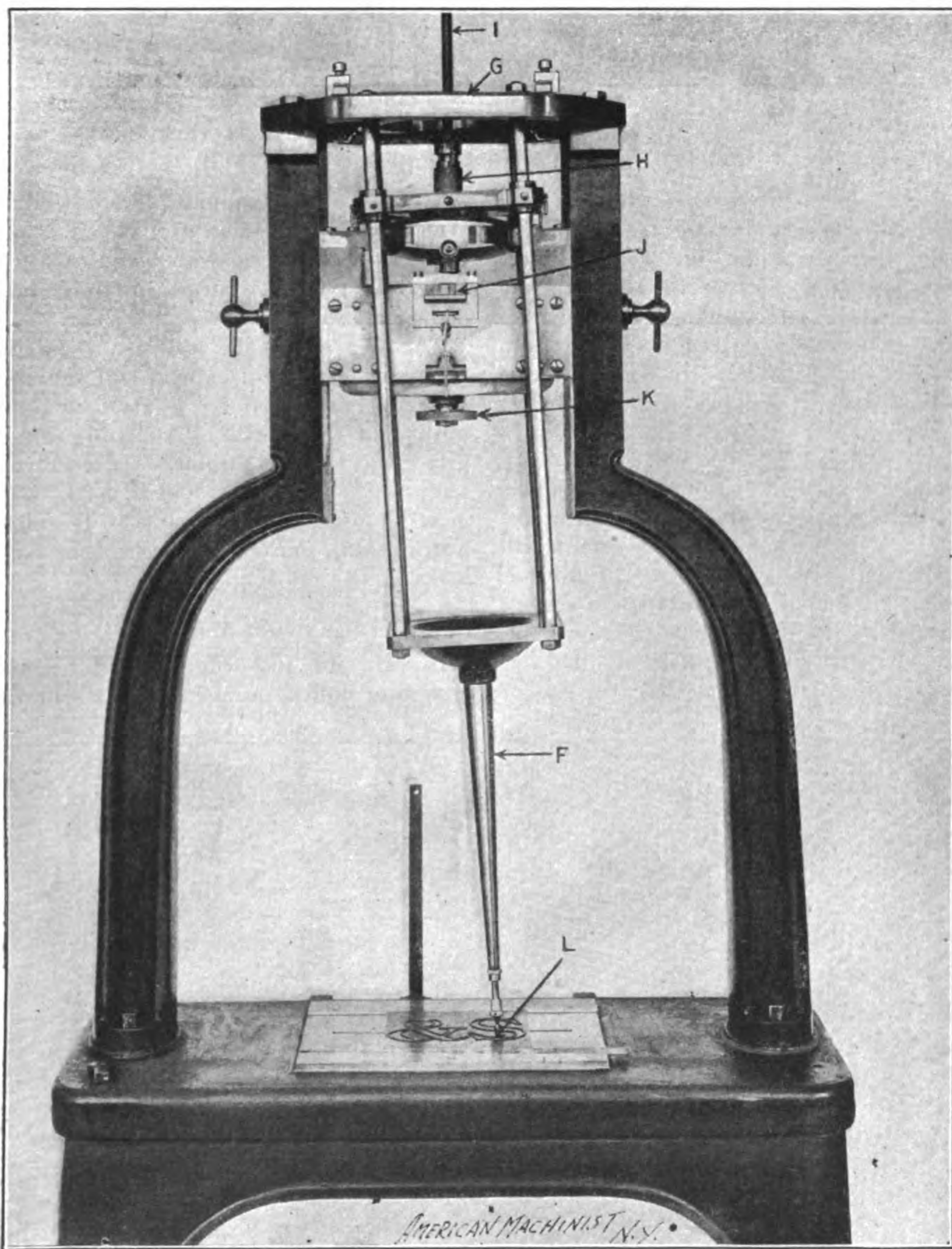


FIG. 3. MATRIX ENGRAVING MACHINE

F, pendulum; G, yoke; H, quill; I, flexible shaft drive; J, matrix; K, micrometer adjustment; L, follower.

moving the long arm pencil over the large outline. This small letter is then filled in solid, that is, leaded, and carefully inspected. This solid letter lends itself more readily to criticism. The focal length of the delineator can be changed to meet the requirements of changes in size of letter, the smaller the letter the higher the mag-

graph machine specially designed to hold a plate that has been coated with wax. This plate is held in a horizontal position at the top of the machine, as shown in Fig. 2.

Immediately under the tracing needle, which works on the face of the wax plate in an inverted position, is a mirror to en-

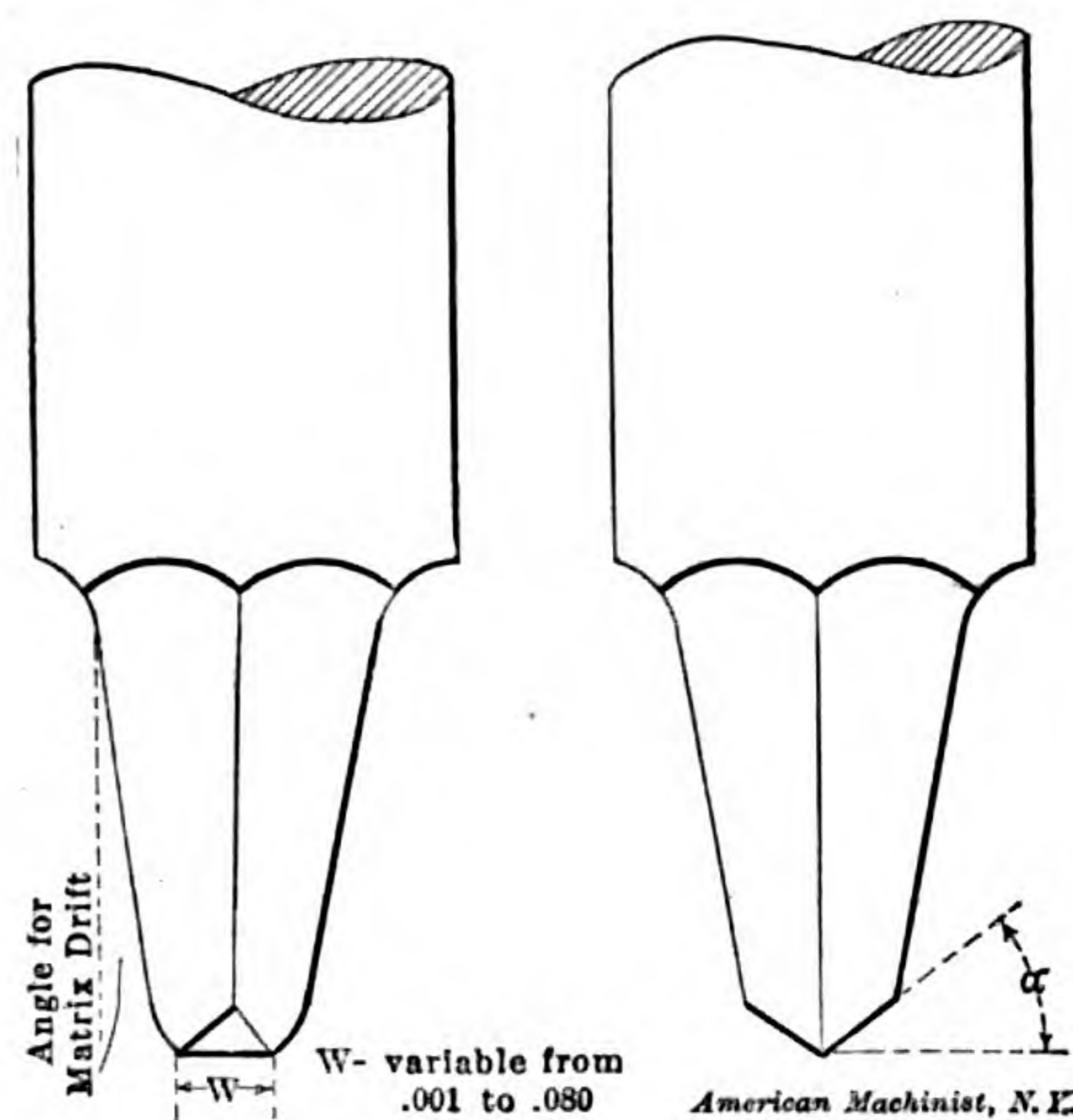


FIG. 5. ENGRAVING TOOL SHOWING FACETS

evolution of the type, the matrix-engraving machine, which consists of two housings between which swings a long pendulum or arm, which is delicately suspended in a compound yoke by means of gimbal screws which gives it a toggle-joint effect. The whole accuracy of the matrix lies in the accuracy of this machine. The quill holder, or the head which holds the tool in the matrix machine, and the work in the punch-making machine, which is built on the same principle, is fitted between hardened, ground and lapped guides or ways, and is perhaps the most highly developed of the many parts that go to make up the machine design. The steel is specially selected and machined and then laid away for three or four months for seasoning or adjustment of the various strains inherent in all steels. It is then carefully fitted in its guides. The central hole in which the quill or tool holder is

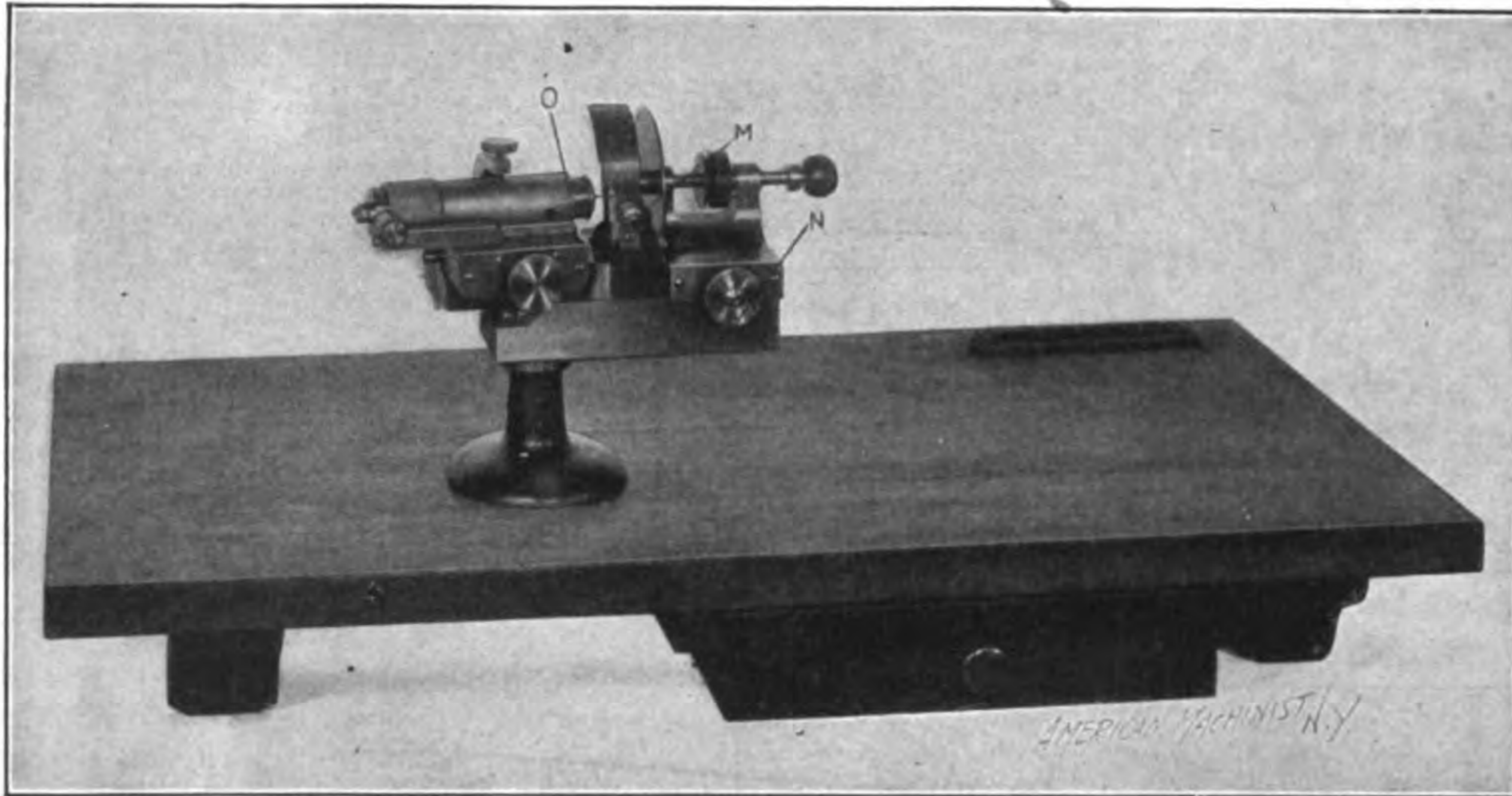


FIG. 6. GRINDER

M, diamond; *N*, micrometer for wheel adjustment; *O*, stop collar.

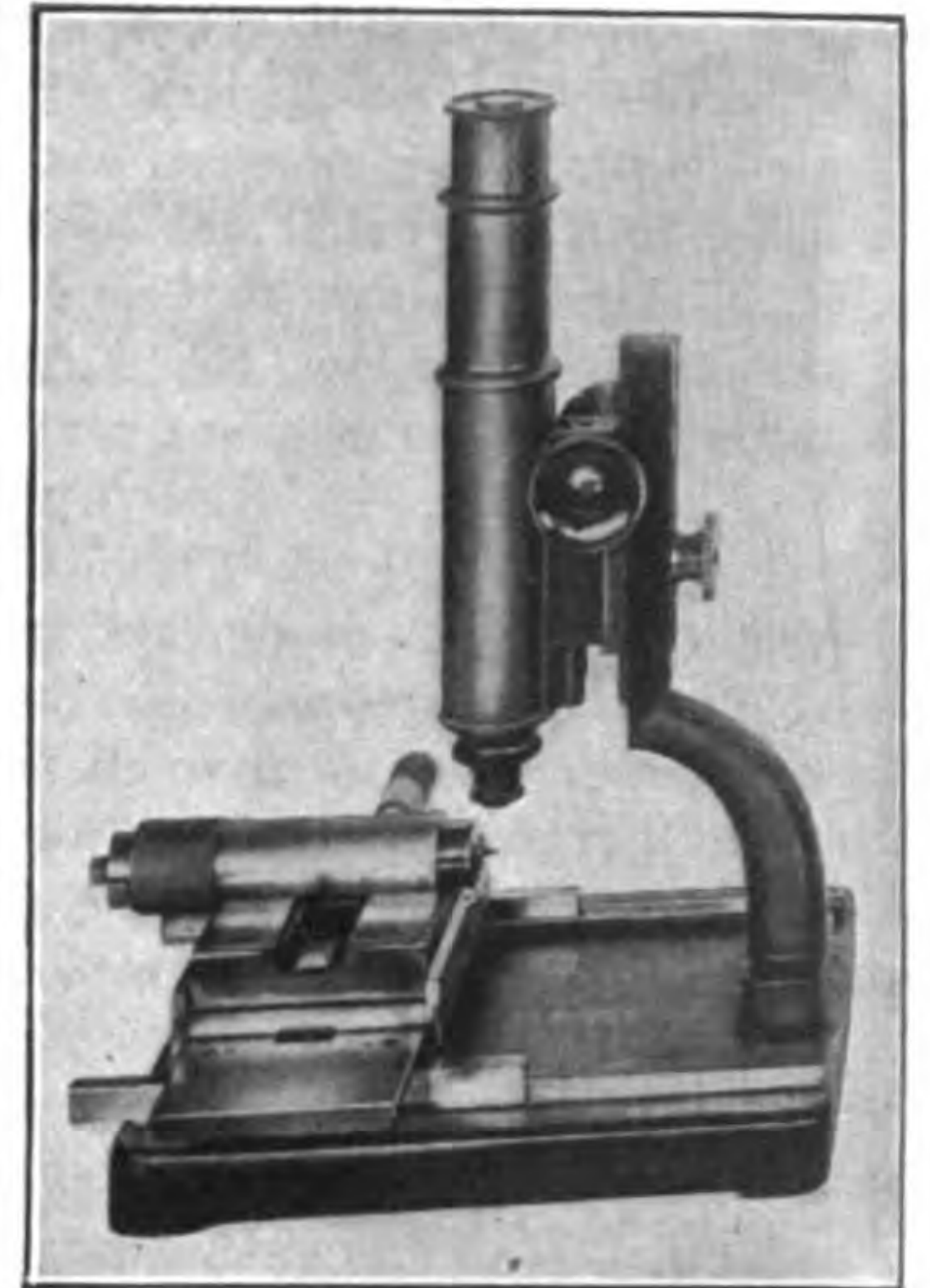


FIG. 7. INSPECTION APPARATUS

held is arranged with positive stop upon which the holder rests, insuring replacement at accurate depths.

The limits of accuracy in the whole construction of this head is within 0.0002 inch. The head which holds the work has a vertical adjustment for the purposes of increasing or decreasing size of matrix-character by changing the ratio of tool movement to follower movement.

This head has a central recess at right angles to the plane of the supporting points, in which is held the matrix holder, which accurately fits the sides of head sliding in over beveled ways against another positive stop, which in turn allows for replacement of holders, a T-headed bolt which is actuated by cam screw, drawing the holder solidly in place. The bed plate upon which the holder rests is in turn adjustable and is controlled by the index wheel, as shown at the bottom of the head in Fig. 4, and is actuated by the nurlled screw below it. Each notch regulates the movement up or down 0.0001 inch for varying depths of cut, and is held in place by a spring latch. The pattern is held flat on the bed plate of the machine by means of a thin brass wedge.

THE QUILL

In Fig. 4 is shown the details of the tool holder which is self-explanatory. The central spindle holding the draw-in chuck, which is hollow, and through which the tool is inserted, runs on ball races to eliminate friction. On the end of the central or revolving sleeve are seen eight slots accurately spaced at 45 degrees, which are used in reproducing the correct outline of tool edge. The two extension lugs on the same end are used for driving the whole tool mechanism. The ring edge on the front end of the sleeve serves as a stop, so that when the tool breaks or becomes dulled the quill can be taken out, the tool reground and the whole reset to the same positive depth of cut.

THE TOOL

The tool has the outline shown in Fig.

5, which shows the faces of chisel cutting edge, which vary in size from 0.001 to 0.080 inch in width, the heavier faces being used for the removal of stock and the finer ones for outlining of the characters. The tool is driven by means of a flexible shaft at a speed of 8000 to 10,000 revolutions per minute.

THE FOLLOWER

This rests on the pattern and is guided by the swinging pendulum or arm, in the end of which is inserted a pin with a ball end which rests in the socket of the follower, and a light spring in tension against the end of the pin holds the follower always in position. The size of the follower is in direct ratio with the size of

the tool, as for example, the pendulum arm with a ratio of 10 to 1, using a tool with 0.008 inch face, would require a follower 10 times as large, or 0.080 inch diameter.

The arm moves the follower along the raised edges of the pattern and the tool which is controlled by it also, cuts the outline of the work. A roughing cut is first made and the surplus stock removed, after which a finishing tool is used. The material used for the matrices is called watchmakers' nickel and resembles hard brass.

GRINDING MACHINES

In case the tool edge should become broken or dulled, necessitating its removal

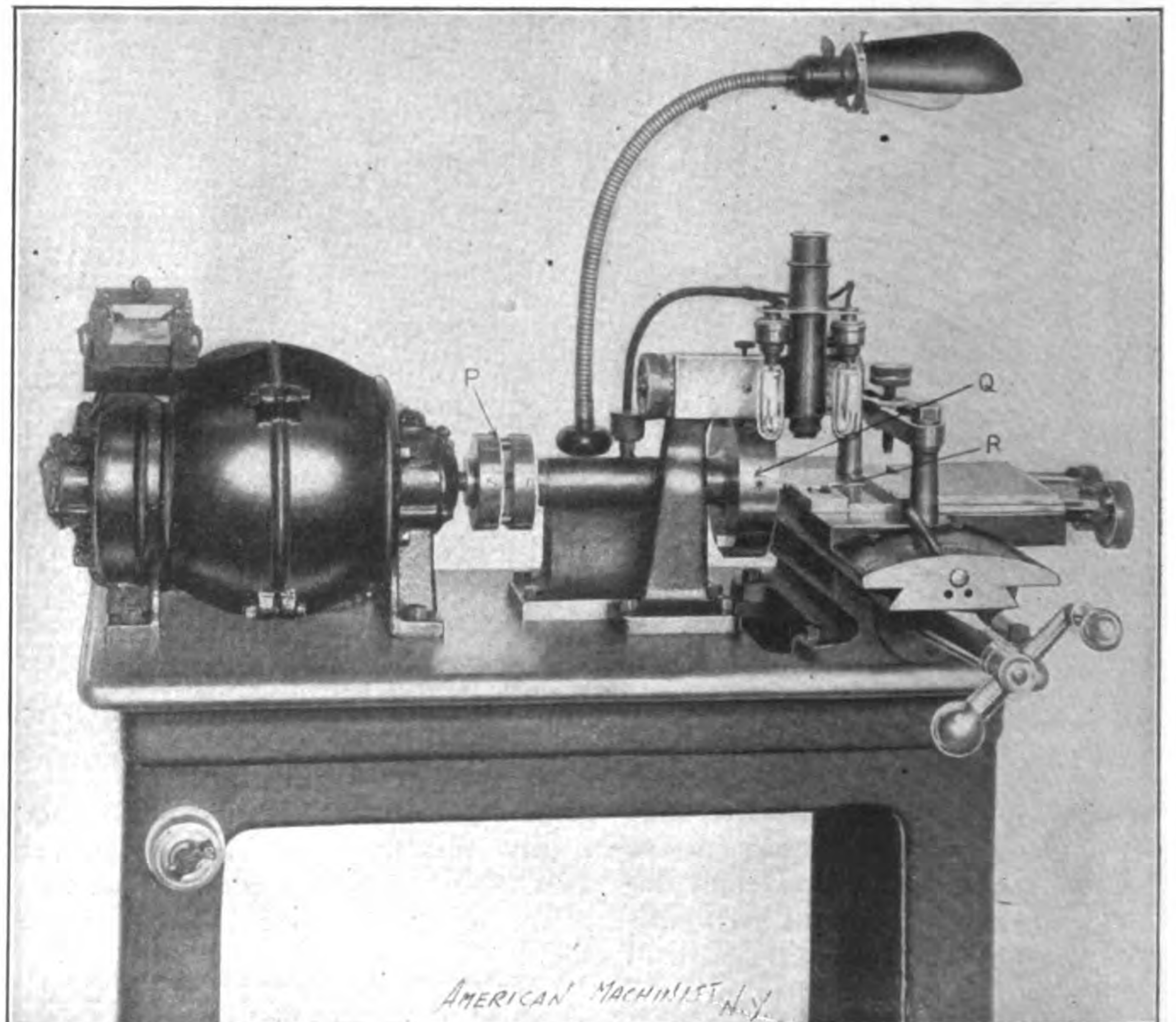


FIG. 8. MATRIX-FIXING MACHINE

P, clutch drive; *Q*, cutter holder; *R*, fixed face of matrix.

in the midst of the operation, it is essential that some means of grinding or renewing the edge be employed that will at the same time insure the same accurate outline of the tool, but more important than all else, the same size and length, and in Fig. 6 is shown a specially designed grinder with small slide rest upon which the quill is held during the grinding operation. The machine consists of a light steel spindle having longitudinal motion by means of which the feed is obtained. On the end of this spindle is mounted a small emery or abrasive wheel. The slide rest is constructed with single trunnion bed which enables it to rotate at the will of the operator, through an arc of 90 degrees, with stops, one of which controls the angle of the tool for matrix draft, and the other the curvature on the end. On the top of the slide rest are two beveled ways with a fixed stop on one end, the quill being held in position on these ways with the ring end against the stop. This ring end is the determining point in this machine for the length of tool and in the engraving machine for the depth of cut.

During the grinding operation, the abrasive wheel naturally wears away and if this were not taken into consideration the size of the tool would be changed. To obviate this, a fixed diamond point, which is also capable of micrometer adjustment in case of wear, is so arranged that the wheel is brought to touch it in passing, thereby insuring the same relative position of the side of the wheel with the tool and grinding the tool always to the same size and contour.

Any desired width of tool face is obtained by means of hardened steel measuring blocks and when a tool of any desired face is ground, the block for that particular face is placed between the end of the ways and the traveling rest brought against it by means of a screw feed, thus changing the position of the tool center relative to the center of rotation.

INSPECTION

To further insure that the grinder has done its work accurately, it is taken to the machine as shown in Fig. 7 and a microscopic inspection takes place. Across the center of the face or lens of the microscope, is arranged a fine scale reading in 0.0005 of an inch and the edge of the tool is brought in alinement with the scale and an accurate reading is readily obtainable.

ALINEMENT OF MATRIX

After the letter or character has been machined it is necessary that a fixed relation exist between it and the sides and top of the bar in which it has been cut, on account of the proper spacing of the type when set. Certain type, on account of their shape and general proportion, such as capital H, O, and lower case o and m are used to set the machine, practically for the whole alphabet. In Fig. 8

is shown the matrix-fixing machine, a specially designed facing machine with inserted-tooth face cutters, which is driven by a clutch rather than a belt on account of the belt tendency to pull sidewise, causing undue wear on the spindle and destroying the accuracy of the alinement. The work is clamped on the machine by means of a frog clamp directly under a microscope that has 2 cross hairs at right angles to each other and one hair adjustable to any angle and by means of which

type is discharged. At the opposite end from the matrix is an opening through which the melted metal enters. The molds are made adjustable so that each character is cast the proper width. Only one mold is necessary for one size of type, and with it all the matrices for that size may be used.

The matrix or master tool which is now ready for the type-founding machine is ready for a conclusion, the type itself is accepted as a conclusion and like all con-

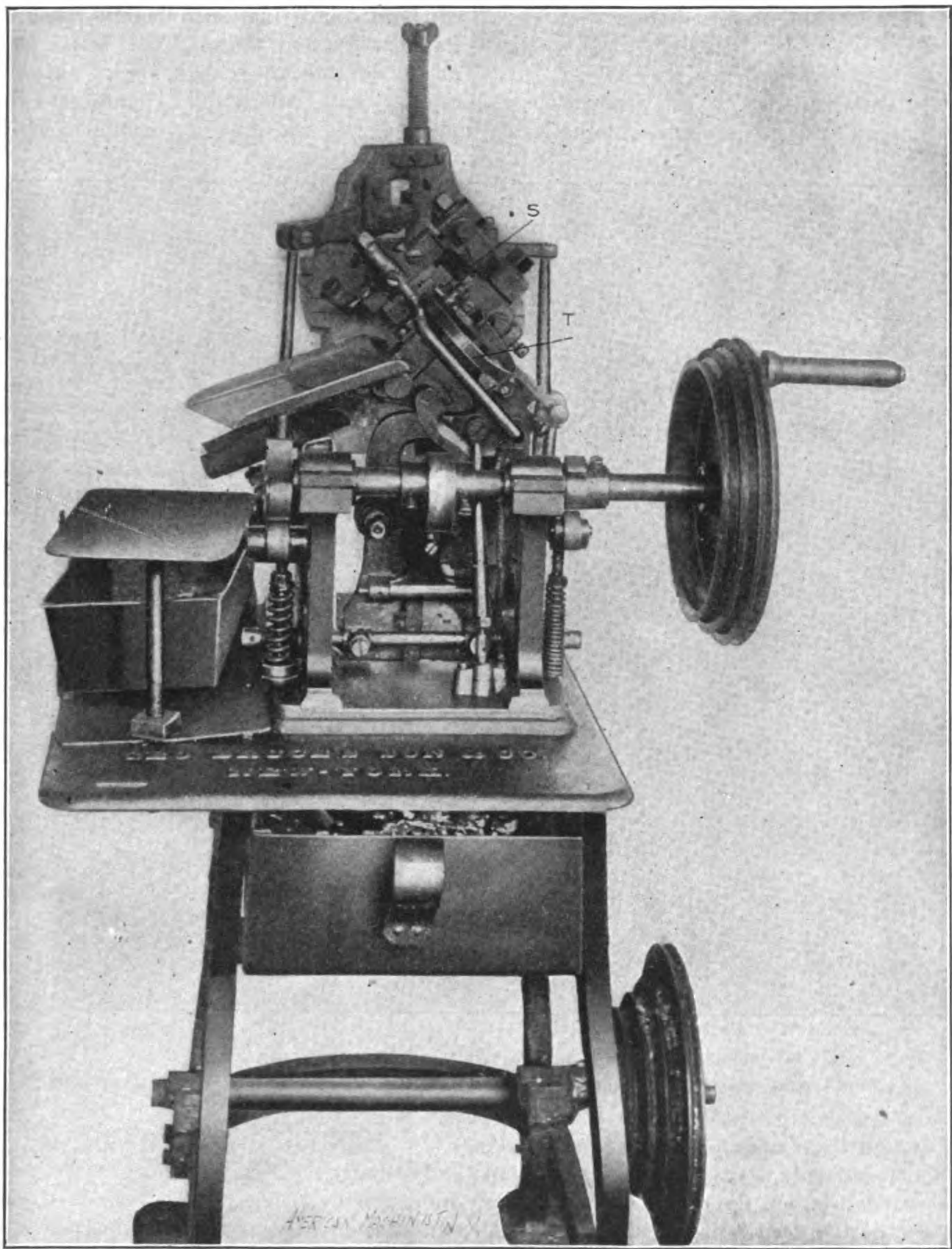


FIG. 9. OLD TYPE HAND MACHINE
S, mold with spring control; T, spring.

the parallelism and position of the letter is fixed with relation to the cutter.

THE MOLD

The mold to receive the matrix is made of hardened steel, and in it is formed the body of the type. The printing end is formed in the matrix, the mold is provided at one end with a guide for holding the matrix snugly against it while the type is being cast, and for withdrawing the matrix and opening the mold when the

clusions has been arrived at through a chain of reasoning, and the set of machines that form this particular chain of accurate reasoning is the result of a mind grown ripe in the development of type founding—L. B. Benton, who is still at work refining these already refined machines.

OLD STYLE HAND MACHINES

For purposes of comparison, between the old and the new, and what the change

really means from an economic standpoint, we must consider the saving in the number of handlings the type received, and Fig. 9 is intended to show the earlier methods, in which were involved repeated handling of the product, which is not only expensive but changes the work from an interchangeable to a hand product with no two lots exactly alike. The product from this machine or type of machine has to pass through such operations as taling, burring by means of wiping across the face of a polishing wheel, grooving, sizing, etc.

AUTOMATIC MACHINE

As shown in Fig. 10, the product passes through all these operations automatically.

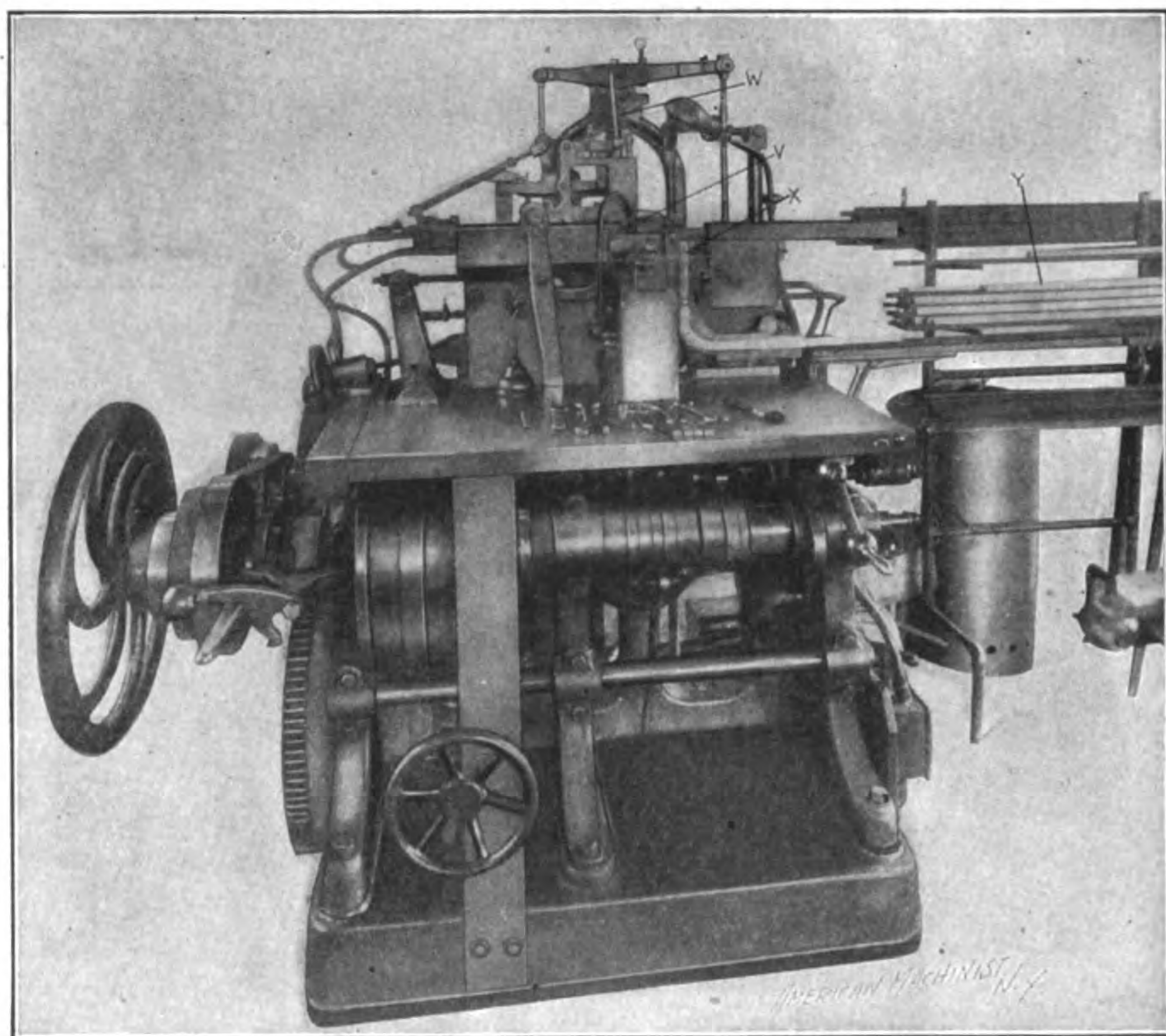


FIG. 10. AUTOMATIC MOLDING MACHINE

V, mold and matrix; W, plunger controlling flow of metal; X, knives for trimming type; Y, showing "sticks" as they are removed.

Through the medium of cams the matrix holder or mold is carried backward and forward, bringing the mold immediately in front of the feed point of the metal. A pump is used to operate in the molten metal to force the metal into the mold and matrix at every operating revolution of the machine. These machines run at different speeds according to the size of the type; the smaller the type the faster the speed, owing to the chill necessary for set. At each revolution a charge is forced into the mold, the time of revolution calculated to chill the type to the proper hardness, the arm controlling the holder is pulled back and the type ejected into a trough and automatically carried along a broaching channel which trims all burs, tales it, grooves it and finishes it complete, ready for use. The type are de-

livered side by side on a specially grooved piece of wood, 3 feet long, called a "stick," on which they are removed from the machine for inspection. Type are cast at the rate of from 10 to 200 per minute, according to size, the speed being limited only by the time it takes the metal to solidify. To accelerate this a stream of cold water is forced through passages surrounding the mold, and a jet of cold air is blown against the outside. The type are made from type metal, a mixture of lead, tin, antimony and copper. As antimony expands in solidifying, advantage is taken of this quality and the mixture is so proportioned that the expansion of the antimony will practically counteract the shrinkage of the other constituents.

TYPE STANDARDS

Formerly the various sizes of types were indicated by names which had developed with the history of type making. It was a source of considerable annoyance to printers that these old standards were not accurate, and that two types of supposedly the same size and sold under the same name by different makers, varied so much that they could not be used side by side. At present the "point" system, by which each size bears a proportionate relation to every other size, is the basis of standardizing, an American point being practically one seventy-second of an inch. Actually it is 0.013837 inch. It is based on the pica size, most extensively used in this country. This size was divided into twelve equal parts and each part called a point; and all other sizes were made to conform to

multiples of this point. The point is so nearly a seventy-second of an inch that printers frequently calculate the length of the pages by counting the lines, the basis being 12 lines of 6-point, nine lines of 8-point, 6 lines of 12-point, etc. This calculation is quite accurate.

German Lifting Magnets

BY FRANK C. PERKINS

Many unique forms of lifting magnets have been designed in Germany as well as in America, and their application in connection with the use of electrically oper-

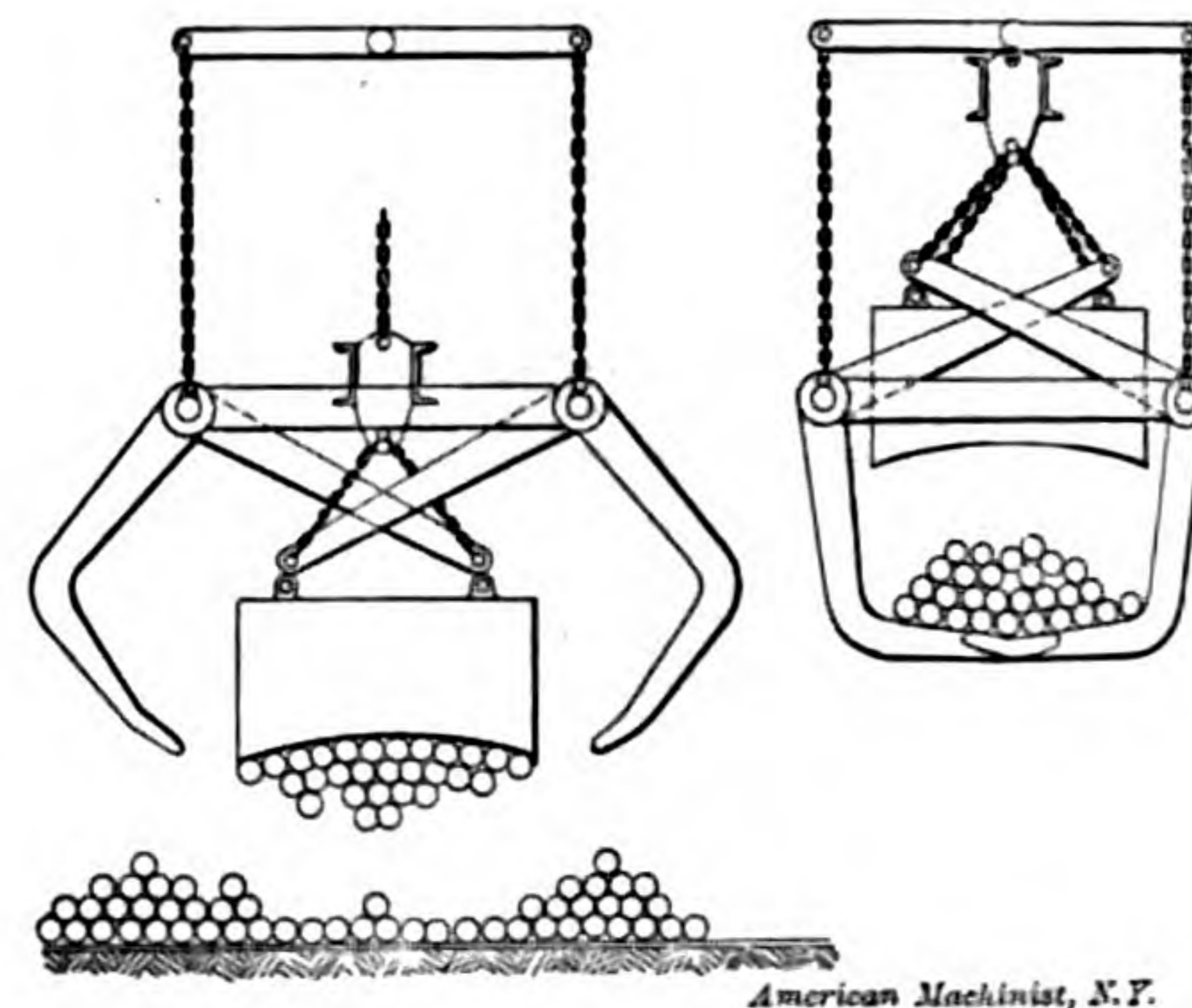


FIG. 1. COMBINED MAGNET AND TONGS

ated cranes is of special interest. A special electric crane was designed and built by Ludwig Stockenholz, A.-G., of Wetter o-Ruhr, in Westphalia, for the Georgs-Marienhütte in Osnabrück. This was equipped with lifting magnets that operated successfully with the crane working at its utmost capacity.

In connection with this crane there was a question of transporting hot as well as cold ingots, and as it is impossible to raise ingots of over 750 degrees temperature by the aid of a magnet, a second lifting appliance had to be provided for the hot ingots. A pair of tongs capable of being controlled from the operator's cab in the electric crane was designed in addition to the magnet of two tons' lifting power. These grippers also act as a protection in case the current is shut off, and Fig. 1 shows the magnet and tongs as it is handling tubes.

By Figs. 2 and 3 are shown two German lifting magnets. The latter is raising a bundle of metal scrap, while the former is holding a number of steel channels, and this is equipped with an electric motor that operates movable arms which revolve to a position under the channels, as shown, to protect them from falling should anything go wrong. These take the place of the tongues shown in Fig. 1.

These German lifting magnets, as well as that shown in Fig. 4, as it is raising a number of cast-iron pigs, were designed and constructed at Berlin, by the Siemens Schuckertwerke. These forms of lifting magnets have been constructed of from 3 to 15 tons' capacity.