(No Model.)

J. BRADY.

METHOD OF MAKING DIES.

No. 335,334. Patented Feb. 2, 1886.

Fig. 1.

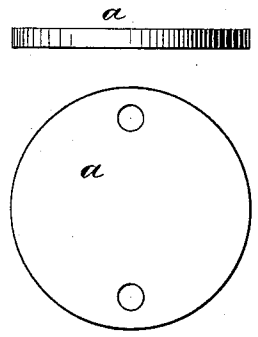


Fig. 2.

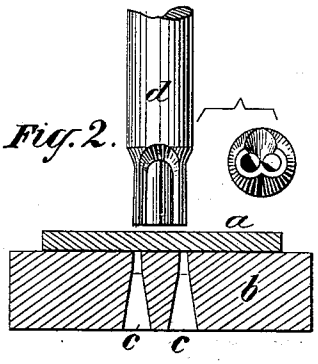


Fig. 4.

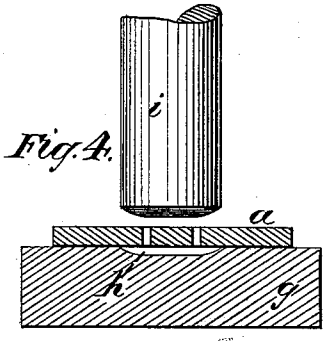


Fig. 3.

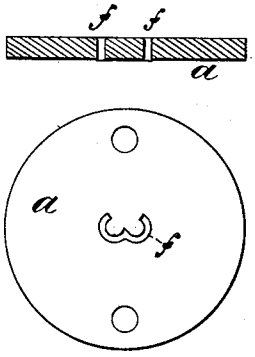


Fig. 5.

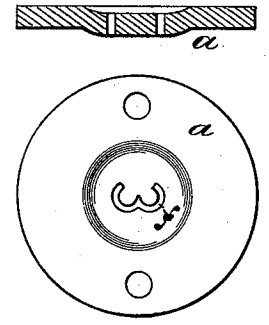


Fig. 6.

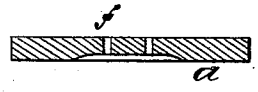


Fig. 7.

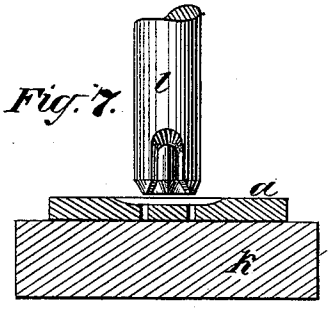


Fig. 9.

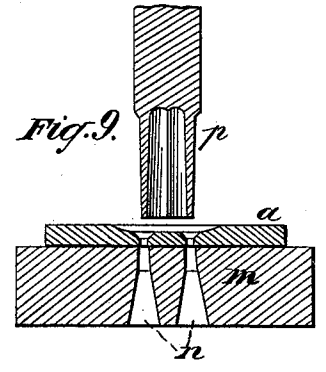
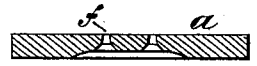


Fig. 8.

Fig. 10.



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UNITED STATES PATENT OFFICE.

JAMES BRADY, OF BROOKLYN, NEW YORK.

METHOD OF MAKING DIES.

SPECIFICATION forming part of Letters Patent No. 335,334, dated February 2, 1886.

Application filed September 8, 1884. Serial No. 142,538. (No model.)

To all whom it may concern:

Be it known that I, JAMES BRADY, of Brooklyn, Kings county, New York, have invented certain new and useful Improvements in the Manufacture of Dies, of which the following is a specification.

My invention applies more especially to the formation of small dies to act in conjunction with corresponding punches for small letters or figures, such as used in check punching and cancelling machines for perforating the papers with figures or letters. In this case it is desirable to make the dies of thin sheet-steel, and cheapness and accuracy of construction are imperative; so that my invention aims to form the die in a manner which will produce the cutting-aperture therein in a rapid, exact manner, and at the same time insure the metal being dense and strong at the cutting-edges of the aperture.

To this end the main feature of my invention may be stated to lie in forming the aperture of the die entirely by successive operations of punching, swaging, and drifting with punches, swages, and drifts of a form corresponding to the said aperture; and the invention further lies in the special nature, order, and combination of the punching, swaging, and drifting operations, as hereinafter fully set forth.

The drawings annexed give sectional and plan views of the dies and the tools used in forming the same from the first to the last stage of the process. The figures are however shown exaggerated in size for better illustration.

Figure 1 represents the die-blank. Fig. 2 represents the first punching operation thereon. Fig. 3 represents the die after this first operation. Fig. 4 represents the second operation, and Fig. 5 shows the die after this operation. Fig. 6 shows a section of the die after the third or face-grinding operation. Fig. 7 represents the fourth or flaring operation, and Fig. 8 gives a section of the die after said operation. Fig. 9 represents the fifth or drifting operation, and Fig. 10 gives a section of the finished die.

The blank from which the die is to be formed is indicated by *a*, and is shown in plan and section in Fig. 1. It is preferably a round disk of thin sheet-steel about one inch in diameter and one-sixteenth of an inch thick; but of course the exact material or size of the disk or die is not an essential point to specify. The disk *a*, being of course in an annealed state, is first placed on a die-block, *b*, as seen in Fig. 2, over an aperture, *c*, therein, of form corresponding to but a little smaller than the desired character to be produced in the finished die, and under a punch, *d*, of corresponding form, in line with the aperture in the die-block *b* below it. The punch *d* is then depressed by the action of a suitable die-press, and the punch is thus forced through the die-blank *a*, thereby cutting therein an aperture of a form corresponding to the character desired, as shown in Fig. 3, which in this case is the numeral 3, the aperture or numeral being, however, a little smaller than that in the finished die.

The above-described operation forms what may be called the "first stage" of the process, and in this operation it is to be noted that the die-blank *a* is punched from the upper side—that is, the side which in the finished die is to be the cutting side in which the punch enters to perforate the paper placed between the two. It will be readily understood, therefore, that when the die-blank is thus punched from its upper side the edges of the character-aperture *f* will be rounding, as illustrated in the section in Fig. 3, from the bending and drawing in of the metal with the punch. Hence the die, if finished after this punching, would have a dull round edge on the character-aperture, whereas it is necessary that it be angular and sharp. In order therefore to neutralize this rounding effect of the first punching, the operations illustrated in Figs. 4, 5, and 6, which compose stages two and three, are resorted to.

In the second stage, as shown in Fig. 4, the punched blank *a* is placed upside down on an anvil-block, *g*, over a slightly rounding and circular depression, *h*, therein, of a size which will a little more than circumscribe the character-aperture. A swaging-punch, *i*, arranged above the block *g*, and having its end of form similar to the depression *h*, and in line therewith, is then forced down on the punched blank *a*, and the upper side of the die is therefore bulged up slightly around the character-aperture on the upper side, as fully shown in Fig. 5. This bulge raises the rounding edges

of the character-aperture slightly above the general surface of the blank, and this raised part is in the next or third stage ground, filed, or milled off to a level with the rest of the die, as seen in Fig. 6, which, as will be seen, will cause the character-aperture to have sharp angular edges at the top of the die.

It may now be argued that if the die-blank were in the first stage punched from the under side the rounding edges referred to would then be on the under side of the die, where they would be unobjectionable, and hence the bulging and grinding operations of the second and third stages might be dispensed with. This, however, is readily answered as follows—that is, when the die is thus punched from the under side, the edges of the character-aperture at the top are, it is true, left comparatively angular and sharp; yet I find that the metal at the edge is also disintegrated and left in a comparatively weak and granular state, which prevents the die taking a good cutting-edge and causes the edge to rapidly break down or crumble off as soon as it is hardened and used. On the contrary, when the die is punched from the top side and then bulged from the under side and ground off on the top, as described, not only is the edge of the character-aperture made very sharp, but the metal is found to be exceedingly compact and tough, and the edges thus rendered very strong, keen, and durable.

The above-described operations being completed, the die-blank is in the next or fifth stage placed upside down on a level anvil-block, *k*, of hardened steel, as shown in Fig. 7, and a punch or swage, *l*, of a form corresponding to the character-aperture of the die, but with a widely-tapering shape, is then forced into the aperture of the die to about half its depth, which will thus leave the lower part of the character-aperture flaring or tapering outward, as shown in section in Fig. 8, as is necessary for the usual back clearance or "freeing" usual in dies. This freeing operation, as above described, and shown in Fig. 7, will not in any way injure the cutting-edge of the character-aperture, for as the right side of the die is placed flatly on a solid anvil-plate, and the tapering punch is forced in from the back side of the die, the effect of this operation will be, in fact, to still further solidify and improve the texture of the metal toward the cutting-edge of the aperture, which is of great advantage to the die and an important result of this operation.

After the freeing operation above described the die is next placed upside down on a die-block, *m*, similar to the first die-block, *b*, but having a character-aperture, *n*, slightly larger than the finished size, with which the aperture in the die-blank *a* is registered. A drift or punch, *p*, works above the die-plate *m*, in line with its aperture *n*, which drift or punch has a very long gradual taper of a size at the tip slightly smaller than the character-aperture in the die-blank as cut by the first punch, *d*, in Fig. 2, and of a size and form or section at or near the root of the taper corresponding to the finished aperture desired. This drift or punch is then slowly forced through the die-blank, so as to gradually widen out the character-aperture to its finished size, making it at the same time slightly flaring toward the wide flare in the under part of the aperture, and gradually compressing and smoothing the metal toward the cutting-edge of the aperture and imparting a hard glaze and polish to the walls of the aperture, as will be readily appreciated, which greatly improves the metal at the cutting-surface of the die, and enables a cutting-edge of unusual strength and keenness to be maintained thereon. As soon as the die is removed from the tapering and finishing punch or drift in Fig. 9 it is then hardened, preferably case-hardened, so that the hardening is confined to the surface of the die, while the center is left soft for strength, and after the hardening the upper surface is ground off slightly by a very fine emery-wheel or its equivalent, which will render the cutting-edge of the aperture very keen, which operation finishes the die so far as my invention is concerned.

It may now be readily observed that all the successive operations described tend to strengthen the metal toward the top of the die and at the cutting-edges of its character-aperture, and instead of straining the metal or displacing the particles thereof all the steps tend to compress and harden the metal and render it very dense, tough, and smooth, and thus admirably adapted to take and retain the cutting-edge necessary in an effective and durable die. It will be further seen that all the operations are done by special tools, and are the simple ones of punching, swaging, drifting, and grinding, which can be done rapidly by inexpensive labor, which enables the manufacture of the dies to be not only rendered very accurate, but also very cheap, which latter is an essential for many purposes where such dies are used in large numbers.

Heretofore dies of this character have been made by the slow and difficult operations of drilling and filing, which are so expensive as to practically prohibit their use for many purposes, whereas by my system the cost is reduced to cents as compared to dollars for the old system.

It will be understood that where I have specified "grinding," grinding with emery-wheels is considered preferable, but filing or other abrading operation will be the equivalent thereof. It will be also understood that it will not be necessary in all cases to employ all the operations described, nor in the exact order stated, and I do not confine myself thereto; but

What I claim as the essentials of my invention are as follows:

1. The method of making character or figure dies, the same consisting in first perforating the die-plate with a punch of a form cor-

responding to the desired character, then hardening and finishing said die by a series of punches corresponding in form to the shape of the aperture, substantially as and for the purpose set forth.

2. The described process of die-making, consisting in first perforating the die-blank with a punch of the form coresponding to the desired charcter forced through from the top or right side of the blank, thence denting the blank on the reverse side, and bulging it up around the character-aperture on the right side, and subsequently grinding off the said bulge, substantially as and for the purpose set forth.

3. A method of die-making combining the following operations: first, punching the die-blank from the upper or right side with a punch having a form corresponding to the desired character, and thus forming an aperture corresponding to said character; secondly, denting or swaging the blank on the reverse side and thereby bulging the die on the right side around the character-aperture; third, grinding or cutting off the said bulge; and, finally, enlarging the aperture to its finished size by compressing the walls thereof by means of a long gradually-tapering drift or punch of section similar to the first forced through the said aperture, substantially as and for the purpose set forth.

4. A method of die-making combining the following operations: first, perforating the die with the desired character-aperture by a punch forced through from the top or right side, bulging the die around the said aperture on the top side, grinding or cutting off the bulge, flaring or freeing the character-aperture on the under side by a widely-tapering punch or swage forced partly through the same; and, finally, enlarging the aperture to its finished size by a long gradually-tapering drift or punch forced through the same, so as to compress, smooth, and toughen the metal at the cutting-edges of the aperture, substantially as herein set forth.

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