CASE REPORT

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The Manufacture and Examination of Hand-Operated Custom-Design Punches

REFERENCE: Kraemer, J. I. and Voorhees, R. S., **"The Manufacture and Examination of Hand-Operated Custom-Design Punches,"** *Journal of Forensic Sciences*, JFSCA, Vol. 28, No. 1, Jan. 1983, pp. 273-277.

ABSTRACT: The process used to fabricate hand-operated punches is described, with special emphasis given to those steps that render the design punched into various media easily distinguishable. Identification of a specific punch is accomplished by considering those designs and the individual marks they produce.

KEYWORDS: questioned documents, punches, toolmarks, striations

Custom punches, for the purpose of this paper, can be defined as hand-operated devices that remove a section of a document by forcing it through a female die with a male punch. Punches of this type are used regularly by transit companies to cancel or validate passes, tickets, and transfers. Examples of more specialized uses are quality control inspectors who verify each stage of production and businesses and fast-food operations that process coupons for promotional offers.

Three companies in this country devote part or all of their production capacity to the manufacture of custom punches. All three use essentially the same manufacturing process, with minor variations, to produce the finished punch. The similarity in the manufacturing processes is a result of their common background.

The Bonney-Vehslage Tool Company of Newark, NJ, began manufacturing punches in 1906. The production process has continued unchanged since this time. In 1926 the shop foreman of Bonney-Vehslage left its employ and formed his own manufacturing company, also in New Jersey, to produce punches by essentially the same process. In 1938 his two sons began producing punches: one remained at the original location; whereas the second relocated to Florida. The P. J. Mieth Manufacturing Company, formerly of New Jersey, has recently located to North Branford, CT. The M. C. Mieth Manufacturing Company is located in Port Orange, FL.

Presented at the 34th Annual Meeting of the American Academy of Forensic Sciences, Orlando, FL, 8-11 Feb. 1982. Received for publication 20 Jan. 1982; accepted for publication 6 May 1982.

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The Fabrication Process

Because of the common heritage, all three companies produce punches of similar design and each actively solicits custom design orders. In addition to producing custom designs each company maintains an existing stock of punches that incorporate different standard designs. A small example of Bonney-Vehslage's standard designs is shown in Fig. 1.

In fabricating a punch, each company begins with two rough-cast malleable iron parts commonly called a frame and a lever. These two parts are mated together early in the process with a temporary fulcrum pin. The frame, the larger of the two parts, will contain a female die. The lever, which will be permanently coupled to the frame at the end of the process, will contain a male design that complements the female design.

Various processes such as grinding, polishing, or plating may be used to improve the appearance of these devices, but it is the action of the male and female components that is of interest to the forensic scientist. Each punch design is unique by virtue of the laborious hand filing and fitting, and the possibilities for its identification are limited only by the media into which the design is punched.

The design in these punches begins with a disk of tool steel measuring about 1 cm (0.4 in.) in diameter, which is to become the female die. The disk is first coined: a master design punch is selected, or created, and this design is punched into the disk. This punch does not go all of the way through the disk; usually it is pressed through to 95% of the thickness (see Fig. 2).

The master punches are heat-treated steel that can wear out with repeated use. When the punch wears out, another is created with files and chisels, and, since a perfect duplicate is not necessary, there may be some minor differences over the years in what should be an identical design.

The disk is then faced: each disk is placed in a lathe and the remaining 5% is shaved off. This process creates a female design with a sharp side that will produce a sharp outline of the design. Since there will be burrs and other defects in the die, each one is custom finished by a craftsman using Swiss files. This process is an illustration of the introduction of unique identifying features and it bears further discussion. The Swiss file is a small file that can fit within the design. These files can be as small as 0.16 cm (0.0625 in.) in diameter and can be used by a craftsman without the aid of magnification. After filing, the design on the disk is essentially completed. It is then heat-treated and press fit into a countersunk hole that had been previously drilled into the frame.

The next step involves the creation of the male design on the lever. Figure 3 shows the rough cast lever; the rectangular area at one end is the face that will become the male design. The first step in the process involves coating the lever face with cupric sulfate and scribing the female design onto this area. In scribing the design, the lever is pressed against the pre-

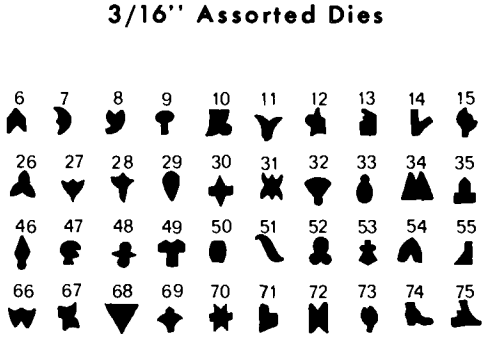

FIG. 1—*Standard punch designs.*

FIG. 2—*Penetration of punch through disk.*

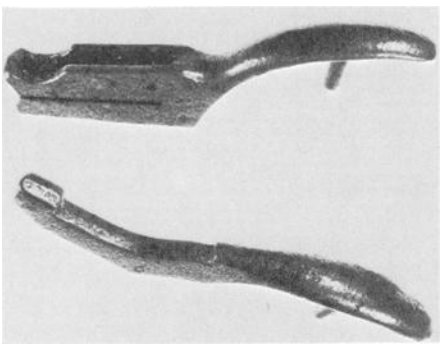

FIG. 3—*Rough-cast lever and frame.*

viously fitted, finished female design; a sharp instrument traces through the female die and etches the outline into the lever face. Any defects in the female die are also etched into the lever face. This scribed face is then shaped with files and punches to mate with the female. It is important to note that once this male design has been finish filed, its final fit can be made by forcing it through the female die with a sharp hammer blow. The lever can then be heat-treated to increase its hardness.

Bonney-Vehslage manufactured approximately 40 000 punches in 1980 using the process described above. Management does not know the total time involved in the manufacture of one punch but estimates that the nearly 40 steps involved require up to 3 h. It can be seen that this process does not lend itself to a high degree of cost effectiveness. A punch represents many hours of custom finish and is prized for its durability. Figure 4 shows a typical punch in its finished condition.

Case Report

In 1981 a case that involved the use of a punch of the type described above was presented for examination. A review of standard designs listed in manufacturers' catalogs indicated that the punch used was produced by Bonney-Vehslage, and it was found that the suspect, a driver for a local transit company, had been issued a punch manufactured by this company. Because the documents involved were of news-grade paper, it was not possible to effect an unequivocal identification. The most that could be stated was that the design punched on

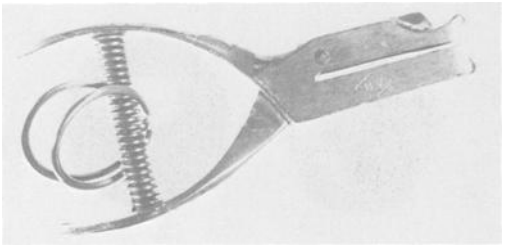

FIG. 4—*Typical punch in finished condition.*

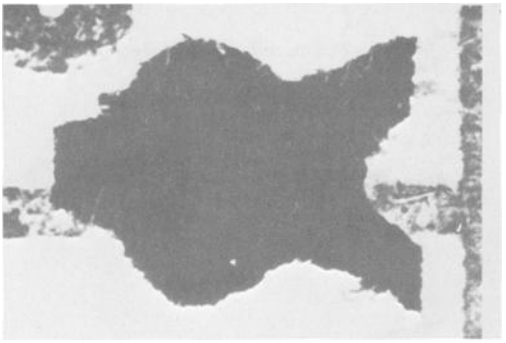

FIG. 5—*Design punched in documents.*

the questioned documents was similar to the design on the punch issued to the suspect (see Fig. 5).

It was hypothesized that identification of a design would be possible from examination of the medium into which it was punched. Individuality in the manufacture of a punch had been assured by observations made at the plant. It then became necessary to determine if this individuality was transferred to the media into which the punch was made.

Research into this question first involved the assembly of many types and grades of paper and ultimately other nonfiber sheet material as well. Several holes were punched into each medium, and the punch was operated without special regard taken for the manner in which the holes were made. This random nature of production was necessary to duplicate possible applications in everyday use.

The test procedure was to examine each of the many holes punched in a given material to ascertain the amount of geometric reproduction possible. Instrumentation included an American Optical comparison microscope for juxtaposition microscopy and a E.P.O.I. MP-6A viewer for taking abstract dimensional profiles of the individual holes produced. Thus, both an individual one-to-one comparison was made and a numerical value of similarity provided.

Only very minor variations were found in the marks punched in similar media. As the quality and thickness of the stock increased, it was found that the number and nature of individualizing marks also increased. Material such as desensitized photo paper, photographic sheet film, and thin plastic sheets were punched, and it was found that the random nature of punch production was readily evident and definite identifications were possible (see Fig. 6).

Examinations were made of striae produced on the edge of the punched media. The relatively low-powered comparison microscope was inadequate for this; thus, a scanning electron microscope was used to produce micrographs of the striae contained within a given section of

FIG. 6—*Designs punched in various media.*

the punch mark edge. It was evident that these marks in heavier paper stock and nonfiber media would readily lend themselves to comparison.

For a toolmark to be of value for establishing a positive identification it must be both unique to the tool and repetitive in nature. As a result of the comparisons made in the various media, it was found that identification lies not with the punch but rather with the medium in which the hole has been made.

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