James E. Behrendt,[1] *M.F.S.*

Class Defects in Printwheel Typescript

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ABSTRACT: Although the identification of printwheel typescript is predicated on the characteristics of the typing system, most of the identifying defects encountered are normally ascribed to the printwheel. Typescript samples from several new printwheels of different manufacture were examined to ascertain whether class defects are present in printwheel typescript. It was found that several different types of class defects commonly occur in typescript samples of new printwheels. These class defects often appear similar to individual identifying characteristics, when in fact, they are indicative of an entire group of printwheels.

KEYWORDS: questioned documents, typewriters, printing equipment, printwheels, typewriter identification

The examination of printwheel produced typescript has been problematical for the document examiner since the inception of the printwheel. Previous research has identified the difficulties in differentiating printwheel and conventional typescripts [*1,2*], classifying printwheel typescripts [*3*], and identifying the typescript as the work of a single printwheel [*4*]. It is the latter problem, the identification of printwheel typescript, that is the most vexatious to the document examiner. This study attempts to ascertain whether any typescript defects may be attributable to a group of printwheels, and thus be categorized as class defects.

Although the identification of printwheel typescript is predicated on the typing system [*4*], most of the identifying defects normally encountered are ascribed to the printwheel. Accurately differentiating between class and individual defects in printwheel typescript is of paramount importance in avoiding an erroneous identification. Ironically, little is mentioned of the presence of class defects in printwheel typescript in the literature. Estabrooks [*1*] and Leslie [*2*] report on beads which may appear on the typeface. Estabrooks [*1*] also notes the variation in density common to printwheel typescript. Other than these two characteristics, the literature appears to attribute most defects as being individual in nature.

Background

Printwheels can be categorized in three groups—monoplastic, dual plastic, and metal. Monoplastic printwheels are made of one plastic material and are molded in a single operation using a thermoinjection process.

Two types of dual plastic printwheels are available on the market. The most common type of dual plastic printwheel is comprised of a glass fiber reinforced polyammide center and

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[1]Document analyst, Regional Crime Laboratory, U.S. Postal Inspection Service, Memphis, TN.

spoke assembly with a glass fiber filled thermoset plastic character sort. The second type of dual plastic printwheel has a plastic hub and spoke assembly with a metal plated character sort.

Metal printwheels are manufactured by bonding thermal plastic characters to precut metal spokes. A metal plating is subsequently applied to the character sort. A damper ring, which is a circular strip of rubberized material, is placed on the spokes to prevent rebounding of the characters.

Most printwheel manufacturers use computer assisted design (CAD) and computer assisted manufacturing (CAM) technology. The CAD section designs the font and prepares the computerized engraving instructions to be used for the manufacture of the mold.

Printwheel molds are most often made from hardened steel. The mold may be comprised of several pieces. For mono and dual plastic printwheels, the base of the mold contains the cavities for the hub, spokes, and backpad shapes. For metal printwheels, the mold contains only the character sort which is to be bonded to the precut metal spoke assembly.

The top half of the mold contains the character shapes and may consist of several sections. Uppercase and lowercase letters, numerals, and punctuation marks are contained in one segment. Other segments contain the various special characters that can be interchanged to form the different sorts available in a particular font. For high volume typestyles, a manufacturer may use a single master ring containing the entire sort to reduce registration problems. A hardened steel mold can produce over one million printwheels.

At times, a manufacturer may elect to use a less expensive mold made of a brass alloy which is referred to as a soft mold. While a soft mold is much less expensive to make, they are less durable than a hardened steel mold and may cause production problems. Under the intense pressure of the thermoinjection process, a soft mold may warp slightly allowing excess plastic to flow between the spoke cavities. The excess plastic may join to the adjacent spoke thereby molding the two spokes together [3] (Fig. 1).

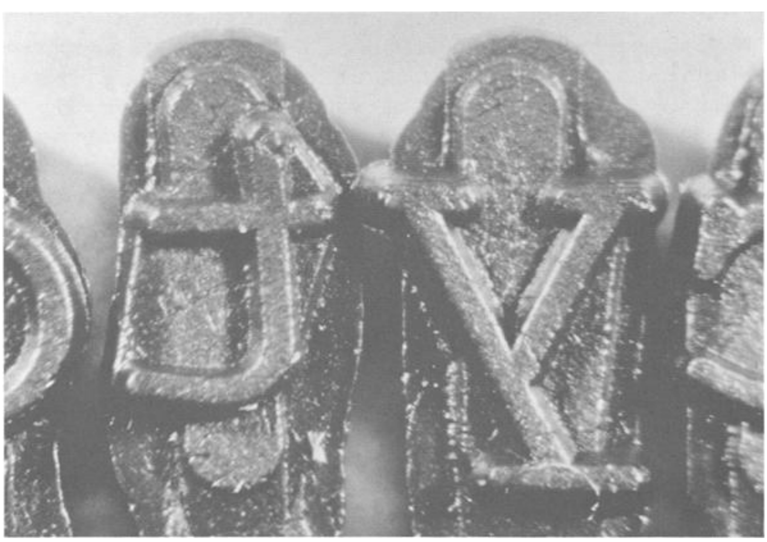

FIG. 1—*The "t" and "y" spokes on this printwheel were molded together by excess plastic that escaped from the mold cavities as a result of warpage of the mold. This is a problem indicative of the use of soft molds.*

Method

Twelve new printwheels were purchased from several different sources. Samples were taken of each printwheel on the same printer. Samples were also taken of each printwheel from several printers to evaluate the effect of the printer on the type samples.

As all of the printwheels were unused before this study, the examination was conducted under the following premises:

1. Any typeface defects consistent between printers can be attributable to the engraving or molding process.
2. Any horizontal or vertical misalignments consistent between printers are attributable to the printwheel.
3. Conversely, any inconsistency in typeface defects or misalignments between printers would be attributable to the printers.

Each sample produced on the same printer was examined to ascertain whether any apparent defects were present. An attempt to determine the probable source of the defects was made by comparing samples from the same printwheel taken from different printers. For ease of discussion, the observable defects have been grouped into three categories: (1) alignment defects, (2) engraving and molding defects, and (3) typescript artifacts.

Observations

Alignment Defects

Misalignments in printwheel typescript can be attributed to either printer malfunctions or to the printwheel itself. To differentiate accurately between class and individual defects, it is necessary to consider the possible sources of printer produced and printwheel produced misalignments.

Printer Defects

There are several possible sources of printer produced alignment defects. Problems may arise in the servomechanism of the printer causing the printwheel to overrotate in either direction. There may be misalignment in the hammer mechanism of the printer causing the spoke of the printwheel to bend left or right of vertical. Misalignments caused by the printer can normally be identified as such if exemplars are available from the same printwheel on different printers. Even so, the possibility that a printer produced misalignment may be a class characteristic of a particular model of printer must be considered and investigated.

Printwheel Defects

Printwheels themselves may also produce what appear to be alignment defects. This is true for both plastic and metal printwheels. Depending upon the cause, a printwheel produced misalignment may be either an individual or class characteristic. Bent or warped spokes are classic examples of individual defects.

Class characteristics are those alignment defects arising from the manufacturing process. As the hub, spokes, backpads, and characters are molded in a single step, it stands to reason that the molding process is the prime source of printwheel produced alignment defects in monoplastic printwheels. A slight misregistration of the mold halves and errors in the CAM program are two possible causes. The multistep molding process used in the production of dual plastic and metal printwheels for the affixture of the character sort is another source of alignment defects in printwheel typescript.

The presence of optical alignment as a cause of alignment defects must also be considered. Unlike the single element, where optical alignment can be verified by an examination of other characters in a particular row or column of the element, the printwheel offers no real basis to distinguish between a slight misalignment and optical alignment (Fig. 2).

The primary source of printwheel produced misalignment in metal printwheels appears to be misregistration in the hub assembly. Attaching the mounting hub to the spoke assembly is a separate step in the manufacture of metal printwheels, in contrast to the single unit design of plastic printwheels. Each batch of metal printwheels from the same manufacturer will exhibit different alignment patterns. The misalignment of each batch are class characteristics of that run and not individual characteristics of a particular printwheel within the batch. Figure 3 is a portion of a test sample from two different batch runs from the same manufacturer. Note the subtle differences in the alignment patterns.

Engraving Defects

Another class defect often encountered in printwheel typescript is typeface defects caused by faulty engraving. On first examination of the typescript, these class characteristics may appear to be individual identifying characteristics. Figure 4 is an illustration of several defects which appear to be caused by wear to the printwheel. Inspection of the printwheel, however, revealed the presence of engraving flaws. Figure 5 is an example of apparent wear damage to the serif actually caused by a flaw in the engraving. These typeface defects occur

FIG. 2—*Examples of horizontal misalignment in the typescript of two new printwheels. The misalignments were consistent in samples taken from different printers and are class characteristics of the mold.*

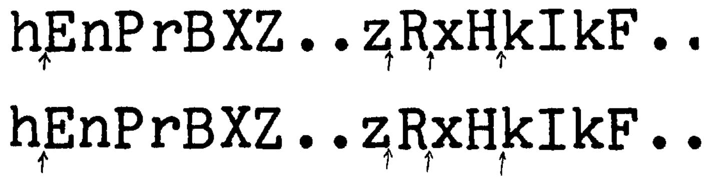

FIG. 3—*Test samples from different batch runs of the same type of printwheel showing the variations in alignment that occur between batches.*

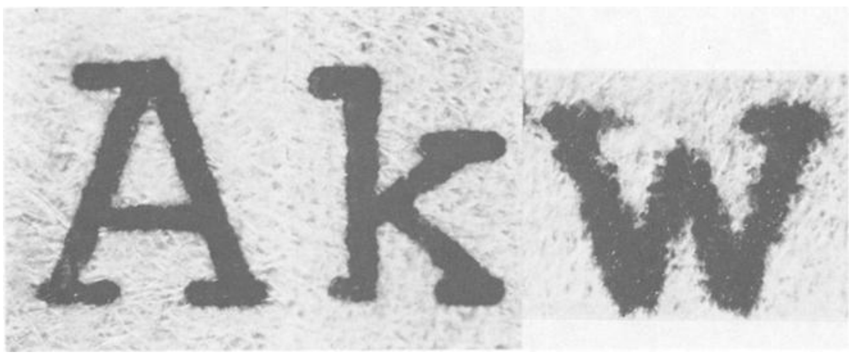

FIG. 4—*Examples of what appear to be wear defects actually caused by flaws in the engraving of the molds. Note the lower left serif of the "A" and "k," and the upper left serif of the "w."*

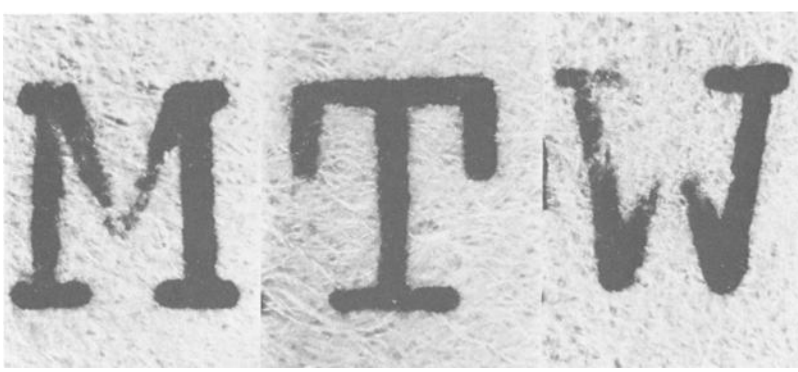

FIG. 5—*Examples of apparent typeface damage caused by engraving flaws. The flaws in the "M" and "W" are due to the engraving tool riding up on the mold, resulting in an uneven cavity depth.*

on both plastic and metal printwheels. To differentiate accurately between this type of class characteristic and an individual identifying defect requires an examination of the printwheel.

Typescript Artifacts

There is a category of class defect which this author shall refer to as typescript artifacts. These artifacts appear as markings in the typescript that are associated with a particular character, but are not a part of that character. Typescript artifacts can be a function of the printer or can be caused by molding defects on the printwheel. They are reproduced consistently throughout the text.

Figure 6 is an illustration of a printer produced typescript artifact. The small mark which appears directly below the "¨" is caused by the hammer hitting the typeface with sufficient force to bend the bottom of the backpad forward and strike the ribbon. This artifact is produced consistently throughout the samples obtained with this printer. When samples were taken from this printwheel on other printers, the artifact was not present.

Mold defects may also cause typescript artifacts. The small marks appearing directly to the left of the cross staff of the "t" and directly above the "c" in Fig. 7 are due to a mold defect. As mentioned, the intense pressures involved in the thermoinjection process may cause a slight warping in a soft mold [3]. When this occurs, excess plastic will escape from the mold cavities. In the case illustrated in Fig. 1, the spokes bearing the characters "t" and "y" were joined together. When the character "t" was printed, the spoke bearing the "y" was twisted forward far enough to cause the upper left serif to print. Conversely, when the "y" was printed, the "t" spoke was twisted forward and the right end of the cross stroke impacted the ribbon (Fig. 7). Several samples were taken from this printwheel and all showed the same artifact.

Conclusions

In theory, the identification of printwheel typescript is fairly straightforward. Typeface defects and misalignments are noted in the conventional manner, the possible effect of the printer is considered and, if the examiner concludes sufficient individuality exists in the defect pattern, the typing system is identified. From the literature, it appears that typeface defects are accorded the greatest weight in the identification formula. The possibility that these typeface defects and misalignments may be class characteristics common to a group of printwheels apparently has not been considered.

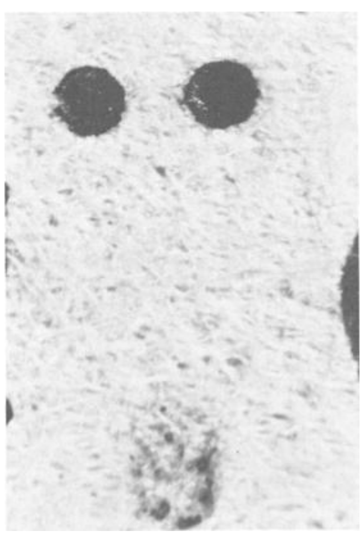

FIG. 6—*The mark appearing under the umlaut is due to extensive hammer pressure on the printer causing the lower portion of the backpad to bend forward and strike the ribbon.*

FIG. 7—*The marks appearing to the left of the "t" and above the "c" are artifacts caused by the bonding of the two spokes illustrated in Fig. 1.*

This study showed that class defects are present in printwheel typescripts. Class defects may occur as misalignments, typeface defects, or artifacts in the typescript. From an examination of the document alone, they appear to be highly individualistic, yet must be accorded the same relative value as other class characteristics. Accurate differentiation between class and individual defects must be predicated on an examination of the printwheel. Without examining the printwheel, an examiner is apt to effect an identification on the presence of class characteristics.

It is the conclusion of this author that printwheel typescript must be examined with extreme caution. Examination of the actual printwheel is almost a prerequisite to differentiate accurately class from individual defects. At times, an identification may not be possible even when several defects are noted in the typescript and the printwheel is available for examination. We are perhaps best cautioned by the words of Shakespeare when he wrote, "The error of our eye directs our mind . . . !" [*5*].

References

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Address requests for reprints or additional information to
James E. Behrendt
Regional Crime Laboratory
U.S. Postal Inspection Service
1407 Union Ave., Rm. 714
Memphis, TN 38161-0003