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Identification of Indented Typewritten Entries with Characters Present on a Lift-Off Correction Ribbon

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ABSTRACT: During the course of a bank fraud investigation, a Smith-Corona printwheel typewriter and a Brother dot matrix thermal printer were seized. Unfortunately, the suspect had removed the carbon film ribbons from both machines, but he neglected to remove the lift-off correction ribbon from the printwheel typewriter. The class characteristics of the questioned and known typewriting were consistent, and spectral images were observed on the platen of the printwheel machine which corresponded to portions of the text on the questioned checks. This interesting, yet circumstantial evidence was overshadowed by the discovery of indentations beneath the typewritten text on certain of the checks. Comparison of the paper fibers in the area of the indentations with the posterior surfaces of characters plucked from the paper and preserved on the correction ribbon formed the basis for an identification.

KEYWORDS: questioned documents, lift-off correction ribbon, carbon film ribbon, paper fiber impressions, typewritten indentations

Although commonplace, single element typewriters are a source of exasperation for most document examiners. These machines rarely develop typeface and alignment defects; consequently, a question of whether a machine did or did not prepare questioned text usually cannot be definitively answered. The carbon film ribbon used to prepare the questioned text can usually not be found. However, if located, the ribbon can readily be identified with corresponding text based upon comparison of the pattern of paper fiber impressions on the film ribbon created during the process of typing the text.

What can be done when a single element typewriter has had its carbon ribbon removed? Such was the situation in a recent criminal investigation. A suspect negotiated several checks at two banks and quietly left town. A seasoned criminal investigator called to ask for assistance. After he explained that he had recovered two new typewriters, both of which were missing their ribbons, it seemed doubtful that anything definitive would come from an examination. Nonetheless, he was encouraged to submit the evidence since a comparison of size and style of type and process (the technology used to place characters on paper) could serve as a basis for elimination, or, provide circumstantial evidence of the typewriters' use.

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Evidence

Thirteen questioned checks, designated as Q1 through Q13, fraudulently drawn on the accounts of two legitimate insurance companies were received. Also submitted for examination were a Brother EP 20 Electric Printer and a Smith-Corona SL 460 Electric Typewriter. Both machines were in excellent condition and appeared to be virtually new.

Preliminary examination of the checks revealed that they were prepared by two different typing processes. The first process used a thermal transfer dot matrix system to produce upper case characters seven dots in height (Fig. 1). This process was observed on the fronts of checks designated as Q1 through Q11. The second process used preformed type resembling Courier style (Fig. 2). This process was noted on the fronts of Q12 and Q13, and on the backs of Q10 through Q13. Carbon film ribbons had been used in both processes. The horizontal spacing of all the type was measured as 2.54 mm per character.

Despite its name, the Brother Electric Printer was by all outward appearances and function a portable electric typewriter. Inspection of the internal components revealed a seven pin thermal print head and the absence of a carbon ribbon.

The Smith-Corona Electric Typewriter was an electronic model equipped with a Regency 10 printwheel. The Smith-Corona's carbon ribbon was also missing. However, closer scrutiny yielded a lift-off correction ribbon.

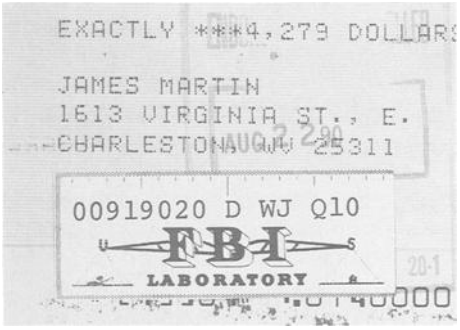


FIG. 1—*Thermal transfer dot matrix system used to produce a portion of the questioned type.*

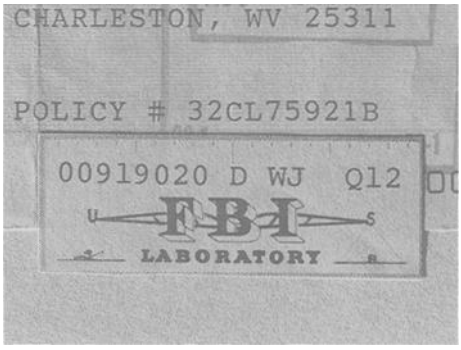


FIG. 2—*Preformed type resembling Courier style used to prepare remainder of questioned type.*

Preliminary Examination

Because the platen of the Brother machine was soft and yielding and exhibited no identifying marks of value, the next step was to take exemplars for comparison with the questioned typewritten entries. A newly purchased carbon ribbon was inserted in the machine to allow exemplars to be taken (Fig. 3). Comparison of the Q1 through Q11 checks with the Brother exemplars revealed that a Letter Gothic type style with upper case letters seven pins in height, horizontal spacing of 2.54 mm per character and a thermal transfer dot matrix process were shared in common. Therefore, the Brother Electric Printer was capable of producing the questioned type found on the fronts of Q1 through Q11. The absence of printing defects, roller impressions and the carbon ribbon precluded an opinion involving a higher level of certainty.

With respect to the Smith-Corona typewriter, a standard of the Regency 10 type style was available in the reference file (Fig. 4). Regency 10 emulates IBM Courier type style, but has distinguishing design variations such as the curve in the lower right leg in the upper case "K" and flatter spirals on the numerals "6" and "9." Comparison of the questioned checks and the Smith-Corona Regency 10 standards revealed consistency in letter style. The Smith-Corona machine had pitch selections of 10, 12 and 15 characters per inch—so it was capable of producing horizontal spacing of 2.54 mm per character which corresponded to the questioned type on the fronts of checks Q12 and Q13, and the backs of Q10 through Q13.

At this point, the examination had established that the Brother and Smith-Corona machines could have produced all of the questioned type on the thirteen checks. Although not conclusive, this finding significantly narrowed the possibilities. With respect to the Brother, nothing could be done to further separate it from all other similar machines, but the Smith-Corona offered additional avenues of investigation.

Platen Examination

Spectral images form upon the surface of most hard platens during routine use. These images are distinguished from carbon characters actually typed on the platen instead of on paper. Subsequent typing results in overlapping of images which are for the most part indecipherable. A well-used platen will have a grid of spectral images extending across its working length and around its circumference.

The platen of the Smith-Corona, unlike the spongy roller of the Brother, was firm and had a semilustrous finish. It also bore spectral images of typewritten characters (Fig. 5). In this case, the cluttering effect caused by overlapping characters was minimal, probably

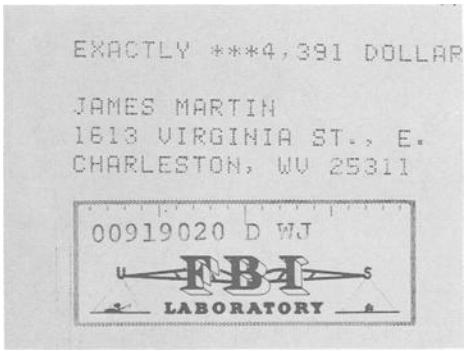
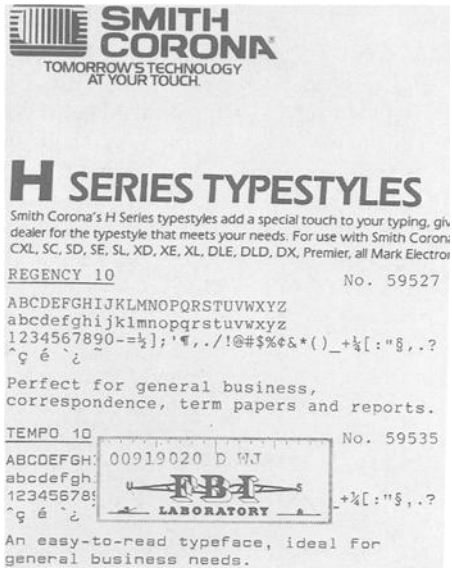


FIG. 3—*Exemplars produced by Brother Electric Printer.*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Perfect for general business, correspondence, term papers and reports.

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FIG. 4—*Manufacturer's standard for Regency 10 type style.*

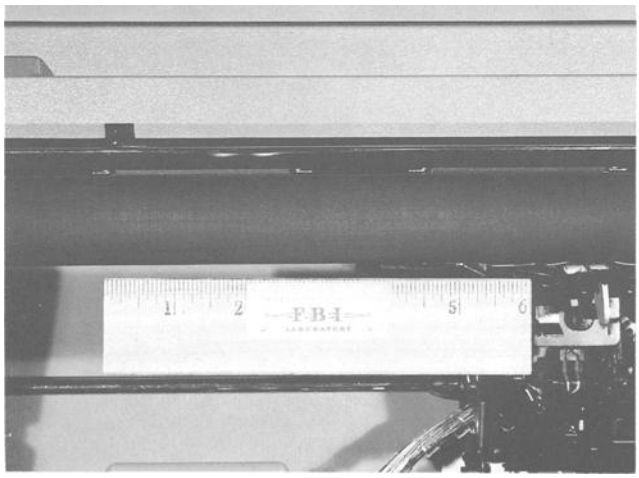

FIG. 5—*Spectral images of type written characters observed on platen of Smith-Corona typewriter.*

due to the relatively new condition of the machine. The type style of the spectral images corresponded to the Regency 10 standard and measured approximately 2.54 mm per character. There were decipherable entries on the platen which corresponded to some portion of the text on all sides of the checks classified as bearing Regency 10 type style (Q10 through Q13).

Although the spectral images could arguably have been the direct result of the process of typing Q10 through Q13, they could just as easily have corresponded to some other document with the same text that was not in the possession of the FBI. They could also have been caused by someone taking exemplars, or, as was later implied by the defense attorney, the result of an attempt to manufacture evidence. Although tantalizing, the images were not conclusive proof that the Smith-Corona was the typewriter used in this case. The next step was to examine the correction ribbon.

Correction Ribbon

Removal of the Smith-Corona correction ribbon from its casing revealed that it had been partially used. The surfaces of the Q10 through Q13 checks were examined for the presence of indentations of typewritten characters which had been lifted from the page. Under oblique lighting and low power magnification (3x), an indented ":" was observed on the back of Q10 (Fig. 6) and an indented "P" was noted on the front of Q12 (Fig. 7). The front of Q13 bore an indented "exactly" entry (Fig. 8) and the back contained an indented "!" (Fig. 9). The indentations were well defined and there was minimal evidence of abrasions to the surface of the paper. No chemical stains and no use of correction fluid or cover-up tape was observed. Very little carbon residue remained in the indentations. The location and nature of these indented entries indicated they were typographical mistakes which had been removed with a lift-off correction ribbon [*1*].

Comparison with the correction ribbon confirmed the presence of characters corresponding to the typed indentations (Fig. 10). Although circumstantial, this evidence constituted a very good likelihood of the Smith-Corona's use in the correction of Q10, Q12 and Q13. The final step toward identification involved paper fiber impressions.

Paper Fiber Impressions

To make cellulose paper on a fourdrinier machine, the cellulose fibers are suspended in a solution of 99.5 to 99.9% water and fed onto a fine screen which moves at speeds

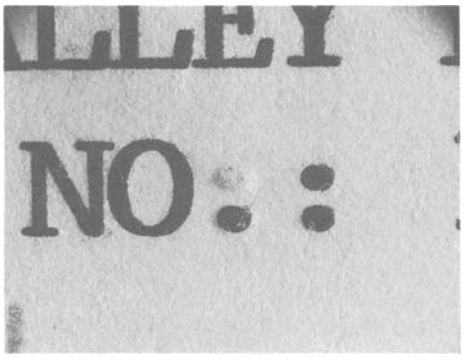

FIG. 6—*Indented typewritten colon observed on Q10.*

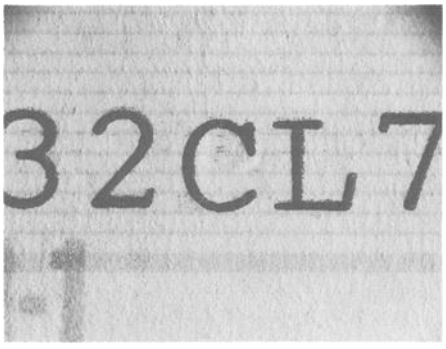

FIG. 7—*Indented typewritten upper case P noted on Q12.*

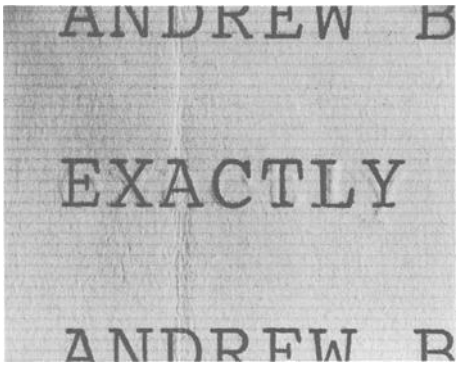

FIG. 8—*Indented typewritten "exactly" entry observed on Q13.*

FIG. 9—*Indented typewritten exclamation point noted on Q13.*

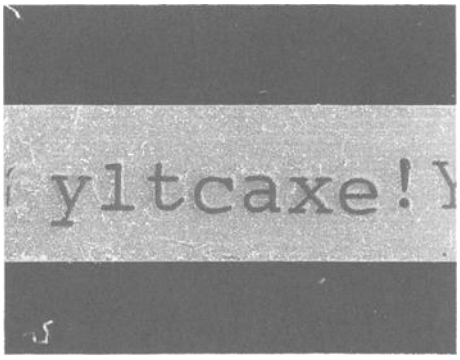

FIG. 10—*Characters present on correction ribbon (a, b, c) that correspond to indented typewritten entries observed on Q10, Q12, and Q13.*

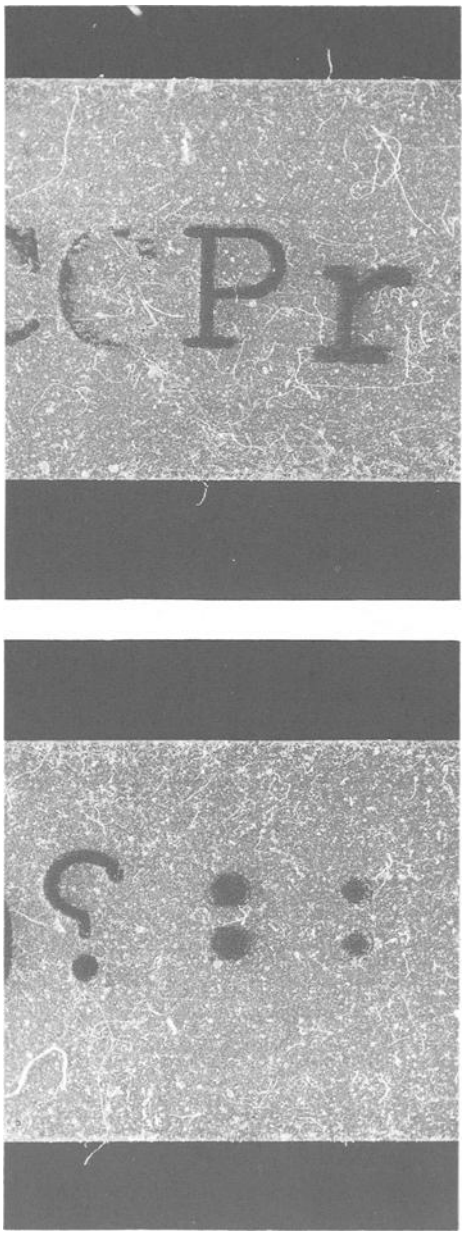

FIG. 10—*Continued.*

of from 500 to 3500 feet per minute [2]. The 0.1 to 0.5% fiber content of the solution arranges itself on the horizontally moving screen in a random, unique pattern.

During the typing process, the carbon ribbon is caught between the typing element and the paper. This results in pressure being exerted upon the film ribbon by both the type element and the paper. The effect of the type element on the carbon ribbon is quite evident—carbon is transferred from the ribbon onto the paper and an indented character

remains on the film. The action caused by the paper, held in place by a finitely yielding platen, is subtle but of great value to the examination. Intersections of fibers formed by their bonding action not only are recognizable, but in some cases individual fibers are noteworthy. The surface of the paper reacts to the pressure placed upon it by the type element and platen by stamping or indenting the relatively soft ribbon base. The ribbon, therefore, contains impressions which correspond to the unique arrangement of the fibers on the surface of the paper [*3*].

A comparison microscope is necessary in order to examine this phenomenon. A Polaroid camera mounted on the microscope ensures a record of the side-by-side comparison. Polaroid 55 sheet film will provide 4″ × 5″ black and white prints for case notes and negatives for enlargements. In the discussion which follows, the ribbon will be mounted on the left platform and the paper will be placed on the right. The controls should be set to provide a split image—the left half will be of the ribbon and the right half of the paper. It is easier to scan areas of interest on the ribbon and paper at approximately 15× magnification. At this magnification, the agreement, which is sometimes excellent, between the outline of the character on the paper and its silhouette on the film can be observed. Once a specific character on the paper and the corresponding segment on the film ribbon are located, greater detail can be observed by increasing magnification to approximately 30×. Through the eyepiece, impressions on the ribbon can be observed on the left and the pattern of paper fibers on the surface of the paper which caused the impressions can be seen on the right.

Distinguishing a specific fiber or prominent portion of a fiber from the mass of fibers on the paper, and subsequently locating the corresponding impression on the ribbon is the goal of the examination. Unfortunately, not all fibers on the paper create an impression on the ribbon. Paper may seem smooth to the unaided eye, but under 30× magnification an uneven topography becomes apparent. Recognizable fibers sometimes dwell in the valleys rather than on the ridges and do not make sufficient contact with the ribbon to leave an impression. Less recognizable fibers can interfere with more interesting fibers. And, in some cases, a prominent fiber observed on the surface of the paper leaves only a partial impression on the ribbon, or none at all.

Control of lighting, in terms of intensity, direction and station can be tedious. Fiber optic lights are preferable for their concentrated, variable intensity light beams and flexible, small barrels which allow freedom of adjustment over the critical areas. Placing the ribbon between microscope slides mounted on trestles approximately one inch off the platform allows ease of lighting from virtually any direction. Polaroid filters which insert into the slots on either end of the bridge of the comparison microscope are useful in providing increased definition to the fibers and impressions.

Use of the overlay feature of the comparison microscope will superimpose one image over the other and aid greatly in tracing the silhouette of the character on the paper with its outline on the film. Slight movement of the left or right platform of the microscope in the x and y axes simplifies the process, especially when attempting to evaluate faint fiber impressions.

Examination of Lift-Off Correction Ribbon

Research by F. J. Gerhart regarding correction ribbons revealed that characters which have been removed from the page may exhibit paper fiber impressions corresponding to the paper fibers in the indented area of the paper [*4*].

The correcting ribbon is similar in appearance to frosted adhesive tape. The side which faces away from the paper (front) has a glossy finish and the side which faces the paper (back) is coated with a tacky adhesive. When the correcting mechanism is activated, the type element strikes the front surface of the ribbon and the back side comes in contact

with the paper. The tension in the correction ribbon mechanism plucks the typed character from the paper and the ribbon advances for the next correction. The characters which were formerly on the page are now stored on the correcting ribbon in the same order in which they were removed.

The principles involved in the creation of paper fiber impressions on carbon ribbons also apply to the examination of correction ribbons. However, their contrasting functions require different examination techniques. The images on carbon ribbons and typed characters on paper are positive (right-reading) images. The outline of the character on the ribbon will superimpose over the character on the paper. The fiber impressions on the ribbon are thus positively oriented to the paper fiber pattern under and around the character on the paper. Mental gymnastics are not required to follow this positive to positive relationship between the two images.

With the correction ribbon, the mind must engage in a few twists and flips. The function of the correction ribbon is to remove, or pluck, the character from the paper. Due to the filtering effect of the adhesive and the ribbon, the character, formerly in direct contact with the paper, is mounted on the adhesive and cannot be examined from the front view as a positive image. Instead, the back side of the character must be examined in reverse view and compared to the indentation which remains oriented in a positive position. Unlike the typed character which is still present in conventional carbon ribbon examinations, the corrected area of the paper is essentially a carbonless indentation which may be partially or completely concealed with a character subsequently typed over its place. One cannot compare the carbon outline of the character on the paper (which has been removed by the tape) with the silhouette on the carbon ribbon (there is none). This renders useless the convenient superimposition feature on the comparison microscope. All of the foregoing circumstances make it very difficult in a microscopic environment to locate precisely the critical area of fibers, and, once fixed, to remain visually and mentally focused.

With respect to the indented "exactly" entry on Q13, the "e" was compared to the "e" found on the segment of the correction ribbon containing the letter grouping of "yltcaxe," the "x" indentation to the "x" on the ribbon, and so on. In each case, the check was placed on the right platform on the comparison microscope and the correcting ribbon was placed back (adhesive) side facing up (toward the ceiling) on the left platform. The two images as viewed through the eyepiece were arranged book-fashion with the centerline serving as a point of departure. Proceeding outward from the centerline, as seen through both the eyepiece and in the photographs, fiber impressions on the correction ribbon (on the left side) and paper fibers on the surface of the paper (on the right side), appeared as mirror images of each other. Conceptually, if both halves of the images as seen through the microscope were transparent, except for the lines caused by the critical fibers and impressions, the symmetry emanating from the centerline would be revealed.

Identification of unique fiber impressions was possible in each letter of the indented "exactly" entry on Q13 and the "yltcaxe" segment on the correction ribbon. The indented "!" entry on the back of Q13 and the indented "P" entry on the front of Q12 were also identified with corresponding characters on the correction ribbon. The indented ":" entry on Q10 exhibited insufficient fiber impressions and was therefore not identified. Figures 11 and 12 depict the impressions on the correction ribbon and the paper fibers observed with respect to the "a" and "!." In both figures, the image on the left is of the back side of the plucked character, and the image on the right side is of the paper fibers in and around the corrected indentation.

The identification of the aforementioned paper fibers and impressions on the ribbon supported the conclusion that the typewritten characters removed from Q12 and Q13 were definitely present on the Smith-Corona correction ribbon.

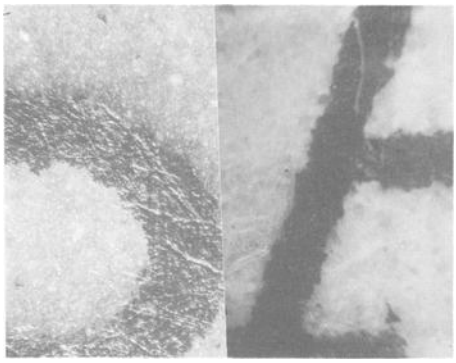

FIG. 11—*Comparison microscope photograph of lower case "a" on correction ribbon (left) and corresponding indentation (right) on Q13.*

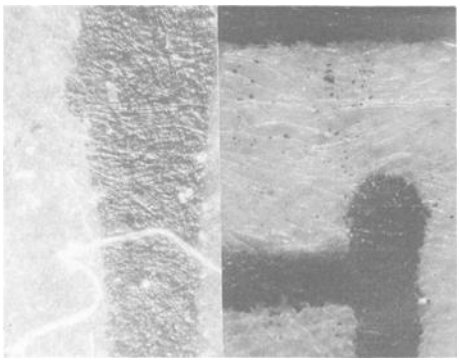

FIG. 12—*Comparison microscope photograph of exclamation point on correction ribbon (left) and corresponding indentation on right Q13.*

Conclusion

The examination of the evidence in this case illustrates that typewriters, like books, should not be judged by their covers. A case, which at first glance seemed unpromising, yielded significant evidence which a jury found helpful in its deliberations. The prosecutor who successfully tried this case, remarked in closing argument that the rapt attention paid by the jury to the evidence presented in regard to the typewriters was matched or exceeded only by one other person—the defendant. A reasonable person might conclude that he was clever enough to remove the carbon ribbons. Through oversight or sloth, the defendant, who had an extensive criminal record, had left behind a gold nugget that was just waiting to be found. He will probably not make the same mistake next time.

References

[*1*] Casey, M. A. and Purtell, D. J., "IBM Correcting Selectric Typewriters: An Analysis of the Use of the Correctable Film Ribbon in Altering Typewritten Documents," *Journal of Forensic Sciences*, Vol. 21, No. 1, Jan. 1976, pp. 208–212.

[*2*] Browning, B. L., *Analysis of Paper*, Marcel Dekker, New York, 1977, pp. 11–12.

[3] Hahn, G. H., "Paper Fiber Impressions on Carbon Tape Ribbons," *Journal of Forensic Sciences*, Vol. 19, No. 1, Jan. 1974, pp. 136–141.
[4] Gerhart, F. J., "Methods of Associating Typewriter Ribbons and Correcting Tapes with a Questioned Text," *Journal of Forensic Sciences*, Vol. 34, No. 5, Sept. 1989, pp. 1183–1195.

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