

*Report to the ARRB - President John F. Kennedy Assassination*  
Analysis of Selected Photographic Evidence

## *STUDY 3*

### *Initial Motion Picture Printing of the Zapruder 8mm Original Movie Film*

OBJECTIVE: Our goal is to analyze the printing characteristics of the copies of the Zapruder "out-of-camera" original film made by the JAMIESON film company 11/22/63, and to document, to the best of our ability, how these copies were produced.

#### *Introduction*

Mr. Zapruder very wisely arranged for three copies of his original film to be printed in order to fulfill the request of Secret Service agent Sorrels for a copy and to provide himself the opportunity to negotiate the sale of his original. The records at NARA provide reasonable assurances of the traceability of copies identified as Secret Service copies 1 and 2, which we, in general, accepted as first generation copies, for which we analyzed manufacturing and edge print and processing markings in Study 1, Part 2.

Rather than limit our study to the analysis of the vintage of the copies as originally requested by ARRB, we believed that we could make a contribution by providing, as in-depth as possible, understanding of the printing characteristics of the first generation copies. Accomplishing the stated goal involved a search of 1960s printing equipment, procedures and laboratory practices and the tutorial and engineering contributions of many industry experts. The JAMIESON film company provided the printing service to Mr. Zapruder, and Mr. Bruce Jamieson has been a key resource in our research.

During our examination of Secret Service copies 1 and 2, we noted two significant characteristics: a.) The presence of a septum line; and, b.) The fact that Secret Service copies 1 and 2 were of different densities. Further, because we have not been able to view and compare the first generation Life Magazine copy with the Secret Service copies or the Zapruder original, our analysis is constrained and limited.

## Part 1

### *Chronology of Events for Printing and Processing of Initial (First Generation) Copies of the Zapruder 8mm Movie Film - General Information*

*Kodak Dallas Processing Laboratory's Role in the Printing of the Zapruder Original:* In interviews in July 1997, with Mr. Philip Chamberlain, Acting Laboratory Manager in 1963, and Mr. Richard Blair, Customer Service Representative<sup>1</sup>, we can summarize the handling of the printing of the Zapruder Original as follows:

- After the original was removed from the camera, perforation identified 0183 and processed without removing the integral leader and trailer, Messrs. Chamberlain and Blair, with Mr. Zapruder present, viewed the film (with a 16mm inspection projector<sup>2</sup>) for processing quality.
- When Mr. Zapruder indicated that he wished copies of his film, Mr. Chamberlain advised that unless the film was sent to Rochester, the film needed to remain in the double 8mm format (16mm width) and that Kodak in Dallas did not have the capability of making prints.
- Kodak ("Pat" Pattist) contacted the JAMIESON film company and arranged for immediate printing of the original. Mr. Blair provided three rolls of Kodachrome II Type A camera film to be used as 8mm print stock.
- When Mr. Zapruder returned with the three printed Type A rolls, they were perforation identified 0185, 0186, and 0187<sup>3</sup> and processed the afternoon of November 22.
- Mr. Zapruder's original was then slit to 8mm and projected by Mr. Chamberlain once or twice for Mr. Zapruder with several members of the lab present.
- We may assume that since Kodak proceeded with slitting the camera original to 8mm, the prints were of reasonable quality. Also, the Secret Service accepted the quality of their prints as sufficient for use as evidence in its investigation of the assassination, and as a printing master for additional copies.

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<sup>1</sup> Reported in detail in Study 1, Part 2.

<sup>2</sup> The inspection 16mm inspection projector was designed to operate at a higher than normal frame rate to evaluate for possible processing induced artifacts.

<sup>3</sup> See Affidavit by Mr. Tom Nulty referenced in Study 1, Part 2.

- On the following day, Mr. Chamberlain recalls viewing one of the prints with a Secret Service agent. Dick Blair recalls a comment, possibly from Pat Pattist, that someone noticed some unsteadiness at every-other 8mm frame. (This can be attributed to film pitch and the 16mm printing sprocket - see text and Part 3, Study 1.)
- The Lab had no further contact with Mr. Zapruder or his films.

*The Printing of Zapruder's Original by JAMIESON:* Last fall I contacted Mr. Bruce Jamieson to review his recollection of the printing of the Zapruder film. Bruce recalled the visit by A. Zapruder, the challenge of selecting a filter pack and light value for the 3400°K amateur film and the printing with Mr. Zapruder present in the dark room.

In brief we found:

- The initial belief that the prints were made on their custom 3-Head printer was incorrect. Mr. Robert Colley, a printer operator, confirms that the Zapruder film was printed on a Bell & Howell Model J printer.
- Further the initial belief that the prints were printed "full aperture", picture plus sound, also proved incorrect based on the examination of the images of the resulting prints.
- The printer operator for the Zapruder film was Marshall Collier, current status and whereabouts - unknown.
- A printer operator in the Lab area when the Zapruder film was printed was Robert Colley. Bruce reviewed the printing of the Zapruder film with him.
- Mr. Robert Colley seems to recollect an edge printing light of some type on the Model J, but is uncertain of its configuration.
- The Kodak Dallas contact for the JAMIESON lab was Erwin "Pat" Pattist, Quality Control Supervisor, who assisted in the selection of the printer filter pack.
- No one at JAMIESON viewed the results of their printing efforts.

Copies of Bruce Jamieson's letters to me are appended.

## Part 2

### *Printer Aperture Selection and Septum Line Study*

*Introduction:* During two visits to the Motion Picture, Sound and Video Branch of the National Archives (NARA), I had the opportunity to study the 8mm movie film shot, by Mr. A. Zapruder, on Kodachrome II film with a Bell & Howell Model 414 PD<sup>4</sup> Director series movie camera.

The camera used is not untypical of several models that position the film with its claw moving in an aperture cutout area adjacent to the image forming picture area. Consequently, scene information falls into this unmasked area due to the excess (circular) imaging area produced by the lens. For normal home movie projection this additional recorded scene information would be of no consequence as the projector aperture would hold back or mask-out this area.

A full description of the camera and its picture taking characteristics follows as *Study 4* of this report. Here, we are concerned with, and wish to understand why this additional or excess image area between the perforations was not printed; or was only partially printed, with a septum line onto one side of the 16mm wide copies (i.e. only one half of the 8mm role after slitting). To do so, we need a conceptual understanding of the printer.

*Printing Format:* When Kodak processed the original film, they fortunately encouraged Mr. Zapruder to obtain prints prior to slitting the processed double 8mm camera film to 8mm width. Kodak provided Mr. Zapruder with three 25-ft. customer rolls (actual length 33 ft.) of Kodachrome II Type A. Thus the unslit original, with 16mm laboratory leader and trailer applied, became the JAMIESON Laboratories "master printing roll", and was printed on a Bell & Howell Model J continuous contact subtractive light printer in 16mm format onto the film supplied. Zapruder took the printed (exposed) rolls back to the Kodak Dallas Laboratory for processing and slitting to 8mm.

*Print Results:* As noted above, JAMIESON personnel did not see the results of their printing efforts. Kodak laboratory personnel recall viewing, in 8mm format, the camera original with Mr. Zapruder and a

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<sup>4</sup> Initials PD stood for: P= power zoom; D = dual electric eye.

print, the next day, with the Secret Service. Because the original and at least one print were identified as slit to 8mm width, we assume that the prints were of reasonable quality - and all three were slit to 8mm.

### *The Bell & Howell Model J Printer Specifications:*

*Fundamental Printer Characteristics* - Essentially, all printing machines consist of a means of moving a processed original and the unexposed stock onto which it is to be copied, together, past an illuminated aperture where the light can be accurately varied to produce the required exposure. Printers are divided into two types according to the way they move the film. These are either continuous printers, where both the original and print stock are moved at a uniform speed, or intermittent printers in which the two strips are moved one at a time and held stationary for the period of exposure. Further definition is required to understand how the print stock is exposed - either in contact with the original strip, or by optical projection in which the original is formed on the print stock by a copying lens.

*The B&H Design 5205 Model J* - The Model J is a 16mm Semi-Automatic Continuous Contact Film Printer designed to print all sound or silent 16mm motion picture film. The film path in its simplest setup leads the print stock and the original from their respective reels through interlocked feed, printing and take-up sprockets. The main drive sprocket, typically called the "printing sprocket" has several teeth that engage with the perforation holes of both films together and move the two in contact, emulsion to emulsion, past an exposure aperture, after which they separate at the take-up sprocket and wind up on separate reels. All this action is a continuous uniform motion, which will cause no undue strain on the perforations.

To achieve quality results, the movement of the film past the aperture must be absolutely uniform and intimate contact between the original and print must be maintained. The printing sprocket is large enough (approx. 4 inches in diameter and having 40 teeth) to permit the aperture to lay within the rotating sprocket flanges and be illuminated from within. A 150-300 watt lamp (often customized to higher output to permit higher printing velocities) furnishes the illumination for exposures. The light intensity is mechanically controlled in order to insure instantaneous light changes that can be duplicated exactly on all prints. Predetermined changes in light intensity enable the operator to be one step ahead of the operation.

Hence, the designation "Semi-Automatic." *Printing Methods* - Five methods of printing are possible.

- (a) To print the picture area and soundtrack from two separate negatives<sup>5</sup> onto one positive film. This method necessitates two separate operations, in which the positive film is run through the printer twice.
- (b) To print the picture area and soundtrack in two operations, even though both the picture area and sound-track are on the same negative film.
- (c) Or, as it rarely if ever occurs, to print both the picture area and soundtrack simultaneously when the two records are on the same negative film.
- (d) To print the picture area only.
- (e) To print the soundtrack only.

*Note:* For further study and comprehension, a full description and details of the operation of a Model J printer are contained in a copy of the *Bell & Howell Design 5205 Model J Operators Manual* appended to this report. An exploded view of the printing sprocket mechanism is shown in *Figure 41. Back Shutter and Sprocket Assembly*, taken from the printer *Shop Manual*, is also appended. (We apologize for the limited reproduction quality of this vintage material)

#### *Printer Aperture - Setting Selected:*

*Options:* Printing a normal silent (no sound track) 16mm film with two rows of perforations would utilize a typical printer aperture setting of "picture-only" - method (d) of the above *Printing Methods* section. The extract from the *Bell & Howell Design 5205 Model J Operators Manual*, method (C) stipulates that it is unusual to set the aperture to print picture and sound simultaneously<sup>6</sup>. The "picture-only" printed area would encompass both 8mm rows of the area between the perforations only - the perforation area would receive no exposure.

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<sup>5</sup> Note, in practice, "reversal film" may be utilized as the original or print film.

<sup>6</sup> The printed area specifications are established in American National Standard PH22.48, appended.

*Septum Identified:* Our (NARA Sept. '97) examination of the (first generation) prints of the motorcade, (side two of the 8mm original) show that the area between the perforations received no exposure (i.e. was not printed). However, on the opposite side, the family pictures side of the double 8mm - 16mm wide - unsilt original, the camera captured between-perforation image information is printed; but, part of that image area is obscured by a thin dark line running along and adjacent to the picture side of the perforations - a septum line. (See Figure 3-1, leader and family pictures scene)

*Footage Number Printing Basics:* For perspective, the reader should be aware that if footage number printing is employed, it is consistently in the same location on a 16mm film. Professional 16mm print films contain only one row of perforations, allowing the opposite side to be used for an applied or photographic sound track. The perforated edge thus becomes the only available "real-estate" where product information and footage numbers can be placed. Professional camera and intermediate films contain "footage" edge markings. When printed, the work-print must contain these footage numbers - printed-through - to facilitate editing. The printing sprocket also contains one row of sprocket teeth and special practices need to be employed if footage number printing is concurrently accomplished at the printing head - discussed later.

*Aperture Selected:* We believe the Model J printer used by JAMIESON was a single head printer modified with footage number printing capability. This would account for the area between the perforations of the family pictures receiving exposure and the perforation area of the motorcade section - none. We therefore conclude that in the thread-up of the original, the motorcade images were located on the soundtrack side of the 16mm printer aperture and the "picture-only" setting was selected.

We base this conclusion on several points:

- That's what Bruce Jamieson believes - and he was present when Zapruder brought his film in for copying.
- The fact that JAMIESON, recognizing that there is no soundtrack area on a double-8mm original - would not logically consider printing (exposing) the sound track area.
- Further, a printer operator might have been concerned that 8mm perforation holes would be positioned over the soundtrack area of

the printer aperture without a mechanism for protecting the picture area. If the soundtrack area were illuminated, the perforation holes would have permitted unobstructed light to reach the print film with some risk of fog into the adjacent picture area<sup>7</sup> of the print.

- It is highly unlikely that anyone, at that time, would be aware that the image extension into the perforation area would be of importance.

We discussed our views with several laboratory personnel and gained support including Mr. Bruce Jamieson with his confirming correspondence<sup>8</sup>.

The remaining question is how did the family pictures side of the double 8mm - 16mm wide - unsilt original, the camera captured between-perforation image information become partially printed? The edge print image quality was a good match for intensity and color balance to the picture image. Our belief is that this was accomplished by an edge print or footage printer light (adjacent to, but outboard the printer sprocket or by a separate footage/edge mark printer with an independent light source). In either case the light source and printing configuration left a thin black (no exposure) septum line.

### *Edge Print or Footage Number Printing:*

*Methods:* We have identified two possible methods for printing footage or edge numbers with the Model J printer: An undercut printing sprocket having an undescribed light source, or an accessory special cut sprocket mounted as the printers feed sprocket with an independent light source. The first is briefly referenced in the printer manual and the latter was available as a "field installed" accessory. It is important to note that with either configuration, no special thread-up of the printer would be required - the only operator action needed, would be to turn on the margin printing light.

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<sup>7</sup> Practical tests, with current product, have shown that the aperture could have been set to picture plus sound without excessive "light-piping" into the picture area adjacent to the perforations. However, even if the laboratory knew there was scene information between the perforations, it would not have been logical for them to take the risk of printing the sound track area without first running practical tests. Footage number printers have a sprocket tooth in the perforation hole at the time of printing, restricting the light.

<sup>8</sup> Copies of my letters seeking input and Mr. Jamieson's replies are appended.



Secret Service Copy of A. Zapruder 8mm Film  
Showing 16mm Printer Septum Line

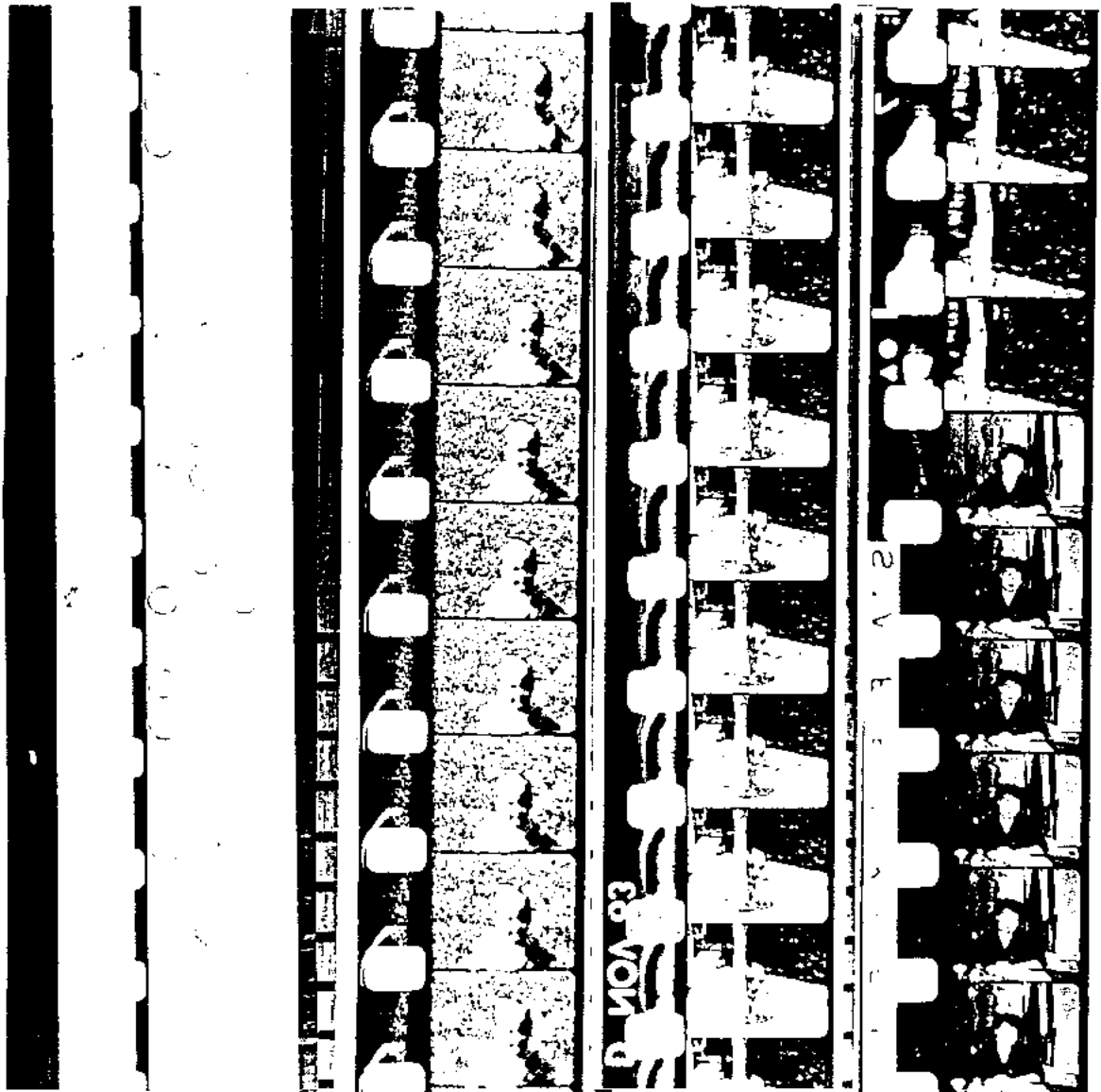


Figure 3-1

The photos are from a Secret Service copy of Mr. A. Zapruder's movie film, the A-side (first half) of the double 8mm roll containing "family" scenes. The JAMIESON film company printed these scenes for Mr. Zapruder on a 16mm Bell & Howell model J contact printer concurrent with the motorcade scenes because the printing occurred prior to slitting the camera original to 8mm width. A thin black, (no exposure for reversal film) septum line occurs between the exposure for the picture area and the exposure for the edge print or footage number area. Images as well as scene picture information occurs between the perforations from the exposure of the edge print light. A section of leader, with the laboratory number 0183 perforated in the original is also shown to provide a clear indication of the size and location of the septum line. (Neg. 4526, frames 6, 15 and 16)

Note: The scene of the lady in black with a dress-form in the background contains the edge markings of the KIIA print film, while the scene of the tree has the product identification of the original KODACHROME II printed-through.

*Customized Printing Sprocket - Printer Modification:* The printer manual (appended) does make a brief reference to a milled slot for edge printing. "A slot is milled in the main casting at the left of the aperture and main sprocket to permit printing the footage markings and trade-marks (key printing) which identify each roll of negative film." Section III, 12. Printer Aperture Jaw. (Figure 3), (c), p14. However, the referenced Figure 3 in the manual does not show the milled slot nor do other parts of the manual reveal any specifications, show the configuration of the milled slot, or describe the edge print (footage number) light source/control or aperture! (Note: In a search of a half dozen or so vintage B&H Model J printers, it was only Kodak's printer that had the milled slot described in the manual.

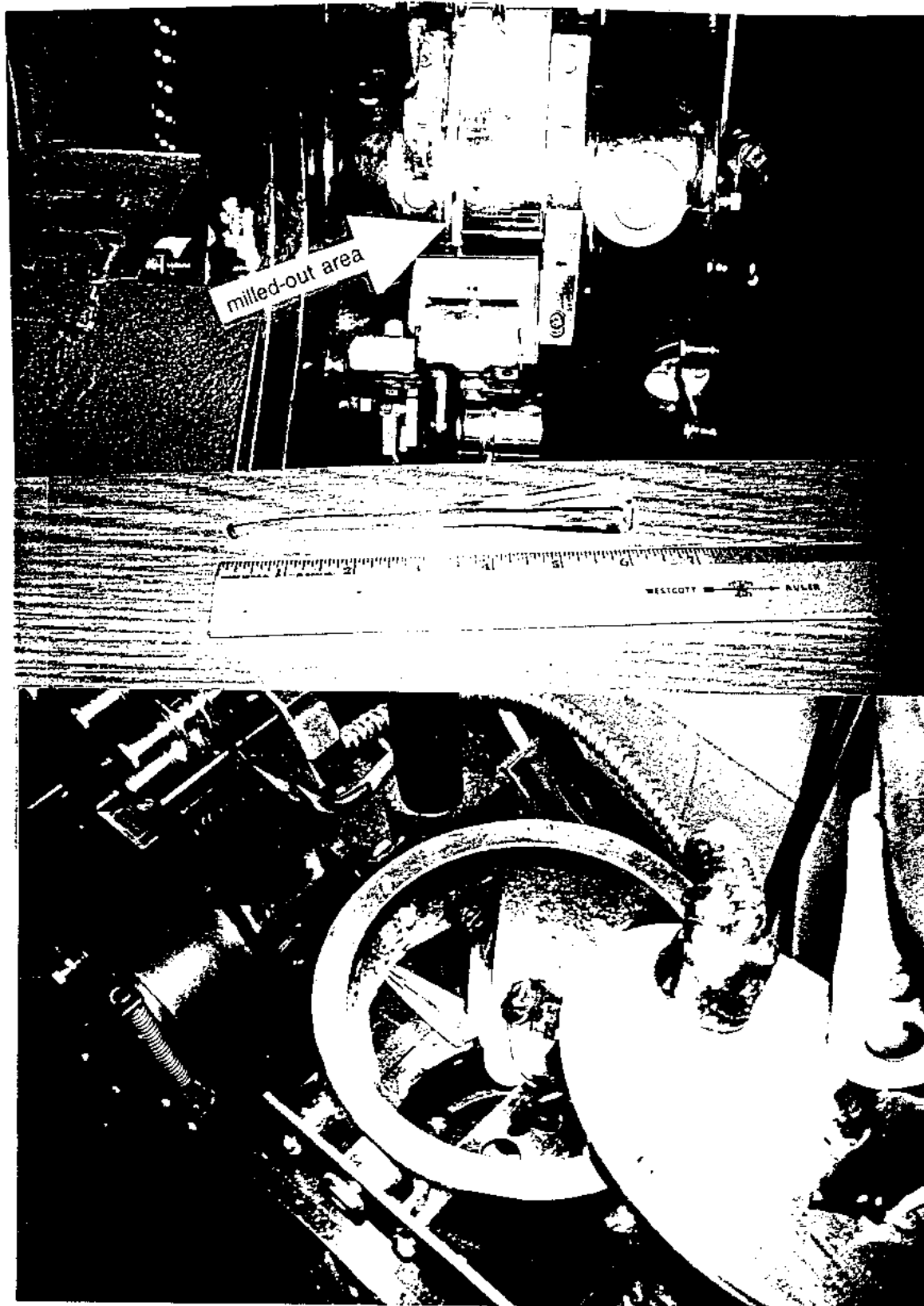
### *Kodak's Bell & Howell Model J:*

*Edge Printing Capability:* Fortunately I was able to locate an old Bell & Howell Model J printer and its worn operator's manual at Kodak. (As mentioned above, the manual is appended to this report).

The Kodak Model J does have a milled slot (referenced in the manual) adjacent to, and to the left of the printing sprocket. Light is directed to the slot area via a clear plastic "light-pipe" illuminated by an independent tungsten lamp controlled by an adjustable power transformer. (See Figures 3-2, 3-3 and 3-4)

A trial print was made to determine the extent and penetration of the light along the perforation edge of the film. The results showed that although edge illumination was achieved, no light penetrated between the perforations.

## Kodak's Bell & Howell Model J Printer



**Figures 3-2 - top**, Showing the printer sprocket, printer aperture and milled-out area for footage-number printing; **3-3 - center**, Showing the Kodak custom "light-pipe"; and **3-4 - bottom**, Showing the independent light source for the light-pipe. (Neg. 133879, frames 1,5 & ?)

At first we believed that the light pipe was too recessed (by about 3/16 in.) and that adjustment to correct decades of non-use was required. We disassembled the light head and moved the "light-pipe" to near contact with the film. (This operation gave us the opportunity to note and photograph the configuration of the "light-pipe" and its independent light source - photos referenced above.) We also positioned the "light-pipe" as far down as possible to determine if we could gain access to the area between the perforations as the film was being lifted from the printer sprocket by the lower stripper shoe.

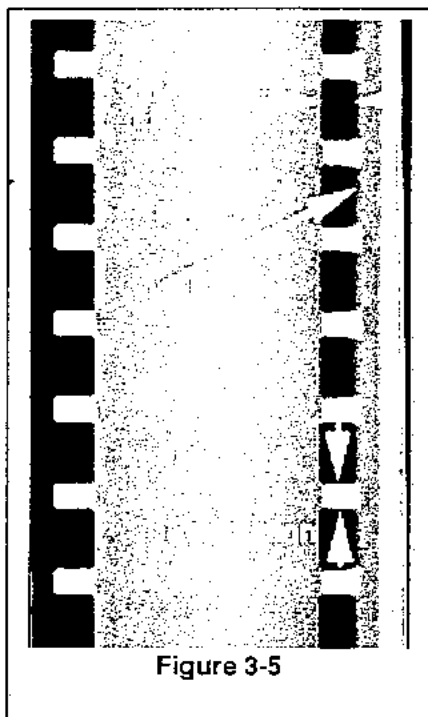


Figure 3-5

The subsequent printer tests established that the configuration of the printer sprocket - by having the film in direct contact with the root diameter of the sprocket (between the sprocket teeth) and without an undercut or bevel ground into the sprocket - precluded any edge print light from reaching the area between the perforations. A clip from the leader area showing the wide septum is shown in Figure 3-5. Our results, were therefore inconsistent with the intent of the edge print light milled slot and light-pipe design!

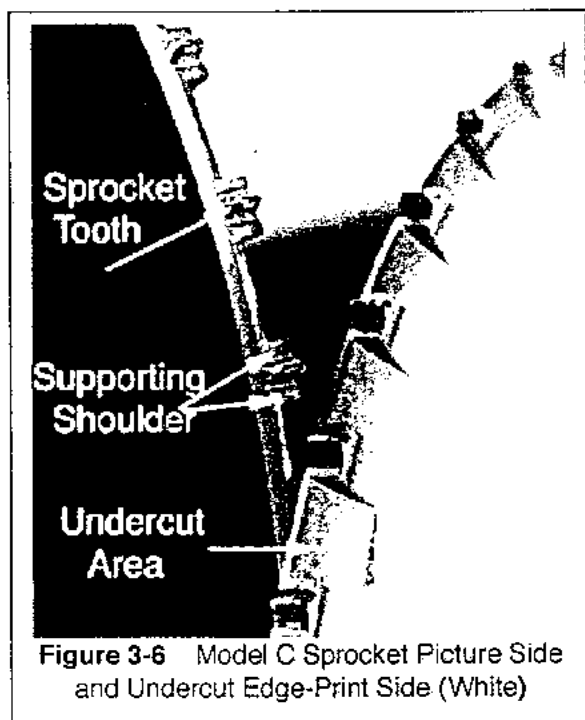
We then tried to determine whether or not the current printing configuration for edge print or footage numbering would have yielded any useful information. We concluded that its value would have been minimal because trade information (product type and code) as well as footage numbering font height penetrate into the area between the perforations and the current Kodak Model J could not have done its job to print footage numbers. We further determined that because the Kodak printer was used as a piece of test equipment subject to high volume use, it must have undergone several printing sprocket replacements during its life. For practice and experience, we did continue testing to try some multiple generation contact printing reported later.

We believe that a previous printing sprocket must have had a bevel cut to reduce the contact area on the root circle - between the teeth - to about 0.5mm (0.02 in.). This would be similar to that shown

in the Bell & Howell drawing 031173 (supplied by Mr. Ehrenberg and appended) for the Model C sprocket, but without the small shoulder at the base of each tooth. Note that the drawing called for white lacquer silk-screened in the bevel cutout to improve light distribution in the edge print area.

*A New B&H Series Model J Printer, the JM and the JM-2<sup>9</sup>:*

*Features:* An improved B&H Model J printer, the JM and the JM-2 features as a new main sprocket, a rotating "D" type aperture, a free wheeling shoulder support and built-in edge light printing for footage numbers to print concurrently with picture printing. (Copy of a Brochure on the printer provided by Mr. Young is appended.) Pictures in the brochure show the switch to turn-on the edge print light, but no configuration, specifications or supporting comments.



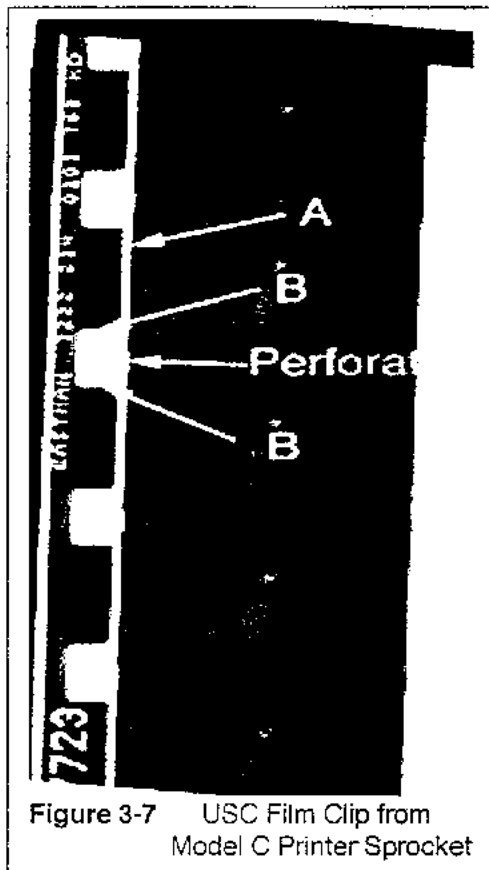
I was able to contact Professor Herbert E. Farmer, Professor Emeritus, USC School of Cinema and Television. The USC School of Cinema and Television has a Model JM in their archives. Herb informs me that the JM uses a Model C type printing sprocket as described in the B&H Drawing 031173 mentioned above. Mr. Richard Sidener of TREISE Engineering kindly loaned me a couple of sprockets to photograph and they are shown as Figure 3-6.

The modification of a basic printer design shows that Bell & Howell was responding to a customer need to provide simplified printing of footage numbers and edge print data. The improvements to the JM could also have allowed "back conversion" to the Model J. We can be reasonably certain that the Model J Printer, Design 5205, was modified by many laboratories to fulfill this customer need with factory supplied accessories or by custom modifications. Incorporating the Model C

<sup>9</sup> Announced in the 1960 SMPTE Progress Report, JSMPTE, May 1961.

printing sprocket with an independent edge print light source or part of the main printing light. This may have been Kodak's approach.

*Model C Sprocket Septum:* To ensure an understanding of the septum that occurs from the use of the Model C type of sprocket, examples of



the resulting septum line are shown in film clip provided by Prof. Farmer as Figure 3-7. The septum line identified as "A" is light because the clip is derived from negative/positive printing. It would be black (i.e. D-Max for reversal films). The light held-back by the shoulder surrounding each tooth, provides a clear area<sup>10</sup> around the perforation hole "B". The shoulder surrounding each tooth is easily seen in the photograph of the sprocket (Figure 3-6). Because we have no evidence to the contrary, we should also recognize that the Model C sprocket might have evolved from an earlier version that did not have the shoulder surrounding each tooth. The resulting septum line would have been the same width as that seen here and on the Secret Service copies - continuing to the edge of each perforation.

*Bell & Howell Margin Printing Assembly:* Through the courtesy of Mr. Irwin Young, CEO, DuArt Film and Video Laboratories, NYC, we were able to obtain a copy of a *B&H 1957 MOTION PICTURE FILM PRINTER ACCESSORIES* brochure which lists *Part No. 030086 - 16MM MARGIN PRINTING ASSEMBLY* for the Designs 5205 Model J Printer - price \$295.00. Mr. Young also provided a copy of the *INSTRUCTIONS FOR FIELD INSTALLATION OF MARGIN PRINTING KIT ON 16MM BELL & HOWELL DESIGN 5205 PRINTER*, which includes photographs of the components and Engineering Drawing 09133 showing the assembly. Copies are appended to this report. He further related to us his experiences as a printer operator using the outboard footage number printer, as the feed sprocket, and the thread-up challenges required to synchronize the footage printing with the following picture printing.

<sup>10</sup> No light would provide a dark or D-Max area for reversal films.

*Margin Printing Kit Septum:* It is not possible, from the margin printing kit instructions or engineering drawing, to calculate or even estimate the width of the necessary septum (no-exposure) line that would protect the edge print light from protruding into the picture area. Samples were needed.

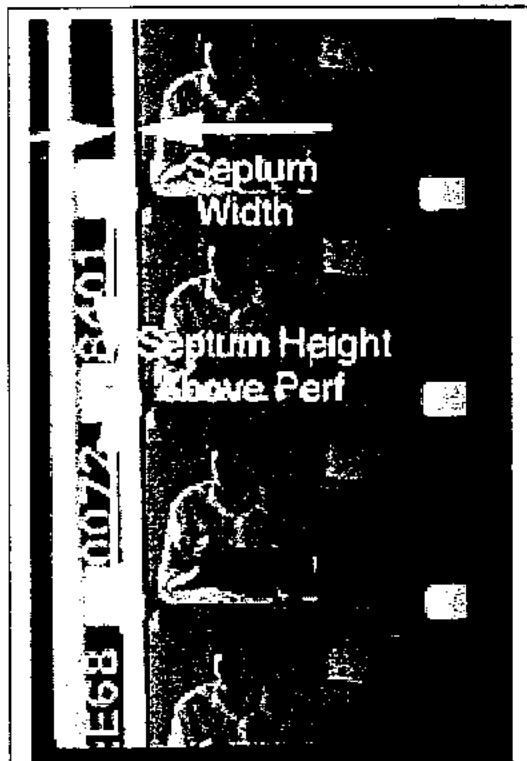


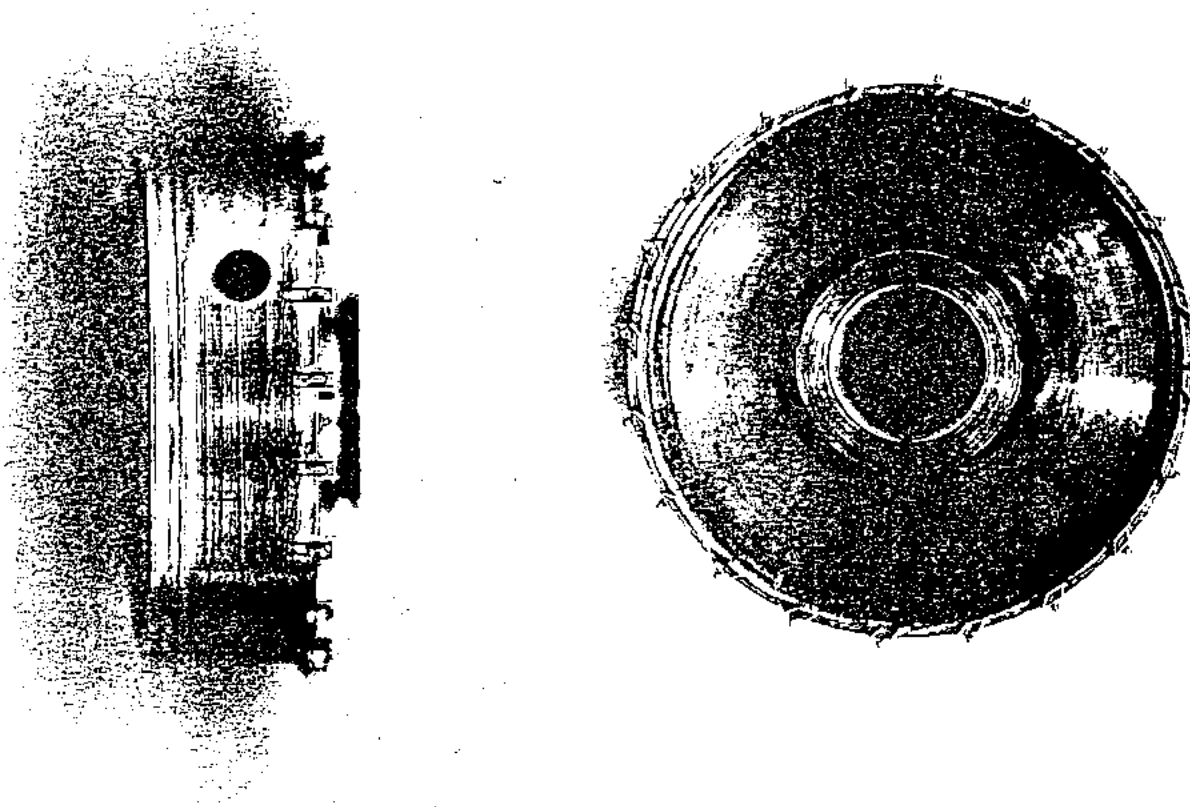
Figure 3-8 USC Film Clip from margin printing feed sprocket of their Model AB printer – Same mechanism as Model J. .

Professor Farmer also informed us that USC School of Cinema and Television has and still uses a margin/footage number printer on their 16mm Model AB printer as supplied by the factory. Herb reviewed copies of the installation instructions for the *Margin Printing Kit* and believes their installation is identical to the accessory kit available for modification of the Model J. The transport of the B&H AB printer is the same as the Model J. Herb kindly provided several samples of a B&W work print showing the derived septum from the USC setup. A selected sample is shown as Figure 3-8.

We can see several differences in the derived septum from the USC clip and the Secret Service copies. The septum line is wider with its thickness penetrating from the picture area to about 1/3 to 1/2 the width of the perforation – about 0.028 inch wide. (We do know that the septum line on Secret Service Copy 1 produced by the JAMIESON printer is about 0.020 inch wide.)

In addition, on one side of the perforation, there is an absence of light equivalent to about 1/2 of the shoulder of the Model C sprocket. Of the examples supplied, we found that there was some variation in the “no-light” area surrounding the perforation and a slight variation in the placement of the septum line. The margin printing sprocket, unlike the picture printing sprocket does not have a pressure pad or roller for precise contact. It also acts as a feed sprocket and thus there are only guide rollers to position the film allowing some film-to-film variability.

The sprocket, part N<sup>o</sup> 28613 (See appended brochure) may or may not be exactly the same as those in use in the 60s, but there is a good chance it is. The sprocket is of a 2-inch nominal diameter and has 20 teeth. Professor Farmer again cooperated by placing his sprocket on a Xerox copier, and with 150% enlargement, provided two views of the sprocket, shown as Figure 3-9.



**Figure 3-9** Margin Printing Modified Feed Sprocket

Part N<sup>o</sup> 28613 for Model J Printer  
In current use, USC Department of Cinema



In examining the sprocket, several key features become evident:

- The protrusion supporting the tooth extends beyond the sprocket tooth, possibly to provide film support.
- The sprocket teeth appear to be rising above the surface of the cylindrical body in the end view, but not in the face view, indicating that there may not be intimate contact between the film and the edge of the sprocket.
- The support for each tooth slants off center axis at an angle to permit the margin print light source to be at the periphery of the cylinder. This machining design precludes the shadow that would occur if the teeth supports were milled perpendicular to the root circle and the light source is off-center.

If time and opportunity had permitted, it would have been desirable to run some controlled tests with the USC margin printing equipment.

*Getting Our Heads Together:* I'm sure the reader is aware that our attempt to exactly replicate the 1963 JAMIESON produce septum line has not been successful. Further, we have had reasonable success of locating some vintage B&H Model J printers for examination. Our analysis data is limited, but we do have data to develop one or two hypothesis about the source of the septum seen of the Secret Service copies. In addition, Bruce provided a reanalysis of his beliefs in his April 21<sup>st</sup> letter to me (appended as A3-19).

I had my best guess, but one evening I placed calls to Malcolm Townsley, Bruce Jamieson and Prof. Herb Farmer and Ted Wilson. We each reviewed possible approaches to the generation of septum lines.

Ted initially believed that the septum could have been produced by a 0.010 inch wire soldered into the aperture area as had been the practice for using 35/32mm width film to generate two rank 16mm prints from a 16mm master<sup>11</sup> however after reviewing additional photographs, he modified his belief. Bruce also affirmed that his lab had never soldered a wire in a printer aperture.

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<sup>11</sup> Described in C, Williams and A Ford, Jr. article *Combination Printing of 35/32mm and 16mm Films*, JSMPTTE Volume 66, March 1957, pp100 - 101.

Malcolm and I discussed the possibility that the printer sprocket that evolved into the Model C sprocket described above, could have had undercut completely to the base of the sprocket tooth. The resulting septum line is the correct width and placement. We also accepted the possibility that the accessory margin printing kit supplied by Bell & Howell could have had enough variation in setup so as to have permitted a septum similar those on the Secret Service copies.

We agreed that the characteristics of the septum favored the printing sprocket modification. The manual and Kodak's Model J provided for a milled-out slot and this approach would best account for the matching image density in the perforation area of the family pictures. On the other hand, the reasonable cost, availability and ease of installation of the accessory margin printing kit probability made it the option of choice for most laboratories.

Herb and I discussed the possibility of the feed sprocket modification generating a septum narrower than the film clips he provided and without a "no-exposure" area at one the edge of each perforation. Our conclusion - yes it's possible - but!

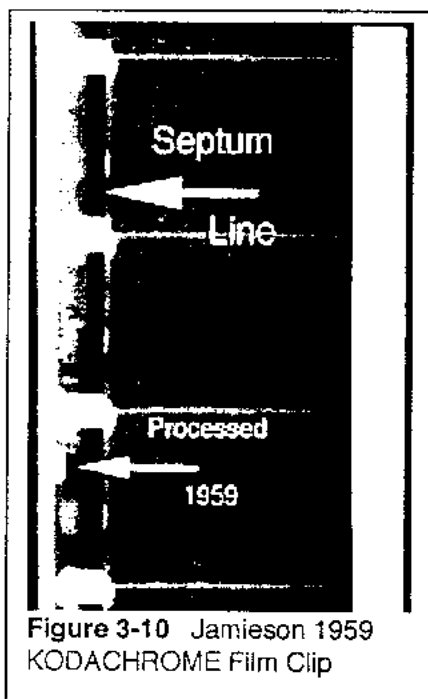


Figure 3-10 Jamieson 1959  
KODACHROME Film Clip

When Bruce and I spoke, he related that whatever approach was used, it was in daily use, part of normal printer thread-up and did not require extensive equipment modification. Bruce provided an additional KODACHROME film clip made about four years earlier showing a similar septum line - Figure 3-10. This sample ensures that the septum seen on the Secret Service copies was not unique.

### *Conclusion:*

1. The JAMIESON film company's equipment produced the septum line seen on the Secret Service Copies.
2. The exact modification to the Model J printer to produce the narrow "perf-to-perf" septum line has not been determined.
3. The occurrence of the septum was not unique to copies made November 22, 1963.
4. Two, highly probable, approaches discussed above could have produced the septum seen.

### *Miscellaneous:*

*Printer Sprocket and Film Pitch - Steadiness:* Release copies are usually printed from a negative on a continuous contact printer whose perforation pitch length is slightly shorter (by about 0.3%) than the print material. This is necessary because the printing drum surface speed is not exactly the same for the negative as for the print medium. The difference is one film thickness - giving a slightly longer radius at the surface of the print film and thus a greater circumference for the print compared to the printer drum contact of the negative. For 16mm films, camera "short" pitch length is 0.2994 in. compared to 0.300 in. for the print film - equivalent to two 8mm pitch lengths. Amateur 8mm camera films are not perforated "short" pitch and thus do not provide ideal pitch length for contact printing. Consequently, when projected, we would expect that contact prints or copies of the Zapruder original would exhibit some unsteadiness caused by slippage during printing.