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## INFRARED EXAMINATIONS WITH AN ELECTRONIC IMAGE CONVERTER

RICHARD J. KUHN

The author is a Document Analyst in the Identification and Detection Division, Investigation Service, Veterans Administration, Washington, D. C. He is a graduate in the field of Criminology from Fresno State College following which he completed two years of post graduate work in Criminalistics at the University of California. His paper describes an infrared viewing unit which has been constructed in the Identification and Detection Division Laboratory.—EDITOR.

During the course of examining a questioned document the analyst may find that he has need for examination in infrared light. The usual procedure in these instances is to photograph the document, using infrared film and an infrared filter over the light source or lens. Considerable time is usually consumed in determining the exact area to be photographed and in securing proper illumination and correct exposure of the negative. Since the results obtained are not always rewarding, the photographic process is far from desirable.

The use of an electronic image converter for examinations in the infrared, and its possible use in criminology, was discussed by Harvalik in 1948 (1). Further references to the possible uses of the device were made in 1949 (2), 1950 (3), and 1951 (4). According to Harvalik, image converters were used as early as 1934 (3).

Electronic image converters are optical devices employing special image tubes containing fluorescent screens which produce a visible image when exposed to light. These tubes were mounted in telescopes during the war and used by snipers equipped with a portable infrared light source. The British produced a number of image tubes, one of which was the type CV 147 (Figure 1). In this country RCA manufactured a similar tube, type 1P25, which is described in an RCA publication (5). None of these tubes is now available from the manufacturers.

A viewing device embodying an image tube, similar to that described by Harvalik for the examination of chromatographic columns (3) was recently constructed in this laboratory with considerable success (Figure 2). The device permits direct visual examination of questioned documents in the infrared.

The image tube employed was the British type CV 147 which is still available on the surplus market, operated by a 2000 volt d. c. power supply.<sup>1</sup> This tube has a spectral sensitivity of from about 300  $m\mu$  to around 1400  $m\mu$ , and the phosphor of the screen has a maximum radiation at about 525  $m\mu$ , which is close to the maximum sensitivity of the human eye. The image tube is mounted in a lucite tube and held in place by two small lucite tubes which fit inside the larger tube and abutt against the image tube on each end (Figure 3). The lucite tubes are then held in place by wood screws. Holes are drilled in the large tube to permit attachment of the tube to

<sup>1</sup> A tube and power supply kit is available from TAB, 111 Liberty Street, New York 6, N. Y., with instructions for assembling at a cost of about \$15.00.

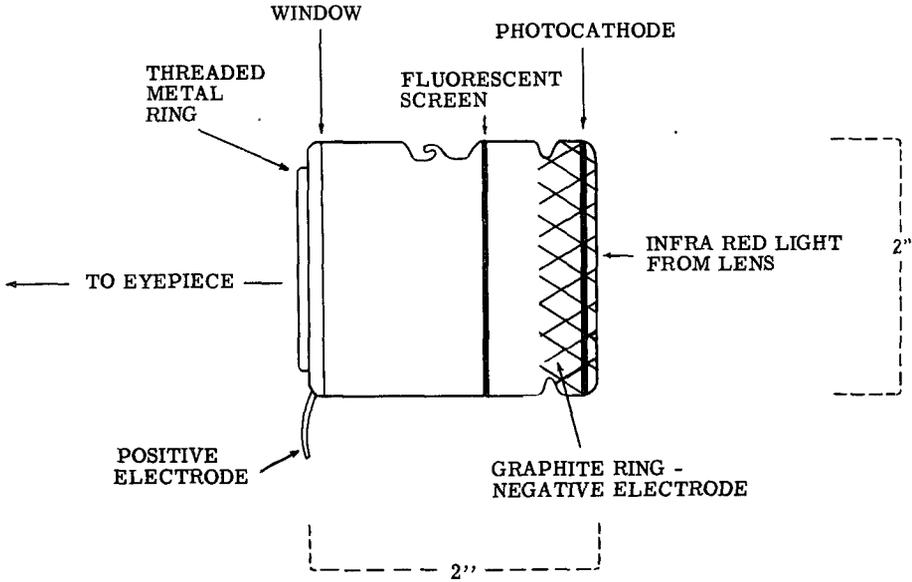


Figure 1

Diagrammatic Sketch of Image Converter Tube, Type CV 147

the wires leading from the power supply. The whole is then mounted in a lucite box large enough to contain enough wire to permit removal of the image tube for replacement. Lucite was found to be an excellent material for the image tube housing since

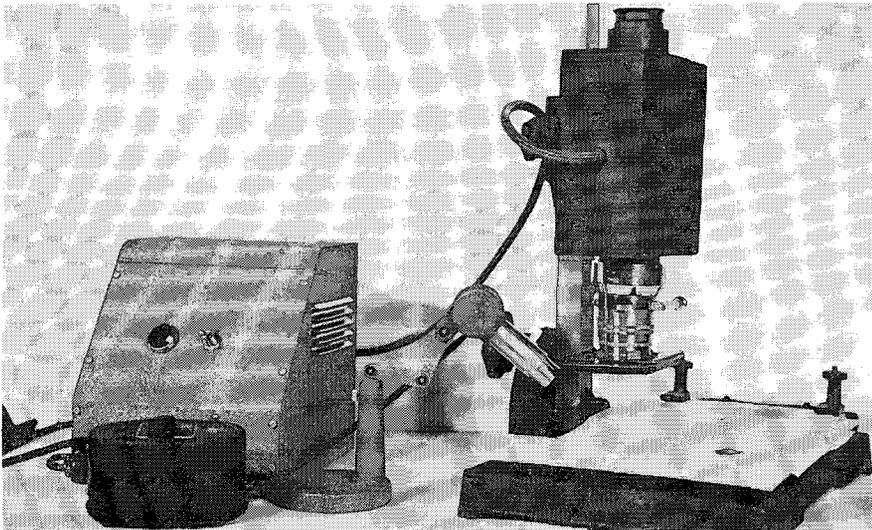


Figure 2

Infrared Electronic Image Converter Unit

The electronic image converting unit installed in a low power microscope tube appears at the right with an infrared filter below the lens and the document in position for examination. A portable light source is shown in the center, and to the left is the power unit necessary to operate the converter tube.

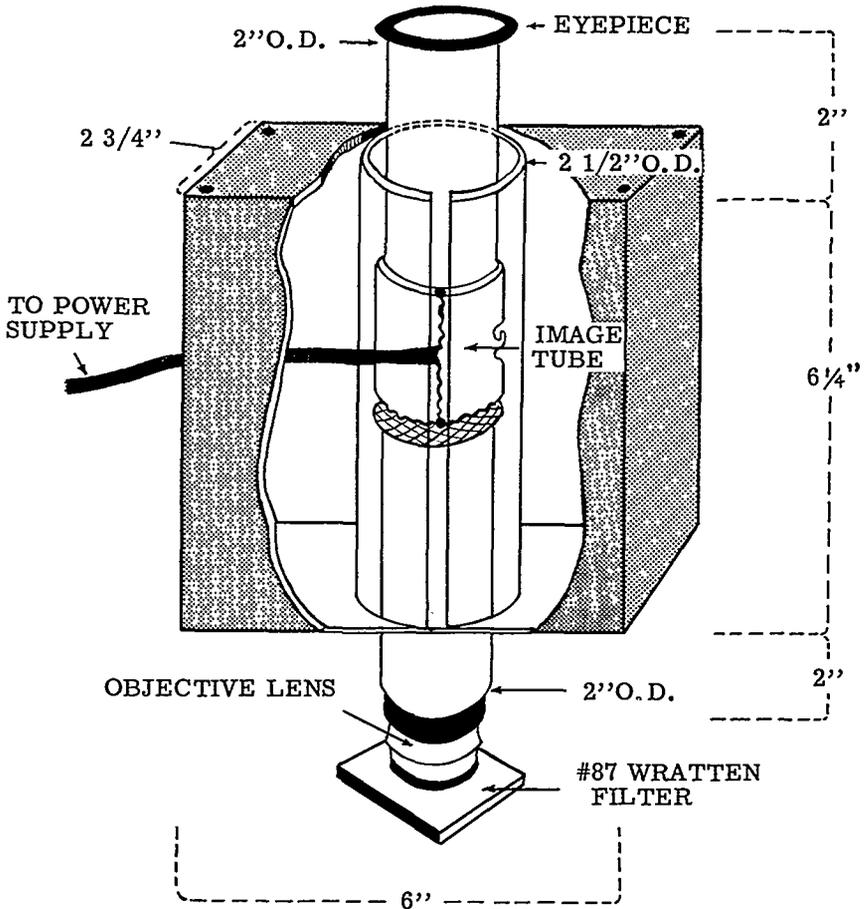


Figure 3

Diagrammatic Sketch of an Electronic Image Converter Unit

it is not a conductor of electricity, works almost as easily as wood, and glues with a firm strong bond. The housing is painted a dull black, both inside and out to prevent stray light from reaching the image tube.

The objective lens system used to focus the infrared image on the photocathode of the tube is a 50 mm photographic lens. A magnifying eyepiece, attached to the viewing end of the tube is focused on the fluorescent screen. The complete electronic image converter is mounted on an adjustable support. With the optical system used the field of view covers an area approximately  $\frac{3}{4}$  inch square and a magnification of  $2\times$  is obtained. A Wratten #87 infrared filter in a filter holder is attached directly to the objective lens to filter out all but the infrared light. It makes little difference whether the lens or the light source contains the filter; however, it is much easier to adjust the illumination if the lens is filtered, and at the same time stray white light is kept out of the optical system.

Heatlamps, microscope lamps, or ordinary mazda lamps will serve equally well as a light source. The Bausch and Lomb improved Nicholas Illuminator is used in this laboratory, inasmuch as the intensity and field size can be readily controlled.

Power to operate the image tube can be taken from any 2 to 6 thousand volt low current power supply. Three suitable units have been described (2, 3), and there are circuits for others in many books on electronics. The power supply kit available on the surplus market is used in this laboratory. The parts are mounted on a 2" x 7" x 7" chassis and installed in an 8" x 8" x 8" sloping panel cabinet equipped with an off-on switch and pilot light. Care must be taken to provide adequate insulation against electric shock.

The image converter lends itself quite well to the criminalistics laboratory since, by the proper selection of filters, observation can be made in the ultraviolet, visible, and infrared regions of the spectrum. The document examiner will find the device useful for rapid, accurate preliminary examination of alterations, obliterations, and erasures. Its value in the restoration of charred documents, especially during the initial period of sorting the various fragments, can be readily appreciated.

The results obtained in examining questioned documents using the electronic image converter are equal to infrared photographs and are accomplished in a fraction of the time and expense required in the photographic process. If a permanent record of the results is desired, an infrared photograph of the area in question can be made, or a camera can be attached to the image converter, and a photograph made through it using panchromatic film.

Other applications of the image converter include its use in analytic chemistry, particularly chromatography, its use in the examination of stains from physiological fluids, and in the examination of inks, paper, hairs and fibers, and many other physical objects through a comparison of their properties of reflection, absorption, and fluorescence in infrared and ultraviolet light as seen through the electronic image converter.

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#### APPENDIX A.

##### *Complete Parts List*

##### Image Tube and Housing

- 1 Image tube, type CV 147
- 1 piece Lucite tubing, 2½" O.D. x 6"
- 2 pieces Lucite tubing, 2" O.D. x 6"
- 2 sheets Lucite ⅛" x 6" x 6"
- 2 sheets Lucite ⅛" x 2¾" x 6"
- 2 sheets Lucite ⅛" x 2½" x 6"
- 4 strips Lucite ⅛" x ¼" x 6" (for shims between tubes)
- 1 oz. Lucite cement

## Power Supply

- 2 Rectifier tubes, type 2X2 ( $V_1, V_2$ )
- 2 2X2 tube sockets
- 1 Oil filled capacitor 0.1-0.1 microfarad, 2000 v. ( $C_1$ )
- 1 Carbon resistor 10 megohm, 2 watt ( $R_1$ )
- 1 Carbon resistor 40 megohm, 2 watt ( $R_2$ )
- 1 Power Transformer, 900 v. @ 35 milliampere; 2.5 v. @ 2 amp; 2.5 v. @ 2 amp ( $T_1$ )
- 1 Pilot lamp, 110 v. 3 watt ( $Pl_1$ )
- 1 1" Jewel-pilot assembly
- 1 Power cord
- 20 ft. Hook-up wire, 2000 v. insulation
- 1 pkg. Rubber grommets
- 2 Screen grid caps
- 2 Two-lug Bakelite mounting strips
- 1 8" x 8" Sloping panel cabinet
- 1 2" x 7" x 7" Chassis
- 1 Switch, SPST
- 1 Switch plate, "off-on"