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THE COMPARISON CAMERA

J. H. Mathews and Lee K. Henke

Dr. Mathews is Chairman of the Department of Chemistry and Director of the Four Year Chemistry Course at the University of Wisconsin. His interest in scientific methods of criminal identification dates back to the Magnuson bomb case in 1923—a case in which an identification was made by metallographic analysis. After this experience he was soon called upon to identify a rifle from a fired murder bullet. Working with meager equipment he was successful in building up a case that resulted in a confession during the course of the trial. Since that time he has been called on for assistance by the law enforcement agencies of Wisconsin on hundreds of occasions and has built up one of the best scientific crime laboratories in the country. A considerable number of new and improved instruments have been built in collaboration with Mr. Henke who is Senior Mechanician in the Chemistry Department. Mr. Henke has had many years of experience as an instrument designer and maker.—EDITOR.

Those of us who for years have had occasion to use a comparison microscope for the examination of bullets and other objects know how very tiring such examinations may become. Not only are they tiring but they are productive of eye-strain.

Both of these difficulties disappear with the use of the comparison camera — the basic idea of which was suggested by May and by Lewis. The operator sits in a comfortable position looking directly ahead at images on a large ground glass screen. The images are large and clear and are seen by both eyes and are viewed at a normal and comfortable distance, thus materially reducing eye-strain.

A series of knurled control knobs, placed in line a few inches below the ground glass, and one at either side of the ground glass, enable the operator to move the specimens in any desired direction and rotate them. After all adjustments of the two juxtaposed images have been made, one sees on the ground glass exactly what he may expect to see in the finished photograph. A time switch enables him to expose for a predetermined length of time.

Both plates and cut films may be used. Eastman Panatomic film is very satisfactory because of its lack of grain and its sensitivity to all colors.

The complete assembly is shown in Fig. 1. For the sake of clarity in description it is probably best to divide the instrument into several parts and describe each separately.

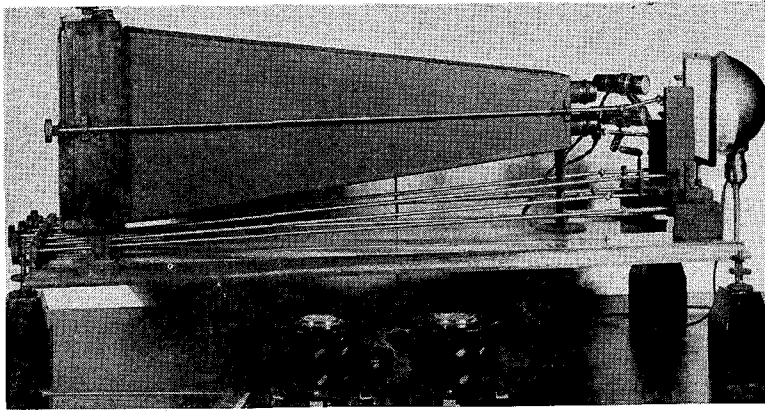


FIGURE 1

The Comparison Camera and Rheostats for Light Control

The Carriage

This part of the instrument (Figs. 2 and 3) has in its assembly the mechanism for transmitting vertical, horizontal, longitudinal and circular motion to specimens being compared and photographed. It is so arranged that the image of one object may be juxtaposed above the other, exactly. The carriage travels on a pair of $\frac{1}{2}$ " square tracks, 8" in length, secured to the base of the instrument and is actuated by a $\frac{1}{4}$ " lead screw (G in Fig. 4) and having 28 threads to the inch. All lead screws are of the same diameter and pitch throughout. Rising from the carriage are two supports capable of being moved to the right or left independently of each other by means of two inclined planes and actuated by individual lead screws (H_1 and H_2 in Fig. 4). Each of these supports carries a bracket to which is attached a small worm and worm gear so arranged that there is virtually no back lash. These worm gear assemblies impart circular motion to the specimens they carry, by turning knobs R_1 and R_2 in Fig. 4. The brackets are moved vertically by means of inclined planes built into the supports. The planes are moved by lead screws (V_1 and V_2 in Fig. 4). The shaft in the center of each worm gear is a small split stud to which different types of specimen mounts may be quickly and easily attached. All lead screws are coupled, by means of small Hooke's joints (universal joint, Fig. 2) to the control rods which terminate in a series of control knobs (Fig. 4) at the lower edge of the plate end of the camera; thus the operator may remain seated while making all adjustments, once the bullets are aligned vertically.

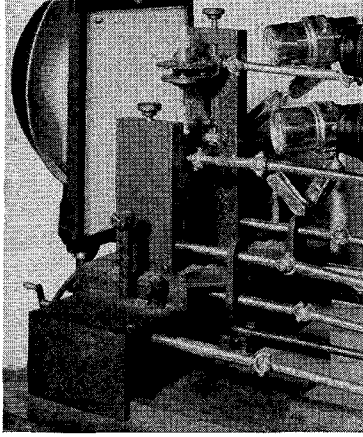


FIGURE 2
Front End of Assembly

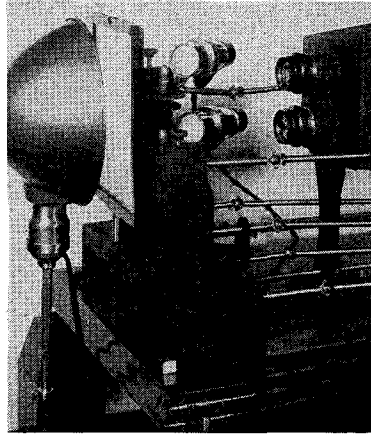


FIGURE 3
Rear End of Assembly

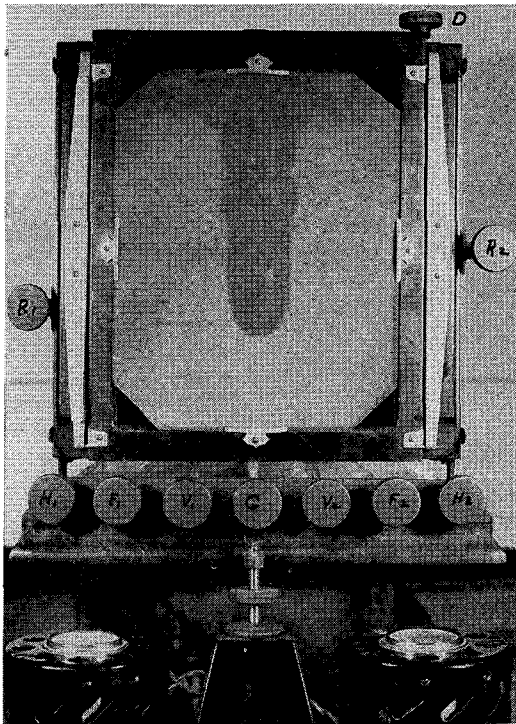


FIGURE 4
*Rear End of
Camera
Showing Controls*

The Camera

The camera is not unlike the conventional 8" x 10" view camera. It is cone shaped, being about 5 inches square at the lens end, about 12 inches square at the plate end and is 36 inches long. The small end has 2 lens rings mounted one above the other. Actually the comparison camera consists of two rigid camera enclosures mounted one above the other with an adjustable horizontal dividing septum to be described later.

The lens rings carry a matched pair of Bausch and Lomb lenses. Various focal length lenses are available, a pair of 112 mm. Tessar Ic lenses are used for low magnifications, a pair of 70 mm. focal length Micro Tessars for greater magnification. The unique feature of the camera body is the fact that it contains an adjustable thin metal partition dividing the camera horizontally into two separate parts, one for each lens. This partition is surfaced with sateen cloth and sprayed with instrument black (a non-glossing lacquer) to prevent halo and ghost images, as the angle of incidence is very low, less than 15 degrees at times. There is no reflection from this metal partition. It is slip hinged at the lens end and supported at the plate end by two bearing blocks through which run two finely threaded vertical rods, one at each side of the plate holder but out of line with the light path. A single control knob (D in Fig. 4) at the top of the rear end of the camera, permits the adjustment of this dividing partition up or down, the two threaded rods being rotated in synchronism by means of a connecting chain and sprocket drive. The movement of the partition permits the making of comparisons of specimens at any point in their length. The rear of the camera is fitted with a conventional 8" x 10" plate back with ground glass permitting the use of standard 8" x 10" cut film or plate holders.

The Base

The base of the instrument is a 1" thick American black walnut board edged with a modified "OG" bead all around. Inset on the under side of this base are two pieces of cold rolled steel $\frac{1}{4}$ " x 1" through which are threaded the three adjusting screws whose ends terminate in knurled knobs, thus giving a three point support for the instrument. In order that the operator may be seated, in a normal position at the instrument, the entire assembly is set on three pyramidal wood blocks of the correct height for the operator's eye level.

Materials used throughout are stainless steel and brass except the inclined planes whose bearing surfaces are faced with cold rolled steel. All exposed brass surfaces are finished with black Hilo crystallizing varnish ("crackle finish"). The camera body is covered with Keratol (simulated leather) and the base is piano finished (several coats of clear Valspar varnish, hand pumiced and polished).

Lighting Equipment

At the lens end of the instrument and back of the carriage is a diffusing screen of opal glass illuminated by an ordinary



FIGURE 5

Comparison Camera Photograph Showing the Matching of an Evidence Bullet and a Test Bullet in an Actual Murder Case

75 watt light bulb in a desk type reflector, thus providing a white background for the objects being photographed.

There are two adjustable microscope type object illuminators (Spencer) which are so positioned that they give oblique lighting to the specimens. These lights are controlled by two rheostats (shown in Fig. 4) so their intensity can be matched or balanced. This is important as a test bullet is usually brighter than the evidence bullet.

Another similar pair of lights (not shown in the accompanying illustrations) is also used on the opposite side on occasion, or both sets can be used, to get the clarity and definition that is so necessary to good photography. Figure 5 shows a typical example of what can be accomplished with a pair of bullets that show good matching. Below the horizontal dividing line is shown the base end of the evidence bullet, above the line is shown the nose end of a test bullet fired from the suspected gun.