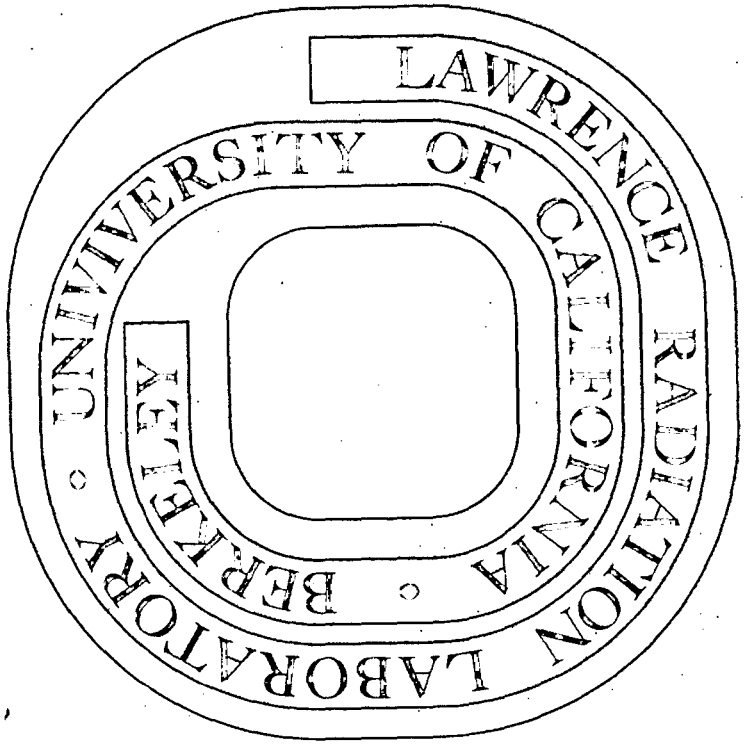
H. Anger

UCRL-20699
UC-48 Biology and Medicine
TID-4500 (57th Ed.)



EIGHTY-LENS OPTICAL CAMERA FOR RECORDING DYNAMIC STUDIES WITH THE SCINTILLATION CAMERA

Hal O. Anger
DONNER LABORATORY

May 1971

AEC Contract No. W-7405-eng-48

DISCLAIMER

UCRL-20,699

Eighty-Lens Optical Camera for Recording Dynamic Studies with the Scintillation Camera

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Introduction

When recording dynamic studies from the scintillation camera (1) as a series of still pictures after injection of a bolus of activity, the usual procedure is to rapidly change Polaroid films or to automatically advance film in a 35 millimeter camera. In either case, each picture in the series integrates scintillations during a separate time interval and a small percentage of the scintillations are lost as the film is being changed or advanced.

The 80-lens camera described here eliminates the loss of information during frame advance that is inherent in the other systems and in fact allows time overlap between adjacent pictures in the series. The time overlap is advantageous in certain clinical situations, such as heart or brain blood flow studies, where it is important to have exposures that last for a relatively long time during a certain phase of the study, such as the venous phase in brain studies or the left ventricular phase in heart studies (2), and where it is also important to have a picture in which the exposure starts just before the maximum concentration of activity in the given compartment. The maximum concentration can of course occur at different times in different patients.

Description

The camera consists essentially of a metal lens board that holds 80 small lenses in a close-packed 8 x 10 array, a moving curtain with holes or slots that act as a shutter, a motor to drive the curtain, and a film holder. The arrangement is shown schematically in Fig. 1. Each lens projects a 0.35 inch diameter image of the scintillation camera cathode-ray tube onto a piece of 4 x 5 cut film.

The curtain moves past the lens array at a constant rate of speed. Typical curtains are shown in Fig. 2. Curtain No. 1 has a series of eight holes whose diameter is equal to the center-to-center distance between lenses. The horizontal spacing between holes is ten times the center-to-center distance between lenses. This curtain gives the user a conventional series of 80 images with zero time loss (and no time overlap) between adjacent images.

Curtain No. 2 has a series of eight slots whose width is four times the center-to-center spacing between lenses. This curtain gives a series of 80 images with a time overlap factor of four. If the curtain is driven at such a speed that a new lens is uncovered every 0.5 second, a new image is started every 0.5 seconds, and the exposure time of each image is 2 seconds.

Curtain No. 3 has both slots and holes and simultaneously produces two sets of 40 images, one with time overlap and one without. This latter curtain has been used almost exclusively for our heart and brain blood flow studies at Donner Laboratory. For these applications, the starting time intervals are usually set at 0.5 second and the exposure time for each image in the first series is therefore 0.5 second. This gives the user a set of 40 images that are conventional except that the loss between images is zero. The total time period covered by the series is 0 to 20 seconds after the camera is activated.

In the second set of images, the starting time intervals are also 0.5 second but the exposure time is two seconds per image. This gives the user a set of 40 additional images which have four times the exposure and four times as many dots as the first set. Thus, when examining the left ventricular phase in a heart study, the user has a second series of pictures, each of which was exposed for two seconds,

but which have starting times at 0.5 second intervals throughout the 0-20 second period after the camera is activated. One of the pictures will show the left ventricular phase of the study at a time when the activity in the left ventricle is at its peak over a two second period. The same is true of the venous phase of a brain blood flow study.

The present drive motor allows starting time intervals of 0.25, 0.5, 1.2, 2.4, 4.8, and 12 seconds. Thus the total time period covered may be as short as 10 seconds for a dual series or as long as 16 minutes for a single series.

In addition to the time overlap capability, other advantages of the 80-lens system are that the images are compactly recorded on low-cost 4 x 5 negative film, the camera has a minimum of moving parts, and a wide range of exposure times is easily provided.

The pictures, being on negative film, are examined with transmitted light, usually on an X-ray view box. Sometimes a magnifying glass is used because of the small size of the individual images. An alternate method of viewing is to project the entire film onto a screen using a View-graph overhead projector.

Results

A heart flow study made with the 80-lens camera using Curtain No. 3 is shown in Fig. 3. The Donner Laboratory 16-inch scintillation camera (3) with a 13-inch diameter useful field was used. Eight millicuries of Tc-99m was injected as a bolus through a catheter into the superior vena cava. The patient was sitting and was positioned for a straight frontal view. In the upper series of 40 pictures, the starting intervals and exposure times were both 0.5 second. In the lower series of 40 pictures, the starting intervals were 0.5 second and the

exposure times were two seconds per picture.

The second example, shown in Fig. 4, was taken under the same conditions as the previous example except the view was a left anterior oblique. The pictures show an obvious aneurism.

Bibliography

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(2) Van Dyke, D., H.O. Anger, Y. Yano, and H.G. Parker. Quantitative Radiocardiography: A Method and Preliminary Results. (To be submitted to J. Nucl. Med., 1971.)

(3) Anger, H.O. Scintillation Camera and Multiplane Tomographic Scanner. Japanese J. Nucl. Med. 6, 125 (1969).
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Figure Captions

Fig. 1. Schematic drawing of 80-lens camera.

Fig. 2. Typical shutter curtains for 80-lens camera giving (No. 1) 80 conventional pictures with zero time loss, (No. 2) 80 pictures with 4x time overlap, and (No. 3) two sets of 40 pictures each, one set with and the other set without time overlap.

Fig. 3. Clinical study showing bolus of Tc-99m going through heart of patient. Curtain No. 3 in Fig. 2 was used. Upper series of 40 pictures, starting time intervals 0.5 second, and exposure times 0.5 second per picture. Lower series of 40 pictures, starting time intervals 0.5 second and exposure times 2 seconds per picture.

Fig. 4. Heart flow study in patient with aneurism. Same exposure times as in Fig. 3.

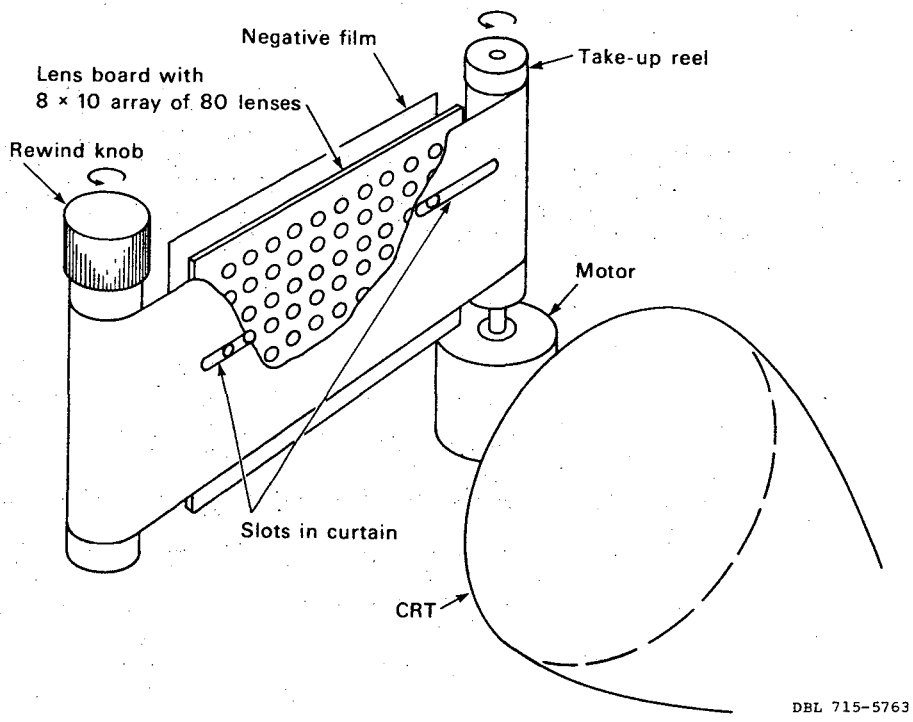

Fig. 1

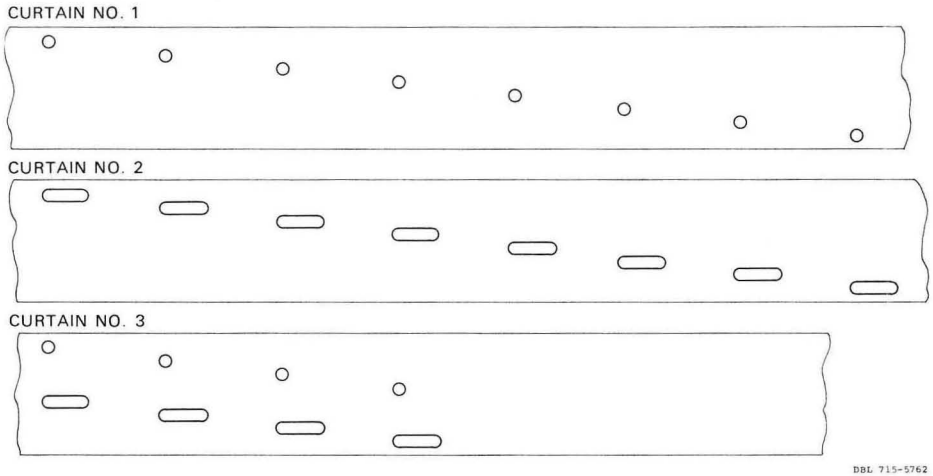

Fig. 2

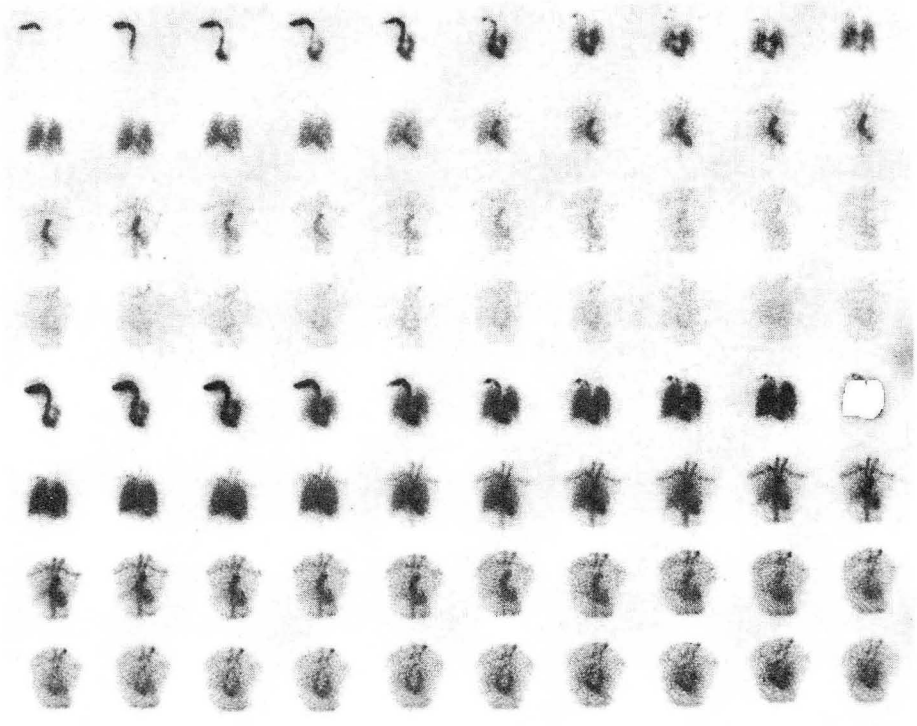

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Fig. 3

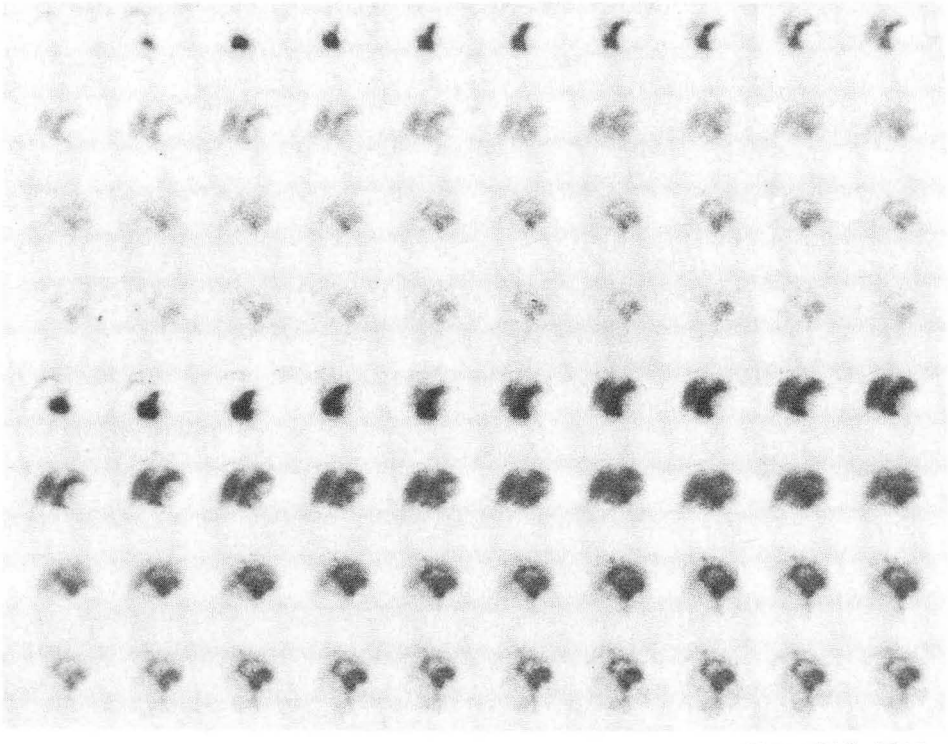

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Fig. 4

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