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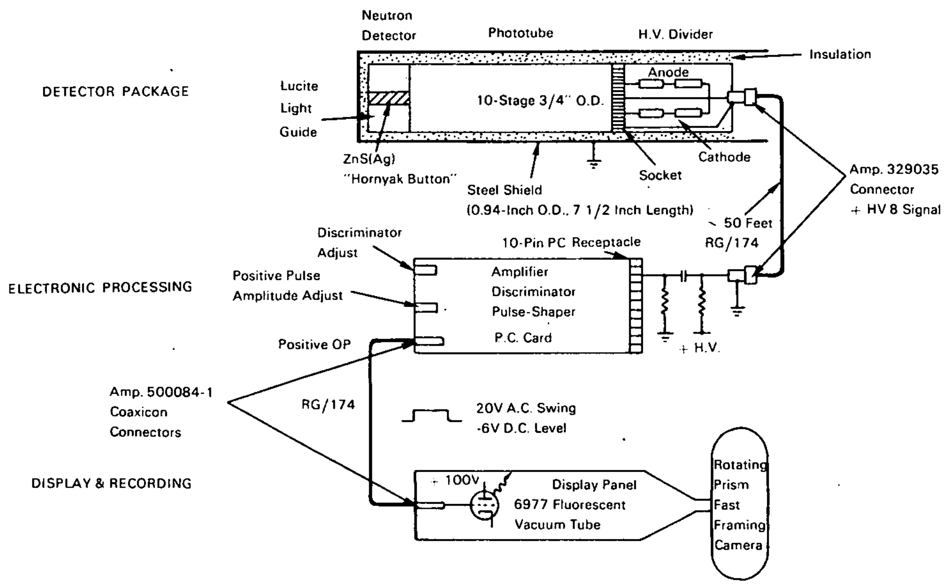
Fast Framing Cameras Provide High-Speed Multi-Channel Data Recording



The problem:

To obtain and record rapidly changing data from reactor physics experiments with relatively inexpensive equipment. Nuclear fission fuel elements are tested under transient conditions, resulting in intentional meltdown of the test element. To observe this meltdown while it occurs, a multichannel hodoscope has been built with detectors sensitive to high energy fission neutrons emanating from the fuel pin. There are 334 channels, each focussed at a small spot surrounding the location of the fuel pin. These channels need to be monitored and the data recorded.

The solution:

Fast-framing cameras can be used in nuclear physics to effectively provide high rates of data acquisition at low equipment cost. Rapidly changing data is presented to a display panel which is in turn photographed. A 16-mm fast-framing camera at 1000 fps views the hodoscope's entire array of 334 lamps.

How it's done:

The multi-channel hodoscope and related equipment are shown in the figure.

Every fission neutron detected by the hodoscope is translated by electronic processing to representation as a digital pulse. The neutron radiation absorbed in the "Harnyak button" scintillator is converted to a linear electrical pulse in the photomultiplier tube and then evaluated in the printed circuit card. A pulse meeting preset conditions is reissued as a positive-going gating signal which turns a 6977 fluorescent vacuum triode into conduction.

(continued overleaf)

The fluorescent vacuum tube, depending on the camera optical system, provides sufficient light on Kodak 2475 Recording Film to yield an image above fog with exposure duration ranging from a few to some tens of microseconds. This step provides analog recording of digital data.

For this experiment, a fast-framing camera is mounted to view the entire display panel of 334 lamps. The experiment is a transient test consuming a few seconds from start to finish. A 450-ft roll of film, running at 1000 frames per second, is sufficient to cover all aspects of a single meltdown. A neutron burst is initiated in the reactor at the same time that the high-speed camera is started. The resulting display pattern reflects the fuel position at any given instant. There is a high flashing rate, say 10^4 flashes per second, along the fuel pin and somewhat less in adjacent lamps. As the pin bends or melts, the flashes promptly follow the change.

With a shutterless fast-framing camera that provides 98% open time, there is essentially a series of one millisecond exposures of the lamp array. At positions corresponding to the fuel location, the film image density is composed of a large number of exposures corresponding to an analog representation of the experimental data. When the film is run through a projector after development, a detailed history of the movement of the fuel, as to both space and time, is obtained. A clock drives a Nixie numerical display giving the time in fractions of a millisecond after the entire sequence is initiated.

Notes:

1. This information may be of interest to persons and organizations concerned with the recording of high-speed experiments.
2. Additional details are contained in the *Procs. 7th Intern. Congress High Speed Photo.*, Zurich, Sept. 12-18, 1965, pp. 516-521.
3. Inquiries concerning this report may be directed to:

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   Argonne National Laboratory
   9700 South Cass Avenue
   Argonne, Illinois 60439
   Reference: B69-10102

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Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to

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