IL9806359

TRAINING DETECTOR AS SIMULATOR OF ALPHA DETECTOR

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1. Introduction[1]

Alpha contamination is a common phenomena in radiation research laboratories and other sites. Training staff to properly detect and control alpha contamination, present special problems. In order to train health physics personnel, while using alpha sources, both the trainers and the trainees are inevitably exposed to alpha contamination. This fact of course, comes in conflict with safety principles. In order to overcome these difficulties, a training detector was developed, built and successfully tested.

Alpha radiation contamination is commonly detected using a proportional counter detector with a large-area thin-mylar entrance window. Since the free path of alpha in air is no more than a few centimeters, the detection is performed by placing the detector very close to the contaminated area. The concept was to continue training the staff with radiation sources, but instead of using alpha sources with a long half-life time, to use short half-life time gamma sources like Tc-99m, which is commonly employed. The developed training unit acts as a proportional detector and imitates the alpha detecting properties.

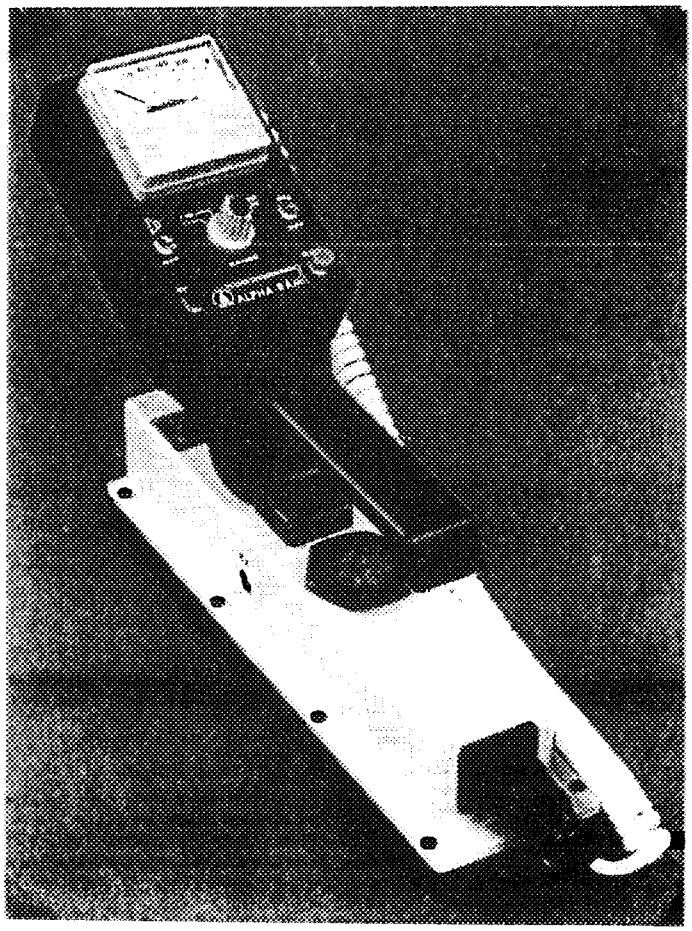

Figure 1. - ALPHA RAM Detector

2. Detector Description

The training detector was built in the housing of an ALPHA-RAM (see Figure 1), a standard alpha detector manufactured by ROTEM Industries Ltd.
Two Geiger-Muller (GM) tubes type C-1320, are installed in parallel within the detector. The lower tube is located very close to the detector bottom. The upper tube is located two centimeters above it. One high voltage power supply operates both GM tubes. The output pulses of each GM tube are transferred to a frequency-to-voltage converter whose output is DC voltage. These two DC voltages are inputs to a comparator whose output serves as a condition to the blocking circuit. Another condition to the blocking circuit is the output of an optical proximity sensor located inside the detector.

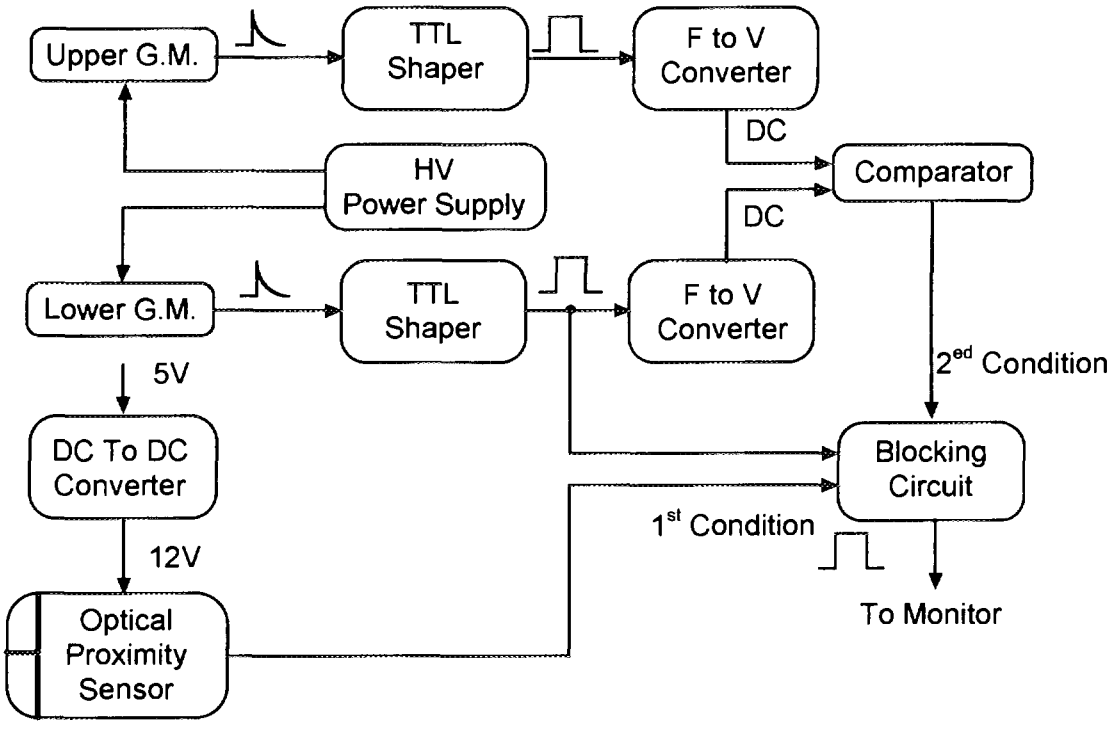

Figure 2. - Training Detector Block Diagram

3. Principle of Operation

The block diagram of the developed training detector is described in figure 2. The pulses from the lower GM tube are transferred to the counter only when the following two conditions are met. The first condition, received from the optical proximity sensor, denotes that the detector is less than ten centimeters from the examined area. The second condition, received from the comparator, represents significant variance between the pulse rates of the two GM tubes. Since the lower GM tube is located closer to the examined area, it produces a higher pulse rate than the upper tube.

The performance of the training detector on a Tc-99m contaminated area, should be very similar to that of an alpha proportional counter on an alpha contaminated area. The training detector will cease sending pulses to the counter, when elevated over ten centimeters above the contaminated area, as reported by the proximity sensor. Moreover, it will cease sending pulses when located within ten centimeters above the contaminated area, but deviated aside from the contaminated spot. In this case the geometry of the two GM tubes will cause them to produce the same pulse rates, which violates the second condition mentioned above. The latter results in the emission of pulses, from the detector to the counter, only when it is located within ten centimeters above the area, and directly above the contaminated spot.

4. Conclusion

The developed training detector operates satisfactory and fulfills the requirements of safely training health physics staff in monitoring alpha contamination.

Reference

[1] J. Paran, D. Tirosh, M. Shmuely, Y. Ronen, H. Assido, Training Detector as Simulator of Alpha Detector, Research Laboratories Annual Report 1993, 1A-1486, pp. 135÷136.