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Abstract

A transistorized alpha air proportional hand and foot counter was developed. Field use for one year shows that low maintenance, low cost, and reliability are obtainable with air proportional detectors.

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Introduction

Hand and foot counters have proved to be valuable aids in the control of radioactive contamination (Fig. 1). Proper enclosures and good technique are, of course, the primary defenses against the spread of contamination. However, incidents do occur, and prompt detection can be ensured by the regular use of hand and foot counters.

Discussion

The most critical components of an alpha-particle hand and foot counter are the detectors. Generally, air proportional detectors have proved noisy, unstable, and expensive to maintain. However, detectors of the type shown here (Fig. 2) have excellent characteristics. Regardless of size, they operate from 1740 v to 1760 v with a point-source efficiency of about 25% and a background counting rate of about 4 counts/min per detector for the larger detectors (5 in. x 13 in.).

The circuit design was based on the philosophy that no interpretation of the counting results should be required. Many of the persons who use these counters are not able to interpret the results anyway. Therefore, we used scaling stages and a scale selector so that an alarm level could be preselected that suited the counting period (Fig. 3). Our present counting period is 10 sec, and the alarm is selected to trip at 4 counts for the feet and 4 counts for the hands. This corresponds to a disintegration rate of approximately 100 dpm.

To operate the counter one pushes the start button, which resets the scalers, gates off the preamplifiers until all reset functions are completed, then turns the preamps on again and initiates a timing cycle. For each pulse formed there is an audible pop from the speaker mounted in the top plate, thus providing visual and audible evidence of contamination. If the selected count level is exceeded, a warning light is turned on, indicating either "foot" or "hand" (Fig. 4). When this happens, a monitor must be called to assist in decontamination.

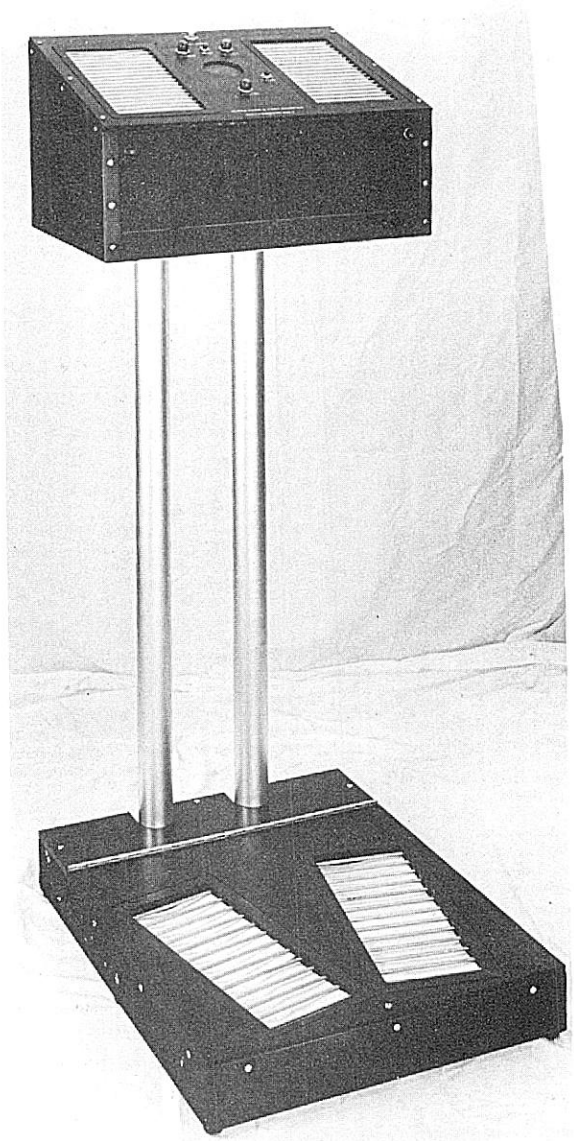

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Fig. 1. Alpha air proportional hand and foot counter.

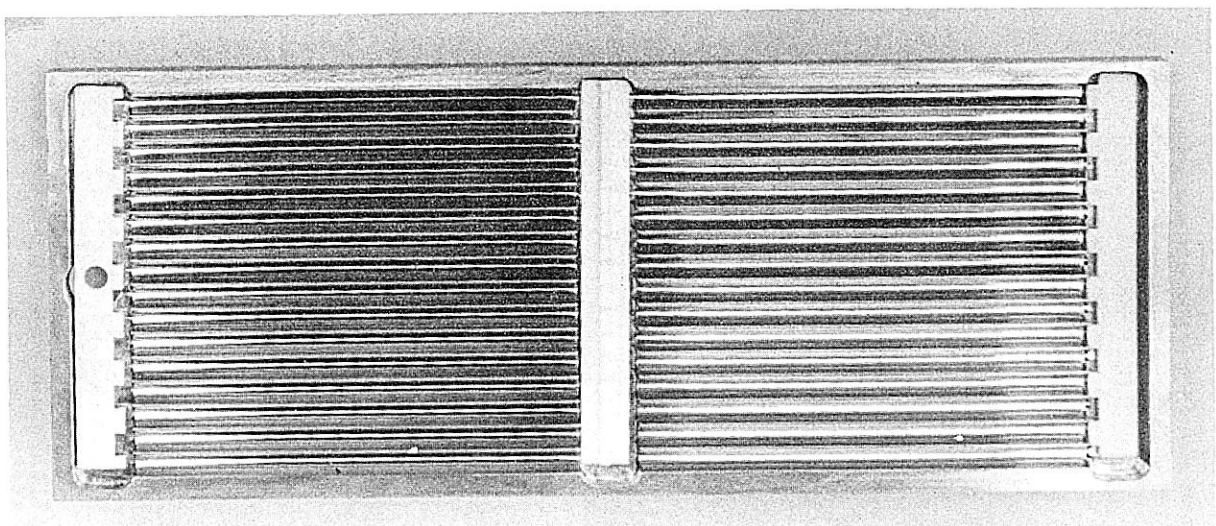

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Fig. 2. Foot detector.

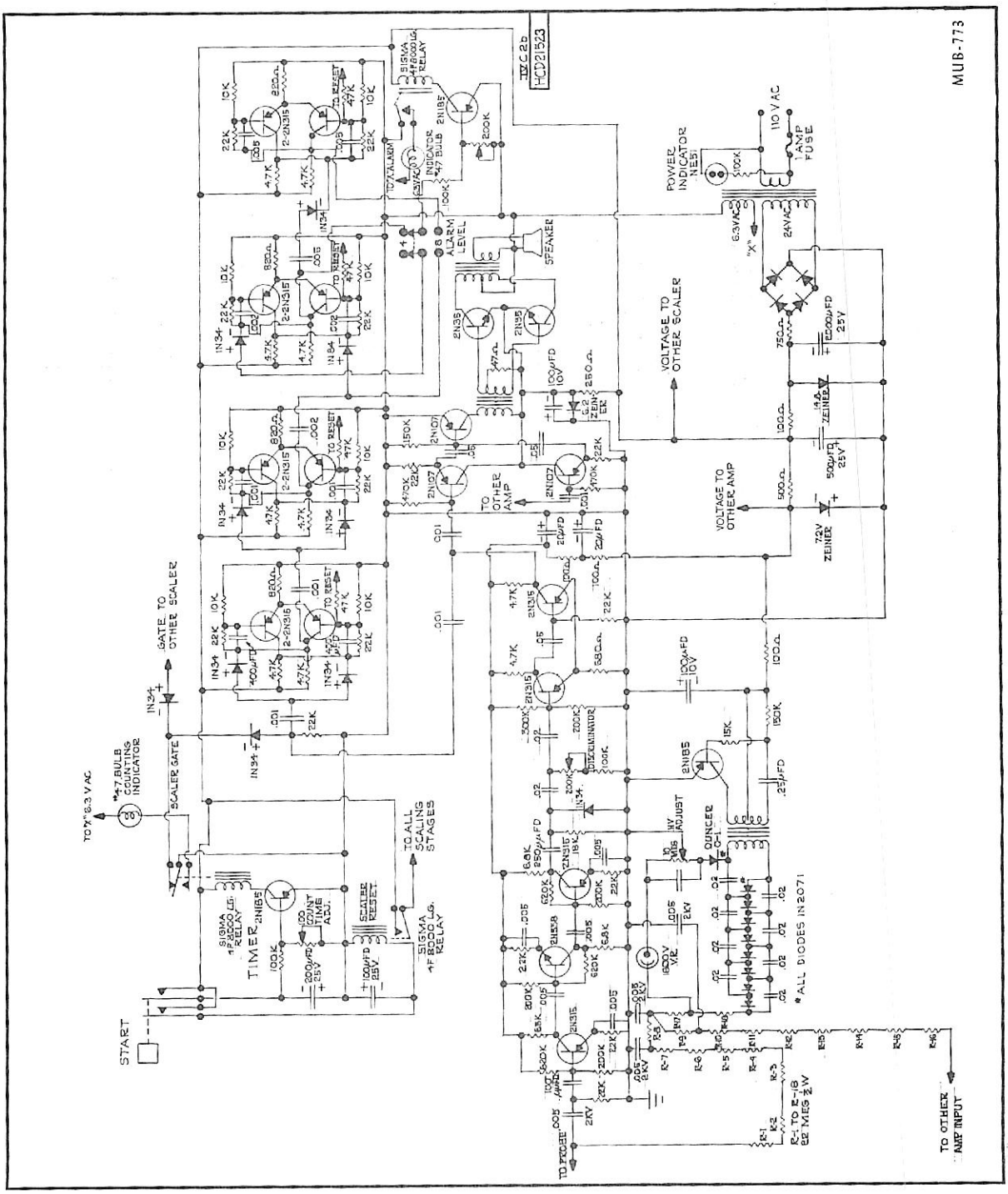

Fig. 3. Circuit diagram.

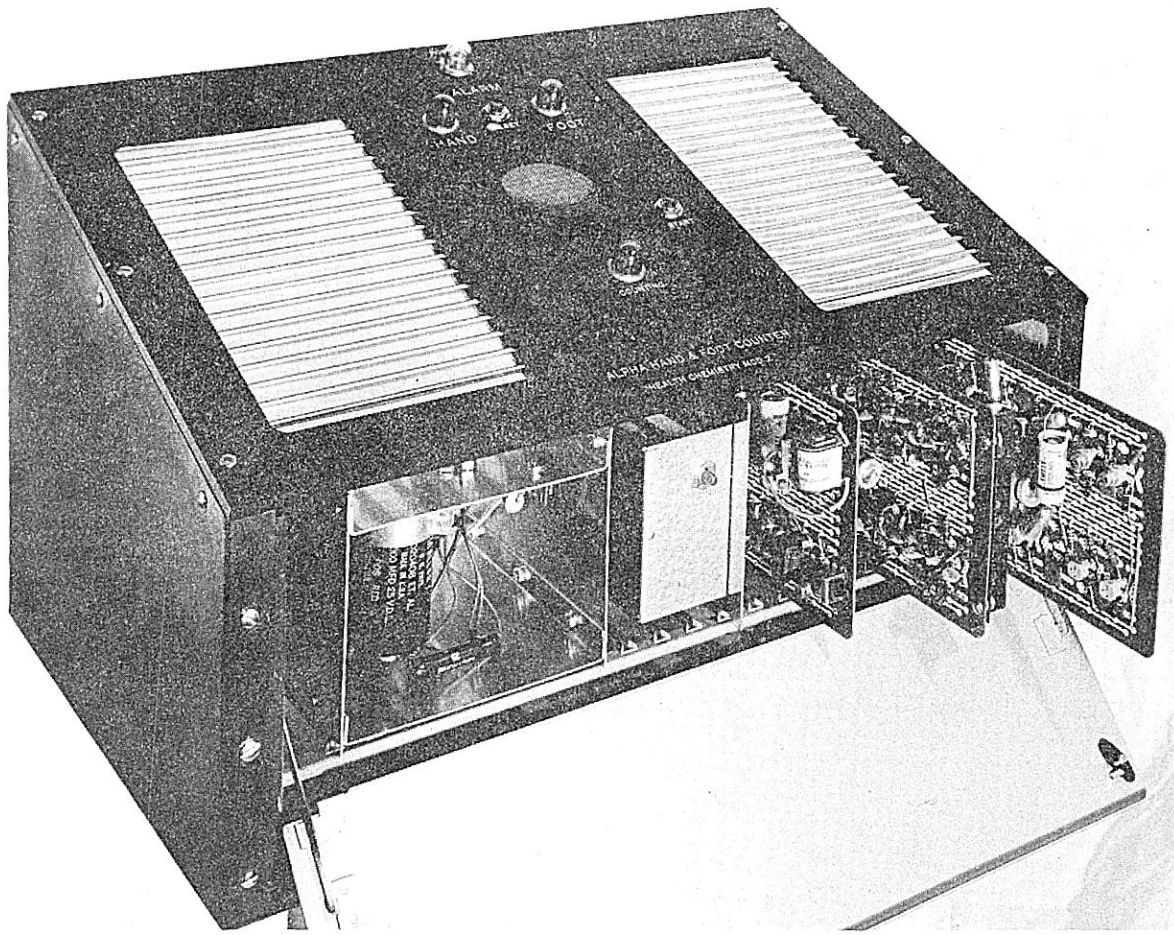

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Fig. 4. Top plate and related components.

Circuit Description

A simple power supply is used. It consists of a transformer, bridge rectifier, filter, and zener diode.

Preamplifiers are three-stage stabilized circuits using feedback and low-frequency attenuation for suppression of high-voltage ripple. The preamp outputs are fed to flip-flops that drive binary scalers with scales of 8. Preselected scaler outputs then activate latching relays that energize the alarm lights. The audio signal is taken from the first half of the flip-flops and is never turned off.

High-voltage supplies are relaxation oscillators followed by eight stages of doubling. The oscillator frequency was made as low as possible so that the low-frequency attenuation in the preamps would be effective.

Observations and Conclusions

After a year of continual use, the only down time was due to a torn Mylar covering on one hand probe, and a leaky diode in one of the high-voltage supplies. If the counter is operated in areas of high humidity, it is necessary to reduce the humidity at the foot probes by using a low-wattage light bulb under each foot probe—7 to 10 is usually sufficient.

This design offers an inexpensive, reliable, and simple instrument. The 10-sec counting time is shorter than desired as far as accuracy is concerned; however, the shorter the counting time, the more often people tend to use this type of instrument voluntarily. The use of preselected alarm levels rather than register read-out seems to be more suitable for this type of counter and for the people that use it. The audio output provides one added degree of confidence for the user, since he can correlate the audible indication with the visual alarms.

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