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TITLE: COMPUTERIZED PLUTONIUM WOUND-ANALYSIS SYSTEM

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COMPUTER-BASED PLUTONIUM WOUND MONITOR

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SUMMARY

A new plutonium wound monitor has been developed at Los Alamos to upgrade a system which has been in use for about five years.¹ The instrument, called a Computerized Wound Screening System, is designed around a readily available personal computer. It includes a full-function 256-channel pulse height analyzer and software necessary to calculate plutonium and americium activity from a spectrum. This new system provides medical and health physics personnel with considerable flexibility in recognizing and recording situations where a wound incurred in a plutonium processing facility might be contaminated. This flexibility includes fast, accurate determination of contaminants in a wound, hard copy printout of results, and full patient logging capabilities via flexible disk storage. Use of a low cost computer greatly simplifies hardware and software design, and makes duplication of the instrument very simple and inexpensive.

FUNCTIONAL DESCRIPTION

The plutonium wound monitor is shown in figure 1. It is built around a TRS-80 home computer which has full color display capability. A color unit was chosen because of the many advantages in having a full color display. These include the ability to see details in a color spectrum easier than in a black and white spectrum, the ability to display individual regions of interest in different colors, and a more attractive overall screen appearance for benefit of the user. Addition of a data acquisition board to the basic computer system turns the unit into a 256-channel pulse height analyzer with five spectrum memories, useful for storing various calibration and background spectra. Each

spectrum can have up to three regions of interest which are highlighted on the screen in different colors. Signal acquisition time is controlled by two software timers, a preset timer and a live time counter. Using the preset timer the operator can set a signal acquisition time from 1 to 65000 seconds. The live time counter keeps track of elapsed time while input pulses are being processed, and will keep the system running until the live time value is equal to the value of the preset timer. Signal processing then ceases, and control of the instrument returns to the main BASIC program which is responsible for calculating plutonium and americium activity, and storing the data on the printer or disk.

Included on the internal data acquisition board is a charge sensitive preamp and programmable 0 - 2500 volt bias supply which is used to operate the photomultiplier tube (PMT)-based wound probe, a sodium iodide detector. The high voltage bias can be set by the user either from the wound analysis software in the instrument or by a simple BASIC command from the computer. This voltage supply and the preamplifier are built in to the unit to allow the system to be used with many different types of detectors, and enhance the usefulness of the instrument as a general purpose pulse height analyzer as well as a wound screening system.

A flexible disk and line printer are provided for operating the system and documenting results. All the wound analysis software is stored on the main system disk along with calibration data and previous region of interest and high voltage values. Data relating to the patient, such as name, date of analysis, and results of sequential wound analyses with pertinent comments, can also be stored on the disk. The line printer is included to provide a permanent record of any data the operator chooses to store.

ELECTRONIC DESIGN

The data acquisition board which transforms the personal computer into

a pulse height analyzer is shown in block diagram form in figure 2. It is of standard pulse height analyzer design with a few enhancements to allow full use of the accompanying personal computer. The detector normally used is a 1.5 inch diameter sodium iodide (NaI) crystal coupled to a PMT. Pulses from the detector are coupled to a charge sensitive preamplifier and shaping amplifier. From the shaping amp the pulses are fed through a buffer amplifier to a peak holding circuit. The peak value in the peak holding circuit is sampled by an 8-bit Wilkinson type analog-to-digital converter, which converts the pulse amplitude to a digital word. The output of the converter is then sent to the computer, which reads it and increments spectrum memory contents according to the amplitude of the pulse.

Detector bias is supplied by a commercial dc-dc converter module. The converter will generate up to 3000 volts with an input of 12 volts, although the output in this system has been limited to 2500 volts. The bias supply is made user-programmable by addition of a digital-to-analog converter circuit to drive the input side of the high voltage supply.

A gain control circuit has been included in the design of the data acquisition board. The function of the gain control is to enable the computer to remotely control the gain of the signal A/D converter. This gives the operator the ability to set the gain of the input circuit in software, and also gives the system auto calibration capability, since the location of peaks in a calibration spectrum can be set by adjusting A/D converter gain automatically.

Communication between the data acquisition board and the computer is controlled by a device select circuit. The purpose of the device select logic is to select the different functions available on the data acquisition board. The device select circuit, under software control, selects whether the computer will communicate with the signal input circuit,

high voltage bias supply, or gain control circuit.

CONCLUSION

The Computerized Plutonium Wound Analysis System was developed to improve significantly on earlier wound analysis designs. It has been designed to automate many of the calculation and calibration procedures associated with plutonium wound monitoring, and to give the user a reliable, self-checking system. Incorporation of disk storage and a line printer simplify record keeping. Use of a readily available home computer and peripherals in the design have resulted in a system which, in preliminary field testing, shows every indication of being comparable in detection efficiency and stability to the previous wound analysis system, at considerably lower overall cost.

ACKNOWLEDGEMENTS

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Fig. 1. Computerized Wound Screening System

Fig. 2. System block diagram

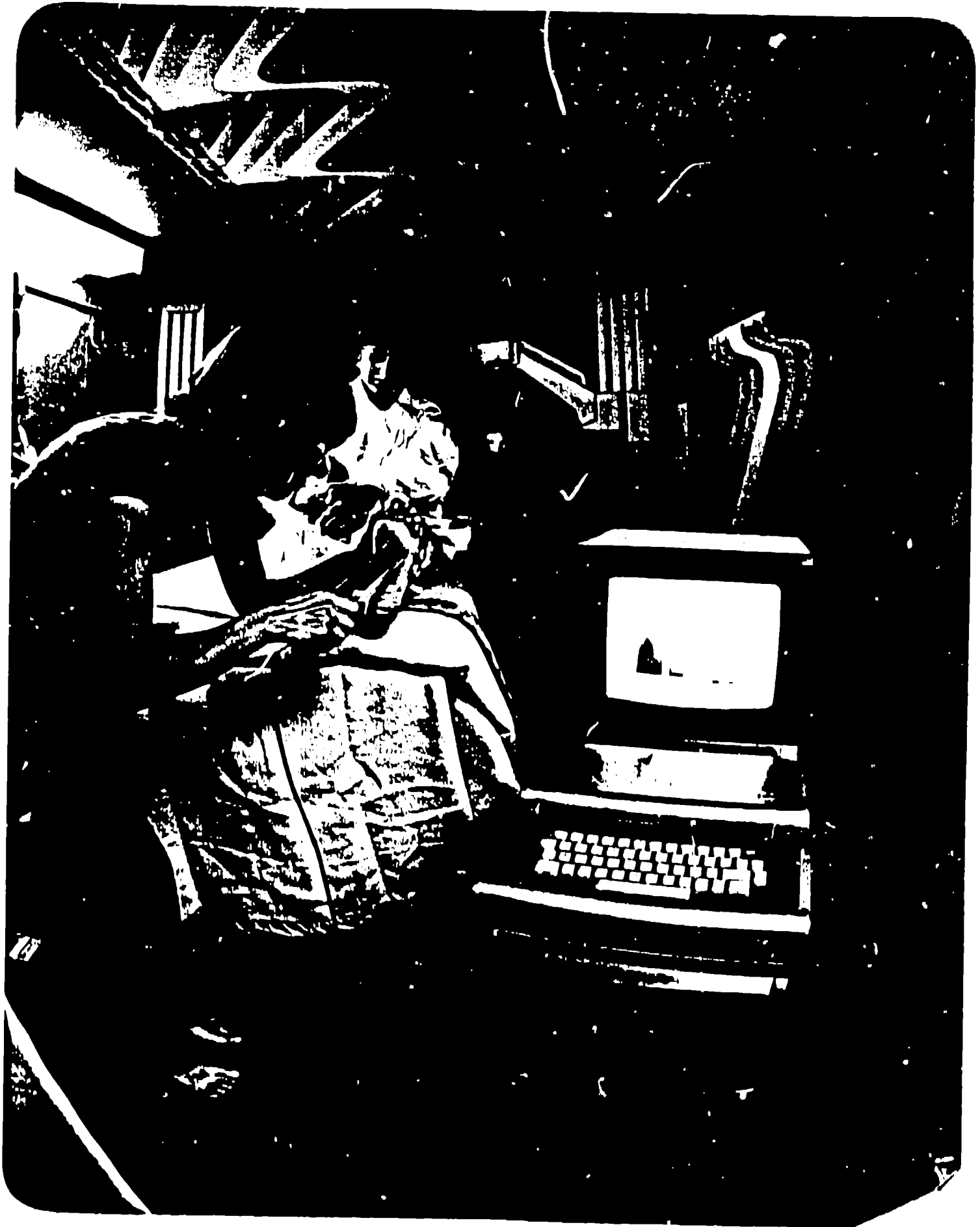


Fig. 1. Computerized Wound Screening System

COMPUTERIZED WOUND ANALYSIS PROBE BLOCK DIAGRAM

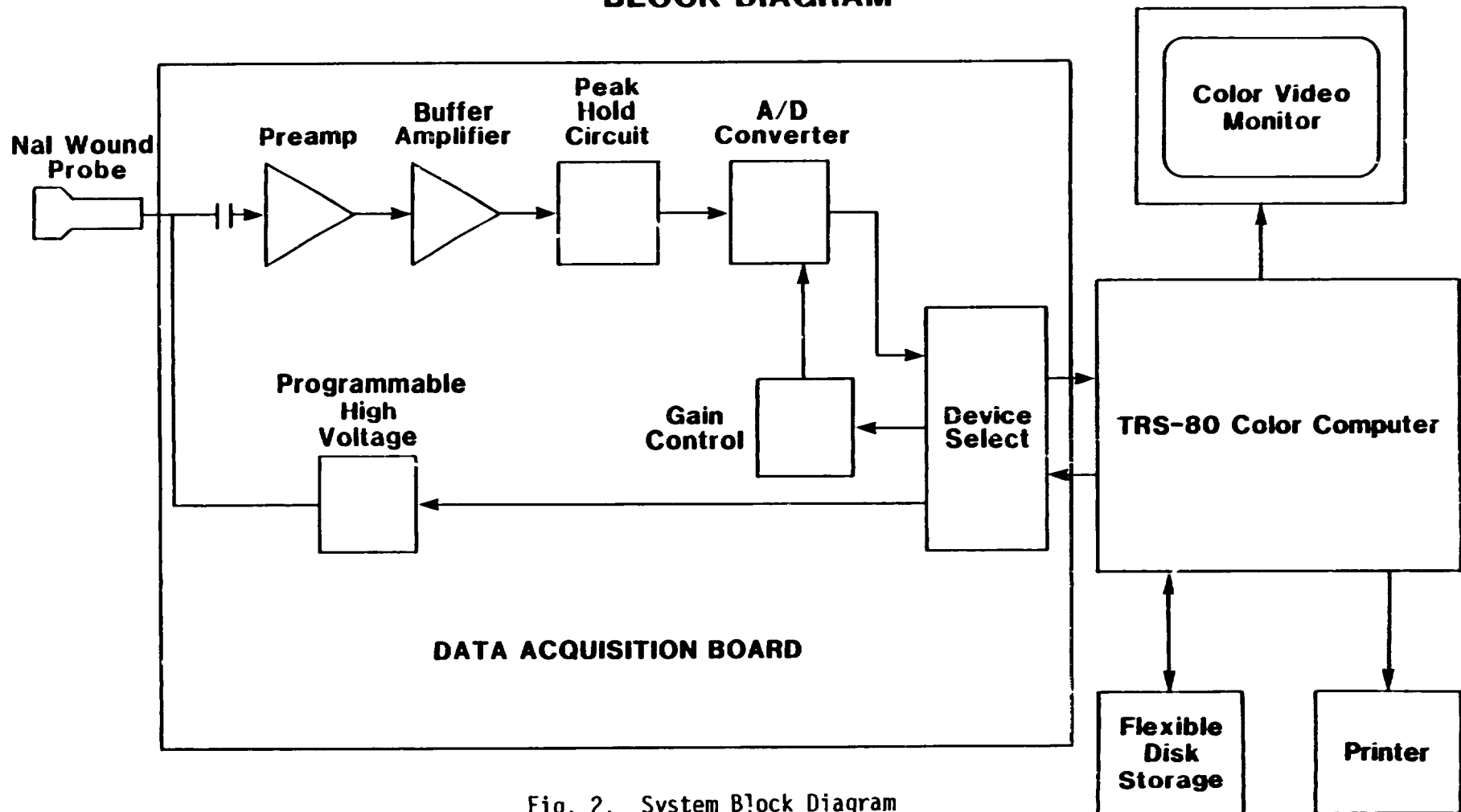


Fig. 2. System Block Diagram