CHAPTER I

INTRODUCTION

1.1 INTERACTION OF NUCLEAR RADIATION WITH MATTER [1]

Nearly all detection methods, the Cerenkov detector being a notable exception, make use of the ionization or excitation produced in a detection medium as a result of the absorption of all or part of the energy of the nuclear particle. In the case of charged particles,ionization and excitation is produced directly by the interaction of the electromagnatic field of the particle with the electron of the detection medium and the resultant ionization and excitation is distributed as a track centered on the track of the particle. In the case of uncharged particles such as γ and x-ray photons, the particle must first undergo some processes, such as a photoelectric or compton interaction, which transfers all or part of its energy to an electron which in turn produces the track of ionization or excitation. Similarly neutron must under-go an interaction,such as collision with a nucleus,and the charged particles product then creates the ionization or excitation.

1.2 NUCLEAR-RADIATION-DETECTION [2]

Nuclear-radiation-detection systems can be classified as to whether their operation is of the pulse type or not. In the pulse type of operation, the output of the detector is a series of signals separated or resolved in time. Each signal represents the interaction of a nuclear particle with the detector. A Geiger-Muller tube is an example of a pulse-type detector. If the pulse character of the output of the detector is used, such as in the case of counting by an electronic counter, the detection system is of the pulse type.

In the non pulse type of operation of a detection system, the quantity measured directly is the average effect due to many interaction of the radiation with the detector. No attempt is made to resolve the individual particles. In fact, this is often impossible because of the high rate at which they occur. Such an arrangement may be referred to as a mean-level detection system. The current-type ionization chamber is a good example of a mean level detection system. The current output is proportional to the number of particles incident upon the detector per unit time.

1.3 PARTICLE COUNTING [2]

The commonest type of measurement performed with nuclear-radiation detectors employing pulse-type detectors is that of particle counting. The number of detector output pulses is the number of particles striking the detector multiplied by the efficiency of the detector. In some application the number of counts occuring in a measured time is determined. Such a detection system is referred to as a counter as shown in Fig. 1.1

The detector may be any of the preceding types which are capable of pulse-type operation. The output of the detector appears as a pulse of current at the input of the preamplifier.

The preamplifier is located physically close to the detector. Often it only serves the purpose of impedance transformation. The overall gain of the system, preamplifier and amplifier combined, depends on the size of the detector output pulses.

The discriminator passes only those pulses with a height exceeding a certain minimum. The action of the discriminator makes it possible to reject the smaller noise pulses while counting larger pulses from nuclear radiation. The discriminator allows the counting of a given radiation type in the presence of other radiation-producing smaller pulses.

The output pulses from the discriminator are of a standard height and usually of a constant width. These go into the scaling stages which will be shown on the display unit.

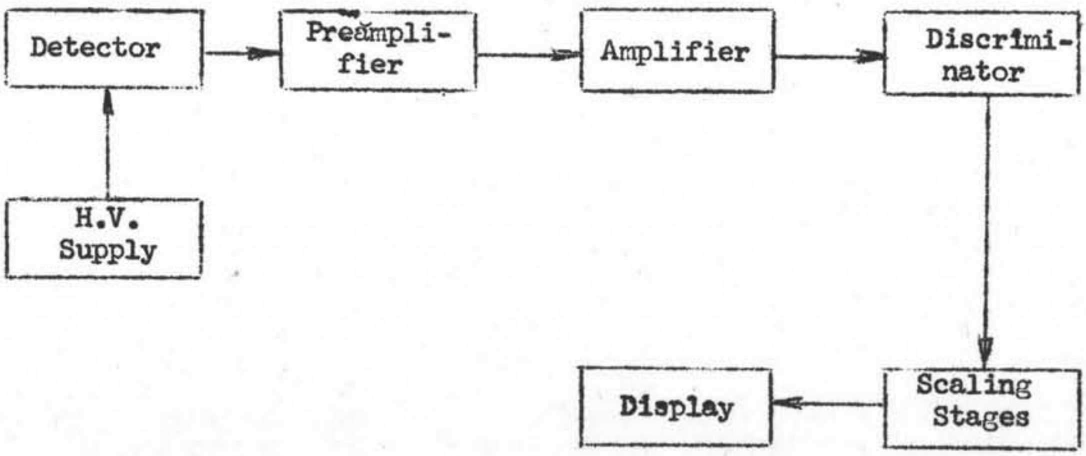
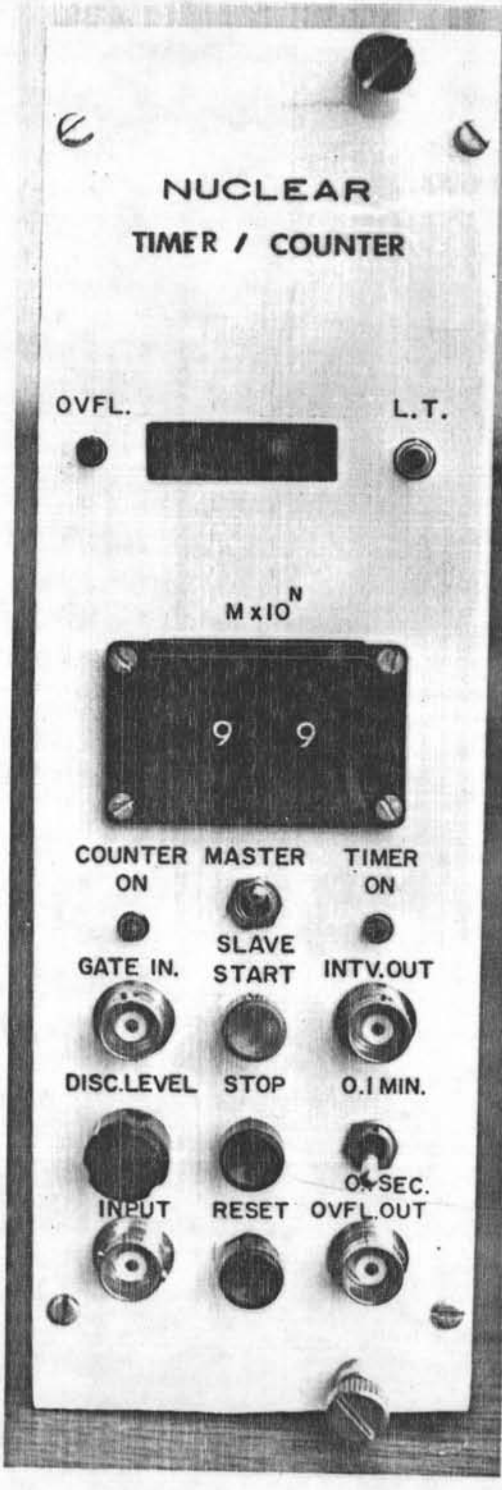


Fig.1.1 Block Diagram of a System for Nuclear-Particle Counting.


NUCLEAR
TIMER / COUNTER
OVFL.
L.T.
M x 10^N
9 9
COUNTER ON
MASTER
TIMER ON
SLAVE
GATE IN.
START
INTV.OUT
DISC.LEVEL
STOP
0.1 MIN.
SEC.
INPUT
RESET
OVFL.OUT