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A Proportional Wire Calorimeter for Magnet Pole Tips,* D. KRAUS, T. LUDLAM, J. RENARDY,† W. WILLIS, E. ZURFLUH, Brookhaven National Laboratory, Upton, N.Y. -We discuss the development of a total absorption calorimeter which is designed to have magnetic properties comparable to those of ordinary steel, and thus can be incorporated into the poles of a spectrometer magnet without compromising the field quality. A test device has been built which consists of an iron structure penetrated by a fine-grain pattern of holes, each acting as a proportional tube such that 90% of the volume is occupied by iron. Measurements of the energy and space resolution of this device in a high energy beam will be presented.

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†Permanent Address: CEN, Saclay, France.

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A PROPORTIONAL WIRE CALORIMETER FOR MAGNET POLE TIPS

Summary

For experiments at high energy colliding beam facilities in which the basic trigger is provided by calorimetry, it is important that the solid angle covered by calorimeter elements be as large as possible. In most spectrometer designs some of the interesting solid angle is unavoidably given over to the presence of magnet structures. The purpose of the development work described here is to evaluate a technique for instrumenting the pole tips of a spectrometer magnet as active calorimeter elements, without significantly degrading the magnetic integrity of the device.

We consider an iron structure in which the sampling elements consist of a large number of proportional wires in an array of small holes, arranged so that the magnetic flux has a connected body of iron to traverse without gaps, and with $\sim$ 90% of the volume occupied by iron. We have analyzed a number of such configurations from the point of view of energy resolution, spatial resolution, read-out technique and ease of mechanical construction. The technique of studying the energy resolution was to compute the resolution for electromagnetic showers using the EGS Monte Carlo program.[1] By comparing a checkerboard array with the usual parallel plate configuration (see Fig. 1) we concluded that there is no intrinsic drawback in using structures based on holes rather than plates. We then studied a number of possible practical arrangements, based on which a test module has been constructed to study experimentally the electromagnetic energy resolution of such a device.

The test device is illustrated in Fig. 2. It consists of a stack of iron plates in which every second plate is 7 mm thick with 2 mm deep sampling slots milled into it. The intervening plates are 17 mm thick and left blank. The sampling slots are 10 mm wide on a 10 mm pitch. In the assembled stack each of these slots (which total 720 in number) is instrumented as a gas proportional chamber with a 12.5 micron diameter wire. The active gas is 90:10 Argon:Methane. The total depth of the stack along the beam is 27 radiation lengths.

For the test module, the signal on each wire is resistively divided and read out at each end, where we digitize analogue sums of small groups of wires: at one side of the stack the readout is configured to measure directly the sampling fluctuations and the longitudinal shower development. At the other side the summed wires are grouped so as to measure the lateral spread of showers, and the precision with which they can be located in the plane perpendicular to the beam. There is a total of 260 readout channels.

At this writing, the test module and readout have been constructed and preliminary exposures have been carried out in a test beam at the Brookhaven AGS. We expect to report on a full set of tests scheduled to take place during the months of June and July.

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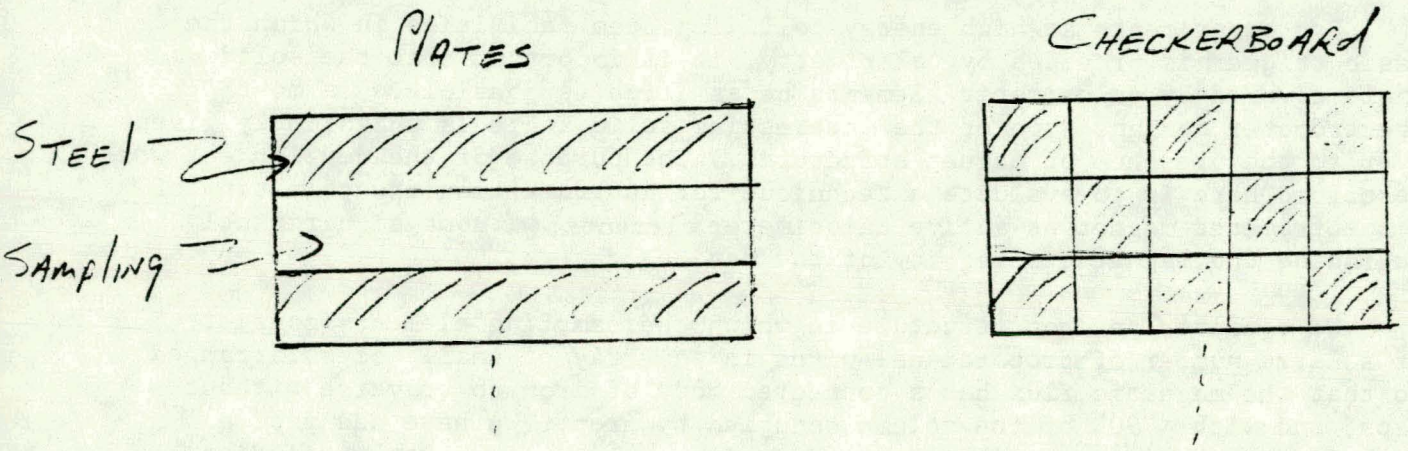
1. R.L. Ford and W.R. Nelson, SLAC-210 (1978).

FIG. 1



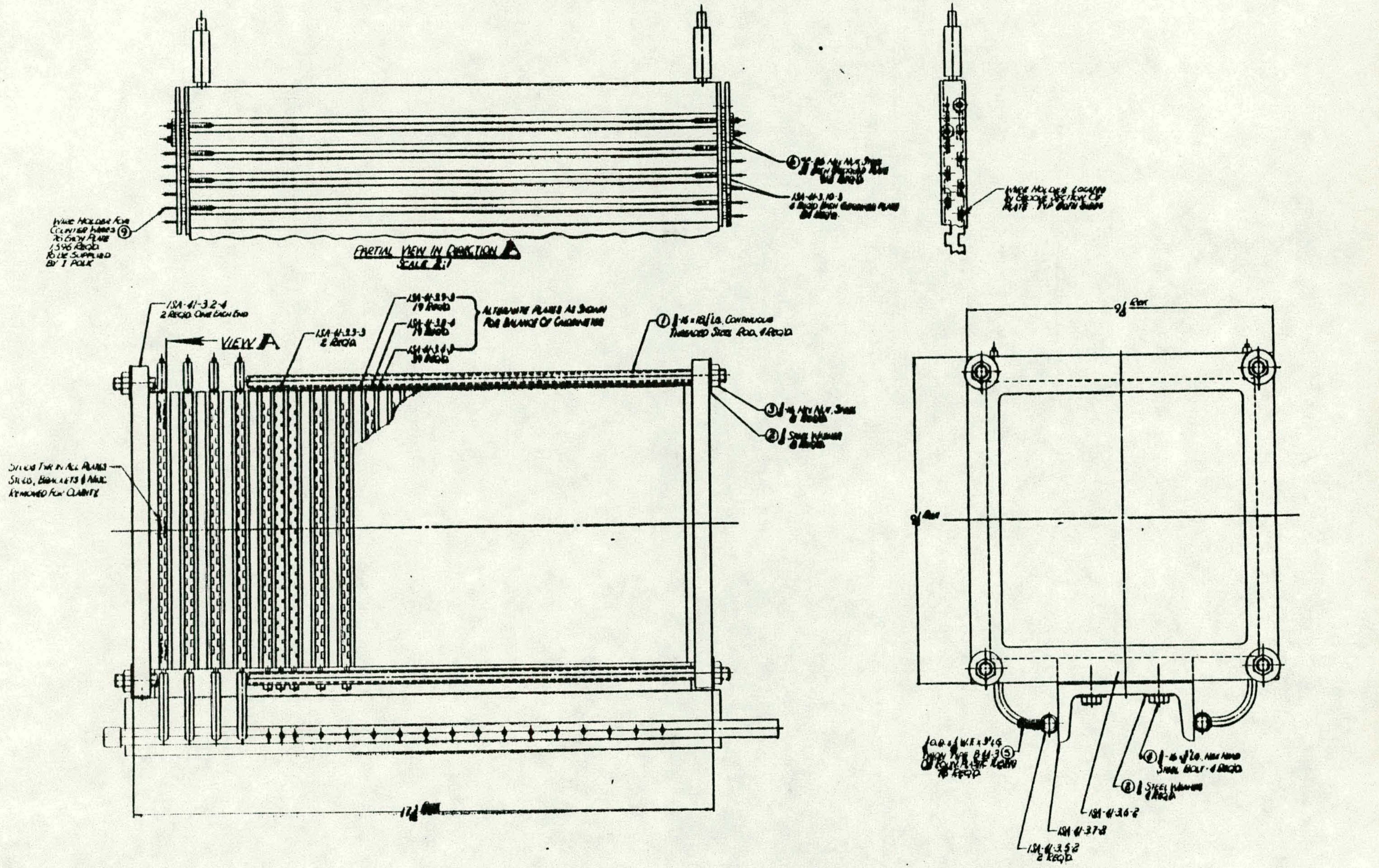

PARTIAL VIEW IN DIRECTION A
SCALE 2:1
VIEW A
ISA-41-3.2-4
2 REQ'D. ONE EACH END
ISA-41-3.3-3
2 REQ'D.
ALTERNATE PLATES AS SHOWN
FOR BALANCE OF CALORIMETER
BY I. POLK

FIG. 2