A-84-019
57-9

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PER DOC REVIEW JAN. 1973

[redacted]

November 19, 1945

N. E. Bradbury

H. L. Anderson

The Screen Type Alpha Chamber

The following description of the screen type alpha chamber is the information requested of O. R. Frisch by W. C. Fernelius of the Monsanto Chemical Company. Dr. Frisch referred the request to Group F-4 because ours is the most recent application of this device. These chambers were used by Group F-4 for alpha assay of plutonium in the determination of the nuclear efficiency of the Trinity Gadget. They also proved useful in determining the fraction of 49 which was converted to 48 in the explosion by means of an alpha ionization analysis. Our design and use of this apparatus is described in LA 356. Mr. Marvin Wilkening who was in charge of these instruments for the Trinity Test has written on the description and application of these chambers in the appended memorandum. The original design is due to O. R. Frisch.

cc: 1 & 2. N. E. Bradbury
3. M. H. Wilkening
4. File
5. F. Chrosley

FINAL DETERMINATION
UNCLASSIFIED
L. M. Redman
JAN 14, 1981

VERIFIED UNCLASSIFIED
PUBLICLY RELEASABLE
~~LANL Classification Group~~
JUN 18 1998

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THE SCREEN TYPE ALPHA CHAMBER

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principle. The alpha chamber in question is different from the conventional parallel plate type of chamber in that a screen is introduced between the collecting and high potential electrodes. The function of this screen is to make the response of the chamber independent of the direction of emission of an alpha particle from the surface of the sample. It achieves this end by protecting the collecting electrode from the field due to the positive ions produced by the alpha particle. Electron collectimnis used to insure a short resolving time. This is accomplished by using pure argon fillings and applying negative potentials to the high voltage and screen electrodes. The advantage of a screen type chamber over the conventional two-electrode type comes only when it is desired that the pulses from the chamber be as directly proportional to the energy of the alphas producing the pulses as possible. Examples of such instances are range analysis of composite samples and careful self-absorption studies.

Advantages. The following points constitute the chief advantages of the alpha screen chambers in use here. All of them are not due necessarily to the addition of the screen.

1. These chambers together with the input circuits used constitute high speed counting units. A dual advantage results. Alpha emitting foils having up to 50,000 c/m can be counted with negligible losses; and what is frequently more important, alpha measurements can be made with good reliability on foils having high beta backgrounds. Short resolving times reduce the piling-up effect of the betas to a minimum. In cases where piling-up becomes appreciable (10^9 to 10^{10} betas/min) the discriminating circuit hereinafter described can be used to permit quantitative alpha counting of such samples.

2. The chambers are practically non-microphonic. A loud hand clap near the chambers or a slight tap on the chambers themselves does not affect their operation.

3. The signal-to-noise ratio is very good (about 50).

4. The day-to-day and week-to-week reproducibility is quite satisfactory.

5. Samples can be changed conveniently.

Physical Design. The attached print gives the details of construction. Some 0.002" annealed tungsten wire with a 0.078" spacing was used for the screen electrode. The preamplifier is built into the squareom on top of the chamber along with filter sections for the -1000v and -500v lines. The -1000v connection is made to the bottom (sample holder) electrode and the -500v connection is made to the screen electrode. Connections are made from the valve on the side of the chamber to a Megavac pump, an open tube mercury manometer, and a tank of argon for evacuating and filling purposes. The chambers are operated at a pressure of one atmosphere of commercially pure argon. Even better characteristics might have been obtained with a mixture of 90 per cent argon and 10 per cent

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carbon dioxide as has been used elsewhere in this laboratory. It is highly important that contaminating oxygen or water vapor be excluded from the chambers. It should be emphasized that the chambers in use here were designed to accommodate foils five inches in diameter. For ordinary counting a two-inch foil is usually satisfactory. Hence, all dimensions of the effective part of the chamber could be scaled down accordingly.

Electronic Circuits. The preamplifier consists of a low-gain three stage 6AK5 circuit with negative feed-back. The filaments are operated by a six-volt storage battery. This circuit showed no tendency to oscillate when properly installed except on rare occasions when a tube failed. A six-stage amplifier also employing negative feed-back has excellent linearity characteristics. The maximum gain of the preamplifier combination is about 10^6. The time constant of the circuit combination as normally used is about 20 microseconds. The maximum output pulse size is 150 volts positive. These pulses are fed to a well stabilized negative-bias discriminator circuit built into a standard scale of 64 or 256 circuit. A precision potentiometer in the discriminator makes it possible to accurately differentiate pulses of different sizes. This was most important for the range analysis work. The high voltage for the -500 and -1000 volt electrodes is obtained from an electronically stabilized power supply.

Summary. The alpha screen chamber serves a useful function when it is necessary to analyze a sample for alpha particle energies or in any experiment requiring that the pulses from the chamber be directly proportional to the original number of ions formed by an alpha particle within the chamber. Our experience here has shown that the screen type chamber can be operated having, in addition to its unique advantage just mentioned, all the other desirable features of the conventional two electrode type chamber including short resolving times.

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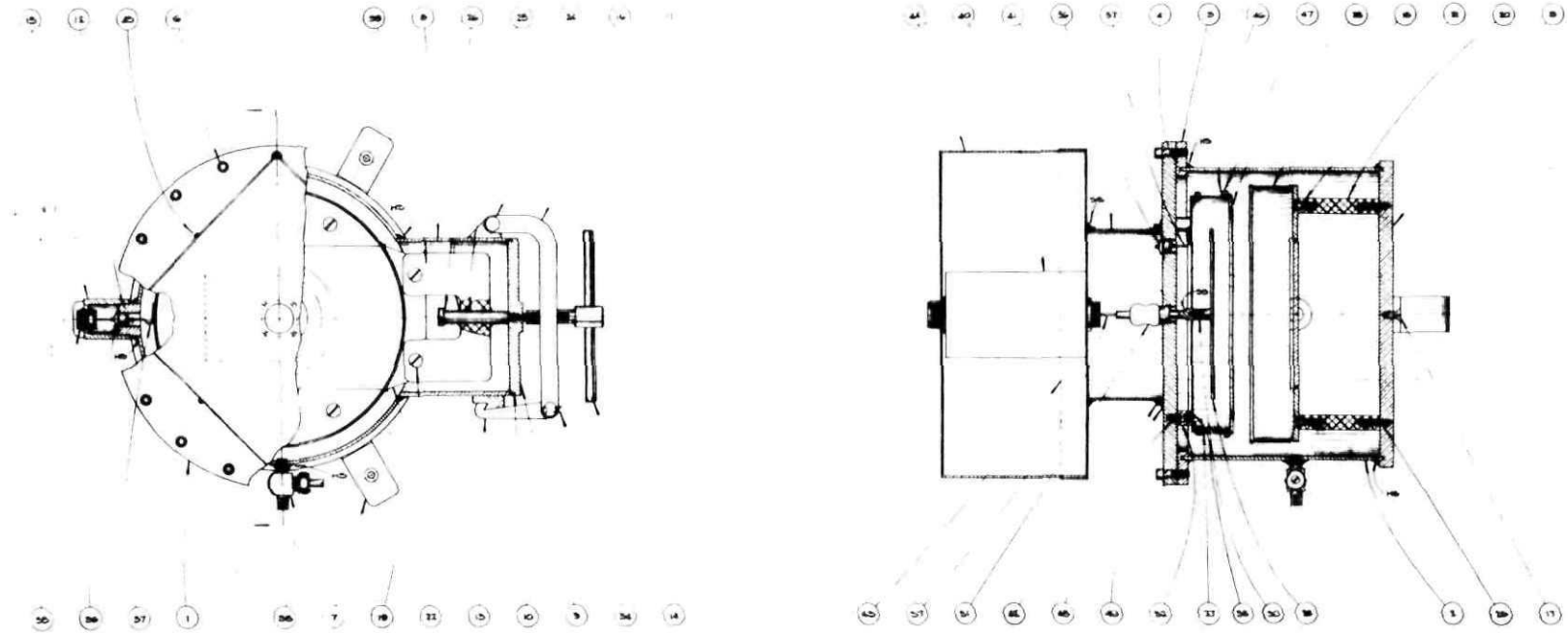
LIST OF ALL STOCK PARTS

PART NO.	QUAN.	NAME	DESCRIPTION	MAT.
4	1	FLANGE [illegible]	1/16" ROUND	[illegible]
8	18	COVER SCREW	SOC CAP - 1/4 NC - 7/8	[illegible]
17	6	LEG SCREW	FLAT HD - 1/4 NC - 1/2	IRON
21	4	SPACER SCREW	FLAT HD - 1/4 NC - 5/8	BRASS
22	2	SLIDE SCREW	FLAT HD - 1/4 NC - 5/8	BRASS
28	1	GRID WIRE	.001" DIA.	NICKEL
31	1	KOVAR SEAL	TO BUT	COMM.
33	3	SPACER SCREW	FLAT HD - 1/4" NF - 3/16"	BRASS
34	2	COTTER PIN	1/16" - 5/8" LONG	[illegible]
35	1	AMPH CONNEC.	M 40	COMM.
36	2	KOVAR SEAL	TO BUT	COMM.
37	5	SEAL LEADS	1 LOT TEST LEAD WIRE	COMM.
38	1	NEEDLE VALVE	1/4" PIPE	COMM.
40	1	PRE-AMPLIFIER	NO. 00	COMM.
42	2	SPACER SCREW	FILL HD - #5 NC - 1/8	BRASS
45	4	CAN SCREW	BUTT HD - #5 NC - 3/16	IRON
47	6	GRID SCREW	FILL HD - #5 NC - 5/16	BRASS
49	3	SPACER STUD	SOC SET SCR - 1/4" NF - 3/8	[illegible]



GENERAL NOTES

1. SHELL AND COVERS TO BE ASSEMBLED AND TESTED UNDER FULL VACUUM
2. SOFT SOLDER ALL KOVAR SEALS AND SEAL LEADS.

SCALE: 0 1 2 3 4 5 6 INCHES

PART 38 WAS 1/8"	[illegible]	[illegible]
PART 49 ADDED	[illegible]	[illegible]
PT 33 WAS 1/4" NC - 3/4"	[illegible]	[illegible]

CHANGED ITEM SIZE

ADDITIONAL SHEETS

SCALE NO. 1

ACC NO. 1

SHEET D

NAME OF TITLE: ALPHA SCREEN CHAMBER

DRAWING NO. Y-5225

SCALE 1

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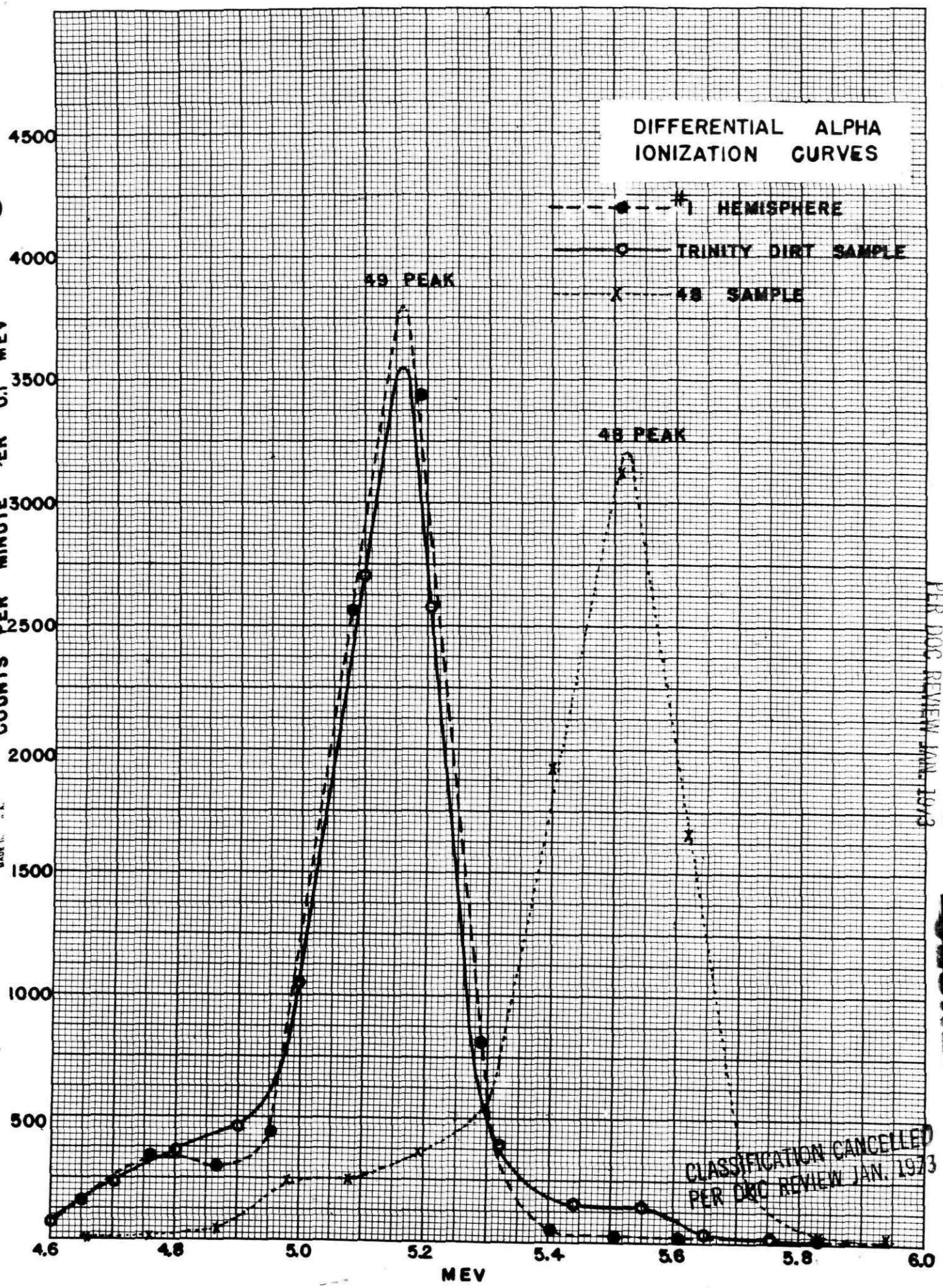

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