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SUMMARY

This volume presents the quarterly results of that portion of the research and development endeavor which is directed toward establishing new techniques or instruments and toward improving present methods for determining, accurately and safely, levels of radioactivity encountered in the course of other phases of work.

2/ The reduction of the midband gain by the use of over-all negative feedback to approximately 1,000 has extended the frequency response of the high-gain, wide-dynamic-range amplifier to beyond six megacycles. More constant values for the resolving time of this amplifier should be obtained by pulse shaping within the gain loop, and the use of shorted delay lines for this purpose is being investigated. Criteria have been established for the counting rates of samples to be used for a determination of resolving time (p. 8).

3/ Design considerations are presented for an instrument to measure the time of fall of a radioactive plummet through a fixed distance (p. 24).

4/ The large-area scintillation monitor for alpha contamination of laboratory air appears to be satisfactory but its discrimination against gamma radiation is not very high. However, a monitor with good gamma discrimination has been developed to count a sample formed by mixing the laboratory air with a controlled amount of "dust" and filtering on a continuous tape (p. 17).

5/ A chamber which will permit the counting of plated alpha samples in a single operation is described (p. 23).

6/ The standard, low-geometry alpha chamber has been calibrated geometrically with an estimated precision of ± 0.07 to ± 0.18 per cent. By counting numerous samples on several geometries, it was determined that the mean deviation from any one position to any of the others does not exceed 0.14 per cent (p. 18).

The investigation of a method for making a series of very thin absorbers is nearly complete (p. 6).

Problem Title -- Plastic Film Absorbers

Report By -- J. S. Stanton

Work Done By -- J. S. Stanton

INTRODUCTION

A series of absorbers is required by the Research Counting Group for its studies of low-energy alpha and beta particles. The thickness or weight range specified is of such magnitude as to require two sets of absorbers. The one set, for thick absorbers, is made from one or more selected sheets of rolled-aluminum or electroscope foils. For the set of thin absorbers, Formvar-E plastic is used. In order for the plastic film to perform satisfactorily as an absorber, the surface of the film must be made conductive to prevent the accumulation of electrical charge. Films are made conductive by the vacuum-evaporation of some suitable metal. Work has concentrated on the development of a set of plastic absorbers ranging from films as thin as possible up to films of a thickness of thin electroscope foil. Some overlap of the weights of the two sets of absorbers is desirable for correlation purposes.

A set of the plastic absorbers is nearly complete, but progress has been slow because of the problems to be solved in making films uniform as they become thicker.

DETAILED REPORT

The whole period was spent in developing a technique for making uniform absorbers weighing approximately 70 to 150 micrograms per square centimeter. These absorbers should not wrinkle, sag, or deform badly under the effects of metal evaporation, variations in temperature and humidity, or other factors.

The weight or thickness of the film is increased by increasing the percentage of Formvar E to ethylene dichloride, the solvent. Beyond a certain percentage the solution becomes so viscous that it cannot spread out sufficiently before the solvent evaporates, leaving a lumpy, uneven center. With such methods to retard solvent evaporation as the use of cold tap water (10 to 12°C) and enclosure of the pan of water in a hood, solutions of six per cent plastic were too viscous; a five per cent solution is about maximum. The weight of films from this percentage solution varies, but the weight range is approximately 40 to 60 micrograms per square centimeter. This appears to be the maximum weight for films 2½ inches in diameter. The weight difference, therefore, must be made up by the conductive metal coating.

Films which had a particularly heavy coating of aluminum wrinkled badly. The wrinkling sometimes occurred when air was first admitted to the evaporation chamber, sometimes at a point in bringing the chamber up to atmospheric pressure, and sometimes a few hours after removal from the chamber. Although some tests were made to determine the cause of this wrinkling, no definite conclusions were reached.

The next step was to use a heavier metal. Although copper was tried, it was given up in favor of silver which is heavier and has a higher vapor pressure. In this case, the silver was evaporated from a quartz crucible instead of from the filament as was done for both aluminum and copper. The crucible increased the efficiency and reduced the time the

filament was on, hence reducing the chance for the film to be damaged by excessive heat. For a light coating of silver the wrinkling was very small, but when a heavy coat was applied the wrinkling again became severe. A film which had 80 micrograms per square centimeter of silver evaporated on it wrinkled badly. This quantity of silver, applied to one side only, may have had some effect on wrinkling, although this again has not been proved. A subsequent test using a lighter-weight film and less total silver but applied to both sides produced a film that did not wrinkle. The amount of silver was 70 micrograms per square centimeter.

The weight of the film supporting the 80 micrograms of silver was approximately 45 micrograms per square centimeter or a total weight of 125 micrograms per square centimeter. This is the maximum weight of any film produced so far. The film was made usable by drawing or stretching out the wrinkles when it was transferred from the aluminum weighing ring to the brass absorber ring.

It is planned to evaporate gold instead of silver and develop some technique for applying equal amounts of metal to each side of a film as a final means of producing absorbers having weights of 150 micrograms per square centimeter.

Problem Title -- Counting Systems for Pulses of Wide Dynamic Range

Report By -- W. H. Baker

Work Done By -- W. H. Baker

INTRODUCTION

After the completion of the Information Report on "Counting Systems for Pulses of Wide Dynamic Range",¹ it was decided that several improvements in the operating characteristics of the counting system might be possible. First, a little reasoning indicated that an advantage might be gained by reducing the midband gain of the main amplifier, thereby reducing the total noise background of our composite counting system.

In our wide-dynamic-range proportional counting system, the fast rise time of the pulse sets the need for a high-frequency amplifier. The low-frequency requirements are set by the desired dynamic range. Since the main amplifier reported in MLM-618 had midband gain to spare, it seemed advisable to reduce this gain by introducing inverse feedback, thereby reducing the noise level while maintaining its high-frequency gain. A method for doing this is given in this report.

The Research Counting Group handles unknown radioactive samples of relatively high disintegration rates which have a wide range of energies and penetrating powers. It is required that their counting instruments be capable of precision results for a wide range of pulse heights and many different combinations of pulse-height distribution. Since the pulse height markedly affects the pulse duration at large gas amplifications, the resolving time (τ) becomes a function of pulse-height distribution. If counting operations are to be speeded up, it is necessary that the resolving time of the whole counting system be improved and made constant, irrespective of the type of sample or the gas amplification of the system. We believe that the solution may be found by reducing τ by a factor of 5 or 10 and by making the resolving time of the discriminator the limiting factor of τ in the system. It is hoped that τ will then be constant regardless of the type of radioactive sample used. We propose to use pulse-shaping networks to accomplish our goal. Preliminary experiments using shorted delay lines are reported here.

Another problem that causes trouble is the seeming inconsistencies in the measurement of τ . A method is proposed which might solve this problem. It is based on the assumption that the sample used for measuring τ should have a sufficiently high disintegration rate to insure a good probability that many pulses will occur within the insensitive time of the system.

DETAILED REPORT

The schematic diagram of the modified main amplifier is shown in Figure 1, and its frequency-response curve is shown in Figure 2. The midband gain is approximately 15 decibels less than that of the main amplifier circuit shown in MLM-618. At this point it became apparent that the problem of resolving time was more important than that of sensitivity. Since a number of experiments and tests on the feedback amplifier would be necessary to come to any conclusions, it was felt that the problem of amplifier sensitivity should be dropped temporarily in favor of the problem of improved resolving time.

Reports from the Research Counting Group showed a variation in resolving time when making absorption measurements. Tau varied from 2 microseconds when counting alpha-initiated pulses on the alpha plateau, to 20 microseconds when counting alpha and beta-initiated pulses on the alpha-plus-beta plateau. This variation seems to be one that we should expect, since pulse duration, which affects tau, is a function of gain and initial pulse size. We would like to obtain a constant tau of 1 microsecond or less, irrespective of the ionization chamber voltage or the use of absorbers.

Since our present scalers have a resolving time which is limited to 2 to 5 microseconds, we must have a better scaler and a better discriminator before we can determine when we have made an improvement in our amplifier. We now have a Hewlett-Packard pre-scaler with a resolving time that is supposed to be 0.1 microsecond. We have had encouraging results with a discriminator whose maximum output-pulse duration is approximately 0.4 microsecond, irrespective of the amplitude and duration of the input pulse. This circuit has not been fully tested as yet. The direction toward which we have pointed is a study of the application of delay lines as pulse shapers. At the present we are interested in shorted delay lines. An experimental setup was devised for testing these delay lines and is shown in Figure 3. A similar circuit was installed at the output of our main amplifier and produced the favorable result shown in Figure 4. This result shows that we can probably eliminate the discriminator as a source of variable tau.

It appears that some of our values of tau are unreasonable and erratic. In analyzing this phase of resolving-time measurements, it seemed reasonable to conclude that if the counting rate of the sample was too low, the errors due to statistics could mask out the losses due to resolving time. It was also reasoned that the counting rate could become so high as to cause tau to depart from its predicted curve. Therefore, it seemed plausible that for a given tau the radioactive sample used to measure tau should have a disintegration rate which would fall between two well defined limits. To obtain some preliminary data for this reasoning, paired samples were obtained and used in a conventional manner. The formula used for calculation is shown below.²

$$\tau = \frac{R_A + R_B - R_C - b}{R_C^2 - R_A^2 - R_B^2} \quad (1)$$

R = recorded rate.

b = background rate.

Subscripts A and B refer to individual members of a pair of sources.

Subscripts C refers to sources A and B counted together.

Since tau should be positive³ it seems reasonable to expect that the value of the numerator of the above equation should be at least one per cent of R_C when using a counting system accurate to a precision of ± 1 per cent. The data in Table I were collected and used to draw the graph of Figure 5.

It would appear from a study of Table I and Figure 5 that the difference due to resolving time losses divided by R_C should fall between one per cent and five per cent. Since the losses become less as tau decreases, it is necessary to use samples of greater disintegration rates if a reliable value of tau is to be obtained.

REFERENCES

1. Baker, W. H., Counting Systems of Wide Dynamic Range, MLM-618, October 15, 1951.
2. Kohman, T. P., A General Method for Determining Coincidence Corrections of Counting Instruments, MDDC-905, A.E.C., June 13, 1945, p. 3.
3. Ibid, p. 8.

TABLE I
CONSISTENCY OF TAU WITH COUNTING RATE

GROUP	ORDER OF MAGNITUDE OF SAMPLES		TAU (min.)	APPROXIMATE THEORETICAL VALUES OF			
	(cts./min.)	(total cts.)		R_A	R_B	R_C	b
1	10,000	10,000	75.6×10^{-7}				
	10,000	100,000	61.1×10^{-7}				0.1
2	150,000	150,000	1.97×10^{-7}				
	150,000	1,500,000	1.86×10^{-7}				3.0
3	500,000	500,000	2.06×10^{-7}				
	500,000	5,000,000	1.86×10^{-7}				5.0
4	750,000	750,000	3.36×10^{-7}				
	750,000	7,500,000	4.18×10^{-7}				7.5

CIRCUIT SCHEMATIC MAIN AMPLIFIER.

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FREQUENCY RESPONSE OF MAIN AMPLIFIER WITH OVERALL FEEDBACK.

L_1 —3/8" BAKELITE COIL FORM,
COIL WOUND 1/2" LONG WITH
NO.34 ENAMELED WIRE.
TWO LAYERS; 1st LAYER
WOUND CLOCKWISE, 2nd
LAYER WOUND CCW.
WINDING WERE SEPARATED
WITH THIN SHEET OF
POLYSTYRENE. THIN COPPER
FOIL WOUND OVER FULL LENGTH
OF COIL. COIL MOUNTED IN
SHIELDED MILLEN COIL CASE
NO.74400.

DELAY LINE PULSE SHAPING.

15

L_1 - 3/8" BAKELITE COIL FORM, COIL WOUND 17/8" LONG WITH NO. 34 ENAMELED WIRE. 1st LAYER WOUND CLOCKWISE, 2nd LAYER WOUND CCW. WINDINGS WERE SEPARATED WITH THIN SHEET OF POLYSTYRENE. THIN COPPER FOIL WOUND OVER FULL LENGTH OF COIL. COIL MOUNTED IN SHIELDED MILLEN COIL CASE # 74400.

-DATA-

2" HEMISPHERICAL CHAMBER CC-2
P-10 GAS CHAMBER
VOLTAGE ADJUSTED TO TOP OF $\alpha + \beta$ PLATEAU, Po. SAMPLE.

EFFECT OF SHORTED DELAY LINE ON AMPLIFIER OUTPUT PULSE.

Problem Title ... **The Development of a Method for the Continuous Monitoring of Alpha-Contaminated Air**

Report By ... **E. A. Reiter**

Work Done By ... **T. L. Zinn and E. A. Reiter**

INTRODUCTION

Investigation of the two proposed methods^{1 2} of monitoring laboratory air for alpha contamination is being continued. An alpha-scintillation-type continuous monitor has been developed and tested, and experiments are being conducted to determine the feasibility of a method of depositing the activity on a continuous tape of filter paper.

DETAILED REPORT

An experimental model of the scintillation monitor² has been calibrated and tested for long periods of time in normal, uncontaminated air and found to be stable under static conditions. The installation of the unit in the working area is nearly complete but tests under operating conditions are still to be run.

Although the scintillation monitor promises to be a useful instrument for the detection of air-borne alpha emitters, it is gamma sensitive and cannot be used in an appreciable gamma flux without adequate shielding. The filter-paper monitor is expected to overcome this limitation.

An experimental setup has been arranged to study the feasibility of the filter-paper monitor. It consists of a mixing chamber through which the monitored air is passed. In the chamber the flow of air is mixed with a small, controlled flow of titanium tetrachloride vapor. The vapor reacts with the moisture in the room air to form hydrochloric acid and titanium oxides - which form a white smoke or fog in the mixing chamber. It is hoped that radioactive gases in the air will be adsorbed on the fog particles and form aggregates of filterable size. As the air is drawn out of the mixing chamber, it will be passed through the filter paper where the aggregates will be deposited. The process can be made continuous by passing the tape of filter paper over a counting device as it leaves the mixing chamber.

It is proposed that the counting device be a gas-flow, proportional counter with a thin, mica window. The tape will be drawn under the window and the activity continuously counted. This monitor will not be sensitive to gamma radiation and should be suitable for use in locations where the scintillation counter is not practicable.

REFERENCES

1. Hood, W. L., Rpt. Gen. Res., MLM-603, p. 9, July 30, 1951.
2. Reiter, E. A., Rpt. Gen. Res., MLM-630, p. 21, October 29, 1951.

Problem Title -- Calibration of the Standard, Low-Geometry Chamber

Report By -- M. L. Curtis

Work Done By -- M. L. Curtis

INTRODUCTION

A standard, low-geometry chamber was designed, built, and measured¹ to evaluate radioactive samples which are in turn used for radiometric calibrations of all Logacs-S at Mound Laboratory. The chamber replaces a temporary standard chamber whose accuracy was in question due to the difficulty in obtaining accurate measurements of dimensions inherent in its design and construction. The task remained of computing geometry factors and checking their accuracy.

DETAILED REPORT

The five dimensions needed in the geometric calibration of the standard low-geometry chamber, along with standard precisions, are given in Table I. Since one of the dimensions is the radius of the sample to be measured, a group of standards was made up,² and autoradiograms were taken of them to determine the size and distribution of activity in each deposit. The autoradiograms showed fairly uniform distribution over a circle about $\frac{1}{8}$ inch in radius, so this dimension was used in the calibration. When samples need to be counted which vary appreciably from this size, a correction will have to be applied.

The Eichelberger formulas³ for geometry determinations were used to calculate the factors. The precision indexes in the dimensions were propagated to determine standard deviations in the geometry factors.⁴ Results are given in Table II.

While the measurements resulted in errors in precision in geometry factors of less than one fifth of one per cent, the absolute accuracy had not yet been proved. One indication of absolute accuracy was found by counting the same sample in all four counting positions. Since an error in any of the dimensions used would influence each geometry factor to a different degree, if all factors give the same result on a given sample, the absolute accuracy must be good.

Accordingly, five samples were counted on all positions whenever their range permitted. The results in disintegrations per minute on each sample agreed on the "four low", "one low", and "one high" positions, but results on the "four high" position were $1\frac{1}{2}$ per cent lower than on the other three positions. An examination of the chamber showed that there was not enough difference in the size of the outer holes in the bottom plate of the proportional chamber and those in the geometry defining surface, so that some shadowing occurred in the "four high" position. The holes in the proportional chamber were enlarged and the counts were repeated. Results listed in Table III show that the mean deviation from any one position to the others does not exceed 0.14 per cent.

The same five samples were also counted on the temporary standard chamber, and it was found to be 0.89 per cent higher than the permanent chamber. These results are shown in Table IV.

An additional check on the accuracy of the standard chamber was made by counting four samples in both the standard chamber and a windowless proportional alpha-beta-gamma counter

(Nuclear Measurements Corporation Model CC-2). A 50 per cent geometry was assumed for the proportional counters for samples mounted on glass, and a 52 per cent for those mounted on platinum. The samples used necessarily are at the lower limit of the Logac range and the upper limit of the proportional-chamber range. In spite of this fact, the results from the two counters differ by less than one per cent in each case (Table V).

The Logacs at Mound used for routine measurements have been recalibrated with standards whose values were determined by counting them in the standard chamber.

REFERENCES

1. Design, construction, and measurements by Instrument Design Group.
2. Samples and autoradiograms prepared by S. Barth.
3. Eichelberger, J. F., Calorimetry Progress Report, MLM-52, February 16-29, 1948, pp. 11 - 13.
4. Worthing, A. G., and Geffner, J., "Treatment of Experimental Data", Wiley and Sons, New York, 1943, p. 208.

TABLE I
DIMENSIONS OF STANDARD LOW-GEOMETRY CHAMBER

ORIFICE	A_1 (cm.)	A_2 (cm.)	σ FOR A_2 (cm.)	A_3 (cm.)	σ FOR A_3 (cm.)
1	0.3175	0.27803	± 0.00015	0.99431	± 0.00020
2	0.3175	0.27812	± 0.00020	0.99144	± 0.00014
3	0.3175	0.27805	± 0.00020	0.98915	± 0.00029
4	0.3175	0.15831	± 0.00014		

$$x \text{ (HIGH POSITION)} = 5.0129 \text{ cm.} \pm \frac{\sigma \text{ for } x}{0.0003 \text{ cm.}}$$

$$x \text{ (LOW POSITION)} = 10.0147 \text{ cm.} \pm 0.0008 \text{ cm.}$$

A_1 = RADIUS OF SAMPLE DEPOSIT

A_2 = RADIUS OF ORIFICE

A_3 = DISTANCE FROM THE CENTER OF OUTSIDE ORIFICES TO THE CENTER OF THE INNER ORIFICE

x = PERPENDICULAR DISTANCE FROM THE TOP OF THE SAMPLE TO THE ORIFICE PLANE

σ = STANDARD DEVIATION IN REPEATED MEASUREMENTS

TABLE II
GEOMETRY FACTORS FOR THE STANDARD LOW-GEOMETRY CHAMBER

POSITION	GEOMETRY FACTOR
4 HIGH (4 HOLES OPEN; HIGH SUPPORT)	$4.1376 \times 10^2 \pm 0.07 \text{ PER CENT}$
1 HIGH (1 HOLE OPEN; HIGH SUPPORT)	$4.0258 \times 10^3 \pm 0.17 \text{ PER CENT}$
4 LOW (4 HOLES OPEN; LOW SUPPORT)	$1.5836 \times 10^3 \pm 0.07 \text{ PER CENT}$
1 LOW (1 HOLE OPEN; LOW SUPPORT)	$1.6022 \times 10^4 \pm 0.18 \text{ PER CENT}$

TABLE III

CHECK ON CALIBRATION OF STANDARD LOW-GEOMETRY CHAMBER

SAMPLE	1-LOW POSITION (dis./min.)	DEV. (%)	4-LOW POSITION (dis./min.)	DEV. (%)	1-HIGH POSITION (dis./min.)	DEV. (%)	4-HIGH POSITION (dis./min.)	DEV. (%)	AVERAGE (dis./min.)
G	9.484×10^7	+ 0.084	9.480×10^7	+ 0.042	9.455×10^7	- 0.221	9.485×10^7	+ 0.095	9.476×10^7
C	5.811×10^7	+ 0.138	5.800×10^7	- 0.052	5.810×10^7	+ 0.121	5.790×10^7	- 0.224	5.803×10^7
I	6.308×10^7	- 0.063	6.293×10^7	- 0.285	6.323×10^7	+ 0.174	6.326×10^7	+ 0.221	6.312×10^7
D	3.541×10^8	+ 0.283	3.526×10^8	- 0.142	3.527×10^8	- 0.113	-	-	3.531×10^8
A	4.353×10^8	+ 0.230	4.341×10^8	- 0.046	4.335×10^8	- 0.185	-	-	4.343×10^8
AV. PER CENT DEVIATION + 0.134				- 0.097	- 0.045		- 0.031		

TABLE IV
COMPARISON OF RESULTS FROM STANDARD LOW-
GEOMETRY CHAMBER AND TEMPORARY CHAMBER

SAMPLE	STANDARD CHAMBER (dis./min.)	TEMPORARY CHAMBER (dis./min.)	DEVIATION (%)
b	9.476×10^7	9.404×10^7	-0.76
C	5.803×10^7	5.748×10^7	-0.95
I	6.312×10^7	6.259×10^7	-0.84
D	3.531×10^8	3.502×10^8	-0.82
A	4.343×10^8	4.295×10^8	-1.10

AVERAGE PER CENT DEVIATION -0.89

TABLE V
COMPARISON OF RESULTS FROM STANDARD LOW-
GEOMETRY CHAMBER AND PROPORTIONAL COUNTER

SAMPLE	STANDARD CHAMBER (dis./min.)	PROPORTIONAL COUNTER (dis./min.)	DEVIATION FROM STANDARD CHAMBER (%)
JJD-1 (POLONIUM ON GLASS)	4.03×10^5	4.00×10^5	-0.74
JJD-2 (POLONIUM ON GLASS)	2.19×10^5	2.18×10^5	-0.46
PU-36 (PLUTONIUM ON PLATINUM)	5.09×10^5	5.11×10^5	+0.39
PU-35 (PLUTONIUM ON PLATINUM)	3.63×10^5	3.66×10^5	+0.83

Problem Title - A Single-Operation Alpha Counter for Plated Samples

Report By - J. F. Combs

Work Done By - J. F. Combs

INTRODUCTION

The present method of evaluating the radioactive content of urine samples requires the alternate counting of the alpha-particle radiation from both sides of a circular plated disk. Thus two counting operations must be performed for each sample. If the evaluation of these samples could be accomplished in a single counting operation, the counting time required per sample would be halved. As the counting time required to count each side of the plated disk is 20 minutes, the savings in time that will result from use of a single operation counter is appreciable. The number of samples evaluated per instrument-operator manhour will be approximately doubled provided operator efficiency is not decreased by a more complicated counter.

The development of such a single-operation counter has been initiated and is described in this report.¹ The counter should be simple to operate and allow sample changes to be made with ease. The over-all background of the instrument must be low. The counting chamber should easily detect 5-million-electron-volt alpha particles.

DETAILED REPORT

The proposed counter has a counting geometry of approximately 50 per cent which is the maximum geometry attainable with any counter for plated alpha activity. To count 50 per cent of the radiated alpha particles in one operation, all of the plated surface area must be exposed to the counting volume at the same time. This is achieved by plating the activity on 1½-inch lengths of 5/16-inch copper tubing which has been spun closed on one end. These plated tubes are connected at the open end to a banana plug to form the center electrode of a concentric ionization chamber during the counting operation.

The chamber consists of two concentric, cylindrical enclosures and a fluorethene base insulator in which the center electrode is mounted. The outer cylinder totally encloses the inner one and is electrically insulated from it. Since the center electrode of the chamber is the plated sample and must be inserted and removed by hand, it must be at ground potential. The ionizing voltage, therefore, is applied to the inner cylinder which encloses the counting volume. The outer cylinder is necessary to keep the operator from coming in contact with the inner cylinder and receiving an electrical shock. Both cylinders are closed at the top and open at the bottom. The open ends are sealed to the base insulator by means of the "O" rings. The entire chamber assembly is mounted on top of an enclosure which houses a pre-amplifier.

The counter will be operated as a gas-filled ionization chamber. The filling gas will be either nitrogen or argon. The charge collected on the center electrode is coupled directly to the input of a stable three-stage preamplifier mounted in the chamber base. The preamplifier employs inverse feedback to obtain a high order of gain stability.

Construction of the chamber and preamplifier was initiated, and at the present time it is 90 per cent complete.

REFERENCE

1. The initial design work was done by C. E. Hemler.

Problem Title -- Viscosimeter Timer

Report By -- A. J. Rogers

Work Done By -- J. A. Williamson and A. J. Rogers

INTRODUCTION

Viscosity measurements of solutions at various temperatures and pressures are based in part on the time of fall of a plummet through a fixed vertical distance in the solution. The fall time of the plummet is to be measured to an accuracy of ± 1 per cent. Timer action is initiated when the plummet, containing a gamma source, passes two pairs of Geiger-Mueller tubes operating into coincidence circuits.

DETAILED REPORT

The operation of the viscosimeter timer is explained by reference to Figure 1. A plummet, containing a radioactive source, is confined within a guide tube in the pressure viscosimeter. Two pairs of well-shielded, Geiger-Mueller tubes operating into coincidence circuits will be spaced a fixed vertical distance apart and aligned parallel to the plummet guide tube. After the plummet is released and reaches terminal velocity in its travel down the guide tube, it passes the first pair of Geiger-Mueller tubes and the timer action is started. When the plummet passes the second pair of tubes, the timer action is stopped. The time of fall is a function of the viscosity of the solution.

For the required timer precision it has been experimentally determined that the gamma source confined within the plummet should have a gamma flux equal to that from 10 milligrams of radium. A cobalt-60 source meeting these requirements will be used.

The coincidence counts from each pair of Geiger-Mueller tubes will be totaled by binary scaling units. Timing action will be initiated at the first scaled count. False timer operation due to spurious coincidences will be minimized by subtracting these events by means of an internal pulse generator. Pulse-repetition-frequency of this generator will be approximately 60 cycles per second.

Operating potentials for the Geiger-Mueller tubes will be supplied by four individually adjustable, regulated, power supplies. The construction of these units has been completed. Other potentials necessary for the operation of the viscosimeter timer will be supplied from a conventional, regulated, low-voltage, power supply.

The coincident circuits and timer network are being constructed and should be available for final testing about February 5, 1952.

All other items required for the completion of the timer are due to be delivered during the first week of February, 1952. At this time the viscosimeter timer will be assembled for final testing and calibration.

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fig 1