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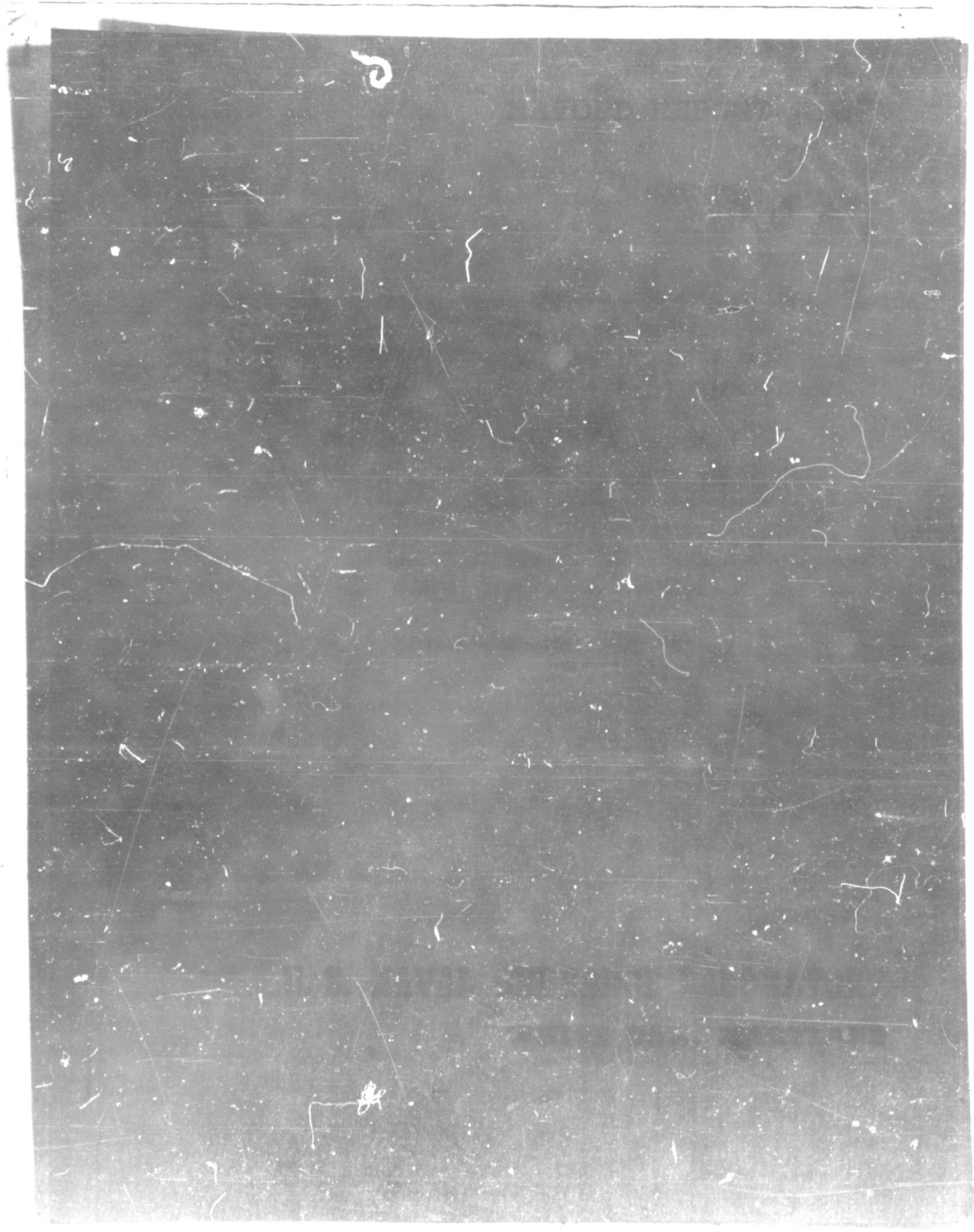
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ELECTRICAL PERFORMANCE CHARACTERISTICS  
OF THE MK 57 MOD 1 DETONATOR

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ABSTRACT: Comprehensive testing of the firing characteristics of the Detonator Mk 57 Mod 1 yielded the following results:

1. With a constant current source, the detonator will fire on a minimum potential of about 3 volts.
2. The constant current firing requirement is about 150 to 250 milliamperes for 0 and 100% firing respectively.
3. When fired by a condenser charged to 27.6 volts, the 50% firing energy was 11,242 ergs, while the average firing time was 22.5 microseconds. Lower voltages require higher energies and longer firing times.

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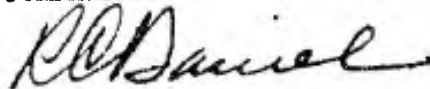
8 November 1954

The work described in this report was undertaken by the Mechanisms and Services Division of the Fuze Department at the request of the Underwater Ordnance Department. It is believed that the data reported could be of aid to design engineers who plan to use the Mk 57 Mod 1 Detonator.

#### Acknowledgment

Acknowledgment is given to Mr. B. B. Herman of this Laboratory for his assistance in performing the firing tests.

JOHN T. HAYWARD  
Captain, USN  
Commander



R. C. DANIEL  
By direction

ILLUSTRATIONS

- Figure 1. General Arrangement of Mk 57 Mod 1 Detonator
- Figure 2. Simplified Schematic of Constant Current Firing Circuit
- Figure 3. Simplified Schematic of Capacitor Discharge Firing Circuit
- Figure 4. Percent Firing as a Function of Constant Current
- Figure 5. Effect of Time of Energy Input on Required Energy for 50 Percent Firing
- Figure 6. Effect of Time of Energy Input on Required Energy for 99.9 Percent Firing
- Figure 7. Effect of Capacitance on Potential Required for 50% Firing

	Page
Table I. Constant Current Firing Data . . . . .	3
Table II. Capacitor Discharge Data . . . . .	4

ELECTRICAL PERFORMANCE CHARACTERISTICS  
OF THE MK 57 MOD 1 DETONATOR

1. Observation of production samples of the Detonator Mk 57 Mod 0 disclosed the fact that without very careful manufacture of the glass-kovar plug assembly a tendency for slippage of the .050 nickel silver contact tubes relative to the .030 kovar pins to which the bridge wire is attached could develop in storage. This condition was unsatisfactory because it resulted in open circuits or high resistances. In order to rectify this deficiency the Mk 57 Mod 1 Detonator was designed. It differs from the Detonator Mk 57 Mod 0 in that .040 pins are sealed into the glass-kovar plug and they serve as both the external contact pins (the nickel silver tubing is eliminated) and the internal contacts to which the bridge wire is soldered. Since the .040 pins of the Mk 57 Mod 1 Detonator are spaced on the same centers as the .030 pins used in the Mk 57 Mod 0 Detonator, the bridge length is reduced by .010.
2. Originally, the Mk 57 Mod 1 Detonator was intended for use in torpedo exploders. However, because it has a very long storage life due to its hermetic seal and stable explosives, it appears certain that it will, in time, find a much broader usage. The detonator is electrically initiated and contains an 800 micro-inch nichrome bridge wire soft soldered across two pins which are imbedded in a glass-kovar plug. The loaded plug and bridge wire assembly of the detonator is inserted into a tin plated gilding metal cup containing the base charge and is hermetically sealed with soft solder. Figure 1 shows the general arrangement of the detonator. A complete detailed description of the unit can be obtained from the drawings listed on Bureau of Ordnance LD 295534.
3. The data supplied in this report are intended as design information. They specify the amount of electrical energy and other parameters useful in determining the firing characteristics of Mk 57 Mod 1 Detonators under varying conditions.
4. Two series of tests were made. One series consisted of determining the percentage of detonators which fired from constant current pulses of various amplitudes. The other series consisted of determining the firing energy as a function of capacitor discharges through the resistance of the bridge wire.
5. A simplified schematic drawing of the constant current firing circuit is shown in Figure 2. Its operation is as follows: With the switch closed, the resistance  $R_y$  is varied until the desired current as shown by the ammeter is obtained. The switch

is then opened and the current allowed to flow through the detonator under test.  $R_v$  is a ballast resistor which is made large compared to the resistance of the detonator to assure, during the test, a constant current within the desired accuracy. The ballast resistor is necessary because the resistance of the detonator will change with time as a function of the amount of current passed. The switch is placed in parallel with the detonator in order to minimize undesirable transient currents. The test procedure consists of applying energy to twenty (20) detonators individually at a fixed current for approximately ten (10) seconds. All those which do not fire during the time period are called misfires. The misfires are not used again. This testing is repeated at different current levels until sufficient data are obtained for establishing the constant current - percent fire relationship. The data obtained from the series of tests are shown in Figure 4 and Table I.

6. The capacitor discharge circuit is shown as a simplified schematic drawing in Figure 3. Each test consisted of firing a group of approximately thirty (30) detonators using varying voltage and a fixed capacitor in a "Bruceton" type of staircase sensitivity test<sup>1</sup>. The results of these tests are shown in Figures 5, 6, 7, and Table II.

7. The constant current firing data show that the fire-no-fire band is very narrow.

8. The capacitor discharge data show that the voltage for firing is approaching a constant minimum value of approximately 3 volts.

<sup>1</sup> Statistical analysis for a new procedure in Sensitivity Experiments, AMP Report No. 101.1R, SRG-P No. 40.

Table I  
 CONSTANT CURRENT FIRING DATA

Constant Current (ma)	Trials	# Fired	% Fired
150	20	0	0
174	20	2	10
186	20	7	35
192	20	10	50
195	20	9	45
200	20	18	90
204	20	18	90
210	20	19	95
216	20	18	90
222	20	20	100

NAVORD Report 3899

Table II

CAPACITOR DISCHARGE DATA

<u>Capacity</u> <u>mfd</u> s	<u>Mean</u> <u>Potential</u> <u>Volts</u>	<u>Standard</u> <u>Deviation</u> <u>Log Volts</u>	<u>Average</u> <u>RC Time</u> <u>Sec.</u>	<u>50% Firing</u> <u>Energy</u> <u>ergs</u>
3.75	27.6	0.0326	22.5	14,242
5.0	24.0	0.0071	30.0	14,352
7.9	20.2	0.0130	47.4	16,149
24.3	12.6	0.0125	145.8	19,400
48.7	9.38	0.0170	292.2	21,400
99.8	7.38	0.0621	598.8	27,145
486.5	3.88	0.0258	2919	36,620
975.0	3.12	0.0301	5850	47,455
3411.0	3.30	0.0455	20466	185,730

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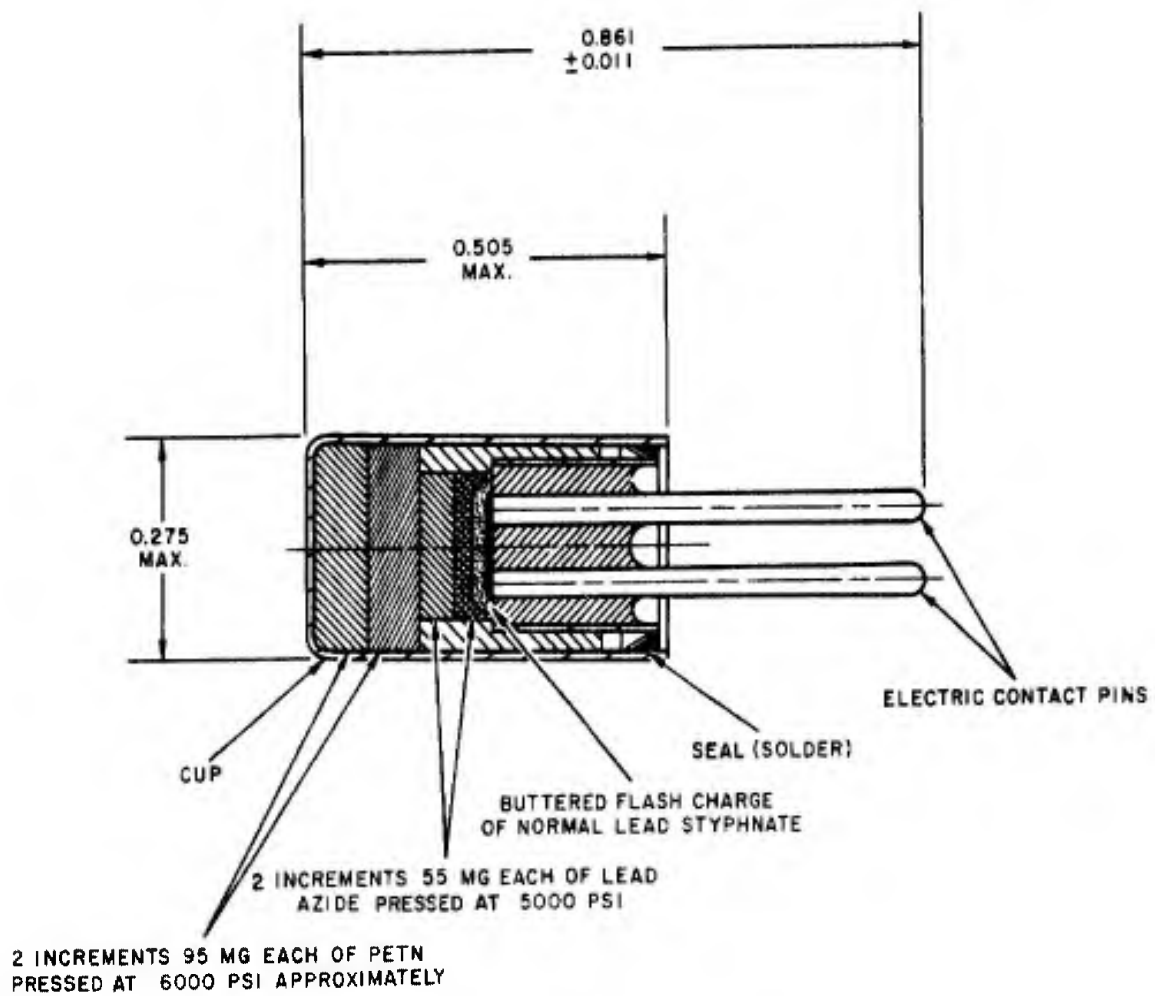


FIG. 1 GENERAL ARRANGEMENT OF MK 57 MOD 1 DETONATOR

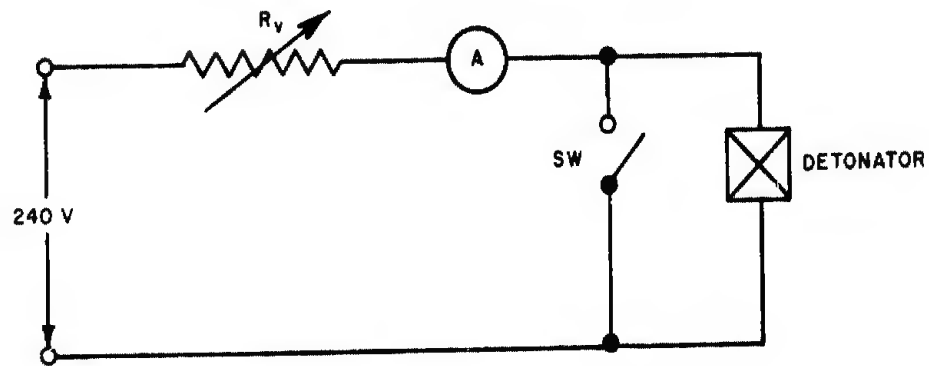


FIG. 2 SIMPLIFIED SCHEMATIC OF CONSTANT CURRENT FIRING CIRCUIT

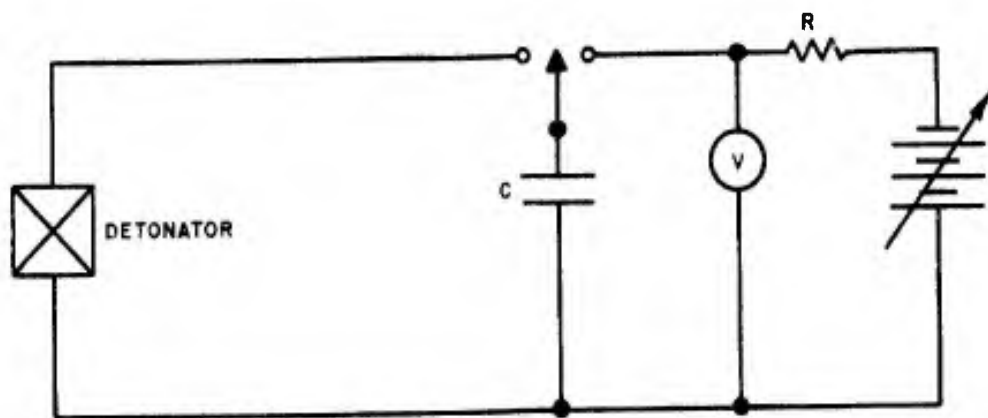


FIG. 3 SIMPLIFIED SCHEMATIC OF CAPACITOR DISCHARGE FIRING CIRCUIT

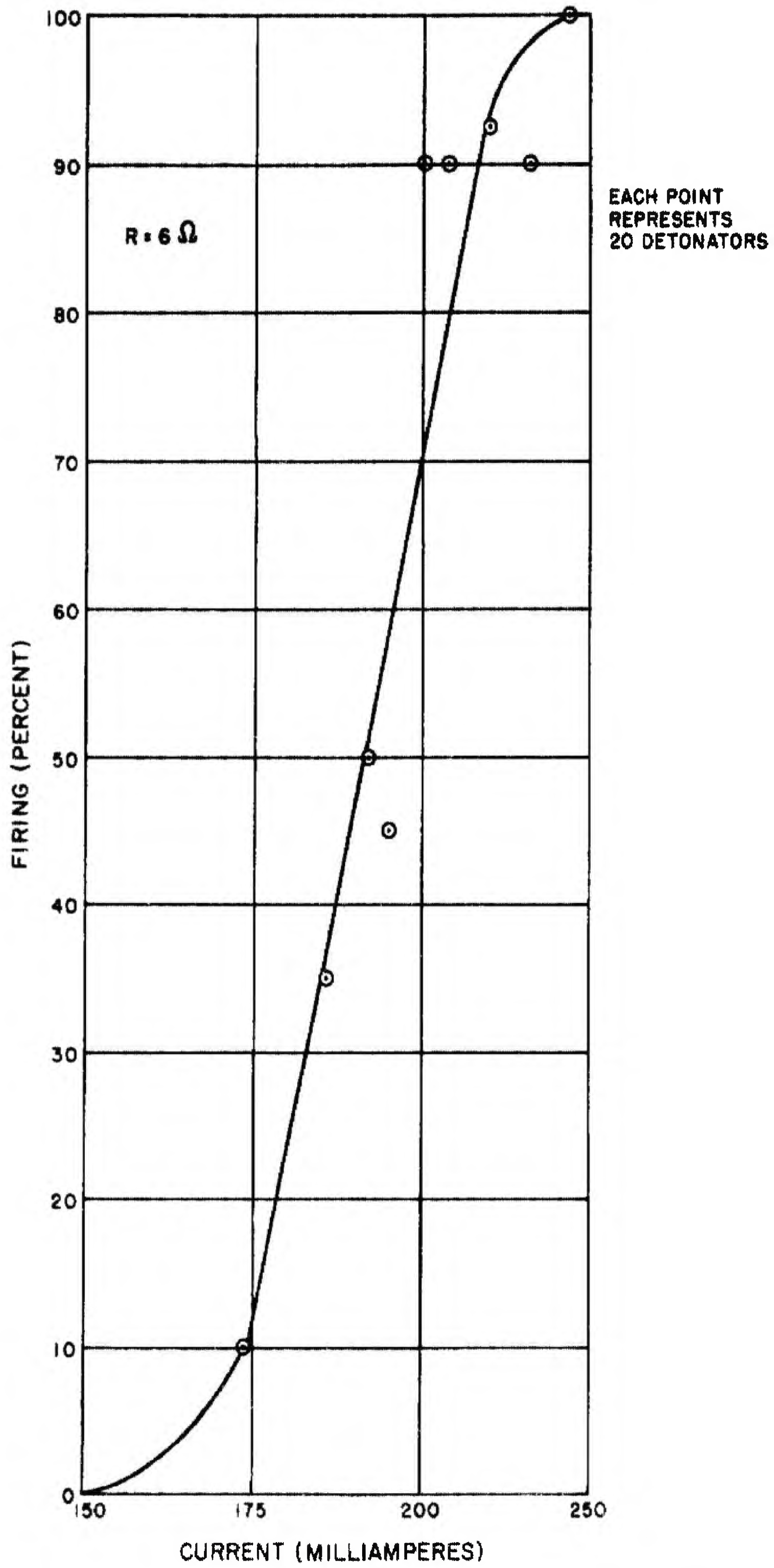


FIG. 4 PERCENT FIRING AS A FUNCTION OF CONSTANT CURRENT

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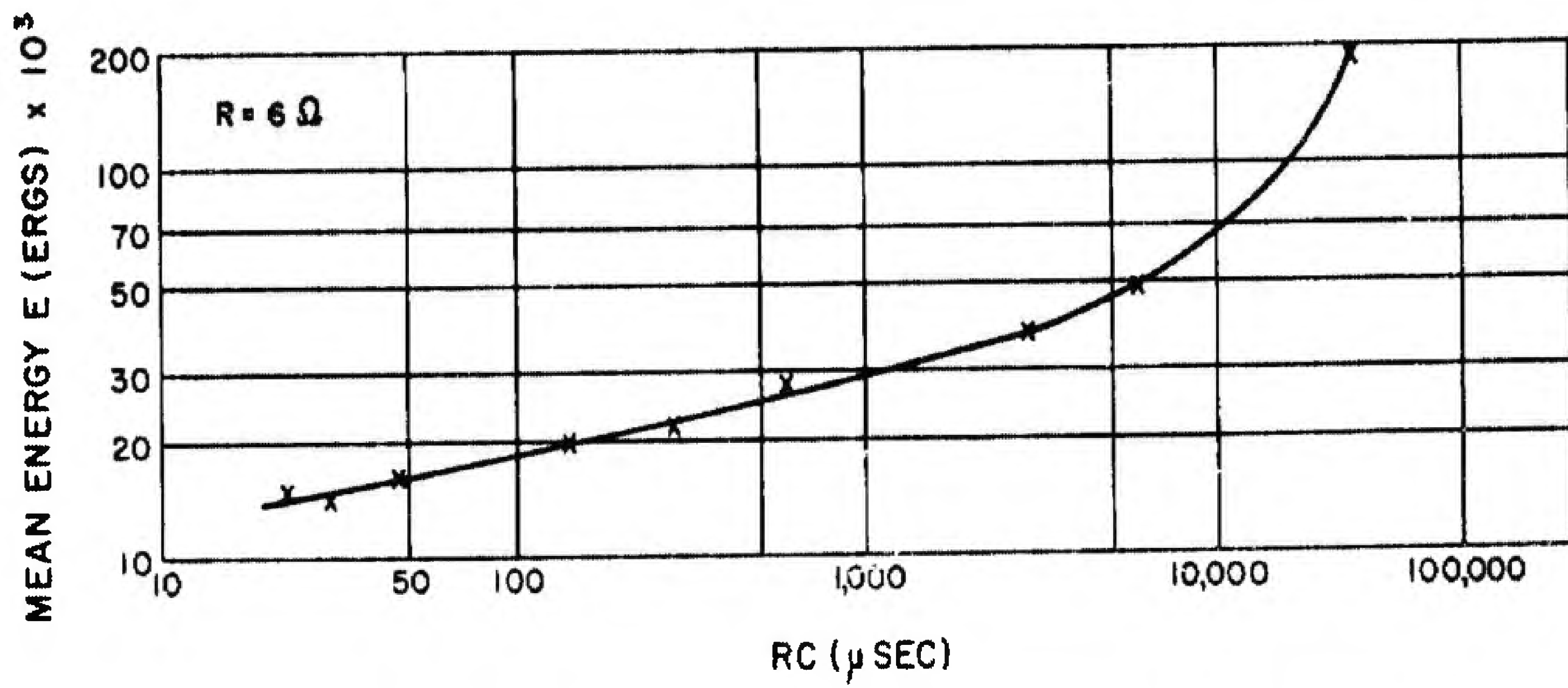


FIG. 5 EFFECT OF TIME OF ENERGY INPUT ON REQUIRED ENERGY FOR 50 PERCENT FIRING

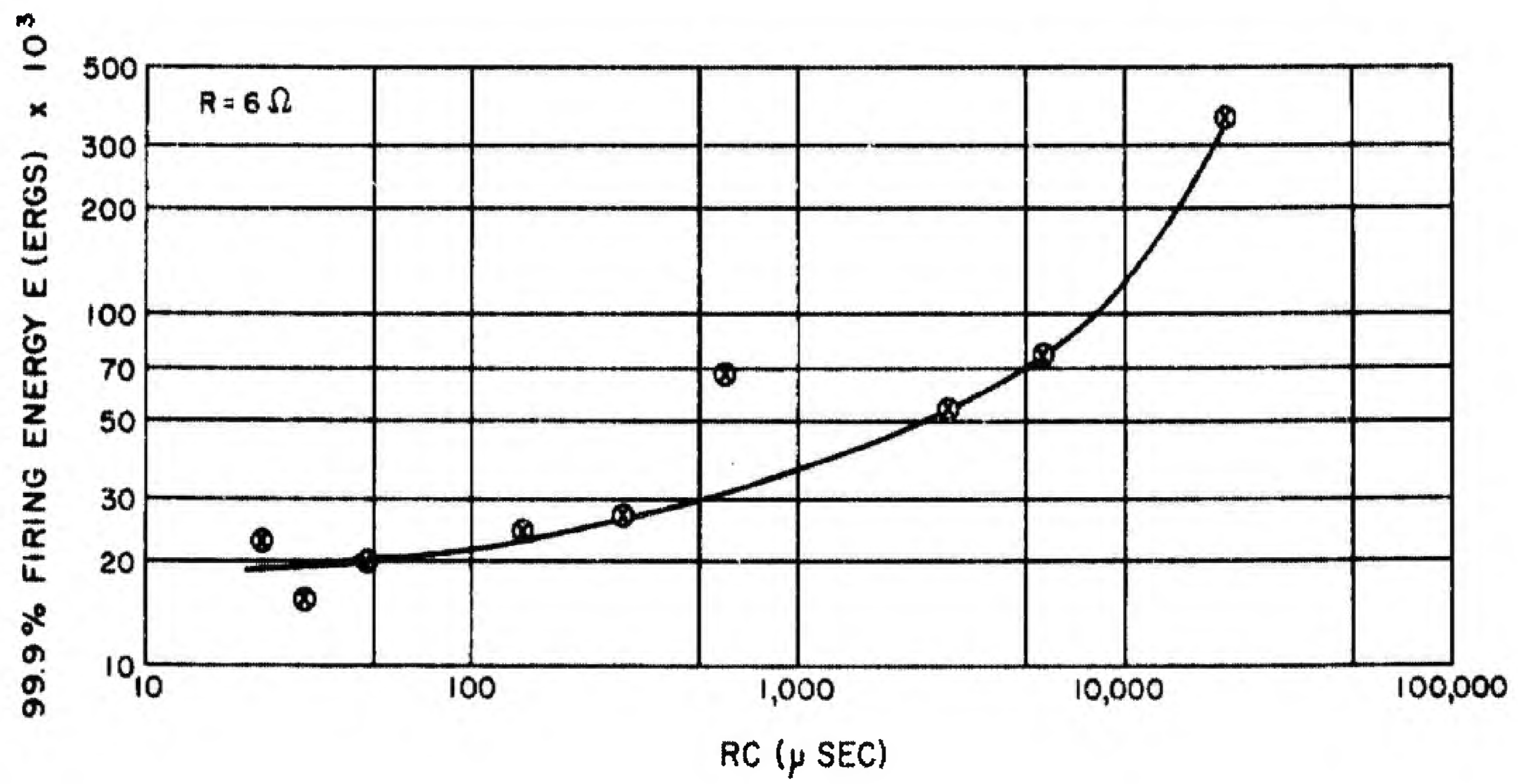


FIG. 6 EFFECT OF TIME OF ENERGY INPUT ON REQUIRED ENERGY FOR 99.9 PERCENT FIRING

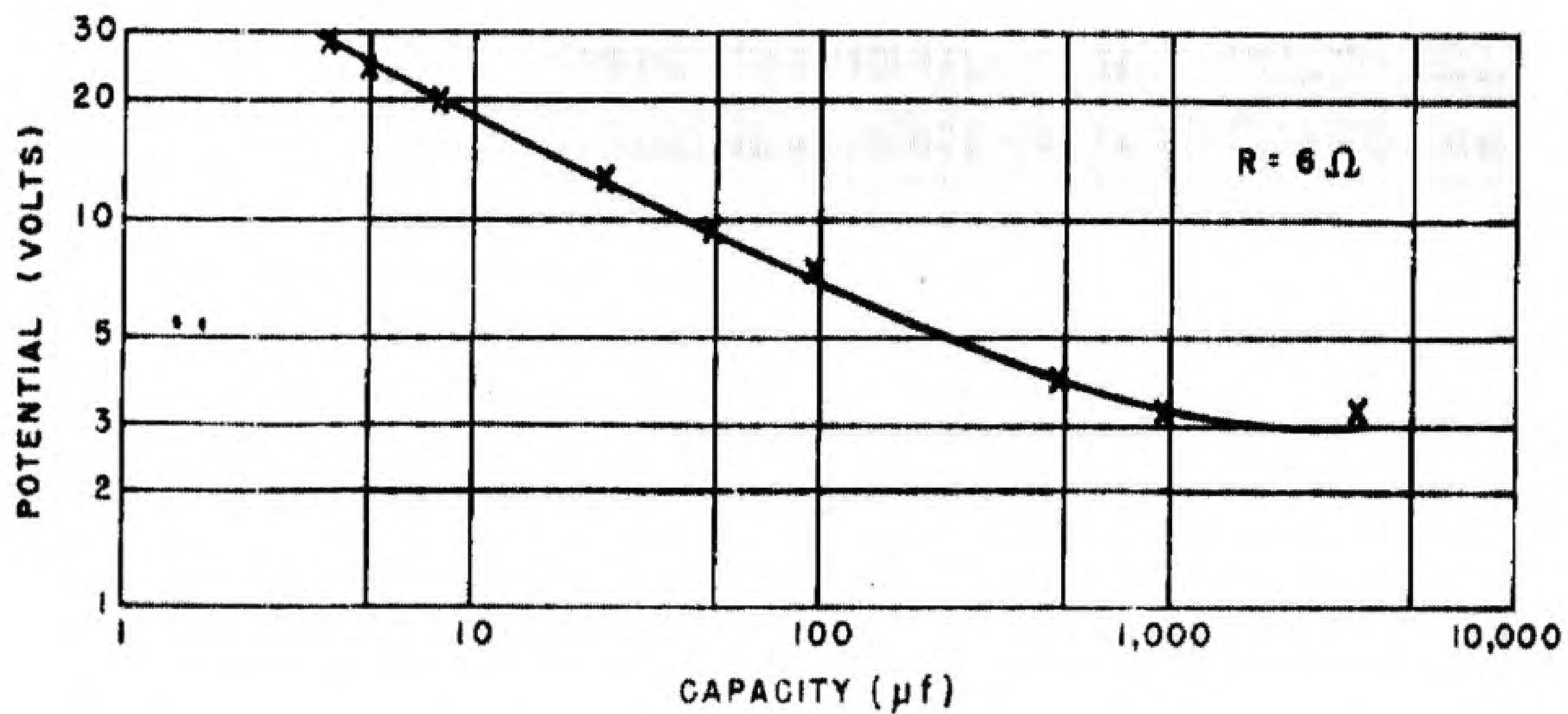


FIG. 7 EFFECT OF CAPACITANCE ON POTENTIAL  
REQUIRED FOR 50 PERCENT FIRING

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