HAROLD E. EDGERTON

PAPERS

MC 25

Series III

Laboratory Notebooks

Number —

Dated Dec 8, 1948 to Apr. 18, 1951

Book No.
December 8, 1948
April 8, 1951

COMPUTATION BOOK

EG&G 9

NAME	NUMBER
HAROLD E. EDGERTON	

M.I.T. CAMBRIDGE, MASS
~~MASS. AVE.~~ 160 BROOKLINE AVE
BOSTON MASS

Course .....

Used from DEC. 8, 1948, to April 8 1951.

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SPRING 1948 U.S.S. ALBEMARLE ENIWETOK.

~~CONFIDENTIAL~~

Harold E. Edgerton

Dec, 8, 1948.

M.I.T. Cambridge, Mass.

~~CONFIDENTIAL~~

112892

SPRING 1948 U.S.S. ALBEMARLE ENIWETOK.

Harold E. Edgerton

Dec, 8, 1948.

M.I.T. Cambridge, Mass.

Notebook # Dec 8, 1948 - April 8, 1951

Filming and Separation Record

____ unmounted photograph(s)

____ negative strip(s)

7 unmounted page(s)
(notes, drawings, letters, etc.)

was/were filmed where originally located between page ____ and ____.
inside front cover

Item(s) now housed in accompanying folder.

R E S T R I C T E D

HEADQUARTERS
TASK GROUP 3.1
JOINT TASK FORCE THREE
Los Alamos, New Mexico

AG 300.4

15 February 1951

SUBJECT: Temporary Duty Orders OS-233 - Shipment TG 3.1

TO: See Distribution

1. The Commander, Joint Task Force THREE, invites the following named non-government employees, Edgerton, Germeshausen & Grier, Inc., Boston, Mass., grade indicated, to proceed from proper duty station to Honolulu, Oahu, T.H., at such time that will enable them to arrive at Holmes & Narver, Honolulu, Oahu, T.H., between 8:00 A.M. and 9:00 A.M. on 2 March 1951, for processing and water shipment through the Commandant, Fourteenth Naval District, to Eniwetok Atoll, Marshall Islands on Temporary Duty for an indefinite period in connection with activities of Task Group 3.1, Joint Task Force THREE. Upon completion of this Temporary Duty the persons will return to Edgerton, Germeshausen & Grier, Inc., Boston, Mass.

NAME, GRADE, PROJECT & EQUIVALENT RANK	QUEEN CLEARANCE NUMBER	DUTY STATION	EMERGENCY ADDRESSEE
BRETTLER, Benjamin Jay Civilian Project: 1.6 Company Grade	97077NY(SF) dtd 5-26-50 (Rein)	Edgerton, Germeshausen & Grier, Inc., Boston, Mass.	Mrs. Rose Brettler, 71 Beacon Street, Boston, Mass. (Mother)
CARR, Lee Derrickson Civilian Project: 1.6 Field Grade	20709 NY dtd 7-20-49	Edgerton, Germeshausen, & Grier, Inc., Boston, Mass.	Mrs. V. R. Carr, 60 Dwight Street, Brookline 46, Mass. (Wife)
DAVIS, Robert Nelson Civilian Project: 1.6 Field Grade	75589JT Rein 1-4-49	Edgerton, Germeshausen & Grier, Inc., Boston, Mass.	Mrs. Oma L. Davis, 76 Spy Pond Parkway, Arlington, Mass. (Wife)
DRAKE, Arthur Klaven Civilian Project: 1.6 Company Grade	AEC 16199NY dtd 4-13-48	Edgerton, Germeshausen & Grier, Inc., Boston, Mass.	Miss Virginia A. Drake (Daughter), c/o Mrs. William Chatfield, Sr., 699 Washington St., Dorchester, Mass.
EASTMAN, Irving Floyd Civilian Project: 1.6 Company Grade	NY 2789 dtd 9-2-48	Edgerton, Germeshausen & Grier, Inc., Boston, Mass.	Mrs. Minnie Eastman, R. R. #1, Winthrop, New York (Mother)

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R E S T R I C T E D

Hq TG 3.1 TDY Orders OS-233 - Shipment TG 3.1 - dtd 15 Feb 51 (Cont'd)

NAME, GRADE, PROJECT & EQUIVALENT RANK	QUEEN CLEARANCE NUMBER	DUTY STATION	EMERGENCY ADDRESSEE
EDGERTON, Harold Eugene Civilian Project: 1.6 Field Grade	52178 NY dtd 5-6-47	Edgerton, Germeshausen & Grier, Inc., Boston, Mass.	Mrs. Esther M. Edgerton, 205 School St., Belmont, Mass. (Wife)
FUSSELL, Lewis Civilian Project: 1.6 Field Grade	8573 NY dtd 5-23-47	Edgerton, Germeshausen & Grier, Inc., Boston, Mass.	Mrs. Elizabeth W. Fussell, 35 Elm St., Concord, Mass. (Wife)
GRIER, Herbert Earl Civilian Project: 1.6 Field Grade	8576 NY dtd 5-20-47	Edgerton, Germeshausen & Grier, Inc., Boston, Mass.	Mrs. Winnifred D. Grier, 163 Country Club Road, Newton Centre, Mass. (Wife)
HARTLEY, Thomas Francis Civilian Project: 1.6 Company Grade	NY 9630 dtd 11-11-49	Edgerton, Germeshausen & Grier, Inc., Boston, Mass.	Mr. Stamford Hartley, Harvard, Mass. (Cousin)
MULLEN, Thomas Mathew Civilian Project: 1.6 Troop Class	NY 11287 dtd 6-5-50	Edgerton, Germeshausen & Grier, Inc., Boston, Mass.	Mrs. Della E. Mullen, 437 Washington St., Brighton 35, Mass. (Mother)
SMITH, Harry Lane Civilian Project: 1.6 Company Grade	8587 NY dtd 5-26-47	Edgerton, Germeshausen & Grier, Inc., Boston, Mass.	Mrs. M. Janette Smith, 34 Park St., Newton 58, Mass. (Wife)
STRABALA, Francis Irving Civilian Project: 1.6 Field Grade	NY 4659 dtd 10-25-48	Edgerton, Germeshausen & Grier, Inc., Boston, Mass.	Mrs. Francis I. Strabala, 391 Winter St., Norwood, Mass. (Wife)
WYCKOFF, Charles Wales Civilian Project: 1.6 Field Grade	46964 NY dtd 10-27-47	Edgerton, Germeshausen & Grier, Inc., Boston, Mass.	Mrs. Helen R. Wyckoff 69 Valley Road, Needham, Mass. (Wife)

2. a. Travel by military or commercial aircraft, commercial rail, commercial bus, military and/or naval vessel is authorized. No expenses (other than transportation in kind) incident to this travel will be chargeable to Joint Task Force THREE funds. All expenses incident to this travel will be borne by the agency by which the employee is employed.

Hq TG 3.1 TDY Orders OS-233 - Shipment TG 3.1 - dtd 15 Feb 51 (Cont'd)

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Hq TG 3.1 TDY Orders OS-233 - Shipment TG 3.1 - dtd 15 Feb 51 (Cont'd)

b. In accordance with CPR T3.5 USA, T11.9, AFM 40-1 USAF, NCPI 2408 USN, it has been determined that quarters and/or subsistence will be furnished at a nominal cost and will be utilized by the employee. Therefore, no deduction from the per diem rate should be made for the occupancy of Government quarters.

3. Travel directed herein is necessary in the military service and in accomplishment of the mission assigned Joint Task Force THREE.

4. Each individual is authorized three hundred and fity pounds (350) of Hold Baggage for travel via government vessel. Baggage in excess of this limitation may not be taken aboard ship unless specifically authorized in writing by these orders or modifications thereto.

5. A duly authorized Military Identification Card, properly prepared and countersigned, will be in each individual's possession prior to departure for the Forward Area.

6. The persons listed above are required to possess an Immunization Record indicating the following immunizations prior to departure from the United States: Typhoid and Smallpox within the last twelve (12) months; Tetanus - Initial immunization, a stimulating dose within one (1) year after initial series and a stimulating dose every four (4) years following the last stimulating dose.

7. Explosives, inflammable or combustible materials, personally owned firearms or signal devices and drugs may not accompany individuals. Personally owned cameras and photographic equipment may not be carried to Eniwetok Atoll.

8. Upon arrival at Honolulu International Airport, Oahu, T.H., you will proceed to Holmes and Narver, 1109 Bethel Street, Honolulu, Oahu, T.H. for the purpose of booking on military and/or naval vessel and obtaining clearance for entry into the Eniwetok Area.

9. Personal hand baggage will be stencilled or tagged with appropriate durable shipping tags giving full name and address as follows:

Mr. John J. Jones (Your own name)
c/o Commander, TG 3.1
APO 187 (HOW), c/o Postmaster
San Francisco, California

10. Unaccompanied hold baggage, as defined in POM, this Headquarters, shipped to the Port of Embarkation for further movement overseas by water shipment, independent of the individual, will be stencilled or tagged with appropriate durable shipping tags as follows:

TO: Naval Supply Center
Freight Trans-Shipment Building 222
Oakland, California
ATTN: Captain O'Donnell

Hq TG 3.1 TDY Orders OS-233 - Shipment TG 3.1 - dtd 15 Feb 51 (Cont'd)

FOR SHIPMENT TO: Mr. John J. Jones (Your own name)
WREN - TU 3.1.1 - TG 3.1 (To be followed by a painted GREEN "X" six (6) inches high)

11. The overseas mailing address will be as follows:

For Eniwetok Atoll including Parry Island:

Name
c/o Commander, Task Group 3.1
APO 187 (HOW), c/o Postmaster
San Francisco, California

For Kwajalein:

Name
Task Group 3.1
Navy Number 824
c/o Fleet Post Office
San Francisco, California

12. The provisions of POR with the exception of immunization requirements are waived in connection with this travel.

13. The provisions of CinCPac Letter Serial 0116 of 25 Oct 50 have been complied with. It is the estimate of the Commander, Task Group 3.1, Joint Task Force THREE, that the above named individuals are good security risks.

14. Dependents, relatives, friends, pets and privately owned conveyances will not accompany personnel to the Port of Embarkation.

15. Immediately upon arrival at Eniwetok Atoll, Marshall Islands, each individual will report in person to the Adjutant General, Task Group 3.1, for the purpose of receiving quarters assignment and further instructions as may be issued by the Commander, Task Group 3.1, Joint Task Force THREE.

16. AUTHORITY: Ltr, Hq Joint Task Force THREE, dtd 1 Nov 50, Subj: "Delegation of Authority" to Commander, Task Group 3.1, Joint Task Force THREE.

BY ORDER OF THE COMMANDER:

ARTHUR W FOUGHTY
Captain USAF
Adjutant General

DISTRIBUTION:
30 cys each individual
2 cys AG, JTF-3, Washington 25, D. C.
2 cys Holmes & Narver, 1109 Bethel Street, Honolulu, Oahu, T.H.
2 cys Capt O'Donnell, NSC, Oakland, California
2 cys CO, Troop Movement Sec., Bldg 209, Ft Mason, Calif.
1 cy Comptroller, JTF-3, Washington 25, D. C.
2 cys LCdr Dobie, JTF-3 Liaison Officer, CinCPac
2 cys Commandant, Fourteenth Naval District, Pearl Harbor, Oahu, T.H.

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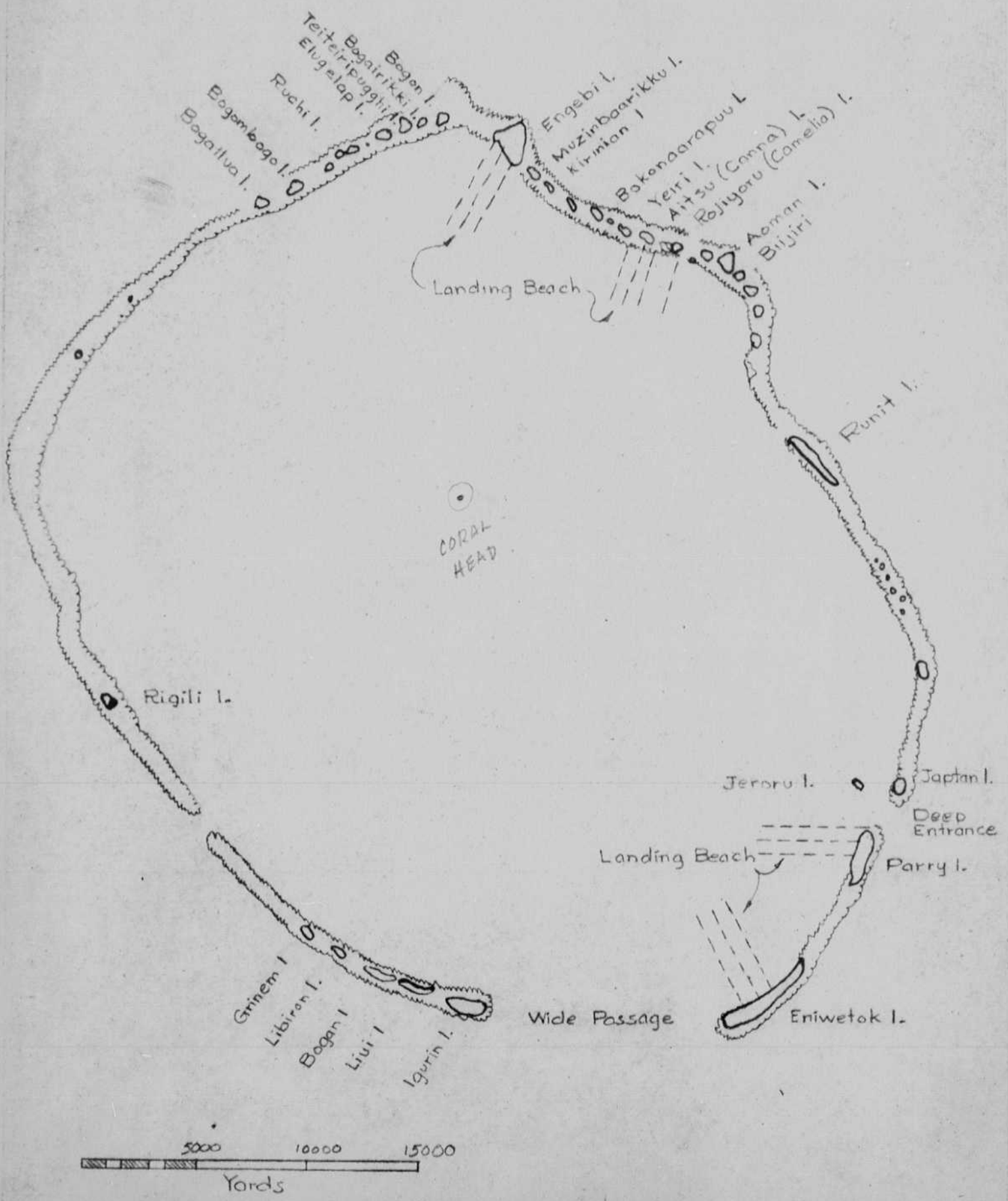
2 cys Commandant, Fourteenth Naval District, Pearl Harbor, Oahu, T.H.

ENIWETOK ATOLL



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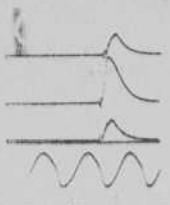
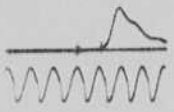


AIR GAP
LOW IND.

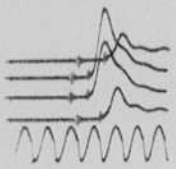
.08 x 10⁶ h.c.
.03

1 MC

0.38



GAP
ABERDEEN
1MC

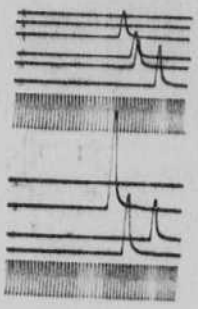


ABERDEEN
1MC.

JULY 20 1950
P45 H.E.E.

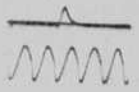
5000
384

390 x10⁶
90 x10⁶
BEAM C

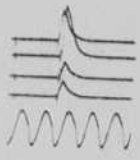


GR MICRO FLASH
1MC

GR MICRO FLASH
1MC



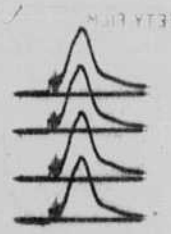
SPARK GAP
LOW IND.
1MC



DITTO
1MC

JULY 20 1950
P43 H.E.E

5000
383

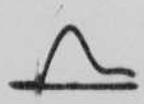


G.R.
MICROFLASH
NEW CIRCUIT

50 x10⁶ b.c.p.
BEAM C

FT 130
2MF 2000 V

235. x10⁶
BEAM C



FT-130
2MF 2000

FT-130 2MF
2200 V.
2000
1500
1000
1MC
JULY 20 1950
P41 H.E.E

5000

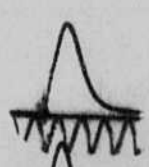
38 x10⁶
BEAM c.p

FT-125
1MC

0.655

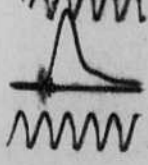
FT-230
1MC

5.6



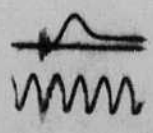
EGG MOVIE
1MC

5.0



GR MICRO FLASH
NEW CIR.

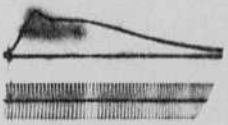
2.0



FT-126.
1MC

JULY 19 1950
P39 HEE

12×10^6
b.c.p.



1 MC

4 FT TO STROBOLUME
935 INTO 1000Ω 2000V.

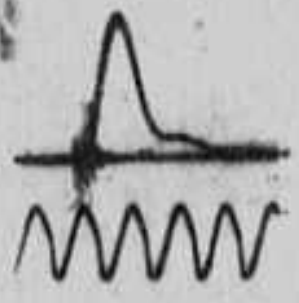
12×10^6 B.C.P.
PEAK

JULY 18 1950
P33 H.E.E.

3 0 1

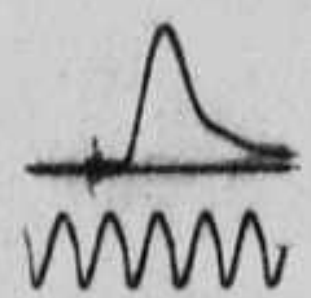
ARGON GAP

0.78 x 10^{6}



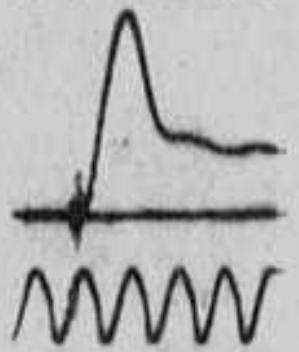
MICROFLASH
NEW CIR

0.31



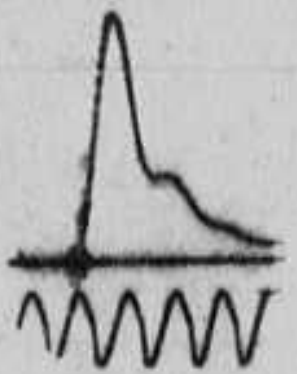
FT-110

0.545



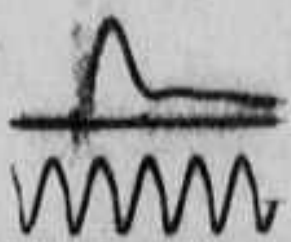
FT-130
NEW CIR.

100.
BEAM



AIR GAP.

0.56



JULY 19 1950
P37 HEE

5000

38 X10"
BEAM C.P

FT-125

IMC

0.655

FT-230

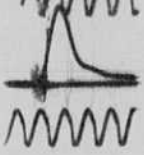
IMC

5.6

EGG MOVIE

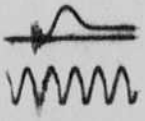
IMC

5.0



GR MICRO
FLASH
NEW CIR.

2.0



FT-126.

IMC

JULY 19 1950
P39 HEE

Dec. 8, 1948.

Harold Edgerton 155 massachusetts

Conf with Bruce Billings yesterday

Conf. with Dr Brian O'Brain on cameras for next tests.

Dec 31 1948 meeting with Grier, Wychoff, Davis, O'Keefe Morris on photography.

Jan 5 1949. Conf with Grier and O'Keefe ~~conf~~ on Teller mcas.

Work on spark source will start & when move to new quarters at Brookline one. is made.

Dec. 8, 1948.

Harold Edgerton 155 massons

Conf with Bruce Billings yesterday

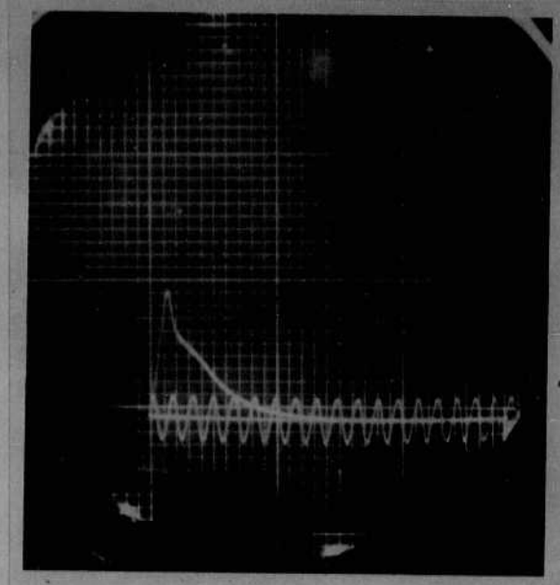
Conf. with Dr Brian O'Brian on cameras for next tests.

Dec 31 1948 meeting with Grier, Wychoff, Davis, O'Keefe Morris on photography.

Jan 5 1949. Conf with Grier and O'Keefe ~~only~~ on Teller mcas.

Work on spark source will start when move to new quarters at 7 x Brookline ave. is made.

EDRL 320
26 nov Date
Put in Jan 5 1949.
H.E. Edg.

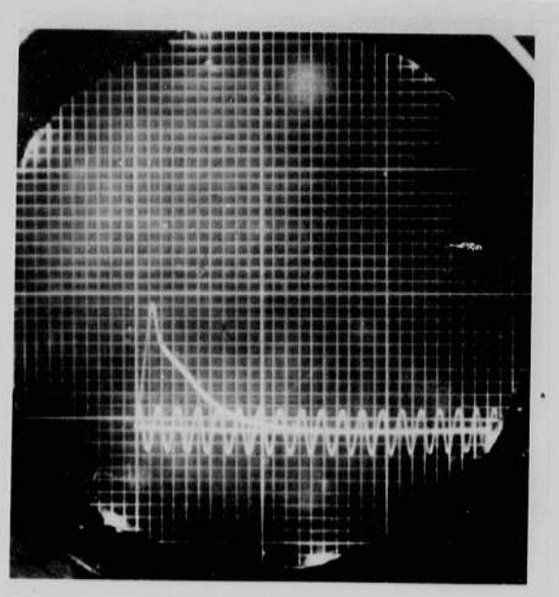


SYNCHRONIZER UNIT SERIAL NO. 104 WITH PT 20D PLANETRON

Input voltage - 105 V A-C
Capacity in unit - 4.4 microfarads
D-C voltage on capacitor - 2500 D-C
Flashtube distance from photocell - 40 inches
Flash light - 12 x 10^6 beam candle power
Timing oscillator - 100 KC or 10 microseconds
Sine time - 6 microseconds
Duration 1/3 of maximum value - 12 microseconds

30

SBRL 370
26 nov date
Put in Jan 5 1949.
HE.Egg.

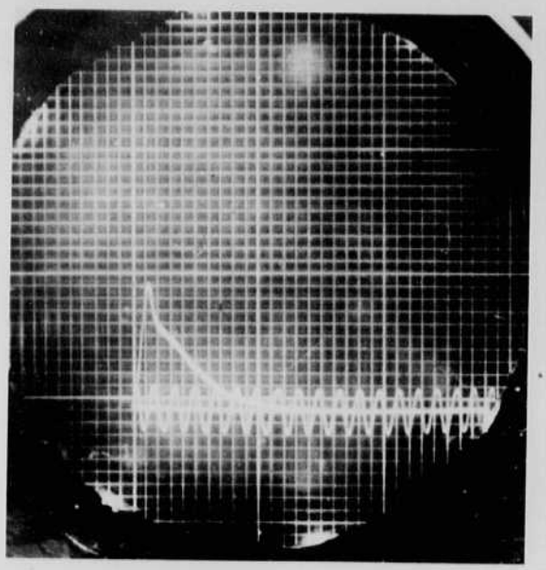


STROBOLUME UNIT SERIAL NO. 104 WITH FT 220 FLASHTUBE

Input voltage = 118 V A-C
Capacity in unit = 4.0 microfarads
D-C voltage on capacitor = 2500 D-C
Flashtube distance from photocell = 40 inches
Peak Light = 12 x 10^6 beam candle power
Timing oscillator = 100 Kc or 10 microseconds
Rise Time = 6 microseconds
Duration 1/3 of maximum value = 12 microseconds

370

SBRI 370
26 nov 48
to 31 Jan to 1949.



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Input voltage = 118 V A-C
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Flashtube distance from photocell = 40 inches
Peak Light = 12 x 10^6 beam candle power
Timing oscillator = 100 Kc or 10 microseconds
Rise Time = 6 microseconds
Duration 1/3 of maximum value = 12 microseconds

30

Hawk Eyeter. 155 mass eve.

Correspondence with C D Miller Battelle Inst Columbus Ohio indicates that the miller camera (40,000 to 100,000 frames per sec) might be useful for the bomb project. Wyckoff has letter with data on resolution. at 500 ft diameter, 3 ft can be resolved.

O'Brien phoned on last Friday about a spectrogram on the type I camera. Resolution was 10^{-8} seconds. Subject a spark gap. (or 10^{-7})

O'Brien states, the type II should give 2½ types resolution of spectra.

He has a scheme that should give micro second exposures at several thousand frames per second on the 35 mm. B.K. cameras. More to come on this, later. the mirror will be either free running or gear driven.

Third item for discussion - Improved type II camera with image dissector should work ok at 1,000,000 f.p.s. O'Brien suggests this for the bomb job and will see Eastman about production of cameras.

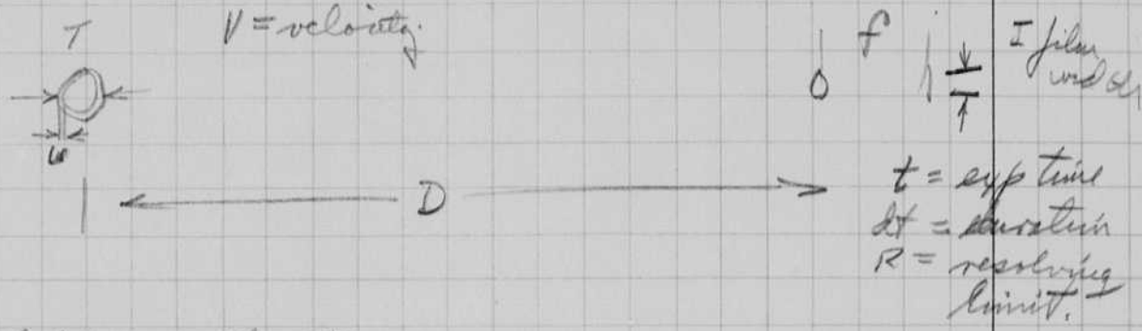
CONFIDENTIAL

July, 14, 1949. H E Edgerton

Conf with Brier, Wyckoff, Davis regarding camera limitations and our measurements. A report is being written which will go to Los Alamos with Brier etc this weekend.

Sept 5 1949. H E Edgerton

Photographic Report. Part I, #1031 14 July 1949 Bikini. Davis.



V_s static uncertainty.

$V_s = \frac{D}{f} \times \frac{1}{2R}$

V_d dynamic uncertainty $= V\,\Delta t$

Discussion of available cameras follow in report. One and 10 microsecond exposures are important for the initial phases of the event.

Trip Report E H E & G out #476. 8 aug 1949
July 25-30 trip.

Radar - out except for military experiments

Spectroscopy - now to be done at N.R.L. with cooperation.

Shock wave photos - great accuracy required.
We are not to undertake aerial photos of shock.

Discussed magneto optic shutter with Herb & Ken.

CONFIDENTIAL

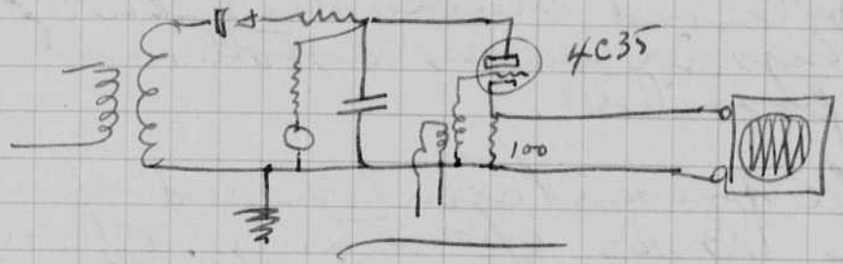
Harold E. Edgerton.

Considerable effort has been put into a rapid capping shutter of the following type.

Fuse wire vaporization into a glass lined volume. The lead vapor deposits on the walls and stops the light.

The operating time is about 50 μs.

Present circuit .5 mf 3000 volts ~~4~~ 45 thyratron for energy.



fuse shutter

The rapatronic shutter with a single glass slug is being tested now. this has a ~~5~~ 5 ms. duration with 1/5000 off to on ratio.

A double glass slug is being made by Polaroid with an ~~op~~ operation of 1/10⁶ or 1/10⁷. Found as much energy is required to fire this. Photographs of stationary objects have been taken with both the single and the double slug.

Harry Smith & Bill Woodward are working on the Rapatronic shutters.

Capt Hale Mason and Frank Stroebel worked on the fuse shutter.

Dr. Brian O'Brian from Rochester was here on Sat March 18 for a conference.

CONFIDENTIAL

E Edgerton
July 10 1950
Monday.

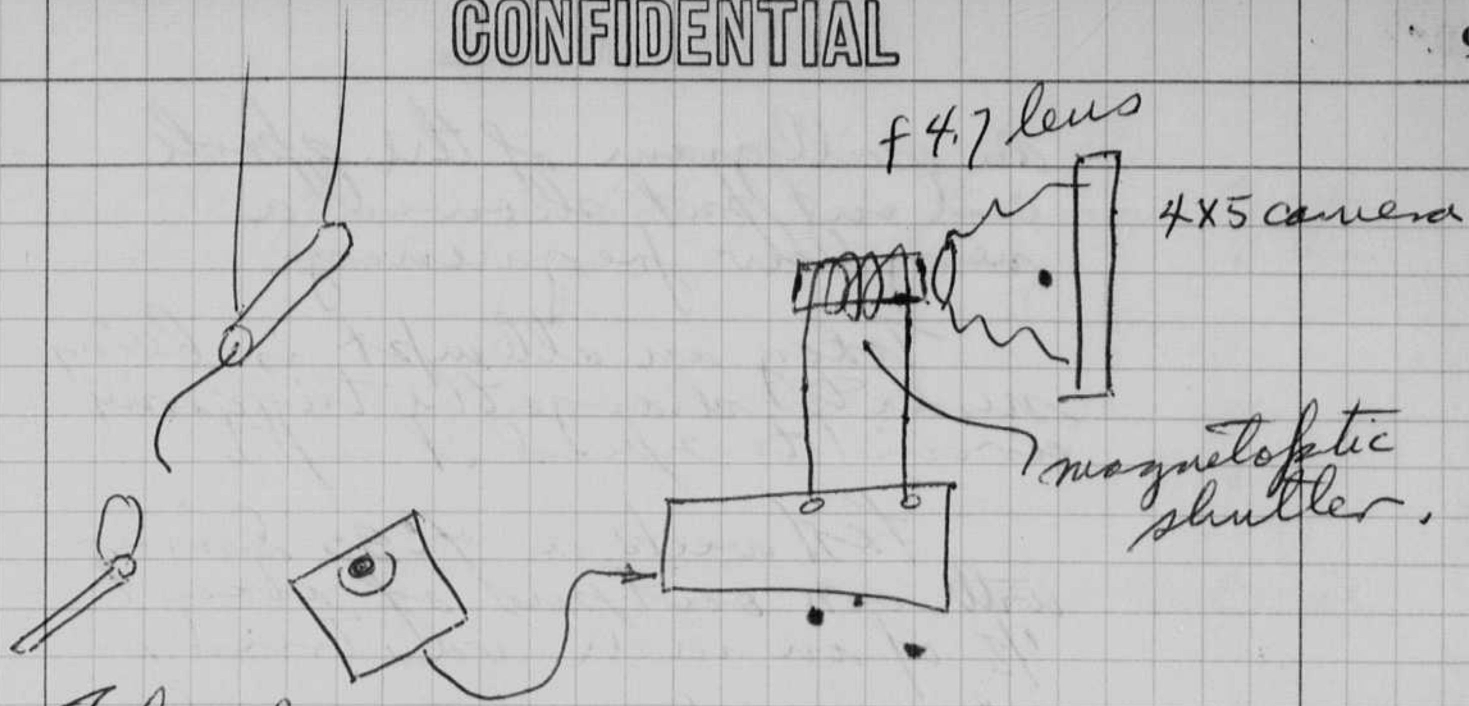
Tests have been made with the Rapatronic camera during the last few weeks by Ward Wyckoff, and the of various subjects such as fine cracks.

The "Rapatronic" camera (a new word) is a magneto optic shutter device with a 7 mf 8000 volt capacitor which discharges through a coil around a glass slug. The discharge effect rotation then causes the light to go through the shutter. By using three polaroid sheets and two heavy glass slugs in series an attenuation of 10^4 is possible.

The present camera and shutter has a 1/3 ms open time. Other coils can be used to change the time to other values. Ward has made a study of this shutter and all information is available. Wyckoff, Smith, and others assisted with the development. Polaroid makes the slugs by annealing the polaroid sheet to the glass slugs as obtained from Bausch & Lomb. One cover glass is an infra red absorbing filter. This is necessary to absorb the infra red since it is not effected by the polaroid. The other cover glass is a filter that lights the light & the green portion of the spectrum.

A series of photos were taken on fine cracks. A diagram of the set up is shown on the next page

CONFIDENTIAL



Fiducial marker as designed by Strobala

1. the firecracker integrated light output gives no exposure through the shutter.

2. a 13 us exposure at an early stage gives a faint image with considerable motion due to high velocity of the incandescent gases from the explosion.

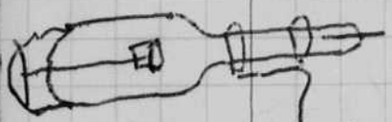
3. a strob-light was used for supplementary lighting. OK but still showed blur. this light was an FT-214 operated from a 3000 + supply and a 30 mf condenser. the rapatronic shutter accepted 13 us of the light. the supplementary light illuminated the gases from the explosion.

4. an attempt was made to use a microflash (G.R.Co.) as supplementary illumination. trouble was experienced with jitter. a test of showed that the jitter was from 15 & 30 us.

an oscillogram of the spark coil output showed a very low frequency.

Today an attempt is being made to charge the triggering circuit to speed it up.

Last week a 1C35 driver with an output of about 1/8 of an inch was tried. This would not trigger the tube with a single turn on the lamp. When a loop at each end was used as shown, the operation was fast but erratic. If the tube operated, it started within a portion of a microsecond.



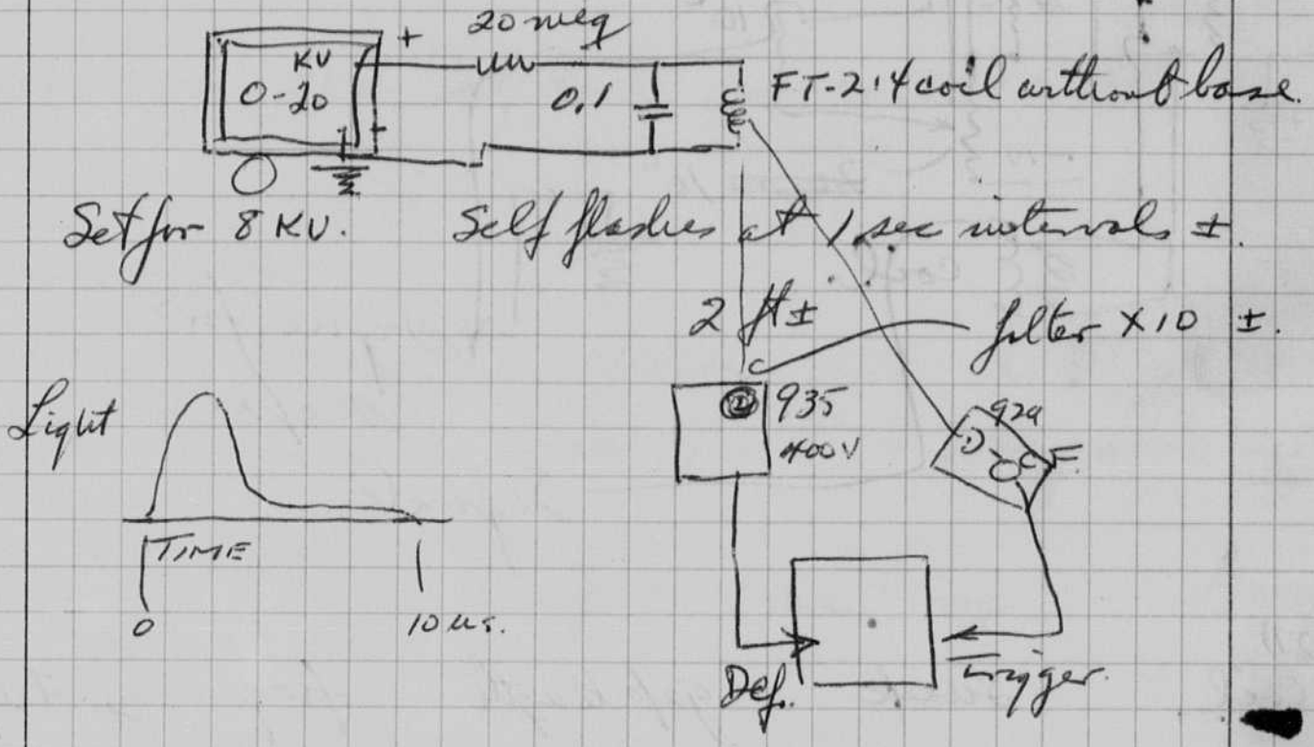
~~Now~~ Gavriel is now using up a driver with a 2D21 tube which I hope will give enough output to ignite the lamp.

I also have a collection of flash tubes of all sorts that I plan to study for output.

Long ago Gemeliannen suggested a series gap as a load of device for operating a flash tube from a high voltage. I plan to get an inverter

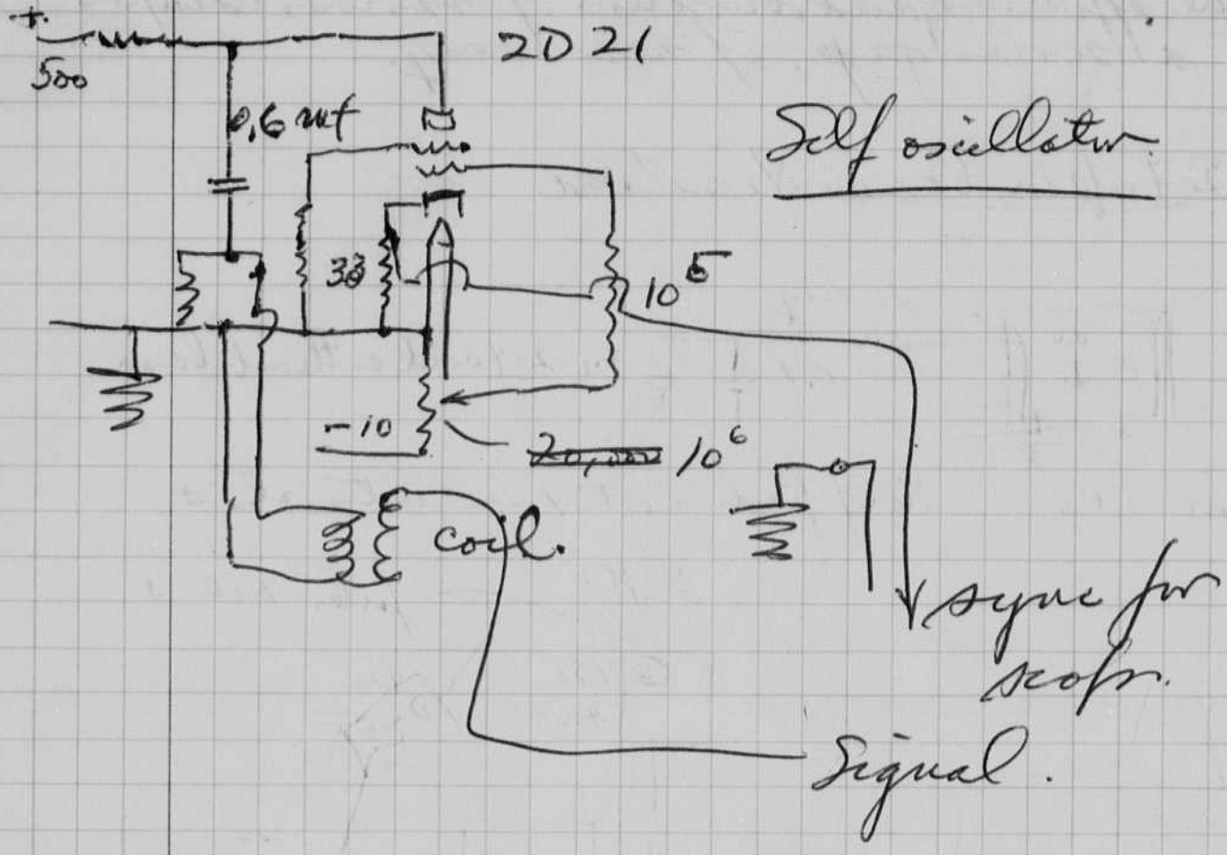
on the efficiency and duration of various lamps with a series gap, if necessary.

Set up in basement east end.



CONFIDENTIAL

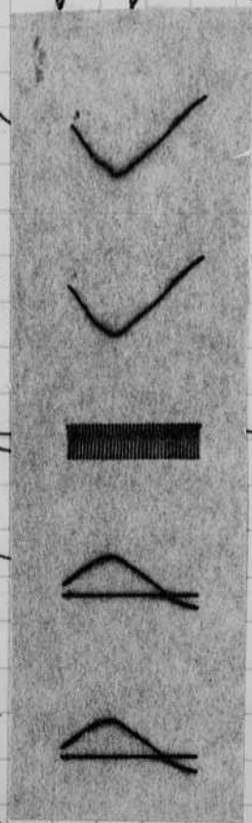
Coil test



Film pk no 27)

	Coil	Sweep	gap length.	frequency.
1	Thordarson	8	1/4 ±	
2	"	8	1/4 ±	
3	1 mc timing wave.			
4)	Model Elect	8	3/16 ±	
5	" "	8	3/16 ±	

Film No. 5353



Thordarson coil tends to arc over.

CONFIDENTIAL

P.C. pickup

Tube. V. Light

filter.

Dist 5354.

1. FT-214 0.1 8KV. Self flash 400V. X2 3/4
and zero. Sweep 7.

2. 1 mc timing wave.

3. FT-214 0.1 8KV Self flash. 400V C.F. X1 3/4.

4 Gap 20 meg. 20m 0.1 7KV ± Self flash X1 7"
Sweep 7. Delaycable 20' X.04 .8 us

5. Sweep 7 1 mc timing.

1. N6Y FT-220 Strobotron 4" away from P.C.
PC had a Density 1 filte

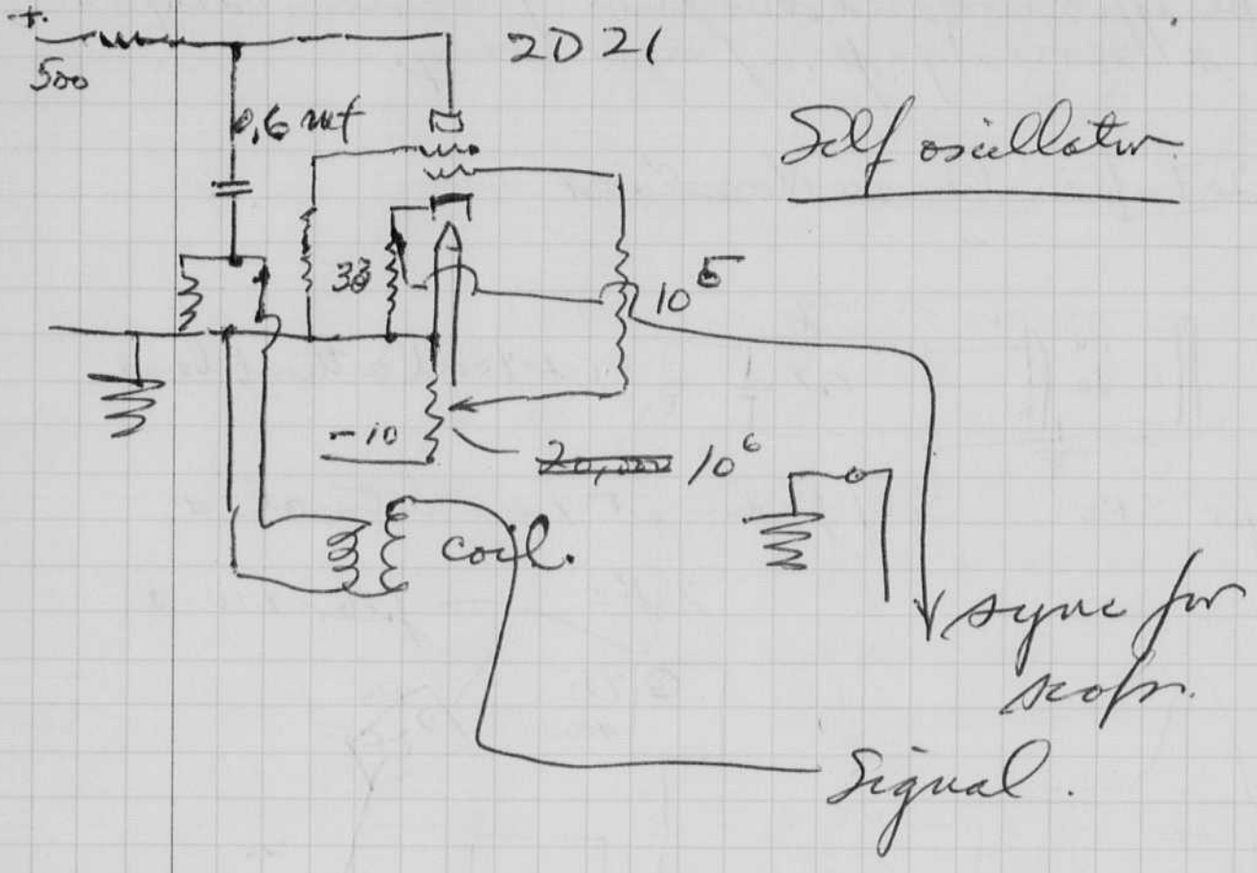
2. 0.5 mf condenser Aberdeen with al gap wi
trigger or terminals.
air gap. 6000 KV X2 36" air ga

3. Timing 1 m.c.

4) Air Gap no filter Cont same as above #4

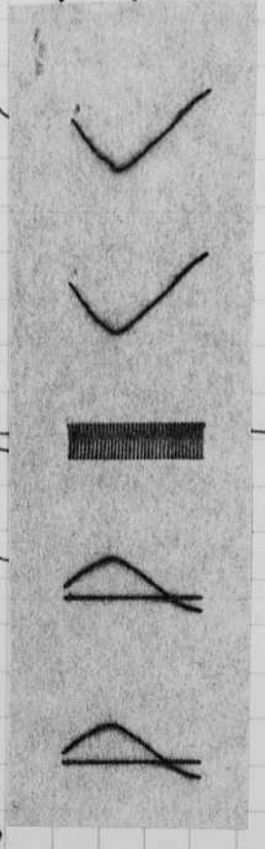
5) " " "

Coil test



Film pkno 27)

	Coil	Sweep	gap length.	frequency.	Film No. 5353
1	Thordarson	8	1/4 ±		
2	"	8	1/4 ±		
3	1 mc timing wave.				
4)	Model Elect	8	3/16 ±		
5	" "	8	3/16 ±		



Thordarson coil tends to arc over.

Tube. V. Light Filter. Dist 5354.

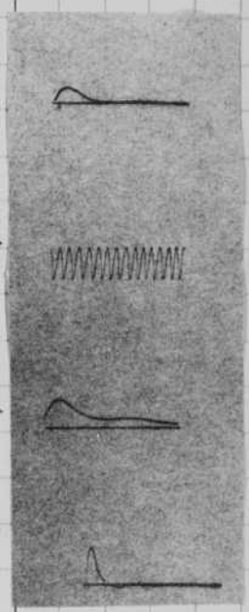
1. FT-214 0.1 8KV. Self flash 400V. X 2 3/4
and zero. Sweep 7.

2. 1 mc timing wave.

3. FT-214 0.1 8KV Self flash. 400V C.F. X1 3/4.

4 Gap 20 meg. 20m 0.1 7KV± Self flash X1 7"
Sweep 7. Delaycable 20' x .04 .8 us

5. Sweep 7 1 mc timing.



1. N6Y FT-220 Strobolume 4" away from P.C.
PC had a Density filter

2. 0.5 mf condenser Aberdeen with al gap wi
trigger or terminals.
air gap. 6000 KV
X2 36" air gap

3. Timing 1 m.c.

4) Air Gap no filter Continue as above 7" —

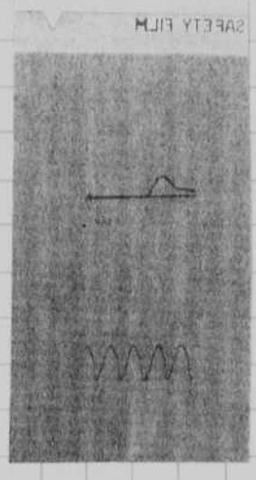
5) " " "

~~Tube~~ C V. Condensers 5356
Filter Dist

1 Air gap ~~0.5 6000~~ Air gap double that of film 5355

1 " 0.5 6000 X2 3 ft

2. 1 Mc. timing wave.



H E Edgerton
S. Gabriel
July 11, 1950.

Light flash tests.

160 Brookline Ave
Boston Mass

Tube	C	V	Filter	Dist.	Sweep Speed
micro flash BR	0.5	7000	X10	3 ft.	8
1 M.C.					
FT-110	0.5	6000	X10	3 ft.	8
				Self flashes. 7 KV.	
FT-230 1/4" orgurgap (Kryptin?)	0.5	7000	X 2	3 ft.	8 Ser air trig
FT-110 1/4" gap in series	0.5/2	10,000	10	3 ft	8

↑ Two sprague photo flash. This shows a short flash with a long tail.

0.75 mf 8 KV. Blew up micro flash tube.

0.5 mf 10 KV 10 3 ft

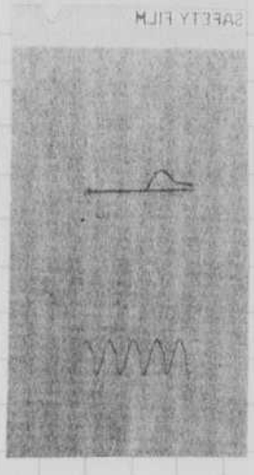
First model micro-flash tube

Tube C V. Conductivity 5356
Filter Dist

1 Air gap ~~0.5 6000~~ Air gap double that of film 5355

1 " 0.5 6000 X2 3/4

2. 1 Mc. timing wave.



H.E. Edgerton
S. Sabroski
July 11, 1950.

Light flash tests.

160 Brookline Ave
Boston Mass.

Tube	C	V	Filter.	Dist. & Re	Sweep On
mini-flash BR 1 mc.	0.5	7000	X10	3 ft. 8	
FT-110	0.5	6000	X10	~~3 ft.~~ 8 Self flashes. 7 KV.	
FT-230 1/4" orgn gap (Kryptron?)	0.5	7000	X 2	3 ft.	8 Ser circ trig
FT-110 1/4" gap in series	0.5/2	10,000	10	3 ft	8

↑ Two sprague photo flash. This shows a short flash with a long tail.

0.75 mf 8 KV. Blew up mini flash tube.

0.5 mf 10 KV 10 3 ft

First model mini-flash tube

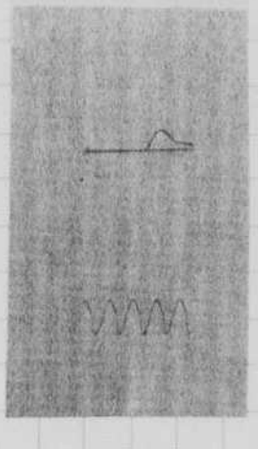
CONFIDENTIAL

Tube C V. Condensers 5356
Filter Dist

1 Air gap ~~0.5 6000~~ Air gap double that of film 5355

1 " 0.5 6000 X2 3 ft

2. 1 Mc. timing wave.



CONFIDENTIAL

CONFIDENTIAL

H E Edgerton
S. Sabroe
July 11, 1950.

Light flash tests.

160 Brook
Boston

Tube	C	V	Filter	Dist.	Sweep
mino flash BR	0.5	7000	X10	3 ft.	8
1 M.C.					
FT-110	0.5	6000	X10	3 ft.	8
FT-230 1/4" orgun gap (Kerr plate?)	0.5	7000	X 2	3 ft.	8
FT-110 1/4" gap in air	0.5/2	10,000	10	3 ft	8

Self flasher. 7 KV.

Sa... air ... trig...

↑ Two sprague photo flash. This shows a short flash with a long tail.

Film no 5358

0.75 mf 8 KV. Blow up mico flash tube.

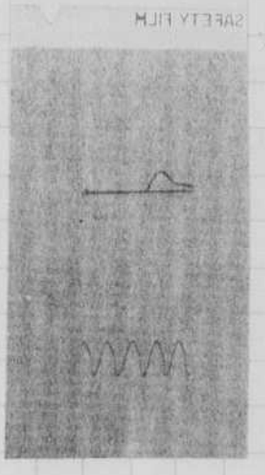
0.5 mf 10 KV 10 3 ft

First model mino-flash tube

CONFIDENTIAL

	Tube	C	V.	Conductivity Filter Dist	5356
1	Air gap	~~0.5~~	~~6000~~	Air gap double that of film 5355	
1	"	0.5	6000	X2	3 ft

2. 1 Mc. timing wave.



CONFIDENTIAL

H.E. Edgerton
S. Entrekin
July 11, 1950.

Light flash tests.

160 Broo
Boston

Sweep

Tube	C	V	Filter	Dist. 8 k
micro flash BR	0.5	7000	X10	3 ft. 8
1 mc.				
FT-110	0.5	6000	X10	3 ft. 8
				Self flashes. 7 KV.
FT-230 1/4" orig gap (Kuiper?)	0.5	7000	X 2	3 ft. 8 Seri air g trig
FT-110 1/4" gap mica	0.5/2	10,000	10	3 ft 8

↑ Two sprayed photo flash. This shows a short flash with a long tail.

0.7 mf 8 KV. Blew up micro flash tube.

0.5 mf 10 KV 10 3 ft

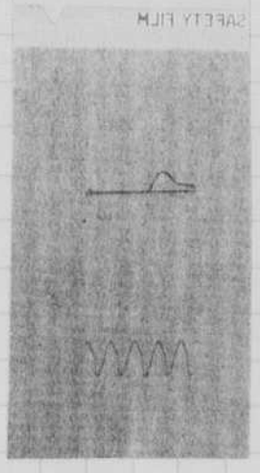
First model micro-flash tube

5359

CONFIDENTIAL

Tube	C	V.	Conductivity Filter Dist	5356
1 Air gap	~~0.5~~	~~6000~~	Air gap double that of film 5355	
1 "	0.5	6000	X2	3 ft

2. 1 Mc. timing wave.



H.E. Edgerton
S. Gabriel
July 11, 1950.

Light flash tests.

160 Bro
Boston

13

Tube	C	V	Filter	Dist.	8
micro flash BR	0.5	7000	X10	3 ft.	8
1 m.c.					
FT-110	0.5	6000	X10	3 ft.	8
FT-230 1/4" argon gap (Kryptin?)	0.5	7000	X 2	3 ft.	8
FT-110 1/4" gap in air	0.5/2	10,000	10	3 ft	8

Self flashes. 7 KV.

Series air gap trig

↑ two sprague photo flash. this shows a short flash with a long tail.

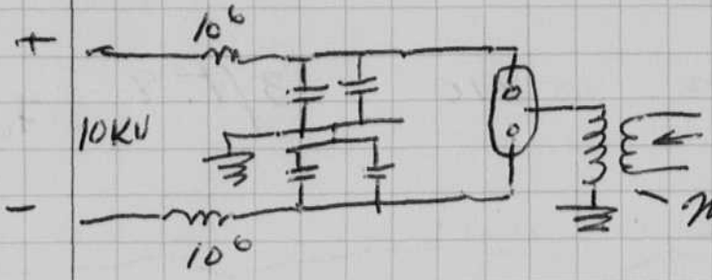
0.75 mf 8 KV. Blow up micro flash tube.

0.5 mf 10 KV 10 3 ft

First model micro flash tube

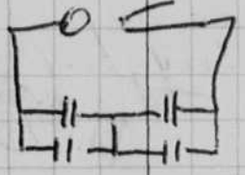
Tube.	C	V	Filter	Dist	Sweep	Film no.
Mark 19. gap 0.5		10, KV.	2	3 ft.	7	5366

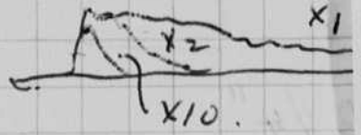
↳ 4 0.5 mf 4KV in ser parallel. 5366



air gap 1/4" ± 0.5 10KV 10 3 ft 7 5367

Spark Same as film 26 except oper air gap.





Ditto 20 3 ft. 7 5368

10

2

1

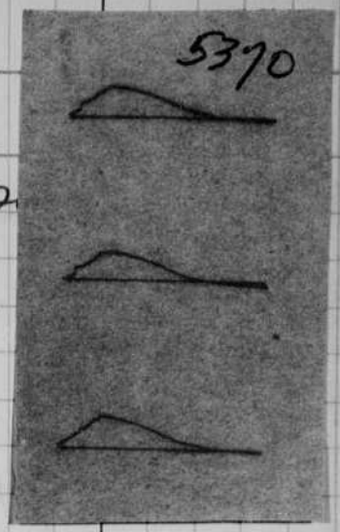
20 5 superimpos shots of slu tuning vari

Air gap 1/4" ± cap 0.125 μf 13 KV 3 ft dis

1) No filter .3
2) " " 1
3) " " 1.3
4) No filter
5) 1 mc trace

Film no 5369

5370



Polarity of Ignition coil & duration of p

1 Positive pulse polarity of Ignition
2 " " " "
3 " " " "
4 " " " "
5 " " " "

Sweep no 8

Movie lamp. 0.1mf 5KV. X2 3ft. Sweep. 7. Film no 5371

4 xenon 2 H2 1/4" spark coil from 2021 Model Flash

Air gap. 1/8" 0.1 6KV X2 7
Triggered X1

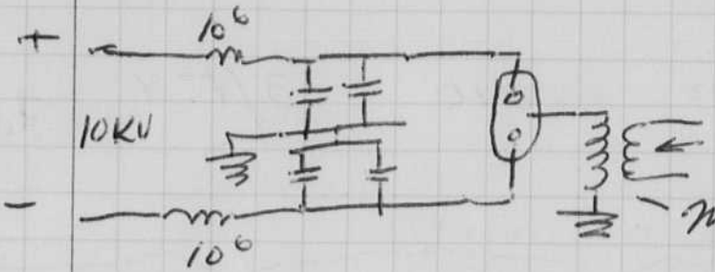
Air gap Do. 6 slots 6

(16) Calib 1 m.c. 6.

FT-130 2mf 2KV X10 4' 7
with sealed beam Reflector!

Tube.	C	V	Filter	Dist	Sweep	Film no.
Marks 19. gap 0.5		10, KV.	2	3 ft.	7	5366

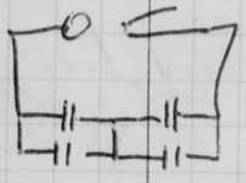
↳ 4 0.5 mf 4KV in ser parallel.

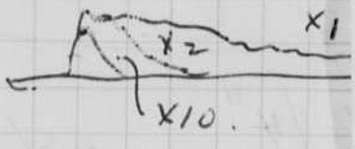


5366

air gap 1/4" ±	0.5	10KV	10	3 ft	7	5367

spark gap. Same as film 26 except open air gap.





5367

Ditto			20	3 ft.	7	5368
			10			
			2			
			1			
			20	5 superimpos shots to sho timing var		

5368

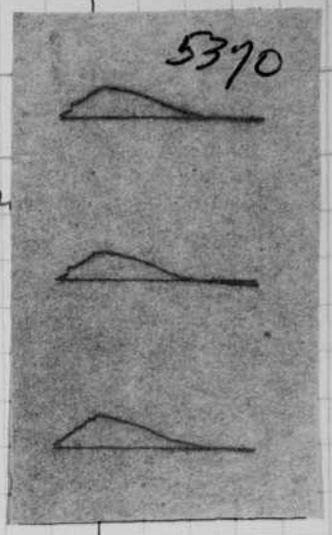
Air gap 1/4" ±	cap 0.125 mf	13 KV	3 ft			

1) No filter .3
2) " " 1
3) " " 1.3
4) No filter
5) 1 mc trace

Film no 5369

CONFIDENTIAL

5370



Polarity of Ignition coil & duration of p

1 Positive pulse polarity of Ignition
2 " " " "
3 " " " "
4 " " " "
5 " " " "

Sweep no 8

Movie lamp. 0.1mf 5KV. X2 3/4. Sweep. 7. Film no 5371

4 x 4mm 2 H2 1/4" spark coil from 2021 Model Rocket

Air gap. 1/8" 0.1 6KV X2 7
Triggered X1

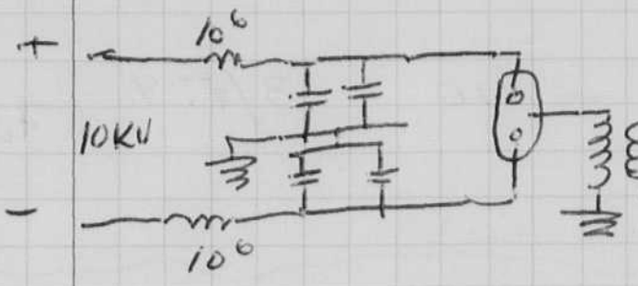
Air gap Do. 6 slots 6

(16) Calib 1 m.c. 6.

FT-130 2mf 2KV X10 4' 7
with sealed beam Reflector! 7

CONFIDENTIAL

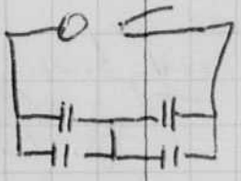
Tube.	C	V	Filter	Dist	Sweep	Film no.
Marks 19. gap 0.5		10, KV.	2	3 ft.	7	5366
→ 4 0.5 mf 4 KV in ser parallel.						5366



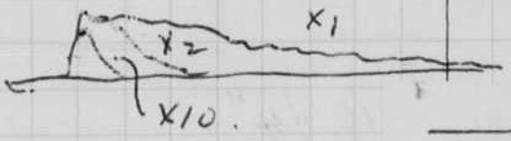
air gap 1/4" ± 0.5 10KV 10 3 ft 7

Same as film 26 except oper air gap.

Sparks



Film no 5367



5368

Ditto 20 3 ft. 7

10

2

1

20 5 superimpos shots 60 sec timing var

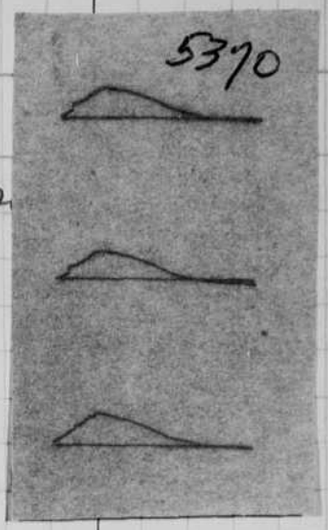
Air gap 1/4" ± cap 0.125 mf 13 KV 3 ft sec

1) No filter .3
2) " " 1
3) " " 1.3
4) No filter
5) 1 mc trace

Film no 5369

CONFIDENTIAL

5370



Polarity of Ignition coil & duration of p

1 Positive pulse polarity of Ignition
2 " " " "
3 " " " "
4 " " " "
5 " " " "

Sweep no 8

Movie lamp. 0.1mf 5KV. X2 3ft. Sweep. 7. Film no 5371

4 xenon 2 H2 1/4" spark coil from 2021 Model Flash

Air gap. 1/8" 0.1 6KV X2 7
Triggered X1 2'

Air gap Do. 6 slots 6

(16) Calib 1 m.c. 6.

FT-130 2mf 2KV X10 4' 7
with sealed beam Reflector!

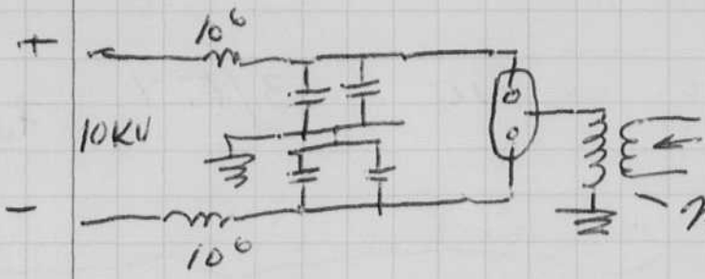
CONFIDENTIAL

CONFIDENTIAL

Film no-
5366
5366

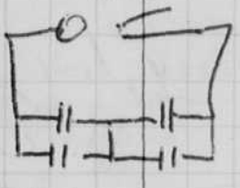
Tube.	C	V	Filter	Dist	Sweep
Marble 19 gap 0.5		10, KV.	2	3 ft.	7

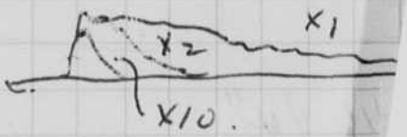
↳ 4 0.5 mf 4KV in ser parallel.



air gap 1/4" ±	0.5	10KV	10	3 ft	7

Same as film 26 except oper
Spark air gap.





Ditto	20	3 ft.	7	
	10			
	2			
	1			
	20	5 superimpose shots to show timing var		

Air gap 1/4" ±	cap 0.125 μf	13 KV	3 ft	Sweep

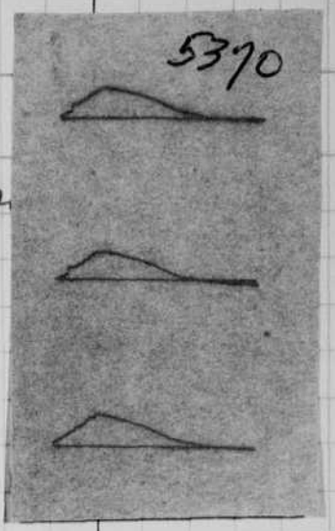
1) No Filter .3
2) " " 1
3) " " 1.3
4) No Filter
5) 1 ms trace

Film no 5369

CONFIDENTIAL

CONFIDENTIAL

5370



Polarity of Ignition coil & duration of p

1 Positive pulse polarity of Ignition
2 " " " "
3 " " " "
4 " " " "
5 " " " "

Sweep no 8

Movie lamp. 0.1mf 5KV. X2 3ft. Sweep. 7. Film no 5371

4 xenon 2 H2 1/4" spark coil from 2021 Model flash.

Air gap. 1/8" 0.1 6KV X2 ~~4~~ 2' 7
X1
triggered

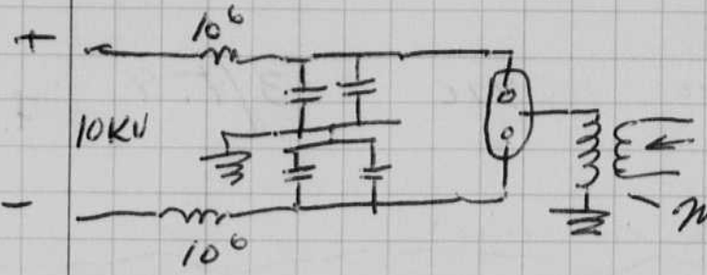
Air gap Do. 6 slits 6

(16) Calib 1 m.c. 6.

FT-130 2mf 2KV X10 4' 7
with sealed beam Reflector !

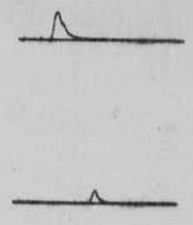
CONFIDENTIAL

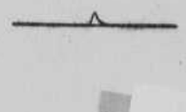
Tube.	C	V	Filter	Dist	Sweep.	Film no.
Marks 19. gap 0.5		10, KV.	2	3 ft.	7.	5366
↳ 4 0.5 mf 4KV in ser parallel.						5366



2021 .6 mf 500 V.

model electric coil.

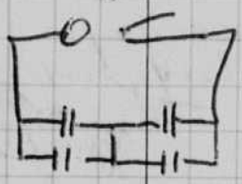


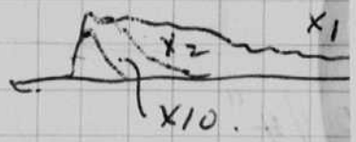


Air gap 1/4" ± 0.5 10KV 10 3 ft 7

Spark

Same as film 26 except oper air gap.



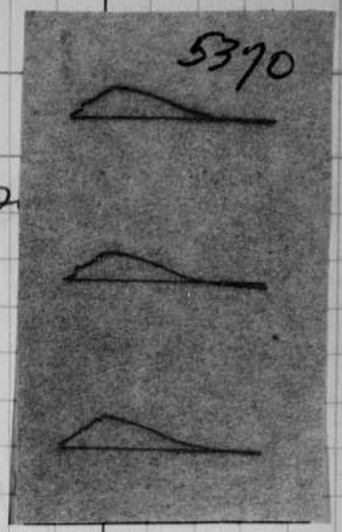


Ditto	20	3 ft. 7	28
	10		Film no
	2		5368
	1		
	20	5 superimposed shots & slow timing variations	

Air gap 1/4" ± cap 0.125 μf 13 KV 3 ft sweep 7 Film no

1) No filter .3 5369
2) " " 1
3) " " 1.3
4) No Filter
5) 1 ms trace

5370



Polarity of Ignition coil & duration of p

1 Positive pulse polarity of Ignition
2 " " " "
3 " " " "
4 " " " "
5 " " " "

Sweep no 8

Movie lamp. 0.1mf 5KV. X2 3ft. Sweep. 7. Film no 5371

4 Xenon 2 H2 1/4" spark coil from 2021 Model Flash

Air gap. 1/8" 0.1 6KV X2 7
Triggered X1 2'

Air gap Do. 6 slots 6

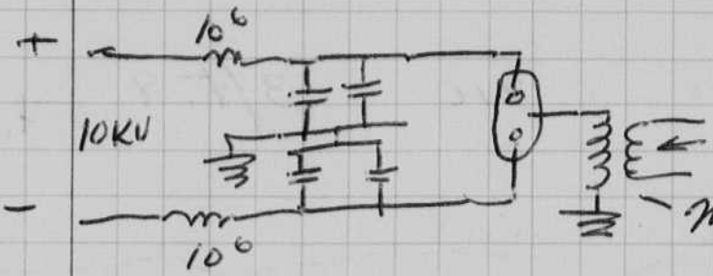
(16) Calib 1 m.c. 6.

FT-130 2mf 2KV X10 4' 7
with sealed beam Reflector!

CONFIDENTIAL

Tube.	C	V	Filter	Dist	Sweep.	Film No.
Mark 19. gap 0.5		10, KV.	2	3 ft.	7.	5366

↳ 4 0.5 mf 4KV in ser parallel.

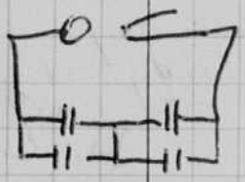


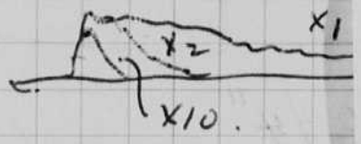
5366

air gap 1/4" ± 0.5 10KV 10 3ft 7

Spark ← air gap.

Same as film 26 except oper





5367

Ditto 20 3ft. 7

10

2

1

20 5 superimpo
shots 0.1 sec
timing vari

5368

Air gap 1/4" ± cap 0.125 mf 13 KV 3ft Scr

1) No filter .3
2) " " 1
3) " " 1.3
4) No Filter
5) 1 mc trace

Film no 5369

CONFIDENTIAL

Polarity of Ignition coil & duration of pulse

Film no 5370

1 Positive pulse polarity of Ignition
2 " " " "
3 " " " "
4 " " " "
5 " " " "

Sweep no 8

Film no 5371

Movie lamp. 0.1mf 5KV. X2 3ft. Sweep 7.
4 xenon 2 H2 1/4" spark coil from 2021 Model Flash

Air gap. 1/8" 0.1 6KV X2 7
Triggered X1

Air gap Do. 6 shots 6

(16) Calib 1 m.c. 6.

FT-130 2mf 2KV X10 4' 7
with sealed beam Reflector! 4

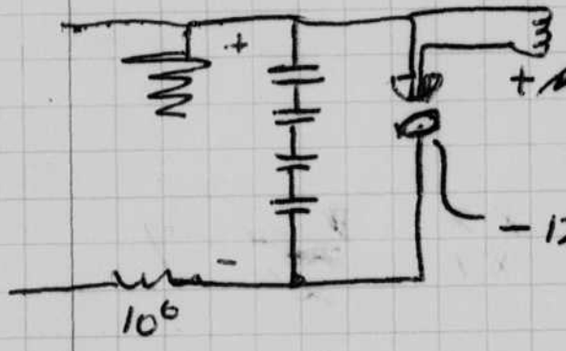
(16.) FT-126 ~~0.5 mf~~ 0.125 8KV. X10 4' 7

Air gap. 0.125 8KV no filter

Trace no 1

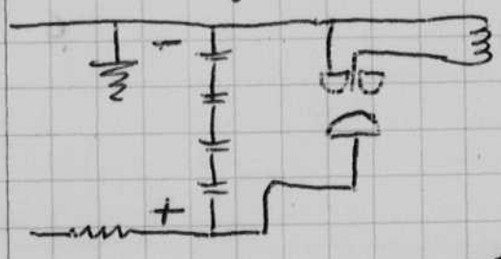
Air gap 0.125 12.5KV 4 ft no filter sweep no 5
Trace no 3 1 mc timing wave

" Trace no 4 1 mc timing wave



Trace no 5 5 simultaneous to show jitter

I then reversed the polarity of the main gap as shown below.

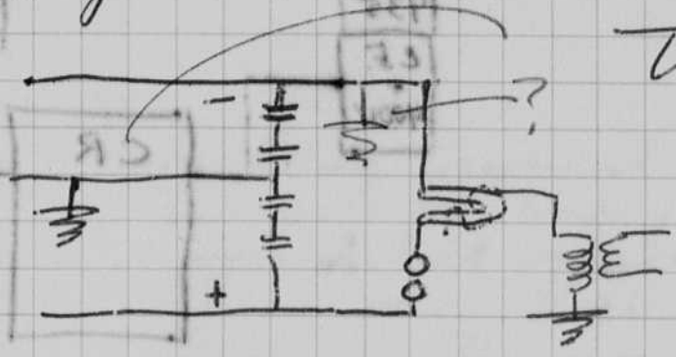


The gap distance (spacing) had to be increased to hold off the 12 KV. this is due to the cathode roughness caused by the starter.

I then reversed the starter pulse and found that the scope could not record the light since the spark went

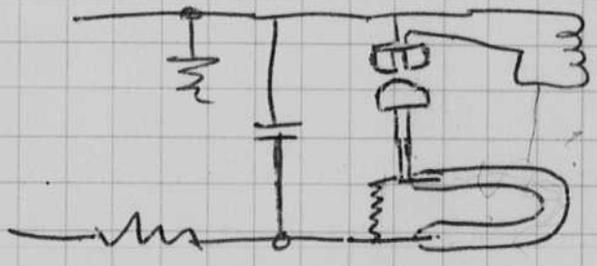
off and was over before the scope got started. Just before leaving for the day Soc put in a 1/2 sec (±?) of delay cable to overcome the scope starting delay. Photos were not made before we left for the day.

By decreasing the voltage of the main gap to 7000 volts from 12,000, the delay in starting was enough to allow the scope to record.



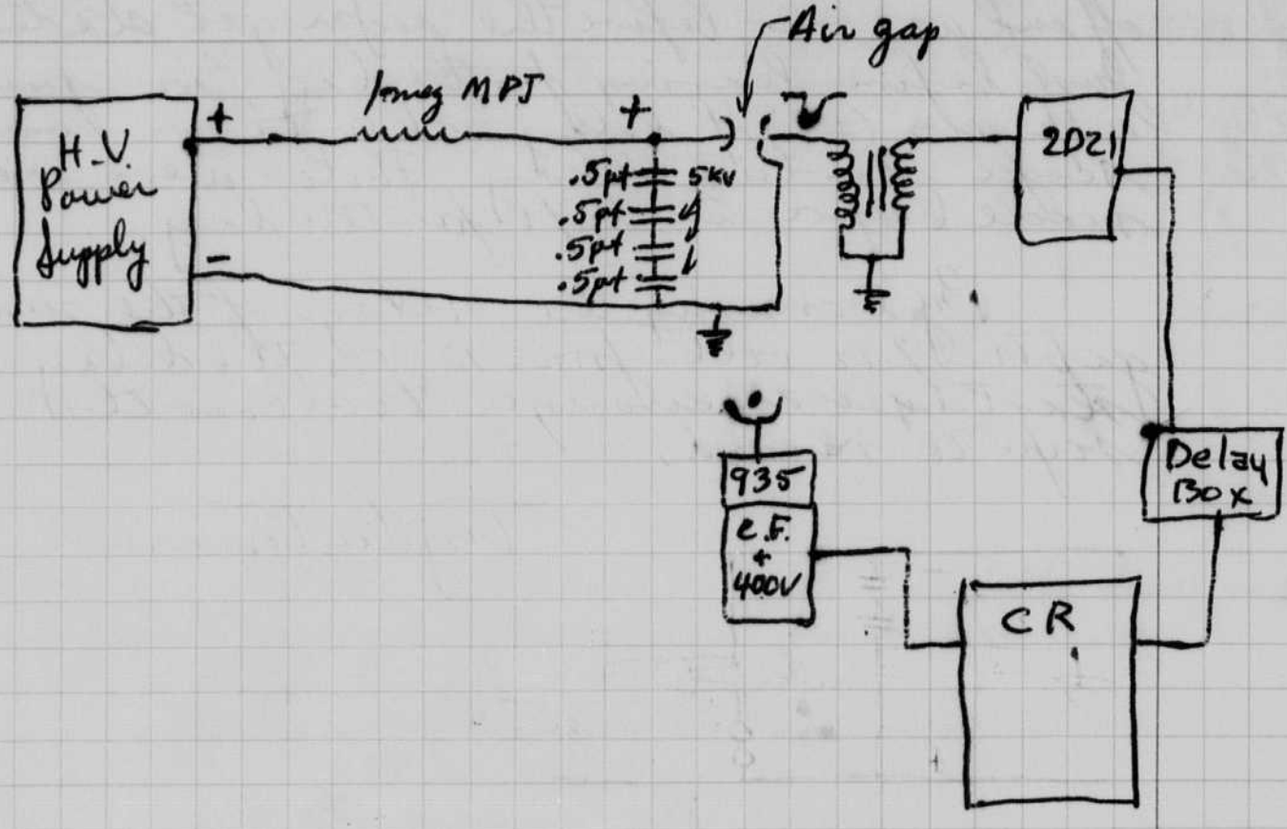
Try this tomorrow.

If trouble is experienced with the single gap try two, one on each side.



Try. Microflash tube
FT-110
Double FT-110
and other tubes.

July 13 1950
H E Clayton
A K Davis



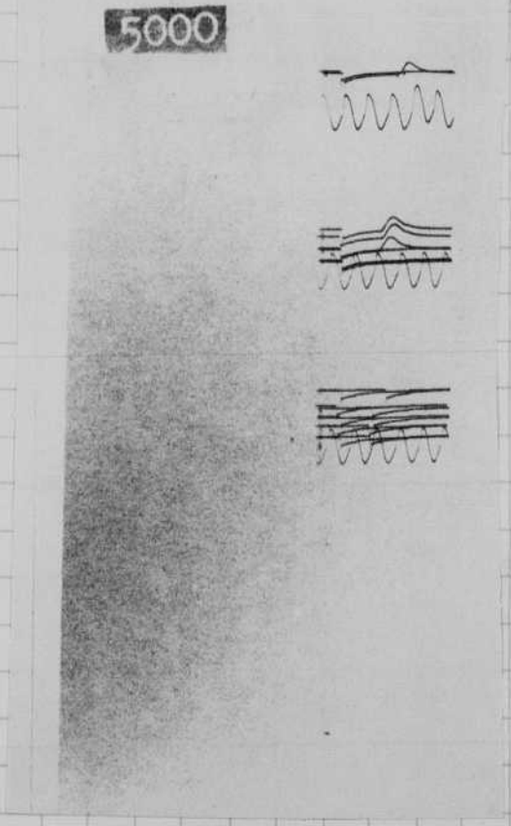
July 13 1950
H E Edgerton
A N Lawrie

C V F D Sweep.

1) air gap 0.125 10KV. x2 4' 6 1mc. Films no 5373

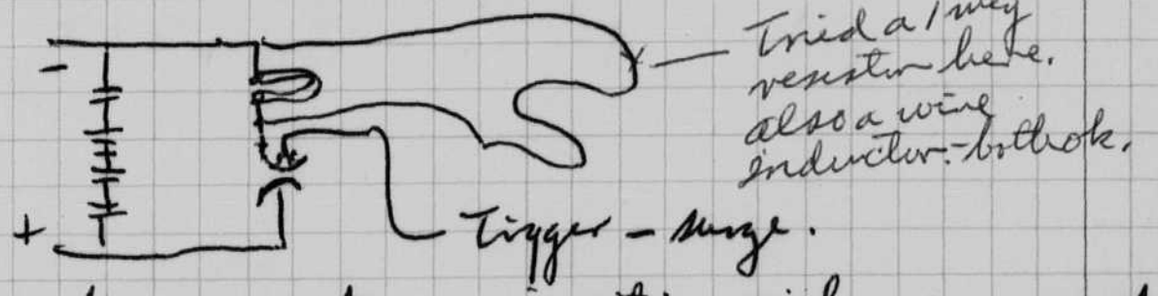
2) 1) 0.125 12KV x2 4' 6 1mc ~~3 discharge~~
3 discharges with axis moved

3. Scope delay transient. Several traces with two sweeps. One from sweep trigger, the other from initial signal plus delay. There should show the delay in the sweep starting.



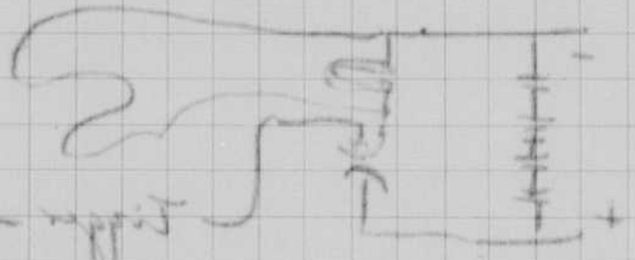
FT-110	.125	12KV.	X 2	D 4'	Swap 7	
"	.125	12KV.	X 2	4'	7	
"	.125	13KV	X 10	4'	7	
FT110 and gap	.125	13	X 10	4'	7	

Film no 5374



note polarity on ignition coil was reversed from negative to positive delay is greater.

Polarity back to negative on ignition coil.



(4) air-gap check. 0.125 ~~12KV~~ X 2 4' 6 sweeps 1 mc (13.5)

0.125 12KV X 2 4' 5 sweeps 1 m.c.

write 3C45 and pulse trans.

air gap. 0.125 13KV. Trigger 3C45 800 v. pulse trans Oscar IV. x2 4'

① Delay is quite small in air gap.

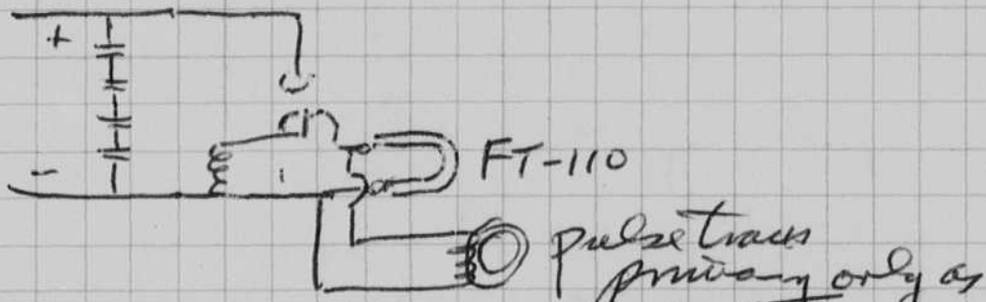
The trigger polarity was reversed this increasing the delay some.

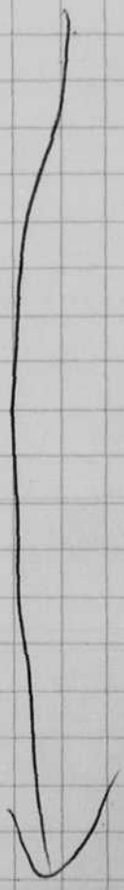
July 15 1950

air gap and FT-110	0.125 13KV	x 10	4'	6
		x 2	4'	6
		1 M.C. trans		6

Film no 5375

② 3C45 800 v pulse trans used as shown.

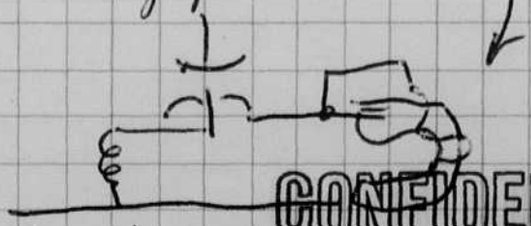


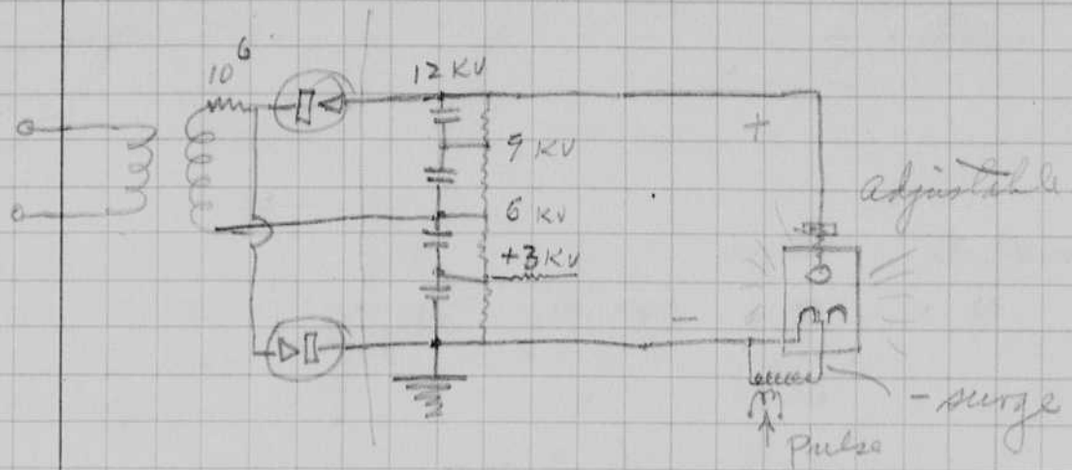


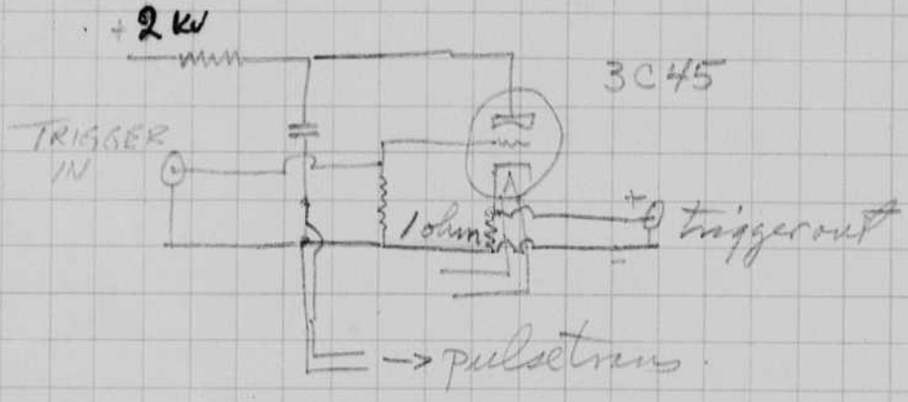
The oscillograms show light from gap and FT-110. By covering each in sequence, it appears that the FT-110 supplies 90% or more of the light.

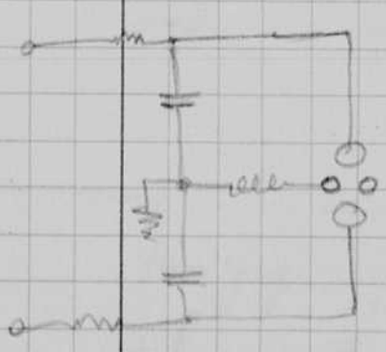
③ Ditto of ② except the FT-110 Trigger was connected to the gap cathode

x 2	4'	6	
x 10	4'	6	




10^6
12 KV
9 KV
6 KV
+3 KV
+
−
adjustable anode
− surge
Pulse

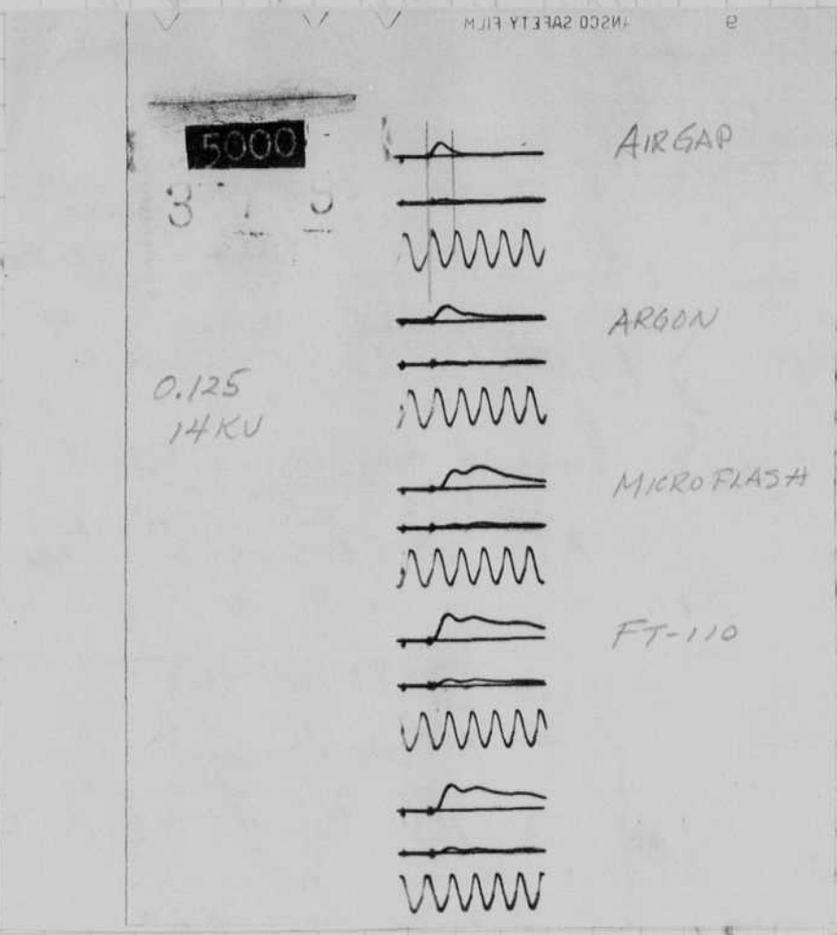

+2 kv
3C45
TRIGGER IN
1 ohm
+
−
trigger out
→ pulse trans.



July 14 50
HE Edgerton

Tube microflash in series with air gap. 0.125 13.5 KV X2 4' 6 1 mc. Film no 5376

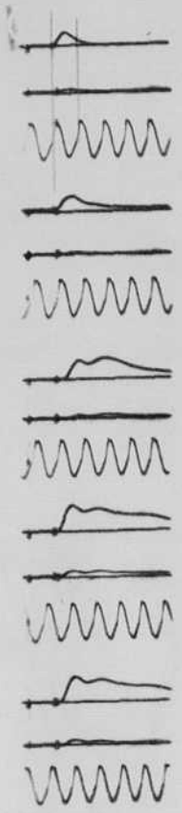
		μf	E	Filter	Distance	sweep	Timing
Tube microflash in series with air gap	1)	0.125	13.5 KV	X 2	4	6	~~1 mc~~ Film no
		"	"	X 10	"	"	1 mc. 5377
		Probe of microflash tied					
Tube FT-110 in series with Air gap	2)	0.125	13.5 KV	X 2	4	6	
		"	"	X 10	"	"	1 mc.
		Probe of FT 110 tied					
Tube Argon in series with Air gap	3)	0.125	13.5 KV	X 2	4	6	
		"	"	X 10	"	"	1 mc
Air gap only	4)	0.125	13.5 KV	X 2	4	5	
		"	"	X 10	4	5	
							~~5~~ mc.
Air gap + lamp with RG 54/AU	1)	0.125	13.5 KV	X2	4	5	Film no 5378
		1 mc.					
Air gap no RG 54/AU	2)	0.125	13.5 KV	X2	4	5	



Cont. July 14 1950

		0.125 μf	13.5 KV	Filter	Distance	Sweep	Timing
Air gap only Probe pulse negative	(1)	"	"	X2	4	6	1 mc ↓
		"	"	X10	4	6	
		1 mc timing wave.					Film no
Air gap in series with argon lamp	(2)	0.125 μf	13.5 KV	X2	4	6	5379
		"	"	X10	4	6	
		1 mc timing trace					
Air gap in series with micro flash	3	0.125 μfd	13.5 KV	X2	4	6	
		"	"	X10		6	
		1 mc timing					
		Probe tied to ~~negative~~ gnd					
Air gap in series with FT 110 lamp	4	0.125 μfd	13.5 KV	X2	4'	6	
		"	"	X10	4'	6	
		1 mc timing					
		Probe tied to ~~negative~~ gnd					
	5	Same as above					

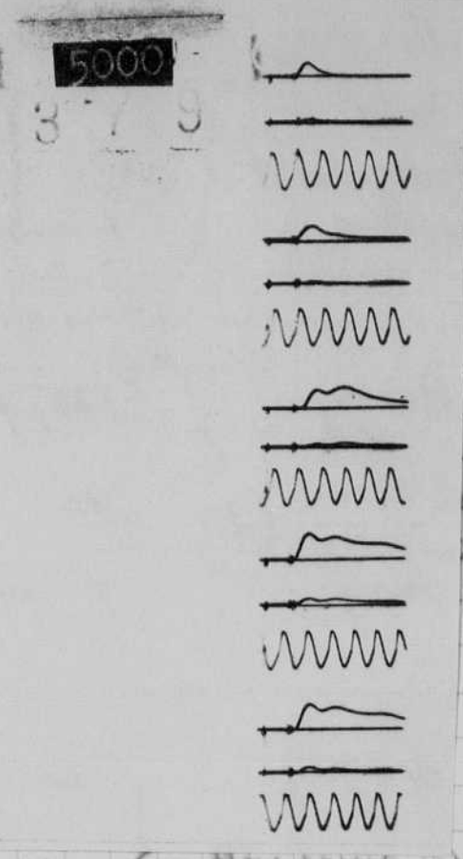
5000



0.125
14KV

Cont. July 14 1950

		0.125 μf	13.5 KV	Filter	Distance	Sweep	Timing
Air gap only Probe pulse negative	(1)	"	"	X2	4	6	1 mc
		"	"	X10	4	6	↓
		1 mc timing wave.					Film no
Air gap in series with Argon lamp	(2)	0.125 μf	13.5 KV	X2	4	6	5379
		"	"	X10	4	6	
		1 mc timing trace					
Air gap in series with micro flash	3	0.125 μfd	13.5 KV	X2	4	6	
		"	"	X10		6	
		1 mc timing					
		Probe tied to ~~negative~~ gnd					
Air gap in series with FT 110 lamp	4	0.125 μfd	13.5 KV	X2	4'	6	
		"	"	X10	4'	6	
		1 mc timing					
		Probe tied to ~~negative~~ gnd					
	5	Same as above					

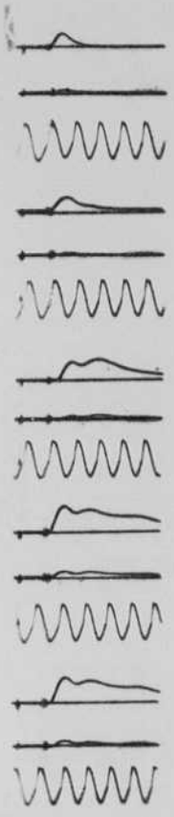


July 18, 1950
Harold E. Edgerton

An equipment for short-time flash photography is being built by B. Darrel and the writer for field use. A circuit will be put in this book when the equipment is finished. Construction was started on Friday. By working Sat and yesterday monday it is nearly finished.

The discharge circuit consists of a 0.125 mf 17KV capacitor and a series triggered air gap. Provision is made for an external series gap or a gas filled lamp. The performance will be as shown in the oscillograms on page 28-29. The micro flash lamp and the FT-140 flash tube as well as others can be used in this circuit.

5000



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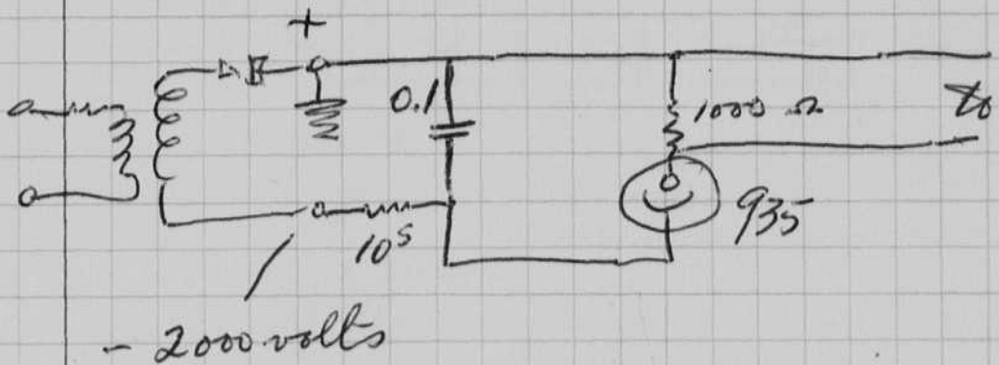
July 18 1950
H. E. Edgerton

A phototube pickup for fast light pulses was built yesterday according to the following circuit.

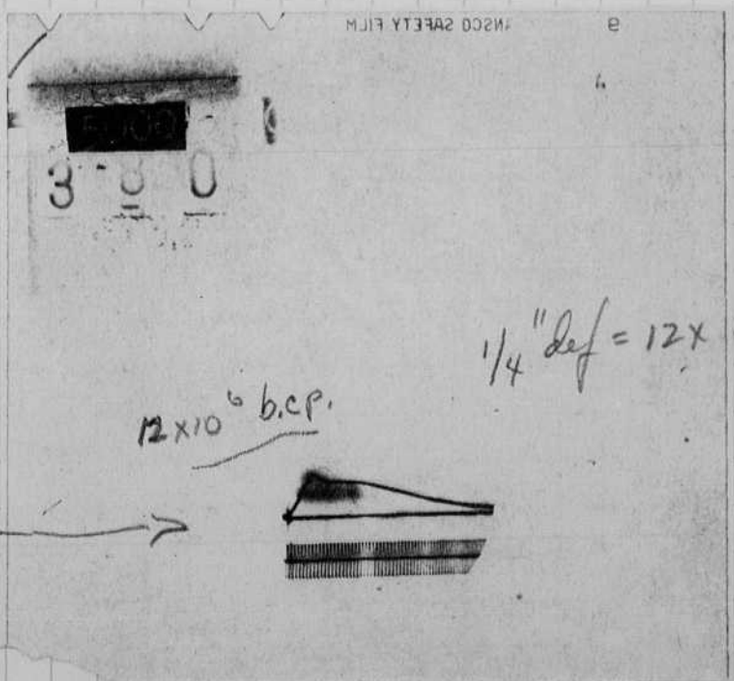


Calibration of above with Strobolume

Distance 4 ft from FT-220 to 935 phototube cathode.

1 mc timing wave on osc.

#380



Assume peak light output = 12×10^6 b.c.p.

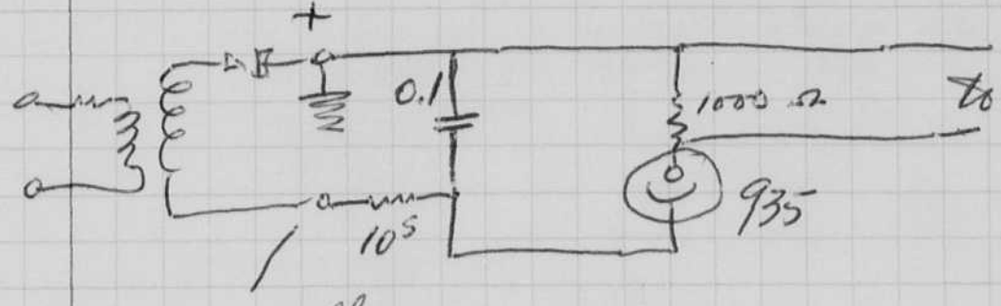
$48. \times 10^6$ b.c.p/inch

12×10^6 b.c.p.

1/4" def = 12×10^6 b.c.p.

July 18 1950
H.E. Edgerton

A phototube pickup for fast light pulses was built yesterday according to the following circuit.

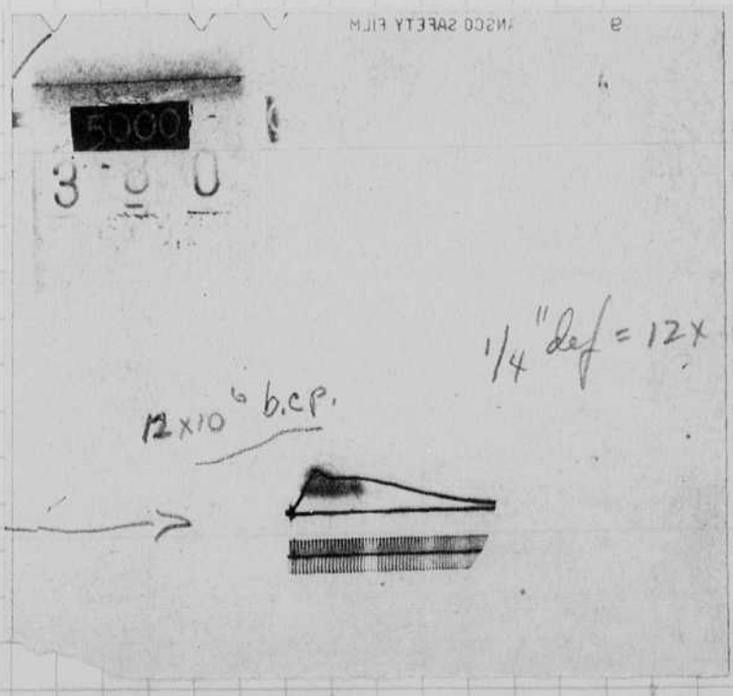


Calibration of above with Strobolume

Distance 4 ft from FT-229 to 935 phototube cathode.

1 mc timing wave on osc.

#380



Assume peak light output = 12×10^6 b.c.p.

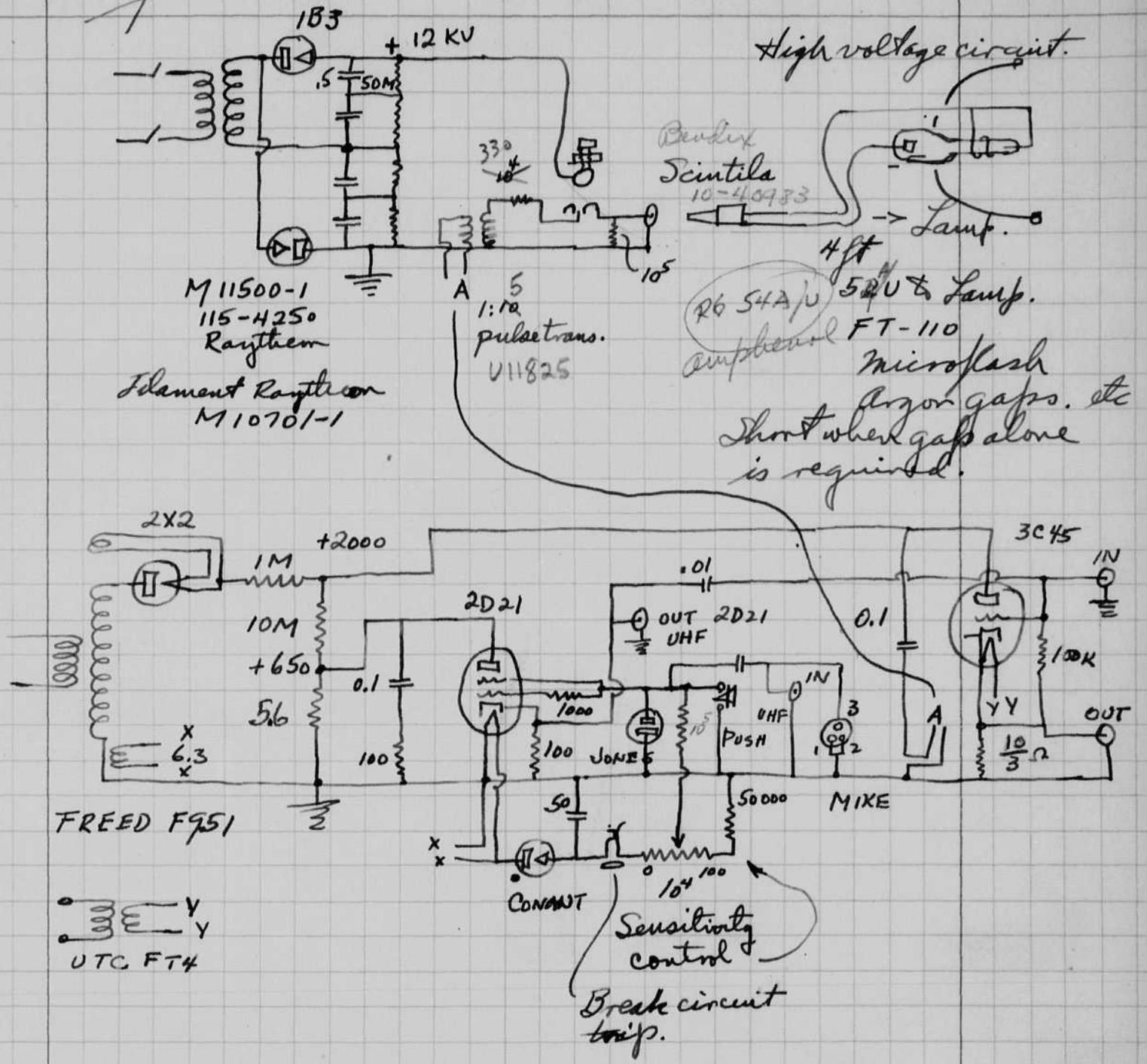
$48. \times 10^6$ b.c.p./inch

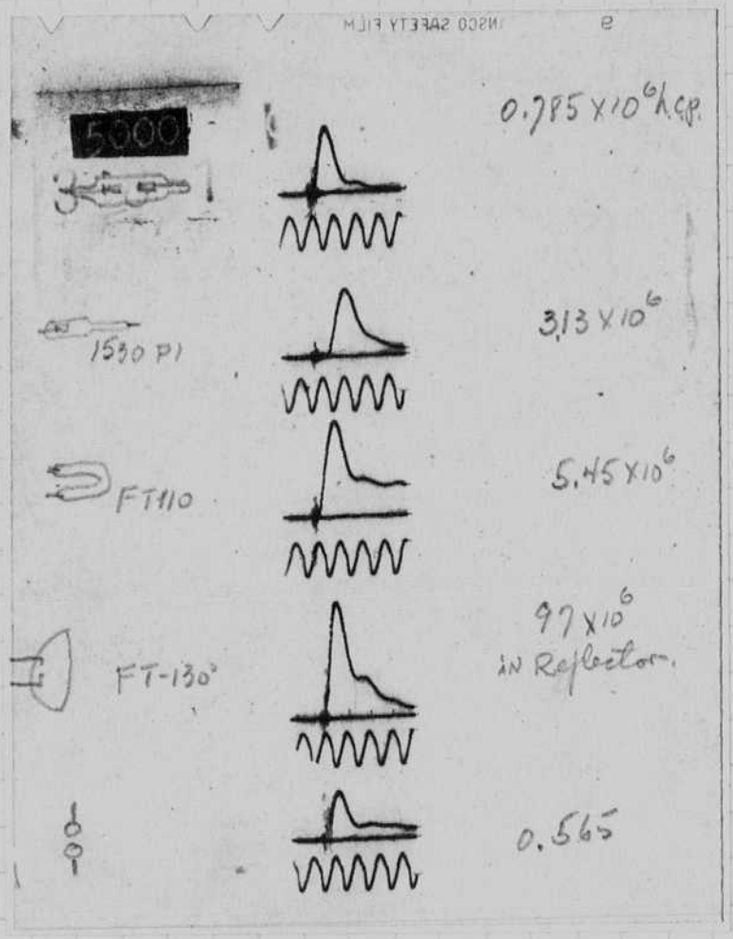
$0.1 \times 200 = 200$ lbs.

July 18 1950

David Edgerton

DRAWING of CIRCUIT 3123 C37





July 19 1950
H E Edgerton

381

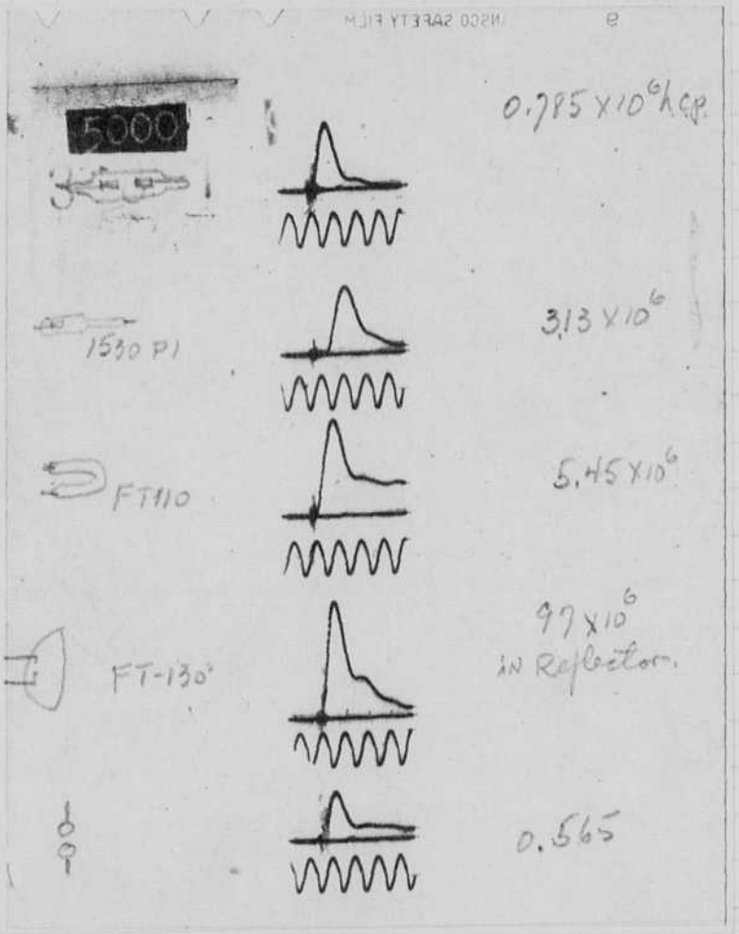
air gap 1/4"
atmospheric press.
in series with
air gap. C = 0.125 V = 12+KV. D = 10" X1
1 mc.

Microflash
lamp in
series with
air gap 0.125 12KV D = 20" X1

FT-110 in
series with
air gap. 0.125 12KV. D = 20 X1

FT-130 in
Reflector
Series gap. 0.125 12KV D = 60" X2
P.C was in the beam
which was a 6" diam spot at 5 ft.

Series gap 1/4" -
in series with
control gap. .125 12KV 10" X1



July 19 1950
H E Edgerton

381

Air gap 1/4"
atmospheric press.
in series with
air gap.
C = 0.125 V = 12+ KV. D = 10" x1
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lamp in
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series with
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Series gap. 0.125 12KV D = 60" x2
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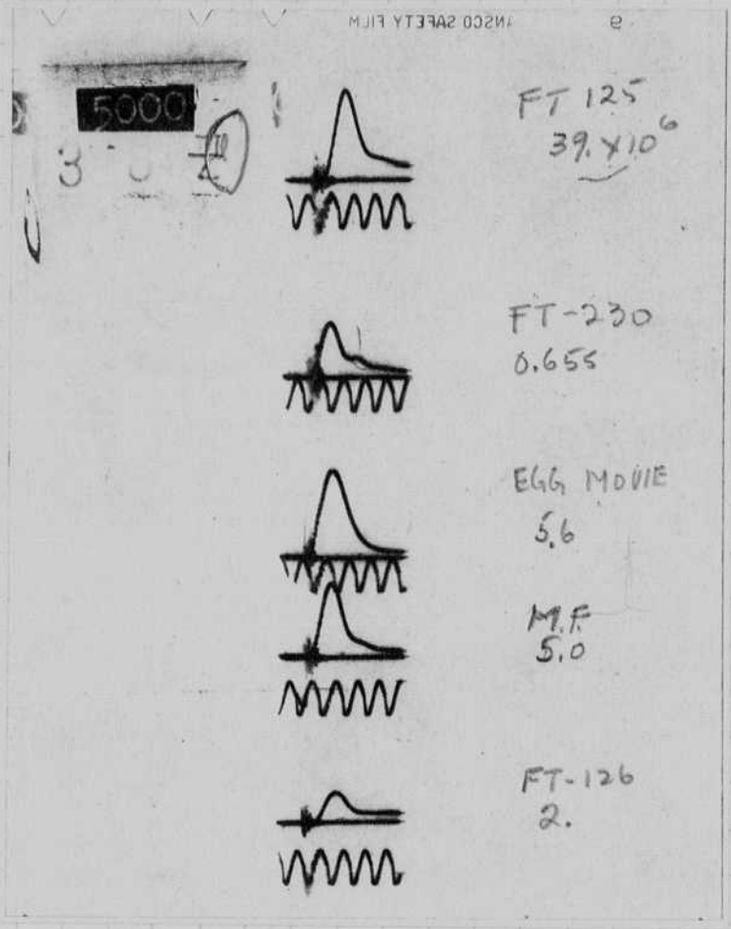


382

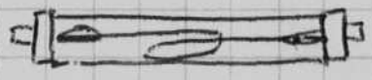
FT-12.5.
air gap 0.125 12KV. D=60" x1

1 Reflector type flash bulb.
1 m.c.

do

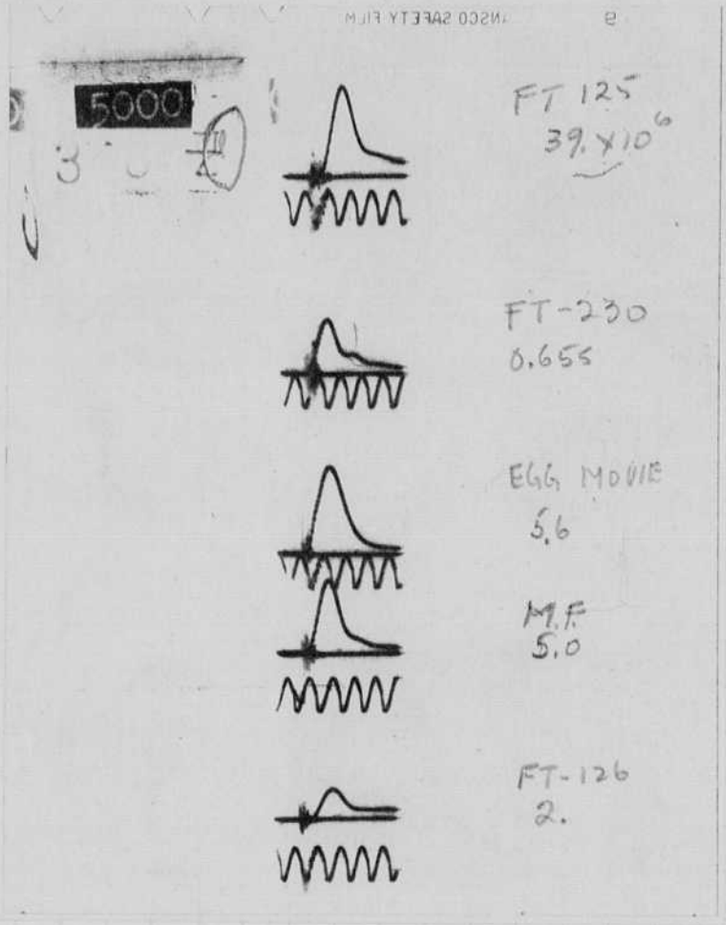
(Krypton)
argon gap FT-230
2 old form television flatron
air gap series. Ditto C&V D=10" x1

3. New Nuvi lamp. D=24" x1
Genes Lamsen



4 microflash tube
new. 1530 P-1 D=24" x1

5 FT-126 old form
new clear group D=24 x1



382

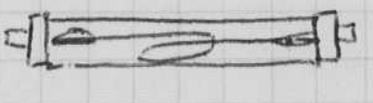
FT-125.
Air gap 0.125 12KV. D=60" x1

1 Reflector-type flash bulb.
1 m.c.

Ar

(Krypton)
argon gap FT-230
2 old from television station D=10" x1
Air gap series. Ditto c&v

3. New Nuvi lamp. D=24" x1
Benes Lumsden



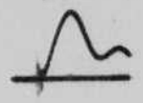
4 microflash tube D=24" x1
new. 1530 P-1

5 FT-126 old form D=24 x1
nuclear group

5000
383

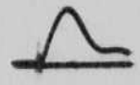
50×10^6 BCP
BEAM C

G.R.
MICROFLASH
NEW CIRCUIT



FT 130
2MF 2000 V

$235. \times 10^6$
BEAM C



FT-130
2MF 2000

FT-130 2MF
2200 V.
2000
1500
1000
1MC
JULY 20 1950
P41 H.E.E

CONFIDENTIAL

July 20 1950
Harold E. Edgerton

Continued tests of flash tubes.

383

Micro flash tube
in Specular 8" Reflector.
Series air gaps as before.
Oscillograph also shows
pulse that starts the
new circuit, thus shows
delay time.

4 photos
showing delay
5ft x 2

FT-130 Sealed Beam
in Argon. Gap without
a series air gap.
Self fires at 2400 - 2600 volts.
2 mf. 2100 volts.

5ft x 2 but 6" off the
center of the
Beam, the
beam spot is
about 8" in
diam at 5ft.

Ditto above but with
Photo tube at center
of beam
2 mf 2100

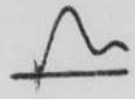
5ft x10

4 shots of FT-130 as above
but with
2200 v
2000
1500
1000
} all on same
record.

5000
383

50×10^6 BCP
BEAM C

G.R.
MICROFLASH
NEW CIRCUIT



FT 130
2MF 2000 V

$235. \times 10^6$
BEAM C

FT-130
2MF 2000

FT-130 2MF
2200 V.
2000
1500
1000
1MC
JULY 20 1950
P41 H.E.E

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Ditto above but with
Photo tube at center
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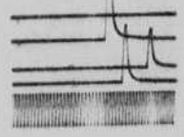
5ft x10

4 shots of FT-130 as above
but with
2200 v
2000
1500
1000
} all on same
record.

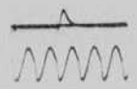
5000
384

390 x10⁶
90 x10⁶
BEAM C

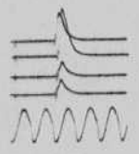
GR MICRO FLASH
IMC



GR MICRO FLASH
IMC



SPARK GAP
LOW IND.
IMC



DITTO
IMC

JULY 20 1950
P43 H.E.E.

Regular micro flash circuit (384)

Sweep 8 was used to get the light trace on the screen.

P.C. was in the beam hot spot — 5 K. (+3") — x10

3/0 x10^6 max.
93.5 x10^6 min

1. Seven records were made to show starting delays.

2. Ditto.

3. ~~Spark gap short~~ 5 K.V. — 4" — x1.

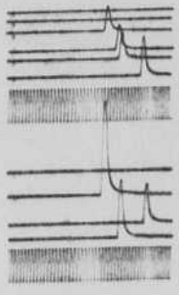
max 0.188 x10^6
min 0.0628 x10^6

4. 5.3 KV. — 4" — x1.

CONFIDENTIAL

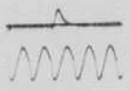
5000
384

390 x10⁶
40 x10⁶
BEAM C

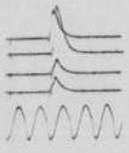


GR MICRO FLASH
1MC

GR MICRO FLASH
1MC



SPARK GAP
LOW IND.
1MC



DITTO
1MC

JULY 20 1950
P43 H.E.C.

Regular microflash circuit (384)

Sweep 8 was used to get the light trace on the screen.

P.C. was in the beam hot spot — 5 KV. (+3") — X10

3.6 x 10^6 max.
93.5 x 10^9 min

1. Several records were made to show starting delays.

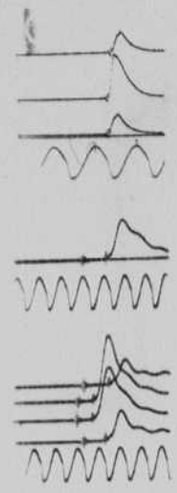
2. Ditto.

3. ~~Spark gap short~~ — 4" — X1.
5 KV.

max 0.188 x 10^6
min 0.0628 x 10^6

4. 5.3 KV. — 4" — X1.

5000



AIR GAP
LOW IND.

$.08 \times 10^6$ hc.
.03

1 MC

GAP
ABERDEEN

0.38

1MC

ABERDEEN

1MC.

JULY 20 1950
P45 H.E.E.

Film 5000
No 385

Demuskaus's central gap assembly - same as p 43 except sweep changed from 6 to 5 position.

Peaks 0.188 x 10^6

3 waves.

4" x 1
1 mc. timing

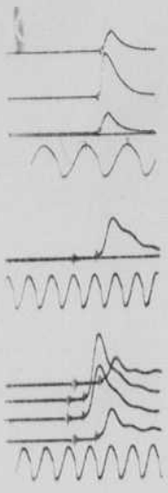
1

2. Aberdeen air gap
Seen through the small hole in the anode
.5 mf 7000 v
1/8" gap.

7" x 1

3. Ditto #2 but with 4 shots to show variation in starting and light output.

5000



AIR GAP
LOW IND.

1 MC

.08 x 10^6 hc.
.03

0.38

GAP
ABERDEEN
1MC

ABERDEEN
1MC.

JULY 20 1950
D45 H.E.E.

Film 5000
No 385

Demuskauser's central gap assembly - same as p 43 except sweep changed from 6 to 5 position.

Peak 0.188 x 10^6

3 waves.

4" x 1
1 mc. timing

1

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Seen through the small hole in the anode
.5 mf 7000 v
1/8" gap.

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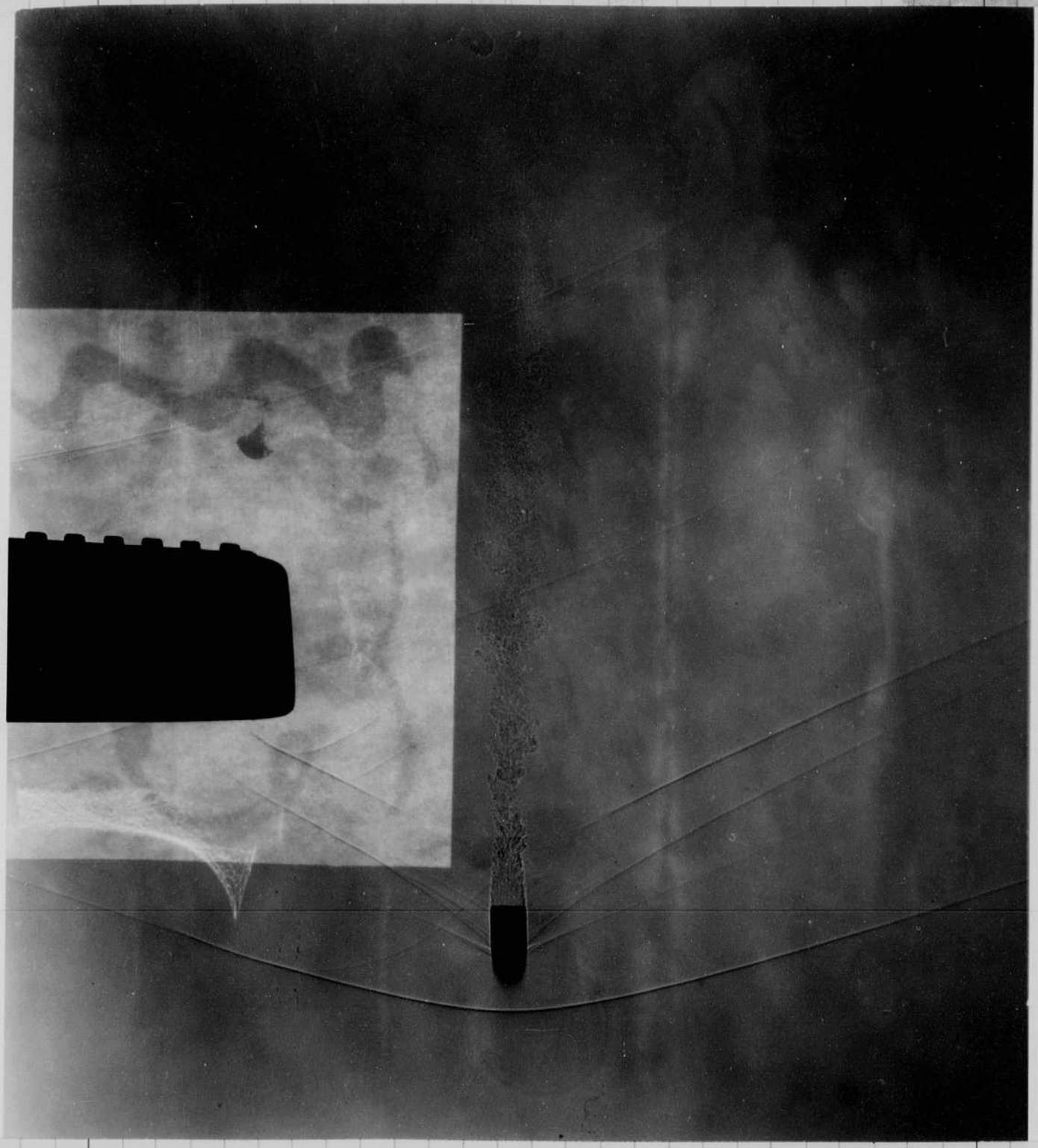
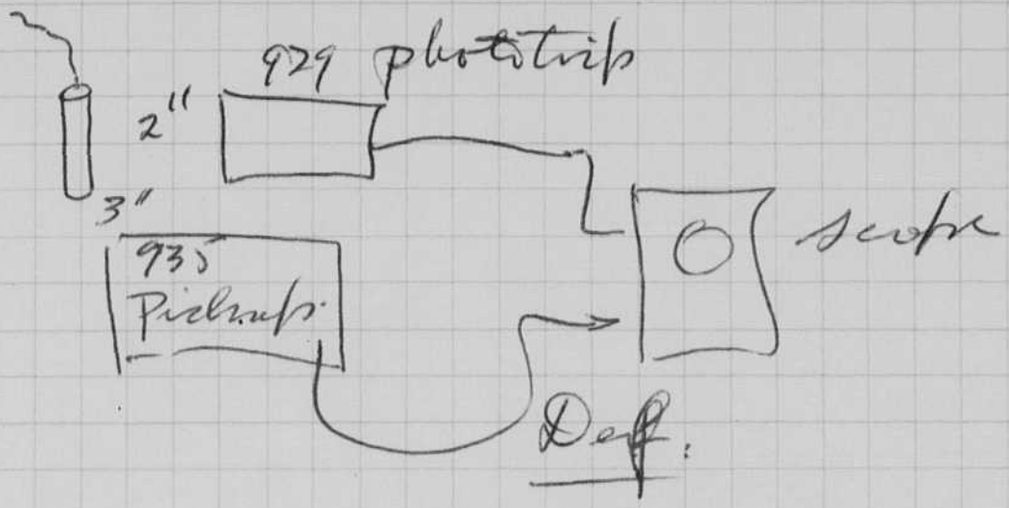
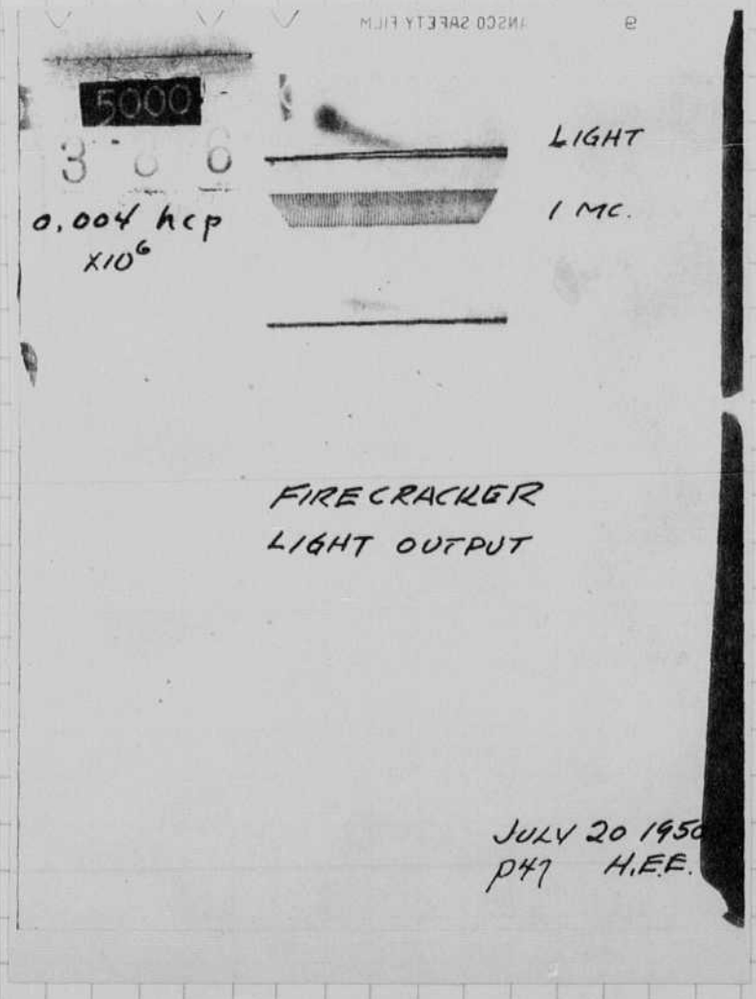


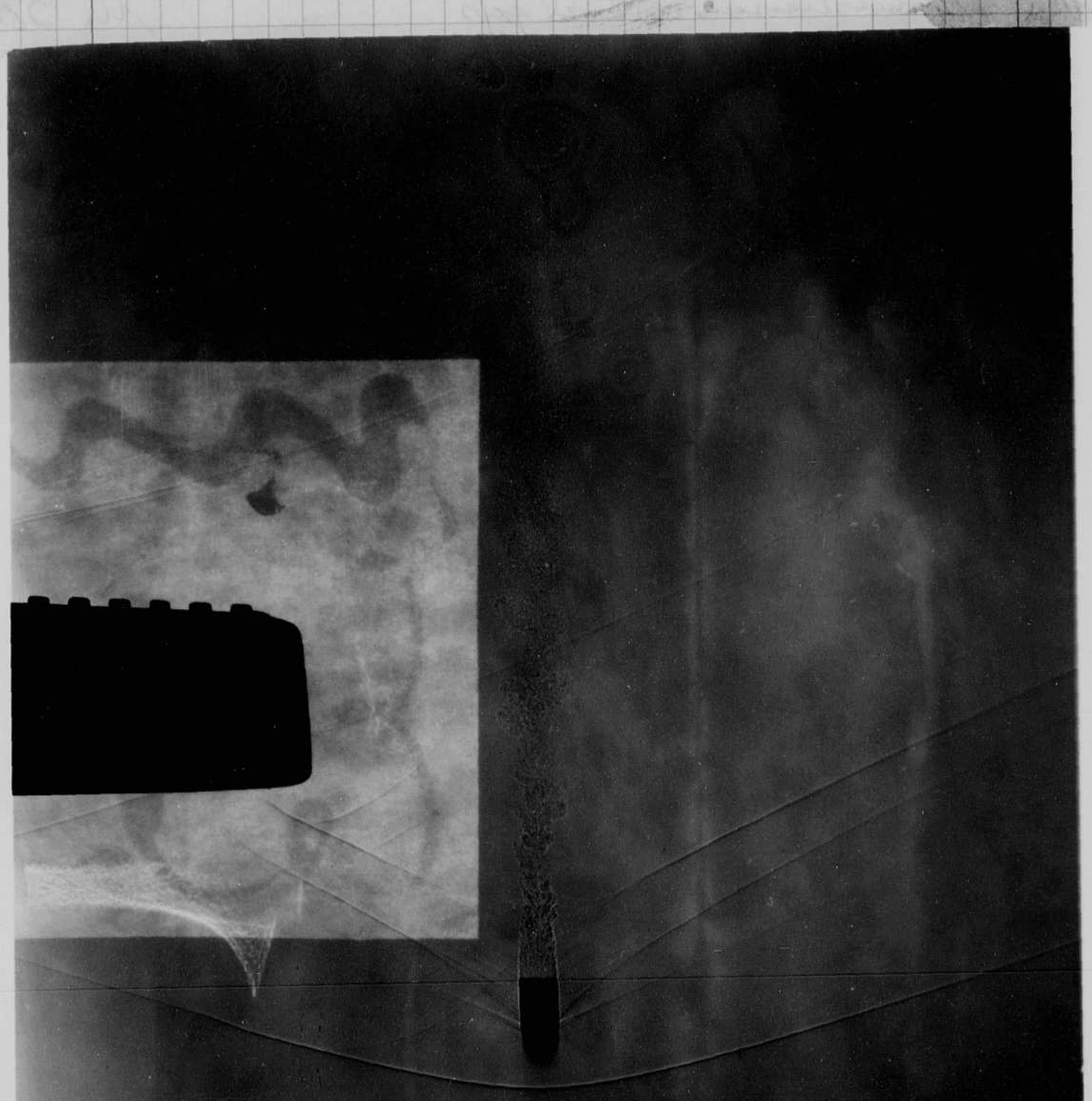
Egg with firecracker.

5000
~~4~~ 386

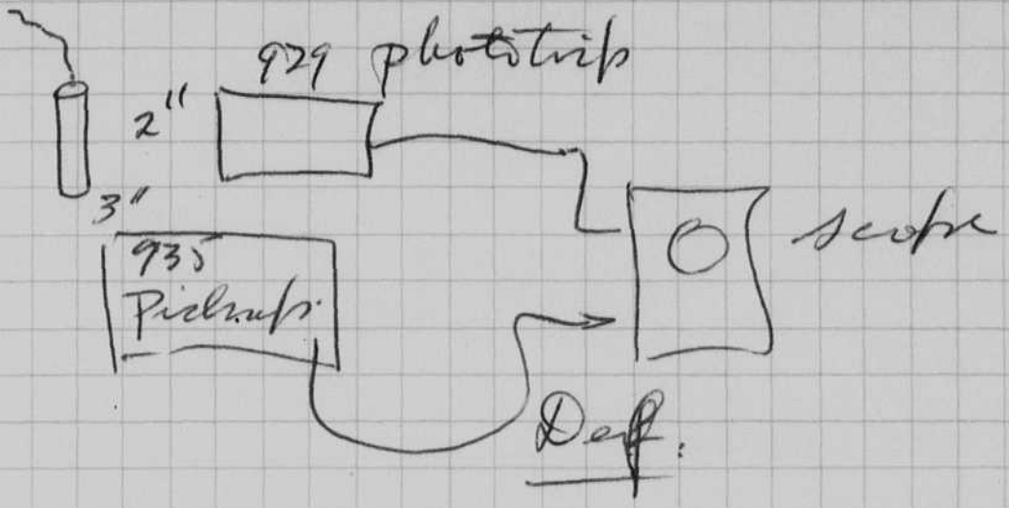


Sweep 8. 1 mc.

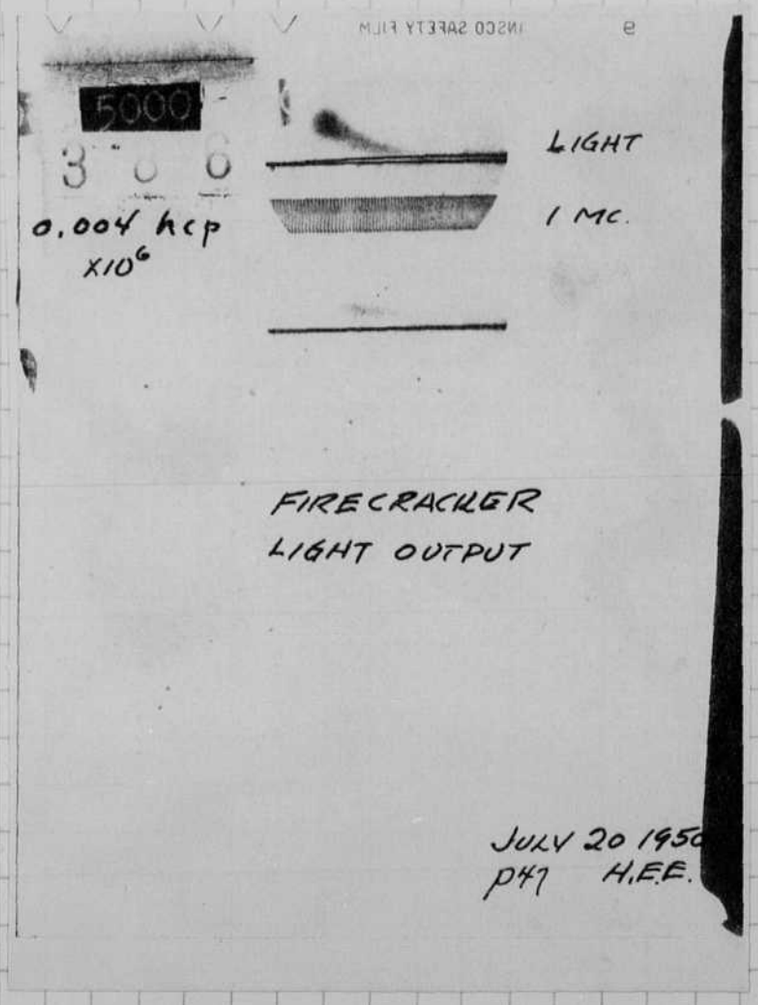


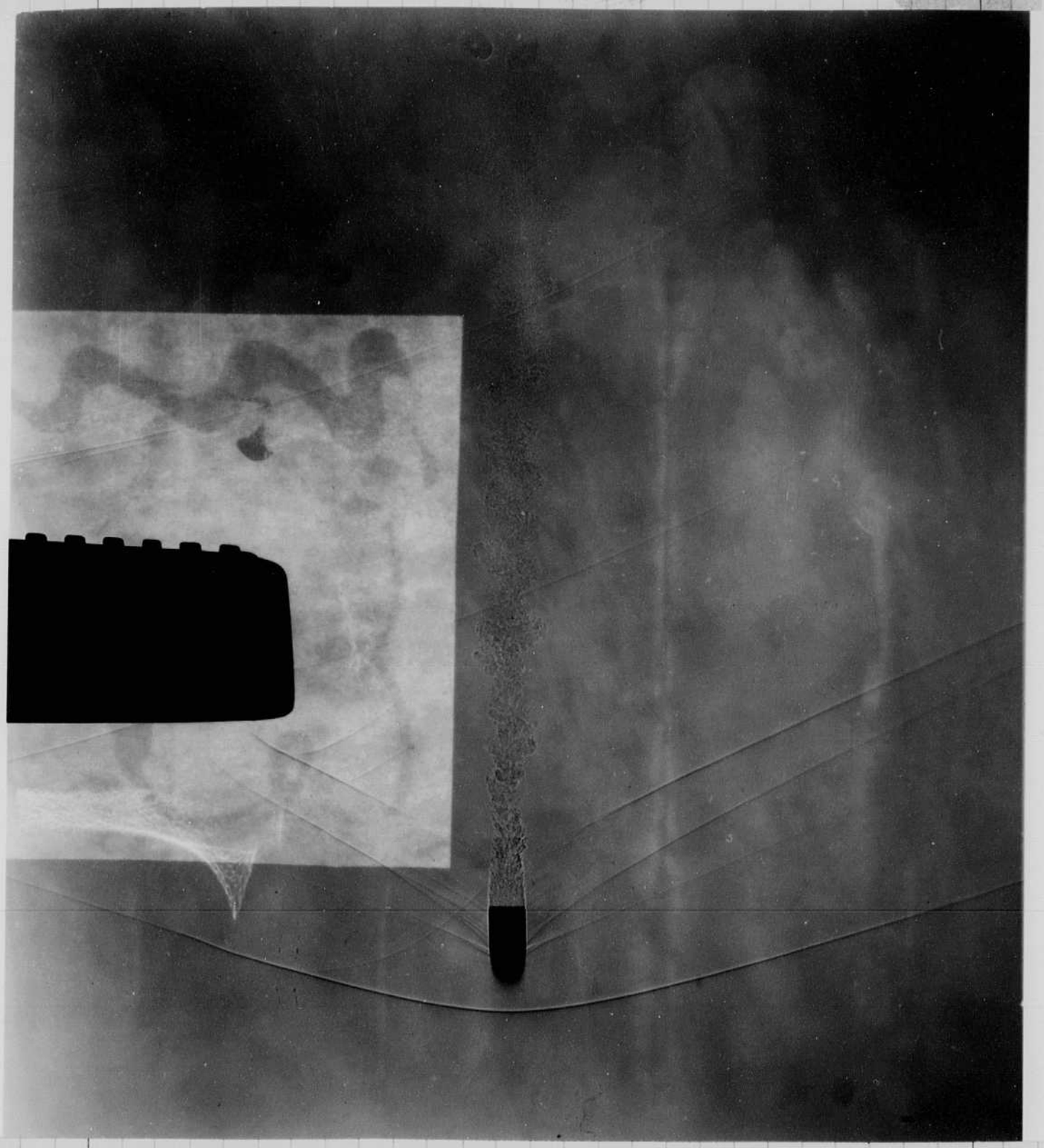


Eff with firecracker. 5800 #386

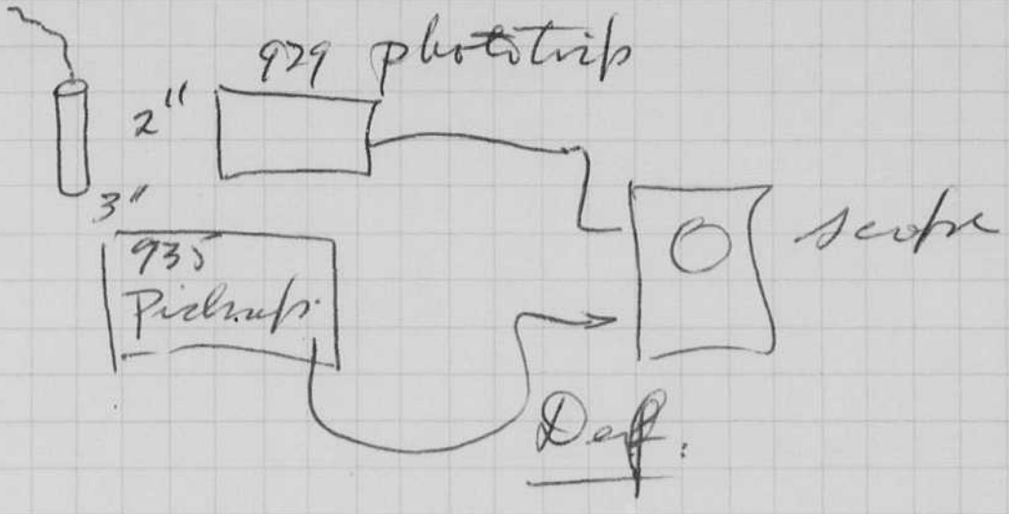


Sweep 8. 1 mc.

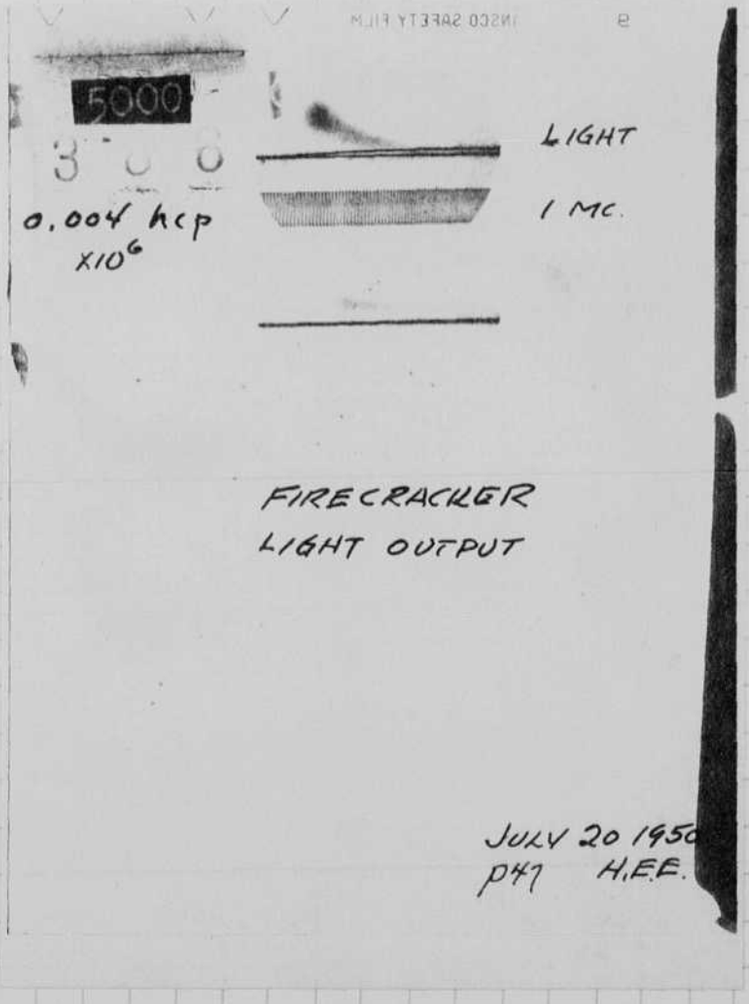


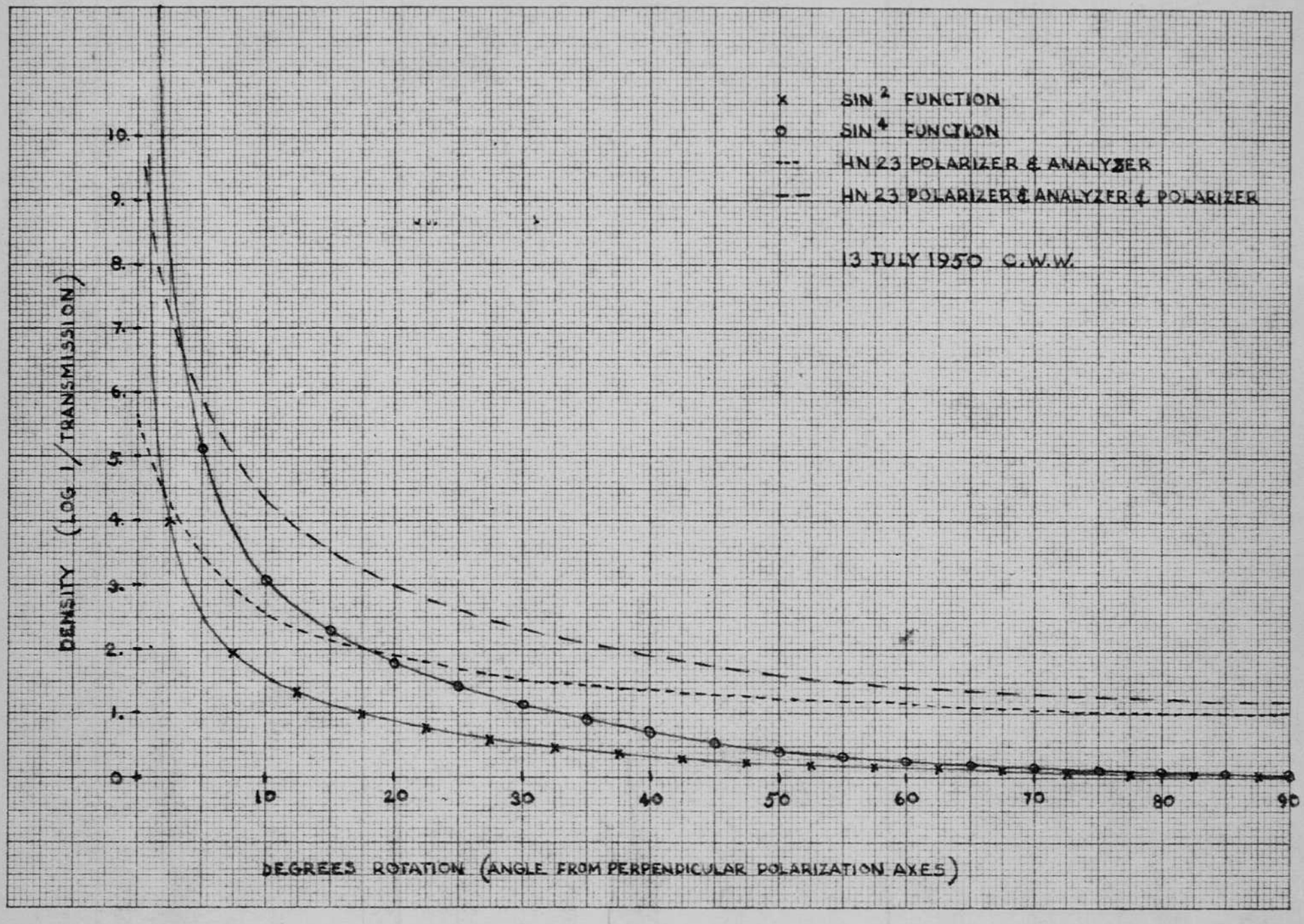


Eff with firecracker. 5800 #386



Sweep 8. 1 mc.

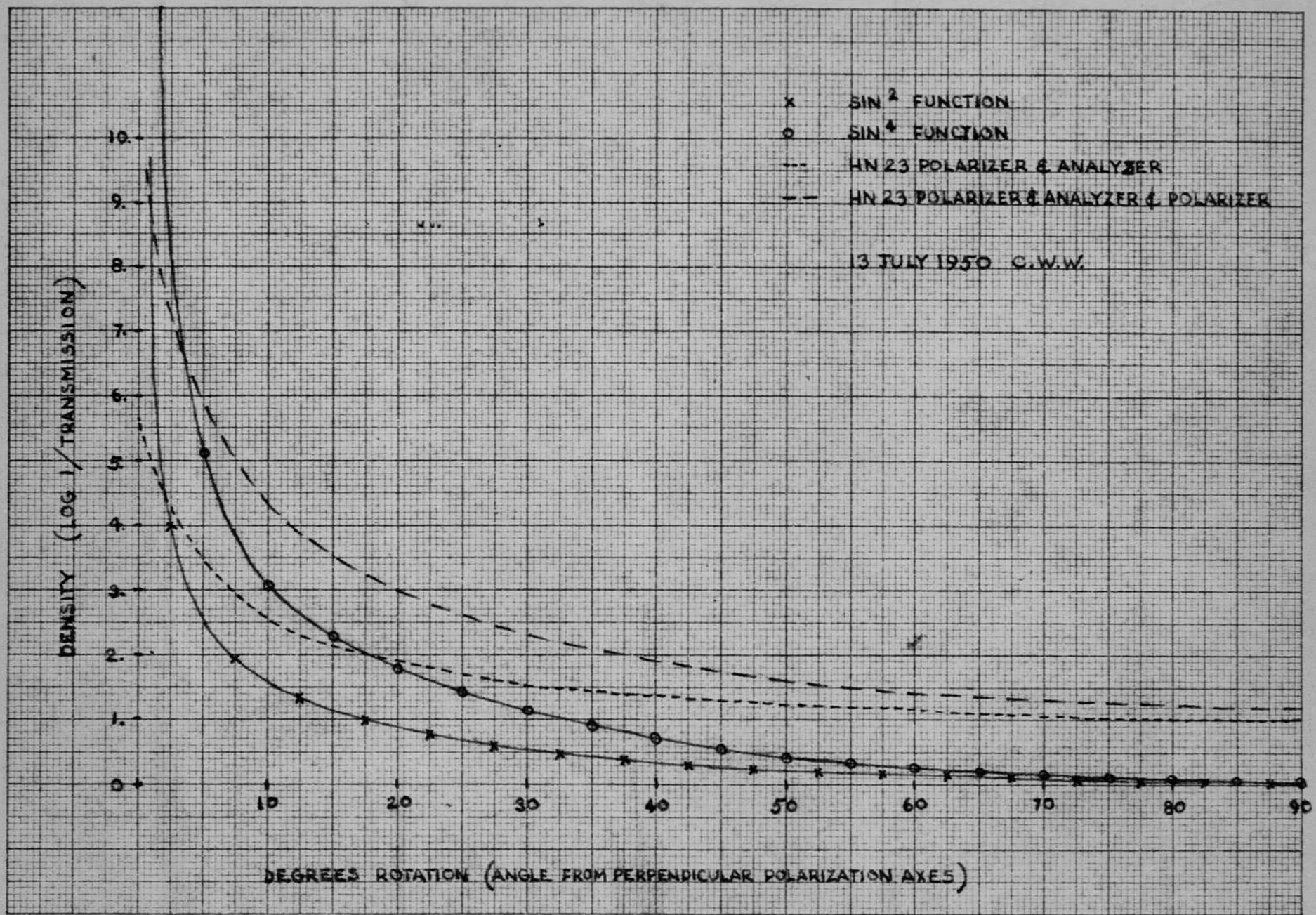




$2\times10^6\left(\frac{D}{D}\right)^2 F$ def. =

Peak

	D	F	def mm	Light cp	bcp / mm	Peak b.c.p.	Pg
Strobe 48"	1	6		12×10^6	2×10^6	12×10^6	33
Argus 10"	1	9	$\left(\frac{10}{48}\right)^2=.0435$			$.785\times10^6$	37
M.F. 20	1	9	$\left(\frac{20}{48}\right)^2=.174$		~~2×10^6~~	3130 "	37
FT-110 20	1	1.3	$\left(\frac{20}{48}\right)^2=.174$			5.45 "	37
airgap. 10	1	6.5	$\left(\frac{10}{48}\right)^2=.0435$			.565	37
FT-230 10	1	7.5	$\left(\frac{10}{48}\right)^2=.0435$			.655	39
EG&G MOVIE 24	1	11.2	$\left(\frac{24}{48}\right)^2=.25$			5.6	39
MF 24	1	10	" = .25			5.0	39
FT-126 24	1	4	" = .25			2.0	43
Local gap. 4"	1	6 mm	$\left(\frac{4}{48}\right)^2=.0069$			.0825	45
" 4"	1	2 mm	$\left(\frac{4}{48}\right)^2=.0069$			.0276	45
Aberdeen gap. 4"	1	9.	$\left(\frac{7}{48}\right)^2=.0213$			.382	45
12KV FT130 60"	2	15.6	$\left(\frac{60}{48}\right)^2=156$			$97.\times10^6$	37
12KV FT-125 60"	1	12.5		1.56		$38.\times10^6$	39.
NEW MICRO FLASH 3" Ref. 60"	2	8.0	$\left(\frac{60}{48}\right)^2$	1.56		$50.\times10^6$	41
2MT 2000 FT-130 60"	1@	7.5	$\left(\frac{60}{48}\right)^2$	1.56		$235.\times10^6$	41
OLD MICROFLASH 1530 60	10	12.5	"	1.56	max.	390×10^6	43
" "	"	3	"	"	min.	93.5×10^6	43.
Firecracker 3"	1	.5	$\left(\frac{3}{48}\right)^2=\left(\frac{1}{16}\right)^2=.0039$			$.0039\times10^6$	47



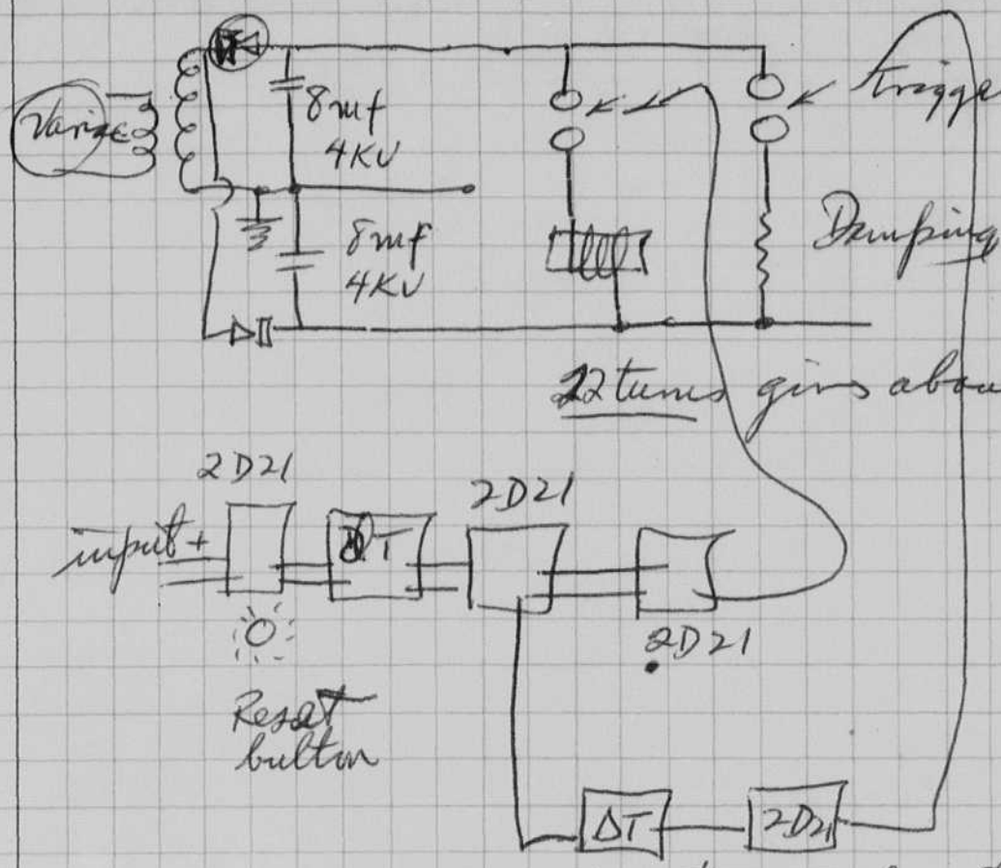
$2\times10^6\left(\frac{D}{D}\right)^2 F$ def. =

Table Peak, ²

	D	F	def mm Light b.c.p.	bcp/mm	Peak b.c.p.	Pg
Strobluna 48"	1	6	12×10^6	2×10^6	12×10^6	37
Argyn 10"	1	9	$\left(\frac{10}{48}\right)^2=.0435$		$.785\times10^6$	37
M.F. 20	1	9	$\left(\frac{20}{48}\right)^2=.174$	~~2×10^6~~	3130 "	37
FT-110 20	1	1.3	$\left(\frac{20}{48}\right)^2=.174$		5.45 "	37
air gap. 10	1	6.5	$\left(\frac{10}{48}\right)^2=.0435$		.565	37
FT-230 10	1	7.5	$\left(\frac{10}{48}\right)^2=.0435$		.655	39
EGG MOVIE 24	1	11.2	$\left(\frac{24}{48}\right)^2=.25$		5.6	39
MF 24	1	10	" = .25		5.0	39
FT-126 24	1	4	" = .25		2.0	43
Low I gap. 4"	1	6 mm	$\left(\frac{4}{48}\right)^2=.0069$		.0825	45
" 4"	1	2 mm	$\left(\frac{4}{48}\right)^2=.0069$		.0276	45
Aberdeen gap. 4"	1	9.	$\left(\frac{7}{48}\right)^2=.0213$		.382	45
12KV FT130 60"	2	15.6	$\left(\frac{60}{48}\right)^2=1.56$		$97.\times10^6$	37
12KV FT12560"	1	12.5	1.56		$38.\times10^6$	39.
NEW MICRO FLASH 8" Ref. 60"	2	8.0	$\left(\frac{60}{48}\right)^2$ 1.56		$50.\times10^6$	41
2mf 2000 FT-130 60"	10	7.5	$\left(\frac{60}{48}\right)^2$ 1.56		$235.\times10^6$	41
OLD MICROFLASH 1530 60	10	12.5	" 1.56	max.	390×10^6	43
" "	"	3	" "	min.	93.5×10^6	43.
Fire cracker 3"	1	.5	$\left(\frac{3}{48}\right)^2=\left(\frac{1}{16}\right)^2=.0039$		$.0039\times10^6$	47

July 21 1950
H. S. Shorter
Hale Mason

Papatmic tune up.



with 22 turn coil set at 70 on dial

Aug 2 1950
H E Edgerton

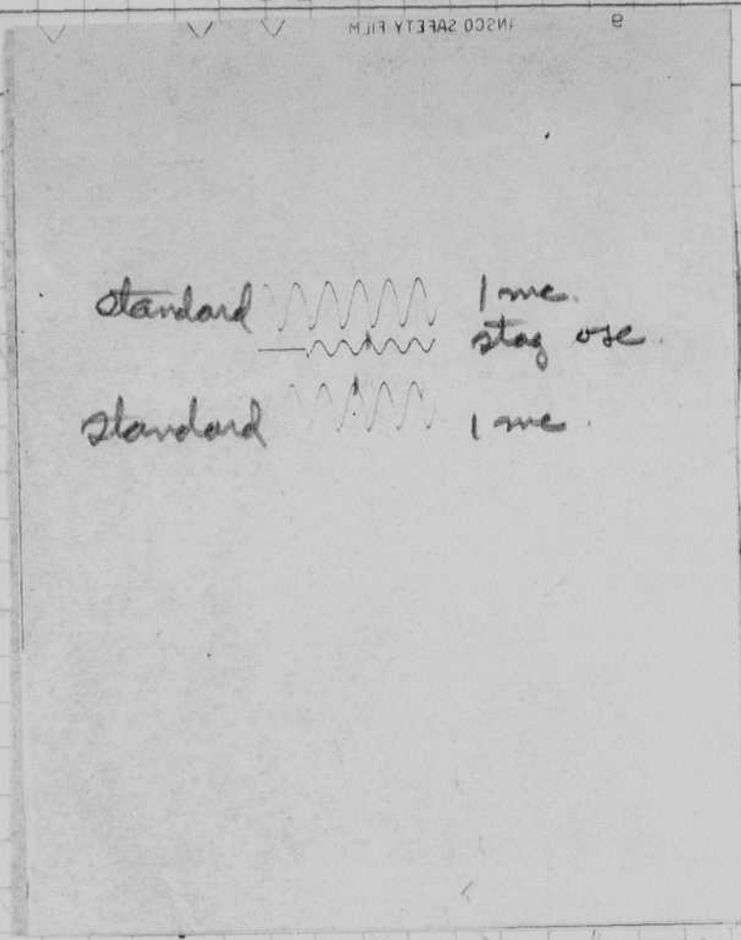
July 25 left noon for Aberdeen - arrived July 26 Wed about 1.30. Went to see Miller first in pur. dept. then Dr Jane Dewey about SR movie equipment.
Set up Rapatronic and shot explosive Pentolite at f 11 — 5 µs. with no delay. Photo trip 6 to 8 ft away with 10 K into a ~~S~~ 6SN7 tube as a cathode follower.

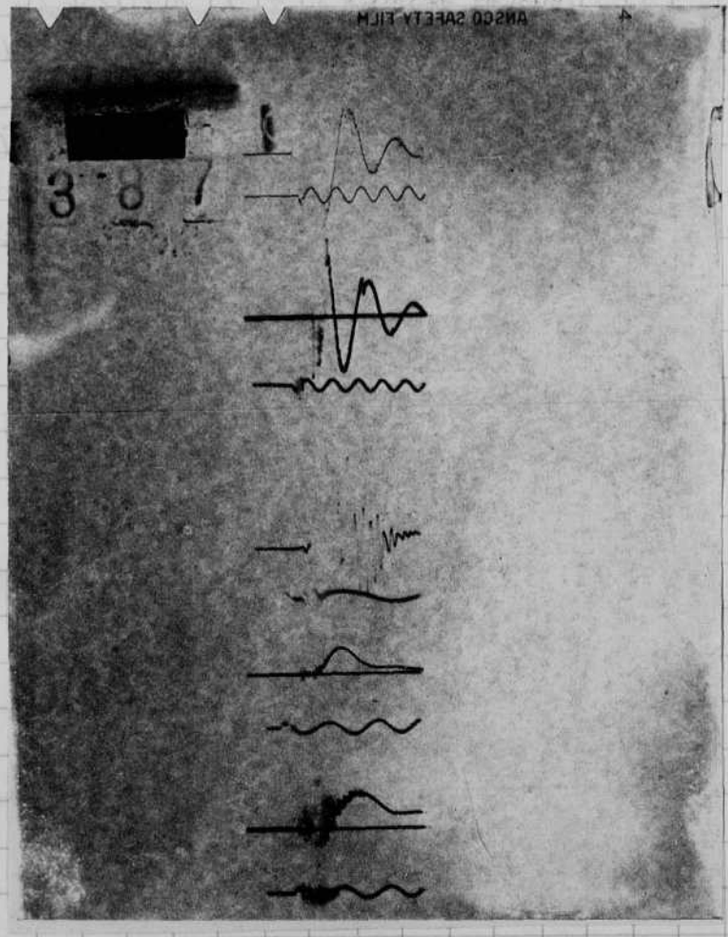
P.C. 929

July 27 ditto explosions. With TNT the resistor in the PC was increased to 100 K. for trip. Exposure was weak on the film.

Pentolite (?) spheres were photographed both with a single exposure and 3 exposures on the same plate. This was done with Sultanoff who is working with a grid type ultra high speed camera.

In afternoon set up in Dunn's lab next door also in the terminal ballistic lab. The problem was to photograph a ball at 4000 fps before it hit a plate of alum





per cycle
0.65 μs

Osc No.

Test of no new Scope # 5 E. J. B.

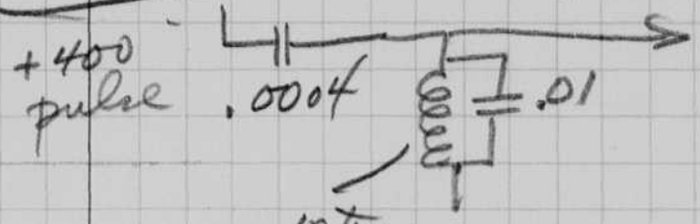
670 Sweepsped Op. KC tuning

670 " " 24 mc.

Exposure test.

935 photo tube pickup with 1000 ohm load resistor into scope with 2000 volts on the plate.

Back to old scope no camera



7 turns 5387

calibrated against 1 mc. on sweep 5.

0.26" = 1 cycle.

1. Current in gap alone on Moviefilm.

2. Ditto but with series resistance cut out High freq component.

$5 \times \frac{5.5}{.19} \times \frac{.19}{53} = 45.$ 3. Spark pulse

$\frac{5}{225}$ mc.

4. Light output 1½ ft ± 6 P.C.

5. " " series spark 8" 1/16" gap.

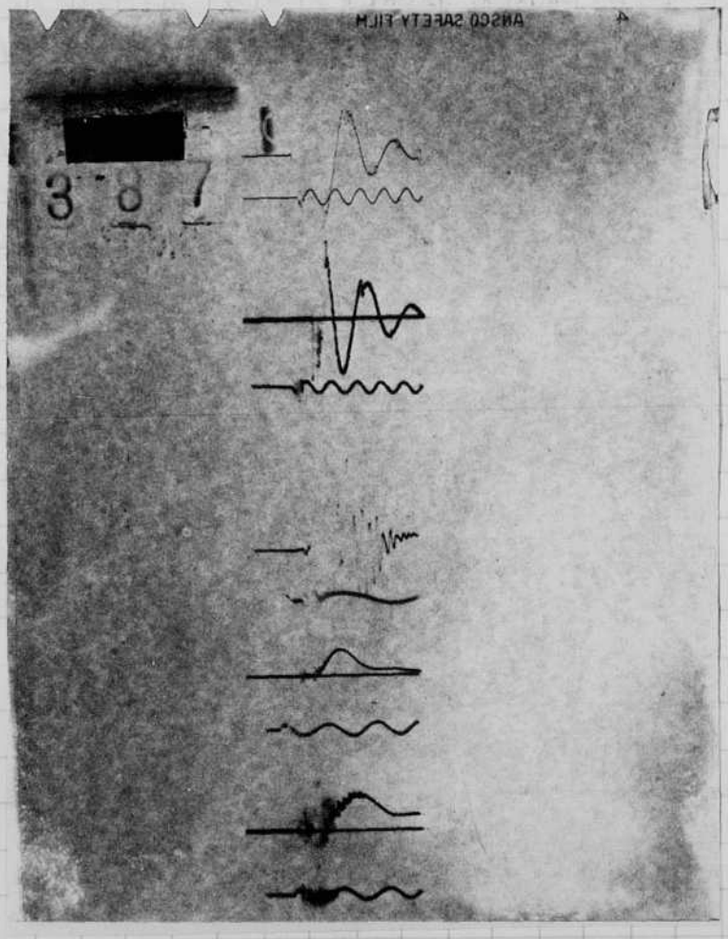
shows large afterglow. ?

---

standard ∧∧∧∧ 1 mc.
—∿∿∿ stag osc.

standard ∧∧∧ 1 mc.

perge
0.65 μs



Osc No.

Test of no new Scope # 5 E. & B.

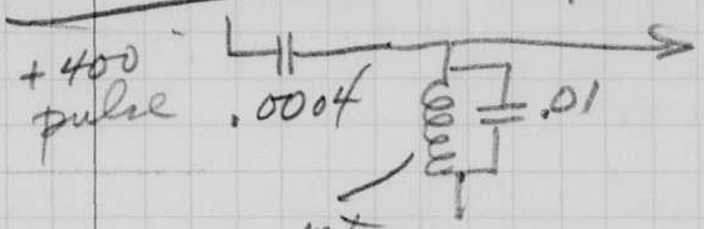
670 Sweep speed Op. KC tuning

670 " " 24 mc.

Exposure test.

935 photo tube pickup with 1000 ohm load resistor into scope with 2000 volts on the plate.

~~Back to old scope~~ no camera



7 Lumo 5387

Calibrated against 1 mc. on sweep 5.

1. Current in gap alone on M view finder.

2. Ditto but with series resistance cut out High freq component.

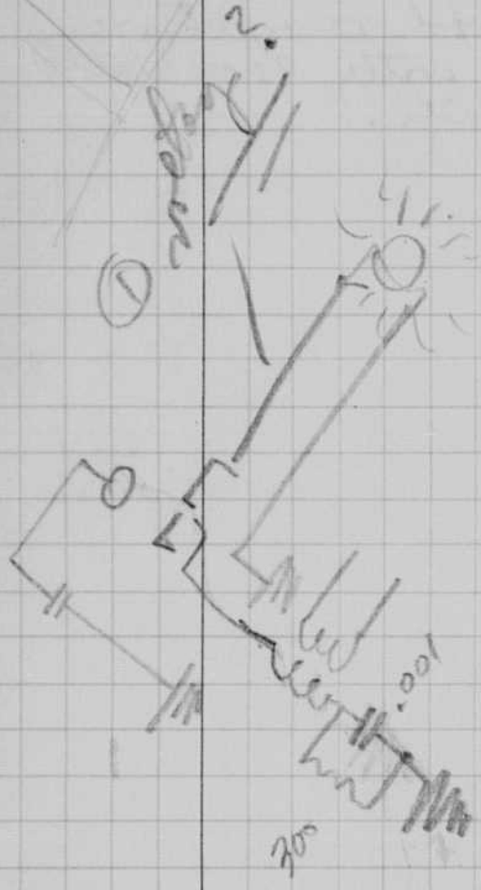
3. Spark pulse

5 x 5/19 x 9/5 = 45/5 = 9 / 225 mc.

4. Light output 1 1/2 ft ± 5% P.C.

5. " " series spark 8" 1/16" gap.

shows large afterglow. ?



① metal

② table

right

angle

0.65 MS/cycle.

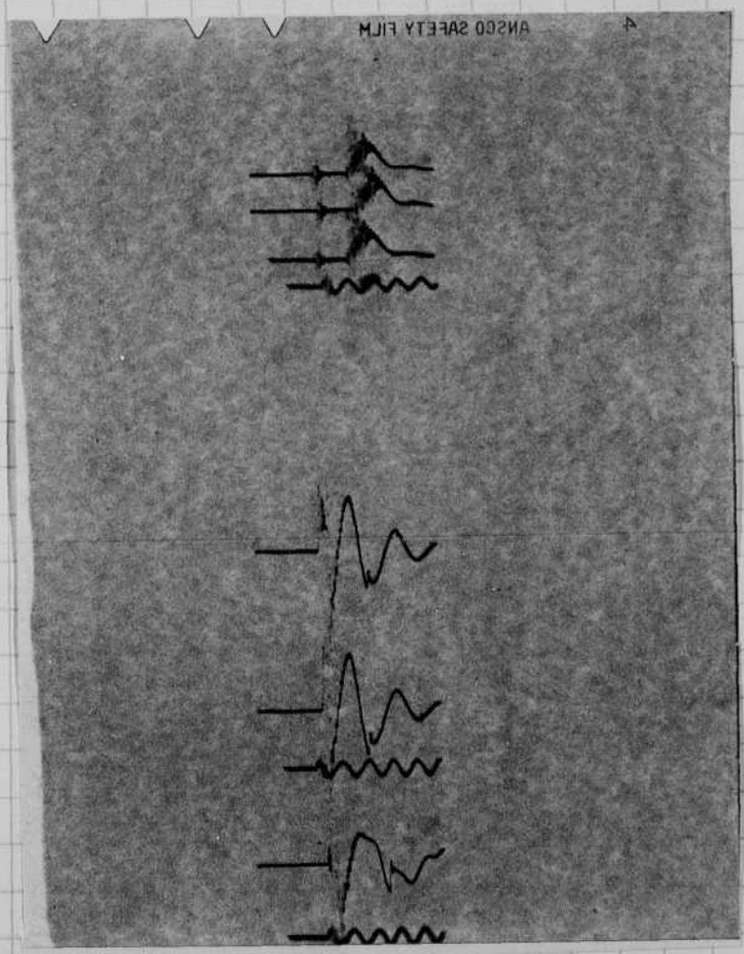
① Oxygen 3 traces + ~~kk~~ mc.

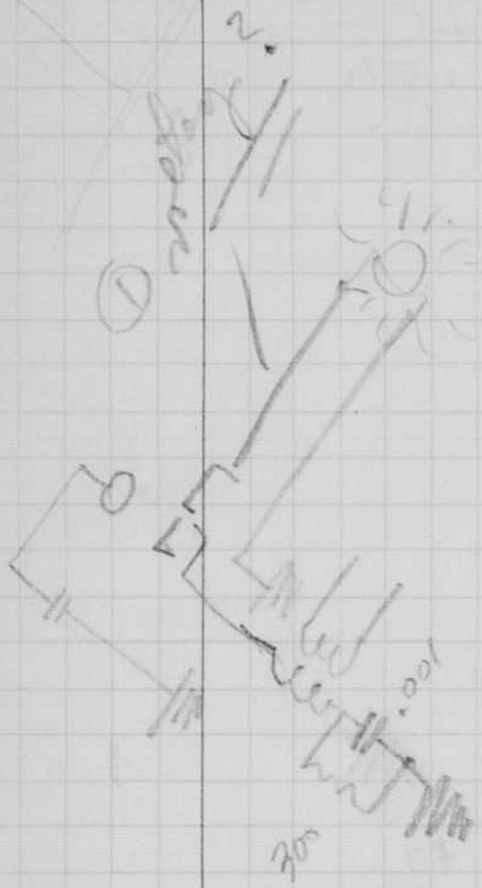
2.

3

4. – ac current with external leads shorted. Spark gap.

5. Ditto but with 4 ft RG 54 cable





2 table

right

0.65 μs/cycle.

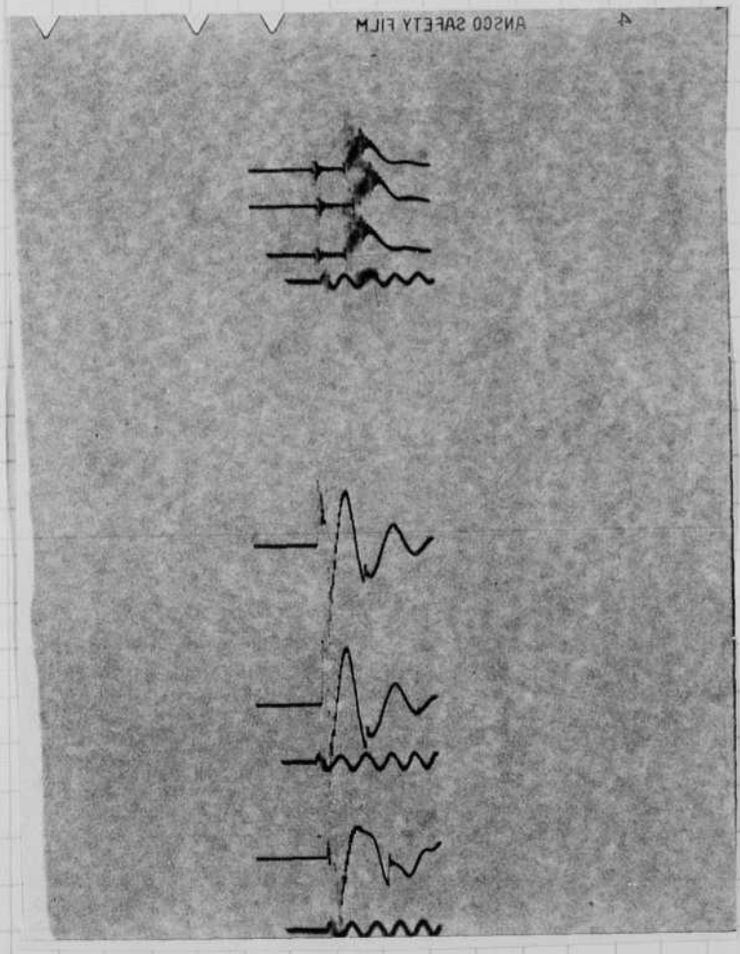
① Oxygen 3 traces + ~~1~~ mc.

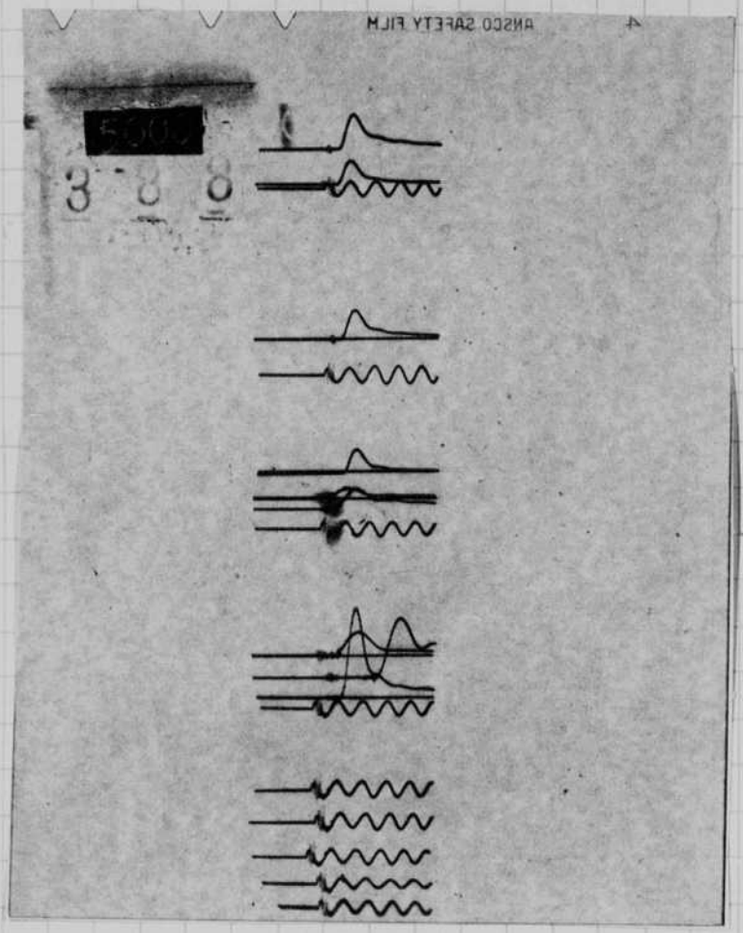
2.

3

4. – ac current with external leads shorted. 5 spark gap.

5. Ditto but with 4 ft RG54 cable





Aug. 3 1950.
Mr. Edgerton.
Mr. Germeshausen.

Light-time curves.

Film no 5388

Oldscope. air gap 0.25 12KV gap.

Film no	D.	C	V	Sweep.	calib	
1	2'	0.25	12KV	6	0.65 μs	2 traces
2	2'	"	"	"	"	with zero line.
3	2'	"	"	"	"	with 4ft RG54 cable and 1/16" gap in series.

a. Open gap no series gap

b. 2' " " with series gap cable and gap. Light from open gap only.

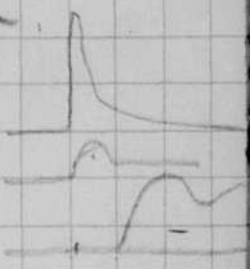
c. 1' 1/16" gap in series with cable. ~~e.~~ Light from small 1/16 gap

d. 0.65 μs/cycle timing wave.

4 4'? Argonne lamp BR 1501 center.

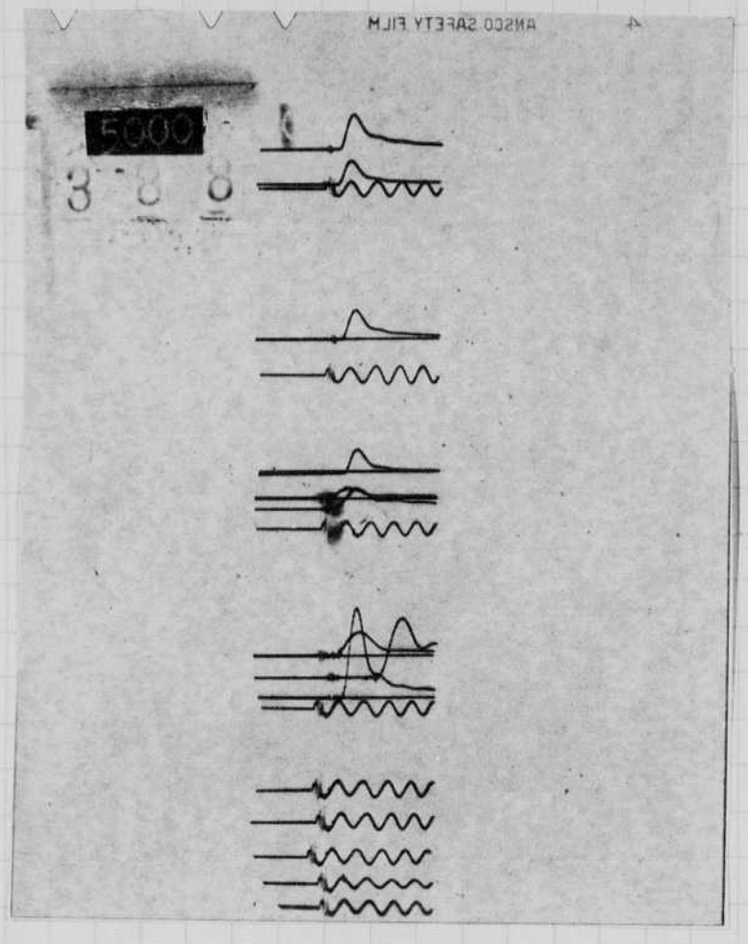
1' Gap (trigger). (above in series). top

1' " without series lamp. bottom



5. Timing waves showing trigger start on position dial.

70
72.5
75
77.5
80.



Aug 3 1950.
H.E. Edgerton
See Morrel.

Light-time curves.

Film no 5388

Oscilloscope. air gap 0.25 12KV gap.

Film no	D.	C	V	Sweep.	calib	
1	2'	0.25	12KV	6	0.65us	2 traces
2	2'	"	"	"	"	with zero line.
3	2'	"	"	"	"	with 4ft RG54 cable and 1/16" gap in series

a. open gap no series gap

b. 2" " with series gap cable and gap. Light from open gap only.

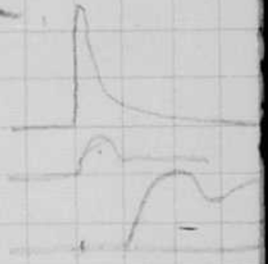
c. 1' 1/10" gap in series with cable. ~~also~~. Light from small 1/10 gap

d. 0.65us/cycle timed wave.

4 4'? Argon Morris lamp SR1501 center

1' Gap (trigger). (above in series). top

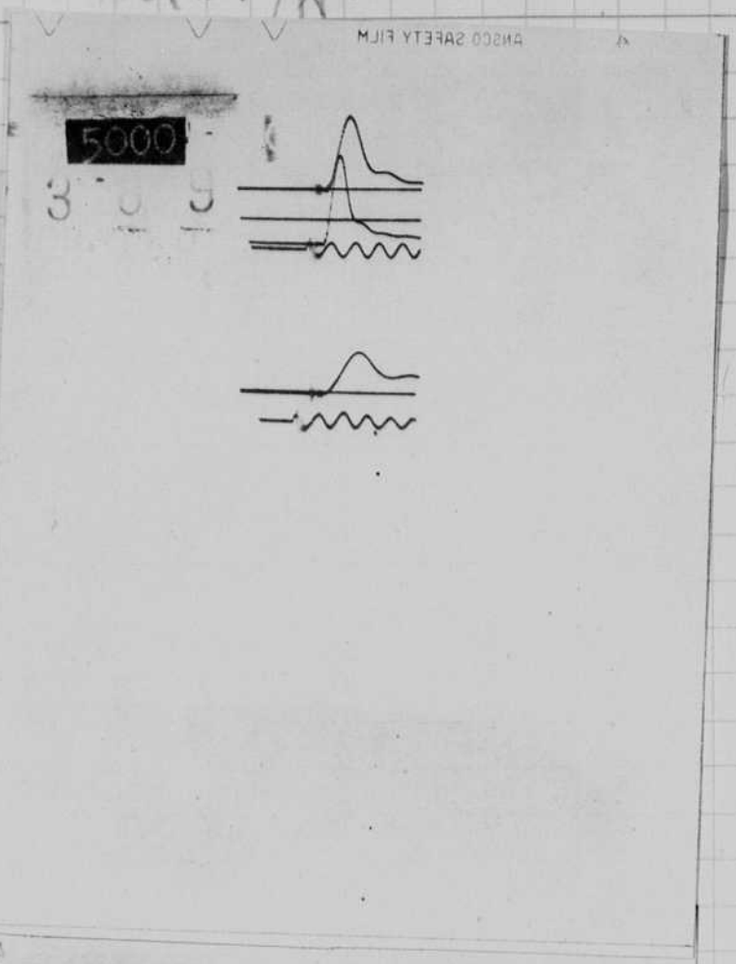
1' " without series lamp. bottom



5, Timing waves showing trigger start on position dial.

70
72.5
75
77.5
80.

54 cable .089 mh/ft.



Cont.

5389.

① 1' Bafe clone. Filmon

1' Bafe light (with FT-130 in series) 5389

4' (with cloth?) FT-130 - 4/4 RG 54.

2. a RG 54 FT-130. } Do not compare max.

b Twin X 4/4 FT-130 300 or line.

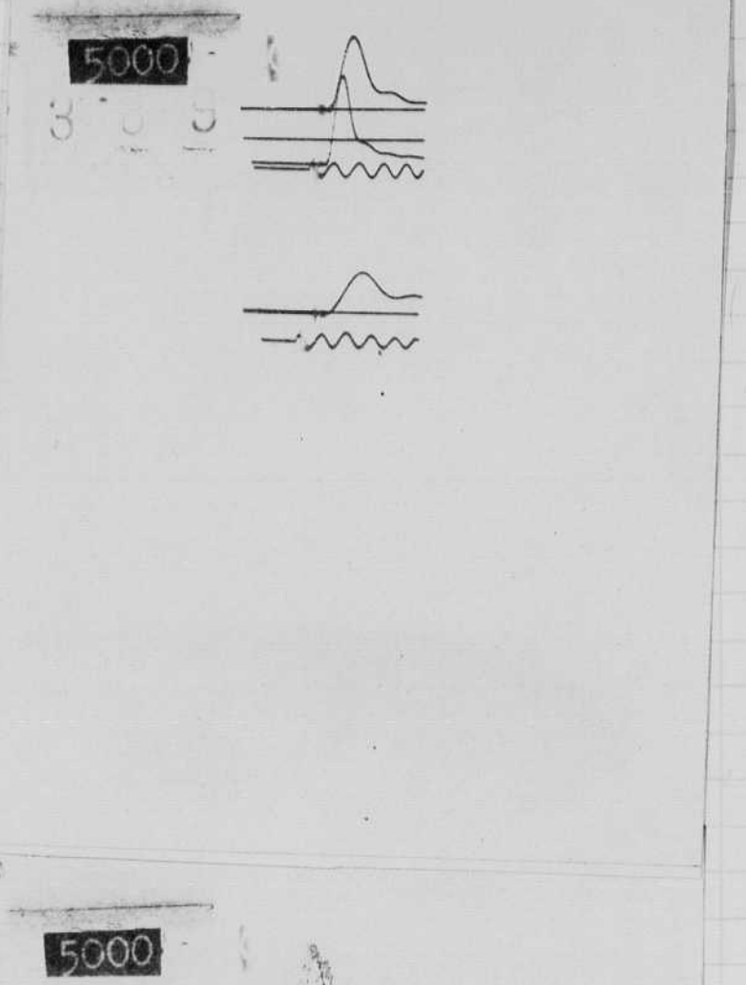
5390

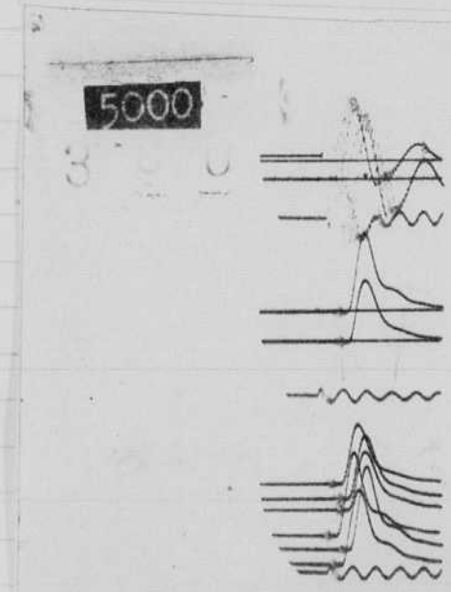
1. Argus FT-130 with 1½ ft lead. ~~5391~~

4' x 2 filter. ($\frac{9}{12}$ x 0.4 olms in and out.

2. Ditto $\frac{18}{12}$ x 0.4 olms in and out.

54 mR/hr .089 mR/hr.





Cont.

5389.

① 1' Gap clone.
1' Gap light (with FT-130 in series) 5389
4' (with cloth?) FT-130 - 4/4 RG 54.

2. a RG 54 FT-130. } Do not compare max.
b Twin x 4/4 FT-130 300 Ω line.

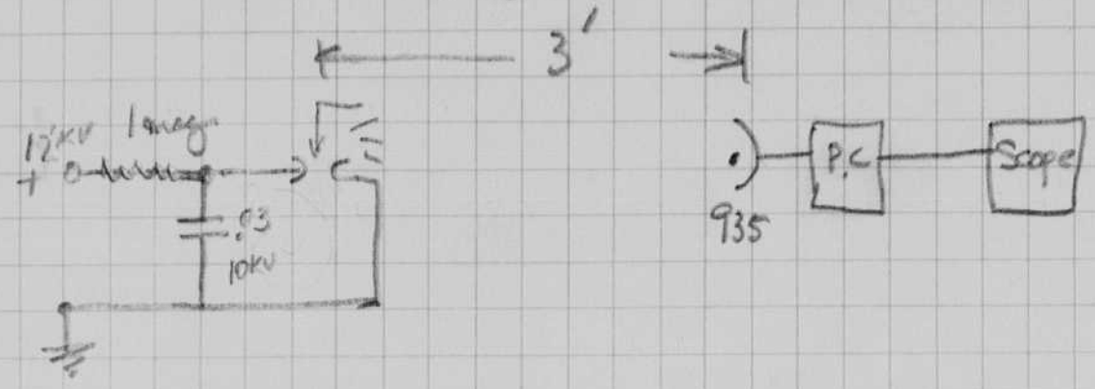
5390 ~~599~~

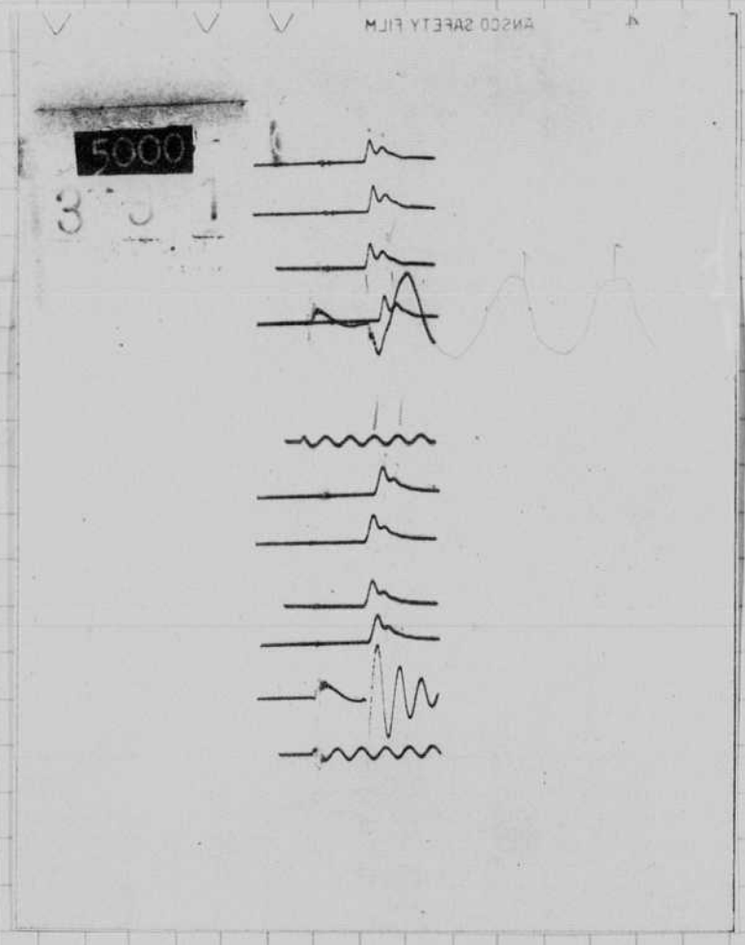
1. Argon FT-130 with 1½ ft lead.
4' x 2 filter. ($\frac{7}{12}$ x 0.4 ohms) in and out.

2. Ditto $\frac{18}{12}$ x 0.4 ohms in and out.

Schematic over Condenser.

Data on page 63





.65 μs/cycle

Aug 3 1950 Cont:-

Using new condenser .03 μfd 10 KV making an air gap ($\frac{3}{8}$") on the condenser trigger from unit and High Voltage approx: 12 KV obtained from unit. Sweep no 6 old scope

Film no 5391

1) Light output from air gap
" " " "
" " " "

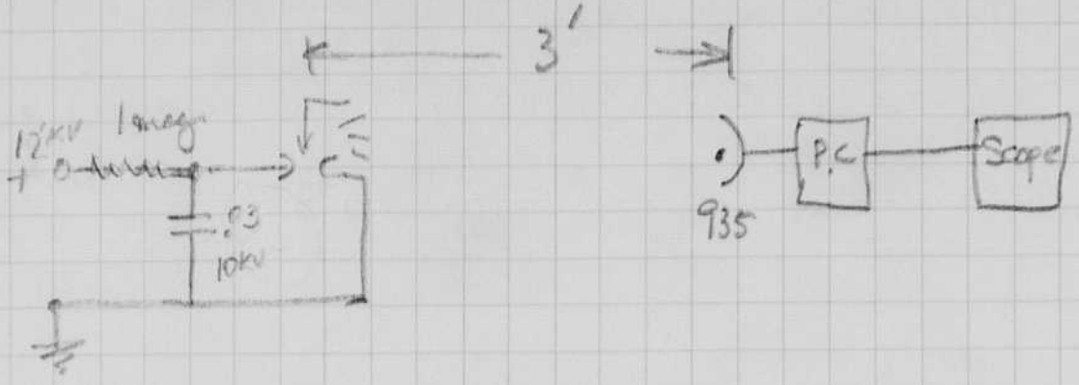
2) Light output from air gap
Resonant freq of air gap
Calibration 0.65 μs/in

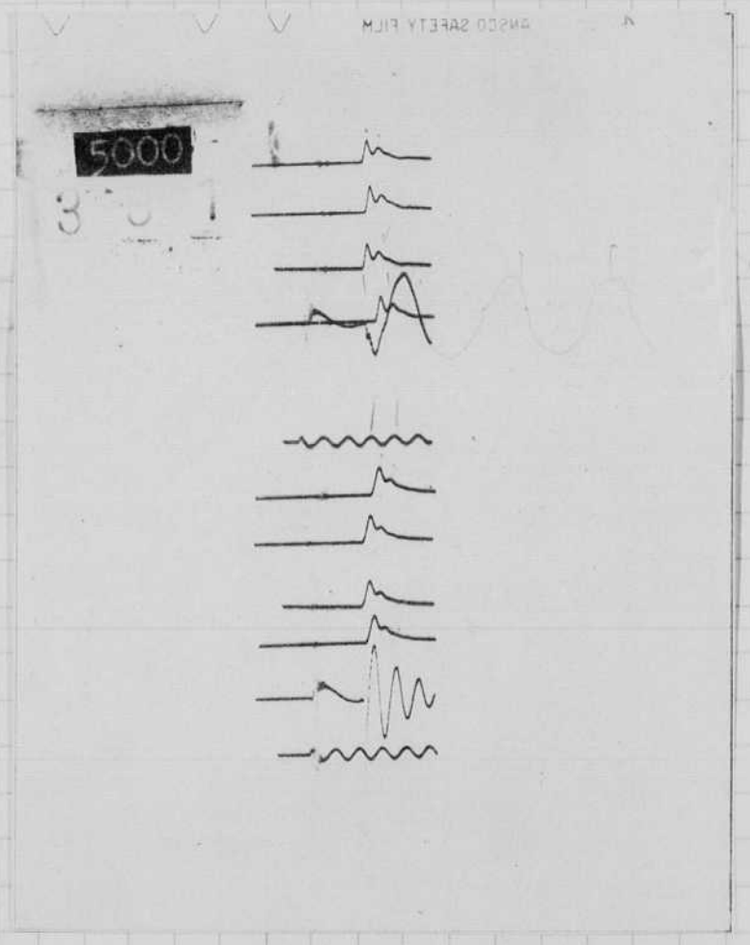
3) Light output from air gap 6-.03 μfd
with filter ×10 @ p.c. 3' away from gap
2 " " " " " "
3 " " " " " "

4) Same as above.
Resonant Frequency of air gap (6-.03 μfd
Calibration 0.65 μs/in

Schematic over Condenser

Data on page 63





.65 ms/cm

Aug 3 1950 Cont:-

Using new condenser .03 μfd 10 KV Film no
making an air gap (3/8") on the condenser 5391
trigger from unit and High Voltage approx: 12 KV
obtained from unit. Sweep no 6 old scope

1) Light output from air gap
" " " "
" " " "

2) Light output from air gap
Resonant freq & air gap
Calibration 0.65 μs/in

3) Light output from air gap 6-.03 μfd
with filter x10 @ p.c. 3' away from gap
2 " " " " "
3 " " " " "

4) Same as above.
Resonant Frequency & air gap (6-.03 μfd
Calibration 0.65 μs/in

Aug 4, 1950 — new 29th Scope 102 24 KV

R. E. Taylor

Reflector type.

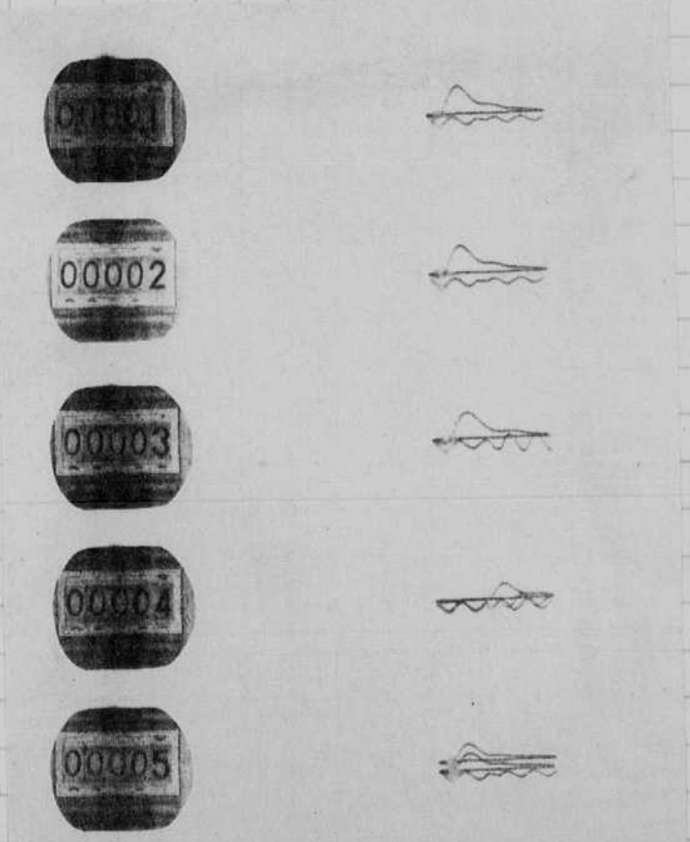
102-1 Argon gap FT-130 0.25 mf 12 KV with series gap. 4 ft x 2 x 10 filters.

2. Ditto

3. Ditto but with 4 ft cable to FT-130.

4. 2 ft away Air gap no filter 1/8" gap open

5. 1 1/2 ft from 1/16" Chlorine gap 1 atmosphere.



Aug 4, 1950 new 29th Scope 102 24 KV

A. E. Edgerton

Reflector type.

no.

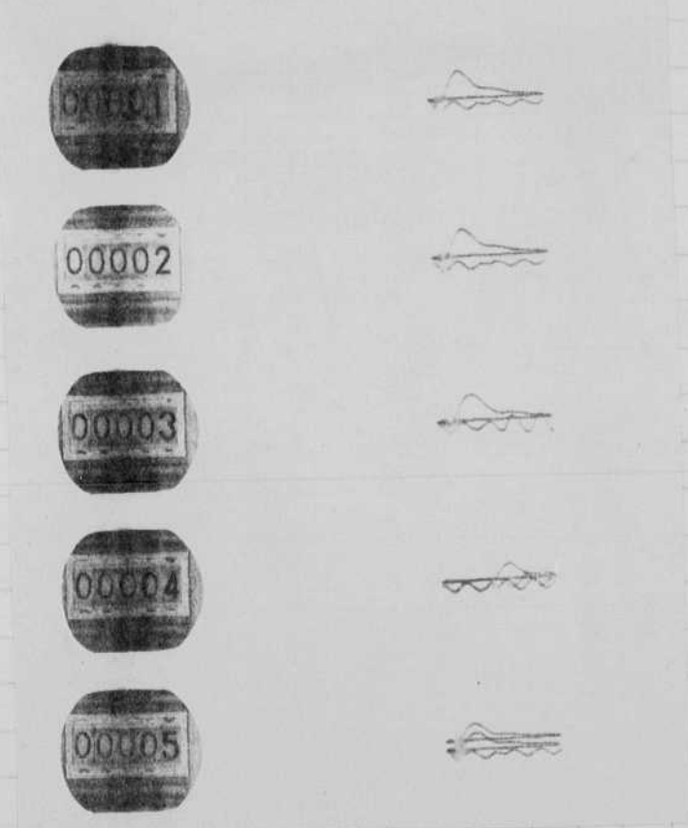
102-1 Argon gap FT-130 0.25 μf 12 KV with series gap. 4 ft x 2 x 10 filters.

2. Ditto

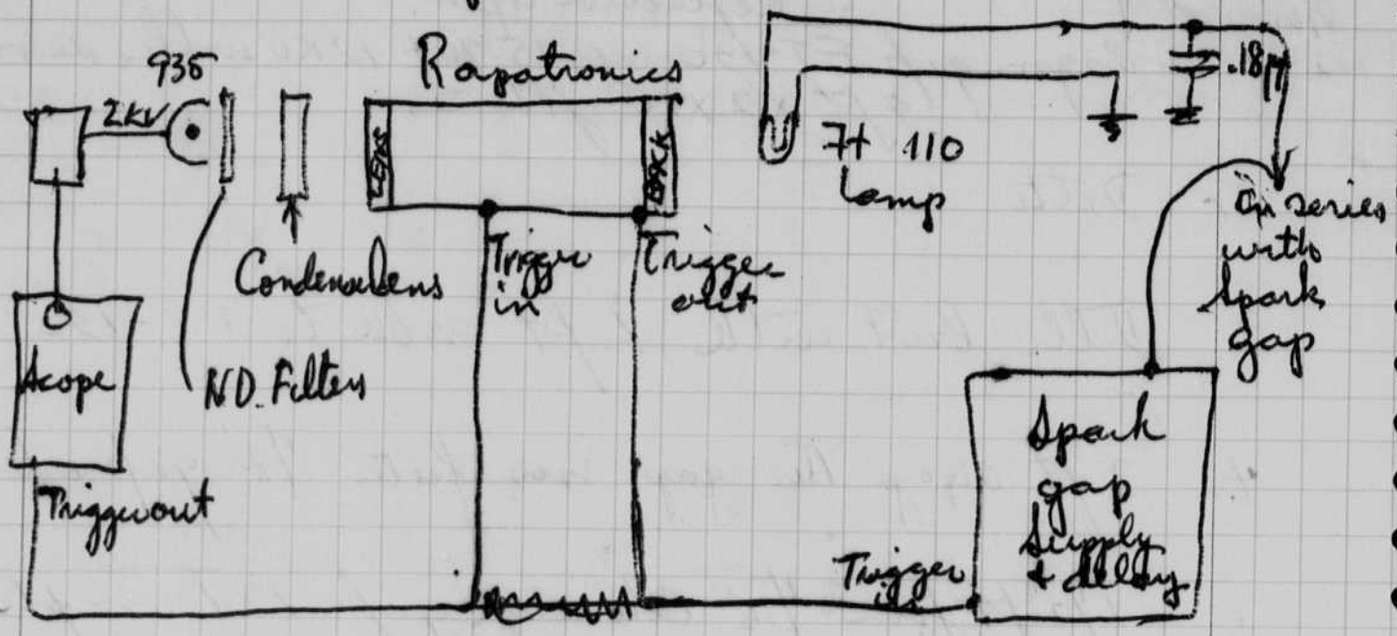
3. Ditto but with 4 ft cable to FT-130.

4. 2 ft away Air gap no filter 1/8" gap open

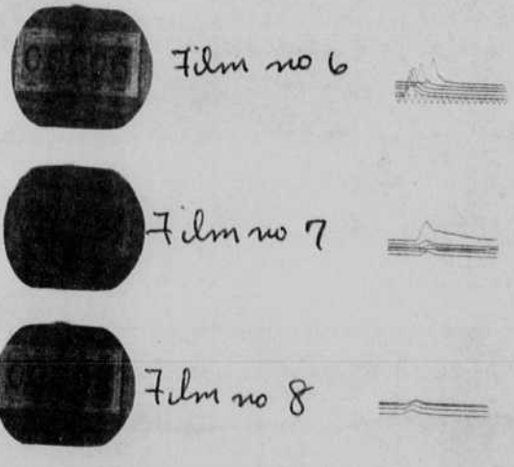
5. 1½ ft from 1/16" Chlorine gap 1 atmosphere.



Schematic of set up



For data on page 67



Aug 4 1950
H E Edgerton
W. W Wolf
J. N Jarvis

Tuning ~~of~~ Rapatronics

Unit

Trigger delay setting of Spark gap

Film no 6

1)	Setting of	100		1) 2.6 μs
2)	"	" 75		2) 1.3 μs
3)	"	" 50	from Analyzing film	3) .65 μs
4)	"	" 25		4)
5)	"	" 0		5) 0 μs

Film no 7

(1) Slug from Rapatronics was pulled up and flashed 7+ 110 lamp on photo cell with condenser lens. It required a N.D. Filter of 1.6. Slug pulled out.

2) Slug in with delay setting of 80 in Spark gap unit

No Filter

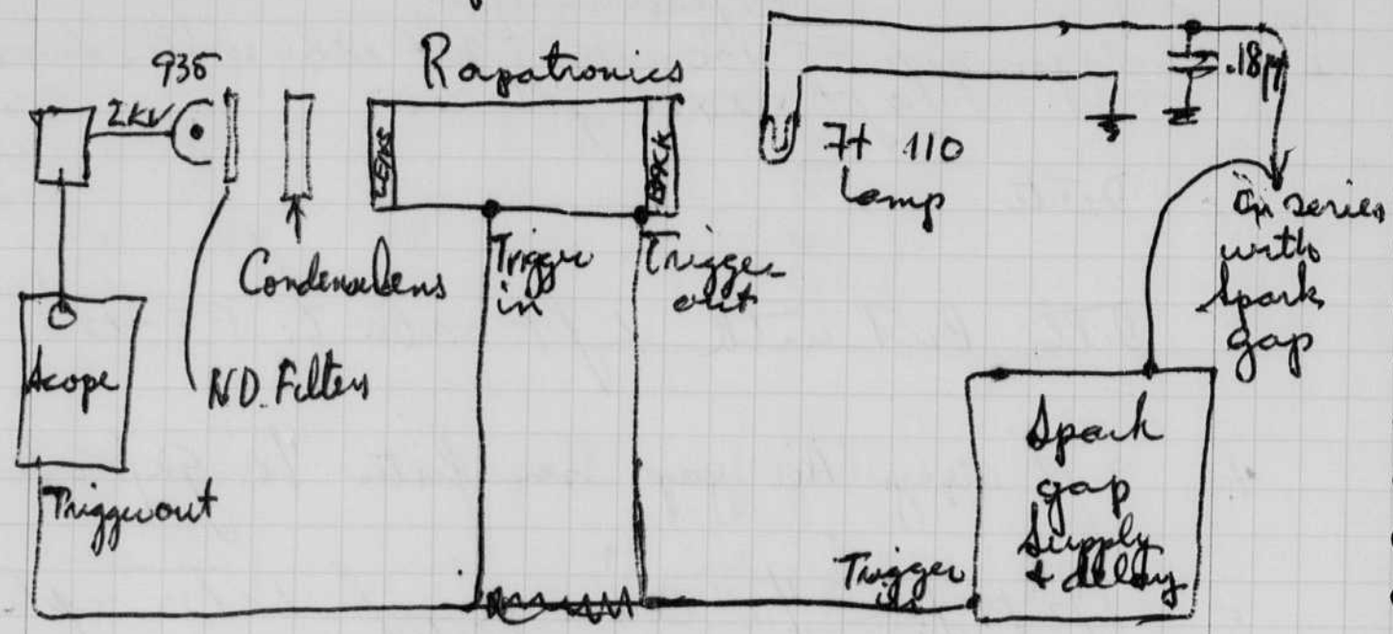
"	"	"	"	"	of	85	"	"
"	"	"	"	"	"	90	"	"
"	"	"	"	"	"	75	"	"

Film no 8

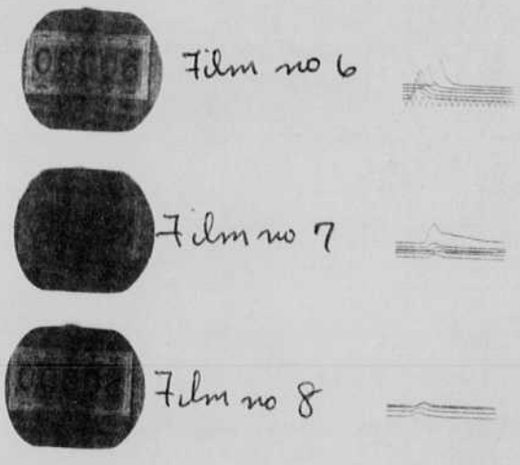
1	Slug in	with	delay	setting	of	80	in	Spark	gap	unit
2	"	"	"	"	"	"	75	"	"	"	"
3	"	"	"	"	"	"	70	"	"	"
4	"	"	"	"	"	"	65	"	"	"

Film no 9

Schematic of set up



For data on page 67



Aug 4 1952

H E Edgerton
W. Wolfe
S. N Gaurwel

Tuning ~~of~~ Rapatronics

Trigger delay setting of Spark gap ~~delay~~ Unit

Film no 6

1)	Setting of 100	From Analysis of Film	1) 2.6 μs
2)	" " 75		2) 1.3 μs
3)	" " 50		3) .65 μs
4)	" " 25		4)
5)	" " 0		5) 0 μs

Film no 7

(1) Slug from Rapatronics was pulled up and flashed FT 110 lamp on photo cell with condenser lens. It required a N.D. Filter of 1.6. Slug pulled out.

2) Slug in with delay setting of 80 in Spark gap unit

No Filter:

Slug in with delay setting of	80	in Spark gap unit
" " " " " "	85	" "
" " " " " "	90	" "
" " " " " "	75	" "

Film no 8

1	Slug in with delay setting of	80	in Spark gap unit
2	" " " " " "	75	" " "
3	" " " " " "	70	" " "
4	" " " " " "	65	" " "

Film no 9

Film no 9

Film no 10

Aug 4 1950
H Edgerton
W. Ward
D. Gavriel

Cont. Timing & Rapatronics

Film no 9

Using same set up as described on page 66 the following pictures were taken:

Film no 9

1.	Timing trace .65 μs/cycle								
2.	Light Calibration standard with slug out and 1.6 N.D. Filter								
3	Slug in	Delay setting of Spark Unit to					20	Sensitivity set	0
4	"	"	"	"	"		40	"	"
5	"	"	"	"	"		60	"	"
6	"	"	"	"	"		70	"	"
7	"	"	"	"	"		80	"	"
8	"	"	"	"	"		90	"	"
9	"	"	"	"	"		100	"	"
10	Timing trace .65 μs/~								

Film no 10

Same set up as above:

1.	Timing trace .65 μs/~								
2.	Slug pulled out	delay setting of Spark Unit set to					0.	Filter	1.6
3	"	"	"	"	"	"	"	10	"	"
4	"	"	"	"	"	"	"	20	"	"
5	"	"	"	"	"	"	"	30	"	"
6	"	"	"	"	"	"	"	40	"	"
7	"	"	"	"	"	"	"	50	"	"
8	"	"	"	"	"	"	"	60	"	"
9	"	"	"	"	"	"	"	70	"	"
10	"	"	"	"	"	"	"	80	"	"
11	"	"	"	"	"	"	"	90	"	"
12	"	"	"	"	"	"	"	100	"	"
13	"	"	"	"	"	"	"	105	"	"
14	"	"	"	"	"	"	"	110	"	"
15	"	"	"	"	"	"	"	100	"	"
16	Timing trace .65 μs/~								Sensitivity set to 50	

Film no 9

Film no 10

Aug 4 1950
H Edgerton
W. Ward
D. Gaviel

Cont. Timing & Rapatronics

Film no 9

Using same set up as described on page 66 the following pictures were taken:

Film no 9

1.	Timing trace .65 μs/cycle								
2.	Light Calibration standard with slug out and 1.6 N.D. Filter								
3	Slug in	Delay setting of Spark Unit to					20	Sensitivity set	0
4	"	"	"	"	"	"	40	"	"
5	"	"	"	"	"	"	60	"	"
6	"	"	"	"	"	"	70	"	"
7	"	"	"	"	"	"	80	"	"
8	"	"	"	"	"	"	90	"	"
9	"	"	"	"	"	"	100	"	"
10	Timing trace .65 μs/~								

Film no 10

Same set up as above:

1.	Timing trace .65 μs/~								
2.	Slug pulled out	delay setting of Spark Unit set to					0.	Filter	1.6
3	"	"	"	"	"	"	10	"	"
4	"	"	"	"	"	"	20	"	"
5	"	"	"	"	"	"	30	"	"
6	"	"	"	"	"	"	40	"	"
7	"	"	"	"	"	"	50	"	"
8	"	"	"	"	"	"	60	"	"
9	"	"	"	"	"	"	70	"	"
10	"	"	"	"	"	"	80	"	"
11	"	"	"	"	"	"	90	"	"
12	"	"	"	"	"	"	100	"	"
13	"	"	"	"	"	"	105	"	"
14	"	"	"	"	"	"	110	"	"
15	"	"	"	"	"	"	100	"	"
16	Timing trace .65 μs/~							Sensitivity set to 50	

Result

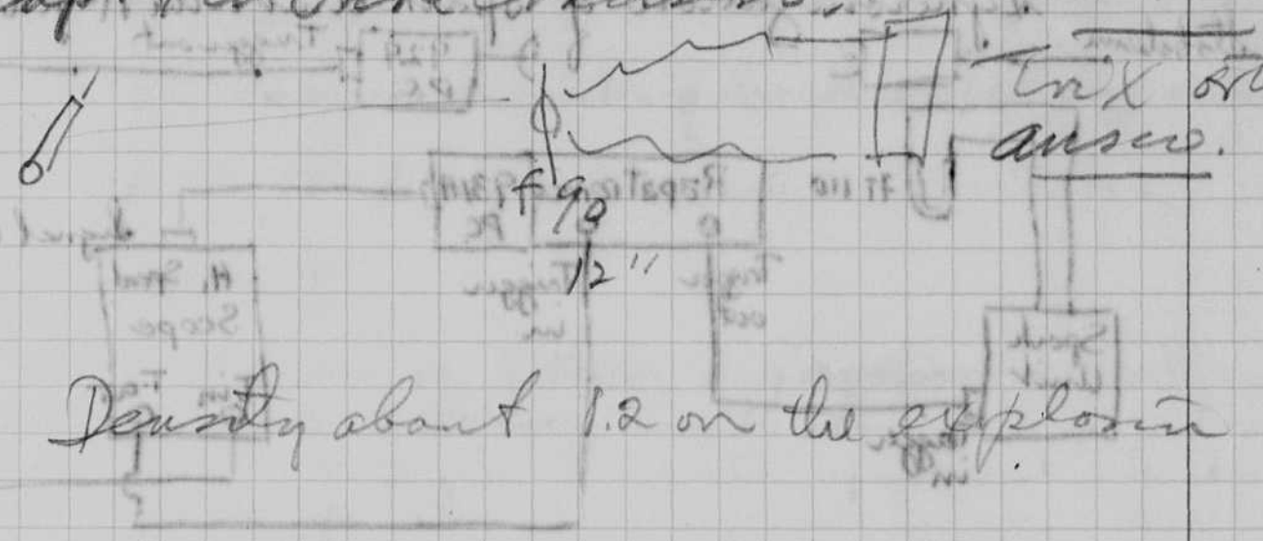
A Heavy effort

B Flight of paper in the air

C Dildo

Exposure without sleeve.

capt Kidd Fire Crackers.

(A) 

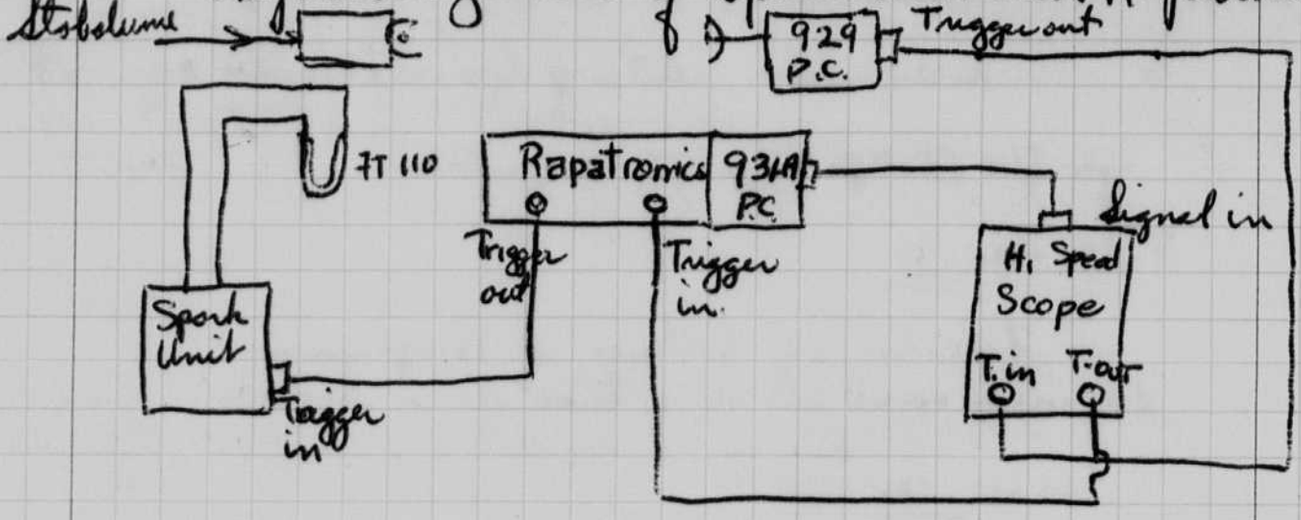
Tri X or the same.

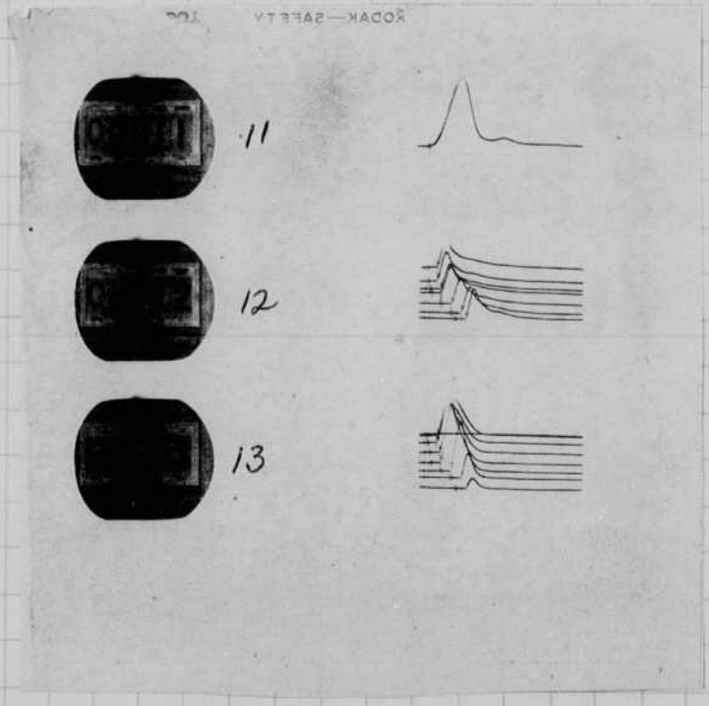
Density about 1.2 on the explosion.

(B) Ditto but with Spark and Lens

C " " " " " " and ×20 filter on the light.

Schematic of set up to get Synchronization of Spark Unit with Rapatronics





Aug 5 1950
H.E. Edgerton
W. Wood
J. Daniel

Syncronization of Spark Unit with Rapatronics

Using the set up as shown on page 72 to obtain syncronization of Spark Unit delay setting with the Rapatronics camera.

Film no 11

Film no 11 taken of Rapatronics shutter opening and closing time.

Film no 12

Using 7T-110 lamp with Spark unit and same set up as on page 72 delay setting of unit was taken: Slug pulled out and double cloth over camera lens.

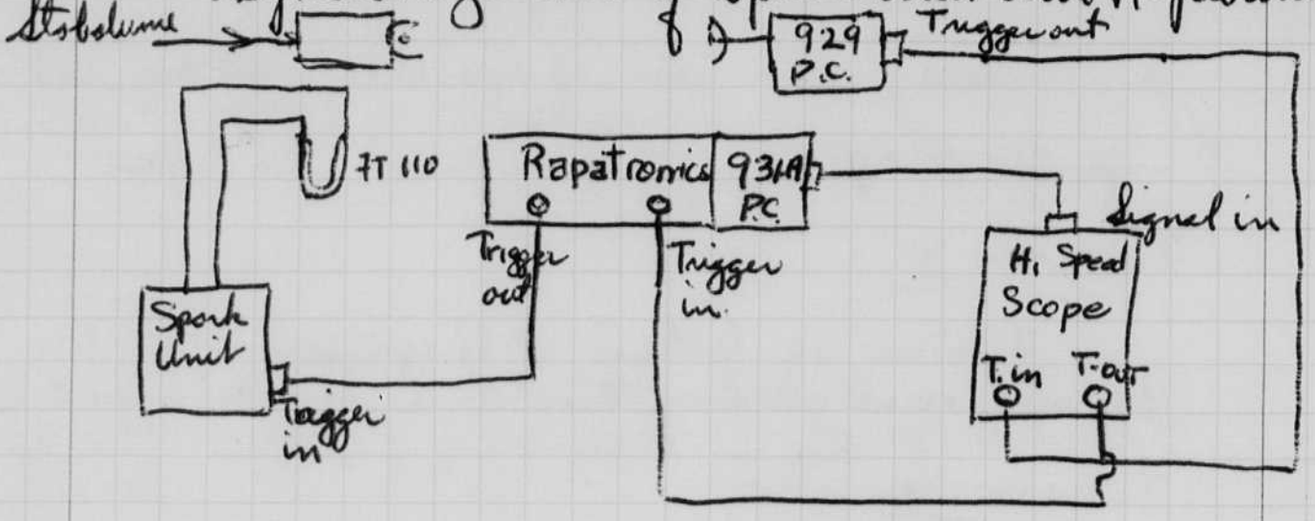
Delay Dial setting on Spark Unit
0 / 20 / 40 / 60 / 80 / 100 / 110

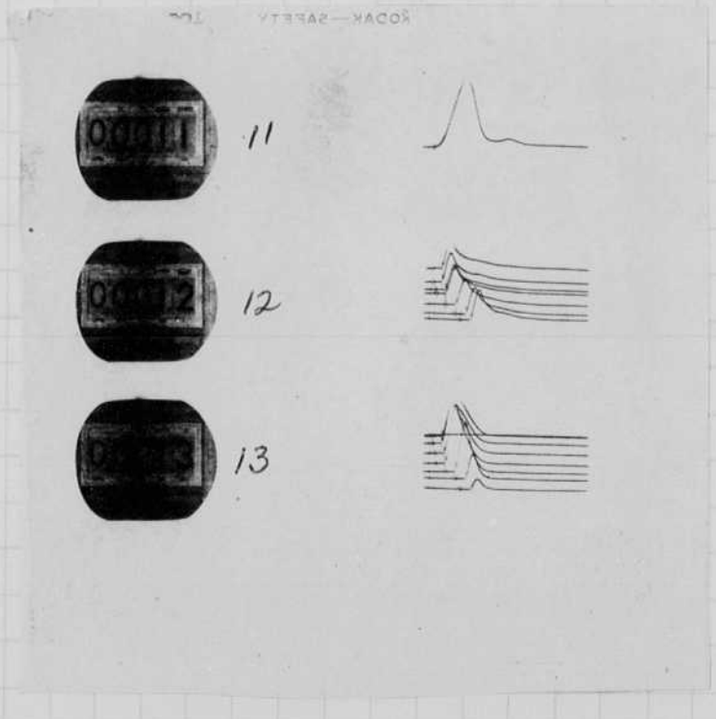
Film no 13

Same set up as above but with slug in

Delay Dial setting on Spark Unit
0 / 20 / 40 / 60 / 80 / 100 / 110

Schematic of Set up to get Synchronization of Spark Unit with Rapatronics





Aug 5 1950
H E Edgerton
W. Wind
S. Gaunt

Syncronization of Spark Unit with Rapatronics

Using the set up as shown on page 72 to obtain syncronization of Spark Unit delay setting with the Rapatronics camera.

Film no 11

Film no 11 taken of Rapatronics shutter opening and closing time.

Film no 12

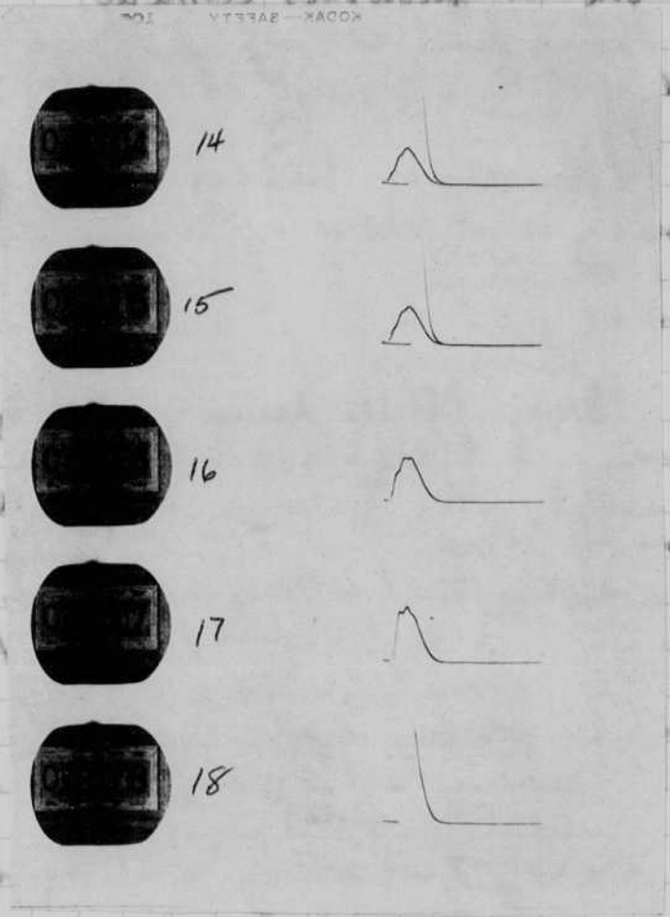
Using 7T-110 lamps with Spark unit and same set up as on page 72 delay setting of unit was taken: Slug pulled out and double cloth over camera lens.

Delay Dial setting on Spark Unit
0 / 20 / 40 / 60 / 80 / 100 / 110

Film no 13

Same set up as above but with slug in

Delay Dial setting on Spark Unit
0 / 20 / 40 / 60 / 80 / 100 / 110



Aug 5 1950
H C E
W W
Suds

Cont's ———

Film no 14

Same set up as on page 72. Using FT 130 Argon lamp. Slug in.
Delay Dial setting of Spark unit

0
100

Film no 15

Same as above
Delay dial setting of Spark unit.

20
110

Film no 16

Same as above
Delay dial setting of Spark unit

40

Film no 17

Same as above
Delay dial setting of Spark unit

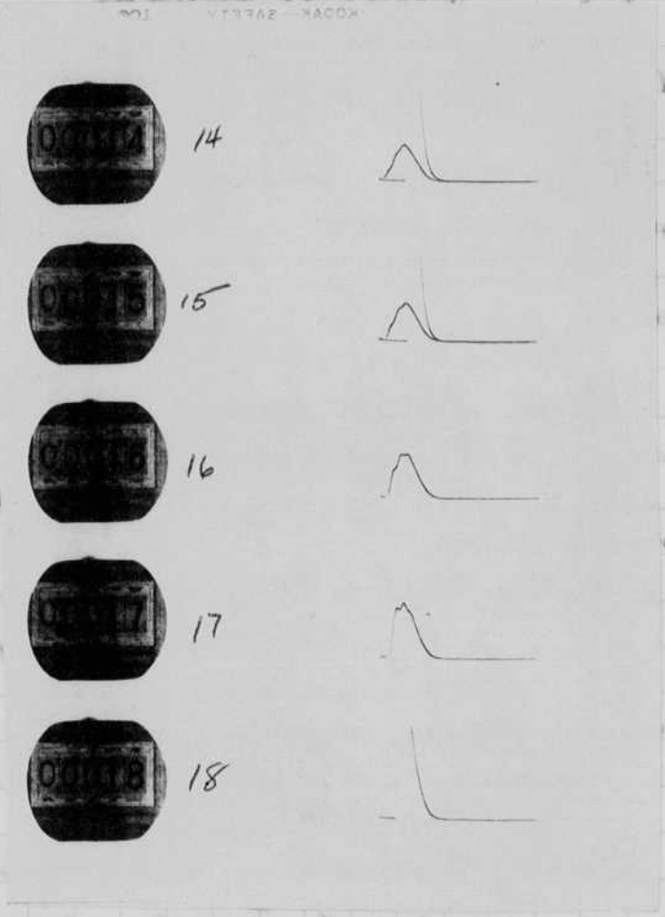
60

Film no 18

Same as above
Delay dial setting of Spark unit

80

[redacted]is
Remarks:- Syncronization was obtained at a dial setting 60 in the Spark unit using lamp FT 110 with Rapatronics
Syncronization was obtained of a dial setting [redacted] in the Spark unit using lamp FT 130 with Rapatronics.



Aug 5 1950
HCE
WW
Lws

Cont'd ——

Film no 14

Same set up as on page 72. Using FT 130 Argon lamp. Slug in.
Delay Dial setting of Spark unit

0
100

Film no 15

Same as above
Delay dial setting of Spark unit.

20
110

Film no 16

Same as above
Delay dial setting of Spark unit

40

Film no 17

Same as above
Delay dial setting of Spark unit

60

Film no 18

Same as above
Delay dial setting of Spark unit

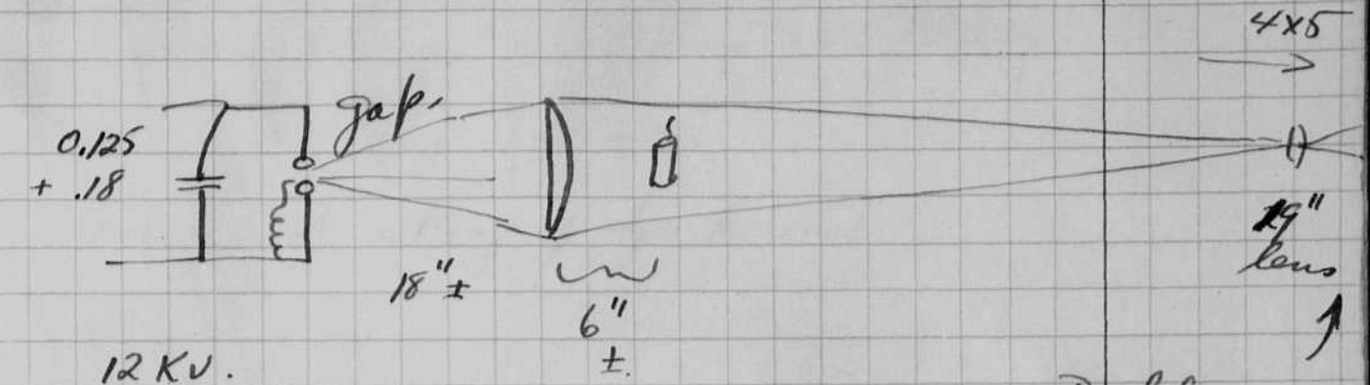
80

Results — Synchronization was obtained at a dial setting 60 in the Spark unit using lamp FT 110 with Rapatronics
Synchronization was obtained at a dial setting 80 in the Spark unit using lamp FT 130 with Rapatronics.

Aug 5 1950
HEE
W W
Eng

Picture taking with Rapatronics

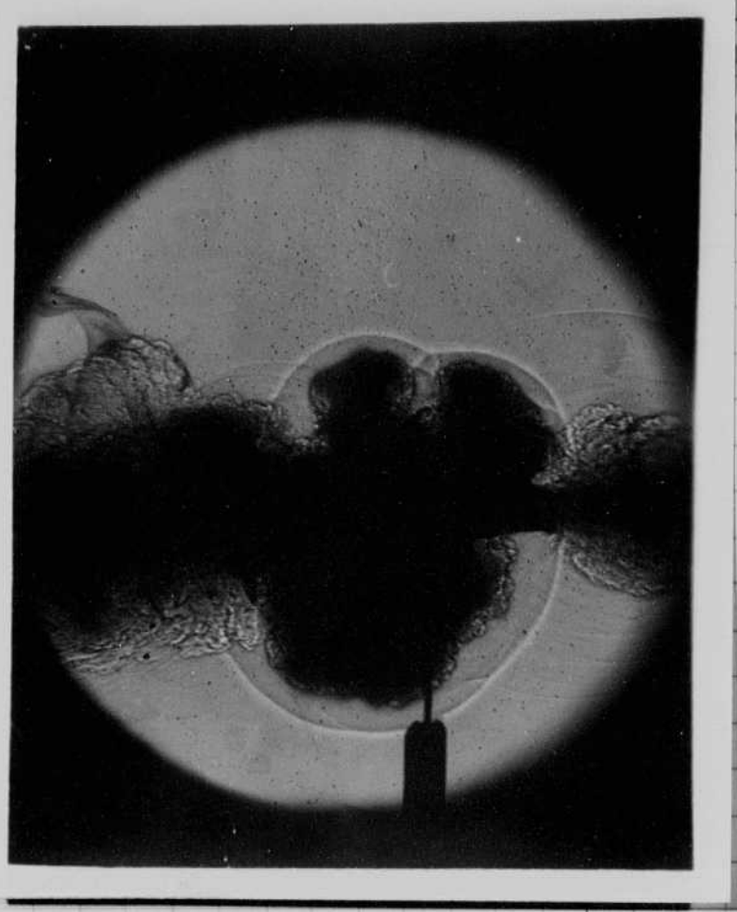
6 x 03
6
.18

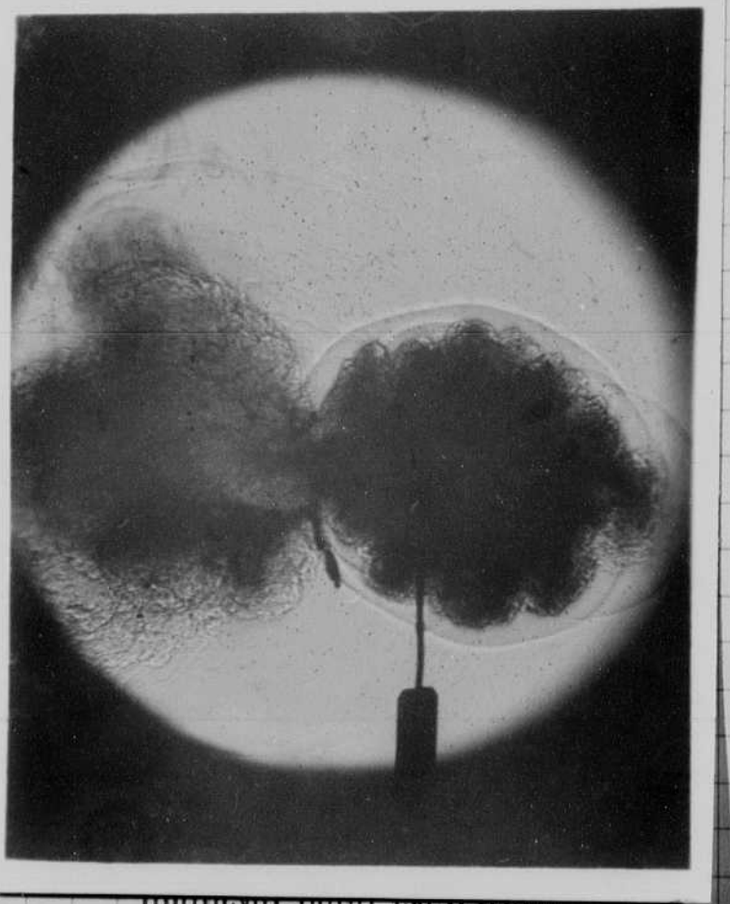


12 KV.
Triggered gap.

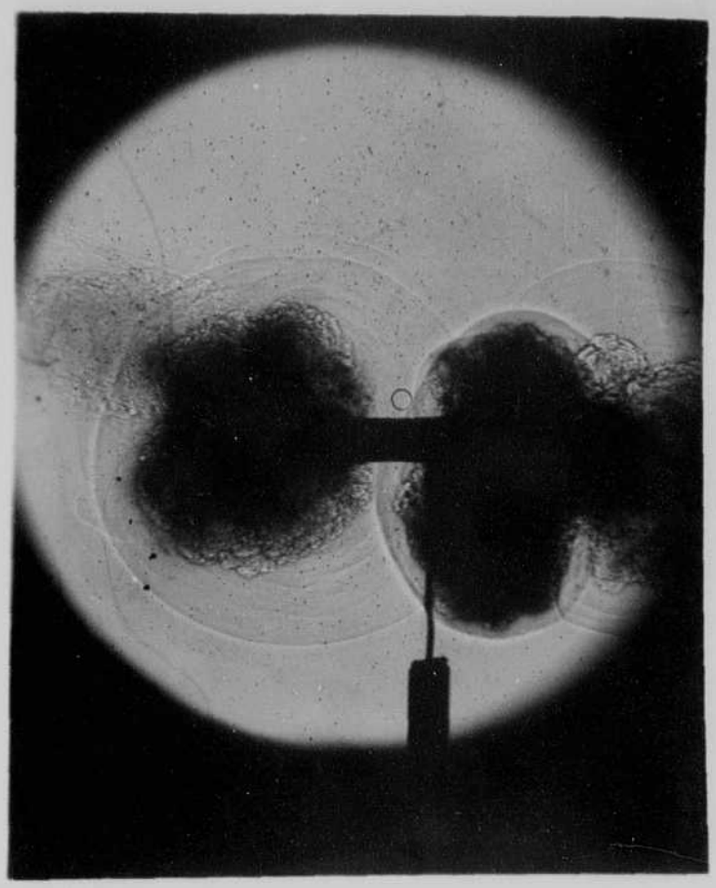
Double Rapatronic plug set for 5 μs. output

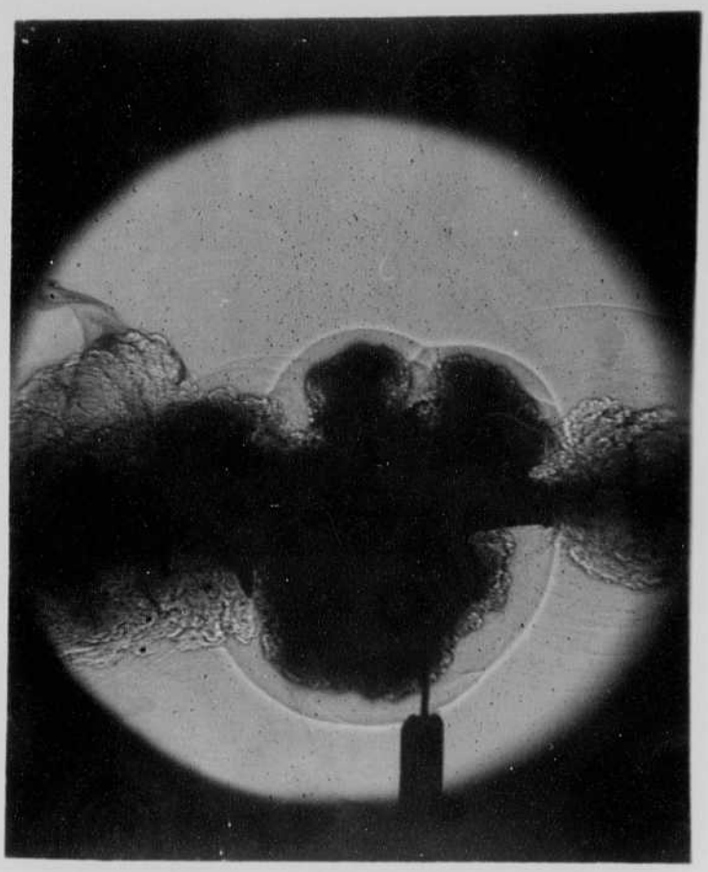
4. 4 μs delay in spark to sync with Rapatronic camera.

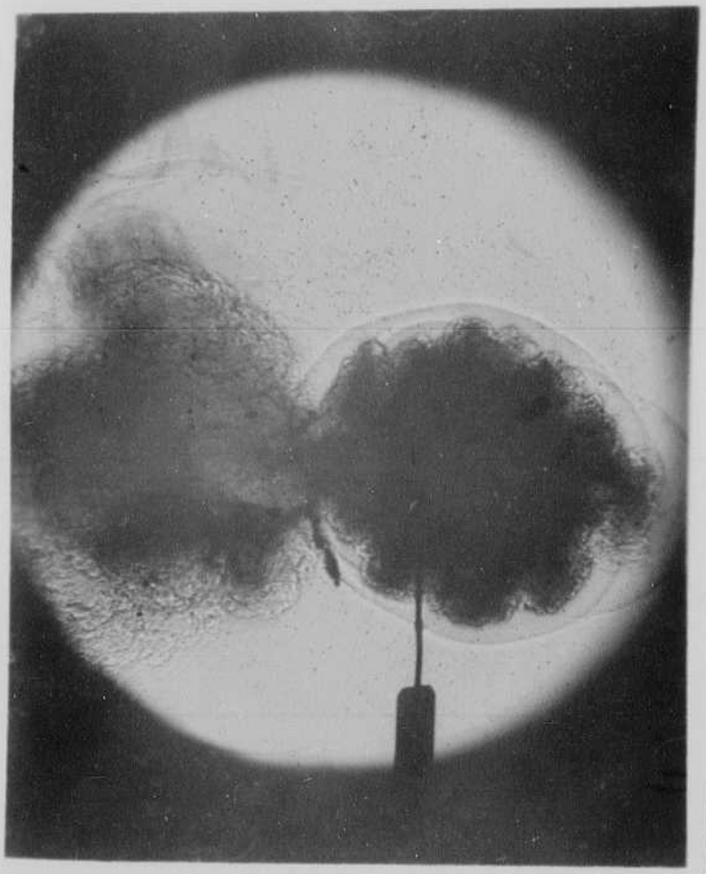


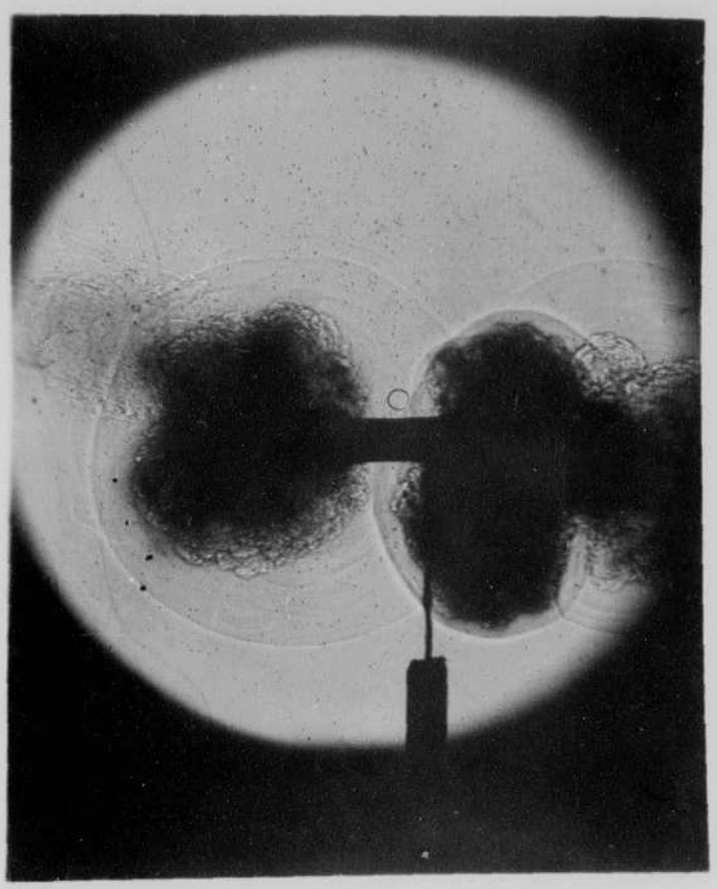


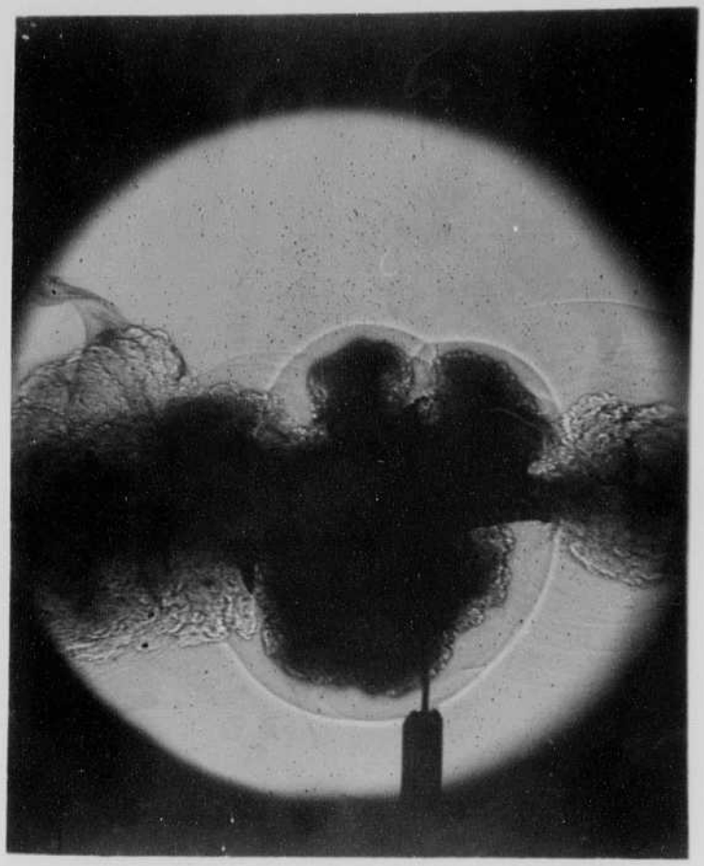
Capt Kidd
Firecracker.

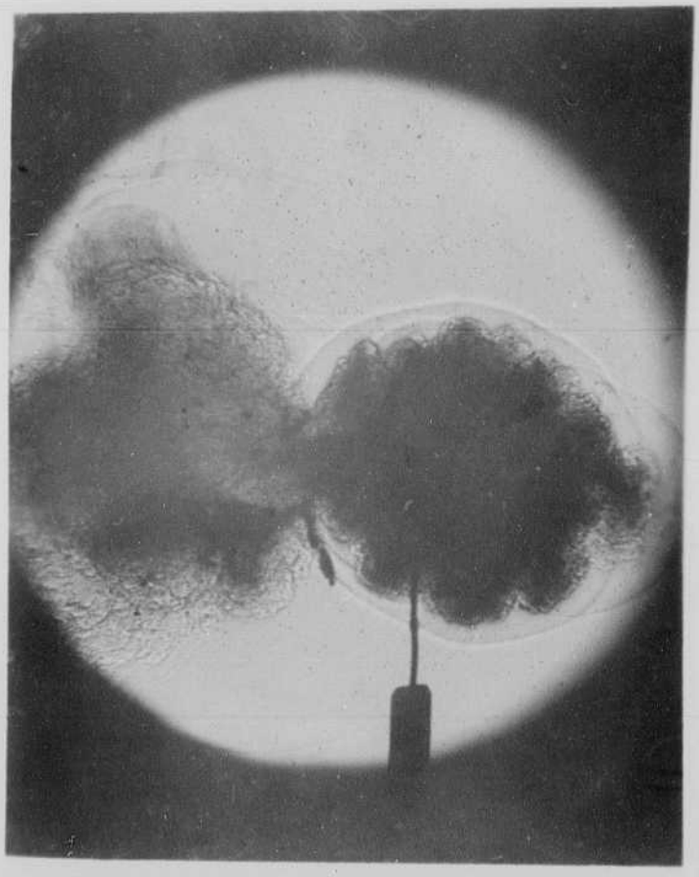


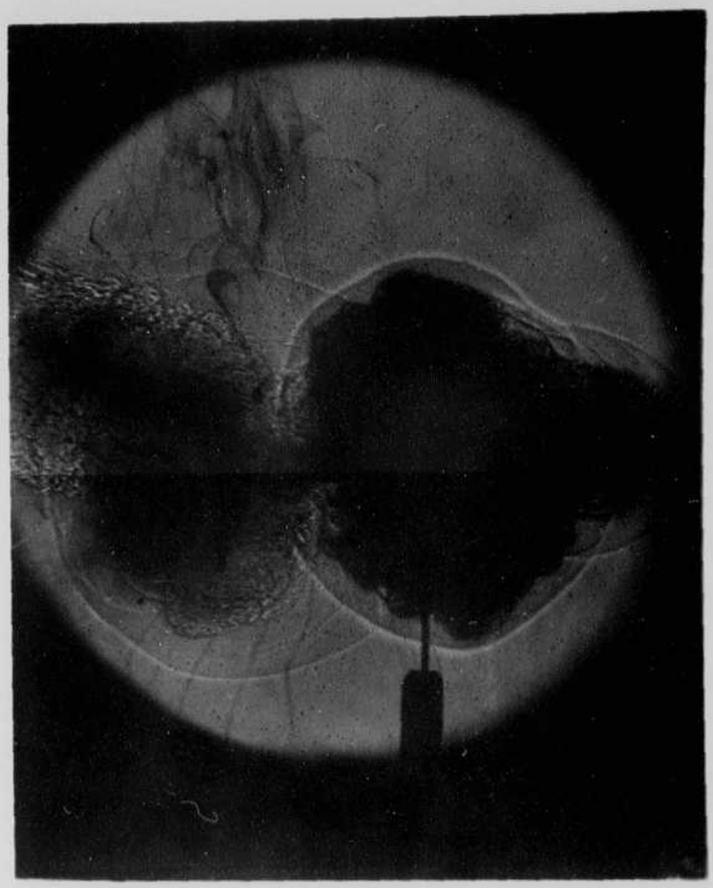


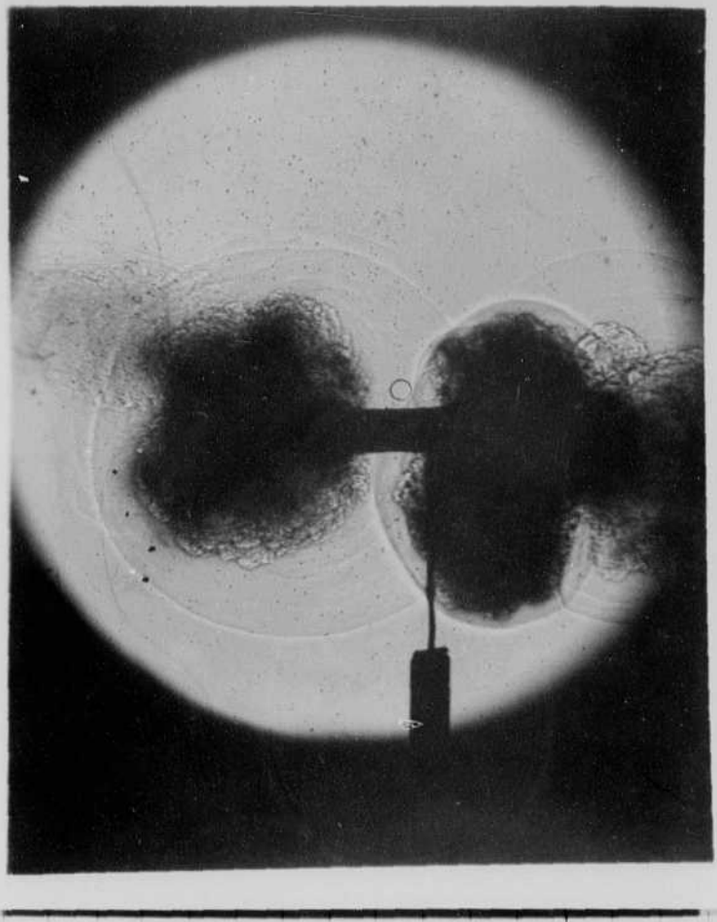




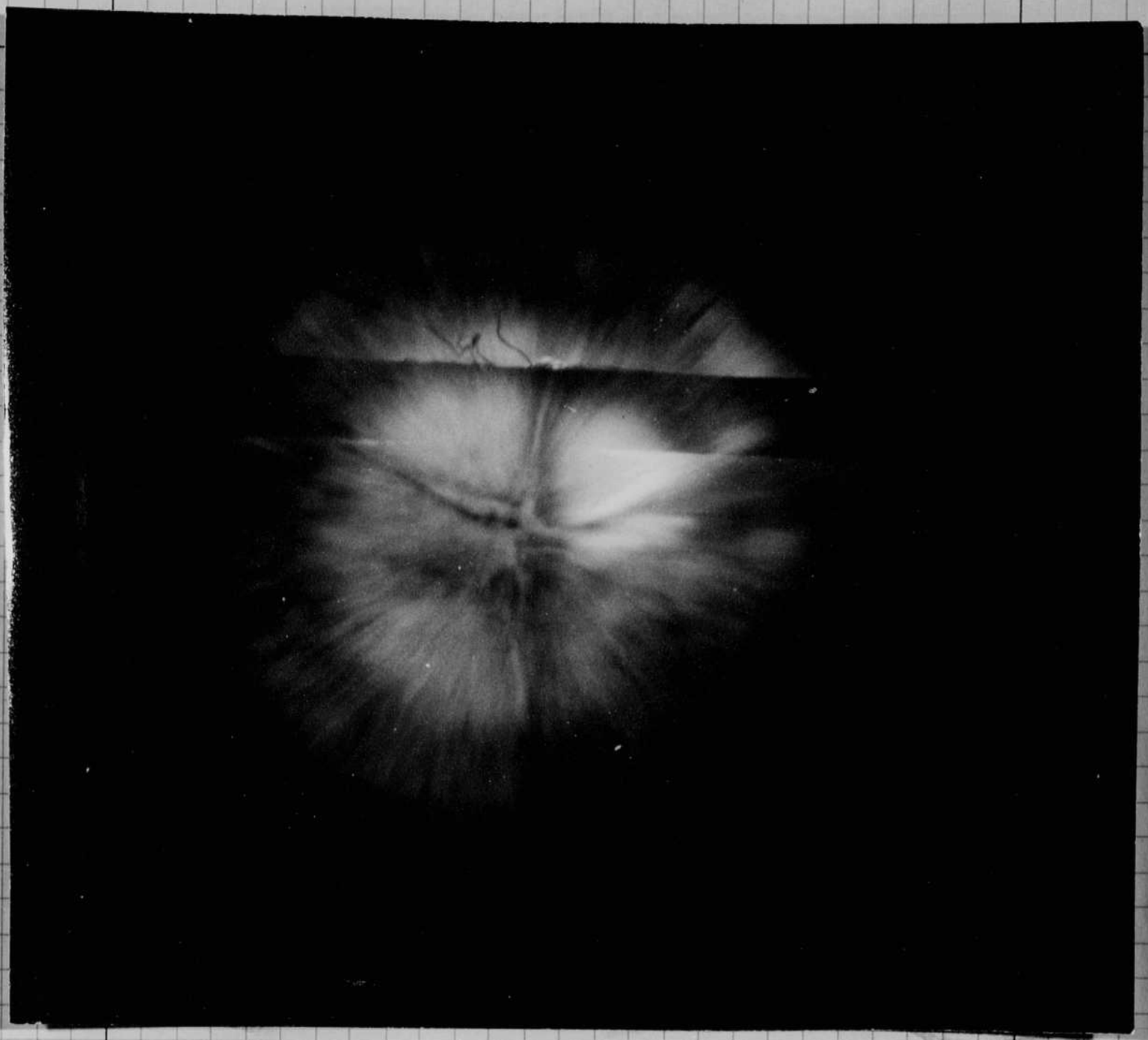




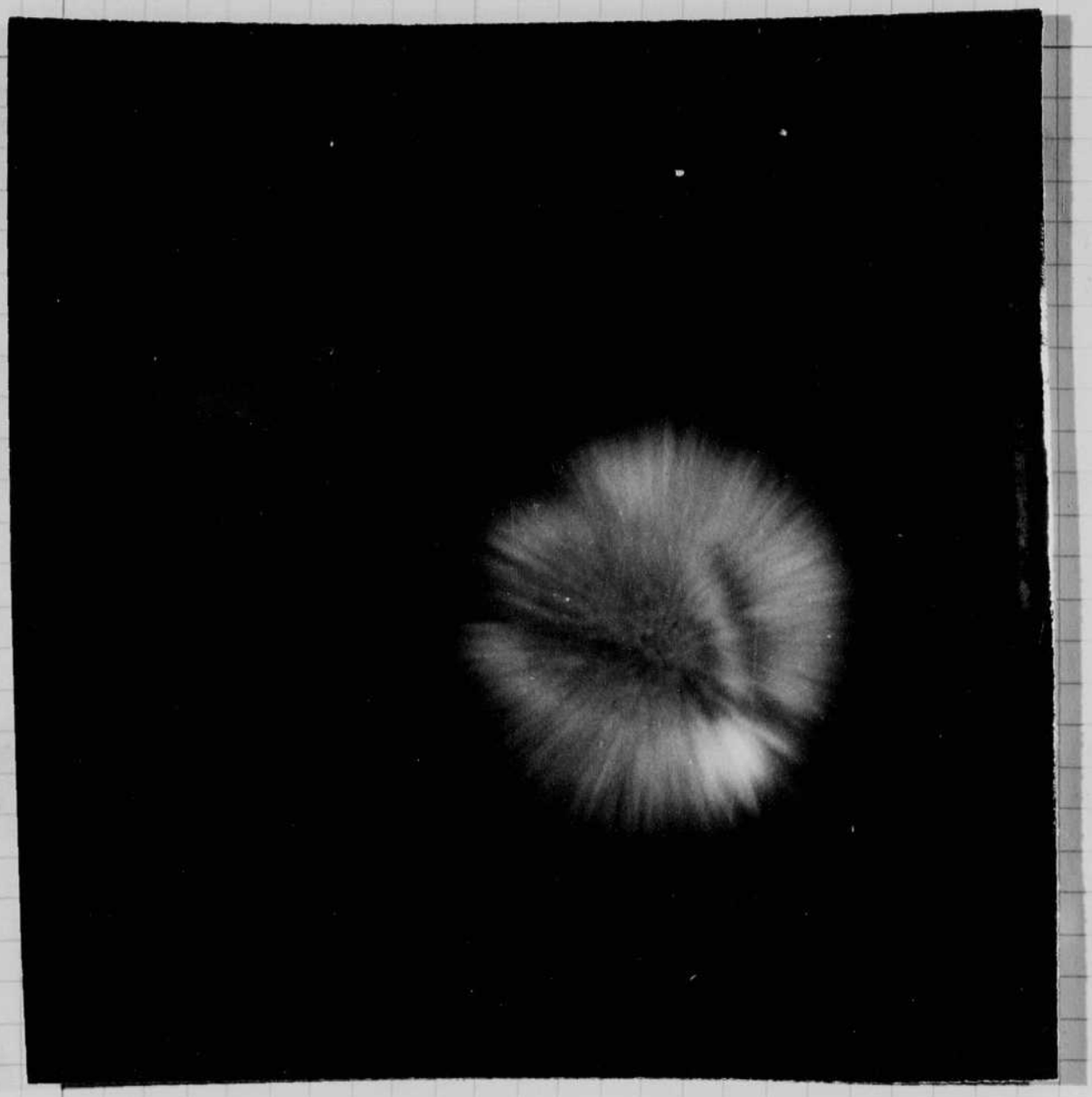




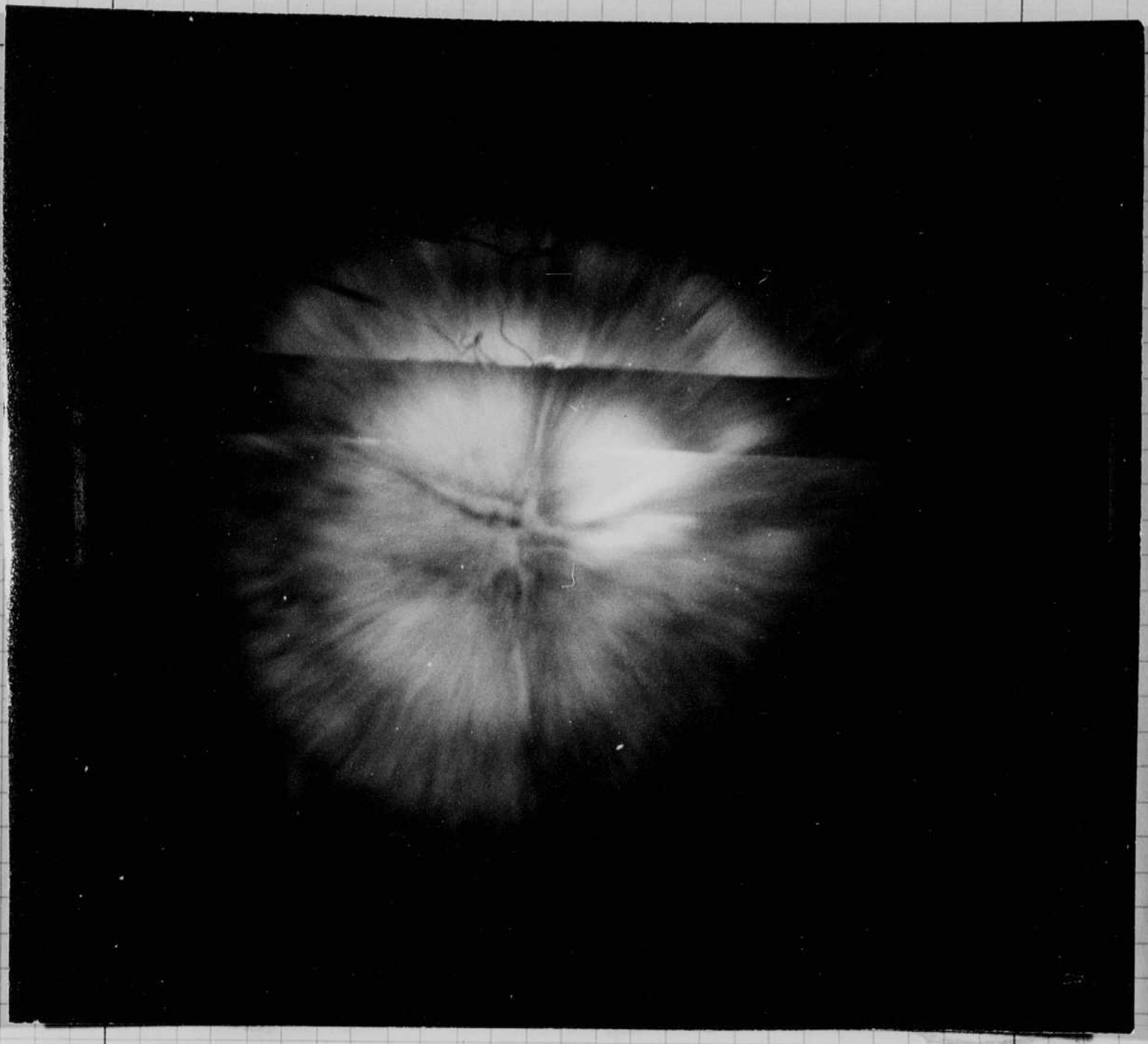
Pentolite sphere 1" diam
Photographed at Aberdeen Md.
Dr. Jane Dewey's lab
Milton Sultanoff



a three flash photo taken at Aberdeen Md.



Pentolite sphere 1" diam
Photographed at Aberdeen Md.
Dr. Jane Dewey's lab
Milton Sultanoff



a three flash photo taken at Aberdeen Md.

Aug. 9 1950
H E Edgerton
K. Gadsden
W. Ward
2 Fellows from Dupont
Firing jet
Slogan, Richland
Davis o.c.

Picture taking with Rapatronics of Dupont 16-A Jet perforator

		Film	Rapatronics Delay
20"	lens	21 A	0 Zero delay
12"	lens	1 A	10 μs

No slide pulled

Focus of Camera

Film no

2 —— 12" lens Film no 4415

17 —— 20" lens. Film no 4416

Could'nt put slide in → 20" lens Film pack no 21 A Rapatronics delay Zero delay Film no

12" lens 1 A 10 μs

Firing jet
16-A Dupont Jet perforator

			Film no	
Tower jet	20"	23	5420	Rapatronics delay
	12"	13	5418	" "

Aug. 9 1950
H E Edgerton
S. Garlick
W. Ward from Dupont
2-Fellows
Firing jet
Hogan, Richard
Davis O.K.

Picture taking with Rapatronics of Dupont 16-A Jet perforator

	Film	Rapatronic Delay
20" lens	21 A	0 Zero delay
12" lens	1 A	10 μs

No slide pulled

Focus of Camera

Film no

2 —— 12" lens Film no 4415

17 —— 20" lens. Film no 4416

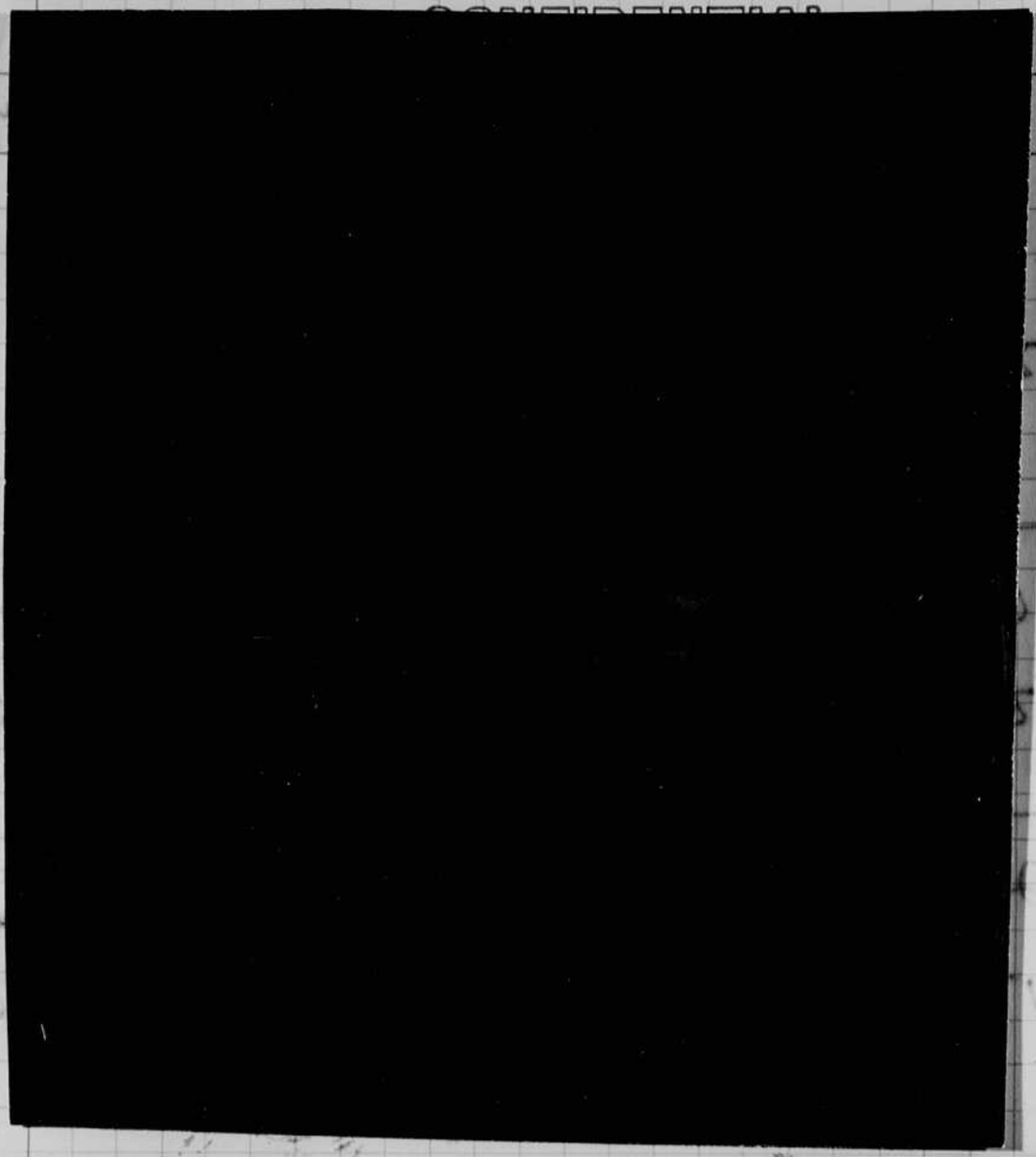
		Film pack no	Rapatronic delay
Couldn't put slide in →	20" lens	21 A	Zero delay Film no
	12" lens	1 A	10 μs

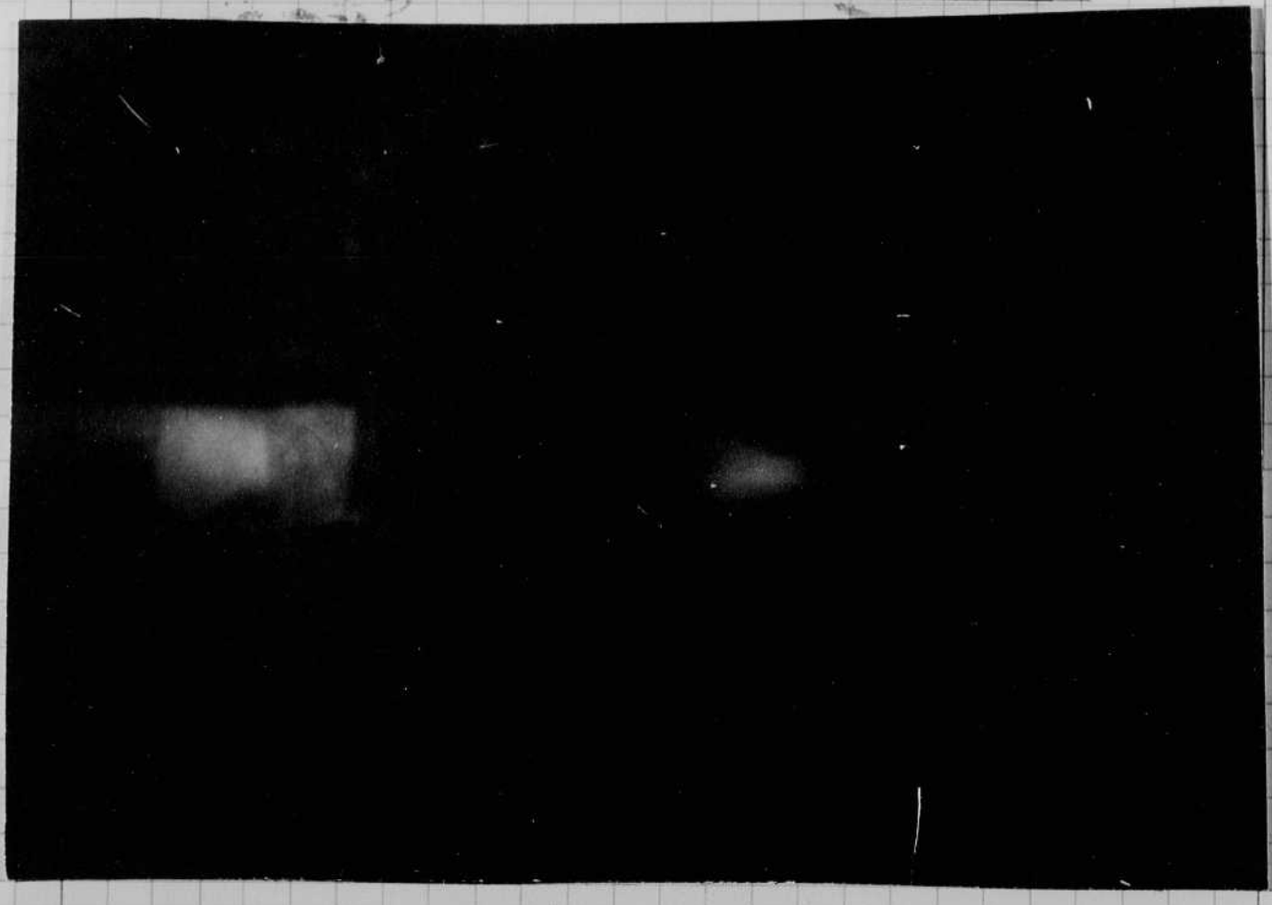
Firing jet
16-A Dupont Jet perforator

Focus on jet

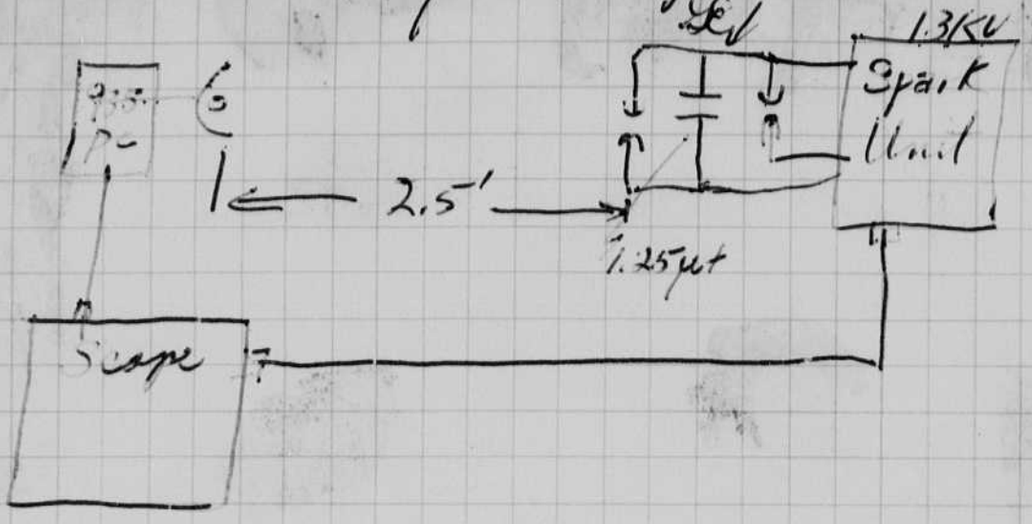
		Film no	
20"	23	5420	~~[illegible]~~ delay
12"	13	5418	" "

				Magnetronics Delay
Jet	20" lens	Film pack no 24	5421	Delay 10 μs
Firing	12" lens	14	5419	15 μs
Focus	20"	5	5422	Zero delay
	12	5A		Zero delay
Jet Firing	20" Film no 5423	.6 Spark gap fixed		Zero delay
	12"	6A		Zero delay





Schematic of set up condition



Oct. 3 1950
~~Aug 14 1950~~ H. E. Edgerton
Soc. Gabriel
Bill Ward.

Finished Land-Polaroid Camera with the Rapatronic shutter f2 2" lens.

Focus chart

Setting	Focus new scale.
∞	36"
15	18"
8	13.5"
5	9.5"
3.5	7.5"

A series of photos were taken of the FT-617 with 600 mf at 4000 volts. The damping resistor was used in the coil driver. Exposure was adequate at f11 with the damped coil. The light at 0 delay showed a thin filament of light in the tube. at 150 μs the lamp showed a peak output. at 500 μs the light was decreasing.

A series was taken of the SM chemical flash bulb. the damping resistance was removed to increase the exposure time. up to 2 millisec at f2 there was no appreciable light. then the light rapidly grew to a peak at 6 ms. (our calabration could have been 5)

Similar photos were made of a #22 flash bulb. Peak came at 17+2 ms. 3 ms showed the fine growing in the bulb.

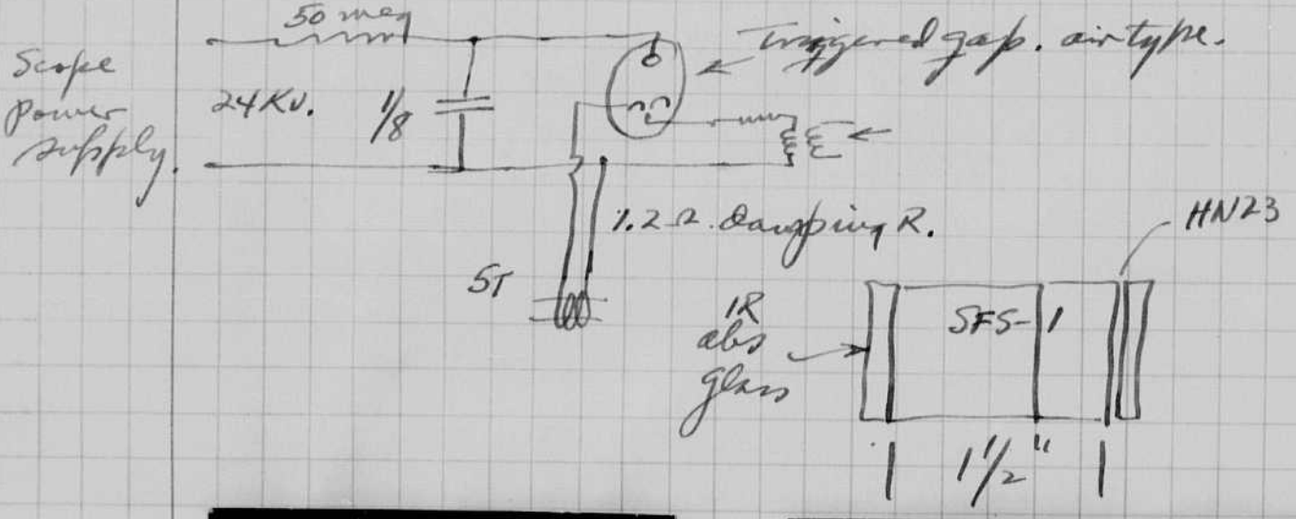
 Harold Edgerton. Feb 14 1951

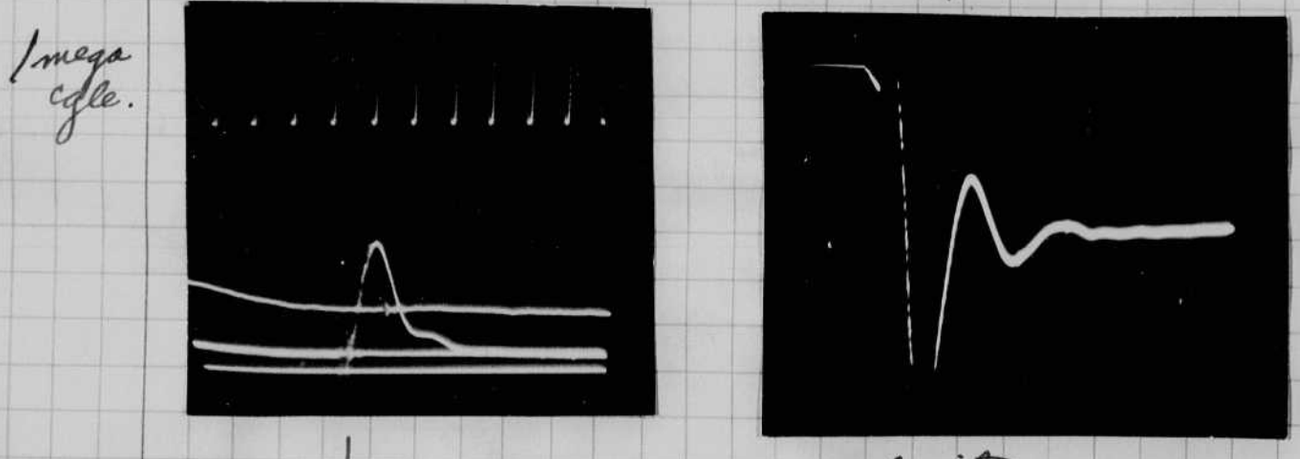
CONFIDENTIAL

A rapatronic shutter with about 1 μs exposure has been developed during the past month with the help of Bill Ward and Bill McRoberts.

The Faraday shutter part consists of a 2½" length of Schott glass # SFS-1 of 1" in diameter. A polaroid HN 23 is cemented under a cover glass on one end and an infra red absorbing glass is used as the other cover glass.

The circuit below drives the coil



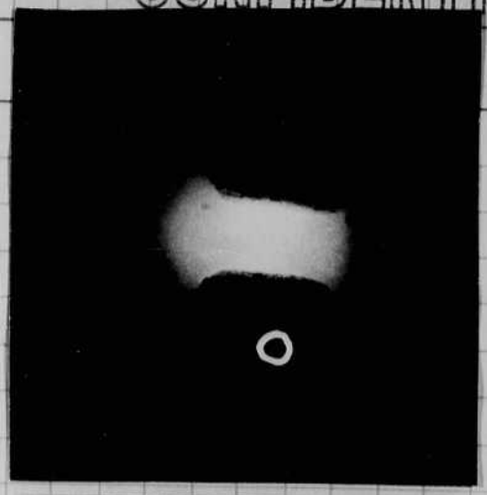


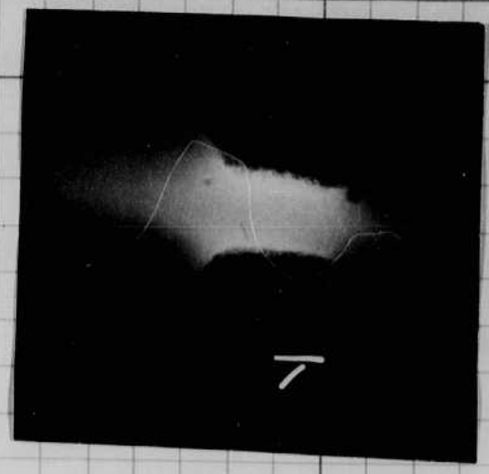
Shutter open curve.

capacitor Shutter voltage curve. 0.3 mc approx freq.

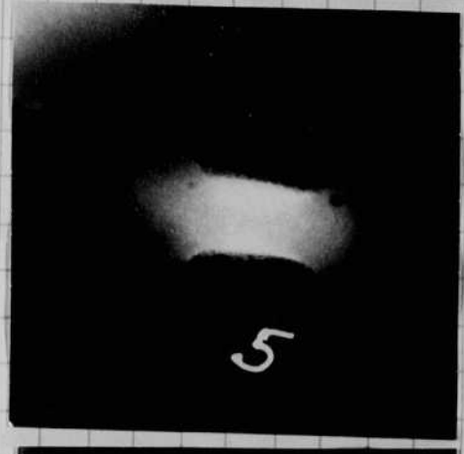
CONFIDENTIAL

Zero time delay.





Total integrated light of the spark.



dial

Spark gap
4 mf 6000 volts.

dial

approx
4 microsec
delay.

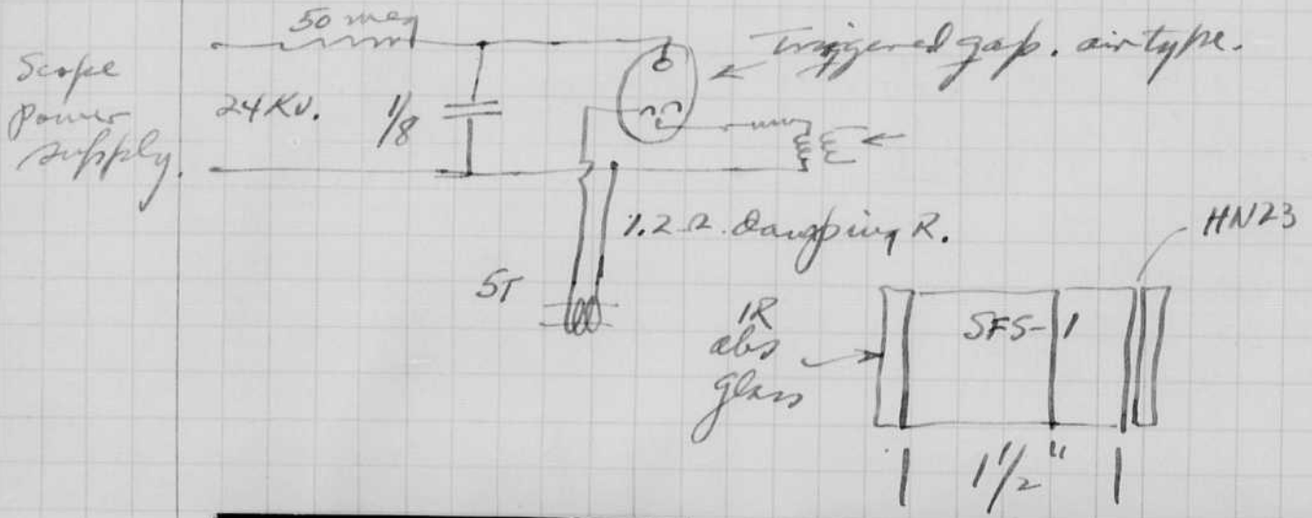
dial.

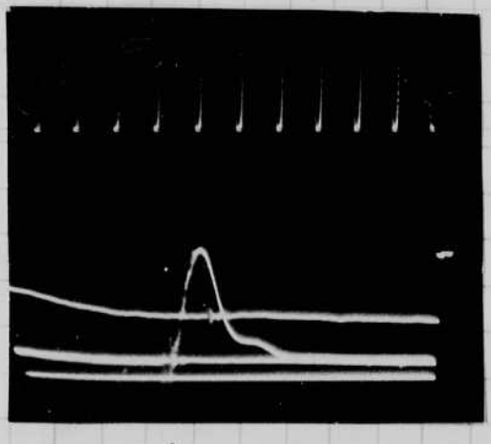
CONFIDENTIAL

A rapitronic shutter with about 1 μs exposure has been developed during the past month with the help of Bill Ward and Bill McRoberts.

The Jordan shutter part consists of a 2½" length of Schott glass # SFS-1 of 1" in diameter. A polaroid HN 23 is cemented under a cover glass on one end and an infra red absorbing glass is used as the other cover glass.

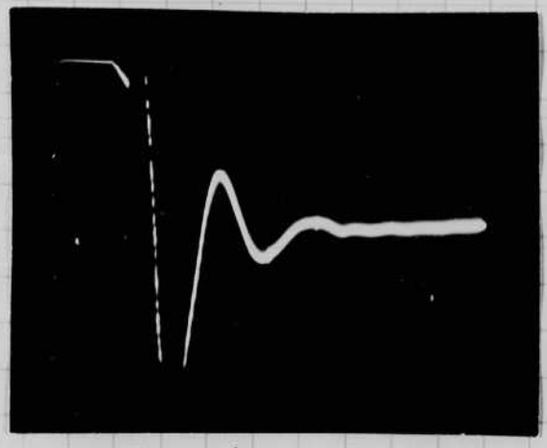
The circuit below drives the coil





1 mega cycle.

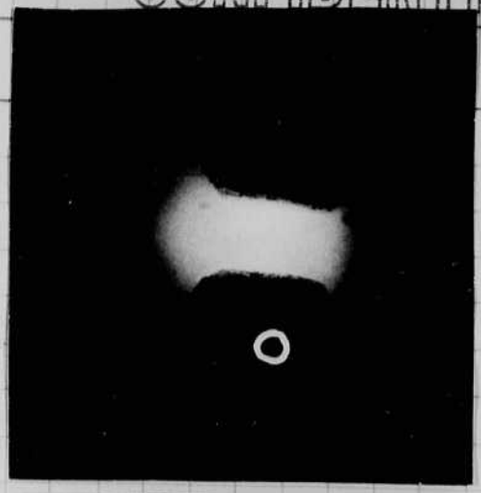
Shutter open curve.

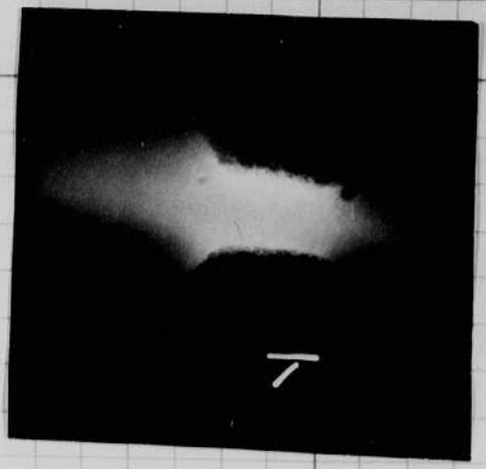


capacitor Shutter voltage curve.
0.3 mf approx freq.

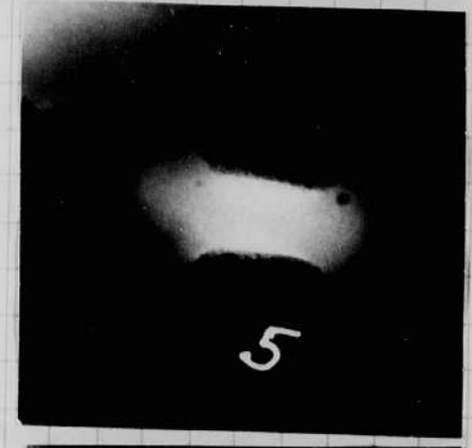
CONFIDENTIAL

Zero time delay.



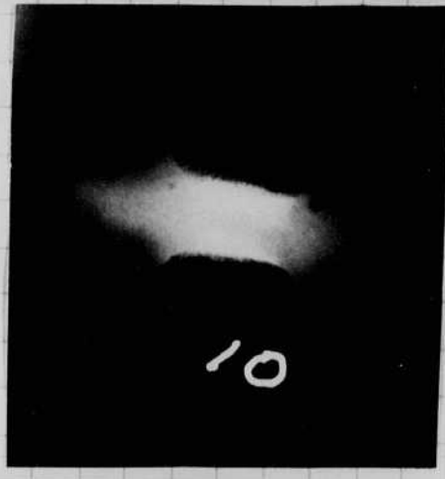


Total integrated light of the spark.



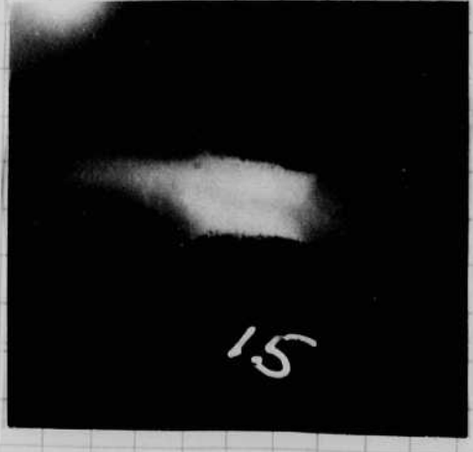
dial

Spark gap
4 mf 6000 volts.



dial

approx
¼ microsec
delay.



dial.

Notebook # Dec. 8, 1948 – April 8, 1951

Filming and Separation Record

____ unmounted photograph(s)

____ negative strip(s)

3 unmounted page(s)
(notes, drawings, letters, etc.)

was/were filmed where originally located between page 90 and 91.

Item(s) now housed in accompanying folder.

Log Recording of Light from High Explosive.

This report describes a method of recording the light output of a high-explosive charge as a function of time. A photomultiplier tube is connected so that the output response is a log function of the light input. Conventional cathode-ray oscillographic apparatus is used to record the resulting voltage.

It was found that a type 9314 photomultiplier tube when connected as shown in the accompanying diagram would produce a voltage that is a log function of the light input. Calibration was made with a flash tube (type FT-214) operated from a 5 mf capacitor charged to 2000 volts. This flash tube has a peak output of about 10^6 candle power with a temperature of about 7000 degrees Kelvin. The tube at a 3.3 meter distance from the photomultiplier tube produced an intensity of

$$E = \frac{10^6}{3.3^2} = 10^5 \text{ meter candles}$$

or lumens per square meter.

The area of the P.M. tube is 1/4 sq inch

$$\text{or } \frac{1}{4} \times \left(\frac{1}{144}\right) \times (.305)^2 = 1.6 \times 10^{-4} \text{ sq meters.}$$

Neutral density filters of density 1, 2, 3 and 4 were used to decrease the light input to the photomultiplier tube. Oscillograms were taken to show the voltage output.

Dr Jussel calculates that the received light at a 5 kilometer distance from the explosion will produce a light output of about 80 [illegible] candles

Notebook # Dec. 8, 1948 - April 8, 1951

Filming and Separation Record

____ unmounted photograph(s)

____ negative strip(s)

3 unmounted page(s)
(notes, drawings, letters, etc.)

was/were filmed where originally located between page 90 and 91.

Item(s) now housed in accompanying folder.

Log Recording of Light from High Explosive.

This report describes a method of recording the light output of a high-explosive charge as a function of time. A photomultiplier tube ~~with a~~ is connected so that the output response is a log function of the light input. Conventional cathode-ray oscillographic apparatus is used to record the resulting voltage.

It was found that a type 931A photomultiplier tube when connected as shown in the accompanying diagram would produce a voltage that is a log function of the light input. Calibration was made with a flash tube (type FT-214) operated from a 5 mf capacitor charged to 2000 volts. This flash tube has a peak output of about 10^6 candle power with a temperature of about 7000 degrees Kelvin. The tube at a 3.3 meter distance from the photomultiplier tube produced an intensity of

$$E = \frac{10^6}{3.3^2} = 10^5 \text{ meter candles}$$

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The area of the P.M. tube is 1/4 sq inch

or $\frac{1}{4} \times \left(\frac{1}{144}\right) \times (.305)^2 = 1.6 \times 10^{-4}$ sq meters.

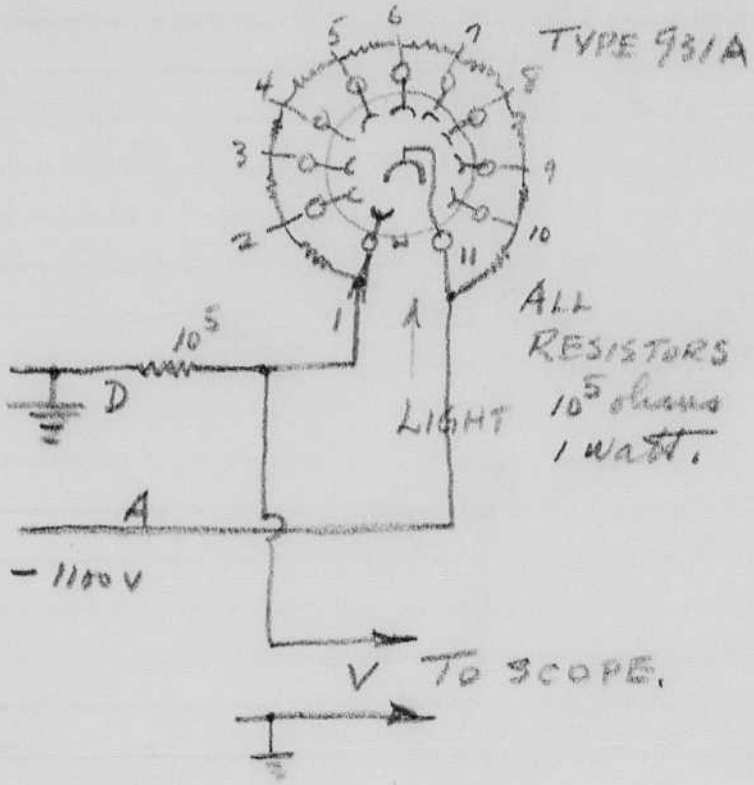
Neutral density filters of density 1, 2, 3 and 4 were used to decrease the light input to the photomultiplier tube. Oscillograms were taken to show the ~~light~~ voltage output.

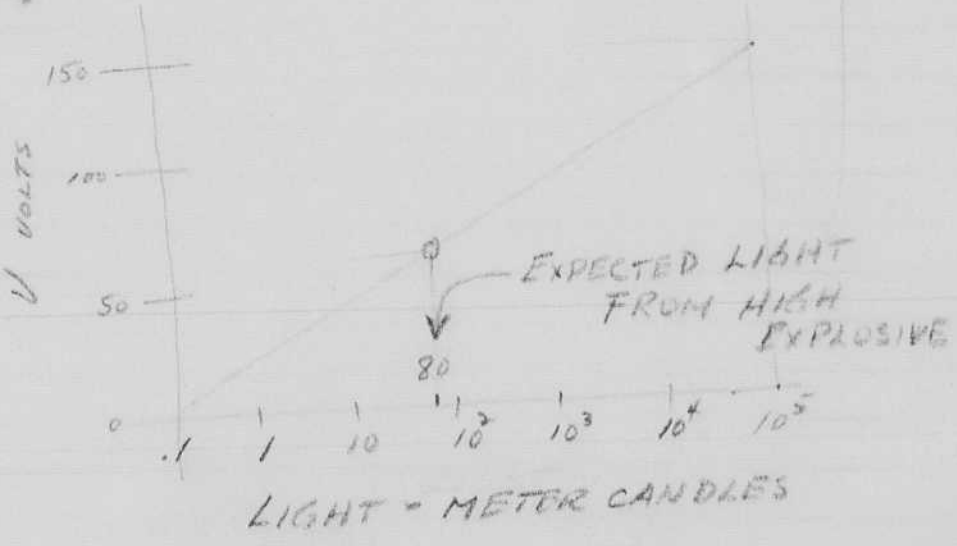
Dr Jusaal calculates that ~~the~~ the received light at a 5 kilometer distance from the explosive will produce a light output of about 80 [illegible] candles

under the following assumptions

Distance 5 kilometers
level 2 tons
diam 1.3 meters.
temp. 5000 degrees

The voltage output of the pm tube at 5 kilometers thus should be about 50 volts under the above conditions. Due to the log presentation, light values of 100 greater or less can be detected.
(than this median value)


TYPE 931A
ALL RESISTORS 10^5 ohms 1 Watt.
10^5
D
LIGHT
A
−1100 V
V
To SCOPE.


150
100
50
0
VOLTS
EXPECTED LIGHT FROM HIGH EXPLOSIVE
80
.1
1
10
10^2
10^3
10^4
10^5
LIGHT - METER CANDLES

Light transmission

1½" SFS-1 Shutter

	mm	units
Open 1 HN23	2.5 x 1000	2500
Assume HN23 absorbs 75% of light		
Open calc. no polaroids	4 x 2500	10,000
Closed	.6 x 1	.6
Open electrical	4.5 x 100	450.

Ratio $\frac{\text{open elect (peak)}}{\text{closed}} = \frac{450}{.6} = 750$

Ratio $\frac{\text{no opt. shutter}}{\text{open shutter (peak) elect.}} = \frac{10,000}{450} = 2.2$

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H.E. Light from subject - Data from Tunnel Feb 14 1951
Bare P.M. tube at 5 kilometers early level

Check data from Tunnel

Energy on cathode = 2×10^{-5} watts of photo multiplier

$\frac{1.3 \times 10^{-2}}{.25 \times 1/144 \times (.305)^2} \div 82$ V. meter candles. Convert to lumens = 1 watt = 650 lumens,

at cathode

1300×10^{-5} lumens on cathode of P.M. tube
1.3×10^{-2} " " " " " "

From 931 A data Sens at 100 volts/stage = 20 amp/lumen

75 " /stage = 3 amp/lumen

50 .18 "

$25 \times 10 = 250$ V. 25. .002 "

cathode area = 0.25 sq inch = $\frac{.25}{12^2}$ sq ft = $.17 \times 10^{-2}$ sq ft.

(Try for a source) FT 220 tube in stratolaunch. → 10^7 c.p. beam peak.

at 10 feet $E = \frac{10^7}{10^2} = 10^5$ ft candles

$= 10^5$ lumens/sq ft

on cathode $10^5 \times .17 \times 10^{-2} = .17 \times 10^3$ lumens.

$= 1.7 \times 10^2$ lumens

This is 10^4 too much.

Try a bare FT 214 with 10^6 c.p. peak

at 10 ft $E = \frac{10^6}{10^2} = 10^4$ ft candles

10^5 meter candles.

on cathode $E = 1.7 \times 10^{-1} = 0.17$ lumens.

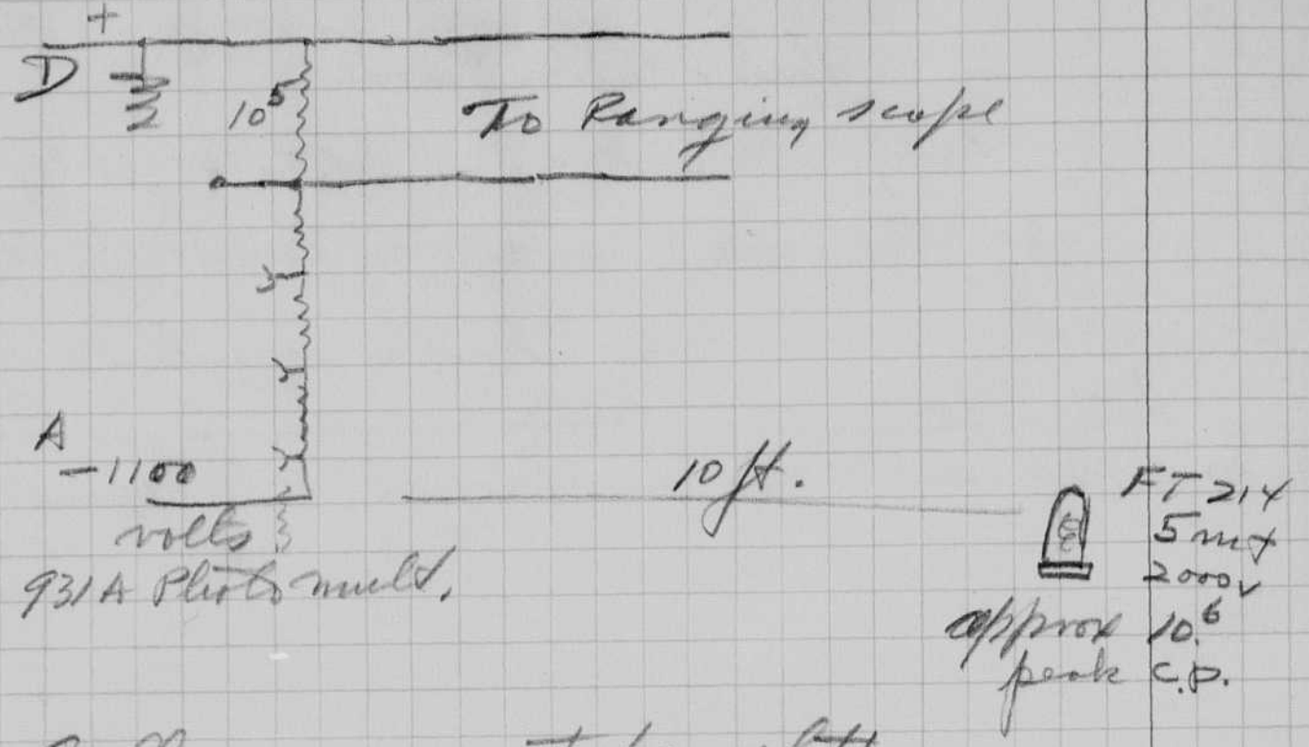
10^3 too much.

Feb 17 1951 MIT

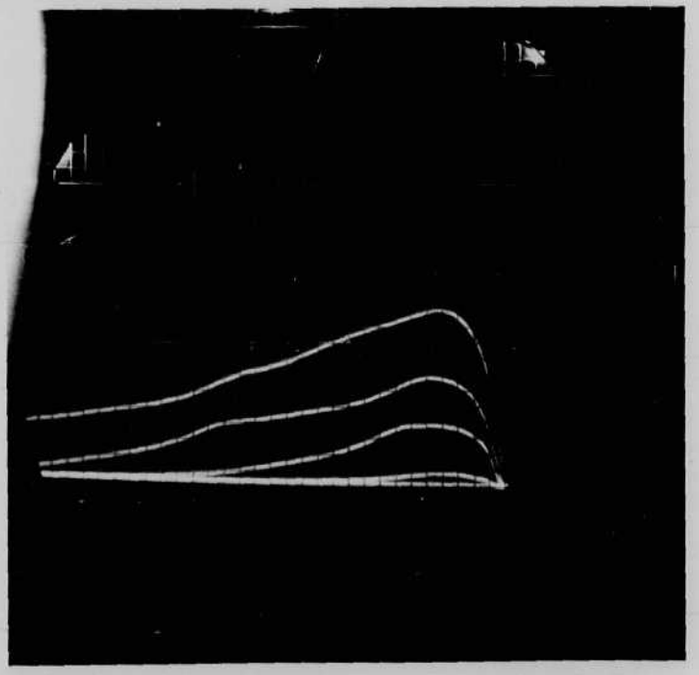
CONFIDENTIAL

H.E. Edgerton
Johnt Mills.

Non Linear Pickup.



Oscillograms were taken of the output of a 300 ms sweep with the Dumont Ranging Scope #256D #244



↑ Light x10 for each curve.

← TIME 300 ms.

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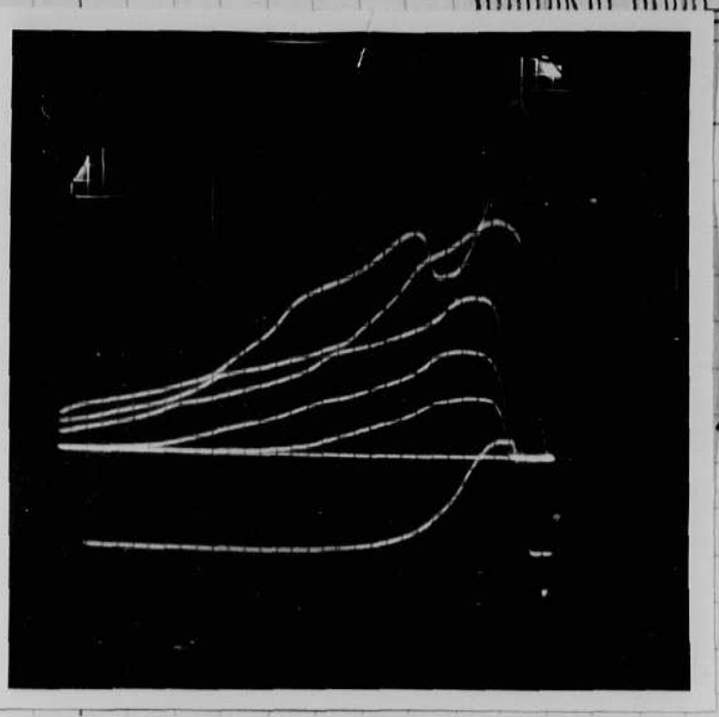
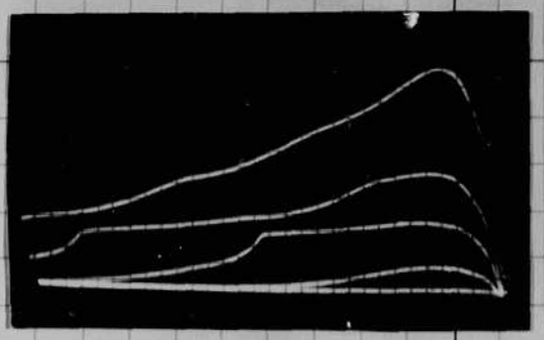
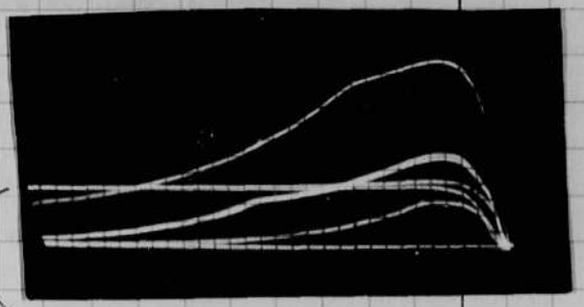


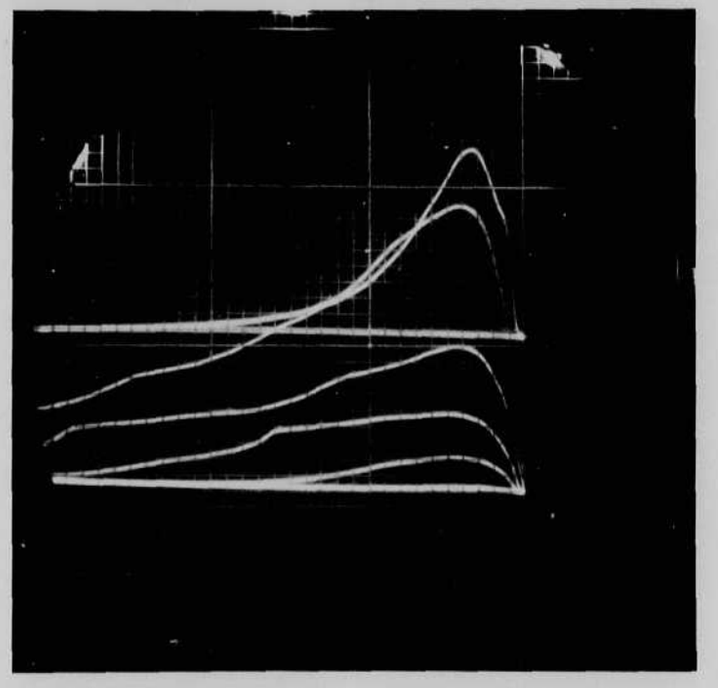


Kinks

5 mf
2500 v

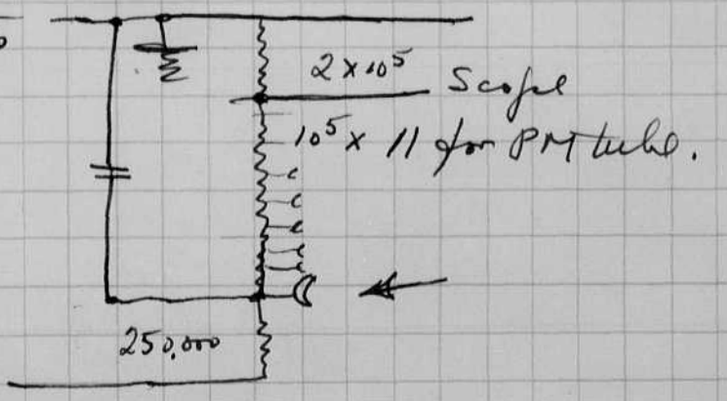


Holdover.



10,5 mf.
2000 v.

Circuit changed to

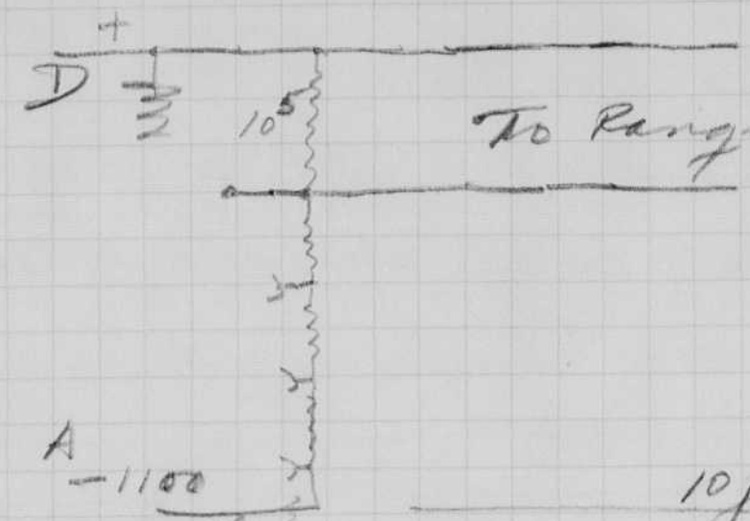


Feb 17 1951 MIT

CONFIDENTIAL

H. E. Edgerton
John Mills.

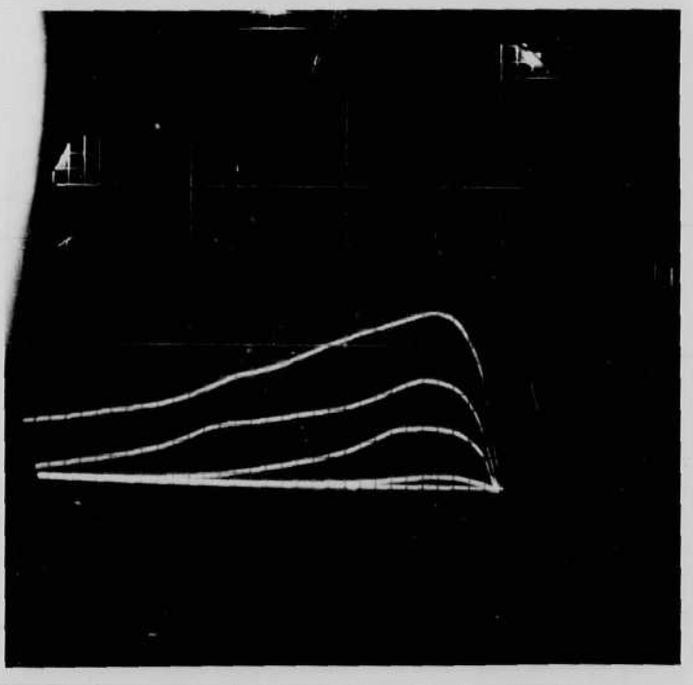
Non Linear Pickup.



10 ft.

FT 214
5 mA
2000 V
approx 10^6
peak C.P.

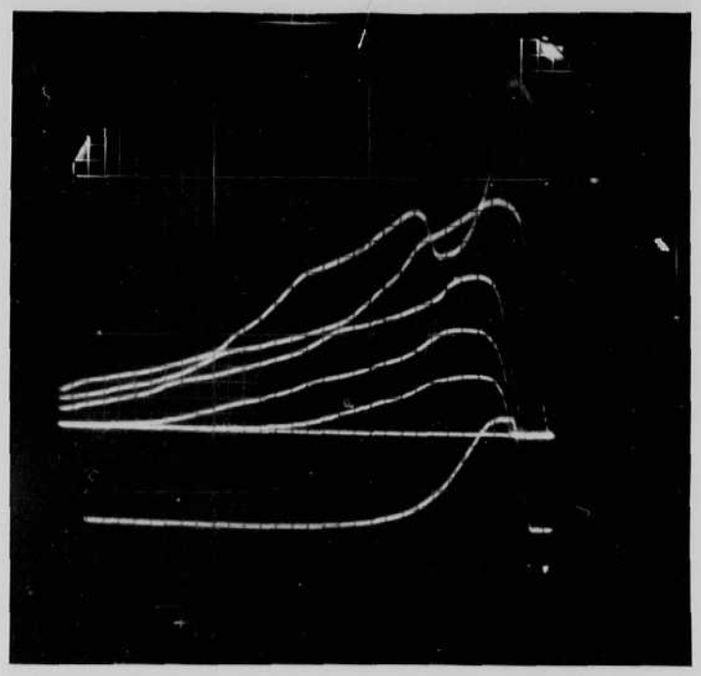
Oscillograms were taken of the output of 300 ms sweep with the Dumont Ranging Scope #256D #244

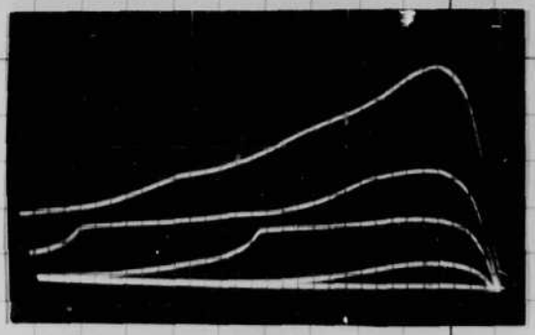


↑ Light x10 for each curve.

← TIME 300 MCS.

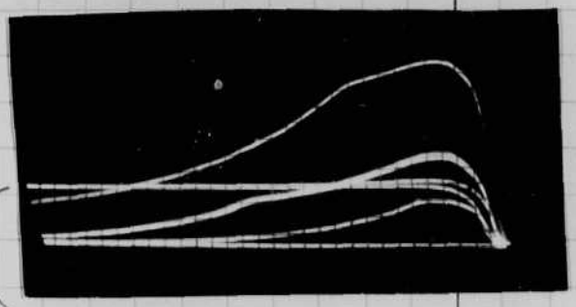
CONFIDENTIAL



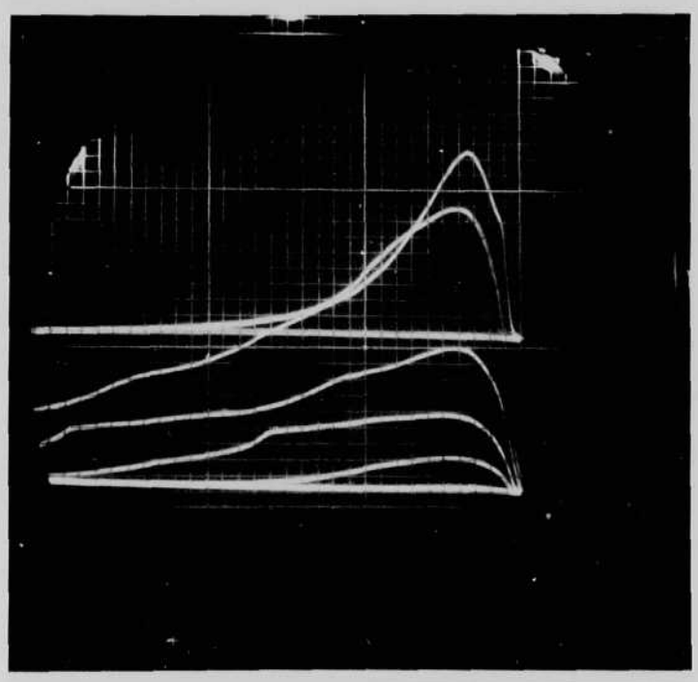


Kinks

5 mf
2500 v

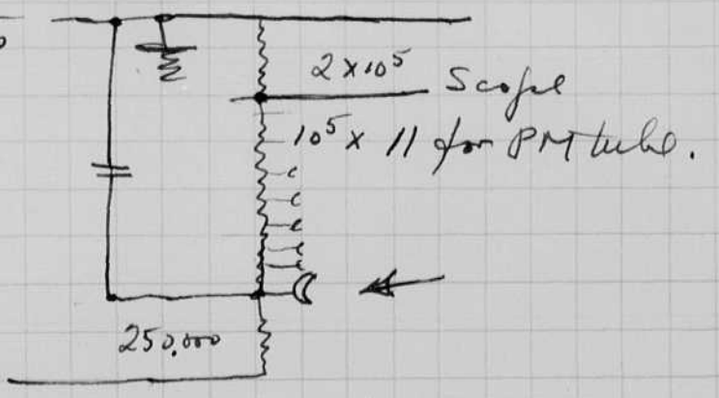


Holdover.



10,5 mf.
2000 v.

Circuit changed to



Parry Island Eniwetok atol - marshalls.
March 18 1951
Harold E. Edgerton

CONFIDENTIAL

The trip to here was completed on Tues mar. 13 via the General E. D. Patrick (ship) from Honolulu. We are established in a cabana on Parry Island. For the past few days we have been looking for and unpacking our boxes from Boston.

I made two trips to Runit where some activity is contemplated shortly. Our group have three photo towers to activate at this location about 2 miles from the center. One of these 75' high towers is located on a reef south east of the x spot. It is here that the 1 us xpatronic will be located.

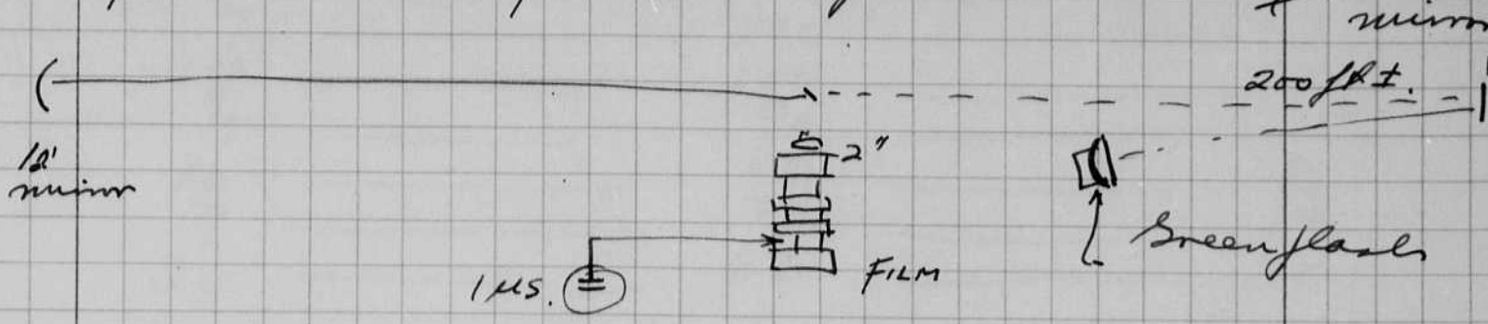
The 1 us xpatronic was set up yesterday for a lab check. A FT-110 was used for a subject. A 90 mm lens was used.

At f 17.5 the direct light from the arc was enough to give an exposure with the polaroids crossed.

The wire shutter at 2600 volts was ok to cut off the light from the green flash and enable one to shoot a 1 us photo of the arc in the tube.

CONFIDENTIAL

Set up mirror as per sketch last night and afternoon. took photos in aft. and evening.



My photocube trigger was used to flash the shutter. the most sensitive setting was 5 and the least was 1. apparently the exposure is about the same on each.

A faint* exposure was recorded from the green flash. a 5/32" image was on the film of the 5" diam reflector * with the rapatronic shutter closed. Exposure seemed to be about right with the trigger operation.

Also set up a fid marker trigger and increased the capacitor from 50 mf to 1000 mf. so the long slow light would trigger the equipment.

Aug 16/1950

Filmpack no #	Setting of Delay	Films no punched
7	110	7
8	100	8
15	90	15
16	80	16
19	70	19
20	60	20

Gaps breaking over

Gap F-8 lower breakdown was second gap

Cam #2 Gap F-9 - first gap

New Gaps in

Cam #2 First gap F-4 ← Changed 17 aug to F-5 due to filter.

Second gap F-14

16 aug 50

Camera #1 Removing Gaps First gap # F-22

Second gap # F-3

Aug 17, 1950

Replacing Gaps First gap # F-1

Second gap # F-2

May 18 1950

Gap changed in Camera #2
First gap

Photos of microsecond Rapatronic
taken by Crook at Parry Island
Eniwetok March 1951

Entire setup. B 488-1

Camera closeups B 488-2

Loris Gardner in charge of photo dept.

Aug 19, 1950

Light Output

...k unit
...k source.
... and an
10' mirror
...k unit only
...l using

...0 Flash lamp.
...t. Photo pick up
...mp. Photo pick up
...6 filter

Picture 00116 — Light output from FT-130 Flash lamp in series with Spark unit and 3-.1 µfd condensers with twisted pair of leads on spark unit. Photo pick up 3' away using 2-X10 and 1-X2 filters

Picture 00117 — Light output from FT-130 Flash lamp in series with Spark unit and 3-.1 µfd condensers with 16" approx of Rg 5/U cable and connector. Photo pick up 3' away using 2-X10 and 1-X2 filters.

No changed was noticed in light duration between pictures 00116 and 00117 of twisted pair of leads as compared to 16" of Rg 5/U cable and connector.

CONFIDENTIAL

Photos of microsecond Rapatronic
taken by Crook at Parry Island
Eniwetok March 1951

Entire setup. B 488-1

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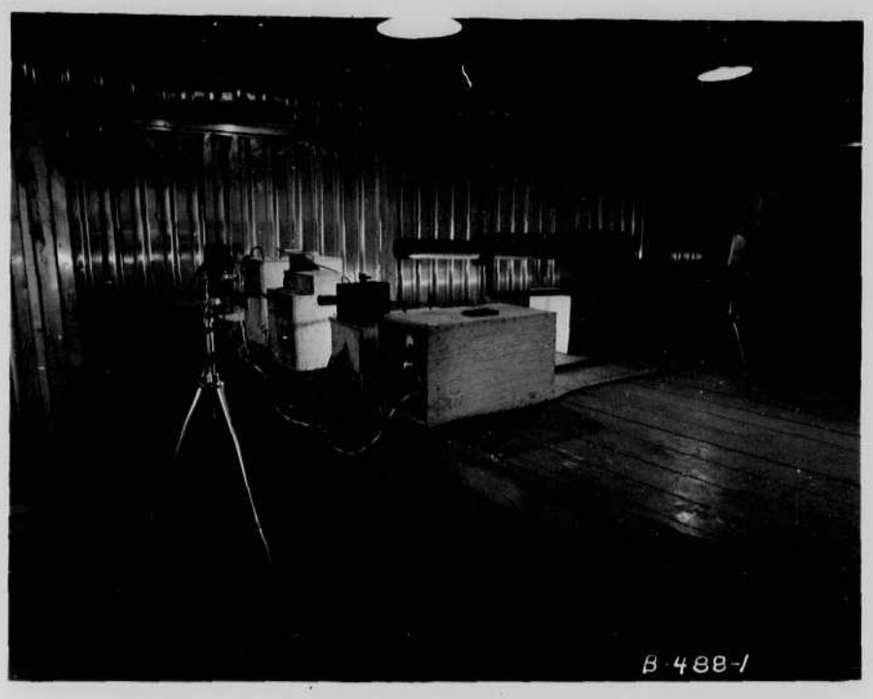
Loris Gardner in charge of photo dept.

CONFIDENTIAL

Aug 19, 1950

Light Output



...k unit
...k source.
... and on
10' mirror

...k unit only
...l using

...0 Flash lamps.
...t. Photo pick ups
...ps. Photo pick ups
...6 filter

Picture 00116 — Light output from FT-130 Flash lamps in series with Spark unit and 3-.1 μfd condensers with twisted pair of leads on spark unit. Photo pick up 3' away using 2-X10 and 1-X2 filters

Picture 00117 — Light output from FT-130 Flash lamps in series with Spark unit and 3-.1 μfd condensers with 16" approx of Rg 5/U Cable and connector. Photo pick up 3' away using 2-X10 and 1-X2 filters.

No changed was noticed in light duration between pictures 00116 and 00117 of twisted pair of leads as compared to 16" of Rg 5/U cable and connector.

Notebook # Dec. 8, 1948 – April 8, 1951

Filming and Separation Record

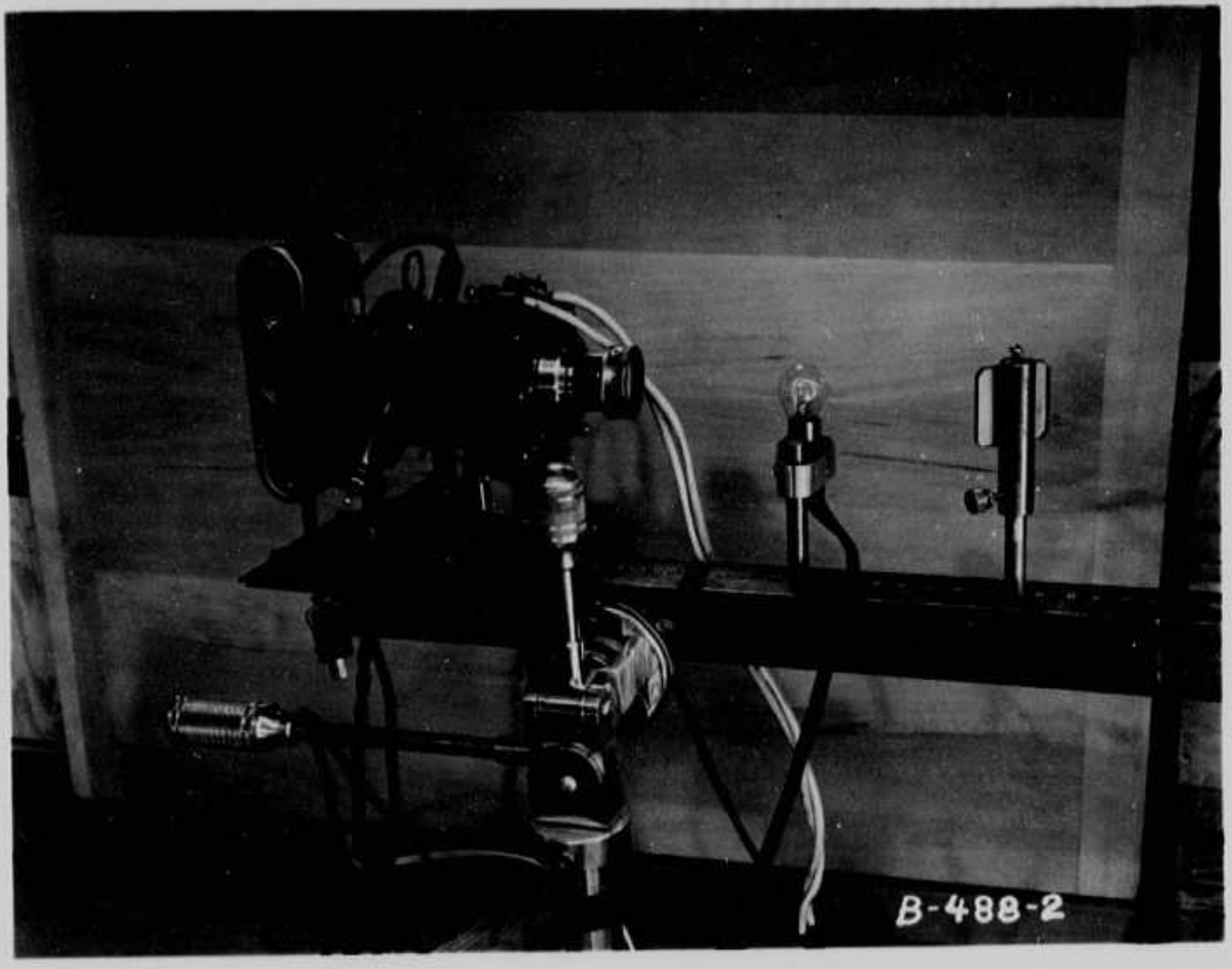
4 unmounted photograph(s)

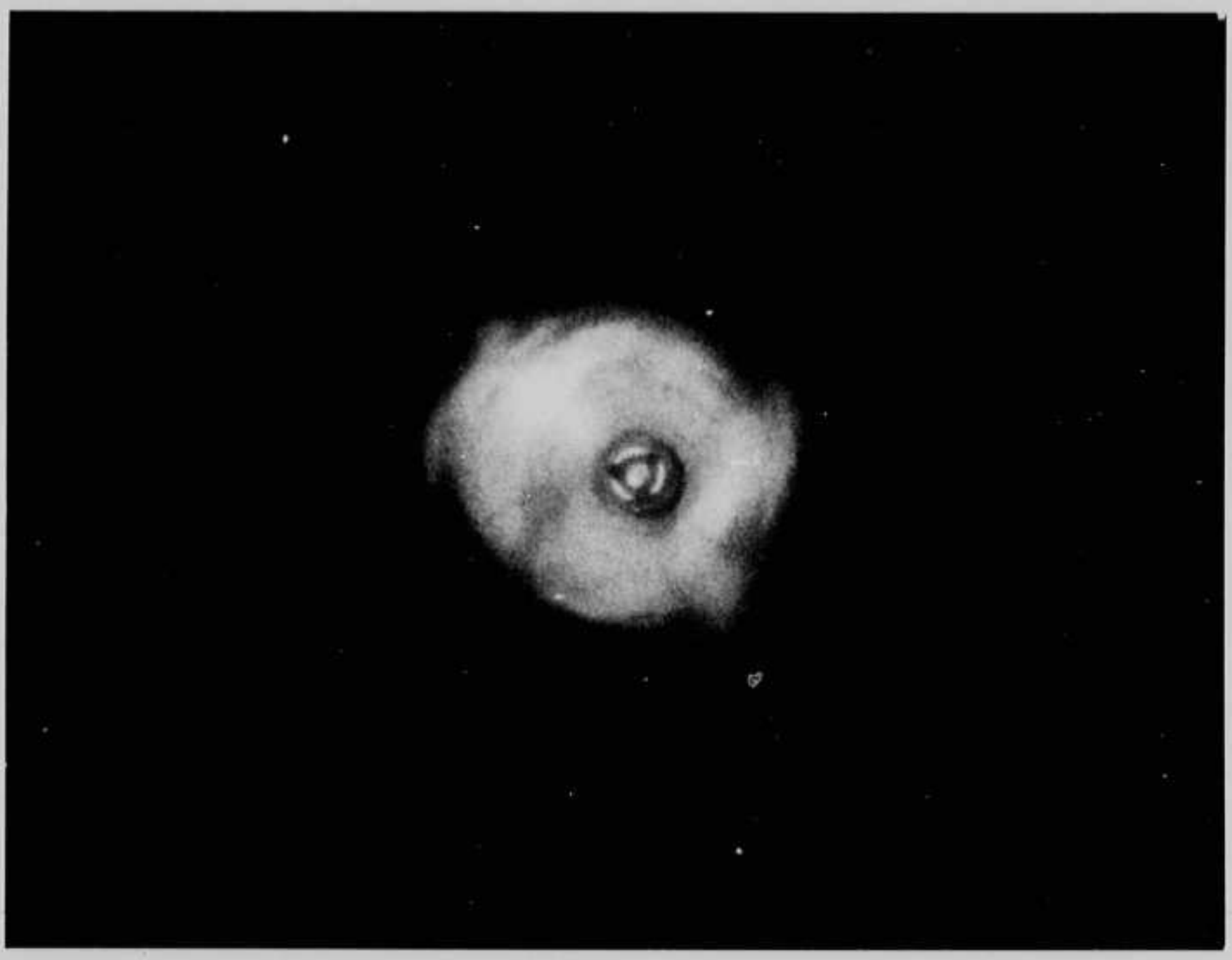
____ negative strip(s)

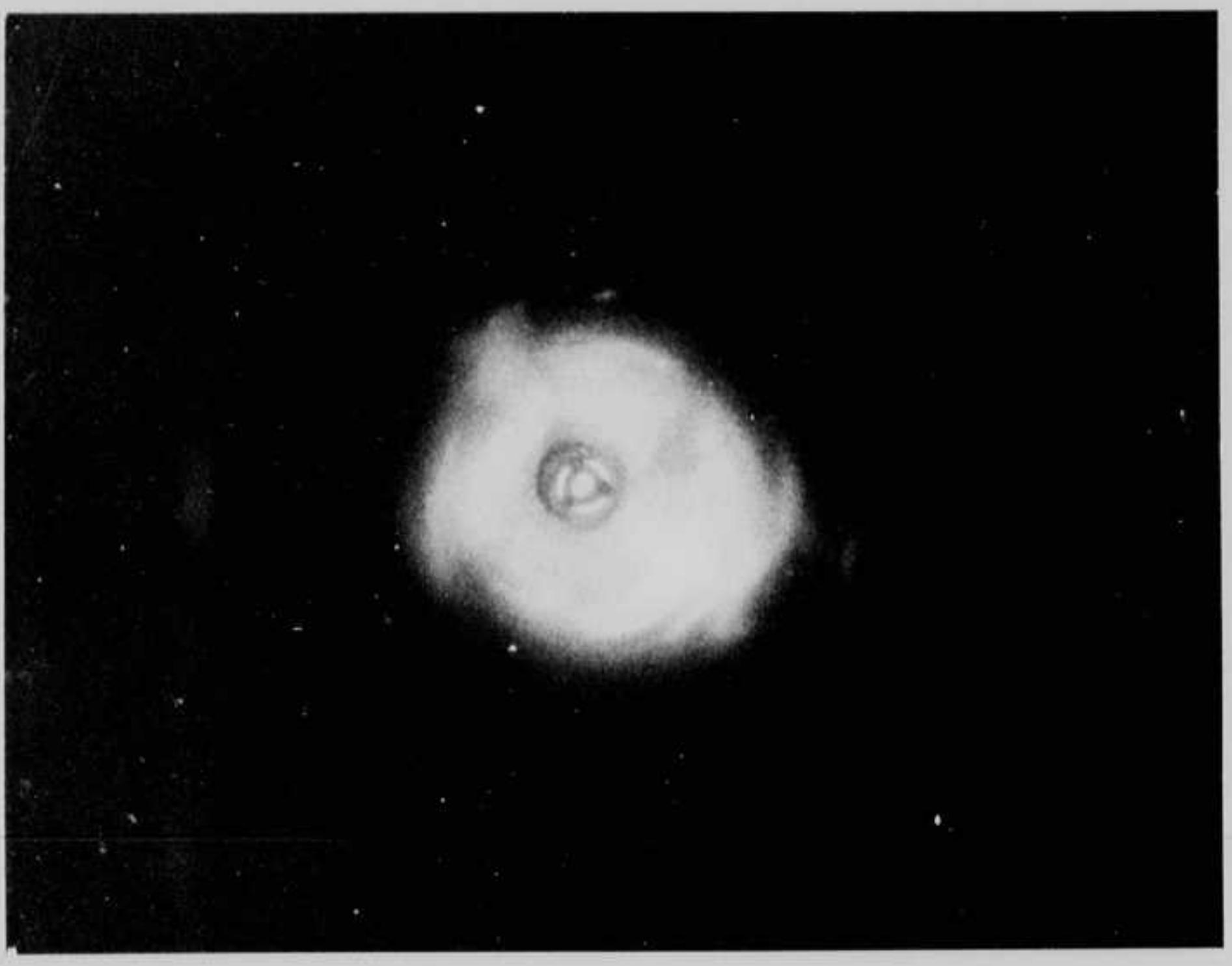
____ unmounted page(s)
(notes, drawings, letters, etc.)

was/were filmed where originally located between page 102 and 103.

Item(s) now housed in accompanying folder.


B-488-2





Notebook # Dec. 8, 1948 - April 8, 1951

Filming and Separation Record

____ unmounted photograph(s)

____ negative strip(s)

__1__ unmounted page(s)
(notes, drawings, letters, etc.)

was/were filmed where originally located between page 104 and 105.

Item(s) now housed in accompanying folder.

HE Edgerton
Feb 13 1951

Data from Jassell

Sandstone.
1200 meter
1 lumen/sq cm
at the 1 ton level.

5 kilometers

50 KT
5 kilometers
no later than 500 T

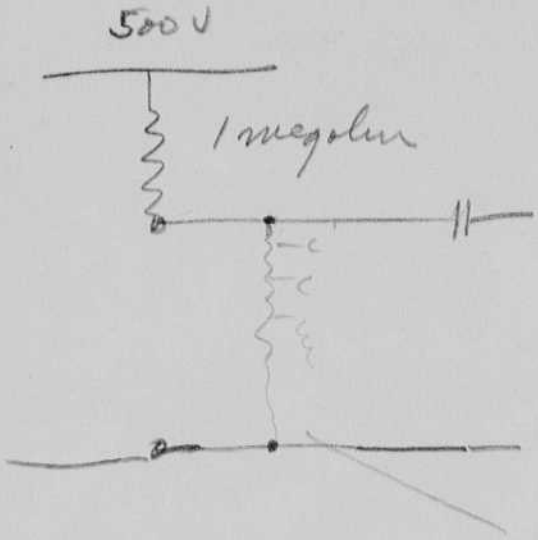
2 tons high exp. 5000° K.
1.3 meters diam
Radius 1.3 meter
Area = $4\pi 1.3^2 = 21.20$ sq meters.
at 5000° —
radiated 3.5×10^7 watts sq meter.

3.5 .5 4
3.3 16.1—

12.8% in band.
$3.5 \times .128 = .45 \times 10^7$ watts sq meter.
$4.5 \times 10^6 \times 21.2 = 9.5 \times 10^7 = 10^8$ watts.

at 5000 meters. $\frac{10^8}{4\pi\, 5000^2} \times 1/3 = 1/10$ watt sq meter
$= 10^{-5}$ watts/sq cm

area of 931 cathode = 2 cm²
2×10^{-5} watts on cathode.

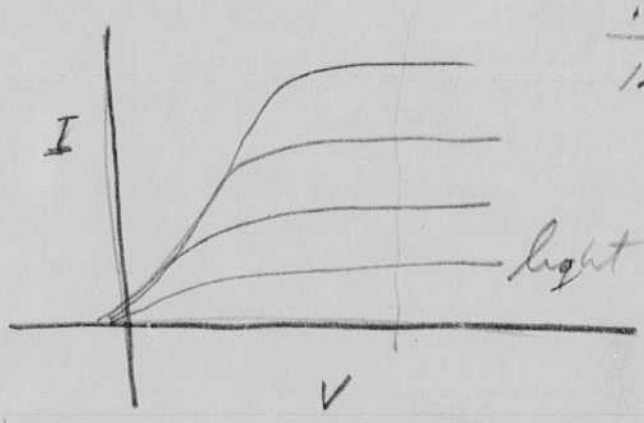


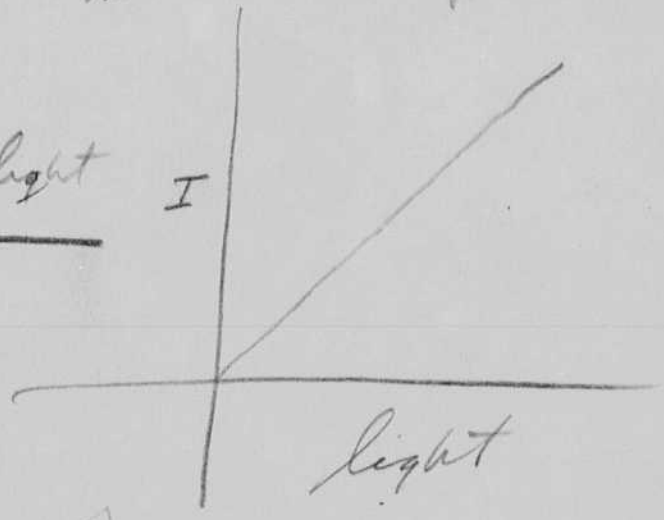
20 × .01
.2 amp.
100 .02 amp.
75 .002
50 .0002 amp.
25

$\frac{10^7}{10^2} = 10^5$ lumens/sq ft.

area of cathode = .25 sq inch
15/16 × 5/16
65
256

$\frac{.25}{12^2} = .173 \times 10^{-2}$ sq ft.





10

$1.5^2 \pi$

$10^{11} \times 10$ lumens $\times \frac{3}{5}$

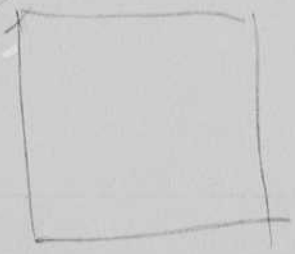
10^{12} lumens

10^{11} c.p.

$\sqrt{10^4} =$ per 30

$E = \frac{10^{11}}{(1500)^2} = \frac{10^3}{2.2} = 400$ lumens/sq ft.

3 inch



3"

Mar 21 1951
Harold E Edgerton
Perry Greenwich

CONFIDENTIAL

Chas Wyckoff Jr. Joe Bogart
Tom Mullins.

Exposure tests were made last night with the sun flash at the air port into the test area.

The 1 μs shutter was used on the direct image of the FT 623 in a 30 inch reflector.

A Fid marker was used to trigger the 1 μs magneto optic shutter. I used a ND2 filter on the front of the pickup mount.

Alignment was made by observing the output from a photo flood at the air port. With out the filter, the current was slightly less than 200 ua.

Tan of angle = $\frac{15'' \times \frac{1}{32}}{\text{3000 meters}} = \frac{1}{2000}$

The bomb at a 3 meter diameter would give the same solid angle at 6 times the distance = 6000 meters.

Light output at 3 meter R = 10^{11} lumens/sq meter
(Data from Fussell) 1 μs time.

High explosive light data from Los Alamos
curve from Felt to Graves.
at 120 μs - average surface brightness
= 2000 candles/meter^2
or 20,000 lumens/sq meter.

Suitable exposure resulted from a 0.4 setting of p.m. gain and a N.D. 2 on the Fid PM tube.

I plan to use the same settings on the actual test.

FT-623 output with 600 mf at 4000 volts
= 300×10^6 lumens
area of lamp = 1/20 sq meter (approx).
surface lum = 6000×10^6 lumens/sq meter
= $6. \times 10^{10}$ lumens/sq meter.

CONFIDENTIAL

March 26 1951
Harold E. Edgerton

CONFIDENTIAL

Grid Rotatronic. Delay Calc.

Pattern at min radius = .008" between dots.
10 dots in pattern. = .08"
diameter = 6.75" x 2
circumference = $2\pi R$ = 42 inches
speed = 300 rpm min
or 5 r.p.s
velocity = 42 x 5 = 210.0 inches/sec.
pattern repeat time
= 210.0 x .08 = 2620 ~~1/sec~~.

$T = 1/2620 = 382$ μs.
Set shutter for 300 μs delay.

April 8 1951
Eniwetok (Parry Island)
A.E. Edgerton

The shot was this a.m. at 7.34 at Runit. I was at Parry near the dock with Eastman, Filliot, and Ward. The flash of light blinded me even when I looked away from the bomb. Clouds excluded a good look at the later stages of the fire ball.

I helped to set up Site M near Runit on the reef to the south. This tower was 75 ft high and about 2 miles from the 300 ft zero tower. Capt Cadwalder, Lee Carr, Bob Morris worked with me.

Photos are to be put in this book to show the arrangement in the tower.
We had 4 Eastman high speed 16 mm cameras
2 Fastax 8 mm "
3 B.R. Slit cameras.
3 K cameras 19" lenses
2 K " 6 inch.

1 Eastman grid 40" lenses
1 WS Raystatronic (Piddletronic)

For later information see "site" books that were used at the different locations.

Notebook # Dec. 8, 1948 – Apr. 18, 1951

Filming and Separation Record

____ unmounted photograph(s)

____ negative strip(s)

__1__ unmounted page(s)
(notes, drawings, letters, etc.)

was/were filmed where originally located between page 106 and 107.

Item(s) now housed in accompanying folder.

Jrw
Los Alamos
Apr 7 1951

MEASURED POINTS ON LIGHT CURVE FOR MARK THREE CASED CHARGE

Lumens/cm^2 (at 40')	Time (μsec)*	Remarks
0.0	47.3	Small bump at beginning of curve.
0.02	49.5	Start of main curve and height of small bump
0.2	50.	
0.4	51.	
0.5	52.	At 120 μ sec conversion of
0.6	53.	these photomultiplier data
0.7	54.	to <u>average</u> surface brightness
0.8	55.	gives about 2000 candles/cm^2.
0.9	56.	Brixner gets 2 - 3000 candles/
1.1	57.	cm^2 for brightness of large
1.5	58.	spots over detonator positions.
1.9	59.	We have not estimated actual
2.4	60.	luminous area seen by Marley
2.8	61.	or multipliers but feel results
3.9	73.	are in essential agreement for
5.0	82.	both intensity and time depend-
5.8	95.	ence.
7.9	103.	
8.5	108.	
9.8	113.	
11.5	118.	
14.1	123.	

* Measured from Alex pulse

From Los Alamos Apr? 1951.

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