

HAROLD E. EDGERTON

PAPERS

MC 25

Series III

Laboratory Notebooks

Number 24

Dated Dec. 19, 1956 to April 29, 1958

Massachusetts Institute of Technology

COMPUTATION BOOK

NAME	Number
HAROLD F. EDGERTON M.I.T. CAMBRIDGE MASS USA.	24

20 D 102.

18 VASSAR ST.

Course ELECTRICAL ENGINEERING.

Used from DEC. 19, 1956, to APRIL 29 1958.

K176063.

HOME 205 SCHOOL ST  
BELMONT MASS  
IU 44869.



MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
COMPUTER CENTER

*Harold E. Edgerton*  
M.I.T. 20 D102  
Dec 19, 1956.

Exposure control flash lamp p 9.  
Boomer. p 94  
P 15. Jan 20 1957 with sub pictures.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
COMPUTER CENTER  
RECEIVED

Notebook # 24

### 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 \_\_\_ and \_\_\_\_.  
*inside front cover*

Item(s) now housed in accompanying folder.

Move from 20D102 to

4-405 made

during Sept 1958

# MASSACHUSETTS INSTITUTE OF TECHNOLOGY

## COMPUTATION BOOK

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### GENERAL INSTRUCTIONS

In all work in which *accuracy* and *ease of reference* are important, much depends upon carrying out the computation in a systematic manner. The following instructions, taken from the *Engineering Department Figuring Book of the Allis-Chalmers Co.*, serve as a guide in this matter.

"All computations, of whatever kind, are to be made in these books, except in cases where special blanks may be provided for specific kinds of computation. Computations may be made in ink or pencil, whichever may be more convenient. Pencil figuring should be done with a soft pencil. All the work of computation should be done in these books, including all detail figuring."

"Each subject should begin on a new page, no matter how much space may be left on the previous page. The subject, with the date of beginning it, should be plainly written at the top of the first page of the subject."

"Work should be done systematically, and as neatly as consistent with rapidity. The books are, however, intended for convenience, and no unnecessary work should be done for sake of appearance only. Errors should be crossed off instead of erased, except where the latter will facilitate the work. Work should not be crowded. Paper costs less than the time which would be expended in attempting to economize space in making erasures."

"Where curves drawn on section paper (or sketches) are necessary parts of a computation, they should be pasted in the book, except where specifically otherwise provided for."

"Computations should be indexed, in the back of the book, by the person using the book."

\* \* \* \* \*

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#### TECHNOLOGY STORE

HARVARD COOPERATIVE SOCIETY, Inc.

40 Massachusetts Ave., Cambridge 39, Massachusetts

Dec 19 1956  
Harold Edgerton

# Oscillator for Stroboscope

The new strobosc using the high pressure xenon optube of Demmeshausen is being designed. So just time today looking into possible oscillators.

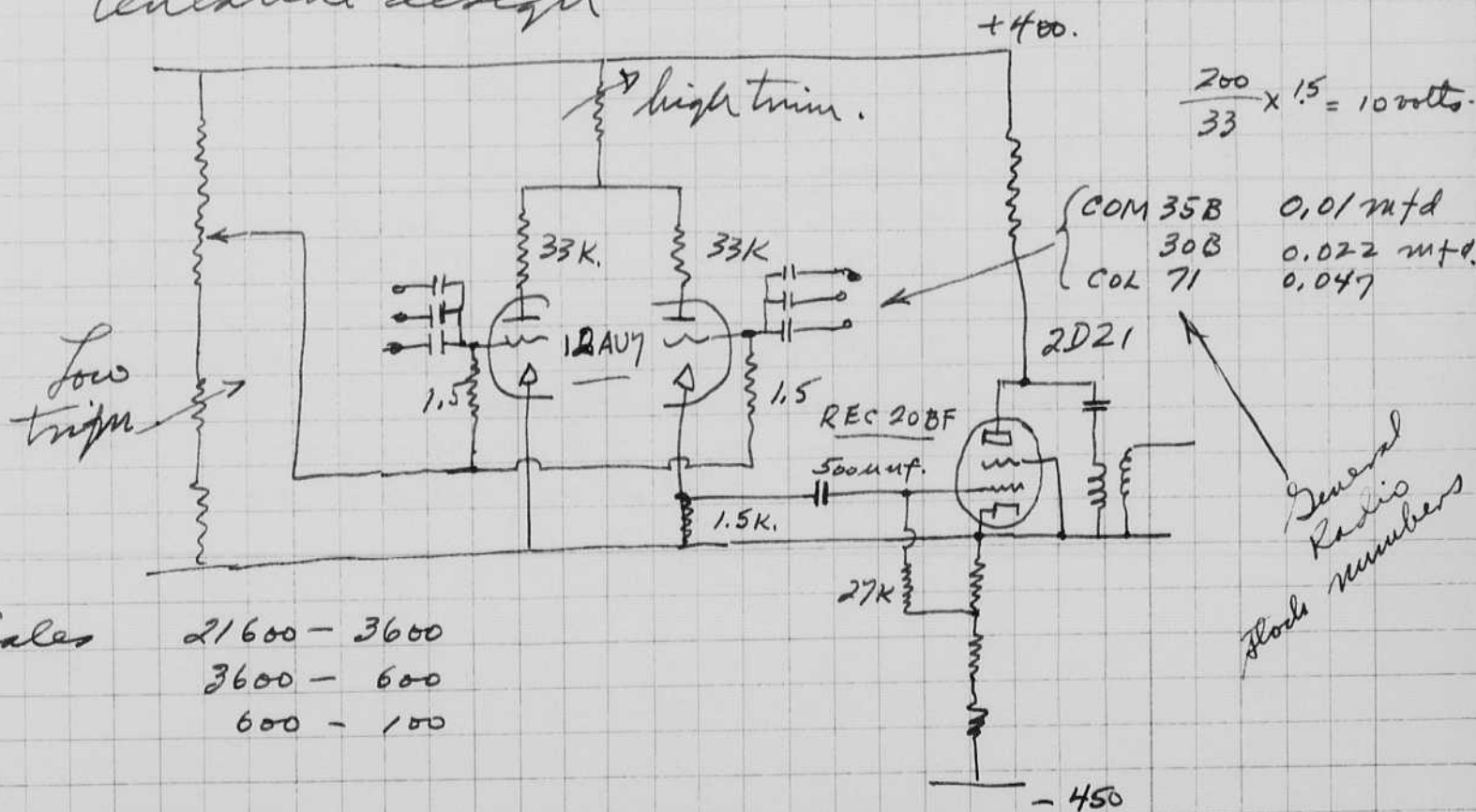
Multivibrator - works fine in 631 instrument. Should be considered for new model. Gives neg pulse. We need a positive pulse for the thyatron.

Blodding oscillator. - may have jitter due to variation in peak currents due to tube instability. Dick Frank says there is usually trouble in obtaining long time stability.

Thyatron oscillator - some troubles due to changes in thyatron char. especially discharge

I plan to see Henry Littlejohn and Mac Holtje at GR. about components for the oscillators.

## Tentative design





Notebook # 24

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\_\_\_ negative strip(s)

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(notes, drawings, letters, etc.)

was/were filmed where originally located between page 0 and 1.

Item(s) now housed in accompanying folder.

10.

Longwood Lane

Sunday Ave

Highly

B Apr 5, 1957 French to the

Dec 21 1956

Harold Edgerton

A working breadboard model of the new Xenon strobe was finished last night and a circuit drawn for General Radio to try out on their first model. I plan to paste in the circuit.

A cathode resistor in the multivibrator is used to couple the output to the thyatron. I found that the operation of the multivibrator was ~~was~~ balanced in time. However when the CR oscillograph was put across the plate of the other triode operation was O.K.? For this reason a .002 mfd capacitor was put there to ground, also an .002 cap was put across the 1500 ohm cathode resistor for the same reason!

Dec 22 1956. Stook the unit down to T.R. yesterday about 9:30 am. Wilkins and Thurston gave it a going over.

I changed the 2.8 meg grid resistors to 2.42 meg so that a top speed of 25000 could be achieved. The scale then came down about as follows.

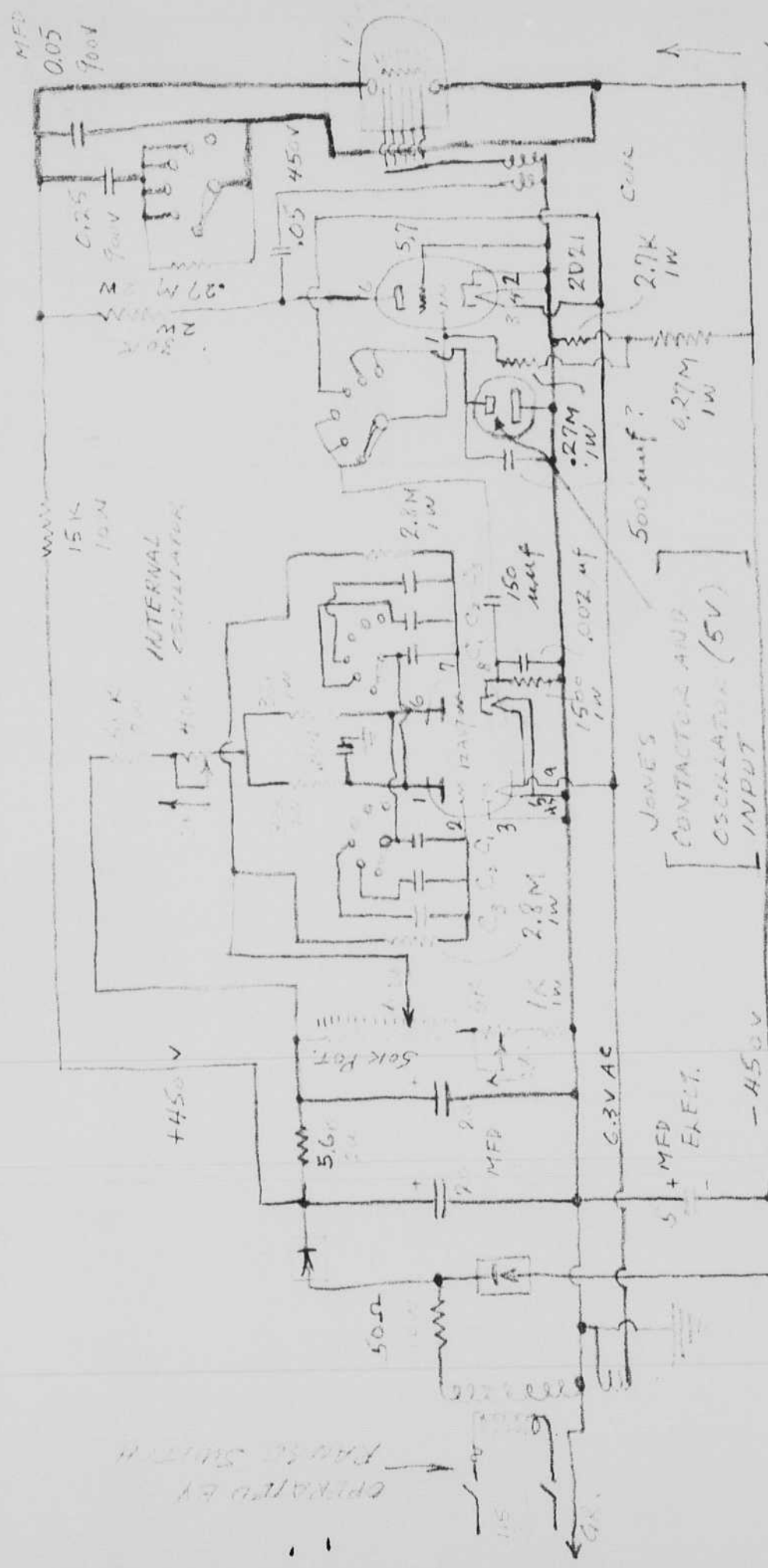
<u>Ratio, 6.25</u>	25,000 - 4000
	4000 - 640
	640 - 102

Notice there is little over lap. The scales will have about 590 mm on each end for overlap etc. about 300 degree rotation of the pot.

Worther and Richmond saw the equipment in action in Wilkins office.

We have only 2 tubes that work properly in the circuit, the others slip or hold over into a continuous arc.

6  
FX-6.



FX-6  
 HOLD RATIO  
 1 TO 6

$C_1 = 0.002 \mu f$   
 $C_2 = 0.012$   
 $C_3 = 0.012$

POSITION	SWITCH	OFF
1	3600 - 21,600 RPM	
2	600 - 3600 RPM	
3	100 - 600 RPM	
4	60 WAVE LINE SYNC	
5	CONTACTOR OR INTERNAL OSC TO COCKS	
6	" " TO 400 CYCLES	

XENON STROBOTAC

HAROLD EDGARTON  
 DEC. 20, 1956.

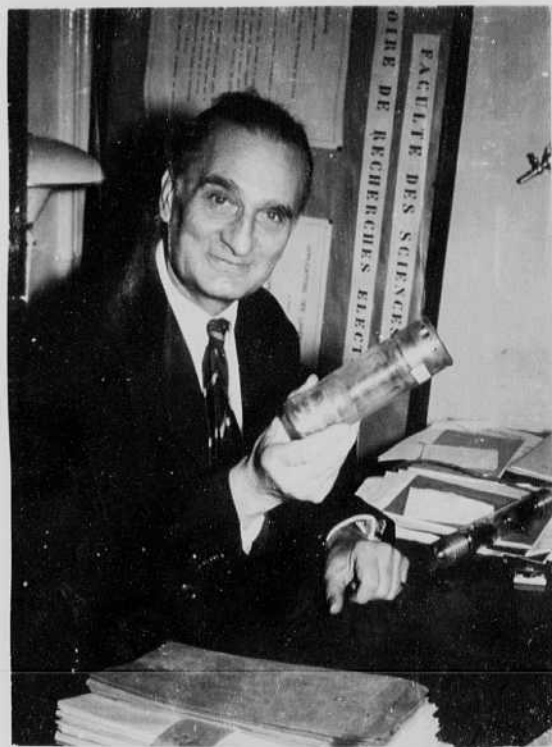
*note that the Grid Resistor were changed (P2) to 2.4 meg so that the scale would be go up to 25000 r.p.m.*

Dec 24, 1956.

Harold Egerton

A design of a reflector-diver for the 501 with an FX-6 lamp using a 500 transformer was made by Bill MacRobert's and myself on Sat Dec 22. We used a Herland focusing reflector on top of our XP-2 driver unit. This will be finished on Wednesday if all goes well.

One problem is lamp starting. A spark is needed to get the FX-6 going



La Porte  
Paris  
1956



Schadler  
Egerton  
Wollroth?  
Basel 1956.

Jan 4, 1957.

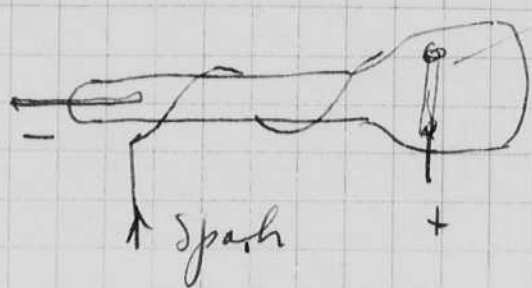
Howard Edgerton.

End on tube design.

The spark wire (external) was wrapped in a ~~8mm~~ 8mm O.D. tube at 2 turns per inch. The arc did not spiral inside opposite the spark wire.

at 1 turn per inch the arc with 1 mfd at 600 volts did spiral, then when it was viewed end on, the light appeared to be a donut.

I next tried a 4mm I.D. tube



Ring anode.

1 mfd at 400 volts shows spiral arc on surface of the glass.

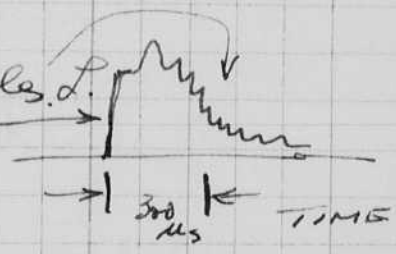


Then ~~450~~ 50 mfd <sup>electrolytic.</sup> was tried at 400 volts. It was bright through a Density 3 filter when viewed end on.

10  $\mu$ s duration with 1 mfd at 600 V.

300  $\mu$ s " " 450 mfd at 400 volts.

Rise very fast (about 20  $\mu$ s) then ripples.



Jan 5 1957

Holloman Air Base Unit Design

Conf yesterday with Pina and Bretter on outdoor silhouette flash device for shadow photos.

Tests made today on roof of M.I.T. Sun 1030 to 11 am at 70° over.

f 4.5 - 1/100 sec Panatomic X film exposure ok

f 16 - 1/100 " " " " ok thin.

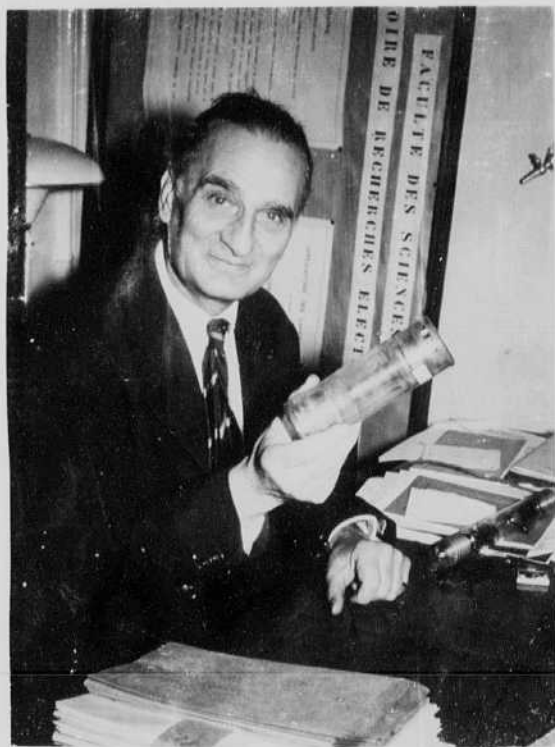
f 4.5 1/100 29 FILTER Panatomic X film " very thin.

Dec 24, 1956.

Harold Edgerton

A design of a reflector-diver for the 501 into an FX-6 lamp using a 500/1 transformer was made by Bill MacRoberts and myself on Sat Dec 22. We used a Heiland focusing reflector on top of our XP-2 diver unit. This will be finished on Wednesday if all goes well.

One problem is lamp starting. A spark is needed to get the FX-6 going



La Porte  
Paris  
1956



Schardin Edgerton  
Wollrath?  
Basel 1956.



Jan 4, 1957.

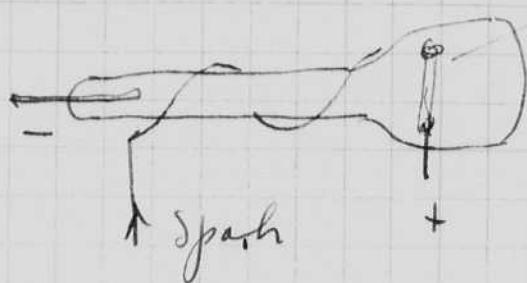
Harold Edgerton.

End on tube design.

The spark wire (external) was wrapped in a ~~8 mm~~ 8 mm O.D. tube at 2 turns per inch. The arc did not spiral inside opposite the spark wire.

at 1 turn per inch the arc with 1  $\mu$ s at 600 volts did spiral, then when it was viewed end on, the light appeared to be a donut.

I next tried a 4 mm I.D. tube



Ring anode.

1 mfd at 400 volts shows spiral arc on surface of the glass.

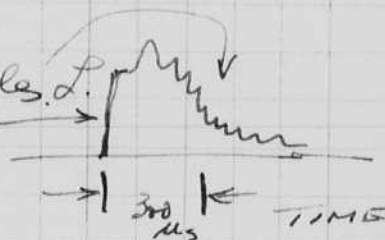


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300  $\mu$ s " " 450 mfd at 400 volts.

Rises very fast (about 20  $\mu$ s) then ripples.



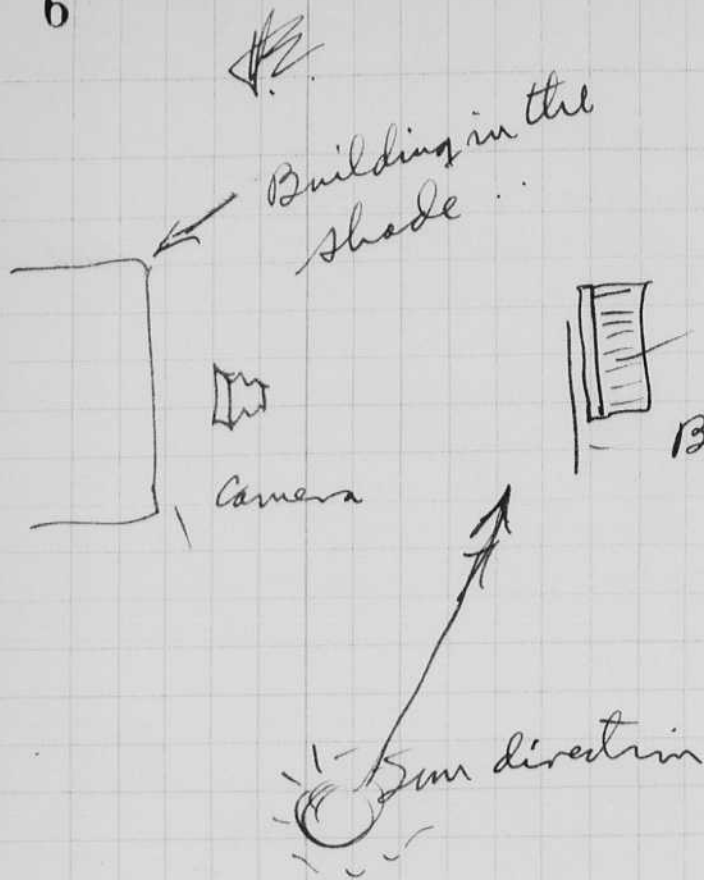
Jan 5 1957

Holloman Air Base Unit Design

Conf yesterday with Rona and Bretler on outdoor silhouette flash device for shadow photos.

Tests made today on roof of M.I.T. Sun 1030 to 11 am at 70° over.  
f 4.5 - 1/100 sec Panatomic X film exposure ok  
f 16 - 1/100 " " " " ok thin.

f 4.5 1/100 29 FILTER Panatomic X film " very thin.



a black cloth 3ft square at the camera seemed to make no difference in the visual effect.

*note:* No exposure when the background is in the shade! This will enable us to shoot shadow photos outside.

*Result by me*

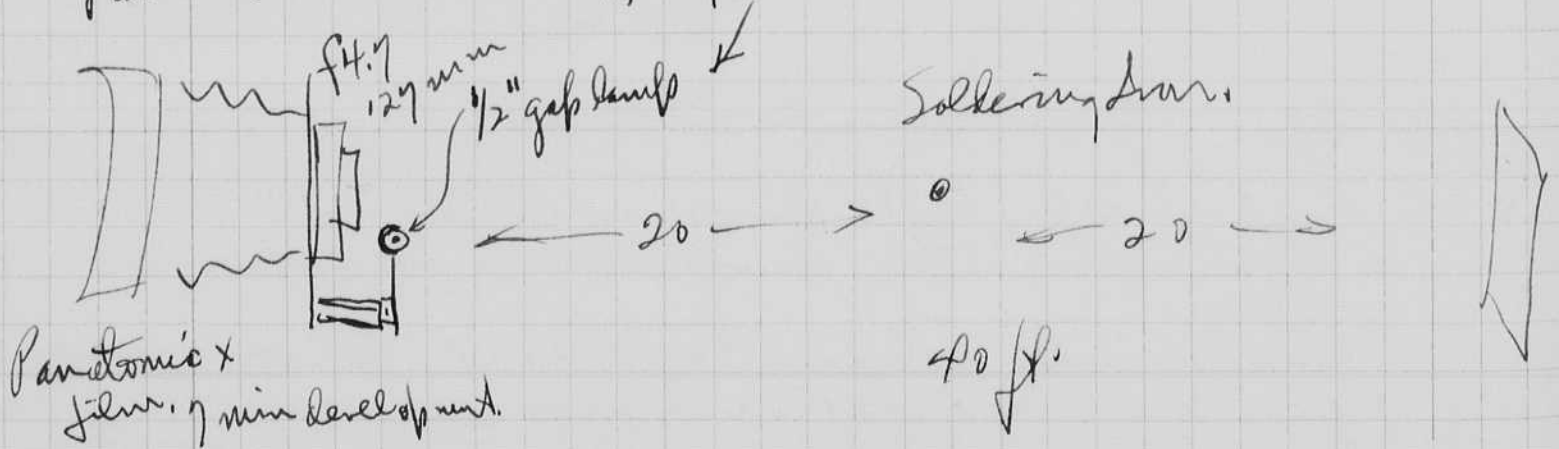
Now try exposure with electronic flash point source. I have an Fx-1 tube type with a 1/2 inch gap. This will be placed near the lens, at 40 feet from the screen.

*NOTE*

2 mfd at 2500 volts - exploded flash tube.

Duration at 2000 volts was about 3 ~~ms~~ <sup>ms</sup>. u.s. with 2 mfd or 4.

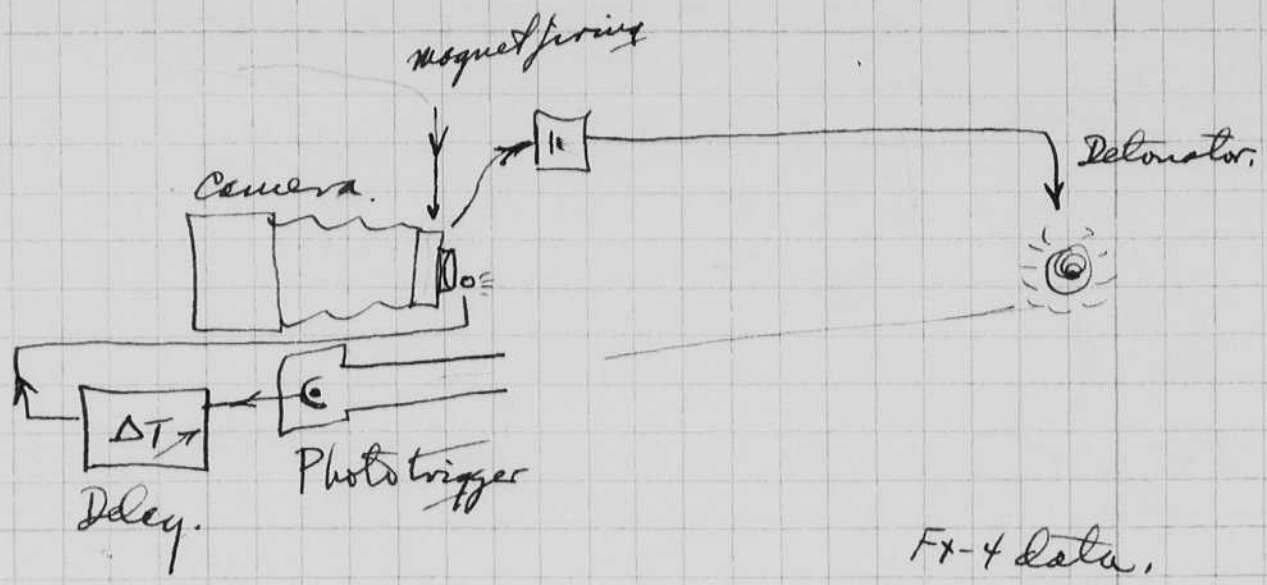
Flash unit constructed 1 1/4 mfd at 2KV±.



Exposures at f11 thin but ok.  
f 4.7 ok.

f8 photo of soldering iron focus on iron - no waves. ok.  
f8 " " " " focus on screen.

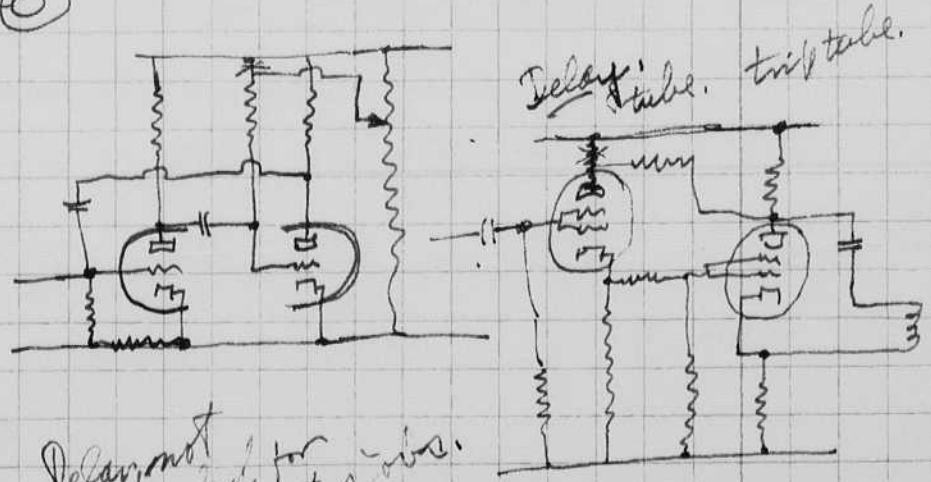
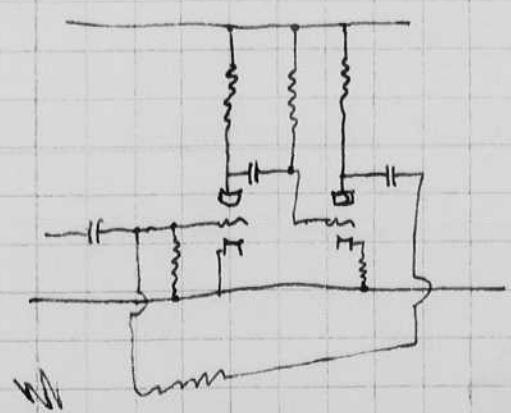
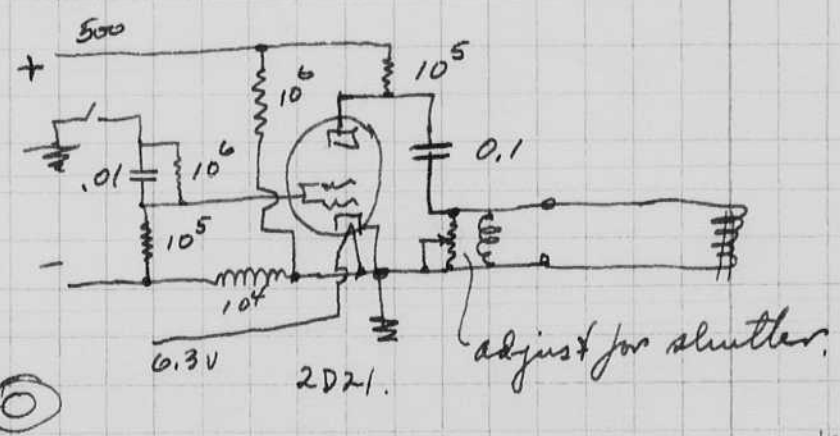
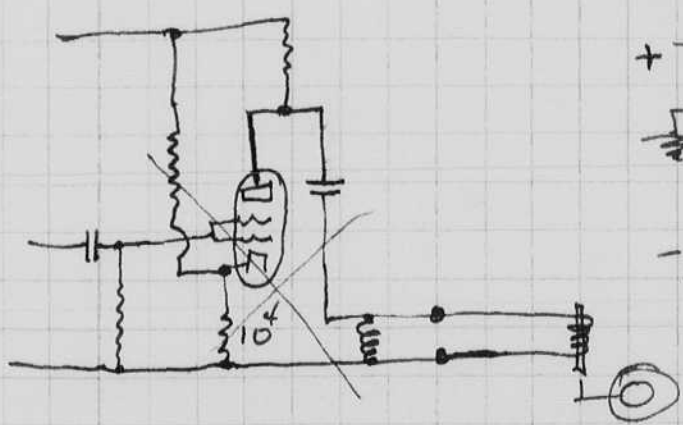
10 + unadjusted  
 gun, 7.5  
 machine



The system above seems to have great promise for many kinds of silhouette photography.

Fx-4 data,

800 volts  
 1000 volts, 2 mfd.  
 $\frac{CE^2}{2} = 1 \text{ wattsec}$   
 peak c.p. = 23,000  
 time 4  $\mu$ s.  
 C.P.S. = .92  
 $\frac{.92}{1} = .92 \text{ C.P./wattsec}$



Delay not needed for most jobs.

Camera.

12"



$$\frac{6'}{20'} = \frac{4''}{f}$$

$$f = \left(\frac{20'}{6'}\right) 4'' = 12''$$

20'

20'

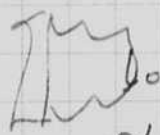
$$5'' \text{ lens} - \frac{20'}{3} = 6.8 \text{ feet.}$$

$$5'' \text{ lens} \quad \frac{20'}{4'} = \frac{5''}{4''} =$$

$$x = 5 \text{ feet.}$$

for 4x4 screen to fill 4"x4"

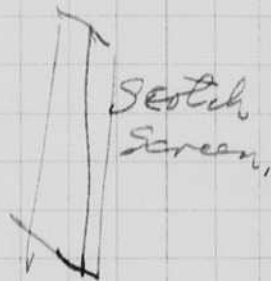
Jan. 6, 1957. I took photos of fire crackers today with the following setup:



5ft.



5ft.

Setup  
Screen.

5 1/4" lens.

1/2" 4mm gap.

125 mfd 2KV

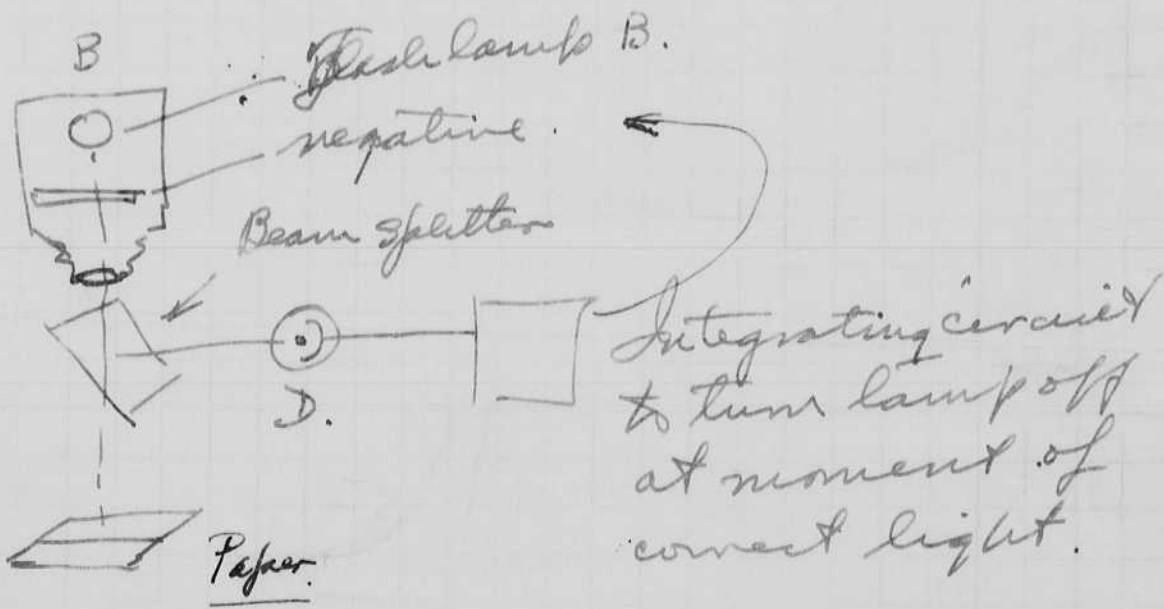
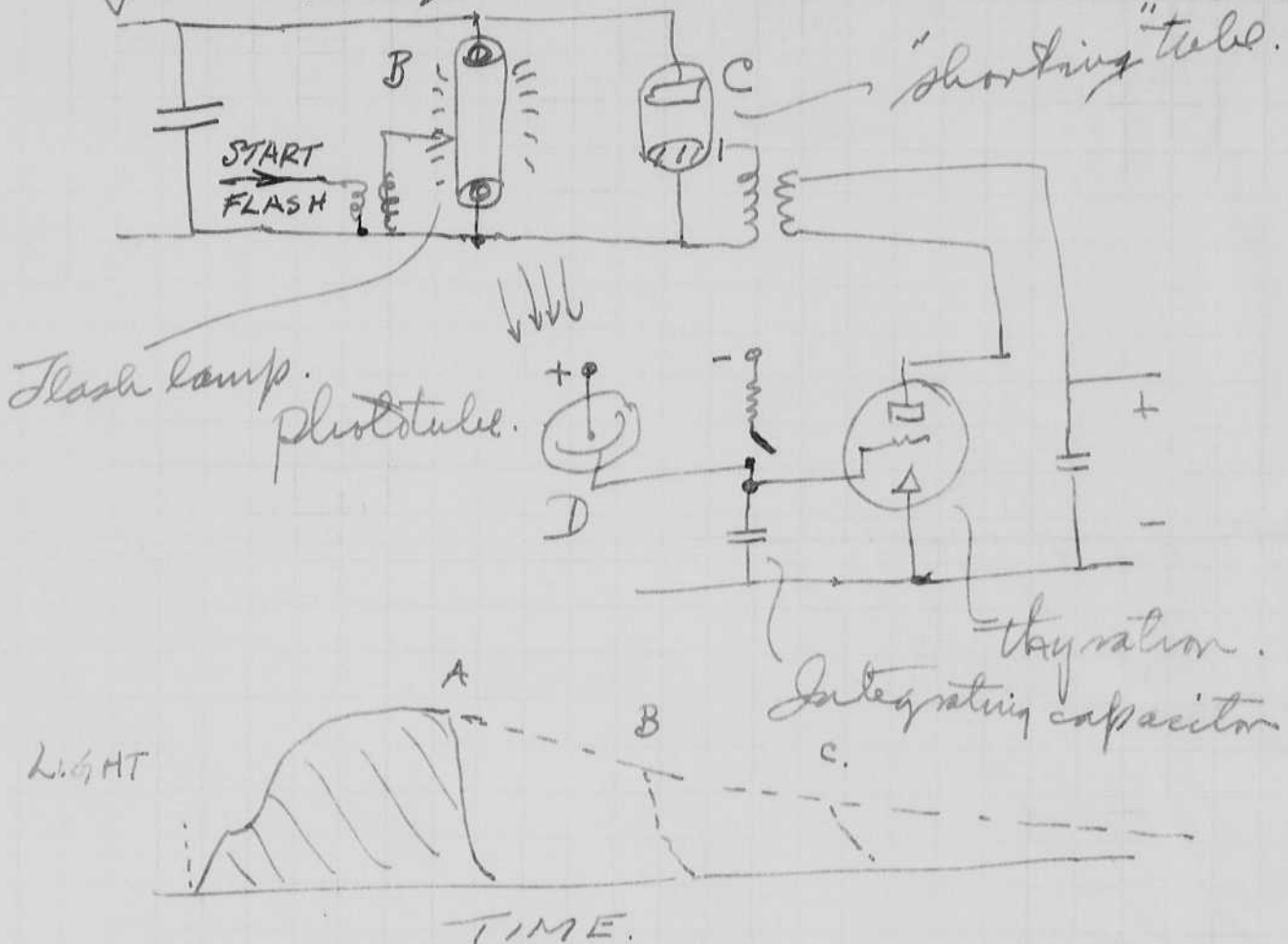
f16

Some photos were taken with the fire cracker moved closer to the screen.

f-16 gives about the correct exposure on the film (ASA 35 daylight) Panatomic X.

10 color Ektacolor 4x5 negs were taken

Photoelectric exposure control with Flash Lamp.



Disclosed & unclassified by me.  
 Jan. 7 '57  
 M. S. Pines

Harold E. Egerton  
 Dec 2, 1956.  
 Belmont Mass.

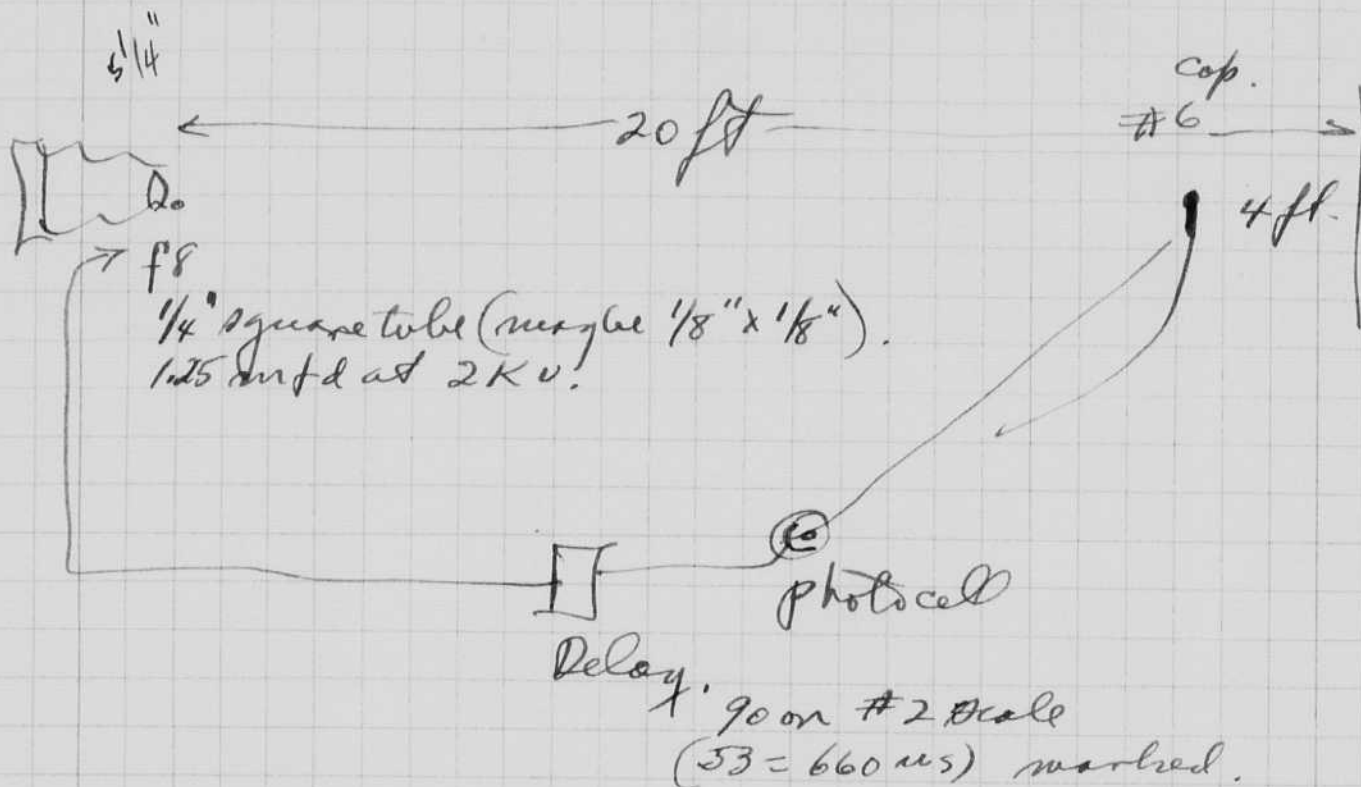
Jan 7, 1957.

Harold Egerton

Conf with Bob Rines and K.J. Demarest today.

Evening - Snow storm all day.

Set up for #6 daynamite caps,



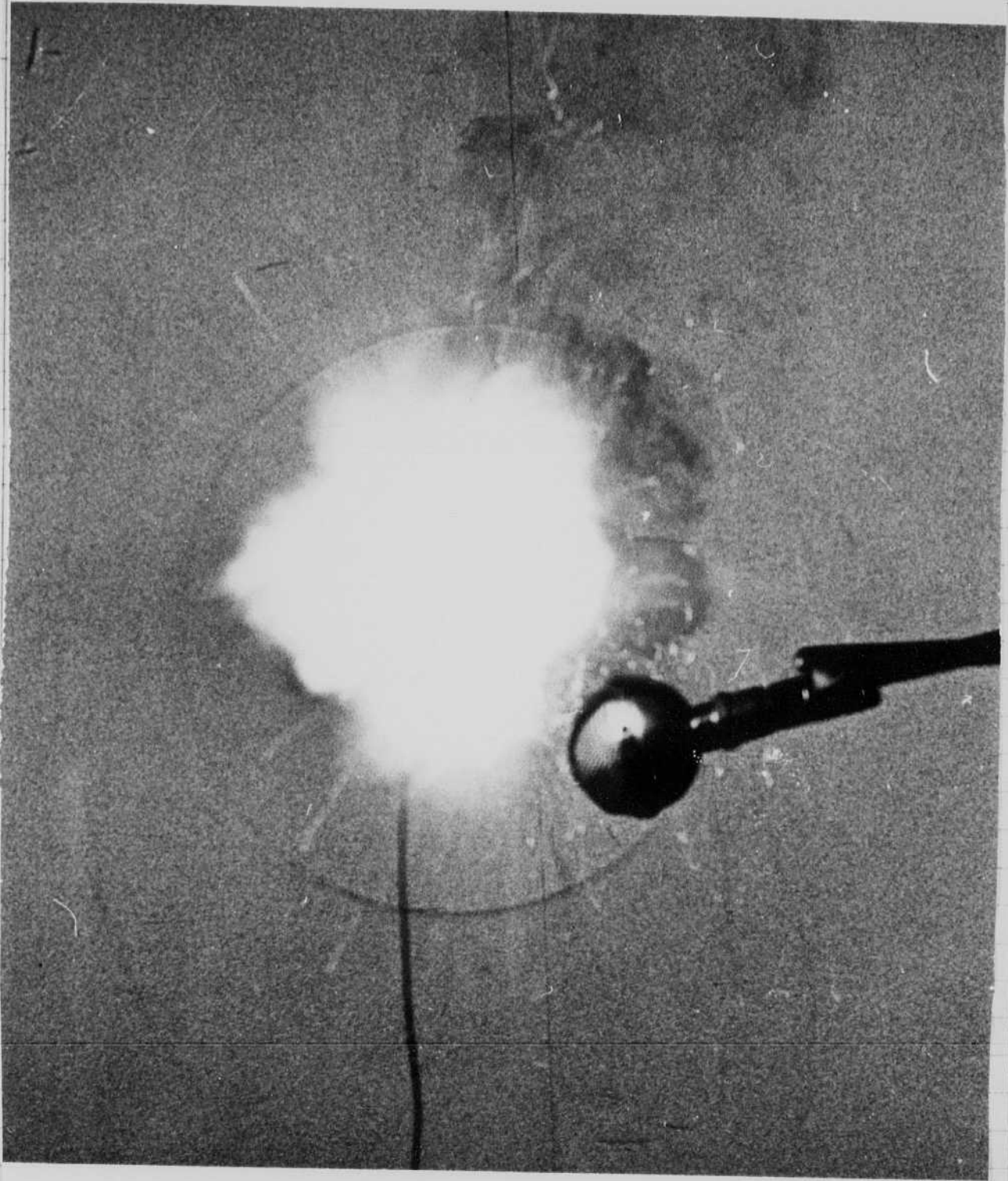
two trial exposures made with XXX and Panchromatic X  
 Photo at 15. Too dark. OK.

First cap - no trigger. a bare 929 phototube  
 at 3 ft into a Caltech folder  
 did not trigger the delay circuit

Photo excellent  
 shows slouch  
 near edge of  
 frame.

Second cap. a 6" diam condenser lens was put  
 at the phototube to increase the sens.  
 trigger was ok. Delay set at 90 on #2 range

3rd cap. a #6 cap. Delay at X5 on dial #2 range.



Captain Kidd Firecracker, about 2+ feet from screen. The lamp and camera was 20 ft away.

- 4th #6 cap. (Different mfg.) delay at 20 on #2 scale
- 5th #6 cap (Same as 4) delay at 10 on #2 "
- 6th #6 ca " delay set at 0 on #2 " no flash
7. " " " " " " " " ok
8. Cap reduced from 1.25 to 0.25 " " " " " " ok?

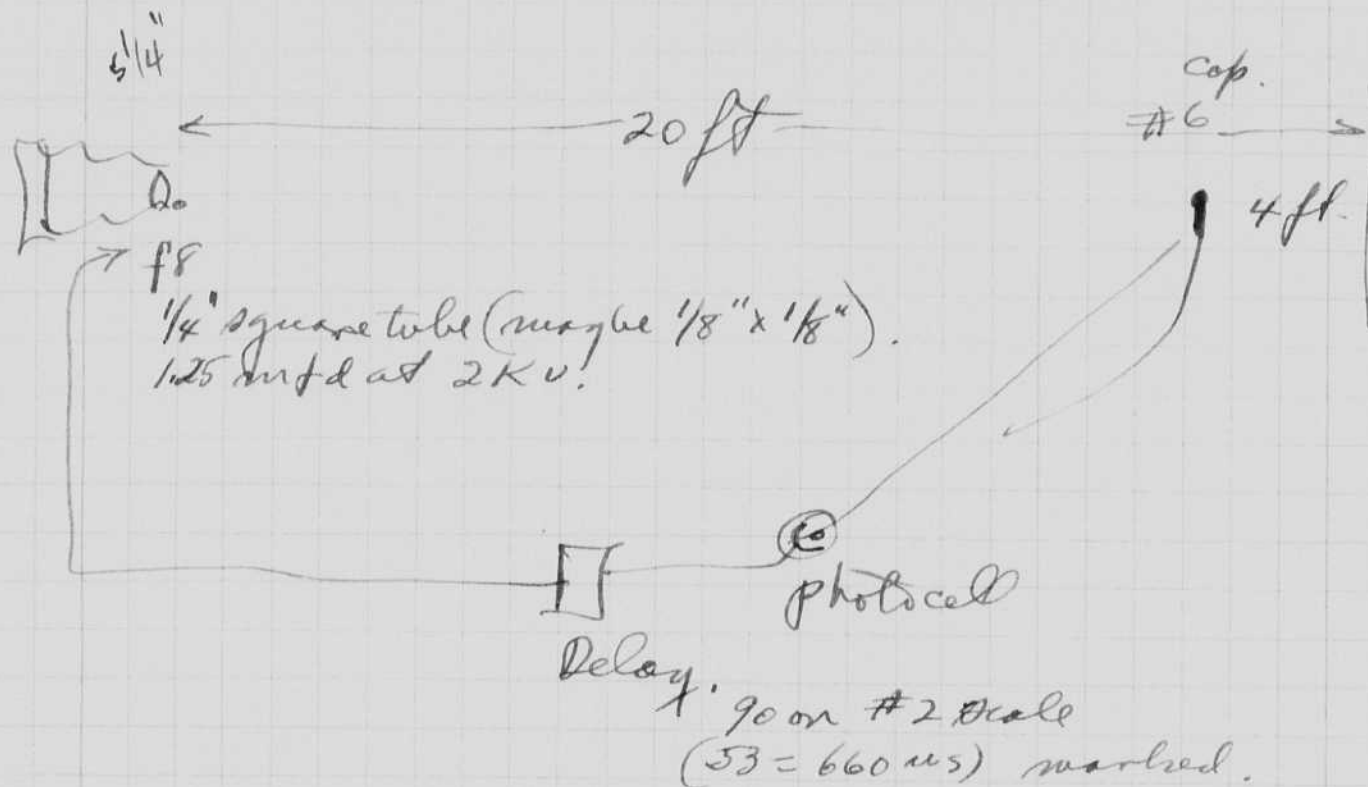
Jan 7, 1957.

H. J. Egerton

Conf with Bob Rines and K. J. Danus today.

Evening - Snow storm all day.

Set up for #6 dynamite caps,



two trial exposures made with XXX and Panchromatic X  
1500 X 25. 1000 X 25. 1500 X 25.

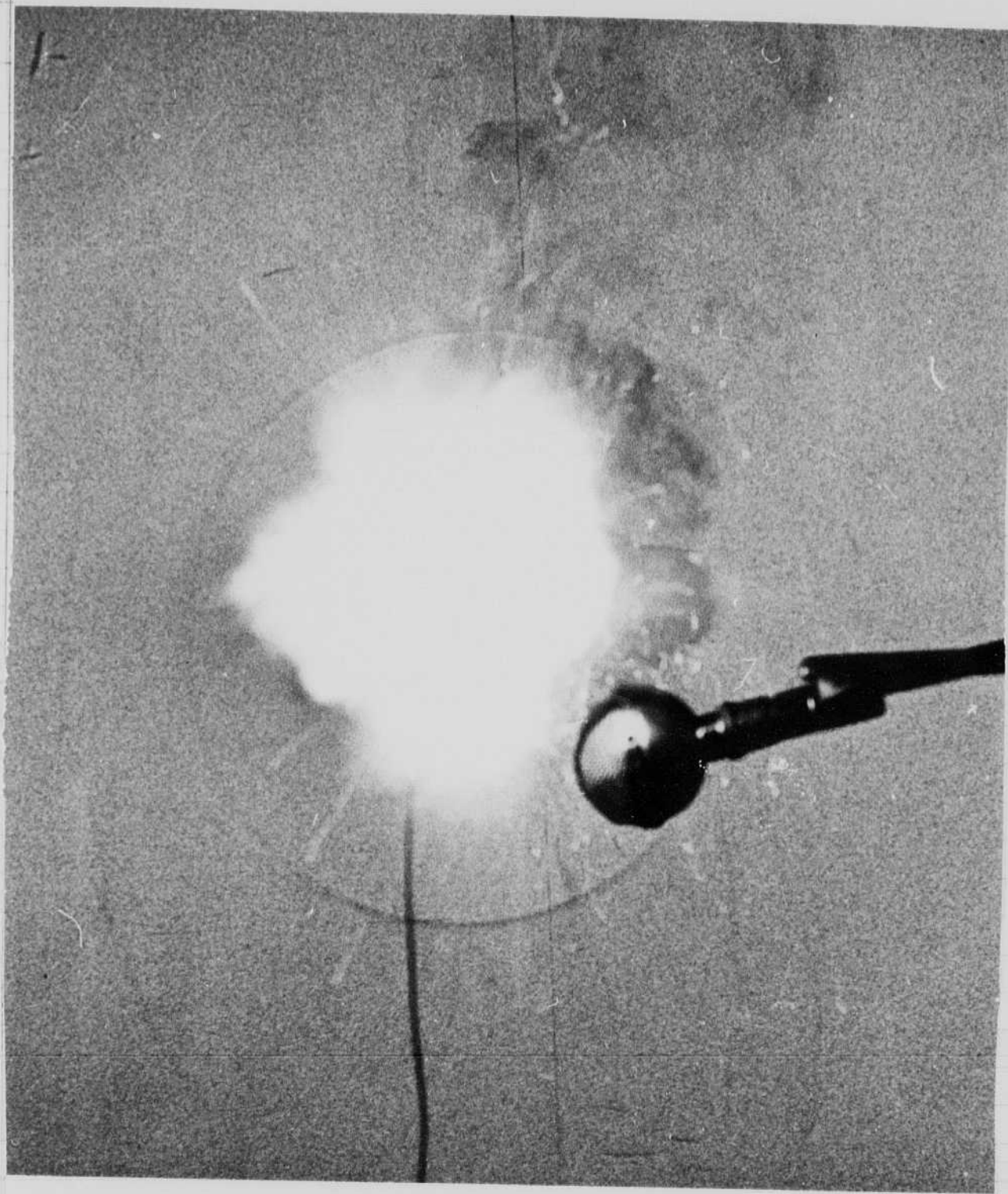
First cap - no trigger. a bare 929 phototube  
at 3 ft into a callus folder  
did not trigger the delay circuit

Photo excellent  
shows shock  
near edge of  
kern.

Second cap. a 6" diam condenser lens was put  
at the phototube to increase the sens.  
trigger was ok. Delay set at 90 on #2 range

3rd cap. a #6 cap. Delay at 45 on dial #2 range.





Captain Kidd Firecracker, about 2+ feet from screen. The lamp and camera was 20 ft away.

4th #6 cap. (Different mtg.) delay at 20 on #2 scale

5th #6 cap (Same as 4) delay at 10 on #2 "

6th #6 ca " delay set at 0 on #2 " no flash

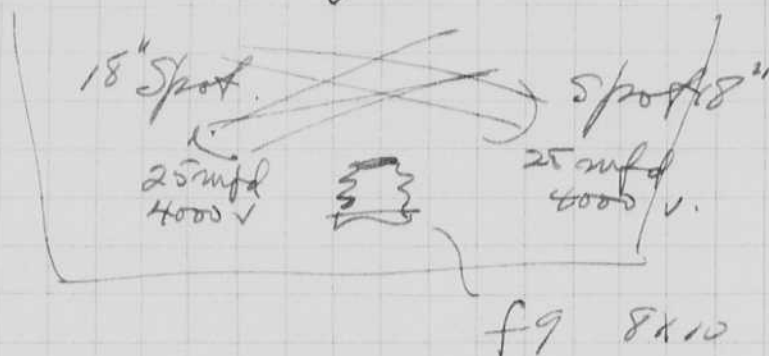
7. " " " " " " " " ok

8. Cap reduced from 1.25 to 0.25 " " " " " " ok?

Jan 10 1957.  
H. E. Edwards

Dynamite photos were terrific. The scheme is all set to try on the roof in sun light now.

Ice Capades photos made yesterday at garden with Red Elmendorf and Mrs. Wychroft, Roy Swanson.



~~Camera~~  
Light - subject about 17 feet.  
4 flashes - 3, - etc to catch.

Ronnie Robertson  
Bobbie Spec.

Rosemarie Henderson.

Milk Drop exposure tonight.

7 1/2 or 8" Background Dark bright Red

Green Pitcher upside down

Lamp FX-1 in cyl reflector  
25 mfd 4000 volts.

Camera FX10 f64

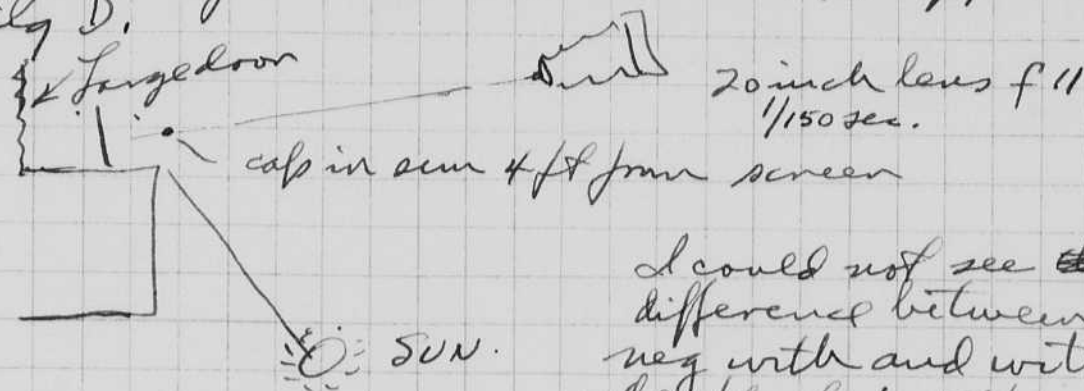
Panchromatic  
Ektachrome }  
Ektachrome }

Photo trip  
Delay to  
catch crown.



Jan 11, 1957  
 JMW

I took the shadow equipment outdoors this afternoon. It was a very clear day right after the snow storm of last night. The screen was put against the radiation stopper back of wing D.



I could not see ~~to~~ any difference between a neg with and without the flash! Apparently the large amounts of snow reflected the light onto the screen. I should have read it with a meter.

To night I am trying the equipment indoors. I have the screen in the shop while I am about 45 feet away.

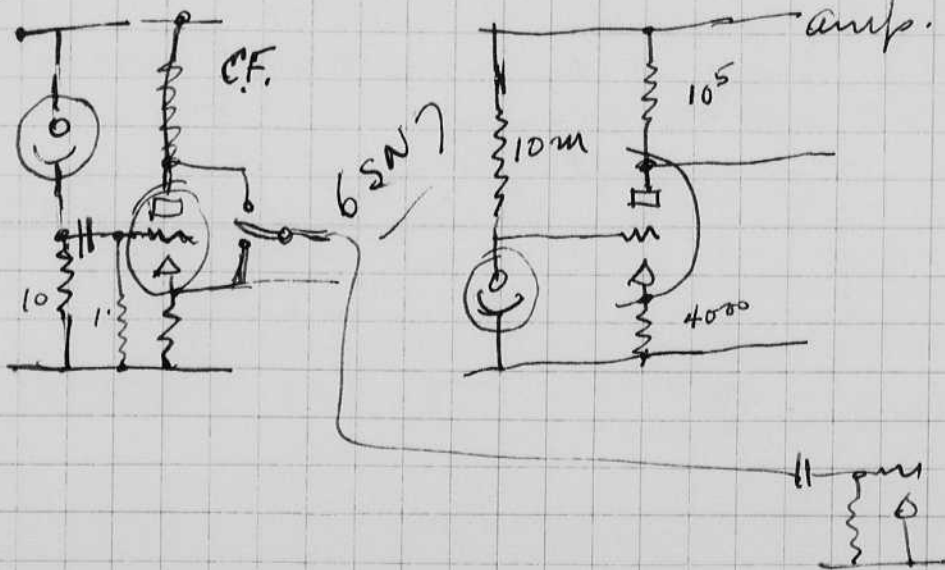
With the 1/2 inch lamp on 1.25 mfd at 2KV I get a density of 1+.

Another photo was taken with a photo flood alone, a third with both the photo flood and the flash.

The photo flood was spotted at 45 degrees and about 8 or 10 feet from the screen.

Exposure for Photo flood was more than for sparks.

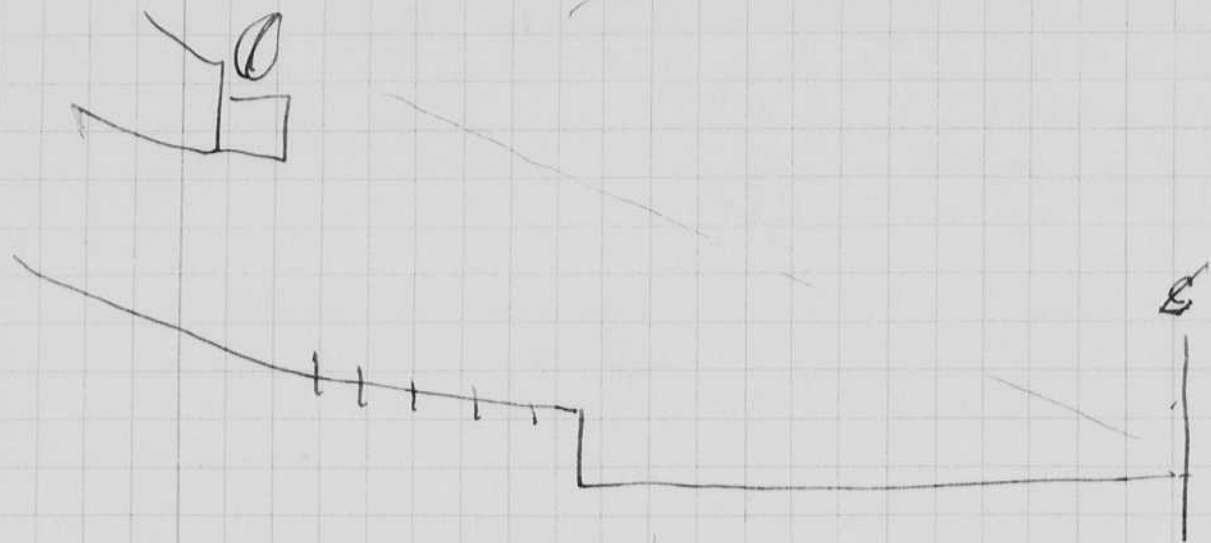
Photo trip



3 cathode cath 6  
 2 plate plate 5  
 1 grid grid 4  
 7-5 heater

Jan. 15, 1957.  
 Harold Edgerton

Color photos of Ice Capades.  
 Jan 12 and Jan 13 at Boston  
 Garden.



$$\text{center } 46 \times 4 = 184 \text{ ft. cond. sec.}$$

$$\text{edge } 56 \times 8 = 448 \text{ ft. cond. sec.}$$

Basic exposure equation

$$IT = \frac{S}{C} A^2 = 184$$

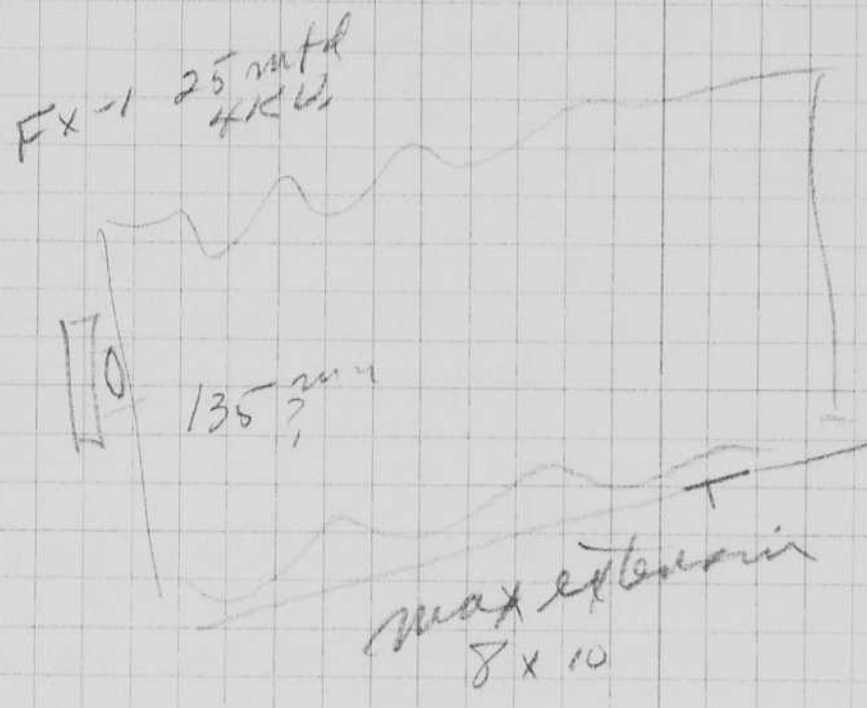
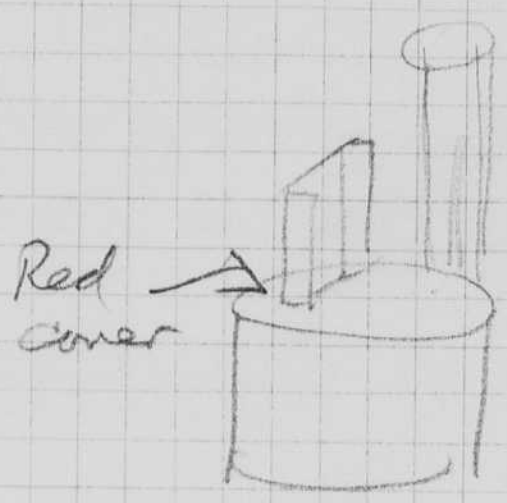
$$A^2 = \frac{184 (15 \cdot 70)}{25} \quad A = \sqrt{184} \approx 13.7$$

actually the lamps were swung apart  
 for the actual shooting so the above  
 are ~~not~~ high.

We shot Kodachrome at f 11 and  
 f 5.6. In some cases the lamps  
 were not up to charge, a 45 sec.  
 time was required for a full charge.

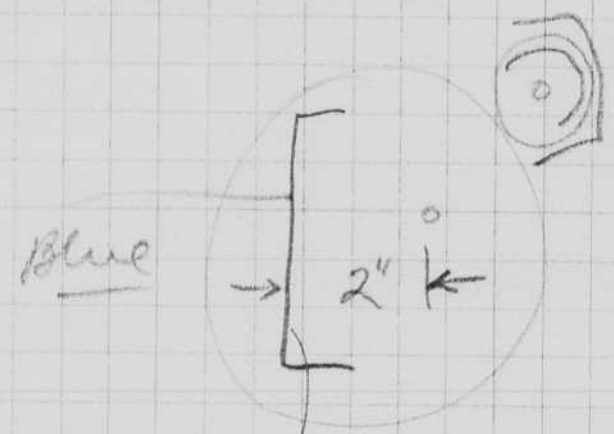
Jan 20 1957

Harold Edgerton  
Esther Edgerton milk drop photos.  
Sunday night.



Fx-1 25 mm  
4K V

135 mm



Fx-1 in 1" Pyrex lens

Light blue.

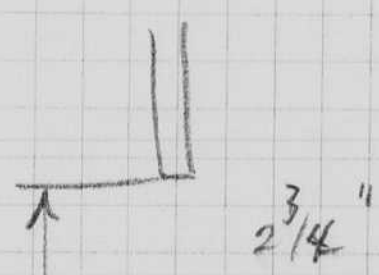


photo cell

$7\frac{5}{8}$  drop.

Delay.  
with extra capacity

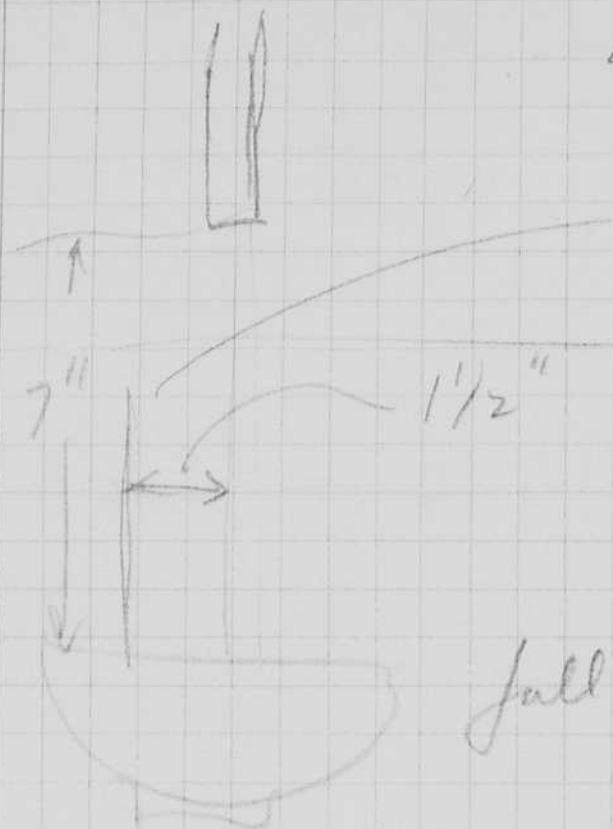
meter white card 14-20  
on BR meter.  
at f 32.

Ektacolor, ASA 25.

70 delay  
71.5 delay

# Splash in cups

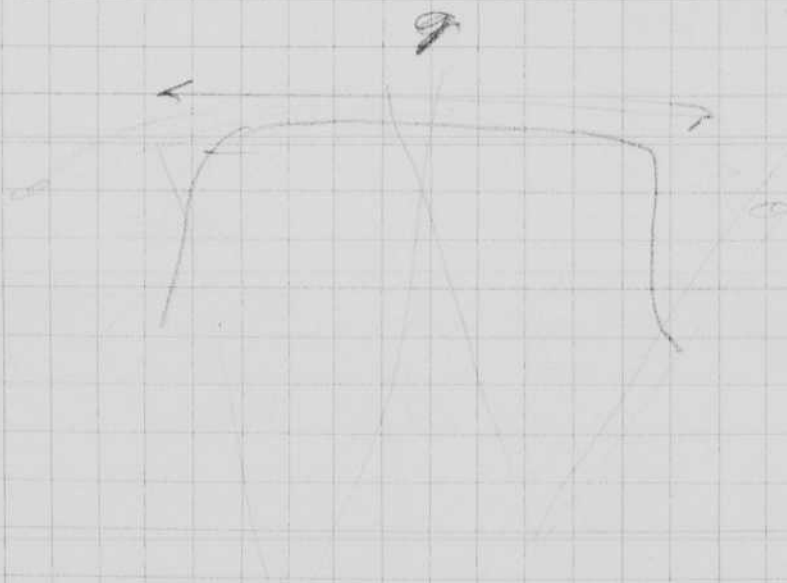
~~John~~  
 mercurochrome in milk  
 1/4 fluid oz in 6x hot mixed  
 milk.  
 Blue background.



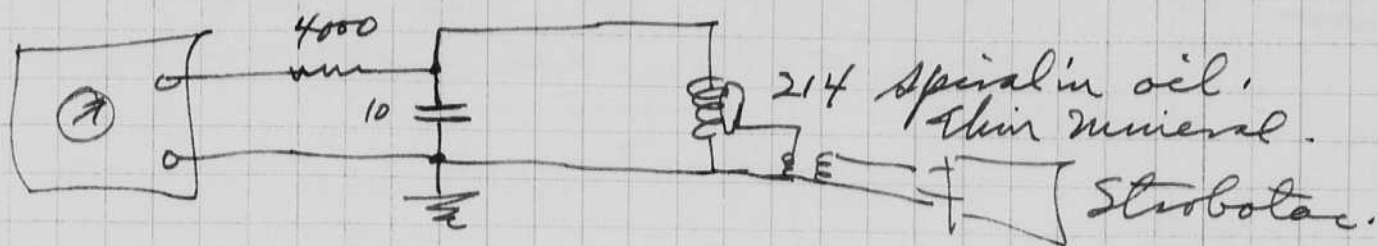
Beaker plus  
 delay with  
 3 reflections

full cups. sale 79

25W3  
 4mfd 2.00



Jan 28, 1957.  
 Harold Elgerton.  
 Roy Swanson.



Started at 500 volts. 10 mfd.

$$10 \times 10^4 \times 10^{-6} = 10^{-1}$$

1550 volts. 10 mfd.

Underwater Lamp FX-1 25 mfd at 4KV.

1980 h.c.p.s. at 25 mfd 4KV. 100 W.S.

with 4 mfd.  $C \frac{1980}{330}$  should be output.

$$IT = A^2 \frac{S}{C}$$

$$DA = \sqrt{\frac{BCPS \ S}{C}} = \sqrt{330 \frac{210}{20}} =$$

$$= \sqrt{\frac{330 \ 125}{6 \ 20}} = \sqrt{\frac{1980}{6}} = \sqrt{1980} = 43.$$

Lamp sub dist  $f \frac{43}{2.8} = 15 \text{ ft.}$

guide factor.

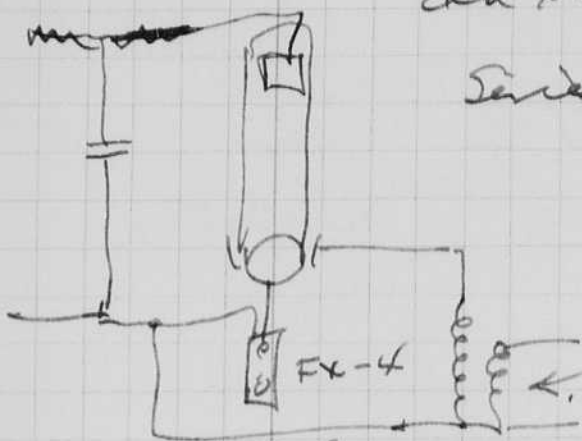
Jan 29 1957  
 Harold Egerton

Mercury tube tests.

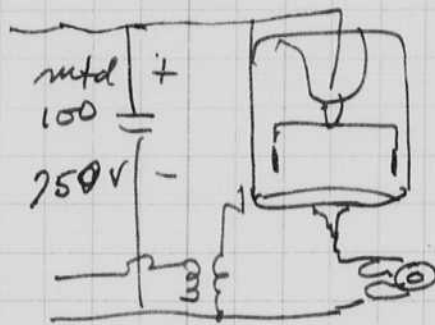
old tube type min 23 to 25 volts.

Series FX-4 min 250 volts - 300.

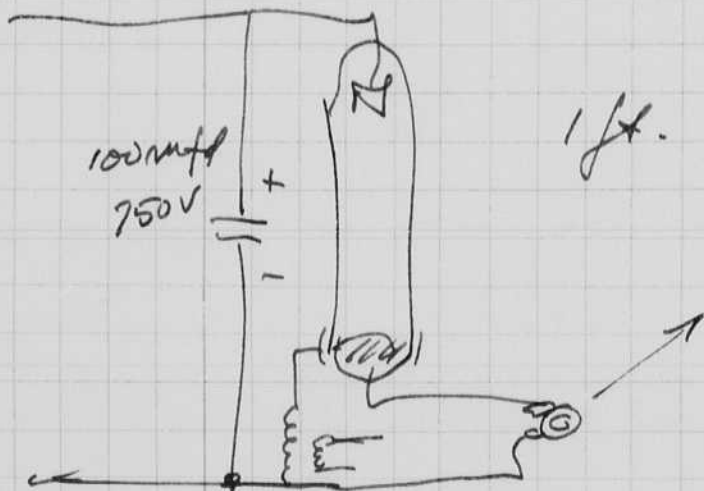
new tube about same.



Test unit spark.  
 Cordeman.



1 ft 98 lum sec / sq ft.



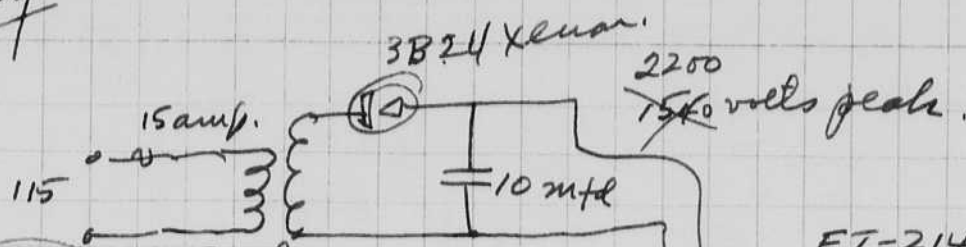
1 ft. 82 lum sec / sq ft.



Jan 30, 1957.

H. E. Egerton

# High Power Strob.



18 amp +  
measured.  
to 20 amps

Raytheon  
Torus M116301  
5ma flash

FT-214 spiral.  
in oil  
24 flashes/sec.

Skips at 48/sec.

Light out just.

Fx-1 ~~2~~ 1 ft 51 = 51 Bare no cable 24 μs  
 (?) 250 ft cable. = 33 60 μs.

FT-214 47 mcps .55 μs. no cable Bare.  
 35 80 μs. with cable

An FT-218 was tried - It seems too hot. Skips, etc.

$$\frac{2200^2}{2} = \frac{22}{24.7} \text{ with sec. } \frac{47}{24} = 2 \text{ op/with.}$$

Feb. 1, 1957  
 H. E. Edgerton & Esther  
 M. I. J. 9:30 pm.

used chilled salt-water

volts          amperes  
                  ma

5                  195      Point -  
 8                  310

polarity reversed

5                  210  
 8                  350

Point +

note change

9                  75  
 12                68  
 15                61  
 20                46

2                  8  
 4                  60  
 5                  145  
 7                  275  
 9                  400  
 12                500+  
 12                180  
 15                175  
 20                115

Bubbles form on point to lower current

used warm salt-water

5                  150 in 2 sec.  
 5                  50 ←

10                20      bubbles coming from spiral wire

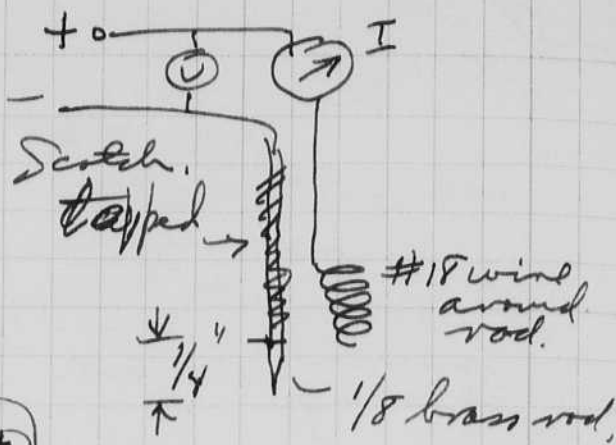
15                20 → 100 → 120

20                80 → 120 → 130      tremendous no. of bubbles from wire

3                  220      immersed 2 1/2" brass plate

4                  490      put probe onto plate

4                  20      no brass plate



\_\_\_\_\_

Relay. Sigma 4R 1000 S SIL.

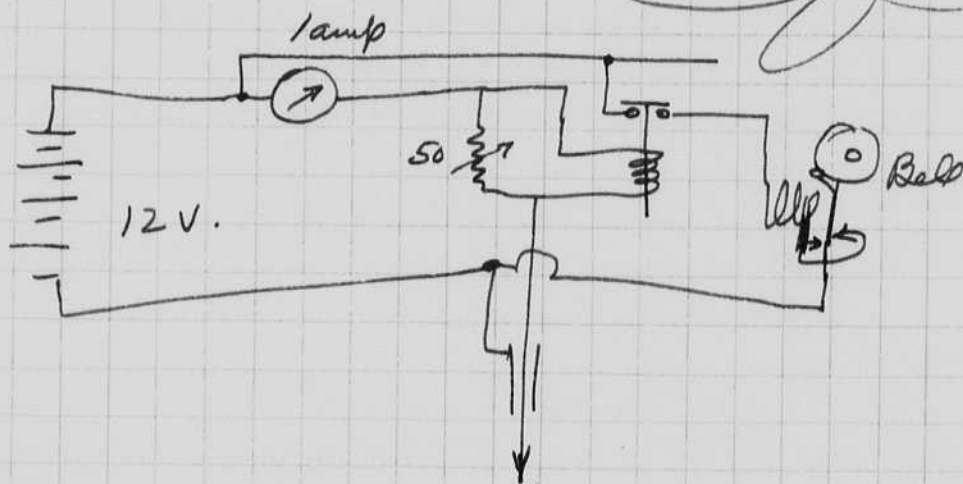
21

1000 ohms

3.4 ma close and open  $\pm$ .



500 ma.  
5 ma. operate.  
10 ohms.  
across relay.



Jan Feb. 2, 1957 cont.

Relay Salt water cooled over night to 38 degrees F

12 volts across power current = 10 ma.

2" square target current = 280 ma

The method works fine.

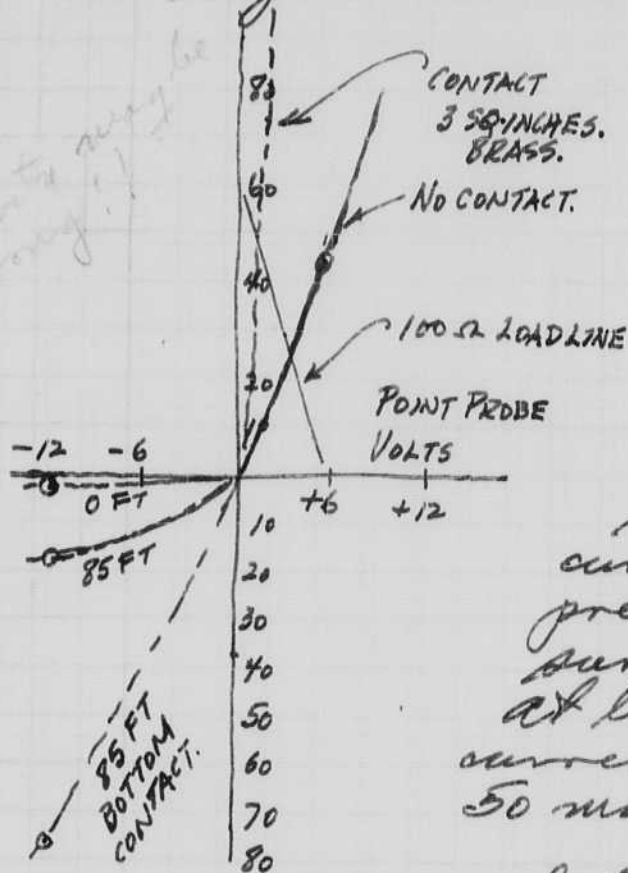
currents about the same for 50° F.

Feb. 3, 1957. Metal Detector  
Under Water Type.

A.S. Edgerton

John H. Hammond

Experiments in the lab. (20D1021417) indicated that the voltampere characteristics of a Point - Plane pair of electrodes was non-symmetrical as shown below.



A trial was made at sea in Boston Harbor with John Light on Feb 2. The point probe was a  $\frac{1}{8}$ " brass rod with a  $\frac{3}{8}$ " bare point in the water. Scotch tape covered the rest of the probe.

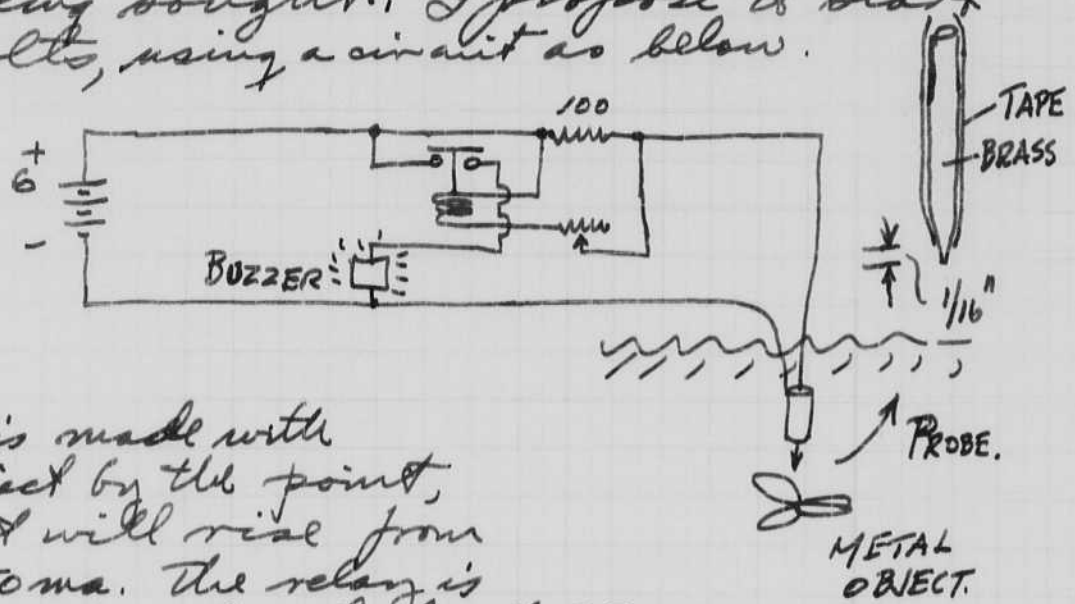
The experiment was not successful since the current increased with pressure. The current at the surface was about 10 ma. at lower ~~press~~ depths the current increased to about 50 ma and rang the buzzer.

I then covered the probe with tape so that only  $\frac{1}{16}$  of an inch showed. Now the V-I curves are as shown with about 1 ma at the surface. The current at 85 feet deep was about 18 ma with 12 volts. It was now discovered that the current suddenly increased to about 75 ma when the bottom was touched. Apparently the contact changes the polarizing action of the film on the negative probe. Thus this system with a negative polarity does not give the desired action since it will operate on ~~the~~ sand and mud. This action was checked in the laboratory after returning from the trip to the harbor today.

Next we returned to the positive point probe. It was noticed that a cloud of bubbles arose from the point. An increase of current

con

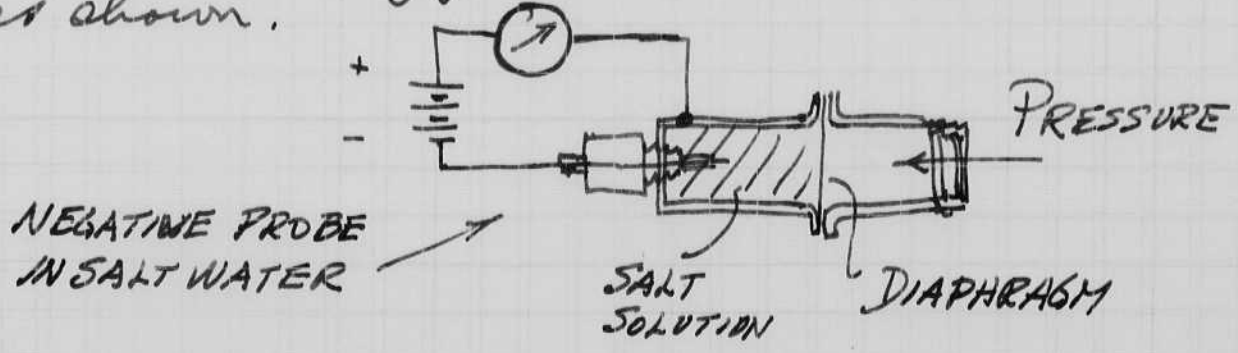
was experienced when a plate of brass was touched. It was observed that the current decreased when the probe was thrust into sand. This is good. Now the system seems feasible. Probably a lower voltage can be used now. However a high voltage may be an advantage to breakdown the surface layers or conducting surfaces that are being sought. I propose to start with 6 volts, using a circuit as below.



When contact is made with a metal object by the point, the current will rise from 25 ma to 50 ma. The relay is adjusted to operate at about 35 ma.

It remains to find the influence of pressure, temperature, salinity, etc on the adjustment.

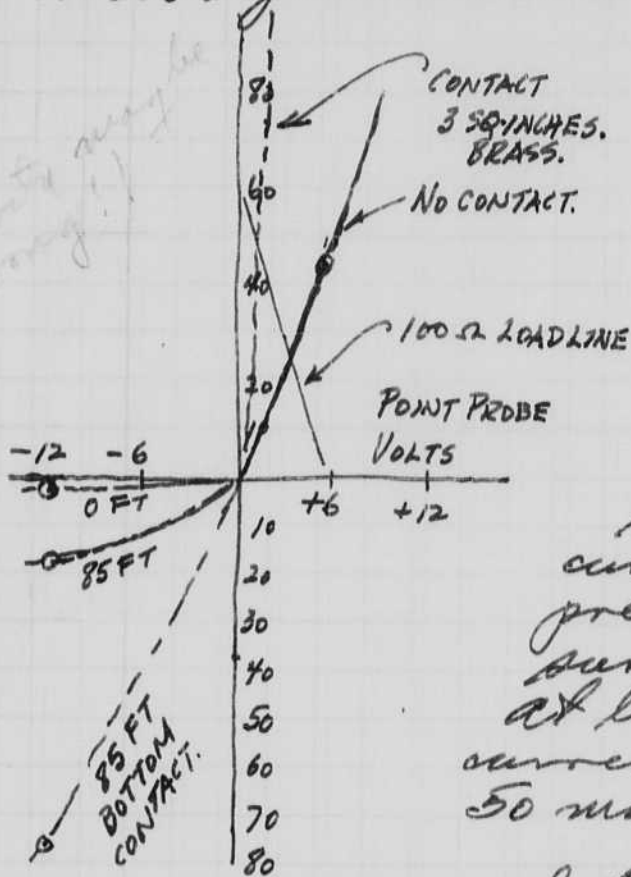
The variation of current with pressure is an interesting phenomena that should be useful. A pressure seal could be used to connect any pressure to a salt cell as shown.



cont.

Feb. 3, 1957. Metal Detector  
Under Water Type.  
A.S. Edgerton  
John H. Hurdman

Experiments in the lab. (20D102 MIT) indicated that the voltampere characteristics of a Point - Plane pair of electrodes was non symmetrical as shown below.



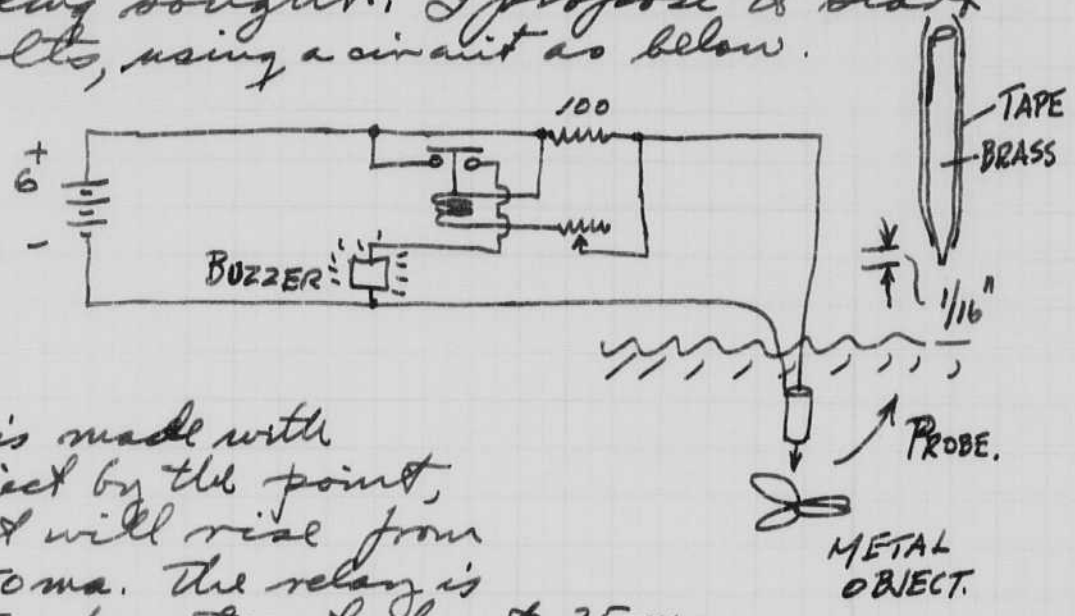
A trial was made at sea in Boston Harbor with John Light on Feb. 2. The point probe was a  $1/8$ " brass rod with a  $3/8$ " bare point in the water. Scotch tape covered the rest of the probe.

The experiment was not successful since the current increased with pressure. The current at the surface was about 10 ma. at lower ~~pressures~~ depths the current increased to about 50 ma and rang the buzzer.

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cont.

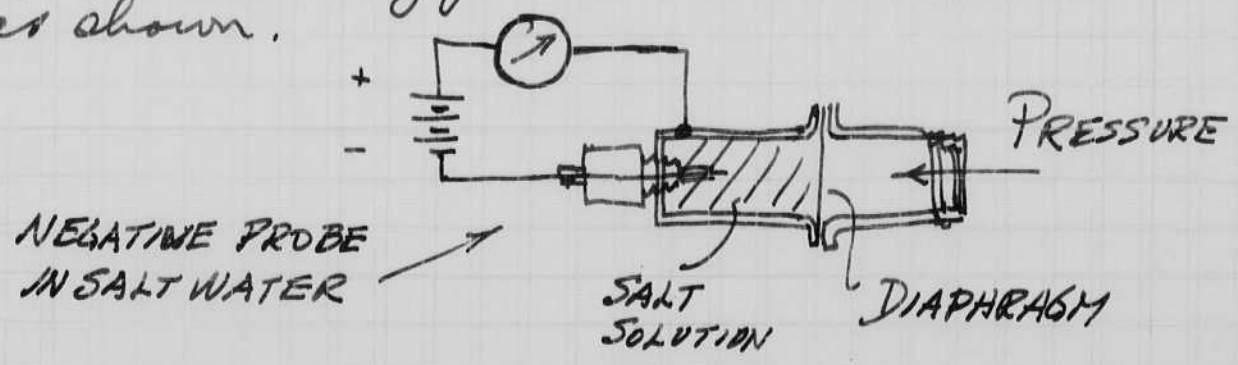
was experienced when a plate of brass was touched. It was observed that the current decreased when the probe was thrust into sand. This is good. Now the system seems feasible. Probably a lower voltage can be used now. However a high voltage may be an advantage to breakdown the surface layers on conducting surfaces that are being sought. I propose to start with 6 volts, using a circuit as below.



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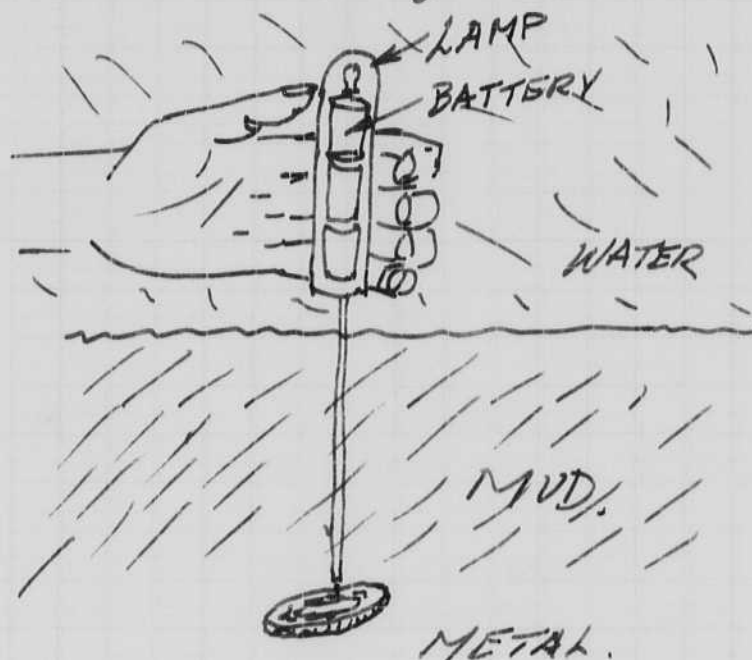
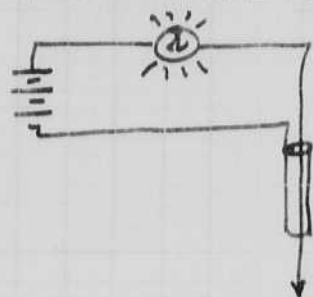
It remains to find the influence of pressure, temperature, salinity, etc on the adjustment.

The variation of current with pressure is an interesting phenomena that should be useful. A pressure seal could be used to connect any pressure to a salt cell as shown.

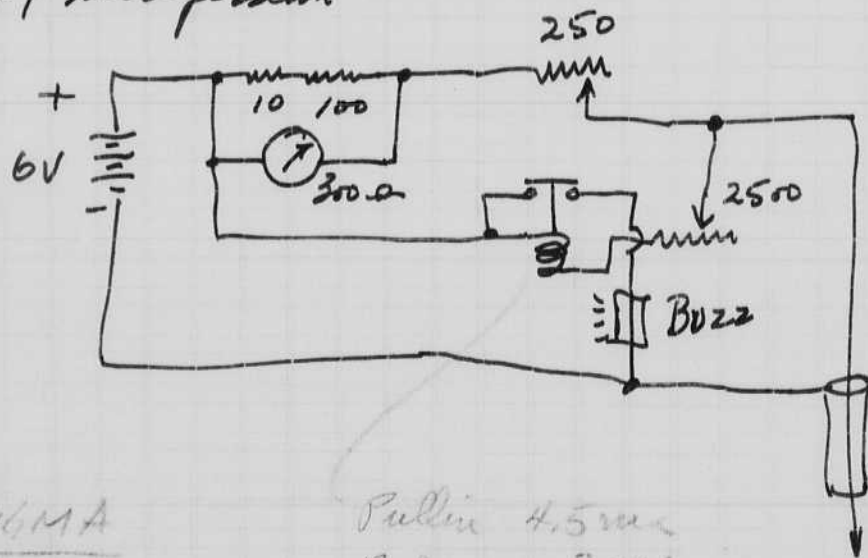


cont.

a diver-carried metal detector should be a most useful device for searching in the mud for metal objects. The device could be a hand-held 6 volt battery case with a lamp bulb in series with the probe.



Feb 4 modification

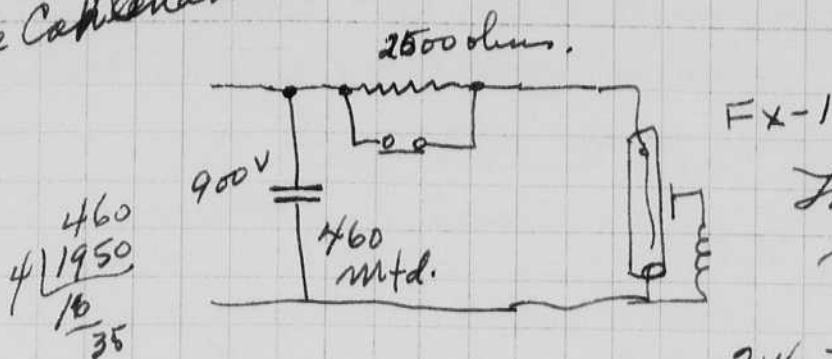


SIGMA  
4R-1000 S SIL.

Pullin 4.5 ma  
Release 2 ma  
max Diff. 1. ma  
1000 ohms



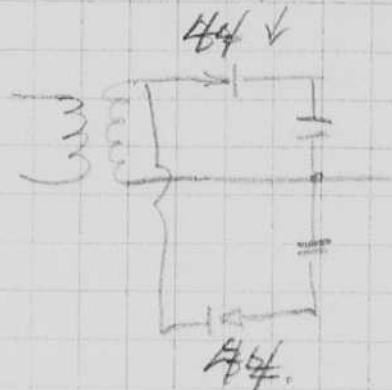
Feb 4 1954  
Harold Edgerton  
Dave Callender.



Large spark  
needed

214 tube requires  
large spark.

Selenium taken out and silicon put in place



RD 106

6 in series on each side.

Sarkis Tarjian

Bloomington Ind

max AC 130

P.V. 400

500 ma DC

2V vol drop.

50,000 ohm bleeder added to hold voltage.

M.I.T. pool

-6 4.8 ma

-12 9.5 ma

+6 4.3 ma

+12 11.5

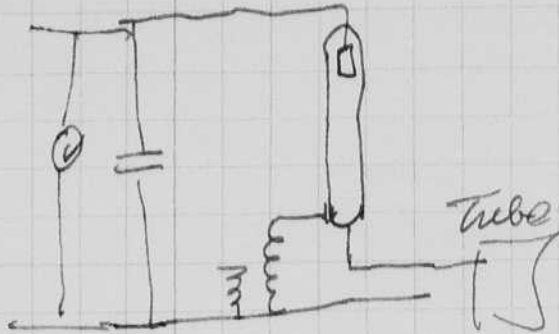
+6 17 on penny

+12 33 on Dollar.

Polarity has very  
small effect. The  
chlorine is different than  
sea water.

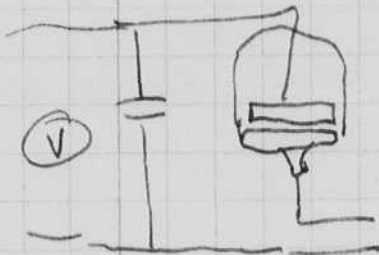
Feb 5 1957  
 Howard Edgerton

Mercury arc tube



Tube 218 with + and external connected  
 min V 320 volts.

Tube	V <sub>min.</sub>	Remarks
FT 218 tube.		
FT-218	320.	Spark and + connected
FA309 Syl	25.	" " + "
FT-218	700V 100mfd 70L 1H.	



FT-218	300	"		
FA309 Syl.	21.5V	"		
V	C	L	D	
FT-218.	700	100mfd	80	1H.



external 500 volts.

$$R_{\text{spark}} = 2.5 \times 50 = 125V \quad 100 \mu s$$

$$I_{\text{avg}} = \frac{125}{0.104} = 1250 \text{ amperes.}$$

$$\frac{36}{150} = 2 \text{ watts}$$

Order 5. 500 21 Buttons  
 Figure 31205 MIT

5R 200S-512

$$\frac{6^2}{500} = \frac{36}{500} = .7 \text{ watts.}$$

all or open cir

V13 5000

Feb. 6, 1957.  
Harold Edgerton.

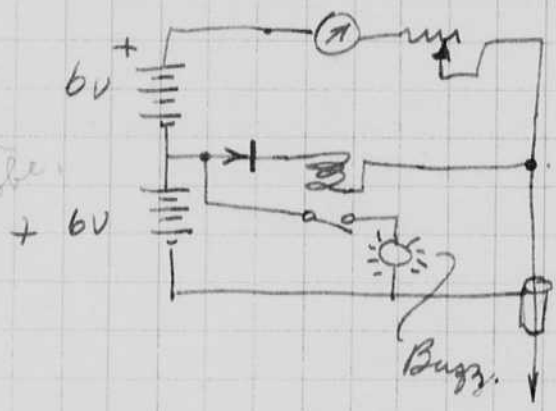
Metal ~~Detector~~ Detector.

I went out with John Light again today to test the following circuit. same as page 24

off Deer Island light in 90 ft of water we hit something right away. then we noticed a bump on the sonar record 12 ft 6 feet high. At bears investigation.

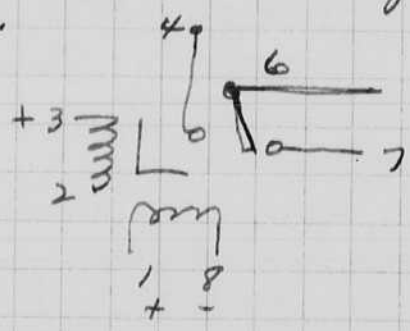
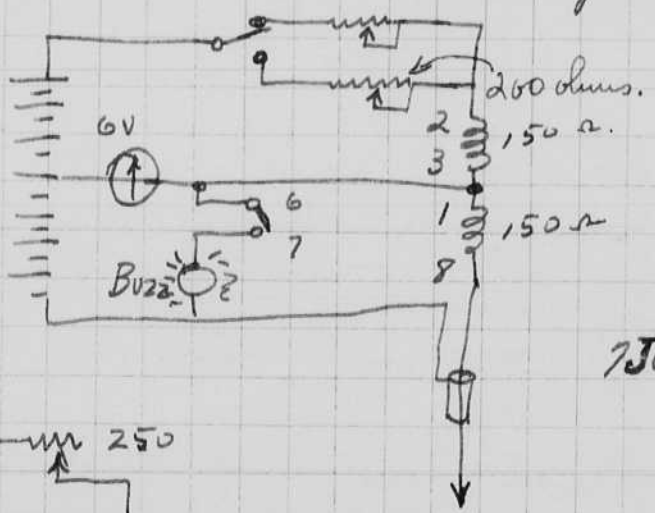
next went out to ~~site~~ site of Propeller loss. Lowered to 100 or 120 feet. Some operations not good. The sensitivity is not positive.

I now come up with a balanced circuit, and a more sensitive relay.



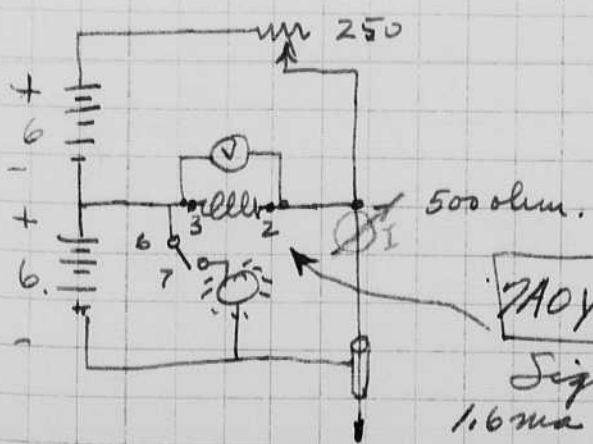
the present relay which requires 4.5 volts to click is too insensitive. a more sensitive relay could be used.

I also could use a differential relay with 2 coils. For example.



750X ~~700X~~ 150 N 2 Hemu  
7A0 150 N 2 Dust cover.

5.8 ma 2.6 D.O. 1.0 diff. pull in.



7A0Y 500 52  
Sigma  
1.6 ma 0.4 out.

Salt water model.  
use higher res model for fresh water.

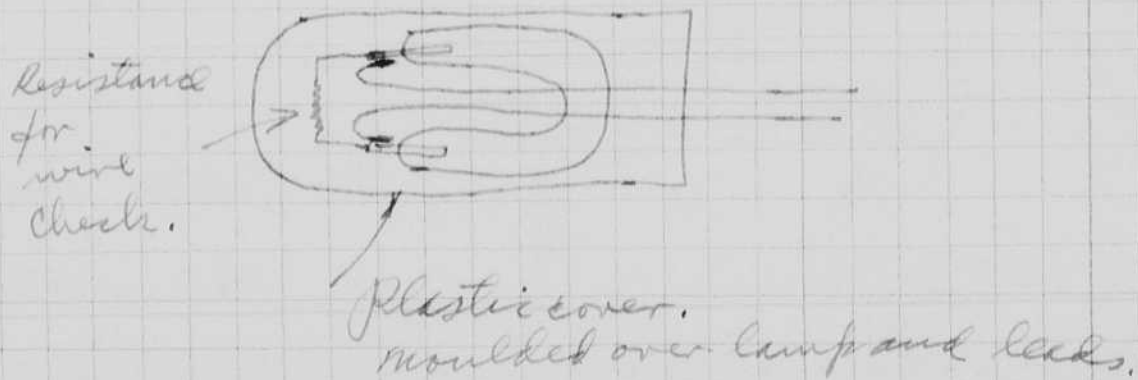
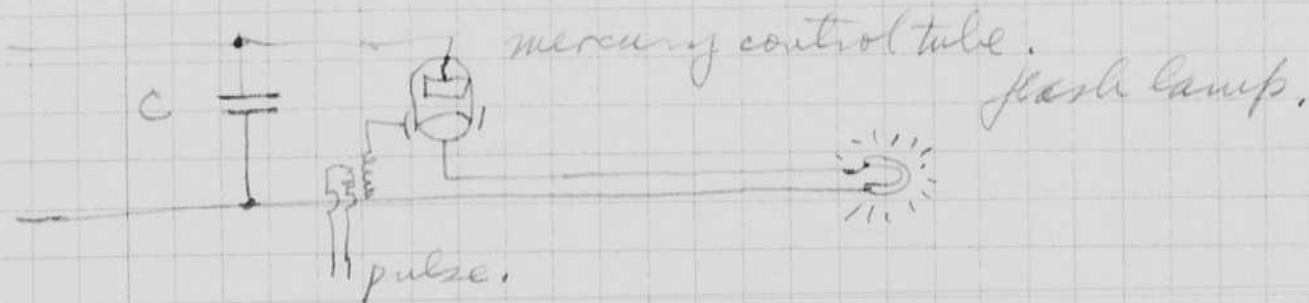
0.075 x 150 = 0.16 ma  
too much  
over load

Feb. 9, 1957  
 Harold E. Edgerton

Will Hicks from American Optical was in yesterday. He brought one of the parallel fiber viewers that is proposed for stomach viewing. Some weeks ago he was in to discuss a flash device especially for photography. I sketch a small V tube on Jan 30 together with a plastic encapsulating cover.

I propose to use as small a tube as possible driven from a low voltage capacitor. The mercury arc tube will enable the starting of the flash to be accomplished without a starting wire, thus a 2 wire system will be used.

There should be a resistor between the leads on the lamp so that open circuits in the wires can be detected.



Designed  
 by me

# Microscope. Lamp.

Feb 9 1957 29

H. Edgerton  
Phil Balligan.

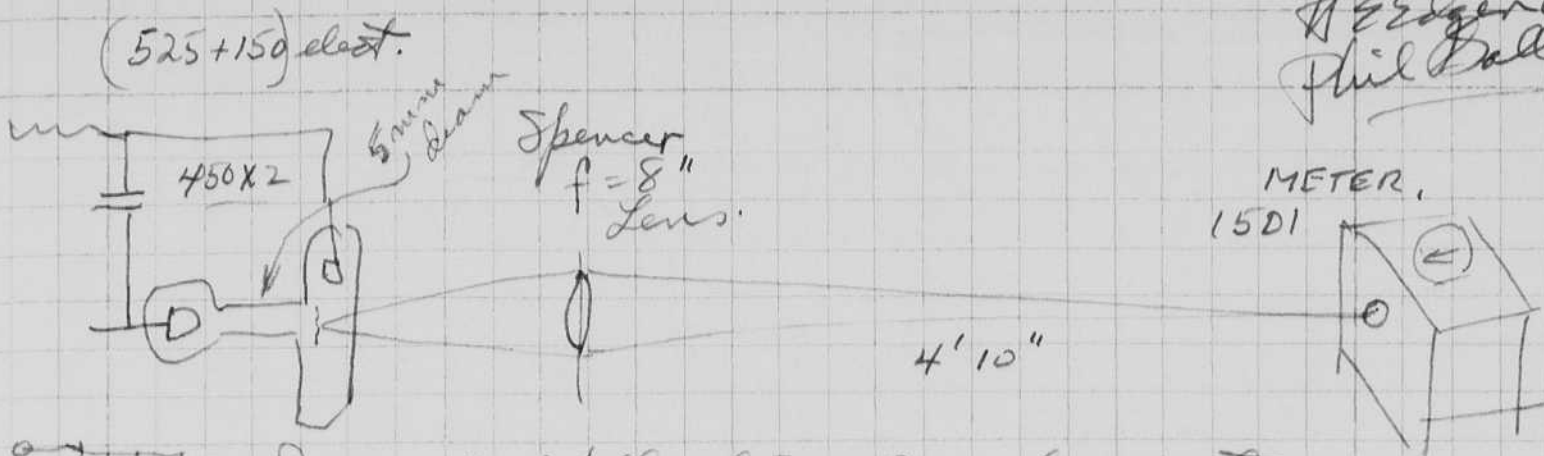


Image just fills diameter of 1501 meter.

Reading  $38 \times 4 = \frac{152}{2} = \underline{\underline{272}}$  lumen sec/sq ft.

W.S.  $\frac{675 \times 900^2}{2} = 272$  watt sec.

Further data is in the Light book.  
As I recall we went up to 425 watt sec (rated) with 900 volts. The discharge time was 400  $\mu$ s. The light out put as measured with a lens as above was about 10 times that of the FX-1 with 100 mfd at 2000 volts. Therefore about 500 c.p.s. per square cm.

At this level there was considerable white deposit on the walls of the tube. Also the anode began to melt badly.

I have just layed out the design of a new H shaped tube with a slight lg larger end chamber.

The blast of <sup>hot</sup> moving gas keeps the end zones free of white deposit. There is considerable sputtering but this seems to be of no consequence.

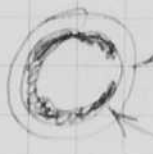
This same design of tube should be perfect for the spot light problem. The heavy wall pyrex seems to be ok at 60 cycles with 1 mfd at 360X2 volts.

$\frac{C.E^2}{2} = \frac{0.360^2}{2} = .26$  watt sec.  $60 \times 2.6 = 156$  watts.

about 1000  
Rushlines  
Feb. 28 '57

One problem is to get the heat away from the center capillary portion. This can be done by using quartz at high temperature, the use of a liquid to carry the heat away, or by a metal conductor. Today I used a nickel cylinder around the tube as a starting band, with 1 mfd at 360 volts. The arc was closely on the edges of the tube.

Sheath of conduction



Space here.

arc in capillary.

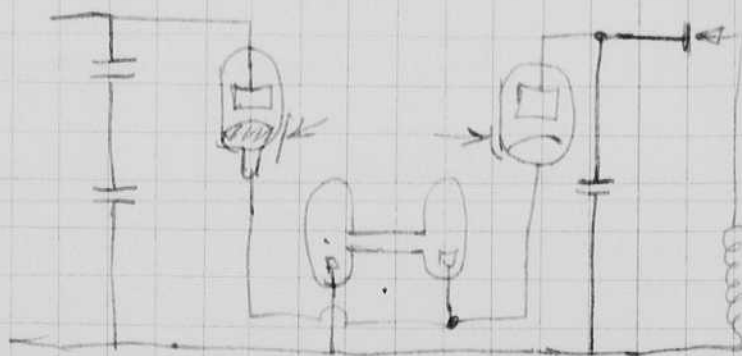
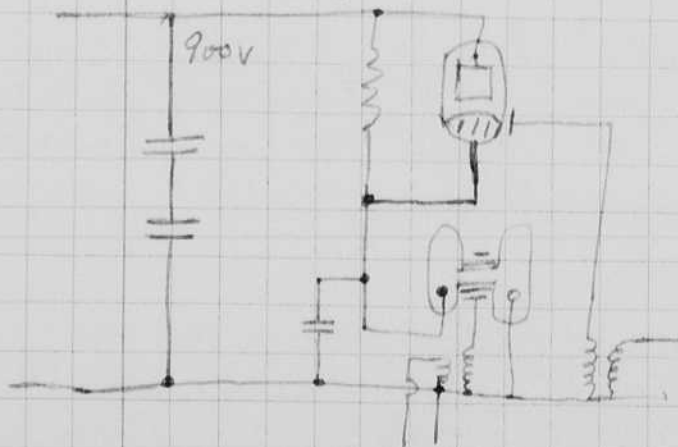
with a spiral of  $1\frac{1}{2}$  turns the arc apparently opens out into a spiral following the wire. The arc seems to fill the tube better when viewed from the end.



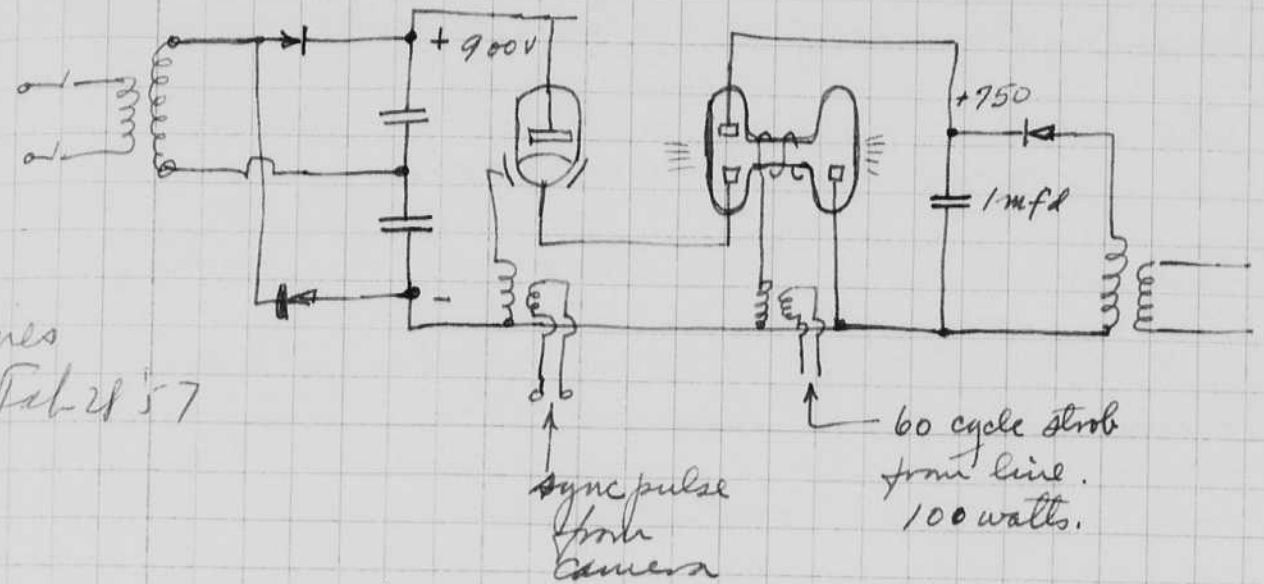
Starting wire.

Spiral arc.

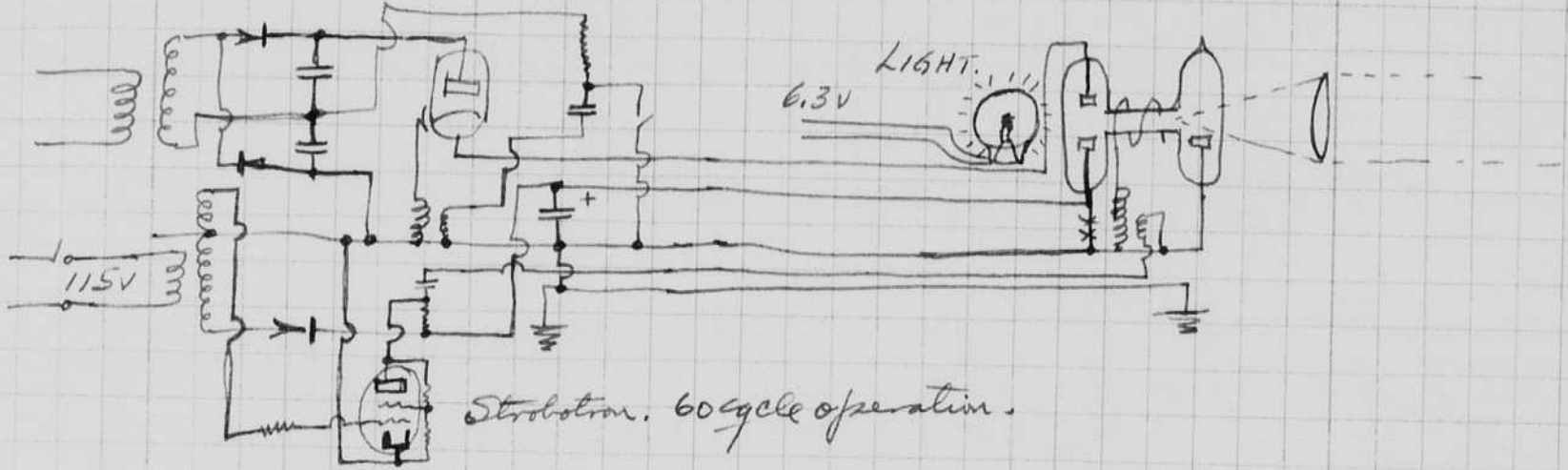
Today I used a D.C. Relay to short the resistance charging the 1 mfd. The single set of points burned badly. If they put both sets of points in parallel, operation was better. I believe the relay can be made to do the job.



A Double ended system is probably best,

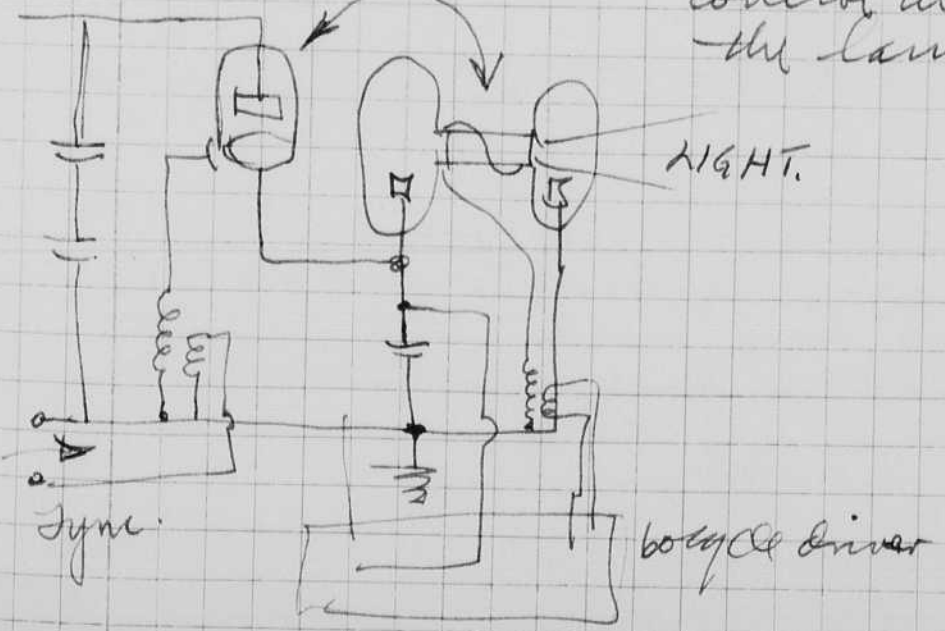


Rms  
Feb 28 '57



Feb 11, 1957

Single pair of diodes with mercury arc tube to control the big flash into the lamp.

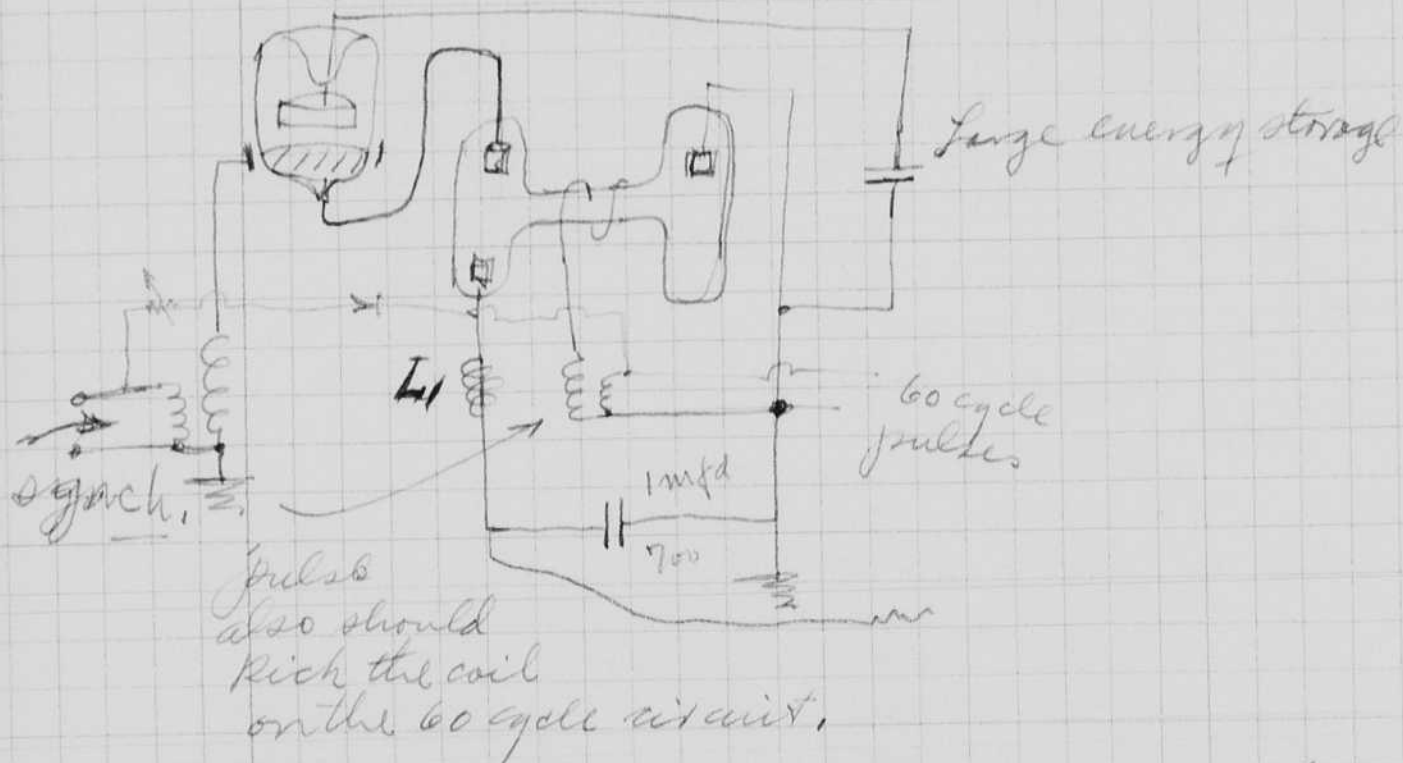


Feb 21 1957  
Hershel E. Edgerton.

I experimented last night with the double duty end-on flash tube for microscope use.

The unit runs very well at 60 cycles from a 1 mfd capacitor at about 700 volts.

The arc did not go through the main capillary, except when it accidentally hit the spark at the time of a 60 cycle flash. It seems that we must also hit the 60 cycle coil with a pulse from the mercury arc tube spark circuit to get proper transfer.



I also propose an inductance  $L_1$  in the 1 mfd circuit to help force the current into the large cathode circuit.

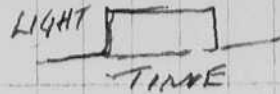
Dave Cahlander helped to set up this experiment last week. I hope to try the system on a microscope shortly for intensity work for visual work and for photo graphy.

Feb 21 '57



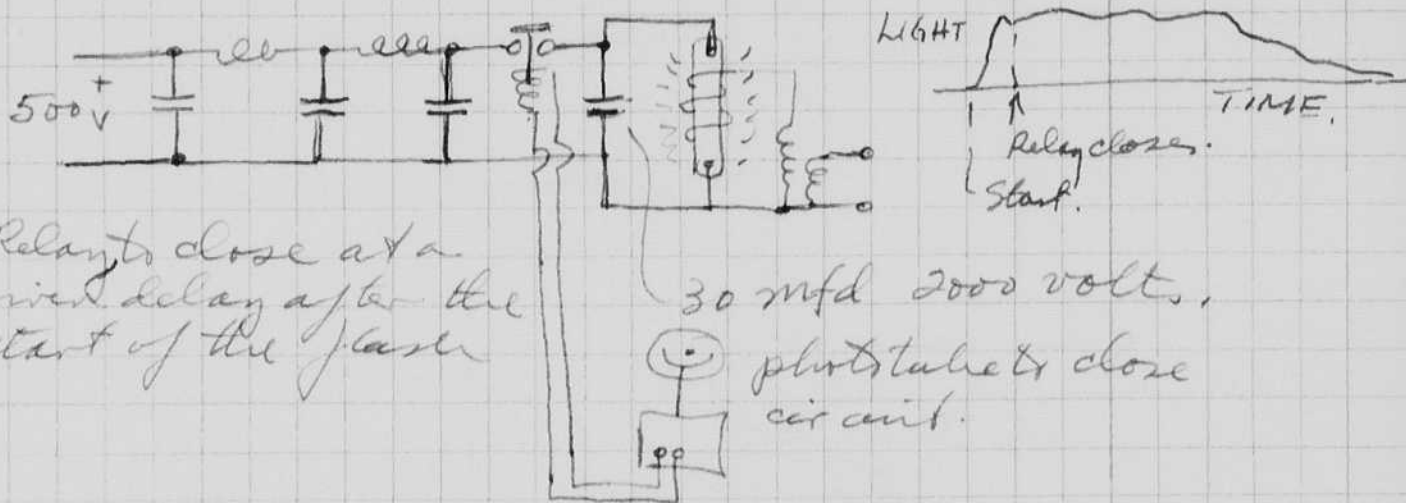
Feb. 21, 1957.  
H. Ekgarten

# Square light Pulses



After people want a light that is constant for a prescribed amount of time. One classic way to do this is to use a lumped transmission line matched to a constant resistance. Usually the result with a flash tube is not too good since the lamp resistance varies during the discharge.

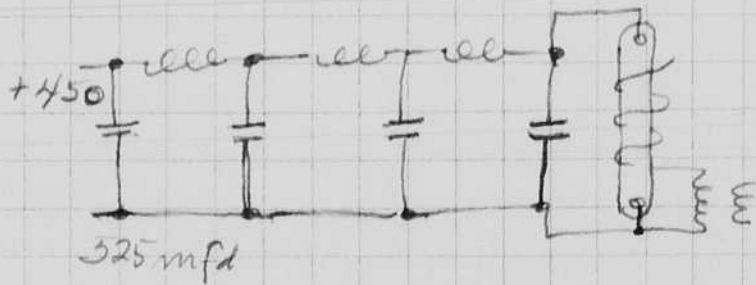
I propose that enough energy be used directly across the lamp for the first pulse to get into the essentially constant resistance characteristic. For example the FX-1 tube with 30 mfd at 2000 volts is like a 2 ohm resistor.



Relays to close at a given delay after the start of the flash

30 mfd 2000 volts, phototube to close circuit.

Another method.



Reduce pressure so that tube starts well with 500 volts.

(5cm x 1.5cm in 6" gap with 4mm O.D. Special FX-1 with slightly lower effy and with lower peak capabilities.

I discussed this problem with Harris of E.C.A. yesterday he wants a 5 msec flash of 800,000 lumen peak output.

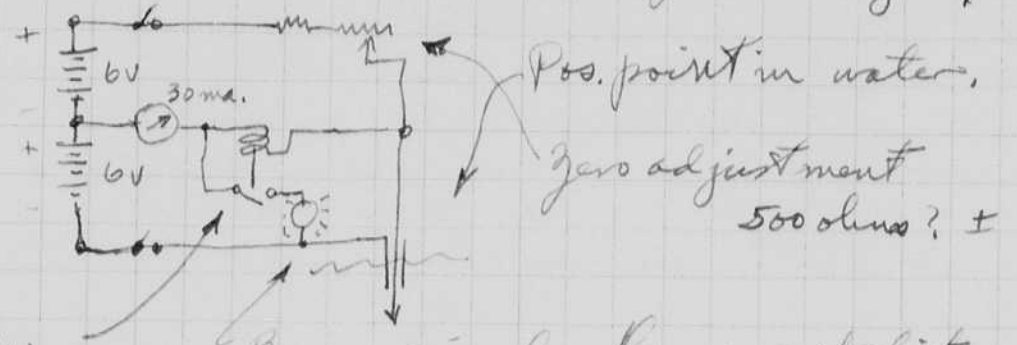
April 7, 57. Reference SMPTE Mar 57 page 127. W.M.C. Griffin a High Intensity Electronic light source for high-speed cameras.

Jones

157

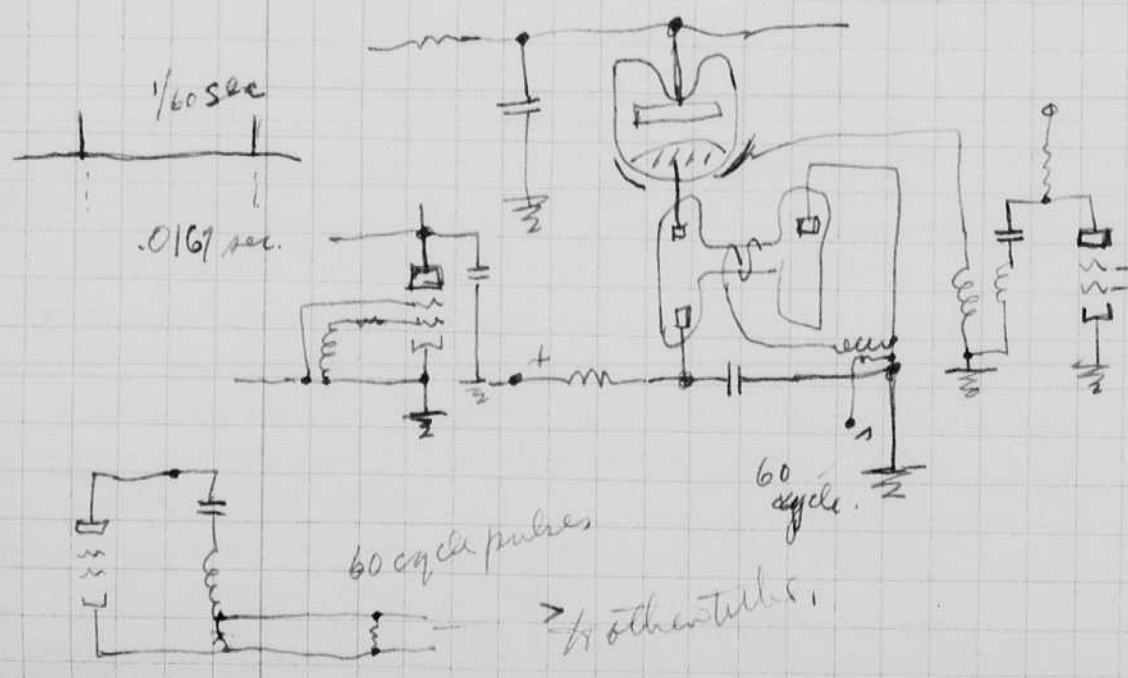
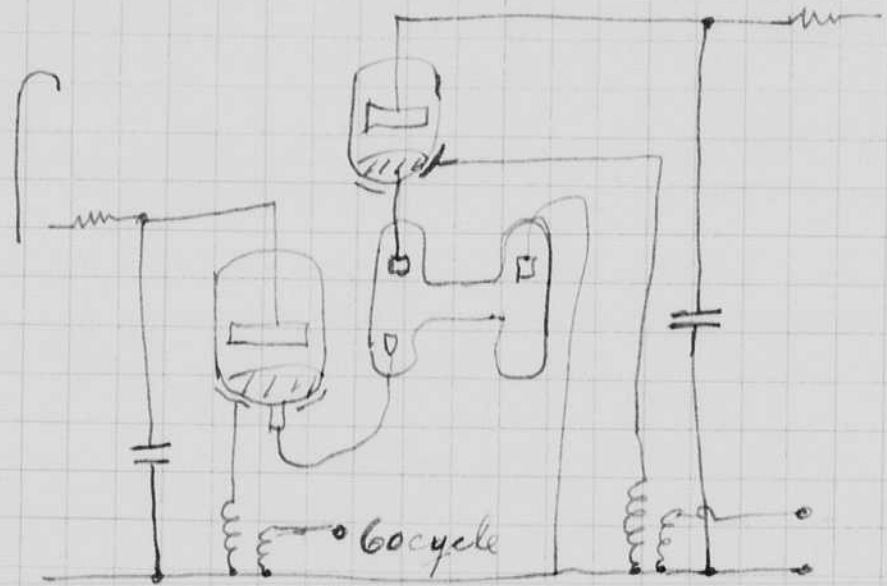
Feb 22 1956.  
Harold E. Edgerton

The bridge underwater metal detector was tried  
Sun Feb 16 in the harbor by John Haramundanis on  
Light's boat. It seems to work fine. Page 29.



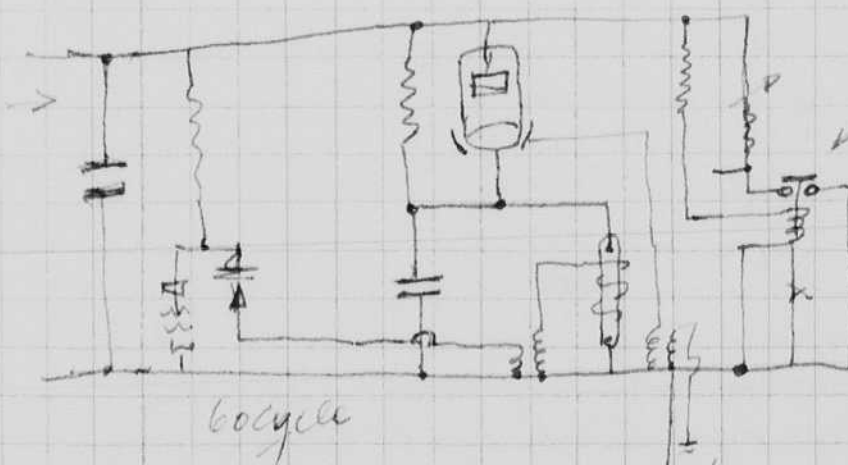
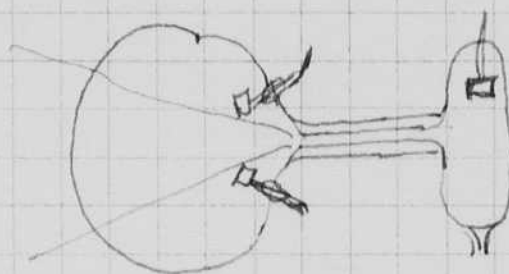
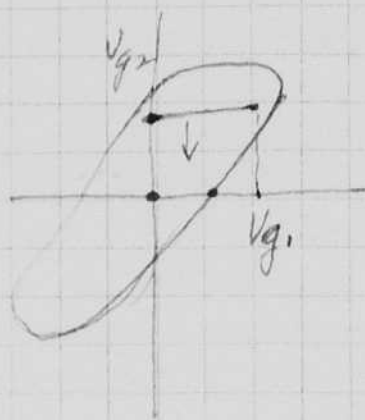
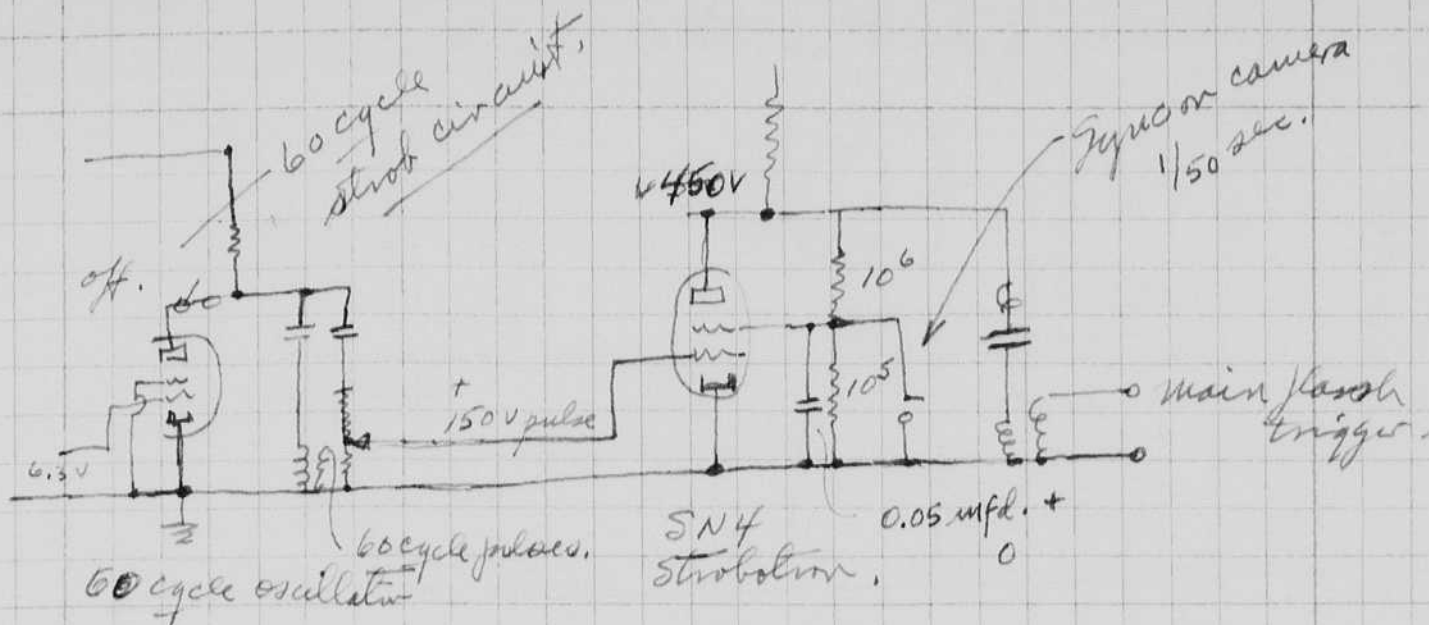
Sigma Relay  
5R 200S-512  
200 ohms  
Sensitive.  
Silver contacts

Buzzer signal when point hit metal.  
Microscope lamp.



Pick up pulses from  
60 cycle circuit  
and feed these into  
the second tube.  
Gate the second  
tube so that the  
contactor sets up  
the circuit so the  
next 60 cycle  
pulse will trigger it.

RUE  
Feb 15



Relay to put over load  
 in cassette 60 cycle  
 part quits or is  
 turned off.

from camera input sync circuit  
 as per above.

Fizeau disc

1/2" spot at 3 ft 2" lens.

actual spot  $\frac{D}{.5"} = \frac{2"}{36}$

$D = .5 \frac{2}{36} = \frac{.5}{18} = .0278"$

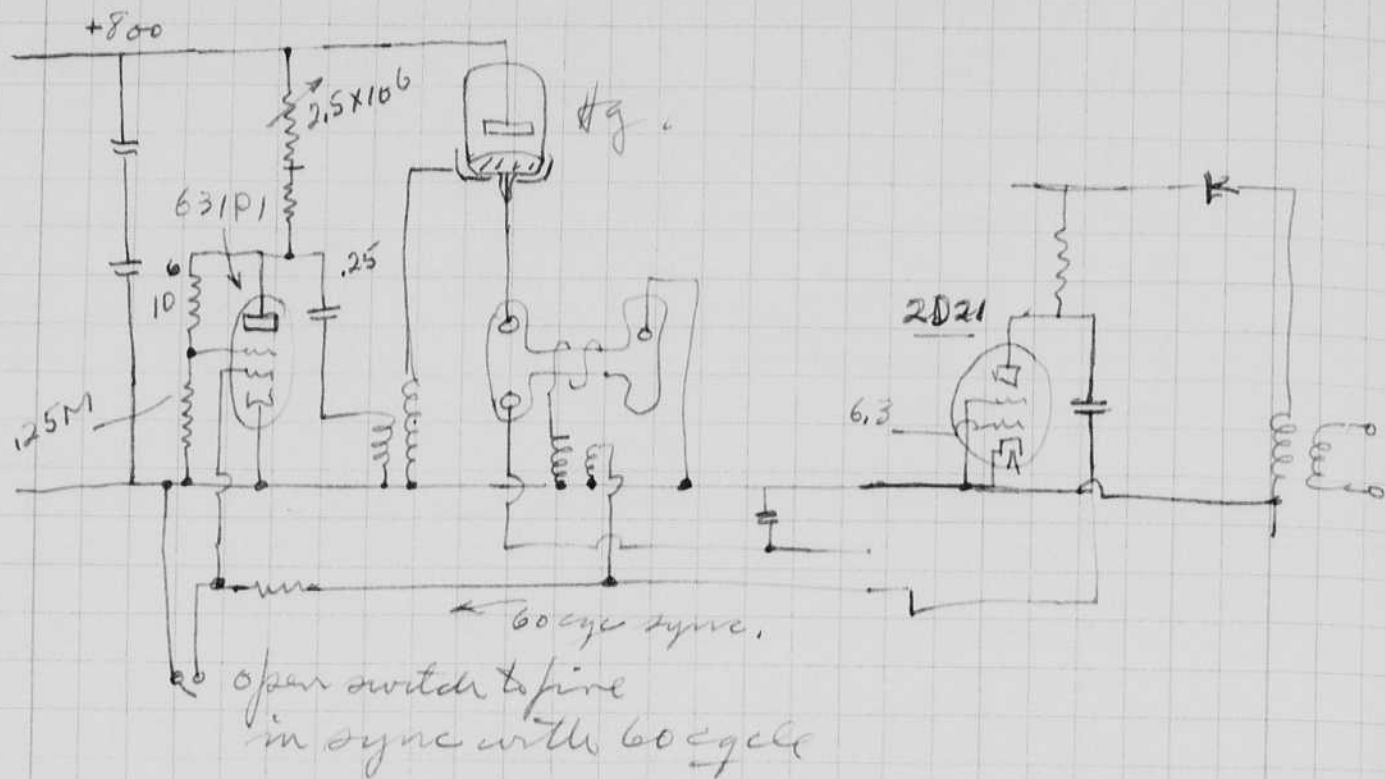
C.P. =  $75 \times (.5)^2 = 18.7$

$\frac{CP}{sq cm} = \frac{26}{40 \times 10^{-4}} = \frac{1}{2} \times 10^4 = 5000$

area =  $\frac{D^2 \pi}{4} = 6.05 \times 10^{-4} sq in$   
 $= 39. \times 10^{-4} sq cm$

Notes

5000 C.P./sq cm



the tubes that I have both quit after running at 60 cycles for a while. I probably should run them better on the pump.

The sync with the 60 cycle seems to be ok now.

The peak light from the side is about 6 times higher than the 60 cycles. I used two capacitors ~~455~~ <sup>series</sup> 450 mfd at 800 volts for this test, the duration was about 40 microseconds. Seems short, check this. also try an. end on video.

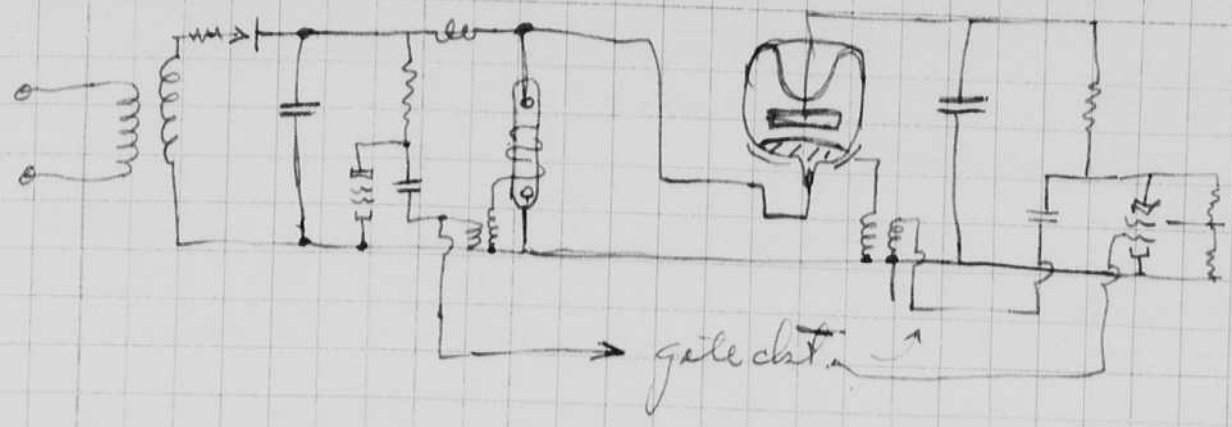
Feb 23, 1957.

The flash tubes started missing after a while while apparently direct to impurities in the gas. I am now repumping them after putting on a new window or two. The blast of gas from the discharge leaves its mark on the glass wall of the tube.

RLM  
Feb 28 1957

Cont  
Feb 23 1957  
H.S. Edwards

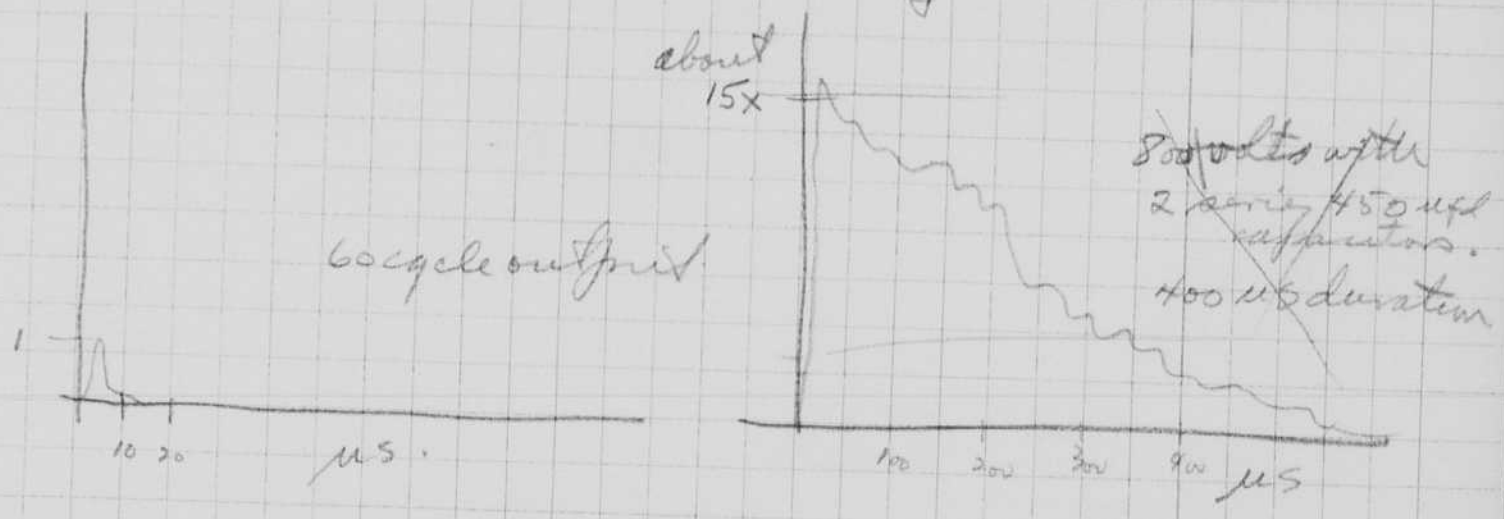
Two element flash tube with continuous plus flash for photography.



This method works fine.  
H.S.

Re pumped tubes. treated with 100 mfd 1000 volts. This evaporates a lot of glass in the capillary which deposits on the outside tube walls. Scaled off at 9 cm.

Testing with 0.5 mfd at 900 ± ? volts from 1/2 wave circuit. Operation looks fine at start. the circuit is noisy.



On another jump it looks like a duration of 150 μs +

Energy increased by two to 4 capacitors 450 mfd (800 volt) 450 V.

Series parallel.

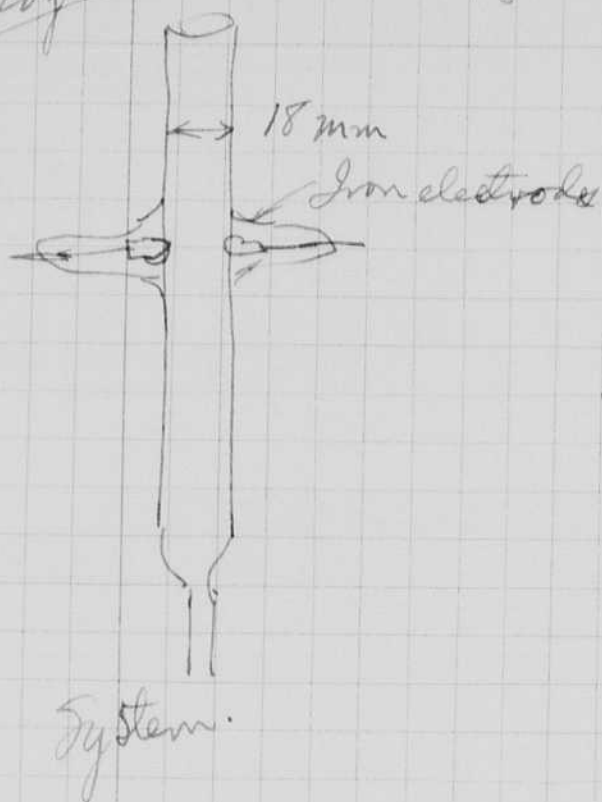
Peak light about same  
Duration about 400 μs.

ines  
157

Feb 23, 1957

H. Edgerton

## Xenon flash tube.



First, after heating and evacuation.

1 cm x 1 cm.

Self flash about 1000 volts.

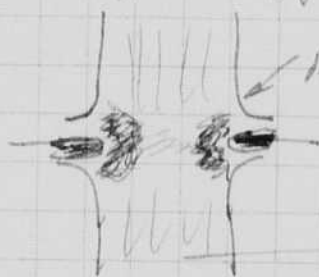
Discharge with 1 mfd 1000 v.



Bright arc

glowing gas due to  
motion?, or  
radiation.

with more capacity for example 50 mfd 1000 v



Bright glow around  
electrode

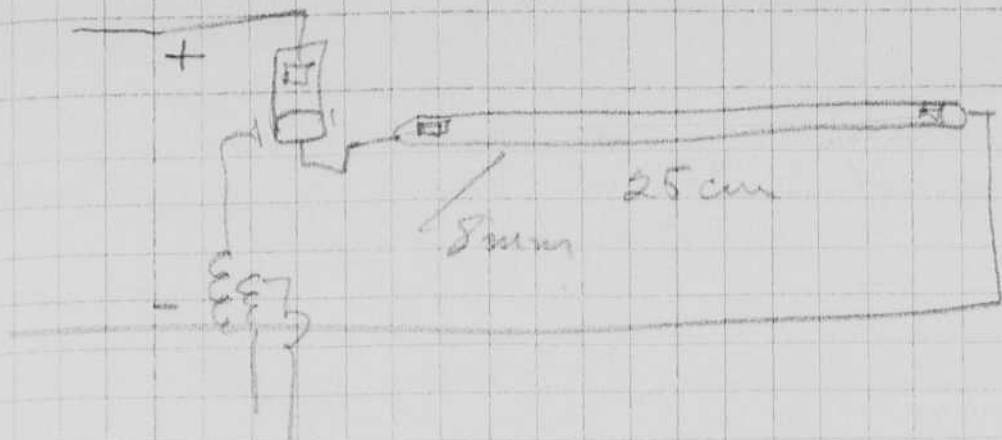
glow in gas  
about same as  
in 1 mfd case.

Pressure 2 cm.

1 mfd looks about the same  
pressure. Voltage about 1500 for  
first flash then seems to drop  
to 1100 v.

15 mfd. same as above  
glow is visible for 4 or 5  
cm from the gap in the vacuum.  
when viewed through 22 filter.

The arc proper is white blue  
glow in tube above and  
below the arc is red white.



70 mm, could not  
fire even with  
external spark  
wire.

30.6 mm  
10.5 mm  
2.8 mm

2.5 mm 2.6 KV min start voltage.  
1 mfd Red .655 } strong lines very narrow.  
+ Blue .486 }  
4KV. Blue .434 } Broad .002

15 mfd 2.5 Brighter than before.

10.8 mm min start 3.5 1 mfd  
15 mfd starting now 4+

spectrum looks  
same.

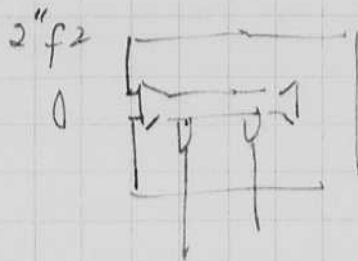
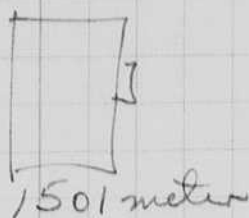
30.6 no go. 4.6 not enough.

10.5 min start 4.7 1 mfd  
7 mfd  
31. one flash then quit

2.8 mm min 2.4 1 mfd. 7 31 100 one flash, crowing.  
lots of continuum - some new lines.

Mar. 4, 1957.

## microscope lamp tests.



H. J. Van Boort  
N. Warmolly  
J. E. Winkelman  
med. and Biol. illus.

July 1956  
VI No 3 p 166.

50x4 reading at 35" 4 caps. Series parallel,  
(200) 800 + volts. 450 mfd each

No lens. Bare lamps. 200 watt sec.

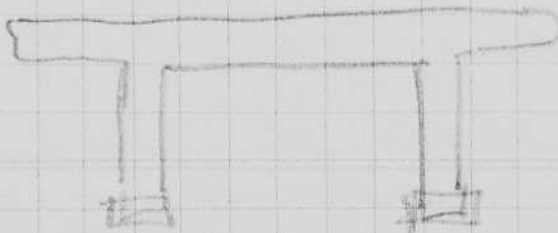
26x1 at 36" BCPS =  $26 \times 3^2 = 234$  B.C.P.S.  
3 ft.

23x1 3 ft. = 207 "

The above lamp runs fine at 60 cycles. I took off the standard starting wire and ran a thin wire around the body between the electrodes. In this way the discharge took a spiral path around the inside side. From the end, the discharge looked like a doughnut.

Mar 8 1957. Yesterday we blew up the Dudd tube (above) with 850 volts at 900 mfd. One end came off. I hope to get it fixed in a few days.

Two 29x4 tubes were tried, these were FX-1 type electrodes and seals



two samples one with 10 cm the other with 20  
Both skip when run at 60 cycles per  
1/2 mfd at 900 volts.



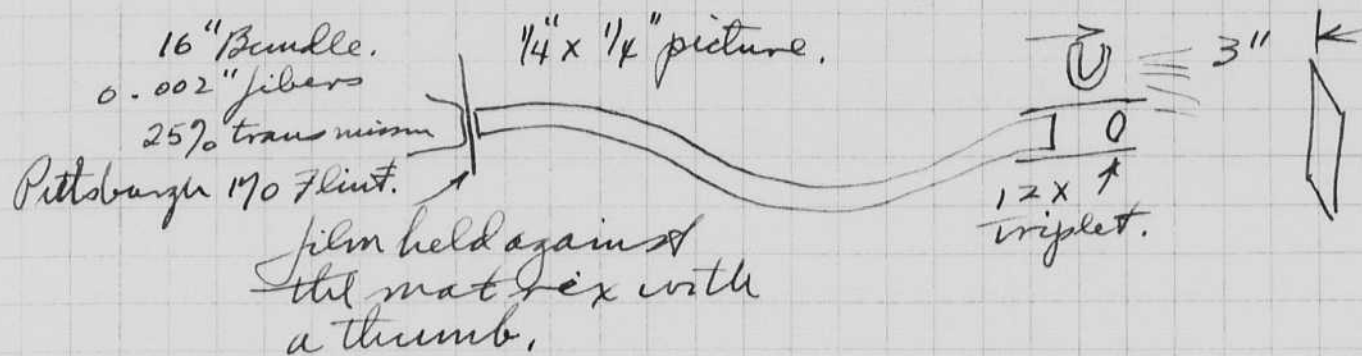
Mar 9 1957

Small lamp for Amer. Opt. tests.

Harold Edgerton

Last week I pumped 6 lamps of which 2 came through ok. I used 10 cm pressure. These lamps were run on the pump with a series mercury lamp to start.

Will Hicks came in today with his device to translate the photo. Details are below.

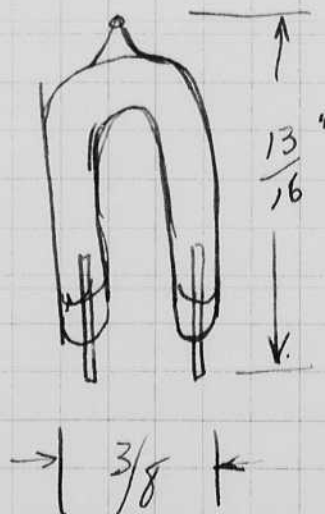


tests with Panatomic X film (ASA 25) were ok with 9 mfd at 350 volts.

Ektacolor tests were made on two films 3, 11, 9, 15 mfd 350 v. } Subject. (KOD)

9 and 15 mfd 350 volts. } Sign on Ektacolor box. (Red and yellow.)

Visual tests were made. It appears that 0.5 to 1. mfd at 500 volts is ample at 50 cycles/sec. 10 f.p.s. is too intermittent. I did not try a frequency above 60 cycles.



March 9, 1957.

Harold S. Edgerton.

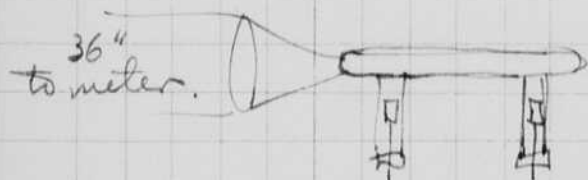
more tests were made with the microscope tubes today with Phil Gallager. We had up to 900 mfd at 850 volts into a quartz FX-1 type. also tried a Pyrex tube with a 5 mm capillary into two large bulbs. Numerical data on the measurements will be found in the light book.

FX-1 Std Lamp 2000 volts  
100 mfd. gives:

$$50 \frac{\text{cps}}{\text{cm}^2}$$

on our meter with f 2 lens 68 cm  
and 36" to meter we get 68 reading.

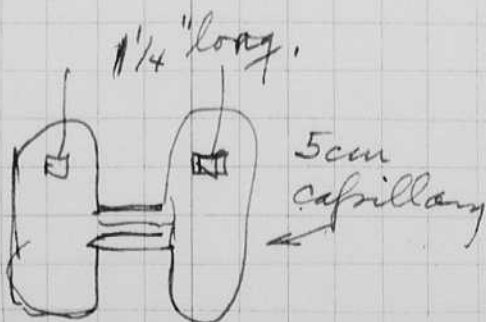
thus  $\frac{50}{68}$  = factor of meter and setup.



V	C	meter. Reading
860	225	132 - 106.
850	450	280 164
850	675	396
	675	352
850	900	432

Philip Stahl:

860	225	96
860	450	176-180
860	900	Blew up.!



March 12 1957  
Harold Edgerton.

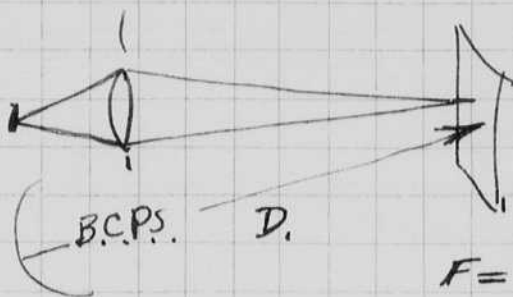
43

James Delvidis from the Navy Sound Lab was here today to test the under water strobe with us. This has two lamps (FX-1) each with 8 mfd at 3500 volts.

$$I = \frac{A^2 C}{T S} \quad \text{exposure equation. Basic equation.}$$

$$IT = \left( \frac{\text{B.C.P.S.}}{D^2} \right) = \frac{A^2 C}{S} \quad \text{lumen seconds} \\ \text{exposure power per sq foot}$$

f 11 with background x film was used.



$$F = \frac{\text{B.C.P.S.}}{D^2} \quad \text{lumen} \frac{\text{sec}}{\text{sq foot}}$$

$$A^2 = \frac{ITS}{C} = \left( \frac{\text{B.C.P.S.}}{D^2} \right) \frac{S}{C}$$

$$A = \sqrt{\left( \frac{\text{B.C.P.S.}}{D^2} \right) \frac{S}{C}} \quad \text{aperture.}$$

March 20, 1957. H.E.

Swansen finished an "on-lens" lamp on a 4x5 (or camera today. I used a 5/8" gap in an FX-1 shape XP-1) with 1.25 mfd at 2KV. a 10" lens was used at almost full opening (f ?). Screen at 20 feet away. Photoflood on 1 minute for heat waves about 1/2 way to screen. 1/400 sec. shutter Exposure on ~~Agfa~~ Panatomic X film ASA 25.

The light from the side of the photoflood was of no consequence! The system now needs to be tried on the roof in the daylight.

Bill MacRoberts is working on an oil cooled FT-214 type spiral. It is in a 2" Pyrex end cap. We are using a 1/2 wave rectifier to ~~drop~~ charge the capacitors. there is some hold over for 1/2 cycles depending upon the flash moment. I plan to show both of these devices at the car venture in Washington next week.

Mar 21, 1957.  
Hewlett & Edgerton

Front element  
12 3/4" marked

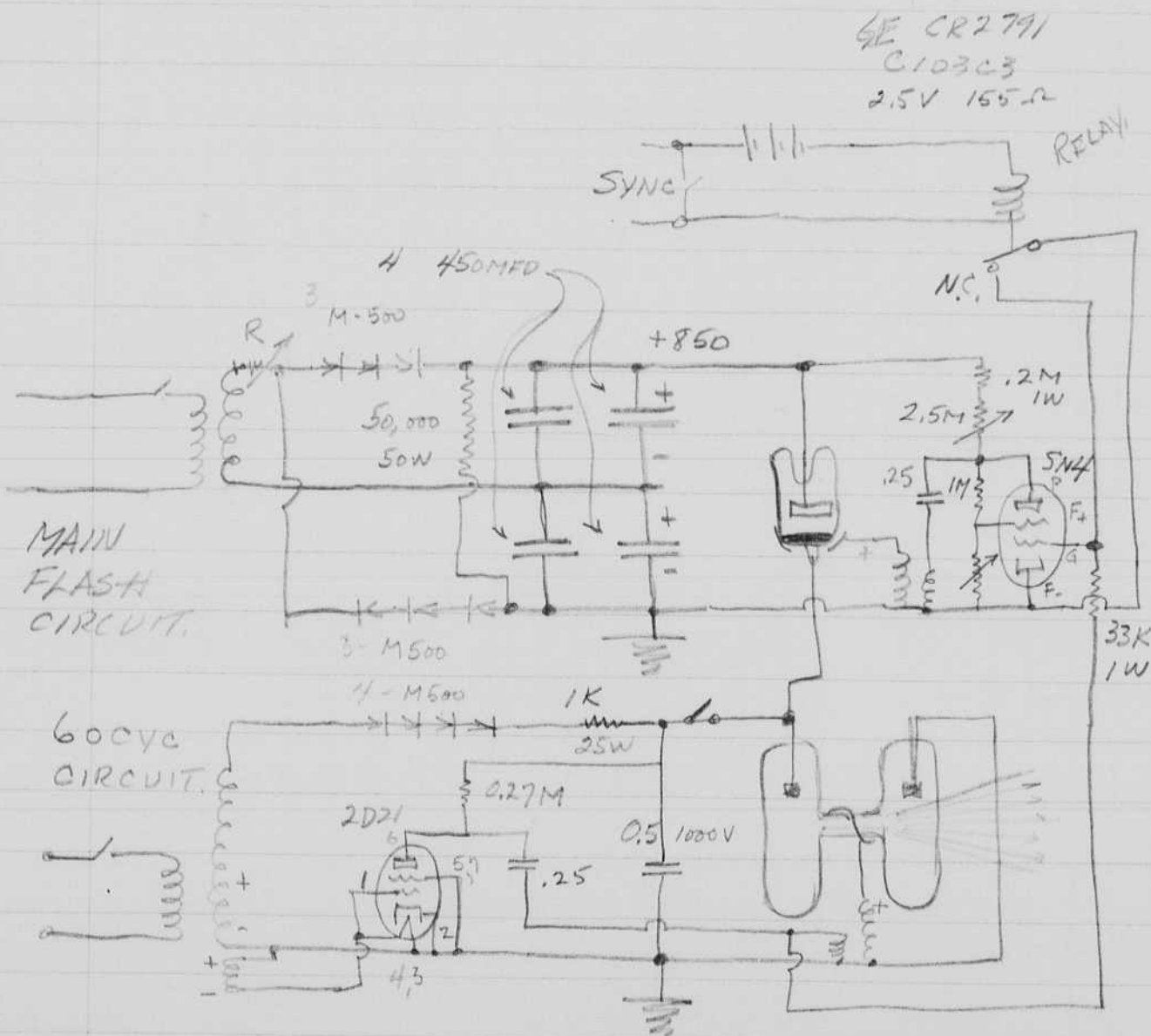
Filmstabilizer run 20

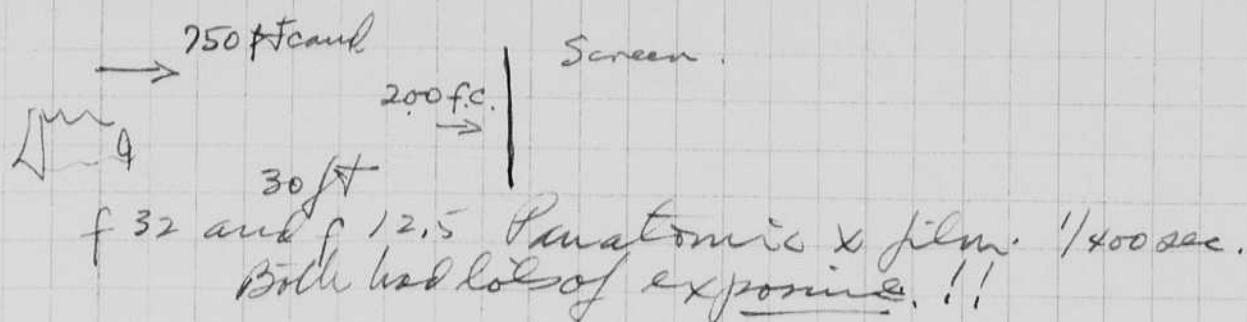
f16 Panatomic X film. 1.25 mff 2KV 5/8 gate.  
Exposure good. Shows heat wave from  
Photo flood after 1 min of heat.

3 negatives at f32. 10 inch lens Panatomic X film ASA 25.

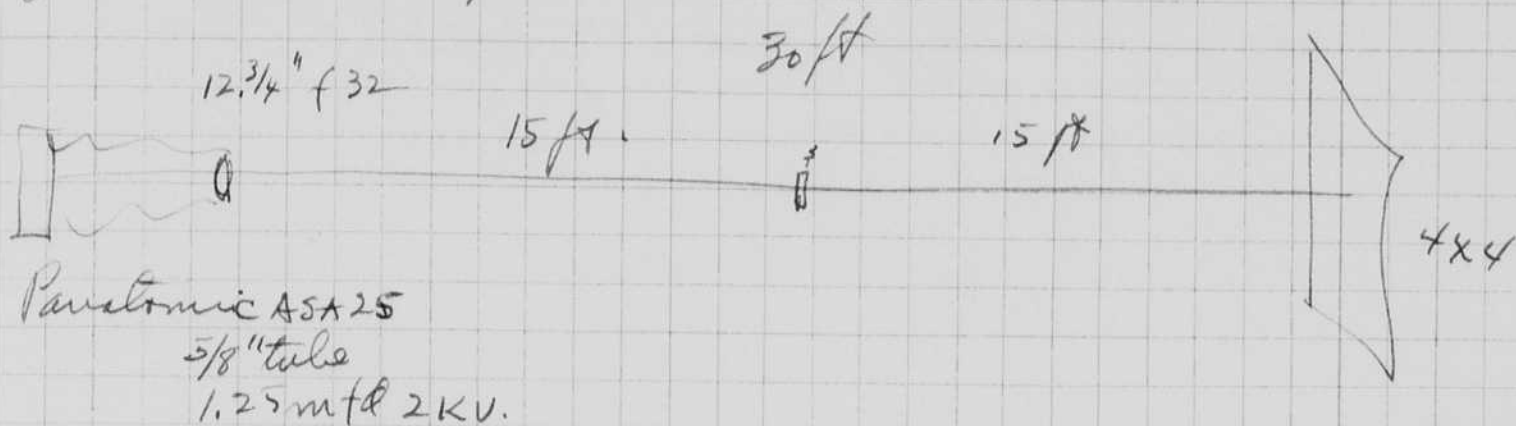
- A. Photo flood at 3 ft from screen at 15 to 20 degree angle.
- B. " and flash.
- C. Flash only.

all processed 2+ min in X Ray developer.  
Exposure OK.





## Time cradler setup.



Polaroid transparency type 46 L  
1/8" hole in X P-1 1.2 mfd 2KV.  
12.5 12 3/4" lens etc.  
5/8" lamp + 35 thin.

Estacolor ASA 25  
5/8 lamp 1.2 mfd 2KV + 12.5 f 2 each }  
f 16.

Mar 28 1959.

43.

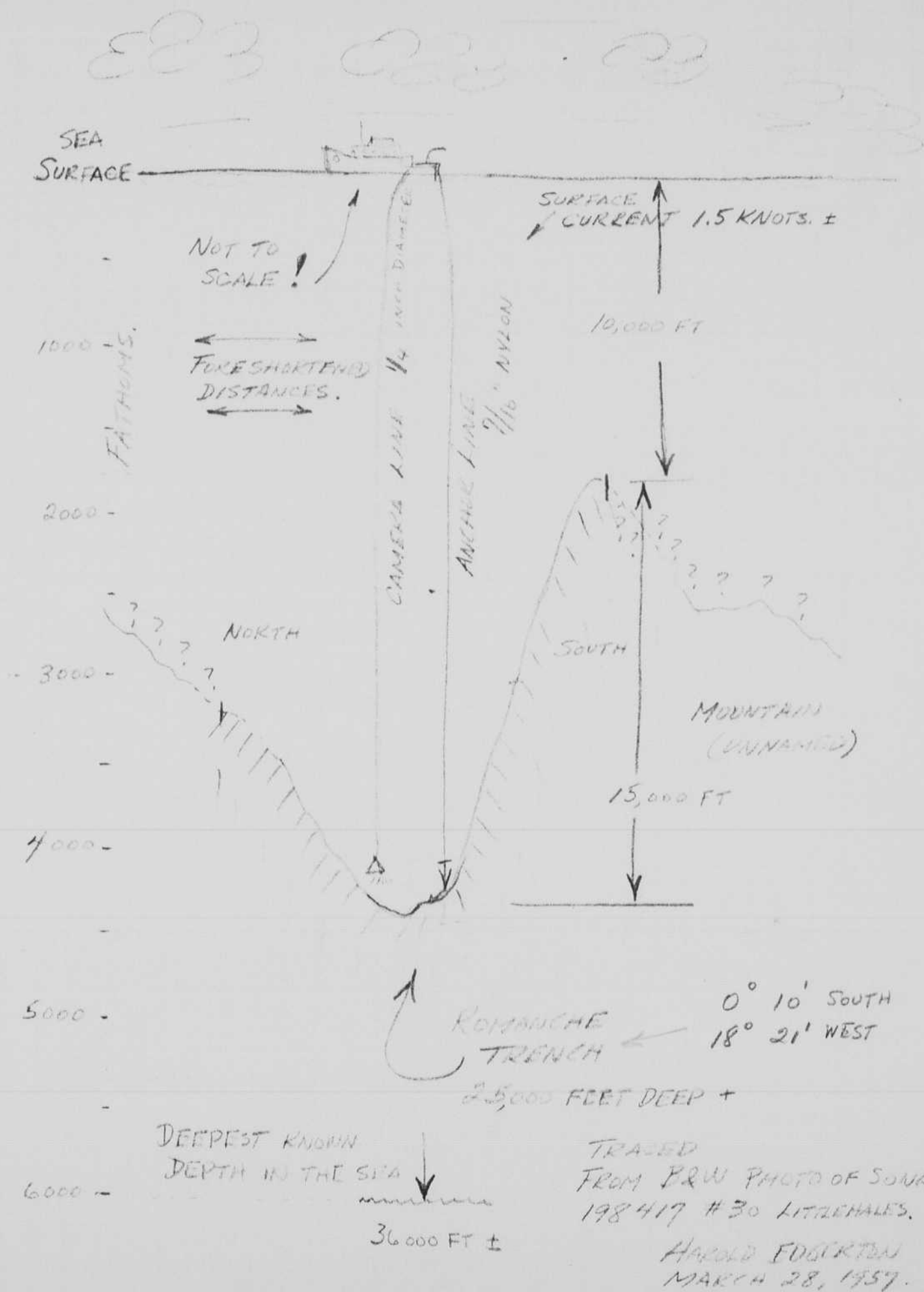
Wash. by air Mar 22 with Estlin. night train to Hickory N.C. to see Mary Jane and family. Chas. Janice and William.

Rtd to Wash. for PSA convention Mar 25, 26. with Chas. Wyckoff.

Robt. J. Uhl discussed thesis proposal today. He wants to measure the infrared output from flash lamps.

Two talks and a question period at the PSA meeting. Monday at 12:30 (actually 12:45+) 300 people on applications of electronic flash, and 9 pm - to a large group (1000 people) in the ball room of the Sheraton Park Hotel.

A question period in the afternoon was held, about 75 people were there.



April 2 1957  
Harold E. Edgerton

Velocity of light Experiment for  
open house.

First experiment

EG84 Double flash with 2nd lamp off.

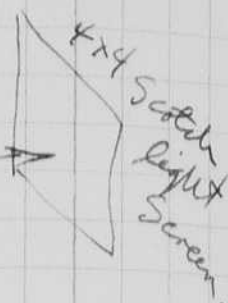
005  
8KV  
5 sparks  
in glass



Mirror

30" diam PM

30 ft

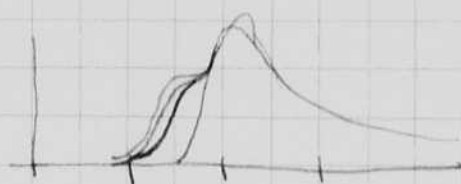
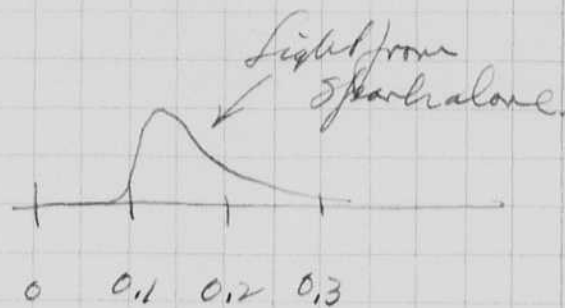


About  
~~200,000~~ 100,000 volts  
on P.M.  
100 ohm  
in last  
stage.



5 volts.

Electron  
cathode ray  
scope.



Light from  
ball.  
note time in  
response.

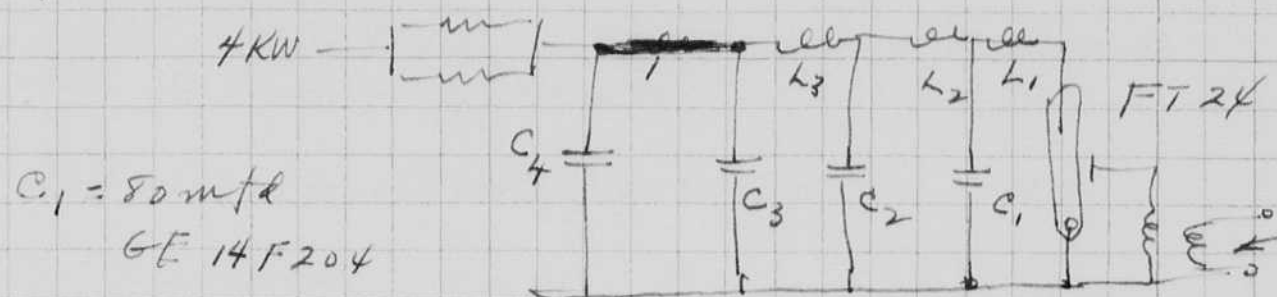


April 7 1957

Harold Edgerton. 54 years old yesterday.

I went with Esther Apr 3 to Rochester to see Bob. Gave talk at Phy. Club of Rook Uni where Bob was president. Then gave an address at the Boehm Memorial Lecture at R.I.T. to students at R.I.T. Delta Lambda Epsilon frat. My neph. Prof. Beletto. etc.

Circuit of Griffin article see page 33 for reference.



$C_1 = 80 \text{ mfd}$   
GE 14F204

$C_2, C_3, C_4 = 100 \text{ mfd } 4 \text{KV}$   
GE 14F311

$L_1 = 0.9 \text{ mh } 10 \text{ WG}_1$

$L_2 = 1.22 \text{ ''}$

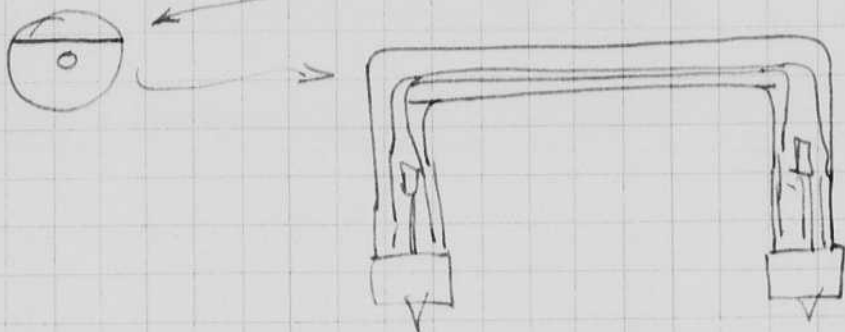
$L_3 = 1.58 \text{ ''}$

Note that a choke is used in the return connected to the lamp. This slows up the first rise of current and the light.

50 April 9, 1957.

Harold Edgerton.

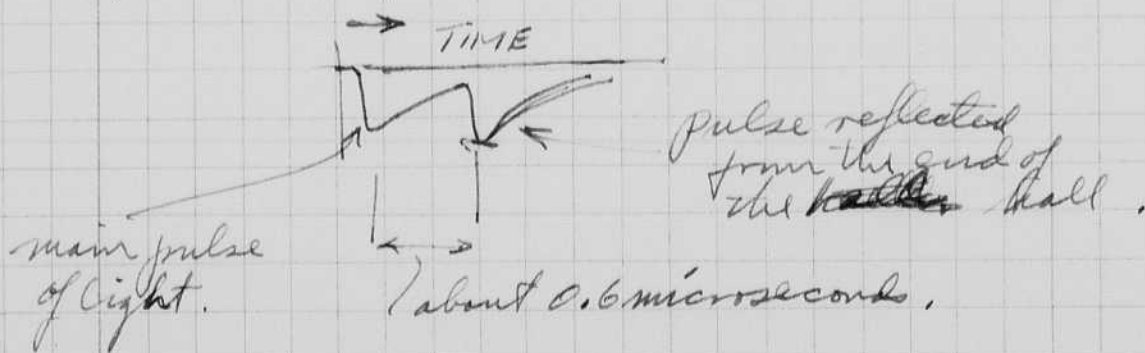
Darby Merrill came in today to talk about line lamps. I told him we could make small diam lamps but there was a lens effect in the outer tube wall. This can be eliminated by grinding the side of the tube flat.



An experiment was accomplished last night in the main corridor of Bldg 20 on the velocity of light. I was helped by Jeffery Wanda and Leslie Orloff.

We used a single flasher part of the Double flash unit. This was directed by a Fresnel lens into scotch light screen located some 250 ft ± away. The reflected light was collected into a ~~pinpoint~~ focus by a 30 inch glass B&L reflector.

About 3 volts was developed across a 100 ohm load, both from the main light and from the reflected beam.



April 12, 1957.

Harold E. Edgerton.

More tests in pool made last Wednesday,  
20 watt sec, 10 mfd 3000 volt? unit 24/sec.  
Oil cooled FT-214.

Lamp in pool 1 ft from window edge.  
Camera in Basement at Window.

Eastman Ektanon Lens 15 mm f 2.7  
25 mm f 1.9

Scene 1 Flash lamp unpaded against pool wall  
16/sec f 2.7 xxx film.

2. Lower flash into pool 24/sec f 4

3. Swimmer. 10 ft f 4  
6 ft f 8  
4' f 11  
4' f 11 several.

Jimmy Smithers last girl

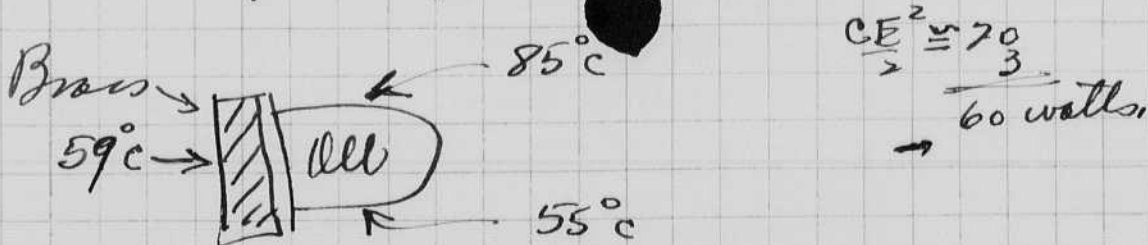
trial exposures on xxx film. - 7 pm  
no daylight, pure pool light.

Apr 12 exps.

Heat run of lamp in air. 3 flashes/sec

2 pm start.

2:20 after 3 f.p.s. continuous



245 Brass now is 62°C.

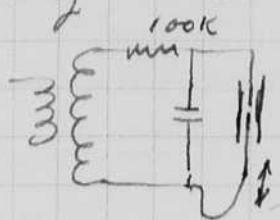
257

" " 72°C.

Bubble 1/4 square inch # !!

52 April 26/1957.

#4204. Experiments for open Hall tomorrow have taken a lot of over time. I have a laser velocity of light set up in Bldg 7. The spark is a 120 cycles + gap in a quartz tube.



40 mil tungsten electrodes  
Quartz tube 50 mil hole  
more electrodes together  
to start the arc going.

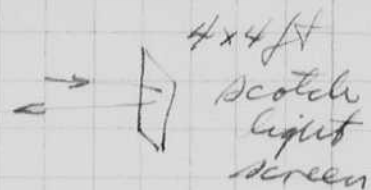
There are about 6 flashes per half cycle. There is some jitter but not too much.

5331  
Don Stevensen  
Bldg 7  
Lobby  
2nd floor.



8" pressure.

500 ft +  
Round trip.



Reflected trip from screen.

Time = 0.5 microsecond

Dist = 500 ft.

$v = \frac{1000 \text{ ft}}{\mu} / \text{sec.}$



Made with Polaroid film in  
the slide ~~copy~~ copier  
from a 35mm Kodachrome.

mt Blanc. 8mm. July 1956

May 3, 1957.

Levied 5000

Milton Swartz and Mr.

<sup>David</sup> Seibold from U.Y.

were here last ~~week~~ night to try the 5000 and 1000 W5 beacons. Barstow took them to the big blue Hill. The lamps were on Dorrance Tab. Visibility was excellent.

The light came in good and strong at the Blue Hill. A Mr. Seymour Farham (Harvard club) reported that he saw the flashes at Mt. Monadnock 68 mile away. The lamps were pointed in the opposite direction or at right angles.

Patrick Wall worked on the project with me. Roy Swanson set up the lamps in Dorrance.

Stroboscope Exhibit

OPEN HOUSE

April 27, 1957

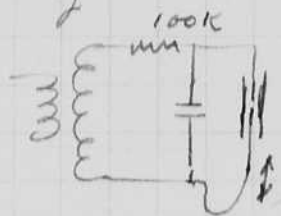
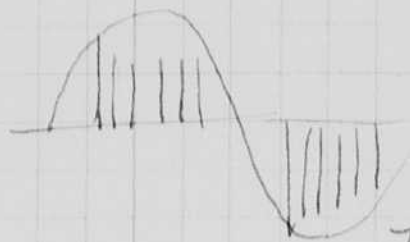
Setup		
10-11 11-12	All meet in 20D-102 to take equipment to 10-150 for display.	
12-1	Lew Smith	Mike Edelstein
1-2	Lew Smith	Mike Edelstein
2-3	Bob Hecht	Bill Levison
3-4	Paul Doering	Bob Salow
4-5	Paul Doering	Bob Hecht
5-6	Ted Quist	Bill Levison
6-7	Ted Quist	Bob Salow
7-8 Cleanup Gang	All	

Return equipment to Building 20 via Edgerton's station wagon which will be on hand back of Building 10 at 7:00 P.M.

Ted Quist	324 Westgate West	Ext. 2501
Paul Doering	100 Memorial Drive	KI7-7735
Mike Edelstein	Atkinson 202 (E.C.)	TR6-4913
Lewis R. Smith	Atkinson 204 (E.C.)	TR6-4913
Bob Salow	222 Babcock Street Brookline	LO6-9360 LO6-4303
Bill Levison	East Campus Goodale 411	UN4-4316
Bob Hecht	East Campus Goodale 410	UN4-4316

52 April 26/1957.

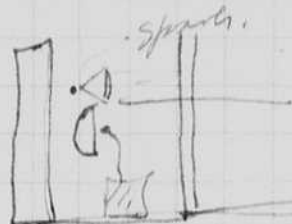
Experiments for open flame tomorrow have taken a lot of over time. I have a line velocity of light set up in Bldg 7. The spark is a 120 cycles + gap in a quartz tube.



40 mil tungsten electrodes  
Quartz tube 50 mil hole  
move electrodes together  
to start the arc going.

There are about 6 flashes per half cycle. There is some jitter but not too much.

5331  
Don Stevenson  
Bldg 7  
Lobby  
2nd floor.



8" pressure.

500 ft +  
Round trip.

4x4 ft  
Scotch  
light  
screen



Reflected pulse from screen.

Time = 0.5 microsecond

Dist = 500 ft.

$v = \frac{1000}{\mu}$  ft/sec.



Made with Polaroid film in  
the slide ~~copy~~ copier  
from a 35-mm Kodachrome.

with Blom. 8am. July 1956

May 3, 1957.

Leaved 5:30.

Meteor Swastly and Mr. <sup>Good</sup> Seibold from U.Y. were here last ~~week~~ <sup>evening</sup> night to try the 5000 and 1000 W.S. beacons. Barstow took them to the big blue Hill. The lamps were on Dorrance Lab. Visibility was excellent.

The light came in good and strong at the Blue Hill. A Mr. Seymour Tamham (Harvard club) reported that he saw the flashes at Mt. Monadnock 68 miles away. The lamps were pointed in the opposite direction or at right angles.

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7-8 Cleanup Gang	All	

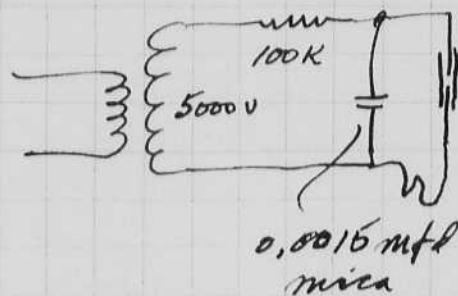
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Bill Levison	East Campus Goodale 411	UN4-4316
Bob Hecht	East Campus Goodale 410	UN4-4316

May 4 1957.  
H. G. B. D. S.

### A.C. Light Source.

The short flash lamps used "open bow" for the transmission of light has the following circuit.



Electrodes tungsten 40 mil seeds  
quartz 50 mil hole 2" long.

I found that I could start a  $\frac{1}{4}$ " spark by heating the quartz with a match. The flame was attracted violently by the high voltage terminal!

After the quartz became hot, the arc started. Once going it kept on without difficulty. The tungsten oxide builds up around the tips of the electrodes making them slick in the quartz and greatly reducing the noise from the spark. The electrodes can be pulled out easily. When the arc starts it usually sends out a puff of tungsten oxide from each end. A blast of ~~hot~~ air can be felt coming from both ends of the quartz.



The next step is to experiment with other gases than air to avoid the oxidation process. Naturally I will try xenon. The XP-2 tube should be the one to work on first. I believe the trick is to heat the quartz so that it acts as a semi-conductor.

Eventually we will want high power operation where water or oil cooling is necessary. I favor oil since it is an insulator.

Convection currents will take the heat away from the quartz.



May 5 1957  
 Museum Boston Harbor

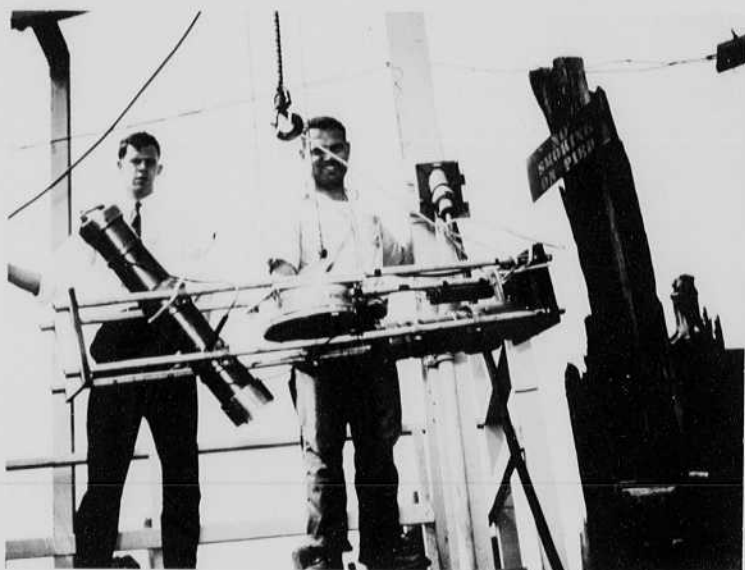


metal detector



Bill MacRoberts      Keef      Gust Wilson

This lamp is one of  
 four 200 W.S. units  
 that are used on the  
 FNRS 3 Bathyscaphe.



Bob Edgerton with deep sea camera at Edo plant.

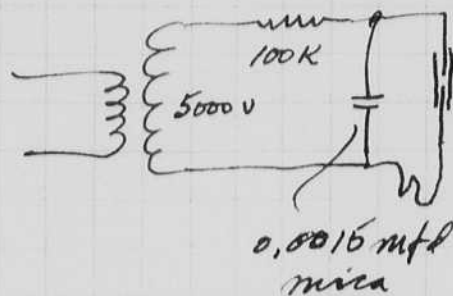
Camera & Battery      Sonar      Lamp.

May 4 1957.

H. G. G. G.

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The short flash lamp as used "open town" for the transmission of light has the following circuit.



Electrodes tungsten 40 mil seeds, quartz 50 mil hole 2" long.

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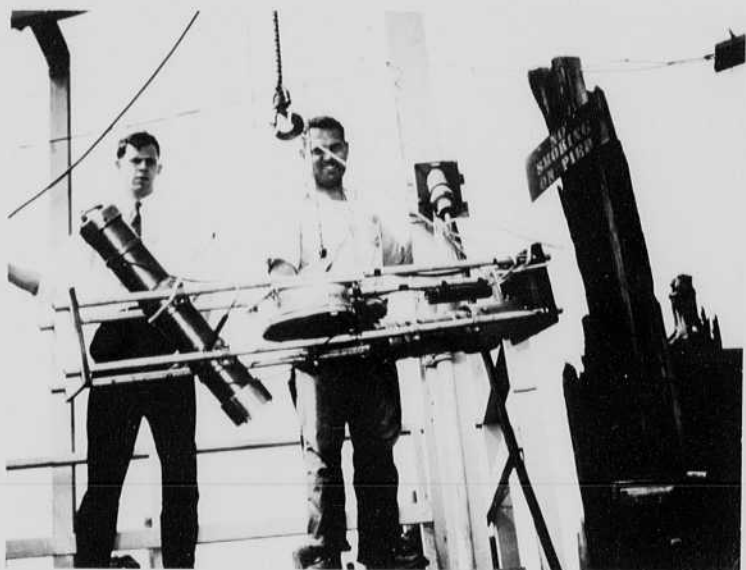


metal detector ↗



Bill MacRobertson      Herb      Gust      Wilbur

This lamp is one of  
four 200 W.S. units  
that are used on the  
FNRS 3 Bathymetric.



Bob Edgerton with deep sea  
camera & Edo plant.

Camera &      Lamp.  
Battery      Sonar

May 9 1957  
Edgeston

"Kodak" from Alfred J. Moran

909 South Broad St New Orleans 25

Paper & film

Tests. Paper. XP-5-TC sample.

100 mfd 2000 volts. Contact shows blisters  
FX-1. and burning.

White effect at about 3 inches away from FX-1

Film in contact to 1" away - developed in hot water -  
exposed as per above to give a white area.

May 11, 1957. Conference yesterday with Dr. Leo Clark  
Howard and Lloyd Bresler about  
summer work on the light in the  
sea.

A photo multiplier circuit will  
be used to trigger the flash when  
a light of about  $10^{10}$  (?) of sunlight lumens/sq ft.  
occurs. In this way we hope to get a  
photo of what causes the light.

Sunlight  $10^4$  lumens/sq foot.  
Flashes of  $10^{-3}$  lumens/sq foot are  
in the water.  $10^{-7}$  of Sun light.

Early visible is  $10^{-7}$  lumens/sq foot as per  
experiments on top of the Dorrance Bldg  
M.I.T. from Big Blue Hill 10 miles away.

Blue Hill exp

$$\left. \begin{array}{l} 5000 \text{ watt sec.} \\ \times 4 \text{ cp/watt.} \\ 20,000 \text{ cps.} \times 10 \text{ reflector factor} = 200,000 \text{ pps beam} \end{array} \right\}$$

$$\text{Light} = \frac{.2 \times 10^{+6}}{(10 \times 5280)^2} = \frac{.2 \times 10^6}{.278 \times 10^{+12}} = .7 \times 10^{-6} \text{ lumens/sq ft.}$$

Wires will be run up the cable so that the  
current can be monitored. Depth gage?

May 25 1957  
Hamed Edgerton

57

I was in Rochester last week on Tues and Wed.  
Movies of the last 4 summer's expeditions in the  
Med and Atlantic were shown to about 200 people  
at the Brookside country club - Amer. Opt. Society.

Phil Sydney, John Niemeyer arranged for me to  
see some color printing done with the type C  
material Kodacolor. Dech Hinowans did the  
printing. He was very good at it. Subjects

Ice capades 20,000 W.S. of entire show.

" " Spots whirling.

Owls - 2 photos.

Pole vaulter. 3 shots 400 W.S. each  
in spot lamp.

I visited the B & L. (Dove Richardson)  
who introduced me to Dr. Tisserand & Finkelstein  
We discussed E & B's products at some length.

Movie units. Underwater  
microscope lamps etc.  
Special flash lamps.

The term at MIT is about over.

thesis student

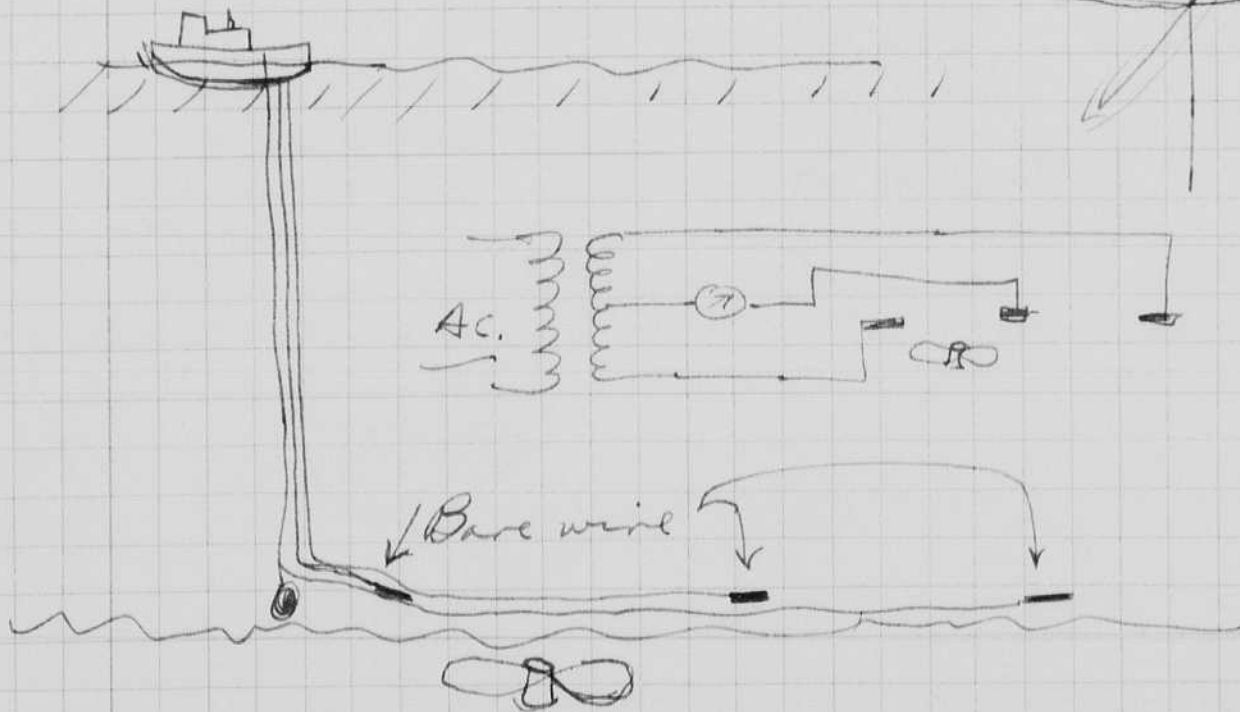
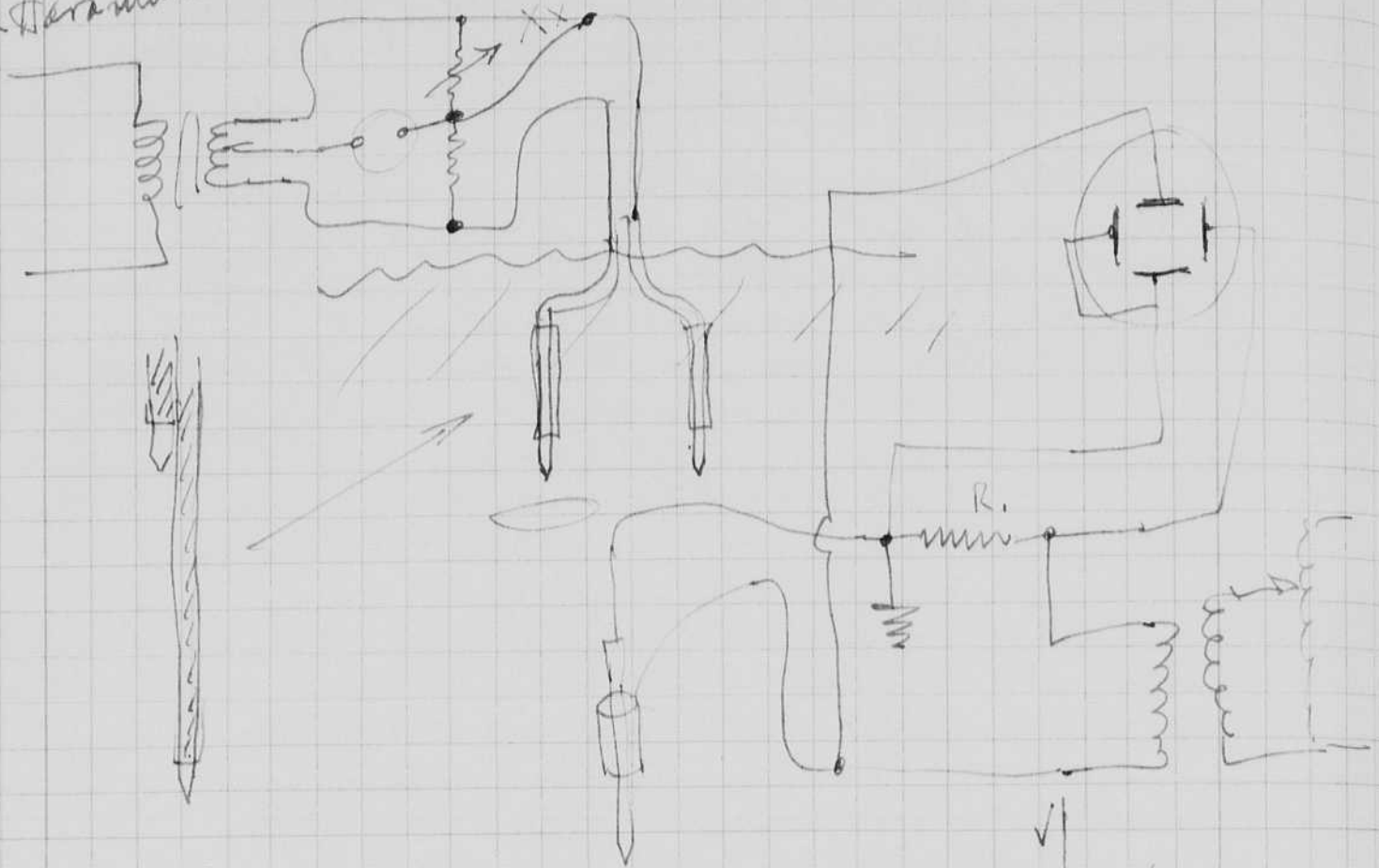
Phil<sub>N</sub> Gallagher - high intensity  
light source.

Lloyd R. Breslau Photo multiplier for  
counting plancton

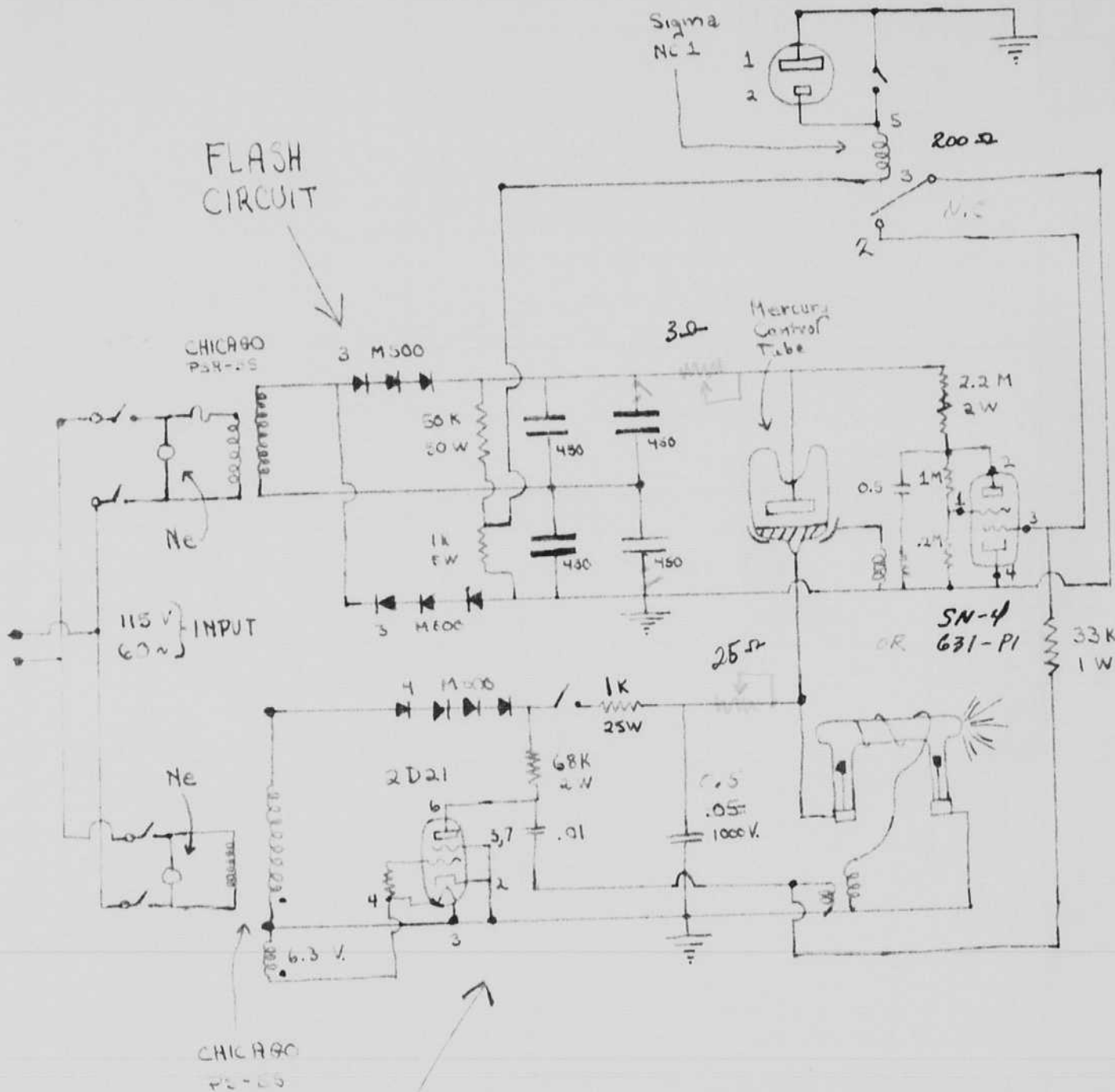
Richard D. Micheli's arc transmitt,  
optical studies of  
demonstrations etc.

May 26, 1957  
 Harold E. Egerton  
 John H. Hammond

AC operation of Metal Detectors.



Jones Plug SYNC CAMERA



FLASH CIRCUIT

CHICAGO P24-25

115 V 60 Hz INPUT

CHICAGO P2-25

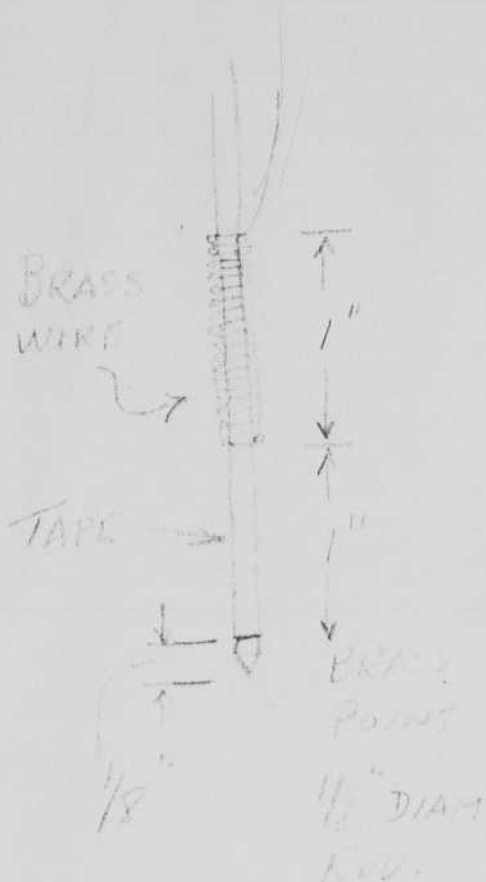
60 CYCLE CIRCUIT

COMBINATION LIGHT

60 cycle plus flash

200 Watt sec.

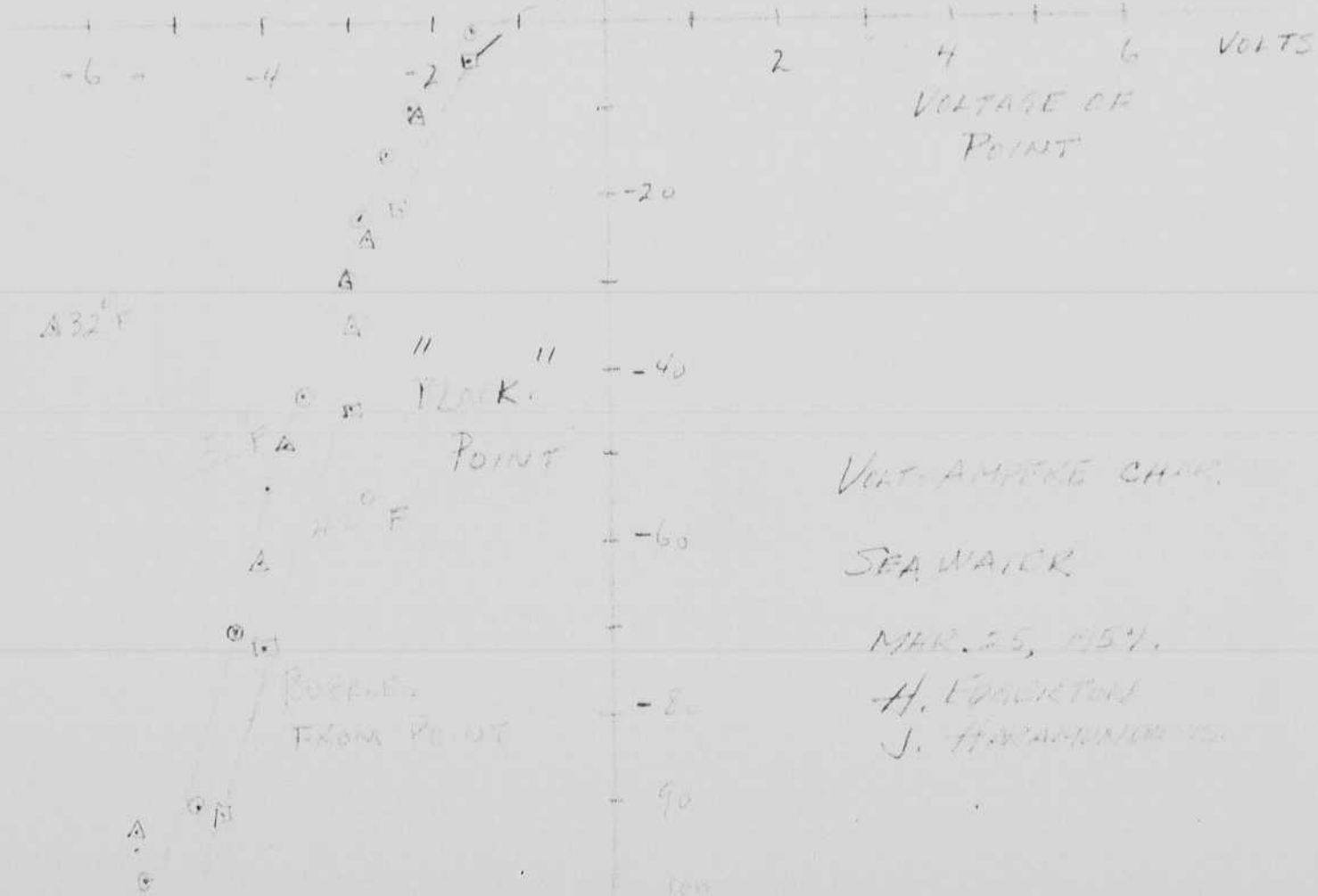
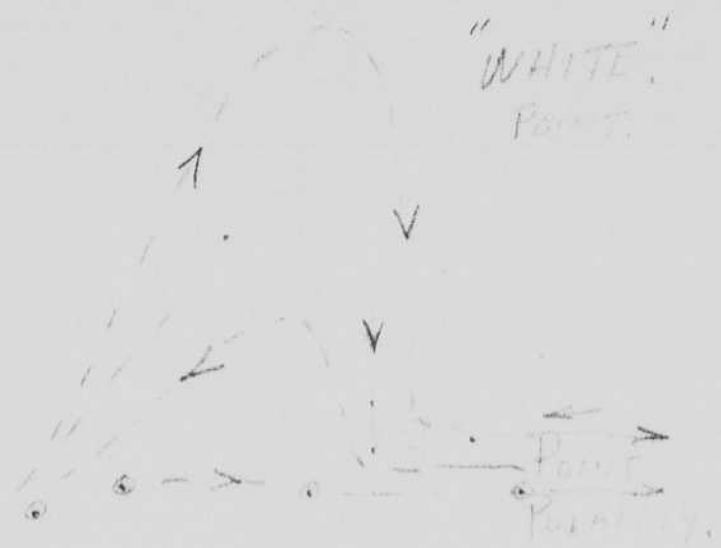
H. Edgerton H.I.E.  
MIT, CAMBRIDGE, MASS.  
FEB. 23, 1957



MILLIAMMETERS

100

CURRENT TO POINT



VOLT-AMPERE CHAR.

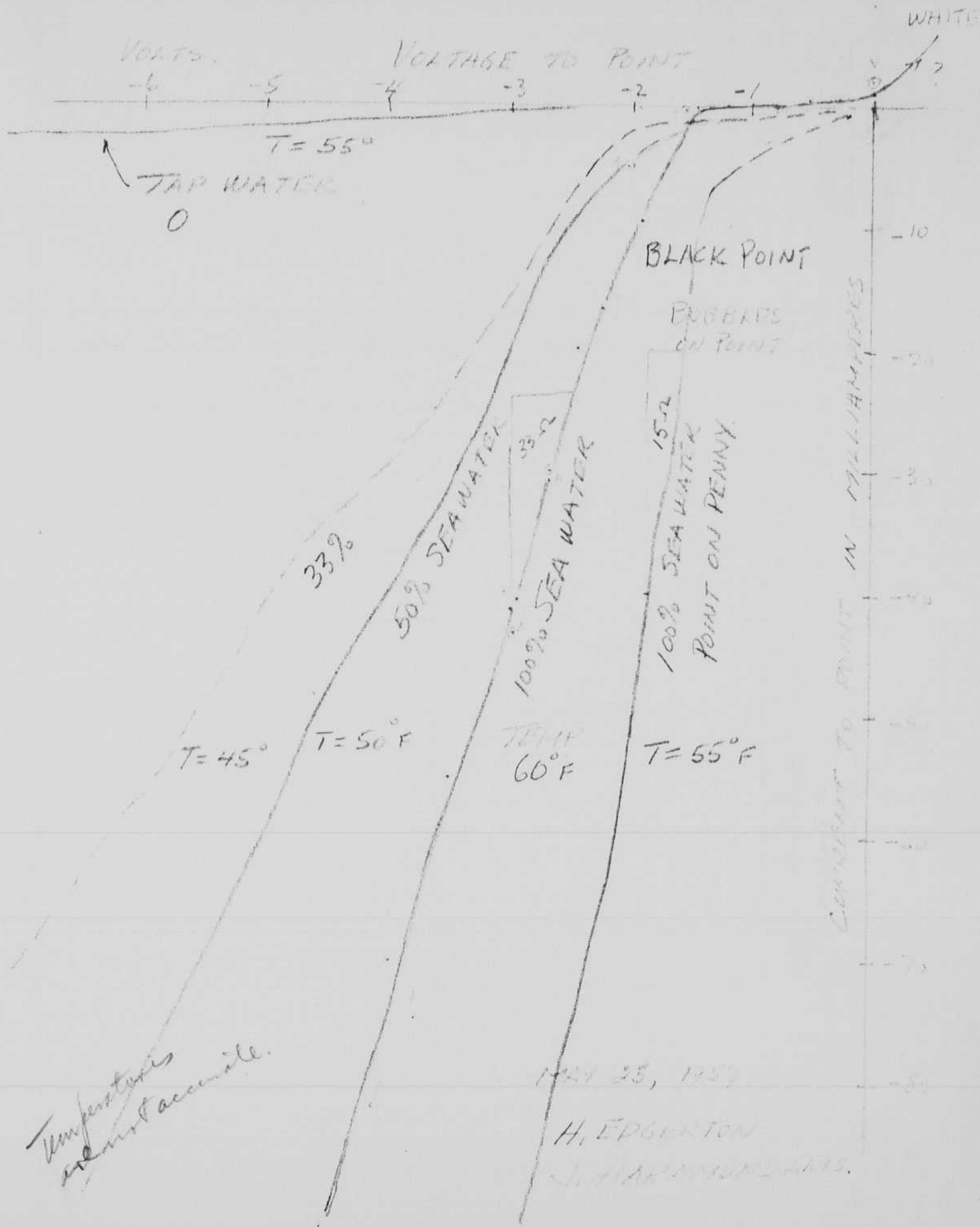
SEA WATER

MAR. 25, 1957.

H. FORBES

J. HARRINGTON





MAY 25, 1957  
 H. EDGERTON  
 J. HARRINGTON

May 29 1957  
 Handed Elyator

Color eye photos from the Bausch and Lomb camera were received yesterday. They were underexposed except for a small spot. Also there was some blue images. The photos were also out of focus. I took the photos to the mass Eye and Ear Hospital where Dr. Donaldson had a look at them. We plan to reshoot after more energy is put in.

Today Bill put in an additional 250 mfd bringing up the total to about 700 mfd. At two feet the incident light from the end of the tube was 115 lumen sec./sq foot. This should do it.

I added two resistors to reduce the output. One resistor, 25 watt size 22 ohms, was in the series discharge of the 0.5 mfd capacitor. Another resistor was in the main discharge, a 3 ohm 25 watt. I noted that 3 ohms reduces the output to  $\frac{1}{2}$ .

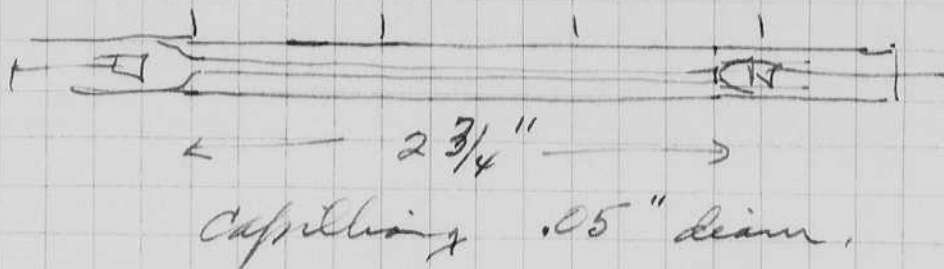
In this way I hope to be able to set the light until the exposure is correct. A G.R. light meter will be used.

$$I = \frac{107 \times D}{\text{area}} = \frac{428 \text{ cps.}}{\frac{1}{4} \text{ sq cm}} = 1600 \frac{\text{cps}}{\text{sq cm}}$$

May 30 1957

Leakometer fast tube.

Sealed Edge on pump.

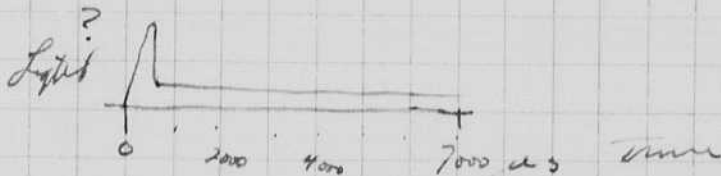


10 mfd at 10 or 2 cm of vacuum gives a 30 us discharge.

$$\frac{RC}{2} = 30 \times 10^{-6} \quad R = \frac{30 \times 10^{-6} \times 2}{10 \times 10^{-6}} = 6 \text{ ohms.}$$

Try 100 us. add resistance in series. try 12 ohms ±  
Experiment shows 20 ohms is about right.  
tube has 1 1/2 cm vacuum.

Now tried 575 mfd at 400V with 22 ohms.

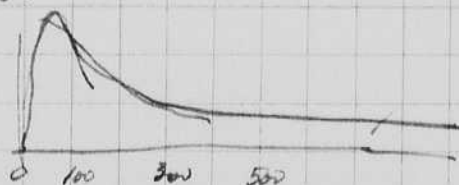


$$1000 \mu s = \frac{RC}{2} \quad C = \frac{2000}{6 \cdot 2} = 333 \text{ mfd.}$$

275 mfd (rated Hico) <sup>400V</sup> 475V give 200 us. No series R

$$200 = \frac{R \cdot 275}{2} \quad R = \frac{400}{275} = 1.5 \Omega \pm$$

275 450 7 ohms.



Sealed off at 2.2 cm. vacuum.

Microscope tubes 130 mfd at 1500 volts. 1.5 cm vacuum.

Some etched wear and some SiO<sub>2</sub> on walls.

Pinched off at 10 cm vacuum  
Show green glow.

$$V_s = 250$$

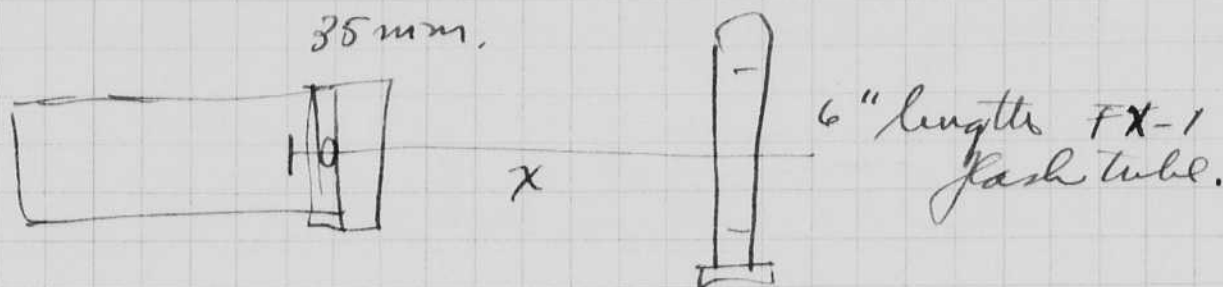
A second tube sealed off at 25 cm. (2000V at .150 mfd treatment) or pump.

Note: The 10 cm lamp shows lower effy than the 25 cm. Data in light books. 10 cm 44 51 25 cm 67 107 700V 450 mfd. 900V 675 mfd.

# Camera design for Flash triggered operation.

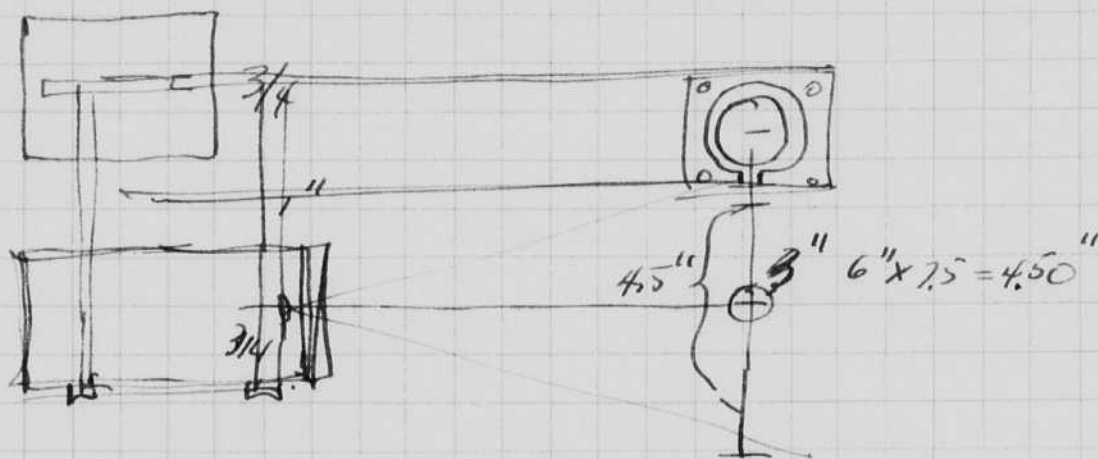
May  
June 1, 1957  
David Ogden.

I inspected the Yonack row yesterday in the C. S. dock at Boston. Richardson showed us his new wrinkles on the rear deck. Geo Clark, Lloyd Breslau.

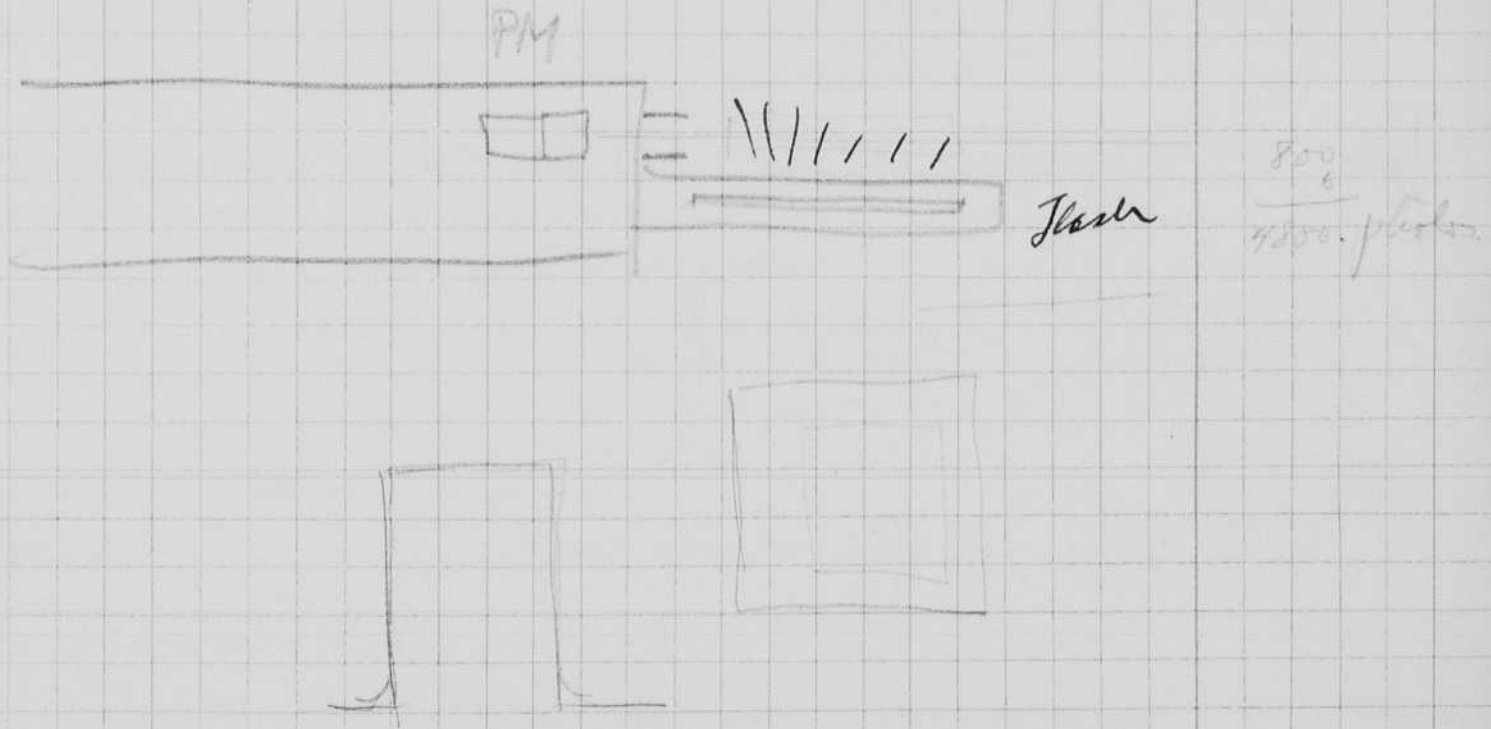
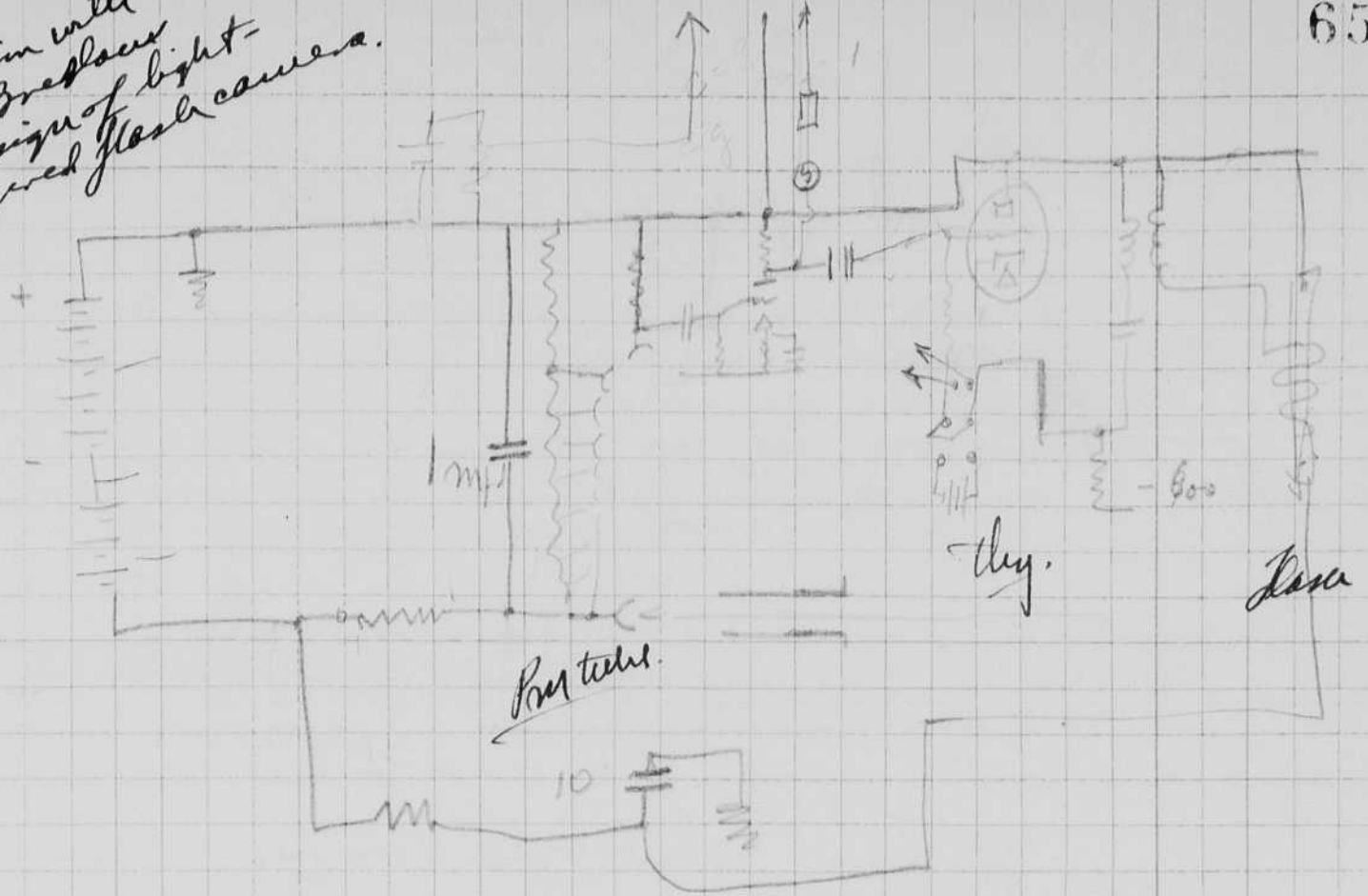


$$\frac{6''}{\frac{1}{2}''} = \frac{x}{3.5 \text{ cm}}$$

$$x = 3.5 \times \frac{6}{1} = 21.0 \text{ cm or } 8.3 \text{ inches.}$$



Discussion with  
Lloyd Brewster  
on design of light-  
triggered flash camera.



We came up with a single case with both lamp and  
P.M. tube. This cuts the wires down to zero. We could have a  
small strobe on the camera which would trigger the  
flash also.

66 Harold Edgerton  
June 1 1957

Flash lamp tests for  
consistency

Cross Guard Boston  
CA 73710

FT-2#<sup>11F</sup> as per sensitometer  
10 mfd 4 ohms series. jittery.

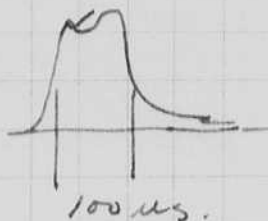
Yamacraw on  
May 31, 1957.  
Richardson

Strobolux



S. 840 10 mfd 4 ohms obs. 70 us.

10 mfd 10 ohms, 100 us, obs.



~~jitter low~~  
light low too??  
jumpy

Strobolux Xcum type R. 10 mfd 10 ohms 100 us

obs. but awkward to  
mount in tube holder

June 2 1957

Special tube 3 7/8" .050" diam. 2.5 cm vacuum.

Shows 30 us from 10 mfd at 400 volts  
Does not trigger consistently

Photos of eye in Bausch and Lomb camera Louis Tommasi  
142 Pleasant St  
Winthrop Mass.

G.R. Light meter

Ground glass removed from B.L. device

6000 light 10 sec.  $\cdot 8 \times 4 = 32$   $\frac{32 \text{ lumen sec. / sq ft}}{10 \text{ sec}} = 3.2 \text{ lumen / sq ft.}$

Flash 200 ws.  $55 \times 4 = 220 \text{ lumen sec. / sq ft.}$

300 ws.  $78 \times 4 = 312 \text{ "}$

Photostat  
300 ws. meter  
Bausch  
H.E.

June 3, 1957  
 H.E. Egerton.

Conf. with Cousteau.

Turtle, Electronic flash.

Black and white one flash per second

- (1) camera. 35 mm
- (2) Shutter synchronized.
- (3) 50 watt second in one lamp.

Color.

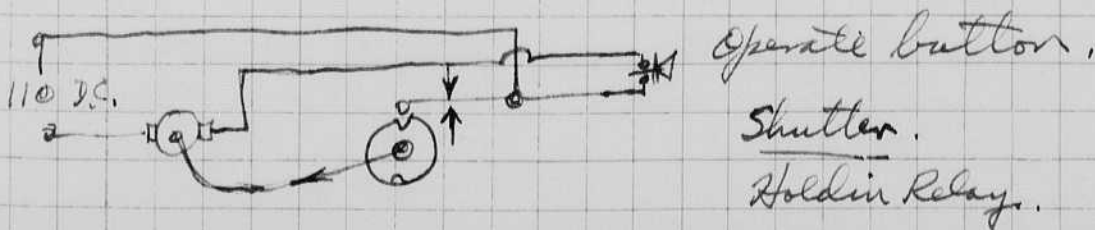
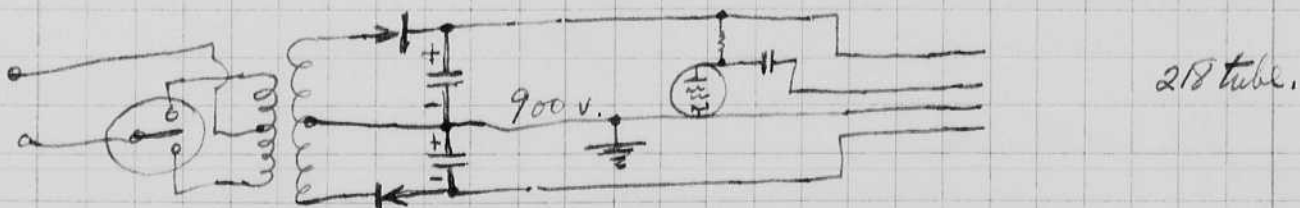
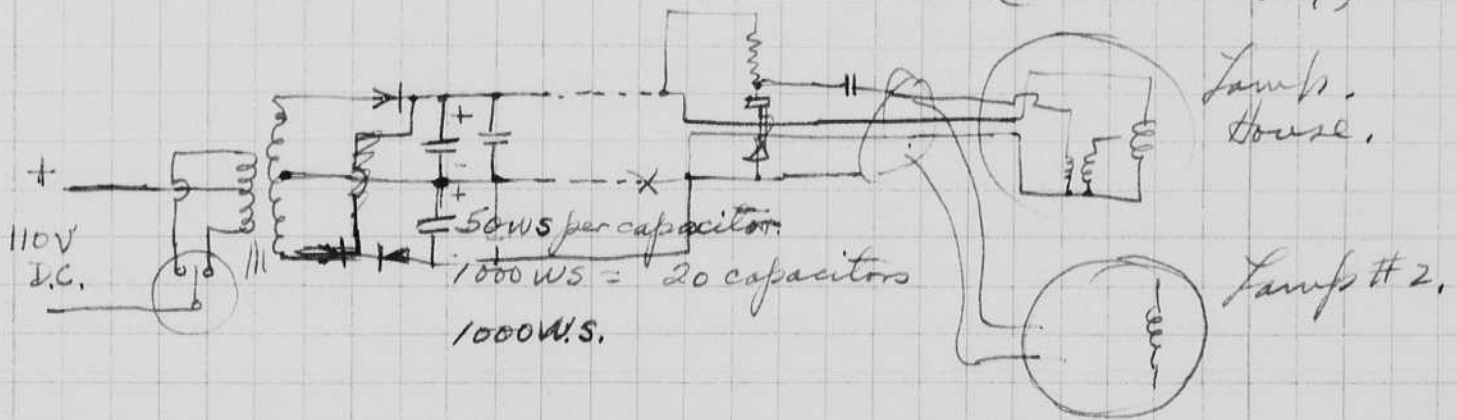
1. camera 35 mm.
2. Shutter
3. Two lights 500 W.S. each.

Power for both - 110 D.C.

Lamps and cameras in water.

35 mm lenses, with correctors?

Pressure 50 atmospheres, 1500 ft.  
(3000 crushing)



June 11, 1957.  
Harold Edgerton.

Left by car (Desoto) with Esther on Wed June for Rochester. First ride on new Mass turnpike. Overnights at Sniffins in Syracuse then to Rochester Thurs day.

Visited B & L. Mr. Jobe where a demonstration of the end on flash tube was made in the B & L of Retina camera. Results pleased B & L very much. I used 200 and 300 watt seconds. (See page 42). The tube has 25 cm of x-ray. I found that 20 cm was not enough.

The heat filter was removed from the Retina camera. Some photos were taken with the yellow filter and some without.

Jobe asked me to quote on a 300 WS unit to do the job. He does not want the flashing light (60 cycles) that we use for focusing. He plans to use a tungsten lamp.

Donaldson.  
L 38200

I showed the oil cooled 24 cycle lamp to many people in Rochester at the EK. and at Duplex Co. This unit was driven by a Cine Special from single frame to 30 flashes/sec 20 WS per flash. Guide no with Raylog at Kodak around of 25-30. The equip was shown to a group at the EK Sales Bldg. There were representatives of the main testing groups.

Experiments were made at Hawkeye plant EK with A.D. Baker on a projector system for photographing a reticle on a character printing system using a cathode ray tube.

Our tests show that 2 h.c.p.s. do what he requires in his photo setups.

I proposed a system using the end on flash tube that has been used in the retina camera.

Robert Frank Edgerton took his degree June 10 1957 Sunday at the U of Rochester in Physics. He is going to continue his studies here next year in the Optics dept.



June 12 1957  
H. Egerton

# Motion Picture printer.

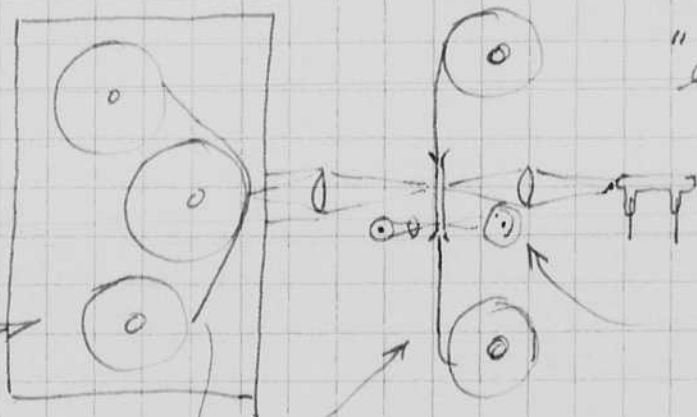
The xenon flash with short exposure has several very important properties for a printer for especially color materials.

These properties are (1) color temperature is practically a constant at daylight quality.  
(2) the intensity can be controlled over a very large range by the adjustment of voltage, capacity, and series resistance.

The contrast in color printing especially is lower when a short flash of light is used. This is very important in making color prints from Kodachrome originals. (Dufay)

The film can be continuously flowing in the machine with a commutator to fire the light at the right time. A continuous light monitoring system can be used to adjust the average exposure of the scene to the correct value.

Film being copied

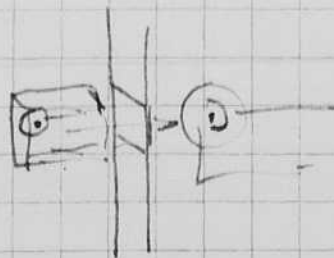


"end on" flash tube run in synchronism with film by contact or photo tube.

photo tube trigger on sprocket holes.

Film being exposed.

Motion must be locked together.



To adjust voltage or series resistance in the strobe.

Exposure control.

June 13, 1957  
Hawes & Egerton.

Screen for photography.

Slide Scotch light	5 yards x 2 ft	# 234C.	\$ 28.80
	10 "		54
	50 "		226

Boards.	Wall board	7¢
	Keasomite	8 1/2
✓	Homesole	10 ¢
	Coletex	8 1/2
	Plywood.	
✓	Plaster board	5 1/2 ¢

✓ Samples obtained today for trial.

This should be tested for exposure in daylight

This is a continuation of an experiment reported on page 13.  
Use Panatomic X film ASA 35 at f 11 20" lens.

Bob and I visited DeLott's store at 530 on the way home. Corcoran made a photo copy of a 35 mm slide of Bob that I had with me. The copier has been in use about 3 weeks as a trial effort. There is some interest by customers and it is growing. The idea is working out well.

Lamp and Camera Housing PH-4, Stainless  
Heat treated, 700° F  
200,000 PST  
From Elg & Hookby July 55 SMPTEV64 yield 18,000  
13% elony.  
46% Reduct  
415 Brown V 7  
343 Rockwell.

Let Ratio = .073

LD = 4.05"

T = 4.05 x .073 = .296 inches.

3/8 is .375

1/4 is .250

$\frac{5}{16} = \underline{\underline{0.3125}}$

June 13  
H.C. Edgerton

# Time Capsule.

put in the ground.  
June 6, 1957 at 3 pm.  
by J.R. Killian.

A pair of glass tubes with various items such as catalogs, a list of the faculty, K.T. Compton's book of statements, etc etc, coins, was buried near the new Compton laboratory. It is our hope that these will be dug up some day possibly 1000 years or so from now.

The location is on the west side of the Compton building some 15 or 20 feet from the center towards the south, the small glass tube is buried 6 feet down in a tube of material that will prevent its being broken by impact, the second larger tube is in a transite tube in a vertical position.

See sketch

Please do not open until 2957

8" inside diam Transite Pipe

Plaster around a set of coins, in at Nat'l Bank

Senior Week Beer mug 1957

The air was exhausted from the tubes, then argon was introduced and the end sealed.

Dowance Beddy

Open area

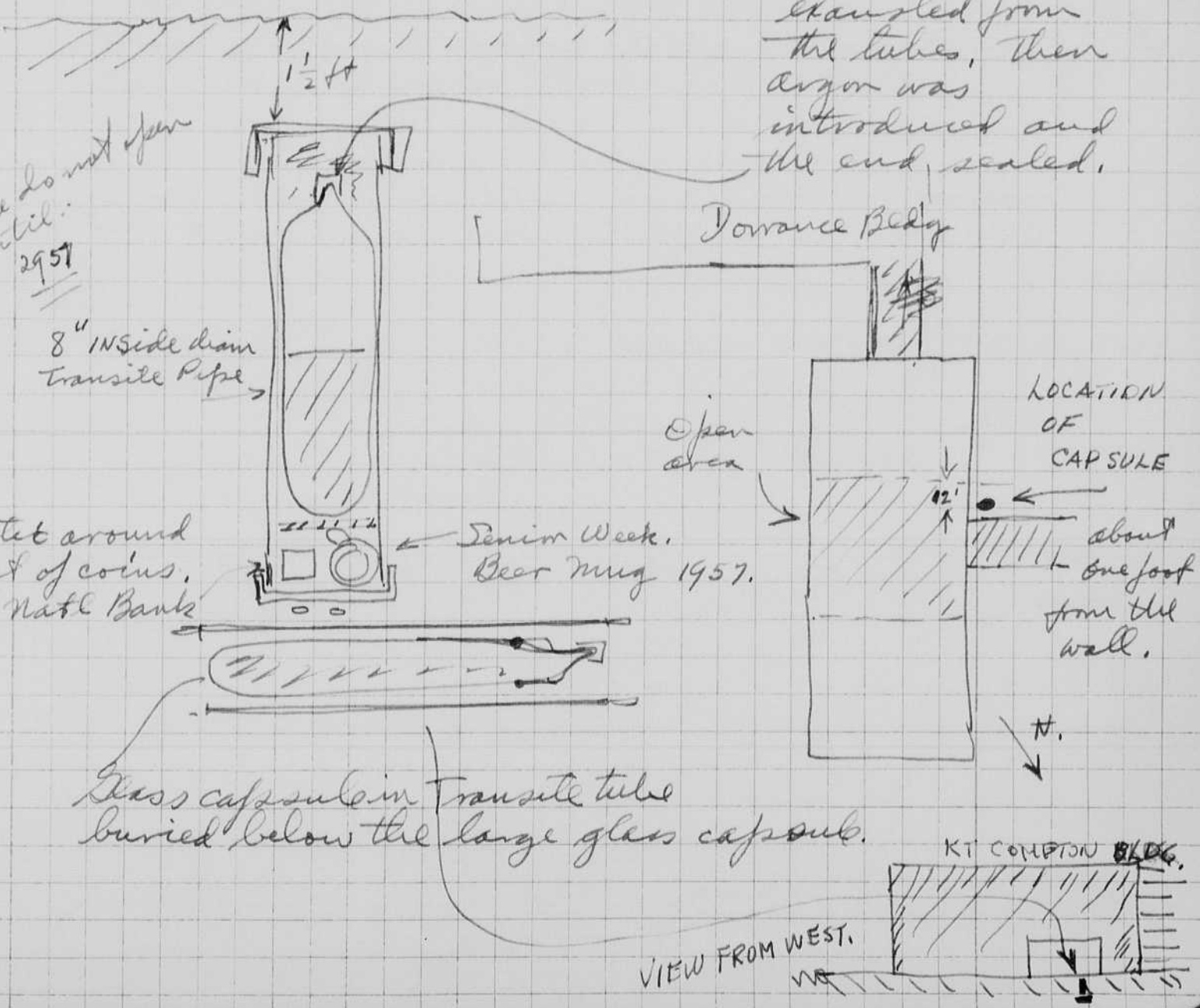
LOCATION OF CAPSULE

about one foot from the wall.

Glass capsule in transite tube buried below the large glass capsule.

VIEW FROM WEST.

K.T. COMPTON BLDG.

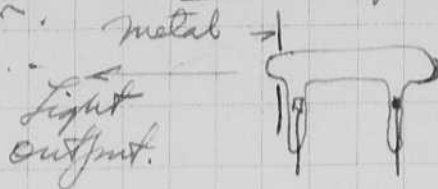


72 June 16 1957

Harold Edgerton.

Robert Edgerton

## Microscope lamp.



Calibration  $3\text{ft} \pm$  Fx-1 20 mfd 2000-1500 V.  
 peak light =  $2 \times 10^6$  h.c.p.  
 above gives 2 cm deflection.

60 cycle operation with 0.5 mfd at 1000 volts.

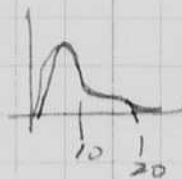
Peak light =  $0.008 \times 10^6$  c.p. = 8000 c.p.

Duration = 10 microsec.

.08 x c.p.s. per flash.

$\frac{30}{2.40}$  c.p.s. for 30 flashes.

.08 x 60 = 4.8 c.p.s. per sec = 4.8 c.p. average.



with 1 mfd the output is slightly more than double this or 10 c.p.

$\frac{1000 \times 250}{4}$

Condenser flash,			I	T.		
mfd	V.		peak,	sec	C.P.S.	cps
			C.P.			(1/4 sec cam)
						Still.
250	900V	100 W.S.	$0.4 \times 10^6$	250	100	400.
500	"	200 W.S.	$0.5 \times 10^6$	500 (400)	200	800.
750	"	300 W.S.	$.66 \times 10^6$	750 (700)	460	<u>1848.</u>

Harold & Bob  
Edgerton.

## Variable light output of underloaded lamp.

73

A very bothersome characteristic of flash tubes is flicker or variable output per flash. This occurs on the microscope illuminator when run at 60 cycles. Also it occurs on the sensitometer on the 100  $\mu$ s. range.

We had a lamp (page 72) up for test. The light variation was about 50 percent at the 60 cycle operation with 900 v and 1/2 mfd. Operation seemed better at 1 mfd at 900 v.

On single flash at 1600 volts we noticed that the light output was at least double when the tube self flashed as compared to a triggered operation.

We observed the tube with a camera which put an enlarged image on the ground glass.

With a triggered gap the arc seemed to be a ribbon of whitish discharge on the wall of the tube adjacent to the starting band. The ribbon seemed to be thin in depth, but about 1/8" or an inch wide.



With self flashing the arc was not on the wall and did not fill the tube. It seemed to be a filament in the space and naturally was brighter than the arc of above.



(The other <sup>coil</sup> above had a cycle time of 60  $\mu$ s.)

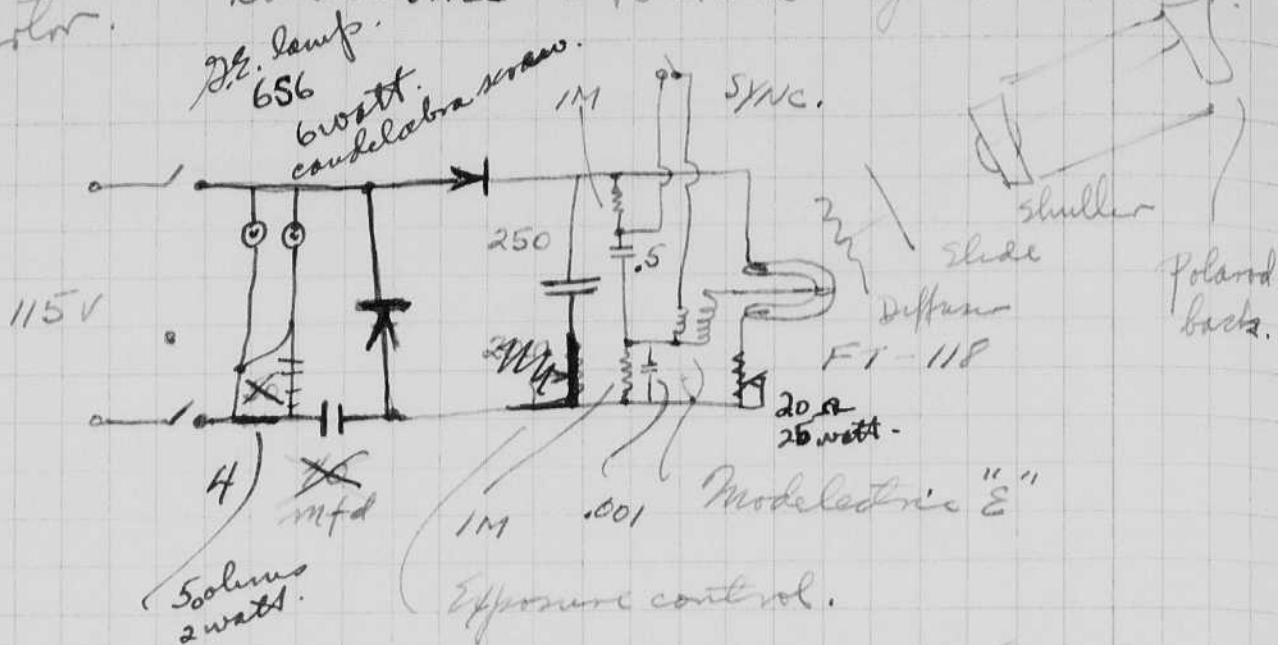
We tried a 1  $\mu$ s spark as a trigger, hoping that the short spark would not ~~trigger~~ influence the arc once that it had started. We could not see any effect. The variable output was the same if not worse.

I tried a single spark band at the middle. The output was erratic!

74 June 17, 1957

Harold Edgerton.

Kodachrome → Polaroid Copier Circuit.



This unit has been in use in Selottes store in Cambridge Central Square for the past three weeks. Mr. Perkins of Polaroid took it there for trial. A price of 3 photos for one \$ is charged.

Tomorrow, I show it to the people at S & S since Polaroid want to consider more.

Sprague capacity 77309 652  
4 mfd 150V  
250 mfd 300V

Lamps 656 General Electric candlebra sockets  
2 used 115 volt 6 watt?

Rectifier Federal 1007A 75 ma too big. !  
Suggest 2 tube Radio Receptor 8J1 65 ma.

Resistor Ohmite 25Ω 25W # 6,22 List

Louis Dejonge Co  
350 Tompkins Ave  
Staten Island NY

Stenstrom La 3 8230 ex 568 Retina Foundation.

June 29 1957.  
Harold Edgerton.

75

The black Scotchlight screen, especially with a Polaroid filter worked quite well the other morning on the roof in daylight. The polaroid filter only helps when the sky is clear. The sun should be at right angles and not directly shining on the screen.

# 234 C Black screen as made by Minn Mining & M.

Flash lamp,  $\frac{3}{4}$ " gap in X-ray 6 m.m. tube  
1 mfd at 2KV. Mounted on leads

Panatomic X film at f16 with  $12\frac{1}{2}$ " lens.

A camera and flash unit are being assembled for transmittal to Italy where Dr. Ketyhnutzer is going to dive in the Bathy scaphie. This equipment should go to tomorrow and arrive in Rome on Monday.

Contract 123/953/14902A

GBL N 33409525 Al Wial

Sent by Pan American to Naples.  
Flash unit 200 WS from 24 volt dc.

and camera of the recycling type  
with a shutter of .080 seconds.  
also 24 volt dc.

**NOW!!**  
in only 60 seconds!

... you can get postcard size black and white prints of your color slides.

... make prints for your album or to send to friends and relatives.

The prints are made right in the store while you wait.

... only \$1.00 for 3 prints.

... ask us.

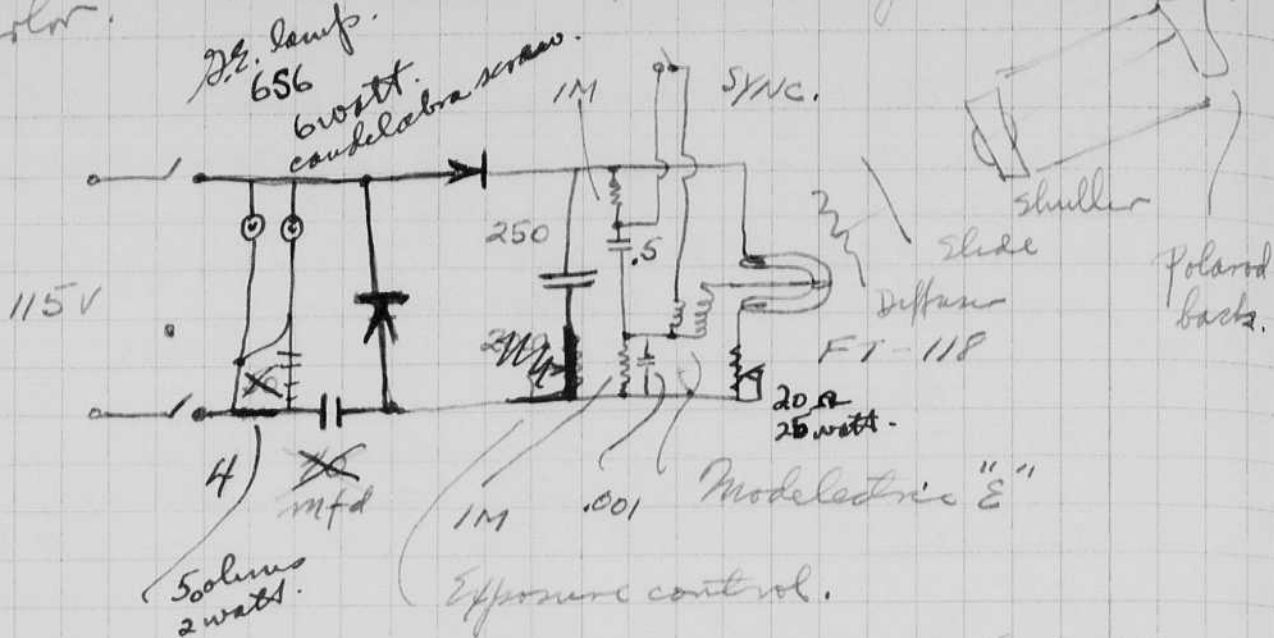
**CLAUS GELOTTE, INC.**  
1290 Massachusetts Avenue  
Cambridge

June 1957.

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Rod lamp  $\frac{3}{4}$ " gap in x even 6 m.m. tube  
1 mfd at 2KV. Mounted on lens

Panatomic x film at f 16 with  $12\frac{1}{2}$ " lens.

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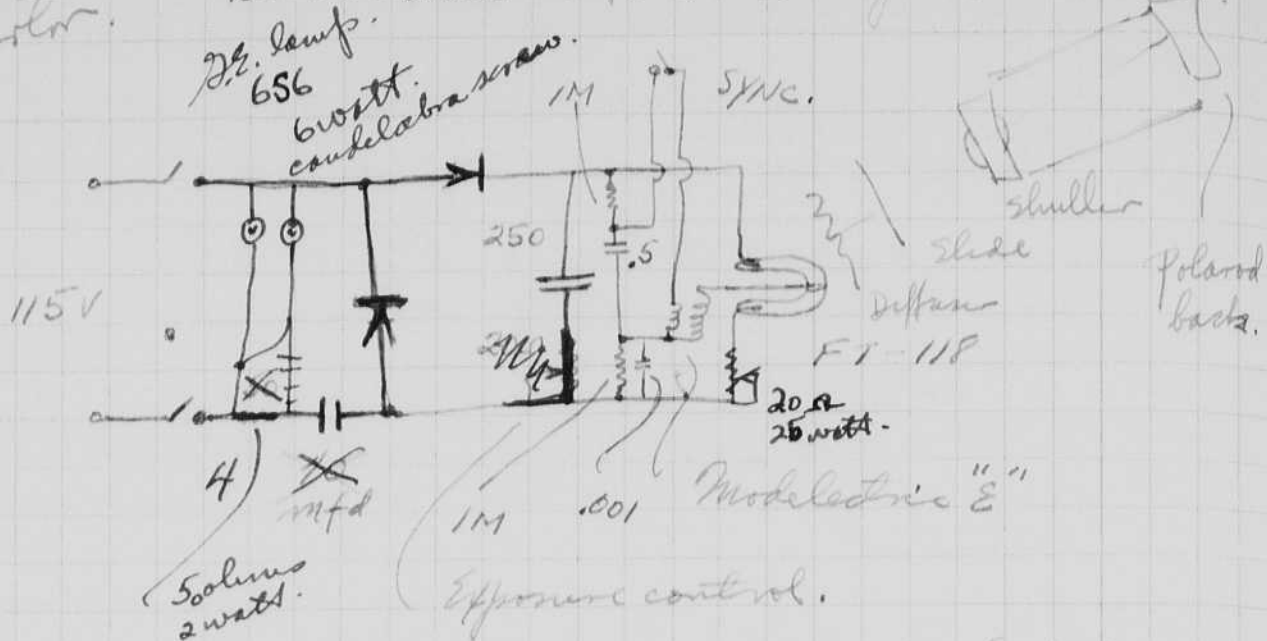
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 330 Tompkins Ave  
 Staten Island N.Y.

Stenstrom La 3 8230 ex 568 Retina Foundation,

June 29 1957.  
Herold Edgerton.

The blacked out light screen, especially with the Polaroid filter worked quite well the other morning on the roof in daylight. The polaroid filter only helps when the sky is clear. The sun should be at right angles and not directly shining on the screen.

# 234 C Black screen as made by Minn Mining & M.

Flash lamp 3/4" gap in X-ray 6 m.m. tube  
1 mfd at 2KV. Mounted on lens

Panatomic X film at f16 with 12 1/2" lens.

A camera and flash unit are being assembled for transmittal to Italy where Dr. Kelchmeyer is going to dive in the Bathy scaph. This equipment should go to tomorrow and arrive in Rome on Monday.

Contract 123/953/14902A

GBL N 33409525 Al Wial

Sent by Pan American to Naples.

Flash unit 200 WS from 24 volt dc.

and camera of the recycling type with a shutter of .080 seconds. also 24 volt dc.

**NOW!!**  
in only 60 seconds!

... you can get postcard size black and white prints of your color slides.

... make prints for your album or to send to friends and relatives.

The prints are made right in the store while you wait.

... only \$1.00 for 3 prints.

... ask us.

**CLAUS GELOTTE, INC.**  
1290 Massachusetts Avenue  
Cambridge

June 1957.

July 5 1957

David Edgerton  
Ray SirdairTests with  
gun shod  
surveys in  
20 D 10 2.

Photo of projected slide on  
Black Scotch light by  
Cass W. Gelsaff. The slide was  
35 mm Kodachrome in a 200 Watt  
projector.

Black Scotch  
screen 4x6 ft

f16 on 12" lens.

2000 v 1 mfd into  
3/4 inch tube.Panatomic X film.  
1/400 sec.Remington rifle with ~~the~~ Hi speed Kleanbore  
22 long Rifle.

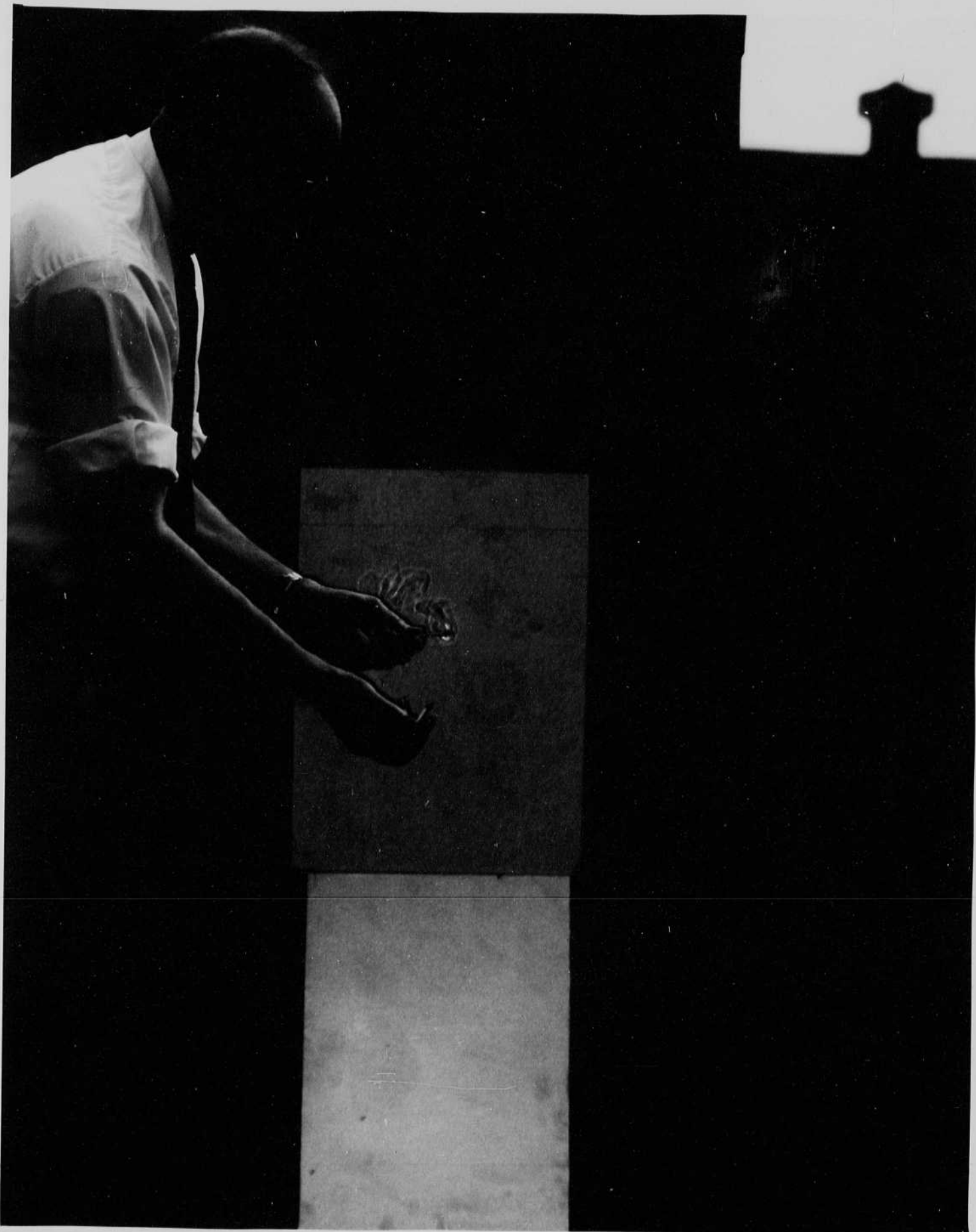
- no. 1. Mike 2" or 3" from breach. Late
  2. " 12" from muzzle. Late
  3. Mike in contact with breach. Gun in field
  4. " " " " " Gun 5 ft from frame.
- The bullet was in this last photo about  
2/3 of the way across the screen.

The Testonic scope showed that the delay was  
about 6 ms. min and 10 max (with 200 shots in  
series).

By using the mike at the breach the bullet was  
out about 6 feet.

5 " Fire cracker experiment. Some ambient light!

6. " " Camera moved, F.C. to screen - 4 ft  
F.C. to camera 12 ft.

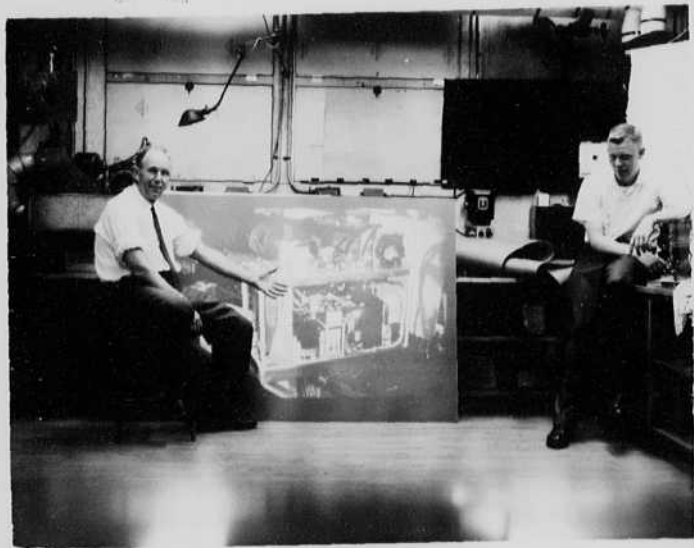


"Black" Scotch

White Scotch.

on roof at M.I.T. in shade  
in direct sun from side.

12-17-44



July 5 1957

Harold Edgerton  
using Sirdair

Photo of projected slide on  
Black Scotch light by  
Class Wyckoff. The slide was  
35mm Kodachrome in a 200 Watt  
projector.

Tests with  
gun shod  
waves in  
20 D 10 2.

Black Scotch  
screen 4x6 ft

f16 on 12" lens.

2000 V 1 mfd into  
3/4 inch tube.

Panatomic X film.  
1/400 sec.

Remington rifle with ~~the~~ Hi speed Kleenbore  
22 long rifle.

- no. 1. Mike 2" or 3" from breech. Late
2. " 12" from muzzle. Late
3. Mike in contact with breech. Gun in full
4. " " " " " Gun 5 ft from frame.

The bullet was in this last photo about  
3/3 of the way across the screen.

The Testonic scope showed that the delay was  
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F.C. to camera 12 ft.



"Black" Scotch

White Scotch.

on roof at M.I.T. in shade  
in direct sun from side.



July 5 1957

Harold Edgerton  
using Suddairtests with  
gun shod  
Suddair  
20 D 10 r.Black scotch  
screen 4x6 ft

f16 on 12" lens.

2000 v / mfd into  
3/4 inch tube.Panatomic X film.  
1/400 sec.Remington rifle with ~~the~~ Hi speed Kleanbore  
22 long rifle.

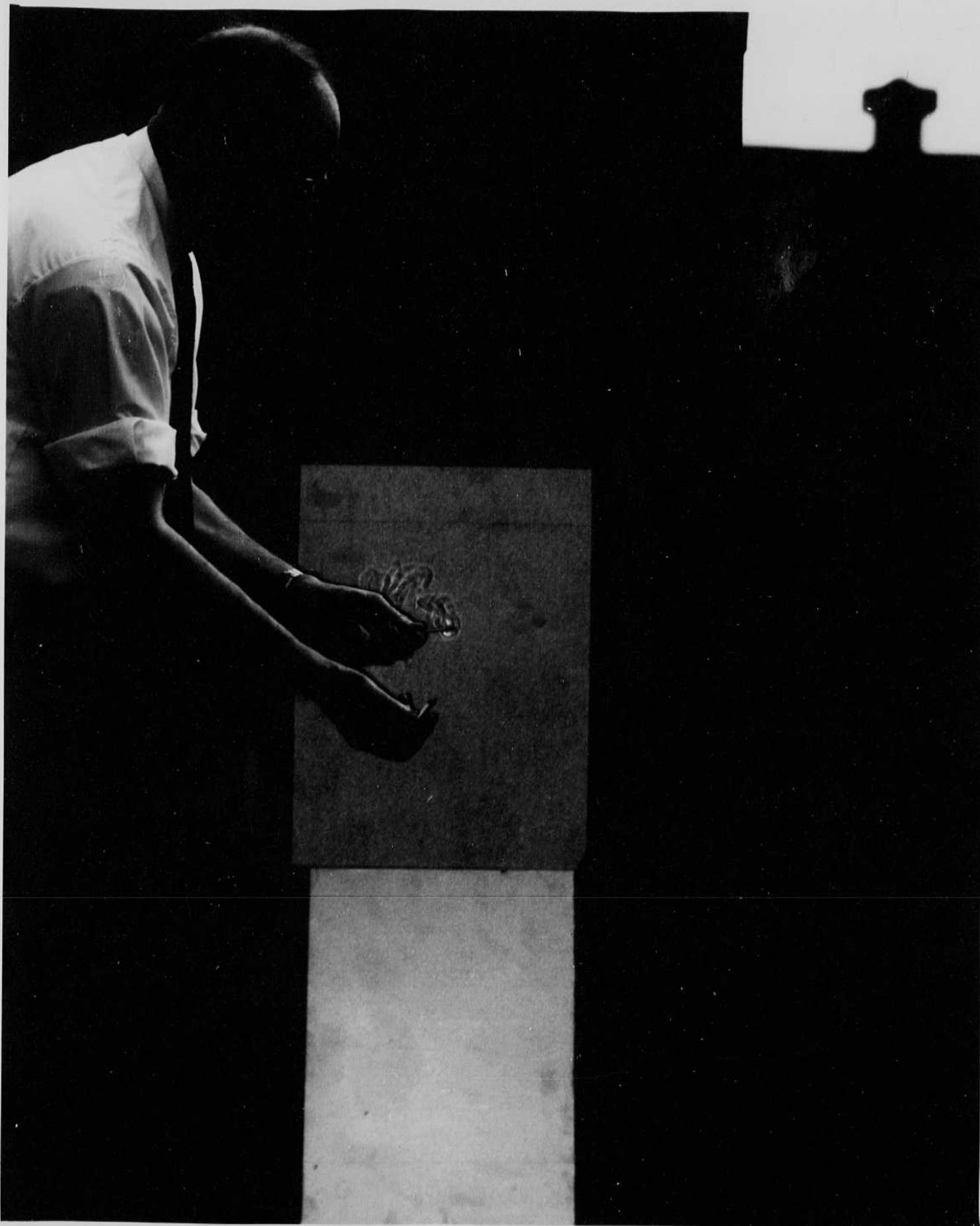
- no. 1. Mike 2" or 3" from breach. Late  
 2. " 12" from muzzle. Late  
 3. Mike in contact with breach. Gun in field  
 4. " " " " " Gun 5 ft from frame.
- The bullet was in this last photo about  
 2/3 of the way across the screen.

The Technic scope showed that the delay was  
 about 6 ms. min and 10 max (with 200 lines in  
 series).

By using the wild at the breach the bullet was  
 but about 6 feet.

5 " Fire cracker experiment. Some ambient light!

6. " " Camera moved, F.C. to screen - 4 ft  
 F.C. to camera 12 ft.



"Black" Scotch

White Scotch

on roof at MIT. in shade  
in direct sun from side.

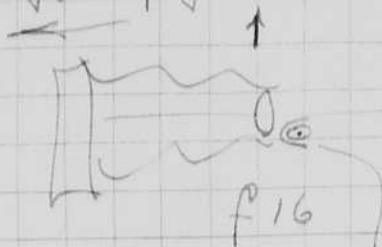
July 6 1957

Harold Egerlon

Shock waves in  
Daylight.

In morning I went to the roof of Bldg 20 with Baslan to shoot shock waves of Cherry Bombs.

Polaroid filter set to kill sky back of camera



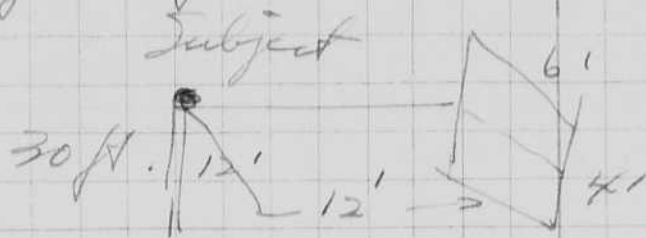
Panatomicx

1 mfd

2 KV

3/8" gap, 4 mm

X cum.



same at  
11, 12, 13 ft.

Camera started to get explosion in  
sync. Delay in shutter about 6 m.s.  
Both mirror and photo cell used to  
sync. I used a 1" tall 6" long over the  
949 photo tube hole to exclude ordinary  
light.

Exposures were good of reflected  
wave from the roof. The main wave  
was up in the 13 or 14 foot shot from  
the center, above all in shade! Clear day.

Exposure with sun at 2:30<sup>pm</sup> and with  
small white cloud. Same conditions  
but without the flash.

Camera should be low to exclude  
the sky light on the 5' solid screen. This  
visual can be seen visually.

Light up to 200 on G.E. meter in sun  
50 " " " with cloud,

~~new~~ new Connection. A. Statco fines dynamite cap with  
3000 volts 45 mfd.  
B. Light from cap triggers lamp

all photos so taken were too early. The shock was in the frame of the explosion. Experiments down stair after winds slowed 20 to 30 m/s.

#1 Cherry Bomb fixed with nickel wire

paper sign

#2 " "

20 on G.E. meter

#3 " "

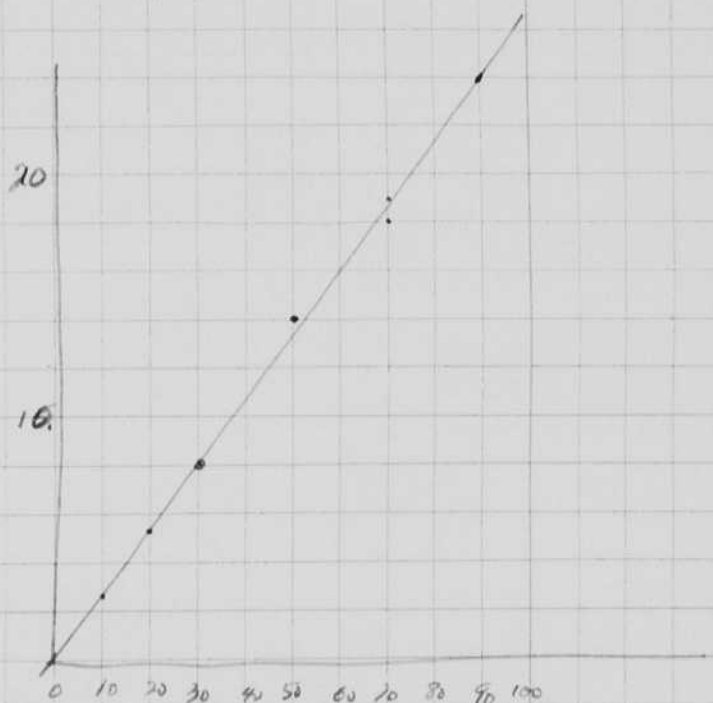
paper sign

#4. #6 Dynamite cap and Cherry Bomb, 20 - on about 5:30 pm.

Old Reliable Time delay circuit Calib.

Scale 3.

50	14 000 us.
30	8,000 +
20	5,500 us
10	2,750
10	2,500
5	1,250
5	1,300
0	.300
0	.300
50	14,500
70	18.
70	19.
90	24,000



Scale 2.

Scale	Time (us)	Photo	Device	Dial	Time	PM
90	1,100					
90	1,200	5	Cherry Bomb	4	1 m/s	7:10
70	.950	6	" 6 no go's	8	2	7:30
50	800	7	" 2 " "	8	2	7:35
30	600	8	" 2 " "	11	3	7:37
10	350	8	Dyn	4	1	7:40?
10	370	9	"			miss shows daylight on neg.
0	250					
0-	270	10	Dyn cap.	3	1-	8:45
		11	" "	2	1-	9:00

Scale 1

90	400
90	375
50	300
30	310
10	250
0	250.

misses due to ~~the~~ Strobometer in the dark. dark.

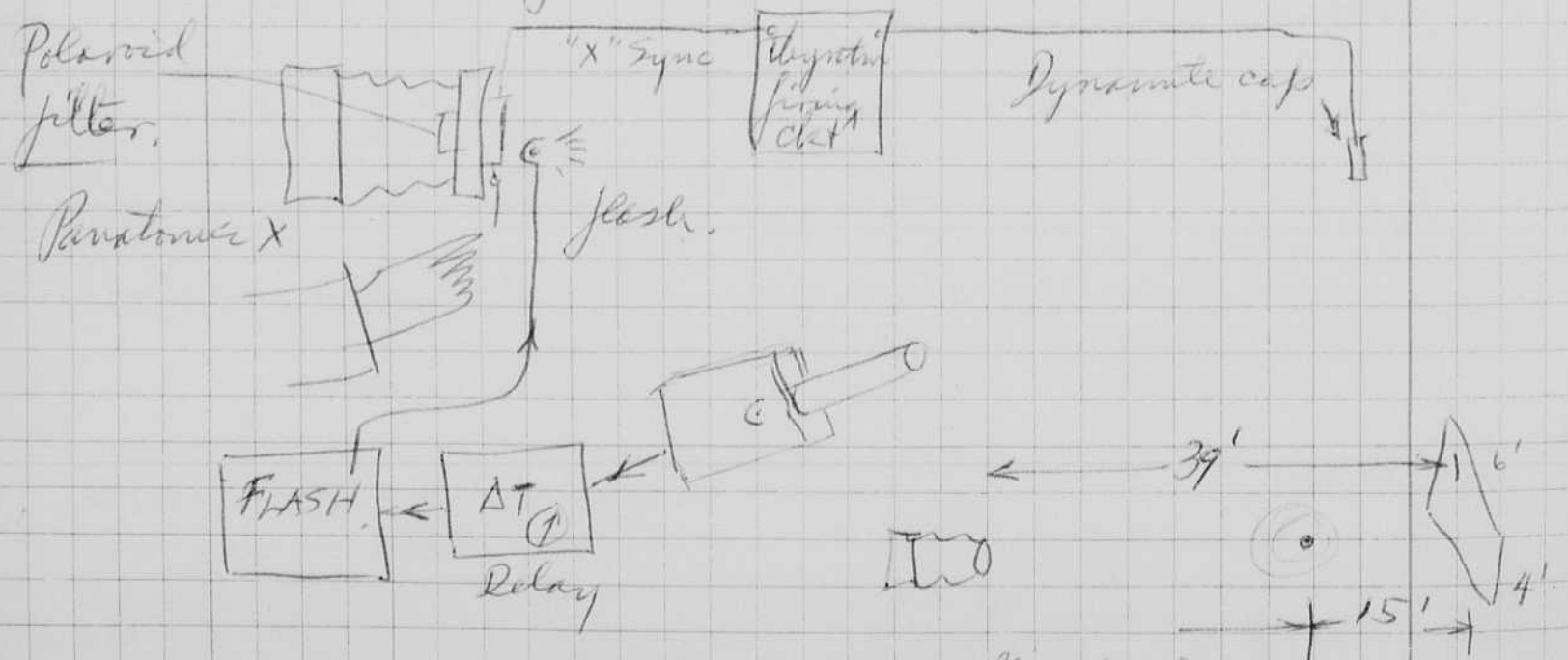
July 7, 1957  
Harold G. Geyer

Yesterday's experiments with the Black Scotch light screen, the polaroid filter and the flash lamp at the lens show that I can work in full sun light. Slow film of ASA25, Panatomic X, was used at f/16 and a 12" lens.

It is preferred however to use a screen that is in the shade.

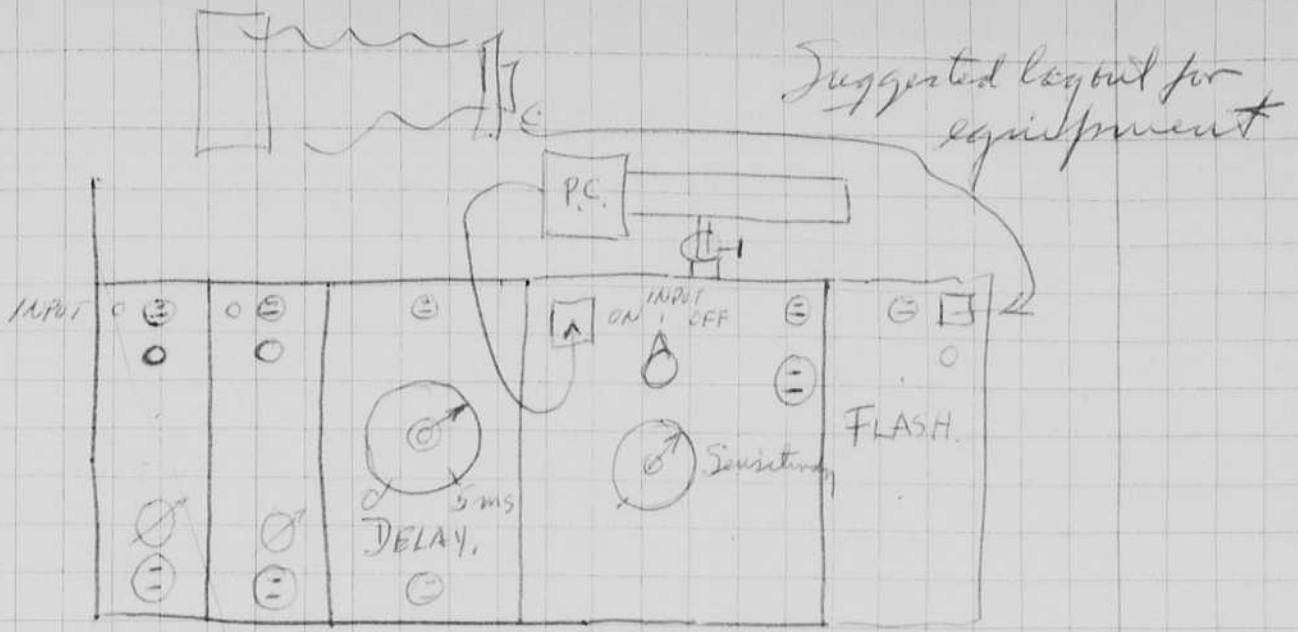
I also found that the camera should be on the ground, so that light from back of the camera would be minimized. I did not try a dark screen at the camera. Yesterday would have been bad because of the strong wind.

The experiments of the daytime were all late due to the shutter-opening delay of 6 to 8 milliseconds. After supper I've put in an adjustable delay circuit and reconnected as follows. The shutter is fired manually. Its X sync contacts fired the cap. A small nickel wire served as a detonator for the Cherry Bombs.

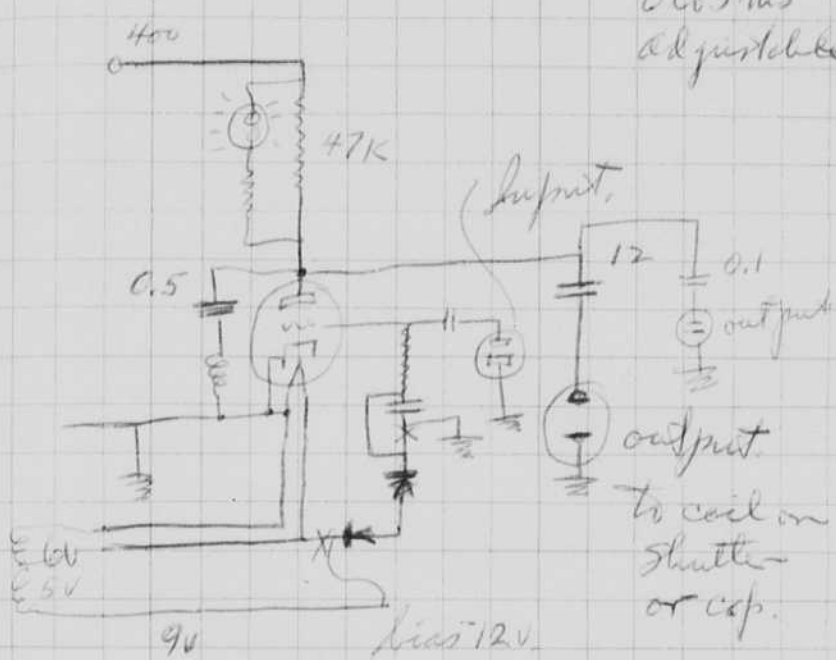


after dark experiments

I used a 30ft camera - Screen spacing in the daytime



0 to 5ms adjustable delay.

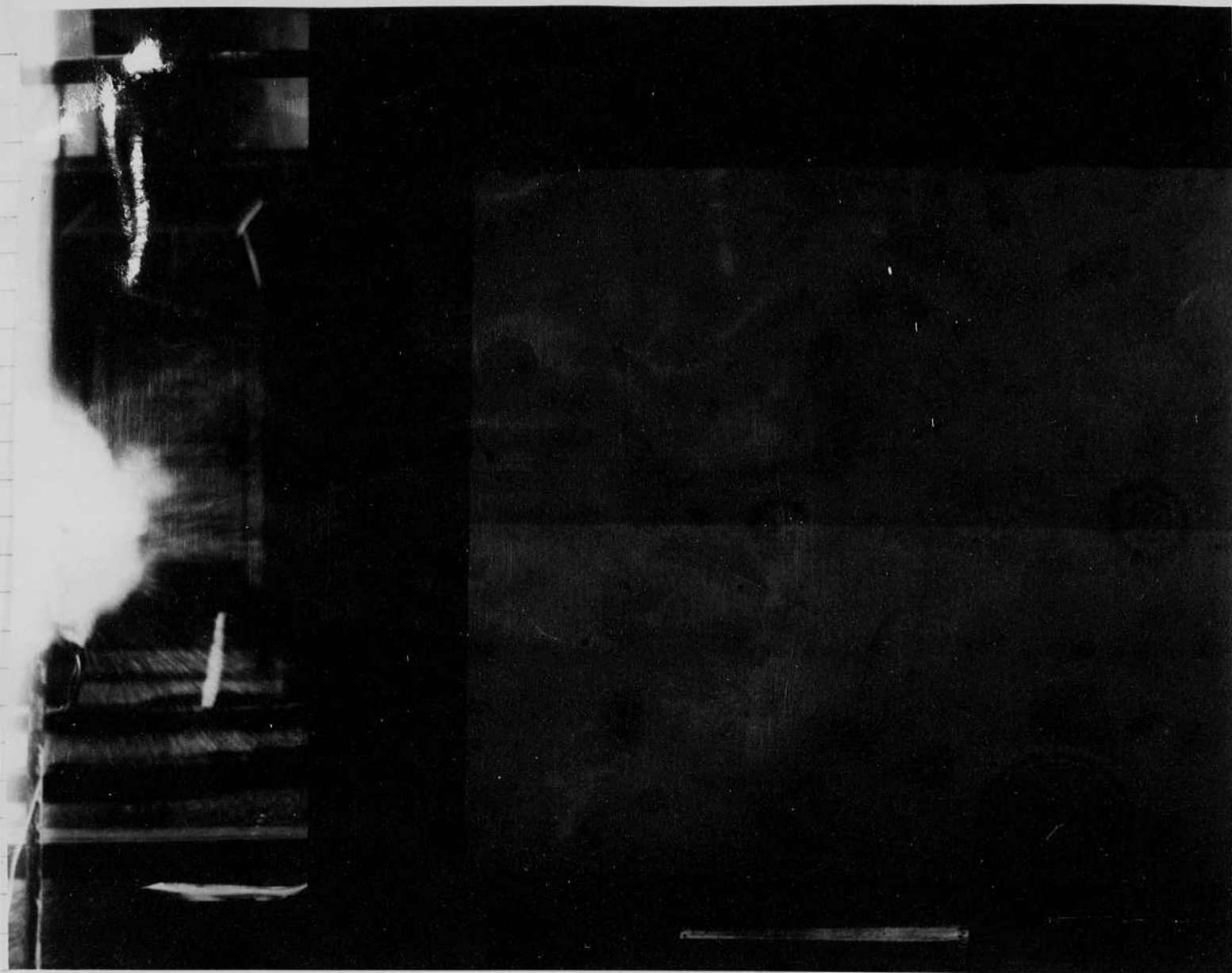


SHUTTER, Remote oper.	DELAY	FLASH & TRIGGER light or sound.	CAP. firing unit.
-----------------------	-------	---------------------------------	-------------------

Remote operation of shutter.

? Put in one box or segregate into several small boxes??

All the above including the camera should be housed in a packing box for field use. In this way it would be protected against blast etc. Doors and windows would open to allow access to lens and controls.



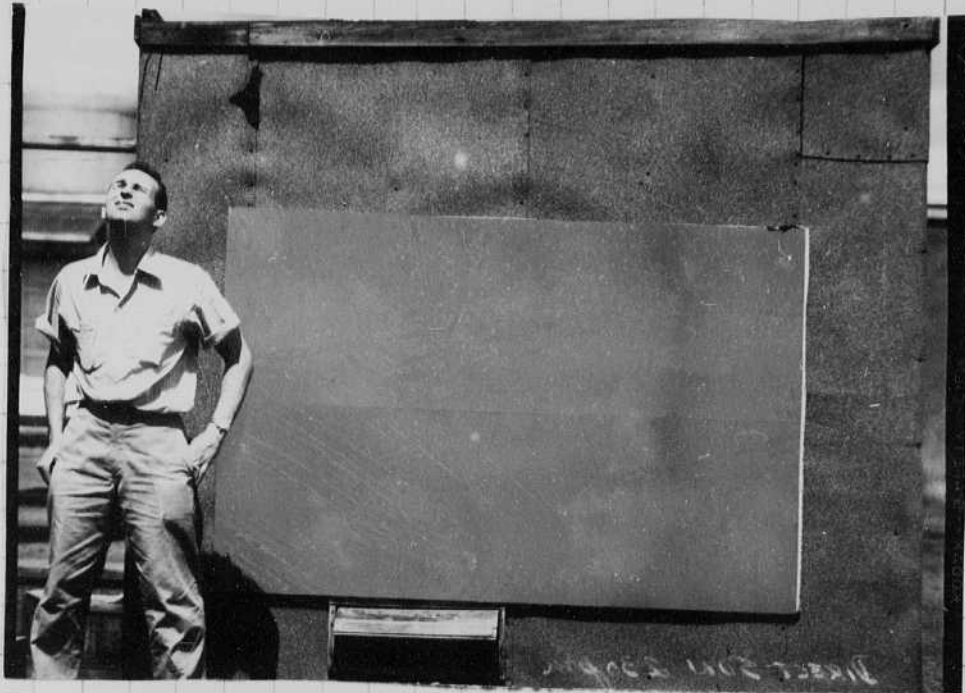
Henry  
Boul-

Shock wave reflected  
from the floor.

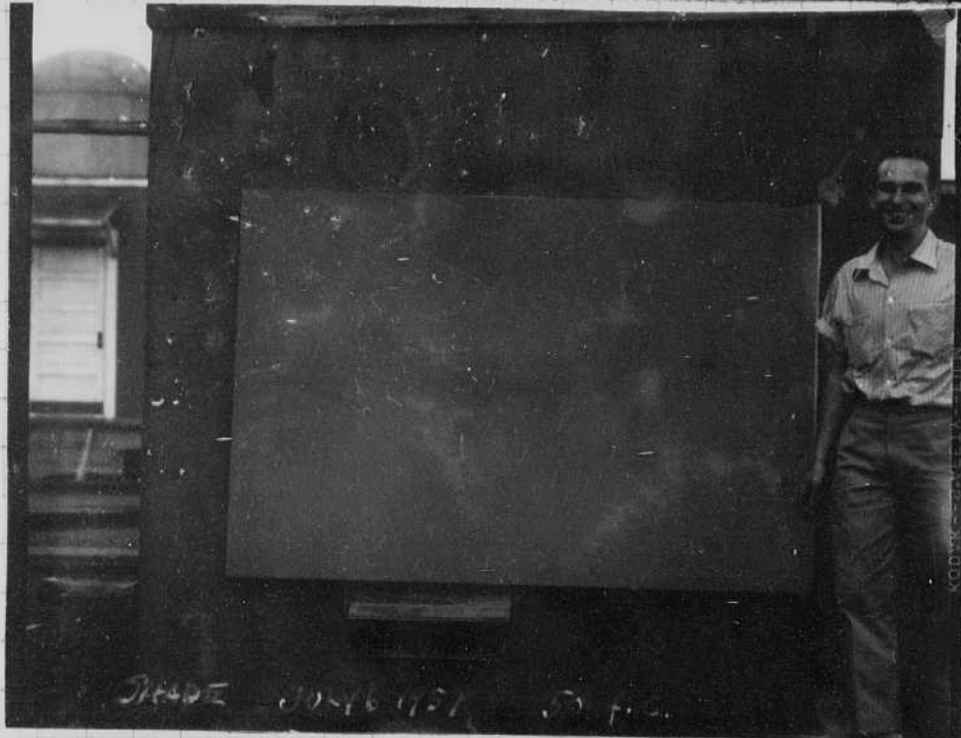
Lloyd  
Breslau

Direct Sun  
125 f.c.

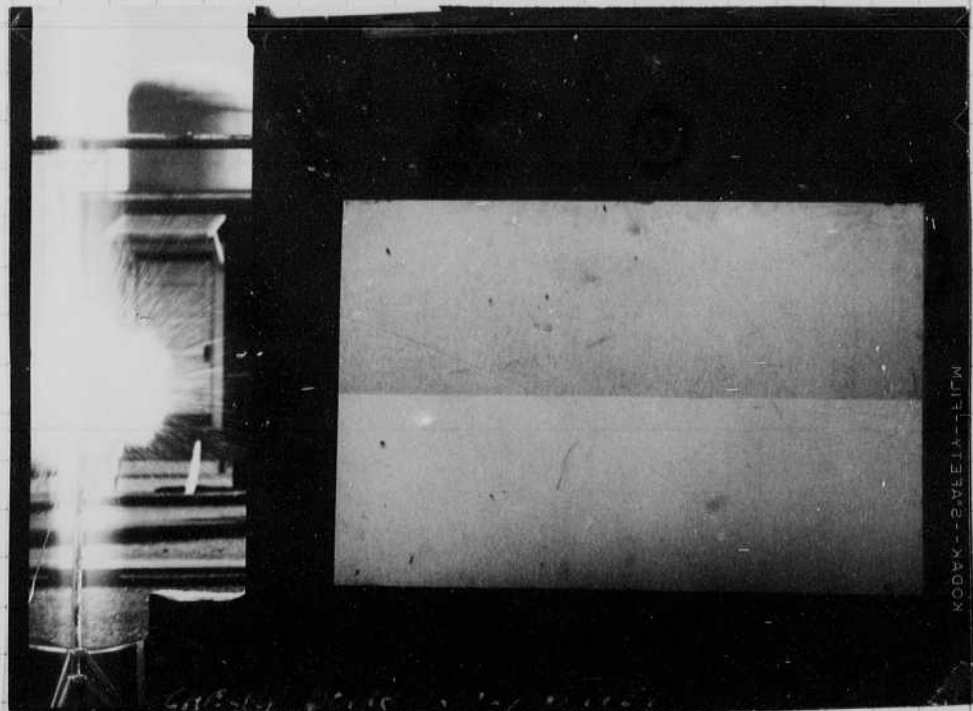
on Roof of  
Bldg 20.



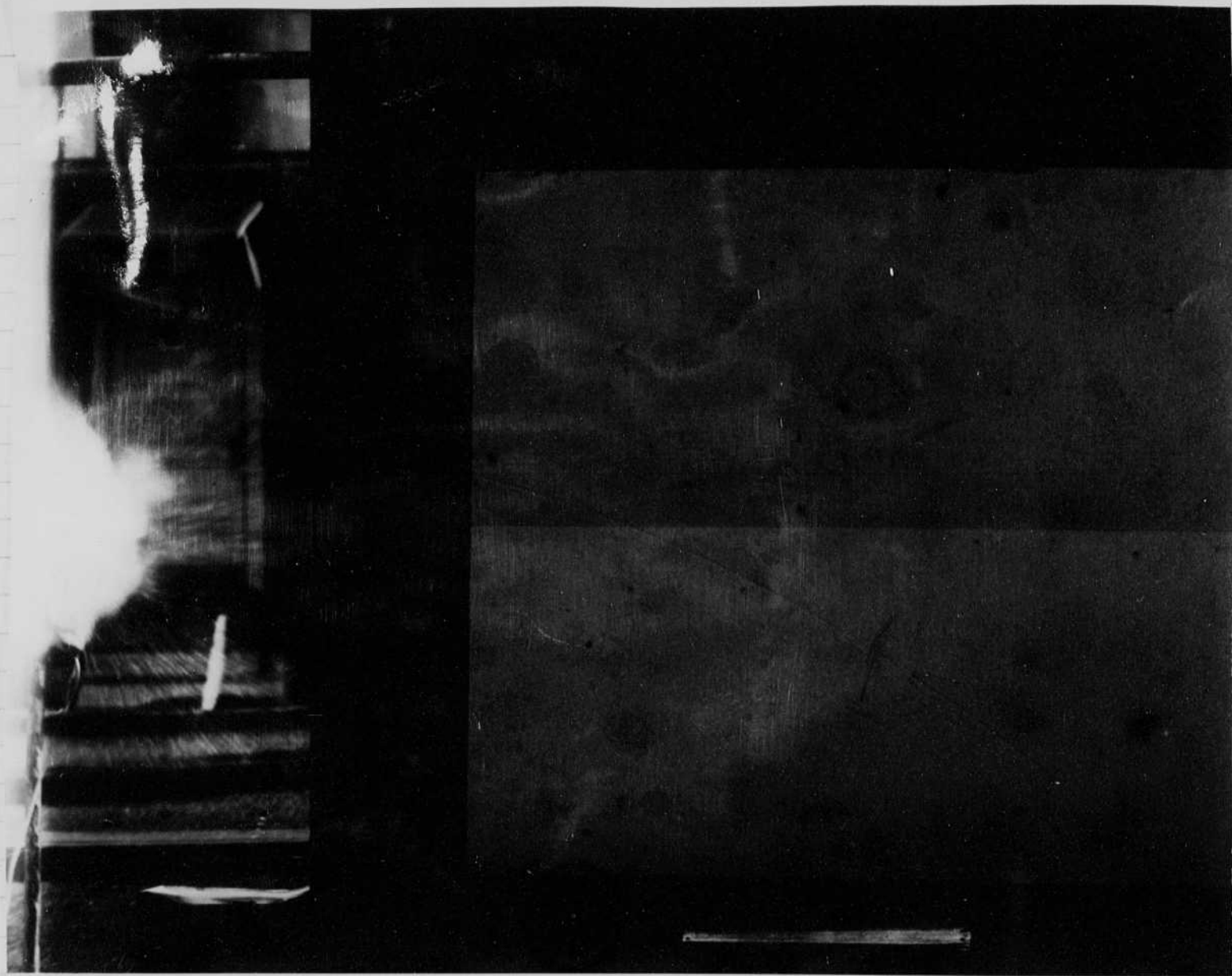
Cloudy  
50 f.c.



Shade  
with flash  
and  
Shockwave.







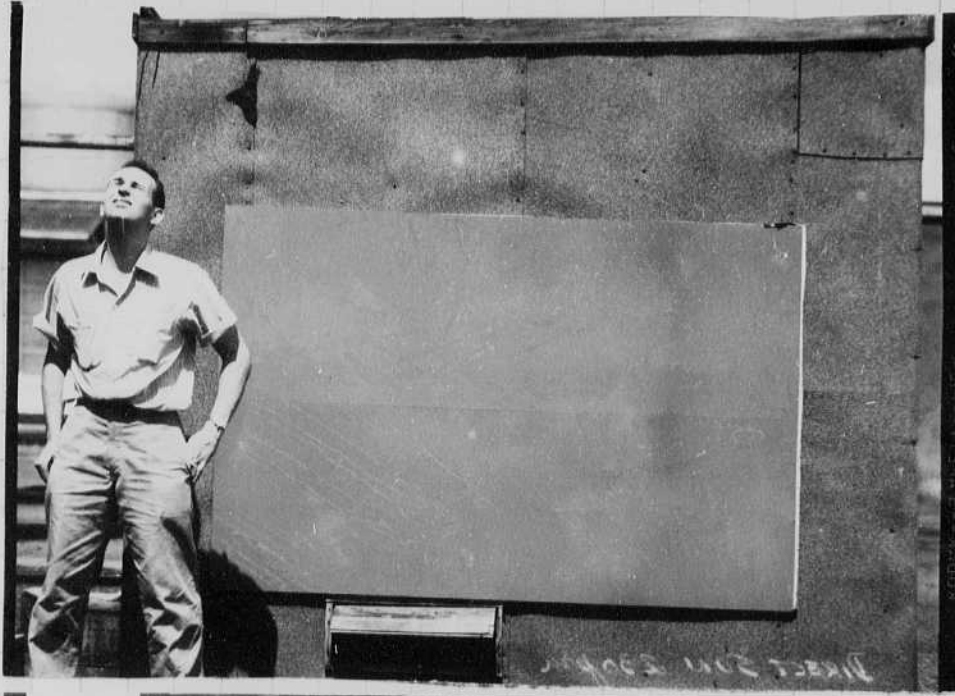
Henry  
Boulton

Shock wave reflected  
from the floor.

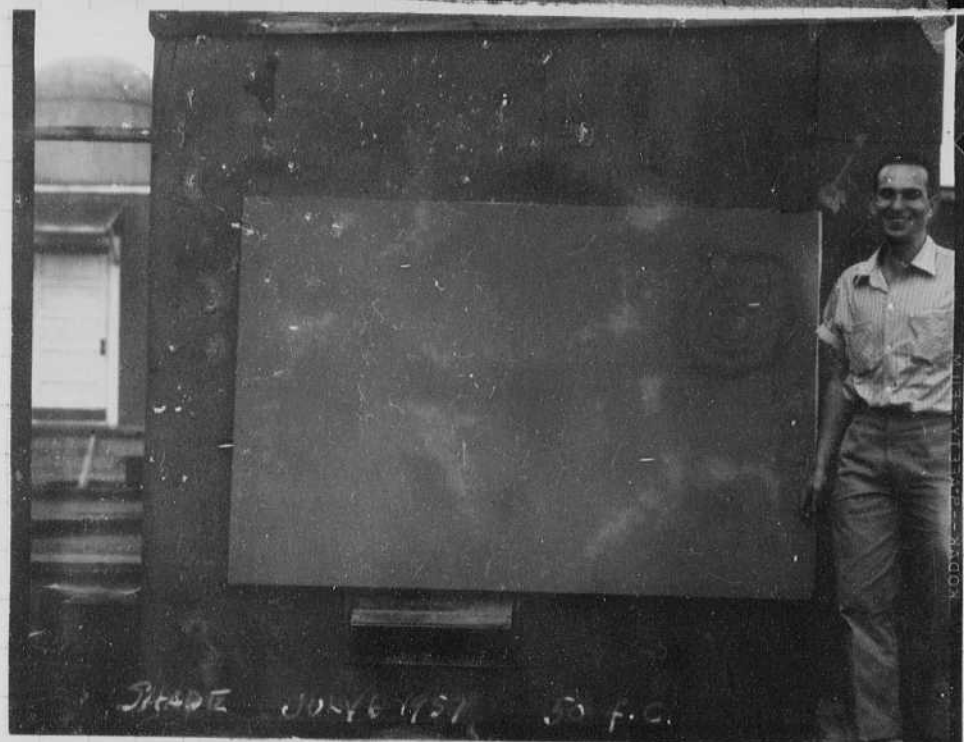
Lloyd  
Bresler

Direct Sun  
125 fc

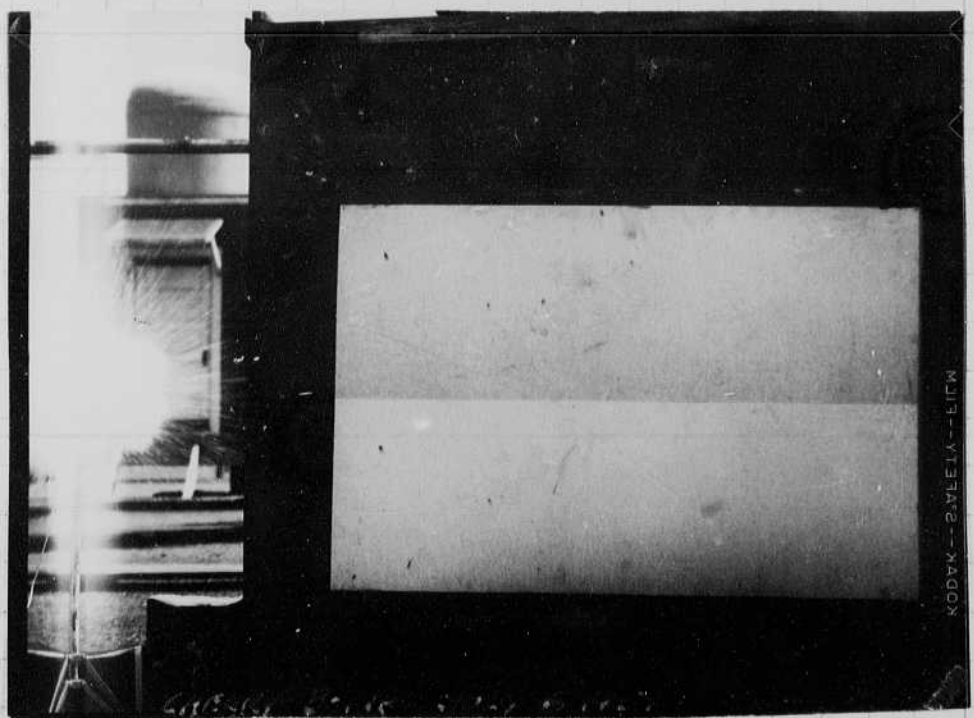
on Roof of  
July 20.



Cloudy  
50 f.c.



Shade  
with flash  
and  
Shockwave.





Dion Mili' 1956+.  
during lecture at M.I.T.  
10-250 about movies.

13 July. 24p. I made coil 50. inch  
of solid wire. The light was  
increased from 10 us to about 60.

I saw no appreciable effect on the  
efficiency or the appearance of  
the wave as a function of time.

try. Experiment to even out light. See page 73

We have had light variation in the  
 $1/10,000$  sec range of the light sensitive meter  
output.

I propose a coil in series with the  
capacitor and lamp. This coil  
should be placed so that its field  
will influence the arc. I hope that  
the

- (1) delay in rise time of the arc and
- (2) the magnetic field will  
both influence the arc to  
become more consistent,  
in flash.

12 July 1957

David E. Edgerton

Harry G. McGuire of Aberdeen P.G. here in am to discuss 24,000 m.c. oscillator for velocity in a gun, with Demushausen and O'Keefe.

14 July 1957. Many experiments were made yesterday with the microscope set up for the Brown and Lomb Retina camera. Data in Light Books.

Stand. FX-1 tube 100 mfd 4000 volts at 3 ft - noffstis

$85 \times 9^2 = 765$  beam c.p.s.

area of FX-1

$4 \text{ mm} \times 6''$   
 $\times \text{area} = \frac{4 \text{ mm} \times 6}{10} \times 2.54 = 6.1 \text{ sq cm.}$

tube area =  $\pi \left(\frac{4}{10}\right) \times 6 \times 2.54 = 19. \text{ sq cm}$

$\frac{765}{19} = 40.7$  c.p.s./sq cm.

this condition when focused on the light meter gave a reading of  $8 \times 36 = 288$ , which is  $40.7 \frac{\text{c.p.s.}}{\text{cm}^2}$   
 $\frac{\text{c.p.s.}}{\text{cm}^2} = .141 (14)$  stillb.

used at Rochester in tests.

	Stillb.
100 WS.	28.4
200 WS	52.3
300 WS	74.0

Seems low  
faded  
400

875 volts.  
820 mfd.  
1210 h.c.p.s. side view  
2" tube between legs.

A 4 ohm 50 watt I.R.C. resistor was used to adjust the lamp.

Light	WS
100	10090
90	85
80	70
70	56
50	43
20	33

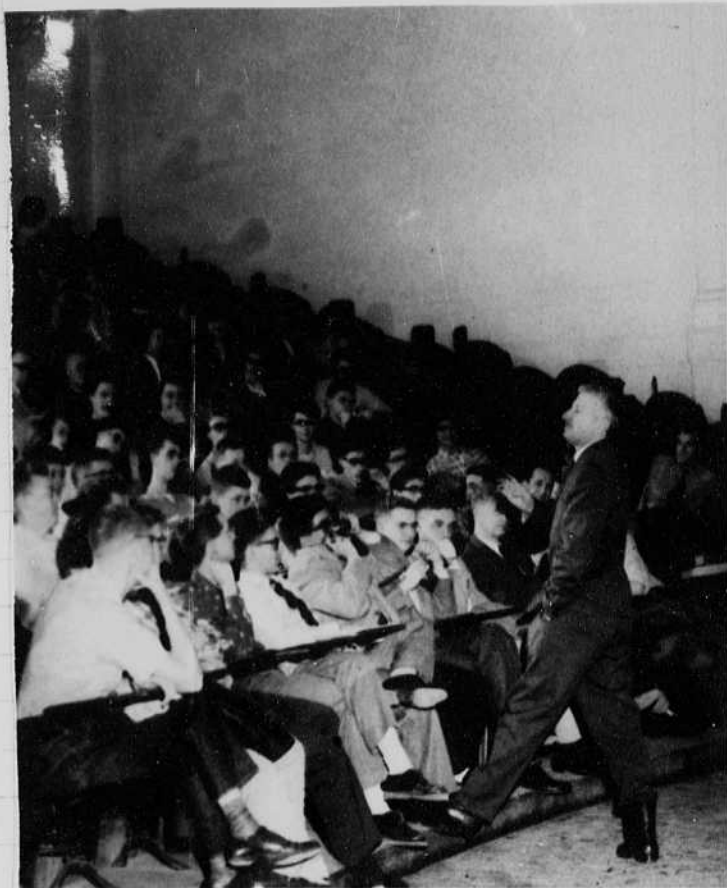
The light at a 3 foot distance with out optics = 18  
with AO condenser = 136.

Try this with meter

thus it appears that more light could be obtained by just placing the lamp closer to the subject!

$\sqrt{\frac{18}{136}} = \sqrt{.133} = 0.125$

$3 \text{ ft} \times 125 = 375 \text{ ft}$   
4.5"



Dion Mili 1956+.  
during lecture at M.I.T.  
10-250 about movies.

15 July. 24 p. 2 m. coil 50. uh.  
of solid wire. the light was  
increased from 10 us to about 60.

I saw no appreciable effect on the  
efficiency or the appearance of  
the wave as a function of time.

Try. Experiment to even out light. See page 73

We have had light variation in the  
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should be placed so that its field  
will influence the arc. I hope that  
the

- (1) delay in rise time of the arc and
- (2) the magnetic field will  
both influence the arc to  
become more consistent  
in flash.

12 July 1957

Donald E. Edgerton

Henry G. McGuire of Aberdeen P.G. here in am to discuss 24,000 mc. oscillator for velocity in a gun, with Genuchoussin and O'Keefe.

14 July 1957. Many experiments were made yesterday with the microscope set up for the Bausch and Lomb Retina camera. Data in Light Book.

Stand. FX-1 tube 100 mfd 4000 volts at 3 ft - no plates

$85 \times 9^2 = 765$  beam c.p.s.

area of FX-1

$4 \text{ mm} \times 6''$

X Area =  $\frac{4 \text{ mm} \times 6}{10} \times 2.54 = 6.1 \text{ sq cm}$ .

tube area =  $\pi \left(\frac{4}{10}\right) \times 6 \times 2.54 = 19.1 \text{ sq cm}$

$\frac{765}{19} = 40.7$  c.p.s./sq cm.

this condition when focused on the light meter gave a reading of  $8 \times 36 = 288$ , which is  $40.7 \frac{\text{c.p.s.}}{\text{cm}^2}$   
 $\frac{\text{c.p.s.}}{\text{cm}^2} = .141 (M)$  stills.

As used at Rochester in tests.

	Stills.
100 WS.	28.4
200 WS	52.3
300 WS	84.0

3" cond. lens  
4"

875 volts.  
820 mfd.  
1210 h.c.p.s. side view  
2" tube between legs.

A 4 ohm 50 watt I.R.C. resistor was used to adjust the lamp.

	Light	WS
100	100 90	600
90	85	-
80	70	-
70	56	1,500
50	43	-
20	33	2,600

The light at a 3 foot distance with out apertures = 18  
with AO condenser = 136.

Try this with meter

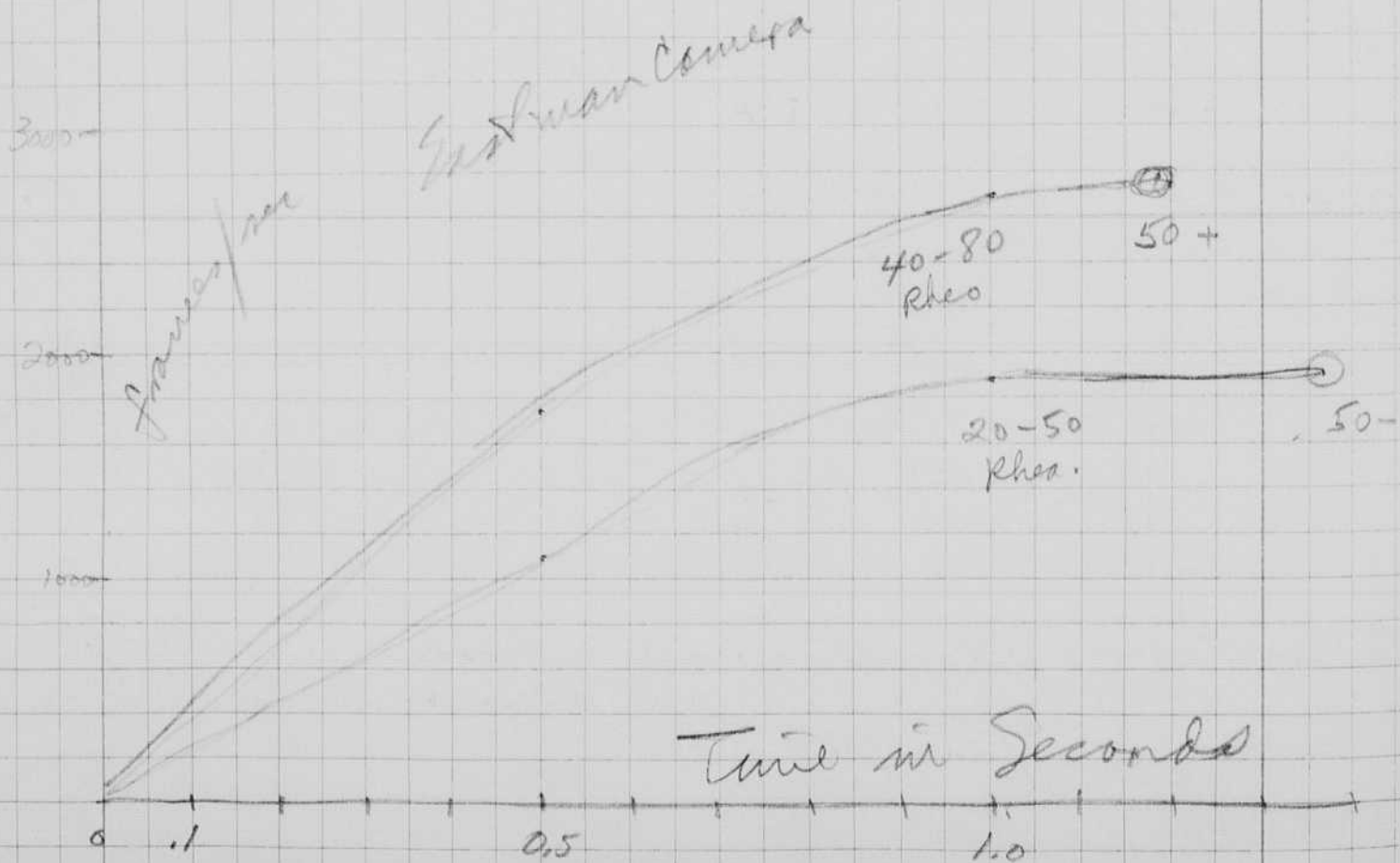
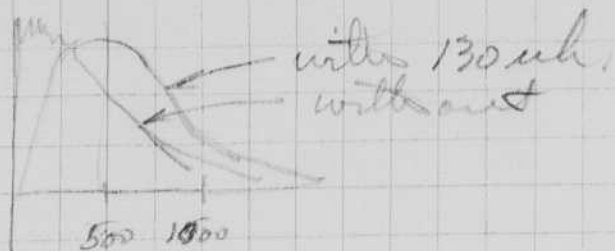
thus it appears that more light could be obtained by just placing the lamp closer to the subject!

$\sqrt{\frac{18}{136}} = \sqrt{.133} = 0.125$

$3 \frac{1}{2} \times 125 = 437.5$   
4.5"

BLY Unit. 300WS with 900 volts into  $\pi$  tube,

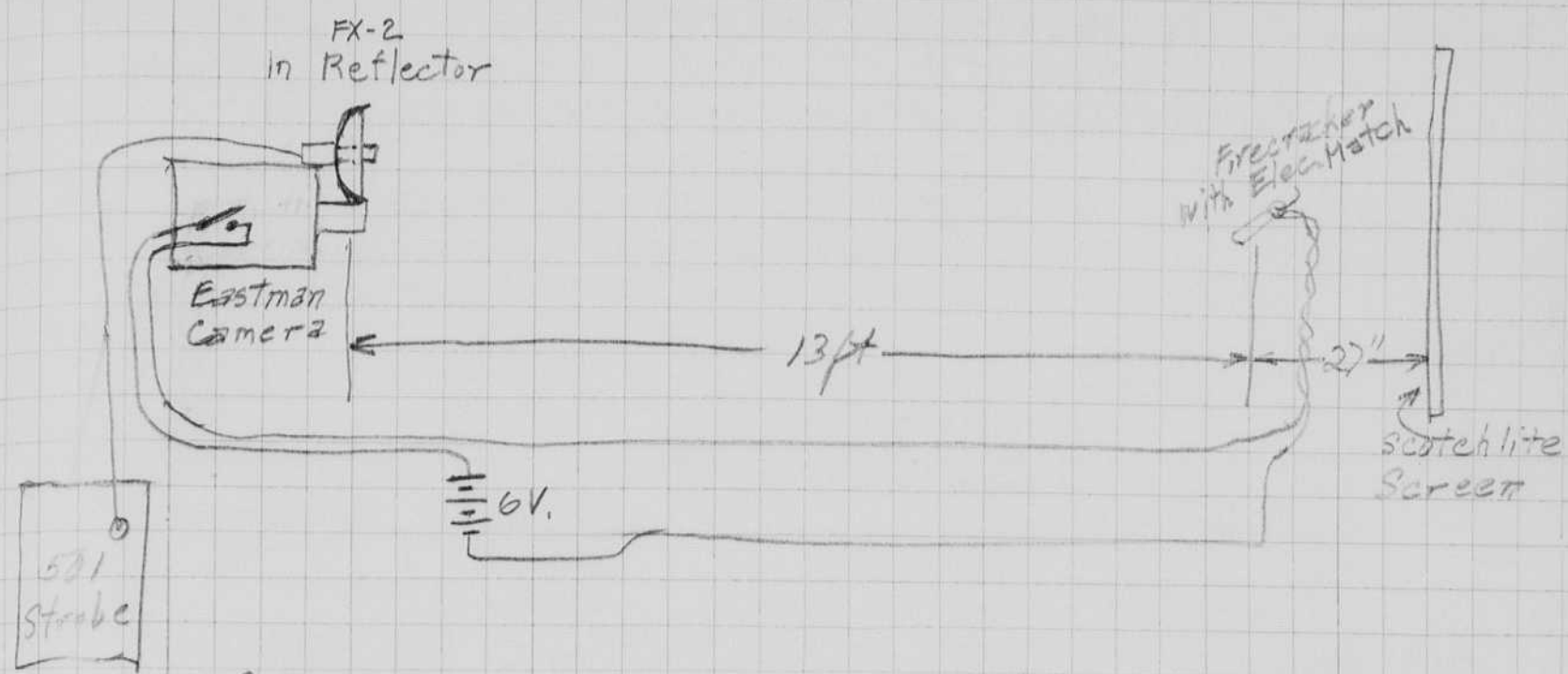
Frank  
 W. Roberts  
 July 11 1957



July 20, '57

High Speed Strobe pictures of firecrackers  
with Eastman Type III Camera #1041  
and 501 Strobe

87  
H.E.E.  
E. Mack



Exp. No.	Film	Camera No.	Volt	Rheostat	Match Delay	Cap.	Lamp Delay seconds	Lamp Run	Subject	Remarks
1	50' XXX	2.7	122	20-50	20ft	1.01	0.25	2	Firecracker	Workable
2	50' XXX	2.7	122	40-80	10ft	0.01	0.25	1.5	Firecracker	Exploded late
3	50' XXX	5.6	122	40-70	10ft	0.01	0.25	1.5	"	Exploded
750 watt Photo Spot 1 1/2 ft. below subject.										
4.	100' XXX	5.6	122	40-full	10ft.	0.01	0.5	1.5	"	} Film jammed in camera.
5.										
750 watt lamp 1 ft below.										
6.	100' XXX	5.6	122	20 full	10ft	0.01	0.5	1.5		Film jammed.
750 watt lamp 1 ft below.										
7.	100' XXX	5.6	122	20-80	10ft	0.01	0.5	1.5		Exploded Film OK
750 watt lamp 1 ft below										
8.	Kodachrome	2.7	122	20-80	10ft	0.01	0.5	1.5	Firecracker	Buzzed Film O.K.
750 watt Photo Spot 1 ft below										
500 " Photo Flood 1 1/2 ft above										
9.	Kodachrome	2.7							same as #8	All O.K.

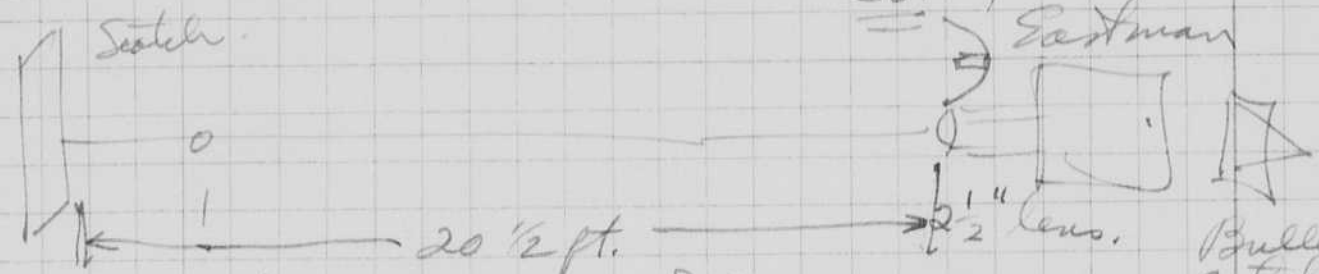


#	FILM	f	V	Rho	Sw	C	Delay	Lamp	Lamp	Remarks
10	XXX	4.5	122	20-80 myanrrr	10ft	.01	0.5	1.5	21 feet.	100 ft. film stuck in camera
11	"	5.6	122	20-80	10	.01	0.5	1.5	21 ft.	100
12	Kod	2.7	122	10-70	15	.01	0.5	1.5	21 ft	100 the fire cracked did not explode.
13	Kod	2.7	"	"	"	"	"	"	"	100 ft.

sk/

for action only.

27 July 1957. Bullet trial.



#	FILM	f	V	Rho	Sw	C	Delay	R.T.	Remarks
1.	XXX 50	5.6	122	20-70					action slow 600 f.p.s.
2	XXX 50	5.6	122	40-80		.01	.7	.5	Powder, bullet tumbled
3	"	"	"	"	"	"	0.75	"	22 short. aver. 2400.
4	"	"	8	"	"	"	"	"	22 short + aver. Eagle
5	"	"	8	"	"	"	"	"	"

no. 1. Was developed in a pan, action came at 200 f.p.s too slow for projection.

no. 2. Powder caused bullet to tumble! action fairly good at 2000 ± f.p.s. Bullet arrived close to camera.

no 3 and 3 sent to Leo Bernd for reversal  
no 4 tossed out due to jerr firing.

27 July. 1957  
H. S. Edg.

89

I went to WHOI on Tuesday noon to help Floyd Breslan and Geo Clarke on the plankton camera. We sailed at 6 pm on 23 July for a spot 100 miles + out to south  
39 39 N      70 51 W      1200 fathoms. 0.6 knot current NE.

Crewford 125 ft long. Coast Guard cutter  
Built in 1928.  
Capt David Castiles  
mate      Caravanagh

15 men in crew  
7 scientists.

I had my deep camera <sup>See p 55.</sup> aboard as used last summer in the Romanche trench. The deep camera went down once as plan.

Depth 1200 fathoms to bottom 25 July 1957

Trix film

1/8" hole in f 3.5 lens with Bahr corrector  
Focus about 4 feet in air

Int. water at 3.32 + 12 hours 10 second rate.  
Lowered to 900 meters in 15 or 20 minutes.

Started up at 5 + 12 hours.  
at 110 meters / minute

Camera surface showed 17 seconds  
between flashes.

The entire 100 feet had not gone through.

Breslan lowered his camera several times after trouble with a lens had been fixed. The last run was made on 26 July between 3:15 and 5 from 0 to 900 meters. A Hubbard photo meter was tied to the camera. Pips from the flash could be easily detected on the Sanborne recorder. The last run was made with new batteries to increase the sensitivity.

I had a peek at the negatives. There was some activity there! The photo multiplier seems to be triggering the lamp. We made another

Crewford is from the Romanche.

August 6, 1957. 160 Brookline Ave  
Boston Mass.

Harold Edgerton.

Left Sunday July 28 for Grand Island, Nebr.  
with parents in Aurora Nebraska July  
29, 30, 31. Left Sat. 31 July for Los Angeles.  
Saw Van Riper in Denver en route.

Ambassador Hotel Aug 1, and 2  
with S.P.I.E. convention. Talked at Banquet  
with movies etc. Aaron Spector met me at the  
gate. also officers of the society.

Richard R. Councilman pres. ( )

Stanley Baker treas ( )

Robt. Wolz Program. (Fairchild)

Ron Rainey.

David Stern. (Gordon Ent)

E. Spencer (Hughes)

Aug 20 1957.

now back Aug 17 from Charlestown S.C. I  
arrived there on the Yamacraw (180 ft long) from  
Woods Hole on a research trip. My job was  
bottom photography with the deep camera, but I  
helped Dr. Geo. Clarke and Floyd Breslau on  
several other projects namely the light triggered  
closeup camera.

One roll of 30 ft of color film was made  
of a 70 fathom bottom off Charlestown. The  
photos showed ripples in the mud  
with 2 fishes. No vegetable type growths.

Aug. 27, 1957

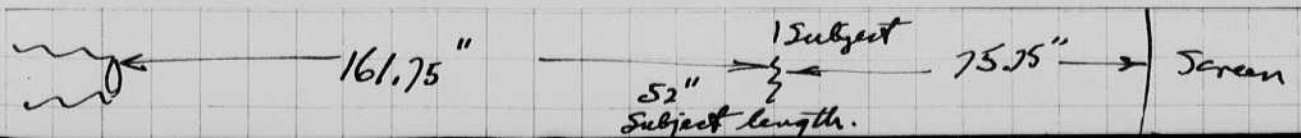
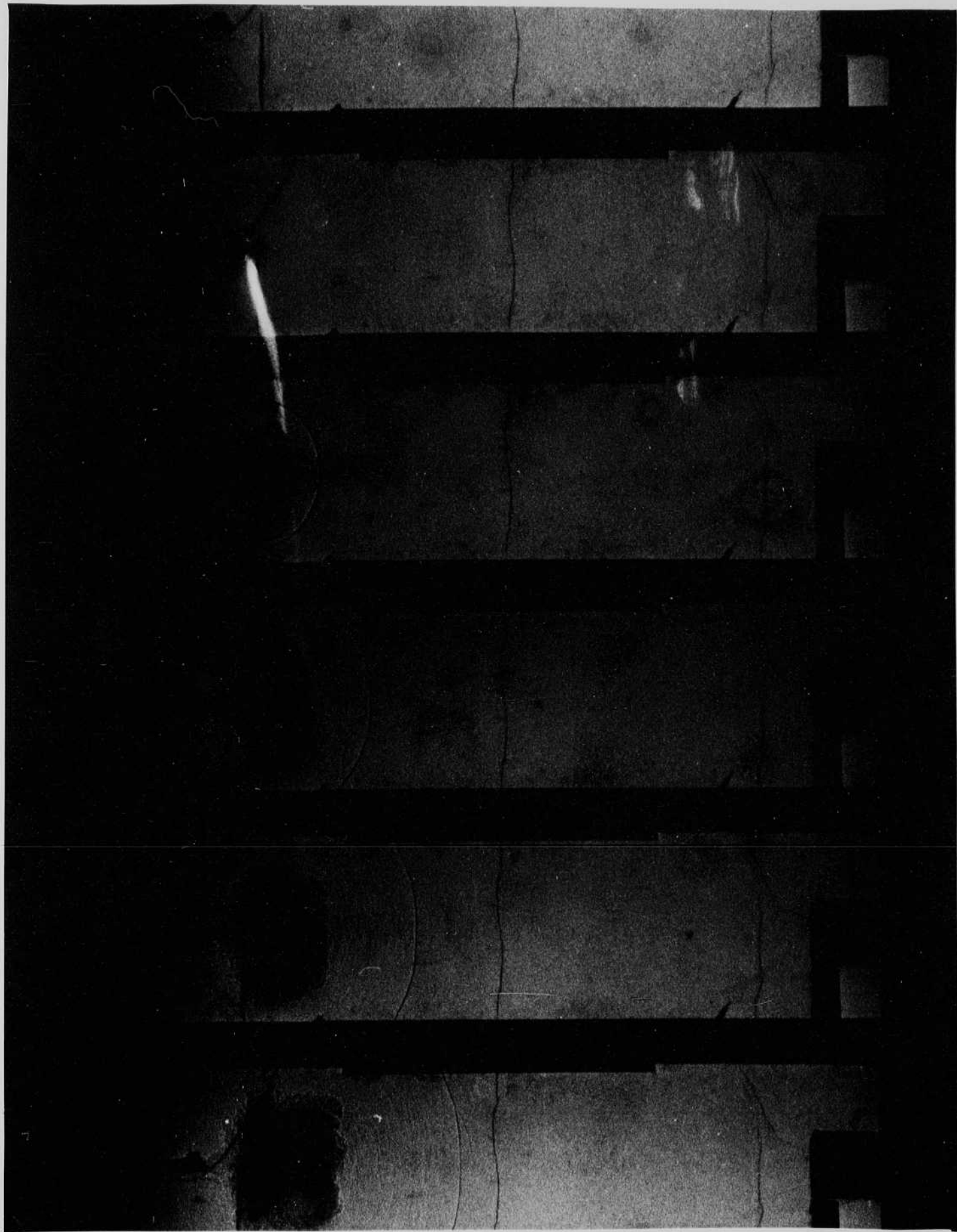
Mary Lou Dixon was here for the  
past month with her children Janice  
and William. Her husband Charlie came  
Aug 12 ±. All left Aug 25 on the 8:30 am train  
for Hickory N.C.

Bob Edgerton arrived from Timber Lake  
camp Aug 23 where he has been a councilor,  
West Bridgewater Vermont. ~~Webb~~ director.  
Bob returned Aug 26 in his mother's car the DeSoto.

22 caliber  
Swift  
vel = 4000+ ft./sec.

4000 f.p.s.

taken by Dome Cahlander.  
Aug. 30, or Sept. 1, 1957



August 6, 1957. 160 Brookline Ave  
Boston Mass.

Harold Edgerton.

Left Sunday July 28 for Grand Island, Neb.  
with parents in Aurora Nebraska July  
29, 30, 31. Left Sat. 31 finally for Los Angeles.  
Saw Van Riper in Denver en route.

Ambassador Hotel Aug 1, and 2  
with S.P.I.E. convention. Talked at Banquet  
with movies etc. Aaron Spector met me at the  
gate. also officers of the society.

Richard R. Councilman pres. ( )

Stanley Baber treas ( )

Robt. Woltz Program. (Fairchild)

Ron Rainey.

David Stern. (Gordon Ent)

E. Spencer (Hughes)

Aug 20 1957.

now back Aug 17 from Charlestown S.C. I  
arrived there on the yawacraw (170 ft long) from  
Woods Hole on a seasonal trip. my job was  
bottom photography with the deep camera, but I  
helped Dr. Geo. Clarke and Lloyd Breslau on  
several other projects namely the light triggered  
closeup camera.

One roll of 30 ft of color film was made  
of a 70 fathom bottom off Charlestown. The  
photos showed ripples in the mud  
with 2 fishes. No vegetable type growths.

Aug. 27, 1957

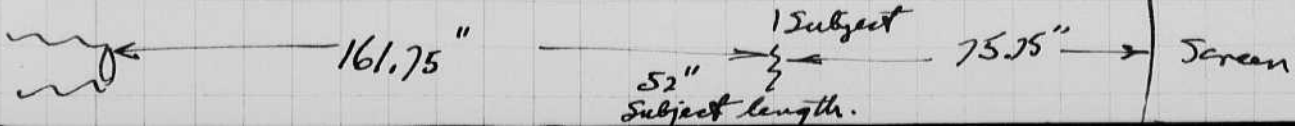
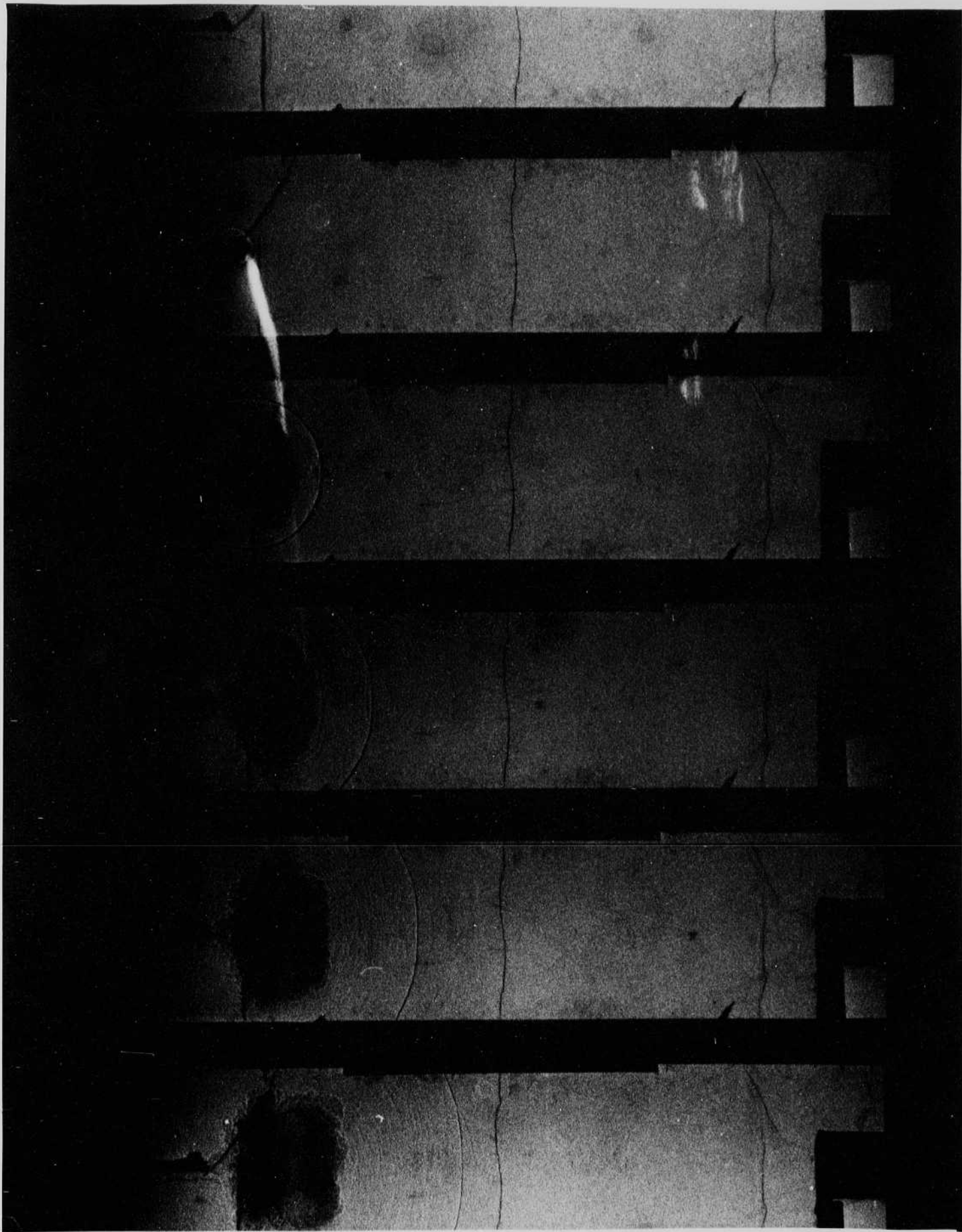
Mary Lou Dixon was here for the  
past month with her children Janice  
and William. Her husband Charlie came  
Aug 12 ±. All left Aug 25 on the 8:30 am train  
for Hickory N.C.

Bob Edgerton arrived from Timber Lake  
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Aug. 30, or Sept. 1, 1957

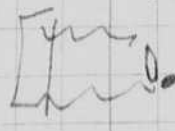


Sept. 6, 1957.

Herold Edgerton.

## Jet Photos

Shadow photos of a type B air plane jet at the National Guard at Logan were made yesterday evening with the help of Dave Calender and ~~McNamara~~ Mc Namara was the operations officer who ran the jet for us.

12" f14 lens.  
 1/2" tube 1/3" mfd at 3KV.

JET



4 x 6 ft  
 Screen  
 "Black"

20 ft ±

← 6 ft →

Photos at 30, 45, and 65 % of speed were made.

Photos show heat waves and irregular edge of the ~~source~~ heat as it comes into the air.

Sept 8 '57.

N.Y. Times of Aug 31 1957 Russian ship reports  
 7 mile depth. Reuters London Aug 31 date line  
 from Tass.  
 Ship VITVAZ Marianas Trench  
 10960 meters 35748 feet 6 4/5 miles

Photo  
Dave Cahlander

11'6"

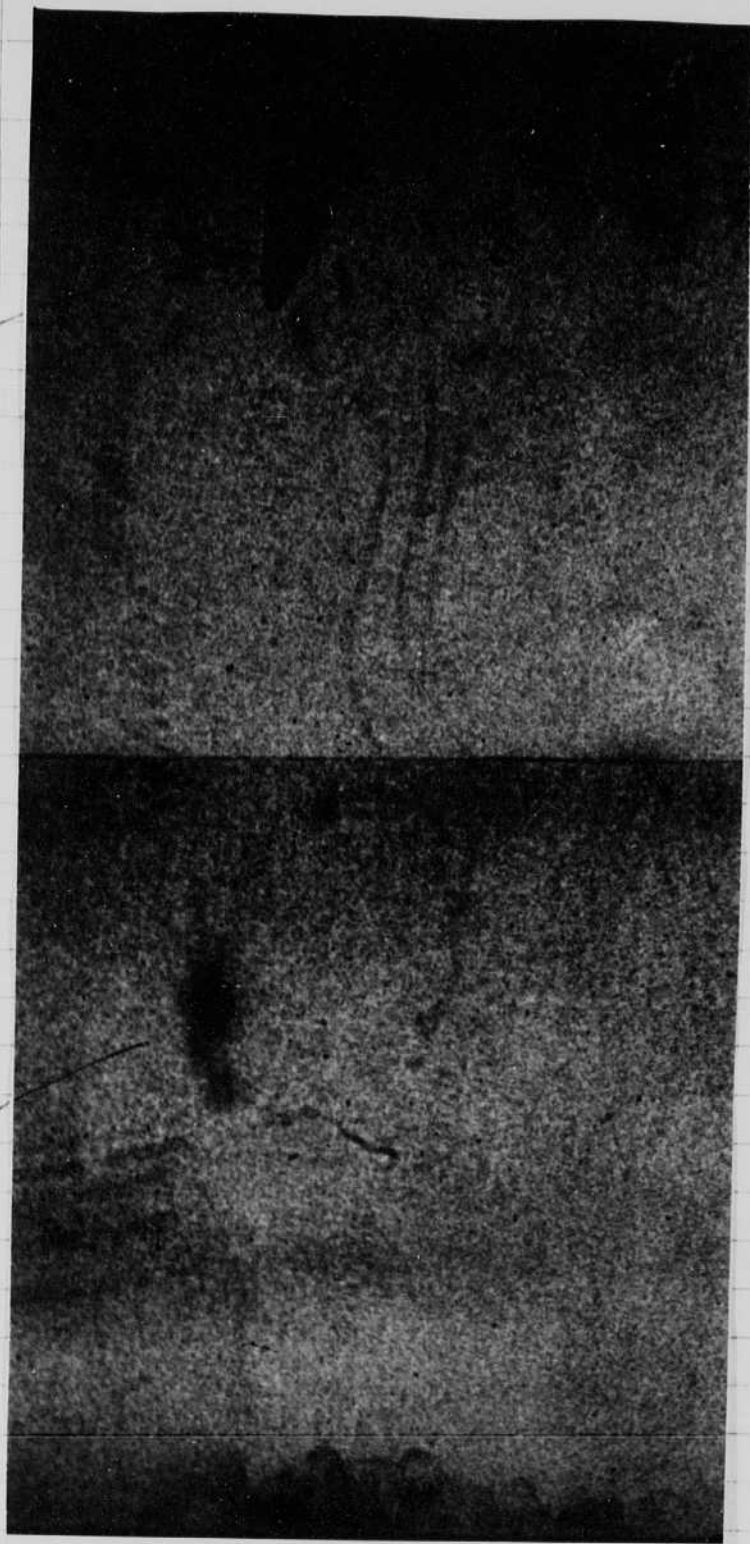
J03 12 foot propeller  
tip photographed at  
North East Hanger  
Sept. 7, 1957.

Doyle Shop, forman

1/4 mfd 2900 rolls.

30 ft to Screen  
Dark.

2800 rpm engine  
16 to 11 gear.



Bleed  
tip.

Due to  
Vortex.

Sept 19 1957

I was in Asbury Park on Sept 11 where I gave a talk  
on Multiflash Photography to the Photo Sci and Engineers  
Convention.

Breslau called yesterday from W.H.O.I. He lost the  
camera casings in the sea while testing for leaks!



Sept. 6, 1957.

Howard Edgerton.

Jet Photos

Shadow photos of a type B air plane jet at the National Guard at Logan were made yesterday evening with the help of Dave Callender and . McNamee was the operations officer who ran the jet for us.

12" f14 lens.

 $\frac{1}{2}$ " tube  $\frac{1}{3}$ " up at 3KV.

JET


 4 x 6 ft  
 Screen  
 "Black"

20 ft ±

← 6 ft →

Photos at 30, 45, and 65% of speed were made.

Photos show heat waves and irregular edge of the ~~source~~ heat as it comes into the air.

Sept 8 '57

N.Y. Times of Aug 31, 1957 Russian ship reports 7 mile depth. Reuters London Aug 31 date line from Tass.  
 Ship VITYAZ Marianas Trench  
 10960 meters 35948 feet 6  $\frac{4}{5}$  miles

11/20/57  
Dive Calibrator

11'6"

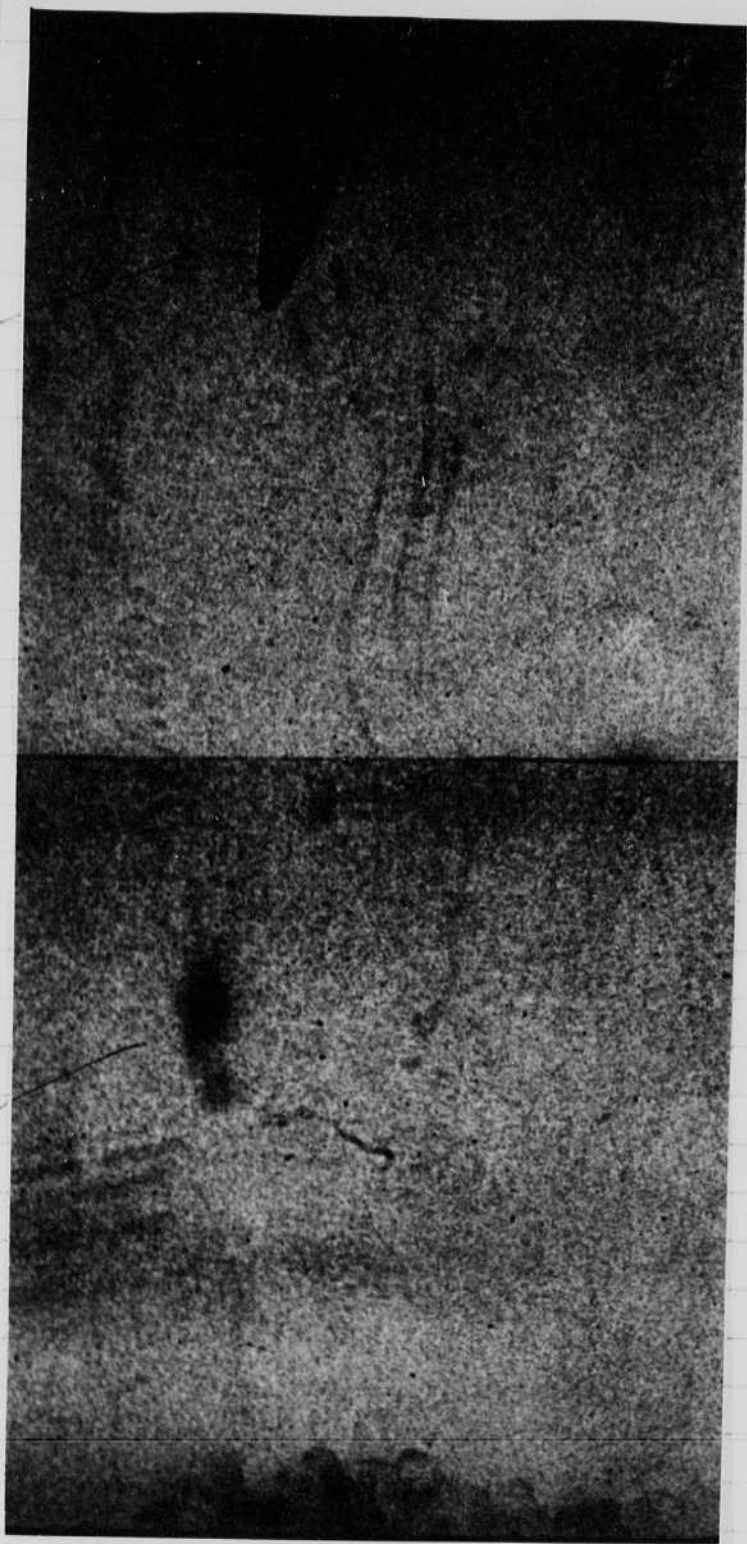
JC3 12 foot propeller  
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North East Hanger  
Sept. 7, 1957.

Doyle Shop, forman

1/4 mfd 2900 rolls,

30 ft to Screen  
Dark.

2800 rpm engine  
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camera casing in the sea while testing for leaks!

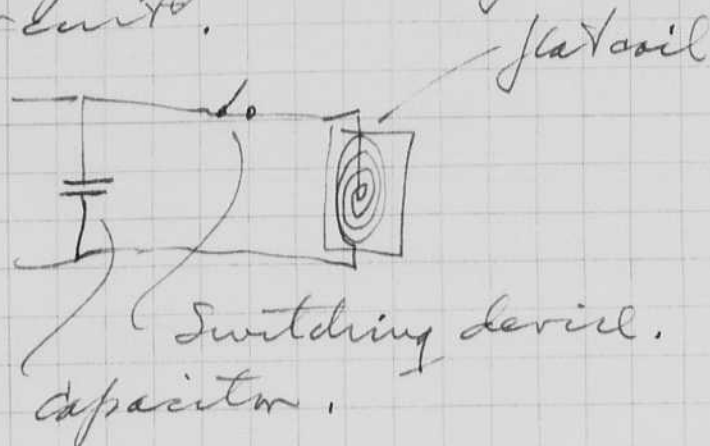
Sonar Transducer

Sept. 19, 1957

David Egerton

A coil of wire in a flat disc when put next to a flat plate of metal will give a violent pulse when driven by a current  $\Delta$ .

I propose the following sort of a circuit.



The coil will give a push to the metal for each half cycle. Therefore the frequency of the discharge should be half the frequency of the desired sonar pulse.

For example I need 12 Kc for the under water spacing equipment. I will use a 6000 cycle discharge circuit.

$$f = \frac{1}{2\pi\sqrt{LC}} = 6000 \text{ cycles/sec.}$$

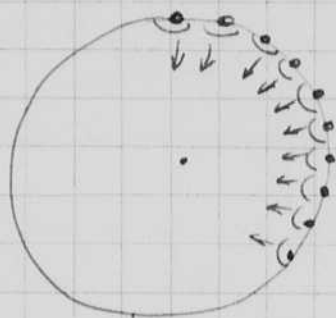
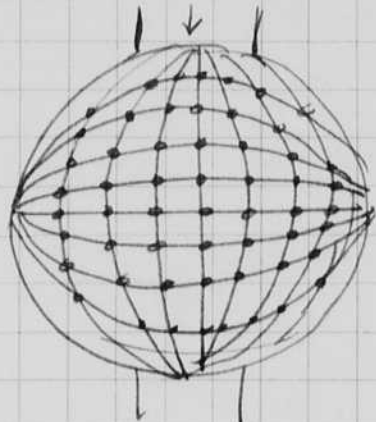
Sept. 29, 1957.

# Deuterium Furnace.

Herold Edgerton

The problem is one of raising the Deuterium gas to a high temperature and pressure so that a small percentage will react due to closeless of the nuclei.

I propose to do this with a large sphere with a multitude of gaps that can be triggered at exactly the same moment. A series of waves will be produced in the gas which will concentrate at the center.

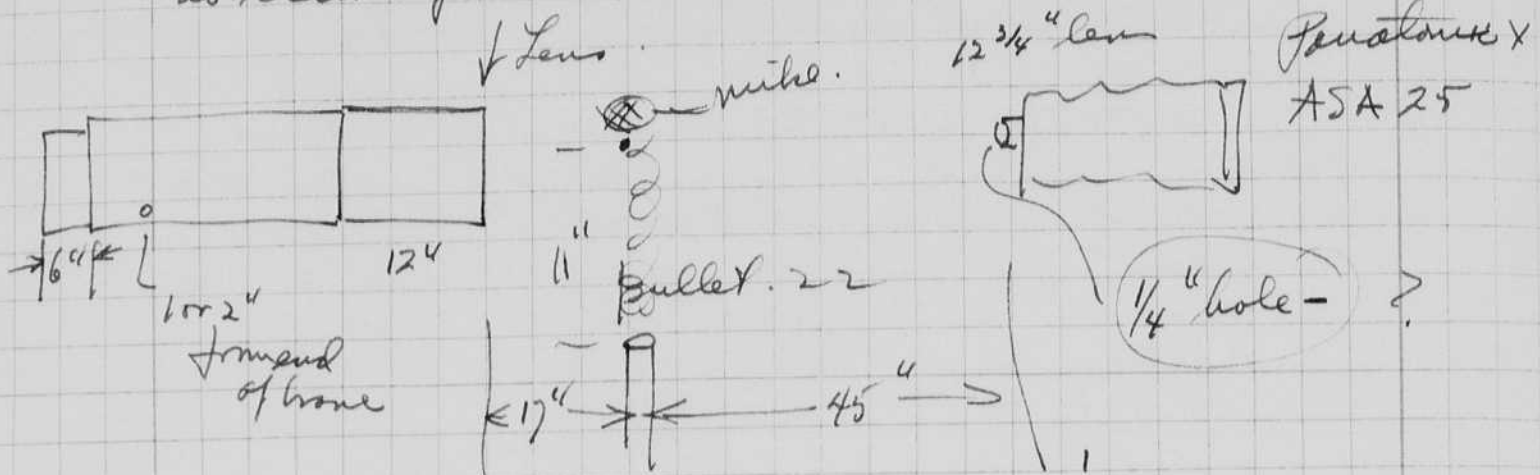


The gas will be heated and expanded into some way for useful exploiting of energy.

96 Oct 3 1957  
Harold Edgerton

# Bullet Photography.

Tests of 10" 19" f.l. Bolex Treneleus,  
as received from Mr. Maass.



Oct. 5 1957.

Some timing variation due to the mike.

Focus of camera on screen. Bullet blurred but shadows are good.  
Focus of camera on the bullet. Background mottled some areas. Bullet and shadows clear but shadows not too pronounced. Too thin a line?

above with bullet at 16" from Treneleus lens.

Set up changed. Bullet is now 6" from the Treneleus lens. The camera lens is sharp focused on the bullet at f 40  $\pm$  on 12 3/4" lens.

Took the mike apart and used the inside front element only

220 Swift 5 feet from Treneleus center.  
10 msec delay  
40 msec delay

- Oct 8 9:230 Air Reserve Squadron 20 E 015 7:30 9:30 Bob Uhe. talk on Strobe.  
" 9. EE Dept 3:30 pm 10-250 17.15. Strobe lab.  
12 picnic at Mt. Mansfield for Grad. Stud.  
14. Talk on Camera uses in Ocean 4 pm 4-231 MIT. Zoology Dept.  
Hersey, Clarke, Backus helped.

Oct 22 1957  
Harold S. Edgerton

Exp. with Van de Graaff Sparks.

97

In connection with the 620 class this term, I have been endeavoring to measure the light output from a Van de Graaff generator in Bldg 58. This generator has a 3.5 ft post and a 2 foot (-) sphere. We first used a 10" diam ball hanging from a wire as a sparking point.

The spark is stronger with a pos. ball than with a negative! The light is about 10 times larger.

The flashes are about 0.1 microseconds in duration - thus difficult to measure. A multiplier photo tube was used as follows.

931 phototube.

Filter D=2+1 factor 1000

Load resistor 50

Input cap = (40 +) m mf.  $RC = 200 \times 10^{-12}$

Distance 20 feet to sparks.

Calibration. Xenon spark  $0.5 \times 10^6$  c.p. peak  $3/4$  us flash.  
0.07 mfd 3KV  $1/2$ " gap x even.

Oct 25, 1957. ~~W. H. S.~~

Left Oct 23 at 3pm on Mohawk for Rochester. Saw Bob at the airport and ate at his house with

Fred Seward 31 Wellington ave  
 Geo Sullivan\* Rochester N.Y.  
 El England }  
 Dove Bellhorn } cook for the night.

Visited Graflex plant on Monroe ave in evening.

On Oct 24 saw Joe Boon who gave me a BB camera for modification for under water.

Fred Tuttle told me of his ammonia Battery.

I visited R.I.T. where I saw McBlittle and Shoemaker.

Dinner with Liz Lowe and Bob. Then I heard Ed

Land of Polaroid give a lecture "Sleeping Beauty II" at the Dryden Theater at the Eastman house.

Oct. 25, Fri. at Cleveland - took 7:45 plane to Cleveland. Saw Red Elenendorf. Dick Blount - lamps that arc. wants movie - Emmett Wiley - Stan Slomski gave me 3 sample FT 30 flash tubes. Cleveland Hotel. Home on United Airline plane at 8:55 to 12:15 Boston.

Oct. 25, 57

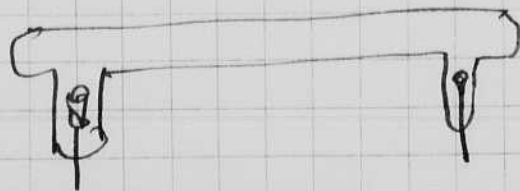
Experiment with 7mm flash lamp.  
 tungsten anode - Tinted cathode.  
 100 mfd at 1000 volts ok.

" 2000 " "

" 3060 " ok.

Anode shows some spots but no erosion.

The anode and cathode are "around the corner" so that the arc blast will not wipe off the melted metal.



The lamp blew up at 100 mfd at 3KV after some time. The quartz near the cathode was weak mechanically.

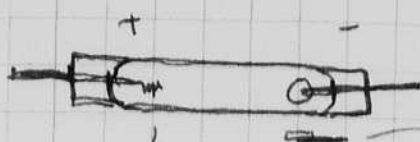
Oct 28 1957  
H. Edgerton

FT-30 tests.

I brought back 3 samples given me by Stan Slomski of Nela Park

1:1 sketch

$$30 \text{ watts} = f \cdot \frac{CE^2}{2}$$

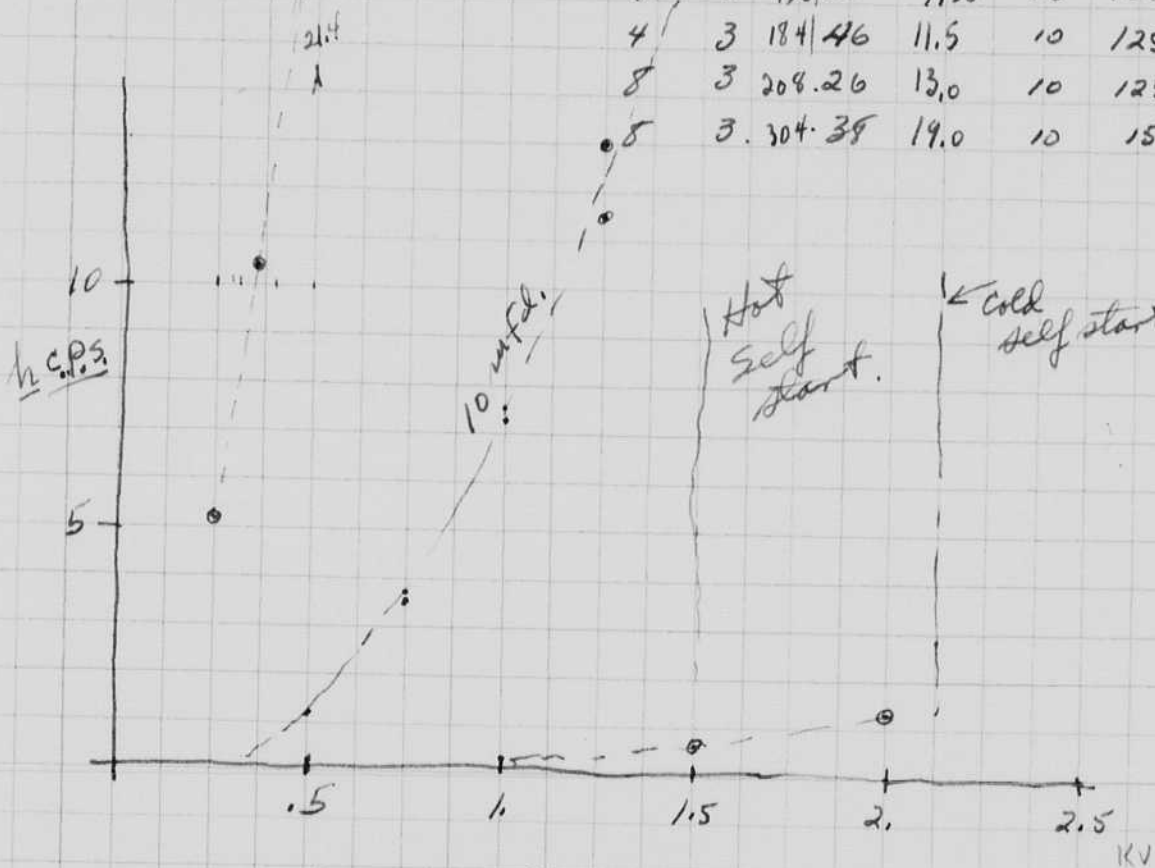


Sintered cathode.

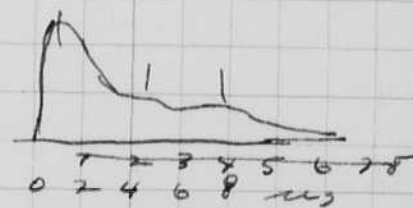
Titanium spiral anode

all of no 3.

#	Start	Self fire	R	D inch. 3"	M <del>1.5</del>	MD <sup>2</sup> C.P.S	C	E.	CE <sup>2</sup> V	η CP/watt.
1	100 V	2300 V	1	3	20	1.25	10	500	125	1.
2	90 V	2000 V	2	3	60/30	3.56	10	750	2.80	1.27
3	90	2300	2	3	116/58	3.74	10	750	2.80	1.33
			4	3	170/30	7.25	10	1000	5.0	1.45
			4	3	184/46	7.50	10	1000	5.0	1.5
			8	3	208/26	11.5	10	1250	7.82	1.47
			8	3	208/26	13.0	10	1250	7.82	1.66
			8	3	304/38	19.0	10	1500	11.3	Self flash 1.68

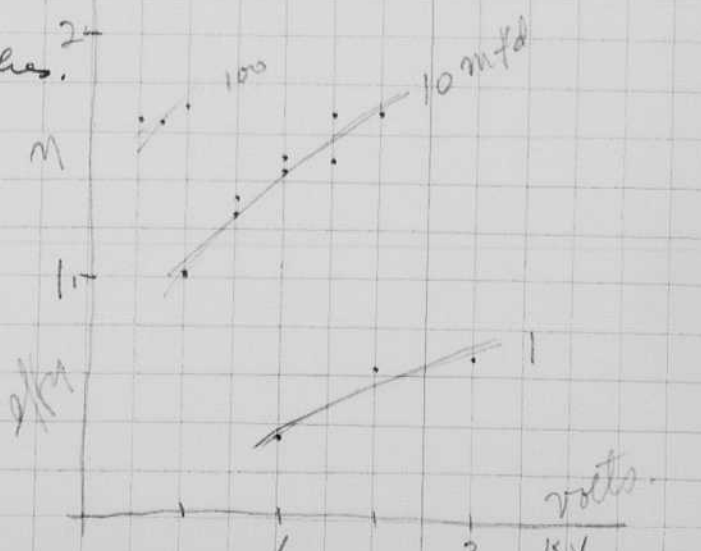


V	C	Dura. ms.
500	10	20
1000	10	15
500	100	55
1000	1	20
1000	.5	2.



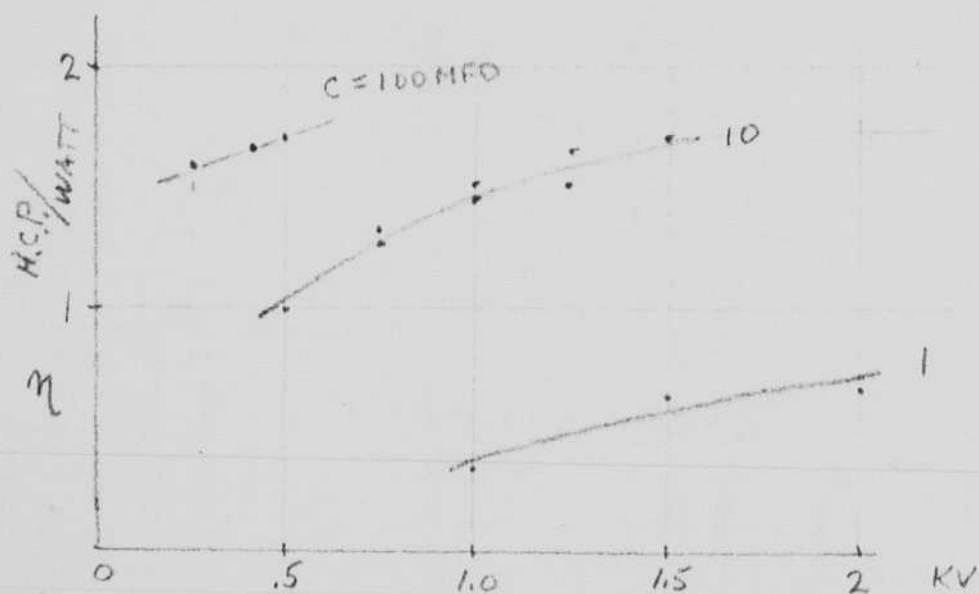
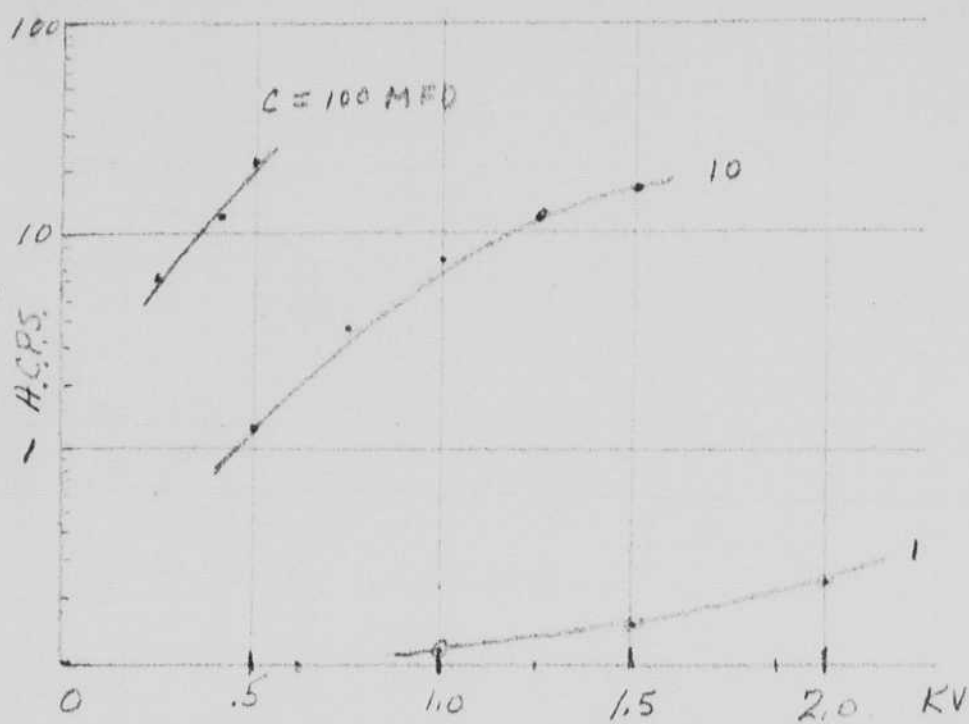
R	D	M	MD <sup>2</sup>	CE	CE <sup>2</sup> V	η
1	3"	3.0	.187	1	1000	.5
1	3"	1.0	.69	1	1500	1.125
1	3"	21.0	2.63	1	2000	2.0
2	3"	41.0	5.1	100	250	3.1
4	3"	41.0	10.3	100	350	6.15
8	3"	43	21.4	100	500	12.5

Self flashes.



roots.





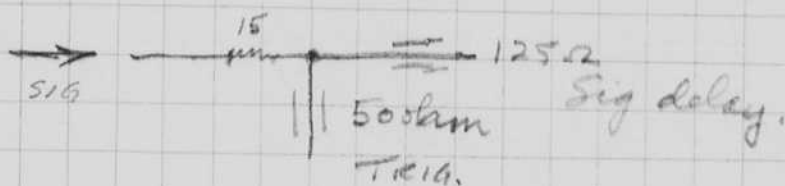
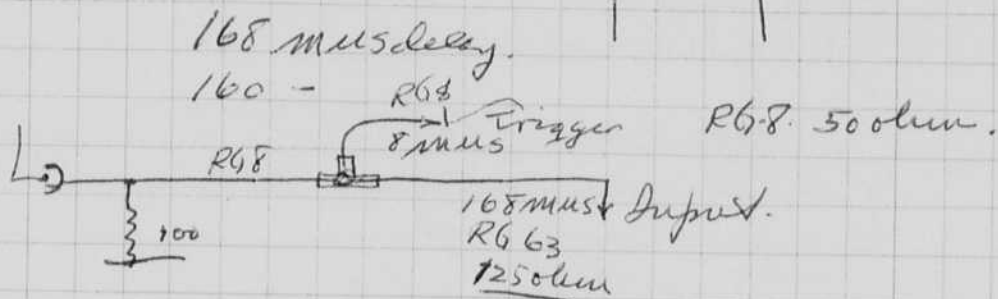
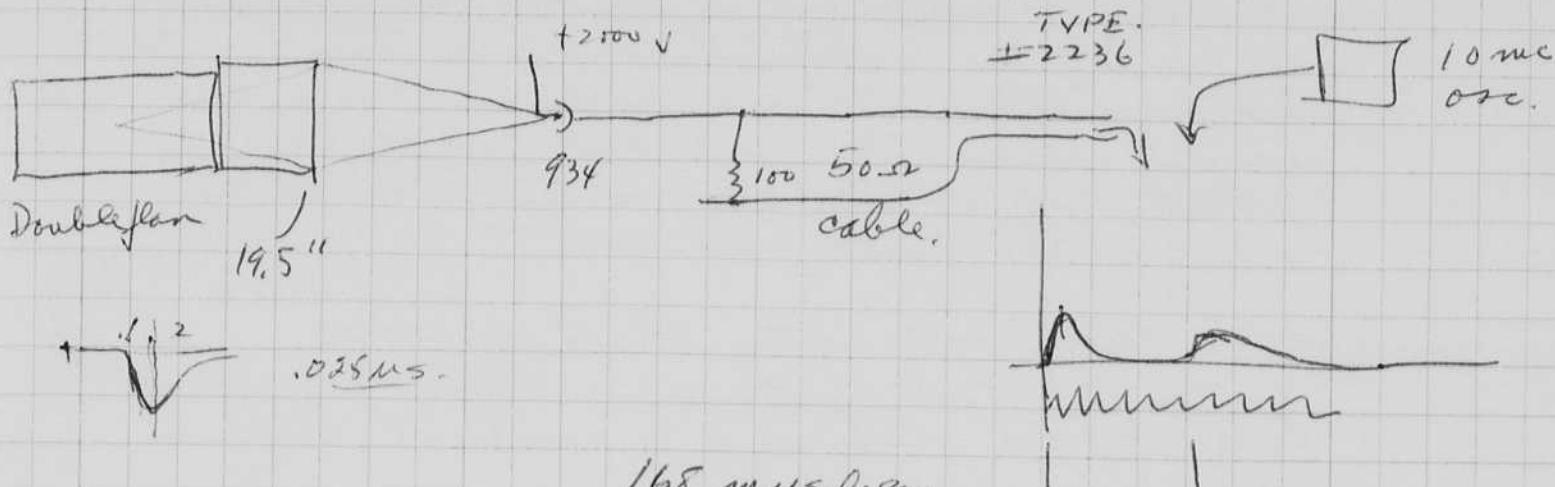
DURATION	V	C	SELF FLASH
$\mu\text{S}$	VOLTS	MFD	1500 - 2000 VOLTS.
55	500	100	MIN. START
15	1000	10	90 VOLTS.
2+	1000	0.5	

H.E.G.  
OCT. 28, 1957

Dr. Kaufmann of Ferrand was here Oct 29 at 11 am to discuss the use of a large flash lamp on a rocket. He wanted to see the light for several hundred miles. Fairbanks 4-2219 Mt Vernon N.Y.

Oct 29 1957

Bob Hartman brought over RBG Scope No. 39, Royal Pan



Leeman BB camera # 578

6 volts D.C. F4BP

Kausser T100 A 6V 285 RPM 3/4" Pulley G1215 Boston Bear

18.2 18.2

camera 1" " G1216 " "

$\frac{1100}{60} \text{ RPM} = 18.2 / \text{sec. ok.}$

6V - 160ma  
12V 200ma no load  
12V 500ma load

Then used 12v and had  $\frac{2095}{60} = 41 \text{ cycles/sec.}$

Oct 31 1957 Mary Anne Dixon was born in Hickory N.C.

Nov. 1, 1957.

Toni was in again to discuss projectors for 16 mm educational movies. He showed me sketches of his idea of using a rotating prism and strobe (60 cycles) for continuous projection of movies. This idea was shown to me several months ago. It seems to have some ~~promise~~ promise if the minor difficulties can be straightened out.

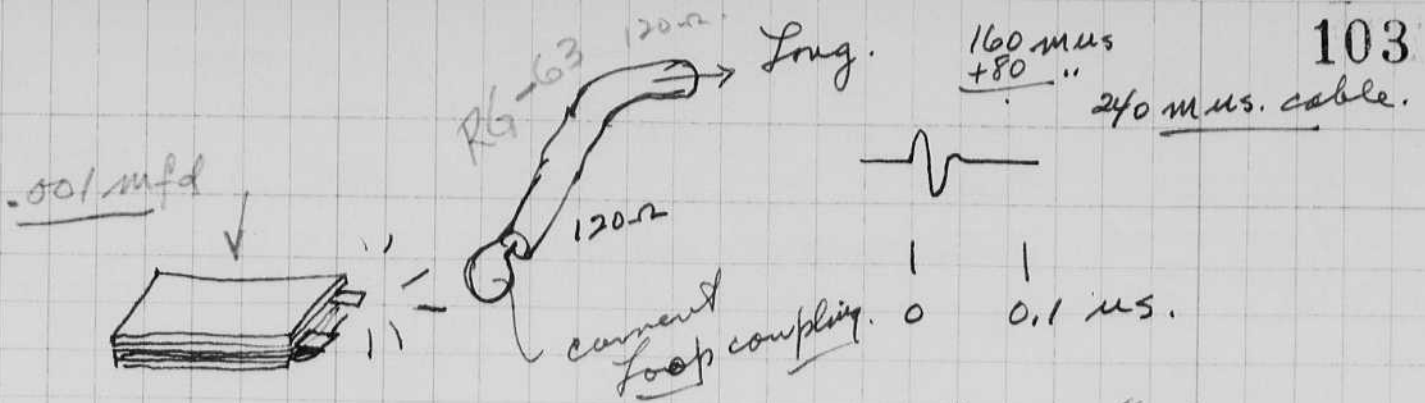
Nov. 7, 1957 More tests with short sparks. Yesterday Bob Hartman and I reworked the light pickup to work at higher frequencies.

The type 935 phototube now has a faster connection to an VHF output connector. I am using 75 ohms in the output at a T near the P.C.

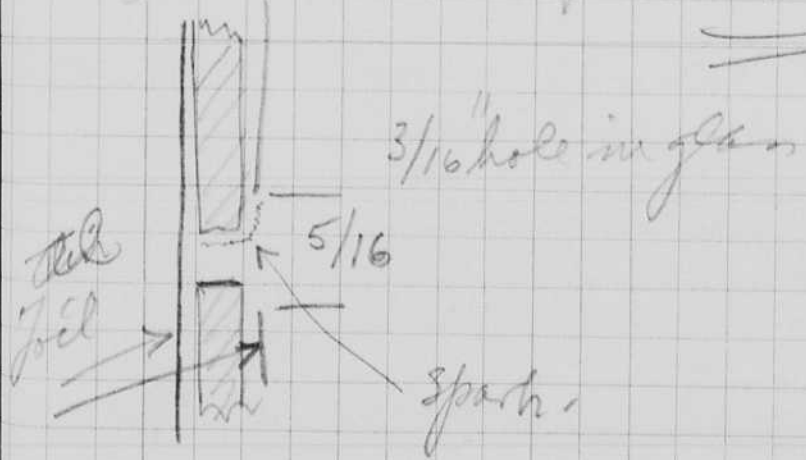
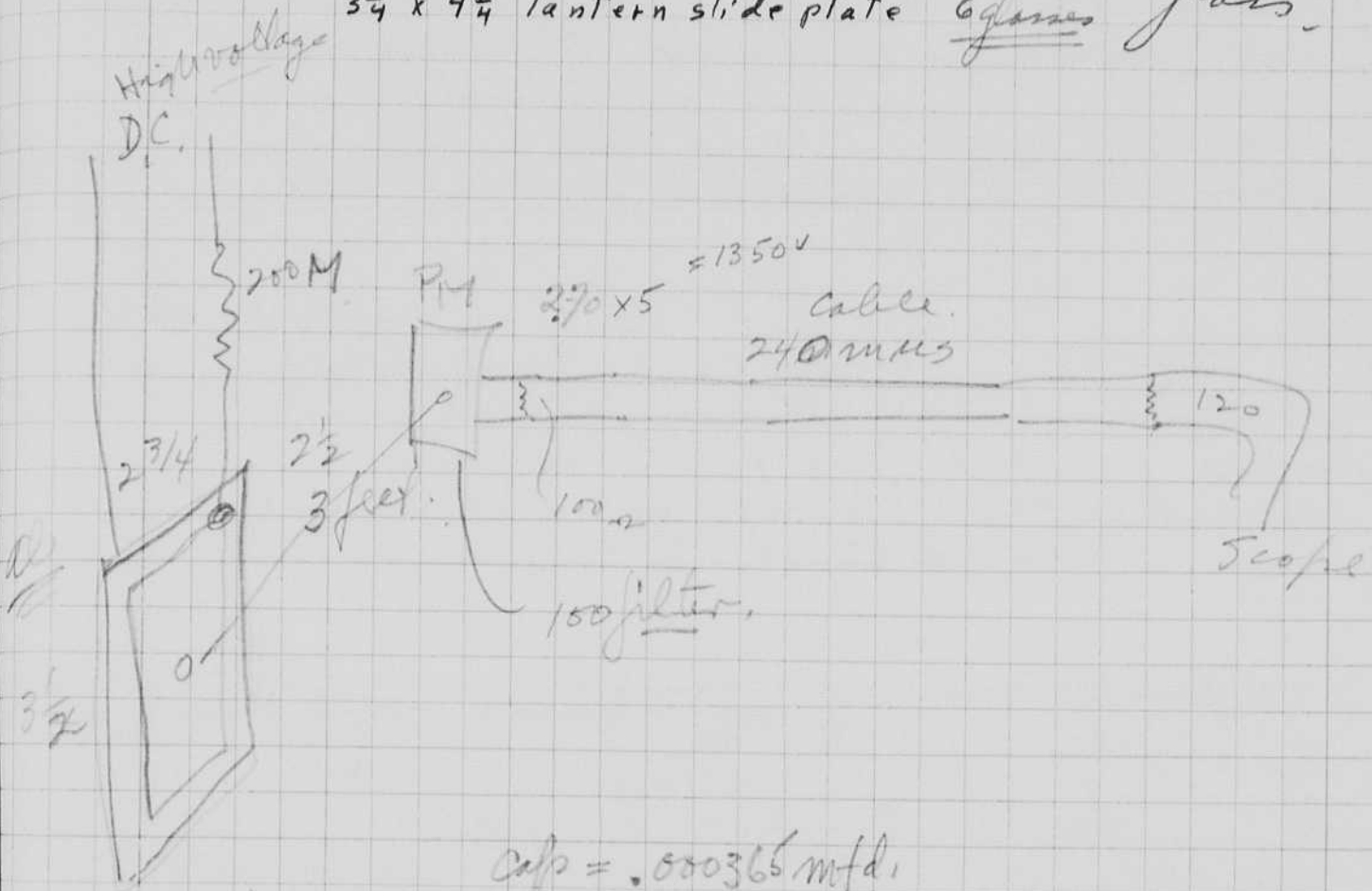
I looked at the double flash light output, the rise time seemed to be about  $\frac{1}{2}$  of 0.01 us. 0.05 us.

<sup>100 ohm</sup> We then used a .001 mfd capacitor with wires directly to the terminals and a glass tube over the wires. The rise time appeared shorter.

Next we connected Bob's 929 pickup to his 120 ohm line, the base was removed from the 929 to reduce inductance effects, there is some ripple with this connection?



5 plate condenser  
 2" x 3 1/4" plates  
 3 1/4 x 4 1/4 lantern slide plate  
 .052" .042" thick  
 glasses



20 KV  
 200 meg.  
 .001 mfd.  
 1/8" gaps.  
 9 flashes/sec.

Verified by instrument  
 by Mr. Feb. 6:15  
 Ruyhnie

Nov 4 1957

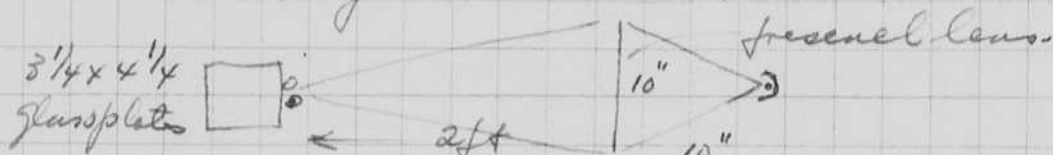
H. E. Edgerton

EGG Scope #

2236 #39

Calibration of sweeps and Intensity. Sweeps 3, 4, 5. Intensity 7 Focus 3.9 Exposure ok on all three sweeps. Position 100 mc. 925 2. Film xxx Pan? Vented 1:2 water.

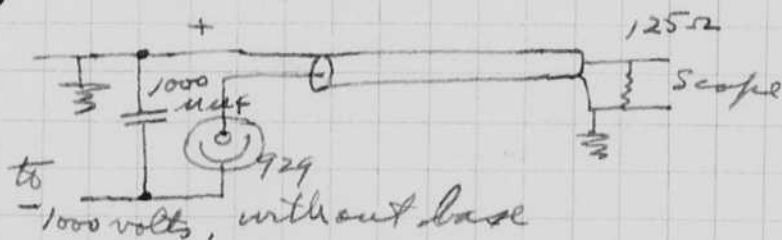
- #1
- |               | Range                    | Int |     |     |                   |
|---------------|--------------------------|-----|-----|-----|-------------------|
| Top one sweep | 4                        | 7   | 935 | 75Ω | .001 Glass spark. |
| Mid about 10  | 4                        | 6   | "   | "   | "                 |
| Bot           | 100 mc. for calibration. |     |     |     |                   |
- To show variation in flashes with time.



- #2. Same as top #1. Sweep 4 Int 7 Focus 3.9 935 75Ω .001 Glass 100 mc. Timing trace on 6 Signal on 5.

- #3. Current or d/dt. Two sweeps Sweep 4 Int 7 - Focus 3.9. 100 mc. timing trace.

- #4. 925 special pickup Same light as above and lens with a slight defocusing to reduce amplification by 1/2.



- #5. PM pickup of same subject 100 ohm load or 931A with 1200 volts.

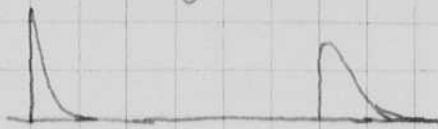
- #6. 929 into 120 Ω line open circuit Capacity 3 1/4 x 4 1/4 with hole in center. .00035 mfd. 100 mc oscillator.

- #7. Ditta.

Nov 5, 1957  
#3 Edgeport  
Dave Colhoun

## Double flash.

Changed  $9$  ohms to  $10\frac{1}{2}$  ohms on second flash.



5 min in Dektak  
1:2  
Panatomic X.

- Photo 1. Camera - Bullet 44" 30 us delay. f 16  
Bullet - Lens 12"  
Focus on bullet.
- Photo 2. Double flash self triggered! f 16
- Photo 3 camera Bullet 44" 30 us. f 16  
Bullet - Lens 12"  
Focus halfway between lens and bullet.  
There may be self flash!!! yes it was.
- Photo 4 Try again # 3. f 16
- Photo 5. Repeat but with. f 32  
for more depth of field.

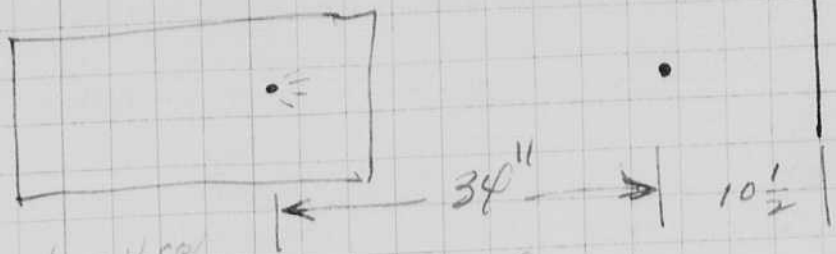
Nov 6 1957 #3 Edgeport.

- Photo no 6. Camera - Bullet 48" ±  
Bullet Screen 6"  
Focus on bullet.  
f 32 on 12 inch f.l. lens.  
Panatomic X film.  
22 Swift 4200 f.p.s.
- No 7. Ditto 6 but Delay increased from 30 to 100 us  
6" scale just in frame at bullet.  
(Photo showed double operation  
of flash unit.)
- No 8. Ditto 6 but 1st gap opened by  $\frac{1}{4}$  turn on screw.
- No. 9. Ditto # 8 f 32 on lens. Looks OK

#1 8x10

22 Swift  
Bullet  
+ 6" rule.

8x10  
Paratonic X film



$$\frac{20}{50} \times \frac{1}{2} = 4\%$$

Exposure time,

#2 8x10 Tri X Glass plate. Photo

Test of FT-230

1000 volts, 100 nfd

$$\frac{20 \text{ c.p.}}{50 \text{ WS}} = 0.4 \text{ c.p./width}$$

Nov. 7, 1957.

Test condenser circuits again.

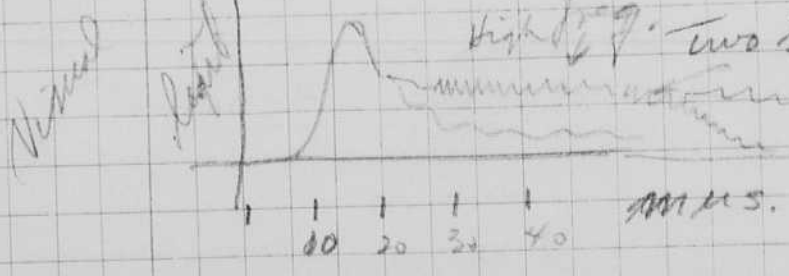
Could not measure light out just from the plate with a hole in the center. (See page 103) with a phototube. I had to use a P.M. tube before.

74 foot piece of 6Q-630 used on signal from Photo tube with 75 ohms at the photo tube. Delay just right for sweep 4 speed.

I tried Bob's high pressure two element gaps. There was no appreciable shortening of the flashes of light.

Nov 9 1957 Sat.

70 nfd ceramic capacitor with  
1/8" spark in air Sproague 7.5K.



maybe phototube goes into jitters.

Why the H.F. oscillations???

Nov 9 1957

etc

$$3 \times 10^{10} \frac{d}{t} = 3 \times 10^{10} \frac{10^{-4}}{10^{-8}} = 3 \times 10^{14} \text{ sec}^{-1}$$

$$d = v t = 3 \times 10^{10} \times 10^{-8} = 3 \times 10^2 = 300 \text{ cm}$$

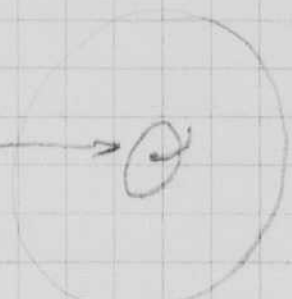
$$= 9 \times 10^2 = 900 \text{ cm}$$

8. Sprayer 7.5KV 470 uF. with 1/8" gap.  
 Trigger by 934 and 10" diam 10" fl. lens.

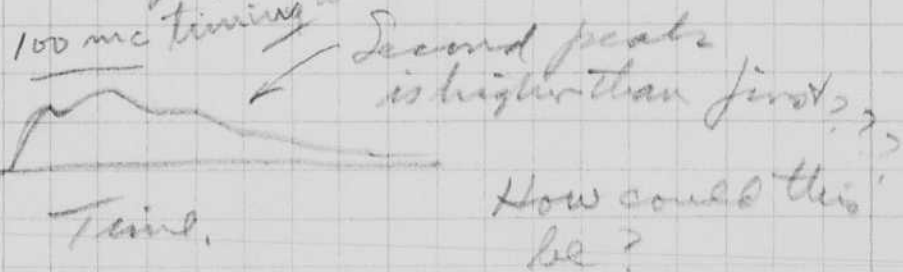
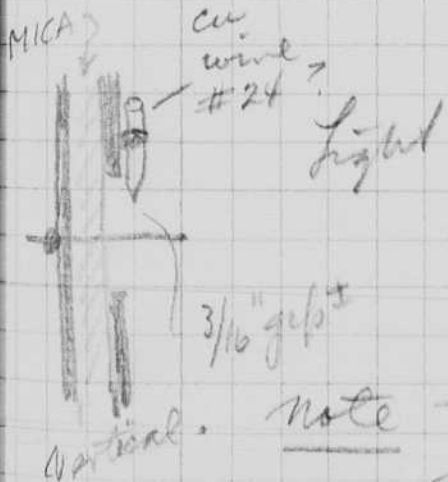
931 PM pickup with 100 x filter 2.5 mV x 500 volts on PM.  
 100 ohm cable to scope  
 Distance = 12 feet to PM.  
 Sweep of 100 mc timing wave  
 Several discharges.

9 Plastic insulated condenser,  
 2 thicknesses .003" thick.  
 Brass disc electrodes 4" diam  
 1/2" hole

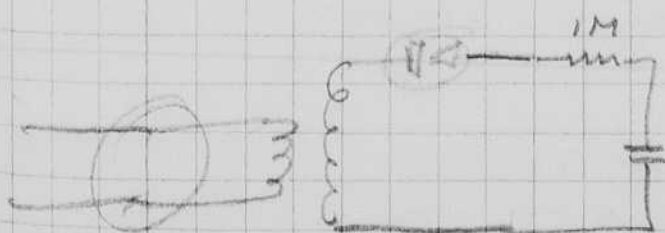
Electrode sparking  
 100 mc timing wave,  
 gap about



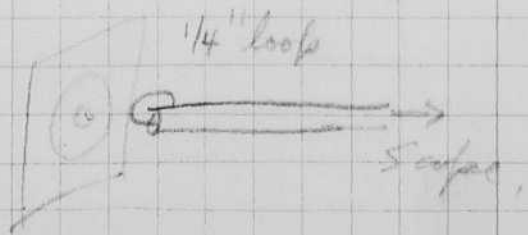
#10 Mica .005" 2 1/2" discs 2 3/16" Al & Cu  
 gaps 1/8" +  
 Point gaps.  
 100 mc timing wave.



Optical. Note the spark can be made to  
 run very steadily at 60  
 flashes/sec if the gap is  
 in a vertical position.



.0001 - .00015 mF measured  
 on B.C. Bridge



#11 Elect pickup near to sparks  
 100 mc.



Helium gas squirted on the gaps.  
 Sync is lost since the light is  
 less than before with air. N.B.

Oxygen gas squirted on the gaps  
 Breakdown increases -  
 More light since voltage higher.  
 No appreciable difference in  
 the light time curve.

$$\frac{CB^2}{2} = \frac{.0001 \times 5000^2}{2} = \frac{.1}{2} \times 2.5 = 0.125 \text{ watt sec.}$$

Argon tried also. Requires less  
 voltage. - Rise slower. Duration  
 may be longer, but not sure.

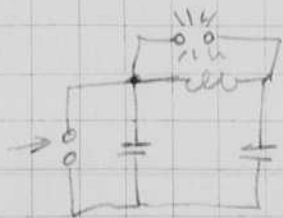
Looks like air is our best bet, so far.

Nov. 10, 1957. Breslau was working on his bug counter  
 today in the lab.



control method for a spark of  
 short duration.

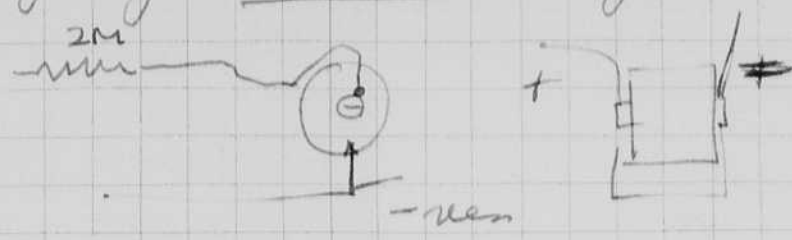
Trigger fires gap.  
 quick discharge into  
 second gap which  
 fires soon. Then  
 holdover discharges the  
 rest of the energy in a  
 dim way.



Crazy Scherlin method.  
 Oscillation doubles voltages  
 on the gap.

I propose to try the first method on a  
 gap in water, hoping that the arc will  
 ionize quickly in the water. The resistance  
 of the water may be high to surges?

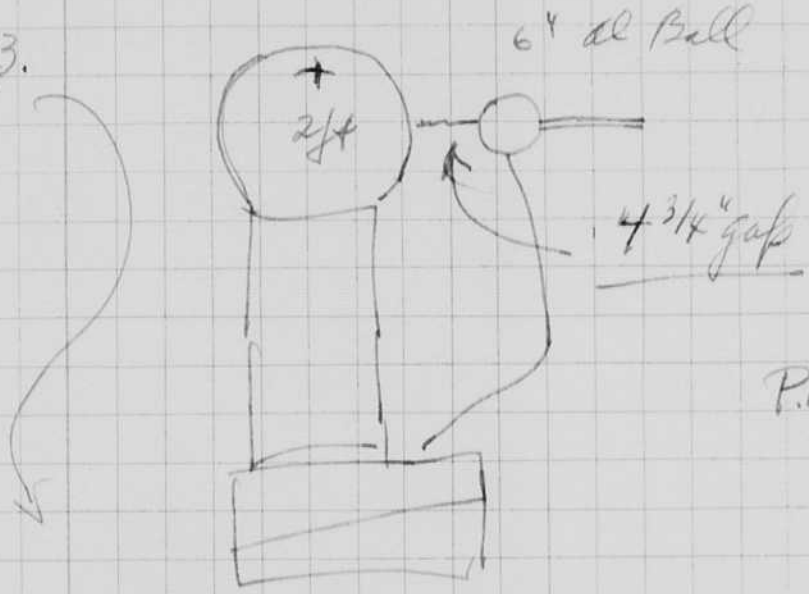
#12. Sproyue condenser. spark. 12k volts.  
60 cycle.



100 mc. single sweep  
Exp of light 1/10 sec  
" " zero 1/10 (with pidents.)

P.M. 2.8 ma. 3 ft to. gap. Sparkles at 3 to 5 second intervals.

exp 13.



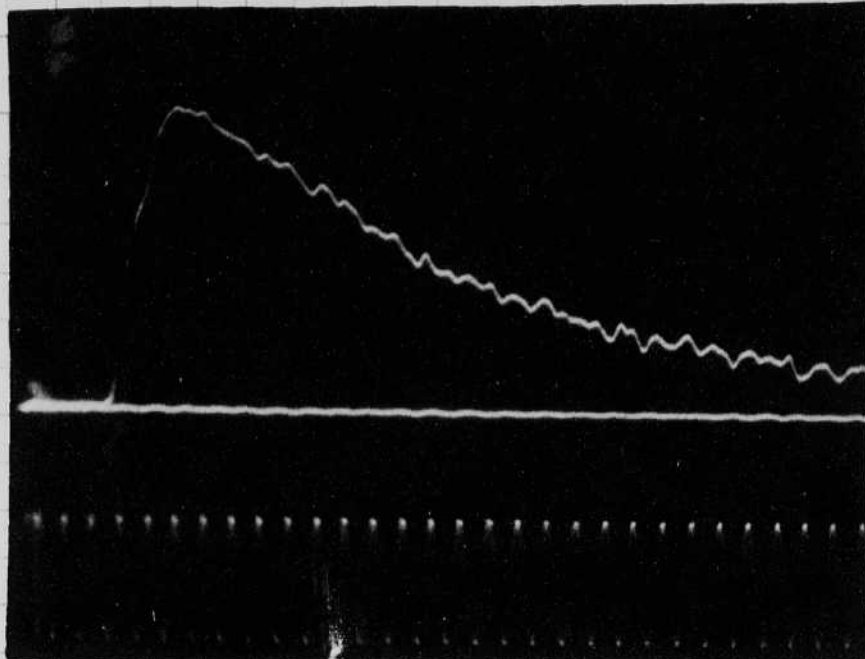
P.M. at 24 feet.

K. pidents with 18" diam. 2 lenses for trigger.

P.M. 24 ft 2.8 ma = 1400 volts.  
Density 2 filter and slit.

Intensity focus Sweep V H. Trimmer

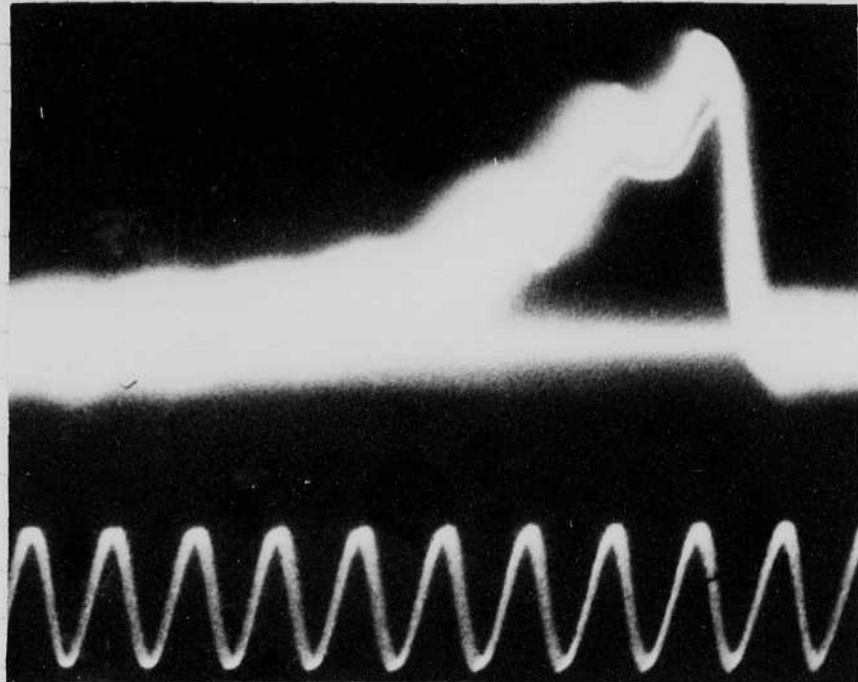
Exp #	Gap	Intensity	Focus	Sweep	V	H.	Trimmer	Notes
#13	4 3/4" gap	7.	2.5	4	7-3.7	3.2	100 mc.	4 3/4" gap. Exposures ok but slow variation of rise and time.
#14	5" gap	7	2.5	(3)	7-100 mc.	6.5 6 6.5	three exposures ± ?	5" gap.
#15	5"	7.	2.5	4	one +	100 mc.		
#16	5"	7	2.5	4	one +	100 mc.		



Double flash  
1st flash

$10^8$  cycles/sec

→ time



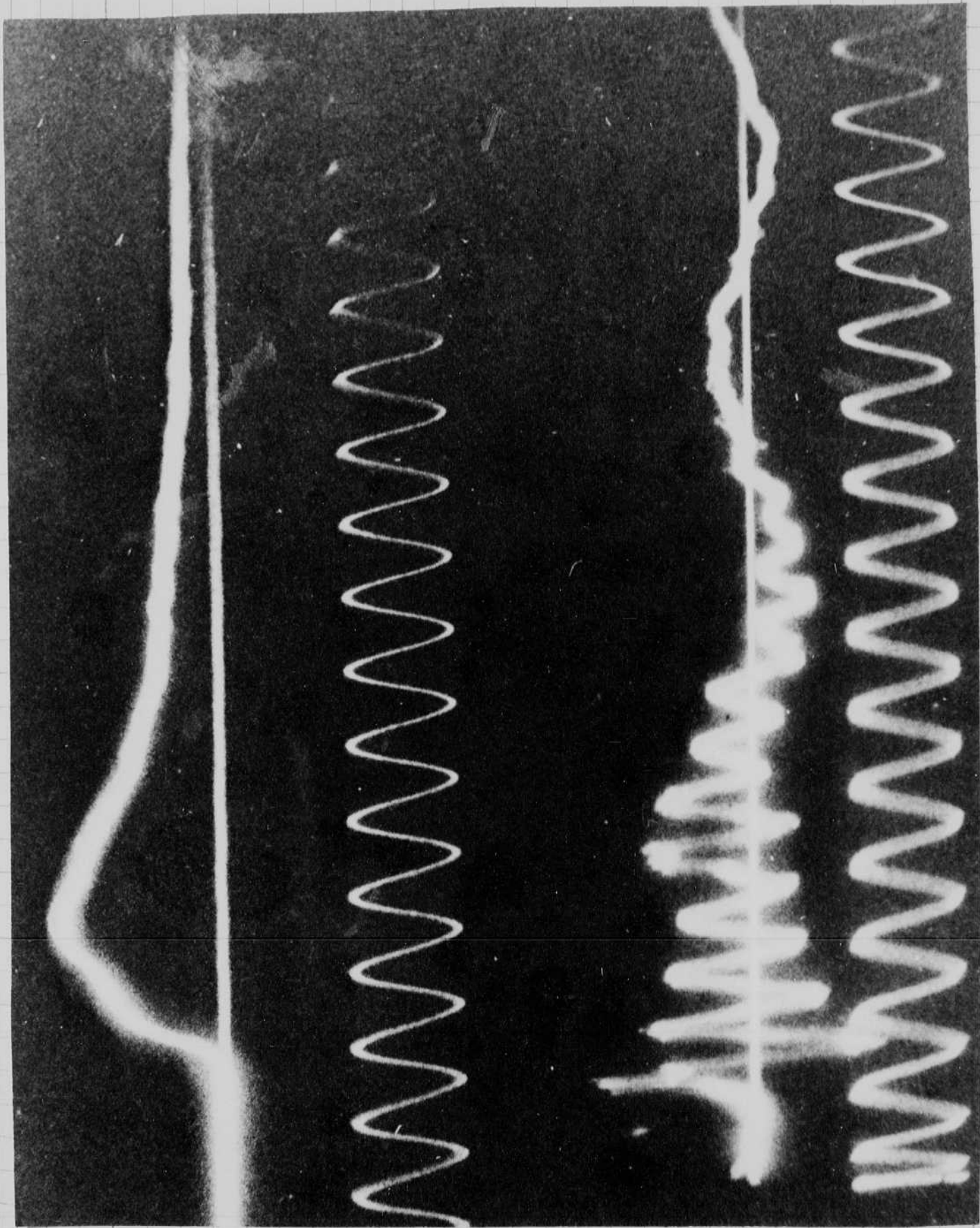
Leak

#8 P107

$10^8$  cyc/sec

TIME

←



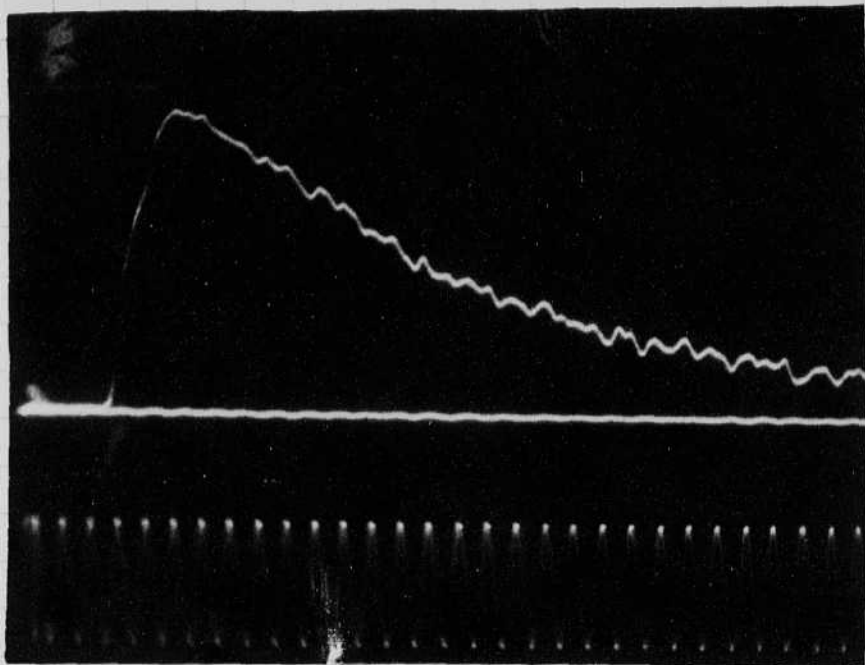
Light ←  
 Exp. # 10  
 p 107.

↑  
 time

10<sup>8</sup> cycles

Pickup

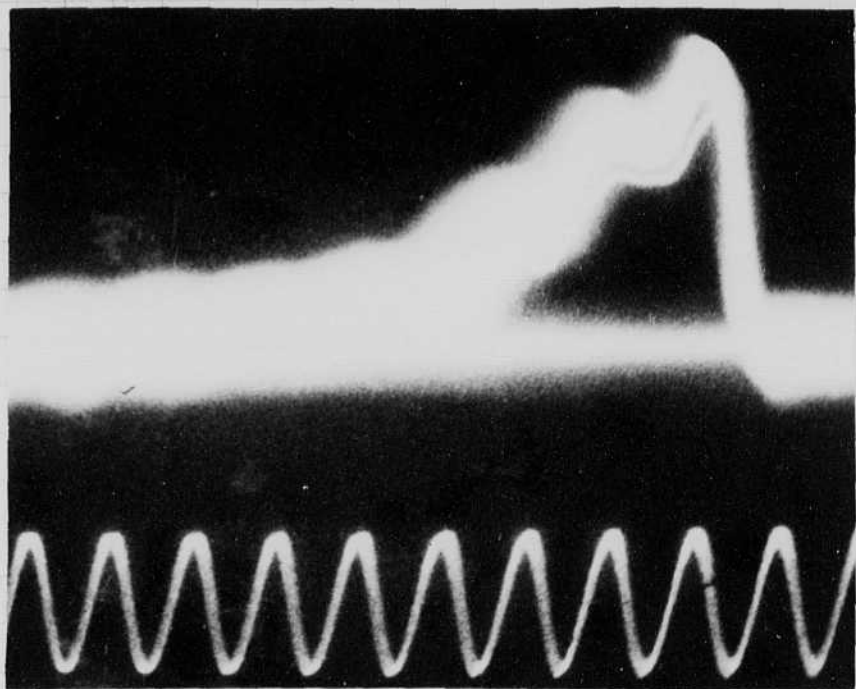
10<sup>8</sup>



Double flash  
1st flash

$10^8$  cycles/sec

→ time



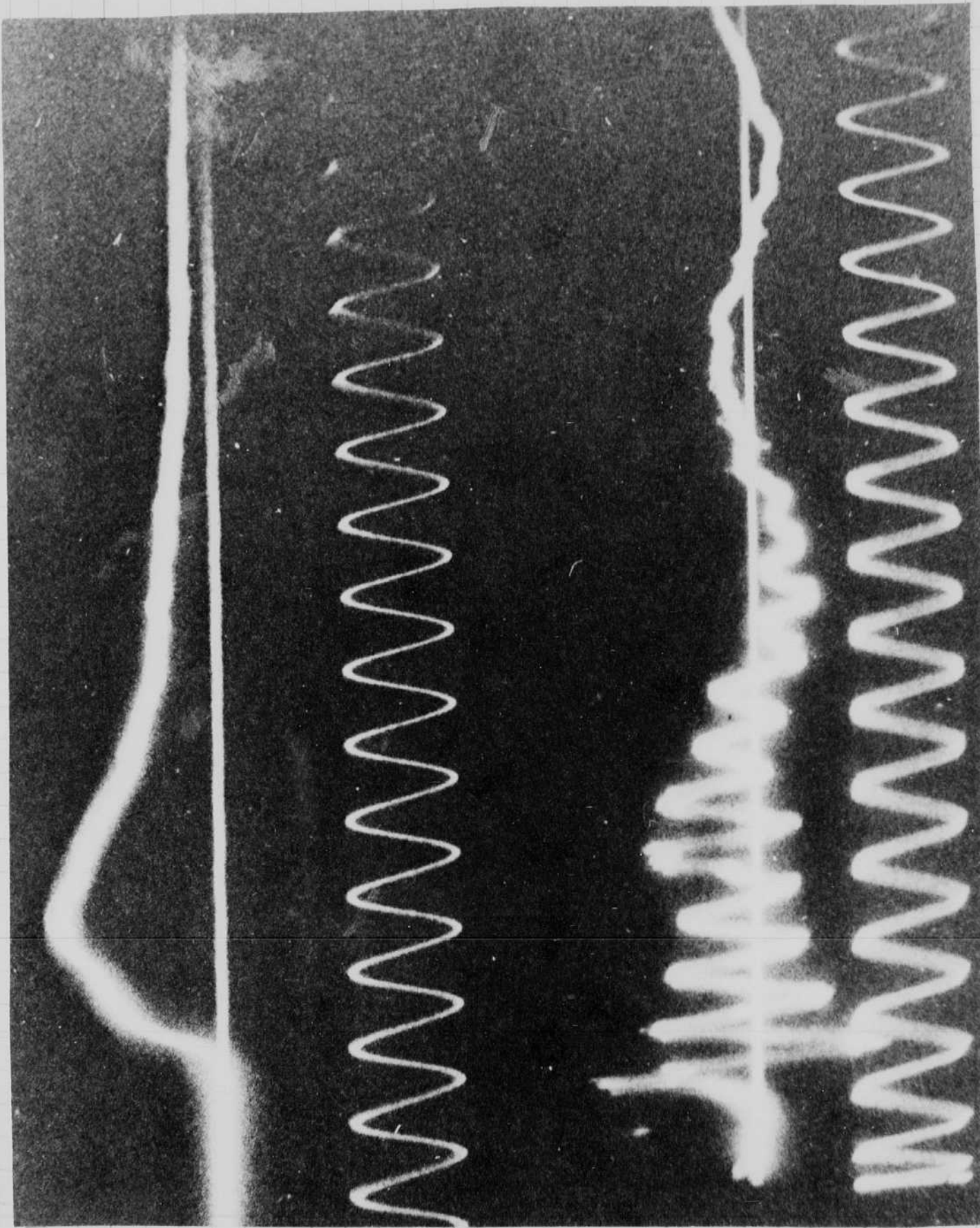
Leak

#8 P107

$10^8$  cyc/sec

TIME

←



light ←  
 100. #10  
 p 107.

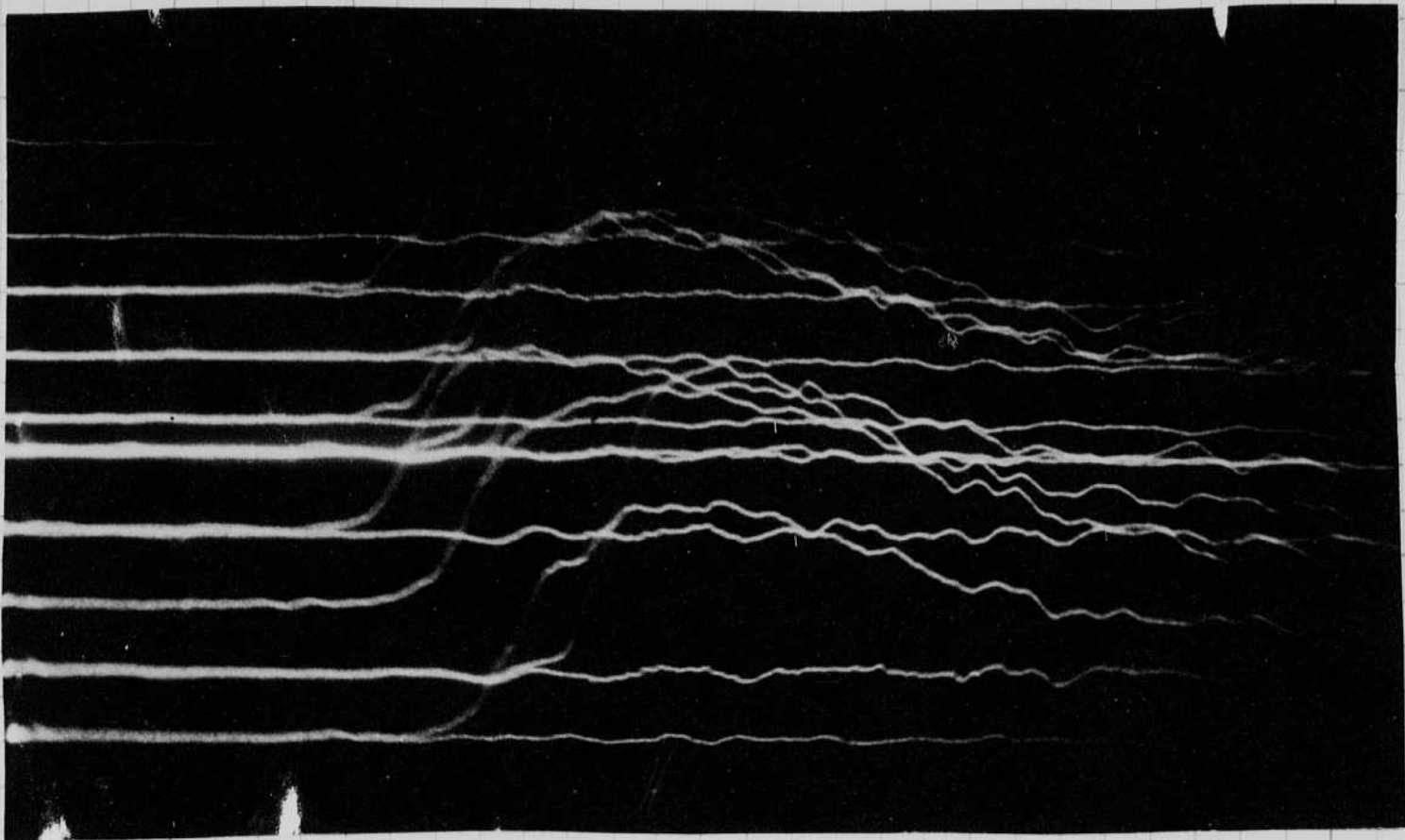
↑  
 time

8  
 10 cycles

Pickup

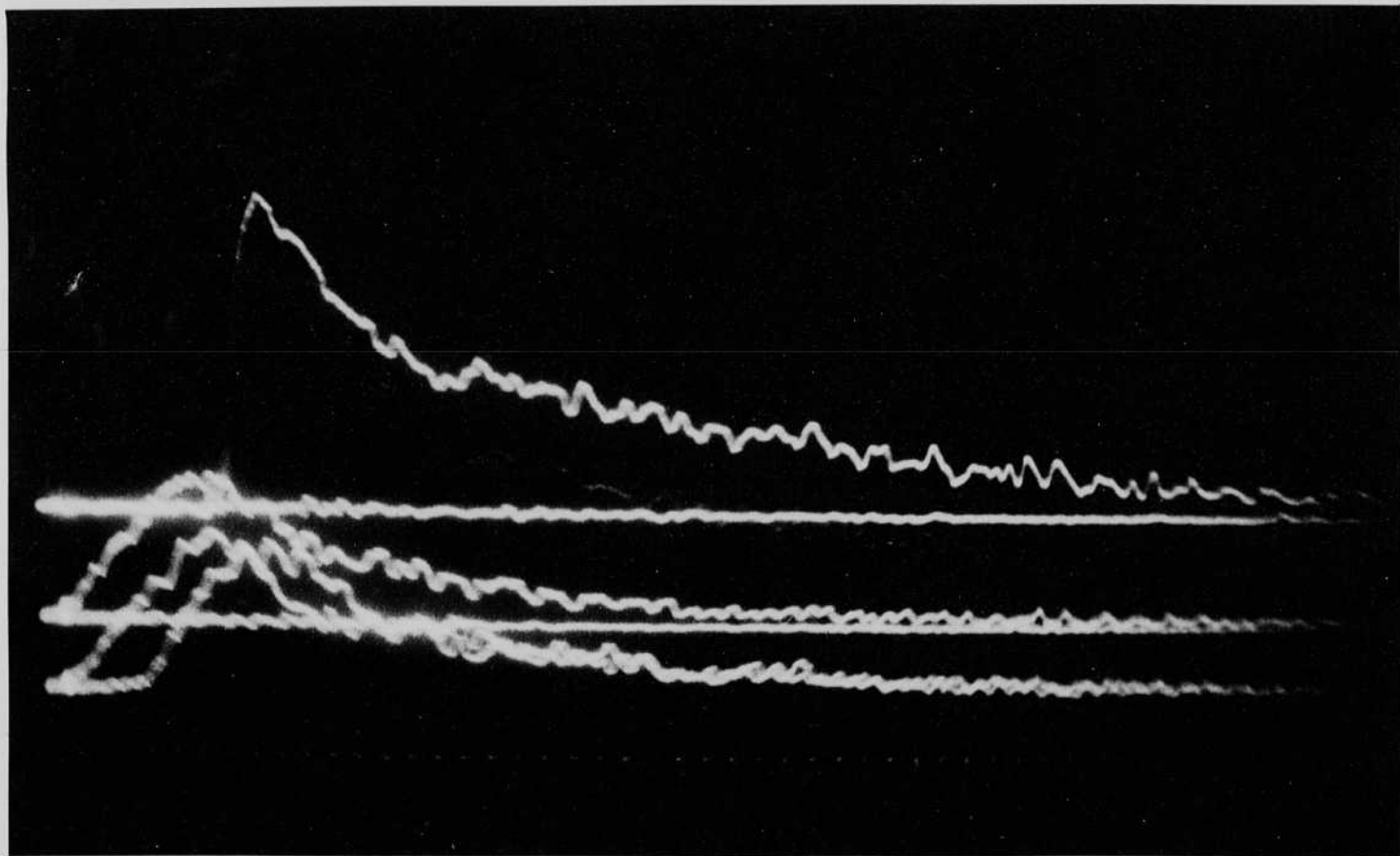
138

Discus 2400  
1000



Discus 2400  
1000  
Van de Graaff. Gen p 109.

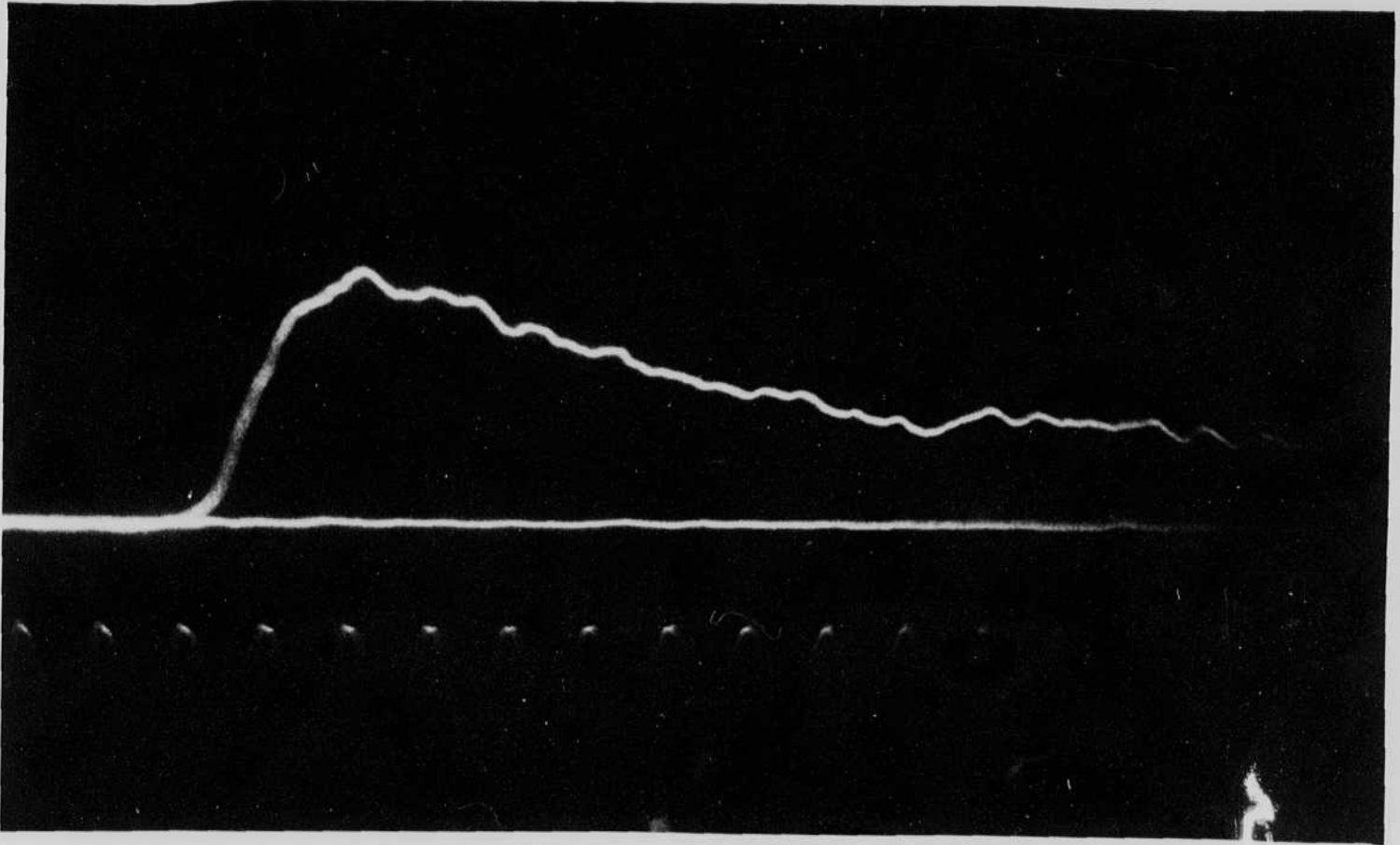
100 mC.



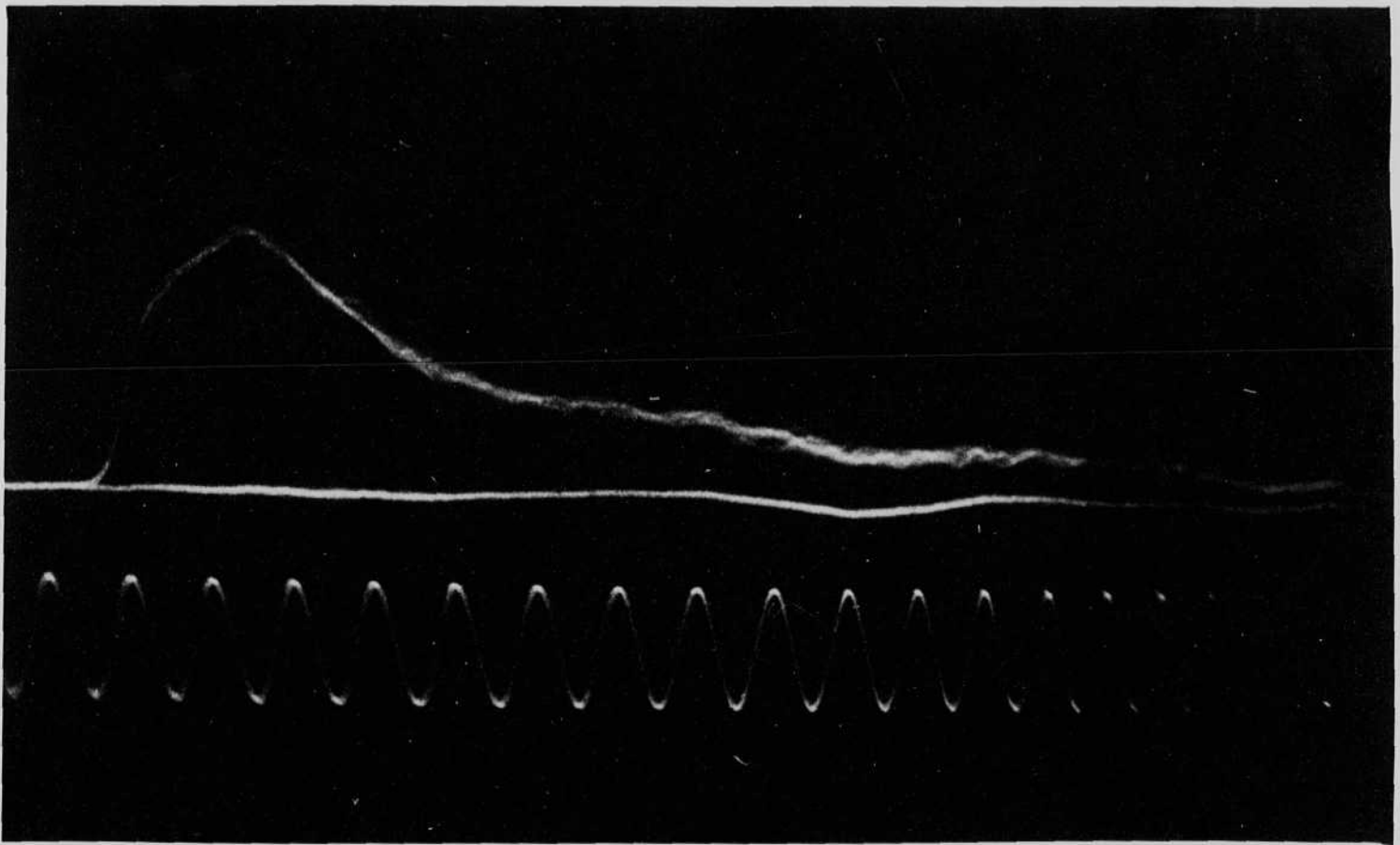
# 14

Van de Graaff.

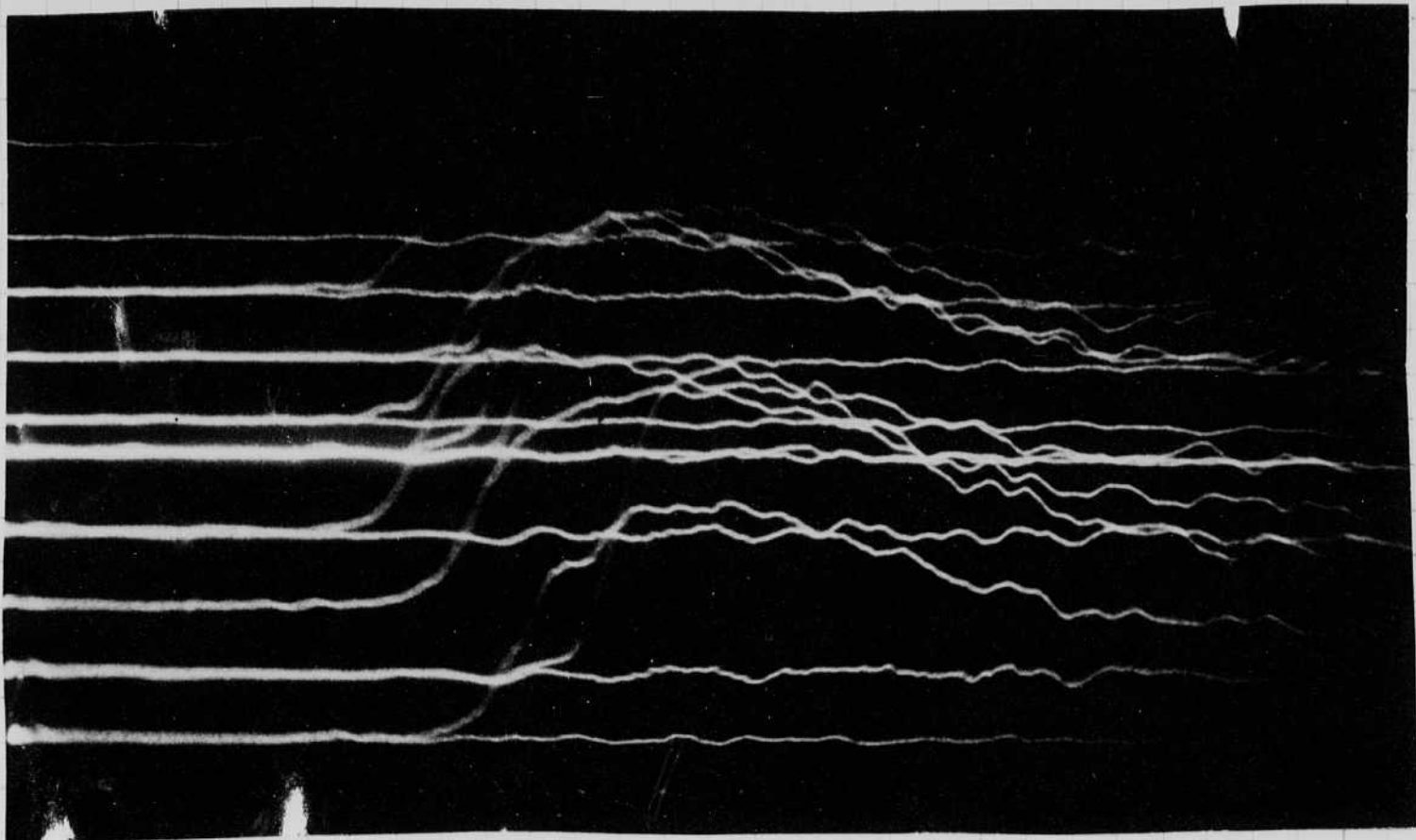
#15

 $10^8$  cycles.

+ Sphere Van de Graaff.

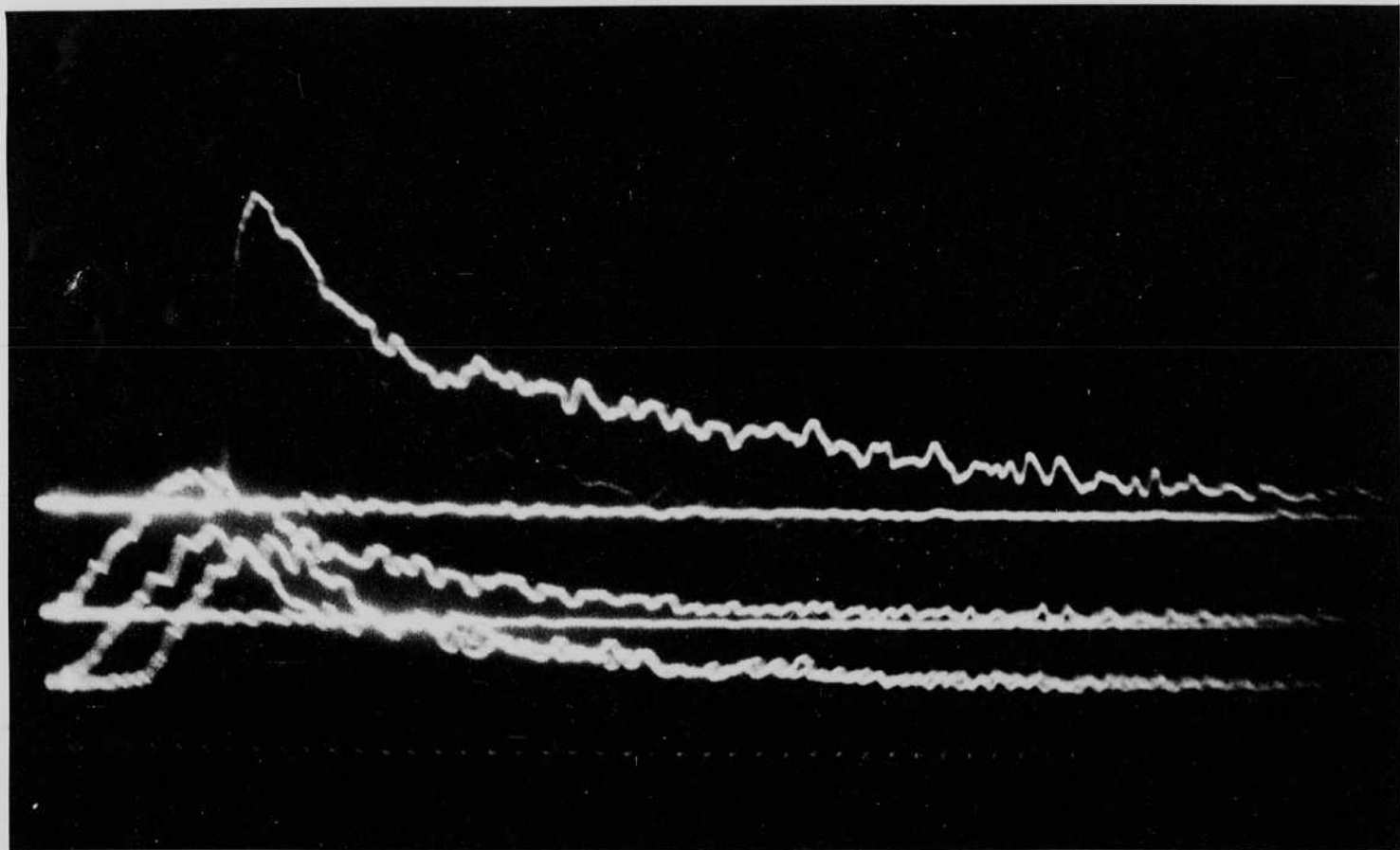






Van de Graaff. Genp 109.

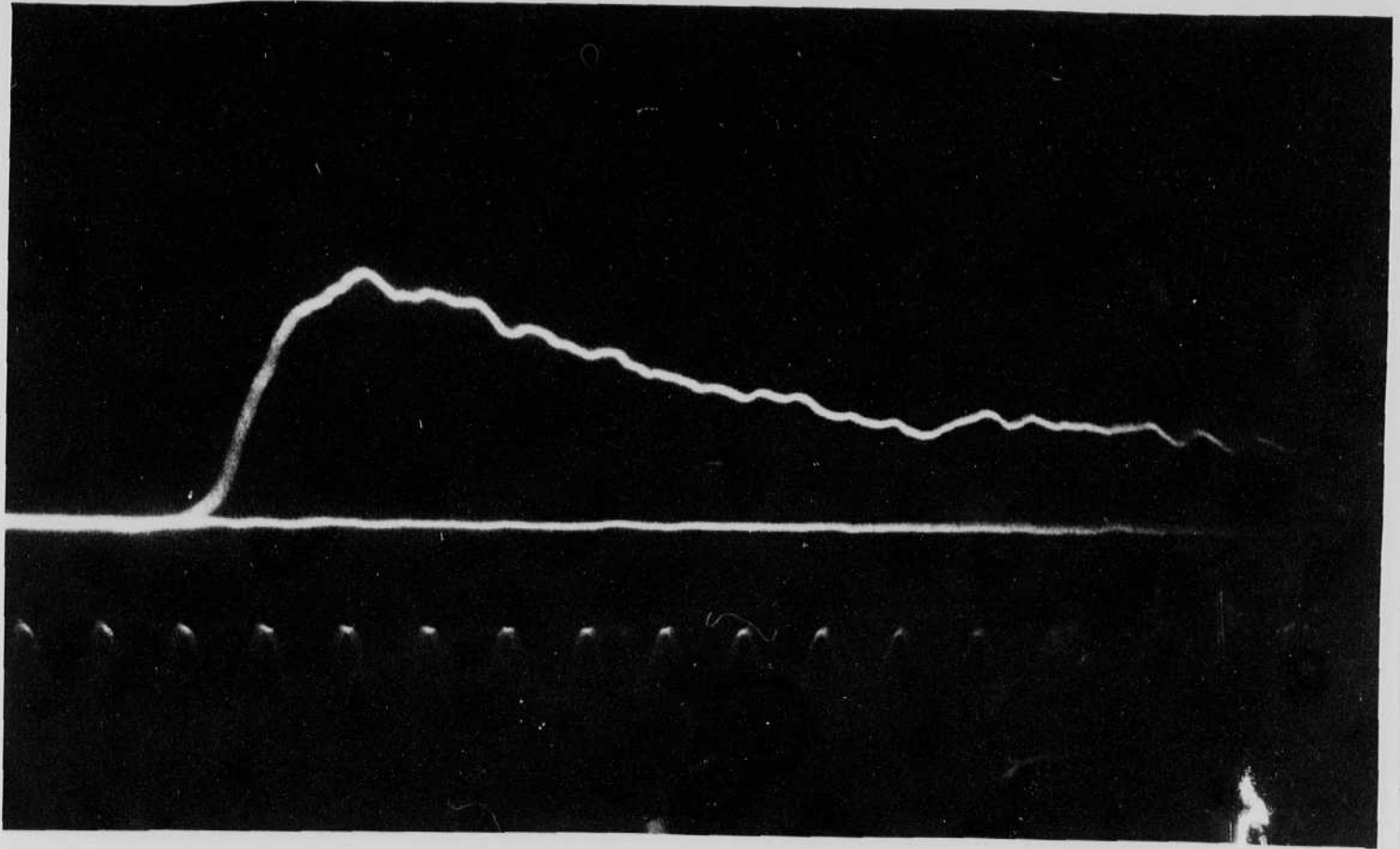
100 m.c.



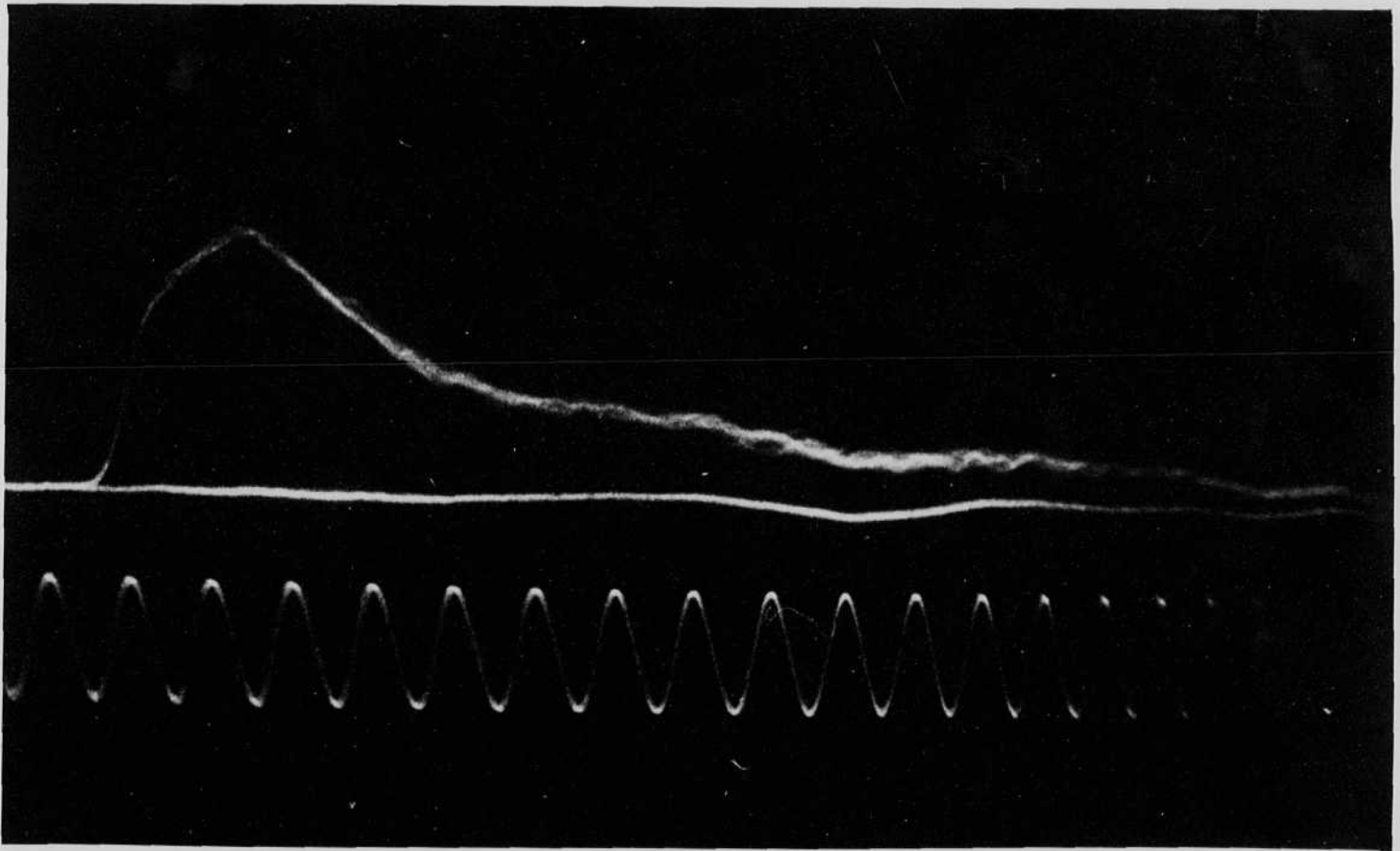
#14

Van de Graaff.

#15

 $10^8$  cycles.

+ Phase Variable Power.



Nov. 15, 1957

H. Edgerton.

Leave at 5pm today for Omaha, United.



Insulation

metal

Gap fed by a ~~series~~ group of resistors.

Nov. 23, 1957. Beth on Thursday night Nov 21 at 10 pm on American X.  
 Esther also returned today from Hickory U.C.

- My trip - Nov 15. overnight at Shelter Fontainebleau in Omaha Neb.  
 16 Aurora Neb.  
 17. Left Grand Island for San Francisco, Cal.  
 18 U of Cal with Hugh Bradner.  
 19 " " " " "  
 working on lighting problem for the H<sub>2</sub> Bubble chamber.  
 20 Las Vegas Nevada for EG&G meeting of directors.  
 21. at Bell & Howell in Chicago.  
 Home at 10 pm.

Day after Thanksgiving Day.

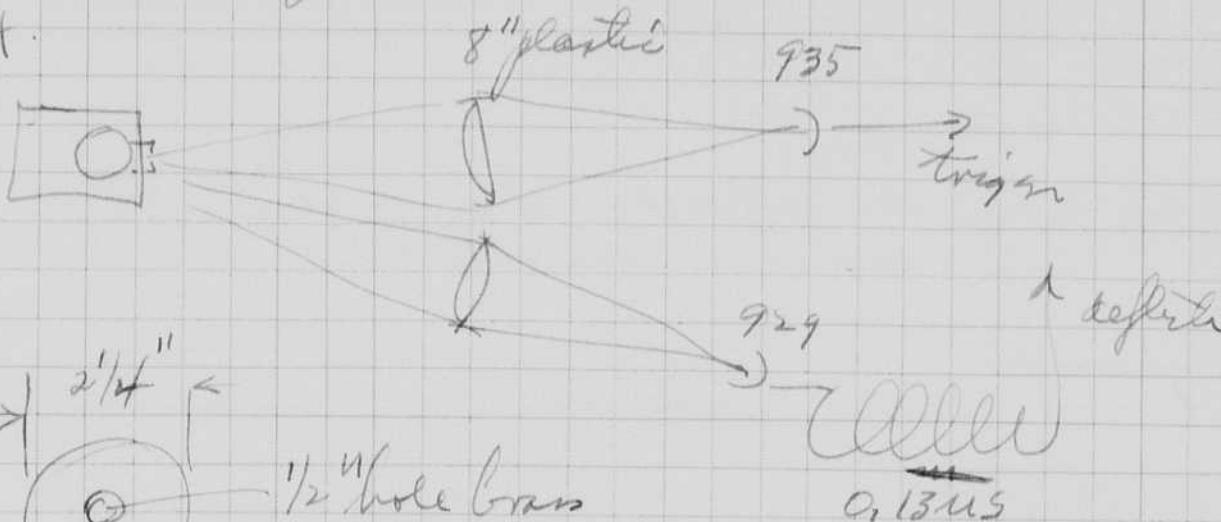
Further experiment with short flashes.

thin glass 19 thousandths from coming arrived  
 4x5 size with electrodes less by 1/2" on edge  
 870 uuf.

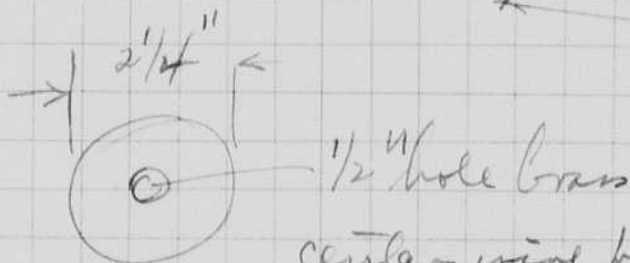
mica 116 uuf.

osc. #1. Small mica 186 uuf. edge sparks .004"  
 Photocell pickup into 125 ohm lead.

250 uuf.



#2 osc.



Same mica

center wire from other side for spark.

Osc should show the rise time difference.

mica .004" thick

capacit. 110 uuf. due to air gap??

Note mica flattened caps. 235 uuf.

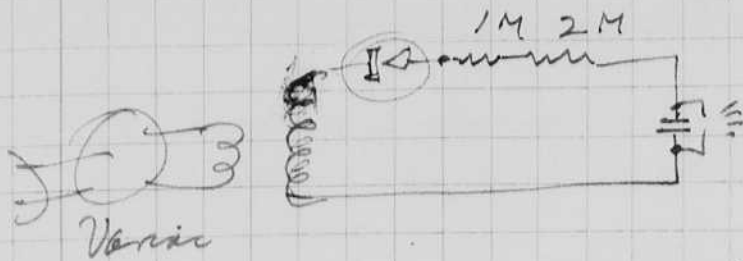
Rise time Duration

	Rise time	Duration	
#1	23.2	78.5	uuf.
#2	12.3	39.	"

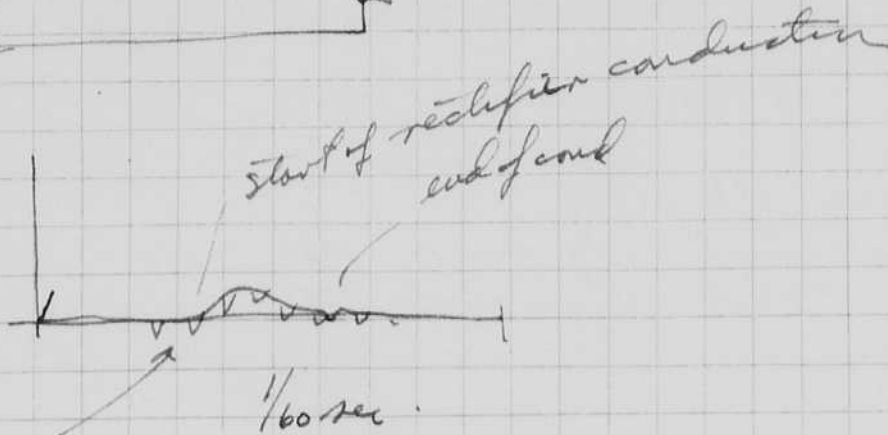
Note effect of center spark arrangement.



Nov. 30 1957  
H. Edgerton.

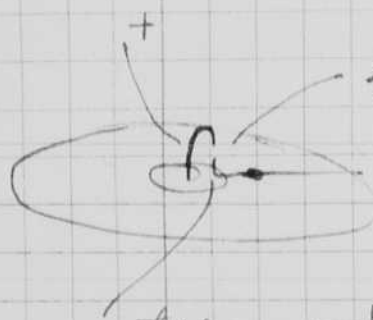
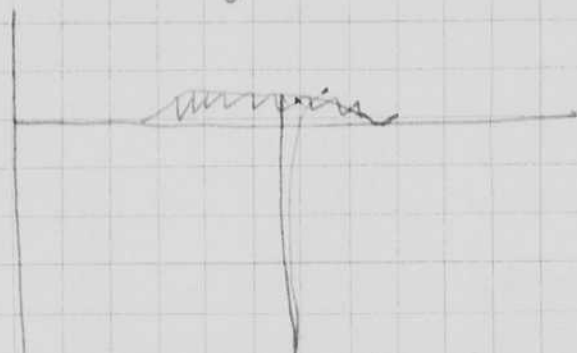


Voltage just below breakdown



many small sparks showing corona or glow starts.

Voltage raised.

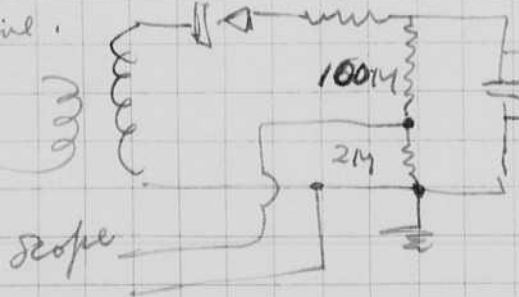


3/16" gap, needle rough points copper wire

Sparks about here in cycle.

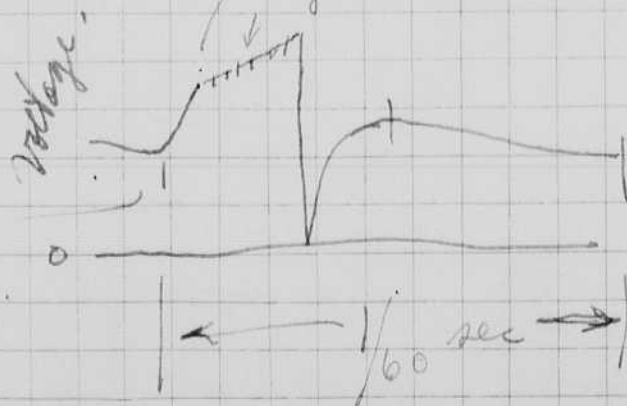
Shows too rapid charging.

negative.



.000250 mfd.

note break in slope of curve. glow or corona.



diag cycle.

with Polarity reversed

the small pre-spark sparks

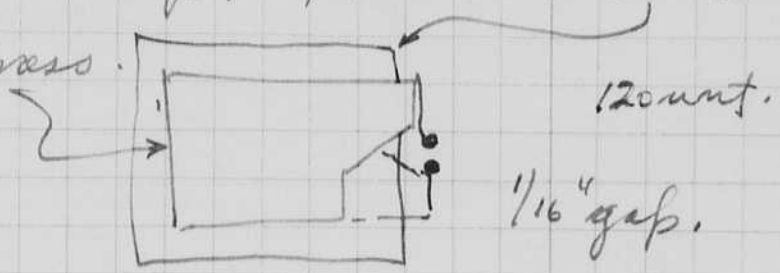
are not so pronounced but the change in slope is about the same.

Nov 30  
57

The sparks does seem to work more regularly with the bottom terminal negative. The arc is in a vertical position.

I put on new electrodes with smoother points. The effects were about the same as before. Thus a small smooth point is effectively the same as a pointed electrode for this particular application.

New mica condenser made of .004 thickness mica plates 1 1/4 x 1 1/4 brass.



Exc #3. 10<sup>8</sup> cycles tuning wave

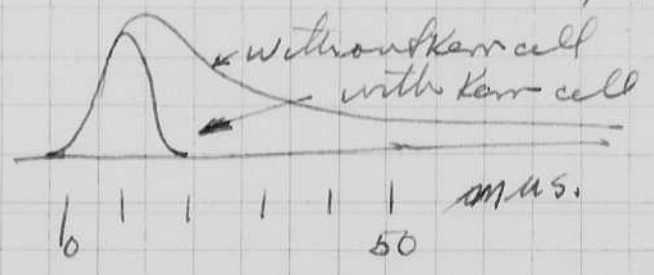
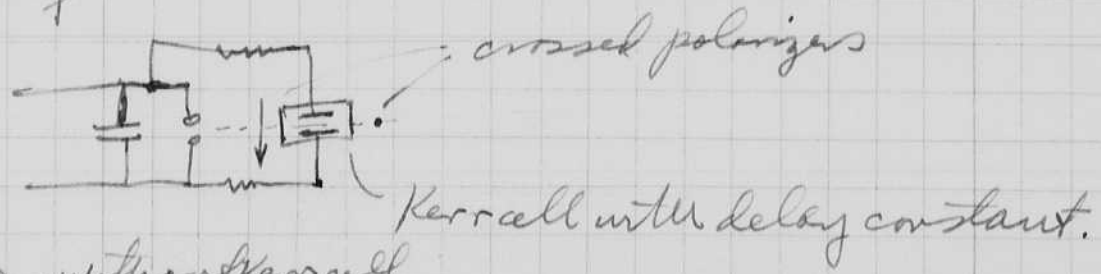
E686. Scope # 2236 # 39.

10764 AEC. no.

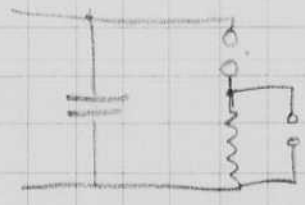
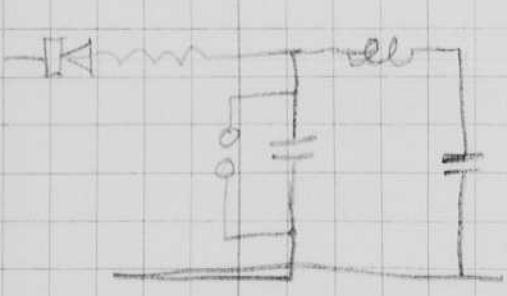
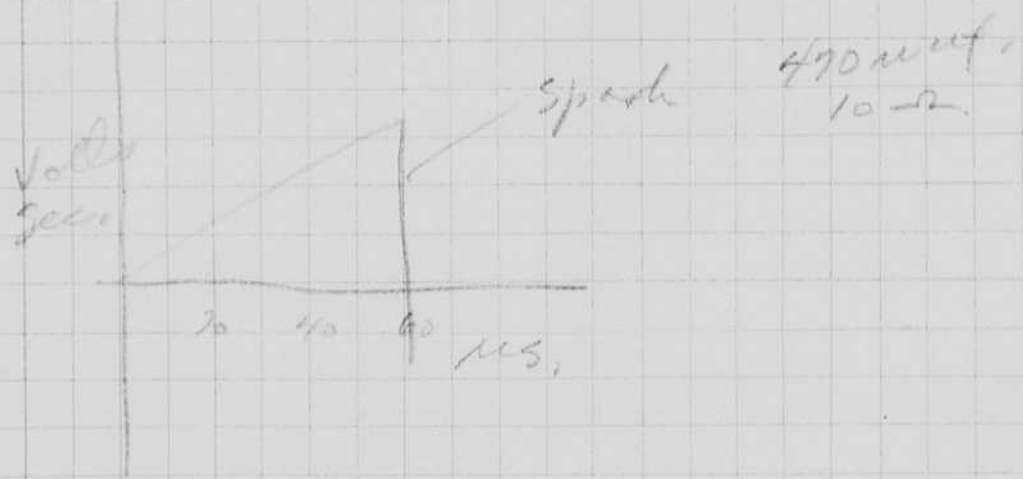
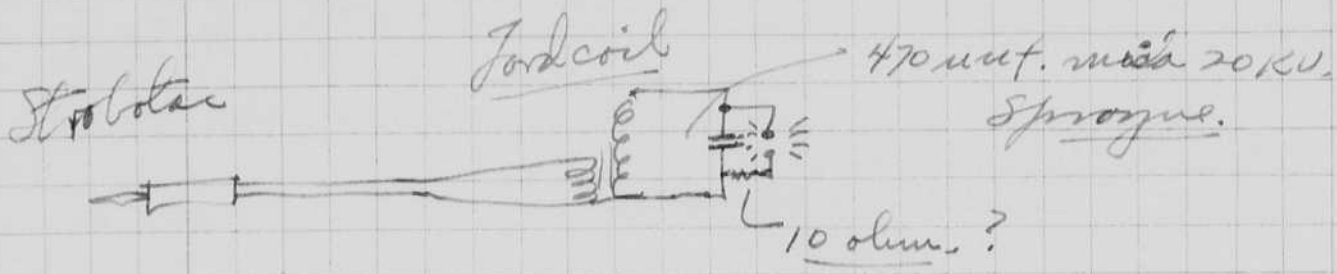
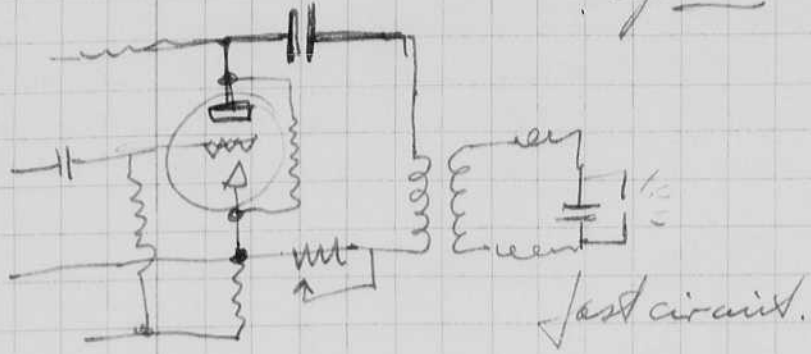
Bars .010" with 2" square plates. - could not read on the scope. Arc seemed weak!

The discharges all have a long tail with a minimum time constant of about 50 m.u.s.

I discussed a Kerr cell cut off unit with Bill MacK and Lloyd Breslav at lunch yesterday.

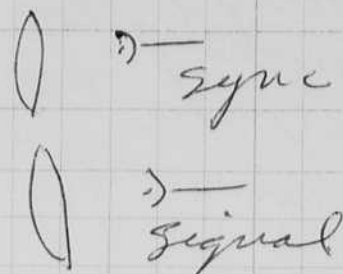
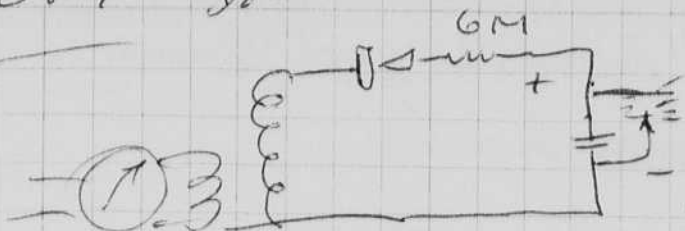


Spark apparatus.



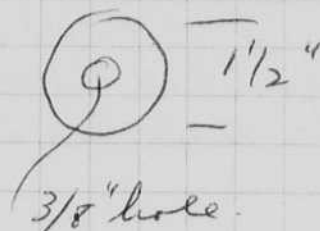
Dec. 7, 1957

Osc #4 ~~29~~  
Duo Coilender.



235  $\mu$ f.  
Mica .004  
Brass plates with phosphine to hold together.

center hole for  
current to come  
through.



1 100  
.01 10 ft.

3 signals top Light.

Middle current?

Bottom  $10^8$  cycles/sec.

930 pm

Repeat on 20 KV instead of 10 KV. on CR tube.

Osc #5

Intensity 6  
Focus 3.

top Light  
Mid current?  
Bot  $10^8$  cycles.

Sparks from Donut 235 mica capacitor.



Jan. 7, 1957  
Harold Edgerton  
20D 102 MIT  
Cambridge Mass.

Short spark.

243 mmf. mica. 004"

1 1/2" disc. air gap 1/8 inch.

Top positive.

Bot print - negative.

I put the condenser and gap into a  
bed of and filled with O<sub>2</sub> gas. The  
color seemed whiter. Otherwise the  
duration seemed the same on the  
scope.

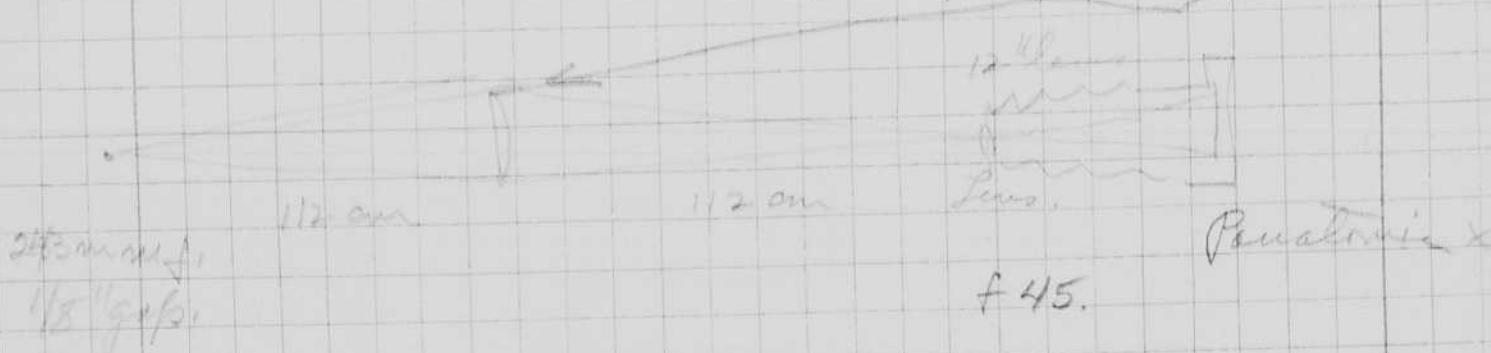
Is this much light sufficient for  
photography - silhouette??

Osc #1 20KV on scope Int 6 Joms 3, Sweeps 5. Sync 10 Stab 6.

234 unit air gap driven at 1 flash  
every 2 seconds from a Hydro-  
gen thyatron from a capacitor.

Light time.  $10^8$  cycles/sec.

Lenses 10cm diam 56cm f.l. from Bull.)



Test 1 no exposure on Panatomic X 2 min X-ray dev  
2 Royal X. Exposure thin! 3" X-ray

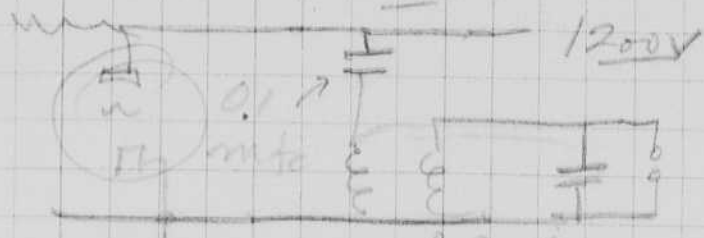
new Developer: Panatomic X still under very  
Royal X.

Photo Royal X with  $6\frac{1}{2}$ " lens

Exposure ok. Soldering iron

Panatomic X ok with  $6\frac{1}{2}$ " lens,

thinner.  
Faded lines from  
Hot Iron.



Model E Model E

248 mfd. Donut

Osc. No. 2.

Spark light from 925 mfd  $\frac{1}{8}$ " gap.

0.35 mfd at  $1700 \pm$  volts into  
thyristor for prism.

Model E coil.  $10^8$  cycles.

Osc. No. 3.

Calibration of light with

FX-11

0.07 mfd at  $7KV \pm$ .

$\frac{1}{2}$ " gap in xenon.

Filter x 10 Density 1 on phototube.

Sweep 2  $10^7$  cycles/sec oscillator.

Peak light

See page 97.

$0.5 \times 10^6$  c.p. peaks.

On Tuesday Dec. 9. I flew to N.Y. on the 8 am Eastern air line  
Plane for a conference with Jacques Cousteau at the  
Eko Factory. We discussed sonar strength of signals.  
Hope to increase output by using a more powerful  
input signal, that is a longer pulse.

1958 trip and effort who discussed same. Not much  
conclusion. 1959 also busy.

Notebook # 24

### Filming and Separation Record

\_\_\_ unmounted photograph(s)

\_\_\_ negative strip(s)

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

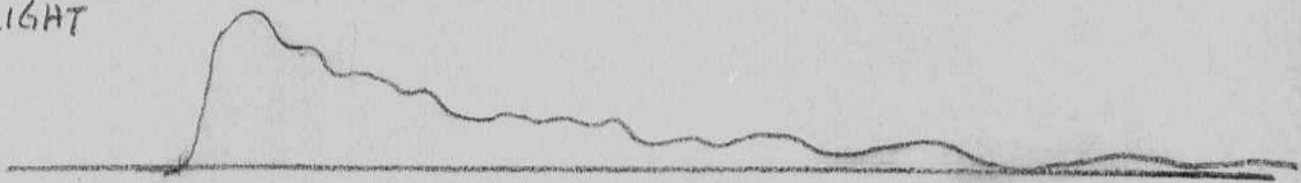
was/were filmed where originally located between page 120 and 121.

Item(s) now housed in accompanying folder.

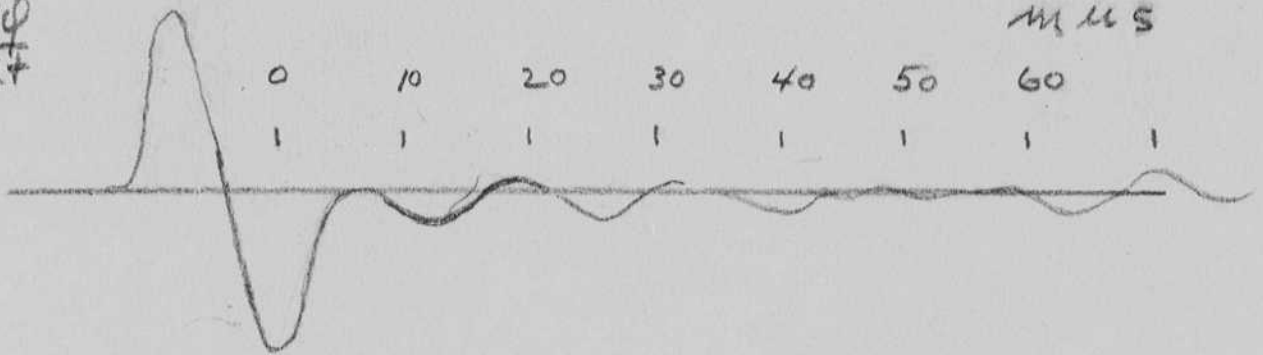
# 4 DEC. 2, 1957

235  $\mu$ f.

LIGHT



$\frac{d\phi}{dt}$

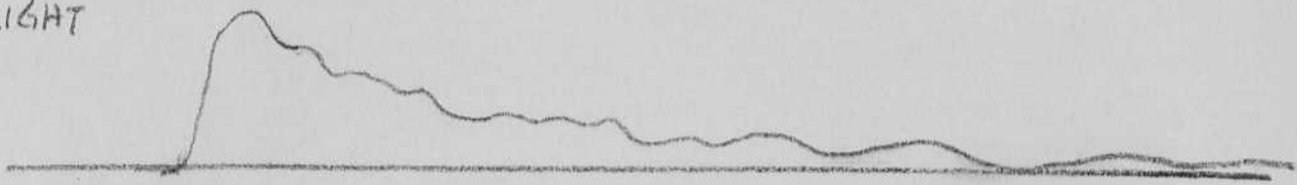


$10^8 - 70 \times 10^8$

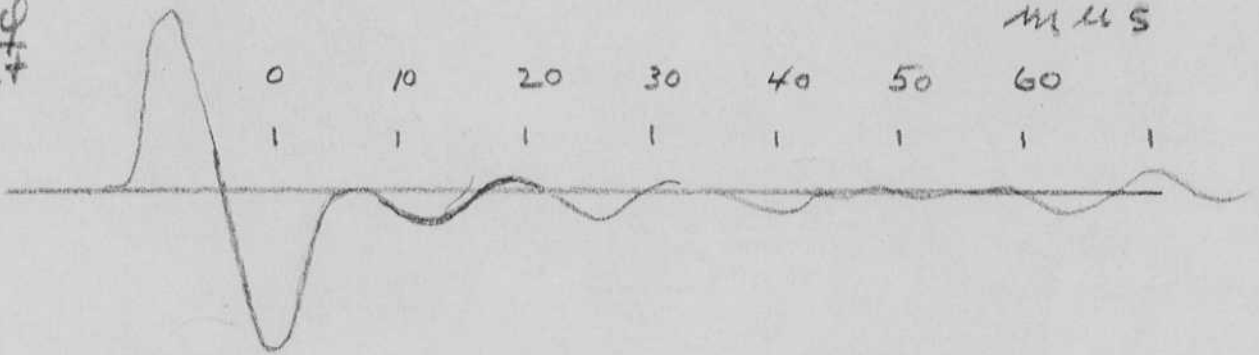
# 4 DEC. 2, 1957

235  $\mu$ f.

LIGHT



$\frac{d\phi}{dt}$



$10^3 - 70 \times 10^3$

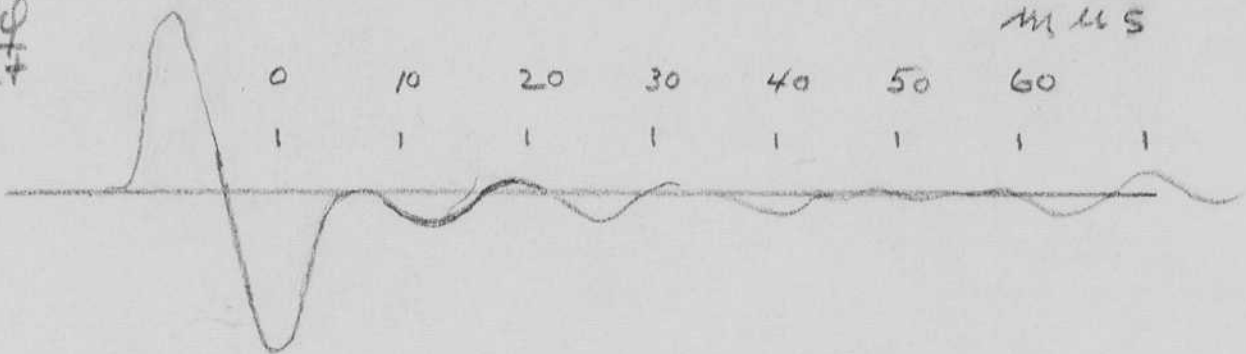
# 4 DEC. 2, 1957.

235  $\mu$ f.

LIGHT

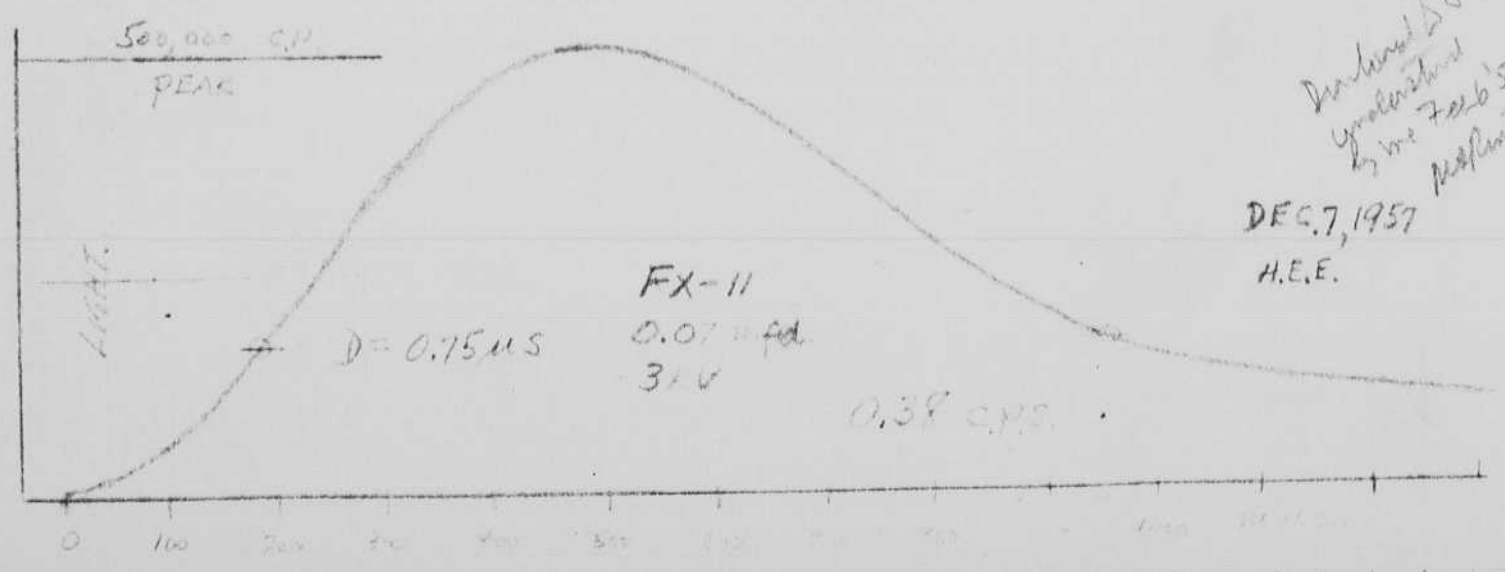
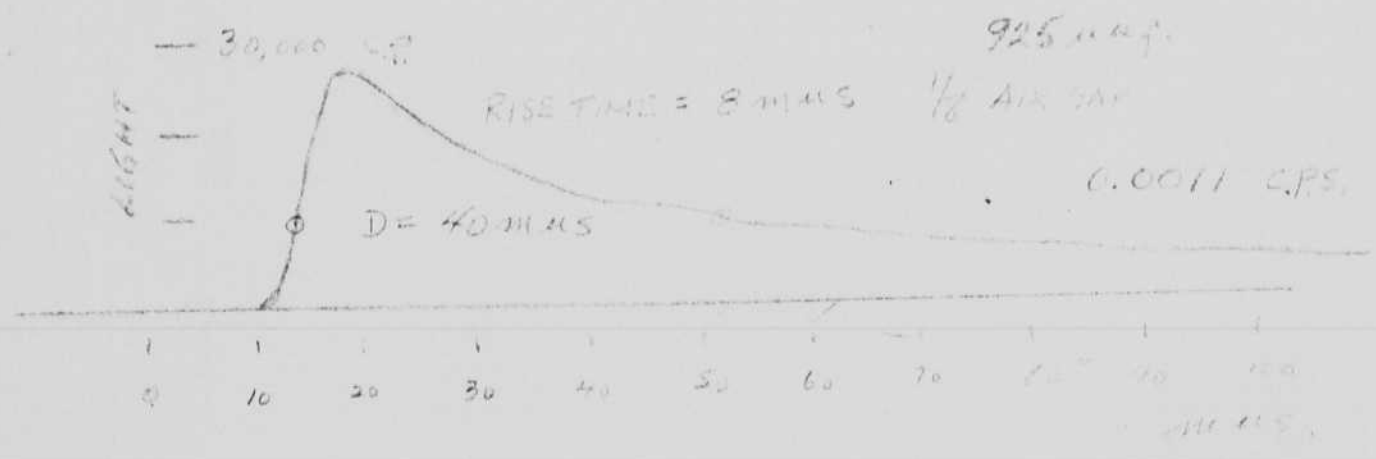
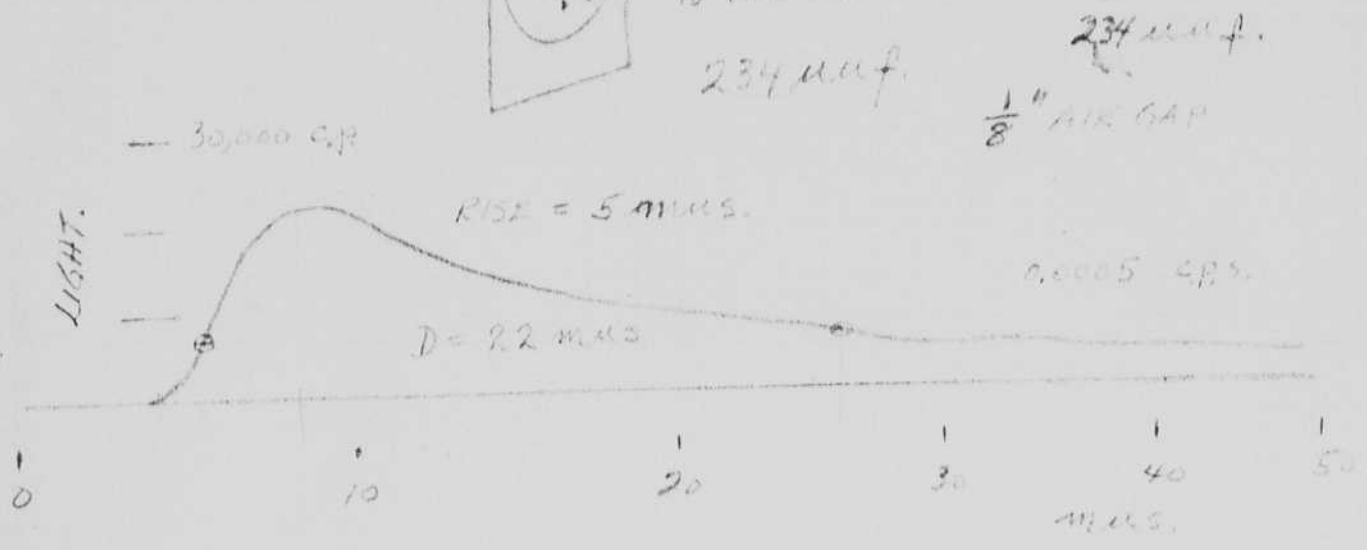
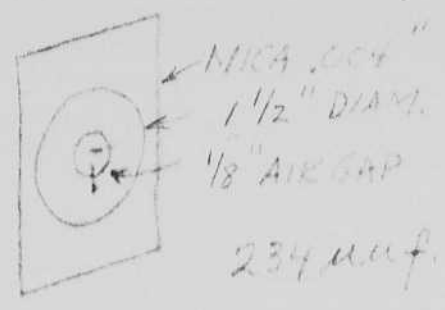


$\frac{d\phi}{dt}$



$\mu$  S

$10^8 - 70 \times 10^8$



Designed & constructed by me Feb 658  
 H.E.E.  
 DEC. 7, 1957

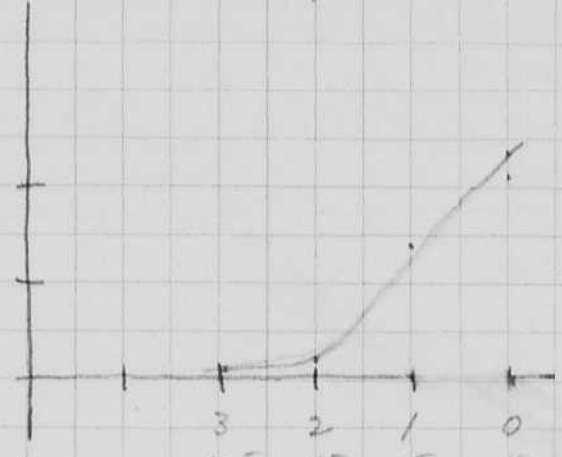
Dec 10 1957. M.I.T. 20D102  
 Harold Edgerton Minicard film tests.

50-1181-4

Light at glass

Ek6 Sensitometer #30.  $10^{-4}$   $1 \times 7$  7 lumen sec/sq ft.  
 $10^{-3}$   $16 \times 30$  480  
 $10^{-2}$   $4 \times 20$  80

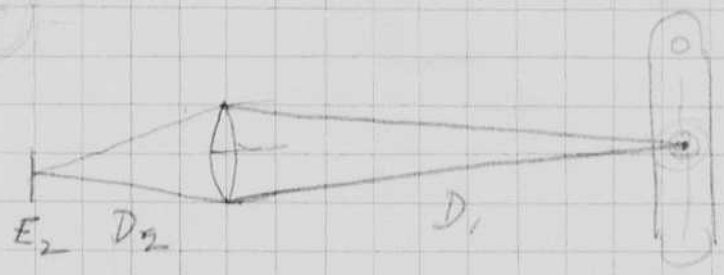
Graded Strip D = 1, 2, 3 and 0.



2.06 2.3  
 1.7, 1.7  
 1.43  
 0  
 $\gamma = 1 \pm$

3	2	1	0	
0.45	4.5	45	450	lumen sec/sq ft.
4.5	45	450	4500	OU.C.S. approx.

CP:  
R<sup>2</sup>



$S = \frac{1}{48}$   
 $S = \frac{1}{50}$   
 Index =  $\frac{1}{200}$

$E = \frac{\text{lumen sec}}{\text{sq ft.}}$   
 at surface

Flux through window of lens per element of volume  $dx dy dz$

$$= \frac{E (\pi r^2)}{4\pi D_1^2}$$

$$E_2 = \frac{E \pi^2 \left(\frac{D_1}{D_2}\right)^2}{4\pi D_1^2} = \frac{E \pi^2}{4 D_2^2} = E \left(\frac{\pi}{D_2}\right)^2 \frac{1}{\left(1 + \frac{D_1}{D_2}\right)^2}$$

$$\frac{1}{D_1} + \frac{1}{D_2} = \frac{1}{D_{\infty}}$$

$$D_2 = D_{\infty} \left[1 + \frac{D_1}{D_{\infty}}\right]$$

$$= \frac{E}{A^2}$$

D72 1:1

Photo f4.5 2 mfd at 1000 v. Exposure ok. arc does not fill tube. 65° 30 sec  
 f4.5 2 mfd at 2000 v ok but not uniform.  
 f4.5 5 mfd at 1000 v 46 mfd! over exposed!  
 f4.5 5 mfd at 2000 v ok.  
 f8 5 " " " " " " " " " " " "

1 1500  
 2 1750  
 3 2000  
 4 2250  
 5 2500



Photo	1 mfd 2000V Silvered	FY-1	f4.5	ok	45 sec	70°
"	"	"	<del>f8</del>		45 sec	70°
	1 mfd 1375	"	f8		"	70°

## Samples for E.R.

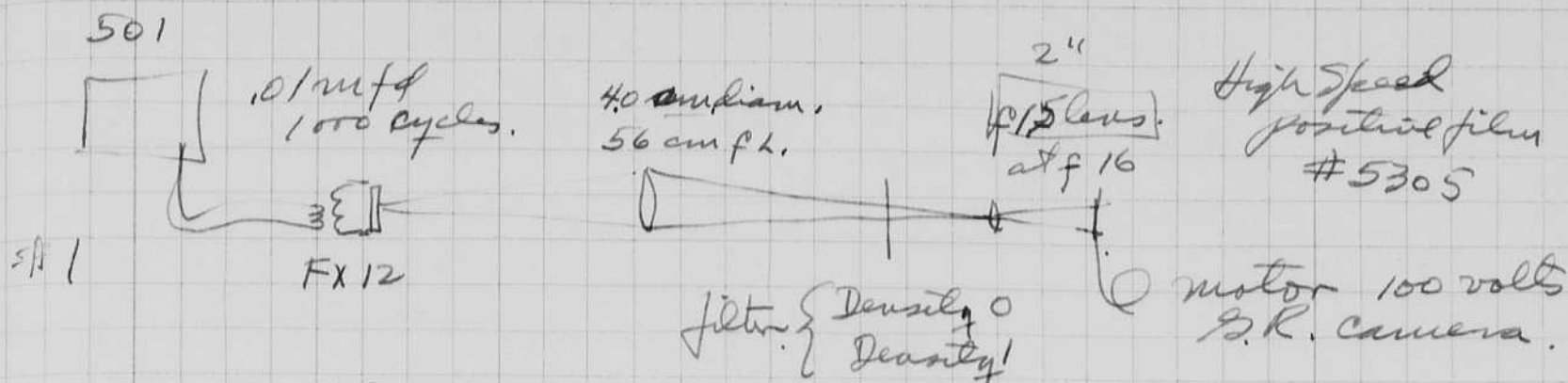
#	1	f8	1 mfd	1500
	2	f8	"	1750
	3	f8	"	2000
	4	f8	"	2250
	5	f8.	"	2500
	6	f4.5	"	1300

## Liquimeter Orig flash. Res.

x 11			10
45 x 16			10
20 x 16			8
36 - 39 x 8			8
24 - 20 x 8	160		6
40 x 4	160		6
23 x 4	92		4
51 - 48 x 2			4
30 x 2	60		2
44 x 1			0

Dec. 14, 1957

# Movies of Tungsten Lamps



Delay for camera .5 sec.

.3 Running time.

Density of film heavy until  $D=0$  { Neg density 2  
 ok. "  $D=1$ . { Neg density 0.8

#2 tried a sample lamp. CLG PH 300 T 8 1/2 / 110  
 Proj. C13 5C  
 300 W T 8 1/2 / 20 V.

~~f/12~~ f/22.  
 no filter used otherwise as per above  
 0.7 sec delay for camera.  
 .75 " " for lamp  
 0.5 sec run time  
 20 turns 5305 film.

the type of back light gives nothing for the lamp since all the light is deflected from the lens.

Lamp burned off at head in tungsten lead. no chance of getting the gas flow pattern with out a parallel plate glass set of windows.



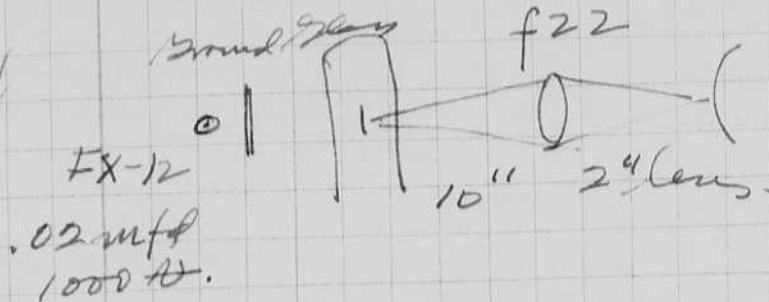
#3. Same but at f/4.  
 arc over shows up on film

New Setup.

5305

5303 film.

#4



GR camera 100V

0.7 sec.

Lamp 0.75.

Runtime 0.1 sec. of lamp.

Stroke weak

Lamp strong at Burnout.

#5

123 volts on camera motor.

0.16 sec run lamp time

Delay .7 sec.

Lamp .75 sec.

Dec 15 1957 Cont.

File except 1" Xenon lamp substituted for the FX-12.

#6

f22

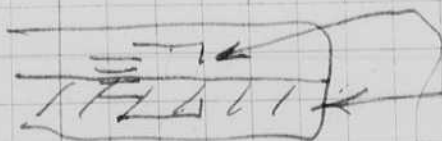
D72 new 1 to 2 water.

Scotch tape on lamp bottom.

#7

Lamp sideways

Tape over part of filament



Tape. The arc seems to end up on the points.

This should give a streak record of the arc transfer. I moved the camera closer. f22

Photo #7 was very good.

127

The arc started at the place where the filament bends from the support to the open end.

#8. Moved closer.

Blanked off lamp to show only one of the bends.

Black Scotch light take.

Speed 2000 cycles.

.02 mfd 1" gap on transformer.

0.7 sec on motor.

0.7 " on lamp.

0.1 run time on lamp.

Overexposed some but readable.

$$\frac{CE^2}{2} = .02 \times 32$$
$$.64 \text{ watt sec}$$
$$\frac{.64}{2000}$$
$$1.28 \text{ KW.}$$

#9. Density 1 filter 10x exp. f22 same film  
no ground glass.

.02 mfd 2000 cycles.

0.15 run time. 24 turns film supply.

This shot was ok!! The arc fogged a bit but not too much.

Tungsten droplets can be seen as streaks and as particles with the flash.

Confusion where both streak and flash occur! The density seems to be less where the particle is photographed by the flash!

10 Forgot x10 filter. ? yes but ok.

11 x10 filter no photo.

Dec 16 1957  
H. G. Edy;

#12. Continued.

.02 mfd  
8KV  
501.  
2000 cycles.



Xenon  
lamps.



$f = 4$

$D = 1$

2<sup>nd</sup> lens.

$f = 22$



old.  
5303 film.

35 mm

123V set on motor

0.7 delay

0.72 lamp tungsten

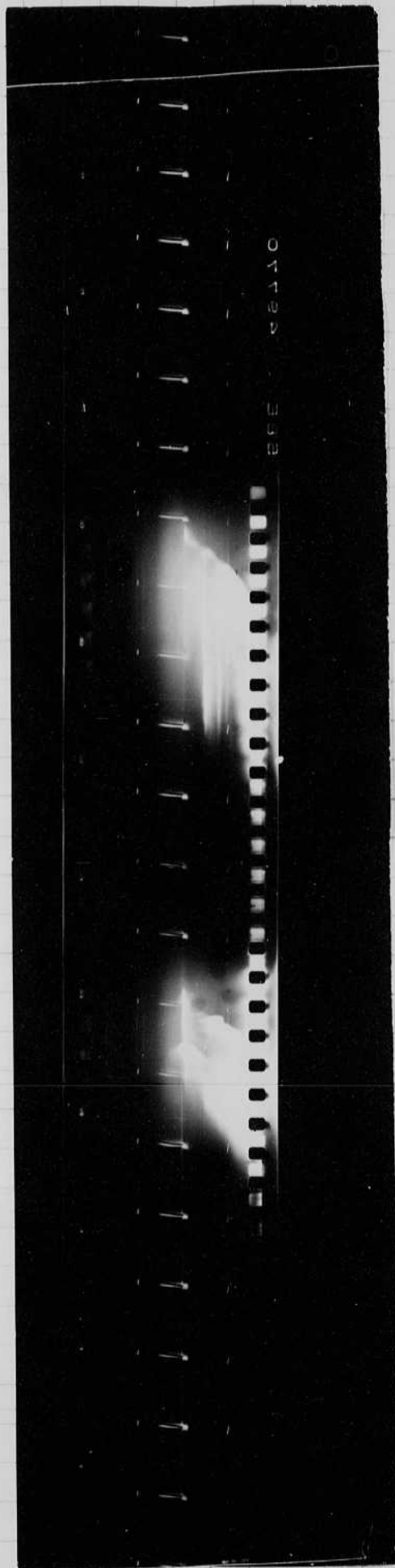
Run. 0.3 sec Xenon.

Came out ok. arc in lamp was bright. causes some fog. Incandescent tungsten drops cause streaks on film.

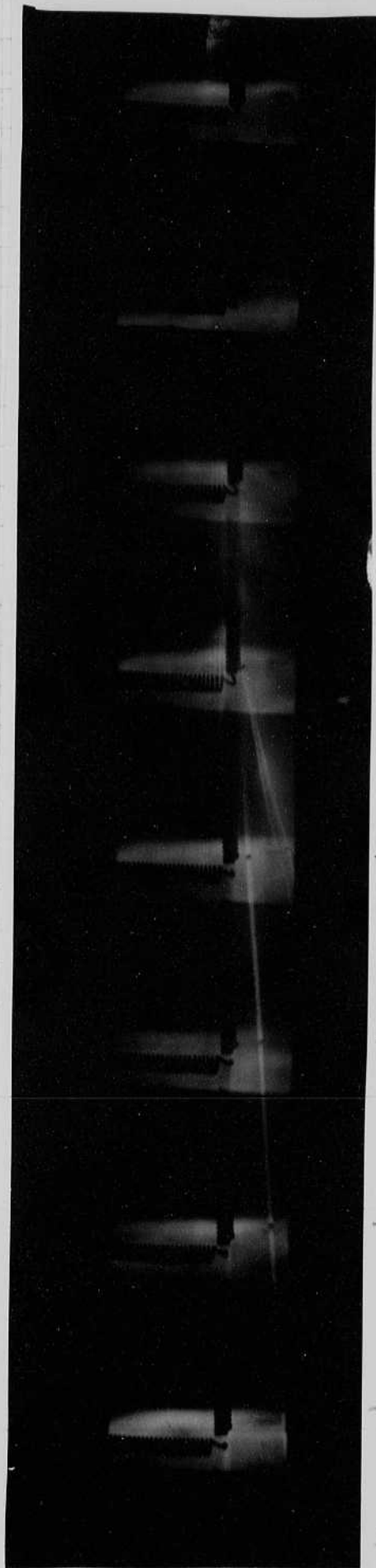
The photos show the arc starting point.

1. Is the arc due to gas breakdown?
2. Does the metal center piece in the filament lead play any part in the starting of the arc? Is this metal tungsten?

#7  
1000 fps



#8  
2000 fps



note  
Droplet  
of tungsten  
melted?  
why dark  
when  
flash  
goes off??

Dec 16 1957  
H. G. Edg.

#12. Continued.

0.02 mfd  
8KV  
501.  
2000 cycles.

5/8"  
Xenon  
lamps.

4<sup>u</sup>  
±

D=1

2<sup>u</sup> lens.

f 22

old.  
5303 film.

35 mm

123Voltson motor

0.7 delay

0.72 lamp tungsten

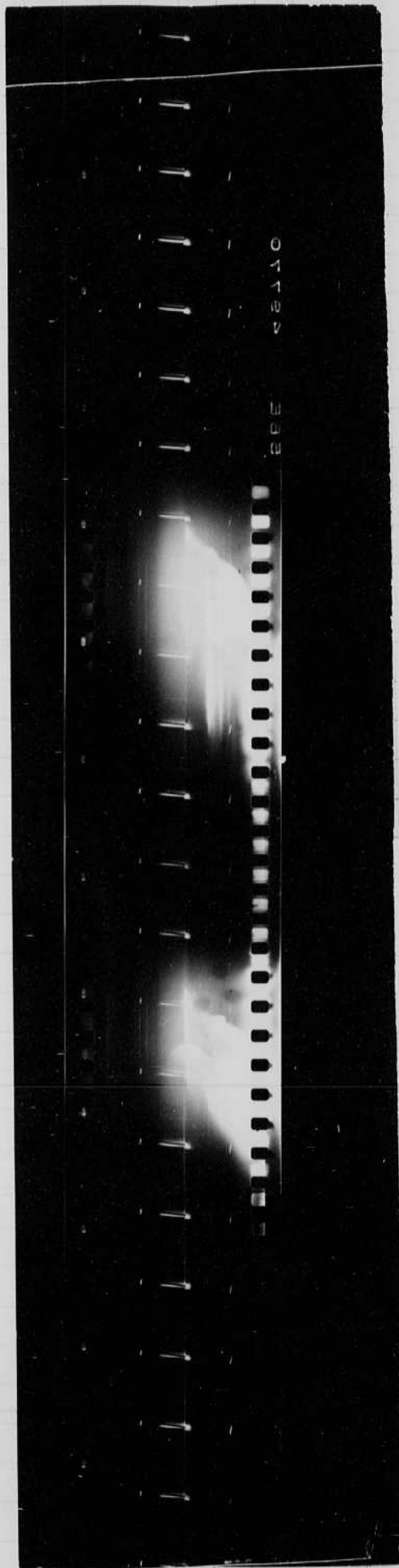
Run. 0.3 sec Xenon.

Camera out ok. arc in lamp was bright. causes some fog. Incandescent tungsten drops cause streaks on film.

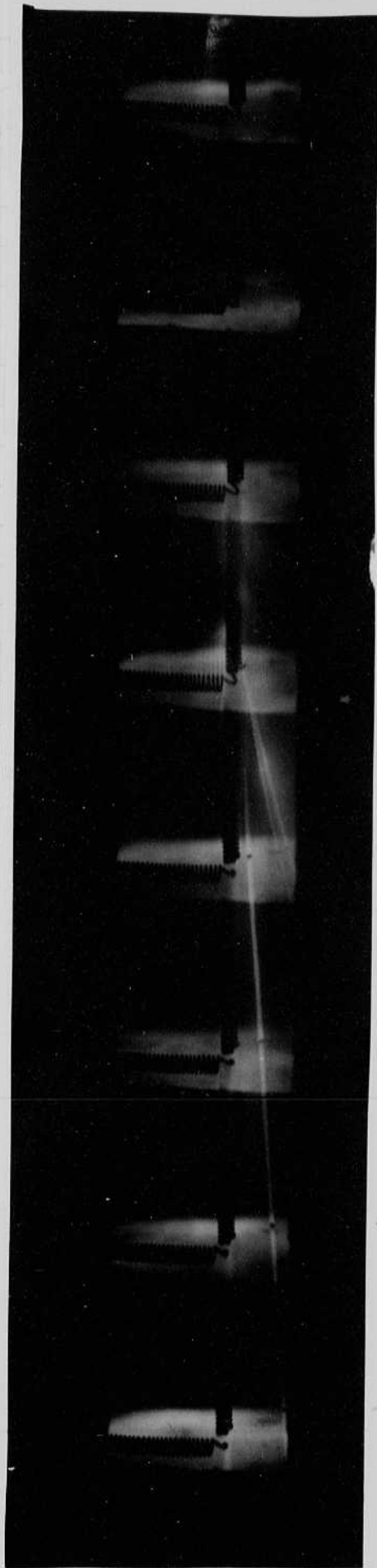
The photos show the arc starting point.

1. Is the arc due to gas breakdown?
2. Does the metal center piece in the filament lead play any part in the starting of the arc? Is this metal tungsten?

#7  
1600 FPS



#8  
2000 FPS



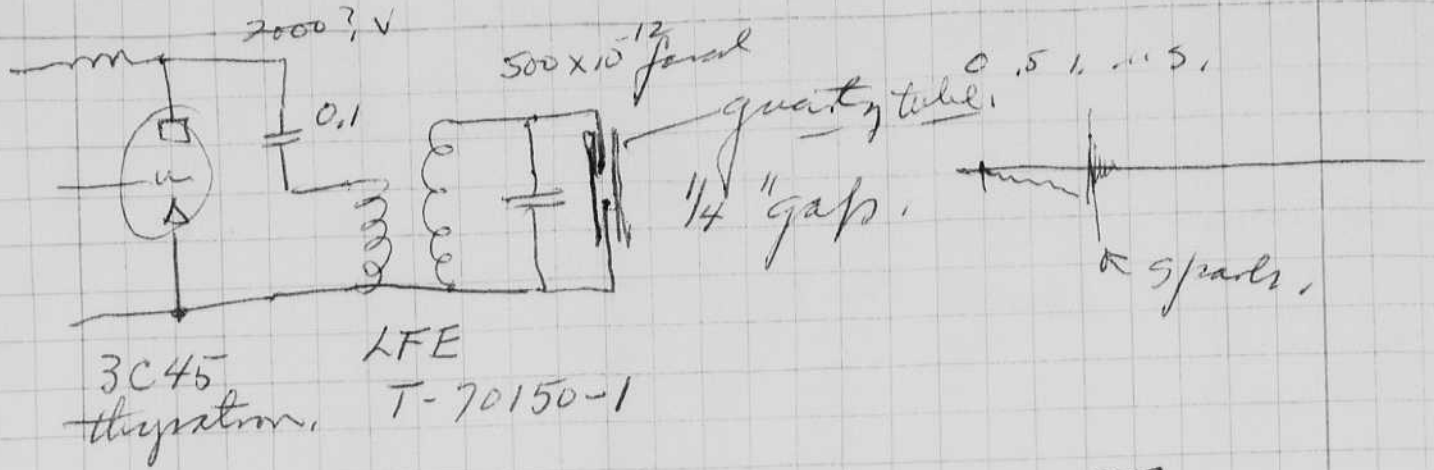
129

note  
Droplet  
of Tungsten  
melted?  
why dark  
when  
flash  
goes off??



Dec. 19, 1957.

Spark Source. Short flash.



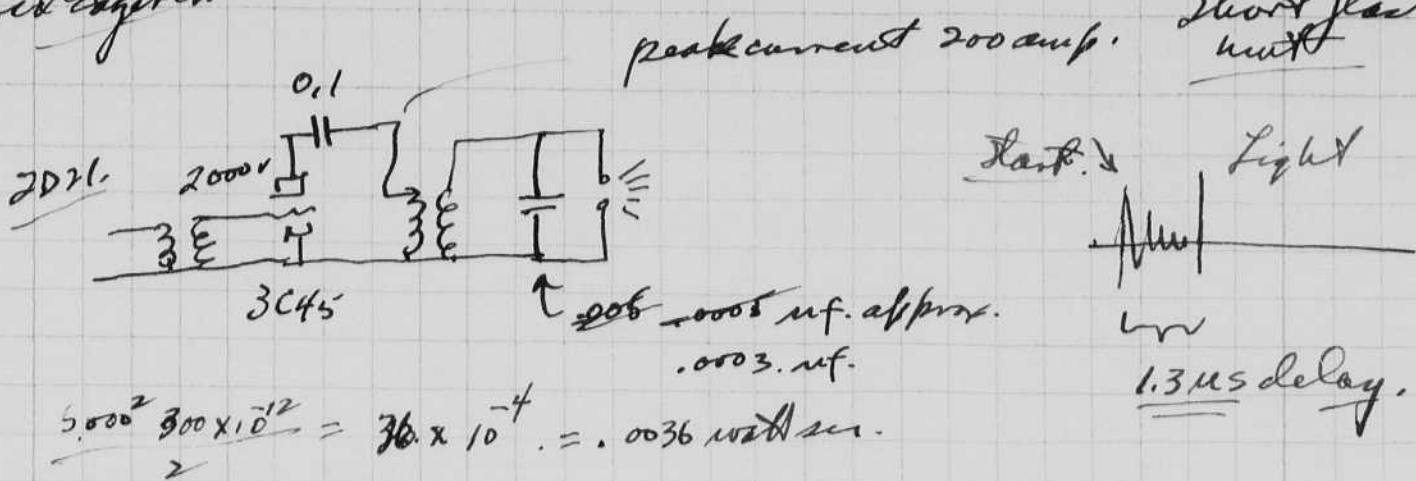
1957  
6.20 class.

Dec 1957  
Party  
Ascarelli  
~~Angelo~~  
Davies  
Bahiana  
Larissa  
left early.

Crice Hill      Bright Cooper      Kezar  
 Bennett Gillette      Sealey  
 Christensen      Compton      Helge Heen.      Bristol  
 Hayward      Wein      Jung  
 Fishman

Dec. 30, 1957.

Harold Edgerton.



$$\frac{5,000^2 \cdot 300 \times 10^{-12}}{2} = 36 \times 10^{-4} = .0036 \text{ watt sec.}$$

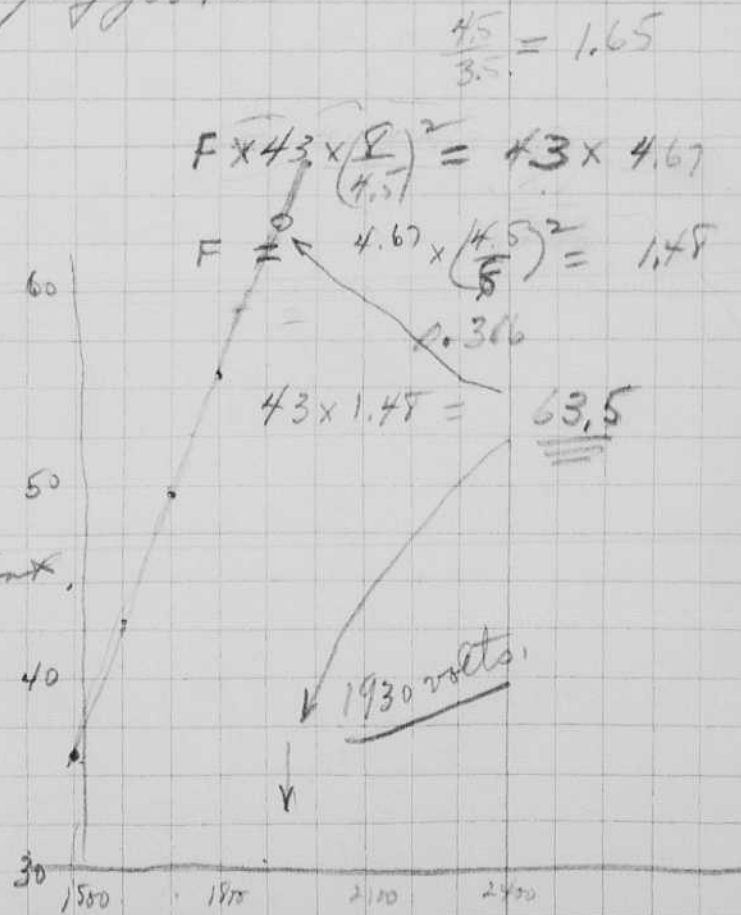
Jan 3 1957. Photos of FX-1 on microcond film  
Letter from A.E. Newman, Dec. 18, 1957.

3,4,5, excellent in uniformity but  
weaks.  
#5 is 1 mfd f8 2500 volts,  
f8 to f3.5 is factor of 5.2

Density of film shows a log E increase of 0.67 is reqd  
 $E = 4.67 \approx 5.$

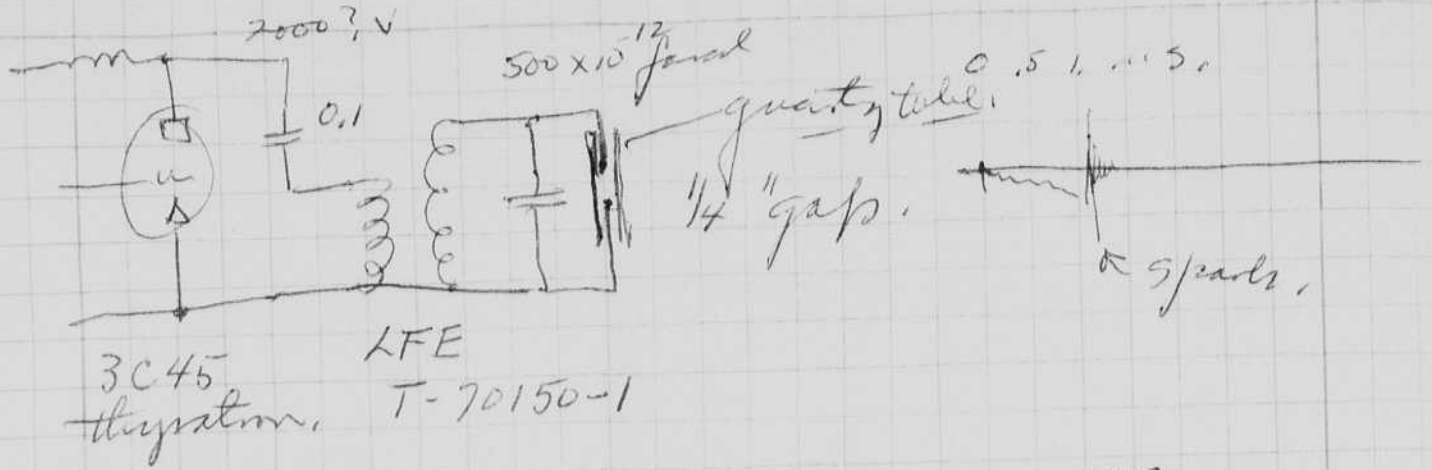
Light test of meter #306 x1 6" to center of FX-1  
1 mfd at 2500 volts.  
Light = 43 lumens/sq foot.

mfd.	Volts	Light
1	2500	43
2.	2000	39.
3	2000	50+
3	1500	36
3	1700	49
2	1800	56
3	1600	43
3	1500	36
2	1400	30
2	1300	24
2	1200	- no start.
2	1800	52 ?
3	1800	56



Dec. 19, 1957.

Spark Source. Short flash.

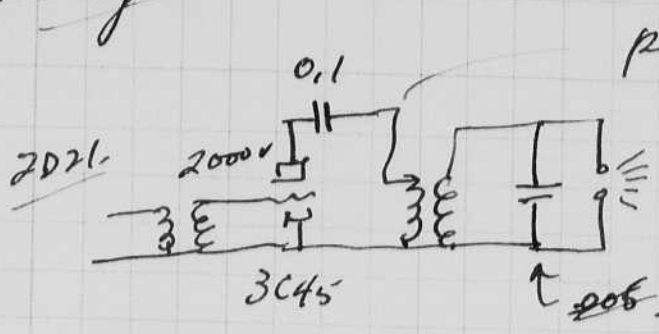


1957  
6.70 class.

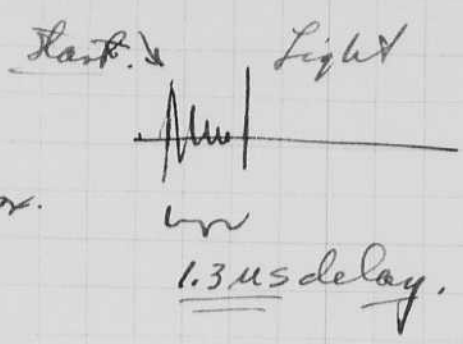
Dec 1957  
Party,  
Ascarelli  
~~Angelo~~  
Daries  
Bahiana  
Jawara  
left early.

Crice Hall      Bright Couper      Kezar  
 Bennett Willette      Sealey  
 Christensen      Helge Heen.      Bristol  
 Hayward.      Coupton      Weinstub  
 Fishman      Jung

Dec. 30, 1957.  
Harold Edgerton.



peak current 200 amp. Short flash unit



$$\frac{5.500^2 \cdot 300 \times 10^{-12}}{2} = 36 \times 10^{-4} = .0036 \text{ watt sec.}$$

200-10000 mf. approx.  
.0003 mf.

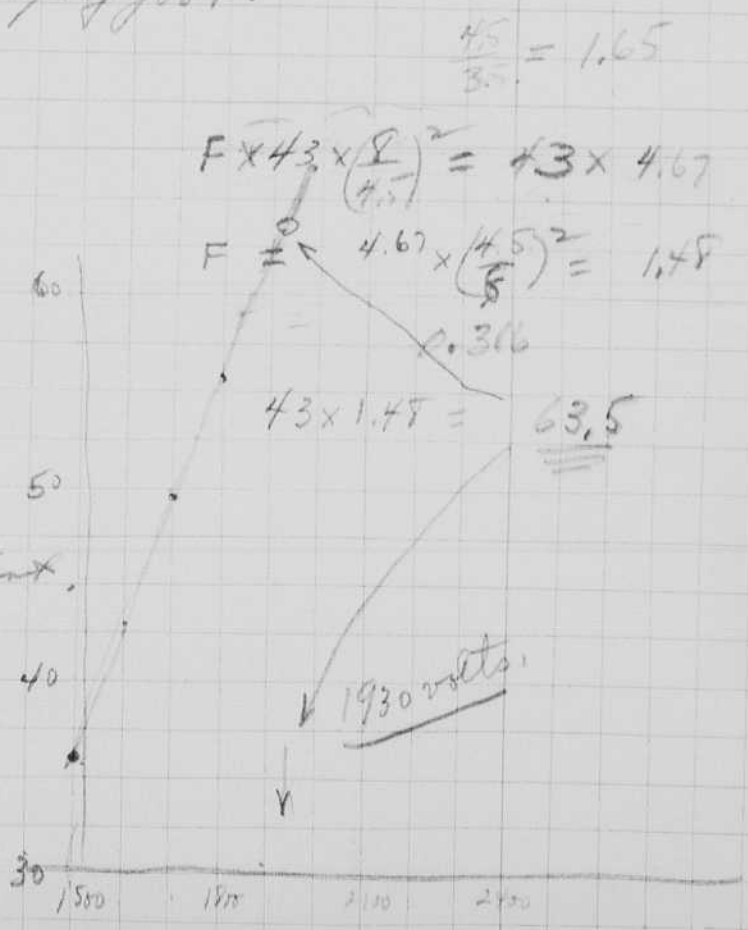
Jan 3 1957. Photos of FX-1 on microcard films  
Letter from A.E. Newman, Dec. 18, 1957.

3,4,5, excellent in uniformity but weak.  
#5 is 1 mfd f8 2500 volts,  
f8 to f3.5 is factor of 5.2

Density of film shows a log E increas of 0.67 is reqd  
 $E = 4.67 \approx 5.$

Light test f meter #306 x1 6" to center of FX-1  
1 mfd at 2500 volts.  
Light = 43 lumens/sq foot.

mfd.	Volts	Light
1	2800	43
2.	2000	39.
3	2000	50+
3	1500	36
3	1700	49
2	1800	56
3	1600	43
3	1500	36
3	1400	30
3	1300	24
3	1200	- no start.
3	1800	52 ?
3	1800	56



Notebook # 24

### 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 130 and 131.

Item(s) now housed in accompanying folder.

Names and addresses of students in Professor Edgerton's 6.20 section - Fall 1957

Gianni Ascarelli  
64 Mt. Vernon St.  
Cambridge  
(Rome, Italy)

Jack Christensen  
265 Westgate West  
Cambridge  
(E. Windsor Hill, Conn.)

Timothy Gillette  
Bemis 202  
East Campus  
(Springfield, Vt.)

Luiz C. Bahiana  
12 Devereaux St.  
Arlington  
(Rio de Janeiro, Brazil)

Ted Compton  
67 Inman St.  
Cambridge  
(Bethesda, Md.)

David M. Hall  
East Campus  
Wood 301  
(Newport, Maine)

Glenn Bennett  
477 Beacon St.  
Boston  
(Amherst, Mass.)

William D. Couper  
242 Westgate West  
Cambridge  
(Johnstown, Pa.)

Gary Hayward  
East Campus  
Hayden 101  
(Anchorage, Ky.)

Glen E. Brick, Jr.  
Baker House  
M.I.T.  
(Webster City, Iowa)

Robert S. Crice  
50 Mass. Ave.  
Cambridge  
(Bandana, Kentucky)

Helge Heen  
3 Pama Gardens  
Brighton  
(Romsdal, Norway)

Gordon W. Bright  
111 Bay State Rd.  
Boston  
(Janesville, Wisconsin)

Richard A. Davies  
Burton House  
M.I.T.  
(Warwick, Virginia)

Check Kan Jung  
East Campus  
Wood 315  
(New York City)

E. H. Bristol  
441 Beacon St.  
Boston  
(Foxboro, Mass.)

Robert C. Duncan  
188 Beal Rd.  
Waltham, Mass.  
(Xenia, Ohio)

Randall Kezar  
114 Pleasant St.  
Arlington  
(Williamstown, Mass.)

David T. Brown  
Burton House  
M.I.T.  
(Milford, N. H.)

Djalma S. Ferreira  
146 Fayette St.  
Watertown  
(Rio de Janeiro, Brazil)

W. G. Seeley  
5 Columbia Terr.  
Cambridge  
(Natick, Mass.)

Bob Buchler  
Burton House  
M.I.T.  
(Bergenfield, N. J.)

Harvey M. Fishman  
Burton House  
M.I.T.  
(Lynn, Mass.)

Sandy Weinreb  
3 Chauncy St.  
Cambridge  
(Atlanta, Georgia)

Gerald Gershon  
819 Beacon St.  
Boston  
(Brooklyn, New York)

Photos. 501181 film.

#	mf	v	Notes
1	3mf	1950 v	Half silvered FX-1 old model.
2	3mf	1950 v	18" from lens.
3	3mf	1530 v	f 4.5 · 2" lens.
4	3mf	1530 v	1/8" scotch tape across the tube by the
5	3	1950	4 1/2" long ±.
6	3	2000	
7	3	2250	

Trip South. Left Sat Dec 21 about 9 or 10 am for Chaddsford Pa to spend the night with Margaret & Robinson and family. (T.F.) Then left at noon Sunday for Washington. Chevy Chase had to see Mary Ellen Poque. (J.W.) 5204 Kenwood.

Visited N.O.L. to see Dr. Albert May on Monday at 8:15. Inspected firing ranges. I showed him my results with short flashes.

Left at 1 pm Monday for Hickory N.C. Over night at Chatham (Davis) north of Danville Va. Arrived Hickory at Mary Louise Dixon's house about 11 am (Chas.) Dec 24. Enjoyed Mary Anne (2 months old) Bill Palmer 1+ (Oct 11) and Janice 3 1/2+ (Aug 14). Busy Christmas! Chas mother and brother and sister from Belmont N.C. were there for dinner.

Left Hickory at 5 pm on Dec 26 for north stopped again at Chatham - then into Washington at noon to have lunch at the A.G. Society with Wisbeid. Saw Marden's movie on Pitcairn Island. Then went to N.I.D.H. to talk and demonstrate the microscope equipment - took trial photos of eye cross sections.

# Baam tests

Jan 4, 1958.  
H. Edgerton

20" 9mm o.d. flash tube.

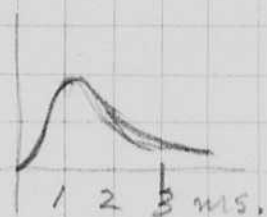
Eventual loading 5000 waltsec at 12 sec interval.

Temp

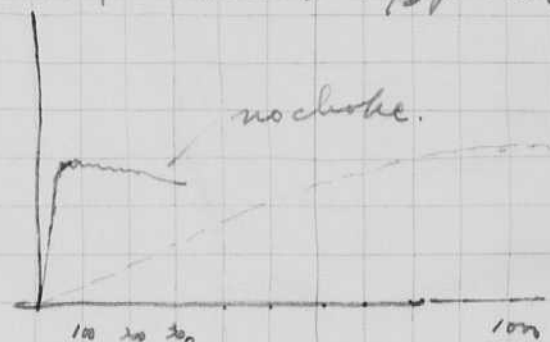
27°C	10.45	2500V	c. 600	13 sec.	mounted in a 4" diam pyrex tube Horizontal 30" length.
35.5	10.50	2500	600	13 sec.	thermo ↓ aluminum Reflector.
42.0	10.54	"	"	13	
46.5	11.00	2500- 2350	"	13.	



Light rises in 50 us. with out choke 2500V 600 mfd 2000 us to 1/3 peak.



2 mh. makes peak at 1 ms.



11.15	2500	600	13 sec.
47.5	11.22	2500	600 13.4

Total 3 ms. with 2 mh choke in series.

47, 46. no choke.

39, 42, 45

with 2 mh.

choke has <sup>small</sup> effect

40.0°C	11.40	2500	600	13 sec.
46	11.44	3250	600	13 sec.
52	11.47	3500 ±	600	13 sec.

$$1.5 \times 2 \times 250 = 750 + 250 = 1000 \text{ J.}$$

$$\begin{array}{r} 1.8 \\ 2 \\ \hline 3.600 \\ 2.50 \\ \hline 2.95 \end{array}$$

38.	11.55 st.	1.8 x 2 + 250 3850	6000	13 sec.
-----	-----------	-----------------------	------	---------

51.5	12.01	4000	600.	13.
------	-------	------	------	-----

78.0°C	12.10	4000 -	600	13
--------	-------	--------	-----	----

off for 2 min for inspection seems to be ok. very slight darkening at anode.

79.0°C	12.20	4000	6000	
--------	-------	------	------	--

84.	12.27	4000	600.	13.
-----	-------	------	------	-----

83	12.35	4000	600.	13
----	-------	------	------	----

85.	1.01	4000	600	13.
-----	------	------	-----	-----

89.0°C	1.22	4000	600	13
--------	------	------	-----	----

90 ±	1.52	"	"	"
------	------	---	---	---

Can't read thermo due to angle off while out to lunch

Saph photo on p 134.

30st	3.15 on	4000	600	13
------	---------	------	-----	----



The inner surface of the 20 inch 9mm tube show spots in the wall. There is a thin layer radiating from small spots of impurities. Some of the spots are copper which appear to be stuck in the wall of the tube. a thin film of density  $0.7 \pm$  (maybe less) appear around each spot. Some of the films have ring variations of density.



← Copper spot in lamp.

French Leuses from Lucien Ball 14 Rue des General  
 10 cm diam Deux Ventilles plein converger Delestraint  
 56 cm f.l. Benoit-Barthierot. Paris 16  
 France  
 (au lieu de 66) !!

Gray - Polaroid Jan 8 1959

750 mfd 45 volts Tungsten Lamp #428 75c

$\frac{C \cdot E^2}{2} = 0.750 \text{ watt sec.}$   $45 \times 10^2 = \frac{2500}{15} = 166.67$

ASA speed 3000.

$DA = \sqrt{\frac{S}{C}} \text{ (BCPS)}$

$40 = \sqrt{\frac{3000}{15}} \text{ (BCPS)}$

$\frac{15 \times 1600}{3000} = \text{BCPS}$

8 = BCPS

Reflector factor = 8

1 cps =

1/2

1/2 watt sec

$\frac{250 \text{ volts}^2 \cdot C}{2} = 1/2 \text{ watt.}$

$C = \frac{1}{2} \cdot \frac{1}{250^2} = \frac{10^6}{.64} = 25 \text{ mfd.}$

V.G.M. Light comparison with G.R. meter and extension photwell

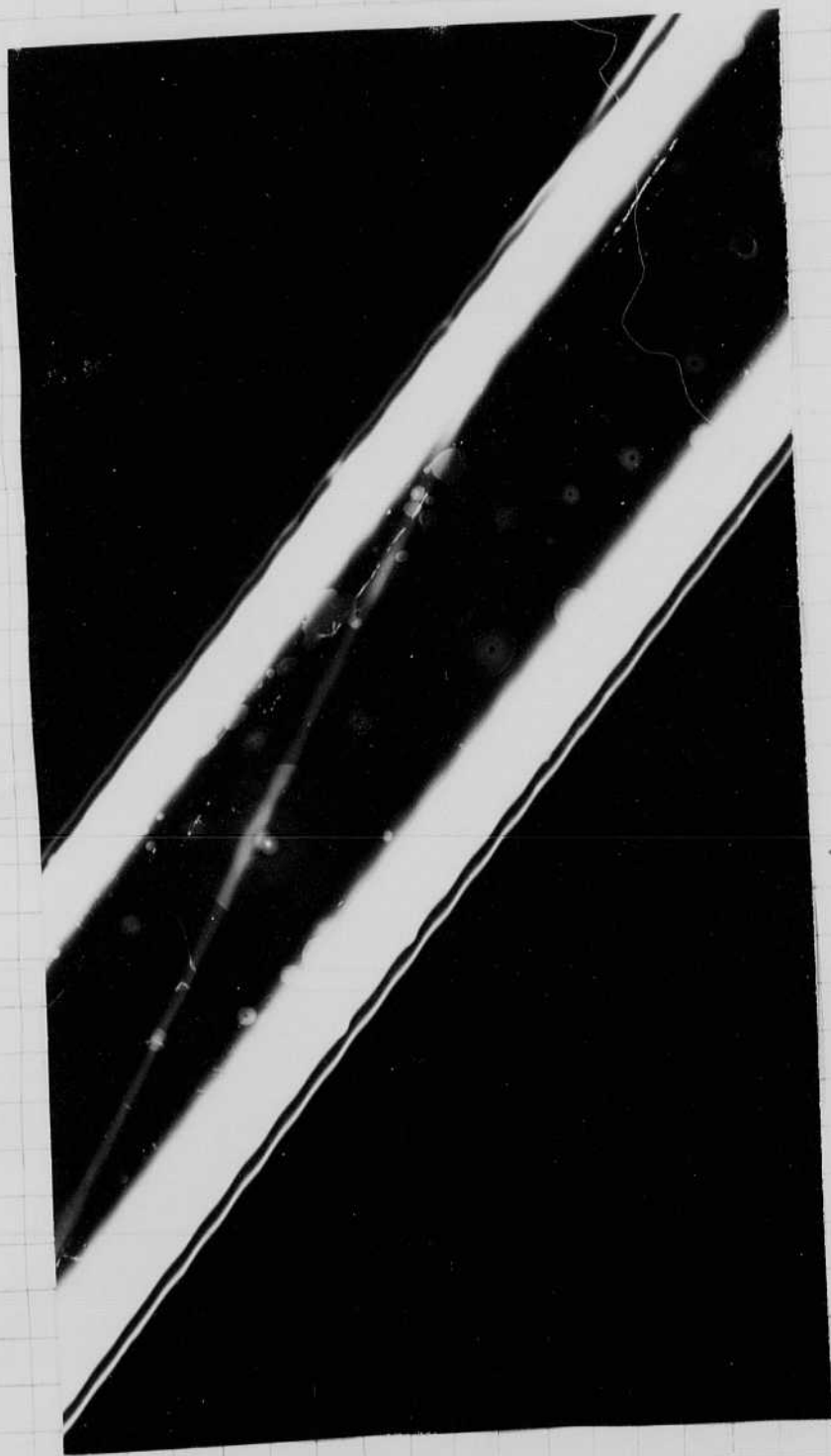
Polaroid flash at 3ft 3.7 1/12 sec shutter.

FT-106 in Eastman Midget Plastic Reflector } 3ft 3.7 125V, 87 mfd, 0.688 w.s.  
 Spotty

FT-106 in reflector (electrodes just inside) 23 125V 87 mfd 0.688 w.s.  
 31 250V 22 mfd 0.688 w.s.

This setup compares favorably with Polaroid flash ← photographically

The inner surface of the 20 inch 9mm tube show spots in the wall. There is a thin layer radiating from small spots of impurities. Some of the spots are copper which appear to be stuck in the wall of the tube. a thin film of density  $0.7 \pm$  (maybe less) appear around each spot. Some of the films have ring variations of density.



← Copper spot in lamp.

Trench Leuses  
10 cm diam  
56 cm f.l.

from Lucien Ball 14 Rue du General  
Delestraint  
Paris 16  
France  
Doux Pentilles plein converger  
Renoiot-Berthiot.

(au lieu de 66)!!

Gray - Polaroid Jan 8 1958

750 mf 45 volts Tungsten Lamp #428 75c

$\frac{C \cdot E^2}{T} = 0.750 \text{ watt sec.}$

ASA speed 3000.

$DA = \sqrt{\frac{S}{C}} \text{ (BCPS)}$

$40 = \sqrt{\frac{3000}{15}} \text{ (BCPS)}$

$\frac{15 \times 1600}{3000} = \text{BCPS}$

$\delta = \text{BCPS}$

Reflectivity factor =  $\delta$

1 cps =

1/2

1/2 watt sec

$\frac{200 \text{ volts}^2 \cdot C}{T} = \frac{1}{2} \text{ watt.}$

$C = \frac{1}{2} \cdot \frac{1}{200^2} = \frac{10^6}{.64} = 25 \text{ mfd.}$

V.P.M. Light comparison with G.R. meter and extension photovolt

Polaroid flash at 3ft 3.7 1/12 sec shutter.

FT-106 in Eastman	} 3ft	3.7	125V, 87 mfd.	0.688 w.s.
Midget Plastic Reflector				
Spotty				

FT-106 in reflector	23	125V	87 mfd	0.688 w.s.
(electrodes just inside)	31	250V	22 mfd	0.688 w.s.

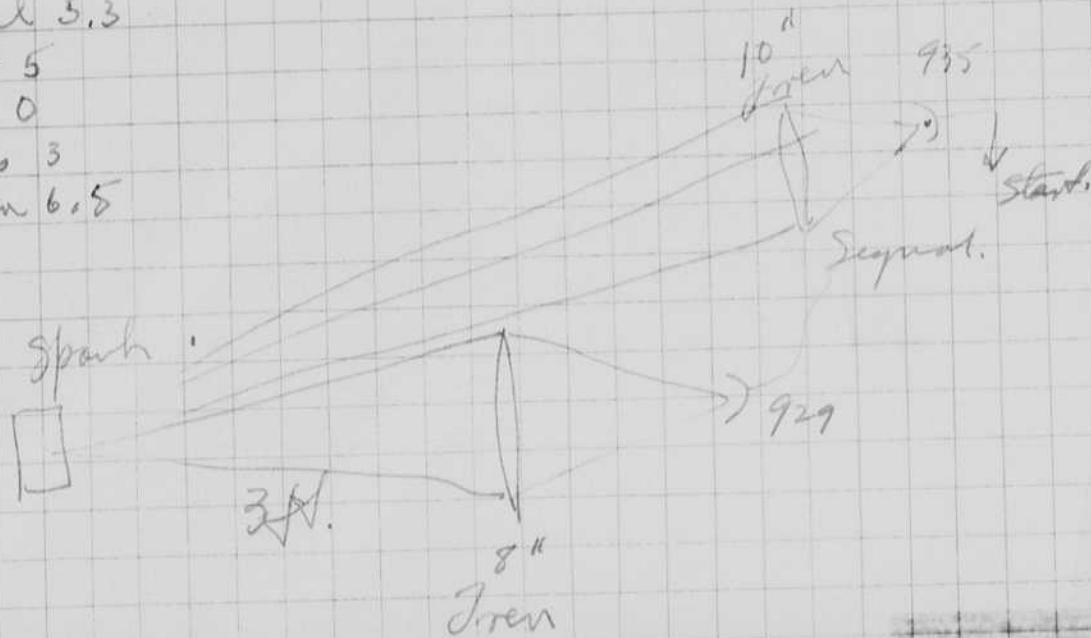
This setup compares favorably with Polaroid flash ← photographically

Jan. 9, 1958.  
Harold Edgerton.

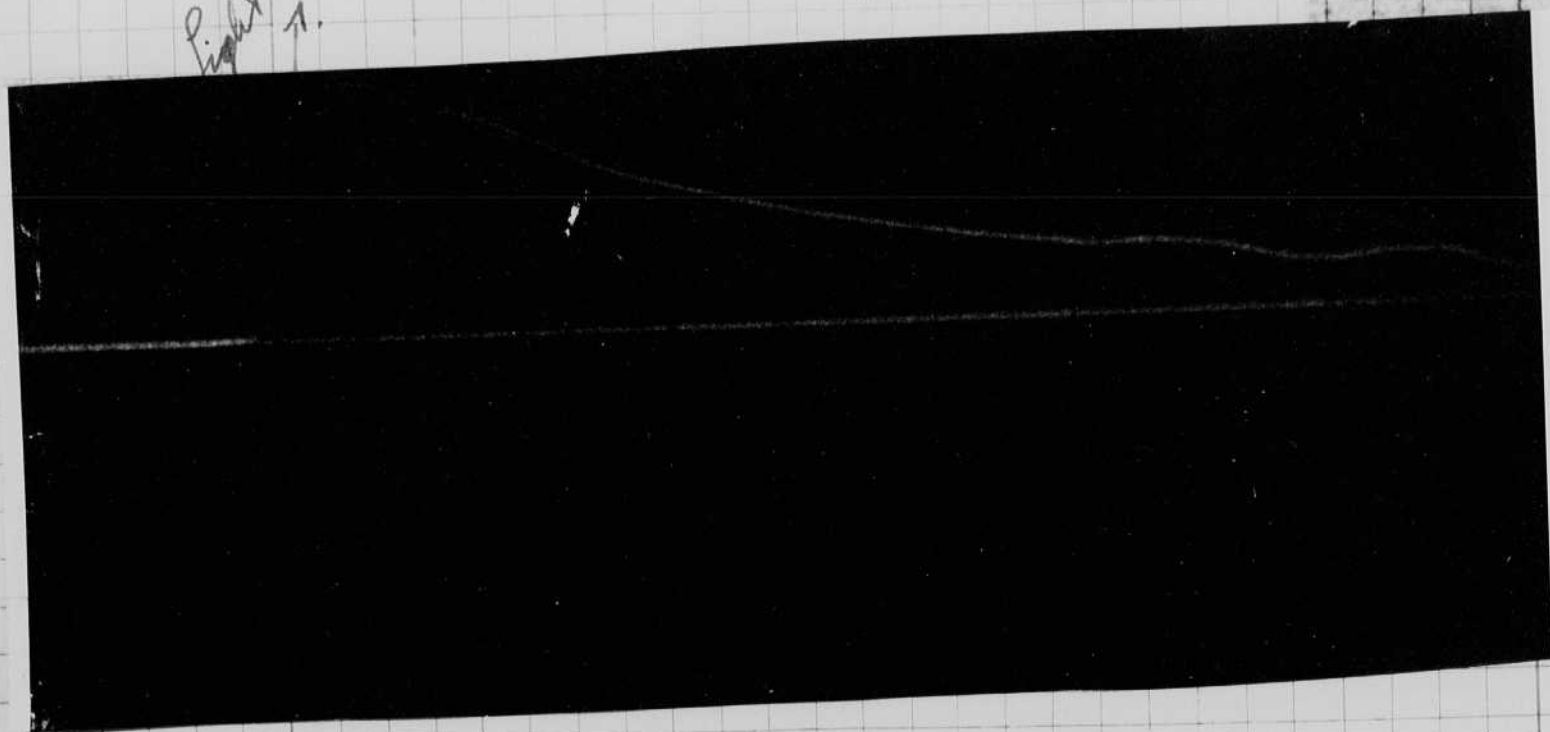
Oscillograms of sparks. Bill has packaged the short spark which is shown on page 122.

Elli Scope #34 2236 type

Speed 5  
Keto High  
Sync Jan 9  
Skel 5.3  
Vert 5  
H 0  
Focus 3  
Disten 6.5



Light 1.



$10^{-8}$

$2 \times 10^{-8}$

$3 \times 10^{-8}$   
seconds

Beacon tube.

Bill MackRoberts  
H. Edgerton.

570 mfd  
4000 volts

4570 wattseconds.  $20 = 2$  millihenries in series.

$92 \times 4 \times 8^2 = 23,600$  h.c.p.s. from 20 inch  
9 mm O.D.  
vacuum 20 cm

$\frac{23600}{4570} = 5.17$  cps/watt. Duration 3 ms.

Reflector Chromolux E. L. Wiegand Co  
7500 Thomas Blvd  
Pittsburgh 8 Pa

Factor of 10 with  $15^\circ$  beam.

Lamp  $\frac{3}{4}$ " from front surface.

Model Phototube  
700 volts 10 mfd

$\frac{1}{2}$  foot reads 7 lumens sq ft.

$7 \times (\frac{1}{2})^2 = \frac{7}{4}$  beam c.p.s.  $\cong 2$

Suppose at 1 mile light is  $\frac{236000}{(5250)^2} = \frac{2}{D^2}$

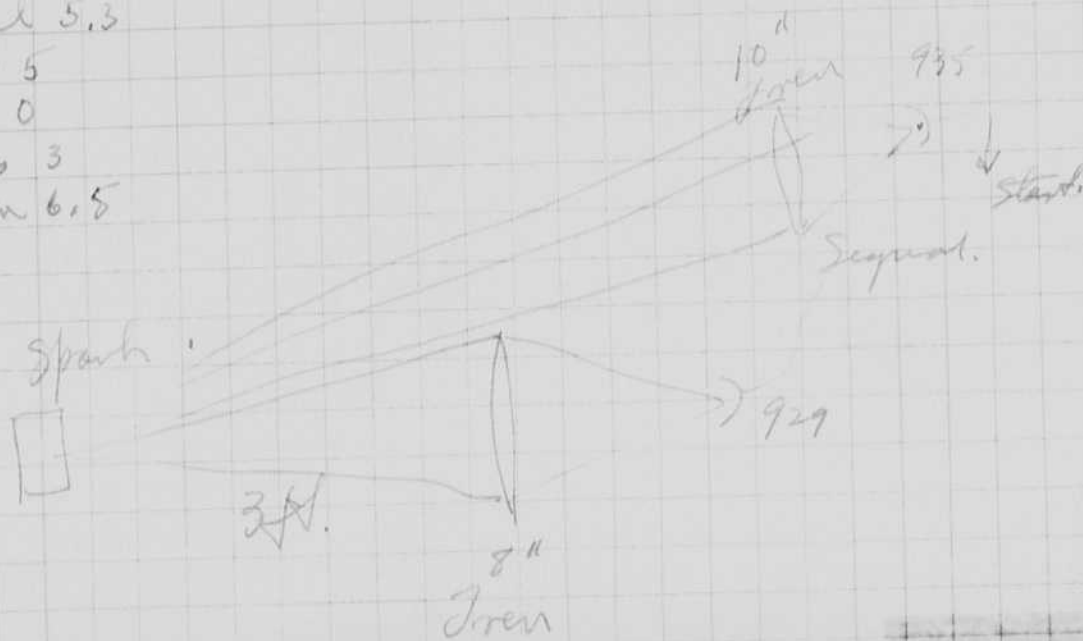
$D = 15$  feet.

Jan. 9, 1958.  
 Harold Edgerton.

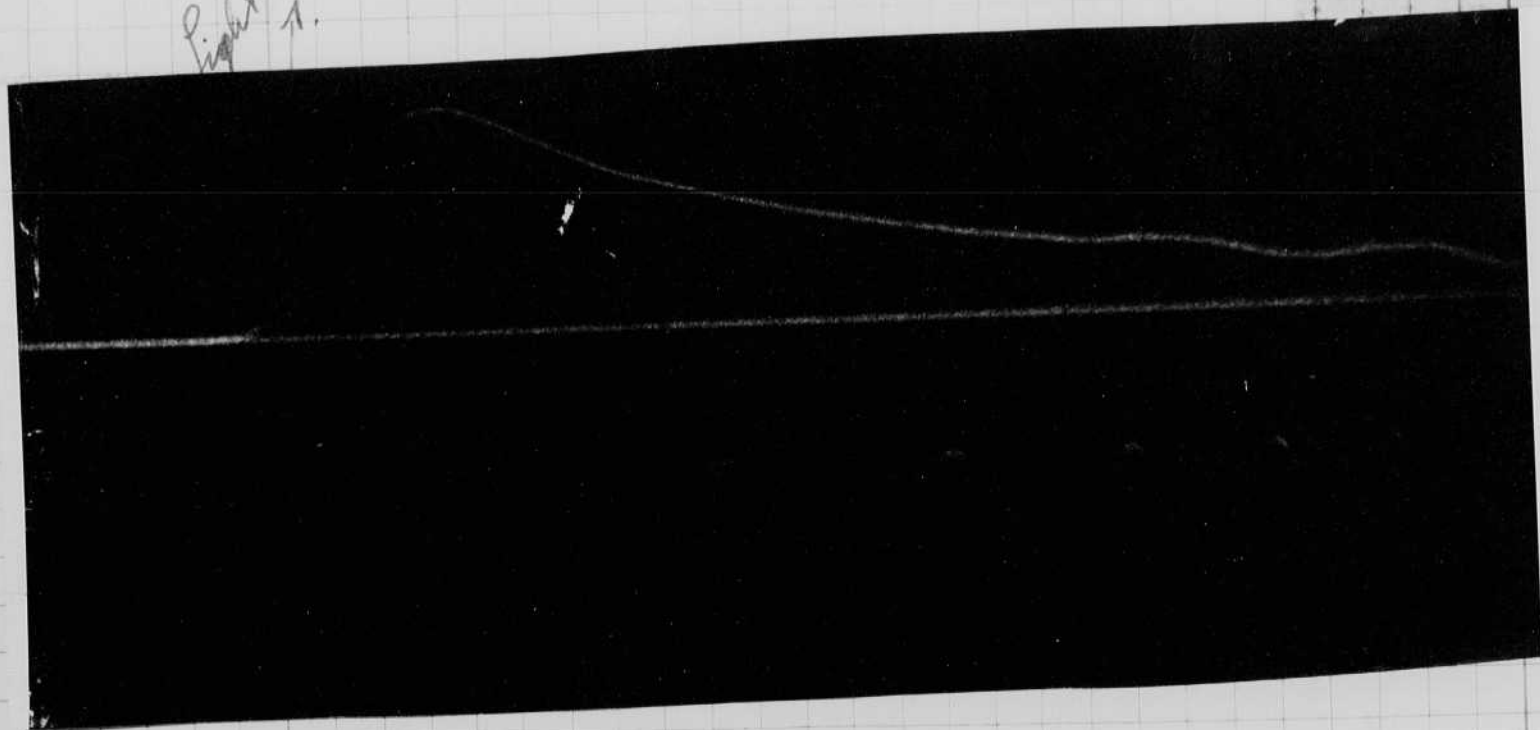
Oscillograms of sparks. Bill has  
 packaged the short spark which is  
 shown on page 122.

Elect. Scope #39 2236 type

Speed 5  
 Gain High  
 Sync In 9  
 Scaled 5.3  
 Volt 5  
 # 0  
 Trms 3  
 Inten 6.5



Light 1.



$10^{-8}$

$2 \times 10^{-8}$

$3 \times 10^{-8}$   
 seconds

Beacon tube.

Bill Mark Robert  
St. Edgerston.

570 mfd  
4000 volts

4570 wattseconds.  $20 = 2$  millihenries in series.

$92 \times 4 \times 8^2 = 23,600$  h.c.p.s. from 20 inch  
9 mm O.D.  
X-curve 20 cm

$\frac{23600}{4570} = 5.17$  cps./watt. Duration 3 ms.

Reflector Chromalux E. I. Wiegand Co  
7500 Thomas Blvd  
Pittsburgh 8 Pa

factor of 10 with  $15^\circ$  beam

Lamp  $\frac{3}{4}$ " from front surface.

Model Photon tube  
700 volts 10 mfd

$\frac{1}{2}$  foot reads 7 lines sep/ft.

$$7 \times \left(\frac{1}{2}\right)^2 = \frac{7}{4} \text{ beam c.p.s.} \cong 2$$

Suppose at 1 mile light is  $\frac{236000}{(5280)^2} = \frac{2}{D^2}$

$$D = 15 \text{ feet.}$$



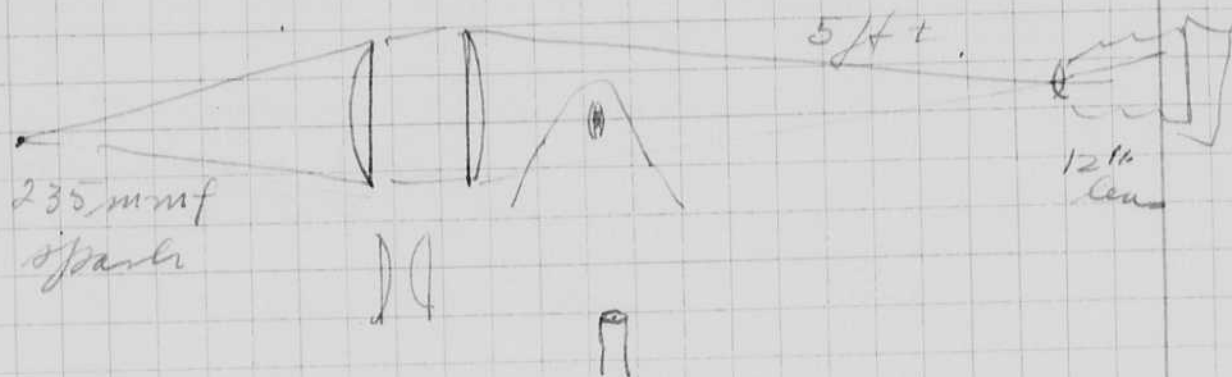
Jan 14 1958.  
Harold Edgerton

In "light" books.

See tests with 22 inch 9mm  
camps. Preparing for roof tests at M.I.T.

Bullet tests with help of Dave  
Cahlander last night. Results excellent of  
22 long rifle.

10cm diam  
4" 56cm f.d.



Jan 27 1958 ~~Bullet photos with the 1/20 us flash~~  
~~are very good.~~

Feb. 1. 1958 Sat. Returned last night from Rochester N.Y. with  
Esther and her mother. Saw Bob who is a good  
student at the U of R. in Physics. Left micro  
scope camp with Len Wall at E.R.

mess of Beacon lamp. 22 inch 9mm.  
570 mfd at 4000 (+)? volts  
B.C.P.S. =  $25^2 \times 4 \times 100 = 275,000$  B.C.P.S.

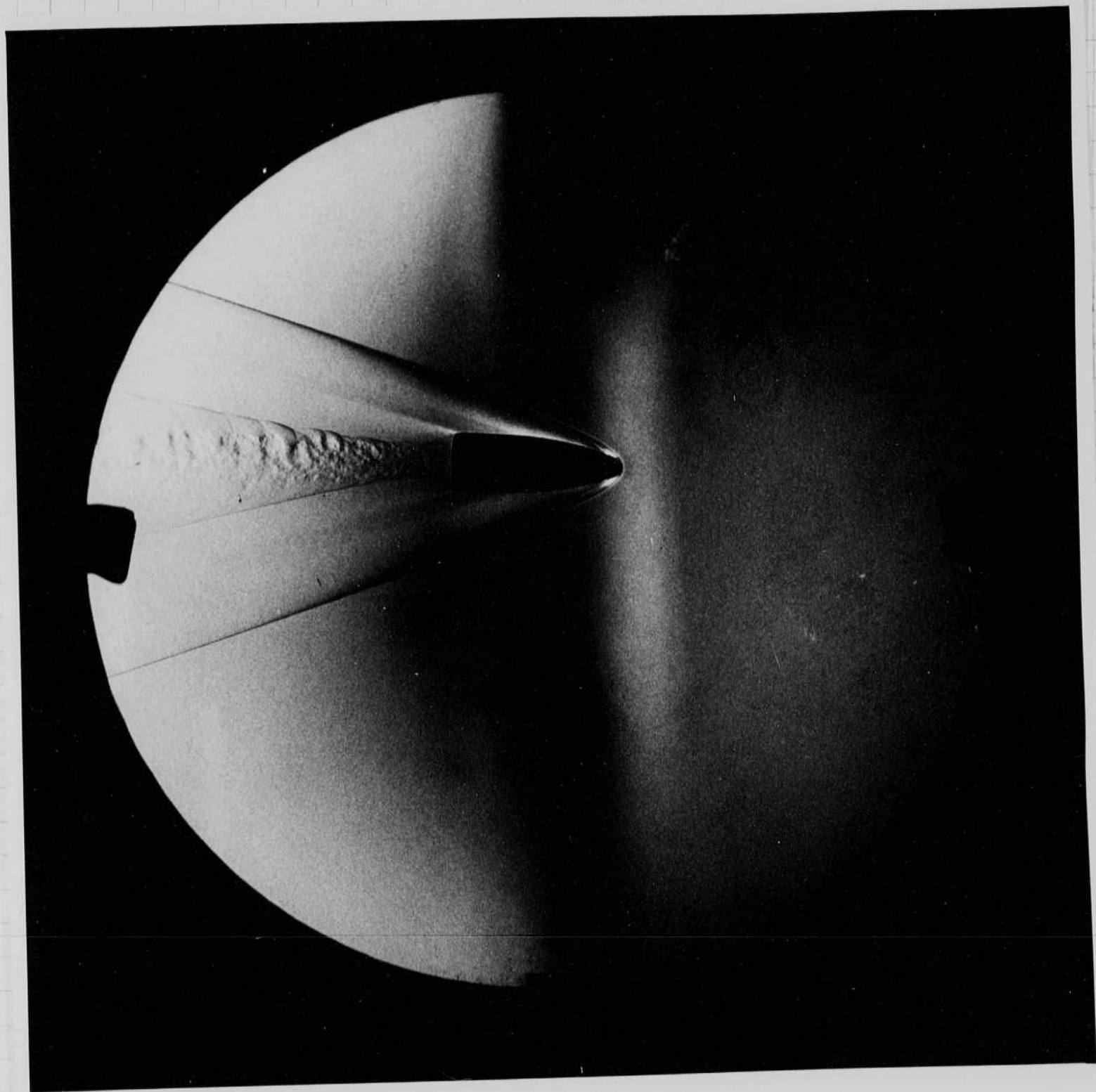
a 70± ft cable decreased the out put to 250,000

$$DA = \sqrt{\frac{\text{B.C.P.S.}}{C}} = \sqrt{\frac{250,000 \cdot 10}{15}} = \sqrt{167,000} = 410$$

$$f = \frac{410}{25 \text{ ft}} = 16 \text{ f aperture for Kodachrome}$$

at 25 feet.

A few photos were taken in the  
lab with Kodachrome f/16 25 ft.



220 Swift.

$\frac{1}{2.0}$  W.S.

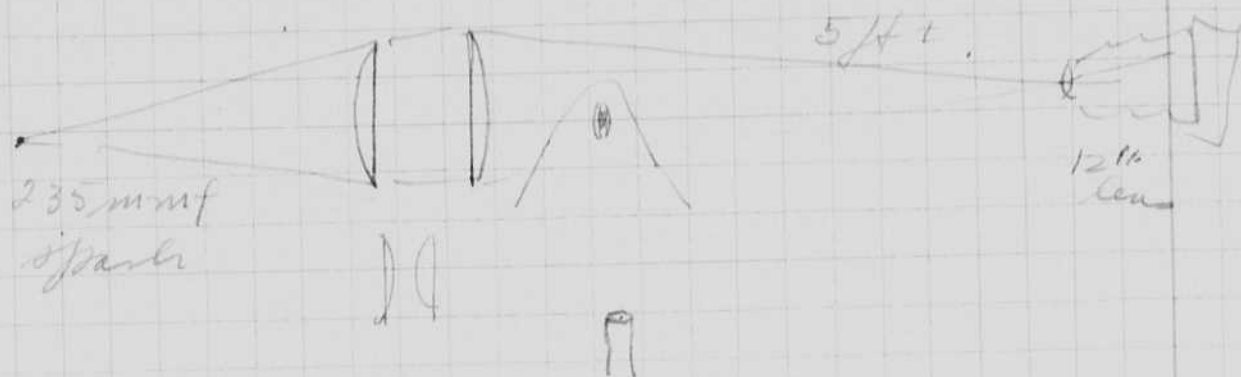
Jan 14 1958.

Harold Edgerton

In "light" books.

See tests with 22 inch 9 mm  
camps. Preparing for roof tests at M.I.T.Bullet tests with help of Dave  
cylinder last night. Results excellent of  
22 long rifle.

$\left( \begin{array}{l} 10 \text{ cm diam} \\ 4'' \\ 56 \text{ cm fd.} \end{array} \right)$



Jan 27 1958 ~~Bullet photos with the 1/20 us flash are very good.~~

Feb. 1. 1958 Sat. Returned last night from Rochester N.Y. with Esther and her mother. Saw Bob who is a good student at the U of R. in Physics. Left microscope camp with Lew Wall at E. R.

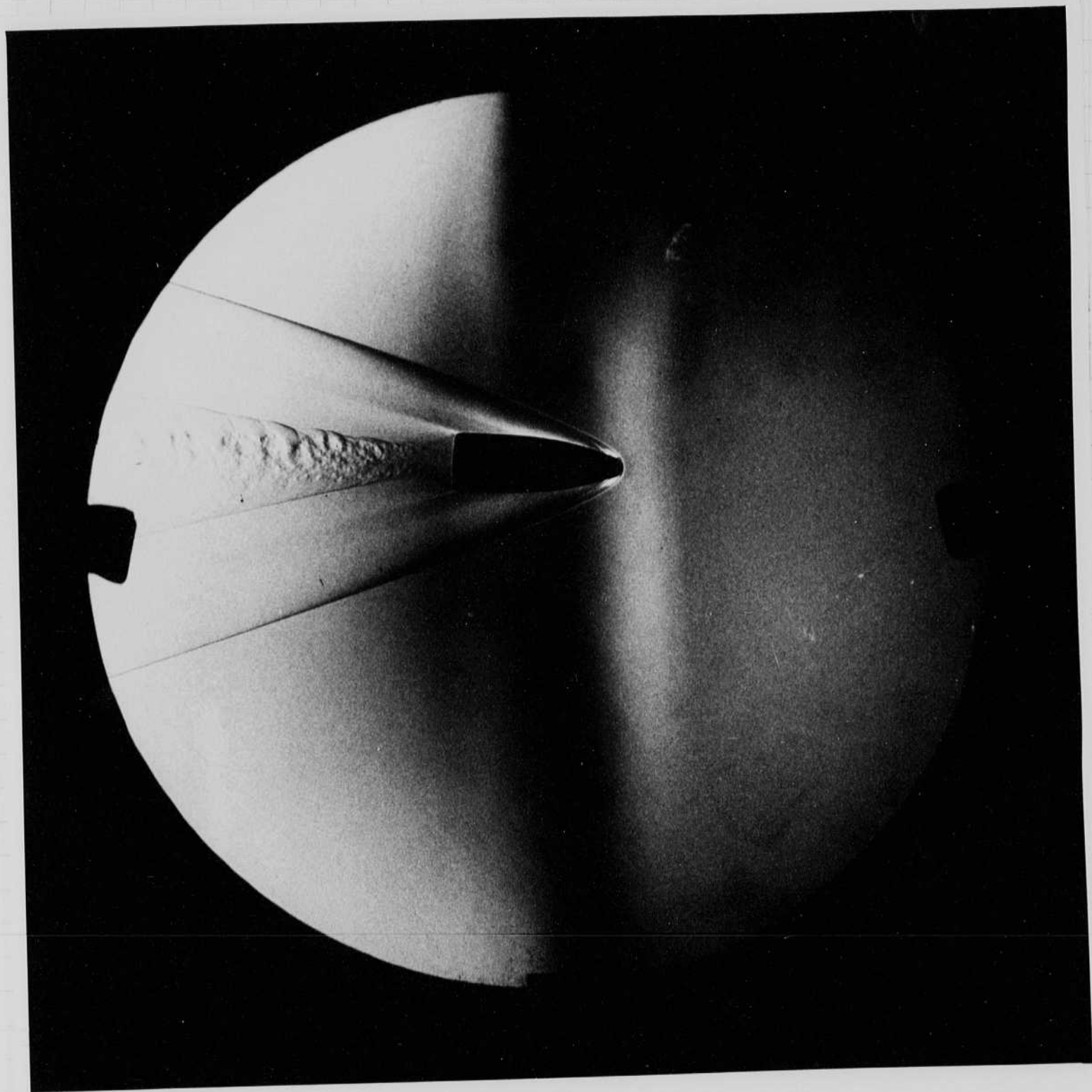
meas of Beacon lamp. 22 inch 9 mm.  
570 mfd at 4000 (+) volts  
B.C.P.S. =  $25^2 \times 4 \times 100 = 275,000$  B.C.P.S.

a 70± ft cable decreased the out put to 250,000

$$DA = \sqrt{\frac{\text{B.C.P.S.}}{C}} = \sqrt{\frac{250,000 \cdot 10}{15}} = \sqrt{167,000} = 410$$

$f = \frac{410}{25 \text{ ft}} = 16 f$  aperture for Kodachrome  
at 25 feet.

A few photos were taken in the  
lab with Kodachrome. f/16 25 ft.



220 Swift.

$\frac{1}{2.0}$  11.5

Jan 18 1958.  
H. J. Edgerton  
Hobby Schmieder.

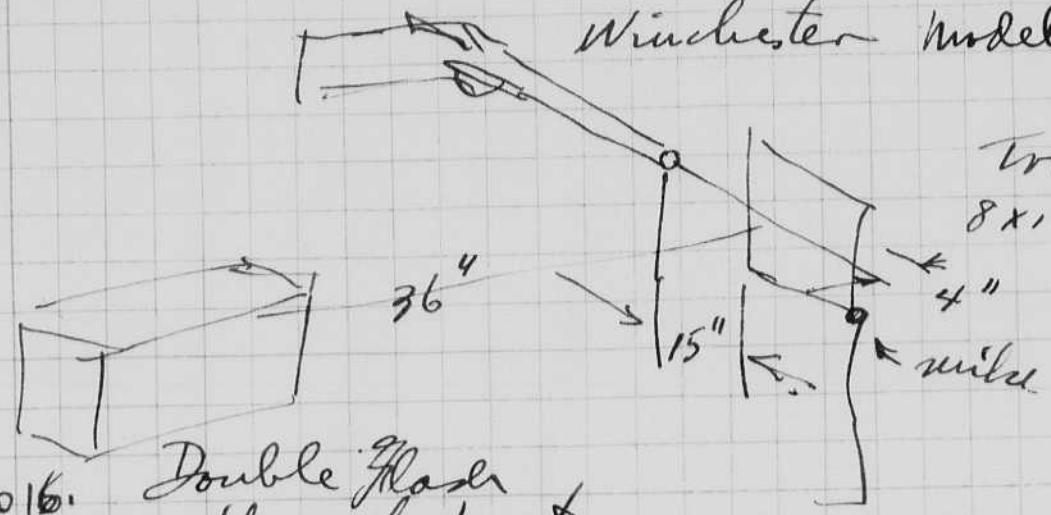
Silhouette.

20B102.  
new take?

22 long Rifle; Remington Hi Speed  
Remington

Winchester Model 52 #32405

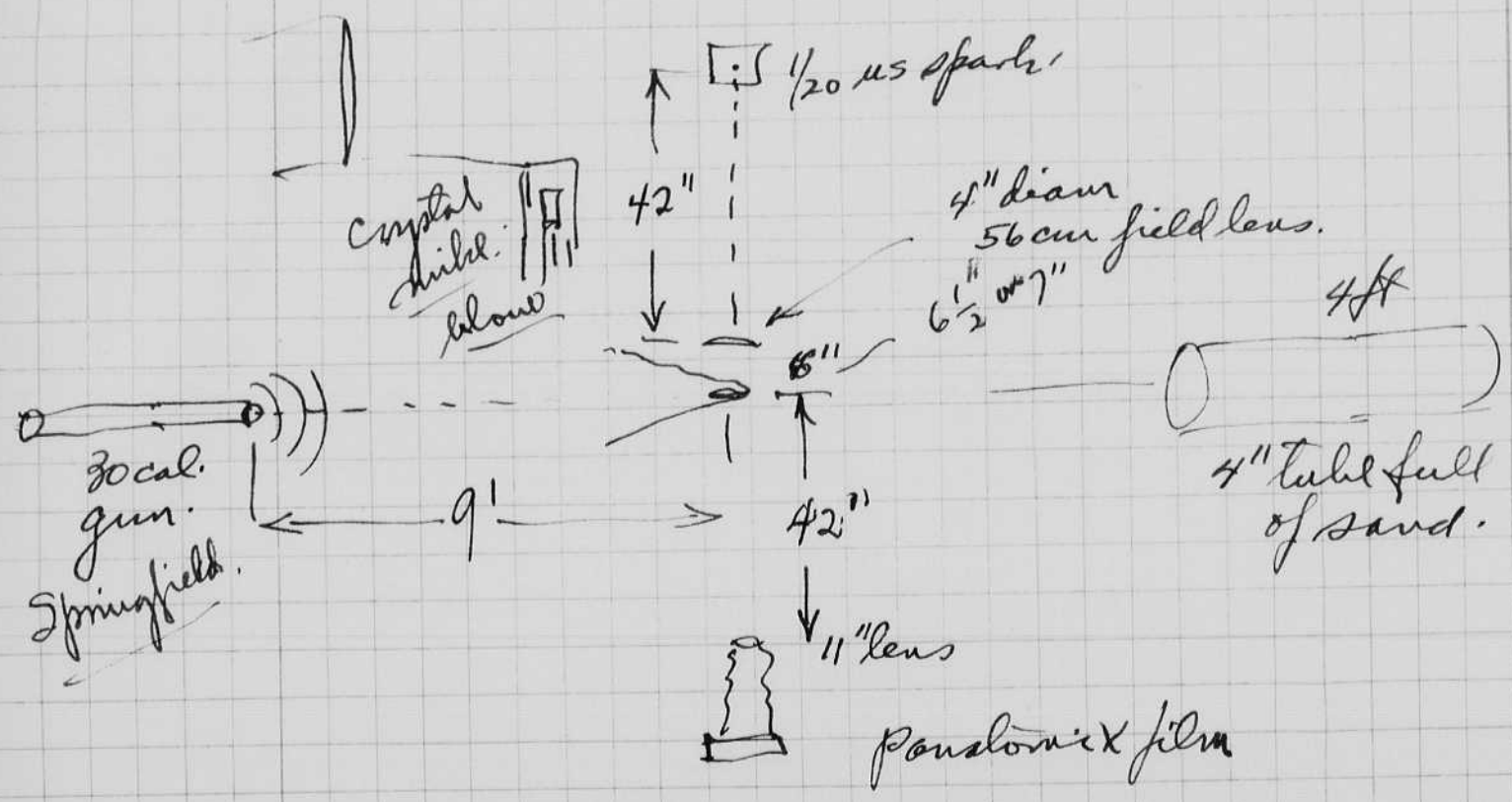
TriX Glass  
8x10 plate.



Double Glass  
without front  
fresnel lens  
Bare sparks 1/8" long.

Type 2307 E2.  
Eg. & G.

30 caliber Armour Piercing ammunition

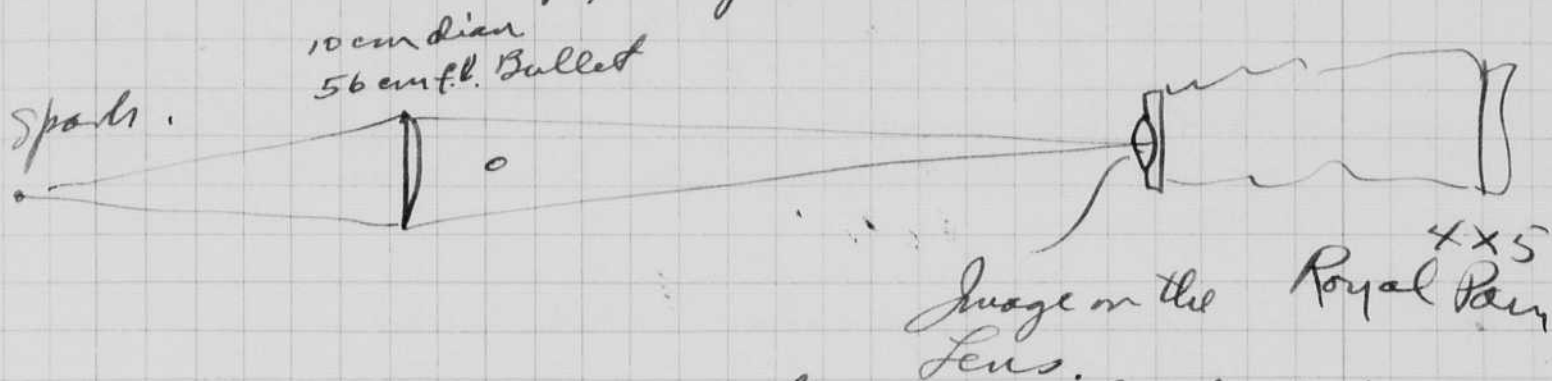


- #1 Bullet too far by 3 inches thin 7mm Dev. D.72. cold.  
 #2 Mike moved 3" towards the gun

Jan. 23, 1958. 30 caliber.  
 270 Swift #.  
 camera to lens 5 ft.

Jan 28 1958 220 Swift and 30 caliber bullets are excellent with 1/20 us flash.

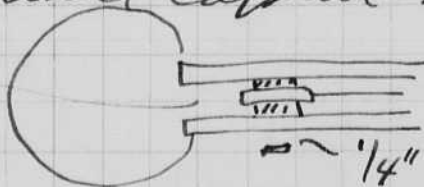
Tonight I tried to take schlieren with a central stop, as follows.



then scotch light stub was put on the lens so that the spot of light hit it!

- #1 220 Swift as per Jan 23 shooting.  
 ok but field uneven.  
 2. Repeat. ok. but field uneven by legs  
 #3 #6 dynamite cap in 1" steel tube with 1/2" hole.

about 1" from end of tube.



The tube was taken off the lens. Lens stopped down so that image of sparks went through with plenty of room to spare.

This one was too late. The explosive products covered the field.

- #4. I moved the dynamite cap cannon back 4".  
 Steel tube exploded.

Feb. 2, 1958.

See page 138.

Harold Edgerton.

250,000 B.C.P.S.

I installed the flash lamp beam 22" tube 9mm with 570 mfd at 4200 volts on the top of the ventilator shaft at M.I.T. the water tight assembly was directed north east by tying it to the top of the burner outlet. the cable went down two floors to the 8th floor where it was connected to the capacitors. John Harsman Dairs helped me with the transport of the equipment from bldg 20.

Esther could just see the flashes from 205 school st. She had to look over a street light and through a lot of trees. also there was a hill in the way. I ran the lamp at 25 seconds between flashes from about 11.15 to 11.40 pm.

When a good clear night comes along I hope to see the lamp from Mt Washington.

Feb. 6, 1956. One report came in from Auburn Maine. Feb. 4?  
Milton Mass 10 miles south.  
Sudbury. " 25 " west.

Feb 5.  
The lamp was used on the Great Blue Hill on last night aimed towards N.Y. Mosah. Conn and Gardner Mass reports were received by radio from pilots of airplanes. Doug Sinclair helped me to put up the apparatus. Robt. de Chencenotte was in charge of the station.  
BL-9-2750 Conover in charge of Dayton's Miss Ridley  
Luis Alvarez. - Mt Wash.  
A66-3383 Durham N.H. Dan Dinamore Air Force.

M.I.T.

Students

Ernest Rudelli 2871  
Jean-David Beyer 2865  
R B Spencer. 2875

Feb. 7, 1958.

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David Edgerton

The Strobe beam was tested last night from the top of the Big Blue Hill. Luis Alvarez and others saw it from the top of Mount Washington. It was also observed by Ralph Hechler at 5000 feet above Manchester N.H.

Evening. Dynamite cap photos.

#1. Heaver steel tube.  $\frac{1}{2}$ " wall thickness.  
Strob did not go.

#2. No explosion - Set up.

#3. Royal Pan film. 3 exposures, no explosion

#4. " " " " " "  
Timing ok. Strobe but no particles in the air.

#5. Backed off 1 inch. Re-set wire. Panatonic x

#6. Exposure test. one flash no expl. " "  
new developer @ 3% 10 min D19.

#5 was timed very well. It shows very high speed particles in motion.

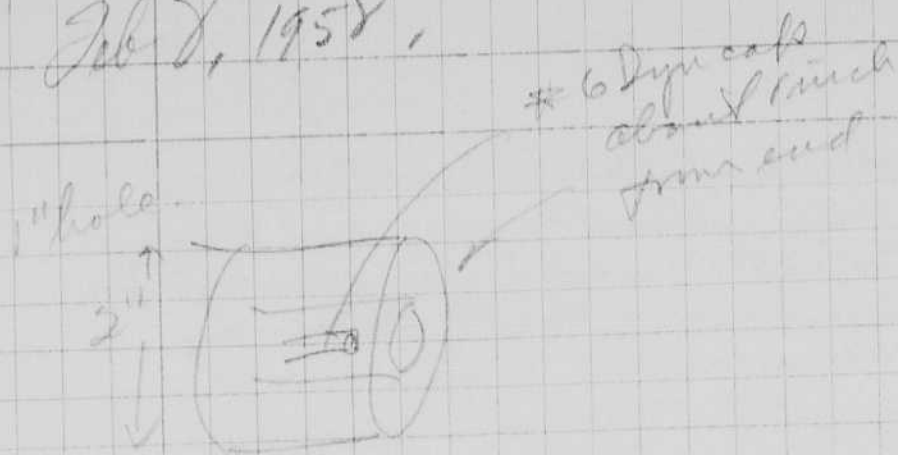
Feb. 18, 1958 Jacques Yves Cousteau and Madame Cousteau Simone were in Boston Sunday Feb 9. from noon until 7pm.

I visited General Radio this morning. Discussed stroboscopes with Mc Holtje Mike Fitch Morris

City Morris  
Bill Thurston. We looked over the 1531 new model. Also discussed at length the Strobolum, Strobolux, and microflash. I suggested a redesign of the Strobolum, including a blimp flash lamp and a very small lamp for special jobs. The microflash and the Strobolux might be discontinued.

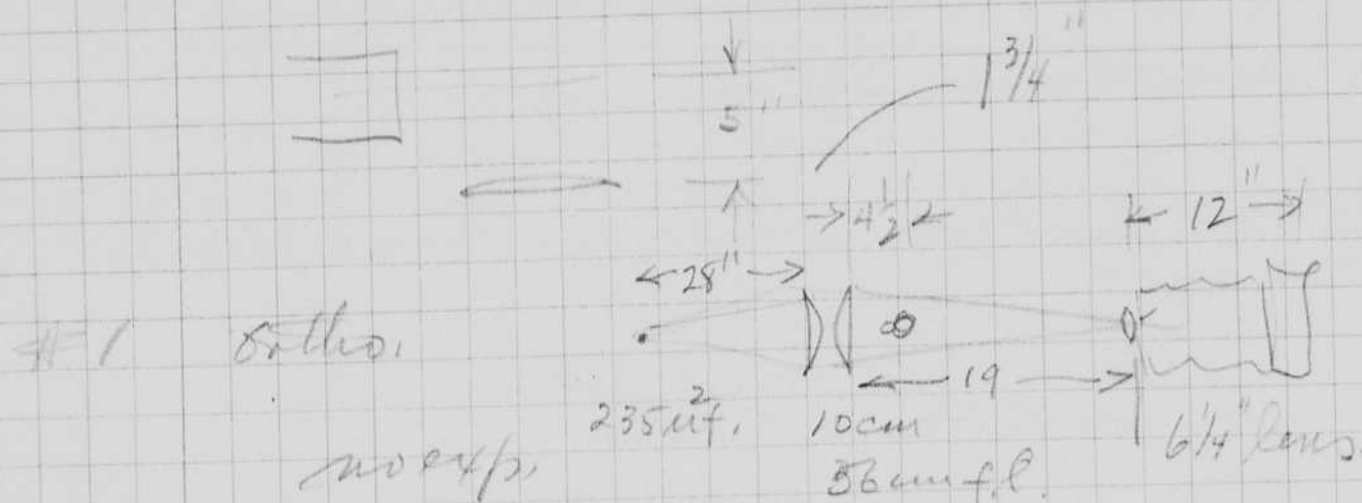


Feb 7, 1958,



\* 6 Dyna caps  
about 1 inch  
from end

Worked with  
Bill Mac Roberts  
in the Searer  
Driver for the  
sup-sea camera.



#2 Royal Ortho. Same set up,  
Exposure 0.1.

#3. Dynacaps. Double flashes U.S.

#4 " " Same U.S.

#5 " " magd  
insulation put in  
mike path.

Excellent!!

#6 Photo of set up Ortho f 11 4x5 6ft

Feb. 17, 1958 cont.

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The lab in 20D is very active now with thesis students.

Jack Christensen	} high speed photography	
Bob Buchler,		
Ed. Bristol.		spectrum of tubes
Warren Moon		spark for sound gun
Hobby Schumacher.		Short sparks.
Dave Hall	Sonar driver.	

Breslaw is on an ocean trip with the self-fired flash unit. He wrote a letter from Cuba.

The 620 students come in each Friday for a 10 to 15 min experiment.

#1. Sonar - meas of velocity of light.

2. Meas of distance.

3. Television use with a meter.

Talked to M.I.T. Alumni Council on Feb 24 1958 at the Faculty Club in the Loan Bldg.

Scheduled to go to Washington Feb. 27 Thursday for a meeting of the research committee. Constant is also to be there. We hope to plan the Guam photography.

Feb 26 1958

## Spectroscopic source Driver.

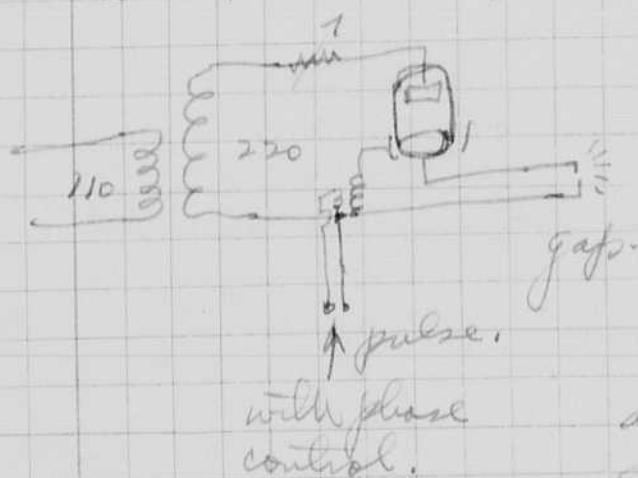
Lined Experiment.

For the past few weeks I have been setting up a driver for a spark gap. This was requested by Brechin of the Jewell Ash Company.

I used the old movie equipment of the type sold by R.R. some years ago. This has a mercury arc tube and 2000 volts of power from 220 ac.

An inductor was put in series with the gap to reduce the current. I ran the equipment at 150 300 and 1500 cycles/sec.

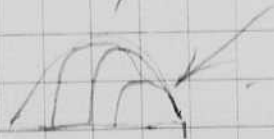
Perhaps the best way would be to use a mercury tube direct to start the arc.



The magnitude of the excitation could be set by a variable resistor or inductor in series with the discharge.

The mercury arc tube and starting spark makes it possible to start the discharge and then to establish the arc for a half cycle or a fraction of a half cycle.

A phase control could be used to vary the intensity, depending upon how much of the cycle is used.



March 9 1958  
Harold Edgerton.

147

All of us have been finishing a stereo camera for Dr. Graham to take to the Indian Ocean on the Atlantis. The trip is supposed to start a week from now.

The camera has a Hyden 1 flash per second timer on the governor. This should give an opportunity to put the record on a chart.

I went to Wash Feb 27 for a meeting of the Research Committee at the U.S. Society. Cousteau told of his plans.

Diving saucer. - needs cameras  
75 mm lenses.  
80 mm lens  
Shutters.  
Contactors.

abyssphere  
abyssphere  
abyssphere.

needs movie and  
still cameras.

Team effort

Discussed.

Cousteau and his wife came to Boston  
Mar. 2 for a talk at the Kresge at 3 pm.  
also for the skin divers at Hancock Hall  
Mar. 3 at 8 pm. Willard (Bliss Stone)

Wood  
Hess H. Busch  
Teinberg.  
Jim Cahill.

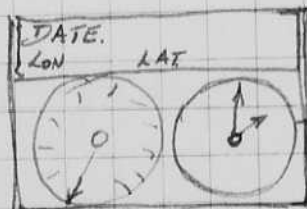
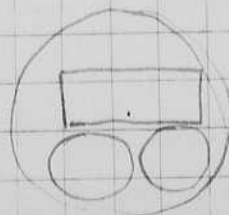
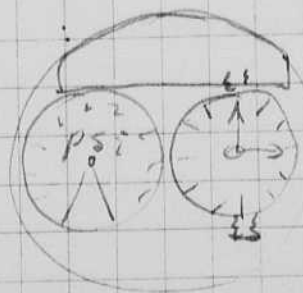
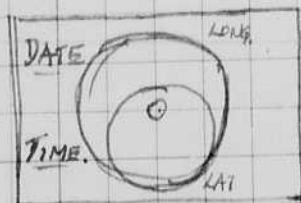
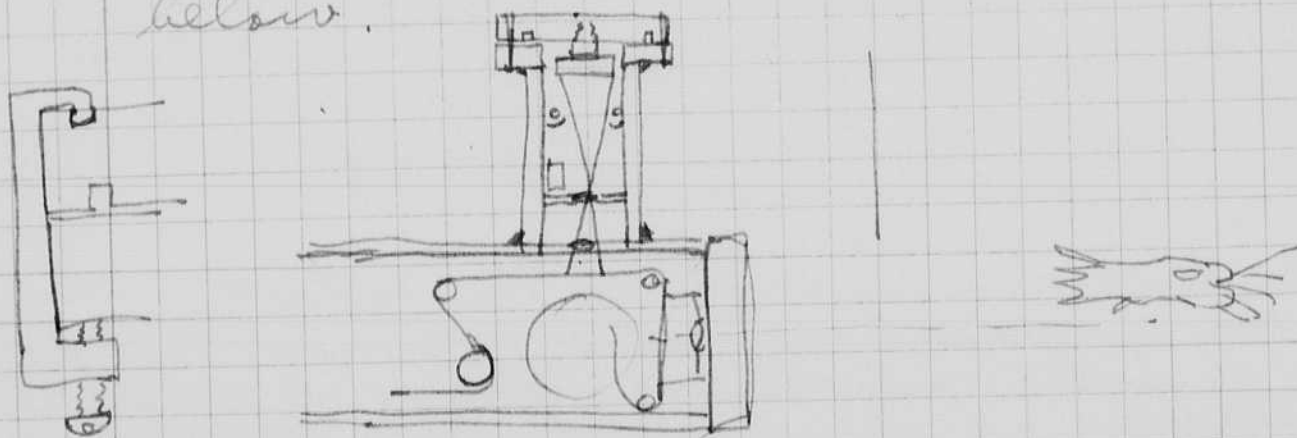
March 16 1958  
Harold E. Edgerton

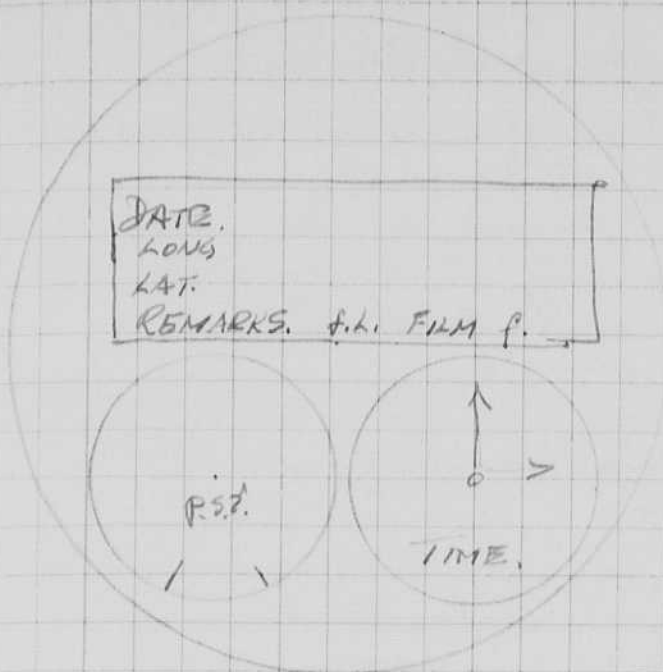
205 School St Belmont Mass.

Our Saturdays at M.I.T. in 20D102 are very busy ones now with a good active group of ~~physics~~ students. Bill MacRobert helps them a great deal. Byron Blanchard has just started to work in the lab. He will be on hand while Bill goes to Guam for the current A.B.C. tests.

One of the jobs finished the past week was the camera for W.A.O. 1. Dr. Graham took the stereo deep sea unit with him on Tuesday night. It is going to be used on the Atlantis on her trip to the Indian Ocean.

There is a great need for a pressure recorder in our cameras. I have ordered a pressure gauge from a local company Ames Standard Gauge - 1000 psi with a 1 1/4" dial and a center connection. I plan to use this in the camera as sketched below.

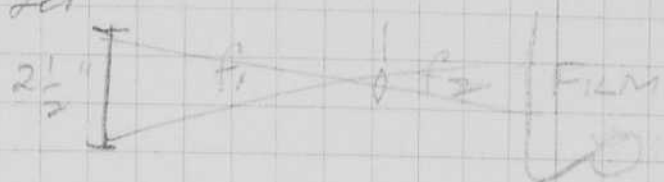




$$2\frac{1}{2} = 1\frac{1}{2} \text{ or film}$$

$$M = \frac{2.5}{1.5} = 1.67, \text{ say } 2,$$

Let



$3\frac{1}{2}$ "  
I.D.

Probably will use standard 4" I.D. end plate for this to standardize the design.

$$\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{F}$$

Let  $F = \frac{1}{2} = 12.7 \text{ mm}$

$$\frac{f_1}{f_2} = 2 \quad f_1 = 2f_2$$

$$\frac{1}{2f_2} + \frac{1}{f_2} = \frac{1}{.5}$$

$$\frac{1}{2} \left( \frac{1}{f_2} \right) = 2$$

$$\frac{1}{2f_2} + \frac{1}{f_2} = \frac{1}{82 \text{ mm}}$$

3.22"

$$\frac{1}{2} \cdot \frac{3}{2} = f_2 = \frac{3}{4} \text{ inches}$$

$$f_1 = \frac{6}{4} = \frac{3}{2}$$

$$82 \cdot \frac{3}{2} = f_2 = 122 \text{ mm } 4.85 \text{ inches}$$

$$\frac{244}{366 \text{ mm } 14.55 \text{ inches}}$$

too long.

$$f_1 + f_2 = \frac{9}{4} = 2\frac{1}{4} \text{ inches}$$

too close.

Try 35mm

$$f_2 = 52.5$$

$$f_1 = 105.0$$

$$\frac{157.5}{254} = 6.2 \text{ inches about right.}$$

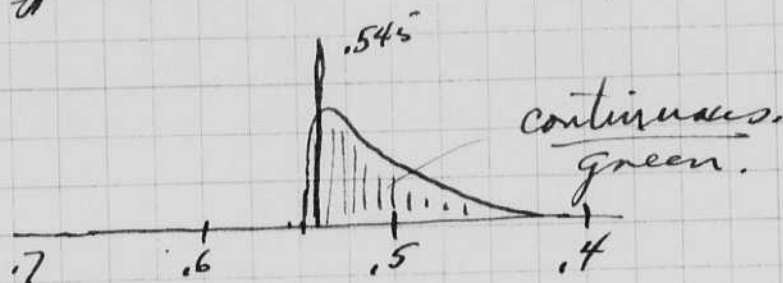
150 April 3, 1958  
Howard Edgerton

Green Glow from E.G. 89.  
gas bottle.

Hand Spectroscope.

Green is continuous with end at  
.5525  $\mu$  at strong end of series.

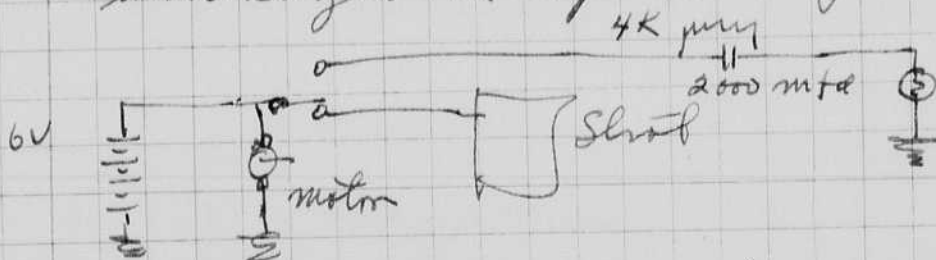
Mercury .545 line in lamp above.



April 6 1958  
205 School St  
Belmont Mass.

My parents\* returned from a 2 week  
trip to Europe (Rome, Copenhagen, Oslo  
Stockholm, Dusseldorf) today. They came in  
at 10.45 on AAL after leaving my sister in  
New York. \* Frank and Mary Edgerton  
Aurora nebraska 104 S. St.

On Sat I tested the marker system  
of page 148. I used a 2000 mfd capacitor  
and a G.E. #48 lamp 2V .06 amp which  
flashes on the charge, then a 4K resistor  
discharges the capacitor for the next flash.



Lens f 3.5  
or Plus X? film.  
maybe xxx.  
check this!

April 13, 1958  
Harold Edgerton

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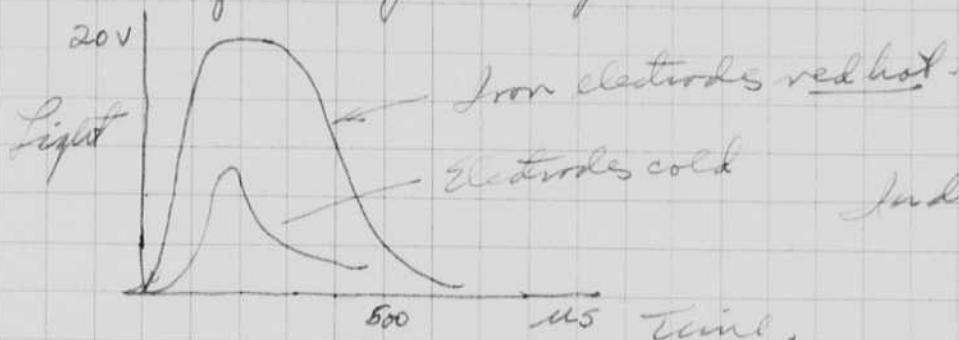
Just returned with Esther from Chadds' Ford Pa where we had taken my parents. Also there were my sister Mary Ellen Pogue, Bush & Ruth Merges & MacKinnon Mary Lou & Janice Dixon, my daughter from Hickory N.C. We were at my sister's house, T.F. Robinsons.

April 23, 1958. I took the movie unit out to Jewell Ash cottage this afternoon. This has a 2000 volt unit supply with a mercury arc tube to start the gap, a 4 mfd capacitor at 150 cycles/second.

$$P = \frac{2000^2}{2} \times \frac{150}{1200} = 1200 \text{ watts.}$$

The mercury arc tube developed a red hot anode in a 30 sec run. The switch would cut out under this load.

Oscillograms of the light were made. 929 photoluluf



43K load res.

45 volts on Battery.

Inductance

50 uh ±. ??

With a small inductance the light rose quicker and lasted a shorter time.

4 spectral curves were made, the last ~~two~~ <sup>one</sup> with 8 mfd and a 20 second exposure. Exposure seems to be ok. I left the equipment there for further experiments.

Yesterday I went to New York at the request of Red Elmendorf from GE at Cleveland Ohio, R.W. Porter talked to Red and Jim A. Wakelin from Princeton U.I. We discussed the possible use of a strobe light on a ~~the~~ satellite.

A rough calculation indicates that 40. c.p.s. should be just visible on the Mung Baker camera.





