HAROLD E. EDGERTON

PAPERS

MC 25

Series III

Laboratory Notebooks

Number 13

Dated Aug. 24 1942 to Mar. 31, 1943

Massachusetts Institute of Technology

COMPUTATION BOOK

NAME	Number
HAROLD E. EDGERTON	13

ROOM 4-117 LAB 8-105

Course .....

Used from AUG 24 1942, to MAR 31 1943.

Vic Finizio

Grat.
TRi 5-0940

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

COMPUTATION BOOK

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."
* * * * * * * *"

TECHNOLOGY STORE
HARVARD COOPERATIVE SOCIETY, Inc.
40 Massachusetts, Cambridge, Massachusetts

Record of Experiments, etc.

starting August 25, 1942

Harold E. Edgerton

Mass. Inst. of Tech.
Room 4-117 8-185
Cambridge, Mass.

Aug 25 1942

Harold E. Edgerton.

A series of quartz lamps has been received from Mela Park. G.E.Co. These will be mounted on a manifold and pumped for tests with pressure-voltage, capacity as regards light output.

The series have the following dimensions as shown in the shadow print on ~~the next page~~. page 5.

	Length.	diam.	
Between electrodes	16.75 cm.	6.5 mm O.D. 4 mm I.D.	
	10.25 "		
	5.4 "		
	2.55 "		
	0.9 "		
	4.6 cm.	12.0 mm O.D.	250 watt Hg
	1.95 cm	8.5 mm OD.	100 watt. "

Aug 25 1942 cont

Harold E. Edgerton.

Just obtained copies this morning from Coleman of NDRC contractor's progress reports Section D3 # 211 (Jan 1 - Mar 31 1942). No 130 (Sept 1 Oct 31 1941) and No 173 (Nov 1 - Dec 31 1941) O. S. Duffendack. Univ of Michigan Ann Arbor.

From report 211 page 12. Description of B.E. lamp. 1½ x 2 cm helix. Hg electrodes water cooled. 120 flashes per second 6 mf 1700 volts. 1 kw tubes became discolored.

Similar tube at Ann Arbor ~~20 cm~~ light increases upto 20 cm then constant. 16 - 18 cm ~~long~~ 1½ mm bore helix 3cm long 12 mm wide. Used with ignitron. 125000 flashes with no deterioration 5 hour life at 30 flashes a second.

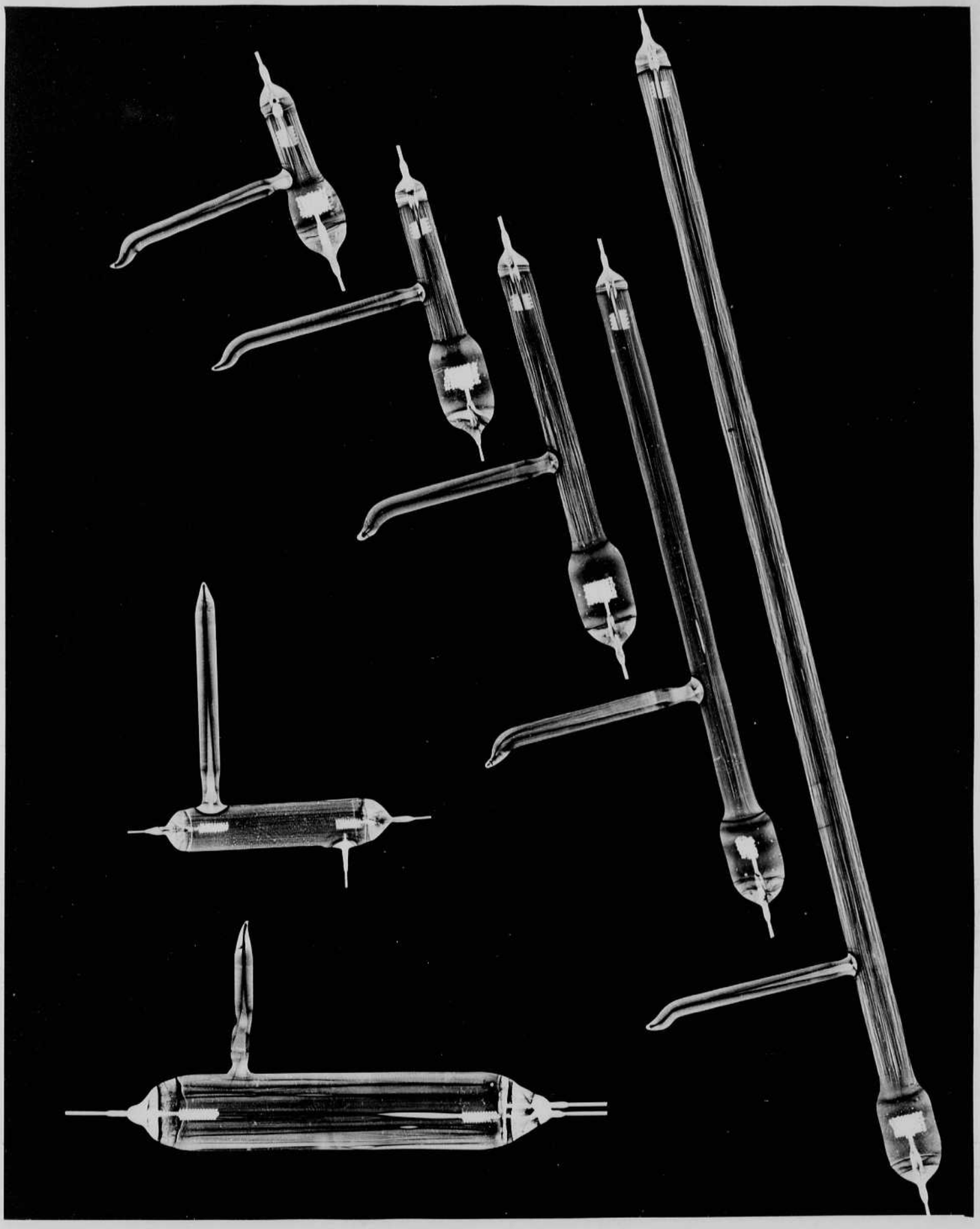
Aug 26 1942

Dr. Harold E. Edgerton — DIC 6066 Conf with.
Barstow and Drier.

Low altitude flasher.
400 mf 4000 volts. 1½ sec.
AC Generator 3ϕ.
6 phase double wye transformer.
6 866 tubes.
max. 4700 V 1.5 amps.
(from R.C.A. handbook.).

there is some question regarding the type 866 tube for this service due to temperature and back voltage at high frequency.

cm 0.8 2.5 5.3 10.2 20.6.



100 watt

250 watt

Quartz tubes received from the General Electric Co Nela Park Cleveland Ohio.

Aug 26 1942

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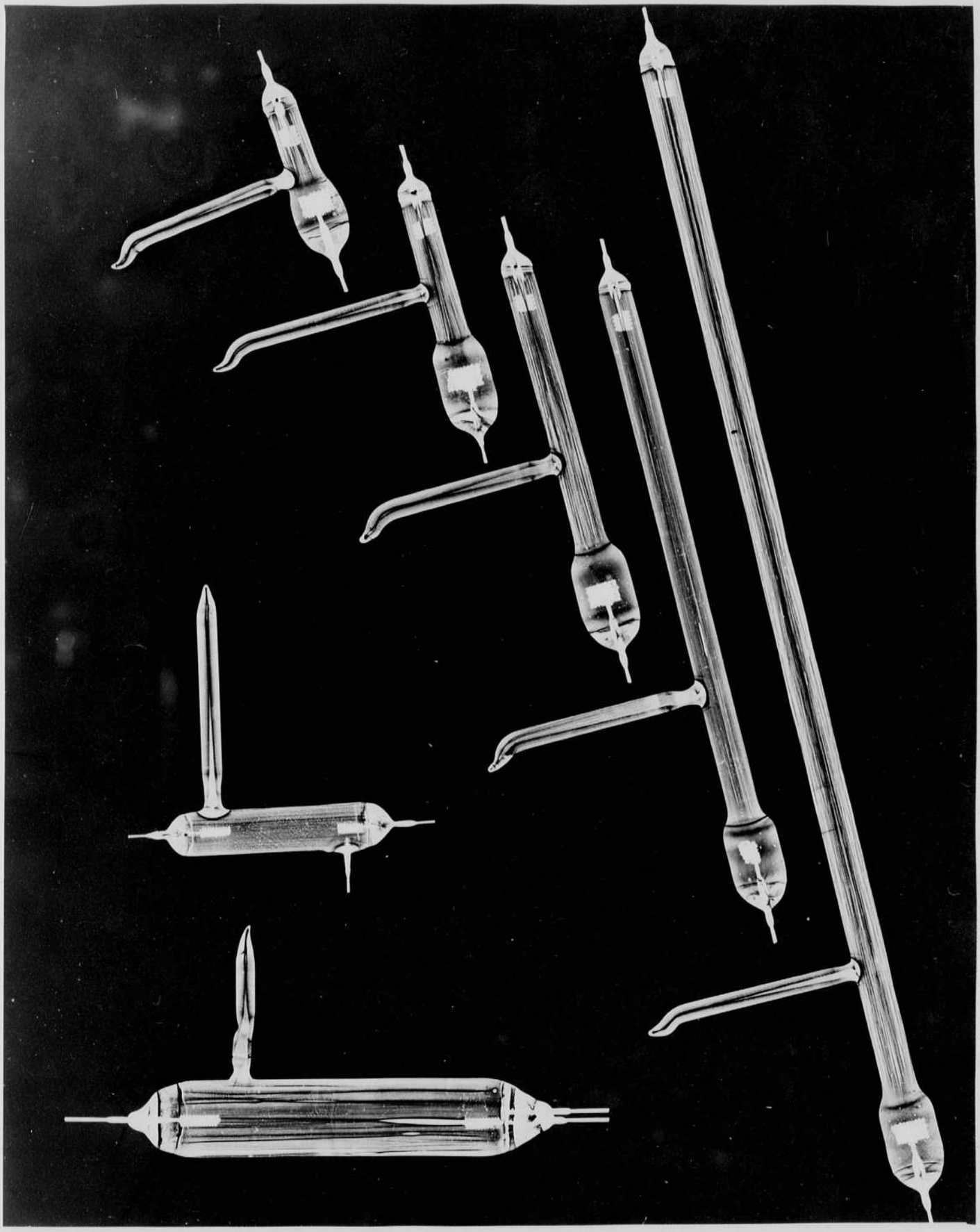
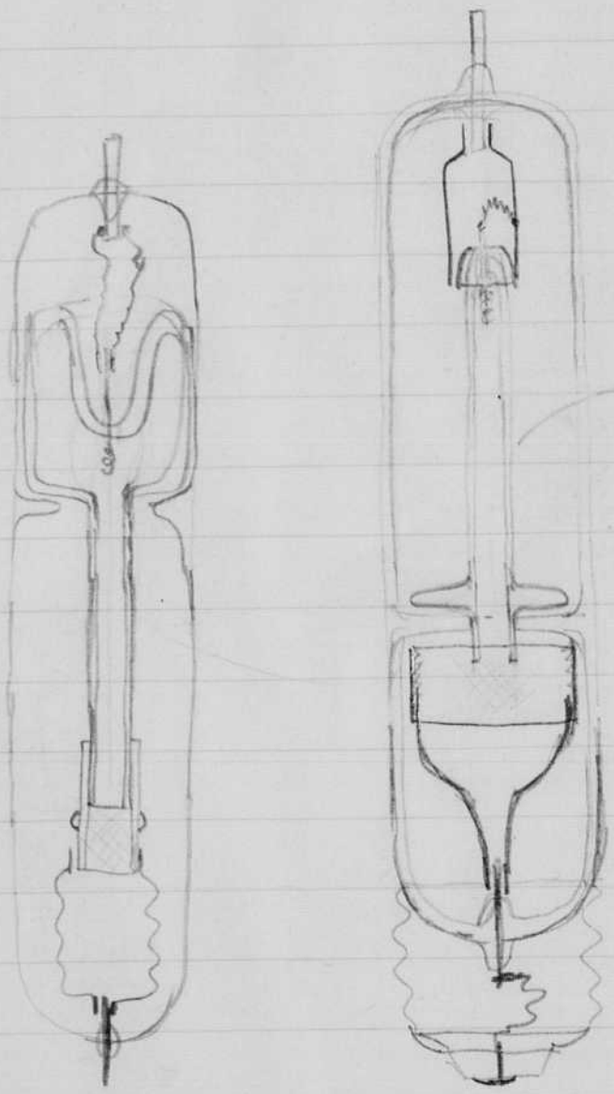


100 watt

250 watt

Quartz tubes received from the General Electric Co Nela Park Cleveland Ohio.



100 watt
continuous lamp
for stroboscope.

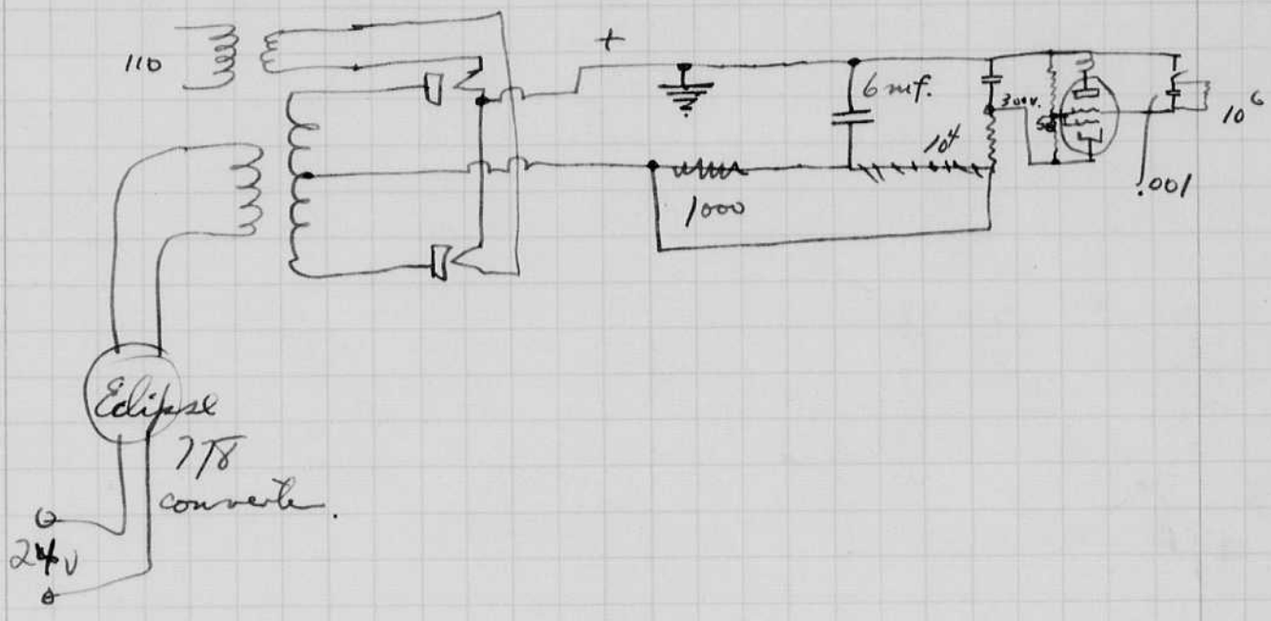
Large cathode in
chamber to catch
sputtered
material.

Aug 25 1942
H. E. Edgerton

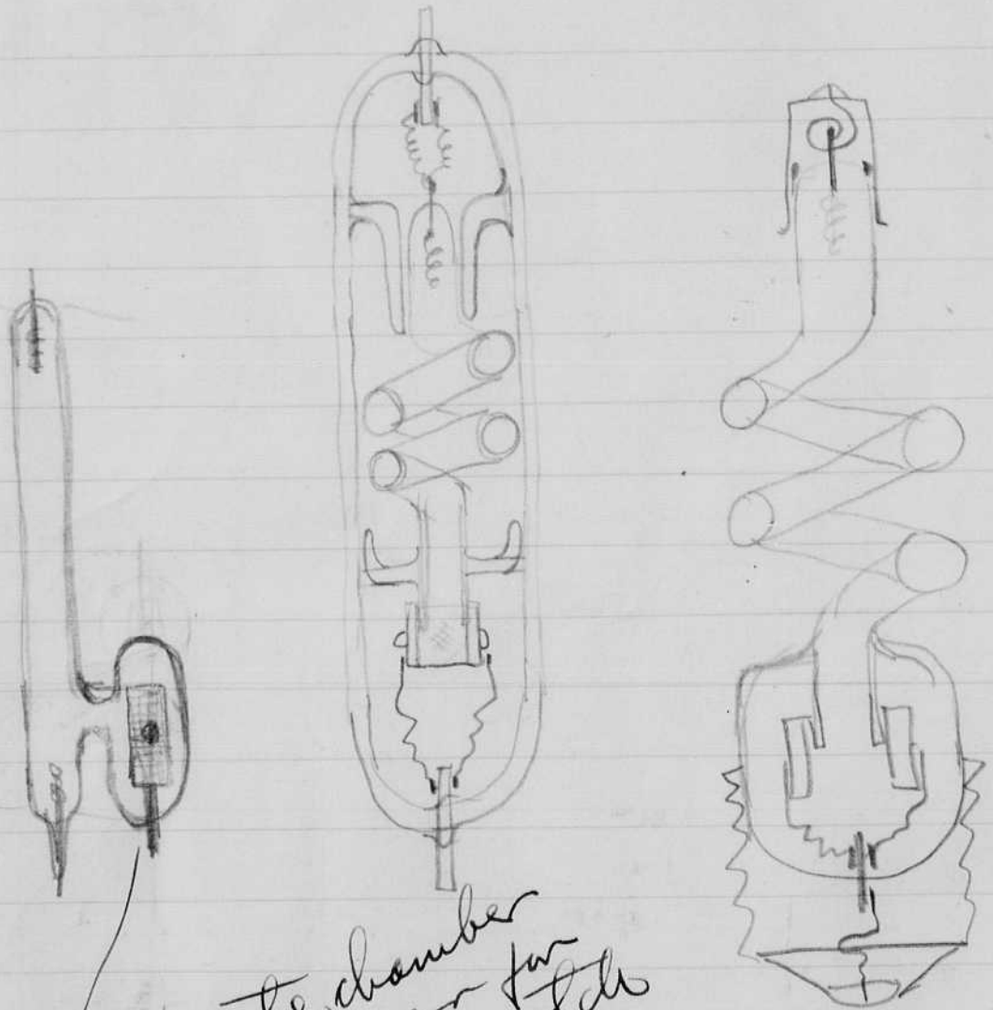
August 27 1942
Samuel F Egerton

Prop. Stroboscope
cont from page 142 book 12.

Experimental setup for trial.



August 27 1942
Harold E Edgerton



Separate chamber around corner for cathode to catch sputtering.

Aug 27 1942
Harold E. Edgerton

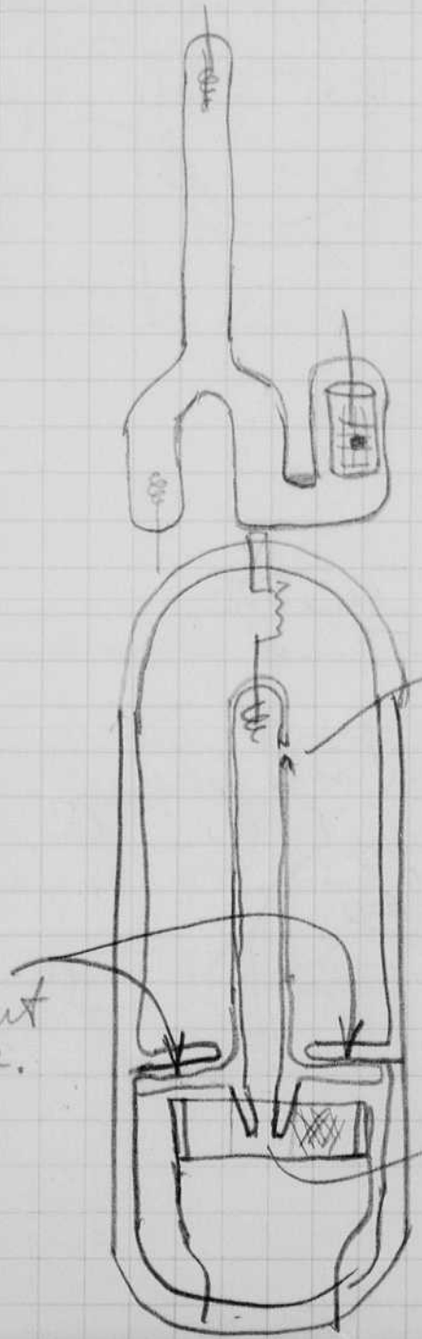
Lamp design.

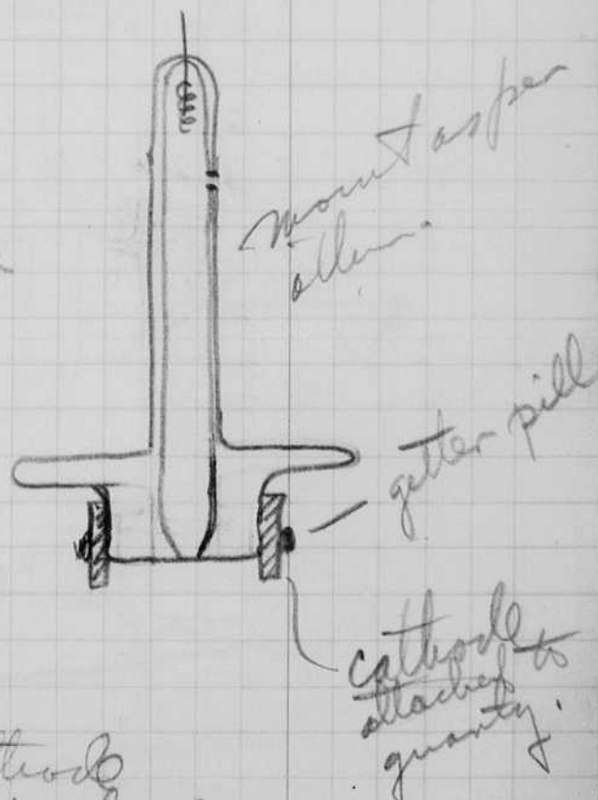
Factors.
1. Small in size to give ultra brilliancy

2. Constricted cathode area or volume to keep sputtering in the cathode end out of the light producing part of the tube.

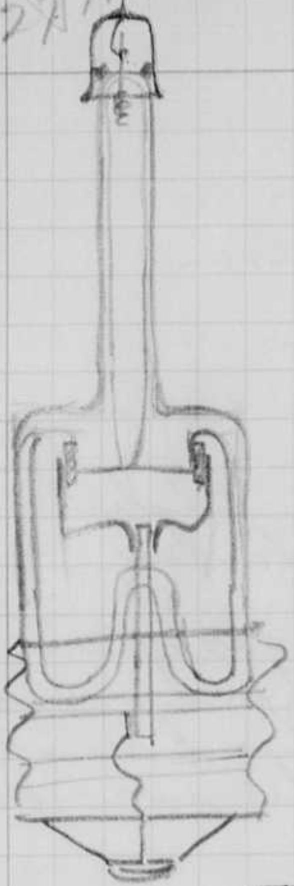
a. Blow of gas after discharge carries sputtered material from the arc path.

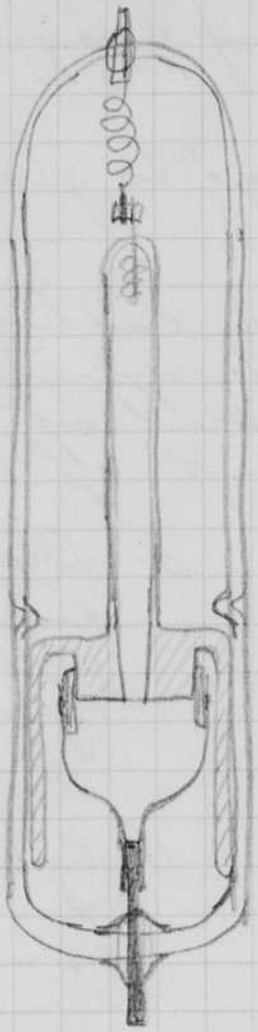
b. Corners prevent direct molecular paths to arc path.

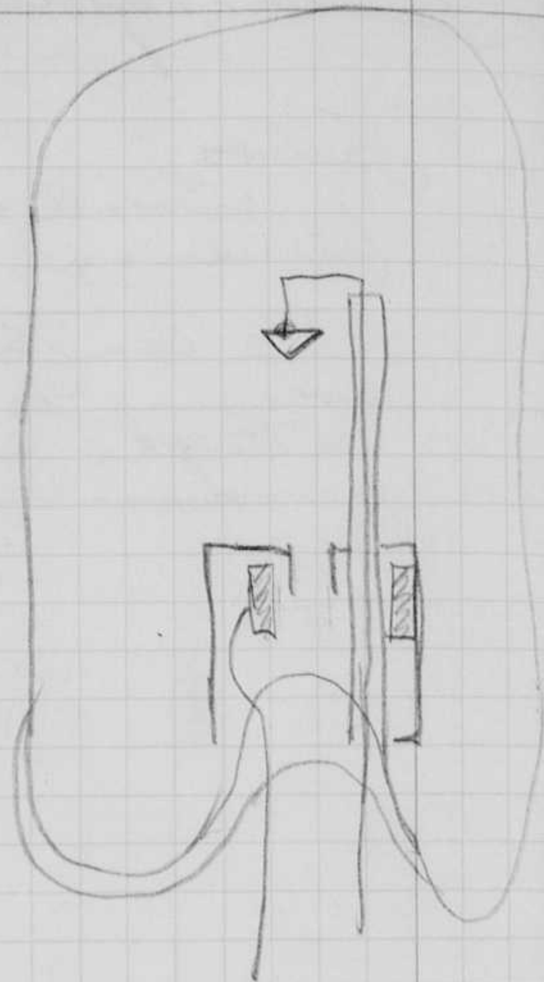


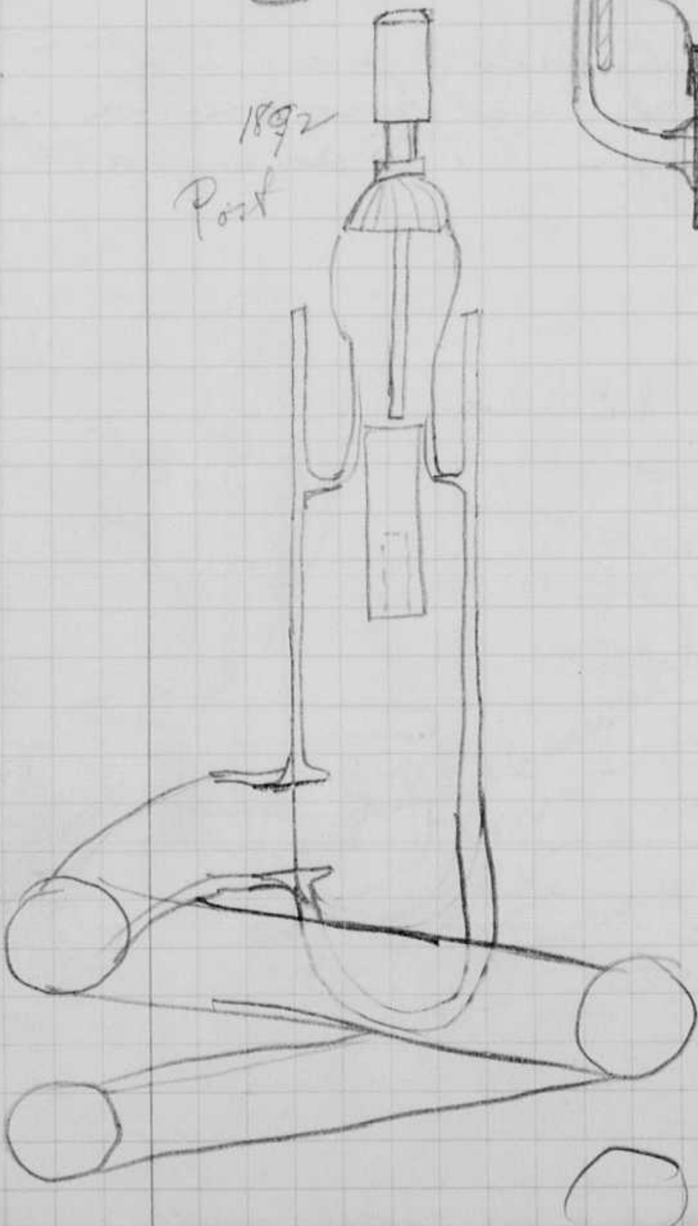


H E Ely
Aug 27 1912









Discussed with Grier and Barstow

Center post for high voltage in place of two legs. Other terminal at opposite end of spiral.

Aug 28 1942
H. E. Edgerton

Telegram received this morning from Wright field stating tests successful up to 15 thousand ft altitude with large flasher 4000 volts 4000 ~.

Long discussion with Hubbard of Radiation lab about power supply for low altitude flasher.

He showed me a MG set that weighs 35 pounds rated 1.5 KW. Output 400 cycles 110 volts. 8000 rpm

$$\left(\frac{CE^2}{2}\right) \times f = \frac{400}{2} \times 16 \times 10^{-6} \times 10^{6} \times \frac{2}{3} = \frac{4270}{2} \text{ watts.}$$

$$= 2135 \text{ watts.}$$

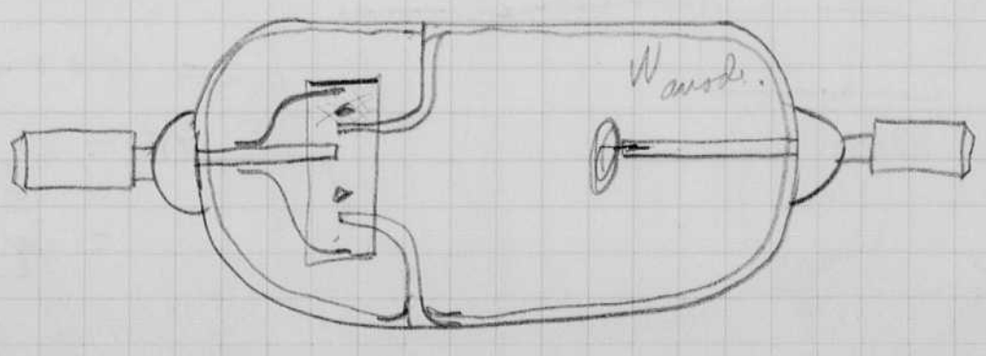
Scale down condenser to fit converter.

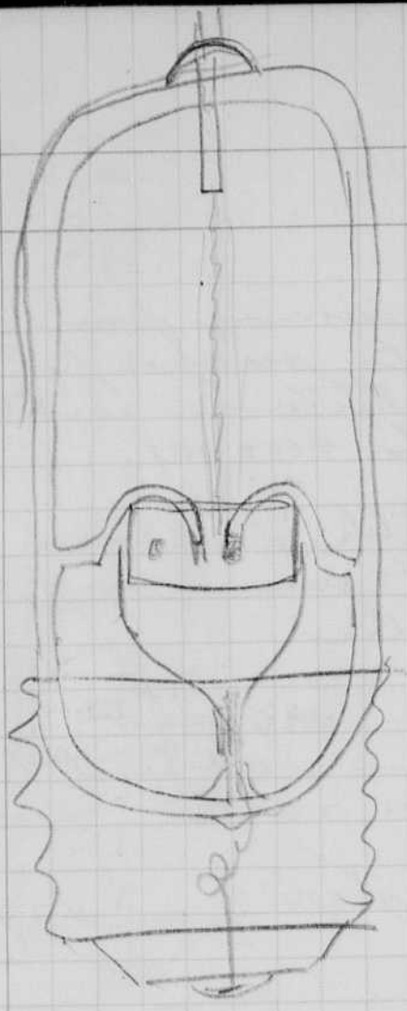
$$\frac{1.500}{2135} \times 400 = 280 \text{ microfards}$$

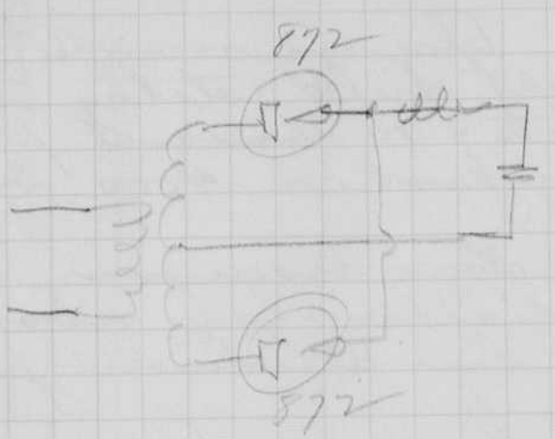
actually 100 amps.

$$\frac{1.500 \times 2}{24} = 125 \text{ amps from Battery}$$

assuming a 50% efficiency.

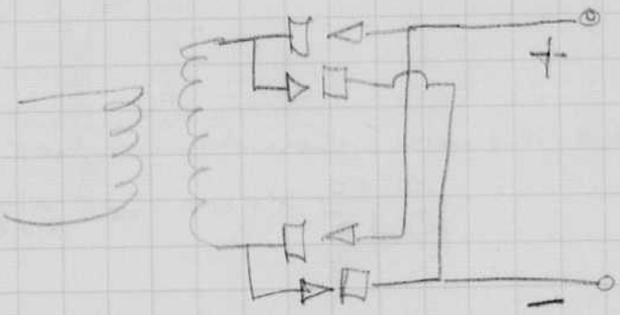




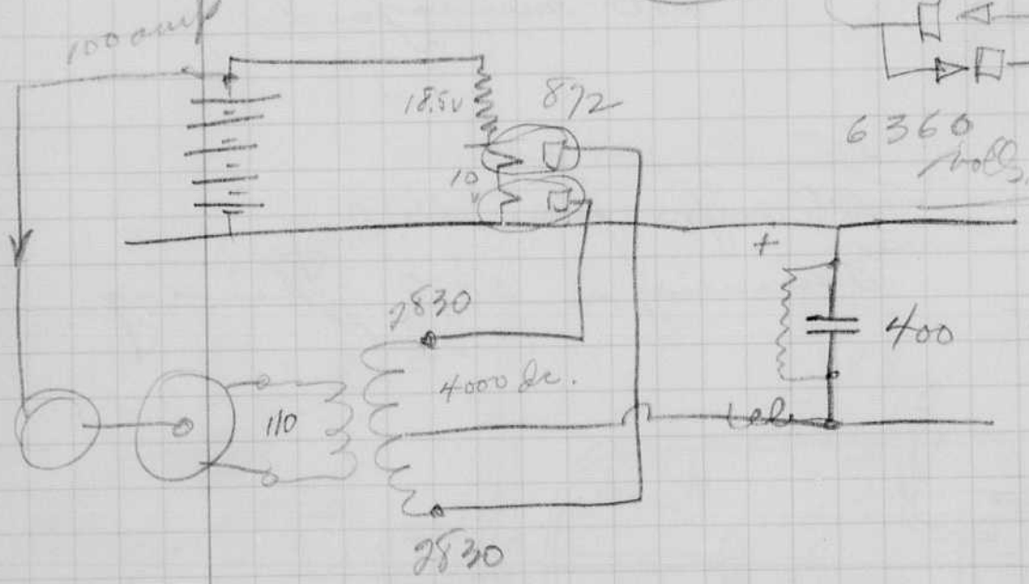


3150v. — 2.5 amp

fil 5 volt 6.75 amp.



6360 volts 2.5 amp.



$i' = 2.5$ amp.

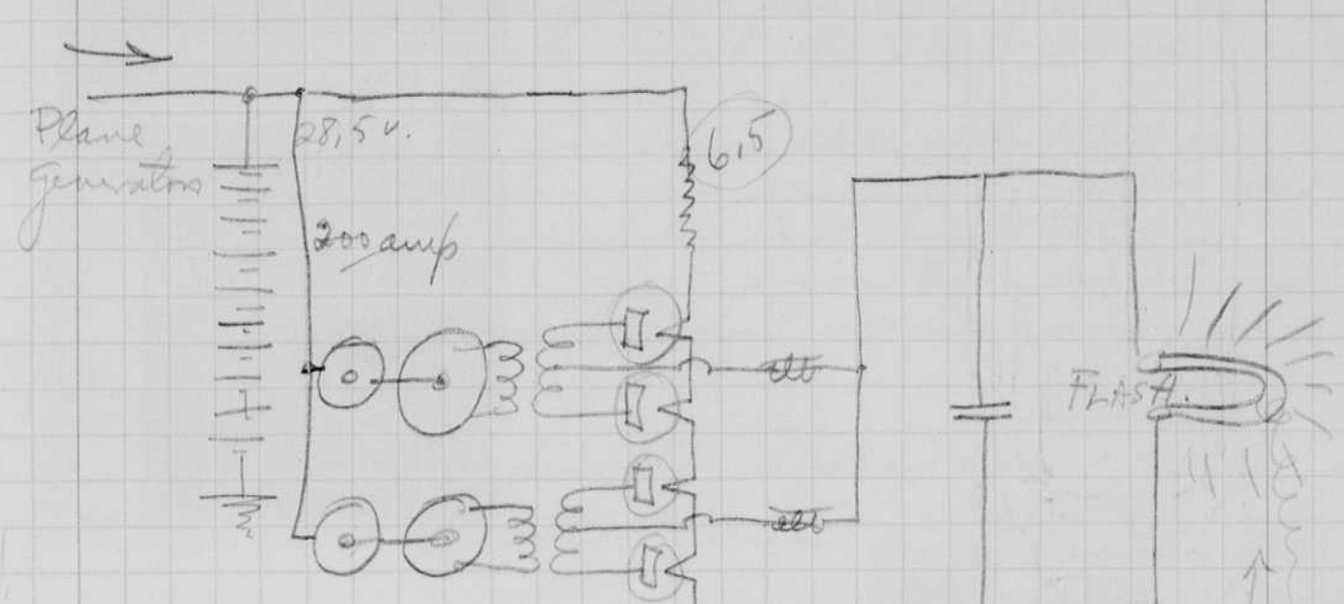
$$e = \int \frac{i'\,dt}{C}$$

$$= 4000$$

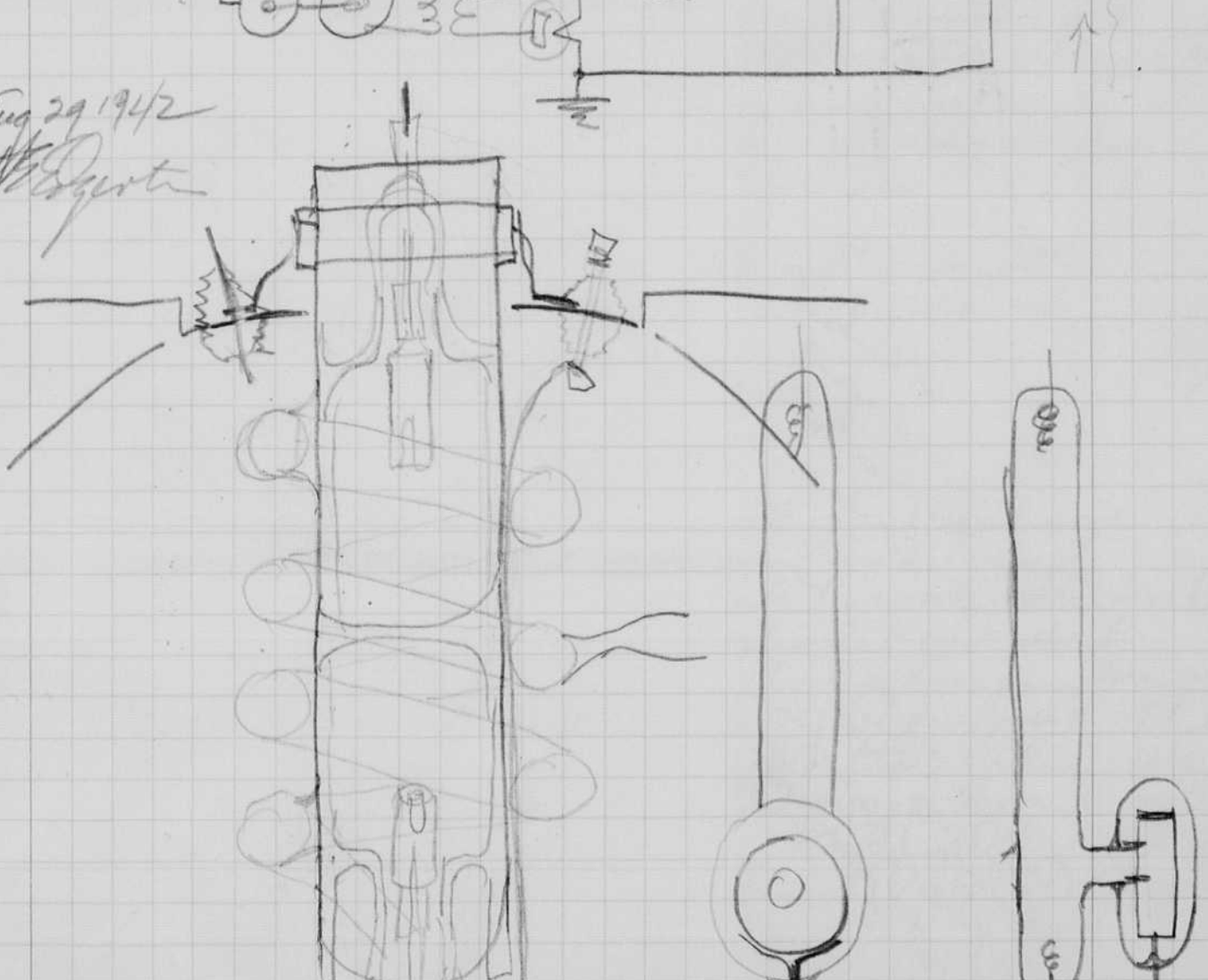
$$dt = \frac{eC}{i'}$$

$$= \frac{4{,}000 \times 400 \times 10^{-6}}{2.5}$$

$$= .64 \text{ seconds}$$



Aug 29 1942



Three Injured In Bomber Fire

Three enlisted men at Wright Field were burned, one severely, when a four-motored heavy bomber caught fire while standing on the flying line at the field at 4:30 p. m. Tuesday.

The injured men were Pvt. Benjamin Ginsburg of Richmond Hill, N. Y., who is confined to the Patterson Field hospital; Pvt. Cecil Morrison of Kansas City, Mo., and Pvt. Morton T. Barov of Charleston, S. C. Pvts. Morrison and Barov were released from the hospital after being treated.

According to field officials the plane exploded and caught fire as it was on the flying line. It was reported to be considerably damaged.

At Cleveland Airport — Kenyon in back window.

Taken on way from Cleveland to Dayton. Bomb bay doors open. Light from flash.

Wednesday Sept. 2, 1942.
Harold E. Edgerton.

Yesterday about 4:30 or 5 p.m. our flash unit went up in smoke with the B24 plane.

The fire occurred when the motor tank on our apparatus was being filled with gas for a trip scheduled for last night to do strip mapping. Three privates were doing the job. One was burned on the hands and face.

This was a terrible disappointment to me and to the group here at Wright field who have been working on the job. However the results to date were very promising and we are going ahead. Plans were made with Col. Haddad for 4 more units to fit B24 ships.

The burnt job worked ok at 5000 ft. with a Wratten #3 filter on the camera at 6 second intervals.

Log of trip to date.

Left Boston Aug 30 at 5.30 for Cleveland. Arrived Cleveland 7.20 am and went directly to neba park to work with Noel on guard lamps. Finished one and met B24, Baisley, Border, Kenyon, Merrill, Taylor and Crentz at the airport. The cameras were aboard with film. We shot pictures on the way home. Some color at 750 feet on Kodachrome were ok. Landed at Dayton about 10.30 or 11.00 pm.

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At Cleveland Airport
Keyser in back window.

Taken on way from Cleveland to Dayton. Bomb bay doors open. Light from flash.

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Log of trip to date.

Left Boston Aug 30 at 5.30 for Cleveland. Arrived Cleveland 7.20 am and went directly to neba park to work with Noel on quartz lamps. Finished one and met B24, Baisley, Border, Kenyon, Merrill, Taylor and Crouts at the airport. The cameras were aboard with film. We shot pictures on the way home. Some color at 750 feet on Kodachrome were ok. Landed at Dayton about 10.30 or 11.00 pm.

Sept 5 1942
Jamed Edgerton

Came from Wright field yesterday with Col Baisley, Major ~~Holland~~ Border Lt. Kenyon. Carpenter in a B-17 no 2539. This morning a discussion was held in my office on flash plotting apparatus.

It was decided to

1. Rebuild old unit to put out maximum power at the maximum rate. This has 2000 volt condensers and operates at ~~4~~000 microfarads.

143 and x28 mit.

2. Plan a duplicate, with improvement of the unit that was destroyed by fire last week.

Baisley and, Border and Kenyon left today about 2 or 3. pm from Boston airport.

Taken at Nela Park
5000 ft f 3.5 Trix film 12½" lens.
August 31 1942. 2x enlargement from negative.

Sept 5 1942
Harold Edgerton

Came from Wright field yesterday with Col Baisley, Major ~~Holdan~~ Boden Lt. Kenyon. Carpenter in a B-17 no 2539. This morning a discussion was held in my office on flash photography apparatus.

It was decided to

1. Rebuild old unit to put out maximum power at the maximum rate. this has 2000 volt condensers and operates at ~~4~~000 microfarads.

143 cond
x 28 mf.

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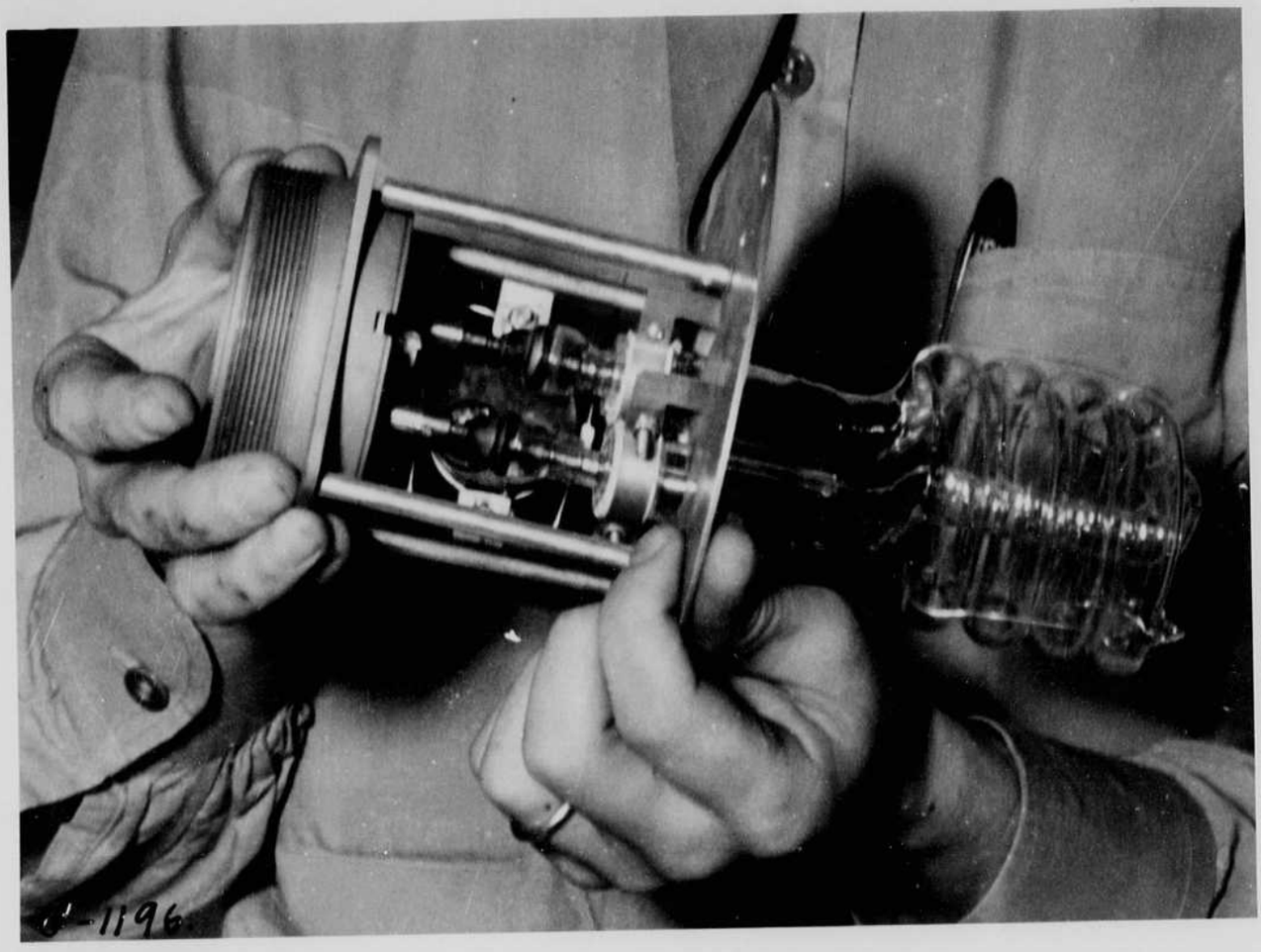
Baisley and, Boden and Kenyon left today about 2 or 3. pm from Boston airport.

Taken at Nela Park
5000 ft f 3.5 Trix film 12½" lens.
August 31 1942. 2x enlargement from negative.



Pearly spiral as used with the big flasher.
2000 mf 4000 volts 6 sec. interval.
Bottom seal cracked.

19

Notebook # 13

Filming and Separation Record

40

22.

____ unmounted photograph(s)

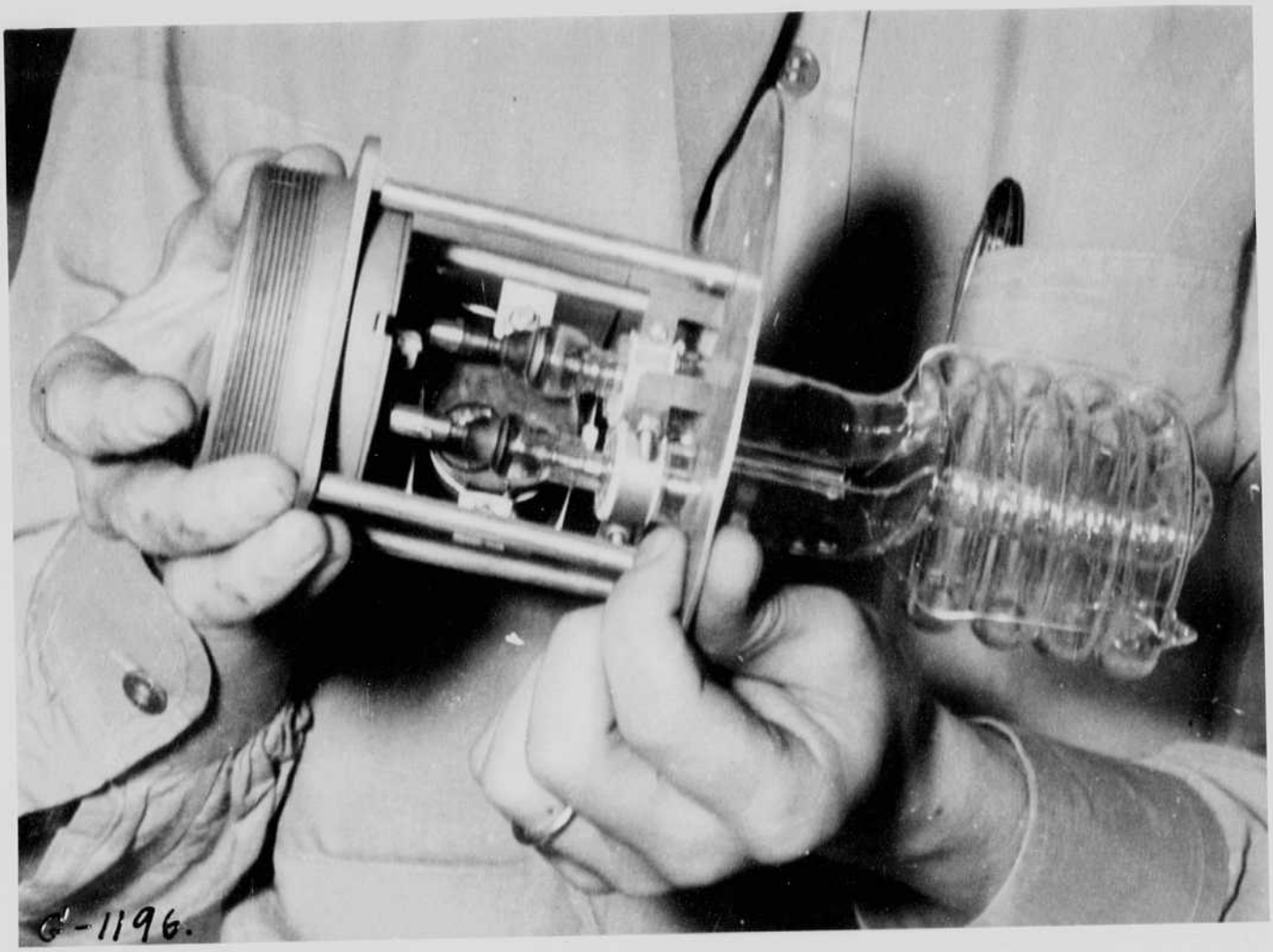
____ negative strip(s)

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

was/were filmed where originally located between page 18 and 19.

Item(s) now housed in accompanying folder.

X.



Pyrex spiral as used with the Fig Jaxtor.
2000 mf 4000 volts 6 sec. interval.
Bottom seal cracked.

Notebook # 13

Filming and Separation Record

40

22.

____ unmounted photograph(s)

____ negative strip(s)

1 unmounted page(s)
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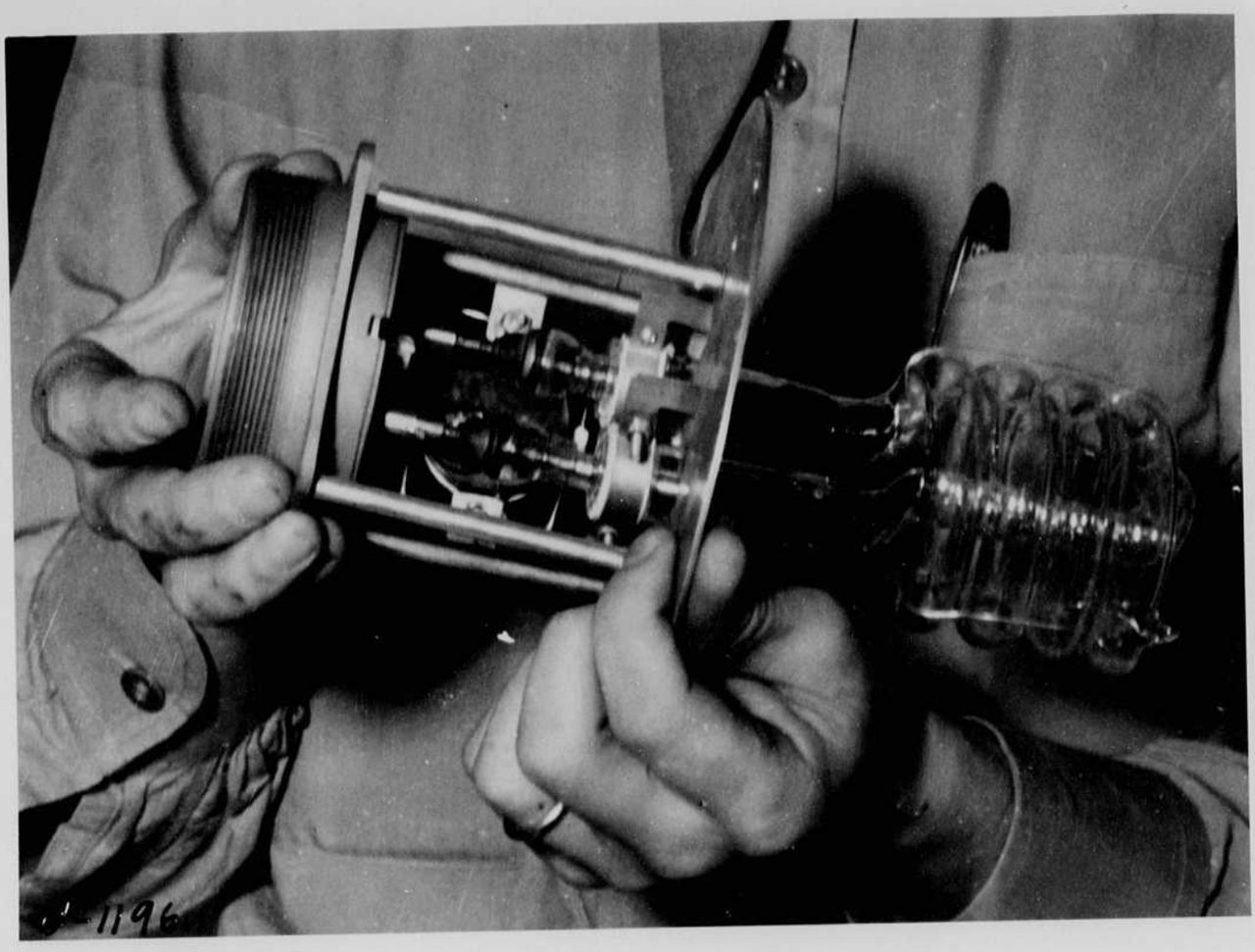

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Bottom seal cracked.

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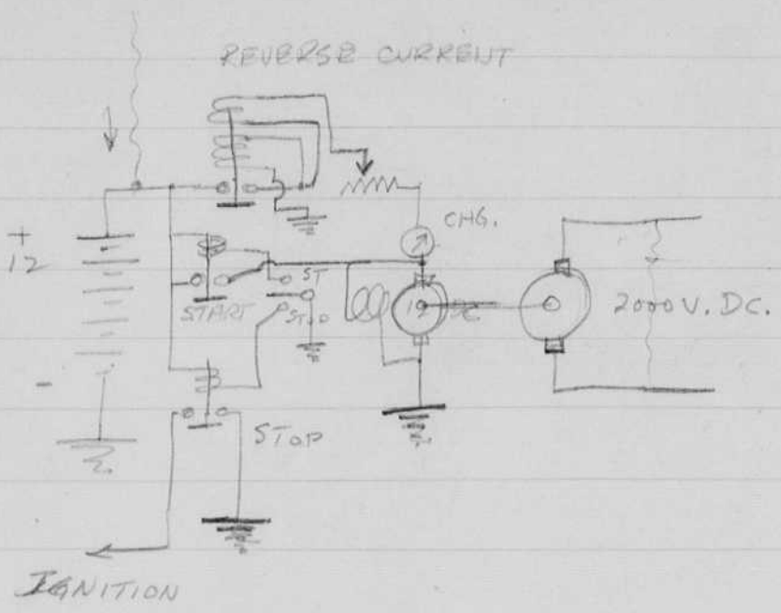

REVERSE CURRENT
CHG.
+
12
-
START
ST
STOP
2000 V. DC.
STOP
IGNITION

Sept. 7, 1942
Harold E Edgerton

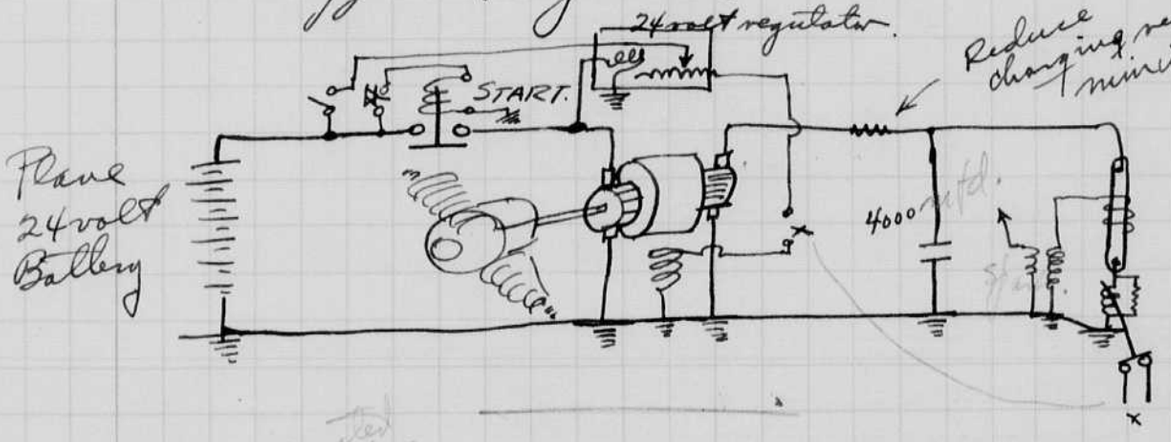
Weight of 5925 set 4000 mf 2000 volts.

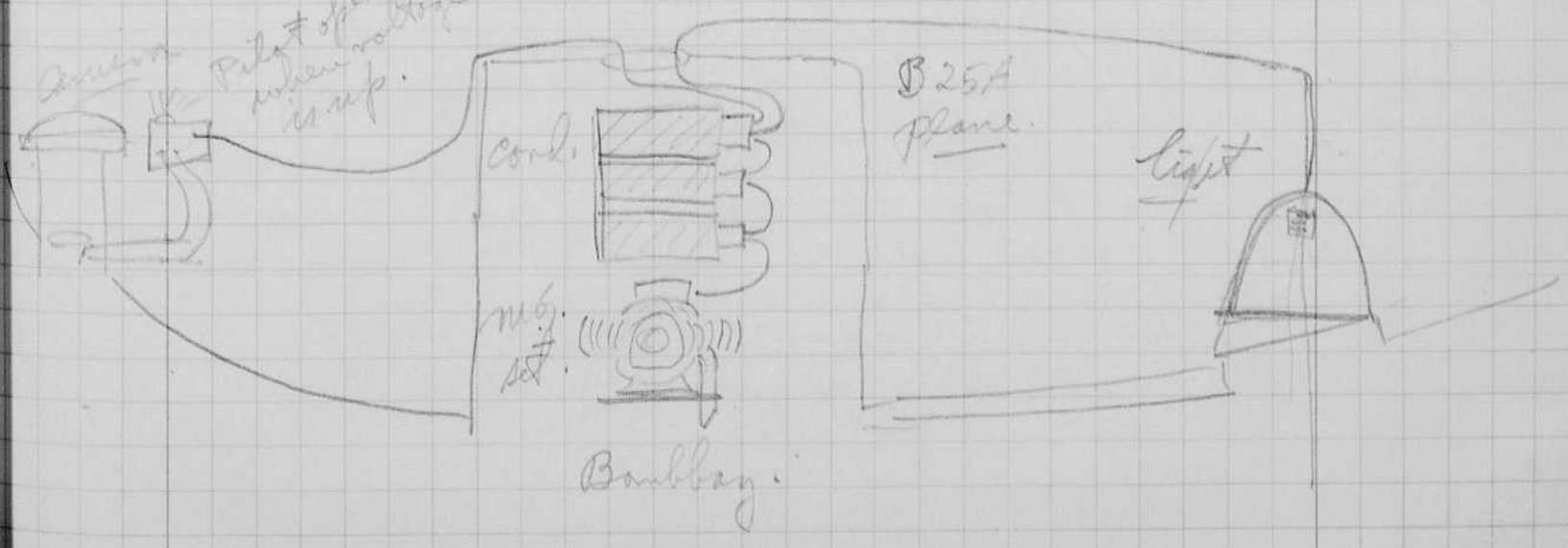
6 Condenser racks @ 162	968	
2 Condenser dollies @ 20 (does not fly). est.		40
1 Motor generator set.	278	
1 - MG Dolly.		22.
Cables and reflector and controls est.	25	
	1261	

Sept. 8, 1942

Worked with Freddie and Herb on the old 2 Kw MG set 2000 volt that is used to charge the 4000 mf unit. Data in Fred's Book.

Suggested system.





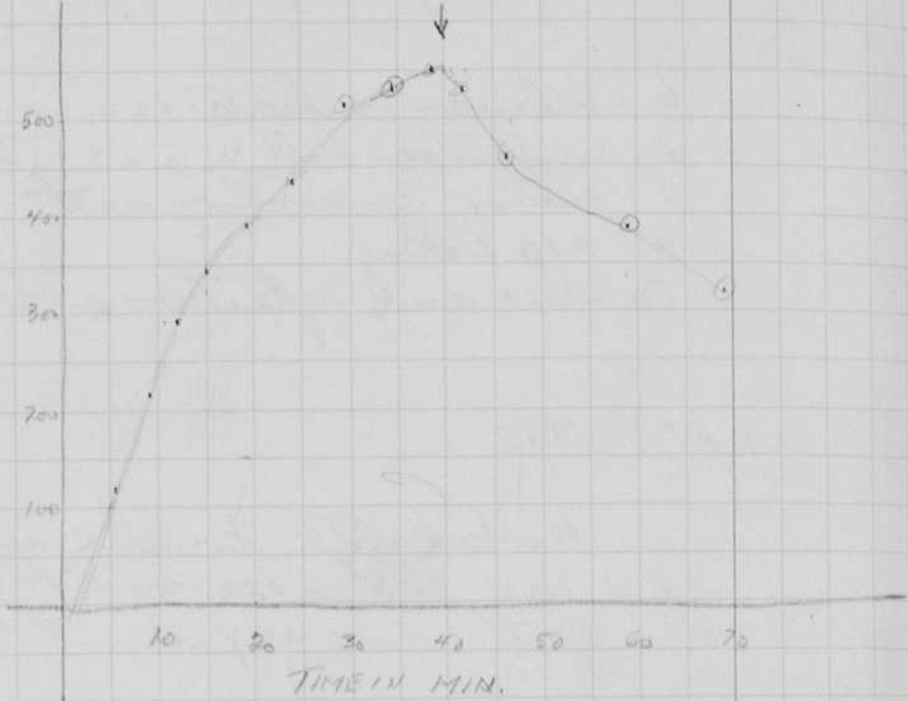
Sept 12 1942

[illegible signature]

time-temp of new oven for pumping tubes. Pump room & 8-101 Room.

230 volts 1 phase.

Set pow.	5 11		20°C
	5 17	6	120
	5 20	9	212
	5 23	12	290
	5 26	15	348
	5 30	19	396
	5 34	23	437
	5 40	29	514
	5 45	34	535
off.	5 49	38	550
	5 53	42	532
	5 58	47	457
	6 04	58	390
	6 14		330



Pumping [illegible] lamp designed by [illegible] and blown by Lewis. It is a slight modification of the regular type.

cm

15-30	76-28	48.0
15-30+	76-42.5	33.5

Seems to give better.

Hydrogen 1 cm + 90 cm oxygen tank
mixed in 1 liter bulb. This was used
to fill the movie lamp.

Press	light	Weston meter 5" below lamp.
10 cm.	15.	150 cycles 1 mf. on movie.
20	15	
30	14	
40	14	

Tried at 1200 ~~all~~ pressures 40 - 20 and 10 cm
chg resistor 500 ohms operation O.K.

10 cm	14	
4.5	14	ok at 1200. seems whiter in color. Blue in cap but red outside on both ends where gas or radiation comes out.
1.5	14	
.[illegible]	1[illegible]	
0.2	13	but is visually very dim.

Exhausted and filled to:

10 cm	15.	operated ok at 1200 cycles.

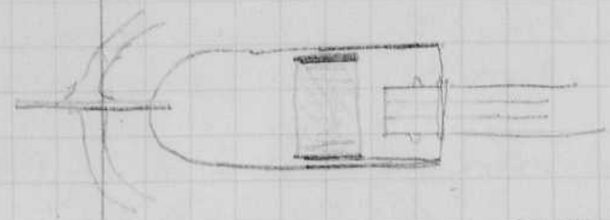
Exhausted and bombed.
20 cm H_2 and bombed
Exhausted and bombed.
Allowed to cool then filled with 10 cm and sealed off.

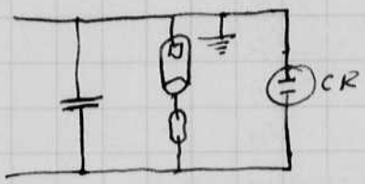
The cathode is more uniformly heated with
10 cm than with 40. At 40 the arc tends to
concentrate at the closest end of the cathode.

Wyckoff looked at this 10 cm lamp and at
old 60 cm lamp. He says 10 cm lamp is brighter at
1200 cycles 1 mf 500 ohms chg. The sound is
~~[illegible]~~ clearer for the 10 cm lamp showing better
starting time.

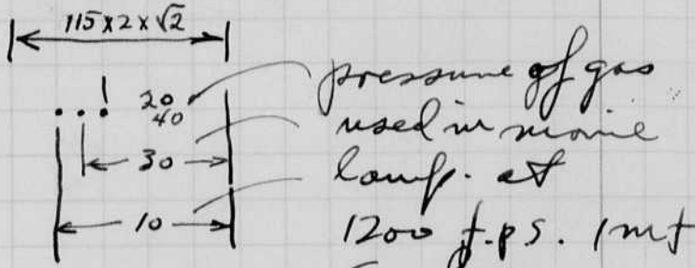
Sept 14 Pumped 5 more lamps sealed off
with 15 cm of gas as per above.

tested for back voltage with a C.R. tube.





175 volts on plate



pressure of gas used in movie lamp. at 1200 f.p.s. 1 mf 500 ohms.

Pumped movie lamps.

1 cm Hz 1 atm 6 — 15 on westin 1200 500 ohm 1 mfd.

15 cm 10 " Westin. " " " "

Explained and used new gas

10 cm	35.*	*Different zero setting
20	47.	
30	47.	
50	47.	
60+	35	Skiffing!

Left Belmont Sept 19 Sat with Wycholt.
Sept 20 in N.Y. RCA with Shelby. Stayed in YMCA.
Arrived ~~Balt~~ Wash. Sept 20. 5 pm. Sept 21, 22, 23 (noon) at Model Basin. Arrived Sept 23 5 pm at Aberdeen.

SHOT	Shell Schedule #	SPEED.	Aperature	f.C.	Speed. at impact	D.C. motor. Volts f.P.S.	
Sept 25.							
1	1	37	2087	2	400 ± ?	12 1300 1375	Bright day.
2	2	75	1011	2		12 1300 1300	
3	3	37.	1484	4		12 1590 1475	
4	4	75	877	6.		12 1490	
Sept 26.							
5 Shot Mushroom torch wrong.	7	75	874	#6.	50-100	12 volt 1240	Cloudy.
6	8	75	758	6	50-100	12 volt. 1200	"
hit wheel	9	75	752	6	75	12 volt	"
H.E. Spring.	9A	75	772	6	35	12 ..	..
	9B	75	768	6	150?	12	..
	5	75 AP.		6	7	8	600.

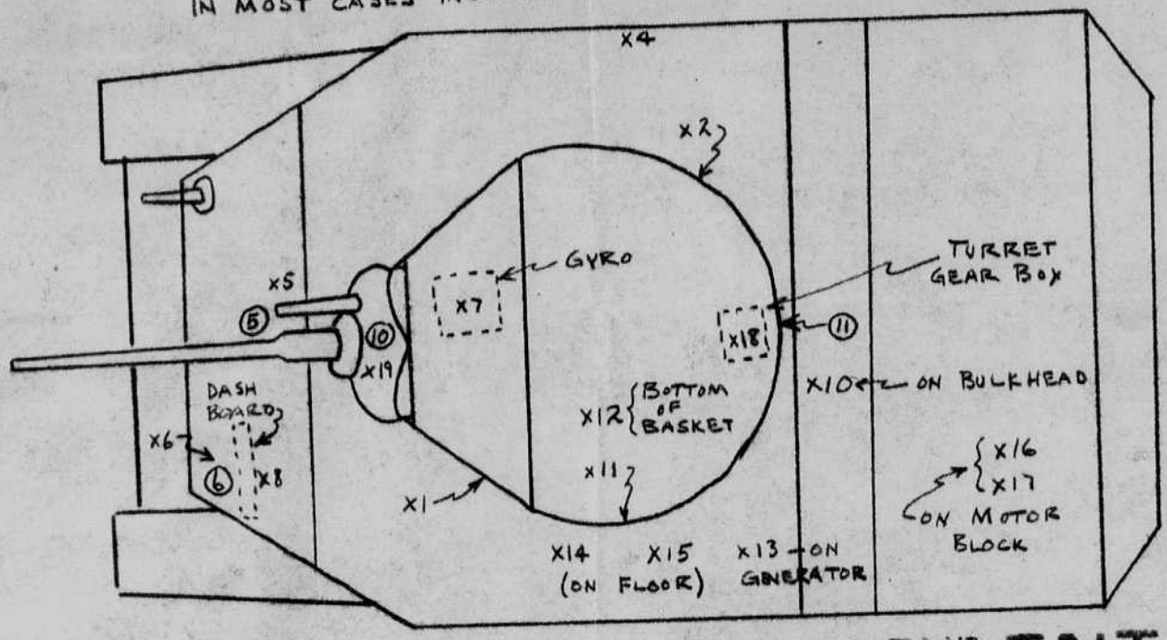
Left Aberdeen with Hoover about 2 or 3 pm on Sunday Sept. 27

Speed record on no. 5.

6.25	4.5/8"
6.25 -	4 5/8
6.00+	4 5/8
	4 5/8
600	4 1/2 action.
	4 1/2
	4 3/8

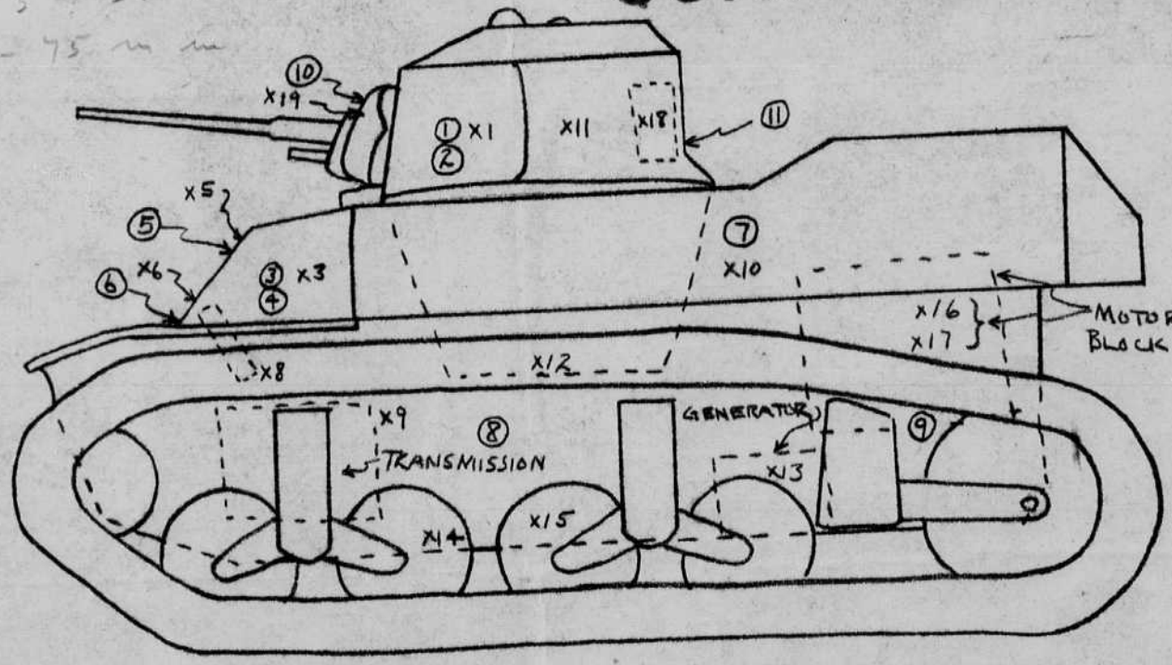
NOTE:
○ — CIRCLES INDICATE POINTS OF SHELL IMPACT.
x - CROSSES INDICATE APPROXIMATE INSTRUMENT LOCATIONS.
IN MOST CASES INSTRUMENTS WILL BE MOUNTED INSIDE TANK.

CH-8212202



CONFIDENTIAL

#1 + 3 = 37 m m
bal - 75 m m



Title LOCATION OF SHELL IMPACTS AND INSTRUMENTS ON M5 TANK.

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., U.S.A.

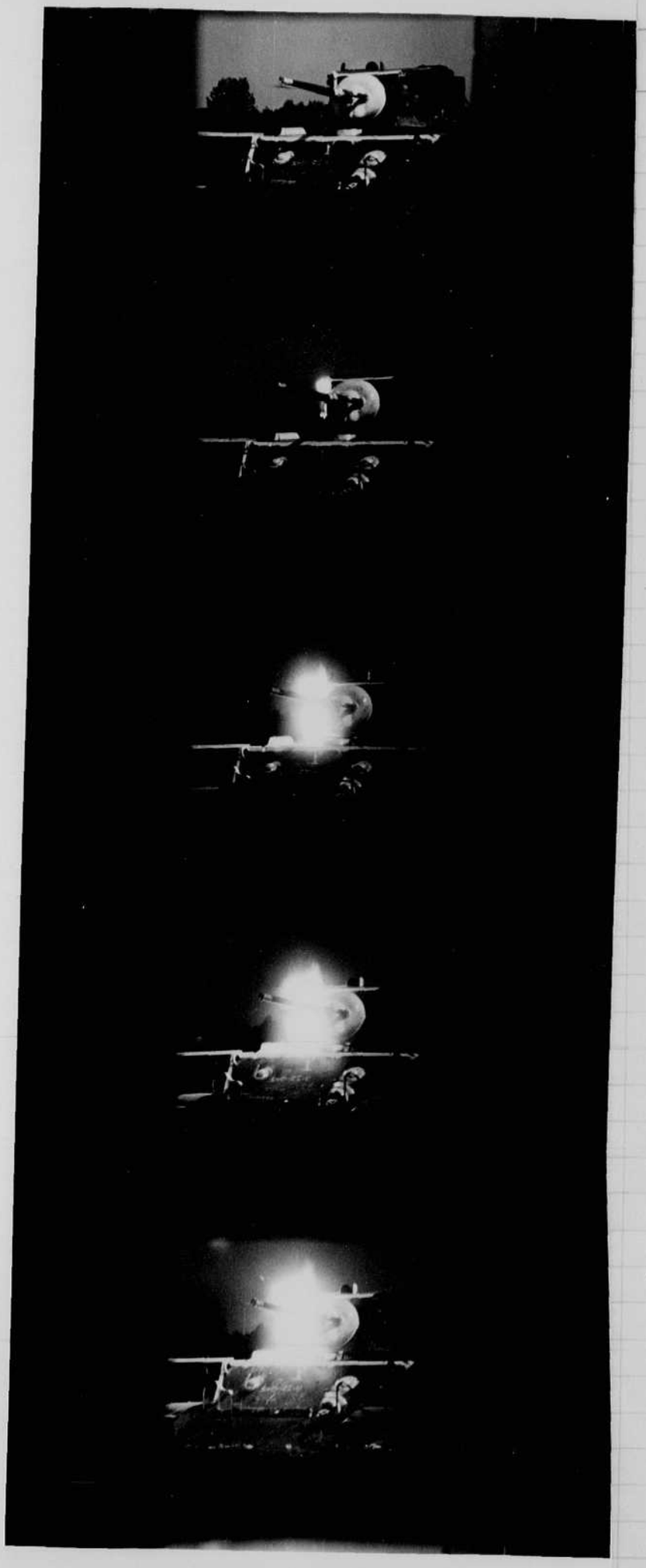
DEPARTMENT GENERAL ENGINEERING LABORATORY

CH 8212202

Date SEPT. 2, 1942 Prepared by A. Cochran

PF-530 (2-50)

PRINTED IN U.S.A.



37 mm shell hitting a tank.
taken at Aberdeen Md.
Sept 25 1942

NOTE:
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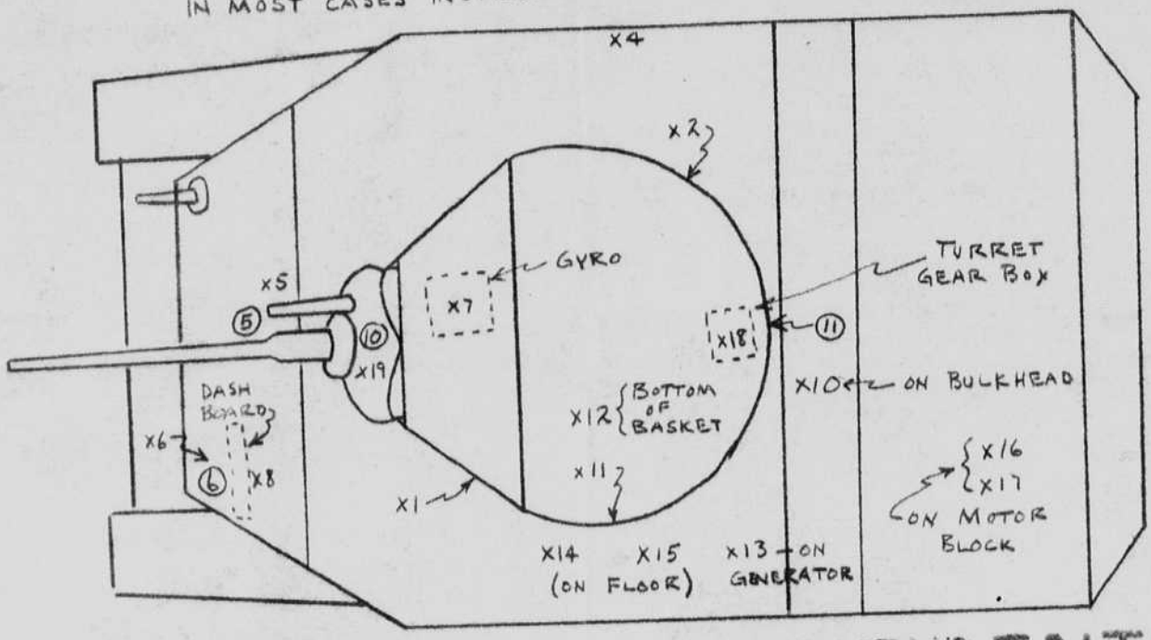
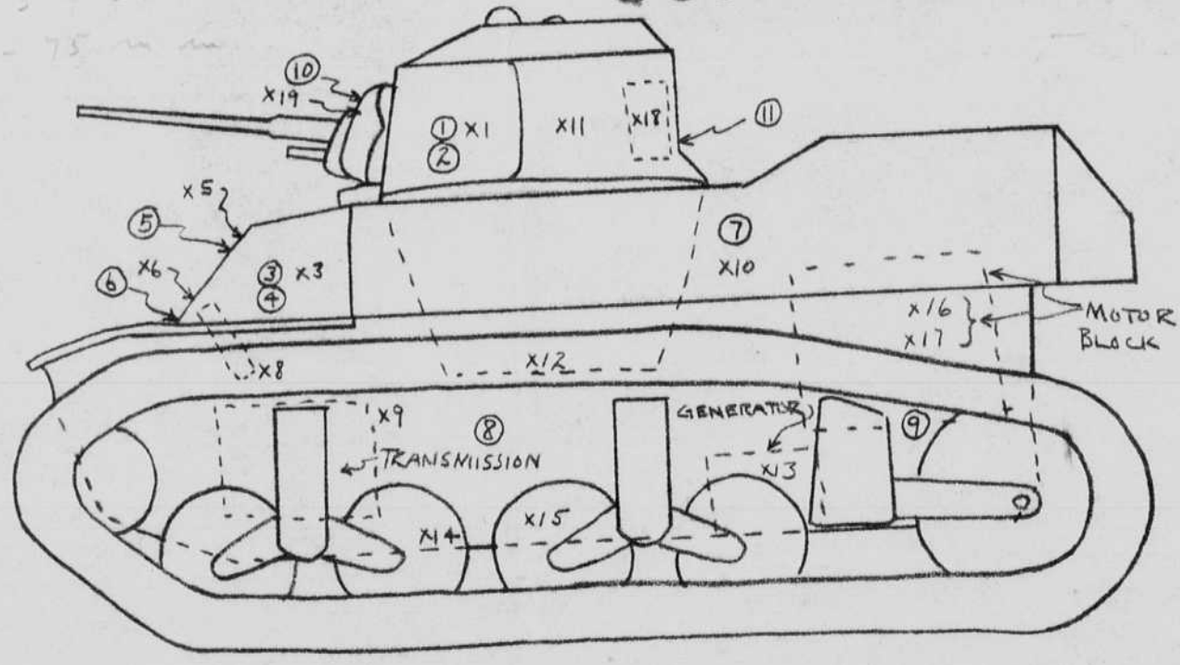


CONFIDENTIAL



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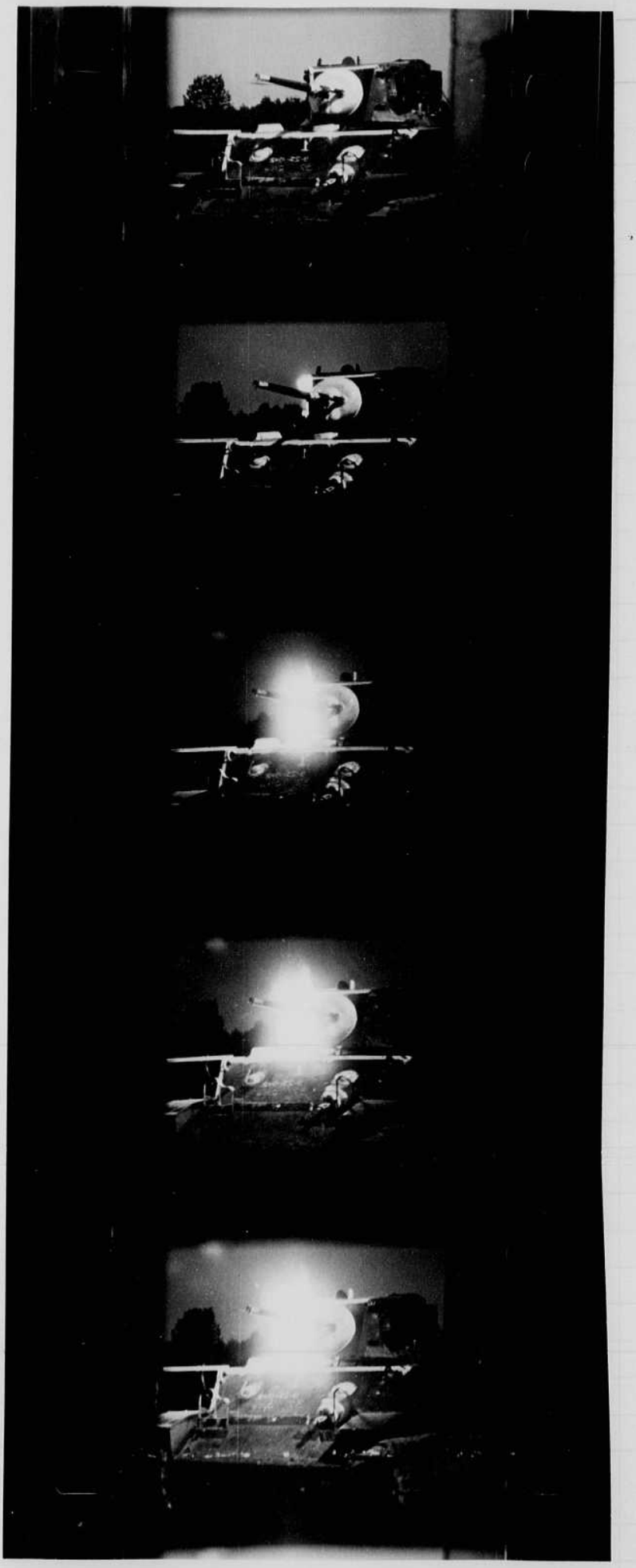
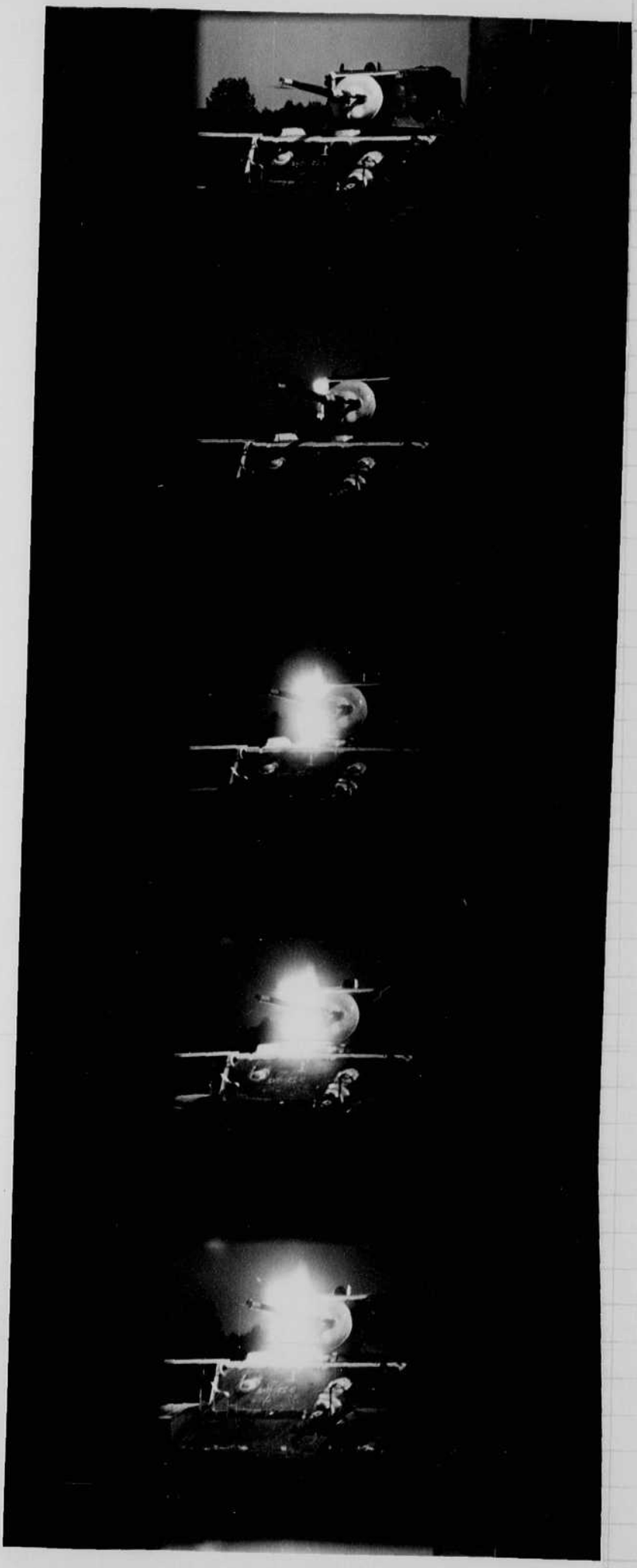


37 mm shell hitting a tank.
taken at Aberdeen Md.
Sept 25 1942

GB Phillips

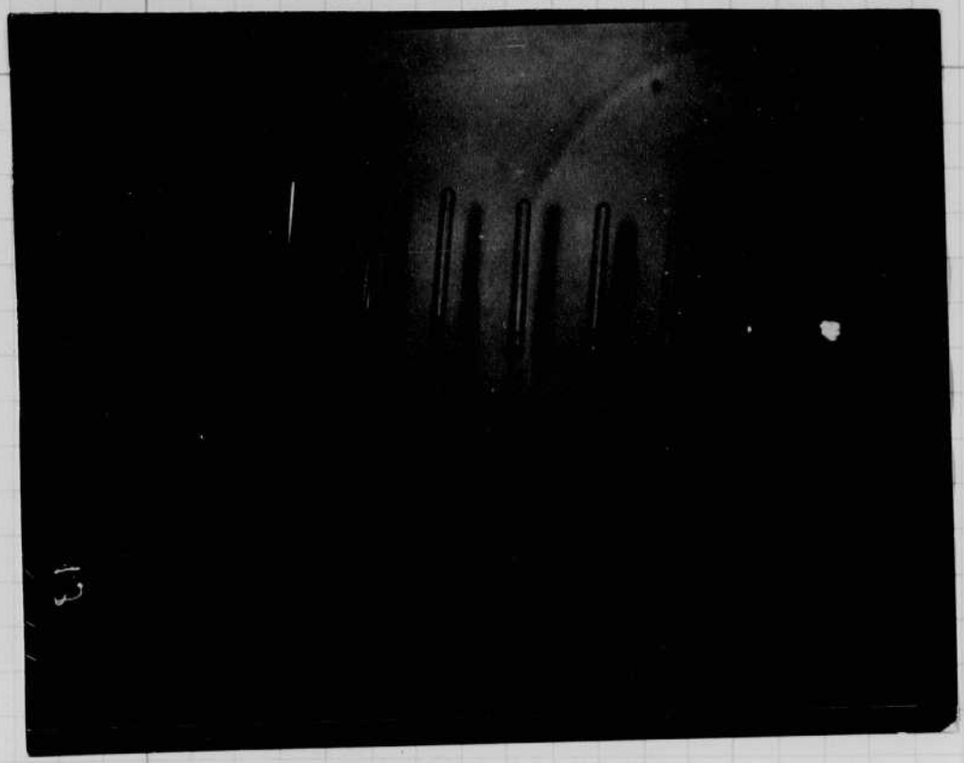
#5

3155



37 mm hitting a tank.
taken at Aberdeen Md.
Sept 25 1942

Harold Edgerton



Taken at Taylor Model Basin ~~Sept~~ Oct. 1, 1942
See Wyckoff note book.
#8 mine cap

Shows shadow of spherical sound wave on the back wall.

Glass tubes filled with air. Note that first tube broken.

October 2 1942
Harold E. Edgerton
RR Station
East Cleveland Ohio.

I left Boston Oct. 5 at 5:45 PM for Indianapolis to consult with Garland at the Electronics Lab. Discussed details with Krasno and after dinner at his home took the night train to Cleveland. Spent today with Enfield, Noel-Roe and others on tube ~~to~~ specifications etc. McClennahan and I are going to N.Y. tonight on the 8:24 train for a visit to Hoboken plant of the G.E. Co.

The Electronics Lab have just received a large order for lamps for the army. It will be about 900 lamps. these will be made at Hoboken.

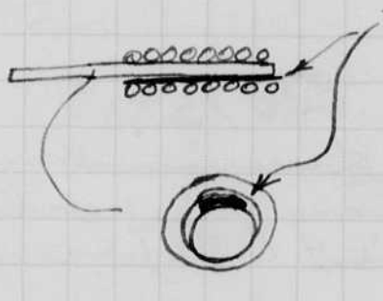
M.I.T.
October 11 1942
Harold E Edgerton.

Returned from Hoboken last night on 5 pm train from Penn Station.

Spent Sunday morning (today) discussing Electronics order tubes with Germeshausen and Grier.

Life test of Beacon lamp. Started 1220 2 flashes per min.
112 mf 2100 volts 1230 260 flashes etc.
2 flashes per minute.

Started pumping of #9 double coil tube on Xenon system. These tubes have a tungsten spiral cathode with thorium metal inside.



Mr. Lex Kenney at G.E.Co. Hoboken made these up for me. Mr. Vie had them put in the tube by a glass blower on the floor named Chuck.

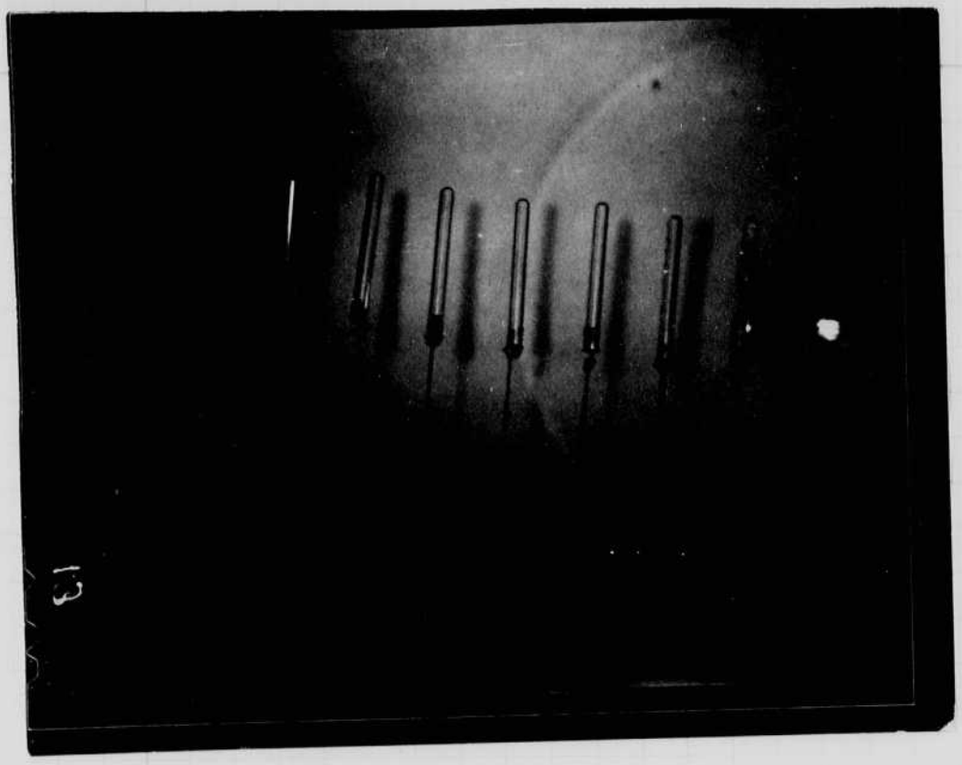
#9 tubes 2 samples with thoriated Nickel
Baked 50 minutes on new system.
Sparked with sparker on electrodes
Filled 1 cm Xenon and operated as stroboscope.
Put 100 ohms in series and operated as glow heat cathode.
Pumped out Gas
filled to 7 cm (+ 1/2?) and sealed off.

Oct 11 pm
Started 2.45 Life test. 2000 volts 36 mf 1/2 min flash interval
One tube cathode with thorium
Other tube cathode pure tungsten. The thoriated end of this tube was treated on the pump with D.C. and the electrode had sputtered a small amount.

Oct. 12.
Off. 10.40 am.
16 hours x 120 = (1920 flashes.)

a photo of these two tubes was taken to show sputtering and a copy will be pasted on the next page.

Harold E. Edgerton



Taken at Taylor Model Basin ~~Sept~~ Oct. 1, 1942
See Wyckoff note books.
#8 mine cap

Shows shadow of spherical sound wave on the back wall.

Glass tubes filled with air. Note that first tube broken.

October 7 1942
Harold E. Edgerton
RK Station
East Cleveland Ohio.

I left Boston Oct. 5 at 5:35 PM for Indianapolis to consult with Hartley at the Electronics lab. Discussed details with Krasno and after dinner at his home took the night train to Cleveland. Spent today with Enfield, Rock Roe and others on tube ~~&~~ specifications etc. McClennahan and I are going to N.Y. tonight on the 8 o'clock train for a visit to Hoboken plant of the G.E. Co.

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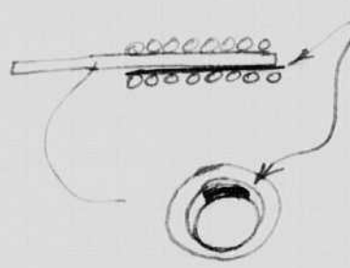

Mr. Rex Kenney at G.E.Co. Hoboken made these up for me. Mr. Vic had them put in the tube by a glass blower on the floor named Chuck.

#9 tubes 2 samples with thoriated [illegible] Had 50 minutes on new system. Sparked with sparker on electrodes. Filled 1 cm Xenon and operated as strobe coil. Put 100 plugs in series and operated as glow to heat cathode. Pumped out gas filled to 7 cm (+ 1/2?) and sealed off.

Oct 11 pm
Started 2:45 Life test. 2000 volts 36 mf 1/2 min flash interval
One tube cathode with thorium
Other tube cathode pure tungsten. The thoriated end of this tube was treated on the pump with D.C. and the electrode [illegible] had sputtered a small amount.

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Off. 10.40 am.
16 hours x 120 = (1920 flashes.)

A photo of these two tubes was taken to show sputtering and a copy will be pasted on the next page.

28 Oct 12 1942

Harold E. Edgerton

8-105 M.I.T.

made two more tubes to test electrodes.

* One has plain tungsten electrodes (one oxidized).
other has one tungsten electrode with a Ba in Ni wire.

Baked 40 min.
~~Filled~~ Sparked with high freq sparker.
~~Filled with Xenon at 7 cm.~~
~~Sealed off. tube cooled.~~

* This tube developed a leak after baking. It was sealed off. Another tube was torched then sparked then filled with Xe 7 cm and sealed off.

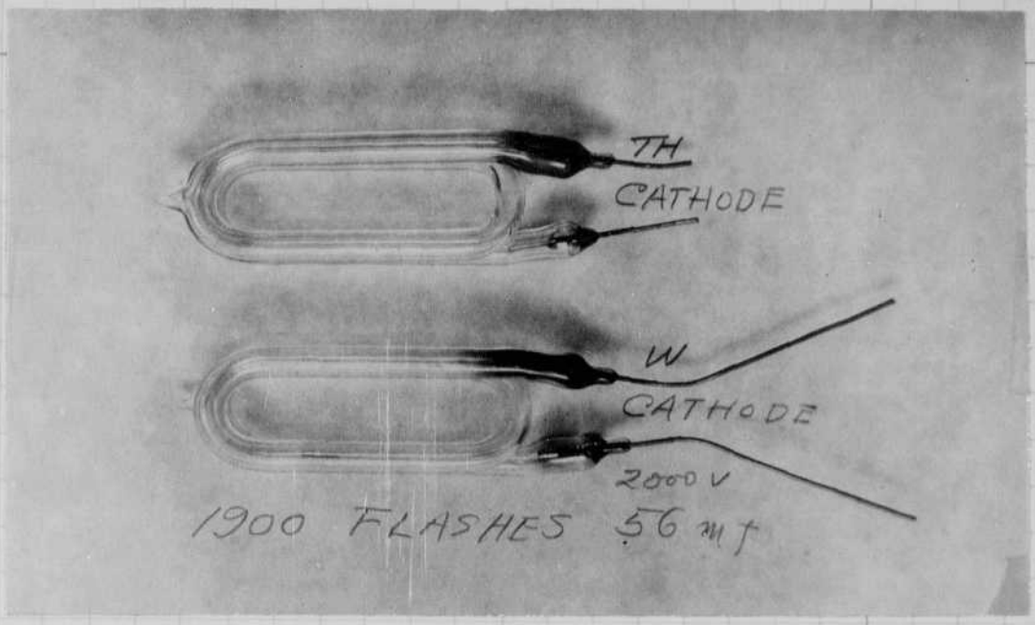
~~First~~ test started 1:50 pm Oct 12.
~~Tube~~ Ba-Al pellet in ~~Nichrome~~ screen.
Spiral with oxidized tungsten with Ba-Ni wire (loose in tube) except for weld point.

Stopped Oct 12 about 2:50.

24 + 24 + 1 = 49 hours

120
98
49
5880 flashes.

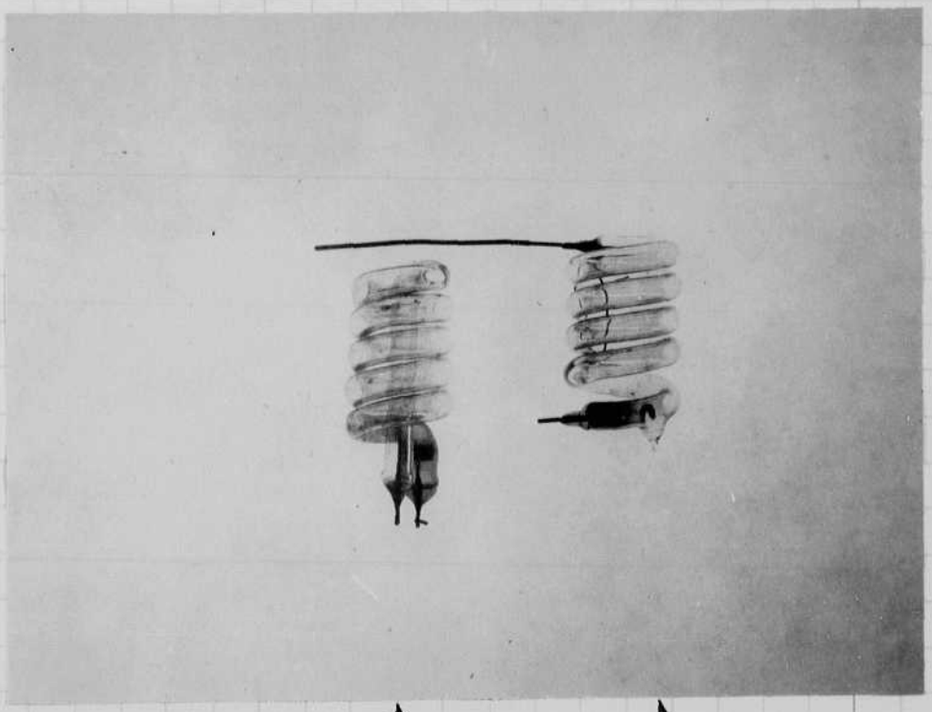
The Ba or W electrode showed very little sputtering.



I oked the thoriated tungsten design for the flash lamp as per above. Discussed with Mr. Miller at Hoboken on Tuesday Oct 13/42.

Oct 13

Charlie spent nearly all day cutting 16 mm films of tanks hit by shells! These were sent today Oct 14 by registered mail to Aberdeen.



5880 flashes
56 mt. volts.
2000 volts.

nickle screen cathode with Ba-al pill getter.

Ba encased in nickle spot welded to tungsten.

28 Oct 12 1942
Jarred E Edgerton
8-105 M.I.T.

made two more tubes to test electrodes.

* One has plain tungsten electrodes (one oxidized).
other has one tungsten electrode with a Ba in Ni wire.

Baked 40 min.
~~Pulled~~ Sparked with high freq spark
~~Filled with Xe at 7 cm.~~
Sealed off. ~~tube cold.~~

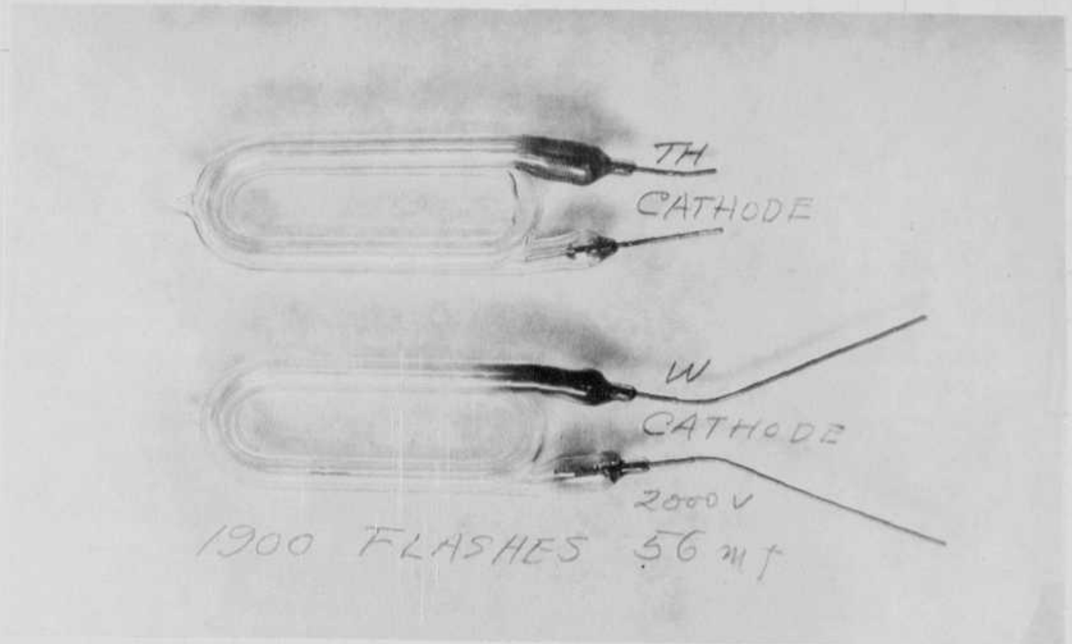
* This tube developed a leak after baking. It was sealed off. Another tube was torched then sparked then filled with Xe 7 cm and sealed off.

~~First test~~ Started 1.50 pm Oct 12.
~~Test~~ Ba-Al pellet in dummy screen.
Spiral with oxidized tungsten with Ba-Ni wire (loose in tube) except for weld point.

Stopped Oct 12 about 2.50.

24 + 24 + 1 = 49 hours
120
98
49
5880 flashes.

The Ba or W electrode showed very little sputtering.



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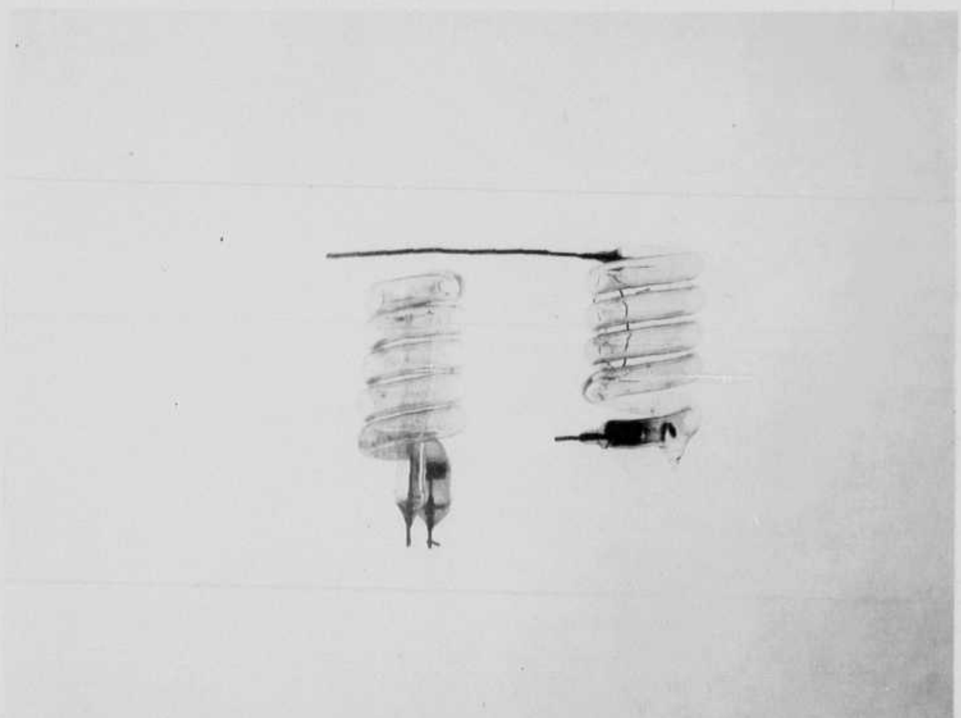


5880 flashes
56 mf.
~~2000 volts.~~ 2000 volts

nickel screen cathode with Ba-Al pill getter.

Ba encased in nickel spot welded to tungsten.

M.I.T. Oct 16 1942

Harold E Edgerton

Tested tubes shown in photo page 5 of this book on the argon system last night. Photo'd all measurements of light output are entered in my blue note book (loose leaf) with other measurements on other tubes.

Two of the tubes blew up at the ends when flashed with 30 mf at 2000 volts. Apparently the lamps are weak at the ends where the glass seals are attached.

Selected readings from photo measurements.

Tube length.	Pressure.	light.	V - 2060 C - 30 mf.
20.6	10cm argon	60	
5.3	16 "	49	
5.3	30	50	
0.8	40	10	
0.8	76	14.	

Chas. Wyckoff left this noon with George Chernak for Wyman Gordon plant (forge shop) at Harvey Ill to see Mr. E. Millard. He Chas will take streak photos of the displacement time curves of a large steam hammer.

08/16/42

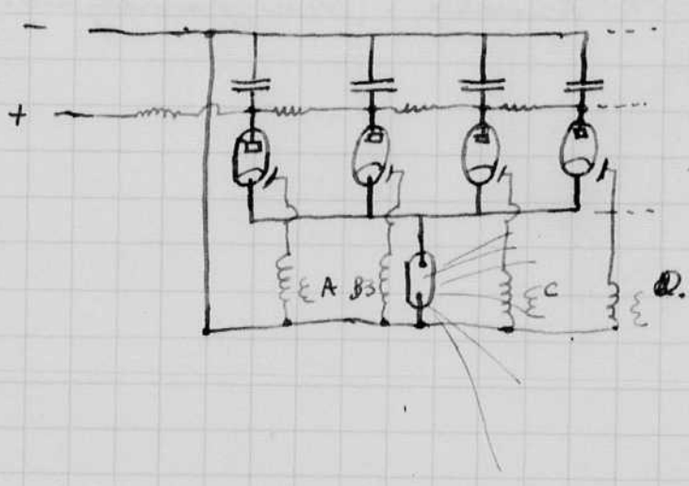
Harold Edgerton

Multiflash for shadow photo of waves.

A shadow photo graph of a wave in water is shown on page 26. This was taken with the microscope flasher 7000 volts 1/3 microfarad. Argon lamp with hydrogen.

On the last trip to Washington at the Taylor Model Basin it was proposed to set up a series of flashes and use a drum camera. It was important to use the lamp at the same point in space for each flash.

For this I proposed the use of a series of condensers and mercury-arc tubes all operating through a common lamp.



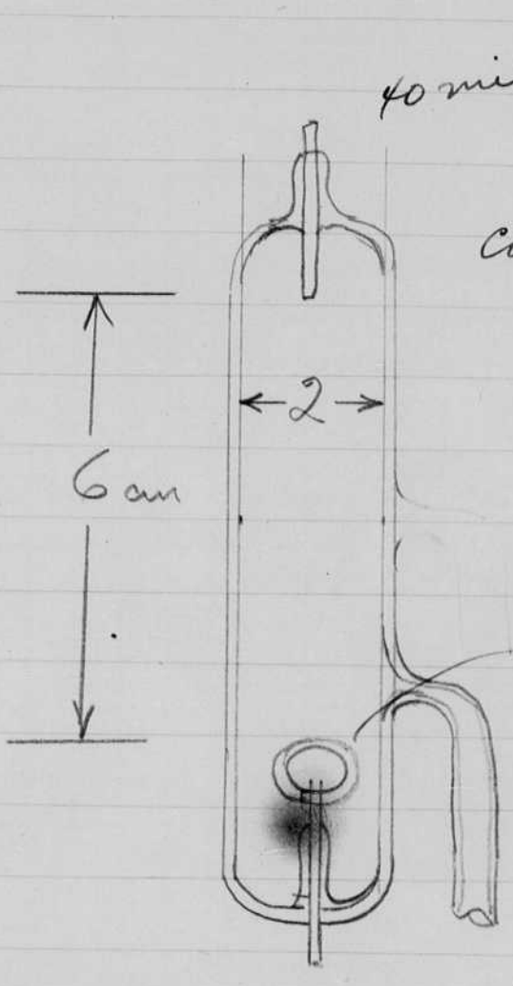
Trip coils A B C D in sequence.

~~T. E. Ogerton~~.
Oct 24 1942

Pumped movie lamps yesterday - also mercury tubes.

Movie lamp schedule.
~~Bake 40 min.~~
Hydrogen bombard anodes and cathodes.
Bake 40 min.
Bomb. electrodes.
H_2 and argon gas 50 cm.
Run on pump 4 seconds. 5 M + 1200 ∧.
Pump out and Bombard.
Fill to 30 cm. and seal off. Gas from bulb - 1 cm H_2 + 1 atmosphere of AR.

Oct 20 and 21 I was in Hoboken with G. G. Milla, A. R. Ruda. Vic Finizio.



Pumped
30. cm argon

one sent to W.L. Sealey
621 South West St
Syracuse
N.Y.

Oct. 23, 1942.

make 2
H.E. Edgerton

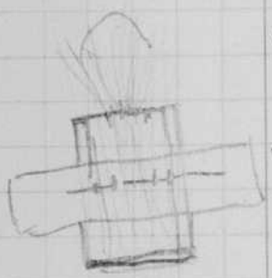
Oct. 27, 1942

Harold E. Edgerton

Diffuser
Leo Popper & Sons
143 Franklin
N.Y.

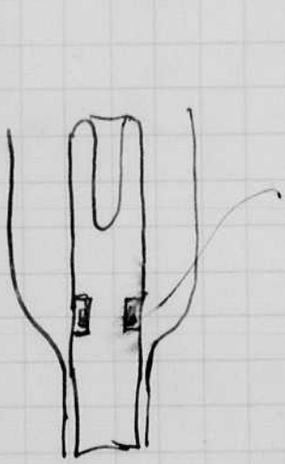
I pumped a straight quartz lamp last night. Tests with 97 mf 4400 volts show greater efficiency than 4 x 97 mf at 2200 volts. Data in Blue Book of photoelectric measurements. *

Fred and Herb are finishing up the remodeling of the B-15 flasher into one to fit a B-25. A D.C. lamp was given 100 flashes last night. There was some darkening of the cathode end. The light is not appreciably cut down.



The flash interval is now 10 seconds
Capacity 2000 mf.
Voltage 2000 volts.

Suggested cathode change.
Cut ring at base as shown. Spot weld 3 Ba al pills in the rim.



Ba and nickle and al will evaporate during bombing. Then allow cathode to cool. Next heat walls of tube to drive Ba back to the electrode.

* 4400 volts 97 mf light = 1.53
2200 " 4x97 " light = 1.29

$\frac{.24}{1.29} = \frac{1}{5}$ or 20 percent increase.

#5690

C.P. = 47.2 candles. 10.23 decimeters.

Std lamp.
115 volts.

200 watt
398 x 112.0 volts. 29.77 decimeters.

$4\pi R^2$ = area of sphere.

$$47.2 \left(\frac{29.77}{10.23}\right)^2 = 47.2 \times 8.43 = 398 \text{ candles.}$$

$\frac{4}{1592}$ lumens per sq meter.

f	Time	Reading	distance 0.5 meter.	on photo-cell meter.
4.5	0.1	76.X10	1592 lumens per sq meter	
			0.1592 " " sq.cm.	

Light on photocell is 0.1 x .1592 = .01592 lumens per sq.cm.

.10	.01592	reading on meter	76 x 10.	165.
1/25 2.5 =	$\frac{.01592}{2.5}$ =		22. x 10	52.0
1/100 10	$\frac{.01592}{10}$			.2
1.	$\frac{.01592}{1} \times 10$		54 x 100	1.8 x 100

= 3.18

= 8.25

Made 12 Hg tubes today 45 min Bake
Bonds. 15 min run
Seal off cold.

Made Straight lamps Stimulux type
rejects for Separation of Compton
Knowles, 1.8 cm Xenon.

Test of Rotary.

E_{DC}	E_{AC}.	Load.
27.0	—	0
26.	143	0
26	140	filaments. 2.85 volts.

Photo test.

6 mf 1250 volts ok on Super X x film
D19 8 min develope.

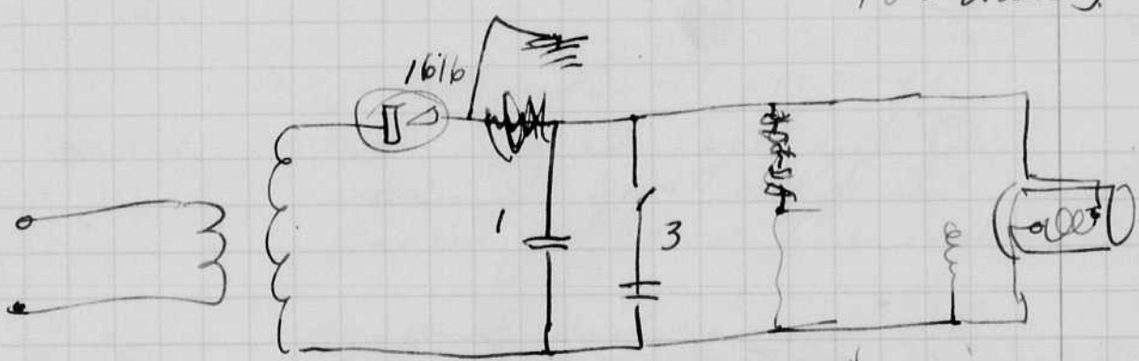
8 ft or 9 ft at f 4.5.

$\frac{4.5}{9}$ / 40.5 = factor.

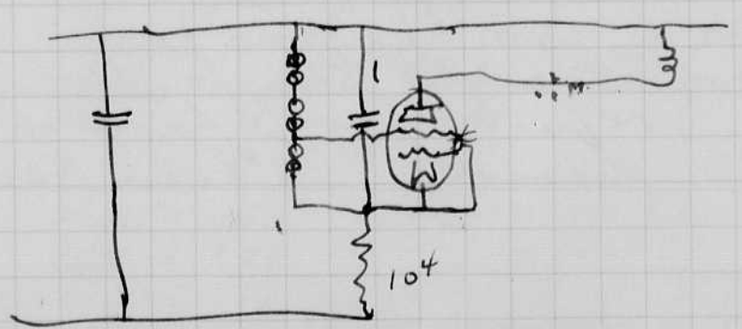
$CE^2 = 6\ 1250^2$

$CE^2 = 25\ 2000^2$ $\frac{16}{640}$.

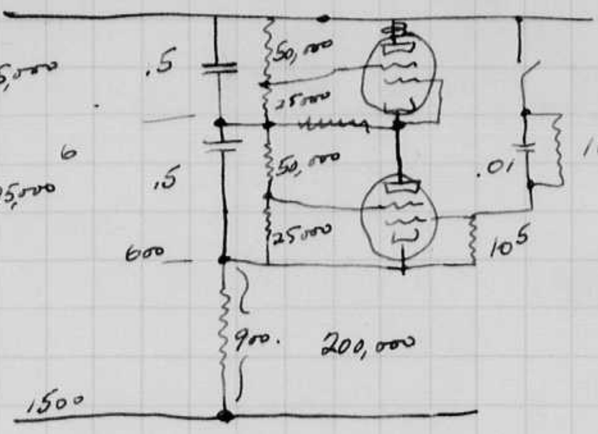
2000 4mf = 16 walls per flash.
30
480 walls.



$IRC = .01$
$R = \frac{.01}{1} \times 10^6 = 10^4$



time constant low
longer



C = .25
RC = .016
$R = \frac{.016}{.25} \times 10^6 = \frac{16000 \times 4}{64000}$.

20

.25
.0525

.25 x 200000 x 10^{-6}
= time constant

200000 + 150000 = 1350 V

150/350 x 1350 = 570

15
38
120
45
2 | 570
285 V

250 + 150 = 1350

150/400 x 1350 = 252

84
3
252

1 mf - RC = .02

$\frac{1 \times 10^{-4}}{}$ = R = 5000 W

E = IR

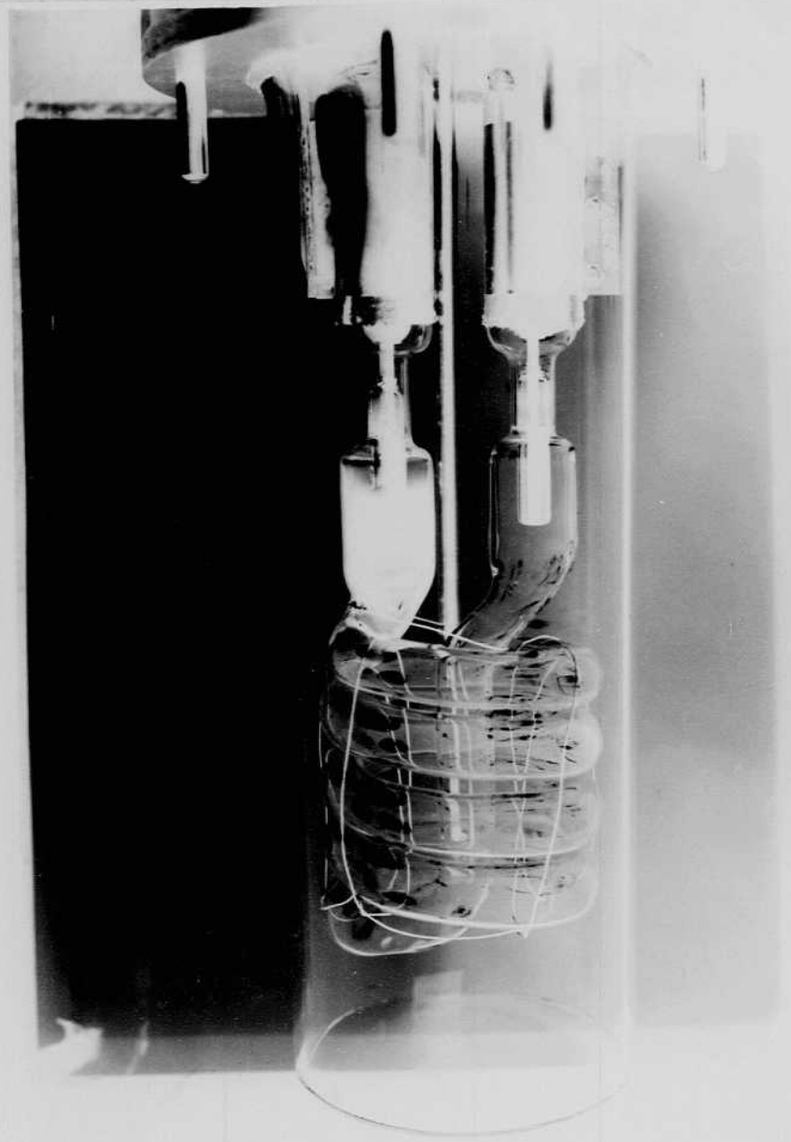
$\frac{1350^2}{20000}$

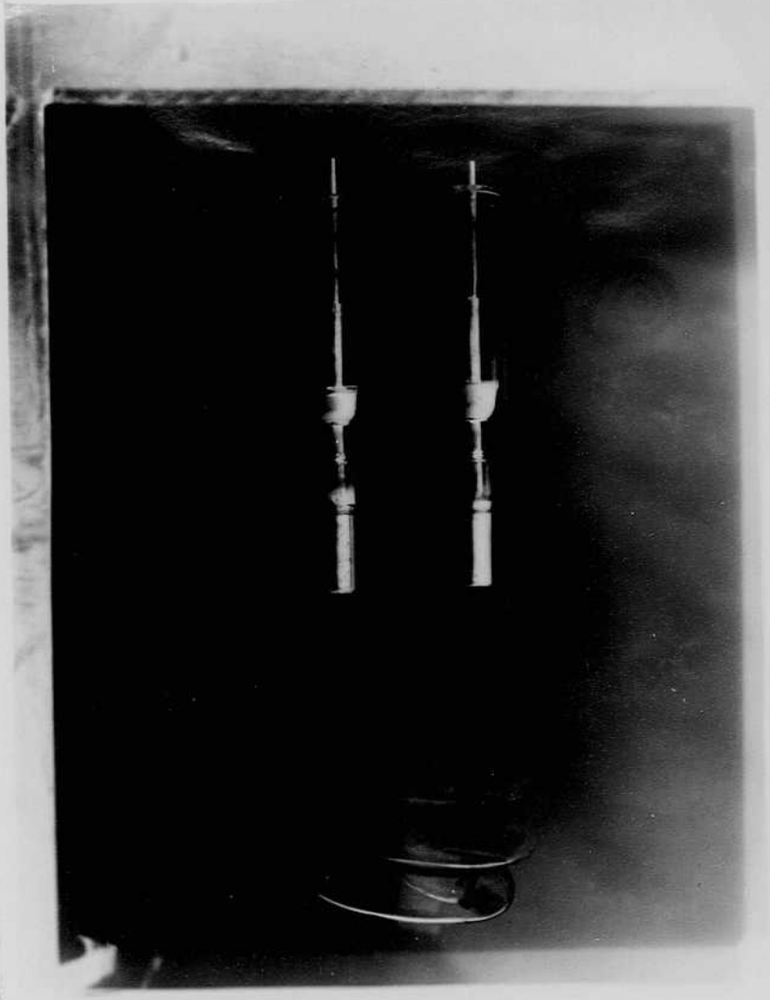
.85 watts
175 x 10

Raytheon
U5449
large size
110 V.
250 V
650 volts

Use separate transformer for sparks.

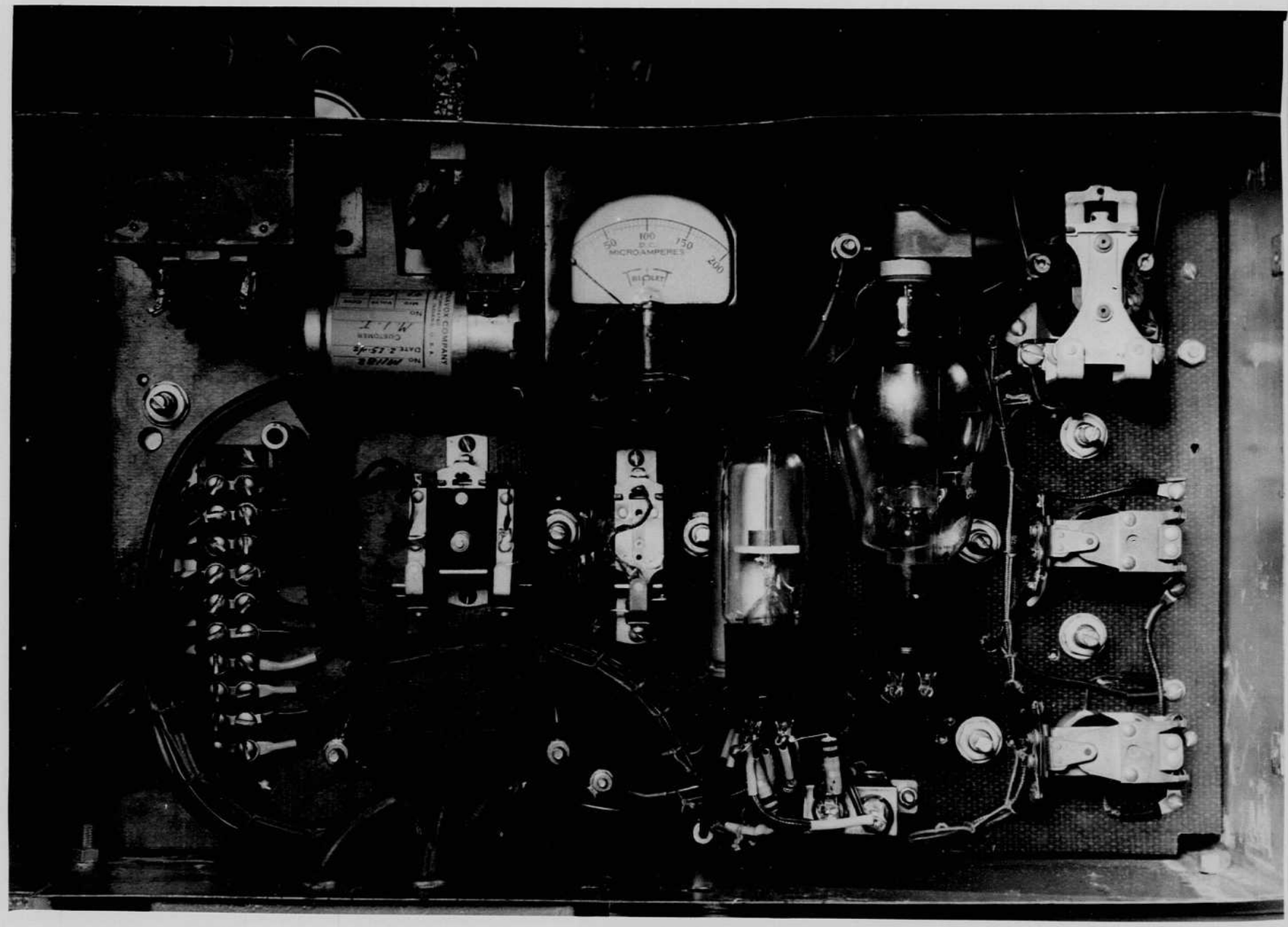
2 mf.	1800	850 avg volts	
	1200	960 " "	
	600	1150 " "	
	0	2100 " "	
1 mf	1800	1250	24 V
	1200	1320	
	600	1510	
	0	2100	



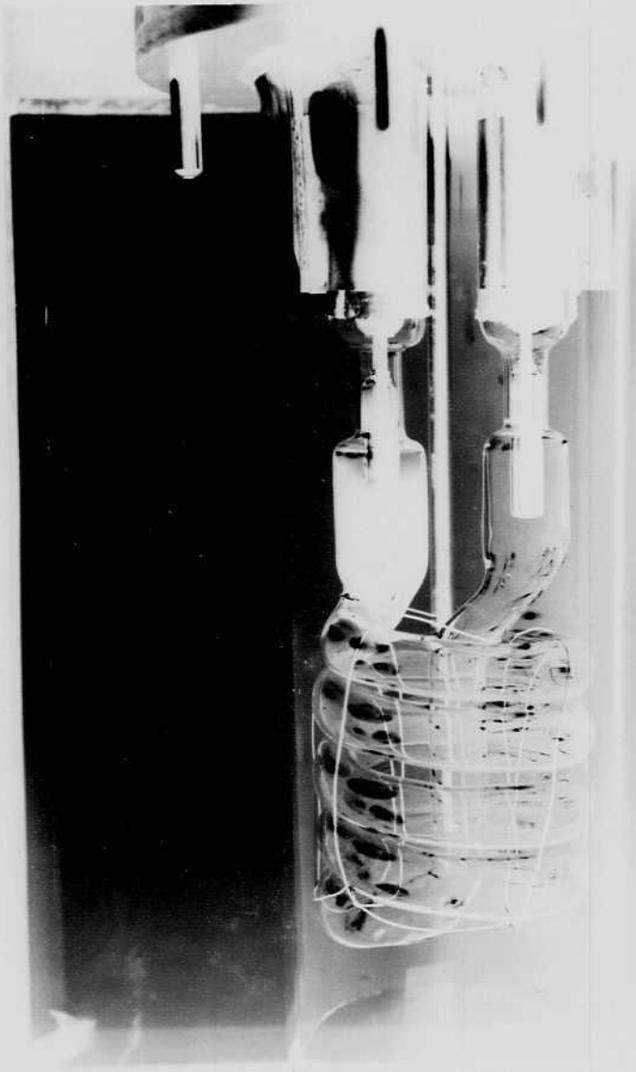


Mo-Ly electrodes.
100+ flashes.

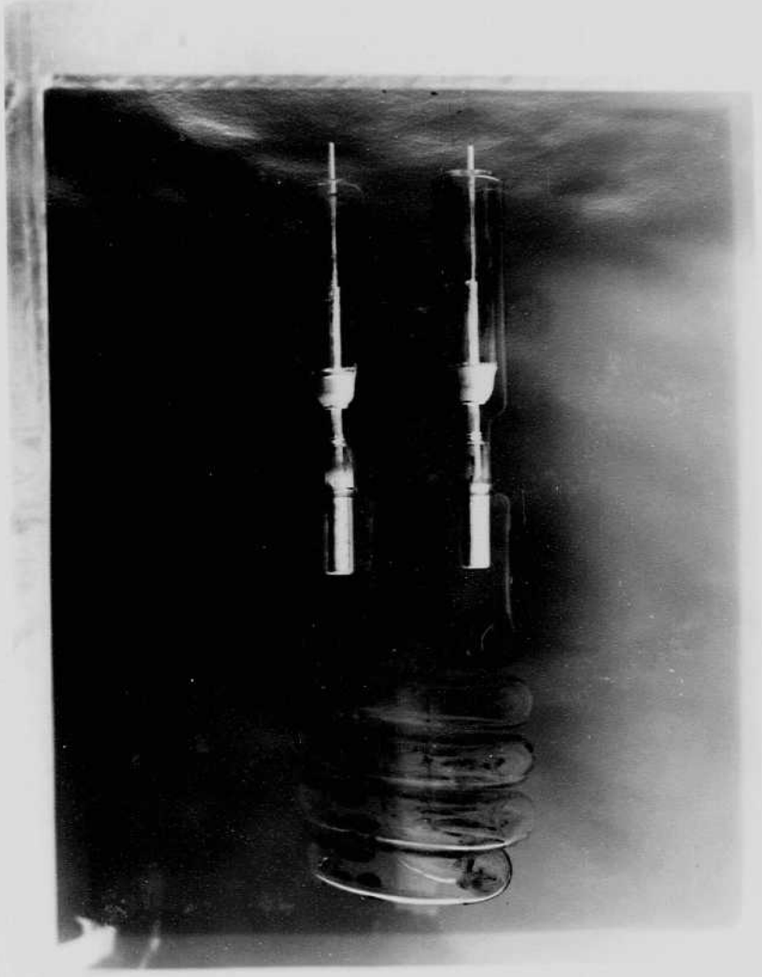
Grantly lamps. Xen Xenon.
Made for us by G.E. Co



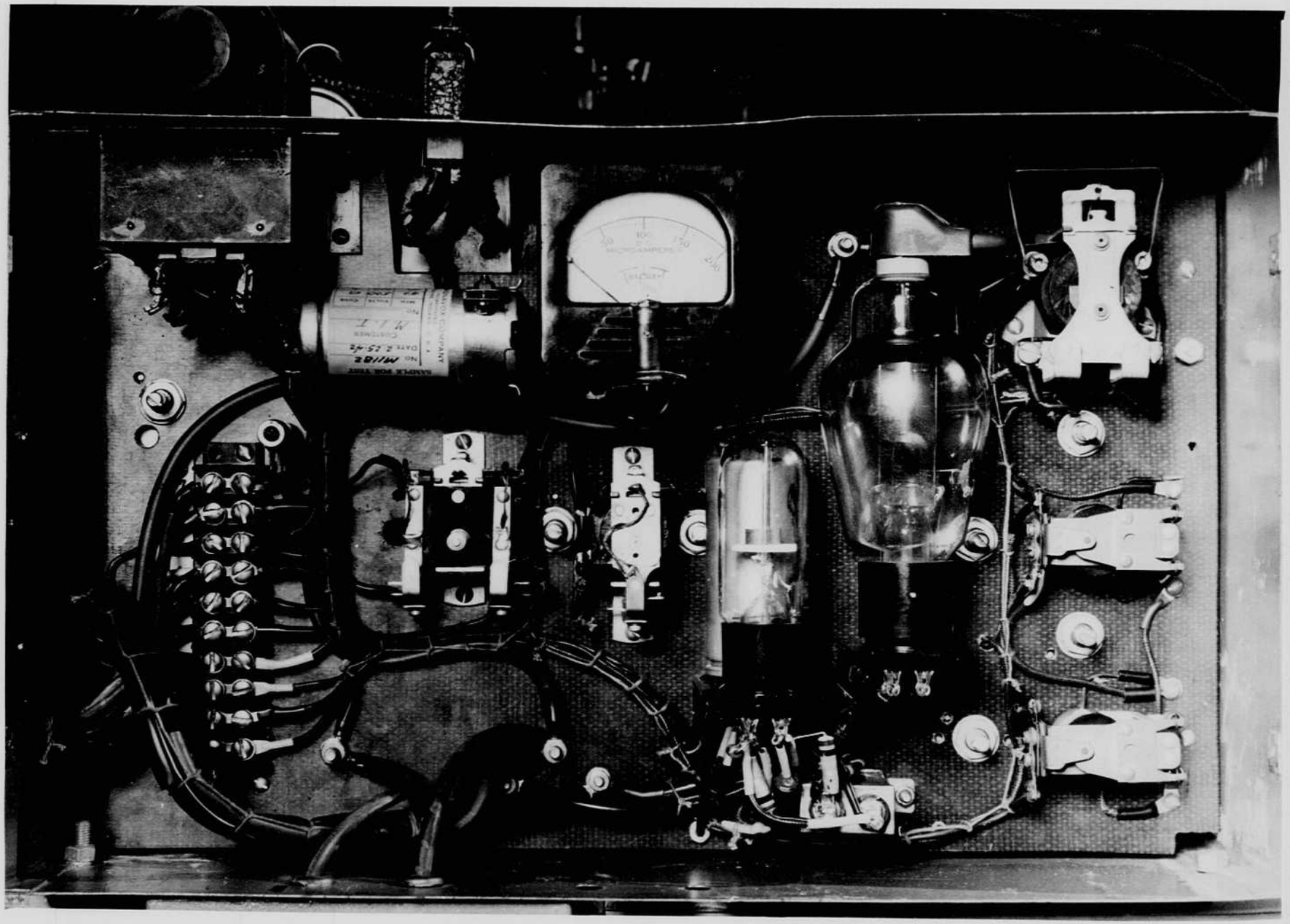
Control Panel on B-18 flasher. as rebuilt.



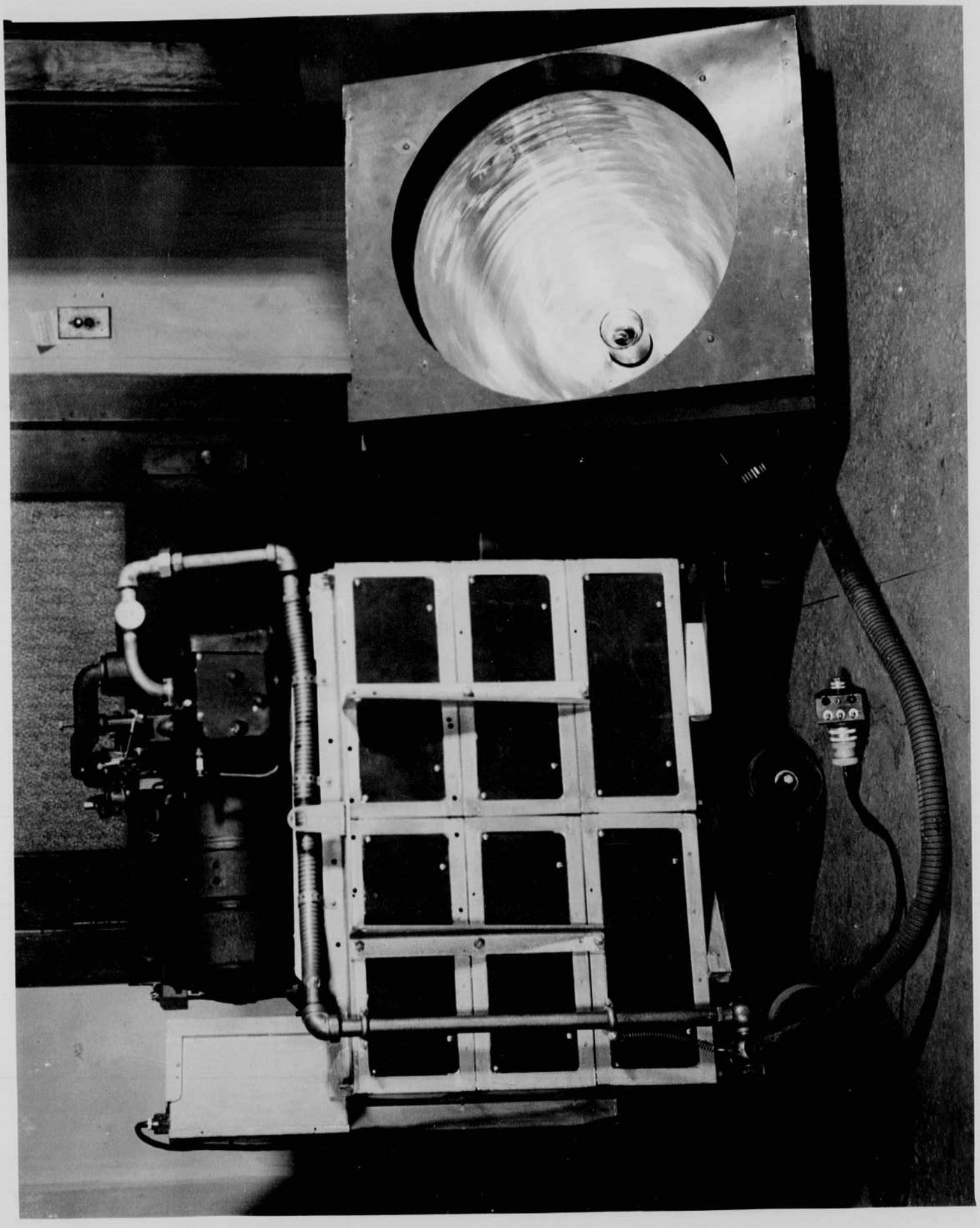
Moly electrode.
100+ flashes.



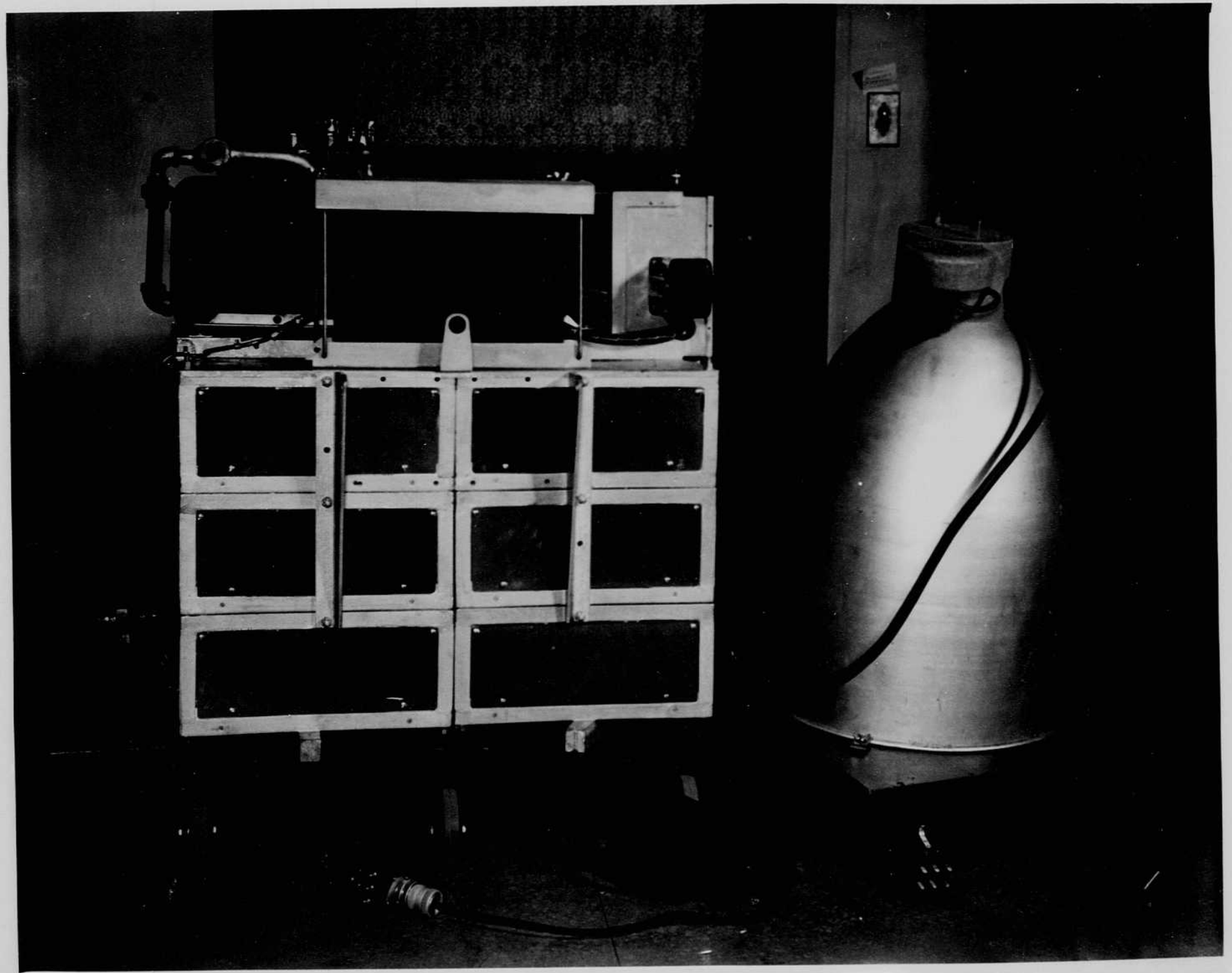
Cranky lamps. Tank xamn.
Made for us by G.E. Co



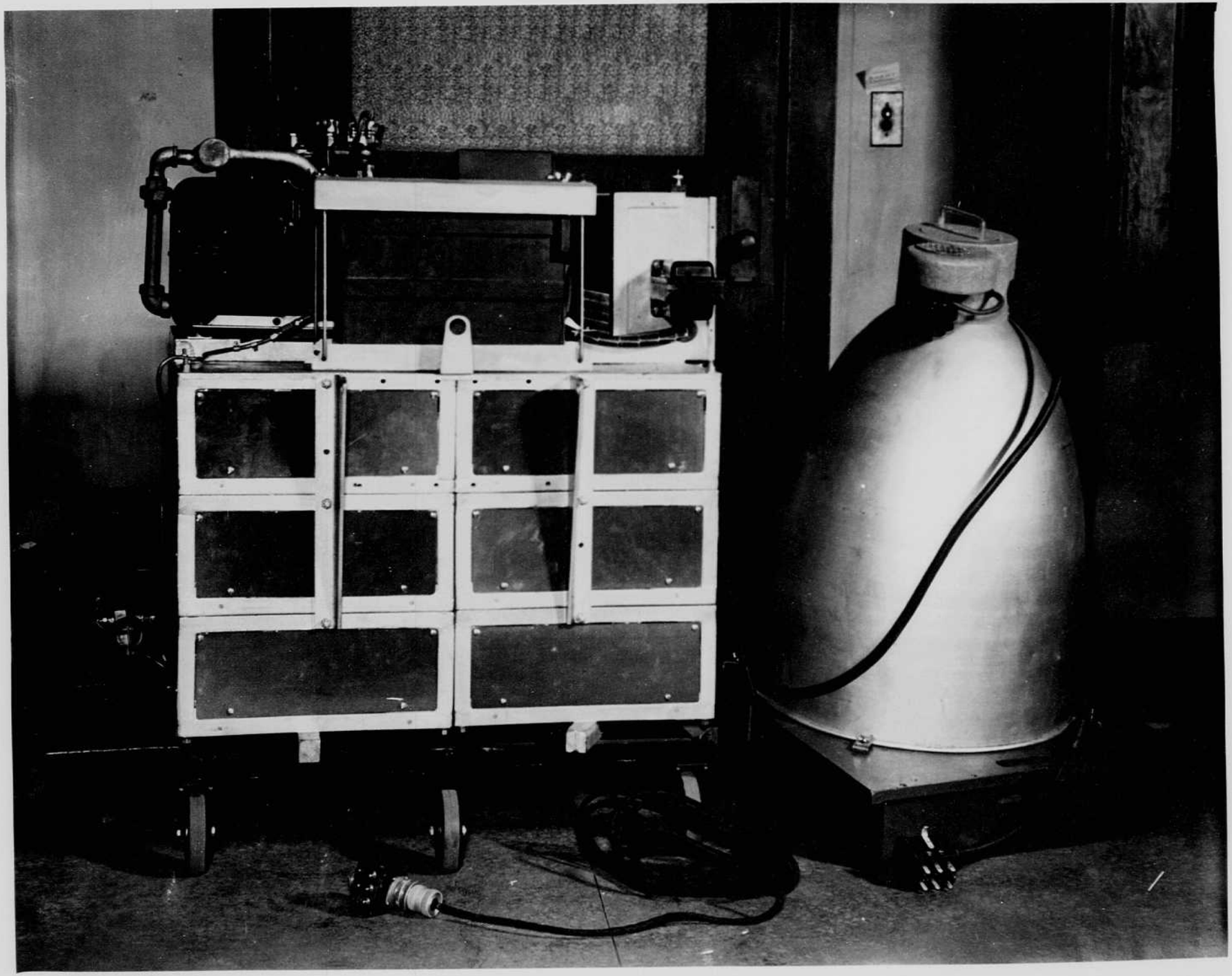
Control Panel on B-18 flasher. as rebuilt.



B-18 flasher. rebuilt for a B-25.



B-18 flasher. rebuilt for a B-25.



Nov. 8. 1932

Harold Edgerton.
Washington D.C.

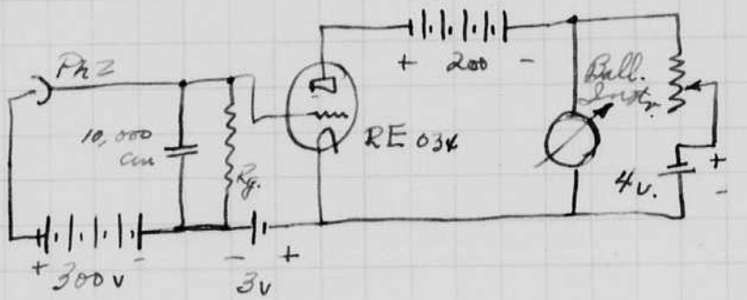
Last week at Model Basin Washington with Wyckoff. See his note book for details of tests.

Messung der Funkenhelligkeit and Funkendauer.

M. Kornetzki V. Tomin and R. Steinitz
Berlin-Charlottenburg

Zetschr. f. techn. Physik. 1933. Nr. 1 p 274.

method of measuring light. Figure 1.



Paul Lee of Polaroid called me from Boston yesterday concerning a flashing source of high power for a signaling device.

I gave him, some time ago, the approximate form of the light time curve. From this he gave me yesterday a merit figure for calculation of the lamps.

Assuming the light-time curve to have the following formula

$$\mathcal{L} = A\varepsilon^{-\alpha t}$$

then the merit $= A/\sqrt{\alpha} = M$

Power $= A/\alpha$

useful range $=$ 0.8 to 1.1 Mm (Infra red).

A = Peak instantaneous light output.
$= \left(\frac{V^2}{R}\right)\eta$ $\left(\frac{V^2}{R}\right)$ = power into lamp.

η = efficiency.
R = lamp resistance.

$$\alpha = \frac{1}{RC} = \frac{1}{\text{time constant}}$$

Light and merit factor in terms of tube constant.

$$\mathcal{L} = \frac{V^2}{R}\eta\,\varepsilon^{-\frac{t}{RC}}$$

$$M = \frac{V^2}{R}\eta\sqrt{RC} = V^2\eta\sqrt{\frac{C}{R}}$$

$$P = \frac{A}{\alpha} = \frac{V^2}{R}RC = V^2C \qquad (*\tfrac{1}{2})\ !\ -$$

$$X = \frac{\text{Merit}}{\text{Power}} = \frac{M}{P} = \frac{V^2\eta\sqrt{\frac{C}{R}}}{V^2C} = \frac{\eta}{\sqrt{RC}}$$

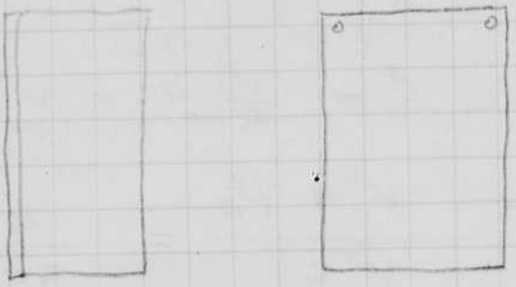
According to the above, X increases with a decrease of R and C. This calls for an increase in voltage when C is considered.

As R is decreased the efficiency ~~also~~ decreases. the problem is to find a maximum. Other factors such as cathode sputtering and crazing may not let us use the maximum value.

Nov. 16 1942
Harold E. Edgerton.

Returned last night with Wyckoff in Ford Italian Wagon from Washington where we have worked for two weeks at the Model Basin for the Navy Dept. See Wyckoff's note book for a description of the work. A showing to Adm Howard, Roop, Mumma, Campbell and was made about 4:30 or 5 on Sat Nov 14. We left about 6:30 pm.

One of our next jobs will be the design of a multiscan unit and the design of new underwater lamps



#8 cap ↓

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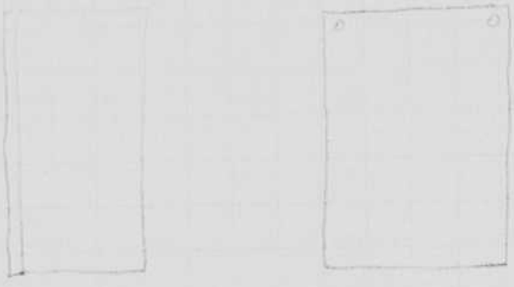
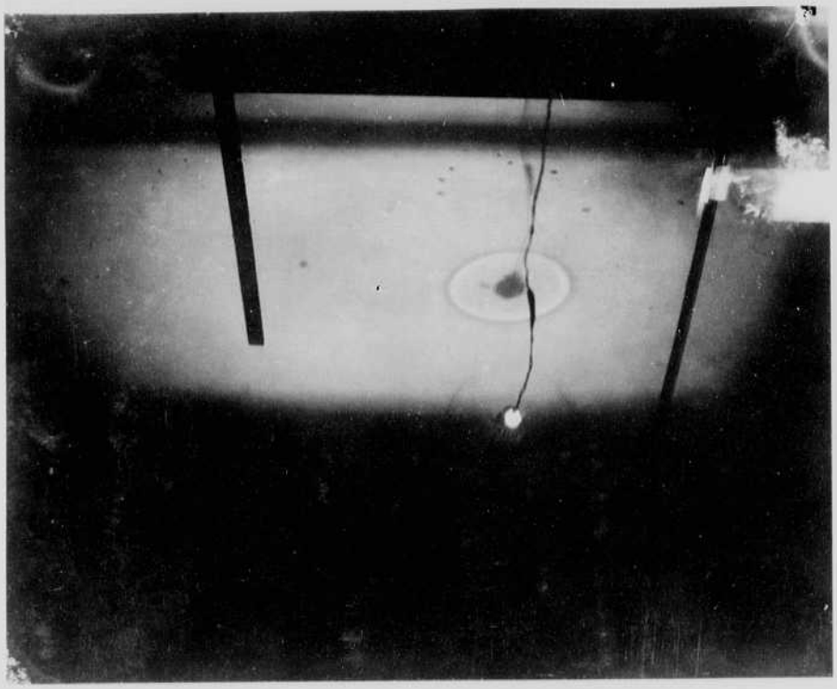
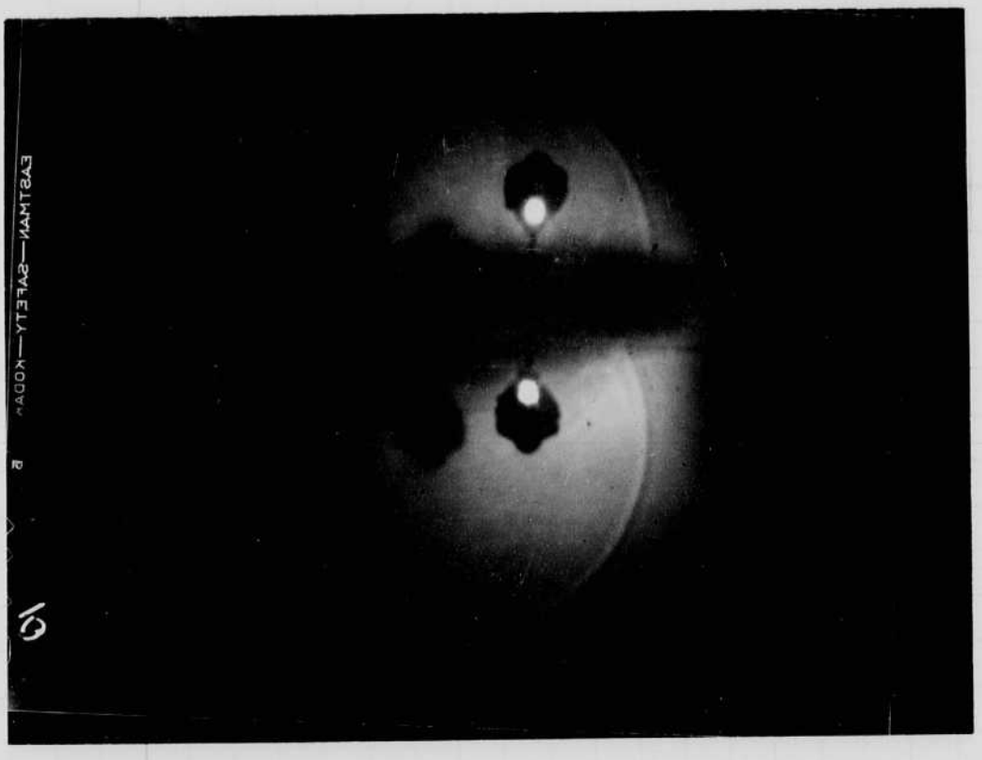
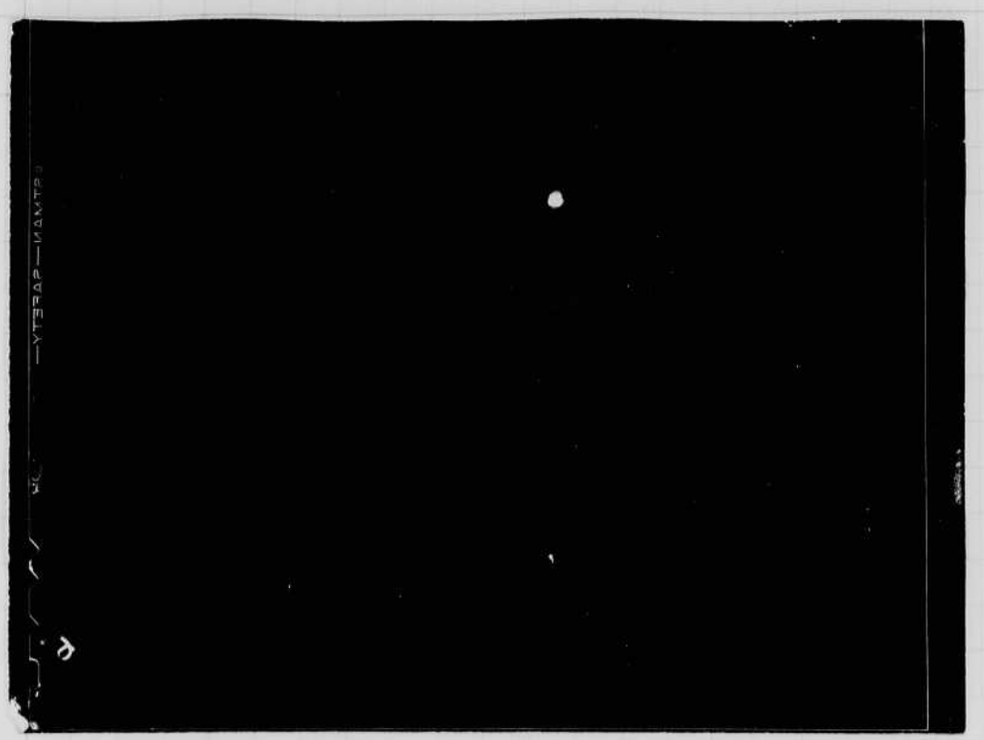
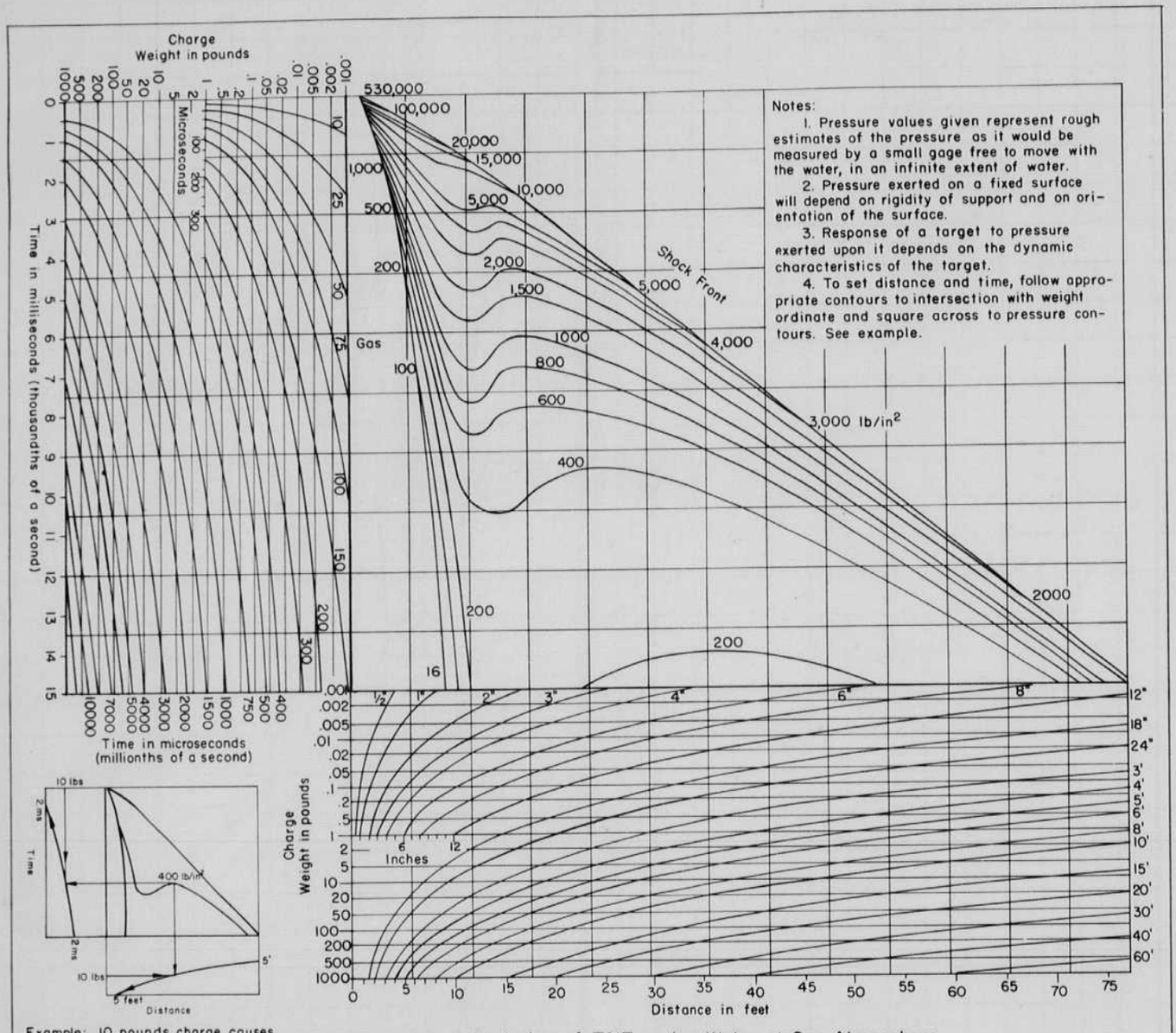


#8 cab ↓




EASTMAN—SAFETY—KODAK





Example: 10 pounds charge causes 400 pounds per square inch pressure at 5 feet distance 2 milliseconds after explosion.

Pressure due to Explosion of TNT under Water at One Atmosphere

Contours represent Pressure in Pounds per square Inch

Tentative Data subject to Correction

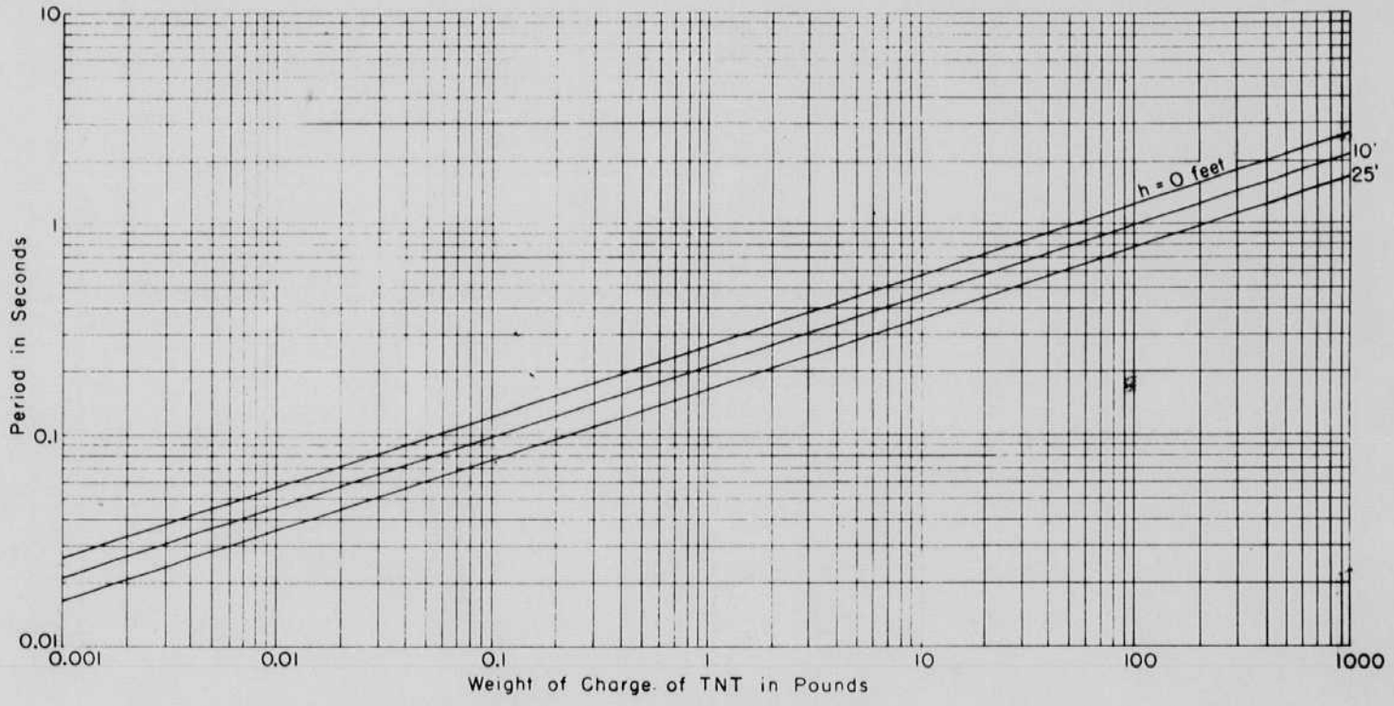
David W. Taylor Model Basin

6 May 1942 S-1110

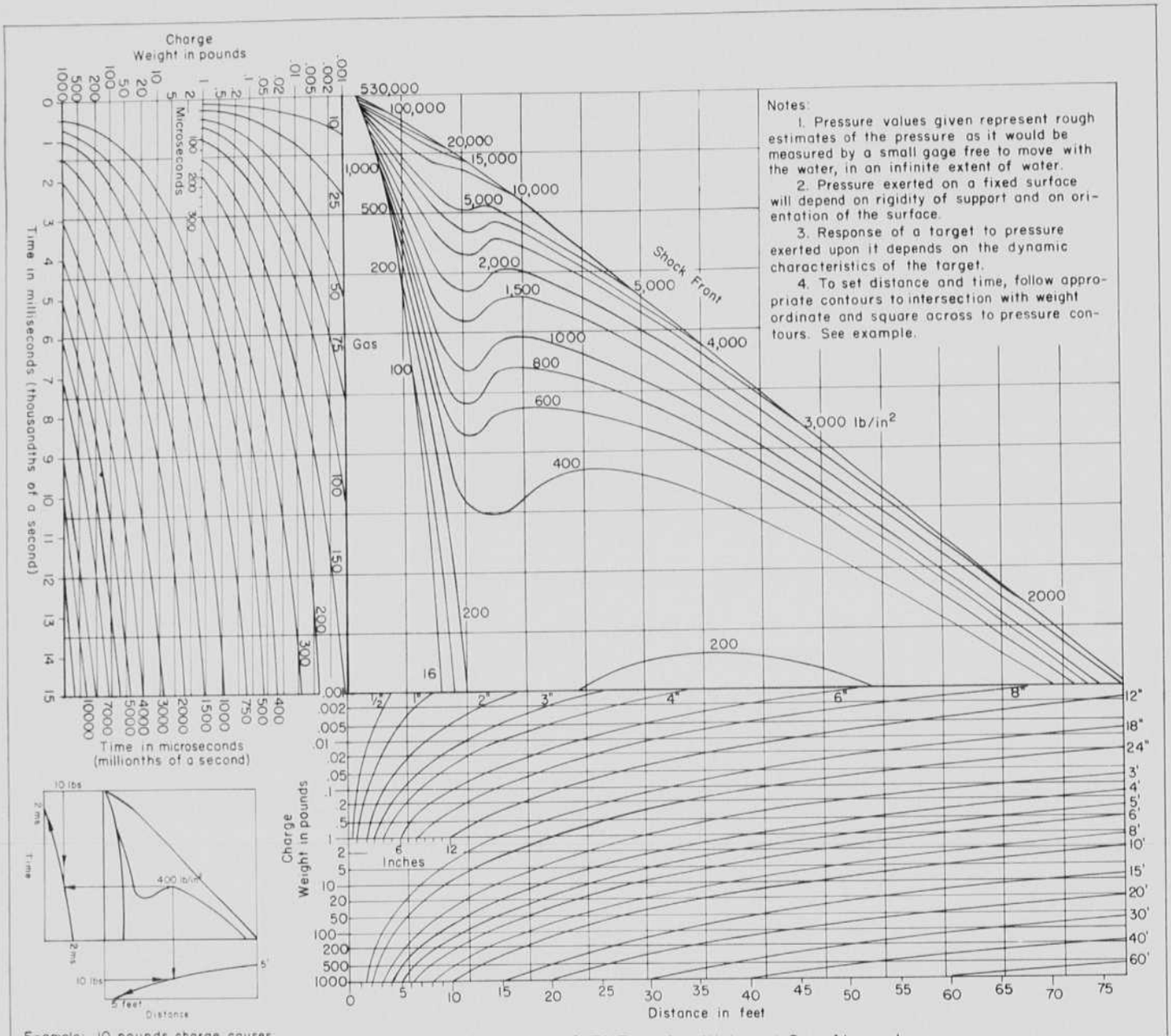
THE DAVID TAYLOR MODEL BASIN
BUREAU OF SHIPS
NAVY DEPARTMENT
WASHINGTON, D. C.

May 1942

Period of Oscillation of an Underwater TNT-Gas Globe as a Function of Weight of Charge



These curves are for oscillations of a gas globe resulting from a charge of TNT exploded under water at a depth of h feet. They are theoretical curves based on the assumption that the total energy of the charge is proportional to the weight of the charge and that one-third of this total energy is lost by radiation and heat effects during the first expansion. The curves are valid for $r_2/r_1 \geqq 10$, where r_2 is the maximum, and r_1 the minimum radius. Experimental data have confirmed values obtained from these curves within about twenty per cent.



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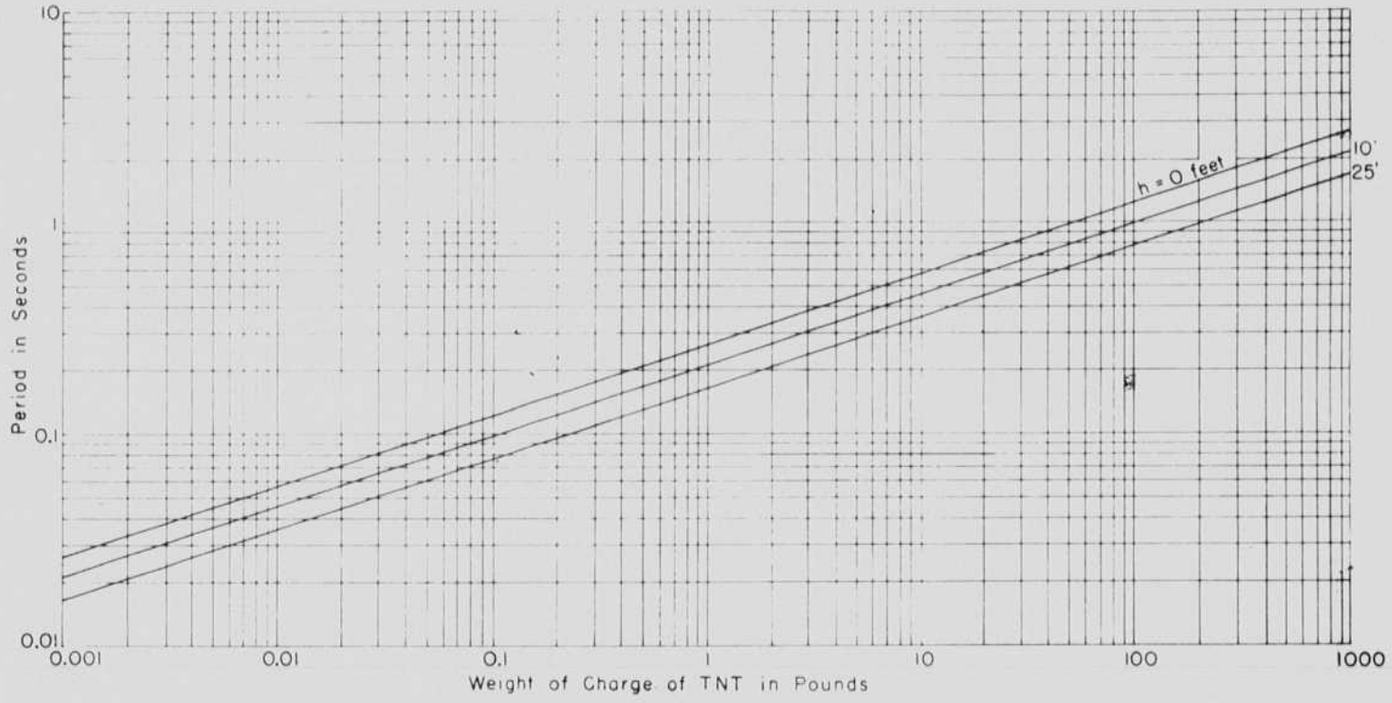

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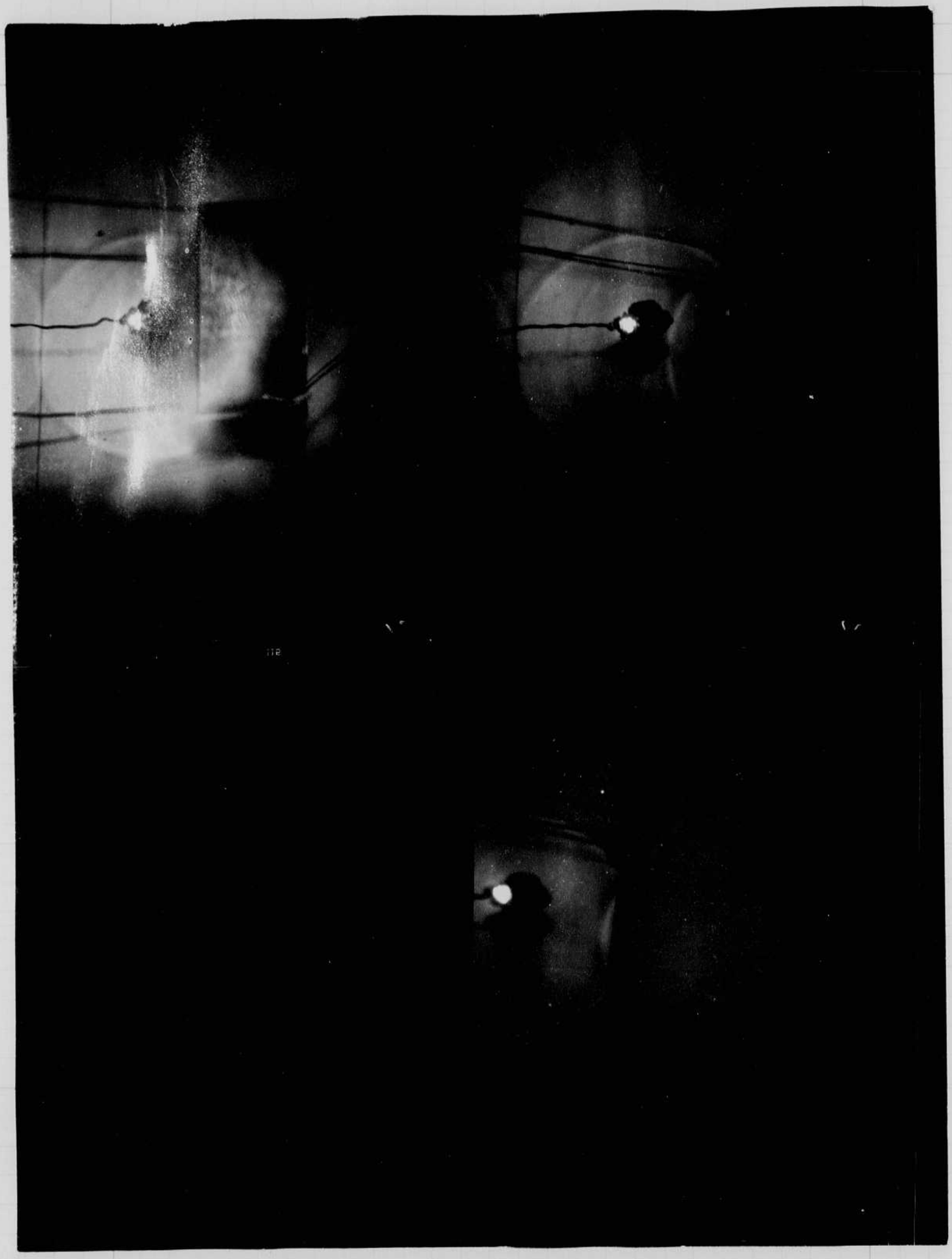


Tuesday Nov. 17, 1942

Harold E. Edgerton

Nov. 20, 1942
Conf. at Polaroid
Land - Fuller
Meas. Lee
and myself.

Conf with Paul Lee this morning on flash lamps to be used with pickups. See page 42-43.

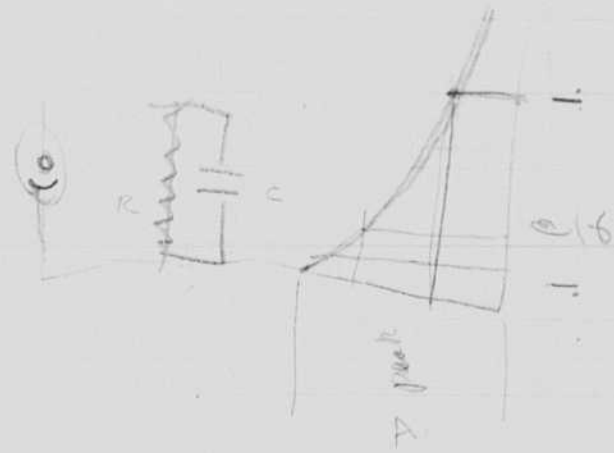
The lamp will operate at 10 flashes per second 10 mf 2000 volts.

Power = $CE^2 \times f = 10\times10^{-6}\ 4\times10^{6}\times10 = 400$ watts.

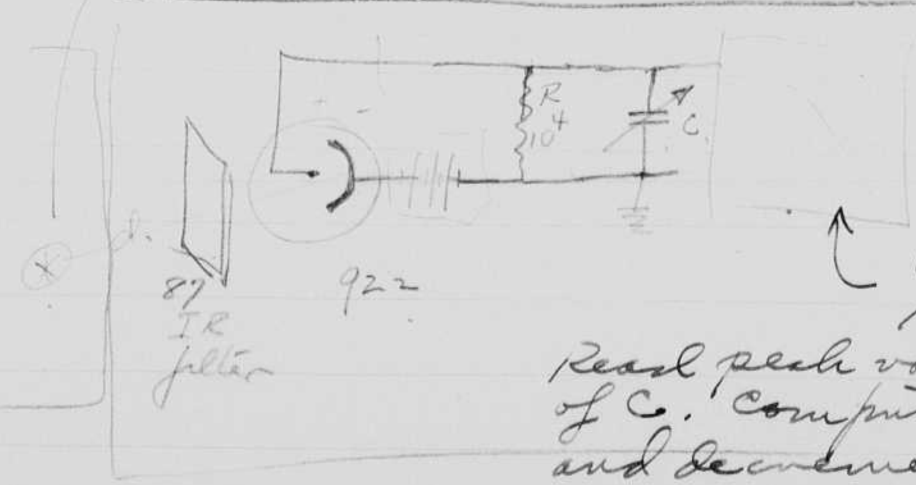
The notes below were made during Lee's visit. They pertain to a photocell measuring scheme for evaluating the light from flash tubes.

$\mathcal{L} = \int_0^{\infty} e\,dt \qquad \eta = \frac{\mathcal{L}}{J}$

A ∝



Strobowink
10 flash per second.



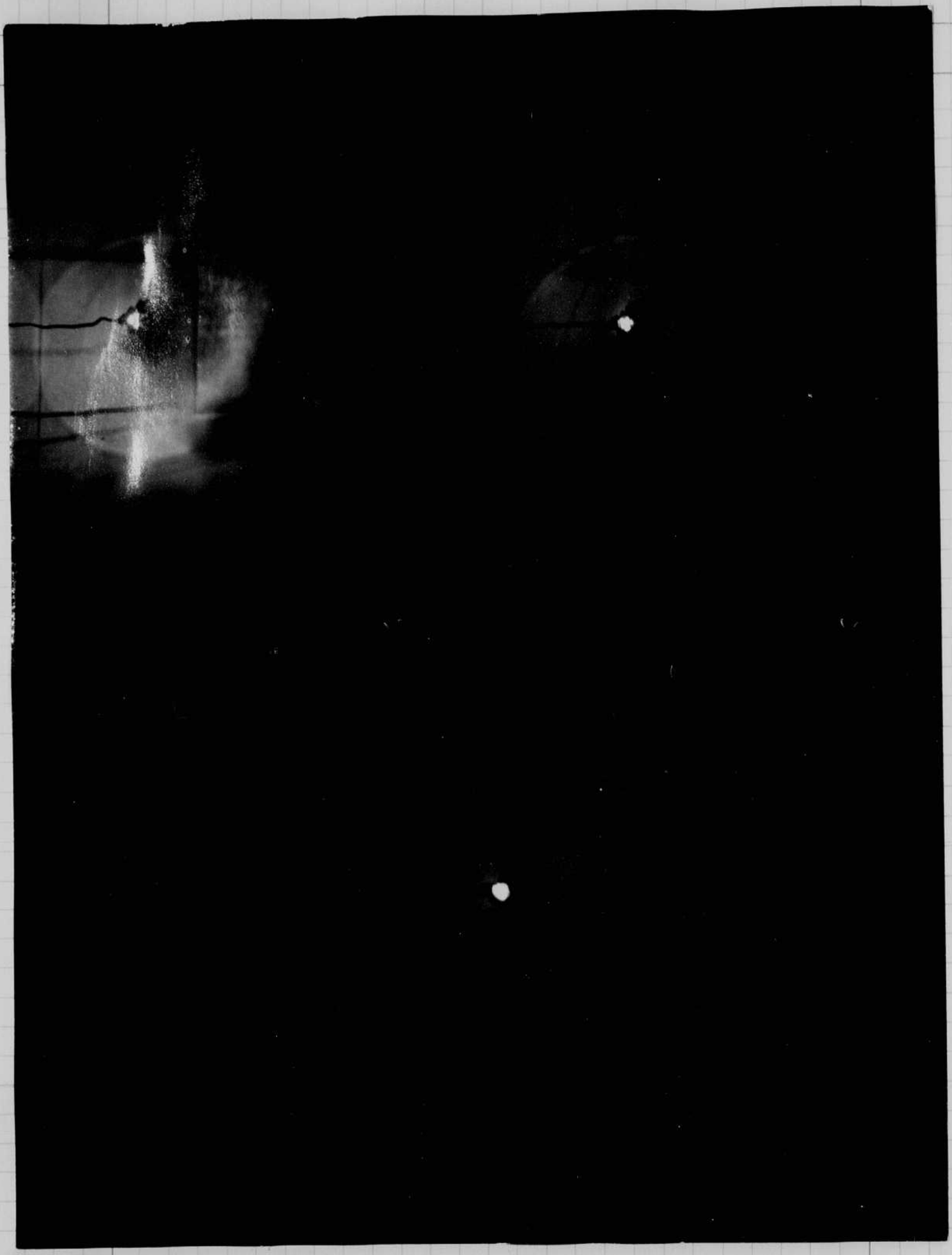
$RC = 10^{-6}$ sec.

$RC\ 10^{-5}$

$C = \frac{10^{-6}}{10^{4}} = 10^{-10}$

Peak voltmeter of side ~~back~~ type.

Read peak volts for ~~two~~ values of C. Compute ~~then~~ peak light and decrement (or time const.)



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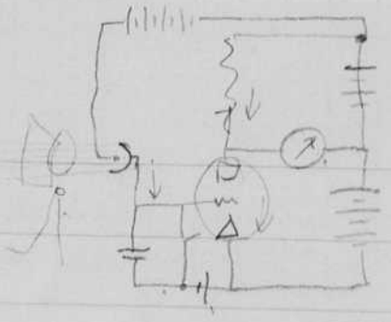
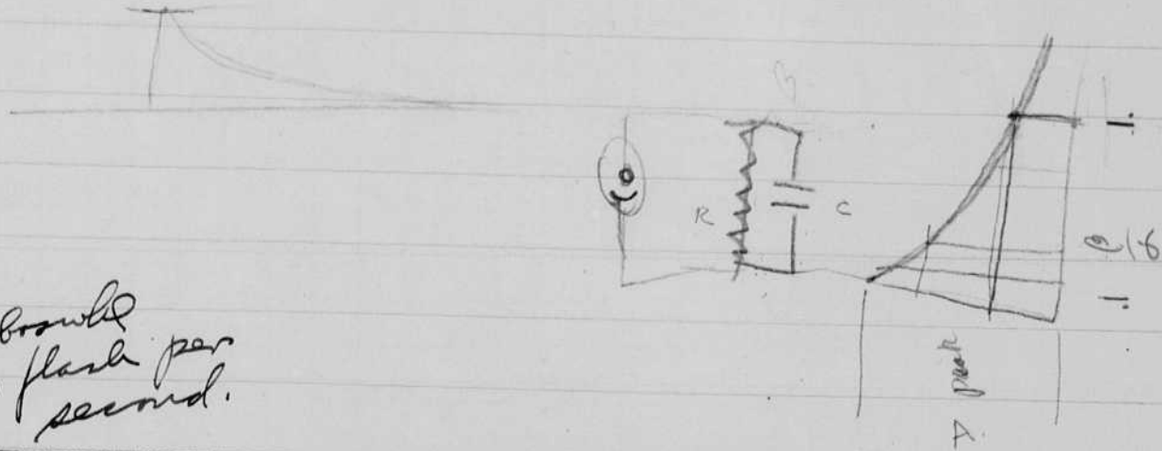


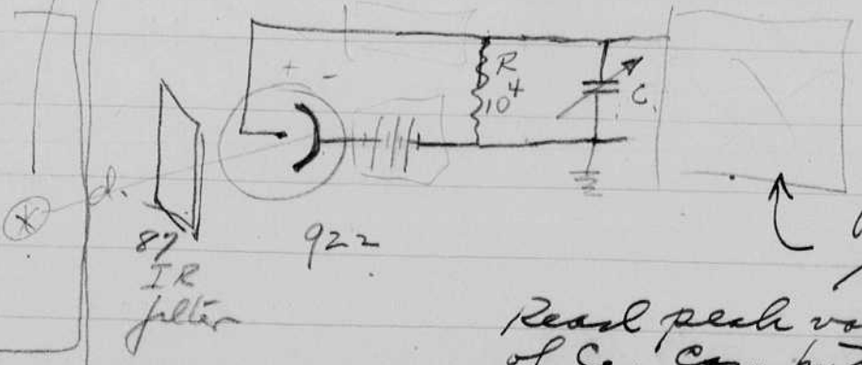
$e = \frac{1}{C}\int_0^t i\,dt.$

$\mathcal{L} = \int_0^t L\,dt.$ $\qquad n = \frac{\mathcal{L}}{I}.$

$A \propto$



Stroboscope
10 flash per second.



$RC = 10^{-6}$ sec.

$RC\ 10^{-5}$ sec.

$C = \frac{10^{-6}}{10^4} = 10^{-10}$ =

Peak voltmeter of side band type.

Read peak volts for two values of C. Compute thence peak light and decrement. (or time const.)

Nov 20 1942

Samuel E Edgerton

Dr. Edwin Hubbl Ballistic Lab. Aberdeen Md. called by phone wednesday asking for movies of a 3000 per second shell.

Chas. and I timed movie apparatus to run at 3000 half frame 35 m m. .25 mf capacity 65 o plus charging. Since one terminal for spark was on the edge of holder, we put in another tube, running the two in push pull through the same transformer (sparks.).

It was found that the coil must be placed in the angle of the operator. In the cathode circuit, the tubes would fire together.

Nov. 23, 1942

Just returned from Aberdeen Md with Chas. Wyckoff. See his book for details of test o at 3000 pictures per second of 5 or 6 ft length. At f 2. Super x film the muzzle blast confused the photography. Lord Cricklefield, England, Millar from Geophysical Lab Washington were present.

Nov 24 1942 Wm Eustis 217 N.O.L. called today to discuss optical high-speed photography.

Phone call from Harvey Hall 5391 Navy about ultra violet light source.

Nov. 26. Call from Creagle AN Expediter at Electronics asking for a better schedule from G.E. I told to phone Millar and Enfield without success - but sent Millar a wire.

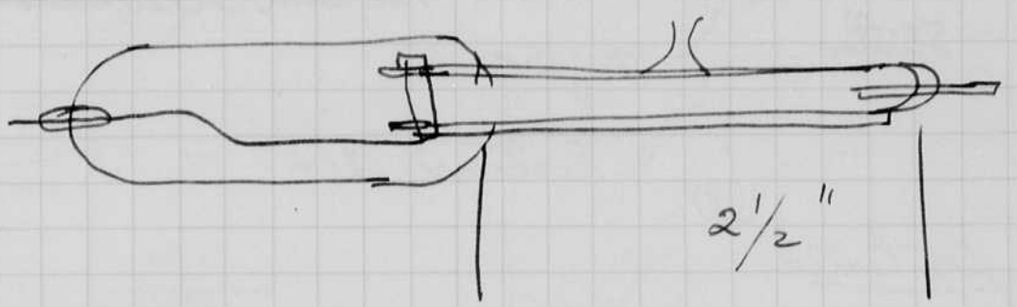
H. Edgerton.
Nov 12, 1942

Pumped 6 Hg tubes and 10 movie camps today.

0.5 cm Hg + 25 cm Ar.

Will here to discuss movie camps for Wright field.

Pumped 4 tubes, as per below.

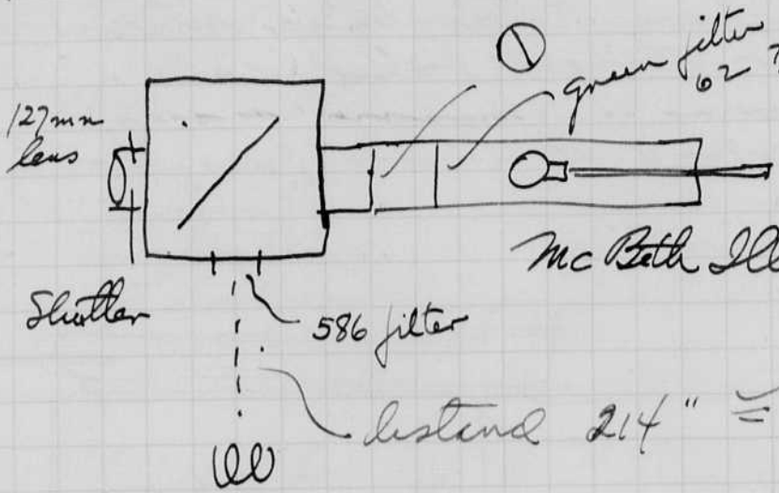


Filled 1 cm Hg 40 cm AR.

Nov 30 1942

~~A E Engstrom.~~
~~Helen Parker~~
Rudgard Jennings.

Measurements of U.V. from flash lamps.



Lamps tested.

2.36 Beam Xenon Spiral 56 mf 2000 volts. 7 cm

2.09 Kodatron Speedgun " " " 10 cm

4.69 cold. Xenon Spiral (Hg) ~~then~~ Beam 56 mf 2000 volts.

1.65. Xenon Short tube (used for microscope) quartz

15.84 Xenon quartz in R40 Bulb. Reflector.

3.76. Check on Xe Spiral Beam. (2,000 V)+
020 milliseconds
~~1/50 sec.~~ speed used
f-4.7 lens with internal
contact synchronizer.

Tests at Rochester 400 watt aircooled lamp.
3.5 meters. gave reading of 2.45.
1/5 sec shutter speed used.

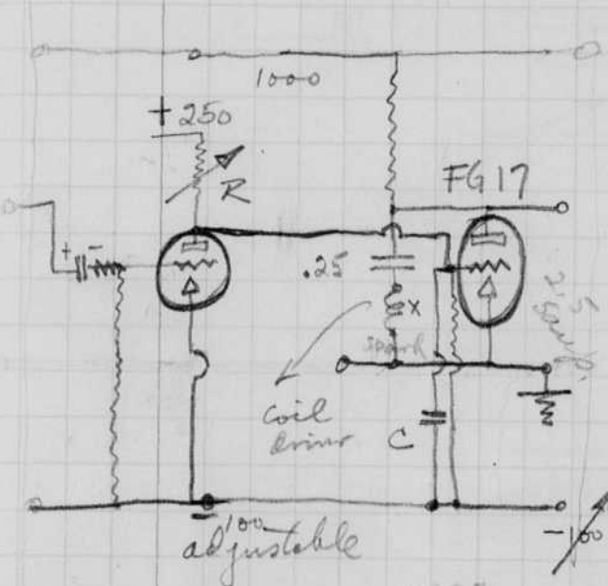
Dec. 4, 1942

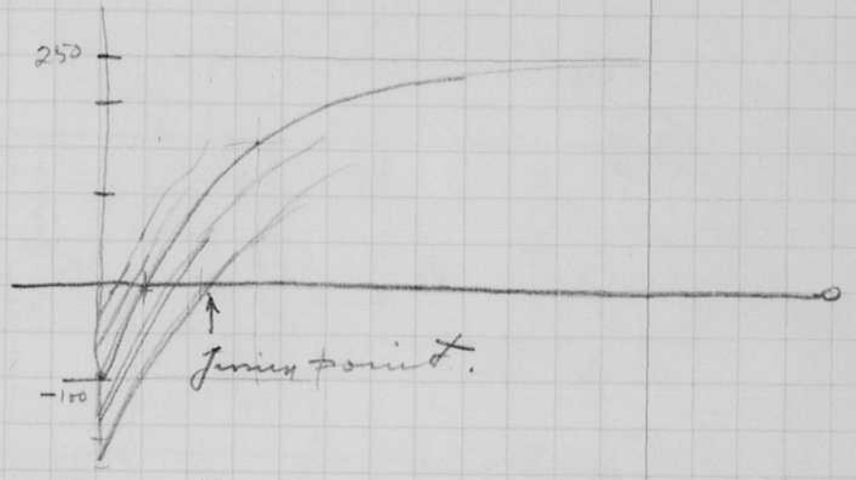
H. E. Edgerton

Pumped movie lamps last few days.

Multiflash for Model Basin due in 60 days
Plan to use 5 units flashing through
a movie or micro second lamps.

A time delay circuit will be put
between flashes. 10 - 100 microseconds.





time delay ≅ 1/3 of RC. = 10 to 100 $\times 10^{-6}$.

Let C = .01 $\times 10^{-6}$ farads.

$10 \times 10^{-6} = \frac{1}{3} R \cdot .01 \times 10^{-6}$ $\quad R = \frac{30 \times 10^{-6}}{.01 \times 10^{-6}} =$ 3000 ohms.

R = = 30,000 ohms.

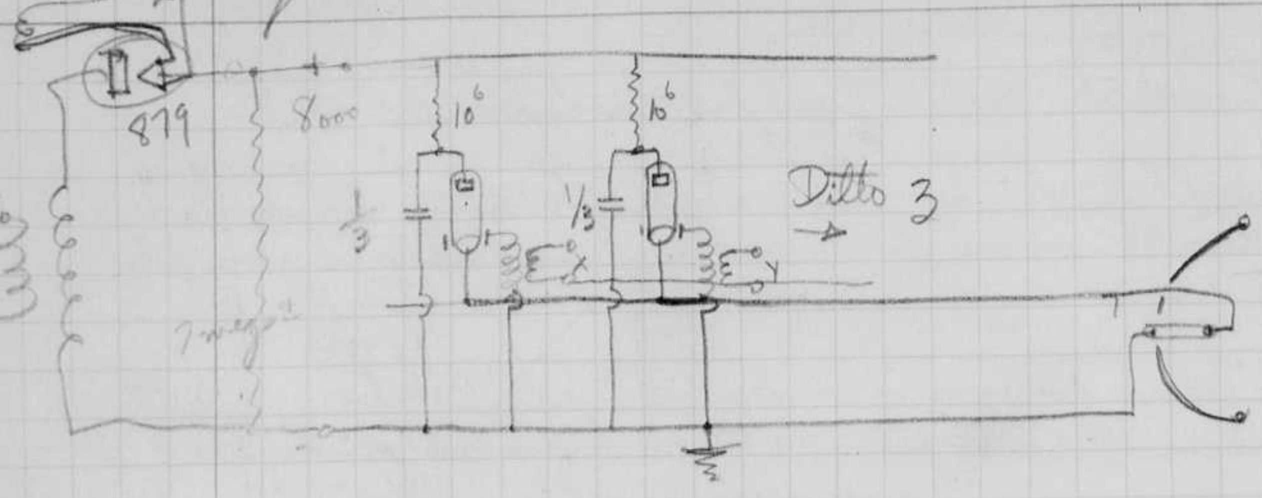
Might be better to use variable condenser.

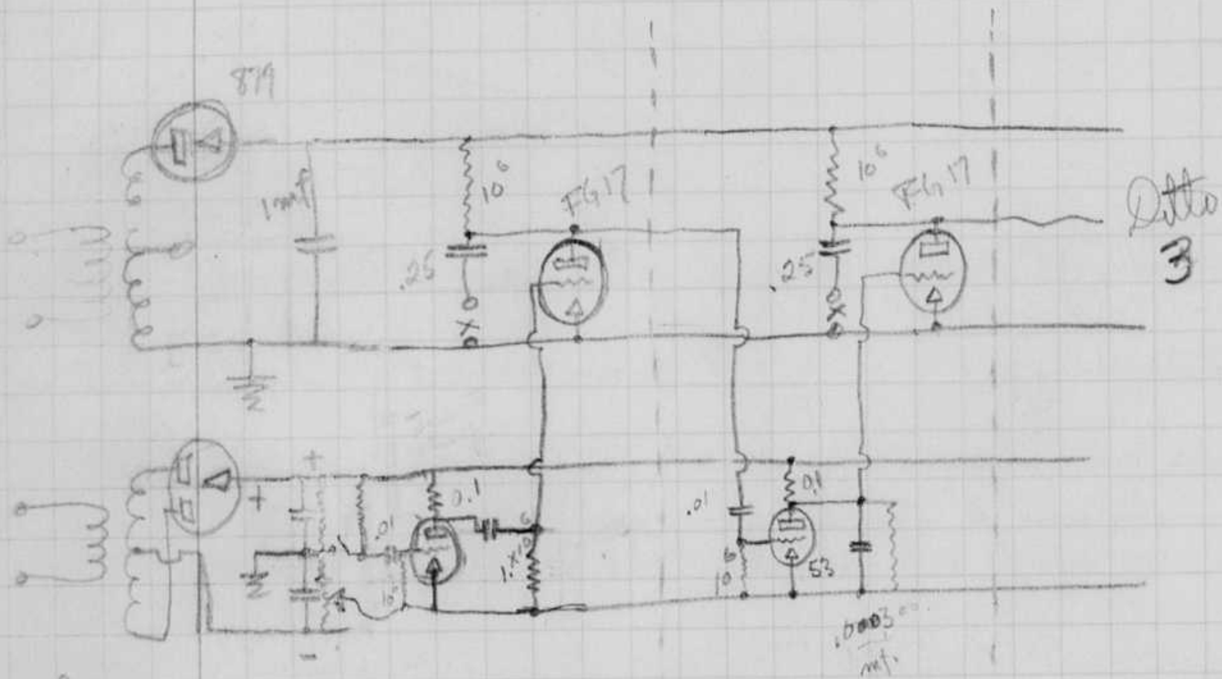
KT727 6 - 100 Mmfd

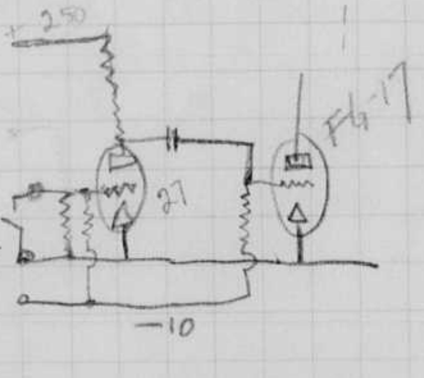
$100 \times 10^{-6} = \frac{1}{3} RC$ $\quad R = \frac{300 \times 10^{-6}}{100 \times 10^{-6} \times 10^{-6}} = 3 \times 10^{6}$ ohms.

Too high for good results due to pinch and leakage.

Dec 5 1942
H. E. Edgerton



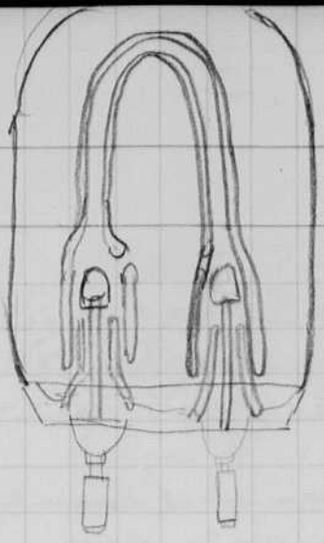


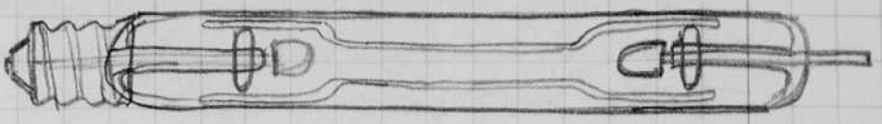


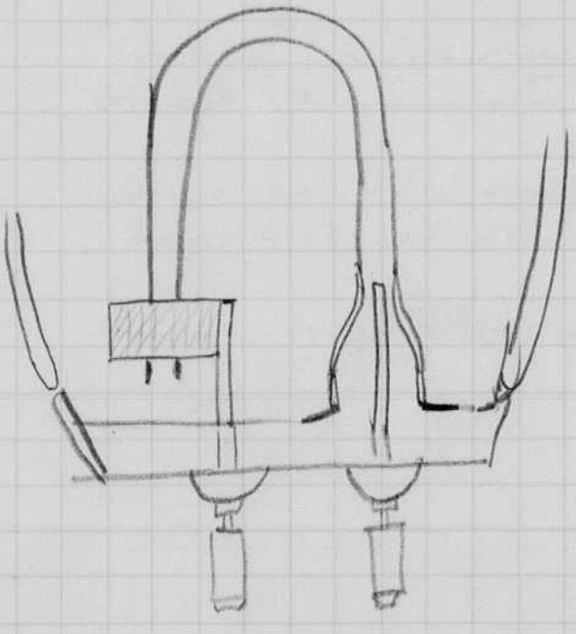
one year ago
Pearl Harbor.
4575 casualties
150 planes!
Arizona
46 Jap planes

Production
47000 planes per year
17000 AA guns to open
start

Int 493 Coconut Grove fire
one week ago.







$$\frac{200^2}{R} = 4$$

$$R = \frac{40000}{4}$$

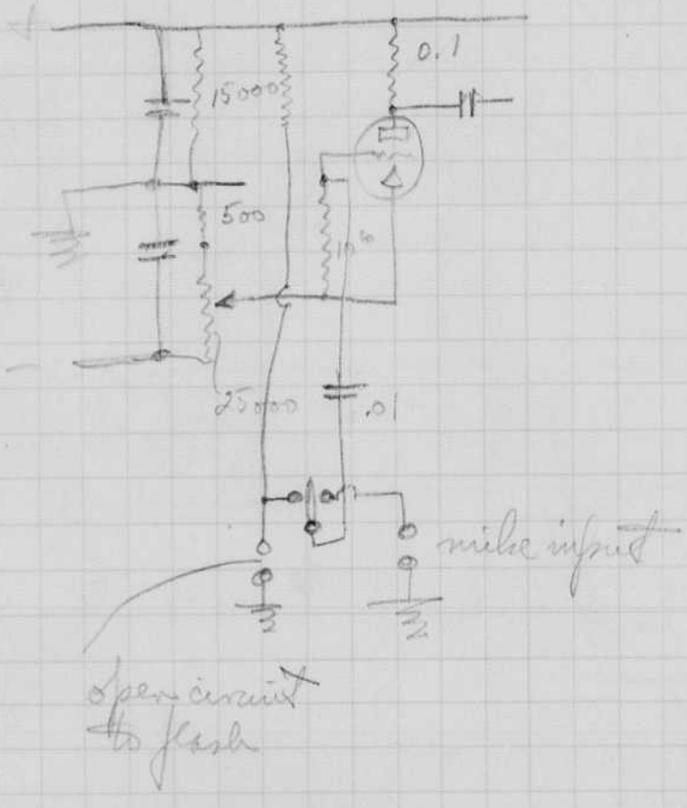
Dec 7 1942

H. E. Edgerton.

Mr. Dunn of Spencer thermostat was in again today. He returned the ~~mock~~ portable that I loaned him some months ago.

Discussed M.E. 8000 per second camera and multiflash stroboscope camera.

Spent day ordering parts for new multiflash also design features and with Wyckoff.



Harold E. Edgerton
Dec. 26, 1942

Left Boston, Federal, Dec 9 with underwater lamps for Washington with Wydoff. met by F. Dr. Campbell and went to Model Basin. Caught 1:30 train for Aberdeen, Md.

Dec 10-11- aberdeen with Dr Johnson, see Wydoff book.
Dec 12 left for Washington
-14-15-16-17-18-19-20 aberdeen on 4000 lb. bombs with Dr Johnson. See Wydoff notebook for details.

Capt Kenyon - Lt Beaumont of Wright field Capt Miller from Langley were at aberdeen on Tuesday Dec 15 to discuss applic of flash to photography.

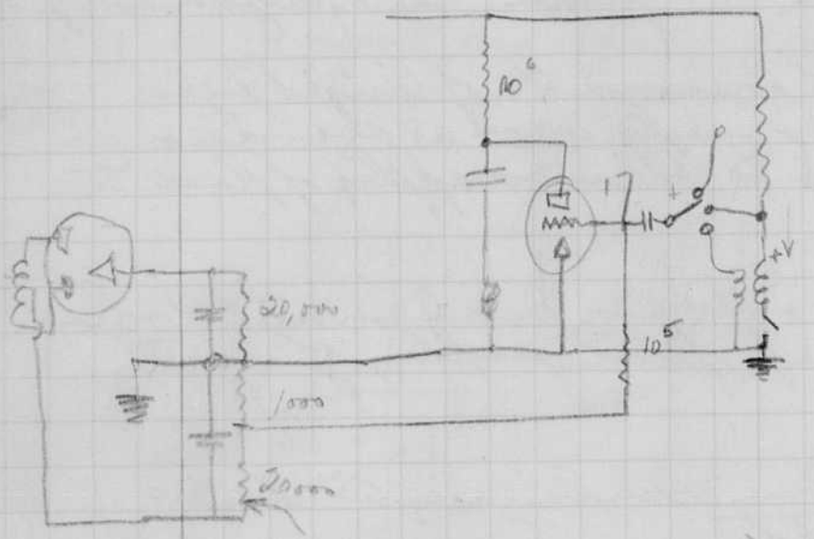
I spent Dec. 16 with Ken Davidson at Hoboken Inst discussing photography of boats. Very cold today.

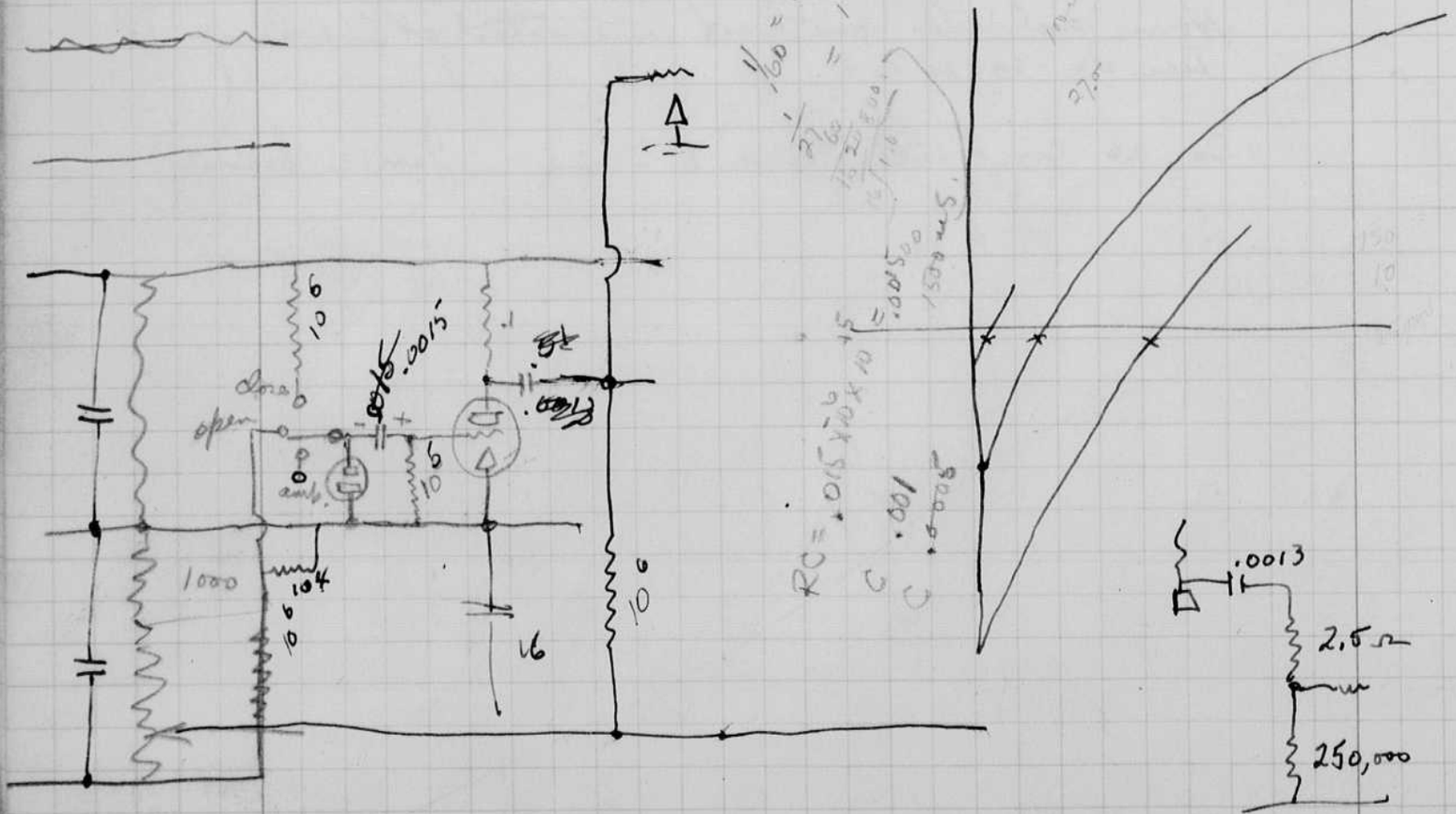
Home sick with sinus trouble contracted at Aberdeen Dec 22-23-24-25.

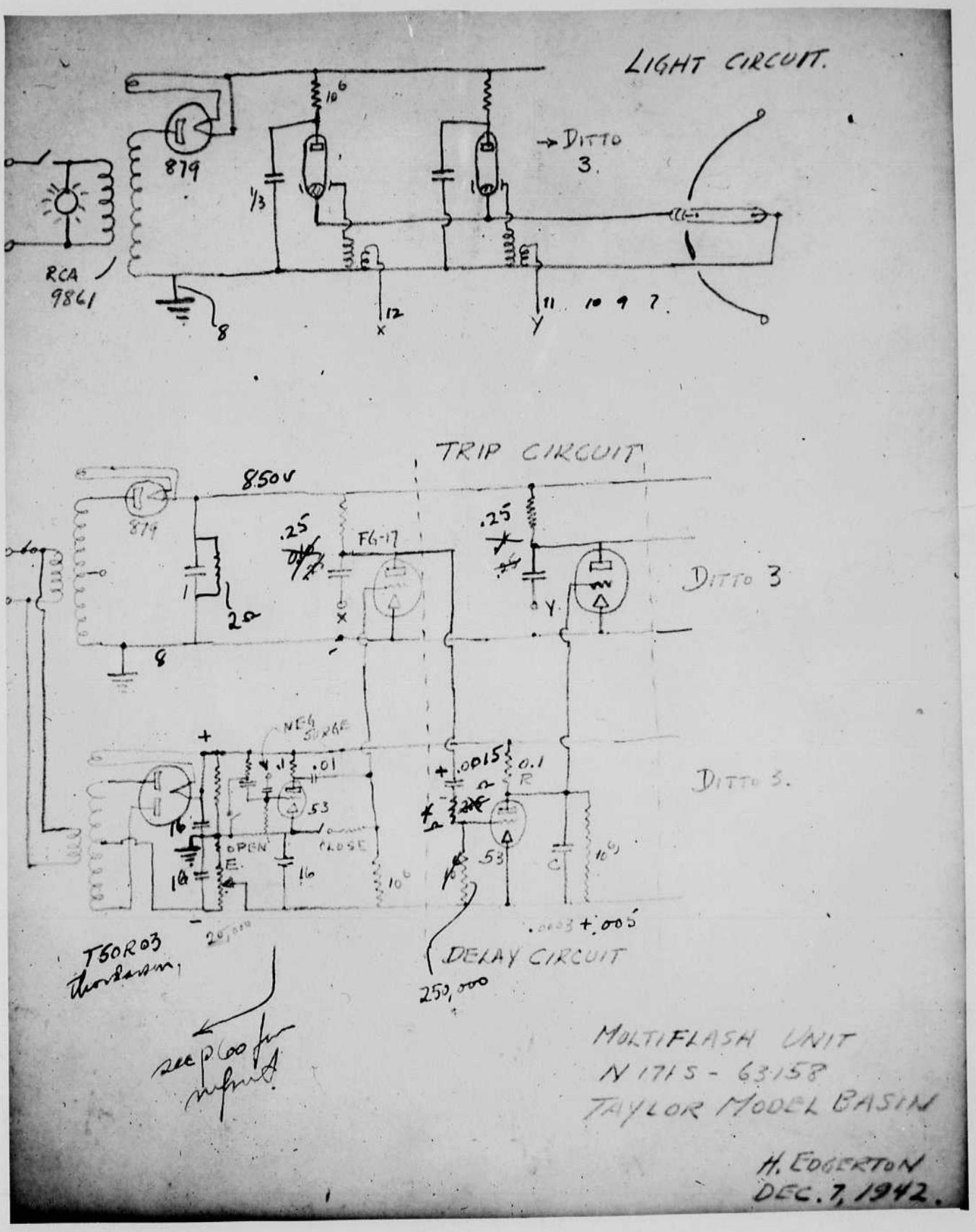
Dec 26 Conf with Rines & Trin. Jan 12 hearing.

Wiring diagram for 5 flash successive unit for Model Basin →

Most of the parts have been received. The wiring is now under way.

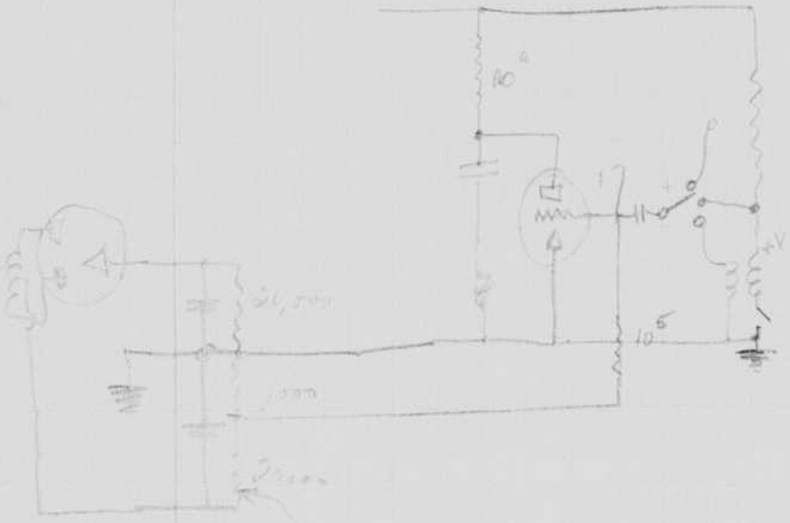


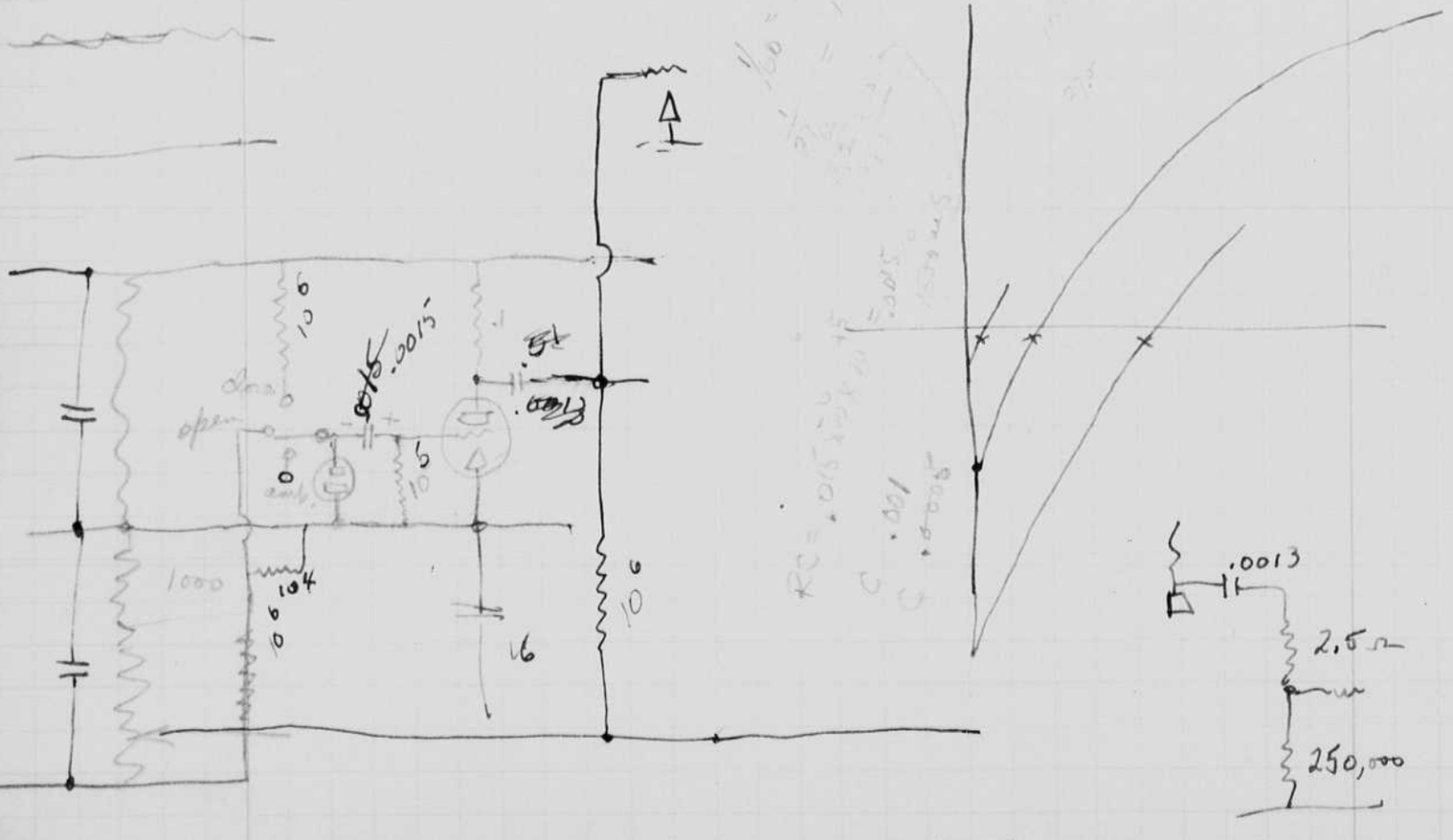


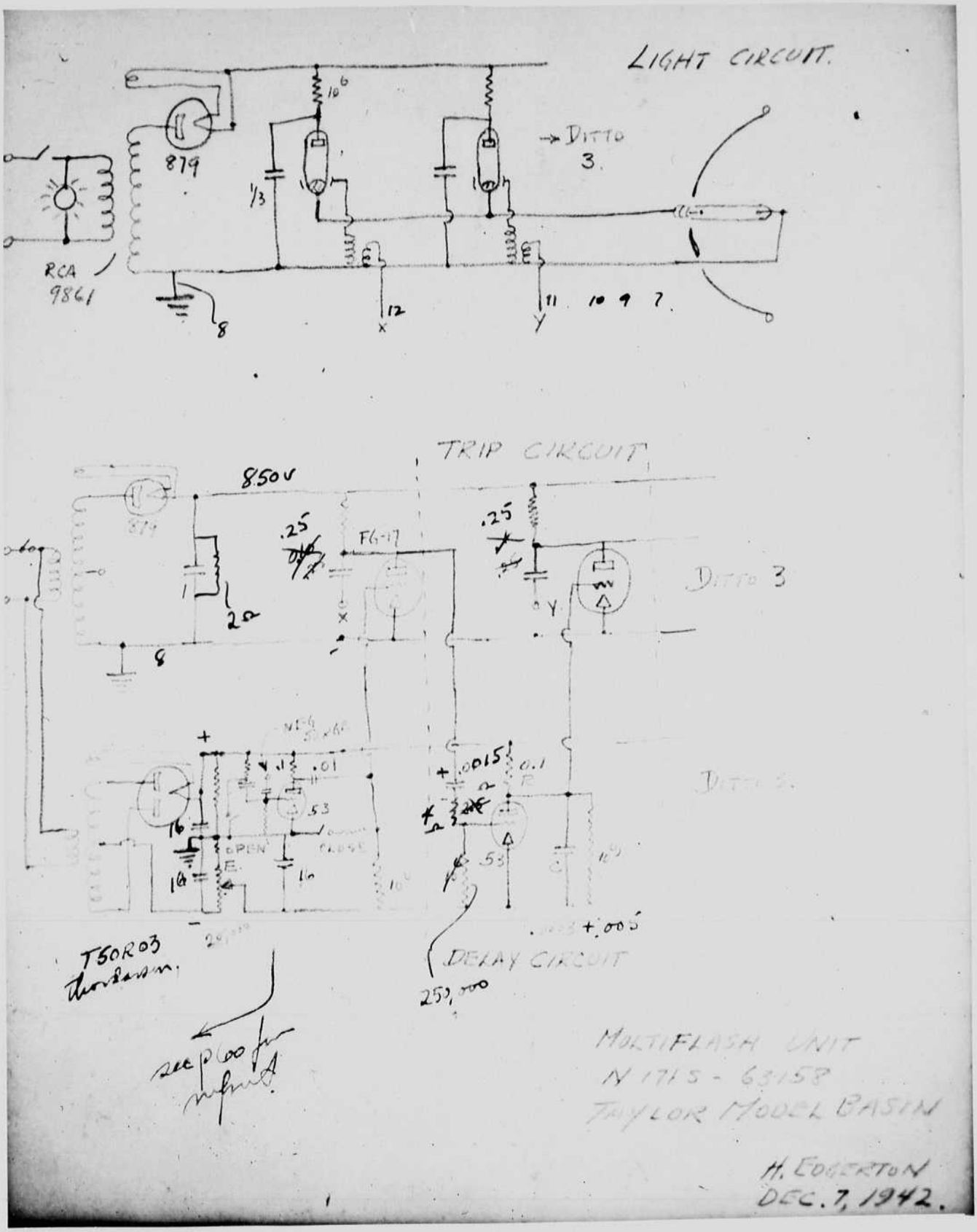

LIGHT CIRCUIT.
879
RCA 9861
10⁶
1/3
→ DITTO 3.
8
12
X
11
Y
10 9 7.
TRIP CIRCUIT
850V
879
.25
FG-17
.25
DITTO 3
2Ω
1
8
X
Y
NEG. SURGE
.01
53
16
OPEN
CLOSE
E.
16
10⁶
.0015
0.1 R
DITTO 5.
53
10⁶
.003 ± .005
T50R03 Thordarson
DELAY CIRCUIT
250,000
see p 60 for input
MULTIFLASH UNIT
N 1715 - 63158
TAYLOR MODEL BASIN
H. EGGERTON
DEC. 7, 1942.

Wiring diagram for 5 flash sweep and unit for Model Plane

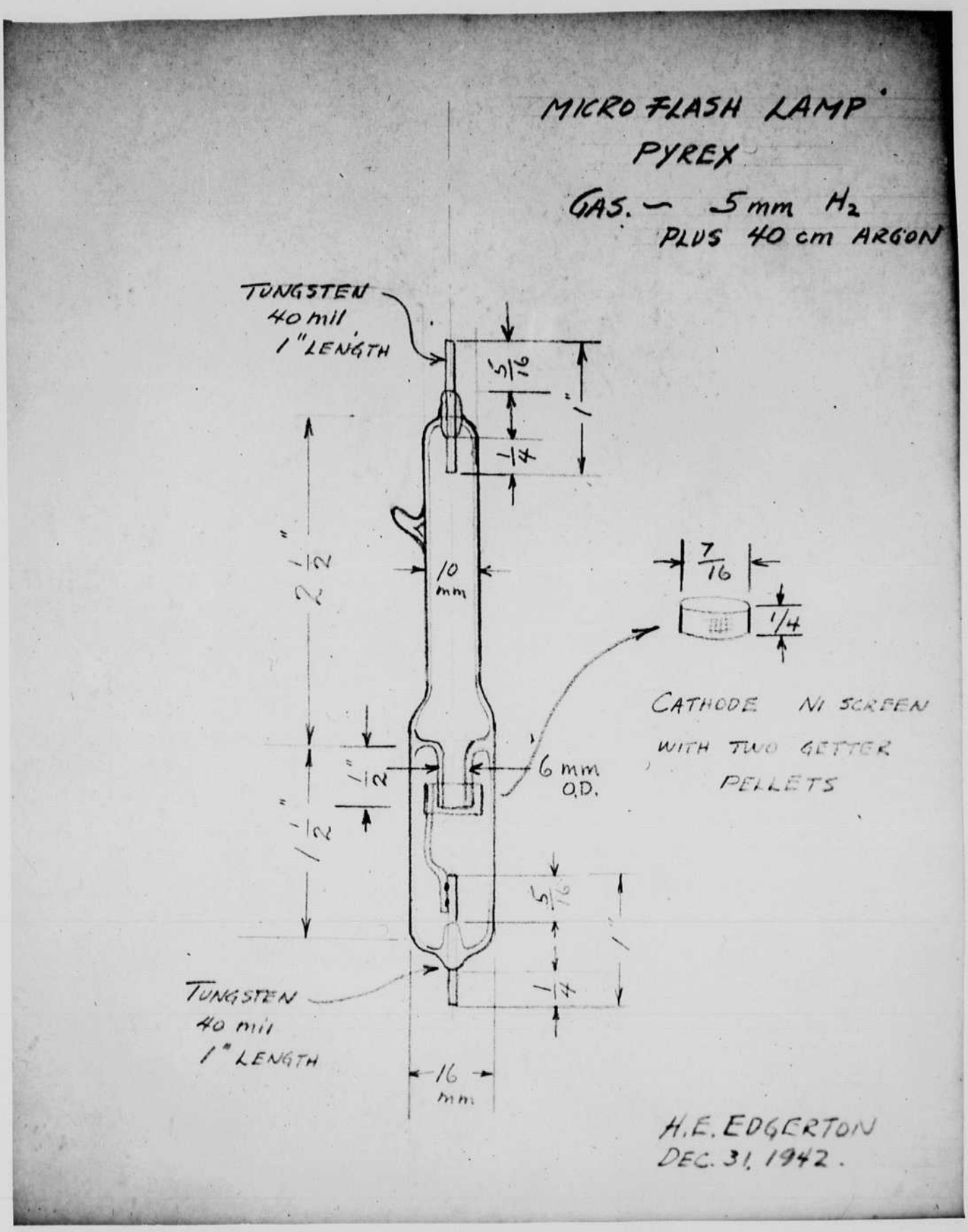
Most of the parts have been received. The wiring diagram is not complete.






LIGHT CIRCUIT.
879
RCA 9861
1/3
10
→ DITTO 3.
8
12
X
11
Y
10 9 7.
TRIP CIRCUIT.
850v
879
.25
FG-17
DITTO 3
2Ω
1
8
.01
.53
16
OPEN
CLOSE
.0015
0.1
.005
DELAY CIRCUIT
250,000
T50R03 Thordarson.
see p 100 for info.
MULTIFLASH UNIT
N 1715 - 63158
TAYLOR MODEL BASIN
H. EDGERTON
DEC. 7, 1942.

Drawing of micrometer tube. →

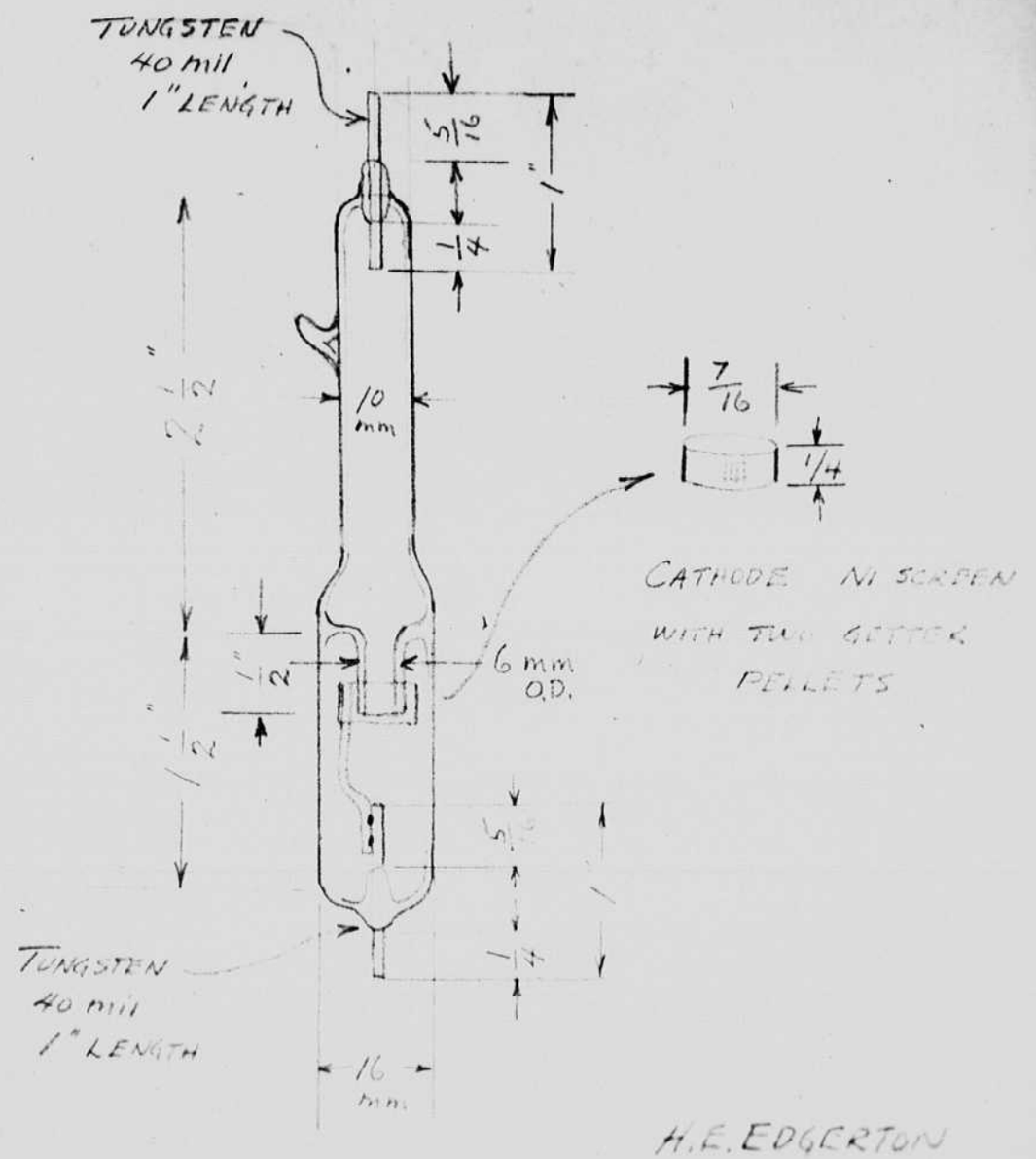

MICRO FLASH LAMP
PYREX
GAS. ~ 5 mm H_2
PLUS 40 cm ARGON
TUNGSTEN
40 mil
1" LENGTH
5/16
1"
1/4
2 1/2"
10 mm
7/16
1/4
CATHODE Ni SCREEN
WITH TWO GETTER
PELLETS
1/2"
6 mm
O.D.
1 1/2"
5/16
1"
1/4
TUNGSTEN
40 mil
1" LENGTH
16 mm
H.E. EDGERTON
DEC. 31, 1942.

Drawing of main frame to be. →

MICRO FLASH LAMP

PYREX

GAS. ~ 5 mm H_2
PLUS 40 cm ARGON



H.E. EDGERTON
DEC. 31, 1942.

Jan 3 1943

Harold E. Edgerton.

Worked Dec 31, Jan 1, Jan 2 with Paul Lee of Polaroid. Measurements were made on an argon gas lamp with his device for measuring the peak light and the duration. Other lamps were also tested.

Power peaked – old set.

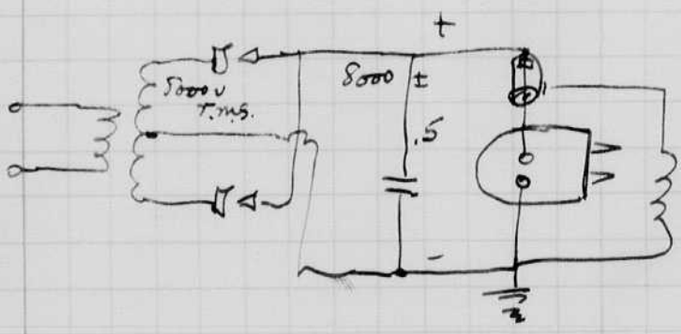
10 flashes per second

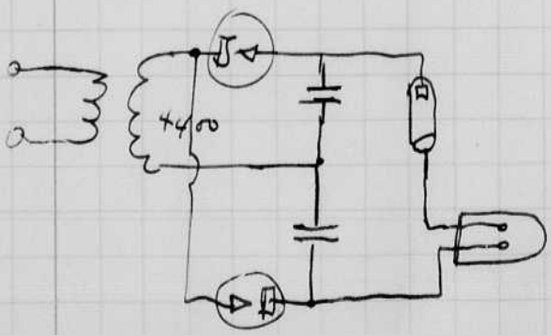
2000 volts 10 mf.

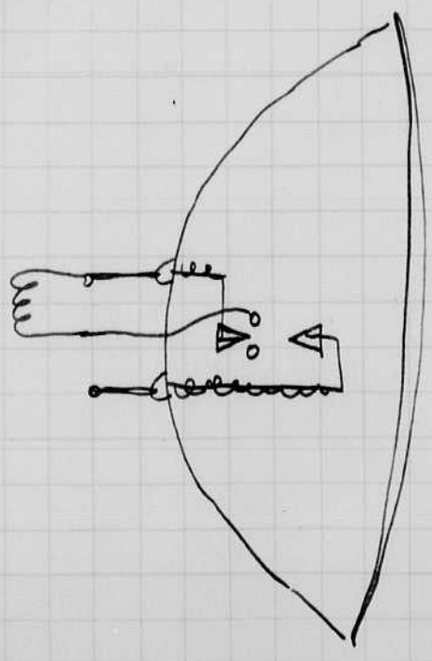
$\frac{CE^2}{2} f = \frac{10}{2} \cdot 10 =$ 200 watts into lamp.

Raise voltage to 4000 v. $C = 2.5$ mf.

Raise to 8000 v. $C = 0.625$ mf.



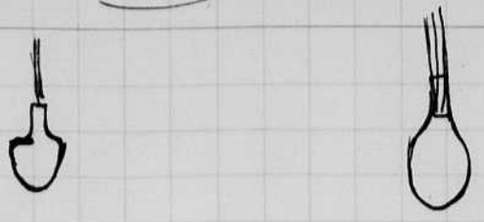


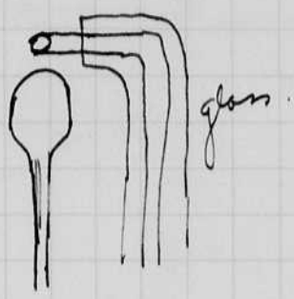


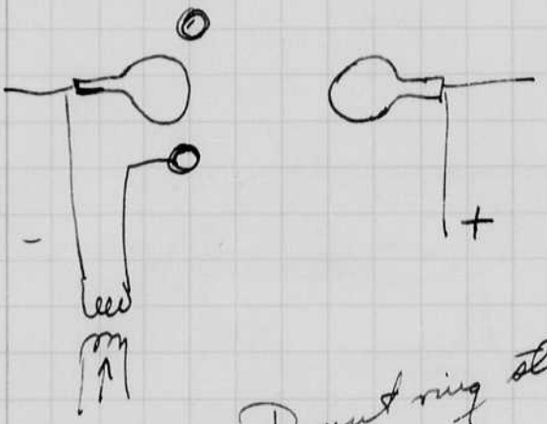
Sealed Beam type.

Bulbs for flash.

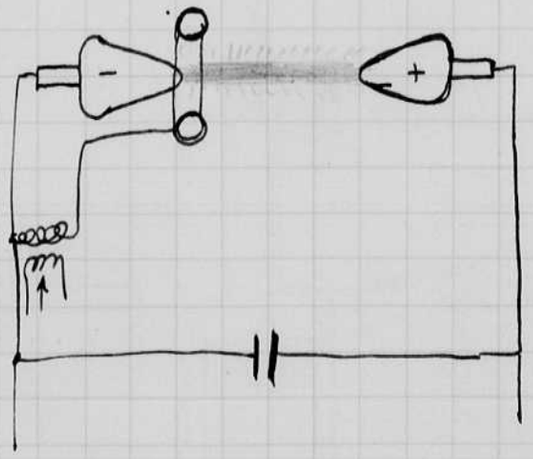
Jan 3 cont.

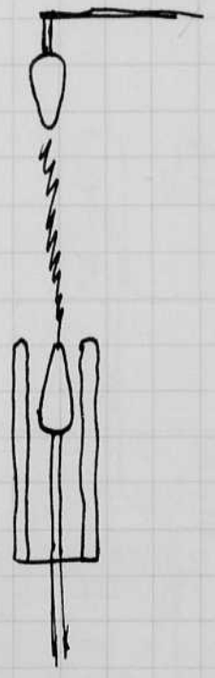






Donut ring starter electrode.





Plotted from
Jan 3 1943 Data
Jim Blevins note book.

$$\frac{250 \text{ lumen seconds}}{\frac{1}{3}\frac{10^8}{2} \times 10^{-7} \text{ joule}}$$

$= 15. \frac{\text{lumen sec.}}{\text{joule.}}$

X_c SiO_2 spiral

$C = \frac{1}{3}$ mf

Hg control tube used.

Lumen seconds

300

200

100

0

$V_{collection} = \frac{10,000}{\frac{112 \times 4}{2}} = 44.5$

ARGON GAP 5/8" 30 cm

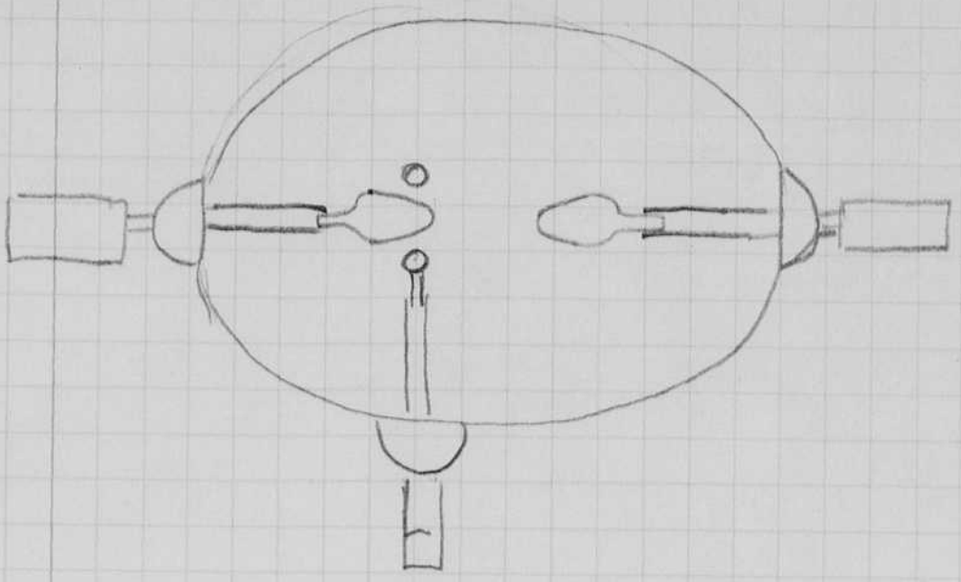
VOLTAGE

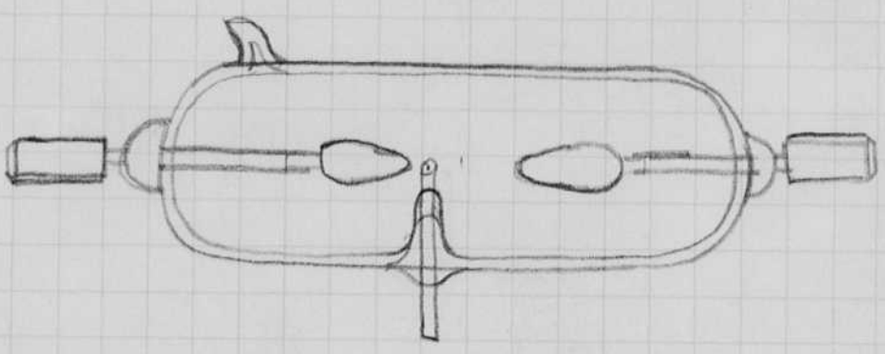
10 20 30 40 50 60 70 80 90 100 $\times 10^6$

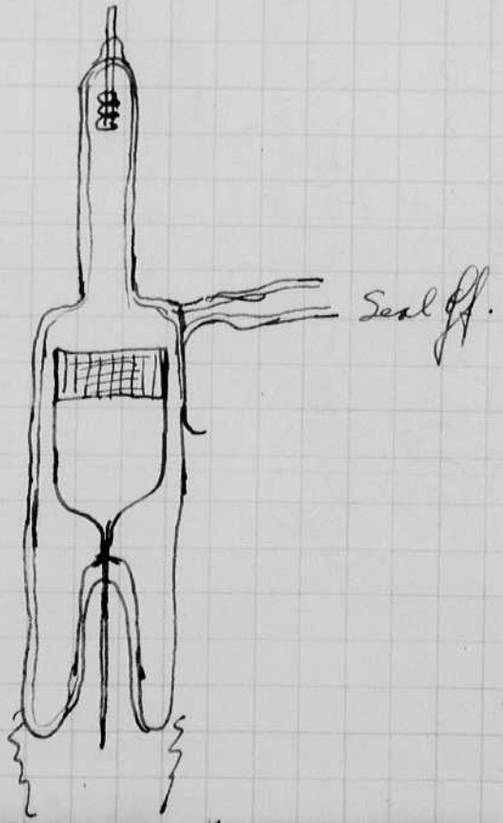
3 cm

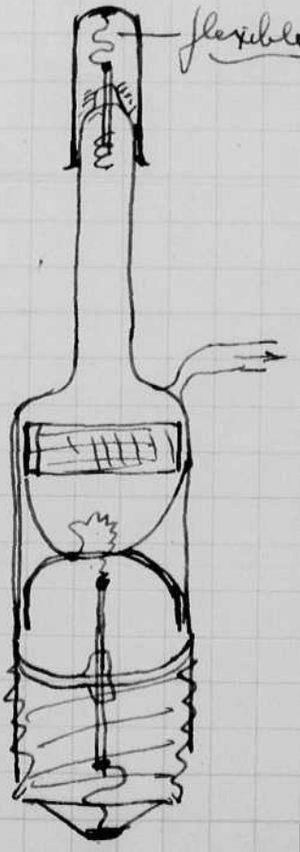
1 cm

Jan. 5, 1943
Harold Edgerton



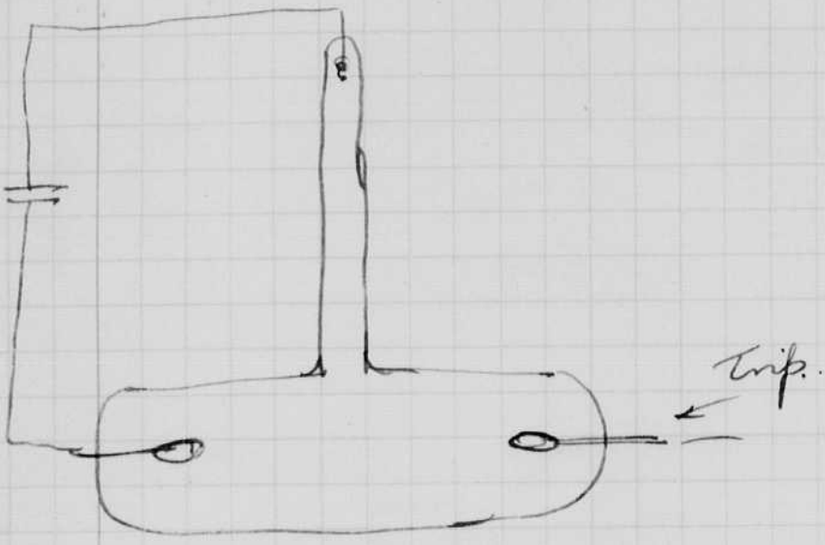


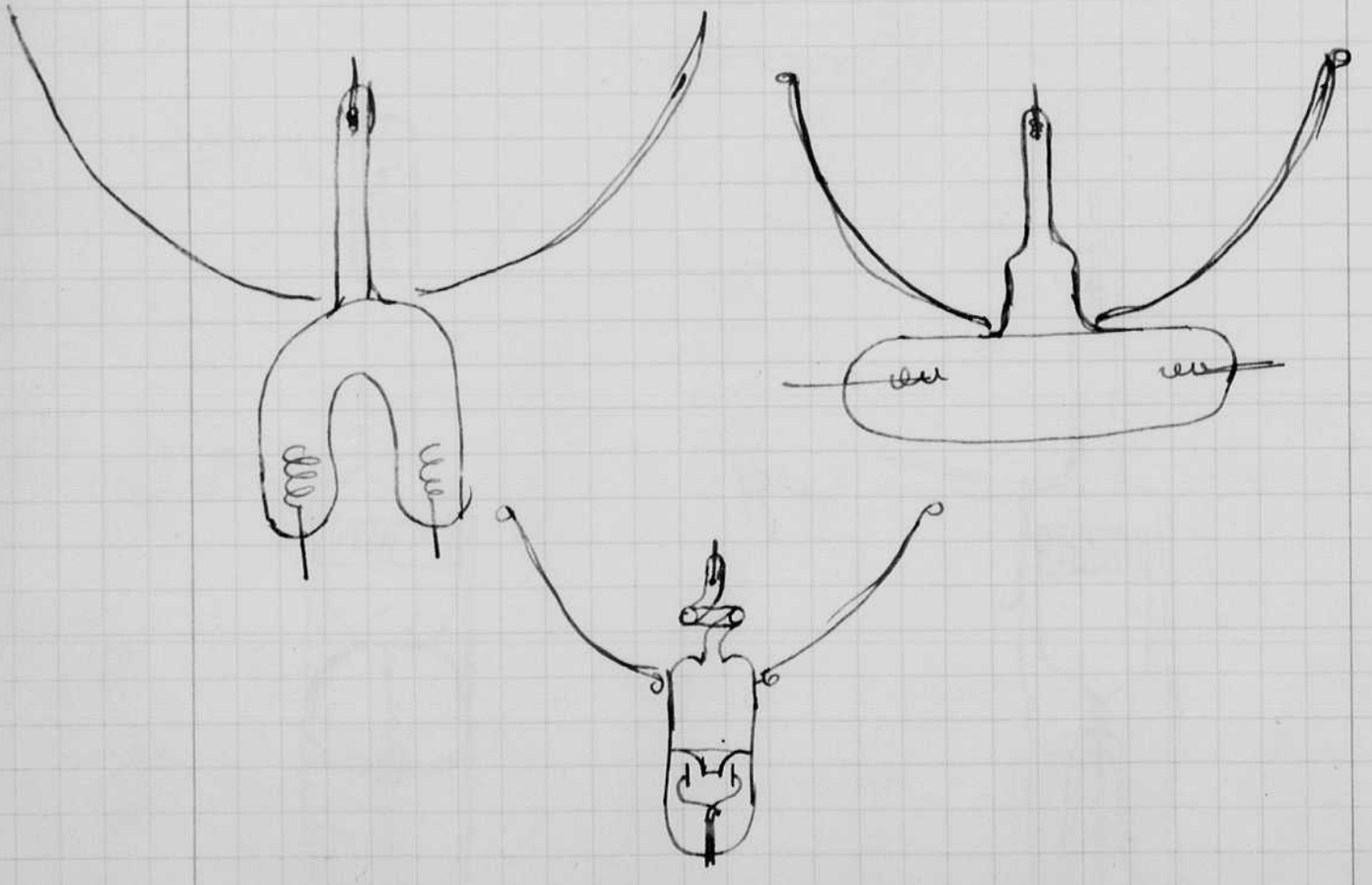




Jan 11 1943.
Harold E. Edgerton.

Worked with Grier on exhibits of stroboscopes to show in Court Room 6 15th floor of the post office building - Boston tomorrow.
Civil suit by city service - Miller.





↑ Shockwave Reflection from Flashpowder light

Jan 11 1943.
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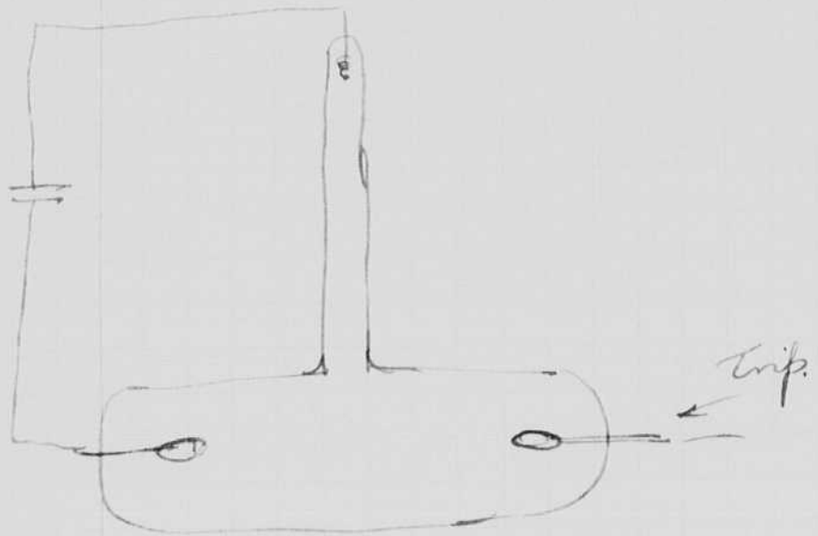
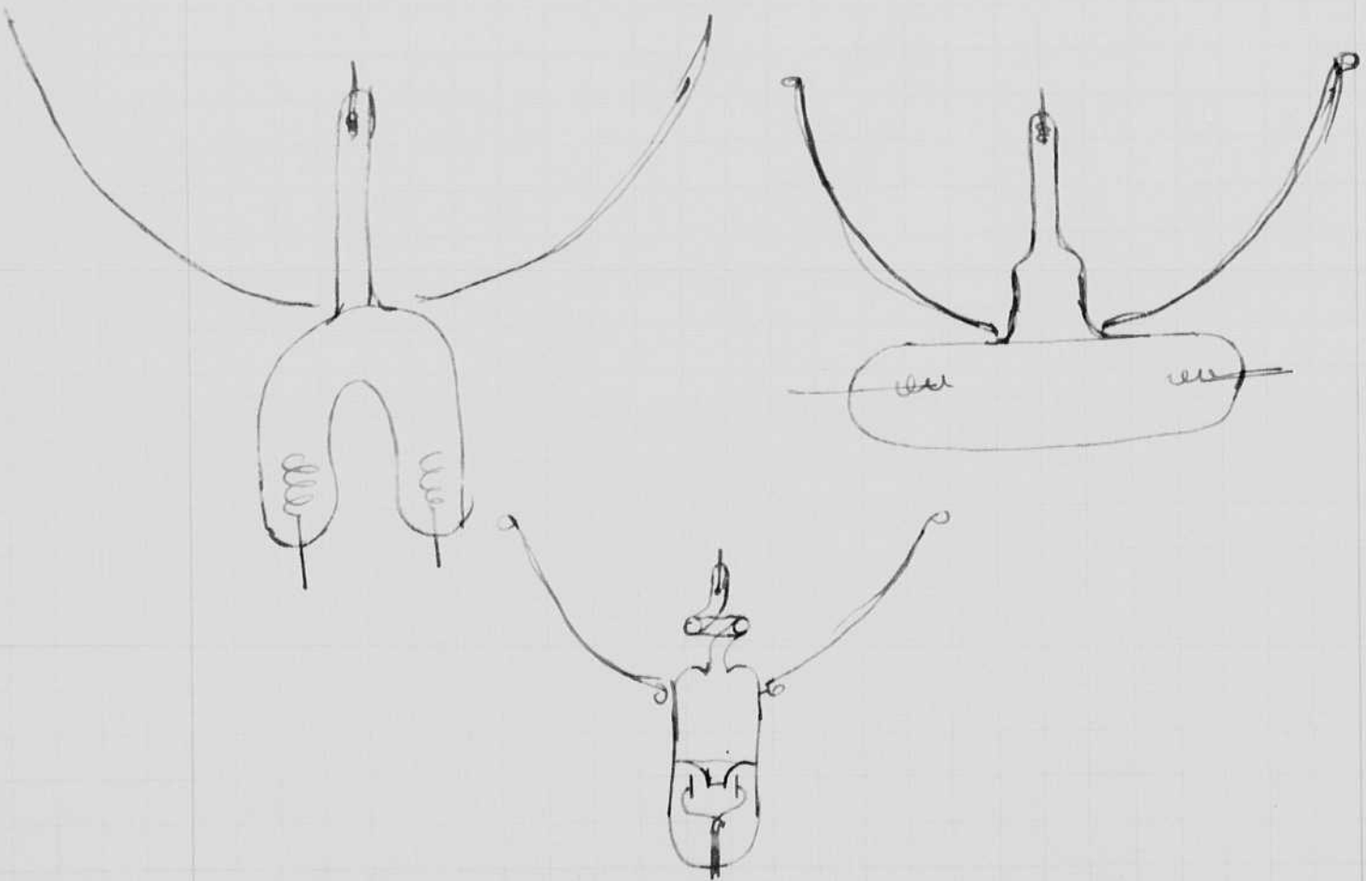
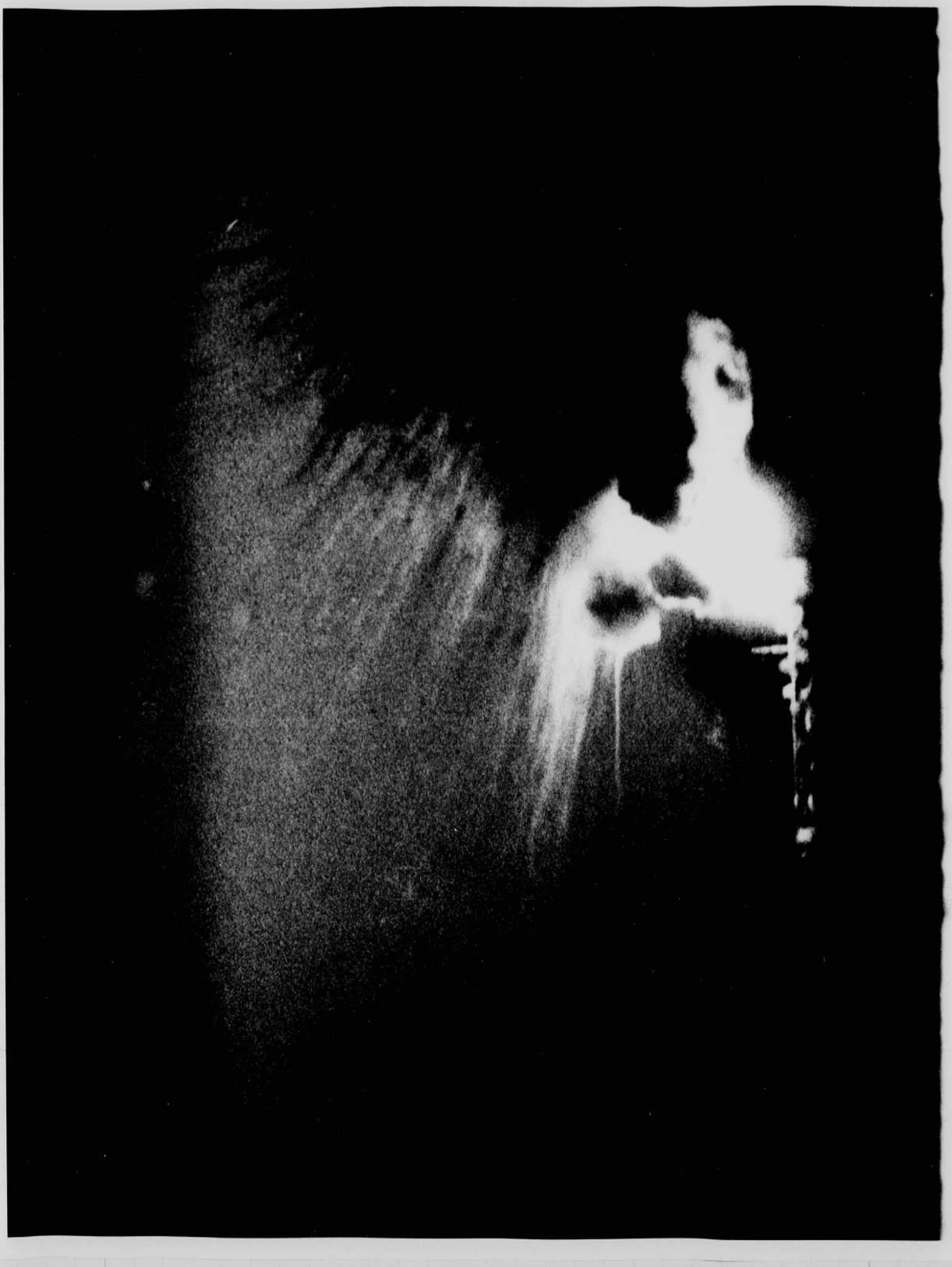
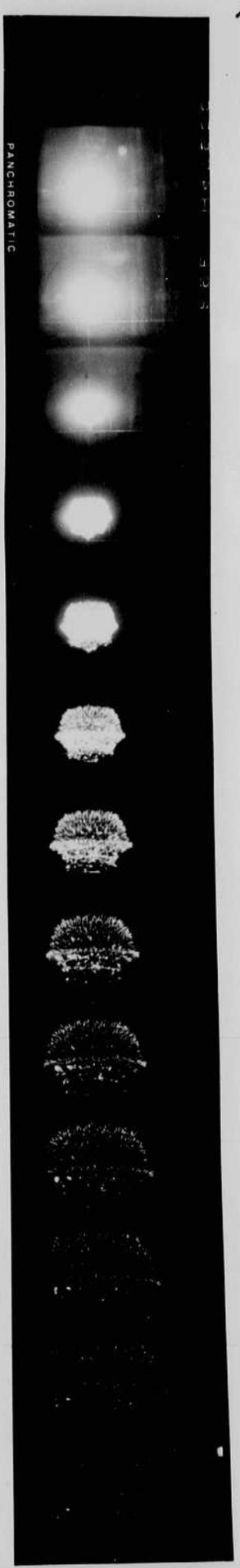




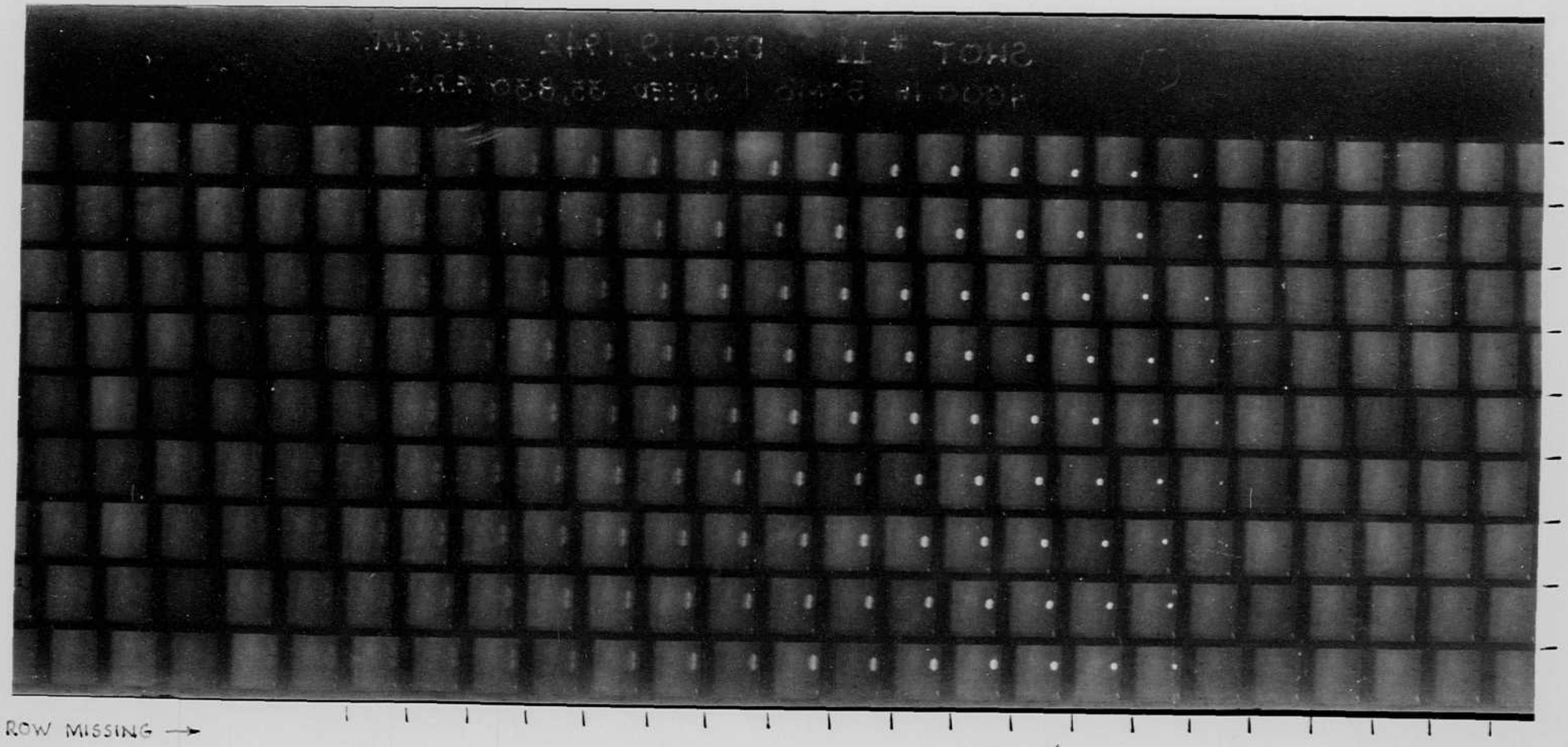


↑ Shockwave Reflection from flashpowder light

4



4



SHOT #11

HIGH SPEED MOTION PICTURES OF 4000 lb BOMB

PHOTOGRAPHED AT RATE OF 35,830 F.P.S. BY

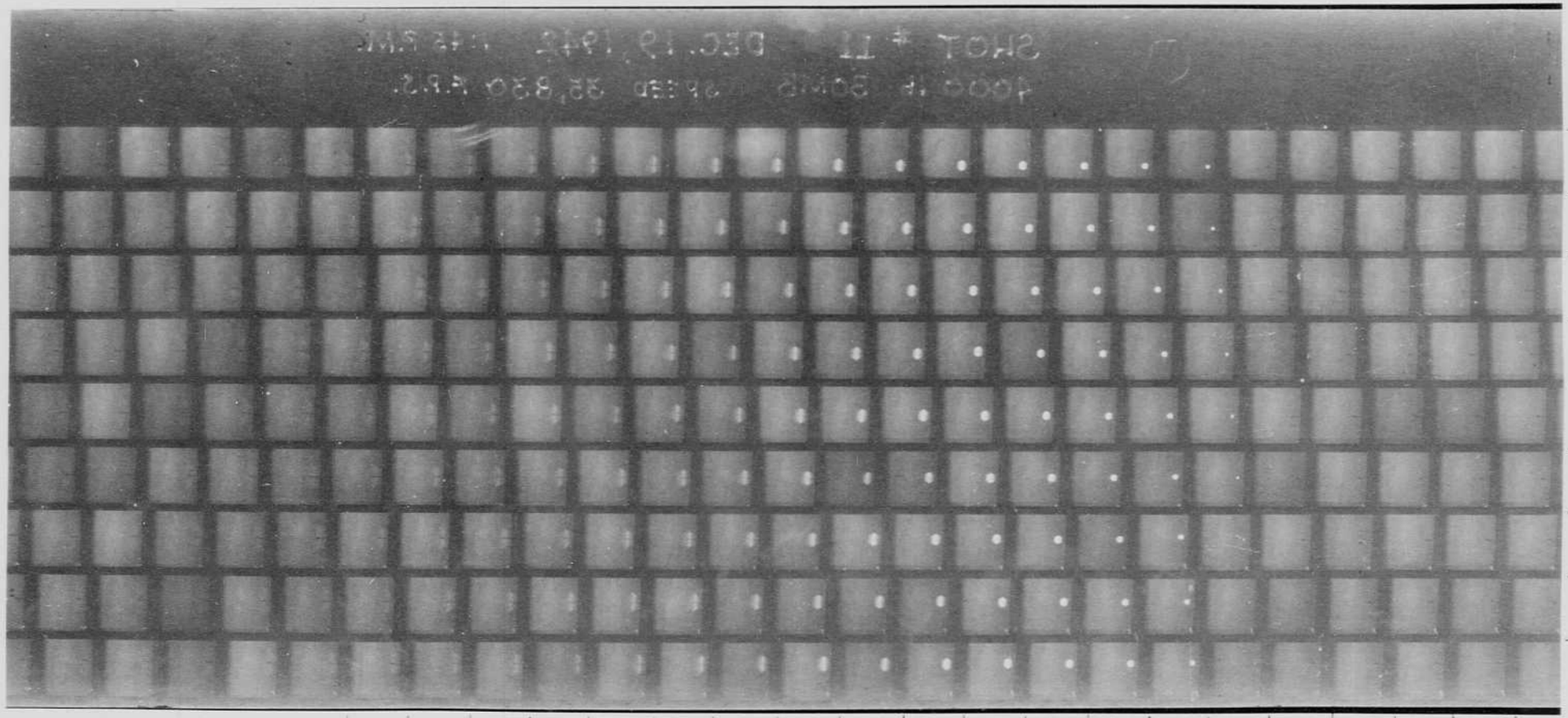
GENERAL ELECTRIC PINHOLE DRUM CAMERA

U.S. ARMY PROVING GROUND, ABERDEEN, MD. DEC. 19, 1942

H.E. EDGERTON – C.W. WYCKOFF

4

4



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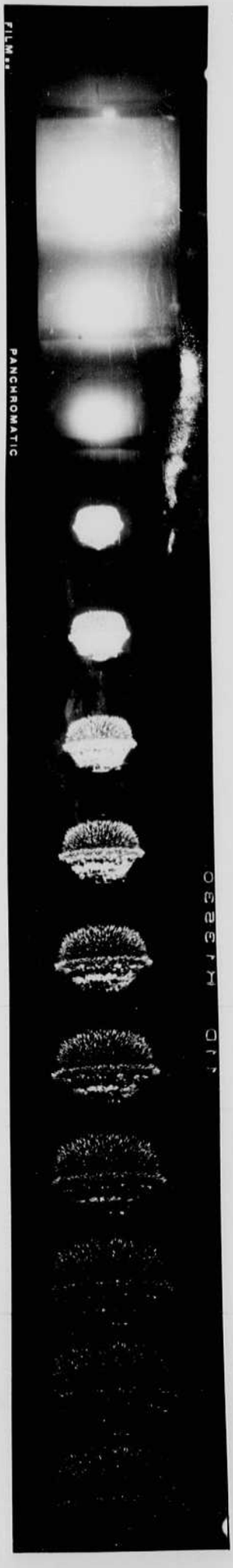
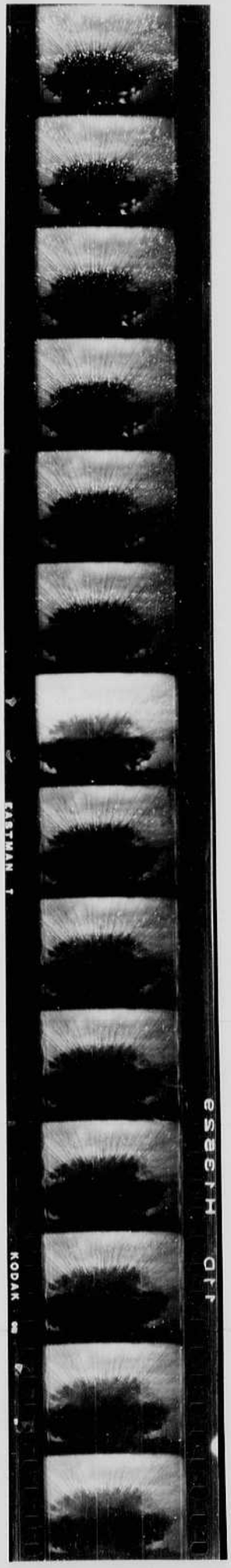
5


FILM..
PANCHROMATIC
KODAK

5


KODAK
EASTMAN

7


NITRATE FILM..
PANCHROMATIC

7

KODAK
JOE HAYES
EASTMAN 4B

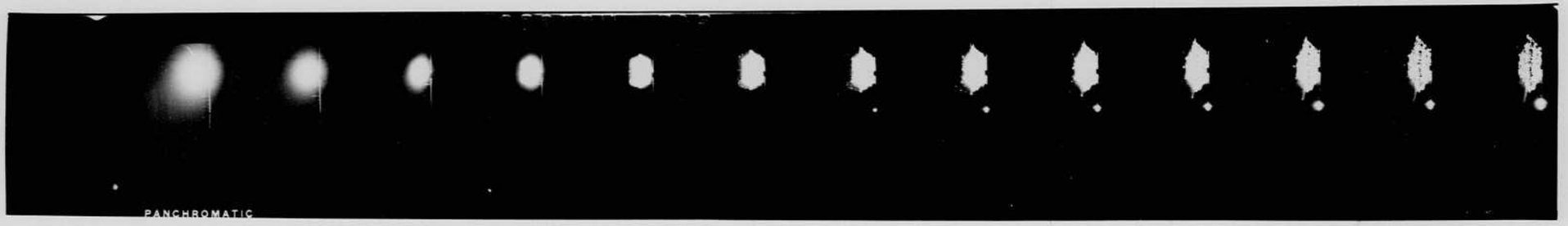
9

JOE HAYES
EASTMAN 4B

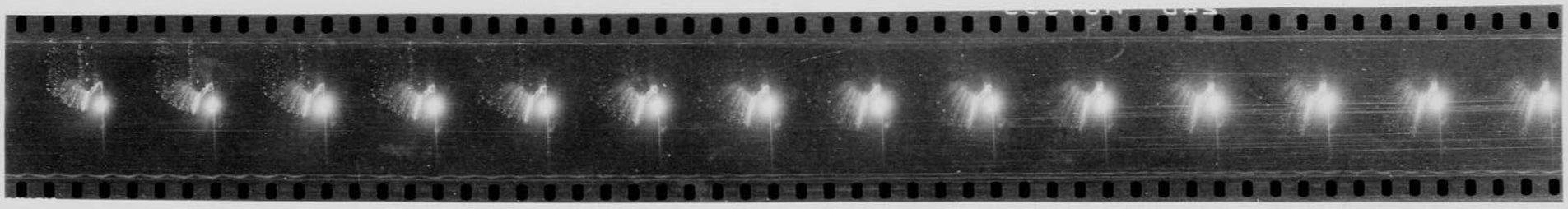
9

KODAK
JOE HAYES
NITRATE FILM
PANCHROMATIC

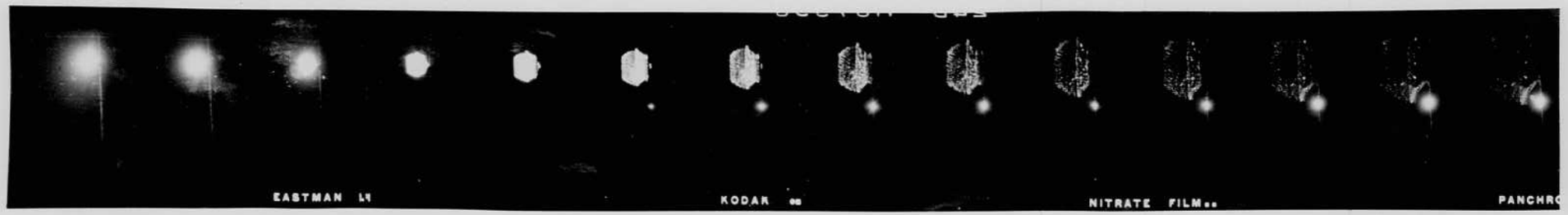
11



10

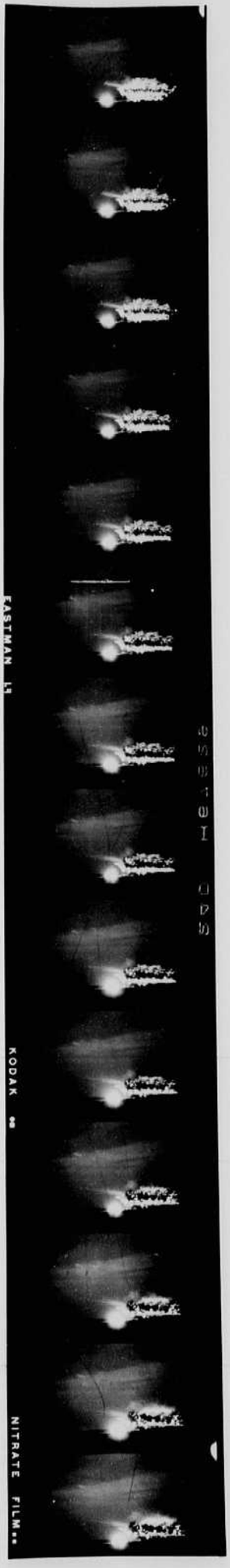


10

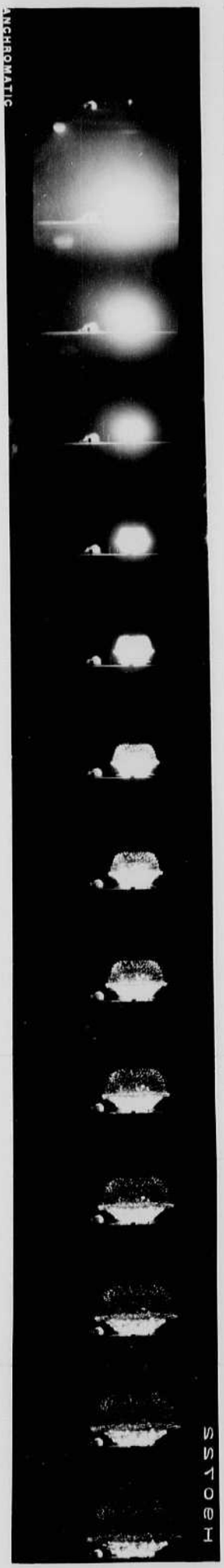


74

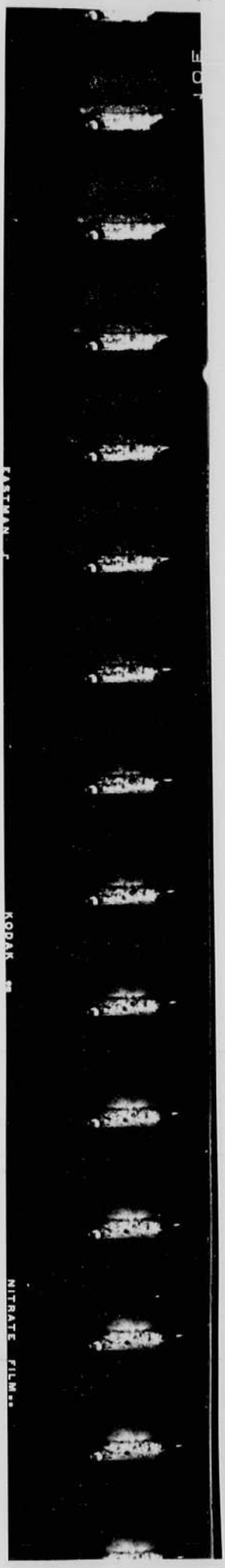
11


EASTMAN 13
KODAK
NITRATE FILM

12


ANCHROMATIC
ISOLAS

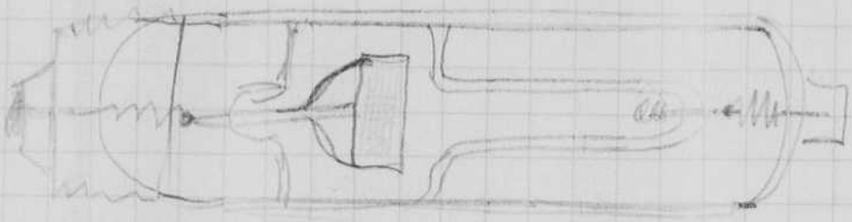
12


JOE
KODAK
NITRATE FILM

Sat Jan 16 1942

Harold E Edgerton

Wydoff and I are back from Aberdeen where we spend the 13 and 14 taking movies of 100 # bombs. TNT and amatol.

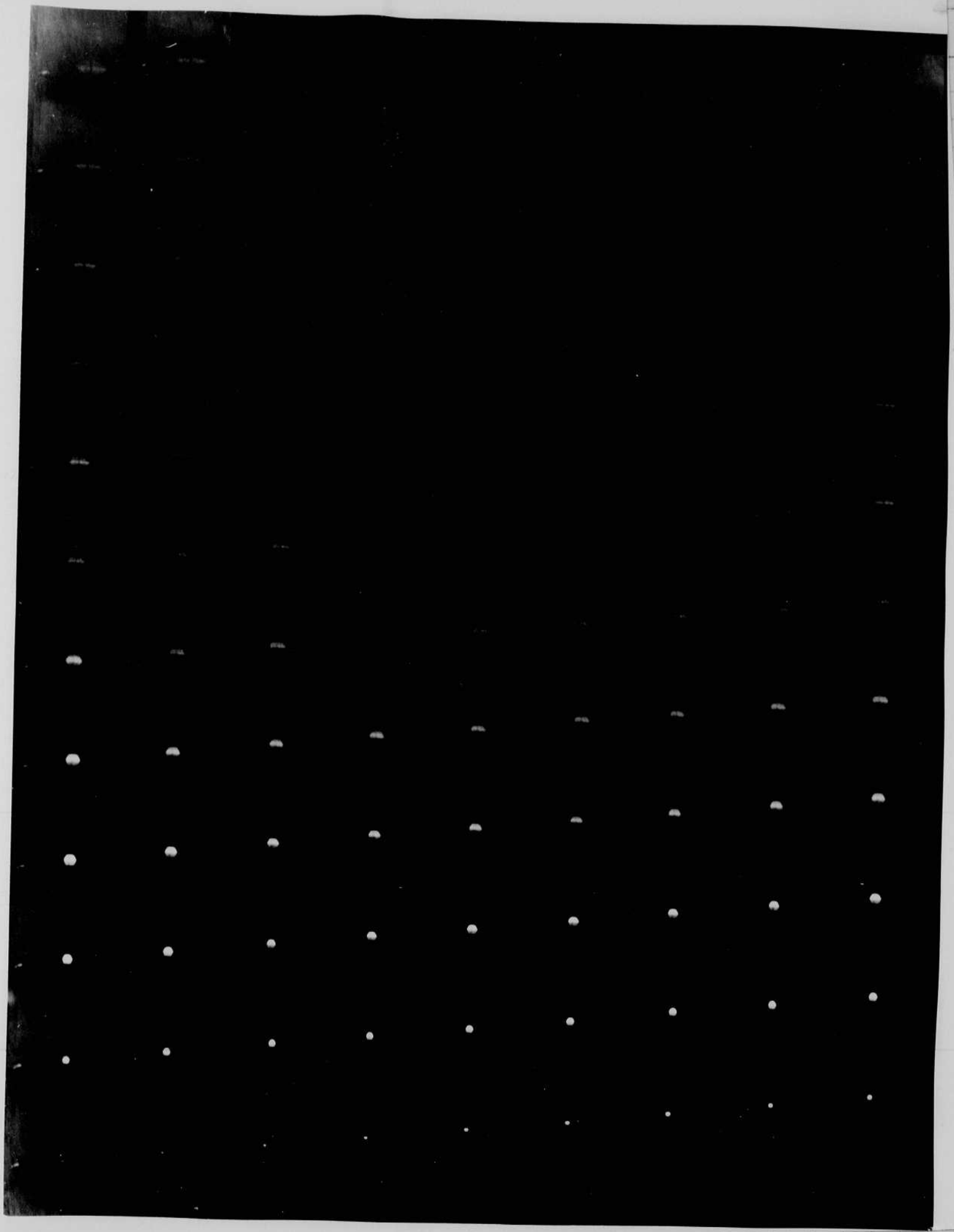


4 grams.

$\frac{4\text{ ft}}{10} = \frac{1}{10} 35{,}000 = 14{,}200$ ft/sec.

35,000

4000 # Bomb.
38,000 ± f.p.s.
#12.
Aberdeen Md.



Sat Jan 16 1942

Harold Edgerton

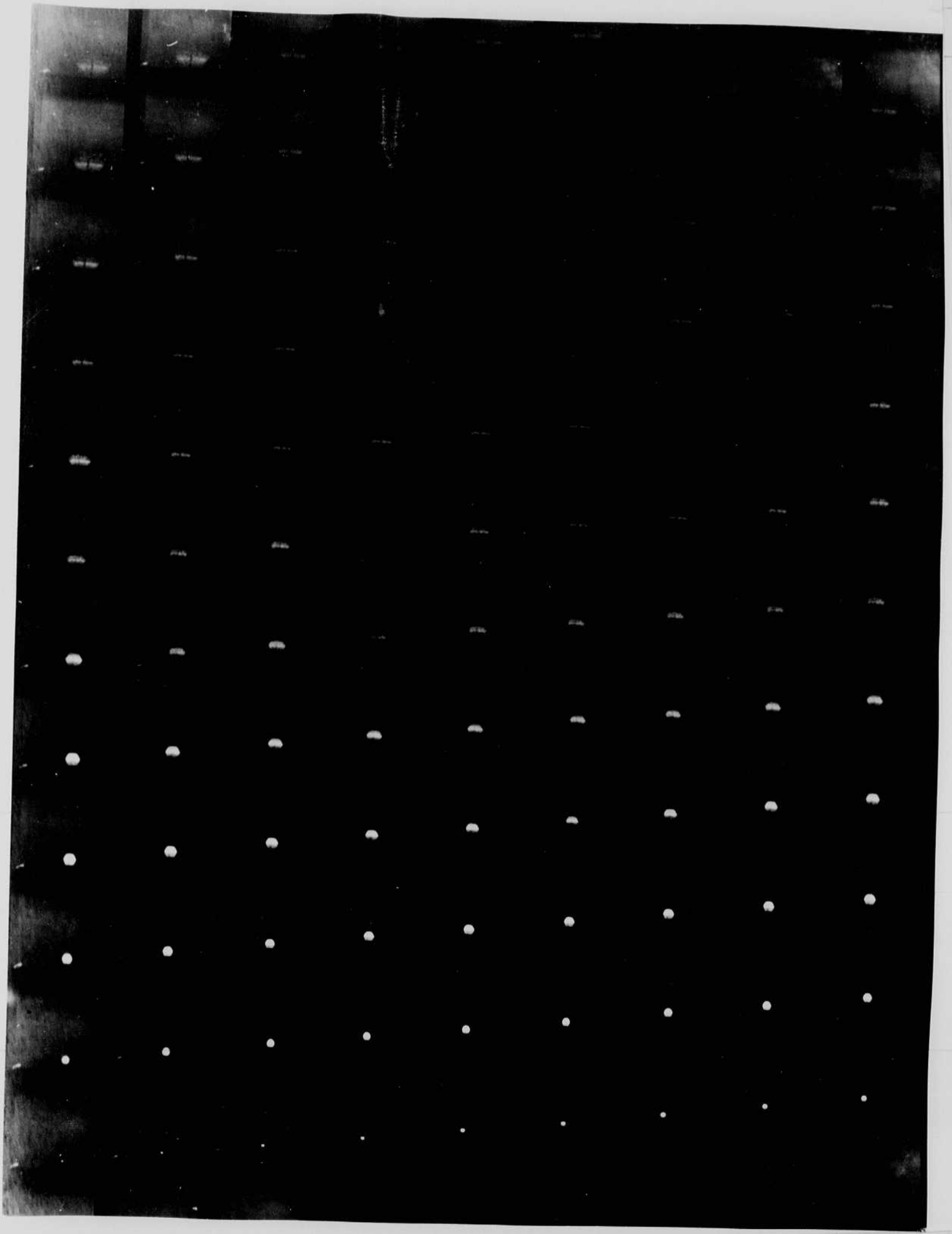
Wydoff and I are back from Aberdeen where we spend the 13 and 14 taking movies of 100 # bombs. TNT and amatol.

4000 # Bomb.
38,000 ± f.p.s.
#12.
Aberdeen Md.

4 grains.

$\frac{4\#}{10} = \frac{4}{10} \times 35{,}000 = 14{,}200\ \#/\text{sec.}$

$\frac{4\#}{10}$
$35{,}000$

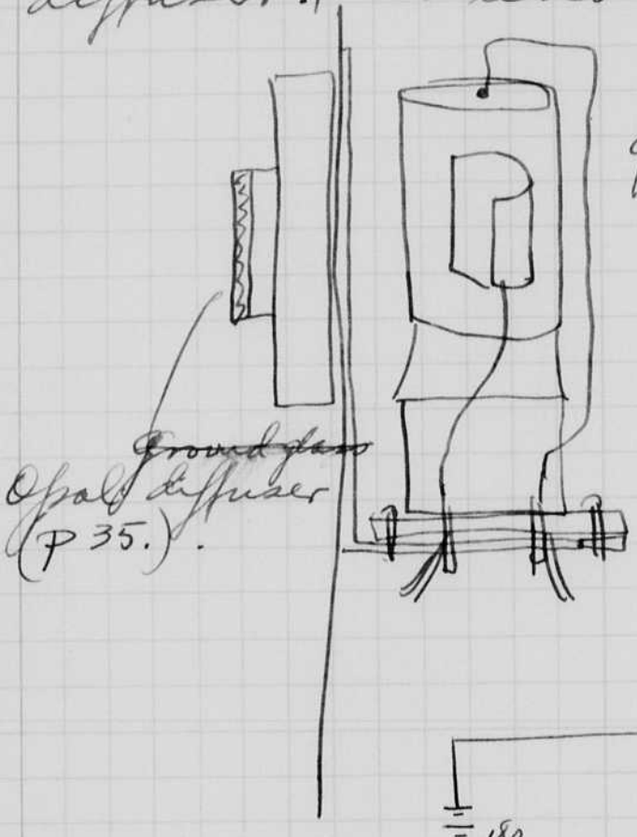


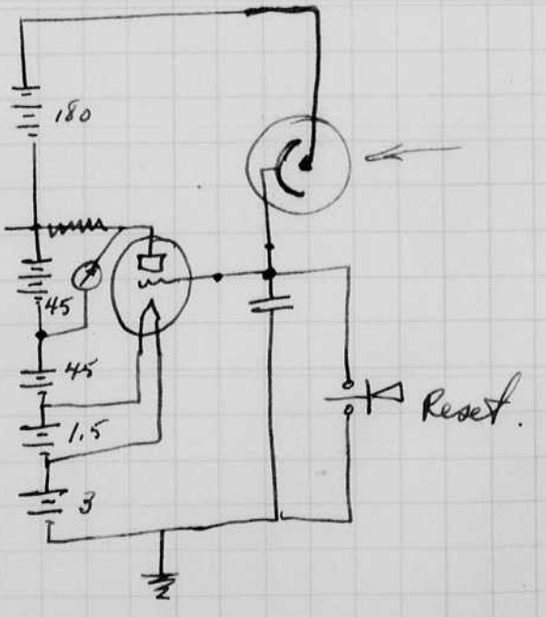
Jan 19 1943

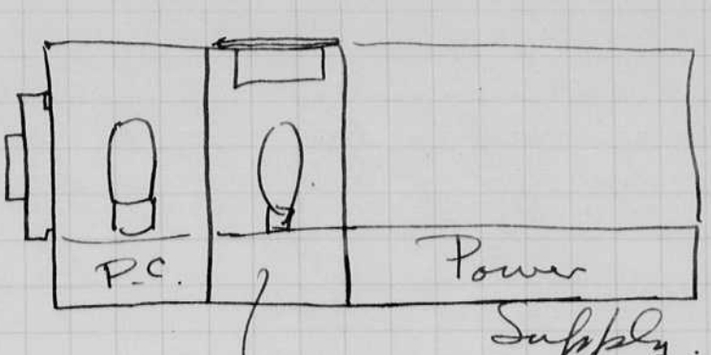
H E Edgerton.

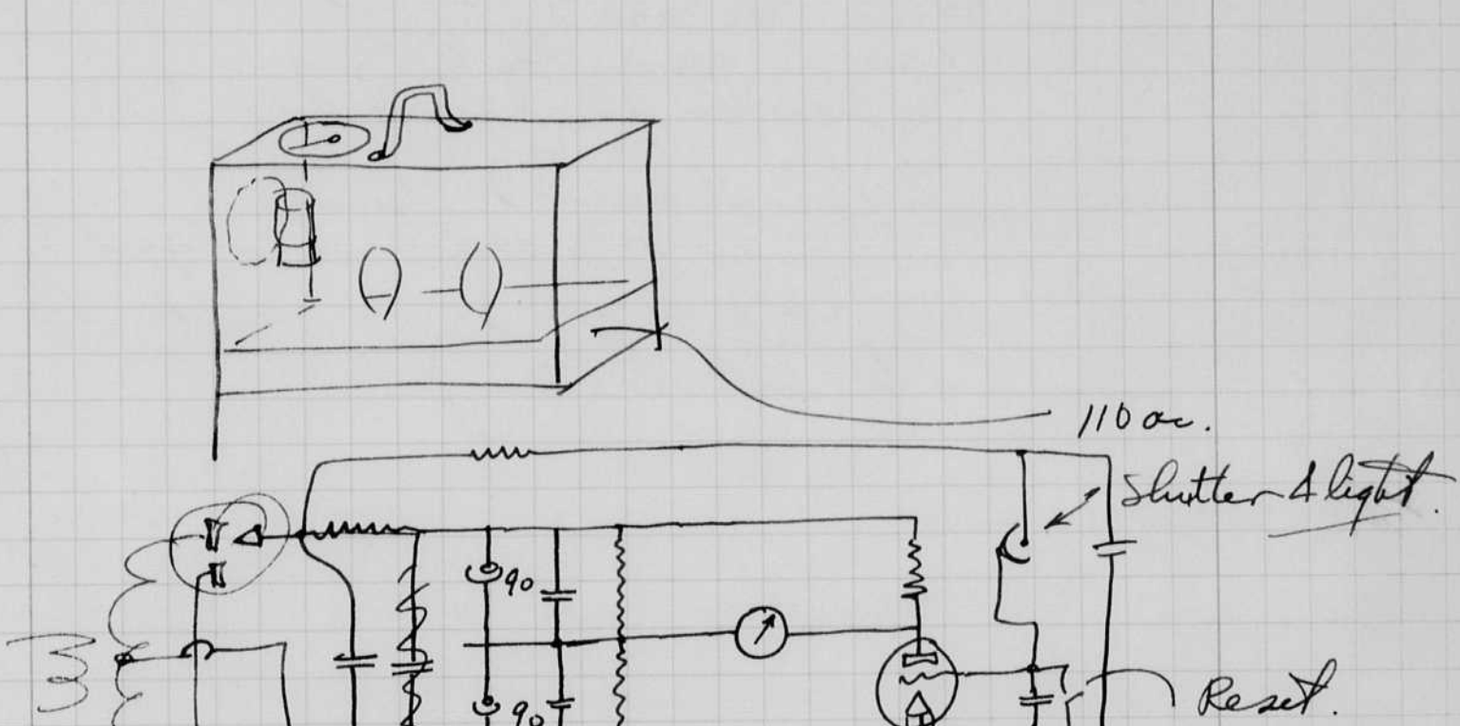
The shutter on the photo cell ~~synchronizing~~ light measuring device finally blew out so that it was open ~~for~~ when cocked.

I am installing a new Eastman Supermatic shutter today. This one is equipped with a ~~flat~~ diffuser. No lens is used.






P.C.
Power
Supply
triode.


110 ac.
Shutter & light
90
90
Reset.

Jan 21 1943
Harold E. Edgerton.

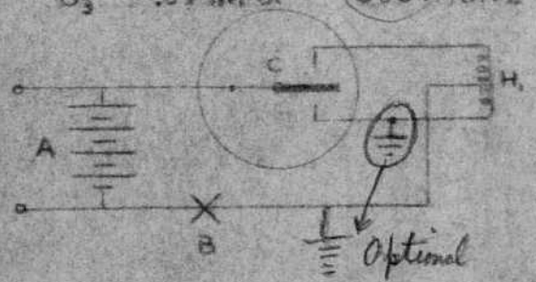
Conf with Lee this morning. Decided to build flasher unit 25 ~~xx~~ 45. We will use gap tube with Kr. Gas. A control lamp of the mercury variety will be needed at first but we hope to get a 3 electrod gap tube to operate eventually.

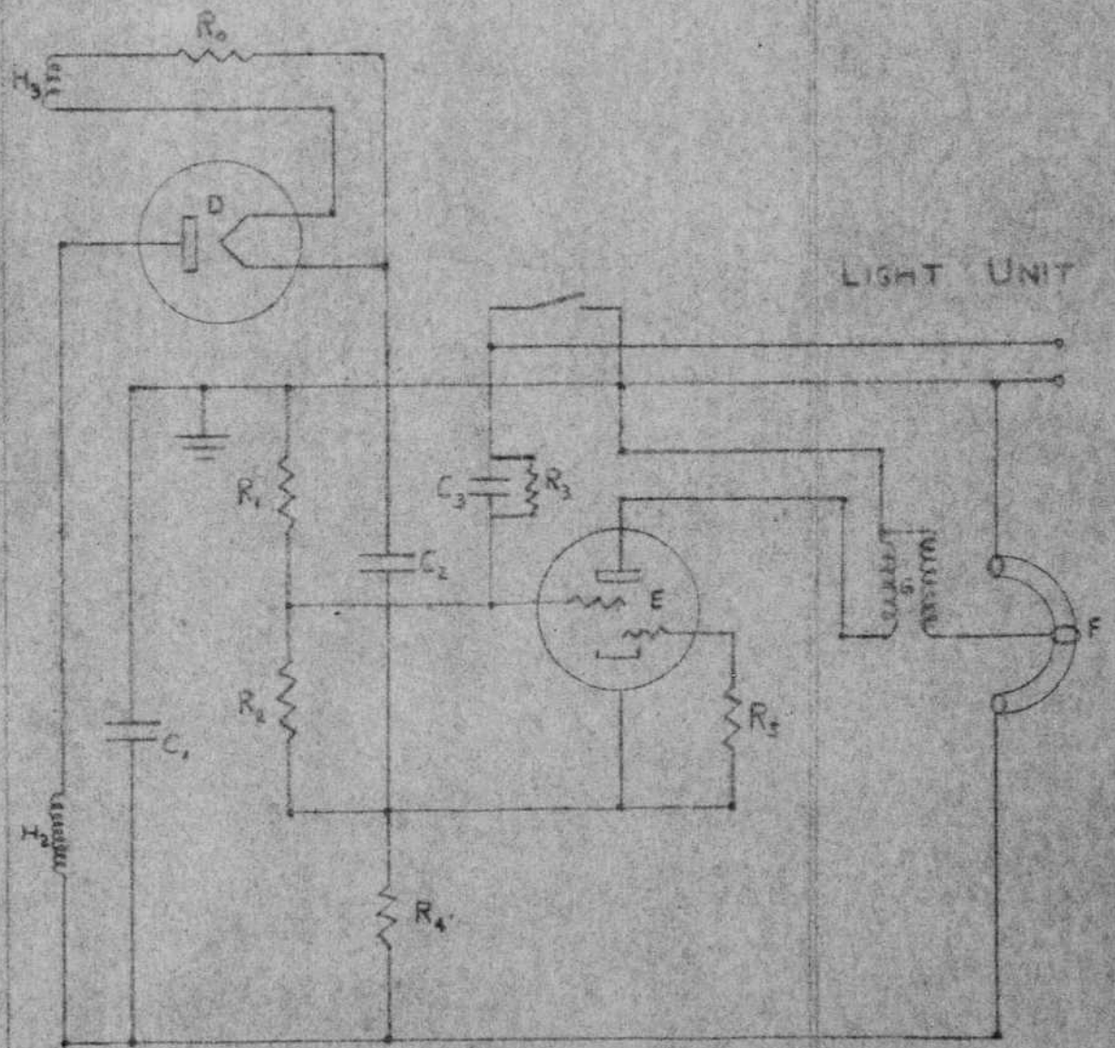
3000 - 4000 volts.
1 mf (possibly 4)
10 flashes per second.
Life 2 hours. (sure)
35% decrease in light

Gap tube ~~Kr~~ gas.
~~Hg~~ control lamps.

A 8 V. NON-SPILL. STOR. BAT.
B TOGGLE SWITCH
C 6 V. NON-SYNC. VIBRATOR
D 879 TUBE
E 631 STROBOTRON TUBE
F #3 KODATRON FLASH TUBE
G SPARK COIL 10:10,000
H SPEC. TRANSFORMER
$H_1:H_2:H_3$ = 6:1600:2.5

R_0	1 OHM	5W	
R	.25 MEG	1W	250 V. DROP
R_1	.05 MEG	.5W	50 V. DROP
R_3	.01 MEG	.25W	
R_4	3 MEG	5W	1700 V. DROP
R_5	.01 MEG	.25W	
C_1	2 8 MFD.		
C_2	1 MFD.	~~300~~ 600 V.	RATE
C_3	.01 MFD.	~~300~~ V.	RATE





EDGERTON PORTABLE SPEED-LAMP : PUBLICATIONS' MODEL

L Ro 9/4/42

Jan 21 1943
Harold E. Edgerton.

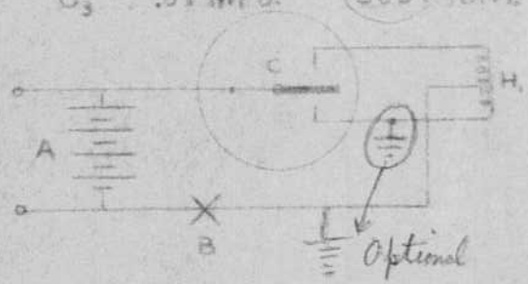
Conf with Lee this morning. Decided to build flasher unit 25 ~~as~~ as U.S. We will use gap tubes with kr. gas. A control lamp of the mercury vapor variety will be needed at first but we hope to get a 3 electrod gap tube to operate eventually.

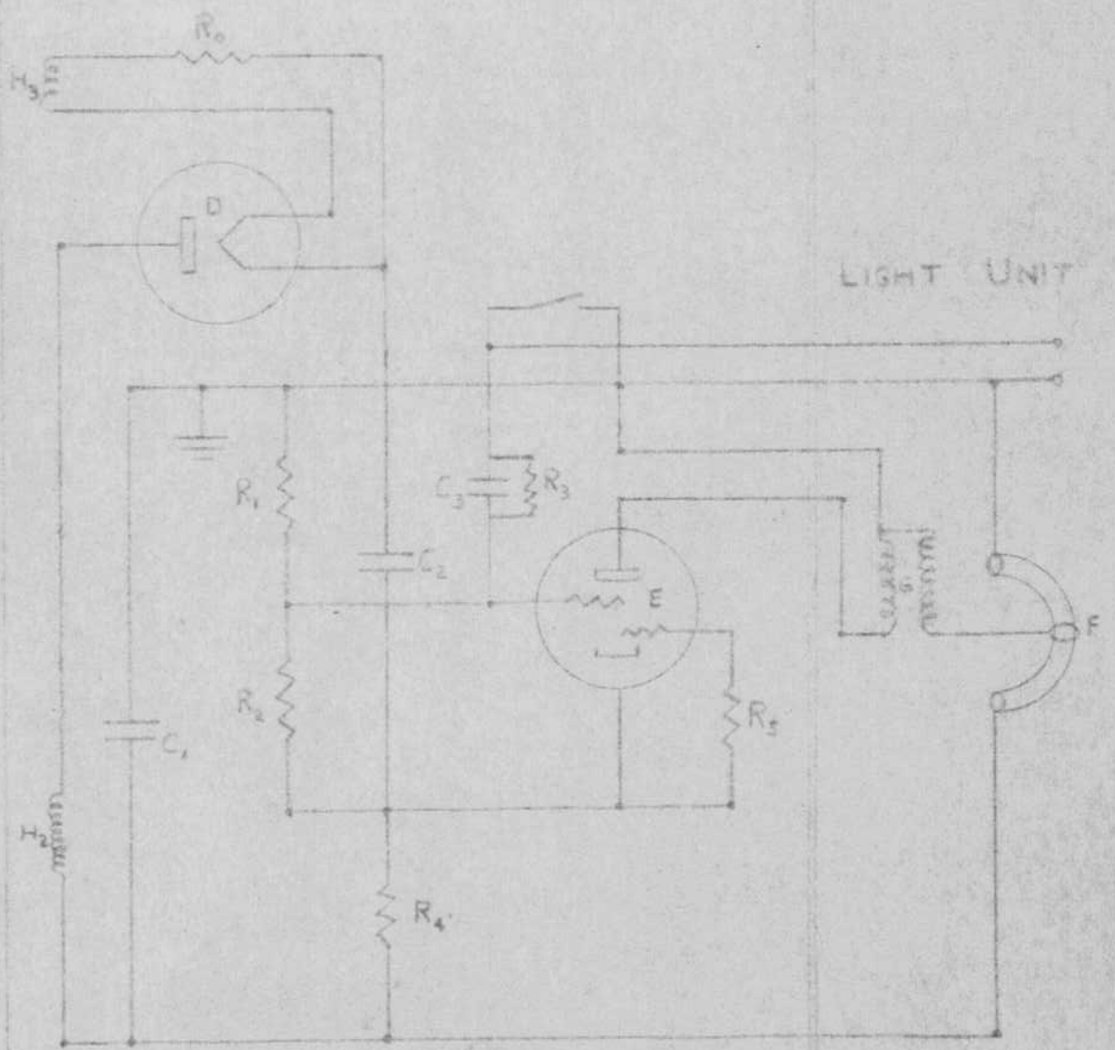
3000 - 4000 volts.
1 mf (possibly 4)
10 flashes per second.
Life 2 hours. (sure)
35% decrease in light

Gap tube ~~kr~~ gas.
Hg control lamp.

A 8 V. NON-SPILL. STOR. BAT.
B TOGGLE SWITCH
C 6 V. NON-SYNC. VIBRATOR
D 879 TUBE
E 631 STROBOTRON TUBE
F #3 KODATRON FLASH TUBE
G SPARK COIL 10:10,000
H SPEC. TRANSFORMER
$H_1:H_2:H_3$ = 6:1600:2.5

R_0	1 OHM	5W	
R_1	.25 MEG	1W	230 V. DROP
R_2	.05 MEG	.5W	50 V. DROP
R_3	.01 MEG	.25W	
R_4	3 MEG	5W	1700 V. DROP
R_5	.01 MEG	.25W	
C_1	28 MFD.	600V	
C_2	1 MFD.	~~300~~ V. RATE	
C_3	.01 MFD.	~~300~~ V. RATE	





EDGERTON PORTABLE SPEED-LAMP : PUBLICATIONS' MODEL

L R0 9/4/42

Jan 25 1943.
H. E. Edgerton.

Jim Nili came from N.Y. yesterday at 5.30 Back boy. He and Wyckoff left for Quebec from North Station at 8.45 pm with the Jenkins camera.

Feb 4 1943.

In response to a phone call from Quebec by Nili ~~& took~~ the microflash unit to Valcartier leaving Jan 27. I took the sample General Radio equipment which is wired as shown in the diagram attached to the next sheet.

Photos of 6" shells were taken on the night of the 28. We returned to Boston arriving at noon Jan 30. Nili left for NY on the 3 pm train.

Feb 2. Major Wyman, Lee, and ~~-~~ were here for a visit to discuss short flash tubes.

~~Feb~~ Jan 27 Carlson was here with Snyder to discuss flash lamps.

Finished multiflasher (5 flash) unit last night but it does not do all it should Circuit P60 - 61 this book.

DWG. NO. P 509 - 1D

RESISTORS

R-1 = 1 Meg Ω	5 Watt	IRC Type MPJ
R-2 = 250,000 Ω		IRC Type BT2
R-3 = 250,000 Ω		IRC Type BT2
R-4 = 750,000 Ω		IRC Type BT2
ΔR-5 = 100 Meg Ω		IRC Type MVG
*R-6 = 10,000 Ω	10 Watt	IRC Type AB
R-7 = 1 Meg Ω		IRC Type BT-1
R-8 = 1 Meg Ω		IRC Type BT-1
R-9 = 150,000 Ω		IRC Type BT-2
R-10 = 5 Meg Ω		IRC Type BT-½
R-11 = 2 Meg Ω		139-861
*R-12 = 2500 Ω	10 Watt	IRC Type AB
R-13 = .25 Meg Ω		IRC Type BT-½

Δ Included in base of V-5
* "B" Coating, #2 Terminal

CONDENSERS

C-1 = 1 µf 1000 V. Paper-Dub. Type TLA-10010
C-2 = 1 µf 1000 V. Paper-Dub. Type TLA-10010
C-3 = 0.001 µf 600 V. Paper-Dub Type 1W
C-4 = 0.001 µf 600 V Paper-Dub Type 1W
C-5 = 0.001 µf 600 V. Paper-Dub Type 1W
C-6 = 0.001 µf 600 V. Paper Dub Type 1W
C-7 = 0.3 µf 8000 V Paper G.E. Type 26F276
C-8 = 20 µf ICE5

TRANSFORMERS

T-1 = Thordarson #74R28
T-2 = RCA #9861 Television Trans.
T-3 = 6 V. Ignition Coil Type VC-500F, Motor Supply.

SWITCHES

S-1 = DPST	139-333	"FIL."
S-2 = DPST	139-333	"PWR."
S-3 =	139-809	"FLASH"
S-4 = SPDT	139-320	"CONTACT"
S-5 = Shorting Switch (on PL 6)		

LAMPS

P-1 = 120 V 6 Watt	139-430
P-2 = 120 V 6 Watt	139-430

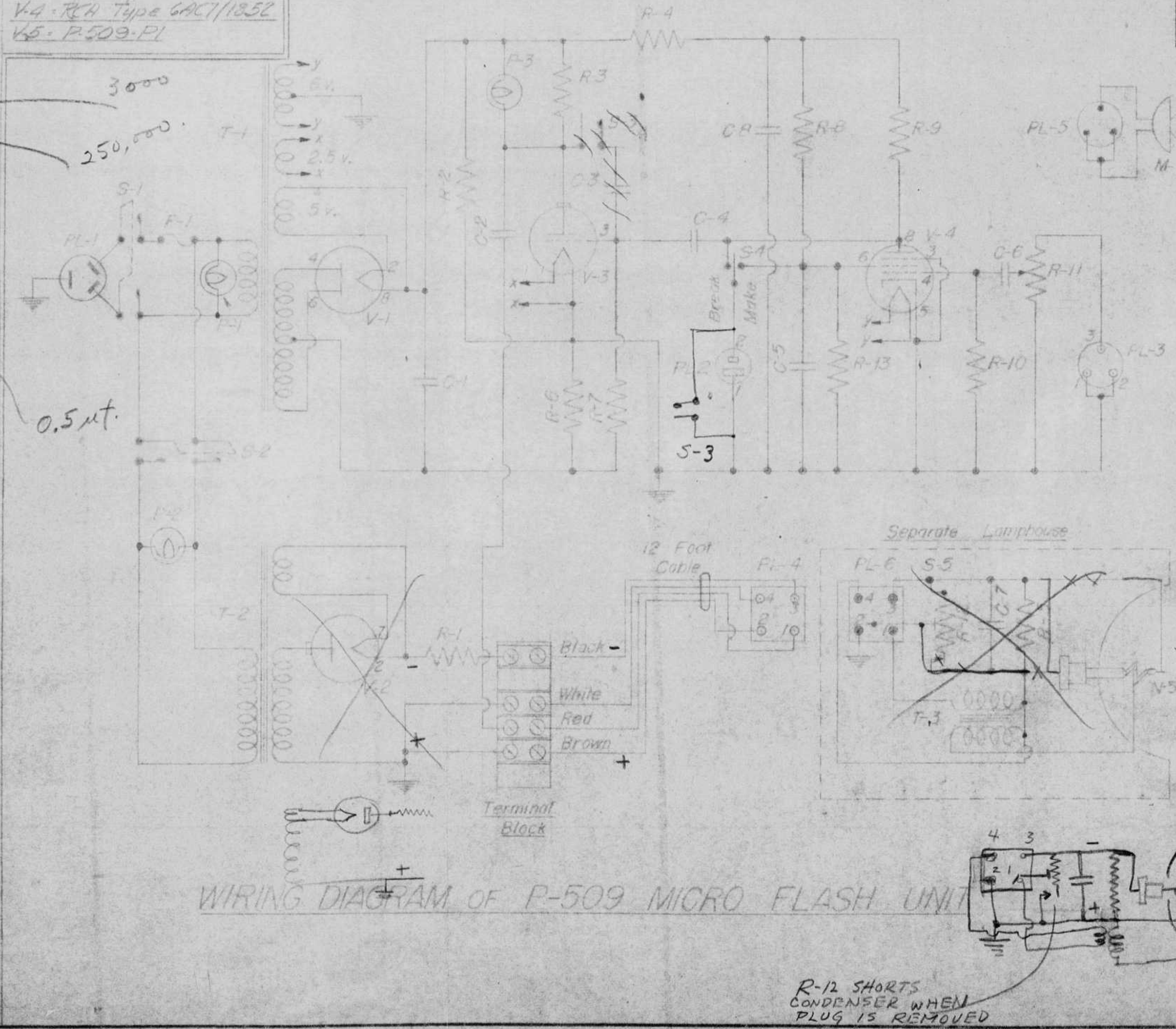
P3 = 115-125 V Neon Lamp, T-4½ Bulb, Clear Finish, Candelabra Screw Base

MISCELLANEOUS

F-1 : Fuse - 2 amp (Bussman) Type 8AG.
M-1 = Crystal Microphone - Shure Type 708SH

TUBES

V-1 : RCA Type 5T4
V-2 = RCA Type 2V3G
V-3 = G.E. Type FG-17
V-4 = RCA Type 6AC7/1852
V-5 = P-509-P1



WIRING DIAGRAM OF P-509 MICRO FLASH UNIT

SCALE:

P509 MICRO FLASH UNIT

GENERAL RADIO CO.
CAMBRIDGE, MASS.

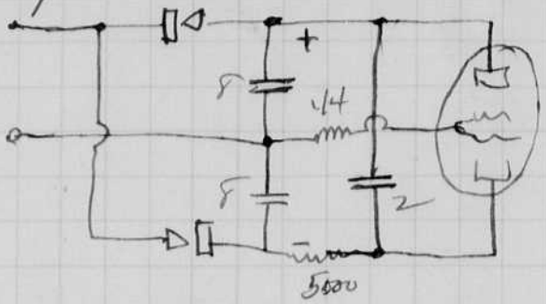
DWG. NO. P 509 - 1D

THIRD ANGLE PROJECTION

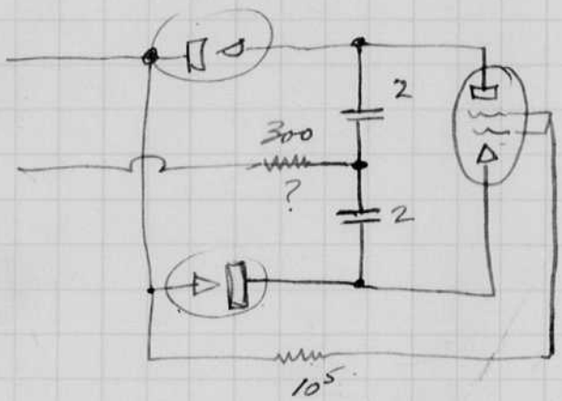
TOLERANCES ON DIMENSIONS IN INCHES
UNLESS OTHERWISE SPECIFIED
FRACTIONAL ± .010
DECIMAL ± .002

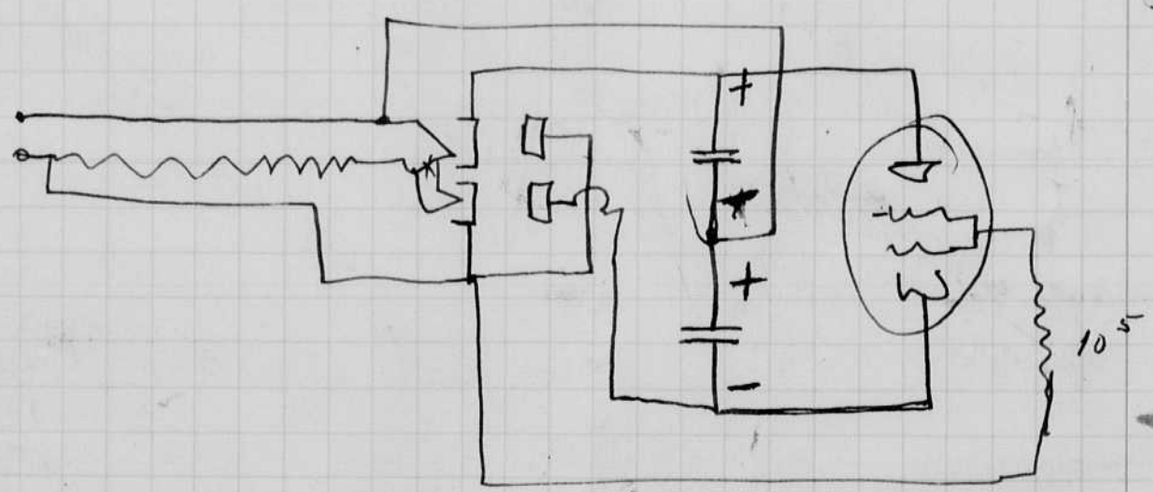
Feb 4 1943
J B Edgerton

60 cycle ~~stroboscope~~
design with
Wilkins



11726





Feb 5 1943

H E Edgerton

Chas Wyckoff.

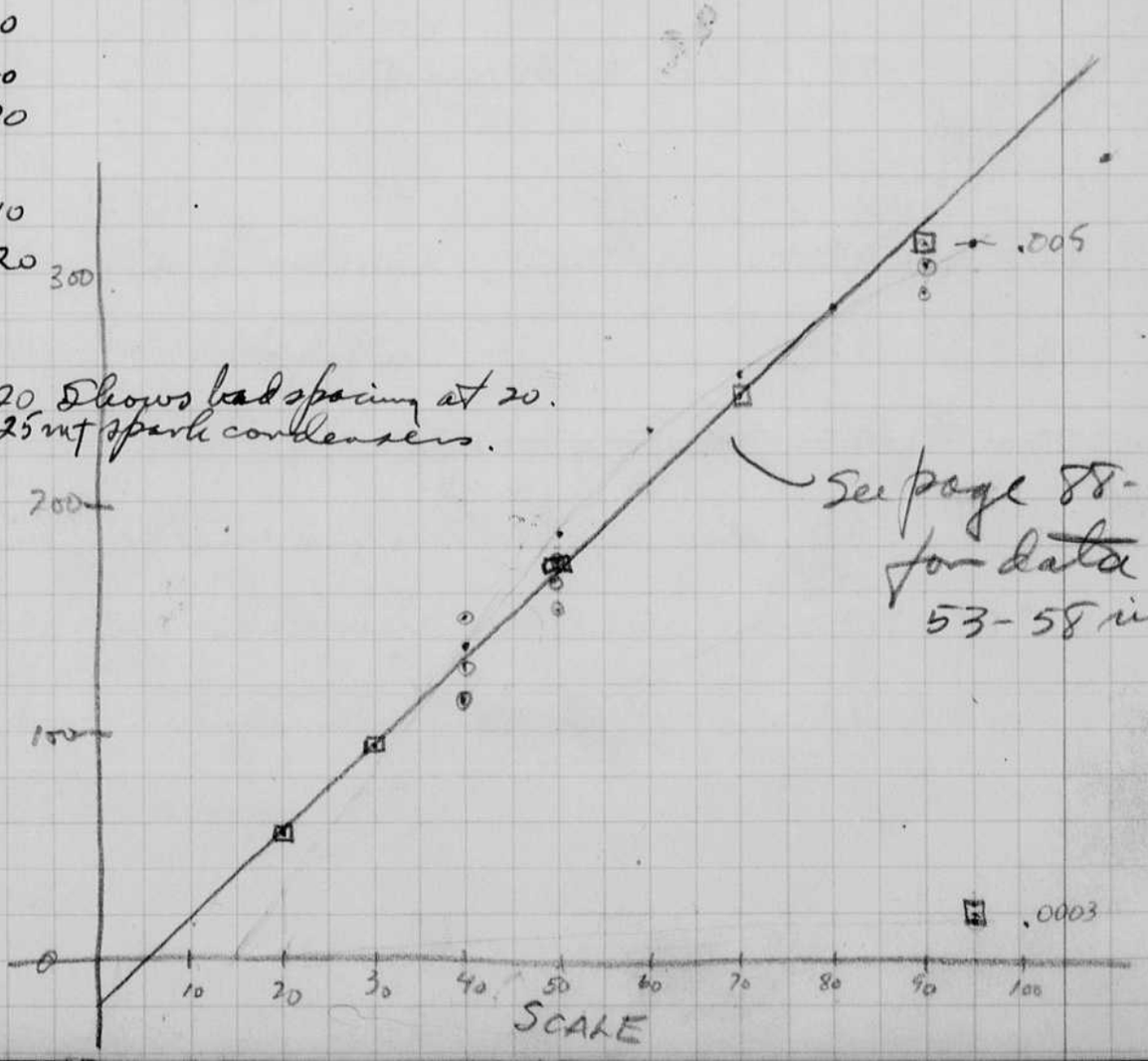
23.14

Calib of 5 flasher. $\frac{1}{120} \times \frac{\text{angle}}{360} \times 10^{-6}$ = us between flashes.

$\frac{1}{43200}$

$\frac{13.00}{.04}$

FILM	Scale of Resistor	Speed	f 8 aperature.	us.
1	15	7200	= not uniform	-
1	20	"	- " "	-
1	30	"	- " "	-
1	40	"	6	139.
1	50	"	8	185.
2	60	"	10	231.5
2	70	"	11.	254.
2	80	"	12.	278.
2	90	"	13.0	301.
2	95	"	13.5°	312.0
3	10			
3	20			
3	30			
4	10			
4	20			
5	20 Ohms load spacing at 20. .25 mf spark condensers.			



See page 88-89 for data 53-58 inc.

Film	Scale.	
6.	20	3 flashes (Two came same place.
7.	30.	
8	90	2 shots
9	40	2 shots. (10k,?)
10	50	
11	95	.0003 Mfd delay cond. Enlarging paper at f:4.7
12	20	" "
13	95	.0003 Mfd cond. were taken out, measured and replaced
		delay of 23 M/S between 1&2, 3&4, 4&5 but 11 S between 2&3
14	95	The above appear to be constant
15	95	Check test for consistancy
16	95	
17	95	
18	95	
19	95	"3 Bangers" flash tube
20	95	Movie lamps #2 (lamphouse moved & celluloid edge of pointer rubbed)
21	95	"
22	95	"

Film	Scale	Remarks
23	20	
24	30	
25	40	
26	50	
27	60	
28	70	
29	80	
30	90	
31	95	
32	95	
33	95	
34	95	
35	95	Spark band raised #2 followed about 15 μsec instead of 23
36	95	Good picture
37	95	4 megs replace 2½ (series with grid of time delay tubes)
38	95	
39	95	on #2 & 4 mercury tubes a lead added between cathode & tube bracket
40	95	leads above removed, others added between band and tube clip
41	95	Xenon tube
42	95	Xenon "
43	95	Argon #2 lamp wires ~~of~~ clamps.

negative sign

45 f4.7 paper Short flash argon lamps 2000 V 1/2 mf.

46 f11 #2 Kodatron. " "

Feb 9 1943

47. f4.7 Pandno Pres 4x5 camera C.R. Oscillograms of osc. 3500 V. Bosch coil 1/4 mf. 10^5 cycles for calibration. Sweep →

48 f4.7 ditto of Delco coil with special " primary. 10^5 cycles for calib.

Bosch coils disconnected
Delco Exp Coils connected.
model Ex 4860 (order 8820-U)
(8-15-1939)

Prim res. 10.38 ohms 200 T?
Sec " 2410 " 5000 T?

Osc 49 f4.7 10^5 timing-current deflects beam.

Pointer 50 f5.6 film Scale set at 95 .0003 mf condensers

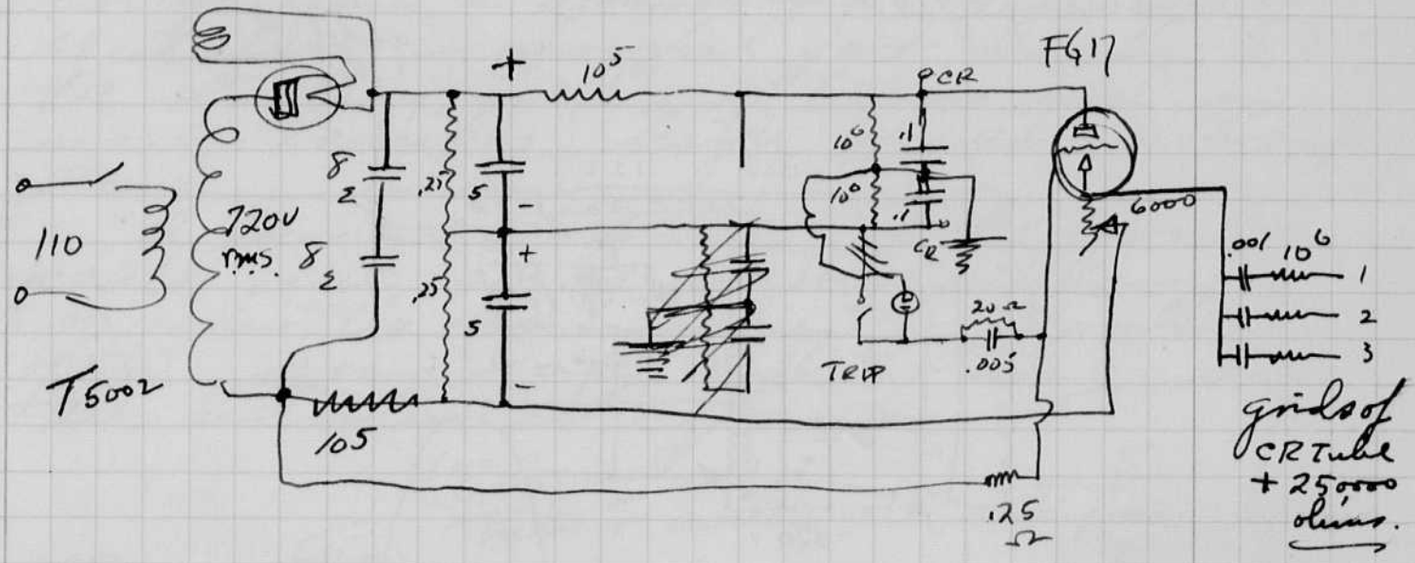
51 " Paper 95 scale. 7200 rpm
52. " " 50 " " "

53. Cond added to each delay .0005 + .0003
Scale 20

54 Scale 30. Skips.
55. " 30 2 flashes. 1 ok 1 blur U.G.
56 90 "
57 50 "
58 70

Feb 9 1943.

Cathode Ray Sweep ckt.
3 element U.F. tube.



3000 V marlborough Variac to C.R. tube.

Calibration 60 volts. = 3.2 cm

$\frac{60 \times 2 \times 1.41}{3.2} =$

$\times 2 \times \sqrt{2}$

About the same in other axis.

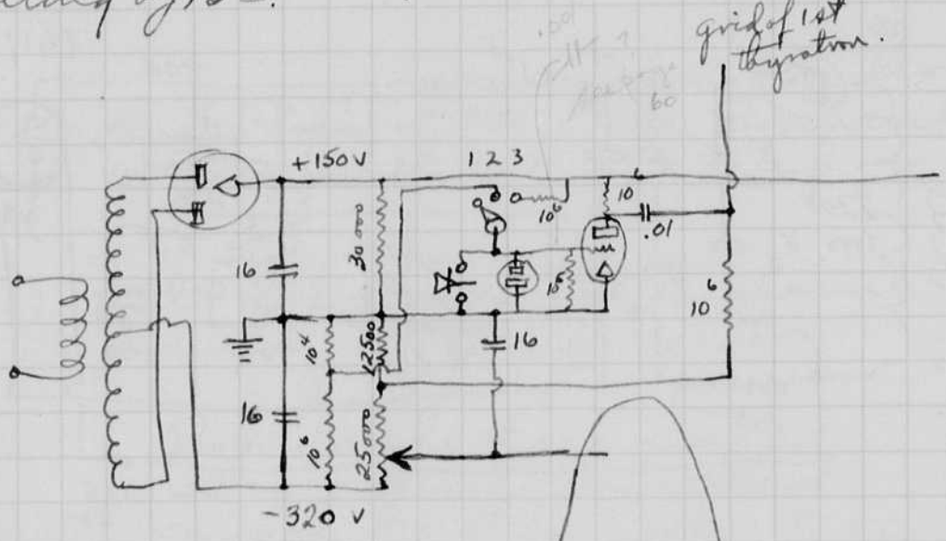
1-2 ms	2-3	3-4	4-5
2.5° 57.8	2.5 57.8	2 46.2	
—	—	—	—
4.0 92.5	4.0 + 92.5+	4.0 92.5	3.0 + 69.4
13.5 312	13.5 312	13.5 312	15. 347
7.5 173	7.0 162	7.75 179.	6.75 156
10.5 243	11.0 254	11.0 254	10. 231.4

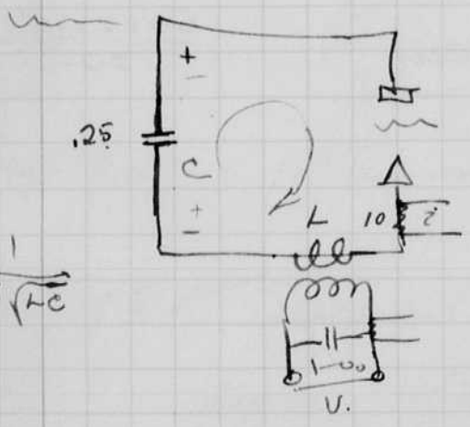
Feb 10 1943

Harold E. Edgerton.

3 flasher for Navy (Taylor model Basin.)

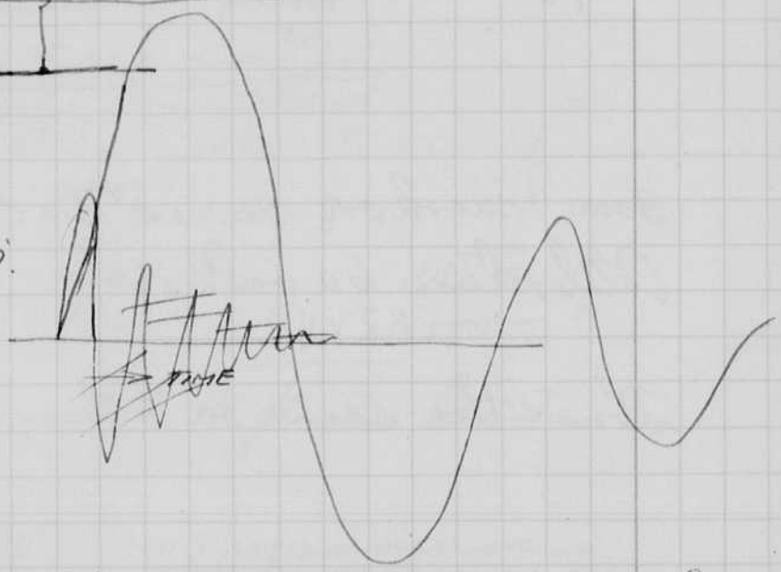
Changed bias slightly so scale ~~reads~~ can be used from 0 to 100. With other constants, the thyratrons oscillate at a setting of 15 ±.

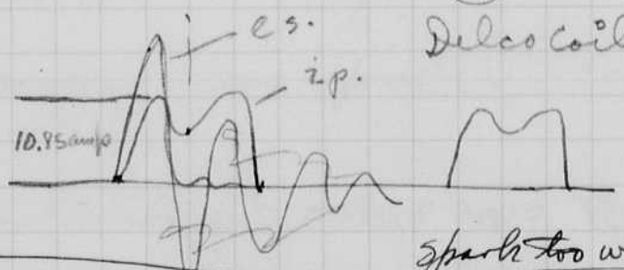




$f = \frac{1}{2\pi\sqrt{LC}}$

$i = \frac{V}{R}$





Delco coil. ~~Special~~
25 turn primary
10.85 amp peak.
.25 mf.

Spark too weak.

58 turn primary shows 24 amp surge with 10 ohm series resistor for osc.
Gives more sparks.

Explained and modernized tool

Feb 17 1943.

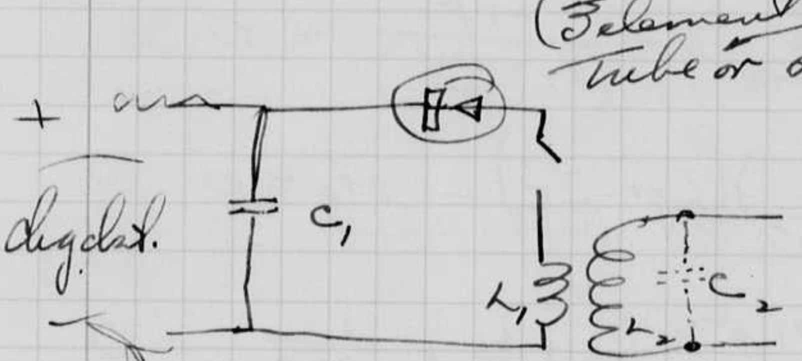
Harold E. Edgerton

Very cold the past few days. 14 below.

Coil excitation system.

A method below is described for producing a unidirectional pulse of voltage from a spark coil. This type of excitation is useful for driving the starting grids of tubes such as movie lamps, high speed stroboscopes etc.

A former solution of the problem was to use a damped secondary winding in order to diminish the oscillations of the secondary inductance with the distributed capacity.



If the frequency of the primary is twice that of the secondary the pulse from the secondary will be almost unidirectional as shown in the oscillogram of the previous page.

$$f_1 = \frac{1}{2\pi\sqrt{L_1 C_1}}$$

$$f_2 = \frac{1}{2\pi\sqrt{L_2 C_2}}$$

$$\frac{1}{2}(f_1) = f_2$$

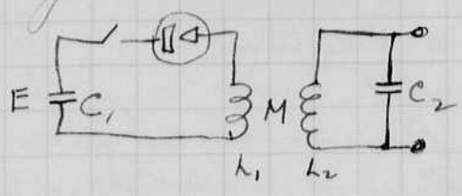
$$\text{or} \quad \frac{1}{\sqrt{L_1 C_1}} = \frac{2}{\sqrt{L_2 C_2}}$$

$$4L_1 C_1 = L_2 C_2$$

Explained & Understood H. E. Grier 2-17-43

Explained and understood C. H. Wyckoff March 13, 1943

Feb 17 1943
H. E. Edgerton



Gilbert Gould started thesis today on design of C.R. method of tube analysis - W.E. told 3 gun type.

$$0 = L_1 p i_1 + \frac{i_1}{pC_1} \mp M p i_2 \qquad \left(L_1 p + \frac{1}{pC_1}\right) i_1 - M p i_2 = 0$$

$$0 = L_2 p i_2 + \frac{i_2}{Cpi} \mp M p i_1 \qquad \left(L_2 p + \frac{1}{pC_2}\right) i_2 - M p i_1 = 0$$

$$i_1 = i_2 M p \frac{1}{\left(L_1 p + \frac{1}{pC_1}\right)} = i_2 \left(\frac{M}{L_1 + \frac{1}{p^2 C_1}}\right)$$

$$\left(L_2 p + \frac{1}{pC_2}\right) - \frac{M^2 p}{\left(L_1 + \frac{1}{p^2 C_1}\right)} = 0$$

$$\left(L_2 p + \frac{1}{pC_2}\right)\left(L_1 p + \frac{1}{pC_1}\right) - M^2 p = 0.$$

$$L_1 L_2 p^2 - M^2 p^2 + \frac{L_2}{C_1} + \frac{L_1}{C_2} + \frac{1}{p^2 C_1 C_2} = 0$$

$$p^2 (L_1 L_2 - M^2) + \left(\frac{L_1}{C_2} + \frac{L_2}{C_1}\right) + \frac{1}{p^2 C_1 C_2} = 0$$

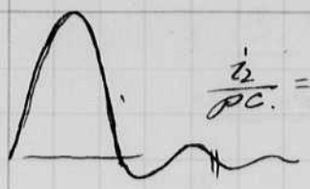
$$p^4 (L_1 L_2 - M^2) + p^2 \left(\frac{L_1}{C_2} + \frac{L_2}{C_1}\right) + \frac{1}{C_1 C_2} = 0.$$

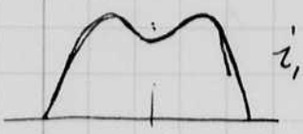
$$ax^2 + bx + c = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$p^2 = \frac{-\left(\frac{L_1}{C_2} + \frac{L_2}{C_1}\right) \pm \sqrt{\left(\frac{L_1}{C_2} + \frac{L_2}{C_1}\right)^2 - \frac{4(L_1 L_2 - M^2)}{C_1 C_2}}}{2(L_1 L_2 - M^2)}$$

Two sets of oscillation roots. Rather long expression for expansion.





This problem would be an easy one to set up on the integraph. The solution would be make for many typical values of the constants or ratios of constants. Object:

(A) To get max ratio of 1st peak of secondary voltage to subsequent peaks.

(B) To be able to predict the voltage output.

Feb. 18, 1943.

H. E. Edgerton Spark Coil measurements

1000 cycles - D.R. Bridge in meas lab. 10-180

	L_2	Q_2	L_1	Q_1	
Delco small $n_1 = 25$ primturns	0.33	1	.3 × 100 mh 30. mh.	1.	
Delco + 30 primturns. $n_2 = 58$ total	5000 turns? "	"	100 mh.	1	$n = \frac{5000}{58}$
Bosch.	15000 turns? 1.57	2.8	1 mh.	6.	

Oscillographic meas of Feb 9 #47, 48 show

frequency of Delco Sec. ≒ 50,000 cycles

" " Bosch Sec ≒ 12,500 cycles

$5 \times 10^4 = f = \frac{1}{2\pi\sqrt{LC}}$ $\quad L = 0.33 h$

$$C = \frac{1}{(2\pi)^2 25\times10^8 \cdot 33} = 30.8 \times 10^{-12} \text{ farads.}$$

$39.4 \quad .0326. \times 10^8$

$.0326 \times 10^{12}$

Prim frequency = $\frac{1}{2}$ sec. frequency = 25×10^4 cycles/sec.

$L_1 = .100 \times 10^{-6}$ henries. = .0001 h.

$$C = \frac{1}{39.4\ 6.25\times10^8\ 100\times10^{-6}} = 0.4 \times 10^{-6} \text{ farads.}$$

$246. \times 10^4 = 2.46 \times 10^6$

Notebook # 13

Filming and Separation Record

____ unmounted photograph(s)

2 negative strip(s)

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

was/were filmed where originally located between page 94 and 95.

Item(s) now housed in accompanying folder.

Feb. 18, 1943.

H. E. Edgerton Spark Coil measurements

1000 cycles - D.R. Bridge in meas Lab. 10-180

	L_2	Q_2	L_1	Q_1	
Delco small $n_1 = 25$ primturns	0.33	1	.3 x 100 mh 30. mh.	1.	
Delco + 30 primturns. $n_2 = 58$ total	5000 turns? "	"	100 mh.	1	$n = \frac{5000}{58}$
Bosch.	15000 turns? 1.57	2.8	1 mh.	6.	

Oscillographic meas of Feb 9 #47, 48 show

frequency of Delco Sec. ≒ 50,000 cycles

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$5 \times 10^4 = f = \frac{1}{2\pi\sqrt{LC}}$ $L = 0.33$ h

$$C = \frac{1}{(2\pi)^2 25 \times 10^8 \cdot 33} = 30.8 \times 10^{-12} \text{ farads.}$$

39.4 .0326. $\times 10^8$

.0326 $\times 10^{12}$

Prim frequency = $\frac{1}{2}$ sec. frequency = 2.5×10^4 cycles/sec.

$L_1 = .100 \times 10^{-6}$ henries. = .0001 h.

$$C = \frac{1}{39.4\ 6.25 \times 10^8\ 100 \times 10^{-6}} = 0.4 \times 10^{-6} \text{ farads.}$$

$246. \times 10^4 = 2.46 \times 10^6$

Notebook # 13

Filming and Separation Record

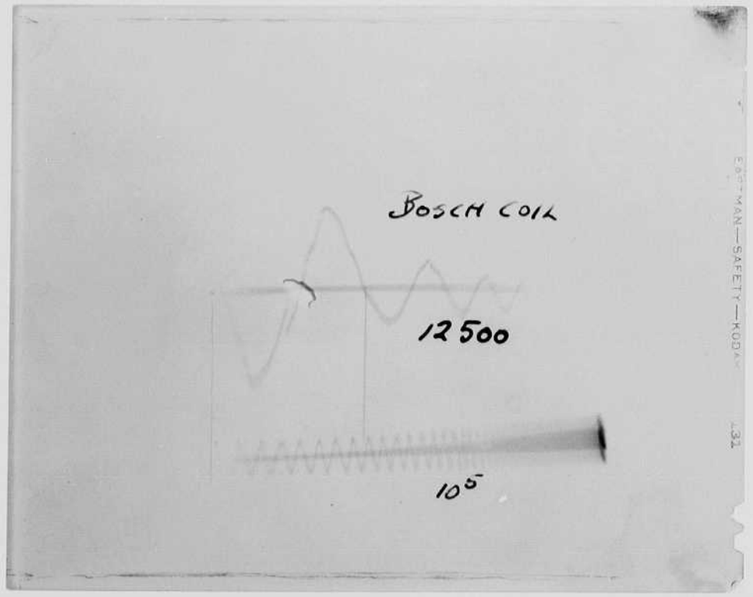
____ unmounted photograph(s)

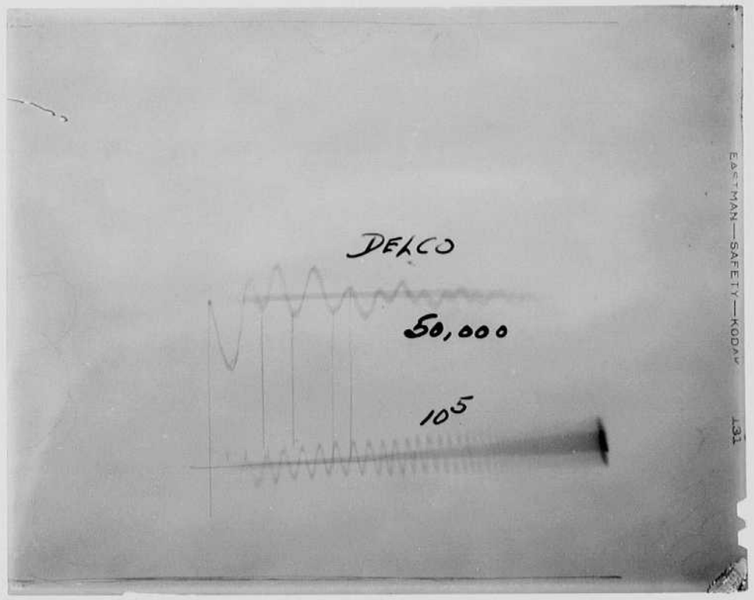
__2__ negative strip(s)

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

was/were filmed where originally located between page __94__ and __95__.

Item(s) now housed in accompanying folder.


BOSCH COIL
12500
10⁵
EASTMAN—SAFETY—KODAK
.31


DELCO
50,000
10⁵
EASTMAN—SAFETY—KODAK
.31

Feb. 21, 1943
Harold E Edgerton

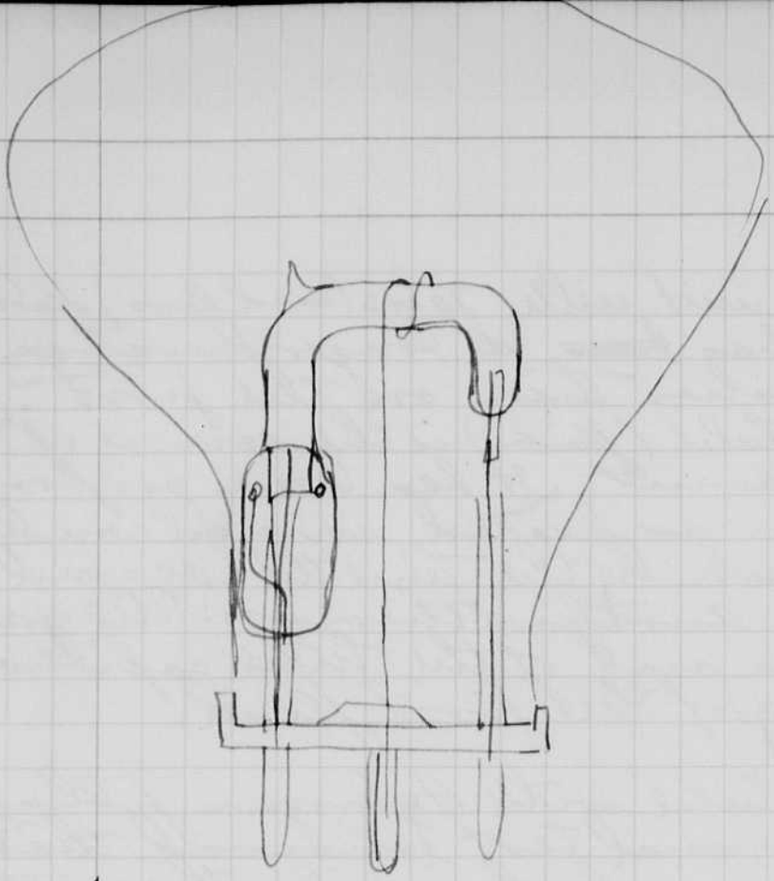
The 5 flash unit with 70 μs (and less) delay between flashes has a longer duration on the last 4 flashes than on the first. Apparently the tube (flash) is the source of the delayed extinguishment. It has been proposed that the gas is in an heated, ionized condition from the first flash by the time the second flash occurs. Another theory is: the gas has been blown out of the tube capillary from the energy of the first flash.

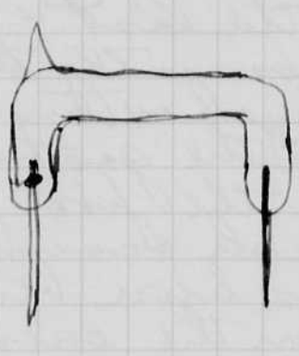
We tried a tube with hydrogen filling on the pump. A visual test showed that the first flash was much brighter than the preceding ones. Various mixtures of gases were also used. A xenon filled tube exhibited the same type of flashes.

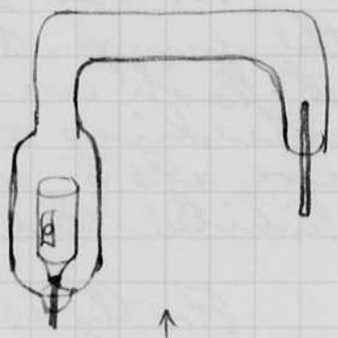
For the above a 621 motion-picture lamp was used. It has a gauze liner to define the arc.

An answer to the above is to use separate tubes on each flash circuit. This gives different lighting for each flash. However with reflector type bulbs the spacing should not be objectional for most problems.

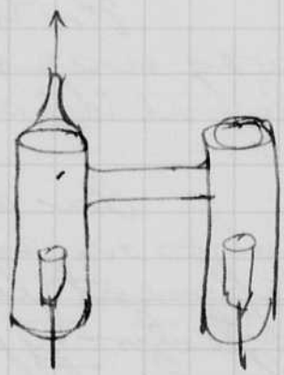
Another solution might be a special lamp with separate anodes for each condenser. Such a tube would be used with the existing argon mercury control tubes. The Hg tubes would not be needed with a separate lamp in each condenser with wide lamp spacing.

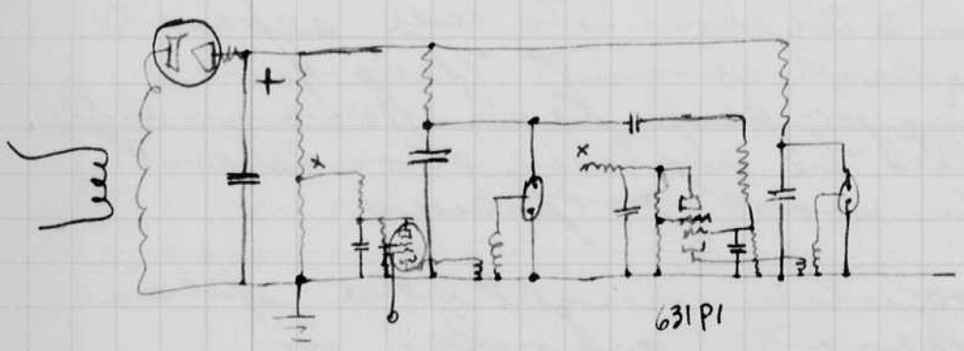




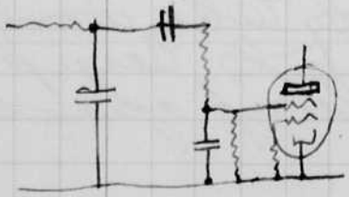


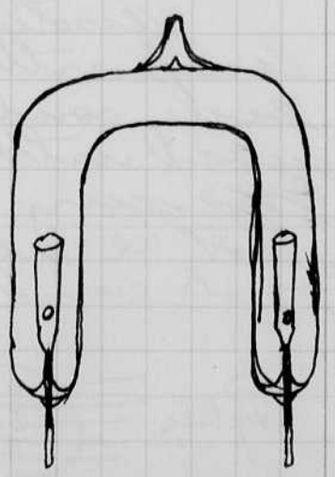
Zgetters
Ba.



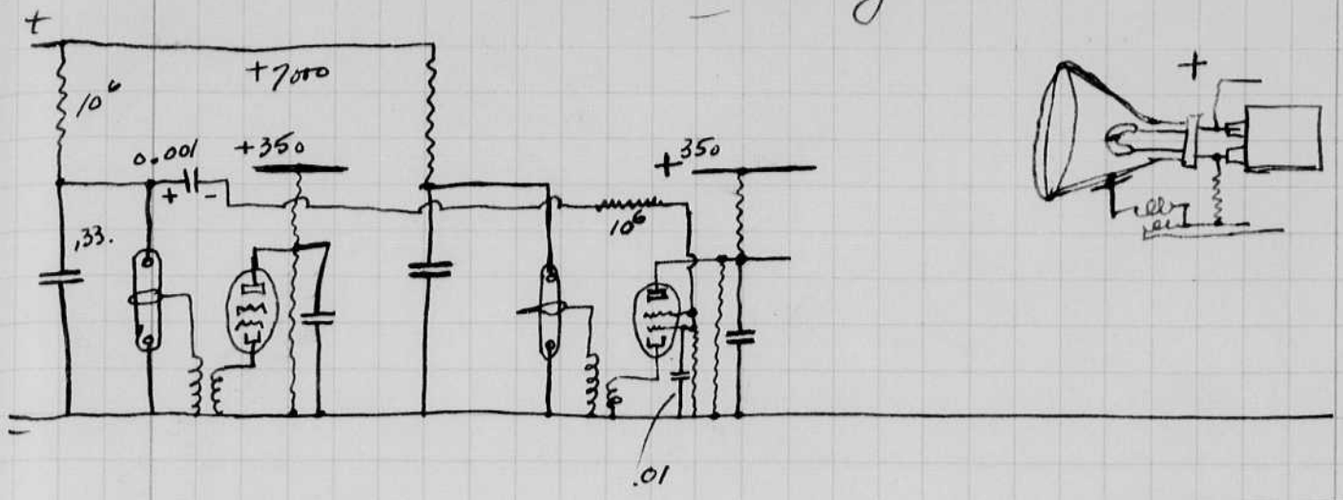


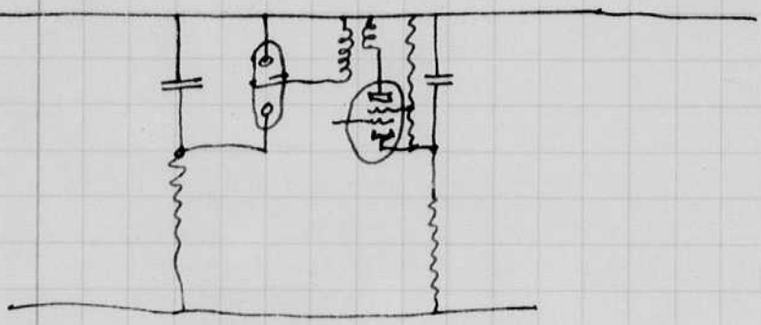
631 P1

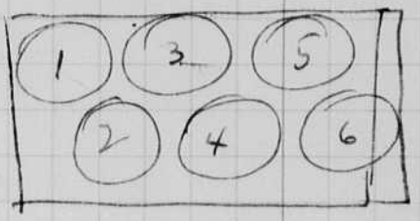


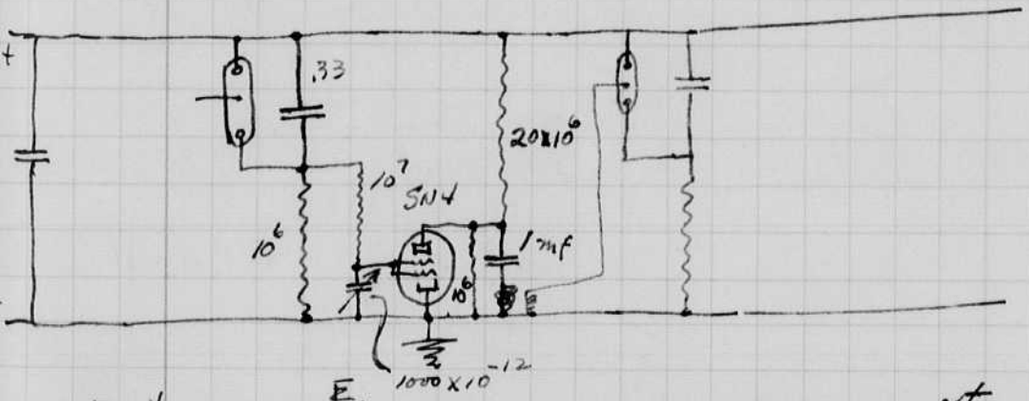


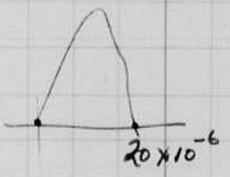
Multistable circuits including a ~~thyratron~~ delay tube.

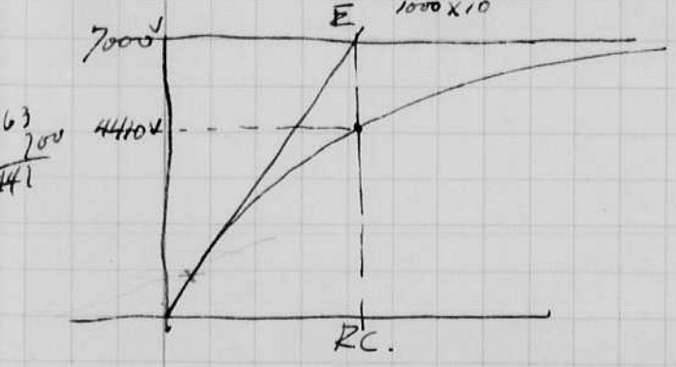












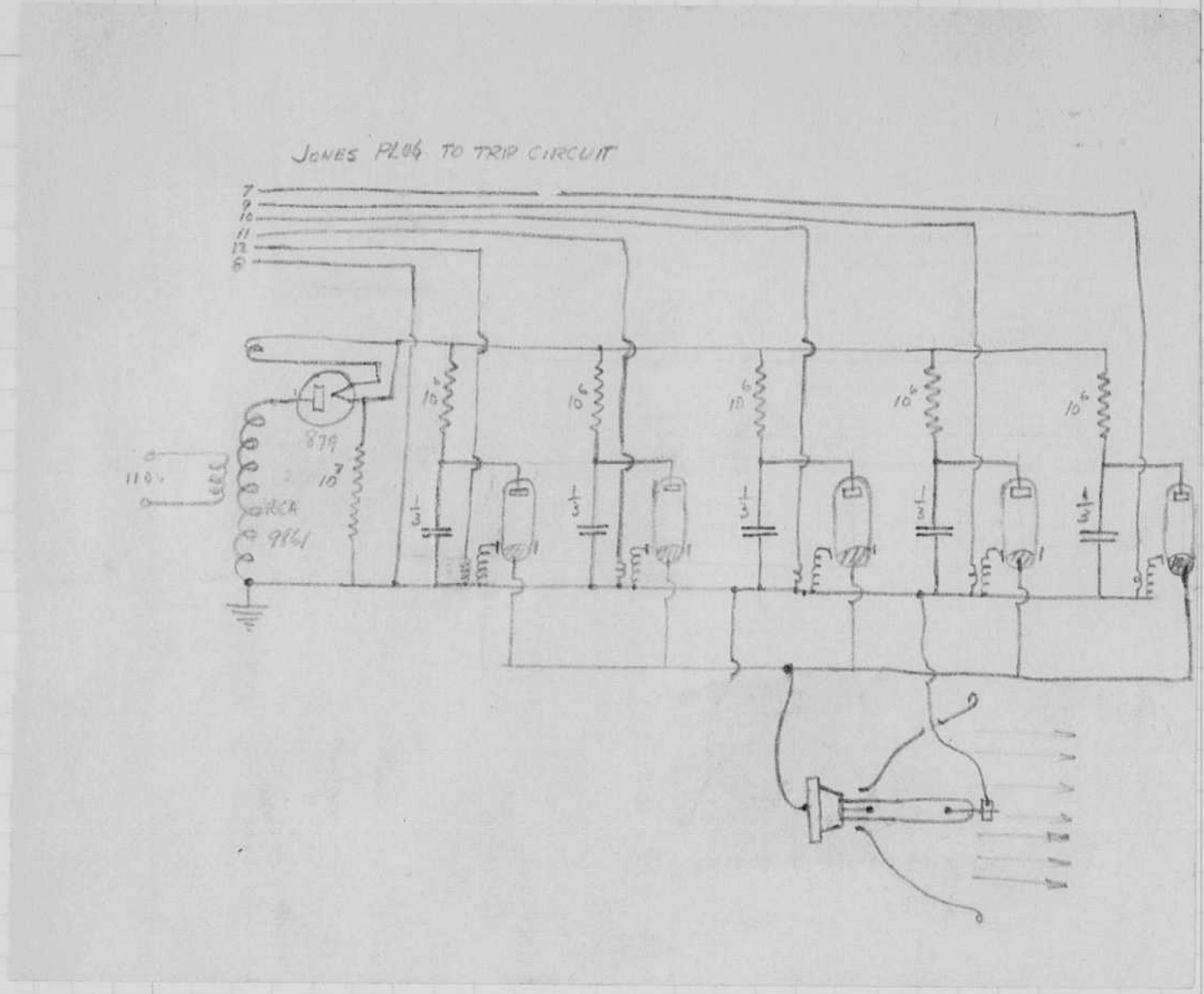
$$\frac{de}{dt} = -E\varepsilon^{-\alpha t} + E = E(1-\varepsilon^{-\alpha t}) \quad \alpha = \frac{1}{RC}$$

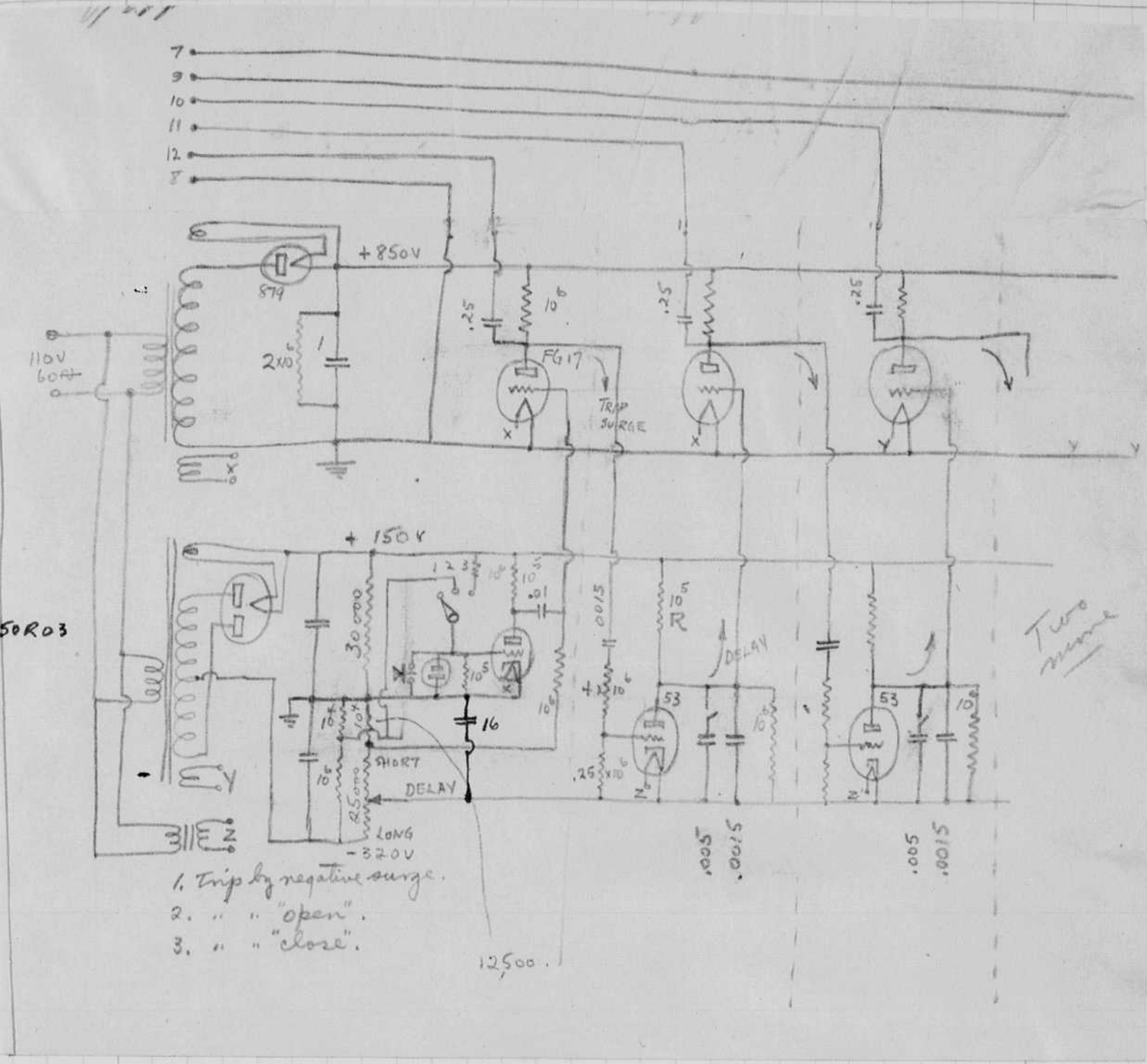
$$\frac{de}{dt} = E\alpha\varepsilon^{-\alpha t} = \frac{E}{RC}\varepsilon^{-\alpha t} = \frac{E}{RC} \text{ when } t=0$$

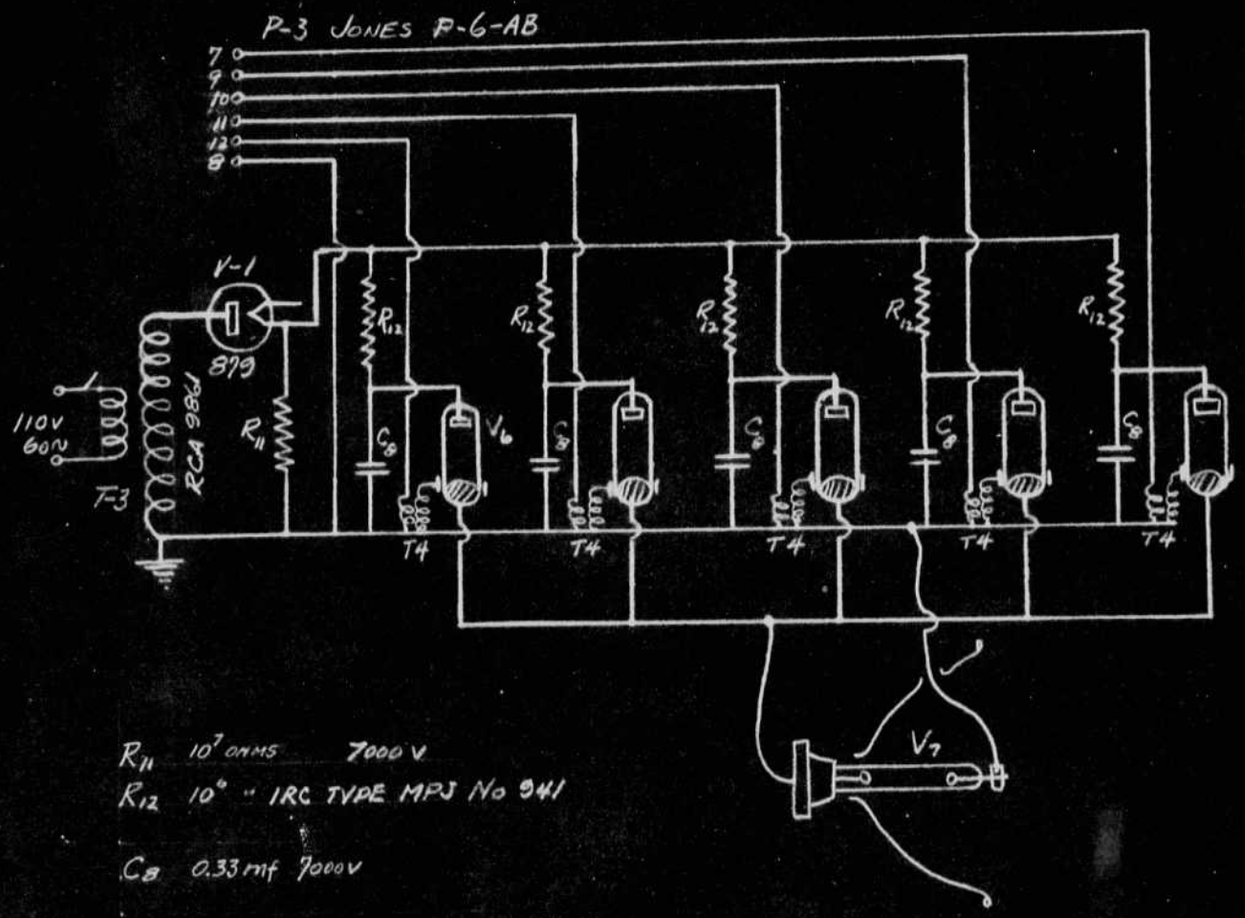
$de = 100$ volts.
$E = 7000$
$dt = 100\times10^{-6}$
$R = 10^7$
$C = ?$

$$C = \frac{7000}{10^7}\cdot\frac{100\times10^{-6}}{100} = 700\times10^{-12}$$

Variable air


JONES PLUG TO TRIP CIRCUIT
7
9
10
11
12
6
879
RCA
9961


7
9
10
11
12
8
+850V
879
110V
60~
2x10⁶
1
.25
10⁶
FG17
TRIP
SURGE
+150V
30000
10⁵
.01
.0015
16
SHORT
DELAY
LONG
-320V
53
DELAY
.005
.0015
Two
more
50R03
1. Trip by negative surge.
2. " " "open".
3. " " "close".
12,500.



R_{11} 10^7 OHMS 7000 V
R_{12} 10^6 " IRC TYPE MPJ No 941

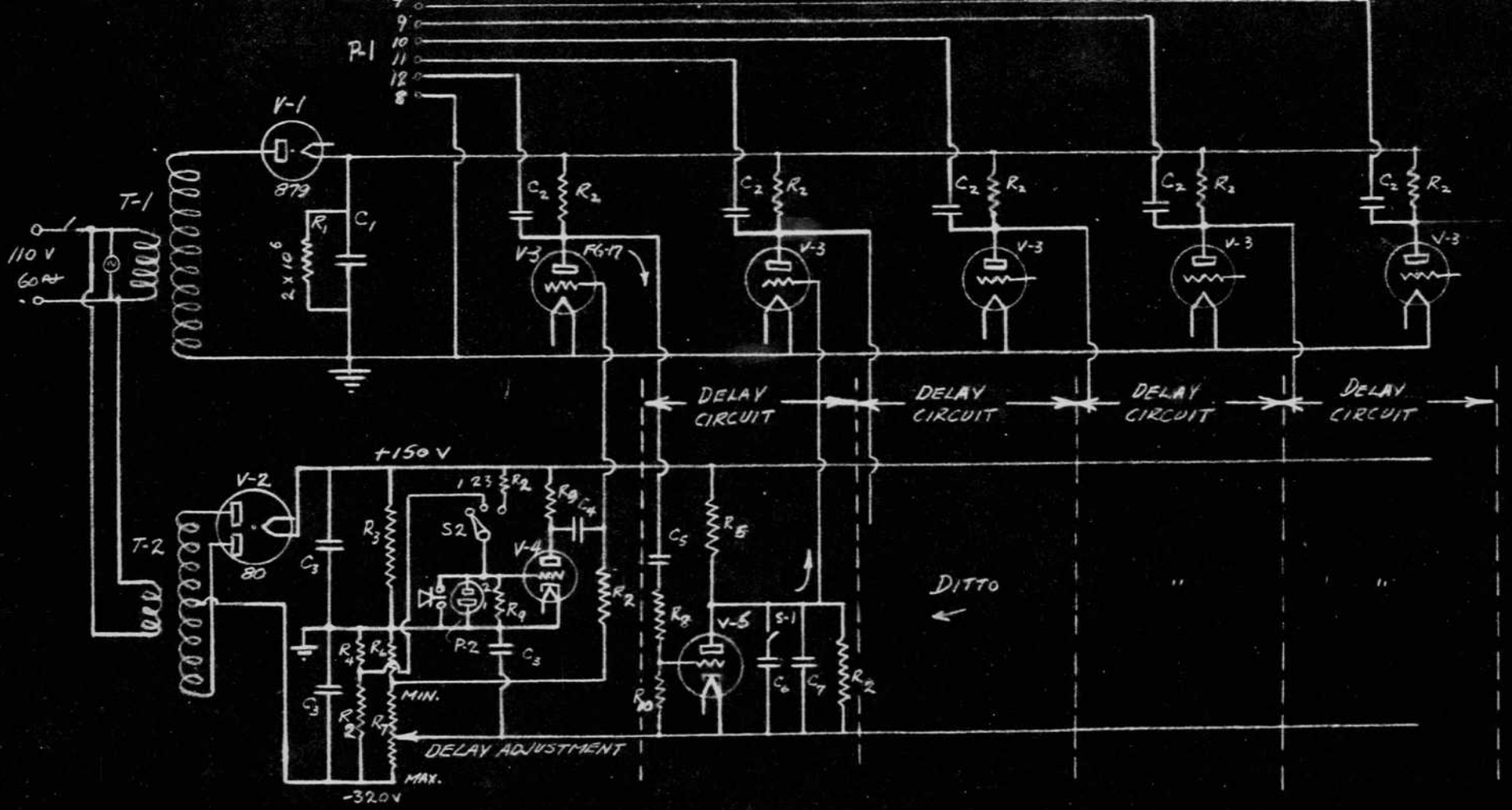
C_8 0.33 mf 7000 V

T-3 RCA 9861 TRANS
T-4 SPARK COIL 60-5000 TURNS

V-1 879
V-6 MERCURY CONTROL
V-7 ARGON 621 TYPE

FIVE FLASHER

H.E. EDGERTON
FEB. 17, 1943



R_1	2×10^6	2 WATT	C_1	1 mf	1000 V	PAPER	V-1	879	P-1 JONES SOCKET S-6-AB
R_2	10^6	2 "	C_2	.25 mf	"	"	V-2	80	P-2 " " S-302-AB
R_3	30,000	10 " WIRE	C_3	16 mf	400 V	ELEC.	V-3	FG-17 G.E. Co	
R_4	10^4	2 "	C_4	.01	400 V	PAPER	V-4	53	
R_5	10^5	2 " 1%	C_5	.0015	1000 V	"	V-5	46	
R_6	10,500	2 "	C_6	.005	400 V	" 1%			
R_7	25000	4 " VARIABLE	C_7	.0015	400 V	" 1%			
R_8	4×10^6	2 "							
R_9	10^5	2 "	T-1 STANCOR P6007 OR EQUIVALENT				S-1 YAXLEY 4 CKT 2 POINT SWITCH		
R_{10}	0.25×10^5	2 "	T-2 THORD. T50R03 OR "				S-2 " 1 CKT 3 POINT "		

5 FLASHER

H. E. EDGERTON
FEB. 17, 1943.

This chart was set up Feb. 22, 1943 during visit of Prof Blewstone (Canada) and Sgt. Basil Evans (R.A.F.)

TYPE	TUBE	C	U	wt.	Dur.	FLASHES PER SEC. RATE.	ENERGY JOULES PER FLASH	WATTS POWER.	(MAX) Distance. * Dxf ↓
KODATRON	FT2	112	2000	60	$\frac{1}{5000}$ 2×10^{-4} 200	1/10	224. $\frac{.0448}{2}\times10^{4}$	22.4	860
Sea Search B-18	FT16	56(70)	3500	150	2×10^{-4} 100	3	342. $\frac{.0685}{2}\left(\frac{.086}{2}\right)\times10^{4}$ 1050.		1340
A-20 DOUGLAS BOSTON	FT12	400	4000	650	10^{-3} 1000.	1/1.5	3200	$.32\times10^{4}$ 2130	3800
SPECIAL B-25 MITCHELL	FT11	4000	2000	1200	10^{-2} 10,000	1/7	8,000.	$.8\times10^{4}$ 1140	f.25 - 6000 ft. 15,000
B-24 LIBERATOR	FT12	4000	4000	4000	5×10^{-3} 5000.	1/6	32,000.	3.2×10^{4} 5330	12,000

* Maximum with xxx film, f2.5 and favorable weather conditions. Based upon tests with B25 unit conducted at Wright Field. Dayton Ohio.

Notebook # 13

Filming and Separation Record

____ unmounted photograph(s)

____ negative strip(s)

__2__ unmounted page(s)
(notes, drawings, letters, etc.)

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

Item(s) now housed in accompanying folder.

This chart was set up Feb. 22, 1943 during visit of Prof Shenstone, and Sgt. Basil Evans (RAF) (Canada)

TYPE	TUBE	C	U	wt.	Dur.	FLASHES PER SEC. RATE.	ENERGY JOULES PER FLASH	WATTS POWER.	(MAX) Dxf * Distance.
KODATRON	FT2	112	2000	60	$\frac{1}{5000}$ 2×10^{-4} 200	1/10	224. $\frac{.0448}{2}\times10^{4}$.	22.4	860
Sea Search B-18	FT16	56(70)	3500	150	2×10^{-4} 100	3	342. $\frac{.0685}{2}$ $\left(\frac{.086}{2}\right)\times10^{4}$ 1050.		1340
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* Maximum with XXX film, f2.5 and favorable weather conditions. Based upon tests with B25 unit conducted at Wright Field. Dayton Ohio.

Notebook # 13

Filming and Separation Record

____ unmounted photograph(s)

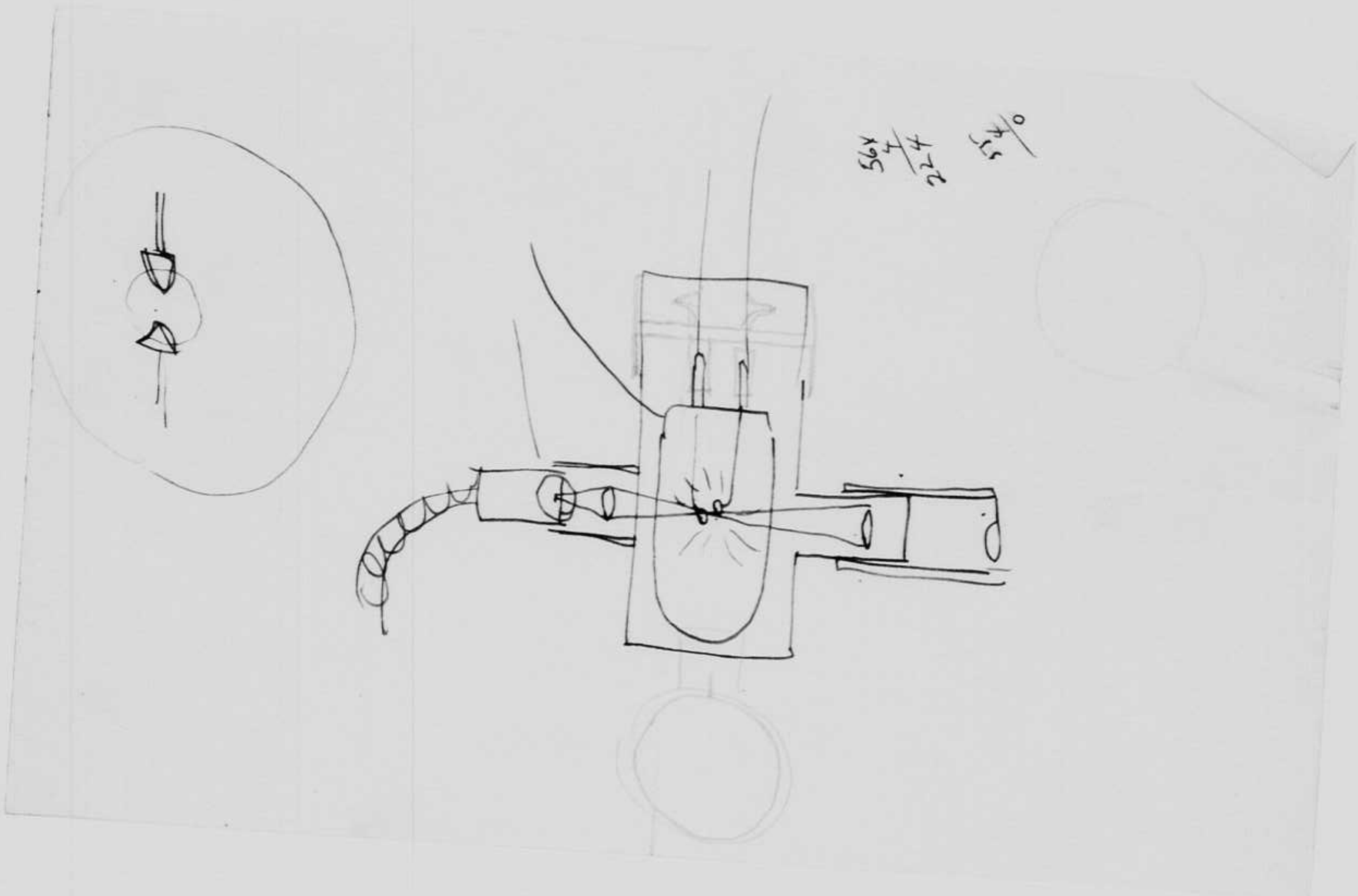
____ negative strip(s)

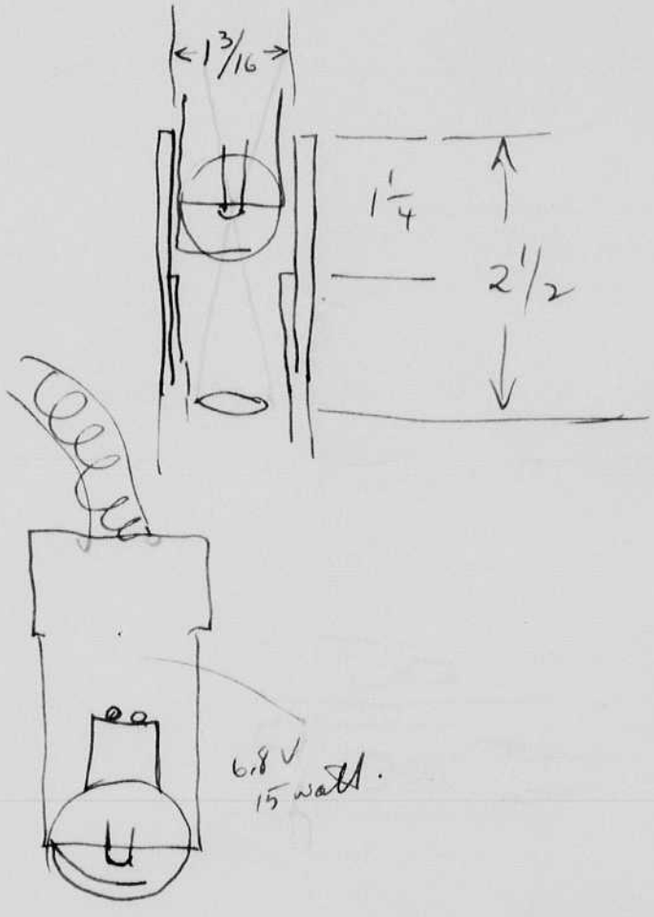
2 unmounted page(s)
(notes, drawings, letters, etc.)

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

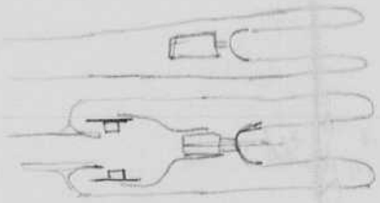
Item(s) now housed in accompanying folder.

This shot was set up Feb. 22, 1943 during visit of Prof Shoustrom and Ed

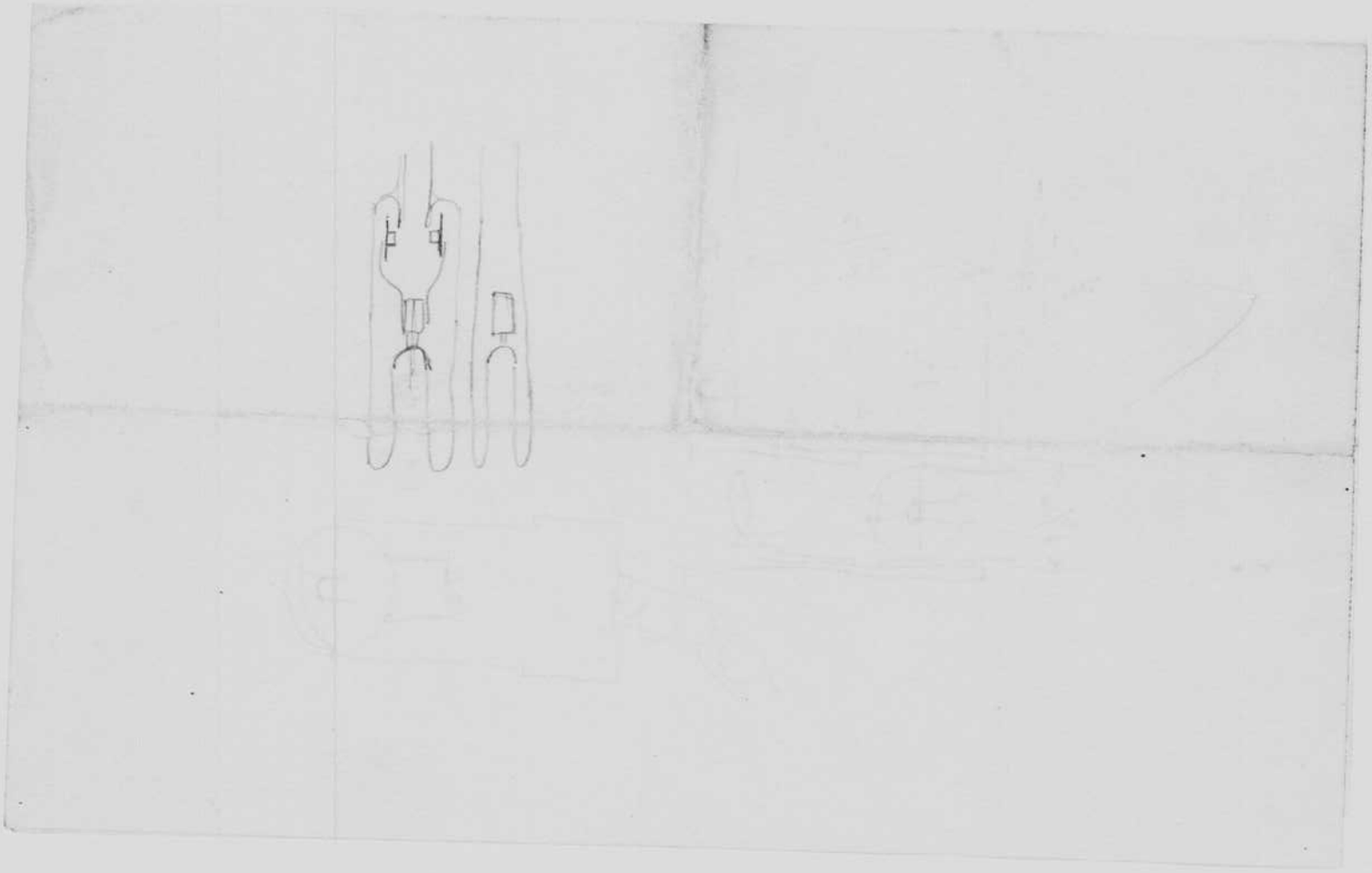



1 3/16
1 1/4
2 1/2
6.8 V
15 watt.

This boat was set sub Feb. 22. 1943 during visit of P— [illegible]

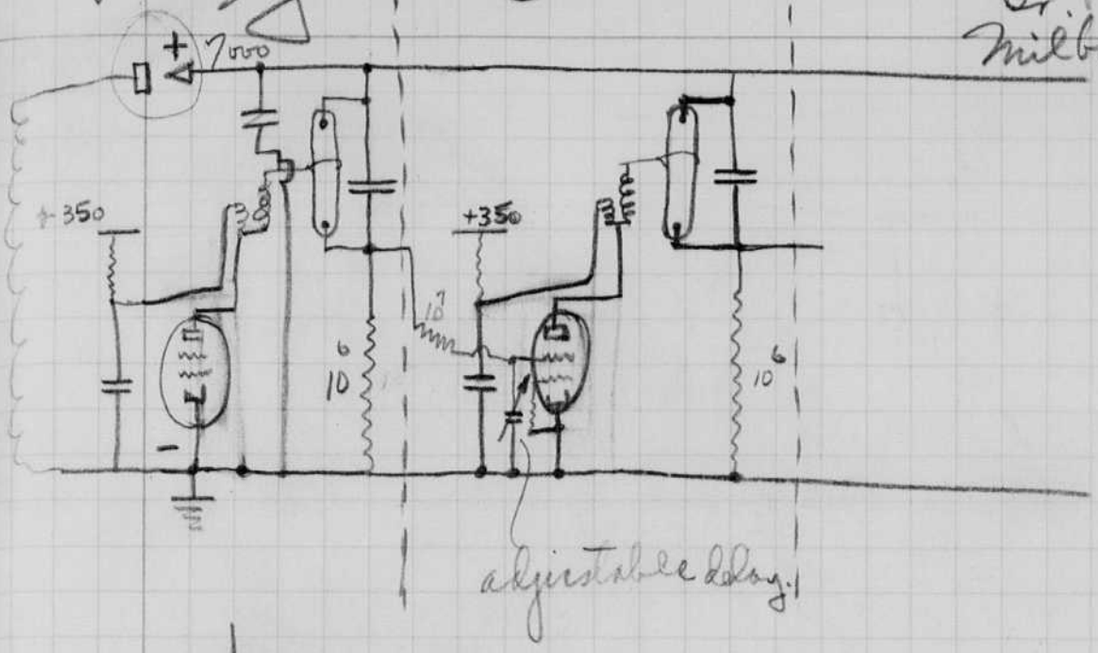


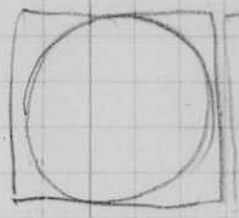
This sheet was set up Feb. 22, 1943 during visit of Prof Ehrenfest and Sal

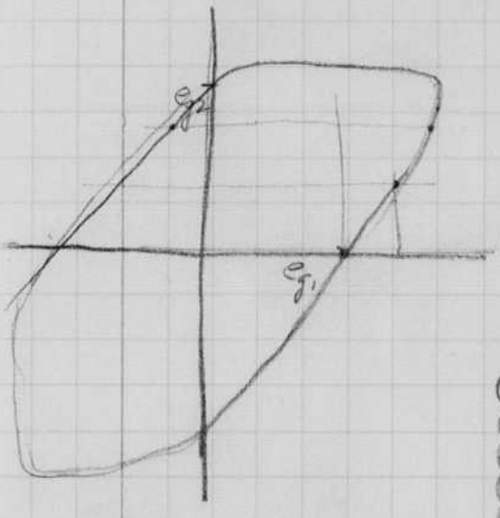


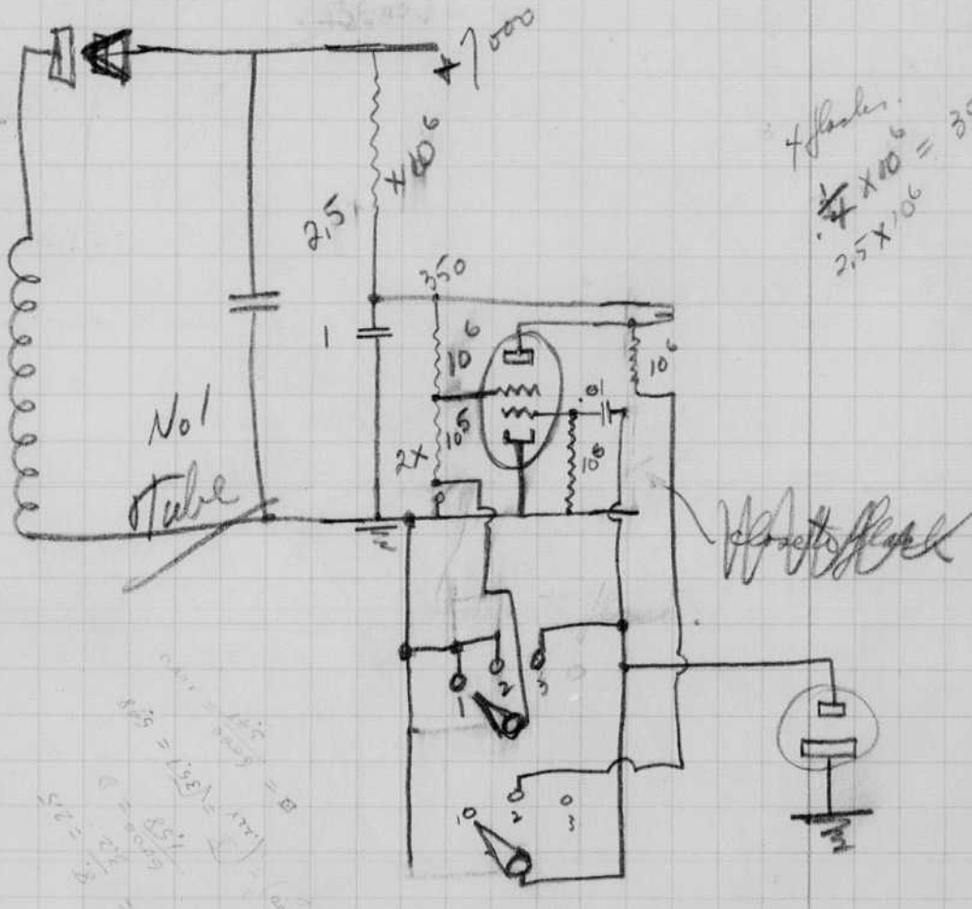
Feb 25 1943

N.Y. yesterday wrote
Dr. Kruse
Milbank Memorial Fund.

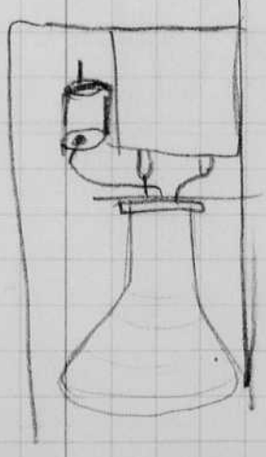






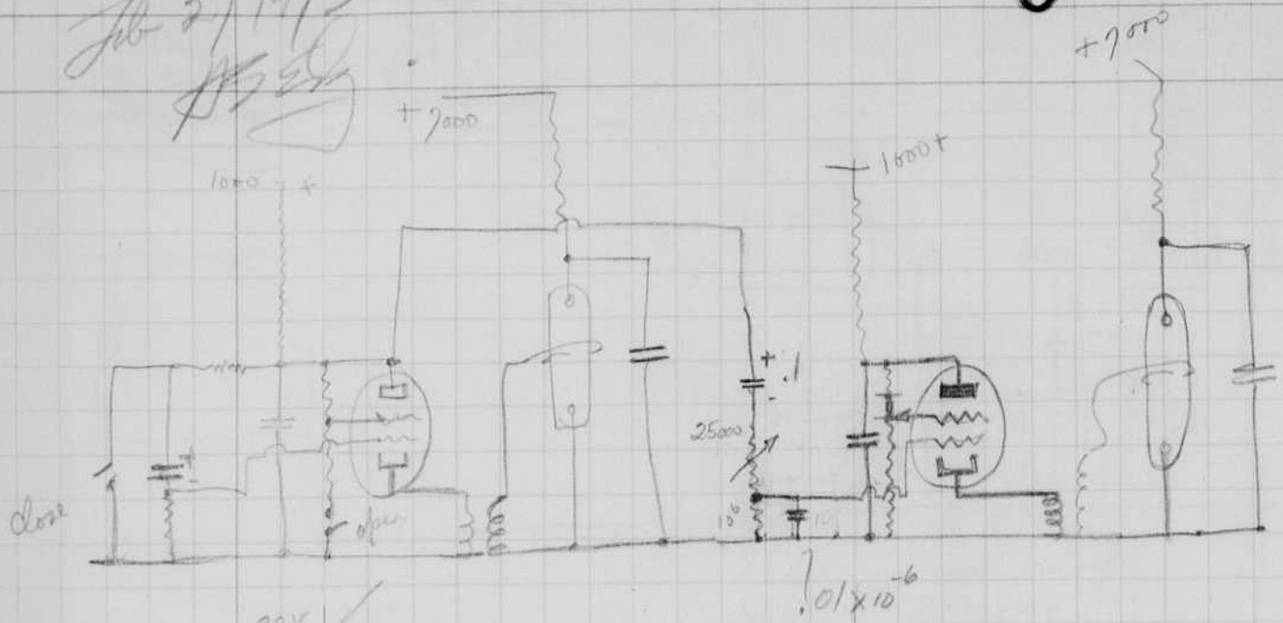


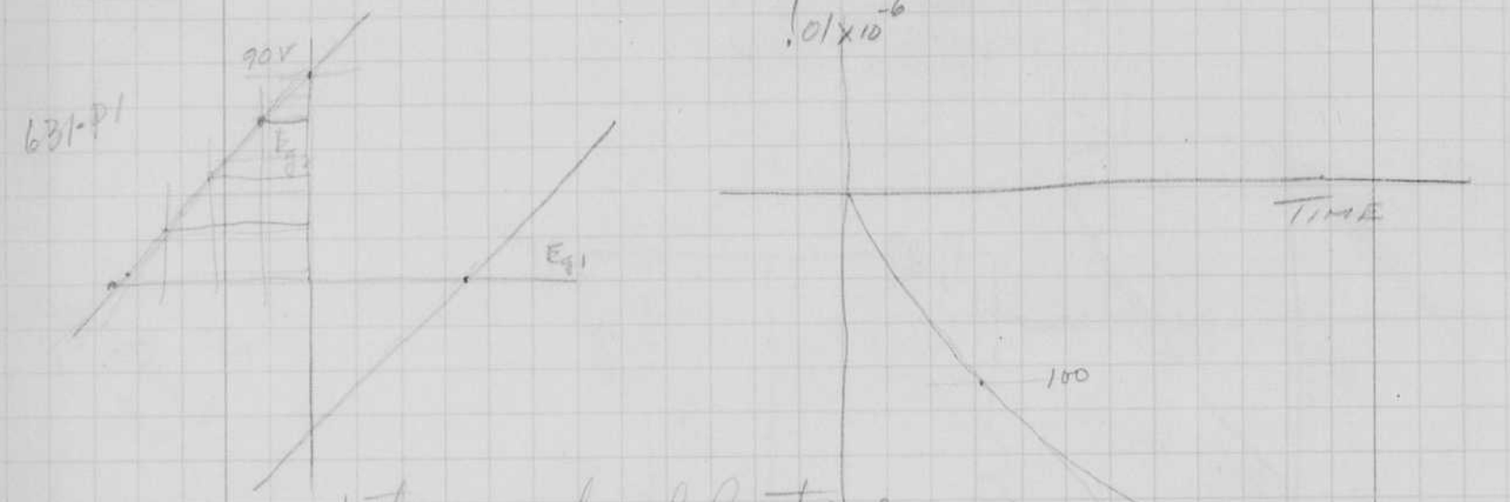
4 flasher.
$\frac{1}{4} \times 10^6 = 2.5 \times 10^6$
$\frac{350\,V}{10}$



1-amplifier
2- contact make.
3- contact break

Feb 27 1943



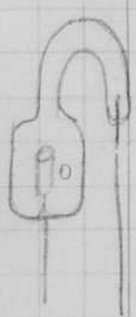


$\frac{1}{2}$ time const = delay time max.

= 100 m s.

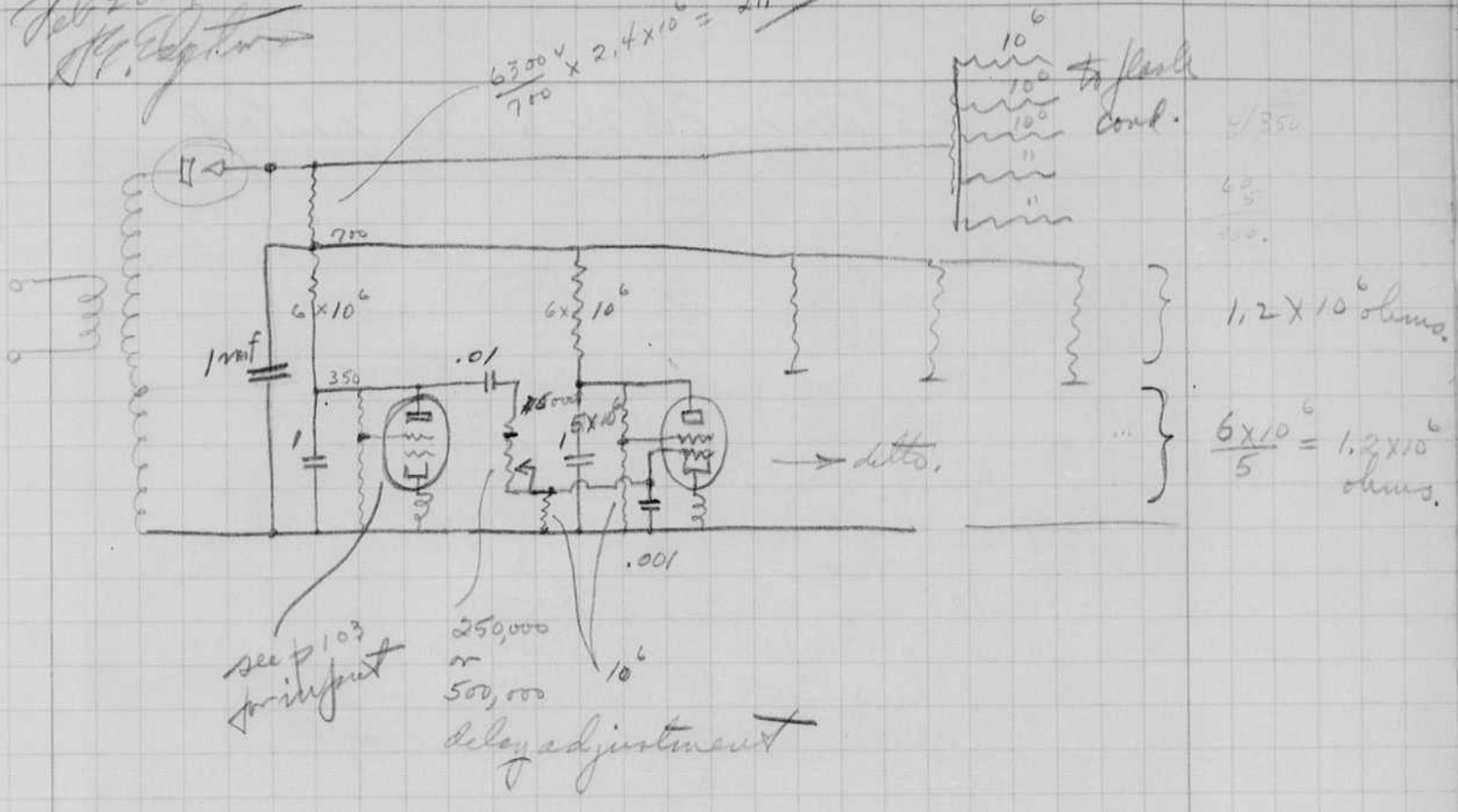
$\frac{1}{2} RC = \frac{1}{2}\ 25000\ C = 100 \times 10^{-6}$

$C = \frac{100\ 10^{-6}}{12500} = .008 \times 10^{-6} = .01$ mf

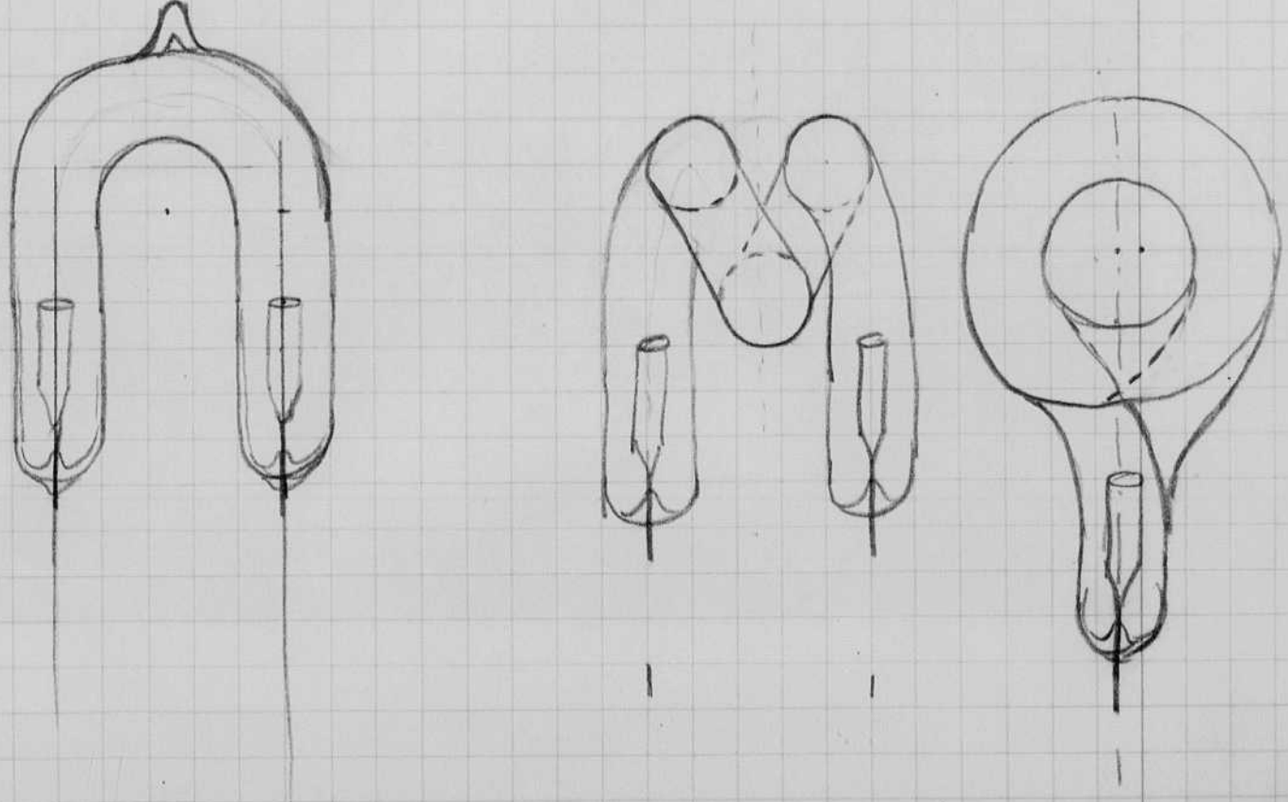


Feb 28, 1943

$\frac{6300}{700} \times 2.4 \times 10^6 = 21.4 \times 10^6$ ohms



$P = \frac{700^2}{20 \times 10^6} = \frac{49}{20} = 2.5$ watts.



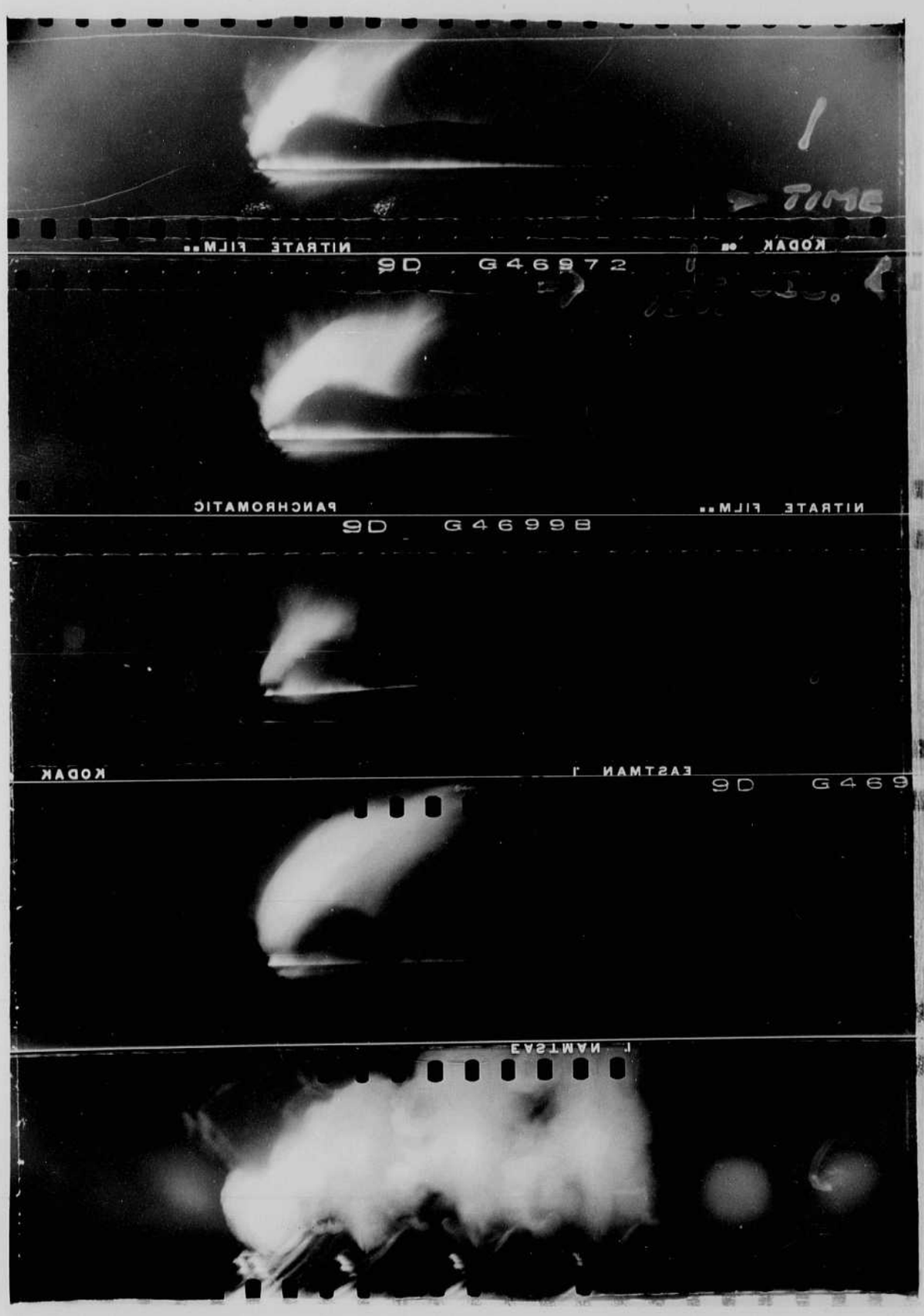
Photos taken Feb 26 for N.A. MacLeod of the Brit. Ed. T. M.

Morgan and were here with MacLeod.

Omm Camera 50 frames
Speed 60 r.p.s.

Enlargement on neg. 3/7 3/4 ?

5 flasher used on photo no 6
Long scale — setting of 30
note first two came close together.


1
TIME
NITRATE FILM
KODAK
9D G46972
PANCHROMATIC
NITRATE FILM
9D G46998
KODAK
EASTMAN
9D G469

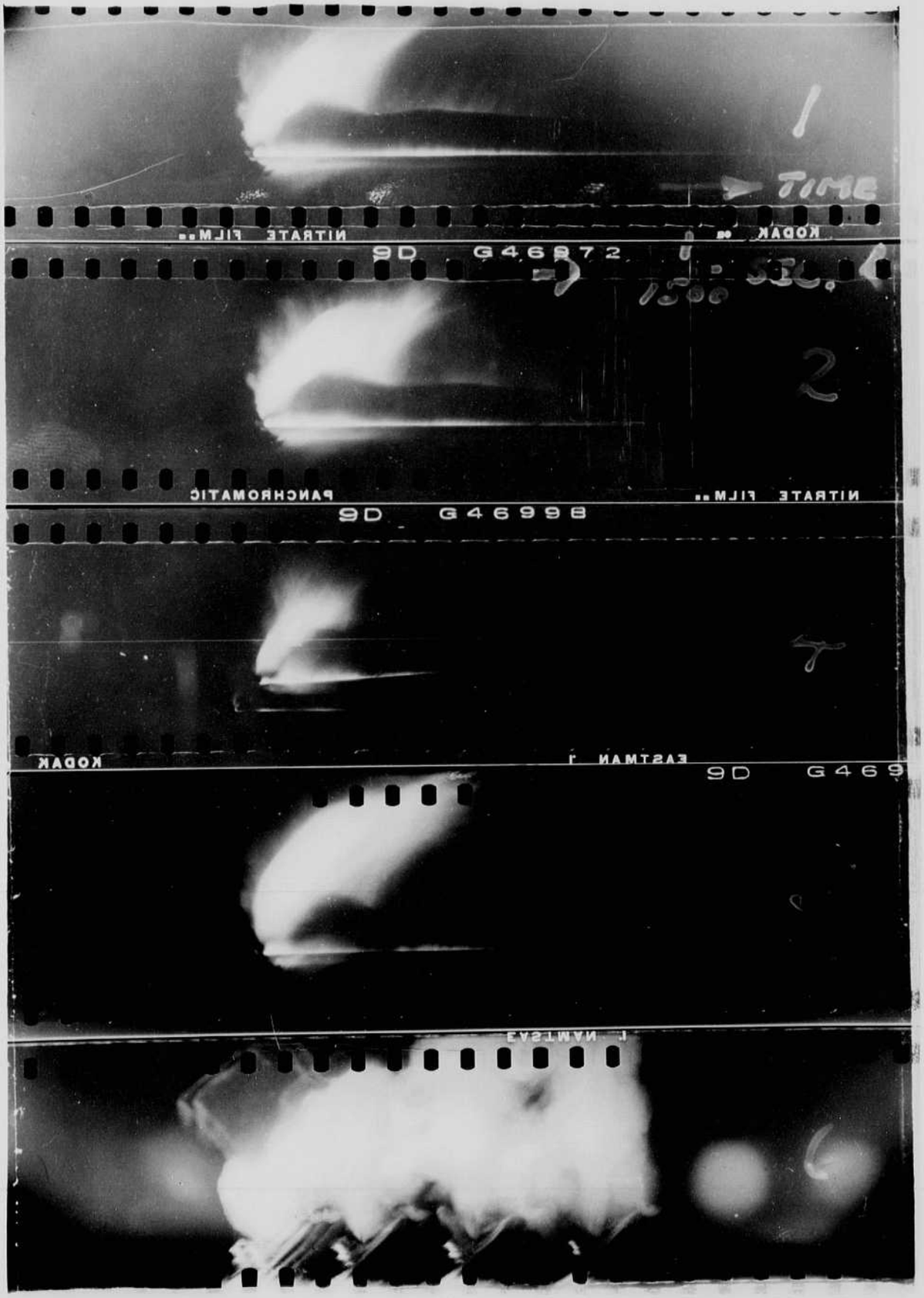
Photos taken Feb 26 for N.A. MacLeod of the Brit. Ed. T. M.

Morgan and [illegible] were here with MacLeod.

Amm Camera 50 frames
Speed 60 r.p.s.

Enlargement on reg. 3/7 3/4 ?

5 flasher used on photo No 6
Long scale — setting of 30
note first two came close together.


1
TIME
NITRATE FILM
9D G46872
2
PANCHROMATIC
NITRATE FILM
9D G46998
KODAK
EASTMAN
9D G469

MAR Feb 1 1943

Gap tube 47 cm Kr f 22. 4 gap. 4 mf 1500 V.

" " f 11 IRed Film no filter over exp.

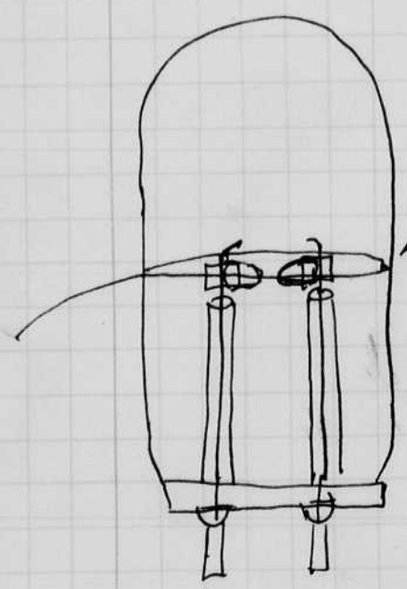
f 36. " " " "

f 5.6 " IR filter Faint Image

f 22 IR film 8000 cut off filter no image.

28 mf 1500 V. f 5.6 IR film IR filter } show core with less exposure

f 11.



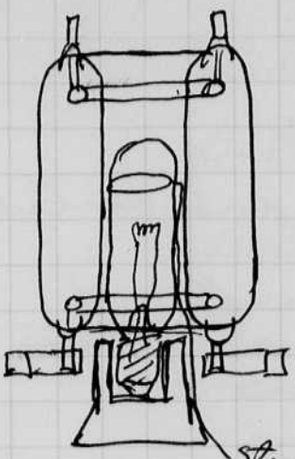
Electrode Tungsten with Ba, Sr sintered by long soak and heat process.

External wire starter. With 1000 ± volts or less the arc would follow the ~~outer~~ inside surface of the bulb. Usually two paths were present one on each side of the bulb in parallel.

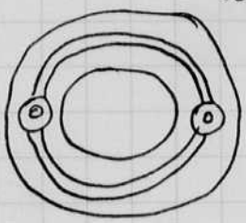
At approx. 1000 or 1200 volts the arc would begin to appear between the points. As the voltage was increased, the arc around the inner surface of the bulb became more and more visible and finally could not be seen at about 1500 volts. The self breakdown was about this value of volts also.

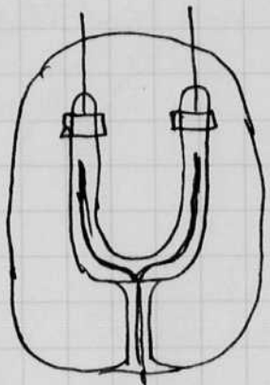
Adams Allen & Herb. Brier

Doughnut shaped tube around a focus lamp.

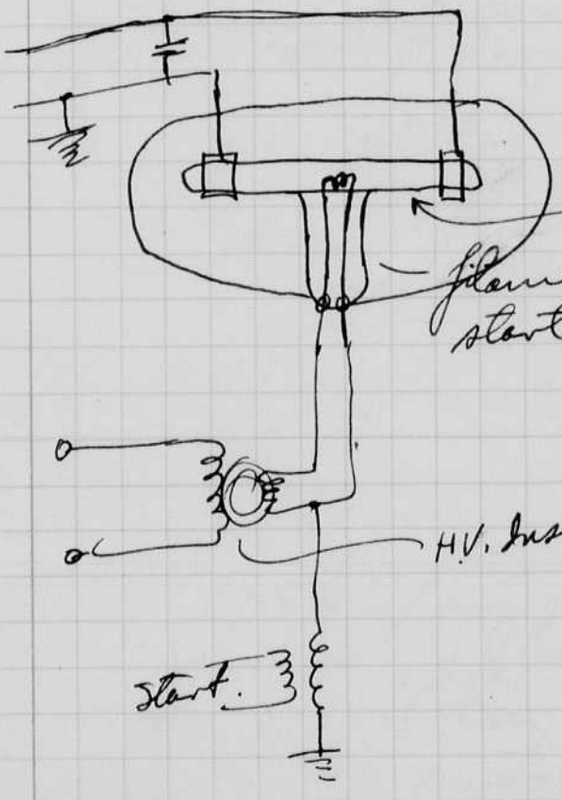


Starting wire inside.





Starter.

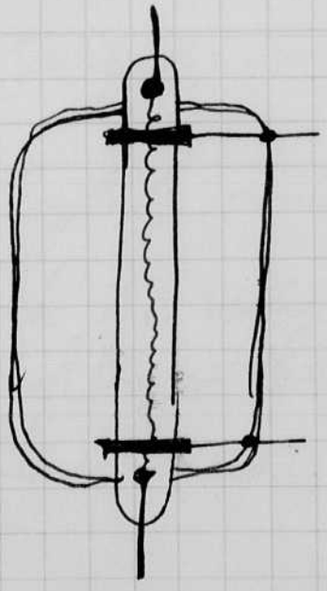


arc on outside surface of glass or quartz ~~tube~~ tube!

filament as starter electrode.

H.V. Insulation.

Start.



3-27-43
Herbert E. Grier

Nov 7 1923
Howard E Duerler

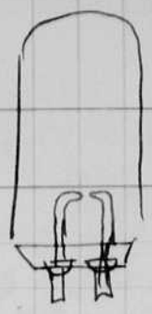
Pumped Movie lamps
1 cm H_2 + 1 atm argon.

Pumped down to 20 cm and sealed off.

all tube run on pump.
most of the above have a getter
in the cathode end!

Mar 2 1943
Harold Edgerton

Gap tube.



Polaroid

Electrode 1/8" moly.

Bulb. Pyrex with bipost seals.

Baked 1 hour in oven

Krypton 2 cm. 28 mf. self flashes at 840 volt setting arc shows glow around ends of both electrodes diffuse glow rises several inches above gap.

Kr. 11 cm pressure self starts at 840 volt setting but slower rate.
Photo taken. f22 Panatomic film.

20. Photo. 1150 V setting.

32 cm " " 1500 V setting, Mercury manometer rises 1 cm due to discharge

40 " ~~1920~~ V 1760

46 1850 (Barely at 1760)

47.5 + if any gas in top of Hg pressure gage.

Film developed 20 min by mistake - should have been 7.

Stille type Gap tube Pumped with Xenon

10 cm	1080 V	self operates
20	1500 V.	" "
30	1920	" "
31	1920	" " Flow max pressure in bulb of tube

Sealed off.

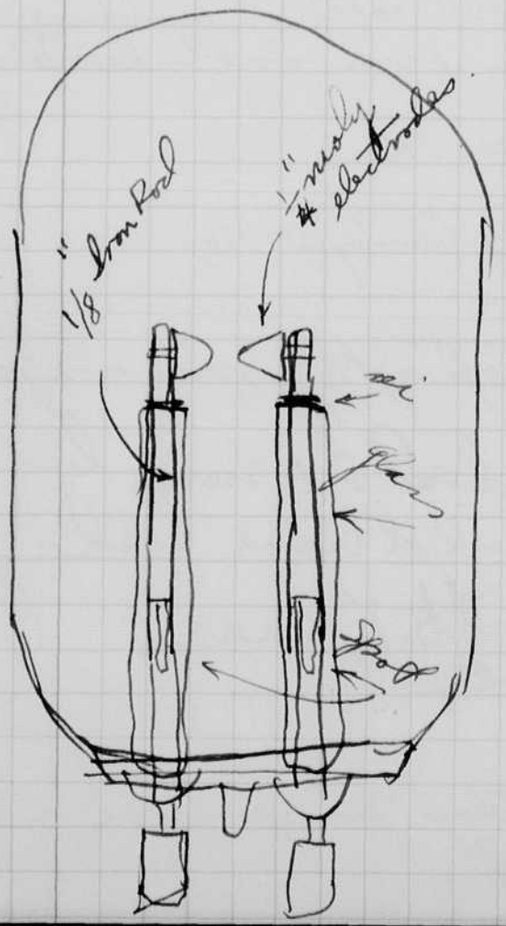
Mar 31 1943
Harold E Edgerton

I made two new gap tubes this morning on the bipost pyrex bases. 1/8" cold rolled steel rods were used as supports for Moly button electrodes. 8 mm glass tubing was put on the posts for insulation.

Hydrogen was first put in the tube at 20 or 30 cm pressure. A 2200 volt transformer was used (AC) to heat the electrodes to a yellow heat to clean off the oxide.

The tubes were baked an hour at 400-500°C. then filled with Krat 36 cm and sealed off.

The gap length is about 1/8 of an inch



The Krypton tube of yesterday (47.5 cm) has gone bad due to sputtered metal on the glass near the seals. A glow starts about 1000 to 1500 volts which eventually breaks down into an arc.

The glass part legs of the present design will help greatly. Also I did not hydrogen clean the tube at low pressure which causes sputtering.

cont.

measurements of the infra red and the light output were made in the afternoon the data is recorded in the loose leaf note book that carries all the data on light measurements.

As I recall the Xe tube gives about twice as much infrared as the Kryptron. The visible from the xenon is about 50% more than from the Kryptron tube. The efficiency of the Xe tube is about 1/20 of that of the standard tridatron type.

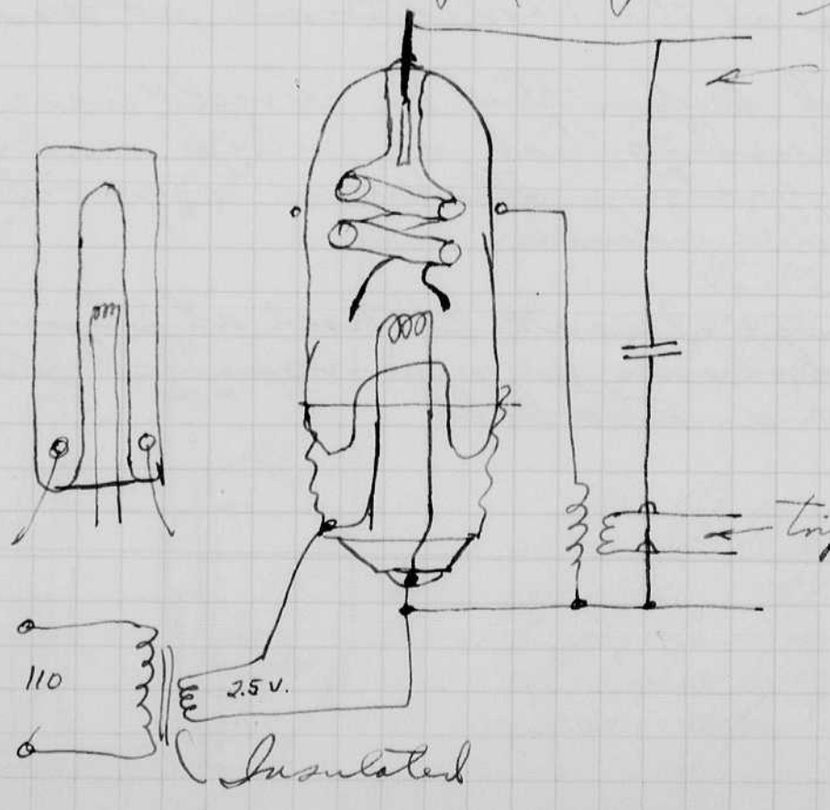
Wyckoff called from Washington this afternoon to tell me that he was going to Dahlgren next Tuesday and would not return until Wednesday or Thursday of next week, that is, about a week from today. At present he is working at the Model Basin at Washington.

I had hoped that he would have returned this weekend so that we could make a motion picture study as requested by Melville Johnson.

Yesterday I sent Ed. Noel at Cleveland a print showing a microsecond flash lamp in a RCA bulb.

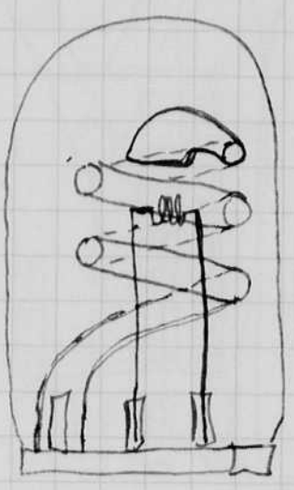
Mar 3, 1913
Herbert Eggerton

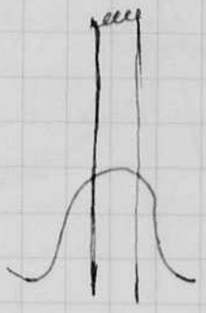
If a low voltage filament is used as a focus lamp in a flash bulb then it can be put directly in the gas of the tube without any danger of flashover from the terminals. It would not be possible to use standard 110 volt filaments in existing tubes now without some trouble due to breakdown. The low voltage filament would be operated by a small transformer in the lamp socket or reflector so that the high current wires would not need to be long. Furthermore the filament transformer would serve as an isolation device so that there could be no possibility of a circuit from the condenser and high voltage to the power input circuit. A heavy cathode could be used a cathode for the filament discharge (or possibly an anode).



3-7-13
Herbert E. Eggerton

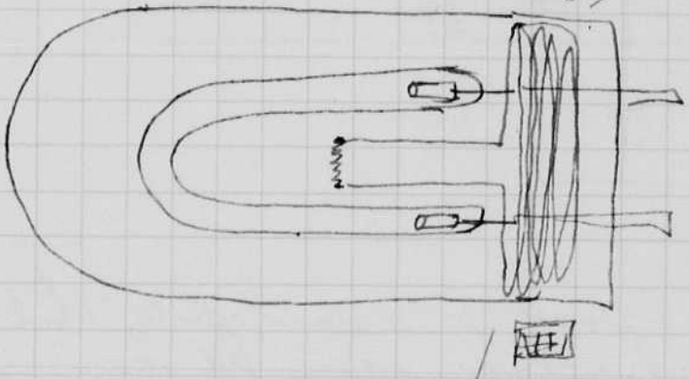
cont.

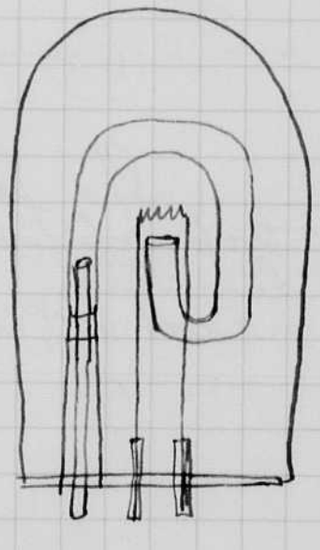


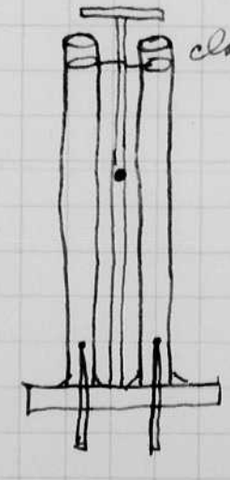


coil

Induction heating of ~~cathode~~ filament.



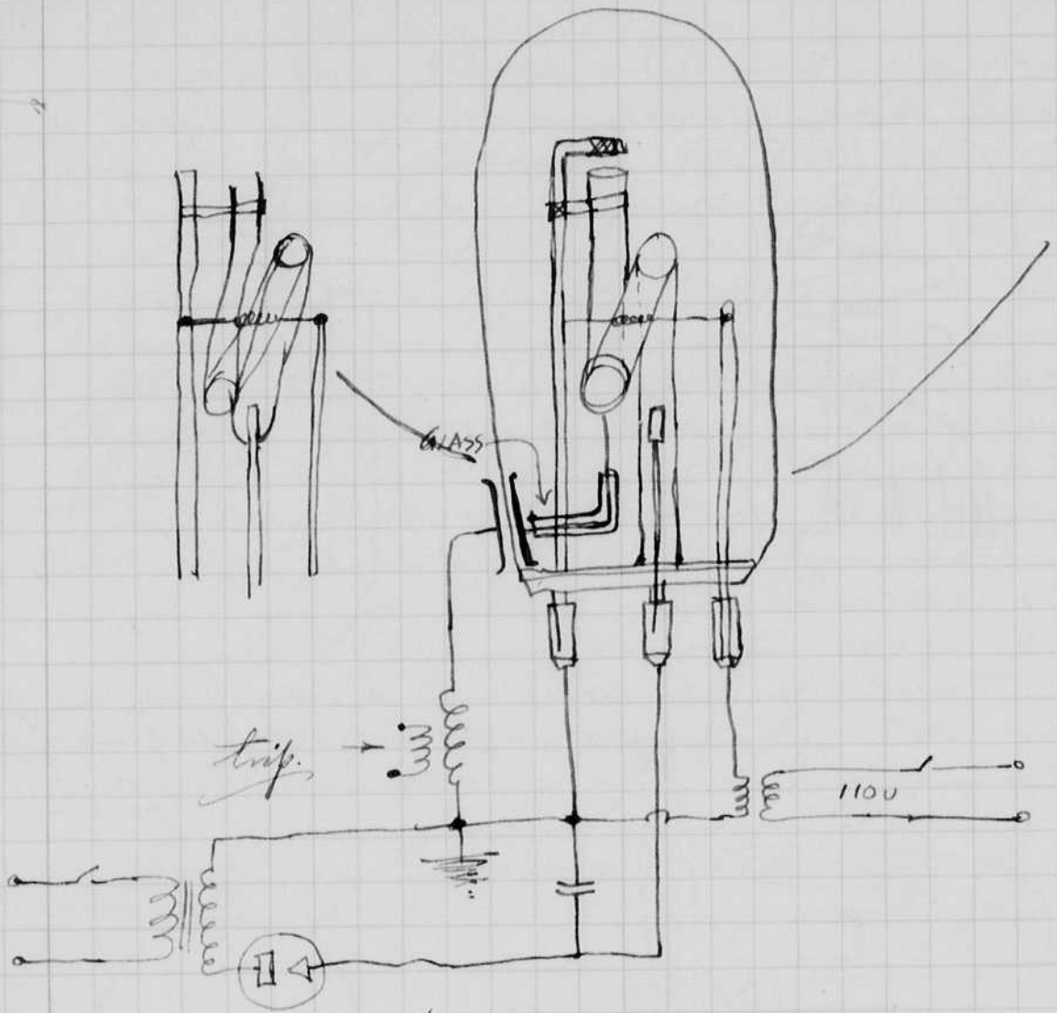




clamps.

3-27-1/3
Herbert E. Ives

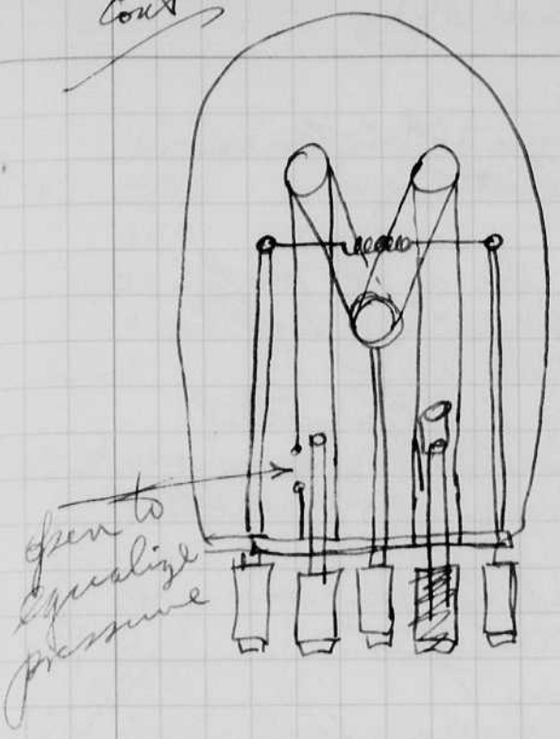
Cont.



If a fourth post is available, the trip spark connection can be carried directly into the bulb without the need of the capacity coupling shown.

3-22-43
Herbert F. O'Brien

cont



This same combination can be put in a reflector bulb.

A five prong base will accomodate the assembly. If the filament and the condenser circuits are combined, a four prong plug will do the connecting.

3-27-43
Herbert S. Price

March 4, 1943
Harold Edgerton

Conference with Wilkins at S.R. on microflash and movie units.

Visited Polaroid Co. - Lee and Matz to deliver a Kr. 36 cm tube. Also left a 28 mf condenser with leads and plugs to fit the bipost lamp. Operated the tube on a 4000 volt adjustable power supply. Breakdown was 1750 volts.

Desirable life: 3 flashes per second. 1/2 hour service. 50% drop in light.

Another type of tube is needed for signaling. Max rate 20 flashes/sec. (avg 1/3 of this). 10° beam 2 hour life. 2 hour life acceptable.

Mar 9. This 647 lamp was operated at 2000 V. 18 mf for a few flashes. The nickle holders finally let go in the tube due to the high current and pressure.

Mar. 4, 1943.

Life test Sftubes.

12.5 x 1800 x

Kr. 47 cm with tungsten Ba Ni electrodes 1/8" gap.

TIME
2:50 2600 V for 1st self flash soon reduced. 210 flashes/min. 65V on var to 4000T 5000 ohms chg. 12.5 mf 668 AC. No leads.
2:53 1800 v.
2:55 250 flashes/min.
3:10 no appreciable darkening 210

Start 3:13 Kr 36cm with Molly electrodes 1/8" gap 2000 V 320
3:15 Speed reduced 240 condenser slightly warm!
3:19 " " 280
3:21 " " 260
Stop 3:28 1300 volt breakdown at end of 15 min Slight darkening
off.

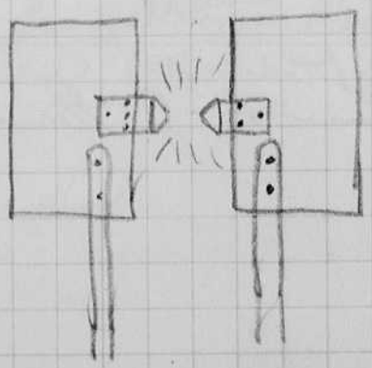
Start 3:45 Same Kr 36 25 mf 60 Variac 950 V avg across condenser E.S.U.
(Initial breakdown 2000 v.). 200 f.p.m.
~~4:03~~
3:53 820 V 224.
3:59 810 220.
Stop ~~5:00~~ 1200 volt breakdown at base
15 min Shows glow to surface.
Tube dark.

Start 4:16 K 47 with Ba Ni Thugster electrodes.
Self flashes due to heat on electrodes after several mins.
Run irregular.
off 4:31 No sputtering visible.

Gemeinhardt and Grier observed these tests.

Evening made two more tubes. Details below

Fossil Iron plates 3/4" x 1"
Electrodes of Ba-Ni-W.



Sealed in Bipost with Rowland Torches about 9 p.m.

Mar. 5, 1943
Bruce Edgerton

One of the tubes mentioned on the previous page was broken in the ~~pump~~ process. The other was pumped this morning, Bubbel, Hydrogen treated, baked, and run on the pumps.

3/16" gap ±. Krypton gas - 10 cm pressure
890 V setting on transformer for self breakdown.

20 cm Kr. 1850 V setting.

30 cm Kr. 1850 V. just starts. (2040 first flash)

31 cm Kr. maximum bulb.

Sealed off.

Life test.

Start	11.26	25 Mf. (start 2100 V ±)	avg 1040	(200 pulses per min)	70 vacuum
	11.29.	"	960	"	"
	11:34	"	960	"	
off.	11:39		980	"	Lamp runs fine no sputtering
Start	12:59		1400 ± first soon drops to 1200		
	1:00		1080		
	1:06.		930		
	1:36		790	780	
off.	2.00 ±				

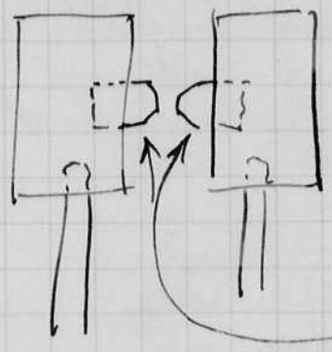
No appreciable darkening.

Visit. from Lt. Bruce - Navy Dept

Witnessed 3-5-43 Herbert E. Grier
3/5/43 Kenneth J. Germshausen.

Cont.

Made another Bipost lamp p 119



3/4 x 1" 40 mil 2 plates
Spotwelded to sides of
1/8". Tungsten Ba Ni
Slugs. 1/8" gap ±.

Pumped on Engr system
Hydrogen heated to reduce oxide
2140 volts 46 cm pressure
Bombed again and filled to
new fas
Sealed off at 36 cm argon.
Breakdown about 2000 volts. ±.

Put in Life test unit. Breakdown variable at first.

Start 9.40 pm AR-36 cm. 210 f.p.m. 1000 volts avg (1560) To Variac

950 AR 36 cm Light (35 cm²) = 12 x 1 1100 922 cell. 990 V. To 25 mf 1500 v.

off 10.10
30 min.

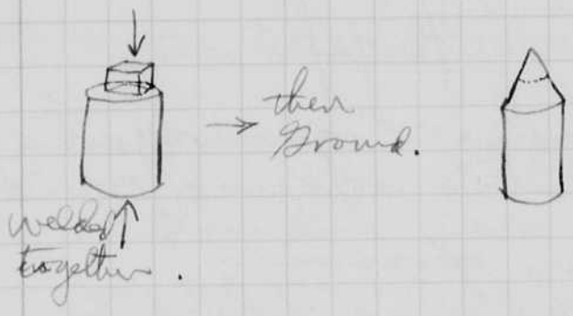
Electrode material used in tests.

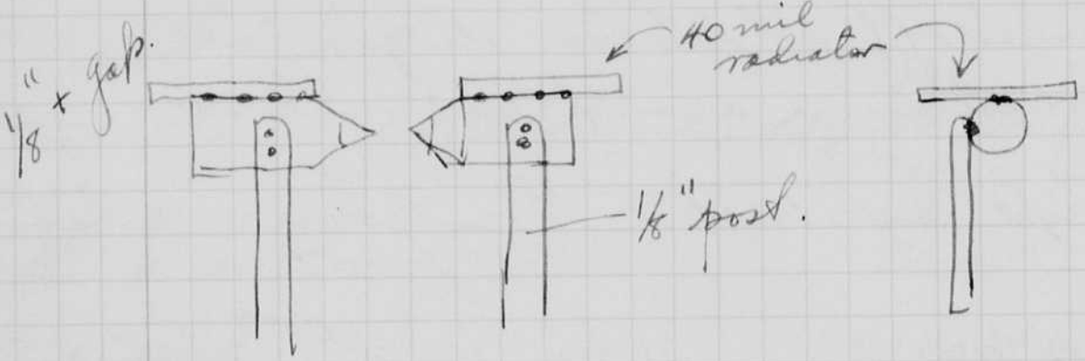
Tungsten	90	~~Volume~~ Weight	} Powder.	Tungsten	} tests.
$BaCO_3$	10	"		1% Ba	
Nickle	9	"		7%	

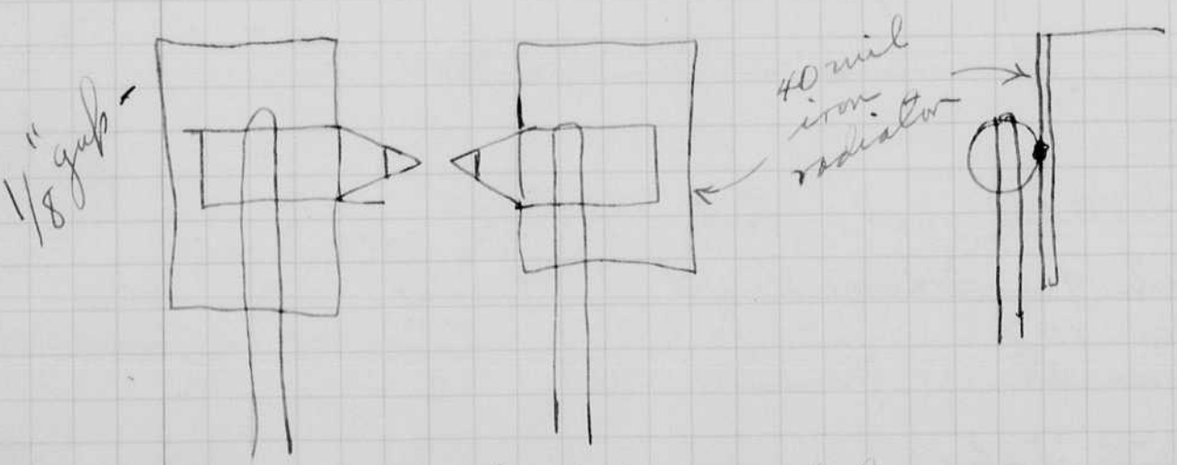
Pressed into shape
Soaked 1200° C overnight to outgas. in Hydrogen
Sintered 1500 + ?

March 6 1943
Sawed Together.

I pumped two more tubes which were sealed into Bifrost lamps last night. The electrodes were of 1/8" cubic pieces of W-Ba-Ni material as per page 122, spot welded into 1/4" iron rod







gap about 1/8 in one tube
3/16 in the other.

Pump schedule.

Bombarded
" with H_2
arc with 5 cm H_2 to clean tips.
Exhausted.
2 cm Kr. and flashed a few times.
Exhausted.
Filled with Kr at 26 cm (max pressure Bulb).
Sealed off.

Initial breakdown about 2000 volts for first flash.

1/8 gap tube varies with avg. volts 700 ±.
Light of flash = 16 units (d = 35 cm) 922 cell.

3/16" gap tube with avg volts of 900 - 800 ±.
Light of flash = 26 units 922 cell

76
4
30

Start 3:04 pm 65 V variac (750 V avg on cond) 304 f.p.m. ok.
off 3:15.
15

Start 5.15
off 554

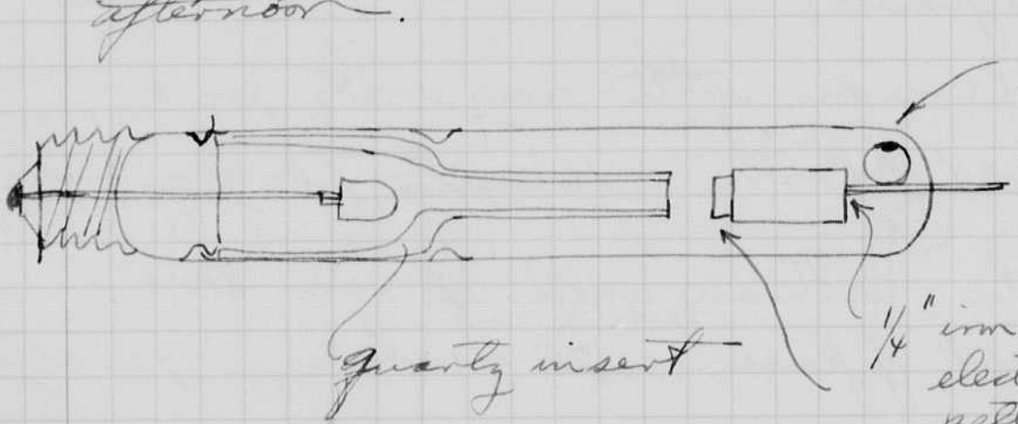
89 54 min total

Slight (if any) sputtering.

March 6 1943
Harold E. Edgerton

The experiments of this week with the gap point source tubes have been very successful. First the life of the tubes has been greatly increased by the Ba tungsten sintered electrodes, Second the tubes have been made to operate as two electrode oscillators and as grid (external) controlled flashers.

Discussed the application of the new cathode to all our lamps. A sample of the movie lamp was designed with Zemeshausen this afternoon.



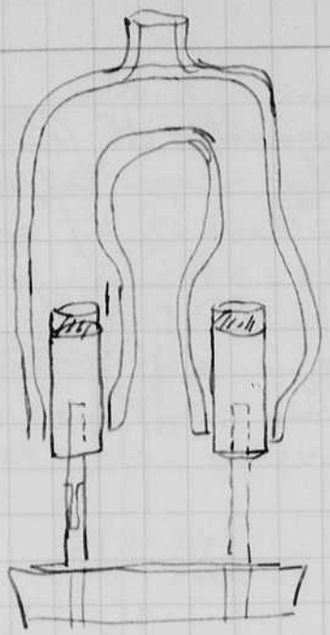
I am scheduled to visit three plants in midwest on Tues, Wed, and Thursday of next week to demonstrate motion picture equipment that the General Radio Co has just delivered. This is the 921 strobotac.

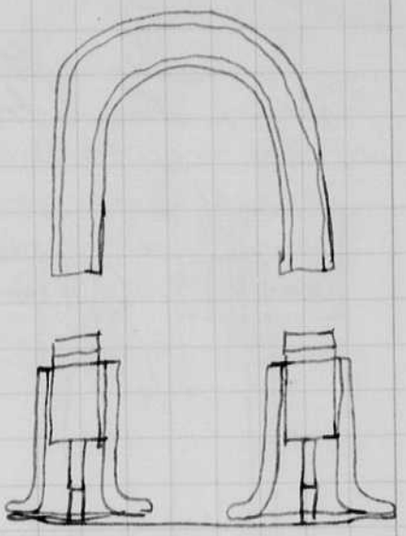
Also Grier and I were to visit G.E. Nela park on March 8 but we have postponed our trip because of a visit by Lovejoy and Baisley from Wright Field. The sea search strobo will be delivered there 3500 V 80 mf. 3. flashes per second rate.

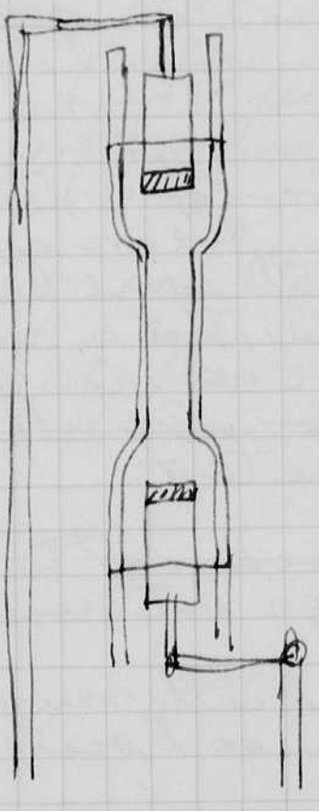
Heavy snow storm tonight, Snow turning into rain and slush.

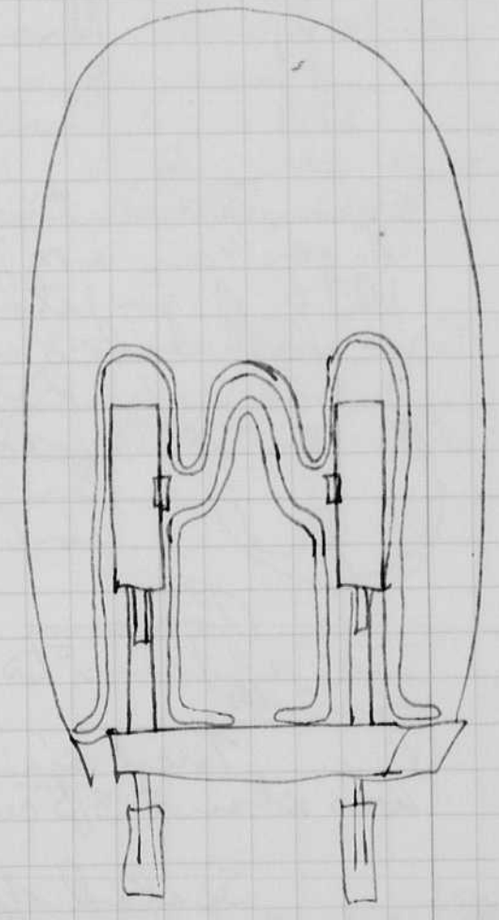
Wydroff is still in Washington. Will be in Dahlgren on tuesday. Home Wed & Thursday.

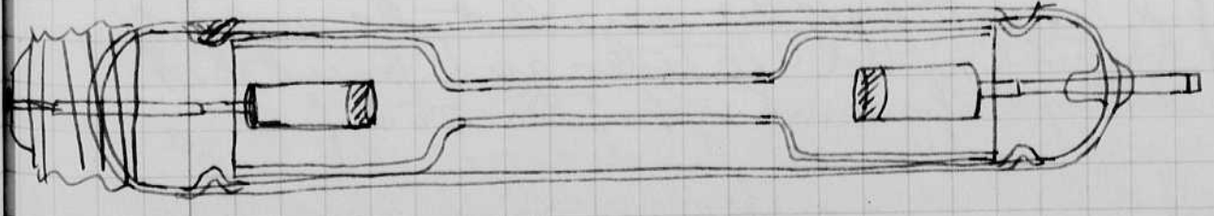
cont.





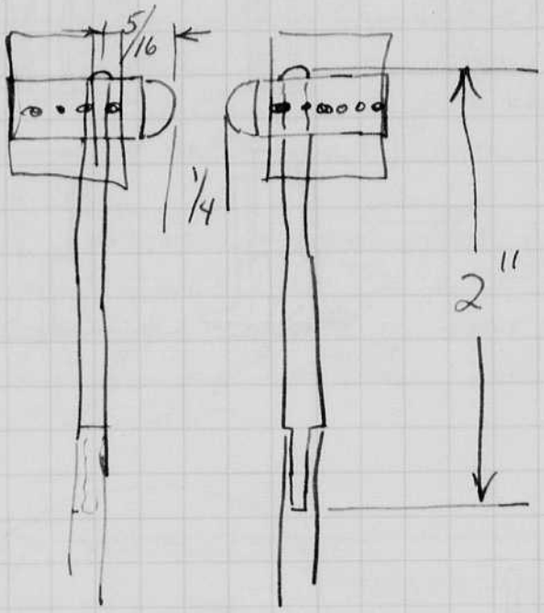


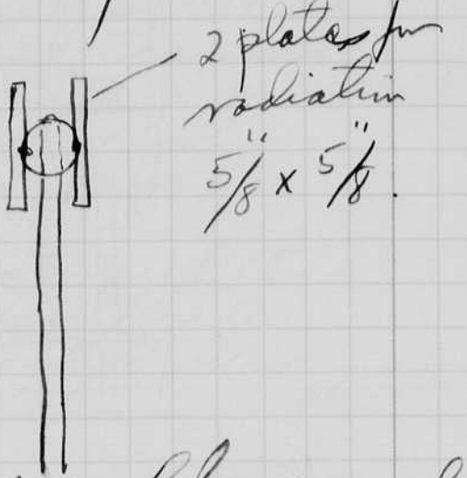




March 7, 1943 Sunday
Harold E Edgerton

In afternoon I made 5 Bipost Pyrex lamps with the new type cathodes.





these group have rounded electrodes with 1/4" gap spacing.

Exhausted on Argon system.
N_2 gas 4cm arc from 7200 v trans with 300 ohm in ser. With Argon 1 atmos. the arc goes around the glass on both sides with some in the center.

For this test a cigarette starting wire was wrapped around the tube & 39 mf at 2140 volts for the test.

Pressure reduced to 30 cm – then arc appears to go between electrode points.

Tried again with new gas. Boundary was about 35 cm so I sealed it off there.

Sealed off a second tube at 28 cm. this tube had longer tips of the new electrode material. I put the tube on the life tester and found that both electrode tips came off with 25 mf at 4000+ volt condenser discharge. I do not believe that these were properly welded since they did not show a color boundary when the tube

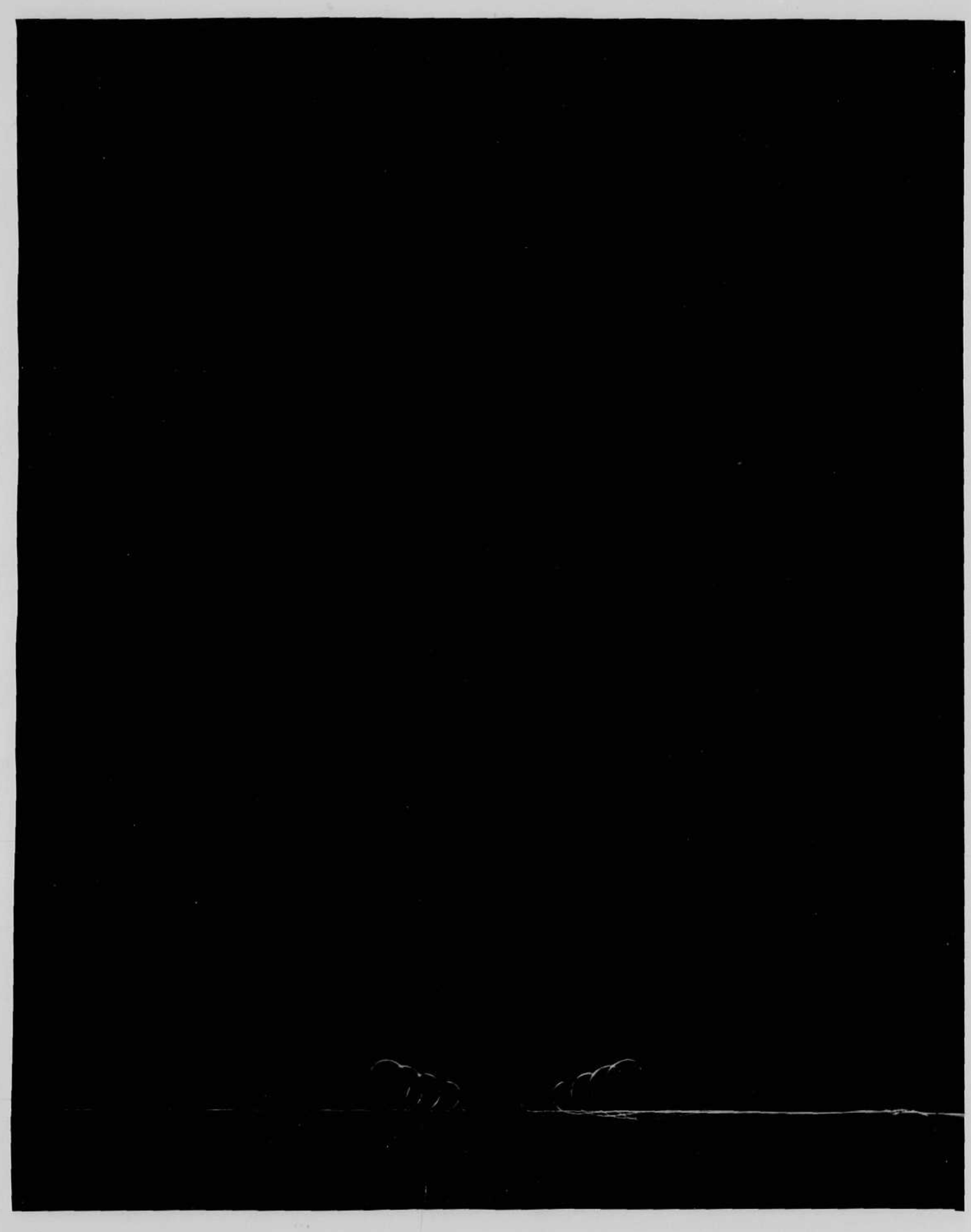
was run with a.c. and 4 cm of Hydrogen during the pumping process.

Argon 35 Bipost after a shakedown has a breakdown of 2600 volts. It runs well as a self oscillator. The rounded points show less ~~heating~~ change in starting voltage due to temperature. In ten minutes the breakdown was 2400 volts.

$35 \times \frac{3000}{2400}$ $\quad 24\overline{)1050}$ (44) 96 90

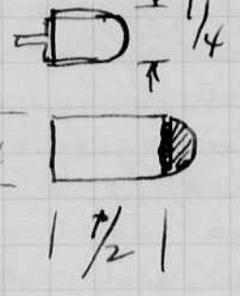
a third tube was sealed off at 4.4 cm to give 3000 volt breakdown after 10 min. It was slightly over this value 3100 volts. This tube was ruined by a spark through the seal from the post to the stopper pin. After a dozen or so sparks the metal shell seal was punctured.

The other two lamps were sealed off with 4 cm of argon. These will be sent or taken to B.S.E. for filling with Krypton and Xenon.



March 9 1943.
Harold E Edgerton

Zemeshum made 2 movie lamps with the new cathode material yesterday and I helped with the pumping.
They ran fine. The cathode did not heat but the anode did run red hot at 1 mf 1200 cycles 470 ohms deg. on our movie unit.

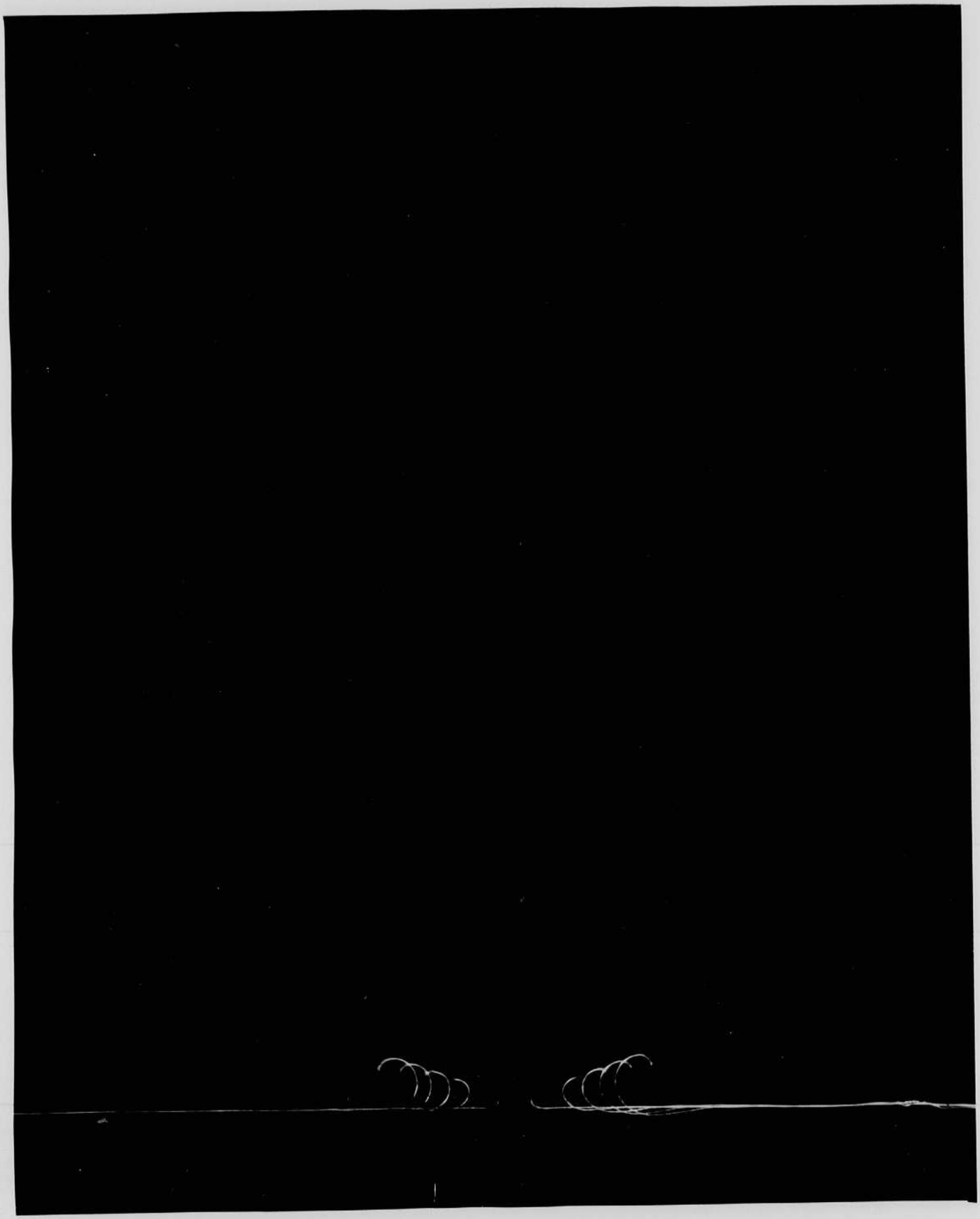


Spot welded Ba Ni W sintered electrode.

There was no observable sputtering after operation on the pump. 30 cm Argon + Hydrogen as per below

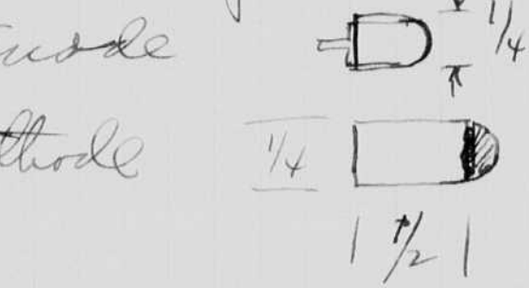
See page 124 for designs. - no getter was used.

One of the above tubes had a solid cathode square of the Ba Ni W material. + this was filled to 40 cm of Argon with Hydrogen 0.5m + 1 atm.



March 9 1943.
Harold E. Edgerton

Zirconium made 2 movie lamps with the new cathode material yesterday and helped with the pumping.
They ran fine. The cathode did not heat but the anode did run red hot at 1 mf 1200 cycles 470 ohms chg. on our movie unit.



- there was no observable sputtering after operation in the pump. 3 cm Argon + Hydrogen to 40 p. below

See page 124 for design. - no getter was used.

One of the above tubes had a solid cathode square of the Ba Ni W material. + this was filled to 40 cm of Argon with Hydrogen 0.5m + 1 atm.

March 12 1943
Harold E. Edgerton

Arrived in Cleveland ~~this morning~~ last night about midnight from South Bend and stayed at the Cleveland Hotel. The day was spent with people at the General Electric Co, discussing flash lamps, distribution and design problems etc.

Conference Sloan, Jeffries, Muntfelt, Enfield and myself in morning. Piper was supposed to come but wired his regrets due to active requests from Wright Field for three more multiflash units.

After lunch Jeffries suggested that the laboratory engage us as consultants to help in the design of flash tubes. The G.E. Co. would then list the lamps of general use and handle all sales directly. This arrangement was to last for the duration of the war. After then it would continue or be modified to a royalty basis.

J. M. Miller Chief Eng.
E. J. Partington Chief Ker. Eng.
J. T. Marshall Chief Div Ej Eng.
E. Hasse. Supervisor Automatic mixture research.
E. Nesbick. Research & exp eng.

Visitors from Chrysler. - 4 men (Wydsoff).

March 13 1943

Dear Edgerton.

I write this at 7 pm at the Athletic Club in Indianapolis. The travels of the week are recorded below.

Tuesday Mar. 9

Left Boston on the 2:10 for the west arriving about 10:30 the next morning in Chicago where I was scheduled to set up and demonstrate the G.R. 621 moving picture apparatus to the Victor adding machine co in Evanston. I made my way to Evanston on the elevated from the LaSalle station. At the address of 636 church (Davis 2220) I found the top two floors of an office building devoted to a research department. Mr. McKay P.C. met me and helped me set up the apparatus. Mr. W.R. Inbody was assigned the job of operating the equipment. Also Mr. V. S. Johnston who originally wrote to me about the equipment. I also met Mr. R.C Buehler who is one of the owners of the Victor adding machine Co. Prof B. J. Spence of NW Uni Physics dept. and Dr. H Snyder also of N.W. Uni.

After dinner at the University Club with McKay, Johnstone, and Spence I stayed over night at the Palmer house. In the morning I took the 9 am North Shore electric line to South Bend in order to install a 621 at the Bendix Plant. The work was finished by 6 pm in time for me to catch a 6 pm train for Cleveland where I arrived about midnight. I stayed over night at the Cleveland Hotel and went out to the G.E. Plant in the morning of March 12 as recorded on the previous page which was written last night on the Pullman to Indianapolis where I am now.

This morning I went to the Lakas Harold

Con't

plant in nor Western Indianapolis to install and time up another 621 GR. high-speed motion picture camera. I contacted Paul Drake first. Russel Fanning was there and was with me all the while, also Schaefer, Dr and Mrs. Rogers (from Austin Texas). etc. (Gallegrey) the equipment was in order by noon and a picture was taken of a vibrating contact in a Barbour Colegrave polarized relay of some sort.

after lunch I went to the P. R. Mallory co. to see Mr. G. L. Peck about condensers. met Rhodes and discussed condensers. Talked to Joe T. Hood on the phone about electrolytic condensers He has a bank for welding service of parallel units totaling

165 mf units. 15000 mf at 400 volts.

.003 m.s discharge time.

$$\frac{CE^2}{2} = \frac{15{,}000 \times 10^{-6} \; 400^2}{2} = 1200 \text{ joules}$$

Peck will send me weight and leakage current of this bank of condensers.

Paper with castor oil condensers should be altylled now. I will see Irvin and report upon my return to M.I.T.

It was suggested to try paper of thinner variety to increase capacity. now use 4 layers of .000 35 — 65 mf.

Suggest. { 2 layers of .000 35 } — 75+ mf.
{ 2 layers of .000 3. }

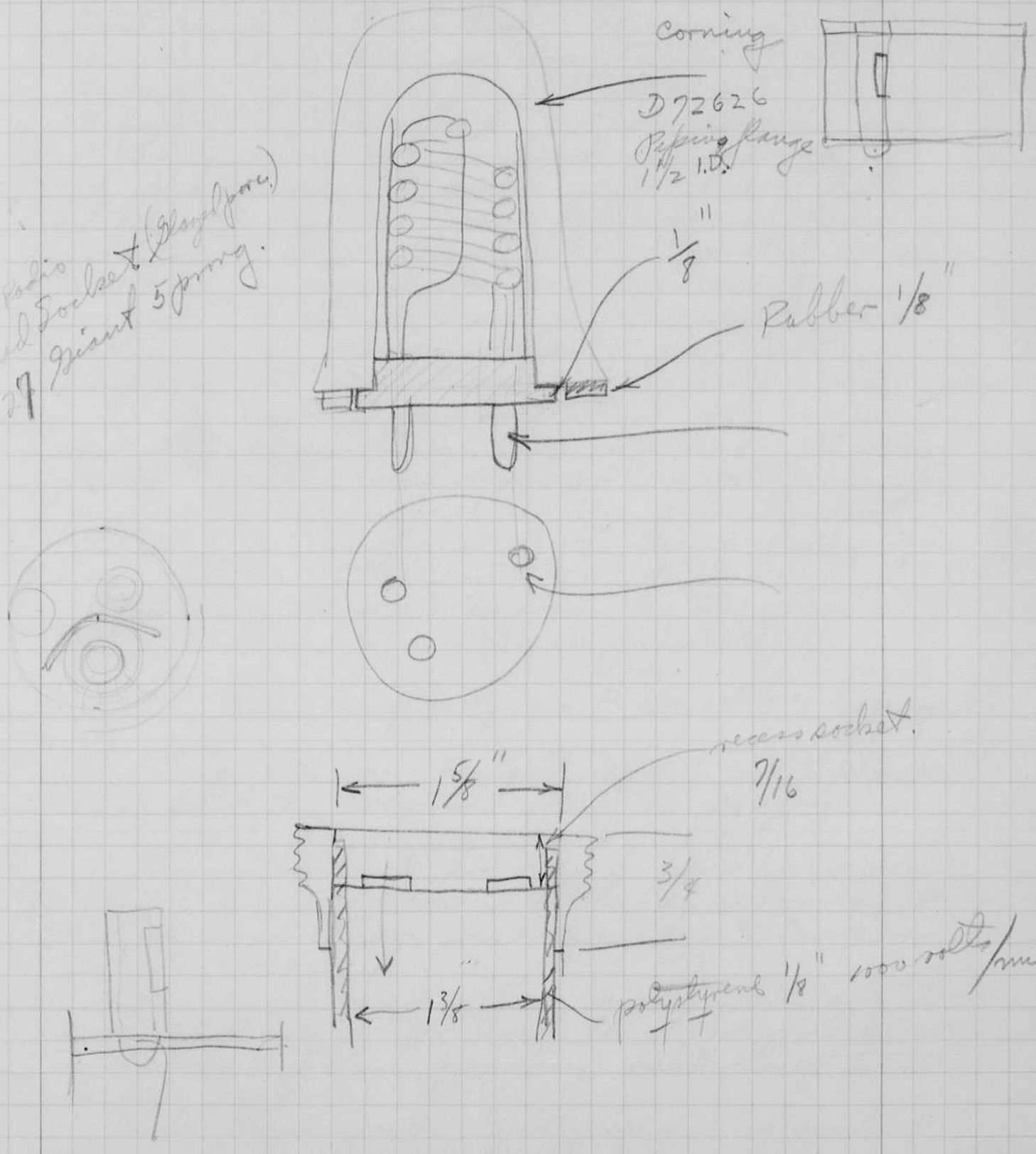
$\left(\frac{14}{13}\right)^2 = 1.16$

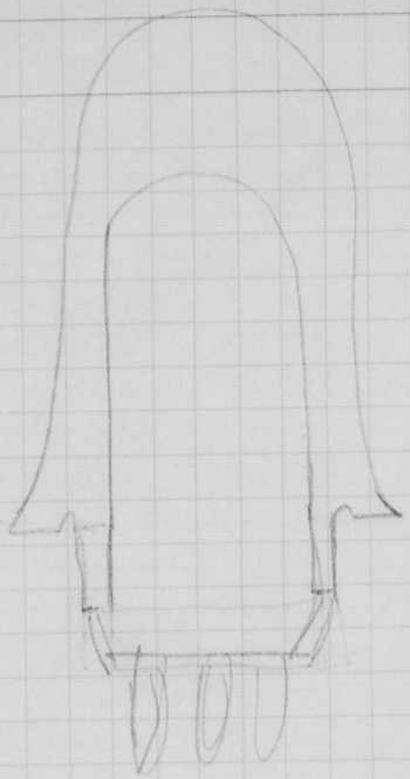
this was written in Indianapolis at Electronics Lab office.
~~Gaastang~~, Peele, Frye, present.

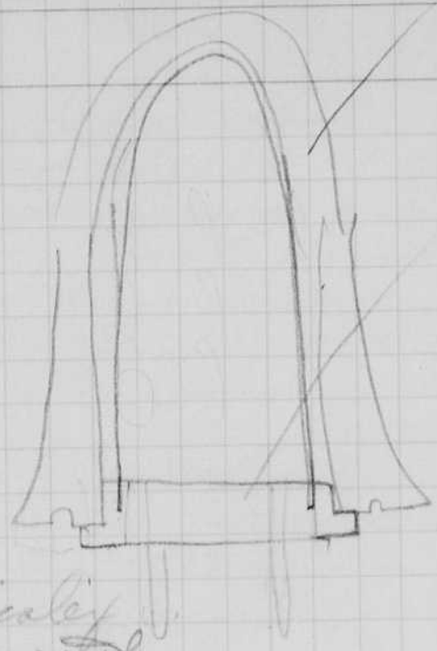
March 14 1943

IGA Giant
Insulated Plugs
& jacks.

X408 Hand Lamps. New Design.







micalex with metal pins

RCA 826

Wed. March 17 1943

Dayton

I left Indianapolis on Sunday night at 5 pm after a full day with Barstang, Jorge, and Peek at the Electronic Laboratory. Stayed at the Moraine Hotel in Dayton. met Baisley, Kenyon and Wooley at Wright field for trip to Boston in a B 25 to pick up a first sample of the sea search photo outfit. It has 56 - to 70 ? microfarads at 3500 volts in a # 16 flashtube. 3 pictures are taken a second in a K 24 Camera.

We took off at 11 am from Wright field and were in Boston at 3 pm with a stopover at Mitchell field for gas.

The flasher was installed on Tuesday and tried while on the ground. It was placed in the rear near the place formerly occupied by the gun turret. The load current did not cause excessive regulation of the voltage. A current of 125 amperes was drawn by the flasher.

$$28.5\text{v} \times 125\text{a} = 3.57\text{ kW power.}$$

$$\text{Power to lamp} = \frac{CE^2}{2} \times f = \frac{56\ \frac{3,500^2}{2} \times 10^{-6}}{2} \times 3 = \underline{1030}\text{ watts.}$$

The group from Wright field tried to leave today but the weather was too soupy.

During the last few days there have been many discussions of the equipment that we have been designing. Conclusions that I remember.

Sea search unit. three more units are to be rushed through for test. About 1000 will be needed in the near future pending results of tests at Langley field, Va.

A20 flash unit. Capt Kenyon suggested a 5 x 7 camera (made by Graflex) in place of the 2 - K24s that have been proposed. This will greatly simplify our problem.

cont.

Many discussions were had about engines - particularly starters and carburation. No engine of small power with a self-starter, for operating aircraft generators has been located. It was decided that Kenyon should see if the aircraft starter could be applied to the Waukesha engine. Also Kenyon is to look into the carburator.

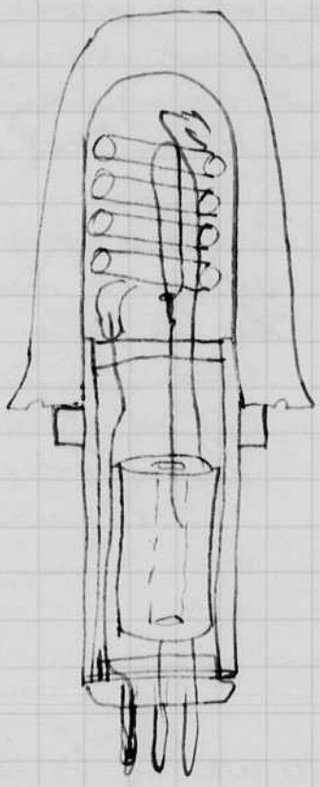
The Leland 1500 volt amp motor-generator was also considered for the A 29 flasher. This generator would supply half of the power needed. Kenyon talked to Major Holliday in Wright field today about available power. The ship has 2 - 100 amp generators except for model C which has 200 amp size. These 200 amp generators can be put on any ship with a cable change to the battery. This will be given more consideration later.

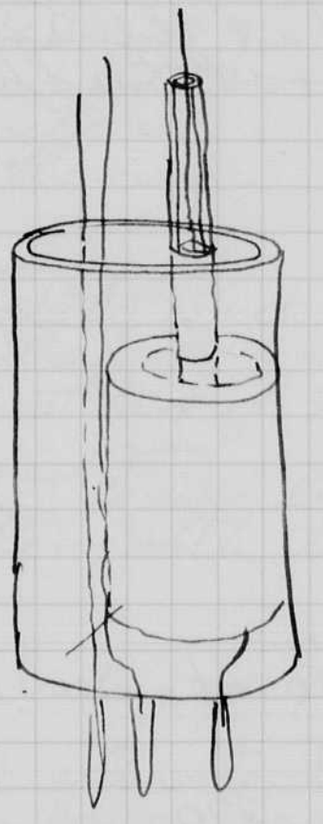
Mar 17 1943

Harold Edgerton

The hand lamp of the Electronic design is weak electrically since the high voltage goes through a plug. We spent probably all day trying to devise a scheme.

I just thought of a method of mounting the coil in the lamp base. This would put all the high voltage inside the lamp where no damage could be done.





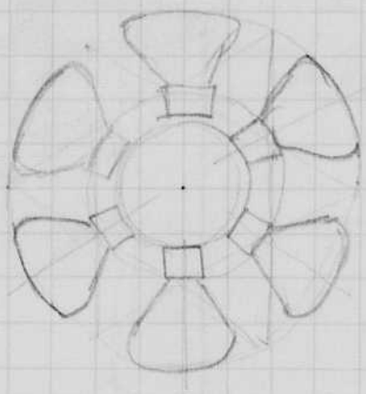
Cont.
Mar 17 1943
H. E. Edgerton

on Sunday Mar 14

There was considerable discussion at the Electronic laboratory with Frye, Peck and Forstang about the large aircraft beacon that was ordered a year + ago by the C.A.A.

I proposed a ring of lamps in the R40 bulbs instead of one large gearly lamp as previously used. For example 12 tubes in a ring shining outward and up at 10 degrees would give good coverage. Extra lamps could be used at the important angles where most traffic was expected.

Another deck spaced between to be placed above to give total of 12 lamps.



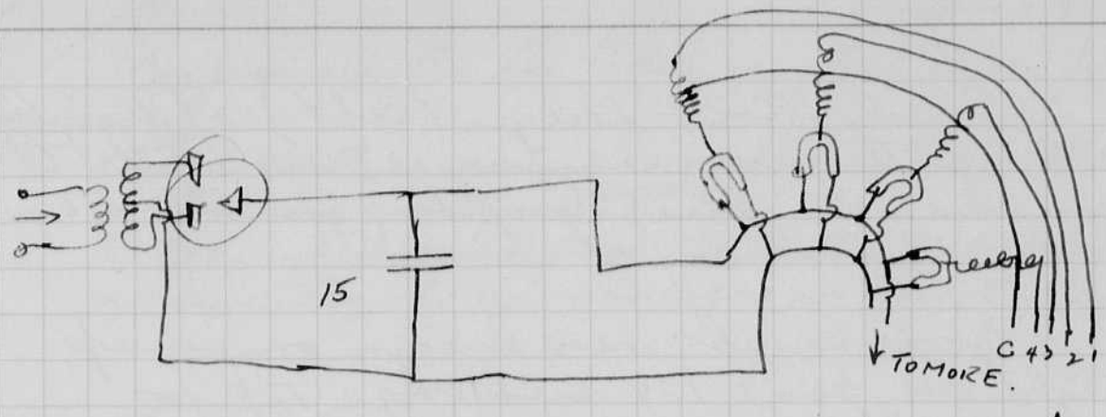
Power $\frac{\overset{90}{\cancel{180}} \text{ mf} \times \frac{3{,}000}{\cancel{2}} \times \frac{1}{3}}{\cancel{2}} = 270$ watts & lamps.

$\frac{270}{12} = 22.5$ watts per lamp

If 1 flash per second P = 67.5 watts per lamp.

$\frac{180 \text{ mf}}{12} = 15.$ mf per lamp.

continued.



to firing circuit that gives each a trip surge in sequence.

This method shows a greatly reduced condenser that operates at a faster rate. The ignition circuit operates to trip the lamps in sequence around the ring.

For the example shown the condenser is reduced to 15 mf from 180. It is flashed at 12/3 = 4 time, per ~~second instead of 1/3 of a~~ once every 3 seconds.

The drain from the power line is more constant with the big condenser

I have read and understood this multiple arrangement of tubes for a beacon

Frederick E. Barstow

March 18, 1943

Read & discussed 3-18-43 Herbert J. Erie

Read and understood March 18, 1943 C. H. Hyckoff

Capt. Lanyon saw the above during visit from Wright Field. H.E.E.

March 18 1943
Harold E. Edgerton

Baisley (Col) Kenyon (capt) of Wright field left this morning in a B25 with the sea search photographic unit. 56 mf 3500 v. 3 flashes per second.

Movie lamps new design on pump tonight. see page 129 and page 124 for specs.

Ran on pump at 1200 frames for 5 seconds with 1 mf 470 ohms 30 cm argon + H2 (2cm).

Filled as follows with gas before sealing off.

1. Put in 1 cm of Hydrogen
2. Filled system to atmospheric press with argon
3. Pumped out to 32 cm pressure and sealed off tube cold.

March 19 1943
Harold E Edgerton

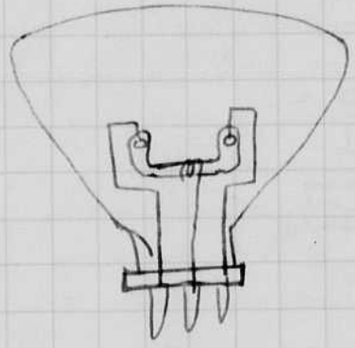
Conference with Lee today on flash tubes for Polaroid Co.

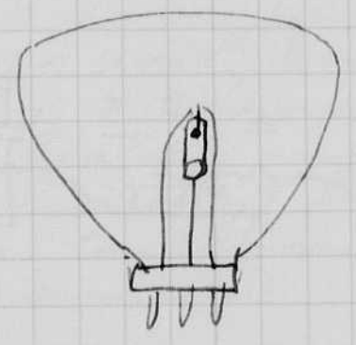
1. Increase power to 500 watts in Gap tube.
2. Measure output.
3. Order Infra-red film to study gap tubes.
4. Investigate condensers for short flashes.

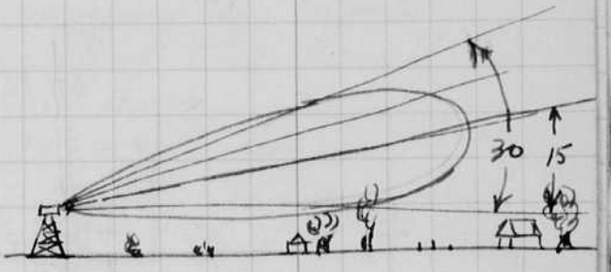
P(138)

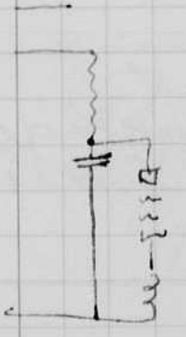
The ~~rotating~~ beacon scheme looks like a very good one. I sent a reflector tube to Barstow yesterday for experimentation.

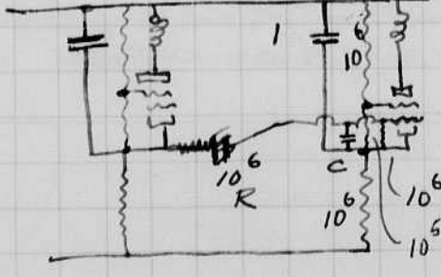
The lamp in the reflector should be placed to give most of the light along the surface of the earth. Such a tube is sketched below.

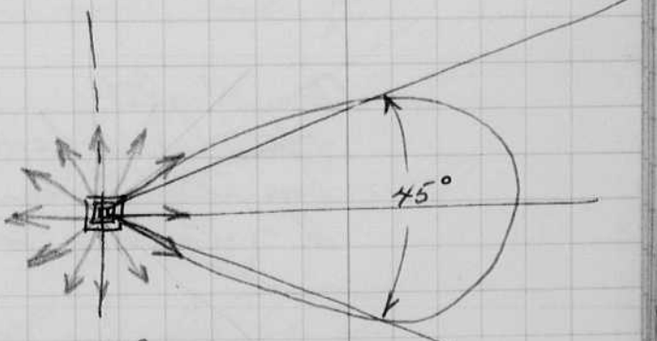








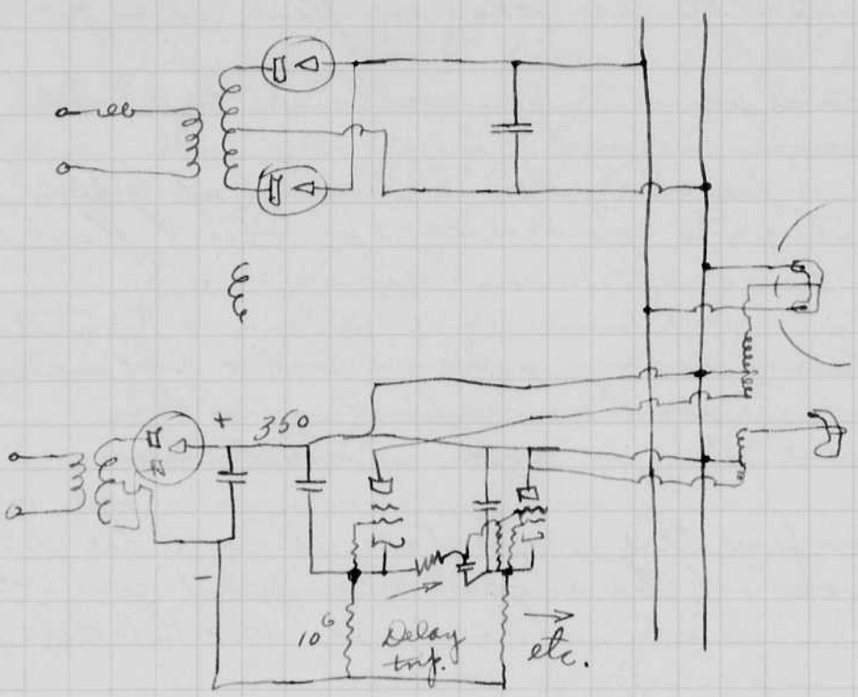


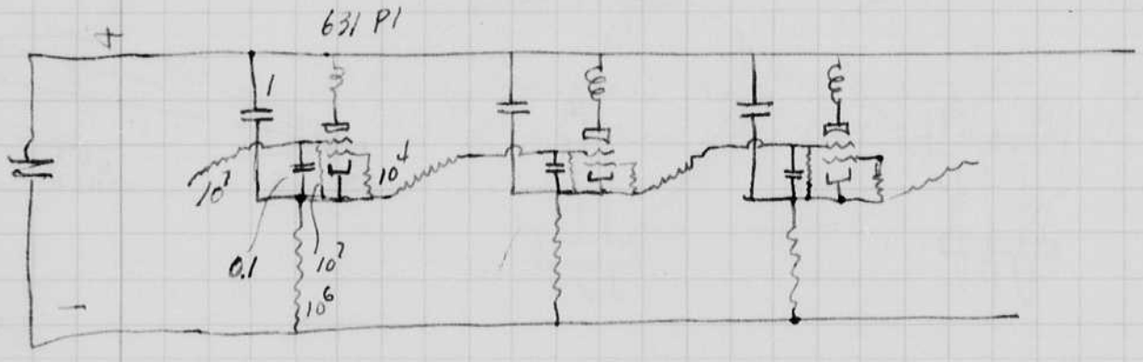


12 lamps.

$RC = \frac{1}{4}$ sec. $= C = \frac{1}{4} \times 10^{-6}$ farads.

Cont.





Close ring.

One strobotron could be used as a trip at 4 flashes per second with a high voltage ignition distributator. This would involve a rotating device - mechanical

March 20 1943

Harold E Edgerton

Capt Kenyon called from Wright field today authorizing us to make the A20 units without the motor generator sets. He also will supply K21 cameras in place of the K24. This relieves us of the bother of making a double intervalometer for alternate flashing. Erie to send time of delivery on Monday. Priority will be checked by Kenyon.

He is going to run the 56 mf unit tonight and will report its action.

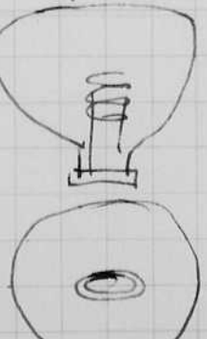
I tested a #16 flash tube today. Results are in my light measurement book. The tube broke after 6 flashes at ~~1/2 second~~ 3 second intervals due to cracking. 4000 volts at 97 x 2 = 194 microfarads. It was trying the tube to see if it would serve for half of the load imposed by an A20 unit. It will not serve.

I next tested a #15 lamp (R40 reflector) as a beacon for heating and life. Some 3000 flashes were clicked off before I left for home at 6 p.m. Conditions 28 mf 2000 volts, interval 3 seconds.

$$\text{Power} = \frac{CE^2}{2} \times f = \frac{28 \times 4}{2} \frac{1}{3} = 18.6 \text{ watts.}$$

Data on light output is in my blue note book of measurements.

Another design to give proper distribution of light would be to use an oval shaped tube, extending the axis that is to be covered by light at a broader angle.



Another method would be to mount a coil the long way of the tube.

March 21 1943 Sunday.
Harold Edgerton

Continued tests of lamps for A20 flasher and for Beacon.

A Pyrex D.I.C. 5925 lamp will operate 1/2 minute at 40 per min 194 M.F. 3100 ohms on a 4200 volt circuit. I tried Ventilation from a small centrifugal fan. This enables the lamp to be used continuously.

A Guarantee D.I.C. 6066 lamp will operate 3 minutes + without cooling

The Beacon R40 #FT15 lamp was speeded upto 2 second intervals in the afternoon and was left running for over night. See data on all above experiments in Blue book of light measurements.

Conf with Lee

See page 141

500 watts input. ~~to gap tube~~
3 flashes/sec.
Life = ?

Osciollograms of current
voltage.
light etc.

...tion. I.R.

Dr. Mees. Class M.
Infra red
pln.
~~tapes~~
144

Other gases.

...r high freq.
...mental size.

H_2 N Ar Kr Ne Xe. ~~Hg~~
He

... x 3 = 150 watts.

Concentrate on Argon.

Get more bulbs and bases.

...of C or V.

25 mf 2000 volts. (test 4000)
osc. 3 discharges sec. (shorted).
extra ~~leads~~ to min. ind.

G.E. Co.
Mallory.

Non inductive winding.

March 21 1943 Sunday.
Harold Edgerton

Continued tests of lamps for A20 flasher and for Beacon.

A Pyrex D.I.C. 5425 lamp will operate 1/2 minute at 70 per min 194 M.f 3100 ohms in a 200 volt circuit. I tried Ventilation from a small centrifugal fan. This enables the lamp to be used continuously.

A Guantz D.I.C. 6066 lamp will operate 3 minutes + without cooling

The Beacon R40 #FT15 lamp was speeded up to 2 second intervals in the afternoon and was left running for over night. See data on all above experiments in Blue book of light measurements.

See page 141

100 flashes/sec.
Continuous operation. I.R.

Broad beam.

Conc. beam

Condensers. for high freq
order experimental size.

$P = \frac{25\ mf\ 2000^2}{2} \times 3 = 150$ watts.

Try increase of C or V.

---

25 mf 2000 volts. (test 4000)
osc. 3 discharges sec. (shunted)
extra leads to min. ind.

G.E. Co.
Mallory.
Non inductive winding.

Chart made on March 21, 1943
Harold E. Edgerton.

Data on Flash Units

Device	Use	Mfg.	Tube	mf C	Volts V	Energy watt sec	Interval seconds	Power KW	*Distance feet	Mapping interval 300 mph 60% overlap 45° coverage seconds	Power for strip map KW	Current required F2011 28.5 power supply 50% eff. amperes	Weight pounds.
Strobotac	Strobo	G.R.Co	631 Strobotron	1 3	300 300	0.045 0.135	.041 .0167						
Strobolux	Strobo	G.R.Co	648 Strobolux	14	800	4.47	.01						
Microflash	Photo	G.R.Co	509 microflash	0.33	7000	8.1	60	—					
Kodatron Port.	Photo	E.K.Co	FT 15	28	2000	55	10	.0055					
Kodatron.	Photo	E.K.Co	Kodatron 2	112	2000	224	10	.022	333 1400	.447 1.35			
Sea Search.	Photo	M.I.T.	FT 16	56	3500	342	0.33	1.050	416 1250	.565 1.70	0.65 0.20	45.7 14.1	135
B-25	Photo	M.I.T.	FT 11	2000	2000	8000	7	1.140	2000 6000	2.72 8.14	2.95 .95	208. 69.	1200
A-20	Photo	MIT	FT 12	400	4000	3200	1.5	2.130	1266 3800	1.72 5.16	1.86 .62	131 43.6	650
B-24	Photo	M.I.T.	FT 12	4000	4000	32000	6	5.320	4,000 12,000	5.40 16.20	5.92 1.98	417. 140.	4000

125 average

*Based upon tests at Wright field with the B-25 unit
with f2.5 lens XXX film
MAX distance gives thin but useful negative

Data on flashers for Wright field
March 24 1943. showing required
power to obtain strip maps at
different altitudes.

Mr. Enfield of G.E. co arrived here on tuesday night mar. 23. Discussed consulting arrangement with Gems, Herb. that night. He stayed over night with us and we resumed conversation the next morning. Left on 4:50 train for Cleveland.

Wt. of 65 mf Castor Oil Mallory Condenser = 55.5 pounds. Received about today.

Electrical

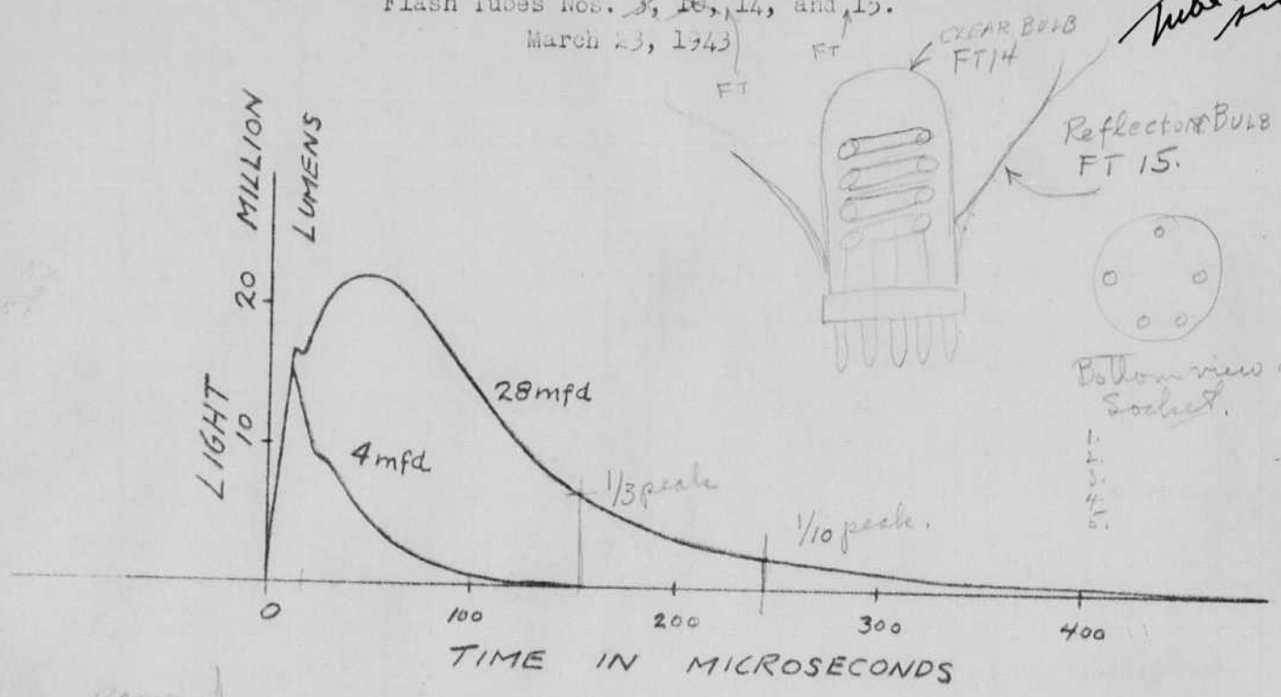
LIGHT-TIME CHARACTERISTICS

Xenon

Spiral Pyrex Flash-Lamp as used in Edgerton, Germeshausen & Grier Flash Tubes Nos. ~~13~~, ~~10~~, 14, and 15.

March 23, 1943

Tube dimensions.



Rated

Normal operating conditions
28 microfarads, 2 kilovolts
2 ~~10~~ seconds between flashes. Life 50,000 flashes. Trigger voltage 1500

~~Integrated~~ Light output = 2900 lumen seconds Exposure factor □ of FT15 = 160
Effective flash duration* = 150 microseconds 10 to 30
Delay time including trigger tube and coil delay = 30 microseconds

*Defined as elapsed time from the start of the flash until the light has decreased to 1/3 of the peak value.

Space.

The quantity of light ~~obtained~~ with the operating conditions ~~is calculated~~ approximately by the following relationship:

and duration may be calculated other

Light output ~~(lumen seconds)~~ = CE^5F lumen seconds

where C = capacity in microfarads
E = voltage in kilovolts
F = lamp efficiency factor = 26 lumens per watt

condenser

~~The duration of the flash is calculated approximately as follows:~~

Effective Flash

Duration = RC microseconds ~~flash factor~~

where ~~R = lamp resistance = 5.3 ohms~~ ~~data~~
C = capacity in microfarads

These expressions are approximate for capacities greater than 10 microfarads and for voltages exceeding 1 kilovolt.

□ Product of distance in feet (light to subject) and aperture for proper exposure with Ilford film.

N.B. No. 1x p. 102
H.E.E. May, 1942

March 25 1943
Harold E Edgerton

The definition of resistance as given in the data sheet or page 145 is an approximate one. It is different than the definition of resistance as given by Murphy and myself which was based upon a current. The page 145 definition is based upon light. It is justified since we are more interested in light than current.

It probably would be preferred to call the factor R a "tube time factor" instead of a resistance so as not to confuse the issue.

→ or "Duration factor"

If the lamp were a true resistance R and if the light were proportional to power, the following mathematical expressions would relate current (i), power (p) and light (L)

R = resistance.
E = initial voltage.
C = capacity.

$$i = \left(\frac{E}{R}\right) \mathcal{E}^{-t/RC}$$

$$p = i^2 R = \frac{E^2}{R} \mathcal{E}^{-\frac{2t}{RC}}$$

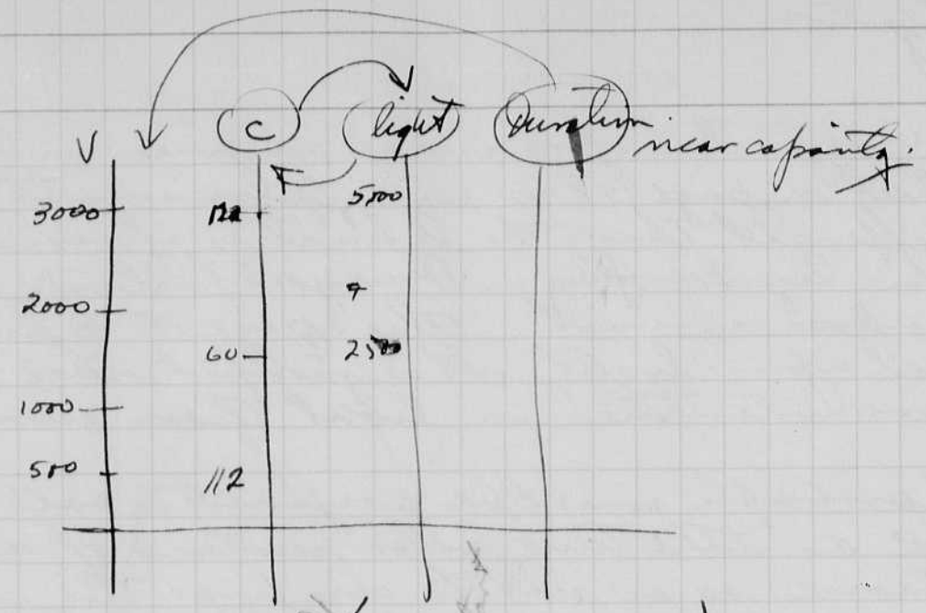
$$1/3 \text{ peak} \cong \frac{1}{\mathcal{E}} \quad \text{or} \quad t = \frac{RC}{2} \text{ seconds.}$$

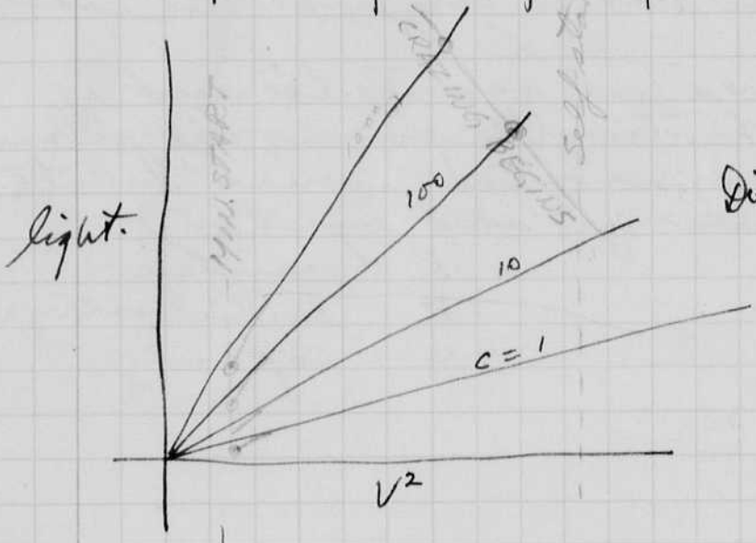
for example $t = 150 \times 10^{-6}$ seconds.
$C = 28 \times 10^{-6}$ farads.

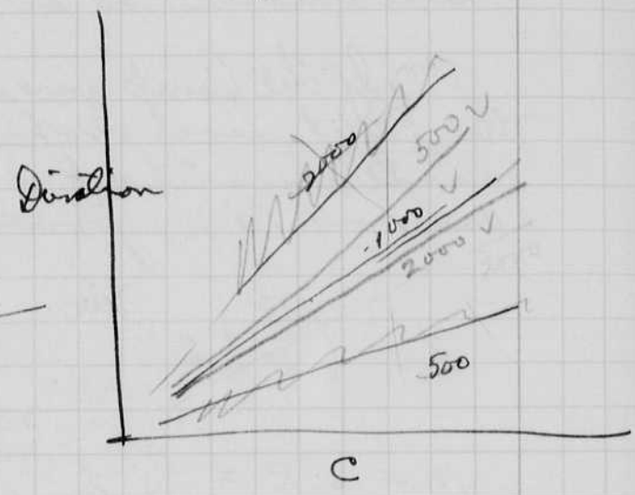
$$R = \frac{2t}{C} = \frac{300}{28} \times 10 = 10.7 \text{ ohms.}$$

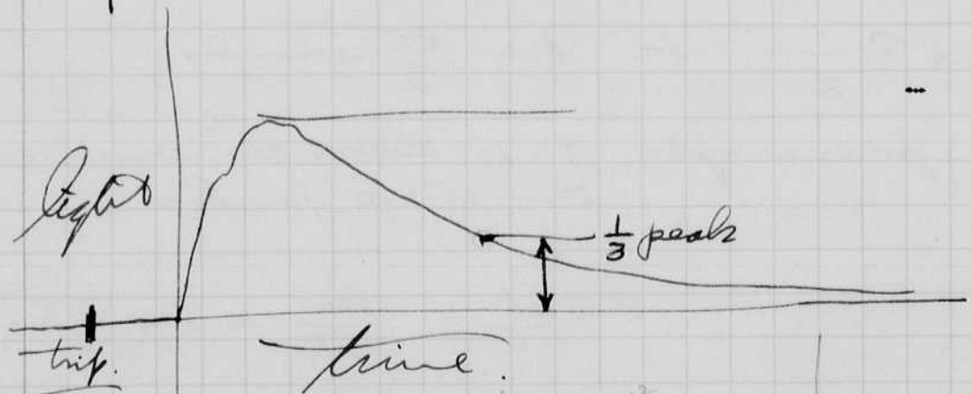
#15 Exp

A life test now in progress shows 150,000 flashes. These were made at 2 second intervals. Slight darkening at the cathode (nickel + Ba fill) but tube still o.k. A few self flashes result when tube is cold.

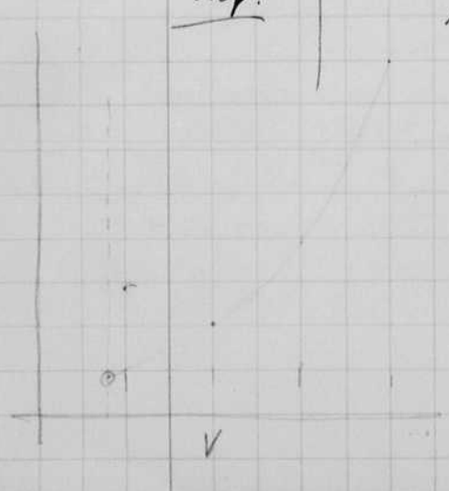


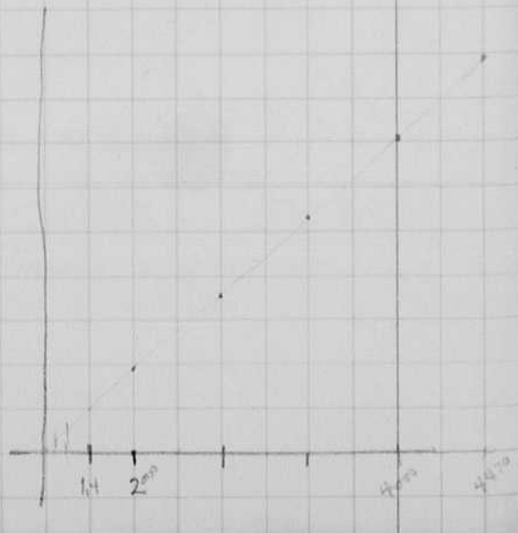






V	V²
4,470	20
4,000	16
3,460	12
2,820	8 × 10⁶
2000.	4. × 10⁶
1,410	2 ×
1,000	1
,707	.5
,500	.25



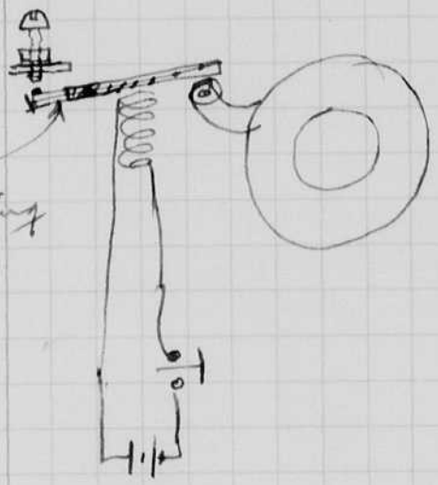


March 30, 1943

Harold E. Edgerton

Portable Synchronizer.

Mr. S Mendelsohn and Mr. Caldwell visited us on Wednesday or Thursday of last week. A synchronizer of the Mendelsohn type was sent from Bloomfield arriving here yesterday. It had a pr contact mechanism in the bath which operated when the magnet was energized.



It was impossible to synchronize since the flash arrived was closed before the ~~con~~ shutter was tripped. open.

Eric attached a piece of solder to the end of the spring, this gave a delay which synchronized the contact time to occur ~~the~~ during the shutter opening time.

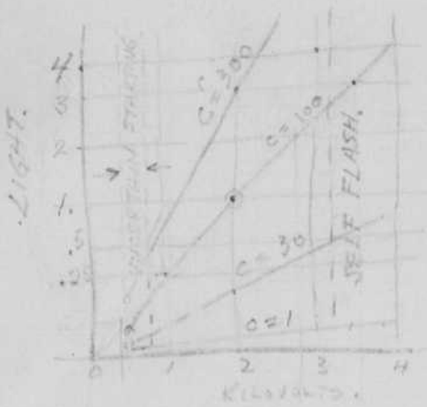
The delay is caused by the mass and spring action of the end parts that operate the contact.

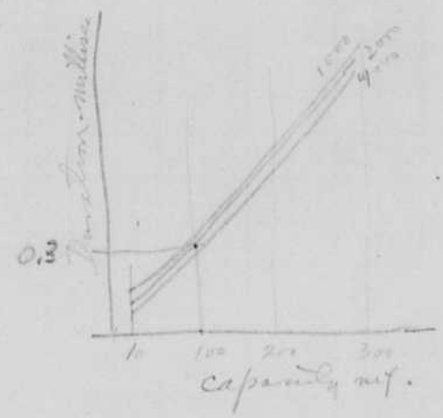
3-30-43 Eric
Herbert E.

I talked to Mr. M today on the telephone arranging a visit to this plant on Friday April 2.

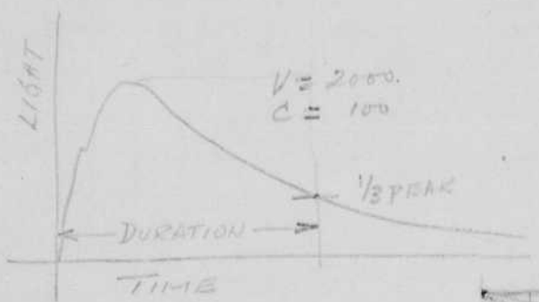
Mar. 31 1943.

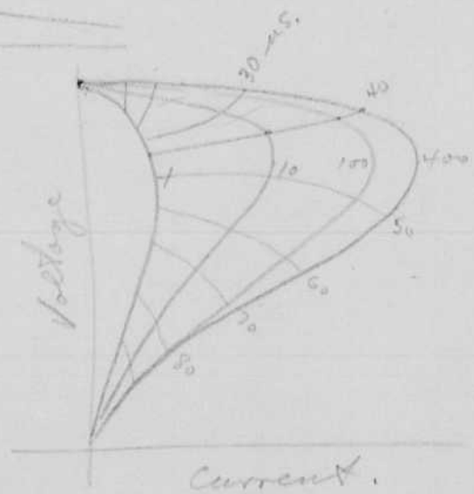
Rewired photocell integrator meter yesterday for AC since batteries are not available due to the war shortage.





Possible methods of presenting lamp performance data.





Ford Mica.

Jan 1942 27. Letter from Johnson.

#2 lamps 112 mt 7000V
10,800 lumens.

#3 lamps 28 mt 7000
2900 ls.

3950 ls. 56 2000

Nyman lamps.
Obtd 2&6 are terminals and
2 goes to far end.
6 to close end.