HAROLD E. EDGERTON

PAPERS

MC 25

SERIES 3. LABORATORY NOTEBOOKS

NUMBER: T-3

DATED: 20 January 1932 – 13 July 1933

Edgerton Ex. HO

2610

EXPERIMENTS WITH STROBOSCOPES, THYRATRONS, ECT.

Massachusetts Institute of Technology

COMPUTATION BOOK

NAME	Number
HAROLD E. EDGERTON.	T-3

Course .....

Used from JAN. 20, 1932 1932, to JULY 13 1933.

Thesis suggestions

Bombardier. ✓

Measure inductance and capacity of condensers by S.S.

Build Photo cell amplifier and meas. performance speed ✓

Flash light outfit. (built).

S. Moisture content tester Science abstracts 2057. Physics 1932

Measure of osc. in neon lamps. Sign transformer, etc, with continuous film camera.

S Construct and test cathode ray oscill amplifier. }

S " " " oscillograph amplifier. }

cathode ray osc. IEE 1932 aug. p 382.

S Ballistic meas of light (Integral) See K.S.

S. Oscillator for B supply for d.c. p 86.

S. Study of vibration in fan blades by special stroboscope microscope arr.

Starting time of thyratrons

Vibration of machinery, microscope, meas of amp. etc.

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."

* * * * * * *"

Harold E. Edgerton
Mass. Inst of Tech
Cambridge Mass.

Jan. 20, 1932.

15 Alden Road
Watertown Mass.

Jan. 20. 1932.

~~H. E. Edgerton~~

Last week, I went to see Mr. David Rines who is now working on a patent application for the stroboscope. I talked to him about an hour and a half and ~~went~~ gave him my three note books to examine. He asked me to look up the prior art.

On ~~Tuesday~~ Monday Jan. 18, Mr Hutchinson of the International Paper company was here and wanted a camera to take pictures at 200 a second with an exposure of 1/10,000 th of a second. This and more can be done. I told him we could make a camera go 400 frames a second with an exposure time of 1/10,000 th of a second. It is going to take it up with the New York office before going ahead on the job.

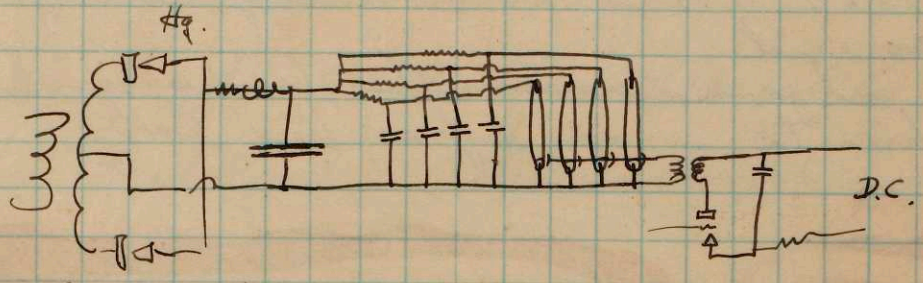
Today Germeshausen and I went over to the Russell Box company to see the strobo. We took out the strobo tube and replaced it with another which Germ made yesterday. At the same time we put in a new thyratron and a new UX 280 rectifier. They seemed very pleased with the outfit out there and use it all the time.

At eleven we stopped in to see Mr. Horton of the G. R. Company to talk to him about the stroboscope, particularly about the Int. Paper company request. Mr. Lampson came in and is going to come over to get the circuit.

Lampson came over and we took some pictures with his new lens mount

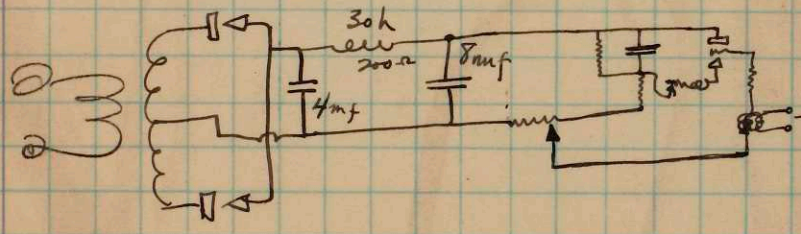
United States Patent Office
Before the Examiner of Interferences
Edgerton vs. Miller - Interference No. 76,771.
Edgerton Exhibit 40
The first notebook entry in Edgerton Notebook T-3.
January 3, 1940.

which is to be used at the "2" street station of the Boston Edison company.



Multiple unit Stroboscope, Spark may be obtained from one spark coil or several.

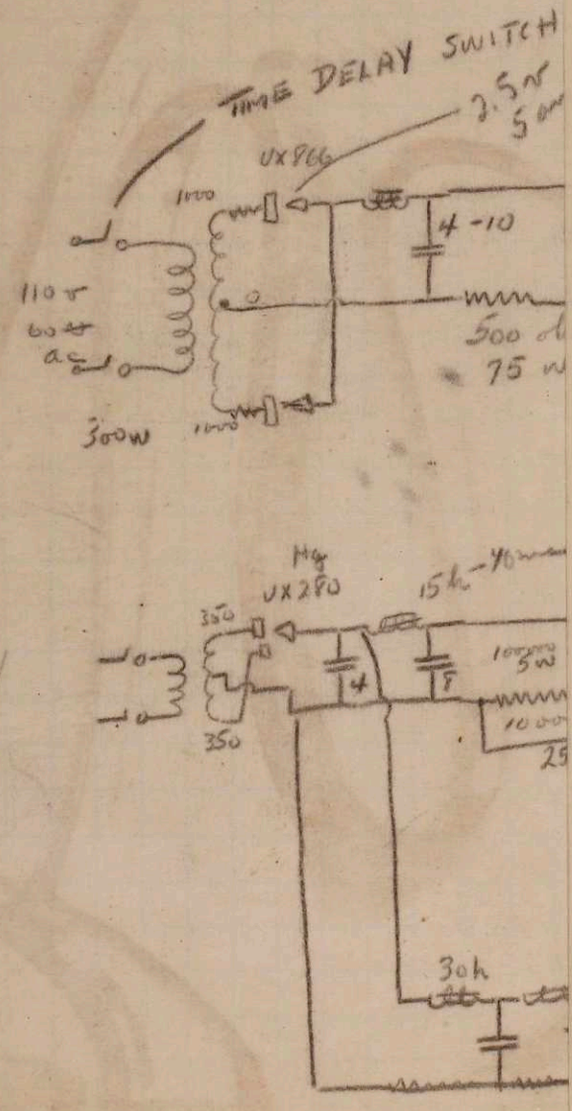
The d.c. for the spark can be obtained from the regular power supply or from any other source of d.c.



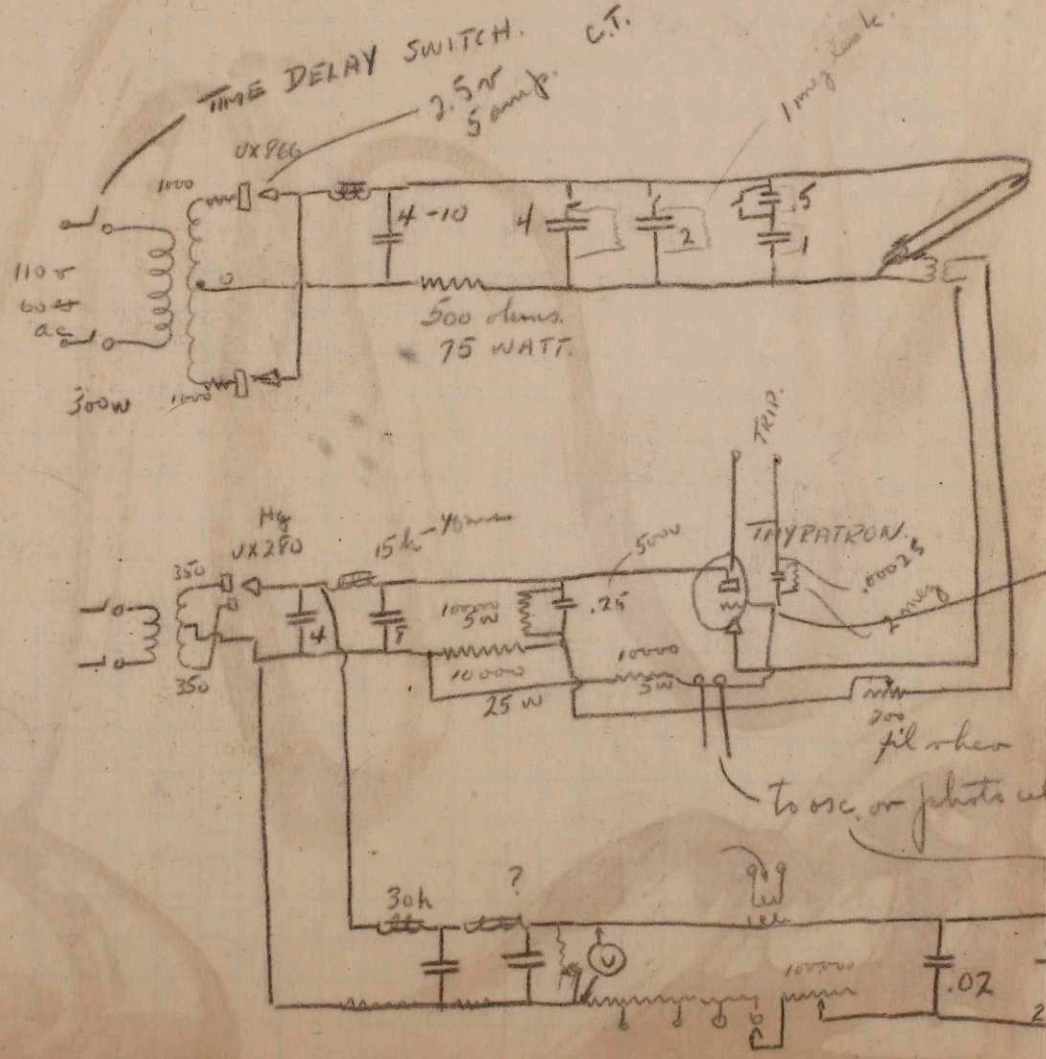
Jan. 21, 1932.
H. E. Edgerton

Lamson of the G.R. Co was over and showed me the pictures we took yesterday. The one with 2 mf at 1000 volts was adequately exposed.

I gave Lamson the below circuit for him to wire up in his lab.



I gave Dawson the below circuit for him to wire up in his lab.



Pri 115 v

Sec 2000 V CT
UY 866 Fil 2.5 V 10 a C.T.
THYRATRON 5 V 6 a C.T.
UX 280 5 V 2 a C.T. ?
PLATE 700 V CT. 30 ma.

JAN. 21. 1932
H. E. EDGERTON.

Jan. 22, 1932.
H. E. Edgerton

H. I. Day of N. Y. called today. He has brought a camera from New York for me to experiment with. I am to get it today at 12.30 at the Station.

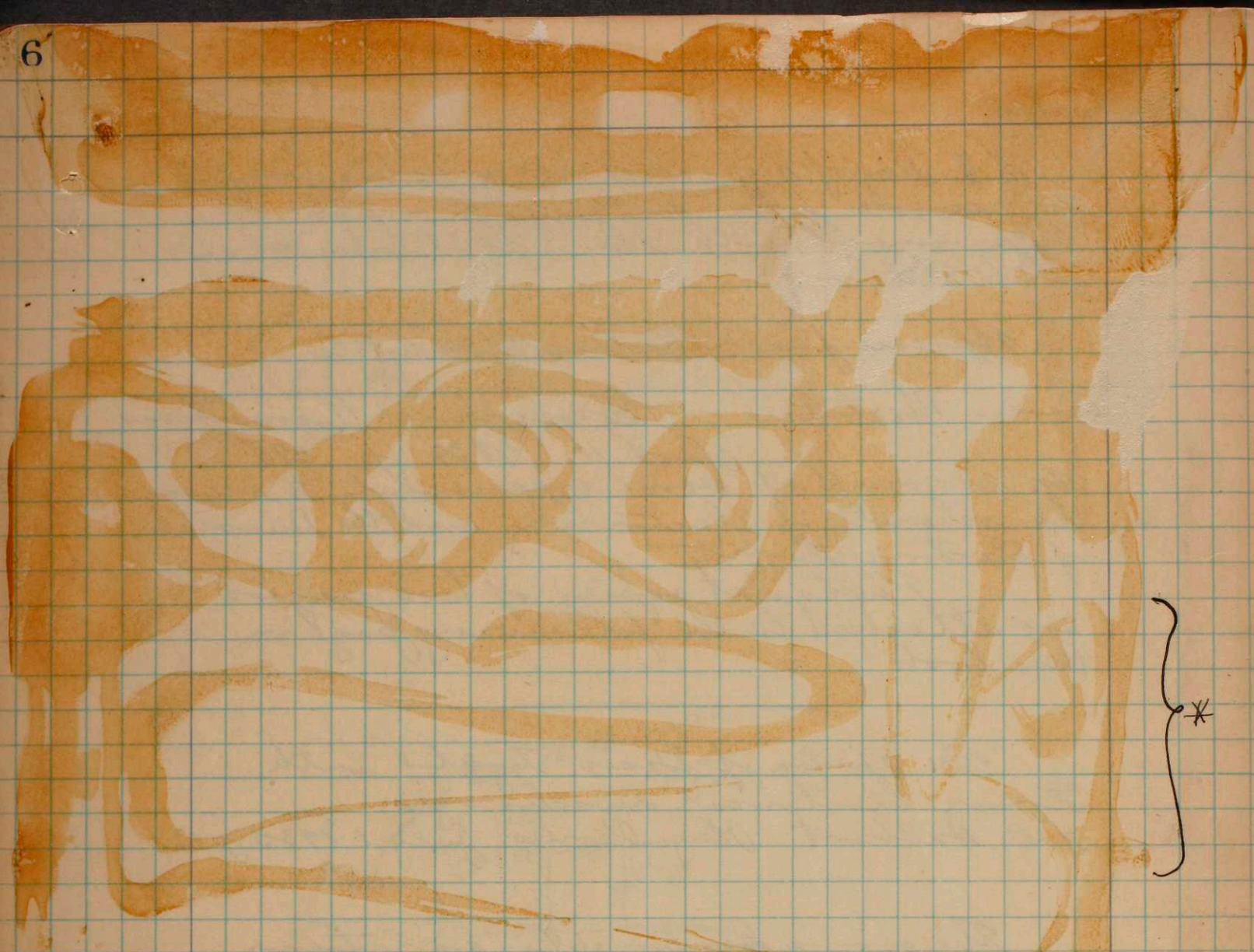
Reference from Mr. Gastham of the G. E. Co.

Charles Wheatstone – Philosophical Transactions Part II 1834. p 583.
"An account of some experiments to measure the velocity of Electricity and the Duration of Electric Light."

Photostat copies of two pages are attached to the following page in this book.

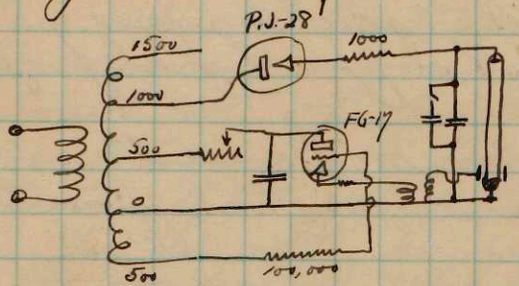
"The Spectra of Gases Lighted with Strong Electrical Discharges.
E. O. Hulburt Phy. Review July 1 1930 p 13.

The camera Day brought is an Eastman Model A and it has a special attachment on it for an electronic lamp and a clock mechanism. It is a camera that Day used for timing races for Mr. Kirby.



Jan. 23, 1932
H E Edgerton.

Started wiring up a 60 cycle Strobscope for use at the Edison Electric Illuminating Co's "L" st. Station, machine 11. Circuit the following.



Dr. J. Campbell of the International Paper company was at Tech today in the morning and he visited to see the apparatus that I showed to Mr. Hutchinson. I am to write Campbell and show him the results of tests I wish to make regarding his problem, which concerns paper machines. He want photographs moving pictures of the fibers in paper as the paper goes through the paper machine. Germeshausen and I showed him the stroboscope and some pictures of what it would do.

Whipple of the aero Lab was over talking to Germ regarding some recording schemes.

Day was over in the afternoon with Paul Olsen showing him some of the labs. We showed them some stunts with the stroboscope.

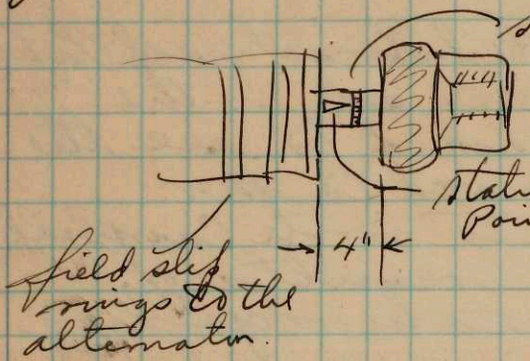
In the evening we gave a party with the Hazens. Those present: Sam Caldwell. Sid Caldwell, Jim Mulligan. Welch Pogue, Lyman Dawes, Bill Hall, Ted Rose, Ralph Bennett, Truman Gray, Malcome Gager, Otto Brune, and bitter halves.

Jan. 24, 1932.
Edgerton.

Picked up Germ. at the Y at 5 and went to Tech. We finished ~~drive~~ up the 60 cycle stroboscope about 10 and took it over to the "L" street station. Richardson met us there and took us out to magline No. 11. The scale was not accurate but I put half of it on anyway.

The electrician Mr. McDonald was going to make a metal pointer for us to read by.

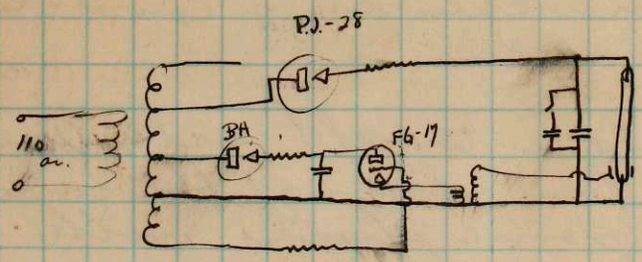
Scale on 11¼" shaft.



$$\frac{11.25 \times \pi \times 2.54}{4} = \quad \text{cm.}$$

There is not quite enough pep in the spark circuit. This can be fixed by putting a rectifier such as a BX Rectythear in this circuit between the resistance and the condenser.

Circuit will be changed to:



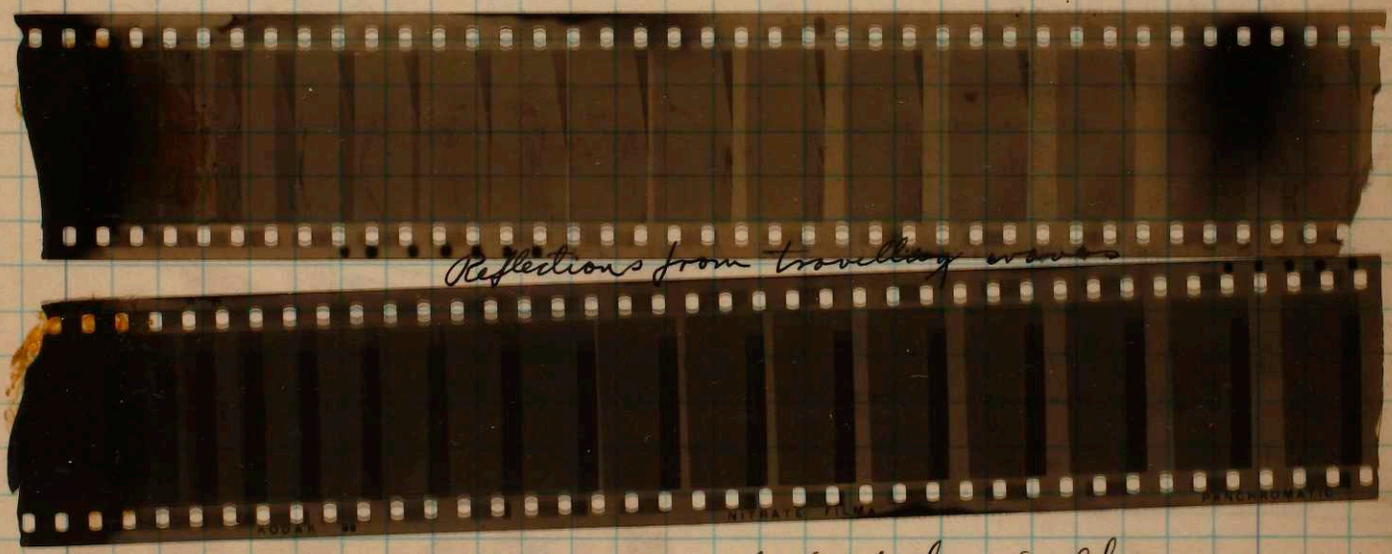
~~0 to 500~~
~~100,000~~

.00.5 amp
5 ma.

Jan. 26, 1932.
N. E. Edgerton.

Worked with Germ and Samson of G.R. on photographs of threads in Paper Pulp which was sent to us by the International Paper CO by Mr. Hutchinson. The camera was somewhat out of focus and there was some fogging on the first set of pictures. Samson left about noon. Germ and I took some pictures to find the focus.

In the aft. Germ took some photos of threads on the pulp with 2 mf at 1000 volts rectified and a 1 ft. strobo. tube. The density was somewhat thin. The pictures were taken on negative film, panchromatic. Some of these pictures were sent to Dr. J. Campbell at Fairmont Falls.



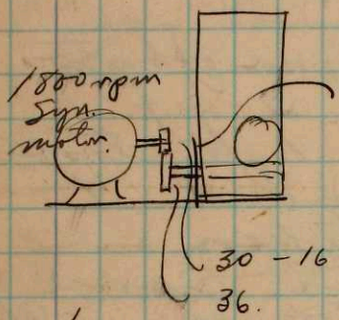
Reflections from traveling waves

Threads on top of the pulp.

Jan. 26, 1932.
H. E. Edgerton.

Corrected 6.03 exam until 2. Germ took more pictures in a.m. Enlarged some in the aft – they were fine. Wrote letter to Ind. Paper Co. and enclosed them with a proposition.

Made a date with Lamson for tomorrow regarding the camera.

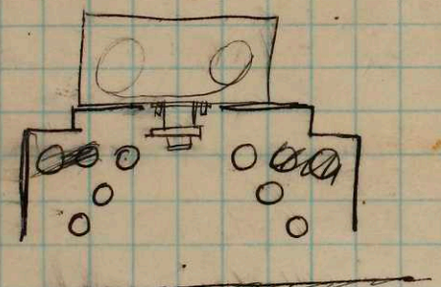


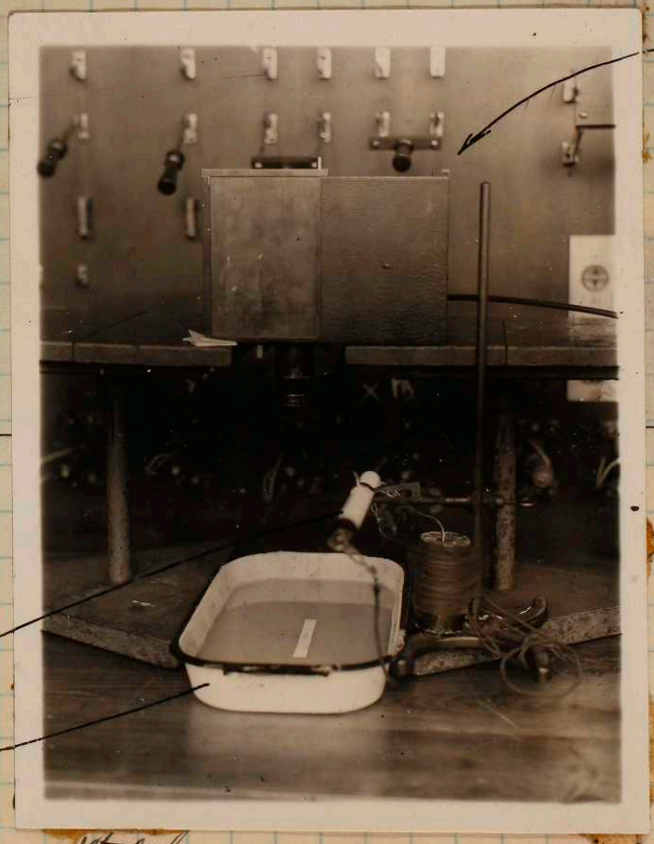
1. Electronic lamp. time.
2. Variable speed.
   Governor ~~motor~~.
   8½ : 1
3. Frame size.
4. Focusing mount.

$\frac{1}{4} \times \frac{30}{36} = \frac{120}{9} = 13$

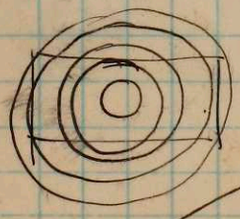
$8\frac{1}{2} \times$

General Radio Camera.





sec.



Strobo tube.

Wood pulp from Hutchinson in pan with threads and scale.

Notebook Number: T-3

Scanning and Separation Record

____unmounted photograph(s)

__5__negative strip(s)

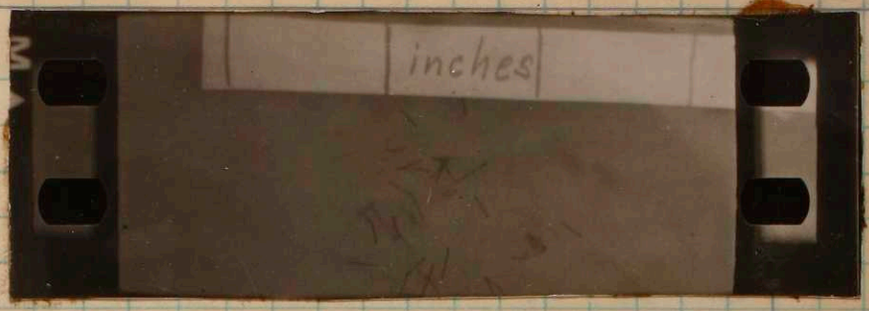
____unmounted page(s)
(notes, drawings, letters ...)

was/were scanned where originally located ~~between page~~ in envelope on page
__11__ ~~and ____~~.

Item now housed in accompanying folder in MC 25, box 166

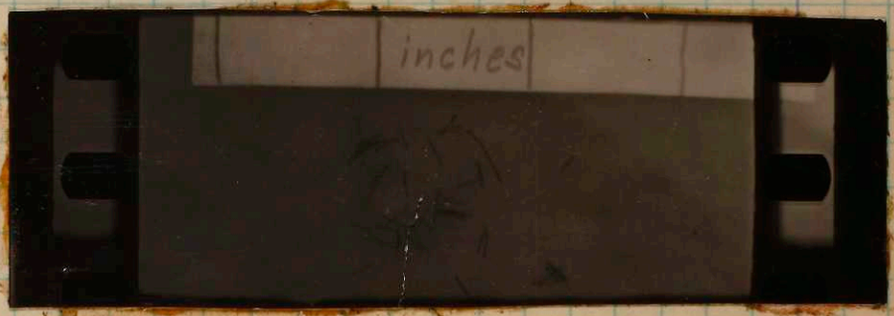
Water-steel

No. 1

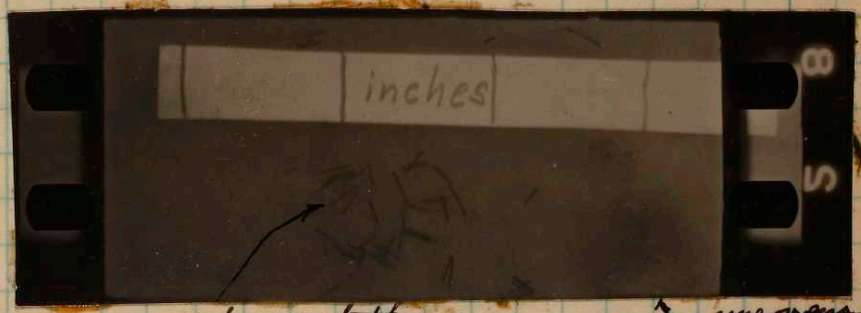


Water agited. 8 frames a sec. 60 a sec.

No. 2

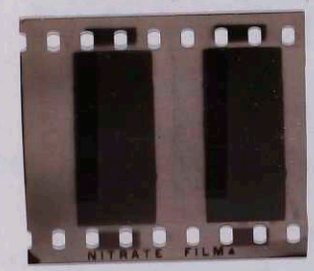


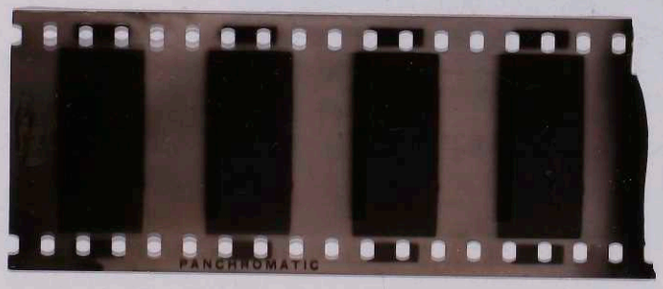
No. 3

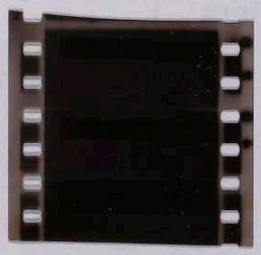


submerged three

Photographs taken and enlarged by K. I. Gennesbausen
Jan. 26. 1932.


NITRATE FILM


PANCHROMATIC



Jan. 27, 1932.

H. E. Edgerton Proctored Exam in morning. Worked with Germ in the afternoon on the stroboscope.

Jan 28, 1932. Proctored Exam in Morning. Spent aft in lab on the strobo. Heard from Int. Paper Co say to go ahead with camera. Saw Jamson about a Syn. motor drive for the continuous drive camera. This is to go 1800 r.p.m. with 16 pictures per rev.

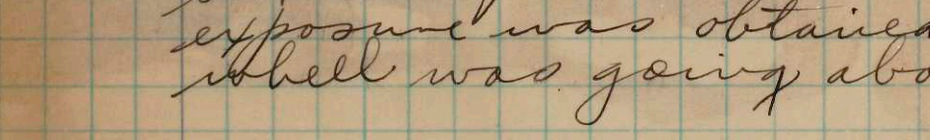
$$\frac{16 \times 1800}{60} = 480 \text{ frames a second.}$$

He is going to order a motor.

Jan. 29, 1932. Germ wired up the old power pack that I used last summer. We are going to try to run 4 tubes in parallel on it at 480 frames a second.

Experimented with two tubes in parallel. they both operate ok with one sparkcoil.

Stark Draper was over and we used his 1 ft rotating wheel camera to snap some shots of the trailer on the tubes. The light from a 1/4 x 6 inch slit was focused on the film. an exposure was obtained while the wheel was going about 2000 r.p.m.



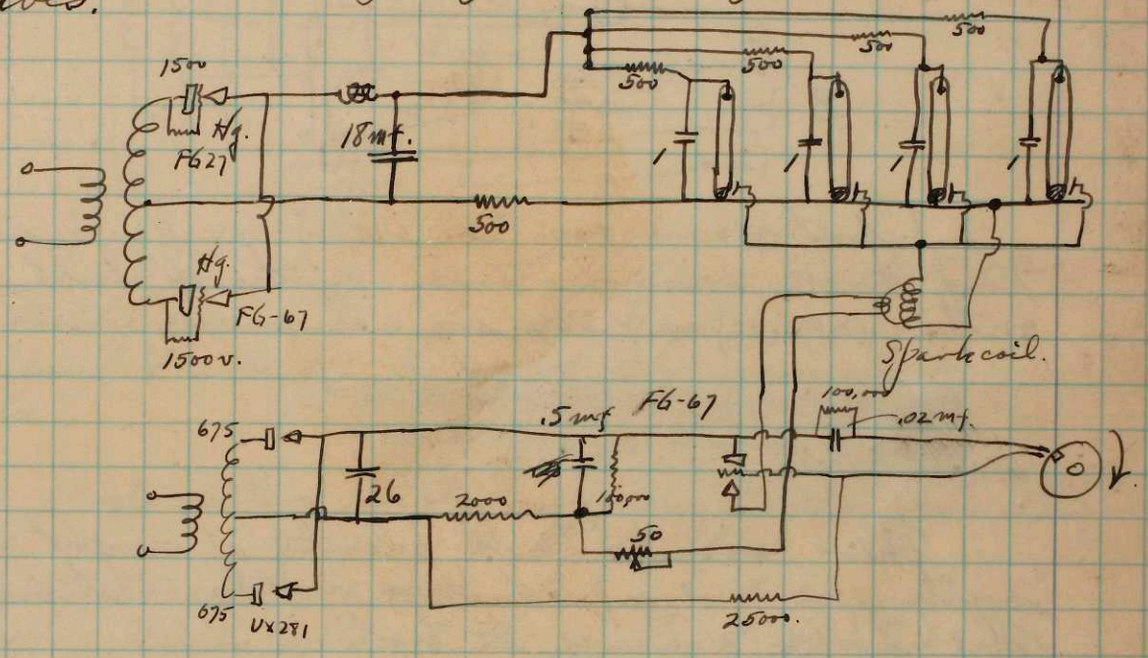
$12 \times \frac{410}{50} \times \frac{205}{5} \times 1 \times \pi = 1288$ inches a sec 1 micro sec. = .00128

.1 inch trailer $\frac{1}{1288} \div .1 = \frac{1}{12,880}$ sec.

H. E. Edgerton.

Jan. 30, 1932. Repeated tests of time of flash with negative film instead of positive. Piece of film attached.

Wired up for parallel operation of 4 tubes.



One of the tubes was defective but the other three worked fine. These were made by Spencer at the Raytheon Inc. The spark circuit takes a lot of power.

$$\frac{10^4 \times .50 \text{ mf.} \times .600^2 \times 480}{2} = 43.2 \text{ watts.}$$

.36 × .5 × 480 / 120.

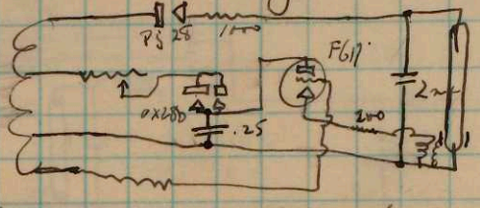
120 / 240 / 480 / 1 / 9 cm

36 / 12 / 72 / 36 / 432

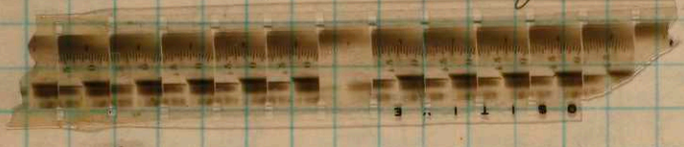
Some trouble was experienced at first. The difficulty was due to the spark circuit which was not charged to a high enough voltage to effectually trip the lamps.

Jan 31 1932
H. E. Edgerton

Came down in the morning and set up the 60 cycle stroboscope (page 7) with a UX 280 in the spark circuit. Also changed tubes. Now using the one with broken glass on the surface of the mercury which Germ made some time ago.



I put some positive film in Day's camera and took some pictures of the 14 inch disc on the (1200 r.p.m.) 804 synchronous machine.



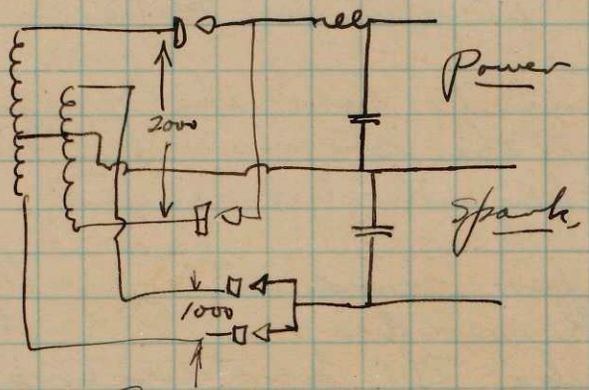
There seems to be plenty of light with even 2 mf at 1000 volts rectified. The tube gets quite hot.

Germ came about 11 and we set up a milk drop experiment. Took movies at 250 frames a second of the drops just as they struck the surface.

For these tests we used three tubes in parallel about 5 or 6 inches from the subject. Each tube was connected to the rectifier system and to 1 mf. Rectifier 1500 volts on each side. 18 mf filter cond.

Feb. 1. 1932
H. E. Edgerton

Changed power supply somewhat in order to reduce voltage. 2 mf used in discharge instead of 1 m.f.

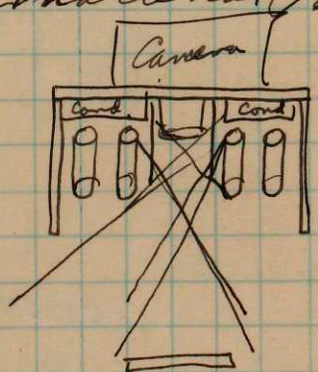


Saw Jamson and Horton in the aft about the camera for the Int Paper Co. Germ and I are to build the power packs.

Feb. 2, 1932 Wrote letters in the morning. Order from Russell Box Co came. Ackerson to build it.

In the aft. Germ and I went down to see Mr. Rines about the patent application.

Started design of the lamp holder for the International Paper Co. Four tubes in it



9 1/4" – 17 1/4"

Feb. 3, 1932
K.E. Edgerton.

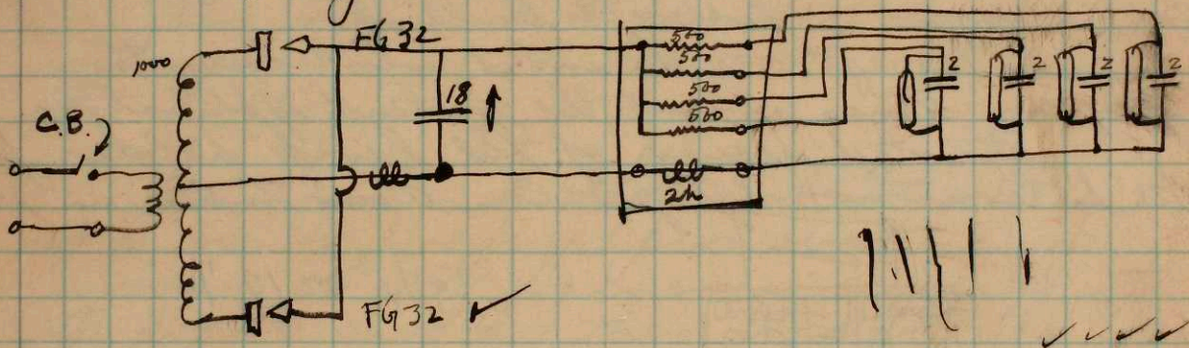
Dept. conf. on grades in morning. In aft. Germ and I went up to the textile department, Prof. Swartz, and looked at a spindle with the stroboscope (2-UX 281 for rectifier 18 inch strobo tube).

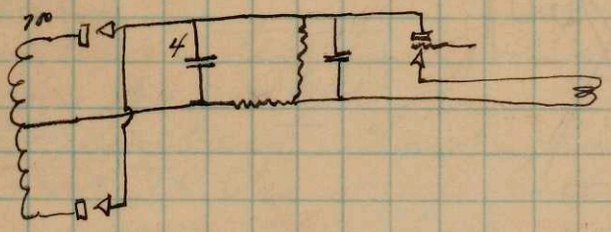
Swartz wants to take photographs of spindles to get the stresses on the threads as they whirl around.

Stark Draper came over in the afternoon and wired up a two stage amplifier for the photocell trip for the camera. (continuously moving film).

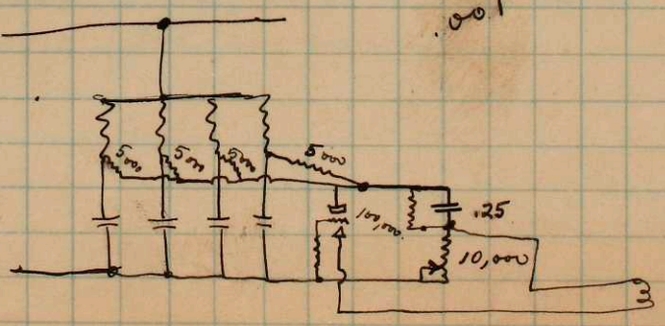
Put together the four tube reflector for the Int. Paper Co. job.

Proposed circuit.





$0.25 \times 010{,}000 \times 10^{-6} =$
$.0025$ sec.
.001



6910
6695
6524
6400
6364
6319-8 or.
6296
6245
6239
6196
6190
6150 Bright.
6122
6100
6089.
6072 ARC
↕ → Band
6015
5960 orange.
5890 green yellow
5869
5860
5850 } Faint.
5350
5816.
5803
5790 Bright. ARC
5770 " "
5726. very weak
5700 medium.
5676 Strong
5596 Medium
5555 Weak
5512 W
5461 5 ARC
5423 M
5405 W
5365 W
5354
5344.
5315
5310
5295

5288
5280
5244
5234 W
5224 W Green
5215 M
5205 M
5196 W.
5160
5145 W.
5133
5128 M
5100
5066
5060
5045 Broad.
5026 W
4982 or 1 W
4973. W
4960 M Blue green
4915 5. ARC
4826 very faint lines between
Exp. band.
4810
4798 W
4740 Blue
4661
4398 M
4355 5 ARC
4345 M "
4337 M "
4218 Violet
4075 ARC?
4045 5. ARC
3984.

U.V. lines.

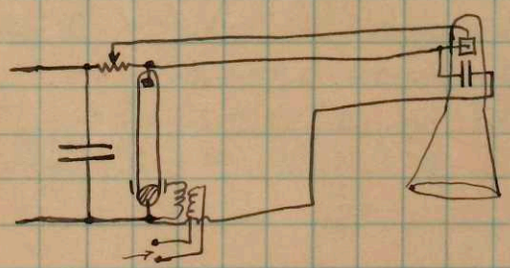
3100
3000
2960
2820
2790
2650
2536
2490
2260-2400 faint band.
2220
2070

Feb 4. 1932,
H. E. Edgerton

The attached list was made at the Raytheon Inc. by Germand with their spectrograph. The U.V. lines were measured by mr. Smith on this quartz instrument.

Percy Spencer had a tube filled with pure helium which we put on the strobo circuit and ran for a while. It had about a cm. of gas in it. It held over at 1000 volts rectified part of the time. A hand close to it would stop it by charge effects.

Spent the morning working with Roland Beers on the cathode ray oscillograph for measuring the volt amp characteristic of the Strobo tube.



There is lots of pickup in the circuit especially when a magnetic deflection is made with a coil around the oscillograph.

Feb. 5, 1932
H. E. Edgerton

Germeshausen and I assembled the reflector which holds the four one foot tubes for the Sid. Paper job. We ran it with 3 tubes for quite a while at 480 cycles a ~~second~~.

The tubes when cold seem to have bright spots in them when first started. These spots are apparently on the walls of the tube and jump around. The color of the tube is blue for such experiments and is not very bright.

Feb. 6, 1932

Worked yesterday afternoon with Germ on gas filled tubes with solid cathodes. He has described the experiment in his note book.

The scale on the shaft blew off in one days run at the 12" street station.

$11\frac{1}{4} \times \pi =$ circumference.

$= 35.323$ inches

$.312 = 5/16$ inch

$.011$

$8.831 \times 2 = 27.43$ cm

3.1416
11.25
157080
62832
31416
31416
353.7300 inches.

$4 \overline{)35.\,5/16} = 8.\,\frac{13\frac{1}{4}}{16} = 8.\,\frac{53}{64}$ $\qquad 8 - \frac{27}{32}$

$4 \overline{)53}$ $\quad 13\frac{1}{4}$

Registration today for 2nd term

$35.\,5/16''$

Feb 9, 1932.
H. E. Edgerton

Germ worked with tubes having iron cathodes with some gas in the tube. He called from a spot on the iron.

Lawson's assistant from the G.R. was over with the camera. We tried some pictures at 480 frames a sec. There was fogging on the film for some reason or another.

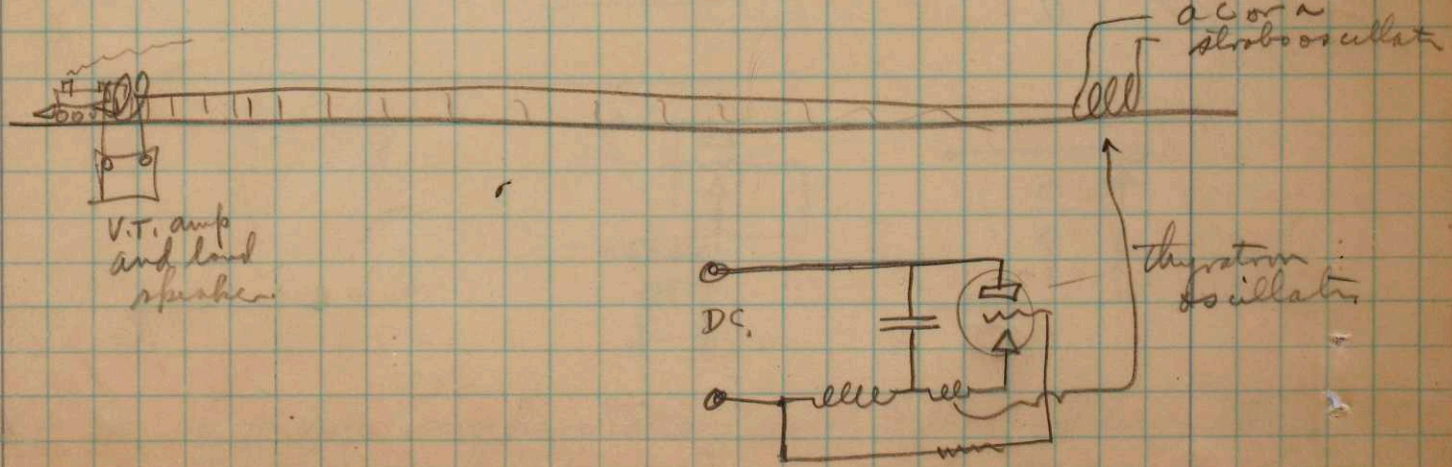
Mr. William G. Knight of the Bangor and Aroostook RR, Derby, Maine, was here today and talked about the stroboscope. He also told me of the freight train problem concerning communication.

Feb 10, 1932.

The wheels and axles of the cars act as a short circuit to the current if you try to use both rails. Radio is out because of the radio commission.

I wonder if a very large current was put at say 500 cycles from a stroboscope circuit through the rails if enough energy would get up to the other end to detect a signal.

Another scheme would be to use a magnetic field from a large coil about the engine and the caboose. ac in the coil would induce a voltage



Feb. 14, 1932.
H. E. Edgerton

The Strobo lab. in 10-088 has been cleaned up for a demonstration tomorrow.

Mr. Hutchins of the Int. Paper Co was here Friday and we showed him the pictures we had taken during the first of the week. We planned to go to his plant at Livermore Falls Maine next weekend with the 480 ~~cycle~~ frame per second camera.

Germeshausen tried a max. energy developer which gave fine pictures.

The supersensitive panchromatic film gives ~~no more~~ denser picture than the standard negative film. We also tried positive but there was a 2:1 ratio between it and the negative.

Today Germ. and I took some 480 f.p.s. movies of milk drops splashing on a surface. We took a 20 ft film which we hope to project.

Feb. 17, 1932.

H. E. Edgerton.

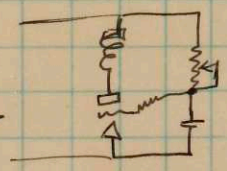
We demonstrated the stroboscope to the visiting committee on monday afternoon. First I explained the ~~theory~~ properties of the device. Then I showed some movies of the motion of a claw mechanism. The 480 p.p.s. camera and lamp were next shown. The 20 ft piece of film showing the falling milk drops was finally shown.

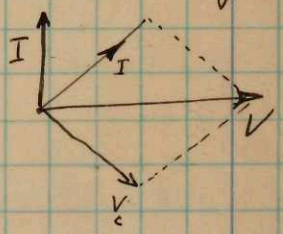
Then they went out to the sub-station and saw the 187 kva. ~~alterna~~ synchronous motor oscillate.

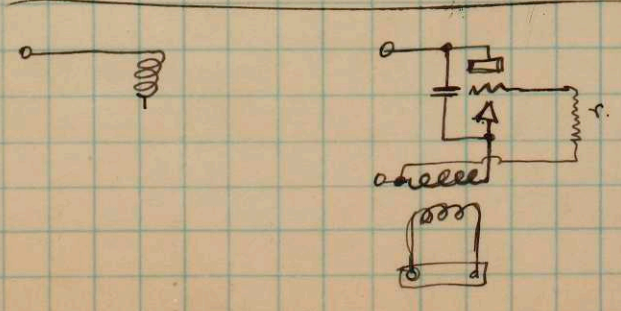
On tuesday, Feb 16, I worked most of the day with Grey and Siebert for their laboratory work in connection with Lyons course. They are to take oscillograms of the oscillations of a synchronous motor ~~and~~ following a sudden change of shaft load.

Mr. Holmes ~~of~~ who I met at the Raytheon Inc. was over to find out about thyratron circuits for timing

I showed him a phase shifting circuit of this type. →







Mr. Sperry of N.Y. was here today and I showed him the stroboscope and the continuously moving film cameras. Draper brought him over.

after seeing the strobo. lab. we took him up to the research labs. ~~to see that room~~ on the third floor. He was very much interested in the integraph.

The patent application from Mr. Rines came yesterday and it is getting into shape.

Melting point of solid metals.

	Bi	271 °C
Cd	Cadmium	320
Pb	Lead	324
K	Potas	62.3
Na	Sodium	~~97.5~~
	tin	231.9
	Selenium	218.5.
	Woodsalloy	75.5.
Ba	Barium	850.
Li	Lithium	

Notebook Number: T-3

Scanning and Separation Record

____unmounted photograph(s)

__1__negative strip(s)

____unmounted page(s)
(notes, drawings, letters ...)

was/were scanned where originally located between page 22 and 23.

Item now housed in accompanying folder in MC 25, box 166

Feb. 24. 1932.

Gerrard and I got the Int. Paper camera and power supply together and took it to their Fitzmine Falls mill on Saturday morning. We arrived about 2 or 3 in the afternoon and had it set up by late afternoon. The plant was very damp and wet.

Another trouble was that the ac voltage was only 90 volts! This underheated our filaments on our rectifiers the water on our commutator was very bad as it consisted of a leak that prevented the trip condenser from discharging.

We took pictures of the formation of the pulp on machine number 11, 900 ft a minute.

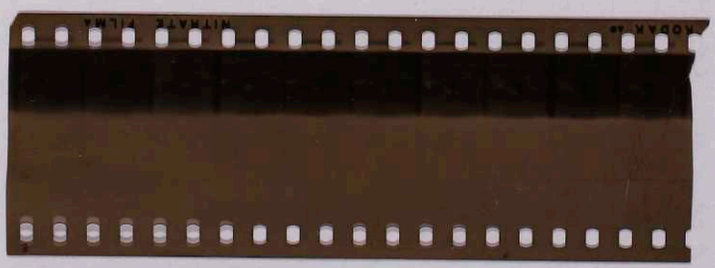
$\frac{900}{60} = 15$ ft a sec.

$\frac{15}{480} = .0312$ of a foot.

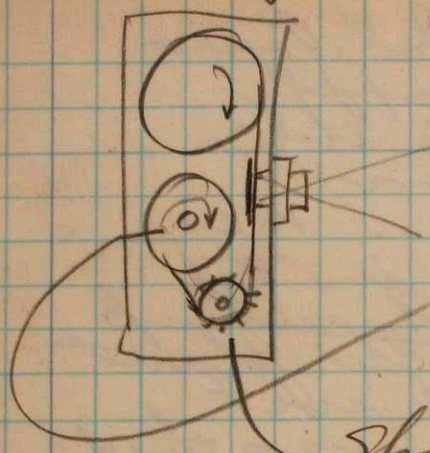
$= .375$ of an inch motion.

Also we photographed the pulp on machine no. 5, 500 ft a minute

We returned to Ottawa on Feb 23 ~~Tuesday~~. Stopped at the G.R. as soon as we came back. Talked to Jepson regarding a camera. Told him of a scheme for running the film through to eliminate the sliding take up reel which is used on all movie cameras.


KODAK
NITRATE FILM

Feb 24 1932
cont.



motor to drive the takeup reel directly!

Sprocket wheel to drive the contact system to trip the strobe lamps.

Also to have a friction governor on it to regulate the speed.

After talking to Lamson we went to the Delta Mfg. Co. and saw Bertram about getting out a power box for us.

Both the G.R. and Delta promised the outfit by March 4th, & called Hutchins and he asked me to write to Dr Campbell about it.

Notebook Number: T-3

Scanning and Separation Record

1 unmounted photograph(s)

____negative strip(s)

____unmounted page(s)
(notes, drawings, letters ...)

was/were scanned ~~where originally located between page~~ in place on page 25 ~~and ____~~.

Item now housed in accompanying folder in MC 25, box 166

Feb. 28, 1932.

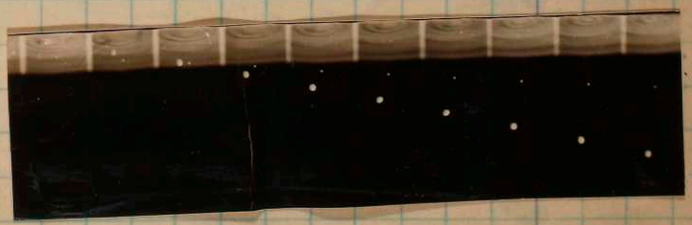
These are contact prints of part of the pictures taken Feb 14. 1932. They show a milk drop as it splashes on a surface of milk.

Copies of this were given to A.W. Hull and to Mr. Horton.

I attended many meetings of the physical society during last week. They were having a convention at Tech and Harvard.

~~Today~~

Ryotaro Mitsuda
Electro-technical Laboratory
Ministry of Communications.
Japan.



Notebook Number: T-3

Scanning and Separation Record

4 unmounted photograph(s)

____negative strip(s)

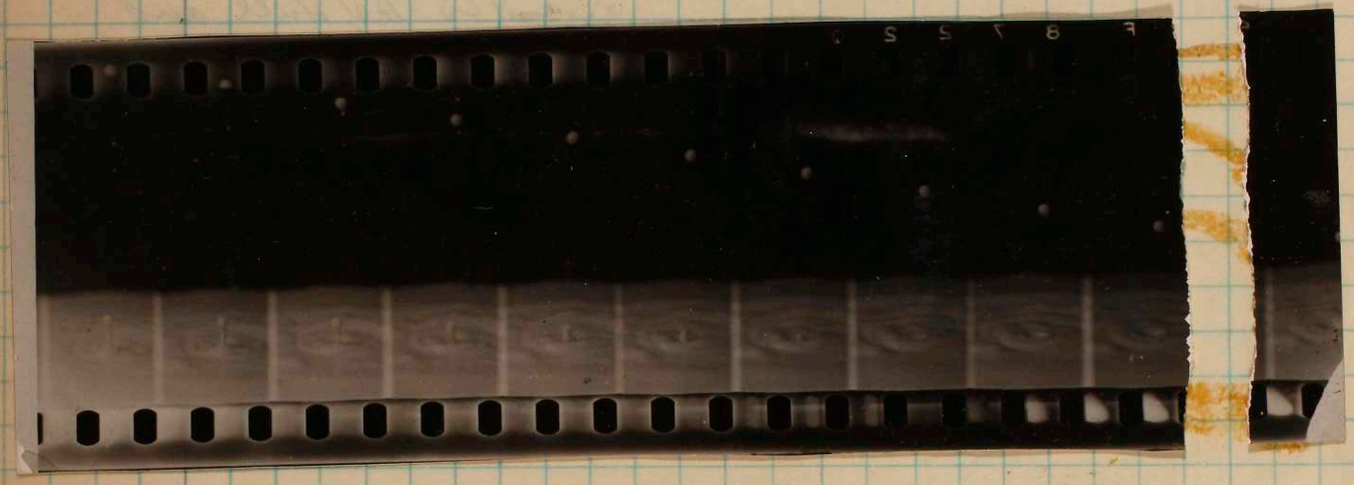
____unmounted page(s)
(notes, drawings, letters ...)

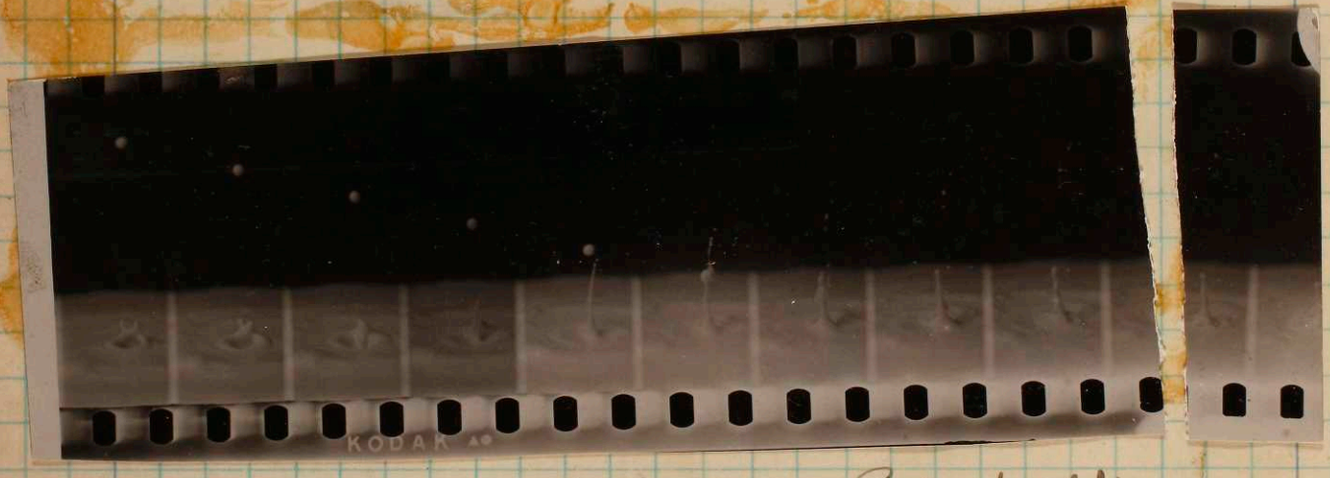
was/were scanned ~~where originally located between page~~ in place on page 26 ~~and ____~~.

Item now housed in accompanying folder in MC 25, box 166

March 1, 1932
H. E. Edgerton.

Saw my Lines this aft. Got data from the Physics lab regarding the cathode ray oscillograph EP-53. and the power-supply to run it.





United States Patent Office
Before the Examiner of Interferences

Edgerton
vs. } Interference 76,771
Miller

Edgerton Exhibit 9.

Pages 26 + 27 of Edgerton Notebook T-3.
(2 pages - page 26)

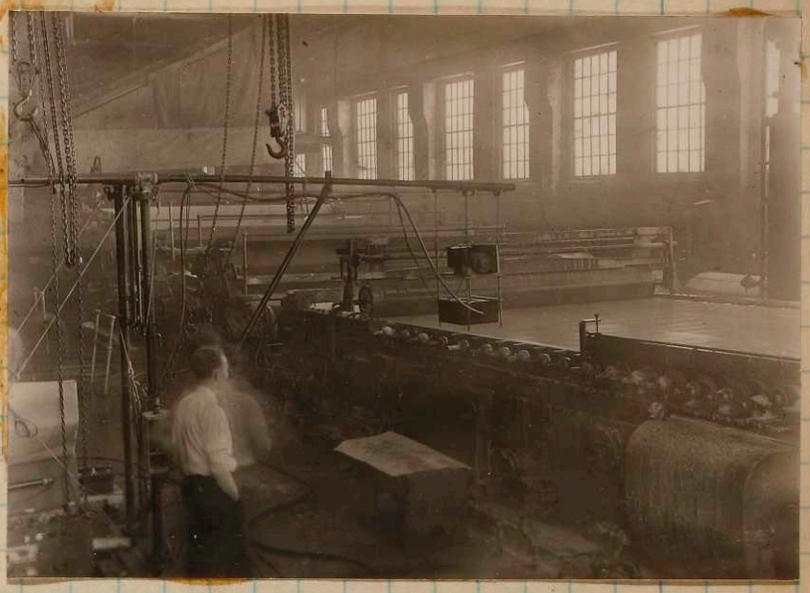
January 2, 1940. Clara Schlosky
Notary Public

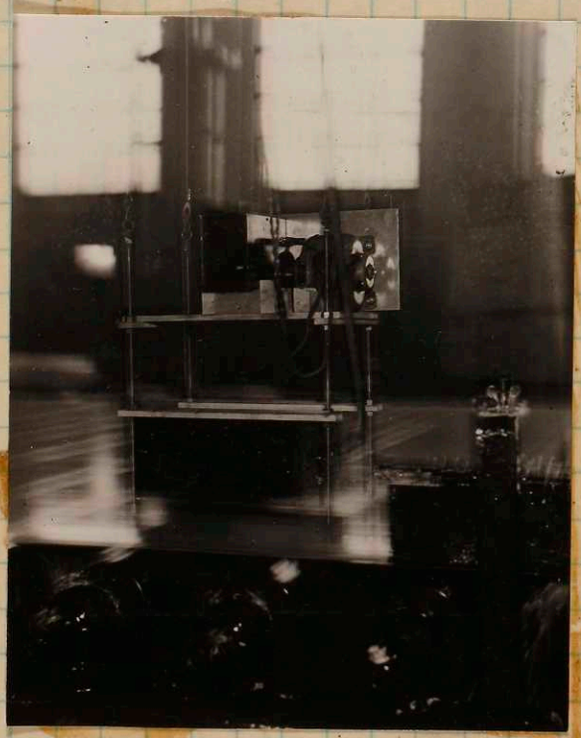
RECEIVED
JAN 18 1940
PATENT OFFICE

March 3 1932
H. E. Edgerton

A photograph taken by Germeshausen in the Otis plant of the Int Paper Co at Livermore Falls, Maine, during our trip there a week or so ago.

The mercury tubes are in the black box just above the web. The camera is above. It is driven by a synchronous motor.





A close up of the camera, motor and lamp house. They are suspended above the wire which was travelling at a rate of 826 ft a minute.

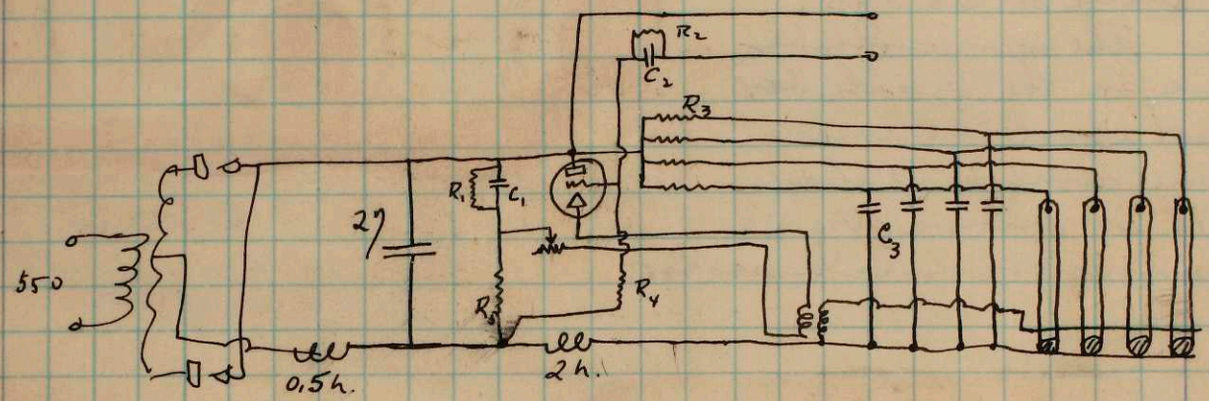
Germ and I saw Lawson yesterday at G.R. about the camera. It is about finished. He wants us to show them the circuit that we are using for the final I.P. Co job.

March 4 1932

H. E. Edgerton

We obtained the camera from the G.R. yesterday for the I.P. co..

Saw Lawson about the circuit that we are using and gave him the data for it.



R_1	200,000	5W	C_1 = 0.25 mf ~~600 v.~~ 1000	
R_2	200,000	1 W	C_2 = 0.002 .. 1500.	
R_3	500	160 W	C_3 = 2.0 mf. 1500 v.	
R_4	10,000	25 W		
R_5	10,000	25 W.		

United States Patent Office
Before the Examiner of Interferences

Edgerton
vs. } Interference 76771
Miller

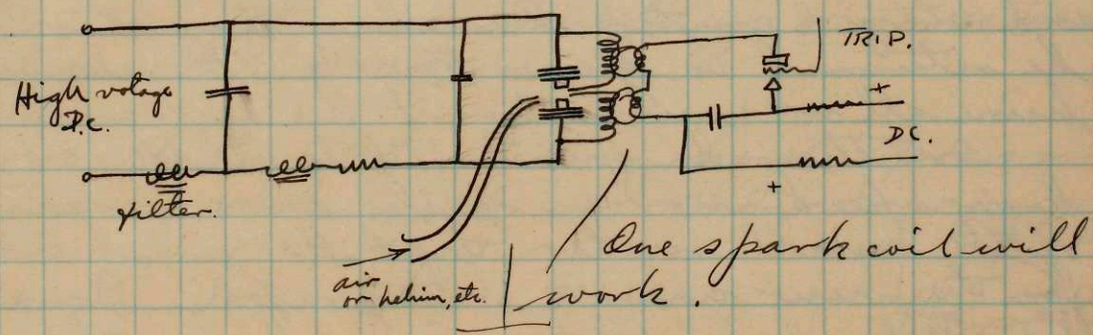
Edgerton Exhibit 8.
Page 28 of Edgerton Notebook T-3.
January 2, 1940. Clara Schlosky
Notary Public

JAN 18 1940

March 4/1932
Hdqrtrs.

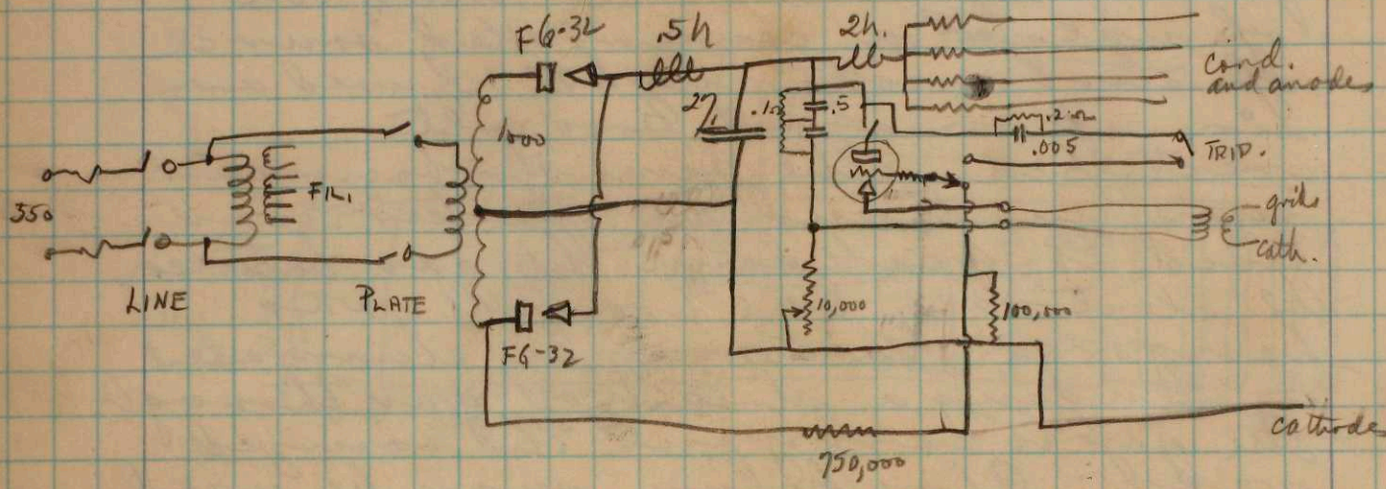
Went over to the Delta Co. this a.m. to see about the power unit for the stroboscope. All the material is in and they were getting the frame together.

Last summer I tried a circuit for Prof. Harris which may be of use as a concentrated source of stroboscopic light. I used an air gap on about 2000 volts rectified. The same stroboscope circuit was used and the sparker was used to break down the gas between the electrodes. One trouble was hang over. This may be eliminated by sending a stream of gas through the gap to carry out the ionized vapor. Also Helium may be used as a medium or may be squirted between the arc faces.



March 8 1932
H. E. Edgerton.

Dimeshomer and I went over to the Delta Co about 4 to get the Stroboscope which we are building for the Int. Paper Co. We brought it over to tech and had it checked and running by about 9 p.m. Several minor changes were made. The circuit is now as given below



March 12 1932
H. E. Edgerton.

Mr. Hutchins came Tuesday morning and stayed until Thursday night when he returned to Glens Falls. We showed him all we could about the apparatus.

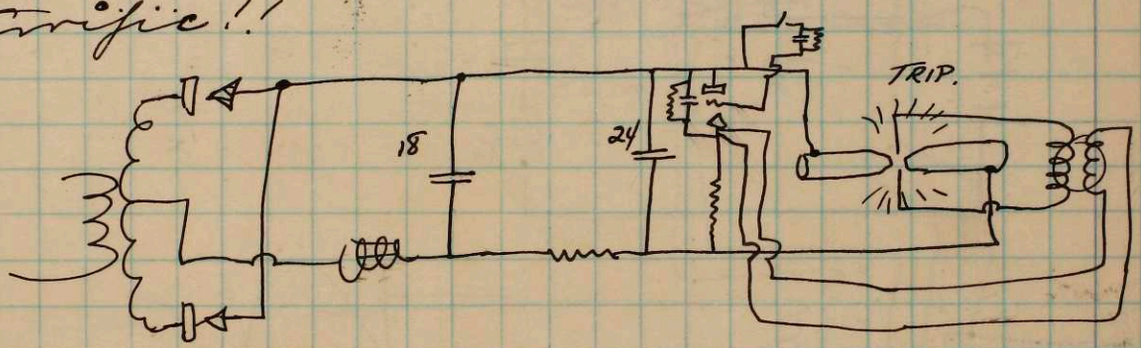
On Thursday we tried to take some high-speed movies of the acceleration of the small motor that Hazen built for the new cinema integraph. Some trouble was experienced in the focus. The focus was about 1 3/4 inches from its first place as determined by tests last week.

March 14, 1932.
H. E. Edgerton.

Last Saturday Germ and I went over to the General Radio Co to talk to Mr. Lamson about the focus in the camera. While there we also talked to Mr. Horton regarding the stroboscope. He just returned from a trip to Schenectady where he found about the G.E. situation regarding stroboscopes.

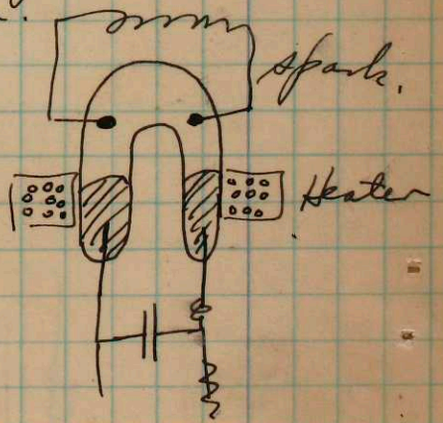
March 16, 1932.

Have been experimenting with the spark gap such has has been previously described. It is possible to project movies with it but the noise is terrific!!

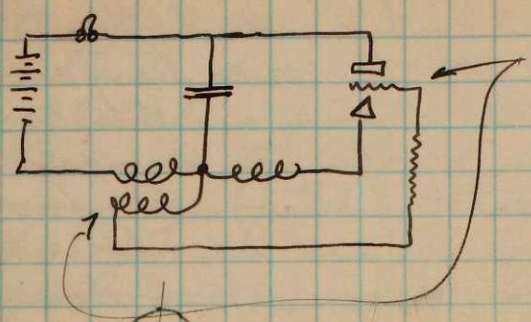


A noise filter or muffler is needed to drown the noise.

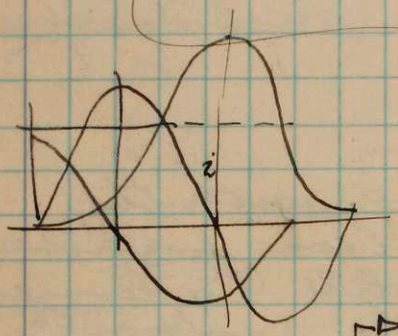
We might use a high pressure mercury arc such as shown.

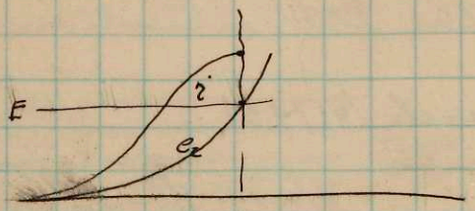


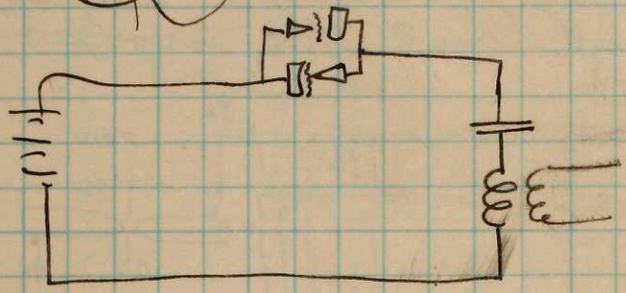
Oscillator.

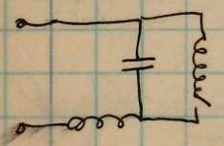


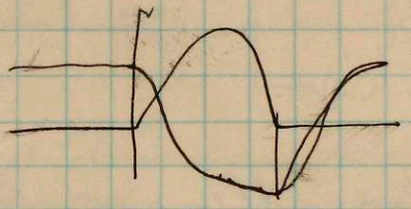
grid neg while charging.





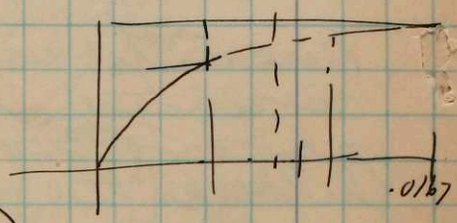


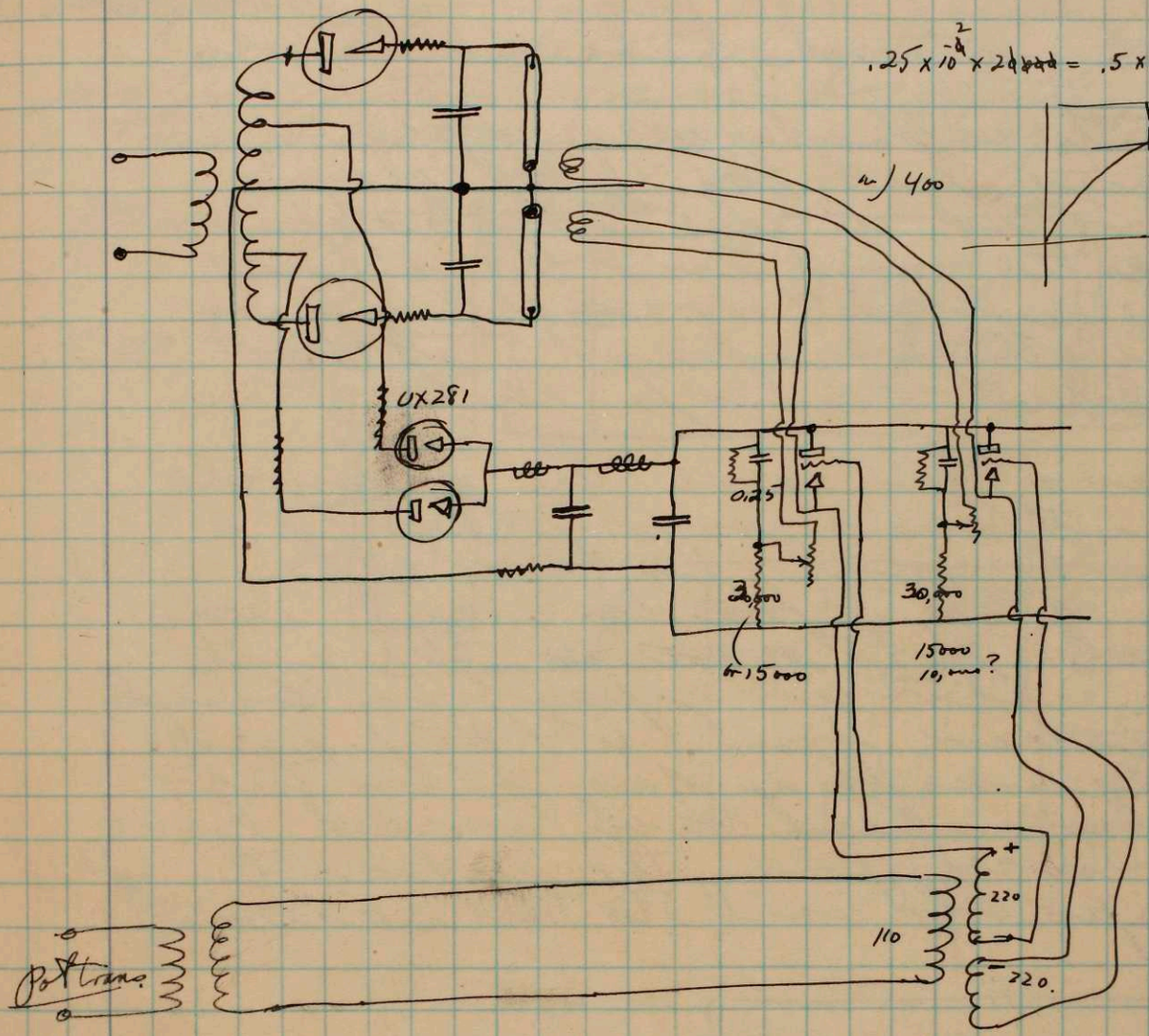




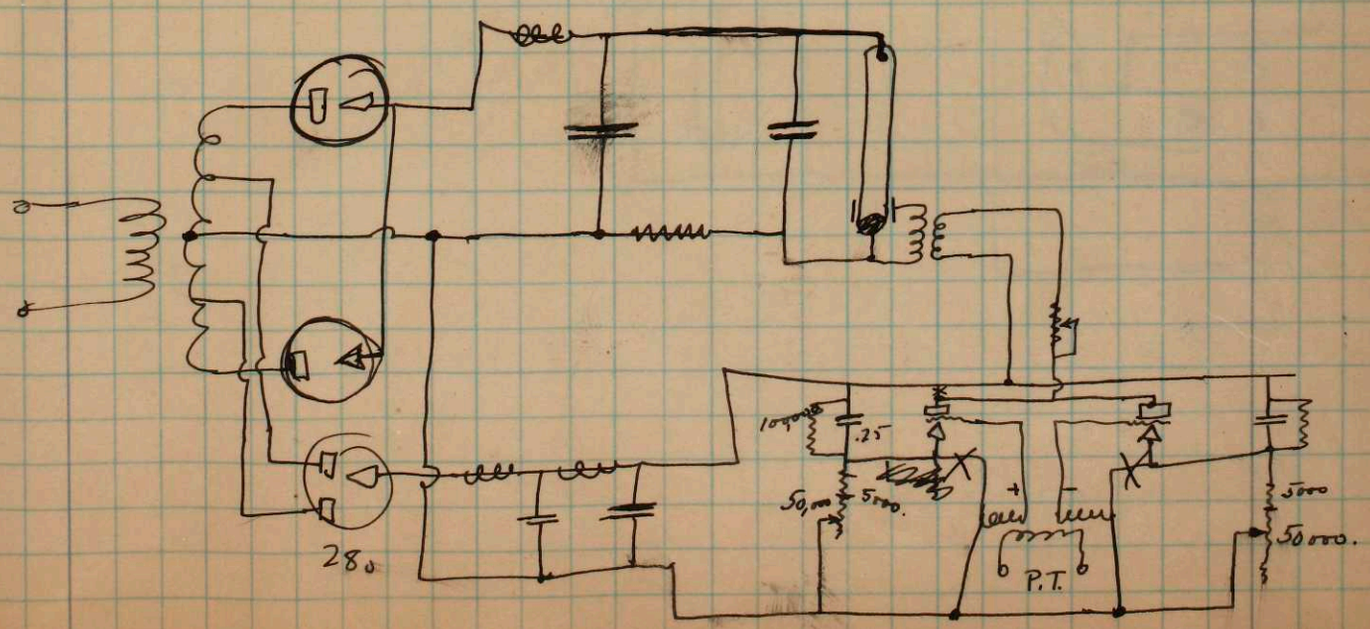
J. E. Eliot.
March 19, 1932.

$.25 \times 10^{-4} \times 2 = .5 \times 10^{-2} = .005$ sec.





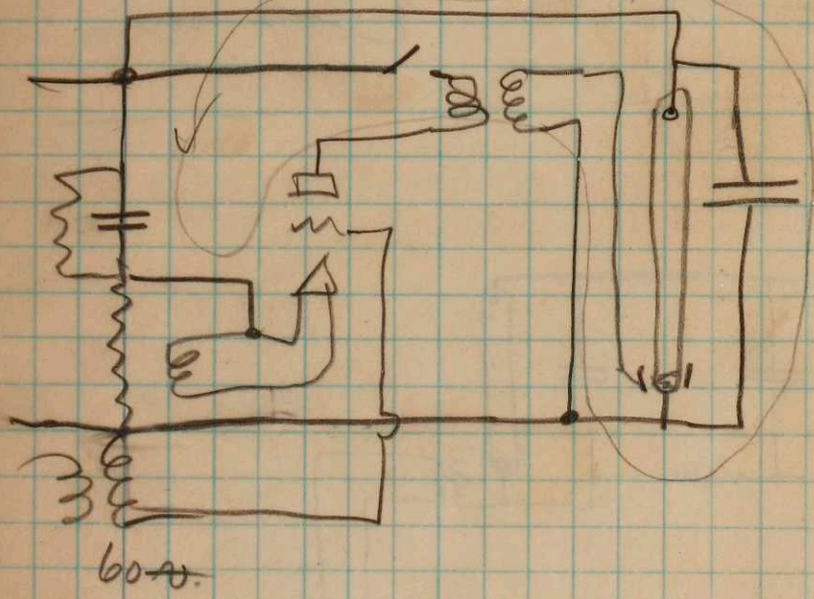
Or.



I have noticed high frequency oscillations in thyratron & rectifier tubes.

Once the cathode was open circuited but the blue glow persisted in the tube, apparently between the grid and the anode & the current was N.F. going through the capacity of the filament transformer.

In another case the grid circuit was connected to a spark coil, but the other end of the spark coil was open. H.F. was in the coil however as sparks could be taken from it (HF) and it caused a gas filled tube to glow. Feed back could have occurred from the capacity of the spark coil to the cathode.



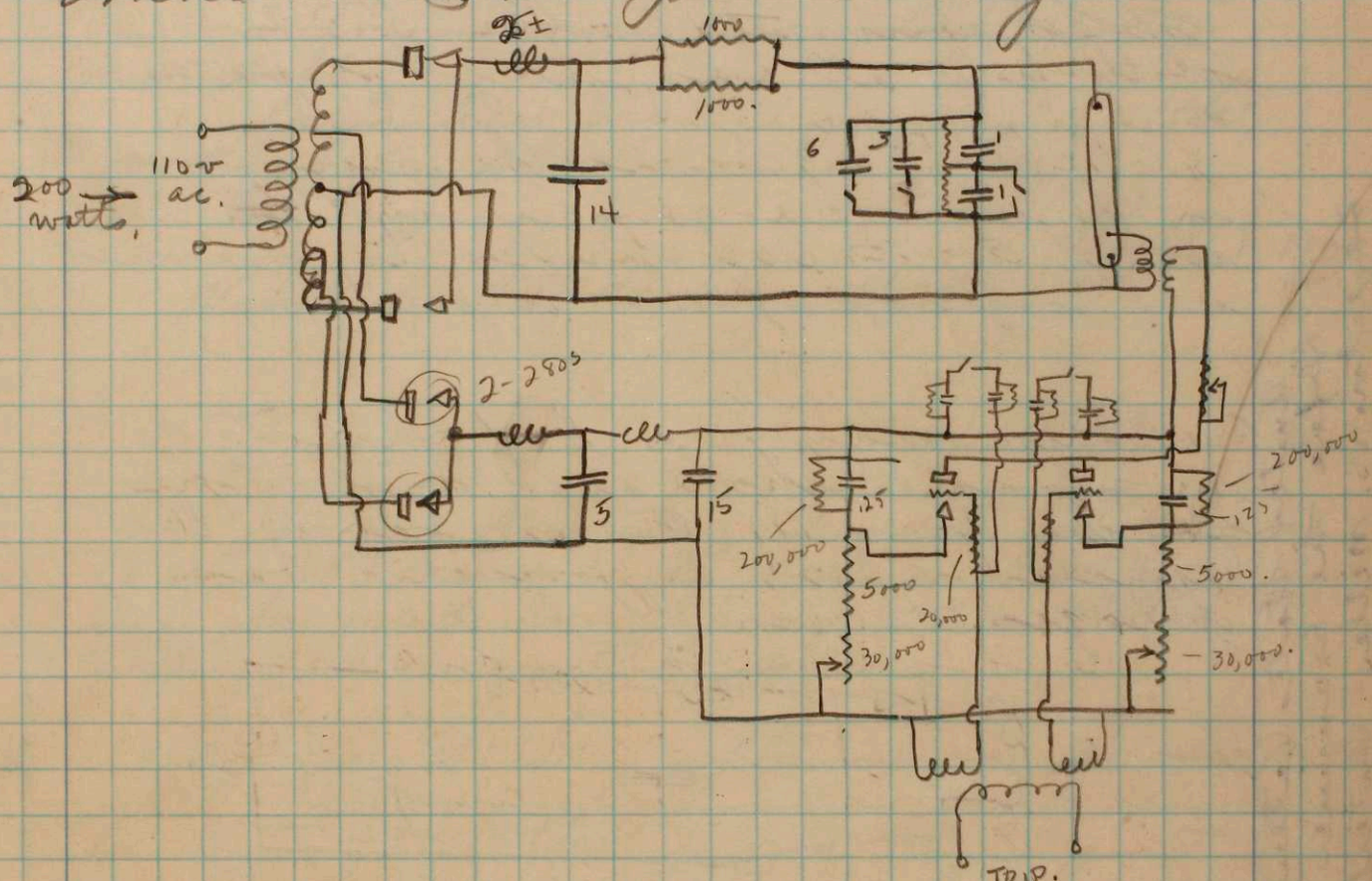
oscillation?

60~.

March 23, 1931.

P. H. Hedgerton

~~180~~ cycle Stroboscope for taking motion picture records of the transients in power systems.



$RC = .125 \times 10^{-6} \times 5000 = 125 \times 10^{-3}$ sec.

.0125

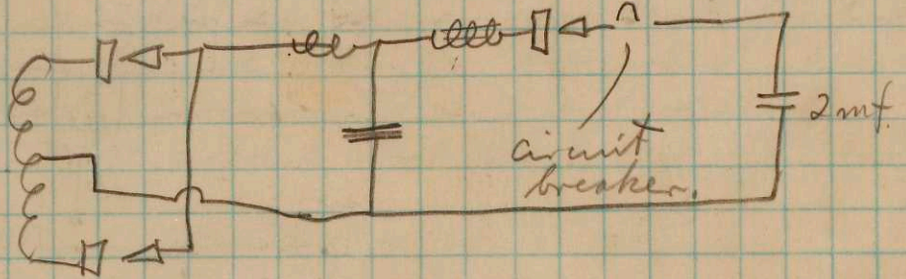
.0167 sec. = 1/cycle sec of 60 cycle

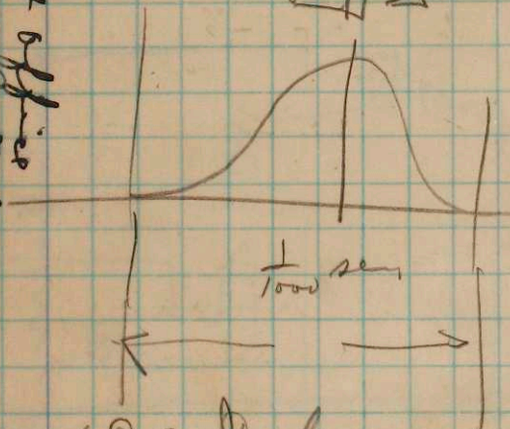
March 29, 1932.
H. E. Edgerton

Mr. Hutchins came yesterday from Glens Falls and brought his variable speed commutator. I have worked with him all day and got it going.

We had to increase the resistance in the main charging circuit ~~to~~ about 500 to 600 ohms to prevent self tripping of the thyratron.

There may be a big advantage in using a choke and a rectifier for charging. (1) To increase the efficiency (2) To prevent back surges.





$$f = \frac{1}{T} = \frac{1}{1000}\ \text{sec} = 2\pi\sqrt{LC}$$

$$= 6.28\sqrt{L\ 2\times10^{-6}}$$

$$\frac{1}{1000} = 6.28 \times 10^{-3}\ 1.41\sqrt{L}$$

$$\frac{10}{1000\ 6.28\ 1.41} = \sqrt{L}$$

$$\frac{3.}{9.\ 10}\quad 10^{\frac{1}{2}} = \sqrt{L}$$

$$1 = L \cong 1\ \text{henry}$$

Prof. D. C. Jackson was down today and arranged for more space for research.

United States Patent Office
Before the Examiner of Interferences
Edgerton vs. Miller - Interference 76771.
Edgerton Exhibit 12.
Page 36 of 8 Edgerton notebooks
January 2, 1940.

T = 3. March 29, 1932.
Dana Scollard, notary Public

March 31 1932
H E Edgerton.

Four machines were moved from 10-098 to give us more room for ~~Stroboscopes~~

S. Togo moved his stuff into 10-088 ~~today~~.

Gema has been figuring on the 1000 f. p. S. strobo.

April 1, 1932.

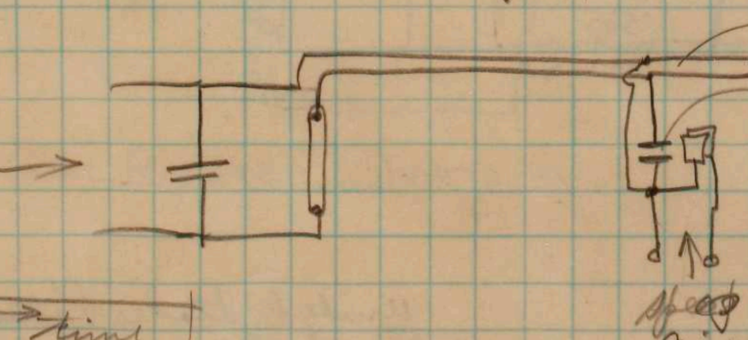
Worked most of the day with Togo.

April 2, 1932,

In the morning I got Jameson to start designing some discs for me to used on April 20 at the Safety committee show.

Spent the afternoon experimenting with Germeshausen and Bergman to determine the peak current in the stroboscope circuit by means of ~~the~~ the cathode ray oscillograph.

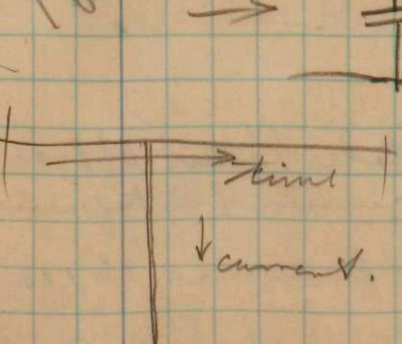
Eisenbister and Hazeltine started work today on 10-088 on the inverter.



Resistance = 0.11 ohms.

volts per cm = $\frac{36}{0.9}$

measured deflection. = 3.5 cm.



$$I = \frac{\left(\frac{36}{.9}\right) \times 3.5}{0.11} = \frac{36 \times 3.5}{.9 \cdot .11} = \frac{126}{.1} = 1260 \text{ amps}$$

peak current.

With one tube the current was oscillatory and a spot could be seen on the anode where there was some mercury.

April 7, 1932
HE Edgerton

Took the stroboscope to the Russel Box and replaced the old one.

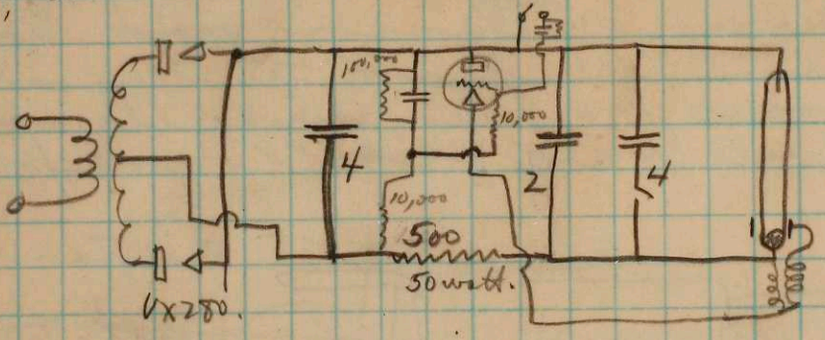
Worked on the cathode-ray oscillograph layout. Designed leads for the safety committee demonstration.

Germo has carried out the charging experiments mentioned on p 36 and they work out fine.

April 8 1932

I took the 60 cycle stroboscope over to the steel ~~factory~~ lab. this a.m. and Albertson took some pictures of its lines.

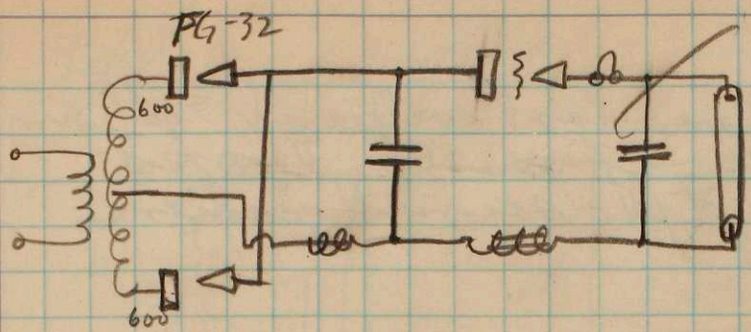
Mr Samson came over this a.m. and we discussed stroboscopes for an hour or so.



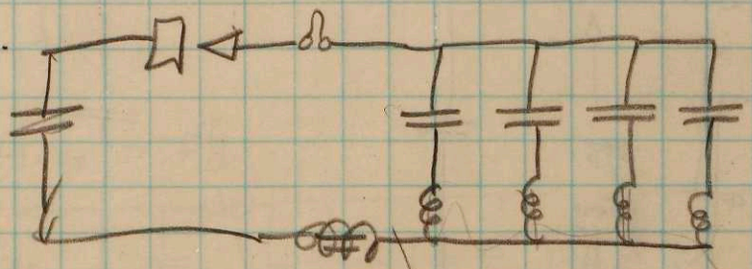
1 - transformer
1 - UX280 tube
2 - sockets.
1 - 10,000 ω 25 watt.
1 - 10,000 ω 2 watt.
1 - 100,000 ω 5 watt.
1 - 2 meg.
1 - .00025 condenser.
1 - FG-17 thyratron.
1 - 500 ohm 50 watt resistor
1 - spark coil
1 - 0-2-4-4 condenser
1 - 0.5 mf condenser.
1 - 500 ohm 50 watt.

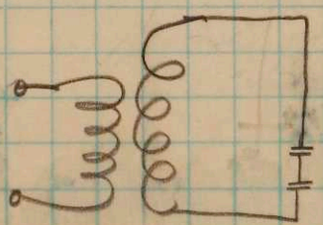
United States Patent Office
Before the Examiner of Interferences
Edgerton
vs
Miller
} Interference 76771

Edgerton Exhibit 35.
Page 38 of Edgerton Notebook T-3.
January 3, 1940. Clara Schlosky
Notary Public



4 cond. in parallel.

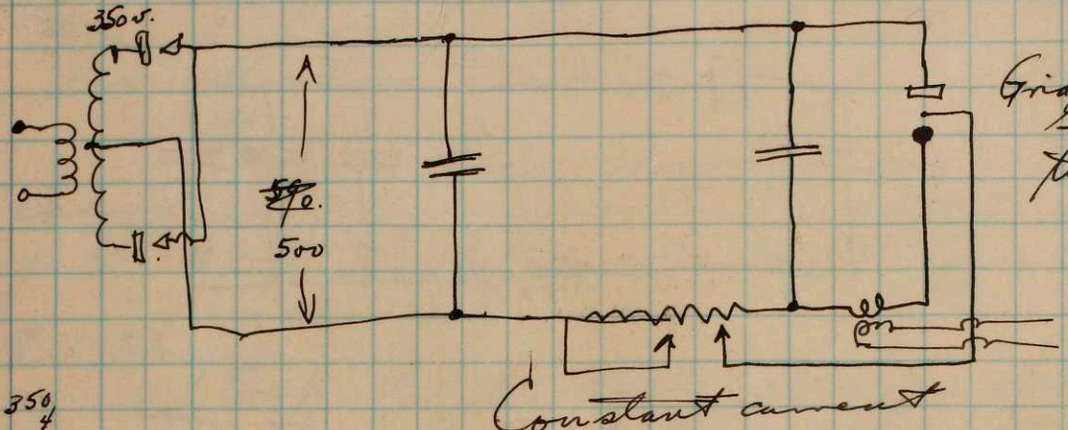




April 13 1932

H. E. Edgerton

We worked over last weekend taking motion pictures of milk drops with the 480 pict per second camera.

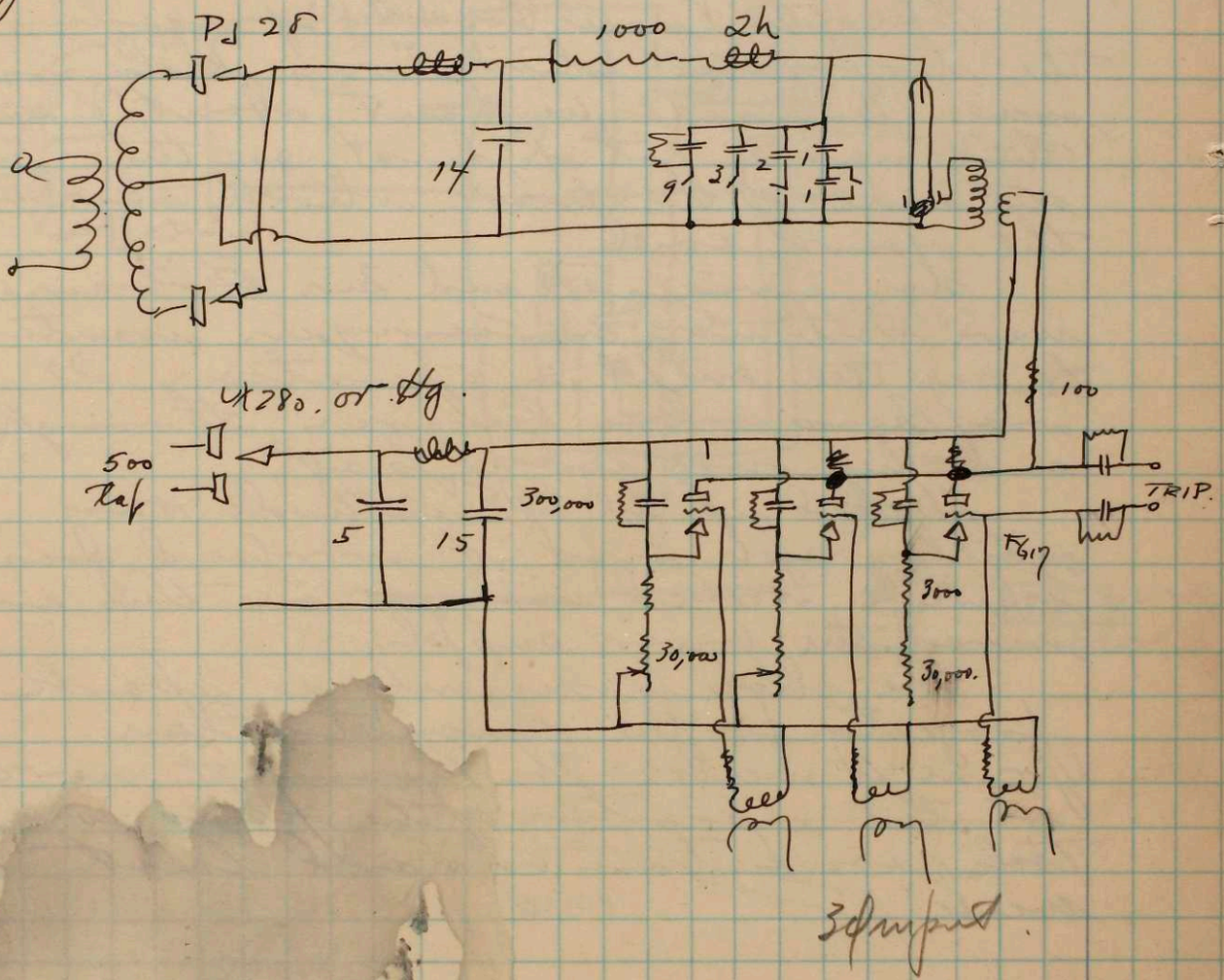


350
4
1400
350
590.

Strobo scope oscillator or cathode ray timing axis.

Lamson of G.R. called I went over to see his experiment. He had a midget stroboscope set up and running in their lab.

3 phase 60 ~ Strobo.



$\frac{1}{LC} = \left(\frac{R}{2L}\right)^2$

$\frac{4L}{C} = R^2$

$R = 2\sqrt{\frac{L}{C}}$ crit damped

over damped $R > 2\sqrt{\frac{L}{C}}$.

$R^2 > \frac{4L}{C}$

$L < \frac{CR^2}{4}$ or $\frac{2 \times 10^{-6} \cdot 500 \cdot 500}{4}$

$\frac{.25}{2} = 0.125$ h.

$\frac{500}{1000}$

April 15 1932
H E Edgerton.

Pike of the Russel Box called up regarding the stroboscope which was flickering some. Germ and I went out about 4:20. There was a lot of dust on the outside of the tube which shorted the spark coil.

Mr. Carrigan 1st and Mr. Bertram were with us. Mr. Carrigan wanted to see the outfit in operation. D.E. wrappers were being run through and they sure did go fast.

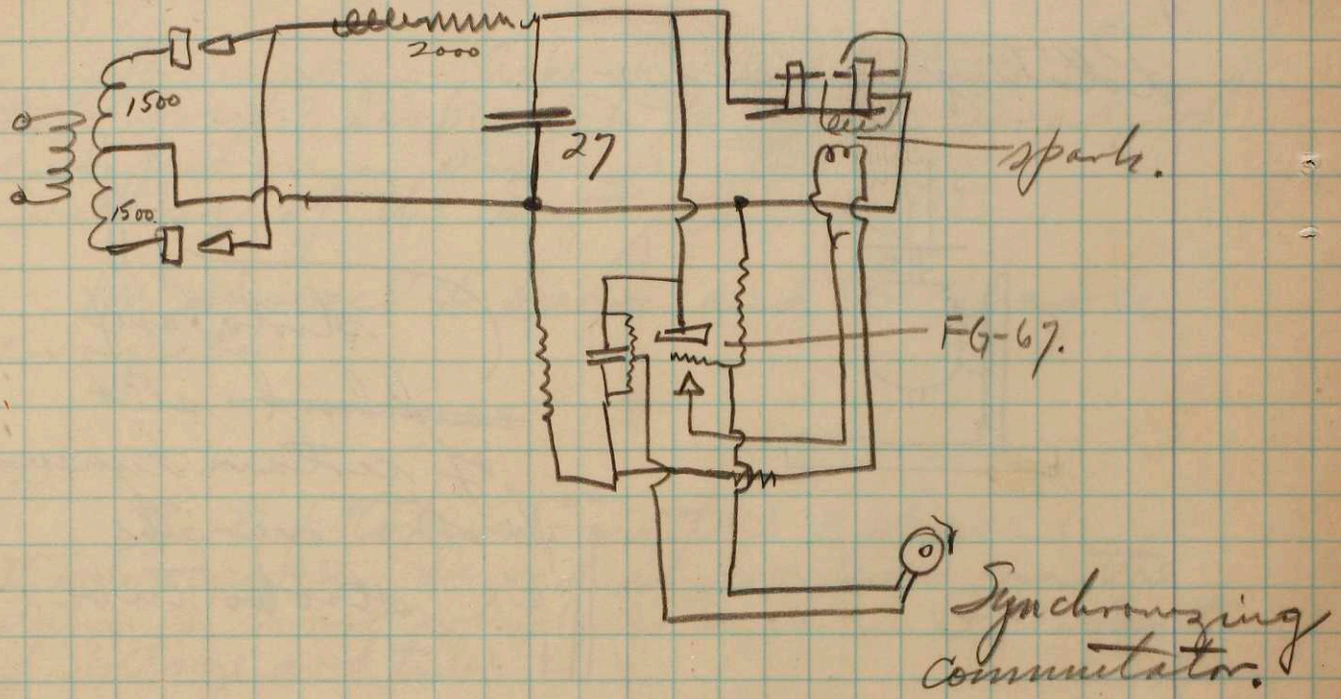
Hooked up the G.E. cathode ray oscillograph and it worked great. Tokerecks worked ~~with me~~ on this and wired the power supply.

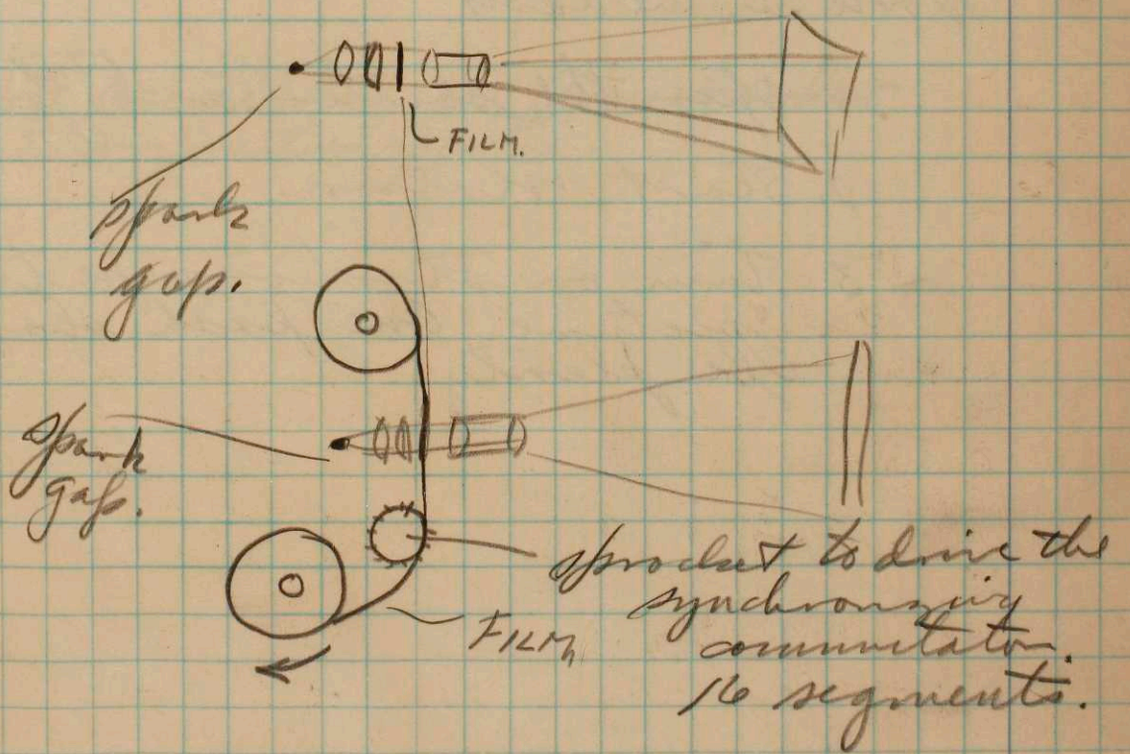
The shop is making a spark projector for the demonstration for next week. The Paramount news printed a positive of the films we took some time ago and last week.

April 16. 1932.

Baldwin from Columbia was here today and stayed until about three. We showed him several improvements to his circuit and he ~~~~ is going to try them. He was present to watch the first spark movie projector in action. Harry Lawrence finished the outfit about 1 o'clock. It was seen in action by R.B. Bennett, John McNeff, Carter, Hazeltine, K.J. Germeshausen.

Spark-Movie-projector. April, 16, 1932.



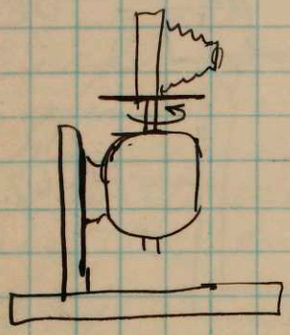


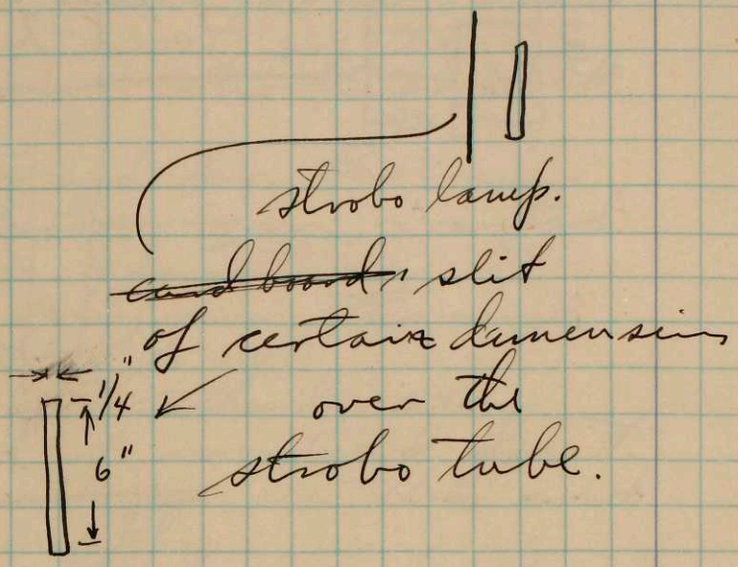
April 17 1932

H. E. Edgerton.

Timing length of discharge.

Rotating camera.





Work in the dark.

1. Open the shutter and (set focus).
2. Start rotation.
3. Turn on strobascope to get picture. One flash should be plenty.

April 20, 1932.
H. E. Edgerton

Gemeshausen, Tokeyoh(C) and I took the ~~stroboscope~~ display & the Gold Bradford and put on a show for the noon meeting of the Safety Committee.

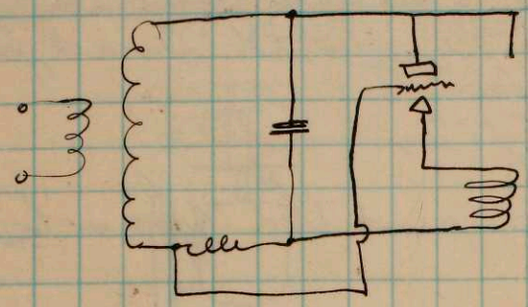
We showed 4 discs and the spark projector

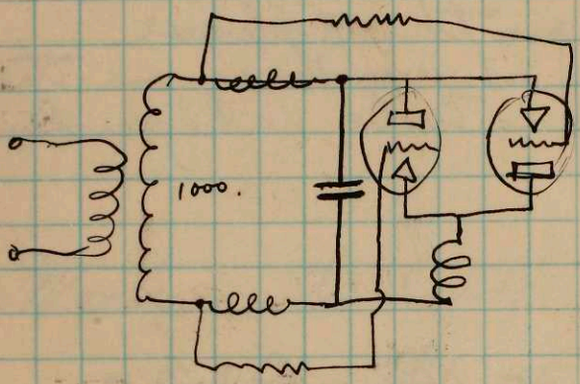
April 21.

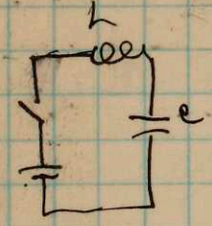
Started Tokeyoh on the 3 phase stroboscope. Dennis is working on the electronic timer which is to be independent of voltage and tube.

H.F. Oscillator or Bombarder for heating metal parts.

April 27, 1932.
H. E. Edgerton. H.F. Bombarder.







$$1E = \left(\rho^2 + \frac{1}{C\rho}\right) i.$$

$$i = \frac{\rho E 1}{\rho^2 L + \frac{1}{C}} = \frac{E}{L}\left(\frac{\rho}{\rho^2 + \frac{1}{LC}}\right) 1$$

$$\frac{\omega \rho}{\rho^2 + \omega^2} 1 = \frac{\sin \omega t}{\omega}$$

$$\frac{\rho}{\rho^2 + \frac{1}{LC}} = \frac{\sin \sqrt{\frac{1}{LC}}\, t}{\sqrt{\frac{1}{LC}}}$$

$$i = \frac{E}{L} \frac{1}{\sqrt{\frac{1}{LC}}} \sin \sqrt{\frac{1}{LC}}\, t.$$

$$= \frac{E \sqrt{LC}}{L} \sin \sqrt{\frac{1}{LC}}\, t.$$

$$= E\sqrt{\frac{C}{L}} \sin \sqrt{\frac{1}{LC}}\, t \quad \text{or} \quad \frac{E}{\sqrt{\frac{L}{C}}} \sin \sqrt{\frac{1}{LC}}\, t.$$

2 kw output.

25 amp peaks in the FG-67 thyratrons.

1000 volts.

$$25 = i_{max} = \frac{1000}{\sqrt{\frac{L}{C}}} = \frac{1000}{\sqrt{L}}\sqrt{2\times10^{-6}} = \frac{1000 \times 1.41 \times 10^{-3}}{\sqrt{L}}$$

$$\sqrt{L} = \frac{1.41}{25} = .055 \qquad 25\overline{)1.41}\ .05$$

$$L = .055^2 = .0030 \text{ henries.} \qquad .05 \times .05 = .0025$$

A sq cm | | | | | | n turns/cm

| l |

Coil 9 cm in diam.

$A = 4.5^2\pi = 63$ sq cm.

Let n = ~~10 turns~~.
= 1 turn per cm.

l = 10 cm.

$$L = 4\pi n^2 A$$

$$L = \frac{N\Phi}{I}$$

$$= \Phi = \frac{4\pi NI}{\frac{l}{A}} \times 10^{-8}$$

m.

$$L = \frac{4\pi N^2 A}{l} \times 10^{-8} \text{ henries.} = \frac{4\pi \overset{1.2}{\cancel{100}} \overset{1.0}{\cancel{10}} 6.3}{10} \times 10^{-8} = 7.\times10^{-5}$$

0.0000.7 henries

$$f = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{6.28 \times \sqrt{.003 \times 2\times10^{-6}}} = \frac{1}{6.\times 8.\times10^{-2}} \quad .0060 \quad 60.$$

$$\sqrt{60\times10^{-3}} \quad \frac{60.\times10}{8.\times10^{-2}} \quad .48. = 2 \text{ cyc sec.}$$

$$.003 \times 2\times10^{-6} \times 10^{-3} = 6\times10^{-9} = .6\times10^{-10} = .8\times10^{-5}$$

$$f = \frac{1}{5}\times10^{5} = \frac{20000}{10000} \text{ cycles/sec}$$

April 25 1932 Pictures of the
A E Edgerton Cathode sfood

1	6 mf	1500 v rectified			
2	6 mf	"			Commercial Process film
3	2 mf	"	2100 DC	25.8° C.	f 4.5
4.	4 mf		"	26.2	
5	8 mf			27.0 c	f 4.5
6	8 mf.			60.0 C.	f 8
7	8 mf			102.0 C	f 8,
8	8 mf.			115.0 C	f 8.

Cooling like this sparks on film

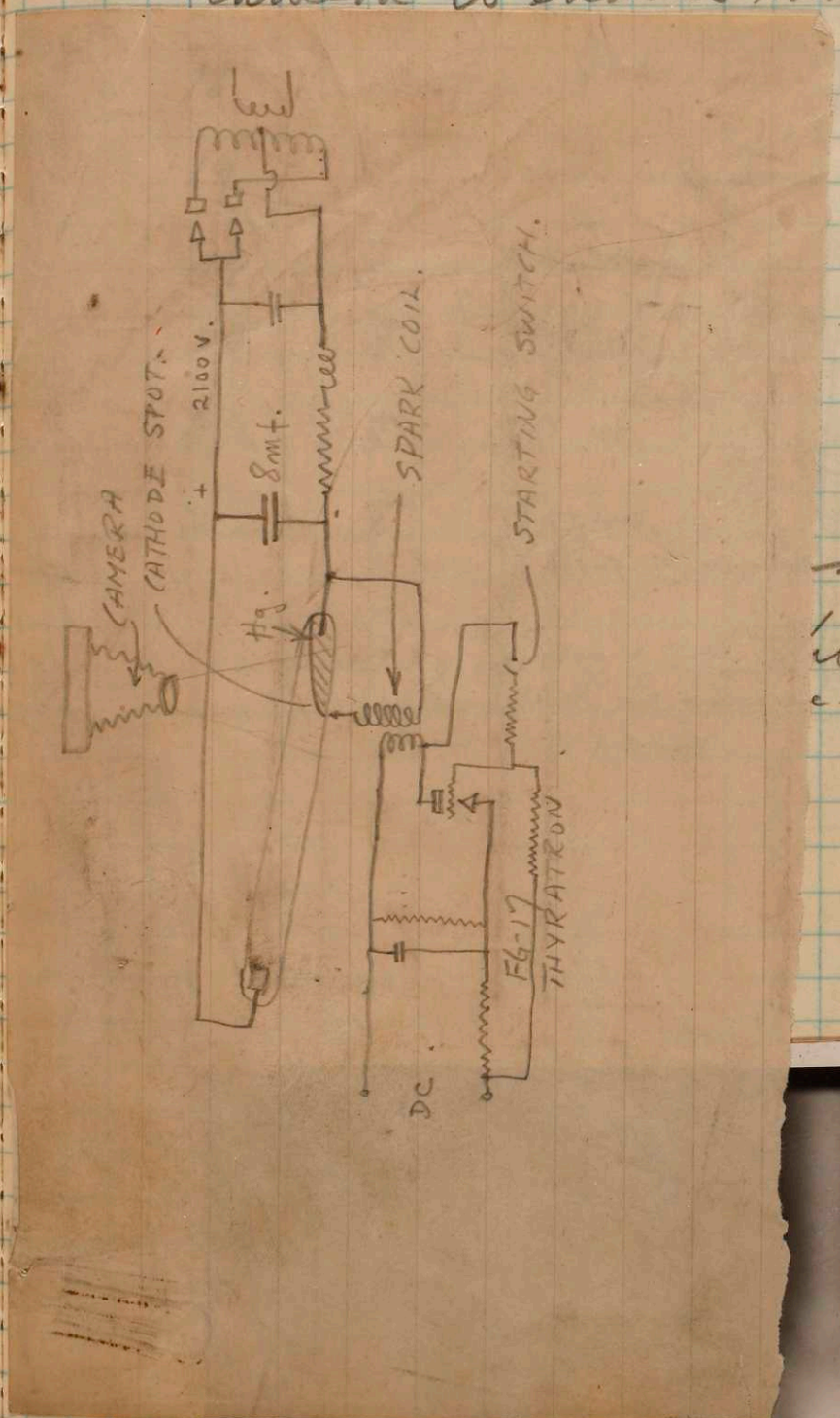
9	8 mf.	glare due to lights.	2100.	off scale.	f 8.
10	8 mf.		2100	"	f 8
11	8	hot	1480	"	f 8.
12	8	hotter	1480	"	f 8.
13	8.	hotest	1480		f 8
14	8 mf		1480	29° C	f 8

for film 14 a coil having 5 turns of no. 10 15 cm in diam.

15	8 mf	coil in series	2100	28° C.	f 8
NG. 16	8 mf	" " "	2100	75° C	f 11
17	8 mf	" " "	2100	67°	f 11

Front lens removed from the camera to enable magnification.

2100 V	30 or 40° C	f ~~5~~	11
2100	"		11
2100	"		11
2100	"		"
2100	"		"
2100	"		"

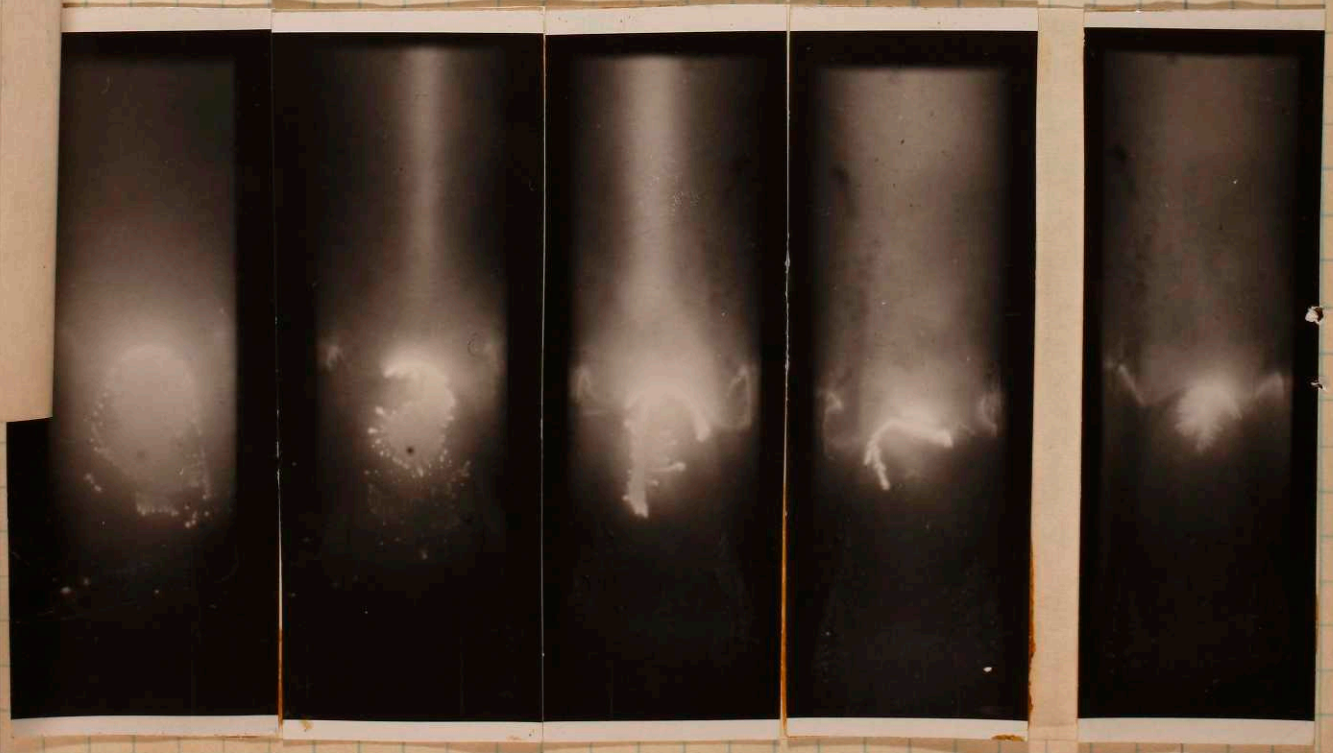


...ll pictures were
...of hot water in the

Front lens removed from the camera to enable magnification.

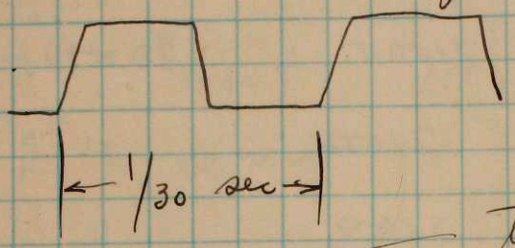
8 mf	Inductance	2100	30 or 40° C	f 11
8	10 coil inductance	2100	"	11
8	no imp	2100	"	11
8	5 turn	2100	"	"
8	20 "	2100	"	"
8	50-100 " ? (two flashes.	2100	"	"

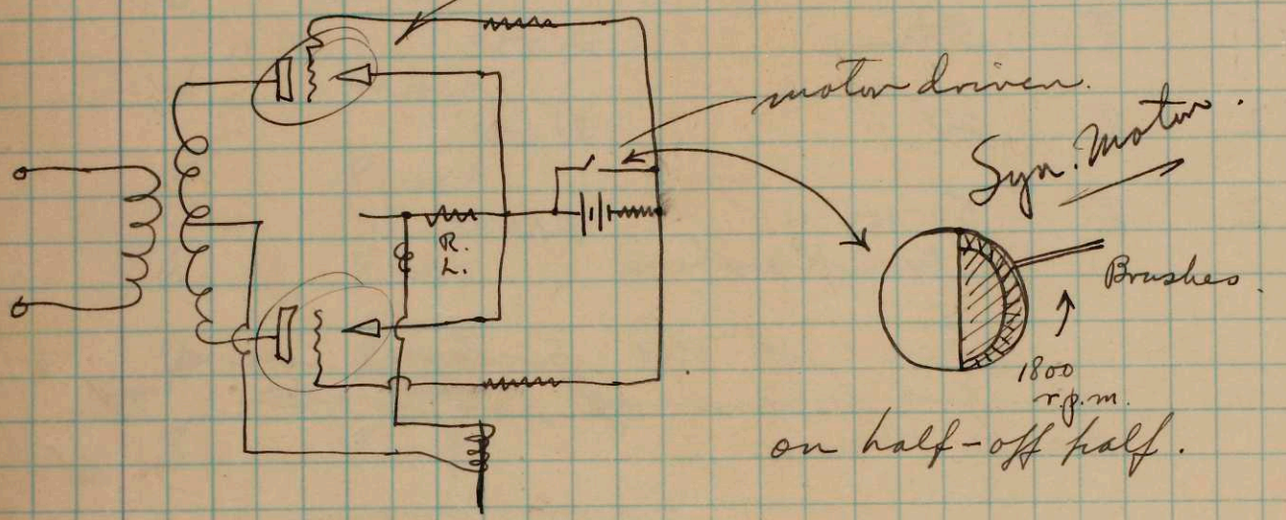
Some of the pictures were spoiled because of hot water in the dark room.



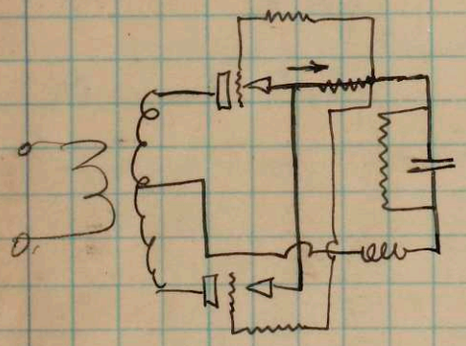
April 29 1932.

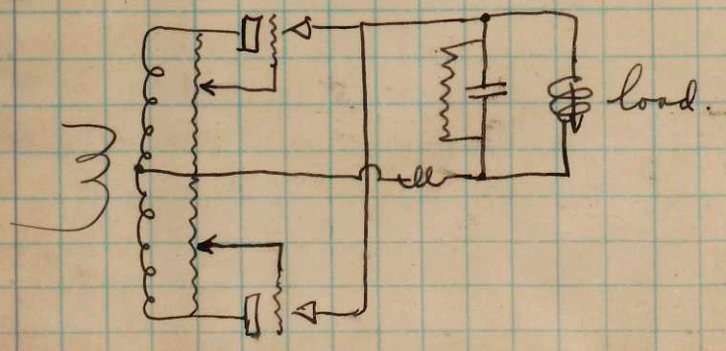
Putman wants a circuit to run a button hole machine. The cycle wants to be?

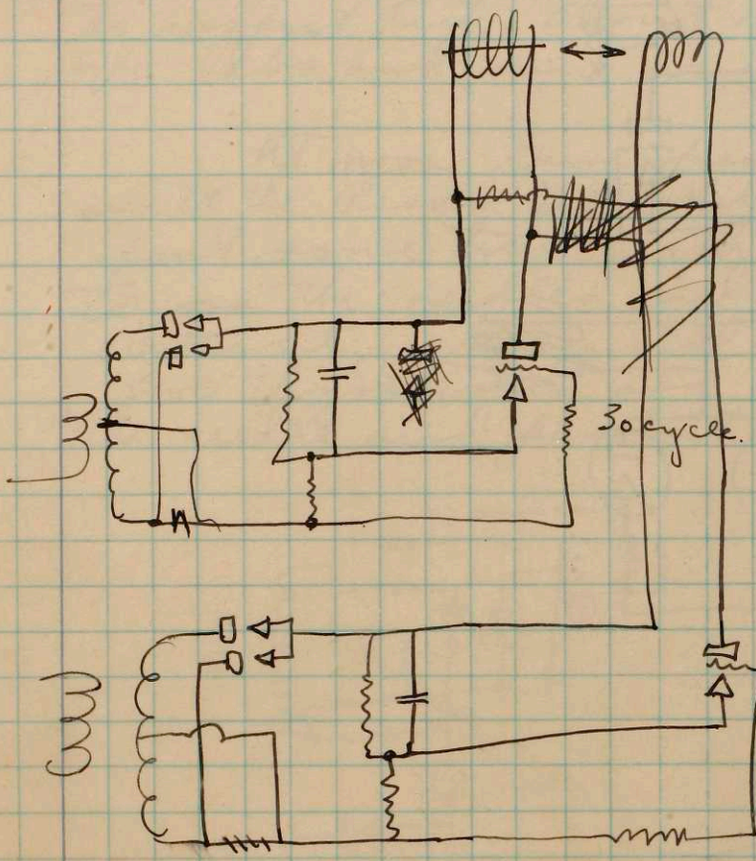


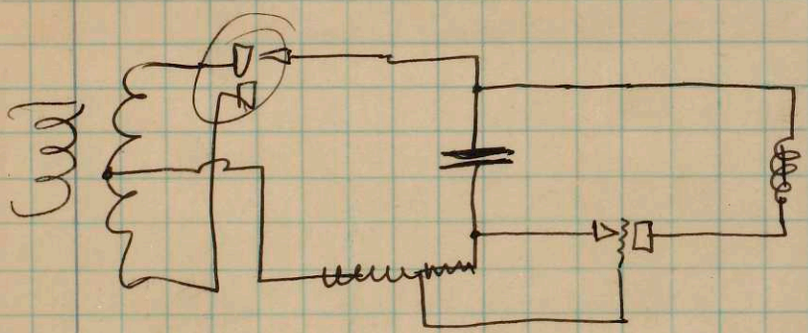


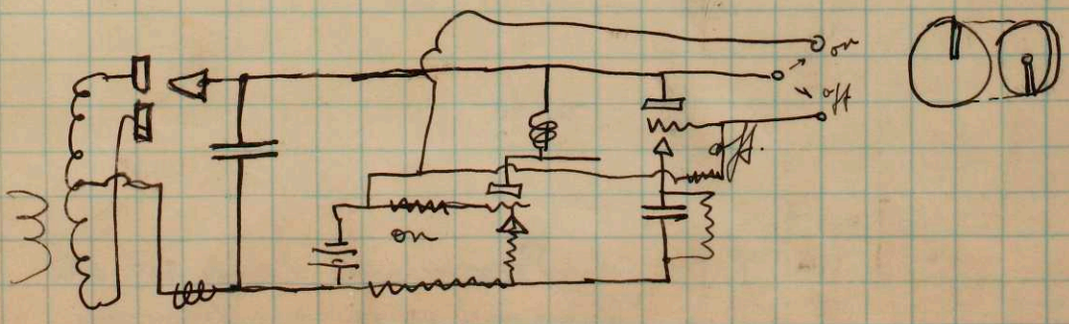
on half-off half.

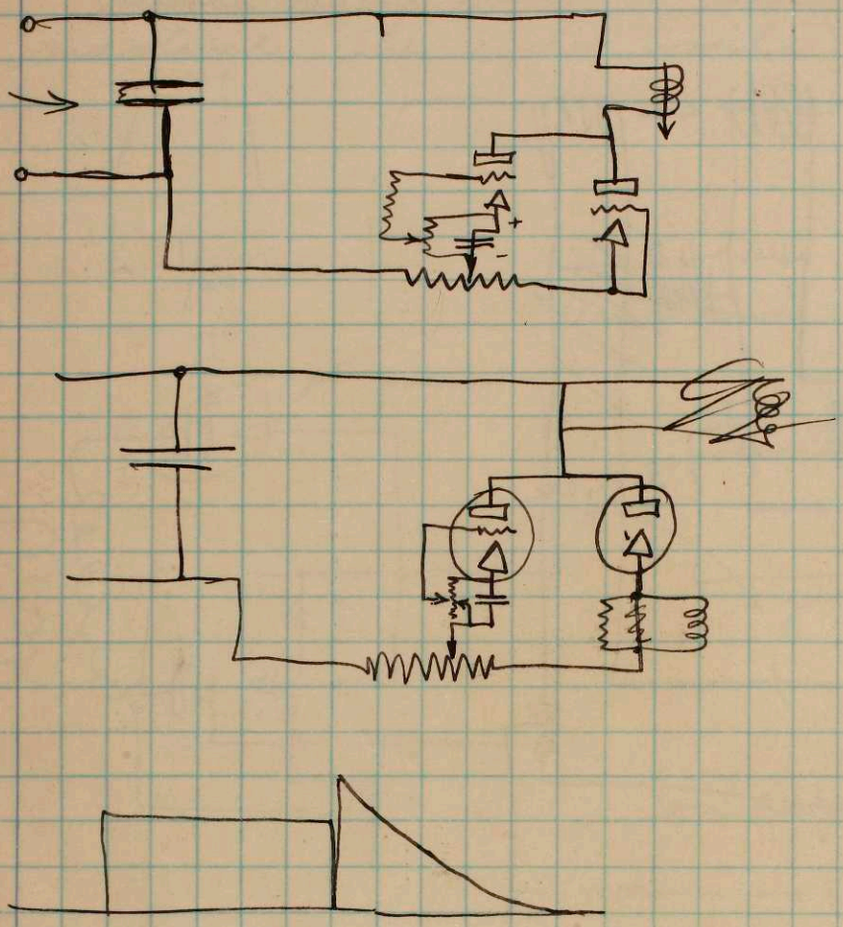


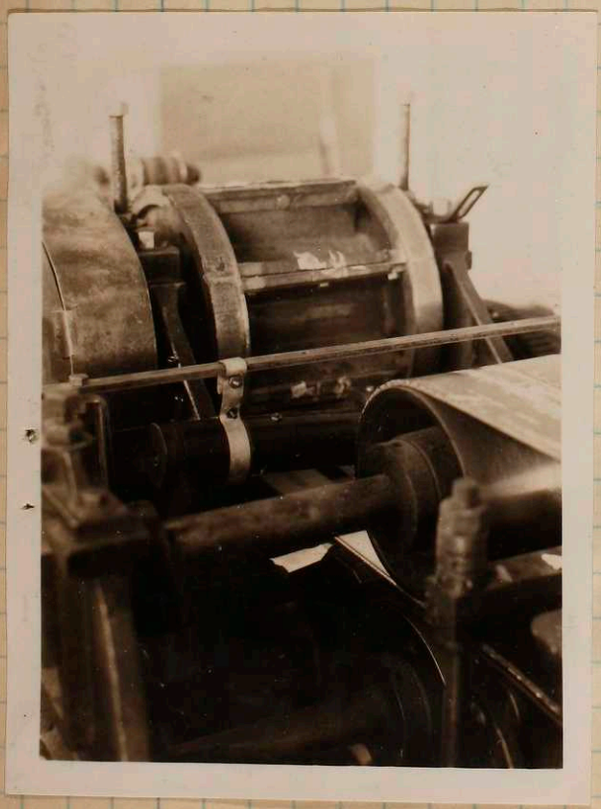


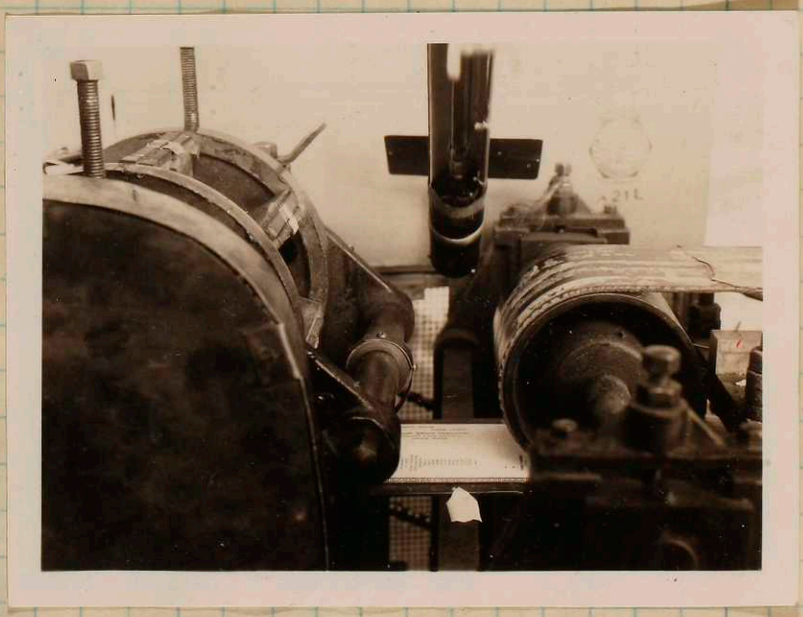

30 cycle.




on
off
on





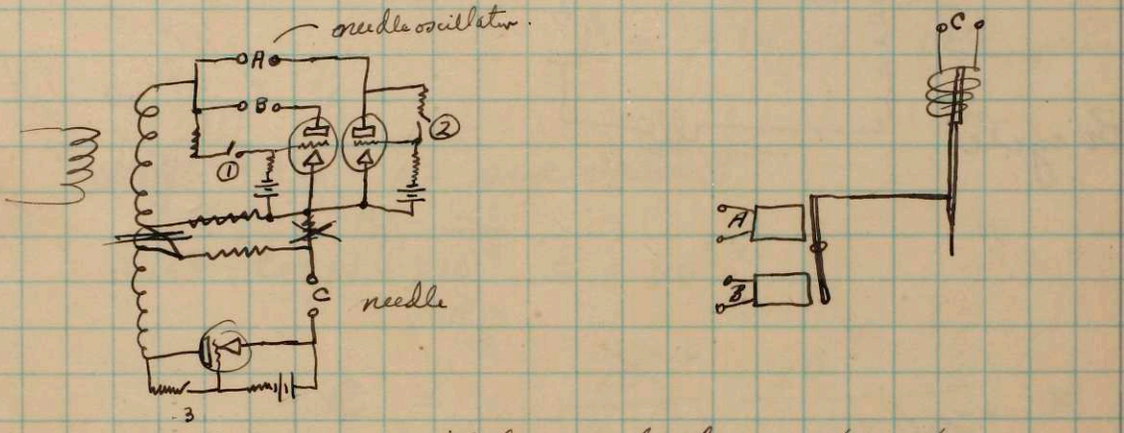


Stroboscopic lamp at the Russel Box company.

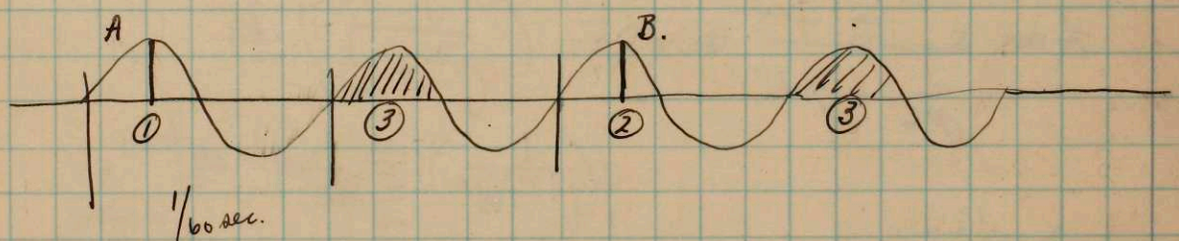
May 4 1932.
H. E. Edgerton.

Yesterday the M. E. Council was here to inspect Tech. About 150 men went through the labs and saw what was going on.

At noon Sennesbausen and I went over to the Reese Button Hole machine co and spent some time with Putman who is trying to run the needles and other motions with electricity. We suggested a scheme that uses two thyratrons and a rectifier to oscillate the needle and punch it.



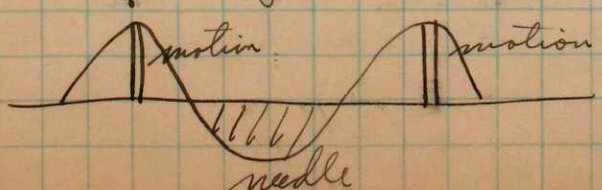
1 and 2 are switches which work at 30 a second.

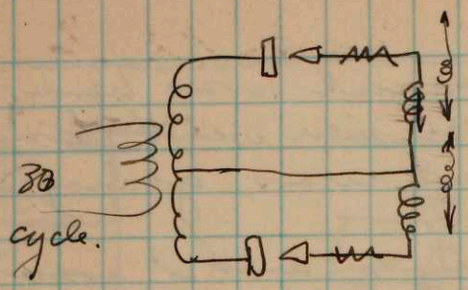


~~This won't work very well~~

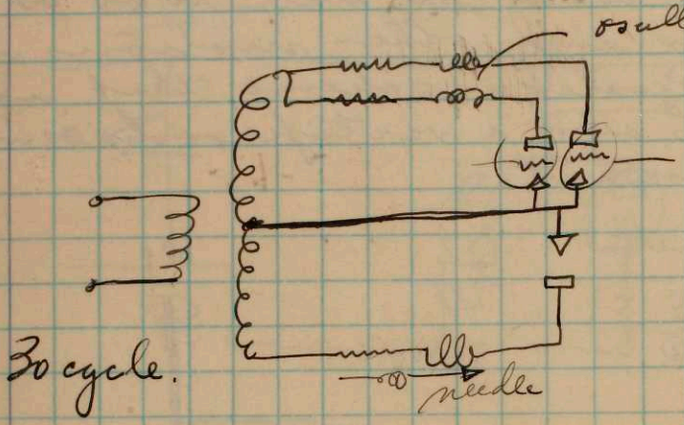
Another scheme is to use dc and a commutator to work all the motions using Burgess contacts throughout.

3o cycle current might offer advantages





N. G.



$$2\pi\sqrt{14.4\times10^{-6}\times.177\times10^{-6}} = 6.28\times1.56\times10^{-5} = 10\times10^{-5}$$ ✓

$$E\frac{1}{\rho C} = \left(\frac{1}{\rho C} + \rho L\right) i'$$

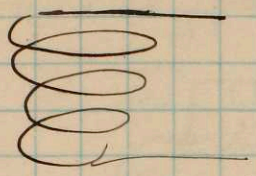
$$i' = \frac{E\frac{1}{\rho C}}{\frac{1}{\rho C} + \rho L} = \frac{E}{L}\left(\frac{1}{\rho^2 + \frac{1}{LC}}\right)1$$

$$\left(\frac{1}{\rho^2+\omega^2}\right)1 = \frac{1}{\omega}\sin\omega t$$

$$i' = \frac{E}{L}\,\frac{1}{\left(\frac{1}{\sqrt{LC}}\right)}\sin\left(\frac{1}{\sqrt{LC}}\right)t.$$

$$= \frac{E}{L}\sqrt{LC} = \frac{E}{\sqrt{\frac{L}{C}}}\sin\left(\frac{1}{\sqrt{LC}}\right)t$$

H. A. Bomberger.



Calc. of inductance. Electronics April 1931. p-598.

3½ inch coil 4 inches high 4 turns per inch.

$L_0 = .9$ microhenries (p 599)

$L = .9(4)^2 = 14.4$ microhenries

$2\pi\sqrt{LC} = 10^{-5}$ seconds

$6.28\sqrt{C \times 14.4 \times 10^{-6}} = 10^{-5}$. 36

$$C = \frac{10^{-10}}{(6.28)^2} \frac{10^{-4}}{14.4 \times 10^{-6}} = 1.77 \times 10^{-7}$$

$.567. \times 10^3$

$= .17 \times 10^{-6} \cong .2$ mf.

$i'_{max} = E\sqrt{\frac{C}{L}} = 25$ amp.

$E = 25\sqrt{\frac{L}{C}} = 25 \frac{14.4 \times 10^{-6}}{.177 \times 10^{-6}}$ 81.

$= 2000$ volts.

$\frac{CE^2}{2} = \frac{.177 \times 10^{-6} \; 2000^2}{2} = \frac{.177 \times 4}{2} = .354$ joules

500 per sec $\times$ .354 = 177. watts.

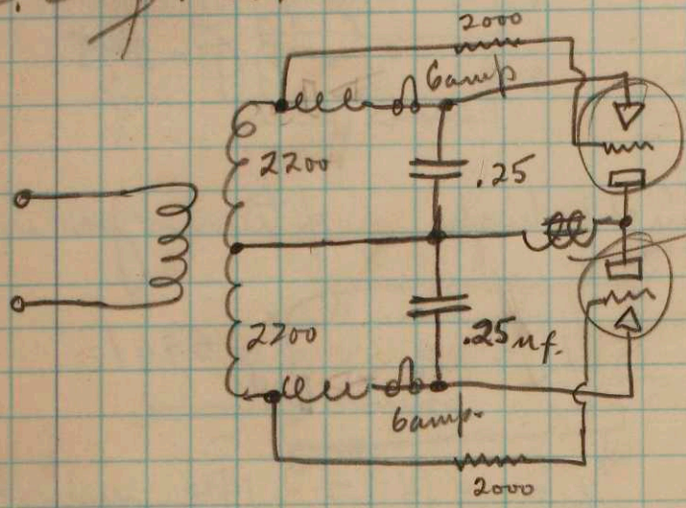
Pomberdex

May, 5, 1932.

H. E. Edgerton

$i = E\sqrt{\frac{C}{L}}$

$T = 2\pi\sqrt{LC}$



$L = 15 \times 10^{-6}$ henries.

FG67.

1000 cycles $10^{+3} = T = 6.28\sqrt{0.25\times10^{-6} \times L}$.

$$L = \frac{10^{-6}}{(6.28)^2 \times .25 \times 10^{-6}}$$

$$= \frac{1}{10.} = 0.1 \text{ henry}$$

Coyl $\omega L = 37.$ ohms.

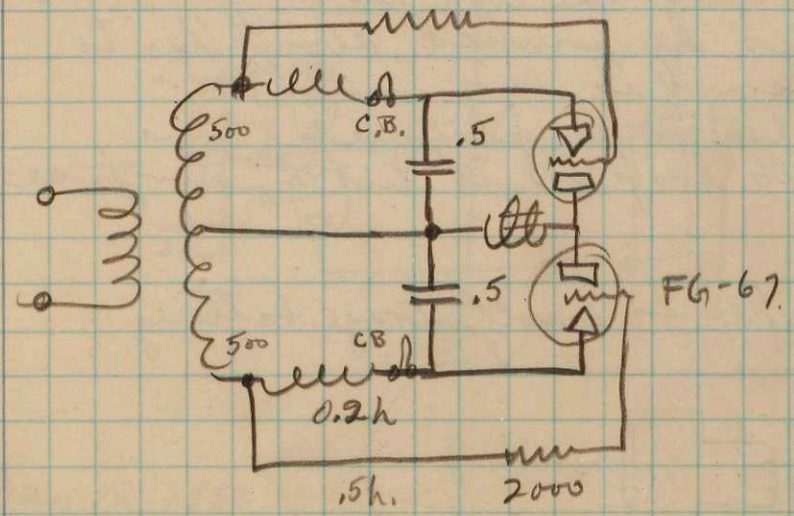
current $= \frac{2200}{37} = 59$ amp.

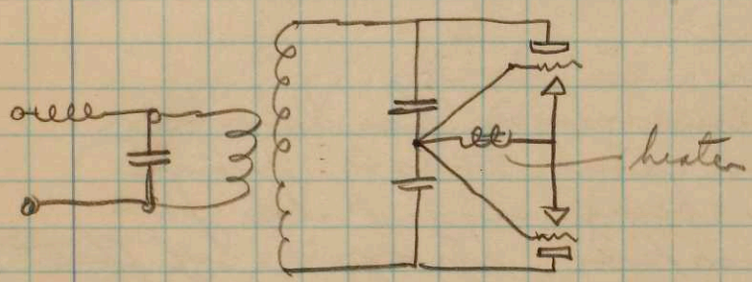
Try 0.20 henry first

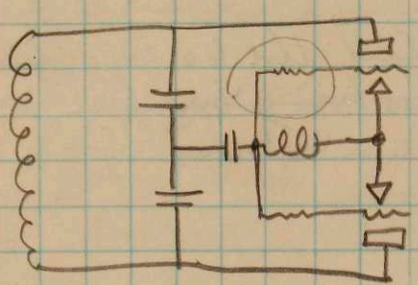
$$i = 2000\sqrt{\frac{.25\times10^{-6}}{0.1}} = 2,000 \times 1.5 \times 10^{-3}$$

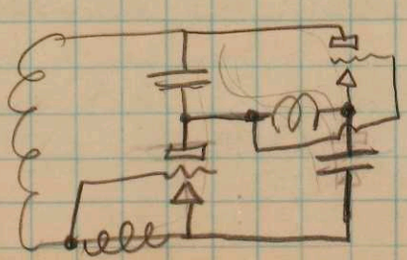
$$= 3 \text{ amp.}$$

Circuit to try.





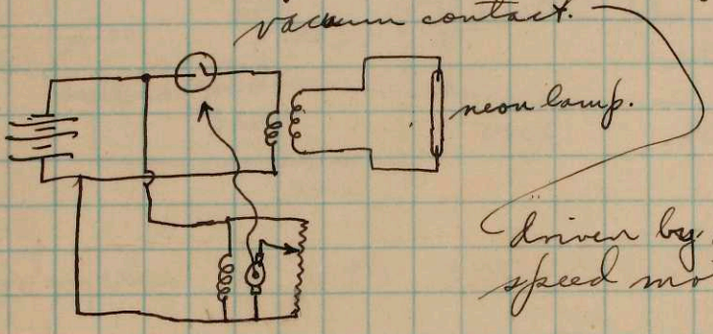




May 9, 1932.
H. E. Edgerton

Yesterday Germs and I took some 480 per sec. movies. We took some pictures of Germs eye as he winked. about 1/40 to 1/100 th of a second is required to shut the eye. also some pictures were taken of a milk drop as it hit a solid surface.

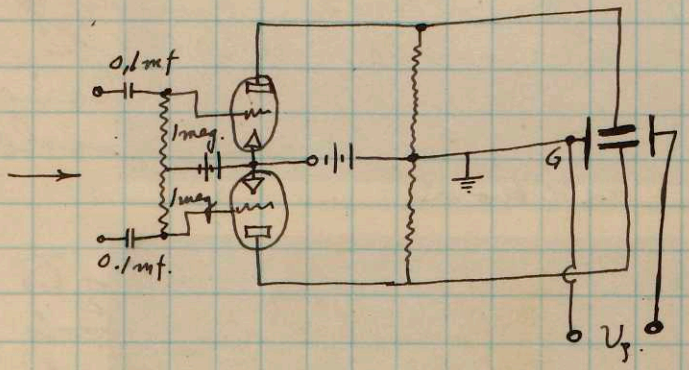
Stroboscope — 6 volt storage battery



The Keystone camera, hand driven with an f 1.5 lens came today from Sager's and it is being rigged up for taking stroboscopic movies of the angular transients of a synchronous machine.

Tolerich finished the 60 cycle stroboscope that he has been working with running up.

Cathode Ray Oscillograph Amplifier. May 10 1932
H. E. Edgerton.



May 16, 1932.
H. E. Edgerton

Mr. Norton of the Ind. cooperation of M.I.T. was in to see about our 480 pict. per second camera. He may want to use one for some research.

Prof. Hardy came down to 10-088 and we showed him our spark gap projector.

May 20, 1932.

Built a pyrex strobo tube last night. today it showed some gas but worked O.K.

Sent Russel Box a note on another strobo. Several days (wed.) ago I spent some time with Lamson at the G.R. looking over the strobo that he has built.

Demos got the strobo scope ~~camera~~ up to 4200 a second on ~~Thur~~ wednesday night. He used a tube with a deionizing grid over the anode.

May 23, 1932.

H. E. Edgerton

Germeshausen has been building some iron-cathode gas-filled tubes which look promising. They have a starting electrode on the inside just above the cathode.

Took the 60 cycle strobo scope over to the spectroscopy laboratory and ~~took a picture~~ Albertson took a picture of the lines. Doperalski helped him. Albertson said that there were many lines.

May 26 1932 Proctored exam in morning. Read theses and reports in the aft.

Tuesday a.m. Marshall of the Russel Boy called and said the strobo was on the fritz. Tube was pushed down into the holder and thus the leads were short circuited. Left two new tubes.

New fiber tube has been ordered for a new holder.

hotter

8 mf 2100 volts.

115°

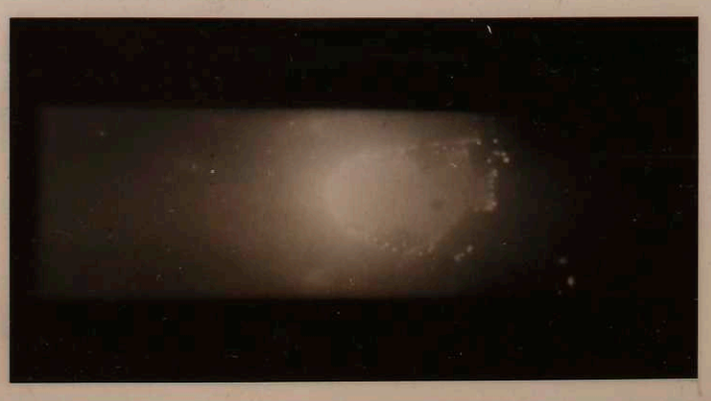
102°C

60°C

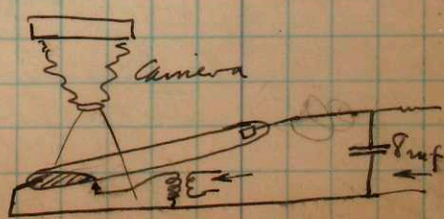
75°C

5 turns of No 8 copper wire. 15 cm diam.

27°C



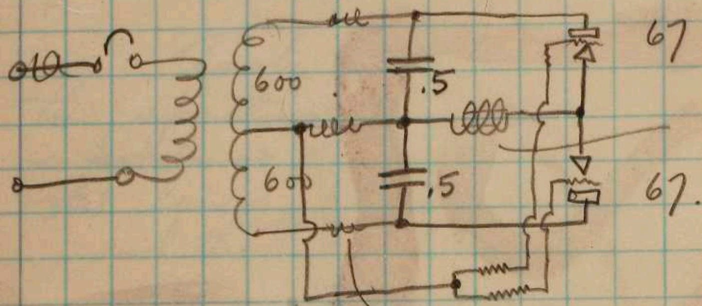
See data of April. 25/1932



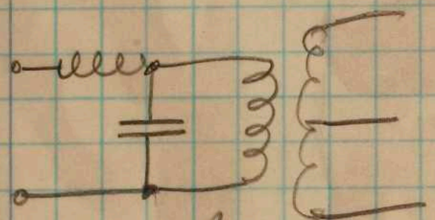
June 2 1932

H.E. Edgerton. Grade conference on Seniors at Tech this morning.

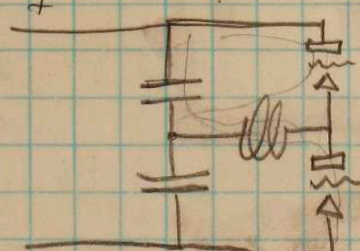
Bombarder See entries of May 5, on pages 56 and 57.

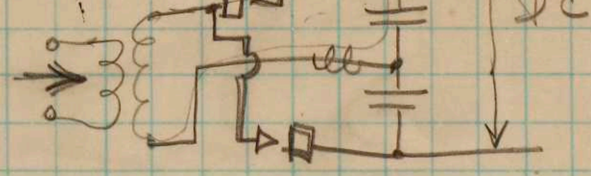


small chokes to hold out r.f.



filter to swamp H.f. from the power circuit.





$0.5\,mf$

$f = \frac{1}{2\pi\sqrt{LC}} =$ $\quad f = 5000$ cycles.

$\sqrt{LC} = \frac{1}{2\pi\, 5000} =$

1. Measure the leakage reactance of half of the transformer.

$LC = \frac{1}{6.28^2\ 5000\ 5000}$ $\qquad 377 \times .02 = 7.7$ ohms

$L = \frac{1}{6.28\ 25\ .5} = \frac{1}{49.2} = .0203.$

June 3 1932
#2 Edgerton.

Set up circuit shown on page 62 and tried to make it work. I got it to work with a Ford spark coil as a load. It worked best when the secondary was shorted. The output of the transformer from half of the high voltage is $\frac{142\text{ v}}{.9\text{ amp.}} = 46.7$ ohms.

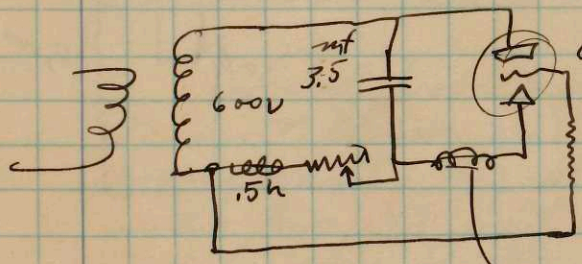
$L = \frac{46.7}{377} = .124$ henries.

Osc. freq. with 0.25 microfarads

$$f = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{6.28}\frac{10^3}{\sqrt{.124 \times 0.25 \times 10^{-6}}} = \frac{10^3}{6.28 \times .17} = 940 \text{ cycles/sec.}$$

$\sqrt{.03} = .17$

June 4, 1932.
More exp with bombarder. Half wave

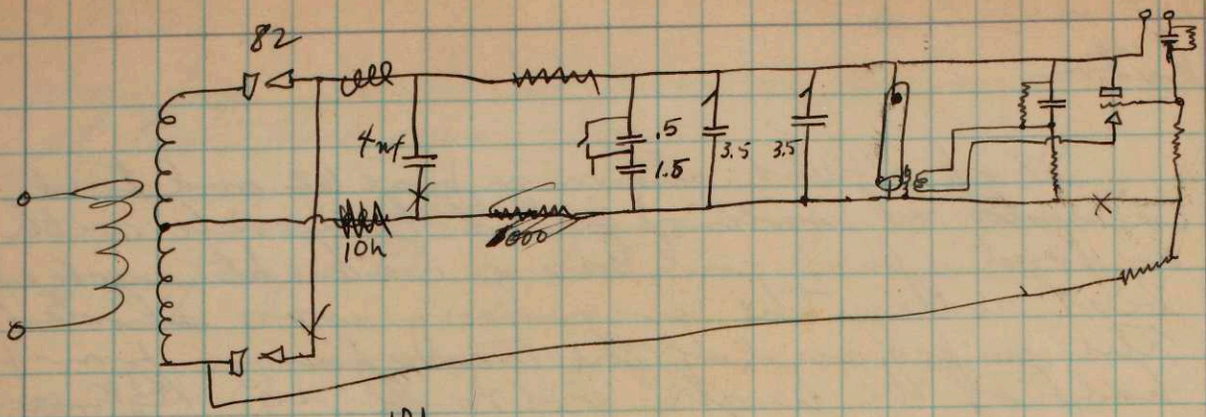


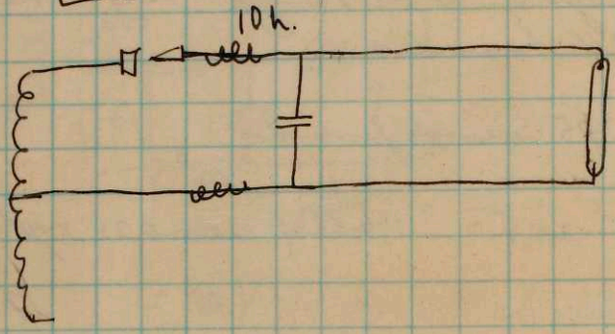
sparks on the grid. better with 20000 more ohms.

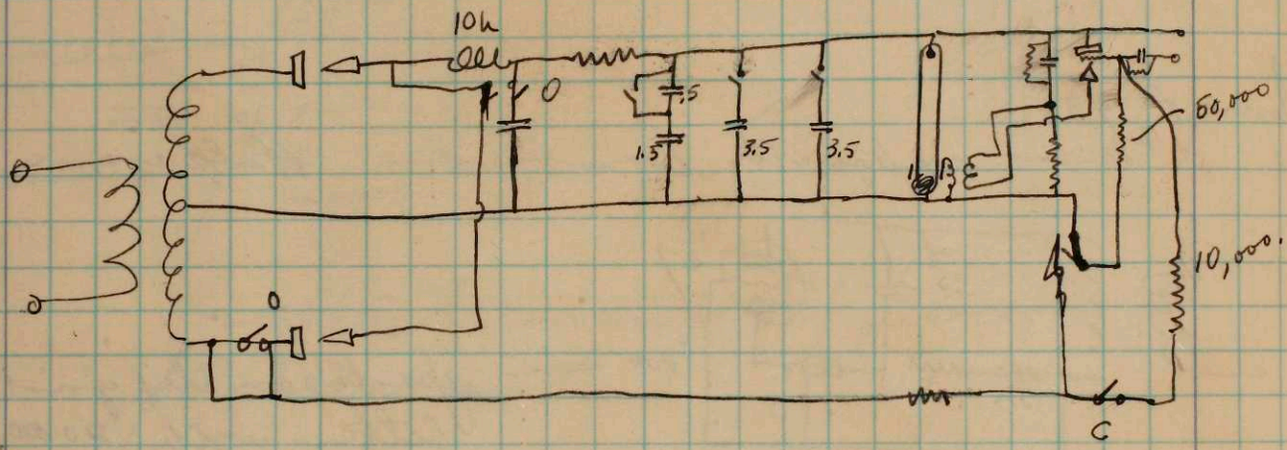
furnace coil

Erik Jesenbister (?) worked with me some.

Hazeltine is working with Jesenbister (?)







60 cycle change over switch.

June 8, 1932
H. E. Edgerton

On last Friday Germ. and I went to the G.R. and spent several hours in the aft. discussing the Stroboscope that they are going to market. Mr. Lamson is going to get one ready to take west with me this summer. Mr. Richman offered me 10% sales profit on all that I sell directly or indirectly.

Today we went over to the Aero Engine lab. and took some high speed movies of a compur shutter when operated at 1/200th of a second. Print below.

In the aft. we went out to the Russel Box company and replaced the lamp holder with a new stronger one. Also I put in a lead glass tube which had not been baked. Pike showed me a patent which he had obtained upon stroboscopes. He loaned this to me.

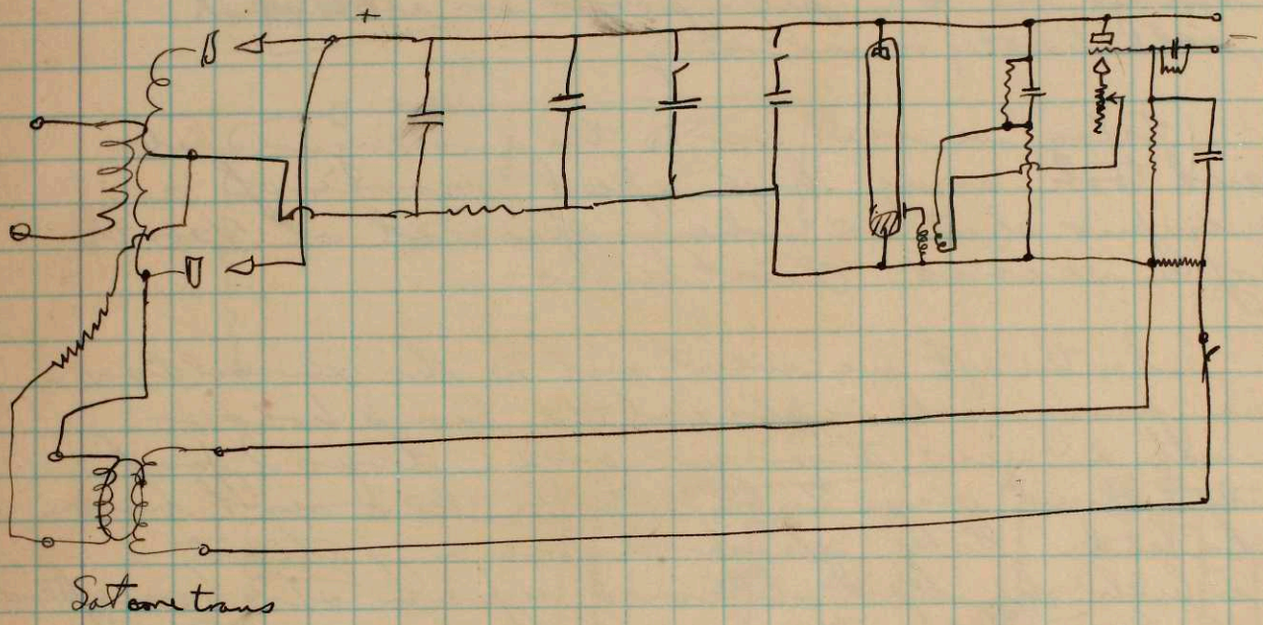
Heard from Mr. Henney of N. Y. (Electronics). We sent them an article several weeks ago. Henney wants the stroboscopic pictures of the milk drop to put on the cover of Electronics. I sent him the negatives today.

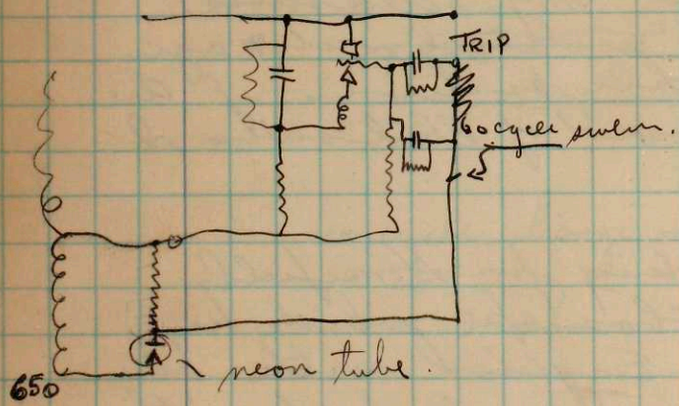
Toporeck has been working for Horsefield, building him a small stroboscope which he is going to take to England with him. Toporeck has been having tough luck with the tubes, several broke while being sealed off after the exhaust.

Made plans for Germeshausen to work half of the time with Lamson on the big movie outfit. Germ. will develope the circuit and Lamson the camera.

June 8 1932
H. E. Edgerton

A 60 cycle trip on a stroboscope is very handy in many cases since a speed device is not required.





600 volts. 2 watts.

$\frac{600^2}{R} = 2$

$R = \frac{600^2}{2} = \frac{360000}{2} = 180{,}000$ ohms.

$\frac{600}{180{,}000} \quad \frac{1}{300} \quad 3$ ma.
$\frac{1}{300}$

$2 \times 10^{-6} \times 1000 \times 12$

.002 sec.

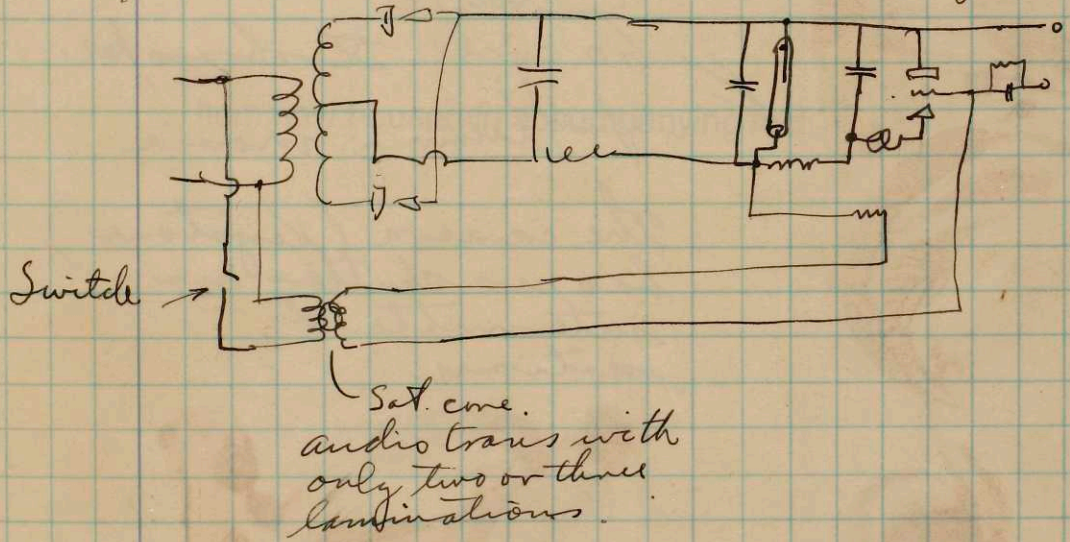
June 10 1932

Eddington.

Spent morning at Tech straightening out various details that came up. Showed a letter from the General Radio company to Dr. Bush and Dr. Jackson. This letter was given me by Mr. Hazlon when I was over to the G.R. yesterday and it out lined our agreements

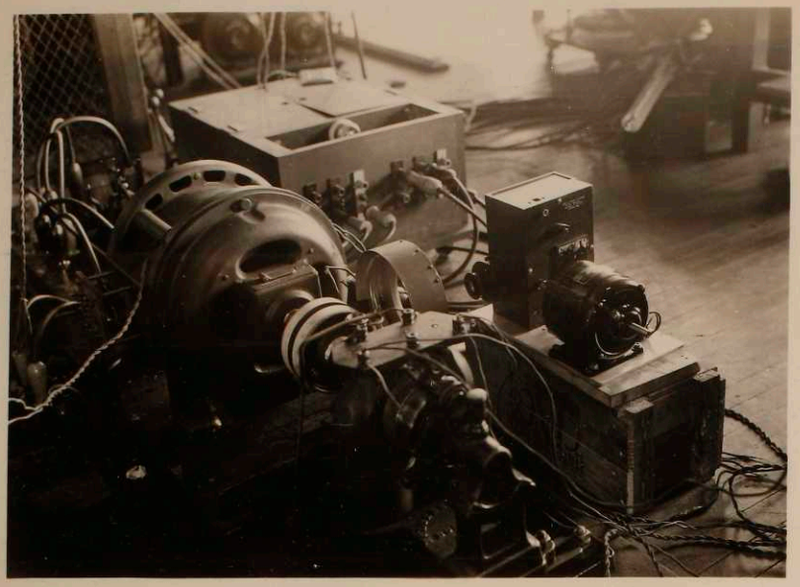
5% royality on all stroboscopic apparatus
10% on all apparatus sold due to my direct effort.
Six months notice of discontinuence.

Made a saturated core transformer yesterday to put in the stroboscope so that it will run 60 cycle.



Tried this out in the stroboscope at G.R. and it worked o.k. Lawson will build a transformer on Monday.

Had lunch with Mr. Morden and Mr Lawson at Walker. Morden makes a vertical ~~pump~~ pulp beating machine.

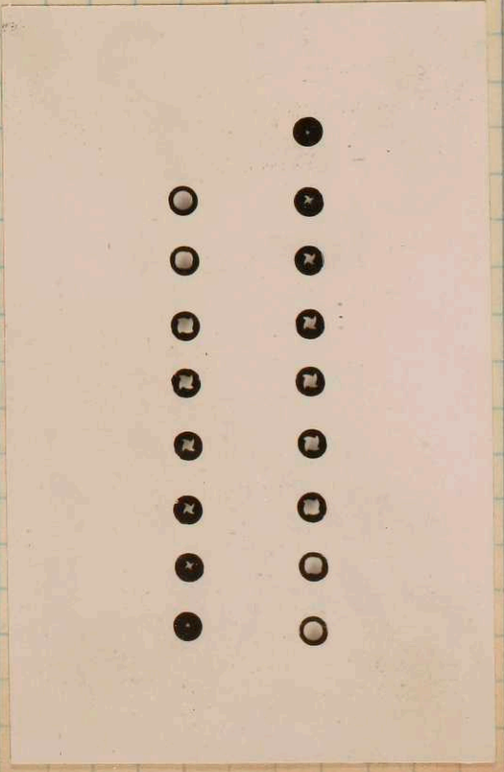


Acceleration test on an induction motor.

Donat tube.

60 cycle Stroboscope for taking movies.

The camera (Keystone) has no shutter nor intermittent motions.



1600 per second movies of the opening and closing of a compur shutter set at 1/200th of a second.

Notebook Number: T-3

Scanning and Separation Record

3 unmounted photograph(s)

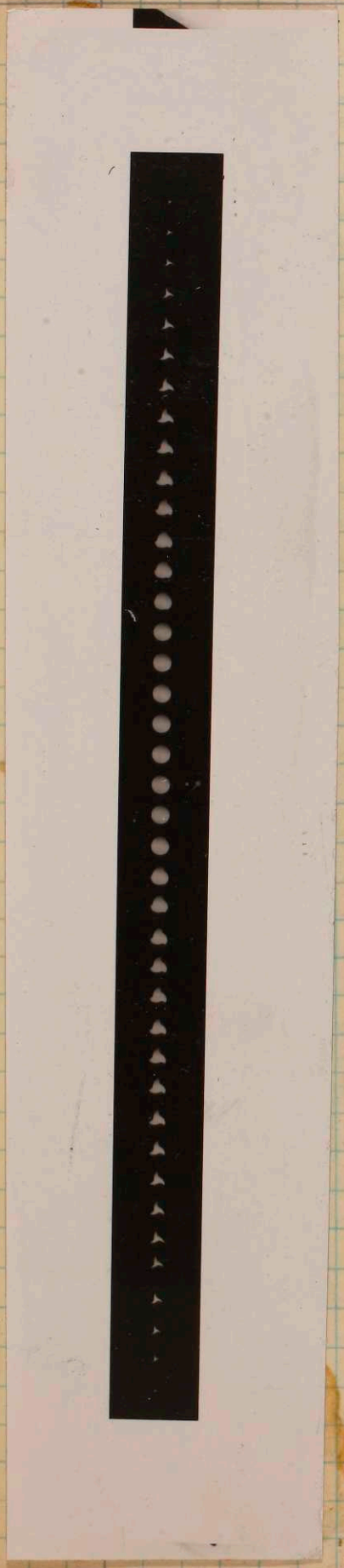
____negative strip(s)

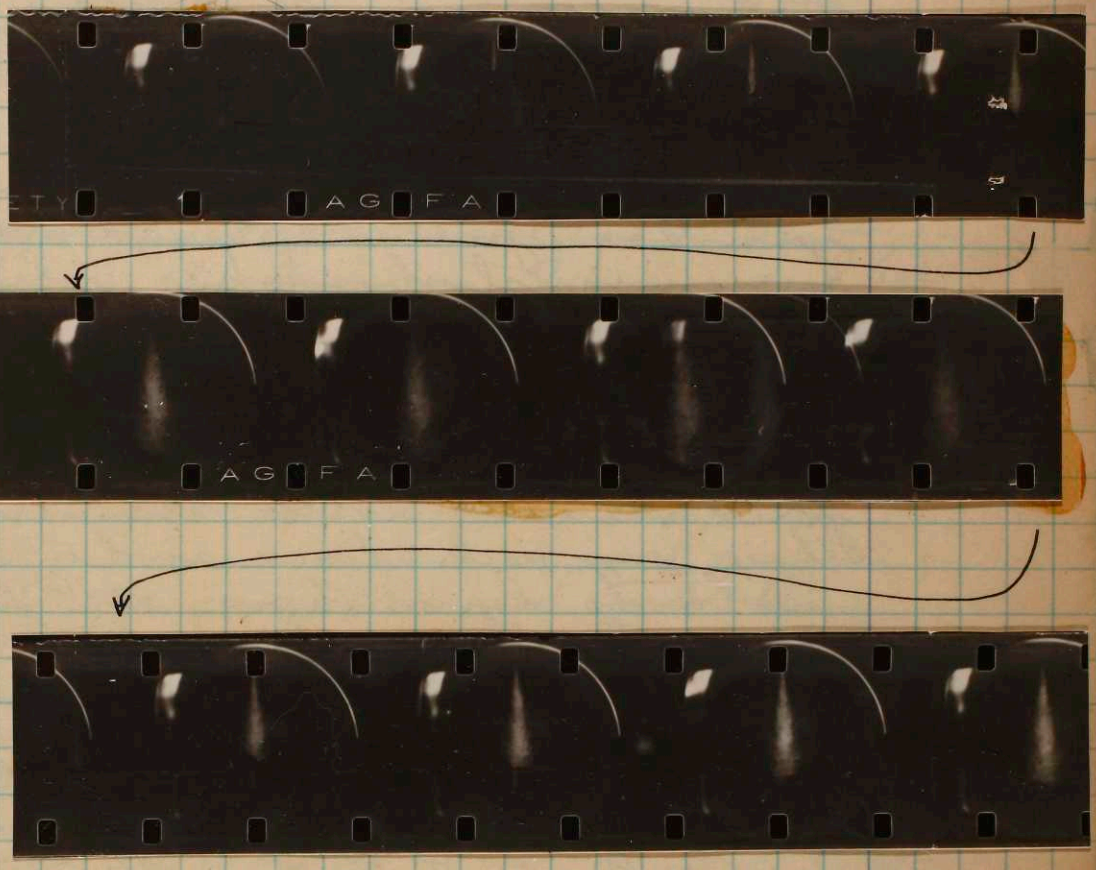
____unmounted page(s)
(notes, drawings, letters ...)

was/were scanned ~~where originally located between page~~ in place on page 69 and ~~____~~.

Item now housed in accompanying folder in MC 25, box 166

Picture of a computer shuttle ($\frac{1}{200}$ setting).





Spray pictures taken by Stark Draper in the aero Engine Laboratory. 2000 a second.

↑ 4/200 per second
picture of a compur shutter ($\frac{1}{200}$ setting).

June 15, 1932
H. E. Edgerton

The G. R. have nearly finished the stroboscope which I plan to take with me on my trip to Nebraska.

Stevens

Mr. Stewart and Mr. Ben Folger of the A. D. Little Company were here yesterday June. 15 1932 and we talked concerning stroboscopic photography.

June. 16, 1932

Assembled apparatus which is to go to Nebraska with me. I am taking three six inch discs and a small motor to drive them. All fits in an old meter box.

Germeshausen and I wrote a letter to Prof. Jackson today outlining the way we wish to work next year here at Tech. We talked to him about it. Further details will be discussed when I return from my trip to Nebraska.

I am leaving Saturday ~~for~~ morning for Syracuse with Esther and Mary Louise. We plan to stop at Schenectady to see ~~Bancroft~~ Francis Boucher. Next Stop is Cleveland. From then to Aurora.

Mr. Folger of A. D. Little Co called me in the late afternoon and asked me to see him. I drove over to his house after supper and we talked concerning the application of stroboscopic photography for ~~his~~ the problem of the Lever Bros Soap Co. He wants us to go ahead. Germs is to see him monday at 10:30 and start the ball rolling.

July 16 1932
Aurora Nebraska
Harold Edgerton.

Esther, Mary Louise and I left Watertown on June 18 (Sat) in the morning. Had lunch with Francis Boucher and his wife in Scotia N.Y. and reached Syracuse N.Y. about 9 at the W.I. Treats home. (248 McKinley Ave). Saw Ruth M and Burch McMorran, Marian and her boy and others.

Left Syracuse in the AM of the 19th and stopped at East Aurora N.Y. next day drove into Cleveland about 3 or 4 p.m.

Attended A.I.E.E. convention 20 and 22. Saw Frank Stearns and his diesel engine. Then went to Akron Ohio and saw Ray Hudson at the Goodyear-Zeppelin Corp. Had the stroboscope along and showed it to many people.

Reached Aurora Nebr on Monday June 27. July 4 at Grand Island. June 29? 30? Trip to Kansas. Donald & Dora with Donnie and John (two sons) of Manhattan, Aunt Kate and John Wilson at Topeka. Mary Wilson there. Mr. Stanley went on this trip with Dad to see the Cozz boy at Topeka.

While in Aurora I demonstrated the stroboscope to the Rotary club and to the Boy Scouts and others.

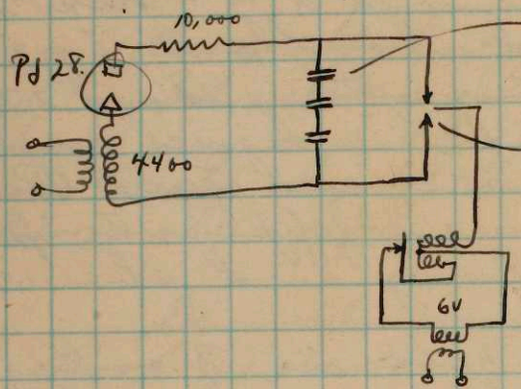
I sent a list of prospective buyers of stroboscopes to Mr. H. B. Richmond of the General Radio Company.

Cambridge Mass
Aug 10 1932
H. E. Edgerton.

Left Aurora Nebr. July 18 reached Chi. July 20. arrived Detroit July 27. Met Esther and Mary Louise at Cleveland on Sunday ~~July~~ Aug 5. Reached Waterloo Sunday Aug. 7.

On Aug 9. Zennesharen and I went over to A. D. Little Co and discussed with Ben Folger the spray photographs.

Aug 12 1932. Experimented with a spark outfit the last few days.



Time of discharge about $\frac{4}{10}$ ×
2000 rpm × 3 ft = 6000 ft/min.
$\frac{6000 \times 12}{60 \cdot 5}$ = 1200 inch/sec.
or one inch = $\frac{1}{1200}$ sec.
.1 inch = $\frac{1}{12,000}$ sec

$\frac{4}{100}$ inch. $\frac{1}{120,000}$ = 33.3 micro. sec. approx.

with 2000 volts
27 mf the discharge time is about 100-150 micro sec.

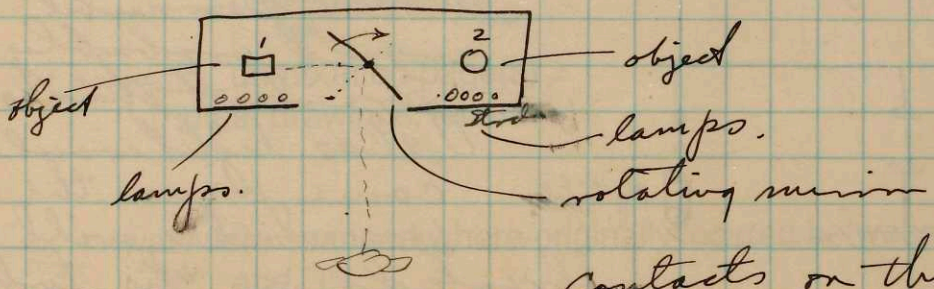
Set up 480 picture per second camera to take photos of drops falling.

Aug. 14. 1932
H. E. Edgerton

Magic Stunts with stroboscopic light.

Dobble wheel. Rotate a wheel or disc at fairly constant speed. Use two stroboscopes of different frequencies to make the two halves appear to be running at different speeds.

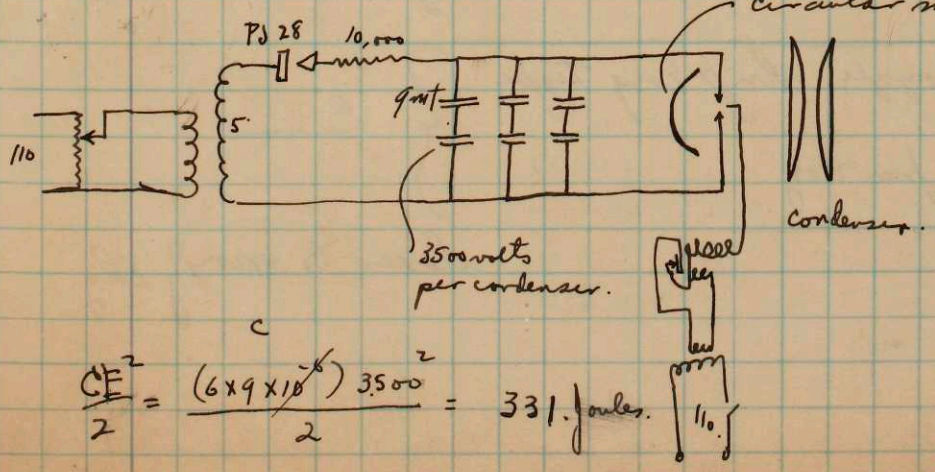
Substitution apparatus. Two types one where the objects rotate. Second where a mirror rotates. Mirrored on both sides.



Contacts on the rotating member. To and switch to change from 1 to 2.

Aug. 20, 1932.

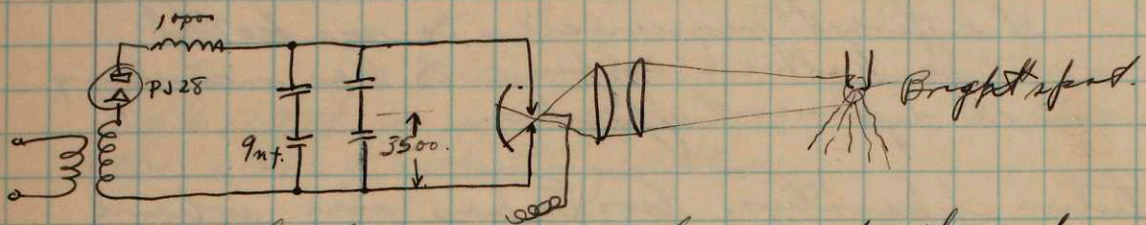
During the last week we have experimented further with the spark photography outfit for the A. D. Little Co. New optical systems for throwing the light quite a distance was built by Germ. A new transformer, 3500 volts, was obtained to get the high voltage.



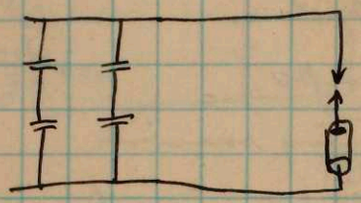
$$\frac{CE^2}{2} = \frac{(6\times9\times10^{-6})\,3500^2}{2} = 331.\ \text{joules.}$$

August 22 1932
H. E. Edgerton

Took pictures of the spray for Little & Co. Used a combination as shown below.



The discharge through the spark gap is oscillatory as is noticed on moving film.



A rectifier tube would probably prevent this oscillation. Also light would come from the tube. 6000 volts will break down the tube if it is hot. So the spark could break down the main gap and then the Hg tube would go by itself. The spark could be used to trip the Hg tube also as well as the gap.

Pictures taken at f 11.

no 1.	close to nozzle. English type.	} Germ.
2	" " " "	
3	Far from " (4 or 5 in)	
4	" " "	
5	close to nozzle. Imp Eng type.	} Germ.
6	" " " "	
7	4 or 5 inch from noz " " "	
8	" " " "	
9	" " " " "	closer to noz } Eng
10	" " " " "	

Notebook Number: T-3

Scanning and Separation Record

____unmounted photograph(s)

2 negative strip(s)

____unmounted page(s)
(notes, drawings, letters ...)

was/were scanned where originally located between page 74 and 75.

Item now housed in accompanying folder in MC 25, box 166

Aug 23 1932
H. E. Edgerton.

Last night just before going home we tried the scheme of using a mercury tube in series with the spark gap. The Hg lamp was very bright. The light appeared to be brightest at the two ends of the tube. One tube broke on the second flash. The other tube ran for several flashes. It got quite hot showing that most of the energy was lost in it instead of the spark gap.

We will undoubtedly get more light if we heat the tube so that the mercury pressure is increased. The discharge time will increase some.

Film on a 1 ft wheel rotating 2100 R.P.M.
Circuit of page 74 upper diagram

9 mf. 9 mf 4.5 mf. Still 4.5 mf

velocity of film = $1 \times 3.1416 \times 12 \times \frac{2100}{60}$ = 1340 inches a sec.

or 1 inch = $\frac{1}{1340}$ th of a second. .747 $\times 10^{-6}$ sec.

.03 inch = .03 × 747 = 22.4 microseconds

4 half cycles in .025 inch.

1 cycles in .00625 inch = 4.66 microseconds per cycle

or 214000 cycles per second

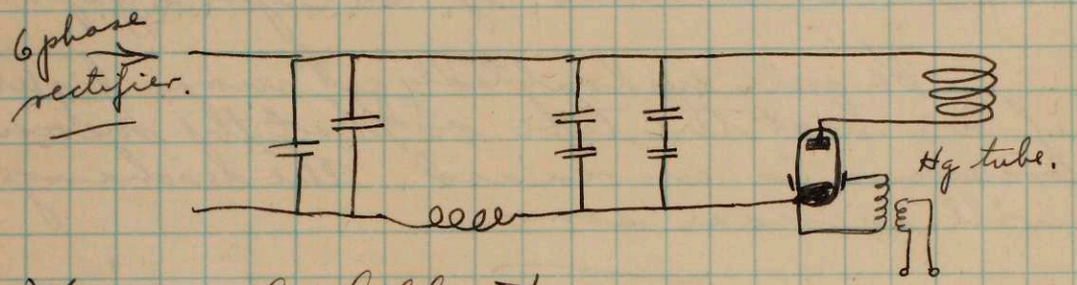
$\frac{1340}{12}$ = 111.6 ft a sec.

Aug 23 1932

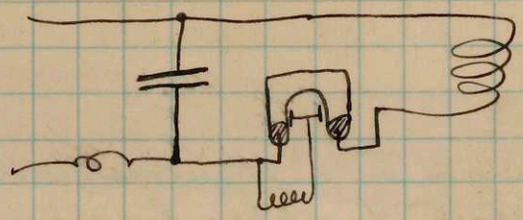
Aug 23 1932

Aug 23 1932.
~~H. E. Edgerton~~

The camera sketched on p 24 was completed yesterday by Joe and we ran the first tests on it. Today we took some photos of dropping milk at 240 frames a second. We took a 25 ft reel and took it over to paramount to have it developed.



It may be better to use a two way Hg tube so the circuit can oscillate.

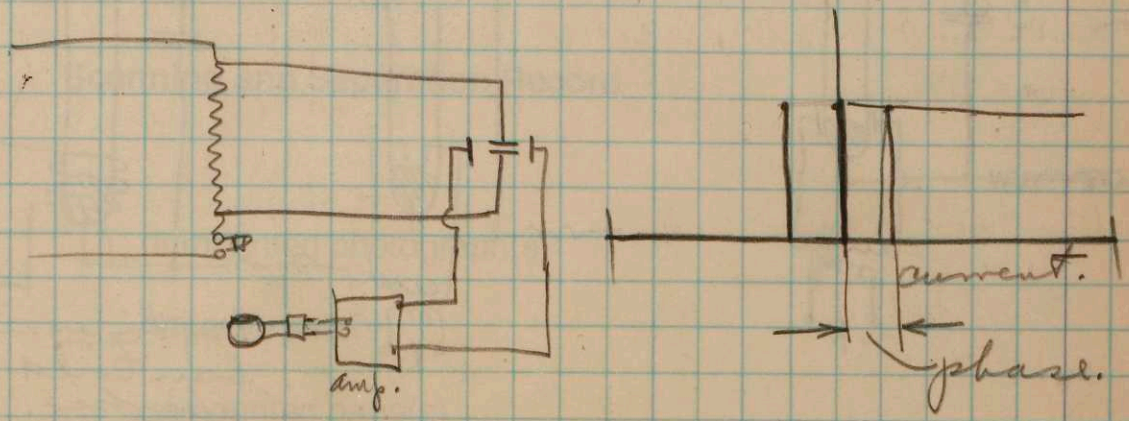


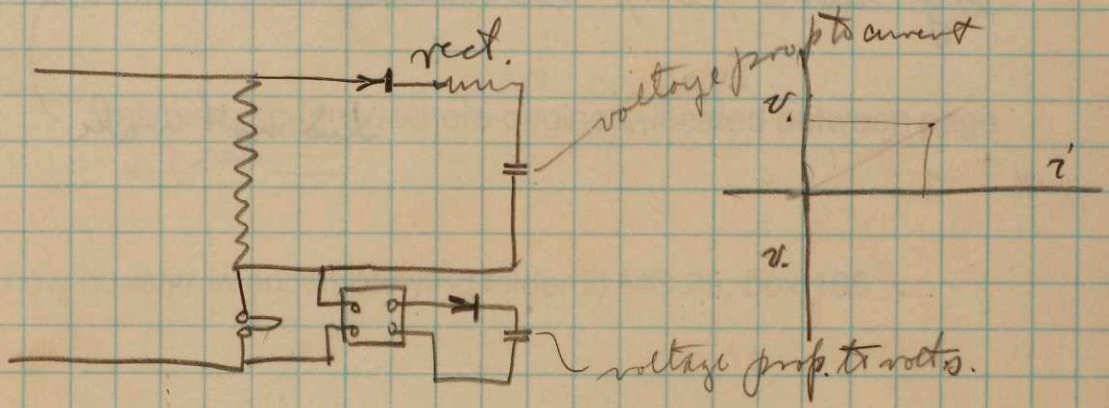
Aug 25 1932.

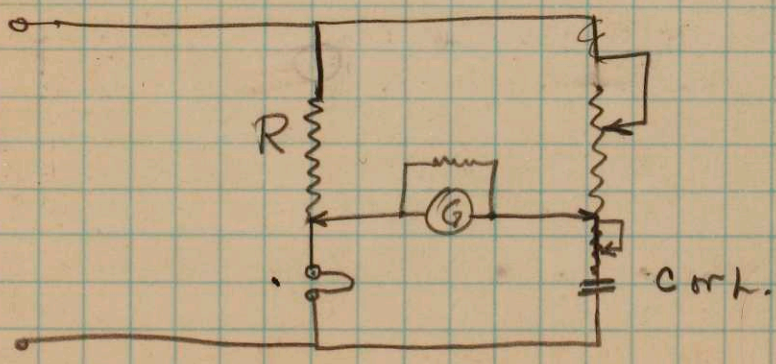
Took more 240 per second movies today. These were of a drop of water and ink. A white background was used. The drops dropped from the bottom of an electric light bulb. The test strips of film were very interesting.

Aug 26 1932
H. E. Edgerton.

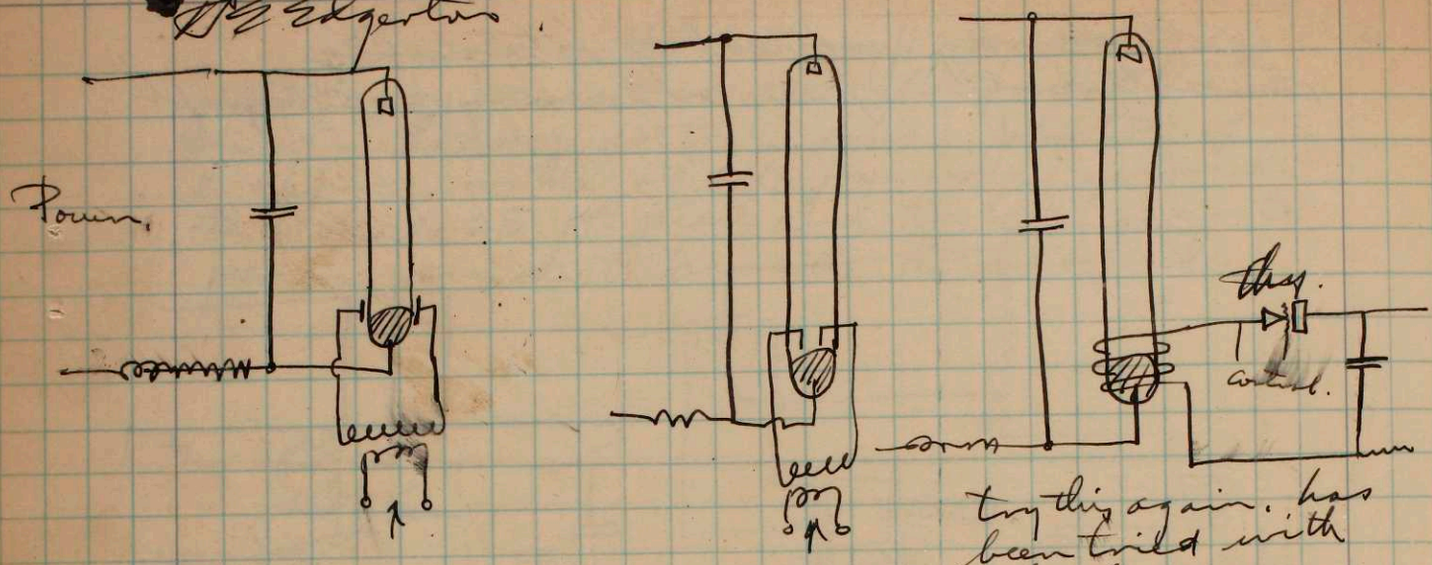
Cathode ray method of determining characteristics of an ordinary oscillograph.







August 26 1932
H. E. Edgerton



try this again. has been tried with sparker.

Fig. tube trip arrangements.

Did not work

Notebook Number: T-3

Scanning and Separation Record

__1__unmounted photograph(s)

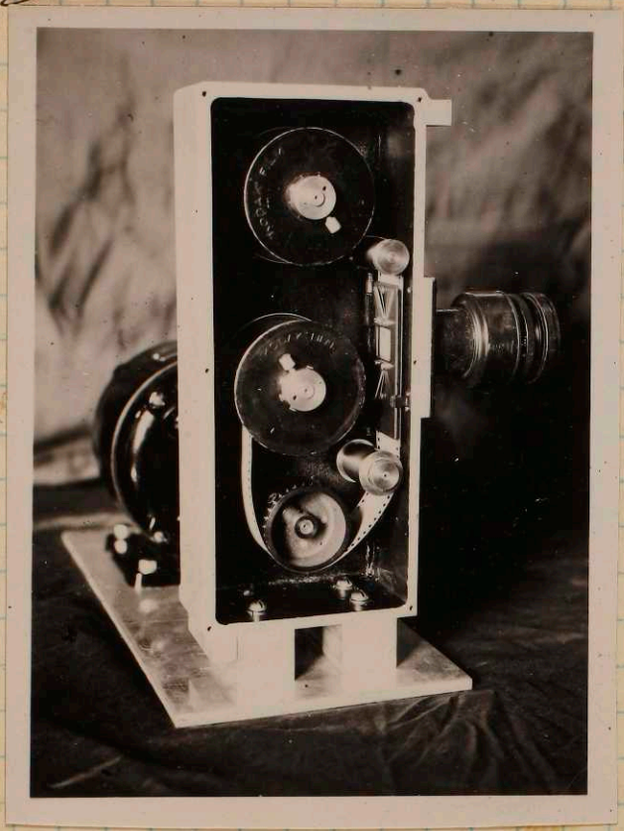
____negative strip(s)

____unmounted page(s)
(notes, drawings, letters ...)

was/were scanned ~~where originally located between page~~ in place on page
__79__ ~~and ____~~.

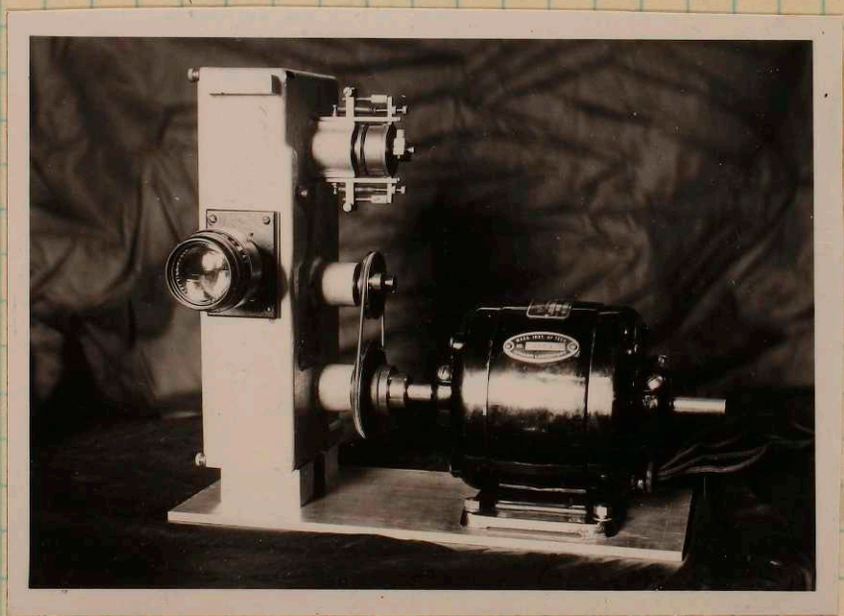
Item now housed in accompanying folder in MC 25, box 166

Aug 27 1932
B.E.E.



Continuous moving film moving picture camera.

When this photo was taken a 1/8 hp 1800 rpm Bodine Synchronous motor was used to drive the sprocket. This takes 240 full 35 mm frames per second.



The camera now has a commutator directly connected to the driving pulley. Also the camera is connected to a d.c motor so that the speed can be increased.

Sept 2 1932
~~H.E.~~ Edgerton

I went to Schenectady on monday Aug. 29th. Saw C.G. Suits in the Laboratory & the G.E. showed stroboscope, Found, Westendorf, Dr Jones, Sherman etc. Saw Metcalfe & Mr. Lee in the evening. Went to Pittsfield on tues and saw Aldrich, MacEachron (?), Humphreys,

Spent morning at the Lever Bros Soap factory, taking spark photos.

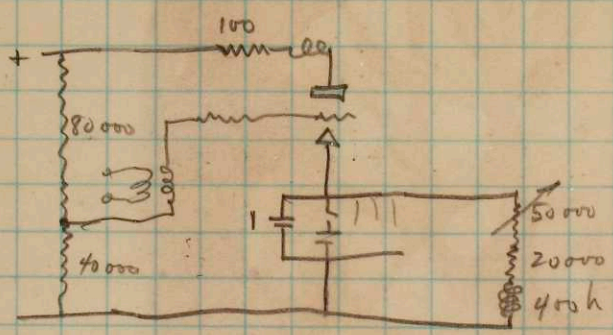
1. Eng noz. Steam f 11
2 " " "
3 " " air

4 Imp Eng Noz. air
5 "
6 " " " Steam
7 " " " "

8
9
10
11
12

} Pictures of the cavitation apparatus in the mechanical Laboratory, Bar Harbor.

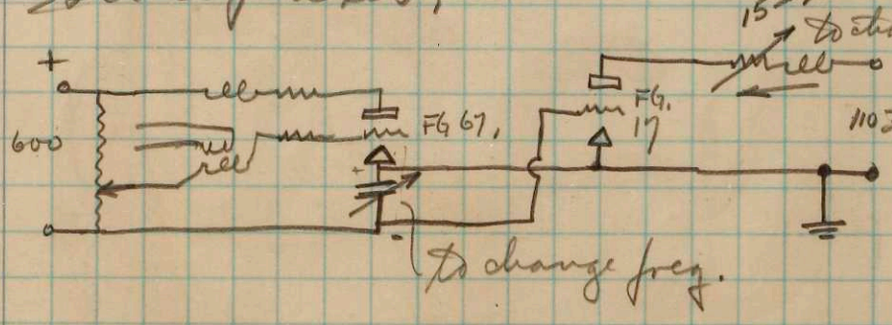
G. E. Sweep circuit.



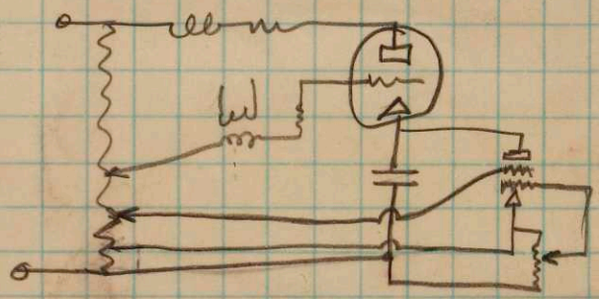
Sept 2 1932
L.E. Ekgren.

Cathode ray D.C. sweep circuit.

The illustration gives a volt-amp characteristic that is flat with current as a function of volts on the grid when current passes through the anode. This constant current should be useful to get a ~~sine~~ linear sweep axis.



2.5 × 110 = 250 watts.
.6 × 110 = 66 watts.
110/.6 = 18 ohms.
110 - 75 = 35
6 | 35 | 6 = 15 ohms.



This scheme was tried on Sat. aft. but it did not work entirely satisfactory. The oscillations put out the 67 which was used to give a constant grid current!

Moved into 10-085 a few days ago.

Notebook Number: T-3

Scanning and Separation Record

4 unmounted photograph(s)

____negative strip(s)

____unmounted page(s)
(notes, drawings, letters ...)

was/were scanned ~~where originally located between page~~ in place on page 82 ~~and ____~~.

Item now housed in accompanying folder in MC 25, box 166

the door. They have two accounts. He is going to bring over

Sept 6, 1932
H. E. Edgerton

Spark Photographs of the safe harbor Cavitation apparatus in the M.E. dept.

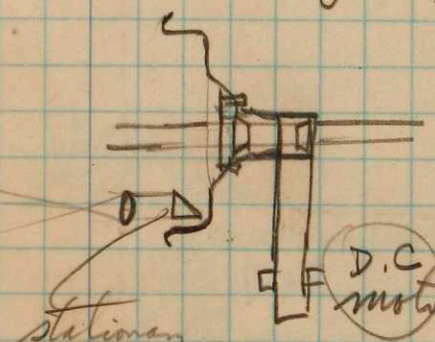
I went with Mr. Fisk of the United Drug Co to the Liggett chocolate factory in Boston to see about taking high speed movies of a wire oscillating at 1800 times per ~~min~~ min to cut off the ends of the choc. They have no ac over there. He is going to bring over a model.

Sept. 9, 1932.
H.E.E.

Took spray photographs in the a.m. at Lever Bros. thin soap solution used.

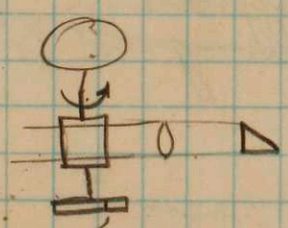
In the afternoon Mr Fish B.K. and Mr. Horton of the United Drug came over with a model of a candy machine and we tried to take some photographs. The conditions were not good in our lab. regarding temperature etc.

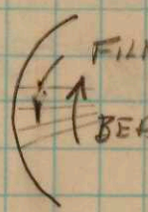
Bought a Model A 1928 Ford Front Brake drum for a camera of the rotating variety. The inside diameter is 11 inches. We are going to drive it by belt. A strip of film about 11 x 11 inches will go on the inside. Hope that this will go to 12,000 r.p.m.



A prism will be used as an optical arrangement to get the light from an objective.

After the camera is operating properly then I plan to try a rotating mirror scheme to further increase the speed on the time axis.





contact arranged to trip the sparks or lamps at the right time in order to synchronize it with the lens opening.

Sept 9 1932 H. E. Edgerton.

High speed stroboscopic work.

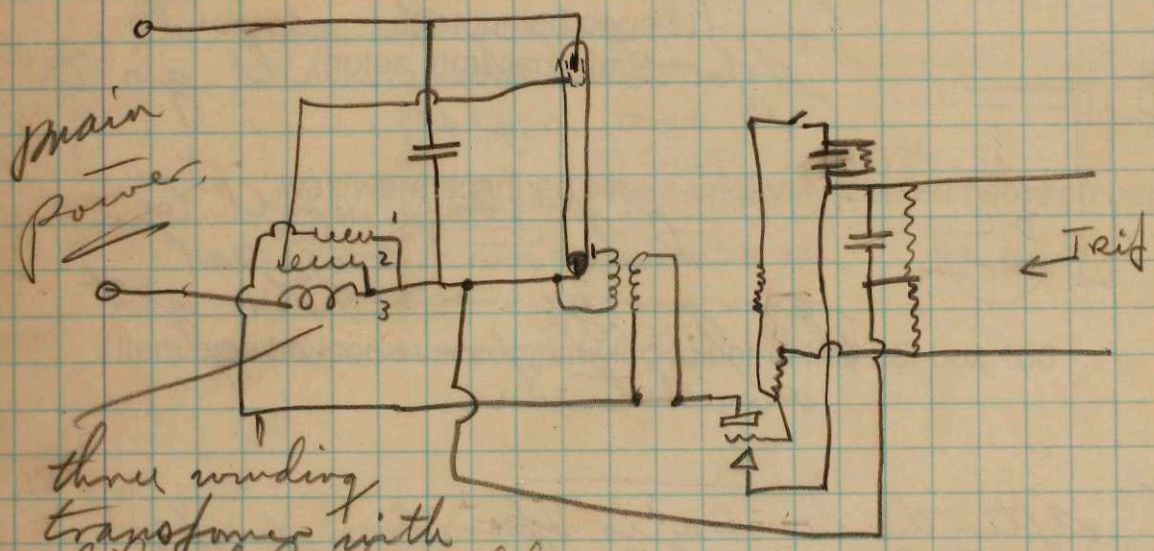
1. Try to use inside grid on the discharge tube.

2. Use smaller diam. glass.

3. Longer tubes

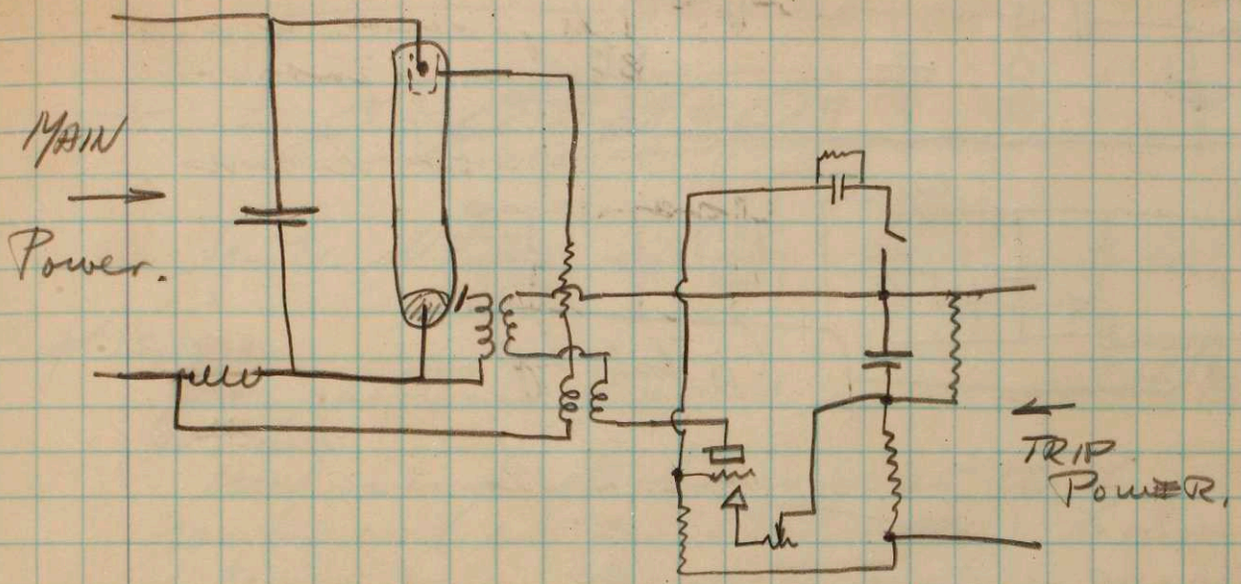
4. Deionization grid.

5. Time input



three winding transformer with lots of leakage between 1 and 3 coils.
Polarity such that charging surge gives neg. kick to the grid. The thyratron gives a positive kick to the grid & start the tube.

cont

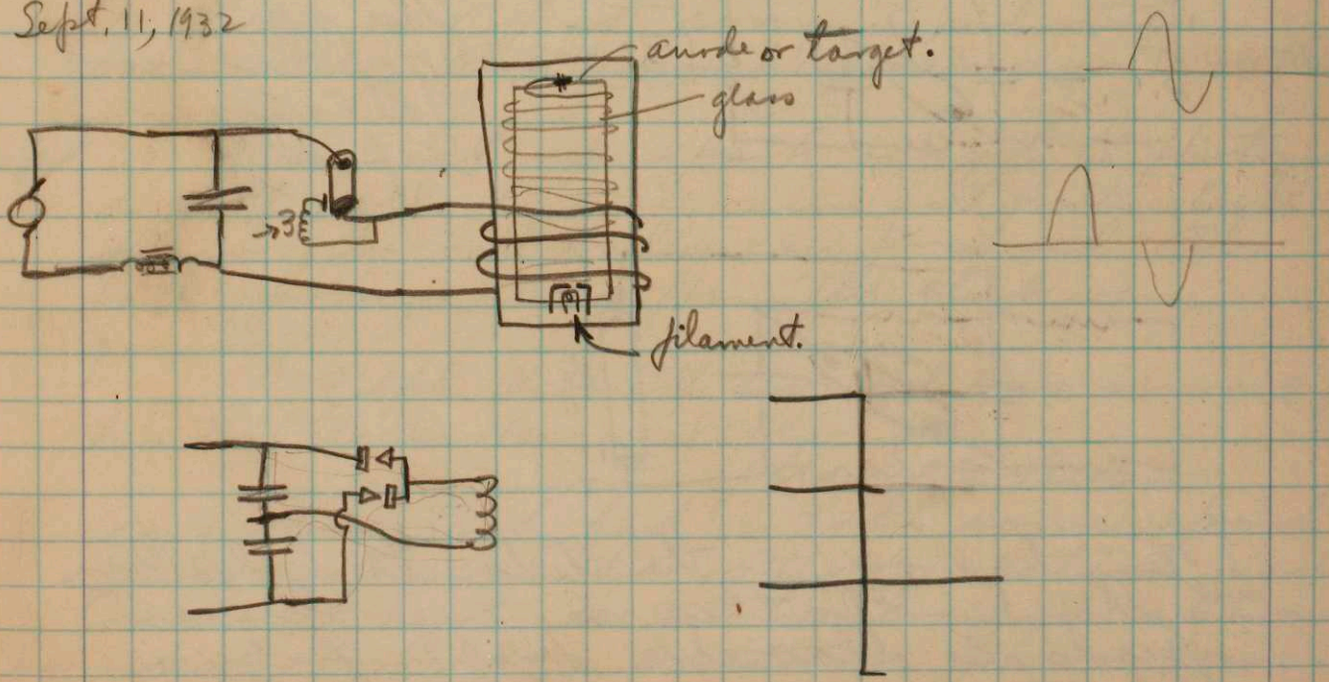


Sept. 10, 1932.
H. E. Edgerton.

I spent most of the day in the lab. Purchased some photographic supplies. Took some spark photographs of the action of a jet of water.

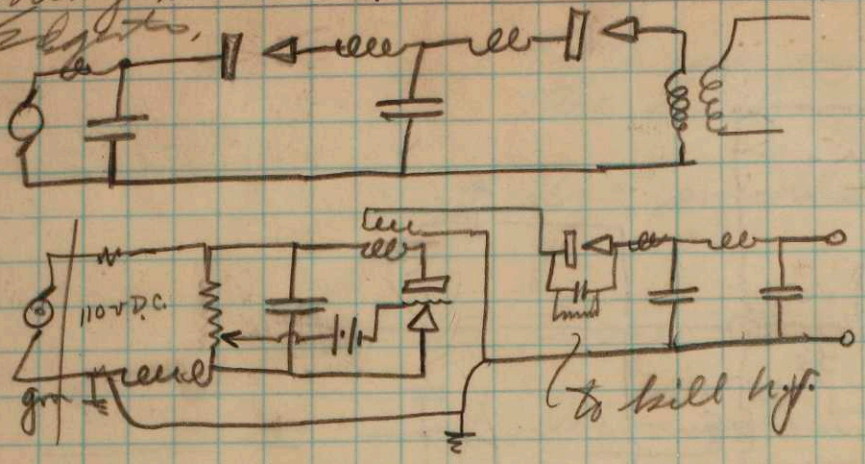
Meyer was helping to set up the glass blowing system in 10-088. He was working on a glass cutter.

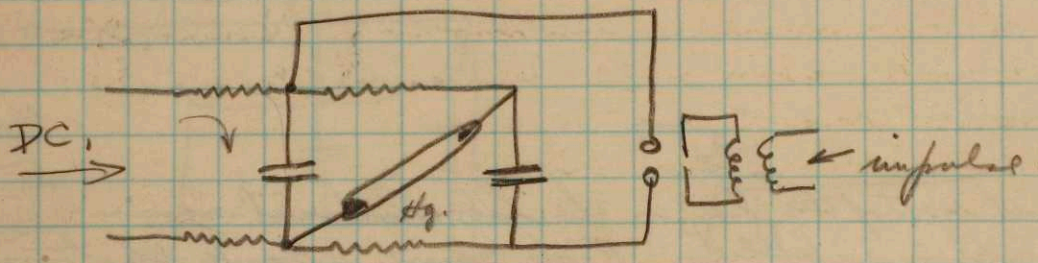
Sept. 11, 1932



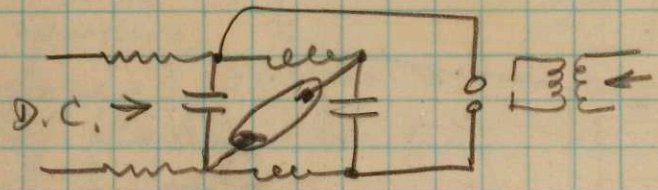
Sept 1 1932

Voltage increaser

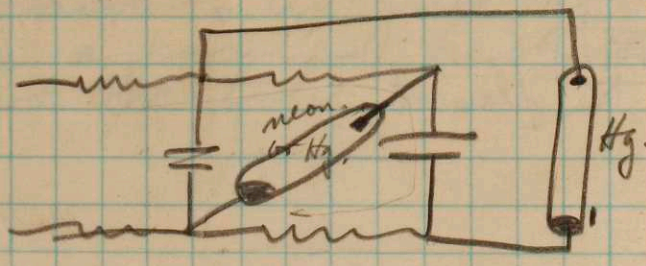




charge parallel Discharge series.

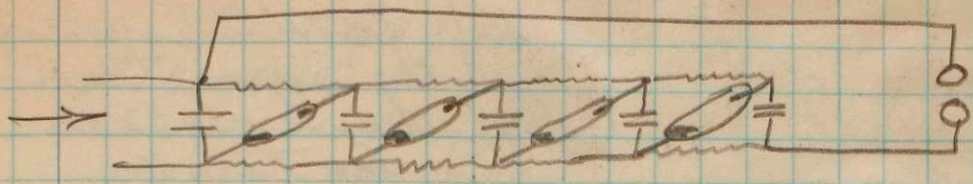


The spark gap does not deionize very rapidly.



Try hydrogen in the tubes to help them deionize. In this manner higher speeds are obtainable. Higher frequencies of light. 4000 seems to be the limit now.

Sept 12 1932.



Ignite all tubes with the same impulse.

Sept 13, 1932

Took spectrum of spark source at Kettle Co. Dr Kohn.

Used visual stroboscope at the Liggett candy co. (Mr. Fish & Mr. Horton) to observe a device on a chocolate making machine.

A 3600 rpm induction motor to drive the stroboscope camera camera. It takes too long to get started.

The camera being made from a ford brake drum is nearly completed.

Sept. 14, 1932.

The brake drum camera was badly out of balance. It ~~and~~ ran up to about 3600 r.p.m. Harry Tawresey took it back to the shop to turn part of it down to aid in the balancing. Profs Jackson & Dahl came down to see the lab.

Sept. 15, 1932. Set up spark outfit to photograph a golf ball. Pictures came out fine. One shows the ball badly compressed. The ball springs away from the club very quickly.

Ralph Bennett arrived this morning from his trip to Alaska and Colorado.

Mr. Merrian of the Safe Harbor 2½ hrs.
cavitation test had us take some spark ~~stro~~ scopic photos of the cavitation machine in the M.E. Dept. He had two brownie cameras which took ~~a~~ simultaneous photos from different angles.

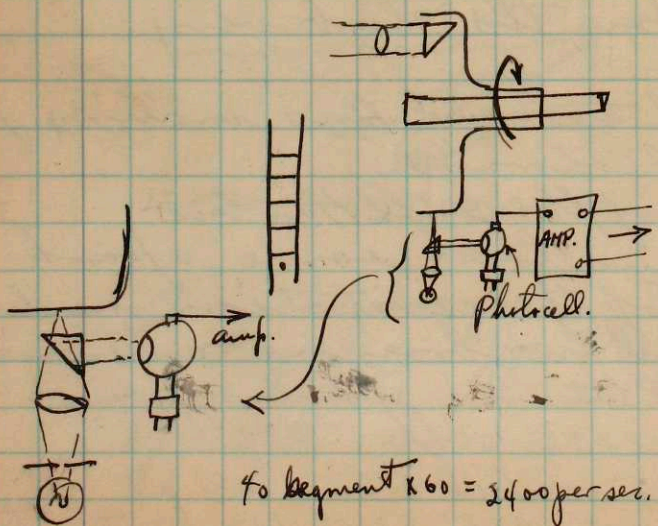
Gray and Milas worked today on a nitrogen activator in my lab. I helped yesterday. The stroboscope circuit did not give enough volts.

Sept 18 1932

K.J. Germeshausen in the Rinso tower of the Lever Bros Co ~~is~~ taking spark photographs of the soap spray from the ~~bazzle~~ nozzle.

Yesterday we took some more spark photographs of the striking of a golf ball with a club. The photos showed enormous deformation of the ball and that the ball and club are not in contact more than 1/1000th of a second. also the club and ball are only together for about a 1/2 inch.

Rim synchronizer for framing 35 m.m. films on rotating drum camera. The camera is built from a Ford brake drum and the film is wrapped around the inside. The outside will be painted black with white lines spaced at the same angle apart as the frames of the film. A photo electric device will be used to trip the tubes at the correct time.



$\frac{11" \times 3.1416}{3/4"} = 46.07$ frames per rev.

1800 r.p.m = 30 r.p.s = 1380 frames/sec.

3600 r.p.m = 60 r.p.s. = 2760 frames/sec.

~~3600 f.p.s.~~

1920 per sec. from a 32 tooth commutator on a 3600 r.p.m. motor.

$\frac{1920}{46} = 41.74 = 2502.6$ r.p.m

Sept. 25, 1932.

Went to N.Y. on Monday Sept. 19. On the way I stopped at Norwich Conn and spent several hours reading the vital records in the ~~con~~ city hall. Also read miscellaneous books in the library across the street. Arrived in N.Y. about 1 o'clock. Stayed at ~~Hotel~~ Wellington.

Sept 20. Saw Mr. Percy Thomas at 120 Broadway in the morning. He told me all about the early developments of mercury lamps etc. In the aft I went over to the Cooper Hewitt Co. and showed them the stroboscope and discussed with them the tubes, especially the life and blackening, etc.

Sept. 21. Went up to Columbia U. in the morning and saw John Russell. He showed me around the place. I then looked up the Roxy theater and saw the electrical equipment there. Next I went down to the Bell Labs and met Dr. Joves. He is using a mercury stroboscope for one of his machines. Also saw Samuel there. He is working on very short wave oscillators.

Sept. 22. A.I.E.E. meeting on machines in the morning at 33 west 39th st. Called A. L. Day in that at noon and was with him at lunch. Showed the stroboscope to many of the people at the Elect. Res. Prod. Inc. at 37th and Broadway in the Fisk Bldg. Santee Knox(?) and others saw it and seemed to be very interested. Left for Boston at 4:30 and arrived at midnight.

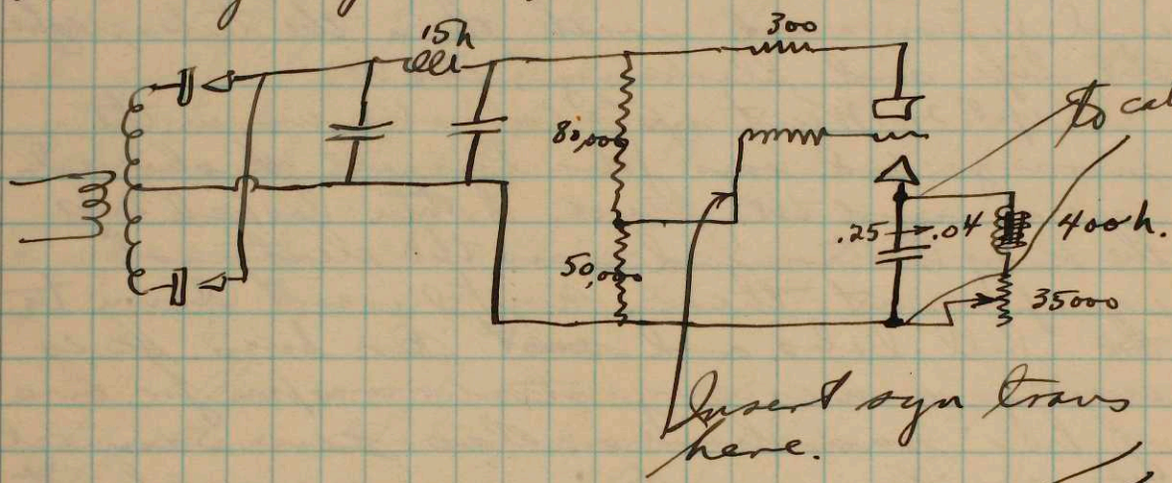
Se

Sept. 23. Cleared off desk at Tech and discussed with Bennet the program for the year. Saw Richmond, Burke, Lamson at the General Radio company. Suggested that the G.E. Condensers be immediately obtained for the stroboscope.

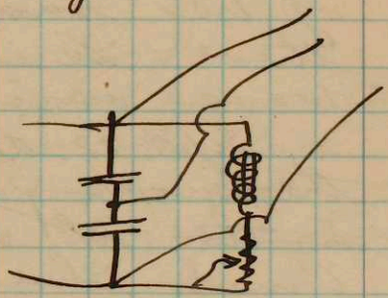
Sept 25, 1932
H. E. Edgerton

Yesterday I worked in the office in the morning. Prichard was in. He has been in Europe France and Germany, for a year and plans to be here this year to work for a doctors degree. Hope to do research on the deionization time of thyratrons and gas discharges.

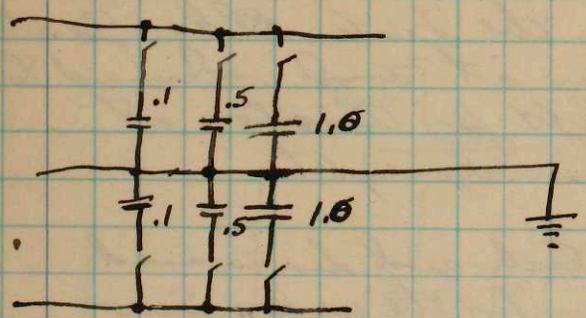
Spent part of the afternoon getting a sweep circuit for the cathode ray oscillograph. Used below circuit.

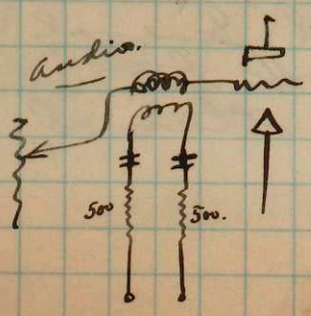


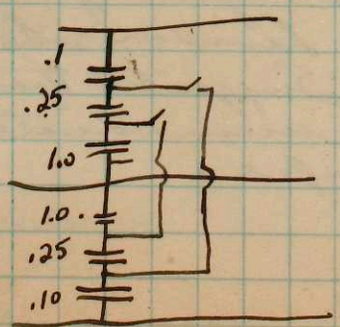
use this scheme to get center of electrostatic system.



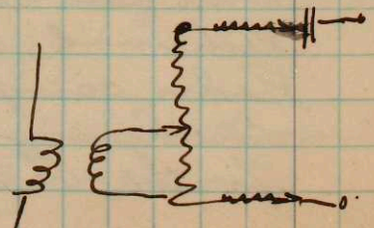
Also use vernier in the freq adjust



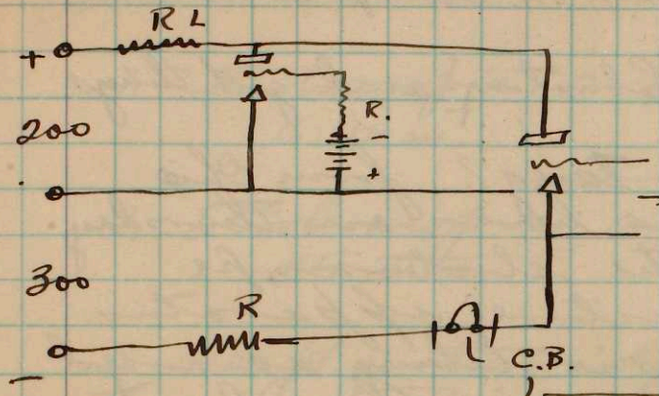


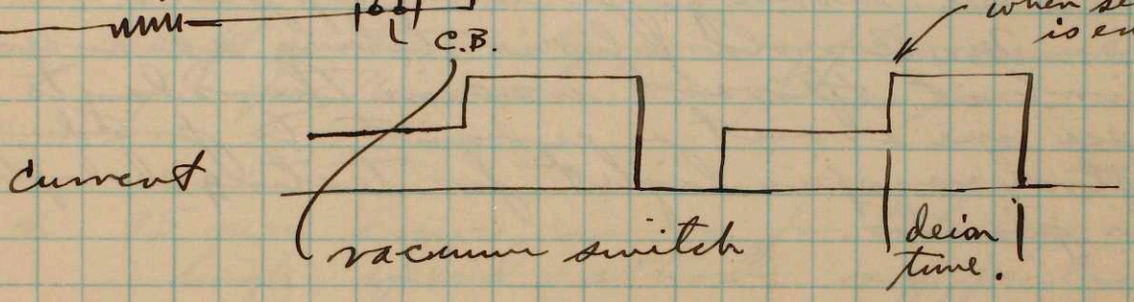


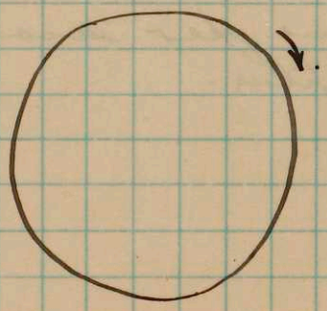
0.05 mf.
0.125 mf.
0.50 mf



Deionizing circuit for test.





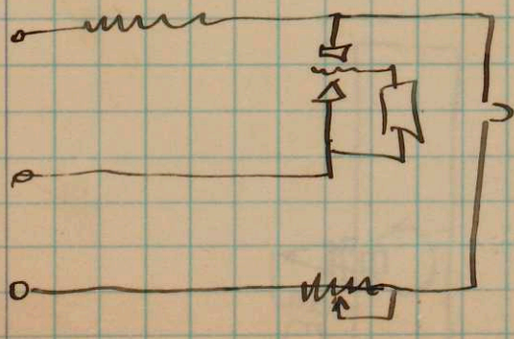


5000 r.p.m.
11 inches
$11 \times 3.1416 \times 5000 =$ vel in inch/sec.

$\frac{11 \times 3.1416 \times 5000}{1{,}000} \quad \frac{15.0}{60} = \frac{15.0}{1{,}000/60} = \frac{.15 \text{ in}}{60} / \text{micro sec.}$

100 micro sec = $\frac{15}{60}$ inches. = 1/4 inch
10 micro sec = $\frac{1.5}{60}$ inch
= $\frac{1.}{40}$ inch.

at 15000 r.p.m.
100 micro sec = 3/4 inch 0.75
10 micro sec 0.075
Should have a resolution of ten times this much.



Vacuum circuit breaker which can be operated for a very short time.

Sept. 26. 1932.
H. E. Edgerton.

Registration day. Worked on sweep circuit — for Cathode ray osc.

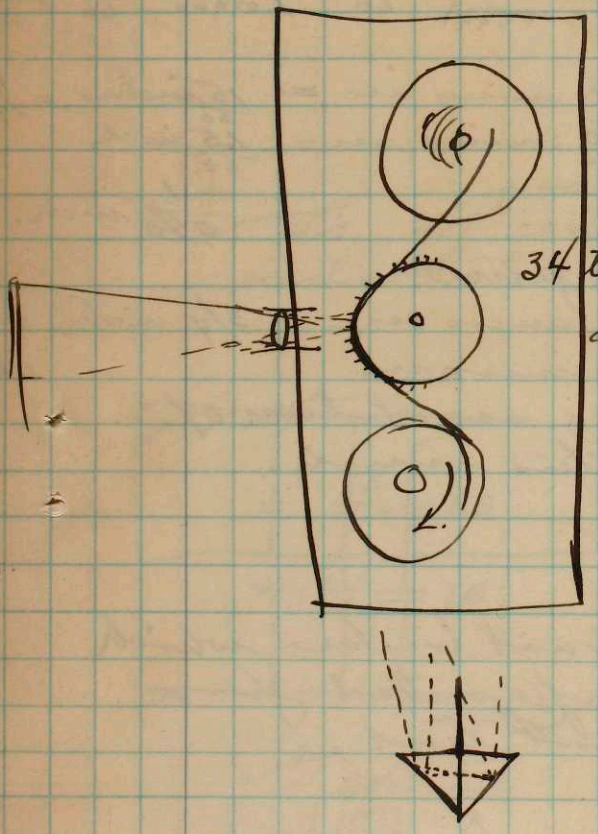
Sept. 30, 1932. Cleaned up the Laboratory and got things started this week.

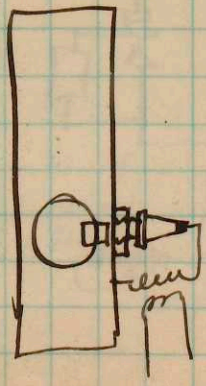
Mr. Markus, Mr. Tang? from Ohio State University were here on Thursday and I showed them the stroboscope and the moving picture apparatus.

Mr. Arnold who is taking advanced work at Harvard was in Thursday to see me about a circuit to produce stroboscopic light for testing cholophyl? in plants.

Oct. 1. 1932

Design of a 1000 frame per second camera using 16 mm film.



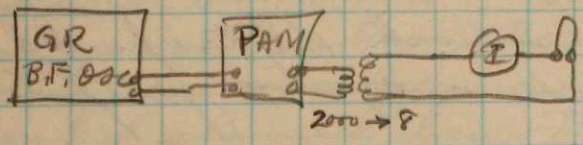


Cameras to build.

1. Stroboscopic 0-40 pict. per. sec.
   16 m.m.
2. Stroboscopic 0-40 ~~pict/sec.~~ camera ordered Keystone hand drive.
   35 m.m.
3. 100 ft continuously moving film camera
   for 16 m.m. 1020 frames/sec.
4. 35 m.m 4mm camera for taking
   high speed cathode ray pictures.

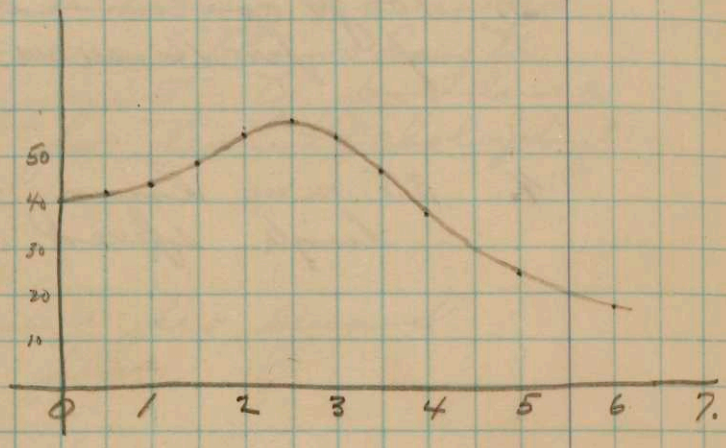
Oct 3 1932
H E Edgerton.

Freq. Calib of element no 1. on the oscillograph
9 element. Sensitive element.



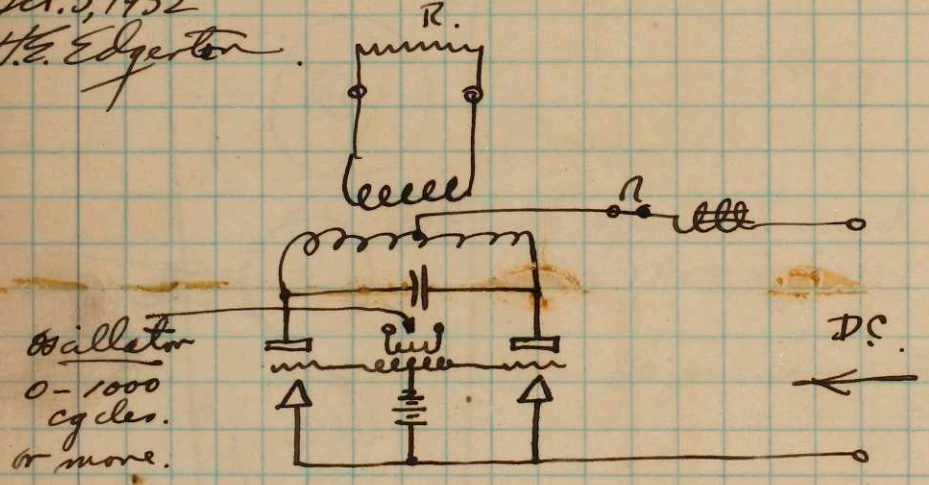
Freq. Current amplitude (crest to crest)

500.	75 ma.	41.2 mm
1000	75	43.
1500	75	48.5
2000	75	54.5
3000	75	53.0
4000	75	37.0
3500	75	46.5
5000	75	24
6000.	75	18
2500.	75	56.5



Oct. 5, 1932
H. E. Edgerton.

Elect Eng.
May 1932



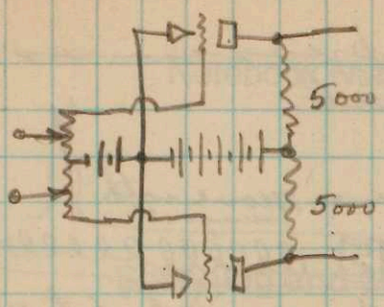
2FG-67 thyratrons.
1. Transformer. Primary 220 volt with midtap.
Secondary. 600-0-600.

Condenser ? 1 mf.

+ ——

——→

Oct. 5. 1932.

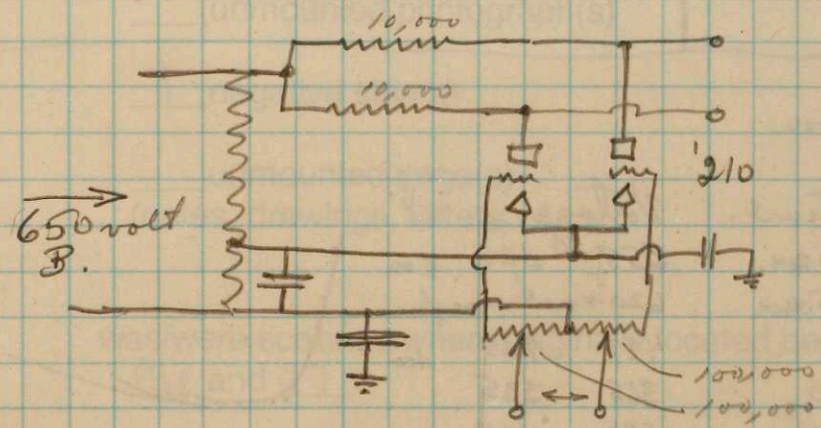


.018 × 5000 = 90.000 volts.

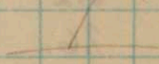
10 type. 7.5 v 1.25 a
$\mu = 8$.
425 volts.
−35 g.
18 milo
1600 = mutual cond.

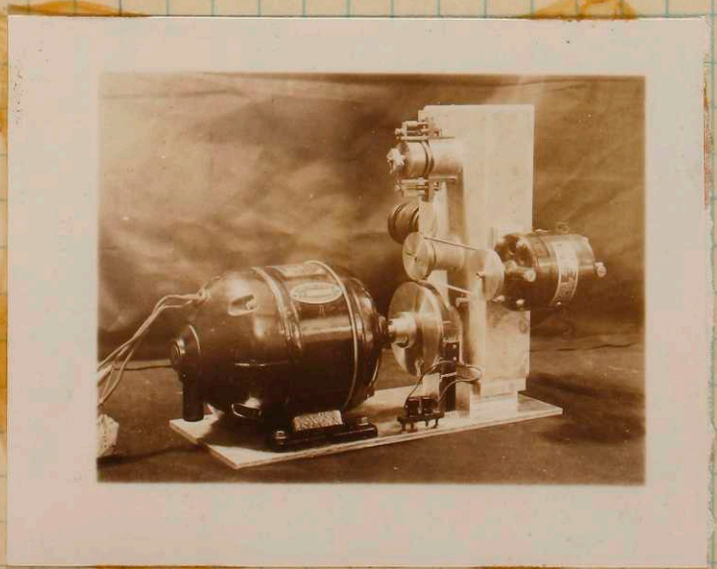
pay use 10,000 Ω.
.018 × 10000 = 180 volts
180 + 425 = 605
+ 35 bias
640 volts.

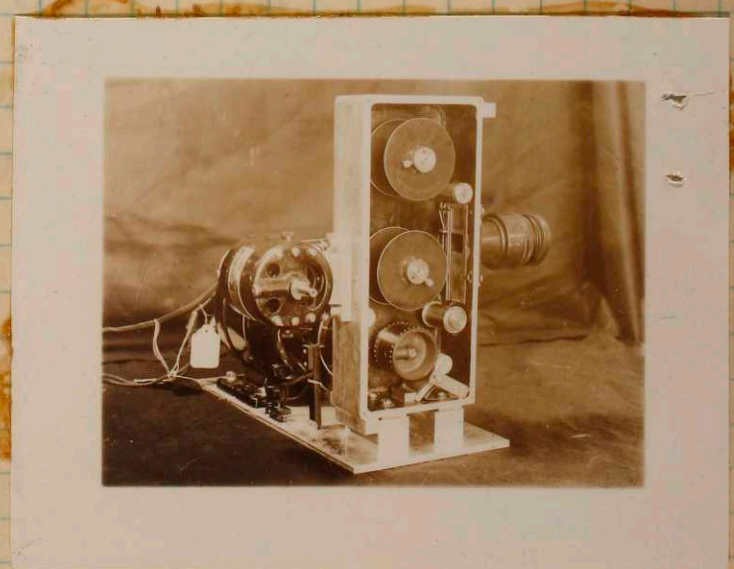
2900
42500 =
.018 ma.



10 steps or less.
35 × .6 × 7 = 144 volts.

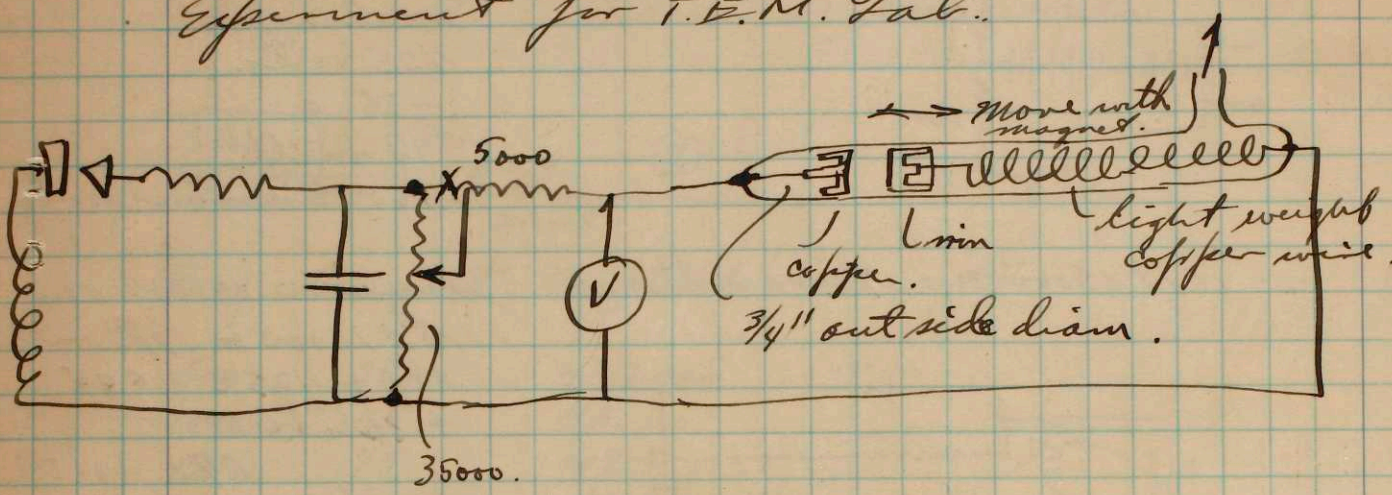




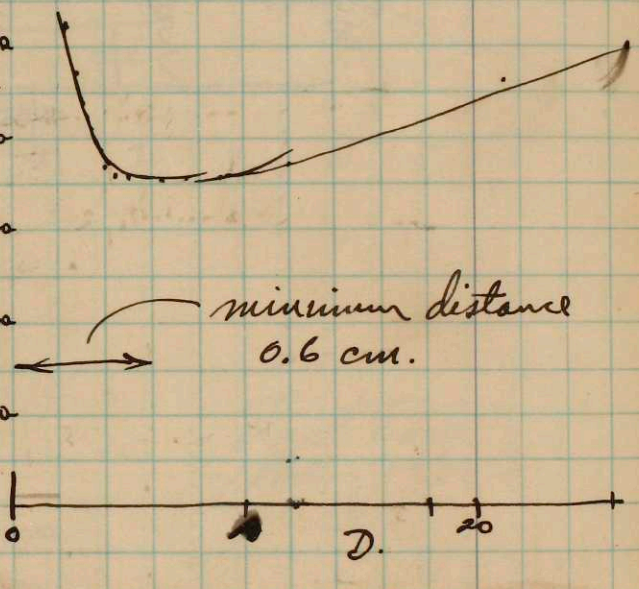


Oct 7 1932
H. E. Edgerton

Breakdown at low pressures.
Experiment for T.E.M. Lab.



Pressure	distance.	Voltage. on.	off.
80 microns	4.3 mm.	355	325
	1.5 mm	620 → not enough.	
	2.8	477	425
	4.0	365	335
	2.2.	525	465
80.	5.1	365	325
	6.2	353	320
	7.6.	353	320
	9.0	352	320
	1x2.0	365	320.
	2x1.5	465	350
	"	465	340.
	26.8	480	
	"	515	
	"	505	350.
	31.4	550 ± 20.	



.6 X 8 = 0.48

CHARTER MEMBERS OF THE
LUNCHEON CLUB.

HD

Notebook Number: T-3

Scanning and Separation Record

____unmounted photograph(s)

__1__negative strip(s)

____unmounted page(s)
(notes, drawings, letters ...)

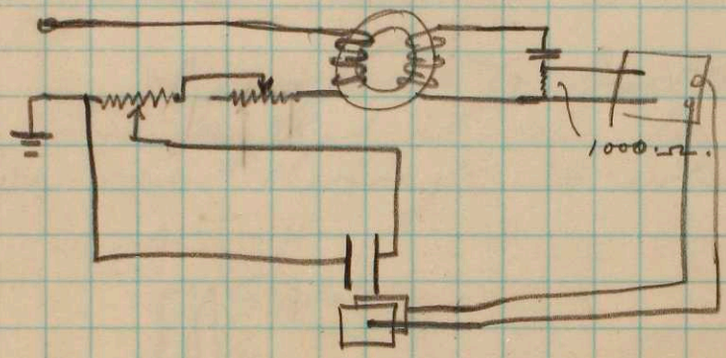
was/were scanned where originally located between page 96 and 97.

Item now housed in accompanying folder in MC 25, box 166

October 19 1932.

Boston A.S.E.E. was over here today and we showed them some of the stroboscope lab.

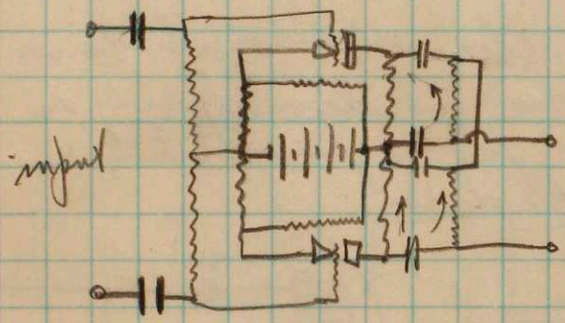
Oct. 26, 1932

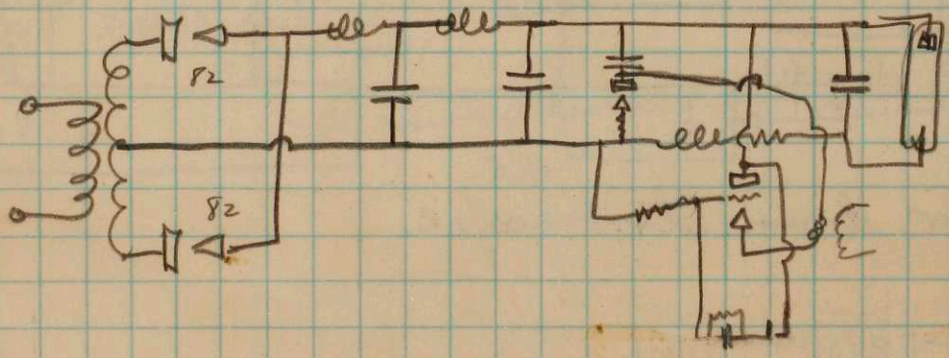


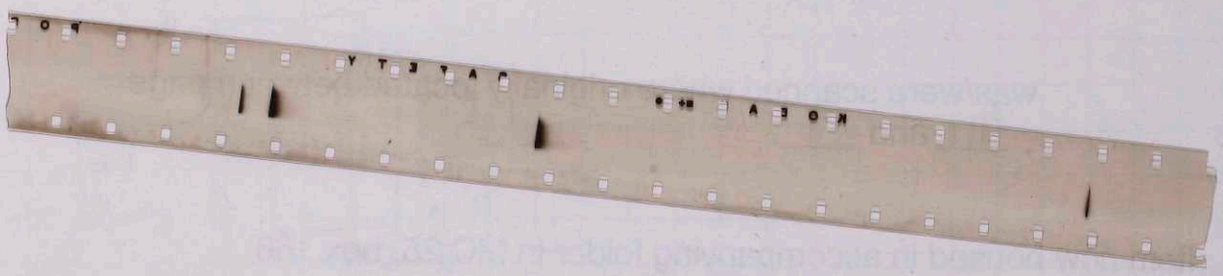
60 cycles.
50,000. ohms 30 / 1.01 Ω =

$\frac{1}{2\pi fc} = 100{,}000.$

$C = \frac{1}{322. \times 10^6} = .01$ mf.







Notebook Number: T-3

Scanning and Separation Record

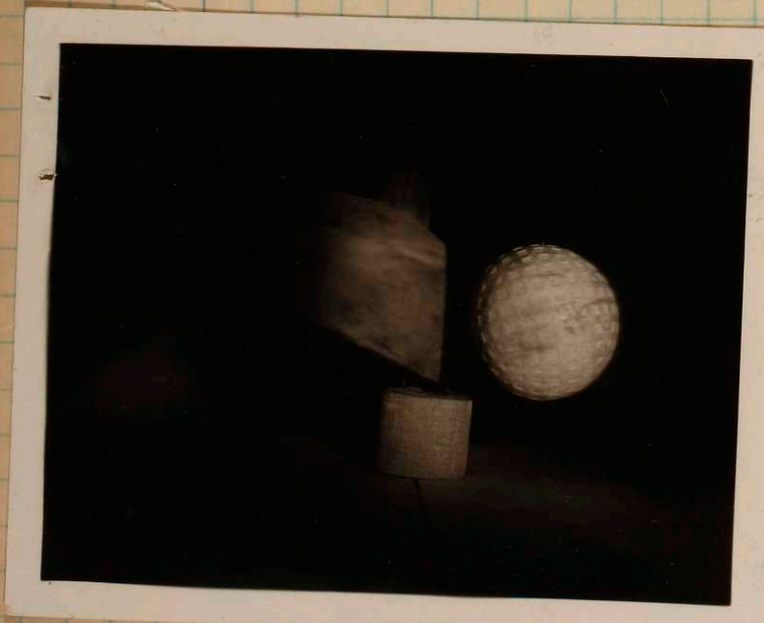
__1__ unmounted photograph(s)

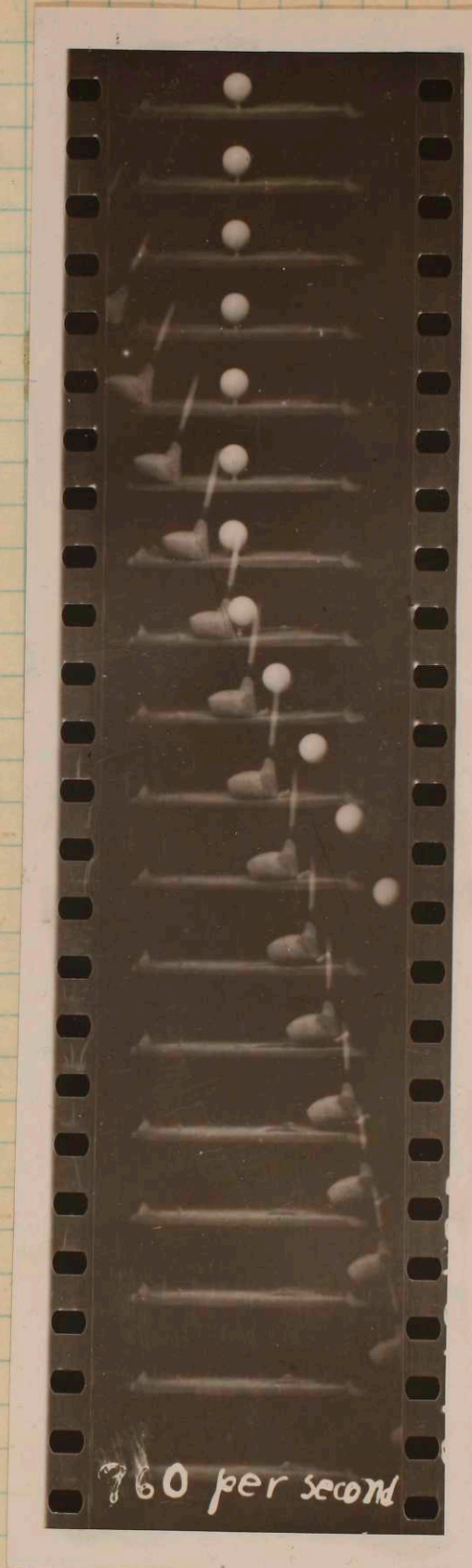
____ negative strip(s)

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

was/were scanned ~~where originally located between page~~ in place on page
100 ~~and ____~~.

Item now housed in accompanying folder in MC 25, box 166




760 per second

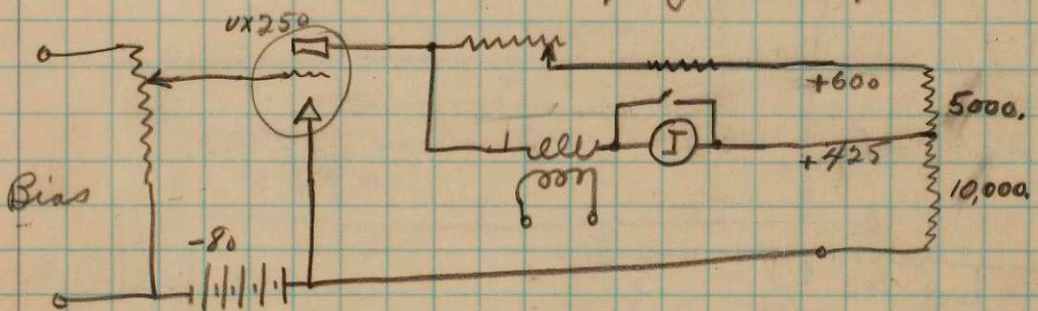
Nov 10 1932 — Spark photos of Golf ball.

H. E. Edgerton

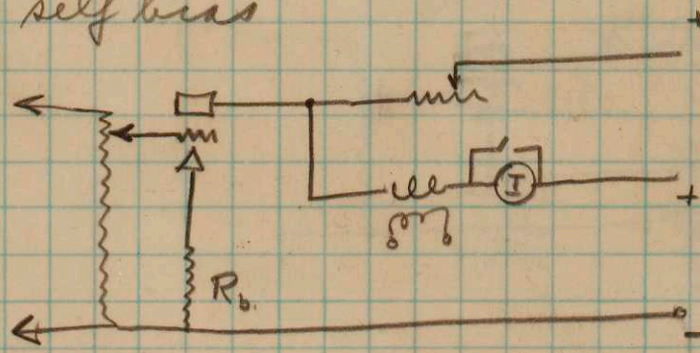
Trip contacts lined up on the front of the ball so that trip will occur as soon as the ball begins to move. Iron wire used in the spark gap.

Picture no.	Ball no.	trip wire Spacing	Aper.
1	5 6	1/16 1/16	32
2	4 5	1/8 1/16	22
3	4 4	1/4 1/8	22
4	3 4	1/8 1/4	"
5	2 3	1/8 1/8	"
6	1 2	1/16 1/8	"
7	6 1	1/100 1/16	"
8	6	- 1/100	"
9	4	3/8	"

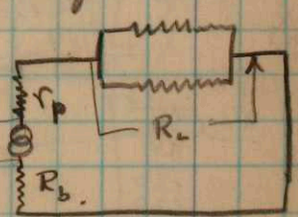
Nov. 12, 1932. Oscillograph amplifier.



With self bias



Equiv cir.



$R = r_p + R_L + R_b$.

grid voltage = $(e_s - i_p' R_b)$.

$$i_p' = \frac{u(e_s - i_p' R_b)}{R}$$

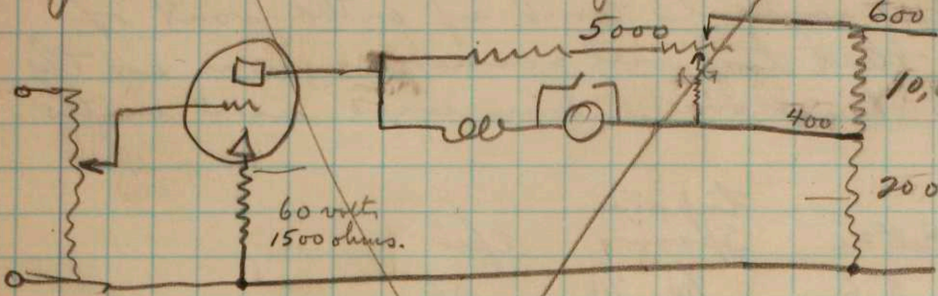
$$i_p' + \frac{u i_p' R_b}{R} = \frac{u e_s}{R}$$

$$i_p'\left(1 + \frac{u R_b}{R}\right) = \frac{u e_s}{R}$$

$$\frac{R + u R_b}{R}$$

$$i_p' = \frac{u e_s}{R + u R_b}$$

Operate UX 250 with 350 plate volts 40 ma -60 bias.



5/25 .25 (36.) 75 150

.04) 1500 60 4 .04

.04) 5000 200

7500 - 3.8 x 1500 6000. 1500 2

1500 4 6000

2000 4000 1500 7500

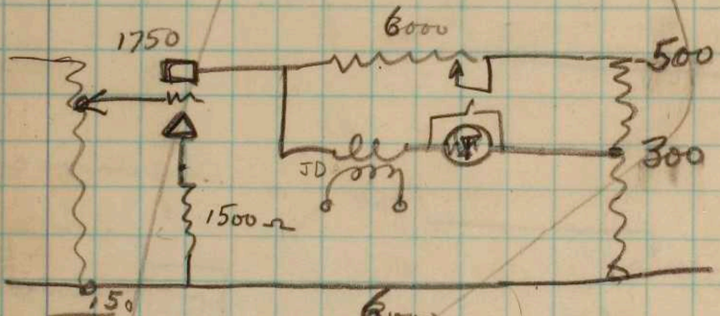
$i_p' = \frac{.004}{1500} =$ 4 ma

$i_{trans} = \frac{4.}{3} =$ 1 ma. 100 ma.

2000 → 2. ratio.

UX-245

$E_p = 250$ $E_g = -50$ 1750 ohms 34 ma. $\mu = 3.5$



34) 50 34 160 170

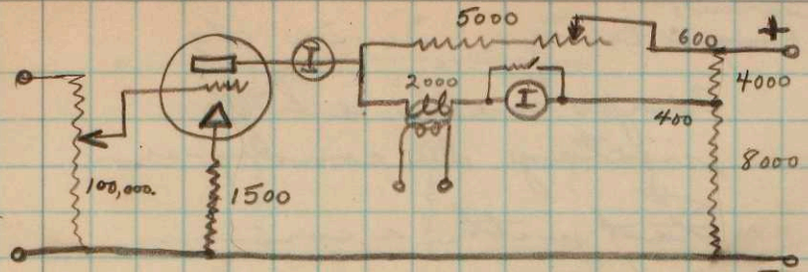
34) 100 3000

6000 1750 1500 6250 - 5250 1,000.

1500 358 75 45 5250

Self bias reduces the effect of the signal since the drop is out of phase with respect to the signal. later?

UX250

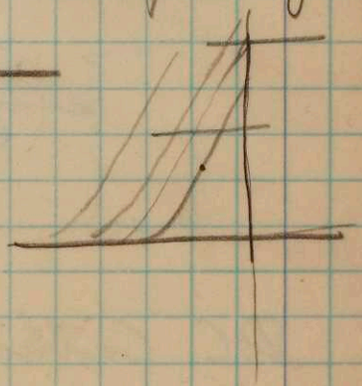


$$e'_p = \frac{\mu e_s}{R + \mu R_o} = \frac{\mu e_s}{7500 + 6000} = \frac{e_s}{3000} + \frac{1}{3,000} \quad .3 \text{ ma}$$

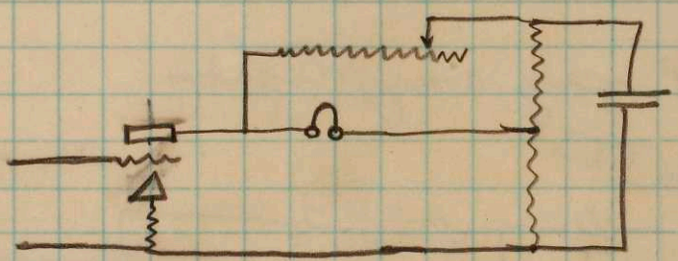
$$0.3 \text{ ma} \times \tfrac{1}{3} = 0.1 \text{ ma.} \qquad 10 \text{ ma.} \quad 5 \text{ volts} = 100 \text{ ma,}$$

50 ma $\quad$ 50 + 40 = 90 ma load from the power pack.

12000) 600,00



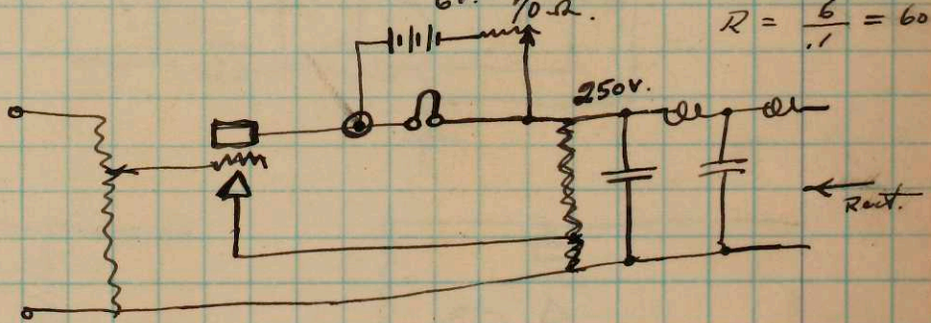
Direct Coupled Amplifier



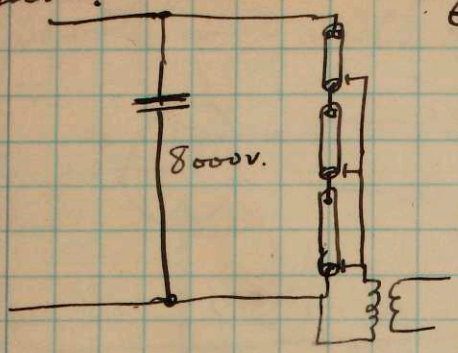
Nov. 25. 1932

$$.100 = \frac{6}{R}$$

$$R = \frac{6}{.1} = 60 \text{ ohms.}$$



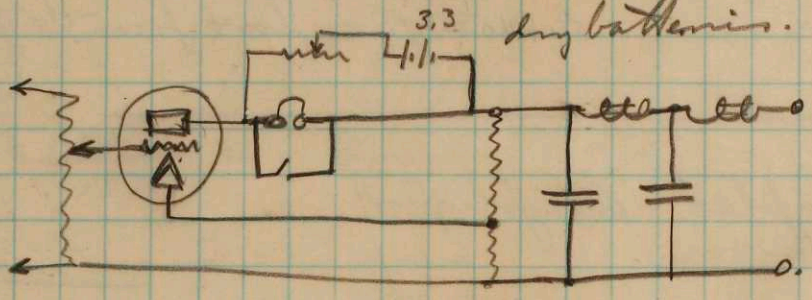
Nov 29 1932
H. E. Edgerton.



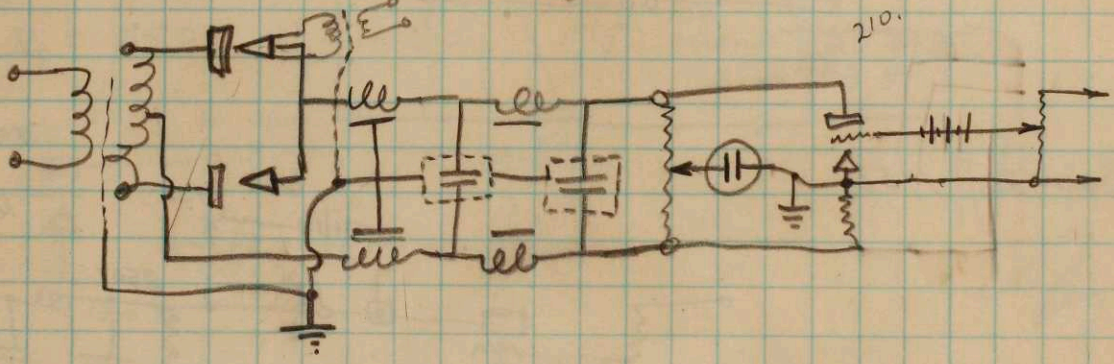
Circuit for stroboscopic study. Series of lamps across a high voltage dc condenser. Start with a common impulse.

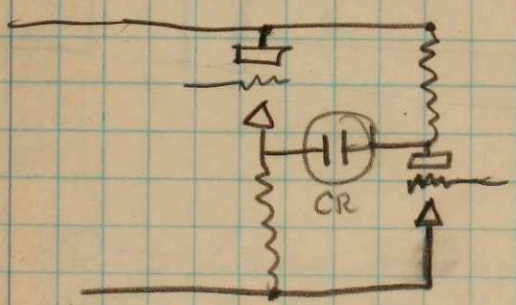
Dec. 3 1932.

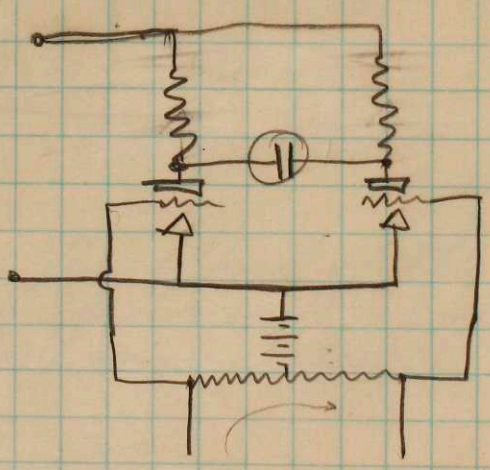
Use dry cells for the balancing out circuits.

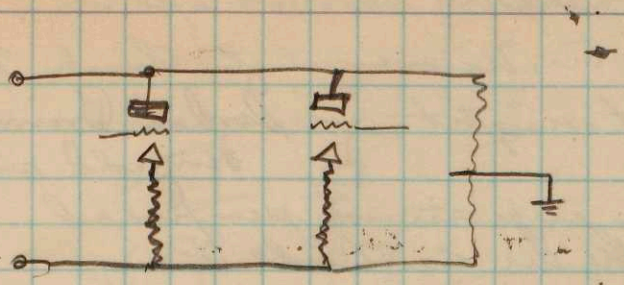


D.C. Cathode ray amplifier





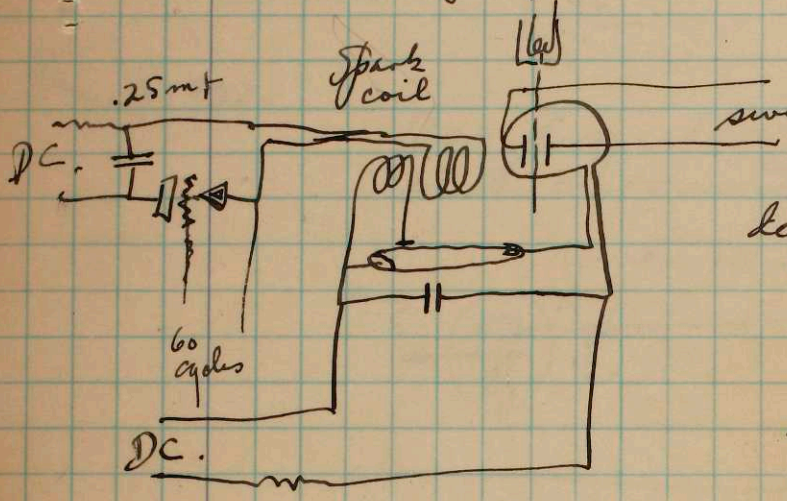




Dec. 17th 1932
H.E. Edgerton.

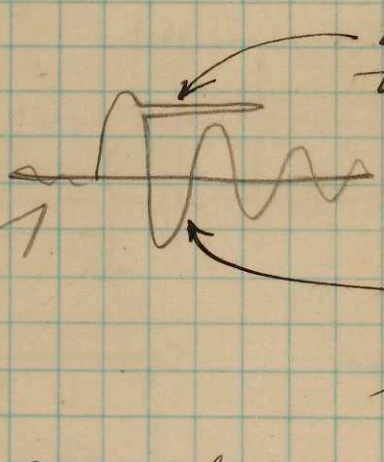
Demonstrated the stroboscope to the Arling ton Universalists church men's club last night. Gordon Brown helped. very cold night.

An interesting experiment performed on Dec 15 1932 with the Cathode Ray Oscillograph.

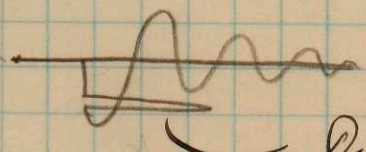


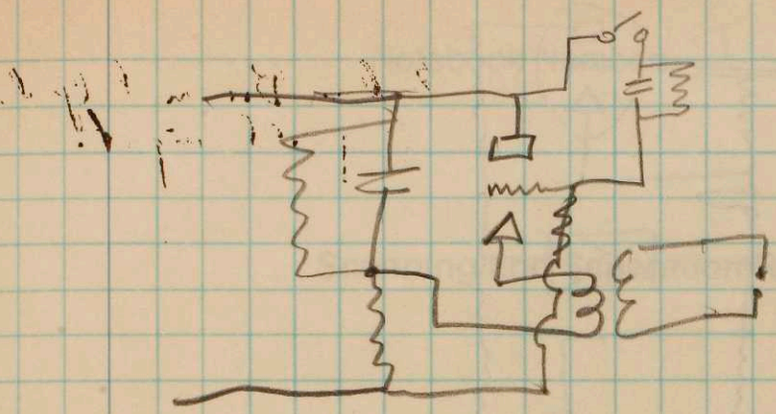
Three factors deflect the beam.
1. The sweep circuit
2. The field from the spark coil
3. the field from the main discharge circuit.

The beam gives the following picture

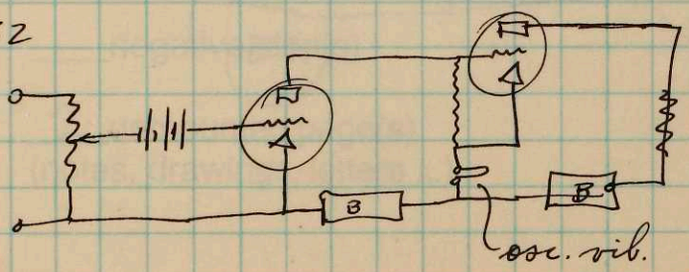


The leads to the spark coil were reversed and the following observed



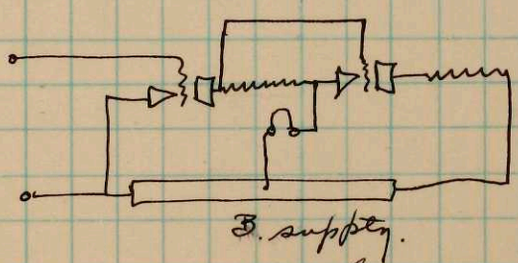


Dec 20 1932



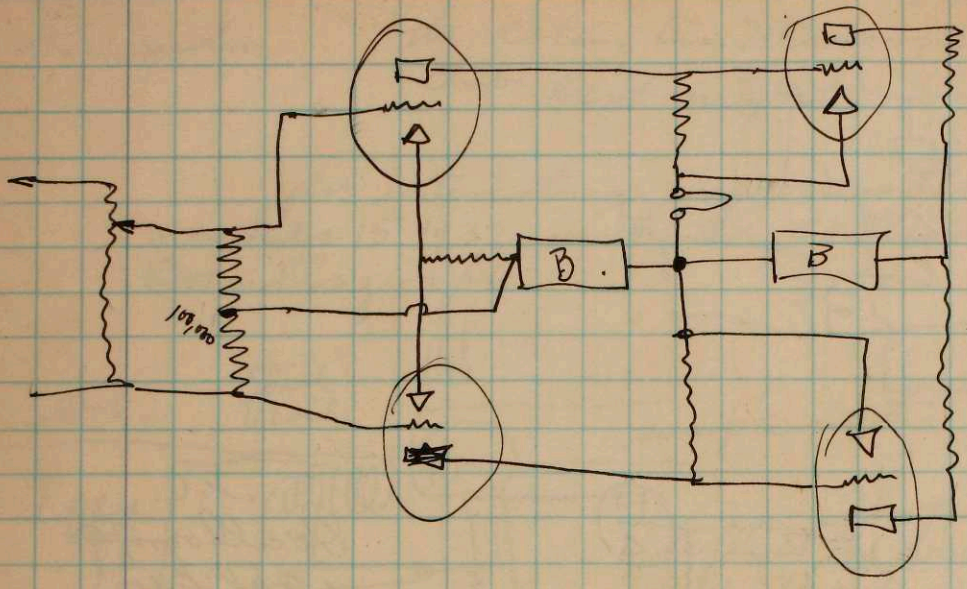
D.C.
Oscillograph
amplifier.
Use 2 UX245
tube in parallel
in each side
4 tube in all.

This circuit should work fine with battery supply. The D.C. is picked out of the vibrator circuit.



If a "B" supply is used there may be some difficulties for sudden transients. One way to avoid the transient characteristics of the filter is to put on a big shunt load.

Another way is to build a mirror circuit which does nothing but keep the current constant in the power pack. The bias possibly can be obtained from a drop wire in such a circuit.


B.
B

Notebook Number: T-3

Scanning and Separation Record

____unmounted photograph(s)

____negative strip(s)

__2__unmounted page(s)
(notes, drawings, letters ...)

was/were scanned where originally located between page 108 and 109.

Item now housed in accompanying folder in MC 25, box 166

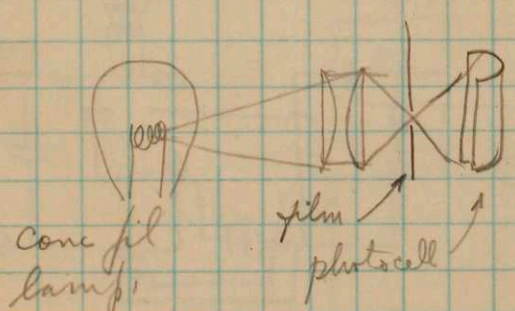
Jan 1. 1933. H.E. Edgerton

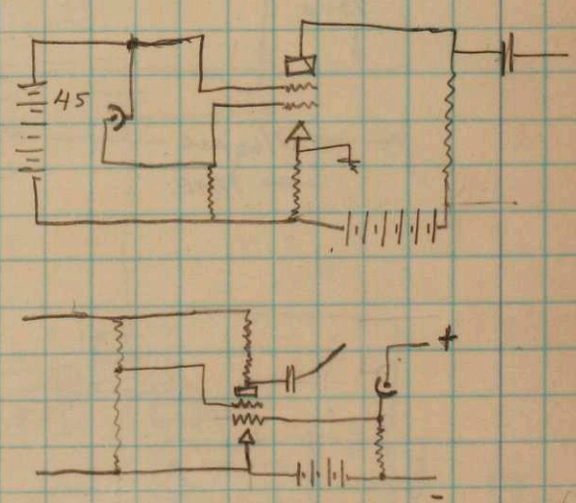
Bennett Brandall and I drove a 1¼ ton truck to atlantic city with a display of scientific apparatus to the convention of the Amer. Asso of Sc for the advancement of Science. We left on Monday Dec 26 at 5 am. and arrived at A.C about 7.30 p.m. We had a truck load. Two van de Graaf electrostatic generators 1.5 million volts total, Several Stroboscopes, a photoelectric cell ~~bug~~ microbe counter, a enzenne? separater, a super sonic wave diffraction apparatus, and Compton's (A.H.) cosmic ray measuring device.

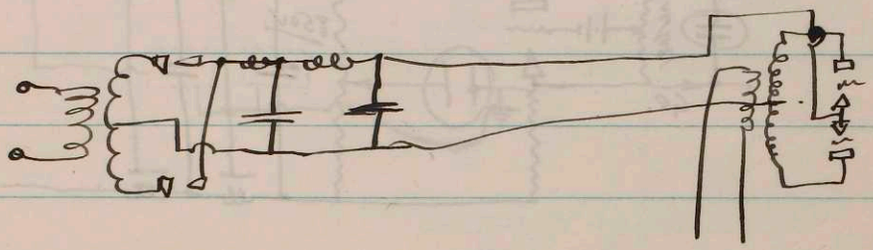
The return trip was made on Friday evening ~~to~~ as far as Princeton where we stayed at the Graduate College with Miller. The remainder of the trip was made Saturday.

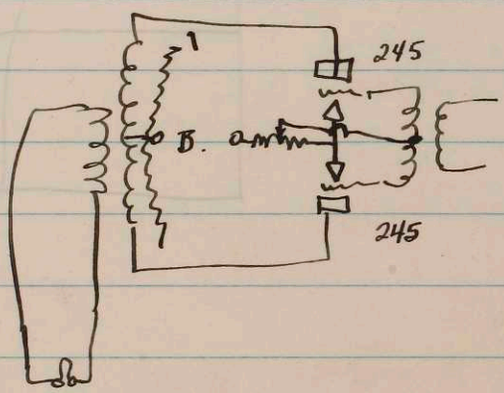
Jan. 8 1933.

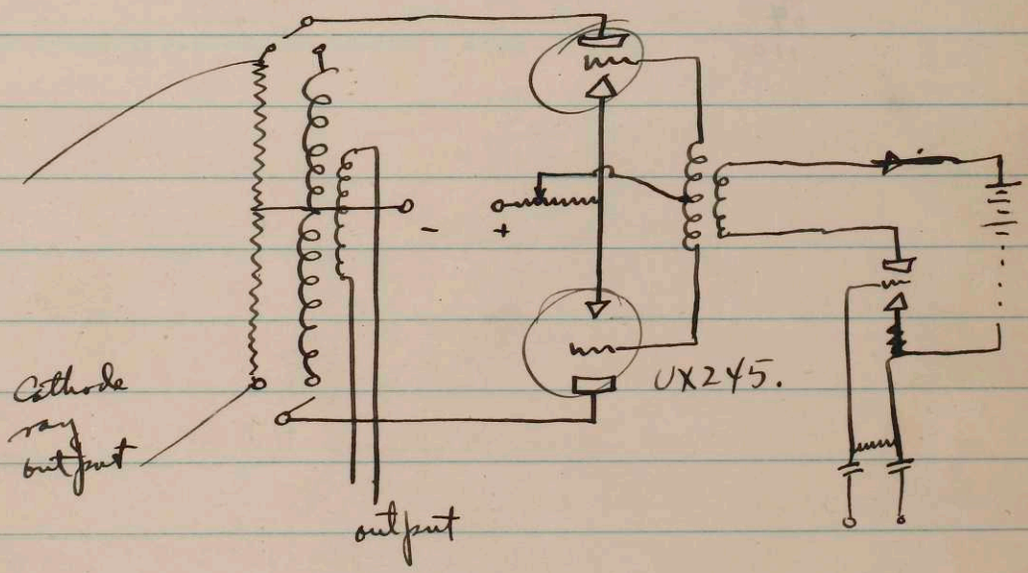
Photoelectric amplifier to trip the strobe in synchronism with the film.







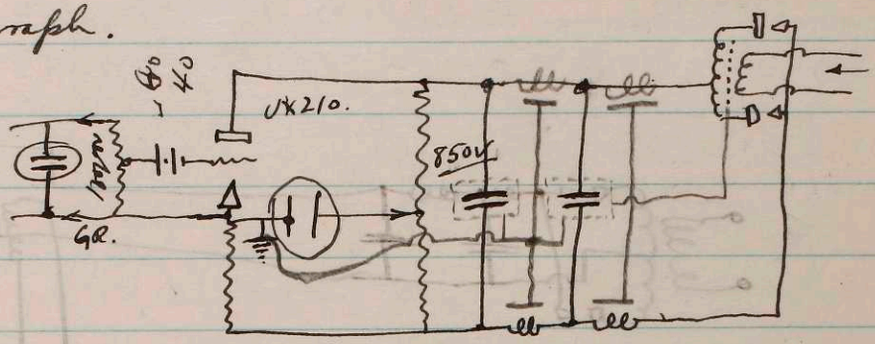

245
B.
245

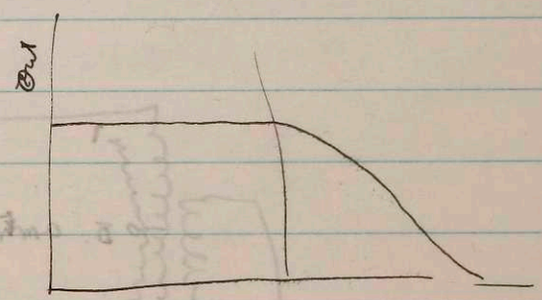

UX245.
Cathode ray output
output

Cathode Ray Oscillograph.

D.C. model

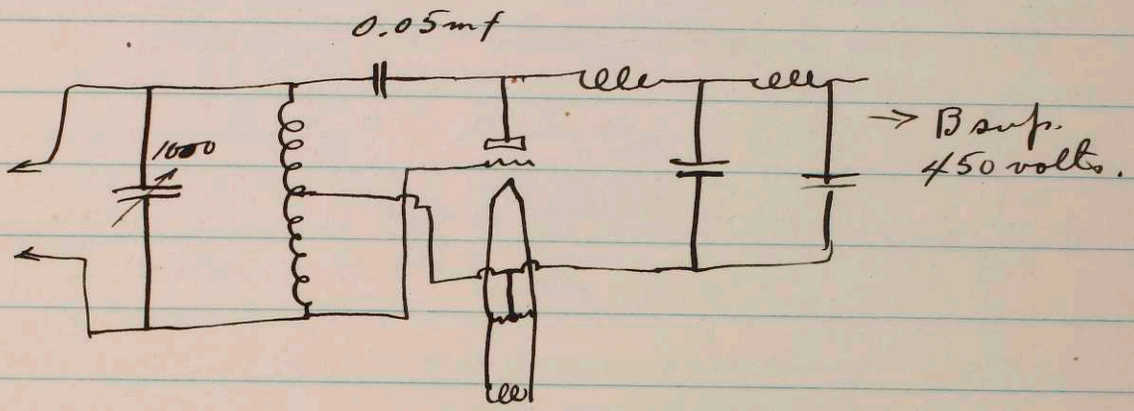
2 - 866's.





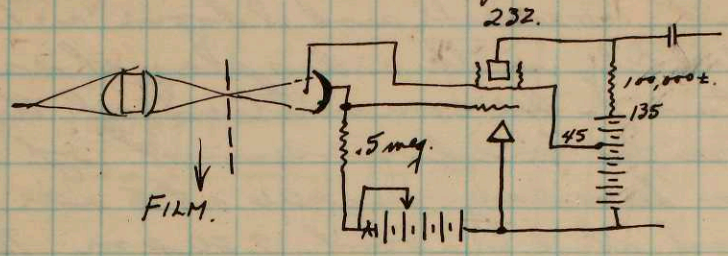
$$
\begin{array}{r|l}
18. & 23 \\
\hline
 & 425 \\
 & 36 \\
\hline
 & 65 \\
 & 54 \\
\hline
 & 110
\end{array}
$$

H.F. Oscillator

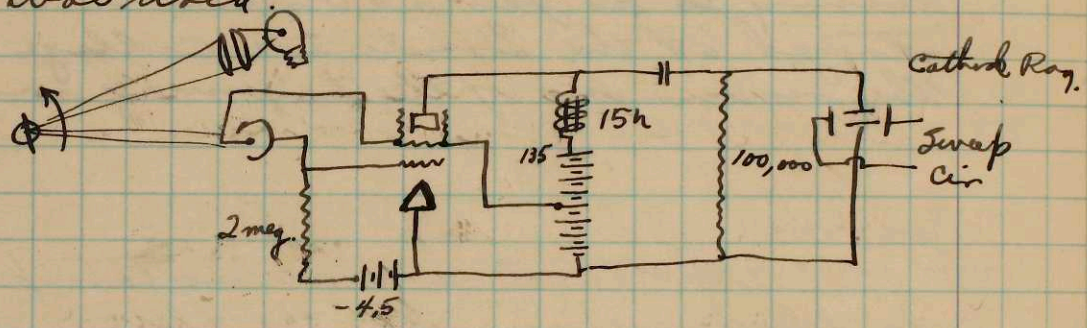


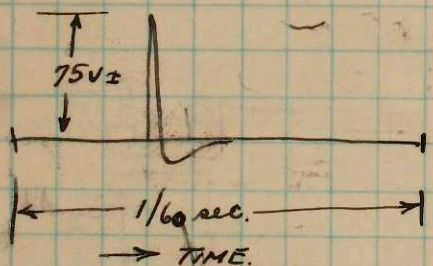
Jan 10 1933

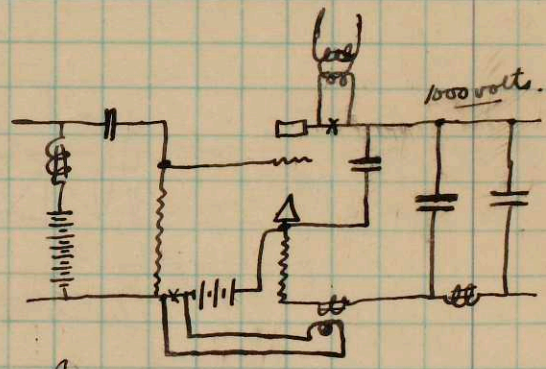
H. Edgerton Photoelectric Amplifier



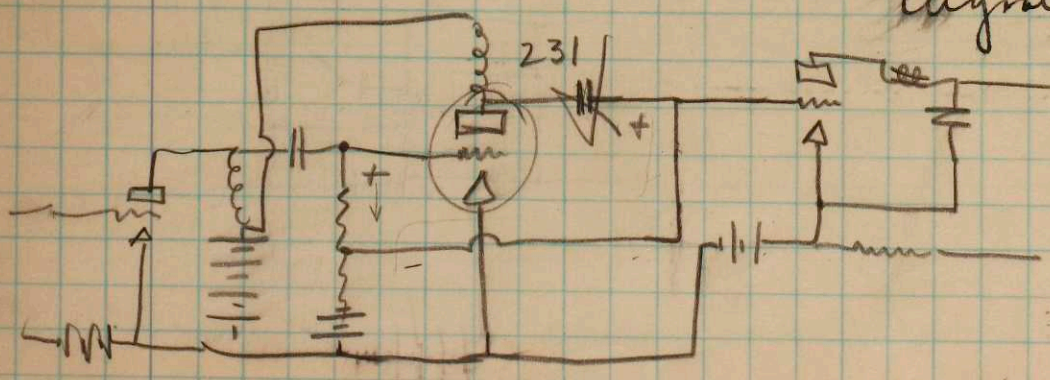
Jan. 16, 1933 Wired up amplifier and photocell as per above and tried it out. A 2 meg resistance was used in the photocell to meg grid. The bias resistor was -4½ volts. I used a rotating mirror to whip the beam across the face of the photo-cell. Impedance coupling was used.



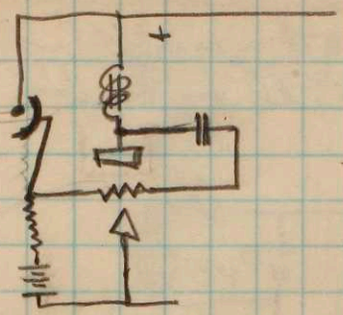




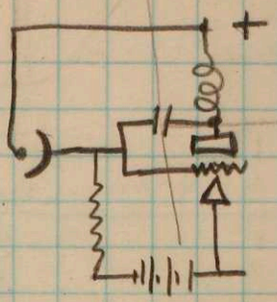
thyratron circuit.

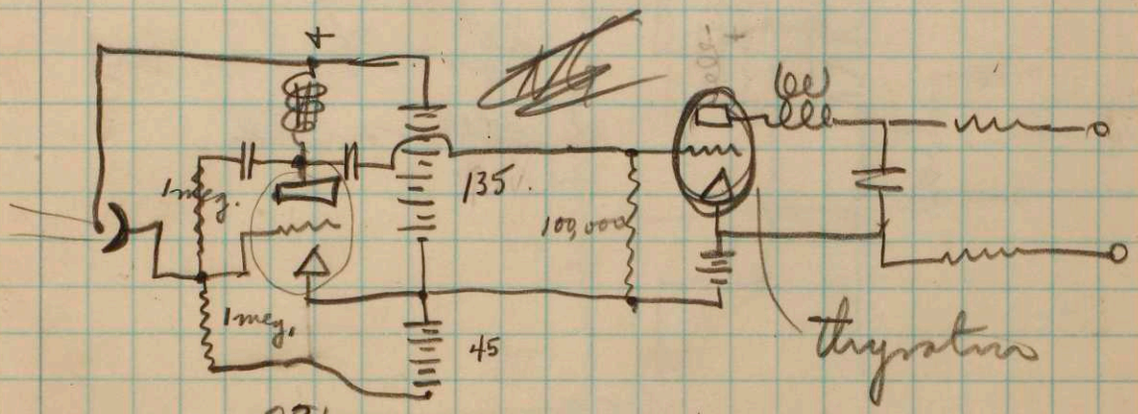


231



231





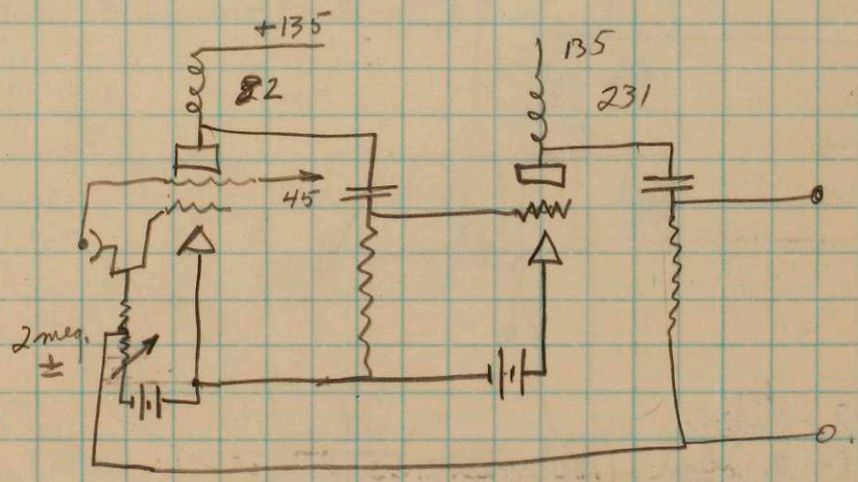
231

NG.

This feed back scheme should speed up the circuit somewhat.

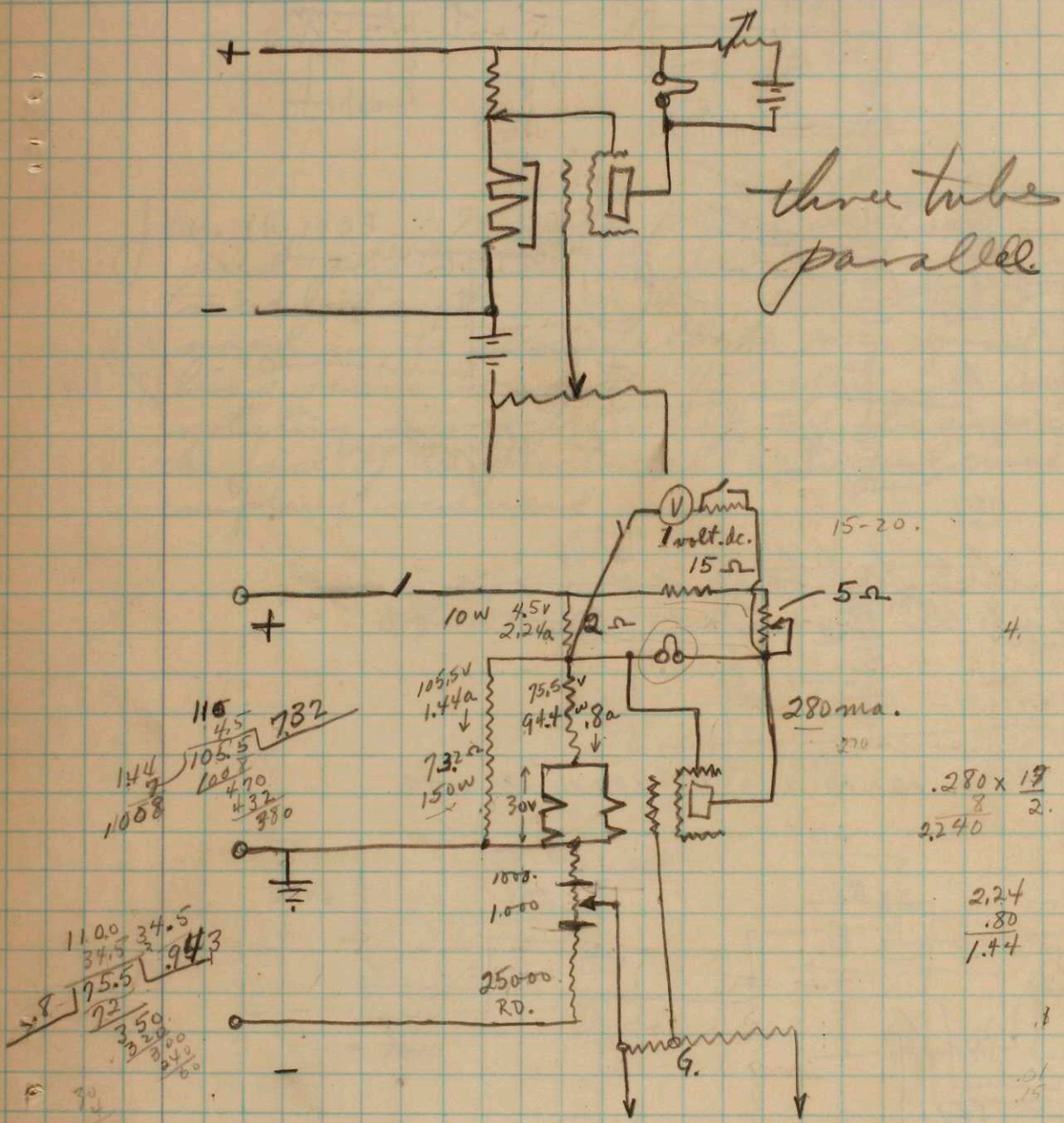
10 mmf = ~~RC~~

$RC = 10 \times 10^{-12} \times 10^{5} = 10 \times 10^{-7}$ seconds

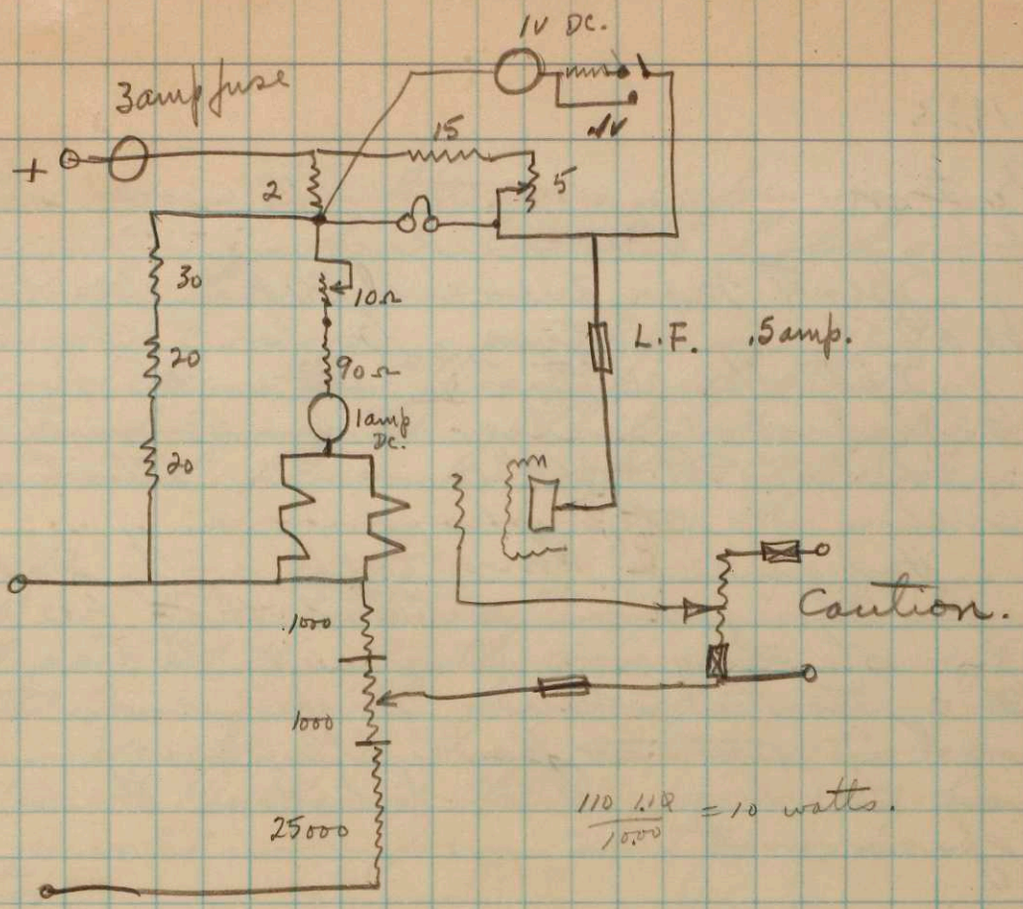


Jan 16 1933
~~H.E.~~ Edgerton.

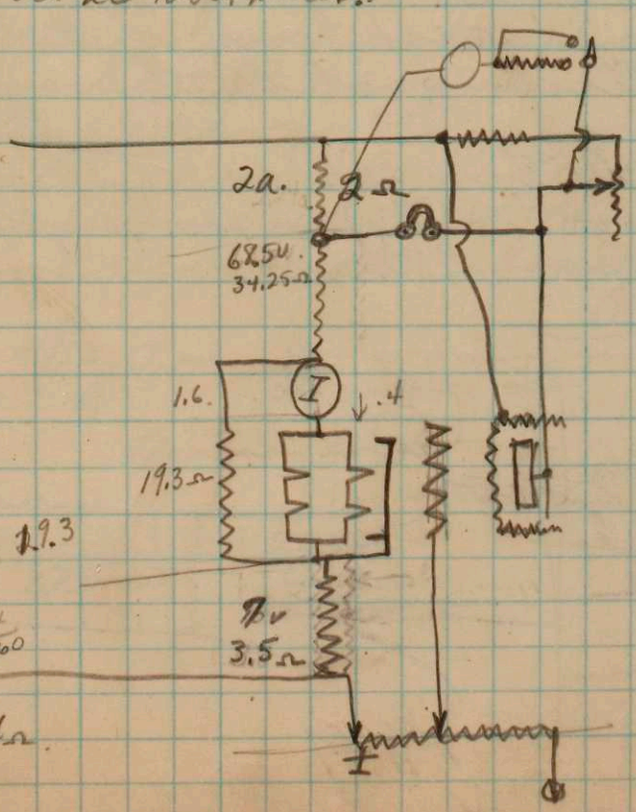
The UX 48 looks like a good amplifier for the oscillograph.



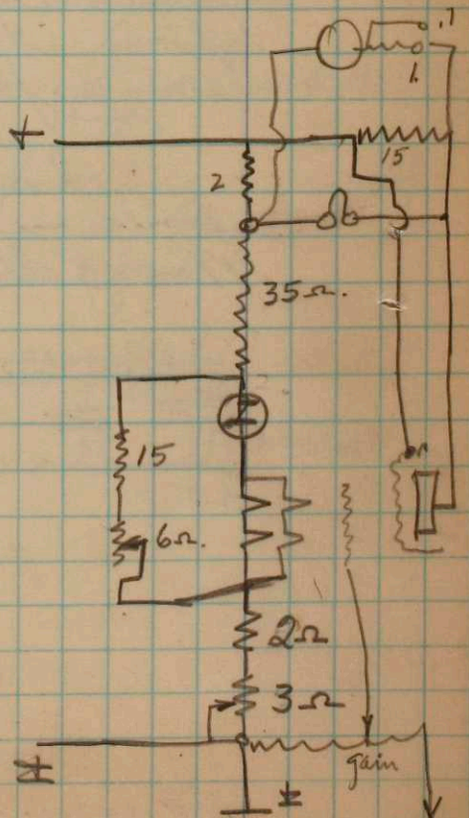
12 - clips.
✓ 1 - 2 ohm 100 watt resistance (10 watts).
✓ 1 - (2 - 20 ohm 150 W
1 - 30 ohm 150 W) (150 watts.
✓ 1 - ~~9~~ 10 ohm ohmite 50 watt.
✓ 1 - 90 ohm. 150 watt. (70 watts)
✓ 1 - 15 ohm 100 watt. (2 watts).
✓ 1 - 5 ohm ohmite 50 watt.
1 - 1000 ohm G. R. potentiometer
1 - 1000 ohm R.D. ohmite
1 - 25,000 " " "



2 Grid leaf clips
1 volt meter 1 volt d.c.
1 Spring return switch two pole 1 gang.
1 1 amp DC meter,
1 fuse socket.
10 3 amp fuses.
1 20 volt dc voltmeter.



9.0 / 4.5 / 30. / 41.5
110.0 / 41.5 / 68.5
30 / 1.6 = 19.3
150 / 144 / 60
10 / 2.24 / 8.96 / 1.040 = 44Ω.



Jan 26 1933

H E Edgerton

Spent Mon, Tues and Wed. in New York at the A.I.E.E. convention. Gordon S. Brown and Ralph Hamilton went with me and helped show a synchronous motor model to the A.I.E.E. convention illustrating the pulling into step phenomena.

Had quite a long talk with Slepian concerning a new method that he has for starting mercury arc tubes. The arc starts when a high resistance rod is ~~~~ partially immersed in the liquid and hit with a surge of current.

Jan 28, 1933. Put tube on the pump in the morning. This tube had a carbon resistor for a starting rod as shown by Slepian in his A.I.E.E. paper of a few days ago. The carbon resistor was about 5/8 of an inch long and ~~~ had a resistance of 10,000 ohms before being used as a starter. I ground the paint from it ~ and used one of the original wires for attaching it to the system.

I ran the tube as a stroboscope from our 1000 volt power supply. Wiring diagram below.

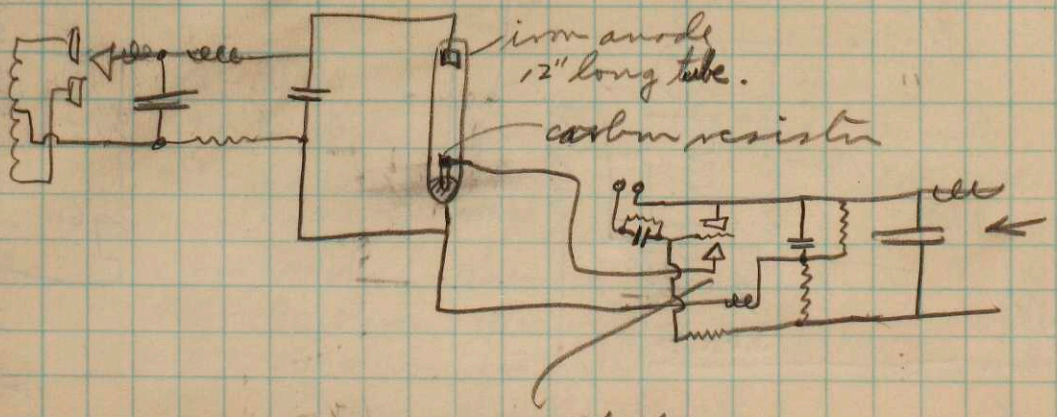


Fig-67

It seems to run O.K. but skipped some

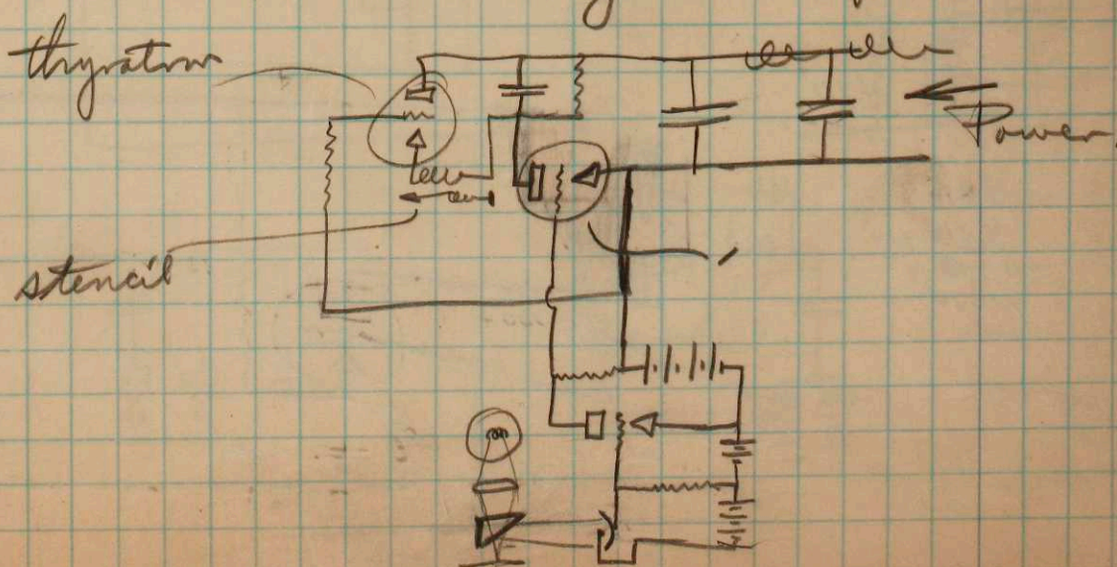
and also some trouble was experienced with the thyratron which tried to hold over some of the time.

I believe that this type of starter will enable us to get higher speeds because it eliminates the spark coil.

Jan 30 1933. Spent this afternoon with Germeshausen and Frati at the Boston American newspaper plant. Mr. Smith there showed us the place. We plan to bring over a stroboscope sometime to look at their presses when the chief mechanic from New York is in Boston.

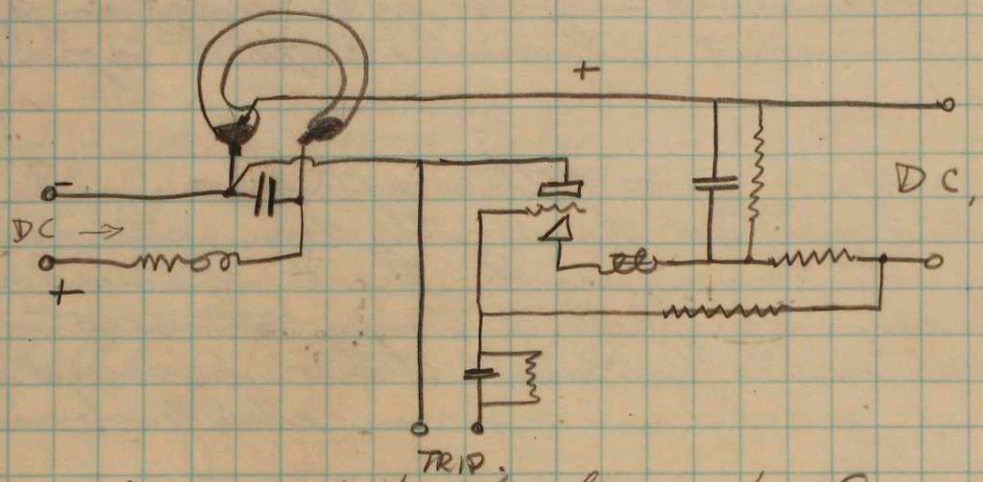
Mr. Smith had an engraving which was made by Mr. Hovey with his photo-electric engraver. This device scratches lines of variable width with a diamond tool driven by the amplified output of a photoelectric cell.

I believe that a thyratron can be used in the circuit and that it should go in punches instead of in lines. The punches would need to be of variable ~~density~~ energy to produce the different density. These engravings should give about the same detail as present etched engravings.



Feb 11 1933

H. E. Edgerton. Met with Bennett to the Navy Yard in the morning to see about obsolete mica high-voltage condensers. Obtained some galbar from Morton and styled them for use in the strobo tubes. Talked to Draper,



Proposed circuit for the high-speed stroboscopes.

$$i' = \frac{E}{\sqrt{\frac{L}{C}}}$$

$E = 800$
$C = .1 \times 10^{-6}$ farad
$L = ?$
$i' = 25$ amperes.
$R = 100$

$$\sqrt{\frac{L}{C}}\,25 = 800$$

$$L = \left(\frac{800}{25}\right)^2 .1 \times 10^{-6}.$$

$$= .1024 \times 10^{-6} \text{ henries.}$$

$\frac{1}{R}\frac{1600}{}$

$$4LC - R^2C^2$$

$$.16 \times 10^{-8} .1 \times 10^{-6} - 100^2 \times .1 \times 10^{-6}.$$

$$.016 \times 10^{-9} - .2 \times 10^{-6} \quad 2\,\Omega$$

$$f = \frac{1}{2\pi}\frac{1}{\sqrt{LC}} \quad \frac{1}{2\pi} \quad \frac{800}{100} = 8 \text{ amps.}$$

$\frac{1}{.2500.} = 4. \times 10^{-4}$ .0004 sec.

$\frac{.1 \times 10^{-6}}{C} \times R = 4 \times 10^{-4}.$

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

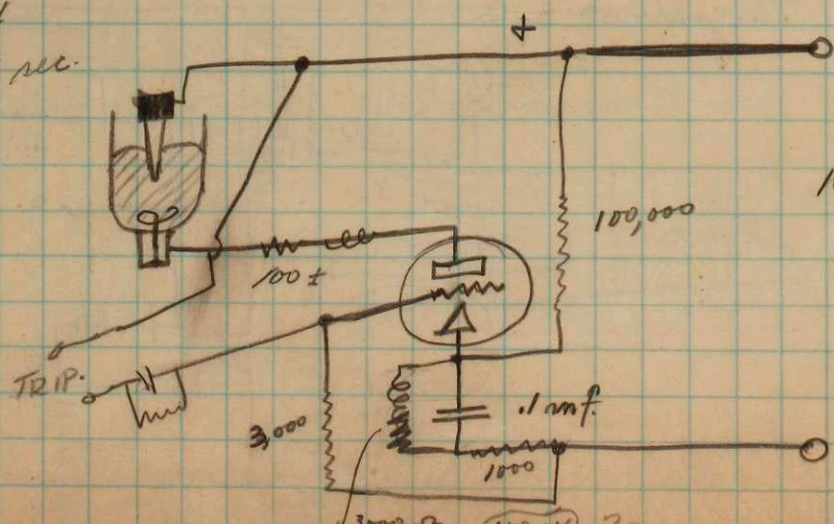
$= 40 \times 10^{2}$

4000

$3\frac{20}{250}$ w.

500 5db

3 db



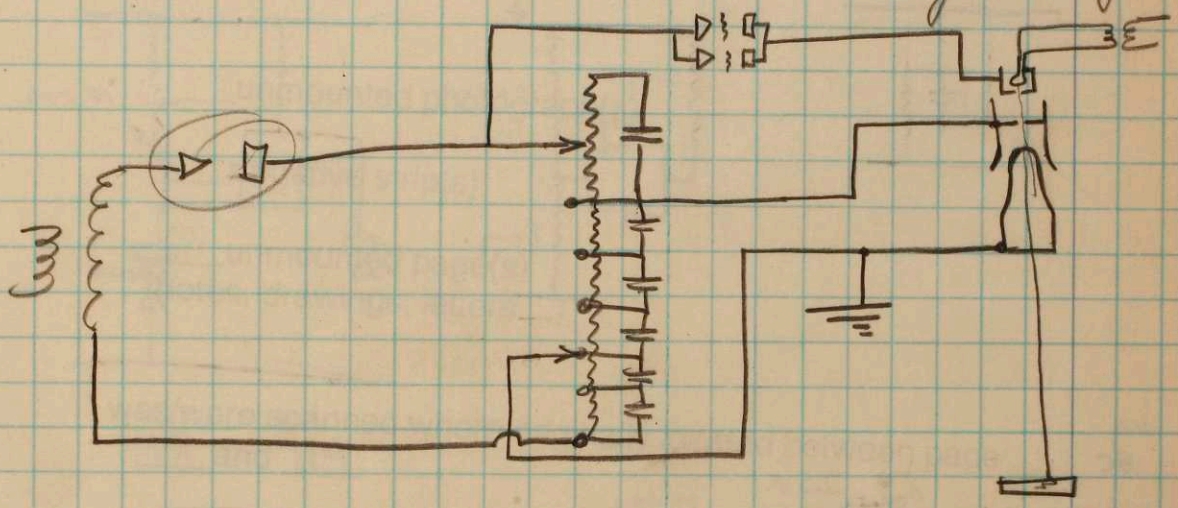
March 13 1933.
H E Edgerton,

I am teaching "Electronics" this term "6.39 T." and it takes a lot of my time.

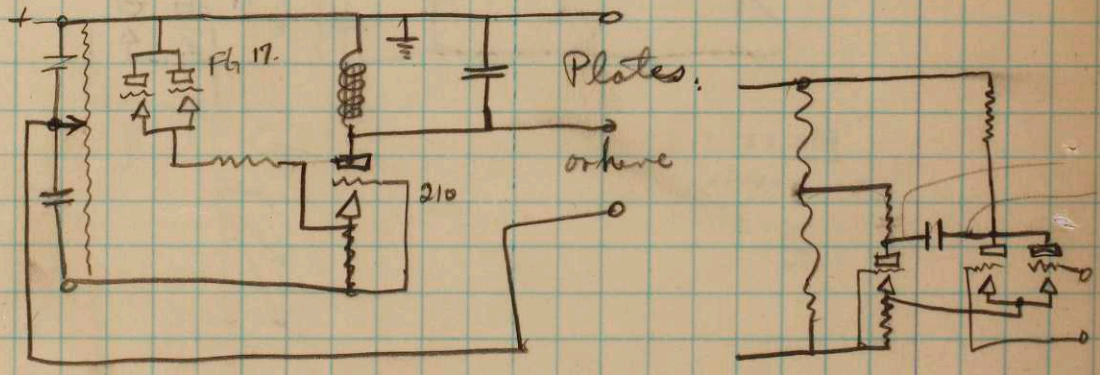
Worked on the high voltage vacuum cathode ray oscillograph which came from the Detroit Edison Co. It works like a charm.

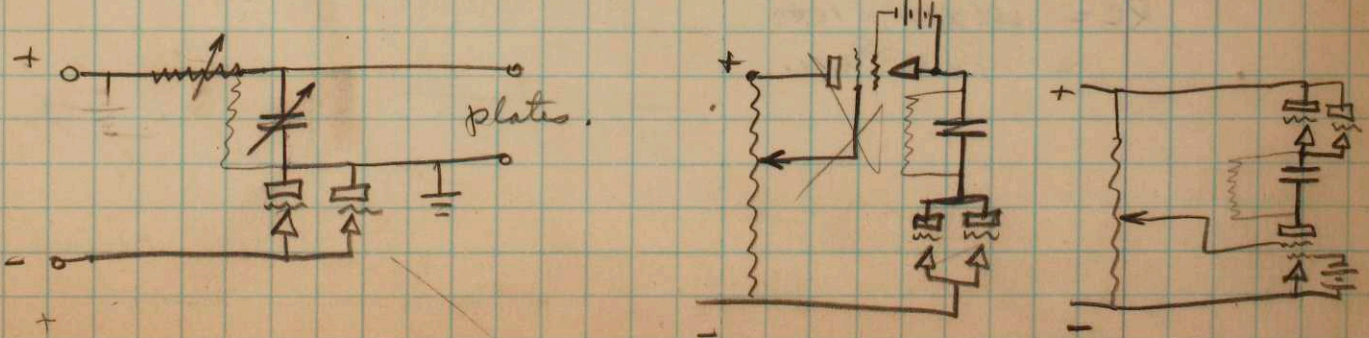
A. I E E trans 1928 p 884 by George.

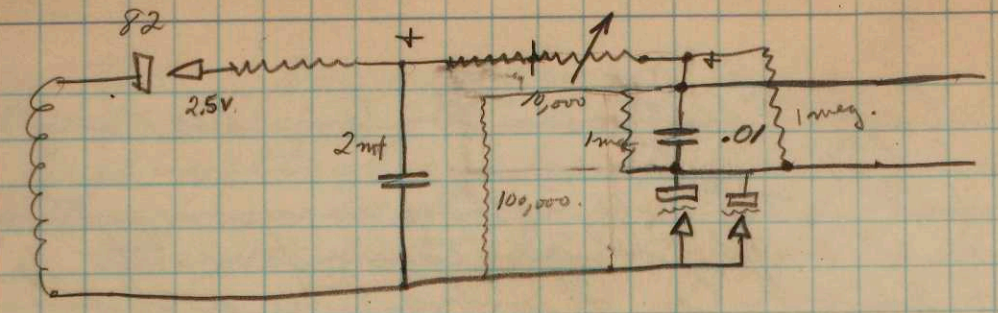
Power circuit

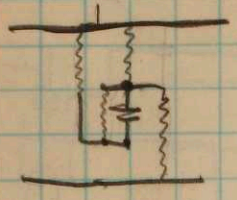


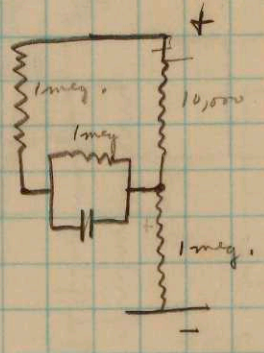
Sweep circuits

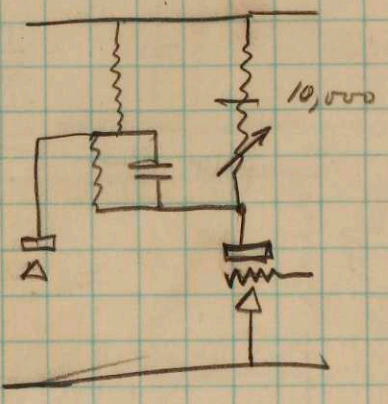




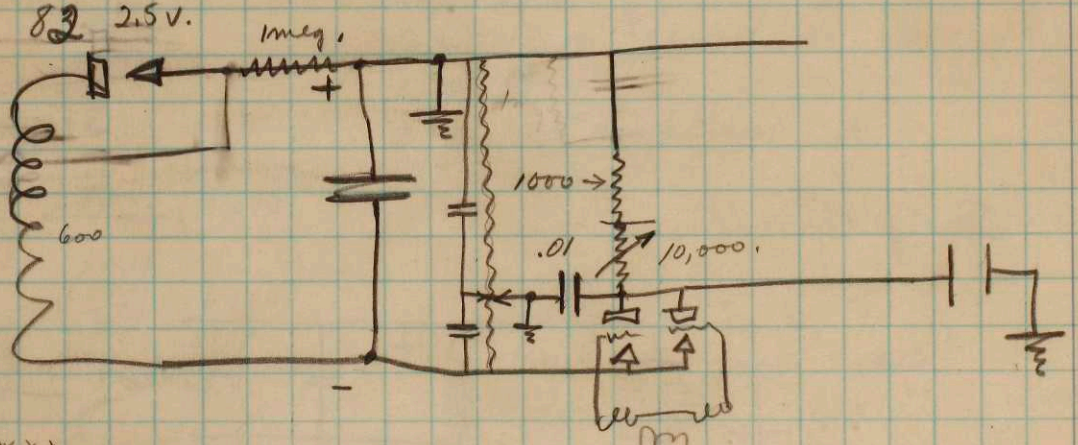








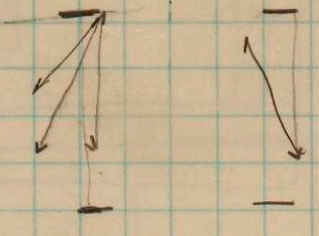
110
AC



~~6 d~~

~~1,00~~.

$\frac{36}{100}$.



$RC = .01 \times 10^{-6} \times 10{,}000$

$= 1 \times 10^{-5}$ sec.

Notebook Number: T-3

Scanning and Separation Record

____unmounted photograph(s)

____negative strip(s)

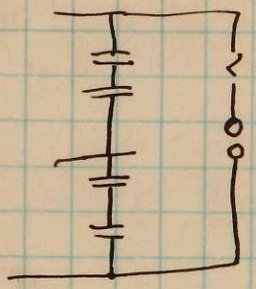
__7__unmounted page(s)
(notes, drawings, letters ...)

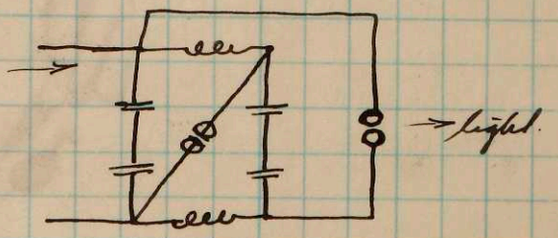
was/were scanned where originally located between page 118 and 119.

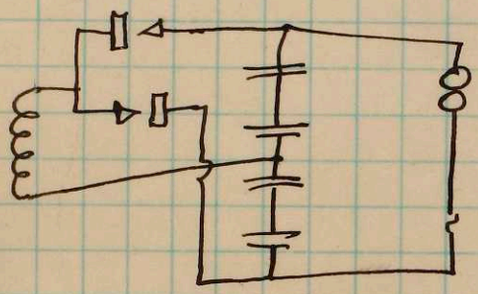
Item now housed in accompanying folder in MC 25, box 166

March 27 1933

H. E. Edgerton Spark photography outfit







April 2 1933.

On Thursday March 31 we made some experiments to determine the velocity of golf balls, clubs, etc. Mr. Francis Ouimet hit the ball. Mr. Bob Adams of the G. E Company and Mr. Dillard of the New England Power Co were there. Adams had a series of clubs of different weights. Pictures at 960 per second.

Film no.	Club No.	Initial club velocity ft./sec.	Final club velocity ft./sec.	Ball velocity ft./sec.	Ball vel / club vel.	club before / club after
1	6			188	~~1.15~~	
2	—					
3	3	159	110	183	1.15	1.4
4	3	160	119	190	1.195	1.34
5						
6	8?	144	116	189	1.30	1.25
7	3	159	92	194	1.215	1.73
8	5.	117	100	191	1.63	1.17.

June 8.

Ball velocity

.348 .153 | 180.5
.195 .157 | 185.
.038

1235.

Ball diam

.510
.399
.111 ball diam
= 1.64"

.510
.401 ✓
.109

$v = \frac{\Delta s}{\Delta t} = \frac{.153 \times \frac{1.64}{.41} \frac{1}{12}}{\frac{1}{960}}$ $\frac{1.64}{.41}$ 80 = 118.

Club before

.783 .093
.690
.593 .097

Ball diam. check.

.564
.455
.109

Club after.

.418 .082
.331 .080
.251

$\frac{1.68}{1.64} = 1.02\frac{1}{2}$

$\frac{1}{8}$ rev in $\frac{1}{480}$ sec.
1 rev in $\frac{8}{480}$
$\frac{480}{8}$ rev/sec. = 60 r.p.s.

Club 5

C.B.	C.A.	Ball.
112.5 109.5	96.8	180.5
115 114.5	94.5	185.
227.5 224	191.3	365.5
	187	182.7

Film 7.

0.213
.111
1.64 — .102 ball diam.

.096
.000 — .124

.190
.043
.147 ✓

50500566 50

.000
.147 .147 189
.293 .146 187.5

$v = \frac{\Delta s}{\Delta t} = .293 \times \frac{1.64}{.102} \quad \frac{180}{960}$

= 723 ft./sec.

.288
.141 — .147
.007 — .148 Ball velocity.

Club before.

.840 .118 151.5
.722 .124 avg .120.
.598 159

$v = .118 \left[\frac{1.64}{.102} \quad \frac{960}{12}\right] =$

1285.

1.02 ✓

C = 1320

after

56 .407 .407 .028 .66
70 .341 .333 .062 .70
271 .271 .073 .13
.198

85
90
94
159 92 193

CB CA Ball
151.5 85 189
159.0 90 187.5
94
310/2 5 269 297 376/2 5
155.

Club 3

Ball velocity

Film # 6 7 1

.353 106* Ball not moving
.247 145
.102

.353
.250
.103 Ball diam.

$C = \frac{1.64}{.103} \times 80 = 1275.$

Club before

.749 .112
.637
.528 .109

~~.103~~
C = 1306

Club after

.321
.231 .090
.144 .087

Club. #8? (or 6)

(145) 116 189
CB CA Ball.
143 115 *
139 111 185.
142 113

Film 4.

Ball velocity

.255
.111 .144
.014 .153
.308
.166
.014 .152
.142 ← low due to distortation of ball.

Ball diam.

~~.403~~ X
~~.276~~
~~.129~~
.381 .379
.273 .272
.108 .107

Club before.

$C = \frac{1.64}{.1085} \times 80 = 1220.$

.748
.621 .127
.492 .129

~~67.5~~

$\frac{134.5}{107.5} = 1250$

Club after.

.391
.298 .093
.200 .098

Club #3.

160	119	191.5
CB	CA	B.
155	113.5	176*
157.5	119.5	187
156.3	116.5	

$\Delta T = \frac{1}{480}$ sec. Film 1

Ball velocity

.320
.024
.316"

.296

Ball diam

.396
.290
.106

$v = \frac{.316 \times 1.68}{.106} \times \frac{40.}{12} = \frac{200}{188}$

$V = d \frac{1.68}{B \times 12} \frac{40}{480}$

$= \frac{d}{B} \times 67.2 \, s^{-}$

134.5^{-}

Club 6.

Film 3.

.496
.391
.105 Ball diam.

5

Ball velocity

.341 .142
.199 .144
.055

$C = \frac{1.64''}{.105}\ 80 = 1245.$

= 69.1
128.2

Club before

.760
.636 .124
.518 .118* Ball in contact with club.

Club after.

.430 .086
.344
.257 .087

1.68

159
~~154~~ (110) (183)

	CB	CA	B.
Club # 3-2?	154.5	107	177.0
	147*	108	179.5

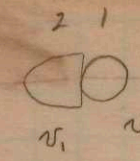
30 / 150.5
21 / 107
177.2

TESTS MARCH. 31, 1933. M.I.T.

VELOCITY IN FT./SEC. BALL DIAM. 1.68" ★★★ ROYAL.

FILM No.	CLUB.	INITIAL CLUB	FINAL CLUB.	BALL VELOCITY	RATIOS. BALL / I.C.	I.C. VELOCITY / F.C.
1	6	NOT SUFFICIENT PICTURES.		~~200~~ 188		
2		NOT SUFFICIENT PICTURES.		CLUB. LOW.		
3	#3	154	110	183	1.15	1.4
4	3	160	119	190 191.5	1.195	1.34.
5		BLANK.				
6	8?	144 145	116	189.	1.30	1.25
7	#3	159.	92.	194 ~~193.~~	1.215	1.73
8.	#5	~~145.~~ 117	~~95.6~~ 100	~~189.~~ 191	~~1.63~~ 1.63	1.2 1.17

CLUB HEAD TWISTS AFTER IMPACT.



$v_1 = 1$

$$v_1' = \frac{m_1 v_1 - m_2 v_1 + 2 m_2 v_2}{m_1 + m_2}$$

$$v_2' = \frac{m_2 v_2 - m_1 v_2 + 2 m_1 v_1}{m_1 + m_2}$$

m_1: 1 2 3 4 $\quad v_2 = 0$.

2	4	6	8
2	3	4	5

$$v_1' = \frac{m_1 v_1 - m_2 v_1}{m_1 + m_2} = \frac{(m_1 - m_2)}{(m_1 + m_2)} v_1$$

$$v_2' = \frac{2 m_1 v_1}{m_1 + m_2} = \left(\frac{2 m_1}{m_1 + m_2}\right) v_1$$

ball

$$\frac{v_2'}{v_1} = \left(\frac{2 m_1}{m_1 + m_2}\right)$$

initial club.

$$\frac{v_1'}{v_1} = \frac{(m_1 - m_2)}{m_1 + m_2}$$

$m_2 = 1$

m_1	v_2'/v_1	v_1'/v_1	v_1/v_1'
1	1	0	∞
2	1.33	.33	3.
3	1.5	.5	2.
4	1.6	.6	1.67
5	1.665	.667	1.5
6	1.72	.715	1.4
8	1.78	.778	1.28
10	1.81		

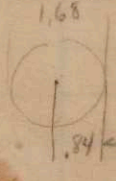
$$\frac{v_2'}{v_1} = \frac{(m_1 + e m_2)}{m_1 + m_2}$$

$$\frac{v_1}{v_1'} = \frac{m_1 + m_2}{(m_1 - e m_2)}$$

$e = \lambda = \sqrt{\frac{H}{h}}$ $\quad H$ = height of rebound. $\quad h$ = dist. dropped.

Kinetic energy translation $= \frac{m v^2}{2}$ foot pounds $\quad m$ pounds (grav) $\quad v$ ft./per sec.

Kinetic energy rotation $= \frac{J_m \omega^2}{2}$ foot pounds $\quad J$ = pound (grav.) feet squared. $\quad \omega$ = radians/sec.



$$\frac{\text{Energy trans.}}{\text{Rotational energy}} = \frac{K_T}{K_R} = \frac{m v^2}{J_m \omega^2} = \frac{W v^2}{\frac{2}{5} W r^2 \omega^2} = \frac{5 v^2}{2 r^2 \omega^2}$$

$$J_m = \frac{2}{5}\left(\frac{W}{g}\right) r^2$$

$$\frac{5}{2} \frac{200^2}{314.^2 (.84)^2} = \frac{1.44}{.705} = 2.04$$

$v = 200$ ft/sec.

$\omega^2 = 2\pi \left(\frac{3000}{60}\right)$ rad/sec.

$= 314.$ rad/sec.

Radius of gyration $= \frac{2r}{\sqrt{10}}$

April 8 1933.

Readings in thousandths of an inch

Ball diam. = 1.68"

Measurement of velocities from films taken April 6 1933. Francis Ouimet at the bat. Adams. Dilliard. Sullivan? present and others.

Measurement made on comparator in Aero engineer lab.

	Ball diam.	Initial club velocity.*	Final club velocity*	ball velocity.	
FILM 1. (club .713)	489 / 427 / 62; 493 / .406. / 87.	774 / 666. / 108.; 288 / 174 / 114 (111) 166.	558 / 475 / 83; 636 / 558 / 78 (80.5)	654 / 528 / 126 (122) (124); 776 / 654 / 122; 896 / 776 / 120	Ball hit high. Club head twists.
FILM 2. (.827)	389 / 313 / 76; 466 / 374 / 92 ?; 460 / 373 / 87; 457 / 369 / 88	184 / 75 / 109; 290 / 184 / 106 (107.5)	466 / 387 / 79; 545 / 466 / 79	568 / 440 / 128; 700 ⊛ / 568 / 132; 696 / 568 / 128 — no distortion.	ball hit low.
FILM 3	475 / 390 / 85; 377 / 314 / 63 / 88; 474 / 383 / 91; 477 / 390 / 87; 476 / 391 / 85; 474 / 388 / 86	858 / 759 / 99; 759 / 647 / 112 (110) reading? doubtful; film turned over	445 / 364 / 81; 364 / 286 / 78 (79.5)	386 / 259 / 127; 259 / 135 / 124 (125.6)	hit low
FILM 4	328 / 413 / 85	608 / 510 / 98; 608 / 706 / 98	346 / 273 / 73; 273 / 203 / 70	~~298 / 176 / 122~~; ~~176 / 62 / 114~~; 149 / 268 / 119; 385 / 268 / 117	
FILM 6.	447. / 357 / 90; 445 / 357 / 88	832 / 734 / 98; ~~734 / 640 / 94~~; 640 / 548 / 97	375 / 300 / 75; 300 / 224 / 76	~~157 / 86 / 171~~; 157 / 034 / 123; 286 / 157 / 129	Shows ball in contact.
FILM 6.	409 / 323 / 86; 324 / 409 / 85	710 / 613 / 97; 613 / 513 / 100 (98.5)	341 / 269 / 72; 269 / 195 / 74 (73)	ball dist 288 / 169 / 119 (117); 169 / 54 / 115	Square hit "
FILM 7	381 / 294 / 87; 380 / 293 / 87	688 / 599 / 89; 599 / 510 / 89	352 / 288 / 64; 288 / 226 / 62 (63)	296 / 186 / 110; 186 / 66 / 120; 380 / 296 / 104 (111)	Shows slight compression.
Film 8	262 / 350 / 88	604 / 515 / 89; 515 / 425 / 90	279 / 215 / 64; 215 / 148 / 67 (65.5)	215 ? / 195 / 120; 70 / 184 / 114; 185 / 302 / 117 (117)	
Film 9	318 / 232 / 86	585 / 496 / 89; 496 / 408 / 88 (88.5)	257 / 190 / 67; ~~256 / 188 / 68~~; ~~188 / 125. / 63~~; 190 / 124 / 66	199 / 86 / 113; 170 / 49 / 121 (118.5); 286 / 170 / 116 distortion (distortion)	Ball in contact with club.

$v = \frac{1.68}{(\text{Ball diam})}\frac{1}{12}\frac{x}{\frac{1}{960}}$

$= \frac{x}{\text{Ball dia}}\ 1342$

reference line

* the velocity of the top of the club head was measured

⊛ Ball distorted

278 278 278 80 960 / 12 =

Aluminum head
6 oz handle
6 oz Assembled

Club ~~head~~ weight in oz.

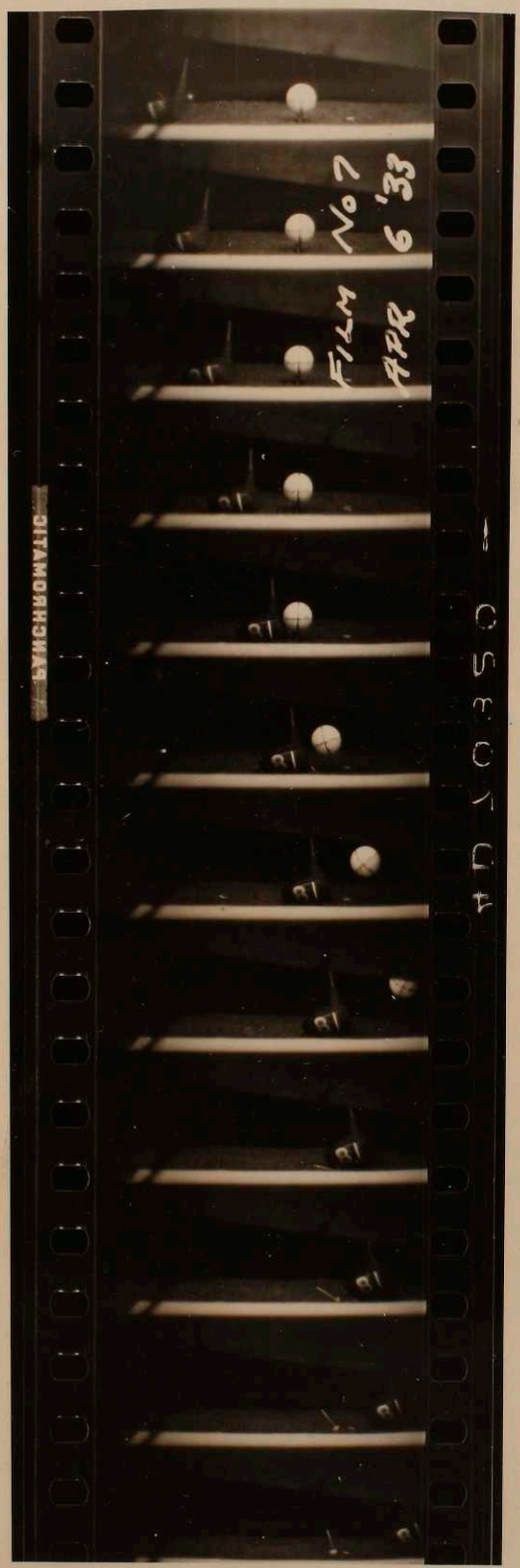
Data from Films taken on April 6, 1933

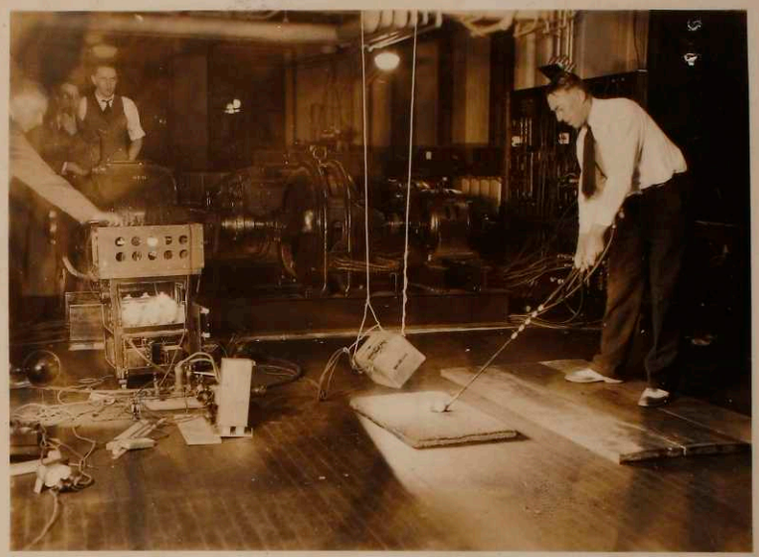
Film no.	Club ~~Ball~~ no.	WT in oz	Initial Club velocity	AVG	Final Club velocity	AVG	Ball velocity	AVG	REMARKS.	Spin R.P.M. ~~RPM Speed.~~
1	4	12	171	169	124	123	191	194	Ball hit slightly high~~er~~. Club head twists.	7200 5200
2	4	12	166		122		197		Ball hit square.	4500
3	4	12	170		123		194		Ball hit slightly low.	~~5000~~
4	7	14.1	151	151	113	113	186	187	Ball hit slightly low.	5000
5	7	14.1	147		114		190		Square hit.	5450
6	7	14.1	156		115		186		Square hit.	4900
7	8	18.0	137	137	97.5	101	172	178.5	Ball hit slightly low.	3500
8	8	18.0	136		100		178.5		Ball hit slightly low.	4100
9	8	18.0	138		104		185		Ball hit square.	5000.

Calculations of above velocities on previous page.
Measurements were made upon the comparator in the Aero. Engine Laboratory.

April 10 1933

Went to Bellows Falls with Hugh Spencer of the New England Power company to see about installing a stroboscope on the generators there. This strobo is to be automatic and is to trip when they have trouble with lightning.





Francis Quimet

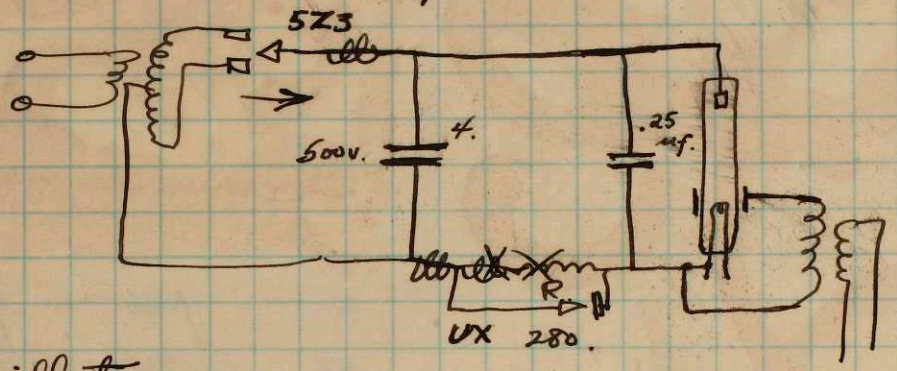
960 picture per second movies camera.

$$\text{energy} = \frac{1}{2} m v^2 = \frac{1}{2} \left(\frac{12}{16}\right) \frac{\text{lbs}}{32.2} (169)^2 = 335 \text{ lb ft.}$$

April 16 1933

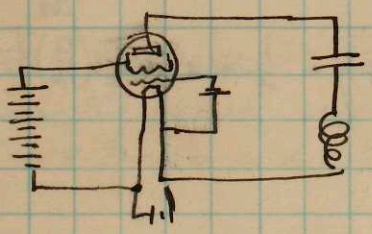
H. E. Edgerton. Dick Mason and Hammer were here at tech on Friday afternoon. I showed them the stroboscope and some of the high speed movies. They both work for the G.E. Co in the patent dept. at Washington D.C. I showed them, especially Hammer, my apparatus and discussed it with him. We discussed in particular circuits whereby the large current surges may be produced by condenser charges as well as by discharges.

Small stroboscope.



Oscillator.
30 – 150 cycles a second.

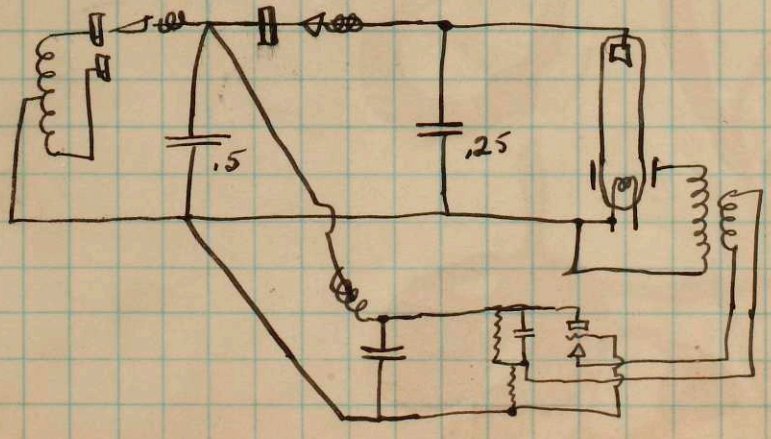
224. Dynatron.



5 times.

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

L or C must vary by $\frac{25}{5}$



Notebook Number: T-3

Scanning and Separation Record

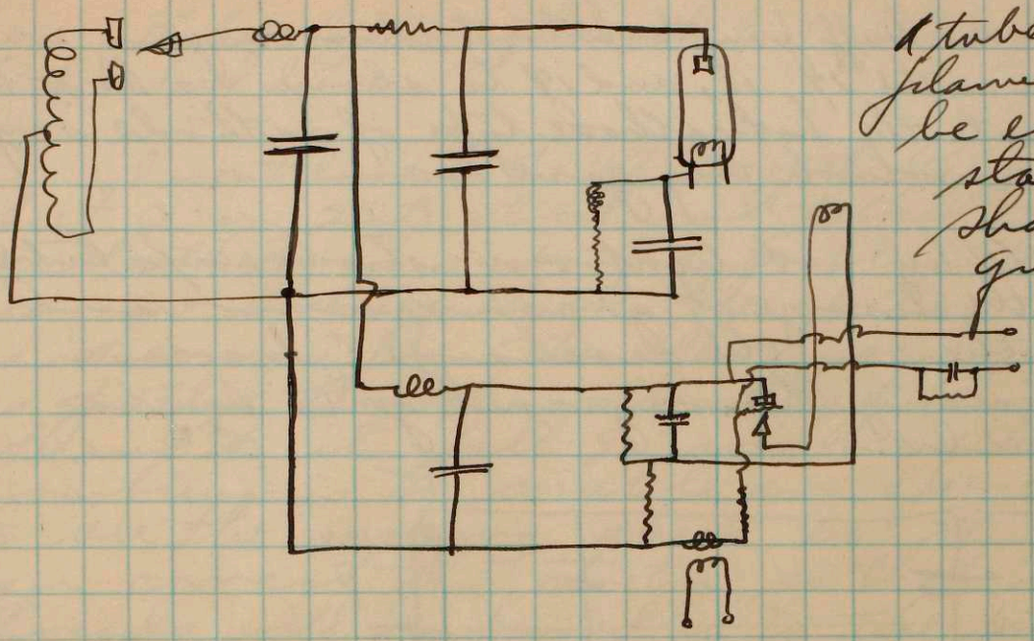
____unmounted photograph(s)

__1__negative strip(s)

____unmounted page(s)
(notes, drawings, letters ...)

was/were scanned where originally located between page 124 and 125.

Item now housed in accompanying folder in MC 25, box 166



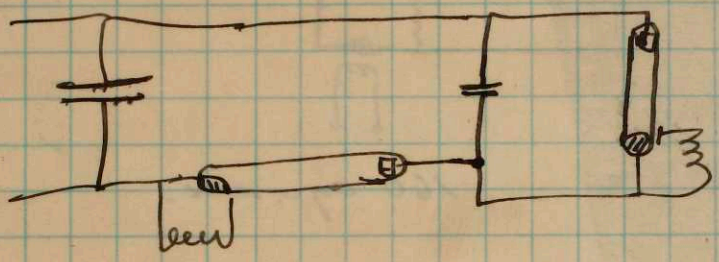
A tube with a filament should be easy to start and should run quite fast.

$\frac{10,000}{60}$ r.p.m = 160 cyc. sec.

April 23 1933
Edgerton.

Mr. Duff from the Detroit Edison Company was here on the 17, 18, and 19 to show us how to operate the hot-cathode type of cathode ray tube which they gave us

Why not light our stroboscope tube on the charge of a condenser and another on the discharge? Increase efficiency this way and go to higher speeds!



Decomposition time much less in this case!!!

United States Patent Office
Before the Examiner of Interferences
Edgerton
vs. } Interference 76,171
Miller

Edgerton Exhibit 36.
Page 126 of Edgerton Notebook T-3,
April 23, 1933.

January 3, 1940. Clara Schlosky
Notary Public

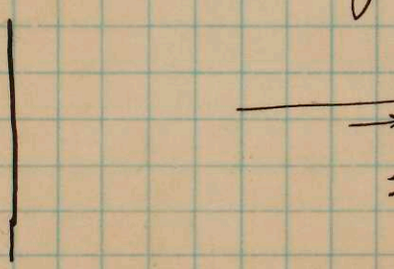
May. 21, 1933

H. E. Edgerton. We have been very busy the last month, especially with school duties.

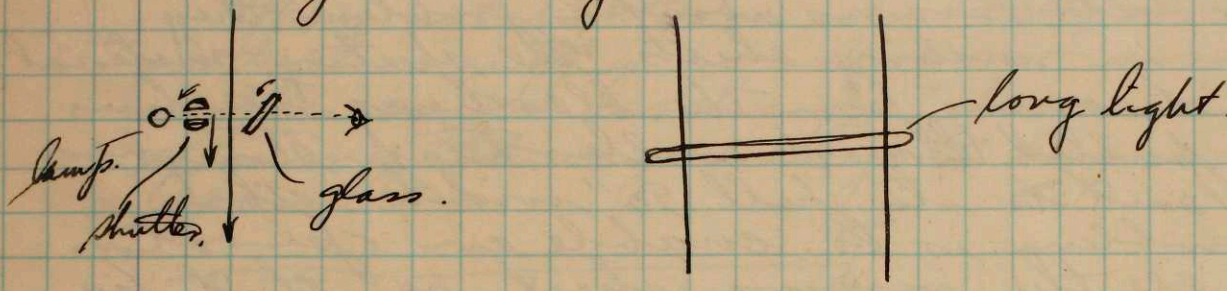
I went down to the offices of the Pepperill Sheet Co. on State street and talked to Mr. Bradsett Parsons about a problem they have in making sheets. The sheeting material as it comes from the bleaching machine is pulled through rollers that straighten it out to its full 90" width. The problem is to enable an operator to see the moving sheet so that he can correct the stretch so that the threads will be ~~parallel to the~~ perpendicular to the edges of the sheet.

Mr. Lampson of the General Radio went to the plant and tried to use a stroboscope for observation. He reported that the experiment was a failure because of the varying speed of the cloth.

I proposed some optical schemes to Mr. Parsons when I visited him (Wednesday May 17?) which may work and solve the problem. One of these would be to use a rotating mirror which would move in such a manner as to stop the motion as observed by an operator.



Another scheme would be to use a light behind the cloth and a rotating pane of glass in front to look through, & shutter to allow the light only when wanted.



90" a minute speed = 1½ ft a second. ×100×12. 1200 ÷600 a sec.

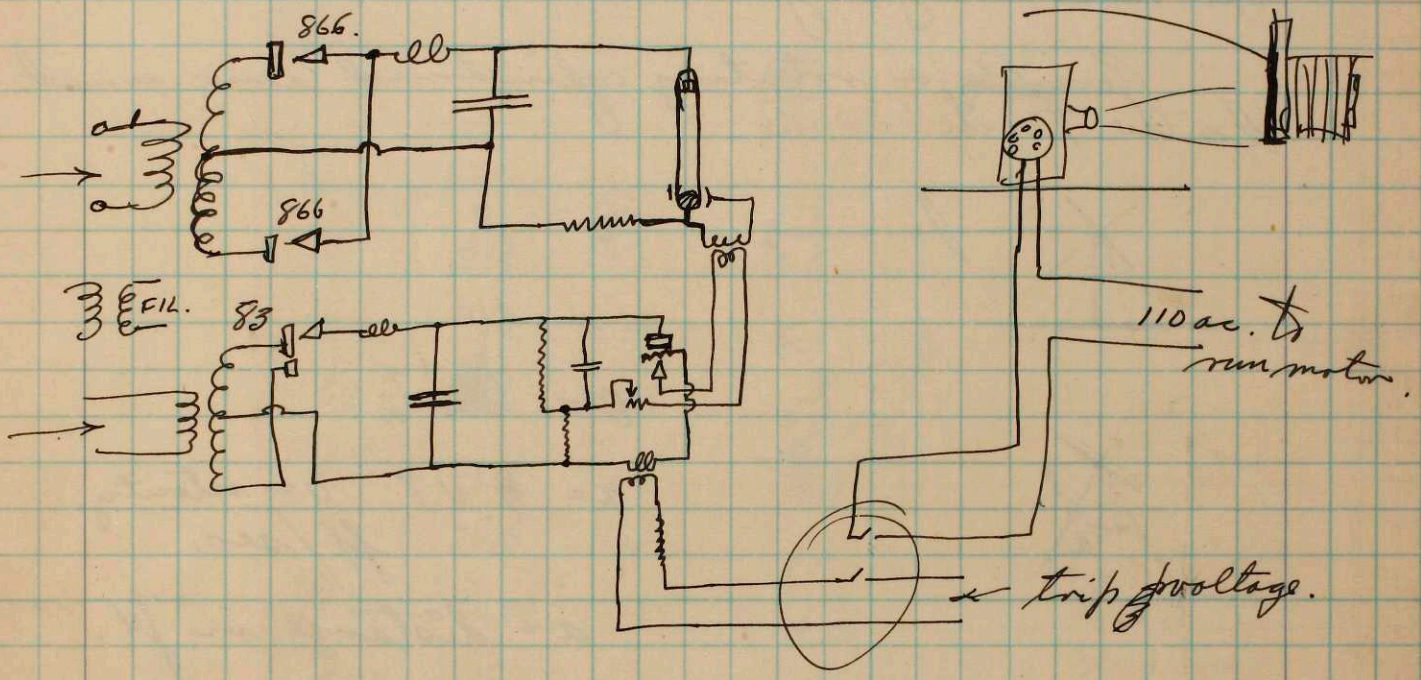
$\frac{1\frac{1}{2}}{\frac{1}{4}} = \frac{3}{2} \times \frac{4}{1} = 6$ $\frac{1}{6}$ of a second looks for a three inch stop.!

I believe that this will work in a satisfactory manner! The first scheme looks the best.

May. 25, 1933.

Last days yesterday.

Stroboscope circuit for the N.E.P. tests at Bellods Falls.



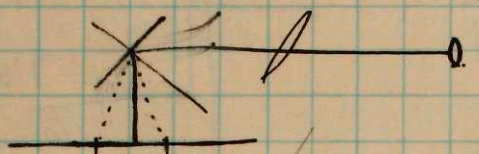
May 27, 1933.

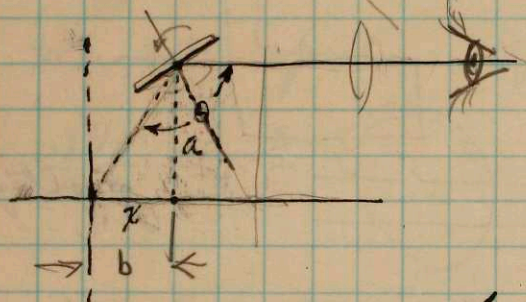
Buell, a graduate student, has started to wire this outfit up today. It is to be put in a box for transportation to Bellows falls.

May 27 1933
H. E. Edgerton

The rotating mirror might be a cylindrical lens so that a magnification would result in one direction. This should give a rather nice way to line up the threads for parallel direction.

Possibly a rotating cylindrical lens would do the trick.





$\theta = \sin^{-1}\frac{x}{a}$

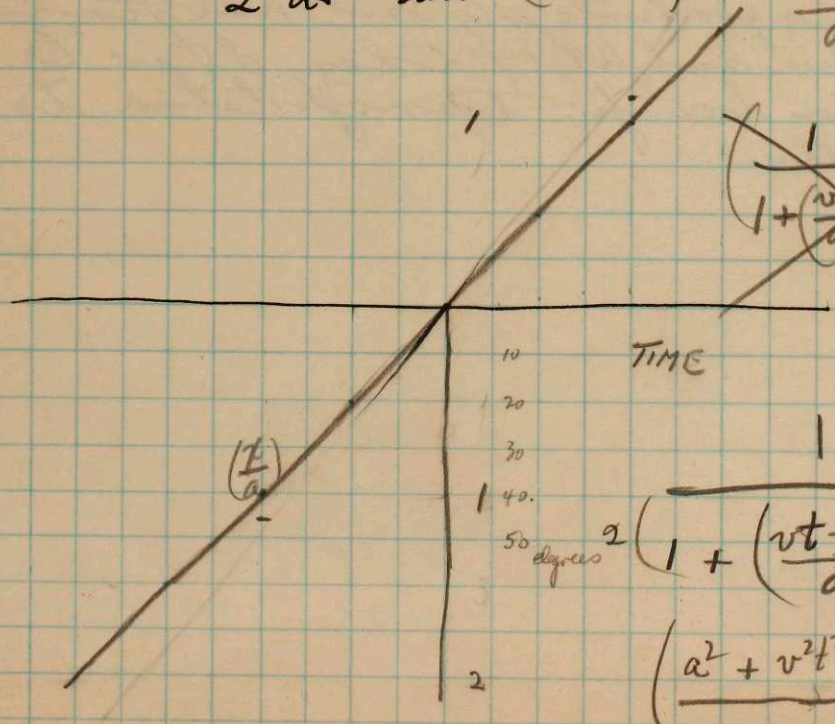
$x = vt$ v = velocity. ft./sec.

a = distance in ft.

$\frac{d\theta/2}{dt}$ = velocity of the mirror.

$\frac{1}{2}\frac{d}{dt}\tan^{-1}\left(\frac{vt}{a} - \frac{b}{a}\right)$ $\frac{d\tan^{-1}u}{dx} = \frac{1}{1+u^2}\left(\frac{du}{dx}\right)$.

$\frac{1}{1+\left(\frac{vt}{a}\right)^2}\frac{v}{a}$



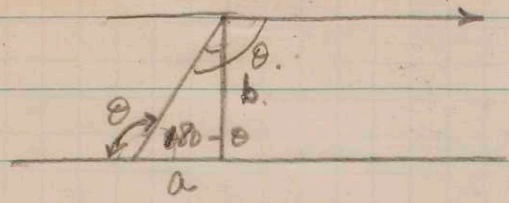
$\left(\frac{x}{a}\right)$

$\frac{1}{1+\left(\frac{vt-b}{a}\right)^2}\left(\frac{v}{a}\right)$

$\left(\frac{a^2 + v^2t^2 - 2bvt + b^2}{a^2}\right)$

Glendive June 9 1933.

84.3



$(180-\theta) = \tan^{-1}\frac{b}{a}$.

let b = 1.

a =	b/a	θ − 90°	θ	$\frac{\Delta\theta}{\Delta t}$:
0		0	90.3	5.7
.1	10	5.7	95.7	5.6
.2	5	11.3	101.3	5.4
.3	3.3	16.7	106.7	5.1
.4	2.5	21.8	111.8	4.7
.5	2.	26.5	116.5	4.45
.6	1.67	30.95	120.95	4.05
.7	1.43	35.0	125.0	3.65
.8	1.25	38.65	128.65	3.35
.9	1.11	42.0	132.0	3.0
1.0	1.0	45.0	135.0	2.8
1.1	.91	47.8	137.8	2.4
1.2		50.2	140.2	2.3
1.3		52.5	142.5	

4.5 ft/sec.

Let b = 1 ft.

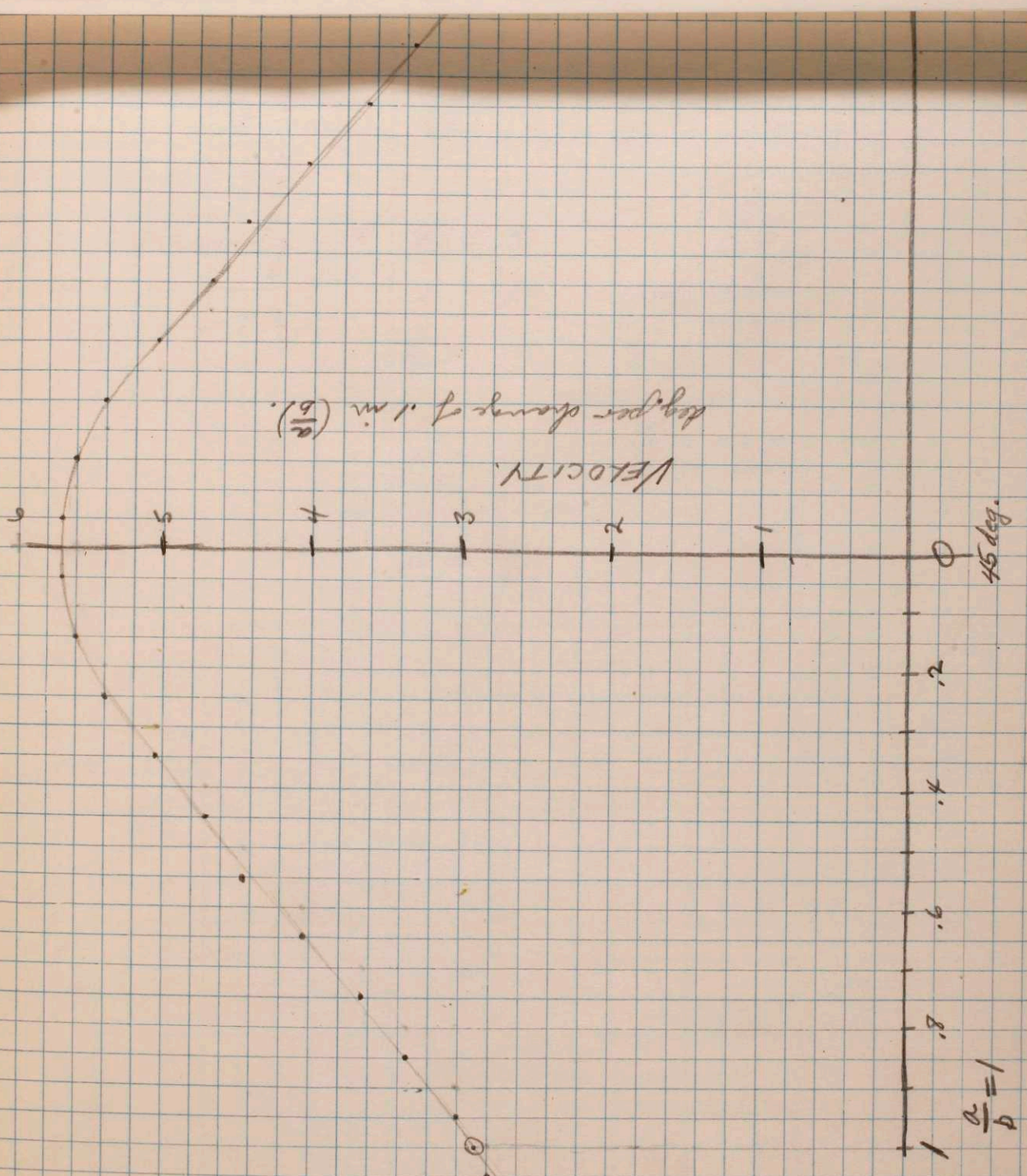
unit time interval = $\frac{.1 \times 1}{4.5}$

$= \frac{1}{45}$ second.

to get r.p.m

$\frac{\Delta\theta}{\Delta t} \times \left(\frac{4.5}{.1 \times 1}\right) \times \frac{60}{360}$ = r.p.m.

$5.7 \times 45.0 \times \frac{1}{60} = \underline{42.6}$ r.p.m. max velocity.


VELOCITY.
dagger-change of $\frac{a}{b}$.
45 deg.
0
1
2
3
4
5
6
$\frac{a}{b}=1$
.2
.4
.6
.8
1

$$\text{velocity} = \frac{1}{2}\left(\frac{a^2}{a^2+b^2+v^2t^2-2bvt}\right)\frac{v}{a} \quad \text{radians/sec.}$$

Let $a = 1$ ft.
$b = .5$ ft. $\quad v = 3$ ft/sec.

$$\text{velocity} = \frac{\left(\frac{1}{2}\right)1}{1.25+3t^2-3t}\left(\frac{3}{1}\right) \quad \text{rad./sec.}$$

velocity at $t = 0 \quad v = \frac{3}{2.5}$

$t = .5 \quad v = \frac{3}{4}$

$t = 1 \quad v = \frac{3}{2.5}$

$t = 2 \quad v = \frac{3}{14.50}$

$t = 3. \quad v = \frac{3}{38.5}$

60 110

.25 × 3 = 1.5 / .75 / .75 / 1.25 / 2.00

12 / 6

1.25 / 2 / 14.50

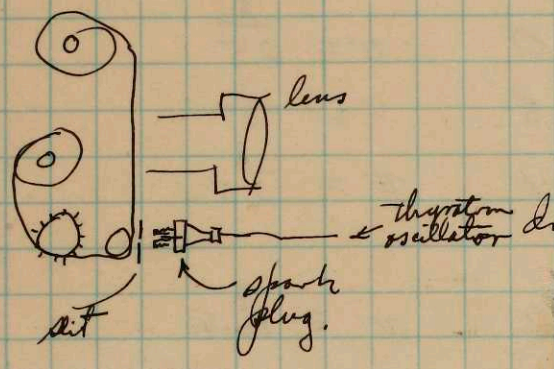
27 / 9 / 18

19.25 / 2 / 38.5

May 31 1933
H. E. Edgerton.

Timing wave on film in camera to determine velocities of film.

A small aero spark plug was mounted on the case of the camera in front of the film. A slit was put between it and the film. Sparks recorded a spot of light on the edge of the film outside of the sprocket as shown on the piece of film which is attached.

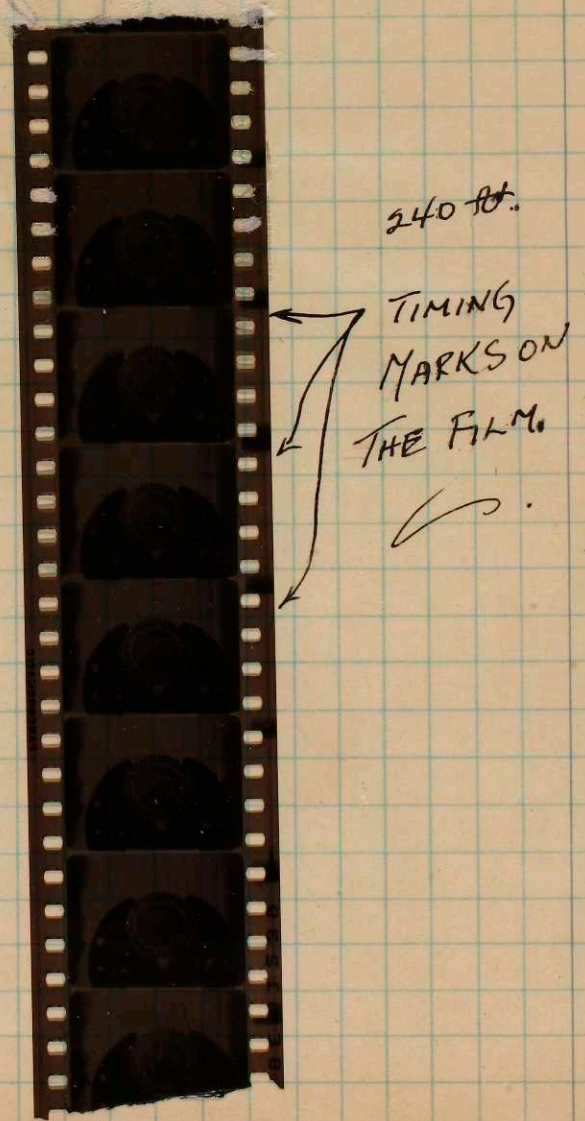


$$\left(\rho\lambda + \frac{1}{\rho C}\right) i' = E1$$

$$i' = \frac{E1}{\lambda} \times \frac{\rho}{\rho^2 + \frac{1}{\lambda C}}$$

$$= \frac{E}{\lambda} \frac{\sin \sqrt{\frac{1}{\lambda C}}\, t}{\sqrt{\frac{1}{\lambda C}}}$$

$$= \frac{E}{\sqrt{\frac{\lambda}{C}}} \sin \sqrt{\frac{1}{\lambda C}}\, t.$$



$C = 1 \times 10^{-6}$
$E = 300$
$\lambda = ?$
$i'_{max} = 50$ amp.

$$\sqrt{\lambda}\, 50 = \frac{300}{\sqrt{1 \times 10^{-6}}}$$

$$\lambda = \frac{90000}{2500} 1 \times 10^{-6} = 40 \times 10^{-6} \text{ henries}$$
$$= .04 \text{ millihenries.}$$

$$2\pi f = \sqrt{\frac{1}{\lambda C}}$$

$$f = \frac{1}{2\pi\sqrt{\lambda C}}$$

$$\lambda C = 40 \times 10^{-6} \times 1 \times 10^{-6}$$

$$\sqrt{\quad} = \sqrt{40 \times 10^{-12}}$$
$$= 6 \times 10^{-6}$$

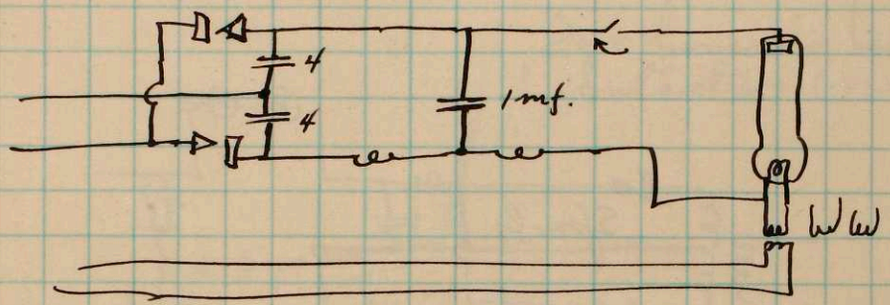
$$6.28 \times 6 \times 10^{-6} = \frac{1}{40 \times 10^{-6}}$$

$$\frac{1}{2 \text{ cycle}} = \pi\sqrt{\lambda C} = 120 \times 10^{-6} \text{ sec.}$$

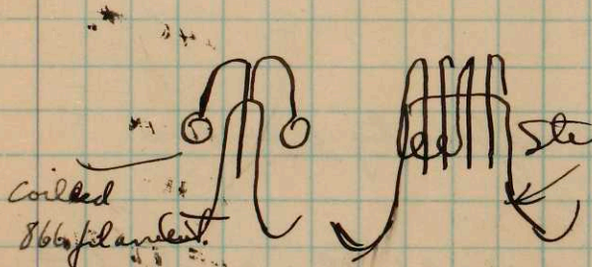
$$.02 \times 10^{6} \text{ cycles} = 20{,}000 \text{ cycles.}$$

May 31 1933
H. E. Edgerton.

Spent considerable time in the afternoon at the G. R. Company with Wilkins talking stroboscopes. They want a simple stroboscope for use as a tachometer. One proposed circuit.



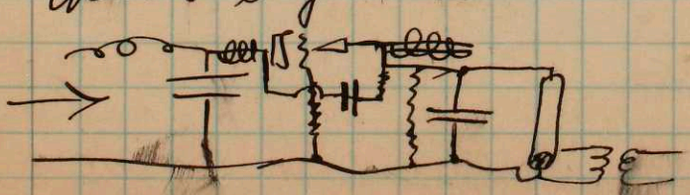
Motor driven switch to close circuit directly. Choke to keep peak current down. Voltage doubler to eliminate the input transformer, three filament windings needed. Proposed tube to have two 866 filaments coiled and near base as sketched.



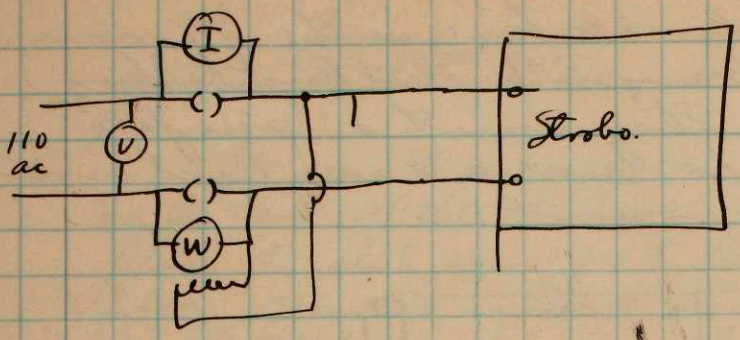
United States Patent Office
Before the Examiner of Interferences
Edgerton } Interference 76,771
vs.
Miller }
Edgerton Exhibit 37
Page 133 of Edgerton Notebook 1-2
January 3, 1940. Clara Selosky
Notary Public

I am going to test the large power unit tomorrow if all goes well

I tried to think up some ways to get out of the loss of energy while charging condensers in the strobo scope circuits. Several circuits using thyratrons and choke coils look good. We tried some of these before.



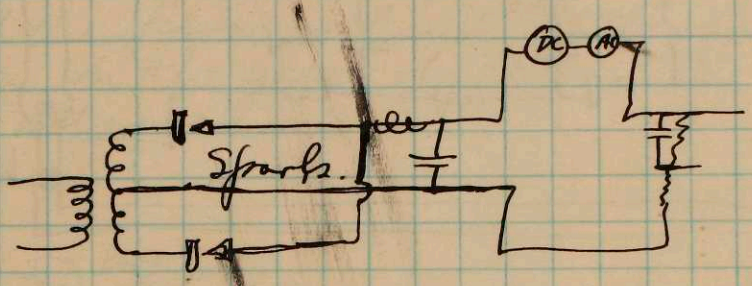
Circuits for testing Strobo at B.R.

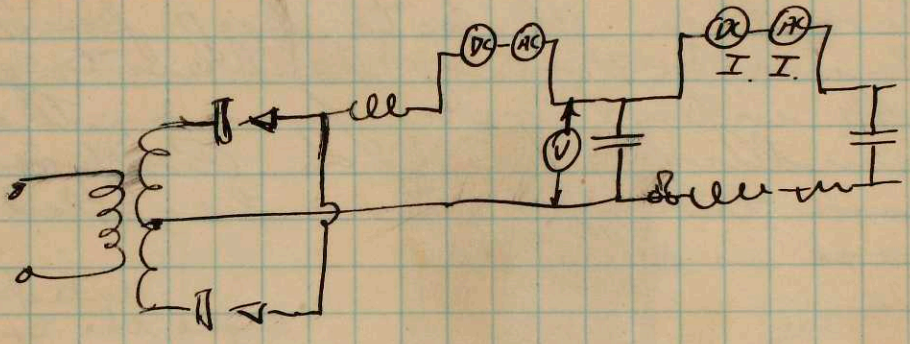


30 60 180

240 480 960.

Speedo.



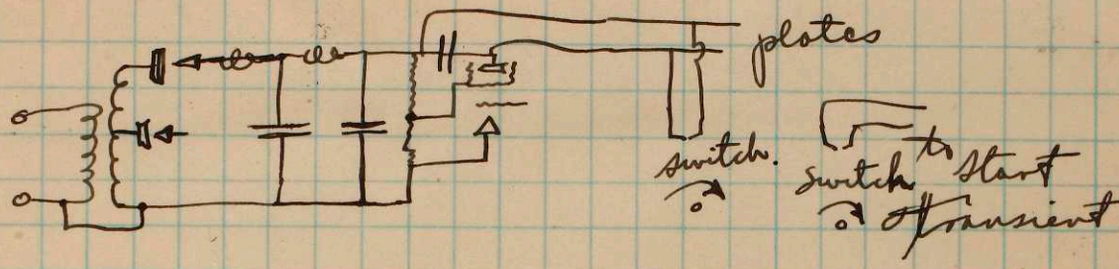


4-18" lamps 1 and 2 mf. capacity across each.

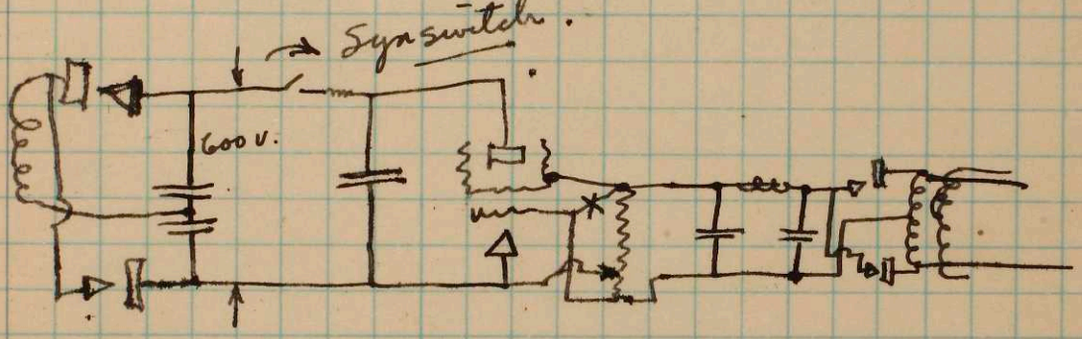
	freq.	Volts	amps	Watts.	V_{dc}	I_{dc}	$I_{a.c.}$	lamps.	Capacity each.	temp.	time.	
June 2.		112	—	145					Filament only.			capacity in sparks
		112	–	280–	1500	0	0	—	main power.			
	60 A	112	–	200	0	0	0	4	Spark only.	Spark power 1140	(1200 N.L)	
	170	112	–	210	0	0	0	4	" "	1070		
		111		240						980	SLOW	
	240	112	–	220	—	—	—	—	" "	1030	M or F	
		111	–	280						890	Slow	
	480	112		250	–	–	–	–	" "	940	M or F	
		111	–	270					" "	820	Slow misses?	
	960	112		270	–	–	–	–	" "	920	M or F.	
		Just resistance setting Blocked.							I_p 0.5 amp thyratron	750 volts.		
	960	112		400					.24 amp.	830	Slow C FAST	

May 31 1933

H. E. Edgerton. Sweep circuits.



Synchronous motor driven contactors (vac contactors?).



June 9th 1933
H. E. Edgerton. Test of 621-A stroboscope. Data.

LOAD TEST 621-A STROBOSCOPE

JUNE 4, 1933
H. E. EDGERTON.

	V	I	W	I_{dc}	I_{ac}	FREQ.	TIME	CAPACITY	NO OF LAMPS.	
				CHOKE CURRENT						
				Vdc.						
2500 ohm	113	8.±	700	.35	1260 .—?	60	7:15	1	4	20 mm tubes 18" Hg anode.
	109.5	11.9	960	.60	1140 —	60	7:21	2	4	
	112.0	8.±	680	.35	1270 —	30	7.22	2	4	
	114.0	.—	510	.20	1350 —	30	7:24	1	4	
	108.0	12.6	1040	.70	1110 —	120	7:27	1	4	
		Circuit runs too hot					7:30.	1	4	
	108.0	15.0	1210	.87	1050 —	120.	7:31	2	4	
500 ohm charging res.	107.5	16.5	1320	.95	[illegible] —	120	7:36	2	4	cold
	108.5	13.5	1080	.70	1110	120	7:38	1	4	
	108.0	12.3	1000	.65	1120	120	7:43	1	4	too hot
	110.0	10.—	690	.35	1270	60	7:45	1	4	18" straight 16 or 18 mm.
	110.0	10 —	730	.40	1260	30	7:51	1	8	4 18" straight 4 18" Hg anode
	Cathode spots appear on the top pool of the Hg anodes.									
	109.0	10 —	730	.40	1240	30	7.59	1	8	
	108.0	12.5	990	.66	1120	30	8:00	2	8	
	106.0	18.2	1400	1.12	950 1.37	60	8:05	2	8	
	107.5	13.2	1045	.72	1080 —	60	8:06	1	8	
	100	35.±	more than 2500 watts.			hold over.				3 tubes ± all Hg anode
				2.2	750 2.5-3.					
	Charging resistors changed to 500 ohm.									
	108.5	13.3	1030	.69	1100 —	60	8:30	1	7	4 Hg anode.
	105.0	21	1560	1.45	870	240		1	4	Hg anode
	tends to hold over tubes gassy.									
	106	20	1610	1.30	920			1	3	iron anode 18"
		stutters at this freq.				480	8.52	1	2	iron cold.
		"	N.G.			480	8.53	1	1	

June 9, 1933.
H. E. Edgerton.

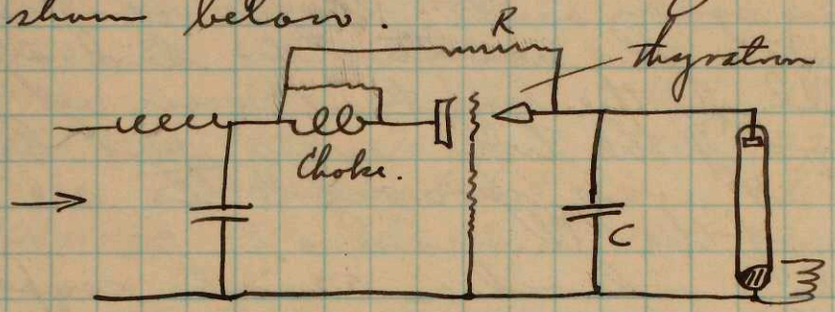
On June 7th I went to the Lewiston Bleachery with Mr. Brackett Parsons of the Pepperell Mfg Co and Mr Germeshausen. We tried the stroboscope on the sheets as they came from the bleacher. The problem is to make it possible to see the ~~the~~ threads in the sheet as they go by so that they can be made parallel. When this is done the sheets are square when they come out. The stroboscopic light with the contactor did not work very well. If the light is run at 60 cycles and if the tube was put behind the sheet it was possible to see the direction of the threads.

I have ordered a 52 inch cooper Hewitt lamp which we are going to attempt to drive with the General Radio power unit. If it works we will use two of these behind the 70 inch sheet material.

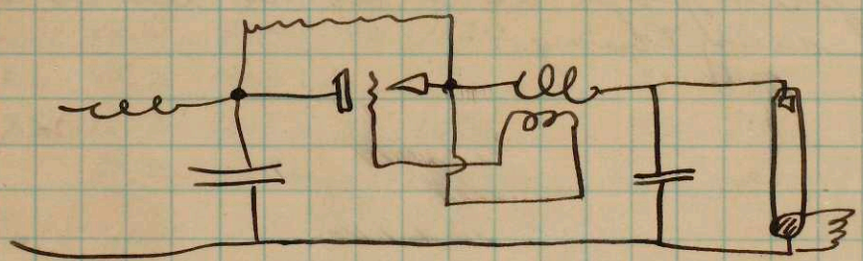
We tried out the mirror scheme but the mirror which I had was not satisfactory for the purpose and so the tests did not mean anything.

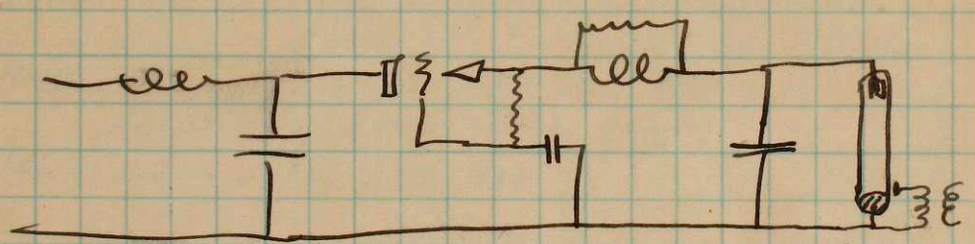
June 9, 1933.
H. E. Edgerton.

The efficiency of our stroboscopic circuits could be greatly increased if we could charge the condenser through a choke instead of through a resistor. Also there would be more time for deionization of the tube. We have tried some of these circuits before. Some possibilities are shown below.



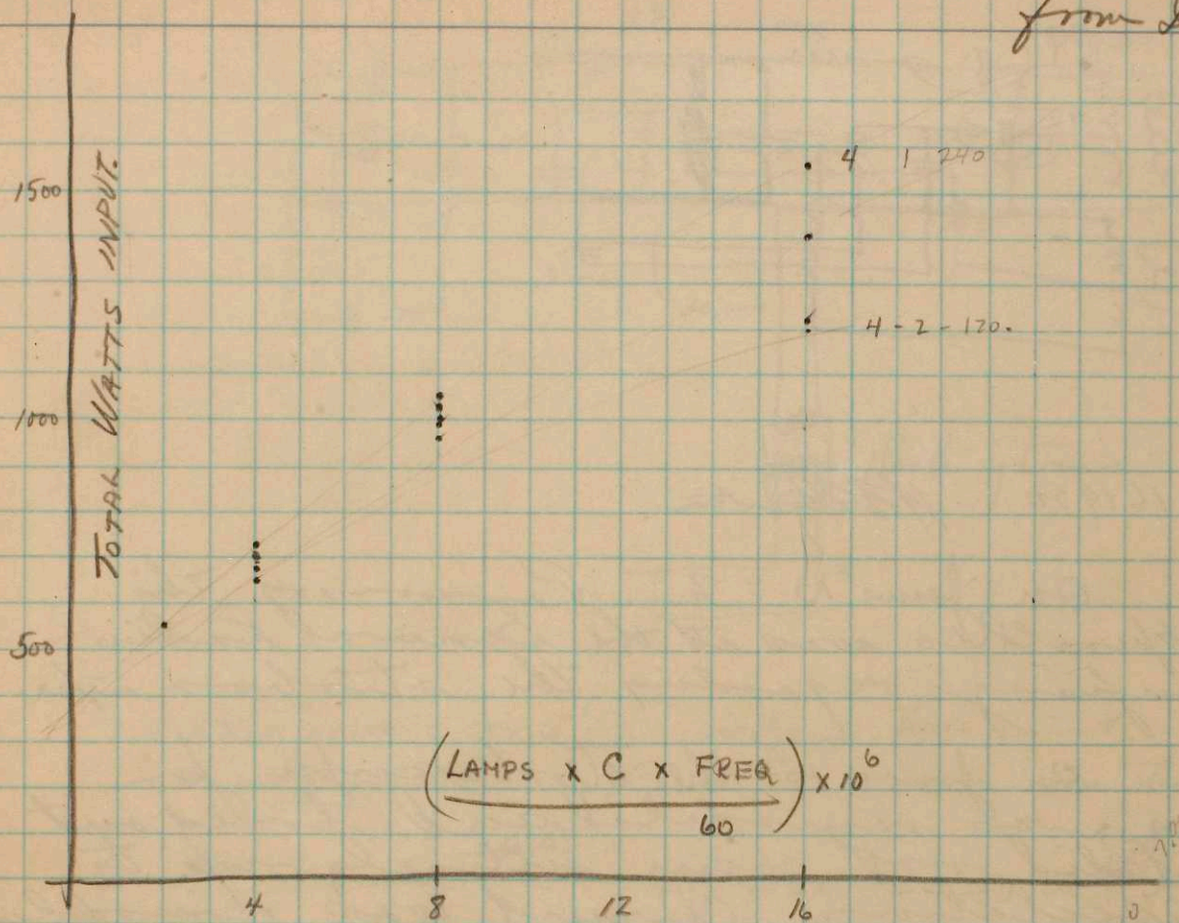
After the condenser C discharges through the tube there is a negative voltage on the grid of the thyratron which prevents it from starting until it is charged slowly through the resistance R.





United States Patent Office
Before the Examiner of Interferences
Edgerton vs. Miller - Interference 76771
Edgerton Exhibit 38.
Page 138 of Edgerton Notebook T-3.
January 3, 1940 Clara Schlosky
Notary Public

from Data page 136.



June 12 1933

Today the 52 inch dc General Electric Vapor lamp coil tube arrived and I tried it out with the General Radio's stroboscope power supply. It worked fine. I used a 16 microhenry inductance in series with the discharge. Apparently there was more light from the tube when the inductance was in. Also the light was bluer. The capacity was about 3 micro farads at 700 volts.

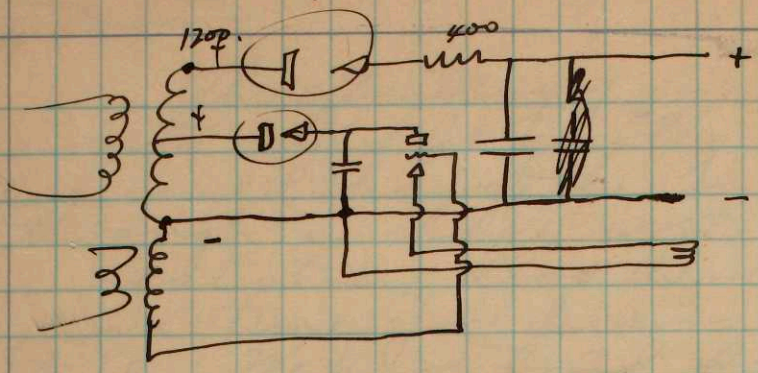
$$\frac{CE^2}{2} \times 60 = \frac{3 \times 10^{-6} \times 700 \times 700}{2} \times 60 \qquad 30 \times 49 \times 3 = 4500 \text{ watts.}$$

I actually measured only 160 watts which included filaments FG-17 5 x 2.5 = 12.5 watts
20 x 281 27.5 x 1.25 19.0
31.5

$$I = E\sqrt{\frac{C}{L}} = 500\sqrt{\frac{3 \times 10^{-6}}{16 \times 10^{-6}}} = \sqrt{\frac{1}{5}} = \frac{500}{2.2} = 250 \text{ amperes.}$$

$$T = 2\pi\sqrt{LC} = 6.28\sqrt{3 \times 10^{-6} \times 16 \times 10^{-6}} = 6.28\sqrt{48}\ 10^{-6} = 42 \times 10^{-6} \text{ seconds.}$$

866 2.5 5amp.



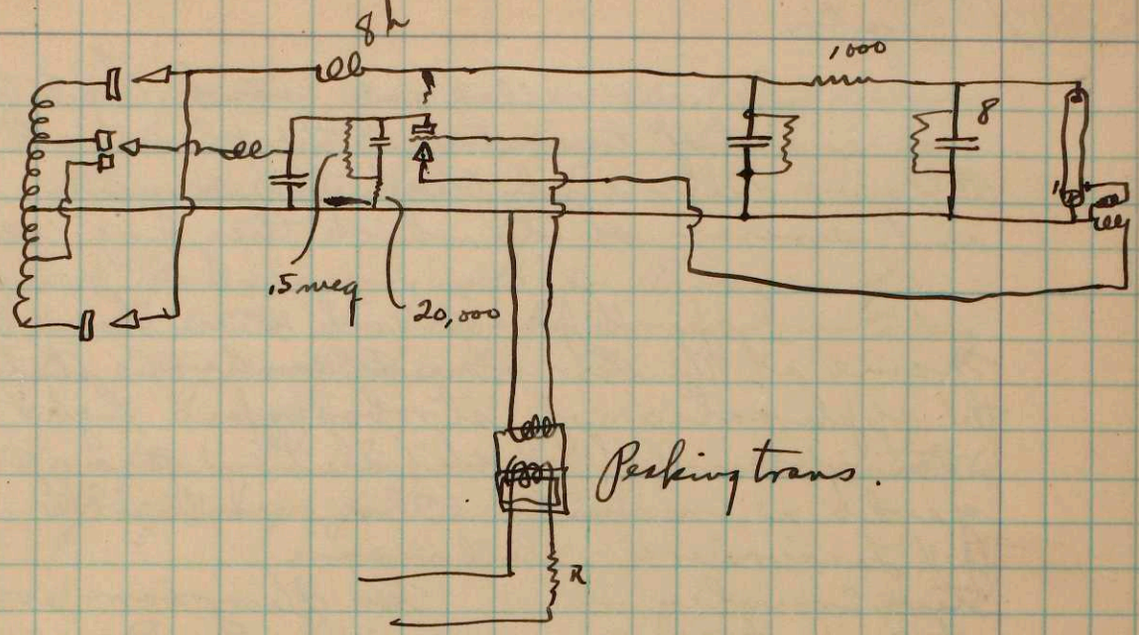
June 16 1930 Hotel Eliot.

On June 13 Mr. Pagenstecher of the Pepperell Co was at the General Radio Company regarding the stroboscope.

On June 15 the stroboscope for there was remodeled and tried out but did not come entirely up to expectation. Circuit was remodeled into the above and tried. Worked much better. G. R. will have it ready by Tuesday night if all goes well.

The automatic stroboscope for the New England Power Co's tests was tested on June 14, with Buell and Spencer present. It worked fine after the sparks power was increased.

June 16. Ready to leave for the Bellows Falls plant in Vermont. A truck is coming for the strobo and the oscillograph. We leave in Spencer's car about noon.



$8 \times 10^{-6} \times 1000 = 8 \times 10^{-3} = .008$ sec. time const.

$20{,}000 \times .25 \times 10^{-6}$ $\quad 4 \times 10^{-6} = .004$ sec time const.

$\frac{.900 \quad .900 \quad 8 \times 10^{-6}(60)}{2} =$ $\quad \frac{6.0}{2} \times 60 = 180$ watts.

June 23, 1933
H. E. Edgerton.

Spencer called and said that there was a lot of trouble in the plant at Bellows Falls and that the camera ran out several shots which they are sending.

I spent June 21 and 22 in Lewiston Maine at the Lewiston Bleachery Co studying the application of stroboscopic light for straightening of cloth (sheeting) going at 90 yards a minute. Oler went with me.
J. V. Lacourssiere - electrician
Steve Crowley - Mr. Harrison was there on the 21st as was Mr. Parsons.

We tried the 52" lamp in five different positions. It appeared it would be best just before the sheet went into the starch machine.

July 6, 1933

My father & mother, Mr. & Mrs. F. E. Edgerton of Aurora Nebraska, were here until yesterday. They were here to attend a Rotary Club convention.

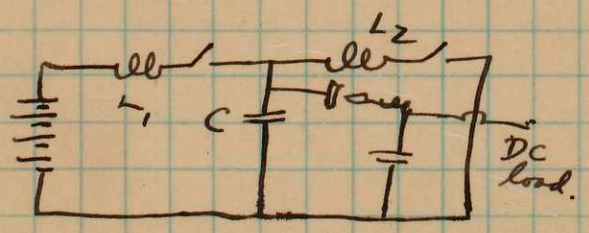
I spent this morning with Mr. Parsons of the Beppenle co. We tried sparles, lenses, and rotating mirrors for stopping sheets.

In the afternoon Germeshausen and I took movies of sprays for Mr. Pease.

July 7, 1933. Mr. Pease brought over Mr. Maxwell Mr. Bodman? (Director of research) both of the Lever Bros Soap co. and Mr. Kleinschmidt. of the Little Co. to see the movies of the spray which we took yesterday.

The new camera which takes the pictures on the sprocket was tried today. About six feet of film are needed to get up to speed when taking 1500 pictures per second. The lamps were run at 500 cycles and the camera took a picture of a white card for this test. This test was made with 16 mm film.

D.C. Voltage increaser. May be useful for auto radios and other places. The two switches to be vacuum type and motor driven.



Operation. Charge condenser through L_2, and allow the switch to open at zero current during the first oscillation. This gives double voltage on C. Then short C through L_2 for 1/2 cycle of mech freq which puts + 4 voltage on C. Close S, again for 1/2 cyc which puts 5 times voltage on C. Repeat. The load will keep it from reaching infinity.

July 13, 1933.

Gerry and I went to Providence R. I. on Tuesday July 11 and spent a very interesting day there at the U. S. Rubber company. Dr. Tidguey was with us all the time. We met mr. Madge the director of research at Providence Mr. Gibbons of Passaic N. J. Mr. Coulin and Mr. Sproul of the sales dept.

I have been working upon optical schemes for the Pepperell co. to stop their sheets in the bleachery so they can be corrected for shift. A cylindrical lens seems to be quite good for enlarging the threads in one direction.

Changed choke in series with discharge for Pep. stroboscope to 3 ohm resistance. This resistor and the 11 inch cylindrical lens was mailed to Mr. Lacouraire at the Lewiston bleachery on the aft of the 13th.

In the evening Gerry and I took two movies of milk coming from a spray jet with different heads. The lamps were run at 1820 flashes per second. The photographs were put on 35 m m film unframed, for measurement purposes. The heads were 23½" and 70". The tubing was 1/4" so there was probably no loss of head due to friction.

							hrs.
Aug	9.	Saw Folger / measured discharge time					4.
Aug.	10	measured time of flash and changed circuit					5.
Aug	11	Went to Lever Bros and saw Folger.					2.
Aug	15?	took pictures in morning.					3.
"	19	took pictures to Folger.					1.
"	18 19	Experimented with circuit and optical systems					5
"	20.	"	Repairbans	6.84			1
"	22	Lever Bros Photographs	Film	3.60	3 days	40 ¢ 120	4.
"	23	Pictures	mail	.49	1 "	25 25	1 1/2
"	26	took 6 cups of 90% water soap sol. at Lever Photo		12.18		¢ 15.00	2.
Sept	2	took pictures of 90% H2O soap sol.		23.11	Exp. sent Folger 5.	23.11 ¢ 168.11	2. 30 1/2
Sept	7 8	Saw Folger about films					1
"	9	Took photos in tower of thin soap.					2.
	12	Saw Little Co Photographers re axwell & Ox — ?					1.
	13	Dr Kohn specimen					2.
Oct	1	Films to Folger.					2
							8