01828

Project PL

Project notebook issued

12/12/42 to J. P. Eckert, Jr.

JSB 12/12/42

Checked
9/5/51

Standard Figuring Book

No. 1602½

2	Columns	to Right,	Units,	Single	Page	Form
3	"	"	"	"	"	"
4	"	"	"	"	"	"
5	"	"	"	"	"	"
6	"	"	"	"	"	"
6	"	Divided,	"	"	"	"
7	"	to Right,	"	"	"	"
8	"	"	"	"	"	"
10	"	"	"	Double	Page	Form
12	"	"	"	"	"	"
14	"	"	"	"	"	"
16	"	"	"	"	"	"
18	"	"	"	"	"	"
20	"	"	"	"	"	"
Unruled						
Quadrille						
Faint						

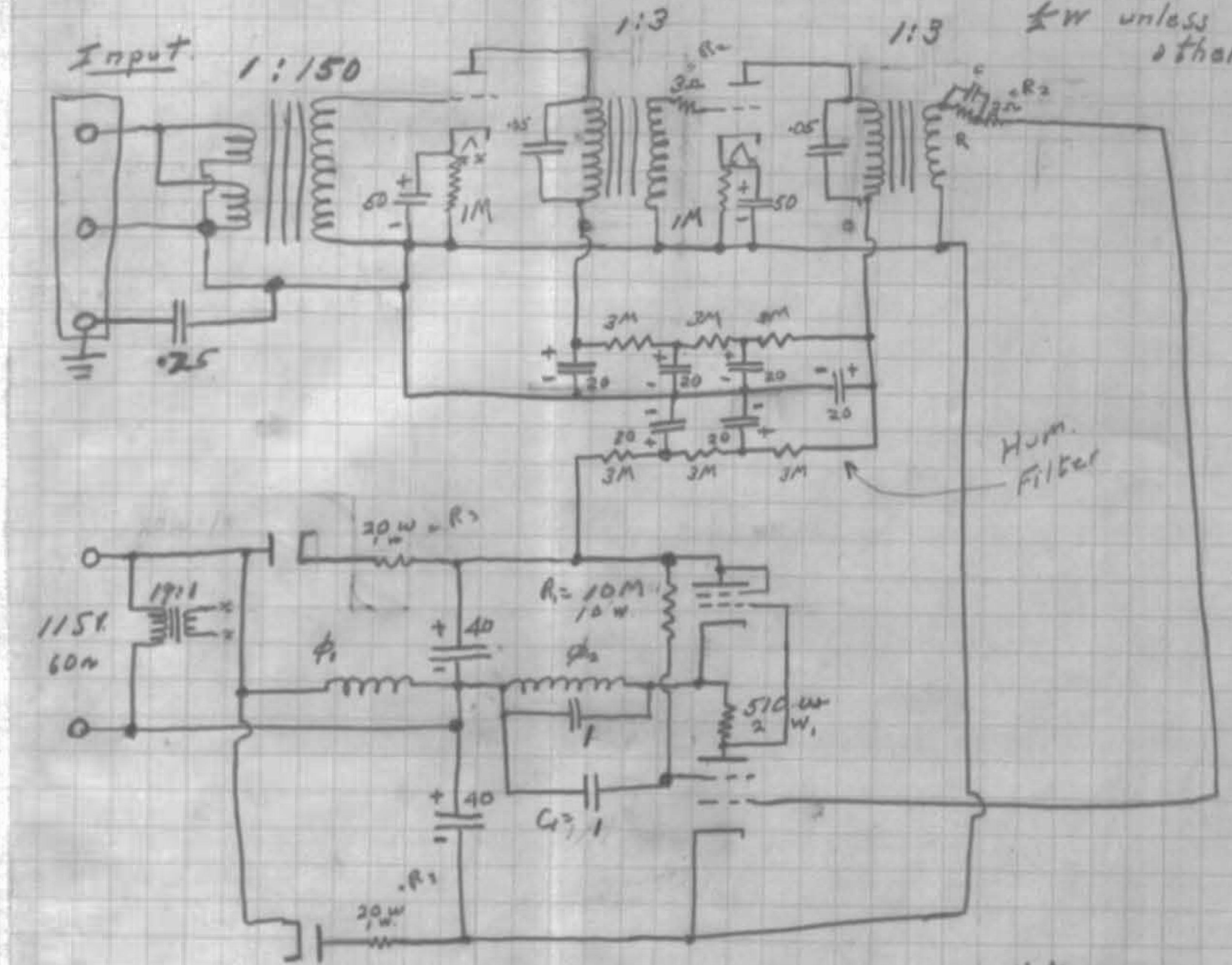
In 150 and 300 Pages

Made in U. S. A.

TO REORDER THIS BOOK, SPECIFY NUMBER, RULING AND THICKNESS AS INDICATED ON BACKBONE OF BOOK

A BOORUM & PEASE PRODUCT

Ω = meg ohm
ω = ohm
M = thousand ohms.
½W unless marked otherwise.



Notes:

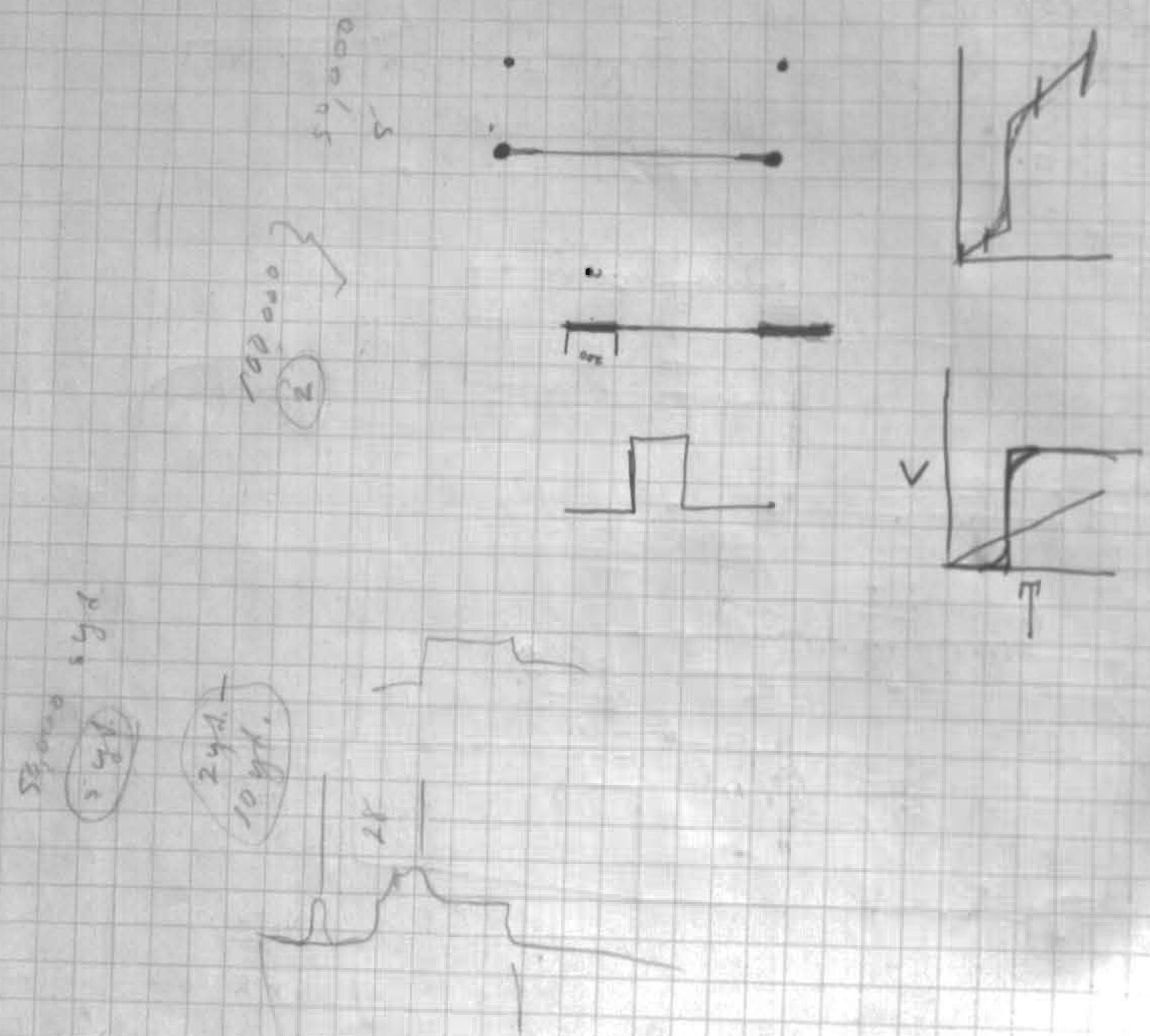
a) C + R are presently left out.

b) R_1 + C_1 are probably useless.

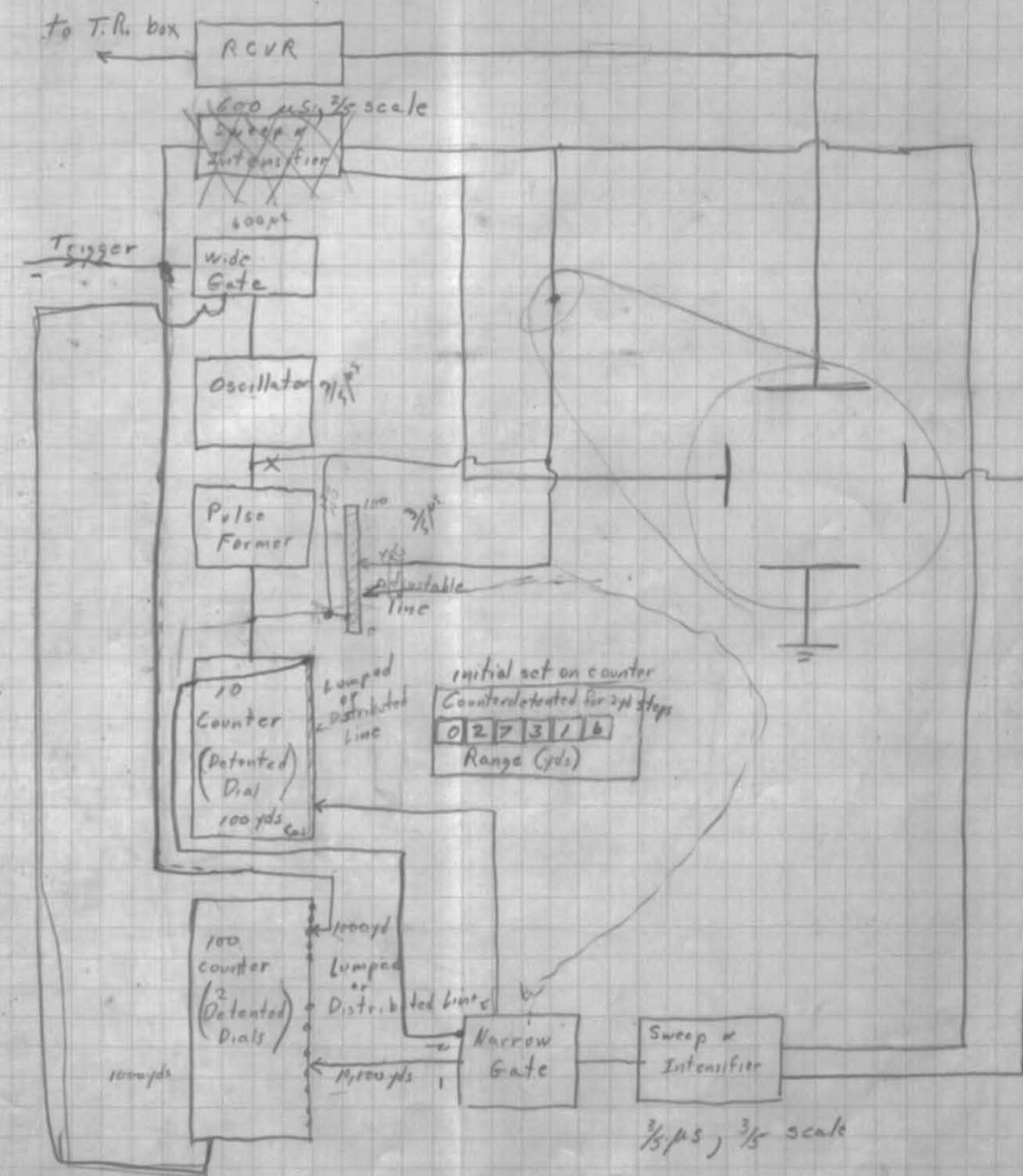
c) Perhaps R_2 + R_3 are also not needed.

d) Perhaps the hum filter has too little or too many sections.

01830

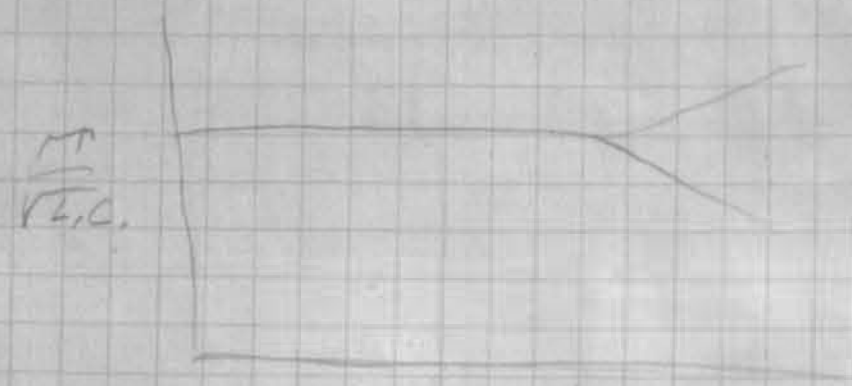


Range System



0-1832

$$\beta = \left[\frac{1-\gamma^2}{1+\gamma^2}\right]\left[\frac{2}{\gamma}\right]$$



α	α^2	$2-\alpha^2$	$2T\alpha^2$	$2+2T\alpha^2$	$\left[\frac{2-\alpha^2}{2+2T\alpha^2}\right]$	$\cos^{-1}[\ ]$	$\frac{1}{\alpha}(\cos^{-1}[\ ])$
0							
.2							
.4							
.6							
.8							
1.0							
1.2							
1.4							
1.6							
1.8							
2.0							
2.2							
2.4							
2.6							
2.8							
3.0							

0-1833

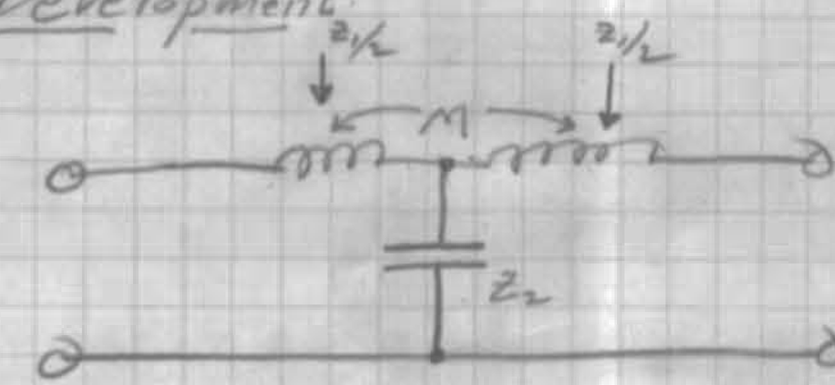
Filter Design

$$P_0 = \frac{L_1 C_2 \omega^2 - 2}{-2(1 + M C_2 \omega^2)}$$

$$\phi = \cos^{-1} P_0$$

$$T = \frac{\phi}{\omega}$$

Development



$$-\frac{Z}{2b} = P_0$$

$$Z = Z_1 + 2Z_2$$

$$b = Mj\omega - Z_2$$

$$Z_1 = j\omega L_1$$

$$Z_2 = \frac{1}{j\omega C_2}$$

$$Z = j\omega L_1 + \frac{2}{j\omega C_2}$$

$$b = j\omega M - \frac{1}{j\omega C_2}$$

$$P_0 = -\frac{\left[j\omega L_1 + \frac{2}{j\omega C_2}\right]}{2\left[j\omega M - \frac{1}{j\omega C_2}\right]}$$

$P_0 =$ (see above)

Let $T^2 = \frac{M^2}{L_1 L_1}$

$$T = \frac{M}{L_1} \leq \frac{1}{2}$$

$$P_0 = \frac{L_1 C_2 \omega^2 - 2}{-2(1 + T L_1 C_1 \omega^2)}$$

Let $\alpha = \omega\sqrt{L_1 C_2}$

$$\frac{T}{\sqrt{L_1 C_1}} = \frac{1}{\alpha} \cos^{-1}\left[\frac{2-\alpha^2}{2+2T\alpha^2}\right]$$

For α from 0 to 3 (.1 intervals)

For T from 0 to .6 (.05 intervals)

$$Z_i = \sqrt{\frac{L_1 + 2M}{C_2} + \frac{(4M^2 - L_1^2)\,\omega^2}{4}}$$

Development

$$Z_i = \sqrt{\frac{(Z_1 + 2Z_2)^2 - 4b^2}{4}}$$

$$Z_1 = j\omega L_1$$

$$Z_2 = \frac{1}{j\omega C_2}$$

$$Z_i = \sqrt{\frac{(Z)^2 - 4b^2}{4}}$$

$Z = Z_1 + 2Z_2$

$b = j\omega M - Z_2$

$b = j\omega M - \dfrac{1}{j\omega C_2}$

$$= \frac{Z}{2} - b$$

$$Z_i = \sqrt{\frac{L_1}{C_2}(1 + 2\gamma) + L_1^2\frac{(\gamma^2 - 1)}{4}\,\omega^2}$$

$$Z_i = \frac{1}{C_2}\sqrt{L_1 C_2 (1 + 2\gamma) + L_1^2 C_2^2\,\omega^2\,\frac{(4\gamma^2 - 1)}{4}} \qquad (1)$$

0.1825

$$Z_i = \sqrt{\frac{L}{C_2}}\sqrt{1 - L\,C_2\,\omega^2\left(\frac{1-4\gamma}{4}\right)}$$

Upon Letting $L = L_1 + 2M$

$$\therefore \frac{L}{L_1} = 1 + 2\gamma$$

$$\therefore Z_i = \sqrt{\frac{L_1}{C_2}}\sqrt{1+2\gamma}\sqrt{1 - L_1 C_2 \omega^2 \frac{(1-4\gamma)(1+2\gamma)}{4}}$$

or

From (1)

$$Z_i = \sqrt{\frac{L_1}{C_2}}\sqrt{(1+2\gamma) + L_1 C_2 \omega^2 \frac{(4\gamma^2-1)}{4}}$$

$$\frac{Z_i}{\sqrt{\frac{L_1}{C_2}}} = \sqrt{(1+2\gamma) + \alpha^2 \frac{(4\gamma^2-1)}{4}}$$

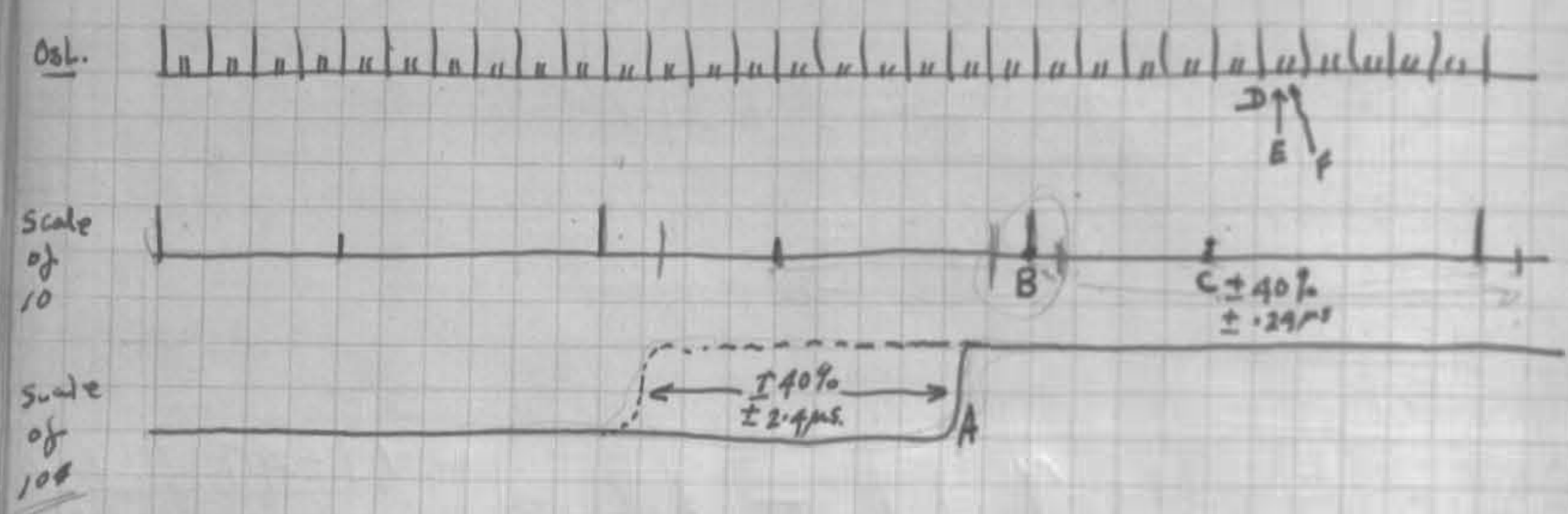
for $\gamma = .15$

$$= \sqrt{1 + .3 - \alpha^2 \left(\frac{1 - .0900}{4}\right)}$$

$$= \sqrt{1.3 - .2275\,\alpha^2}$$

for $\gamma = .15$
cut off at $\alpha = 2.2$

$$= \sqrt{1.3 - 1.1} = \sqrt{.20} = (.45 \text{ of max value}.$$

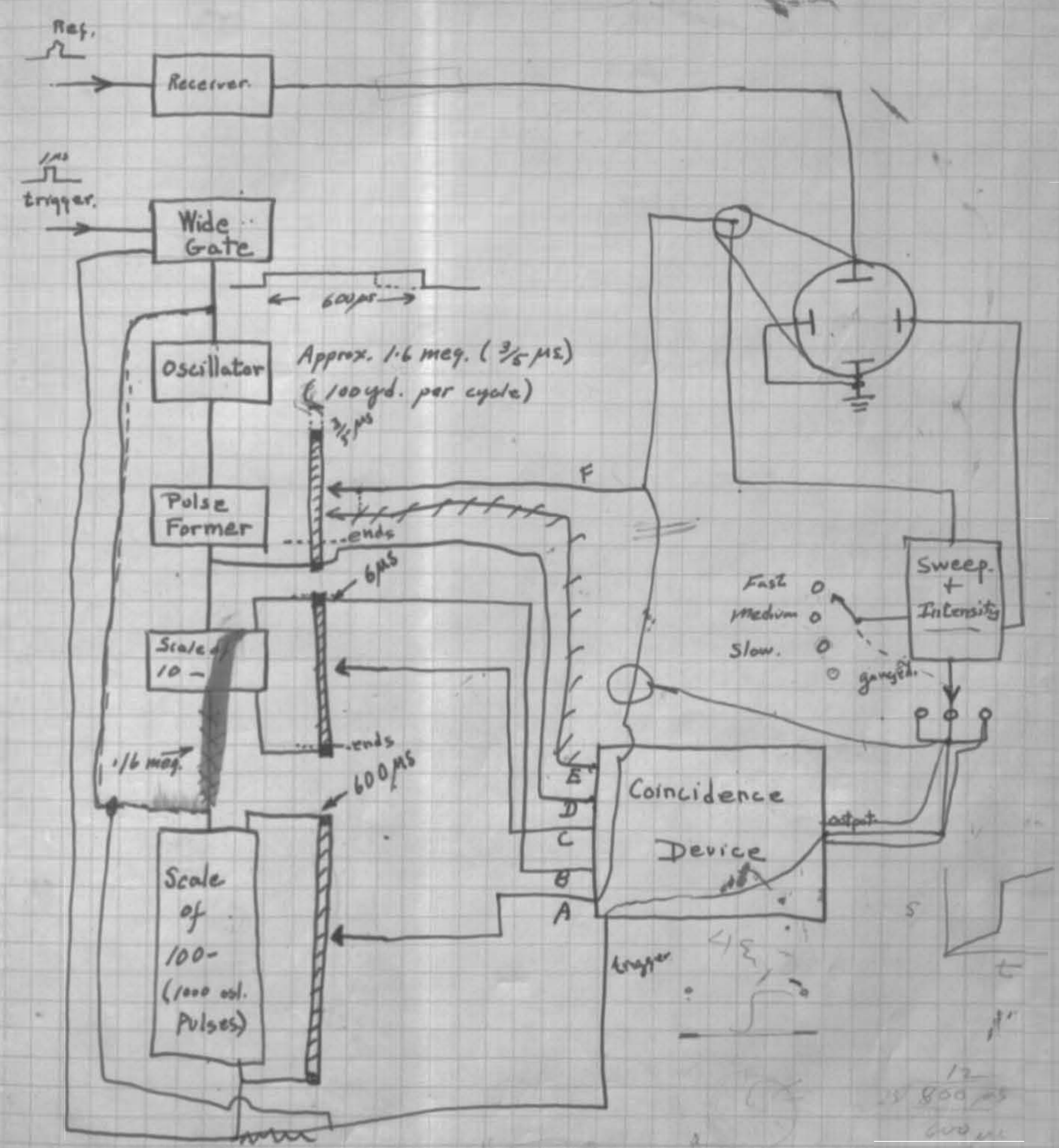


First line — ± 2%

Second line — ± 4%

Third line ± .4% { or third — ± 4%
+ fourth — ± 4%

time Axes



0-1838

$$z = e^{-4K}$$

RCA Material

Eff in ms.ind / 2

Iron Core Material.

DC -M-	No.	freq.	
3-4	111-11	100 meg.	upper Limit
6-8	123-15	50 meg.	
16-20	123-13	15 meg.	
60-80	123-11	1 meg.	

quicker without studs -

Ordered - ½ lb - pulver - 111-11, 123-15, 123-13

ordered - 25 - .743" x 1" - 111-11, 123-15, 123-13

orderder 25 - .368" x 1" with stud 111-11, 123-15, 123-13

0-1840

calc. for 0.18

0-1841

PLEASE FILL OUT STARRED LINES ON TYPEWRITER

Shipment Nº 7313

SHIPPING ORDER

Radiation Laboratory

*Date 12/17/42

Recorded by

TO PURCHASING AGENT:

Please ship the equipment described below to:

*Individual Mr. J. Brainerd

*Organization Moore School of Electrical Engineering - University of Pa. 200 S.33rd. St.

*Address Philadelphia, Pennsylvania

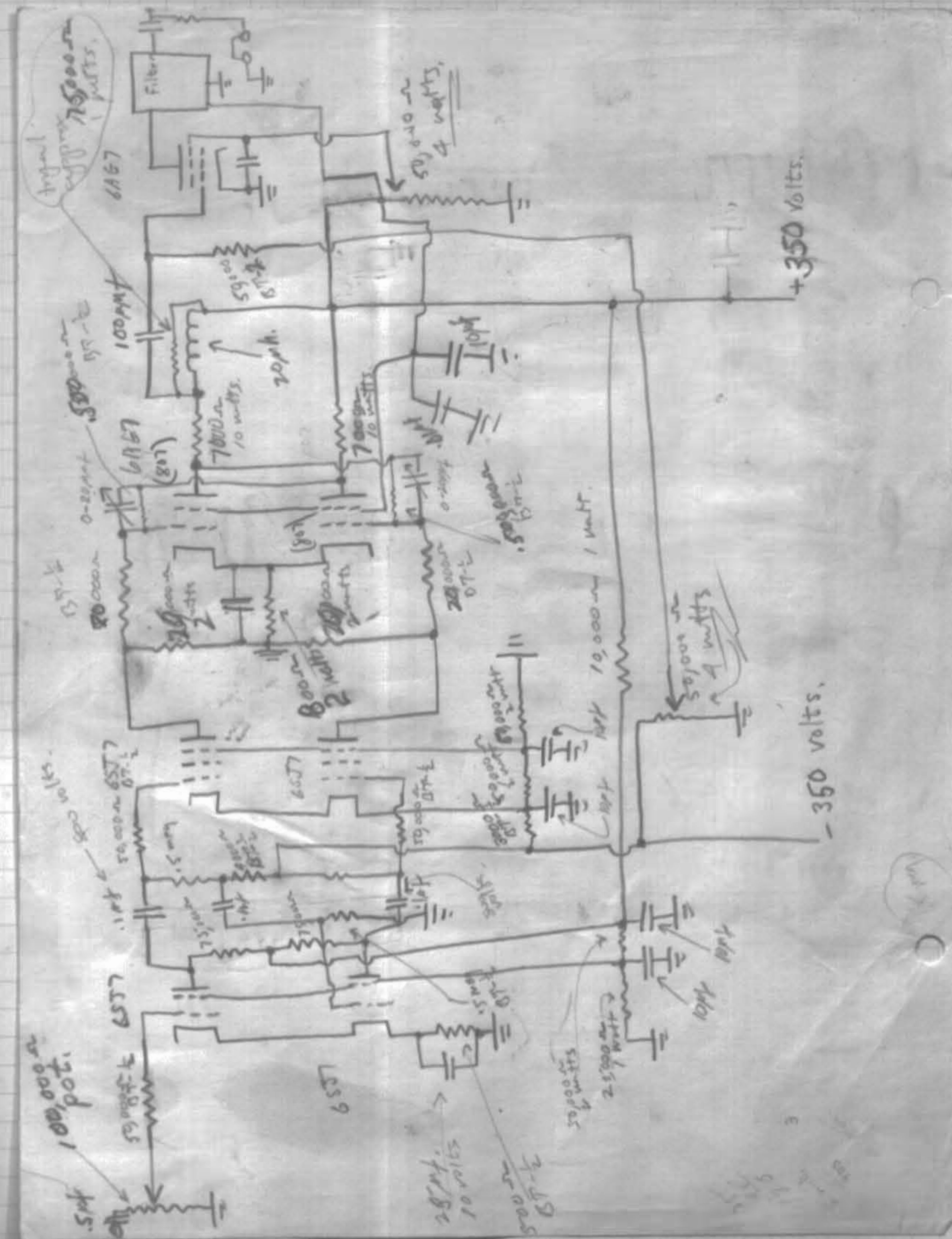
How shipped .... Insured for $ .... Date shipped ....

No. and Kind of Packages	DESCRIPTION OF CONTENTS			Shipping Weight	Value
	Our Ser. Number	Manufacturers Numbers	Model and Kind of Equipment		
			4 DuMont 2511 A5 CR Tubes		
		(10)—	4 Shields for above		
			28 .005 ufd mica condensers		
			6 954 tubes		
			6 807 tubes		
			6 6AG7 tubes		
		(6) →	12 6AC7 tubes		
		(4)—	3 National XMA acorn tube sockets (1 back ordered)		
			4 Freed 11011 transformers		$150.00
			1 Input socket assembly with cable connector		
			On loan to be returned in equipment that is being made under another NDRC contract at University of Pennsylvania.		

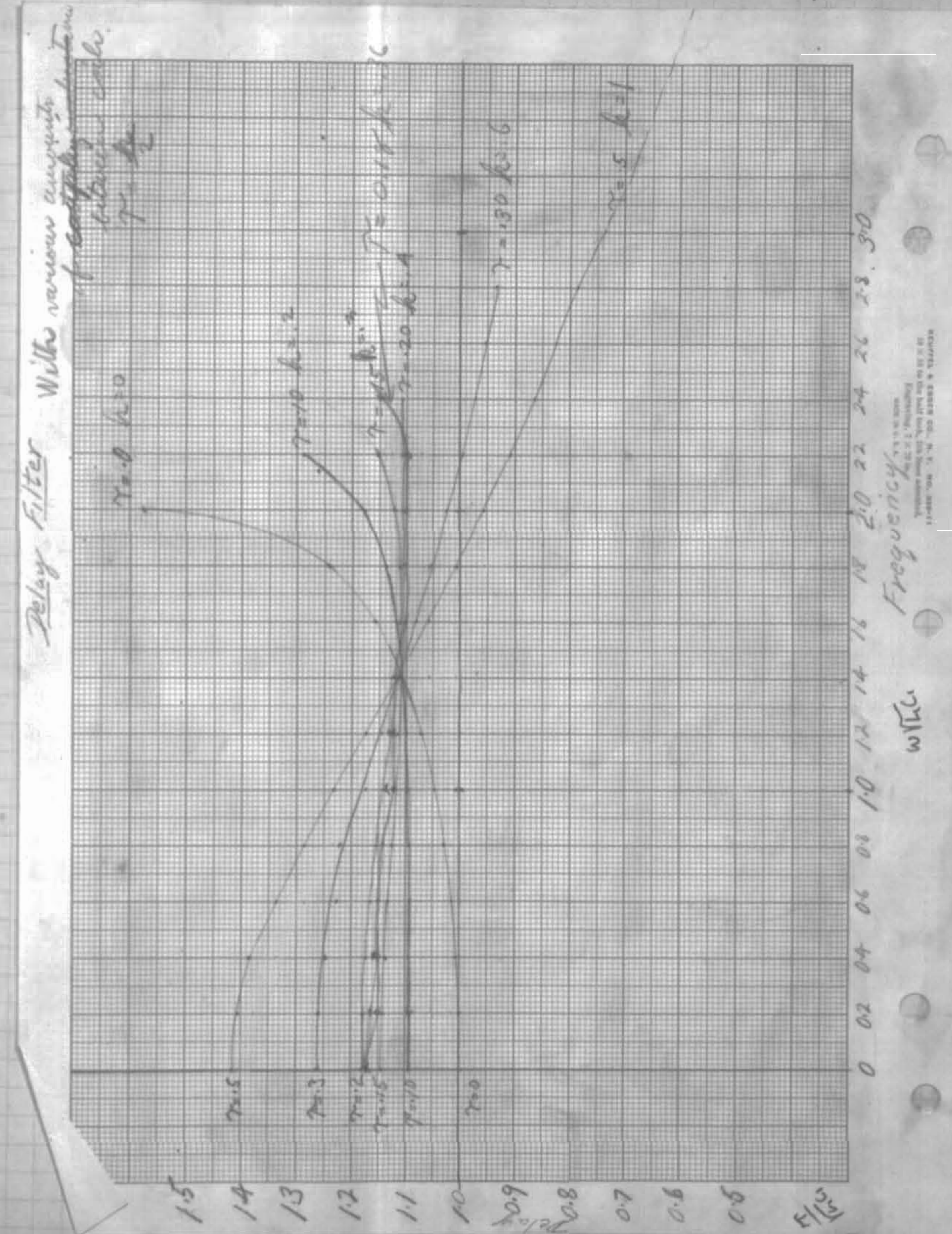
Packing Slip: Gratis ...., Loan ...., Credit ...., Exchange ...., Repair ....

See above

Square Wave Generator. 0-1843

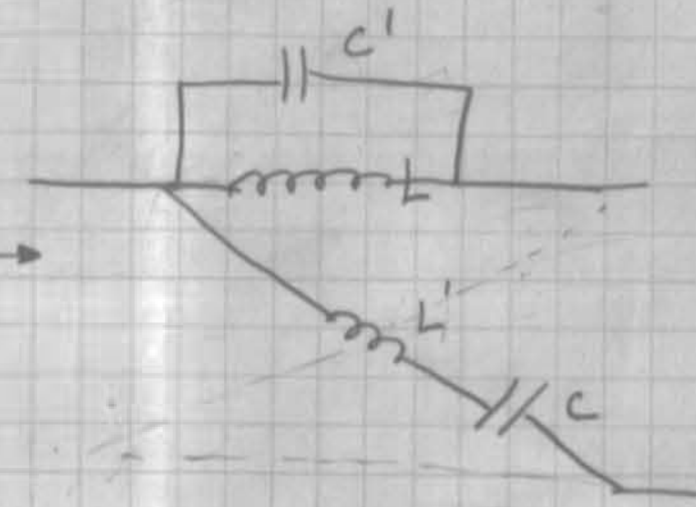


$\frac{2}{\sqrt{.42}}$



Delay Filter based on Min Phase Shift Theory

Consider the lattice section

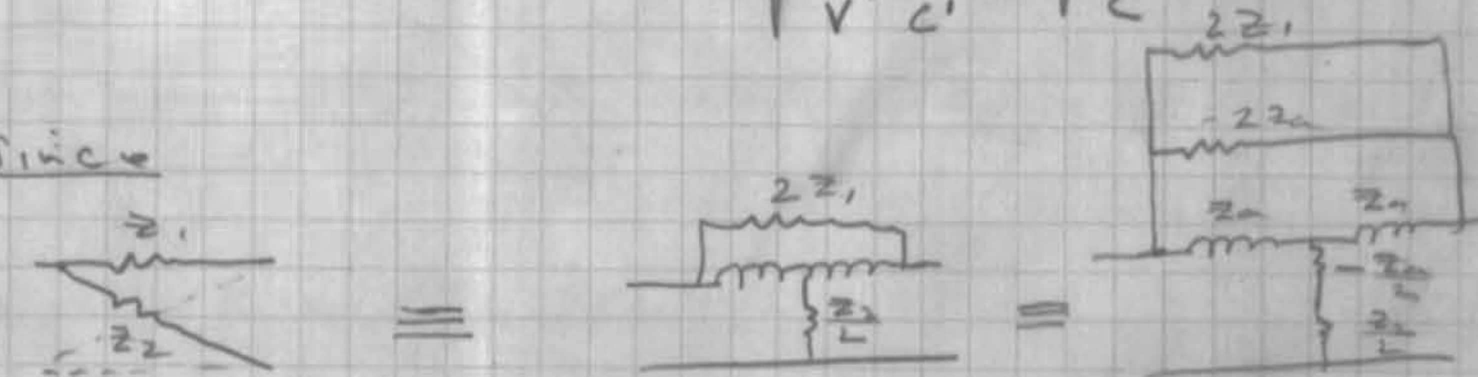


$$LC' = L'C = K$$

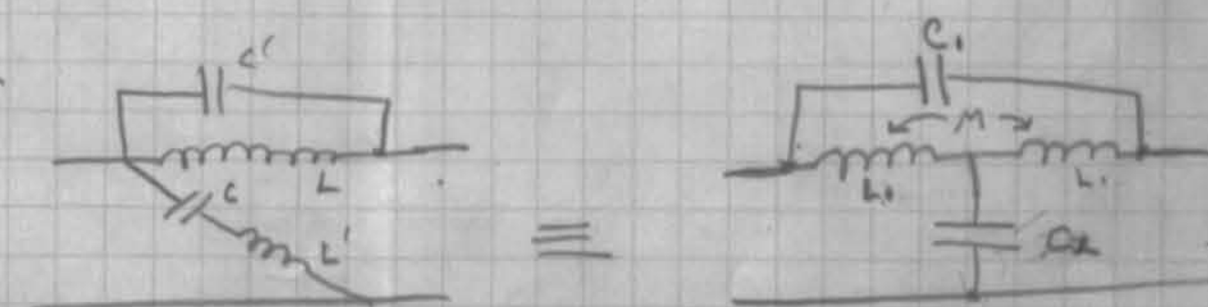
$$\frac{L}{L'} = \frac{C}{C'} = V \qquad Z = \sqrt{Z_1 Z_2} = \frac{\left(\frac{-j}{\omega C'}\right)(\omega L)\left(j\omega L' - \frac{j}{\omega C}\right)}{\left(j\omega L - \frac{j}{\omega C'}\right)}$$

$$= \sqrt{\frac{2}{V}\,\frac{L}{C'}} = \sqrt{\frac{2L}{C}}$$

Since



Then



Let $\frac{M}{L_1} = R$

where $C = \frac{C_2}{2}$

$L = 2L_1(1+R)$

$L' = 2L_1R$

$C' = 2C_1$

where $C_2 = 2C$

$L_1 = \frac{L}{2+2R}$

$C_1 = \frac{C'}{2}$

For our Filter

$$C_2 = 200\,\mu\mu f$$
$$L_1 = 5\text{ mh.}$$
$$R = .27$$

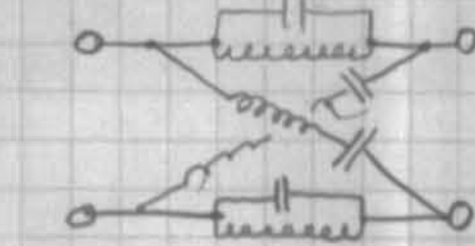
$$V = \frac{L}{L'} = \frac{\cancel{2}L_1}{\cancel{2}L_1}\frac{(1+R)}{R} = \frac{1.27}{.27} = \frac{C}{C'} = 4.7$$

Now. $C = 100\,\mu\mu f$

$$C' = \frac{.27}{1.27}(100)$$

$$C_1 = \frac{C'}{2} = \frac{(.27)}{(1.27)}\frac{(100)}{2} = \frac{(.27)(50)}{(1.27)} = 10.6\,\mu\mu f$$

Z_K = approx. 7000 Ω



$$L = 2L_1(1+R)$$
$$C = \frac{C_2}{2} = 100\,\mu\mu f$$

$$\frac{L}{R} = CR'$$

$$R' = \frac{L}{CR} = \frac{(2)(5)(1+R)(10^{-3})}{(100)(10^{-12})(60)}$$

$$= \frac{12.7}{60} \times 10^7$$

$$= \frac{127}{60} \times 10^6$$

$$= 2.11\text{ meg.}$$

$$R'' = \frac{2.11}{2} = 1.06\text{ megs.}$$

1.8 henries – coils bucking

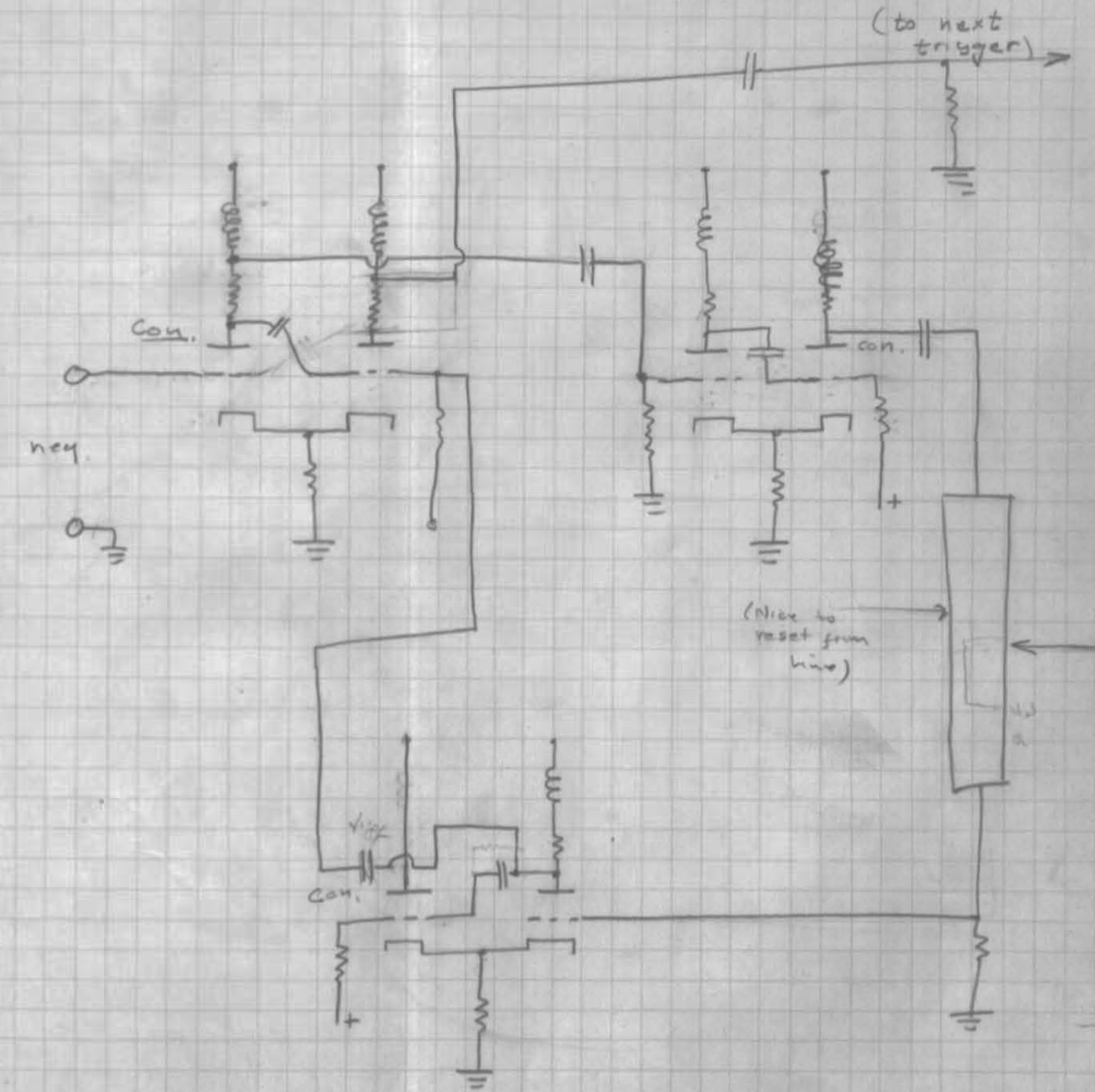
$$L_1 + L_1 - 2M = 1.8$$
$$L_1 + L_2 + 2M = 108$$

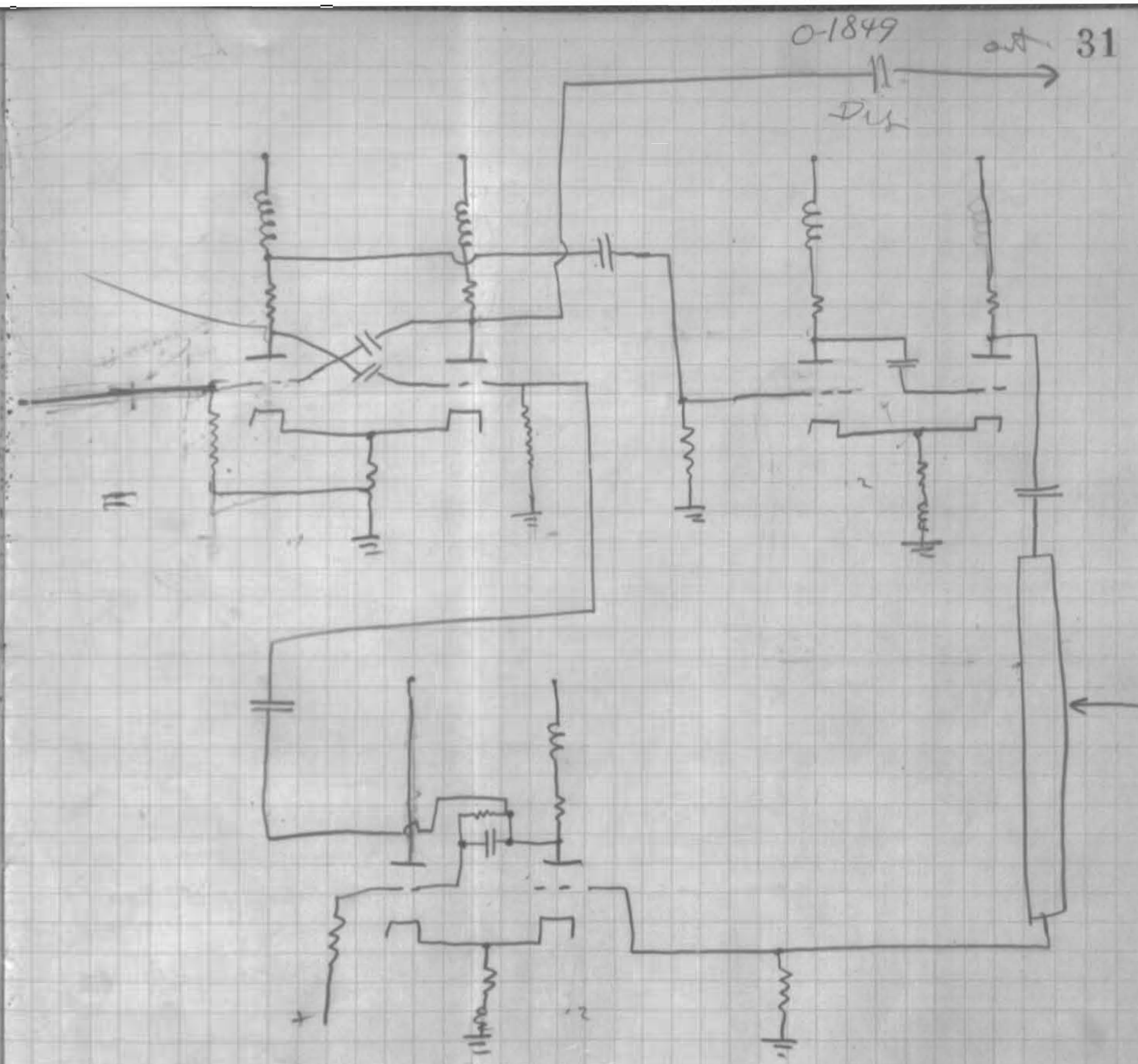
$$4M = 108 - 1.8 = 106.2$$

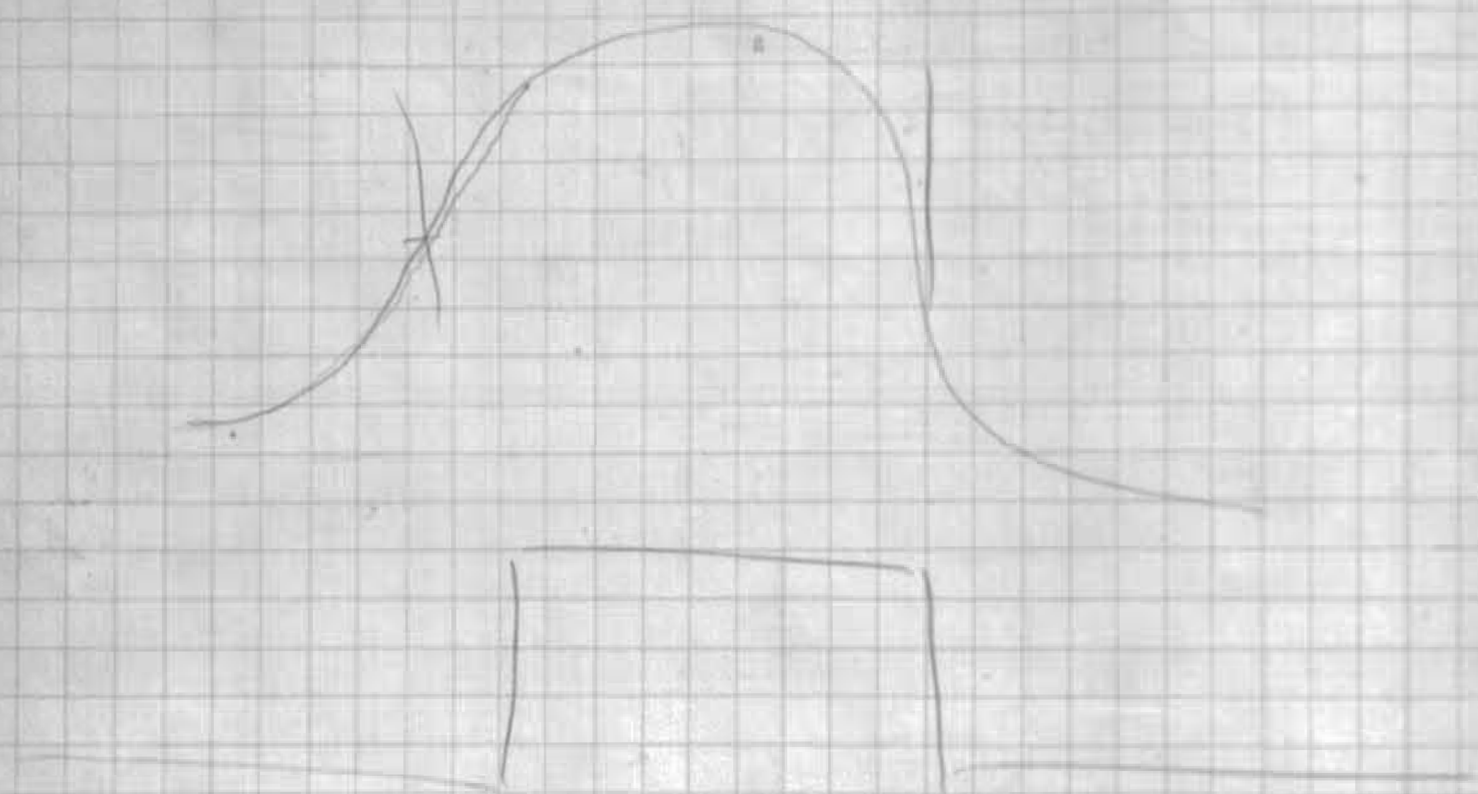
$$K = \text{approx. } \frac{106.2}{108} = 98.5\%$$

04848

Trigger Circuit –

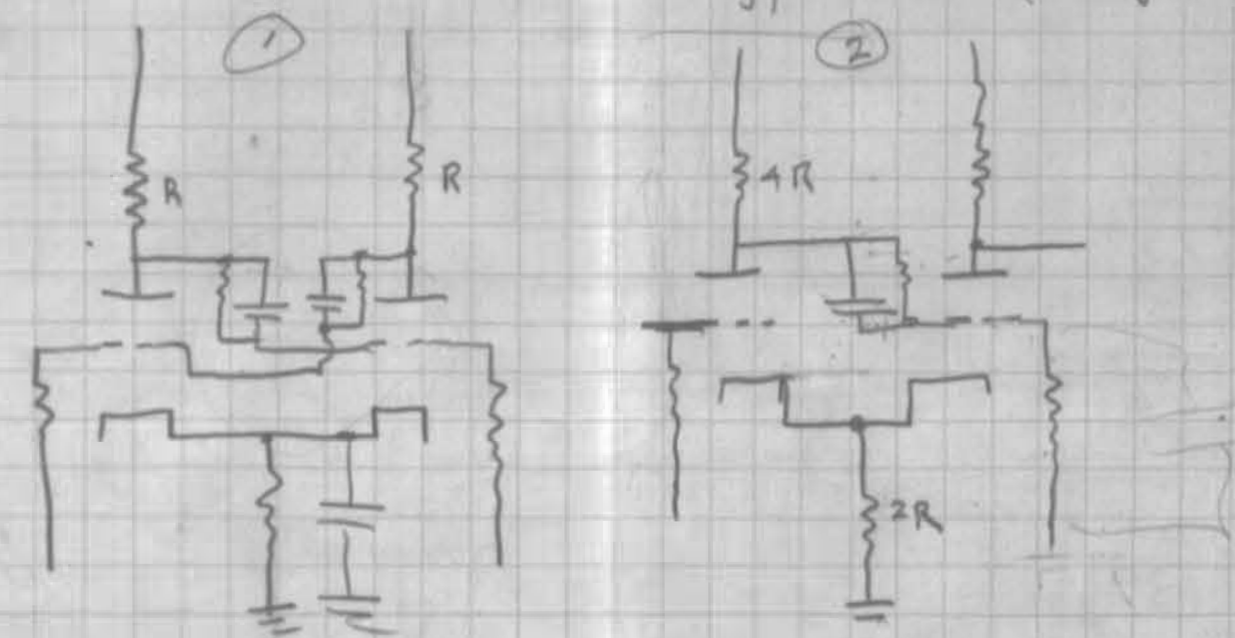



0-1849
out
Diff

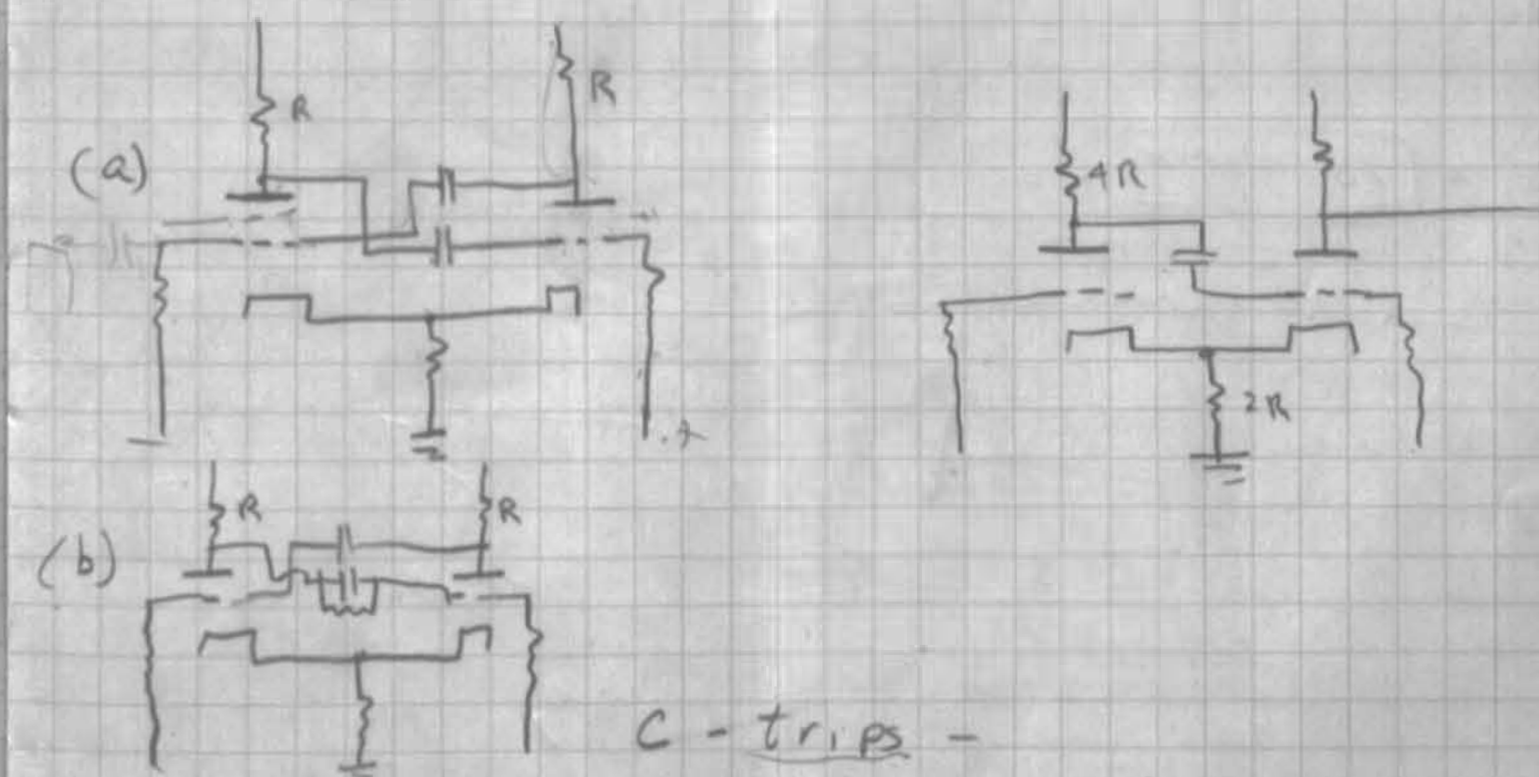


General Types

A - triggers - (stays where put type)



B - triggers (stay where thrown for a definite interval if not reset by pulse)

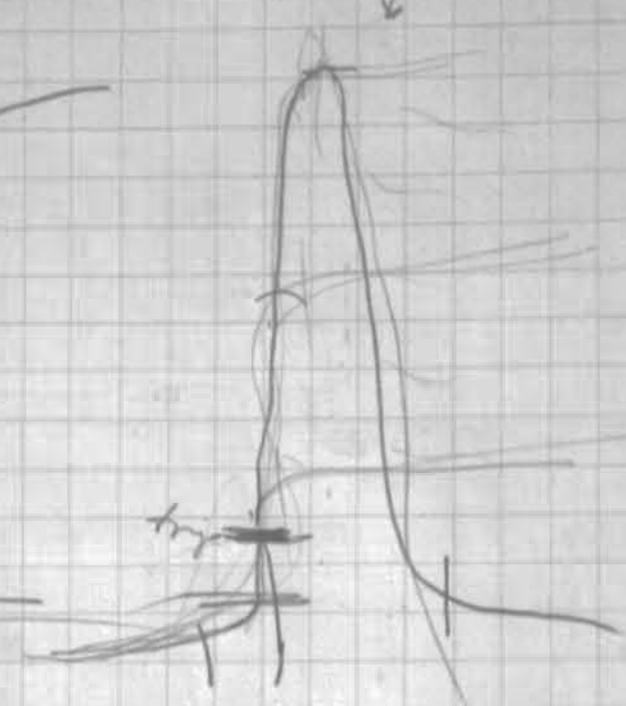


C - trips -

with appropriate biases A circuits will operate as trips

(also B with restrictions)

0-1852



6SJ7 $= \frac{1650}{13} =$ ap. $\boxed{13}$

6AC7 $= \frac{9000}{16} =$ ap $\boxed{56}$

800

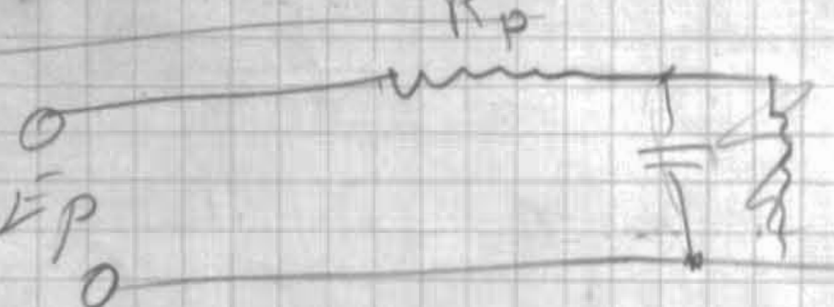
6AG7 $= \frac{7700}{20} =$ ap $\frac{1}{20}\mu s$ $\boxed{39}$

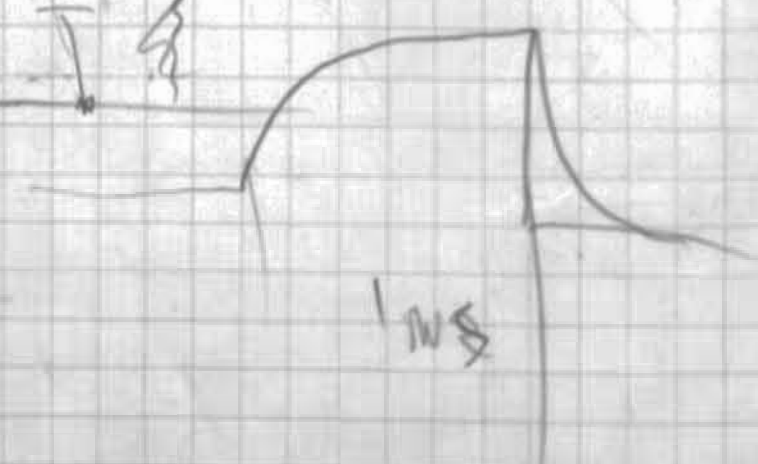
6L6 or 807 $\frac{6000}{20} =$ ap. $\boxed{30}$

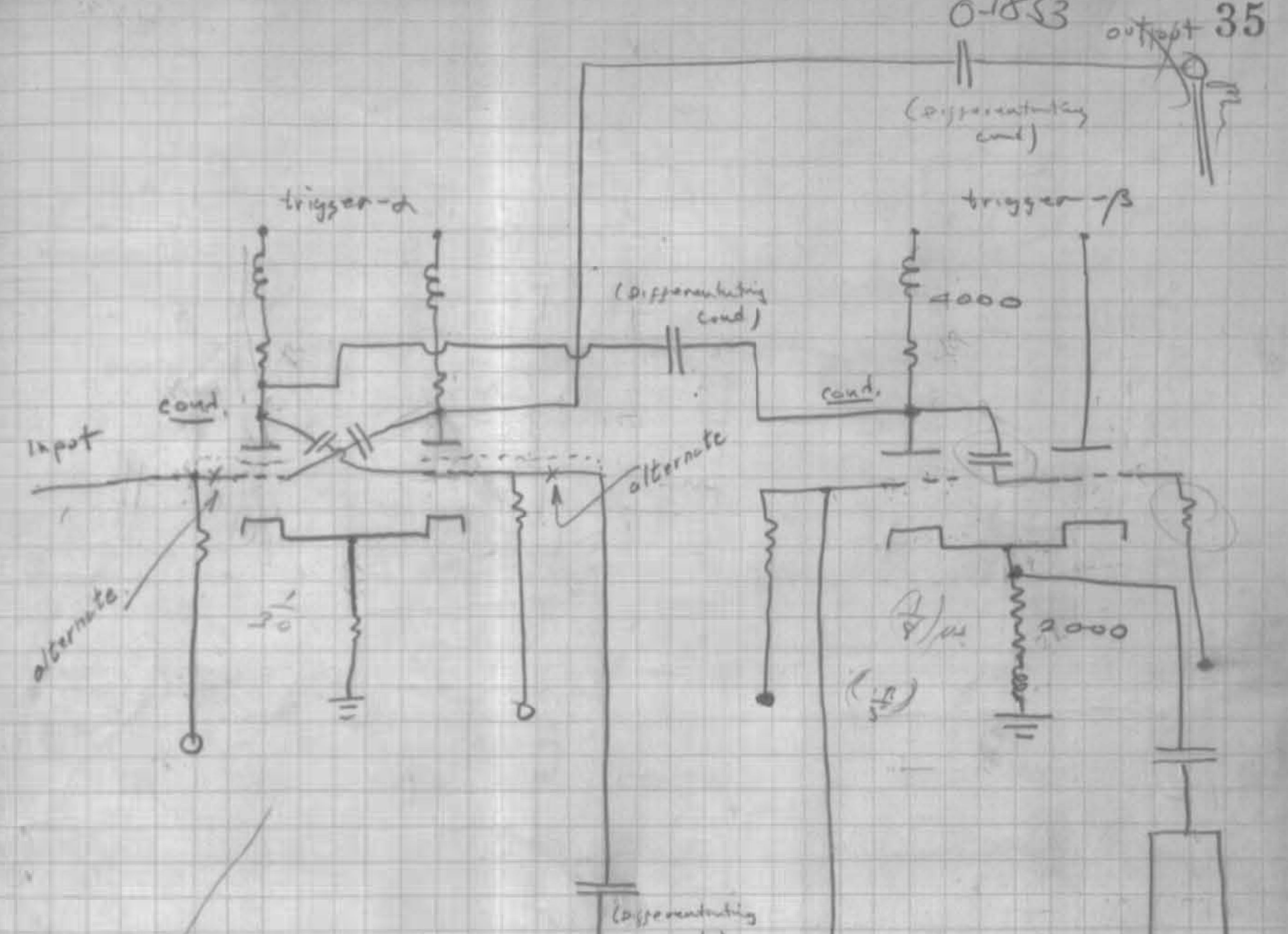
6SN7GT $\frac{2600}{26^*} = \boxed{10 \text{ gpmx.}}$

(90)(6 μs)

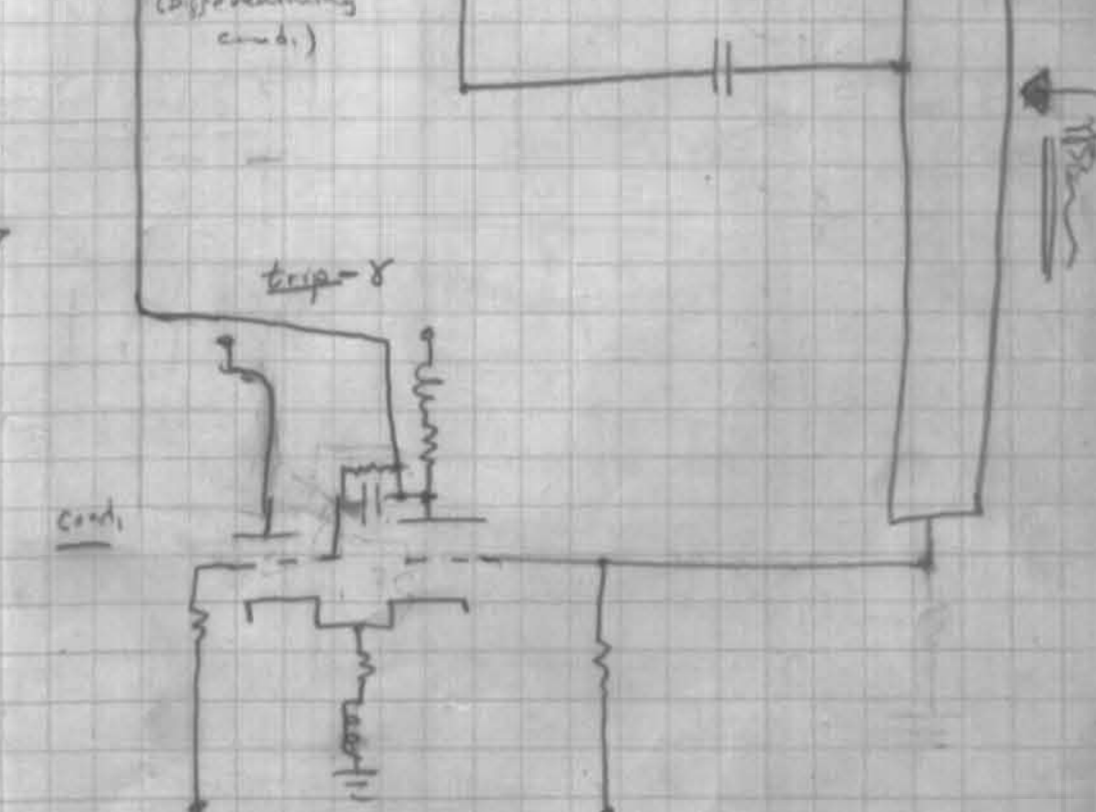
volt / μs



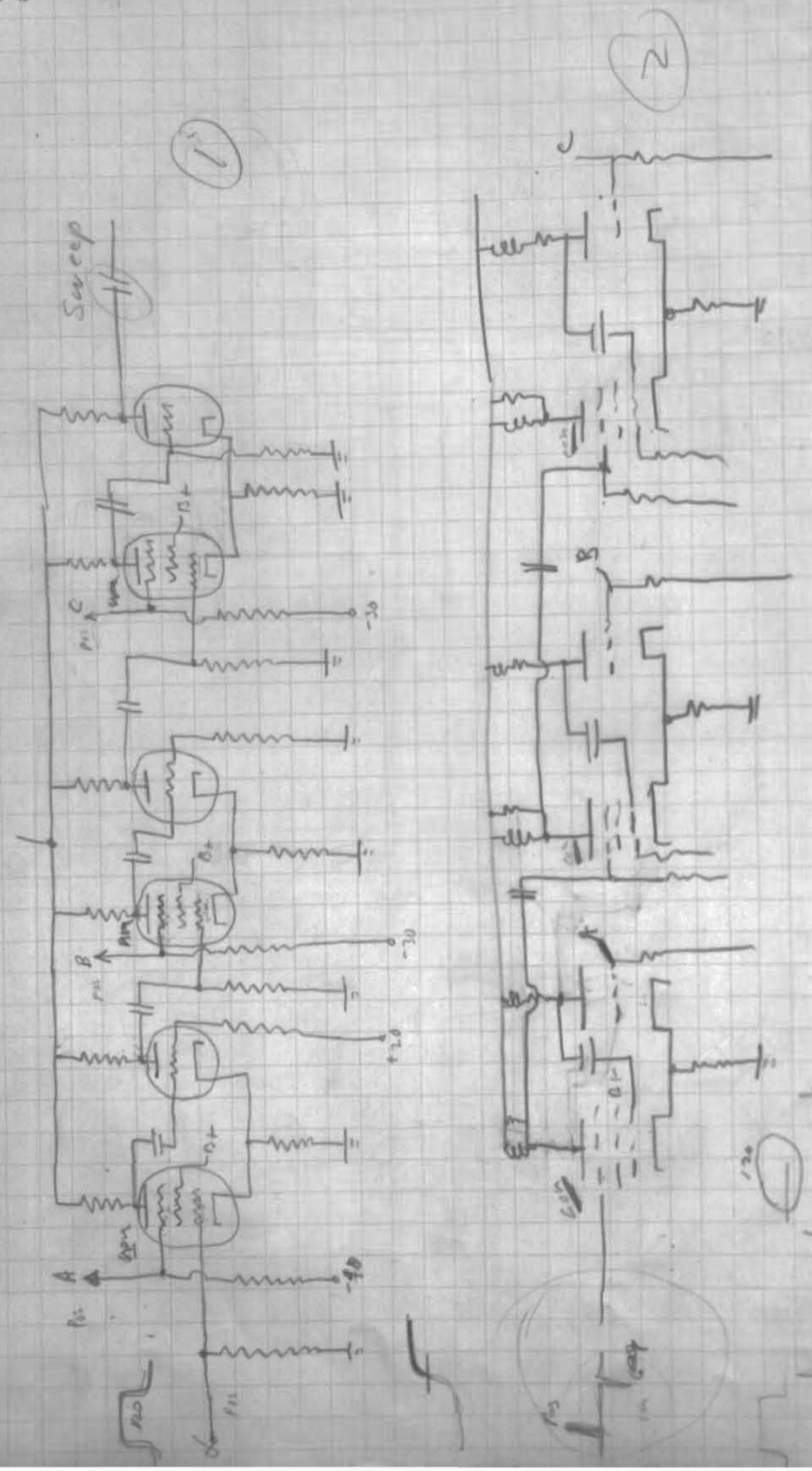


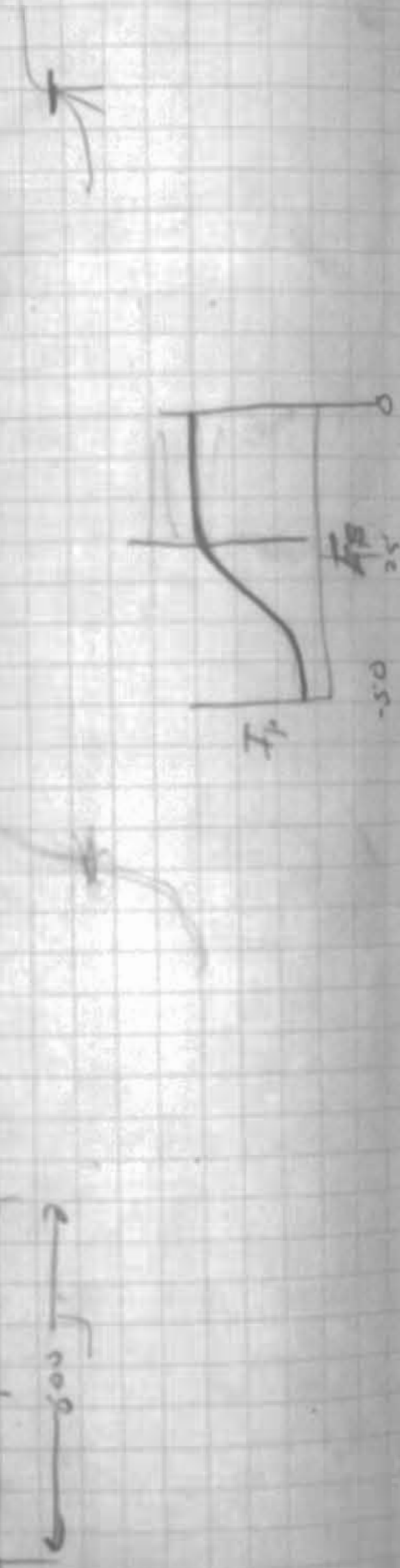


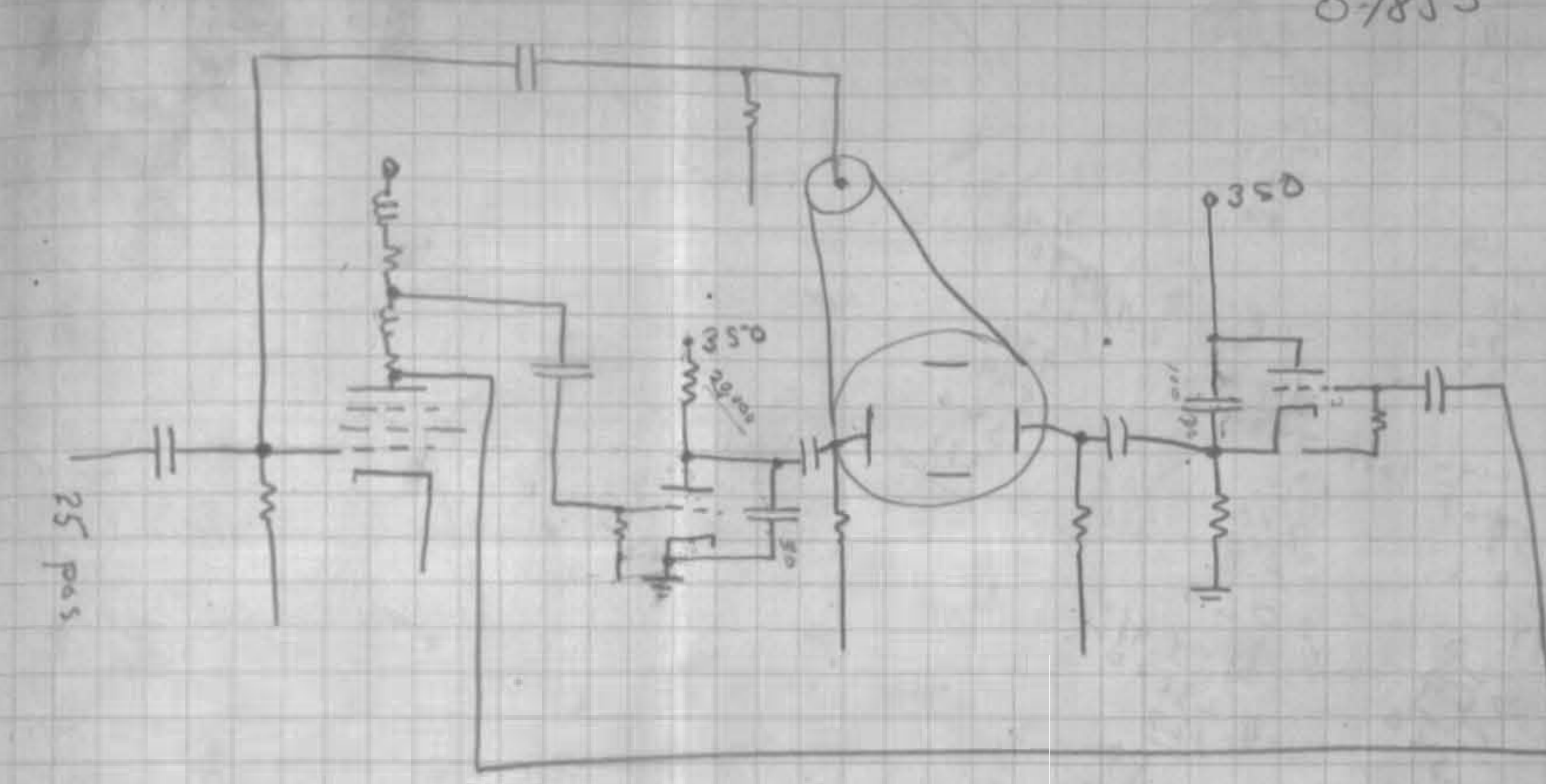
{ trigger α has sufficient gain so that input pulses introduced directly into the output are negligible & so that }
it only trip on neg pulses.

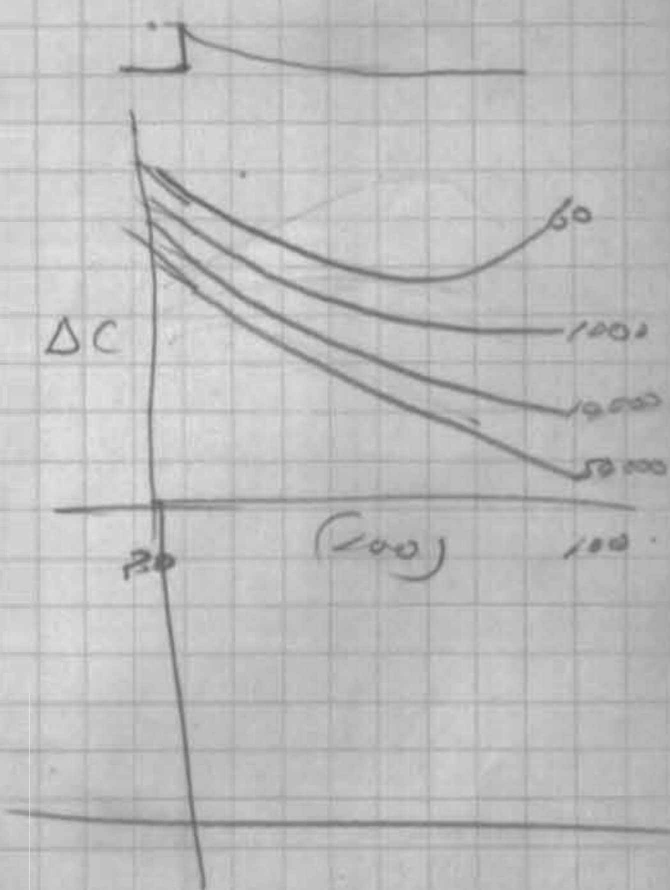


0/854

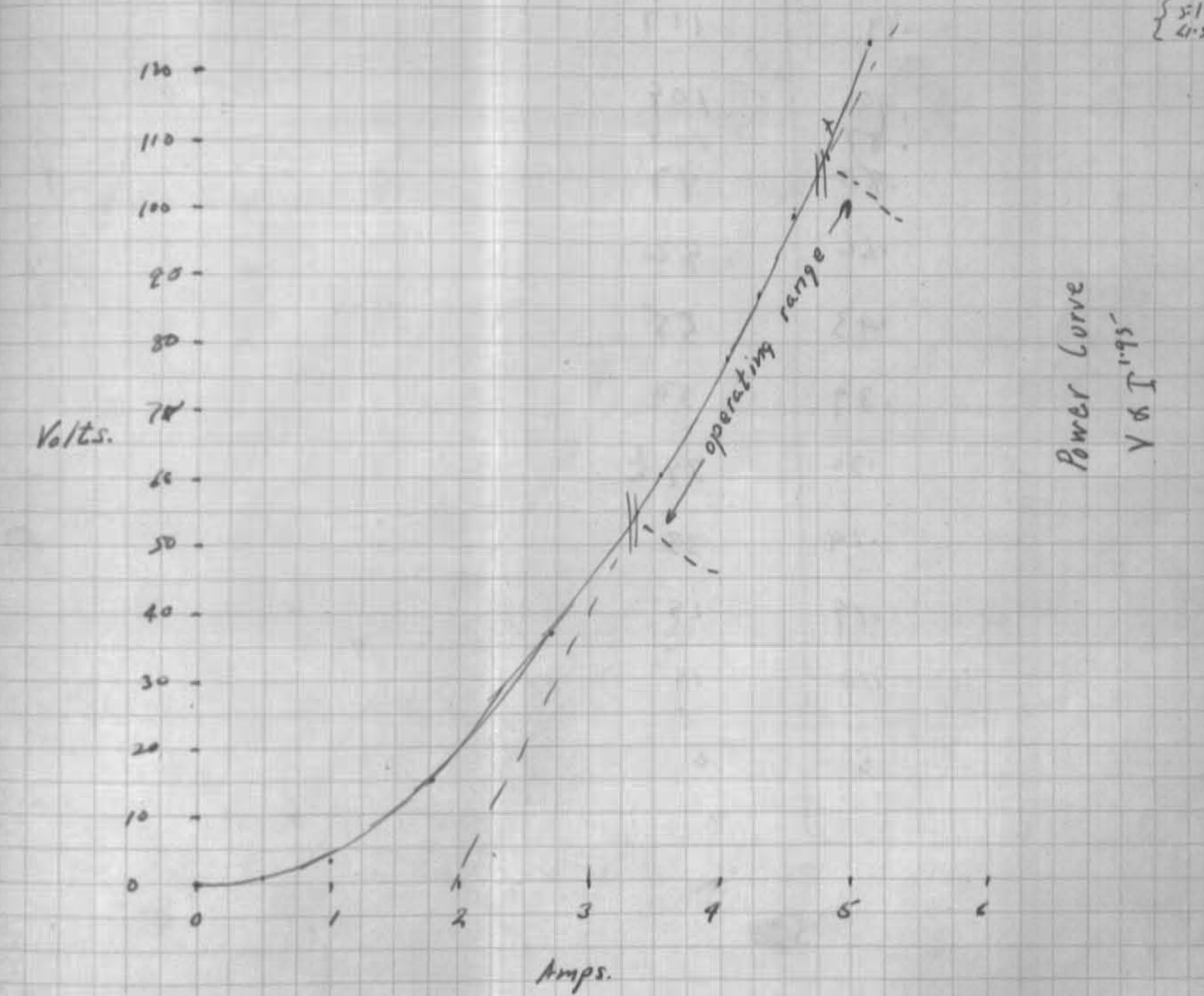








Voltage Current Characteristic of two 300 watt Mazda lamps in parallel.



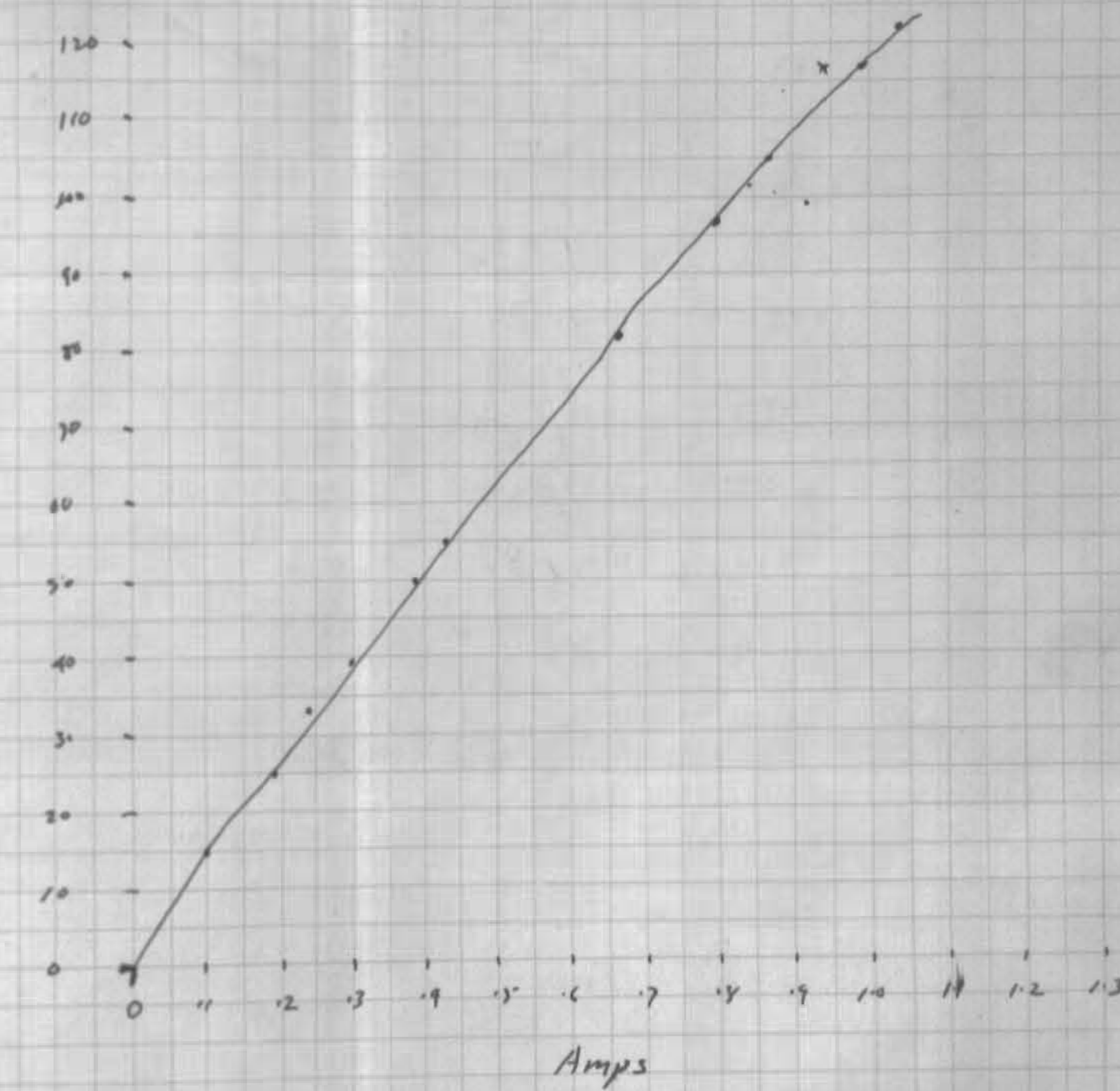
Wattage	— 300	150	100	75	15
2 Current	— 4.70 3.30	2.36 1.67	1.57 1.11	1.20 .88	— 2.46×10^{-1} 1.67×10^{-1}
Voltage	— 105 55	105 55	105 53	105 55	105 53
	Ratio = 1.43	1.41	1.43	1.37	1.46

 Carbon lamp – 120 watts – 120 volts.

A	E
1.04	122
.99	117
.90	109
.87	105
.80	97
.66	82
.43	55
.39	50
.30	39 ½
.29	33
.19	25
.10	15
0	0

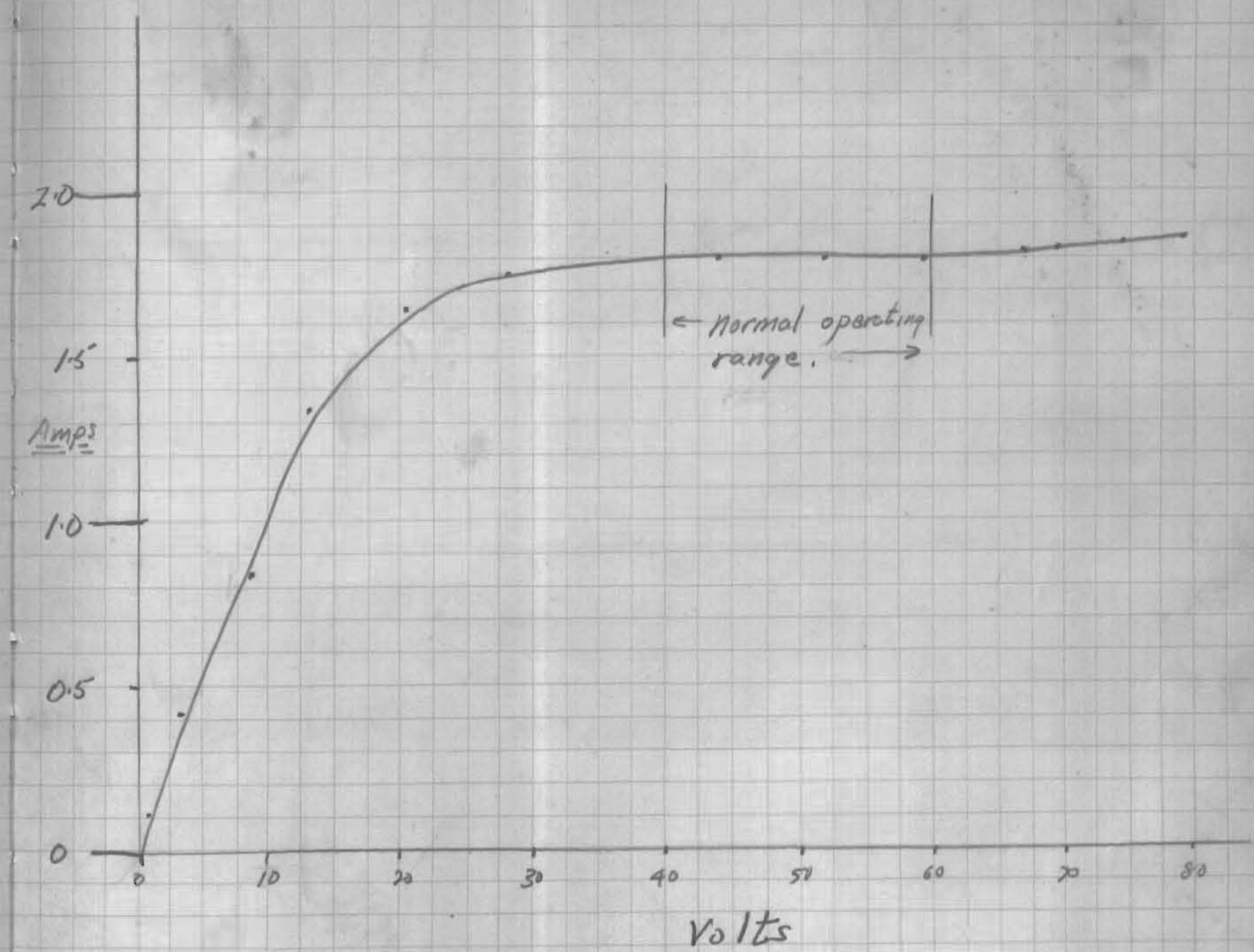
Ratio = $\frac{.87}{.43}$ = 2.05

120 W. – 120 volt – carbon lamp.



RCA 876 Regulator

A	V
.11	1
.42	3.5
.84	7.0
1.36	13.0
1.65	20.5
1.76	28.4
1.80	44.0
1.80	52
1.80	59.7
1.81	64.3
1.82	66.5
1.84	72.0
1.87	79.0



H+R - 2-876

2 -

5.50 net.

RCA - type 876 - regulator

886 -

$2\frac{1}{2}$ Watt Argon $I_{lamp} = 25$ ma.

1. W/out partition $I = 3.20$ μa
2. Aperature only $I = 2.28$ μa
3. polaroid $I = .037$ μa.
4. lens only $I = 3.$ μa.
5. lens & Polaroid $I = .052$ μa

Neon 2 watt. I lamp = 20 ma.

1. W/out partition $I = .22$
2. aperature only $I = .08$
3. polaroid $I = .030$
4. lens only $I = .12$
5. lens & Polaroid $I = .033$

---

with 200 Watt bulb 23 volts ~~20~~ volts ~~was~~ were read on the Voltohmmeter. (23 μa.)
Supply voltage = 275 v.
Spacing between bulb & cell = 5 ft.
Saturation point of photocell is 25.6 μa.
16" away from source the output is 20. μa.

Crater lamp lamp current = 50 ma.

1. W/out partition $I = 1.2$ μa.
2. aperature only $I = .88$ μa
3. poloroid $I = .16$ μa.
4. lens only $I = 1.85$ μa
5. lens & Poloroid $I = .25$ μa.

Neon lamp 1 watt 110 v (Edison base) $I_{lamp} = 20$ ma.

1. W/out partition — $I = .11$ μa
2. aperature only — $I = .05$ μa
3. poloroid — $I = .0125$ μa
4. lens only $I = .11$ μa.
5. lens & Poloroid $I = .033$ μa.

Small neon – twisted elements $I_{lamp} = 5$ ma.

1. W/out partition — $I = .063$ μa.
2. aperature only $I = .03$ μa.
3. Poloroid $I = .006$ μa.
4. lens only $I = .054$ μa.
5. lens & Poloroid $I = .013$ μa.

Sharpless — *1) Lumped parameter lines report
2) Alternate range systems.
3) Distributed Lines translations. (any time)

Vince — *1) Range System report + diagram.
2) Range system itself.

Joe — 1) Lines - distributed lines. oscillograms - etc.
2) Test video amplifiers.

Parker — 1) Video amplifiers - regular
2) Better Video amplifier.

Rosen (also stock room) — 1) Analizer - follow ups.
2) Range system. (both regular and alternate)

Pres — 1) study junk
2) Equation solver.
3) or analytic solutions of the ∫'s.

Mauchly — 1) PZ-3 - 4. (consult on range)
2) Range systems - (Regular + alternate)
3) Equations for trigger circuits.
4) Report on equations for trigger circuit

Chambers — Run. PA - general consultation on PL.

Brainerd — Chief

0·1865

$$Z = \sqrt{\frac{L'}{C}}$$

$C\ 2.2K^2 = L'$

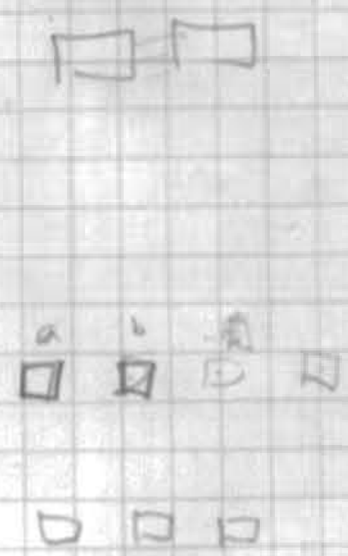
$(20)(4.84) = 968$

$$\begin{array}{r} 277 \\ 36\overline{)1000} \\ \underline{72} \\ 280 \\ \underline{252} \\ 280 \end{array}$$

$L = 70.3\ \mu h$

$$L' = L + \frac{1}{4}L + \frac{1}{12}L + \frac{1}{36}L + \frac{1}{108}L + \frac{1}{324}L$$

$$\begin{array}{r} = \quad .250 \\ + \quad .087 \\ .028 \\ .009 \\ .003 \\ \underline{.001} \\ 1.378 \end{array}$$

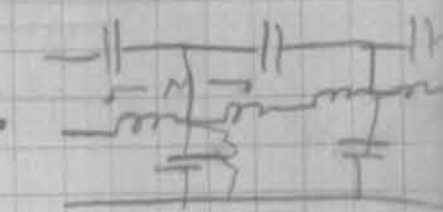


Experiments de Lines.

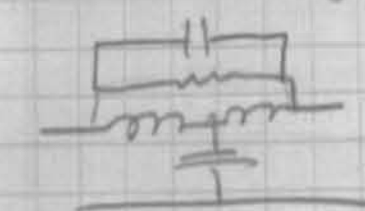
α)

1) a) Set up adjustable Line — mutual only
b) " " " " — Mutual + Cap
c) " " " " — Mutual + Res.
d) " " " " — Mutual + Cap + Res

2) As above except (a + c)
a) with cap different →
b) with Res to gnd.



3) ~~As above~~
a) → above circuit res. only (dif mutuals)



b) above circuit ~~res~~ + Cap.

(4) Repeat 3) → with [illegible] above with

β) Repeat all of above with continuous mutual —

(γ) Repeat (β) with mutuals opposed. (var. comp.)

(δ) — Repeat (β) + (γ) — with iron cores — (specialized mutual)

(3) — Set up ordinary line as [illegible]

0-1867

Expenses. – Boston –

	12.60	Fair
	12.60	Fair
3.15	~~2.95~~	berth
1.89	~~1.98~~	chair
	.55	break
	.55	lunch
	.50	cab.
	.10	tip
	.40	cab.
	.10	– tip
	.25	– tip – pulmann
	1.50	Dinner
	.15	tip
	total	$34.23

To Boston + Return – 30.13

Meals, taxis + tips – 4.10

Total $34.23

General trans. near phila.

Vince –	.53	– trolley car.
Abe –	.15	– " " .
Pres	.30	" " .
"	.56	Walker Bros.
Nelson	.56	" " .
1 Notebook	.10	" " .
Total	$2.20	

[48¢ from above goes to vince]

Keys – .53
Carfair .15

23 Coils – $4.28

Carfair – $ .30

Chedaker – Note-book + Lines. (Video Report)

Parker – Line.

Vince – Video Amplifier.

Brainerd – Part List.

12.60
12.60
25.20
6.30
31.50
9.00
40.50
.24
40.74

40.74
34.23
6.51

51.58
34.80
16.78

27.88
13.61
14.27

25.20

Profit
4.74
16.78
6.51
13.79
4.00

11.45
.57
12.02

293
2.20

Dr. Doolittle - resistor data -

Draft card -

Frank. Int. Card -

P.C. Recorder -

Stephens - exam

Rademacher - exam

Shohat - problem - mun.

Swann - problem - exam.

Field Exciter - 150 mill choke (look up)

Inventory.

Paper - Sims.

French translation - Lines.

Delux. Video.

Nelson - Attenuator.

Gunner - estimate - anti-hunt circuit

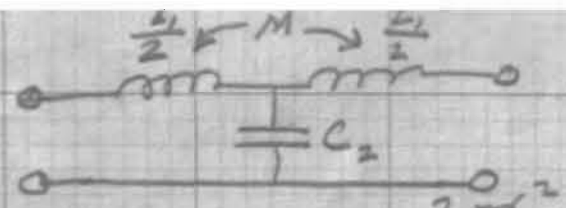
B. Sheppard - adress - 489 First Ave. Apt - 4 C (no phone)

Patent - motor control -

Charge Barrett - 1807
8 ft - 4 cond. rubber cov. cable.
2 DPDT Sw.
1 DPST Sw.
1 6.3 trans.

Gather up own transformers

Delay Filter.



$\alpha = \omega\sqrt{L_1C_1}$	α^2	$2-\alpha^2$	$2T\alpha^2$	$2+2T\alpha^2$	$\frac{2-\alpha^2}{2+2T\alpha^2}$	$\cos^{-1}\left[\frac{2-\alpha^2}{2+2T\alpha^2}\right]$	$\frac{1}{\alpha}\cos^{-1}\left[\frac{2-\alpha^2}{2+2T\alpha^2}\right] = \frac{T}{\sqrt{L_1C_1}}$
0	0	2	0.0	2	1	—	—
.2	.04	1.96	.008	2.008	.9761	.219	1.095
.4	.16	1.84	.032	2.032	.9055	.438	1.095
.6	.36	1.64	.072	2.072	.7915	.657	1.095
.8	.64	1.36	.128	2.128	.6391	.877	1.096
1.0	1.00	1.00	.200	2.200	.4545	1.099	1.099
1.2	1.44	.56	.288	2.288	.2448	1.323	1.10
1.4	1.96	.04	.392	2.392	.0167	1.587	1.13
1.6	2.56	−.56	.512	2.512	−.2229	1.796	1.12
1.8	3.24	−1.24	.648	2.648	−.4683	2.058	1.14
2.0	4.00	−2.00	.800	2.800	−.7143	2.366	1.18
2.2	4.84	−2.84	.968	2.968	−.9569	2.847	1.29
2.4	5.76	−3.76	1.152	3.152	−1.193	—	—
2.6	6.76	−4.76	1.352	3.352	—	—	—
2.8	7.84	−5.84	1.568	3.568	—	—	—
3.0	9.00	−7.00	1.800	3.800	—	—	—
0	0	2	0	2.000	1.0000	0	—
.2	.04	1.96	0.0160	2.0160	.9722	.236	1.180
.4	.16	1.84	*0.064	2.064	.8915	.470	1.175
.6	.36	1.64	0.144	2.144	.7649	.700	1.167
.8	.64	1.36	0.256	2.256	.6028	.924	1.155
1.0	1.00	1.00	0.400	2.400	.4167	1.141	1.141
1.2	1.44	.56	0.576	2.576	.2174	1.352	1.127
1.4	1.96	.04	0.784	2.784	.01437	1.585	1.132
1.6	2.56	−.56	1.024	3.024	−.1852	1.757	1.098
1.8	3.24	−1.24	1.296	3.296	−.3762	1.957	1.087
2.0	4.00	−2.00	1.600	3.600	−.5556	2.160	1.080
2.2	4.84	−2.84	1.936	3.936	−.7215	2.377	1.084
2.4	5.76	−3.76	2.304	4.304	−.8736	2.633	1.097
2.6	6.76	−4.76	2.704	4.704	−1.0119	—	—
2.8	7.84	−5.84	3.136	5.136	−1.1373	—	—
3.0	9.00	−7.00	3.600	5.600	−1.2500	—	—
0	0	2	0	2.000	1.0000	0	—
.2	.04	1.96	.024	2.024	0.9689	.252	1.260
.4	.16	1.84	.096	2.096	0.8779	.499	1.248
.6	.36	1.64	.216	2.216	0.7401	.737	1.228
.8	.64	1.36	.384	2.384	0.5705	.964	1.205
1.0	1.00	1.00	.600	2.600	0.3846	1.176	1.176
1.2	1.44	.56	.864	2.864	0.1955	1.374	1.145
1.4	1.96	.04	1.176	3.176	0.0126	1.558	1.113
1.6	2.56	−.56	1.536	3.536	−0.1584	1.730	1.081
1.8	3.24	−1.24	1.944	3.944	−0.3144	1.891	1.051
2.0	4.00	−2.00	2.400	4.400	−0.4595	2.043	1.022
2.2	4.84	−2.84	2.904	4.904	−0.5791	2.188	.995
2.4	5.76	−3.76	3.456	5.456	−0.6891	2.331	.971
2.6	6.76	−4.76	4.056	6.056	−0.7860	2.475	.952
2.8	7.84	−5.84	4.704	6.704	−0.8711	2.628	.939
3.0	9.00	−7.00	5.400	7.400	−0.9459	2.811	.937
0	0	2	0.0	2.000	1	0	—
.2	.04	1.96	.012	2.012	.9741	.228	1.140
.4	.16	1.84	.048	2.048	.8984	.455	1.138
.6	.36	1.64	.108	2.108	.7780	.679	1.132
.8	.64	1.36	.192	2.192	.6204	.901	1.126
1.0	1.00	1.00	.300	2.300	.4348	1.121	1.121
1.2	1.44	.56	.432	2.432	.2303	1.338	1.115
1.4	1.96	.04	.588	2.588	.01546	1.555	1.111
1.6	2.56	−.56	.768	2.768	−.2023	1.775	1.109
1.8	3.24	−1.24	.972	2.972	−.4172	2.001	1.112
2.0	4.00	−2.00	1.200	3.200	−.6250	2.246	1.123
2.2	4.84	−2.84	1.452	3.452	−.8227	2.537	1.153
2.4	5.76	−3.76	1.728	3.728	−1.009	—	—
2.6	6.76	−4.76	2.028	4.028	—	—	—
2.8	7.84	−5.84	2.352	4.352	—	—	—
3.0	9.00	−7.00	2.700	4.700	—	—	—
T=0.5 0	0	2	0	2.000	1.000	0	—
.2	.04	1.96	.04	2.040	.9608	.281	1.405
.4	.16	1.84	.16	2.160	.8519	.651	1.378
.6	.36	1.64	.36	2.360	.6949	.802	1.337
.8	.64	1.36	.64	2.640	.5152	1.030	1.288
1.0	1.00	1.00	1.00	3.000	.3333	1.231	1.231
1.2	1.44	.56	1.44	3.440	.1628	1.407	1.173
1.4	1.96	.04	1.96	3.960	.0101	1.561	1.115
1.6	2.56	−.56	2.56	4.560	−.1228	1.694	1.059
1.8	3.24	−1.24	3.24	5.240	−.2366	1.809	1.005
2.0	4.00	−2.00	4.00	6.000	−.3333	1.911	.956
2.2	4.84	−2.84	4.84	6.840	−.4152	1.999	.909
2.4	5.76	−3.76	5.76	7.760	−.4845	2.077	.865
2.6	6.76	−4.76	6.76	8.760	−.5434	2.145	.825
2.8	7.84	−5.84	7.84	9.840	−.5935	2.206	.788
3.0	9.00	−7.00	9.00	11.00	−.6364	2.211	.737

For T = 0.10

For T = 0.20

For T = 0.30

For T = 0.15

T = 0.0

$\frac{2-\alpha^2}{2}$	$\cos^{-1}\frac{2-\alpha^2}{2}$	$\frac{1}{\alpha}\cos^{-1}\frac{2-\alpha^2}{2}$
1	0	~~1.000~~
.98	.2	1.000
.92	.403	1.008
.82	.609	1.015
.68	.823	1.029
.50	1.047	1.047
.28	1.287	1.073
.02	1.551	1.108
−.28	1.855	1.159
−.62	2.240	1.244
−1.00	3.142	1.571
−1.42	—	—
−1.88	—	—
−2.38	—	—
−2.92	—	—
−3.50	—	—

$$\mathcal{D}_0 = \sqrt{1+2T}$$

T = 0.18

α	α^2	$2-\alpha^2$	$2T\alpha^2$	$2+2T\alpha^2$	$\frac{2-\alpha^2}{2+2T\alpha^2}$	$\cos^{-1}\frac{2-\alpha^2}{2+2T\alpha^2}$	$\frac{T}{\sqrt{L_1C_1}}$
		2	0	2	1	0	1.17
		1.96	.0144	2.0144	.974	.227	1.15
		1.84	.0576	2.0576	.896	.459	1.15
		1.64	.1296	2.1296	.771	.687	1.15
		1.36	.2304	2.23	.610	.915	1.14
		1.00	.36	2.36	.424	1.119	1.12
		.56	.519	2.519	.222	1.359	1.13
		.04	.706	2.706	.015	1.568	1.12
		−.56	.922	2.922	−.192	1.764	1.10
		−1.24	1.17	3.17	−.392	1.973	1.10
		−2.00	1.44	3.44	−.582	2.192	1.10
		−2.84	1.74	3.74	−.759	2.434	1.10
		−3.76	2.08	4.08	−.921	2.755	1.15
		−4.76	2.44	4.49	—		