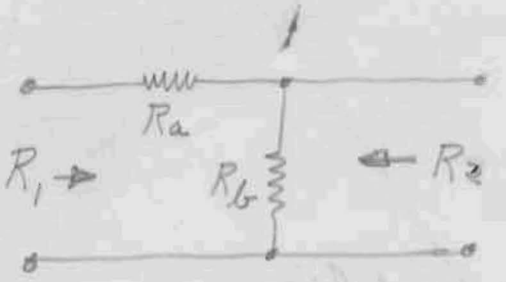
2nd April 61

L Pads as Matching Devices



$R_a = \left[R_1(R_1 - R_2)\right]^{1/2}$

$R_b = R_1 R_2 / R_a$

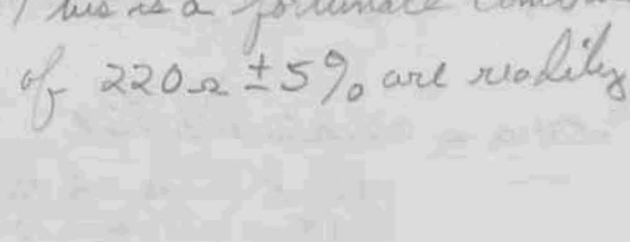
$m = R_1/R_2$ $\quad \alpha = (m^2 - m)^{1/2} + 1$ $\quad R_1 = R_a\left(\frac{R_b}{R_a} + 1\right)^{1/2}$

$\alpha = \frac{\text{load current without the attenuator}}{\text{load current with the attenuator}}$ $\quad R_2 = \frac{R_a R_b}{R_1}$

Let: $R_1 = 620$, $R_2 = 310$, $m = 2$

Then: $R_a = 438$, $R_b = 438$, $\alpha = 2.414 = 7.66$ DB

If pad is to be symetrical with center grounded we have:



This is a fortunate combination as carbon resistors of 220Ω ±5% are readily available as commercial item.

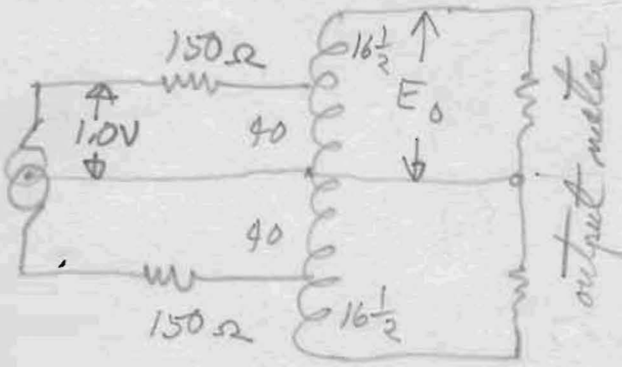
also: $\alpha = \frac{R_1}{R_b} + 1 = \frac{R_a}{R_2} + 1$

(over)

15/6/62

Test of Line transformer

MC	E_0	Loss DB
0.6	.615	
1.0	.591	
1.6	.550	2.2
2.2	.496	3.1
2.8	.429	4.3
3.5	.361	
5.0	.224	
.4	.619	1.2
.3	.608	
.2	.595	
.15	.564	
.10	.465	



Theoretical maximum $E_0 = 0.707V$

With 8" leads on 300 Ω terminals the natural frequency is 2.05 mc

$16\frac{1}{2}$ turns winding .056" wire
40 turns " .032" "

Winding 3.9" dia, 4.7" long, l/d = 1.21 n = 113, L/l = 195 L = 760 (computed)
This is medium frequency coil of 21/8/61
Resonates at 1.35 mc with 11.9 pf external capacity.
C_0 = 9.4 pf L_0 = 655 μh measured.

Test of Line Transformer Revised 15/6/62

2nd Version

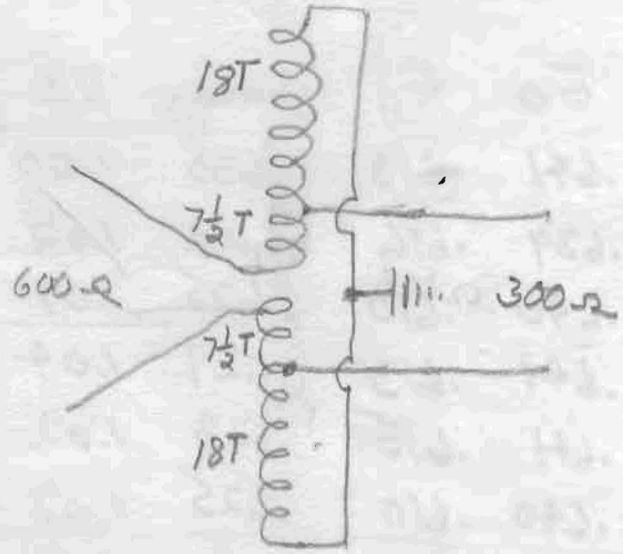
MC	Average E_0	DB Loss	MC	E_0	E_0	Average	DB	Percent Difference $E_0 - E_0$
0.6	.588		1.6	.641	.618	.630	1.00	3.7
1.0	.625		1.7	.639	.616	.628	1.02	3.7
1.6	.630		1.8	.640	.610	.625	1.07	4.8
2.2	.627		1.9	.641	.613	.627	1.04	4.5
2.8	.630		2.0	.641	.615	.628	1.02	4.1
3.5	.611		2.1	.640	.610	.625	1.07	4.8
5.0	.630		2.2	.639	.609	.624	1.08	4.8
7.0	.518		2.3	.638	.610	.624	1.08	4.5
10.0	.451		2.4	.638	.606	.622	1.12	5.1
15.0	.220		2.5	.637	.606	.623	1.10	5.0
.4	.539		2.6	.640	.610	.625	1.07	4.8
.3	.495		2.7	.638	.612	.625	1.07	4.2
.2	.378		2.8	.639	.616	.628	1.02	3.7
.15	.290		2.9	The load had an unbalance of about				
.10	.170		3.0	3% which caused most of above.				

Measured natural resonance at 2.41 mc with 8" leads on 300Ω terminals

Theoretical maximum $E_0 = 0.707$

There is slightly greater loss (0.1 DB) and unbalance (1.4%) near resonance.
This resonance is desirable as it keeps powerfactor of transformer near unity.

(Details over)



Gap between 600Ω ends of winding $\frac{1}{16}$" wide filled with plastic tubing to reduce capacity.

$7\frac{1}{2}$ turn winding = .056 wire

18 turn winding = .032 wire.

Winding 3.9" dia, 2.25" long, $l/d = .576$, $n = 51$ turns

$L/d = 63$ $L = 246\ \mu h$

$$C_0 = 1/(6.28 \cdot 2.41 \cdot 10^6)^2\, 246 \cdot 10^{-6} = 10^{-12}/.229 \cdot .246 = 10^{-12}/.0562$$

$C_0 = 17.8$ pf effective

Transformer performance poor at less than 1.0 mc because inductance too low. Poor above 5.0 mc because capacity too high. The geometric center of range of best performance is near 2.3 mc.

5th Version   coil $1\frac{3}{8}$" long.

$4\frac{1}{2}$T, .056" plus 11T, .032" wire on each half.

Resonates at 1,855 mc with 53 pf shunt, & 3.65 mc free

MC	Volts	
~~0.4~~	~~.38~~	
0.6	.492	
1.0	.584	
1.6	.625	↑
1.8	.628	0.07 DB
2.0	.629	↓
2.2	.630	↑
2.4	.629	0.06 DB
2.6	.628	
2.8	.626	↓
3.5	.598	
5.0	.558	Very unbalanced.
7.0	.500	
10.0	.40	
0.4		

4th Version 18/6/62

Each half coil $5\frac{1}{2}$T, .056" plus 13T, .032" wire.
Coil $1\frac{11}{16}$" long.
f_0 = 3.15MC free & 1.79 MC with 39pf shunt across coil

MC	25pf Volts	60pf	shunt 39pf volts
0.6	.529		.538
1.0	.600		.600
1.6	.617	.631	.626
1.8	.618	.631	.626
2.0	.619	.629	.631
2.2	.622	.627	.628
2.4	.623	.626	.625
2.6	.622	.623	.628
2.8	.626	.620	.625
3.5	.612		.600
~~4.5~~	.620		.585

5th Version coil 1 3/8" long.

9 1/2 T. .056" plus 11 T. .032" wire on each half.

Resonates at 1.855 mc with 53 pf shunt, & 3.65 mc free

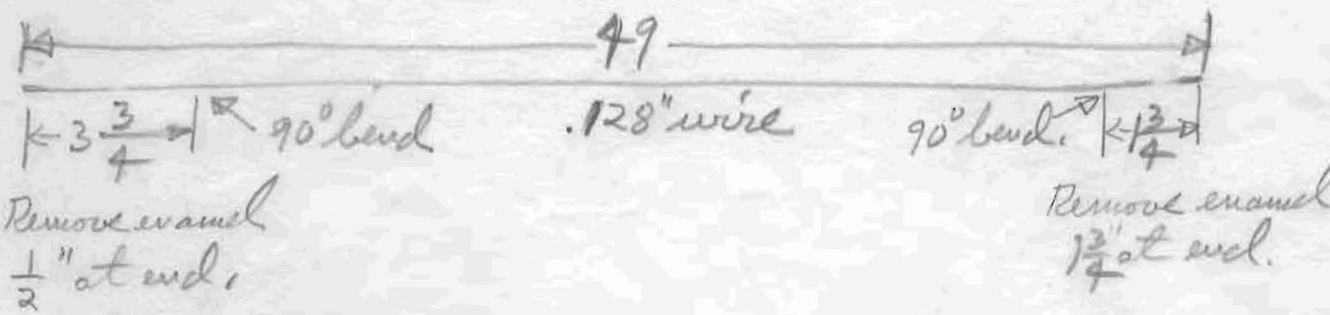
MC	Volts	
~~0.4~~	~~.38~~	
0.6	.492	
1.0	.584	
1.6	.625	↑
1.8	.628	0.07 DB
2.0	.629	↓
2.2	.630	↑
2.4	.629	0.06 DB
2.6	.628	
2.8	.626	↓
3.5	.598	
5.0	.558	Very unbalanced.
7.0	.500	
10.0	.40	
0.4		

16/6/62

Line Transformer Second Revision (3rd Version)

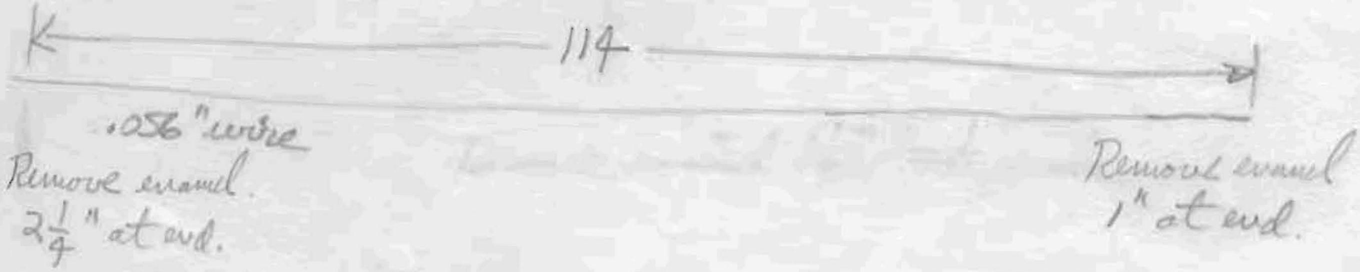
Outside coil $3\frac{1}{2}$ turns .128" wire. D = 4.0".
600Ω lead $3\frac{1}{2}$", 300Ω lead 2", $3\frac{1}{2}$ turns = 44"
Subtract $\frac{1}{8}$" at each bend & $\frac{1}{4}$" at center of coil

$-\frac{1}{4}+3\frac{3}{4}-\frac{1}{8}+44-\frac{1}{8}+1\frac{3}{4}=49$" total length.



Inside coil $8\frac{1}{2}$ turns .056" wire D = 3.93"
Wrapping lead $2\frac{1}{4}$", Center tap lead $6\frac{3}{4}$", $8\frac{1}{2}$ turns = 105"

$2\frac{1}{4}+105+6\frac{3}{4}=114$" total length.



$$C_0 = \frac{MC_0^2 C}{(MC_F^2 - MC_0^2)}$$

MC_0 = Resonance operating with external capacitor

MC_F = Resonance free

$$L = 1 / \omega^2 C$$

6th Version.

Each half $3\frac{1}{2}$T .056 plus $8\frac{1}{2}$T .032

Coil $1\frac{1}{8}$" long. Shunt capacity 77 pf.

Resonates at 1.96 MC with 77 pf.

Resonates at 4.52 MC free.

MC	Volts	
0.4	.270	
0.6	.400	
1.0	.552	
1.6	.620	↑
1.8	.628	0.15DB
2.0	.630	↓
2.2	.630	↑
2.4	.629	0.18DB
2.6	.626	↓
2.8	.617	
3.5	.579	
5.0	.491	
7.0	?	
10.0	.345	

18/6/62

2nd. Revised Transformer. or 3rd Version,

Each half = $3\frac{1}{2}$ turns .128" wire plus $8\frac{1}{2}$ turns .056" wire, Coil 2" long overall,

This version ~~turns too sharply and~~ is not appreciably more efficient than previous version,

$f_0 = 4.6$ mc free or 2.2 mc with 81.5 pf

$KC_0\omega_0^2 = 1 = K(C_0+81.5)\omega_1^2$, $C_0 4.6^2 = (C_0+81.5)2.2^2$

$(4.6^2-2.2^2)C_0 = 2.2^2 \cdot 81.5$, $C_0 = 395/(21.16-4.84) = 395/16.32 = 24.2$ pf

$L_0 = 1/\omega^2 C = 1/(6.28 \cdot 4.6 \cdot 10^6)^2 \cdot 24.2 \cdot 10^{-12} = 1/835 \cdot 24.2 = 10^{-6}/.0202 = 49.5$ μh

MC	Secondary Volts Free	Secondary Volts With 82 pf	DB loss With 82 pf	Volts With 82 pf
0.6	.285	.302		.295
1.0	.455	.495		.472
1.6	.565	.628	1.04	.600
1.8	.590	.646		.610
2.0	.598	.654		.619
2.2	.610	.660		.621
2.4	.620	.662	0.58	.625
2.6	.634	.650		.628
2.8	.634	.650	0.73	.622
3.5	.635	.600		.579
4.5	.652	.520		.516
7.0	.645	.410		

Balanced Load of 5% lower resistance

This transformer has about 10 to 15 percent imbalance which is reduced to about 8% with a balanced load.

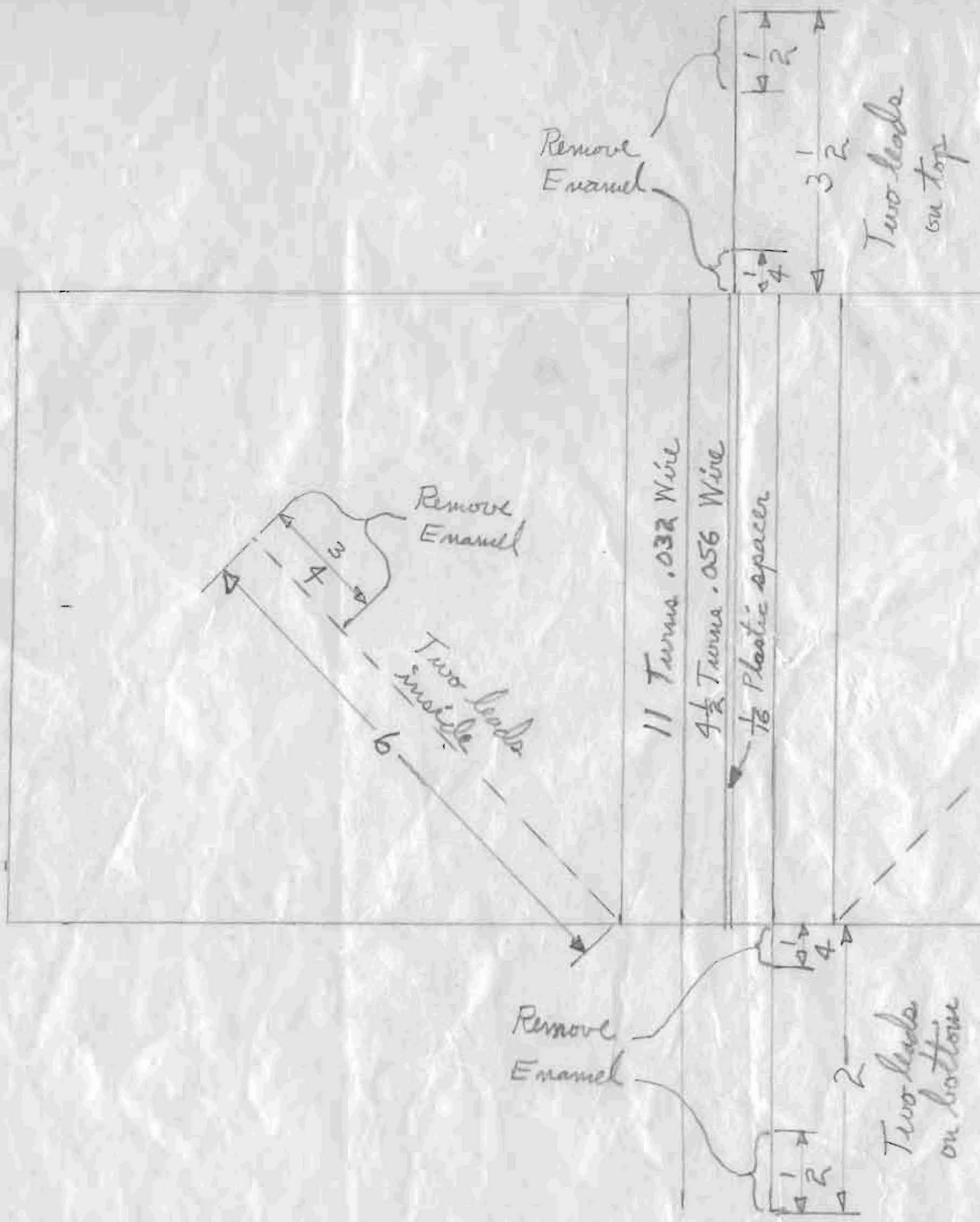
20/6/62

7th Version

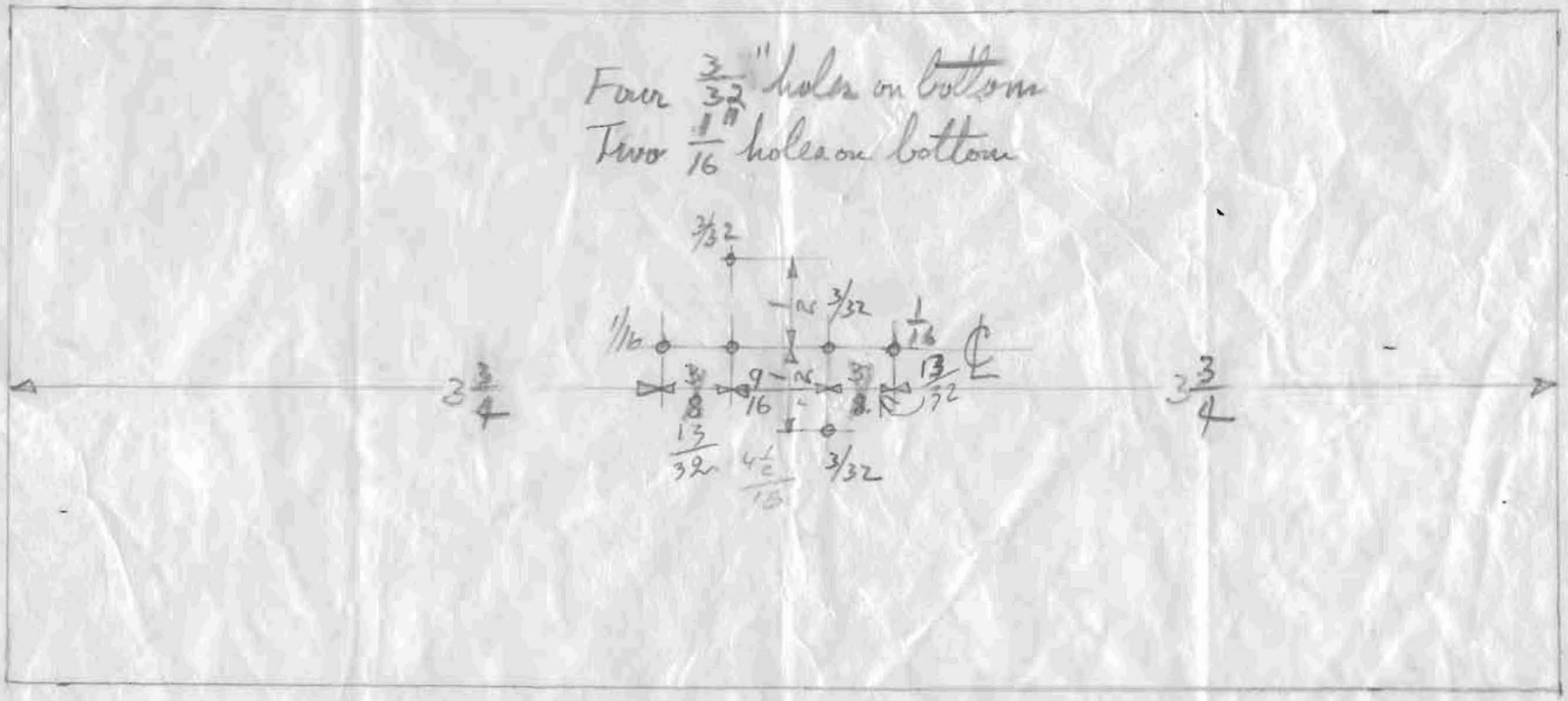
Each half coil $2\frac{1}{2}$ Turns .056" plus 6 turns, .032" wire
Coil 13/16" long

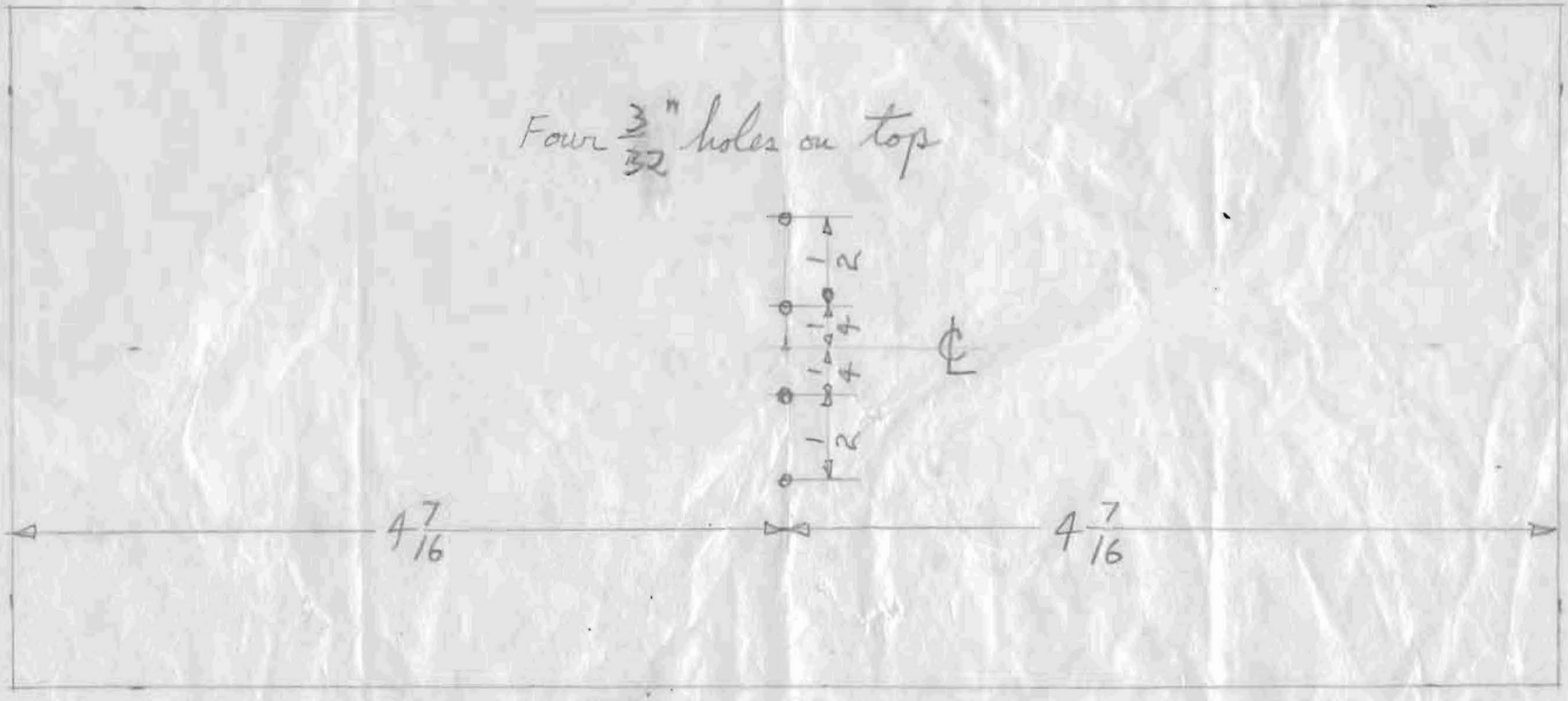
Resonates at 2.25 MC with 109 pf.
" " 6.12 MC free.

MC	Volts.			
0.6	.247			
1.0	.438			
1.6	.603	.592	.578	.585
1.8	.620	.616	.604	.610
2.0	.627	.626	.614	.622
2.2	.629	.629	.624	.629
2.4	.621	.624	.630	.630
2.6	.610	.614	.629	.628
2.8	.592	.602	.622	.619
3.0	.572	.585	.614	.607
3.5	very large .513	large capacity about 120 pf.	small about 100 pf	
5.0	.360			
7.0	?			
10.0	.190			

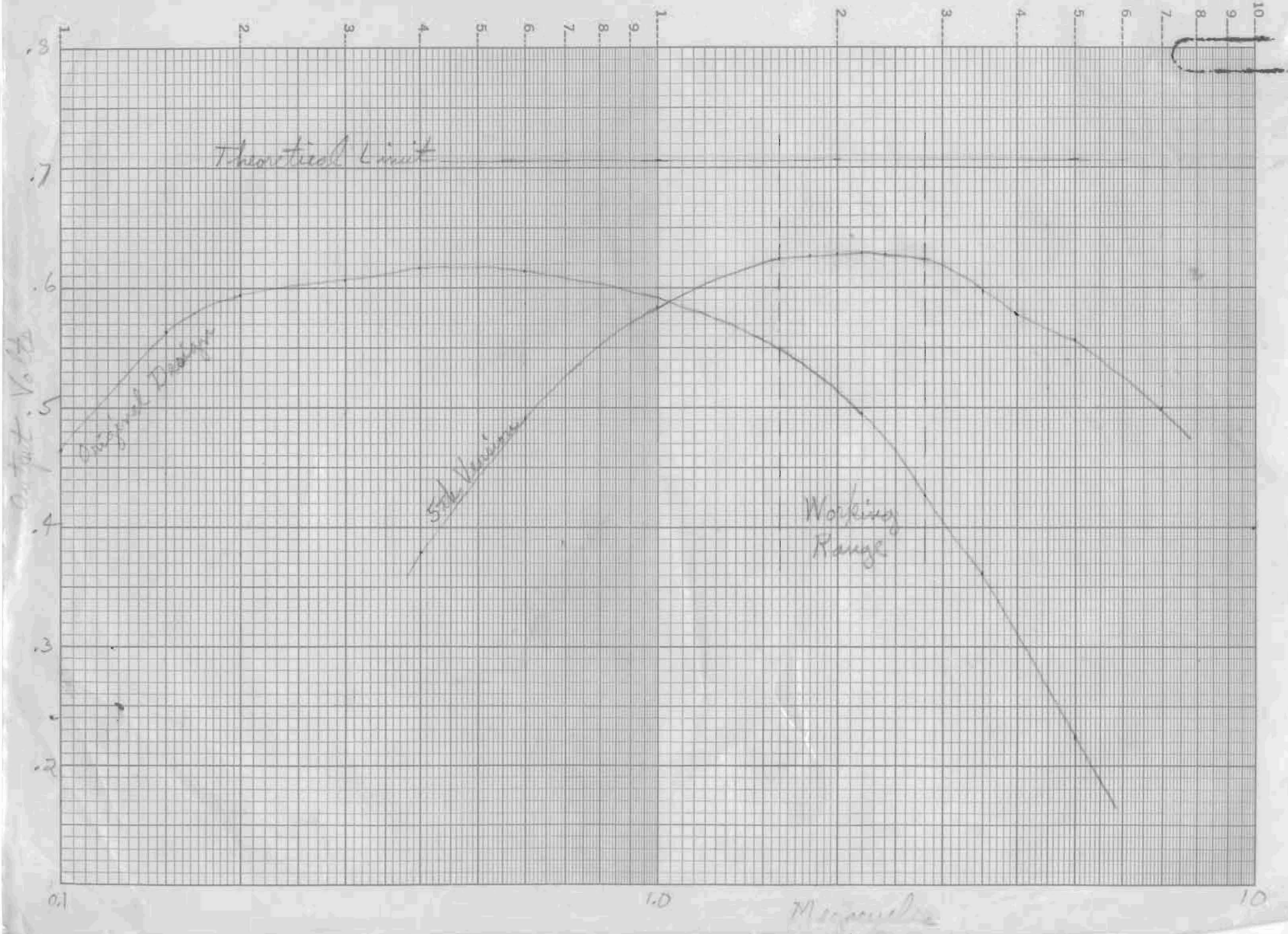


Make 15 with 2" leads
Make 17 with 5" leads
Complete job with cleaned ends of wire.

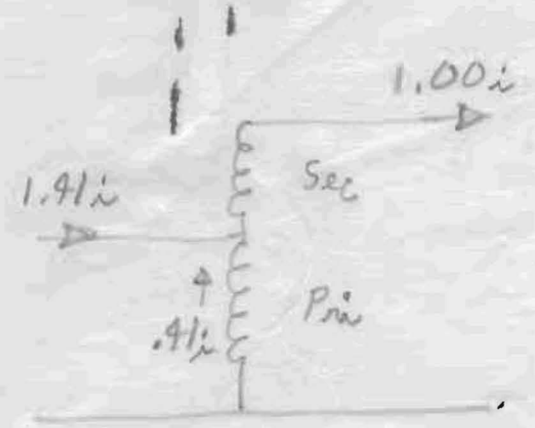

Four 3/32" holes on bottom
Two 1/16" holes on bottom
3/32
3/32
1/16
1/16
3 3/4
3 3/4
3/8
9/16
3/8
13/32
13/32
3/32
℄


Four 3/32" holes on top
1/2
1/4
1/4
1/2
℄
4 7/16
4 7/16

359-61 KEUFFEL & ESSER CO.
Semi-Logarithmic, 2 Cycles × 10 to the inch,
5th lines accented.
MADE IN U.S.A.



25/7/66



Secondary loss = Primary loss.

$1.00^2 R_S = .41^2 R_P$

$N_S = \frac{.293}{.707} = .414 N_P$

or $N_P = 2.42 N_S$

$R_S = \frac{N_S}{\ell_S} \qquad R_P = \frac{N_P}{\ell_P}$

$1.00 \frac{N_S}{\ell_S} = .17 \frac{N_P}{\ell_P}$

$1.00 \frac{N_S}{\ell_S} = .17 \frac{2.42 N_S}{\ell_P}$

$\frac{1.00}{\ell_S} = \frac{.41}{\ell_P}$

$\ell_P = .414 \ell_S$

Length of primary and secondary turns are equal

Length of primary and secondary windings are equal.

$N_S \ell_S = N_P \ell_P$

$N_P = 2.42 N_S$

$N_S \ell_S = 2.42 N_S \ell_P$

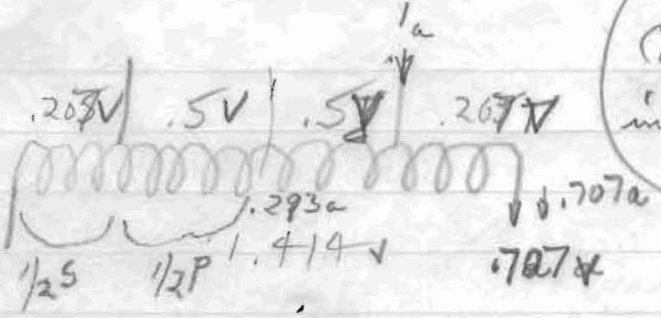
$\ell_P = .414 \ell_S$

Same result.

Link Transformer

3/8/64

Capacity of each insulator to can 4.1 pf.



$\frac{.5}{.207} = 2.42 : 1$ turns ratio $= \frac{n_p}{n_s}$

Make winding have equal loss in primary + secondary.

Loss $\propto I_p^2 R_p = I_s^2 R_s$

$R \propto$ (number of turns)/(wire diameter) $\propto n/d$

$R_p = R_s I_s^2 / I_p^2 = R_s \, .707^2 / .293^2 = 5.83 R_s$

$\frac{n_p}{d_p} = 5.83 \frac{n_s}{d_s}$ or $d_p = \frac{n_p}{n_s} \frac{d_s}{5.83} = 2.42 \frac{d_s}{5.83} =$

$d_p = d_s / 2.42 =$

When $d_s = .064''$, $d_p = .0265''$

Transformer Tester Calibration

25/7/63

MC	Correction	Input Volts.
14.6	+ 5.5% +1.5%	30.3
11.0	+ 4.5%	29.5
7.5	+ 3.0%	29.1
5.5	+ 2.0%	28.8
2.4	+ 0.5%	28.4
1.8	+ 0	28.3
.67	+ 0	28.3
.91	+ 0	28.3

Calibration.
at 50 cycles

about 14/8/64

Volts End to End RMS	Peak AC	Observed DC
0	0	0
2	1.4	1.1
5	3.5	3.2
10	7.	6.7
20	14	13.8
40	28	28

MC	Reference Volts
1.9	28.0
2.2	28.0
2.6	28.0
5.5	28.4
6.4	28.8
7.5	29.1

Time	Peak DC	40K ma	actual	obs
2	1.4	35	25	
5	3.5	87	80	
10	7.0	175	165	
20	14	350	340	
40	28	700	690	

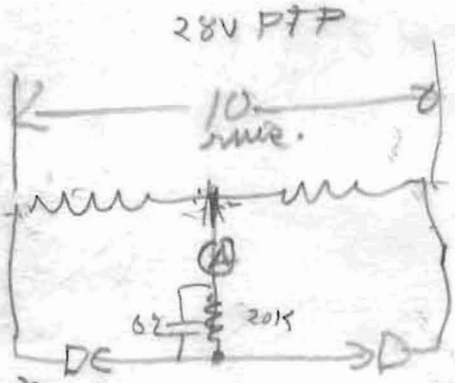
+ —▷

Red
Cathode

40KΩ
1 ma = 40V
.707
28V

707
40
28,280

.707
30
21210
21V



10K × 700
750/3 × 30K
10 × 7.10^6

$\frac{14}{20K}$ = .7 ma

$\frac{1.4}{.04M}$ = 35

.28 ma

$\frac{7.7\text{V peak}}{20K}$ = .35 ma

2828

70/1 × 30K = 2100K = 20K

.02 × 10

$\frac{1.4}{2}$ = 70

$2 \times 10^{-8} + 20 \times 10^{3}$

4×10^{-4}

$\frac{10^4}{4 \times 625}$ = 400 cps

415 Black.

5+12 Tan + Maroon

5+5 Tan + Black

1+27+29 Brown + Dark Brown

6+15 Brown

26 Orange + Black

Tan + Maroon seed

415	=	76
17	=	3
10	=	2
57	=	10
21	=	4
26	=	5
546 Total		

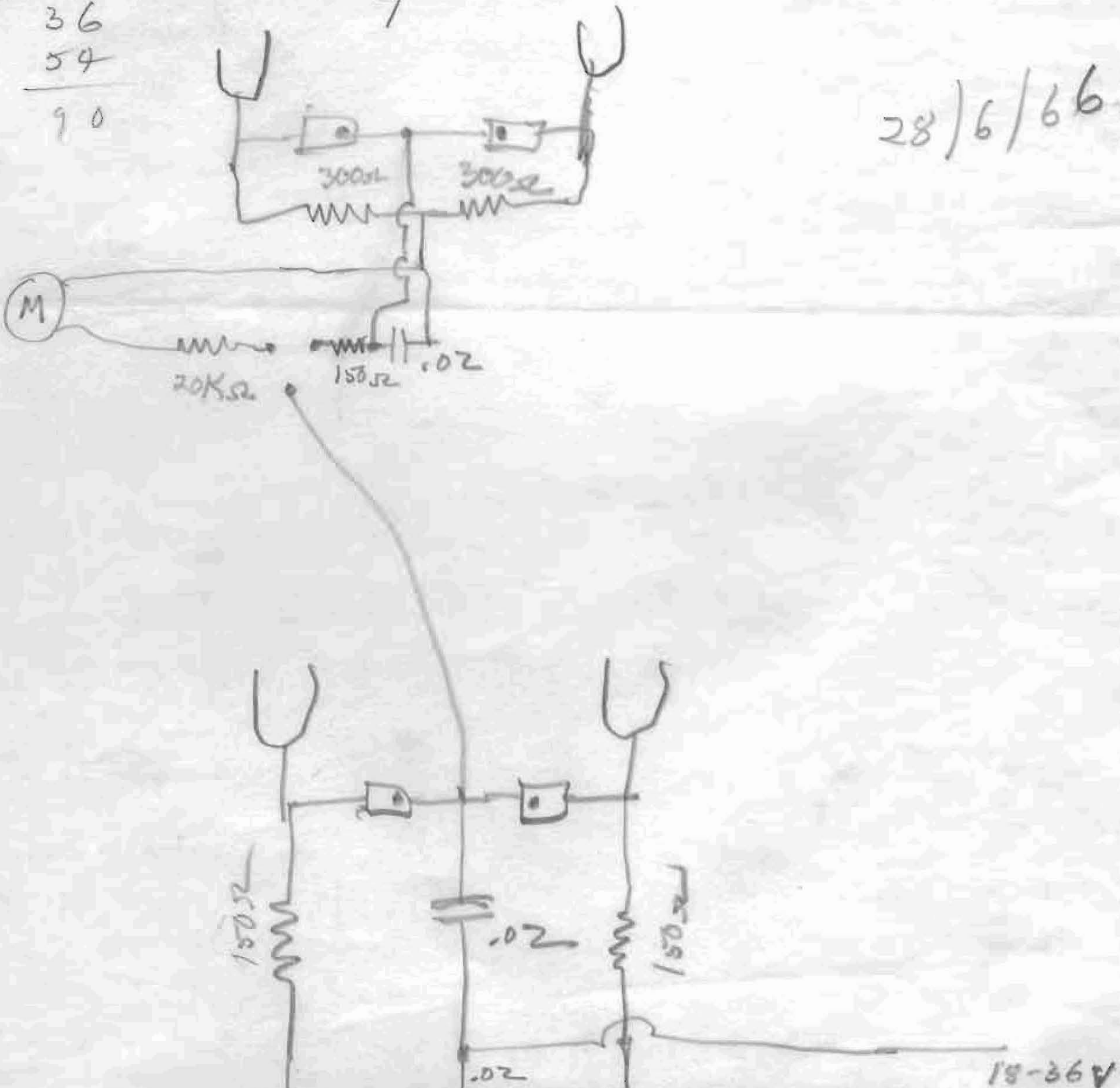
Tan + Maroon   Tan + Black.

36   7

54

90

28/6/66



Line Transformer Tester

14/8/64

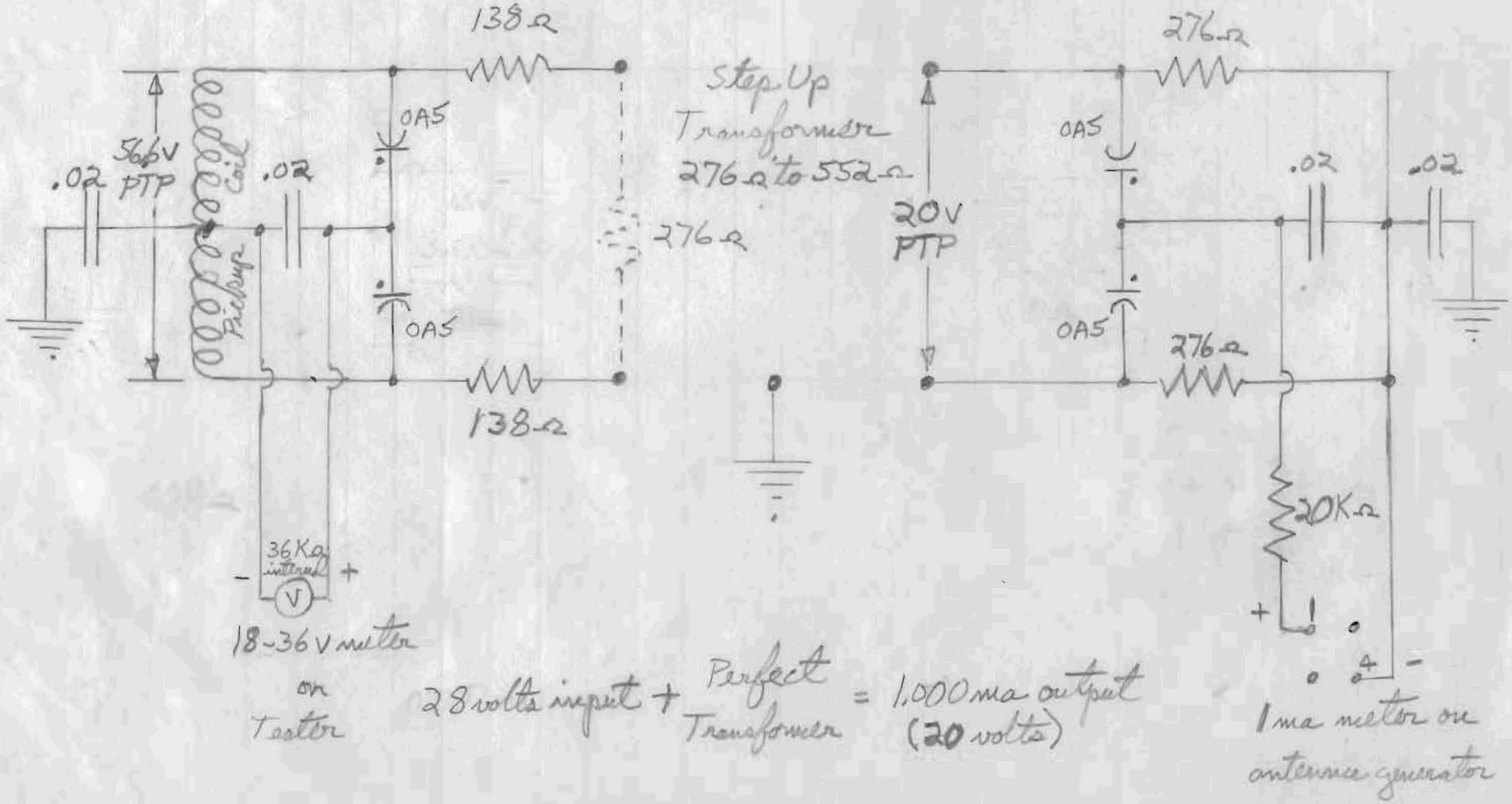
Pickup coil gives 20V RMS = 56.6V PTP. Power = $\frac{20^2}{552}$ = 0.73 watt

$\frac{56.6}{2}$ = 28.3 V peak at source

$\frac{28.3}{2}$ = 14.1V peak at transformer input

14.1 × 1.414 = 20V peak at load

$\frac{20V}{20K\Omega}$ = 1.00 ma standard.



28/6/66

Test Oscillator Coils

1.8 to 2.4 mc coil 36 turns .056" wire $3\frac{1}{16}$" dia $4\frac{3}{16}$" long.

$\frac{l}{d} = \frac{4.188}{3.063} = 1.37$, $n = 36$

From chart $\frac{L}{d} = 17.5$, $L = 17.5 \cdot 3.063 = 53.6$ microhenries.

New coil .70 to .93 mc

Required inductance $= \left(\frac{1.8}{.7}\right)^2 53.6 = 354$ microhenries.

let $l = 5"$; $d = 5\frac{3}{16}"$; $\frac{l}{d} = \frac{5}{5.188} = .964$, $\frac{L}{d} = \frac{354}{5.188} = 68.2$

From chart $n = 62$ turns. Wire $= \frac{5}{124} = .040"$ wire

Length of wire $= \frac{5.188 \pi 63}{12} = 84$ feet

Coils for Impedance Transformer Tester 28/8/64

Low Band				High Band.			
MC	pf	Q	R	MC	pf	Q	R
1.05	436	290	1.19	3.5	379	218	0.55
2.10	106	362	1.90	7	92.5	280	0.85

Low Band:

$C_0 = 4.0$ pf

$L_0 = 52.2$ μh measured

$R = 328\,MC/Q$

$l = 4.22''$, $d = 3.06''$
$l/d = 1.38$, $n = 36$
$L/d = 17.5$
$L = 53.5$ μh computed.

1/9/64 Dial reading 0.05 mc too high. Thus the coil is about 2.5% too many turns or 5% too much inductance. Try slipping turns out to lengthen coil.

High Band:

$C_0 = 3.0$ pf

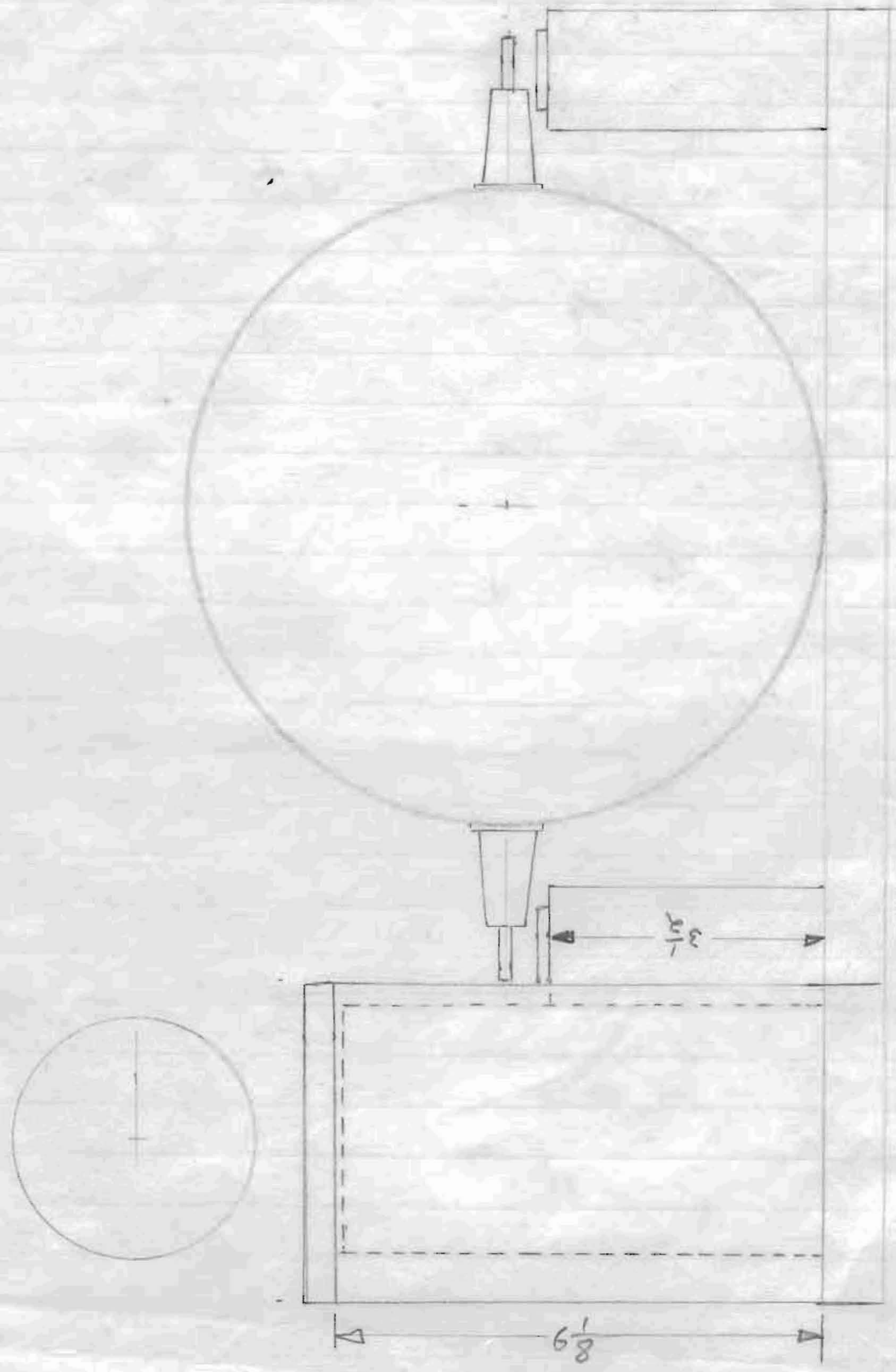
$L_0 = 5.4$ μh. measured

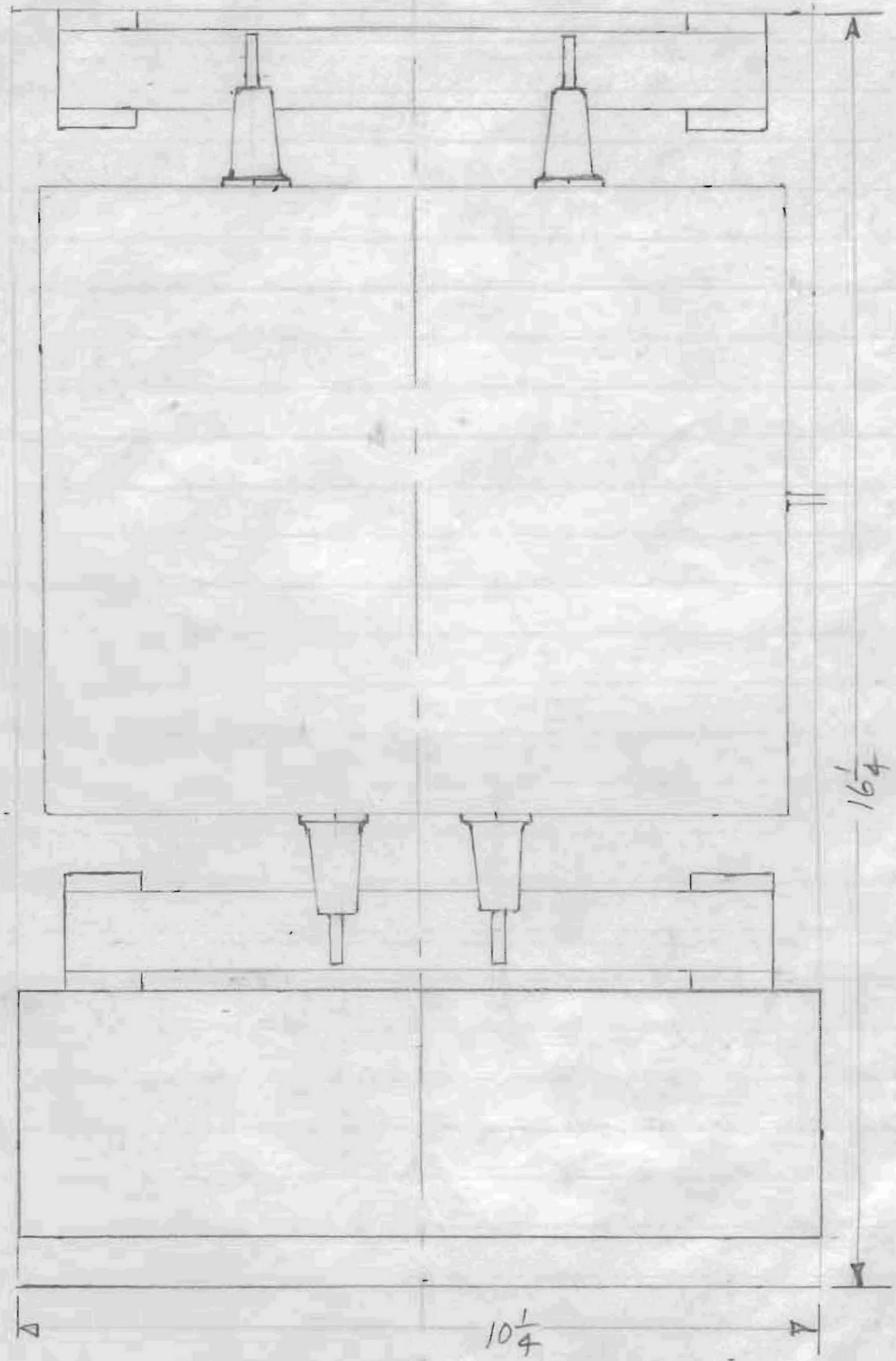
$R = 34\,MC/Q$

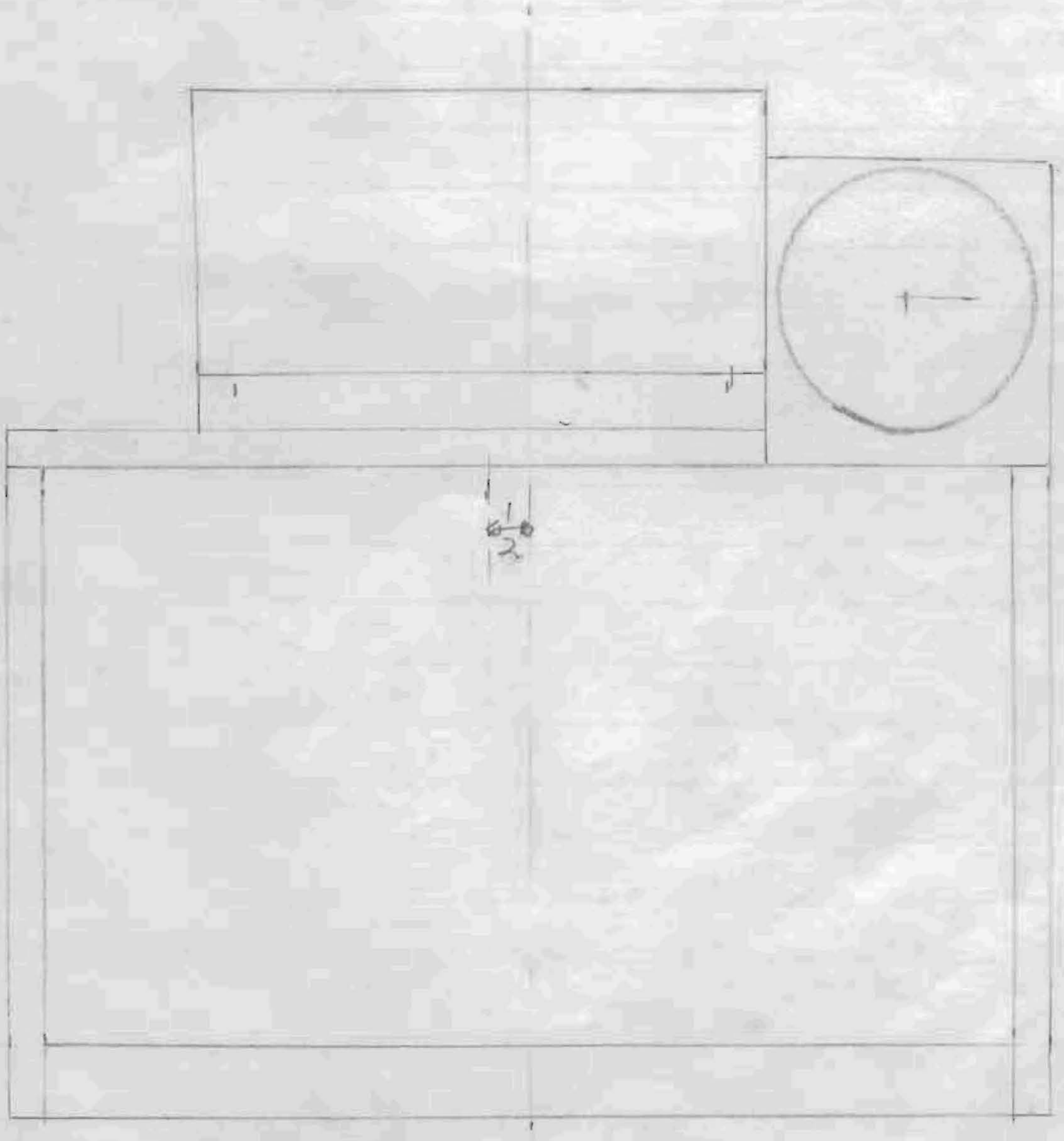
$l = 1.61''$, $d = 1.68$
$l/d = .96$, $n = 14$
$L/d = 3.4$
$L = 5.7$ μh computed.

7/9/64 Dial Reading
0.02 MC too low at 7.5 mc
Exact at 6.4 mc
0.02 MC too high at 5.5 mc
Slightly greater range is caused by slightly lower C_0 of this coil compared to the pair of toroid coils.

Each has 4 turn center tapped pickup coil at center of winding to provide energy at load.


6 1/8


16 1/4
10 1/4


1/2

Coil		J	K	L	M	N	O.	P
Can	Dia	8	Same as J with 64.3 pf across ends	8	Same as L with 118 pf across ends	8	Same as N with 277 pf across ends	Same as L with 75 pf across ends
	Length	9		9		9		
Form Dia		4		4		4		
Coil Length		1.2		0.88		.52		
½ Pri	Position	middle		middle		middle		
	Turns	8.5		6		3.5		
	Length	.3		.22		.13		
	Wire	.025		.025		.025		
½ Sec.	Position	end		end		end		
	Turns	3.5		2.5		1.5		
	Length	.3		.22		.13		
	Wire	.057		.057		.057		
C_0	Measured	13	—	10?	—	13	—	—
	Computed	8.02	4.1	8.54	1.9?	8.88	9.5	6.7
L_0, uh		76.7		43.7		18.3		
X_L at 2.1 mc		1010		576		241		
R_0	ohms	7.8, 10.5		3.0 5.5		2.4		
	MC	1.8 2.2		1.1 2.2		2.2		
f_0	~~Computed~~							
	Measured	6.42	2.20	8.25	2.20	12.5	2.20	6.40
MC		Output Voltage as Percent of Theoretical						
1.9		92.2	97.0	86.1	97.6	63.5	93.8	86.8
2.2		93.0	97.5	88.8	98.2	69.3	99.4	89.7
2.6		93.5	97.2	90.6	97.8	75.1	95.5	91.7
5.5		83.1	83.5	72.0	71.8	41.1	41.3	73.4
6.4		86.4	86.2	75.2	75.5	45.4	45.9	78.0
7.5		87.6	87.8	77.5	78.0	50.0	50.3	81.3
Date		18/9/64	18/9/64	21/9/64	21/9/64	21/9/64	21/9/64	22/9/64

Impedance Transformers. 276 to 552 ohms.

Coil		A	B	C	D	E	F	G	H	I
Can	Dia.	8	8	8	8	8		8		
	Length	9	9	9	9	9		9		
Form Dia.		4	4	4	4	4		4		
Coil Length		4.9	4.4	3.9	2.5	1.75		1.60		
½ Pri.	Position	end	middle	middle	middle	middle		middle		end
	Turns	32	31	25	16	13		11		
	Length	1,15	1.2	0.9	.63	.44		.45		
	Wire	.025	.025	,025	,025	,025		.025		
½ Sec.	Position	middle	end	end	end	end		end		middle
	Turns	13,5	13.5	10.5	6.5	5.5		4.5		
	Length	1,15	1.0	1.0	.63	.44		.35		
	Wire	.064	.057	.057	.057	.057		.057		
C_o, pf	Measured	18	10?	12	12	12	—	10?	—	15.3
	Computed	13,55	7.52	7,92	7.85	7.54	5.4	7.84	5.6	18.10+16.5
L_o, uh		412	480	351	187	148		111		106
X_{L_o} at 2.1 mc		5440	6320	4630	2470	1950		1460		1390
R_o ohms, MC		51, 1.1	37, 1.1	23, 1.0	12, 1.1 19, 1.72	10,6, 1.20 18.3, 1.93		10.1, 1.50 15.8, 2.20		16.1, 1.5 42.3, 7.1 ?
f_o	~~Computed~~	~~1,85~~	~~2,30~~	~~2,45~~	~~3.37~~	3.77				
	measured	2.13	2.65	3.02	4,16	4.77	2,20	5.40	2.20	3.64 1.91 mc
MC	Output Voltage as Percent of Theoretical									
1,9		78.5	81.5	88.6	93.2	93.9	95.9	93.6	96.1	97.0
2.2		76.5	78.5	87.3	92.8	93.8	95.8	93.8	96.2	97.4
2.6		72.0	74.5	85.2	92.0	93.2	95.6	93.5	96.2	97.1
5.5		60.0	47.0	66.2	83.0	84.7	85.5	85.9	86.1	87.6
6.4		57.0	42.0	63.2	83.5	86.2	86.8	87.8	88.2	88.3
7.5		50.0	37.0	58.0	81.8	85.8	86.0	87.8	88.2	88.1
Date		16/9/64	16/9/64	16/9/64	16/9/64	16/9/64	17/9/64	17/9/64	17/9/64	21/9/64

F: Same as E with 30.0 pf across ends.

Performance of E was checked & found same.

H: Same as G with 41.7 pf across ends.

I: Standard Type Used at Bothwell.

I (output voltage): with 49 pf across ends

Measured C_o much too high because of unbalanced manner transformer must be connected to Q machine.

Center point disconnected from can when C_o, L_o, R_o measured on Q machine. f_o measured by grid dip meter. It is same with or without center point connected to can.
Computed C_o based on measured L_o and f_o. The current distributes differently when no external capacity. Correct values of C_o are probably in range 4.4 to 5.6 pf.

9 July 1966

More tests were made on some transformers. A new coil 0.67 to 0.91 mc was constructed. Examination of coil 5.5 to 7.5 mc disclosed the two halves of pickup winding were in parallel instead of series. This seems to be reason four turns were necessary.

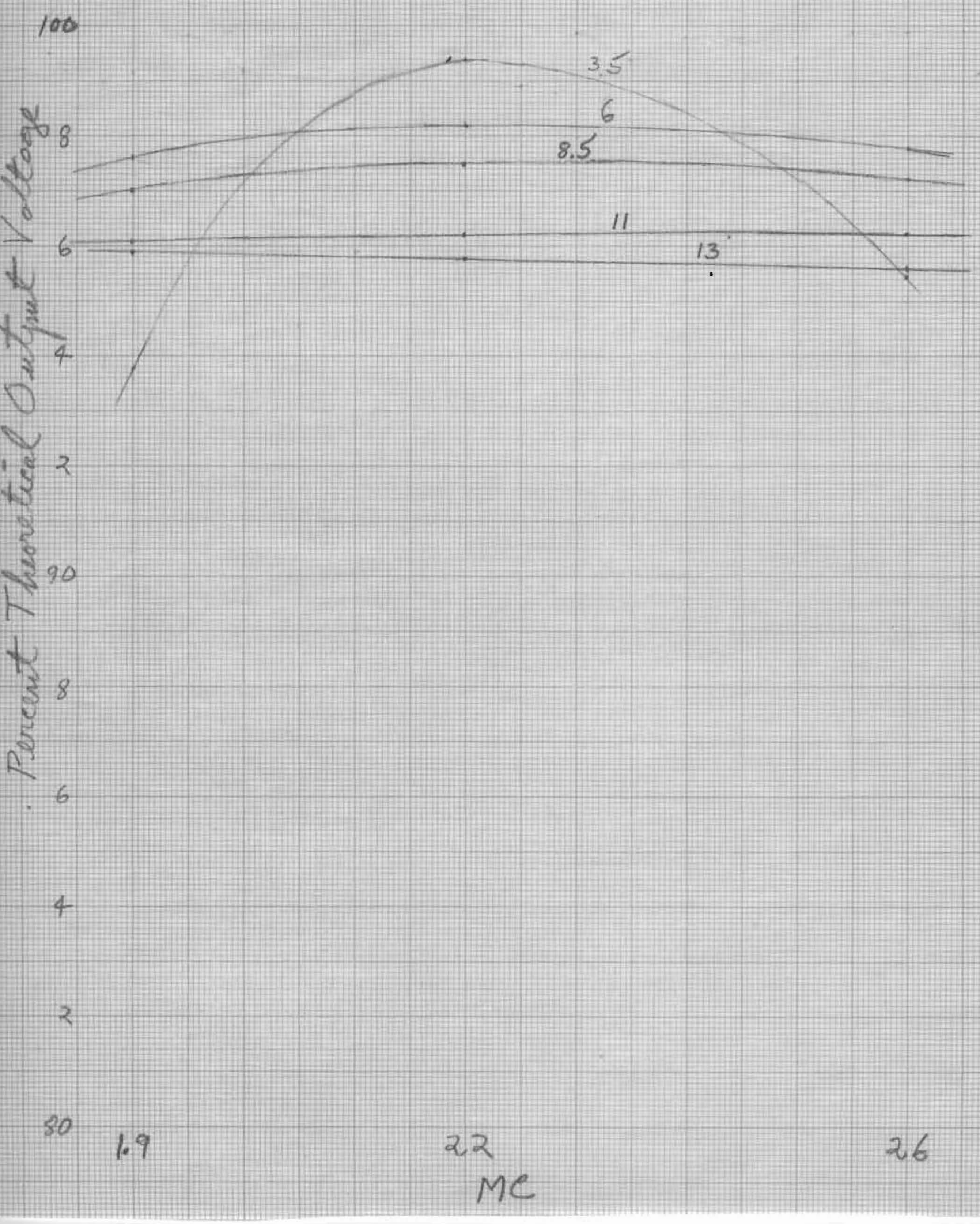
In view of this deficiency of test equipment, all the data of 16/9/64 to 22/9/64 over range 5.5 mc to 7.5 mc all invalid and probably too low.

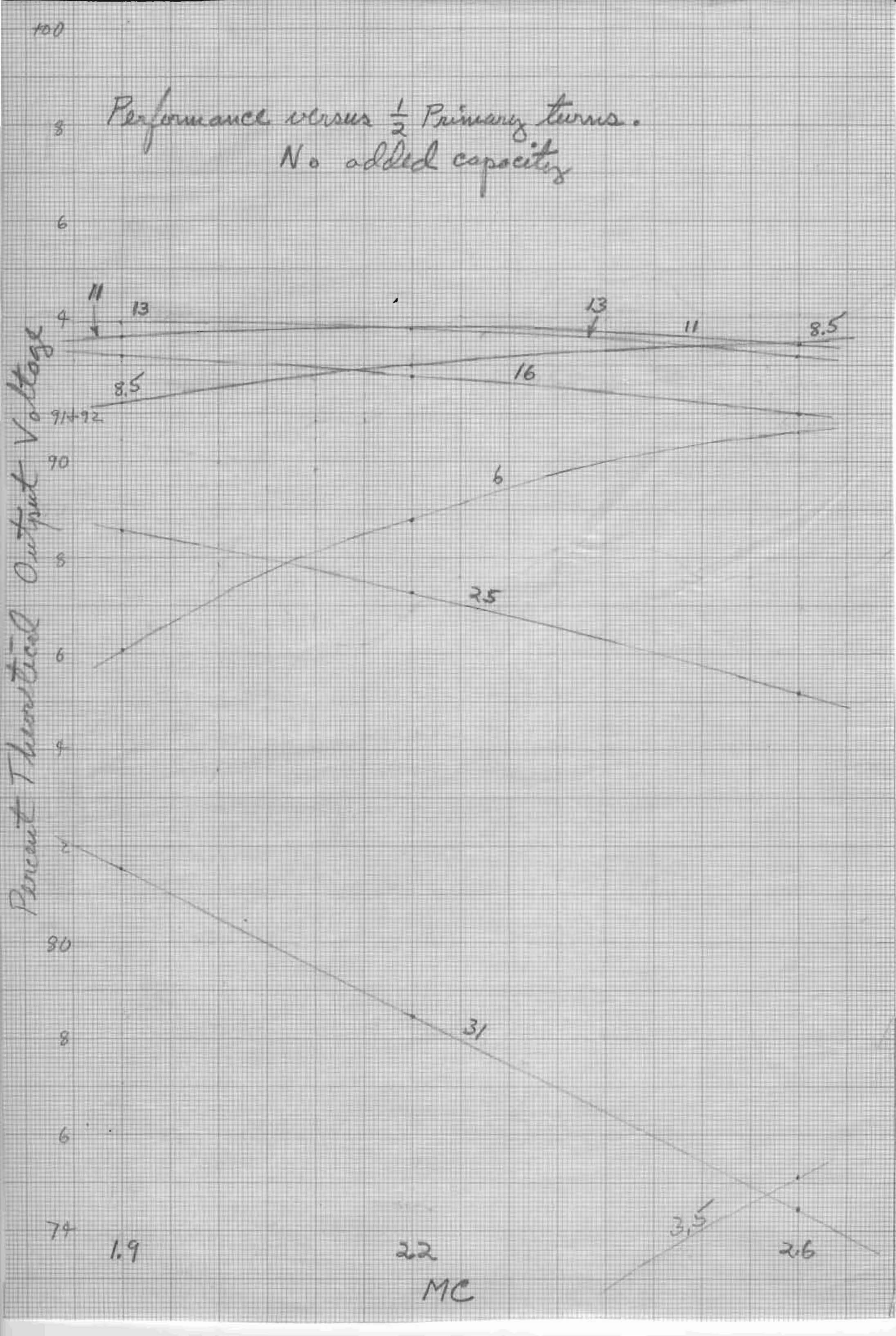
A new pickup coil of two turns in series was placed on oscillator and found satisfactory.

G.R.

9 July 66

Performance versus $\frac{1}{2}$ Primary turns
Resonate at 2.2 mc by added capacity





Performance versus 1/2 Primary turns.
No added capacity
100
8
6
4
91+92
90
8
6
4
2
80
8
6
74
Percent Theoretical Output Voltage
11
13
13
11
8.5
8.5
16
6
25
31
3.5
1.9
2.2
2.6
MC

Impedance Transformer 276 to 552 ohms

Coil		S	Same with more capacity added across ends.	T	Same with more capacity added across ends.	U	Same with more capacity added across ends.
Can	Diameter	$6\frac{1}{8}$		$6\frac{1}{8}$		$6\frac{1}{8}$	
	Length	5		5		5	
Form	Diameter	$3\frac{1}{16}$		$3\frac{1}{16}$		$3\frac{1}{16}$	
Coil	Length	1.82		1.72		1.30	
$\frac{1}{2}$ Pri	Position	Outside		Inside		Outside	
	Turns	11		11		11	
	Length	.50		.50		.32	
	Wire	.025		.025		.025	
$\frac{1}{2}$ Sec	Position	Inside		Outside		Inside	
	Turns	4.5		4.5		4.5	
	Length	.33		.33		.27	
	Wire	.057		.057		.057	
C_0	Measured	16.0		8.7		15.1	
	Computed	10.6	8.0	3.3	2.0	10.8	11.8
L_0, uh		62.8		69.8		75.6	
X_L at 2.1 mc		828		920		995	
R_0 ohms at 2.1 mc		10.21		9.70		23.2	
f_0 Measured		5.52		7.25		4.70	
Tuned	f in MC	2.10	1.89	2.10	1.86	2.10	1.90
	added C pf	81	105	79	103	65	81
MC		Output Voltage as Percent Theoretical					
1.8		96.7	97.8	96.2	97.0	96.3	97.5
2.1		97.8	98.1	96.5	97.3	97.1	97.9
2.4		98.0	97.8	97.1	97.0	97.3	97.5
Date		20/10/64	20/10/64	20/10/64	20/10/64	20/10/64	20/10/64

C_0 is measured on basis of f_0
C_0 is computed on basis of tuned f and C. This is not as good because C_0 is the difference of large numbers.

V	Same with more capacity added across ends
$6\frac{1}{8}$	
5	
$3\frac{1}{16}$	
1.18	
Inside	
11	
.32	
.025	
Outside	
4.5	
.27	
.057	
8.4	
6.8	5.6
86.2	
1136	
20.7	
5.91	
2.10	1.90
60	76
96.2	96.8
96.5	97.1
96.8	96.8
20/10/64	20/10/64

19/7/66

Transformer test, 28,3v input

	75.6 μh Trans. Coil Only		88pf on S.		Medium 125 μh Toroid		Lattice A		Long 50.4 μh Toroid	
MC	Pri.	Sec	Pri.	Sec	Pri.	Sec.	Pri.	Sec	Pri	Sec
.67	.572	.741	.600	.782	.662	.900	.942	.939	.517	.643
.91	.653	.845	.683	.900	.763	.960	.941	.941	.608	.752
1.8	.712	.924	.727	.988	.723	.975	.913	.940	.739	.905
2.4	.733	.942	.694	.980	.728	.972	.887	.935	.762	.940
5.5	.738	.951	.326	.761	.720	.963	.720	.950	.770	.965
7.5	.729	.942	.178	.646	.725	.958	.680	.955	.770	.960
11.0	.702	.920	.468	.432	.730	.935	.720	.930	.765	.940
14.6	.682	.905	.804	.298	.720	.920	.808	.900	.750	.923

This is coil U of 20/10/64
3" coil in 6" can

.057" wire
28 turns,
10 turns off center

3/16 × 1/16 strap.
17 turns,
6 turns off center

Tape

If device looks like 300 ohms input the Pri voltage will be 0.707
14.14 volts true. In this case the secondary voltage will be
1.000 if no loss. The actual reading will be voltage efficiency.

Resonance
in Can 5.5 mc.
Data taken
in air.

$C_0 = 1/(6.28 \cdot 5.5)^2 \cdot 10^{12} \cdot 125 \cdot 10^{-6} = 10^{-12}/1192 \cdot 125 \cdot 10^{-6} = 10^{-12}/.149 = 6.7$

University
Q machine

29/7/66

Ferrite toroid

					Computed L	Permeability
30 turns .042" wire, $L_o = 6.95\mu h$, $C_o = 5.7pf$					1.35 μh	5.14
MC	2.75	5.50	8.25	11.0		
ohms	.52	1.17	2.43	4.61		
49 turns .028" wire, $L_o = 18.1\mu h$, $C_o = 6.5pf$.					3.60 μh	5.02
MC	1.7	3.4	5.1	6.8		
ohms	1.2	3.5	8.9	19.3		
80 turns .018" wire, $L_o = 47.6\mu h$, $C_o = 5.8pf$.					9.60 μh	4.96
MC	1.65	2.1	3.15	4.20		
ohms	1.75	4.36	9.92	19.6		

$h = .31''$, O.D. = 1.125", I.D. = .435"

$$L = .0117\,N^2 \cdot .31 \log_{10}\frac{1.125}{.435} = .0015\,N^2\,\mu h.$$

PMG Q machine

300 to 600 ohm transformers

29/7/66

Can 8" dia. x 9" long. Coil 4" dia. Secondary at center of winding

Coil		A	W		X
Coil length		5.0"	1.75"		2.23"
½ Primary	turns	32	15.5		20.5
	wire	.027"	.024"		.024"
½ Secondary	turns	13.5	6.5	Same with	8.5
	wire	.064	.057"	17.2 pf	.057"
L_0 measured in uh	Air	484	210	added to	319
	Can	406	190	resonate	284
L_0 Can/Air		.84	.90	at 2.1 mc	.89
C_0 pf	measured, Air	12.0	18.0		18.0
	computed, Can	13.9	17.6		18.6
C_0 Can/Air		1.16	.98		1.03
f_0 MC	computed, Air	2.28	2.59		2.10
	measured, Can	2.12	2.76	2.10	2.19
f_0 Can/Air		.93	1.07		1.04
R_0 Air	mc	.5 .75 1.05	.5 .7 1.0 1.5		.5 .7 1.0
	ohms	8.2 14 28	5.3 7.7 12.2 36		8.2 13.2 27
R_0 Can	mc	.5 .75 1.05	.55 .7 1.0 1.5		.5 .7 1.0 1.2
	ohms	17 25 41	8.9 11.0 17.3 38		13 19 34 51

Relative test volts with 28.3 V input

MC	Pri	Sec	Pri	Sec	Pri	Sec	Pri	Sec	Pri	Sec
.67	.840	.915	.720	.928	.720	.933	.748	.945		
.91	.863	.895	.745	.958	.742	.965	.770	.956		
1.8	.950	.842	.750	.958	.742	.962	.778	.942		
2.4	1.007	.780	.753	.955	.740	.962	.790	.927		
5.5	1.2?	.55	.770	.915	.698	.927	.910	.830		
7.5	?	.35	.798	.896	.700	.905	1.00	.760		
11.0	—	—	.955	.780	.943	.720	1.2?	.45		
14.6	—	—	1.2?	.61	1.2?	.47	?	.27		

PMG Q machine

300 to 600 ohm transformers

29/7/66
Red + Blue dots

Ferrite toroid 2.28" O.D., 1.23" I.D., 0.49" thick, permeability = 70

Design		B	A	C	D
½ Primary	turns	6	19	25	17
	wire	3/16"×1/16"	.057"	.032"	.032"
½ Secondary	turns	2.5	8	10	7
	wire	3/16"×1/16"	.057"	.081"	.081"
L_o, uh measured		50.4	486	870	
C_o pf	measured, Air	7.0	6.5	5.7	
	computed, Can			7.2	
C_o Can/Air				1.27	
f_o mc	computed, air	8.5	2.83	2.26	
	measured, can			2.01	
f_o Can/Air				.89	
R_o	mc	1.0 2.0 4.0	.66 .99 1.2	.50 .75	
	ohms	1.6 4.1 19	7.2 12 16	13.7 23	

Relative test volts with 28.3V input

MC	Pri	Sec	Pri	Sec	Pri	Sec	Pri	Sec	Pri	Sec
.67	.517	.643			.751	.978				
.91	.608	.752			.758	.966				
1.8	.739	.905			.770	.963				
2.4	.762	.940			.781	.942				
5.5	.770	.965			.910	.846				
7.5	.770	.960			.987	.788				
11.0	.765	.940			1.2?	.62				
14.6	.750	.923			?	.51				

Design A coil: N = 54, h = .67", O.D. = 2.40", I.D. = 1.13"

$$L = 0.01170 \cdot 54^2 \cdot .67 \log_{10} \frac{2.40}{1.13} = 7.0 \mu h$$

$$\text{Permeability} = \frac{486}{7.0} = 69.5$$

PMG Q machine 300 to 600 ohm transformers 29/7/66

Ferrite toroid 1.34" O.D., .72" I.D., .37" thick, Permeability = 70

Design		A	B		C	
½ Primary	turns	10	19		17	
	wire	.057"	.024"		.024	
½ Secondary	turns	4	8		7	
	wire	.057"	.057"	Same with	.057	Same with
L_0 uh measured		125	466	6.0 pf	363	5.5 pf
C_0 pf	measured, Air	4.3	3.8	added to	4.3	added to
	computed, Can	6.7	6.5	resonate	6.3	resonate
C_0 Can/Air		1.6	1.7	at 2.1 mc	1.47	at 2.4 mc
f_0 mc	computed, air	6.9	3.78		4.02	
	measured, can	5.5	2.90	2.10	3.32	
f_0 Can/Air		.80	.77		.83	
R_0	mc	.65 1.3 2.6	.35 .7 1.0		.5 1.0 1.36	
	ohms	2.7 4.9 13	5.5 10.9 18		5.9 12.0 18.7	

Relative test volts with 28.3 v input

MC	Pri	Sec	Pri	Sec	Pri	Sec	Pri	Sec	Pri	Sec
.67	.662	.900	.728	.982	.730	.984	.733	.982	.733	.985
.91	.703	.960	.732	.981	.733	.985	.741	.990	.737	.990
1.8	.723	.975	.735	.979	.730	.982	.733	.980	.732	.983
2.4	.728	.972	.738	.972	.732	.973	.739	.977	.736	.980
5.5	.720	.963	.757	.940	.730	.942	.742	.941	.724	.955
7.5	.725	.958	.780	.920	.738	.933	.758	.933	.731	.944
11.0	.730	.935	.850	.860	.775	.890	.801	.898	.729	.920
14.6	.720	.920	.922	.793	.850	.810	.850	.852	.760	.878
Wire length on ½ secondary									15.2"	

(over)

PMG Q Machine

300 to 600 ohm transformers 5/8/66

Can 4" dia x 5" long. Coil 1 3/4" dia. Primary under secondary

Design	A			
Coil length	.7"			
½ Primary turns	13			
½ Primary wire	.024			
½ Secondary turns	5.5	Same with		
½ Secondary wire	.057	91 pf		
L_o measured uh, Air	58.0	added to		
L_o measured uh, Can	54.2	resonate		
L_o Can/Air	.93	at 2.1 mc		
C_o pf, measured, Air	14.0			
C_o pf, computed, Can	16.5			
C_o Can/Air	1.18			
f_o MC, Computed, Air	5.58			
f_o MC, measured, Can	5.32			
f_o Can/Air	.95			

R_o Air, mc	1.0	1.5	2.0	3.0
R_o Air, ohms	4.6	6.6	9.2	19.5
R_o Can, mc	1.0	1.5	2.0	3.0
R_o Can, ohms	6.4	8.8	12.2	23.3

Relative test volts with 28.3v input

MC	Pri	Sec	Pri	Sec	Pri	Sec	Pri	Sec
.67	.457	.638	.472	.661				
.91	.550	.752	.580	.900				
1.8	.660	.900	.703	.980				
2.4	.687	.939	.709	.983				
5.5	.720	.970	.481	.737				
7.5	.709	.961	.371	.620				
11.0	.680	.932	.177	.405				
14.6	.628	.890	.091	.293				

Wire length on ½ Secondary 31.5"