4/5/63

First and Third Resonances in Coils

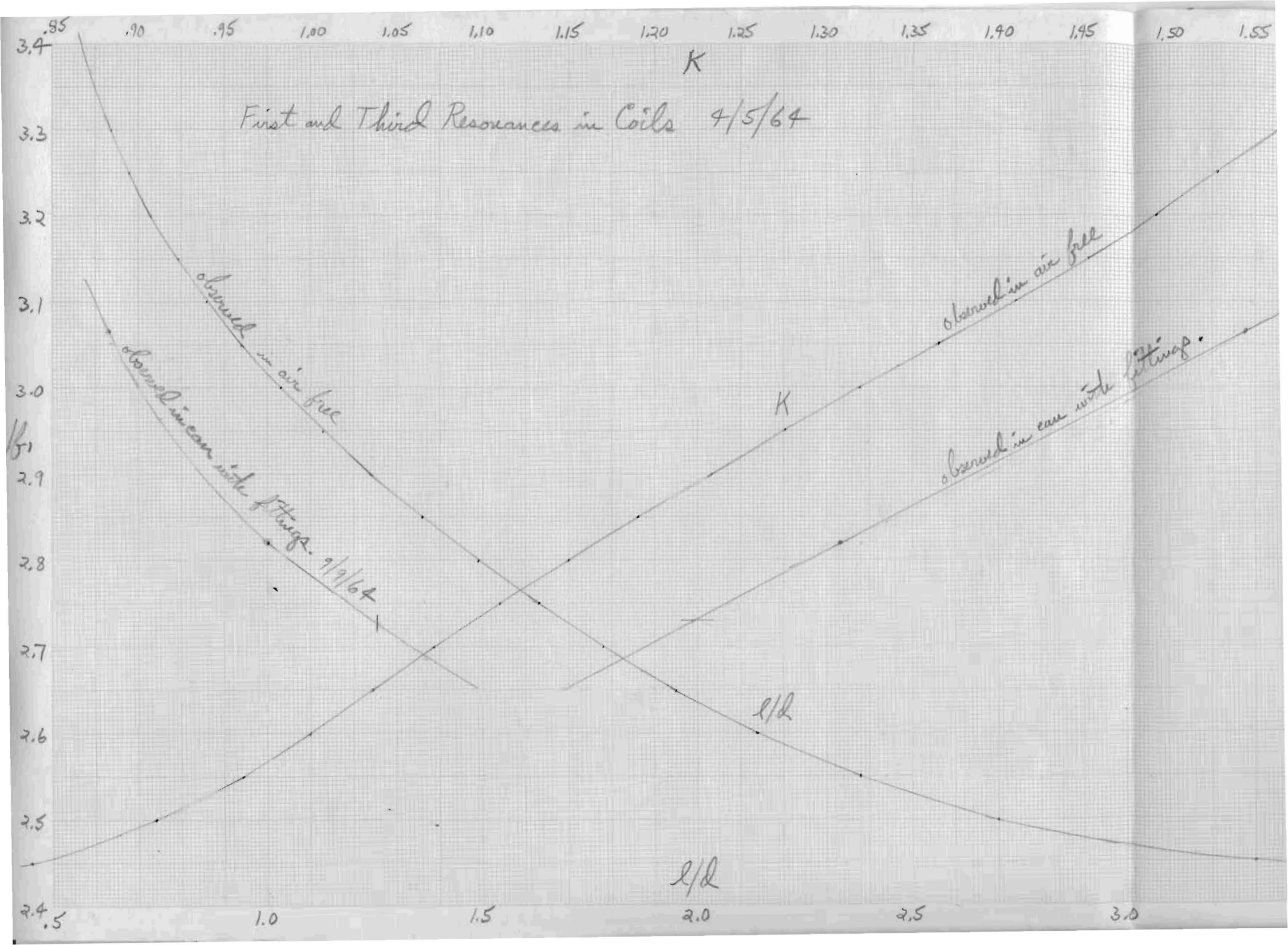
$\frac{f_3}{f_1}$	$\frac{l}{d}$	$K = f_c/f_1$
3.30	.64	1.562
3.25	.68	1.528
3.20	.73	1.492
3.15	.79	1.452
3.10	.86	1.410
3.05	.94	1.365
3.00	1.03	1.320
2.95	1.13	1.276
2.90	1.24	1.233
2.85	1.36	1.191
2.80	1.49	1.150
2.75	1.63	1.110
2.70	1.78	1.072
2.65	1.95	1.036
2.60	2.14	1.000
2.55	2.38	.960
2.50	2.70	.910
2.45	3.30	.840
2.40	9?	.6?

l = length of coil
d = diameter of coil
N = number of turns in free space.
f_1 = first mode natural resonance
f_3 = third mode natural resonance
f_c = computed half wave resonance
$T = N\pi d$ = wire length.
V = velocity of light
$f_c = V/2T$

Let d be inches, $V = 300$ meters per microsecond
$f_c = 150 \times 39.37 / N\pi d$ megacycles $= 1880/Nd$ mc
$K = f_c/f_1$
$N = 1880/Kdf_1$
When placed in can the turns will change.
N_a = turns of coil in can
$S = N_a/N$
Present cans have $S = 0.96$
so:
$N_a = 1805/Kdf_1$
$tpi = N_a/l$ = turns per inch
$w = 1/2\ tpi$ = wire diameter

Choose f_1 and f_3. This fixes l/d and K from graph.
Choose d. This fixes l, N_a and tpi

Using slightly different f_3/f_1, plot N_a versus tpi for fixed d;
Or slightly different d, plot N_a versus tpi for fixed f_3/f_1.
Integral values of tpi may be secured from these plots and realizable coils made.


First and Third Resonances in Coils 4/5/64
K
.85
.90
.95
1.00
1.05
1.10
1.15
1.20
1.25
1.30
1.35
1.40
1.45
1.50
1.55
3.4
3.3
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
2.4
f₁
observed in air free
observed in coax with fittings 9/9/64
K
observed in air free
observed in coax with fittings
l/d
l/d
.5
1.0
1.5
2.0
2.5
3.0

Observational Data

8/4/64

Secondary Resonance

Turns	Length	Condition	Grid Dip Meter	Resonance KC		
150	11.55"	Free Space	4.7	1870	.948	
		In box	4.1			1770
140	11.66"	Free Space	5.6	2015		
134	11.16	"	5.8	2050		
132	11.00	In can	5.3			1965
130	10.83	Free space	5.93	2075	.960	
		In can	5.45			1990
128	10.66	" "	5.55			2010
124	10.34	" "	5.8			2050
122	10.16	Free Space	6.50	2175	.962	
		In can	6.00			2090
120	10.00	In can	6.10			2105
112	9.34	Free space	7.30	2330	.958	
		In can	6.80			2230
102	8.50	Free space	8.20	2500	.960	
		In can	7.70			2400
94	7.84	Free space	9.1	2680	.954	
		In can.	8.5			2555

The natural frequency in can is about 0.96 times in space.

Coils are 6.18" dia, 12 tpi, .051 wire

Observational Data

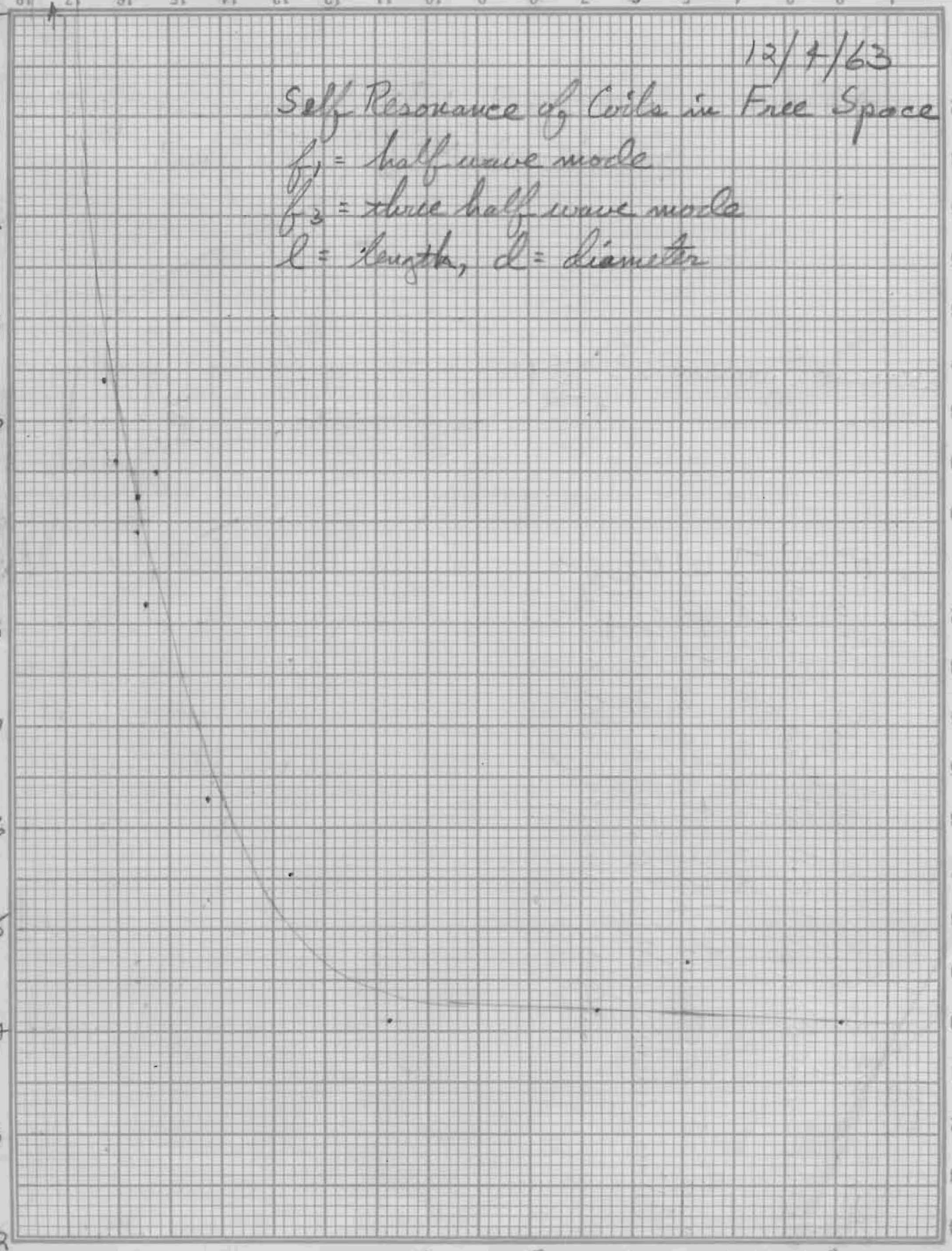
12/4/63

Self Resonance of Coils in Free Space

f_1 = half wave mode

f_3 = three half wave mode

l = length, d = diameter



Observational Data

12/4/64

Coil	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
length	11.55	7.84	14.3	15.0	4.75	5.43	.813	1.35	11.67	10.75	35.2	35.44	35	33.8	5.60
diameter	6.17	6.18	3.96	2.30	5.33	3.96	5.17	3.31	6.18	9.08	6.21	4.42	6.25	12.8	15.13
l/d	1.87	1.27	3.61	6.52	.891	1.371	.157	.408	1.89	1.185	5.66	8.02	5.60	2.66	.370
turns	150	94	100	156	28	38	14	12	140	44	211	319	140	76	23
tpi	13	12	7	10.4	5.90	7	17.2	8.33	12	4	6	9	4	2.25	4.10
centers	.077	.083	.143	.096	.169	.143	.058	.120	.083	.250	.167	.111	.250	.444	.243
wire diameter	.040	.051	.080	.045	.080	.080	.051	.057	.051	.080	.080	.045	.128	.188	.080
gap	.037	.032	.063	.051	.089	.063	.007	.063	.032	.170	.087	.066	.122	.256	.163
g/c	.48	.39	.44	.53	.53	.44	.12	.52	.39	.68	.52	.59	.49	.58	.67
L/d	245	130	62		14	19		4.2					80		
uh	1510	802	246		75	75		14					500		
wire length	242	152	103.5	94.0	39.1	39.4	18.9	10.4	226	104.6	343	369	229	252	91
fc	2.03	3.24	4.750	5.24	12.60	12.50	26.0	47.3	2.17	4.70	1.435	1.334	2.15	1.951	5.40
f1	2.02 / 2.02	2.79 / 2.68	5.90 / 5.93	7.80 / 7.90	8.64	10.00 / 10.00	7.20 / 7.25	23.6	2.02	4.10	2.11 / 2.11	2.16 / 2.16	3.1	2.28 / 2.27	3.27
f2	3.70	5.31 / 5.32	10.35	13.8	17.50	19.5	20.6	59.0		7.99	3.79	3.89		4.10	7.82 / 7.80
f3	5.30 / 5.30	7.80 / 7.75	14.25	19.4	26.30	29.5	40?	98.0		12.0	5.13 / 5.11	5.21 / 5.22		5.76 / 5.73	12.3
fc/f1	1.01	1.163	.804	.668	1.46	1.25	3.6	2.00	1.07	1.145	.680	.616	.694	.86	1.65
f2/f1	1.83	1.905	1.750	1.76	2.02	1.95	2.85	2.50		1.950	1.80	1.80		1.905	2.39
f3/f1	2.63	2.820	2.410	2.47	3.04	2.95	5.5?	4.15		2.925	2.42	2.41		2.53	3.76
	?	?					?		?				?		

wire length in feet

fc is computed from length of wire

Underlined values of f1 f2 f3 are secured from small coils of frequency meter.

fc f1 f2 f3 in megacycles

Coils 5, 6, 7, 8 have several inches of beads at each end giving more capacity

? Dubious measured frequencies.

Coil 7 has broad absorption indicating a lot of loss.

Coil 15 has resonances at 3.27, 7.82, 12.3, 17.0, 21.6, 25.6, 30.0 mc (7 modes)

Coil 4 has resonances at 7.80, 13.80, 19.4, 23.2, 31.3

(over)

also another coil 173 turns, 1.67" Dia 15" long 11.52 tpi, 0.087 spacing
Wire 0.040" dia, gap .047, g/s = 0.54
l/d = 9.0, L/d = 80 L = 134 μh.
Wire length = 75.6 feet, f_c = 6.51 mc

9.20?
f_1 = 10.75 mc, f_2 = 18.1 mc, f_3 = 26.4 mc, f_4 = 31.6 mc
f_c/f_1 = .606 f_2/f_1 = 1.68, f_3/f_1 = 2.45, f_4/f_1 = 2.93

also coil 6.18" dia 9.00" long, l/d = 1.455 n = 105 turns
4d = 148, L = 914 μh

6.125

Observational Data

Coil	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
length	15	7.78	9.34	10.90	7.33	6.11									
diameter	1.67	3.16	3.16	3.16	6.15	6.15									
ℓ/d	9.0	2.452	2.941	3.448	1.191	.994									
turns	173	102	113	121	123	111									
tpi	11.52	13	12	11	16.65	18									
centers	.087	.077	.083	.091	.060	.056									
wire diameter	.040	.036	.036	.036	.028	.028									
gap	.047	.041	.047	.055	.032	.028									
g/c	.54	.53	.57	.61	.53	.50									
ℓ/d	80														
wh	134														
wire ft length	75.6	84.4	93.6	1000											
f_c	6.51	5.84	5.26	4.92	2.48	2.76									
f_1	9.207 10.75	6.22	6.05	5.98	2.06	2.10									
f_2	18.1														
f_3	26.4				5.96	6.20									
f_c/f_1	.606	.940	.870	.822	1.71	1.32									
f_2/f_1	1.68														
f_3/f_1	2.45				2.89	2.96									

16 resonates at $f_4 = 31.6$ mc, $f_4/f_1 = 2.93$

Observational Data