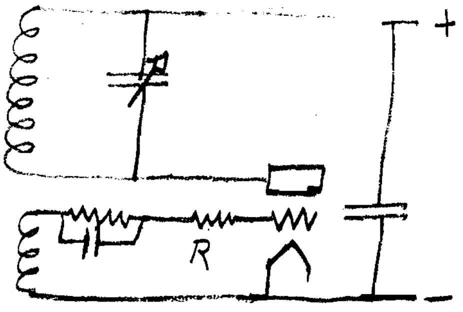
Radio Receiver Design by K.R. Sturley, 1953

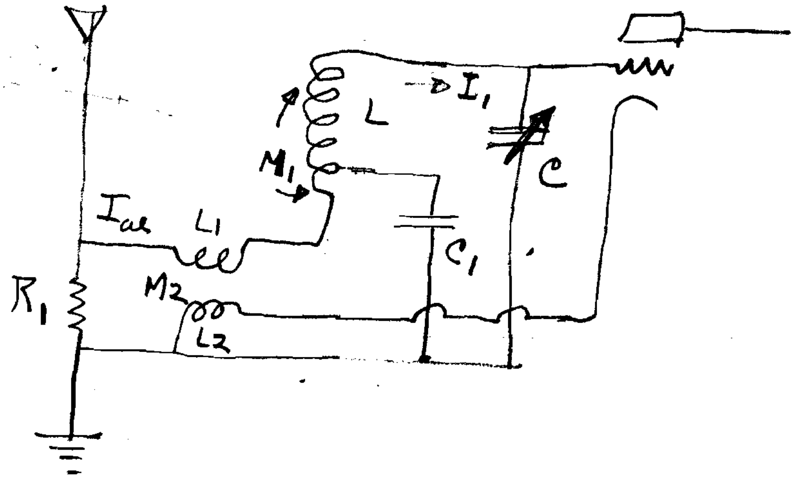
Fig 6.6, page 388 is tuned anode oscillator with amplitude stabilization by grid resistor. R = 1000 ohms approx.



If capacity is placed across Grid-Filament the effect of R is increased.

Pages 346 to 358. When low I.F. frequency is used (50 KC) the recommended system is to have the mixer input circuit formed of inductive and capacity coupling which buck each other to zero at image frequency near high frequency end of band. Also a scheme is put forward where the mixer grid is tapped far down on the grid coil. Here there is series tuned circuit consisting to top of grid coil and tuning condenser which is resonated to image frequency near high frequency end of band. This looses a lot of gain when I.F. frequency is low.

pages 352&3



$C_1 = .005$ mfd.
frequency determined by LC
f_s = signal frequency

$$(I_{ae} - I_1)\frac{1}{j\omega_1 C_1} = I_1\left(j\omega_1 L + \frac{1}{j\omega_1 C}\right) + I_{ae}\, j\omega_1 M_1$$

$$I_1 j\omega_1 L\left(1 - \frac{f_s^2}{f_1^2}\right) = -I_{ae}\left(\omega_1 M_1 + \frac{1}{\omega C_1}\right)$$

$$f_s = 1/2\pi\left(\frac{LCC_1}{C+C_1}\right)^{1/2}$$

Grid to Cathode voltage $= E = E_C - E_{L_2} = \frac{I_1}{j\omega_1 C} - I_{ae}\, j\omega_1 M_2$

$$= -I_{ae}\left\{\left[\left(\omega_1 M_1 + \frac{1}{\omega_1 C_1}\right)\Big/\omega_1 L\left(1 - \frac{f_s^2}{f_1^2}\right) j\omega_1 C\right] + j\omega_1 M_2\right\} = 0$$

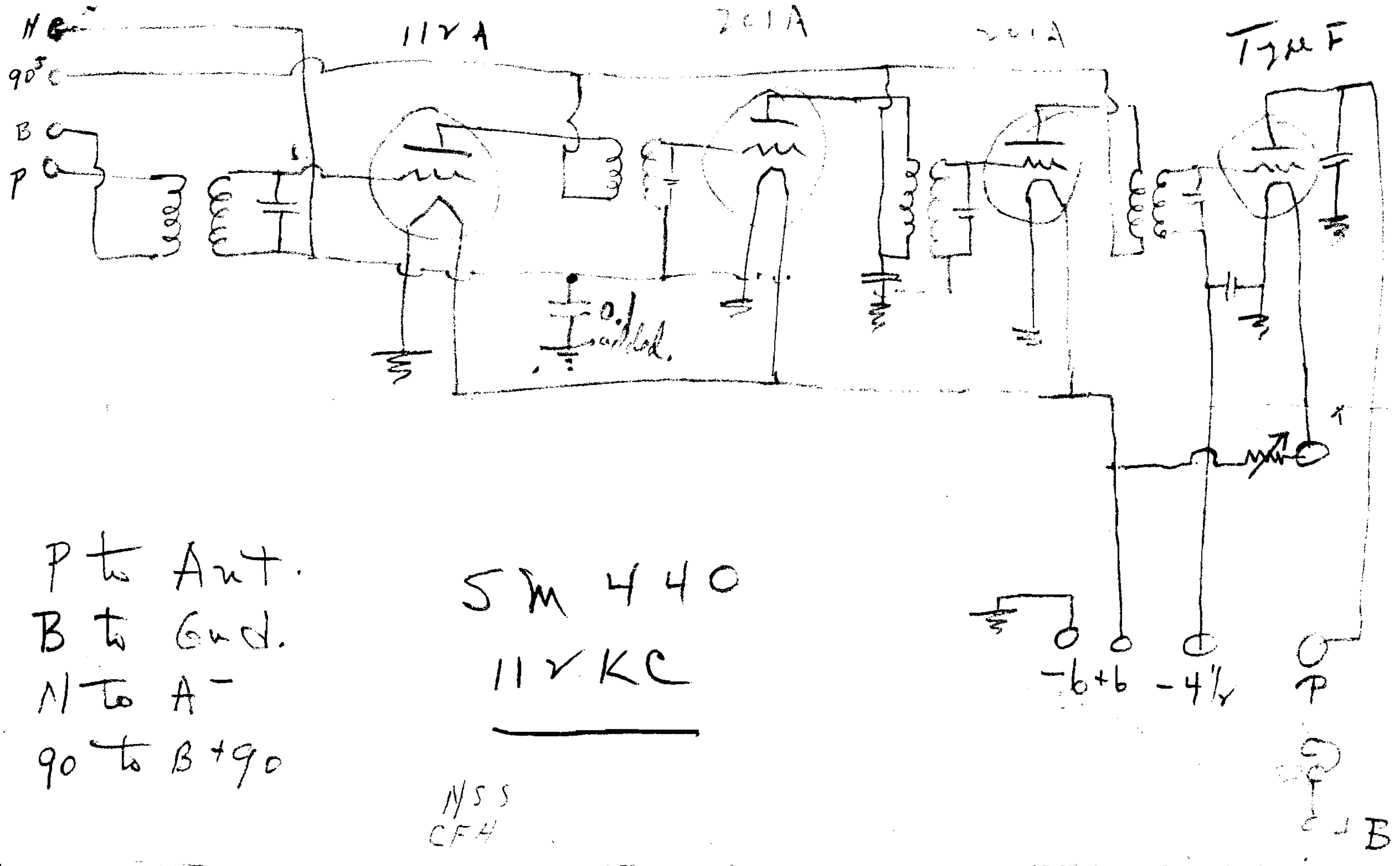
when $\omega_1^2 LC\left(1 - \frac{f_s^2}{f_1^2}\right) = \frac{M_1}{M_2} + \frac{1}{\omega_1^2 M_2 C_1}$

$$LC = (C_1 + C)/\omega_s^2 C_1$$

therefore $\left[f_1^2/f_s^2 - 1\right]\left[C_1 + C\right]/C_1 = (M_1/M_2) + (f_3^2/f_1^2)$ 5.45

where $f_3 = 1/2\pi(M_2 C_1)^{1/2}$

Two points of optimum suppression may be achieved over the wave range because the right hand side of 5.45 contains two independently variable terms. Choose f_1 + f_3. Then solve for C_1, M_1, M_2



1st August 61

1. Rivited partitions between stages tight to chassis.
2. Fixed open in 3rd transformer primary
3. added 0.1 mfd bypass from grid returns to ground.
4. Removed wire for filament rheostat in detector and connected last filament in parallel with other three as intended by manufacturer.
5. added 200pf across secondary of first transformer to bring it into tune at 112KC.

	Pri.	Sec
Q	26	31
L_0 mh	1.09	3.21
C_0 pf	95	55
R_0 ohms	30	73
M mh	1.36	
K	.73	
Operating Q		14.3
Tuning Cap, pf		569
Tuned Impedance		32,300 ohms

all at 112 KC

D.C. ohms	16.8	8.4

all data taken with transformer mounted in place inside shield can

Transformer dimensions:

Amplifier dimensions:

Last Transformer 3DB points $\log^{-1} 2.0375 = 109.0$ KC
$\log^{-1} 2.0675 = 116.9$ KC

Difference $= 7.9$ KC
Sum $= 225.9$
Average 113 KC
$Q = 113/7.9 = 14.3$

R_G = Tuned Impedance $= Q\omega L = 14.3 \cdot 112 \cdot 10^3 \cdot 6.28 \cdot 3.21 \cdot 10^{-3} = 32{,}300$ ohms

$C_{GP} = 8$ pf approximate

$X_{GP} = 1/(6.28 \cdot 112 \cdot 10^6 \cdot 8 \cdot 10^{-12}) = 10^6/5.6 = 178{,}000$ ohms.

Feedback is small because $X_{GP} \gg R_G$

$X_{GP}/R_G = 5.5$

10/8/61

Last transformer in SM 440 amplifier

Sec = 8.4 Ω D.C., Pri. = 16.8 Ω D.C.

Sec:

Freq	100 KC	112 KC	200
C pf	736	569	143
Q		31.	

$C_0 = \frac{736 - 4 \cdot 143}{3} = \frac{164}{3} = 55\,pf.$

$L_0 = 1/(6.28 \cdot .1 \cdot 10^6)^2 \cdot 791 \cdot 10^{-12} = 1/312 = 3.21$ mh

$R_0 = \frac{\omega L_0}{Q} = \frac{6.28 \cdot .112 \cdot 10^6 \cdot 3210 \cdot 10^{-6}}{31} = 72.9$ ohms at 112 KC

Pri:

Freq	112	224
C pf	1760	369
Q	26	

$C_0 = \frac{1760 - 4 \cdot 369}{3} = 95\,pf$

$L_0 = 1/(6.28 \cdot .112 \cdot 10^6)^2 \cdot 1855 \cdot 10^{-12} = 1/919 = 1.09$ mh

$R_0 = \frac{\omega L_0}{Q} = \frac{6.28 \cdot .112 \cdot 10^6 \cdot 1090 \cdot 10^{-6}}{26} = 29.5$ ohms at 112 KC

Pri + Sec aiding:

Freq	70 KC	112	140
C pf	680	225	126
Q		25	

$C_0 = \frac{680 - 4 \cdot 126}{3} = \frac{176}{3} = 59\,pf$

$L_0 = 1/(6.28 \cdot .07 \cdot 10^6)^2 \cdot 739 \cdot 10^{-12} = 1/143 = 7.02$ mh

$R_0 = \frac{\omega L_0}{Q} = \frac{6.28 \cdot .112 \cdot 10^6 \cdot 7020 \cdot 10^{-6}}{24} = 206$ ohms.

$M = \frac{7.02 - (3.21 + 1.09)}{2} = 1.36$ mh

$K = \frac{1.36}{(3.21 \cdot 1.09)^{1/2}} = \frac{1.36}{1.87} = 73\%$

(over)

1/8/61

Input Stage Only using 10KΩ input dummy. constant 1 volt input

Freq KC	Output Volts
100	.15
110	.24
120	.45
125	.75
130	1.44
134	2.02
140	1.12
145	.65
150	.44
160	.27
180	.15

Freq KC	Output Volts } on 1st grid.	DB Gain	Input Gain +17DB
82	.13	-17.7	-0.7
95	.24	-12.4	4.6
100	.35	-9.1	7.9
105	.66	-3.6	13.4
108	1.09	0.7	17.7
110	1.64	4.3	21.3
112	2.02	6.1	23.1
114	1.75	4.9	21.9
117	1.02	0.2	17.2
120	.66	-3.6	13.4
125	.39	-8.2	8.8
135	.21	-13.5	3.5
150	.13	-17.7	
175			

added 200pf

3 DB widths.

14 ma	$\log^{-1}$	2.0601	=	114.9
	$\log^{-1}$	2.0484	=	111.9
				3.0
8 ma	$\log^{-1}$	2.0605	=	115.0
	$\log^{-1}$	2.0475	=	111.5
				3.5
2.3 ma	$\log^{-1}$	2.0614	=	115.2
	$\log^{-1}$	2.0475	=	111.5
				3.7

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Freq KC	$Log_{10}F$	3rd Grid. mv	2nd Grid mv	1st Grid mv	10KΩ Summing Input mv	direct input Input mv
82	1.914	415	415	400	>1000	220
95	1.978	219	115	71	670	32
100	2.000	154	61	24.8	200	10.8
105	2.021	100	23.8	5.7	38	2.4
108	2.033	70	10.0	1.73	10.0	.73
110	2.041	55	5.4	.75	4.0	.29
112	2.049	46	4.0	.48	2.7	.23
114	2.057	45	5.1	.58	2.9	.26
117	2.068	62	10.0	1.37	[illegible]	.56
120	2.079	86	17.5	3.35	11.2	1.27
125	2.097	130	40	11.2	29	4.1
135	2.130	223	112	58	56	18
150	2.176	350	295	248	600	58
175	2.243	560	740	1000	>1000	88

2.049
1.914
.135
2.049
2.184

KC	Log
85	1.929
90	1.954
115	2.061
130	2.114
140	2.146

2/8/61

Freq KC	3rd Grid DB	2nd Grid Total DB	2nd Grid Gain DB	1st Grid Total DB	1st Grid Gain DB	Input Total DB	Input Gain DB	Input Gain
82	0.1	0.1	0.0	0.4	0.3			+1.9 DB
95	5.7	11.3	5.6	15.4	4.1	0.9	-14.5	4.5
100	8.7	16.8	8.1	24.6	7.8	13.0	-11.6	7.4
105	12.5	24.9	12.4	37.4	12.5	30.9	-6.5	12.5
108	15.6	32.5	16.9	47.7	15.2	43.8	-3.9	15.1
110	17.7	37.8	20.1	55.0	17.2	52.5	-2.5	16.5
112	19.2	40.4	21.2	58.8	18.4	59.6	0.8	19.8
113.4						61.8	4.6	23.6
114	19.4	38.3	18.9	57.2	18.9			
114.8						59.6	2.4	
117	16.6	32.5	15.9	49.7	17.2	49.1	-0.6	18.4
120	13.8	27.6	13.8	42.0	14.4	37.0	-5.0	14.0
125	10.2	20.4	10.2	31.5	11.1	21.8	-9.7	9.3
135	5.5	11.5	6.0	17.2	5.7	1.6	-15.6	4.4
150	1.6	3.1	1.5	4.6	1.5			
175	-2.5	-4.9	-2.4	-7.5	-2.6			

1/8/61

Overal using 10K Ω dummy

Freq KC	S.D Input mv	Input mv	Gain DB	Input mv.	Gain DB
82	>1000	>1000		>1000	
95	380	>1000		198	6.5
100	94	450	-0.6	50	18.5
105	12.0	61	16.8	7.3	35.2
108	2.70	11.0	31.6	1.58	48.9
110	1.00	3.3	42.1	.68	55.8
112	.44	1.31	50.1	.34	61.8
113.4	.34	113.2 1.03	52	113.6 .252	64.4
114.8	.44	114.5 1.31	50	114.8 .34	61.8
117	1.48	5.1	38.3	1.05	52.0
120	5.9	24	24.9	3.8	40.9
125	34	156	8.6	20	26.4
135	310	>1000		172	7.8
150	>1000	>1000		>1000	

I_p =	8.0	2.3	14.0
E_p =	92 Volts	92V	92V
E_G =	-4.25	-7.1V	-1.42V

similar to UX112A tubes

31/7/61

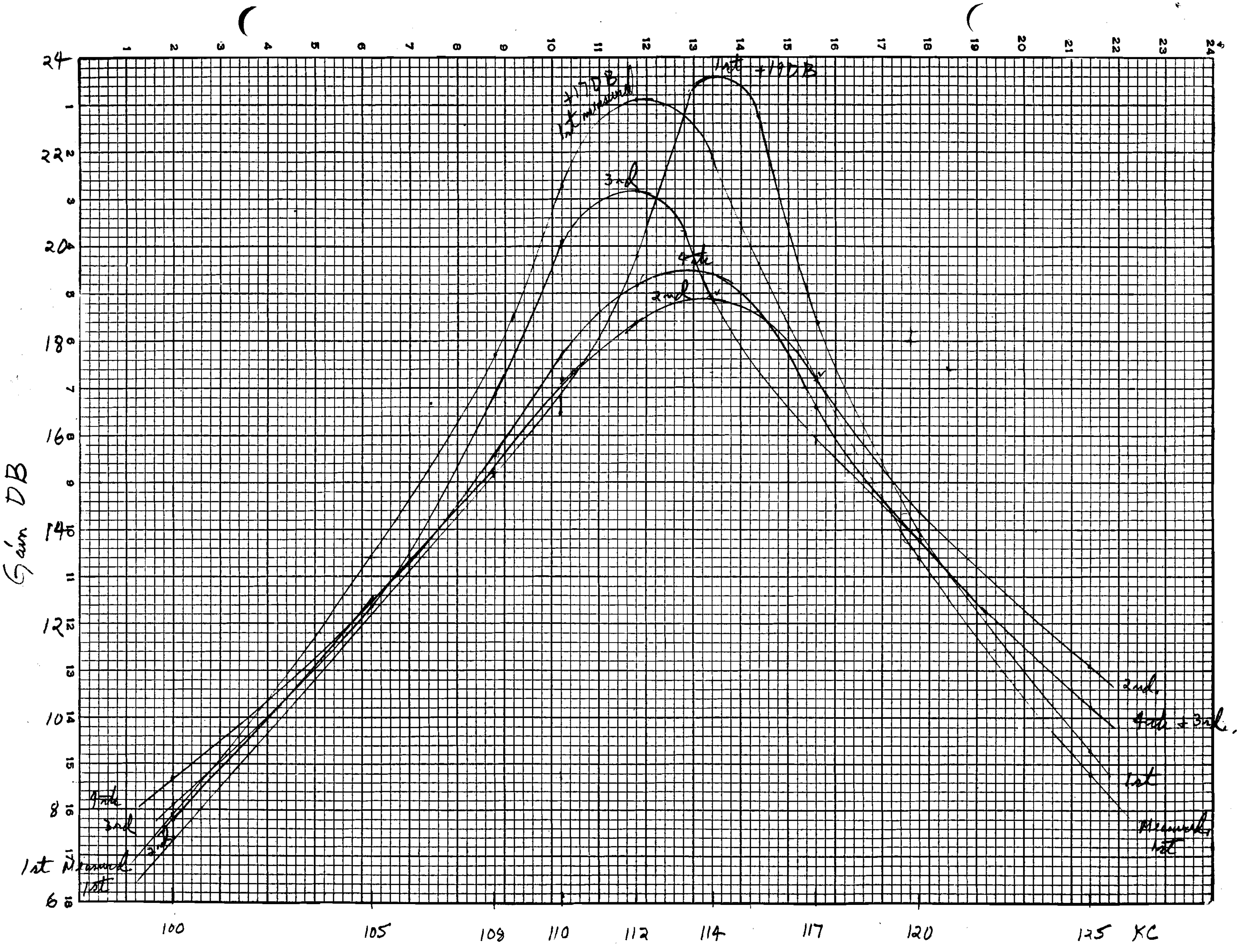
112 KC Amplifier SM440

Test frequencies 85, 95, 100, 105, 108, 110, 112, 114, 117, 120,
125, 135, 150 KC

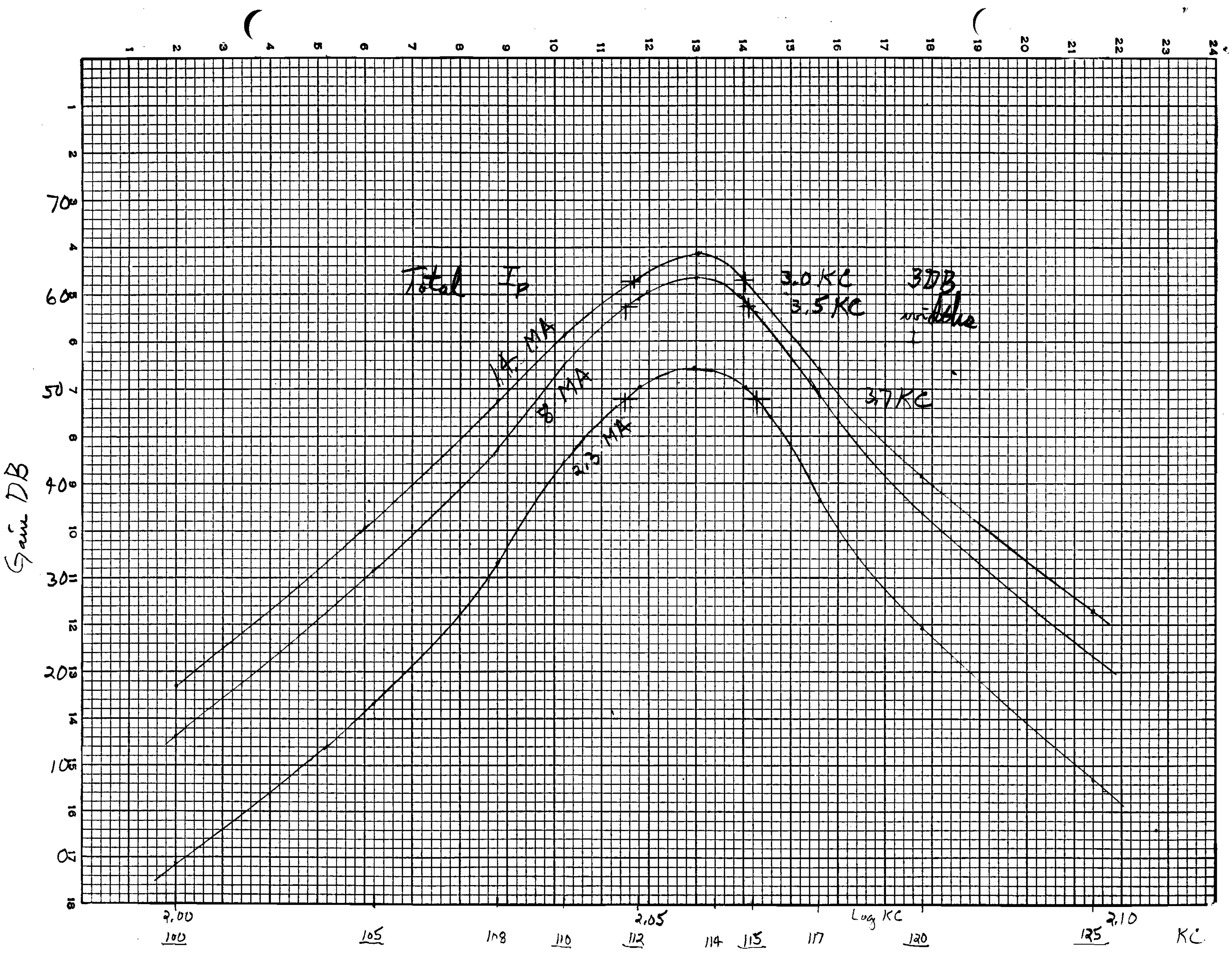
Detector $22\frac{1}{2}$V Ep, -1.3V Eg = 0.16ma = operating conditions
" 0V Eg = 0.42ma
90V Ep, -4.5V Eg = 2.8ma

When signal generator meter is at 40 the output is 1 volt on output meter. Use 40 as reference at CW set
100% modulation is achieved when signal generator meter reads 80 at modulation set
Transformer between detector + output meter has 1 to 4 voltage ratio.
at detector grid 420mv gives 1 volt on output meter.

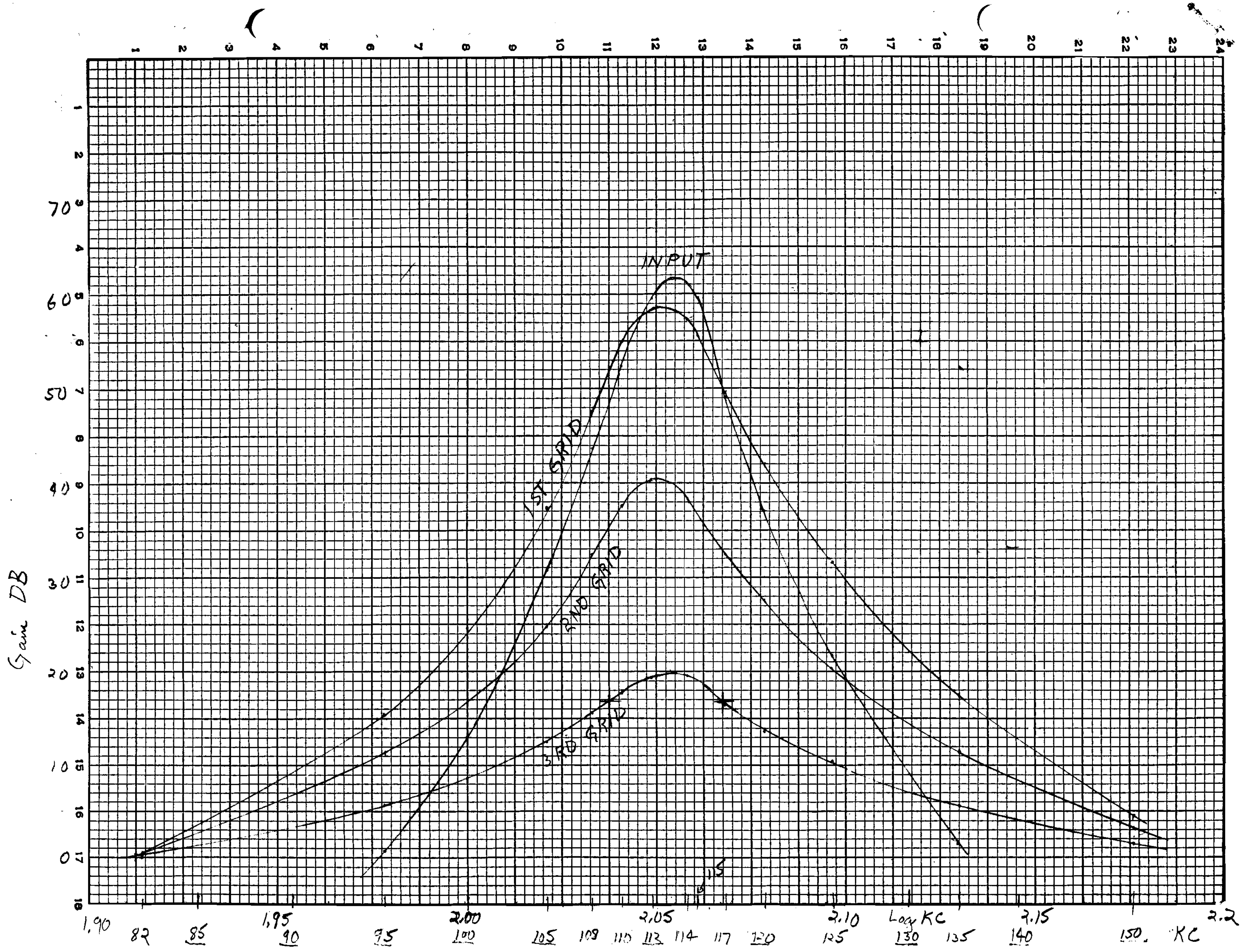
Input circuit is 10000 Ω to simulate Rp of mixer tube. This turned out to be too high. The response curves taken on first transformer are narrower than response curves of other three transformers. a better value would be 7000 ohms. this would broaden first transformer response and raise apparent gain of first transformer.



Gain DB
24
22
20
18
16
14
12
10
8
6
100
105
109
110
112
114
117
120
125
KC
1st +17DB
+17DB 1st measured
3rd
4th
2nd
2nd.
4th + 3rd.
1st
Measured 1st
1st Measured
1st



Total I_P
14. MA
8 MA
2.3 MA
3.0 KC
3.5 KC
3DB
widths
3.7 KC
Gain DB
70
60
50
40
30
20
10
0
2.00
2.05
2.10
Log KC
100
105
108
110
112
114
115
117
120
125
KC


INPUT
1ST GRID
2ND GRID
3RD GRID
Gain DB
70
60
50
40
30
20
10
0
1.90
1.95
2.00
2.05
2.10
2.15
2.2
Log KC
82
85
90
95
100
105
108
110
113
114
115
117
120
125
130
135
140
150
KC

6 Nov 60

Low frequency stage #2

Center frequency = $\log^{-1} 2.822 = 664$ KC at 15.5 DB

3 DB frequencies at 12.5 DB = $\log^{-1} 2.607 = 405$ KC

$= \log^{-1} 3.082 = 1208$ KC

$Q = 664/(1208-405) = 664/803 = 0.828$

$\underline{R_{RF}} = \omega L/Q = 6.28 \cdot 664 \cdot 10^{3} \cdot 1.95 \cdot 10^{-3}/.828 = \underline{9820 \text{ ohms}}$

$R_{RF}/R_{DC} = 9820/1320 = 7.42$ times

Medium frequency stage #3

Center frequency = $\log^{-1} 2.988 = 973$ KC at 15.8 DB

3 DB frequencies at 12.8 DB = $\log^{-1} 2.778 = 600$ KC

$= \log^{-1} 3.168 = 1473$ KC

$Q = 973/(1473-600) = 973/873 = 1.115$

$\underline{R_{RF}} = \omega L/Q = 6.28 \cdot 973 \cdot 10^{3} \cdot 1.27 \cdot 10^{-3}/1.115 = \underline{6960 \text{ ohms}}$

$R_{RF}/R_{DC} = 6960/1940 = 3.59$ times

High frequency stage #1

Center frequency = $\log^{-1} 3.235 = 1719$ KC at 15.0 DB

3 DB frequencies at 12.0 DB = $\log^{-1} 3.140 = 1380$ KC

$= \log^{-1} 3.335 = 2162$ KC

$Q = 1719/(2162-1380) = 1719/782 = 2.20$

$\underline{R_{RF}} = \omega L/Q = 6.28 \cdot 1719 \cdot 10^{3} \cdot .27 \cdot 10^{-3}/2.2 = \underline{1325 \text{ ohms}}$

$R_{RF}/R_{DC} = 1325/570 = 2.32$ times

(over)

Use $C_{GP} = 8\,pf$ for a UV201 tube

$X_{GP} = 1/6.28 \cdot .664 \cdot 10^6 \cdot 8 \cdot 10^{-12} = 10^6/33.3 = 30{,}000$ ohms.

$R_G = Q\omega L = .828 \cdot 6.28 \cdot 664 \cdot 10^3 \cdot 1.95 \cdot 10^{-3} = 6740$ ohms $\quad X_{GP} \gg R_G$

$X_{GP}/R_G = 4.45$

$X_{GP} = 1/6.28 \cdot .973 \cdot 10^6 \cdot 8 \cdot 10^{-12} = 10^6/48.9 = 20{,}500$ ohms.

$R_G = Q\omega L = 1.115 \cdot 6.28 \cdot 973 \cdot 10^3 \cdot 1.27 \cdot 10^{-3} = 8650$ ohms $\quad X_{GP} \gg R_G$

$X_{GP}/R_G = 2.37$

$X_{GP} = 1/6.28 \cdot 1.719 \cdot 10^6 \cdot 8 \cdot 10^{-12} = 10^6/86.4 = 11{,}600$ ohms.

$R_G = Q\omega L = 2.20 \cdot 6.28 \cdot 1719 \cdot 10^3 \cdot 0.27 \cdot 10^{-3} = 6400$ ohms $\quad X_{GP} \gg R_G$

$X_{GP}/R_G = 1.81$

2nd Sept 1961

$\frac{X_{GP}}{R_G}$ is greatest for low frequency stage. Consequently this stage is most stable. By putting it in middle of amplifier, between medium and high frequency stages, the entire amplifier is stabilized.

The high frequency stage is least stable. By putting it at start and driving from a low impedance signal generator, it is stablized and performance improved.

If a high impedance input circuit had been used, the first stage probably would have oscillated. Some damping in form of positive grid bias would be needed.

1st October 60

Priess Coils   Design probably 1924 or 5

Stage	1	2	3
D.C. Resistance, ohms	8.7 *	1320	1940
1000 cycle inductance, mh	.27	1.95	1.27
Core, strips	0	26	39
Circuit capacity, pf	32.2	27.4	22.1
Circuit Apparent series resistance, ohms	1330	6960	9820

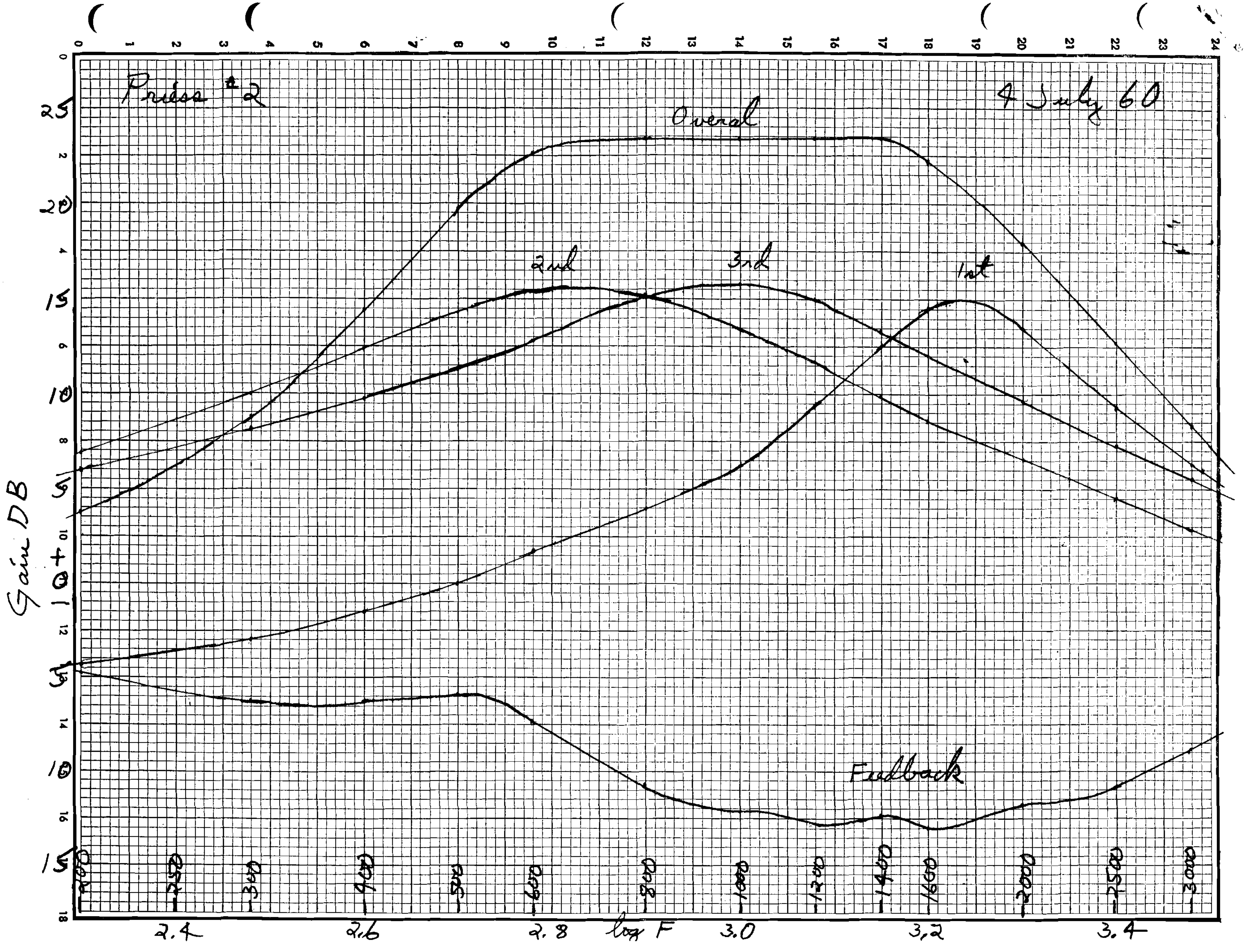
* 1st stage has external series resistor of 0 to 1000 ohms set at 560 ohms.

Ad in Radio News, November 1926, page 55

Priess Radio Corp.
687 Broadway, N.Y.C.
Straight line 9 tube, single dial control
Table model $195, Console $335
No details on circuit, but probably a superhet.

This stagger tuned triplet probably made about 1925.
Priess still worked for someone else in 1923 as shown
by patent filings.

(over)



Press #2
4 July 60
Overal
2nd
3rd
1st
Feedback
Gain DB
log F
2.4
2.6
2.8
3.0
3.2
3.4
200
250
300
400
500
600
800
1000
1200
1400
1600
2000
2500
3000