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Microwave mixers and duplexers Smith, D.P.

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REPORT NO. ERB-174

UNCLASSIFIED

LABORATORIES
OF
THE NATIONAL RESEARCH COUNCIL OF CANADA
ELECTRICAL ENGINEERING AND RADIO BRANCH

ANALYZED



MICROWAVE MIXERS AND DUPLEXERS

BY

D. P. SMITH

(AN UNCOMPLETED REPORT)

OTTAWA

OCTOBER, 1947

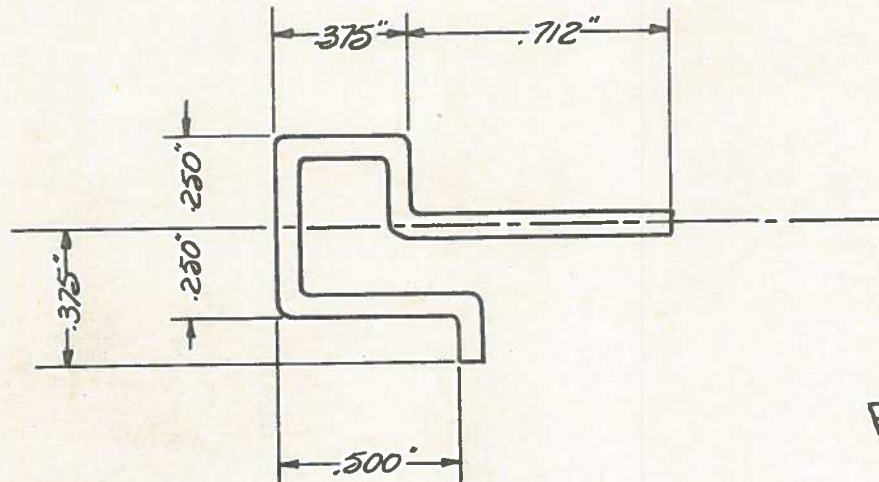


FIG. 2

NOTE: INNER RADIUS OF ALL
BENDS .050"-.100"

MAT'L: 1/16" BRASS ROD

ONE REQ'D PER UNIT

ASS'Y Dwg # GL111*-1199C

REVISED MAY 13/44 - EHB

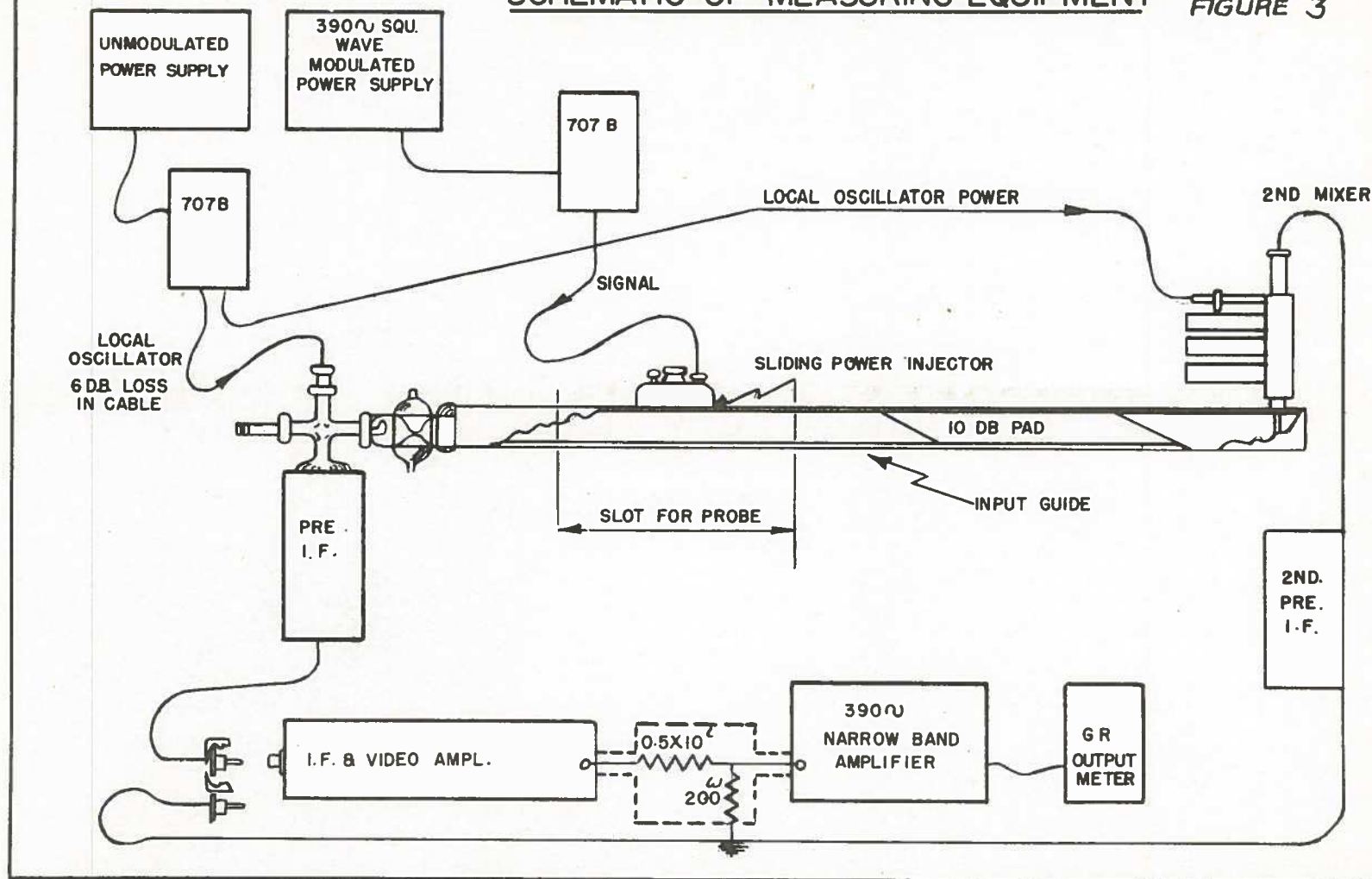
V	ROUGH FINISH
VV	FINE FINISH
VVV	EXTRA FINE FINISH
G	GRIND
P	POLISH

STANDARD TOLERANCES		
UNLESS OTHERWISE SPECIFIED		
INCHES	FRACTIONAL	DECIMAL
0-6	$\pm \frac{1}{64}$	$\pm .005$
OVER 6-24	$\pm \frac{1}{32}$	$\pm .010$
OVER 24	$\pm \frac{1}{16}$	$\pm .015$

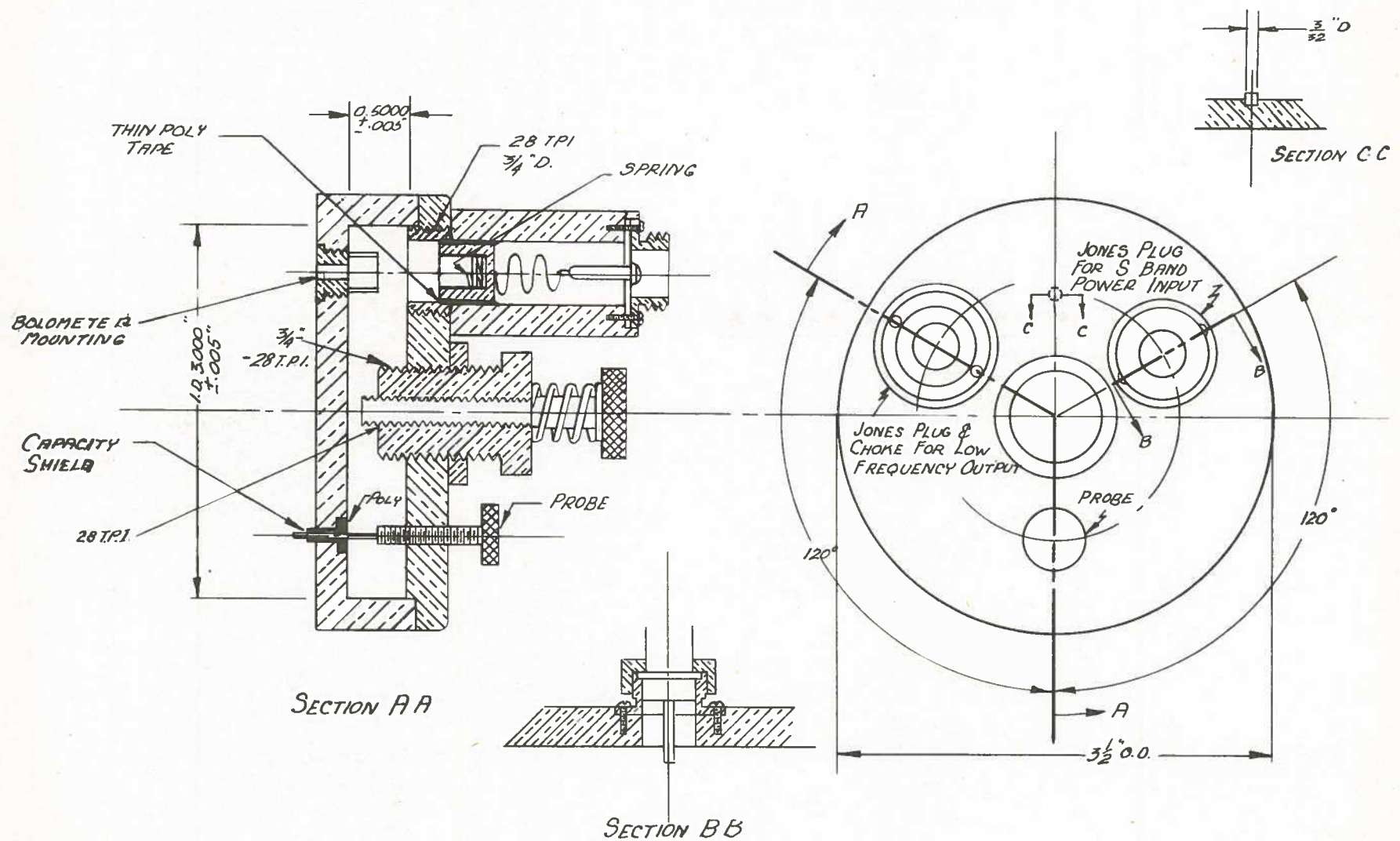
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CHECKED	AS	DATE	11-8-44	SCALE	
ENG. APPROV.	AS	DATE	Aug 23-44	FINISH	VV ALL OVER
NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA					
NAME				DWG. NO.	R-RF
DETAIL #1 - LOOP DETAIL				GL111*-1099-A	

SCHEMATIC OF MEASURING EQUIPMENT

FIGURE 3



STANDING WAVE PROBE FIGURE 4



SATURATION CHECK

CRYSTAL QY 4904

CRYSTAL CURRENT 0.5MA

Δ 10^{-7} CMS

AMPLIFIER
GAIN 20

Δ GAIN 20
AND PROBE WITHDRAWN

OUTPUT SIGNAL

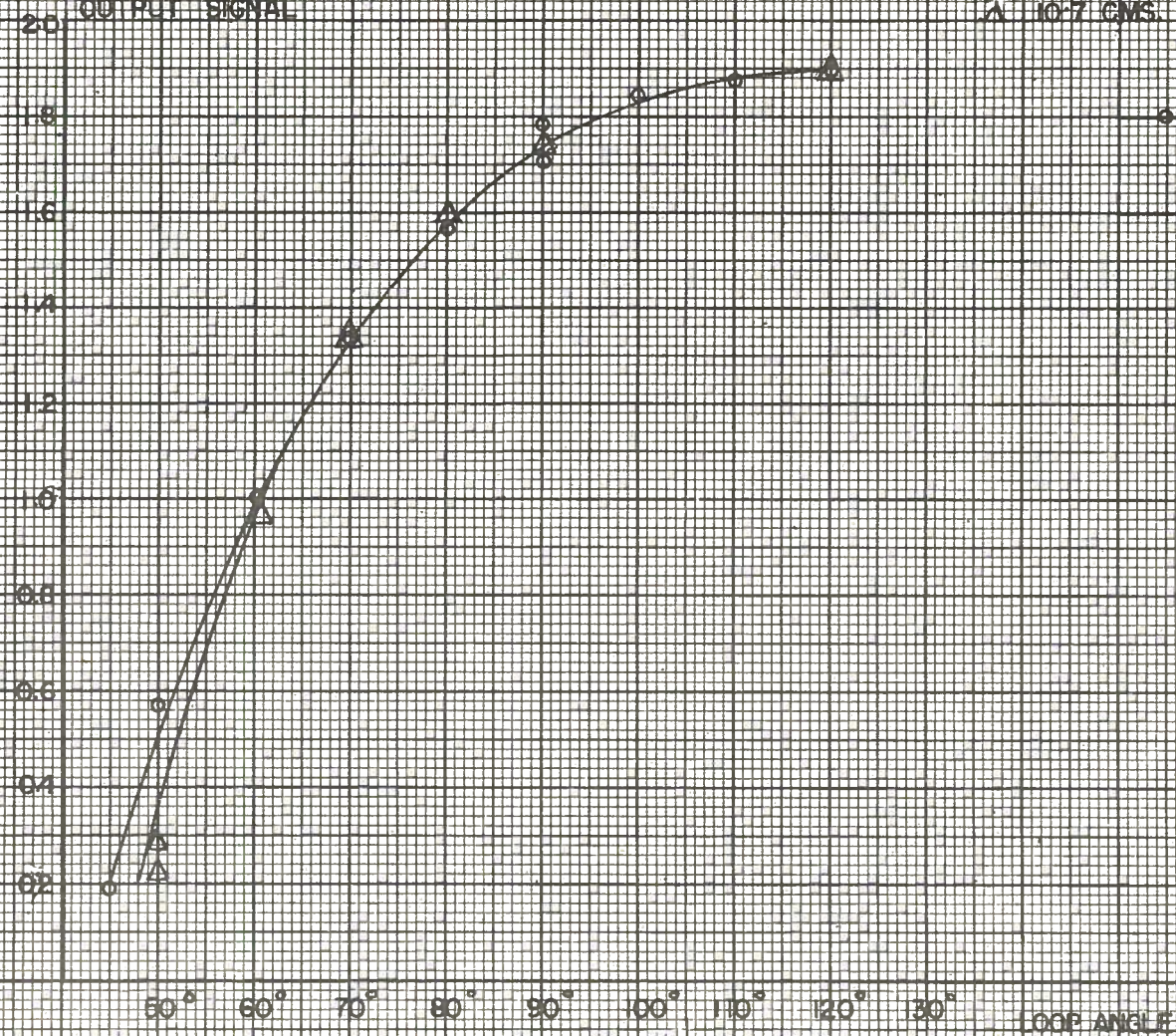


FIGURE 5

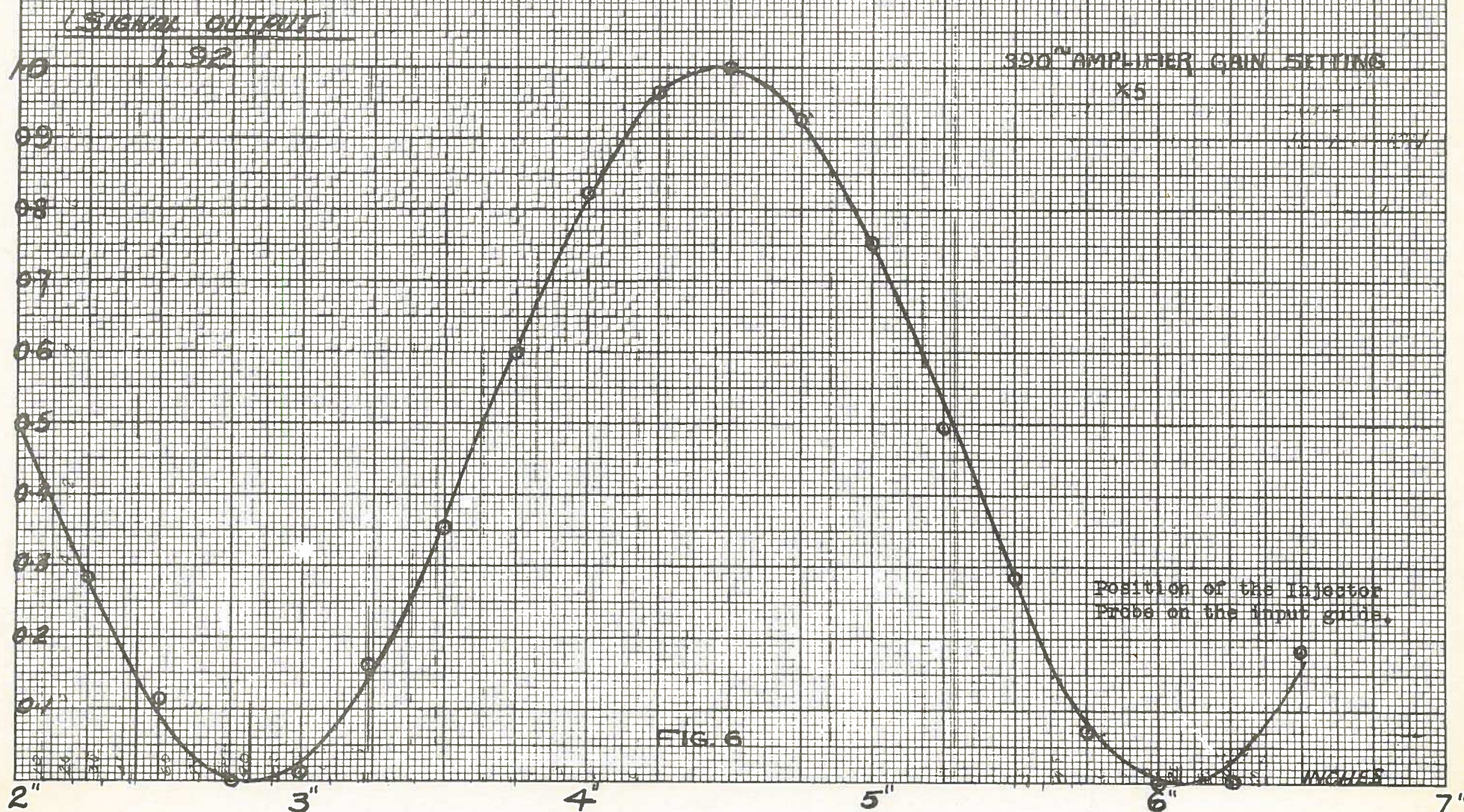
LAW OF THE SUPERHET SYSTEM

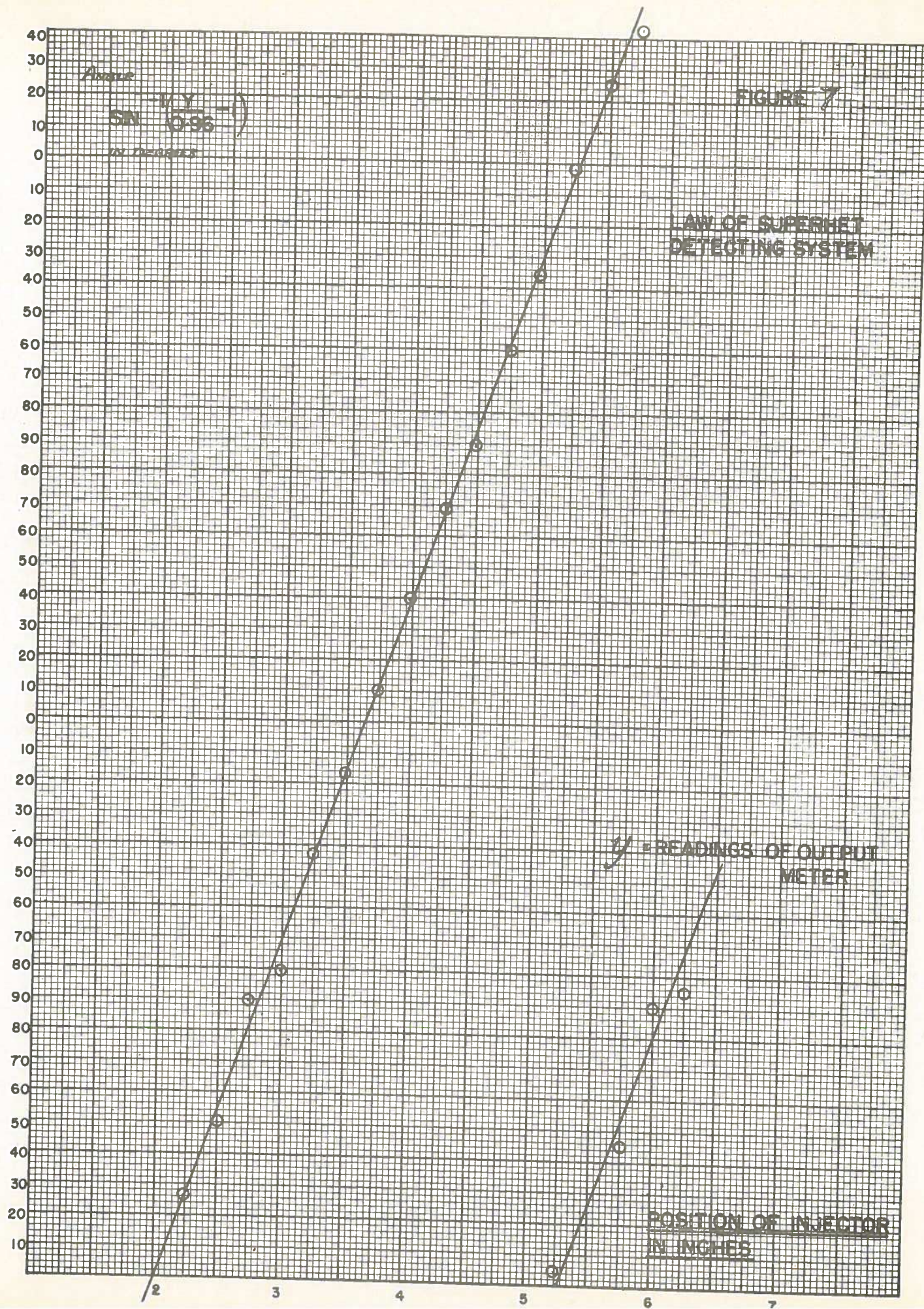
Output from mixer and amplifier system when measuring the standing waves from a complete reflection.

THE PLOTTED POINTS ARE (SIGNAL OUTPUT)
1.92

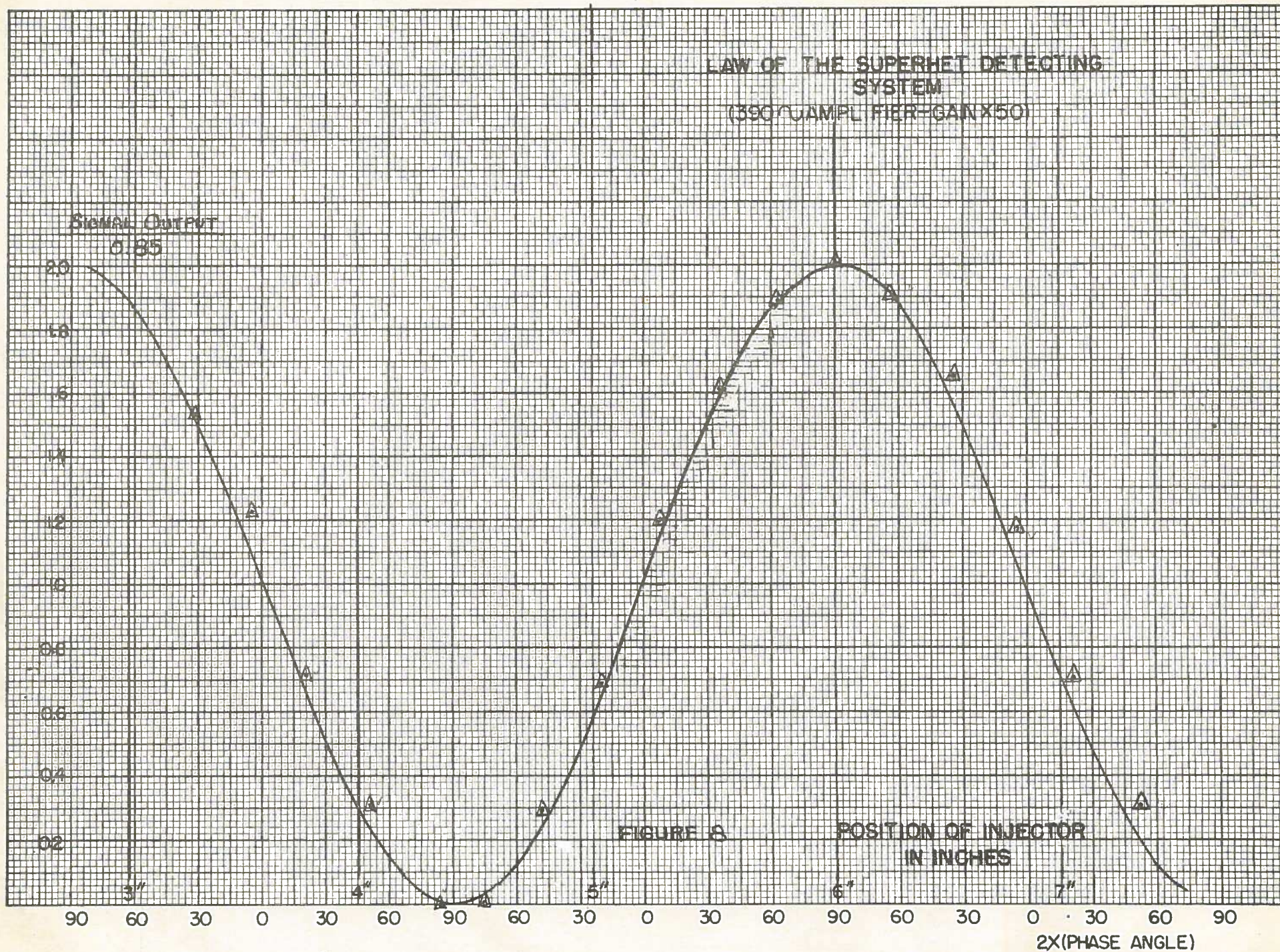
THE CURVE IS $2Y = (1 + \sin \frac{4\pi x}{\lambda_g})$

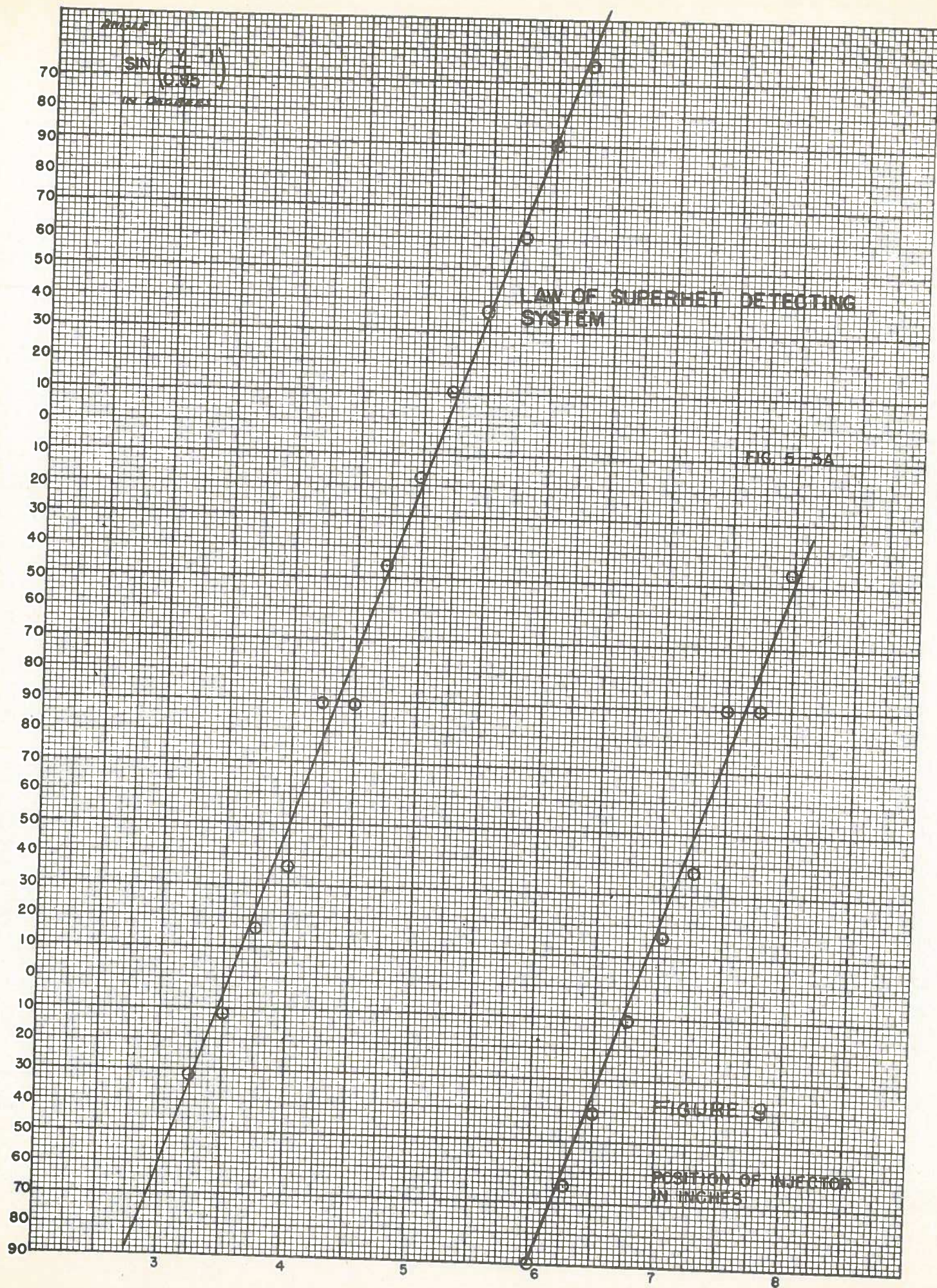
$\lambda_g = 16.6 \text{ cms}$





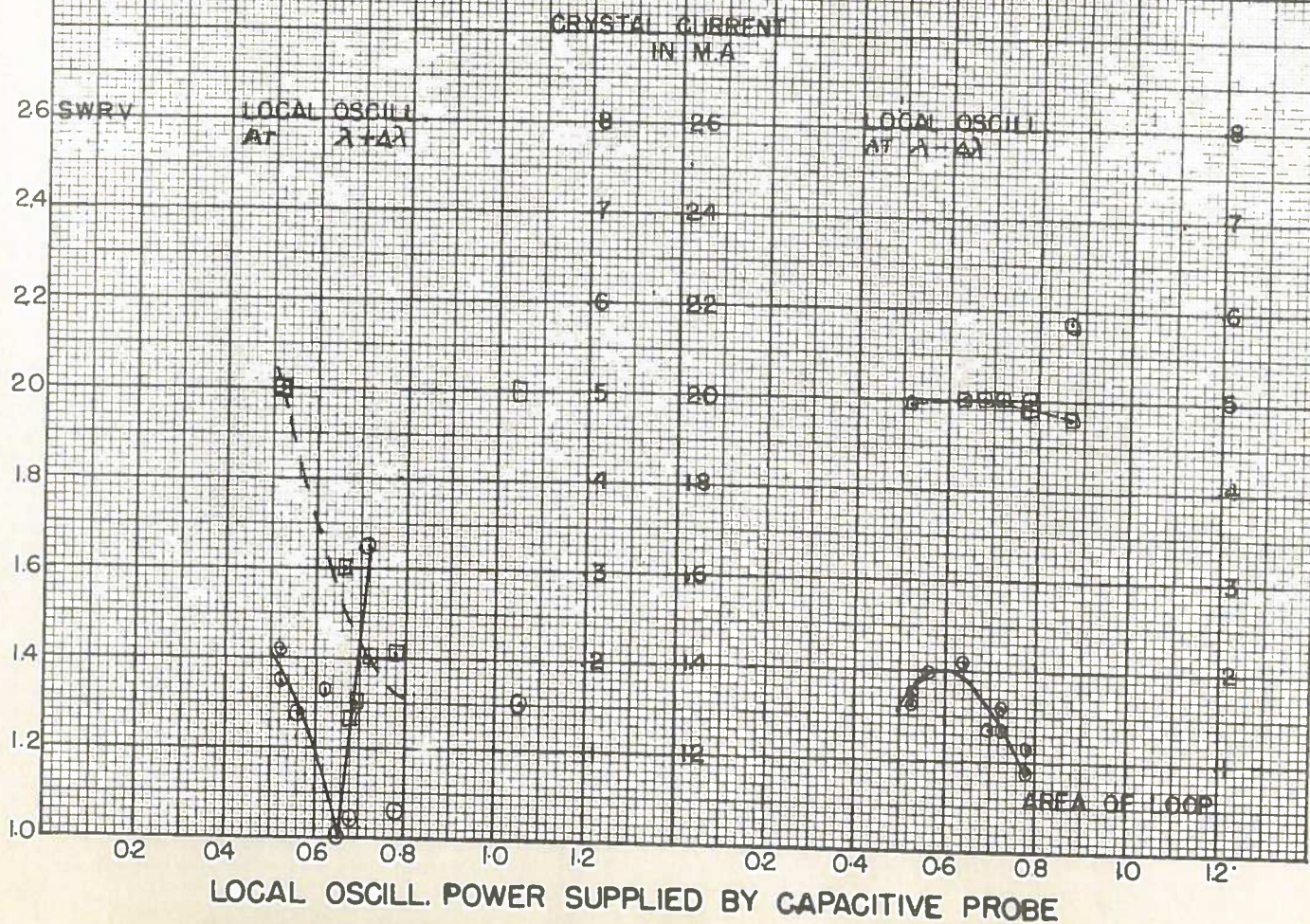
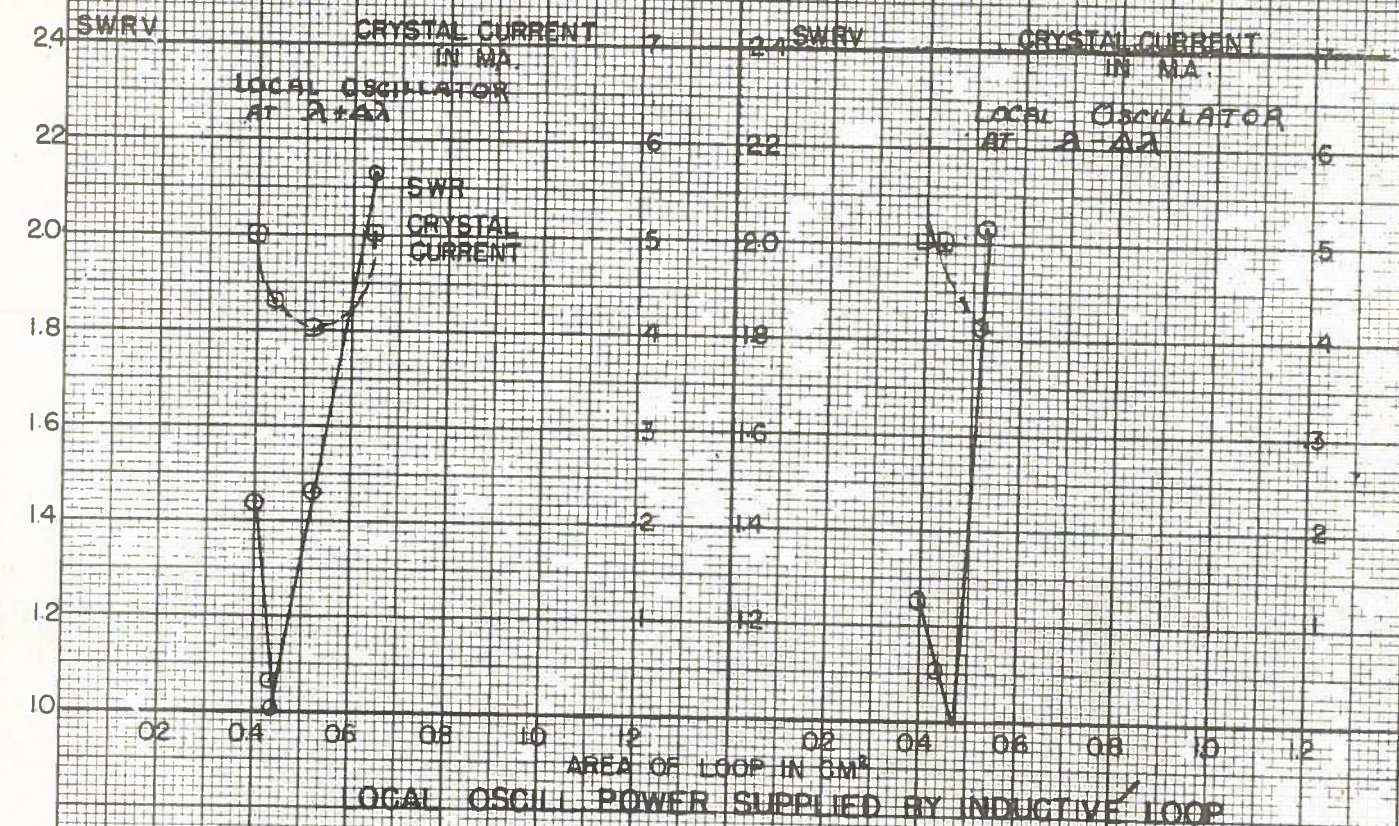
LAW OF THE SUPERHET DETECTING SYSTEM (390 VAMPL FIER-GANX50)



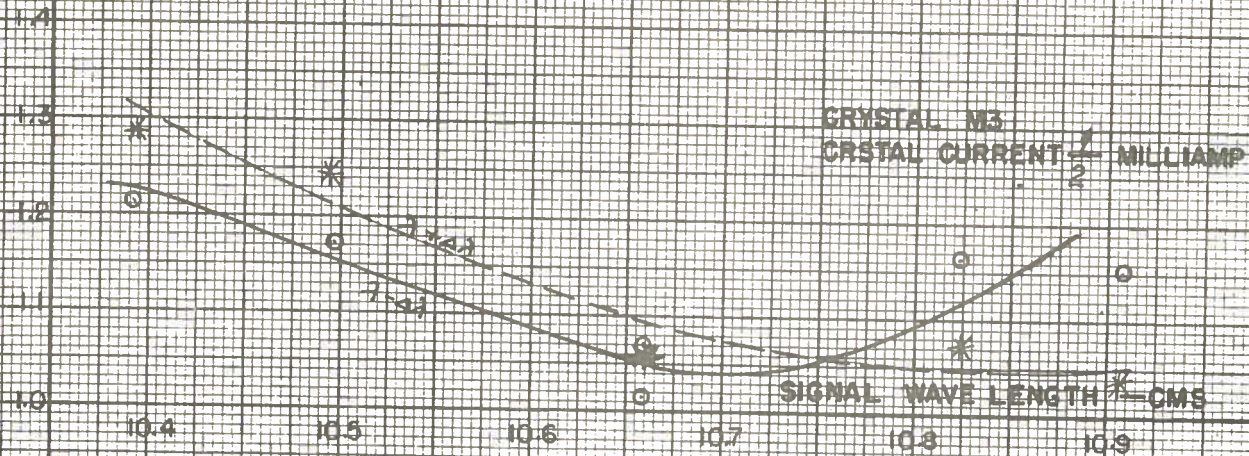


INPUT SWR AS A FUNCTION OF LOOP AREA

FIGURE 10

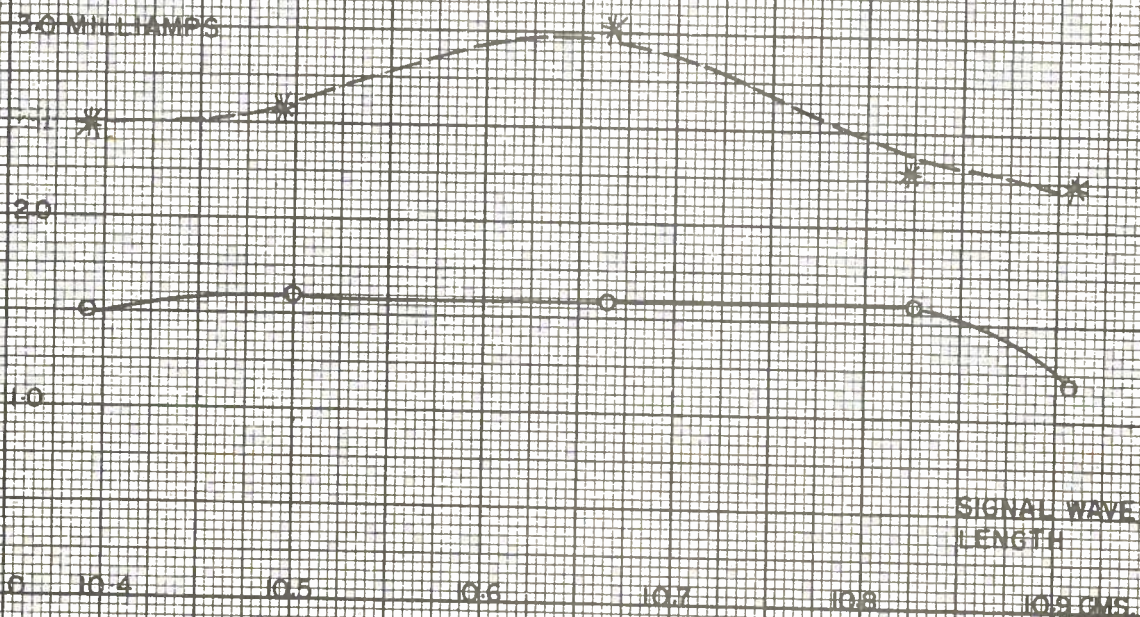


SWR MATCH GUIDE



MAXIMUM CRYSTAL CURRENT FROM M^oNALLY TUBE THROUGH 6 DB OF CABLE

30 MILLIAMPS



BEHAVIOUR OF MIXER WITH LARGE LOOP
OVER BAND OF λ

DWG 11

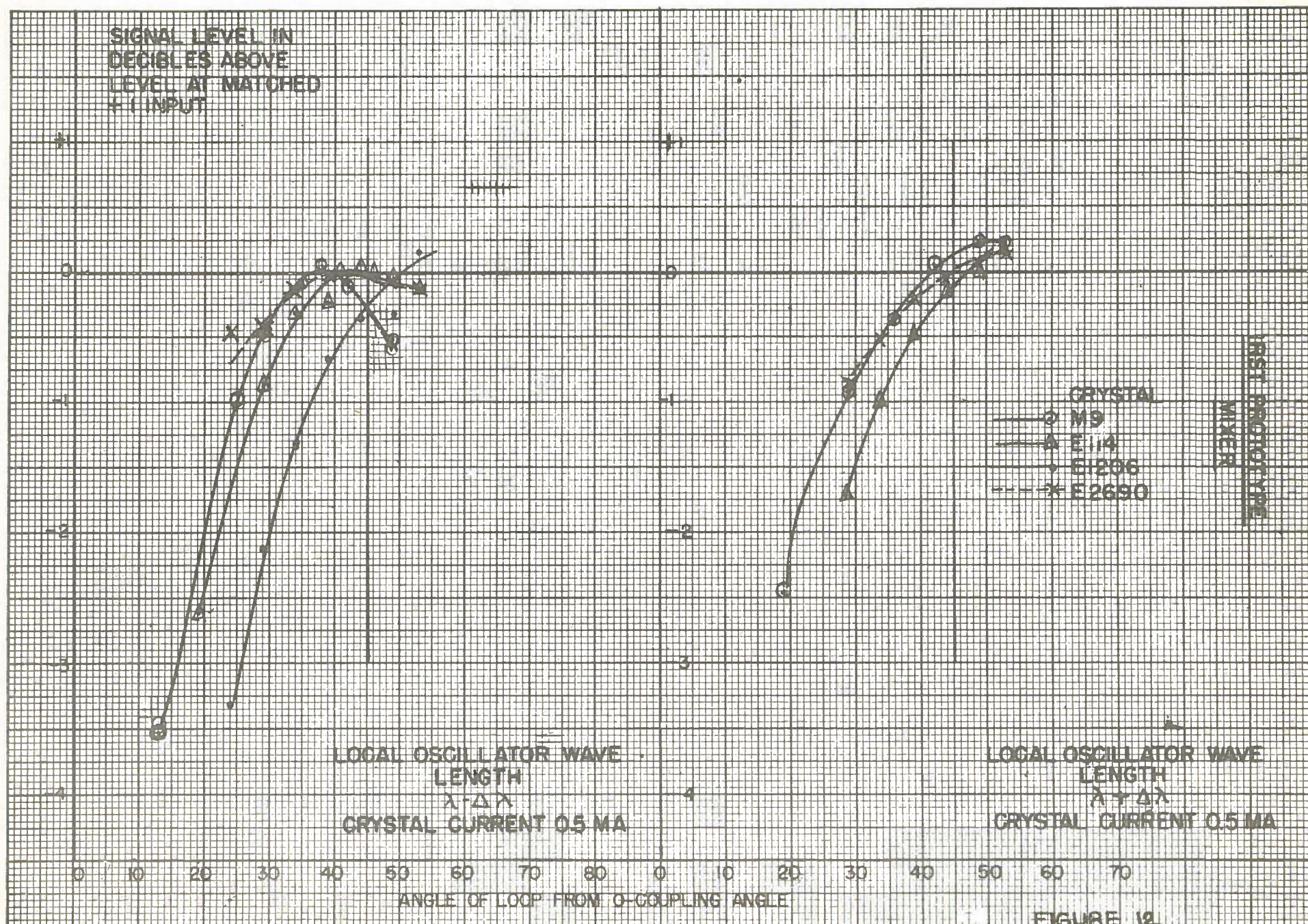


FIGURE 12

MEASURED OUTPUT AS A FUNCTION OF LOOP ANGLE

14 OUTPUT SIGNAL POWER
[($\lambda + \Delta\lambda$) LOCAL OSCILL.]

12

10

8

6

4

2

0

50 60 70 80 90 100 110 120 130 140

[($\lambda - \Delta\lambda$) LOCAL OSCILL.]

12 OUTPUT SIGNAL POWER

10

8

6

4

2

0

50 60 70 80 90 100 110 120 130 140

CRYSTALS

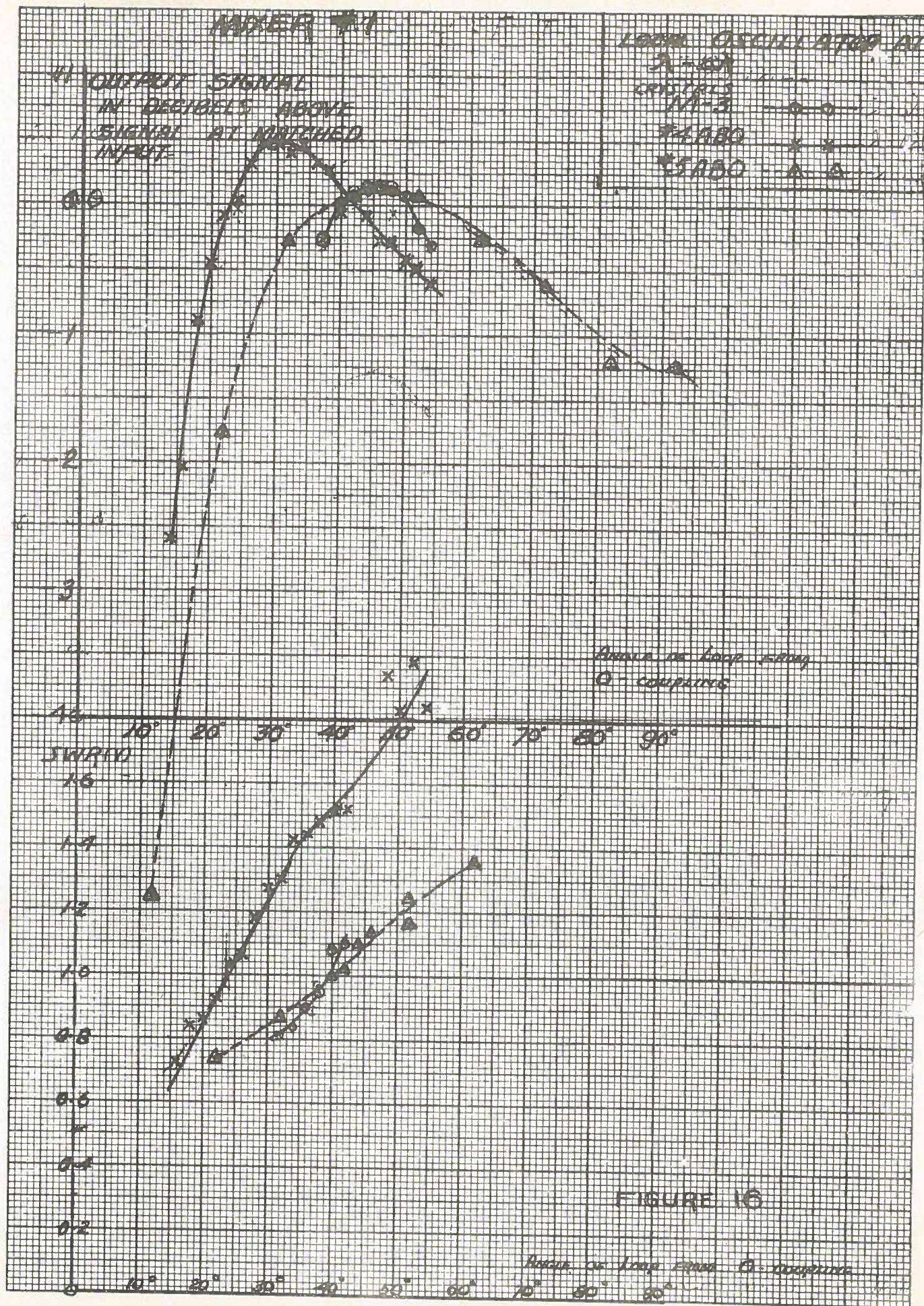
- O — M9 ($\lambda - \Delta\lambda$)
- X — M9 ($\lambda + \Delta\lambda$)
- △ — E114 ($\lambda - \Delta\lambda$)
- — E114 ($\lambda + \Delta\lambda$)
- — E1206 ($\lambda - \Delta\lambda$)
- * — E1206 ($\lambda + \Delta\lambda$)
- ◻ — E2690 ($\lambda - \Delta\lambda$)
- △ — E2690 ($\lambda + \Delta\lambda$)

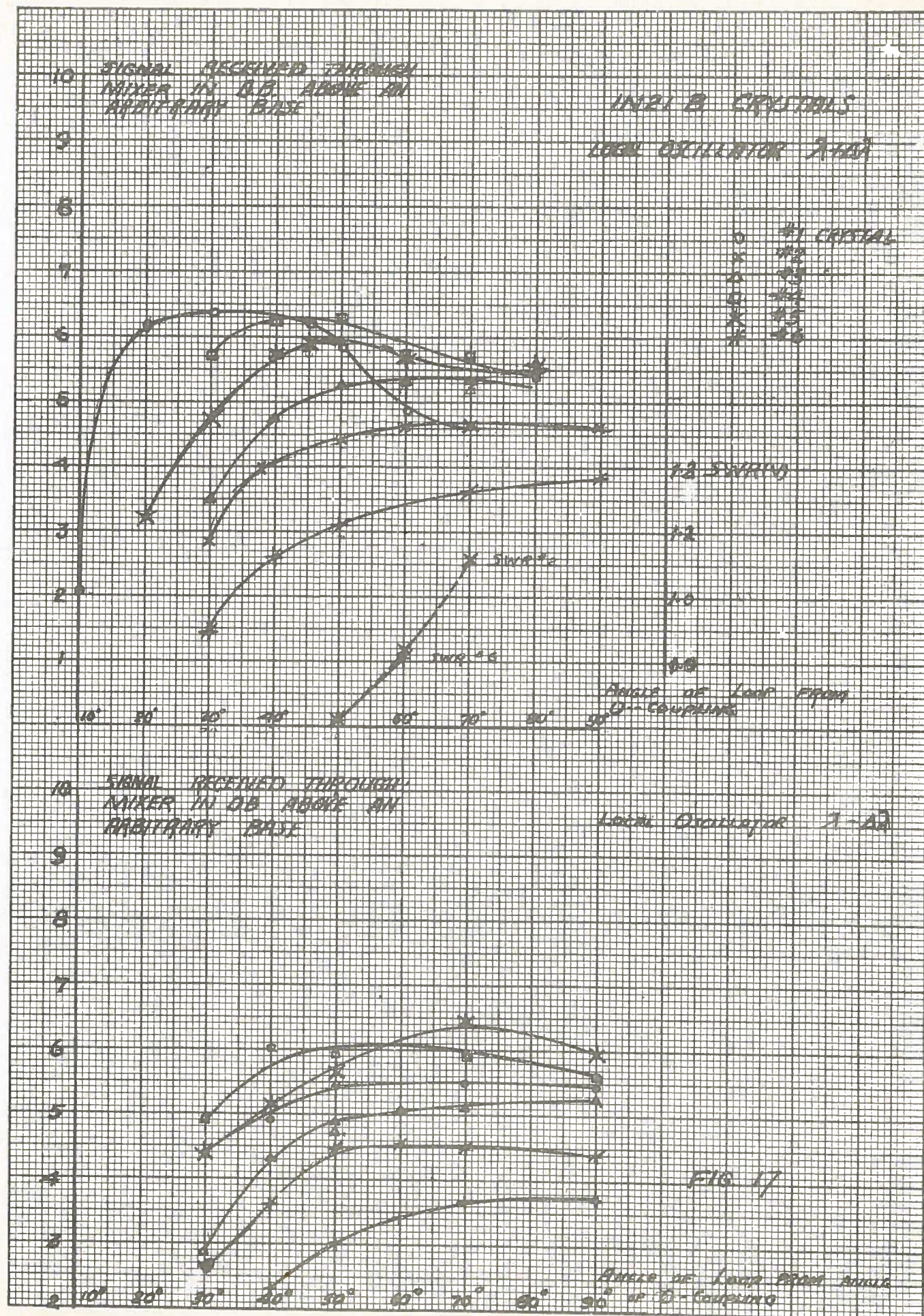
CRYSTAL CURRENT 0.5 MA.

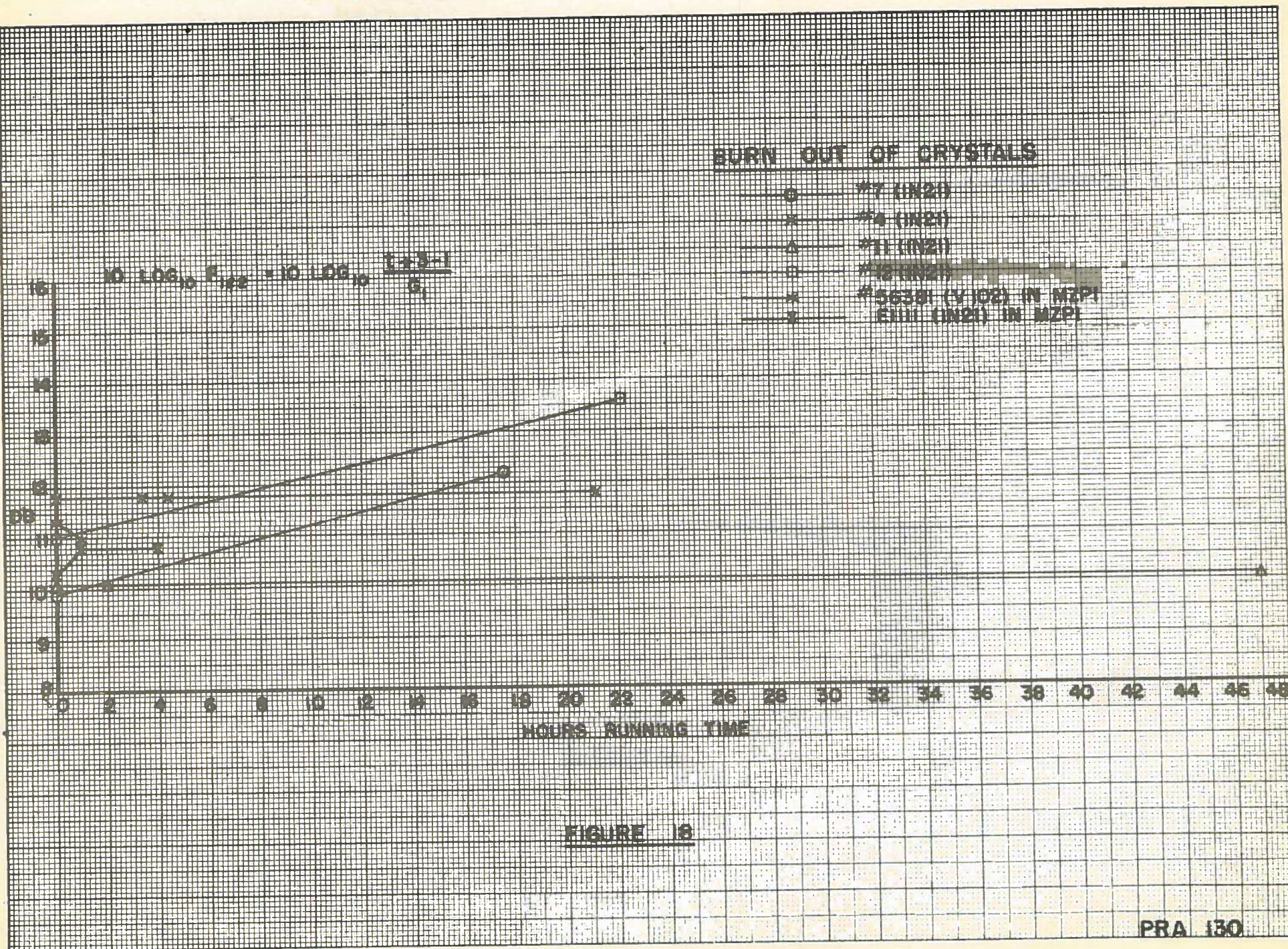
LOOP ANGLE

LOOP ANGLE

Fig. 13







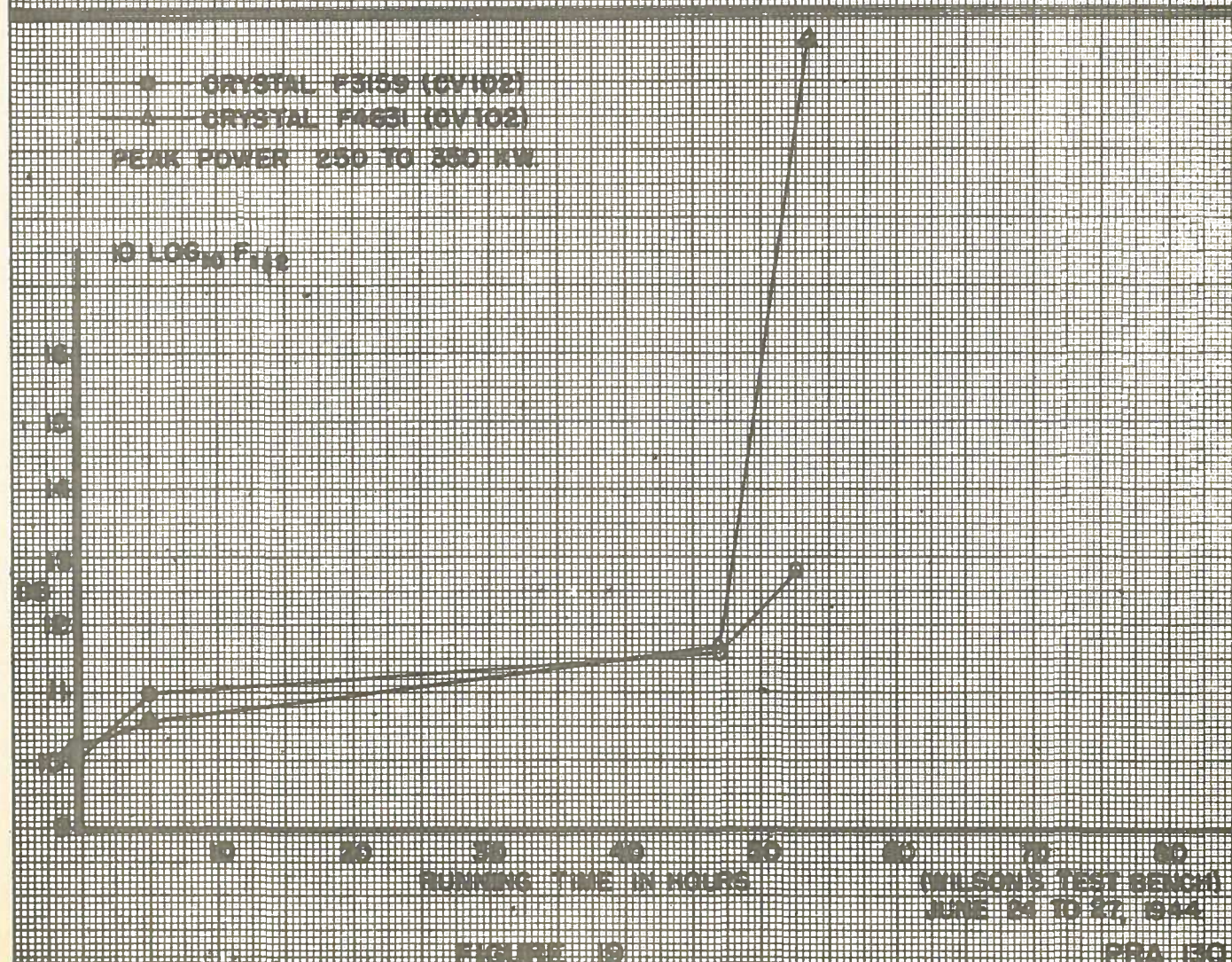
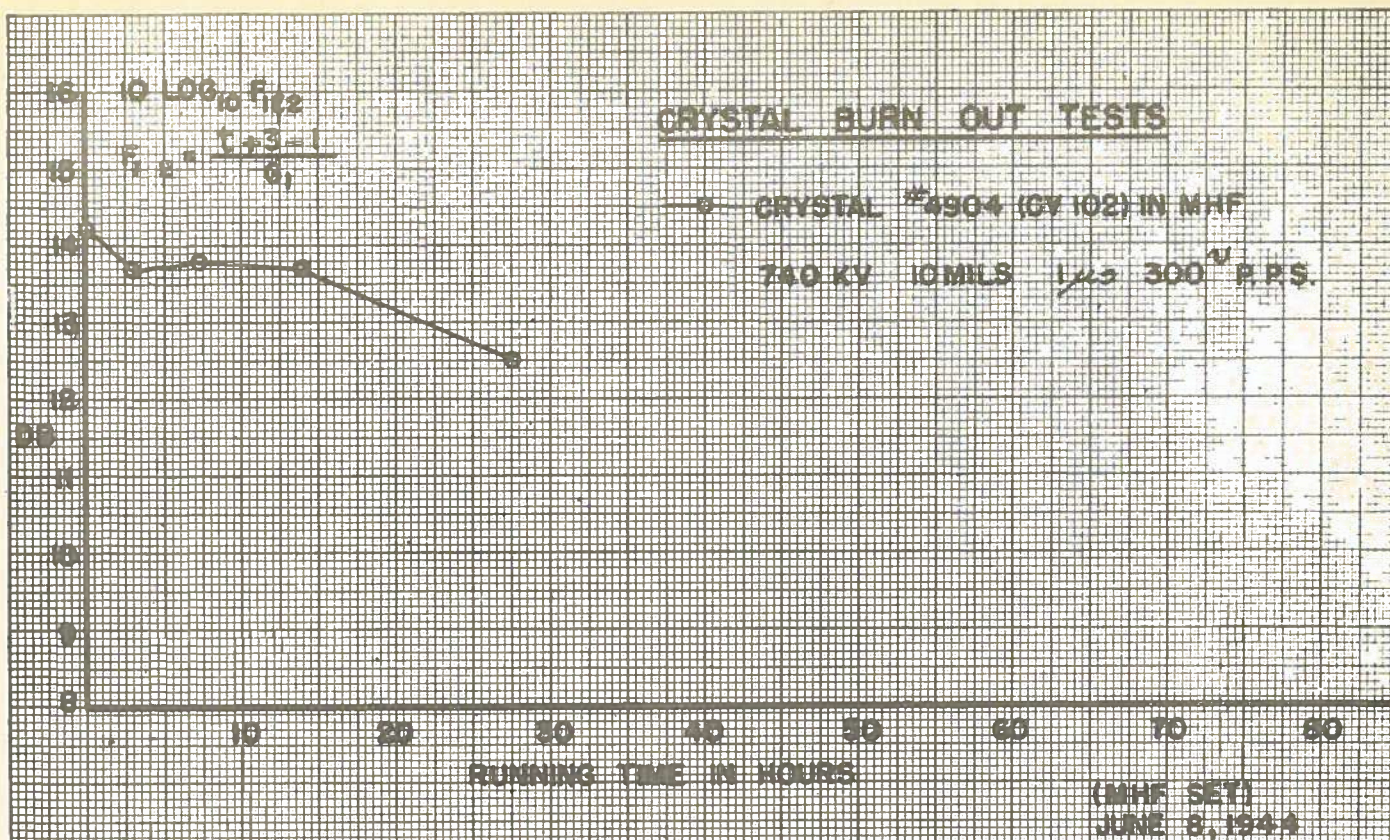
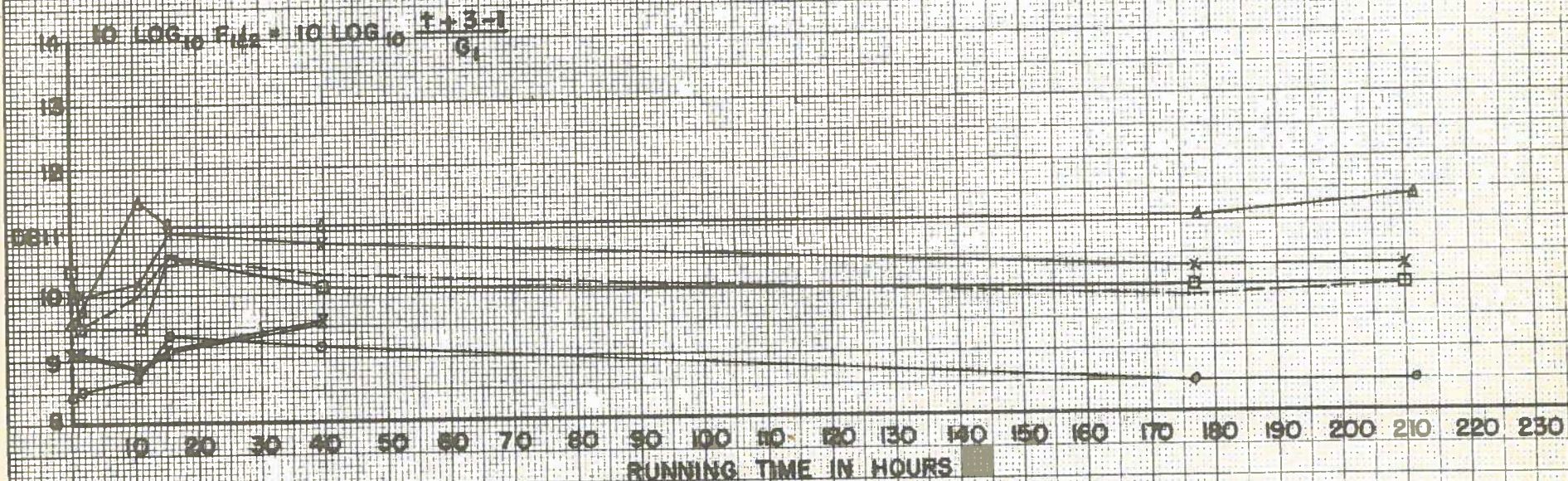


FIGURE 19

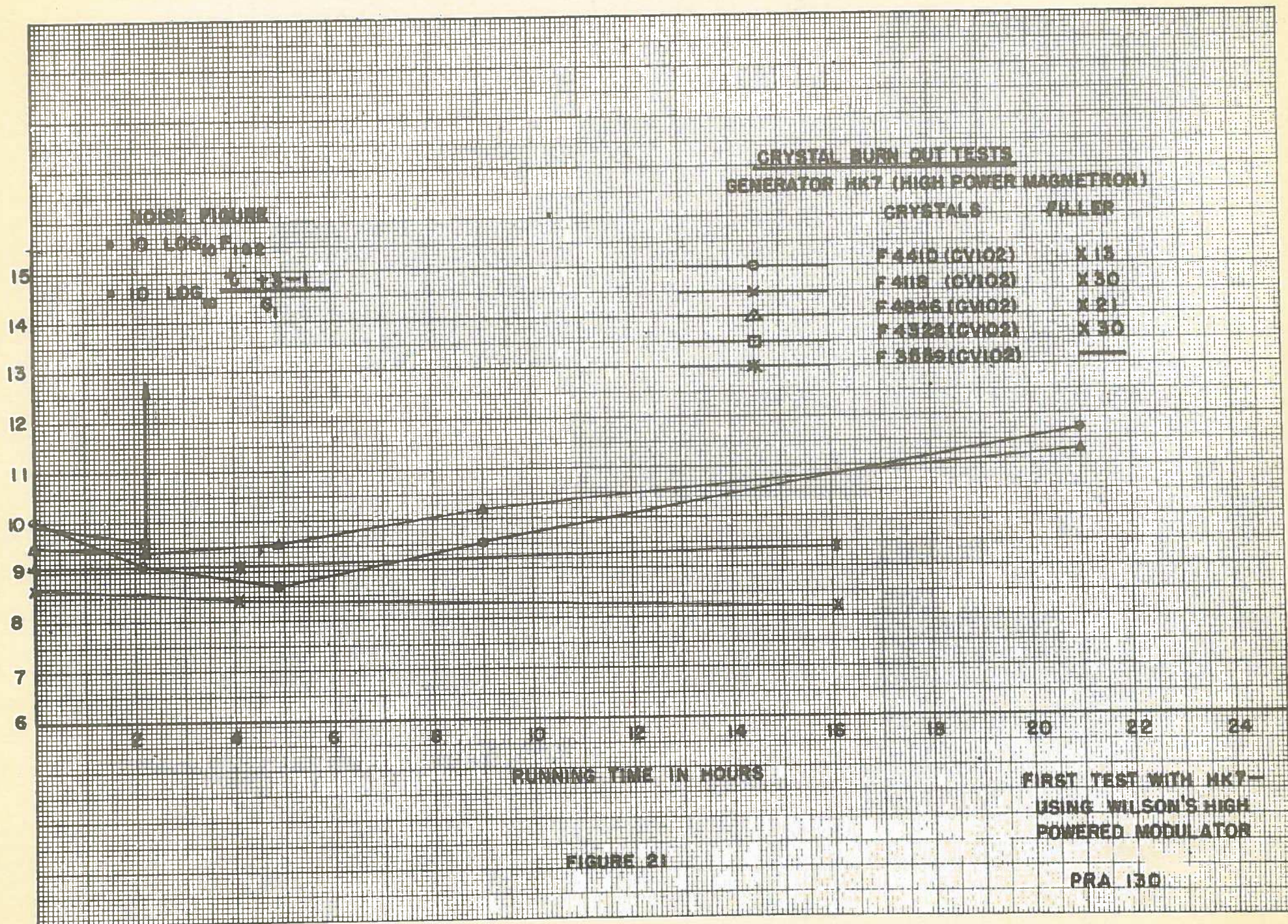
BURN OUT OF CV 102 CRYSTALS

- x CONTROL
- o F 4757
- Δ F 4556
- x F 4879
- F 4653
- AVERAGE



PEAK POWER 170 TO 200 KW
 PULSE LENGTH $1/\mu s$
 RECURRENT FREQUENCY 300~
 JULY, 1944.

FIGURE 20



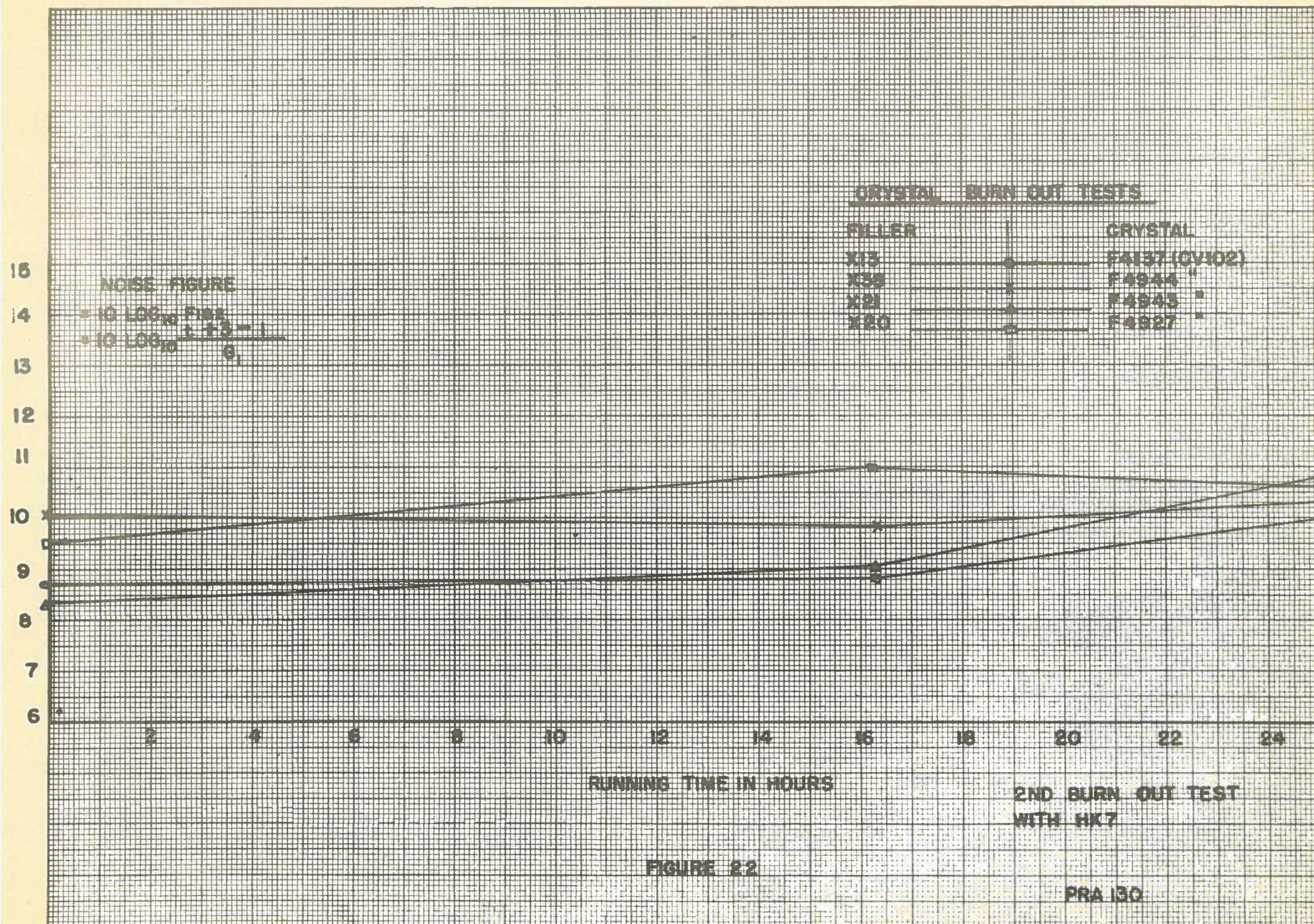
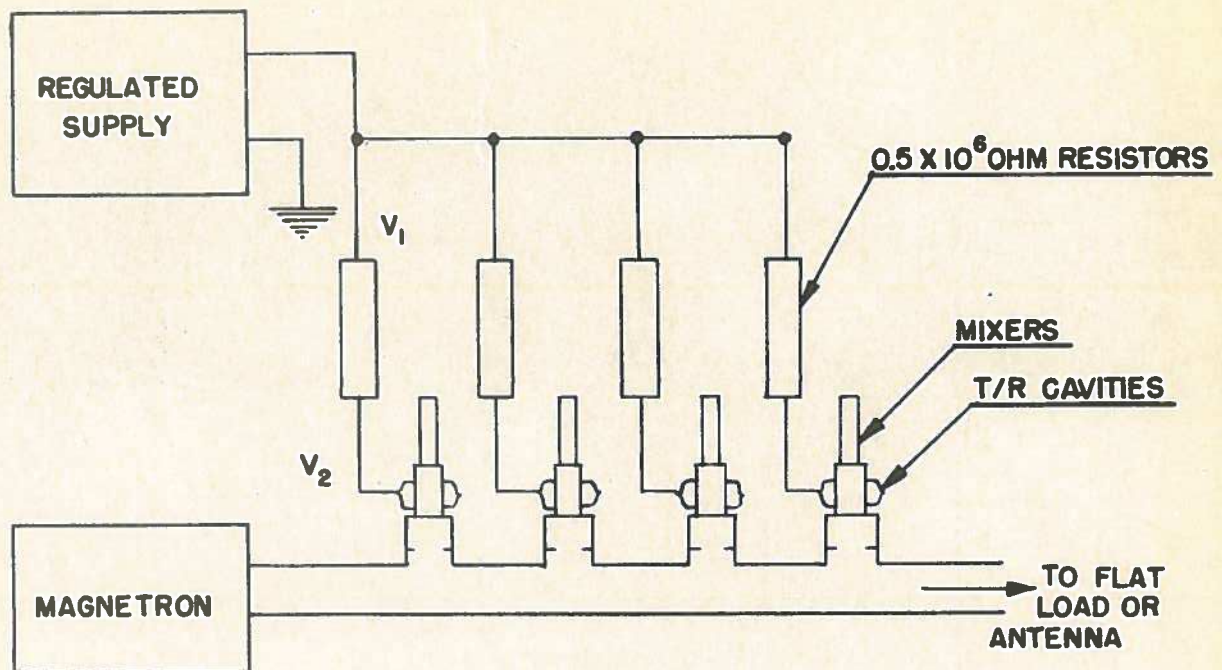
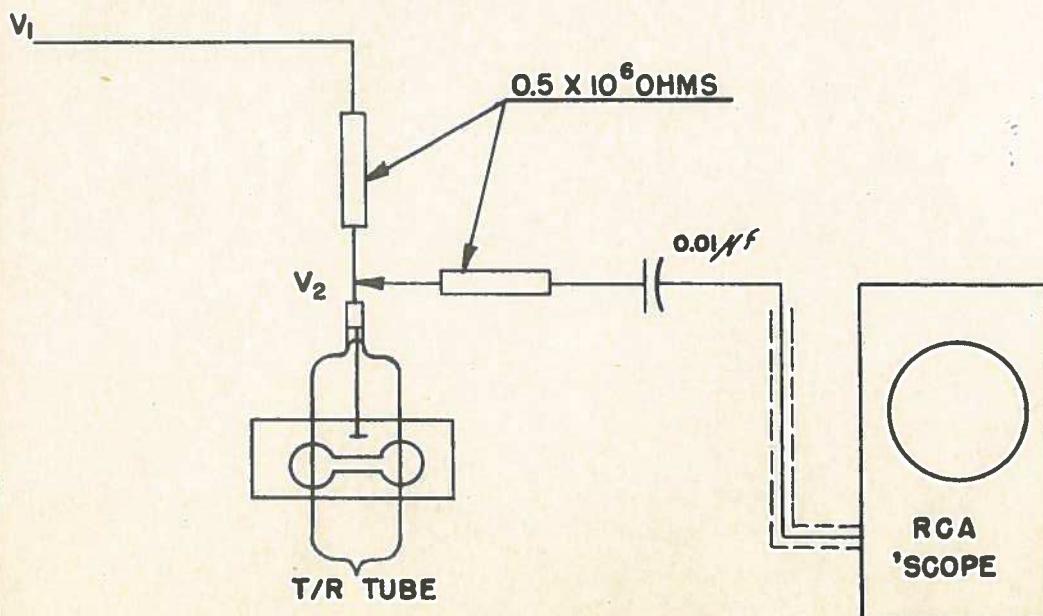


FIGURE 23



T/R CAVITIES MOUNTED ON SHORT WAVE GUIDE STUBS—WHOSE LENGTHS AND IRISES ARE CHOSEN TO CAUSE NO REFLECTIONS ON THE MAIN GUIDE WHEN THE T/R'S ARE ARCING.

SKETCH OF BURN OUT TEST ASSEMBLY.



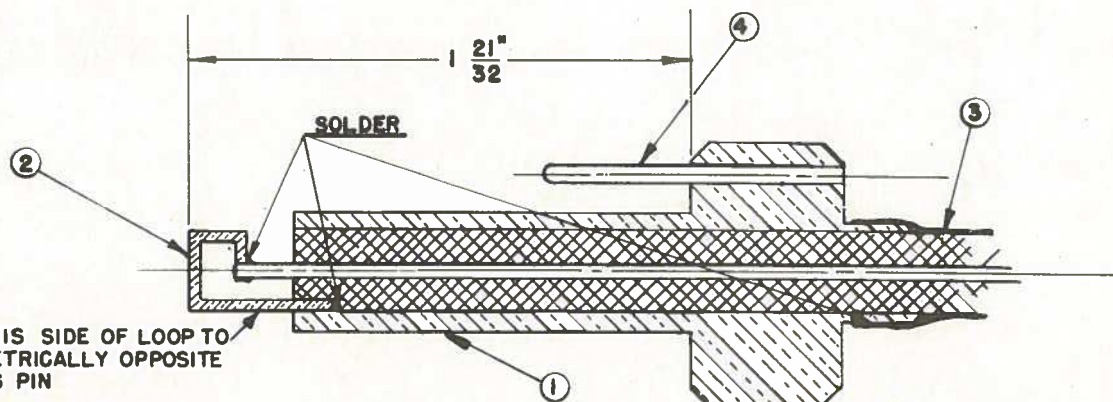
TEST FOR RELAXATION OSCILLATIONS IN T/R TUBES.

FIGURE 25

NOTE: REAM .265" TO FIT AS48M CABLE OR
SUITABLE DIA. TO FIT ANY OTHER CABLE

Technical drawing of a bracket with the following dimensions and features:

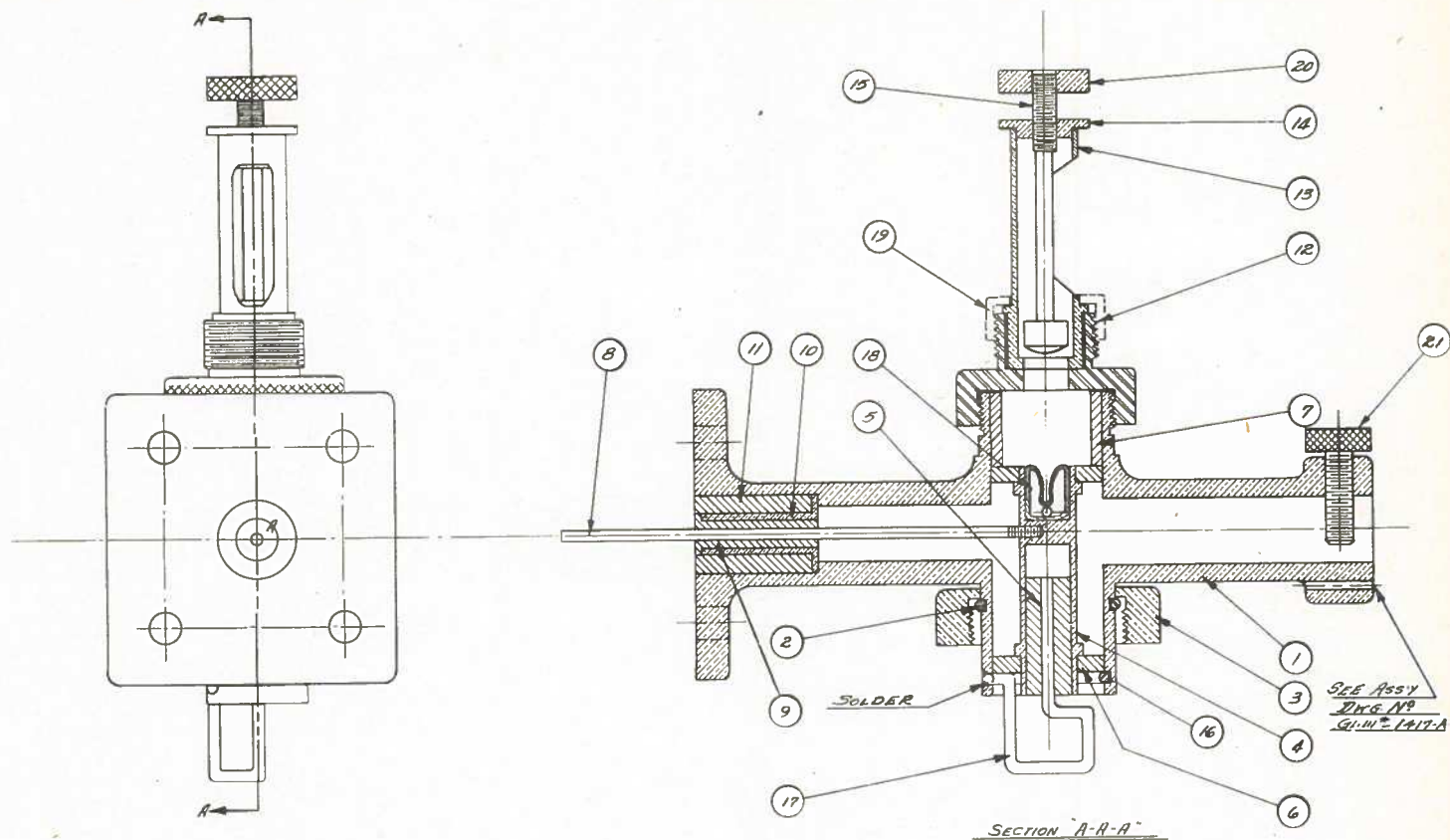
- Overall width: $15\frac{15}{32}$ inches
- Top horizontal section width: $3\frac{16}{16}$ inches
- Vertical section height: $5\frac{32}{32}$ inches
- Bottom horizontal section width: $1\frac{4}{4}$ inches
- Radius: $\frac{1}{8}$ inch R.
- Hole: $\frac{1}{8}$ inch diameter hole.
- Callout: **#60 DRILL (.040") DIA. HOLE.**
- Callout: **CURVE TO FIT TUBE ON ASS'Y. DWG.**



NOTE: INNER DIAM. OF OUTER
CONDUCTOR MAY BE VARIED
SLIGHTLY TO FIT CABLE USED
IN EQUIPMENT IN QUESTION
IF THIS IS NOT AS48M.

TO FIT IN MIXER-DWG. # GL III¹-1205A

4	---	1/16" STEEL LOCATING PIN
3	---	AS48M CABLE
2	GL III 1418A	LOOP
1	GL III 1419A	OUTER CONDUCTOR
ITEM	DWG NO.	DESCRIPTION

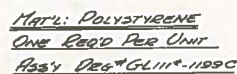


NOTE: (1) SWEAT DETAIL 20 TO DETAIL 15.
(2) FOR DETAIL PURPOSES LOOP HAS
BEEN ROTATED 45° AND THEN DRAWN
IN SECTION VIEW

ITEM	PART NO	QUAN	MAT'L	DESCRIPTION
21	GL III* 1106A	1	BRASS	CENTER CONDUCTOR
20	GL III* 1196A	1	BRASS	KNURL HEAD SCREW
19	-	1	STEEL	NUT
18	RDY. 181A	1	PHAS PHLY BRONZE	STD JONES PLUG NUT
17	GL III* 1099A	1	BRASS	CRYSTAL CONTACT
16	GL III* 1199A	1	STEEL	LOOP DETAIL
15	GL III* 1206A	1	BRASS	LOCK RING
14	RTF 281A	1	BRASS	ROD
13	RTF 281A	1	BRASS	CAP
12	GL III* 1196A	1	STEEL	UPPER BARREL
11	GL III* 1199A	1	POLY	CRYSTAL BARREL SUPPORT
10	GL III* 1199A	1	BRASS	OUTER INSULATOR
9	GL III* 1099A	1	POLY	CHOKE SLEEVE
8	GL III* 1106A	1	BRASS	INNER INSULATION
7	ROX 205A	1	POLY	DESCRIPTION
6	ROX 205A	2	POLY	DESCRIPTION
5	GL III* 1101A	1	POLY	DESCRIPTION
4	GL III* 1100A	1	BRASS	DESCRIPTION
3	GL III* 1107A	1	BRASS	DESCRIPTION
2	REL C- 124A	1	STEEL	DESCRIPTION
1	GL III* 1805A	1	BRASS	DESCRIPTION

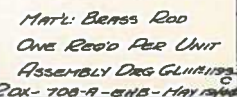
REV 25 11-44 D.C.

DRAWN BY	ENBELL	DATE	AUG 8 1946	SUPERSEDES
CHECKED	AS	DATE	10-8-44	SCALE
ENG APPROV		DATE		FINISH
NATIONAL RESEARCH COUNCIL-RADIO SECTION - OTTAWA CANADA				
NAME	MIXER ASSEMBLY			DWG NO
				GL III* 1199C



ROUGH FINISH
FINE FINISH
EXTRA FINE FINISH
CRD
P FOLCH

STANDARD TOLERANCES UNLESS OTHERWISE SPECIFIED		
SIZES	FRACTIONAL	DECIMAL
0-6	± 1/64	± .005
OVER 6-24	± 1/32	± .010
OVER 24	± 1/16	± .015



V	ROUGH FINISH
VV	FINE FINISH
VVV	EXTRA FINE FINISH
G	GRIND
P	POLISH

STANDARD TOLERANCES		
UNLESS OTHERWISE SPECIFIED		
SIZE	TOLERANCE	FINISH
0-6	± .005	± .005
0.075	± .005	± .005
0.075	± .005	± .005



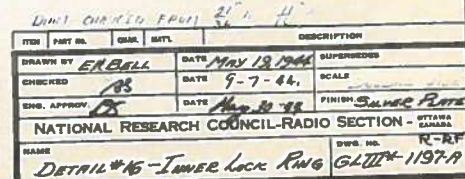
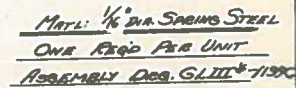
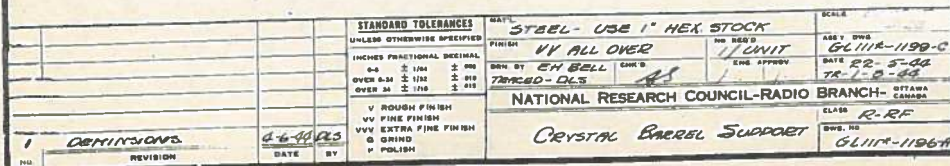
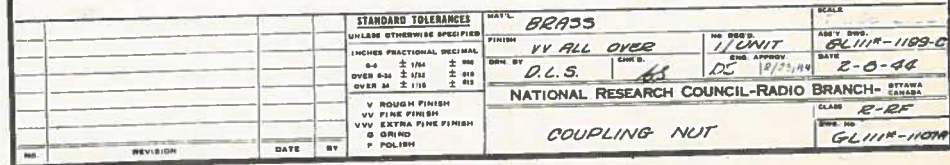
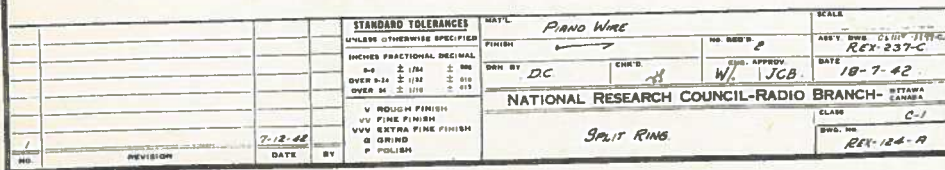
STANDARD TOLERANCES			
UNLESS OTHERWISE SPECIFIED			
INCHES	FRACTIONAL	DECIMAL	
0-6	± 1/64	± .008	
OVER 6-24	± 1/32	± .010	
OVER 24	± 1/16	± .015	
V ROUGH FINISH			
VV FINE FINISH			
VVV EXTRA FINE FINISH			
G GRIND			
P POLISH			

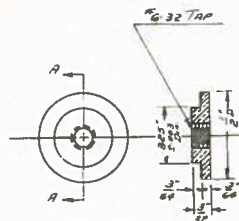
MATERIAL POLYSTYRENE		SCALE	
PARTIAL	A5 SHOWN	NO. DES. D	ASST. DWS
DATE BY 5/13/54	ENG. D	11 UNIT	GL 11-1195A
TESTED BY DLS	48	ENG. APPROV	DATE MAY 18-54
			1-B-64
NATIONAL RESEARCH COUNCIL-RADIO		BRANCH- OTTAWA CANADA	
		CLASS	R-2F
DETAIL #11 - OUTER INSULATOR		DWS NO.	GL 11-1195A



V	ROUGH FINISH
VV	FINE FINISH
VVV	EXTRA FINE FINISH
G	GLASS
P	POLISH

REVISED - JUNE 27 th 66 - D.L.S.				1199 C
ITEM	PLANT NO.	QUAN	MATL	DESCRIPTION
DRAWN BY EMB.		DATE May 12 1966		SUPERSEDES
CHECKED <i>ES</i>		DATE 11-7-66		SCALE
ENG. APPROV <i>ES</i>		DATE Aug 27 66		FINISH <i>As NOTED</i>
NATIONAL RESEARCH COUNCIL-RURAL SECTION -				
				ONTARIO CANADA
NAME	DETAIL #10 - CHOKE SLEEVE			DWG NO. R-RP GLI# 1198 A





SECTION A-A
SOFT SOLDER INTO DETAIL 13

STANDARD TOLERANCES		MATERIAL		SCALE	
UNLESS OTHERWISE SPECIFIED		BRASS		1" = 1/8"	
FINISH		VV ALL OVER		DATE 12/1/43	
INCHES FRACTIONAL DECIMAL		VV ALL OVER		DATE 12/1/43	
OVER 1/16 1/32 1/64		VV ALL OVER		DATE 12/1/43	
OVER 1/32 1/64 1/128		VV ALL OVER		DATE 12/1/43	
OVER 1/128 1/256 1/512		VV ALL OVER		DATE 12/1/43	
OVER 1/512 1/1024 1/2048		VV ALL OVER		DATE 12/1/43	
OVER 1/2048 1/4096 1/8192		VV ALL OVER		DATE 12/1/43	
OVER 1/8192 1/16384 1/32768		VV ALL OVER		DATE 12/1/43	
OVER 1/32768 1/65536 1/131072		VV ALL OVER		DATE 12/1/43	
OVER 1/65536 1/131072 1/262144		VV ALL OVER		DATE 12/1/43	
OVER 1/262144 1/524288 1/1048576		VV ALL OVER		DATE 12/1/43	
OVER 1/1048576 1/2097152 1/4194304		VV ALL OVER		DATE 12/1/43	
OVER 1/4194304 1/8388608 1/16777216		VV ALL OVER		DATE 12/1/43	
OVER 1/16777216 1/33554432 1/67108864		VV ALL OVER		DATE 12/1/43	
OVER 1/67108864 1/134217728 1/268435456		VV ALL OVER		DATE 12/1/43	
OVER 1/268435456 1/536870912 1/1073741824		VV ALL OVER		DATE 12/1/43	
OVER 1/1073741824 1/2147483648 1/4294967296		VV ALL OVER		DATE 12/1/43	
OVER 1/4294967296 1/8589934592 1/17179869184		VV ALL OVER		DATE 12/1/43	
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OVER 1/68719476736 1/137438953472 1/274877906944		VV ALL OVER		DATE 12/1/43	
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OVER 1/18446744073709551616 1/36893488147419103232 1/73786976294838206464		VV ALL OVER		DATE 12/1/43	
OVER 1/73786976294838206464 1/147573952589676412928 1/295147905179352825856		VV ALL OVER		DATE 12/1/43	
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OVER 1/1180591620717411303424 1/2361183241434822606848 1/4722366482869645213696		VV ALL OVER		DATE 12/1/43	
OVER 1/4722366482869645213696 1/9444732965739290427392 1/18889465931478580854784		VV ALL OVER		DATE 12/1/43	
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OVER 1/4835703278458516698824704 1/9671406556917033397649408 1/19342813113834066795298816		VV ALL OVER		DATE 12/1/43	
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