

AD-A048 862

NAVY ELECTRONICS LAB SAN DIEGO CALIF
CARR INLET ACOUSTIC RANGE. SONAR PROPAGATION PATHS TO 1000 YARD--ETC(U)
SEP 65 F R ABBOTT, D J FRAUGHTON

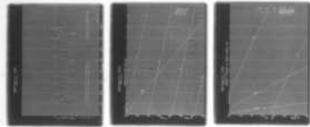
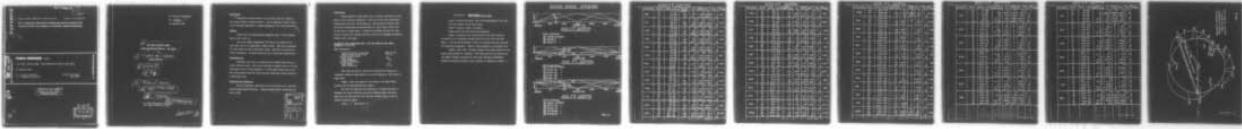
F/G 17/1

UNCLASSIFIED

NEL-TM-843

NL

| OF |
AD
A048 862



END
DATE
FILED
2-78
DDC

AD A 048862

MOST Project -2

Onc

U. S. NAVY ELECTRONICS LABORATORY, SAN DIEGO, CALIFORNIA • A BUREAU OF SHIPS LABORATORY

This is a working paper giving tentative information about some work in progress at NEL.
If cited in the literature the information is to be identified as tentative and unpublished.

File

Good

DDC FILE COPY
NEL/Technical Memorandum 843

TECHNICAL MEMORANDUM TM-843

CARR INLET ACOUSTIC RANGE. SONAR PROPAGATION PATHS TO 1000 YARDS.

21 September 1965

F. R. Abbott (Code 3130)
D. J. Fraughton (Code 3370)

SF 001 03 16 (8132)
NEL E11461

NEL/Technical Memorandum 843

Nel Technical Memorandum

No. TM-843

21 September 1965

(6) CARR INLET ACOUSTIC RANGE.
SONAR PROPAGATION PATHS TO 1000 YARDS.

by

(10) F. R. Abbott — D. J. Fraughton

Code 3130/3370

(11) 21 Sep 65

(12) 15 P

(9) Technical memo.,

(14) NEL-TM-843

(16) F0003

(17) SF000316

U. S. Navy Electronics Laboratory
San Diego, California 92152

253 550 B

THE PROBLEM

Determine the practicability of using Carr Inlet for submarine hull sonar frequency response studies. Such an appraisal requires analyses of frequency dependence of signal propagation over a prescribed path.

RESULTS

Results for one thousand yard propagation path, in the frequency band of 100 to 700 c/s.

For a unit signal transmitted, the level at the receiver will vary from 0.25 to 2 in amplitude or 18db in level. This can be tolerated for some studies by use of correction curves. The level is sensitive to bottom attenuation. A bottom reflection loss of 10db was assumed herein.

RECOMMENDATIONS

Undertake sonar tests of submarine hull resonant modes and associated scattered sound. This can be performed by adding a day to the scheduled noise trials of some submarine. It would guide future work on target classification along the lines projected from model studies described in NEL Report 1273.

ADMINISTRATIVE INFORMATION

Work was performed at NEL under AS 02 101 SF 001 03 16, task 8528 on NEL Problem E11461 (entitled: "Target Strength Study") during May and June of 1965.

1

ACCESSION NO.	
NTSC	White Section <input checked="" type="checkbox"/>
DSG	Buff Section <input type="checkbox"/>
UNANNOUNCED <input type="checkbox"/>	
JUSTIFICATION	
<i>Notes on file</i>	
BY	
DISTRIBUTION/AVAILABILITY CODES	
BEST.	AVAIL. AND/OR SPECIAL
A	

INTRODUCTION

Simple geometric shaped shells act as enhanced scatterers of sonic beams at their resonant frequencies. This has not yet been successfully demonstrated using full scale submarines. The persistent resonant modes can best be established and characterized in a quiet body of water such as Carr Inlet in Puget Sound. A simple ray and phase analysis was used herein to predict any problems that will arise due to propagation anomalies between source and target.

CALCULATED SOUND INTENSITIES OVER A 3000 FOOT RANGE IN CARR INLET - BETWEEN 100 to 800 C/S.

Basic Assumptions:

Velocity of sound in sea water	4900 ft./sec
Depth of water in Carr Inlet	300 ft.
On Surface Reflections -	
Phase change	180°
Sound attenuation	0 db
On Bottom Reflections -	
Phase change	0°
Sound attenuation	10 db

This study was made to indicate the feasibility of making low frequency calibration measurements on a moored submarine at Carr Inlet in Puget Sound.

Figure 1 shows the geometry of the paths at the three depths studied, and the corresponding path lengths.

The next five pages are the tabulation of calculations made to determine the sound intensities along the different paths, the phase angle that the sound arrives with, and the resultant value of the vectorially combined signals:

Column 3 "Total Waves" is:

$$\text{Total Waves} = \frac{\text{Range Length}}{\text{Wave length @ freq. noted}}$$

Column 4 "δfrom direct path" shows the % displacement of the last wave with respect to the direct path A.

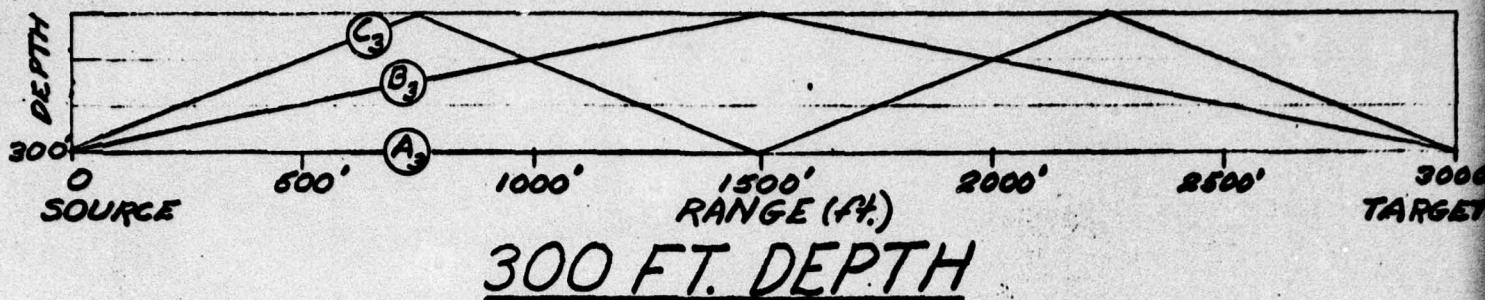
Column 5 converts column 4 to degrees.

Column 6 and 8 are from the basic assumptions.

Figure 2 illustrates the cyclic nature of the sound intensity resultants as the frequency increases from 100 to 200 c/s at 300 feet depth. A typical vector diagram is shown to illustrate how the resultants are determined graphically. Figure 3 shows amplitude in rectangular form.

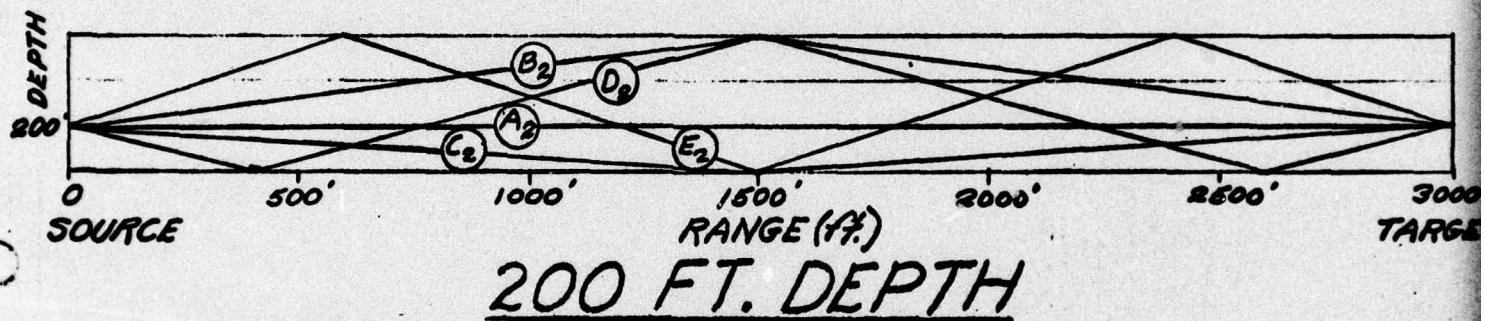
Figures 4 and 5 show the phase change of each path relative to the direct path, plotted vs. frequency. From these plots one can readily see the number of phase reversals each vector goes through and determine maximum and minimum intensities quite readily, as indicated on Figure 3.

SOUND PATHS STUDIED



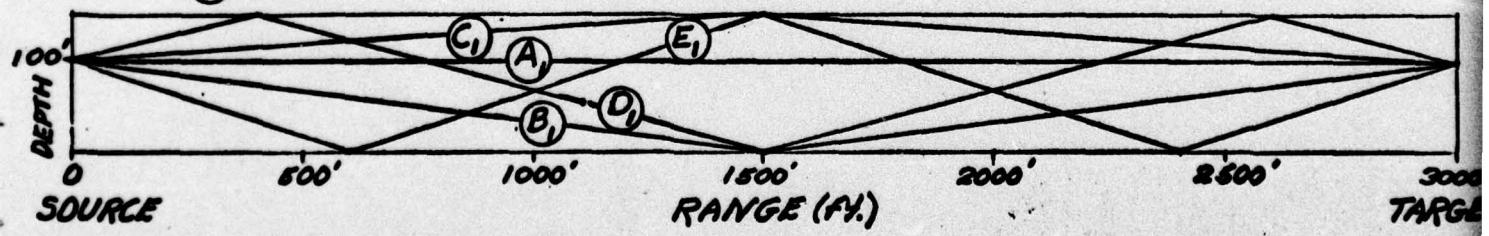
PATH LENGTHS:

- (A₃) 3000.00 FEET
- (B₃) 3059.4 "
- (C₃) 3231.0 "



PATH LENGTHS:

- (A₂) 3000.00 FEET
- (B₂) 3027.06 "
- (C₂) 3006.66 "
- (D₂) 3104.86 "
- (E₂) 3162.25 "



100 FT. DEPTH

PATH LENGTHS:

- (A₁) 3000.00 FEET
- (B₁) 3027.06 "
- (C₁) 3006.66 "
- (D₁) 3104.86 "
- (E₁) 3162.25 "

63.68	.0
64.94	.26
68.58	.90
<hr/>	
64.28	.0
65.56	.28
69.24	.96
<hr/>	
64.90	.0
66.18	.28
69.90	.0
<hr/>	
65.51	.0
66.81	.30
70.55	.04
<hr/>	
66.12	.0
67.43	.31
71.21	.09

300 FT. DEPTH

CYCLES/SEC.	PATH	TOTAL WAVES	δ FROM DIRECT PATH	δ°	PHASE SHIFT	$\Sigma \delta^{\circ}$	Ampl.	Resultant
140	A ₃	85.71	.0	0°	0°	0°	1.	
	B ₃	87.41	.70	252°	180°	72°	1.	1.32
	C ₃	92.31	.60	216°	360°	216°	.3	
150	A ₃	91.84	: 0	0°	0°	0°	1.	
	B ₃	93.65	.81	292°	180°	112°	1.	1.39
	C ₃	98.91	.07	25°	360°	25°	.3	
160	A ₃	97.96	.0	0°	0°	0°	1.	
	B ₃	99.90	.94	338°	180°	158°	1.	
	C ₃	105.50	.54	194°	360°	194°	.3	
170	A ₃	104.08	.0	0°	0°	0°	1.	
	B ₃	106.14	.04	14°	180°	194°	1.	
	C ₃	112.10	.02	7°	360°	7°	.3	
180	A ₃	110.20	.0	0°	0°	0°	1.	
	B ₃	112.39	.19	68°	180°	248°	1.	
	C ₃	118.69	.49	176°	360°	176°	.3	
190	A ₃	116.33	.0	0°	0°	0°	1.	
	B ₃	118.63	.30	108°	180°	288°	1.	
	C ₃	125.28	.95	342°	360°	342°	.3	
200	A ₃	122.44	.0	0°	0°	0°	1.	
	B ₃	124.88	.44	158°	180°	338°	1.	
	C ₃	131.88	.44	158°	360°	158°	.3	
300	A ₃	183.71	.0	0°	0°	0°	1.	
	B ₃	187.35	.64	230°	180°	50°	1.	
	C ₃	197.86	.15	54°	360°	54°	.3	
400	A ₃	244.90	.0	0°	0°	0°	1.	
	B ₃	249.75	.85	306°	180°	126°	1.	
	C ₃	263.75	.85	306°	360°	306°	.3	
500	A ₃	306.12	.0	0°	0°	0°	1.	
	B ₃	312.18	.06	22°	180°	202°	1.	
	C ₃	329.69	.57	205°	360°	205°	.3	
600	A ₃	367.20	.0	0°	0	0°	1.	
	B ₃	374.47	.27	97°	180°	277°	1.	
	C ₃	395.47	.27	97°	360°	97°	.3	
700	A ₃	428.57	.0	0°	0	0°	1.	
	B ₃	437.06	.49	176°	180°	356°	1.	
	C ₃	461.57	.0	0°	360°	0°	.3	
702	A ₃	429.80	.0	0°	0°	0°	1.	
	B ₃	438.31	.51	184°	180°	4°	1.	
	C ₃	462.89	.09	32°	360°	32°	.3	

300 FT. DEPTH

CYCLES/SEC.	PATH	TOTAL WAVES	S FROM DIRECT PATH	δ°	PHASE CHG.	$\Sigma \delta^{\circ}$	Ampl., 10 ⁻⁴	PERIOD, sec.
704	A ₃	431.03	.0	0°	0°	0	1.	
	B ₃	439.57	.54	194°	180°	14°	1.	2.15
	C ₃	464.22	.19	68°	360°	68°	.3	
706	A ₃	432.28	.0	0°		0	1.	
	B ₃	440.84	.56	202°	↑	22°	1.	2.00
	C ₃	465.56	.28	101°		101°	.3	
708	A ₃	433.53	.0	0°		0	1.	
	B ₃	442.11	.58	209°		29°	1.	1.80
	C ₃	466.91	.38	137°		137°	.3	
710	A ₃	434.78	.0	0°		0	1.	
	B ₃	443.39	.61	220°		40°	1.	1.62
	C ₃	468.26	.48	173°		173°	.3	
720	A ₃	441.18	.0	0°		0	1.	
	B ₃	449.91	.73	263°		83°	1.	1.72
	C ₃	475.15	.97	349°		349°	.3	
730	A ₃	447.09	.0	0°		0	1.	
	B ₃	455.95	.86	310°		130°	1.	.90
	C ₃	481.52	.43	155°		155°	.3	
740	A ₃	453.17	.0	0°		0	1.	
	B ₃	462.15	.98	353°		173°	1.	.25
	C ₃	488.07	.90	324°		324°	.3	
750	A ₃	459.42	.0	0°		0	1.	
	B ₃	468.61	.09	32°		212°	1.	.32
	C ₃	494.79	.37	133°		133°	.3	
760	A ₃	465.12	.0	0°		0	1.	
	B ₃	474.33	.21	76°		256°	1.	1.52
	C ₃	500.93	.81	292°		292°	.3	
770	A ₃	471.70	.0	0°		0	1.	
	B ₃	481.04	.34	122°		302°	1.	1.50
	C ₃	508.02	.32	115°		115°	.3	
780	A ₃	477.71	.0	0°		0°	1.	
	B ₃	487.17	.46	166°		346°	1.	2.10
	C ₃	514.49	.78	281°		281°	.3	
790	A ₃	483.87	.0	0°		0°	1.	
	B ₃	493.45	.58	209°	↓	29°	1.	2.01
	C ₃	521.13	.26	94°		94°	.3	
800	A ₃	489.80	.0	0°	0°	0°	1.	
	B ₃	499.49	.69	248°	180°	68°	1.	1.45
	C ₃	527.51	.71	256°	360°	256°	.3	

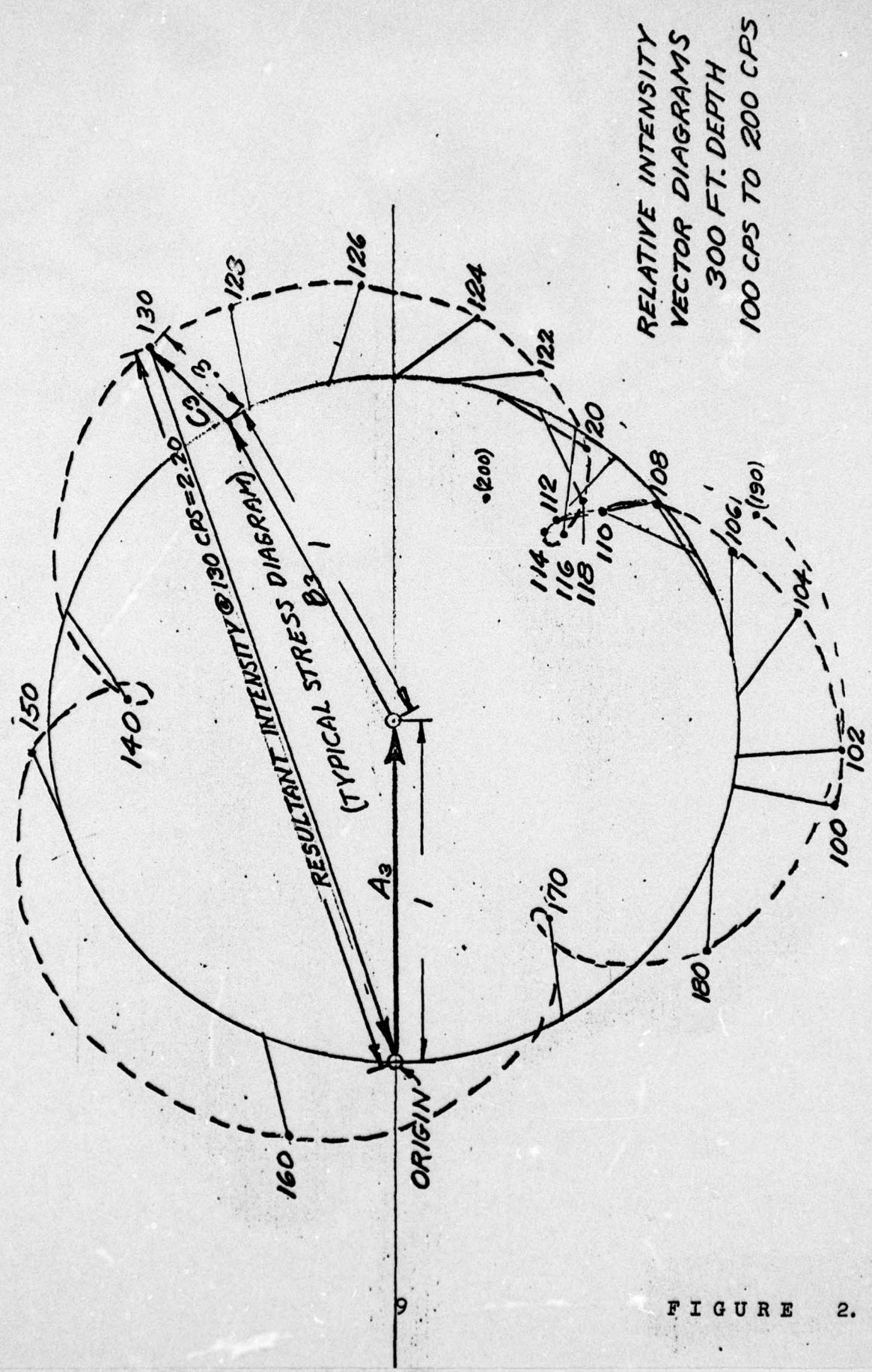
200 FT. DEPTH

CYCLES/SEC	PATH	TOTAL WAVES	S' FROM DIRECT PATH	δ°	PHASE CHG.	$\Sigma \delta^\circ$	Amplitude	Resultant
100	A ₂	61.22	.0	0°	0°	0°	1.	
	B ₂	61.78	.56	202°	180°	22°	1.	
	C ₂	61.36	.14	50°	360°	50°	.3	
	D ₂	63.36	2.14	50°	180°	230°	.1	
	E ₂	64.54	3.32	115°	360°	115°	.3	
200	A ₂	122.44	.0	0		0°	1.	
	B ₂	123.55	1.11	40°		220°	1.	
	C ₂	122.72	.28	101°		101°	.3	
	D ₂	126.73	2.29	104°		284°	.1	
	E ₂	129.07	6.63	226°		226°	.3	
300	A ₂	183.71	.0	0		0°	1.	
	B ₂	185.33	1.62	223°		73°	1.	
	C ₂	184.08	.37	133°		133°	.3	
	D ₂	190.09	6.38	137°		317°	.1	
	E ₂	193.61	19.90	324°		324°	.3	
400	A ₂	244.90	.0	0		0°	1.	
	B ₂	247.11	2.21	76°		256°	1.	
	C ₂	245.44	.54	194°		194°	.3	
	D ₂	253.46	8.56	202°		22°	.1	
	E ₂	258.14	13.24	86°		86°	.3	
500	A ₂	306.12	.0	0°		0°	1.	
	B ₂	308.88	2.76	274°		94°	1.	
	C ₂	306.80	.68	245°		245°	.3	
	D ₂	316.82	10.70	252°		72°	.1	
	E ₂	322.68	16.56	202°		202°	.3	
600	A ₂	367.35	.0	0°		0°	1.	
	B ₂	370.66	3.31	166°		346°	1.	
	C ₂	368.16	.81	346°		346°	.3	
	D ₂	380.18	12.83	299°		119°	.1	
	E ₂	387.21	19.86	310°		310°	.3	
700	A ₂	428.57	.0	0°	0°	0°	1.	
	B ₂	432.44	3.87	313°	180°	133°	1.	
	C ₂	429.52	.95	342°	360°	342°	.3	
	D ₂	443.55	14.98	353°	180°	173°	.1	
	E ₂	451.75	23.18	65°	360°	65°	.3	

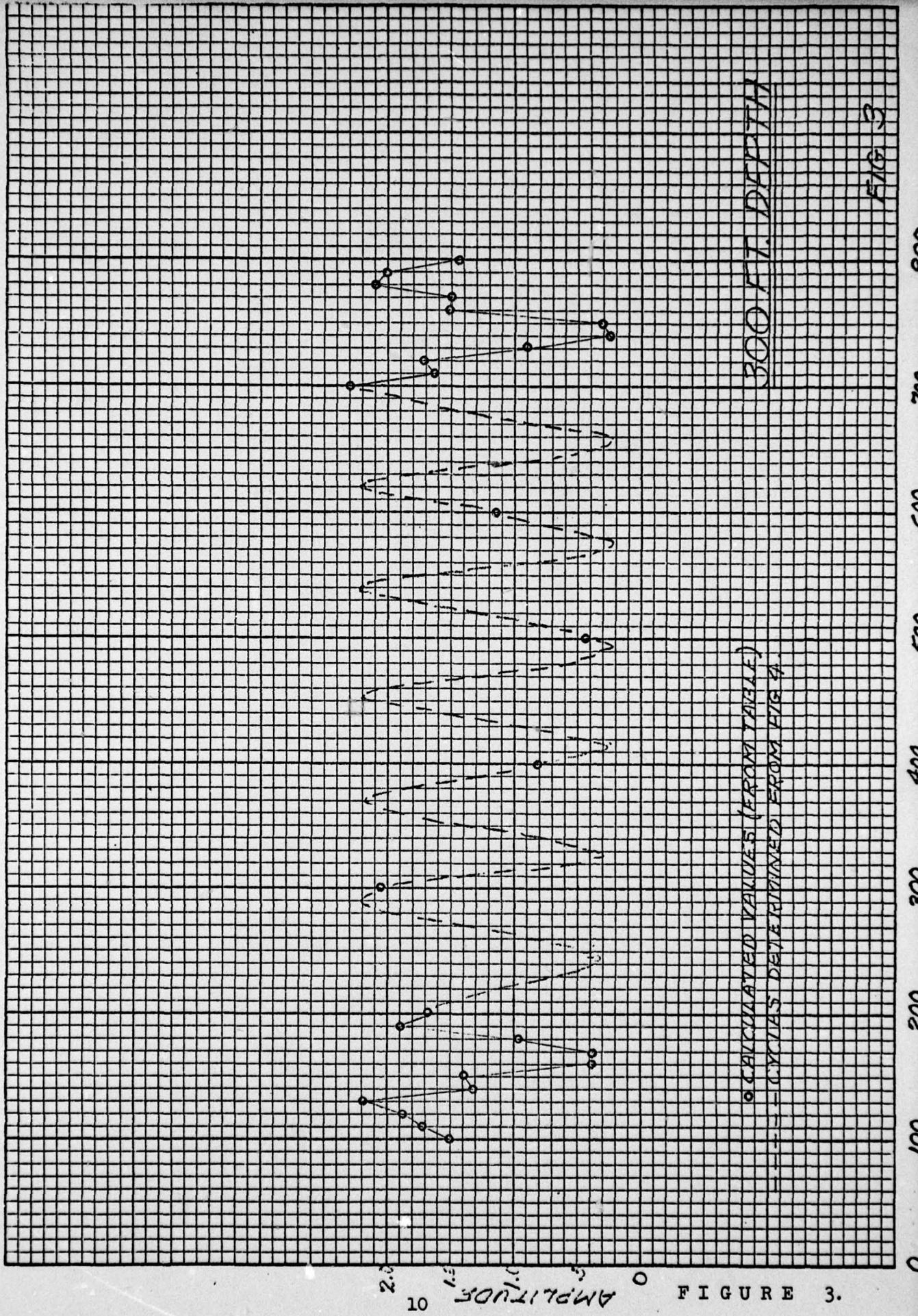
100 F.T. DEPTH

CYCLES/SEC.	PATH	TOTAL WAVES	S FROM DIRECT PATH	δ°	PHASE CHG.	$\sum \delta^\circ$	Amp.	Resultant
100	A,	61.22	.0	0°	0°	0°	1.	
	B,	61.78	.56	202°	360°	202°	.3	
	C,	61.36	.14	50°	180°	230°	1.	
	D,	63.36	2.14	50°	360°	50°	.3	
	E,	64.54	3.32	115°	180°	290°	.1	
200	A,	122.44	.0	0°	1	0°	1.	
	B,	123.55	1.11	40°		40°	.3	
	C,	122.72	.28	101°		281°	1.	
	D,	126.73	2.29	104°		104°	.3	
	E,	129.07	6.63	226°		46°	.1	
300	A,	183.71	.0	0		0°	1.	
	B,	185.33	1.62	223°		223°	.3	
	C,	184.08	.37	133°		313°	1.	
	D,	190.09	6.38	137°		137°	.3	
	E,	193.61	9.90	324°		144°	.1	
400	A,	244.90	.0	0		0°	1.	
	B,	247.11	2.21	76°		76°	.3	
	C,	245.44	.54	194°		14°	1.	
	D,	253.46	8.56	202°		202°	.3	
	E,	258.14	13.24	86°		266°	.1	
500	A,	306.12	.0	0°		0°	1.	
	B,	308.88	2.76	274°		274°	.3	
	C,	306.80	.68	245°		65°	1.	
	D,	316.82	10.70	252°		252°	.3	
	E,	322.68	16.56	202°		22°	.1	
600	A,	367.35	.0	0°		0°	1.	
	B,	370.66	3.31	112°		112°	.3	
	C,	368.16	.81	292°		112°	1.	
	D,	380.18	12.83	299°		299°	.3	
	E,	387.21	19.86	310°		130°	.1	
700	A,	428.57	.0	0°	0°	0°	1.	
	B,	432.44	3.87	313°	360°	313°	.3	
	C,	429.52	.95	342°	180°	162°	1.	
	D,	443.55	14.98	353°	360°	353°	.3	
	E,	451.75	23.18	65°	180°	245°	.1	

FIG. 2



K-E 10 X 10 TO THE INCH 46 0705
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



K-E 10 X 10 TO THE INCH 46 0705
7 X 10 INCHES MADE IN U.S.A.
REUPPEL & ESSER CO.

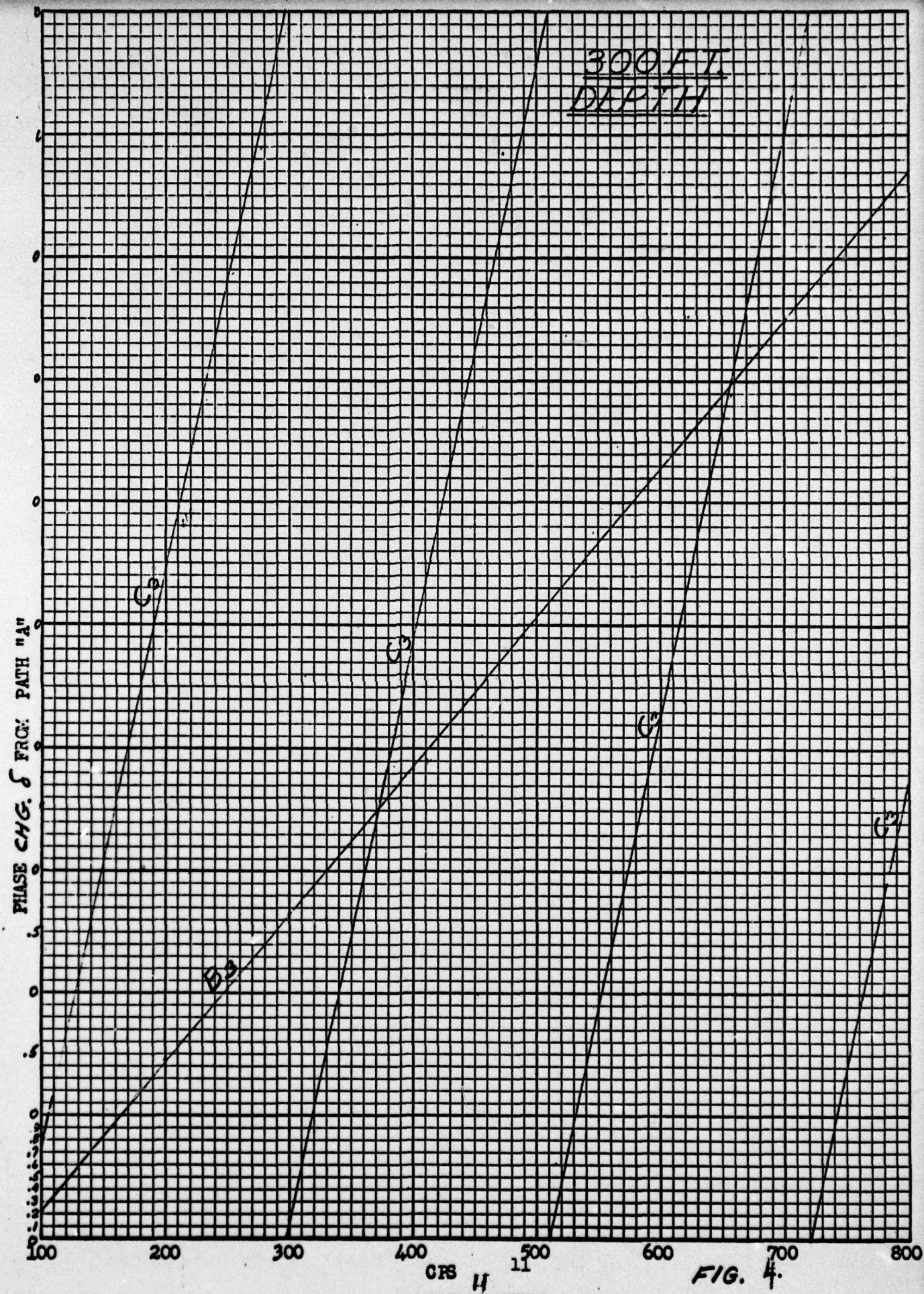


FIG. 4.

K+E 10 X 10 TO THE INCH 46 0705
7 X 10 INCHES MADE IN U.S.A.
HEUFFEL & ESSER CO.

PHASE CHANGE δ FROM PATH "A"

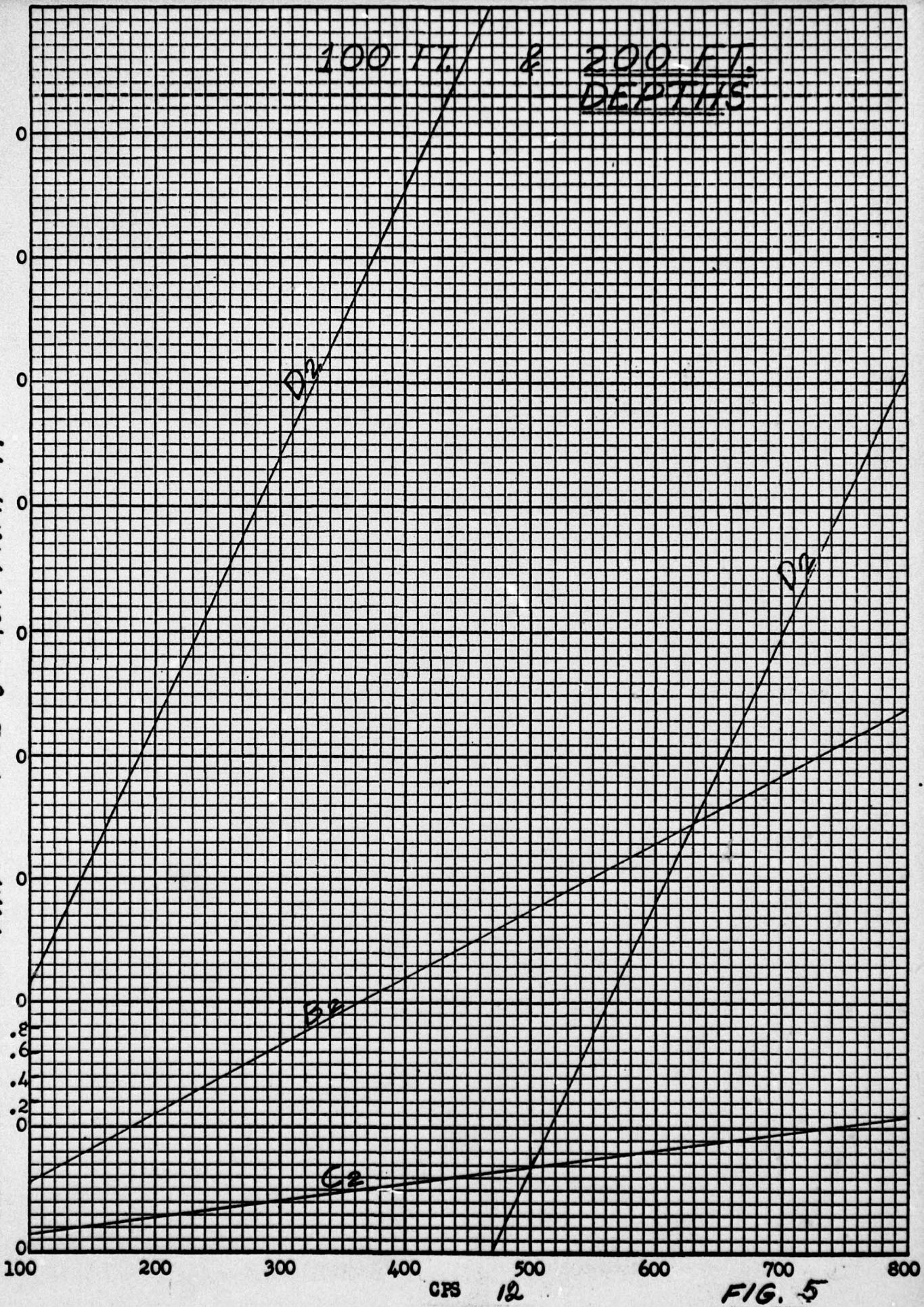


FIG. 5