AD-A046 676 NAVY UNDERWATER SOUND LAB NEW LONDON CONN F/G 17/1

CALCULATED AZIMUTHAL DIRECTIVITY PATTERNS FOR SEVERAL FREQUENCI--ETC(U)

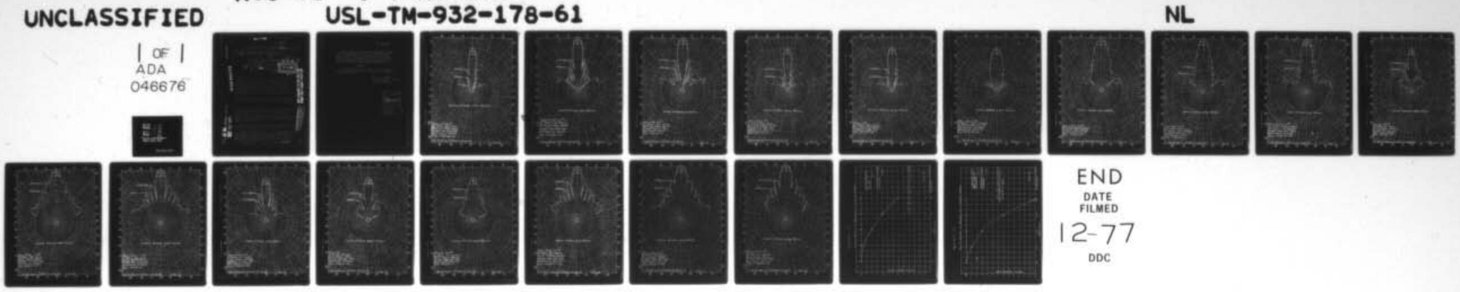
AUG 61 G T ADKINS

UNCLASSIFIED USL-TM-932-178-61 NL

| OF |

ADA

046676



END

DATE

FILMED

12-77

DDC

MOST Project

Copy 2 of 28 Copies

USL Problem
No. 1-651-00-00

003306

U. S. Navy Underwater Sound Laboratory
Fort Trumbull, New London, Connecticut

THIS COPY FOR Buships 689C

AD A046676

CALCULATED AZIMUTHAL DIRECTIVITY PATTERNS FOR SEVERAL FREQUENCIES USED IN SCANNING SONARS

by

George T. Adkins

USL Technical Memorandum No. 932-178-61

3 Aug 1961

22 p.

INTRODUCTION

This memorandum presents calculated directivity patterns, for several frequencies, for scanning sonars that have 48 stave transducers and use 12 or 16 staves for forming the acoustic beams. Constant time delay type beam forming networks were assumed in the computations for one set of patterns, constant phase shift type beam forming networks for the other. The shading used in the 16 stave calculations includes a cosine squared function and the shading derived from a typical single stave beam pattern; the shading for the 12 stave calculations is based on only single stave shading.

The computations assumed that transducer staves were spaced a half wave length (λ/2) apart (for 5 Kc.). The basic computations were made by the Theory and Analysis Branch of the Laboratory.

DISCUSSION

Figures (1) through (5) present the calculated beam patterns for the different frequencies for the 16 stave receiving beam and a constant time delay beam forming network. Noted on these figures are the first and second minor lobes, and their level relative to that of the major beam. Also noted on each figure, are the beam widths at the 3 db and 6 db down points. Figures (1) through (5) show that up to 20% increases in frequency have little effect on the acoustic beam.

Figures (6) through (9) present the calculated beam patterns for the different frequencies for a 16 stave receiving beam and a constant phase shift type beam forming network.

Figures (10) through (14) presents the calculated beam patterns for the different frequencies for the unshaded 12 stave beams and a constant time delay beam forming network. The beam patterns themselves are acceptable; however, it should be noted that the first minor lobes are down only 14 db as compared to about 20 db for 16 stave receiving beams.

254 200

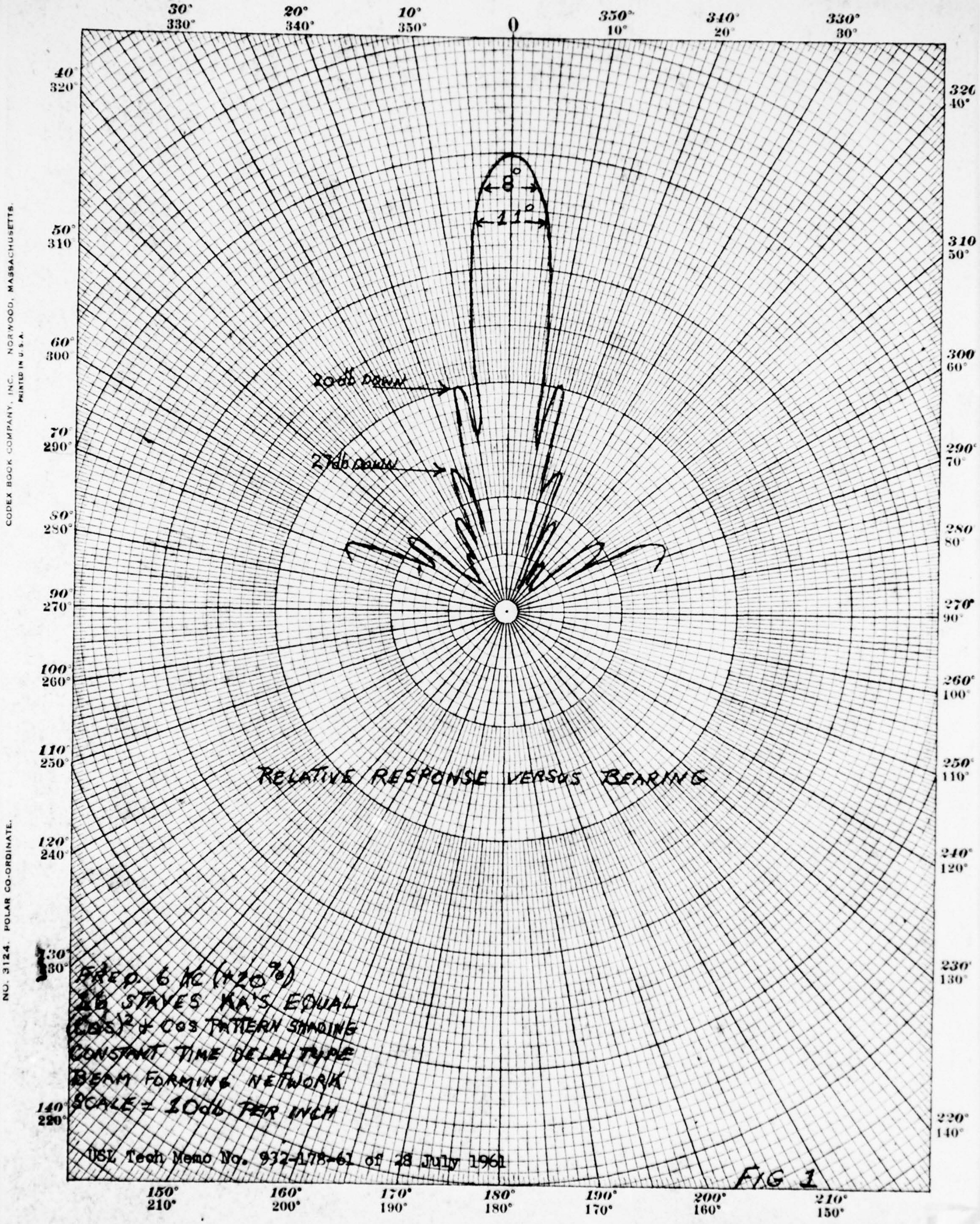
Encl 1 to USL ltr ser 932-180

Figures (19) and (20) present the relative on-axis response in db versus frequency for the 16 and 12 stave patterns and for constant phase shift type and constant time delay type beam forming networks. For the 12 stave patterns with the constant phase shift type, the response drops off .7 of a db at 6.0 Kc, for the same condition, the 16 stave response drops off -1.5 db. No drop is experienced with the constant time delay system.

CONCLUSIONS

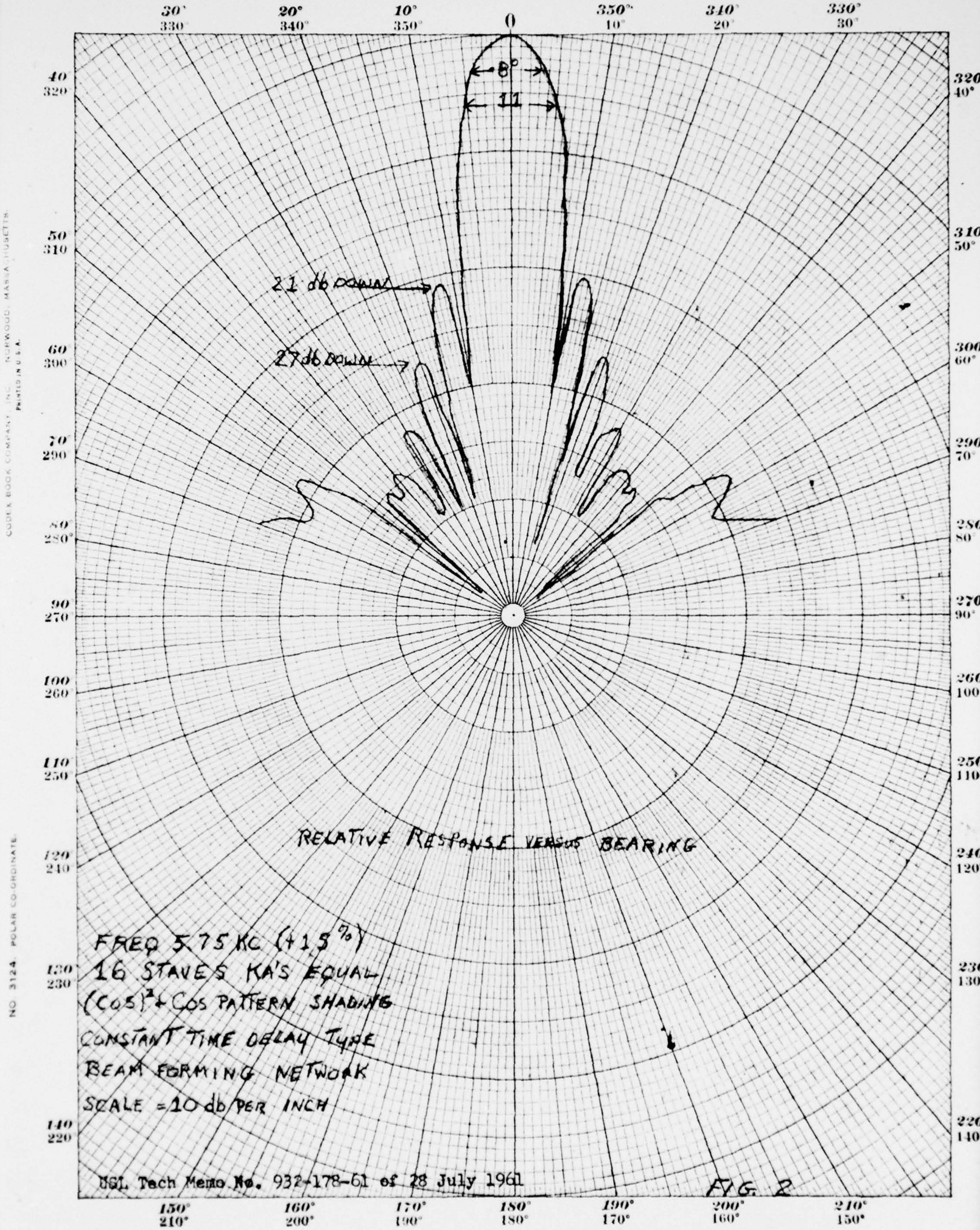
The constant phase shift beam forming arrangement appears to be limited as to how much the stave spacing can vary from $\lambda/2$ and still be satisfactory.

George T. Adkins per mf
GEORGE T. ADKINS
Electronic Technician



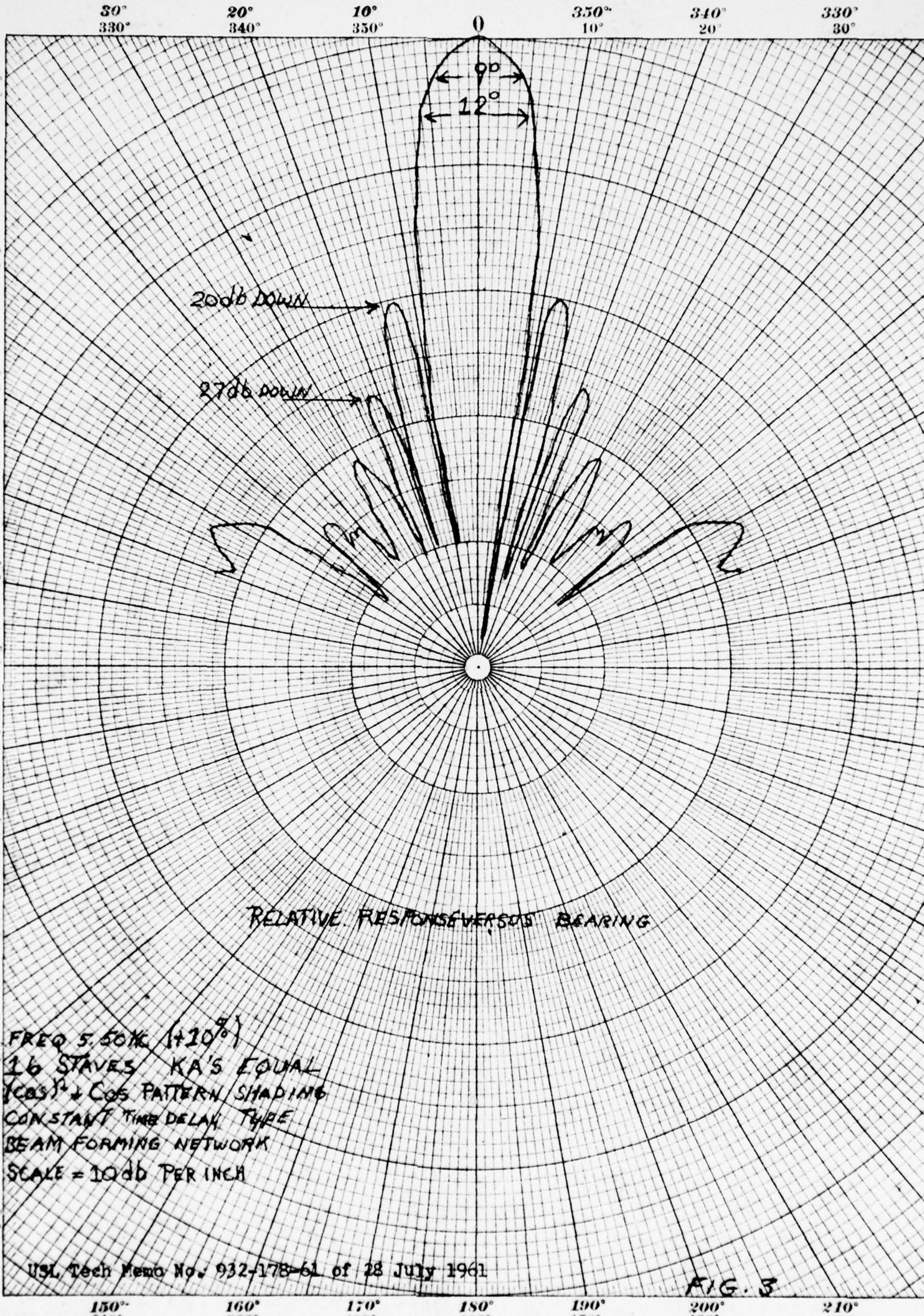
8°
11°
20db DOWN
27db DOWN
RELATIVE RESPONSE VERSUS BEARING
FREQ. 6 KC (±20%)
STAVES KA'S EQUAL
(COS)² + COS PATTERN SHADING
CONSTANT TIME DELAY TYPE
BEAM FORMING NETWORK
SCALE = 10db PER INCH
USL Tech Memo No. 932-178-61 of 28 July 1961
CODEX BOOK COMPANY, INC. NORWOOD, MASSACHUSETTS.
PRINTED IN U.S.A.
NO. 3124. POLAR CO-ORDINATE.

FIG 1



USL Tech Memo No. 932-178-61 of 28 July 1961

FIG. 2



USL Tech Memo No. 932-178-61 of 28 July 1961

FIG. 3

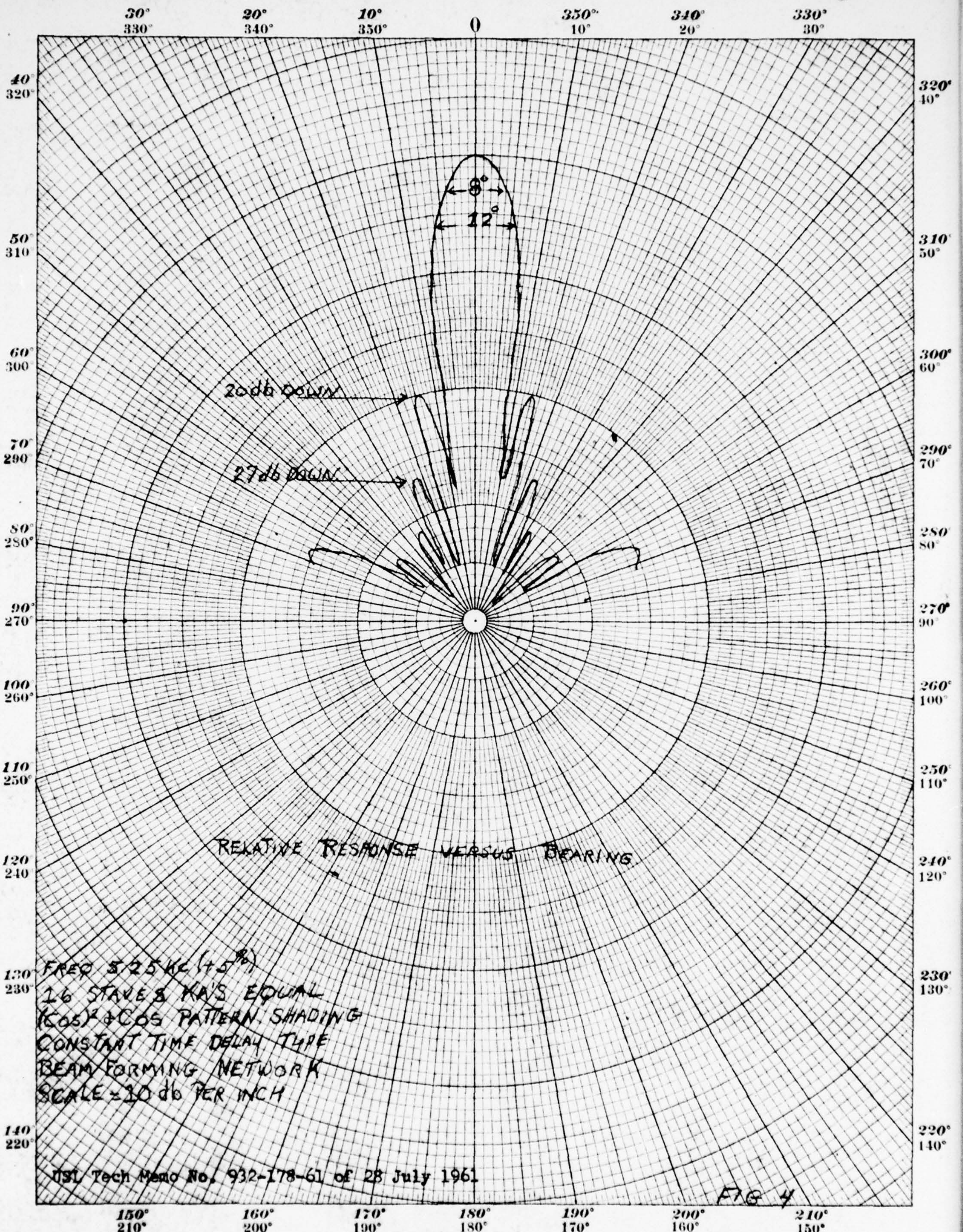
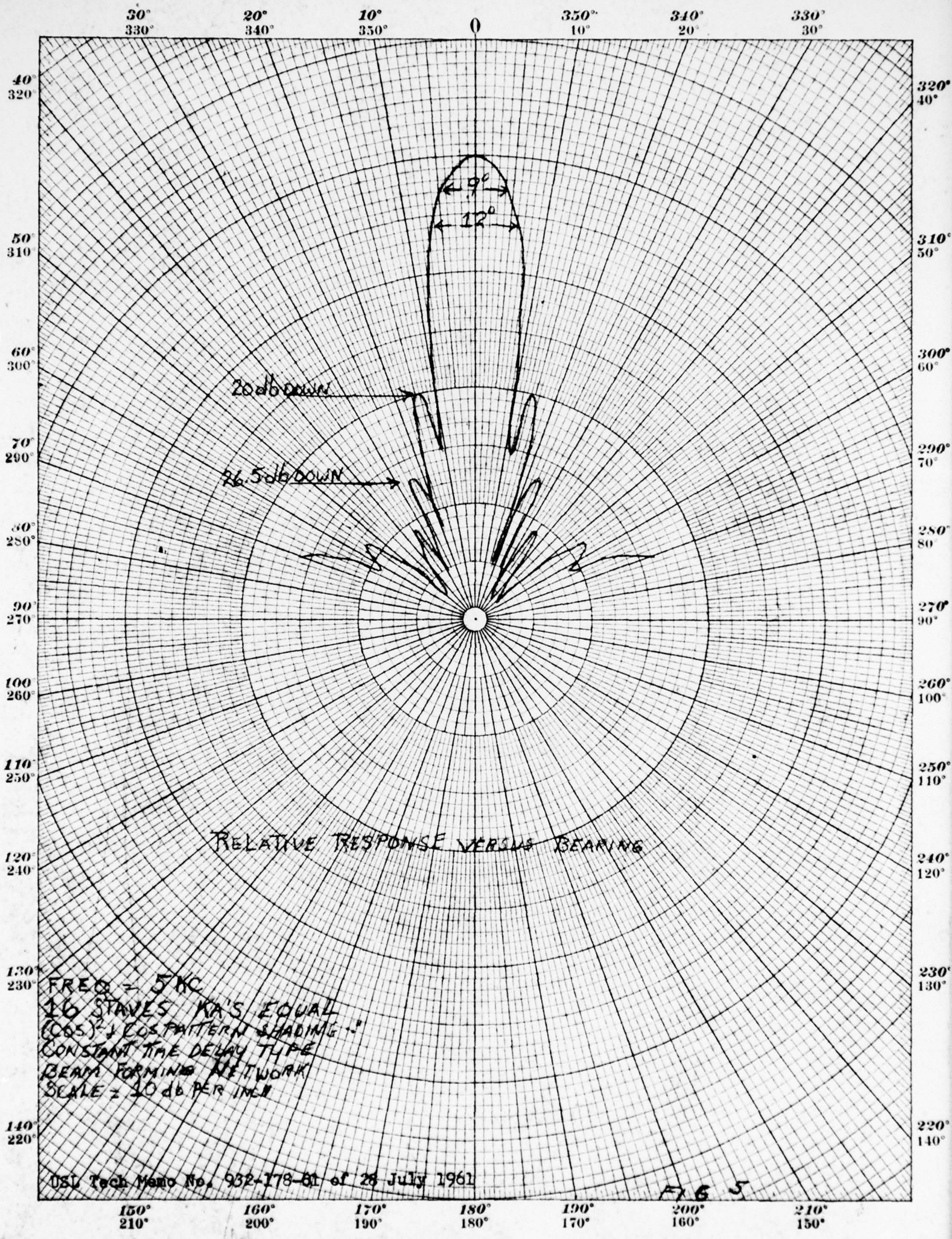
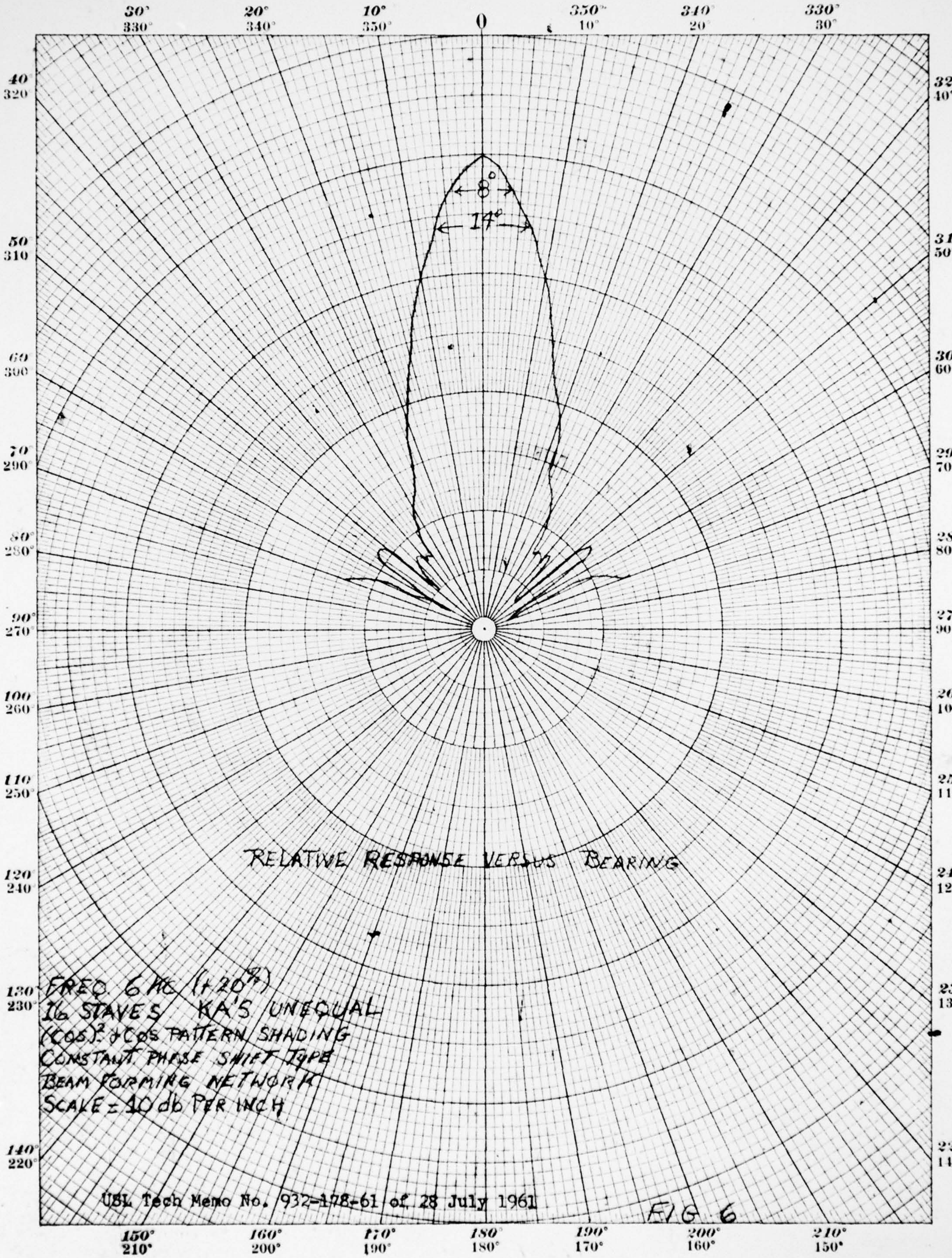

8°
12°
20db DOWN
27db DOWN
RELATIVE RESPONSE VERSUS BEARING
FREQ 5.25 KC (4.5%)
16 STAVES KA'S EQUAL
(COS)² & COS PATTERN SHADING
CONSTANT TIME DELAY TYPE
BEAM FORMING NETWORK
SCALE = 10 db PER INCH
USL Tech Memo No. 932-178-61 of 28 July 1961

FIG 4

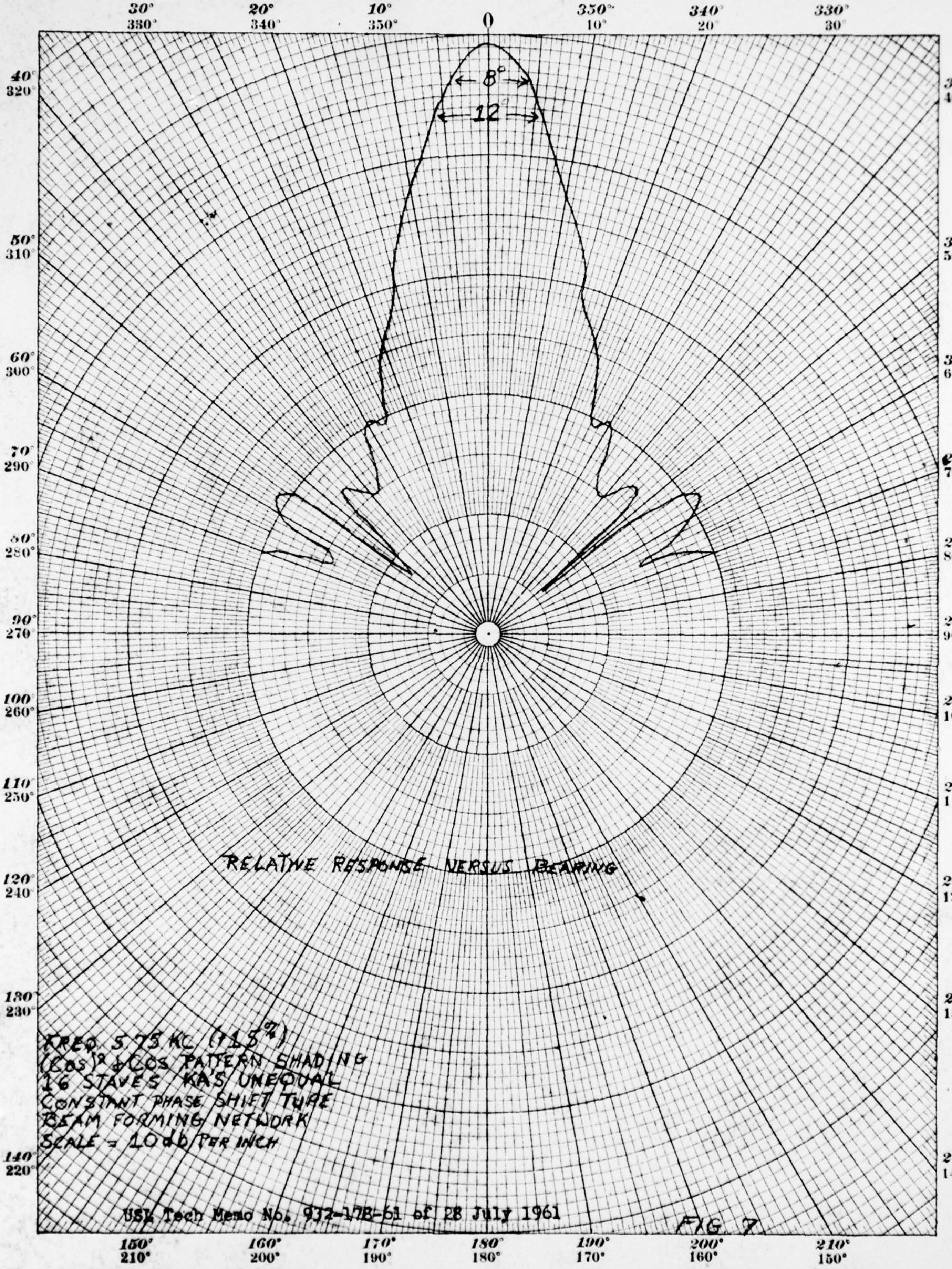


9°
12°
20db DOWN
26.5db DOWN
RELATIVE RESPONSE VERSUS BEARING
FREQ = 5KC
16 STAVES KA'S EQUAL
(COS)² + COS PATTERN SHADING
CONSTANT TIME DELAY TYPE
BEAM FORMING NETWORK
SCALE = 10 db PER INCH
USL Tech Memo No. 932-178-61 of 28 July 1961
FIG 5



USL Tech Memo No. 932-178-61 of 28 July 1961

FIG 6



USL Tech Memo No. 932-178-61 of 28 July 1961

FIG 7

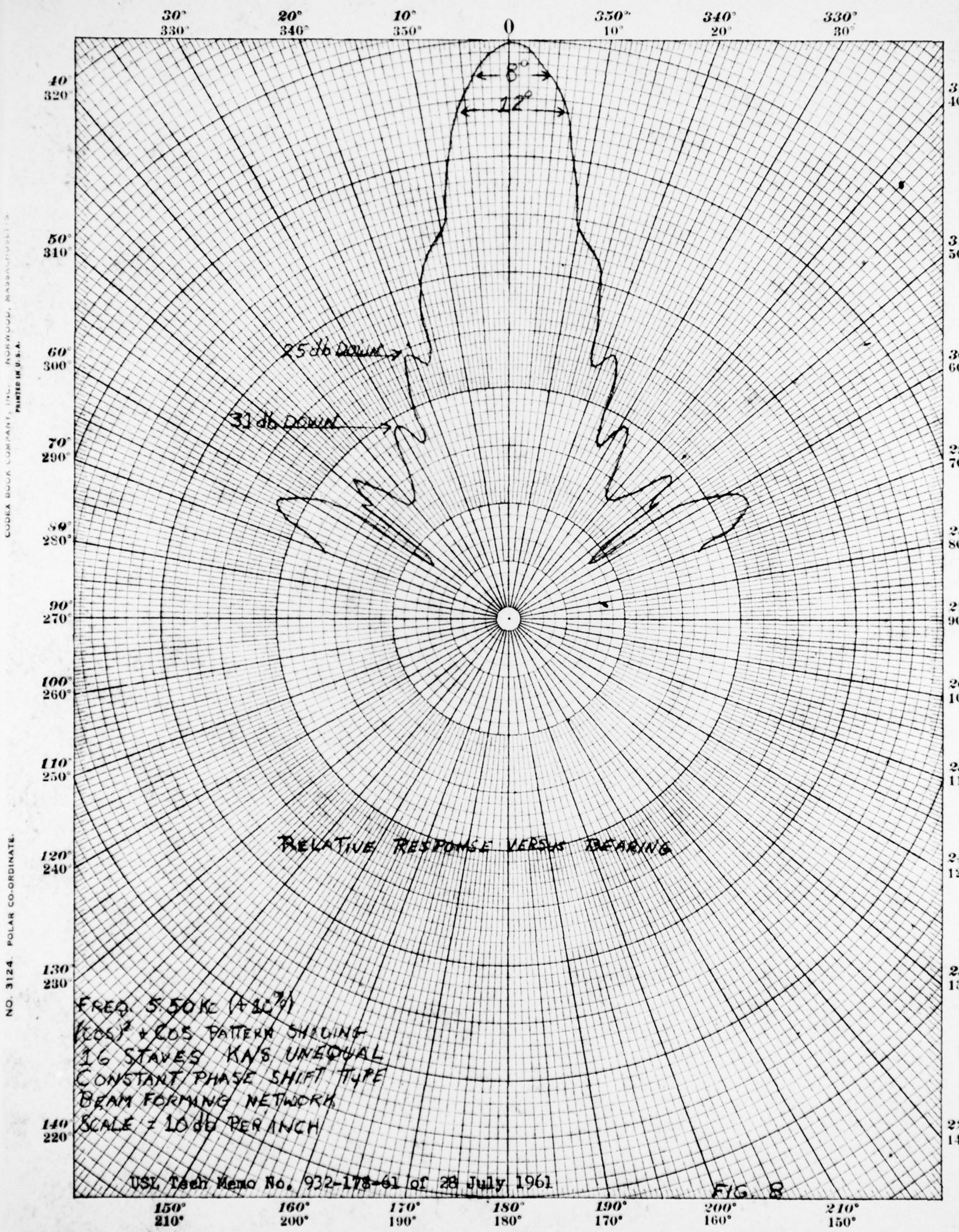
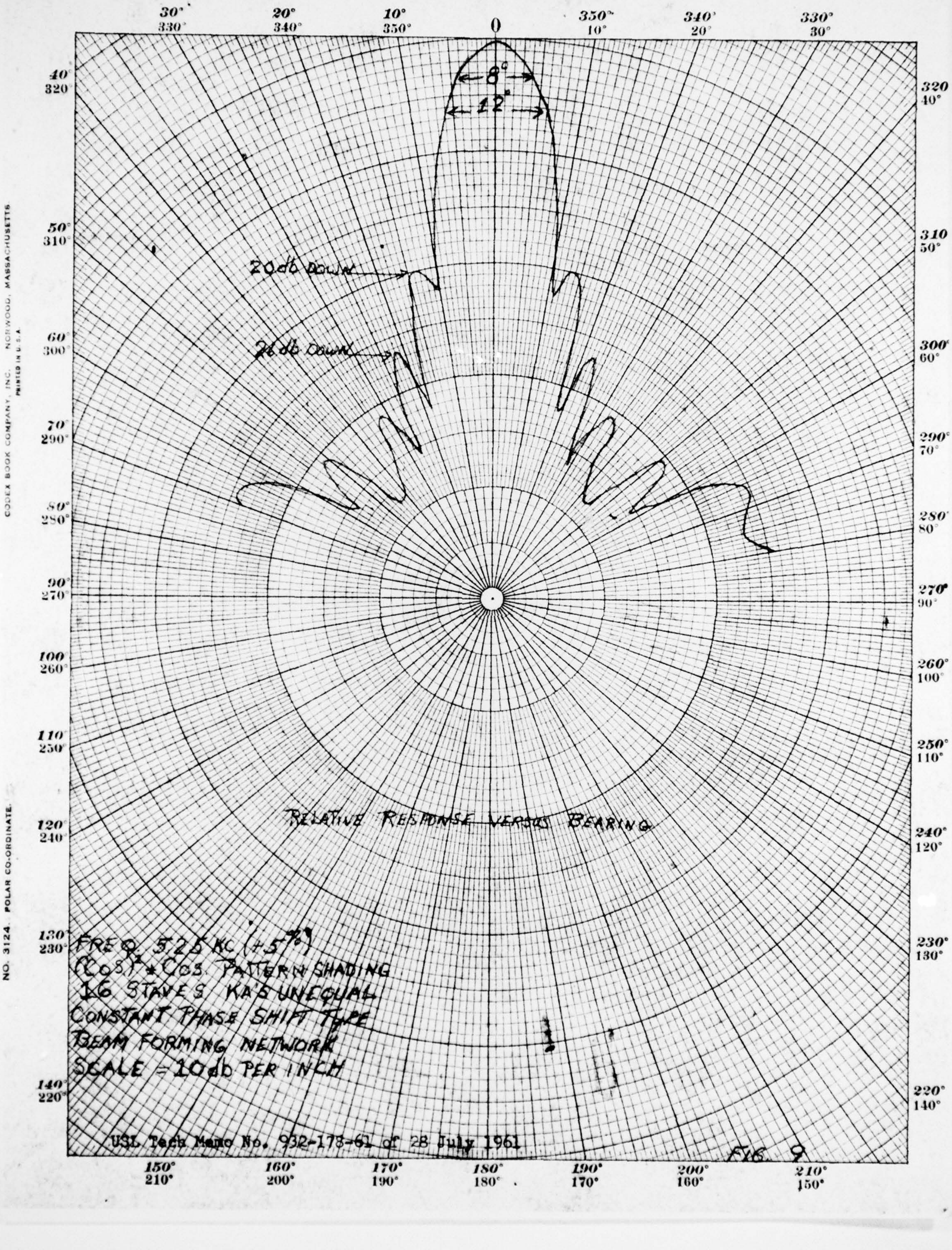
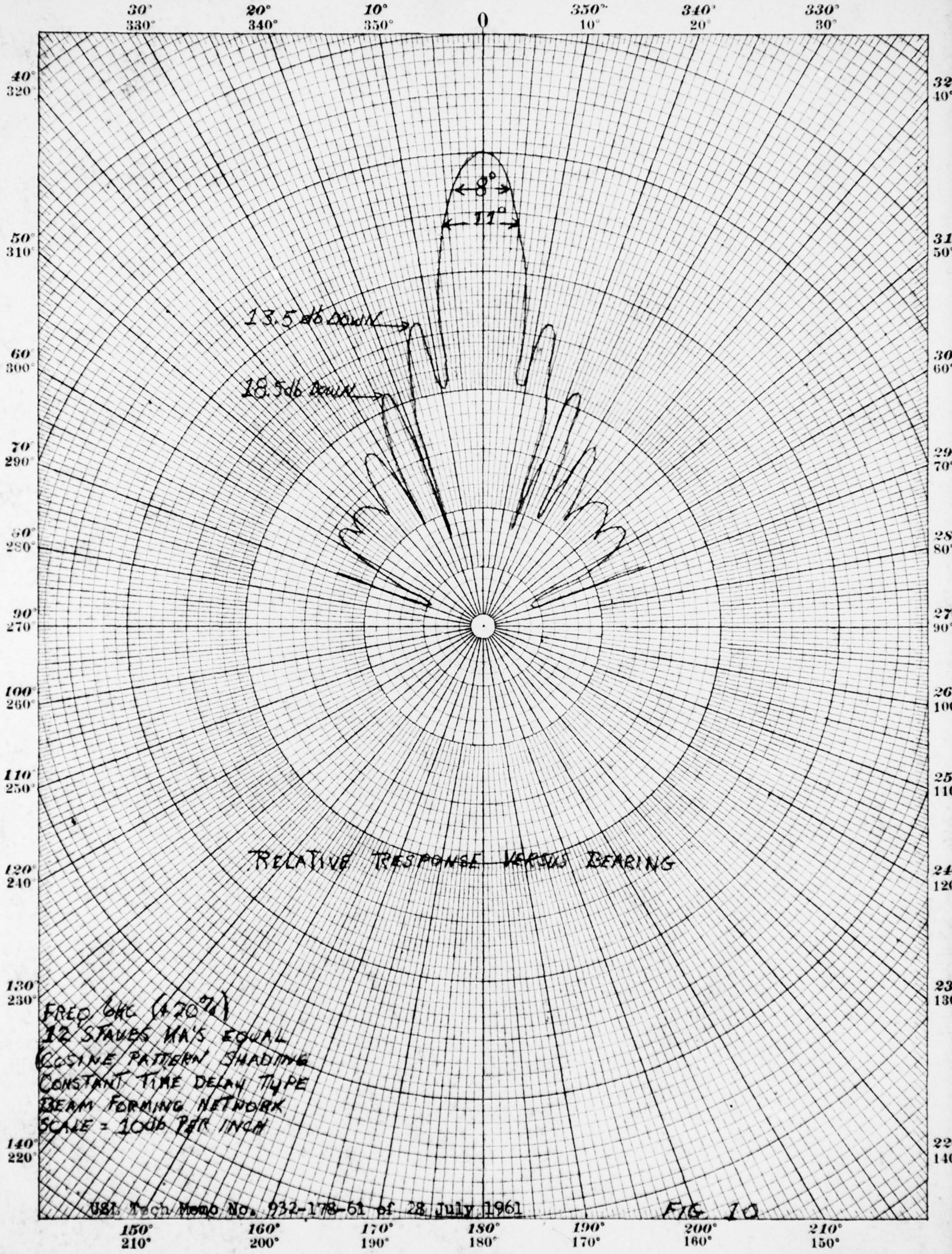

8°
12°
25 db DOWN
31 db DOWN
RELATIVE RESPONSE VERSUS BEARING
CONSTANT PHASE SHIFT TYPE
BEAM FORMING NETWORK
SCALE = 10 db PER INCH
USL Tech Memo No. 932-178-61 of 28 July 1961
NO. 3124. POLAR CO-ORDINATE.
CODEX BOOK COMPANY, INC. NORWOOD, MASSACHUSETTS
PRINTED IN U.S.A.

FIG. 8



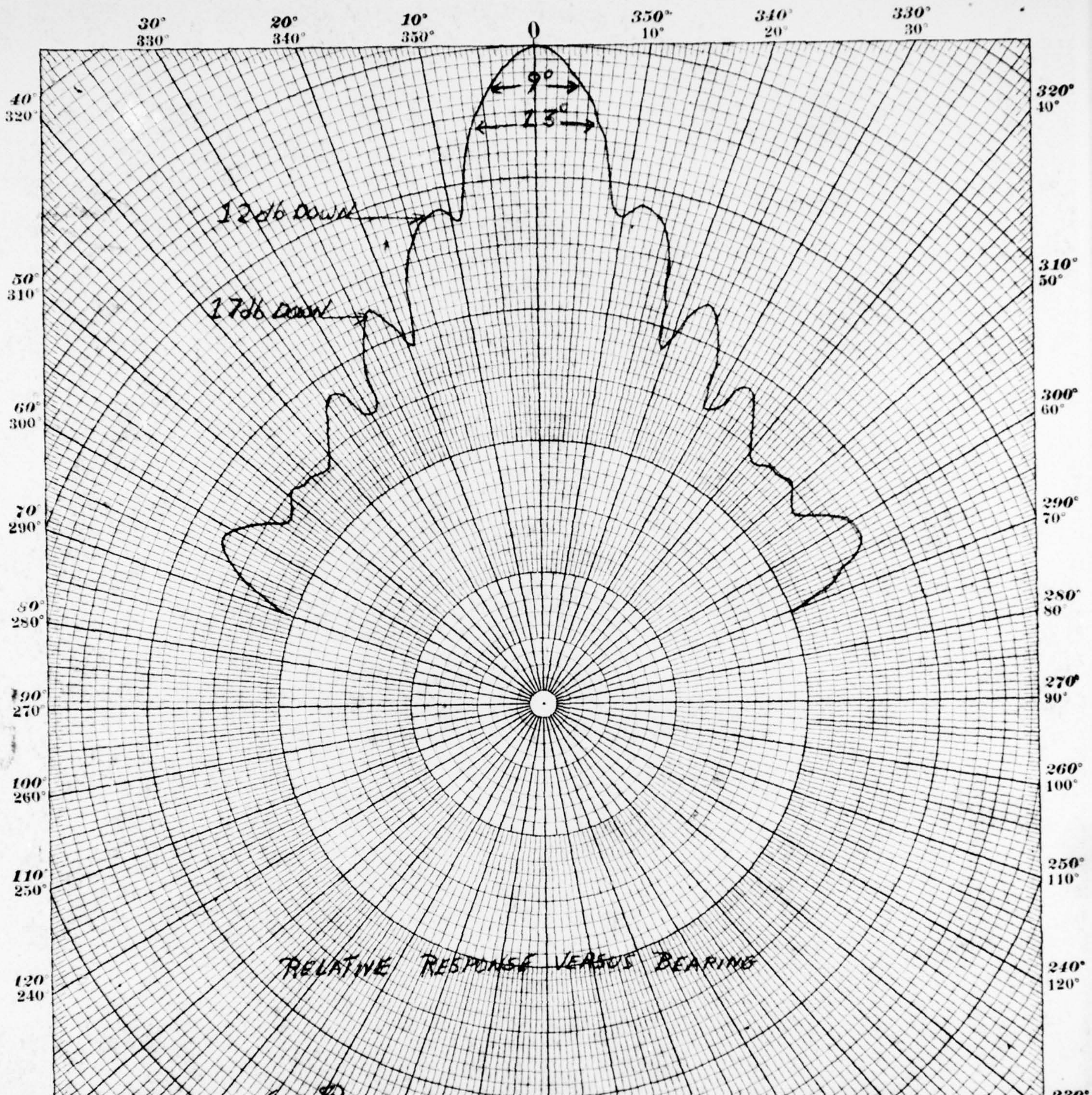
USL Tech Memo No. 932-178-61 of 28 July 1961

FIG. 9



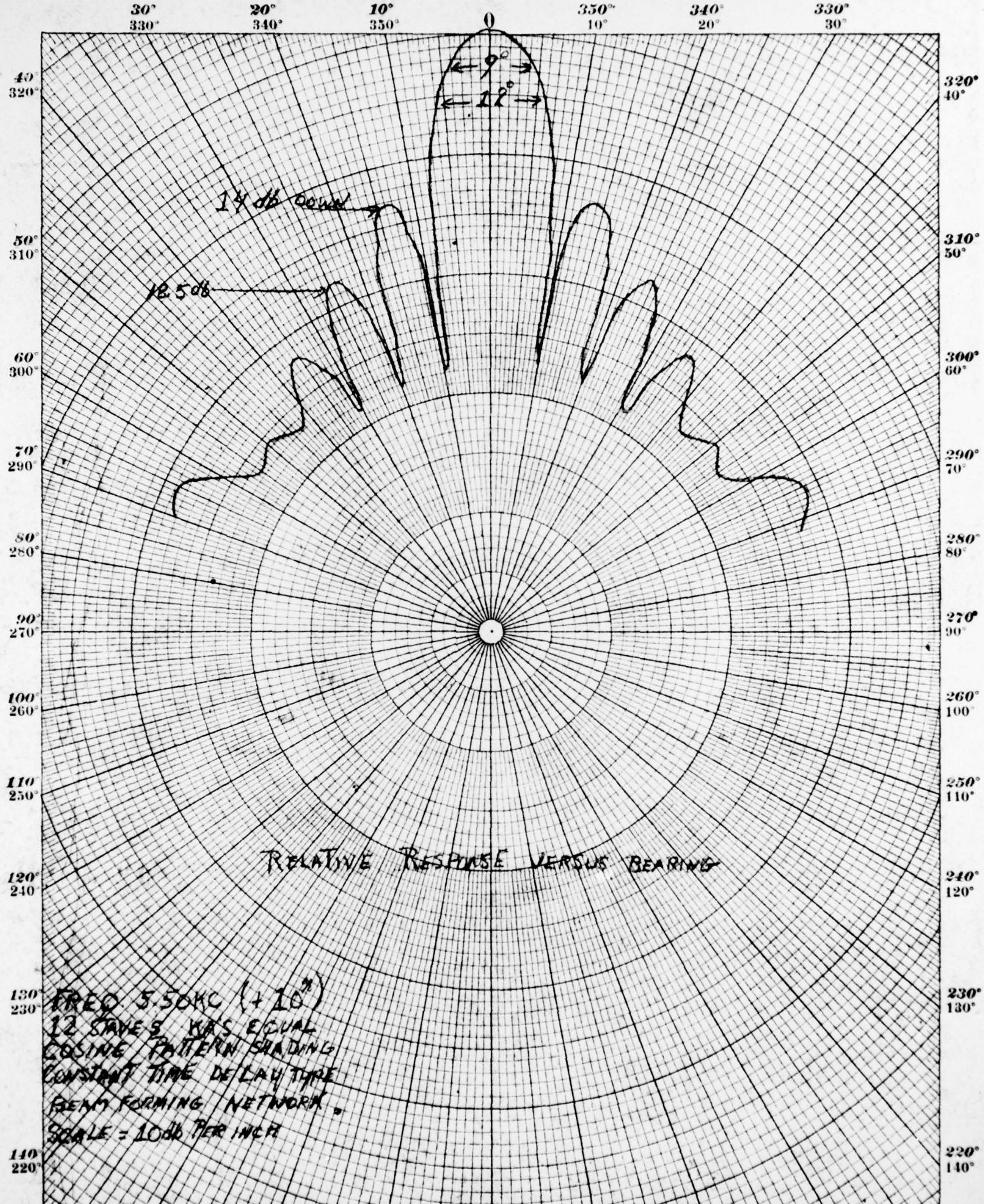
USL Tech Memo No. 932-178-61 of 28 July 1961

FIG. 10



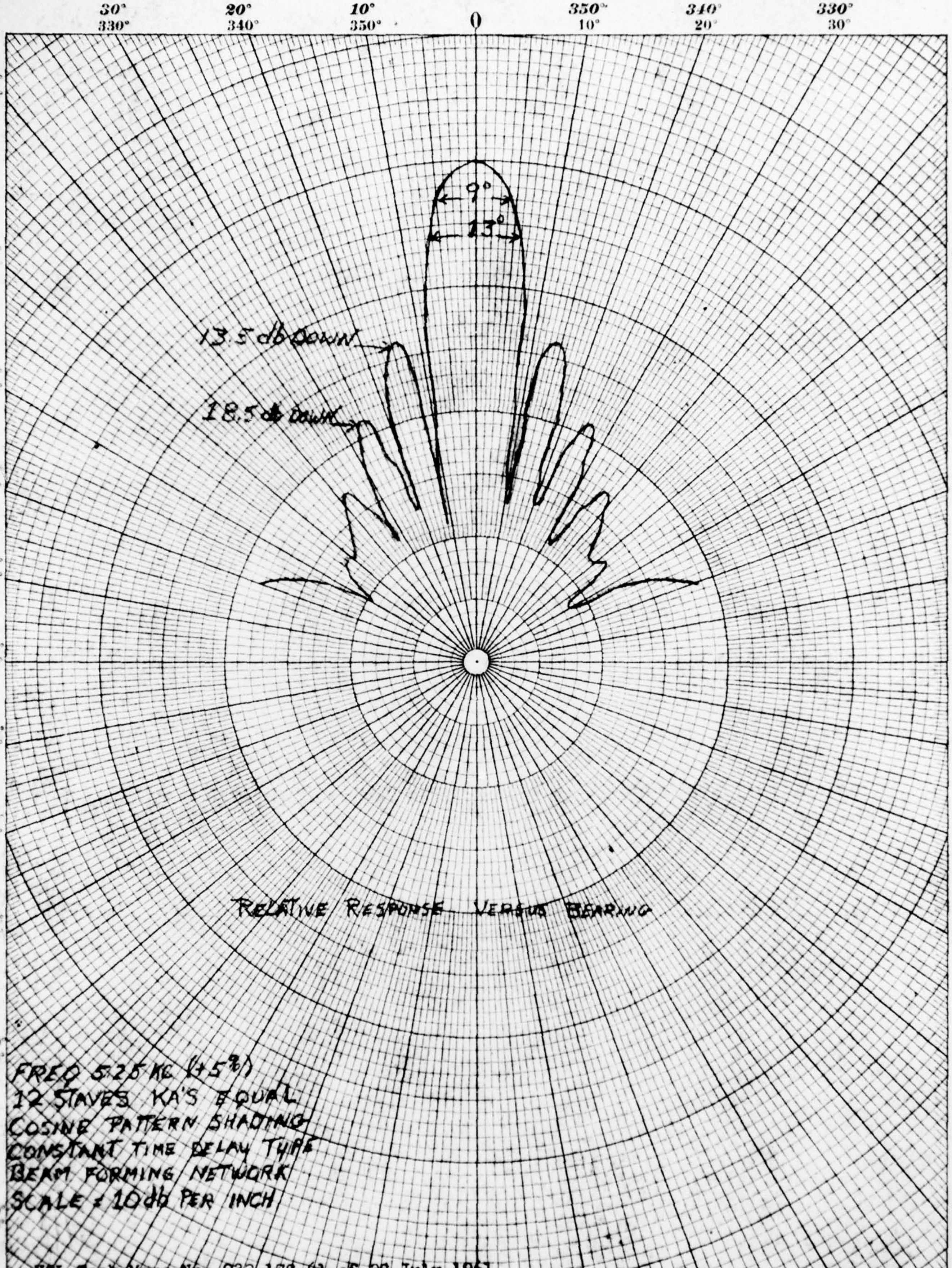
USL Tech Memo No. 932-178-61 of 28 July 1961

FIG. 11



USL Tech Memo No. 932-178-61 of 28 July 1961

FIG. 12



FREQ 5.25 KC (±5%)
12 STAVES KA'S EQUAL
COSINE PATTERN SHADING
CONSTANT TIME DELAY TYPE
BEAM FORMING NETWORK
SCALE: 10 db PER INCH

USL Tech/Memo No. 932-178-61 of 28 July 1961

FIG. 13

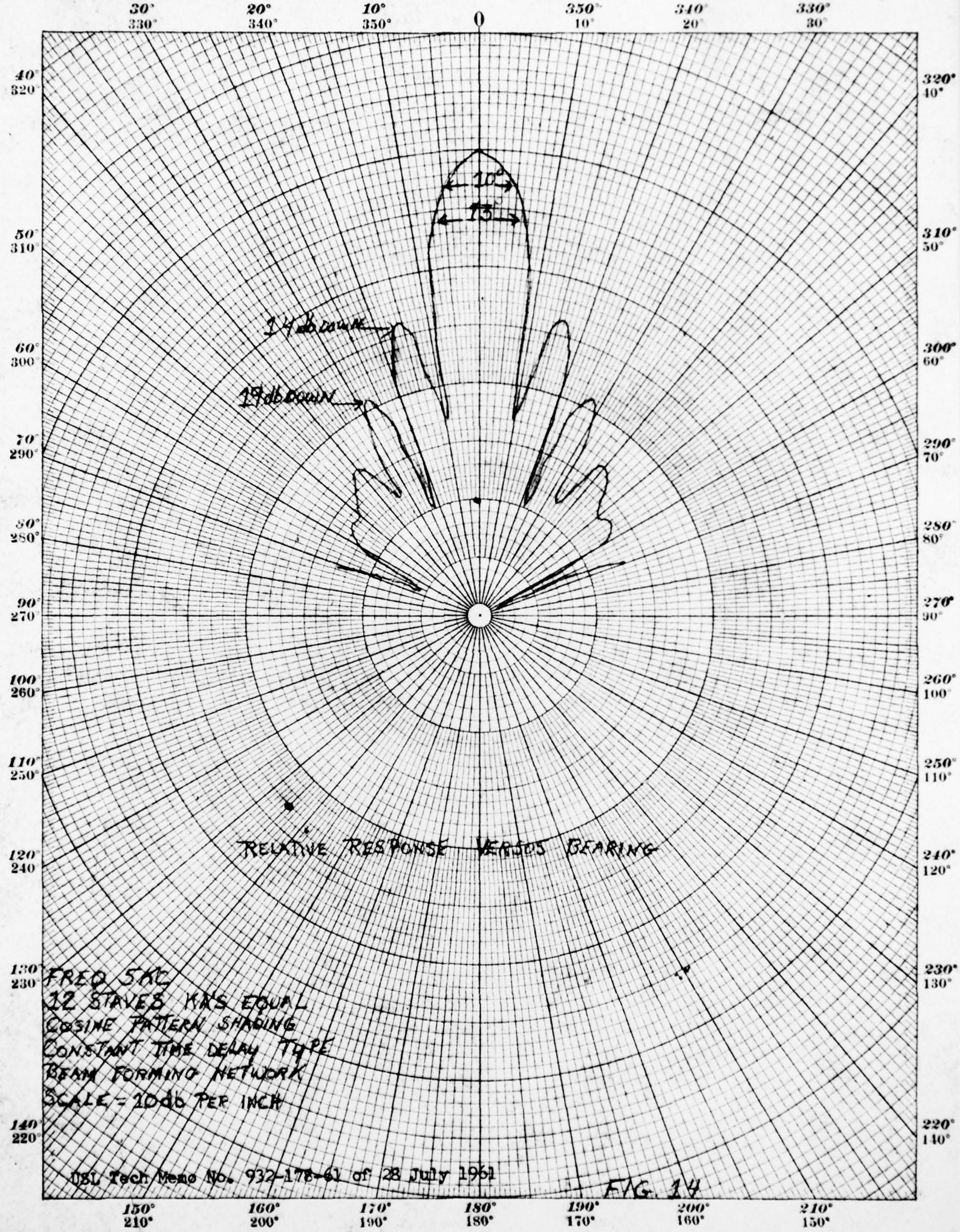

10°
13°
14 db down
19 db down
RELATIVE RESPONSE VERSUS BEARING
FREQ 5KC
12 STAVES KA'S EQUAL
COSINE PATTERN SHADING
CONSTANT TIME DELAY TYPE
BEAM FORMING NETWORK
SCALE = 10db PER INCH
USL Tech Memo No. 932-178-61 of 28 July 1961

FIG. 14

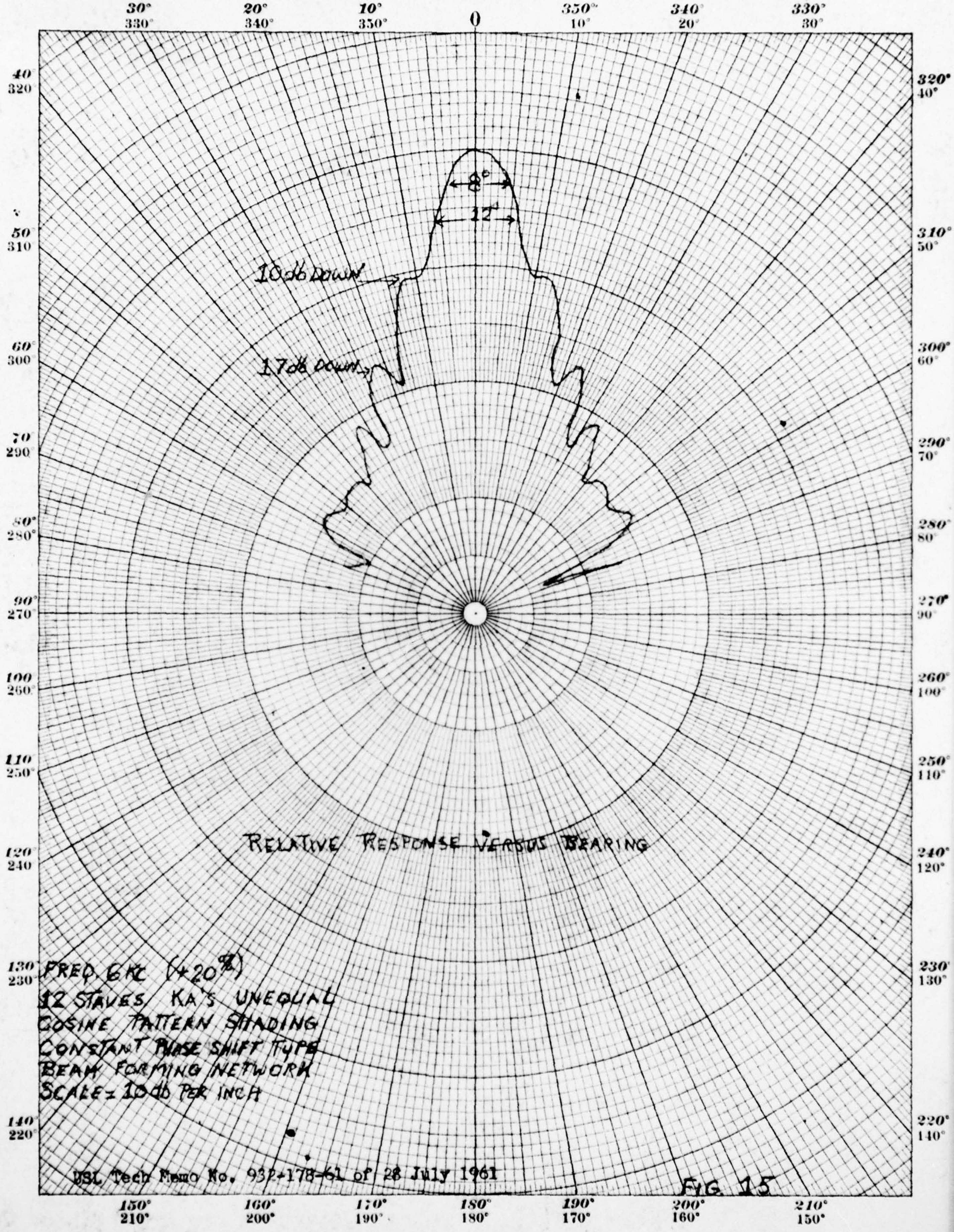
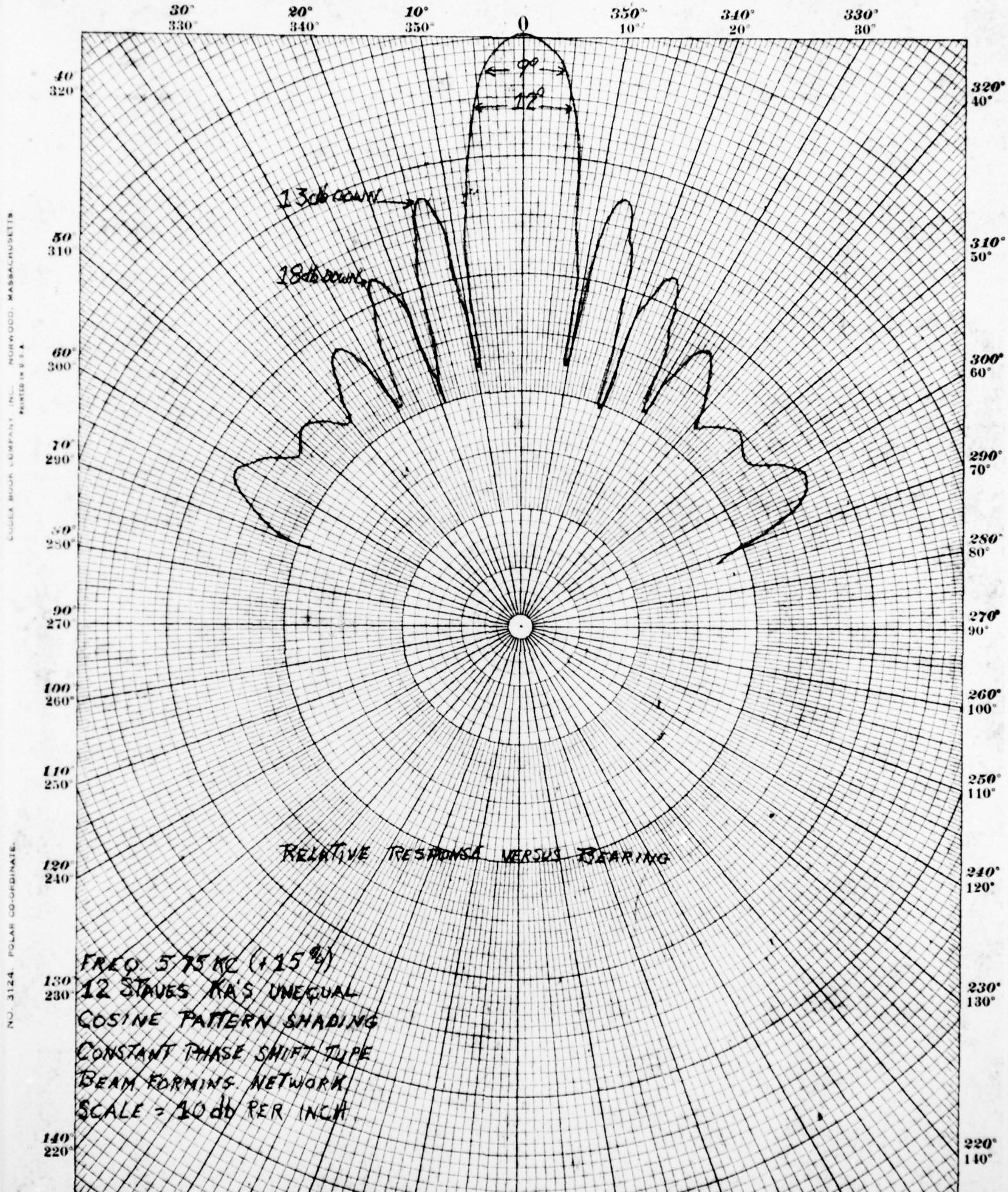
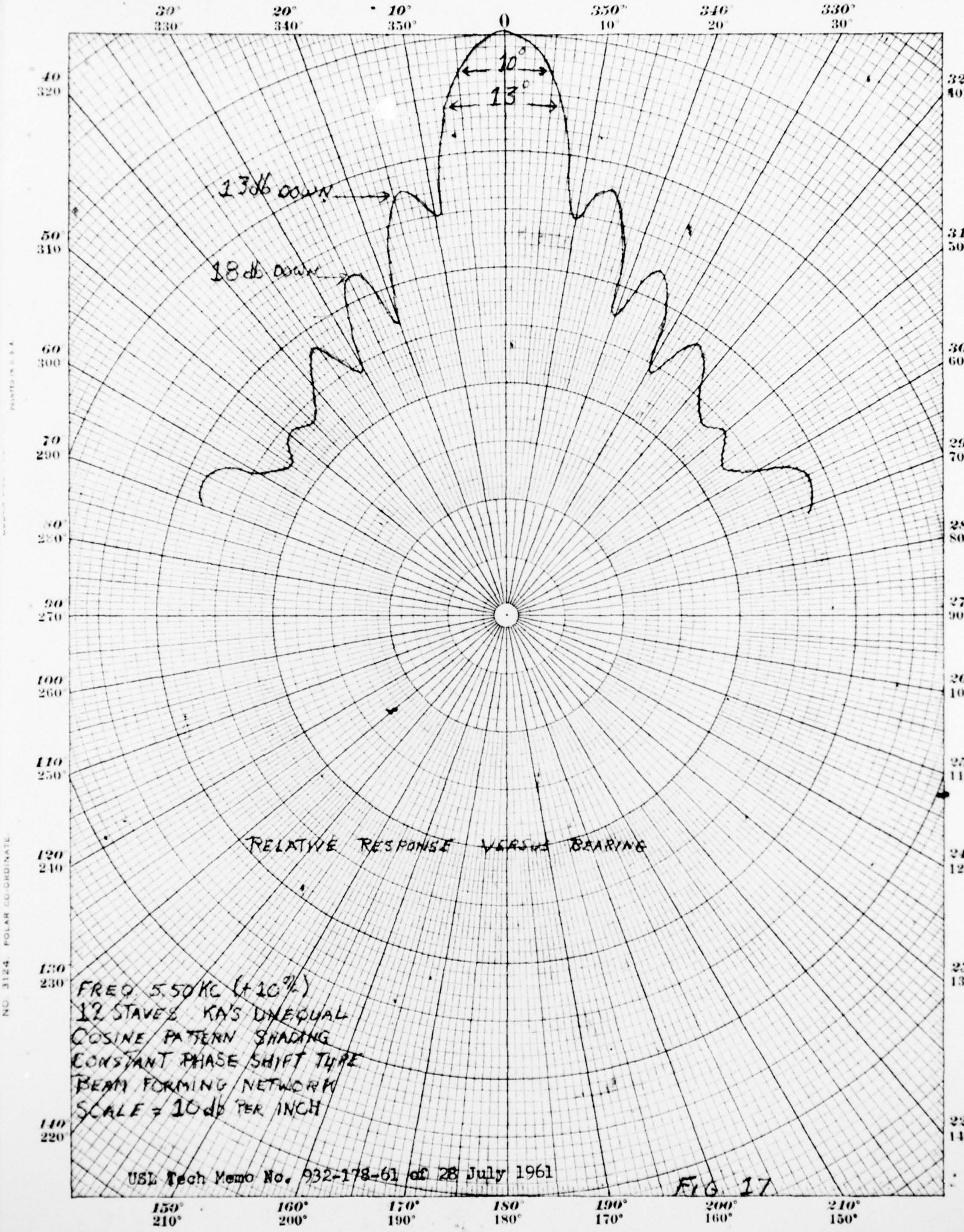

8°
12°
10db DOWN
17db DOWN
RELATIVE RESPONSE VERSUS BEARING
FRED 6 KC (+20%)
12 STAVES KA'S UNEQUAL
COSINE PATTERN SHADING
CONSTANT PHASE SHIFT TYPE
BEAM FORMING NETWORK
SCALE = 10db PER INCH
USL Tech Memo No. 932-178-61 of 28 July 1961
CODEX BOOK COMPANY, INC. NORWOOD, MASSACHUSETTS.
PRINTED IN U.S.A.
NO. 3124. POLAR CO-ORDINATE.

FIG 15



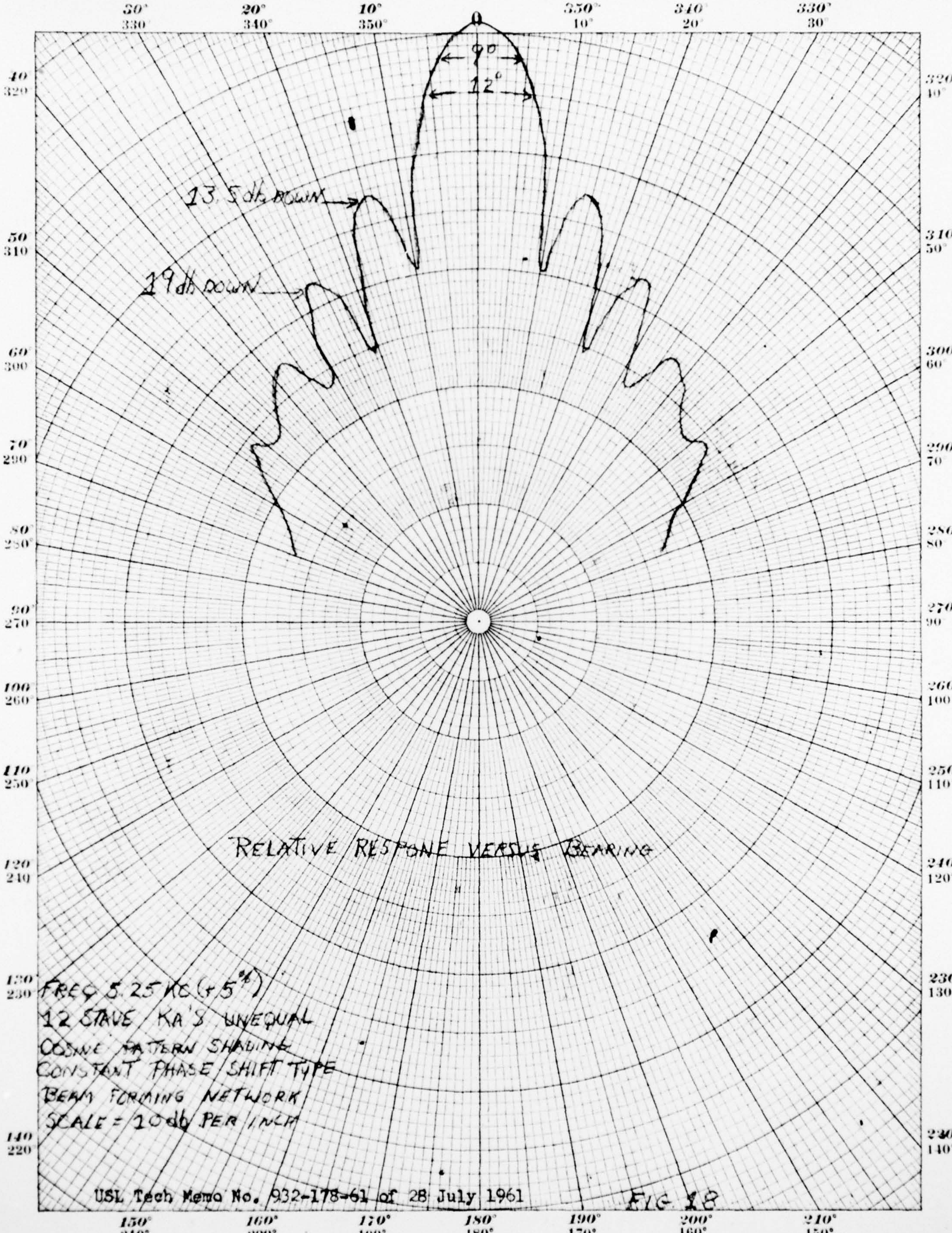
USL Tech Memo No. 932-178-61 of 28 July 1961

FIG. 16



USL Tech Memo No. 932-178-61 of 28 July 1961

FIG. 17



USL Tech Memo No. 932-178-61 of 28 July 1961

FIG. 18

RELATIVE RESPONSE VS FREQUENCY FOR 12 ELEMENT PATTERNS

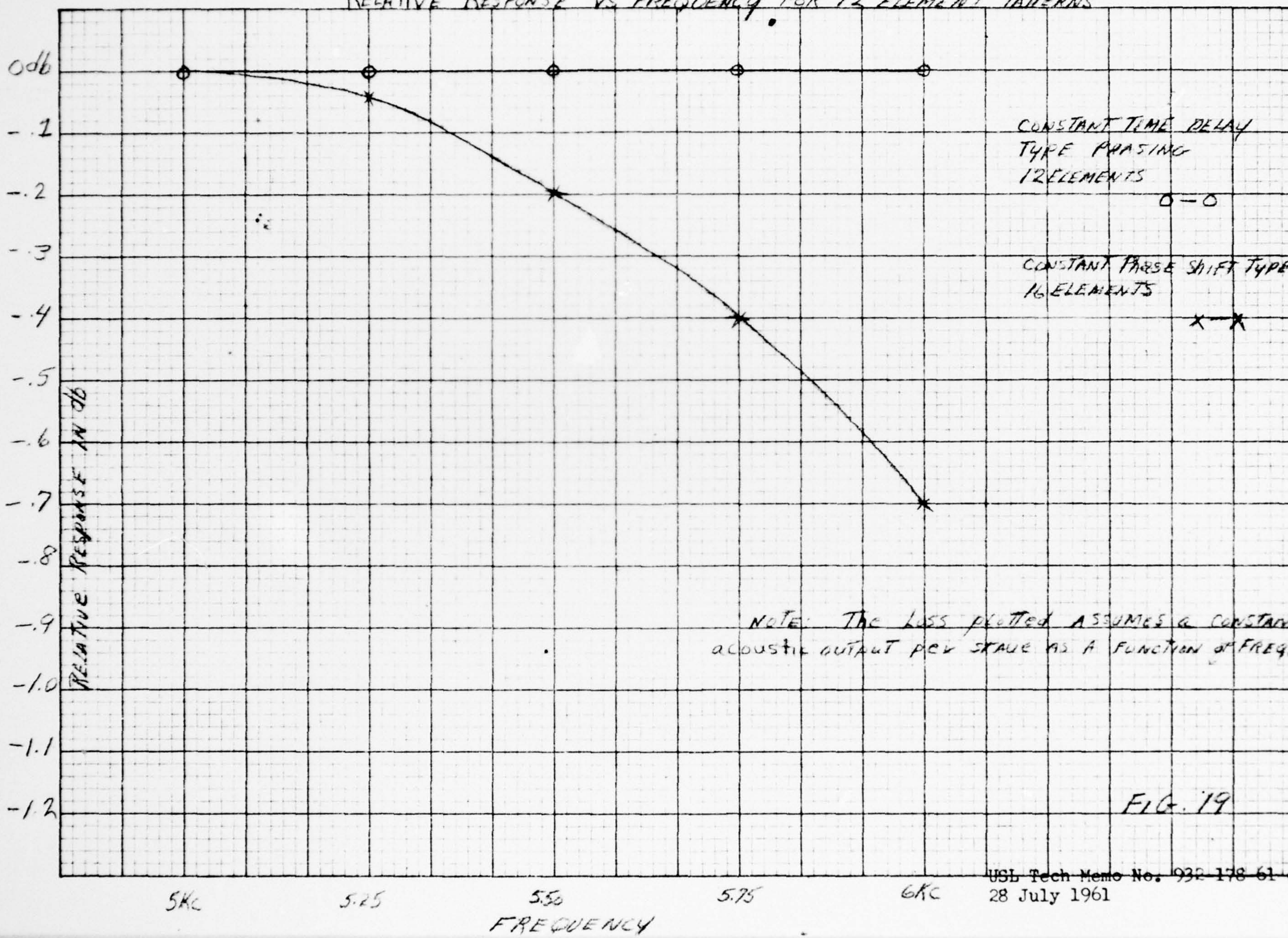


FIG. 19

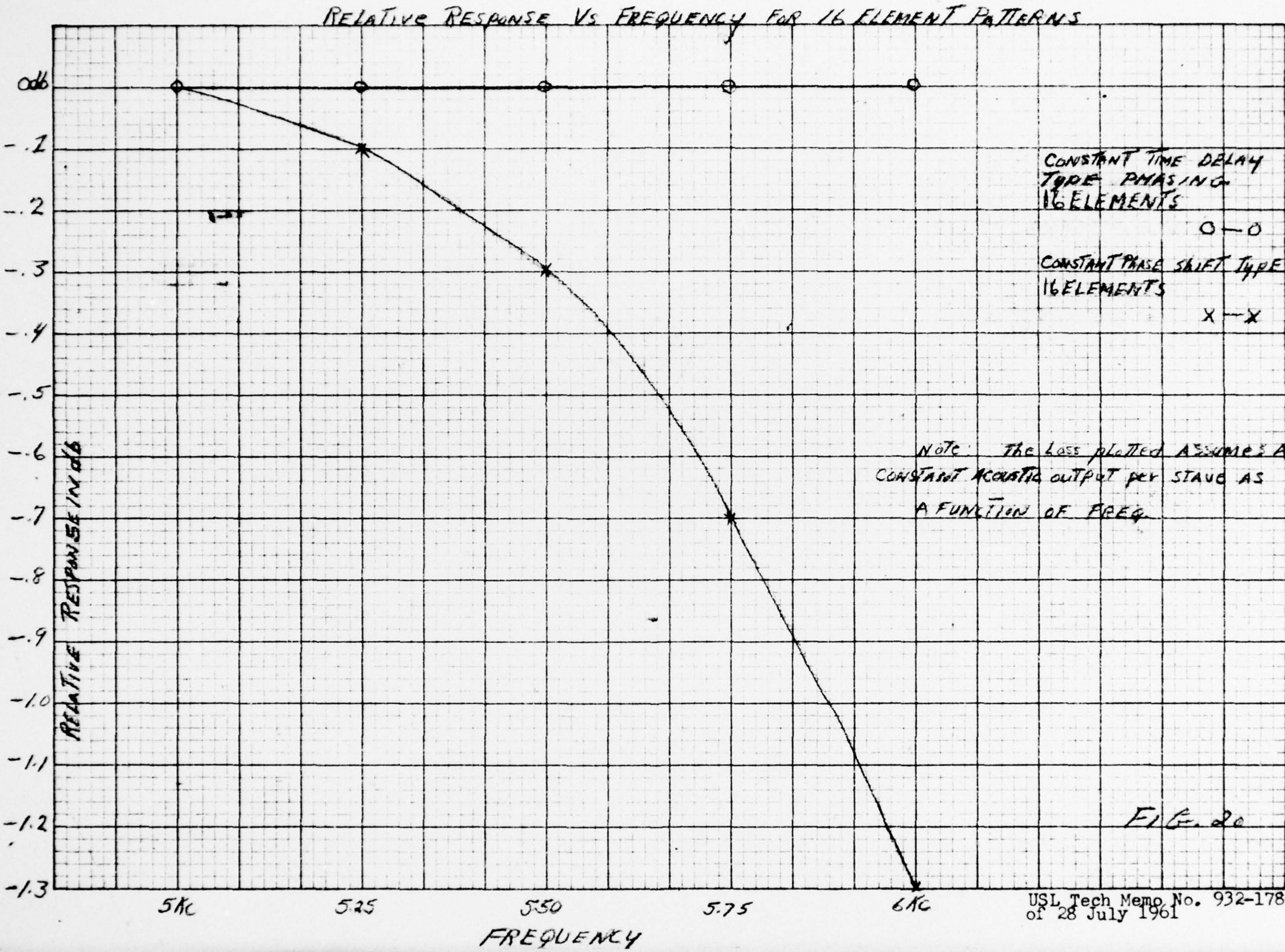

RELATIVE RESPONSE VS FREQUENCY FOR 16 ELEMENT PATTERNS
0db
-.1
-.2
-.3
-.4
-.5
-.6
-.7
-.8
-.9
-1.0
-1.1
-1.2
-1.3
RELATIVE RESPONSE IN db
5KC
5.25
5.50
5.75
6KC
FREQUENCY
CONSTANT TIME DELAY TYPE PHASING 16 ELEMENTS
O—O
CONSTANT PHASE SHIFT TYPE 16 ELEMENTS
X—X
NOTE: THE LOSS PLOTTED ASSUMES A CONSTANT ACOUSTIC OUTPUT PER STAVE AS A FUNCTION OF FREQ.

FIG. 20