UCRL-474
Copy No. 2

UNCLASSIFIED

UNIVERSITY OF CALIFORNIA RADIATION LABORATORY

BEVATRON
D. C. MODEL MAGNET TESTS

April - September 1948

by

D. C. Sewell
Alice Dodson
Eugene Cox
James Hulse
Arthur Redmond

CONTENTS

I. INTRODUCTION

II. GENERAL SPECIFICATIONS

III. QUANTITIES USED TO COMPARE MODELS

IV. TYPES OF MEASUREMENTS MADE ON D. C. MODEL MAGNETS

V. RESULTS

I. INTRODUCTION

This report is a summary of the results that were obtained from D. C. model magnet tests of the bevatron. These tests were made from April through September 1948. The main purpose of this work was to determine the magnet design that would meet the general specifications laid down by the initial calculations for the machine.

Four general types of measurements were made:

(1) Magnetization - the flux density at the gap center compared to the ampere turns applied to the magnet,

(2) Return path flux - the flux density at various positions in the iron return path compared to the number of ampere turns applied to the magnet,

(3) Uniformity - the variation of the flux density with position in the magnet gap,

(4) Coil flux linkage - the total flux linkages of the exciting coil compared to the number of ampere turns applied to the magnet.

The data for each model have been arranged in this general order.

While these tests were in progress it was decided to build the machine in two stages. The magnet for the initial stage would have a large aperture which would allow larger vertical and horizontal oscillations of the ions, and larger tolerances for the R. F. tracking system. This larger aperture design also would give smaller losses from gas scattering.

It has been assumed that the larger aperture design must be capable of being converted, by rewinding the existing coils and by adding poles to the existing steel yoke, to a magnet which will meet the specifications outlined in Section II of this report.

D. C. model magnets were used for these initial tests because they can be fabricated more cheaply and quickly than A. C. models. Also at the time these tests were made, D. C. magnetic measurements could be made with greater speed than the A. C. measurements.

Models DC6A.3 and DC6.6 were chosen as the large aperture (4' high by 14' wide) and the small aperture (1' high by 4' wide) design as a result of these tests. It was decided at this point that further tests should be made dynamically on A. C. models. The results of these A. C. tests will be covered in another report.

The results of the magnetic measurements on the quarter scale operating model which is now being constructed will be given in another report.

II. GENERAL SPECIFICATIONS

The following are the general specifications for the bevatron magnet:

A. The maximum stored energy of the magnet is not to exceed eighty megajoules.

B. The rise time to peak current should not exceed 2 seconds with 100,000 KVA. (A shorter time is preferred.)

C. The total weight of steel is not to exceed 10,000 tons.

D. The peak ampere turns is not to exceed 735,000 ampere turns.

E. The peak magnetic field at the center of the gap is to be at least 16 kilogauss.

F. The value of n is dependent on theoretical factors. This value was first taken as 0.75 and later changed to 0.73.

G. The radial width of the usable magnetic field at the injection field is not to be less than 48 inches. At the maximum magnetic field the useful radial width is not to be less than 18 inches.

H. The inside dimensions of the vacuum chamber are to be at least 12 inches in height and 48 inches in radial width.

III. QUANTITIES USED TO COMPARE MODELS

Models were made to scale in linear dimensions and coil placement. The results were computed for the full scale magnet from all quantities which were measured on model magnets. These results were compared directly with the full scale specifications.

A. The weight of the full scale magnet steel was computed from the weight of the model magnet steel scaled up.

$$T_{FS} = T_M \, (360^\circ/\theta) \, (S)^3$$

where

T_{FS} is the weight of the full scale magnet steel

T_M is the weight of model steel computed from model dimensions

θ is the "angular length" of the model in degrees

S is the scaling factor.

B. The gap height scales directly as the scaling factor, S.

C. The radial pole width scales directly as the scaling factor, S.

D. The flux density in the model and the full scale magnet are equal.

E. The number of ampere turns on the full scale magnet is computed from the model magnet.

$$(NI)_{FS} = (NI)_M(S)$$

where

$(NI)_{FS}$ is the number of ampere turns on the full scale magnet

$(NI)_M$ is the number of ampere turns on the model magnet.

F. The average volts per coil turn is computed from the total coil loop flux linkage measurements on the model magnet.

$$\phi_M = (\phi_t)_M / N_M$$

where

ϕ_M is the average flux in maxwells linking a coil turn on the model magnet

$(\phi_t)_M$ is the total measured flux linkage on the model magnet in maxwell turns

N_M is the number of turns in the coils of the model

$$\phi_{FS} = \phi_M (S)^2 (360^o/\theta)$$

where

ϕ_{FS} is the average flux in maxwells linking a coil turn on the full scale magnet

θ is the angle in degrees over which the flux linkage measurement was made

$$(V/N)_{FS} = \frac{\phi_{FS}}{t} (10^{-8})$$

where

$(V/N)_{FS}$ is the volts per turn on the exciting coils on the full scale magnet

t is the rise time in seconds.

G. The peak KVA is computed in the following manner:

$$KVA = (V/N)_{FS} (NI)_{FS} \times 10^{-3}$$

H. The useful gap width, the radial distance from $n = 1.0$ to $n = 0.5$, was determined from the radial uniformity curves. The value, n, is computed from the change in magnetic field in relation to the change in radius.

$$H = H_o (r_o/r)^n$$

$$n \ln. r_o/r = \ln. H/H_o$$

$$-n/r = (1/H) (dH/dr)$$

$$n = -(r/H) (dH/dr)$$

where

H is the magnetic field at a point

H_o is the magnetic field at gap center

r_o is the radius at gap center

r is the radius where field is H

I. The efficiency of the magnet is computed from the ratio of the mmf that appears across the center of the air gap to the total mmf produced by the current in the exciting coils.

$$(NI)g = 2.02\ (H)g(L)g$$

where

$(NI)g$ is the number of ampere turns across the air gap

$(H)g$ is the magnetic field in gauss at the center of the air gap

$(L)g$ is the length of the air gap in inches

then

$$\% \text{ Efficiency} = \frac{(NI)g \quad 100}{NI}$$

where

NI is the number of ampere turns of the exciting coils.

J. The stored energy of the full scale magnet is calculated from the total coil loop flux linkage measurements.

$$W_M = 10^{-8} \int_0^I I\ (d\phi_t)_M$$

where

W_M is the stored energy on the model magnet in joules

I is the current in amperes

$(\phi_t)_M$ is the total flux linkages in maxwell turns

$$W_{FS} = W_M\ (360^\circ/\theta)\ (S)^3$$

where

W_{FS} is the stored energy of the full scale magnet

θ is the angle of the model magnet through which the flux was measured

K. Average coil leakage coefficient is calculated from the total coil loop flux linkage measurements and the magnetization measurements.

$$L = \phi_t / NHA$$

where

L is the average coil leakage coefficient at a given current

ϕ_t is the total flux linkages in maxwell turns

N is the number of turns on the exciting coils

H is the flux density at the gap center

A is the pole area calculated from the minimum specified useful width at the injection field.

NOTE: It has been assumed for the calculation of these quantities that the flux density at the gap center is constant inside the magnet quadrant, but that it falls to zero immediately outside the end of the quadrant.

IV. TYPES OF MEASUREMENTS MADE ON DIRECT CURRENT MODEL MAGNETS

A. The flux density in the gap center was measured at various currents with a General Electric fluxmeter (Cat. No. 32C247G6) and a calibrated search coil. The search coils were approximately one centimeter high and 1 centimeter in diameter. They were wound with a large number of turns of small wire (A. W. G. #46) which gave them an effective area of approximately 1500 turns cm^2. Two procedures were used to make these measurements:

1. The search coil was held stationary while the exciting current was turned on and off. (The residual field must be added to these measurements.)
2. The exciting current was held constant while the search coil was flipped through 180°.

B. Flux in various positions in the magnetic path was measured at various exciting currents. A loop of wire was placed around the magnet part in which the flux was to be measured. This loop was connected to a fluxmeter. The observations were made when the exciting current was turned on and off.

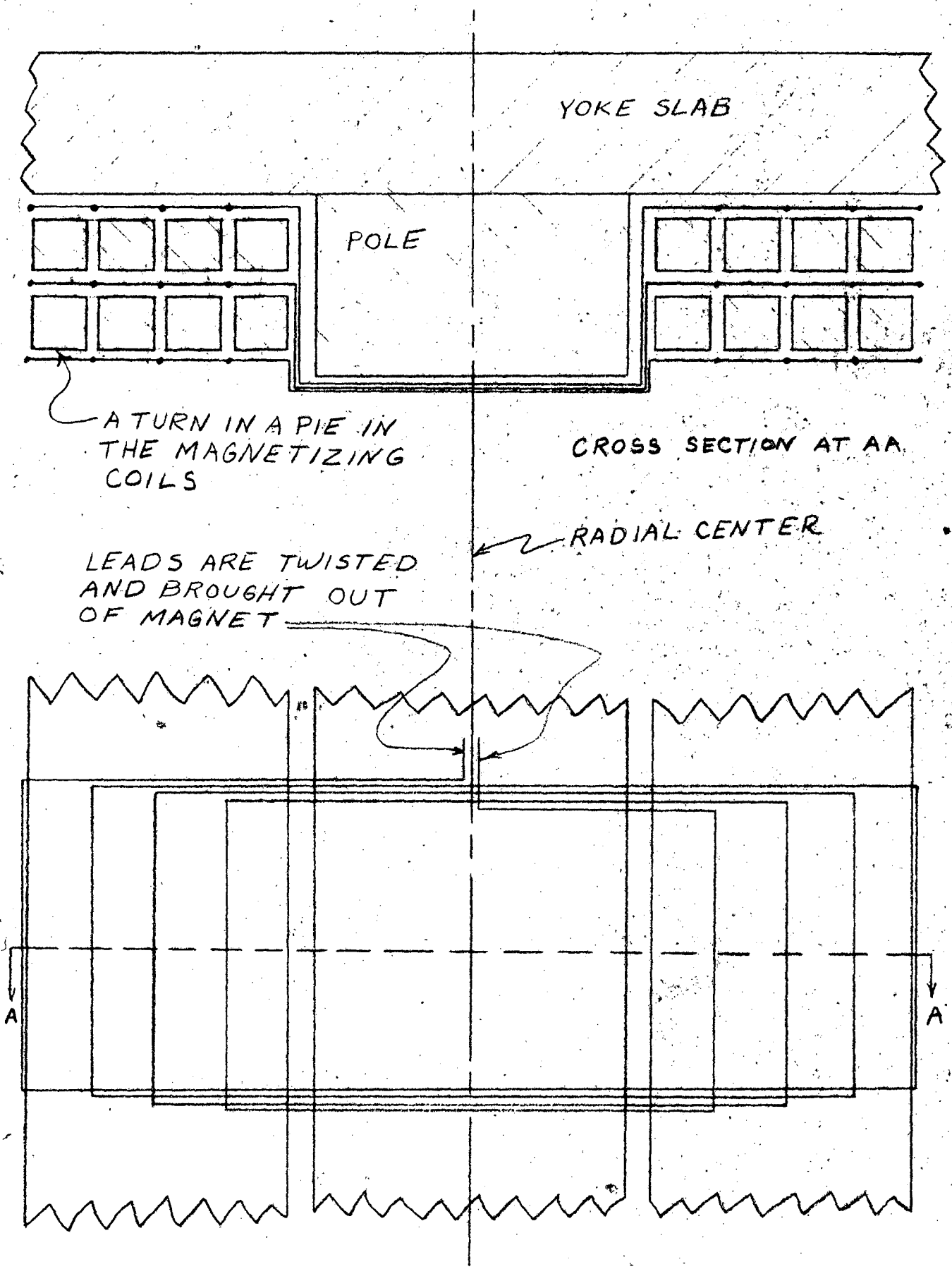
C. Coil flux linkages were measured by placing wire loops across the magnet pole end between the coil pies in such a manner that each exciting coil turn corresponded to a coil flux loop. (See sketch on following page.) The exciting current was turned on and off and deflections were observed on a fluxmeter.

D. Uniformity measurements (variations in flux density) at constant current were made within the model magnet gap along a radius and along an arc. A roving search coil, a stationary bucking coil, and a flux meter were used for these measurements. Differences in the magnetic field at a constant exciting current were measured by moving the search coil from point to point and observing the deflections on the fluxmeter.

E. Residual field measurements were made on the model magnets by flipping a search coil through 180° and observing deflections on a flux meter.

F. Stray field (flux density outside the magnet gap) was measured by the same procedure described in "D" of this section.

SCHEMATIC DRAWING OF LOOPS USED TO MEASURE COIL FLUX LINKAGES ON BEVATRON MODEL MAGNETS



Loops used to measure coil flux linkages on bevatron model magnets

BEVA 1/4 240

V. RESULTS

A. Table I

B. Models

Two types of DC model magnets were designed and tested concurrently to predict magnet performance on the full scale bevatron. One type had the exciting coils across the air gap (referred to as Type A), and the other type had the exciting coils above and below the air gap (referred to as Type B). Type B was designed with "wings" to increase the useful gap width at the injection field. These "wings" will saturate at the higher fields and give a smaller useful gap width, hence, a greater magnet efficiency.

Revised APRIL 26, 1949 A.D.

Job 94-9
4-13
D.C.S.

BEVATRON MODEL MAGNET TESTS (PAGE 1)

Model	Iron (Tons) Full Scale	Gap (Inches) Full Scale	Pole Width Inches Full Scale	Field (Gauss) Center of Gap	Amp Turns X 10^3 Full Scale	Peak KVA Full Scale (1 Sec. Rise)	Useful Gap Width (Inches) m=1/2 to m=1	Ave. Coil Leakage Coeff.	Volts Per Coil Turn	Efficiency o/o	Energy Megajoules Full Scale
DC1	9600	14	48 (+ wings) (72)	16000 245	9.0	236,000	5 46	1.40	261	50	67.9
DC3	7950	14	54	16000 230	5.0	127,000	22 26	1.35	253	91	63.2
DC3A	8650	26	108	8600	5.0	126,000	~~~73~~ ~~~73~~	1.26	251	91	~63.2
DC4	9800	14	48 (+ wings) (66)	16000 379	7.0	206,000	18 ~40	1.58	293	65	80.3
DC4B	9800	14	48 BENT (+ wings) (66)	16000 208	7.1		20 ~ .52			64	
DC4C	9800	14	66	16000	8.0	256,000		1.76	320	56	~96.5
DC5A	8900	26	108	8000 197	4.4	100,000	94 95	1.20	226	94	62.2
DC5	8050	14	54	14100 205	4.3	107,000	44 44	1.40	250	94	
Ideal		14	48	16000	4.52	84,500	48	1.00	187	100	42.3
		26	96	8000	4.20	78,500	96	1.00	187	100	39.3
		54	168	4000	4.36	71,100	168	1.00	163	100	35.5
DC6A	8700	54	179.25	5000	6.63	147,700		1.18	223	82.5	67.0
DC6	~~9930~~	14	48 (+ wings) (66)	16000	7.27	217,800		1.61	299	62.2	81.3
DC6.1	9930	14	48(+ WINGS 66)	16000	7.09	204,800		1.55	289	63.9	79.2
DC6A.1	8700	54	179.25	5300	7.06	157,000	135	1.12	222	82.9	69.1

BEVATRON MODEL MAGNET TESTS (PAGE 2)

MODEL	IRON (TONS) (F.S.)	GAP (INCHES) (F.S.)	POLE WIDTH (INCHES) (F.S.)	FIELD (GAUSS) GAP CENTER	AMPERE TURNS X10⁵ (F.S.)	PEAK KVA (1 SECOND RISE) (F.S.)	USEFUL GAP WIDTH (INCHES) $n = 0.5$ TO $n = 1$	AVE. COIL LEAKAGE COEFF.	VOLTS PER COIL TURN	EFF. (IN %)	ENERGY (MEGA JOULES) (F.S.)
DC6A	8700	54	179.25	5000	6.63	147,700		1:18	223	82.5	67.0
DC6	19930	14	48 + WINGS 66	16000	7.27	217,800		1.61	299	62.2	81.3
DC6.1	9930	14	48 + WINGS 66	16000	7.09	204,800		1.55	289	63.9	79.2
DC6A.1	8700	54	179.25	5300	7.06	157,000	135	1.12	222	82.9	69.1
DC6A.2	8790	54	179.25	5300	7.21		135			80.7	
DC6.2	10190	14	48 + WINGS 66	16000	6.65					68.0	
DC6.3	10450	14	48 + Wings 66	16000	6.47					69.7	
DC6.4	10090	14	48 + WINGS 66	16000	6.81					66.4	
DC6.5	10,020	14	48 + WINGS 66	16000	6.85	188,000		1.47	275	66.0	73.0
DC6.6	10,180	14	48 + WINGS 66	16000	6.56					69.0	
DC6.7	10,340	14	48 + WINGS 66	16000	6.45					70.2	
DC6.8	10,440	14	48 + WINGS 66	16000	6.49					69.9	
DC6.9	10,290	14	48 + WINGS 66	16000	6.58					68.9	
DC6A.3	8950	54	179.25	5350 5300	7.06 6.96	158,000	141	1.12	224	82.7 83.0	69.7
DC6A.4	8950	54	179.25	5300	6.72					86.1	
DC6A.5	8950	54	179.25	5300	6.61					87.5	
DC6A.6	8950	54	179.25	5300	6.68					86.5	

1 Model Magnet DC1 Index

a. Discussion

b. Sketch

c. Photographs

BEVA 15

BEVA 13

d. Graphs

L-DC1-1 (cor)	Efficiency and leakage coefficients
H-DC1-1	Flux density around the magnetic path
U-DC1-1	Radial uniformity
U-DC1-1a	Radial uniformity - Expanded
F-DC1-1 (cor)	Coil flux linkage
F-DC1-1a (cor)	Total coil flux linkage
E-DC1-1 (cor)	Stored energy
S-DC1-1	Stray field

1 Model Magnet DC1

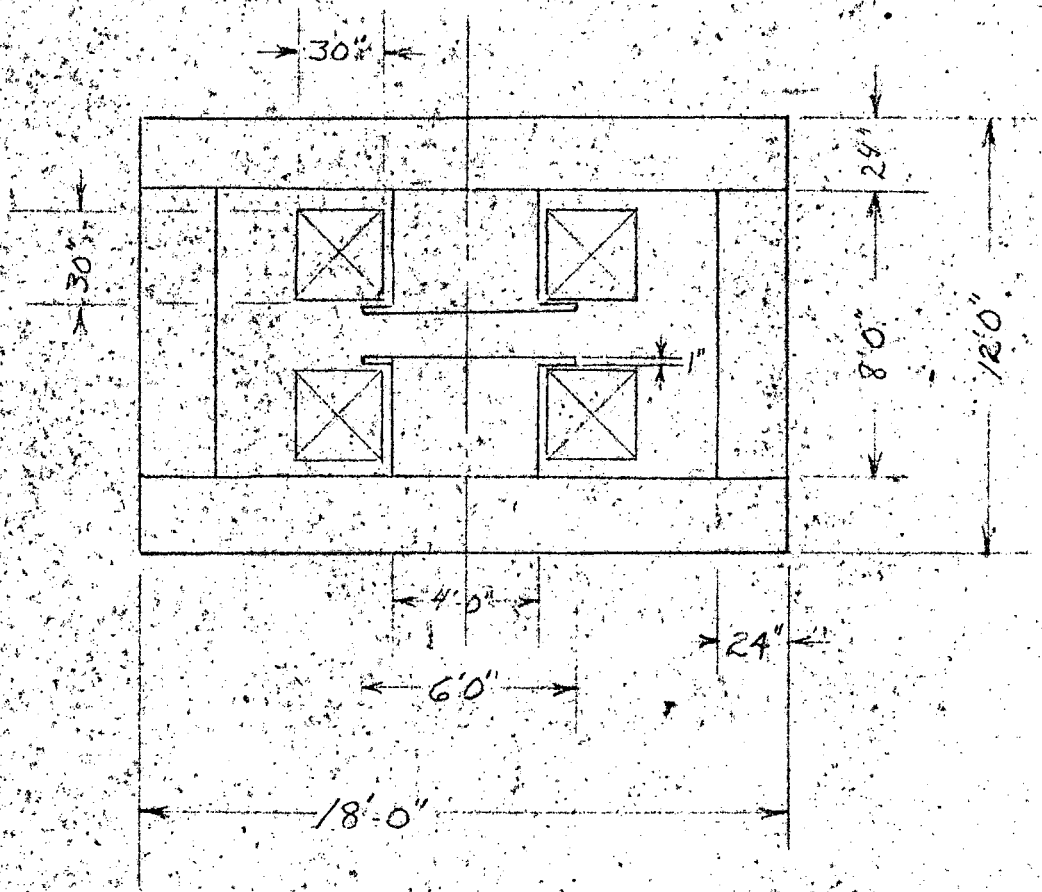
a. Discussion

Bevatron model magnet DC1 was the first attempt to make a DC model (type B) to predict performance of the magnet for a full scale bevatron.

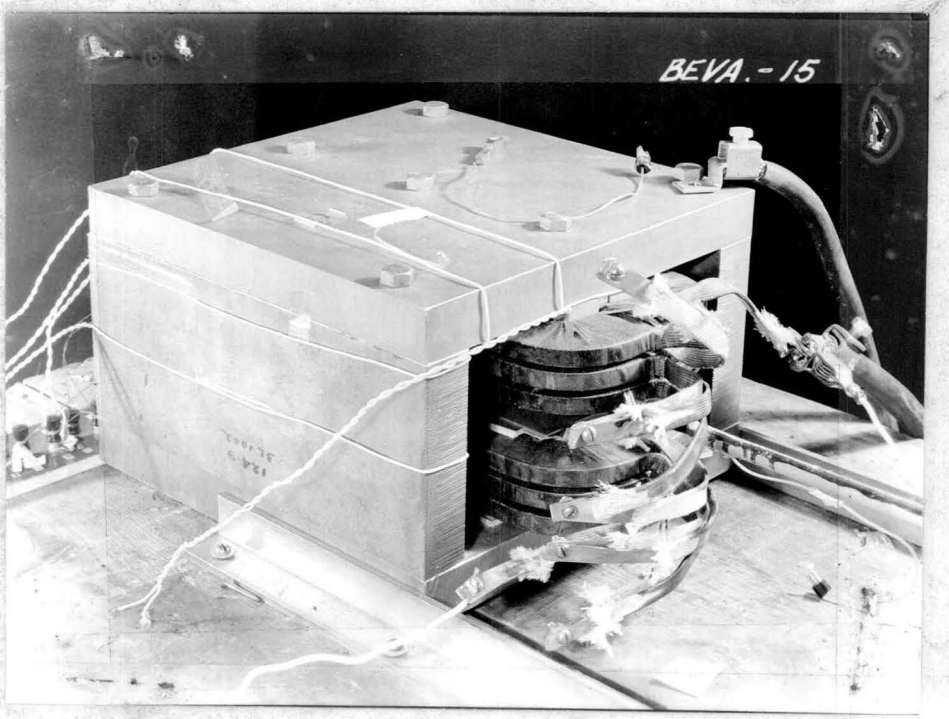
This magnet failed to meet some of the general specifications. (See Section II and Table I) The ampere turns required were 9.0×10^5 instead of the specified 7.35×10^5. The peak KVA required was 236×10^3 for a rise time of one second. The specified 100×10^3 KVA is for a rise time of not greater than 2.0 seconds. The useful gap was 5 inches when the magnetic field strength was 16 kilogauss at the gap center instead of the specified 18 inches.

The efficiency of this magnet was only 50 percent. The flux loop measurements showed that a portion of the iron in the magnetic path reached saturation when the field in the gap was approximately 15,000 gauss. It was decided that drastic design changes should be made. These changes will be shown in the following model. (See model DC4)

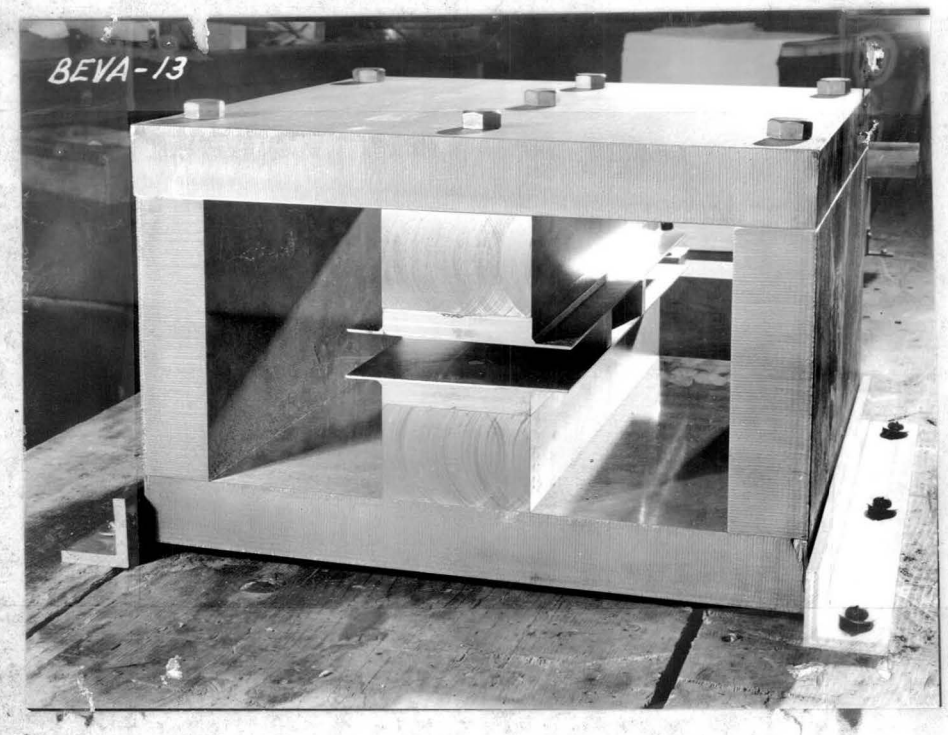
BEVATRON MODEL MAGNET DC 1



GAP 14"
RADIUS 50'
$n = 0.75$
MODEL COILS: 6 COILS 25 TURNS EACH = 150 TURNS
DIMENSIONS ARE FULL SCALE
MODEL IS 1/16 SCALE
ASSEMBLY DWG. 3L 1062



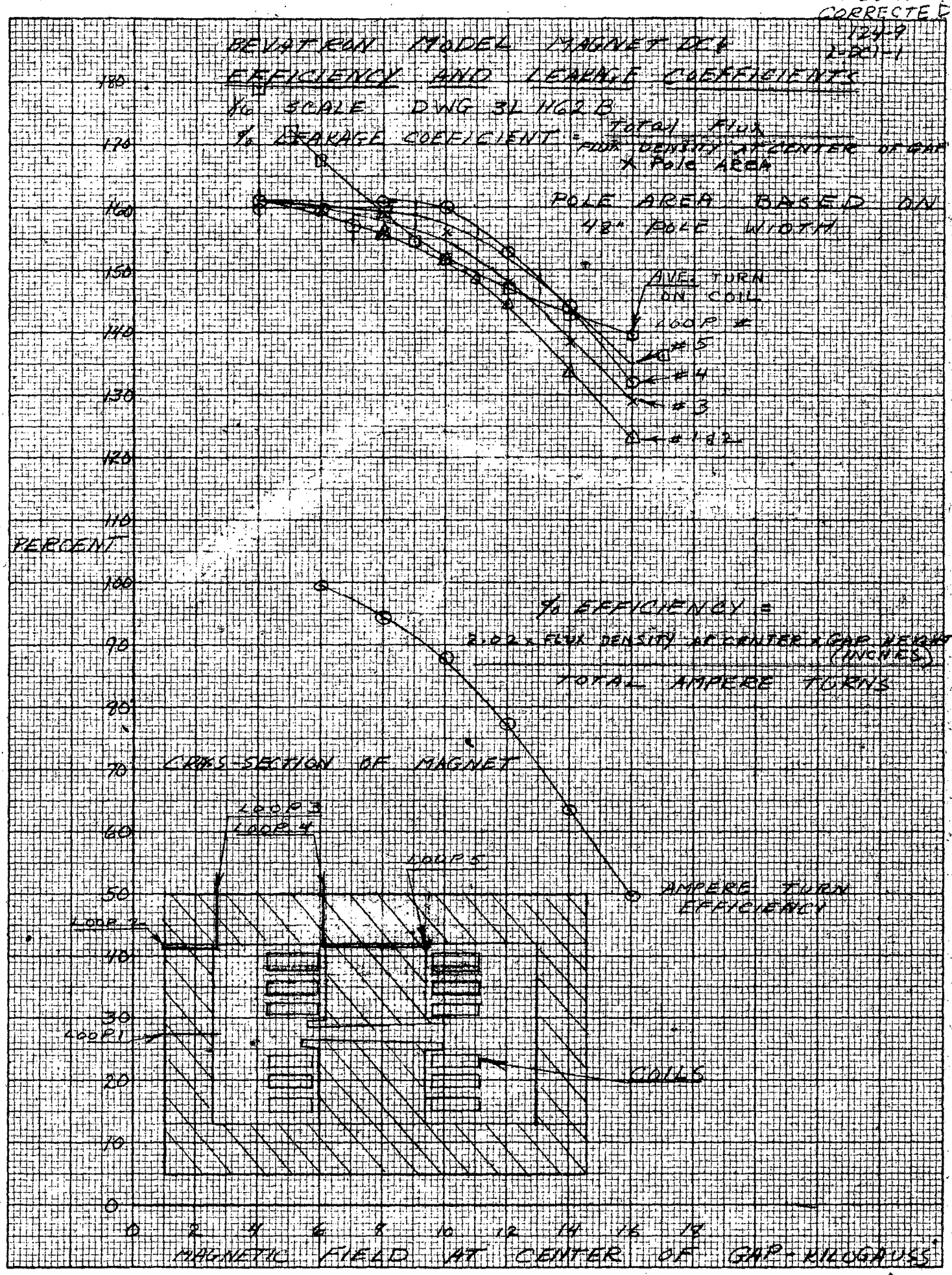
BEVA 15



BEVA 13

Bevatron Model Magnet DC1

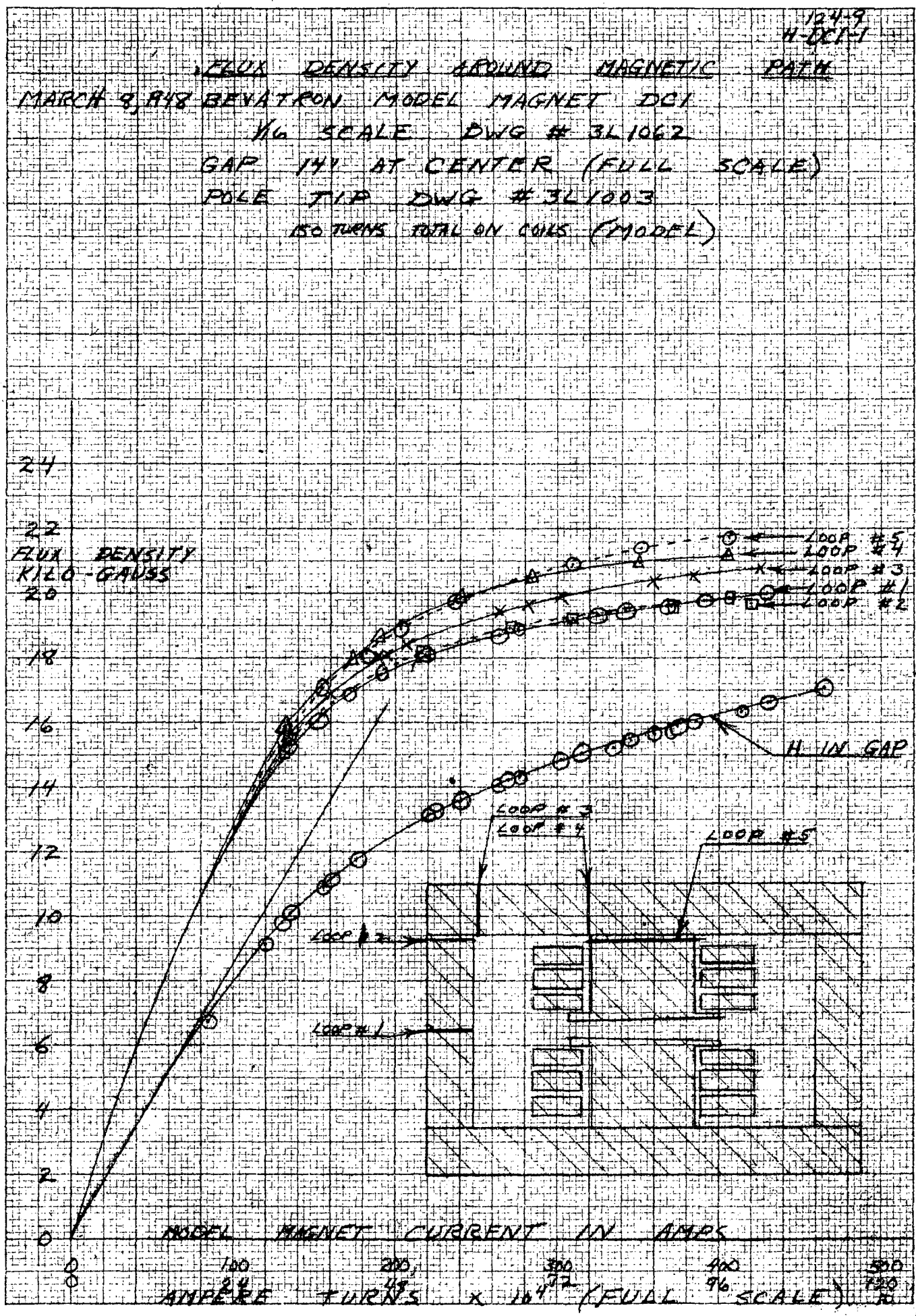
4-28-48.
CORRECTED
124-9
2-DC1-1

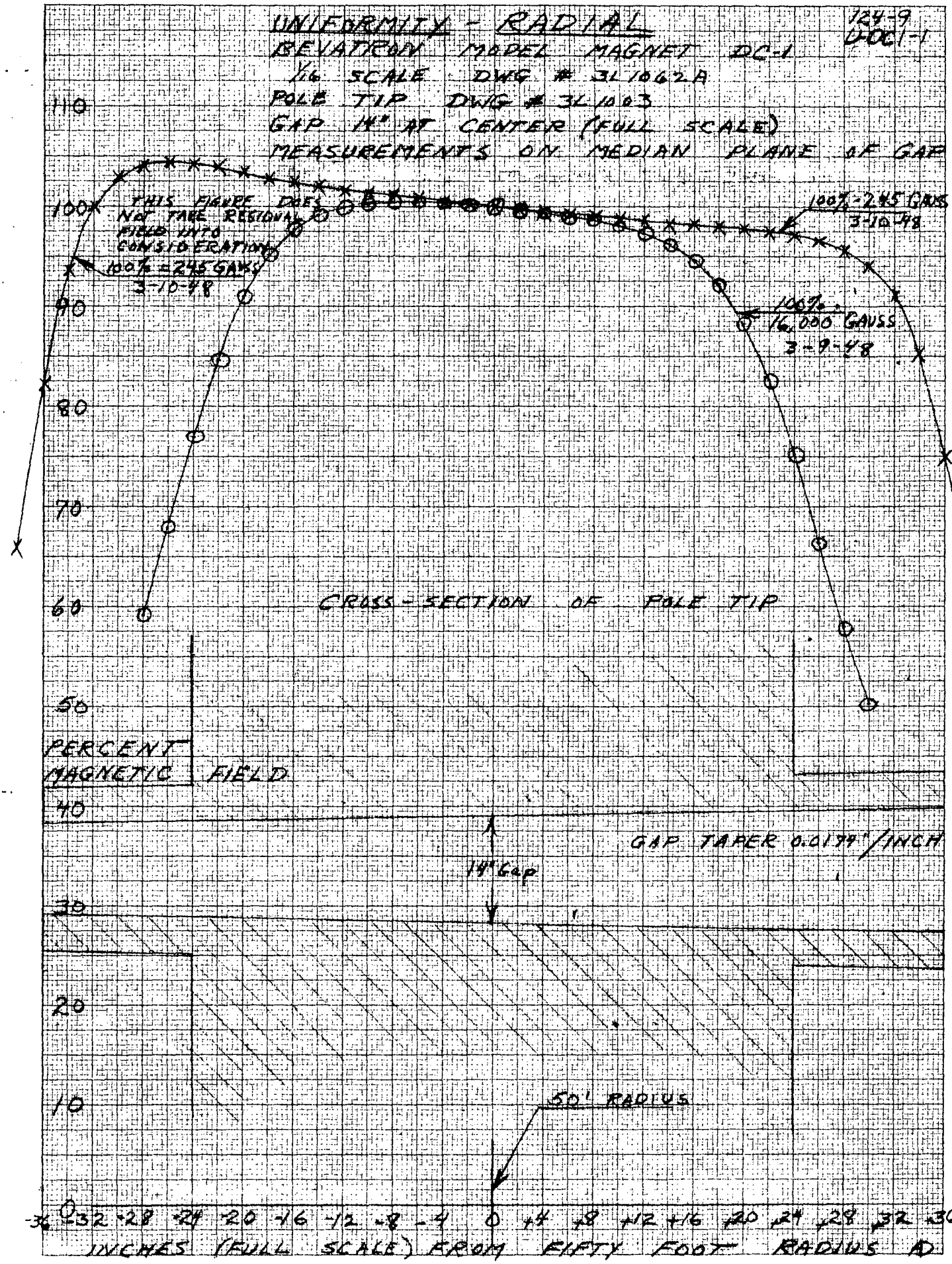


KEUFFEL & ESSER CO., N. Y. NO. 359-12G
10 X 10 to the ½ inch, 5th lines accented.
MADE IN U.S.A.

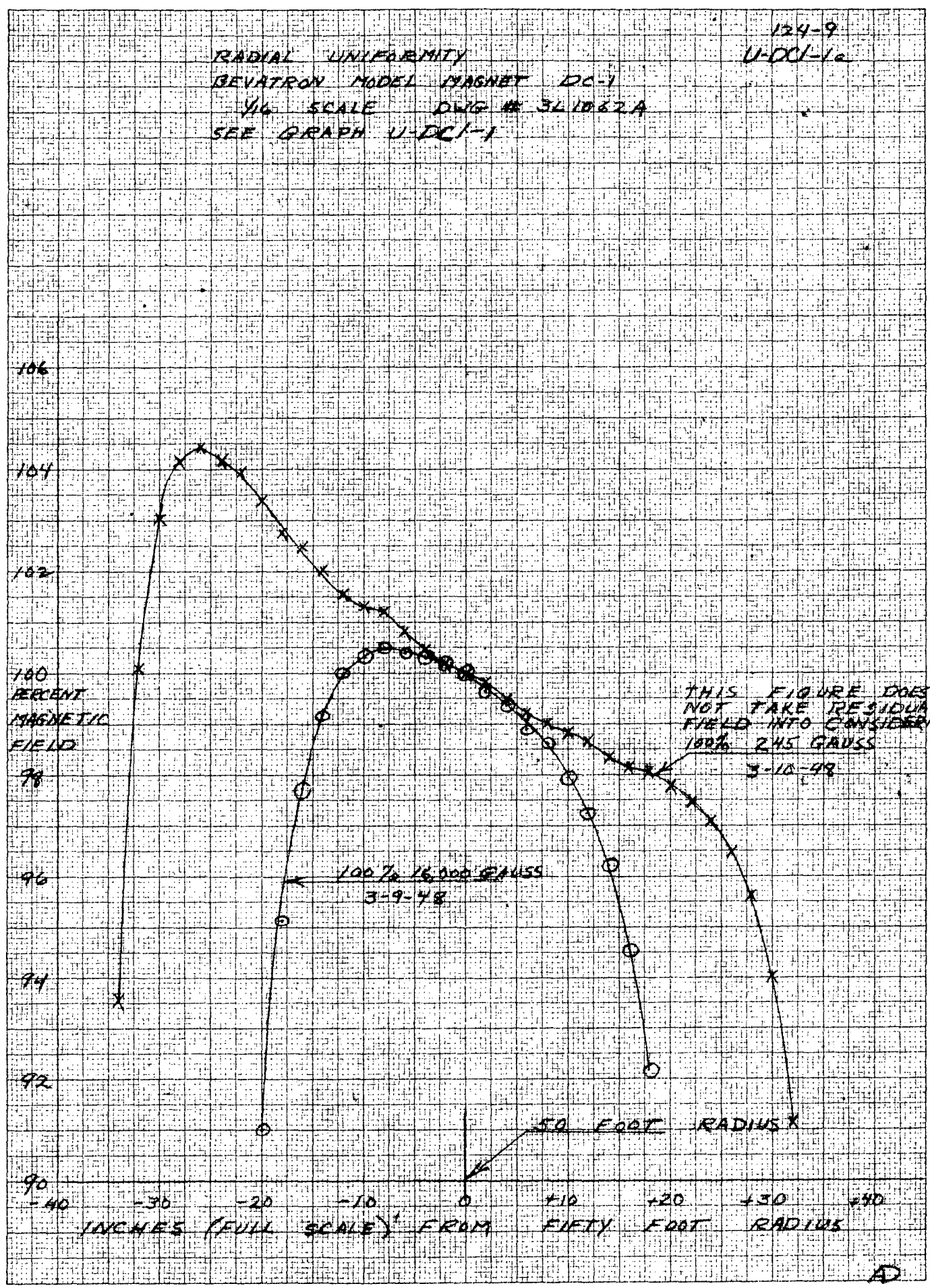
124-9
H-DC1-1

FLUX DENSITY AROUND MAGNETIC PATH
MARCH 9, 1948 BEVATRON MODEL MAGNET DC1
1/6 SCALE DWG # 3L1062
GAP 14" AT CENTER (FULL SCALE)
POLE TIP DWG # 3L1003
150 TURNS TOTAL ON COILS (MODEL)





KEUFFEL & ESSER CO., N. Y. NO. 359-14
Millimeters, 10th lines heavy.
MADE IN U.S.A.



KEUFFEL & ESSER CO., N. Y. NO. 359-14
Millimeters, 10th lines heavy.
MADE IN U.S.A.

121-8

FDC1-1

CORRECTED 4-19-48

APRIL 19, 1948

ELEVATION MODEL MAGNET DC4

COIL FLUX LINKAGE

½ SCALE DWG 3L 1062

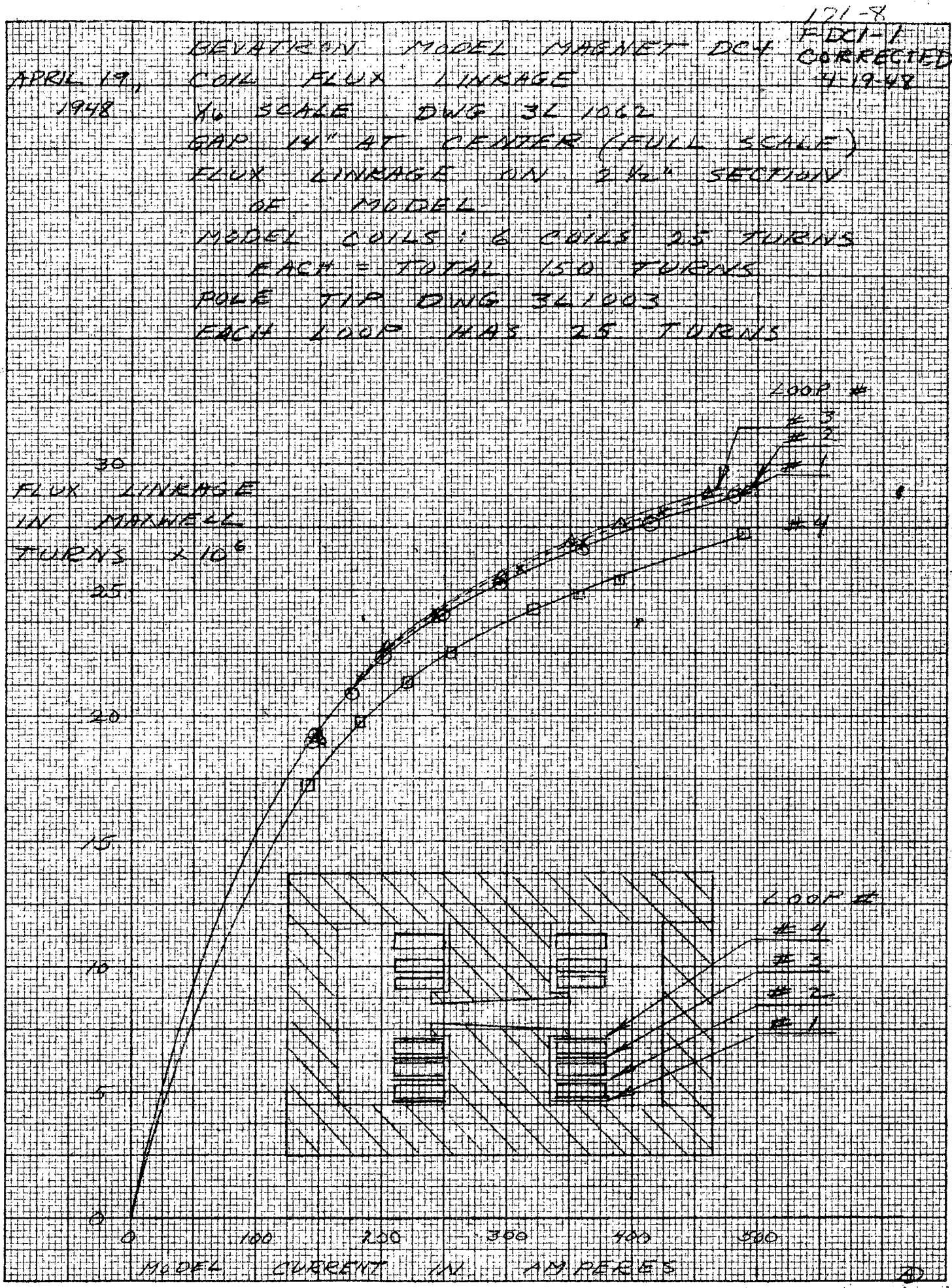
GAP ½" AT CENTER (FULL SCALE)

FLUX LINKAGE ON 2½" SECTION OF MODEL

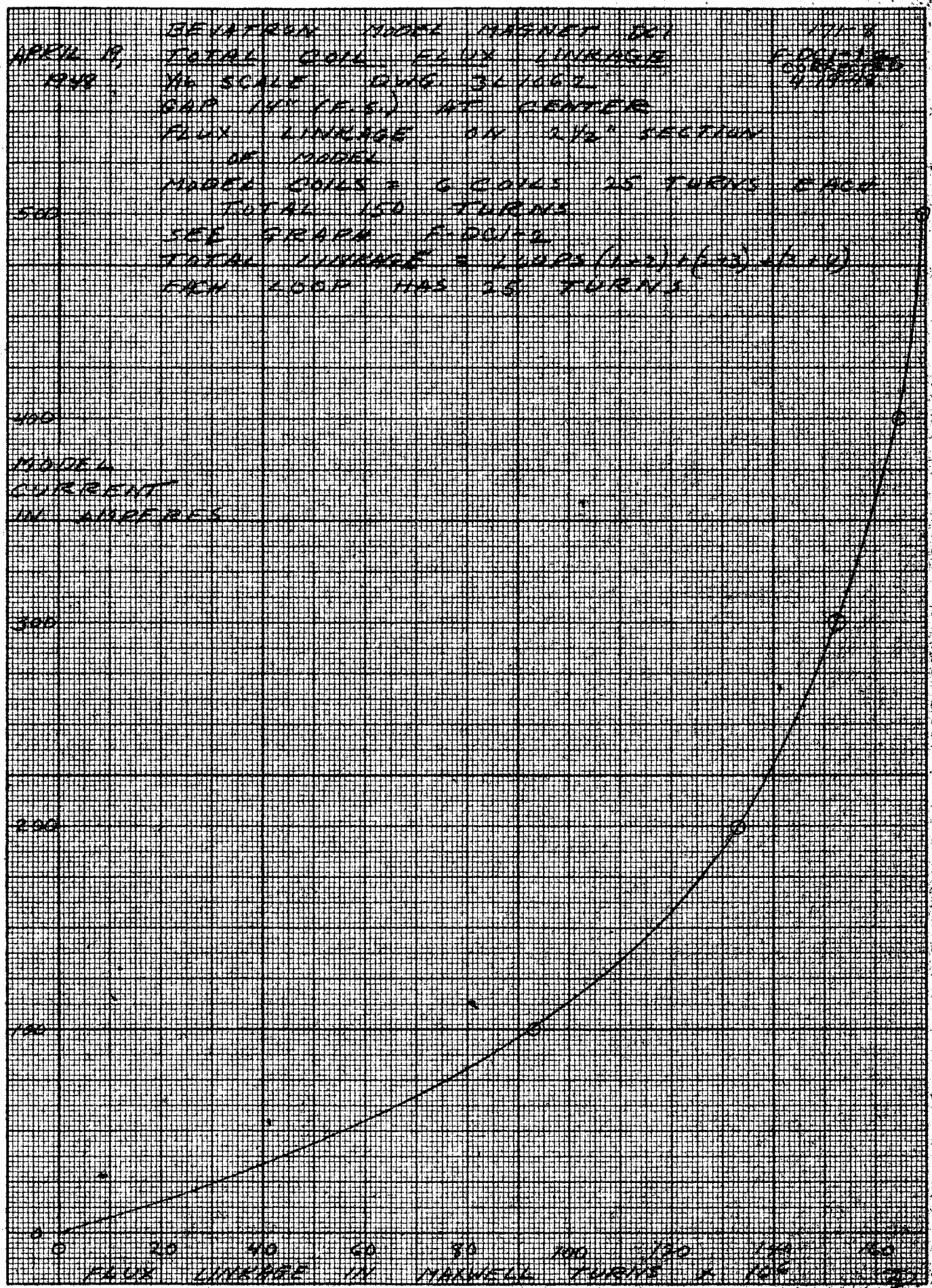
MODEL COILS: 6 COILS 25 TURNS EACH = TOTAL 150 TURNS

POLE TIP DWG 3L 1003

EACH LOOP HAS 25 TURNS



KEUFFEL & ESSER CO., N. Y. NO. 358-138
10 × 10 to the ½ inch. 5th lines accented.
MADE IN U.S.A.



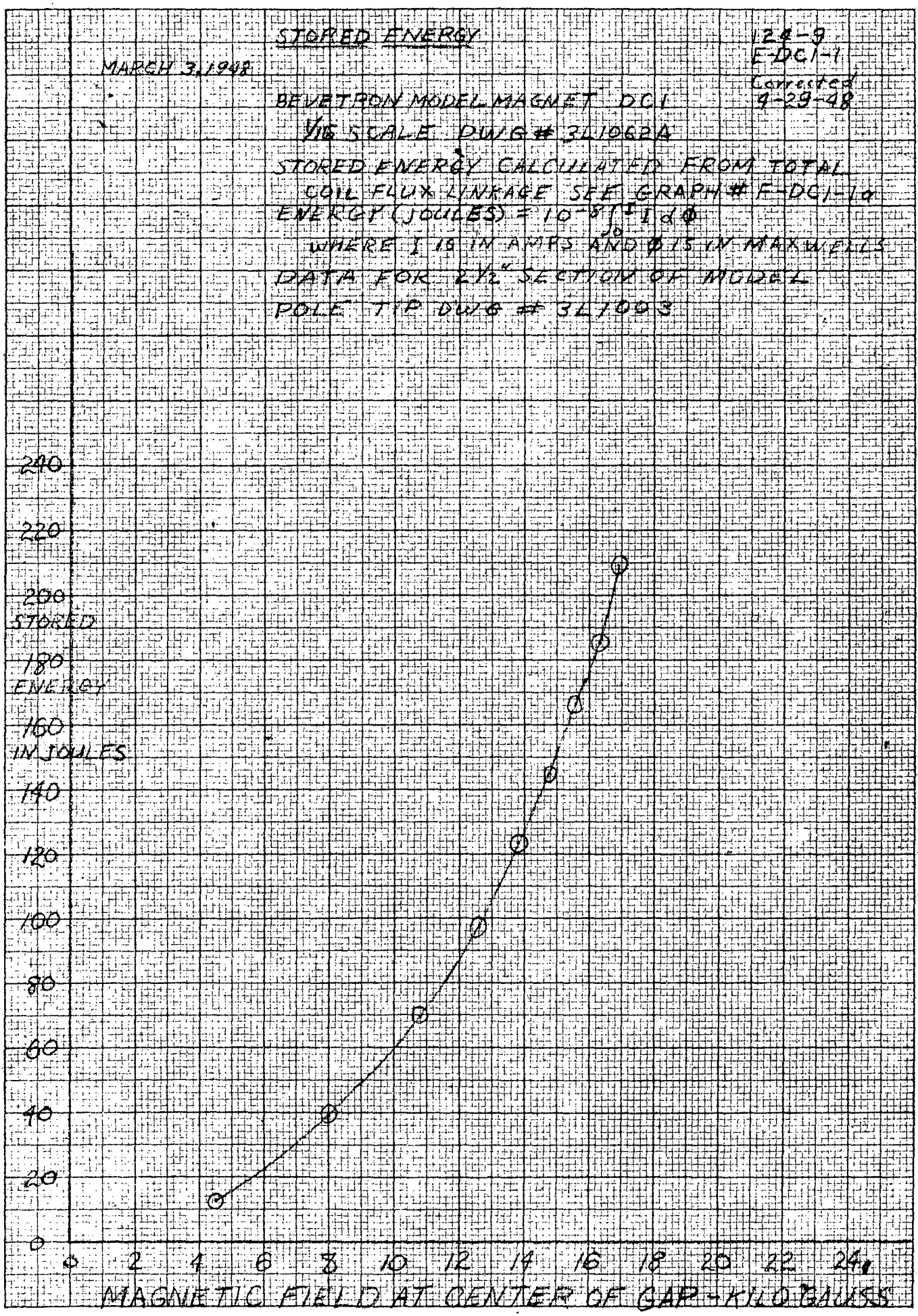
EUGENE DIETZGEN CO.
PRINTED IN U.S.A.
NO. 340 - M DIETZGEN GRAPH PAPER
MILLIMETER

STORED ENERGY

124-9
E-DC1-1
Corrected
9-29-48

MARCH 3, 1948

BEVATRON MODEL MAGNET DC1
1/16 SCALE DWG # 3L1062A
STORED ENERGY CALCULATED FROM TOTAL COIL FLUX LINKAGE SEE GRAPH # F-DC1-1a
ENERGY (JOULES) = $10^{-8} \int_0^{\Phi} I \, d\Phi$
WHERE I IS IN AMPS AND Φ IS IN MAXWELLS
DATA FOR 2½" SECTION OF MODEL
POLE TIP DWG # 3L1003



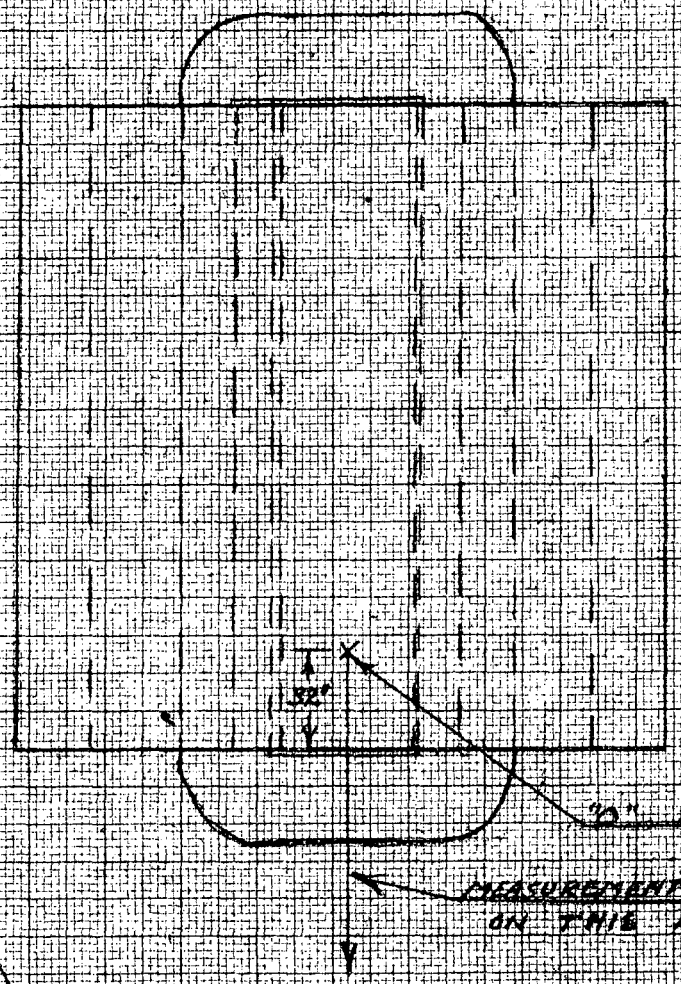
KEUFFEL & ESSER CO., N. Y. NO. 359-11G
10 × 10 to the ½ inch, 5th lines accented
Ruled area 7 × 10 in.
MADE IN U.S.A.

124-9
5-DC1-1

STRAY FIELD

MARCH 17, 1948 ELEVATION MODEL MAGNET DC1
1/4 SCALE DWG # 3L 1062A
MEASUREMENTS ON MEDIAN PLANE
OF GAP 4 ON 50 FOOT (FULL SCALE)
RADIUS
"0" POINT IS 32 INCHES (FULL SCALE)
IN FROM EDGE OF POLE PIECE

PLAN VIEW OF MODEL



PERCENT MAGNETIC FIELD

100% = 3026 GAUSS
THIS FIGURE DOES NOT TAKE RESIDUAL FIELD INTO CONSIDERATION

100
90
80
70
60
50
40
30
20
10
0

0 20 40 60 80 100 120 140 160
INCHES (FULL SCALE) FROM "0" POINT

DEDSON

KEUFFEL & ESSER CO., N.Y. NO. 389-14
Millimeters, 10th lines heavy.
MADE IN U.S.A.

2 Model Magnet DC4 Index

a. Discussion

b. Sketch

c. Photographs

BEVA 17

d. Graphs

L-DC4-1	Efficiency and leakage coefficients
H-DC4-1	Flux density around the magnetic path
H-DC4-2	H in the gap center
U-DC4-1	Radial uniformity
U-DC4-1a	Radial uniformity - Expanded
F-DC4-1	Coil flux linkage
F-DC4-1a	Total coil flux linkage
F-DC4-2	Coil flux linkage (Low field)
F-DC4-2a	Total coil flux linkage - low field
E-DC4-1	Stored energy

2 Model Magnet DC4

a. Discussion

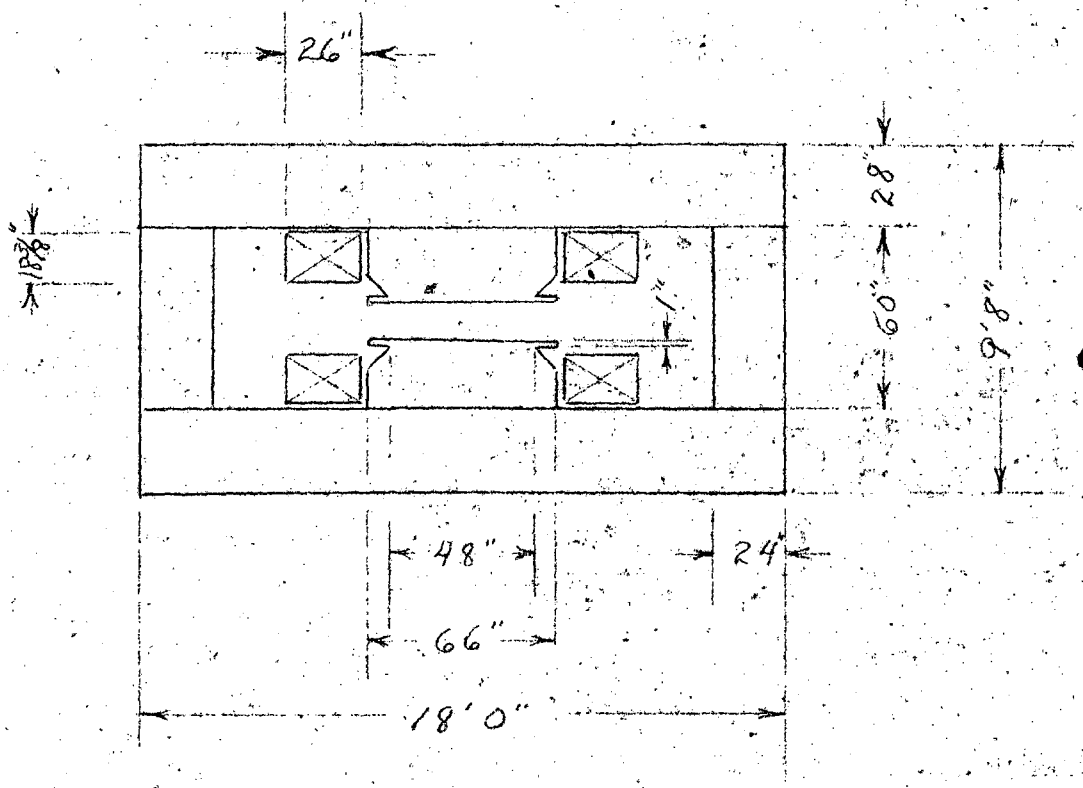
Bevatron model magnet DC4 was designed to correct faults observed in the tests made on model DC1. The thickness of the yoke slabs was increased. The distance between the yoke slabs was decreased. The height of the poles and the total radial width of the poles were decreased. Notches were cut in the pole pieces to form "wings", but the same radial width at the base of the pole was retained. The cross-sectional area of the exciting coils was decreased.

Model DC4 failed to meet some of the general specifications. (See Section II and Table I.) The peak KVA required was 206×10^3 for a rise time of one second. The specified 100×10^3 KVA is for a rise time of not greater than 2.0 seconds. The radial width of the usable field at injection field was 40 inches instead of the specified 48 inches.

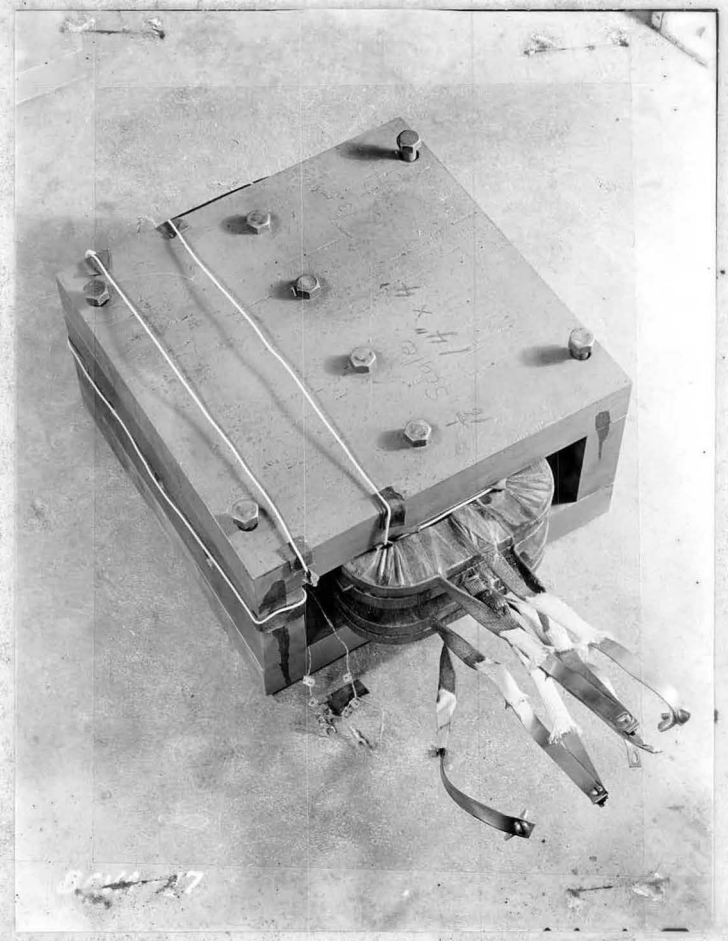
A comparison of magnet performance on DC4 and DC1 shows some improvements. The number of ampere turns required was decreased from 9.0×10^5 to 7.0×10^5. The peak KVA required was decreased from 236×10^3 to 206×10^3 for a rise time of one second. The useful gap width at 16 kilogauss field was increased from 5 inches to 18 inches. The efficiency of the magnet was increased from 50 percent to 65 percent.

It was decided to change the profile of the pole pieces to increase the useful width of the magnetic field at the injection field. (See DC4B and DC4C.)

BEVATRON MODEL MAGNET DC 4

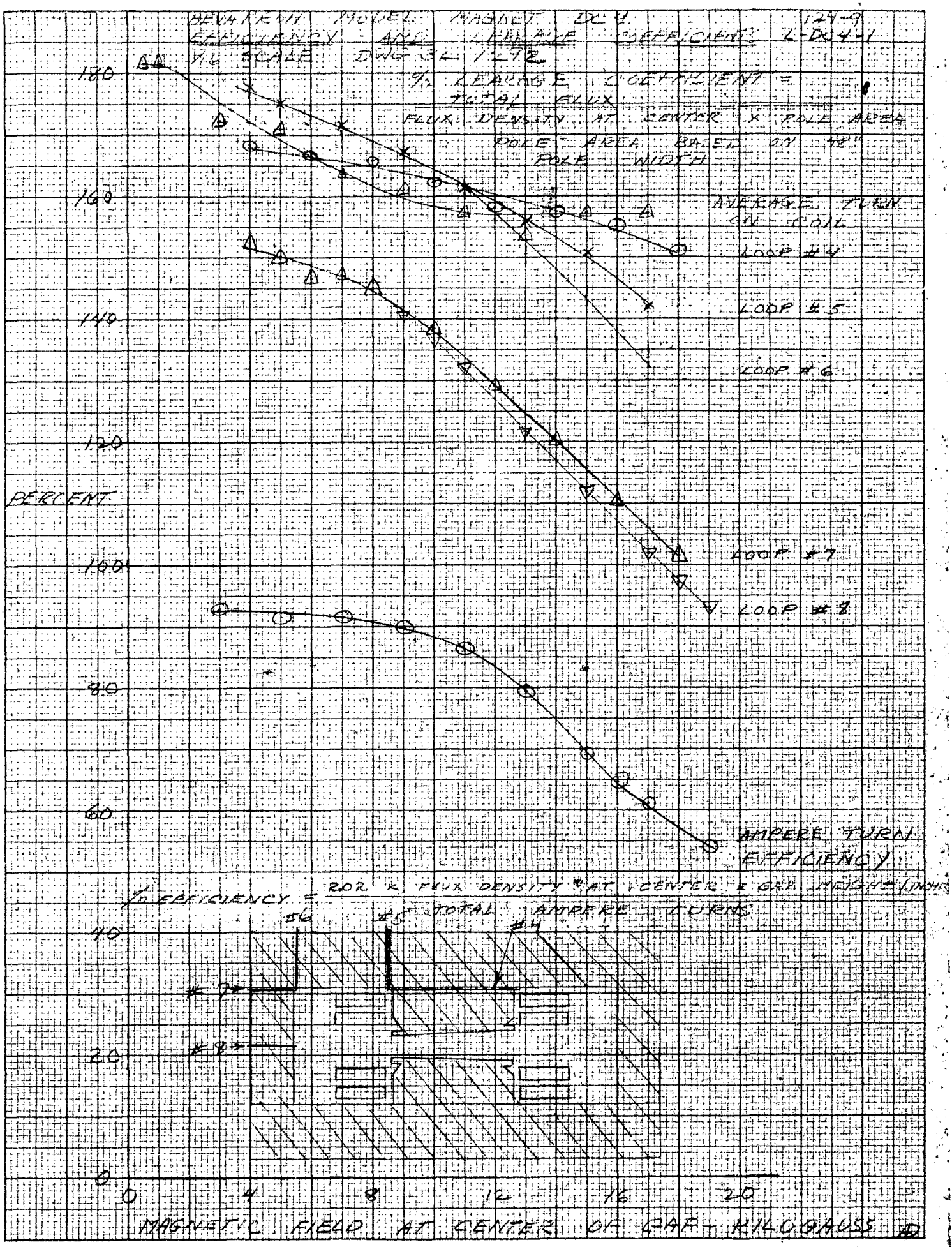


GAP 14"
RADIUS 50'
$n = 0.75$
MODEL COILS: 4 COILS 23 TURNS EACH = 92 TURNS
DIMENSIONS ARE FULL SCALE
MODEL IS 1/16 SCALE
ASSEMBLY DWG. 3L1292
POLE TIP DWG. 3L 1262-1



BEVA 17

Bevatron model magnet DC4



KEUFFEL & ESSER CO., N. Y. NO. 359-12G
10 X 10 to the ½ inch, 5th lines accented.
MADE IN U.S.A.

DEVIATION MODEL MAGNET DC4 124-9

FLUX DENSITY AROUND MAGNETIC PATH M-DC4-1

4-1-48

APRIL 1, '48

1/16 SCALE DWG 3L 1291A

GAP 14" AT CENTER (FULL SCALE)

92 TURNS TOTAL ON MODEL COILS

LOOP #5

LOOP #6

LOOP #4

¼ IN GAP

LOOP #7

LOOP #8

FLUX DENSITY KILO-GAUSS

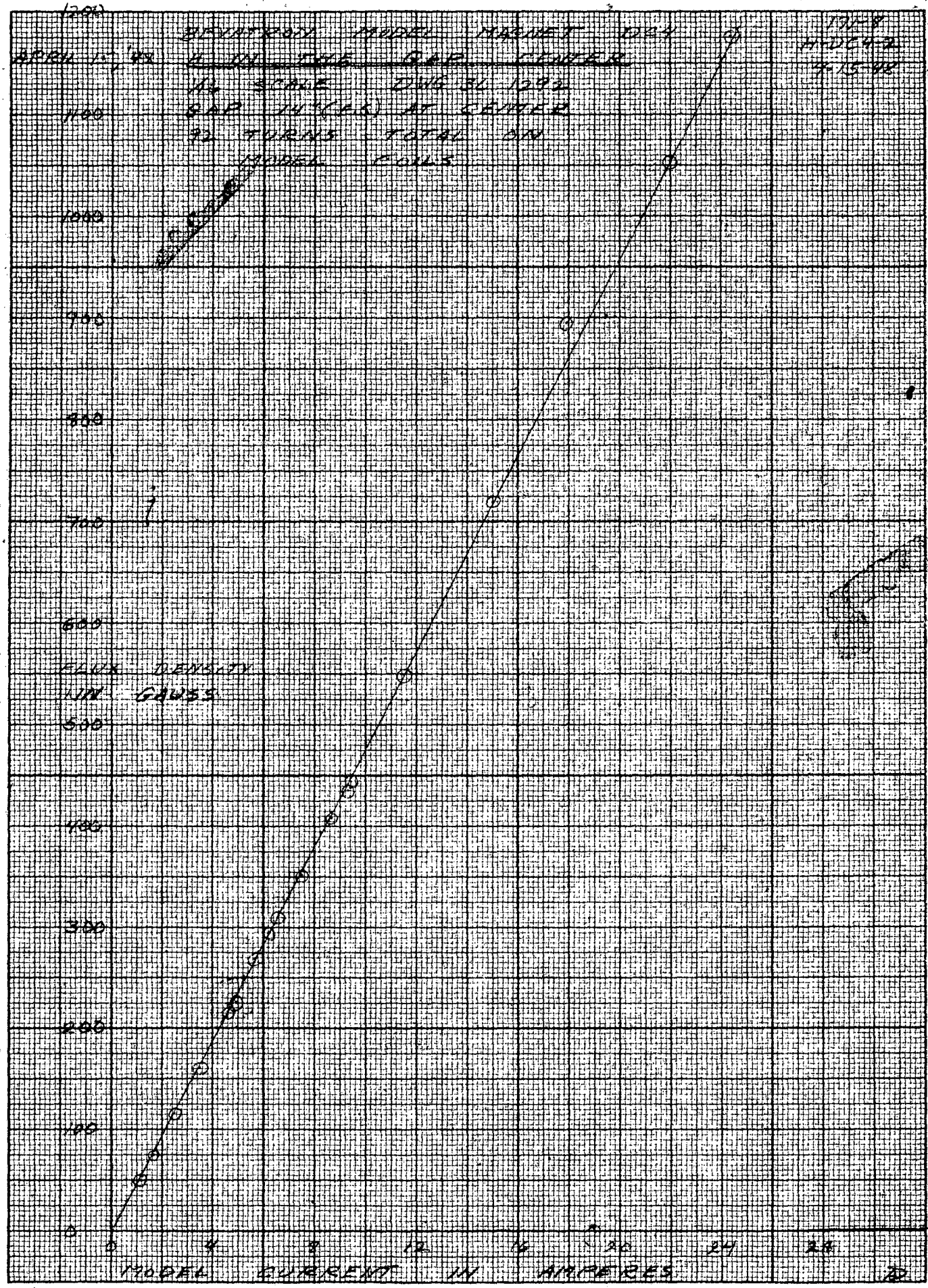
LOOP POSITIONS

#6 #5 #4 #7 #8

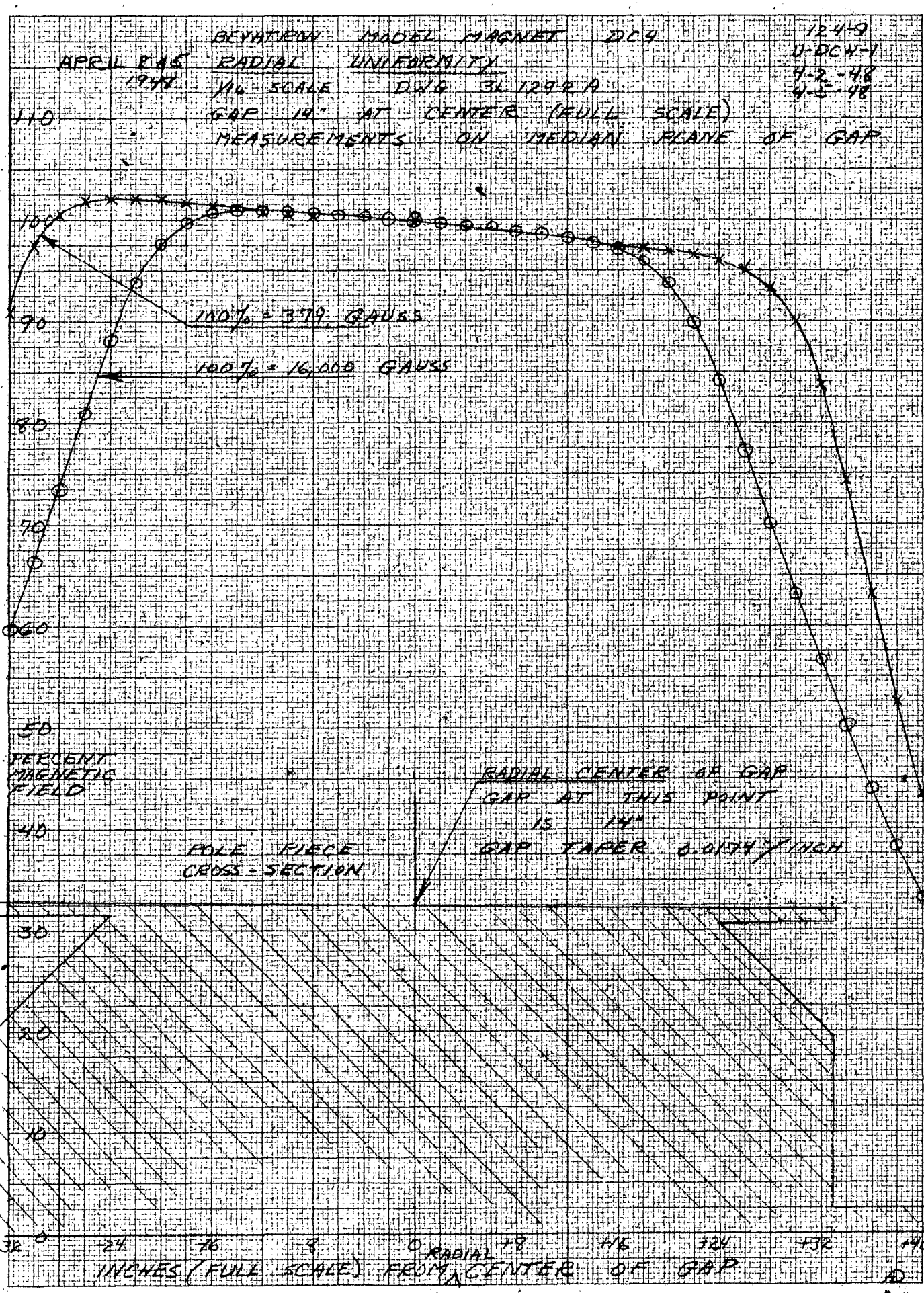
AMPERE TURNS x 10³ (FULL SCALE)

MODEL CURRENT IN AMPERES

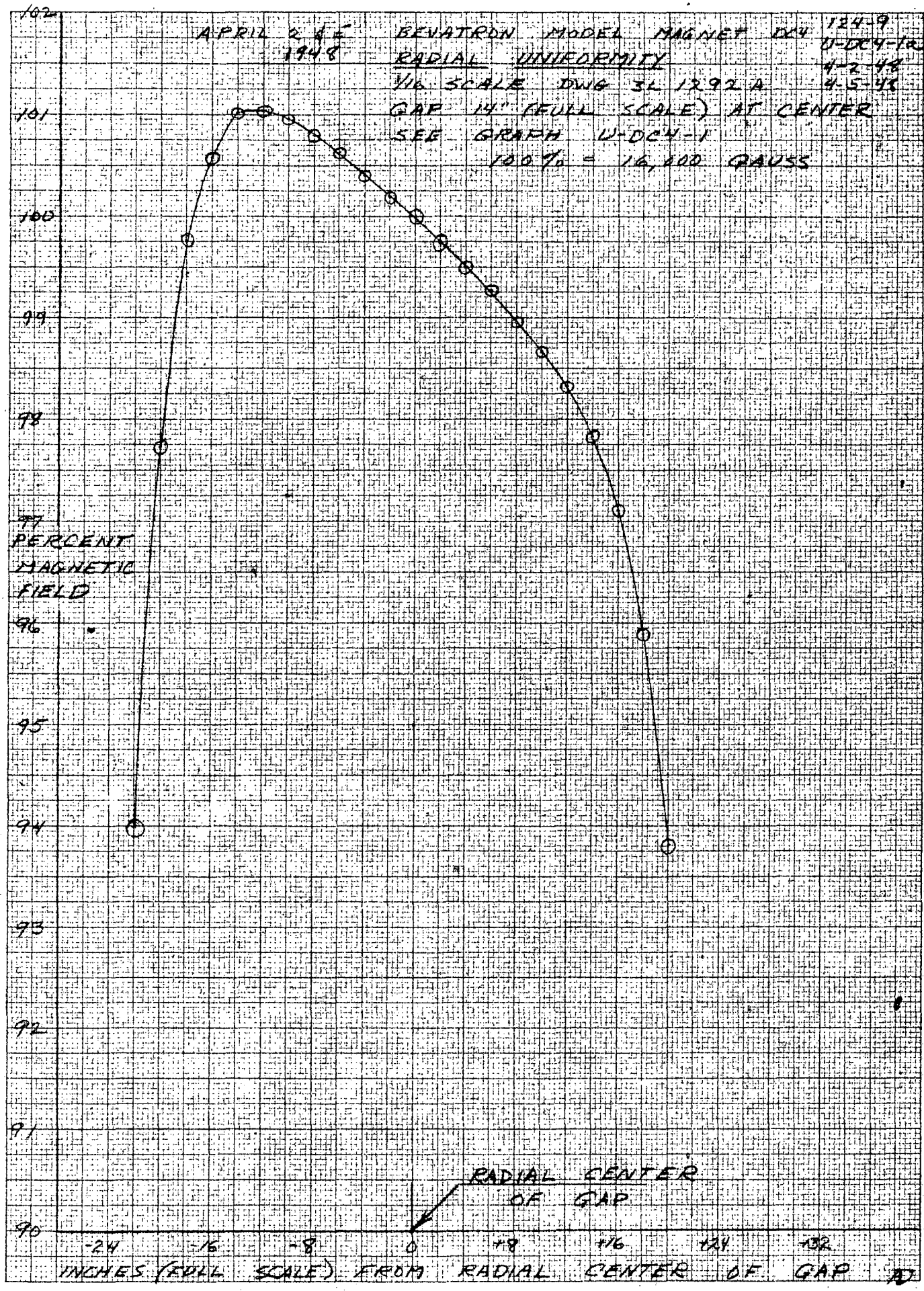
KEUFFEL & ESSER CO., N. Y. NO. 358-14
Millimeters, 10th line heavy.
MADE IN U.S.A.



EUGENE DIETZGEN CO.
PRINTED IN U.S.A.
NO. 340 - M DIETZGEN GRAPH PAPER
MILLIMETER



KEUFFEL & ESSER CO., N. Y. NO. 359-14
Millimeters, 5th line heavy.
MADE IN U.S.A.



KEUFFEL & ESSER CO., N. Y. NO. 359-14
Millimeters, 10th lines heavy.
Made in U. S. A.

124-9
F-DC4-1
4-1-48

BEVATRON MODEL MAGNET DC 4

COIL FLUX LINKAGE

APRIL 1, 1948 Y/C SCALE DWG. # 3L 1282A

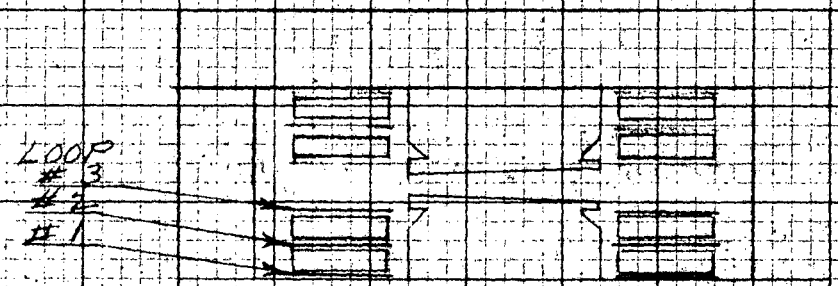
GAP 14" AT CENTER (FULL SCALE)

FLUX LINKAGE ON 2½" SECTION OF MODEL

MODEL COILS : 4 COILS 23 TURNS EACH

92 TURNS TOTAL

EACH LOOP HAS 23 TURNS



LOOP II

FLUX LINKAGE IN MAXWELLS TURNS x 10^6

40
30
20
10
0

0 100 200 300 400 500 600

MODEL CURRENT IN AMPERES

AD

KEUFFEL & ESSER CO., N. Y. NO. 359-6
5 x 5 to the ½ inch.
MADE IN U.S.A.

APRIL 1, '48

DEVATRON MODEL MAGNET DC4

TOTAL COIL FLUX LINKAGE

124-9

F-DC4-1a

4-1-48

½ SCALE DWG 3L 1292A

GAP 1¼" AT CENTER (FULL SCALE)

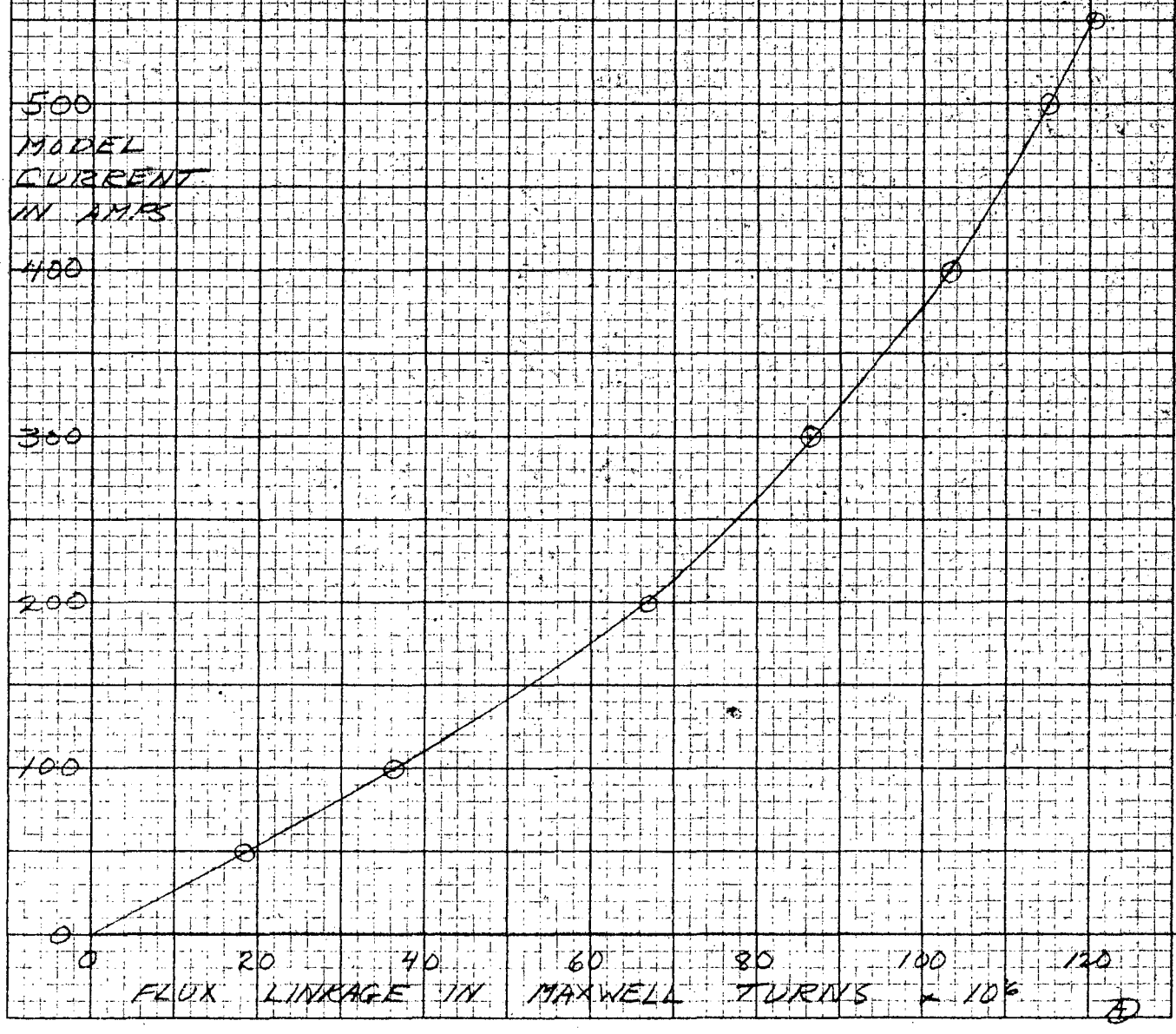
FLUX LINKAGE ON 2½" SECTION OF MODEL

MODEL COILS: 4 COILS 23 TURNS EACH. 92 TURNS TOTAL

SEE GRAPH F-DC4-1

TOTAL LINKAGE = (LOOP 1+2) + (LOOP 2+3)

EACH LOOP HAS 23 TURNS



KEUFFEL & ESSER CO., N. Y. NO. 359-6
7 × 5 to the ½ inch.
MADE IN U.S.A.

BEVATRON MODEL MAGNET DCY F-DCY-2

APRIL 16, 48 COIL FLUX LINKAGE 4-16-48

ALL SCALE DWG 32 12924

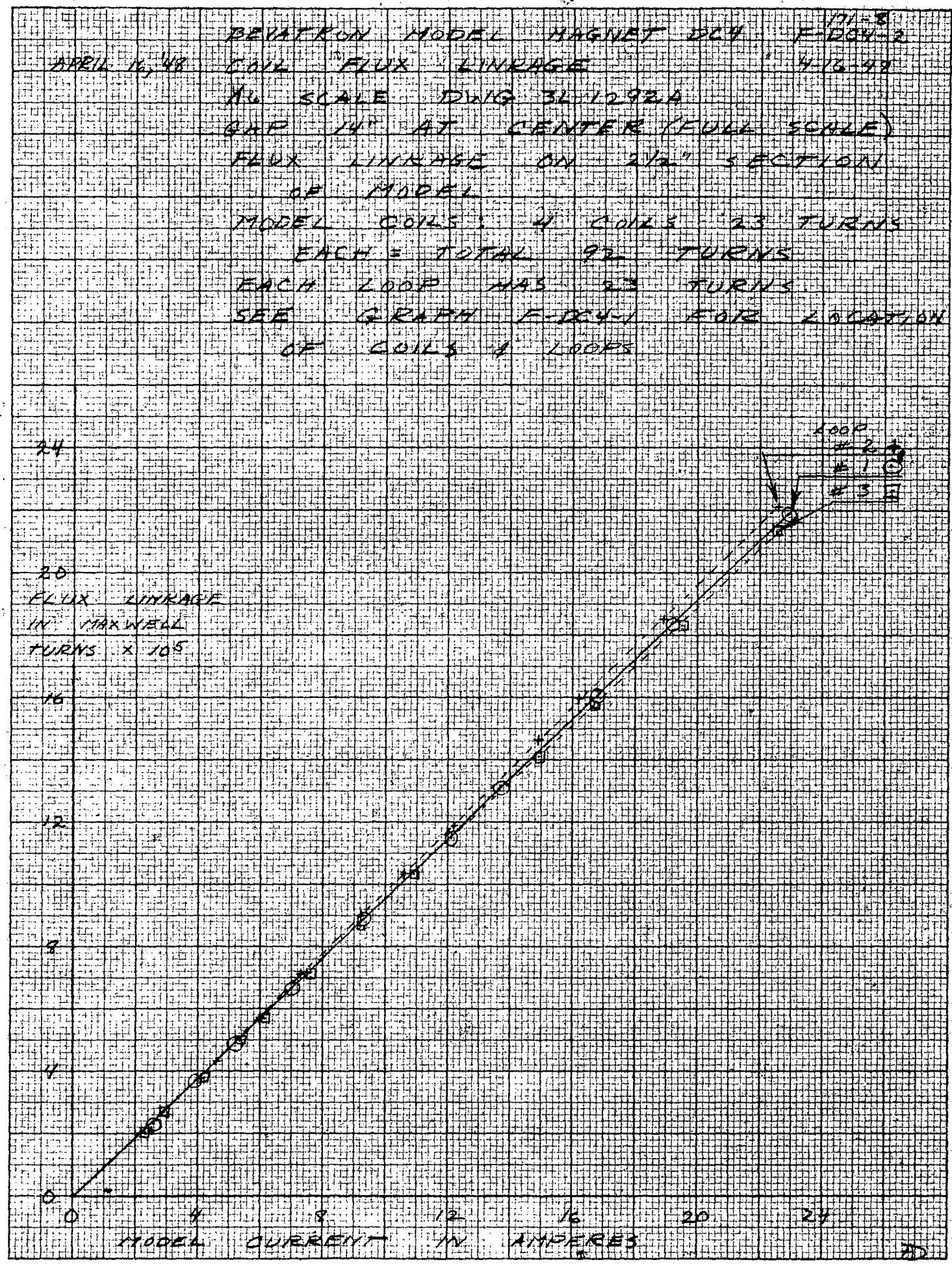
GAP 14" AT CENTER (FULL SCALE)

FLUX LINKAGE ON 2½" SECTION OF MODEL

MODEL COILS: 4 COILS 23 TURNS EACH = TOTAL 92 TURNS

EACH LOOP HAS 23 TURNS

SEE GRAPH F-DCY-1 FOR LOCATION OF COILS & LOOPS



KEUFFEL & ESSER CO., N. Y. NO. 358-130
10 X 10 to the ½ inch, 5th lines accented.
MADE IN U.S.A.

BEVATRON MODEL MAGNET DC4

APRIL 16, '48 TOTAL COIL FLUX LINKAGE

F-DC4-2a

4-16-48

1/16 SCALE DWG 3L 1292A

GAP 14" AT CENTER (FULL SCALE)

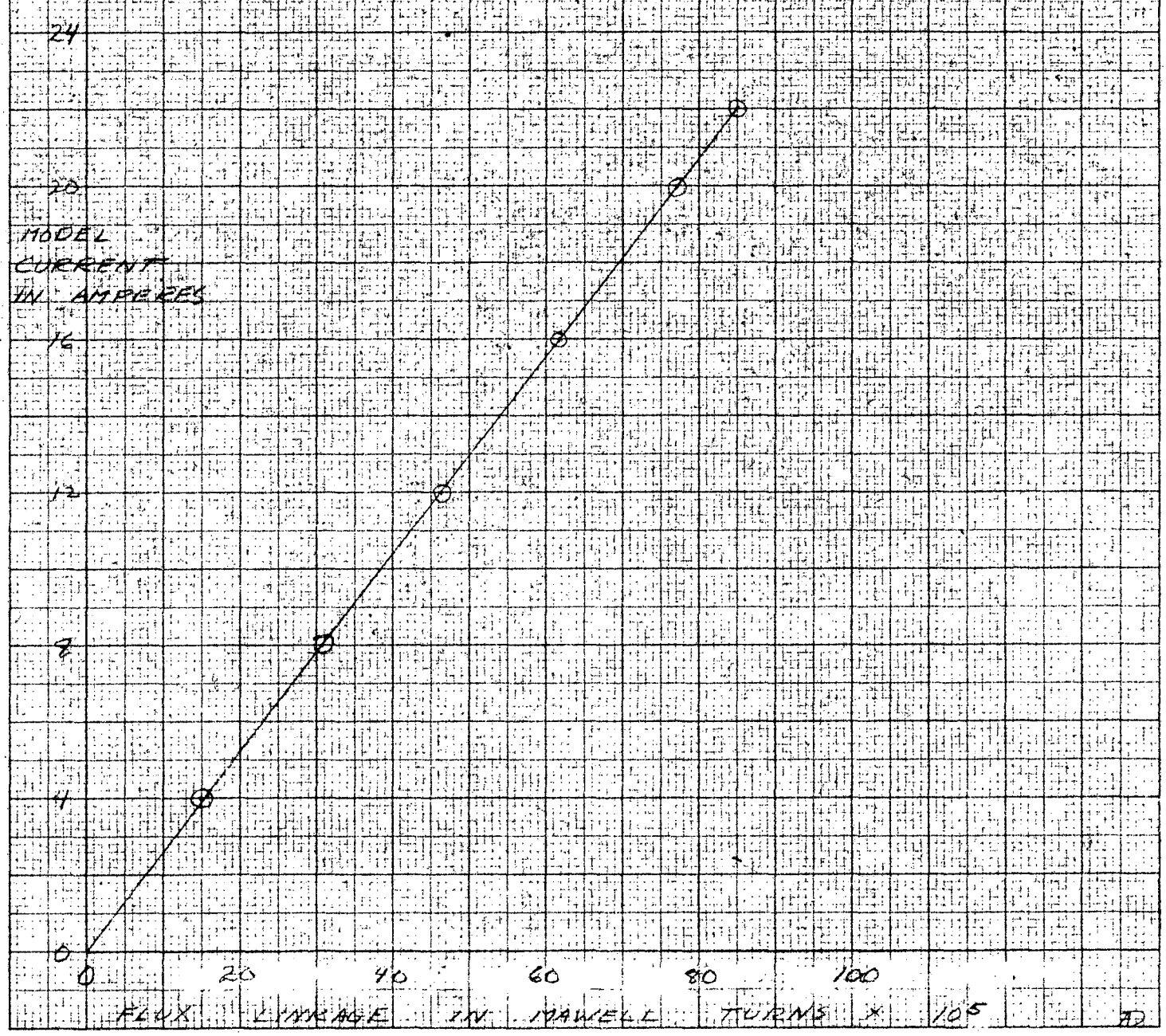
FLUX LINKAGE ON 2½" SECTION OF MODEL

MODEL COILS: 4 COILS 23 TURNS EACH = TOTAL 92 TURNS

EACH LOOP HAS 23 TURNS

SEE GRAPH F-DC4-2

TOTAL LINKAGE = LOOP (1+2) + (2+3)



KEUFFEL & ESSER CO., N. Y. NO. 359-130
10 X 10 to the ½ inch, 5th lines accented
MADE IN U.S.A.

BEVATRON MODEL MAGNET DC4 124-9

STORED ENERGY E-DC4-1

APRIL 1, 1948 1/6 SCALE DWG SL 12924 4-1-48

STORED ENERGY CALCULATED FROM TOTAL COIL FLUX LINKAGE

SEE GEARY F-DC4-10

ENERGY (JOULES) = $10^{-7} \int I \, d\phi$

WHERE I IS IN AMPERES $d\phi$ IS IN MAXWELL TURNS

DATA IS FOR 2½ SECTION ON MODEL

MODEL STORED ENERGY IN JOULES

240
220
200
180
160
140
120
100
80
60
40
20
0

0 2 4 6 8 10 12 14 16

MAGNETIC FIELD AT CENTER OF GAP - KILOGAUSS

AD.

KEUFFEL & ESSER CO. N. Y. NO. 359-14
Millimeter, 5th line heavy.
MADE IN U.S.A.

3 Model Magnet DC4B Index

a. Discussion

b. Sketch

c. Graphs

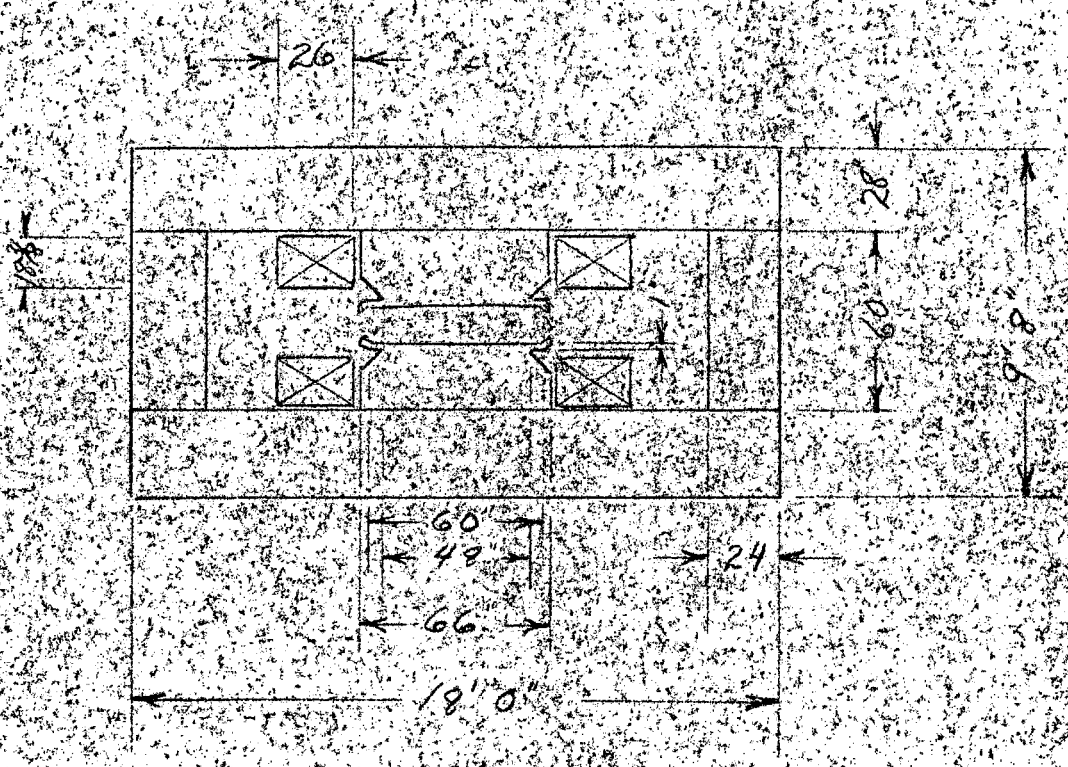
H-DC4B-1	H in gap center
U-DC4B-1	Radial uniformity
U-DC4B-1a	Radial uniformity - Expanded

3 Model DC4B

a. Discussion

Bevatron model magnet DC4B was designed to try to increase the useful radial width of the magnetic field at the injection field by changing the profile of the pole pieces of model DC4. The outer 3" on each "wing" of the pole was bent slightly toward the gap center. This was the only change from model DC4. Although this change did not give the proper shaped magnetic field it was concluded from these measurements that the useful gap width at the injection field could be increased to approximately 50 inches by making small changes in the shape of the wings. The pole pieces were not further modified to obtain the desired field at this time. Otherwise, the performance of model DC4B was similar to that of DC4 on the basis of the measurements which were made.

BEVATRON MODEL MAGNET DC 4B

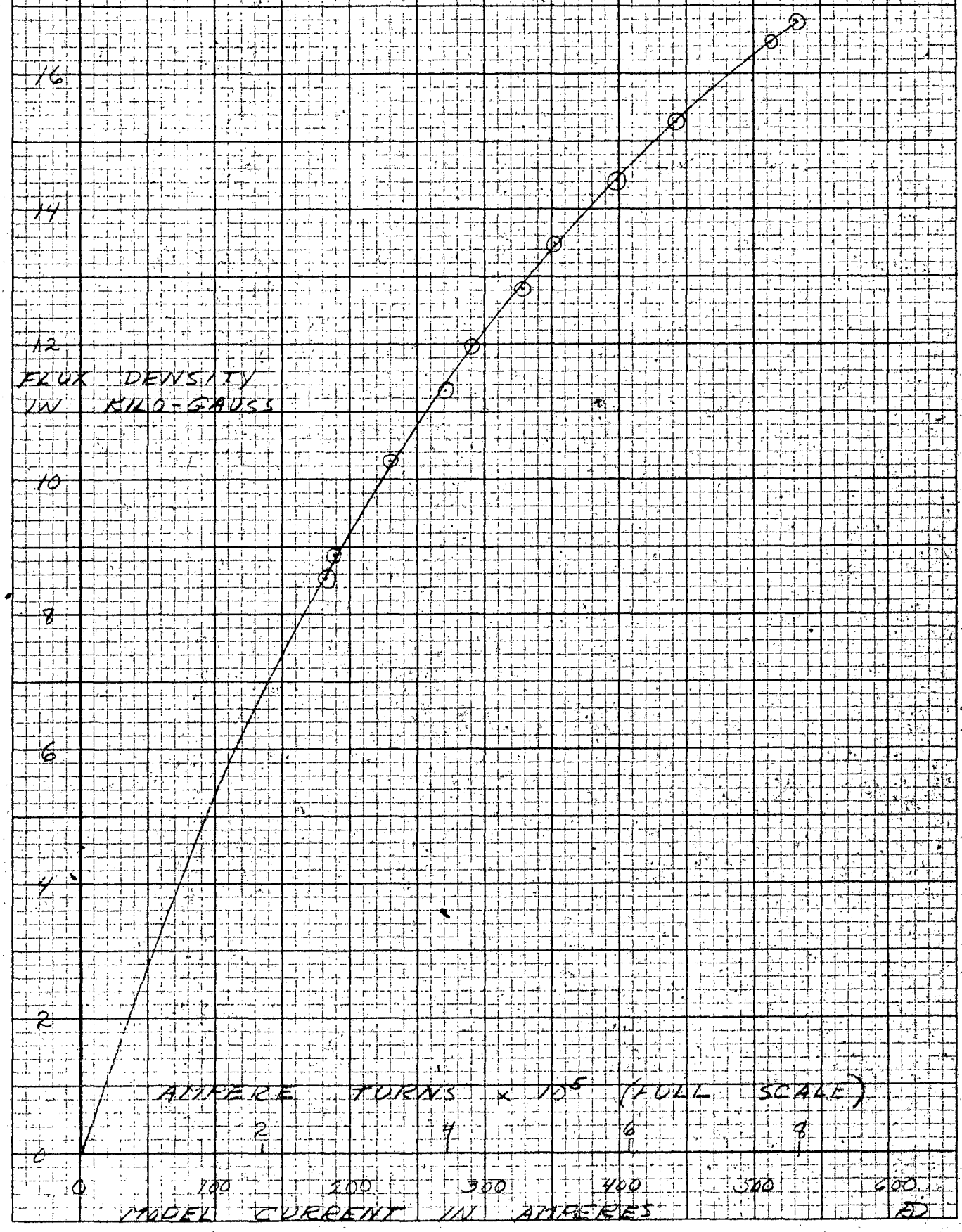


GAP 14"
RADIUS 50'
$n = 0.75$
MODEL COILS 4 COILS 23 TURNS EACH = 92 TURNS
DIMENSIONS ARE FULL SCALE
MODEL IS 1/16 SCALE
ASSEMBLY DWG #3L 1292
POLE TIP DWG 3L 1262-2

4 IN GAP CENTER

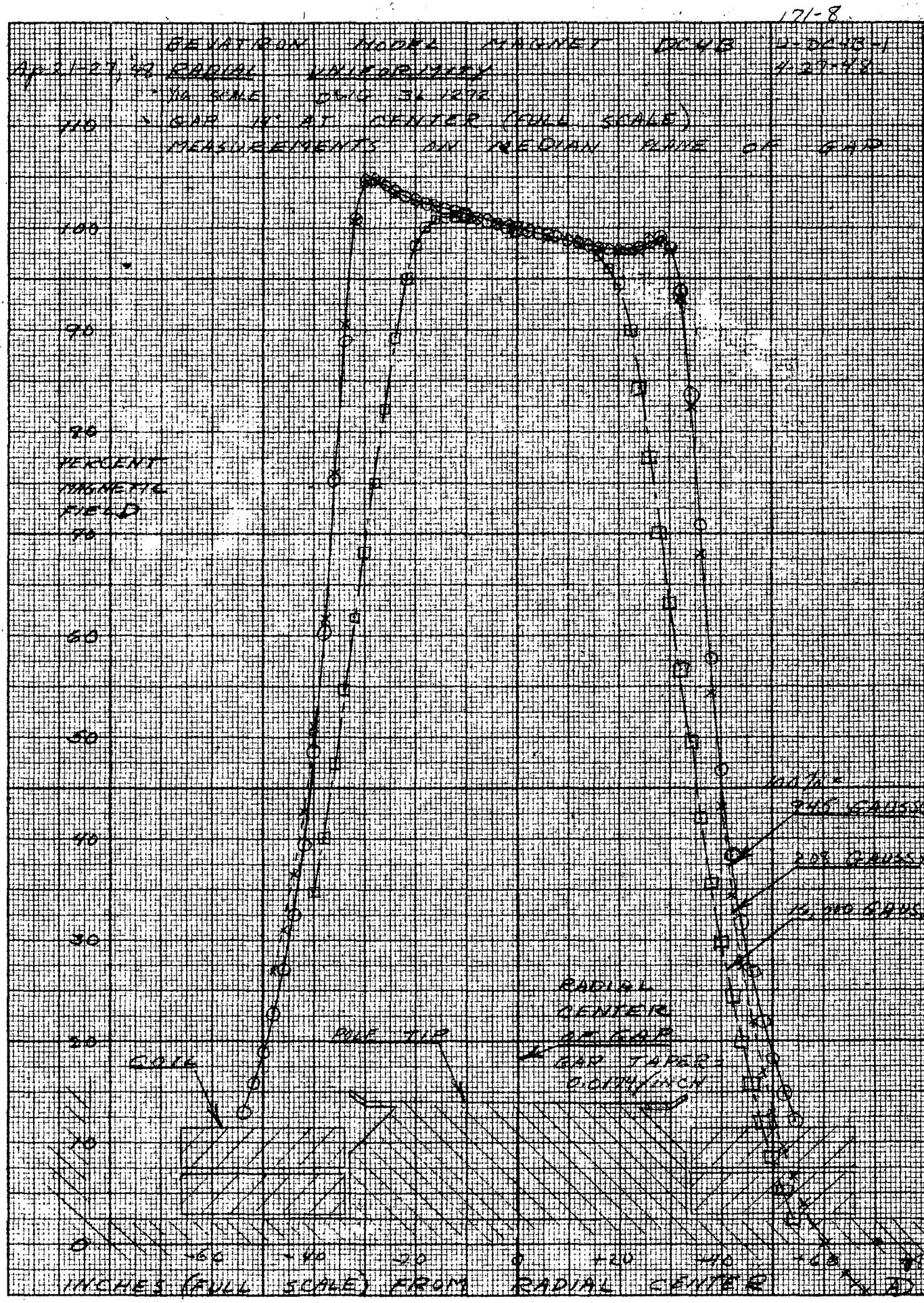
APR 23, 1948 BEVATRON MODEL MAGNET 171-8
DC 48 - 1/16 SCALE DWG 34 1292 # DC 413-1
4-23-48

GAP 14" (F.S.) AT CENTER
92 TURNS TOTAL IN MODEL COILS

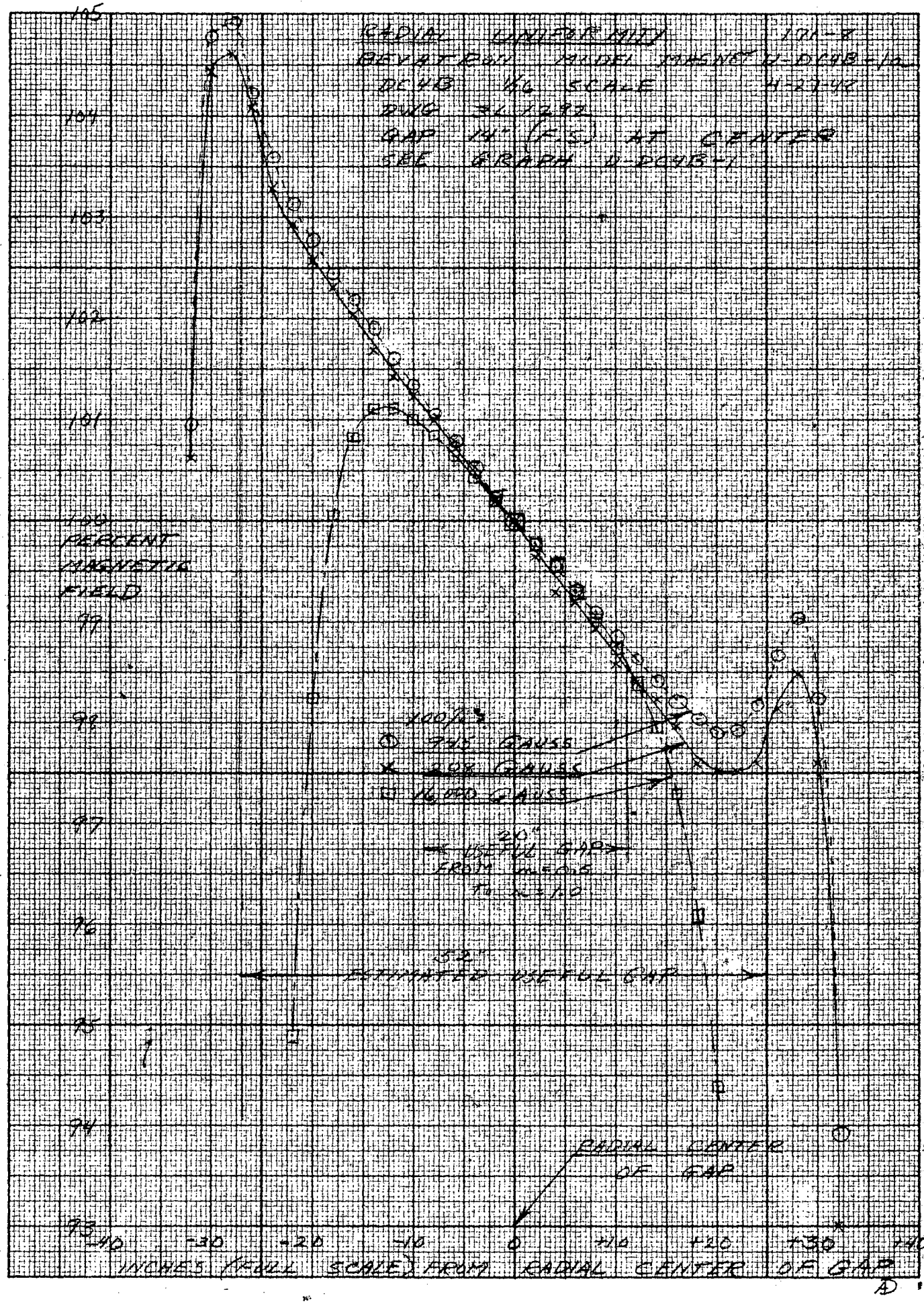


KEUFFEL & ESSER CO., N. Y. NO. 359-6
5 X 5 to the inch.
MADE IN U. S. A.

171-8



EUGENE DIETZGEN CO. PRINTED IN U.S.A.
NO. 340 - M DIETZGEN GRAPH PAPER MILLIMETER



EUGENE DIETZGEN CO.
PRINTED IN U. S. A.
NO. 340 - M DIETZGEN GRAPH PAPER.
MILLIMETER

4 Model Magnet DC4C Index

a. Discussion

b. Sketch

c. Graphs

L-DC4C-1	Efficiency and leakage coefficients
H-DC4C-1	Flux density around the magnetic path
U-DC4C-1	Radial uniformity
U-DC4C-1a	Radial uniformity - Expanded
F-DC4C-1	Coil flux linkage
F-DC4C-1a	Total coil flux linkage
E-DC4C-1	Stored energy

4 Model Magnet DC4C

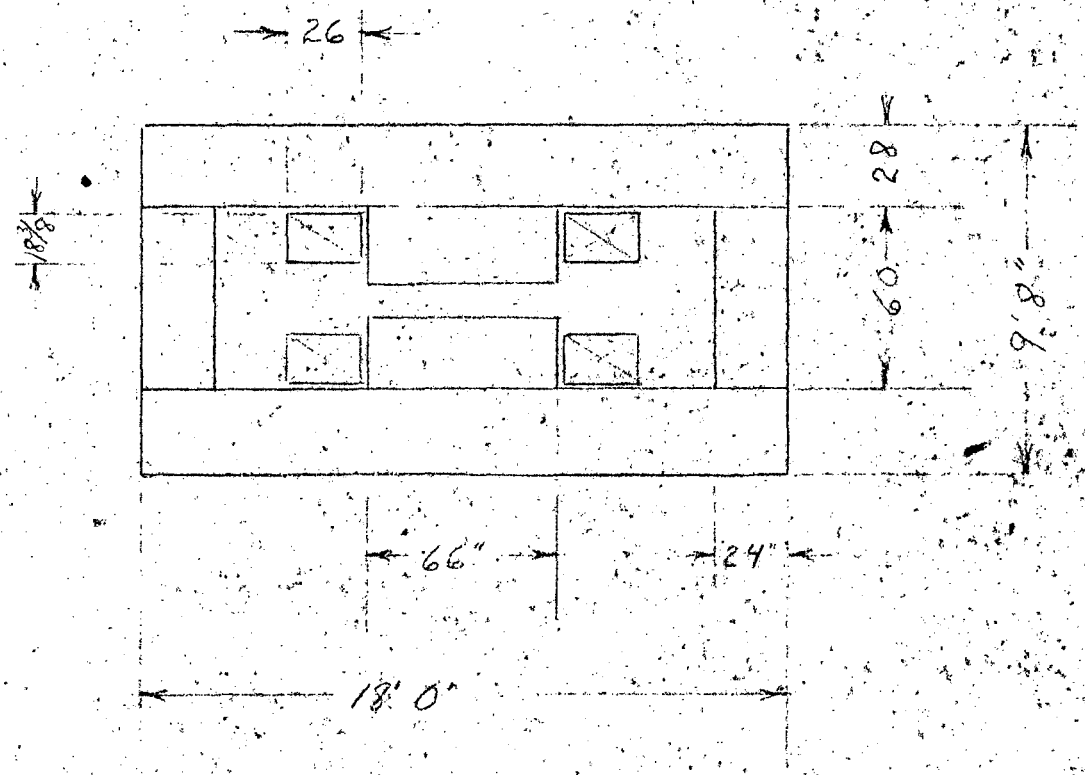
a. Discussion

Bevatron model magnet DC4C was designed to observe the difference in magnet performance caused by a solid pole piece. The pole pieces were designed with straight sides, without notches or "wings". This was the only change from model DC4.

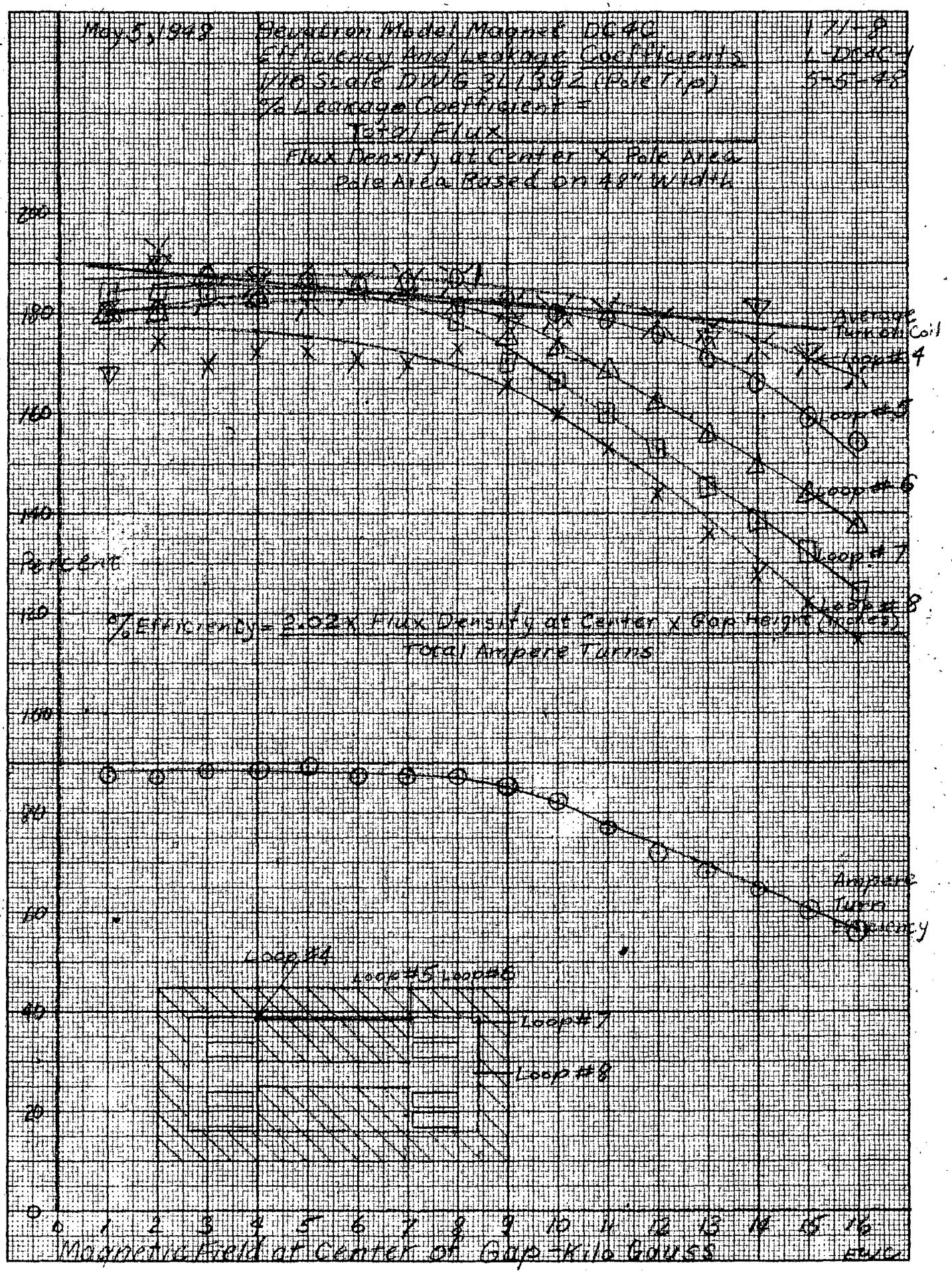
Model Magnet DC4C failed to meet some of the general specifications. (See Section II and Table I.) The number of ampere turns required was 8.0×10^5 instead of 7.35×10^5 as specified. The peak KVA required was 256×10^3 for a rise time of one second. The specified 100×10^3 KVA is for a rise time of not greater than 2.0 seconds. The maximum stored energy was 97 megajoules instead of 80 megajoules as specified.

A comparison of magnet performance on DC4 and DC4C shows some differences. The number of ampere turns required was increased from 7×10^5 to 8×10^5. The peak KVA required was increased from 206×10^3 to 256×10^3 KVA for a rise time of one second. The useful radial width of the magnetic field at the injection field was increased from 40 inches to 46 inches. The efficiency of the magnet decreased from 65% to 56percent. The maximum stored energy increased from 80 megajoules to 97 megajoules. It was concluded from the preceding comparison of models DC4 and DC4B that the "winged" poles are more efficient for this type magnet. The next type B model was DC6.

BEVATRON MODEL MAGNET DC 4C

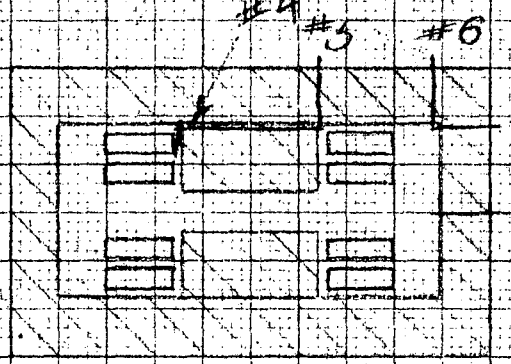


GAP 14"
RADIUS 50'
$n = 0.75$
MODEL COILS : 4 COILS 23 TURNS EACH = 92 TURNS
DIMENSIONS ARE FULL SCALE
MODEL IS 1/16 SCALE
ASSEMBLY DWG. 3L 1292
POLE TIP DWG. 3L 1392



EUGENE DIETZGEN CO. PRINTED IN U.S.A.
NO. 340 - M DIETZGEN GRAPH PAPER MILLIMETER

April 29, 1948 Bevatron Model Magnet DC4C +171-8
Flux Density Around Magnetic Path H-DC4C-1
1/16 Scale DWG 3L1392 (Pole Tip) 4-29-48
Gap 14" (Full Scale) at Center
92 Turns Total on Model Coils



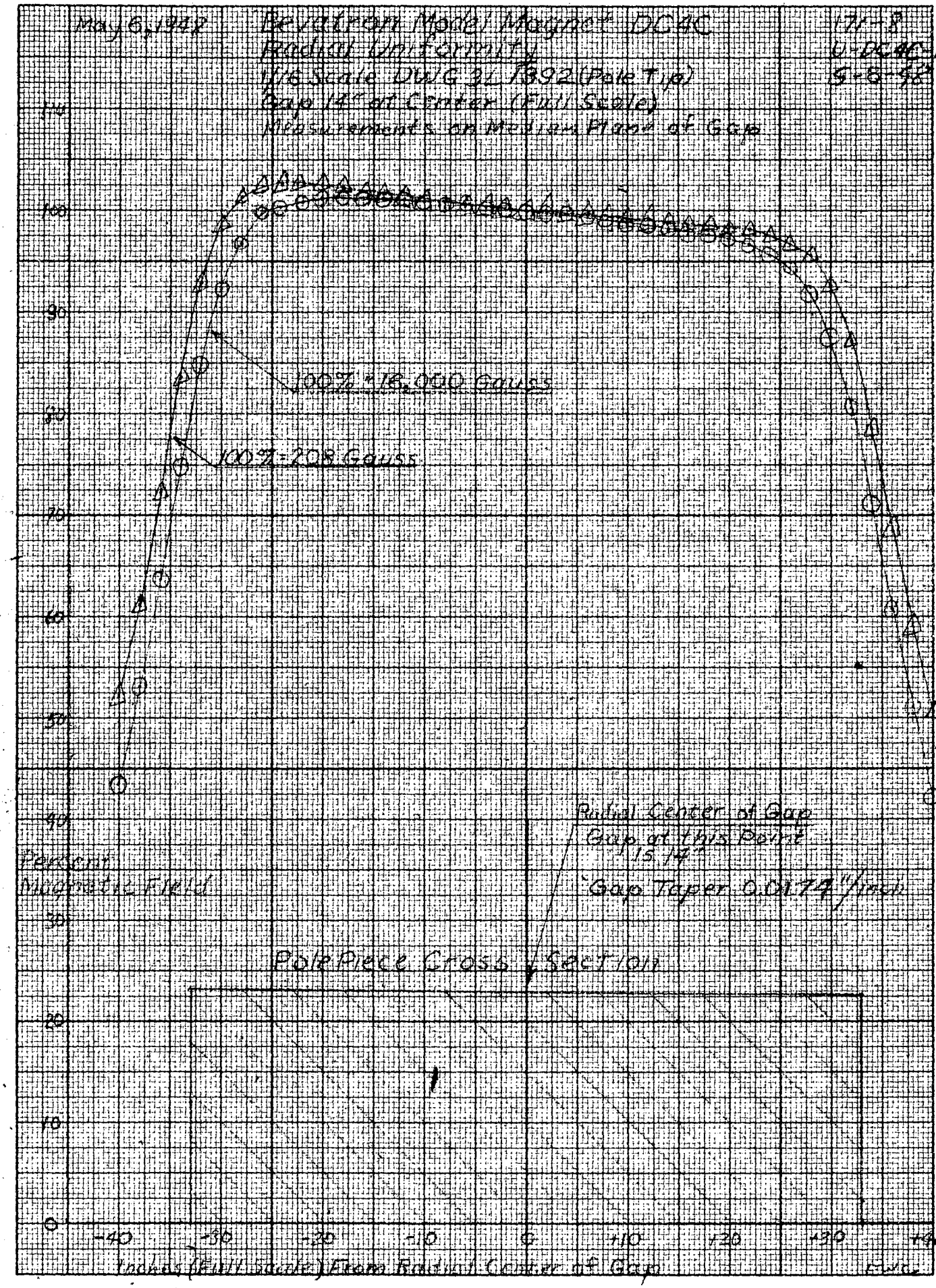
Flux Density in Kilo-Gauss

H in Gap Loop #
4
5
6
7
8

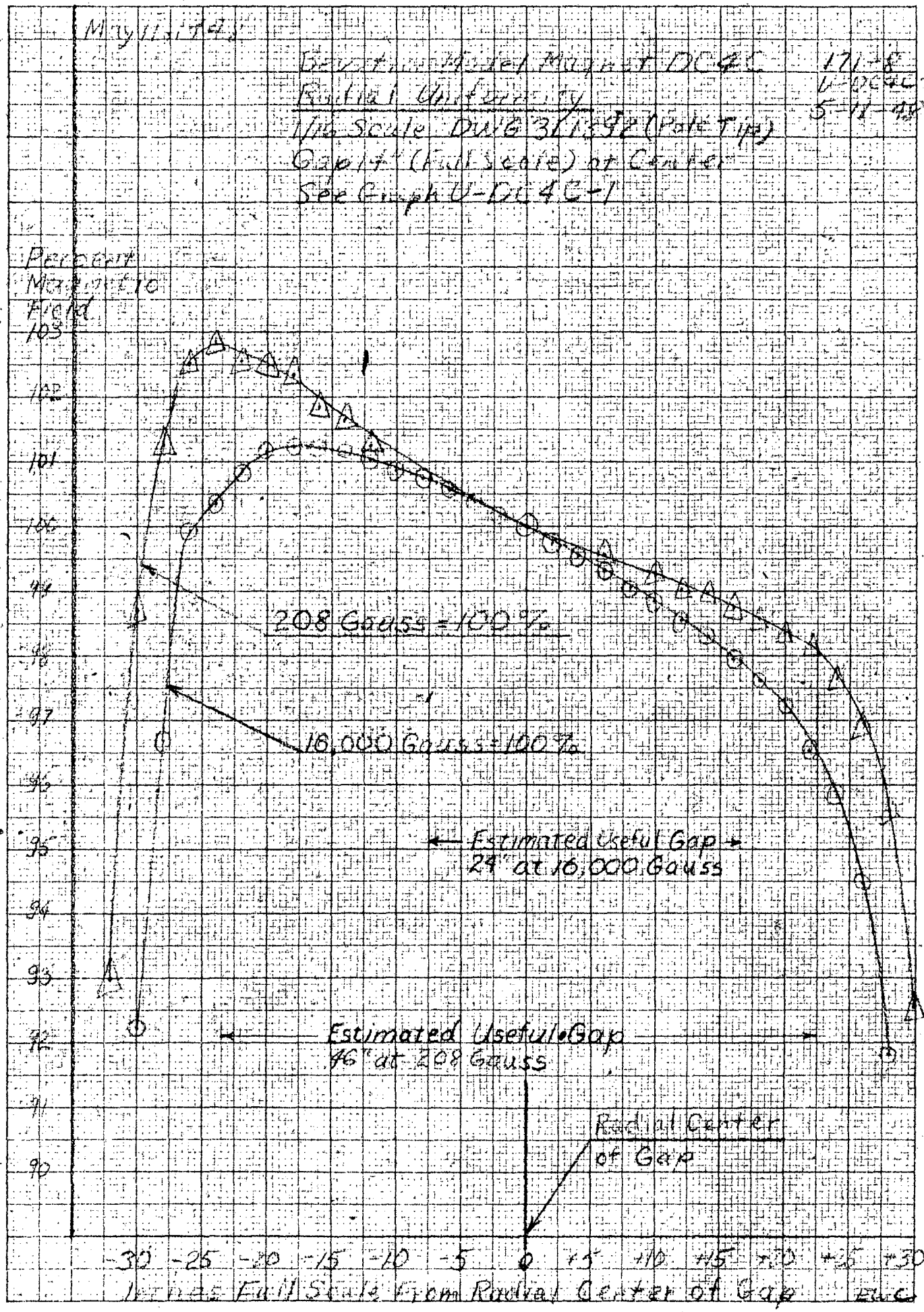
Ampere Turns X 10⁴ (Full Scale)

Model Current in Amperes

KEUFFEL & ESSER CO., N. Y. NO. 359-11G
10 × 10 to the ½ Inch, 5th Line accented
Engraved on 7 × 10 in
MADE IN U.S.A.



EUGENE DIETZGEN CO.
NO. 340 - M DIETZGEN GRAPH PAPER
MILLIMETER



KEUFFEL & ESSER CO., N. Y. NO. 359-11G
10 × 10 to the ½ inch, 5th lines accented
Entering 7 × 10 in.
MADE IN U.S.A.

April 27, 1948 Electron Model Magnet DC 4C 171-8

Coil Flux Linkage F-DC4C-1

1/16 Scale DWG 3L13992 (Pole Tip) 4-27-48

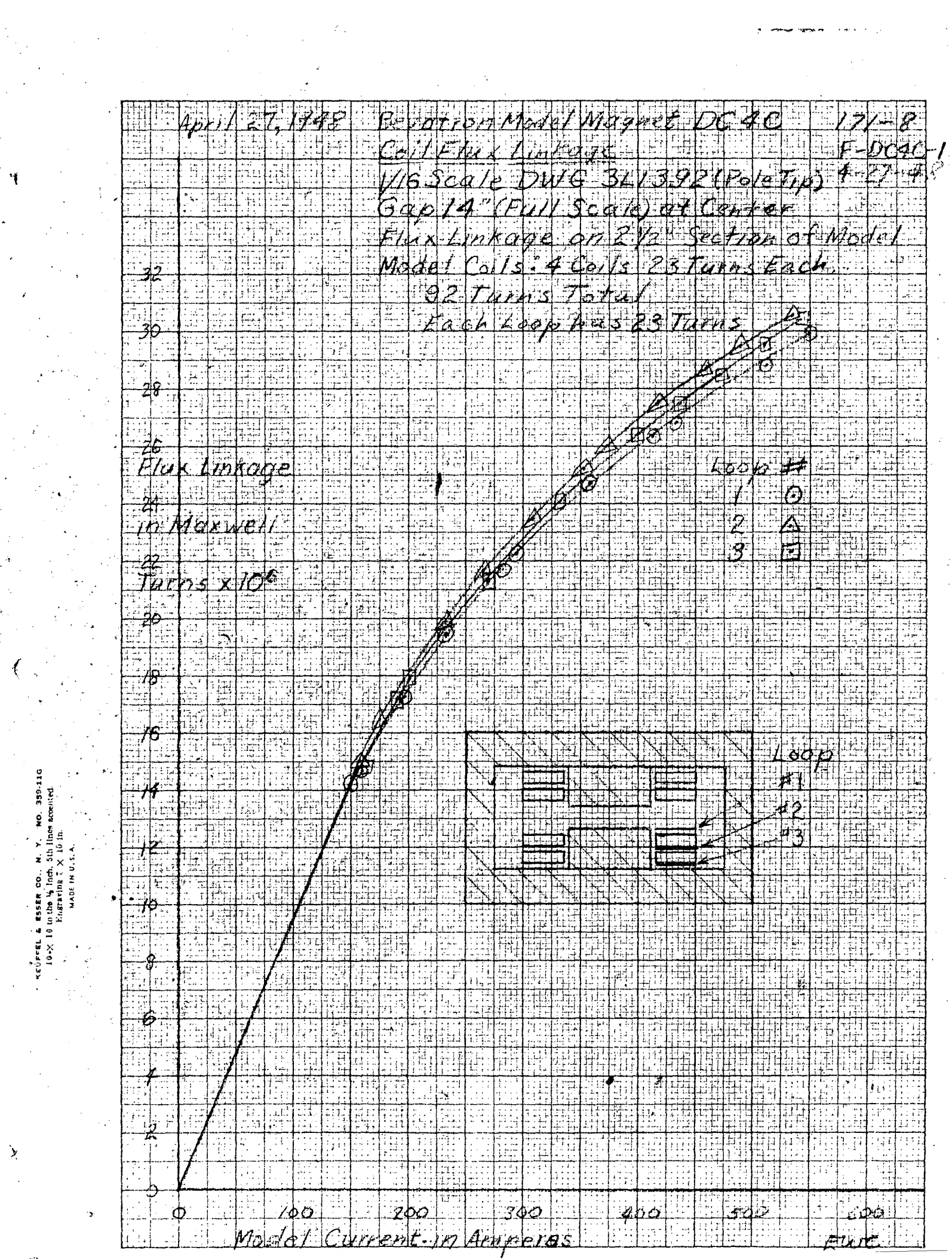
Gap 14" (Full Scale) at Center

Flux Linkage on 2½" Section of Model

Model Coils: 4 Coils 23 Turns Each.

92 Turns Total

Each Loop has 23 Turns



KEUFFEL & ESSER CO., N. Y. NO. 359-11G
10-X 10 to the ½ Inch, 5th lines accented.
Engraving 7 X 10 in.
MADE IN U.S.A.

May 4, 1948 Betatron Modal Magnet DC4C 11-8

Total Coil Flux Linkage F-DC4C-1α

1/16 Scale PWG 32/392 (Pole Type) 5-4-48

Gap 14" (Full Scale) at Center

Flux Linkage on 2½" Section of Model

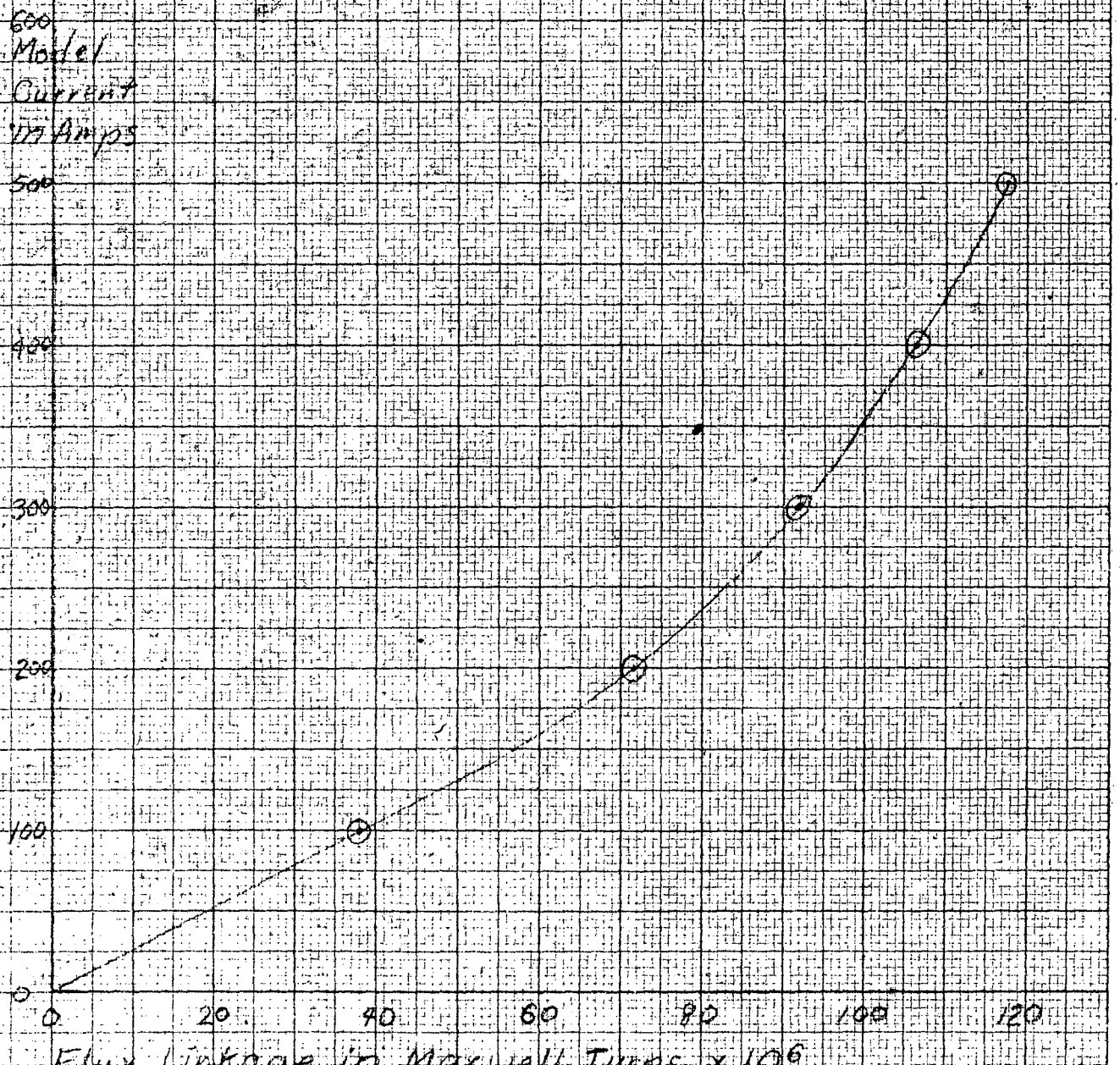
Model Coils - 4 Coils 23 Turns Each

92 Turns Total

See Graph F-DC4C-1

Total Linkage = Loops (1+2) + (2+3)

Each Loop Has 23 Turns



KEUFFEL & ESSER CO., N. Y. NO. 359-11C
10 × 10 to the ½ Inch, 5th lines accented.
Engraving 7 × 10 in.
MADE IN U.S.A.

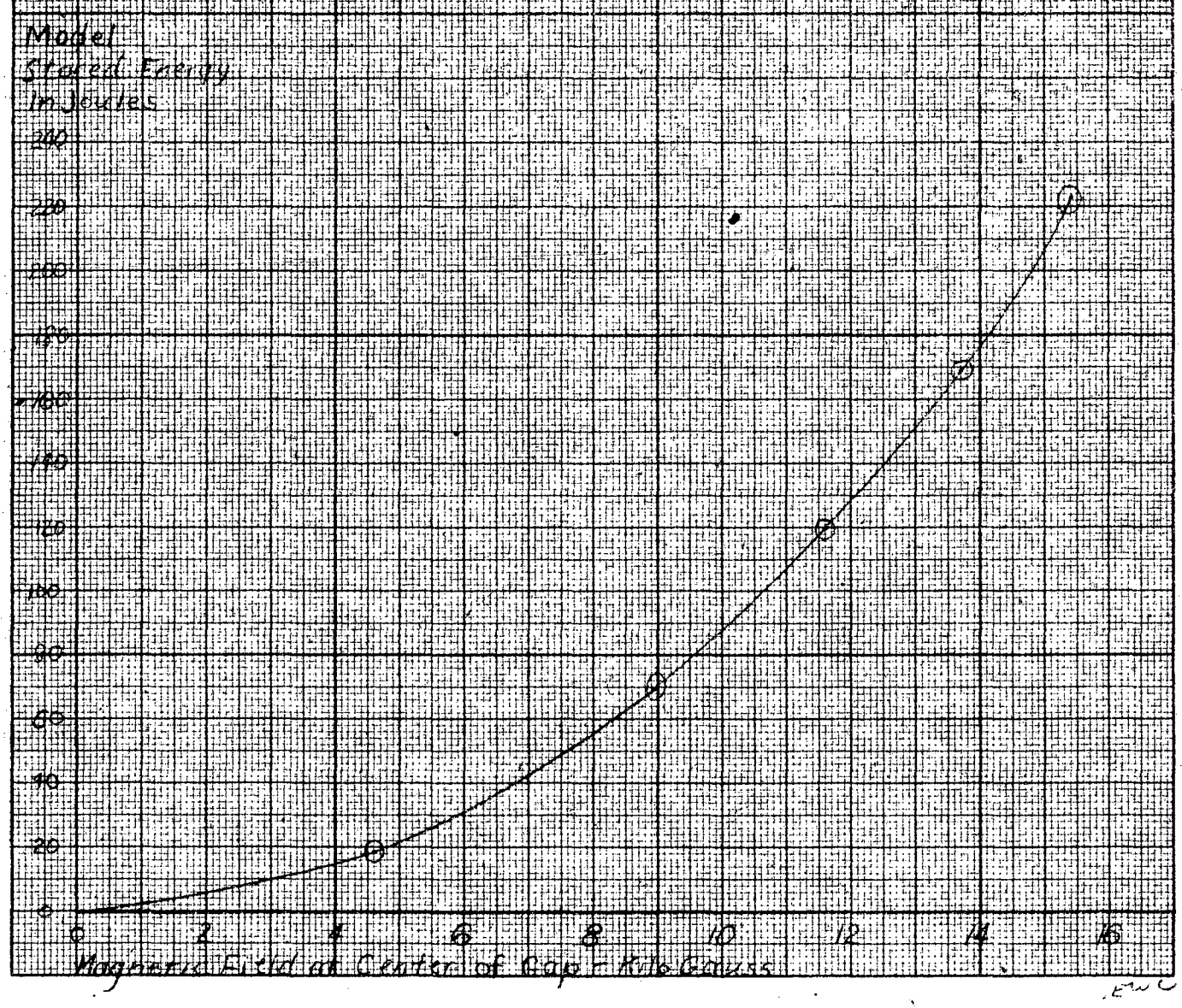
May 11, 1948

Bevatron Model Magnet DC4C
1/16 Scale DWG 31.1392 (Pole Tip)
Stored Energy Calculated From
Total Coil Flux Linkage

171-2
E-DC4C-1
5-11-48

Energy (Joules) = $10^{-8}\int^{I} I\, d\phi$
Where I is in Amperes
ϕ is in Maxwell Turns

Data is For 2½" Section on Model



NO. 340 - M DIETZGEN GRAPH PAPER
MILLIMETER
EUGENE DIETZGEN CO.
PRINTED IN U.S.A.

5 Model Magnet DC3 Index

a. Discussion

b. Sketch

c. Photographs

BEVA 16

d. Graphs

L-DC3-1	Efficiency and leakage coefficients
H-DC3-1	Flux density around the magnetic path
U-DC3-1	Radial uniformity (26")
U-DC3-1a	Radial uniformity (26") - Expanded
U-DC3-2	Radial uniformity (62")
F-DC3-1	Coil flux linkage
F-DC3-1a	Total coil flux linkage
E-DC3-1	Stored energy

5 Model Magnet DC3

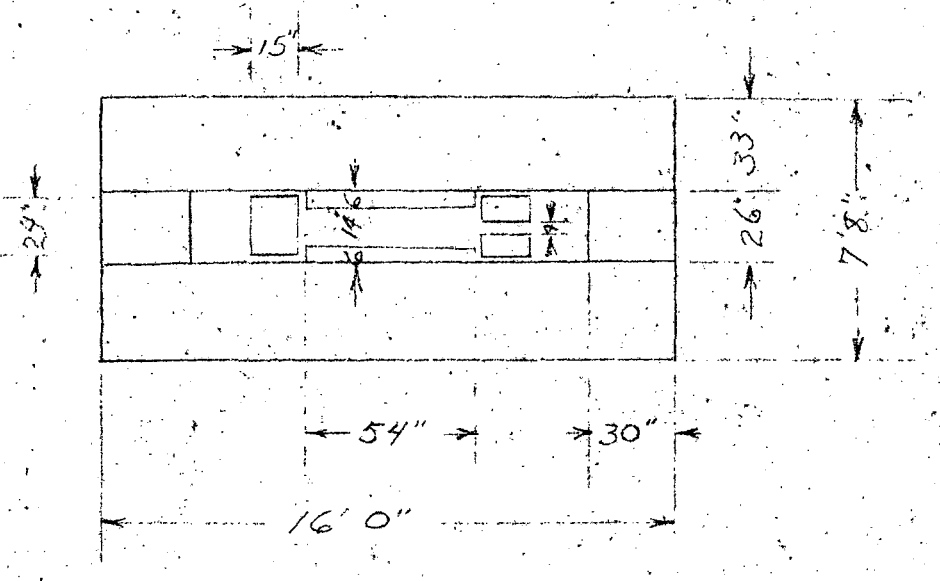
a. Discussion

Bevatron model magnet DC3 was the first attempt to design a DC model magnet of type A to predict performance of the magnet for a full-scale bevatron.

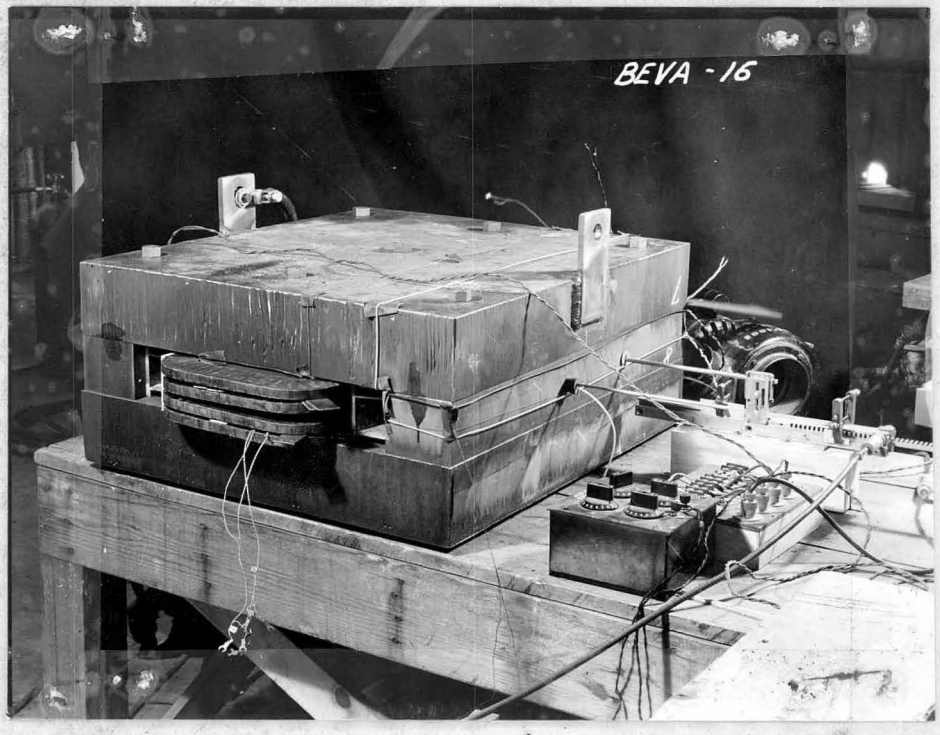
This model met the general specifications except that the useful width of the magnetic field at the injection field was 26 inches instead of the specified 48 inches.

A decision was made at this time to design a model magnet with a larger aperture, 2 feet by 8 feet, as an initial stage in the development of the bevatron. This magnet was to be designed so that it could be converted to the 1' x 4' aperture at a later time. Changes were made to adapt model DC3 for the larger aperture. (See model DC3A.)

BEVATRON MODEL MAGNET DC3



GAP 14"
RADIUS 50'
$n = 0.75$
MODEL COILS : 4 COILS 27 TURNS EACH = 108 TURNS
DIMENSIONS ARE FULL SCALE
MODEL IS 1/8" SCALE
ASSEMBLY DWG. 3L 1192



BEVA 16

Bevatron Model Magnet DC3

BEVATRON MODEL MAGNET DC3 L-DC3-1

EFFICIENCY AND LEAKAGE COEFFICIENTS

1/8 SCALE DWG 5L/192

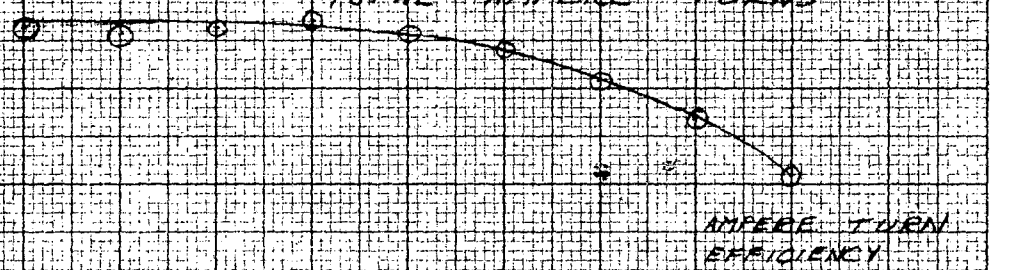
% LEAKAGE COEFFICIENTS =

$$\frac{\text{TOTAL FLUX}}{\text{FLUX DENSITY AT CENTER OF GAP} \times \text{POLE AREA}}$$

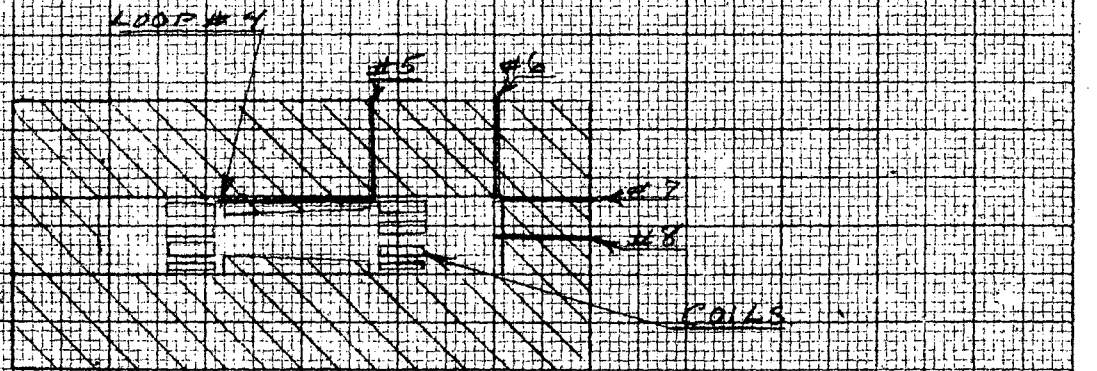
POLE AREA BASED ON 48" GAP WIDTH

% EFFICIENCY =

$$\frac{2.02 \times \text{FLUX DENSITY AT CENTER OF GAP} \times \text{GAP HEIGHT (INCHES)}}{\text{TOTAL AMPERE TURNS}}$$



CROSS-SECTION OF MAGNET



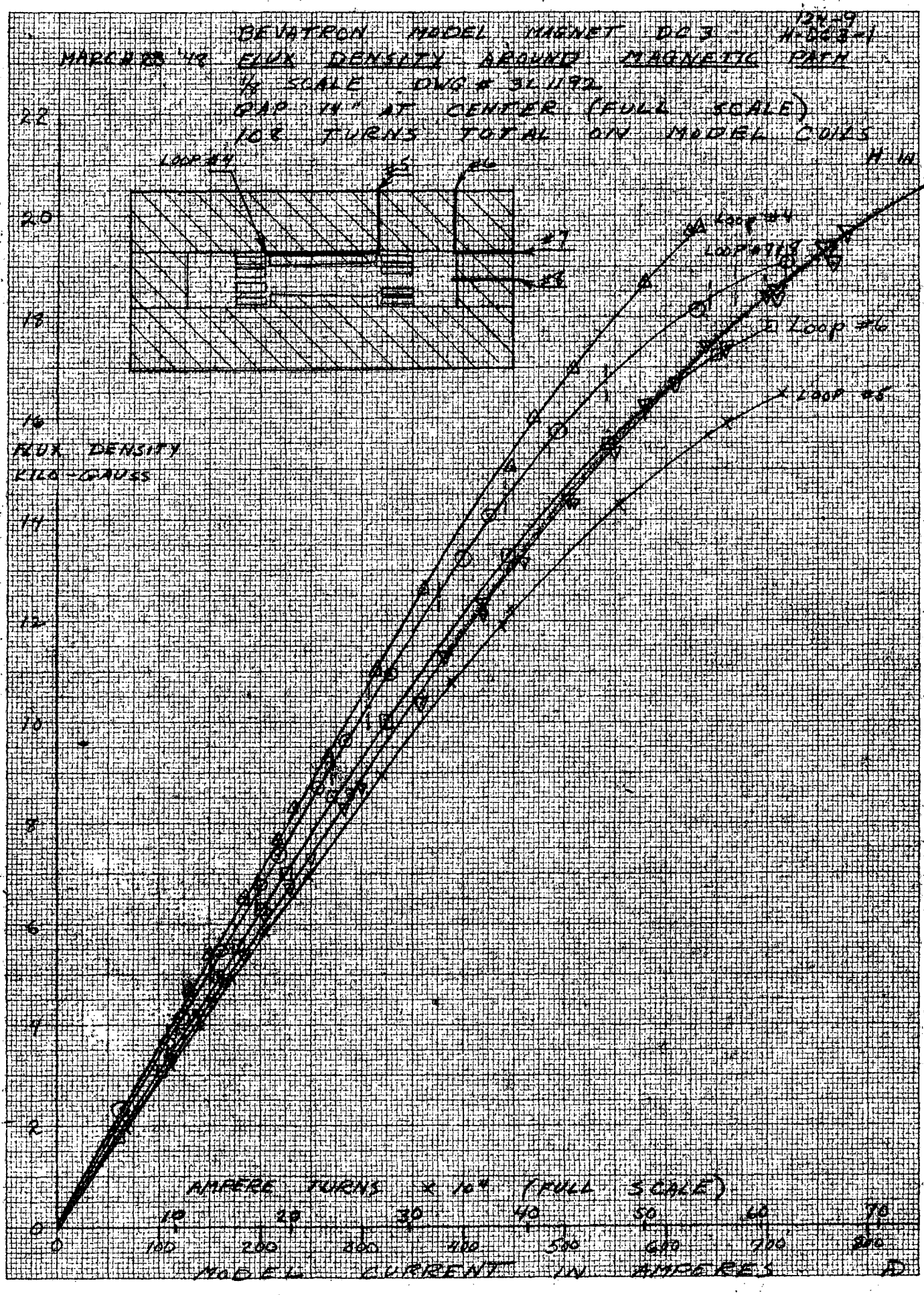
PERCENT

180
160
140
120
100
80
60
40
20
0

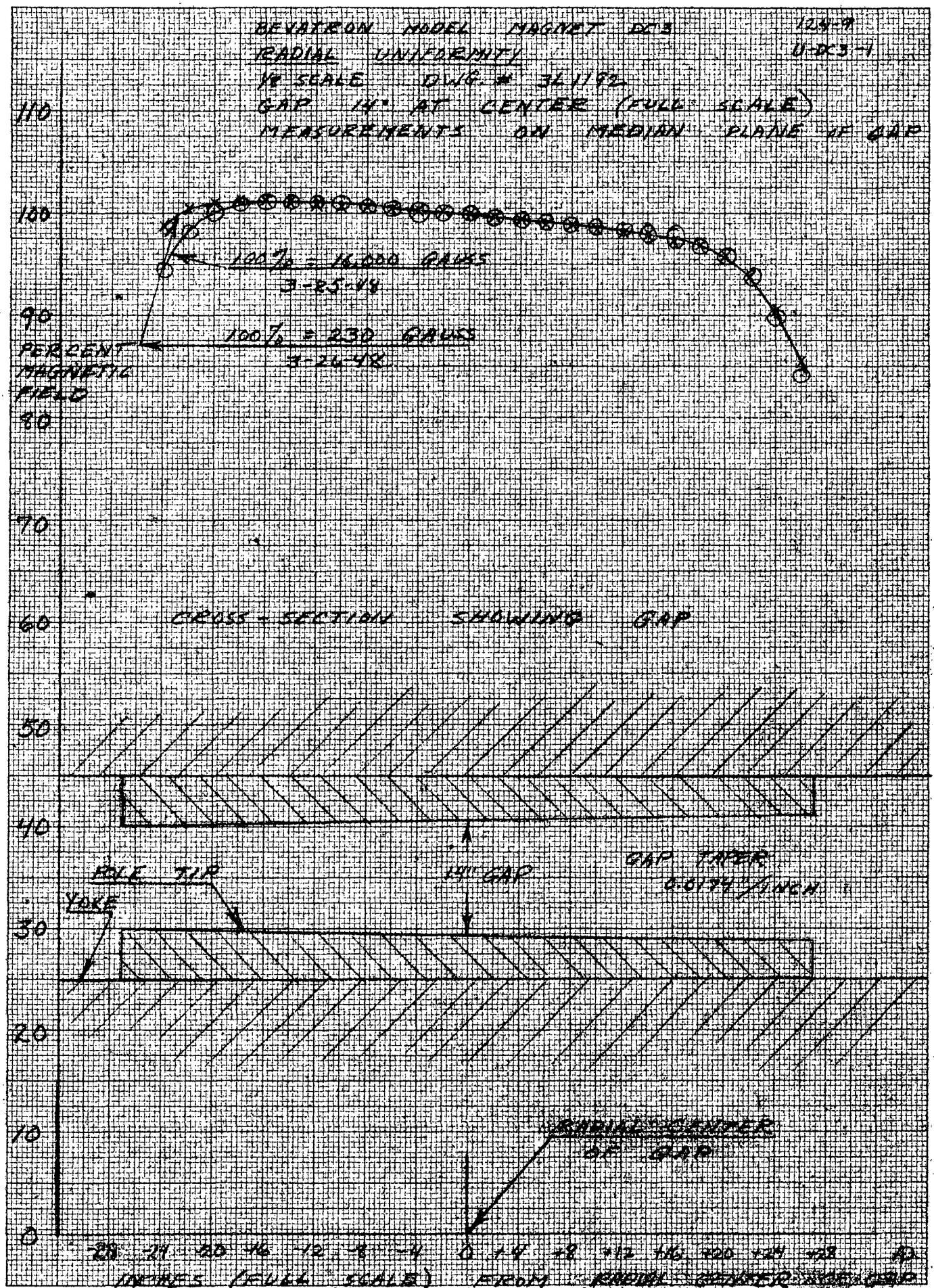
0 4 8 12 16 20 KG

MAGNETIC FIELD AT CENTER OF GAP - KILOGAUSS

KEUFFEL & ESSER CO., N. Y. NO. 359-11G
10 × 10 to the ½ Inch, 5th lines accented.
Engraving 7 × 10 in.
MADE IN U.S.A.



BEVATRON MODEL MAGNET DC 3
MARCH 28 '48 FLUX DENSITY AROUND MAGNETIC PATH
1/8 SCALE DWG # 3L1192
GAP 14" AT CENTER (FULL SCALE)
108 TURNS TOTAL ON MODEL COILS
LOOP #4
#5
#6
#7
#8
H IN GAP
Loop #4
Loop #6
LOOP #5
FLUX DENSITY
KILO-GAUSS
AMPERE TURNS x 10⁴ (FULL SCALE)
MODEL CURRENT IN AMPERES

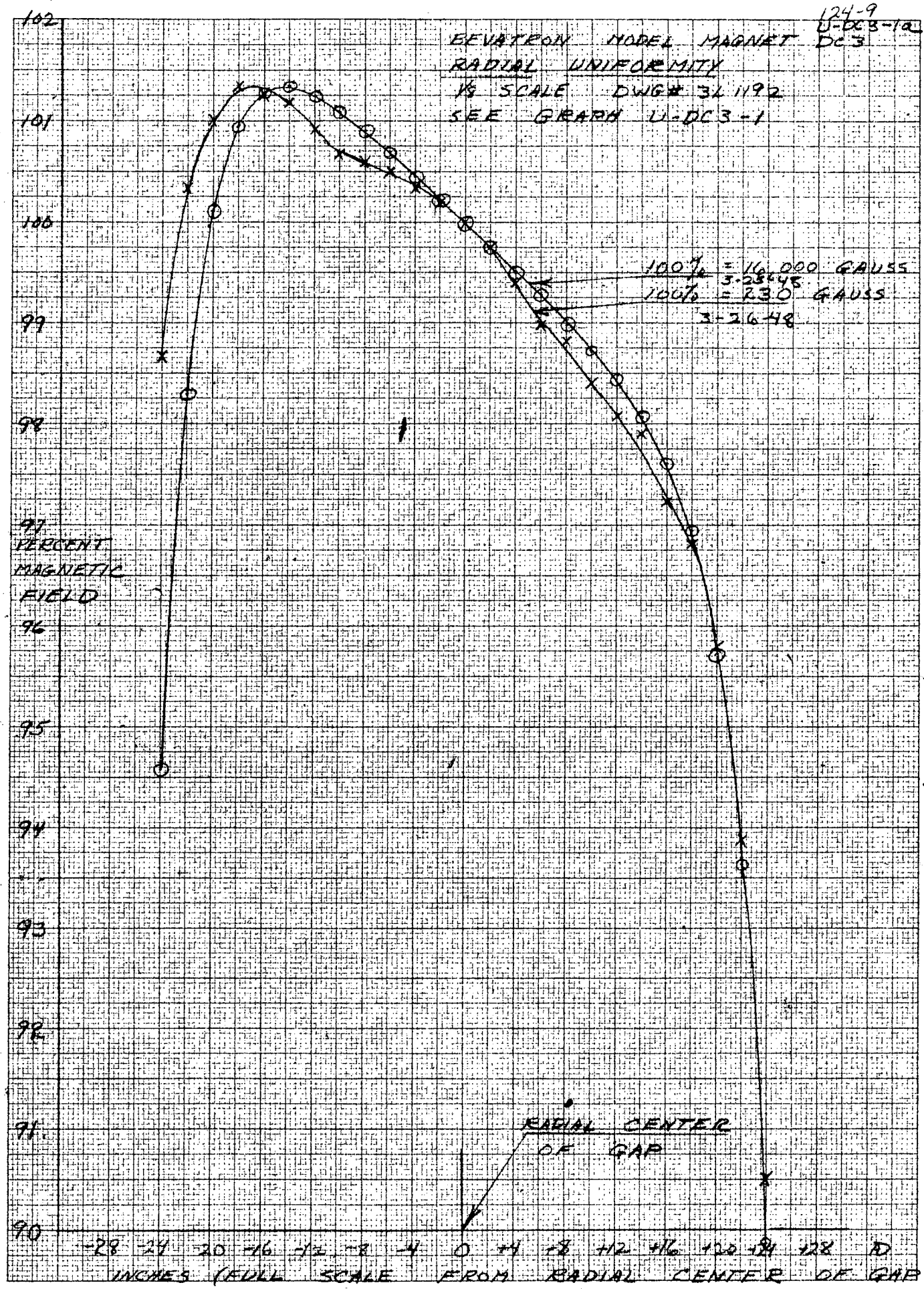


KEUFFEL & ESSER CO., N. Y., NO. 360-14
Millimeters, 10th lines heavy.
MADE IN U. S. A.

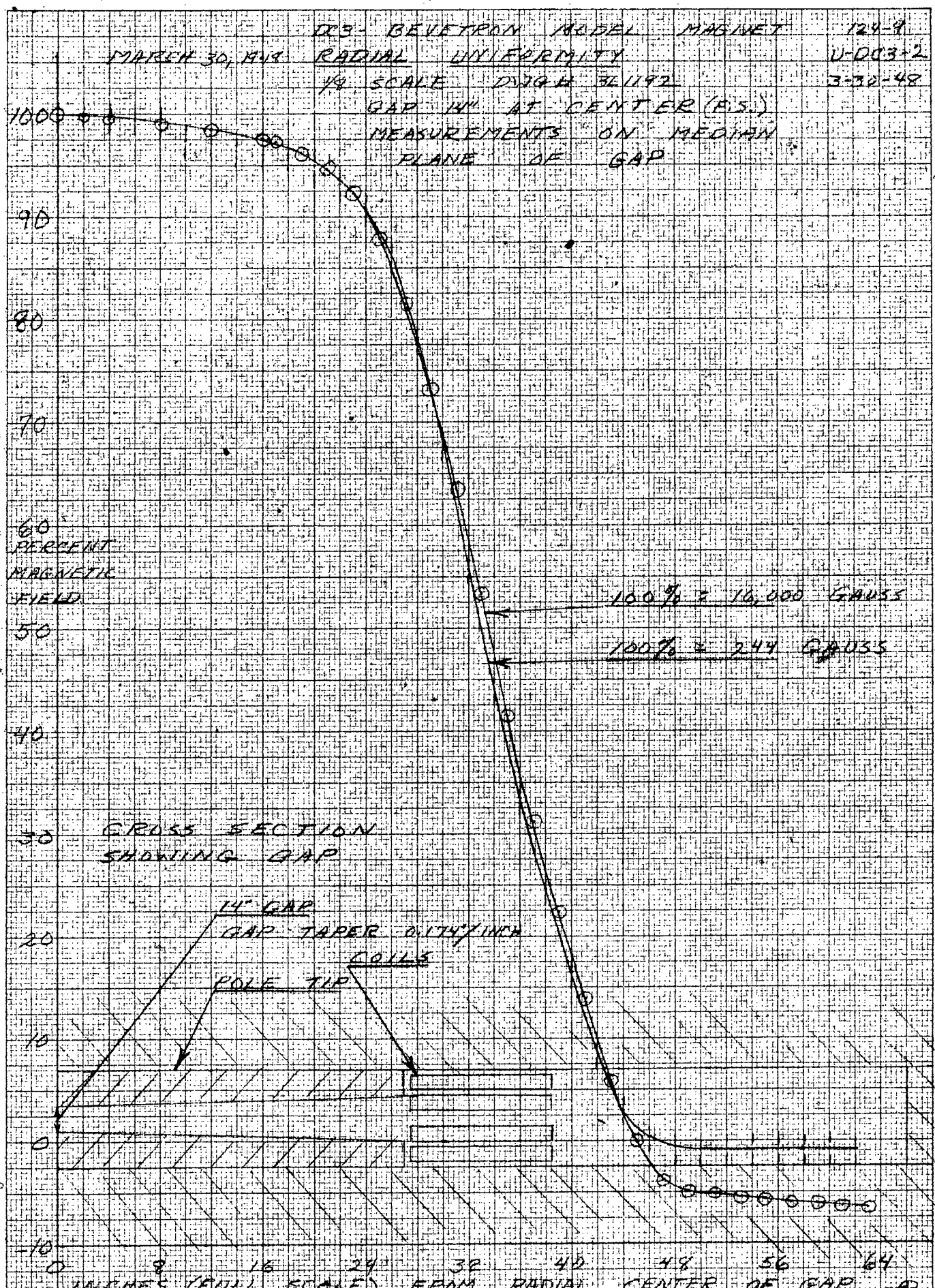
124-9
U-DC3-12

ELEVATION MODEL MAGNET DC3
RADIAL UNIFORMITY
½ SCALE DWG# 3L 1192
SEE GRAPH U-DC3-1

100% = 16,000 GAUSS
3-25-48
100% = 230 GAUSS
3-26-48



KEUFFEL & ESSER CO., N. Y. NO. 359-14
Millimeters, 10th lines heavy.
MADE IN U.S.A.



KEUFFEL & ESSER CO., N. Y. NO. 359-14
Millimeters, 10th lines heavy.
MADE IN U.S.A.

COIL FLUX LINKAGE 124-9

MARCH 23, 48 BEVATRON MODEL MAGNET DC3 F-DC3-1

½ SCALE DWG # 3L 1172

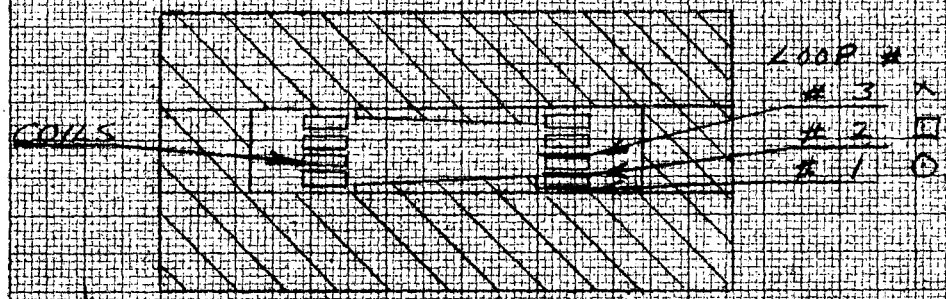
GAP 14" AT CENTER (FULL SCALE)

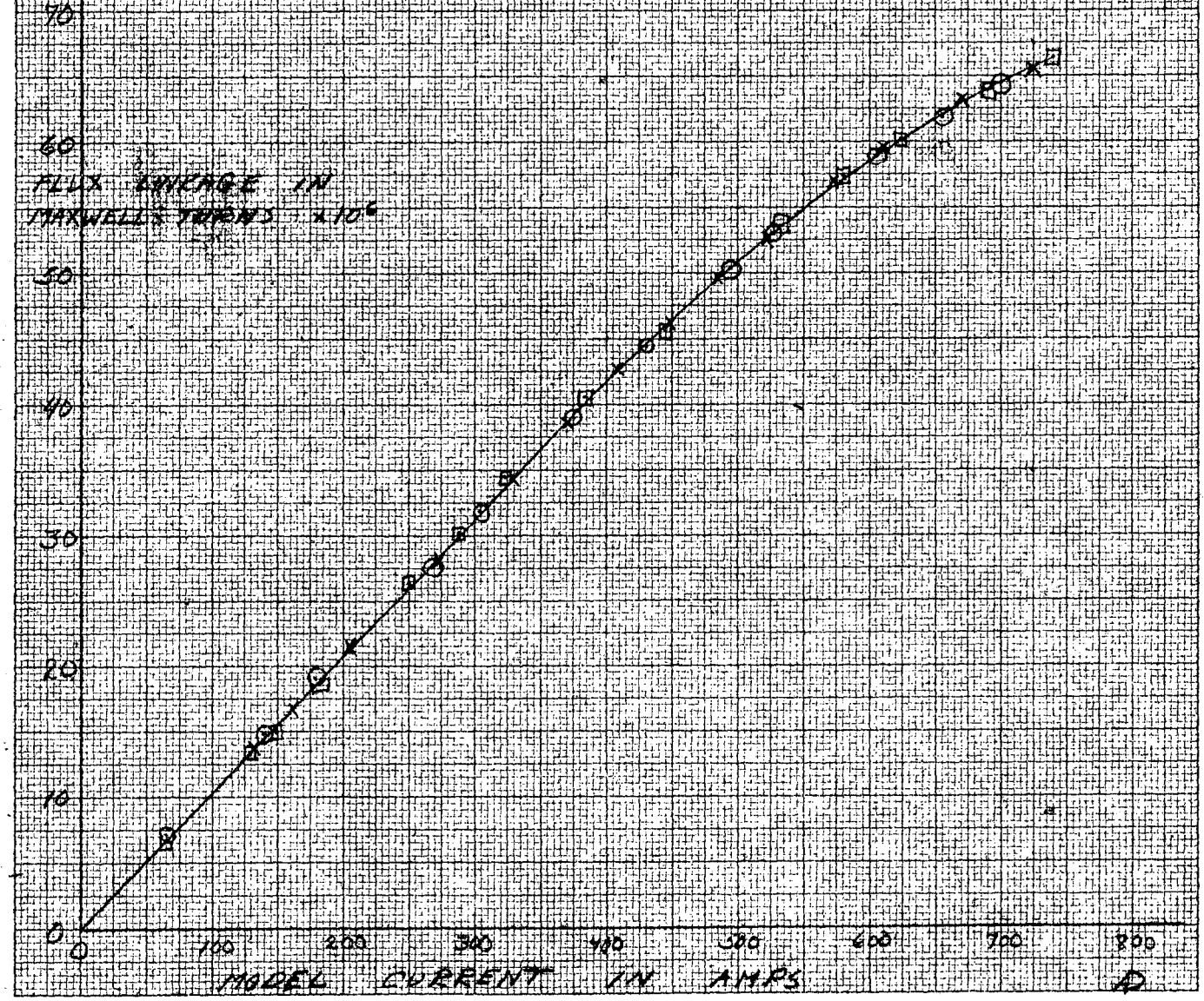
FLUX LINKAGE ON 2½" SECTION ON MODEL

MODEL COILS: 4 COILS 27 TURNS EACH

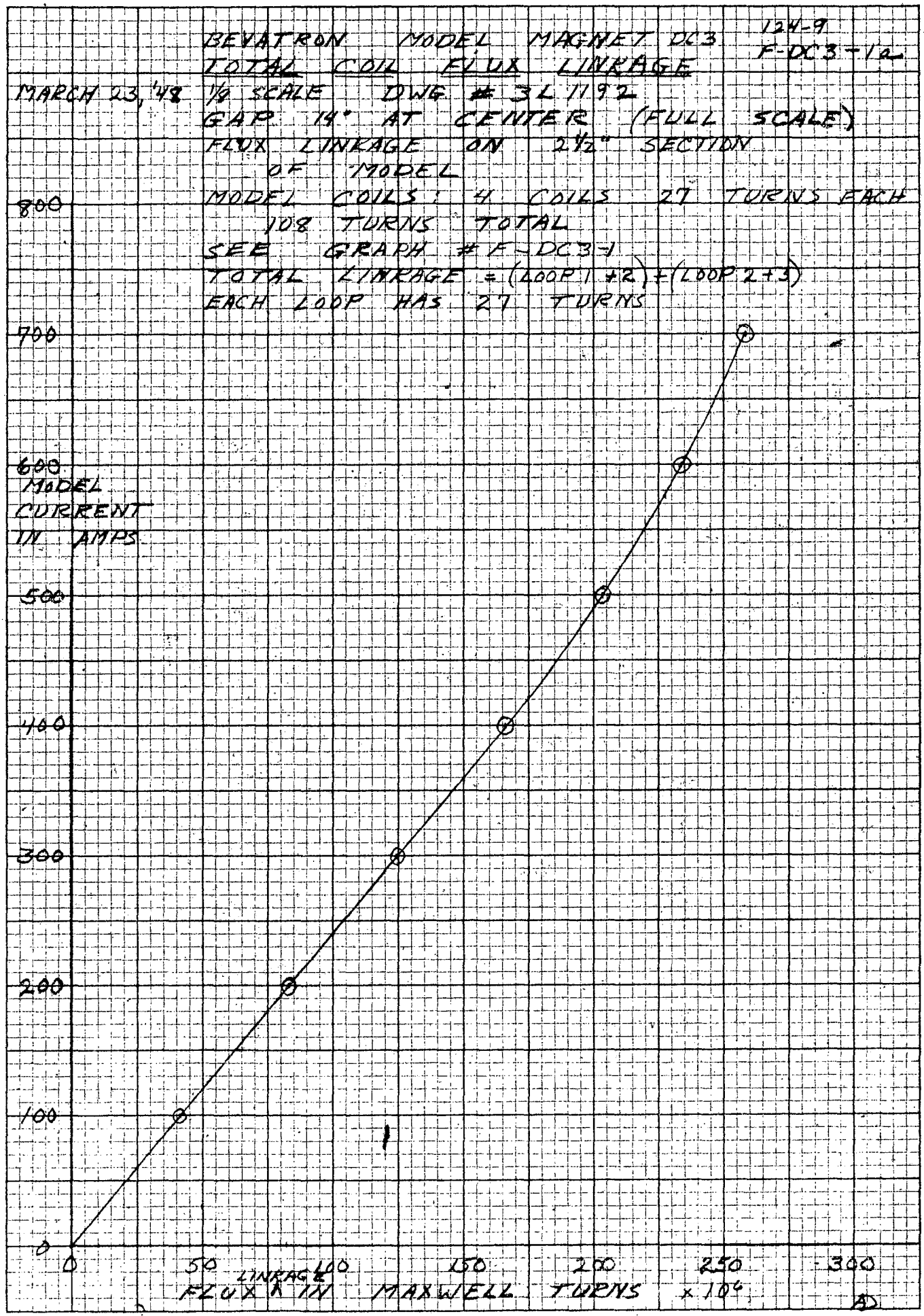
108 TURNS TOTAL

EACH LOOP HAS 27 TURNS





KEUFFEL & ESSER CO., N. Y. NO. 359-14
Millimeters, 10th lines heavy.
MADE IN U.S.A.



KEUFFEL & ESSER CO., N. Y. NO. 359-6
5 X 5 to the ½ inch.
MADE IN U.S.A.

E-DC3-1

BEVATRON MODEL MAGNET DC3

MAR 23 '48 STORED ENERGY

1/8 SCALE DWG # 3L 1192

STORED ENERGY CALCULATED FROM TOTAL COIL FLUX LINKAGE

SEE GRAPH E-DC3-1a

$\text{ENERGY (JOULES)} = 10^{-8} \int_0^{\Phi} I \, d\Phi$

WHERE I IS IN AMPS & Φ IS IN MAXWELL TURNS

DATA FOR 2½" SECTION OF MODEL

MODEL STORED ENERGY JOULES

900
800
700
600
500
400
300
200
100
0

0 2 4 6 8 10 12 14 16 18 20

MAGNETIC FIELD AT CENTER OF GAP - KILOGAUSS

KEUFFEL & ESSER CO., N. Y. NO. 359-6
5 X 5 to the ½ inch.
MADE IN U.S.A.

6 Model Magnet DC3A Index

a. Discussion

b. Sketch

c. Photographs

BEVA 18

d. Graphs

L-DC3A-1	Efficiency and leakage coefficients
H-DC3A-1	Flux density around the magnetic path
U-DC3A-1	Radial uniformity
F-DC3A-1	Coil flux linkage
F-DC3A-1a	Total coil flux linkage
E-DC3A-1	Stored energy

6 Model Magnet DC3A

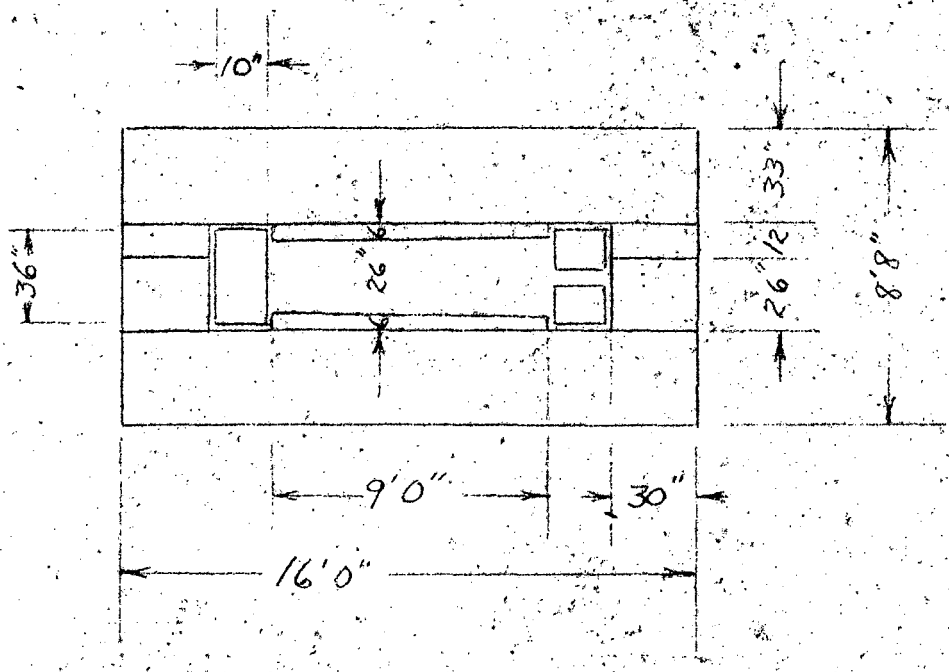
a. Discussion

Bevatron model magnet DC3A was a larger gap design of model DC3. The general specifications (see Section II) for the smaller aperture (1' x 4') apply to this larger aperture (2' x 8') except for the maximum flux density at the gap center and the width of the useful magnetic field. It was decided to accept whatever was available for the maximum flux density and useful gap width when the other specifications were met, with the additional provision that when this model is converted to give the 1' x 4' aperture, all of the original specifications must be met.

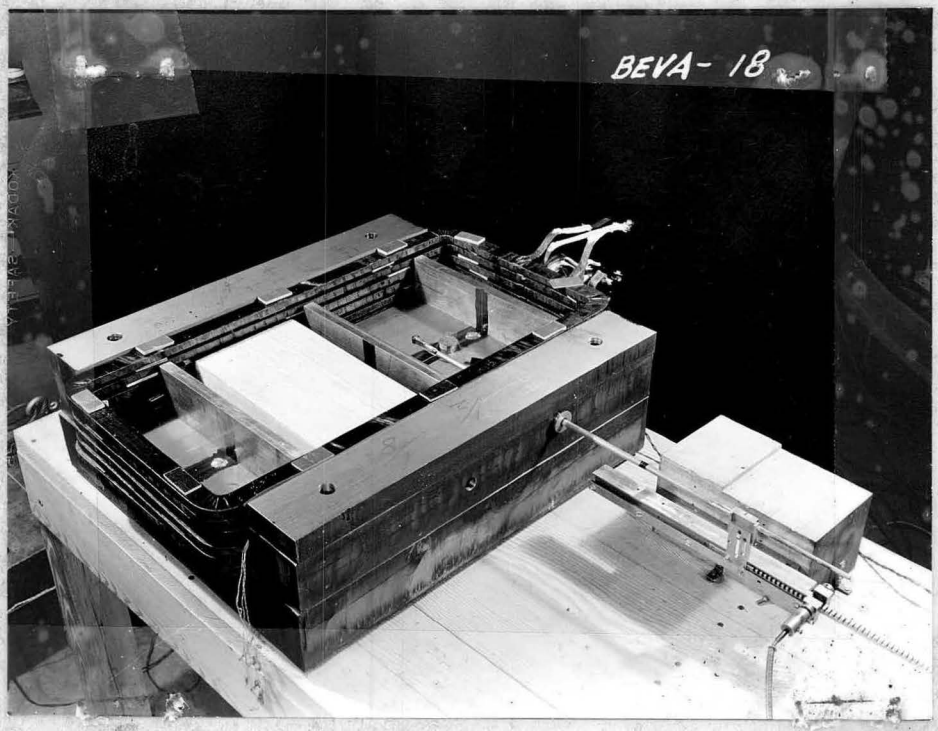
The following design changes were made in model DC3 to give this model DC3A. The pole pieces were increased in radial width from 54 inches to 108 inches. The gap was increased from 14 inches to 26 inches. Extensions were added to the legs to increase the distance between the yoke slabs. The cross-sectional area of the exciting coils was increased. An error in the design resulted in an n of 0.40 instead of 0.75 as specified.

It was decided after testing this model to change the design to increase the useful gap width at the injection field. (See model DC5 and DC5A.)

BEVATRON MODEL MAGNET DC 3A.



GAP 26"
RADIUS 50'
n = 0.40
MODEL COILS: 6 COILS 17 TURNS EACH = 102 TURNS.
DIMENSIONS ARE FULL SCALE.
MODEL IS 1/8 SCALE
ASSEMBLY DWG. 3L 1192



BEVA 18

Bevatron Model Magnet DC3A

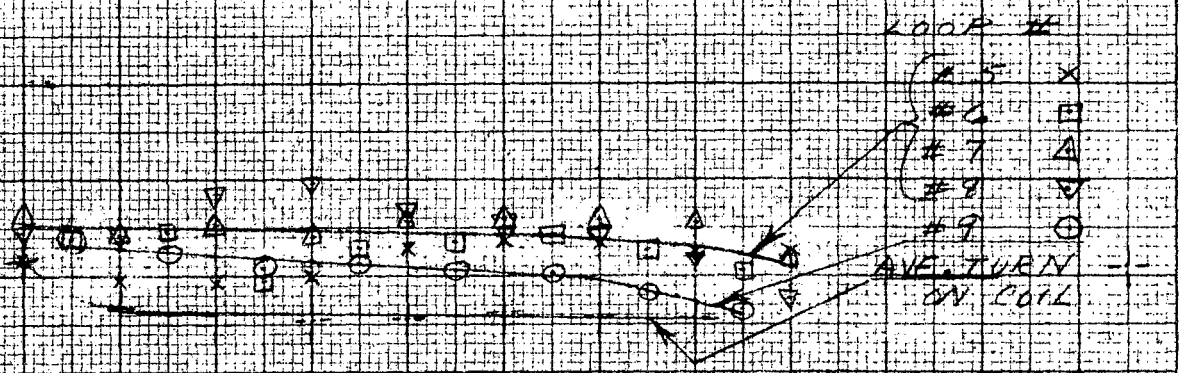
BEATRON MODEL MAGNET - DC3A 124-9

EFFICIENCY & LEAKAGE COEFFICIENT L-DC3A-1

#8 SCALE DWG 3L 1192

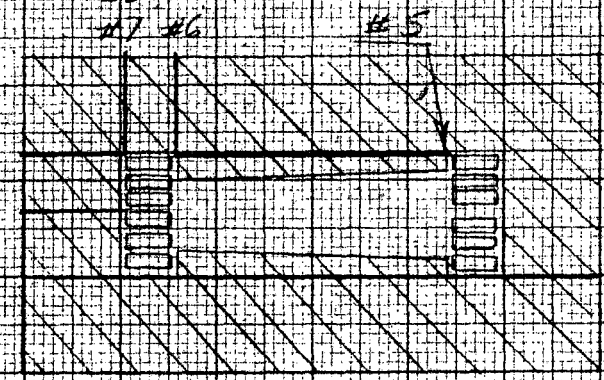
% LEAKAGE COEFFICIENT = $\frac{\text{TOTAL FLUX}}{\text{FLUX DENSITY AT CENTER} \times \text{POLE AREA}}$

POLE AREA BASED ON 96" POLE WIDTH



% EFFICIENCY = 2.02 x FLUX DENSITY AT CENTER x GAP HEIGHT (INCHES) / TOTAL AMPERE TURNS

CROSS-SECTION OF MAGNET



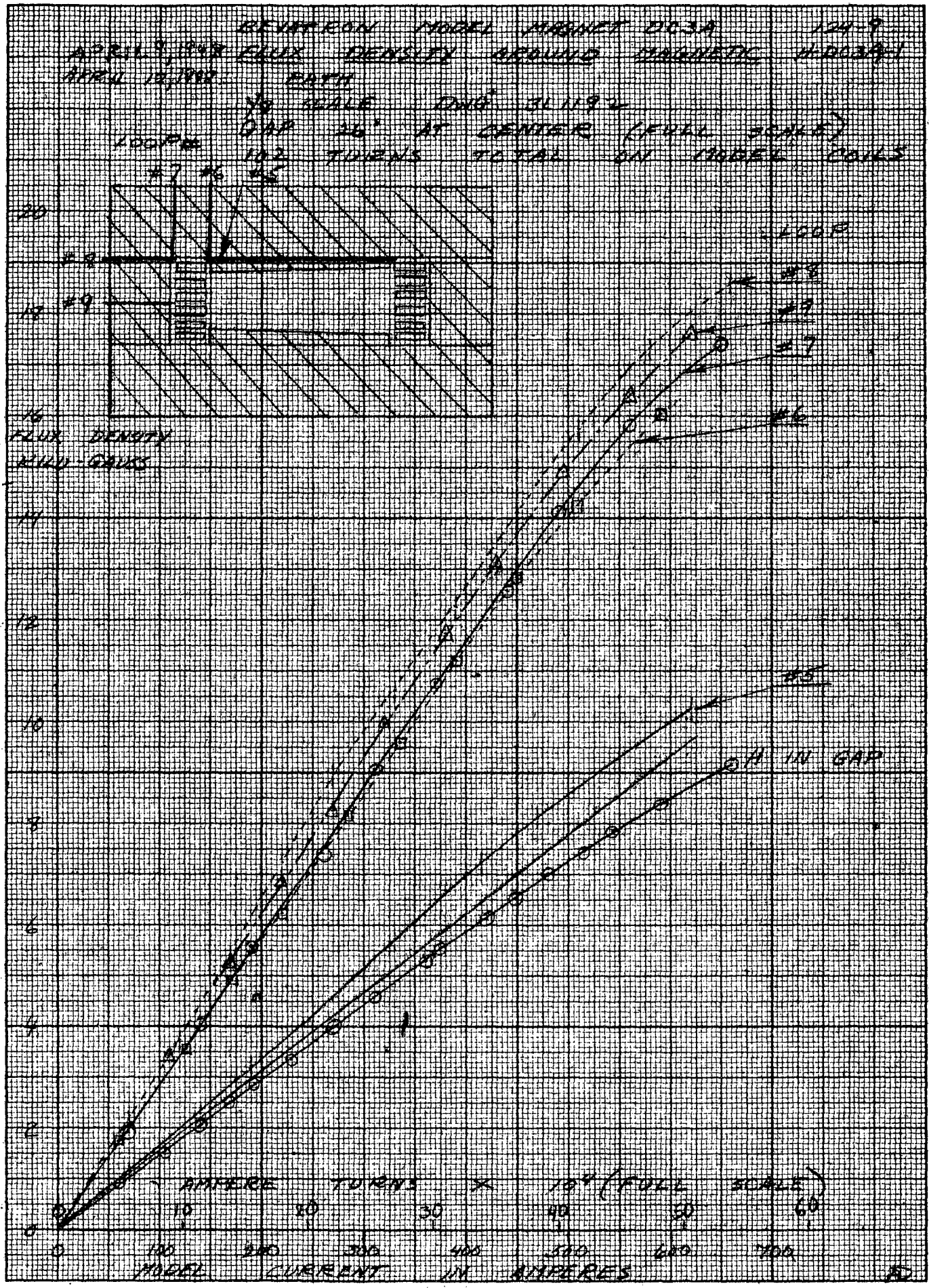
PERCENT

180 160 140 120 100 80 60 40 20 0

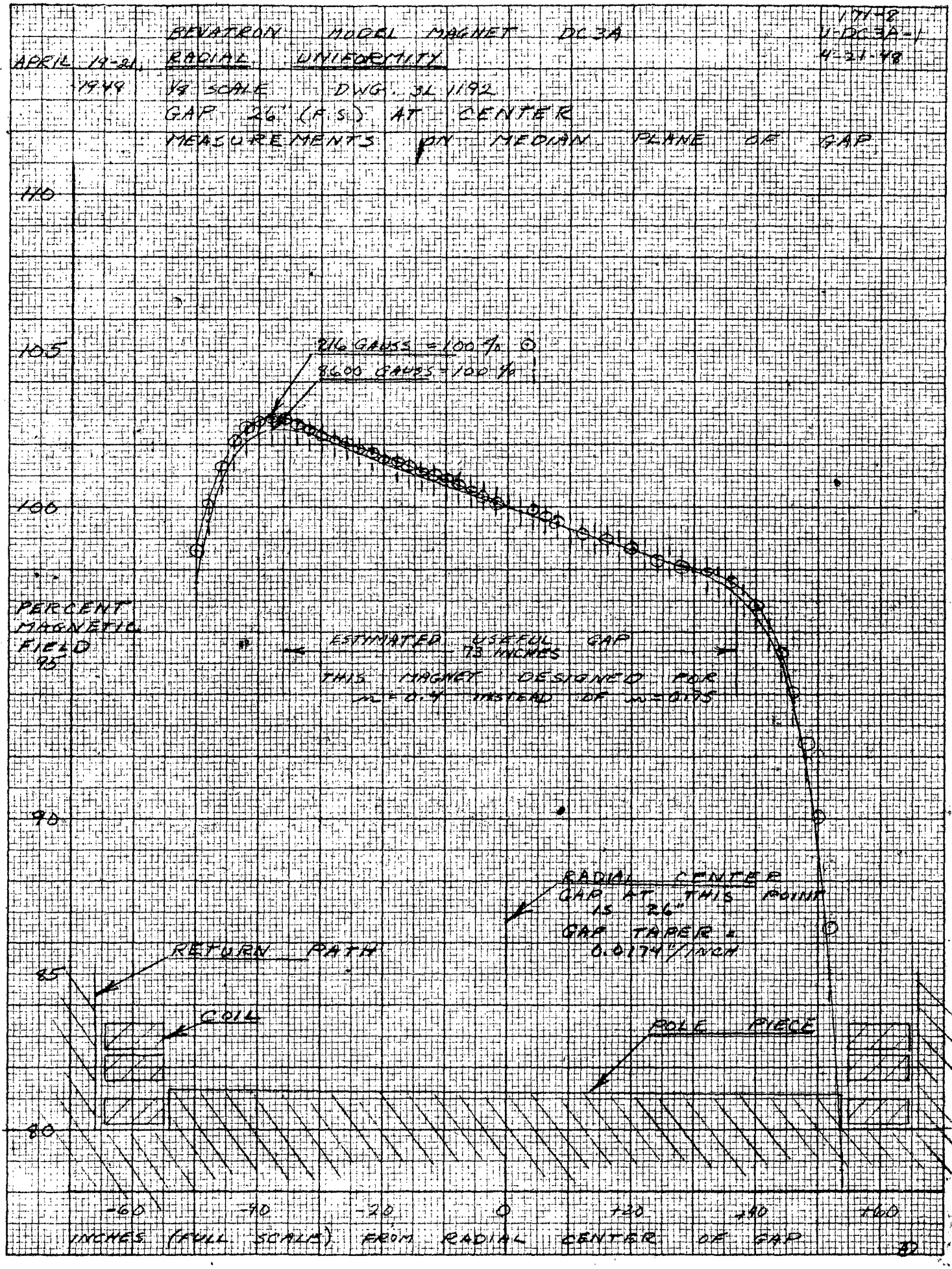
0 2 4 6 8 10 12

KILO-GAUSS - MAGNETIC FIELD AT CENTER OF GAP

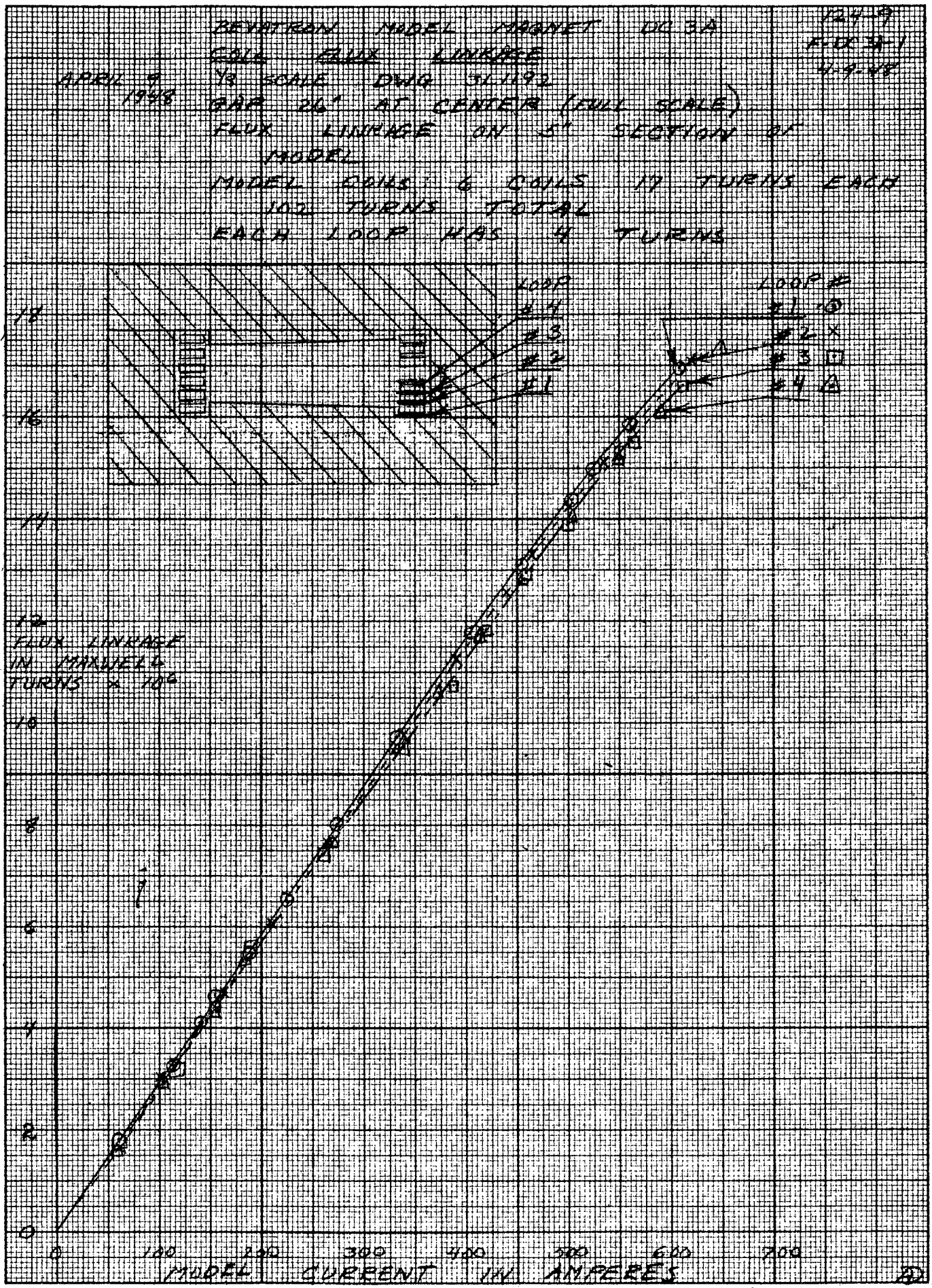
KEUFFEL & ESSER CO., N. Y. NO. 359-10G
10 X 10 to the ½ inch, 5th lines accented.
MADE IN U.S.A.



EUGENE DIETZGEN CO.
PRINTED IN U.S.A.
NO. 340 - M DIETZGEN GRAPH PAPER
MILLIMETER



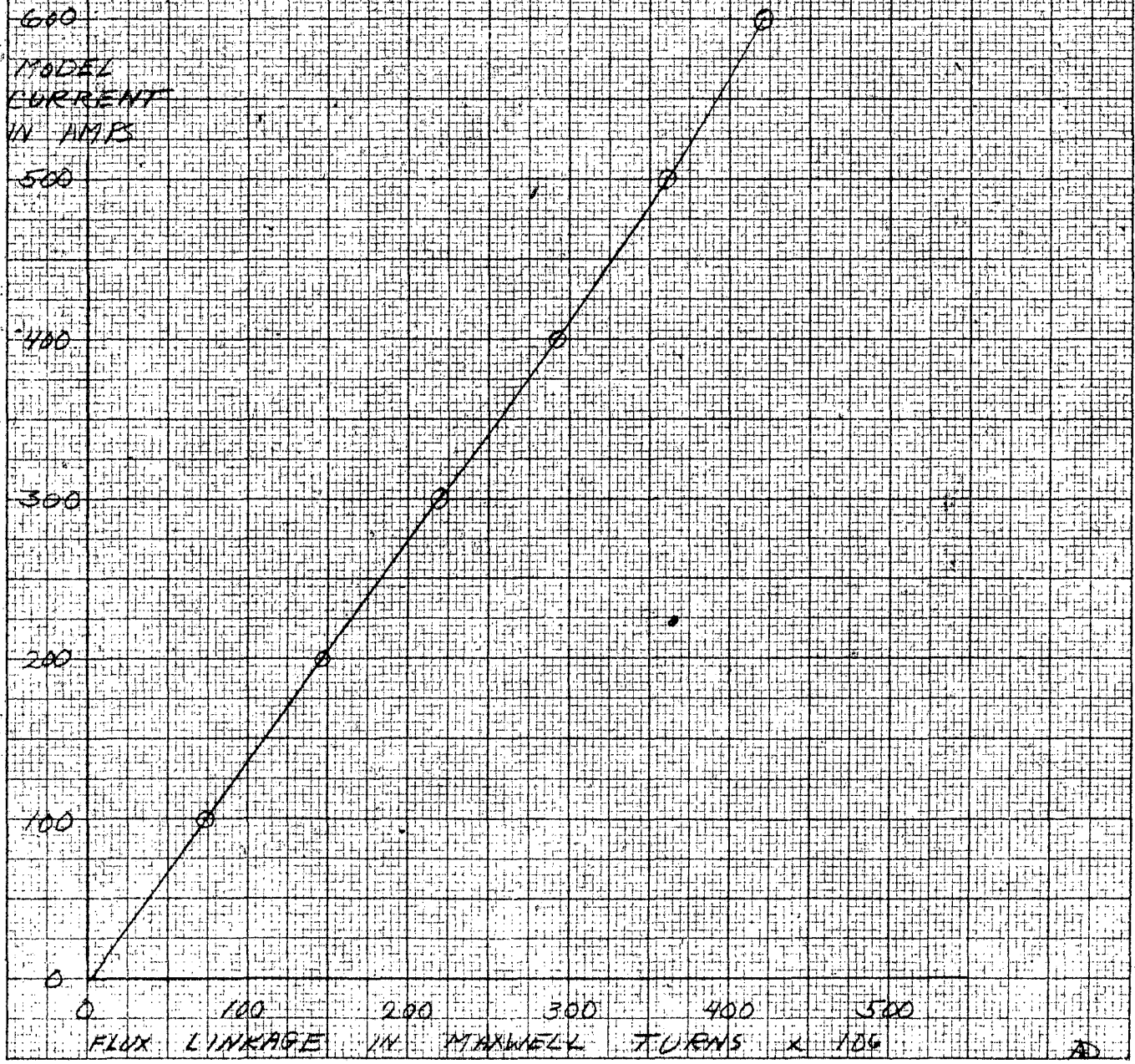
KEUFFEL & ESSER CO., N. Y. NO. 359-12G
10 X 10 to the 1/2 inch, 5th lines accented.
MADE IN U.S.A.



EUGENE DIETZGEN CO.
PRINTED IN U.S.A.
NO. 340 · M DIETZGEN GRAPH PAPER
MILLIMETER

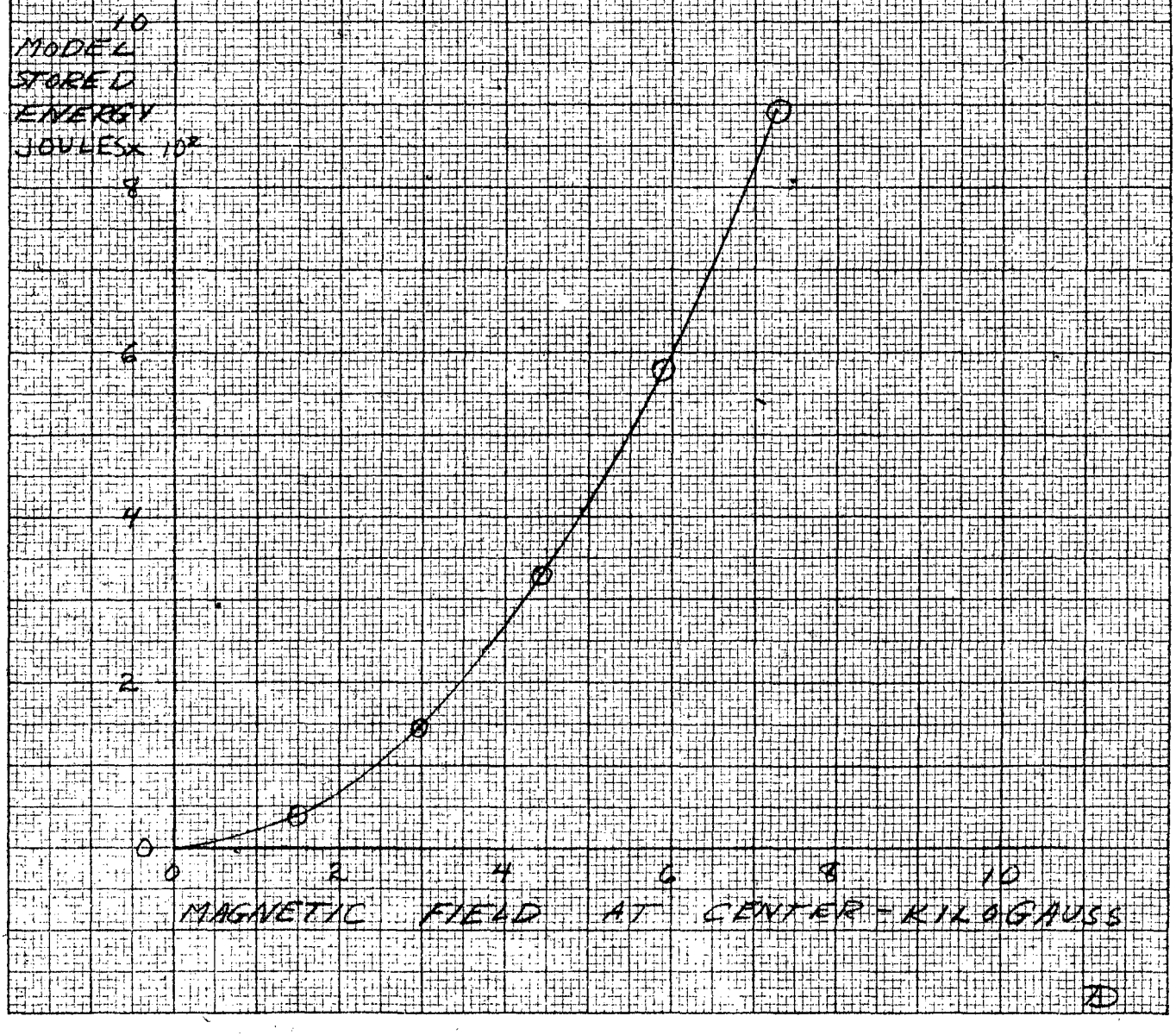
BEVATRON MODEL MAGNET DC3A
APRIL 9, '48 TOTAL COIL FLUX LINKAGE
1/8 SCALE DWG 3L 1192
GAP 26" AT CENTER (FULL SCALE)
FLUX LINKAGE ON 5" SECTION OF MODEL
MODEL COILS - 6 COILS 19 TURNS EACH - 102 TURNS TOTAL
SEE GRAPH F-DC3A-1
TOTAL LINKAGE = LOOPS (1+2)+(2+3)+(3+4)
EACH LOOP HAS 4 TURNS

F-DC3A-1a
4-9-48



KEUFFEL & ESSER CO., N. Y. NO. 359-11G
10 × 10 to the ½ inch, 5th lines accented
Engraving 7 × 10 in.
MADE IN U.S.A.

BEVATRON MODEL MAGNET-DC3A 171-8
APRIL 9, '56 1/8 SCALE DWG 3L 1192 E-DC3A-1
5-10-48
STORED ENERGY CALCULATED FROM
TOTAL COIL FLUX LINKAGE E-DC3A-1a
ENERGY(JOULES) = $10^{-8} \int_0^I I \, d\phi$
WHERE I IS IN AMPERES ϕ
ϕ IS IN MAXWELL TURNS
DATA FOR 5" SECTION ON MODEL



KEUFFEL & ESSER CO., N. Y. NO. 399-11G
10 × 10 to the ½ Inch, 5th lines accented.
Engraving 7 × 10 In.
MADE IN U.S.A.

7 Model Magnet DC5 Index

a. Discussion

b. Sketch

c. Photographs

BEVA 23

d. Graphs

L-DC5-1	Efficiency and leakage coefficients
H-DC5-1	Flux density around the magnetic path
U-DC5-1	Radial uniformity
U-DC5-1a	Radial uniformity - Expanded
F-DC5-1	Coil flux linkage
F-DC5-1a	Total coil flux linkage
E-DC5-1	Stored energy

7 Model Magnet DC5

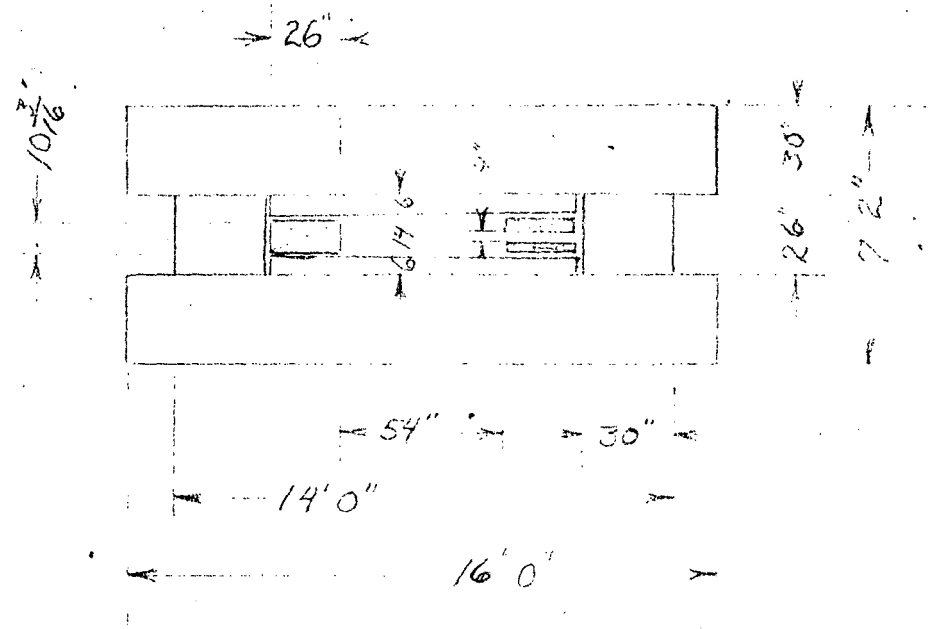
a. Discussion

Bevatron model magnet DC5 was similar in design to model DC3. Changes were made in the exciting coils in an effort to increase the useful gap width. The distance between the leg slabs was decreased but the radial width of the yoke slabs and the thickness of the leg slabs were not decreased.

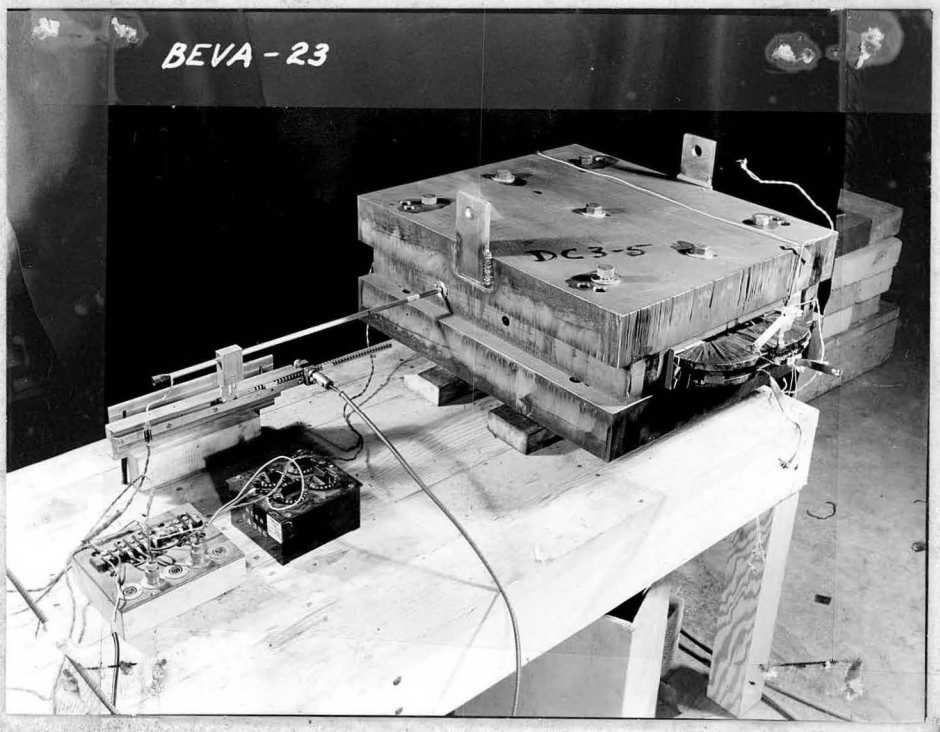
A comparison of magnet performance of model DC5 with the performance of model DC3 shows some changes. The peak KVA required was increased from 127 x 10^3 to 142 x 10^3 KVA for a rise time of one second. The useful radial gap width was increased at the injection field from 26 inches to 44 inches and at 16 kilogauss from 22 inches to 44 inches.

Model magnet DC5 was then modified for the larger aperture (2' x 8') model of DC5. (See DC5A)

BEVATRON MODEL MAGNET DC 5



$n = 0.75$
GAP 14"
RADIUS 50'
MODEL COILS: 2 COILS 46 TURNS EACH = 92 TURNS
DIMENSIONS ARE FULL SCALE
MODEL IS 1/8 SCALE
ASSEMBLY DWG. 3L 1402



BEVA 23

Bevatron Model Magnet DC5

GENERATOR MODEL MAGNET DC3
EFFICIENCY AND LEAKAGE COEFFICIENTS
½ SCALE DWG 3L 1402

17-8
L-DC3-1
5-10-48

LOOP # 3

LOOP # 4

AVERAGE TURN ON COIL

% LEAKAGE COEFFICIENT = TOTAL FLUX / FLUX DENSITY AT CENTER × POLE AREA
POLE AREA BASED ON 48" WIDTH

% EFFICIENCY = 2.02 × FLUX DENSITY AT CENTER × GAP HEIGHT (INCHES) / TOTAL AMPERE TURNS

AMPERE TURN EFFICIENCY

PERCENT

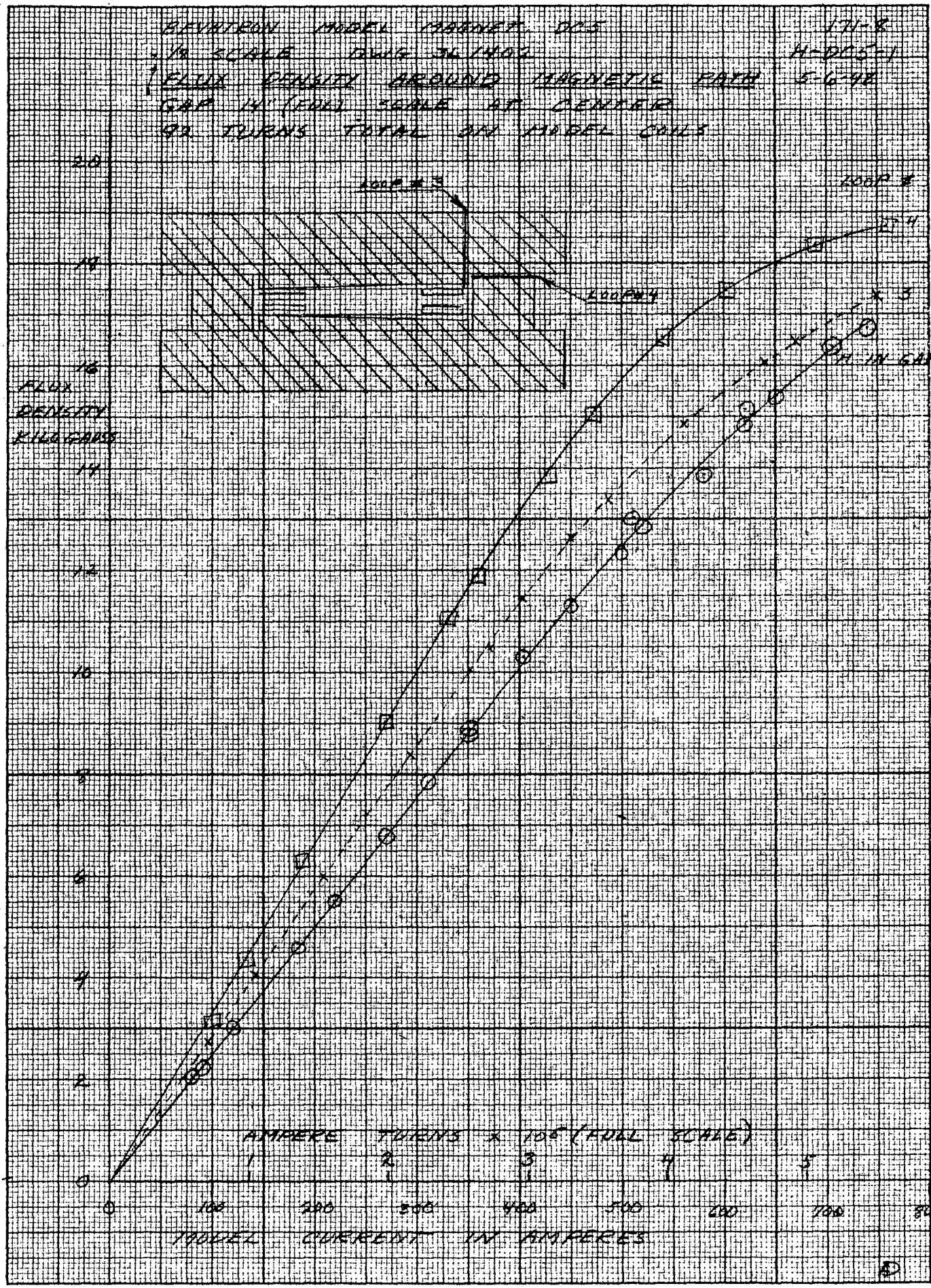
CROSS-SECTION OF MODEL

LOOP # 3

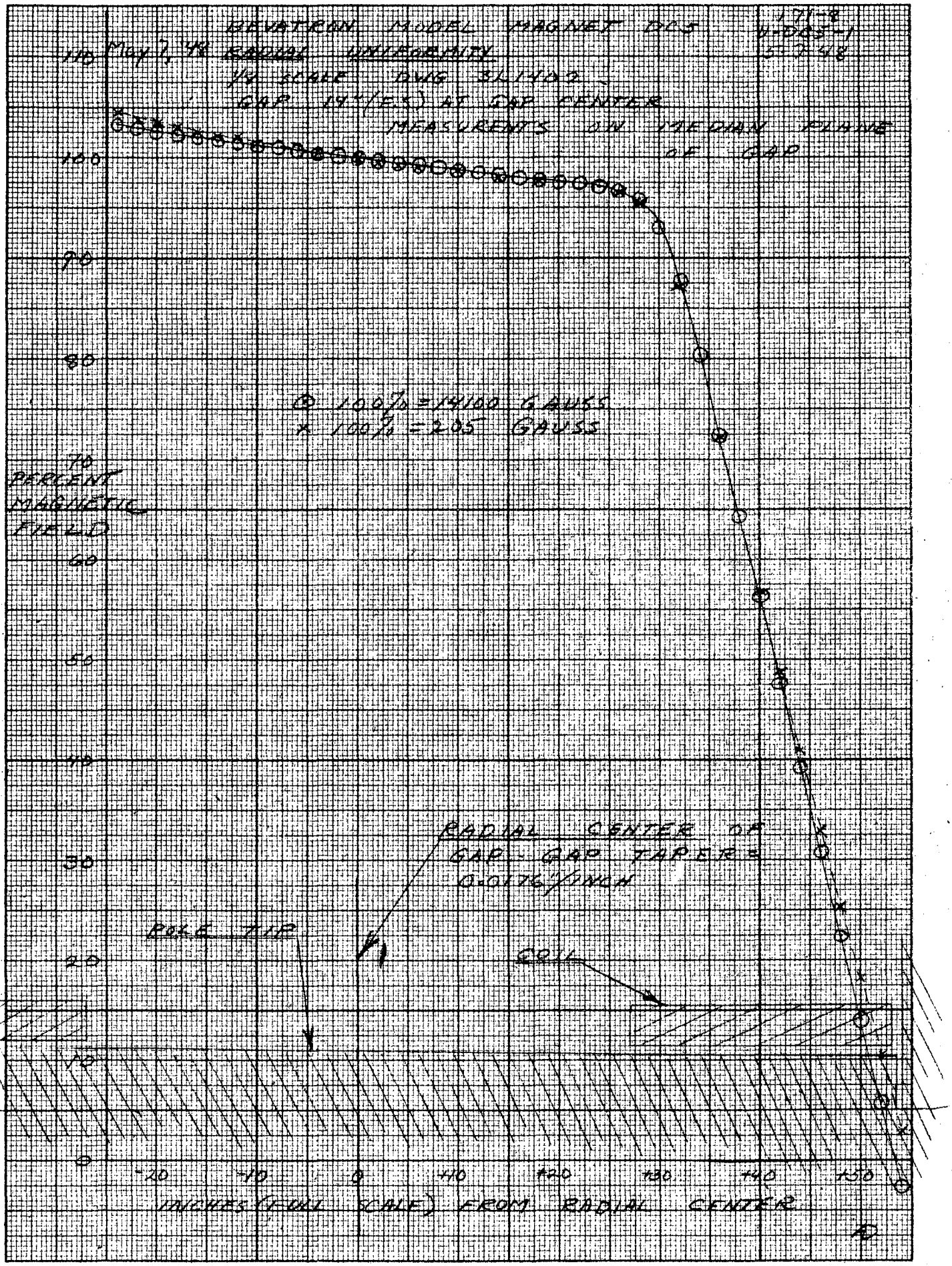
LOOP # 4

MAGNETIC FIELD AT CENTER OF GAP- KILOGAUSS

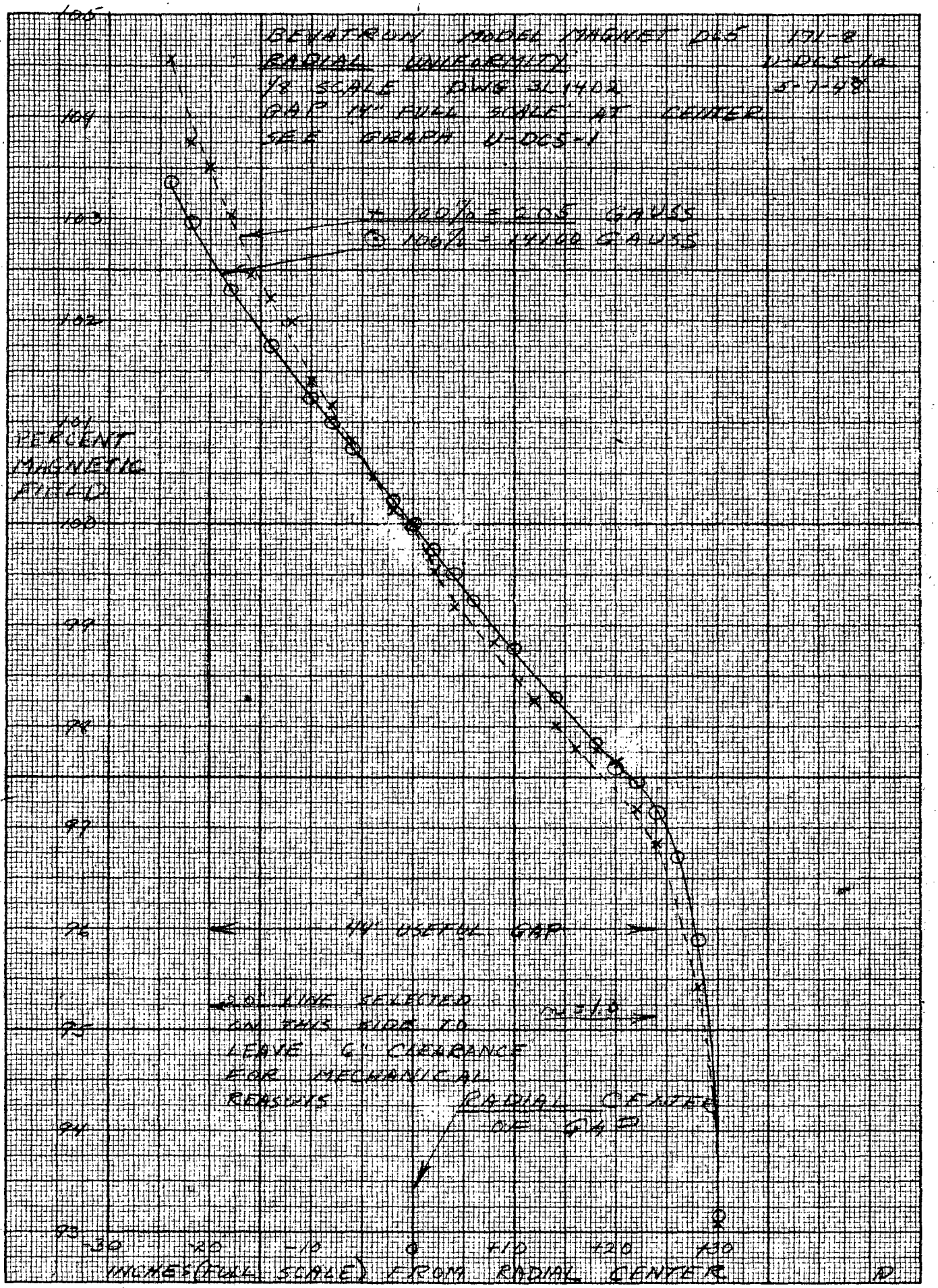
KEUFFEL & ESSER CO., N. Y. NO. 359-11G
10 × 10 to the ½ inch, 5th lines accented
Engraving 7 × 10 in.
MADE IN U.S.A.



EUGENE DIETZGEN CO.
PRINTED IN U.S.A.
NO. 340 - M DIETZGEN GRAPH PAPER
MILLIMETER



EUGENE DIETZGEN CO.
PRINTED IN U.S.A.
NO. 340 - M DIETZGEN GRAPH PAPER
MILLIMETER



EUGENE DIETZGEN CO.
PRINTED IN U.S.A.
NO. 340 - M DIETZGEN GRAPH PAPER
MILLIMETER

May 6, 1948

Bevatron Model Magnet DC5

Coil Flux Linkage

1/8 Scale DWG 3L1402

Gap 14" at Center (Full Scale)

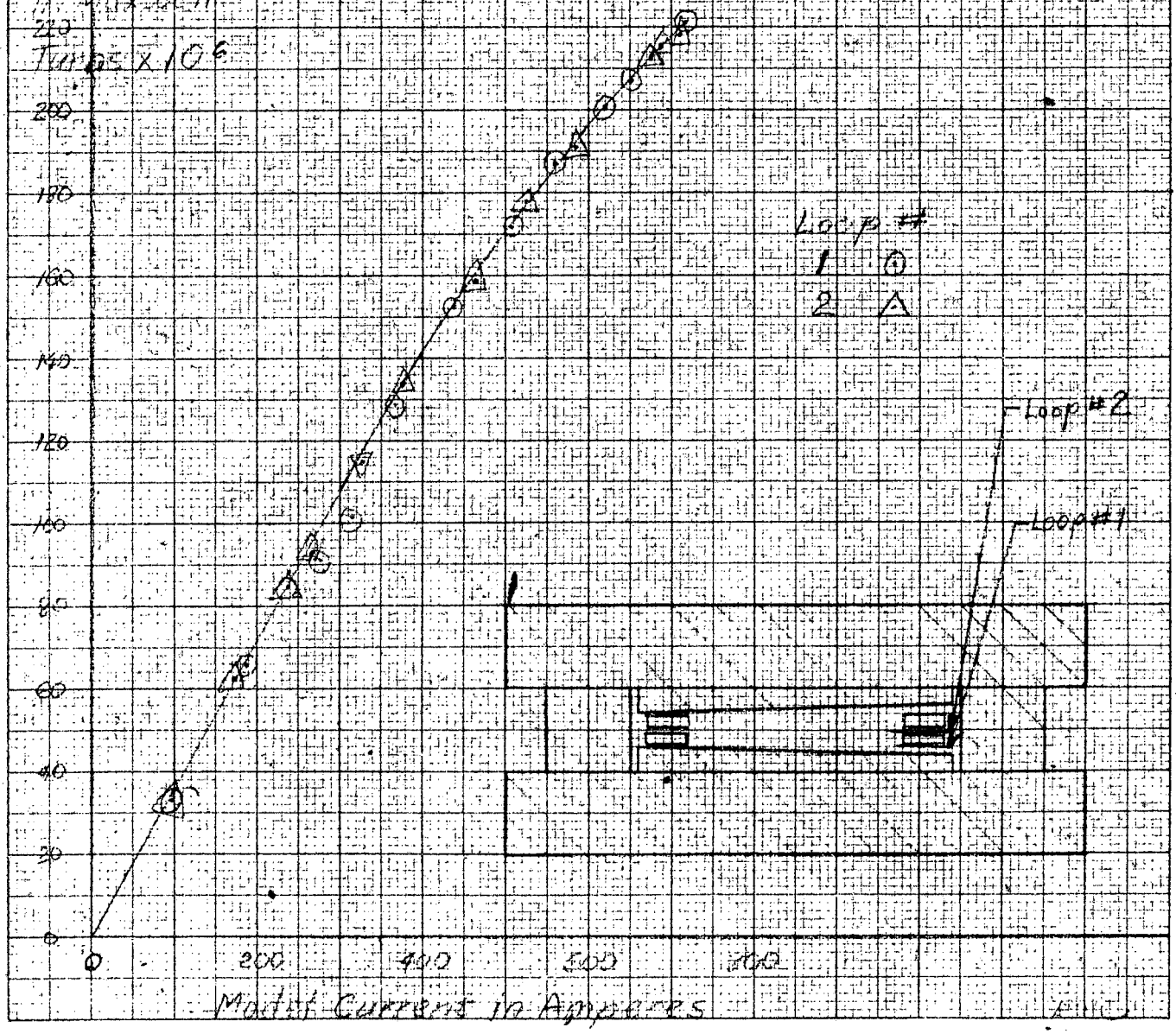
Flux Linkage on 5th Section of Model

Model Coils: 2 Coils 46 Turns Each

92 Turns Total

Each Loop has 46 Turns

171-8
F-205-1
5-6-48



KEUFFEL & ESSER CO., N. Y. NO. 359-11G
10 × 10 to the ½ Inch, 5th Lines accented
Engraving 7 × 10 in.
MADE IN U.S.A.

May 10, 1948

Berator Model Magnet DC5 171-8

Total Coil Flux Linkage F-DC5-1a

1/8 Scale DWG 3L1402 5-10-48

Gap 1/4" at Center (Full Scale)

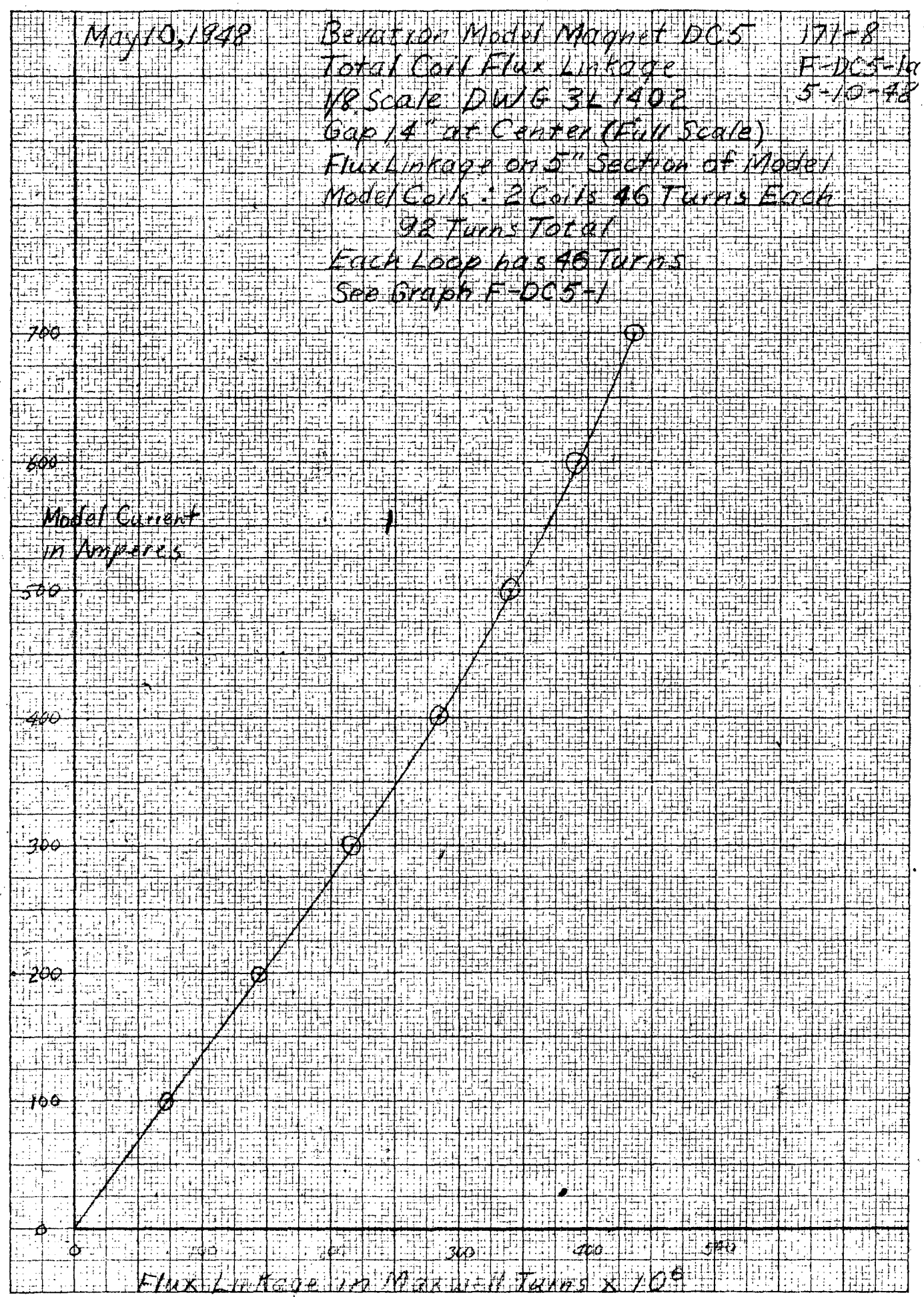
Flux Linkage on 5" Section of Model

Model Coils: 2 Coils 46 Turns Each

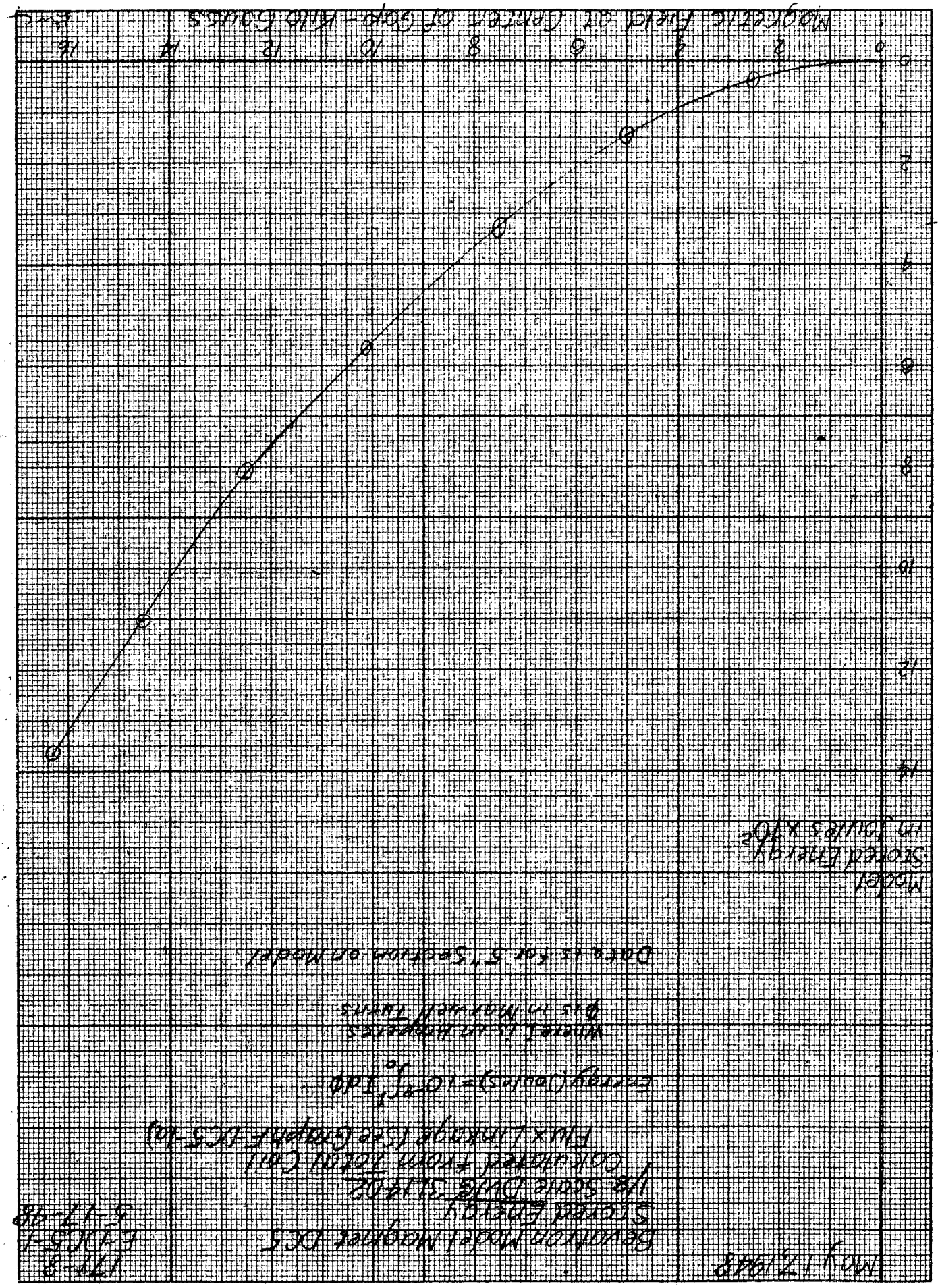
92 Turns Total

Each Loop has 46 Turns

See Graph F-DC5-1



KEUFFEL & ESSER CO., N. Y., NO. 359-11G
10 × 10 to the ½ inch, 5th lines accented.
Engraving 7 × 10 in.
MADE IN U.S.A.



NO. 340 - M DIETZGEN GRAPH PAPER
MILLIMETER

EUGENE DIETZGEN CO.
PRINTED IN U.S.A.

8 Model Magnet DC5A Index

a. Discussion

b. Sketch

c. Photographs

BEVA 20

d. Graphs

L-DC5A-1	Efficiency and leakage coefficients
H-DC5A-1	Flux density around the magnetic path
U-DC5A-1	Radial uniformity
U-DC5A-1a	Radial uniformity - Expended
F-DC5A-1	Coil flux linkage
F-DC5A-1a	Total coil flux linkage
E-DC5A-1	Stored energy

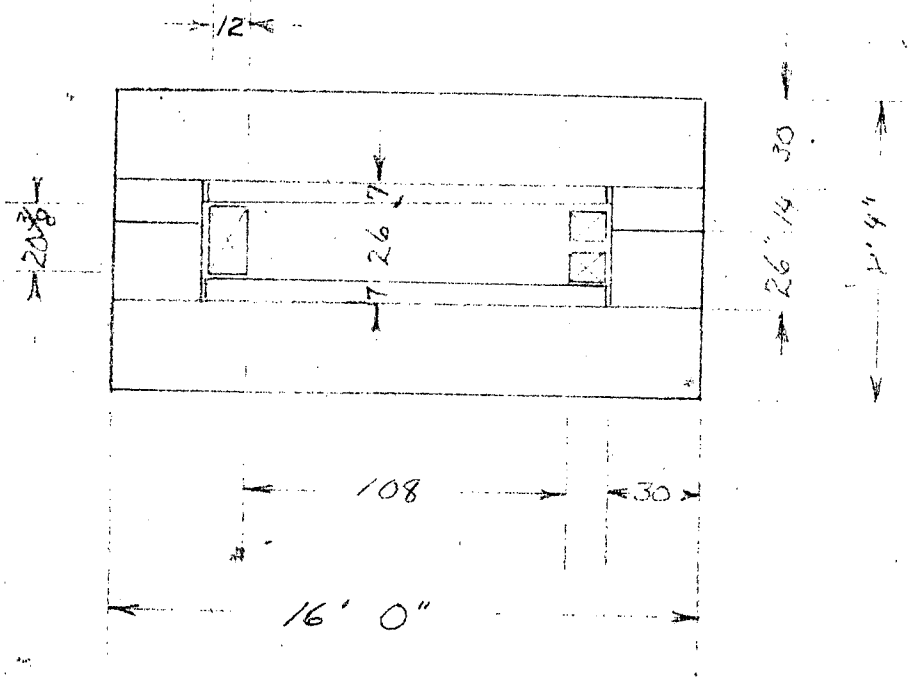
8 Model Magnet DC5A

a. Discussion

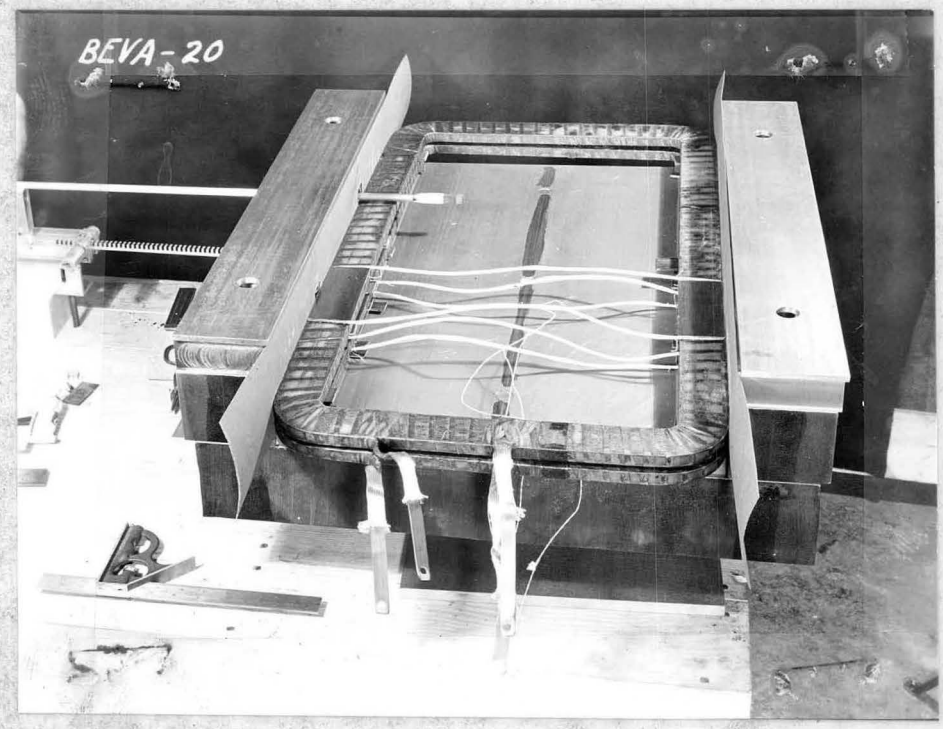
Bevatron model magnet DC5A was designed to adapt model magnet DC5 to a larger aperture. The radial width between the inner edges of the coils was increased from 54 inches to 108 inches. The gap was increased from 14 inches to 26 inches. Extensions were added to the leg slabs to increase the distance between the yoke slabs, and the legs were moved out to increase the distance between leg slabs.

The n value in the model magnet design was changed from 0.40 on DC3A to 0.75 on DC5A. The exciting coil placement was changed in an effort to increase the useful gap width. These changes increased the useful width of the magnetic field at the injection field and at the higher fields from 73 inches to 94 inches. A decision was made at this time to design a model magnet with an even larger aperture, 4' x 14', as an initial stage in the development of the bevatron. This magnet was to be designed so that it could be converted to the 1' x 4' aperture at a later time. (See model DC6 and DC6A)

BEVATRON MODEL MAGNET DC5A



GAP 26"
RADIUS 50'
$n = 0.75$
MODEL COILS: 4 COILS 26 TURNS EACH = 104 TURNS
DIMENSIONS ARE FULL SCALE
MODEL IS 1/8 SCALE
ASSEMBLY DWG. 3L 1402



BEVA 20

Bevatron Model Magnet DC5A

BEATRON MODEL MAGNET DC5A X-DC5A-1

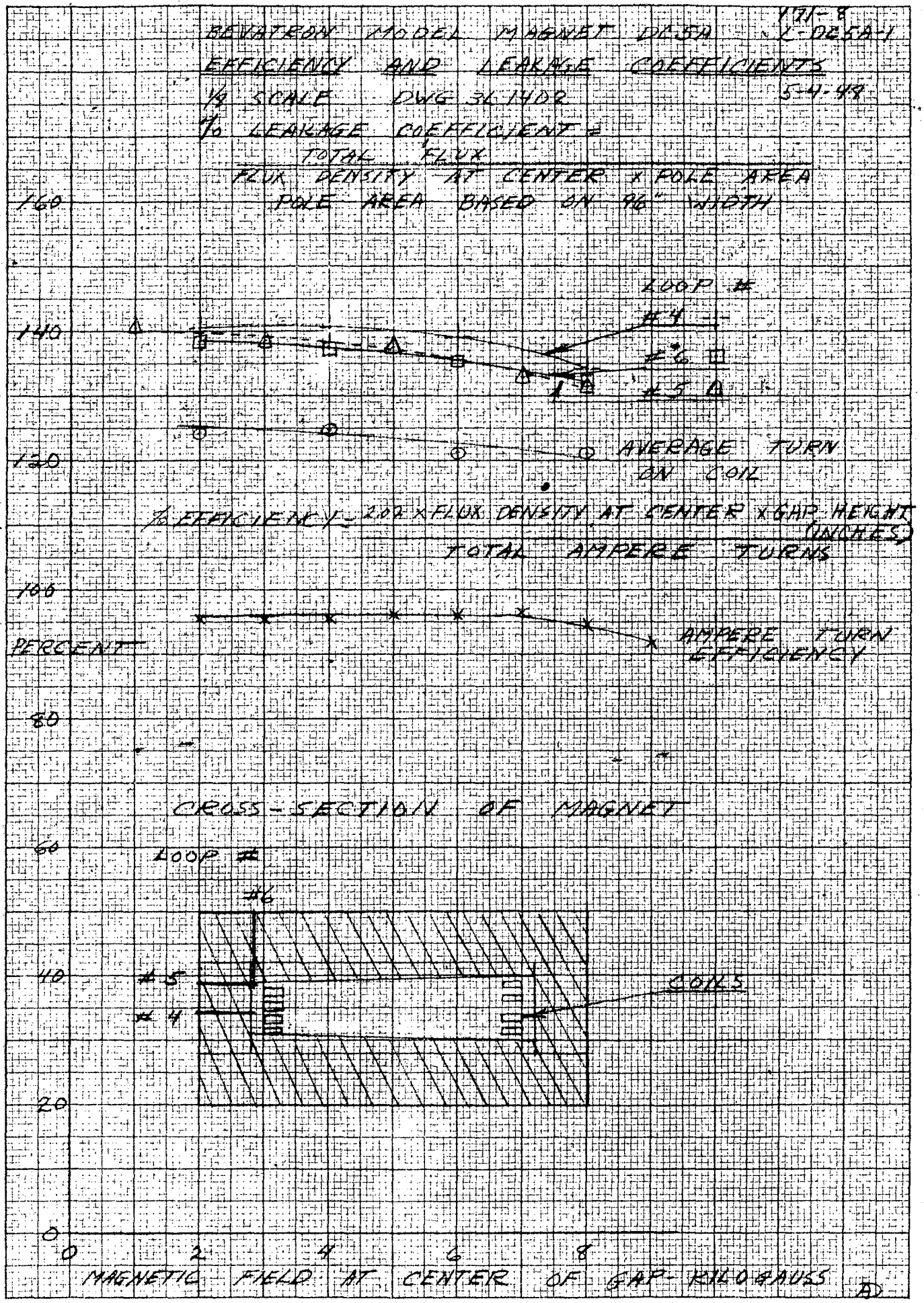
EFFICIENCY AND LEAKAGE COEFFICIENTS

5-4-48

½ SCALE DWG 3K 1402

% LEAKAGE COEFFICIENT =

$$\frac{\text{TOTAL FLUX}}{\text{FLUX DENSITY AT CENTER} \times \text{POLE AREA BASED ON 96" WIDTH}}$$



KEUFFEL & ESSER CO., N. Y. NO. 359-11G
10 × 10 to the ½ inch, 5th lines accented.
Engraving 7 × 10 in.
MADE IN U.S.A.

171-8
H-DC5A-1
4-29-48

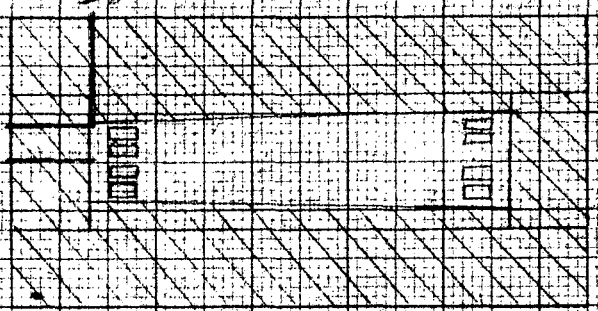
BEVATRON MODEL MAGNET DC 5"A

FLUX DENSITY AROUND MAGNETIC PATH

1/8 SCALE DWG. SL 1402

GAP 26" (FULL SCALE) AT CENTER

104 TURNS TOTAL - ONE MODEL COIL



FLUX DENSITY IN K.G. GAUSS

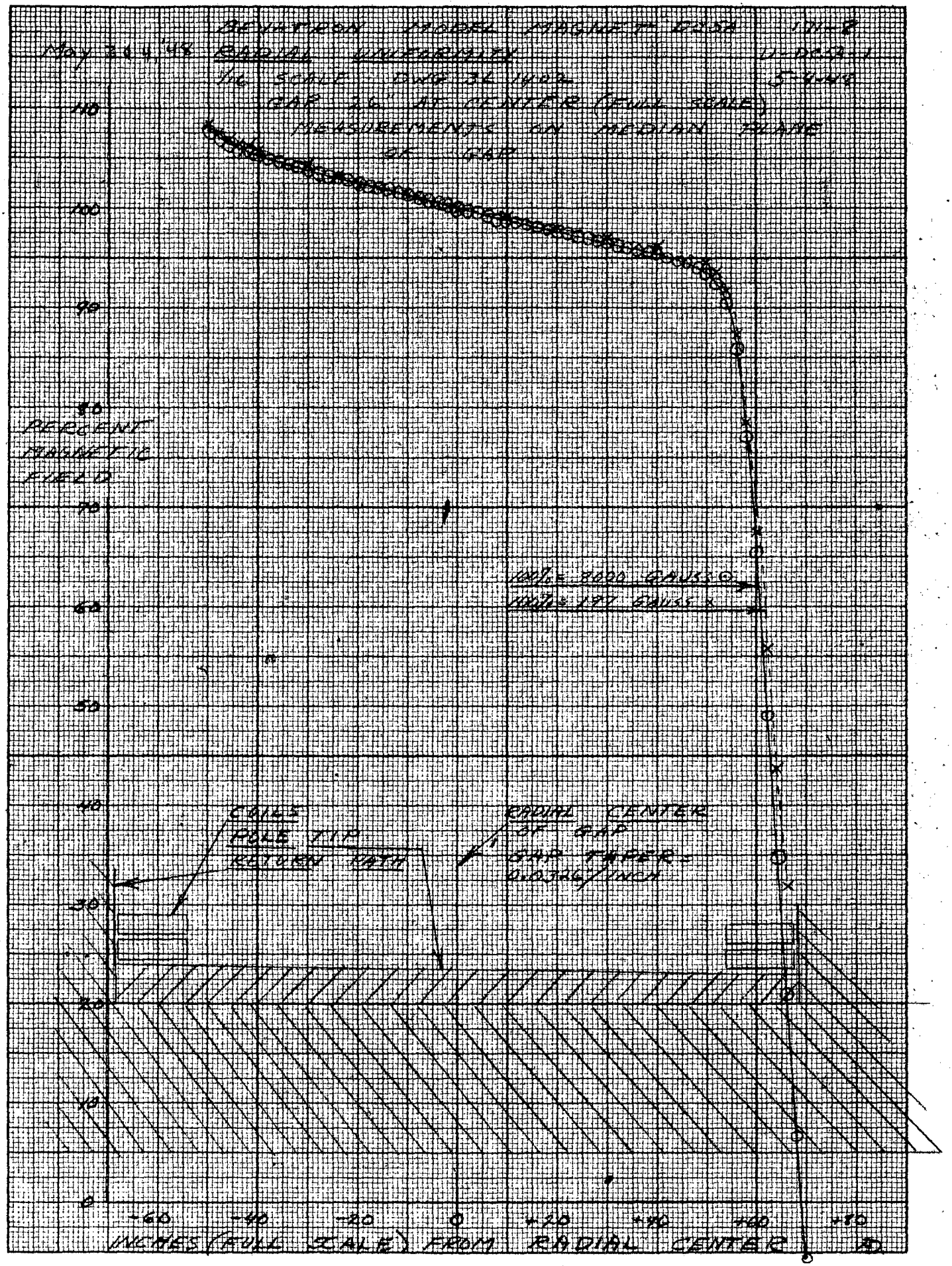
100% EFFICIENCY

H IN GAP

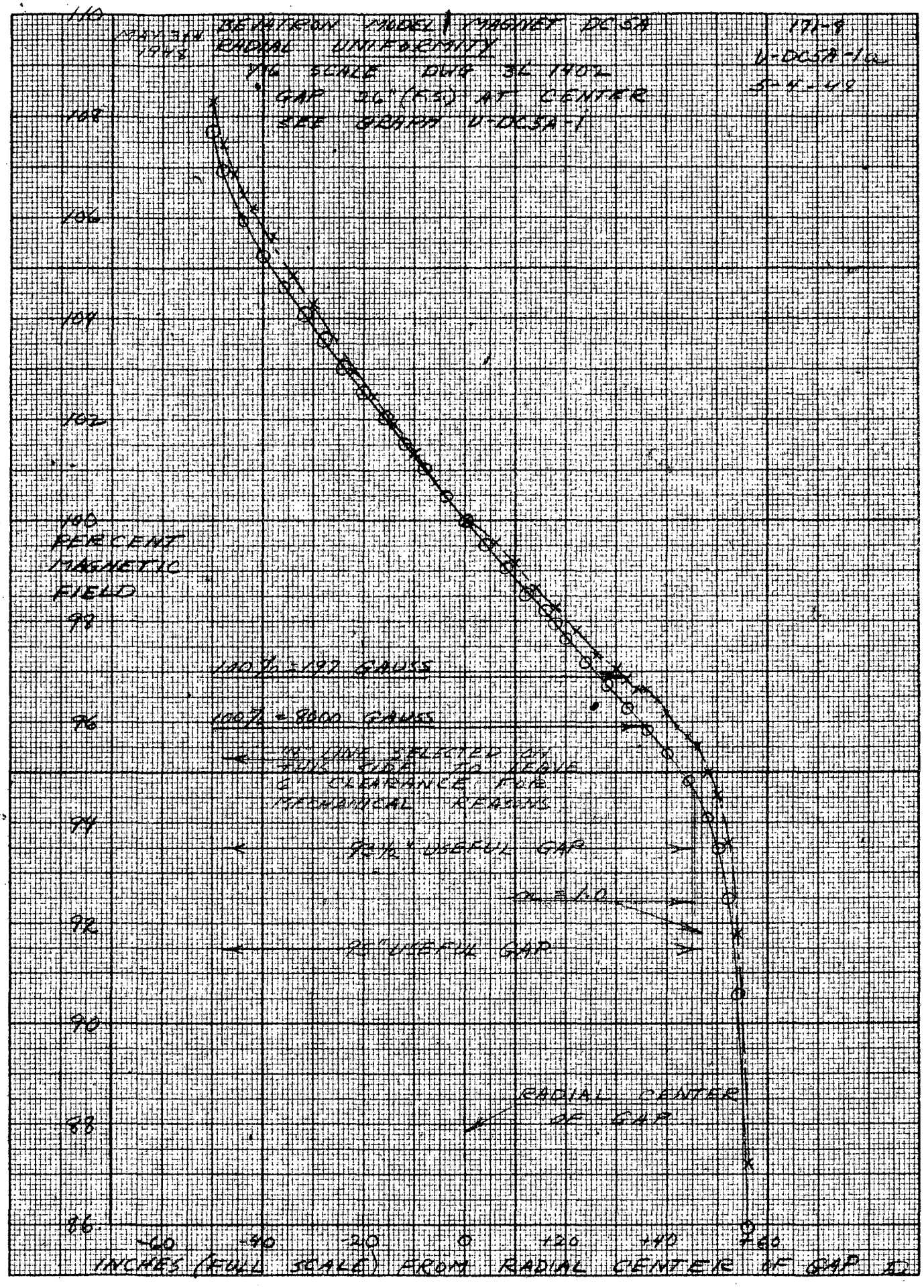
AMPERE TURNS × 10^4 (FULL SCALE)

MODEL CURRENT IN AMPERES

KEUFFEL & ESSER CO., N. Y. NO. 359-143
10 X 10 to the ½ Inch. 5th lines accented.
MADE IN U. S. A.



EUGENE DIETZGEN CO.
PRINTED IN U.S.A.
NO. 340 - M DIETZGEN GRAPH PAPER
MILLIMETER



EUGENE DIETZGEN CO.
PRINTED IN U.S.A.
NO. 340 - M DIETZGEN GRAPH PAPER
MILLIMETER

Apr 29, 1948

Betatron Model Magnet DC5A

Coil Flux Linkage

1/8 Scale DWG # 3L1402

171-B

F-DC5A-1

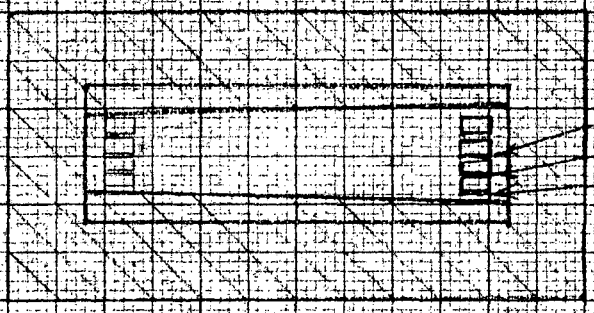
Gap 26" at Center (Full Scale) 4-29-48

Flux Linkage on 5" Sector of Model

Model Coils: 4 Coils 26 Turns Each

104 Turns Total

Each Loop Has 26 Turns



Flux Linkage in Maxwells

Turns x 10^6

110
100
90
80
70
60
50
40
30
20
10
0

Loop #
1
2
3

0
100
200
300
400
500
600

Model Current in Amperes

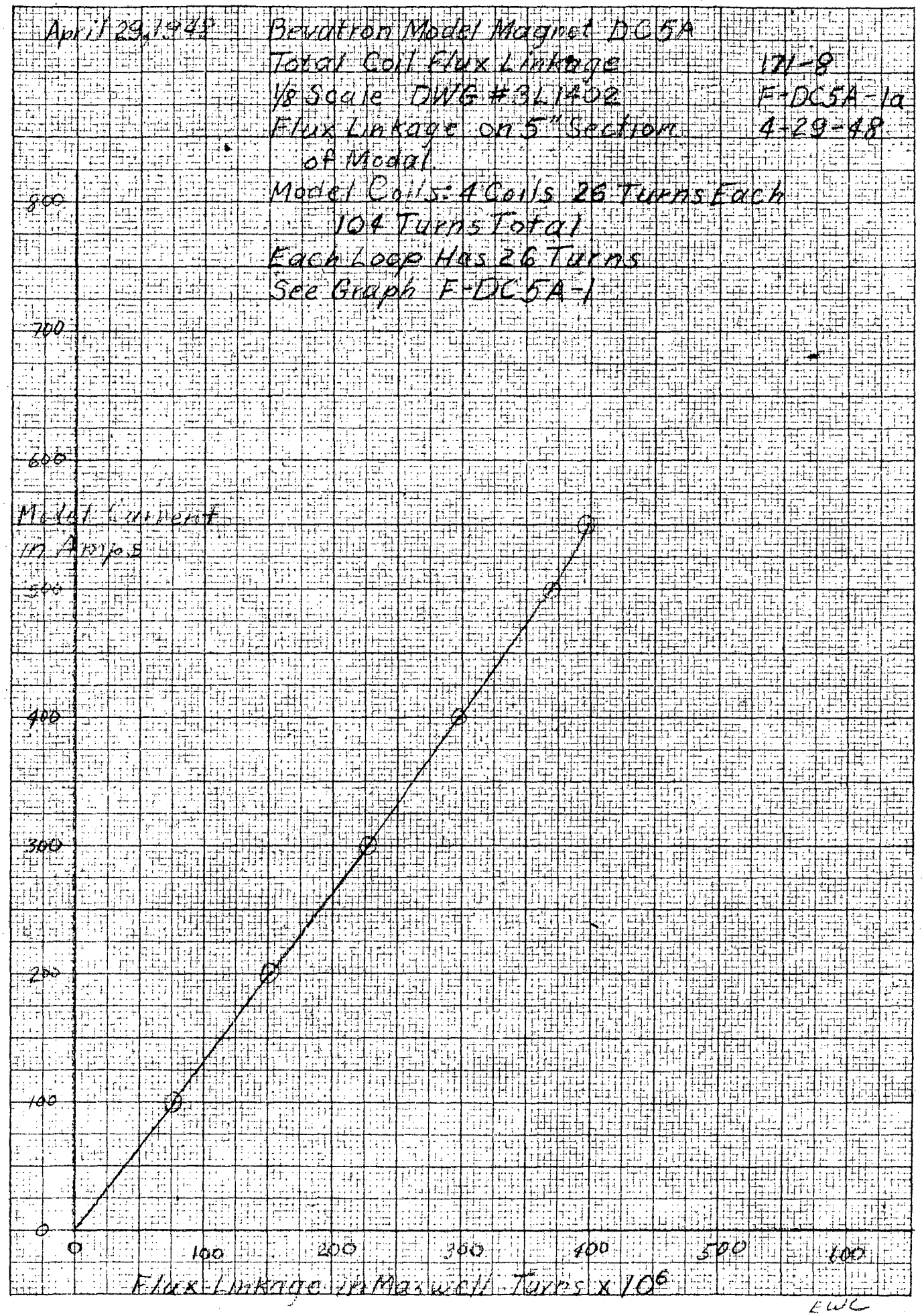
KEUFFEL & ESSER CO., N. Y. NO. 359-11G
10 × 10 to the ½ Inch, 5th lines accented.
Engraving 7 × 10 in.
MADE IN U.S.A.

April 29, 1948

Bevatron Model Magnet DC5A
Total Coil Flux Linkage
1/8 Scale DWG #31.1402
Flux Linkage on 5" Section of Model

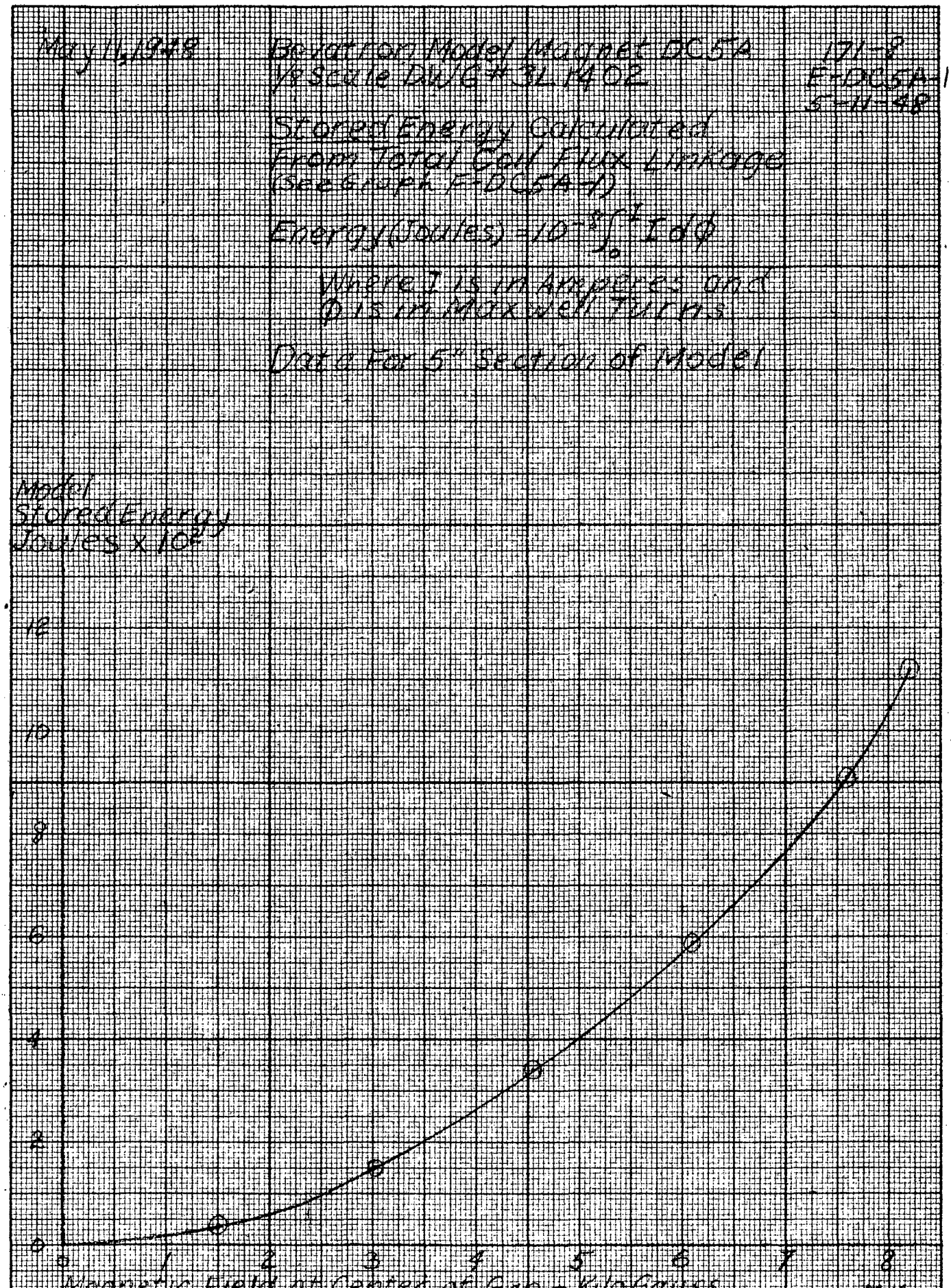
171-8
F-DC5A-1a
4-29-48

Model Coils: 4 Coils 26 Turns Each
104 Turns Total
Each Loop Has 26 Turns
See Graph F-DC-5A-1



KEUFFEL & ESSER CO., N. Y. NO. 359-11G
10 × 10 to the ½ Inch, 5th lines accented.
Eccentric 7 × 10 In.
MADE IN U.S.A.

EWC



EUGENE DIETZGEN CO.
PRINTED IN U.S.A.
NO. 340 - M DIETZGEN GRAPH PAPER
MILLIMETER

9 Model Magnets DC6 and DC6A series Index

a. Discussion

b. Sketches

c. Photographs

BEVA 34

BEVA 35

BEVA 36

BEVA 37

d. Graphs

1) Model Magnets DC6 series

a) Model magnet DC6

H-DC6-1	Magnetization at center
H-DC6-2	Flux density around the magnetic path
H-DC6-3	Flux density around the magnetic path
H-DC6-4	Sketch showing location of flux loops
H-DC6-5	Flux density around the magnetic path
H-DC6-6	Magnetization at center - Low field
F-DC6-1	Coil flux linkage
F-DC6-1a	Total coil flux linkage
F-DC6-2	Coil flux linkage - Low field
E-DC6-1	Stored energy

b) Model magnet DC6.1

L-DC6.1-1	Efficiency and leakage coefficients
H-DC6.1-1 (cor)	Magnetization at gap center
H-DC6.1-2	Flux density around the magnetic path
H-DC6.1-3	Flux density around the magnetic path
H-DC6.1-4	Flux density around the magnetic path
H-DC6.1-5	Sketch showing location of the flux loops
F-DC6.1-1	Coil flux linkage

F-DC6.1-1a Total coil flux linkage

F-DC6.1-2 Coil flux linkage - Low field

E-DC6.1-1 (cor)Stored energy

c) Model magnet DC6.2

H-DC6.2-1 Magnetization at gap center

H-DC6.2-2 Flux density around the magnetic path

H-DC6.2-3 Flux density around the magnetic path

H-DC6.2-4 Flux density around the magnetic path

H-DC6.2-5 Sketch showing location of the flux loops

d) Model magnet DC6.3

H-DC6.3-1 Magnetization at gap center

H-DC6.3-2 Flux density around the magnetic path

H-DC6.3-3 Flux density around the magnetic path

H-DC6.3-4 Flux density around the magnetic path

H-DC6.3-5 Sketch showing the location of the flux loops

e) Model magnet DC6.4

H-DC6.4-1 Magnetization at gap center

H-DC6.4-2 Flux density around the magnetic path

H-DC6.4-3 Flux density around the magnetic path

H-DC6.4-4 Flux density around the magnetic path

H-DC6.4-5 Sketch showing the location of the flux loops

f) Model magnet DC6.5

H-DC6.5-1 Magnetization at gap center

F-DC6.5-1 Coil loop flux linkage

F-DC6.5-1a Total coil loop flux linkage

E-DC6.5-1 Stored energy

g) Model magnet DC6.6

H-DC6.6-1 Magnetization at gap center

H-DC6.6-2 Flux density around the magnetic path

H-DC6.6-3 Flux density around the magnetic path

H-DC6.6-4	Flux density around the magnetic path
H-DC6.6-5	Sketch showing location of the flux loops
H-DC6.6-6	Magnetization at gap center - Low field
U-DC6.6-1	Radial uniformity
U-DC6.6-1a	Radial uniformity - Expanded.

h) Model magnet DC6.7

H-DC6.7-1	Magnetization at gap center

i) Model magnet DC6.8

H-DC6.8-1	Magnetization at gap center

j) Model magnet DC6.9

H-DC6.9-1	Magnetization at gap center

2) Model magnet DC6A series

a) Model magnet DC6A

L-DC6A-1	Efficiency and leakage coefficients
H-DC6A-1	Flux density around the magnetic path
H-DC6A-2	Flux density around the magnetic path
H-DC6A-3	Flux density around the magnetic path
H-DC6A-4	Sketch showing location of flux loops
H-DC6A-5	Magnetization at gap center - Low field
F-DC6A-1	Coil flux linkage
F-DC6A-1a	Total coil flux linkage
E-DC6A-1 (cor)	Stored energy

b) Model magnet DC6A.1

H-DC6A.1-1	Magnetization at gap center
U-DC6A.1-1	Radial uniformity
U-DC6A.1-1a	Radial uniformity - Expanded
F-DC6A.1-1	Coil flux linkage
F-DC6A.1-1a	Total coil flux linkage
E-DC6A.1-1	Stored energy

c) Model magnet DC6A.2

H-DC6A.2-1	Magnetization at gap center
H-DC6A.2-2	Flux density around the magnetic path
H-DC6A.2-3	Flux density around the magnetic path
H-DC6A.2-4	Flux density around the magnetic path
H-DC6A.2-5	Sketch showing location of flux loops
H-DC6A.2-6	Magnetization at gap center - Low field

U-DC6A.2-1 Radial uniformity

U-DC6A.2-1a Radial uniformity - Expanded

d) Magnet magnet DC6A.3

H-DC6A.3-1 Magnetization at gap center

H-DC6A.3-2 Magnetization at gap center - Low field

H-DC6A.3-3 Flux density around the magnetic path

H-DC6A.3-4 Flux density around the magnetic path

H-DC6A.3-5 Flux density around the magnetic path

H-DC6A.3-6 Sketch showing the location of flux loops

U-DC6A.3-1 Radial uniformity

U-DC6A.3-1a Radial uniformity - Expanded

F-DC6A.3-1 Coil loop flux linkage

F-DC6A.3-1a Total coil loop flux linkage

E-DC6A.3-1 Stored energy

S-DC6A.3-29 Flux density on yoke

S-DC6A.3-30 Flux density on yoke

S-DC6A.3-31 Sketch showing location of flux loops on yoke

S-DC6A.3-32 (cor) Flux density on coils

S-DC6A.3-33 Flux density on coils

S-DC6A.3-34 Flux density on coils

S-DC6A.3-35 Flux density on coils

S-DC6A.3-36 Flux density on coils

S-DC6A.3-41 Stray field - Azimuthal uniformity - 2100 gauss

S-DC6A.3-42 Stray field - Azimuthal uniformity - 5050 gauss

S-DC6A.3-43 Stray field - Azimuthal uniformity - 200 gauss

S-DC6A.3-44 Stray field - Radial uniformity - 200 gauss

S-DC6A.3-45 Stray field - Radial uniformity - 2100 gauss

S-DC6A.3-46 Stray field - Radial uniformity - 5050 gauss

S-DC6A.3-47 Leakage flux summary

e) Model Magnet DC6A.4

H-DC6A.4-1 Magnetization at gap center

H-DC6A.4-2 Magnetization at gap center - Low field

f) Model Magnet DC6A.5

H-DC6A.5-1 Magnetization at gap center

H-DC6A.5-2 Magnetization at gap center - Low field

g) Model Magnet DC6A.6

H-DC6A.6-1 Magnetization at gap center

H-DC6A.6-2 Magnetization at gap center - Low field

9 Model Magnets DC6 and DC6A Series

a. Discussion

Bevatron model magnets DC6 and DC6A were designed to incorporate the best features observed on the previous DC model magnets of both type A and type B. A decision was made at this time to enlarge the aperture from 2' x 8' to 4' x 14' for the initial stage. These were the first models designed to accomodate both a large (4' x 14') and a small (1' x 4') aperture without leg extensions. It was decided to use pole pieces similar to those used on model DC5A for the larger aperture (model DC6A), and similar to those used on model DC4 for the smaller aperture (model DC6). It was decided that at a later date the actual shape of the wings could be determined to give the maximum width field at the injection field (see model DC4B). The radius of the initial stage (4' x 14' aperture) was set at 552 inches instead of 600 inches as on the models DC3A and DC5A. The radius on the final stage (1' x 4' aperture) remained at 600 inches. These were the first models built in $2\frac{1}{2}^{\circ}$ sectors on the arc of a circle. This series was 1/12 scale.

(1) DC6 series

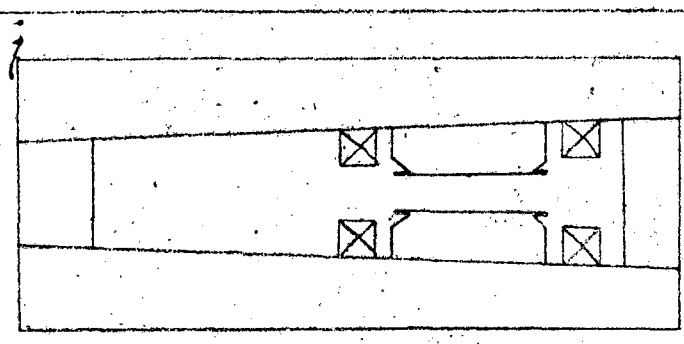
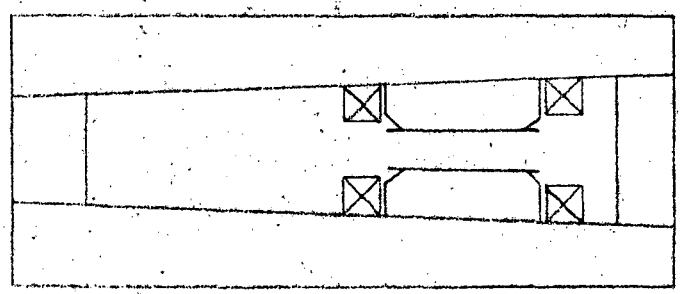
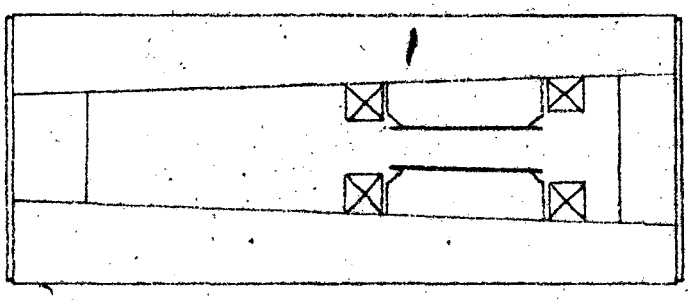
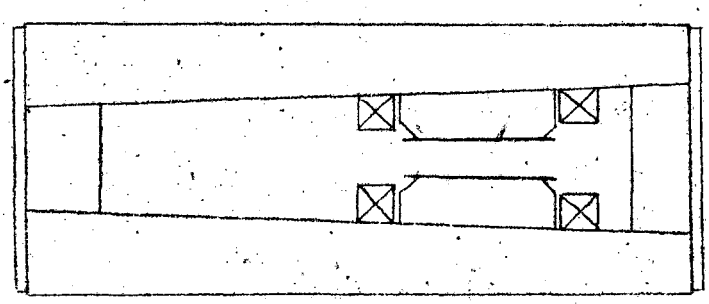
Bevatron model magnets DC6 through DC6.9 are the designs for the 1' x 4' aperture for this series. Small changes in the placement of the steel and the design of the coils were made on these models to obtain the maximum magnet efficiency for the minimum amount of steel and copper. (See sketches for the actual mechanical changes.) Model DC6.6 was chosen as the final design for this model.

(2) DC6A series

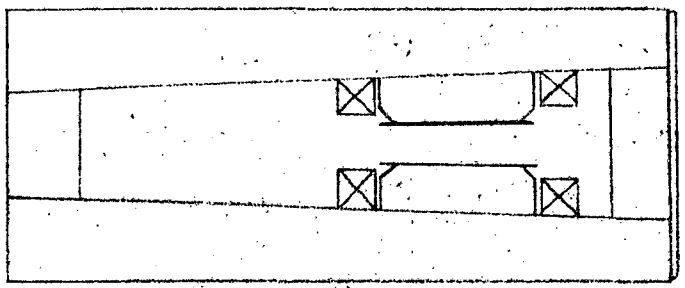
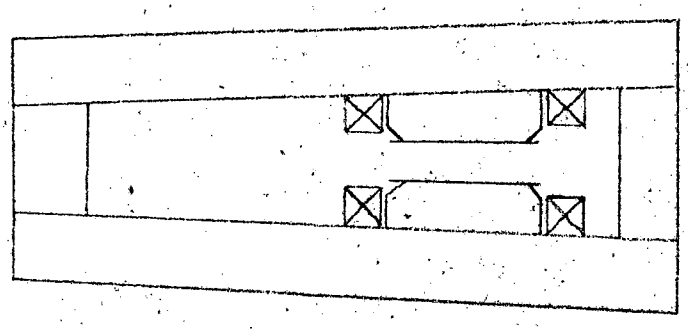
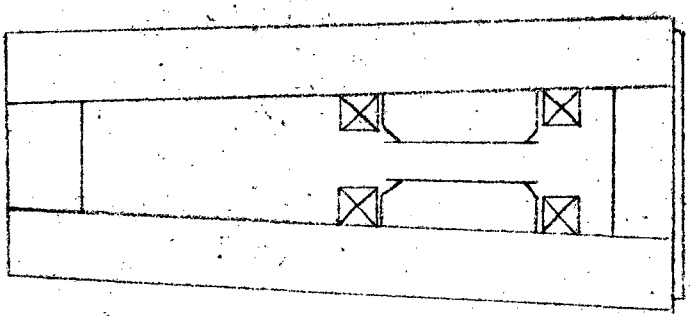
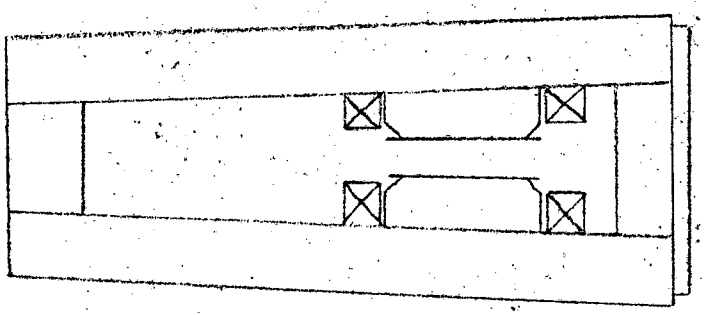
Bevatron model magnet DC6A was the original design of the larger aperture (4' x 14') in this series. On model DC6A.1, the end of the exciting coil was bent up closer to the edge of the yoke for mechanical reasons. On model magnet DC6A.2 the parallel sided yoke slabs used on

model DC6.5 were substituted for the original tapered yoke slabs. Model magnet DC6A.3 had three inches of steel added to the outer leg slabs to conform to model DC6.6. Various copper to copper spacings on the exciting coils were tested to observe the changes in magnet efficiency on models DC6A.4, DC6A.5, and DC6A.6. The vertical spacing of 19-7/8" on model DC6A.3 gave an efficiency of 83% as compared to 86% to 87.5% on models DC6A.4, DC6A.5, and DC6A.6 which had closer spacing. Model magnet DC6A.3 was chosen as the final design for this model.

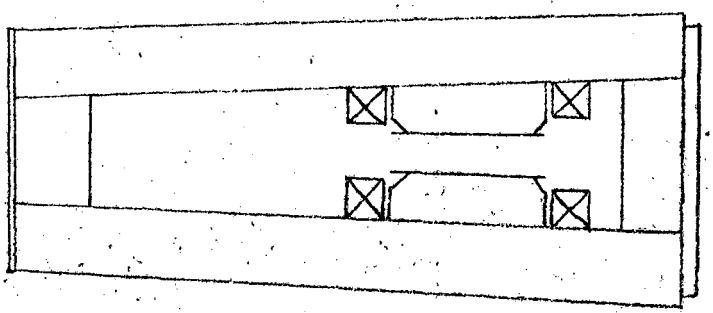
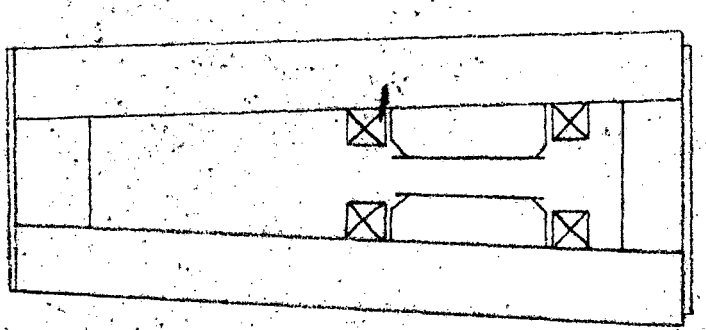
DC6 SERIES BEVATRON MAGNET

MODEL NUMBER	CROSS SECTION	REMARKS
DC6 —		AS SHOWN ON DWG 3L1635
DC6.1		SAME AS DC6 EXCEPT COILS ARE CLOSER TO POLES - COIL TO POLE CLEARANCE IS 1" (WAS 8")
DC6.2		SAME AS DC6.1 EXCEPT 3" (F.S.) STEEL PLATE ADDED TO EACH LEG SLAB
DC6.3		SAME AS DC6.1 EXCEPT 6" (F.S.) STEEL PLATE ADDED TO EACH LEG SLAB

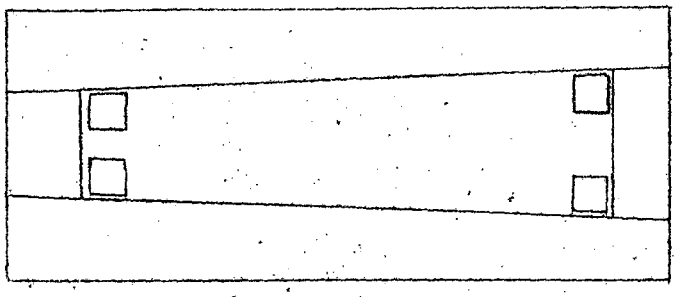
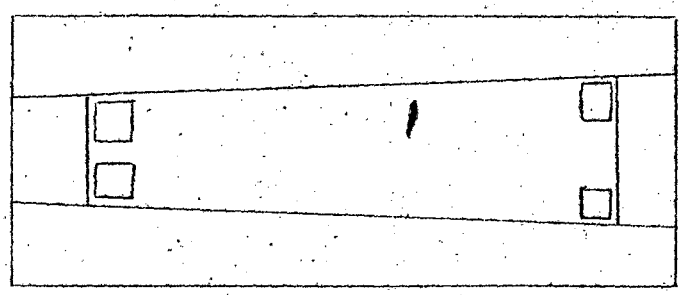
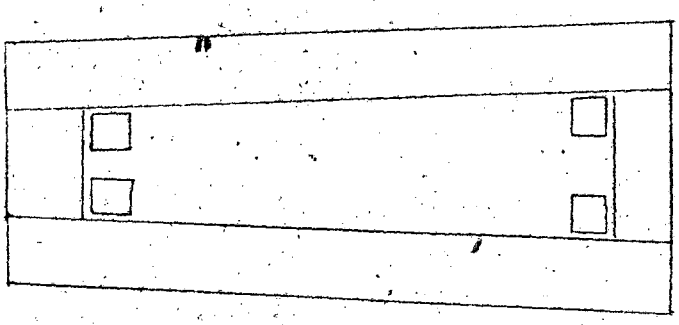
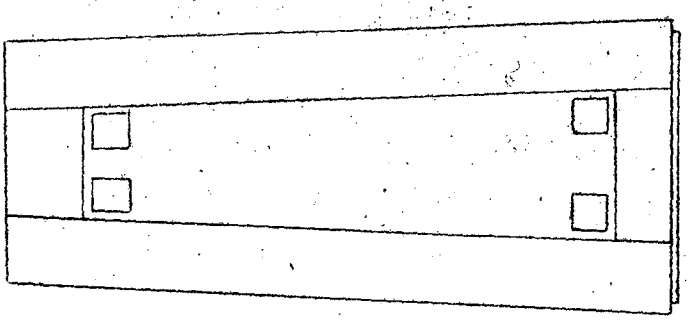
DC6 SERIES BEVATRON MAGNET

MODEL NUMBER	CROSS SECTION	REMARKS
DC6.4		SAME AS DC6.1 EXCEPT 3" (F.S.) STEEL PLATE ADDED TO OUTER LEG SLAB
DC6.5		SAME AS DC6.1 EXCEPT TOP & BOTTOM YOKE SLABS HAVE UNIFORM HEIGHT
DC6.6		SAME AS DC6.5 EXCEPT 3" (F.S.) STEEL PLATE ADDED TO OUTER LEG SLAB SEE FOLLOWING SKETCH FOR DIM. OF THIS MODEL
DC6.7		SAME AS DC6.5 EXCEPT 6" (F.S.) STEEL PLATE ADDED TO OUTER LEG SLAB.

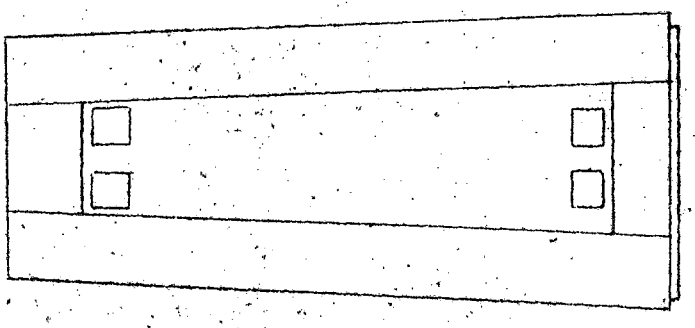
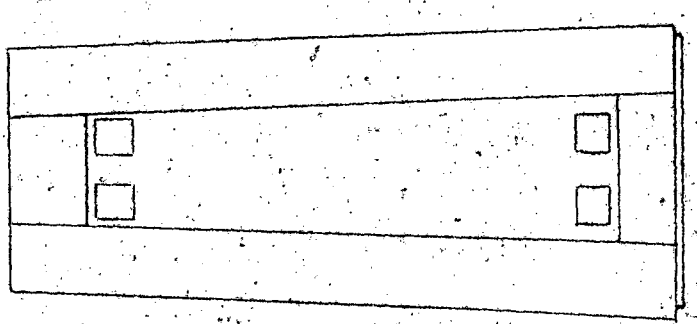
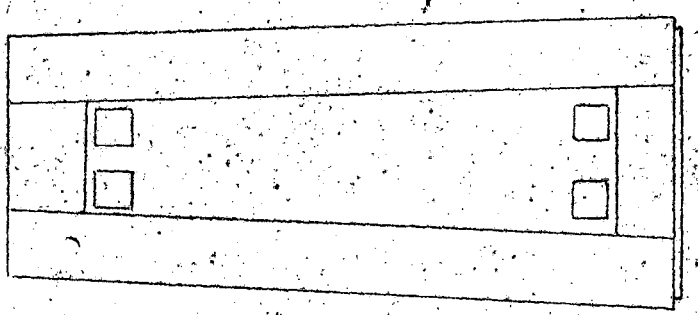
DC6 SERIES BEVATRON MAGNET

MODEL NUMBER	CROSS SECTION	REMARKS
DC6.8		SAME AS DC6.5 EXCEPT 6" (F.S.) STEEL PLATE ADDED TO OUTER LEG SLAB AND 3" (F.S.) STEEL PLATE ADDED
DC6.9		SAME AS DC6.5 EXCEPT 3" (F.S.) STEEL PLATE ADDED TO EACH LEG SLAB

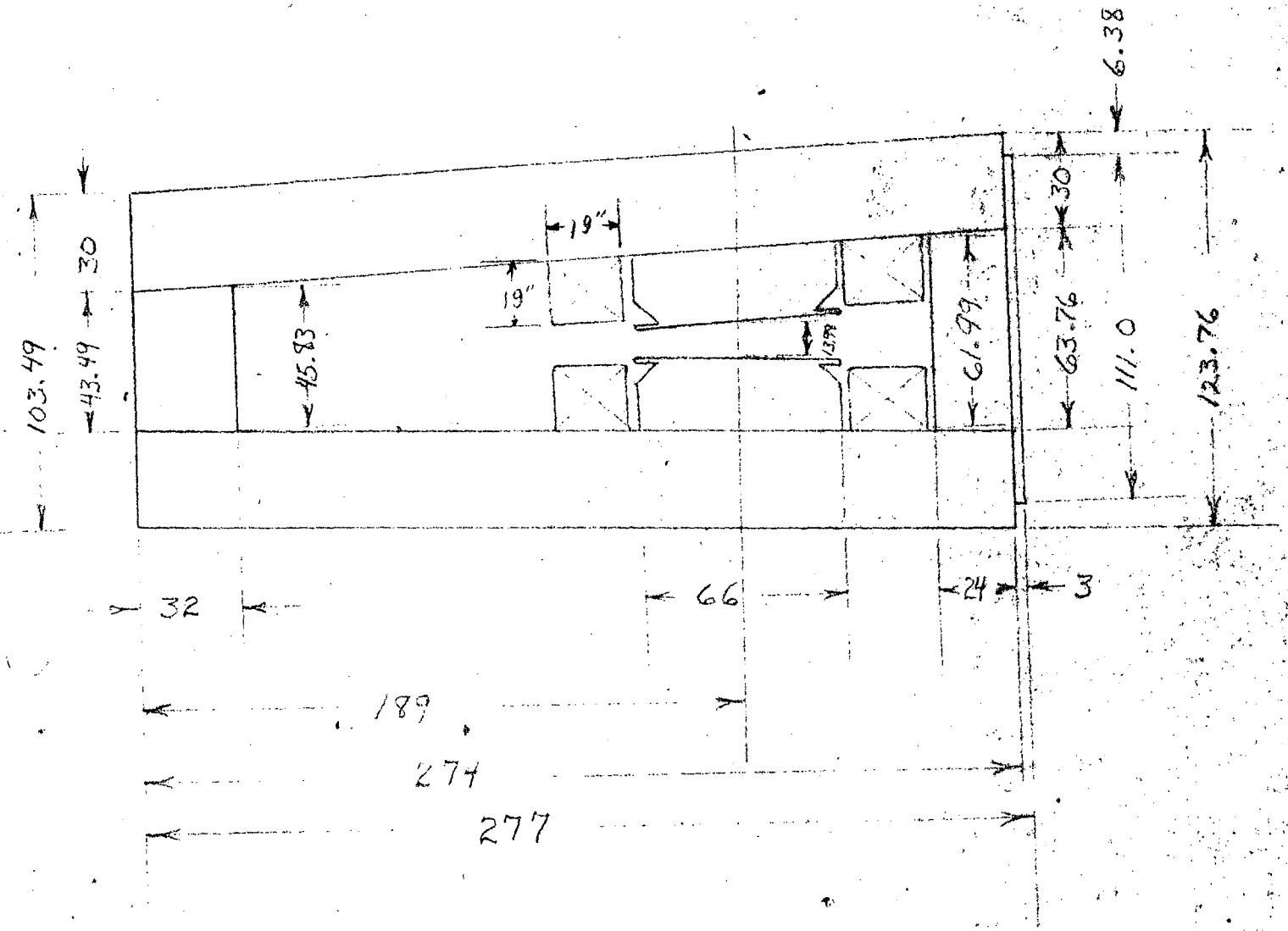
DC6A SERIES BEVATRON MAGNET

MODEL NUMBER	CROSS SECTION	REMARKS
DC6A		AS SHOWN ON DWG. 3L1635
DC6A.1		SAME AS DC6A EXCEPT COIL ENDS HAVE A LONGER BEND DWG. 3L1703C
DC6A.2		SAME AS DC6A.1 EXCEPT TOP & BOTTOM YOKE SLABS HAVE PARALLEL SIDES. DWG. 3L1962
DC6A.3		SAME AS DC6A.2 EXCEPT 3" STEEL PLATE ADDED TO OUTER LEG SLAB. OUTER SIDE OF EXCITING COIL SPACED 19 7/8" COPPER TO COPPER SEE FOLLOWING SKETCH FOR DIM. OF THIS MODEL

DC6A SERIES BEVATRON MAGNET

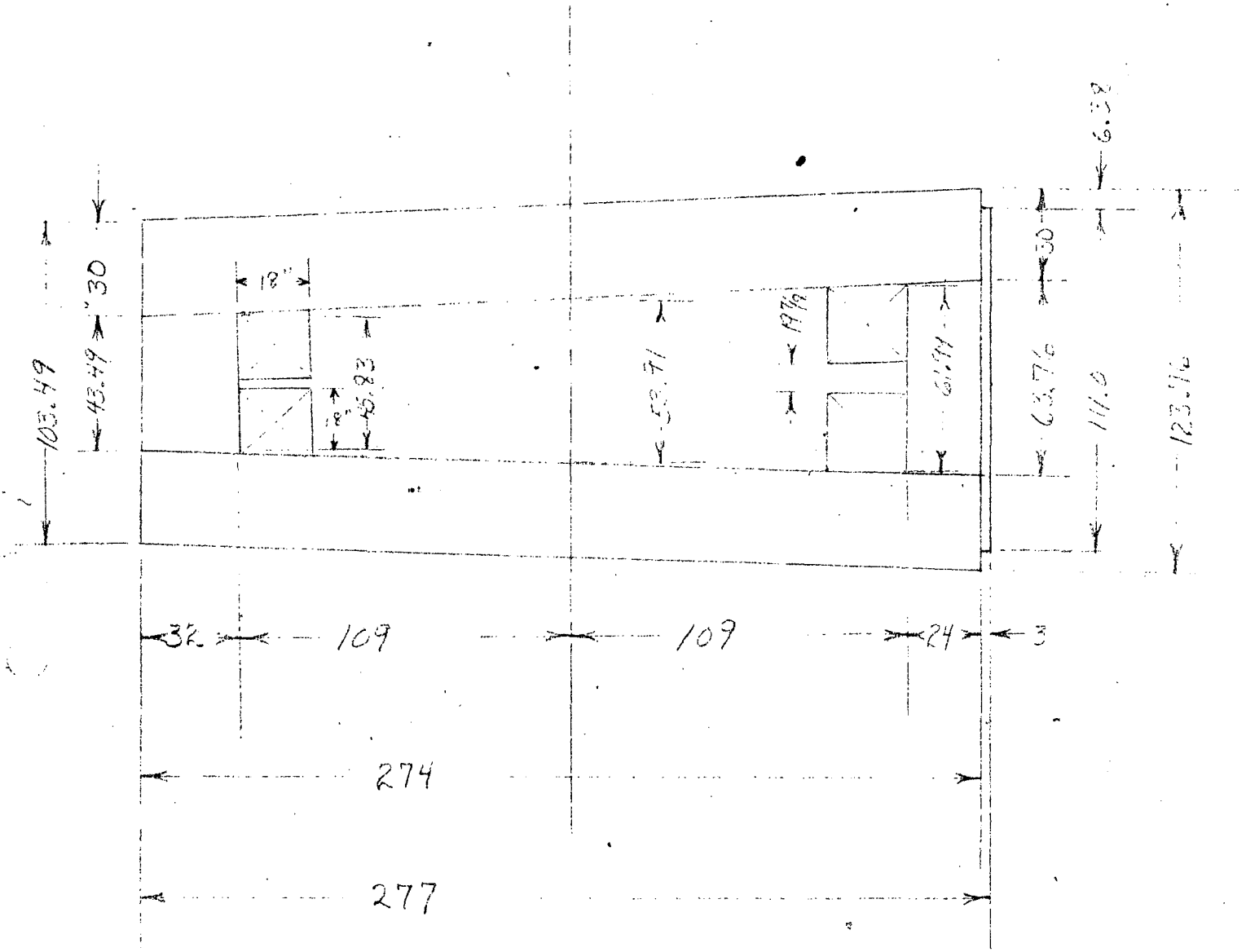
MODEL NUMBER	CROSS SECTION	REMARKS
DC6A.4		SAME AS DC6A.3 EXCEPT, OUTER SIDE OF EXCITING COIL SPACED 8 5/8" COPPER TO COPPER
DC6A.5		SAME AS DC6A.3 EXCEPT OUTER SIDE OF EXCITING COIL SPACED 13 7/8" COPPER TO COPPER
DC6A.6		SAME AS DC6A.3 EXCEPT OUTER SIDE OF EXCITING COIL SPACED 10 7/8" COPPER TO COPPER

BEVATRON MODEL MAGNET DC 6.6

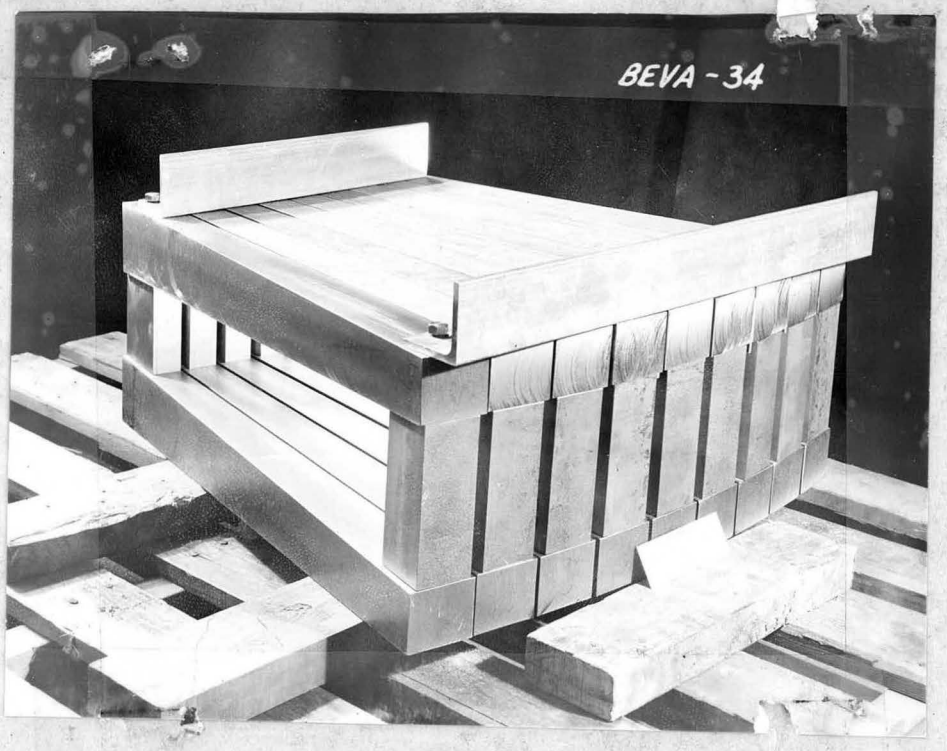


GAP 13.98"
RADIUS 608"
n = 0.77
MODEL COILS: 4 COILS 21 TURNS EACH = 84 TURNS
DIMENSIONS ARE FULL SCALE INCHES
MODEL IS 1/12 SCALE
ASSEMBLY DWG. 3L1635
COIL DWG. 3L1923
YOKE DWG. 3L1962
3" STEEL PLATE ADDED TO OUTER LEG SLAB

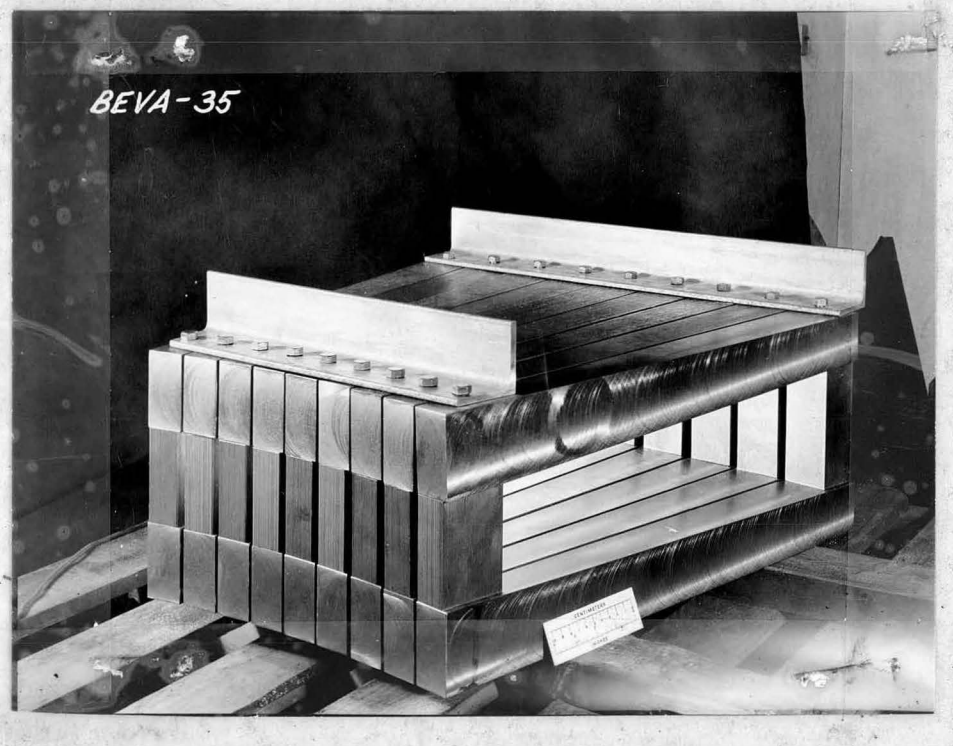
BEVATRON MODEL MAGNET DC 6A.3



GAP 53.91
RADIUS 552
$\frac{r}{R}$ = 0.76
MODEL COILS : 2 COILS 49 TURNS EACH = 98 TURNS
DIMENSIONS ARE FULL SCALE
MODEL IS ½ SCALE
ASSEMBLY DWG 3L 1635
COIL DWG. 3L 1703 C *
YOKE DWG 3L 1962
3" STEEL PLATE ADDED TO OUTER LEG SLAB
OUTER COIL SPACING 19⅞" COPPER TO COPPER

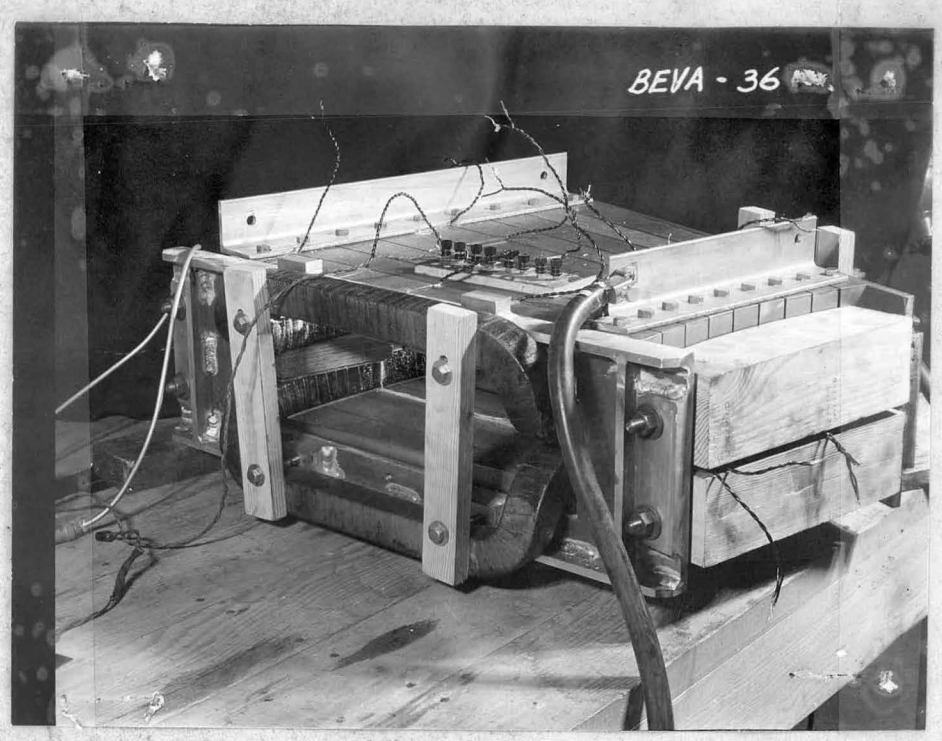


BEVA 34

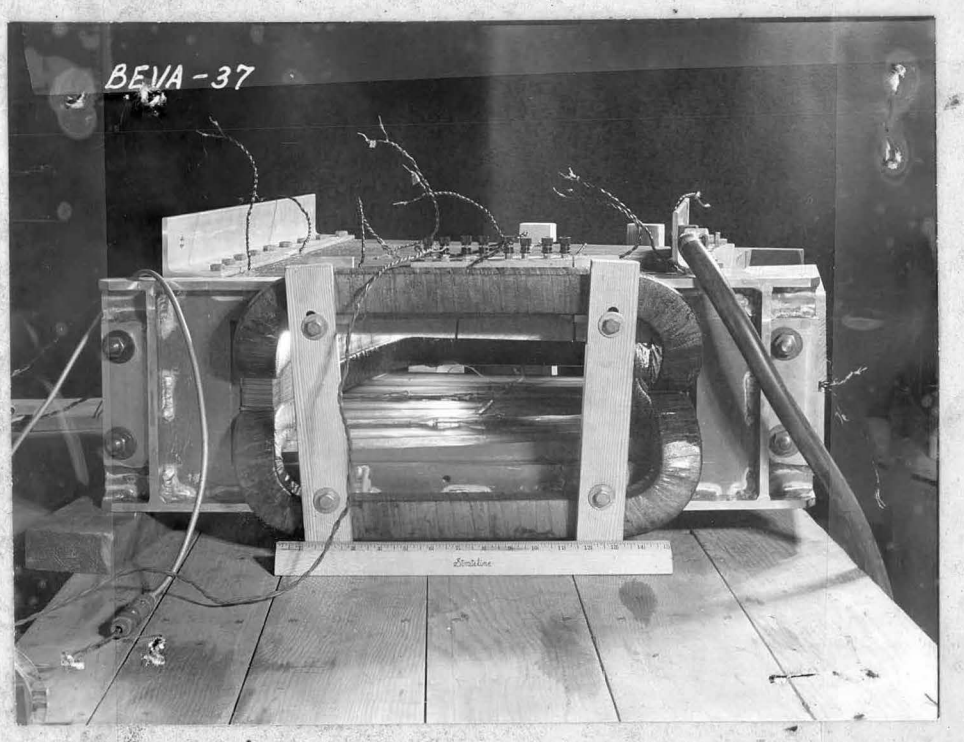


BEVA 35

Bevetron Model Magnet DC6A

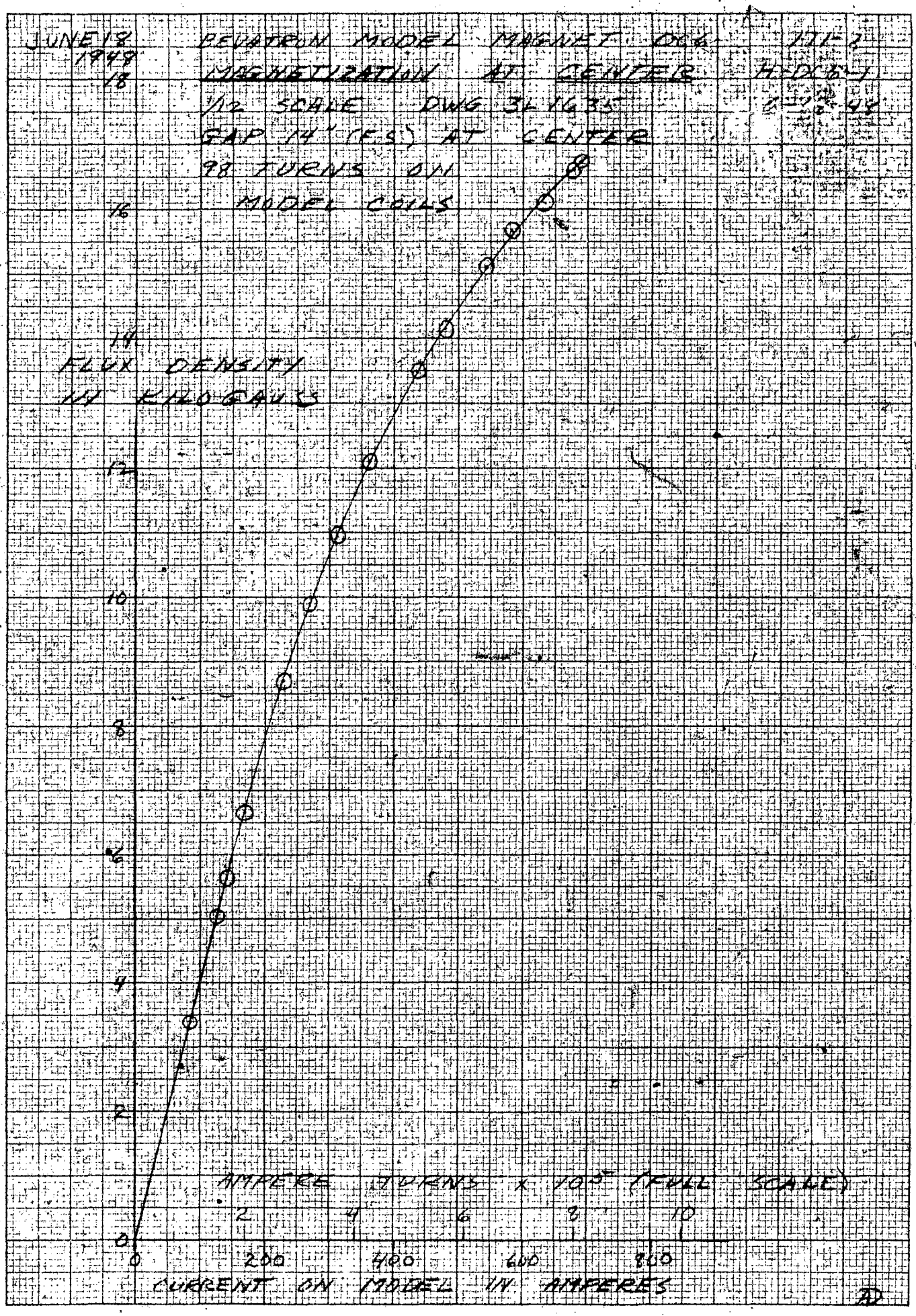


BEVA 36

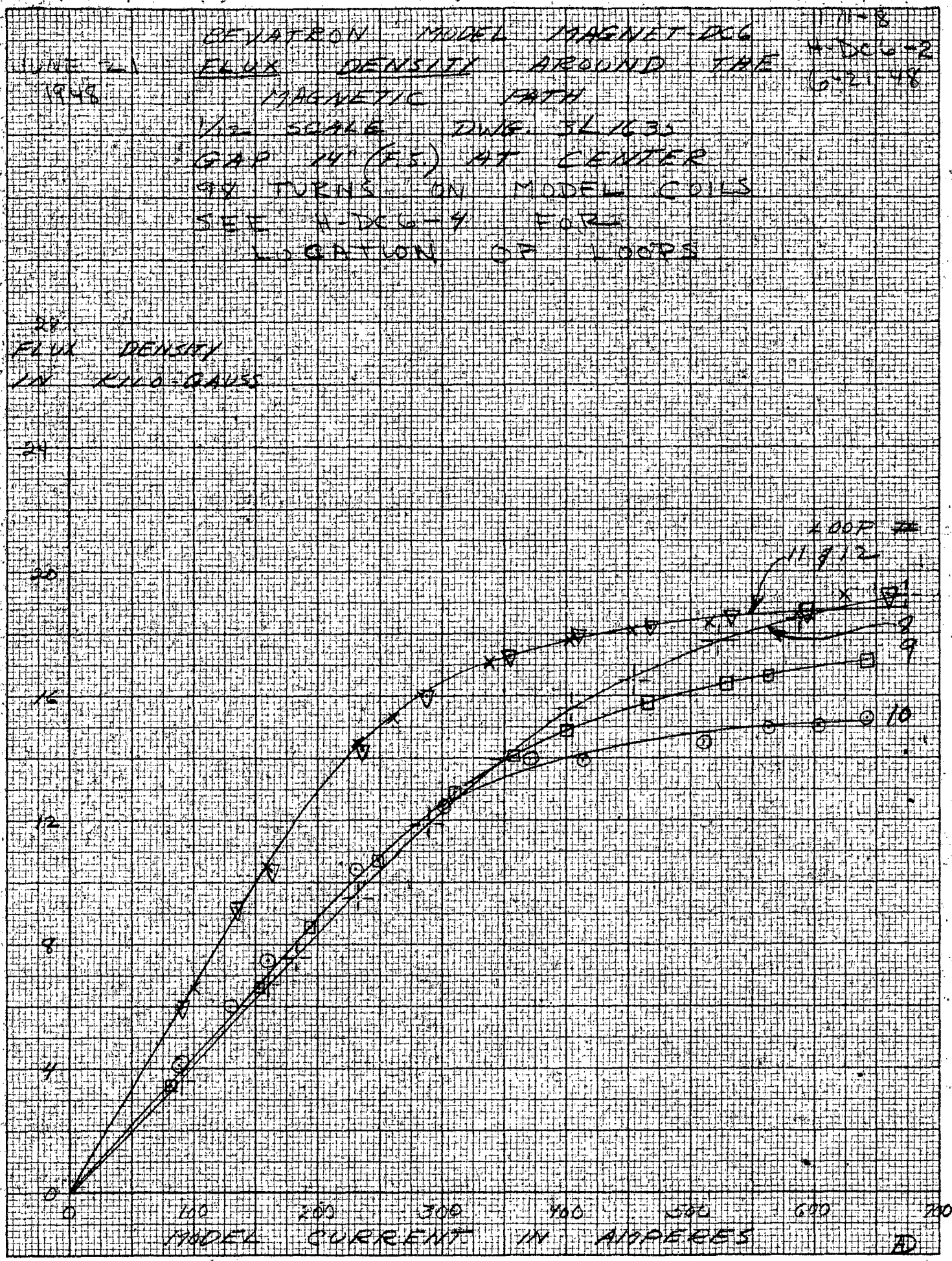


BEVA 37

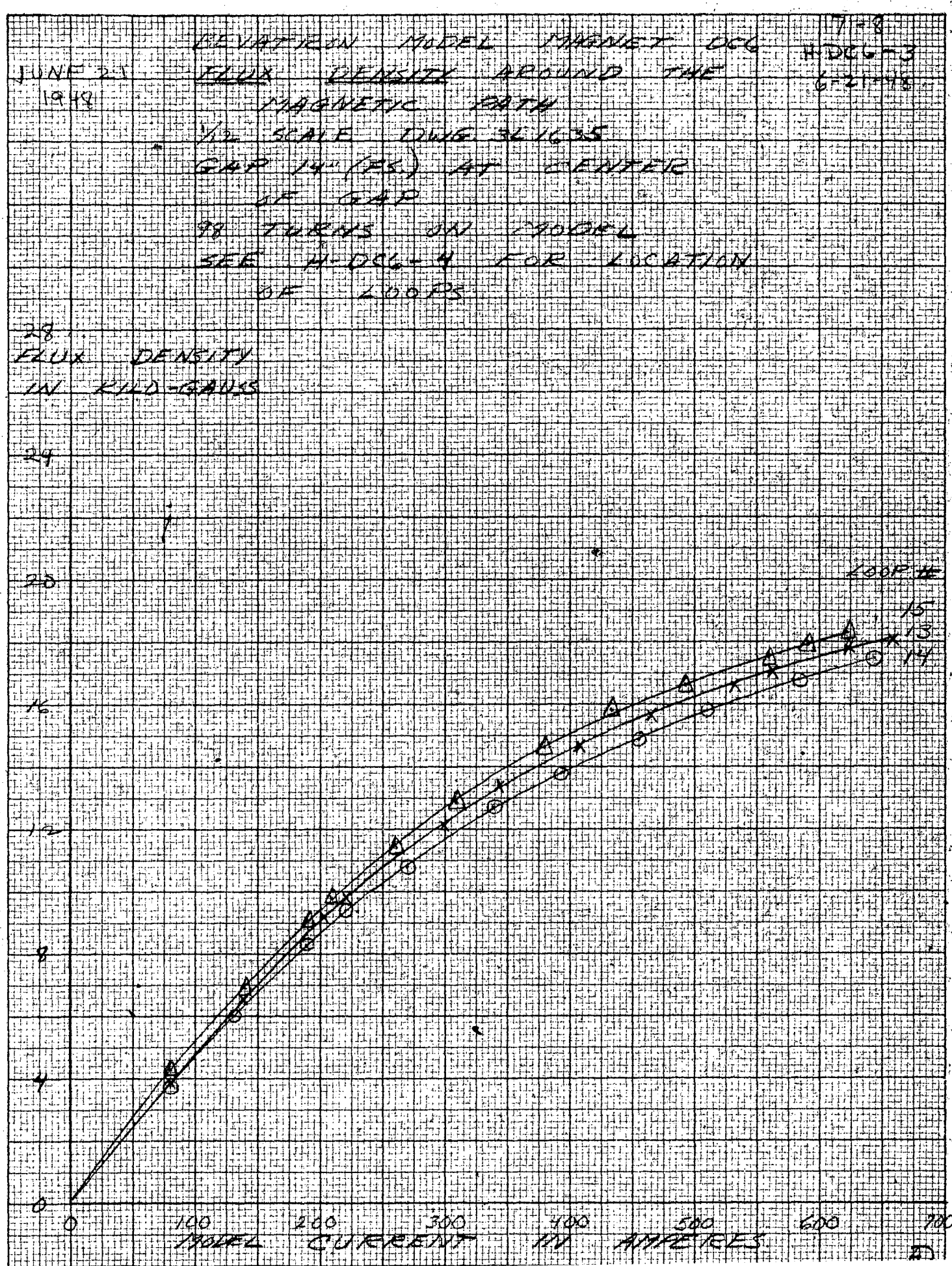
Bevatron Model Magnet DC6A



KEUFFEL & ESSER CO., N. Y. NO. 358-11G
10 × 10 to the ½ inch, 5th lines accented.
Engraving 7 × 10 in.
MADE IN U.S.A.



BEVATRON MODEL MAGNET-DC6
FLUX DENSITY AROUND THE
MAGNETIC PATH
1/12 SCALE DWG. 3L1635
GAP 14" (F.S.) AT CENTER
98 TURNS ON MODEL COILS
SEE H-DC6-4 FOR
LOCATION OF LOOPS
JUNE 21
1948
H-DC6-2
6-21-48
FLUX DENSITY
IN KILO-GAUSS
LOOP #
11 & 12
8
9
10
0
4
8
12
16
20
24
28
0
100
200
300
400
500
600
700
MODEL CURRENT IN AMPERES



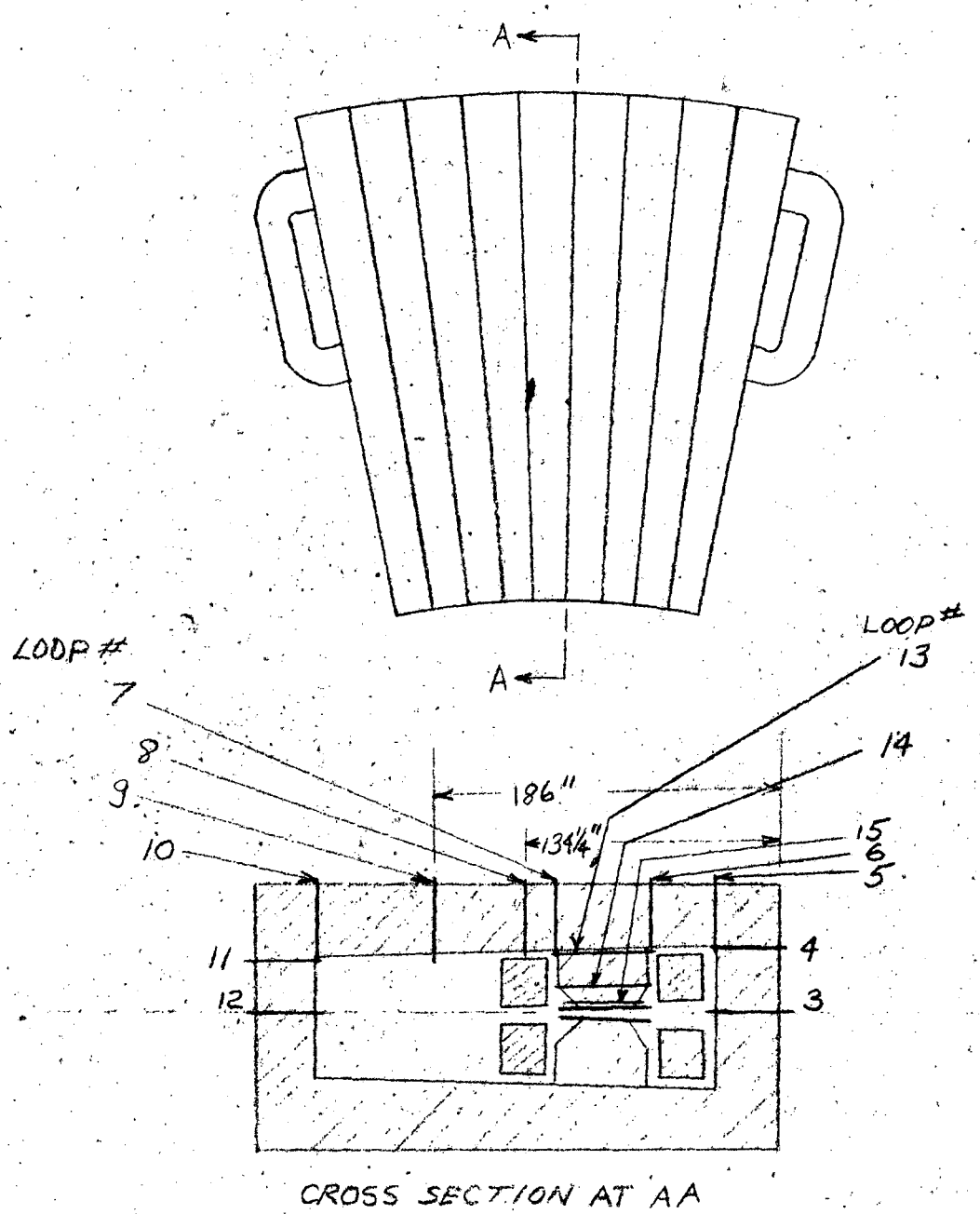
KEUFFEL & ESSER CO., N. Y. NO. 359T-12G
10 X 10 to the ½ inch, 5th lines accented.
Engraving 7½ X 10 in.
MADE IN U.S.A.

JUNE 21, 1948

BEVATRON MODEL MAGNET DC6
LOCATION OF FLUX LOOPS
1/12 SCALE DWG 3L/635

GAP 14" (FS) AT CENTER
98 TURNS ON MODEL
SEE GRAPHS H-DC6-2
H-DC6-3
H-DC6-5

171-8
H-DC6-4
6-21-48



CROSS SECTION AT AA

JUNE 21 1948

REVISION MODEL MAGNET DC6

FLUX DENSITY AROUND MAGNETIC PATH

1/2 SCALE DWG 3L 16 35

GAP 1/4" (F.S.) AT CENTER OF GAP

98 TURNS ON MODEL

SEE H-DC6-4 FOR LOCATION OF LOOPS

11-8
H-DC6-5
6-21-48

FLUX DENSITY IN KILO-GAUSS

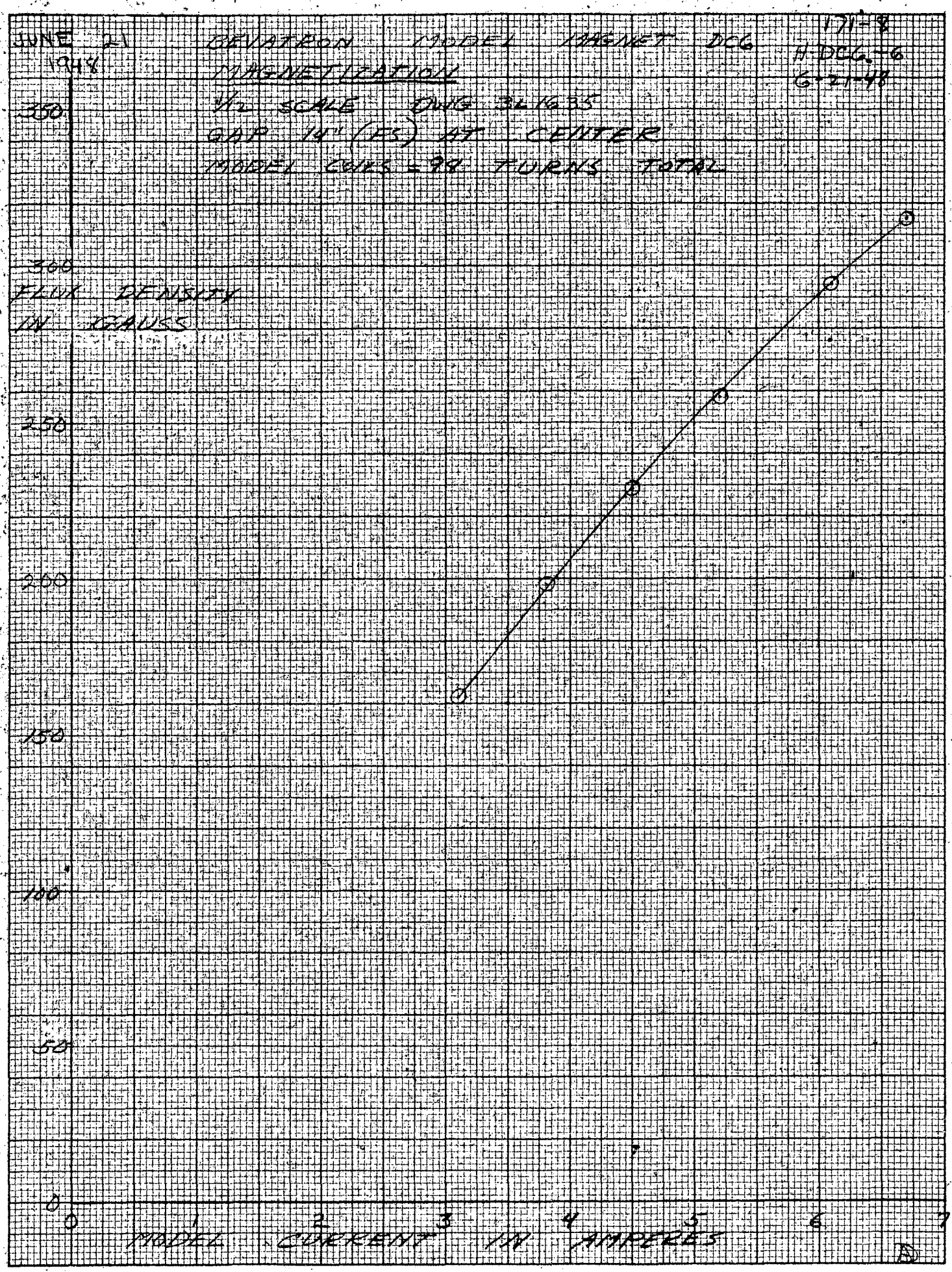
28
24
20
16
12
8
4
0

1 GAP
4
3
5
6
7

0 100 200 300 400 500 600 700

MODEL CURRENT IN AMPERES

KEUFFEL & ESSER CO., N. Y. NO. 3597-12G
10 × 10 to the ½ inch with lines accented.
Engraving 7½ × 10 in.
MADE IN U.S.A.



KEUFFEL & ESSER CO., N. Y. NO. 359T-12G
10 X 10 to the ½ inch, 5th lines accented.
Engraving 7½ X 10 in.
MADE IN U.S.A.

BEVATRON MODEL MAGNET DC 6

JUNE 9 1948

COIL FLUX LINKAGE

1/12 SCALE DWG 32 K 35

GAP 14" (F.S.) AT CENTER OF GAP

MODEL COILS: 2 COILS 49 TURNS LOOP #1

EACH: 98 TURNS TOTAL

EACH LOOP HAS 7 TURNS

FLUX LINKAGE IS ON 7.51°

SECTION ON MODEL

177-8

F-DC6-1

6-18-48

FLUX LINKAGE IN MAXWELL TURNS x 10^6

32

28

24

20

16

12

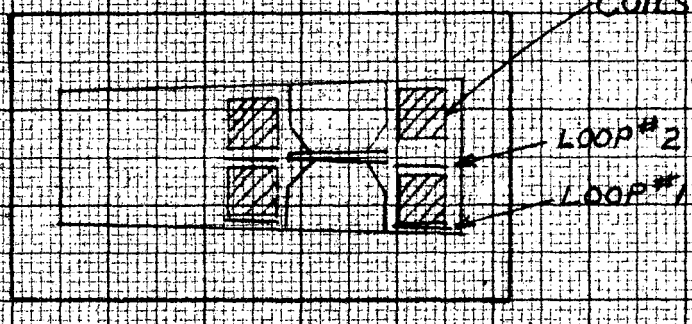
8

4

0

100 200 300 400 500 600 700

MODEL CURRENT IN AMPERES

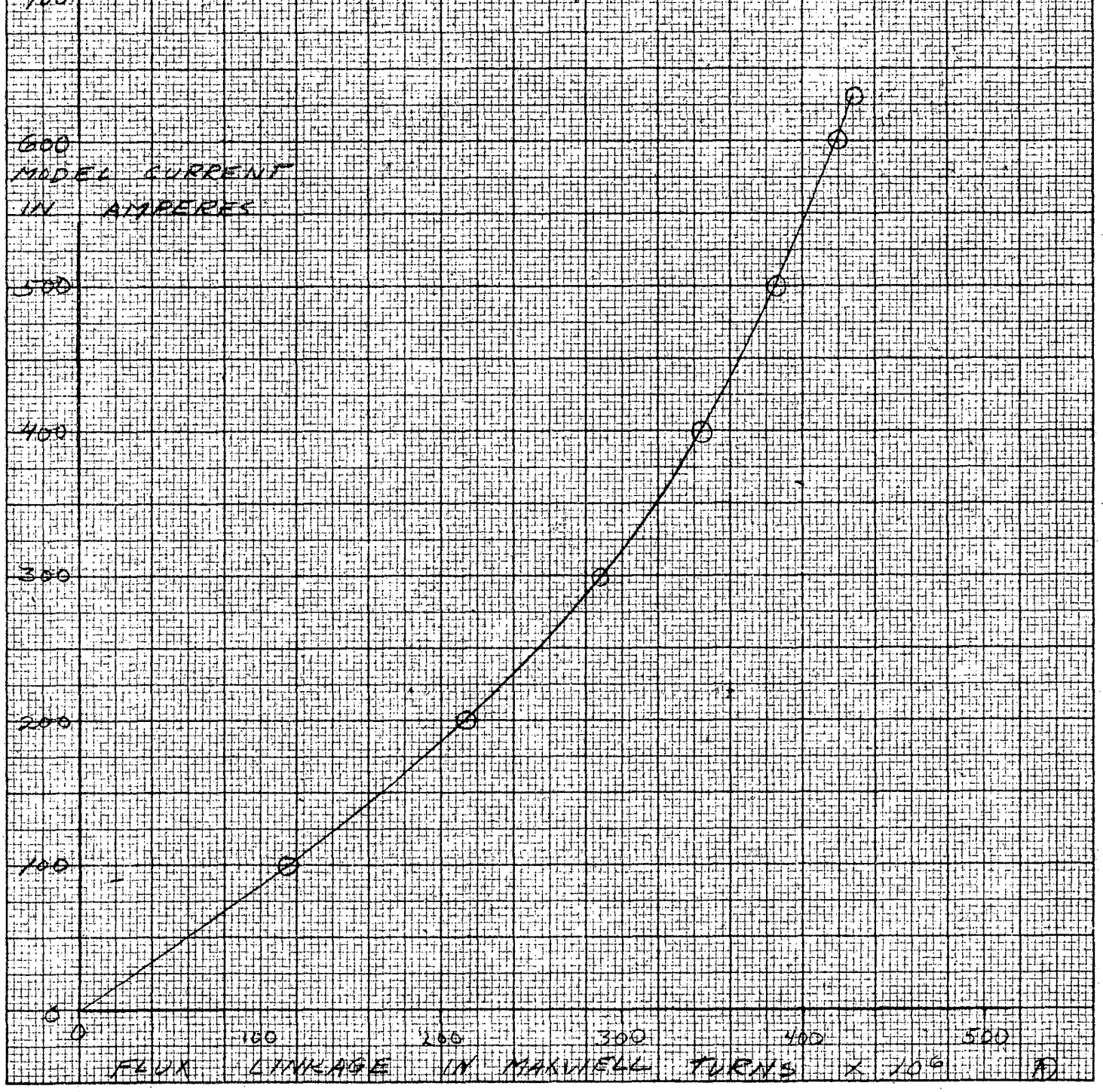


KEUFFEL & ESSER CO., N. Y. NO. 359-139
10 X 10 to the ½ inch. 5th lines accented.
Engraving 7 ⅛ X 10 in.
MADE IN U.S.A.

171-8
F-DC6-1a
6-18-48

JUNE 18, 1948

BEVATRON MODEL MAGNET DC6
TOTAL COIL FLUX LINKAGE
1/12 SCALE DWG 3L1635
GAP 14" (F.S.) AT CENTER OF GAP
MODEL COILS - 49 TURNS EACH
ON 2 COILS = TOTAL 98 TURNS
SEE GRAPH F-DC6-1
FLUX LINKAGE IS FOR 7.51°
SECTION OF MODEL
TOTAL LINKAGE = LOOP #1 + #2 x 7



KEUFFEL & ESSER CO., N. Y. NO. 359T-12G
10 X 10 to the ½ inch, 5th lines accented.
Engraving 7½ X 10 in.
MADE IN U.S.A.

JUNE 18

CYCLOTRON MODEL MAGNET DC6 - 171-8

F-DC6-2

6-24-48

COIL FLUX LINKAGE

1/12 SCALE DWG 3L 1635

GAP 14" (EA) AT CENTER

FLUX LINKAGE ON 7.5° SECTION

ON MODEL

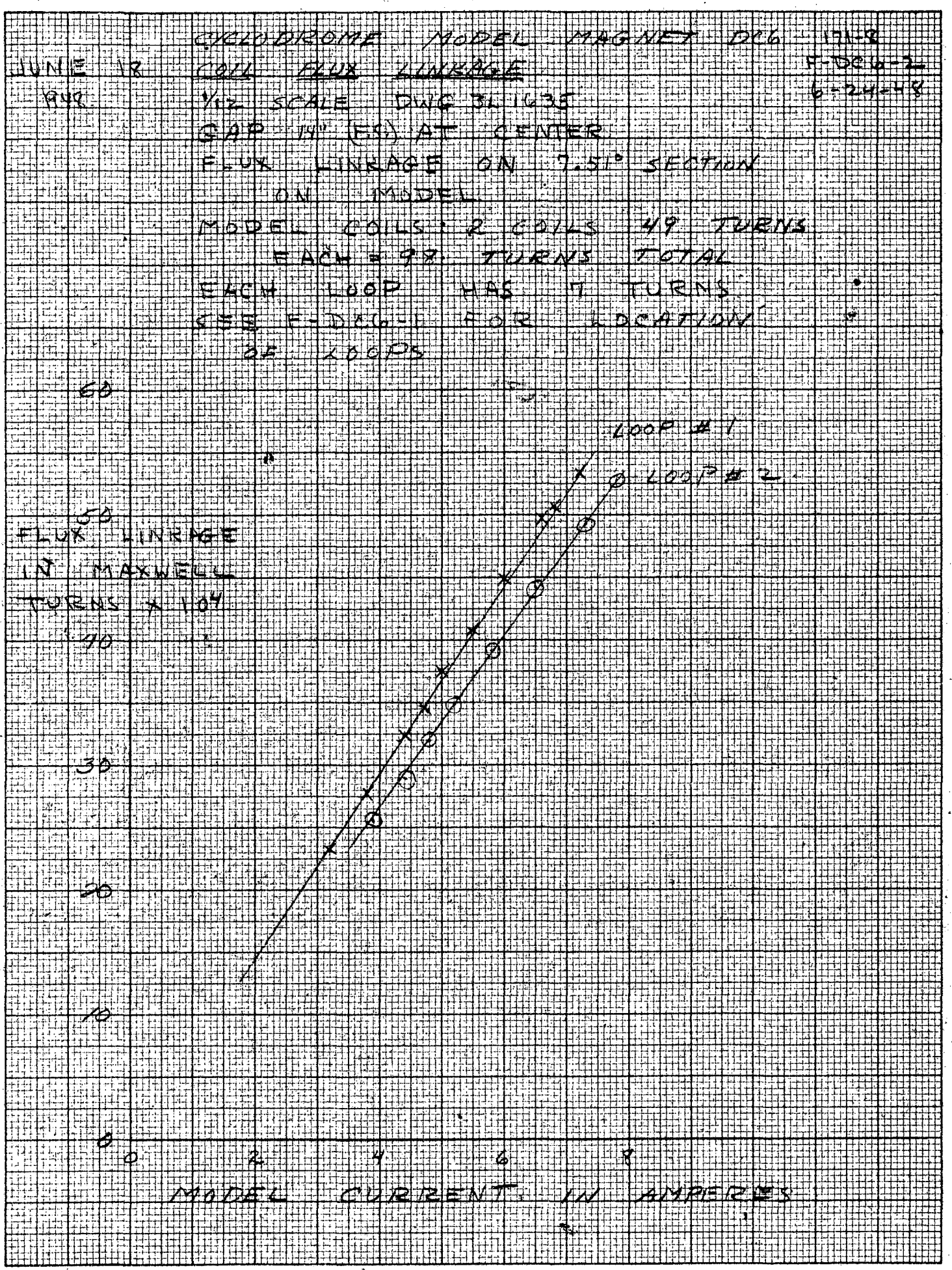
MODEL COILS: 2 COILS 49 TURNS

EACH = 98 TURNS TOTAL

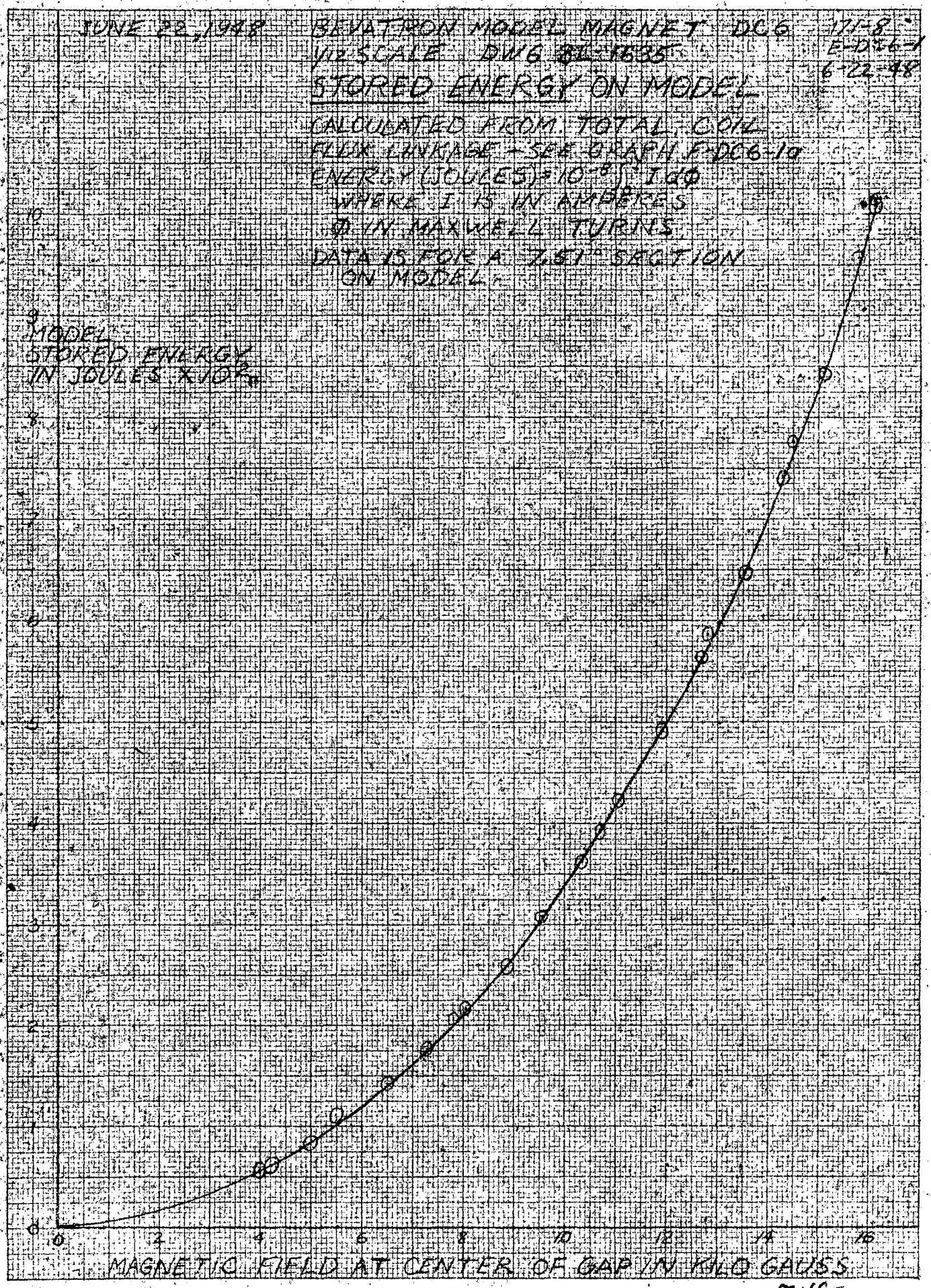
EACH LOOP HAS 7 TURNS

SEE F-DC6-1 FOR LOCATION

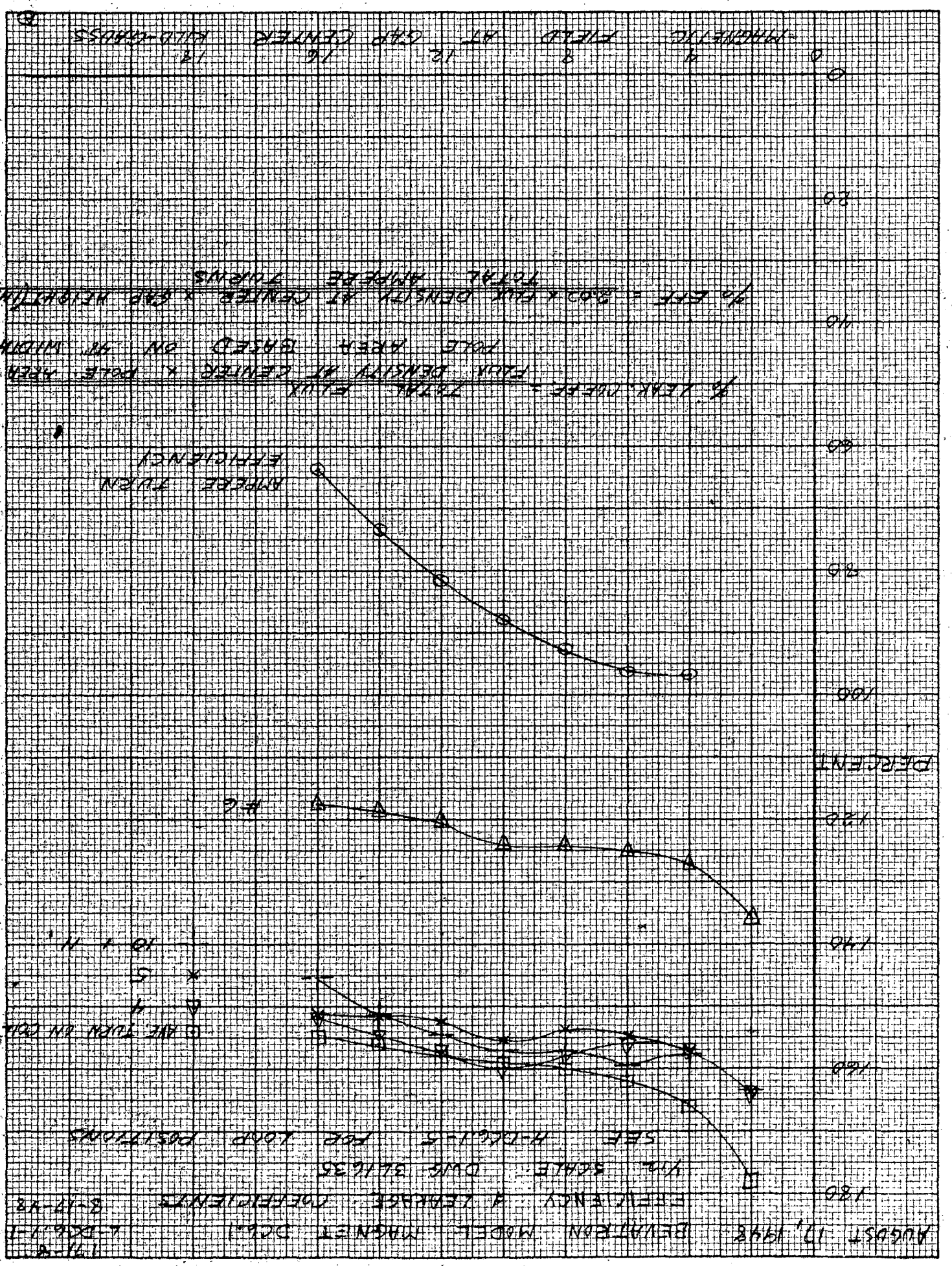
OF LOOPS



KEUFFEL & ESSER CO., N. Y. NO. 359T-12G
10 X 10 to the ½ inch, 5th lines accented.
Engraving 7¾ X 10 in.
MADE IN U.S.A.


JUNE 22, 1948
BEVATRON MODEL MAGNET DC6
1/12 SCALE DWG BL-1635
171-8
E-DC6-1
6-22-48
STORED ENERGY ON MODEL
CALCULATED FROM TOTAL COIL
FLUX LINKAGE - SEE GRAPH F-DC6-1a
ENERGY (JOULES) = 10^-8 ∫ I dΦ
WHERE I IS IN AMPERES
Φ IN MAXWELL TURNS
DATA IS FOR A 7.51° SECTION
ON MODEL.
MODEL
STORED ENERGY
IN JOULES X 10^2
0
1
2
3
4
5
6
7
8
9
10
0
2
4
6
8
10
12
14
16
MAGNETIC FIELD AT CENTER OF GAP IN KILO GAUSS

EWC



KEUFFEL & ESSER CO., N. Y. NO. 359T-120
10 × 10 to the ½ inch, 5th lines accented.
Engraving 7¼ × 10 in.
MADE IN U.S.A.

CORRECTED
191-8
H-DC6.1-1
6-28-48
REPLACES
H-DC6.5-T

CYCLOTRON MODEL MAGNET DC 6.1

JUNE 28, 1948

MAGNETIZATION IN CENTER OF GAP

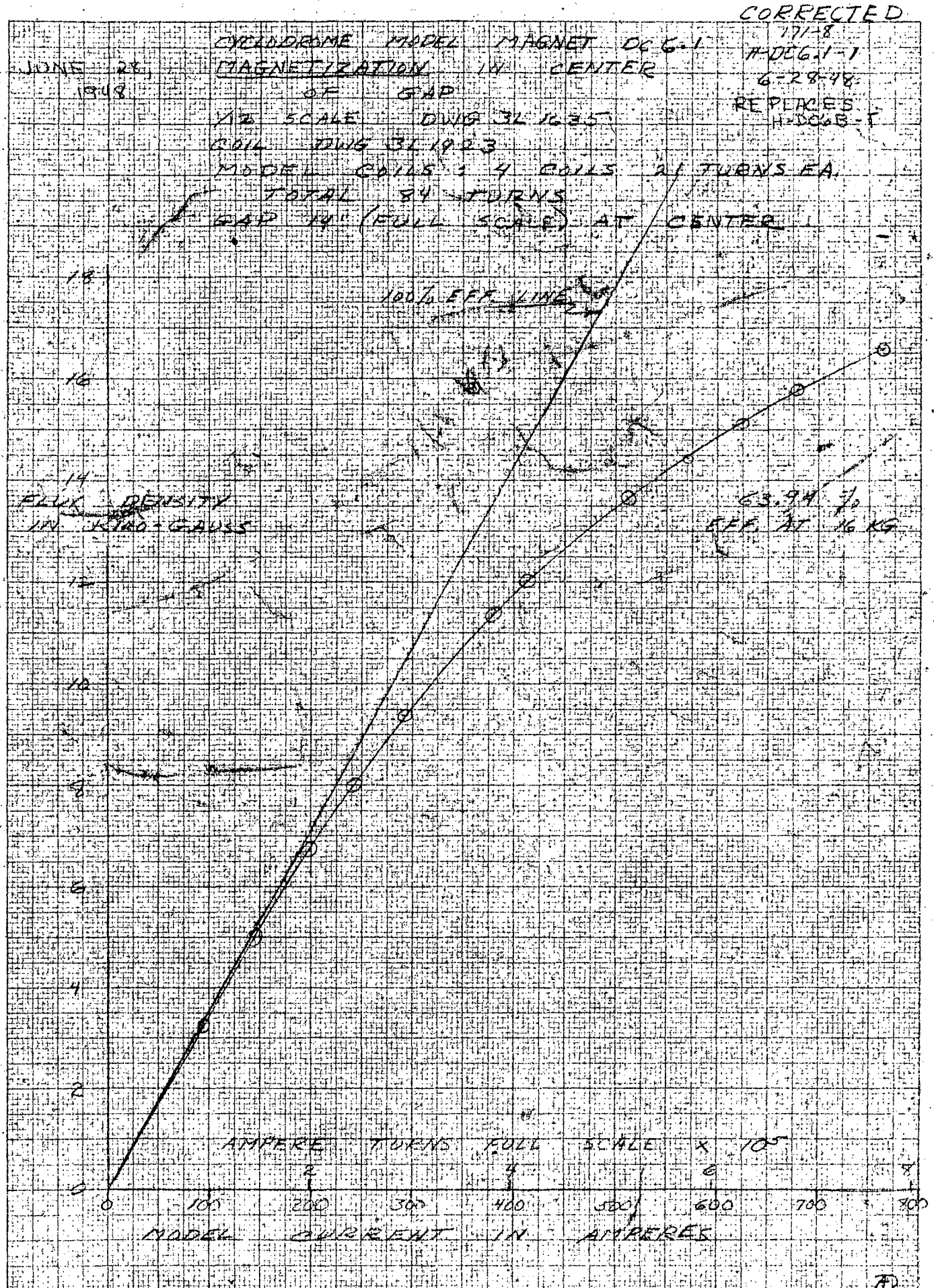
1/2 SCALE DWG 32 16 35

COIL DWG 32 1923

MODEL COILS : 4 COILS 21 TURNS EA.

TOTAL 84 TURNS

GAP 14" (FULL SCALE) AT CENTER



KEUFFEL & ESSER CO., N. Y. NO. 359-11-0
Millimeters, 5 mm. lines accented, cm. lines heavy.
MADE IN U.S.A.

JUNE 28, 1946

CYCLOTRON MODEL MAGNET DC6.1

171-8

H-DC6.1-2

6-28-46

FLUX DENSITY AROUND MAGNETIC PATH

1/2 SCALE DWG 3L1635

COIL DWG 3L1923

MODEL COILS: 4 COILS 21 TURNS EACH

TOTAL 84 TURNS

GAP 14" (F.S.) AT CENTER

LOCATION OF LOOPS SHOWN ON H-DC6.1-5

LOOP

6 □

4 ○

5 ×

FLUX DENSITY IN KILOGAUSS

24
22
20
18
16
14
12
10
8
6
4
2
0

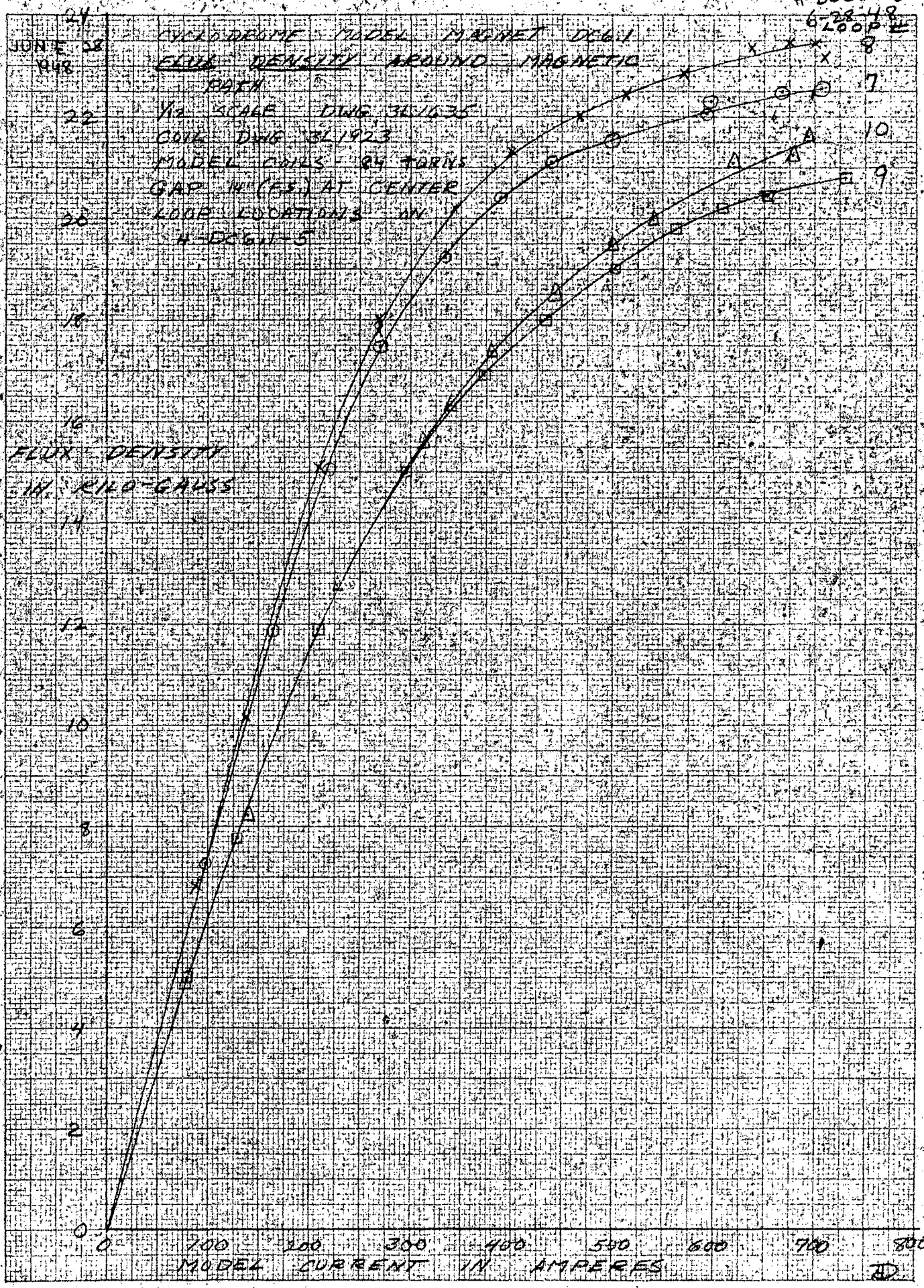
0 100 200 300 400 500 600 700 800

MODEL CURRENT IN AMPERES

D

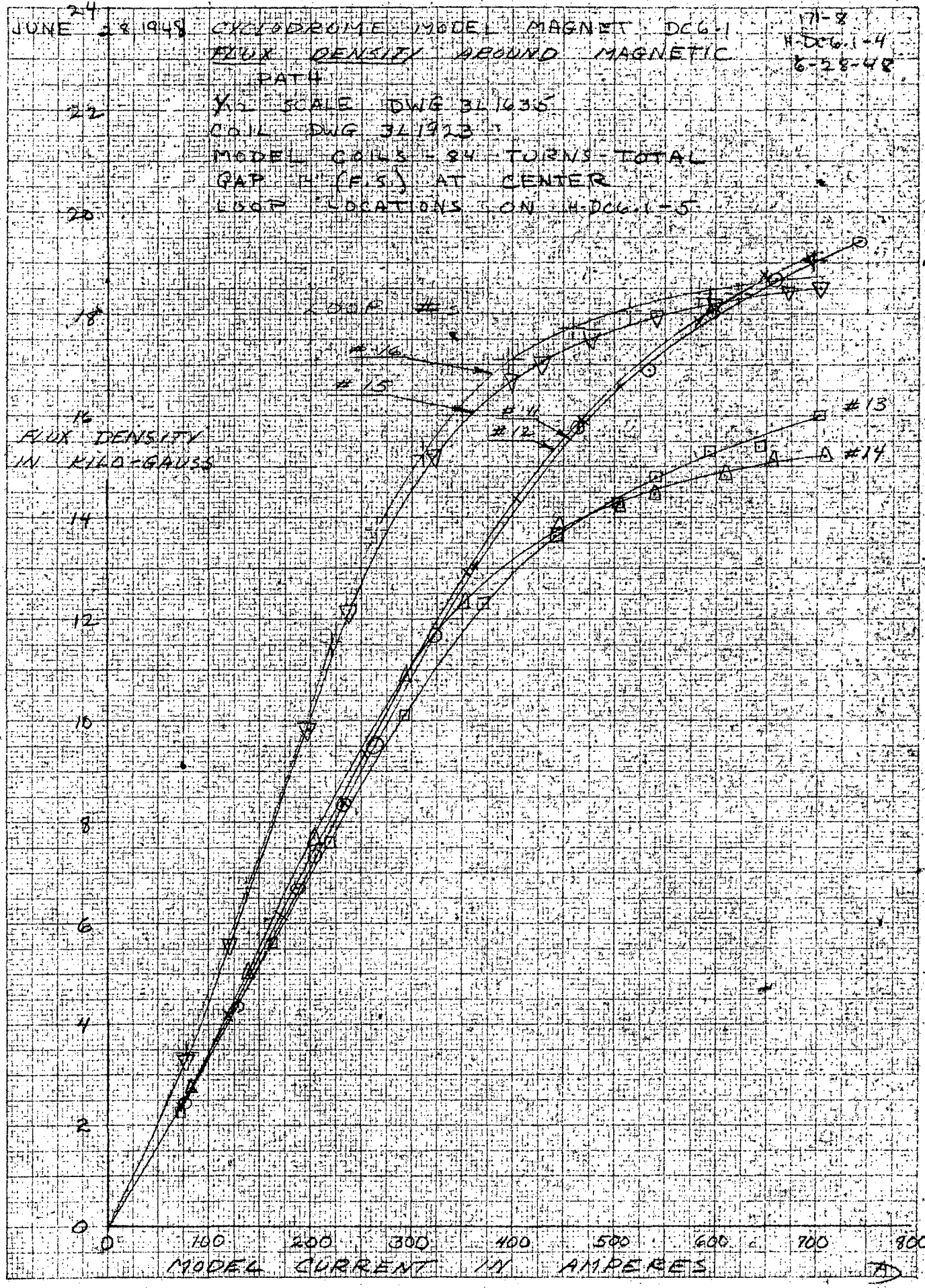
KEUFFEL & ESSER CO., N. Y. NO. 359-14 G
Millimeters, 5 mm. lines accented, cm. lines heavy.
MADE IN U.S.A.

171-8
H-DC6.1-3
6-28-48



KEUFFEL & ESSER CO., N.Y. NO. 359-14G
Millimeters, 5 mm. lines accented, cm. lines heavy.
MADE IN U.S.A.

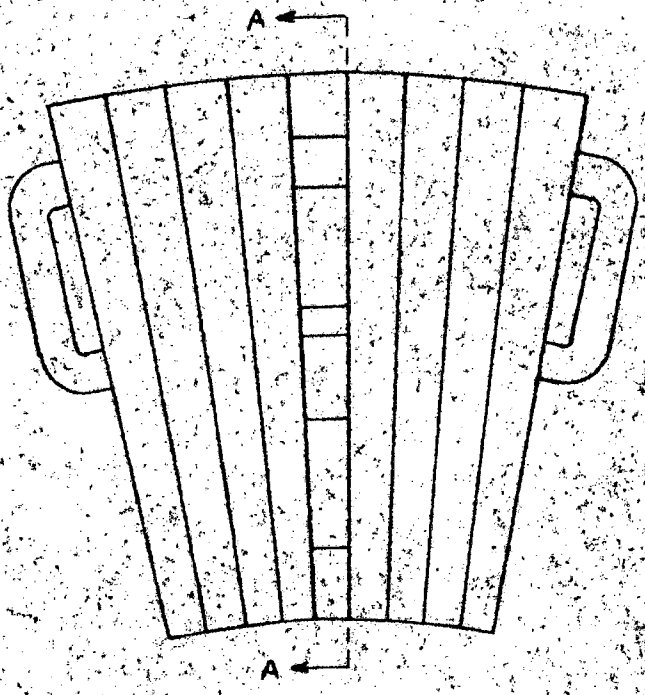
88

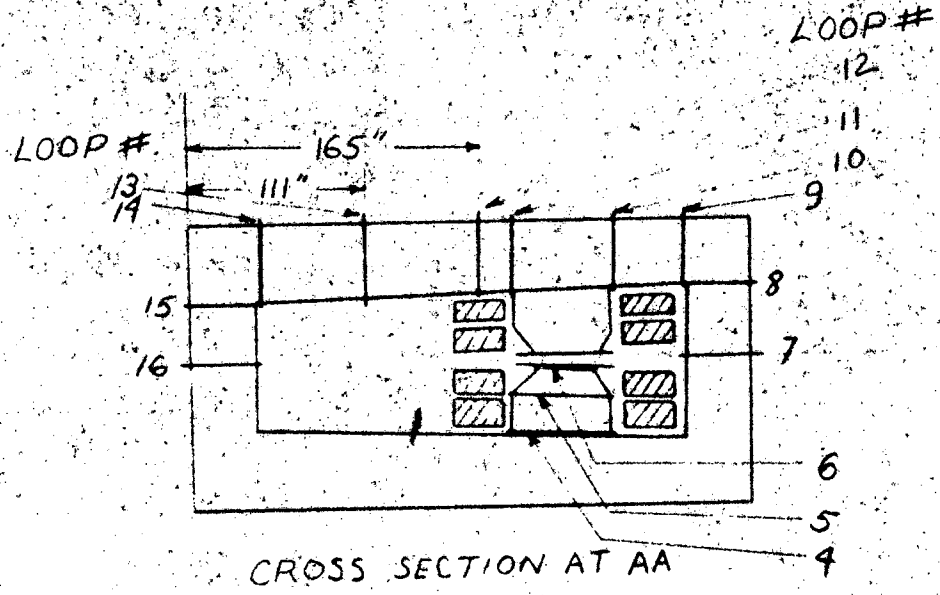

JUNE 28, 1948 CYCLOTRON MODEL MAGNET DC6-1
FLUX DENSITY AROUND MAGNETIC PATH
X-Y SCALE DWG 3L1635
COIL DWG 3L1923
MODEL COILS - 84 TURNS - TOTAL
GAP 4" (F.S.) AT CENTER
LOOP LOCATIONS ON H-DC6.1-5
171-8
H-DC6.1-4
6-28-48
LOOP #
#16
#15
#11
#12
#13
#14
FLUX DENSITY IN KILO-GAUSS
0
2
4
6
8
10
12
14
16
18
20
22
24
0
100
200
300
400
500
600
700
800
MODEL CURRENT IN AMPERES

JUNE 28, 1948

CYCLODROME MODEL MAGNET DC6.1
LOCATION OF FLUX LOOPS
1/12 SCALE DWG 3L1635
GAP 14" FULL SCALE AT CENTER
COIL DWG 3L1923
84 TURNS TOTAL ON MODEL COILS
SEE GRAPHS H-DC6.1-2, H-DC6.1-3, H-DC6.1-4

171-8
H-DC6.1-5
6-28-48





CROSS SECTION AT AA

JUNE 30, 1948

CYCLODROME MODEL MAGNET DC6.1

171-8
F-DC6.1-1
6-30-48

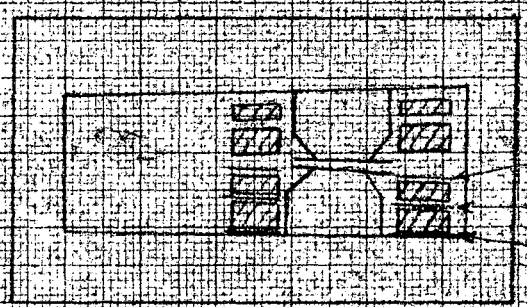
COIL FLUX LINKAGE

½ SCALE DWG 3L1835
COIL DRAWING 3L1823
MODEL COILS: 4 COILS 21 TURNS EACH
TOTAL 84 TURNS
GAP 14" (E.S.) AT CENTER
EACH LOOP HAS 21 TURNS
FLUX LINKAGE IS ON 5.56° SECTION
ON MODEL

FLUX LINKAGE
IN MAXWELL TURNS
X 10^6

100
90
80
70
60
50
40
30
20
10
0

LOOP #
1 ○
2 △
3 □



0 100 200 300 400 500 600 700 800

MODEL CURRENT IN AMPERES

EWC

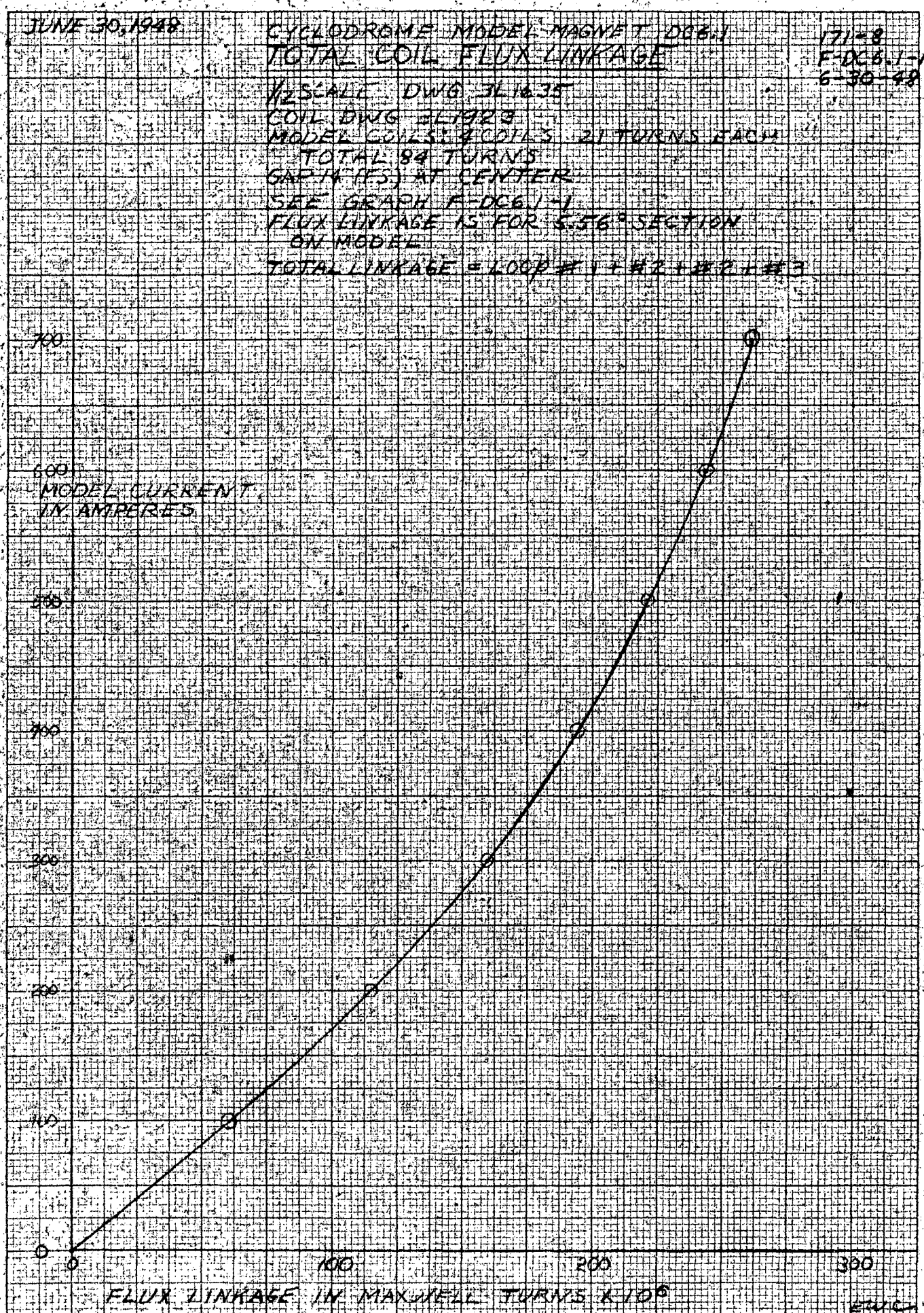
KEUFFEL & ESSER CO., N. Y., NO. 359-14-G
Millimeters, 5 mm. lines accented, cm. lines heavy.
MADE IN U. S. A.

JUNE 30, 1948

CYCLODROME MODEL MAGNET DC6.1
TOTAL COIL FLUX LINKAGE

(7)-8
F-DC6.1-1a
6-30-48

½ SCALE DWG JL 1635
COIL DWG JL 1923
MODEL COILS: 4 COILS 21 TURNS EACH
TOTAL 84 TURNS
GAP ¼" (F.S.) AT CENTER
SEE GRAPH F-DC6.1-1
FLUX LINKAGE IS FOR 5.56° SECTION ON MODEL
TOTAL LINKAGE = LOOP #1 + #2 + #C + #3



EWG

KEUFFEL & ESSER CO., N. Y. NO. 359-11G
10 X 10 to the ¼ inch, 5th liner accented.
Engraving 7 X 10 in.
MADE IN U.S.A.

JULY 2, 1948

CYCLOTRON MODEL MAGNET DC6.1

17-8

F-DC6.1-2

7-2-48

COIL FLUX LINKAGE

½ SCALE DWG 3L1635

COIL DWG 3L1925

GAP 12 (FS) AT CENTER

MODEL COILS: 4 COILS 21 TURNS EACH
TOTAL 84 TURNS

EACH LOOP WAS 21 TURNS

FLUX LINKAGE IS ON 5.56° SECTION OF MODEL

SEE GRAPH F-DC6.1-1 FOR LOCATION OF LOOPS

LOOP #5

FLUX DENSITY IN MAXWELL TURNS X 10⁵

35
30
25
20
15
10
5
0

0 5 10 15 20 25

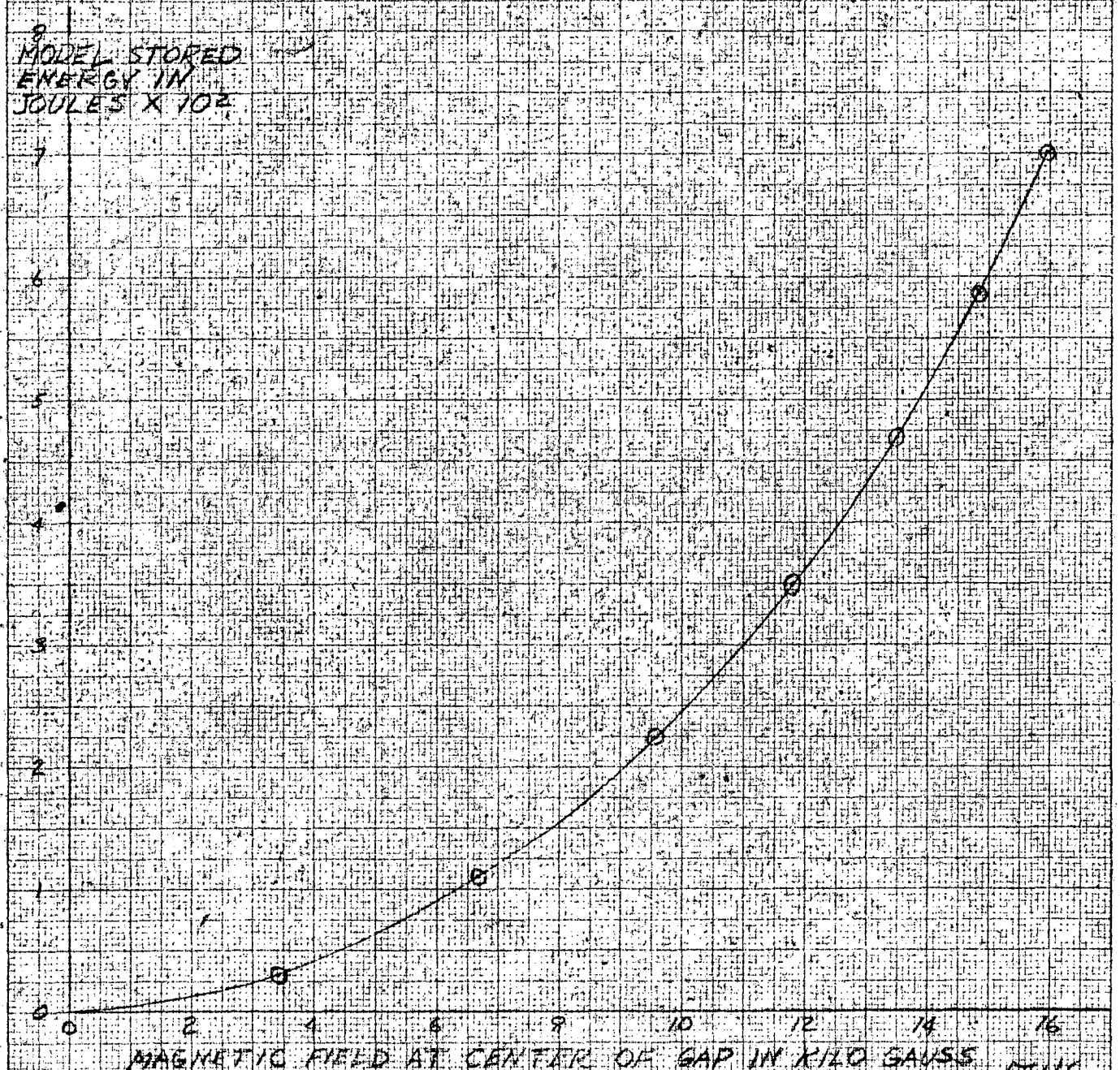
MODEL CURRENT IN AMPERES

EWC

KEUFFEL & ESSER CO., N. Y. NO. 359-110
10 X 10 to the ½ inch, 5th lines accented
Engraving 7 X 10 in.
MADE IN U.S.A.

JULY 19, 1948

CYCLODROME MODEL MAGNET DC6.1 171-8
½ SCALE DWG 3L1635T E-DC6.1-1
STORED ENERGY ON MODEL 7-19-48
CALCULATED FROM TOTAL COIL FLUX CORRECTED
LINKAGE - SEE GRAPH E-DC6.1-14
ENERGY (JOULES) = $4\pi \cdot 10^{-8} \int I \, d\phi$
WHERE I IS IN 10^3 AMPERES
ϕ IS IN MAXWELL TURNS
DATA IS FOR A 5.56° SECTION ON MODEL



KEUFFEL & ESSER CO., N. Y. NO. 358-14G
MADE IN U.S.A.

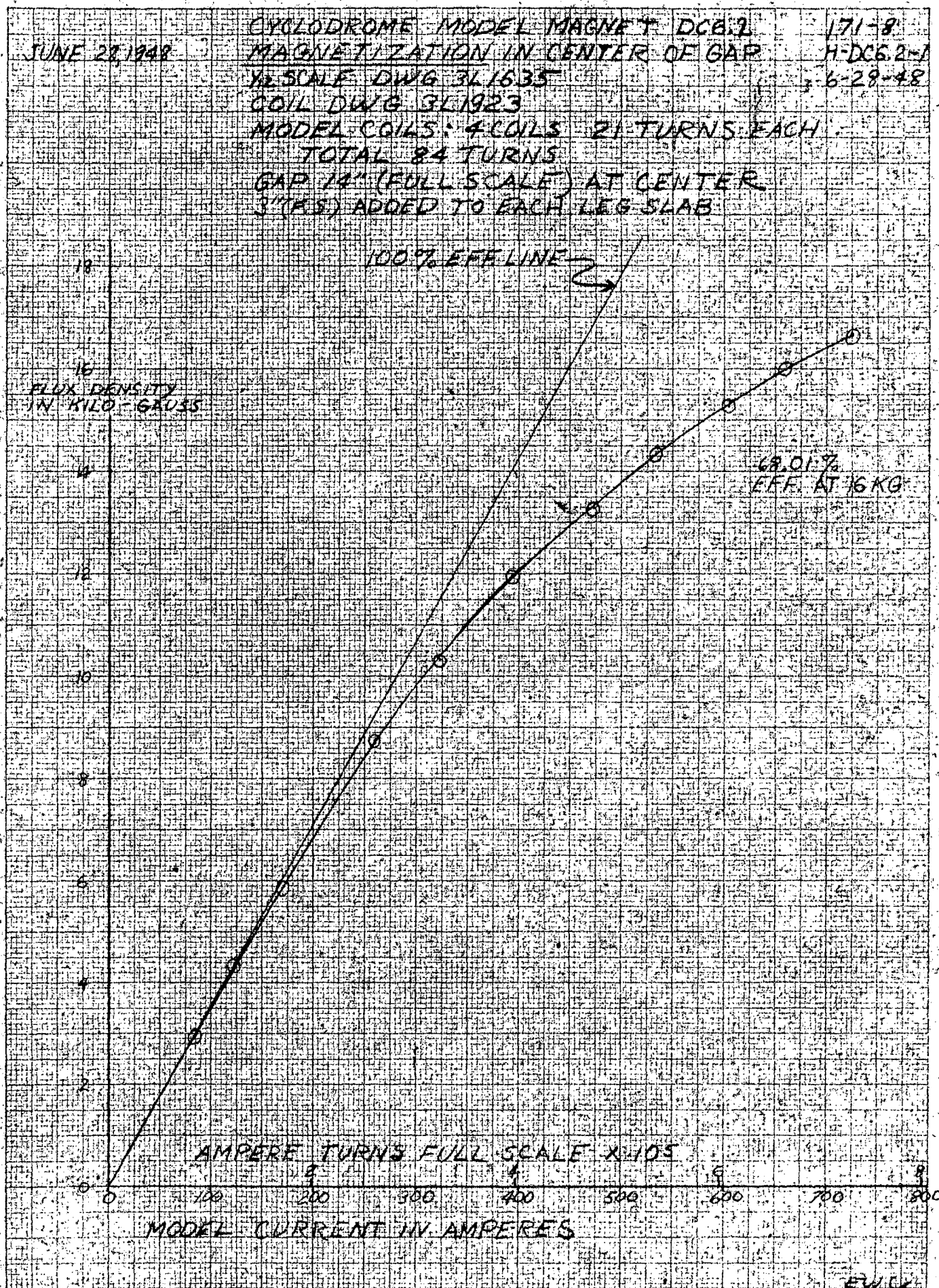
JUNE 28, 1948

CYCLODROME MODEL MAGNET DC6.2

MAGNETIZATION IN CENTER OF GAP

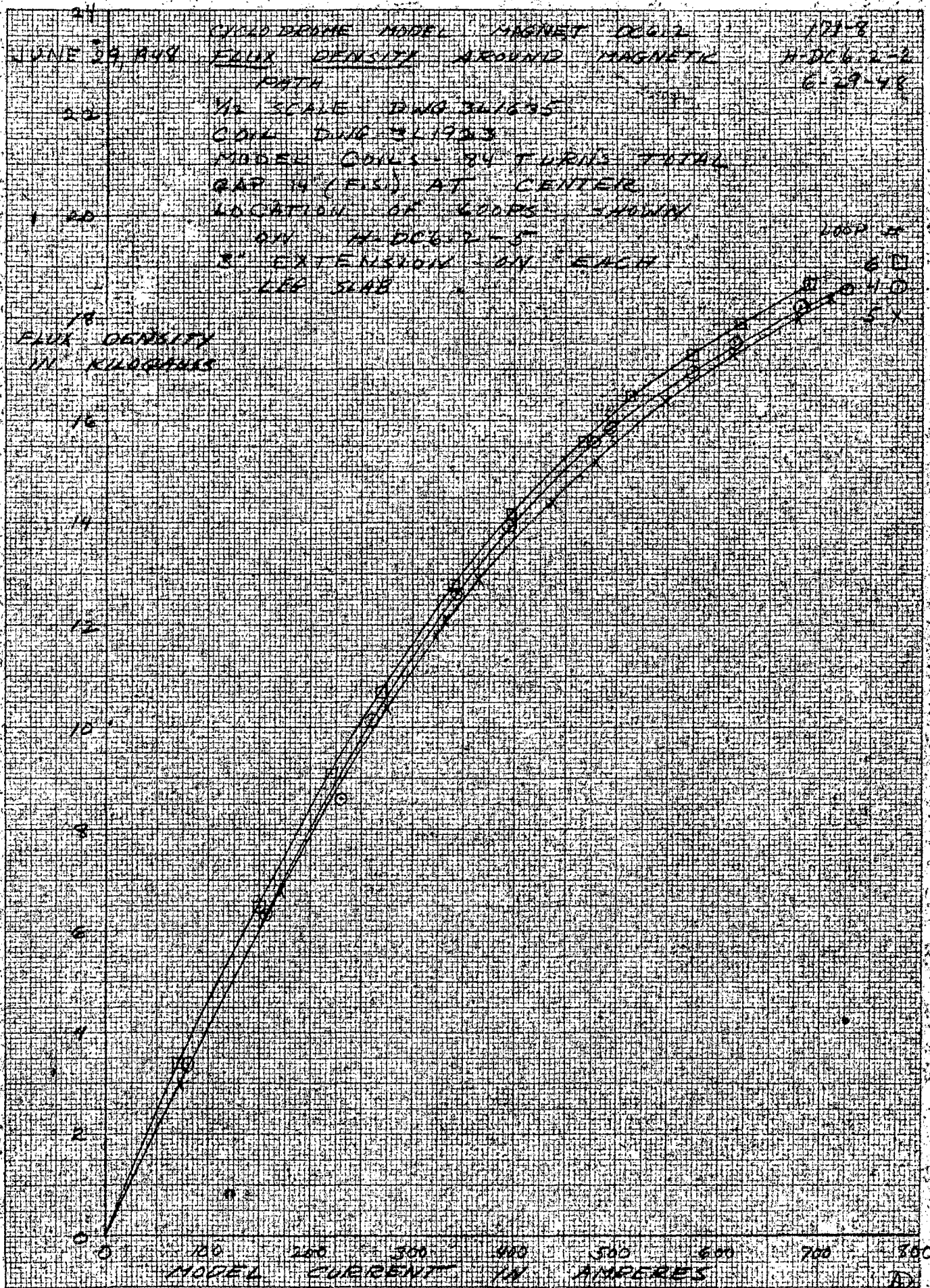
171-8
H-DC6.2-1
6-29-48

½ SCALE DWG 3L1635
COIL DWG 3L1923
MODEL COILS: 4 COILS 21 TURNS EACH
TOTAL 84 TURNS
GAP 1¼" (FULL SCALE) AT CENTER
3" (F.S.) ADDED TO EACH LEG-SLAB

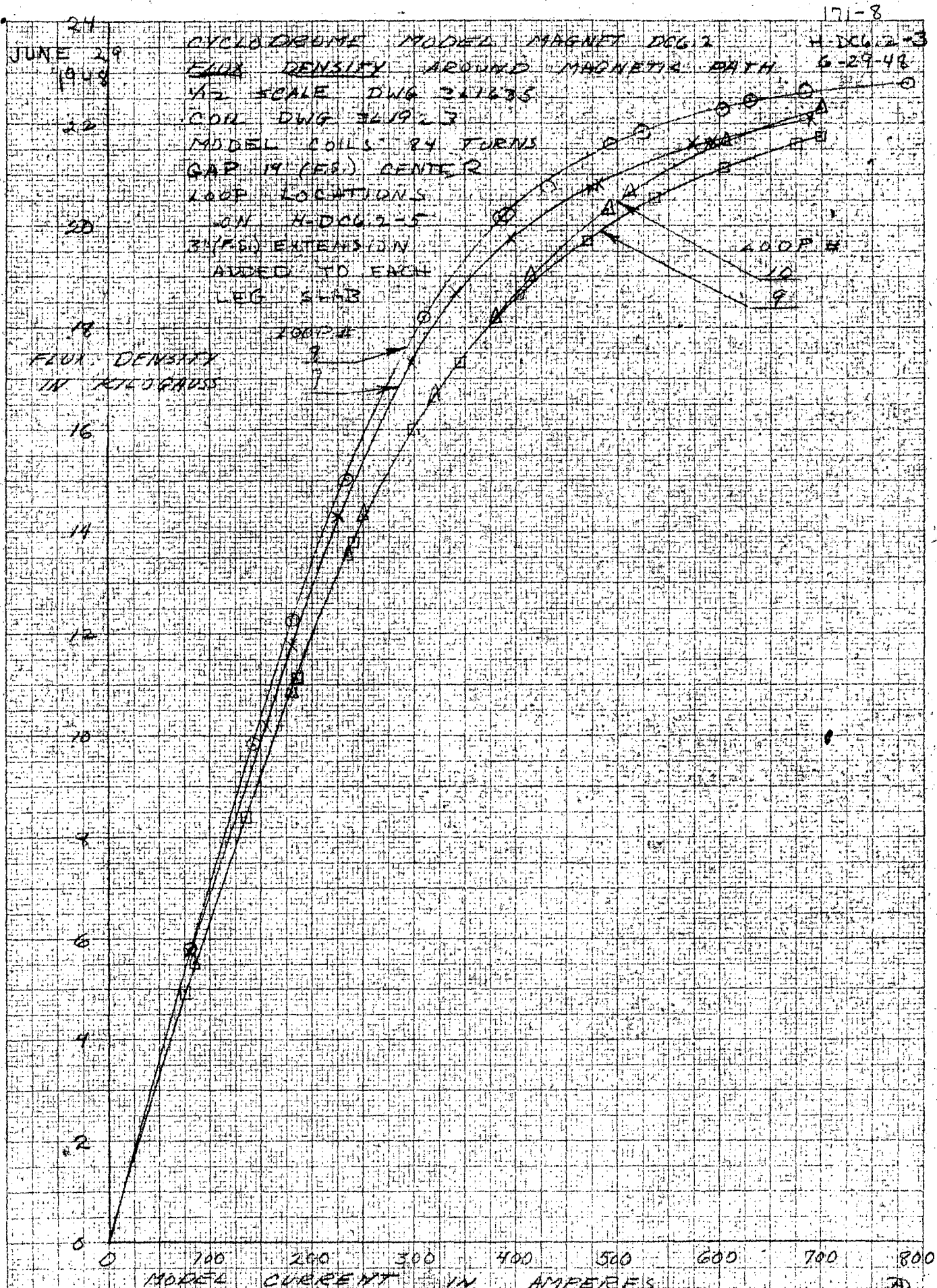


EWC

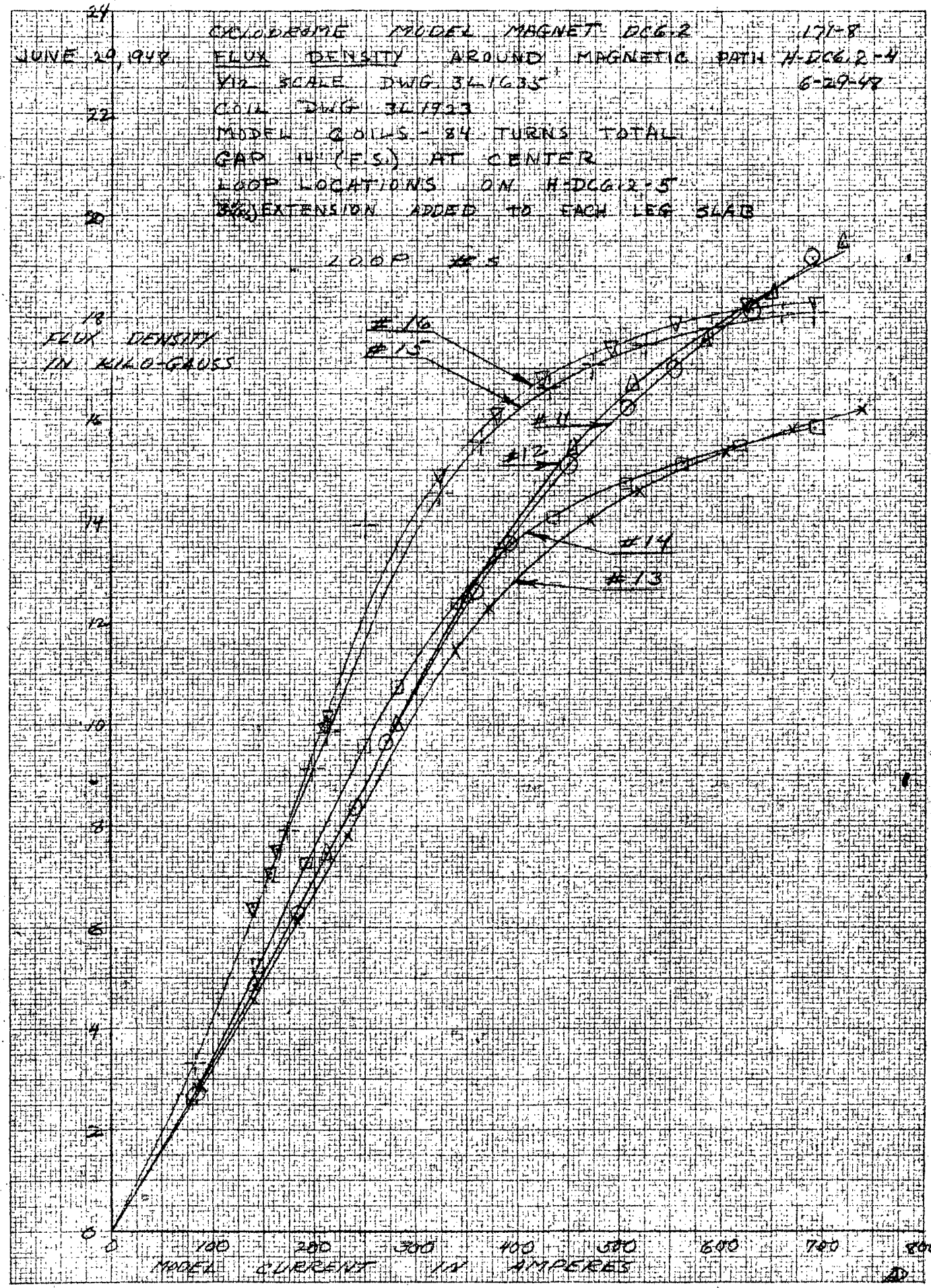
KEUFFEL & ESSER CO., N. Y. - NO. 359 14 G
Millimeters, 5 mm. lines accented, cm. lines heavy.
MADE IN U.S.A.



KEUFFEL & ESSER CO., N. Y. NO. 359-14 G
Millimeters, 5 mm. lines accented, cm. lines heavy
MADE IN U.S.A.



KEUFFEL & ESSER CO., N. Y. NO. 359 14 G
Millimeters, 5 mm. lines accented, cm. lines heavy.
MADE IN U.S.A.



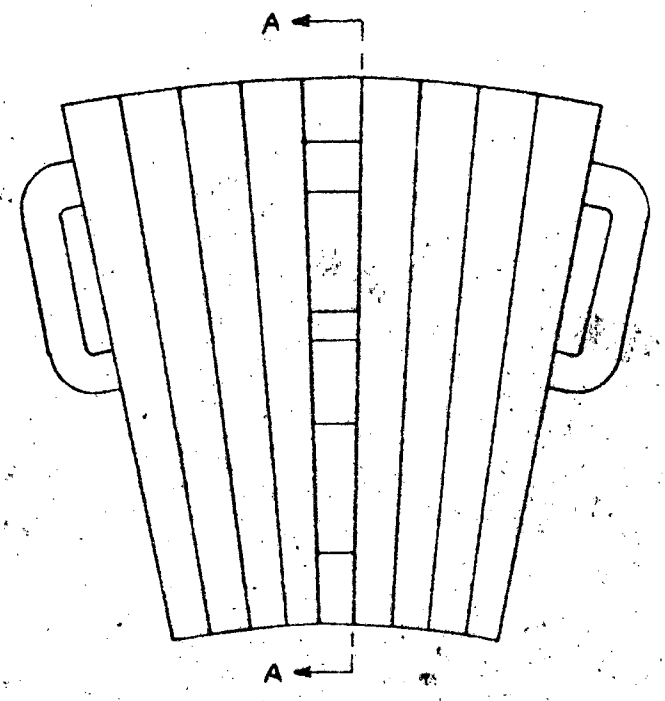
KEUFFEL & ESSER CO., N. Y., NO. 359 146
Millimeters, 5 mm. lines accented, cm. lines heavy.
MADE IN U.S.A.

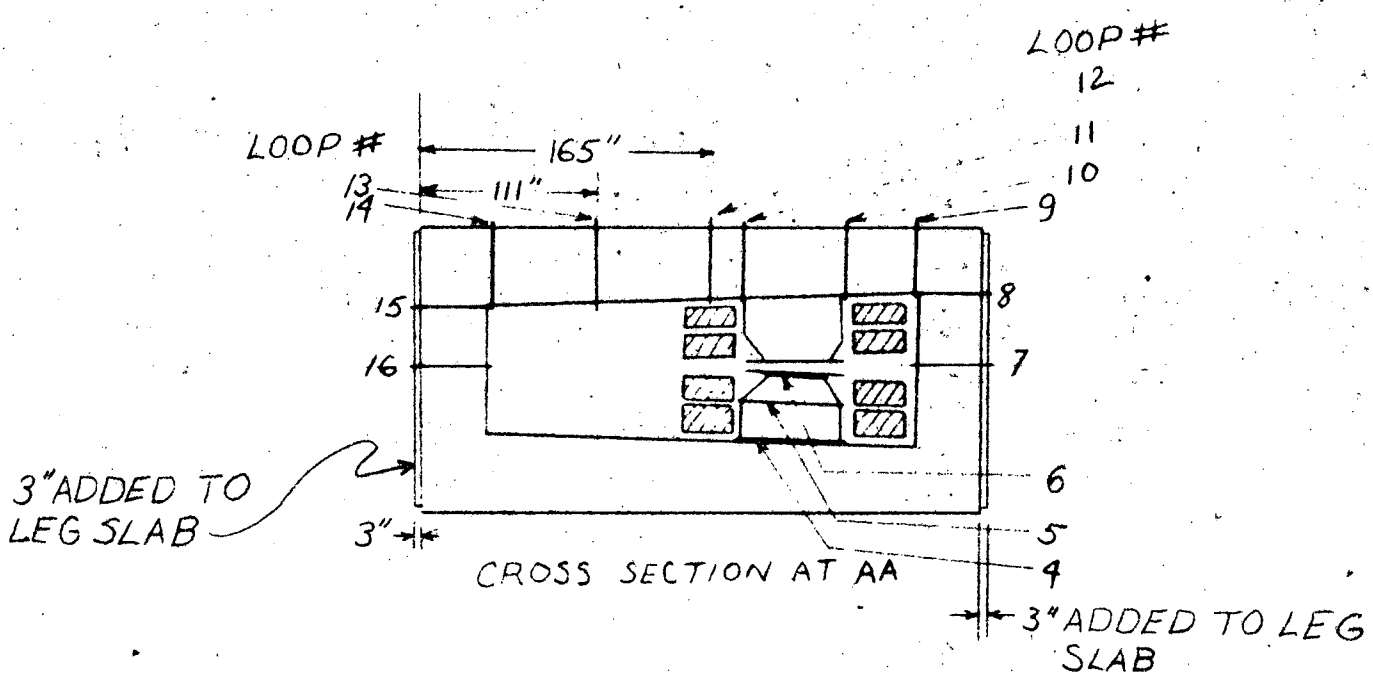
JUNE 28, 1948

CYCLODROME MODEL MAGNET DC6.2
LOCATION OF FLUX LOOPS

171-8
H-DC6.2-5
6-28-48

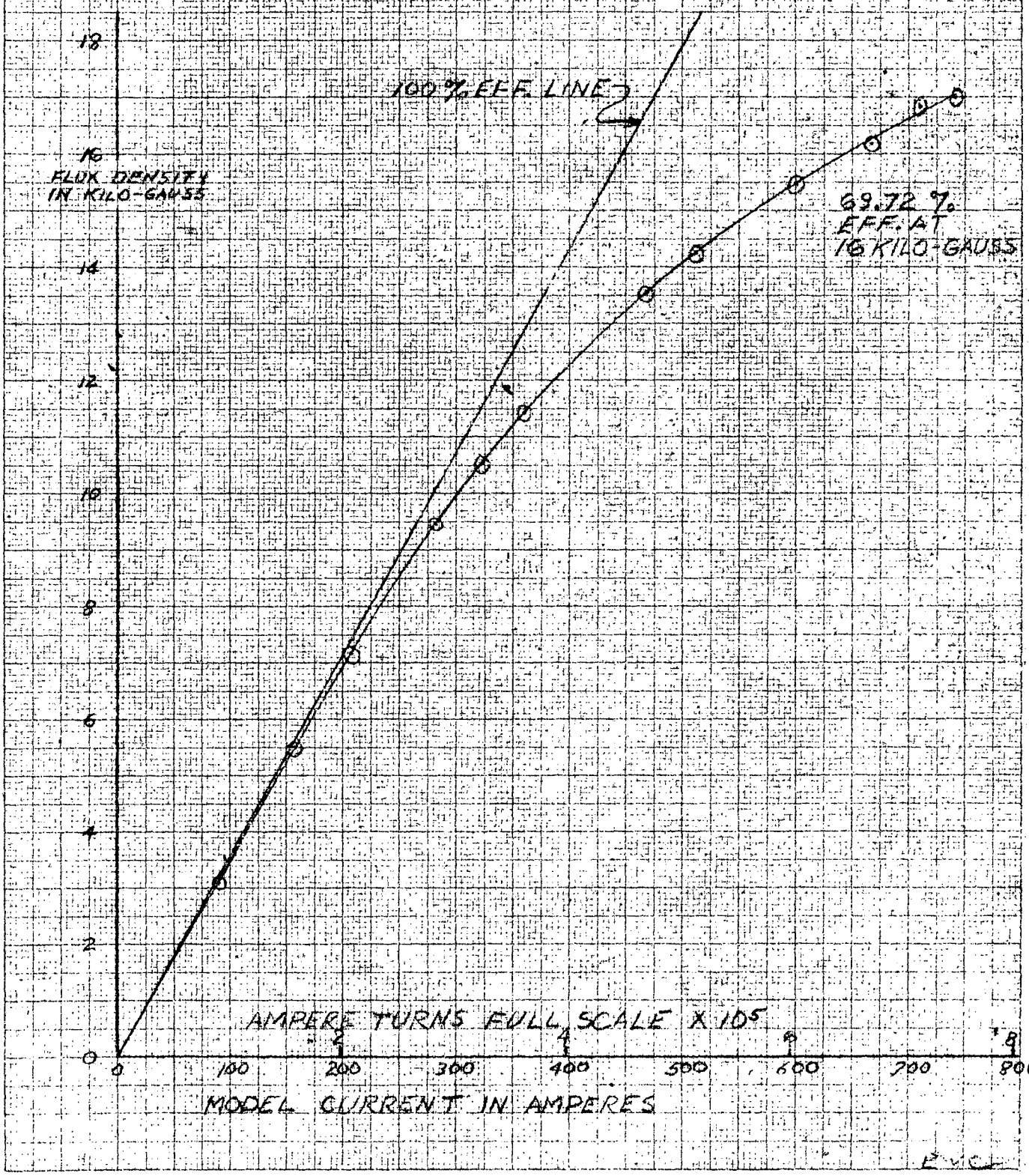
1/12 SCALE DWG 3L1635
GAP 14" FULL SCALE AT CENTER
COIL DWG 3L1923
84 TURNS TOTAL ON MODEL COILS
SEE GRAPHS H-DC6.2-2, H-DC6.2-3, H-DC6.2-4





JUNE 29, 1948

CYCLODROME MODEL MAGNET DC 6.3 — 171-8
MAGNETIZATION IN CENTER OF GAP — H-DC6.3-1
1/12 SCALE DWG 3L 1635 — 6-29-48
COIL DWG 3L 1923
MODEL COILS: 4 COILS 21 TURNS EACH
TOTAL 84 TURNS
GAP 14" (FULL SCALE) AT CENTER
6" (FULL SCALE) ADDED TO EACH LEG SLAB



E.V.C.

KEUFFEL & ESSER CO., N. Y., NO 369 14 G
Millimeters, 5 mm lines accented, cm lines heavy.
MADE IN U.S.A.

JUNE 30, 1948

CYCLOTRON MODEL MAGNET DC 6.3

FLUX DENSITY AROUND MAGNETIC PATH

½ SCALE DWG 3L1635

COIL DWG 3L1923

MODEL COILS - 84 TURNS TOTAL

GAP .14" (F.S.) AT CENTER

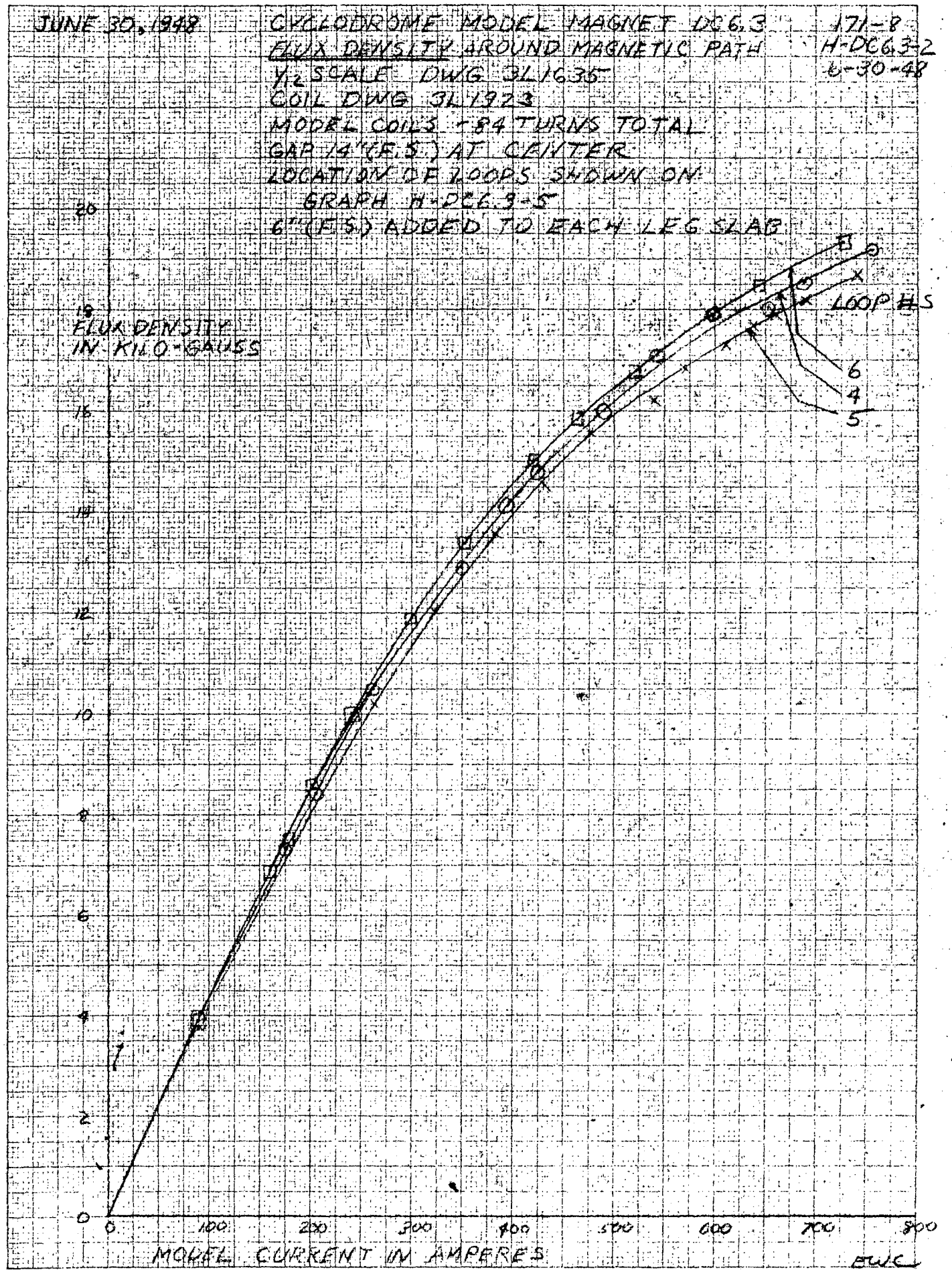
LOCATION OF LOOPS SHOWN ON GRAPH H-DC6.3-5

6" (F.S.) ADDED TO EACH LEG SLAB

171-8

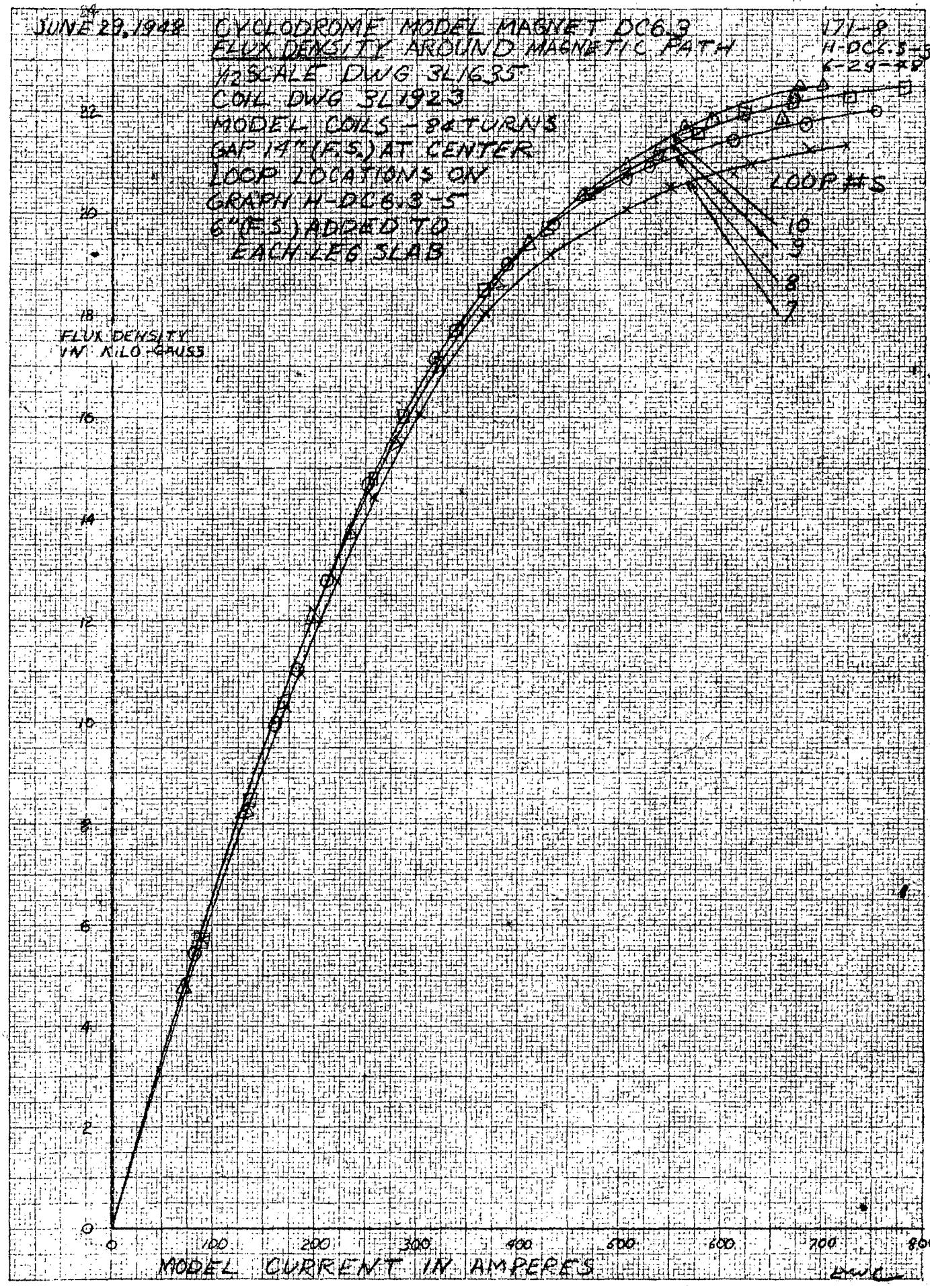
H-DC6.3-2

6-30-48



BWC

KEUFFEL & ESSER CO., N. Y. NO. 359-14 G
Millimeters, 5 mm. lines accented, cm. lines heavy.
MADE IN U.S.A.


JUNE 29, 1948 CYCLODROME MODEL MAGNET DC6.3
FLUX DENSITY AROUND MAGNETIC PATH
1/2 SCALE DWG 3L1635
COIL DWG 3L1923
MODEL COILS - 84 TURNS
GAP 1.4" (F.S.) AT CENTER
LOOP LOCATIONS ON
GRAPH H-DC6.3-5"
6" (F.S.) ADDED TO
EACH LEG SLAB
171-8
H-DC6.5-3
6-29-48
LOOP #S
10
9
8
7
FLUX DENSITY
IN KILO-GAUSS
0
2
4
6
8
10
12
14
16
18
20
22
0
100
200
300
400
500
600
700
800
MODEL CURRENT IN AMPERES

JUNE 29, 1948

CYCLODROME MODEL MAGNET DC6.3 V71-8

FLUX DENSITY AROUND MAGNET I.C. PATH

H-DC6.3-4

6-29-48

VIZ SCALE DWG SL 1635

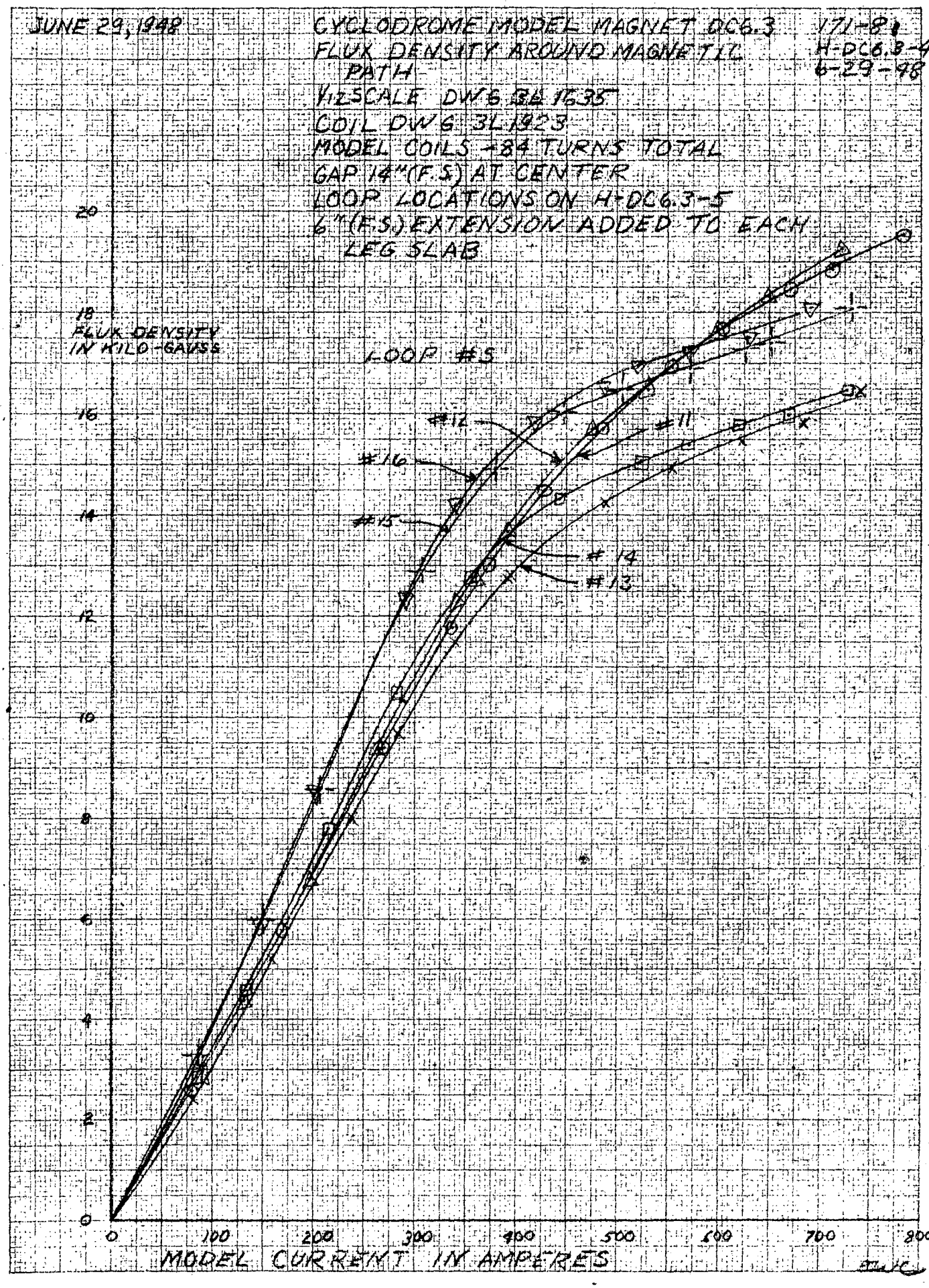
COIL DWG 3L1923

MODEL COILS -84 TURNS TOTAL

GAP 14" (F.S.) AT CENTER

LOOP LOCATIONS ON H-DC6.3-5

6" (F.S.) EXTENSION ADDED TO EACH LEG SLAB

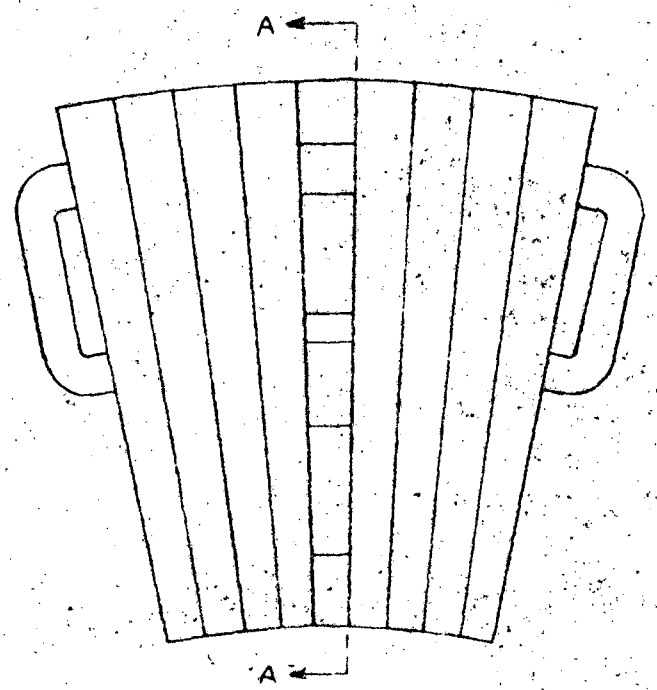


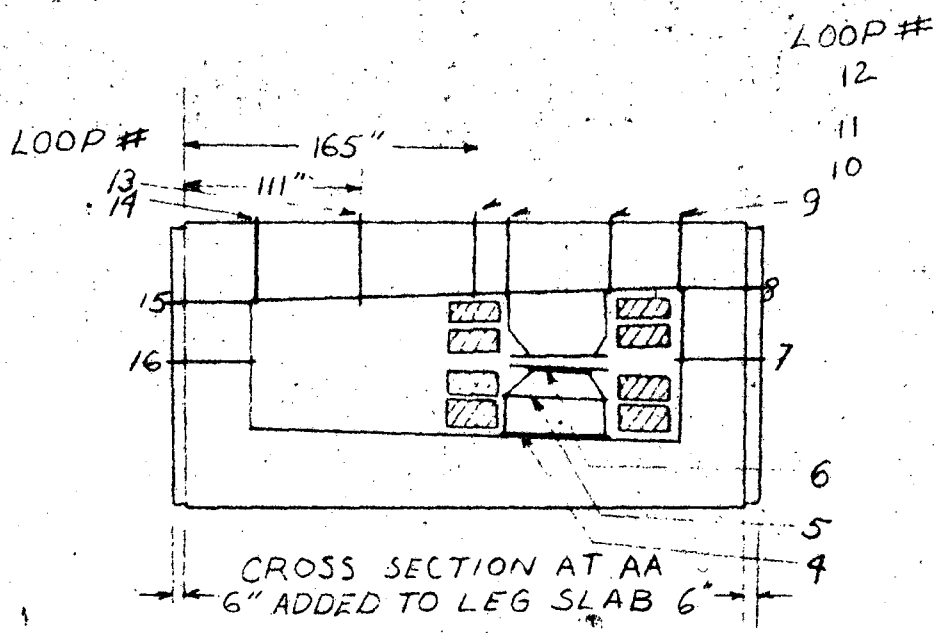
KEUFFEL & ESSER CO., N. Y. NO. 359-14 G
Millimeters, 5 mm. lines accented, cm. lines dashed.
MADE IN U.S.A.

JUNE 28, 1948

CYCLODROME MODEL MAGNET DC6.3
LOCATION OF FLUX LOOPS
1/12 SCALE DWG 3L1635
GAP 14" FULL SCALE AT CENTER
COIL DWG 3L1923
84 TURNS TOTAL ON MODEL COILS
SEE GRAPHS H-DC6.3-2, H-DC6.3-3, H-DC6.3-4

171-9
H-DC6.3-5
6-28-48



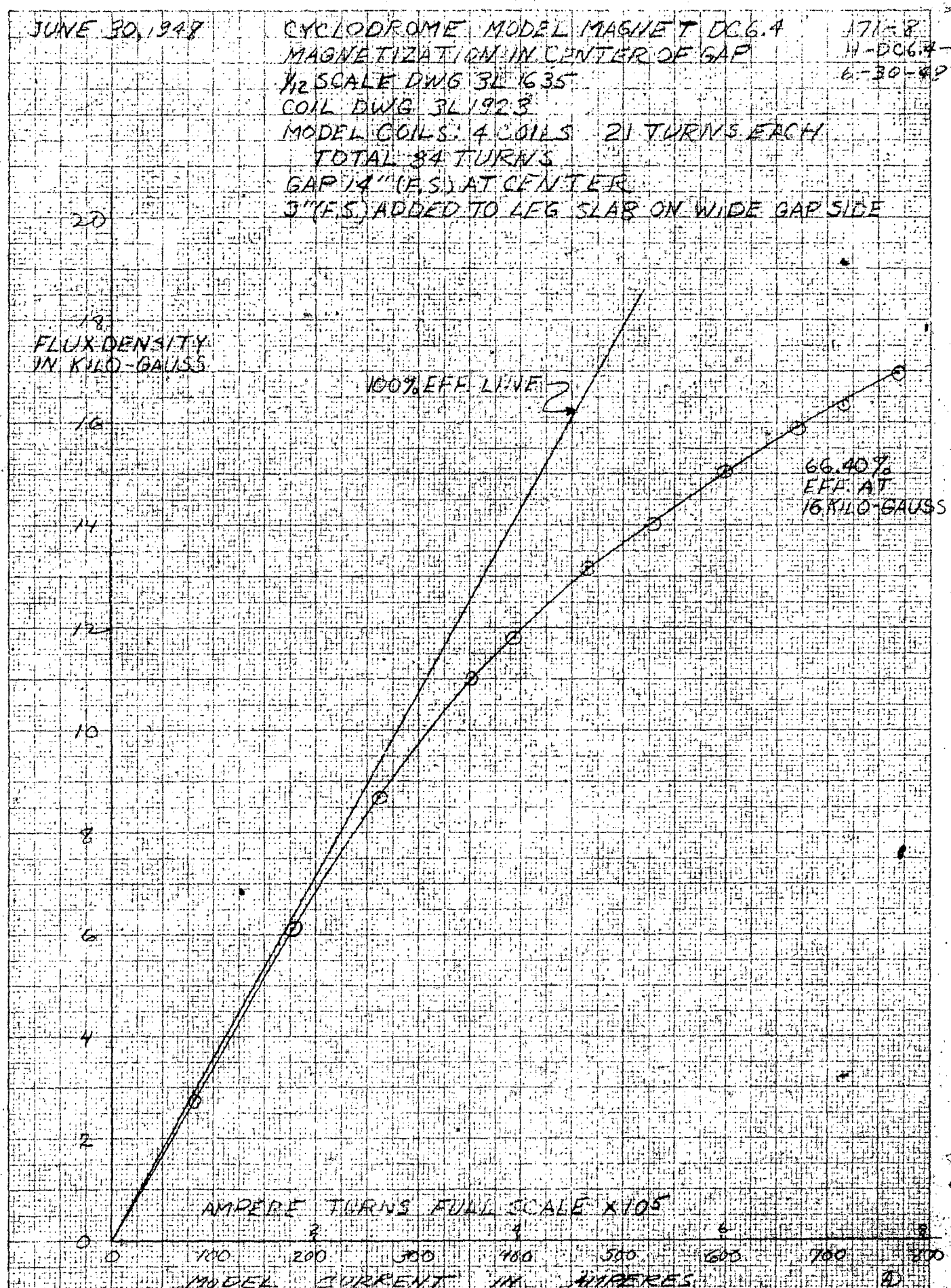


JUNE 30, 1948

CYCLODROME MODEL MAGNET DC 6.4
MAGNETIZATION IN CENTER OF GAP

171-8
11-DC6.4-
6-30-48

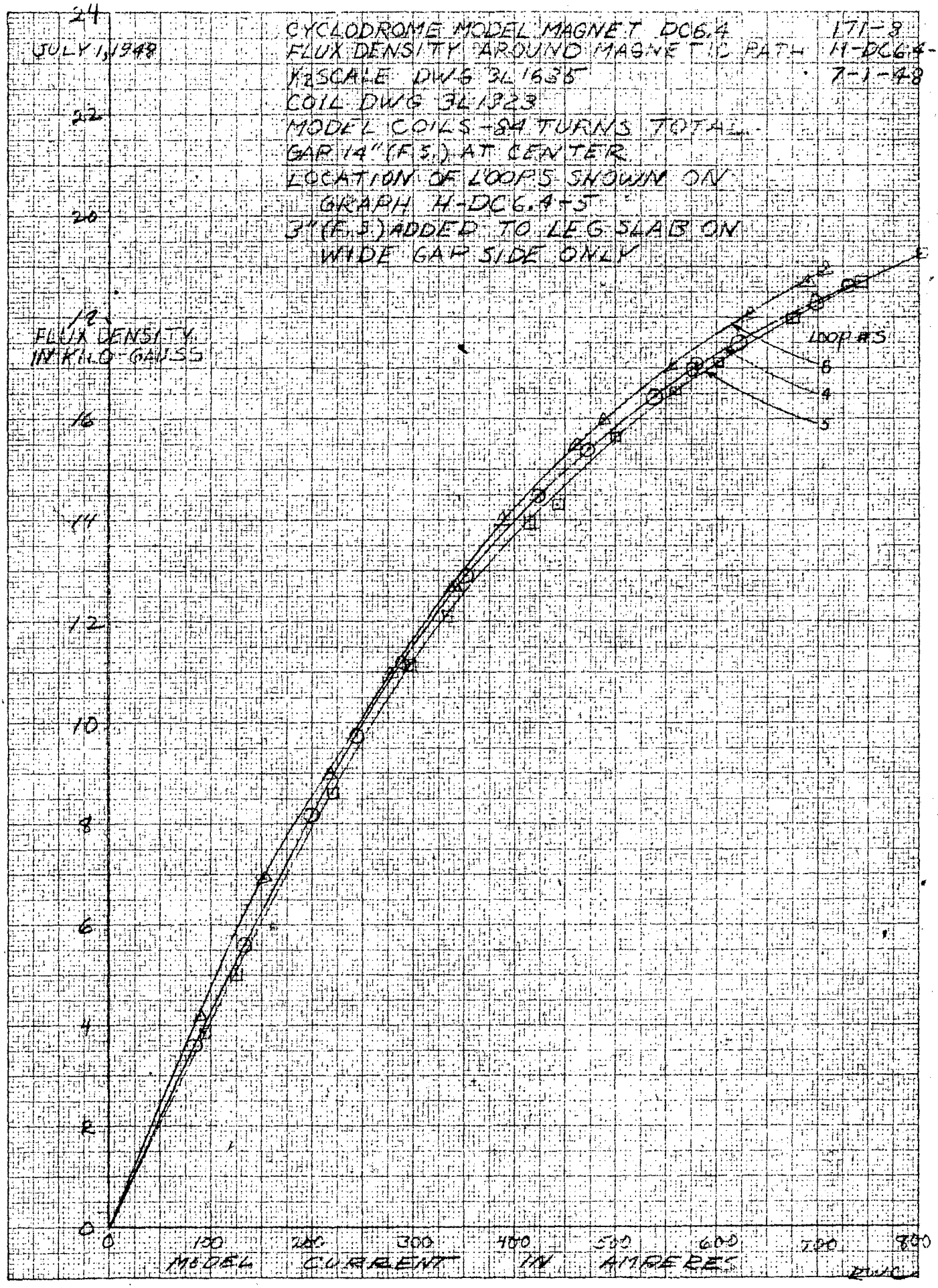
1/2 SCALE DWG 3L 1635
COIL DWG 3L 1923
MODEL COILS: 4 COILS 21 TURNS EACH
TOTAL 84 TURNS
GAP 1/4" (F.S.) AT CENTER
3" (F.S.) ADDED TO LEG SLAB ON WIDE GAP SIDE



KEUFFEL & ESSER CO., N. Y. NO. 359-146
Millimeter, 5 mm. lines accented, one inches heavy.
MADE IN U.S.A.

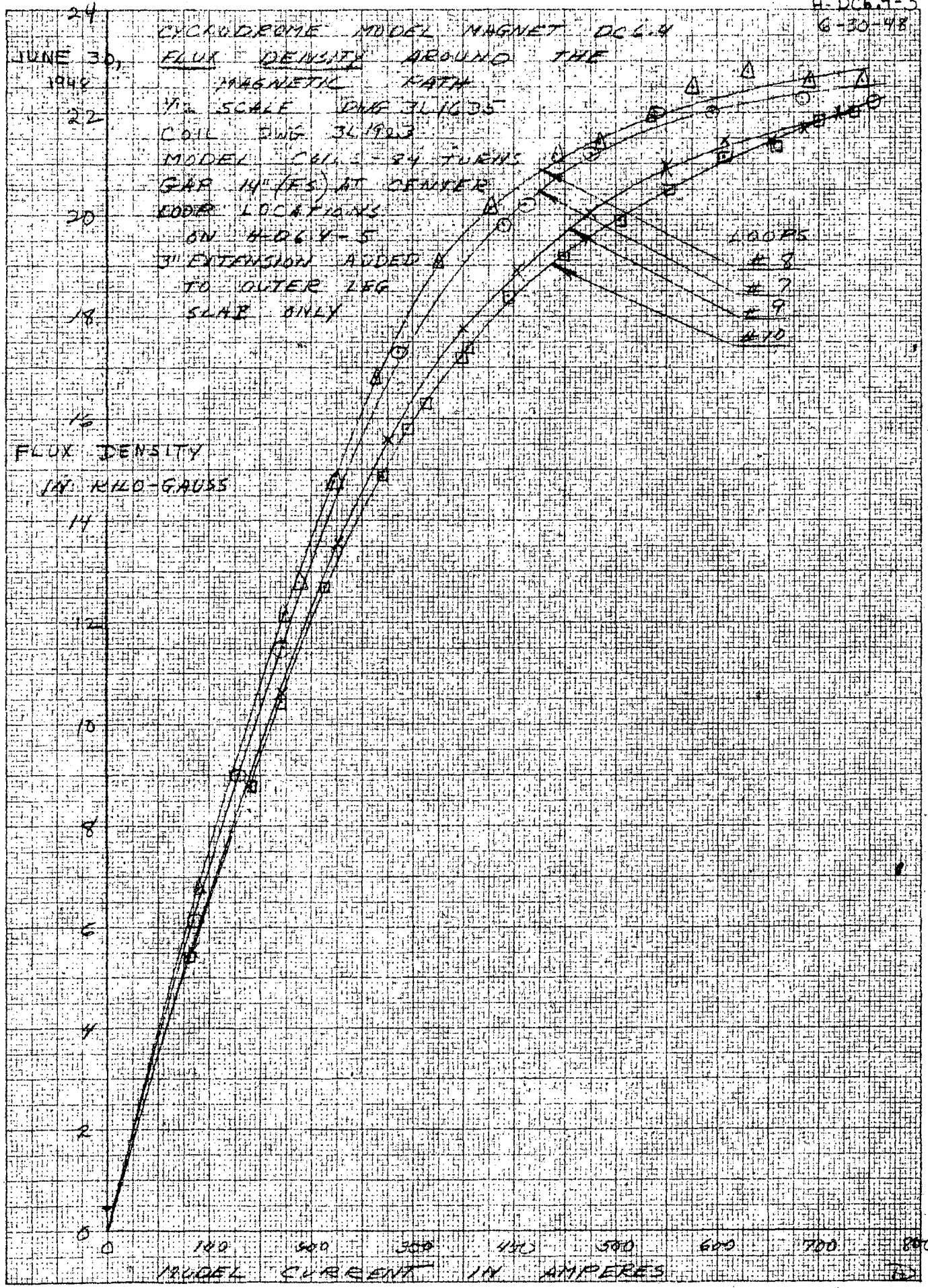
JULY 1, 1948

CYCLODROME MODEL MAGNET DC6.4 — 171-8
FLUX DENSITY AROUND MAGNETIC PATH — H-DC6.4-2
K2 SCALE DWG 3L1635 — 7-1-48
COIL DWG 3L1323
MODEL COILS - 84 TURNS TOTAL
GAP 14" (F.S.) AT CENTER
LOCATION OF LOOPS SHOWN ON GRAPH H-DC6.4-3
3" (F.S.) ADDED TO LEG SLAB ON WIDE GAP SIDE ONLY



KEUFFEL & ESSER CO., N. Y. NO. 359-14G
MADE IN U.S.A.

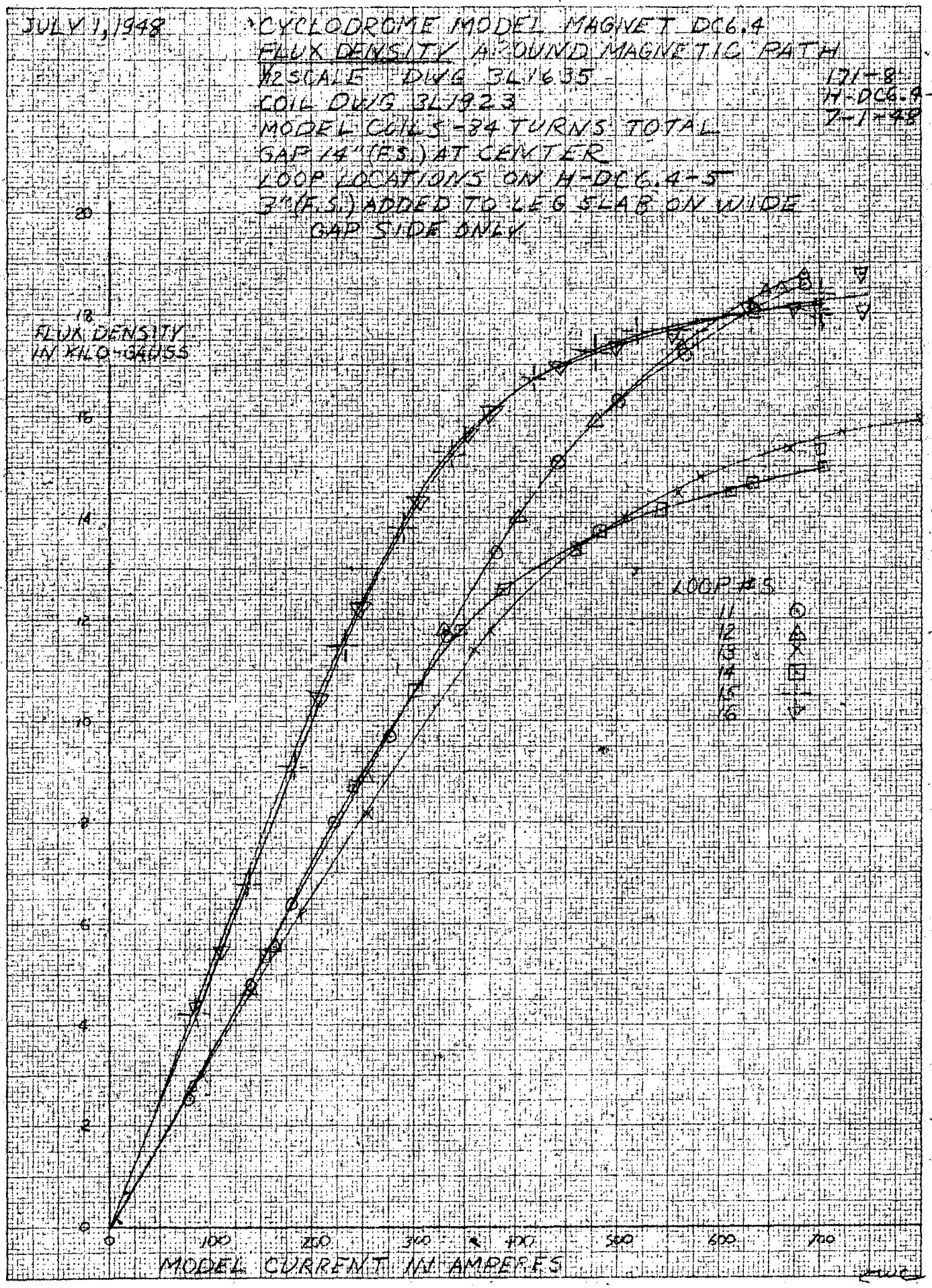
171-8
H-DC6.4-3
6-30-48



JULY 1, 1948

CYCLODROME MODEL MAGNET DC6.4
FLUX DENSITY AROUND MAGNETIC PATH
½ SCALE DWG 3L16635
COIL DWG 3L1923
MODEL COILS - 34 TURNS TOTAL
GAP 14" (EST.) AT CENTER
LOOP LOCATIONS ON H-DC6.4-5
3" (E.S.) ADDED TO LEG SLAB ON WIDE GAP SIDE ONLY

171-8
H-DC6.4-4
7-1-48



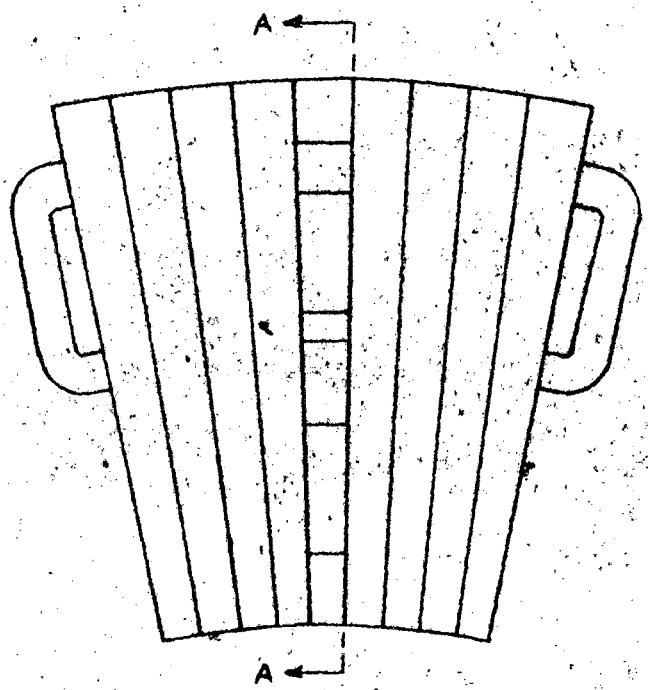
KEUFFEL & ESSER CO., N. Y. NO. 359-149
Millimeter, 5 mm. lines accented, cm. lines heavy.
MADE IN U.S.A.

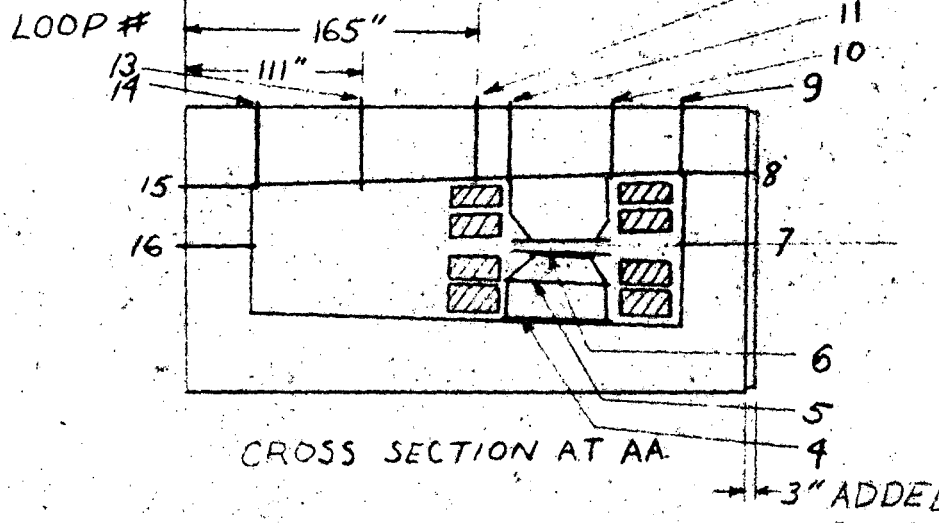
JULY 1, 1948

171-8
H-DC6.4-
7-1-48

CYCLODROME MODEL MAGNET DC6.4
LOCATION OF FLUX LOOPS

1/12 SCALE DWG 3L1635
GAP 14" FULL SCALE AT CENTER
COIL DWG 3L1923
84 TURNS TOTAL ON MODEL COILS
SEE GRAPHS H-DC6.4-2, H-DC6.4-3, H-DC6.4-4

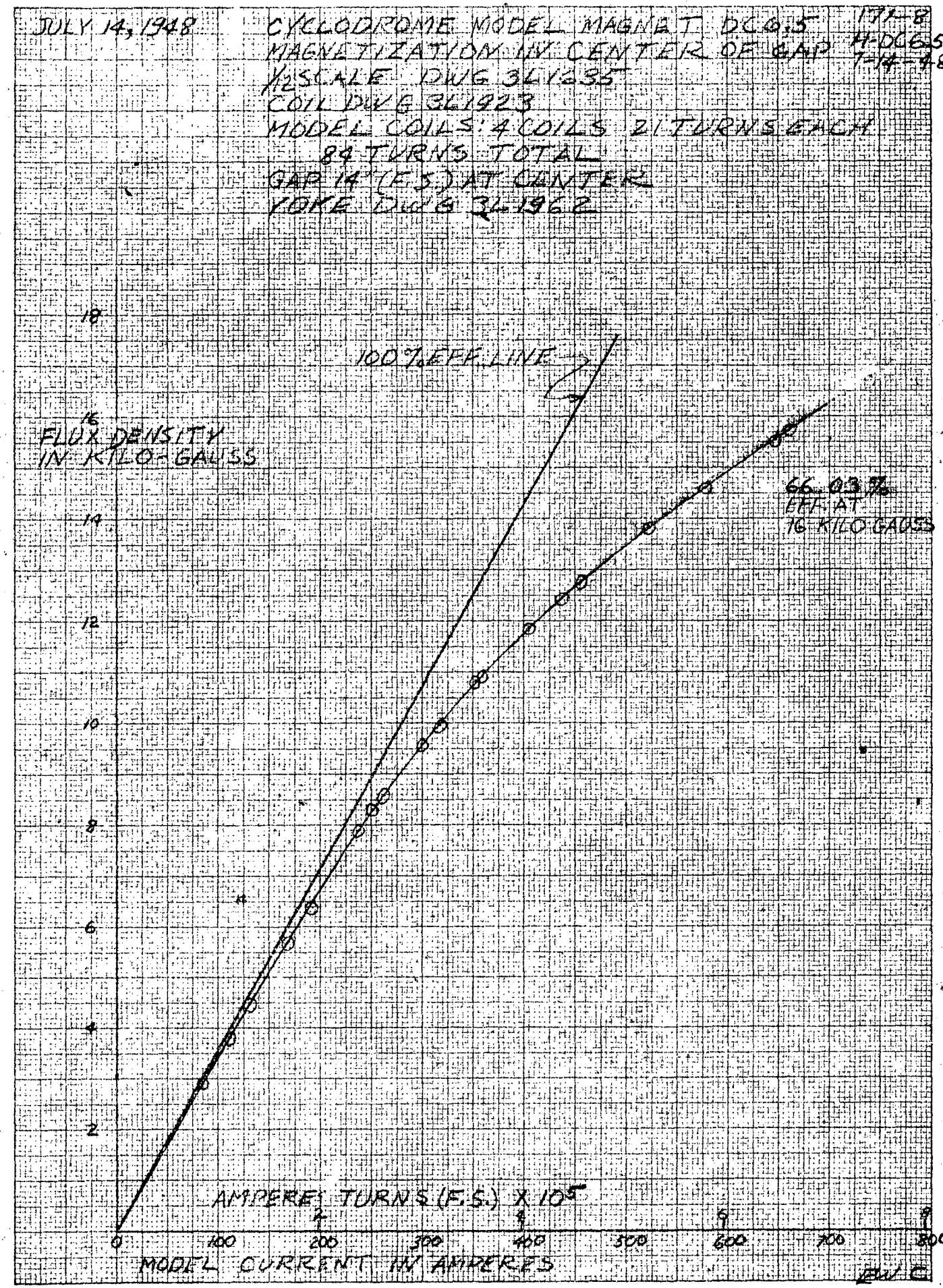




CROSS SECTION AT AA

JULY 14, 1948

CYCLOTRON MODEL MAGNET DC 0.5 171-8
MAGNETIZATION AT CENTER OF GAP M-DC65-1
7-14-48
½ SCALE DWG 3L-1935
COIL DWG 3L-1923
MODEL COILS: 4 COILS 21 TURNS EACH
84 TURNS TOTAL
GAP 14" (F.S.) AT CENTER
YOKE DWG 3L-1962



EW C

KEUFFEL & ESSER CO., N. Y. NO 169-146
Millimeter, 5 mm lines accented every fifth line
MADE IN U.S.A.

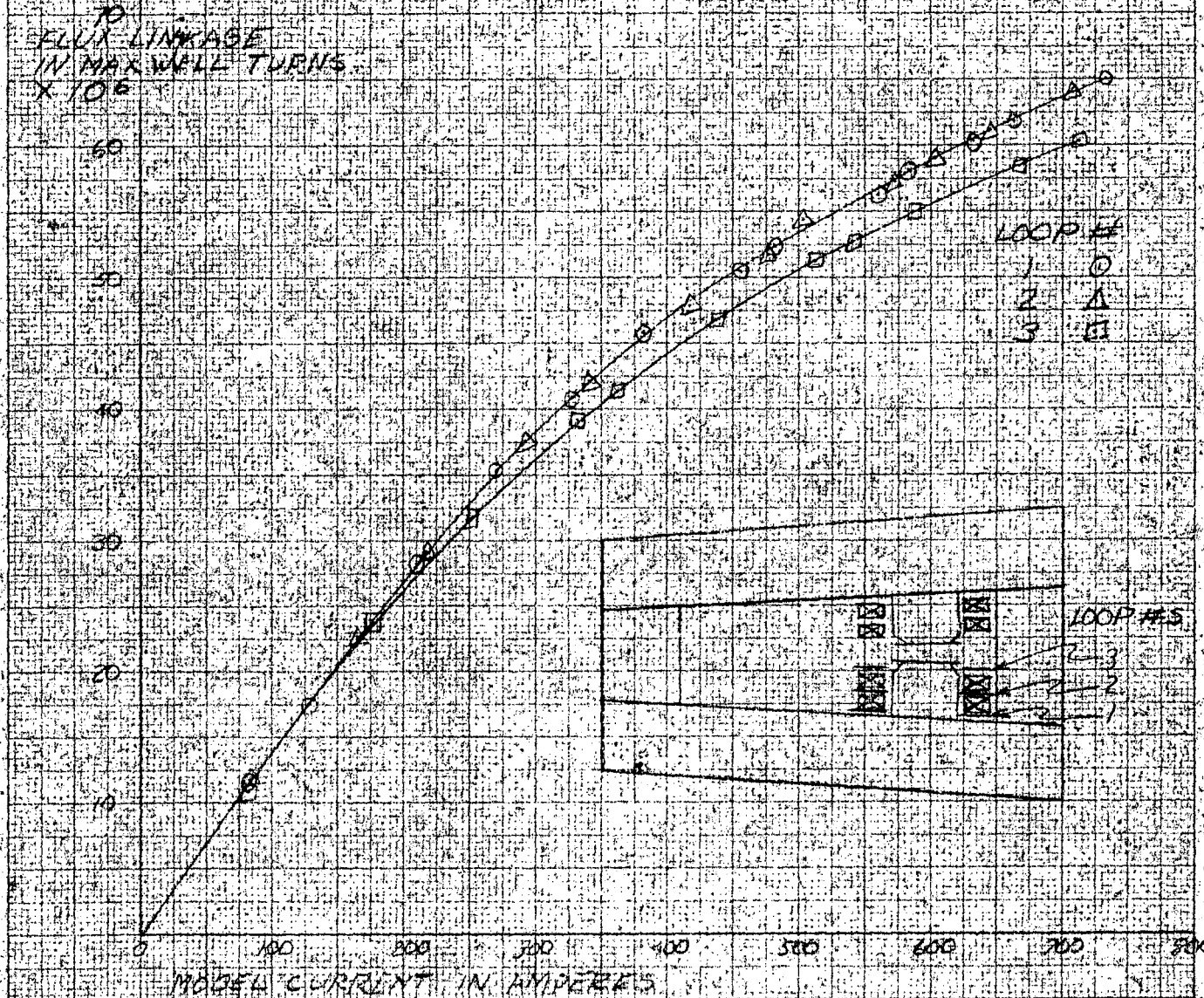
JULY 14, 1948.

CYCLODROME MODEL MAGNET DC 6,5

COIL LOOP FLUX LINKAGE

171-8
F-DC6.5-1
7-19-48

VIA SCALE
COIL DRAWING 3L1923
MODEL COILS: 4 COILS 21 TURNS EACH
84 TURNS
GAP 14 (F.S.) AT CENTER
YOKE DWG 3L1962
EACH LOOP HAS 21 TURNS
FLUX LINKAGE IS ON 5.56 SECTION
OF MODEL



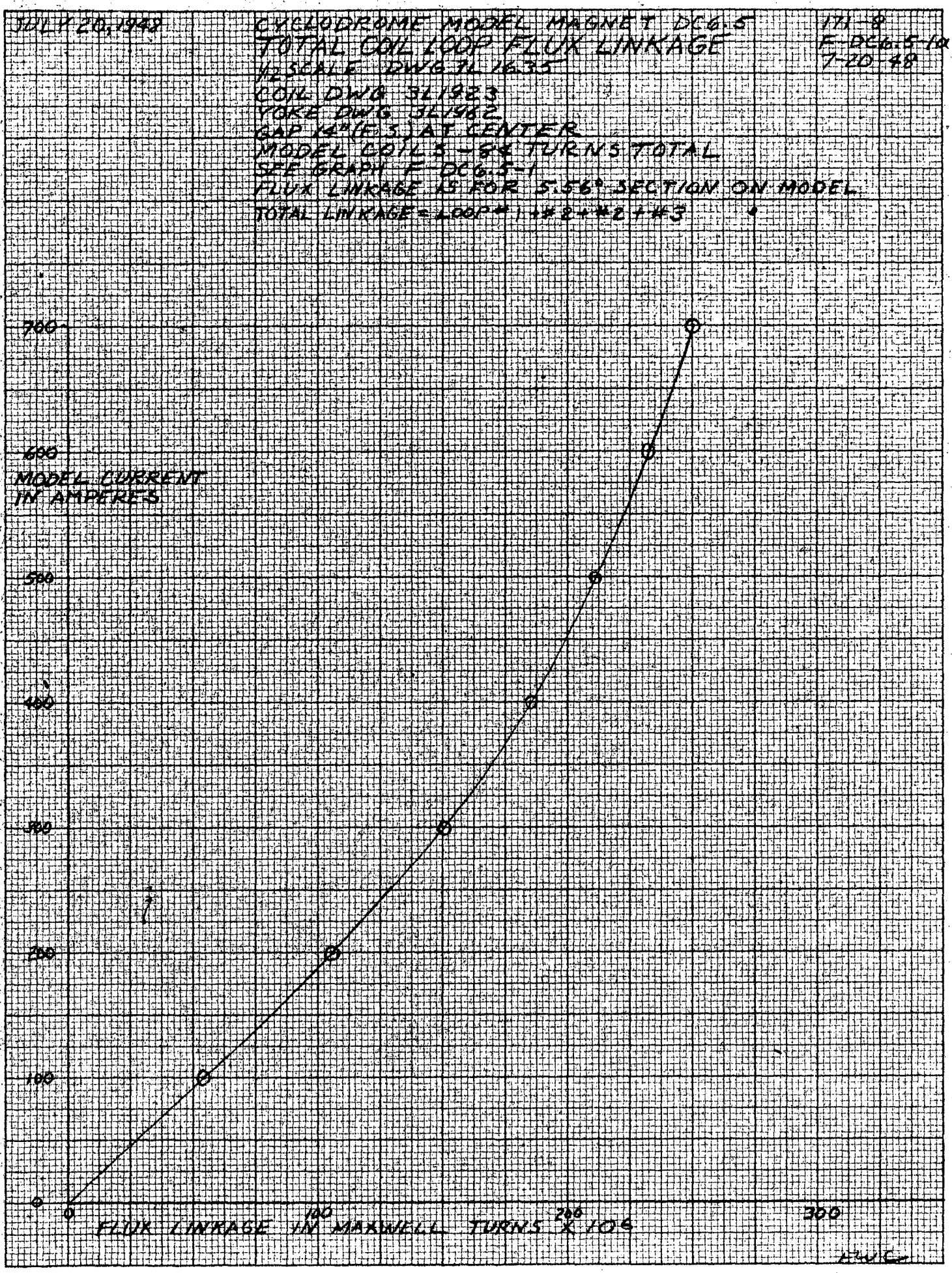
EWC

KEUFFEL & ESSER CO., N. Y. NO. 389-140
Millimeter, 5 mm. lines accented, cm. lines heavy.
MADE IN U.S.A.

JULY 20, 1949

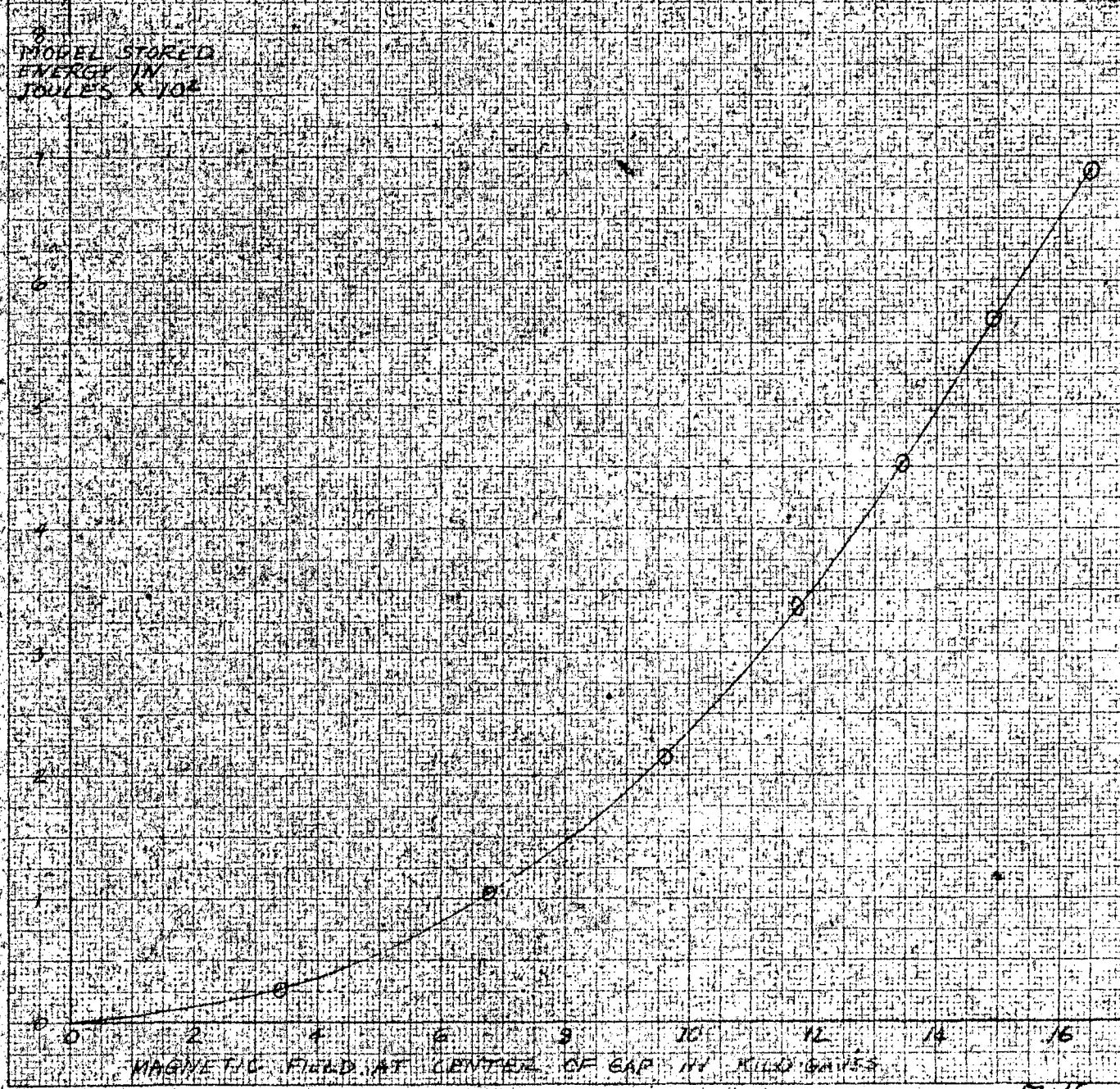
CYCLODROME MODEL MAGNET DC6.5
TOTAL COIL LOOP FLUX LINKAGE
½ SCALE DWG TL 16.35
COIL DWG 3L1923
YOKE DWG 3L1962
GAP 14" (6.3) AT CENTER
MODEL COIL 3-54 TURNS TOTAL
SEE GRAPH F-DC6.5-1
FLUX LINKAGE AS FOR 5.56° SECTION ON MODEL
TOTAL LINKAGE = 4 COIL #1 + #2 + #2 + #3

171-8
F-DC6.5-1A
7-20-49



KEUFFEL & ESSER CO., N. Y. NO. 3597-12G
10 × 10 to the ¼ inch, 5th lines accented.
Engraving 7½ × 10 in.
MADE IN U.S.A.

JULY 20, 1948 CYCLODROME MODEL MAGNET DC6.5 171-8
STORED ENERGY ON MODEL E-DC6.5-1
1/2 SCALE DWG 3L1635 7-20-48
COIL DWG 3L1923
YOKE DWG 3L1962
CALCULATED FROM TOTAL COIL LOOP
FLUX LINKAGE - SEE GRAPH
F-DC6.5-1a
ENERGY (JOULES) = $10^{-8}\int_0^I I\,d\phi$
WHERE I IS IN AMPERES
ϕ IS IN MAXWELL TURNS
DATA IS FOR A 5.56° SECTION OF MODEL

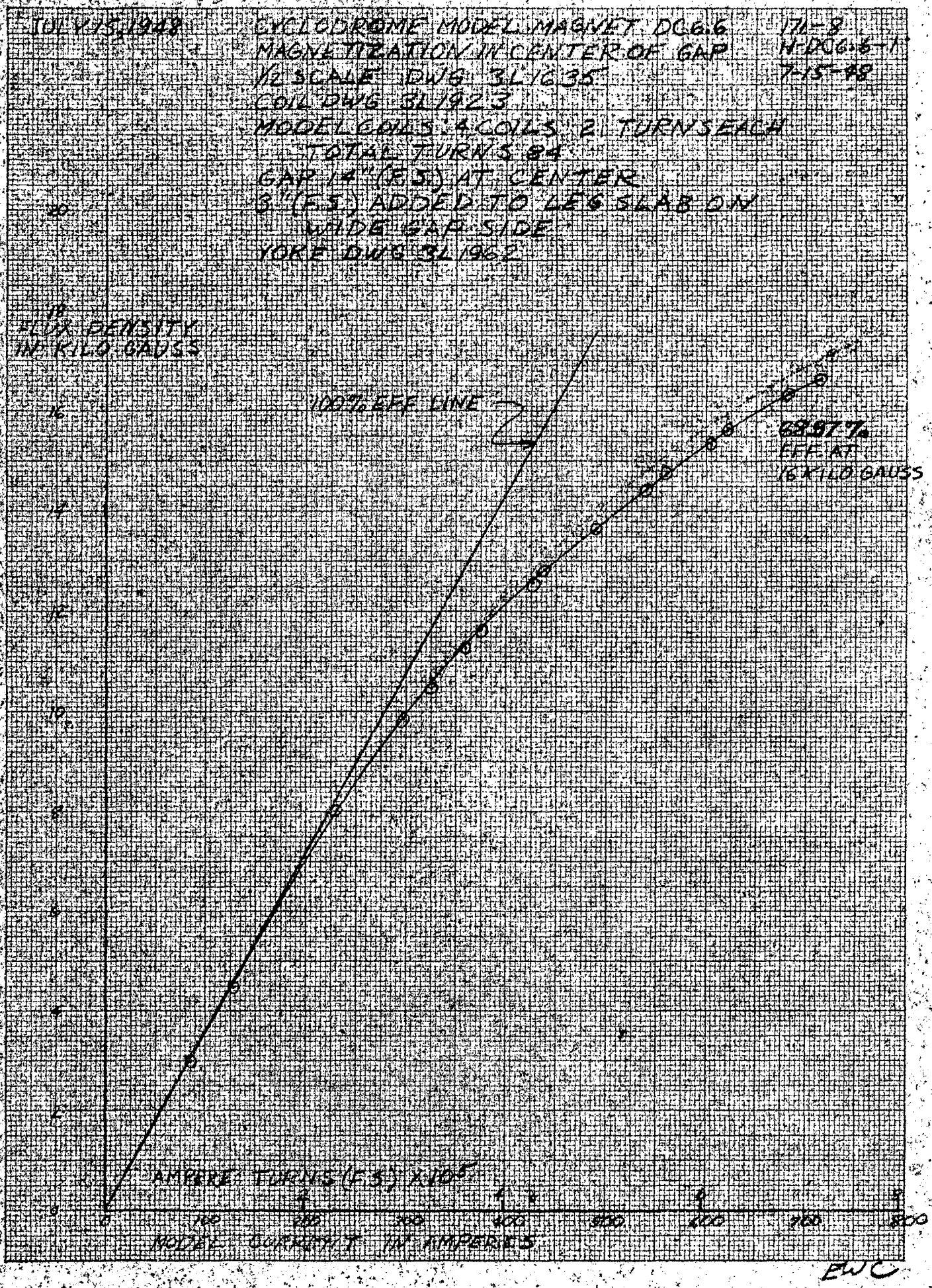


EWC

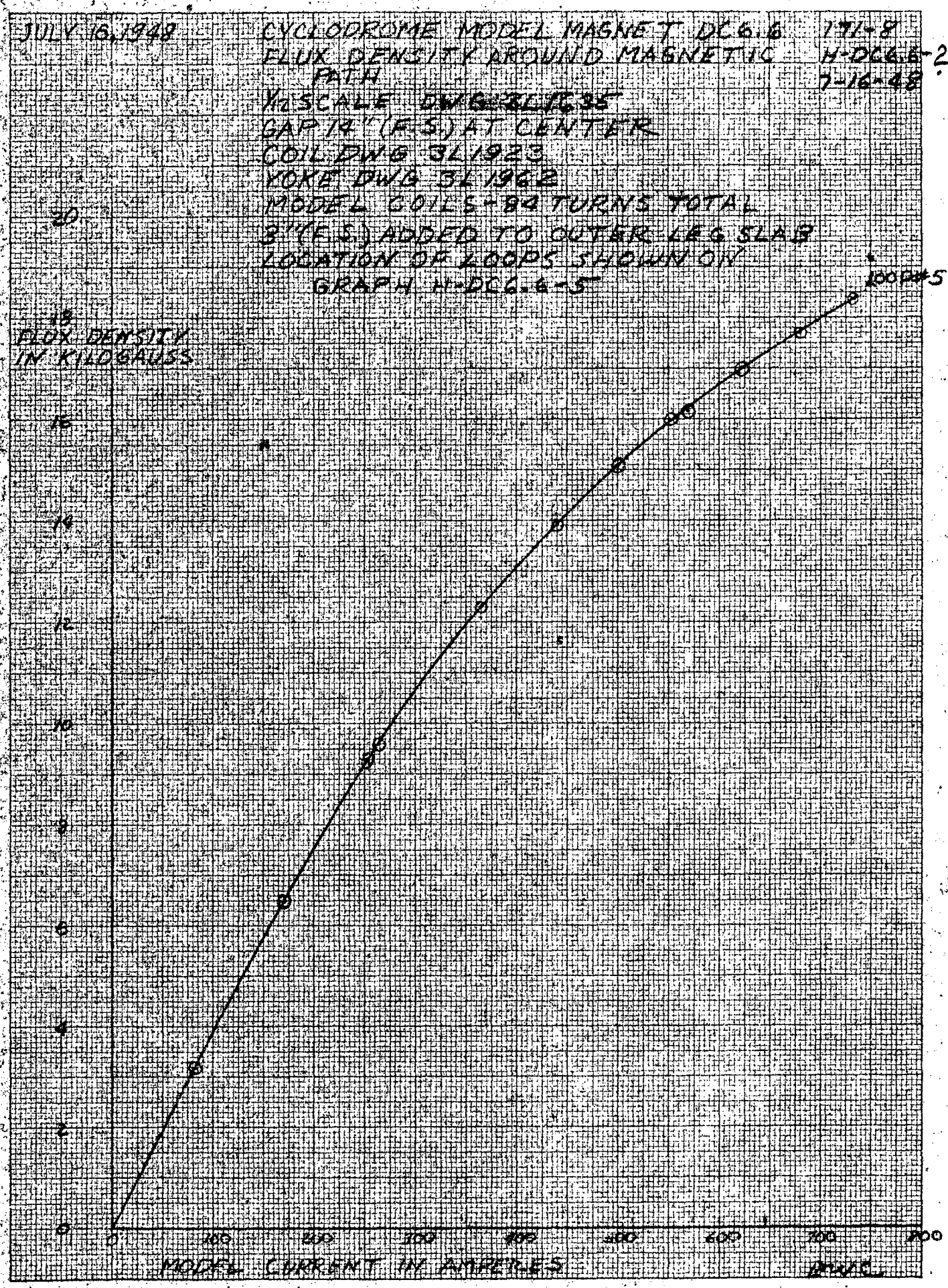
JULY 15, 1948

CYCLOTRON MODEL MAGNET DC6.6
MAGNETIZATION IN CENTER OF GAP
1/2 SCALE DWG 3L/G35
COIL DWG 3L1923
MODEL COILS: 4 COILS 2 TURNS EACH
TOTAL TURNS 84
GAP 1.4" (F.S.) AT CENTER
3" (F.S.) ADDED TO LEG SLABS ON
WIDE GAP SIDE
YOKE DWG 3L1962

17L-8
M-DC6.6-1
7-15-48

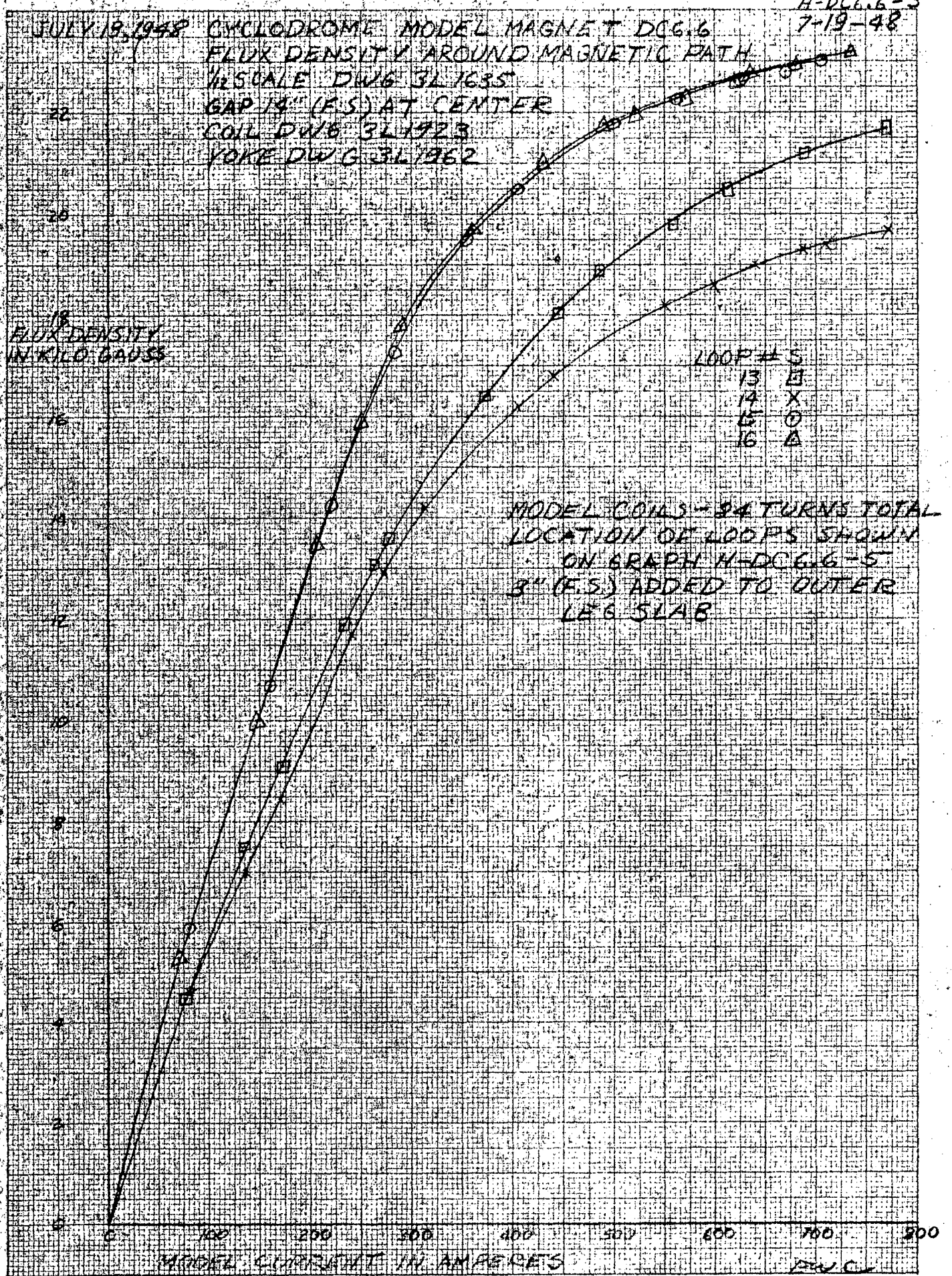


EWC


JULY 16, 1948
CYCLODROME MODEL MAGNET DC6.6
FLUX DENSITY AROUND MAGNETIC PATH
1/12 SCALE DWG 3L1635
GAP 14" (F.S.) AT CENTER
COIL DWG 3L1923
YOKE DWG 3L1962
MODEL COILS - 84 TURNS TOTAL
3" (F.S.) ADDED TO OUTER LEG SLAB
LOCATION OF LOOPS SHOWN ON GRAPH H-DC6.6-5
171-8
H-DC6.6-2
7-16-48
LOOP #5
FLUX DENSITY IN KILOGAUSS
0
2
4
6
8
10
12
14
16
18
20
0
100
200
300
400
500
600
700
800
MODEL CURRENT IN AMPERES

171-8
H-DC6.6-3
7-19-48

JULY 19, 1948 CYCLODROME MODEL MAGNET DC6.6
FLUX DENSITY AROUND MAGNETIC PATH
½ SCALE DWG 3L1635
GAP ¼" (F.S.) AT CENTER
COIL DWG 3L1723
YOKE DWG 3L1962



MODEL COILS - 24 TURNS TOTAL
LOCATION OF LOOPS SHOWN
ON GRAPH H-DC6.6-5
3" (F.S.) ADDED TO OUTER
LEG SLAB

DWG C

171-8

JULY 19, 1948

CYCLODROME MODEL MAGNET DC6.6 H-DC6.6-4

FLUX DENSITY AROUND MAGNETIC PATH 7-19-48

½ SCALE DWG 3L1635

GAP 14" (E.S.) AT CENTER

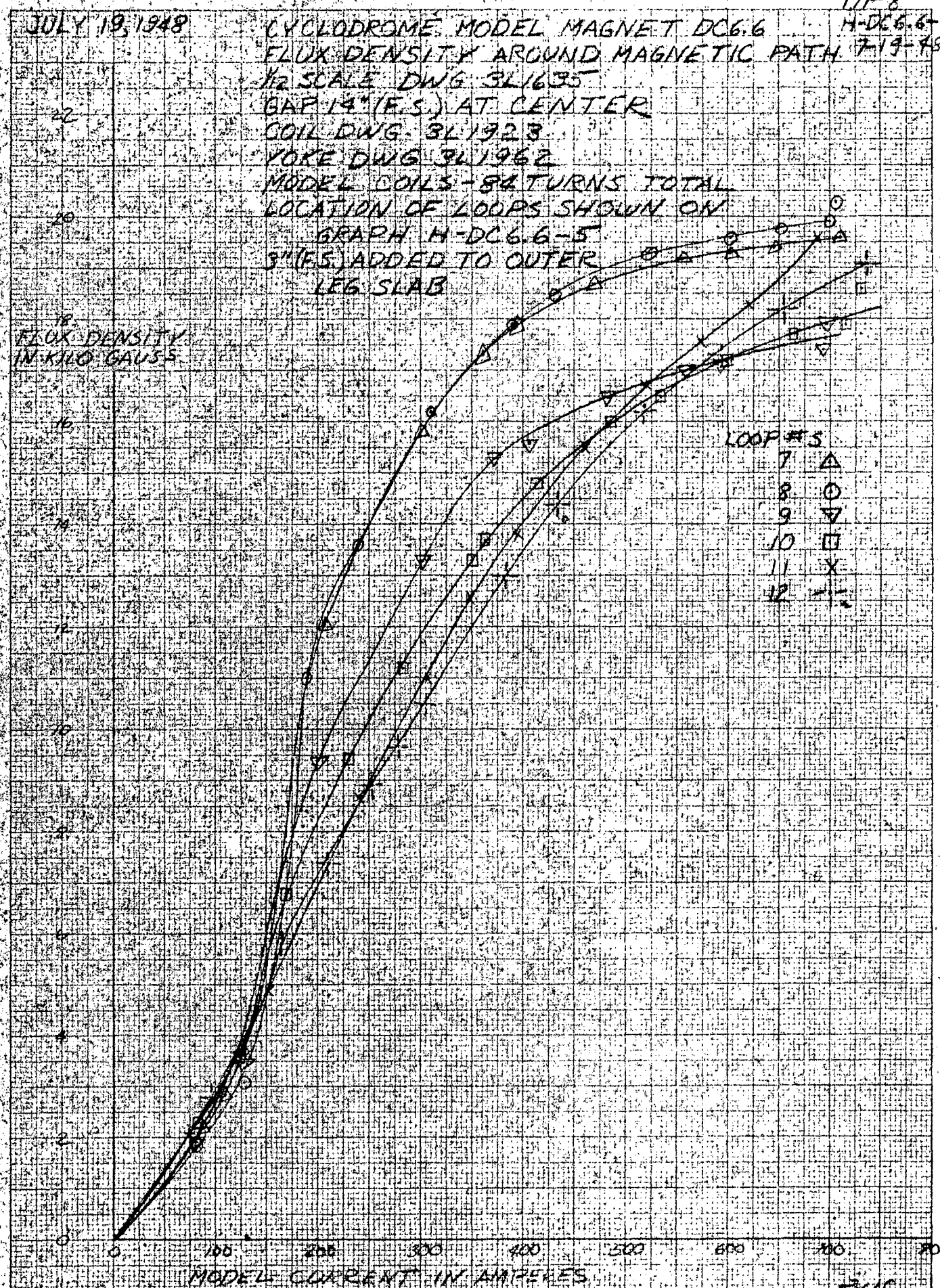
COIL DWG 3L1923

YOKE DWG 3L1962

MODEL COILS - 84 TURNS TOTAL

LOCATION OF LOOPS SHOWN ON GRAPH H-DC6.6-5

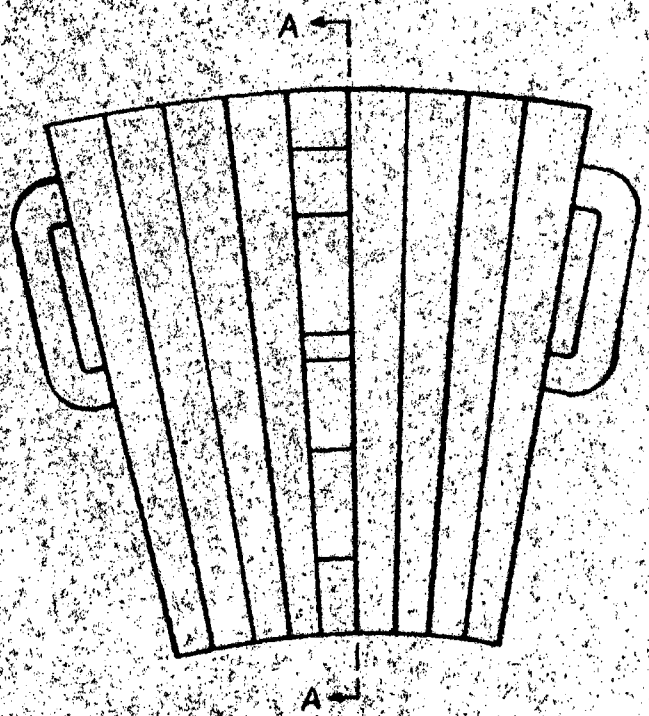
3" (E.S.) ADDED TO OUTER LEG SLAB

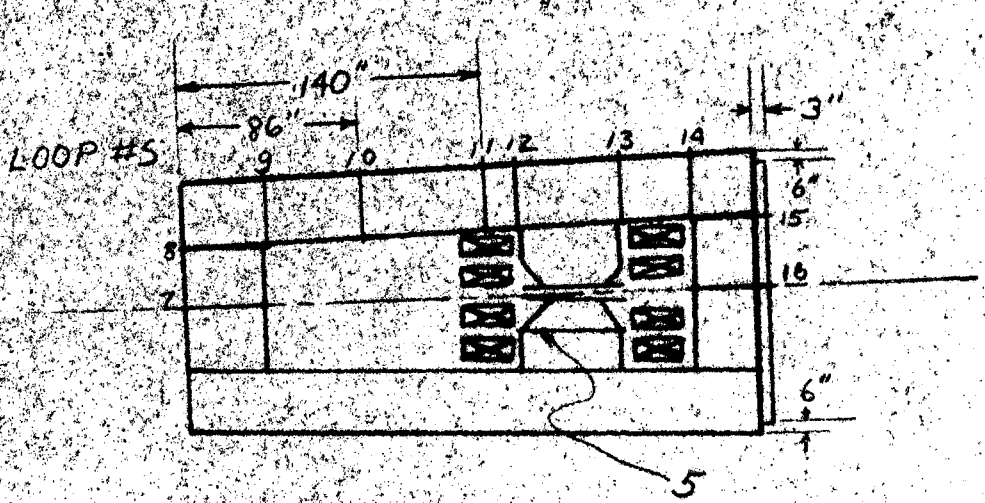


JULY 19, 1948

171-8
H-DC6.6-5
7-19-48

CYCLODROME MODEL MAGNET DC6.6
LOCATION OF FLUX LOOPS
1/12 SCALE DWG 3L 1635
COIL DWG 3L 1823
YOKE DWG. 3L 1962
84 TURNS TOTAL ON MODEL COILS
3" (F.S.) ADDED TO OUTER LEG SLAB
GAP 14" (F.S.) AT CENTER
SEE GRAPHS H-DC6.6-2 H-DC6.6-3 H-DC6.6-4

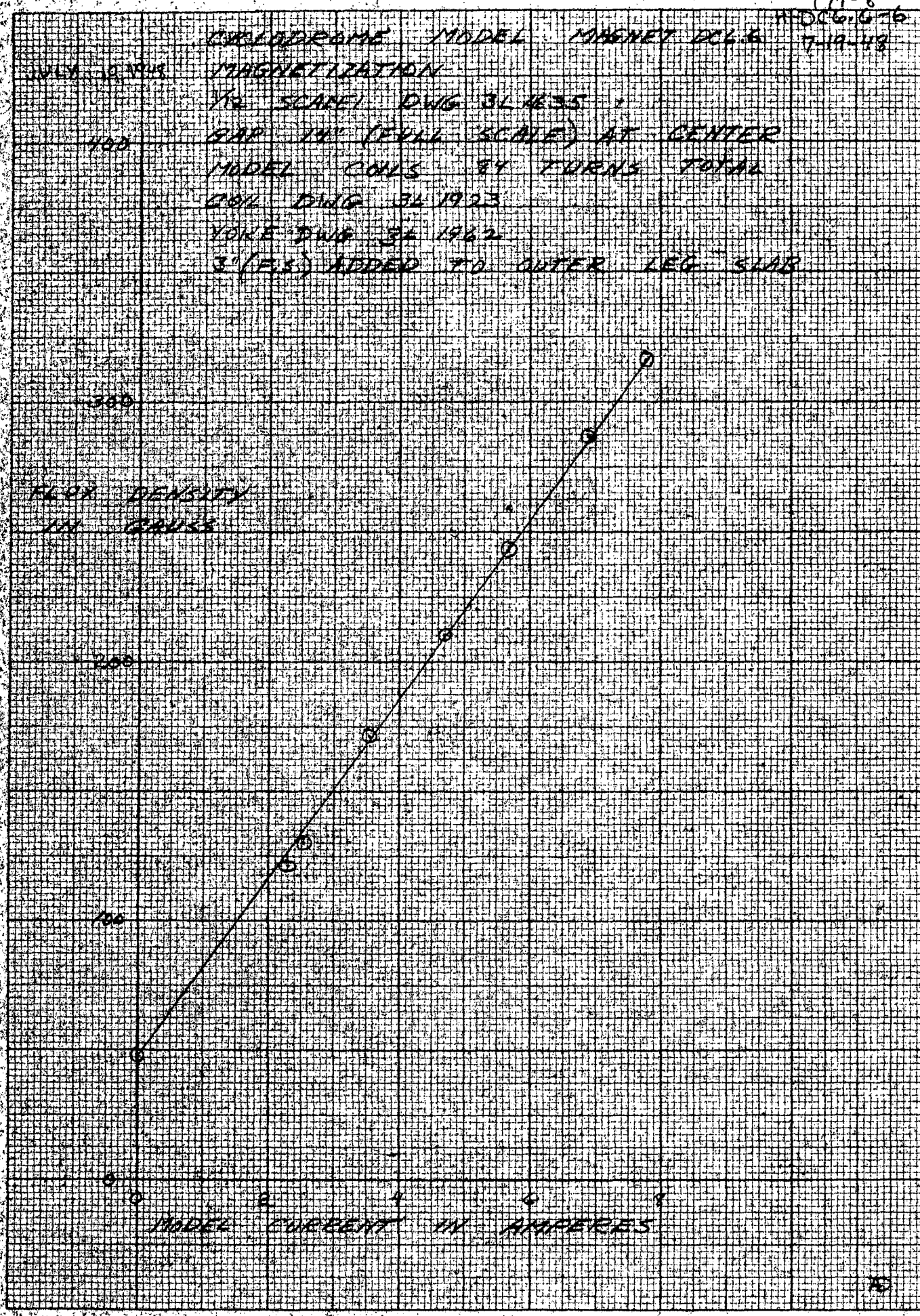




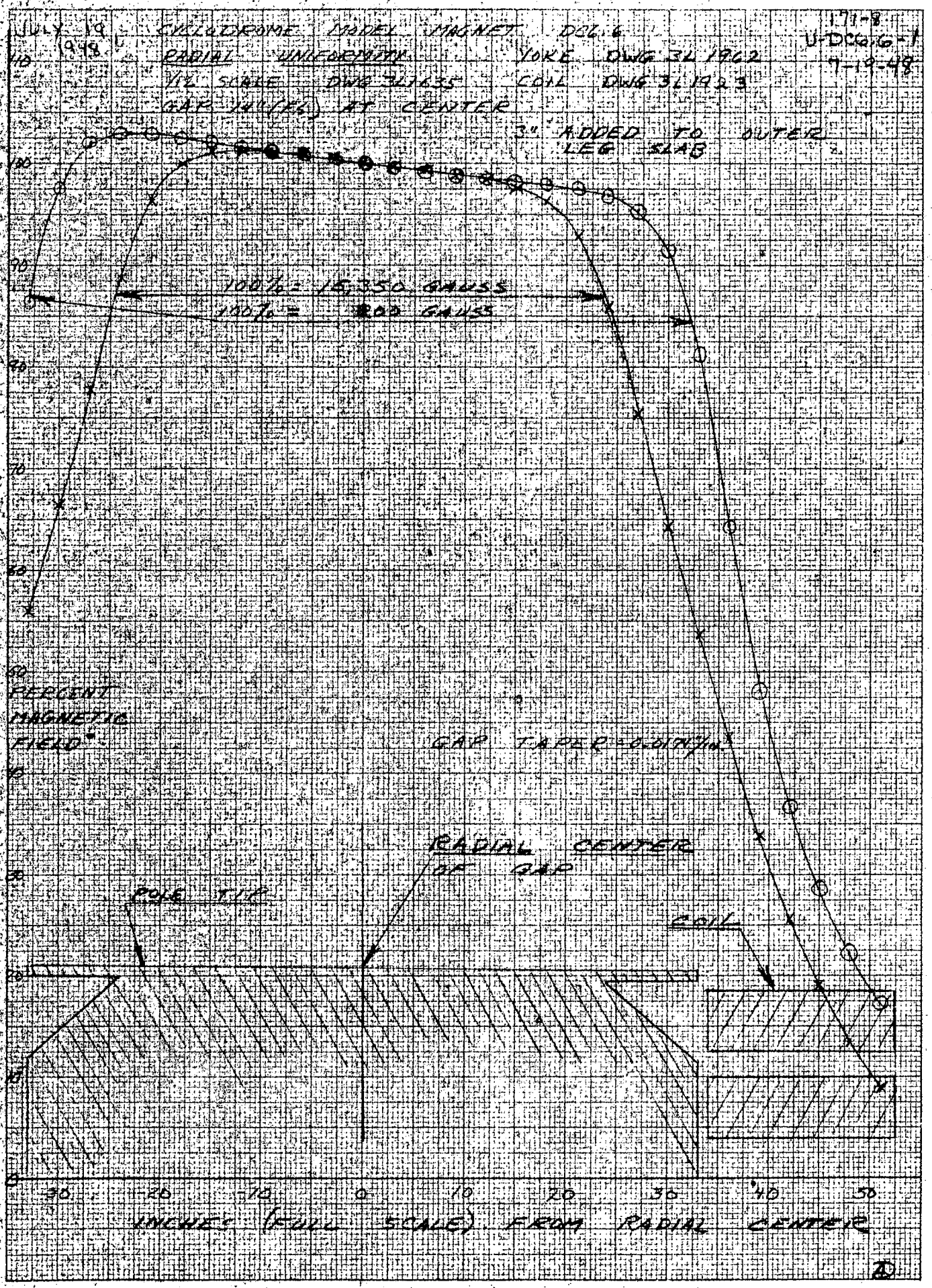
CROSS SECTION AT AA

EWC

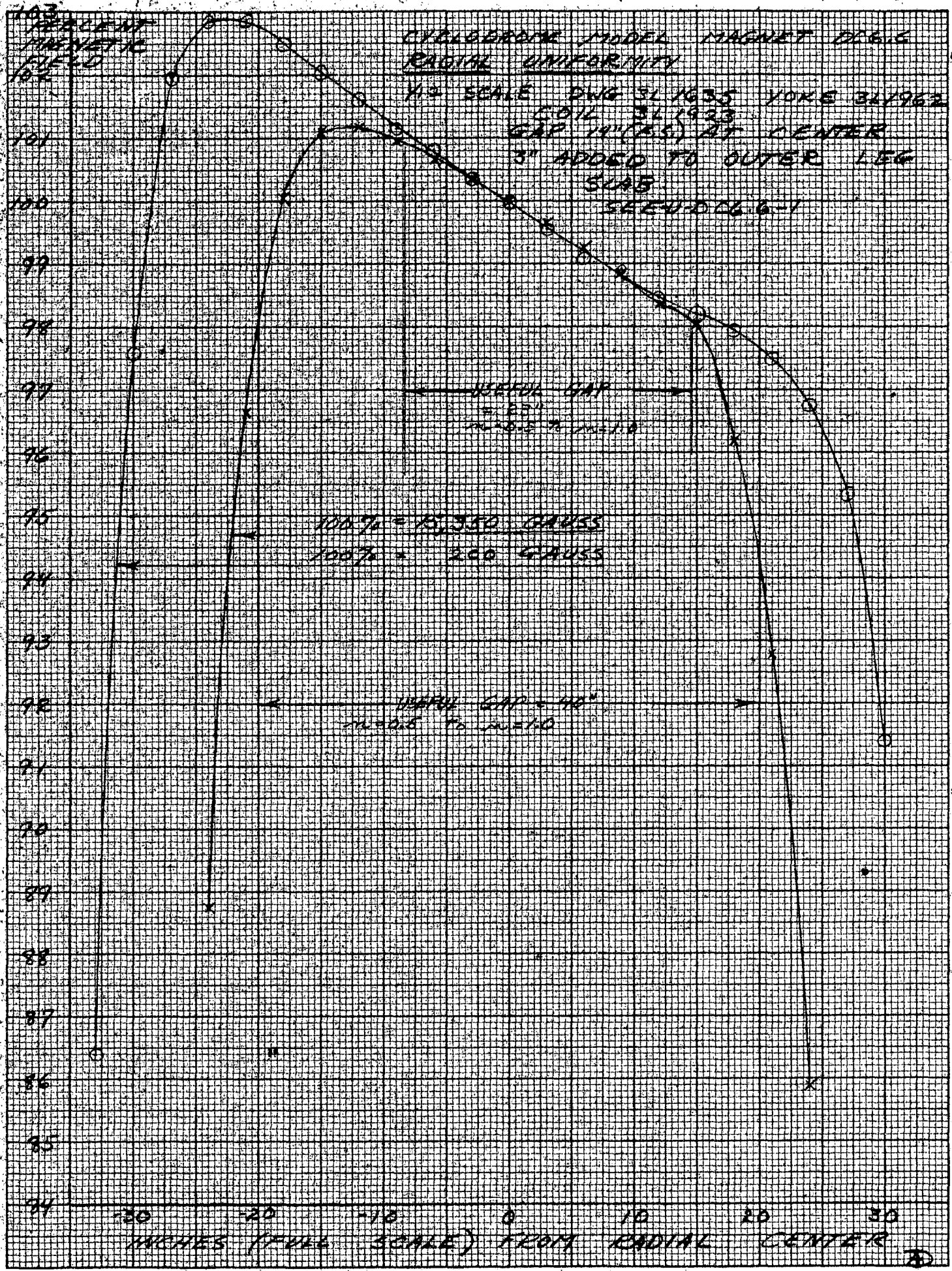
171-8
H-DC6.6-6
7-19-48



EUGENE DIETZGEN CO.
PRINTED IN U.S.A.
NO. 340-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH


JULY 19 1948
CYCLODROME MODEL MAGNET DCL 6
RADIAL UNIFORMITY
YOKE DWG 3L 1962
1/12 SCALE DWG 3L1635
COIL DWG 3L 1923
GAP 14" (FS) AT CENTER
3" ADDED TO OUTER LEG SLAB
171-8
U-DCG.6-1
7-19-48
100% = 15,350 GAUSS
100% = 800 GAUSS
PERCENT MAGNETIC FIELD
GAP TAPER = 0.0174"/in.
RADIAL CENTER OF GAP
POLE TIP
COIL
INCHES (FULL SCALE) FROM RADIAL CENTER

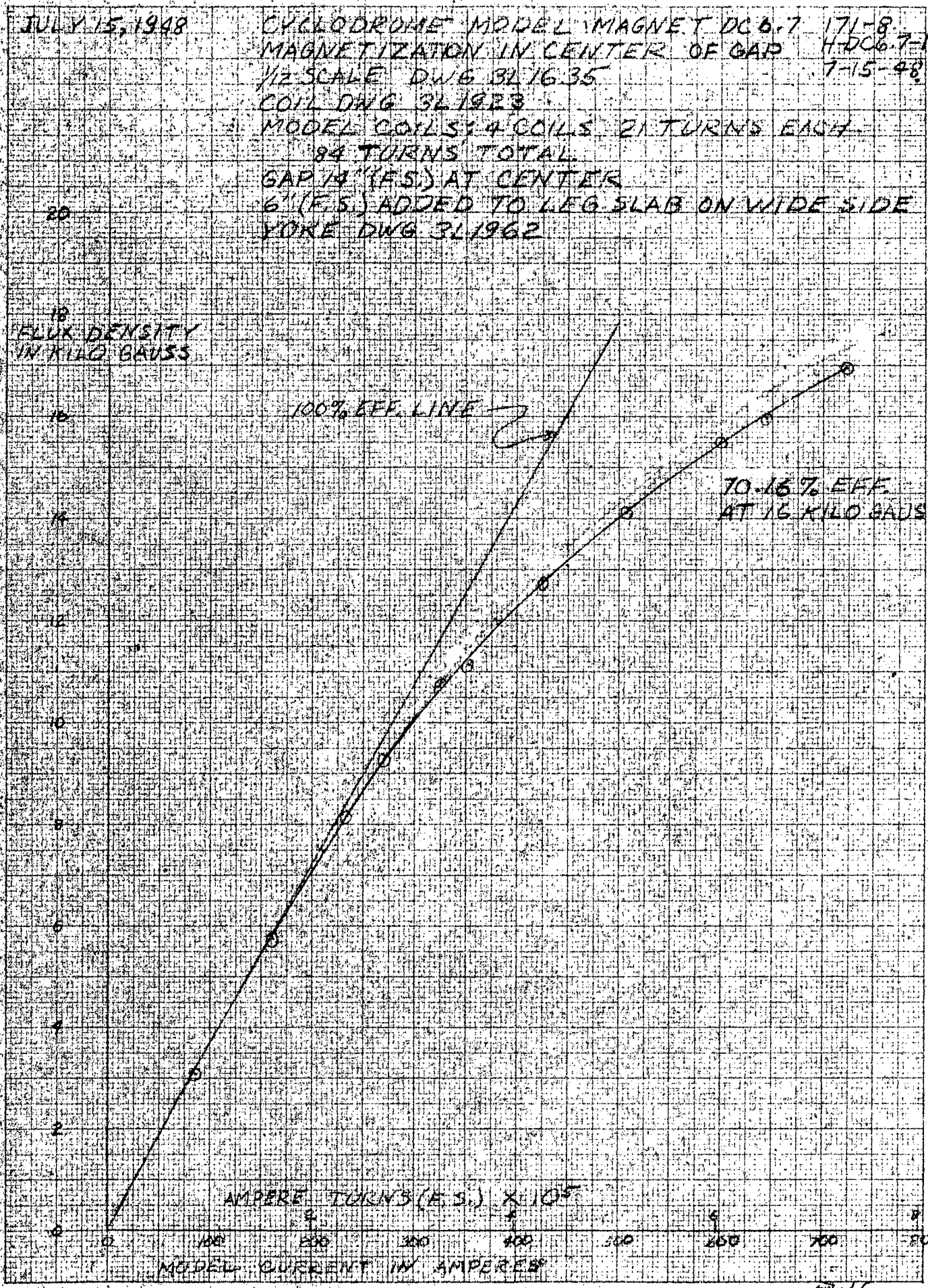
171-8
U-DC6.6-10
7-19-48



KEUFFEL & ESSER CO. N. Y. - NO. 3397-120
10 X 10 to the ¼ inch 5th lines accented.
Engraving 7½ X 10 in.
MADE IN U.S.A.

JULY 15, 1948

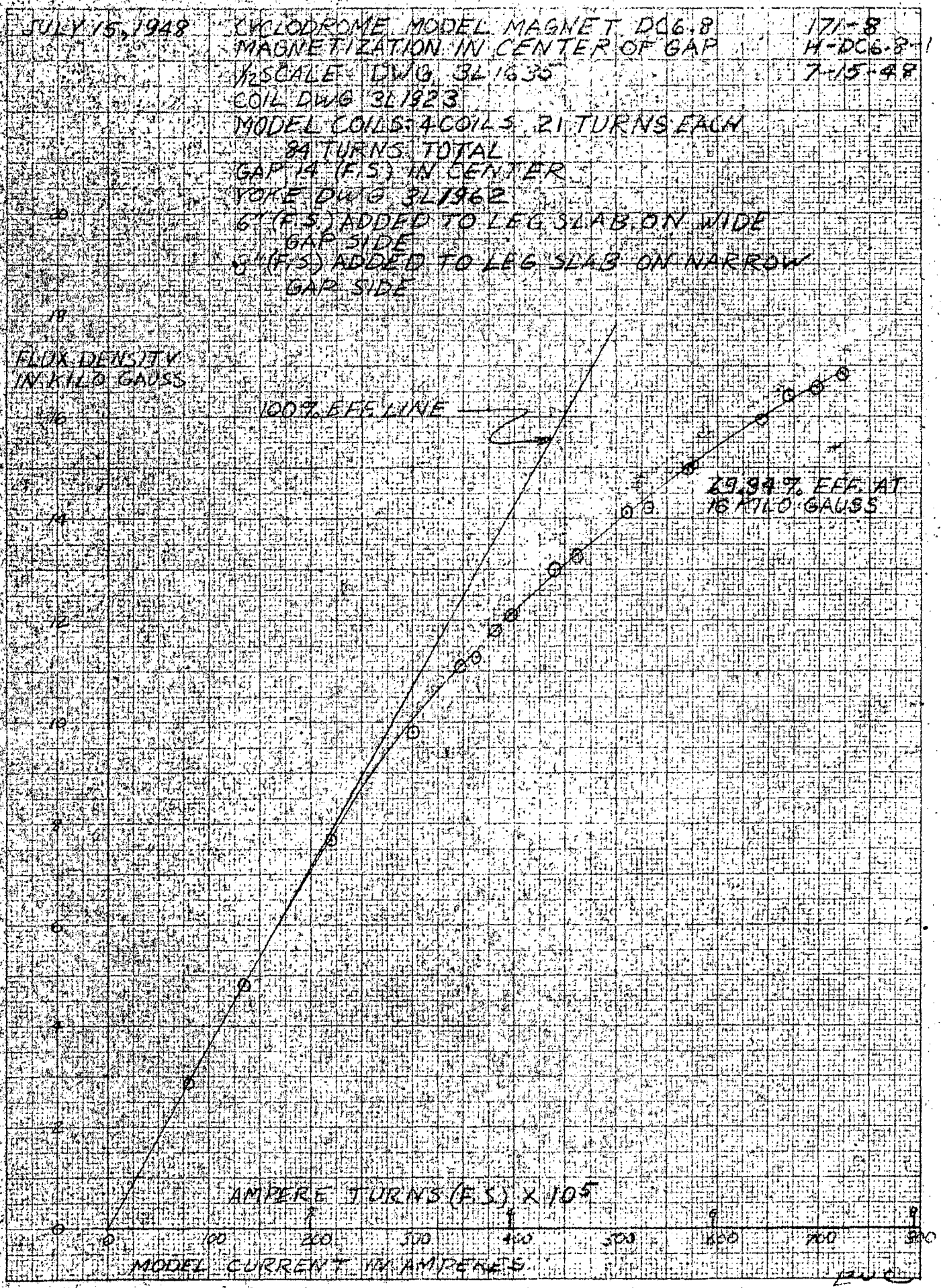
CYCLODROME MODEL MAGNET DC 6.7 171-8.
MAGNETIZATION IN CENTER OF GAP H-DC6.7-1
7-15-48.
½ SCALE DWG 32 1635
COIL DWG 32 1923
MODEL COILS: 4 COILS 21 TURNS EACH
84 TURNS TOTAL
GAP 1/4" (F.S.) AT CENTER
6" (F.S.) ADDED TO LEG SLAB ON WIDE SIDE
YOKE DWG 32 1962



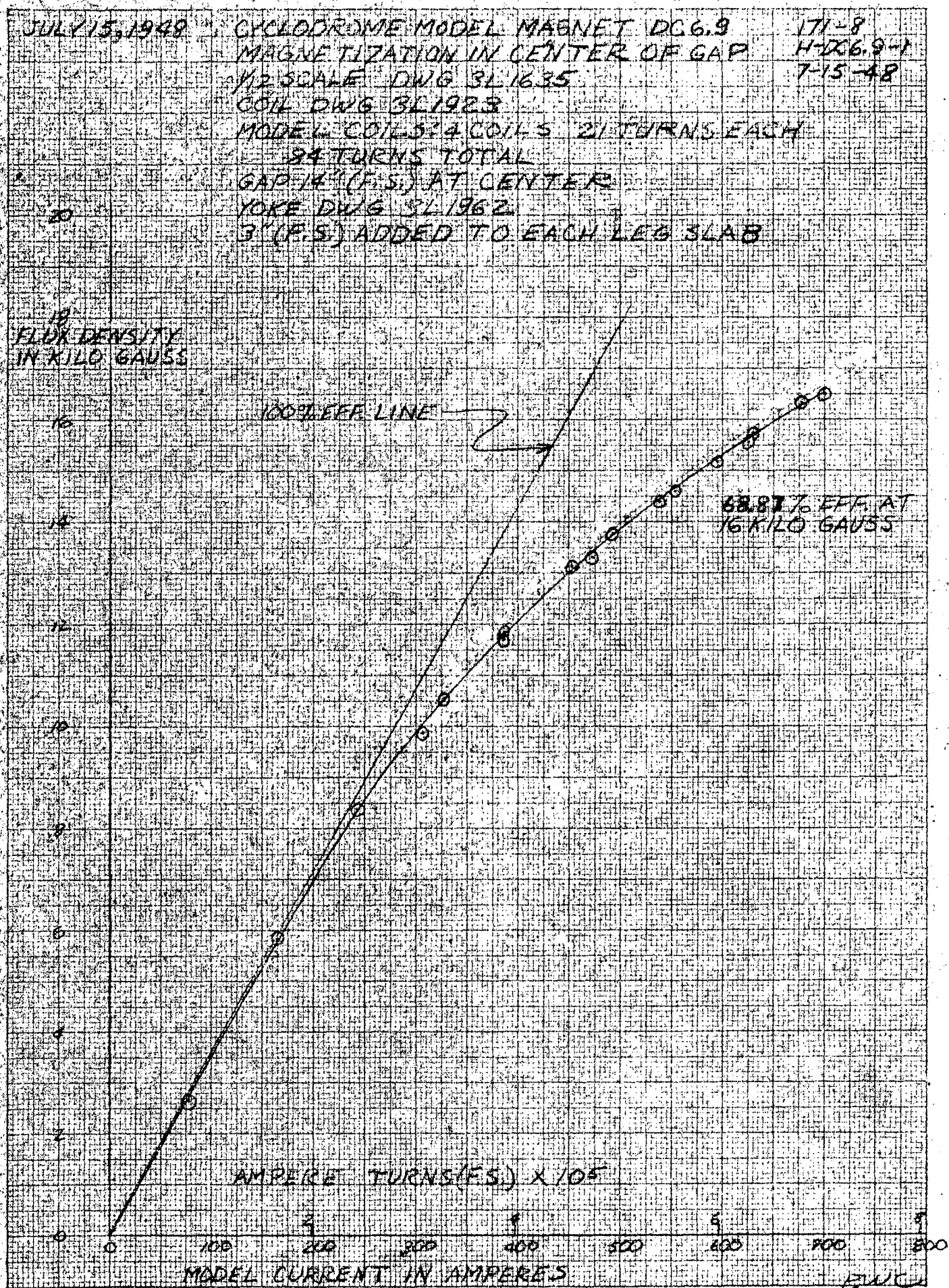
JULY 15, 1948

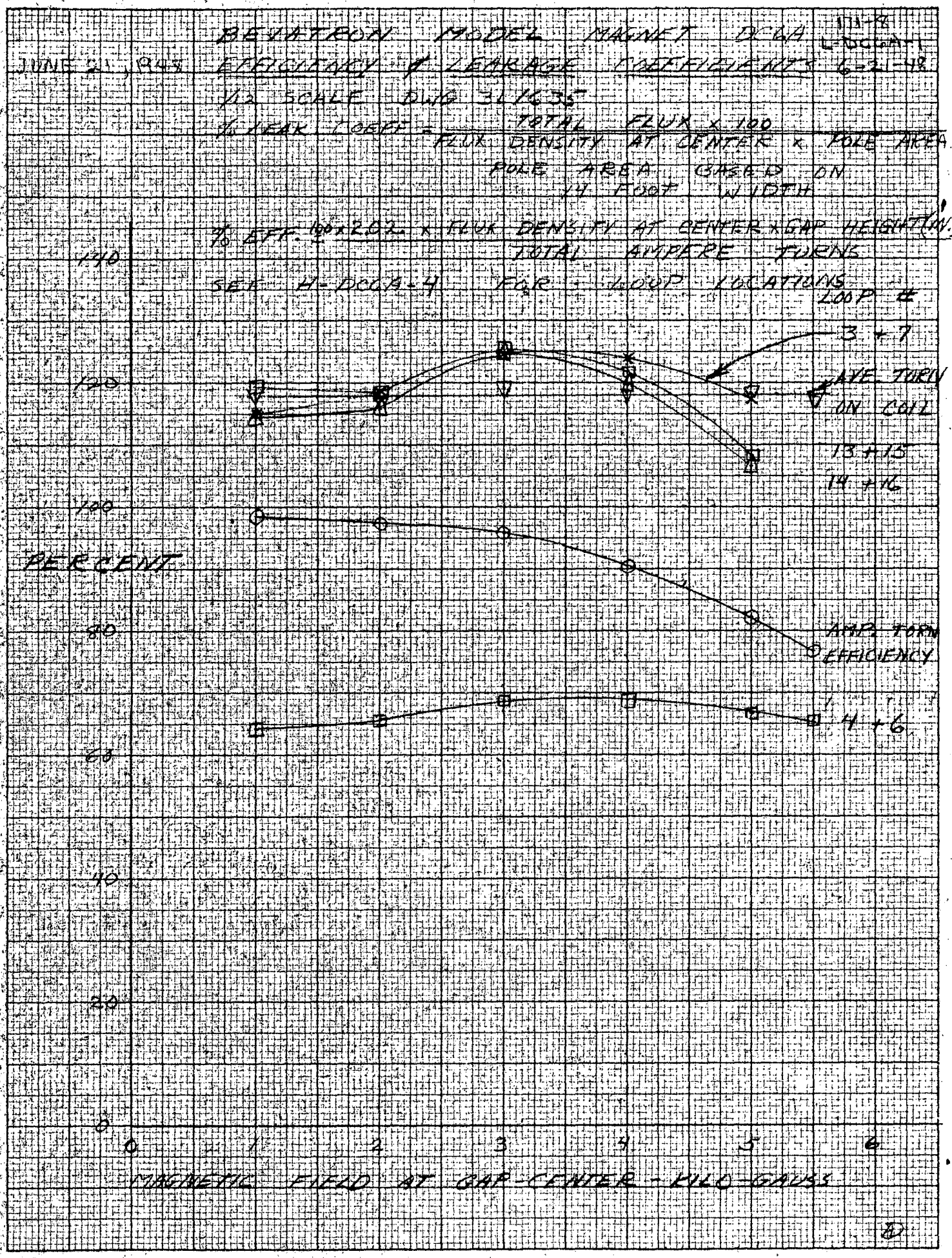
CYCLODROME MODEL MAGNET DC6.8
MAGNETIZATION IN CENTER OF GAP
½ SCALE DWG 3L1635
COIL DWG 3L1823
MODEL COILS: 4 COILS 21 TURNS EACH
84 TURNS TOTAL
GAP 14 (F.S.) IN CENTER
YOKE DWG 3L1962
6" (F.S.) ADDED TO LEG SLAB ON WIDE GAP SIDE
3" (F.S.) ADDED TO LEG SLAB ON NARROW GAP SIDE

171-8
H-DC6.8-1
7-15-48



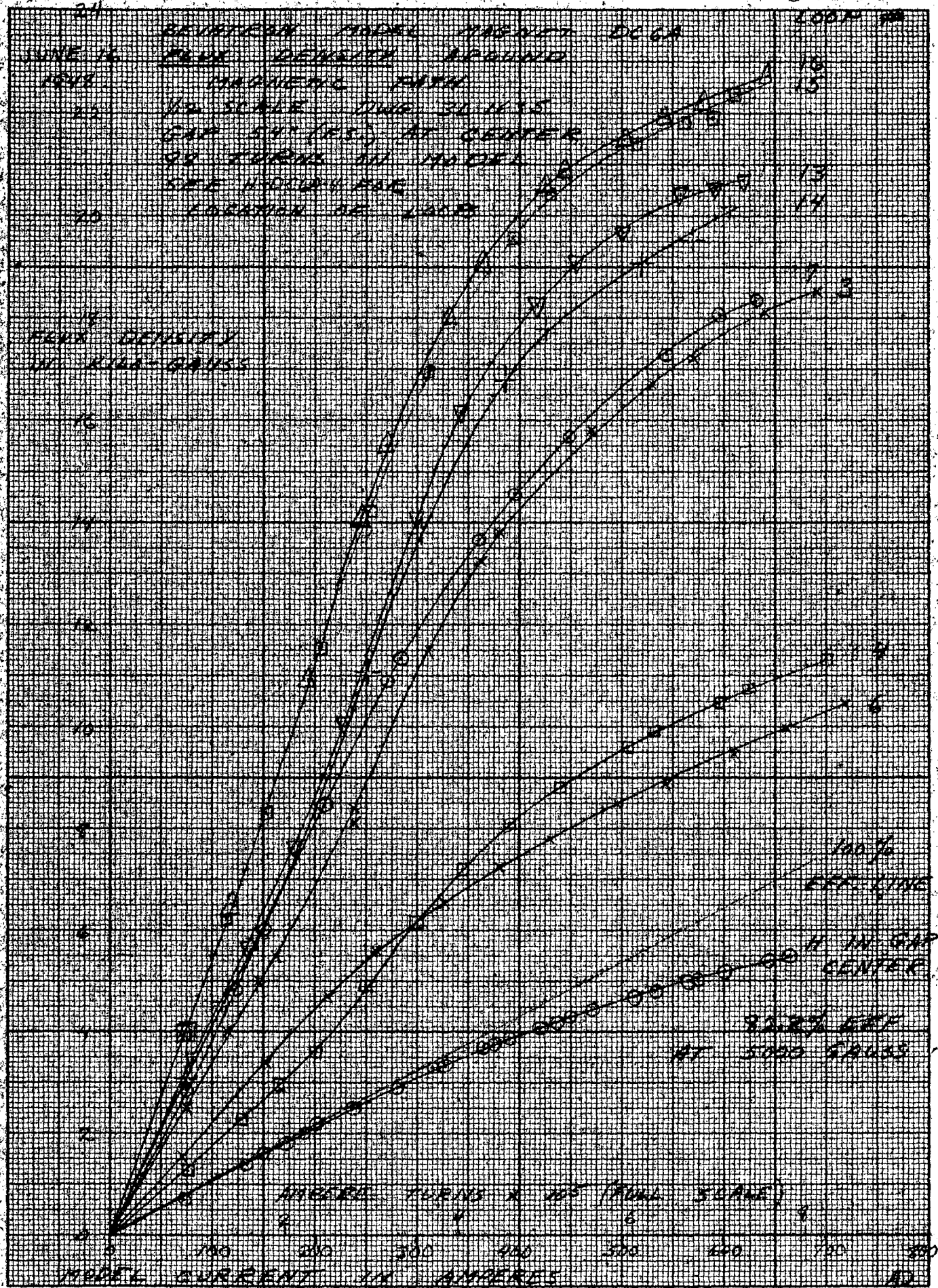
JULY 15, 1948 CYCLOTRON MODEL MAGNET DC 6.9 171-8
MAGNETIZATION IN CENTER OF GAP H-DC 6.9-1
1/2 SCALE DWG 3L1685 7-15-48
COIL DWG 3L1923
MODEL COILS 4 COILS 21 TURNS EACH
84 TURNS TOTAL
GAP 1.4" (F.S.) AT CENTER
YOKE DWG 3L1962
3" (F.S.) ADDED TO EACH LEG SLAB



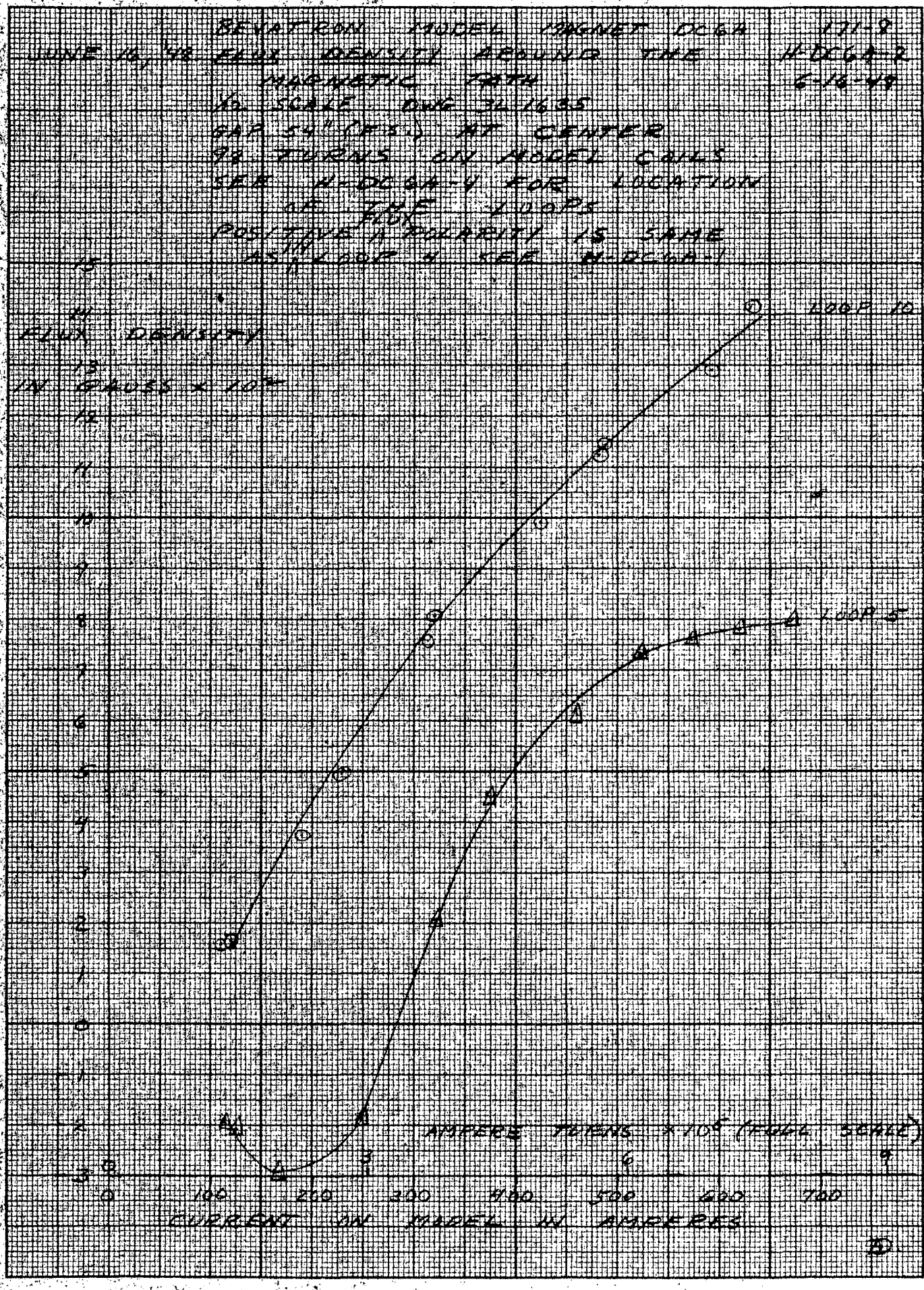


BEVATRON MODEL MAGNET DCGA
EFFICIENCY & LEAKAGE COEFFICIENTS
JUNE 21, 1948
1/12 SCALE DWG 3L1635
% LEAK COEFF = TOTAL FLUX x 100 / FLUX DENSITY AT CENTER x POLE AREA
POLE AREA BASED ON 14 FOOT WIDTH
% EFF. 100 x 2.02 x FLUX DENSITY AT CENTER x GAP HEIGHT (IN.) / TOTAL AMPERE TURNS
SEE H-DCGA-4 FOR LOOP LOCATIONS
LOOP #
3 + 7
AVE. TURN ON COIL
13 + 15
14 + 16
AMP. TURN EFFICIENCY
4 + 6
PERCENT
140
120
100
80
60
40
20
0
0
1
2
3
4
5
6
MAGNETIC FIELD AT GAP-CENTER - KILO-GAUSS

171-8
H-DC6A-1
6-16-48

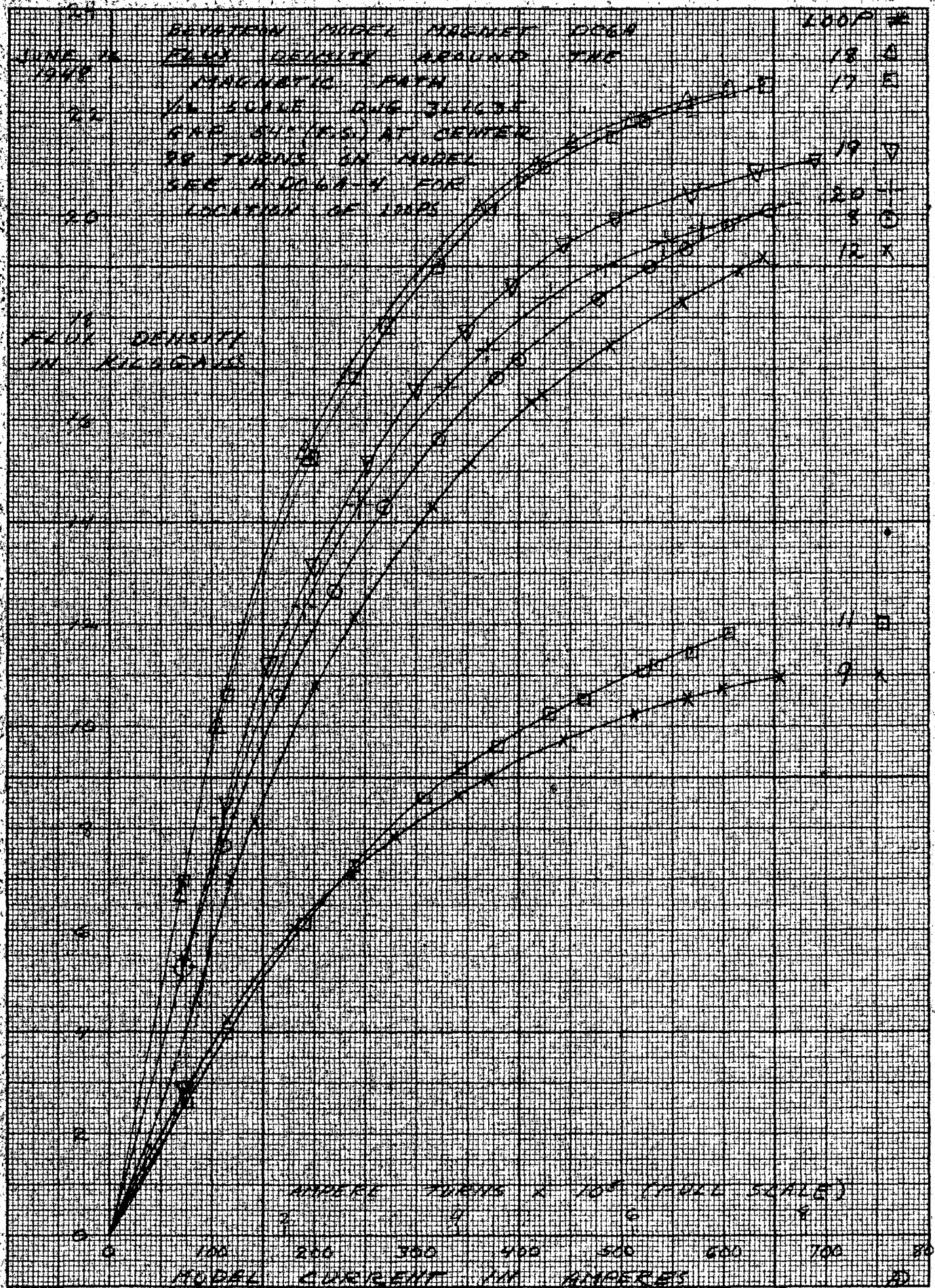


NO. 340 K DIETZGEN GRAPH PAPER MILLIMETER
EUGENE DIETZGEN CO. PRINTED IN U.S.A.



NO. 340 M DIETZGEN GRAPH PAPER MILLIMETER
EUGENE DIETZGEN CO. PRINTED IN U.S.A.

171-8
H-DC6A-3
6-16-48



NO. 340 - M DIETZGEN GRAPH PAPER - MILLIMETER - EUGENE DIETZGEN CO. PRINTED IN U.S.A.

JUNE 16, 1948

BEVATRON MODEL MAGNET DC6A
FLUX DENSITY AROUND THE
MAGNETIC PATH

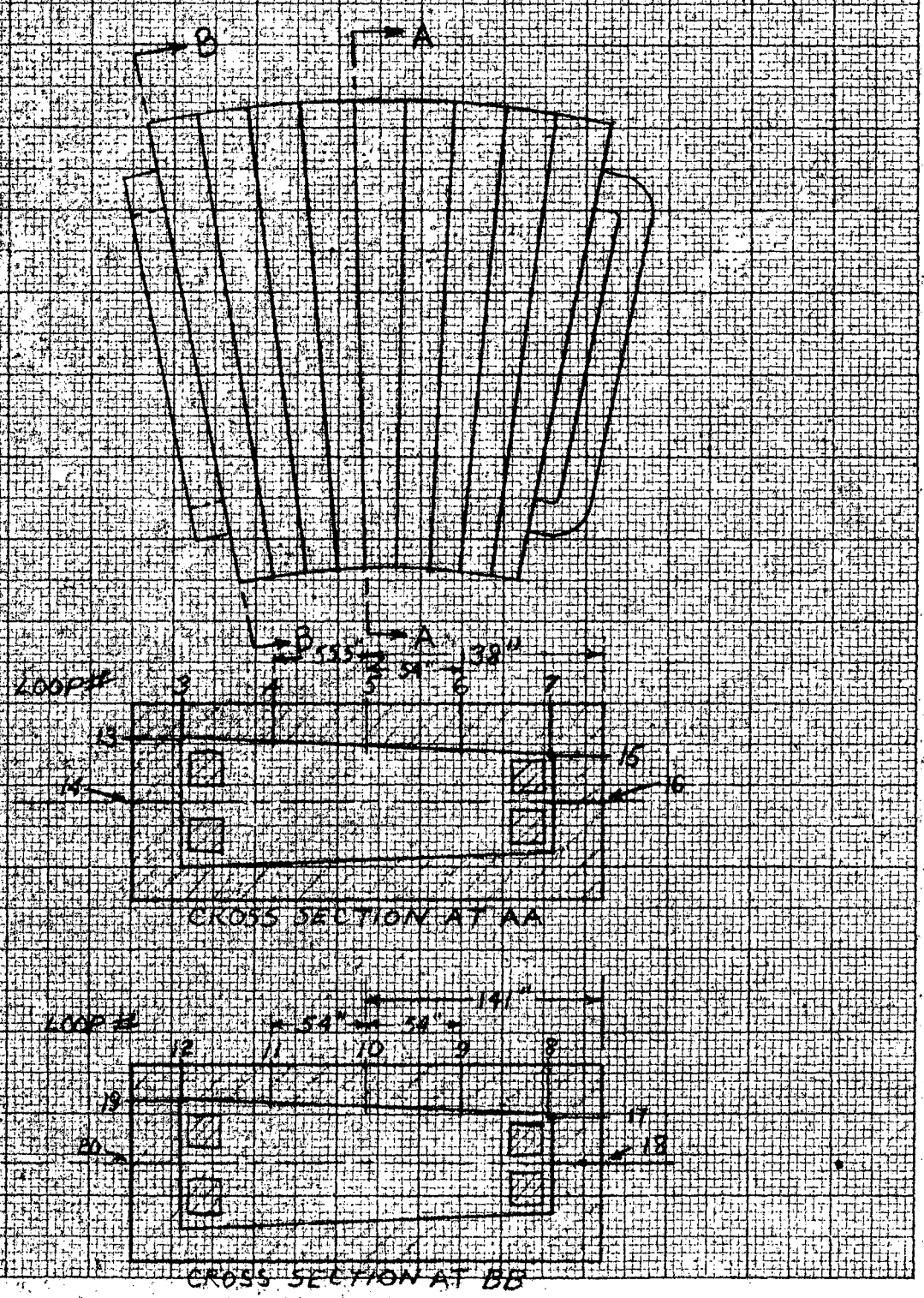
171-8
H-DC6A-4
6-16-48

1/12 SCALE DWG 3L1635

GAP 54" (F.S.) AT CENTER

LOCATION OF FLUX LOOPS

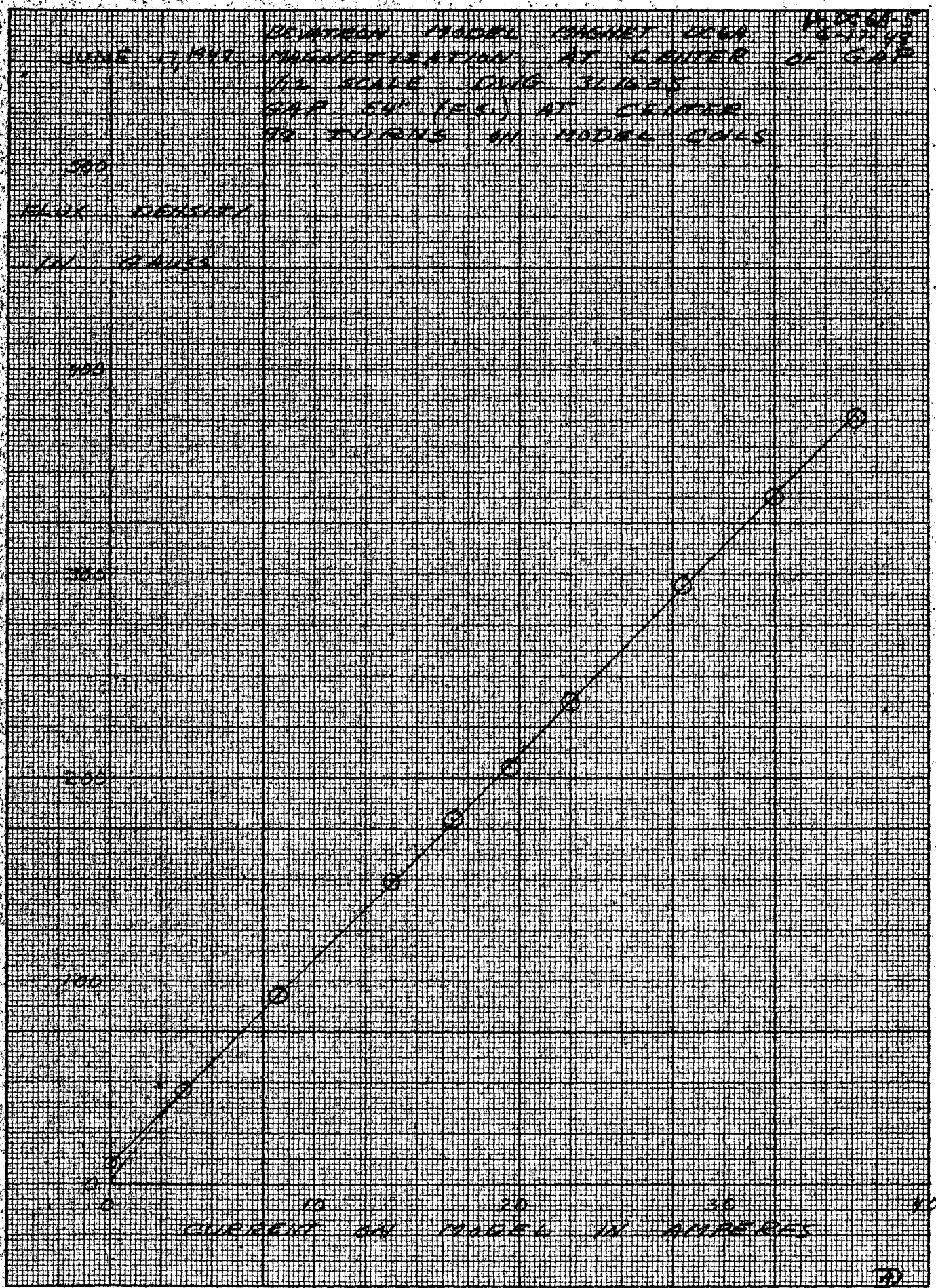
SEE GRAPHS H-DC6A-1
H-DC6A-2
H-DC6A-3



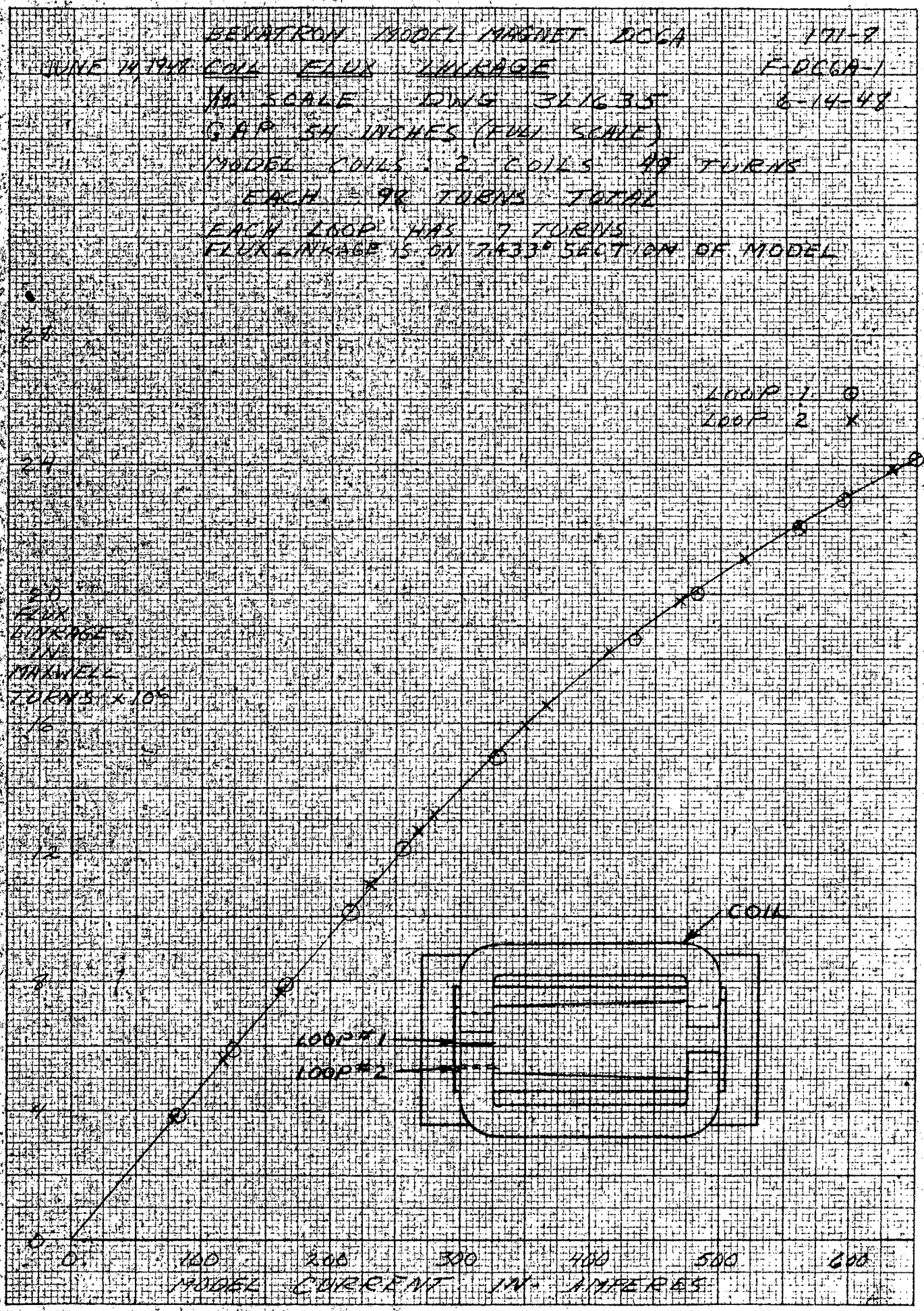
CROSS SECTION AT AA

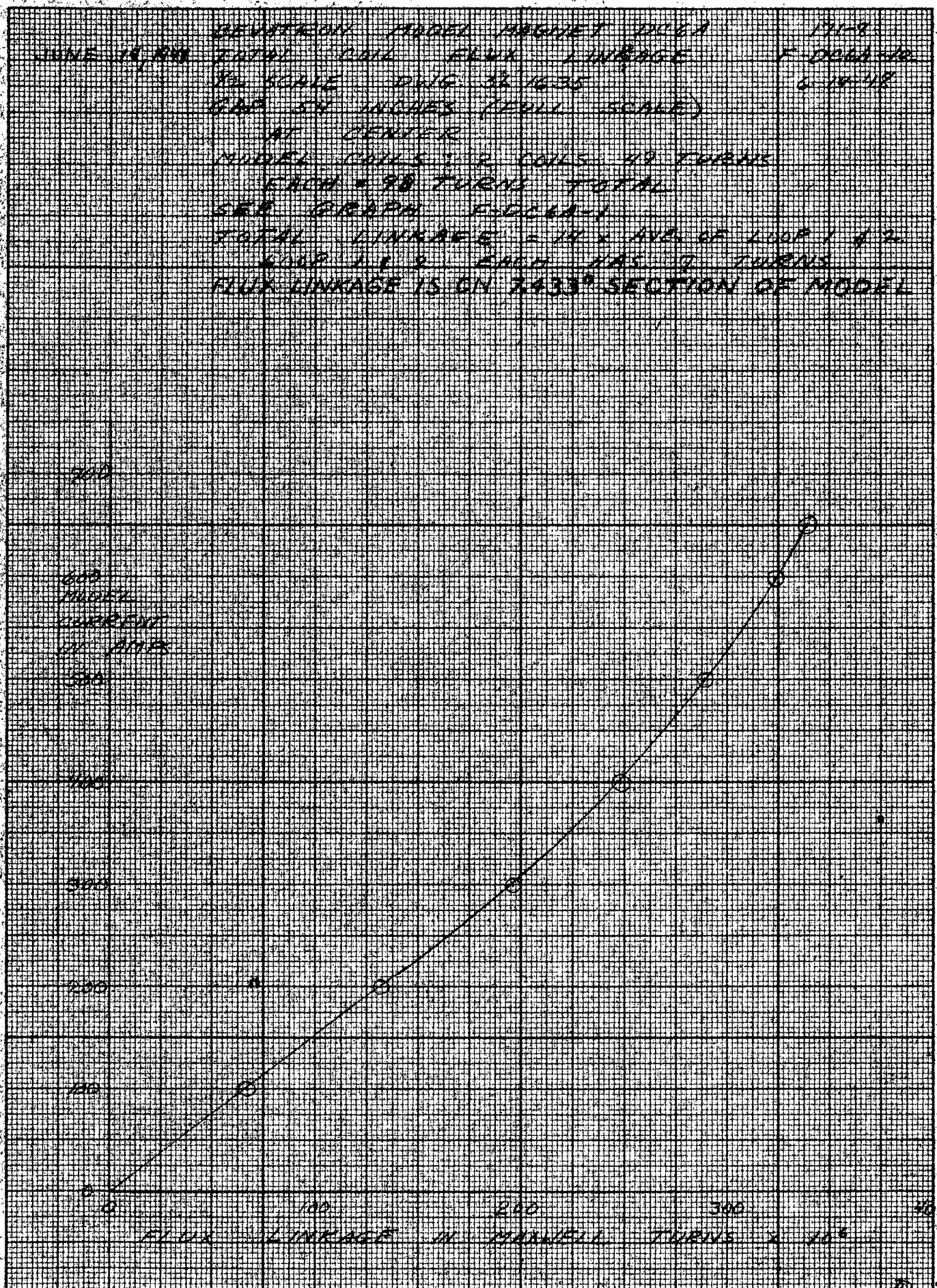
CROSS SECTION AT BB

KEUFFEL & ESSER CO., N. Y. NO. 359-110
10 X 10 to the ½ inch, 5th lines accented
Engraving 7 X 10 in.
MADE IN U.S.A.



EUGENE DIETZGEN CO.
PRINTED IN U.S.A.
NO. 340 M. DIETZGEN GRAPH PAPER
MILLIMETER


BEVATRON MODEL MAGNET DC6A
171-8
JUNE 14, 1948 COIL FLUX LINKAGE
F-DC6A-1
1/2 SCALE DWG 3L1635
6-14-48
GAP 54 INCHES (FULL SCALE)
MODEL COILS: 2 COILS 49 TURNS
EACH = 98 TURNS TOTAL
EACH LOOP HAS 7 TURNS
FLUX LINKAGE IS ON 7.433° SECTION OF MODEL
LOOP 1 ⊙
LOOP 2 ×
FLUX LINKAGE IN MAXWELL TURNS × 10^6
28
24
20
16
12
8
4
0
COIL
LOOP #1
LOOP #2
0
100
200
300
400
500
600
MODEL CURRENT IN AMPERES

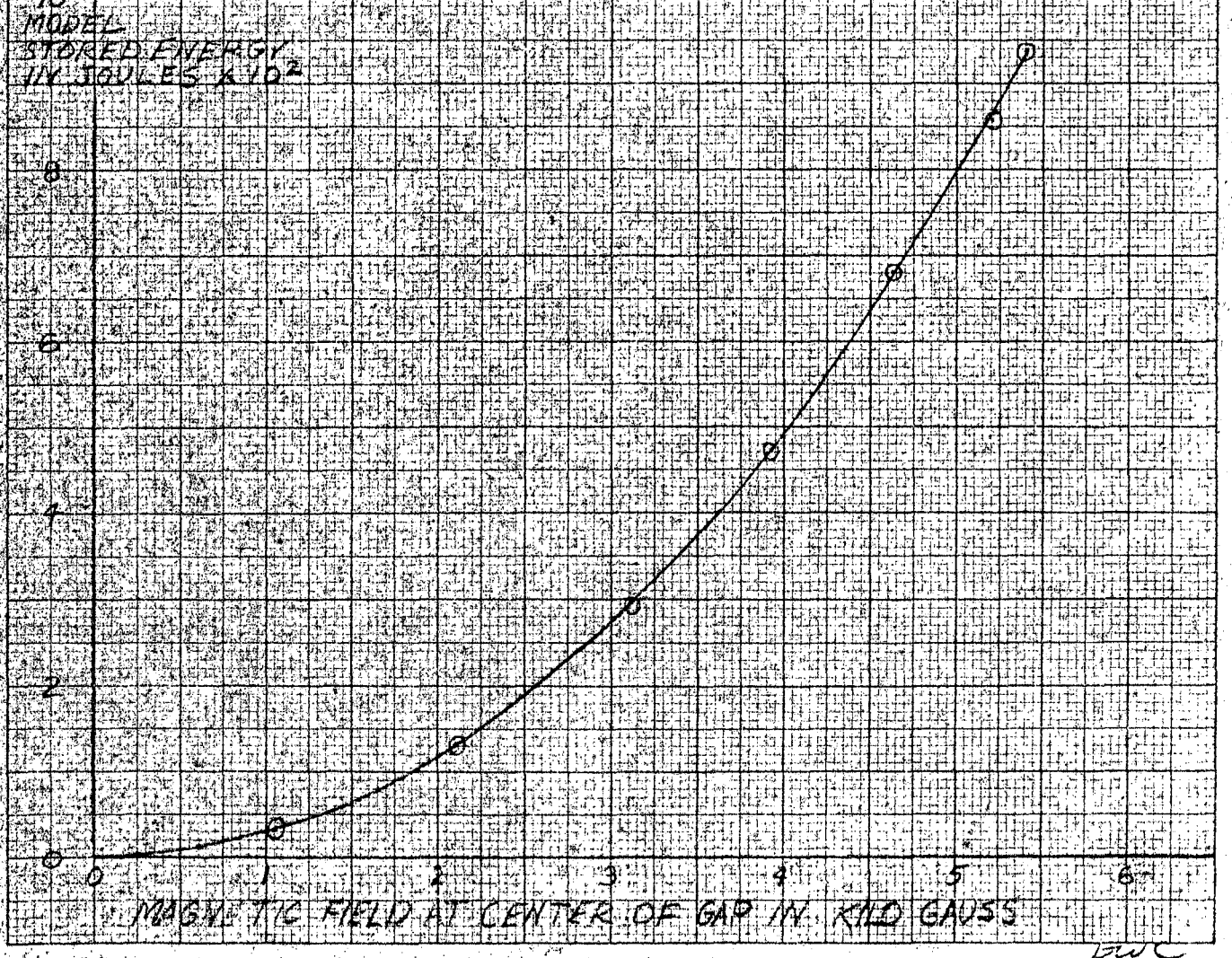


NO. 340 H DIETZGEN GRAPH PAPER MILLIMETER
EUGENE DIETZGEN CO. PRINTED IN U.S.A.

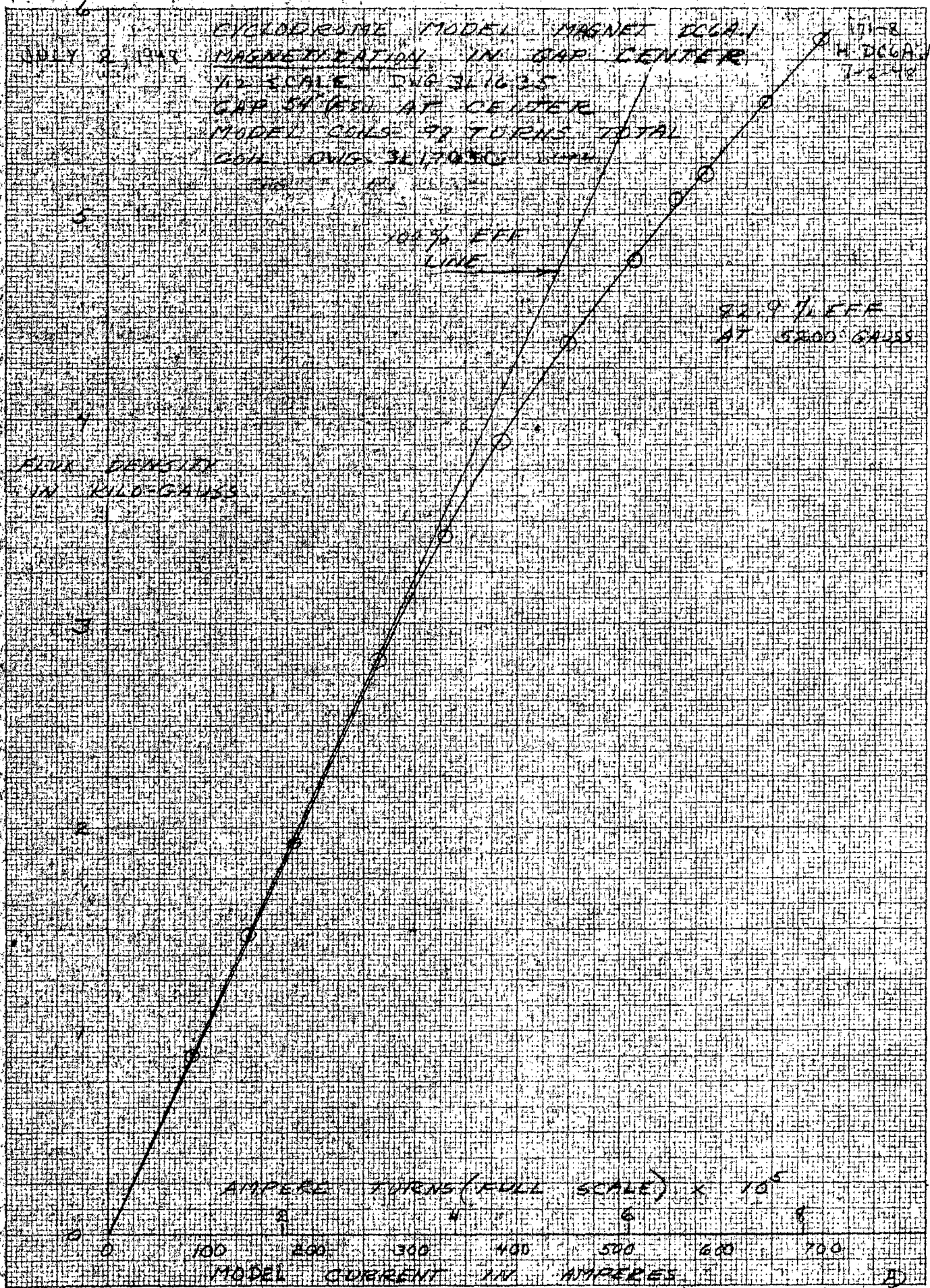
JULY 14, 1948

CYCLODROME MODEL MAGNET DC6A
1/12 SCALE - DWG 3L1635
STORED ENERGY ON MODEL
CALCULATED FROM TOTAL COIL
FLUX LINKAGE F-DC6A-1
ENERGY (JOULES) = $10^{-8}\int_0^F I\,d\phi$
WHERE I IS IN AMPERES AND
ϕ IS IN MAXWELL TURNS
DATA IS FOR A 7.433° SECTION ON MODEL

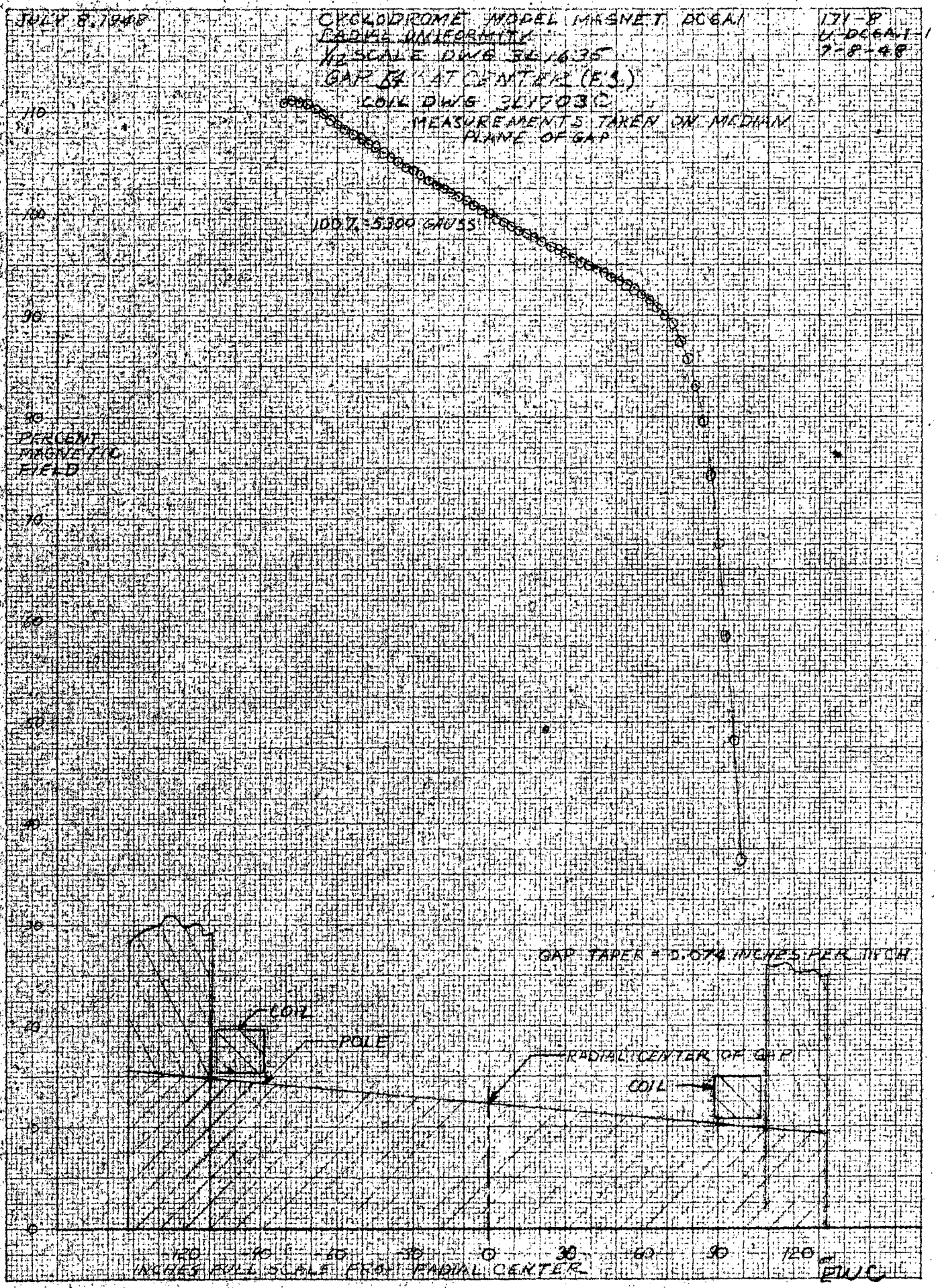
171-8
E-DC6A-1
7-14-48
CORRECTED

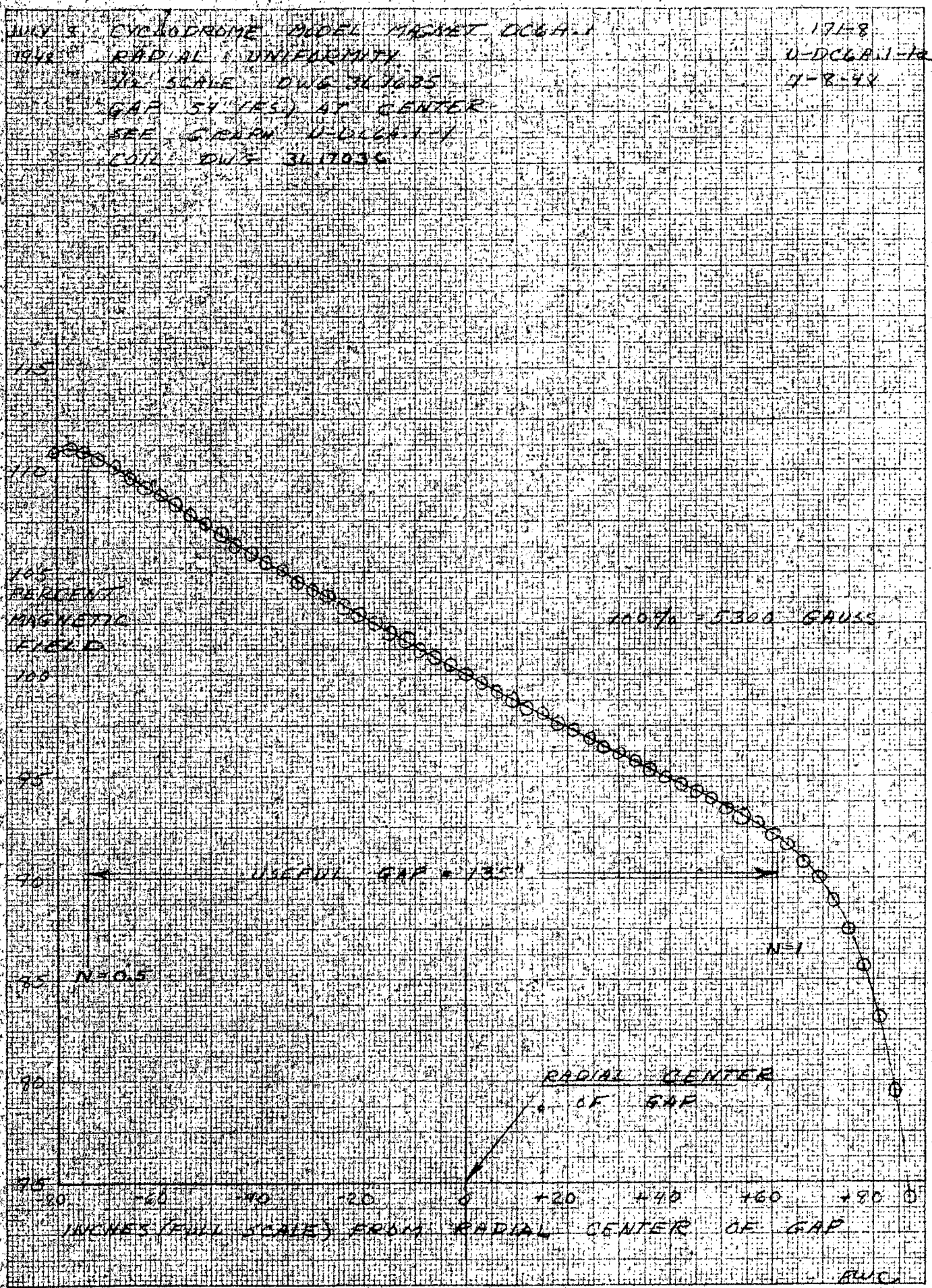


EWC



CYCLODROME MODEL MAGNET DC6A.1
JULY 2, 1948
MAGNETIZATION IN GAP CENTER
1/2 SCALE DWG 3L1635
GAP 54" (FSD) AT CENTER
MODEL COILS 98 TURNS TOTAL
COIL DWG 3L1703C
171-8
H DC6A.1-1
7-2-48
100% EFF LINE
92.9% EFF AT 5200 GAUSS
FLUX DENSITY IN KILO-GAUSS
AMPERE TURNS (FULL SCALE) x 10^5
0
1
2
3
4
5
6
0
100
200
300
400
500
600
700
MODEL CURRENT IN AMPERES


JULY 8, 1948
CYCLODROME MODEL MAGNET DC6A1
RADIAL UNIFORMITY
1/12 SCALE DWG 3L1635
GAP 54 AT CENTER (F.S.)
COIL DWG 3L1703C
MEASUREMENTS TAKEN ON MEDIAN PLANE OF GAP
171-8
U-DC6A1-1
7-8-48
100% = 5300 GAUSS
PERCENT MAGNETIC FIELD
110
100
90
80
70
60
50
40
30
20
10
0
GAP TAPER = 0.074 INCHES PER INCH
COIL
POLE
RADIAL CENTER OF GAP
COIL
-120
-90
-60
-30
0
30
60
90
120
INCHES FULL SCALE FROM RADIAL CENTER
EWC


JULY 8 1948
CYCLODROME MODEL MAGNET DC6A-1
RADIAL UNIFORMITY
1/12 SCALE DWG 3L1635
GAP 54" (FS) AT CENTER
SEE GRAPH U-DC6A-1-1
COIL DWG 3L17036
171-8
U-DC6A-1-12
7-8-48
115
110
105
PERCENT MAGNETIC FIELD
100
95
90
85
80
75
100% = 5300 GAUSS
USEFUL GAP = 135"
N=0.5
N=1
RADIAL CENTER OF GAP
-80
-60
-40
-20
0
+20
+40
+60
+80
INCHES (FULL SCALE) FROM RADIAL CENTER OF GAP
AWC

171-8
F-DC6A.1-1

11-1-48

CYCLOTRON MODEL MAGNET DC6A.1

JULY 7 COIL FLUX LINKAGE

1/4" SCALE DWG 32/635

GAP 54" (FULL SCALE) AT CENTER

MODEL COILS: 2 COILS 49 TURNS EACH. 98 TURNS TOTAL

EACH LOOP HAS 7 TURNS

FLUX LINKAGE IS ON 7.433" SECTION OF MODEL

COIL DWG 32/703C

LOOP # 1 ⊙

LOOP # 2 △

FLUX LINKAGE IN MAXWELL TURNS K.LOC

24

20

16

12

8

4

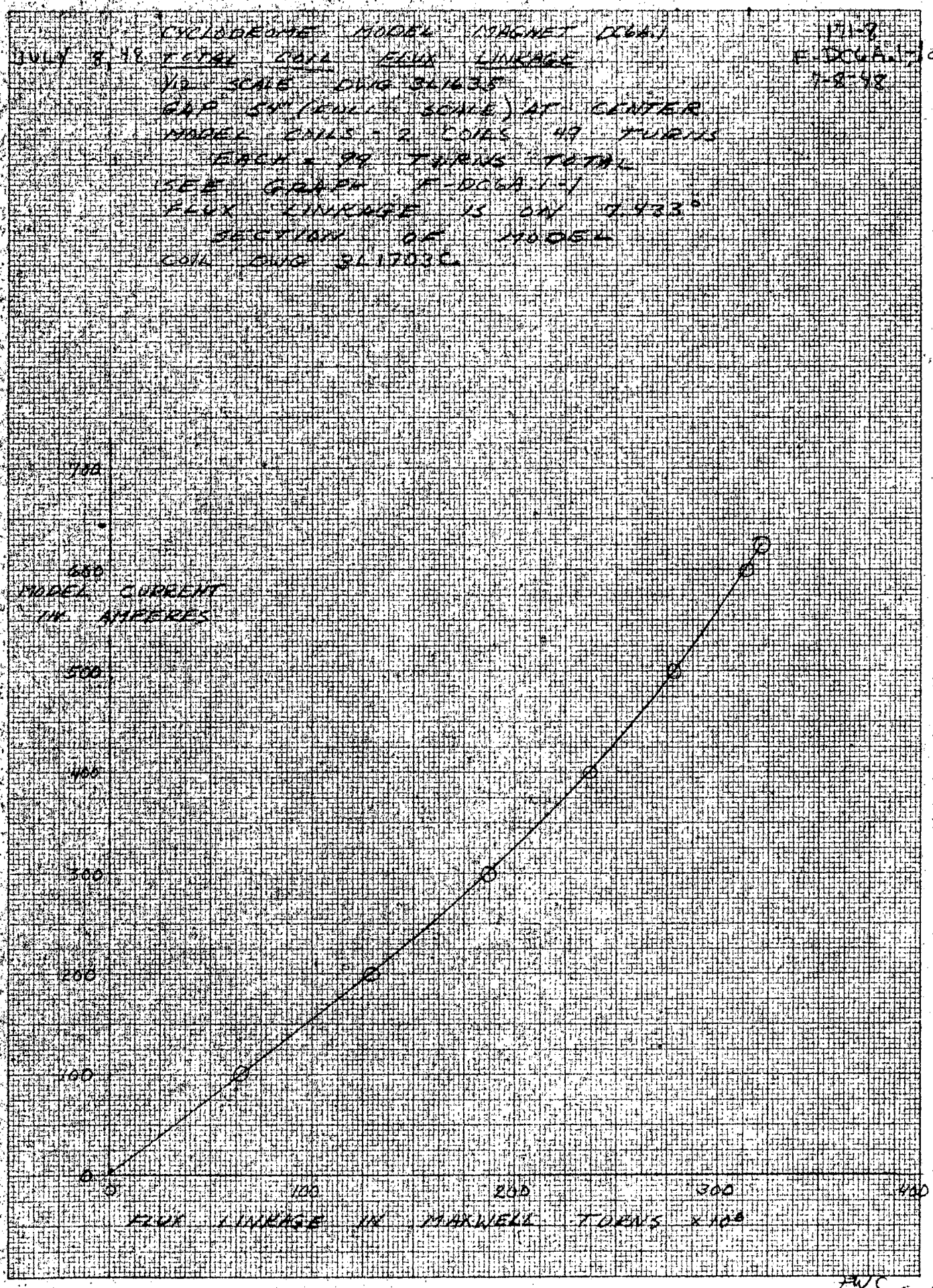
0

0 100 200 300 400 500 600

MODEL CURRENT IN AMPERES

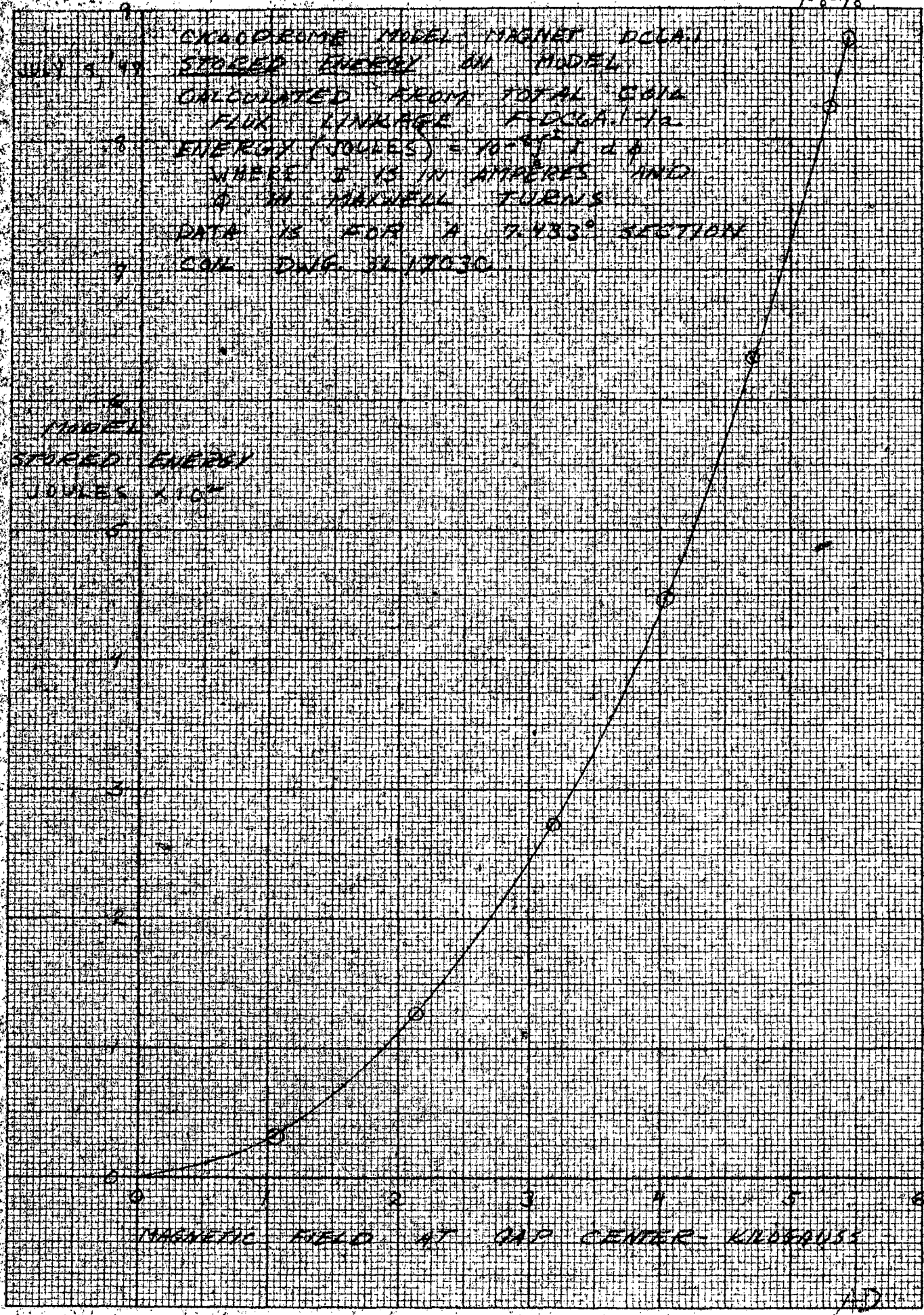
LOOP # 1

LOOP # 2


CYCLODROME MODEL MAGNET DC6A.1
JULY 8, 48 TOTAL COIL FLUX LINKAGE
1/12 SCALE DWG 3L1635
GAP 54" (FULL SCALE) AT CENTER
MODEL COILS - 2 COILS 49 TURNS
EACH = 99 TURNS TOTAL
SEE GRAPH F-DC6A.1-1
FLUX LINKAGE IS ON 7.433°
SECTION OF MODEL
COIL DWG 3L1703C
F-DC6A.1-1a
7-8-48
MODEL CURRENT
IN AMPERES
700
600
500
400
300
200
100
0
0
100
200
300
400
FLUX LINKAGE IN MAXWELL TURNS x 10⁶

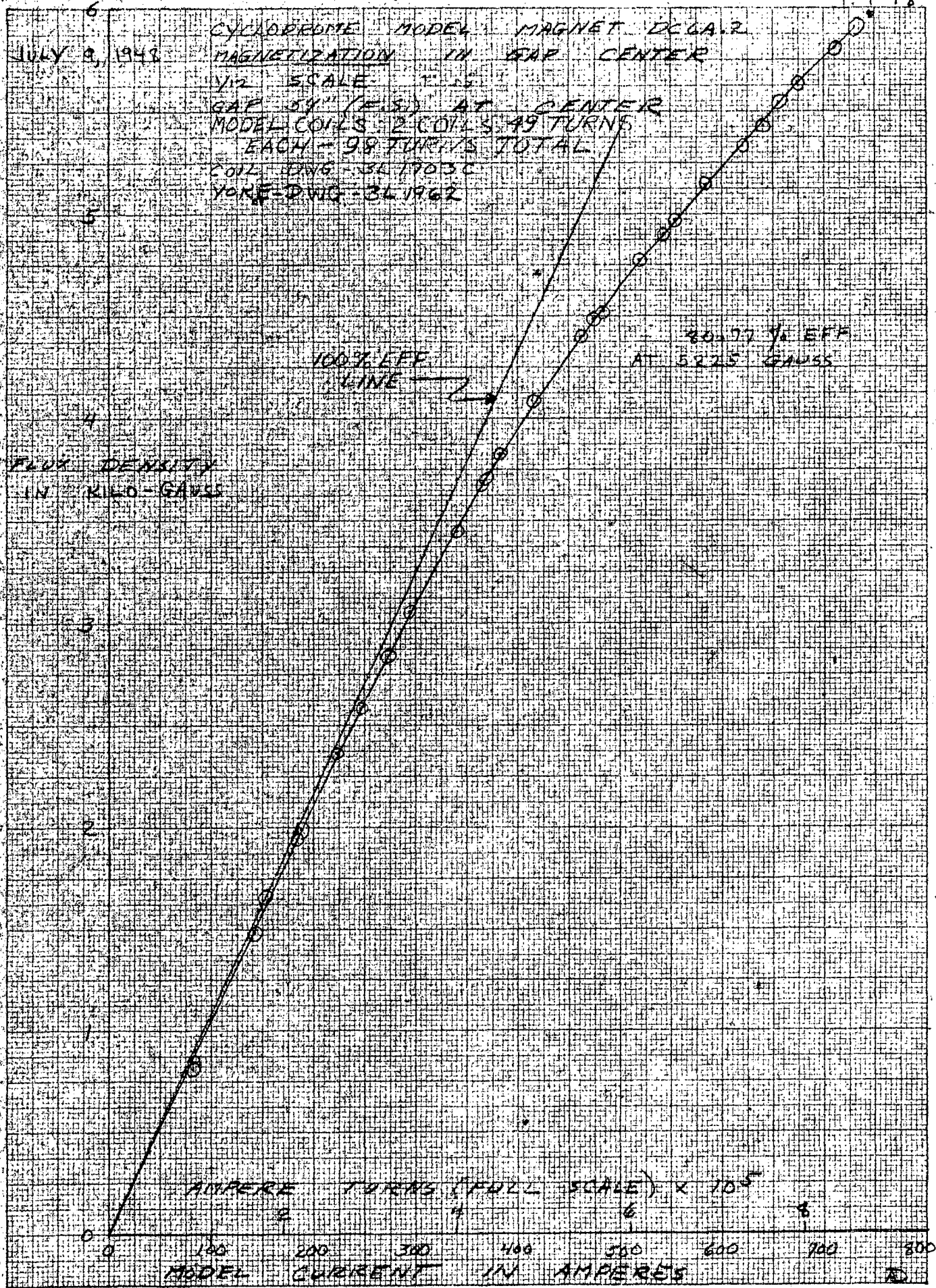
ZWC

171-8
E-DC6A.1-1
7-8-48

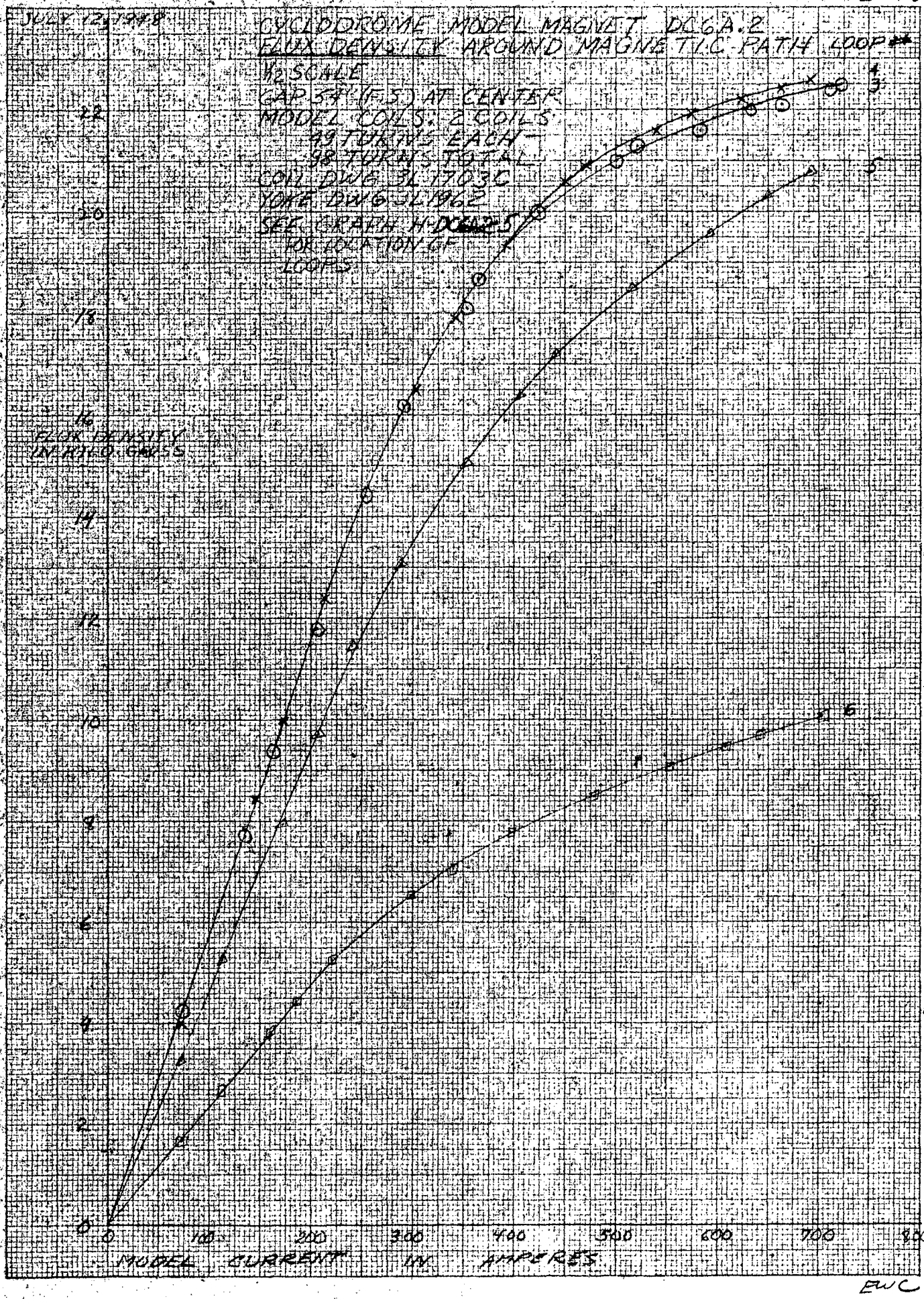


NO. 340-20 DIETZGEN GRAPH PAPER
20 X 20 PER INCH
EUGENE DIETZGEN CO.
PRINTED IN U.S.A.

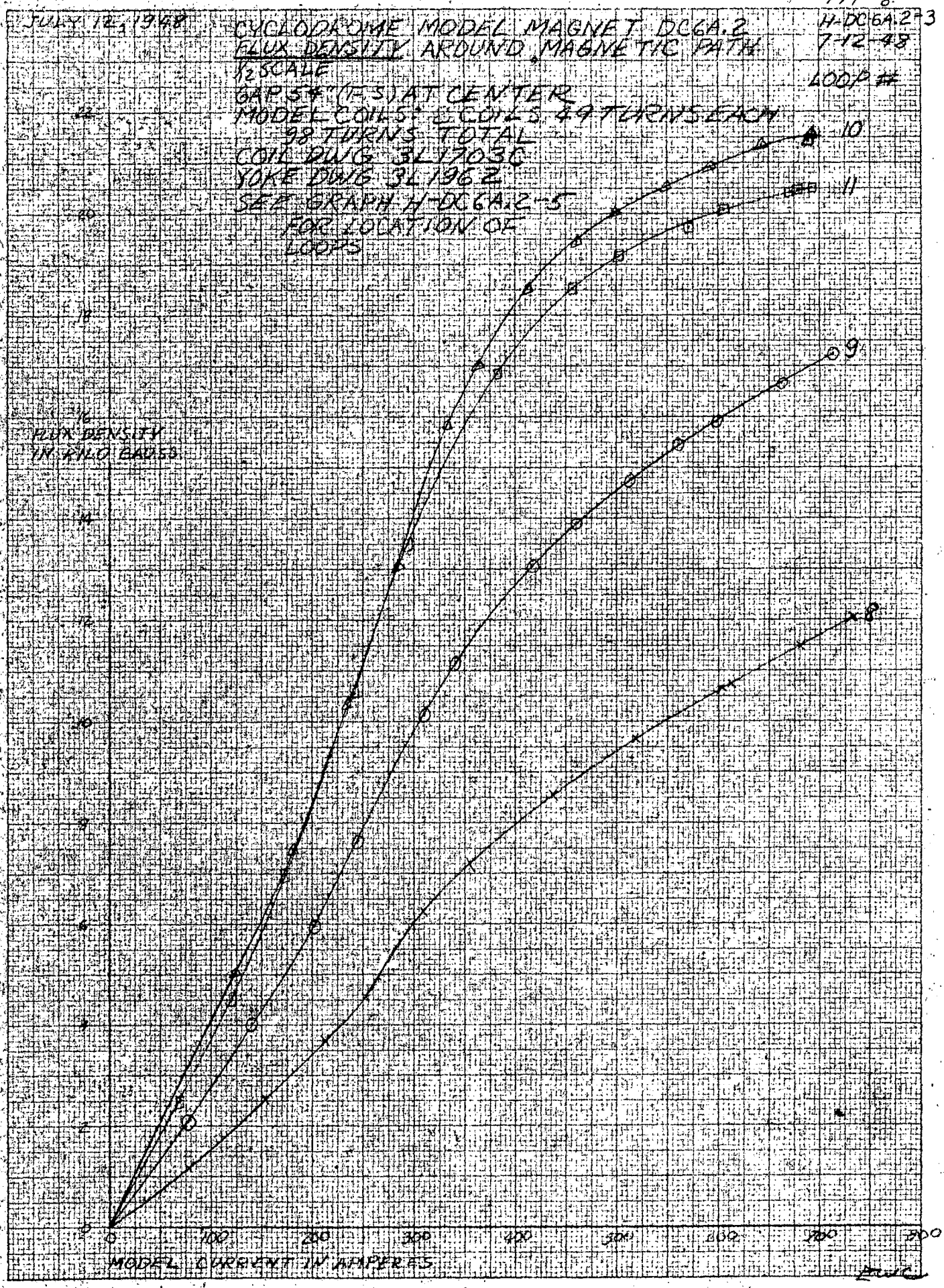
171-8
H-DC6A.2.-1
7-9-48



171-8
H-DC6A.2-2
7-12-48



EWC


JULY 12, 1948
CYCLODROME MODEL MAGNET DC6A.2
FLUX DENSITY AROUND MAGNETIC PATH
1/2 SCALE
GAP 54" (F-S) AT CENTER
MODEL COILS: 2 COILS 49 TURNS EACH
98 TURNS TOTAL
COIL DWG 3L1703C
YOKE DWG 3L1962
SEE GRAPH H-DC6A.2-5
FOR LOCATION OF
LOOPS
H-DC6A.2-3
7-12-48
LOOP #
10
11
9
8
FLUX DENSITY
IN KILO GAUSS
0
2
4
6
8
10
12
14
16
18
20
22
0
100
200
300
400
500
600
700
800
MODEL CURRENT IN AMPERES

171-8
H-DC6A.2-4
7-12-48

JULY 12, 1948

CYCLODROME MODEL MAGNET DC6A.2
FLUX DENSITY AROUND MAGNETIC PATH

1/2 SCALE
GAP 58" (F.S.) AT CENTER
MODEL COILS: 2 COILS 49 TURNS
98 TURNS TOTAL
COIL DWG 3L7P03C
YOKE DWG 3L7962
SEE GRAPH H-DC6A.2-5
FOR LOCATION OF LOOP
POSITIVE FLUX FOLLOWS IS
IN SAME DIRECTION AS
LOOP #8 - SEE GRAPH
H-DC6A.2-3

LOOP #1

FLUX DENSITY
IN KILO GAUSS

20
15
10
05

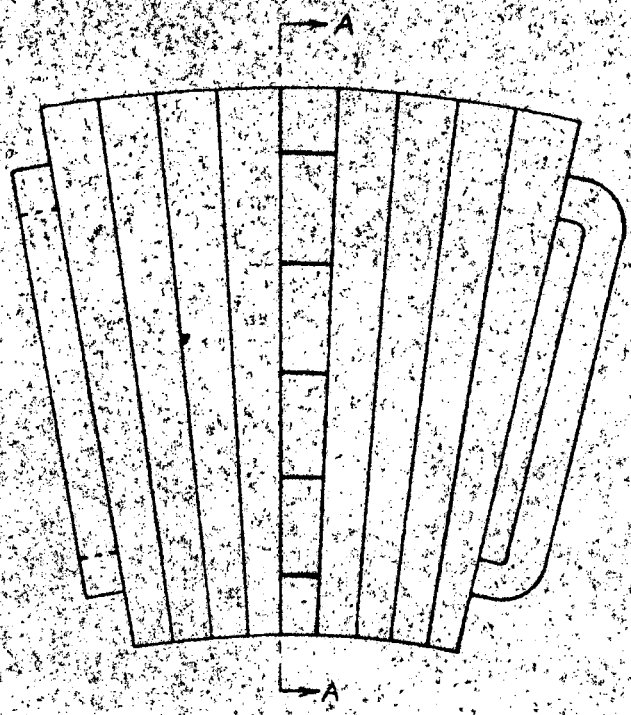
MODEL CURRENT IN AMPERES
100 200 300 400 500 600 700 800

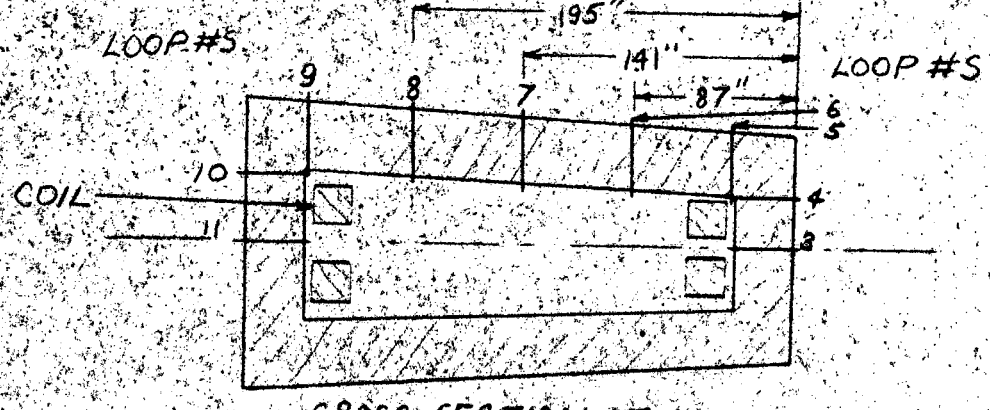
DWC

JULY 12, 1948

171-8
H-DC6A.2-5
7-12-48

CYCLODROME MODEL MAGNET DC6A:2
FLUX DENSITY AROUND MAGNETIC PATH
1/2 SCALE
GAP 54" (F.S.) AT CENTER
LOCATION OF FLUX LOOPS
SEE GRAPHS H-DC6A.2-2
H-DC6A.2-3
H-DC6A.2-4





CROSS SECTION AT AA

PWC

171-8

JULY 12, 1948 CYCLOTRON MODEL MAGNET DC6A.2 H-DC6A.2-6

MAGNETIZATION AT CENTER OF GAP 7-12-48

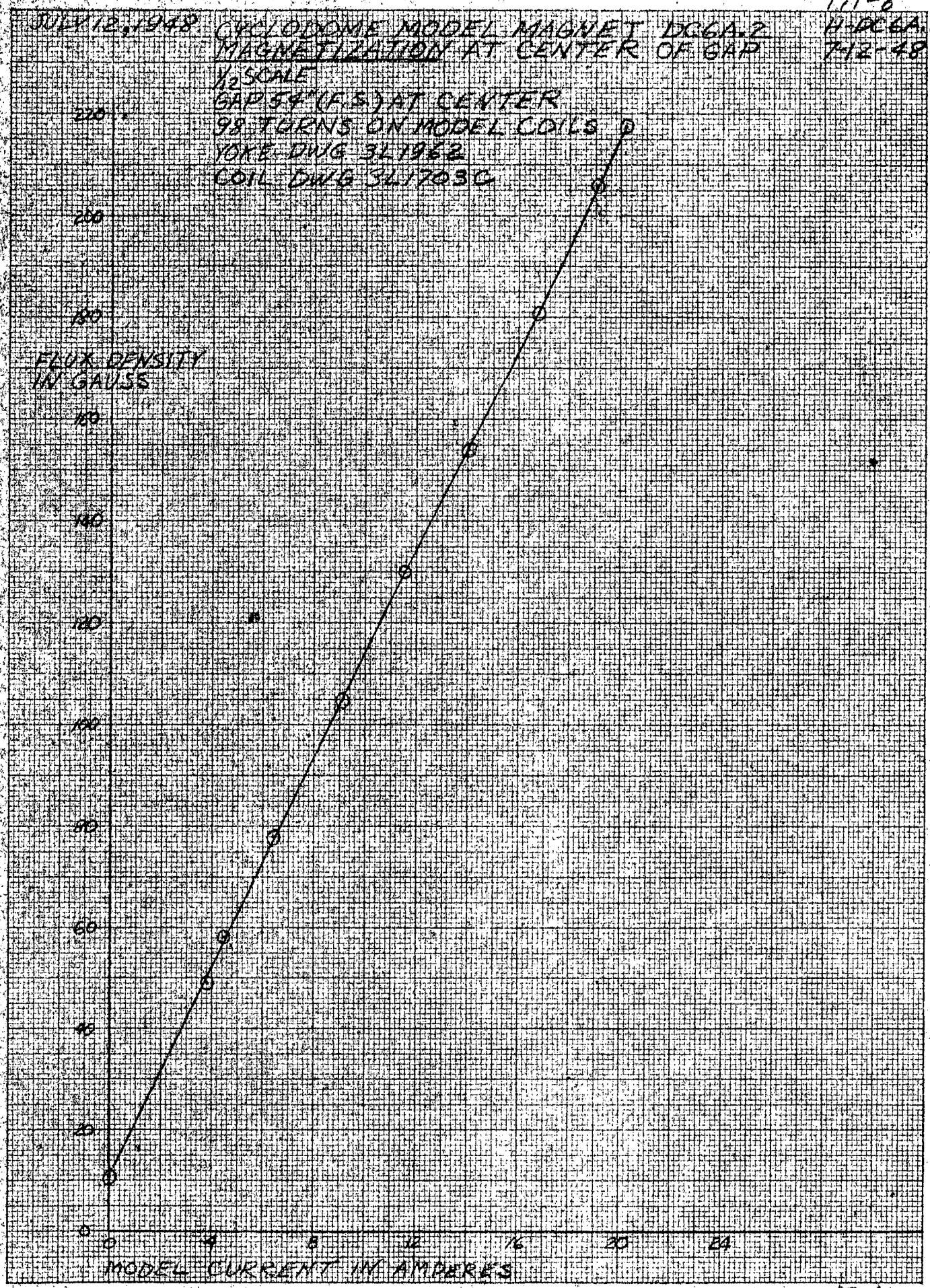
½ SCALE

GAP 5¼" (F.S.) AT CENTER

98 TURNS ON MODEL COILS

YOKE DWG 3L1962

COIL DWG 3L1703C



EWC

JULY 13, 1948 CYCLOTRON MODEL MAGNET DC6A.2 17-8
RADIAL UNIFORMITY U-DC6A.2-
½ SCALE DWG 34 1635 7-13-48
GAP 5" AT CENTER (F.S.)
MODEL COIL 5 88 TURNS TOTAL
COIL DWG 34 1703C
YOKE DWG 34 1862
MEASUREMENTS
TAKEN ALONG
MEDIAN PLANE
OF GAP

○ 100% = 196 GAUSS
× 100% = 5225 GAUSS

PERCENT MAGNETIC FIELD

GAP TAPER = 0.0734 INCHES PER INCH

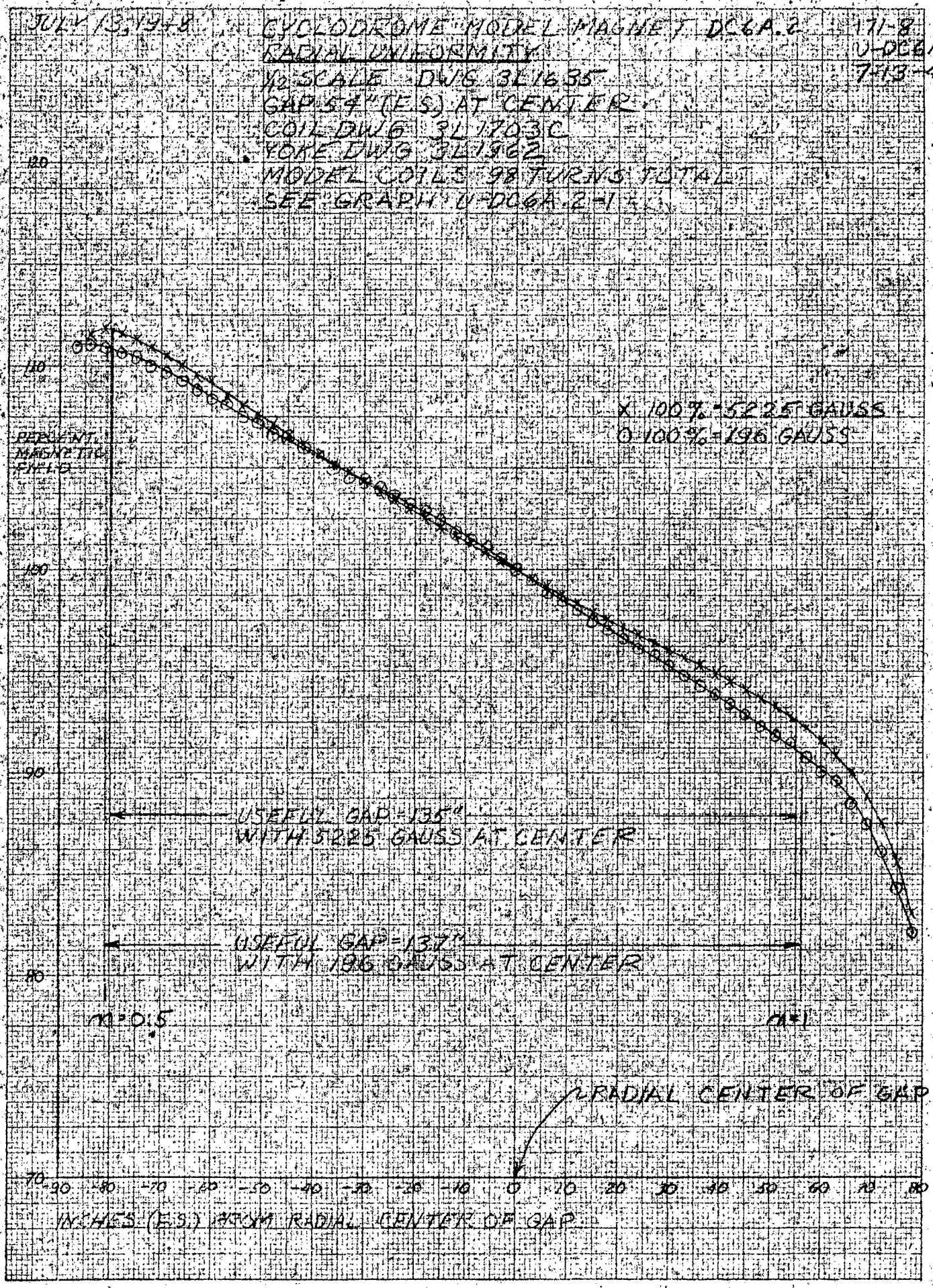
COIL

RADIAL CENTER OF GAP

INCHES (F.S.) FROM RADIAL CENTER OF GAP

EWC

KEUFFEL & ESSER CO., N. Y. NO. 359-146
Millimeter, 5 mm. lines accented, cm. figured every 1
MADE IN U.S.A.


JULY 13, 1948
CYCLODROME MODEL MAGNET DC6A.2
RADIAL UNIFORMITY
1/12 SCALE DWG 3L1635
GAP 54" (F.S.) AT CENTER
COIL DWG 3L1703C
YOKE DWG 3L1962
MODEL COILS 98 TURNS TOTAL
SEE GRAPH U-DC6A.2-1
171-8
U-DC6A.2-1a
7-13-48
X 100% = 5225 GAUSS
O 100% = 196 GAUSS
PERCENT MAGNETIC FIELD
120
110
100
90
80
70
USEFUL GAP = 135"
WITH 5225 GAUSS AT CENTER
USEFUL GAP = 137"
WITH 196 GAUSS AT CENTER
n = 0.5
n = 1
RADIAL CENTER OF GAP
-90 -80 -70 -60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60 70 80
INCHES (F.S.) FROM RADIAL CENTER OF GAP

FWC

CYCLODROME MODEL MAGNET DC6A-3 171-8

JULY 23 1948 H IN GAP CENTER H-DC6A-3-1

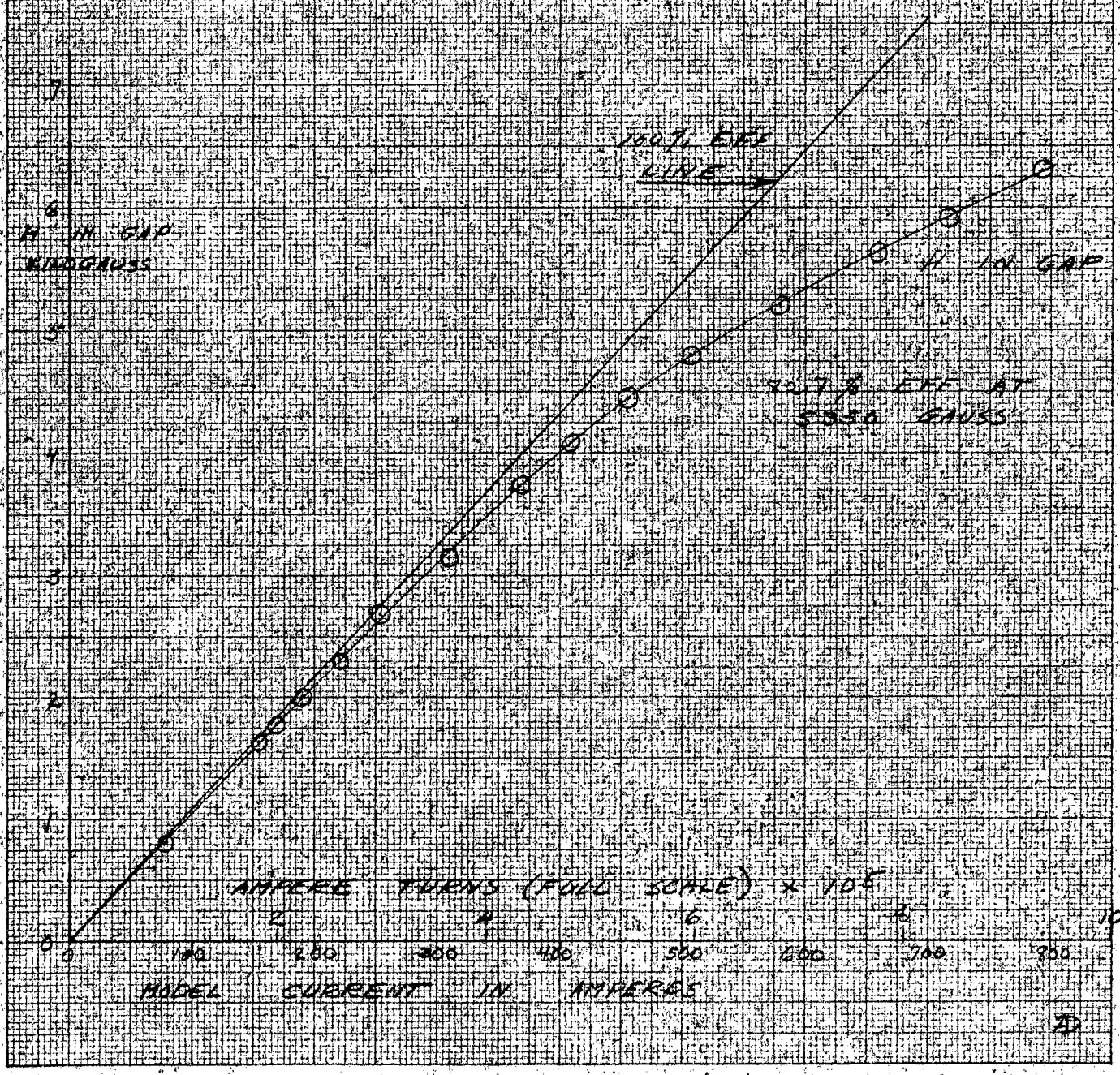
1/12 SCALE DWG 3L1635 COIL 3L1923 7-23-48

YOKE 3L1962

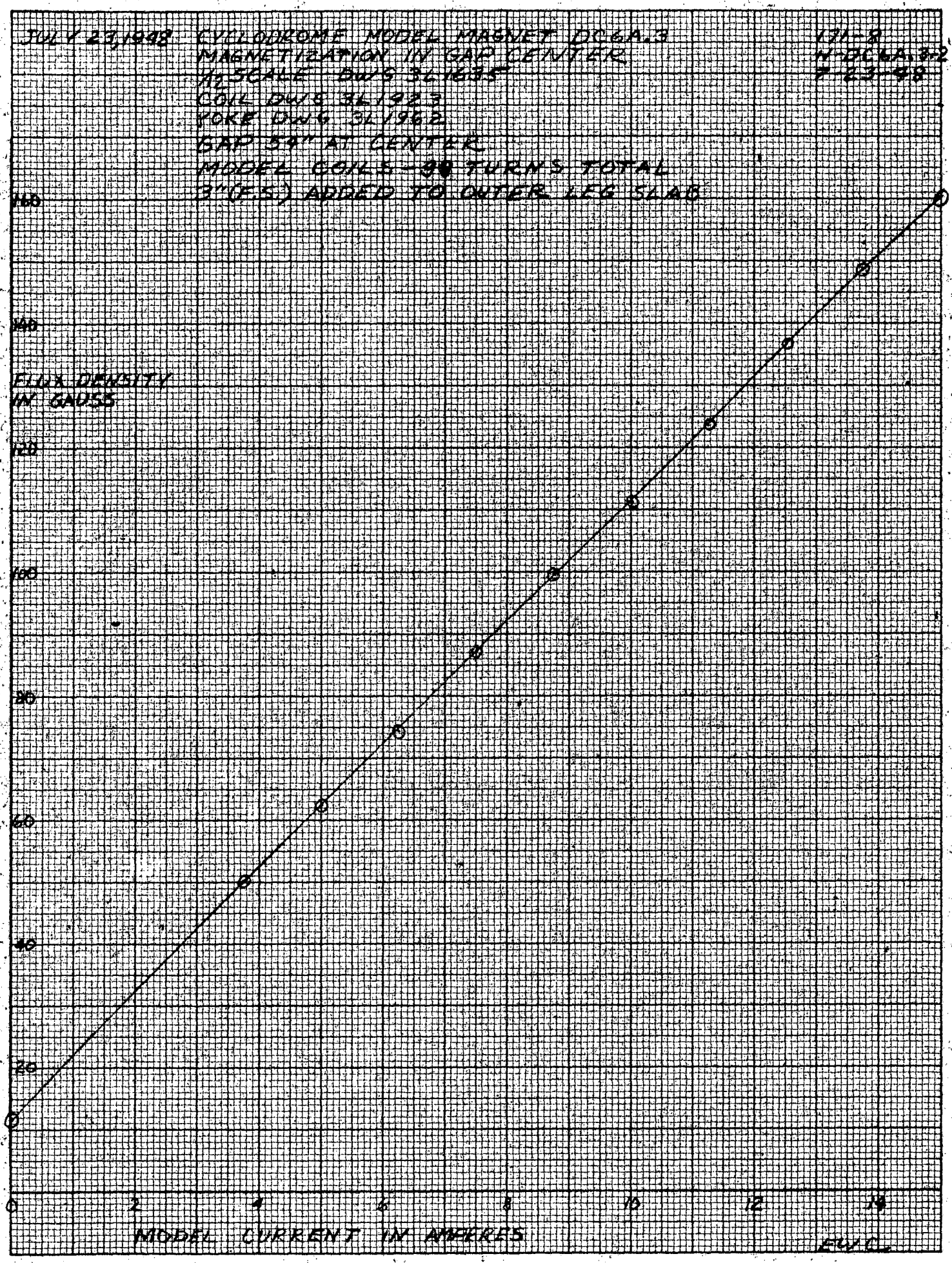
GAP 54" (F.S.) AT CENTER

3" (F.S.) ADDED TO OUTER LEG

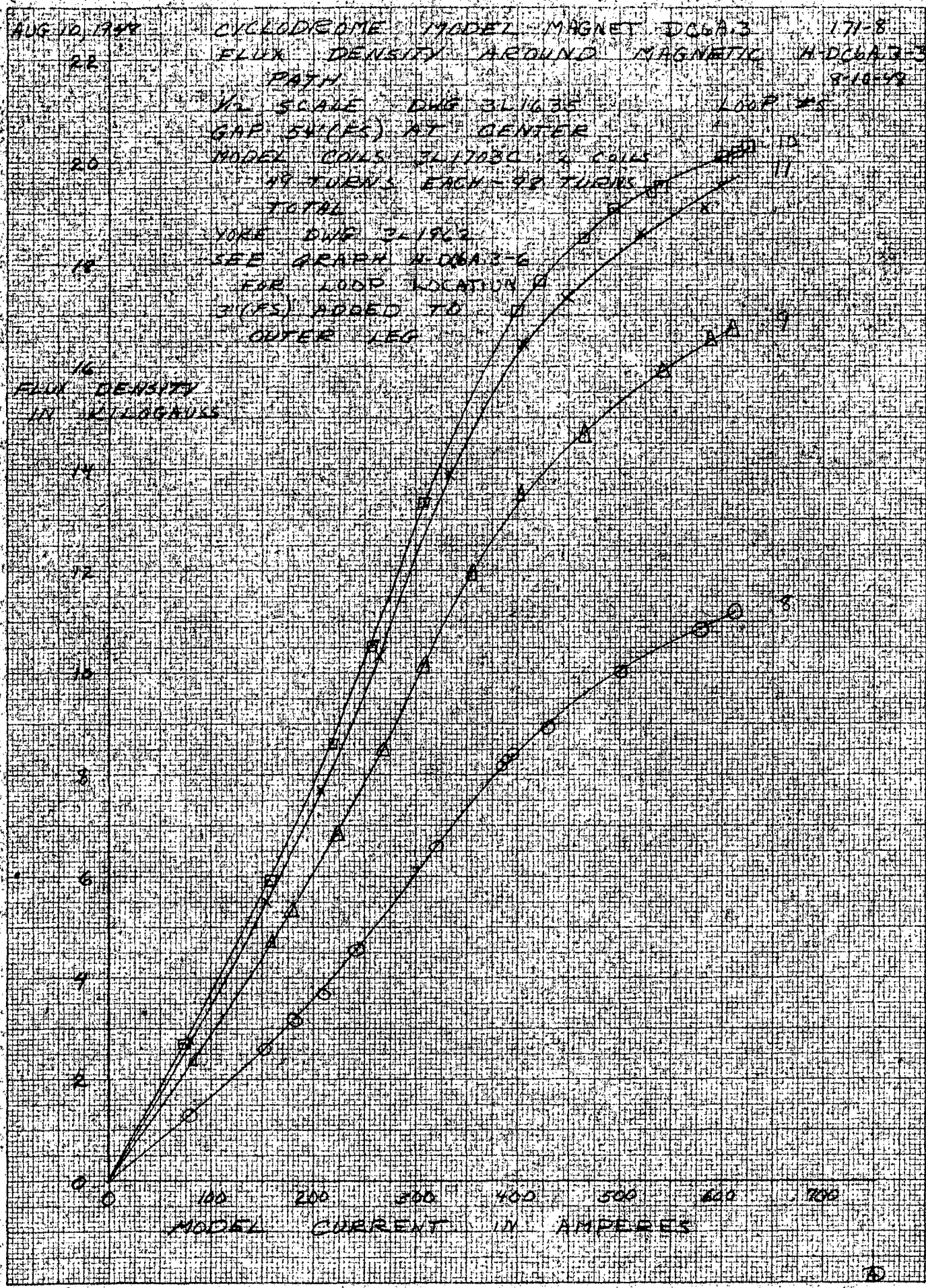
98 TURNS TOTAL ON MODEL



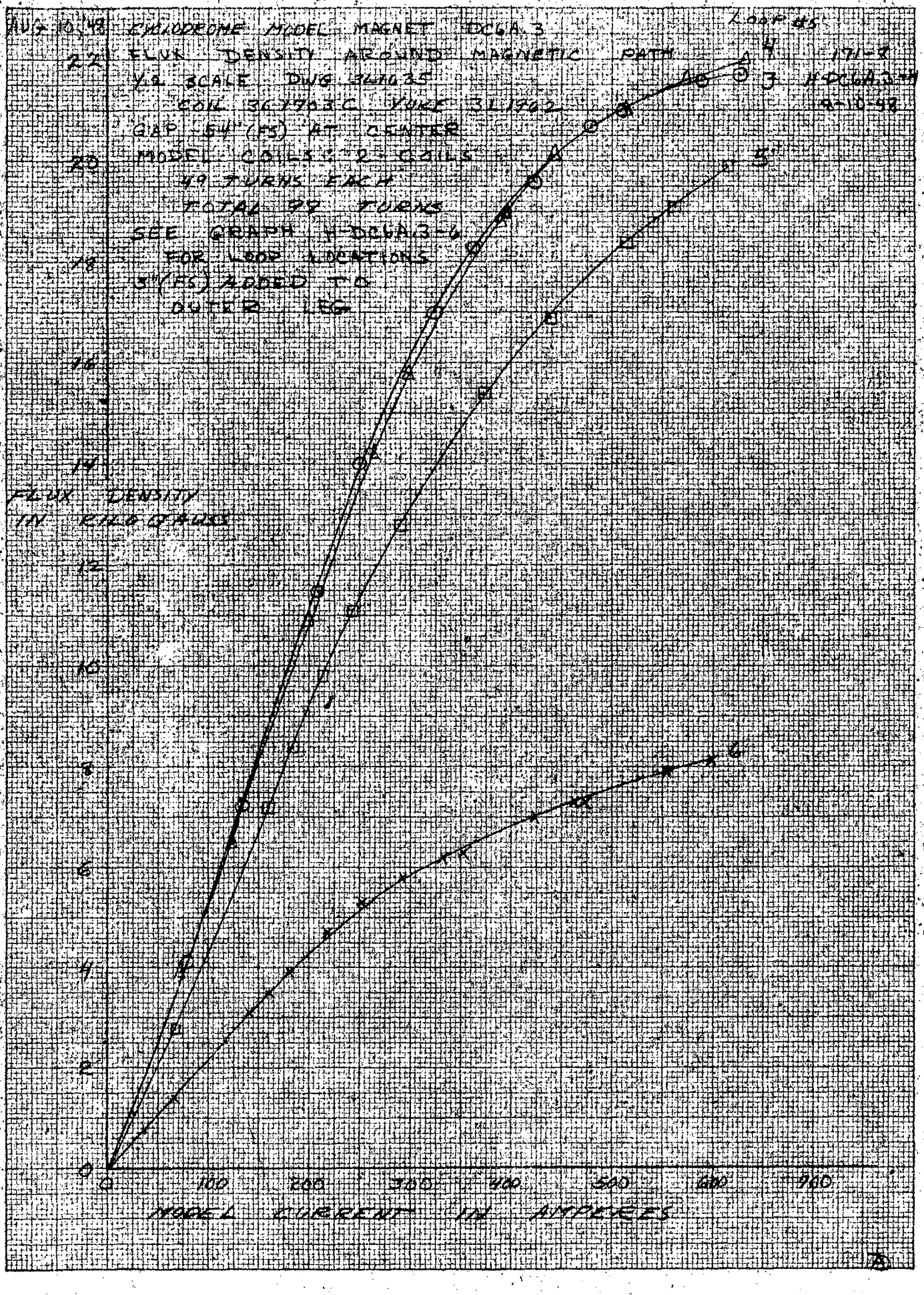
KEUFFEL & ESSER CO., N. Y. - NO. 359-14G4
Millimeters, 5 mm. lines accented, cm. lines heavy.
MADE IN U.S.A.



KEUFFEL & ESSER CO., N. Y. NO. 359T-12G
10 X 10 to the ½ inch, 5th lines accented.
Engraving 7½ X 10 in.
MADE IN U.S.A.



KEUFFEL & ESSER CO., N. Y. No. 359-140
Millimeters & inch lines accurately, cm. lines heavy.
MADE IN U.S.A.


AUG 10, '48
CYCLODROME MODEL MAGNET DC6A.3
FLUX DENSITY AROUND MAGNETIC PATH
1/2 SCALE DWG 3L1635
COIL 3L1703C YOKE 3L1962
GAP 54" (FS) AT CENTER
MODEL COILS: 2 COILS
49 TURNS EACH
TOTAL 98 TURNS
SEE GRAPH H-DC6A.3-6
FOR LOOP LOCATIONS
3" (FS) ADDED TO
OUTER LEG
LOOP #5
4
3
5"
6
171-8
H-DC6A.3-4
9-10-48
FLUX DENSITY
IN KILOGAUSS
0
2
4
6
8
10
12
14
16
18
20
22
0
100
200
300
400
500
600
700
MODEL CURRENT IN AMPERES

171-8

H-DC6A3-5
8-10-45

AUG 10 '49 CYCLODROME MODEL MAGNET DC6A-3
FLUX DENSITY AROUND MAGNETIC PATH

LOOP #7

1/2 SCALE 3L635
GAP 5¼" (FS) AT CENTER
MODEL COILS DWG 3L1703C
2 COILS 49 TURNS EACH
98 TURNS TOTAL
YOKE DWG 3L1962
SEE GRAPH H-DC6A3-6 FOR LOOP LOCATION
3" (FS) ADDED TO OUTER LEG SLAB
POLARITY IS SAME AS LOOP #8

FLUX DENSITY IN GAUSS

2500
2000
1500
1000
500
0

0 100 200 300 400 500 600 700

MODEL CURRENT IN AMPERES

AD

KEUFFEL & ESSER CO. N. Y. NO. 358-145
Millimeters, 5 mm. lines accented, cut lines heavy.
MADE IN U.S.A.

AUGUST 10, 1948

CYCLODROME MODEL MAGNET DC6A.3

FLUX DENSITY AROUND MAGNETIC PATH

1/2 SCALE DWG 3L1635

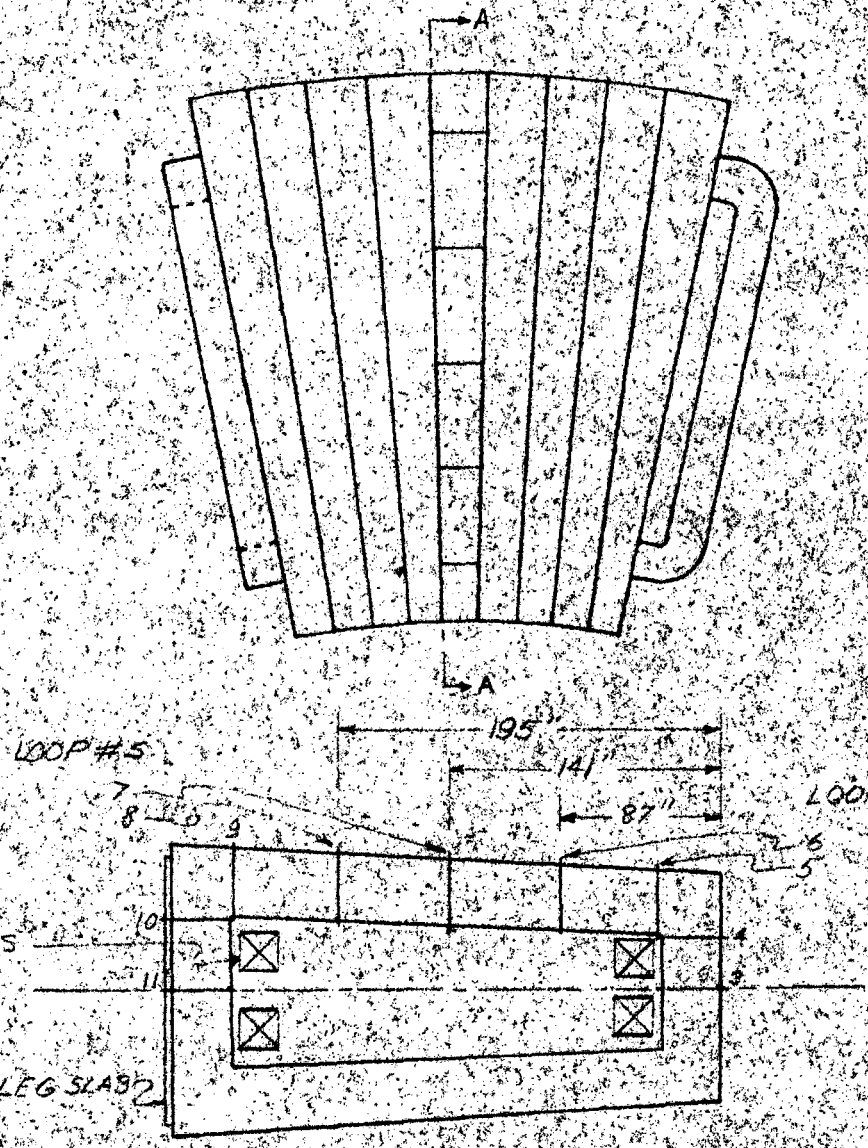
GAP 54" (F.S.) AT CENTER

YOKE DWG 3L1962

COILS DWG 3L1703C - 38 TURNS TOTAL

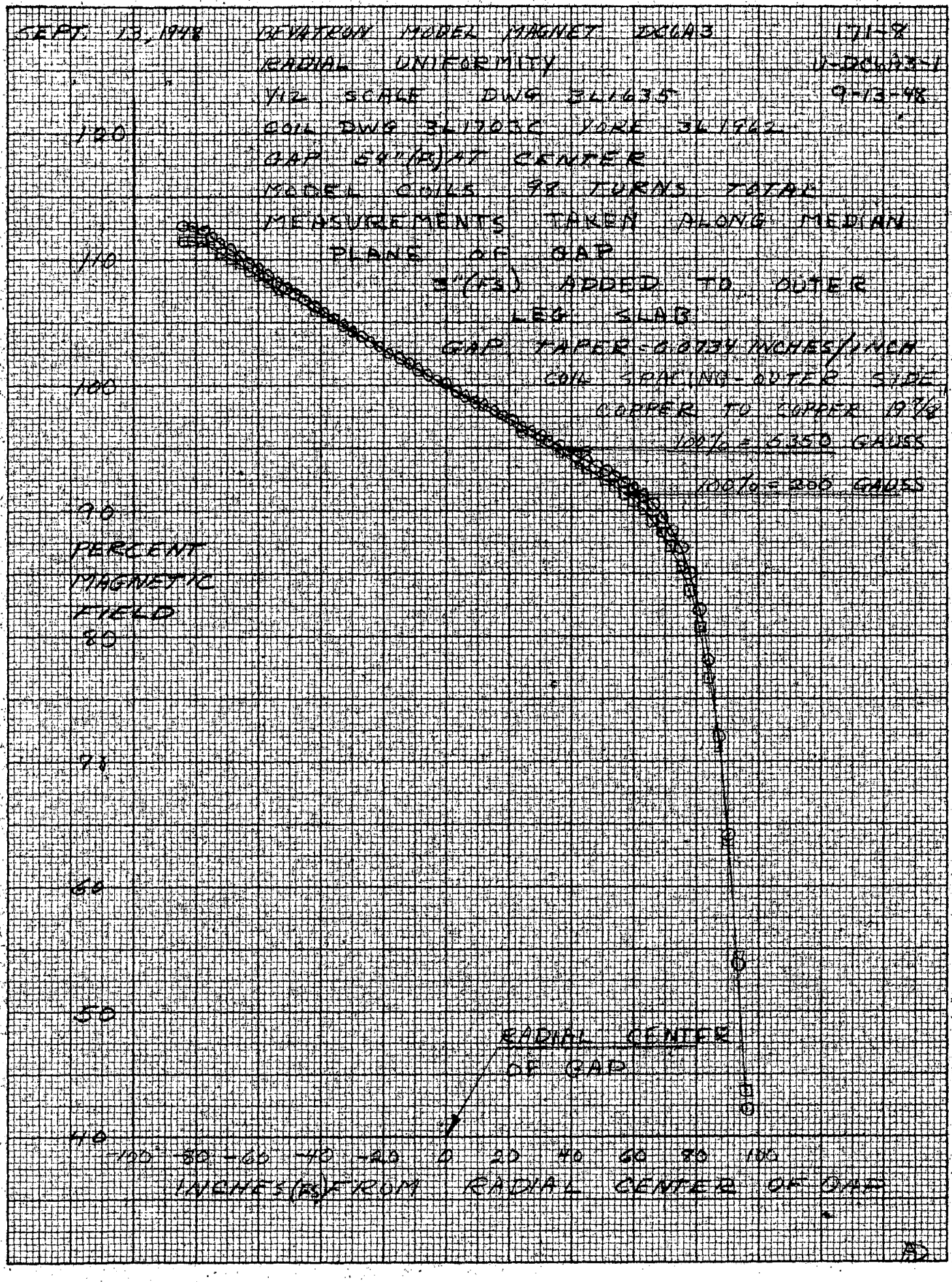
SEE GRAPHS H-DC6A.3-3
H-DC6A.3-4
H-DC6A.3-5

171-8
H-DC6A.3-6
8-10-48

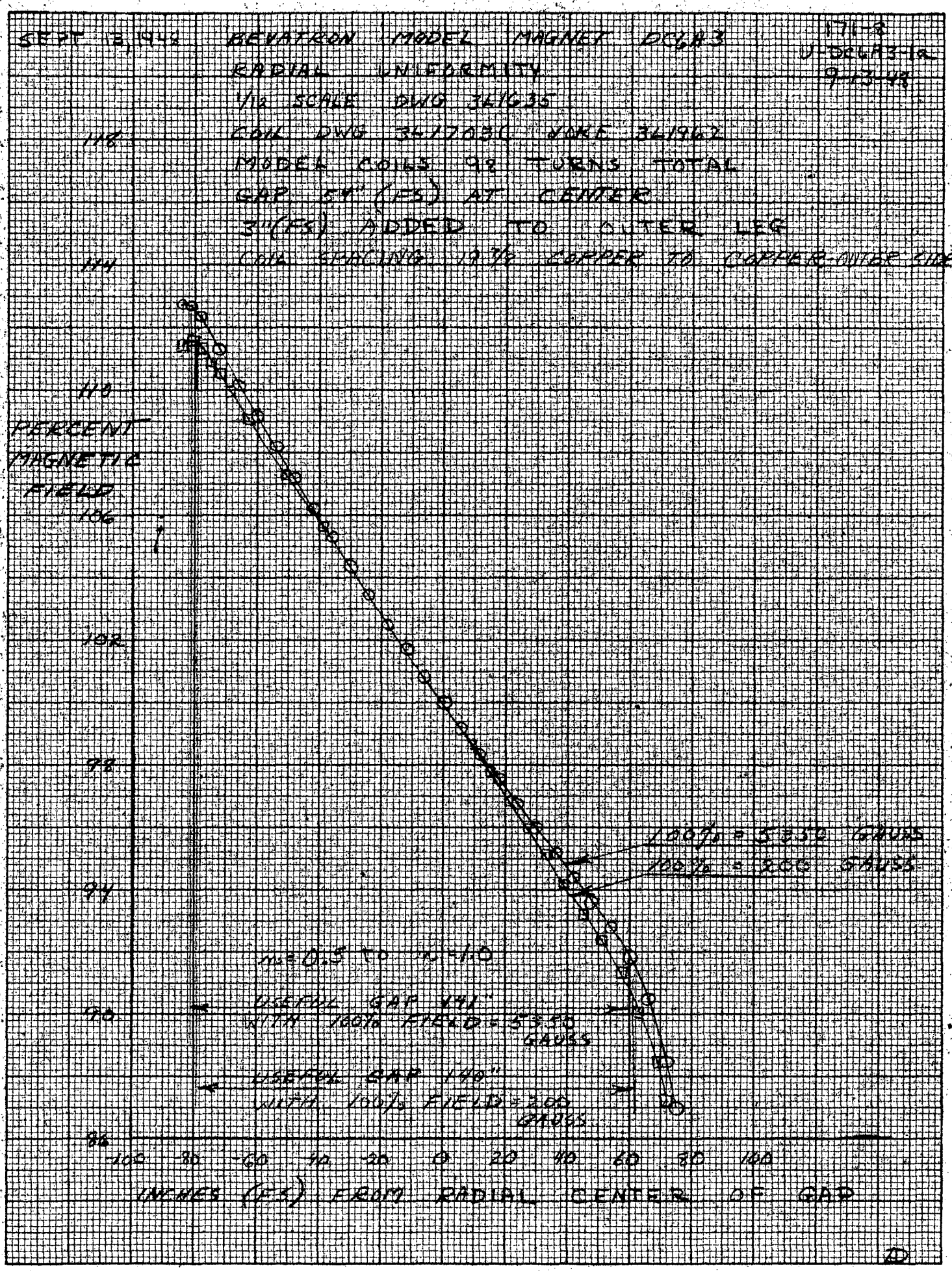


CROSS SECTION AT AA

EWC



KEUFFEL & ESSER CO., N. Y. NO. 359T-12G
10 X 10 to the ½ inch, 5th lines accented.
Engraving 7½ X 10 in.
MADE IN U.S.A.


SEPT 13, 1948
BEVATRON MODEL MAGNET DC6A3
RADIAL UNIFORMITY
1/12 SCALE DWG 3L1635
COIL DWG 3L1703C YOKE 3L1962
MODEL COILS 98 TURNS TOTAL
GAP 54" (FS) AT CENTER
3" (FS) ADDED TO OUTER LEG
COIL SPACING 19 7/8 COPPER TO COPPER-OUTER SIDE
171-8
U-DC6A3-1a
9-13-48
PERCENT MAGNETIC FIELD
118
114
110
106
102
98
94
90
86
100% = 5350 GAUSS
100% = 200 GAUSS
n = 0.5 TO n = 1.0
USEFUL GAP 141" WITH 100% FIELD = 5350 GAUSS
USEFUL GAP 140" WITH 100% FIELD = 200 GAUSS
-100
-80
-60
-40
-20
0
20
40
60
80
100
INCHES (FS) FROM RADIAL CENTER OF GAP

AUG 10, 48 CYCLODROME MODEL MAGNET DC6A3 171-8

COIL LOOP FLUX LINKAGE F-DC6A.3-1

X2 SCALE DWG 3L1635 8-10-48

GAP 54"(FS) AT CENTER

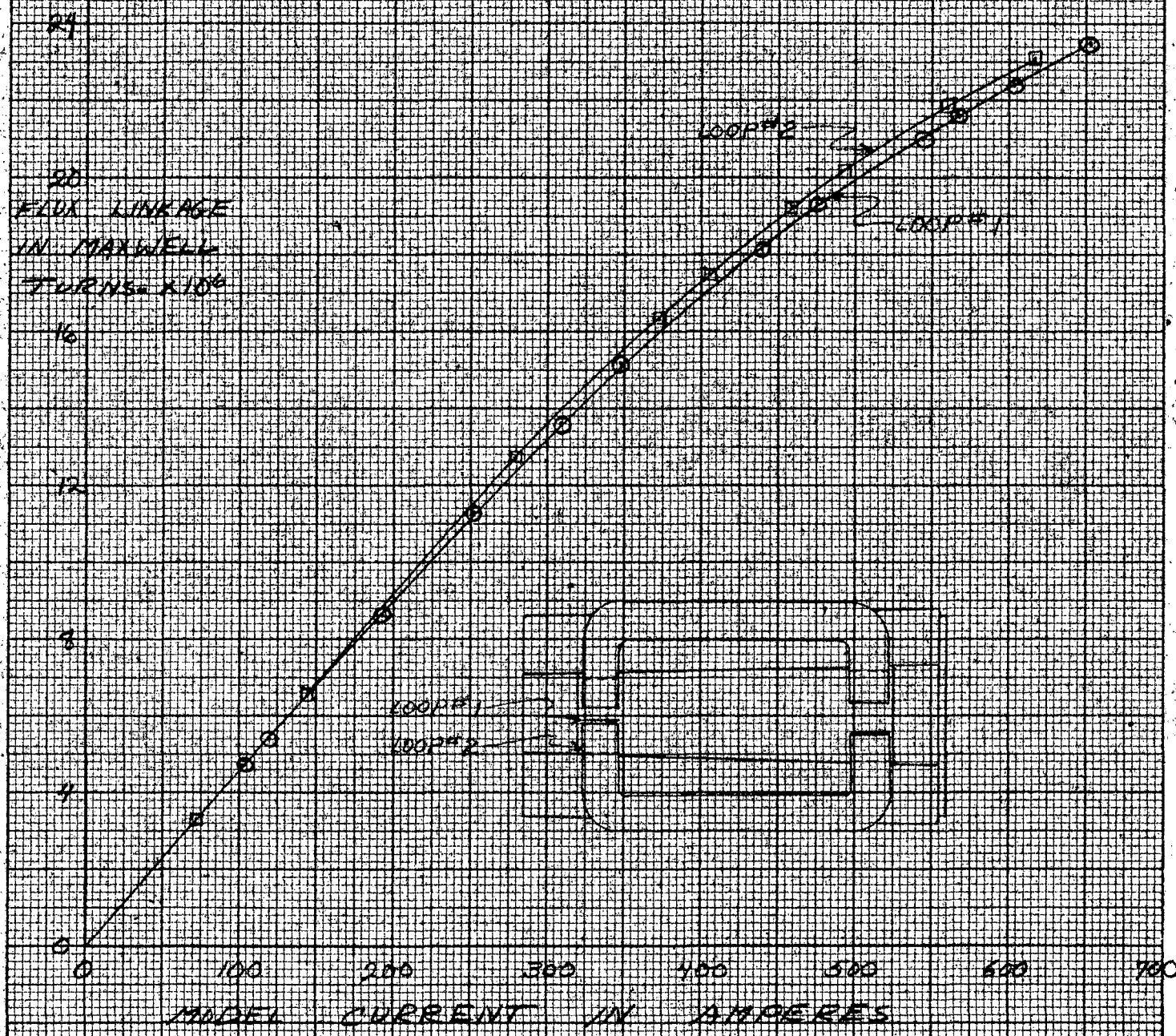
MODEL COILS: DWG 3L1703C - 2 COILS

49 TURNS EACH - TOTAL 98 TURNS

EACH LOOP HAS 7 TURNS

FLUX LINKAGE IS ON 7.433° SECTION OF MODEL

3"(FS) ADDED TO OUTER LEG SLAB



KEUFFEL & ESSER CO., N. Y. NO. 359T-12G
10 X 10 to the ½ inch, 5th lines accented.
Engraving 7½ X 10 in.
MADE IN U.S.A.

AUGUST 10, 1948

CYCLOTRON MODEL MAGNET DC6A.3

TOTAL COIL LOOP FLUX LINKAGE

½ SCALE DWG 3L1635

MODEL COILS DWG 3L1703C

2 COILS 49 TURNS EACH

98 TURNS TOTAL

YOKE DWG 3L1962

GAP 5" (F.S.)

FLUX LINKAGE IS ON 7.433° SECTION ON MODEL

3" (F.S.) ADDED TO OUTER LEG SLAB

SEE GRAPH FDC6A.3-1

127-9
F-DC6A.3-1a
9-10-48

MODEL CURRENT IN AMPERES

600
500
400
300
200
100
0

0
100
200
300

FLUX LINKAGE IN MAXWELL TURNS X 10⁶

EWC

KEUFFEL & ESSER CO., N. Y. NO. 3567-120
10 X 10 to the ½ inch, 5th lines accented
Engraving 7½ X 10 in.
MADE IN U.S.A.

AUGUST 10, 1948

CYCLODROME MODEL MAGNET DC6A.3
STORED ENERGY ON MODEL
CALCULATED FROM TOTAL COIL
LOOP FLUX LINKAGE
SEE GRAPH F-DC6A.3-1α

$$\text{ENERGY(JOULES)} = 10^{-1} \int_0^{\Phi} I \, d\Phi$$

WHERE I IS IN AMPERES
AND Φ IS IN MAXWELL TURNS
DATA IS FOR A 7.833" SECTION
OF MODEL

½ SCALE DWG 3L16.3-5
COIL DWG 3L17.03C
YOKE DWG 3L13K2

71-8
E-DC6A.3-1
9-10-48

MODEL STORED ENERGY IN JOULES X 10^2

0 1 2 3 4 5 6

MAGNETIC FIELD AT GAP CENTER IN KILOGAUSS

BWC

KEUFFEL & ESSER CO., N. Y. NO. 359-120
10 × 10 to the ½ Inch, 5th lines accented.
Engraving 7½ × 10 in.
MADE IN U.S.A.

AUGUST 16 1948 BEVATRON MODEL MAGNET DC6A3 171-8

FLUX DENSITY ON YOKE S-DC6A3-29

1/12 SCALE DWG 3L7635 8-16-48

COIL 3L1703C - 2 COILS 49 TURNS

EACH = 98 TURNS TOTAL

GAP 54" (FS) AT CENTER

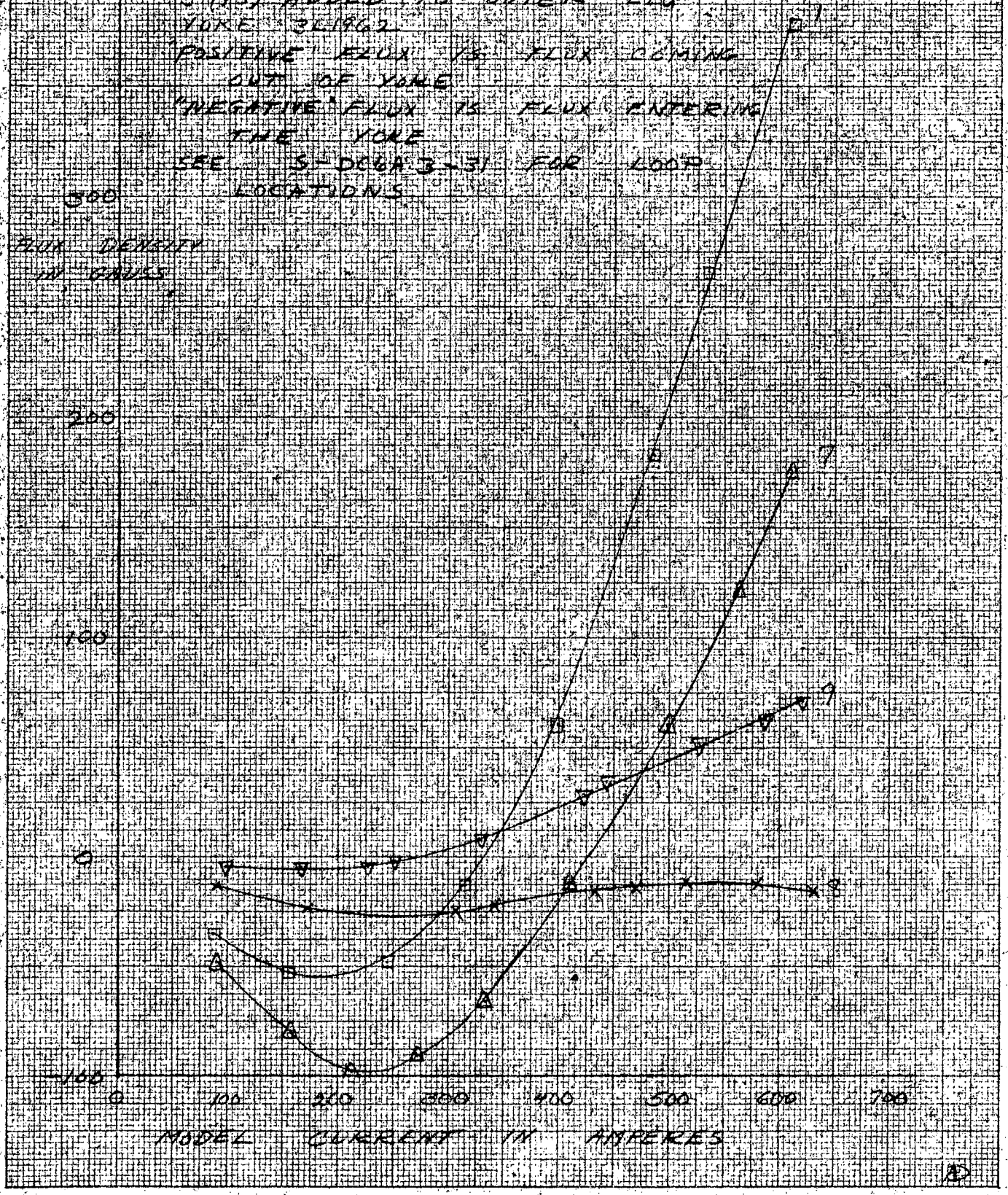
3" (FS) ADDED TO OUTER LEG

YOKE 3L1962

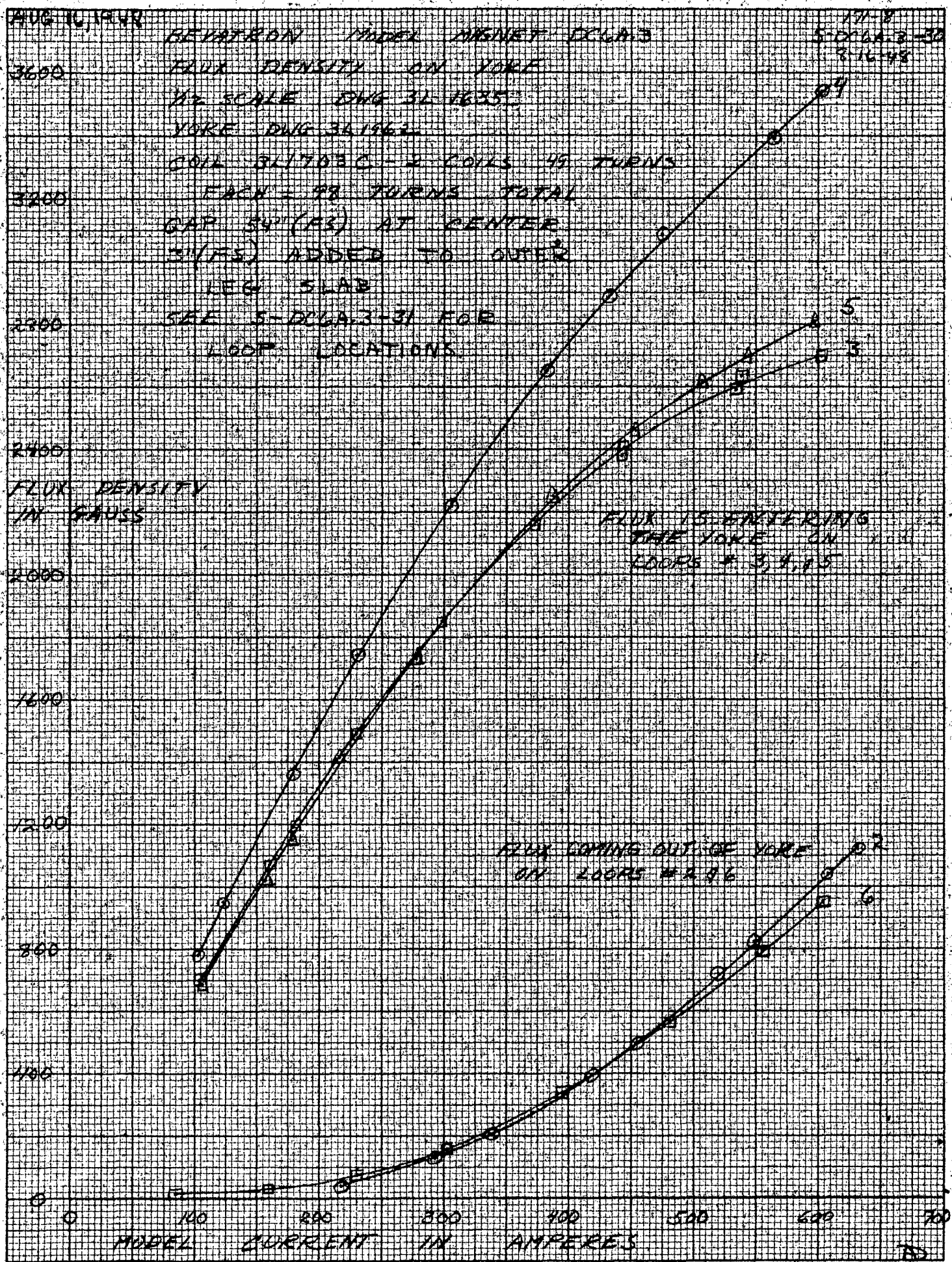
"POSITIVE" FLUX IS FLUX COMING OUT OF YOKE

"NEGATIVE" FLUX IS FLUX ENTERING THE YOKE

SEE S-DC6A3-31 FOR LOOP LOCATIONS



KEUFFEL & ESSER CO., N. Y. NO. 359-140 Millimeters, 5 mm. lines accented, cm. lines heavy. MADE IN U.S.A.



KEUFFEL & ESSER CO., N. Y. NO. 8597-12G
10 × 10 to the ½ inch, 5th lines accented.
Engraving 7½ × 10 in.
MADE IN U.S.A.

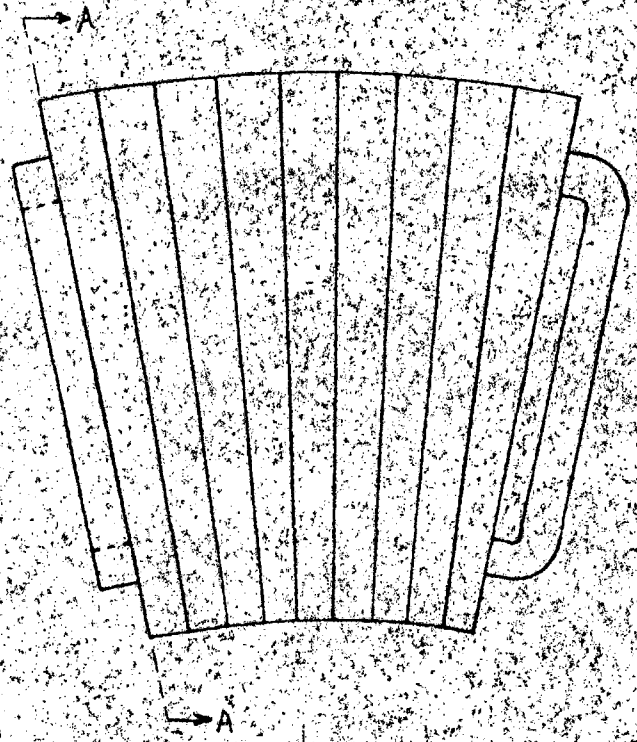
AUGUST 16, 1948

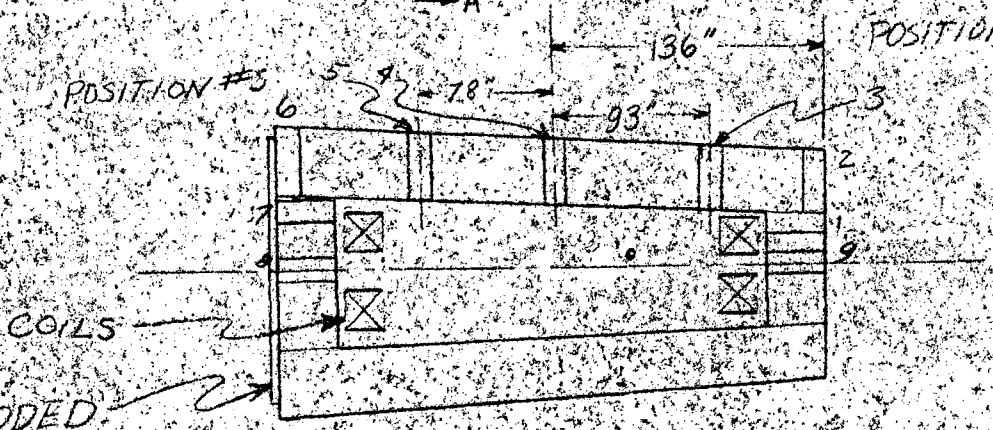
171-8

BEVATRON MODEL MAGNET DC6A.3

S-DC6A.3-31
8-16-48

FLUX DENSITY ON YOKE
1/12 SCALE DWG 3L1635
YOKE DWG 3L1962 COIL DWG 3L1703C
GAP 5" (F.S.) AT CENTER
3" (F.S.) ADDED TO OUTER LEG SLAB

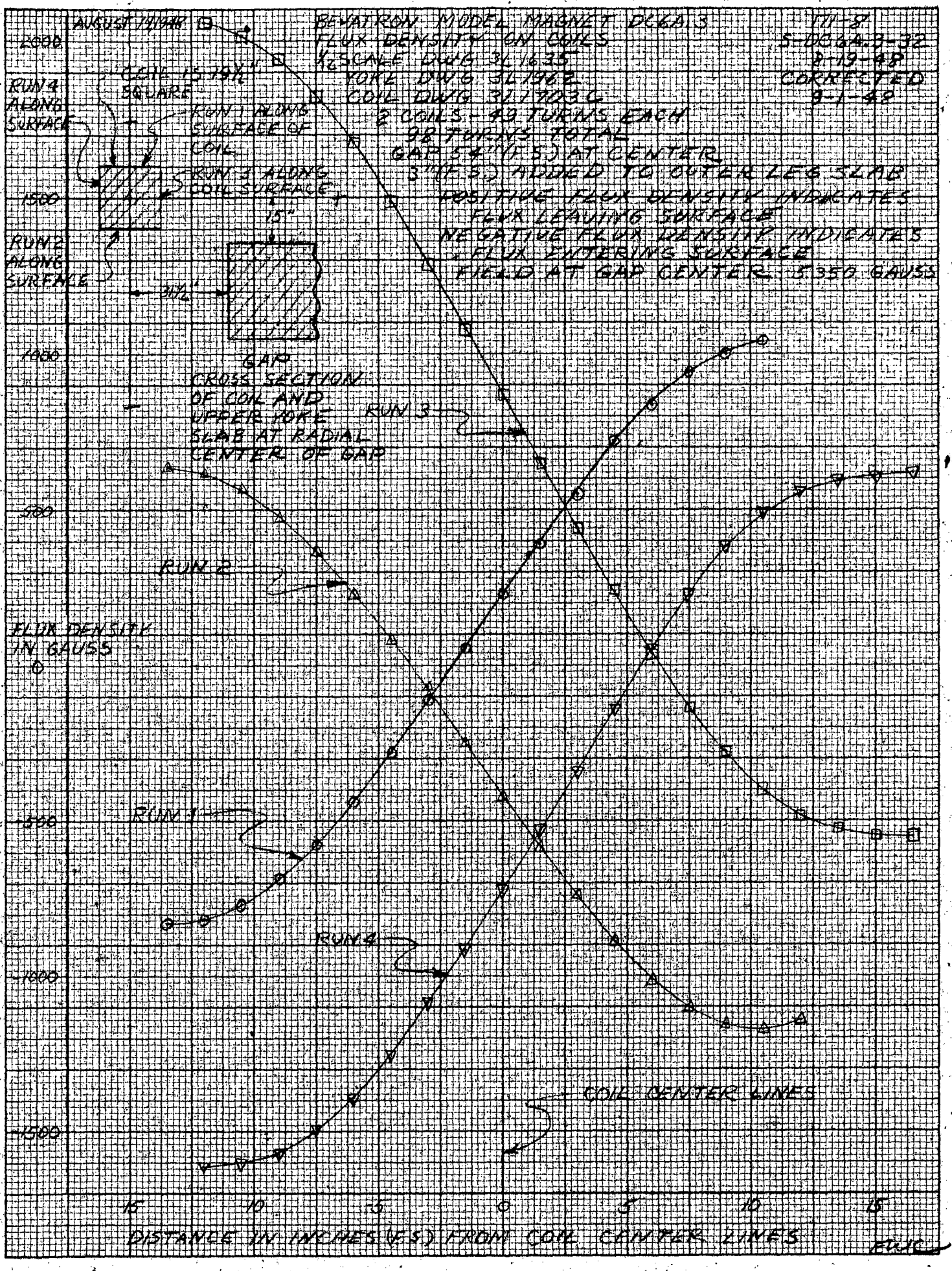




CROSS SECTION AT AA

SEE GRAPHS S-DC6A.3-29
S-DC6A.3-30

EWC

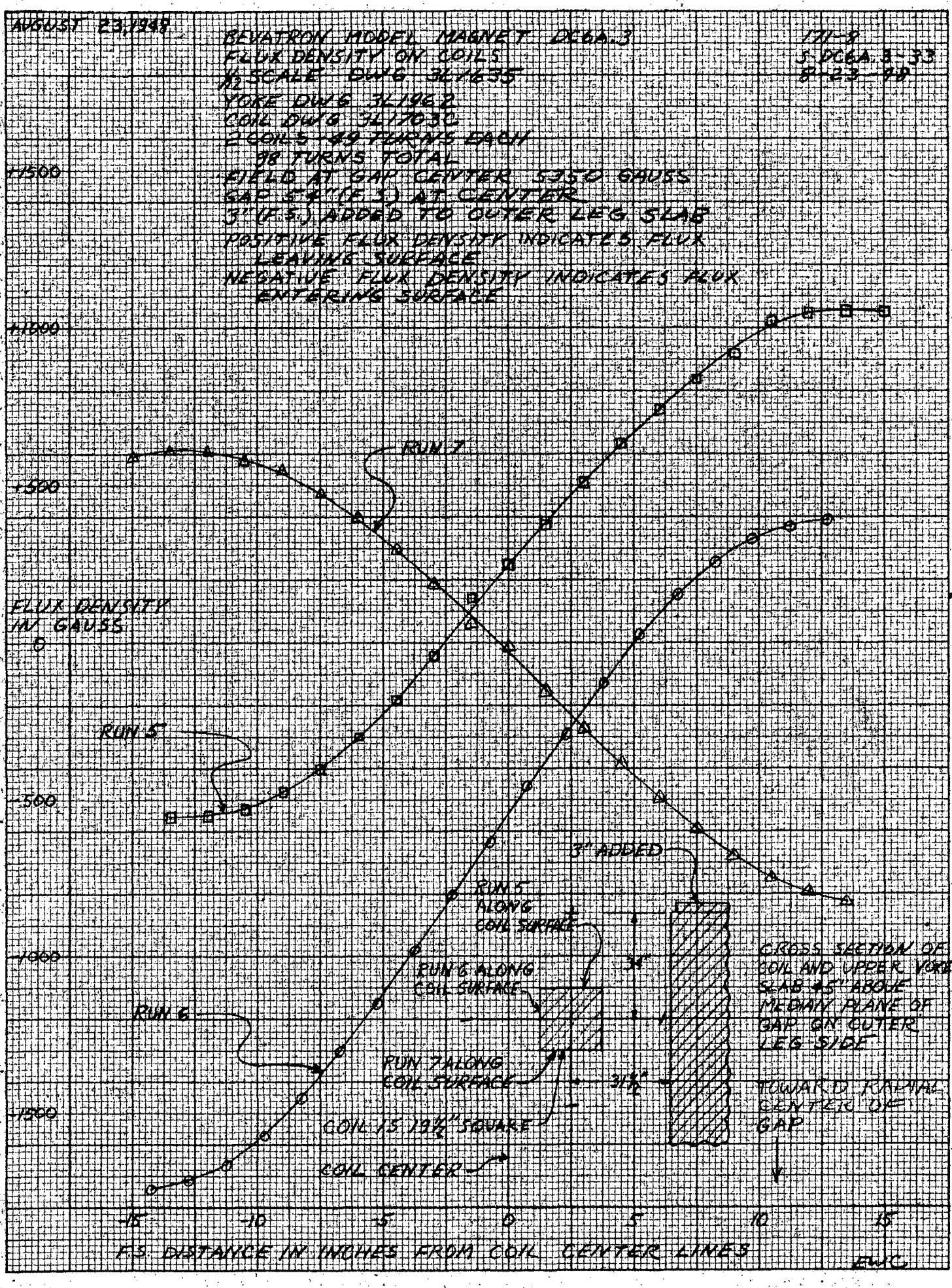


KEUFFEL & ESSER CO., N. Y. NO. 359-120
10 × 10 to the ¼ inch, 5th lines accented.
Engraving 7½ × 10 in.
MADE IN U.S.A.

AUGUST 23, 1948

BEVATRON MODEL MAGNET DC6A-3
FLUX DENSITY ON COILS
½ SCALE DWG 3L-1635
YOKE DWG 3L19628
COIL DWG 3L17038
2 COILS - 49 TURNS EACH
98 TURNS TOTAL
FIELD AT GAP CENTER 5350 GAUSS
GAP 5¾" (F.S.) AT CENTER
3" (F.S.) ADDED TO OUTER LEG SLAB
POSITIVE FLUX DENSITY INDICATES FLUX LEAVING SURFACE
NEGATIVE FLUX DENSITY INDICATES FLUX ENTERING SURFACE

171-9
S. DC6A. 3-33
8-23-48



EWC

KEUFFEL & ESSER CO., N. Y. NO. 359T-12G
10 X 10 to the ½ inch, 5th lines accented.
Engraving 7½ X 10 in.
MADE IN U.S.A.

AUGUST 23, 1948

BEVATRON MODEL MAGNET DC6A.3
FLUX DENSITY ON COILS
½ SCALE DWG 3L K35

YOKE DWG 3L 19612
COIL DWG 3L 17033C
2 COILS - 49 TURNS EACH
98 TURNS TOTAL
FIELD AT GAP CENTER 3,350 GAUSS
GAP 3-4" (F.S.) AT CENTER
3" (F.S.) ADDED TO OUTER LEG SLAB
POSITIVE FLUX DENSITY INDICATES FLUX LEAVING SURFACE
NEGATIVE FLUX DENSITY INDICATES FLUX ENTERING SURFACE

DWG. #
5-DC6A.3-3A
8-23-48

2000
1500
1000
500
0
-500
-1000
-1500

FLUX DENSITY IN GAUSS

RUN 8 ALONG COIL SURFACE
RUN 9 ALONG COIL SURFACE
RUN 10 ALONG COIL SURFACE
RUN 10
RUN 8
RUN 9

COIL CENTERS

-15 -10 -5 0 5 10 15

F.S. DISTANCE IN INCHES FROM COIL CENTER LINE

COIL IS 19½" SQUARE

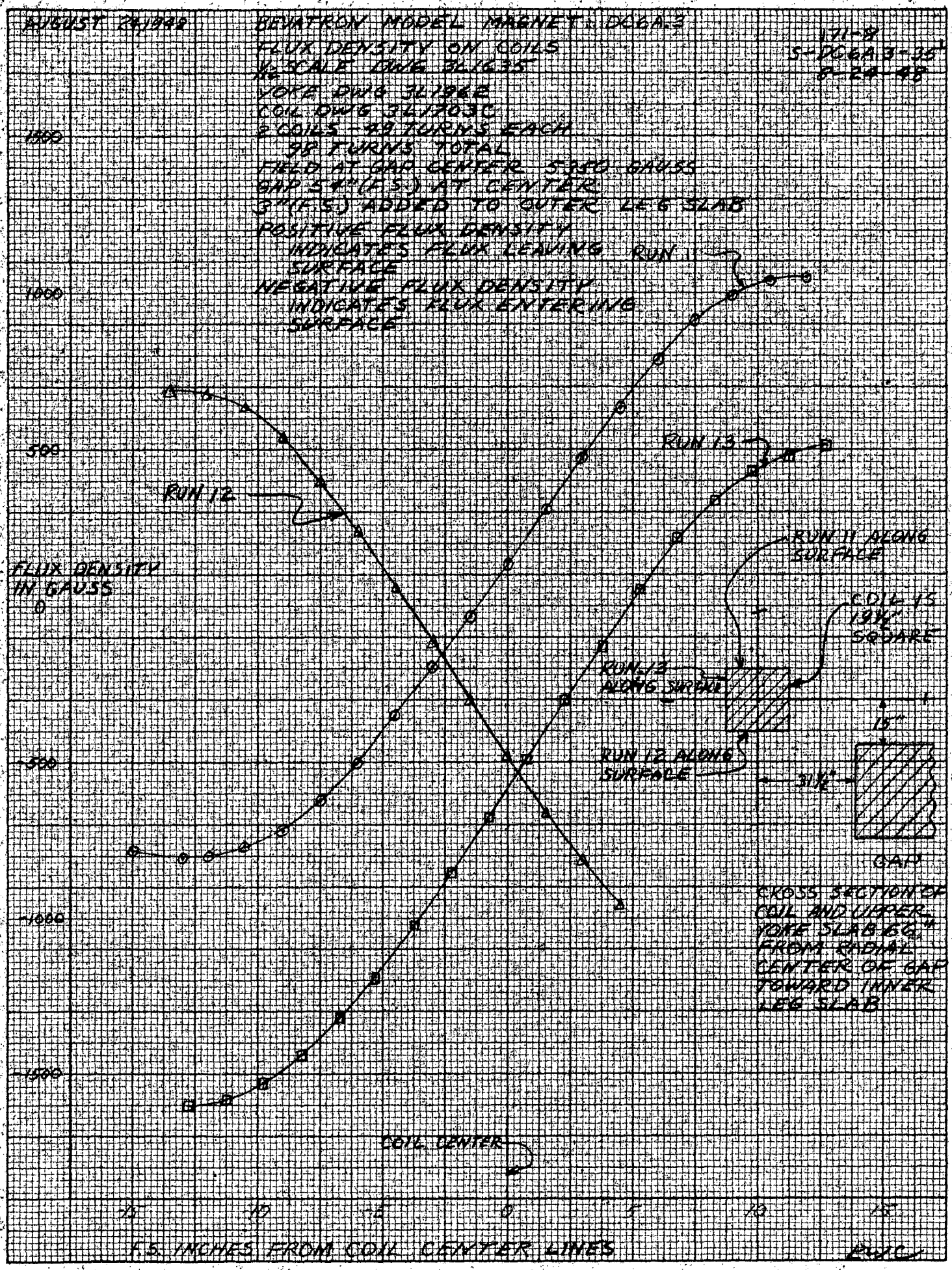
3½"

2"

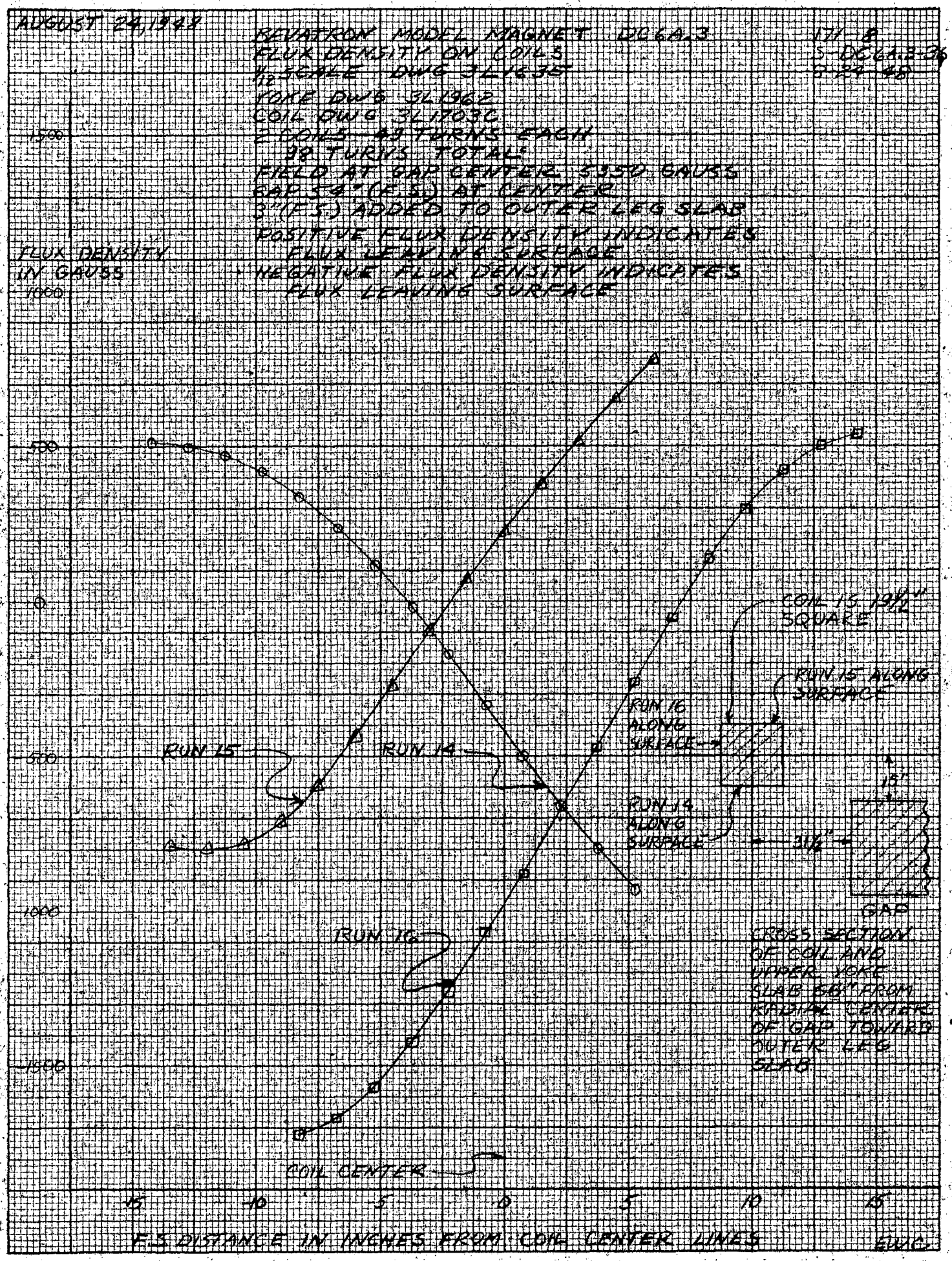
TOWARD RADIAL CENTER OF GAP

CROSS SECTION OF COIL AND UPPER YOKE SLAB 38½" ABOVE MEDIAN PLANE OF GAP ON INNER LEG SIDE

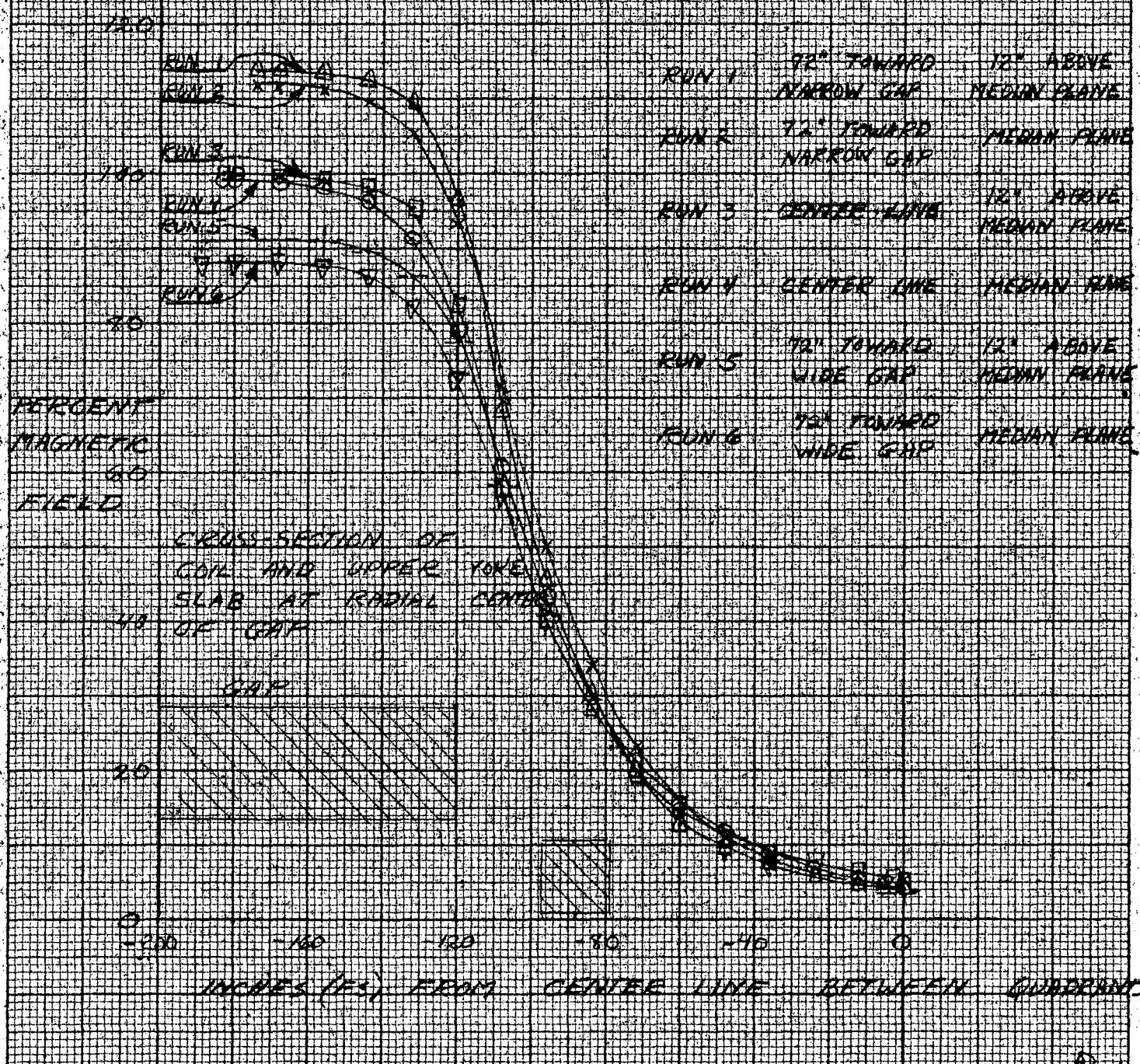
KEUFFEL & ESSER CO., N. Y. NO. 358T-126
10 × 10 to the ½ inch, 5th lines accented.
Engraving 7½ × 10 in.
MADE IN U.S.A.



KEUFFEL & ESSER CO., N. Y. NO. 359T-12G
10 X 10 to the ½ inch, 5th lines accented.
Engraving 7½ X 10 in.
MADE IN U.S.A.


AUGUST 24, 1948
BEVATRON MODEL MAGNET DC6A.3
FLUX DENSITY ON COILS
1/12 SCALE DWG 3L1635
YOKE DWG 3L1962
COIL DWG 3L1703C
2 COILS 49 TURNS EACH
98 TURNS TOTAL
FIELD AT GAP CENTER 5350 GAUSS
GAP 54" (F.S.) AT CENTER
3" (F.S.) ADDED TO OUTER LEG SLAB
POSITIVE FLUX DENSITY INDICATES
FLUX LEAVING SURFACE
NEGATIVE FLUX DENSITY INDICATES
FLUX LEAVING SURFACE
171-8
S-DC6A.3-36
8-24-48
FLUX DENSITY
IN GAUSS
1500
1000
500
0
500
1000
1500
RUN 15
RUN 14
RUN 16
COIL CENTER
COIL IS 19½" SQUARE
RUN 15 ALONG SURFACE
RUN 16 ALONG SURFACE
RUN 14 ALONG SURFACE
15"
31½"
GAP
CROSS SECTION OF COIL AND UPPER YOKE SLAB 58" FROM RADIAL CENTER OF GAP TOWARD OUTER LEG SLAB
-15
-10
-5
0
5
10
15
F.S. DISTANCE IN INCHES FROM COIL CENTER LINES
EWC

SEPT 23, 1948 BEVATRON MODEL MAGNET DC6A3 171-8
VERTICAL COMPONENT - STRAY FIELD S-DC6A3-41
1/12 SCALE DWG 3L1635 9-23-48
COIL DWG 3L703C YOKE DWG 3L1962
3" (FS) ADDED TO OUTER LEG SLAB
GAP 54" (FS) AT CENTER
MAGNETIC FIELD 2100 GAUSS AT
GAP CENTER = 100%
SEE GRAPH S-DC6A3-5
CURVES ARE DRAWN FOR TWO QUADRANTS



REUFFEL & ESSER CO., N. Y. NO. 359Y-12G
10 X 10 to the ½ inch, 5th lines accented.
Engraving 7½ X 10 in.
MADE IN U.S.A.

SEPT 24, 1948 BEVATRON MODEL MAGNET DC6A3 171-8

S-DC6A3-42

VERTICAL COMPONENT STRAY FIELD 9-24-48

1/12 SCALE DWG 3L1635

COIL DWG 3L1703C YOKE 3L1962

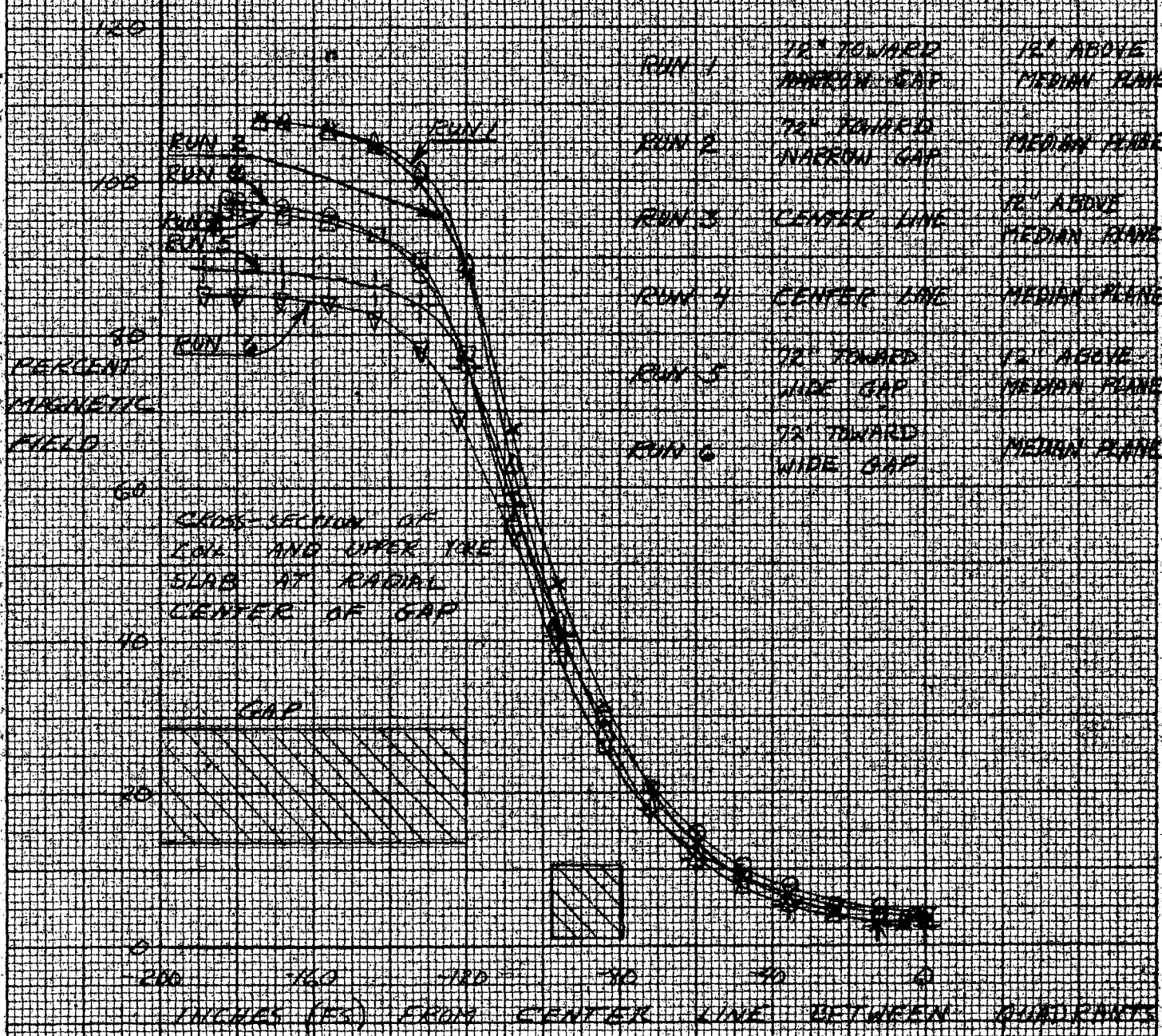
3"(FS) ADDED TO OUTER LEG SLAB

GAP 54"(FS) AT CENTER

MAGNETIC FIELD 5050 GAUSS AT GAP CENTER = 100 %

SEE GRAPH S-DC6A3-5

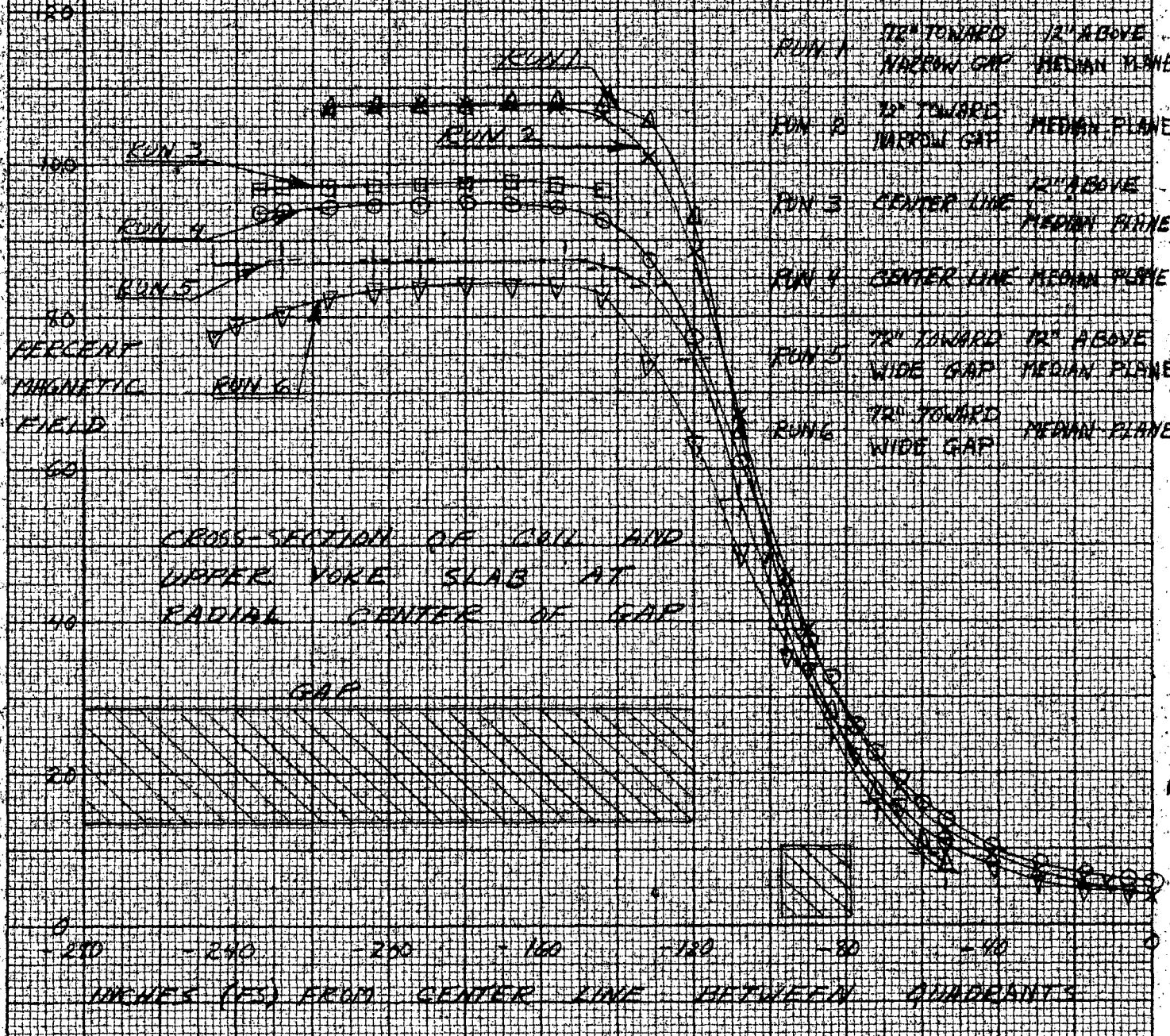
CURVES ARE DRAWN FOR TWO QUADRANTS



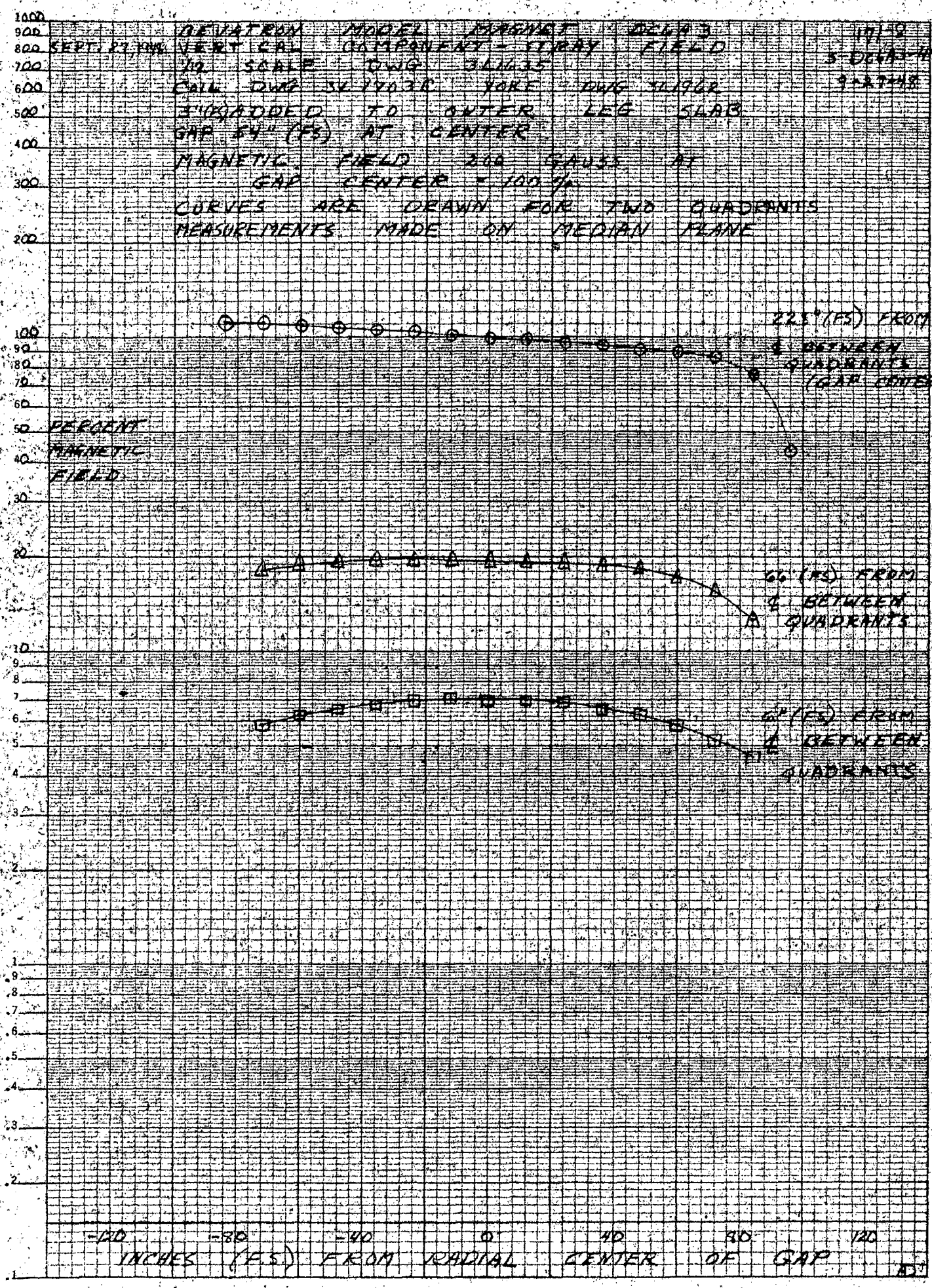
KEUFFEL & ESSER CO., N. Y. NO. 359T-12G
10 × 10 to the ½ inch, 5th lines accented.
Engraving 7½ × 10 in.
MADE IN U.S.A.

171-8
S-DC6A3-43
9-24-48

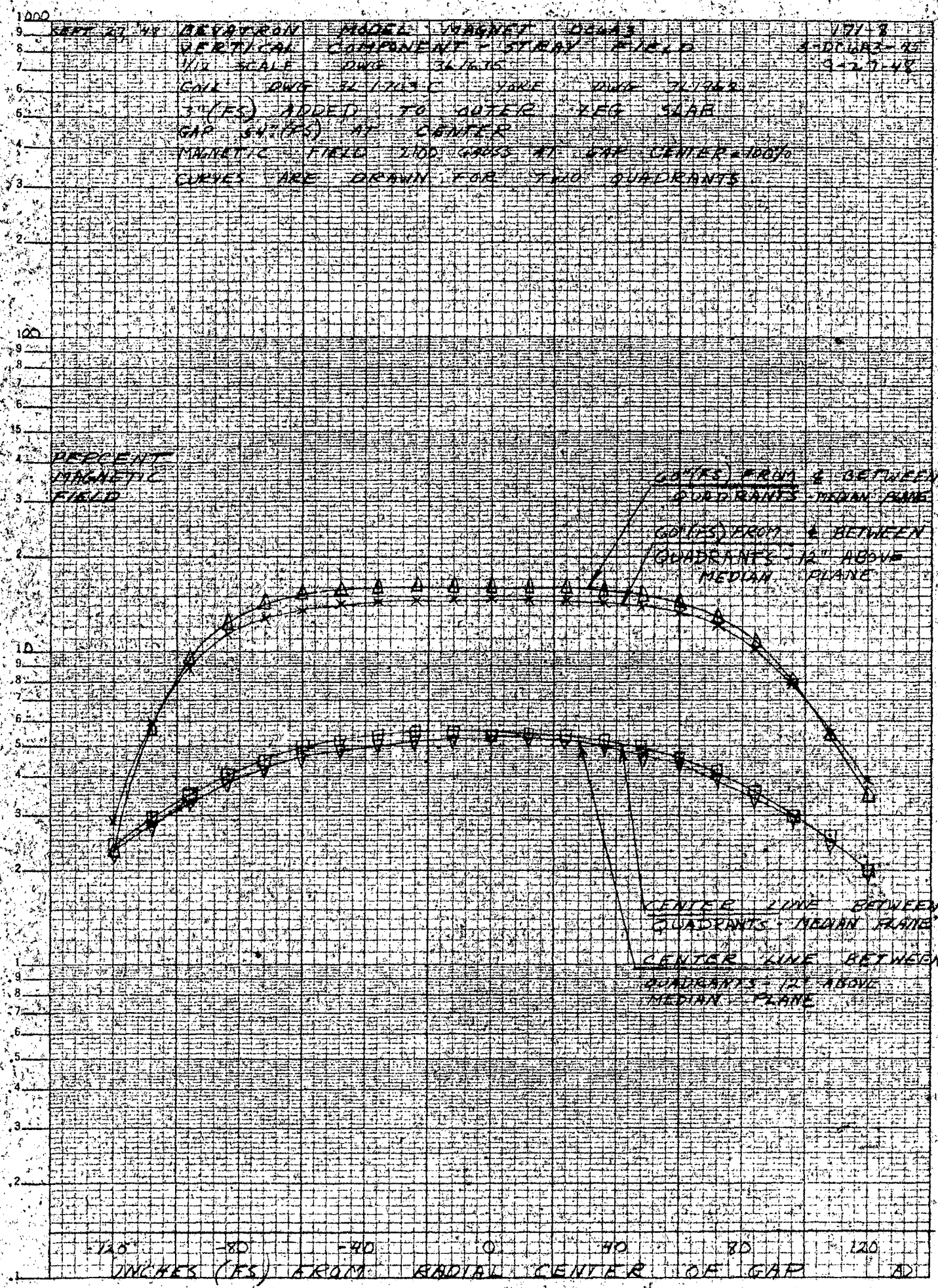
SEPT 24, 1948 BEVATRON MODEL MAGNET DC6A3
VERTICAL COMPONENT - STRAY FIELD
1/12 SCALE DWG 3L1635
COIL DWG 3L1703C YOKE 3L1962
3" (FS) ADDED TO OUTER LEG SLAB
GAP 54" (FS) AT CENTER
MAGNETIC FIELD 200 GAUSS AT
GAP CENTER = 100%
SEE GRAPH S-DC6A3-5
CURVES ARE DRAWN FOR TWO QUADRANTS

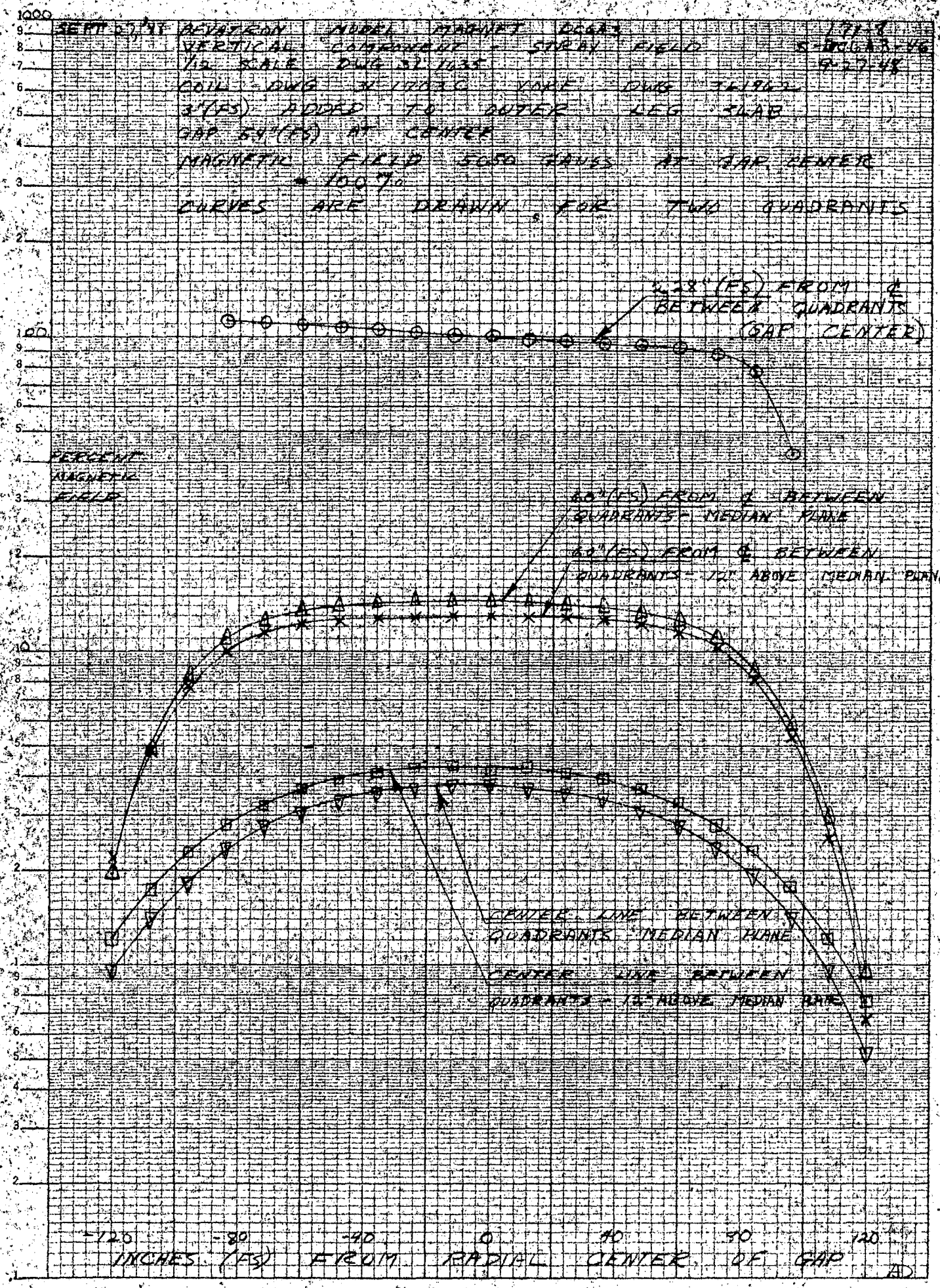


KEUFFEL & ESSER CO., N.Y. NO. 359T-12G
10 × 10 to the ½ inch, 5th lines accented.
Engraving 7½ × 10 in.
MADE IN U.S.A.



BEVATRON MODEL MAGNET DC6A3
SEPT. 27, 1948
VERTICAL COMPONENT - STRAY FIELD
1/2 SCALE DWG 3L1635
COIL DWG 3L1703C YOKE DWG 3L1962
3" (FS) ADDED TO OUTER LEG SLAB
GAP 54" (FS) AT CENTER
MAGNETIC FIELD 200 GAUSS AT
GAP CENTER = 100 %
CURVES ARE DRAWN FOR TWO QUADRANTS
MEASUREMENTS MADE ON MEDIAN PLANE
171-8
3-DC6A3-44
9-27-48
225" (FS) FROM
℄ BETWEEN
QUADRANTS
(GAP CENTER)
PERCENT
MAGNETIC
FIELD
66" (FS) FROM
℄ BETWEEN
QUADRANTS
6" (FS) FROM
℄ BETWEEN
QUADRANTS
-120
-80
-40
0
40
80
120
INCHES (F.S.) FROM RADIAL CENTER OF GAP


SEPT 27, 48
BEVATRON MODEL MAGNET DC6A3
VERTICAL COMPONENT - STRAY FIELD
1/12 SCALE DWG 36 1635
COIL DWG 32 1703 C YOKE DWG 32 1762
3"(FS) ADDED TO OUTER LEG SLAB
GAP 54"(FS) AT CENTER
MAGNETIC FIELD 2100 GAUSS AT GAP CENTER = 100%
CURVES ARE DRAWN FOR TWO QUADRANTS
171-8
3-DC6A3-45
9-27-48
PERCENT MAGNETIC FIELD
60"(FS) FROM & BETWEEN QUADRANTS - MEDIAN PLANE
60"(FS) FROM & BETWEEN QUADRANTS - 12" ABOVE MEDIAN PLANE
CENTER LINE BETWEEN QUADRANTS - MEDIAN PLANE
CENTER LINE BETWEEN QUADRANTS - 12" ABOVE MEDIAN PLANE
-120
-80
-40
0
40
80
120
INCHES (FS) FROM RADIAL CENTER OF GAP
KEUFFEL & ESSER CO., N. Y. NO. 359-010
Semi-Logarithmic, 4 Cycles X 10 to the inch.
MADE IN U.S.A.


SEPT 27, '48 BEVATRON MODEL MAGNET DC6A3
VERTICAL COMPONENT - STRAY FIELD
1/12 SCALE DWG 3L 1035
COIL DWG 3L 1703C YOKE DWG 3L1962
3"(FS) ADDED TO OUTER LEG SLAB
GAP 54"(FS) AT CENTER
MAGNETIC FIELD 5050 GAUSS AT GAP CENTER
= 100%
CURVES ARE DRAWN FOR TWO QUADRANTS
171-8
S-DC6A3-46
9-27-48
2.28"(FS) FROM ℄ BETWEEN QUADRANTS (GAP CENTER)
PERCENT MAGNETIC FIELD
60"(FS) FROM ℄ BETWEEN QUADRANTS - MEDIAN PLANE
60"(FS) FROM ℄ BETWEEN QUADRANTS - 12" ABOVE MEDIAN PLANE
CENTER LINE BETWEEN QUADRANTS MEDIAN PLANE
CENTER LINE BETWEEN QUADRANTS - 12" ABOVE MEDIAN PLANE
-120
-80
-40
0
40
80
120
INCHES (FS) FROM RADIAL CENTER OF GAP
KEUFFEL & ESSER CO., N. Y. NO. 359-610
Semi-Logarithmic, 4 Cycles X 10 to the Inch.
MADE IN U.S.A.

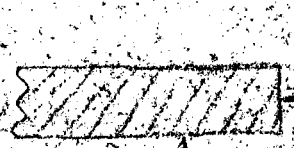
PAGE 1	RADIATION LABORATORY - UNIVERSITY OF CALIFORNIA - BERKELEY ENGINEERING NOTES	JOB NUMBER 171-8	FILE NO. C	PAGE 1

SUBJECT: BEVATRON LEAKAGE FLUX

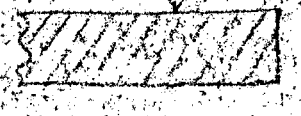
NAME: E. W. Cox

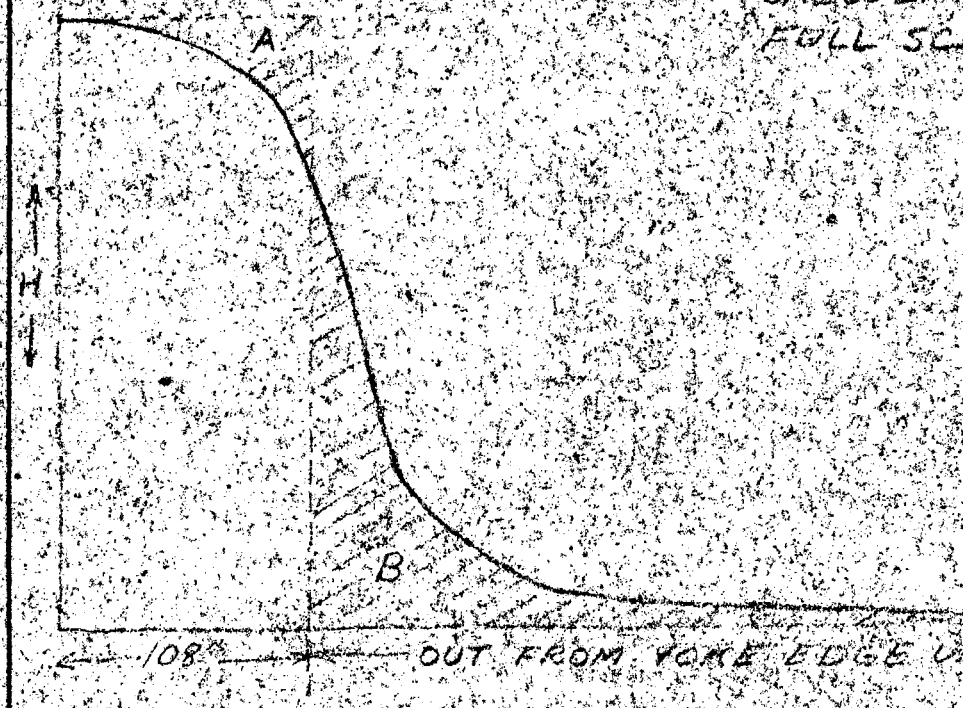
DATE: 10-6-48

5-DC6A.3-97



GAP IS 54" (F.S.) AT GAP CENTER.





CALCULATIONS ARE FOR FULL SCALE 360° BEVATRON

① MAXWELLS IN GAP @ 5050 GAUSS (ASSUMING FIELD UNIFORMITY IS CONSTANT TO EDGE OF YOKE — SEE GRAPH F-DC6A.3-16) = 21.4×10^9

② MAXWELLS IN AREA "A" (INTEGRATED BETWEEN MAGNET COILS) = $0.244 \times 10^9 = \frac{0.244 \times 10^9 \times 100}{21.4 \times 10^9} = 1.1\%$ OF ①

③ MAXWELLS IN AREA "B" (INTEGRATED TO H=0 OUTSIDE GAP) = $1.53 \times 10^9 = \frac{1.53 \times 10^9 \times 100}{21.4 \times 10^9} = 7.2\%$ OF ①

④ TOTAL % LEAKAGE FLUX = ③ − ② = 7.2 − 1.1 = 6.1

SEPT 3, 1948 BEVATRON MODEL MAGNET DC646 11-8

MAGNETIZATION AT GAP CENTER #DC646-1

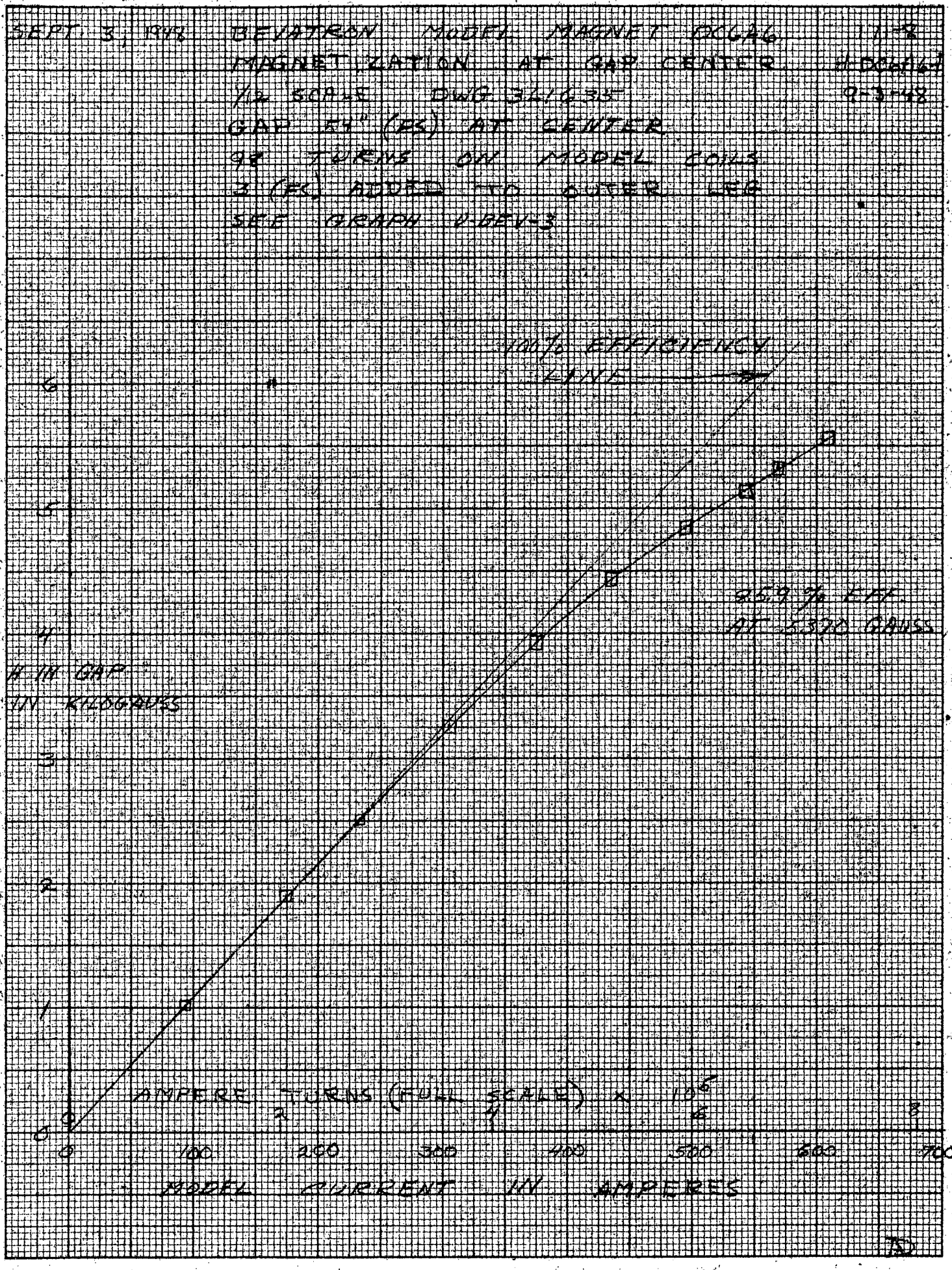
1/2 SCALE DWG 32/6 33 9-3-48

GAP 54" (FS) AT CENTER

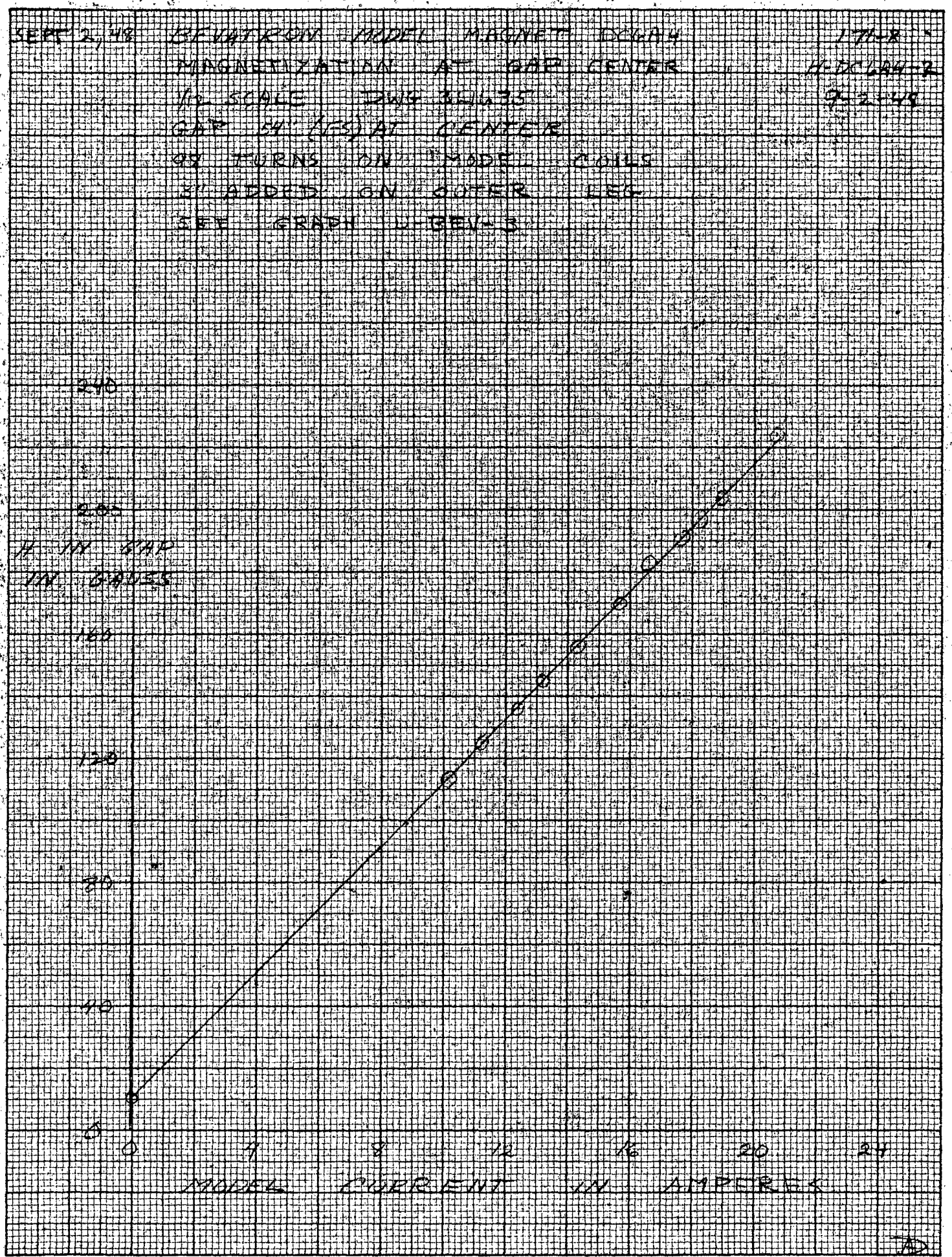
98 TURNS ON MODEL COILS

3 (FS) ADDED TO OUTER LEG

SEE GRAPH V-BEV-3



KEUFFEL & ESSER CO. N. Y. NO. 3397-120
10 X 10 to the ½ inch, 5th lines accented.
Engraving 7½ X 10"in.
MADE IN U.S.A.


SEPT 2, 48
BEVATRON MODEL MAGNET DC6A4
171-8
MAGNETIZATION AT GAP CENTER
H-DC6A4-2
1/12 SCALE DWG 3L1635
9-2-48
GAP 54" (FS) AT CENTER
98 TURNS ON MODEL COILS
3" ADDED ON OUTER LEG
SEE GRAPH U-BEV-3
H IN GAP
IN GAUSS
240
200
160
120
80
40
0
0
4
8
12
16
20
24
MODEL CURRENT IN AMPERES
KEUFFEL & ESSER CO., N. Y. NO. 359T-12G
10 X 10 to the ½ inch, 5th lines accented.
Engraving 7½ X 10 in.
MADE IN U.S.A.

CALIBRATION MODEL MAGNET DC6A5F T-8

SEPT. 7, 1948 MAGNETIZATION AT GAP CENTER H-DC6A5-1

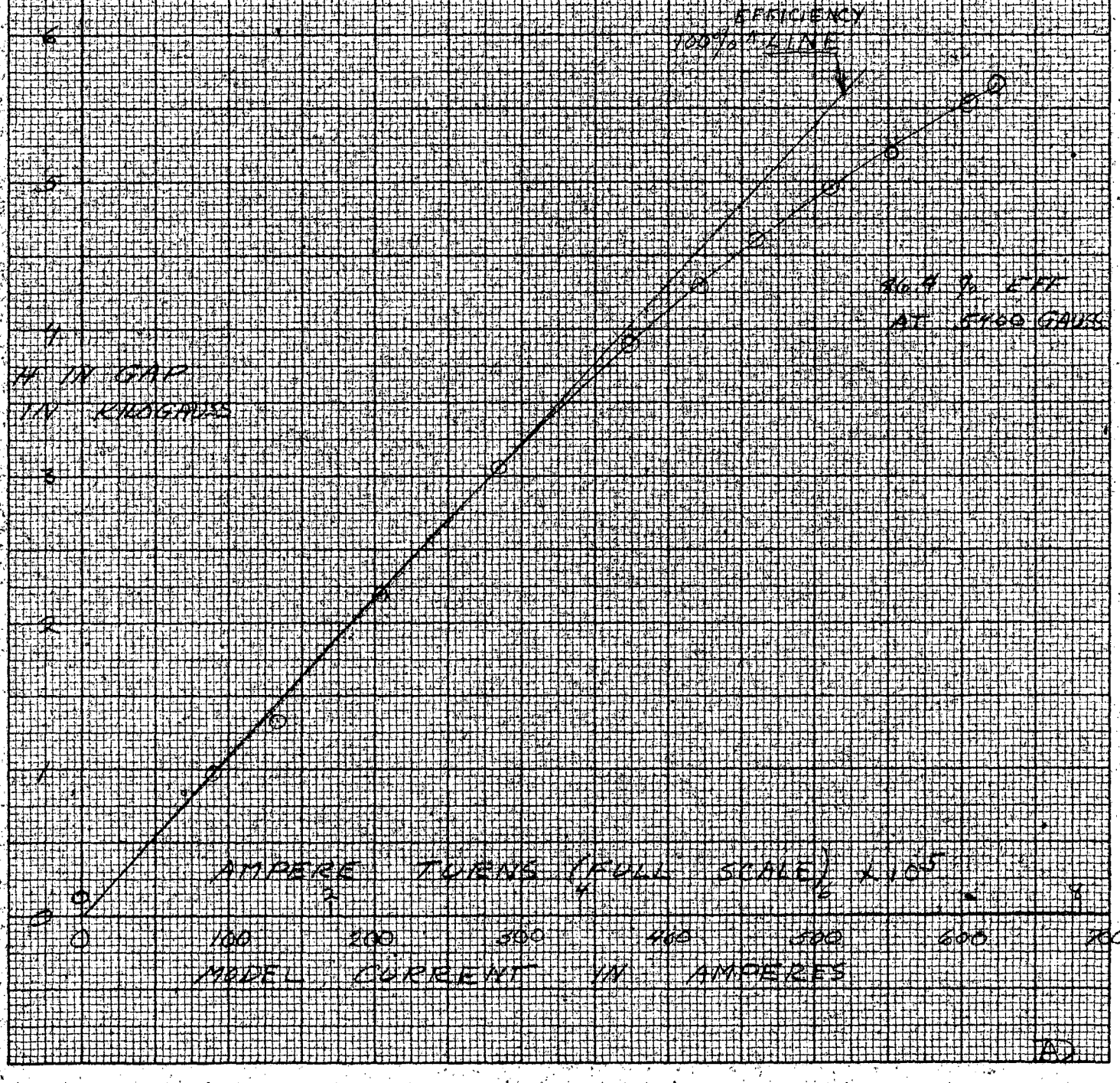
½ SCALE DWG 3L1633 9-8-48

GAP 5" (ES) AT CENTER

98 TURNS ON MODEL COILS

3" (ES) ADDED TO OUTER LEG

SEE GRAPH H-DEV-3



KEUFFEL & ESSER CO. N. Y. NO. 358-1128
10 X 10 to the ¼ inch, 5th lines accented.
Engraving 7¾ X 10 in.
MADE IN U.S.A.

SEPT 3, '48 BEVATRON MODEL MAGNET DC6A5 171-8

MAGNETIZATION AT GAP CENTER H-DC6A5-1

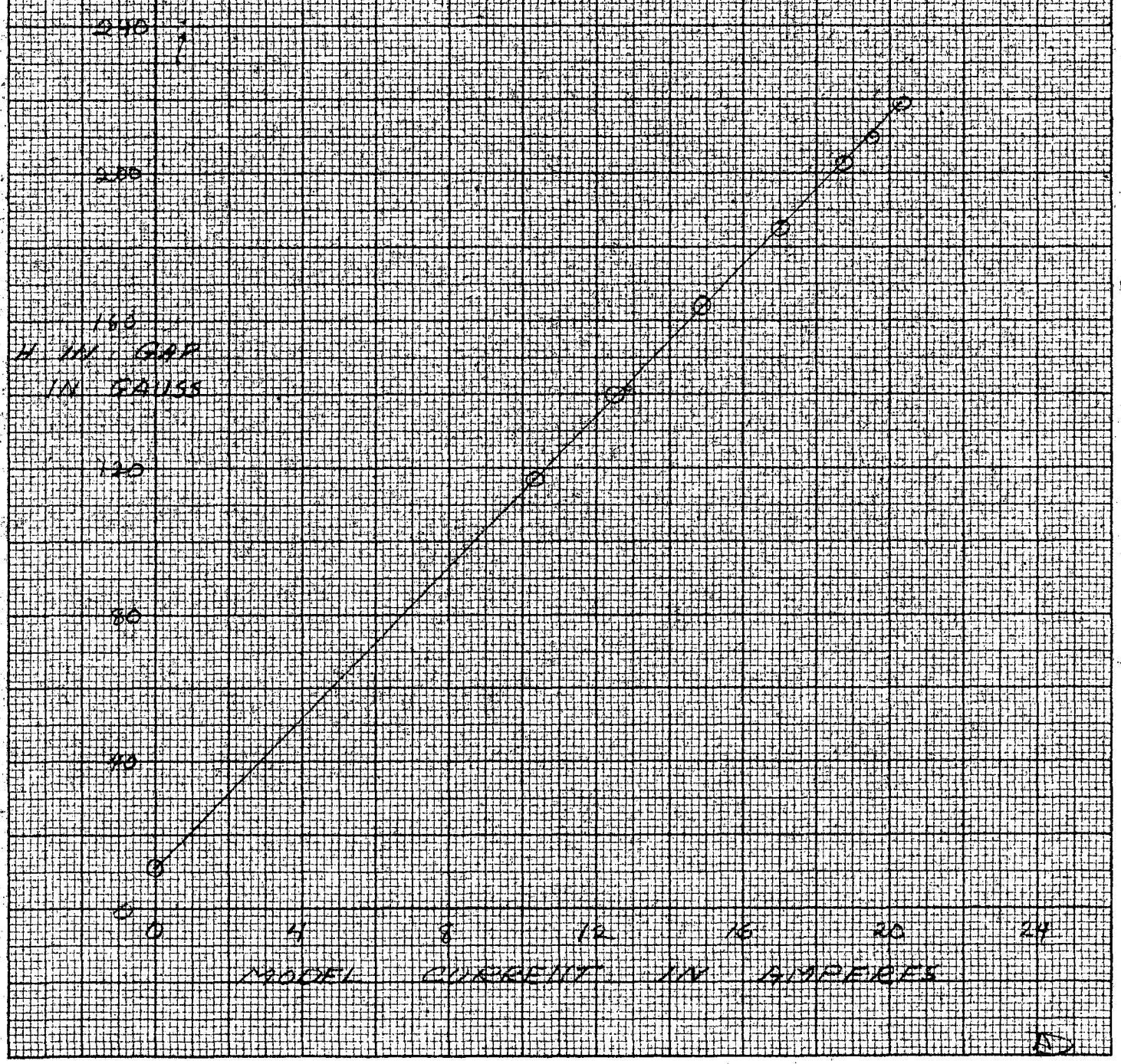
1/12 SCALE DWG 3L1625 9-3-48

GAP 5¼" (FS) AT CENTER

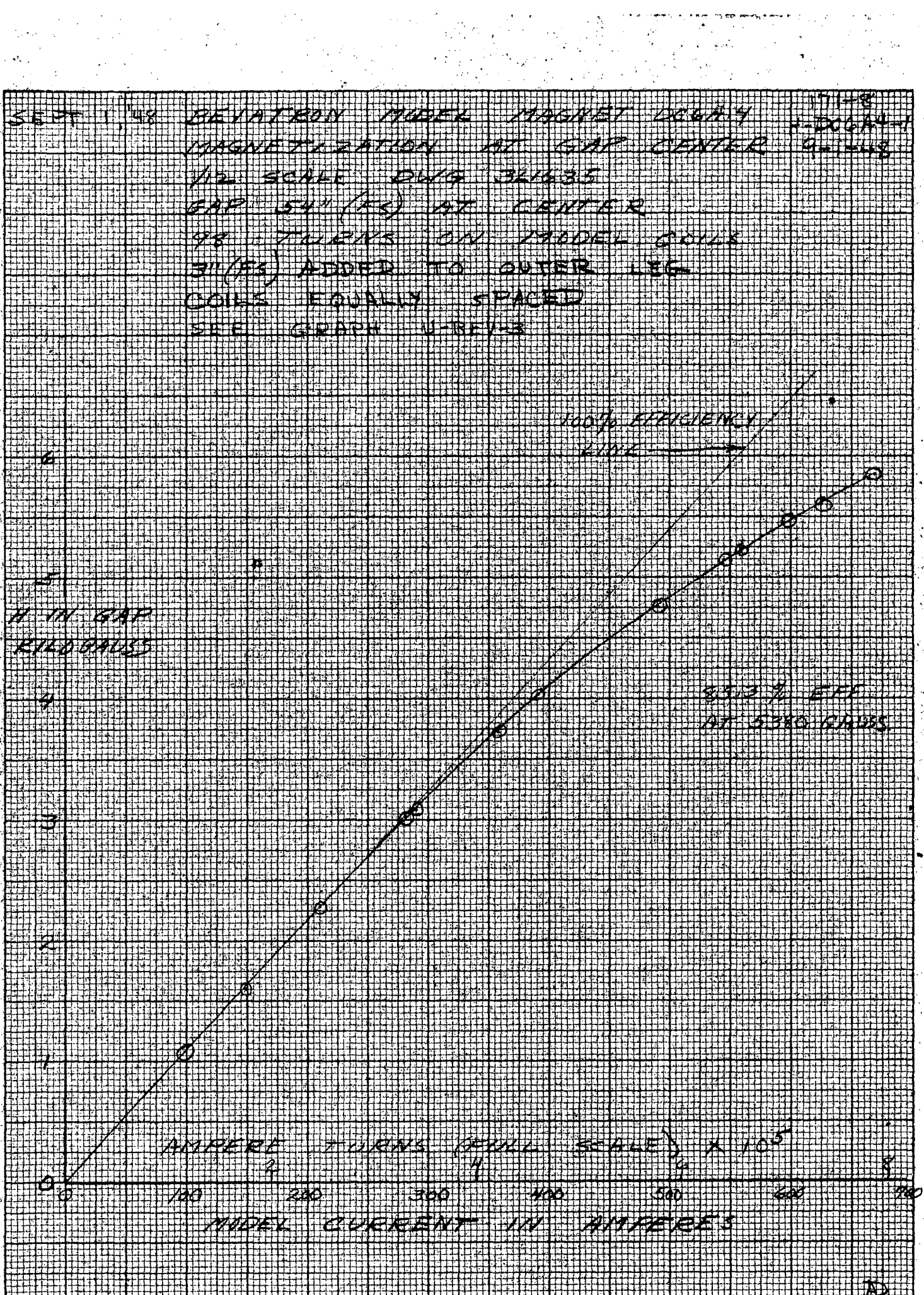
98 TURNS ON MODEL COILS

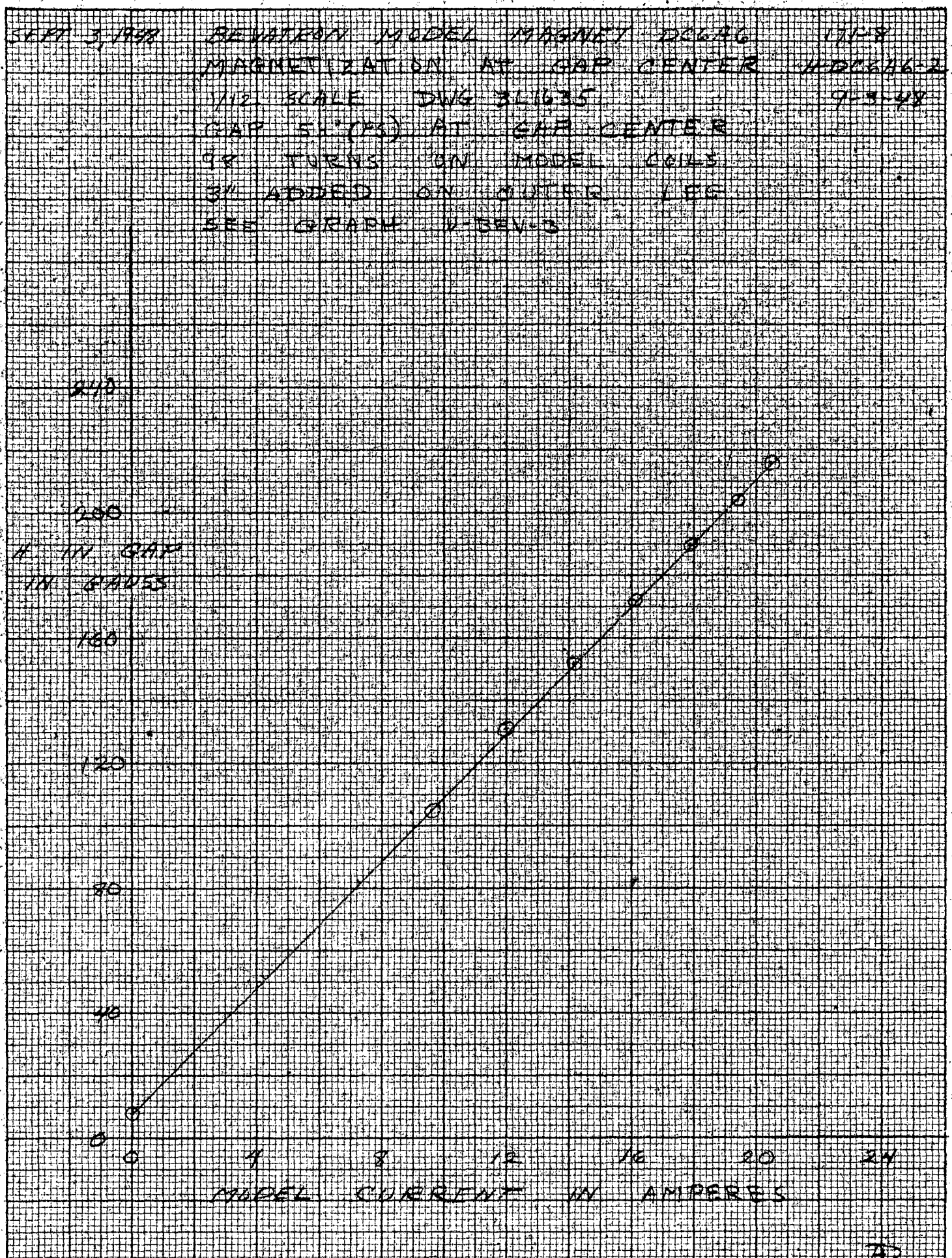
3" (FS) ADDED TO OUTER LEG

SEE GRAPH U-BEV-3



KEUFFEL & ESSER CO., N. Y. NO. 359T-12G
10 X 10 to the ½ inch, 5th lines accented.
Engraving 7½ X 10 in.
MADE IN U.S.A.


SEPT 1, '48 BEVATRON MODEL MAGNET DC6A4
MAGNETIZATION AT GAP CENTER
1/12 SCALE DWG 321635
GAP 54" (FS) AT CENTER
98 TURNS ON MODEL COILS
3" (FS) ADDED TO OUTER LEG
COILS EQUALLY SPACED
SEE GRAPH U-BEV-3
171-8
H-DC6A4-1
9-1-48
100% EFFICIENCY LINE
H IN GAP KILOGAUSS
85.3 % EFF AT 5380 GAUSS
AMPERE TURNS (FULL SCALE) X 10^5
MODEL CURRENT IN AMPERES
0
1
2
3
4
5
6
100
200
300
400
500
600
700
2
4
6
8


SEPT 3, 1948
BEVATRON MODEL MAGNET DC6A6
171-8
MAGNETIZATION AT GAP CENTER
H-DC6A6-2
1/12 SCALE DWG 3L1635
9-3-48
GAP 5½" (FS) AT GAP CENTER
98 TURNS ON MODEL COILS
3" ADDED ON OUTER LEG
SEE GRAPH V-BEV-3
H IN GAP
IN GAUSS
240
200
160
120
80
40
0
0
4
8
12
16
20
24
MODEL CURRENT IN AMPERES
KEUFFEL & ESSER CO., N.Y. NO. 359T-12G
10 X 10 to the ½ inch, 5th lines accented.
Engraving 7½ X 10 in.
MADE IN U.S.A.