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MEASUREMENTS OF LINAC STEERING DIPOLES

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AGS DIVISION TECHNICAL NOTE

No. 123

MEASUREMENTS OF LINAC STEERING DIPOLES

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Two types of steering dipoles have been used at the linac in the past. Both are cosine wound and designed to be installed as a nested pair. A pair of each design type was tested to establish the strengths and magnetic lengths; the results are reported here.

The measurements were made using a Bell model 610 Hall probe mounted on a movable xy stage. The magnets were run at 2 amperes which was the power supply limit. The magnetic center of the dipole was found first and all measurements were referred to this point. The axial variation of the transverse field was measured in each case. The accuracy of the measurements was about 2%. The area under the curves of flux density versus location was measured with a planimeter and was estimated to be accurate to 5%.

Type I: BNL Design

The BNL design steering dipoles (D 25M-1612-4) consist of an inner (vertical steering) pair of coils attached to aluminum half cylinders, and an outer pair of coils which fit over these. No potting is used in the construction. A layer of Kapton insulation separates the two magnets. An iron shell with cooling fins fits over these coils. Inspection of the coils indicated that they had run hot in the past. The power supply limitation of 6 amps should not be extended or these dipoles may burn out. Caution is required in aligning these dipoles since they have not been carefully centered

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on the aluminum cylinders or within the finned outer shell.

Figures 1 and 2 show the magnetic field plots for the inner and outer dipoles, respectively. The field is seen to fall to the earth's field at the end of the measurement range. The results are summarized in Table I.

Type 2: FNAL Design

The FNAL design steering magnet (FNAL drawing numbers 0326-MD-2912 Rev. A and 0326-MD-2913 Rev. B) were purchased from Elma Engineering, Palo Alto, California. These units are of potted construction (material unknown) and have no additional cooling provision. Communication with E. Gray of FNAL indicated that these units "ran hot" at 10 amperes and melted at 12 amperes. These limitations must be carefully observed.

Figures 3 and 4 show the magnetic field plots for the inner and outer dipoles respectively. The field exhibited little or no flatness along the beam axis. The field changes sign after passing the physical end of the dipoles. This sign change was reproducible and clearly associated with the dipole being powered. It was not observed with the BNL design dipoles. Figure 5 shows this effect on a larger scan, where it is seen to eventually return to the earth's field value. The area under the negative protion is 11% of the area in the positive portion.

A summary of the results are shown in Table I. The values include the algebraic sign of the field.

Conclusions

Both types of steering magnets can be used in the linac HEBT line. They appear to give about 2 mrad bend at 200 MeV at the maximum current rating. Care in alignment is required (marking of the magnetic centers is needed).

lsk

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TABLE I

Magnet Type	Maximum Current (Amps)	Resistance (Ohms)	$\int_{-\infty}^{\infty} \frac{B.d\ell}{I}$ (Gauss-cm/A)	L_{eff}^{*} (cm)	Max.Bend Angle at 200 MeV (mrad)
BNL Inner	6	5.0	1028	34.3	2.87
BNL Outer	6	5.0	972	26.1	2.72
FNAL Inner	10	2.25	447	15.2	2.08
FNAL Outer	10	1.23	464	14.5	2.16

$$^{*}\ L_{eff} = \frac{\int_{-\infty}^{\infty} B.d\ell}{B_{max}}$$

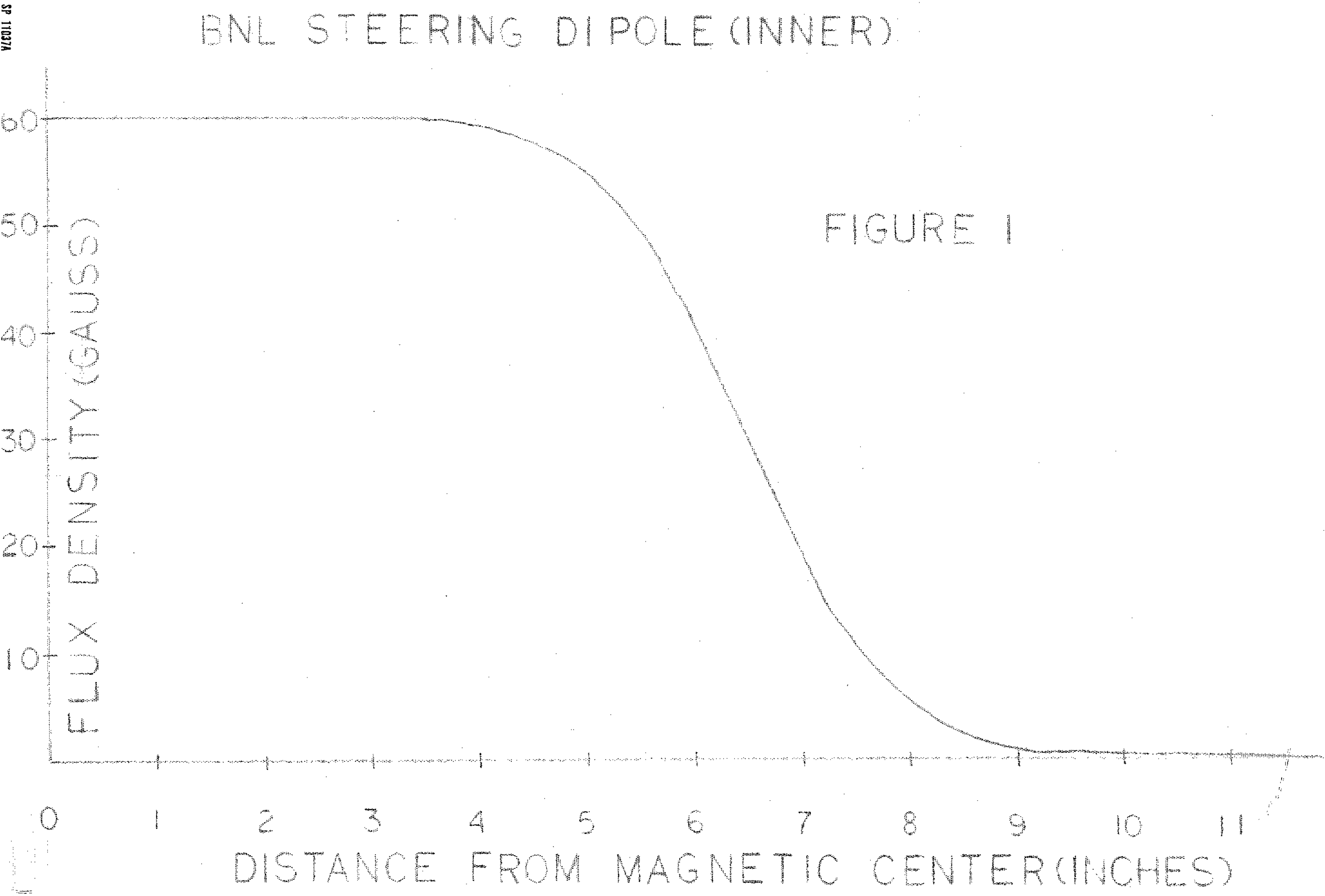

FIGURE 1

BNL STEERING DIPOLE (OUTER)

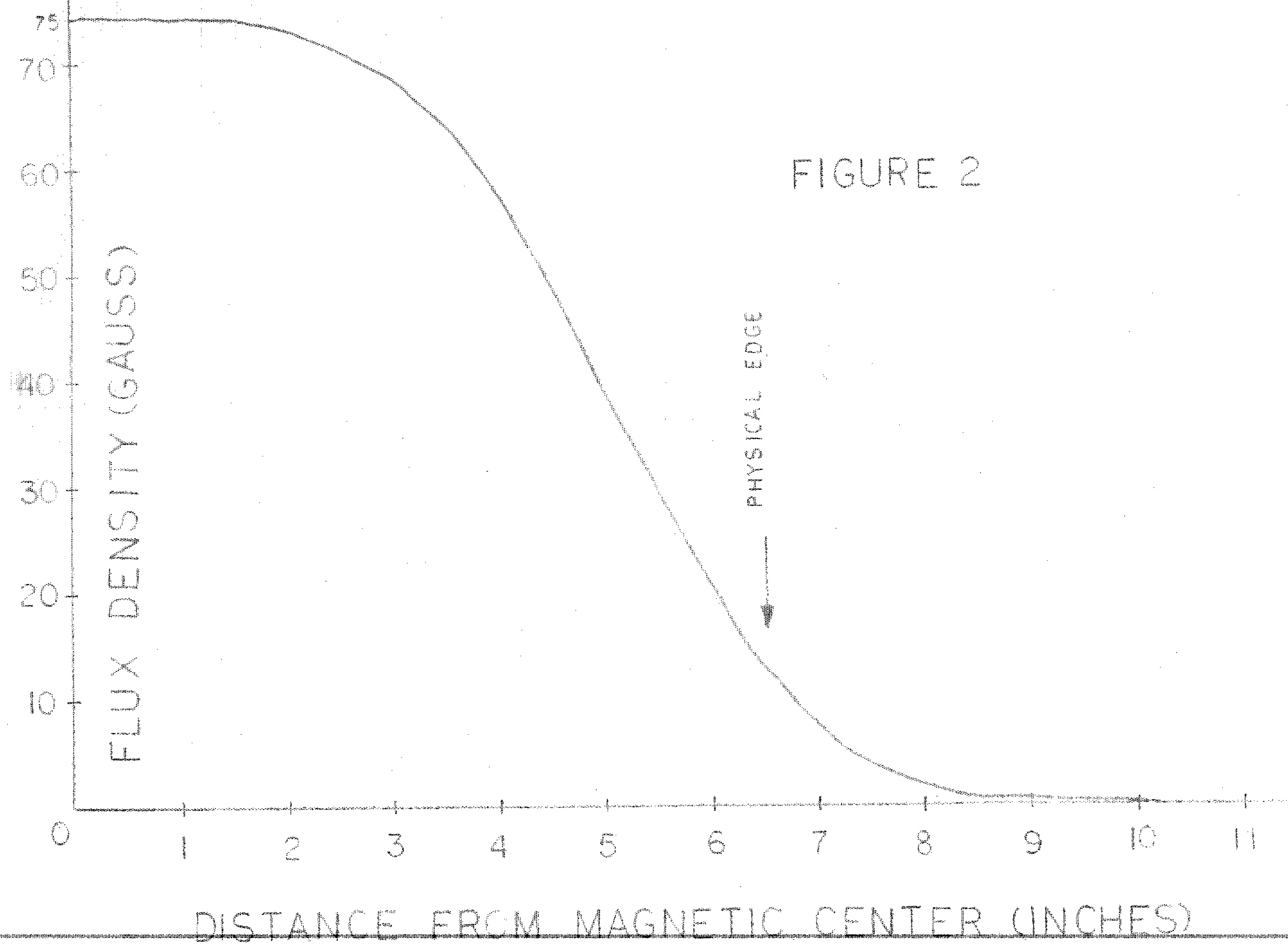

FIGURE 2

FNAL DIPOLE (INNER)

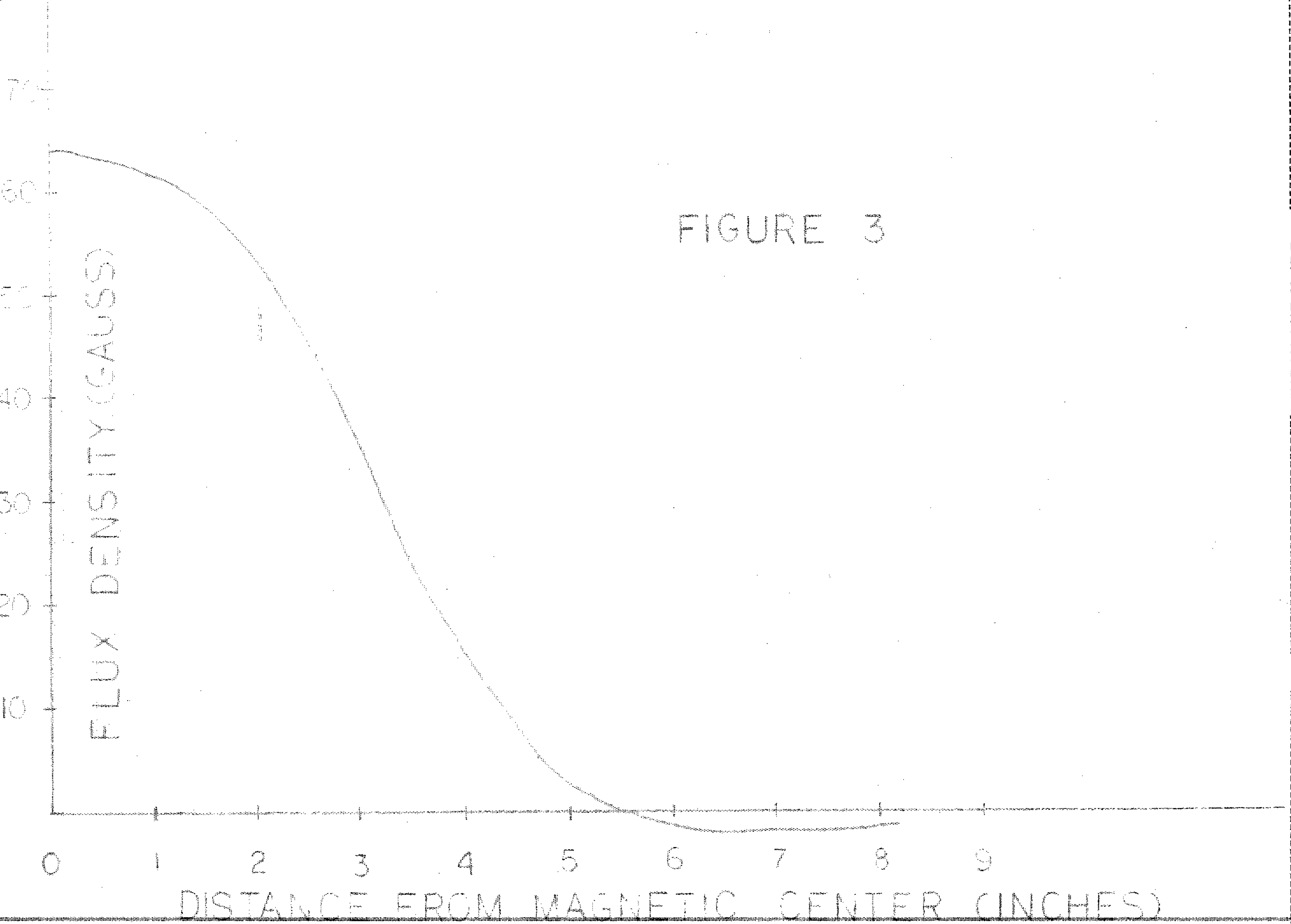

FIGURE 3

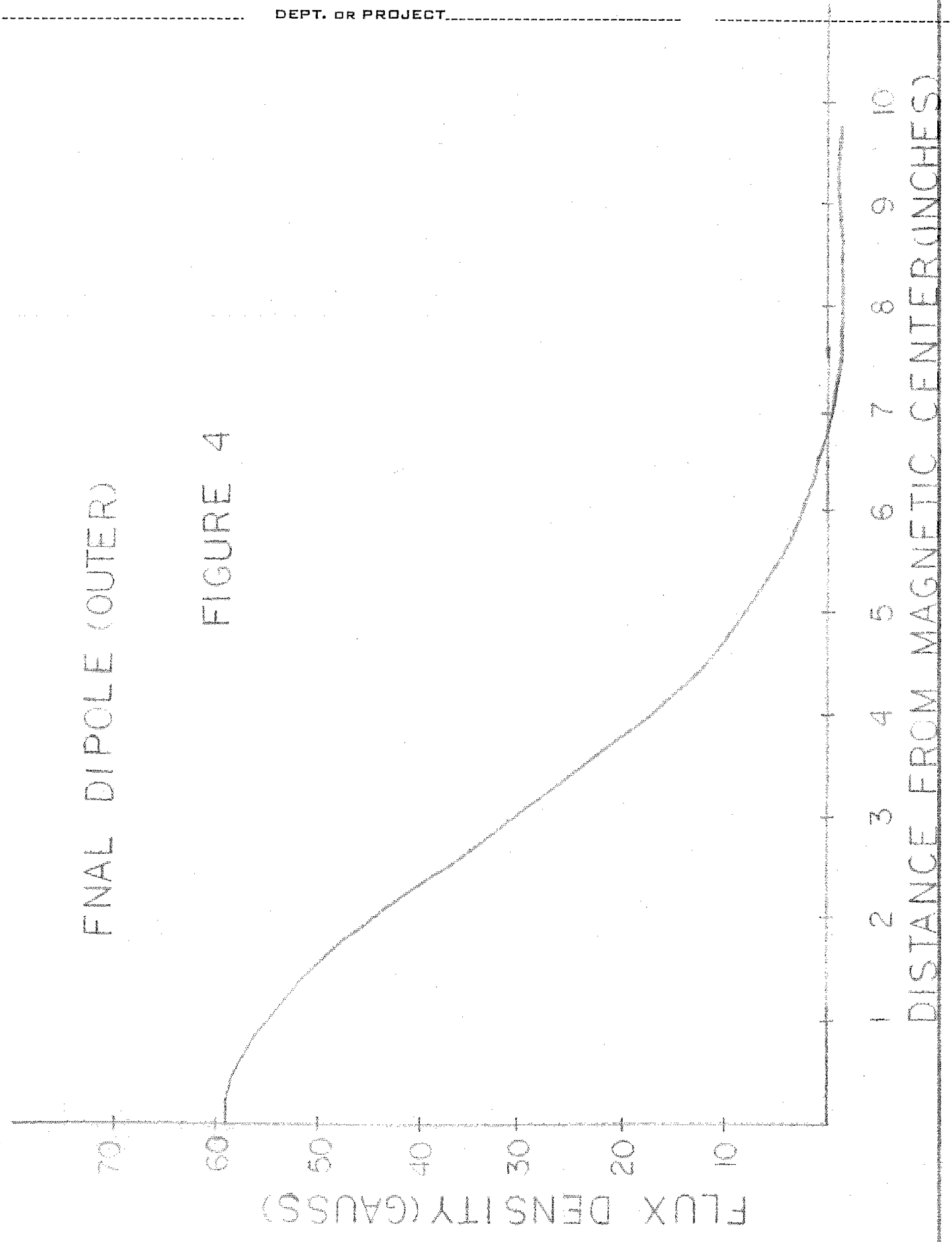

FIGURE 4

FINAL DI POLE (OUTER)

FIGURE 5

FINAL DIPOLE (CENTERED)