MEASUREMENT OF THE P.M.Q.'S FIELD

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Abstruct

a 16 segmented P.M.Q. (permanent magnet quadrupole) was made of strontium ferrite material. A magnetic field distribution was calculated with $\mu=1$ approximation, and calculated values were compered with experimental results.

Introduction

Technical difficulties when the P.M.Q. are fablicated are to coincide a center of quadrupole field to a mechanical center of the structure, and to reduce the contribution of undesiered multipoles fields. To settle the difficulties the fabrication error of each sugments and the alignment error at assembling should be estimated. A P.M.Q. which was made of strontium ferrite material was fabricated and a field distribution of each segments were measured to determine these errors.

Measurement and analysis

For a homogeniously magnetized 2 dimensional material, the magnetic field distribution[1] (see Fig. 1) is discribed by

$$\left.\begin{aligned} \underline{B}^{+}(\underline{z}) &= \underline{B}_r \sum_{n=1}^{\infty} F_n \underline{Z}^{n-1} \quad \text{for } |\underline{Z}|<r_1 , \\ \text{where } F_1 &= \ln\frac{r_2}{r_1} \cos(\pi/M) \frac{\sin(\pi/M)}{\pi} \quad \text{and} \\ F_n &= \frac{n}{n-1}\left[\left(\frac{1}{r_1}\right)^{n-1} - \left(\frac{1}{r_2}\right)^{n-1}\right] \cos^n(\pi/M) \frac{\sin(n\pi/M)}{n\pi} \end{aligned}\right\} \quad (1)$$

In Eq. (1), B, B_r and z are complex variables, and the dagger means complex conjugate. $\underline{B}(\underline{z})$ replesents the magnetic field at the point z and B_r is the magnitude of remanent field in the material. r_1 and r_2 is the inside radius and the outside radius in the 16 segmented quadrupole system, respectively.

The field distribution in the region of $|\underline{Z}|<r_1$ was measured and field vectors at each measuring points are shown in Fig. 1. These vectors fairly agreed with the vectors calculated from the equation (1).

Conclusion

From these measurements we can determine the fablication error of each segments and will be able to select appropriate segments from many segments. The P.M.Q. of excellent performance will be accembled using these selected segments.

Reference

1) K. Halbach, Nucl. Instr. and Meth. 169 (1980) 1.

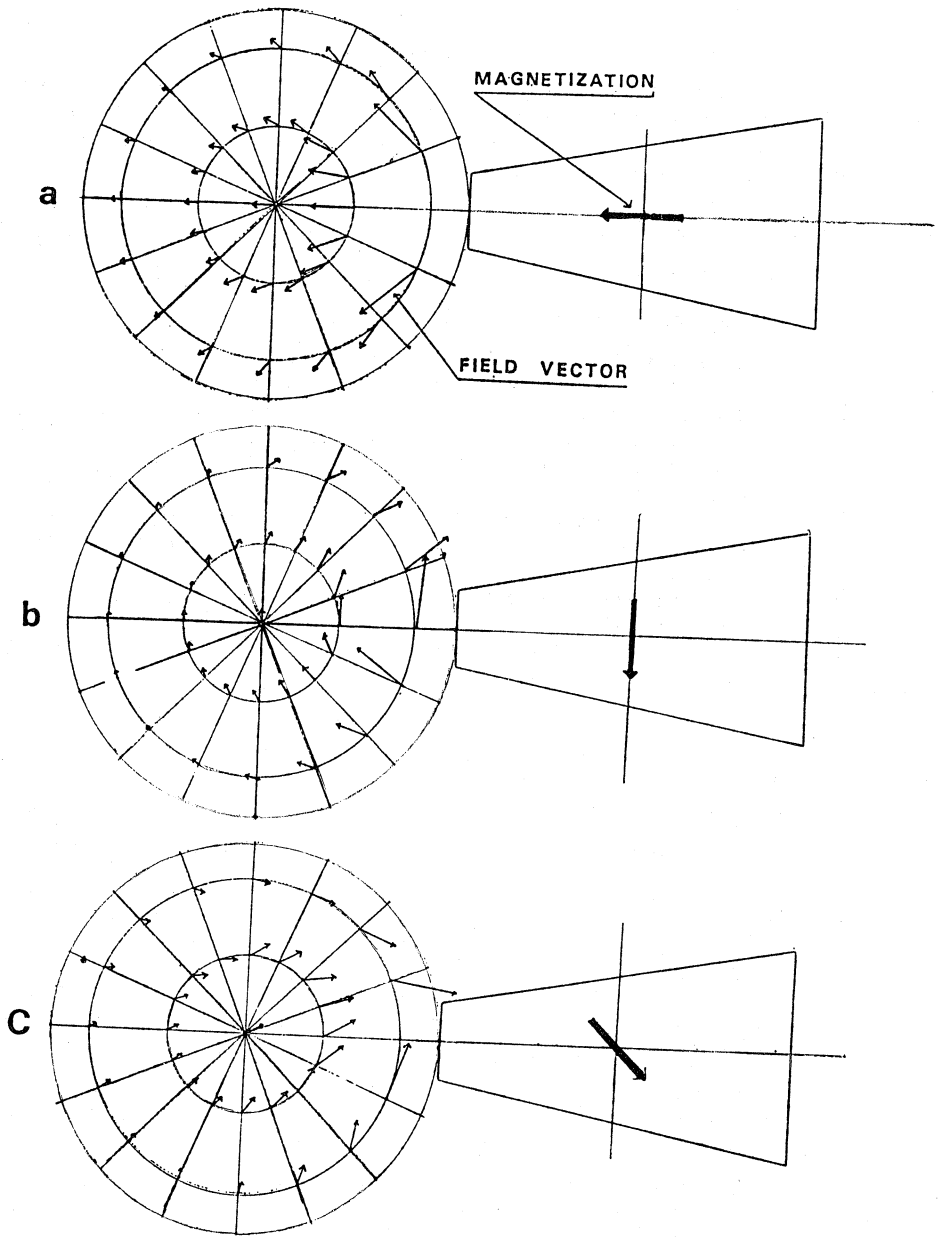

Fig. 1. The field distribution of a trapezoidal segment magnet measured by a hall element. The shape of segment in (a), (b) and (c) is same but the orientation of magnetization in the segment is different from each other. The field was measured at r=4 mm and r=8 mm for 16 different θ. r is measure from the quadrupole center when segments are assembled.