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CAMBRIDGE, MASSACHUSETTS

Subject: Conference on Magnetic-core Switching Phenomena

To: C.W. Adams, D.R. Brown, and N. H. Taylor

From: A. Katz

Date: June 16, 1952

Abstract: A conference was held at which the eddy-current shielding problem was discussed and plans for its solution formulated.

Present: D.R. Brown A. Katz
F. Browne (Transducer) W.N. Papian
F. Helwig J.D. Porter

For some time Porter and Helwig have been devoting a portion of their time to the solution of the parabolic differential equation.

(1) $$\frac{\partial^2 H}{\partial x^2} = \sigma \frac{\partial B}{\partial t} \qquad (\sigma = \text{constant})$$

$$B = f(H)$$

subject to the conditions

$$H(o,t) = (a,t) = H_e \qquad t \geq o$$

$$H(x,o) = o \qquad o < x < a$$

The solution to this equation with its associated conditions represents the response of a semi-infinite plate of magnetic material of thickness a to a step of magnetomotive force of amplitude H_e. Interest in this problem arose when Papian was investigating, in connection with his thesis, the effect of eddy-current shielding on the response time of a magnetic material. Equation (1) is derived from Maxwell's Equations

subject to the following assumptions:

a) Displacement currents negligible

b) Semi-infinite plate geometry

c) Homogeneity and isotropy of medium

If the solution to this equation were to correspond reasonably well to the results obtained experimentally, then one might say that eddy-current shielding is a major factor in determining the response time of a magnetic core. It is then apparent that a solution to equation (1), whether it explains the experimentally observed double-humped voltage pulse or not, represents an important bit of information for use in the design of magnetic arrays and circuits.

The importance of the problem is recognized elsewhere also, as evidenced by the work of Euling of R.C.A. and Browne of Transducer Corp. The latter, having recently arranged for the use of the Whirlwind computer in the numerical computations, was anxious to correlate his work with ours.

A meeting was consequently arranged and the following conclusions reached:

A. Numerical computation

a) Porter to continue with his 6-point difference equation approach, modifying it to use greater precision.

b) Helwig to continue with his differential-difference equation approach using the Runge-Kutta method of integration.

c) Browne to use a 4-point difference equation approach.

B. Evaluation of numerical solutions; interpretation of solutions in terms of experimental evidence and of solid-state physics; formulation of alternative approaches.

a) This area is to be the responsibility of Browne, Katz, and D. Buck.

Meetings of this group are to be held about once every two weeks to discuss problems and progress.

Signed A. Katz
A. Katz

Approved
W.N. Papian

AK/cs

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