MASSACHUSETTS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRICAL ENGINEERING

Report No. 1

Prepared by W. I. Frank

PROGRESS REPORT TO THE DEPARTMENT OF ELECTRICAL ENGINEERING

SUBJECT OF RESEARCH: S. B. Thesis: Rectangular Hysteresis Loop Materials in a Non-Destructive Read System

Period Covered by this Report: September and October, 1952

Student Working on Research: W. I. Frank

Laboratory: Digital Computer Laboratory, Whittemore Building

Supervisor: Dudley A. Buck

Summary of Work Currently Active: Different schemes for setting up quadrature fields were used, and several kinds of magnetic materials were tried in single-core tests of the non-destructive read system.

Progress:

The first tests were made with a ceramic memory core, using an iron path for the quadrature field (also referred to as the beta field) - see Figure 1; signal output was never better than 0.1 volt.

When the iron path was replaced by various ceramic materials, outputs up to .55 volt were obtained, with up to 95% fewer ampere turns than in the first tests.

When employing a relatively large beta field, output could be increased by "reinforcing" the remanent flux in the memory core, which was done by letting d-c current flow in the magnetizing winding of the memory core in such a direction as to add to the remanent flux. Using a similar "reinforcing" technique with small beta fields resulted in decreasing output signals. W. N. Papian found a satisfactory explanation for this phenomenon.

Kenneth Olsen suggested, and first tried, a different way of setting up quadrature fields when using metallic tape cores; by attaching leads directly to the tape, the core itself forms the path for the quadrature field current. (See Figures 2 and 3). Output pulses of up to 20 volts and a base width of under 0.2 microsecond into 93 ohms have been obtained. Speed of the system seems limited only by the rise time and width of the quadrature current pulse.

So far, it has not been possible to embed wire conductors inside toroidal ferrite cores and thus use them in conjunction with internally-generated beta fields. Attempts to do this before firing the ceramic material were made; the resultant cores, however, were twisted out of shape and could not be used.

The attached photographs show typical test set-ups of externally-(Figure 4) and internally-(Figures 5 and 6) generated beta fields. An indication of physical size is given by the dimensions of the lucite boards on which they are mounted: they measure 3 x 3 inches.

It was observed that output voltage did not increase linearly with the amount of material used. For instance: a 120-wrap metallic-ribbon memory core would only yield between 10 and 20 times the output that two wraps of the same material would yield with the same excitation in the beta field. Observations were hampered by the necessity of handling the magnetic-core tape. Even the most careful handling of these very thin (1/8 to 1 mil thick) ribbons noticeably changes and largely destroys the special rectangular qualities imparted to the material by the manufacturer.

Next Step:

In order to obtain more precise measurements, special bobbins were prepared. Magnetics, Inc., then wound the series of cores on these bobbins containing 1, 2, 4, 8, 16, 32, and 64 wraps of the same material before annealing them. Measurements will be taken both with an externally-generated beta field, as in Figure 1, and with an internally-generated field, as in Figure 2. It is expected that the output caused by the external beta field will be more nearly proportional to the number of wraps in the memory core than that produced by the internal beta field.

Signed Werner I. Frank
Werner I. Frank

Approved D A Buck
Dudley A. Buck

WIF/bs

Drawings attached: 52878-79-80

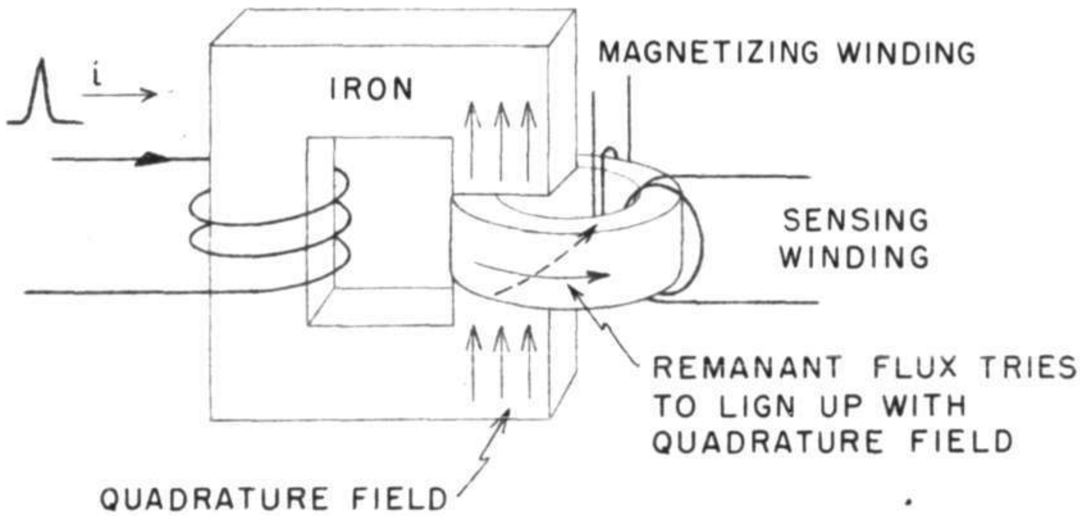

FIG. 1

EXTERNALLY GENERATED β FIELD

A-52878

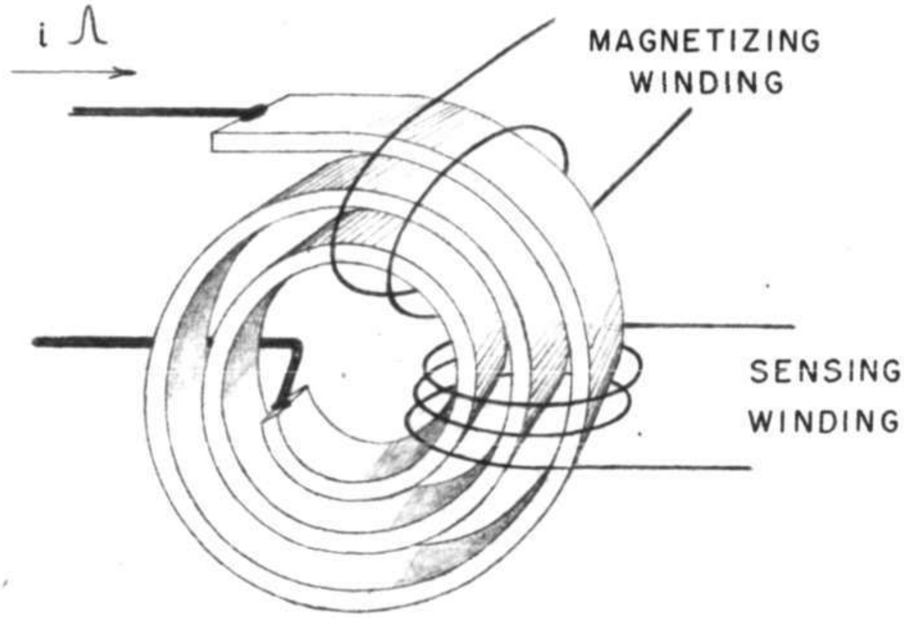

FIG. 2

METALLIC RIBBON TYPE MEMORY CORE CONNECTED
TO GENERATE β FIELD INTERNALLY

A-52879

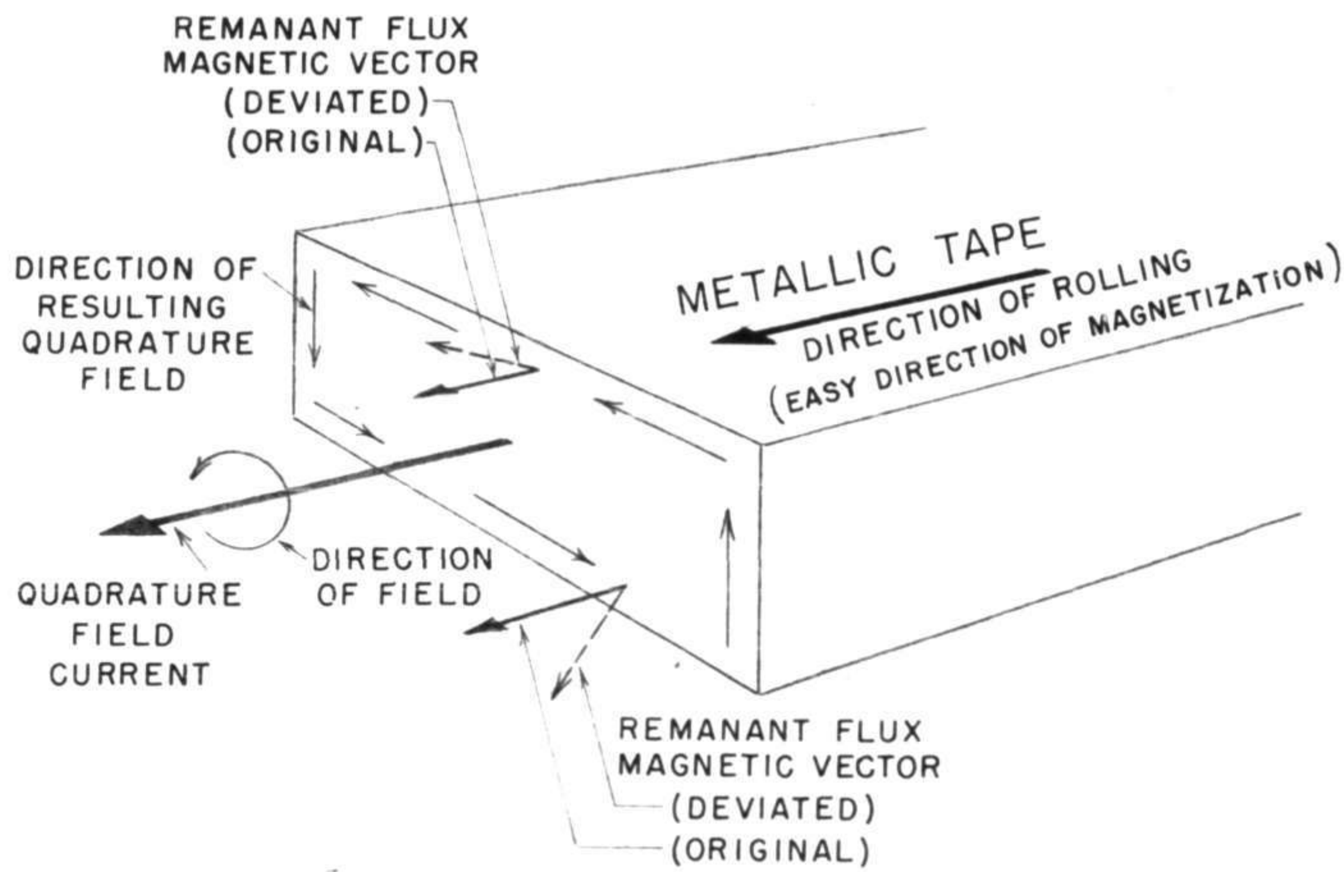

FIG. 3

INTERNALLY GENERATED QUADRATURE FIELD

A-52880

A-53000

FIG. 4

ARRANGEMENT FOR AN EXTERNALLY GENERATED β FIELD

F·1654

A-53001

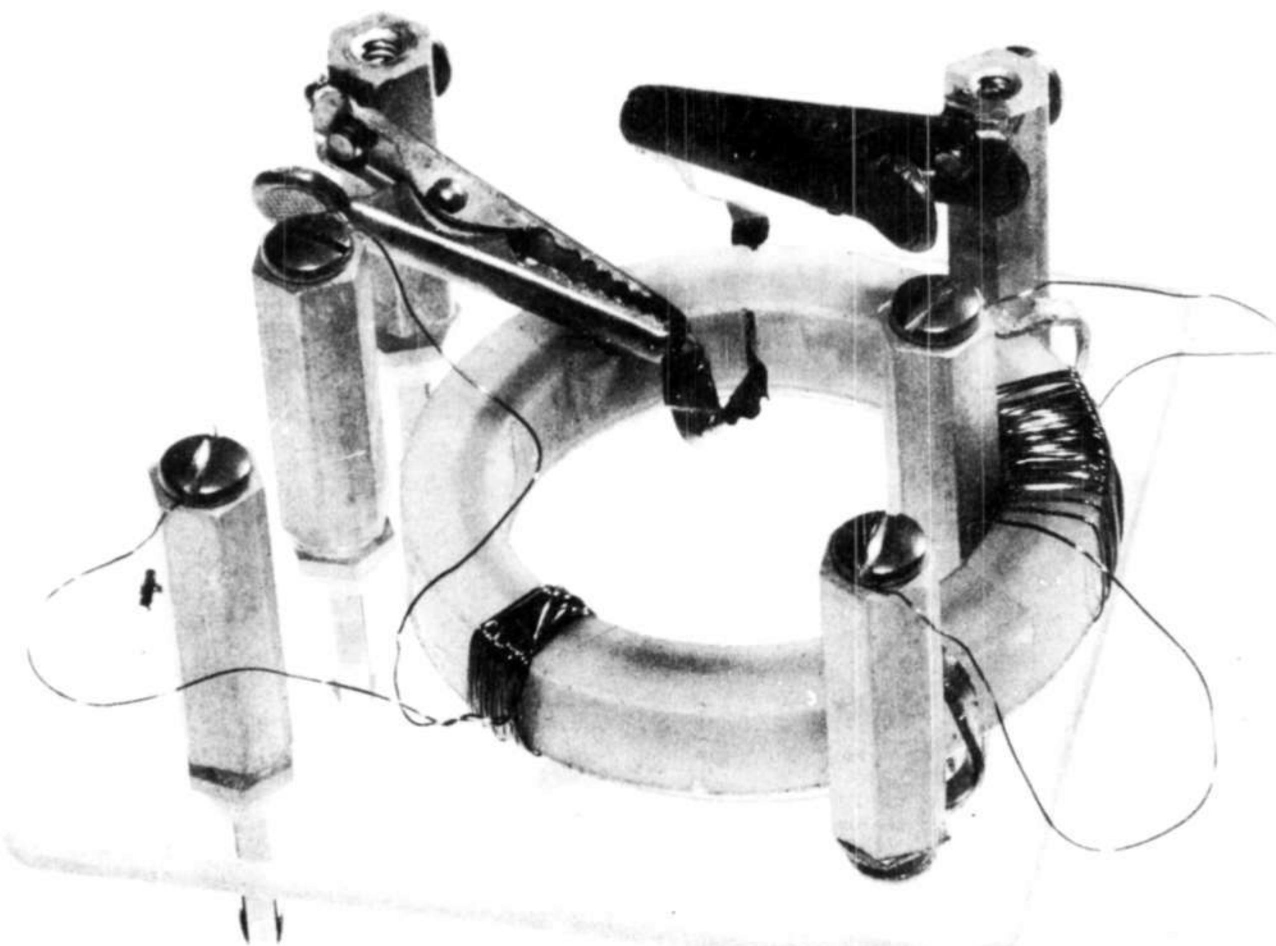

FIG. 5

1 MIL DELTAMAX USED WITH INTERNAL β FIELD

F-1655

A-53002

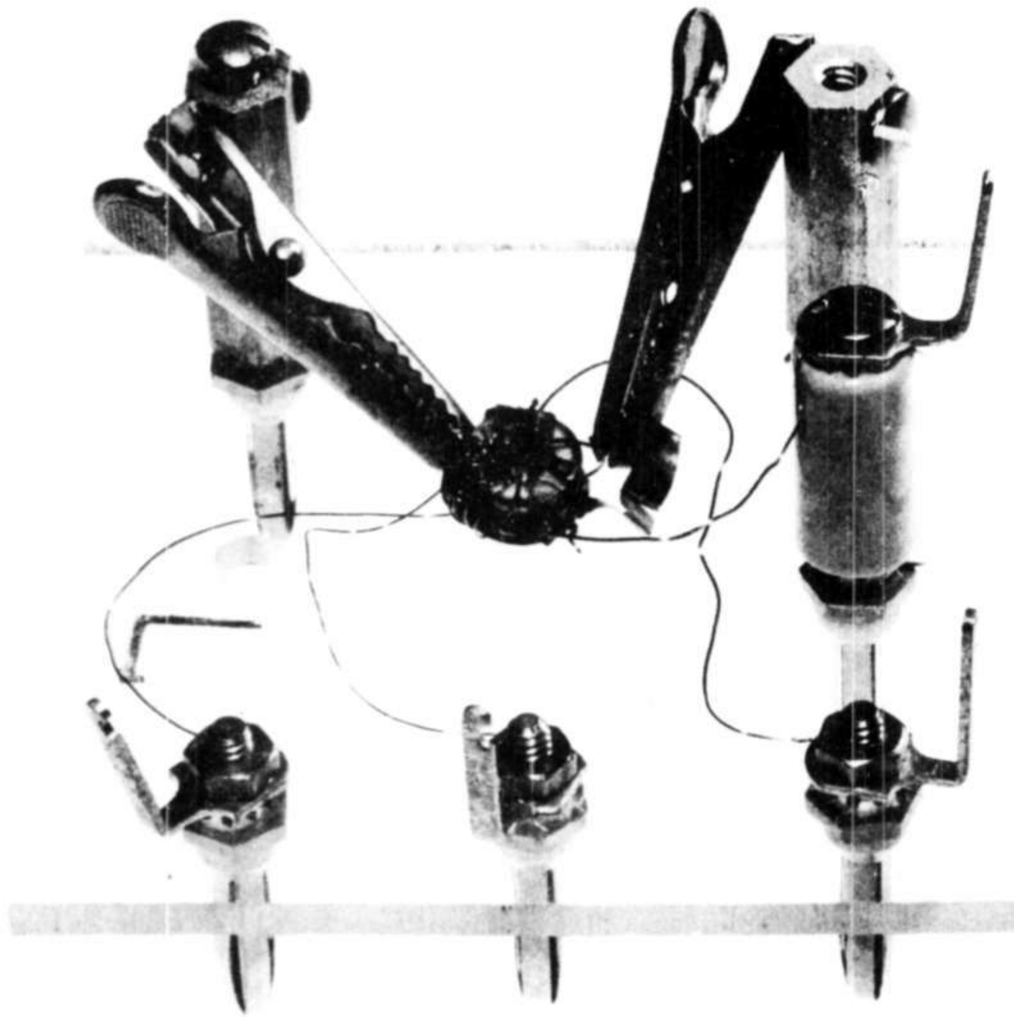

FIG. 6

$\frac{1}{4}$ MIL MO-PERMALLOY WITH INTERNAL β FIELD

F-1656