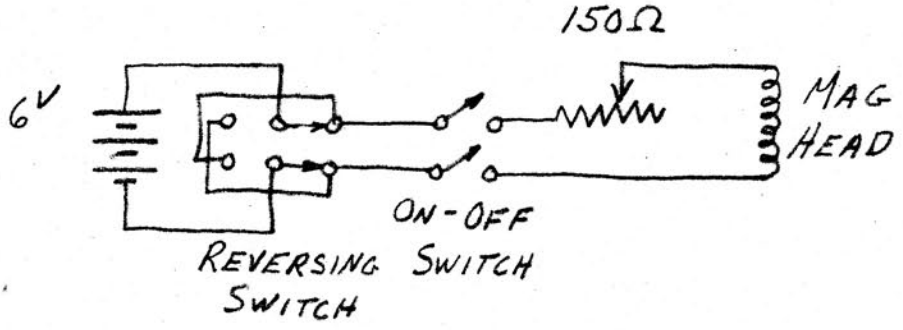
1. Electrical test Equip for First Magnetic Recording Tests with air Bearing Head.

1.1 Recording Circuit

Information was recorded by passing current through the head in one direction and then the other. The circuit is shown below:



STATIC RECORDING CIRCUIT

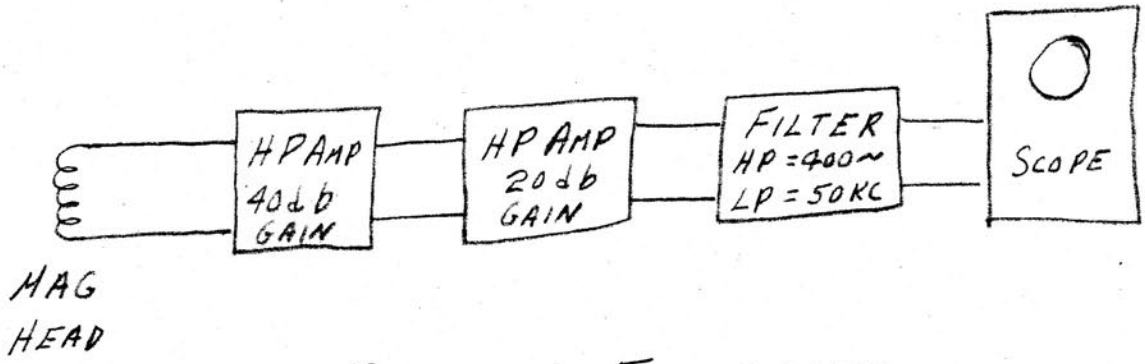
For all of these tests 0.5 amps was used as the recording current. An unknown winding on one of the metal cased 701 Drum heads was used for recording and playback. The resistance of this winding was about 1 ohm.

1.2 Reading Equipment

The reading of recorded information was made with the same winding as that used for recording. Two amplifiers and a filter were used to amplify the signal from the head. The output

JWH 6-3-53

of the filter was applied to an oscilloscope. a diagram of this equipment configuration is shown below.



READING EQUIPMENT

1.3 METHOD OF RECORDING

the information was recorded by changing the direction of current flow in the head along with manual movement of the disk. all recording and reading was done with the air applied to the air bearing head. the preliminary recording was done by spacing the disk about 1/8" between changes of current. Later recording was accomplished by spacing the disk with a micrometer head in order to achieve greater cell densities

1.4 Recording Surface

the disk used in this test was about 17" in diameter and .05 inches thick the material was aluminum having a

DWH 6-3-53

very highly polished surface. the disk was first sprayed with aluminum chromate primer in a very thin coat. the magnetic material was 3M red oxide mixed about 50-50 with varnish. this mixture was sprayed on the primed surface and baked for 45 min at 136°F. In the baking process the disks were supported on both edges and became rather warped in the process. the details of the mechanical aspects of the disk are given in the next section.

the recording surface was rather rough following baking and was buffed with fine emery paper to obtain a smooth surface.

1.5 Experimental Equipment

Pictures of the equipment used for this experiment are included on the next Page.

JWH 6-3-53

Picture # 1 in Envelope
at rear of Diary

Picture # 2 in Envelope
at rear of Diary

Picture of Experimental Equipment

WH 6-3-53

2. Mechanical Test Equipment for first magnetic recording tests with air bearing head.

2.1 General assembly – Photographs of the assembly are included in this report. The assembly consisted of four aluminum disks mounted on a cast iron base and rotated by a Graham Varidrive unit. The two air heads were manually positioned and set screwed in place.

2.2 The Disks

The four aluminum disks were 16" O.D. by .038 thick. Coated the disks measured .041 thick (one side only coated). The disk used for the tests had a run out of .060-.040 inch. This disk seemed to have one large wave and one small wave in its surface due to warpage from the baking process of 1.4. [The commercial name for these disks is "alcoa Recording circles".]

2.3 Air Heads

a close up of the air heads [illegible] in the lower photograph of page 4.

Both heads were constructed of aluminum and were 1" O.D. The magnetic head had 9, .013 Dia holes equally spaced angularly on its face; the other head, an earlier model, had 8 holes equally spaced on its face. The heads were slightly preloaded against the disk. Previous static tests indicated that the face of the head was spaced .001 to .002 from the disk. The air heads were connected in parallel to a 40 PSIG air supply. This pressure was held substantially constant throughout the tests.

2.4 Magnetic element of air head

As mentioned previously the magnetic element used was a 701, metal cased, drum head. The only modification was in the case. In the initial position, position 1, the end of the laminations was spaced .002 to .003 below the surface of the air head. The second position for the laminations tested was with the head surface and the end of the laminations in the same plane.

DDJ
4-8-53

3 Test Results

3.1 Preliminary Test

HEAD SETTING	POSITION 1*
RECORDING CURRENT	0.5 AMP
BIT SPACING	~ 8/INCH
READING SPEED	500 rpm = 400 in/SEC
AIR PRESSURE	40 lb
FILTER SETTINGS	BAND PASS 400 - 50,000 cps

RESULTS

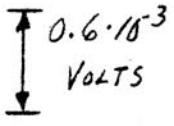
READ VOLTAGE MAX. 0.6 millivolt PK-PK
MIN. 0.4 millivolt PK-PK

SPREAD (WIDTH OF READ BACK PULSE 20% to PK TO 20%) ≅ 53 μ SEC
≅ .021"

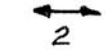
NOISE LEVEL ≅ .04 millivolts PK-PK

Pictures of the read back voltage are shown below. The voltage and time scales are indicated.

Picture 3



Picture 4



* Head Settings are explained in section 2 of this report of the experiment

JWH 6-3-53

3.2 Bit Density Measurements

3.2.1 all parameters except bit density same as in 3.1

Bit Density 40 Bits/inch

Read Back Voltage 0.6 millivolts Pk-Pk

the picture below shows the read back voltage for a recorded pattern of

— 11111 00000 1111 0000 111 000 11 00 101 —

Picture 5

3.2.2 all parameters except bit density same as in 3.1

Bit Density 25 Bits/inch

Read Back Voltage 0.6 millivolts Pk-Pk

Pattern — 11111 00 11111 00 111 00 11 00 1 —

the picture below shows the read back voltage for this test

Picture 6

JWH 6-3-53

3.2.3 all parameters except bit density head setting, and speed, same as in section 3.1

BIT DENSITY	40 bits/inch
HEAD SETTING	POSITION 2
READING SPEED	470 rpm = 375 "/SEC

RESULTS

READ BACK VOLTAGE	1.3 millivolts
SPREAD	32 μ sec
	0.012 "

The picture below shows the read back voltage for the above conditions. The pattern written was 11111 00000 11110 0000 11100 01100 101.

Picture 7

JWH 5-3-53

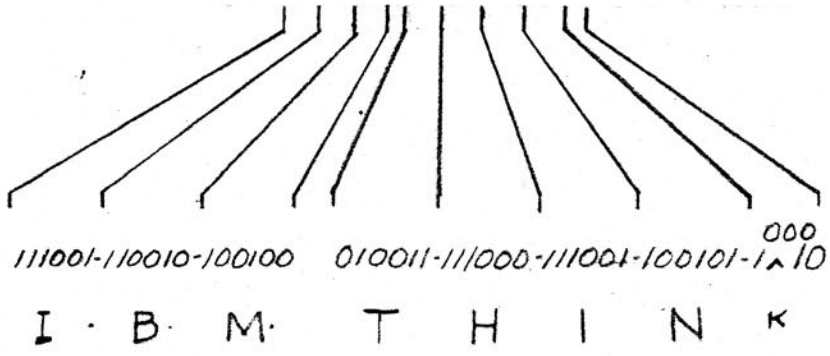
3.2.4 all parameters except bit density same as in sec 3.2.3

BIT DENSITY - 50 bits/inch

RESULTS - Same as Sec 3.2.3

the picture below shows the readback voltage for the above conditions. the pattern is shown below the picture.

Picture 8



3.2.5 Pulse amplitude about the Disk

Pulses were recorded every 1/2" around the disk. a 3" gap was left. the center of the trace has been blanked with tape to prevent blurring. Pulses for a full revolution are shown Head Setting was Position 2. Other parameters are as in sec 3.2.4

Picture 9

3.3 Erasing tests

3.3.1 Permanent Magnet Erase

A permanent magnet was used to erase a portion of the magnetic surface where some pulses had been written. This process increased the noise level on the surface by a factor of about 3. A picture of the non erased and erased portion of the surface is shown below. The non erased portion is to the left and the erased portion to the right. The almost blank portion of the sweep is the position where a group of pulses are recorded. They are not visible due to the high intensity of the sweep at this slow sweep rate.

Picture 10

JWH 6-3-53

3.3.2 Erasing with the Magnetic Head

the pulses recorded were erased by passing a direct current through the head for several revolutions of the disks. this method reduced the amplitude of the recorded pulses by approximately a factor of 10. It was noted that one or two pulses remained. these were not recorded pulses as they had the form of a dipole rather than the flux changes which were recorded. application of a permanent magnet to the surface had the effect of eliminating these pulses. It is thought that these pulses may represent metallic particles which had been magnetized and which have a coercive force greater than that which the magnetic head applied to the surface.

JWH 6-3-53

4 Comments on Test Results

4.1 Magnetic Results

the results of this experiment were very encouraging from the Magnetics point of view. the spread of between 10 and 20 mils indicates that recording at 50 bits per inch should be relatively easy with the possibility of extending to 100 bits per inch.

Perhaps the most encouraging result was the small amount of variation in pulse amplitudes about the disk (see sec 3.2.5). Judging from the pulse amplitudes observed it would appear that the head is following the disks better than on most drums where an amplitude variation of about 2:1 is usually observed

It is felt that the next Magnetics test should be to count pulses on and off the disks

JWH 6-8-53

4.2 Comments on Mechanical Results

4.2.1. Disk speed.— During the tests the speed was held to 500 RPM or below. Above this speed contact of air head and disk became apparent. This was thought to be due to an insufficient preload of head to disk which allowed the head to cock. This condition allowed the disk to hit the head at intervals and emitted a ticking sound. (Later with a larger preload the disks were run at 900 RPM with no sign of contact

4.2.2. Air Head— The air heads followed the disk very well considering their mass and the speeds involved. The actual spacing of the head from the disk did not seem to vary much as shown by the pulses on the scope

4.2.3 Vibration— The critical speeds of the system seemed to be a slightly more than 500 & 1000 RPM. This did not affect the

DNJ 6-8-53