KEN'S PATENT
3,161,861
PATENTED: December 15, 1964

MAGNETIC CORE MEMORY
Olsen & Dick Best
(FILED: November 12, 1949)

PRIOR ART/PROBLEMS

1. Errors in "writing" and "reading" result from respective currents which are either too large or too small (hysteresis of the cores not exactly rectangular).

2. Magnetization of the cores change over a range of currents and any value of current in the range will SHIFT the magnetization of the core to some extent.

3. Currents in the range change the magnetization and cause output voltages in the sensing conductor which sometimes indicate a complete shift of magnetization and other times are unable to do so (i.e.errors).

   3a. Sometimes 2-1/2 currents are intended to indicate a change but may result in an output voltage insufficient to indicate the change.

   3b. Sometimes a 1/2 unit of current from a row or column falls within the range which may result in a sufficient change in magnetization to give rise to an incorrect output voltage.

4. To AVOID errors of this type (a) individual currents (1/2 units) must be maintained below the range, (b) full unit of current by a row and column through a selected core must be kept above the range.

5. Current control within narrow tolerance limits.

6. Magnetization characteristics affected by temperature, which narrows the current limits even further.

7. Individual core characteristics vary and further limit the range.

8. Prior art vacuum tube and transistor-operated sources prone to the above errors and required frequent adjustments.

9. Row and columns had to be bi-directional for reading and writing.

10. Prior art vacuum tube and transistor circuits were difficult to operate in two directions and control of currents was difficult.

11. Separate sources for writing and reading increase the COST and COMPLEXITY and number of currents to control.

12. It is necessary to keep the timing of the current pulses through the row and column conductors following an input pulse to the memory, within certain limits in order to provide correct timing of the output pulses from the sensing conductor.

13. Prior art used constant current sources.

14. Errors increased as speed of operation was advanced.

INVENTION

1. Constant voltage source

2. Low impedance switches

3. Current control by means of resistors connected in series with conductors

4. **(Regulate timing by line properties and resistors).** Value of resistors when combined with inductance of the lines, provide the correct time constant for appropriate rise time of the current pulses.

5. Current is set by setting voltage from the constant voltage supply (once rise time is set) using Ohm's law; resistance of line and switches is negligible compared to resistor (series).

6. High speed operation is enhanced by ELIMINATION OF SHUNTING CAPACITANCE.

7. Transistors are used as line selecting switches between the lines and the power supply.

NOTE:

. 1 power supply simplifies control of currents.

. Provides an advantage in setting voltage and in controlling voltage in response to environmental factors.

. Voltage source in series with switching transistors renders insignificant any changes in the internal impedance.

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I N T E R O F F I C E M E M O R A N D U M

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Subject: GENESIS OF MEMORY PATENT 3,161,861

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It is my memory that the basic idea for that patent was my own, and I worked with Dick Best on the development of it.

For all the years we were using vacuum tubes to drive memories, we tried to develop high quality current sources which are the ideal way of driving a memory core array. Because of the amount of wire, we always had to put a resistor across source memory to damp out the ringing. With vacuum tubes, current sources were relatively easy to build and voltage sources exceedingly difficult. With transistors, a half voltage source, is easy to build because it is easy to saturate a transistor and make it like a short circuit.

In my masters' thesis, a number of years earlier, I made the Thevenin equivalent of the standard current driven resistor network of a D to A converter and drove it with voltage sources instead of current sources. It dawned on me that this trick also worked on memory. We already had a resistor in series with it to keep it damped and driving the resistor through an on/off switch, according to Thevenin's theory, it was the same as driving a parallel resistance through a current source. This meant that a simple transistor, turned off and on, could be used to drive a core memory without the complexity and expense of making a current source. The simplicity of the switch was very important because in a 4000 word memory, there were 256 switches or current sources.

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KO:3846

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