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SUBJECT: ASSOCIATION OF COMPUTING MACHINERY CONVENTION, SEPTEMBER 1952

To: P. Youtz

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Date: October 27, 1952

Abstract: This report covers only the storage devices which were discussed at the convention. Five papers were presented which dealt directly with these devices and additional information was contained in papers which were concerned with entire computers.

J. C. Chu of Argonne National Laboratory reported on the "Oracle" Computer which will use Williams electrostatic storage. The memory element of this computer will differ in two major respects from the usual conception of Williams systems. The first difference is in the use of two CRT's per digit. Each of these CRT's stores identical information in identical raster positions. The readout from both tubes is compared, and if the two do not coincide, the correct information is assumed to be a "dash" (i.e. a refilled "dot"). This information is then written in both tubes. The basic assumption of this method is that blemishes on the tube surface which prevent writing a "dash" constitute the major source of trouble. Adjacent spot interference which causes "dots" to turn into "dashes" is not detected by this system. However, it is expected that this trouble may be ameliorated since a reduction in the blemish problem permits higher accelerating voltages which, with their finer focus qualities, reduce such interference.

This redundant system of storage is a simplified version of the idea presented by P. Sherertz of the Naval Research Laboratory last December (see M-1380). His proposal required at least three tubes per digit with different raster arrangments on each tube. Such an arrangment was intended to correct for both blemishes and spot interaction.

The second new feature of the "Oracle" storage system is the inclusion of an automatic current control for each CRT. This is accomplished by reserving one storage register for a reference signal. After a period of normal storage operation, a "dash" followed by a "dot" is written in this register. The "dot" readout is used to actuate an AGC system which controls the bias on the tube.

Dr. Robinson of Ferranti, outlined the program used by them in the testing of the tubes in the Ferrut Computer. For the most part these

tests are routine. Robinson's group checks for blemishes using a continuous line scan and reports few rejections due to blemishes. In part this is due to the low accelerating voltage used (1000 volts). A special gun is used to obtain fine focus (0.3 mm spot) at this low voltage. They perform a spot-interaction test principally to determine the maximum operating beam current, and also use a test which writes alternating arrays to determine the minimum beam current. They are satisfied with the tube performance, but since theirs is a serial computer their requirements are not as stringent as those of most American Computers. To our knowledge the tube they are using, a special one developed by GE (England), has not been tried in this country.

Chu and Klein of Argonne reported their test results on a group of American tubes. These included regular 3" and 5" CRT's as well as a special tube (RCA 3611) constructed for Williams storage use. In their tests the blemish characteristics of the tubes were ignored, and they tested for spot interaction only.

They found that the 3JP1 gave the best results among commercial CRT's. The RCA 3611 tested considerably better than any of the commercial tubes. Unfortunately, no information is immediately available on this tube. The original intent of the work at RCA was to produce better surfaces to reduce the blemish problem. No changes were contemplated in the electron gun. It would appear from Chu and Klein's results that gun changes have been made but this is unconfirmed. No blemish characteristics have been reported on this tube.

The most interesting report of the conference was given by R. Schumann of Argonne National Laboratory. This concerned preliminary work on a method of improving storage reliability in the presence of spot interaction. In this system, the information is stored in the usual manner using a two-dot mode (instead of dot-dash). In contrast to the conventional system, readout is taken from both dot locations. The gain in reliability comes from the fact that in a normal system an intentionally erased dot and one which has been erased by extraneous refill are difficult to distinguish using a fixed reference level. However, in this system because the two adjacent dots are both subjected to the same amount of extraneous refilling, the difference in their readout amplitudes retains the same polarity even after considerable refilling of the spots. By using this amplitude difference as the readout signal, Schumann was able to obtain an improvement in the "repetitive consultation number" (spot interaction) by factors ranging from two to forty with a median of about ten. This system involves only a slight increase in reading time and a small amount of circuitry. Although the work is still in its preliminary stages, it seems to hold promise of being a considerable advance in the art.

One paper was presented on ferroelectric storage. Anderson, of Bell Telephone Laboratories reported on their work with crystals of

barium titanate. They have directed their work toward using single crystals rather than polycrystalline material. The resulting storage elements show higher discrimination ratios for the single crystals than for the polycrystalline elements. Their main effort has been expended in developing methods for growing large crystals; maximum sizes of one half inch square have been obtained. Very little work has been done in the testing of multi-element memories formed on these single crystals.

In another paper, Holt of NBS reported on his memory element which consists of two diodes and a capacitor. Storage is accomplished by virtue of a long discharge time constant of the condenser through the diode back resistance, contrasted with short readout times through the diode forward resistance. The stored information must, of course, be regenerated periodically as in the Williams system. Holt described possible external circuitry which might be used to implement a complete system. The chief drawback of the scheme, and it appears to be a formidable one, is the large number of diodes that are required. It would not seem that present crystal diodes would lead to a system of storage having greater reliability than that presently obtained with Williams storage.

The amount of new information presented at the conference was not impressive. Although the Williams system is the only one in widespread use, its reliability is not commensurate with other computer components. There seems to be no hope of any immediate increase in this reliability. Computers which have obtained reliable operation with the system have generally obtained such results through special programming. In general-purpose computers this places a considerable burden on the programmer. In special-purpose computers which use the same program for many problems this may not be such an important consideration.

However, since most of the computers built to date have been general purpose, some disappointment with Williams storage is evident. At least one computer, SEAC, has discontinued use of the Williams storage pending a reevaluation of the system. Unfortunately few computer projects are in a position to do this. On the other hand, new computers are being built with Williams storage, and the engineers working on these computers are quite optomistic. Whether their optimism is justified probably depends upon the outcome of the research and construction of special CRTs for storage use, such as the RCA 3611.

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