18 June 1965
Declass Review by NGA.

MEMORANDUM FOR THE RECORD

X1 SUBJECT: [redacted] Briefing on the CYPRESS Chip Storage and Retrieval System, 10 and 11 June 1965 at San Jose', California

WARNING - PROPRIETARY INFORMATION

1. Summary: The CYPRESS system began as a photo chip microfilm storage and retrieval system with aperature cards as primary output. It now includes photodigital recording and video recording although the latter is mostly in the conceptual stage.

2. Comment: Image CYPRESS is costly and may be slow. Careful study of a specific use should be made before purchase. Simpler methods will often suffice. Maintenance will prove costly just as in the Mini-
X1 card system (some [redacted] per year for a small system).

Photodigital CYPRESS will probably be packed for large systems (not needed at all for small systems) which reduces the importance of the chip
X1 as a unit record. The [redacted] system uses a much larger disk record with much less toy-train-switching and plumbling. Random access is an appealing siren, sitting on the rocks of wasted space (per chip) and increased average access time; it charms one away from the problems of file organization only to throw one rapidly back into the problems in order to manage batch retrieval efficiently. One-at-a-time retrieval, although needed, is seldom efficient. Very few cells can be in movement at once.

Video CYPRESS is impressive as a concept, but the chip mechanics remain the least impressive part. As a reality, it remains to be seen. Its progress should be carefully monitored. I can not recommend more on the basis of this exposure.

To repeat, the chip decreases as a logical-sized unit record as we go from image CYPRESS, to photodigital, to video.

3. I attended on invitation of [redacted] of OCR. Their visit was 25X
to discuss a solicited proposal from [redacted] to provide the video CYPRESS sys- 25X
tem as the Agency mass document storage and retrieval system from hard copy input to hard copy output. Indexing, however, was not proposed. It was assumed that, by other means, the address of the chip of a wanted document is known. Those attending the meeting were:

X1 [redacted]

GROUP 1
Excluded from automatic downgrading and declassification

X1 SUBJECT: [redacted] Briefing on the CYPRESS Chip Storage and Retrieval System, 10 and 11 June 1965 at San Jose', California

X1 [redacted]

The sessions were held in San Jose', California, [redacted] 25X
25X

X1 4. [redacted] of SSD reviewed the photo image CYPRESS system and the photodigital system. The photo image system is quite similar to the plans as I reported them two years ago (8 May 1963). They now plan 8 images per chip (a 24X reduction) only. Input will still be via microfilm so they can use Diazo film as the storage chip. Output is still to Mil D Diazo aperature cards by contact printing. Hard copy can be made from the aperature cards.

They still plan:

32 chips per cell = 256 images
450 cells per tray = 115,200 images
5 trays per file = 576,000 images
3 to 5 files in a system

Twenty-five feet per second cell delivery speed in the pneumatic system was quoted, or 1000 cells per hour. A single tube delivery system is planned, with switching and delays to return cells to their home location and this will probably control the effective size of the system. They pointed out that parallel tubes were possible, but did not indicate they planned to go this route.

This is still referred to as the engineering drawing system. It was found to be the most costly of some 20 systems examined by the CHIVE group.

5. The Photodigital CYPRESS is new. However, two systems [redacted] 25X
X1 [redacted] have been sold to the AEC for delivery in about 2 years. They will be used for mass digital data storage to replace magnetic tapes. Digital bits will be recorded on the chips photo optically - somewhat a'la Minicard but more like the photoscopic disk work being done by [redacted] 25X
X1 [redacted] It employs electron beam recording on special DER film made by Eastman (Digital Electron Beam Recording). It has a 7.5 mil ESTAR base with a 5 micron emulsion, very hard. It has a high silver-to-gel ratio; no optical sensors, thus "insensitive" to room lighting; is somewhat similar to EK 649GH film. The recording beam is ½ micron wide.

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Because the recorded data cannot be read back until the chip is developed, the read-back method of accuracy-checking used on magnetic media is not available. High redundancy recording is used instead. Every data bit is recorded twice, plus some 66 check bits per 300 data bits. These are used with elaborate error correction and detection techniques at readout time. 4,000 core positions are required for these techniques. They can detect and correct up to 5 six-bit characters (can detect a sixth, but cannot correct it) per line on a document. But note such detection and correction must be done every time the chip is read out. The techniques include matrix inversion.

5,000,000 bits can be recorded on one chip. At 6 bits per character, this is 833,333 characters. However, for digital recording, the bits per character is up to the user; it's basically just a string of bits. One file holds 1/3 trillion bits. The AEC configuration will hold 2.5 trillion bits (3 file modules)*. They will have 1 controller (electronic control computer), 2 input stations, and 1 output station.

1.5 second cell-retrieval time was stated or 3 second retrieve and return. They plan to overlap the return.

Readout is 2 megabits per second.

Input can be temporarily recorded on a disk file to be immediately available for retrieval and to be later replaced with the developed chip. They record at 500 kilobits per second or 21.5 seconds to fill an entire chip (5,000,000 data bits)**.

They hope to be able to contact print duplicate photo digital chips later, permitting reproduction of data stores.

6. The Video System was presented by several ASDD engineers and a
X1 sum-up was made by [redacted] of SDD. Several items described by ASDD are not yet offered for delivery.

X1 [redacted] explained the input method.

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* File Module: 5 trays in first one, 10 trays in succeeding ones.

**This seems to bear out my previous figures:
for 300 data bits, each is recorded twice plus 66 bits for error checking = 666 bits or 2.22 bits per data bit. 5,000,000 data bits per chip = 11,100,000 total bits. At 500,000 bits per second record speed, a full chip would take 22.2 seconds.

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A special scanning disk will scan <u>microfilm images</u> of documents (silver haloid, diazo, or Kalvar) and digitize the data. The data rate is a function of the scan disk speed. Expect about 4 seconds per chip.

They are also experimenting with a line scanner to be used on hard copy. They have experimented with 100, 150 and 170 lines per inch scanning. A space compression technique is used as follows:

When data (mixed black and white spaces in close proximity) are scanned, they are recorded as 6-bit data records, the first bit being reserved to indicate that the word <u>is</u> a data word. When blank space is encountered (continuing black or continuing white), the first bit indicates this is a space-compression word, the second bit indicates whether white or black space is encountered, and the remaining 4 bits record the <u>number</u> of data bits being compressed. This variable length of space compression even packs up spaces between words. At 100 lines per inch, compression ratio is about 3:1, at 150, 5.5 to 1.

About 126 characters are recorded to identify a single alphameric typed character.

This plan is black and white only; no grey scale.

Output would reverse the process, scanning the chip and depositing electrostatic charges on paper for Xerographic development. They scan at 2700 characters per second (I guess they mean the 6-bit word; this is not clear to me) or 2025 lines per minute; 2 seconds for an $8\frac{1}{2}$ x 11 page.

This output description requires an unscrambler which I am unable to
X1 supply. [redacted] went on to describe a 48-character set and a capability of expanding to lower case characters. I suddenly found him describing a <u>character</u> recognition recording and print-back technique. Later he demonstrated print-back only. I believe that this character printing was only a laboratory technique to establish certain criteria for their further work. It was <u>not</u> described as part of the ultimate system. I was surprised by the implication that we had received a demonstration of "the technology involved".

Such scanning can, of course, also be delivered to a TV viewer. This was demonstrated by loops of magnetic tape being read (iteratively about 30 times per second) and "printed" on a TV screen. Pictures were shown too. The demonstrated TV technology is well within the current state of the art. Input to chips was unconvincingly demonstrated and there was <u>no</u> throughput demonstration; that is, the output scanning of a chip and recording it on the tape loop was not shown.

25X1

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25X1

7. [redacted] spoke further on the video file and display devices. We were told that at about 2000 scan lines per page, both input and output was possible at a rate of 10 to 30 pages per second.

They have made a 3000 line flying spot scanner. A 940-line 20 megacycle scanned image of a page was shown; it was of poor quality.

At 10 pages per second input and output, they will use a buffer to regenerate images for TV viewing (The magnetic tape loop is one type of buffer). One buffer can drive several viewers. Or, a page of hard copy can be scanner-"exposed" in 1/10 second.

A chip holds about 2 square inches of recording area on each surface (front and back). They propose to use both. Magnetic chips can rub without damage, thus 64 chips can be put in a cell, "probably more". Later, however, we were informed that the proposal to CIA was based on 32 chips per cell.

10,000 bits can be recorded on one 2" length of track on a chip, 100 tracks per side. Use a high density and high velocity 6-mil scanner; 600-800 ips. Four megabit transfer rate.

Can write one track, read, and check it in 16 2/3 milliseconds. The limiting factor is moving from track to track: 7 milliseconds. Read <u>and</u> write 600,000 bits per second; read, only, at twice that rate.

Reading and writing at the 5000 bits per inch per track requires physical contact of the read-write heads. They find that it takes 1,400,000 passes to "wear out a track". "One track in 40 will have an error."

It is possible to get grey scale, maybe 8-10 shades, possibly 16. But <u>only</u> digital black and white recording is proposed to CIA. Grey scale will require analog recording. "Color is possible."

The reading and writing takes place over a drum (see attached sketch B). Note that, as shown in the sketch, the right-hand surface can be read (or written onto) by opening the cell, picking the correct chip, and pulling it over the drum. The process is reversed to return the chip to its cell. To read the other surface of the chip, the cell must be moved to position two (see red arrow) and the process repeated, this time pulling the chip up counterclockwise over the drum. Because it appears to be more rapid to read several chips on the same side than to read both sides of one chip, then both sides of the next, etc., I asked if this were the recording plan: record all chips on one surface, then all on the other surface; or use this method per cell. I was confused by the reply but inferred that they did not agree with my conclusion that reading first one side, then the other, of one chip at a time would be a slow method.

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8. On Friday morning we received a summary by [redacted] and others. At this time the attached sketches (A through G) were received, with a caution concerning their proprietary nature. Their disclosure outside CIA is not authorized. 25X

Most of my notes about the sketches are recorded thereon.

Video printer: 40 to 50,000 6-bit characters per second. About 10 seconds per page. Present plan is to display 1/3 of a page at a time; buffer will hold 6 times this or two full pages. "It is possible" to handle a full page at a time. May encounter a delay of 7 seconds to access a new page. Can have 3 buffers and 5 printers per buffer, or total of 15 printers which would use up all channels of the electronic system controller (a small computer).

Currently planning 100 x 100 lines per inch. Demonstration of quality at this density: very readable but I would expect eye strain to result (obviously a personal reaction).

Printers and viewers can be up to 2,000 feet away from central unit. Printer will yield $8\frac{1}{2}$" x 11" paper.

The core requirements for the controller are:

image system		4,000 bits (may grow)
photodigital system		8,000 bits
video system	at least	16,000 bits
7 data channels		

Proposed to CIA:

16,000 chip system, or about 1.2 million pages with average compression of 3 times.
digital; no grey scale

9. CYPRESS Simulation: Overlap is logical and essential to get any reasonable speed out of the CYPRESS system. The speed of the system, bottlenecks, and ways to break the bottlenecks for different assumptions concerning input volume and the volume and nature of output requests can be simulated with a computer. [redacted] explained their use of the GPSS (I assume General Purpose Simulation System) to study the problem. The simulation results of several different mixes were displayed. The work is most interesting and may be worth a closer examination. Recording the results was impossible and nothing was supplied in writing, but there follows a sketchy description of the method.

X1

X1

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a. Elements of System

Files
Video chip converter
Distribution buffer
Shuttle buffer
Document printer
Video buffer
Display
Scanner

b. Processing Sequence

	Scan Request	Print Request
1/		Queue for & seize Dist. Buffer
2/	Queue for & seize Shuttle Buffer	Same as Scan
3/	Queue for & seize Cypress File	Same as Scan
4/	Position tray, transfer cell to flip buffer	Same as Scan
5/	Queue for & seize pneumatics	Same as Scan
6/	Transport cell to shuttle buffer	Same as Scan
7/	Releast file & pneumatics	Same as Scan
8/	Seize video converter	Same as Scan
9/	Transfer cell to video converter	Same as Scan
10/	Release shuttle buffer	Same as Scan
11/	Pick chip	Same as Scan
12/	Queue for Module Controller	Same as Scan
13/	Use module converter to transfer 1 page	Same as Scan
14/		Transfer 3 pages
15/	Repeat steps 12 & 13	Initiate printing
16/	Queue for & Seize file	Same as Scan
17/	Queue for & seize pneumatics	Same as Scan
18/	Transport cell to file	Same as Scan
19/	Release: video converter pneumatics file	Same as Scan

c. Job Set Up

Used random numbers for delay between requests (average 45 seconds). Ten seconds to print. 31 second delay on display requests. 1 second average use time. Run time one hour.

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d. Data Obtained

(Figures supplied for only a single simulation)

Element	No. of Units	% Utilization	No. Entries	Avg. Use Time	Max. Contents	Avg. Contents	% Zeros	Time in Queue
Files	2	30	1150	1.9	1	.05	79.5	.31
Pneumatics	1	25	1150	.77	1	0	98.5	.006
Shuttle buffer	1	67	576	4.2	3	.19	50.6	1.17
Video chip converter	1	83	576	5.2	1	.23	33.6	1.43
Module controller	1	40	876	1.66	1	0	100	0
Distribution buffer	1	44	621 pgs	14	1	0	100	0
Printer (Priority 1)	5	50	621 pgs	43 sec/doc/printer				
1/P Scanner (Priority 2)	1	90	368* documents					

Results were most interesting but too much detail was received too fast to record any clear impressions about the CYPRESS system.

* 2 pgs per document

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X1

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10. Other Attachments

a. A sample of the type of output paper being used is attached (H & I).

b. A list of some of the items to be considered in a systems study for CYPRESS are listed in exhibit J. There was no comment as to who would/should do this when.

c. A copy of my 2-year old report on image CYPRESS is attached. It is still pertinent.

[redacted] 25X

Systems Branch
IPD/NPIC

Distribution:
1 - Ch/SYB/IPD
1 - P&DS
X1
1 - [redacted]
1 -
1 -
1 -
1 -

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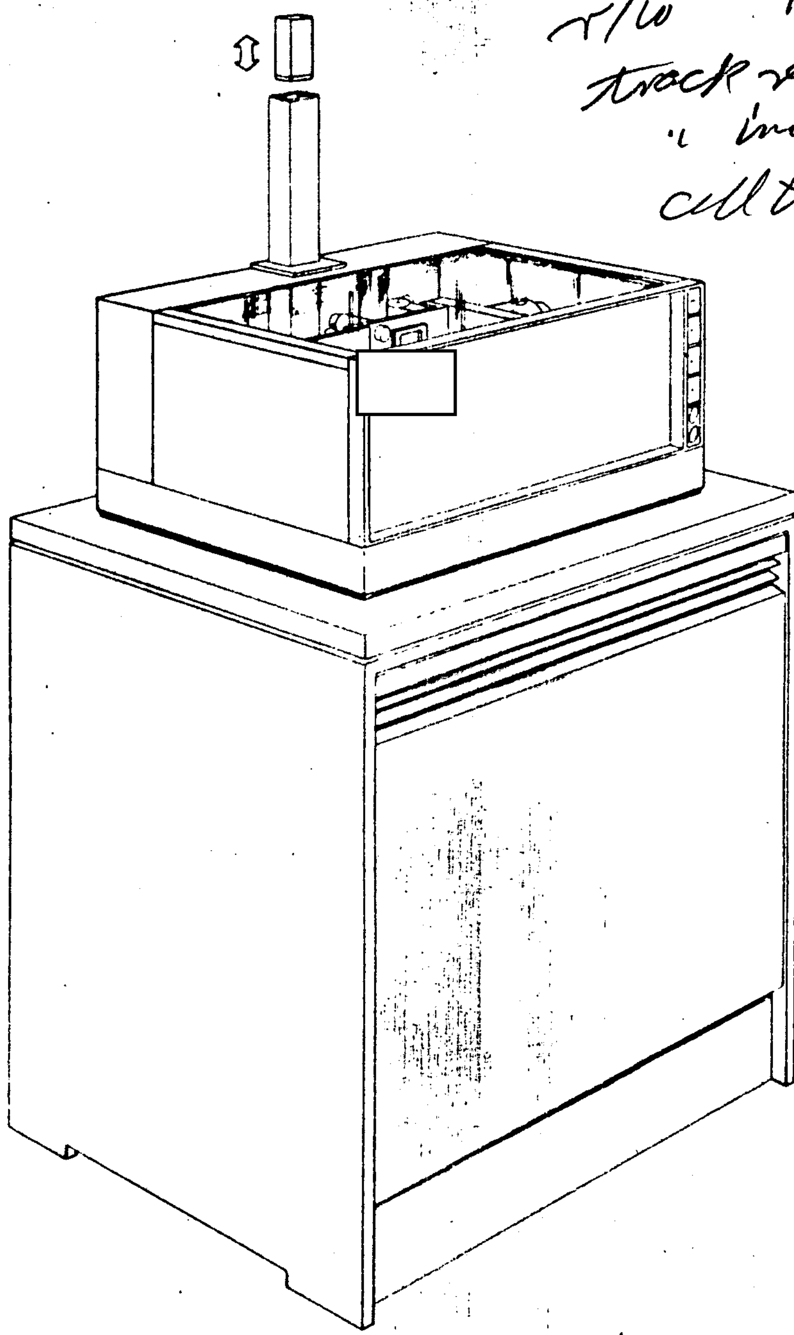
(A)

r/10 ~ 4 megabits/sec
track read 3 ms
" increment 5 ms
cell thruput 2200/hr
MAX

= about 2x
the file
thruput

5X1

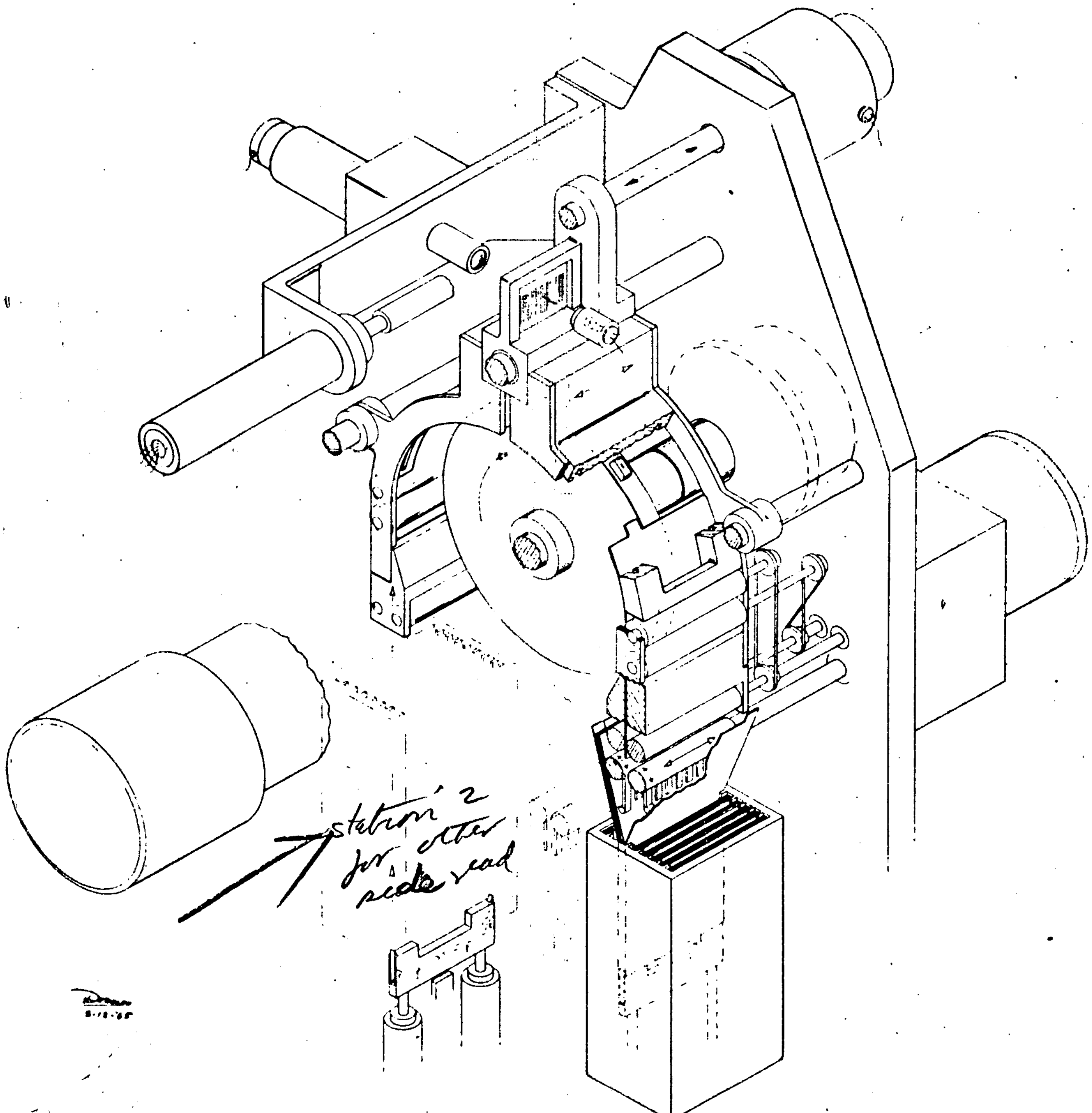


Video Chip Converter

DEDOL PS
5-19-66

takes from a cell buffer ~~+ read~~ opens, selects reads a chip on one side. Must go back in cell & cell moves, pull out again to read other side.
~ 3 pages on one side

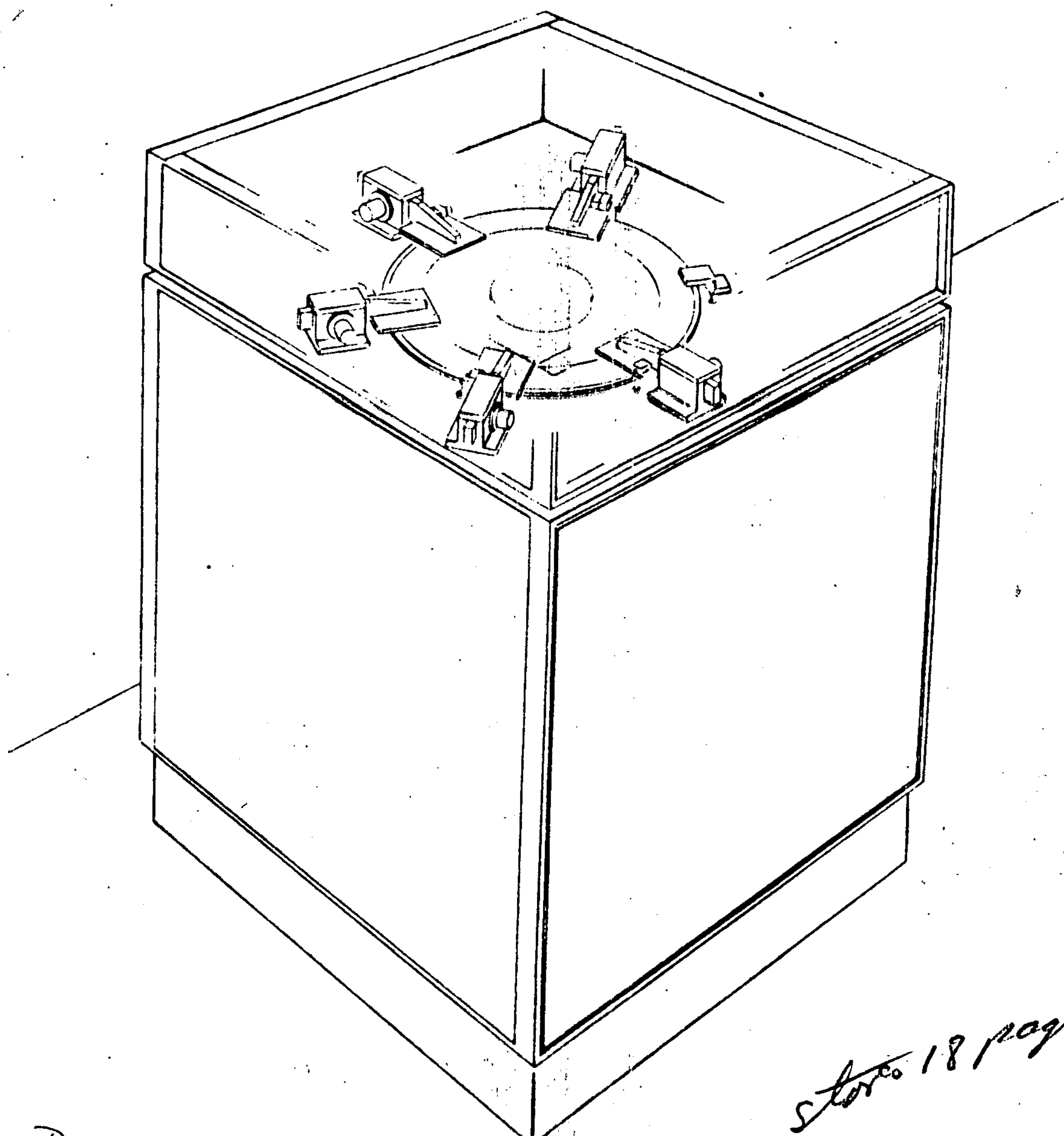
XX



Video Chip Converter

printers 5
pgs/channel 3
load time < 1 sec
unload ~10 sec
tracks/page 6

uncompressed page = ~1,000,000 bits



stores 18 pages

DEDOAPA 5·24·65

Distributing Buffer - not made yet

OP Write onto a disk. From here to core. OP 8 lines at a time for an 8-stylus printer ~10 sec/pg printing.

These 3 pages are
exhibit J

8 May 1963

X1 [redacted] CYPRESS SYSTEM

X1 TRIP REPORT -- [redacted]

X1 1. Accompanied [redacted] DD/P to receive briefing
X1 at [redacted] on 29 April 1963: Cypress Information Retrieval System and other developments.

2. CYPRESS was originally a proposal to the Redstone Arsenal to build a storage and retrieval system for 1,500,000 engineering drawings currently stored in Mil-D microfilm aperture cards. I doubt if they
X1 got the contract, but [redacted] has now decided to market the system. Concepts are fairly well set, some breadboard pieces were shown, but considerable development remains. No target date was given. The system is being developed by some of the same people who worked on the WALNUT system. They stated that it would have the WALNUT capacity, a greater input and output speed, and less reduction (24X).

As stated, the system <u>starts</u> with a Mil-D size microfilm image mounted in an aperture card. It is aimed primarily at the engineering drawing field with thought also given, secondarily, to documents.

<u>INPUT</u>: The Mil-D microfilm image is contact-printed onto a Diazo film chip 1.4" x 2.6" (6 times the area of minicards) which also contains a machine-readable chip number and a strip of magnetic tape capable of holding 100 characters. This strip gives a limited Minicard-type capability to pass chips across a reading head and select the desired ones. They pointed out that this very low density of the magnetic tape could obviously be increased to hold more information -- but also explained that this low density gave them positioning latitude at the read head. I concluded they do not plan to increase the density at this time.

More detailed information, or indexing, will be input to an [redacted] 25X1
1440 computer which also handles the retrieval logic on an 8K program store (along the WALNUT lines.)

They are also thinking of multiple-image storage on a single chip by subdividing the frame. 8 legal-size images can be stored at a 24X reduction; 16 at 40X; and 32 at 60X has been "considered." They do not have the capability of handling multiple chips as a <u>set</u>, as Minicard does, hence the necessity of subdividing the chip. (The first machines will output only the full Mil-D size.)

STORAGE AND RETRIEVAL: Chips are mechanically loaded in a plastic cell which will hold 32 chips, each chip sliding in its own grooves to avoid contact with others. The cell has a hinged cover. Cells are moved pneumatically. A file holds 6,272 cells or 200,704 chips or 1.6 million legal-size images (@ 8 per chip). The system can hold up to 5 files. (a million chips).

Chips can be updated, purged, or re-arranged. They can increase speed by proper chip filing and therefore plan to develop automatic chip filing (or refiling) logic with an eye to rapid retrieval. Any "ordering" of the file in lieu of random storage will probably mean dedicated storage space which will reduce the storage capacity of the system.

OUTPUT: A search request goes to the 1440 computer which, like WALNUT, searches its index and produces blank [redacted] Diazo aperture cards 25X1 containing chip addresses and other information (up to 57 columns). An "addressed" chip is retrieved by retrieving the applicable cell, opening it, removing the chip, vacuum cleaning the image area (nice!), contact printing onto the Diazo film in the aperture card, closing and refiling the cell, and developing the print by ammonia under pressure. Developing takes 2 seconds and is overlapped with a 2 second exposure of the next chip. Output speed: 1,000 cards per hour.

Input and output are combined at a single station and functions are carefully overlapped for throughput speed. Requests and cells can be queued by the computer. Up to 3 input/output stations (and 5 files) can be handled by one system. They expect to have up to eight cells in transit in the system at one time. Cells can be inserted or removed at any input/output station.

VAPOR DEVELOPMENT: So far as I know, ammonia-vapor-pressure development of Diazo film is a break-through (and this information must be 25X1 handled carefully as [redacted] proprietary). We saw a breadboard set up of a piston for varying pressure, a cylinder of ammonia for metered application, and a chip loading and holding device. I inferred that the 2 seconds exposure time might be reduced, but that this equalled the time to remove a chip from a cell and therefore met their objective.

VIEWER AND SMALL RETRIEVAL SYSTEM: They plan to build a viewer with a 15" x 20" screen which will accept hand-loaded cells. It will present, full size, two legal-size images at a time, will probably have other magnifications, too. It will have a "joy stick" for moving the image around on the screen.

There is some thinking under way for building a 100-cell input for the viewer to serve as a small retrieval mechanism.

A small system would require a camera, punch, film processor, and viewer. The index would be manually controlled. This is somewhat similar to [redacted] new Miracode system except that chips in cells would be used instead of small rolls in magazines. X1

25X

Some of the [redacted] systems men talked with: X1

[redacted]

COMMENTS: For high-quality photographs, I think it is a mistake to have two stage input and output: hard copy to microfilm to Diazo chip to Diazo aperture card to hard copy. For line drawings and textual material, the degredation is probably not significant but the 2-stage input still seems to be unnecessary. Using the cell as the movable unit instead of the chip gives less flexibility than Minicard, more than WALNUT. You have to open the cell to read a magnetic strip and here I believe Minicard will be much faster. On the other hand, the Cypress and WALNUT ability to address a single chip by specific location eliminates the Minicard need for file expansion and permits efficient use of a computer for handling the index. (I am at a loss to know why they want 100 characters on magnetic tape on the chip when they can store information about the chip in the computer without limitation.) *

The idea of vacuum cleaning the chip image area prior to print-out is excellent.

The small system with a viewer is interesting. I don't believe they have done a lot of thinking about this, yet.

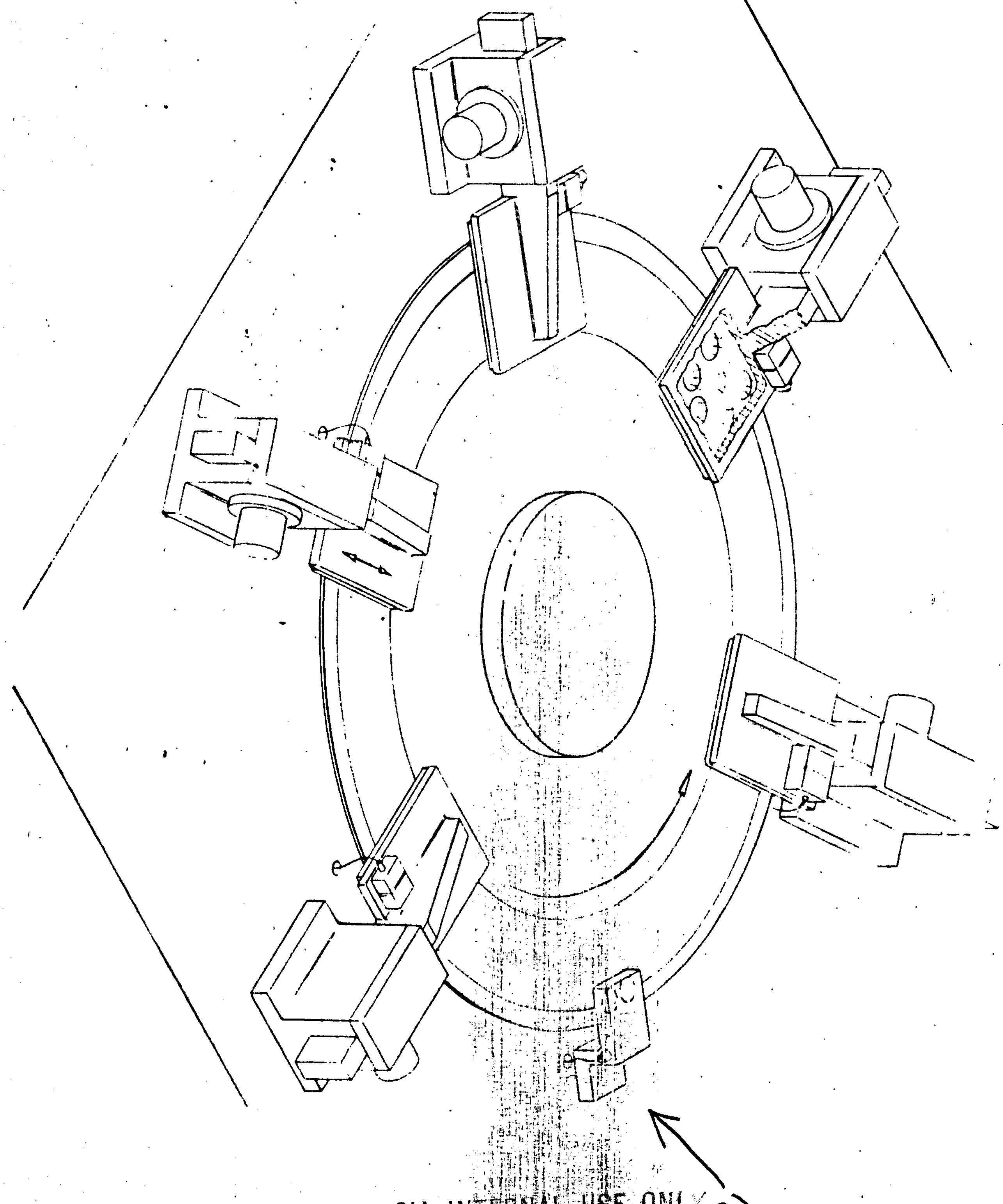
Inability to handle sets with ease appears to be a drawback. For high quality photographs, 60X reductions are not acceptable.

If the Cypress chip were bigger, [redacted] might do a good job of building a SCRAM storage and retrieval unit. Mundane things like costs and a completion date were not mentioned. 25

* the 1440 is only for processing control & is not planned to hold index info

CIA INTERNAL USE ONLY

5 read-write heads on one buffer disk



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E

4 tape loops

ea loop has 6 heads

ea track = 1/3 page, or a frame

page capacity / tape - 2

write rate 4 Mb/s

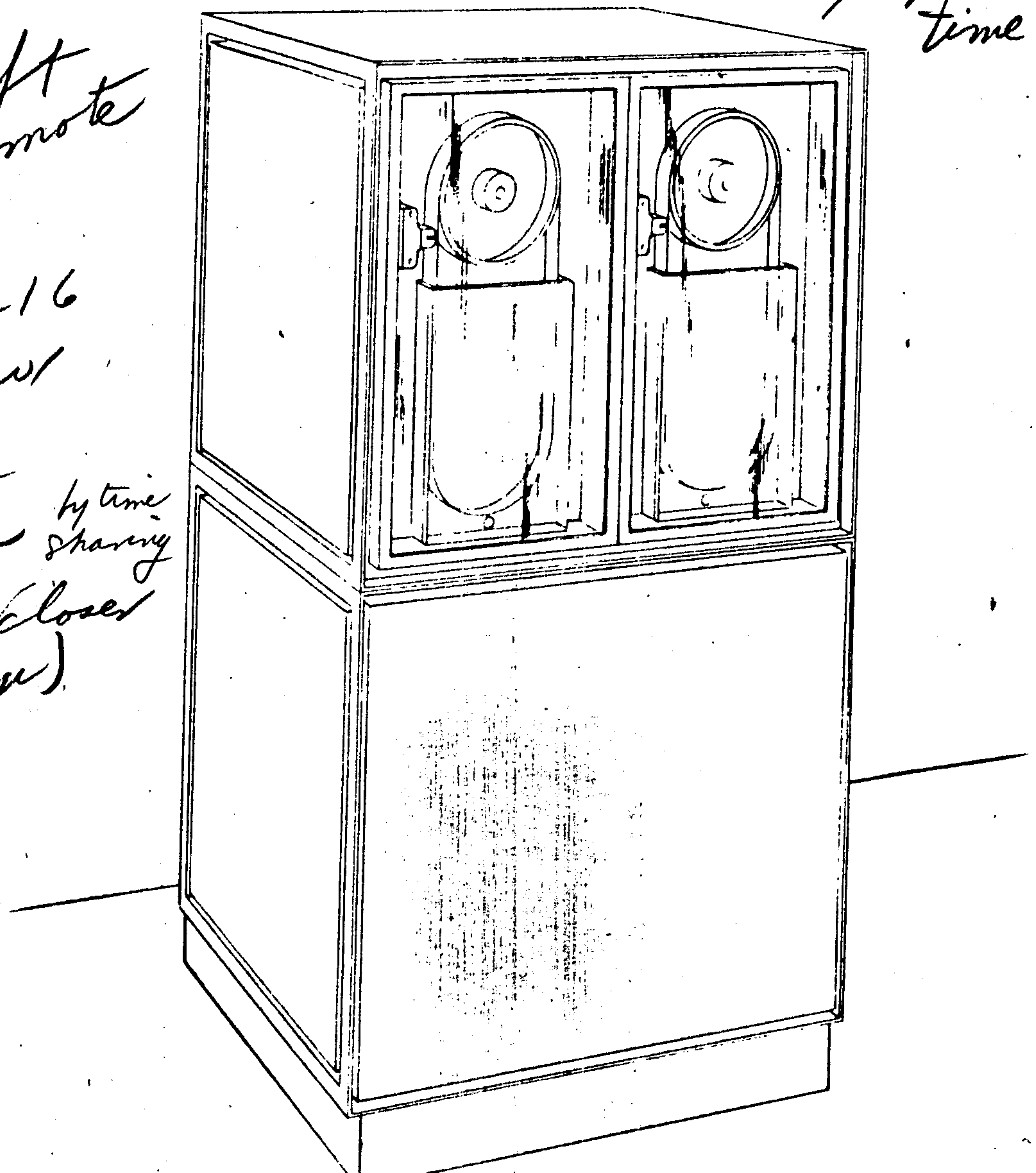
read 12 Mb/s

pg / track = 1/3

page load time - 200 ms

TV display up to 2000 ft remote

Could drive 16 displays w/ the 4 tape loops by time sharing (8 sounded closer to the plan)



Video Buffer

Ivan 5-4-65

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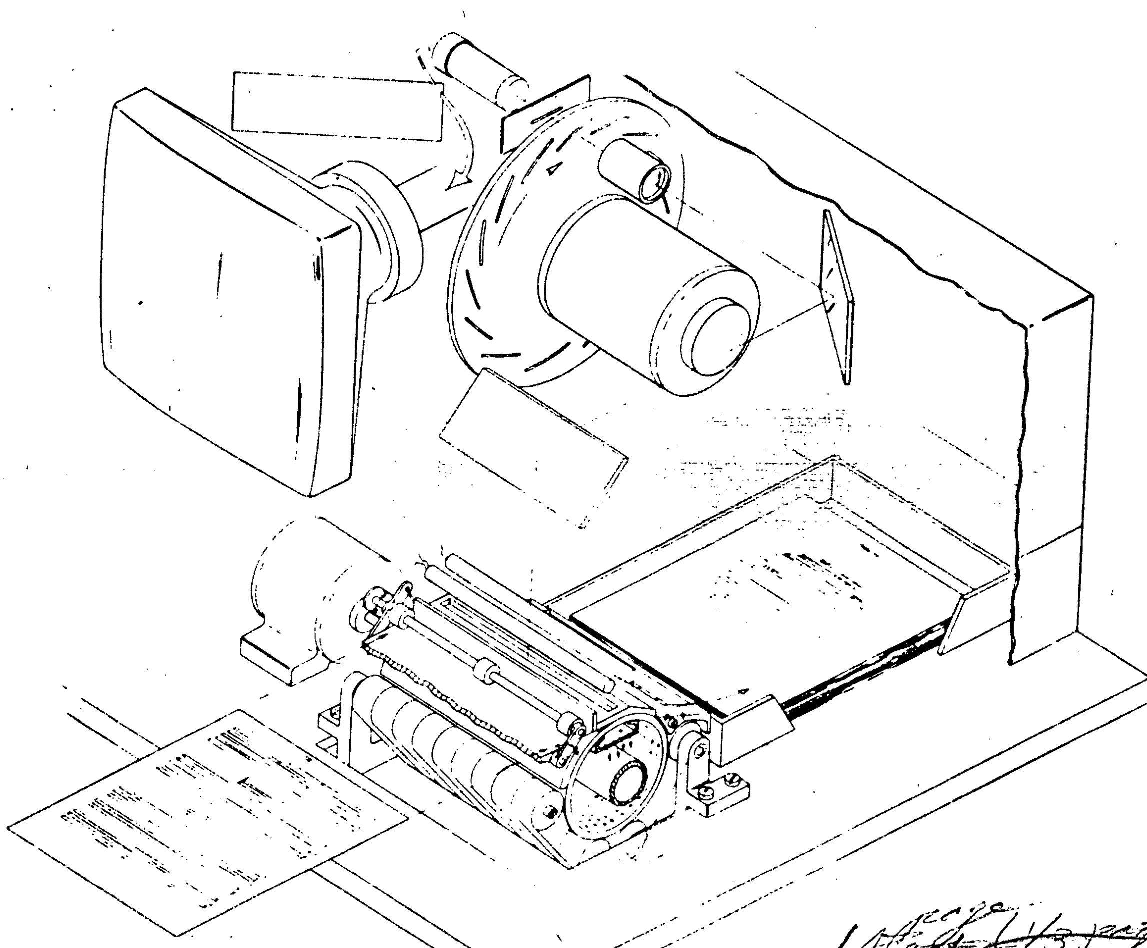
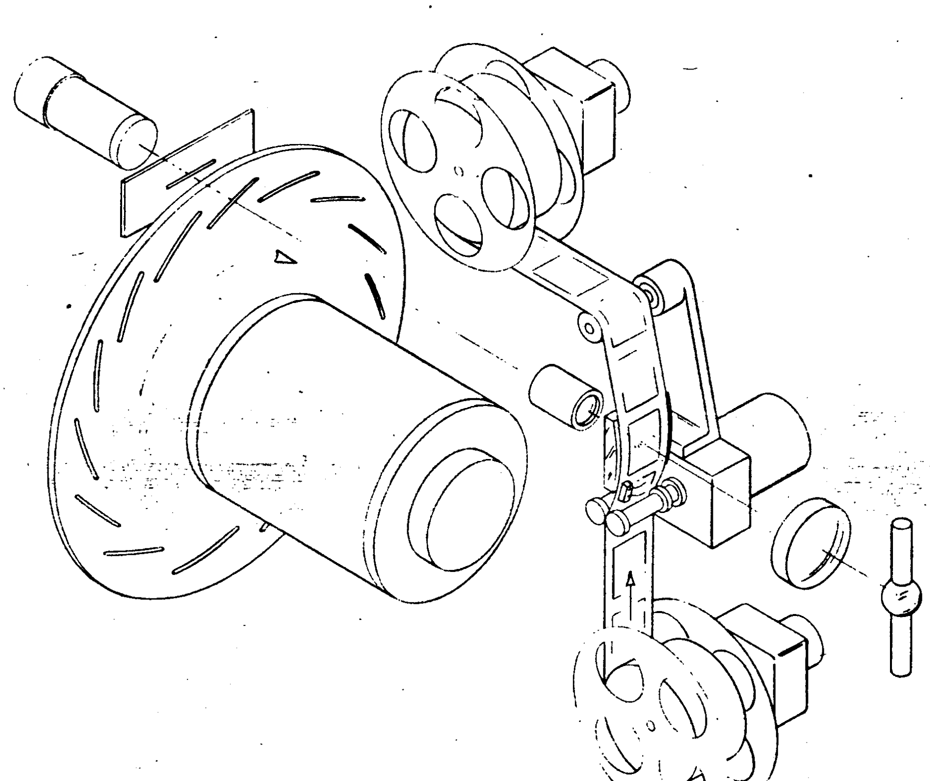


1 ea / Page Scanner

Approved For Release 2005/11/21 : CIA-RDP78B04770A002900030024-3



DEDOLPH
4-12-65

microfilm
scan detail

35mm
12:1

scan 1 frame/sec

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ABCDEFGHIJKLMNOPQR   STUVWXYZ0123456789   .)+$*-/,(='‡
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Not a sample of system quality.

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Agency Visit to [redacted] **Morning of June 11, 1965**

The following detailed agenda is pertinent for this visit.

Introduction	Recap - Image, Photo Digital and now Video for information storage and retrieval.
Document Systems and Components	The Document System. Summary description of the modules. System configurations - terminals, printers, displays.
Modelling & Simulation	Purpose of simulation, averages, particle flow, interaction.
Techniques	Simulation program, measured parameters, questions, summary of models simulated. Model assumptions, input, delays, functions.
Simulation Analysis and Conclusions	Models #1 through #4 - Assembly - Conclusions - Questions

Some Key Inputs for System Definition

- Mechanizing a problem.
- User development of system characteristics.
- List and discuss elements.

Key Inputs to System Definition

The following are some basic inputs necessary for system definition.

General - Hours per working day.

System Capacity
- Current file size by document size distribution.
- Projected yearly growth of file.
- Initial base conversion capacity.
- Input rate per day from zero to 1st year, 2 - N
- Purge rate and criteria of purge.
- Document size and growth trends.

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Input

- Quality identification and measurement - range of sample documents. Resolution, contrast, background density, form of input, paper, film, etc.
- Indexing status of conversion documents and index plans.
- One or two surface capture per page.
- Surfaces per document - a distribution.
- Range of input quantity per day.
- Tolerable delay between document receipt and capture.
- Preference to batch or interleave.

Output

- Form of terminals (Printer/Display)
- Total daily activity per day for 1st year (carful - size).
- Total daily activity per day for 2nd year and until mature.
- # terminals in system and distances from central - 1st year.
- # terminals in system and distances from central - 2nd year.
- # terminals in system and distances from central - through maturity.
- Request distribution per terminal per day.
- Terminal deviation from normal per day.
- Distribution of output pages (surfaces) per document per request.
- Request delay distribution (seconds between last output and next request).

Operational Features

- Input request priority levels.
- Output request priority levels.
- Operational hours per day (block sizes).

- Index and addressing support for total system.
- Host CPU and time sharing planning.
- System analysis, usage statistics and report generation.
- Identification of back-up file system.
- Shut down and recovery procedures.
- System maintenance agreements.
- Operating physical environment.
- Operational personnel and training.
- Awareness of limiting system parameters.

Changes to

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