

MICROGRAPHICS AT DDC

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Office of Customer Relations

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13. ABSTRACT

The Defense Documentation Center's micrographics program is described, including technical aspects of production and the equipment that makes those techniques unique in the production of microform products. Descriptions are given of various equipment modifications which result in better performance, and in some cases, a new role for the equipment. These equipments include: an automatic microfiche-to-roll film converter, a roll microfilm-to-microfiche converter, a microfiche-to-105mm roll film printer, and a dual 35mm and microfiche camera. (U)

14.

KEY WORDS

LINK A

LINK B

LINK C

ROLE

WT

ROLE

WT

ROLE

WT

MICROFICHE

MICROFILM

MICROGRAPHICS

MICROFORMS

MODIFICATIONS

PHOTOGRAPHIC TECHNIQUES

PHOTOGRAPHIC EQUIPMENT

PHOTOGRAPHIC PRINTERS

* MICROPHOTOGRAPHY

SPECIAL PURPOSE CAMERAS



DEFENSE SUPPLY AGENCY
DEFENSE DOCUMENTATION CENTER
CAMERON STATION
ALEXANDRIA, VIRGINIA 22314

PREFACE

The Defense Documentation Center's micrographics program is described, including the technical aspects of microform production and the equipment that makes these techniques unique in the production of microform products.

DDC relies on microform as a storage and production medium. Roll microfilm and microfiche are handled side by side, and new applications are constantly sought for these micromedia. The vast collection of more than 70 million pages of text, drawings, and photographs must be available for reproduction on a daily request basis. Shelf copies of these documents are uneconomical to store on a continuing basis since only a small percentage of the documents over two years old are requested.

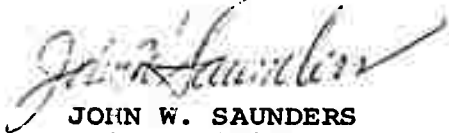
This is a prime application for high quality micrographics, since the original documents are destroyed. All subsequent reproduction, including offset press masters, are produced from microform.

The micrographics system at DDC is designed for and operated in a production environment. The enlargement of documents from microfilm on a production scale is a compromise for lowest cost, highest volume, and best photographic quality. Emphasis is placed on making a master microfilm of consistent quality to enable volume duplication and enlargement without the need for continuous adjustment of exposure variables.

Computer-Output-Microfilm is another micrographics process used at the Center. This report will not include that process as it is reported in AD 708 600, An Interim Process Report of Computer-Output-Microfilm Activities and Experiences at the Defense Documentation Center, by Samuel E. Blumberg.

This document reflects the outstanding contributions of Mr. George P. Quigley and his staff of personnel in the Photographic Processing Division, Directorate of Production. These contributions make this report significantly different from any other on production micrographics.

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PAST MICROGRAPHICS EFFORTS

Microphotography of documents distributed by DDC began as a means of quickly recording and controlling a vast amount of captured German aeronautical research program documents at the close of World War II. One of our predecessor organizations, the Air Documents Division at Wright Field, Ohio, sorted through 1500 tons of documents in an effort to pass on to American industry the closely guarded German and Japanese secrets that ranged from rocket fuels to synthetic rubber. Out of more than 800,000 documents, 55,000 formed the beginning of the DDC document collection, and, beginning in December 1945, those documents were cataloged, abstracted, indexed, and recorded on microfilm.

Roll microfilm (35mm) was produced for each document and duplicated using a diazo process. Enlarged reproduction of the microfilm was accomplished using V-mail silver halide paper enlargers and developers converted to 35mm operation. These machines produced enlargements at a 5 feet-per-minute rate and subsequently were converted to 15 feet-per minute operation.

Microcard production and distribution was initiated in April 1954. The microfilm format was changed from 35mm to 16mm and document copies were offered as full size, microfilm and microcard reproductions. Approximately 66,000 titles were offered in the microcard format until May 1961 when the program was discontinued and 35mm microfilm was again adopted.

Electrostatic reproduction units manufactured by Xerox as "Copyflo" were placed in operation in late 1956. Our organization was then known as the Armed Services Technical Information Agency (ASTIA). By 1960 the V-mail equipment was completely replaced by nine electrostatic units operating at 20 feet-per-minute each, two shifts per day.

ASTIA was reconstituted as the Defense Documentation Center for Scientific and Technical Information (DDC) in 1963. That year requests for more than one million documents were filled.

In August of 1965 microfiche replaced 35mm roll microfilm as the basic microform for storing documents. The microfiche format is a sheet of microfilm 105 x 145mm, approximately 4 x 6 inches, having a pattern of images 12 across in 6 rows filmed at a reduction ratio of 20:1. The first row

of the first sheet is used for an eye readable title area.¹ Automatic microfiche enlargers were installed to produce paper copy enlargements. These units, Microcard Model EL-4 enlargers, used a dry-silver, heat-developed paper. This process in contrast with the Copyflo operation was slower and more costly, and it produced documents having less desirable physical characteristics for DDC users.

Alternative production equipment for inexpensive and fast microfiche enlargements was not available, so dual format (35mm and microfiche) operation was established. Enlargements are now made from roll microfilm while distribution copies of film are in the microfiche format. Equipment was modified to produce new machines capable of converting roll microfilm to fiche and vice versa. In the future, a dual-format camera will be used (another modification) that produces both roll microfilm and microfiche in one exposure.

MICROFICHE PROCESSING

DOCUMENT INPUT PROCESSING

Each document accessioned by DDC is microfiched in the initial processing. On the average, 170 documents are processed daily into the technical report collection. The processing flow includes initial acceptance screening and descriptive cataloging of each document (title, author, source, technical report number, contract producing the report) and determination of distribution and security constraints. The document is then examined by a subject-oriented scientist who reviews the document for scientific content and assigns retrieval terminology for computer searching. The author's abstract is reviewed and edited for completeness, accuracy and machinability.

TEXT PROCESSING SYSTEM

Cataloging, retrieval terminology, release or distribution conditions and the narrative abstract are stored on magnetic tape and searched, using magnetic mass storage drums.

¹Federal Microfiche Standards, Committee on Scientific and Technical Information (COSATI), Federal Council for Science and Technology, 3rd ed., April 1968, PB 16763 available from the National Technical Information Service, Springfield, Virginia, 22151.

This information is transmitted to the computer area from keyboard stations at various locations in the input processing path using a data input application package called "Text Processing System." Document data is therefore available on a daily basis even while the document is still in initial processing. An editorial group recalls and reviews the input data and releases it for permanent storage.

MICROFICHE HEADER PREPARATION

Since microfiche must have an eye-readable title and data area a method was developed to retrieve the information in the proper format from computer storage. This eliminated a requirement for additional manpower to type the titles and produced error-free copy. As document data input to the computer is completed for each document the entry is flagged and on a daily basis the fiche header information is printed out. (A printout copy is sent to document storage daily for pulling documents for microfiche processing.) The original copy of the printout is sent to the Quality Control Branch² in the microphotographic area. The original printout is examined for photographic quality and sent to the copy camera area where negative sheet film reproductions are shot for cutting and use during report filming. Back-lighted title holders on each microfiche camera, a DDC development, produce sharp, high-contrast fiche titles. These computer-prepared fiche headers are produced at lower cost and lower error rate than conventionally typed headers.

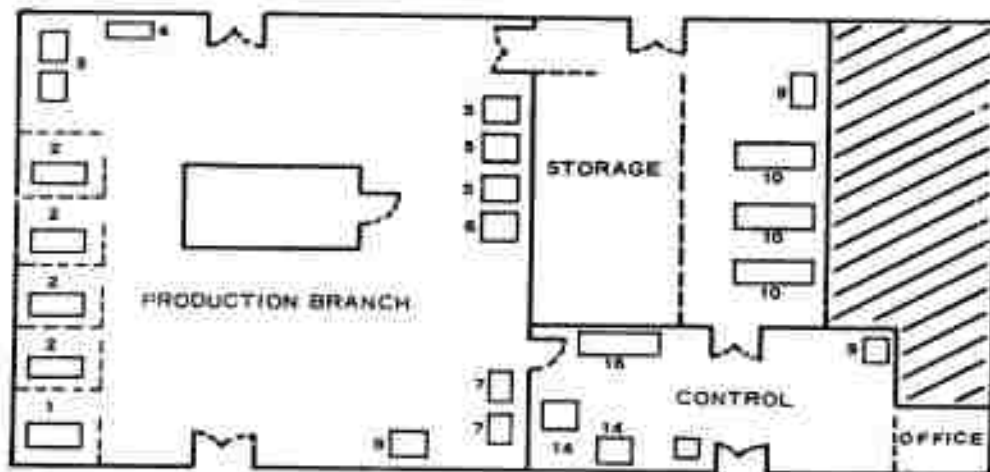
MICROFICHE MASTER GENERATION

DDC uses five 105mm microfiche cameras. One camera is a variable reduction ratio Bell and Howell Microfiche camera and the other four are fixed, 20:1 reduction Microcard (now NCR) Model SR-1 cameras.

Documents arrive daily at the microfiche camera area and are immediately entered in a document control log. This log serves as a locator and status indicator for documents during micrographic processing. If a document must be recycled because of some filming sequence error or fails to meet standards of master microfiche quality, the log will indicate the processing status. (In a high volume microfiche operation involving classified material, a central log is essential.)

²Refer to Figure 1 for photographic equipment and organizational locations.

Photographic Processing Division

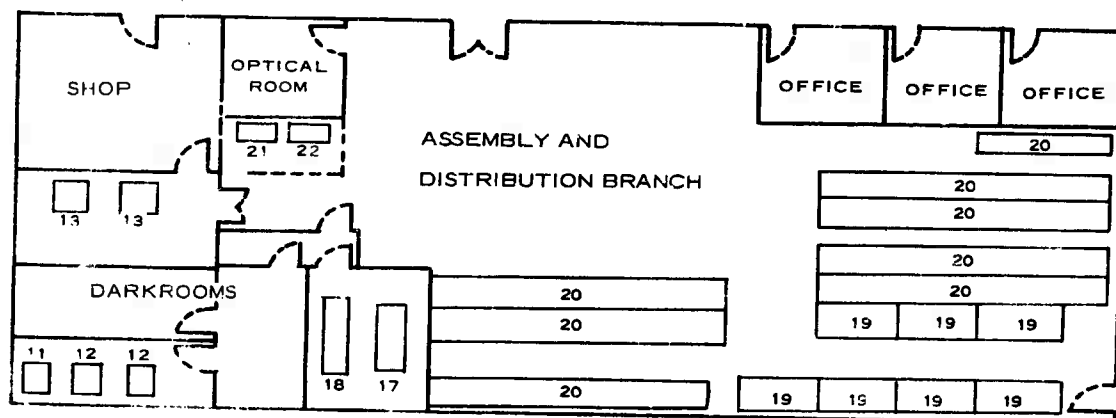


PRODUCTION BRANCH

1. Bell and Howell Microfiche Camera
2. NCR (Microcard) SR-1 Microfiche Camera (4)
3. Roll to Microfiche Converters (2)
4. Kodak MRD-2 Roll Camera
5. Microfiche to 35mm Converter (3)
6. Microfiche to 16mm Converter
7. Ozalid-GAF Microline FP-2 Duplicators (2)
8. DDC Diazo Strip Printer
9. Kodak Prostar Developer (2)
10. Xerox Copyflo Enlarger (3)
11. Kodak Silver Roll-to-Roll Printer
12. APAC-DDC Silver Sheet-to-Roll Fiche Printer (2)
13. Technifax HiR Diazo Fiche Duplicator (2)

EQUIPMENT EVALUATION AND QUALITY CONTROL BRANCH

14. Richards-DDC Microfiche Inspection Station (2)
15. Macbeth Quantalog Desitometer
16. Film Testing Lab.
17. Pakomat Film Processor
18. GAF Transflo Processor



ASSEMBLY AND DISTRIBUTION BRANCH

19. Diebold Power Files (Microfiche) (7)
20. Roll Microfilm Storage
21. Alves Microfiche Cutter
22. Kodak Microfiche Cutter

Microfiche headers arrive daily from the copy camera area and are matched with their respective documents. Special documents, that is, documents of unusual dimensions or those having a large number of oversized fold-out pages, are separated for assignment to the Bell and Howell variable reduction camera. Documents awaiting the cameras are stored on holding shelves in accession number order. Since accession numbers in the AD-500,000 series are all classified and the AD-800,000 series are all unclassified, accession number order also separates the classified documents, simplifying inventory control.

A camera operator is assigned a batch of documents approximating a daily workload. The operator then assigns a reel number and receives a DDC Form 08, Camera Operator's Listing, the batch of documents and their corresponding header film slips. During filming the camera operator uses the form 08 listing to indicate filming sequence, notations as to equipment functioning, and retake information when an error in sequence or filming procedure is discovered during filming requiring a restart. The form 08 accompanies the reel of film during its entire processing in the microphotographic area. Cameras are unloaded and the film is developed daily.

Documents are photographed one page at a time rather than "two-up" or two pages side-by-side. Oversize documents and those having large fold-out drawings and illustrations were an important consideration in choosing that mode of filming since they must be photographed in overlapping sections. The camera operator sections the areas to be photographed with each shot and applies a section number for reader reference.

INSPECTION AND QUALITY CONTROL

The developed reels of camera master film are sent with accompanying form 08 listings to the quality control group for inspection. Each master film is examined for resolution, page sequence, hand shadows, and any other deficiencies that would indicate the required overall quality had not been achieved. Notations on the log sheet made by the camera operator are checked against the film during inspection. If an operator had a strange noise in the camera or suspected a filming error a notation on the log sheet alerts the film inspector. Measurements of background density, line clarity and archival permanence are also checked against a standard for consistency. Production duplication and enlargement of future distribution copies of documents can then be achieved

with minimum need to alter settings on high volume processors. Rejected masters are crossed out with a marking pen and the log sheet is returned with appropriate notations to the camera section for retake.

INITIAL DUPLICATION

After passing inspection and quality control checks, a positive silver master copy is produced using a Recordak roll-to-roll duplicator. The positive master is inspected, cut into sheet and copied the required number of times on an APAC duplicator, producing negative microfiche in 400-foot rolls.

The copies are developed and sent to the quality control group for inspection. Defective fiche are marked with a large X and reordered. The rolls are then released for cutting, collating and enveloping. The X-ed fiche are discarded during the cutting operation on automatic fiche cutting equipment.

After having been placed in envelopes and grouped by document number, the fiche are transferred to a staging area. Here they are distributed into trays, one for a disaster vault file and others for organizations receiving fiche on an automatic basis by profile.

MICROFICHE STORAGE AND DUPLICATION

Microfiche masters are retained in storage for subsequent duplication or for enlargement into paper copies. DDC does not prestock duplicate microfiche or paper copies as the demand for copies of a particular report cannot be predicted with a reliability sufficient to justify the additional storage and file maintenance. Each request for extra copies of a report is satisfied by copying a positive or negative silver master. Using this original master as a working copy, rather than an intermediate master, produces duplicates having a quality level exceeding Federal standards. This concept of maximum quality of microfiche was adopted because many of DDC's customers also duplicate and distribute microfiche copies to their customers using DDC microfiche as masters.

Demand microfiche copies are produced using Technifax Corporation Hi-R diazo duplicators. Experiments are underway investigating other equipment and procedures such as small diazo exposure units that would be located at the microfiche files where copies could be exposed and the master returned

to file in one operation. Development and packaging of the exposed duplicate films for shipment is completed in another area apart from the files.

FULL-SIZE COPY PRODUCTION³

REQUEST VALIDATION

Requests for full-size copies of technical reports received each day are checked that night by computer to determine customer authorization for receiving the reports. Shipping document order forms are machine-printed for valid requests. Each contains a mailing label, a shipment control card, and, for classified documents, necessary security receipts. The shipping documents are sorted into categories by type of copy desired and sequenced by accession number.

PREPARATION FOR ENLARGEMENT

Upon receipt of the validated orders in the Assembly and Distribution Branch each morning, microform masters are retrieved from the storage files. If the master is roll film, it is sent to the diazo strip printer in the Production Branch where individual document strips are copied into thin-base 200-foot rolls of diazo film. The document strips of master film are then returned to storage.

If the master is fiche, and no 35mm copy is available, the fiche is sent to the fiche-to-roll film converter area in the Production Branch along with other fiche for conversion to 35mm film.

Exposed film from the converters is developed in a Kodak Prostar developing unit. Since this developing unit does not require a dark room, it can be located alongside the conversion and printing equipment. The master microfiche is returned to storage after conversion.

ENLARGEMENT

The film produced from fiche conversion and from the strip printer are loaded in Xerox Copyflo printers which produce rolls of paper enlargements at 40 feet-per-minute. DDC personnel made the speed conversion from the normal 20 feet-per-minute operation. After printing, the film produced from fiche conversion is sent to storage for filling

³See Figure 2.

[illegible]

future requests for paper copy. The inexpensive thin base diazo film produced in the strip printer is discarded after printing. This intermediate film replaced a costly splicing and unsplicing operation and this procedure provides availability of the stored master film within a day.

BINDING AND SHIPPING

Rolls of paper enlargements are transferred to a bindery where they are cut into documents. Manual cutting boards are used for this operation. The rolls of paper are mounted on motor-driven feed spindles triggered by a slight pull on the paper. Experience has shown this manual operation to be more effective and efficient than the slower photocell-activated cutters that have been tested at DDC.

The cut pages are jogged and then stapled or bound with fasteners. After trimming, the documents are given a quality check, wrapped and shipped. The shipping request, a punched computer card set that accompanied the order, is separated. This produces a mailing label and a shipment card. The shipment card is returned to the Data Processing Division to complete the document order record. For classified documents, accountability records in the card set are completed and included with the shipment.

Automatic Document Distribution

Automatic Document Distribution (ADD) provides customers with shipments of documents according to their particular interest profiles on an automatic basis. The number and type of recipients are controlled for this program.

The ADD production cycle begins with preparation of two computer listings. One is sequenced by document accession number, listing the customers who are to receive each document; and the other in customer sequence, listing the AD numbers of the documents to be shipped. After the printouts are reviewed by a project officer they are released to the Production Branch.

Positive silver master fiche are used for producing negative distribution fiche on the sheet-to-roll printer, which produces 400-foot rolls of negative fiche. The copies are developed and sent to quality control for inspection. Defective fiche are marked with a large X and reordered. The rolls are then released for cutting, collating and

enveloping. The X-ed fiche are discarded during the cutting operation on automatic fiche cutting equipment.

The fiche now in envelopes and grouped by document number are transferred to a staging area. The staging area contains a microfiche storage tray for each ADD customer. The trays are filled according to the computer listing. Security, distribution limitations, and overall quality are noted in a final check given each customer after the last fiche are distributed to the trays.

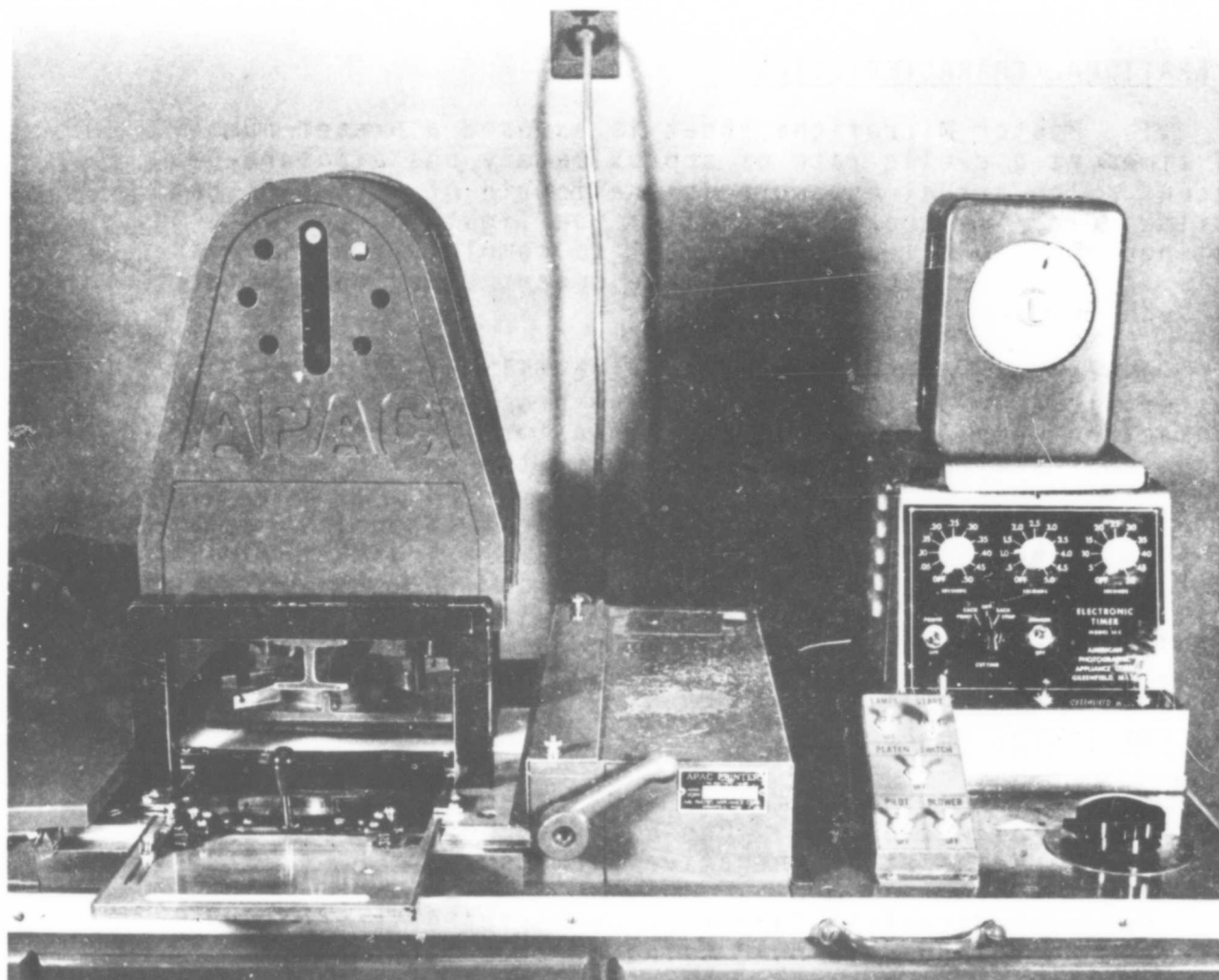
Security receipts are generated for each tray and a shipping list is attached. The trays are transferred to Shipping, completing the cycle.

EQUIPMENT MODIFICATIONS

Modified and redesigned equipment are important to microphotographic systems since equipment does not exist to perform many necessary production functions required in this expanding technical field.

The concepts leading to the modifications were designed by DDC technicians and necessary precision machining and optical installation were performed by contractors. In some instances the equipments produced are more than modifications of existing equipment. The microfiche converters, fiche-to-roll and roll-to-fiche, for example, have a new role and contain different internal mechanisms.

The following operational characteristics and photographs of six examples of equipment modification were chosen as those that make this micrographics program unique.



APAC-DDC MICROFICHE SHEET-TO-ROLL PRINTER

An American Photographic Appliance Corporation (APAC) Printer was modified to an automatic, repeat exposure, sheet-to-roll, microfiche contact printer utilizing 400-foot rolls of 105mm-wide silver photographic film. Modifications included a platen for holding and positioning the master fiche that slides out for ease in loading. The roll film transport system and light source were also modified to accommodate the silver film stock.

OPERATIONAL CHARACTERISTICS

The Master Microfiche sheet is exposed a preset number of times at a cyclic rate of approximately one exposure-per-second. The actual exposure is one-fourth of a second, but a time delay is incorporated after the light source is extinguished to allow the filament to completely extinguish. This is necessary to prevent image smear, since no shutter as such is used.

A pressure platen compresses the film stock to the master fiche prior to exposure using pressurized air. The contact between film and master is uniformly firm and produces copies with good resolution over the entire image area.

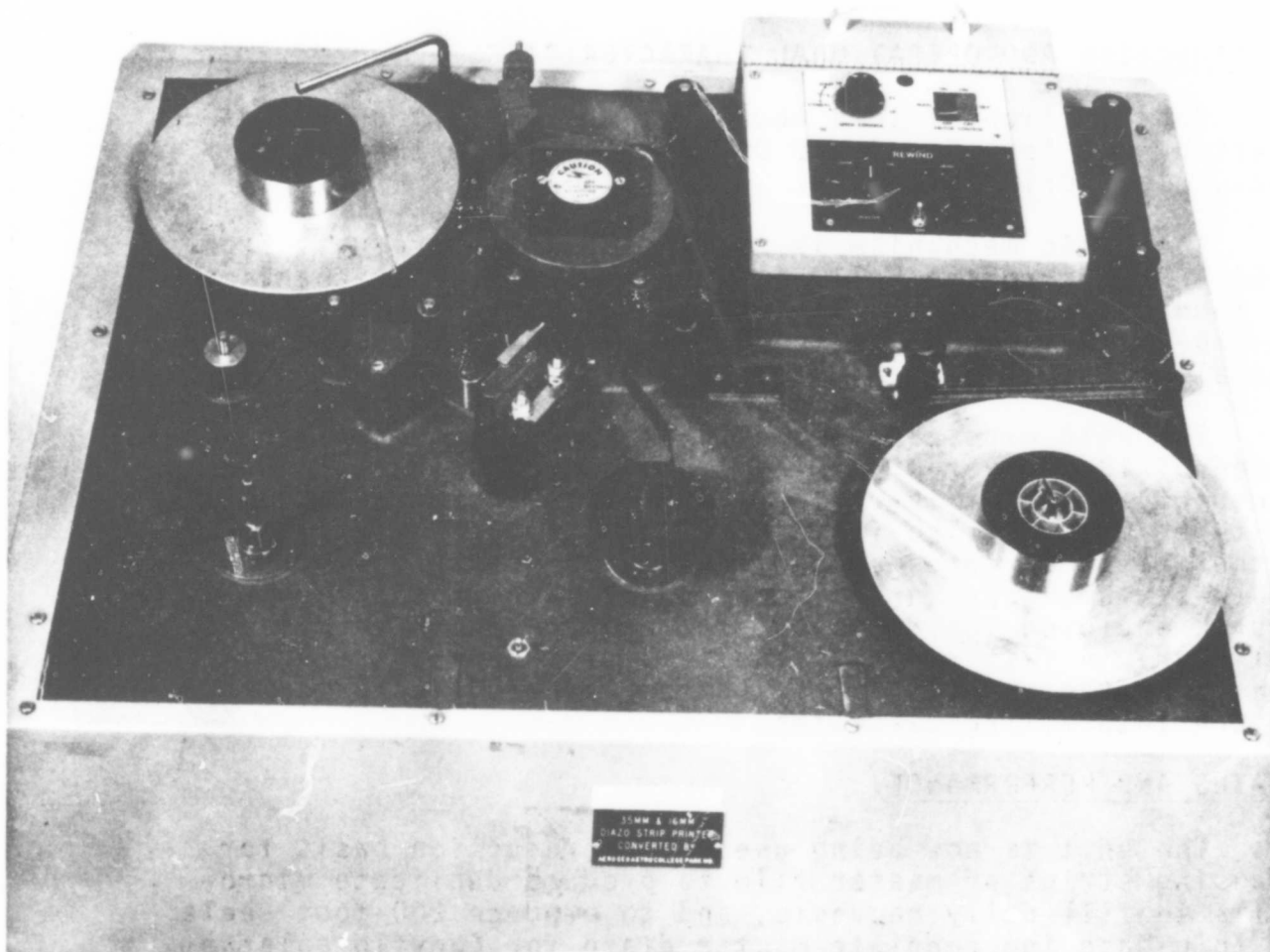
The variables of exposure time, light intensity, delay of film advance, and number of cycles are all directly resettable by calibrated dials.

Spring-loaded clips are provided on the printing platen to hold the master film in position during exposure.

PRESENT STATUS AND APPLICATION

Two machines are installed and are used for all initial duplication of microfiche. One unit is masked to print positive, and the other, negative formats.

Recordak Microfile Card film number 8464 is used in 400-foot rolls and developed using a Pakomat Processor. Three rolls can be processed at a time at 40 inches-per-minute each.



DDC STRIP MICROFILM DIAZO PRINTER

The objective of this modification was to make a machine capable of rapid exposure of short, individually fed, strips of master microfilm and produce long rolls of exposed diazo film. The exposed rolls are developed rapidly in GAF Micro-line duplicators and cut to be transmitted to requesters. Long rolls of thin base diazo film are also produced as intermediate master rolls for Copyflo full-size electrostatic enlargements, thus allowing the strips of master film to be returned to file. The manual operation of heat splicing strips of master film for roll duplication and enlargement, then cutting the rolls for refiling, was eliminated by this modification.

CONSTRUCTION AND OPERATIONAL CHARACTERISTICS

Construction of this equipment was performed on contract by the Aero Geo Astro Division of Aiken Industries Inc., Alexandria, Virginia.

The basic mechanism is a drive and exposure unit from a GAF FP-2 Microline Roll Film Duplicator. The mechanism is mounted on a tilted, horizontal chassis. Power required is 120-volt, 10-amp, single-phase, as provided by conventional wall outlets.

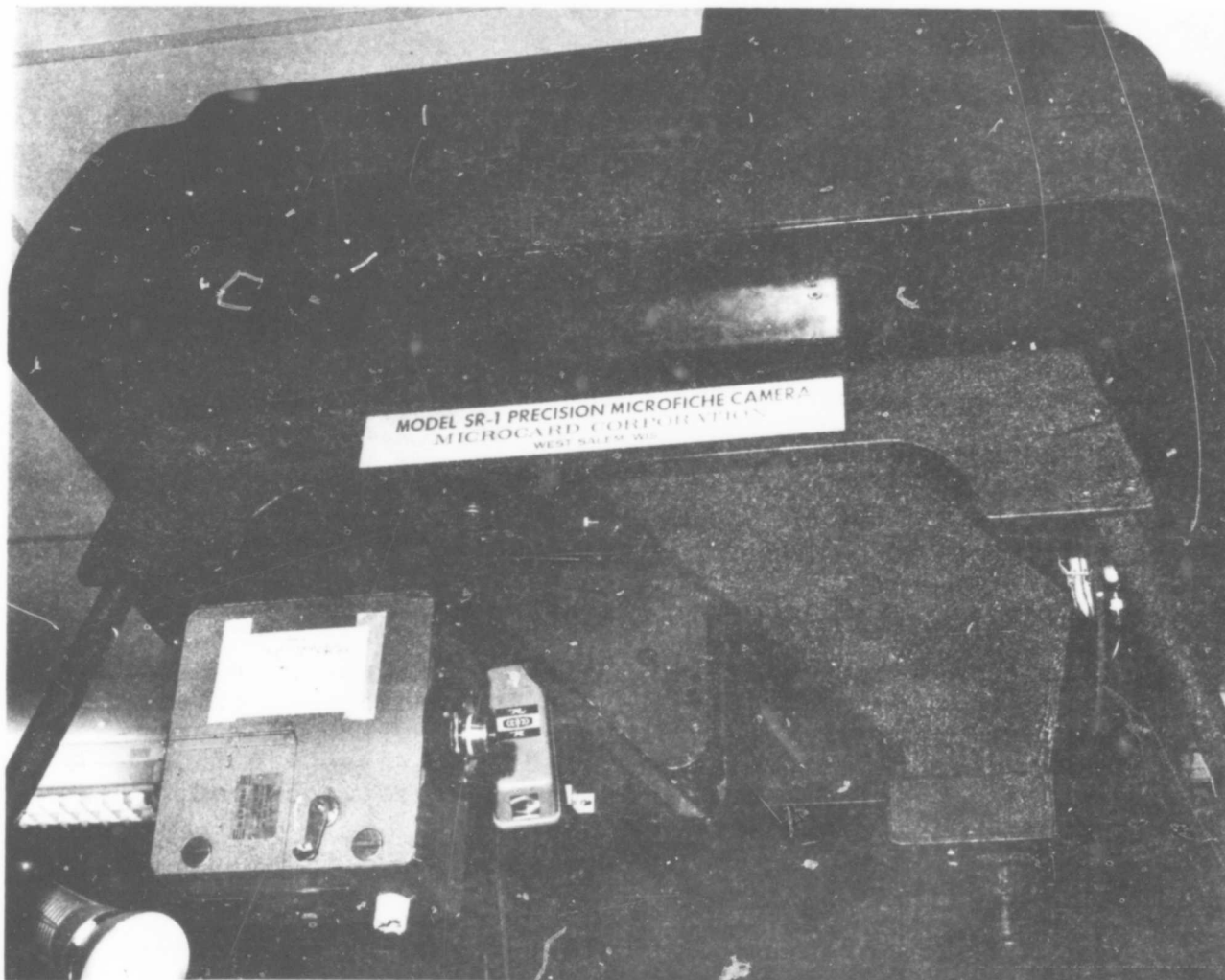
The unit exposes diazo film at a nominal operating speed of 10 feet-per-minute at light source half-life. The speed of transport is variable from 0 to approximately 30 feet-per-minute. The film capacity is 1000-foot rolls and either reels or cores can be mounted on the spindles. A 400-watt, high pressure mercury vapor lamp is the light source enclosed inside an optical quality polished glass cylinder. A fast rewind spindle is provided at the bottom center of the chassis to rewind completed strips prior to return into filing cassettes.

STATUS AND PERFORMANCE

The unit is now being used on a production basis for exposing strips of master film to produce duplicate microfilms to fill daily requests, and to produce 200-foot reels of thin-base intermediate master diazo for Copyflo enlargement.

Performance has been very satisfactory from both quality and reliability standpoints. Overall production and work flow have improved since less handling is required and out-of-file delays for requests have been reduced by the timely return of the master film to storage.

Contract specifications are prepared for procurement of additional units to allow sufficient production capability to eliminate the splicing operation still required for peak workloads.



DUAL MICROFICHE AND ROLL MICROFILM CAMERA

The objective of this modification effort was to make a camera that would simultaneously expose 35mm as well as microfiche images. A minimum of additional operator effort and no loss of production over conventional microfiche exposure was a goal. The required camera modifications were performed on contract by Mechanical Technology Company Inc., Alexandria, Virginia.

CONSTRUCTION

Basically the unit is a Microcard Corporation (now NCR) Model SR-1 step-and-repeat microfiche camera upon which a Kodak Model C camera head is mounted. The Model C is equipped with an 87mm f4.5 lens and is electrically connected to the SR-1 control circuits. A beam-splitting mirror is mounted in the optical path of the SR-1 and displaces part of the image to the side-mounted roll film unit.

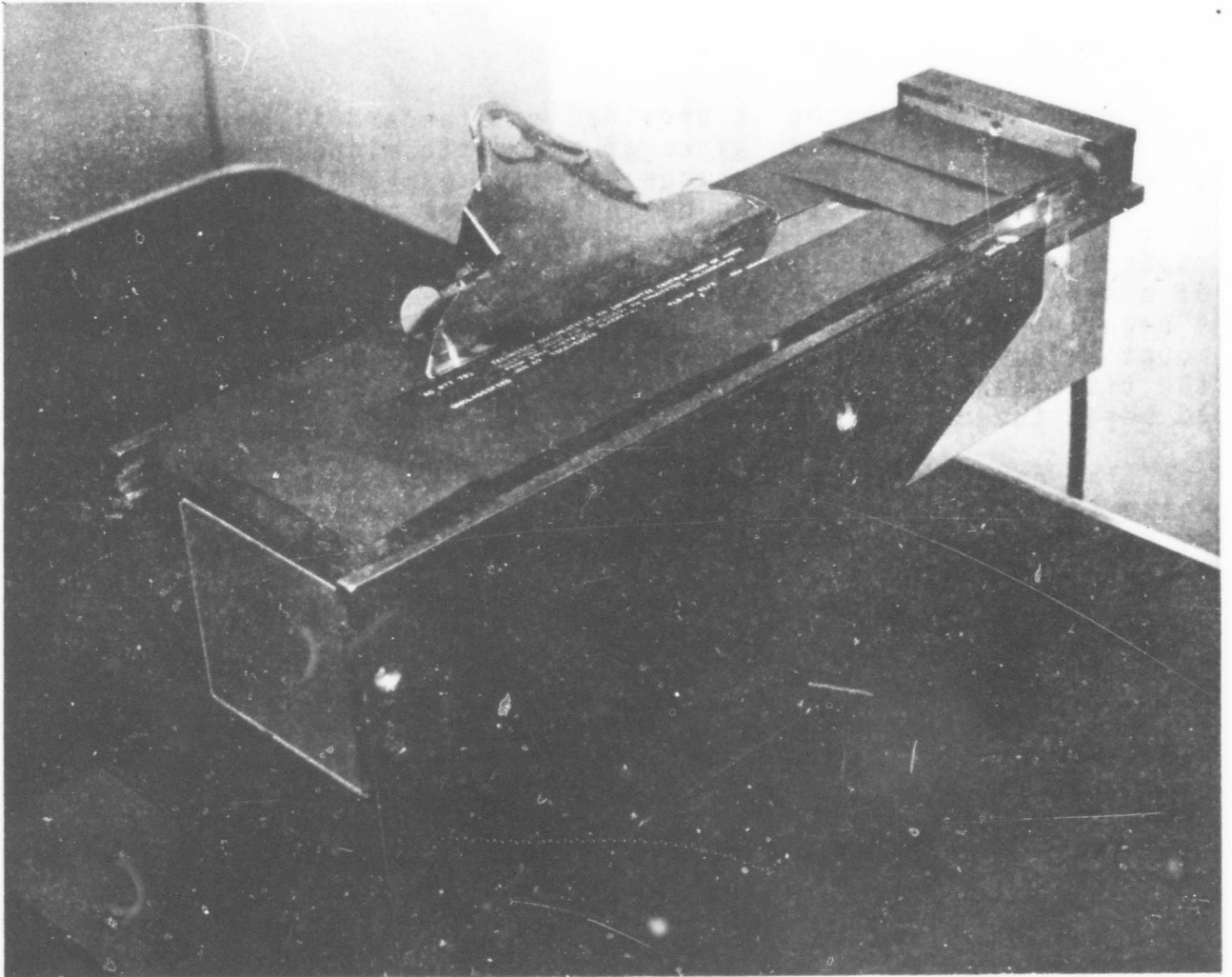
The dimensions are essentially those of the SR-1, 84 inches high, 54 inches wide, and 39 inches deep, having a weight of approximately 850 pounds.

STATUS OF PERFORMANCE

The unit is now being used on a production basis for dual filming of selected reports. Resolution and overall quality are high and well within government and military specifications. The other microfiche cameras are presently being modified. Modifications will use a Kodak MCD-2 roll film camera head with an EL-Nikkor 80mm f5.6 lens. A first surface mirror attached to the lens mount and offset from the SR-1 optical path will be used in place of a beam-splitter. The EL-Nikkor lens is used "wide-open" at f5.6 and preliminary tests indicate excellent resolution and performance will be obtained.

OPERATIONAL CHARACTERISTICS

Operation is the same as a standard Microcard Corporation Model SR-1 step-and-repeat microfiche camera. The only additional function that the camera operator has is to load and unload the roll microfilm camera head. Both cameras use Kodak AHU microfilm and are unloaded for processing at the end of each shift. The roll film unit does, however, require more frequent loading and the operator must remain alert to footage remaining in the roll film unit prior to beginning each new microfiche title. Since both cameras are triggered from a common switch the roll film camera can only be reloaded between titles.



BACKLIGHTED TITLE HOLDER

The objective of this modification was to improve image uniformity and contrast on microfiche titles (accession numbers, security markings, and title information).

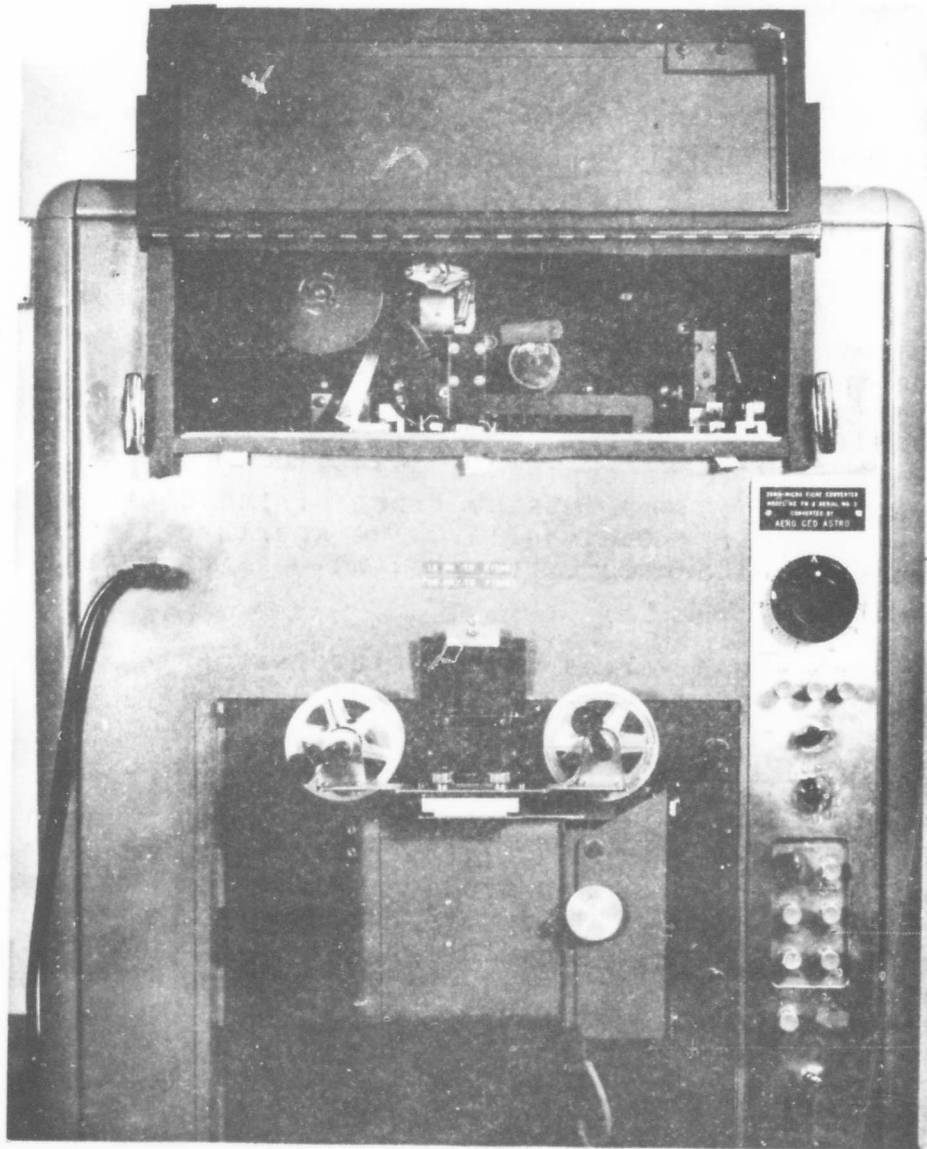
BACKGROUND

Reflected lighting is provided as standard illumination for fiche titles on both types of automatic microfiche cameras used at DDC. An opaque negative paper title is photographed as a last step during exposure of a master microfiche. After the page images on a fiche sheet are exposed, the camera film is positioned in the image plane of a separate title lens mounted to one side of the camera. A negative paper title strip, or header, is placed in a mount illuminated on two sides by lamps. The shutter of the title lens is tripped just prior to advancing the film to begin the next microfiche.

The contrast ratio between the black background and white lettering on DDC computer printed titles using reflected side lighting is sometimes inadequate to produce high quality microfiche titles.

MODIFICATION

The fiche title holders were modified by DDC technicians to incorporate a light source and clear plastic base beneath the title strip. Negative film fiche titles are produced from computer printouts using a lithographic camera and sheet film. Transillumination of the fiche titles on film produces a contrast ratio many times that possible with reflected lighting and effectively evens out differences in character density produced during computer impact printing. A fiche title is produced on the master having characters of uniform density.



DDC ROLL MICROFILM TO MICROFICHE CONVERTER

The objective of this modification was to make a machine capable of converting 16mm or 35mm microfilm to Federal (COSATI) specification microfiche. The conversion was performed by the Aero Geo Astro Division of Aiken Industries Inc., Alexandria, Virginia, using a Microcard EL-4 chassis.

OPERATIONAL CHARACTERISTICS

Kodak direct duplicating film, 105mm, on daylight loading reels is used to provide negative microfiche directly upon normal development.

Positioning of microfiche film for next frame exposure, and advance to next line is automatic. Exposure begins on lines one or two, leaving header area clear if desired.

The roll film to be copied is manually positioned across an aperture on the outside front of the converter. Reels are provided for long rolls. The aperture is back-lighted between and during exposures, which aids manual positioning and alignment.

Production speed varies with operators. An average operator produces approximately 40 fiche per shift.

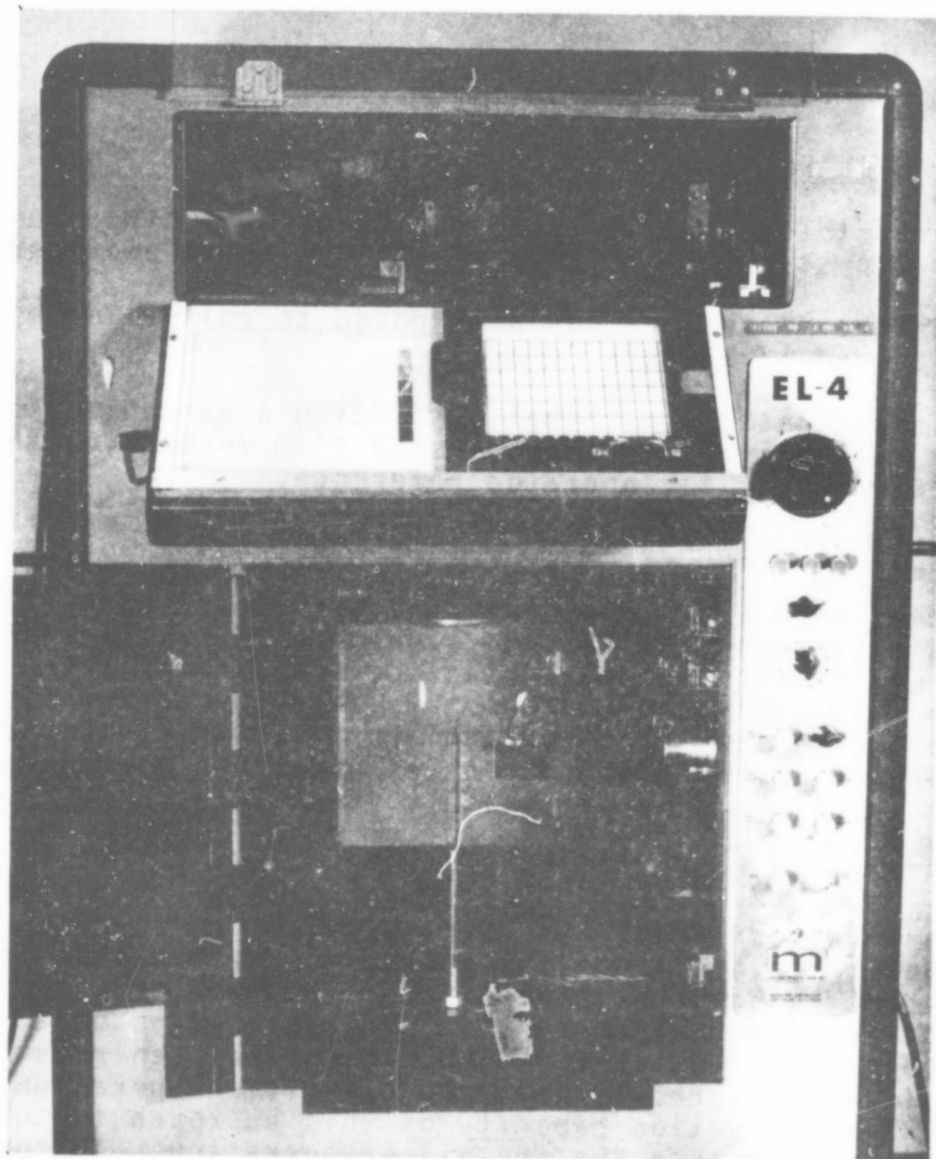
CONSTRUCTION AND DIMENSIONS

A steel rack frame that provides structural support is paneled with sheet metal. A side panel provides access to wiring. Front panel doors provide access for loading and maintenance. The frame and housing dimensions are those of the basic EL-4; 62 inches high, 30 inches wide, and 25 inches deep (plus 6 inches for roll film positioning unit). The weight is approximately 450 pounds.

PRESENT STATUS AND APPLICATION

Two machines are operational and are used on a production basis to convert documents on 35 and 16mm roll film to microfiche as requested. Header information is typed, photographed, and applied to the film produced by the converter. Diazo copies are then made for distribution. The microfiche meet Federal specifications for format and technical characteristics as distribution copies.

The control panel provides for adjustment of exposure light intensity, and positioning of the microfiche automatic stepping head for first frame to be exposed. Since autopositive type film is utilized, any frames or line areas that are to be clear, such as title area and first frames of the first line, must be "flashed" or exposed to clear light to burn out the image areas.



DDC AUTOMATIC MICROFICHE TO ROLL FILM CONVERTER

The objective of the modification effort was to produce from an EL-4 automatic dry silver enlarger a machine capable of converting COSATI specification microfiche to 35 or 16mm roll microfilm automatically, without sign reversal (negative to negative). This conversion would enable subsequent enlargement of the information on the fiche using a web-fed electrostatic Copyflo microfilm enlarger capable of producing enlarged copy at 40 feet-per-minute. This modification would result in faster and less expensive paper copy production than the previous dry silver process using the EL-4 machine.

OPERATIONAL CHARACTERISTICS

Programmable automatic stepping to first desired frame and automatic stopping at last desired frame are provided.

An entire microfiche can be exposed to roll film in two minutes and 12 seconds.

Exposure control is manual, utilizing a variable light intensity calibrated to a step density film mounted on the fiche viewing light for operator reference.

CONSTRUCTION AND DIMENSIONS

A steel rack frame that provides structural support is paneled with sheet metal, a side panel provides access to wiring. All relays are octal plug operator replaceable mounted on a single panel, accessible through the front panel door. The frame and housing are those of the basic Model EL-4, 62 inches high, 30 inches wide, and 25 inches deep, with a weight of approximately 450 pounds.

PRESENT STATUS AND APPLICATION

Extensive testing of the first model began in June, 1969. The aim was to develop less expensive, volume reproductions on plain paper stock from microfiche. Four converters (one is a fiche-to-16mm converter) are now in operation on a production basis. Costs of reproduction have been reduced by one-half as compared to previous dry-silver operation of EL-4's, while production capacity of this approach is substantially greater than the dry-silver operation. Customer reaction favors the black print on white paper stock, particularly the superior physical characteristics of the paper.

Kodak direct duplication film is utilized and developed in a Kodak Prostar Developing Unit at 10 feet-per-minute in 90°F Prostar developer.

Resolution, density, and Xerox Copyflo compatibility have been of the highest quality and exceeded expectations.

SPECIAL FEATURES

Precision grid reference plate for mounting microfiche carrier. This carrier also serves as an effective mask to prevent exposure of clear areas around each frame, and glass

sandwich design assures a flat plane for exposure of the microfiche.

DESIGN CONCEPT AND CONTRACTUAL SUPPORT

The design concept was originated at DDC and consisted of modifying a Microcard Corporation (NCR) Model EL-4 enlarger designed to produce paper enlargements from microfiche. The conversion consisted of replacing the paper transport system with a Kodak Model C camera head installed in a new mount with its lens removed. The projection lens on the EL-4 was replaced with an 80mm f5.6 EL Nikkor lens providing a two times magnification of the film plane of the camera head. The EL-4 light source modified to accept 6-volt automobile bulb operation at 2.5 volts. One unit currently is utilizing a 500-watt, internal proximity reflector, CZA projection bulb. Operating speed is essentially unchanged, but control of exposure light is within a better operating range. The 6-volt automobile bulb must be operated at full intensity for average negatives leaving little reserve for negatives of above average density.

Aero Geo Astro Division of Aiken Industries Inc., Alexandria, Virginia, with Mr. E. Taubes as project engineer performed the camera head installation and collimation on a fixed-fee contract. Wiring modifications on the EL-4 and camera were performed by DDC technicians.