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IDHS 1410 FORMATTED FILE SYSTEM

(IDHS 1410 FFS)

[redacted] OPERATOR'S MANUAL

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TABLE OF CONTENTS

Paragraph		Page
SECTION ONE - IDHS 1410 SYSTEMS OPERATIONS		
1-1.	INTRODUCTION	1-1
1-2.	THE 1411 CENTRAL PROCESSOR UNIT	1-1
1-3.	CARD INPUT/OUTPUT	1-1
1-4.	PRINTED OUTPUT	1-2
1-5.	MAGNETIC TAPE STORAGE	1-2
1-6.	MAGNETIC DISK STORAGE	1-2
1-7.	1415 CONSOLE	1-2
1-8.	THE 1410/7010 OPERATING SYSTEM	1-3
SECTION TWO - EQUIPMENT		
2-1.	1415 CONSOLE	2-1
	a. I/O Printer	2-1
	(1) Request Key	2-2
	(2) Release Key	2-5
	(3) Cancel Key	2-6
	(4) Word-Mark Key	2-6
	(5) Shift Keys	2-6
	(6) Lock Key	2-7
	(7) Copy Control Lever	2-7
	(8) Paper Release Lever	2-7
	(9) Margin Set Lever	2-7
	(10) Index Selector Lever	2-7
	(11) Console Reply Routine	2-7
	(12) Console Load Read and Write Operations	2-9
	b. Control Section	2-9
	(1) Emergency Power Off	2-9
	(2) Power On	2-9
	(3) Power Off	2-10
	(4) DC Off	2-11
	(5) Computer Reset	2-11
	(6) Ready Light	2-11
	(7) Mode Switch	2-11
	(8) CE (Customer Engineer)	2-11
	(9) I/E Cycle	2-11
	(10) Address Set	2-12
	(11) Run	2-12
	(12) Display	2-12
	(13) Alter	2-14
	c. Control Keys	2-14
	(1) Start Key	2-14
	(2) Stop Key	2-15
	(3) Program Reset	2-15

d. Indicator Light Panel ---------- 2-15
(1) I Ring ---------- 2-16
(2) A Ring ---------- 2-16
(3) Clock ---------- 2-16
(4) Scan ---------- 2-16
(5) Subscan ---------- 2-16
(6) Cycle ---------- 2-16
(7) Arith ---------- 2-17
(8) Status Lights ---------- 2-17
(9) I/O Channel Control ---------- 2-18
(10) I/O Channel Status Indicator Lights ---------- 2-20
(11) Systems Check Indicator Lights ---------- 2-21
(12) Power Indicator Lights ---------- 2-23
(13) System Control Indicator Lights ---------- 2-25
e. 1415 Console CE Test Panel ---------- 2-25
(1) Compatibility Switch ---------- 2-27
(2) I/O Check Stop Switch ---------- 2-27
(3) 1410 I/O Check Reset Switch ---------- 2-27
(4) Sense Bit Switches ---------- 2-27
(5) Check Control Switch ---------- 2-27
(6) Print-out Control Switch ---------- 2-28
(7) Start Print-out Switch ---------- 2-28
(8) Asterisk insert Switch ---------- 2-28
(9) Cycle Control Switch ---------- 2-28
(10) Address Entry Switch ---------- 2-28
(11) Disk Write Switch ---------- 2-29

2-2. 1402 CARD READ-PUNCH, MODEL 2 ---------- 2-29
a. Card Read Punch Lights ---------- 2-30
(1) Stacker ---------- 2-31
(2) Fuse ---------- 2-31
(3) Power ---------- 2-31
(4) Transport ---------- 2-31
b. Reader Keys and Lights ---------- 2-31
(1) Reader Start ---------- 2-31
(2) Reader Stop ---------- 2-31
(3) End of File ---------- 2-32
(4) Reader Ready ---------- 2-32
(5) Validity ---------- 2-32
(6) Reader Stop ---------- 2-32
(7) Reader Check ---------- 2-32

c. Punch Unit Keys and Lights ---------- 2-33
(1) Punch Start ---------- 2-33
(2) Punch Stop ---------- 2-33
(3) Punch Ready ---------- 2-33
(4) Punch Stop ---------- 2-33
(5) Punch Check ---------- 2-33
(6) Chips ---------- 2-33

3. 1403 PRINTER ---------- 2-33
a. Method of Printing ---------- 2-33
b. Printer Keys and Lights ---------- 2-34
(1) Print Start ---------- 2-34
(2) Print Stop ---------- 2-34
(3) Check Reset ---------- 2-34
(4) Print Ready ---------- 2-34
(5) End of Forms ---------- 2-34
(6) Forms Check ---------- 2-34
(7) Print Check ---------- 2-34
(8) Sync Check (Synchronizer Check) ---------- 2-34
c. 1403 Carriage Controls ---------- 2-34
(1) Carriage Restore ---------- 2-35
(2) Carriage Stop ---------- 2-35
(3) Carriage Space ---------- 2-35
(4) Single Cycle ---------- 2-35
d. 1403 Manual Controls ---------- 2-35
(1) Feed Clutch ---------- 2-35
(2) Paper Advance Knob ---------- 2-35
(3) Vertical Print Adjustment ---------- 2-36
(4) Lateral Print Vernier ---------- 2-36
(5) Print Density Control Lever ---------- 2-36
(6) Print Timing Dial ---------- 2-36
(7) Print Unit Release Lever ---------- 2-36
(8) Print Line Indicator and Ribbon Shield ---------- 2-36
(9) Horizontal Adjustment ---------- 2-38
(10) R. H. Tractor Vernier ---------- 2-38
(11) Tractor Slide Bar ---------- 2-38
e. Indicator Panel Lights ---------- 2-39
(1) Gate Interlock ---------- 2-39
(2) Brush Interlock ---------- 2-39
(3) Shift Interlock ---------- 2-39
(4) Thermal Interlock ---------- 2-39
(5) High Speed Start ---------- 2-39
(6) Low Speed Start ---------- 2-40
(7) High Speed Stop ---------- 2-40
(8) Low Speed Stop ---------- 2-40
f. Tape Controlled Carriage ---------- 2-40
(1) Control Tape ---------- 2-40
(2) Punching the Tape ---------- 2-41
(3) 8-Lines-Per-Inch Spacing ---------- 2-42
(4) Carriage Tape Brushes ---------- 2-42
(5) Inserting Control Tape in Carriage ---------- 2-43
(6) Ribbon Changing ---------- 2-43
(7) Forms Insertion ---------- 2-44
(8) Paper Stacker ---------- 2-45

-4. MAGNETIC TAPE UNITS ---------- 2-46
a. Reflective Spots ---------- 2-46
b. File Protection Ring ---------- 2-47
c. Tape Checking ---------- 2-47

d. Keys and Lights ---------- 2-47
e. Density Switch ---------- 2-48
f. Address Selection Dial ---------- 2-48
g. Select Light ---------- 2-48
h. Ready Light ---------- 2-48
i. Tape Indicate On Light ---------- 2-48
j. File Protection Light ---------- 2-49
k. Fuse Light ---------- 2-49
l. Tape Density Light ---------- 2-49
m. Load Rewind Key ---------- 2-49
n. Start Key ---------- 2-49
o. Unload Key ---------- 2-49
p. Reset Key ---------- 2-50
q. Reel Door Interlock ---------- 2-50
r. Reel Release Key ---------- 2-50
s. Operating Pointers ---------- 2-50

2-5. 1301 AND 1302 DISK STORAGE ---------- 2-51
a. Access Mechanisms ---------- 2-52
b. File Control Unit Functions ---------- 2-53
c. Switches and Lights ---------- 2-53
(1) Power On Switch ---------- 2-53
(2) Power On Light ---------- 2-53
(3) DC-On Light ---------- 2-54
(4) DC-Off Switch ---------- 2-54
(5) Power-Off Switch ---------- 2-54
(6) HAO Switch ---------- 2-54
(7) Write Inhibit Switch ---------- 2-54
(8) Write Inhibit Light ---------- 2-54
(9) Test Mode Light ---------- 2-54
(10) Thermal Light ---------- 2-54
(11) Fuse Light ---------- 2-54
(12) Write Format Track Switch ---------- 2-54
d. I/O Channel Status Indicators ---------- 2-54
(1) Not Ready ---------- 2-56
(2) Busy ---------- 2-56
(3) Data Check ---------- 2-56
(4) Condition ---------- 2-56
(5) No Transfer ---------- 2-57
(6) Wrong Length Record ---------- 2-57

2-6. 1414 I/O SYNCHRONIZER ---------- 2-57
a. Off Line Operation ---------- 2-57
b. Synchronizer Keys and Switches ---------- 2-58
(1) Off Line Mode ---------- 2-58
(2) Off Line ---------- 2-58
(3) Check Stop ---------- 2-58
(4) Space ---------- 2-58
c. Card-to-Card Off-Line ---------- 2-59
d. Card-to-Printer Off-Line ---------- 2-59

2-7. ELECTROPLOTTER II ---------- 2-60
a. Description ---------- 2-60
b. Optional Accessory Features ---------- 2-61
(1) Line Drawing Interpolator ---------- 2-61
(2) Alphanumeric Printer ---------- 2-61
(3) Program Controlled Scale Selection and Origin Change ---------- 2-61
c. Operating Instructions ---------- 2-61
d. Operating Controls ---------- 2-63
(1) Symbol Selection ---------- 2-63
(2) Pen Selection ---------- 2-63
(3) Servo On ---------- 2-63
(4) Vac ---------- 2-63
(5) Off-Scale/Reset ---------- 2-63
(6) Paper Advance ---------- 2-63
(7) Sparc ---------- 2-63
(8) Print ---------- 2-63
(9) Clear ---------- 2-63
(10) Start ---------- 2-63
(11) Stop ---------- 2-63
(12) Origin ---------- 2-63
(13) Points ---------- 2-63
(14) Lines ---------- 2-64
(15) Free Run ---------- 2-64
e. Operating Procedures ---------- 2-64
f. Operator Adjustments ---------- 2-66
(1) Origin Adjust ---------- 2-66
(2) Fine Scale Adjust ---------- 2-66
(3) Null Detector Adjust (Points) ---------- 2-66
(4) Null Detector Adjust (Lines) ---------- 2-67

2-8. TAPE REEL LABELING, IDENTIFICATION, AND HANDLING ---------- 2-67
a. File Identification ---------- 2-67
b. Reel Serial Number ---------- 2-67
c. File Serial Number ---------- 2-67
d. Reel Sequence Number ---------- 2-68
e. Tape Handling ---------- 2-68
f. Tape Splicing ---------- 2-69

SECTION THREE - THE 1410 OPERATING SYSTEM

3-1. PURPOSE ---------- 3-1
3-2. DESCRIPTION ---------- 3-1
a. Programming Systems ---------- 3-1
b. Service Programs ---------- 3-1
c. System Monitor ---------- 3-2
d. Autocoder ---------- 3-2
e. COBOL ---------- 3-3
f. FORTRAN ---------- 3-4
g. Input/Output Control System ---------- 3-4

h. Generalized Tape Sort ---------- 3-4
i. Utility Programs ---------- 3-5
(1) Snapshot ---------- 3-5
(2) Storage Print ---------- 3-5
(3) Tape Print ---------- 3-5
(4) 1301 Print ---------- 3-5
j. System Generation ---------- 3-5

3-3. INITIALIZATION AND REINITIALIZATION ---------- 3-6
a. Initialization Cards ---------- 3-6
b. Initialization Status Character ---------- 3-7
c. Operator Initialization Procedure ---------- 3-8
d. Reinitialization with Rewind Procedure ---------- 3-9
e. Reinitialization without Rewind Procedure ---------- 3-9

3-4. MONITOR CONTROL CARDS AND THEIR SEQUENCE ---------- 3-9
a. Control Card Formats ---------- 3-9
(1) ASGN Card ---------- 3-9
(2) COMT Card ---------- 3-10
(3) DATE Card ---------- 3-10
(4) EXEQ Card ---------- 3-11
(5) END Card ---------- 3-11
(6) JOB Card ---------- 3-12
(7) PAUSE Card ---------- 3-12
b. Control Card Sequencing and Batch Processing --------- 3-12

3-5. RESTARTS FROM CHECKPOINTS ---------- 3-13
a. Immediate Restart ---------- 3-13
b. Delayed Restart ---------- 3-13

3-6. SYSTEM GENERATION OPERATING PROCEDURES ---------- 3-15
3-7. CONSOLE INQUIRIES ---------- 3-16
Class A Messages ---------- 3-16
Class B Messages ---------- 3-17

3-8. CLOSING SYSTEM FILES ---------- 3-18
Class C Messages ---------- 3-18

3-9. DEFINITION OF TERMS ---------- 3-19

SECTION FOUR - FORMATTED FILE SYSTEMS - DESCRIPTION AND OPERATING PROCEDURES

4-1. GENERAL ---------- 4-1
a. The Formatted File ---------- 4-1
b. The Data ---------- 4-1

4-2. THE FILE RECORD ---------- 4-2
a. Fields ---------- 4-2
b. Groups ---------- 4-3

c. Periodic Subsets ---------- 4-3
d. Periodic Sets ---------- 4-3
e. Fixed Set ---------- 4-4
f. Variable Set ---------- 4-4

4-3. FILE RECORD FORMAT ---------- 4-4
4-4. FILE GENERATION OPERATIONS ---------- 4-5
a. File Structuring Phase ---------- 4-5
b. Start #1 (Create Mode) ---------- 4-8
c. Start #1 (Change Mode) ---------- 4-8
d. Start #2 ---------- 4-9
e. File Generation Operator Messages ---------- 4-13

4-5. FILE MAINTENANCE OPERATIONS ---------- 4-14
a. Input Processor Phase ---------- 4-14
b. Sort Phase ---------- 4-14
c. File Maintenance Proper ---------- 4-14
d. Cross-Index Updater Phase ---------- 4-14
e. Start #1 (Starts with FMIP) ---------- 4-15
f. Start #2 (Starts with FMSORT) ---------- 4-19
g. Start #3 (Starts with FMPROPER) ---------- 4-19
h. File Maintenance Operator Messages ---------- 4-21

4-6. PERIODIC PRESORT ---------- 4-31
a. Start PS ---------- 4-31
b. PS Console Message ---------- 4-31

4-7. RESTORING AFTER FM - FILESORTER ---------- 4-31
4-8. LOGICAL FILE MAINTENANCE (LFM) ---------- 4-34
a. LFM Run Types ---------- 4-34
b. LFM Run Instructions ---------- 4-36
c. LFM Console Messages ---------- 4-36

4-9. RETRIEVAL OPERATIONS ---------- 4-39
a. Retrieval Input Editor ---------- 4-39
b. Retrieval Input Processor ---------- 4-39
c. Retrieval Cross-Index Processor ---------- 4-39
d. Retrieval Proper ---------- 4-39
e. Sort Phase ---------- 4-39
f. Retrieval Run Type 1 (Card Input) ---------- 4-41
g. Retrieval Run Type 2 (Tape Input) ---------- 4-41
h. Retrieval Run Type 3 (Execute Sort) ---------- 4-44
i. Retrieval Operator Messages ---------- 4-45

4-10. SUPPLEMENT TO RETRIEVAL OPERATIONS ---------- 4-49
a. File Numeric ---------- 4-49
b. Group ID (Report/Request Number) ---------- 4-50
c. Search Number ---------- 4-50

4-11. OUTPUT OPERATIONS ---------- 4-52
a. Run Type 1 ---------- 4-52
b. Run Type 2 ---------- 4-52
c. Run Type 3 ---------- 4-57
d. Output Program Run Type 1 ---------- 4-57
e. Output Program Run Type 2 ---------- 4-57
f. Output Program Run Type 3 ---------- 4-58
g. Output Program Operator Messages ---------- 4-58

4-12. PERMANENT DISK FILE UPDATE/SYSTEM LIBRARIAN OPERATIONS---- 4-59
a. Permanent Disk File Update Run Setup ---------- 4-63
b. Permanent Disk File Update Operator Messages --------- 4-63
c. System Librarian Run Setup ---------- 4-65
d. System Librarian Program Operator Messages ---------- 4-67

LIST OF ILLUSTRATIONS

Figure		Page
1-1	Typical 1410 Configuration	1-1
1-2	The 1410 Operating System	1-3
1-3	The 1410 Formatted File System (FFS)	1-5
2-1	1415 Printing Layout	2-3
2-2	I/O Printer Keyboard	2-3
2-3	Console I/O Printer Control Instructions	2-4
2-4	I/O Channel Status Indicators Set During 1415 Read Operation	2-5
2-5	I/O Channel Status Indicators Set During 1415 Operation	2-8
2-6	Power Keys, Lights, and Switches	2-10
2-7	Control Keys	2-10
2-8	CPU Control Indicator Lights	2-15
2-9	Status Indicator Lights	2-17
2-10	I/O Channel - Control Indicator Lights	2-19
2-11	I/O Channel - Status Indicator Lights	2-20
2-12	System-Check Indicator Lights	2-22
2-13	Power Indicator Lights	2-24
2-14	System Controls Indicator Lights	2-25
2-15	Compatibility and C.E. Controls	2-26
2-16	1402 Card-Transport Schematic	2-30
2-17	1402 Card Read-Punch Keys, Lights, and Switches	2-31
2-18	1403 Printer, Operating Keys, and Lights	2-35
2-19	1403 Printer Manual Controls	2-37
2-20	Printer Indicator Panel	2-39
2-21	Tape Punch	2-41
2-22	729 and 7330 Magnetic Tape Units, Operating Keys and Lights	2-48
2-23	Magnetically Coated Disk	2-52
2-24	Head Arrangement	2-52
2-25	I/O Channel Status Indicators Set During 1301 or 1302 Operations	2-55
2-26	1414 Panel	2-58
3-1	System Generation Flow	3-6
3-2	Example of Job Batching	3-14
4-1	1410 FFS File Record Layout	4-6
4-2	File Generation Operator Flow Diagram	4-7
4-3	File Generation Run Initiation Card	4-10
4-4	File Generation Run Deck	4-11
4-5	Example of FG Job Batching	4-12
4-6	File Maintenance Run Initiation Card	4-16
4-7a	File Maintenance Operator Flow Diagram, Part I	4-17
4-7b	File Maintenance Operator Flow Diagram, Part II	4-18
4-8	File Maintenance Run Deck	4-20
4-9	Periodic Sort Run Deck	4-32
4-10	Periodic Sort Operator Flow	4-32
4-11	File Sorter Operator Flow Diagram	4-33
4-12	File Sorter Run Deck	4-33

4-13 Operator Flow Diagram for LFM ---------- 4-35a
4-14 LFM Run Deck ---------- 4-36
4-15 The Retrieval Run Initiation Card ---------- 4-40
4-16 Retrieval Operator's Flow Diagram ---------- 4-42
4-17 Retrieval Run Deck ---------- 4-43
4-18 Output Run Initiation Card ---------- 4-53
4-19 Output Operator Flow Diagram and Run Deck (Run Type 1)---- 4-54
4-20 Output Operator Flow Diagram and Run Deck (Run Type 2)---- 4-55
4-21 Output Operator Flow Diagram and Run Deck (Run Type 3)---- 4-56
4-22 Permanent Disk Updater Run Initiation Card ---------- 4-60
4-23 System Librarian Run Initiation Card ---------- 4-61
4-24 Permanent Disk File Updater Operator Flow Diagram and Run Deck ---------- 4-62
4-25 System Librarian Flow Diagram and Run Deck ---------- 4-66

SECTION ONE

IDHS 1410 SYSTEMS OPERATIONS

1-1. INTRODUCTION: This manual has been developed as a reference and supplemental text in support of training IDHS 1410 Systems operators, and as an operator's guide. The 1410 data processing system, using the formatted file concept, provides a data handling system which simplifies and accelerates the development of the user's report. A typical 1410 configuration is shown in figure 1-1 below.

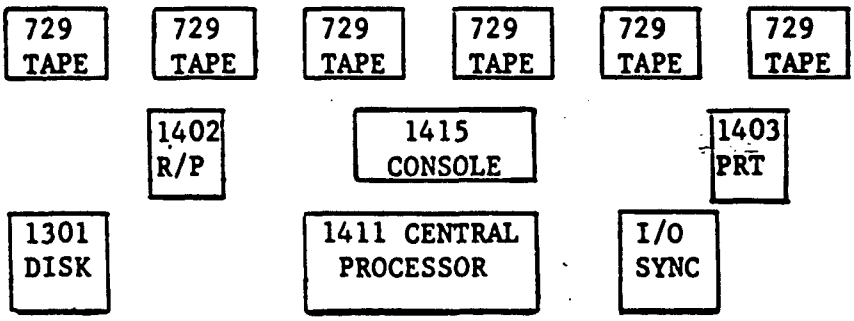


Figure 1-1. Typical 1410 Configuration

1-2. THE 1411 CENTRAL PROCESSOR UNIT: The 1411 CPU makes use of the stored program concept, variable word length instructions, and operands. It provides an editing capability, a powerful table lookup capability, and employees add-to-storage logic. A magnetic core memory is coupled to the 1411 CPU. It ranges in size from 10,000 to 100,000 storage positions, and utilizes a read time of about 4 microseconds.

1-3. CARD INPUT/OUTPUT:

a. The 1402 Card Read Punch Model 2 is used to read and to punch data cards. One side of the 1402 contains a read feed, the other side contains a punch feed. The read feed, if properly programmed, is capable of reading 800 cards per minute. Its file feed device may be loaded with as many as 3000 cards. If properly programmed, the punch feed has a rated speed of 250 cards per minute. The feed hopper can hold up to 1200 cards.

b. The stored program controls the card reading, punching, and stacking operations. Data passes from the card reader to the 1414 input/output synchronizer to core memory or from core memory to the 1414 input/output synchronizer to the card punch unit. The synchronizer makes it possible for the 1411 CPU to continue processing data while cards are being read or punched.

c. The 1402 reader/punch has five radial type stackers with a capability of 1000 cards each. Cards from each feed can be directed to one of three stackers.

1-4. PRINTED OUTPUT: The 1403 printer can produce output documents at a rate of 600 lines per minute. Data are transferred to a printer synchronizer before printing. A standard dual speed tape-controlled carriage permits high speed skipping at 75 inches per second for skips of 8 lines or more. Each of 132 print positions may print any one of 48 different characters.

1-5. MAGNETIC TAPE STORAGE:

a. The 729 or 7330 tape units may be attached to the 1410 System. The magnetic tape that is used is a plastic material coated with metallic oxide. It can be easily magnetized, in tiny spots called bits; patterns of these bits form codes representing alphabetic or numerical information.

b. Magnetic spots written on tape remain there until erased; therefore, tape is an ideal storage medium. Data stored on magnetic tape are read sequentially. The system can search the tape for data to be used. These tapes, commonly used to set up a library of information or a file of procedures, can also store program steps (instructions).

1-6. MAGNETIC DISK STORAGE:

a. The magnetic disk is a thin metal disk coated on both sides with magnetic recording material. The 25 disks are mounted on a vertical shaft and are slightly separated from each other to provide space for the movement of read/write assemblies between them. The shaft revolves, spinning the disks at a maximum of 1790 revolutions per minute.

b. Data are stored as magnetized spots in concentric tracks on both upper and lower surfaces of each disk. There are 250 tracks on each surface for storing data. The concentric tracks are accessible by the read/write heads which move horizontally between the spinning disks.

c. The read/write heads are mounted on an access mechanism, which has 24 arms arranged like teeth on a comb. The arms move horizontally between the disks; no vertical motion is involved.

d. The magnetic disk data surface can be used many times. Each time new data are written on a track, the old data are erased as the new are recorded. The recorded data may be read as often as desired.

1-7. 1415 CONSOLE:

a. The 1415 console provides the operator a means of communication

with the 1410 data processing system. Through the console, the operator may enter information, display storage contents, and read or write records to or from magnetic tape or disk. The console is also designed to aid program debugging. A console I/O printer is provided to enter or display storage data. It can also be used as an output device for printing special instructions to operators or informing operators of errors within the system.

b. The console I/O printer can print 64 characters: 10 numeric, 26 alpha, and 28 special.

1-8. THE 1410/7010 OPERATING SYSTEM:

a. The IDHS 1410 installation makes use of the 1410/7010 operating system. This system is composed of a group of computer programs as illustrated in figure 1-2.

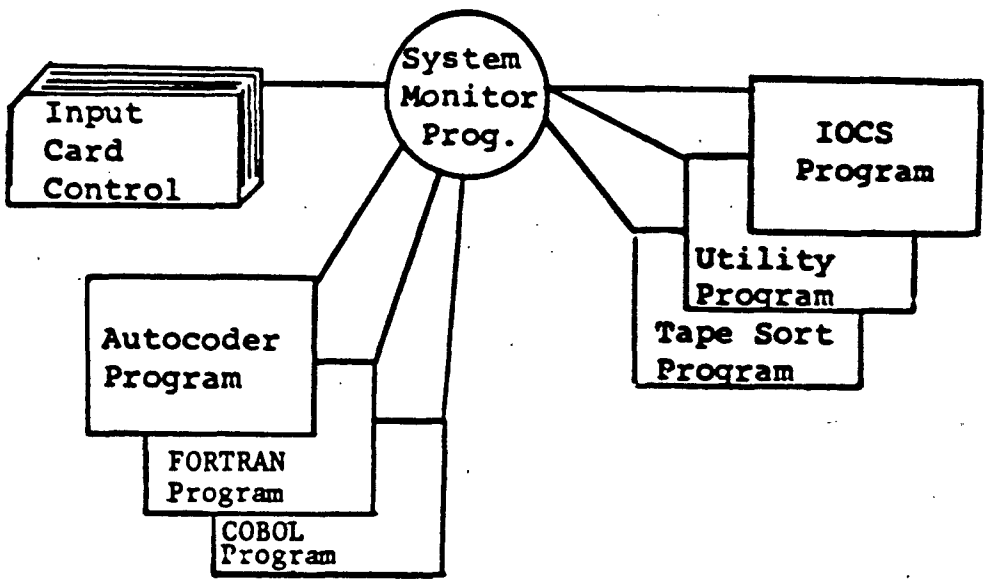


Figure 1-2. The 1410 Operating System

Under control of cards generated by operating personnel, the system monitor program directs which program of the group is to be operated or executed.

b. System monitor communicates with the operator via a console typewriter regarding errors or setups involved with the program currently being executed. The Autocoder, Fortran, and Cobol programs perform the function

of affording the programmer a much simpler language with which to create programs to do his specific jobs. The tape sort program provides the capability for sorting data files or for sorting parts of a data file. For instance, it may be required that data be sorted into numerical or perhaps alphabetic sequence. The utility program is capable of converting data on cards to printed data on paper, or printing the contents of the computer memory unit, to mention only a couple of its uses. The IOCS program (input, output, control system) performs the jobs of moving data between cards and memory, between memory and magnetic tape, or between tape and magnetic disk storage, again to mention only a few.

c. In order to implement the Formatted File System (FFS), it was necessary to create several large scale programs to be merged with the already existing 1410/7010 Operating System. These Formatted File System (FFS) programs are:

(1) File Generation

(2) File Maintenance

(3) Retrieval

(4) Output

(5) System Librarian and Disk Update

Refer to figure 1-3.

d. The file generation program was developed in order to construct or structure the format of a file. This program is also capable of revising or changing the format of a file. Reference is made here to the layout or pattern of the file rather than to the data content of the file. The file maintenance program provides the capability of changing the data within a particular file. The retrieval program is used to search a file or a group of files to obtain specific information at the request of using personnel. For instance, a file might contain information on airline flights. This file then could be searched to find (retrieve) all flights leaving Kennedy International Airport on the 15th of August bound for O'Hare Field in Chicago. Once the information requested is obtained by the retrieval program, it is turned over to the output program which in turn will structure the answer in the form of a report and print it out on paper. The system librarian and disk update programs perform the job of keeping all tables such as cross index, file format, and all routines in their proper places so that other programs may make proper use of these tables and routines. The programs just discussed, along with the 1410 operating system, make up the Formatted File System.

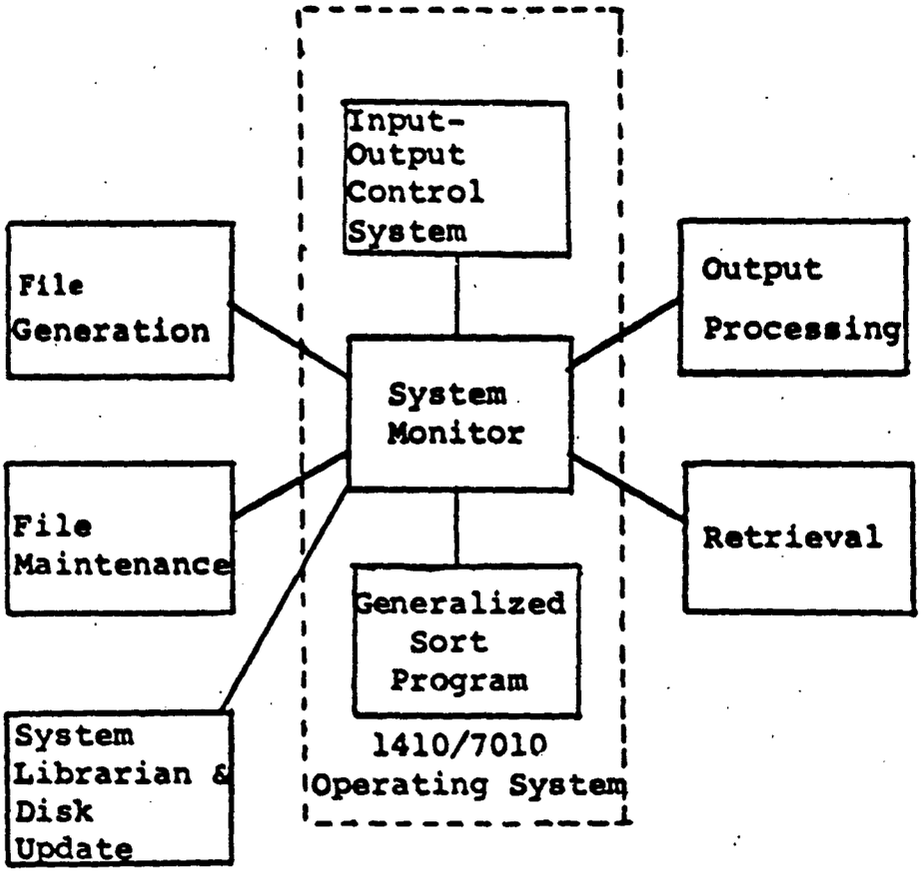


Figure 1-3. The 1410 Formatted File System (FFS)

SECTION TWO

EQUIPMENT

2-1. 1415 CONSOLE: The 1415 Console contains the operating and controlling keys, lights, and switches of the 1410 Data Processing System. The console comprises an I/O printer, a control section, an indicator-light panel, and a CE test panel.

a. I/O Printer. The I/O printer on the 1415 console has the ability to:

Provide an operating log of all major manual console I/O printer operations. (Reset key operations are not logged.) All alterations to internal data and their addresses are logged by the I/O printer. Before the alteration is made, the data must be displayed through the use of the console I/O printer.

Provide display facilities for some registers and all storage locations,

Provide an inquiry mode of operation under control of console operator.

Provide messages under program control. A programmed print-out can be overlapped with compute if the overlap option is included.

Provide print-out of the instruction-address register, A- and B-address register, Op-register, Op-modifier register, A- data register, B-channel contents, assembly register, and the unit-select and unit-number register for both channels 1 and 2 on manual-stop, programmed-stop, and error-stop operations (Figure 2-1).

The console I/O printer (figure 2-2) can print 64 characters (10 numerical, 26 alphabetic, 28 special), a word-mark symbol, and an underscore symbol (invalid bit parity print-out). This printer has no type bars or movable carriage. Instead, it has a sphere-shaped element containing the 64 characters. The element moves from left to right across the paper during a printing operation. Maximum speed of the console I/O printer is 932 characters per minute.

Because this unit is used as an I/O printer, the normal functions of carriage return, index, backspace, and tabulation are inoperative from the keyboard.

The 1415 console can be used as an inquiry station by using the console inquiry keys (figure 2-2). The entry of inquiries and the print-out of their replies are under program control, and can occur while the system is operating in either the "RUN" mode or the "I/E CYCLE" mode.

The use of each key is discussed by the order of use during an inquiry request operation.

(1) Request Key

(a) A console inquiry is initiated by pressing the inquiry-request key. A signal, requesting permission to process a console inquiry, is sent to the central processing unit.

(b) The inquiry request, is discovered by the 1410 system with a TEST AND BRANCH instruction (J (IIIII) Q). If the latch is set ON, the program branches to a subroutine that contains the READ CONSOLE PRINTER instruction M (% T O) (BBBBB) R, (figure 2-3). Acknowledgment of the inquiry request by the 1410 system causes the character "I" to be printed by the console I/O printer. The I/O printer is then impulsed to take a single space. As soon as the space operation is completed, the I/O printer keyboard is unlocked. The manual entry of the inquiry request, character by character, can now proceed. The first inquiry character is placed in the storage address specified by the READ CONSOLE instruction B-address. Subsequent characters are placed in the next higher storage positions.

(c) If a request is made but has not yet been recognized, pressing the cancel key resets the inquiry status latch. If an error is recognized while printing the message, pressing the cancel key sets the condition I/O channel-status indicator ON, and the program continues. Figure 2-4 shows the conditions that set the I/O channel-status indicators and that turn ON their associated lights during an I/O printer read operation.

(d) Error Condition: Any system error stops the system and initiates an error print-out operation, and the inquiry request operation is ended.

	Printout Ident	I A R	A A R	B A R	Operation Code OP Modifier	A Data Register B Channel Contents Assembly Channel	CH #1 Unit Sel Reg	CH #1 Unit Num Reg	CH #2 Unit Sel Reg	CH #2 Unit Num Reg
Normal Stop (S/S)	S	xxxxx	xxxxx	xxxxx	x x	x x x	x x		x x	
Half-Cycle (D/S)	C	xxxxx	xxxxx	xxxxx	x x	x x x	x x		x x	
Error Stop (D/S)	E	xxxxx	xxxxx	xxxxx	x x	x x x	x x		x x	
Address Set (S/S)	B	xxxxx								
Storage Scan Set (S/S)	#	xxxxx								
Display (S/S)	D	xxxx xxxxxxxx								
Alter (S/S)	A	xxxxxxxx								
Console Inquiry (S/S)	I	xxxxxxxx								
Console Reply (S/S)	R	*xxxxxxxx								

*_____ Indicated Invalid Character (Underlined)

Figure 2 - 1. 1415 Printing Layout

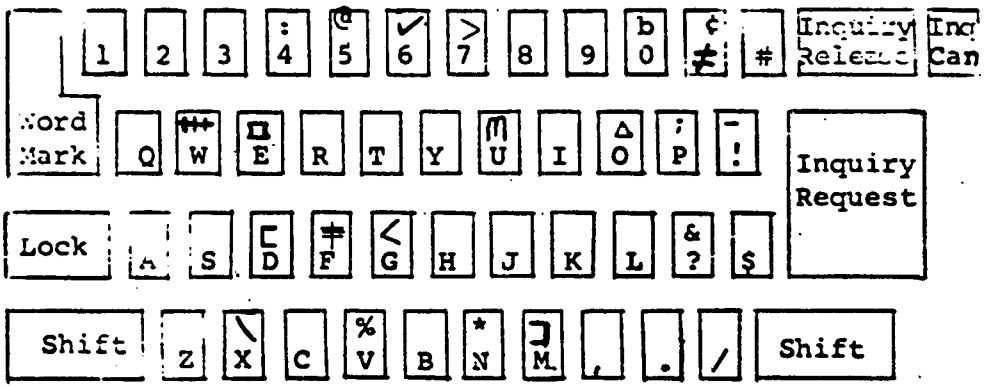


Figure 2-2. I/O Printer Keyboard

I/O Unit	X-CTRL Field	Description	Mnemonic	d-Character: Character	d-Character: Control	Operation	Notes
Console I/O Printer	%TO	Read from console I/O printer	RCP	R	Read	Transfer data direct from the console I/O printer to storage.	1. Data transfer is operator-controlled. See console operating features 2. Word marks in storage are undisturbed in move. 3. Word marks in storage are erased and entered during a load operation
		Write on console I/O printer.	WCP	W	Write	Transfer data direct from storage to the console I/O printer and print.	1. Group mark, word mark is not printed with message. 2. Positions containing word marks are indicated in output line only in a load operation.

Figure 2-3. Console I/O Printer Control Instructions

Indicator	d-Character Bit	Condition
Not Ready	1	Never set
Busy	2	Never set
Data Check	4	Processing unit detects in-character validity error
Condition	8	Cancel Key operated during inquiry
Wrong Length Record	B	Wrong length record
No transfer	A	No message request - Cancel Key operated before inquiry

Figure 2-4. I/O Channel Status Indicators Set During 1415 Read Operation

(2) Release Key.

(a) The inquiry is released to the processing unit by pressing the release key after the correct number of characters have entered storage. The programmer has already specified the length of the inquiry (a certain number of characters that occupy specific storage locations). The next higher storage location must contain a previously inserted group mark with a word mark over it. As the last inquiry character is entered in its storage location, the accessing circuitry is set up to read out the group mark with a word mark. The operator must press the release key at this time to obtain a correct length record, and to insure the processing of the inquiry.

(b) If it is desirable to request a second inquiry while entering a first inquiry, this can be accomplished by holding down the inquiry request key while pressing the inquiry release key to release the first inquiry.

(c) Operating the release key also initiates a carriage-return and line space operation and locks the keyboard.

(d) Wrong Length Record (Inquiry). Operating the release key when the number of characters printed is less than the prescribed format on an inquiry request causes:

1. A carriage return and line space operation.

2. The wrong length record I/O channel status indicator to be set ON.

3. The program to go to the next instruction.

(e) When the number of characters printed is more than the prescribed format on an inquiry request, it causes:

1. The I/O printer to lock up and an immediate carriage return and line space operation. The last character that caused the lockup does print but does not enter storage.

2. The wrong length record I/O channel status indicator to be set ON. The operator must then press the release key or the cancel key to continue programming.

(3) Cancel Key.

(a) Operating the cancel key terminates the inquiry routine in process at that time. Operating the cancel key during the inquiry-request-message printing sets the condition I/O channel status indicator ON, releases the system, initiates a carriage return and line space operation, and allows the normal program to resume.

(b) If it is desirable to request a second inquiry while cancelling a first inquiry, this can be done by holding down the inquiry request key while pressing the cancel key to cancel the first inquiry. This causes the inquiry status latch to remain ON.

(c) After initiating a request, the inquiry status latch can be reset off, by pressing the cancel key, before any characters are entered.

(4) Word Mark Key. Pressing this key prints a word mark and backspaces the carriage after printing. Pressing a character key prints the character under the word mark, and enters both the word mark and the character into storage. The word mark key must be pressed first when entering a character with a word mark into storage.

(5) Shift Keys. Pressing either one of the two shift keys shifts the printer into uppercase. Figure 2-2 illustrates the I/O printer keyboard. The characters shown at the top of the keys are uppercase characters and require a shift key to be operated before

pressing the character key. The printer automatically returns to lowercase shift when the key is released.

(6) Lock Key. Pressing this key activates the shift keys, and locks the printer in uppercase shift until released by pressing one of the shift keys.

(7) Copy Control Lever. Operating the copy control lever (located at the left end of the carriage) positions the carriage forward or backward so that various thicknesses of printing material are accommodated. The copy control lever can be set in five different positions. Moving the lever forward decreases the distance between the platen and printing mechanism, and moving the lever to the rear increases the distance.

(8) Paper Release Lever. Pulling forward on the paper release lever (the inner lever located at the right end of the carriage) releases the pressure of the front and rear feed rolls from the platen. This permits more accurate paper positioning and easier paper removal. This lever should be left in the forward position when the pin feed platen is used. It should be pushed back only when it is desired to move the paper backwards through the platen.

(9) Margin Set Levers. The left and right margins are determined by the position of the margin stops on the margin rack. The left or right margin is set by operating the associated margin set lever (located at the rear of the keyboard). The margin set lever is operated by exerting pressure toward the rear of the printer and sliding the lever to the right or left.

(10) Index Selector Lever. When the index selector lever (the outer lever located at the right end of the carriage) is set toward the rear, the platen double spaces for each line of printing (three lines per inch). With the index selector lever set toward the front of the machine, the platen single spaces for each line of printing (six lines per inch).

(11) Console Reply Routine.

(a) A reply routine or programmed print-out can occur at any time. The CONSOLE WRITE instruction, M/L (% T 0) (BBBBB) W, causes:

1. The character "R" to print.

2. A single carriage space operation.

3. Data to be transferred from storage and printed by the console I/O printer until a group mark with a work mark is sensed in storage. A valid blank in storage causes the I/O printer to space.

4. A carriage return and line space operation.

5. The program to continue with the next instruction. Figure 2-5 shows the conditions that set the I/O channel status indicators ON and that turn on their associated lights during an I/O printer write operation.

Indicator	d-Character Bit	Condition
Not Ready	1	Never set
Busy	2	Carriage returning
Data Check	4	I/O Printer detects output character validity error
Condition	8	Never set
Wrong Length Record	B	Never set
No Transfer	A	Never set

Figure 2-5. I/O Channel Status Indicators Set During 1415 Write Operation

(b) CPU Processing Error: A CPU processing error during the data transfer ends the reply routine and initiates an error print-out operation. Operation of the start key is necessary to complete the programmed print-out.

(c) I/O Printer Error: If a parity error is sensed in the I/O printer, the error character is printed and underlined. The data-check I/O channel status indicator is also set ON. The reply routine continues until a group mark with a word mark is sensed in storage.

(12) Console Load Read and Write Operations.

(a) If the console I/O printer is addressed on a "load write" operation (L Op code), blank characters in storage are printed as small "b's" and word marks are printed as inverted circumflexes over the character associated with the word mark.

(b) It is possible to enter word marks into storage during a console inquiry routine if the instruction calls for a "load-read" operation. The word mark prints on the log sheet and enters storage. A printer space operation generates a blank character in storage.

b. Control Section. The control section (figure 2-6 and figure 2-7) contains the power keys and lights and other keys and switches that control the 1410. The power keys, lights, and switches (figure 2-6) control the application of power to the 1410.

(1) Emergency Power Off.

(a) This pull switch should be used only in case of emergency, when all power must be shut off immediately to prevent injury to an individual or damage to the machine. If this switch is used, only a customer engineer should turn on the power.

(b) Pulling the switch removes all power from all the units.

(2) Power On.

(a) Operating this switch normally provides full operating power to the 1410 system, either from a power-off or a d.c.-off condition. (Power is applied to the 1414, the tape adapter unit, and the disk storage control unit only if their respective CE panel power local-remote switches are set to REMOTE.) Also, a power-on reset operation is initiated whenever power is initially applied or reapplied to the system, and causes all system registers, latches, rings, etc., to be reset. The initial operation of the switch starts the internal sequencing of power to the system and turns on the illuminated portion of the power-on key. The key light remains ON until the emergency power-off switch or power-off key is operated.

(b) When the system reaches full operating power, the ready light is turned on.

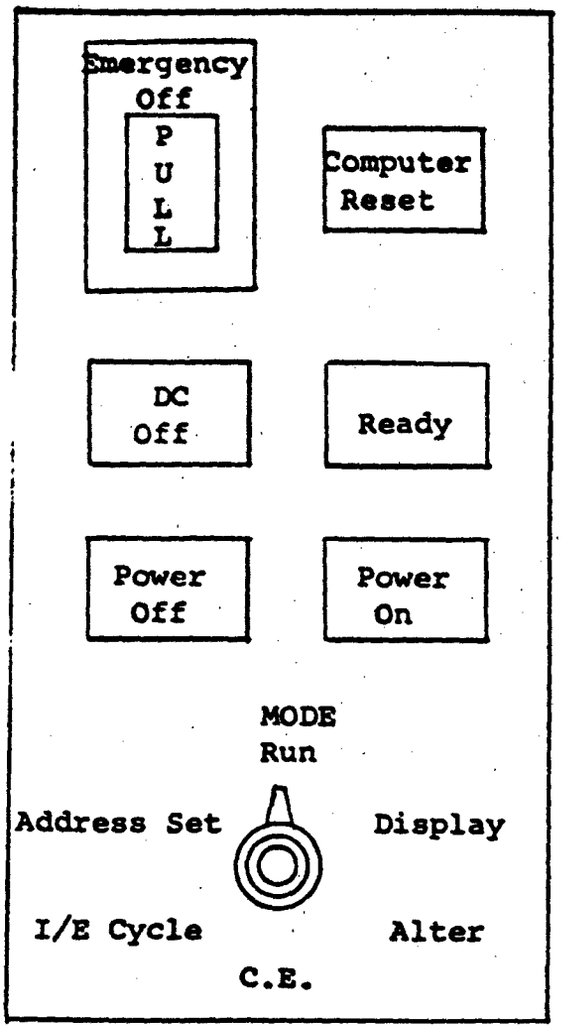


Figure 2-6. Power Keys, Lights, and Switches

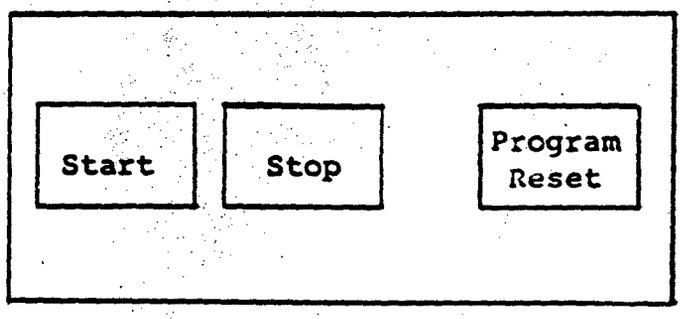


Figure 2-7. Control Keys

(3) Power Off.

(a) Pressing the power-off key removes all power from the system, except those units with CE panel power local-remote switch set to LOCAL. The removal of system power also turns off the "ready" light and the illuminated portion of the power-on key.

(b) To restore full operating power to the system, the power-on key must be operated.

(4) DC Off. Pressing this key turns off the system d.c. power only, except in those units with CE panel local-remote switch set to LOCAL. The key is used when the machine will be idle for a short time. Operating the key turns off the "ready" light, but the light comes on again as soon as full power is restored to the system. Power-on light remains on.

(5) Computer Reset. Operating this key resets the check circuits, resets the program to 00001, resets all timing clocks, and resets all machine indicators (that is, overflow latches, compare triggers, etc.). The inquiry latches (except the console inquiry latch) and the tape-density latch are not reset.

(6) Ready Light. The ready light is turned on when full operating power is applied to the system. It takes a short time for the machine to reach ready status because the power is supplied to the various system components in a specified sequence. The ready light turns on immediately if the power-on key is pressed while the machine is in the DC-OFF mode.

(7) Mode Switch. The six modes of machine operation are selected by the mode switch. The six modes are modified by the CE controls. Usually, these CE controls are set to the normal or off operating mode. Anytime the mode switch setting is changed, it initiates a stop print-out operation as soon as the execution of the previous setting is complete.

(8) CE (Customer Engineer). When the mode switch is set to CE, the customer engineering function of storage scan is available for use.

(9) I/E Cycle.

(a) With the mode switch set to I/E CYCLE, the first operation of the start key causes the machine to read one complete instruction from storage, then stop and print-out. Because this print-out occurs while the machine is in the I/E CYCLE mode, the print-out is preceded by the printing of a "C." The carriage then spaces and prints out the contents of the instruction-address register, A- and B-address registers, Op-register, Op-modifier register, A-data register, B-channel contents, assembly-channel output, and the unit select and unit-number registers for channel 1 and channel 2.

(b) The second operation of the start key causes the execution of that instruction (called the execution phase) and then machine operation stops. Another C print-out operation occurs exactly as previously described.

(c) Subsequent operation of the start key results in the machine's going through alternate instruction and execution cycles.

(10) Address Set.

(a) This setting of the mode switch is used to start a program at a specific place in storage. Operation of the stop key or turning the mode switch to the "address set" position causes a normal stop print-out operation.

(b) The start key is then pressed and a B-character is printed on the console I/O printer. The carriage then takes a single space operation. The address that is now printed by operating the I/O printer keys enters the instruction-address register and is followed by an automatic carriage return and line-space (index) operation.

(c) The mode switch may then be positioned at either the RUN setting or the I/E CYCLE setting. Pressing the start key starts the program with the instruction located at the printed address.

(d) This switch setting, when used with the address-entry switch on the console CE panel, permits altering the contents of A-, B-, C-, D-, E-, or F-register, depending on the setting of the switch. With this switch in the NORMAL position, the contents of the instruction-address register are altered. If any address register is altered other than the instruction-address register, the address-entry switch must be returned to the NORMAL position before pressing the start key. Pressing the start key starts the program at the unaltered address in the instruction-address register.

(11) Run. When the mode switch is set to RUN, pressing the start key causes the system to run continuously under control of the stored program.

(12) Display.

(a) Any portion of storage may be displayed on the console I/O printer log sheet by using the DISPLAY setting of the mode switch. The display may be of any length, from one field to a multiple line print-out.

(b) During a display operation, this sequence of events takes place:

The system is stopped by operating the "stop key" or setting the mode switch to DISPLAY.

With the mode switch set to DISPLAY, operating the start key results in printing a character "D" followed by a single carriage-space operation.

The high order address of the field to be displayed is manually printed on the console I/O printer by operating the appropriate keys.

An automatic carriage-return and index operation takes place following the printing of the fifth address character.

NOTE: If an extra key is pressed when keying in the address, the extra character overrides the automatic carriage-return and leaves the carriage on the same line. The next print-out takes place on the same line with no error indication or machine stop.

A character "D" is automatically printed, followed by a single space operation.

The contents of storage, starting at the high-order position previously printed, are printed until a word mark is recognized. The character and its associated word mark are printed (first character of the adjacent field).

(c) The adjacent field can be displayed if the start key is pressed again. A continuous display results from holding the start key in its operated position. The display operation can be ended at any time by pressing the stop key.

(d) The display operation is momentarily held up if an end-of-printing-line signal is encountered. An automatic carriage return and index operation takes place, followed by a resumption of the display operation. If the last character in storage is printed during a display operation, internal circuitry ends the display and causes a carriage return.

(e) Usually a display operation must precede an alter operation. If the mode switch is reset to the RUN or I/E CYCLE setting, operation of the start key allows the program to proceed, beginning with the next sequential instruction.

(f) Error Conditions: If a system error occurs during a display operation, an error print-out occurs. Channel errors are ignored; address errors cause a stop. The carriage returns when the stop key is pressed or the error is reset.

(13) Alter.

(a) By using the ALTER setting of the mode switch, in combination with the console I/O printer, it is possible to alter the information in any storage location. However, a display operation of the specific storage location must be completed before an alter operation can be performed. This display operation prerequisite insures having a record of the storage location contents before the alteration takes place.

(b) Upon completion of the display operation, the alter operation is initiated by rotating the mode switch from DISPLAY to ALTER and pressing the start key. The character "A" is printed, signifying an alter operation, followed by a carriage space operation and the unlocking of the keyboard. Unlocking the keyboard allows the manual-alter printing operation to proceed.

(c) If one or more fields (but less than a full line) were previously displayed, only the first displayed field can be altered. Only the first line from a multiple line display can be altered.

(d) The correct characters are printed and replace the previously displayed incorrect data. Correct data are kept by reprinting all the correct characters. Any previously displayed word mark must be reentered into storage. Valid blanks are entered in storage by operating the space bar, or the blank character key (b).

(e) The alter operation continues until a word mark is sensed if one or more fields (but less than one line) were displayed. An alter operation ends when the end-of-line condition is sensed if a multiline display preceded the alter operation. Either one of these conditions locks the keyboard and initiates a carriage return and index operation. When a character is entered into the last location of storage during an alter routine, internal circuitry terminates the alter routine and causes a carriage return.

(f) If an error other than a data error occurs, the alter routine terminates and the carriage returns.

c. Control Keys. Control keys (figure 2-7) include start, stop, and program reset.

(1) Start Key. With the mode switch set to RUN, the operation of the start key causes the system to begin executing instructions and resets the parity-check circuits. Also, the start key initiates the operation when the mode switch is set to I/E CYCLE, DISPLAY or ALTER. It is also active in some customer engineering operating modes.

(2) Stop Key. Operation of the stop key, while the program is running, stops the program after executing the current instruction. The "S" character is printed, followed by a single carriage space operation. Following the space operation, the contents of the instruction-address register, A- and B-address register, Op-register, Op-modifier register, A-data register, B-channel contents, assembly-output register, and the unit select and unit number registers for channel 1 and 2 are printed out.

(3) Program Reset Key. Operating this key resets the check circuits, resets the program to 00001, and resets the A- and B-data registers, Op-register, Op-modifier register, and the console-inquiry latch.

d. Indicator Light Panel. Refer to figure 2-8.

	CENTRAL PROCESSING UNIT				
I Ring	A Ring	Clock	Scan	Cycle	Arith
OP	1	A	N	A	Carry in
1 6	2	B	1	B	
2 7	3	C	2	C	Carry out
3 8	4	D	3	D	
4 9	5	E		E	A Compl
5 10	6	F	Sub Scan	F	B Compl
11		G	U		
12		H	B	I	
		J	E	X	
		K	MQ		

Figure 2-8. CPU Control Indicator Lights

(1) I Ring. These lights indicate the 13 steps of the instruction ring (OP and 1 through 12).

(2) A Ring. These lights indicate the 6 steps of the A ring (1-6).

(3) Clock. These lights indicate the 10 steps of the main clock (A-K).

(4) Scan. These lights indicate what type of address modification is taking place.

(a) The N light indicates that a storage location is operating in a + 0 modification cycle.

(b) The 1 light indicates that the CPU is operating in a - 1 address modification cycle.

(c) The 2 light indicates that the CPU is operating in a + 1 address modification cycle.

(d) The 3 light indicates that storage is being re-addressed and the CPU is operating in a - 1 address modification cycle.

(5) Subscan. These lights indicate what portion of a field is being addressed during arithmetic operation and certain other system executions.

(a) U (Units). This light indicates that the units position of the field is being addressed.

(b) B (Body). This light indicates that the body of the field (excluding units position of the field) is being addressed.

(c) E (Extension). This light indicates that the extension portion of the field is being addressed.

(d) MQ (Multiplier-Quotient). This light indicates that the multiplier or quotient is being addressed during a multiply or divide operation. It is also used to indicate special conditions during an edit operation.

(6) Cycle. These lights indicate the 8 types of cycles in which the CPU can operate (A, B, C, D, E, F, I, X).

(7) Arith.

(a) CARRY IN: This light indicates that the carry latch has been set ON.

(b) CARRY OUT: This light indicates that the adder has a carry output.

(c) A COMPL (A COMPLEMENT): This light indicates that channel A data are being complemented.

(d) B COMPL (B COMPLEMENT): This light indicates that channel B data are being complemented.

(8) Status Lights. Refer to figure 2-9.

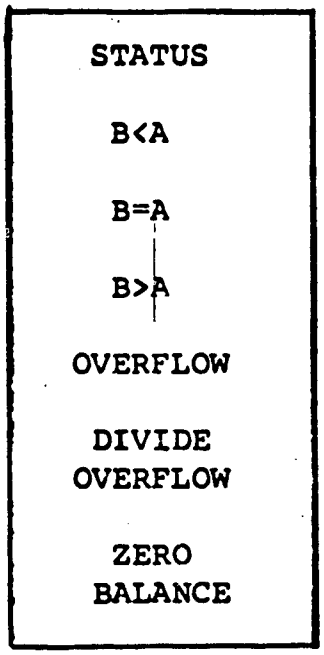


Figure 2-9. Status Indicator Lights

(a) B <A (LOW). This light indicates that the B-field is less than the A-field. A computer reset operation or a power-on reset operation turns the light ON. The light remains ON until the condition is reset by a stored program operation.

(b) B = A (EQUAL). This light indicates that the B-field is equal to the A-field. The light remains ON until the condition is reset by a stored program operation, a computer reset operation, or a power-on reset operation.

(c) B > A (HIGH). This light indicates that the B-field is greater than the A-field. The light remains ON until the condition is reset by a stored program operation, a computer reset operation, or a power-on reset operation.

(d) OVERFLOW. This light indicates that an arithmetic overflow condition has been detected. The overflow condition can be detected only during an add or subtract operation, but not during a zero and add, zero and subtract, multiply or divide operation. The light remains ON until the condition is reset OFF by a stored-program test operation, a computer reset operation, or a power-on reset operation.

(e) DIVIDE OVERFLOW. This light indicates the occurrence of a divide overflow condition. The light remains ON until the condition is reset OFF by a stored-program test operation, a computer reset operation, or a power-on reset operation.

(f) ZERO BALANCE. When ON, this light indicates the occurrence of a zero-balance condition. It is set by the result (which is zero) of any add, subtract, zero and add, zero and subtract, or multiply operation. The light remains ON until the condition is reset by the computer reset, or power-on reset. It is also reset by the result (which is not zero) of any add, subtract, zero and add, zero and subtract, or multiply operation.

(9) <u>I/O Channel Control</u>. Refer to figure 2-10. There are two sets of I/O channel control lights. One set indicates channel 1; the other set indicates channel 2, if channel 2 is present. The description applies to both channels.

I/O Channel Control	
CH 1	CH 2
Interlock	Interlock
RBC Interlock	RBC Interlock
Read	Read
Write	Write
Overlap in Process	Overlap in Process
Not Overlap in Process	Not Overlap in Process

Figure 2-10. I/O Channel-Control Indicator Lights

(a) INTERLOCK. This light indicates that either an I/O read or write operation has been called for. The light is turned off when the status is satisfied following a read or write operation. The status test is satisfied if either:

1. A BRANCH IF ANY I/O CHANNEL STATUS INDICATION ON instruction R(I) is given before encountering the next I/O unit instruction on the same channel; or,

2. A specific R (I)d instruction is given, which results in a branch before encountering the next I/O unit instruction.

If the status test is not satisfied before the next I/O instruction for that particular channel is called for, the system is interlocked and the interlock light remains ON.

(b) RBC INTERLOCK (Read Back Check Interlock). This light indicates that the system has completed a successful write operation, but has not called for a read-back check (write-disk check) operation.

1. READ. This light indicates that an I/O read operation has been called for. The light remains ON until the next I/O operation.

2. WRITE. This light indicates that an I/O write operation has been called for. The light remains ON until the next I/O operation.

(c) OVERLAP IN PROCESS. This light is turned on at the beginning of any I/O operation that is performed in the OVERLAP mode. If the system stops because of an error during the I/O operation, the light remains ON to indicate what type of I/O operation was in process when the error occurred. The light turns off at the end of the data transfer, when no error occurs.

(d) NOT OVERLAP IN PROCESS. This light turns on at the beginning of any I/O operation that is "not" performed in the OVERLAP mode. It is turned off at the end of the data transfer. The light signifies what type of I/O operation was in process when the system stopped because of an error.

(10) I/O Channel Status Indicator Lights. Refer to figure 2-11.

I/O Channel Status	
CH 1	CH 2
Not Ready	Not Ready
Busy	Busy
Data Check	Data Check
Condition	Condition
Wrong Length Record	Wrong Length Record
No Transfer	No Transfer

Figure 2-11. I/O Channel - Status Indicator Lights

The I/O channel-status indicator lights indicate the setting of their associated indicators. The indicators were set as a result of the last I/O operation on that particular I/O unit. Whenever the not ready, busy, data check, condition, wrong-length record, or no transfer I/O channel status indicator is set ON, the corresponding indicator light is also turned ON. One set of indicator lights is associated with channel 1; another set of indicator lights is available for use with the channel 2 special feature. Figures 2-4 and 2-5 show the conditions that set the indicators ON and turn on their associated lights during an I/O printer read or write operation.

(a) NOT READY. The not ready light indicates that one of the input or output units on that channel has not completed a previous operation. Refer to the individual I/O unit writeup for the specific conditions that turn on the not ready light.

(b) BUSY. The busy light indicates that one of the input or output units on that channel has not completed a previous operation. Refer to the individual I/O unit writeup for the specific conditions that turn on the busy light.

(c) DATA CHECK. The data check light, when ON, indicates that one of the input or output units on that channel has detected a data parity condition. Refer to the individual I/O unit writeup for the specific conditions that turn on the data check light.

(d) CONDITION. The condition light indicates that one of the input or output units on that channel has encountered an end-of-file condition or a data-transfer control error condition relating to that unit. Refer to the individual I/O unit writeup for the specific conditions that turn on the condition light.

(e) WRONG LENGTH RECORD. The wrong length record light indicates that one of the input or output units on that channel has encountered or sent a wrong length record. Refer to the individual I/O unit writeup for the specific conditions that turn on the wrong length record light.

(f) NO TRANSFER. The no-transfer light indicates that an operation of one of the input or output units on that channel has resulted in a no-transfer condition. Refer to the individual I/O unit writeup for the specific conditions that turn on the no-transfer light.

(11) Systems Check Indicator Lights. Refer to figure 2-12.

SYSTEM CHECK		
PROCESS		PROGRAM
A Channel	A Register Set	I/O Interlock
B Channel	B Register Set	Address Check
Assembly Channel	OP Register Set	RBC Interlock
Address Channel	OP Modifier Set	Instruction Check
Address Exit	A Character Select	
	B Character Select	

Figure 2-12. System-Check Indicator Lights

(a) A-CHANNEL. This light indicates that an A-channel parity error has been detected.

(b) B-CHANNEL. This light indicates that a B-channel error has been detected.

(c) ASSEMBLY CHANNEL. This light indicates an error at the assembly output or an error when merging zones, numerical information, and word marks during any operation.

(d) ADDRESS CHANNEL. This light indicates that a validity error has been detected on the channel that supplies data to the various address registers.

(e) ADDRESS EXIT. This light is only active during an indexing or store address-register operation, and indicates that a validity error has been detected at the address-register exit channel.

(f) A-REGISTER SET. This light indicates that the A-data register has failed to reset.

(g) B-REGISTER SET. This light indicates that the B-data register has failed to reset.

(h) OP-REGISTER SET. This light indicates that the Op-register has failed to set.

(i) OP-MODIFIER SET. This light indicates that the Op-modifier register has failed to set.

(j) A-CHARACTER SELECT. This light indicates that no character is, or extra characters are, gated on the A-channel.

(k) B-CHARACTER SELECT. This light indicates that a malfunction in the storage-character selection and regeneration circuitries has been detected.

(l) I/O INTERLOCK. This light indicates that the program has failed to test the I/O channel status-indicator prior to the next I/O instruction on that channel.

(m) ADDRESS CHECK. This light indicates that an improper storage address has been given by the programmer, or that an operation goes beyond the capacity of core storage.

(n) RBC INTERLOCK (Read Back Check Interlock). This light indicates that the read back check (write disk check) operation had not been completed before another operation of that disk storage channel was called for.

(o) INSTRUCTION CHECK. This light indicates that an improper instruction has been given by the programmer.

(12) Power Indicator Lights. Refer to figure 2-13.

POWER	
THERMAL	I/O OFF LINE
CB TRIP	TAPE OFF LINE
	DISK OFF LINE

Figure 2-13. Power Indicator Lights

(a) I/O OFF-LINE. This light indicates:

1. The I/O synchronizer off-line switch (located on the CE panel) is on.

2. The I/O synchronizer power is shut down.

(b) THERMAL. When the internal temperature of the system has exceeded the allowable limit or a blower circuit breaker has tripped, the power turns off and the light turns on.

(c) CB TRIP (Circuit Breaker Trip). When one of the circuit breakers in the system has tripped, all d.c. power turns off and the light turns on.

(d) TAPE OFF-LINE. This light indicates:

1. That either one, or both, tape-transmission channels is operating off-line (CE use only).

2. That power is shut down for either one, or both, tape-transmission channels.

(e) DISK OFF-LINE. This light indicates:

1. That either one, or both, disk transmission channels is operating off-line (CE use only).

2. That power is shut down for either one, or both, disk transmission channels.

(13) System Controls Indicator Lights. Refer to figure 2-14.

SYSTEM CONTROLS	
1401 COMPAT	OFF NORMAL
PRIORITY ALERT	STOP

Figure 2-14. System Controls Indicator Lights

(a) 1401 COMPATIBILITY LIGHT. This light indicates that the system is in the 1401 mode of operation (capable of running IBM 1401 programs). It is turned on when the compatibility switch is in the 1401 (ON) position.

(b) OFF NORMAL LIGHT. This light indicates that certain CE switches on the console are not in the proper position for normal operation. The light is ON if:

1. Print-out-control switch is set to INHIBITED.

2. Asterisk-insert switch is set OFF.

3. Cycle-control switch is not set OFF.

4. Check-control switch is not set to STOP NORMAL.

5. Storage-scan switch is not set OFF.

6. Address-entry switch is not set to NORMAL.

(c) STOP. This light, when ON, indicates that the system has stopped and that operator intervention is required to start a new operation.

(d) PRIORITY ALERT. This light, when ON, indicates that the machine is operating in the PRIORITY ALERT mode and is ready for an interruption (priority feature must be installed).

e. 1415 Console CE Test Panel. The 1415 Console customer engineering test panel (figure 2-15) is provided primarily for customer engineers when diagnostic testing and performing preventive maintenance routines. However, certain functions of the panel can be used advantageously by customer personnel when checking new program routines.

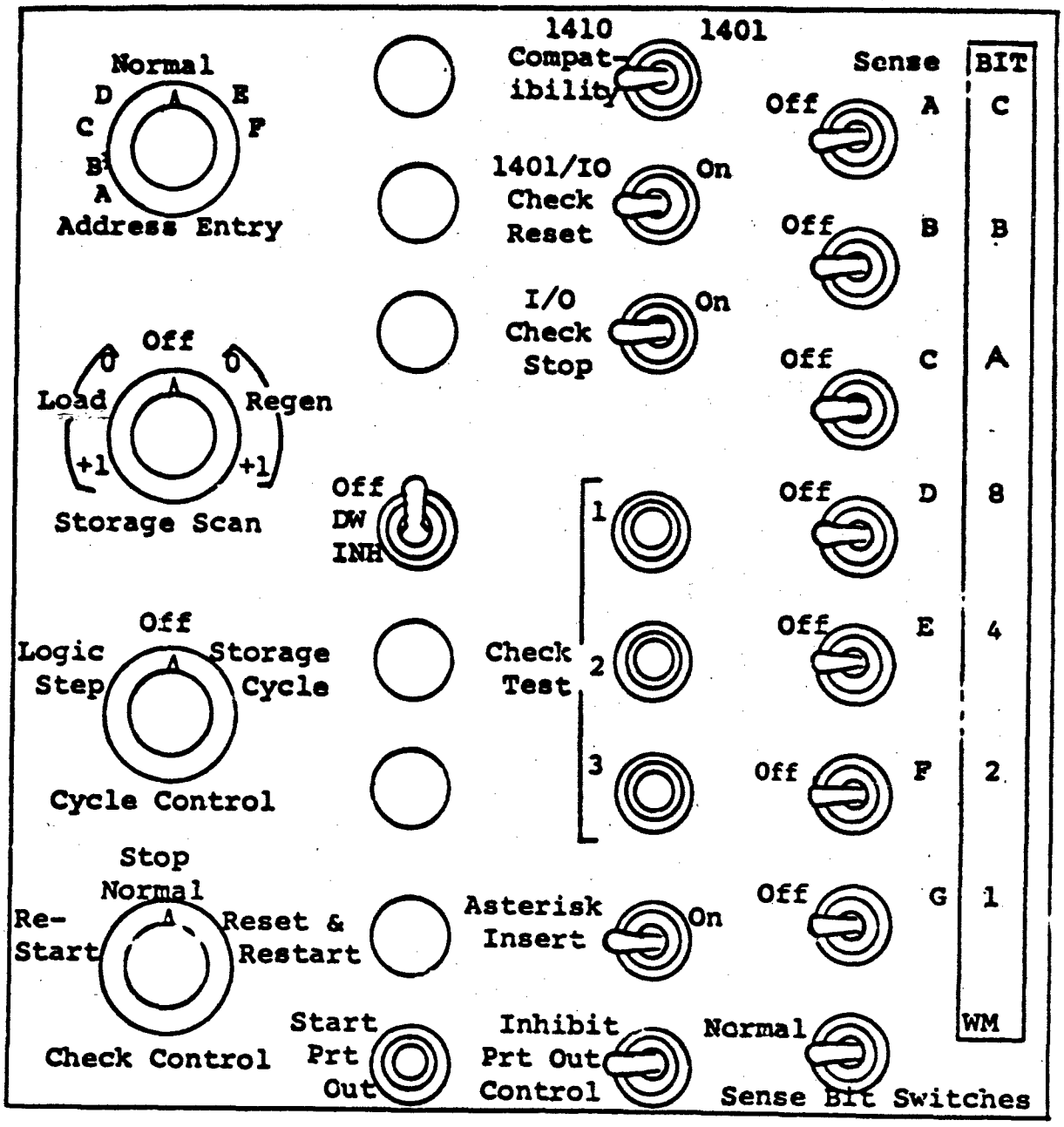


Figure 2-15. Compatibility and C.E. Controls

(1) Compatibility Switch. This switch (figure 2-15), when set to the 1401 setting, makes it possible to run 1401 programs on the 1410. Usually, the switch is set to the 1410 setting.

(2) I/O Check Stop Switch.

(a) This switch is operative only when the 1410 is operating in 1401 mode. The I/O check stop switch, when set to the ON position, stops programming at the completion of an I/O operation if the error occurs during that operation. Error conditions that can cause this are: hole-count check in the card reader or card punch, validity error in the card reader, print check, or any one of a number of control errors.

(b) The stored program controls the system in the event of an I/O error when this switch is in the OFF position.

(3) 1401 I/O Check-Reset Switch. This switch is operative only when the 1410 is in 1401 mode and is used in conjunction with the I/O check stop switch. Operating this switch resets any I/O unit error conditions that are sensed when the I/O check stop switch is set OFF. (The switch is primarily used by the customer engineers for diagnostic testing.)

(4) Sense-Bit Switches. Sense switches are tested by the program. When ON, they can cause a change (branch) in program operation. The sense-bit switches are active as sense switches (A-G) when operating in the 1401 mode.

(5) Check-Control Switch.

(a) The check-control switch is a 3-position rotary switch. When it is set to a STOP NORMAL, any CPU error or input parity error, with the asterisk-insert switch set OFF, results in an immediate stop and an error print-out operation. For normal operation, the switch is set to the STOP NORMAL position, with the asterisk-insert switch ON.

(b) When set to RESTART, any of the previously mentioned errors result in an immediate stop. Following the error print-out operation, the program is restarted automatically. If the error print-out is bypassed (print-out-control switch), the program is restarted immediately following the stop.

(c) When set to RESET AND RESTART, any of the previously mentioned errors results in an immediate stop in the same manner as the RESTART setting. An error print-out operation is followed by a computer-reset operation. When the computer-reset operation is completed, the

program is restarted. If the error print-out is bypassed (print-out control switch), computer-reset and the program-start follow the stop.

(6) Print-Out Control Switch. This toggle switch controls all stop print-out operations, including error print-out. When set to NORMAL, the print-out takes place. When set to INHIBITED, the print-out does not take place.

(7) Start Print-Out Switch. This switch is used when the program routine fails to advance and a stop print-out operation cannot be initiated by pressing the stop key. Operating this switch initiates a stop print-out operation. Printing the contents of the various registers aids in determining the cause of failure. This switch can also be used to initiate occassional print-outs while single cycling with print-out control OFF.

(8) Asterisk-Insert Switch. This toggle switch, when ON, converts any input unit character of incorrect parity to an asterisk, and enters it into storage in place of the invalid character. When the toggle switch is set to the OFF position, a wrong-parity character from any input unit stops the operation and initiates an error print-out operation, unless inhibited by the print-out control switch. If the check-control switch is set to STOP NORMAL, the data transfer stops. If the check-control switch is set to RESTART, the full record can be entered into storage and used for diagnostic purposes or for the reconstruction of the incorrect record.

(9) Cycle-Control Switch.

(a) This is a rotary 3-position switch that is used in conjunction with any setting of the mode switch.

(b) When the cycle-control switch is set to OFF, system operation is not controlled by this switch.

(c) When the cycle-control switch is set for STORAGE CYCLE, pressing the start key advances the program by single storage cycles. A print-out operation as described in the I/E CYCLE mode switch setting occurs at the end of each cycle, unless inhibited.

(d) When the cycle-control switch is set to LOGIC STEP, pressing the start key advances the program by single logic steps.

(10) Address-Entry Switch.

(a) This is a 7-position rotary switch (A,B,C,D,E,F, and NORMAL). This switch enables a console-printed address to enter the selected address register (A, B, C, D, E, F, or IAR if the switch is set to NORMAL position). To activate this switch, the console mode switch

must be positioned to the ADDRESS SET setting.

(b) For normal system operation, the switch must be set to NORMAL.

(11) Disk-Write Switch.

(a) The disk-write switch (figure 2-15) facilitates testing programs on a RAMAC-oriented 1410 system. It prevents writing test data on permanent records in disk storage. When this switch is set to the OFF position, normal disk-storage operations can be performed.

(b) When the switch is set to the INHIBIT position, all disk-storage instructions, with the exception of WRITE DISK and WRITE DISK WITH WORD MARKS, are performed normally. When these two instructions are encountered, data are transferred from core storage to disk storage, parity and record length are checked; however, no data are written on the surface of the disk. Automatic comparison of the record address in core storage and the address on the disk record is performed, however, and the unequal-address compare indicator turns ON if an unequal condition occurs.

(c) A WRITE-DISK-CHECK instruction must follow the write operation, which results in an error condition because no data was written on the disk.

2-2. 1402 CARD READ-PUNCH, MODEL 2: The card read-punch used with the 1410 Data Processing System is a modified 1402-2. The card reader enters data into the system through an 80-position read synchronizer, and the card punch receives data from the system through an 80-position punch synchronizer (these two synchronizers are located in an 1414 Input-Output Synchronizer).

The card reader has a rated speed of 800 cards per minute (actual card speed realized is governed by the stored-program instructions). The card reader is equipped with a large-capacity, card-loading device called a file feed. With the file feed device, the read feed can be loaded with as many as 3,000 cards.

Cards pass through the 1402-2 read feed face down, 9-edge first, from right to left, past two sets of reading brushes and a stacker-selector station (figure 2-16). The read-check brushes read the card to establish a hole-count check. The read brushes also read the entire card for a hole-count check (comparison of the same card as read by the read-check brushes and the read brushes) and direct the data into the read synchronizer for later transmission to storage.

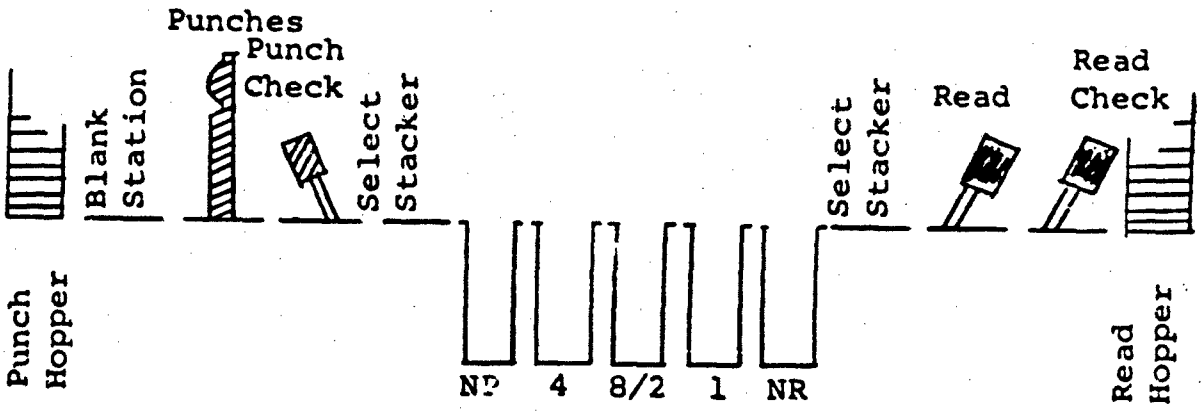


Figure 2-16. 1402, Card-Transport Schematic

The card punch has a rated speed of 250 cards per minute. Cards pass through the 1402-2 punch feed face down, 12-edge first, from left to right, past a blank station, the punch station, the punch-check brushes, and a stacker-selector station (figure 2-16). The punch-check brushes read the entire card to establish a hole-count check (comparison of the same card as read by the punch-check brushes against the impulses received by the punch magnets).

The 1402 card read punch has five radial-type stackers (figure 2-16), with a capacity of 1000 cards each. Cards from each feed can be directed to three of the five pockets by the program.

The cards in the card reader can be directed to the NR (normal read) pocket, the 1 pocket, or the 8/2 pocket. The cards in the card punch can be directed to the NP (normal punch) pocket, the 4 pocket, or the 8/2 pocket.

NOTE: Cards in either the punch or reader which result in validity errors or a hole-count check are automatically stacked in the NP or NR pocket.

a. Card Read-Punch Lights. The 1402 card read punch has several lights (figure 2-17) that refer to the machine rather than to one of the two units. These lights are:

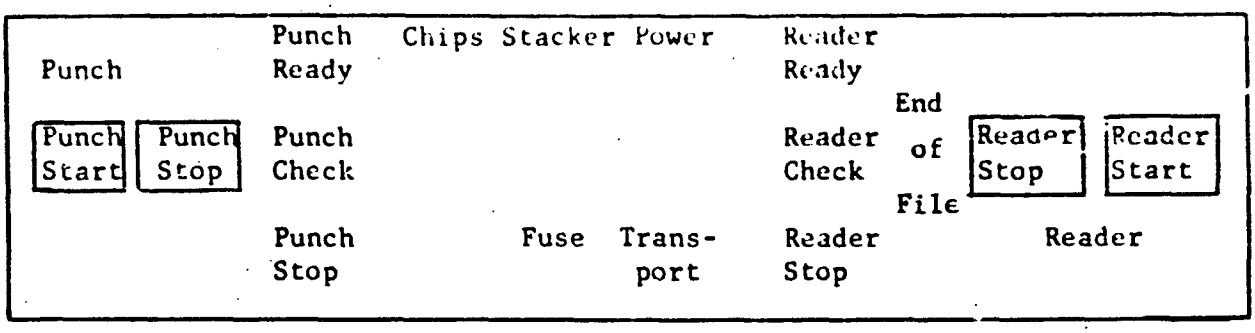


Figure 2-17. 1402 Card Read-Punch Keys, Lights, and Switches

(1) Stacker. This light indicates that one or more pockets are full. Both the reader and the punch units stop.

(2) Fuse. This light indicates that a fuse has blown in the reader or punch unit.

(3) Power. This light indicates that power is being supplied to the 1402.

(4) Transport. This light indicates that a card jam has occurred in the stacker area. Card feeding is stopped in the rest of the 1402 until the jam is removed.

b. Reader Keys and Lights. The card reader unit has certain keys and lights (figure 2-17) which are:

(1) Reader Start.

(a) Operating this key feeds three cards into the read feed, fills the reader synchronizer with the contents of the first card, and turns on the reader-ready light.

(b) When the reader has been stopped, pressing the start key turns on the reader-ready light, and allows the cards to continue feeding under program control.

(c) When the cards are removed from the read feed hopper and the end-of-file key is not operated, pressing the start key moves the remaining two or three cards to the stacker area unprocessed.

(2) Reader Stop. Operating this key stops the reader and turns off the reader-ready light.

(3) End-of-File.

(a) Operation of this key activates circuits that signal a last-card condition in the central processing unit. The last-card condition can be used by the stored program to initiate an end-of-file routine. The end-of-file latch is turned on following the data transfer of the last card. The next card-read instruction is interpreted as a NO OP.

(b) The end-of-file key, which can be pressed at any time, causes the card reader to operate in one of the following ways:

1. With four or more cards in the read hopper, all the cards are processed and run into a stacker. Operating the stop key or processing the last card causes the end-of-file condition to be reset.

2. With three cards remaining in the feed, a card-read or card-feed instruction before the operation of the end-of-file key causes the program to set the not ready I/O channel status indicator Pressing the end-of-file key and then the start key allows the last three cards to be processed and run into a stacker. Operating the stop key or processing the last card causes the end-of-file condition to be reset.

3. With the one, two, or three cards to be processed in the read hopper, pressing the end-of-file key and then the start key feeds the card or cards and turns on the reader-ready light after the first card passes the second read station. The card or cards are processed and run into a stacker. Operating the stop key or processing the last card causes the end-of-file condition to be reset.

(4) Reader Ready. This light indicates that the reader is under stored-program control.

(5) Validity. This light indicates that an invalid character has been detected during a feed operation. The light remains ON until the next feed instruction is started. During the read instruction, the invalid character is transferred from synchronizer to storage.

(6) Reader Stop. This light indicates a feed failure or card jam during a feed operation. This error stops the reader and turns off the reader-ready light.

(7) Reader Check. This light indicates the detection of a hole count error, parity error, or synchronizer-timing error during a feed operation. The light remains ON until the next feed instruction is started. During the read instruction, the data are transferred from synchronizer to storage, and the CPU sets the data check I/O channel status indicator ON and the program can test it.

c. Punch Unit Keys and Lights. The card punch unit has certain keys and lights (figure 2-17) which are:

(1) Punch Start.

(a) Operating this key feeds two cards into the punch feed and turns on the punch-ready light.

(b) When the punch has been stopped, pressing the start key turns on the punch-ready light, and allows card punching to resume under program control.

(c) When the cards have been removed from the punch feed hopper, pressing the start key moves the three cards remaining in the punch feed to the normal punch pocket. The first card that enters the normal punch pocket is unchecked.

(2) Punch Stop. Operating this key stops the punch and turns off the punch-ready light.

(3) Punch Ready. This light indicates that the punch is under stored-program control.

(4) Punch Stop. This light indicates a feed failure or card jam during a punch operation. This error stops the punch and turns off the punch-ready light.

(5) Punch Check. This light indicates the detection of a hole-count error, parity error, or synchronizer-timing error during a punch operation.

(6) Chips. This light indicates that the chip receptacle is full or not in place.

2-3. 1403 PRINTER: The 1403 printer is another output unit for the 1410 Data Processing System. The standard printing capacity is 100 positions, with an additional 32 positions available as a special feature. Each position can print 48 different characters: 26 alphabetic, 10 numerical, and 12 special characters (& , . - $ * / % # @ ≠ ¤).

a. Method of Printing.

(1) The alphabetic, numerical, and special characters are assembled in a chain. As the chain travels in a horizontal plane, each character is printed when it is positioned opposite a magnet driven hammer that presses the form against the chain.

(2) When each character is printed, it is checked against the corresponding position in the print synchronizer to insure that printed output is accurate. Also the machine checks to see that the character is printed in the correct print position, that only valid characters printed, and that overprinting does not occur.

b. Printer Keys and Lights. These keys and lights are shown in figure 2-18.

(1) Print Start (Front and Back). Operating this key turns on the ready light.

(2) Print Stop (Front and Back). Operating the stop key turns off the ready light. If the stored program attempts to execute a print instruction, the program automatically sets the not-ready I/O channel status indicator ON in the CPU and turns on its associated light.

(3) Check Reset. This key resets a printer error indication. The print-start key is then pressed to resume operation.

(4) Print Ready. This light indicates that the printer is ready to print.

(5) End-of-Forms. This light indicates an end-of-forms condition and the machine stops.

(6) Forms Check. This light indicates that there is paper-feed trouble in the forms tractor or that the carriage stop has been used. This light must be cleared by the check-reset key before the print-start key is effective.

(7) Print Check. This light indicates a print error.

(8) Sync Check (Synchronizer Check). This light comes ON to show that the chain was not in synchronism with the printer-compare counter. The timing is automatically corrected. The light is extinguished by operating the printer-reset key.

c. 1403 Carriage Controls. The carriage controls are shown in figure 2-18.

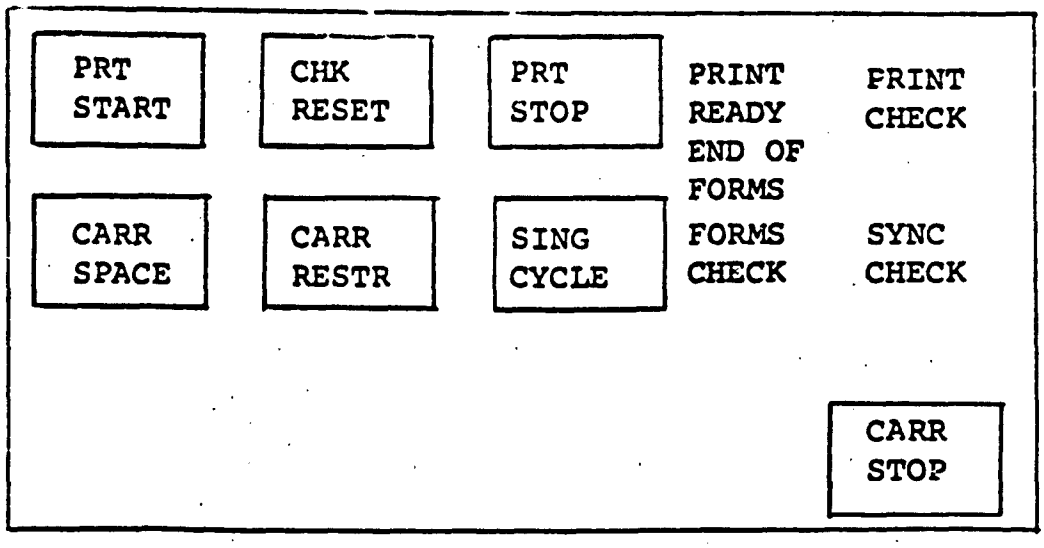


Figure 2-18 1403 Printer, Operating Keys, and Lights.

(1) Carriage Restore. Pressing this key positions the carriage at channel 1 (home position). If the carriage feed clutch is disengaged, the form does not move. If it is engaged, the form moves in synchronization with the control tape.

(2) Carriage Stop. Pressing this key stops carriage operation and turns ON the forms-check light.

(3) Carriage Space. Each time it is pressed, this key causes carriage tape and the form to advance one space.

(4) Single Cycle. This key initiates the operation of the printer for one print cycle on each pressing of the key when the end-of-form light is ON and no paper jam exists. This allows printing of the last line of a form.

d. 1403 Manual Controls. (Refer to figure 2-19.)

(1) Feed Clutch. The feed clutch controls the carriage-tape drive and form-feeding mechanism. If it is set to neutral, automatic form-feeding cannot take place. It is also used to select six- or eight-lines-to-the-inch spacing.

(2) Paper Advance Knob. This knob positions the form vertically. It can be used only when the feed clutch is disengaged.

(3) Vertical Print Adjustment. This knob makes possible fine spacing adjustments of forms at the print line. Carriage tape is not affected by this knob.

(4) Lateral Print Vernier. This knob obtains fine horizontal positioning.

(5) Print-Density Control Lever.

(a) As many as six forms can be printed at one time, and the print hammer unit is designed to adjust automatically for different thicknesses of forms. However, to provide a vernier control for print impression, a print-density control lever is used. When this lever is set at position E, print impression is lightest. When this lever is set at position A, print impression is darkest. Between these two settings are intermediate settings. Position C is considered the normal setting. This lever moves the type chain closer to or farther from the hammer unit.

(b) The setting of this lever must be considered together with the forms thickness, to determine the normal setting of the print-timing dial. A chart is provided on the printer to determine the normal setting.

(6) Print-Timing Dial.

(a) A movable dial is set to a fixed indicator. Numbers around the dial provide a means of setting the print timing for a specific operation. The setting of the print-density control lever must be set before the print-timing dial is set. The nominal setting is read from the same chart as the print-density control lever.

(b) The chart should give the correct setting of the print-timing dial. However, this setting can be checked (by rotating the dial slowly in each direction from the normal setting) to determine the limits of good print quality.

(7) Print-Unit Release Lever. This lever permits access to the form transport area.

(8) Print-Line Indicator and Ribbon Shield.

(a) The lower ribbon shield is also used as a print-line indicator. It pivots along with the ribbon mechanism. The front side of this shield is marked to show print position location (figure 2-19).

(b) When used as a print-line indicator, the shield indicates where the lower edge of characters will print.

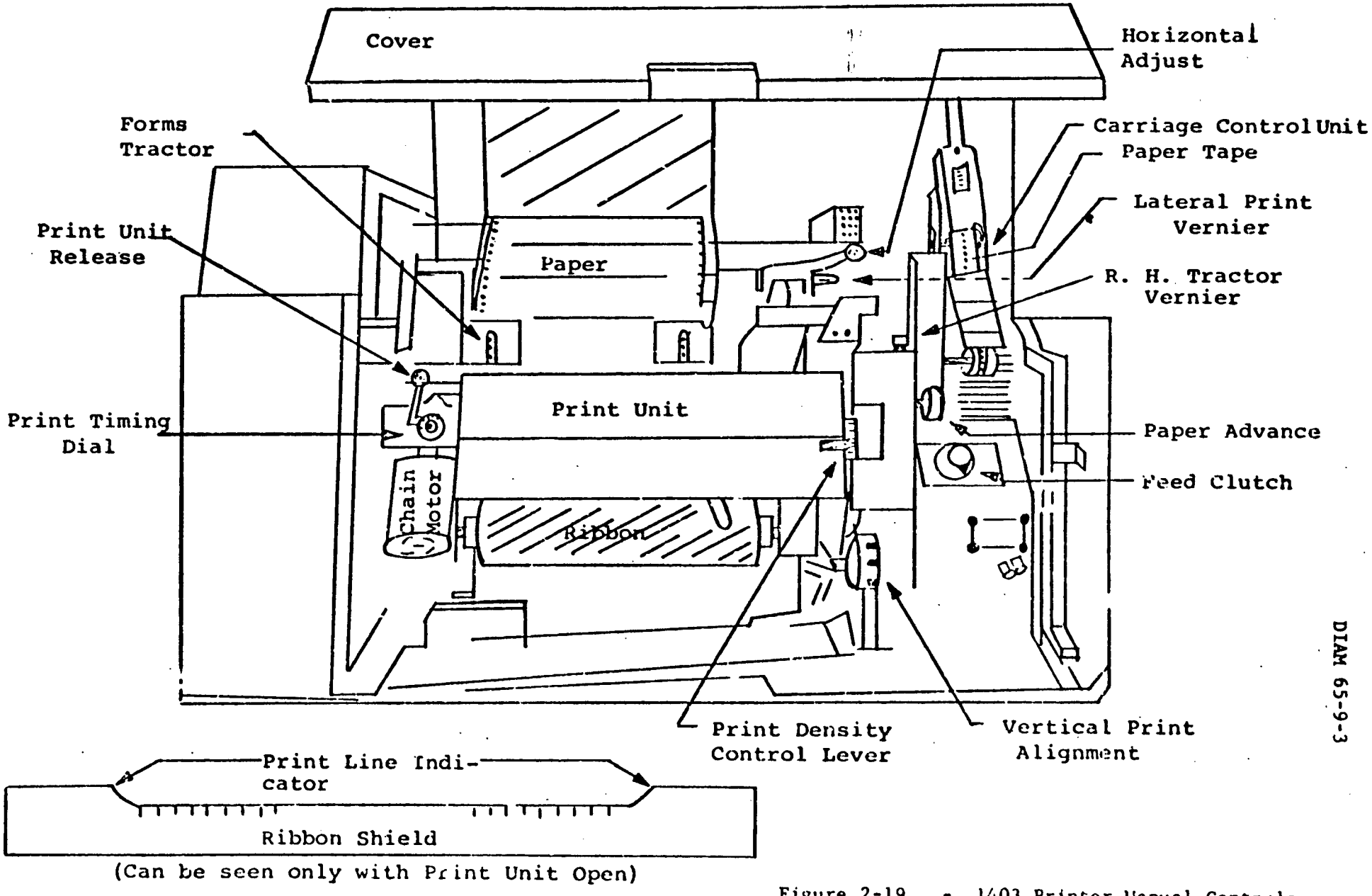


Figure 2-19. - 1403 Printer Manual Controls

(c) When the printer frame is open, the indicator pivots against the forms so that the print line may be set with respect to the forms.

(9) Horizontal Adjustment. This device positions the printing mechanism horizontally. When the lever is raised, the print mechanism unlocks, and can be positioned horizontally within its 2.4-inch travel.

(10) R. H. Tractor Vernier. This knob allows for fine adjustments in paper tension. It can be used for adjustments of up to one-half inch.

(11) Tractor Slide Bar. (Can be Seen Only With Print Unit Open.)

(a) There are two tractor slide bars, upper and lower. The forms tractors are mounted on these bars. The forms tractors are movable, and to facilitate this movement there are notches in the tractor slide bar. A procedure for proper adjustment of these notches, according to the form being used, is given for the upper tractor slide bar. The description would be the same for the lower slide bar.

(b) The left tractor is locked in place by a spring-loaded latch in one of the nine notches located one inch apart on the tractor slide bar. The third notch from the left end is the normal location for most applications.

(c) The first notch is used for forms from 5-1/2 to 18-3/4 inches in width. When this notch is used, the print unit's lateral movement is limited to .4 inch.

(d) The second notch is used for forms from 4-1/2 to 17-3/4 inches in width. When this notch is used, the print unit's lateral movement is limited to 1.4 inch.

(e) The third notch is used for forms from 3-1/2 to 16-3/4 inches wide. When this notch or notches 4 through 9 are used, full lateral print unit movement (2.4 inches) is possible.

(f) The ninth (last) notch can be used for forms from 3-1/2 to 10-3/4 inches wide. When this notch is used, the first usable print position is 38.

(g) The right-hand tractor is locked in place by spring-loaded pins snapped into any one of 27 holes, located one-half inch apart on the tractor slide bar.

(h) The movement of the tractor slide bar, in which the holes are located, is controlled by the right-hand tractor vernier. Movement of up to ½ inch can be made by using the vernier knob.

e. Indicator Panel Lights.

(1) Gate Interlock. This light turns on when the print unit is not locked in position (figure 2-20).

GATE INLK		HS START
BRUSH INLK	SHIFT INLK	LS START
	THER INLK	HS STOP
		LS STOP

Figure 2-20. Printer Indicator Panel.

(2) Brush Interlock. This light is on if the carriage tape brushes are not latched in position for operation.

(3) Shift Interlock. This light turns on to indicate that the manual feed clutch is not properly positioned.

(4) Thermal Interlock. This light indicates that a temperature above the operating limit has been sensed in the hammer unit or chain-drive unit; the light remains on until the temperature drops to an acceptable level. The 1403 is interlocked during this time.

(5) High Speed Start. This light turns on when a high-speed skip has been initiated.

(6) Low Speed Start. This light turns on when a low-speed skip or line spacing has been initiated.

(7) High Speed Stop. This light turns on to indicate that high-speed skipping is to be stopped.

(8) Low Speed Stop. This light turns on to indicate that a low-speed skip stop has been initiated. It is on when the carriage is not in motion.

c. Tape-Controlled Carriage. The tape-controlled carriage controls high-speed feeding and spacing of continuous forms. The carriage is controlled by punched holes in a paper tape that corresponds in length to the length of one or more forms. Holes punched in the tape stop the form when it reaches any predetermined position.

Carriage skip channels 1-12 are standard. The tape circuits initiate special signals that are sent to the CPU when channels 9-12 are sensed. Program testing of carriage channels 9 and 12 is standard.

Vertical spacing and skipping are initiated by the stored program. Horizontal spacing is 10 characters to the inch. Vertical spacing of either six or eight lines to the inch can be manually selected by the operator.

Forms skip at the rate of 33 inches per second. With the dual-speed carriage, distances of less than eight lines are skipped at 33 inches per second, and those of more than eight lines at 75 inches per second. The last eight spaces skipped in a high-speed skip are skipped at 33 inches per second.

The carriage accommodates continuous forms, up to a maximum of 22 inches in length (at 6 lines per inch) or 16½ inches (at 8 lines per inch). The minimum length is 1 inch. For efficient stacking of forms, the recommended maximum forms length is 17 inches. The width of the form can vary from a recommended minimum of 3½ inches to a maximum of 18-3/4 inches, including punched margins.

Forms can be designed to permit printing in practically any desired arrangement. Skipping to different sections of the form can be controlled by the program and by holes punched in the carriage tape.

(1) Control Tape. The control tape (see figure 2-21) has 12 columnar positions indicated by vertical lines. These positions are called channels. Holes can be punched in each channel throughout the length of the tape. A maximum of 132 lines can be used to control a form, although for convenience, the tape blanks are slightly longer.

Horizontal lines are spaced six to the inch for the entire length of the tape. Round holes in the center of the tape are prepunched for the pin-feed drive that advances the tape in synchronism with the movement of a printed form through the carriage. The effect is exactly the same as though the control holes were punched along the edge of each form.

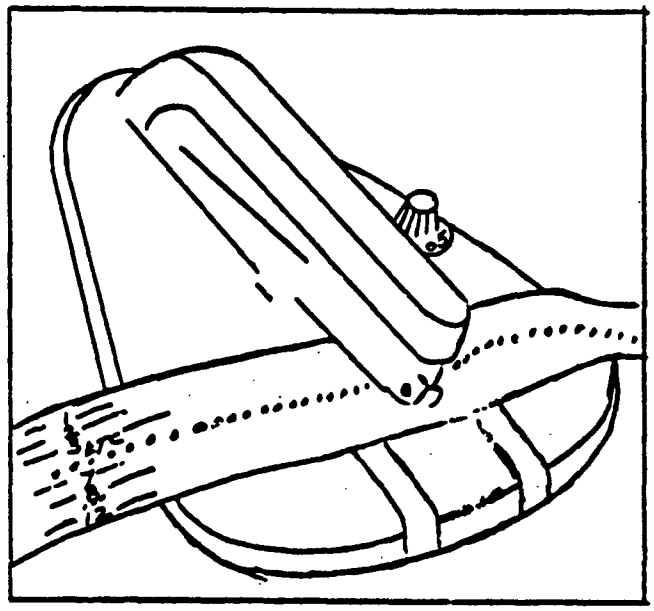


Figure 2-21. TAPE PUNCH.

(2) Punching the Tape.

(a) A small, compact punch (figure 2-21) is provided for punching the tape. The tape is first marked in the channels in which the holes are to be punched. This can be done easily by laying the tape beside the left edge of the form it is to control, with the top line (immediately under the glue portion) even with the top edge of the form. A mark is then made in the first channel, on the line that corresponds to the first printing line of the form. Additional marks are made in the appropriate channels, for each of the other skip stops, and for the overflow-signal required for the form.

(b) The marking for one form should be repeated as many times as the usable length of the tape (22 inches) allows. With the tape thus controlling several forms in one revolution through the sensing mechanism, the life of the tape is increased. Finally, the line corresponding to the bottom edge of the last form should be marked for cutting after the tape is punched.

(c) The tape is inserted in the punch by placing the line to be punched over a guide line on the base of the punch and placing the center feed holes of the tape over the pins projecting from the base. The dial is then turned until the arrow points at the number of the channel to be punched. Pressing on the top of the punch, toward the back, cuts a rectangular hole at the intersection of a vertical and horizontal line in the required channel of the tape. The tape should never be punched in more than one channel on the same line. Holes in the same channel should not be spaced closer than 8 lines apart. After the tape is punched, it is cut and looped into a belt. The bottom end is glued to the top section, marked glue, with the bottom line coinciding with the first line. Before the tape is glued, the glaze on the tape should be removed by an ink eraser; if this is not done, the tape ends may come apart. The center feed holes should coincide when the two ends of the tape are glued together.

(d) The last hole punched in the tape should be at least four lines from the cut edge, because approximately the last half inch of the tape overlaps the glue section when the two ends are spliced. If it is necessary to punch a hole lower than four lines from the bottom of the form, the tape should be placed with the top line (immediately under the glue portion) four lines lower than the top edge of the form, before marking the channels. To compensate for the loss, the tape should then be cut four lines lower than the bottom edge of the form.

(3) 8-Lines-Per-Inch Spacing. The control tape for 8- lines-per-inch spacing is punched as it would be for normal 6-lines-per-inch spacing. Each line on the tape always equals one line on the form, regardless of whether the latter be 6 or 8 lines per inch. In measuring a control tape for a document printed 8 lines to the inch, every 1/8 inch on the form represents one line on the tape.

(4) Carriage Tape Brushes.

(a) Two sets of reading brushes, mounted on the same frame, are used to sense holes in the carriage control tape. A small contact roll is used for each set of brushes. One set is called the slow brushes The other set is called the stop brushes. Seven spaces, as measured by the control tape, separate the brush sets. The slow brushes are position ahead of the stop brushes.

(b) The slow brushes are used to control high-speed skipping. They regulate the speed of the last eight spaces of a high-speed skip.

(c) All carriage tape brushes can function to stop a carriage skip under control of the stored program.

(5) Inserting Control Tape in Carriage.

(a) Raise the counter-balanced cover of the printer to gain access to the tape-reading mechanism.

(b) Turn the feed clutch to a disengaged (neutral) position.

(c) Raise the brushes by moving to the left the latch located on the side of the brush holder.

(d) Place one end of the tape loop, held so that the printed captions can be read, over the pin-feed drive wheel so that the pins engage the center drive holes.

(e) Place the opposite end of the loop around the adjustable carriage control tape idler.

(f) Remove the excess slack from the tape by loosening the locking knob on the idler and moving the idler in its track. Tighten the knob when the desired tension is reached. The tape should be just tight enough so that it gives slightly when the top and bottom portions of the loop are pressed together. If it fits too tightly, damage occurs to the pin-feed holes.

(g) Press the brushes down until they latch, and close the printer cover when the tape is in position.

(h) Press the carriage restore key to bring the tape to its home position, and turn the feed clutch knob back to the engaged position. The carriage is ready to operate.

(6) Ribbon Changing.

(a) To change the ribbon on the 1403 Printer:

1. Turn off the power in the printer.

2. Lift up the printer cover.

3. Pull back and unlock the print unit release lever. Swing the print unit out.

4. Open the top ribbon cover.

5. Unlatch the print-line indicator ribbon shield and swing it against the form.

6. Push the top ribbon roll to the right (hinged side of print unit), lift out the left end of the ribbon roll, and remove roll from the drive end of mechanism.

7. Slip the ribbon out from under the ribbon correction roll.

8. To remove the bottom roll, press the ribbon roll to the right, and lower the left end of the ribbon roll and romove it from the drive end of the mechanism.

(b) When replacing the ribbon in the machine, hand-tighten the ribbon to remove slack from in front of the printing mechanism. Ribbons are available in widths of 5, 8, and 11 inches in addition to the standard 14 inches. The ribbon width lever can adjust the ribbon-feed mechanism to accommodate the various ribbon widths.

(7) Forms Insertion.

(a) Raise the counter-balanced cover of the printer to gain access to the print and forms area.

(b) Turn the feed clutch knob to a neutral position.

(c) Unlock and swing back the print unit by using the print unit release lever.

(d) Unlock the paper guide bars by pulling out on the raised handles (upper and lower).

(e) Open the upper and lower forms tractors.

(f) Set the left forms tractors slightly to the left of the first unit position by pulling up or down in the tractor lock (upper and lower tractor).

(g) Insert form on pins and close tractor cover.

(h) Pull out on right tractor pin and move tractor to desired location to line up the right side of form. The pin should latch in one of the recessions in the tractor slide bars.

(i) Insert form on pins and close tractor covers.

(j) Use the tractor vernier knob to tighten the tension on the form. This knob is used for adjustments of up to one-half inch.

See note on page 2-45.

(k) Check the position and line where printing will occur, by swinging the ribbon shield against the form (it is marked with each print position). If the horizontal alignment is not correct, it can be adjusted by using the horizontal adjustment knob and/or the lateral print vernier knob for slight adjustments. The vertical adjustment can be made by using the paper advance knob and/or vertical print adjustment knob.

(l) Return the upper and lower paper guide bars to the closed positions.

(m) Return the print unit to its normal position and lock it in place.

(n) Restore the carriage tape to the first printing position by pressing the carriage restore button.

(o) Return the feed-clutch knob to a drive position at either six or eight lines per inch, depending on the form to be printed.

(p) Close the outside cover of the printer.

Some 1403 printers have the tractor-mounted jam detection device which, together with elimination of front "clip-on" paper guides, eliminates the need for the upper and lower paper guide bars. The forms insertion procedure for a 1403 with the tractor-mounted jam detection device instead of the upper and lower tape guides is the same except that steps (d) and (l) are skipped.

(8) Paper Stacker.

(a) The paper stacker provides a manual control for optimum stacking of paper at the rear of the printer. Two controls permit the operator to set up the paper stacker for each individual run.

(b) The upper lever controls the position of the paper guide at the stacker. This lever is indexed (0-6) so that the setup position can be recorded for reference in the operator's procedures.

(c) The lower lever is a speed control that is set to keep light tension on the paper form feeding into the stacker. The speed control has five settings. The setting of this control is selected according to the carriage operation being used. For example, if the job is a listing operation with no long skips, the slow position is selected. However, this must also be conditioned by the kind of forms being used because of varying weight of the paper.

2-4. MAGNETIC-TAPE UNITS (729 & 7330): Magnetic tape is a special plastic tape, coated on one side with a layer of magnetic oxide material. Data are recorded on the magnetic oxide of the tape in the form of magnetized spots or bits. Information written on tape remains there indefinitely, or until the tape is used in a new write operation. When the recorded information is no longer needed, the tape can be used to record new data. The write operation automatically erases old information. Reflective spots, manually placed on the tape, are photoelectrically sensed to indicate the beginning (or load point) and the physical end of the useful portion of the tape. The load-point reflective spot is about 12 feet from the front end of the tape, and the reflective spot designating the end of the usable tape is 18 feet from the physical end. Tape is wound on plastic reels 10½ inches in diameter. A full reel contains about 2,400 feet of usable tape, but lengths as short as 50 feet can be used.

During reading or writing, tape is moved from the file reel, through the left vacuum column across the read-write head, through the right vacuum column, to the machine reel.

Reading or writing on a tape takes place while the tape moves across the read-write head. The vacuum columns control separate drive motors and permit the read-write mechanism and each one of the two tape reels to move tape independently of the other two units. The read-write mechanism feeds tape according to instructions for the stored program. The file reel feeds tape when the tape reaches a minimum slack point in the vacuum column, and the machine reel winds tape when the slack tape reaches a maximum low point in the vacuum column.

The head assembly, located between the vacuum columns, is built in two sections. The lower section is stationary, but the upper section can be moved up or down under control of the tape-unit keys. When the upper section is up, the operation can thread tape. When down, it places the read-write head in close contact with the tape for reading and writing. The tape reels are accessible when the reel door is open.

a. Reflective Spots.

(1) Reflective spots, also referred to as photosensing markers, are placed on the tape to enable the tape unit to sense where reading and writing are to begin and to stop. The markers are small pieces of plastic, one inch by 3/16 inch, coated with vaporized aluminum on one side and with adhesive on the other. They are fastened to the base (uncoated) side of the tape. The photoelectric cells sense them as either the load-point marker where reading or writing is to begin on tape, or as the end-of-reel marker where reading or writing is to stop.

(2) There must be about 12 feet of tape between the beginning of the reel and the load-point marker. This footage is used to thread the tape over the feed rolls and the read-write head. Information must not be stored in this space. To indicate the load point, the one-inch dimension of the marker must be parallel to, but not more than 1/32 inch from, the channel 1 edge of the tape - the edge nearer the operator when the reel is mounted.

(3) About 18 feet of tape should be reserved between the end-of-reel marker and the physical end of the tape attached to the hub of the machine reel. To indicate end-of-reel, the marker must be placed parallel to, but no more than 1/32 inch from, the C-track edge of the edge of the tape (the edge nearer the tape unit when the reel is mounted).

(4) Place load-point and end-of-reel markers on tape with care. They should be properly aligned and pressed tightly onto the tape with back of the fingernail. To reduce the collection of dust on the unrolled tape, place markers while the tape is loaded on a unit. If this is done away from the unit, keep the unrolled end of tape off the floor and away from dusty areas.

b. File-Protection Ring. The back of the tape reel (machine side) has a circular groove that can hold a plastic ring. This ring (called a file-protection ring), when inserted, permits writing on tape. A tape can be read whether or not the ring is inserted. The file-protection ring would be removed from the tape reel after writing on tape is completed thereby preventing accidental writing and a resultant loss of valuable tape records. Never remove the file-protection ring while tape is loaded in the vacuum columns of the tape unit, because this could cause a broken or damaged tape.

c. Tape Checking. The 729 and 7330 tape units have increased reliability through two features: the two-gap head and dual-level sensing. The two-gap head makes it possible to automatically verify the validity of recorded information at the time it is written. The relative positions of the read and write gaps are such that a character recorded by the write gap passes the corresponding read gap; and, thus, when each character of a record is written it is read and a parity check is applied. If an error is detected, the stored program receives a signal, and corrective action can be taken.

d. Keys and Lights. The operating keys and lights of the 729 and 7330 magnetic tape units are located at the top of the unit, above the tape reels (figure 2-22). The lights are all on the upper row, and the keys are on the lower row. The address selection dial is at the left.

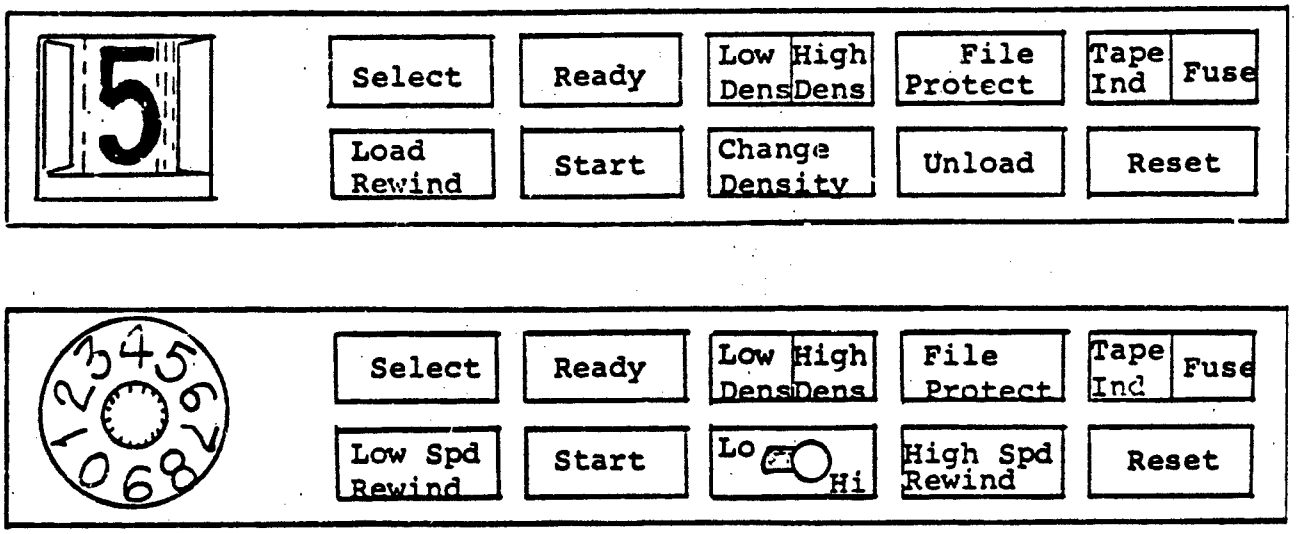


Figure 2-22. 729 and 7330 Magnetic Tape Units, Operating Keys and Lights.

e. Density Switch. This selects high or low density operation, depending on the tape operating mode desired.

f. Address Selection Dial. This dial assigns a number, from 0 to 9 and blank, to the tape unit, to identify it to the stored program. The setting should not be changed when a tape operation is in progress.

g. Select Light. The select light turns on automatically when the address selection dial is properly positioned and the unit is addressed by the computer, whether the computer is ready or not.

h. Ready Light. This light, when ON, indicates that the tape unit is ready for operation. See Start Key for method of turning this light on. The reel door should never be opened when the ready light is ON.

i. Tape Indicate On Light. This indicator is turned ON by:

(1) Sensing the end-of-reel marker while writing on tape.

(2) Sensing the tape mark while reading tape.

The indicator can be turned off by:

(1) Pressing the unload key on the tape unit.

(2) Executing a rewind tape and unload operation or executing a BRANCH IF CONDITION I/O CHANNEL STATUS INDICATOR ON (end of file) instruction in the stored program. (Because of the rapid internal processing speed in executing the instructions that turn the light off, it may appear as if the light was never turned on.)

j. File-Protection Light. This light automatically turns on if the unit is loaded with a reel that does not have the file-protection ring inserted in the back of the reel. The tape cannot be written as long as the file-protection light is ON. This light is ON whenever the tape unit is not in ready status.

k. Fuse Light. This light turns on automatically whenever a fuse in the unit has blown.

l. Tape Density Lights. These two lights (high and low) indicate the density in which the tape unit is operating. They are controlled by the setting of the density switch on 7330's, and by operating a button on the 729's.

m. Load Rewind Key. This key is operative only when the reel door is closed and the ready light is OFF. Use of this key, after tape has been properly mounted in the magnetic tape unit, lowers tape into the columns, lowers the head assembly, and moves tape in the rewind direction until the load point reflective spot is sensed. If the reflective spot is not to the right of the read-write head when this key is pressed, the tape will rewind from the machine reel.

Caution: Do not open the reel door during rewind or load point searching.

n. Start Key. Use of this key places the tape unit in ready status and turns on the ready light, provided that:

(1) The reel door is closed.

(2) Tape has been loaded into the columns.

(3) The tape unit is not in the process of finding the load point (rewind or load point operation).

o. Unload Key. This key is operative only when the ready light is OFF, tape is in the vacuum columns, and the reel door is closed. Use of this key raises the head assembly, and removes the tape from the columns, regardless of the distribution of tape on the two reels. If the tape is

not at load point when the operator wishes to change tape reels, a load-point search should be initiated first by pressing the load-rewind key. Pressing the unload key also turns off the tape-indicate-on light.

p. Reset Key. On a 729 II or IV, this key turns off the ready light. It also stops any tape operation except load and unload. If this key is pressed during a high-speed rewind, the operation stops, and then continues as a slow-speed rewind. If the reset key is pressed during a slow-speed rewind, the operation stops.

q. Reel Door Interlock. When the door is open, the interlock contact prevents any normal operation of the tape unit. The reel door should never be opened when the ready light is ON, or during any load-rewind operation.

r. Reel Release Key. When this key is pressed, both reels may be turned manually for threading tape or removing the file reel. To operate the reel release key, open the reel door.

Note: Steps required to place a 7330 tape unit in ready status after a high-speed rewind are:

(1) Open the reel door.

(2) Press and hold the reel release button through step 5.

(3) Manually rotate the takeup reel a few times until the load point is on the reel.

(4) Move the read-write head lever to a vertical position. This will lower the head.

(5) Rotate each reel, as necessary, to move the tape into the vacuum columns properly.

(6) Close the reel door.

(7) Press the load rewind and start keys.

s. Operating Pointers. Consider the following points whenever a tape unit is in operation:

(1) Do not change the address of a tape unit by operating the address selector switch during the execution of a program that uses other tape units. This applies whether the unit is in ready status or not.

(2) Never set two tape units to the same address.

(3) Do not open the door of a tape unit unless the tape is out of the vacuum columns and the read-write head is raised.

(4) In the event of a power failure with tape units in ready status, have a customer engineer remove the tape from the read-write head and the vacuum columns of every unit in ready status before power is restored.

(5) Do not operate the d.c. OFF key on the 1410 with the tape units in ready status, because extraneous noise may be recorded on the tape when d.c. is turned on.

(6) Rules that must be followed for tape unit operations are:

(a) 7330 Tape Units. When a tape unit is in write status, the tape unit cannot be switched into read status unless preceded by a backspace.

(b) 7330 Tape Units. If a tape unit is in read status, and a write operation is called for, the system must be programmed to: backspace the last record read, rewrite this record, and then continue in write status. In a write, backspace, read, write sequence, the backspace causes an unchecked erase forward (occurs only on first backspace after write). This may be used with discretion.

2-5. 1301 and 1302 DISK STORAGE: High data capacity, swift access, flexibility of data organization and processing modes available with disk storage are provided by the design of the 1301 and 1302 Disk Storage. The recording medium of disk storage consists of thin, magnetically coated metal disks. Data and control information are recorded as magnetized spots on concentric tracks on the surfaces of the disks (figure 2-23). Each data recording surface of the 1301, Models 1 and 2, contains 250 data tracks; each surface of the 1302, Models 1 and 2, contains 500 data tracks.

In the 1301 and 1302, the magnetic disks are mounted on a vertical shaft. The shaft rotates, spinning the disks at about 1,790 revolutions per minute. An access mechanism positions read-write heads (figure 2-24) close to the spinning disks to make the tracks accessible for reading or writing. The 1301-1 and 1302-2 use two access mechanisms.

A stack of 25 magnetic disks (50 disk surfaces) with the associated access mechanism(s) make up a disk storage module. The 1301-1 and the 1302-1 are single module units; the 1301-2 and the 1302-2 are double module units.

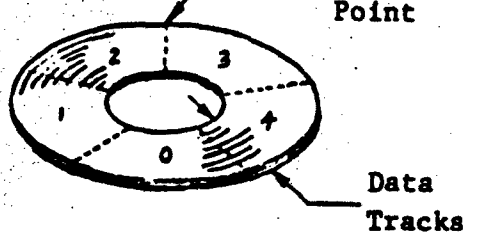


Figure 2-23.
Magnetically Coated
Disk

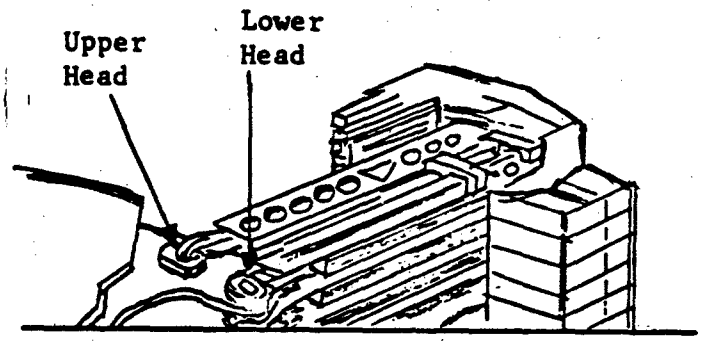


Figure 2-24
Head Arrangement

Of the 25 disks in a stack, 20 disks (40 disk surfaces) are used to store data. The remaining 5 disks (10 surfaces) are used for machine control and as alternate surfaces as follows: 6 surfaces are used as alternate surfaces, 1 surface is used to provide format tracks, 2 surfaces (the top disk surface and the bottom disk surface) are not used for data processing operations. One surface opposite the format surface is a spare surface and is not addressable.

The six alternate surfaces are provided so that each data bit can be stored in a magnetically perfect medium. If a disk defect is encountered, the entire track in which the defect occurs is disabled and an alternate surface is specified. This alternate surface is given the address of the disabled track.

The format disk surface and its usage in providing flexibility of record length and format are discussed later.

a. Access Mechanisms.

(1) Information is written on or read from the disk surfaces by magnetic read-write heads mounted on a comb-like access mechanism. The access mechanism has 40 data read-write heads, 1 format head, and from 2 to 6 alternate surface heads. One additional head is used for maintenance purposes.

(2) The access mechanism is hydraulically driven to simultaneously move all heads horizontally to any area of the 250 data cylinders of the access group. After the horizontal movement is completed to the correct track location, one of the data head elements, which consists of both read and write heads, is electronically selected to perform the reading or writing operation on a particular track in the cylinder. The read-write head associated with the format track is moved laterally in unison with the read-write heads.

b. File Control Unit Functions. The 7631 File Control performs a variety of functions in a disk storage processing operation; some of these are:

(1) Decode and execute control instructions transmitted from the computer main storage to the disk storage units by way of data channels.

(2) Assemble and disassemble characters transmitted between the computer and disk storage.

(3) Perform data and program checking (parity checking, address verification, invalid operation codes, error detection, etc.) of information received from or going to the computer.

(4) Provide monitoring services and allied programmed interrogation between disk storage and the attached computer, by the use of communication signals to indicate various disk storage processing conditions. Some of these monitored conditions are: disk storage receipt of a transmitted control instruction, successful or unsuccessful execution of a disk operation, and indication of the status of the several disk modules. See "Disk Storage Operation Status".

c. Switches and Lights. The control panel on the right front cover of the 7631 is intended primarily for maintenance purposes. In addition to the exposed section, the control panel has a covered section intended for customer engineering use only. On the exposed section there are 122 indicator lights that reflect the status of the data and controls within the 7631. The customer engineering section contains 35 switches for simulation of data and machine control. Operator switches are available in a switch and light assembly above the indicator section of the control panel.

(1) Power-On Switch. This switch sequentially turns on the a.c. and d.c. power to the 7631 and attached 1301 and 1302 units. Depression of this switch, with d.c. power off, will turn on d.c. power.

(2) Power-On Light. This light turns on when a.c. power is on in the 7631, 1301 and 1302 units.

(3) DC-On Light. This light turns on when d.c. power is developed in the 7631.

(4) DC-Off Switch. This switch turns off d.c. power in the 7631, 1301 and 1302 units.

(5) Power-Off Switch. This switch removes d.c. and a.c. power from the 7631 and all connected 1301 and 1302 units.

(6) HAO Switch. This switch must be on to execute the home address operation.

(7) Write Inhibit Switch. This switch, when on, allows the customer engineer to perform a write sequence of operations without the actual writing, thus not disturbing the customer's data.

(8) Write Inhibit Light. This light is on when the write inhibit switch is on.

(9) Test Mode Light. This light indicates that the 7631 and the attached disk storage units are not available for normal customer use.

(10) Thermal Light. This light automatically turns on if the internal machine temperature exceeds 115 degrees fahrenheit; d.c. power is automatically turned off. DC power can be restored with the power-on switch after the machine returns to normal operating limits.

(11) Fuse Light. This light turns on and d.c. power is removed if any auxiliary a.c. or d.c. circuit breakers trip.

1301-1 and -2 - 1302-1 and -2 SWITCH

(12) Write Format Track Switch. This key-operated lock switch has a read (RD) and a write (WR) position. To position the switch, a key must be inserted and turned. The switch must be set to the WR position to perform a write format track operation. The position of this switch has no effect on any operation except write format. Each disk module has its individual write format track switch.

d. I/O Channel Status Indicators. The I/O channel status indicators that can be set by a disk storage operation are outlined in figure 2-25 and described as follows:

Indicator	Cause	d-Character in R or X(1)d
Not ready	Access inoperative or 7631 off-line 7 7631 power off Home address switch check	1
Busy	Addressed access in motion 7631 (Model 3 or 5) busy in shared use	2
Data Check	Parity check Check character code check Write disk check Format character check Invalid track number	4
Condition	Wrong Length format No record found Write check without mode setting Disk storage circuit check File control circuit check Invalid operation code	8
No transfer	No read or write operation performed (No data or address is transferred)	ß (A-bit)
Wrong length	Short or long record	- (B-bit)

Figure 2-25. I/O Channel Status Indicators Set During 1301 or 1302 Operations.

(1) Not Ready. This indicator is set on if the 7631 File Control is off-line, if the disk storage is not available for use (power off or off-line status), or if the access mechanism cannot be moved or operated electrically. A home address check also turns on this indicator. A home address check results whenever a full track with home address instruction is given and the home address switch (located on the 7631 control panel) is not in the on position.

(2) Busy. The busy indicator is turned on if an access is addressed while in motion, or if (shared operation) the 7631 Model 3 or 5 is not available because it is being used by the other sharing system.

(3) Data Check. This indicator is turned on as a result of a parity check, a check character code check, a write disk check, a format character check, or an invalid track number check.

(a) A parity check results whenever a data character being transferred between core storage and disk storage fails to pass an odd-bit parity test.

(b) A check character code check results when code characters, generated for each disk record and address during the write operation, do not compare bit for bit when read during a read operation.

(c) A write disk check error results when the character sent from core storage fails to compare with the character previously written on disk.

(d) A format character check results from an illegal code being used to write the format track. (Only BCD 1, 2, or 3 and 4 can be used.)

(e) Invalid track number check occurs when the track address cannot be interpreted by the disk storage unit as a legal track address.

Note: To correct the machine after an invalid track number check, seek cylinder 0, and then seek the desired cylinder.

(4) Condition. This indicator is turned on as a result of: Wrong length format, no record found, write check without mode setting, disk storage circuit check, file control circuit check, and invalid operation code.

(a) The wrong length format results when an attempt is made to write a format track for a greater number of characters than the track will hold.

(b) The no record found results when the address specified by the instruction cannot be located on the specified track.

(c) A write check without mode setting results from an illegal write check operation. This occurs when the operation to be write checked has no meaning or application to the write check operation.

(d) A disk storage circuit check indicates a circuit failure in the disk storage unit.

(e) A file control circuit check indicates a circuit failure in the 7631.

(f) An invalid operation code check occurs when invalid operation codes are sent to the 7631 or the code fails to pass an odd-bit parity test.

(5) No Transfer. This indicator is turned on if data or addresses are not transferred between the 1411/7114 and the 7631 when the operation to be performed requires this transfer. If the write inhibit switch is set on at the 7631 during a write operation, the no transfer indicator is turned on.

(6) Wrong Length Record. This indicator is turned on when a long or short record is detected.

2-6. 1414 I/O SYNCHRONIZER:

a. Off-Line Operation. Both the 1402 Card Read Punch and the 1403 Printer may be used off-line when not being used by the computer. Thus, it is possible to perform a card-to-card or a card-to-printer operation without removing either unit from the system. With a card-to-card operation in off-line mode, the 1403 printer may be used by the computer in an on-line operation. The panel (figure 2-26) of the 1414 I/O Synchronizer, to which the 1402 and 1403 are attached, contains the necessary switches and keys to perform the operations.

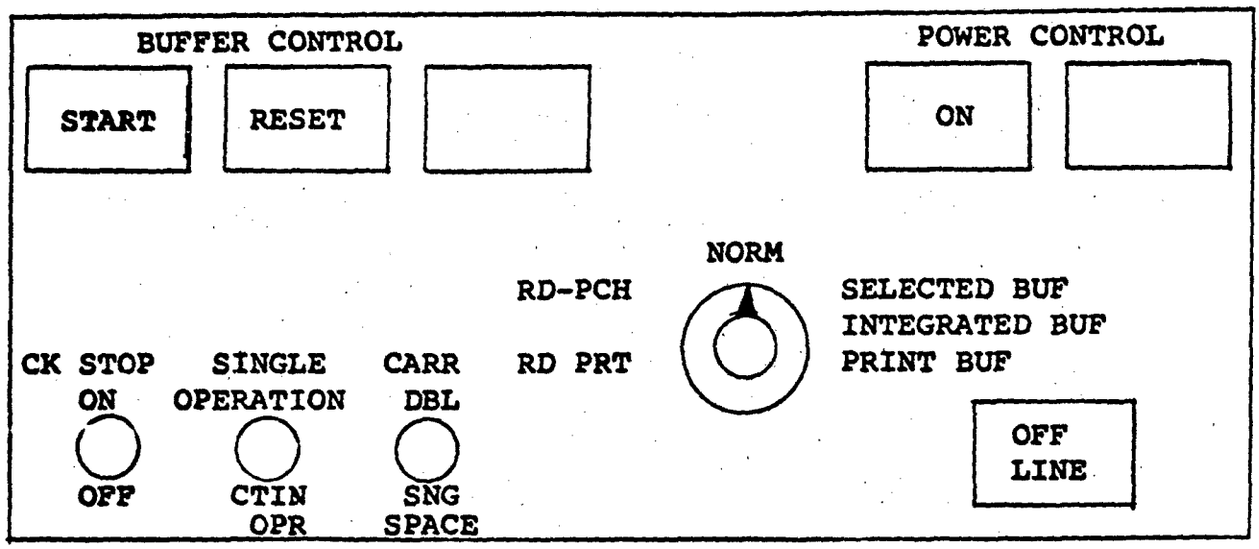


Figure 2-26. 1414 Panel

b. Synchronizer Keys and Switches.

(1) Off-Line Mode. This switch selects the type of off-line operation to be performed. It allows one or two units to be logically removed from the computer line without tying up the entire synchronizer. The switch is set to the normal position when all units are operating on-line. To perform a card-to-card operation the switch is set to the RD-PCH position. For a card-to-printer operation, the switch is set to the RD-PRT position.

(2) Off-Line. This key removes the area selected by the off-line mode switch from computer control. Pressing this key also activates the 1414 power control on and off keys. When in the off-line mode, the key is lighted. When lighted, depression of this key returns the selected area to on-line operation (the off-line mode switch should also be returned to the normal position).

(3) Check Stop. With on-line operation this switch is normally in the off position. When in the on position, the synchronizer is stopped after an operation during which an error was detected.

(4) Space. This switch causes either single or double carriage spacing in the printer when it operates off-line.

c. Card-To-Card Off-Line.

(1) The card deck to be reproduced is placed in the read feed, and blank cards are placed in the punch feed of the 1402. The data from the first card fed through the read feed goes to the read buffer. From there, the record (data) is sent to the punch buffer, finally to be recorded in the first card through the punch feed.

(2) Cards must be run-in to both read and punch feeds. This run-in causes the first card (read feed) to load into the read buffer. After run-in (both read and punch units ready), the 1414 switches and keys are set as follows:

SWITCH	SETTING	NOTES
Off-Line	On	
Off-Line Mode	Rd-Pch	Removes the reader and punch from computer control
Check Stop	On	Stops the operation after the card in which an error occurs.
	Off	Allows errors to be ignored.

d. Card-To-Printer Off-Line.

(1) The card deck to be printed is placed in the read feed of the 1402. The data from the first card read goes to the read buffer. The contents of the read buffer are transferred to the print buffer and the line prints.

(2) Cards are run-in to the 1402 read feed to load the first card into the read buffer. After the run-in is complete (and the printer is ready) the operation is set up as follows:

SWITCH	SETTING	NOTES
Off-Line	On	
Off-Line Mode	Rd-Prt	Removes both the reader and the printer from computer control.
Check Stop	On	Stops the operation after the card in which an error occurs.
	Off	Ignores errors.
Space	Single	Causes a single space before each print line.
	Double	Causes a double space before each print line.

2-7. ELECTROPLOTTER II:

a. Description.

(1) The Electroplotter II is an automatic graph plotter designed for plotting points or alphanumeric symbols, and for drawing lines of various colors or widths. The graphic information may be obtained from punched cards, punched tape, magnetic tape, or from a computer output coupler. The basic operating procedure is the same for all Electroplotters. However, when using machines equipped with the various input control options, some of the operator settings are replace by programmed actions.

(2) The graph is made by a moving printer/pen mechanism which is accurately positioned over the recording paper by motors controlled by digital-to-analog converters which respond to the input data. Once the Electroplotter is set up by the operator, graphs are produced automatically.

(3) The basic machine positions the plotting mechanism by means of the X coordinate and the Y coordinate numbers, each four digits long. These coordinate designations may be either read from a summary punch or entered by thumb switches on the control panel. The number thus entered is displayed (in binary-coded-decimal form) on the control panel.

(4) In addition to entering the coordinate designations, the reference point of the graph may be assigned any value on either axis between +9990 and -9990 in 10-count increments by means of the origin offset thumb switches. Fifteen different scales are available for controlling the size of the plot. Both the origin value assignment and scale selected are displayed on the control panel. If for any reason the plotting mechanism is driven to the edge of the board, the equipment stops and an "off-scale" indicator is illuminated. The erroneous "off-scale" value may then be cleared by depressing an "off-scale reset" switch.

(5) Accessory features may be added to permit a more varied use of the Electroplotter II, and to reduce the number of steps required by the operator before starting a plot.

b. Optional Accessory Features.

(1) Line Drawing Interpolator. Drawing inked straight lines between consecutive coordinate locations.

(2) Alphanumeric Printer. Any one of the 10 numerals, 26 letters, and 10 special symbols may be printed at the coordinate location.

(3) Program Controlled Scale Selection and Origin Change. Permits the graph size and location to be program controlled instead of operator selected, resulting in faster setup.

c. Operating Instructions.

(1) Resetting all the X, Y coordinate values to zero positions the printer mechanism at the origin of the graph. When a positive number is entered in the X-axis coordinate data register, the mechanism moves to the right; negative numbers cause leftward deflection. Plus Y data causes upward deflection, and minus Y data causes downward deflection. The amount of deflection depends on the value of the number divided by the scale selected. For example, if X = +1500, Y = +0000 is entered, the mechanism will move 1-1/2 inches to the right if a 1000 counts per inch scale is used or 7-1/2 inches to the right if a 200 counts per inch scale is used. Further reduction in the scale will cause larger motion.

(2) Fifteen scales may be selected in multiples of 100 counts/inch from 100 counts/inch to 1500 counts/inch. Intermediate scale factors required when changing between plots with different units of measurement, such as the adjustment required to change from centimeters to inches, or pounds to kilograms, are preset by the operator before starting the automatic plotting program.

(3) The scale is determined by the maximum range of the data, divided by the plot size. For example, if the full 9999 counts are to be plotted on an 11 by 17-inch graph sheet with a useful area 10 inches high by 15 inches wide, the plotter may be set as follows:

(a) X scale equals 666 counts per inch.

(b) Y scale equals 1000 counts per inch.

(c) Origin location set to lower left corner of the graph area to produce a 1-quadrant plot (all numbers positive).

(4) If the input data does not start at zero, the lower left corner of the graph may be assigned the values from which the data starts by means of the origin offset feature. For example, if the requirement is to prepare a plot in which Y data equals altitude between 20,000 and 70,000 feet, and X data equals time from minus 1 second to plus 14 seconds, the plotter may be set for X = 1 inch per second Y = 5,000 feet per inch as follows:

(a) X "scale" to 100 counts/inch (1 count equals .01 second).

(b) Y "scale" to 500 counts/inch (1 count equals 10 feet).

(c) X "origin offset" to - 100 (-1 second).

(d) Y "origin offset" to +2000 (+2000 feet).

(e) Origin location set to lower left of the 10 x 15 inch graph area.

(5) The origin offset thus moves the mechanism in the <u>opposite</u> direction from the coordinate data values so as to place the designated origin at the start of the graph. Note that the origin offset is scaled by exactly the same factor as the coordinate data; that is, when computing the inches displacement of a origin offset, the origin offset (in counts) must be divided by the scale (in counts per inch).

(6) If a graph is prepared in which both lines and printed data are present, the offset required to position the pen over the printer reference point is internally generated and need not be contained in programmed data.

d. Operating Controls.

(1) Symbol Selection. A thumbwheel for selecting one of 12 printer symbols or numbers; and indicating push switches for selecting (if equipped with the alphanumeric printer option) which alphanumeric zone printer is used in order to expand the print selection to 48 choices. A special switch allows transfer to input program control.

(2) Pen Selection. Indicating push switches for selecting the proper line weight or color by selecting and offsetting to the designated pen. These switches are used only with the "additional pen" option. A special switch allows transfer to input control.

(3) Servo On. Applies power to the motors which move the printer/pen carriage.

(4) Vac. Activates the paper holddown vacuum. Internal valves permit selection of the entire table, for large sheet plotting; or only the lower quarter for small sheet plotting.

(5) Off Scale/Reset When the "OFF SCALE" light indicates a stop due to a data value beyond the edge of the useful plotting area, depressing the "RESET" switch enters the next set of coordinates in order to resume operation.

(6) Paper Advance. On those machines equipped with the paper advance feature, this switch advances one sheet of fanfolded plotting paper.

(7) Spare. An unused extra position provides for a special switch and indication to operate future special accessories.

(8) Print. Depressing this switch operates the printer for one stroke.

(9) Clear. Clears data from all registers.

(10) Start. Starts automatic plotting operation after proper mode switches have been selected.

(11) Stop. Interrupts automatic plotting.

(12) Origin. A manual mode switch disconnects the plotting mechanism from the data register to permit adjustment of the "ORIGIN" knobs.

(13) Points. Three push switches to provide a choice of:

(a) Manual plotting of points only from the rotary data switches on the left of the panel.

(b) Read only of one set of coordinate data for operator check.

(c) Continuous plotting from program input.

(14) Lines. Four illuminated push switches to provide for operator selection, or display of program selection, of 1/4-, 1-, 4-, or 8-inch maximum line length if provided with the line drawing feature.

(15) Free Run. Selects free run mode or displays program selection of free run from magnetic tape input.

e. Operating Procedures.

(1) The following information is required to set up the system:

(a) Tape character positions of X data in the record.

(b) Tape character positions of Y data in the record.

(c) Scale factor for X axis.

(d) Scale factor for Y axis.

(e) X origin offset (unless program controlled).

(f) Y origin offset (unless program controlled).

(g) Symbol or multiple digit annotation character position(s).

(h) Setup instruction character position.

(i) Lines or points instruction character position.

(j) Pen color or weight required, if multiple pens are used.

(k) Designation of which files on the tape are to be plotted.

(2) If the Electroplotter is equipped with the "program control" of origin and scale feature, setting the origin and scale "fine adjustment" is required only if the engineering or scientific units of measurement are changed. If not equipped with this feature, the operator must reset the scale adjustment each time a plot is required which is:

(a) A different size.

(b) Located on a different portion of the board.

(c) Expressed in different engineering or scientific units of measurement. In any case, the operating procedure is as follows:

1. Power on, depress "CLEAR" and "ORIGIN", set all "ORIGIN OFFSET" and "DATA" switches to zero. Depress "SERVO ON" and wait one minute for the servo power supply to come on.

2. With the "ORIGIN" button latched, adjust the "ORIGIN" knobs to align the printer carriage cursors with the graph lines at the plot origin.

3. Depress one or more of the 800/400/100 "counts/incounts/cm" switches to obtain the approximate scale factors in each axis.

4. Enter the X scale number in the X "DATA" switches. The scale number represents the full graph scale and is equal to the maximum value on the X axis, minus the X origin value. If the origin is zero, the scale number is the maximum value on the X axis.

5. Adjust the X scale "FINE ADJUST" to align the X axis cursors with the maximum edge of the graph.

6. Reset X "DATA" to zero, and enter the Y scale number in the Y "DATA" switches.

7. Adjust the Y scale "FINE ADJUST" to align the Y axis cursors with the maximum edge of graph paper.

The equipment is now ready for starting the automatic plotting action as follows:

8. Depress "CLEAR".

9. Set the "ORIGIN OFFSET" switches to the assigned value of the origin; if the origin is program controlled, set to zero.

10. Set "PEN SELECTION" to "EXT".

11. Set "SYMBOL SELECTION" to the assigned symbol. If the symbol is program controlled, depress the "EXT" button.

12. Load the input reader and depress the "START" switch on the reader, or if tape input: load and position tape, push "PLOTTER CONTROL" button (red, on the tape unit).

13. Depress "CONTINUOUS PLOT" and "START".

Each subsequent time that the input reader or tape must be loaded, depress "STOP" and repeat steps 12 and 13 above.

(d) At the beginning of each eight hours, the pen should be cleaned, and if needed, re-filled with writing fluid. If India ink is used, the pens should be washed out with warm water every two hours.

(e) Each time the equipment is turned on, steps 1 through 7 should be checked. See manufacturer's manual for plugboard wiring.

f. Operator Adjustments. In addition to the switches on the contr panel, there are, associated with each axis, four rotary controls that may be adjusted by the operator.

(1) Origin Adjust. Used to set the plotting origin at the intersection of the vertical and horizontal lines through the graph paper origin. One revolution of this 10-turn control will move the origin 3.4 inches, thus the plotter is displaced about the same amount as the knob is turned. When placing the graph paper on the plotter, if the paper is not exactly in the correct horizontal or vertical position, the operator may make a slight adjustment of the origin as a faster means of matching the paper origin than moving the paper.

(2) Fine Scale Adjust. This adjustment provides for a continuously adjustable 3 to 1 variation in the size of the plot. Clockwise rotation of this control will cause a more expanded plot to be produced. In combination with the scale select switching, a total variation in plot size of 45 to 1 may be obtained. Once set to match the plotting units with the graph paper used, this adjustment needs little attention. The operator must reset the fine scale adjustment each time a plot is required which is a different size or is expressed in different engineering or scientific units.

(3) Null Detector Adjust (Points). Two controls, one for each axis, are located under the left corner of the control panel. When the servo is moving from point to point, the null detector allows the printer to record the point only after the designated coordinate positio is reached. The adjustment of the points null detector determines the accuracy of the plotted points. This adjustment is set by first turning the upper pair of controls one-third turn clockwise (from the counter-clockwise end) and repeating a typical series of a few graph points three times over. With this setting, the repeated points may not fall exactly superimposed, but rather may be scattered slightly. With this setting, the null detector is too "loose". While the equipment is automatically plotting the pattern again, rotate either axis points adjustment slowly clockwise until the plotter hesitates at null before printing the points. This locates the adjustment that sets the null detector to "tight". For faster plotting, rotate the same adjustment

back counterclockwise one-eighth turn. Repeat the procedure of setting until too "tight", and then back one-eighth turn, with the control for the other axis. Repeat the same series of graph points on a clean sheet of paper. Note that the repeated points are now plotted more accurately. If additional accuracy is required, the upper adjustments should be rotated very slightly clockwise to "tighten" the null. If the plotter frequently pauses or interrupts plotting (note that an occasional pause is normal; and that the plotter will pause if the symbol is being changed), both adjustments should be rotated very slightly counterclockwise to "loosen" the servo null in order to enable faster plotting. Correct adjustment is obtained when a typical plot of several points may be printed several times over with all repeated points falling close to the average position.

(4) Null Detector Adjust (Lines). Two controls, one for each axis, located under the left corner of the control panel. Similar to the points null detector, the lines null detector allows the pen to start a line only after the exact coordinate is reached. The adjustment of the lines null detector determines the accuracy of the beginning of each line. It is adjusted in the same manner as the points adjustment except that the Electroplotter is to be operated in the 1-inch line mode and the beginning of the lines observed while setting the lower adjustments in the same manner as described for points in the preceding paragraph.

2-8. TAPE REEL LABELING, IDENTIFICATION, AND HANDLING: Since most inputs and outputs involved within the Formatted File System are tape reels, it becomes apparent that some system must be devised for uniquely identifying each reel of tape. A formatted file might consist of as many as 18 reels of tape. On the other hand, there will not be more than one file per reel of tape. The following is an explanation of the numbering system used in FFS. Note this numbering system could be different from installation to installation.

a. File Identification. The file identification consists of five characters that identify the file to which the reel of tape belongs.

Example: CMFLA is the name given to the Commercial Flight file.

b. Reel Serial Number. The reel serial number is a 5-digit integer assigned to the reel when it enters the tape library of the using installation.

Example: 02057.

c. File Serial Number. The file serial number is a 5-digit integer equal to the reel serial number of the first reel of the file.

Example: There are 4 reels to a file:

Reel 1 is serial #20466.
Reel 2 is serial #20467.
Reel 3 is serial #20471.
Reel 4 is serial #21200.

20466 is also the serial number of the file contained on those 4 reels.

d. Reel Sequence Number. The reel sequence number is a 4-digit number that identifies the position within the tape file of this particular reel.

Example: 0007 is the seventh reel of a file.
0021 is the twenty-first reel of a file.

e. Tape Handling. Utmost care should be taken to protect tape from dust and dirt. Foreign particles can reduce the intensity of reading and recording pulses by increasing the gap between the tape and the head. The following rules should be observed in tape handling.

(1) Keep tape in dust proof container when not in use.

(2) Keep container closed while tape is out.

(3) Store tapes in elevated cabinets, away from paper or card dust.

(4) Do not use top of tape unit as work area.

(5) Identify tape reels with a material that can be removed without leaving a residue.

(6) Place load points and reflective spots on tapes with care.

(7) Clean tape with lint-free cloth and IBM tape developer transport cleaner.

(8) Never remove file protect ring while tape is loaded in columns.

(9) Protect edges of the tape:

(a) Handle reels near the hub.

(b) Avoid pinching reels or hitting exposed tape.

(c) When mounting reels, make sure they are firmly seated for proper alignment.

(d) Make sure hub has been tightened.

(e) Take care in starting and winding tape.

(f) Always place sponge rubber grommets on stored reels to prevent free end unwinding.

(g) When tape break occurs, divide the reel. Splicing is not recommended.

(h) Normal use of reel that has been dropped is unsatisfactory.

f. Tape Splicing. No permanent method exists for splicing tape. It should be done only in emergencies.

SECTION THREE

THE 1410 OPERATING SYSTEM

3-1. PURPOSE: The 1410 Operating System is an integrated set of programs and programming systems that provide a 1410 installation with a convenient and efficient means of fulfilling its data processing requirements. These requirements are to write, assemble, and execute programs with a minimum of programmer, machine, and operator time.

Note: See "Definition of Terms" at the end of this section.

3-2. DESCRIPTION: The 1410 Operating System is divided into 3 main categories, as follows: Programming Systems, Service Programs, and System Monitor.

a. Programming Systems.

(1) A programming system consists of a language and its associated processor. The programming systems available with the 1410 Operating System are: Autocoder, COBOL, and FORTRAN.

(2) Use of these languages reduces the time required by programmers to write and debug programs. The writing of source programs is simplified and thereby speeded up solely as a result of the symbolic nature of these languages. A further aid in saving time is the ability to use Autocoder Macro instructions, FORTRAN statements, and COBOL statements to produce a series of machine language instructions.

b. Service Programs. Service programs provided in the 1410 Operating System are collections of prewritten routines that will perform functions according to control information supplied by the user. Some of these function independently, while others are designed to be used in conjunction with the user's program. The service programs include:

(1) Tape Sorting Program

(2) Input/Output Control System (IOCS)

(3) System Generation Program

(4) File-Processing Supervisor

(5) The Utility Programs:

(a) Snapshot

(b) Storage Print

(c) Tape Print

(d) 1301 Print

c. System Monitor.

(1) System Monitor is the supervisory program in the 1410 Operating System that calls prespecified programs or routines into core storage as required. System Monitor, operating from control information supplied by the user, provides Compile-and-Go and Batch Processing capabilities.

(2) The System Monitor is the heart of an operating system. It performs such major functions as the assignment of input/output units, program loading and relocation, and the linkage of independently compiled programs.

(3) The System Monitor contains three major elements:

(a) The Resident Monitor.

(b) The Transitional Monitor.

(c) The Linkage Loader.

The Resident Monitor consists of control routines that remain in core storage while the operating system is functioning. It includes the operating system's IOCS, input/output assignment routines, end-of-program routines, and absolute-program loader, and other frequently used routines. The Transitional Monitor contains routines required to permit transition from run to run and from one job to the next during batch processing. The Linkage Loader performs the functions required to convert relocatable programs into absolute programs for execution. The Transitional Monitor and the Linkage Loader are called into core storage when required.

(4) All jobs to be performed in an operating system are controlled by the System Monitor in accordance with instructions provided by the user via control information in the Standard Input Unit.

d. Autocoder. The Autocoder programming system provides users of the 1410 Operating System with a convenient and efficient means of writing programs. Features provided in the Autocoder language and processor not only simplify the task of writing source programs, but also facilitate the running and debugging of object programs. Among

these features are the following: (1) Mnemonic Operation Codes, (2) Label Processing, (3) Macro System, (4) Relocatable Object Programs, and (5) Assembly Listings.

(1) Mnemonic Operating Codes. The operating codes in the Autocoder language have a mnemonic relationship to the machine instructions with which they are associated, thereby greatly simplifying the task of the programmer who would otherwise be required to work with the abstract language of the computer. For example, the mnemonic operation code "M" is easier for a programmer to remember and associate with the operation "Multiply" than its machine language equivalent "@".

(2) Label Processing. By assigning a label to a data field that is easily associated with the data it contains (such as ITEM, SALARY, DATE) or to a routine that is easily associated with the function performed by that routine (such as PROCESS, ERRORCHECK, etc.) a programmer can impart to his program a structural clarity and ease of reference that is impossible in machine-language coding.

(3) Macro System. The Autocoder Macro System provides facilities for the creation and processing of macro-instructions. A macro-instruction permits the programmer to specify, in one instruction, a series of related operations to be performed. Macro-instructions are translated by the Autocoder processor into the machine-language instructions required to perform the indicated operations. These macro-instructions are contained in a "macro-library", contained within the System Operating File.

(4) Relocatable Object Programs. Object programs produced by the Autocoder processor are in relocatable format. This format offers two advantages. First, it permits the program to be loaded into any available area of core storage during batch processing. Second, it permits independently compiled programs to refer to locations in other programs. These references are then linked when the programs are combined during batch processing.

(5) Assembly Listings. Assembly listings are produced for all programs compiled by the Autocoder processor. These listings show the source program relation to the object program. Labels are related to core-storage assignments, symbolic instructions to their machine-language equivalents, etc. The listing is arranged in a format that permits ease of reference. In addition, coding errors detected by the processor are indicated in the listing, making it an invaluable aid in program debugging.

e. COBOL.

(1) The COBOL programming system enables users of the 1410

Operating System to create business-oriented object programs with a minimum of programmer effort. COBOL (Common Business Oriented Language) source programs are written in a language similar to ordinary business English, thereby permitting the user to associate his program more directly with the related problem.

(2) Object programs produced by the 1410 COBOL processor will be in relocatable format. This format permits FORTRAN-compiled and/or Autocoder-compiled subroutines to be incorporated into an independently compiled COBOL program at object time.

f. FORTRAN.

(1) The FORTRAN programming system enables users of the 1410 Operating System to create programs for scientific problems with a minimum of programmer effort. FORTRAN (FORmula TRANslation language) source programs are written in a language containing terminology similar to mathematics, thereby permitting the user to associate his program more directly with the related problem.

(2) FORTRAN source programs can be written for use independently or as subprograms, i.e., programs that can be combined for execution as a unit with other programs. Subprograms can contain references to labels in other subprograms, and these will be linked when the subprograms are combined at object time.

g. Input/Output Control System (IOCS).

(1) The 1410 Input/Output Control System (IOCS) is a set of prewritten routines that will perform all input/output functions for an object program. Among these functions are scheduling of read and write operations, error detection and correction, end-of-file handling, check-point and restart facilities, and blocking of records.

(2) When the user defines his machine configuration during System Generation, only those IOCS routines he will require become part of the System Monitor section of his System Operating File. The IOCS resides in core storage when programs are being executed.

(3) Macro-instructions provided for use with the IOCS are of two types: one type results in linkages to routines within the IOCS; the other type results in generated routines within the user's programs.

h. Generalized Tape Sorting Program. The 1410/7010 Generalized Tape Sorting Program consists of a set of prewritten routines provided in relocatable form on the Master File. It has the ability to sort or merge data records on tape in ascending or descending sequence. It will handle fixed-length or variable-length records, and can include linkages to specialized routines written by the user.

i. Utility Programs. A set of four utility programs are provided with the 1410 Operating System: Snapshot, Storage Print, Tape Print, and 1301 Print. Output from these programs is obtained on the Standard Print Unit. All four programs use a standard scheme of abbreviation for nonprintable characters.

(1) Snapshot. The Snapshot utility program will print all or selected areas of core storage at intervals specified by the user. The Snapshot program can be combined with the user's program by the System Monitor. Information will be printed as it appears in core storage, with word marks indicated above the appropriate characters. The settings of various indicators and registers will also be listed.

(2) Storage Print. The Storage Print utility program will print all or selected areas of core storage in accordance with control information provided by the user. Unlike the Snapshot program, it will be executed only when specifically requested at object time by user-supplied control cards. The printed listing is provided in machine language. Word marks will be indicated where they appear in core storage. Settings of various indicators and registers will also appear in the printed listing.

(3) Tape Print. The Tape Print utility program will print all or a portion of the contents of a tape. Tape Print will print the contents of one or more files or a specified number of data records within a file. Records can be on tape in fixed-length or variable-length format, and in odd or even parity. Printed listings can show separator characters as separate characters or as word marks above the appropriate characters. An end-of-file message will be printed after each complete file. Tape identification, mode, and parity will be indicated; data record and character counts will be made.

(4) 1301 Print. The 1301 Print utility program will print all or selected areas of 1301 Disk Storage. Data to be printed can be in disk storage in either the Move mode or Load mode, and will be written out in the Full Track mode of operation.

j. System Generation.

(1) The 1410 Operating System is made available to users on a reel of tape called the master file for the installation. This master file will be made up for use with a tape-oriented system or a disk-oriented system, whichever is required. From this tape, the user creates a system generator file for his installation. The system generator file is then used to create specific system operating files in accordance with control information provided by the user. This is called system generation. An installation's system operating files can include relocatable and absolute programs supplied by the user, in

addition to the required and optional components of the operating system.

(2) In addition to creating one or more system operating files, system generation can include the creation of a system library file. System generation routines can also be used to update the SGF, to update SOF's and system libraries, and to print a listing of the elements contained on the generated SOF. A detailed listing of the contents of the Macro library may also be printed. System operating files can be created for use on tape or on 1301 disk storage. Figure 3-1 depicts the general flow of data during the creation of an operating system.

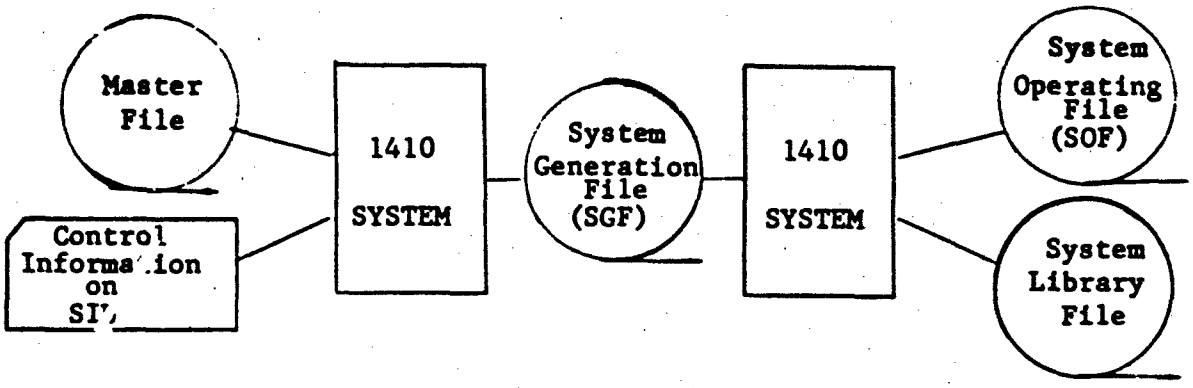


Figure 3-1. System Generation Flow.

3-3. INITIALIZATION AND REINITIALIZATION: Generally speaking, the term "initialization" covers any procedure involving preparation of the machine and/or programs to do work. However, here initialization refers only to the procedure used at the beginning of the day. Reinitialization is the procedure used to begin again, and is usually occasioned by a machine or program failure that makes it necessary to reload the system monitor. The operating system also provides restarts from checkpoints, the procedures for which are discussed in a later paragraph.

a. Initialization Cards. One of the functions of the System Initialization routine is the processing of cards that contain "daily information" for the system. These initialization cards, which are placed at the beginning of every standard input unit deck, consist of

a DATE card, a SPOOL[1] card, and ASGN cards. These are the only cards which are acceptable prior to the first JOB card. ASGN cards for the following cards can be included in the pack of initialization cards:

(1) Any Work file (MWn)

(2) Any Teleprocessing file (MTn)

(3) Any System file except the SOF and SIU.

Although the system will accept ASGN cards for the go file and job file during initialization, it would be pointless since the first job card would cancel them before they were used.

b. Initialization Status Character.

(1) Prior to bringing the Bootstrap routine[2] into core storage, the operator enters a character into location 00000. This character in location 00000 informs the initialization routine of the type of procedures to be used, as follows:

(a) Initialization

(b) Reinitialization with Rewind. (The card reader will be run out, and initialization cards are to be placed first in the hopper.)

(c) Reinitialization without Rewind. (The card reader will be left in the same position as it was when the situation requiring reinitialization occurred).

(d) Restart from Checkpoint. (See "Restarts from Checkpoints", page 3-13.)

(2) A blank in location 00000 tells the transitional monitor that the system is not in initialization status.

(3) If a word mark is entered with the status character, it causes the initialization routine to allow the operator the opportunity to change the I/O assignment symbol for the System Operating File or the Standard Input Unit. The new assignments may be made when the message "ENTER SOF/SIU ASGN SYMB" appears on the console printer. Note this printout under "Console Messages from IBM Programs."

[1] Specifications for the SPOOL card are explained on pages 46 and 47 of the IBM System Reference Manual "IBM 1410 Operating System (1410-PR-115) System Monitor; C28-0319-3."

[2] Bootstrap routine - The program that loads the system monitor from disk to core storage.

c. Operator Initialization Procedure.

Step 1. Ready SIU and other units as required. The first card in the hopper must be the Bootstrap I Routine Card.[3]

Step 2. Set Mode Switch to CE.

Step 3. Hit START button.

Step 4. Enter 00000.

Step 5. Set Mode Switch to DISPLAY.

Step 6. Hit START button.

Step 7. Display 00000.

Step 8. Console Printer will print 2 lines of blanks (Ø).

Step 9. Set Mode Switch to ALTER.

Step 10. Hit START button.

Step 11. Enter A L cde 00012$r into location 00000, where "c", and "r" indicate the channel of the SIU:

"c" can be: % for channel 1 or ¤ for channel 2

"d" can be: 1 for card reader or B for tape

"e" can be: Ø for card reader or Ø-9 for tape

"r" can be: R for channel 1 or X for channel 2

Enter the coding for your installation's SIU in the blanks below.
A L ✓ _ _ _ ØØØ12 $ ✓ _ _ _ _____
("A" could have a word mark with it.)

Step 12. Press COMPUTER RESET then START.

Note: The asterisk insert switch must be set to ON.

[3] Bootstrap 1 Routine Card - A small program generated by the System Generator DiskLoader program and punched on a card. This card, when read, calls in the Bootstrap Routine that loads System Monitor.

d. Reinitialization with Rewind Procedure.

Step 1. Run out the cards in SIU, place initialization cards in the hopper followed by the next job(s) to be processed.

Step 2. Follow steps 1 through 12 under "Operator Initialization Procedure" except place a "B" instead of "A" as the status character.

Step 3. The message ENTER JOB NUMBERS: will appear on the console printer.

Press INQUIRY REQUEST.
Type in 4 characters:
ØØbb ("b" here means blank).
Press INQUIRY RELEASE.
Processing will continue from SIU.

e. Reinitialization without Rewind Procedure. This type reinitialization can be accomplished only if the SIU is tape. In the FFS system, SIU is the card reader.

3-4. MONITOR CONTROL CARDS AND THEIR SEQUENCE: The following cards are some of the control cards used by the system. Their formats are described first, followed by explanation of the sequence in which they are positioned in batch processing decks.

a. Control Card Formats. Some of the more commonly used monitor control cards are shown with an explanation of each. Note that at system generation time an option is provided to have all monitor control cards printed on the console I/O typewriter and/or on the printer during batch processing. Regardless of the option chosen, JOB cards and COMT cards are always logged on the console I/O typewriter and on the printer.

(1) ASGN card.

Line 3 5	Label 6 15	Operation 16 20	21 25 30
0 1	M.O.N.$.$.	A.S.G.N.	MW1, A.1, B.1
0 2	M.O.N.$.$.	A.S.G.N.	MR.2, B.2
0 3			
0 4			

(a) ASGN cards are used during initialization and throughout the batch to specify particular input/output units to be used by

monitor and by programs under monitor control. Card 01 says to assign symbolic name MW1 to the #1 tape on channel A, and to assign MW1 to the #1 tape on channel B as the alternate.

(b) In other words, if IOCS finds tape A1 is at end of tape or is rewinding, it will switch the writing to channel B drive #1. IOCS continues writing on B1 until end of tape is reached then switches back to A1.

(2) COMT Card.

Line 3 5	Label 6 15	Operation 16 20	21 25 30
0 1	MONSS	COMT	THIS JOB CON
0 2	MONSS	COMT	STOP HERE FO
0 3			
0 4			

COMT cards are used to print desired messages on the SPR and console typewriter to operators and programmers. The contents of columns 21 through 72 are typed and printed.

(3) DATE Card.

Line 3 5	Label 6 15	Operation 16 20	21 25 30
0 1	MONSS	DATE	65355
0 2			
0 3			
0 4			

The DATE card is one of the initialization cards. Columns 21 and 22 contain the last two digits of the year. Columns 23-25 contain 001-365 the day of the year.

(4) EXEQ Card.

Line 3 5	Label 6 15	Operation 16 20	21 25 30
0 1	MON$$	EXEQ	PAYROL,SOF,MR2
0 2	MON$$	EXEQ	FILE MAINTE
0 3			
0 4			

The EXEQ card informs monitor that the program named in the first operand is to be located, loaded, and then given processing control. Note in the example that PAYROLL is the program to be operated. This is called the first operand. There could be a second and third operand on the card that would tell monitor where to find the program PAYROLL and where to get the data that PAYROLL needs for processing.

(5) END Card.

Line 3 5	Label 6 15	Operation 16 20	21 25 30
0 1	MON$$	END	
0 2			
0 3			
0 4			

The END card must be the last card in the batch processing deck. When this card is read, the resident monitor does the following:

Types two messages:

END SIU and

20501 ENTER B MESSAGES

All Class B console inquiries will now be accepted except $B1, which will be ignored. During this time, the system monitor is in a wait loop and will remain until $BX is typed in. After $BX is entered, the transitional monitor again starts reading from SIU. It ignores all cards until it finds a JOB card, then begins processing.

(6) JOB Card.

Line 3 5	Label 6 15	Operation 16 20	21 25 30
0 1	MON$$	JOB	ABC TRIAL R
0 2	MON$$	JOB	XYZ
0 3	MON$$	JOB	RETRIEVAL &
0 4			

The JOB card divides the batch into groups of runs. Any time monitor reads a JOB card it performs certain housekeeping functions that prepare the system for the next group of programs. For instance, monitor cancels certain I/O assignments and turns off switches and indicators, and prints out contents of column 21-72 of the JOB card.

(7) PAUSE Card.

Line 3 5	Label 6 15	Operation 16 20	21 25 30
0 1	MON$$	PAUSE	
0 2			
0 3			
0 4			

When transitional monitor recognizes a PAUSE card, control passes to the monitor wait loop. Processing is stopped, and $5Ø must be entered on the console printer to continue.

b. Control Card Sequencing and Batch Processing.

(1) The monitor control cards must be placed in the input deck in proper sequence along with source program and data cards as the particular job or batch may require. If initialization of the system is also to be accomplished then the Bootstrap 1 routine, DATE, SPOOL and ASGN cards required will be the first cards in the deck.

(2) A batch consists of one or more jobs. A job can consist of one or more runs. The beginning of a job is signaled to the monitor by a JOB card; each run contains one EXEQ card, usually at the beginning. Within one job, EXEQ cards can be given for any combination of runs, which should perform a logically related sequence of functions.

(3) The first card of a job must be a JOB card. ASGN cards for a run must precede the EXEQ card. Control or data cards for a program named in an EXEQ card must follow the EXEQ card. The MODE card must precede the EXEQ card for the program to which the MODE card applies.

(4) The following example is used to demonstrate batch processing and the control cards involved.

(a) Two jobs are to be performed. The first job consists of:

1. Execution of Autocoder to change the source program to an object program.

2. Execution of Linkage Loader to change the object program from relocatable to absolute format.

3. Execution of the object program for testing purposes.

4. Execution of Utility programs to record the results of the test.

(b) Job number two consists of generating a file by using programs from the FFS library. Refer to figure 3-2.

3-5. RESTARTS FROM CHECKPOINTS: Checkpoint records are written on the core image file under control of an IOCS macro-instruction (IOCTL CHKPT) issued by a program that has processing control. From these records, which are an image of core storage as it appeared at the time the checkpoint was requested, the dependent program can be restarted should its execution be temporarily interrupted, i.e., machine failure, power failure, etc. There are two types of restarts: (1) Immediate restart and (2) Delayed restart. Both do identically the same thing except delayed restart may require operator help to reestablish the machine status.

a. Immediate Restart. An immediate restart is initiated by the $7Ø console inquiry (type A message). It may be given any time the monitor is controlling a dependent program. When the monitor sees this inquiry, it immediately loads the restart routine which reads the core image file (MDM) to obtain the most recent checkpoint. From this the restart routine is able to reconstruct the machine status and program status that existed at the time the checkpoint was taken. Control is then turned over to the dependent program to resume processing.

b. Delayed Restart. The delayed restart is accomplished through use of initialization procedures. (Follow "Operator Initialization Procedure," page 3-8.) The character "D" must be entered into location

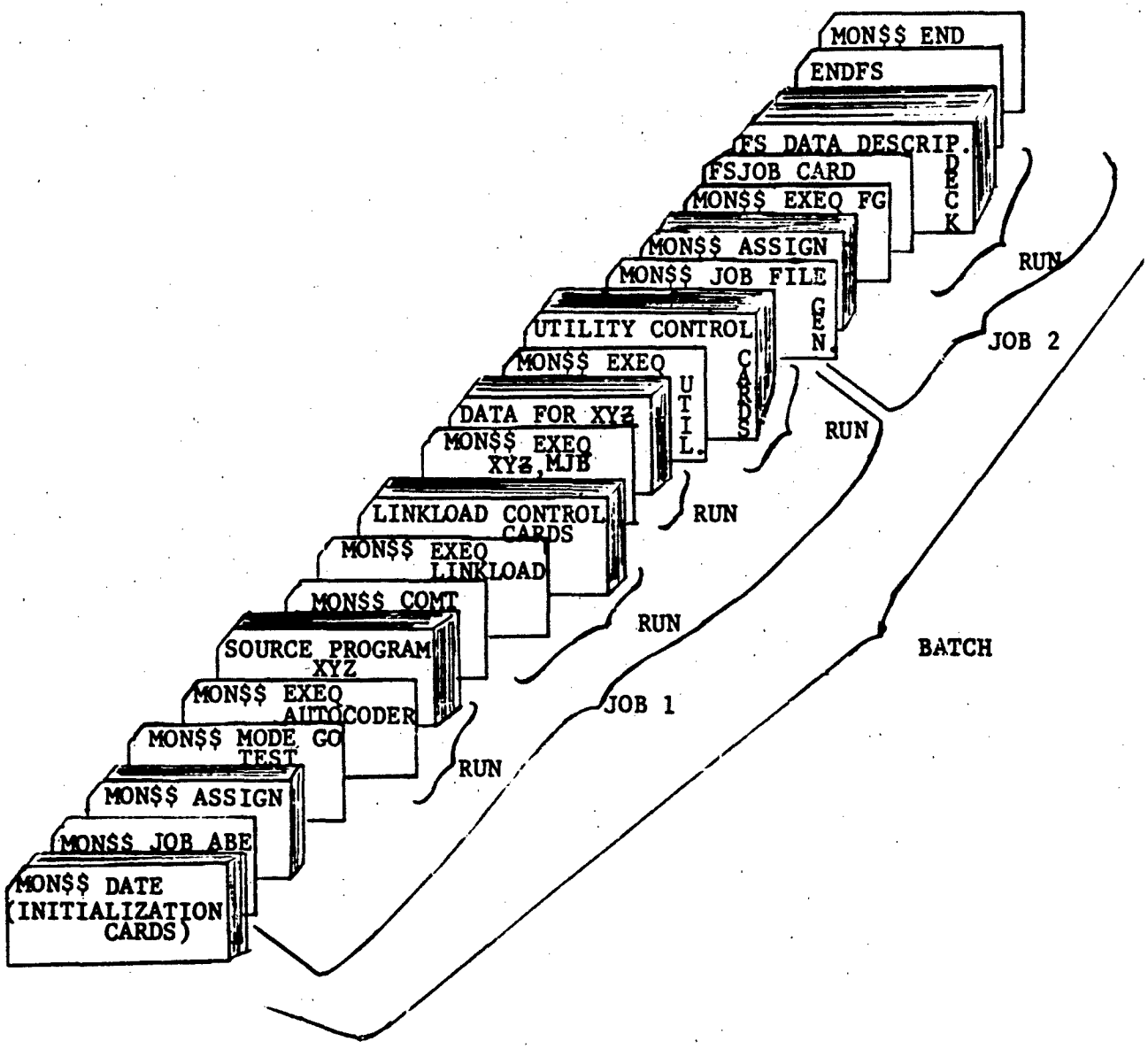


Figure 3-2. Example of Job Batching.

when performing the initialization procedure. This informs the initialization routine that a restart is being requested. The initialization routine requests the checkpoint number be entered by the operator via the I/O typewriter with "ENTER RST NUMBER". The operator may enter the three character identification of any checkpoint that is on the currently assigned MDM tape (core image file).

Note: Press INQUIRY REQUEST
Type 3 character ID
Press INQUIRY RELEASE

This causes the restart routine to find the requested checkpoint data, load it in, and turn control over to the dependent program. For this type restart, the machine must be set up identically to what it was at the time the checkpoint was taken. That is, all tapes mounted on the same units, etc. The same is true of immediate restart but generally it requires no operator action.

3-6. SYSTEM GENERATION OPERATING PROCEDURES:

a. System generation is accomplished in three distinct runs:

(1) Load disk with contents of IBM supplied master file and produce a system generator file.

(2) Load disk with SGF and produce system operating file.

(3) Load disk with SOF for production operations.

b. In order to generate an SGF, the master tape must first be loaded onto disk by using the system generator disk loader program.

Step 1. Mount master file reel on any tape unit.

Step 2. Alter ØØØØØ to bLcBu00012$N

c = channel
u = tape drive

Step 3. Press RESET and START.

Step 4. Follow console messages.

Now follow the procedures listed under "Operator Initialization Procedure" (page 3-8) with the following exceptions:

Substitute "Master File" for "System Operating File"

The SGF will be produced on the work file MW2.

This entire procedure is repeated to make an SOF from the SGF.

3-7. CONSOLE INQUIRIES:

a. Console inquiries are used to communicate control information to various portions of the system monitor. The messages that can be entered through the console printer are divided into four classes:

CLASS A: Messages that can be accepted by the resident monitor during the execution of a dependent program.

CLASS B: Messages that can be accepted by the transitional monitor when it is in storage between jobs.

CLASS C: Messages that are communicated to the transitional monitor in reply to a request from the transitional monitor for specific control information.

CLASS D: Messages that are communicated to the bootstrap routine in reply to a request from the initialization routine for specific control information.

b. The various messages are entered by:

(1) Depressing the Inquiry Request key.

(2) Typing in the message.

(3) Depressing the Inquiry Release key.

c. Class A Messages. The following messages can be accepted during execution of a dependent program. Unless otherwise stated, the entire message consists of the three characters listed.

(1) $10: This message causes immediate entry to the unusual-end-of-program portion of the resident monitor's end-of-program routine. The contents of core storage are written on the core image file, and the remainder of the current job is canceled (when the job is not in TEST mode). This message can be entered at any time.

(2) $20: This message requests the transitional monitor to notify the operator when it can accept class B messages. This message can be entered at any time. The notification is given after the next JOB card is read.

(3) $3x (x = Any Input Wanted): This message is used to provide console input to a dependent program. It is to be used only in accordance with instructions from the program or the person responsible for the program.

(4) $50: This message causes the resident monitor to exit from its wait-loop routine and return control to the dependent program. This message can be entered at any time the dependent program indicates that it is using the wait-loop routine.

(5) $70: This message signals the resident monitor to initiate immediate restart procedures. (See "Restarts from Checkpoints.")

(6) $8x: This message, which has three forms (x = A, R, or C), is given by the operator in reply to a message from the resident IOCS. The three forms and their uses are explained with the IOCS messages 20101, 30101, 30102. (See the "Console Messages from IBM Programs.")

d. Class B Messages. The following messages can be accepted only while the transitional monitor is in core storage between jobs. By means of a console message: 20501 ENTER B MESSAGES, the transitional monitor notified the operator that class B messages can be accepted. Class A messages can also be accepted at this time. This message is written if the operator previously entered the $20 console inquiry (described above) and each time a monitor END card is read from the standard input unit. After the transitional monitor notifies the operator, it enters a waiting loop for instructions from the console.

(1) $B4: This message causes the transitional monitor to close, rewind, and unload the core image file tape. This file contains records of core storage used for restarting from checkpoints or for obtaining storage prints. The operator then mounts another tape on the unit used for this file. (This message is applicable only if the core image file, which is optional, has been specified for the installation at system generation.)

(2) $B5ss: This 5-character message indicates to the transitional monitor that the physical unit represented by assignment symbol "ss" is currently unavailable for use.

(3) $B6ss: This 5-character message indicates to the transitional monitor that the physical unit represented by assignment symbol "ss" is now available for use. The transitional monitor removes the unavailable indication it had set in response to a $B5ss message for this physical unit.

(4) $Bcvwxyz: This message indicates that the operator can disconnect, direct, or change the assignment of the 1311 disk drives

on a specific channel. The letter c represents a channel number. If c is replaced with A, channel 1 is specified; if it is replaced with B, channel 2 is specified. The letters vwxyz represent the drive numbers for the disk drives that are on the channel. The number 0, 1, 2, 3, or 4 is placed in the position occupied by v, w, x, y, or z, respectively. The number entered in the v, w, x, y, or z position represents the disk drive number to which input/output operations are directed by the program. If a drive is to be disconnected, the corresponding position is left blank.

(5) $BX: This message indicates that the operator has no more class B messages at this time. It causes the transitional monitor to exit from the waiting loop it had entered to allow the operator to make console inquiries. After performing the functions indicated by each of the other class B messages, the transitional monitor returns to the waiting loop for further messages. Therefore, the $BX must be given to enable the transitional monitor to resume its processing. After the $BX message is entered, the transitional monitor completes functions related to previous class B messages.

3-8. CLOSING SYSTEM FILES: Core image files should be closed from the console by the $B4 message, rather than permitted to run to end of reel. On the core image file, certain control records, necessary for execution of the storage print program, are written at the beginning of the tape only when this file is opened. (Opening also occurs only during initialization and after each close order - $B4 - from the console.) If the records of a checkpoint are split between two reels of the core image file, a restart cannot be made from that checkpoint. That is, failure to close the core image file from the console will make restarting from a checkpoint impossible.

a. Class C Messages. The following message is given in reply to a message from the transitional monitor. The message from the transitional monitor, 20502 SUB FOR SS, notifies the operator than an ASGN card specified an assignment symbol "ss" for a physical unit that is currently unavailable (as indicated by a previous $B5ss message).

b. $Clss: This message specifies that the assignment symbol "ss" is to be substituted for the one contained in the ASGN card. The substituted physical unit must be currently available. The $B6ss message cannot be used at this time to indicate that the unit specified on the ASGN card is now available; it must have been given before the ASGN card was read.

3-9. DEFINITION OF TERMS: The general terms listed below are defined for use within this publication and all publications concerned with the 1410/7010 Operating System. Terms associated with a particular component of the operating system are defined within the publication describing that component.

a. Absolute Program. A machine-language program in a format ready for loading directly into a specific area of core storage.

b. Alternate Input Unit. An input/output unit that can be substituted for the standard input unit (SIU) to permit interruption of batch processing for a high-priority job or for unscheduled diagnostic routines.

c. Batch. A collection of jobs to be performed under the supervision of the system monitor.

d. Batch Processing. The processing of a collection of jobs by the computer without need for operator intervention between jobs.

e. Compile-and-Go. The compilation and subsequent execution of one or more programs within the job without need for operator intervention.

f. Job. One or more runs specified by the user to be compiled and/or executed as a logical unit without need for operator intervention.

g. LIB. System Library File, a group of relocatable subroutines or programs.

h. Macro Library. Contains the complete set of macro-routines stored on the SOF.

i. MGO. Go File -- contains relocatable programs compiled by the language processors.

j. MJB. Job File -- the output file used by Linkload. It contains programs in absolute format.

k. MDM. Core image file -- used by resident monitor for checkpoints, recording unusual end-of-program etc.

l. Master File. The tape file, provided by IBM, containing all elements of the IBM 1410/7010 Operating System. The master file is the source file for each installation's initial system generation run.

m. Processor. A machine-language program that translates source programs written in a symbolic language (i.e., Autocoder, COBOL, FORTRAN) into machine-language instructions. This process is called a "compilation."

n. Relocatable Program. A machine-language program of subprogram in a format that allows reassignment of addresses, thus making possible its conversion into an absolute program with address adjusted to correspond to any available area of core storage. This format also enables effective communication among several subprograms constituting a single, complete program.

o. Run. A major function performed by a computer, such as the execution of a compilor or an object program.

p. Standard Input Unit (SIU). A card reader or magnetic tape unit from which control information for the system monitor and other elements of the operating system can be read. It may also serve as the input medium for source program or other data.

q. Standard Print Unit (SPR). A tape unit or printer specified by the user to receive printer output from programs operating within the framework of the 1410/7010 Operating System.

r. Standard Punch Unit (SPU). A tape unit or card punch specified by the user to receive card-punch output from programs operating within the framework of the 1410/7010 Operating System.

s. Subprogram. The basic program element within the operating system. A subprogram can be a complete program in itself or a program segment (such as a subroutine) that is to be combined with other program segments to form a complete program.

t. System Generator File (SGF). The tape or disk file containing elements of the operating system, selected from the master file, which are needed to satisfy the total processing requirements of a specific installation. This file may also contain user-originated subprograms.

u. System Library. A file of relocatable programs created for use under control of the system monitor.

v. System Monitor. The supervisory program in the 1410/7010 Operating System that calls prespecified programs or routines into core storage as required. The system monitor, which operates in accordance with control information supplied by the user, provides compile-and-go and batch processing capabilities.

w. System Operating File (SOF). A tape or disk file, created by the user from the system generator file, containing absolute programs including the system monitor, which satisfy the particular processing needs of an installation. This file, if on tape, may also contain the system library.

SECTION FOUR

FORMATTED FILE SYSTEMS DESCRIPTION AND OPERATING PROCEDURES

4-1. GENERAL:

a. The Formatted Files.

(1) Large amounts of multisource information covering a broad range of subjects and received at the data processing complex in varied forms. This information is categorized by subject and/or application and added to a collection of similarly categorized data called a file (or data file).

(2) The file has a definite structure or pattern called the file format which facilitates the placing of elements of information in the file and their subsequent retrieval. When the elements of information are arranged according to the file format, each arrangement contains a description of an activity, event, objective, person, place, thing, etc. Each such arrangement of elements of information is called a file record (or data record).

(3) Thus, a formatted file is an ordered collection of related file records, each of which contains data arranged according to a previously established file format.

b. The Data.

(1) The values applied to some elements of the description of an event or activity do not change over the span of space or time covered by a file record. However, there may be other elements which assume several values within the span of the event covered by the file record. The file record must include each of the values attained by such varying elements in order to contain a complete and accurate history or description. The elements whose values do not change during the span need be recorded only once in the file record, ordinarily. Provision must be made for recording the changing elements several times.

(2) The data which describes the unchanging elements during the span of a file record is called fixed data. The file format allows for the insertion of one value for each of these fixed data elements in a file record. The data which may attain several values for the same descriptive element is called periodic data. The file format allows for a number of entries in each periodic data element in the file record.

(3) In addition to fixed and periodic data, there is a type of data which may be categorized as remarks or comments related to the event described by the file record. This type of data is quite variable in content and size from one file record to another, and might be appended to those file records requiring such remarks or comments.

4-2. THE FILE RECORD:

a. Fields.

(1) The file record is a collection of elements of data arranged in the pattern specified by the file format. The smallest unit of data is the field. Each field has a defined length and contains only one specific type of data. If the data content of the field is fixed data, the field is a fixed field and will appear only once within the file record. If the data content of the field is periodic data, the field is a periodic field and may appear many times within the file record. Assume that the following report was received:

> American Airlines DC8B, passenger flight #123 from Boston to San Diego completed with stops in Cleveland, Omaha, Salt Lake. LV Boston 2312, 25 Dec 64. Ar Cleveland 0037. Altitude 35500. LV Cleveland 0054, 26 Dec 64. Ar Salt Lake 0425. Altitude 35500. LV Salt Lake 0440, 26 Dec 64. Ar San Diego 0610. Altitude 31500.

(2) The report concerns a commercial flight (an event) from Boston to San Diego and contains information which can be broken up into several fields, such as airline name, flight number, point of departure, and point of destination. Each type of data in this report will be used in a specific field of the file record.

(3) Types of information such as flight number, aircraft type, and airline names are unchanging during the event and are, therefore, classified as information belonging to the fixed field category.

(4) Some of the information types are repeated within the report. For example, there are four locations from which a leg of the flight originated: Boston, Cleveland, Omaha, and Salt Lake City. This information changes during the event and is, therefore, placed in periodic fields. The periodic field named LEG ORIGIN would appear four times in the file record, once for each of the places from which a take-off occurred. If more stops and, therefore, more legs were given in the report, the number of periodic fields would increase. This characteristic of periodic fields to appear more than once within a file record allows the length of a file record to be variable even though field lengths are fixed.

b. Groups. Within the file record there can exist a closer relationship between some of the fields than exists between other fields. For example, in the report described above, data on the date and time of each takeoff is included. To accommodate this data, the file record could contain two periodic fields named DATE and TIME. However, because of the nature of the data in these two fields, they are often reported, retrieved and manipulated as a unit called a group. A group is a collection of two or more adjacent fields within a file record which may be treated as a single data entity. The fields within a group do not lose their individual identities because of this grouping and may be treated like any other field. Groups are named just as are fields, and a title such as TAKEOFF DATE/TIME might be appropriate in this case. Groups are categorized as either periodic groups or fixed groups, depending upon which type of fields are grouped. Both fixed and periodic fields cannot be included within the same group.

c. Periodic Subsets. The change of a value recorded in one periodic field is usually accompanied by changes in other associated periodic fields. In our example, the number of passengers, altitude, and gross weight are likely to change in each leg of the flight. Periodic fields containing information which is related in this manner are consolidated into periodic units called periodic subsets. When periodic data is added to a file record, it is usually added in units of periodic subsets rather than individual periodic fields or groups. (This is not meant to imply that individual fields or groups in an existing subset cannot be changed for correction or updating.) The periodic subset structure is specified by the file format, while provision is made for as many identically structured periodic subsets as is required.

d. Periodic Sets.

(1) In some circumstances, certain periodic data changes which occur in the history of an event are not directly associated with other periodic data changes. For example, at some of the stops in the flight, unscheduled maintenance functions may be performed. The maintenance activities are not related to, or normally associated with, the altitude, number of passengers, or the gross weight, etc. during each leg of the flight. The periodic data concerning maintenance activities may be entered into separate periodic subsets which have a different structure than the periodic subsets containing data about each leg of the flight.

(2) Periodic subsets having identical formats are grouped together into periodic sets. Thus, each periodic subset within a periodic set contains the same fields and groups in the same order, with only the data content of the periodic subsets varying. Periodic subsets having different formats are grouped into different periodic sets. The number of periodic subsets that may be in one periodic set is limited to 599, or the lesser number which causes the limitation on the size of

the file record itself to be exceeded. The number of periodic sets per file record is limited to a maximum of eight.

e. Fixed Set. The collection of all the fixed fields of a file record is often called the fixed set. Since fixed fields are non-repetitive within a file record, there is always one and only one fixed set in any file record. The first data fields of a file record are always the fixed fields, which comprise the fixed set. After the fixed set comes the periodic set(s), if any. Next to appear is the variable set which is described next.

f. Variable Set. The 1410 Formatted File System allows for one additional type of data to be contained in a file record. It is data which cannot be readily formatted and is typified by remarks or comment which are often added locally and not received from the ordinary source This unformatted data is entered into a set called the variable set. The variable set, unlike the other sets, can contain only one field of variable length. This is the only field in the file record which is not of fixed length. There can only be one variable set/field per file record. If a file record has a variable set, it appears after the periodic set(s) (if any) in the file record. The data content of the variable set cannot be utilized as a parameter or factor for retrieval or output processing, as may be data content of the fixed and periodic sets. However, the data content of the variable set may be retrieved and output, as may the data content of the fixed and periodic sets.

4-3. FILE RECORD FORMAT:

a. Figure 4-1 illustrates the layout of a file record. The elements outlined with dashed lines contain control information only and are program maintained. One point illustrated by figure 4-1 is the inclusion of a field in more than one group. Notice periodic field 2E in each of the periodic subsets of periodic set 2. It is included in periodic group 2F as well as 2H. Thus, field 2E may be referenced by refering to:

Field 2E
Group 2F (Field 2E accompanied by 2D)
Group 2H (Field 2E accompanied by 2G)

There is no practical limitation on the number of groups within which a field may be defined.

b. Record Control Group (Record ID).

(1) Some means must be provided for distinguishing one file record from another so that each may have a unique identity. In the 1410 FFS this is accomplished by each file record having unique data

content in a special group called the record control group or record ID. This record control group consists of one or more initial fields of the fixed set. The file designer ensures that the characteristics of the sum of the information in the record control group is such that no two file records will ever have identical data content in their record control groups. In figure 4-1 fixed fields FA and FB are the components of the fixed group FC which is the record control group or record ID.

(2) The order in which the file records are kept in the data file is also controlled by the record control group. The file records are ordered in ascending sequence by the data content of their record control groups. The record control group may be thought of as a file's "sort key" - major to minor - left to right. The maximum number of characters that may be included in the record control group is 30.

4-4. FILE GENERATION OPERATIONS: The File Generation Program consists of two phases:

File Structuring (phase 001)
File Revision (phase 997)

File structuring provides a pattern, file format table (FFT), of what the format of a new file will look like; file revision does the actual changing or alteration to the format of an existing file.

a. File Structuring Phase.

(1) FFS checks its inputs for validity to insure that no illegal format file table is built. If errors are detected, the FFT is not built, all inputs are read in and checked, and a complete printout of error inputs and a diagnosis for each results.

(2) If no errors are found, the FFT is written on tape for input to the FFS Relocatable Execution Library; it is punched on cards for backups, and a listing of inputs with associated FFT is printed for file documentation.

(3) File Generation may be operated in 2 modes:

Create Mode
Change Mode

Refer to figure 4-2. If the file structure job card calls for "create" or "change" mode, file structure phase must operate to build an FFT. Notice if the job were to change, file revision would be called in and operated. If "job" card were "create", file revision would not run.

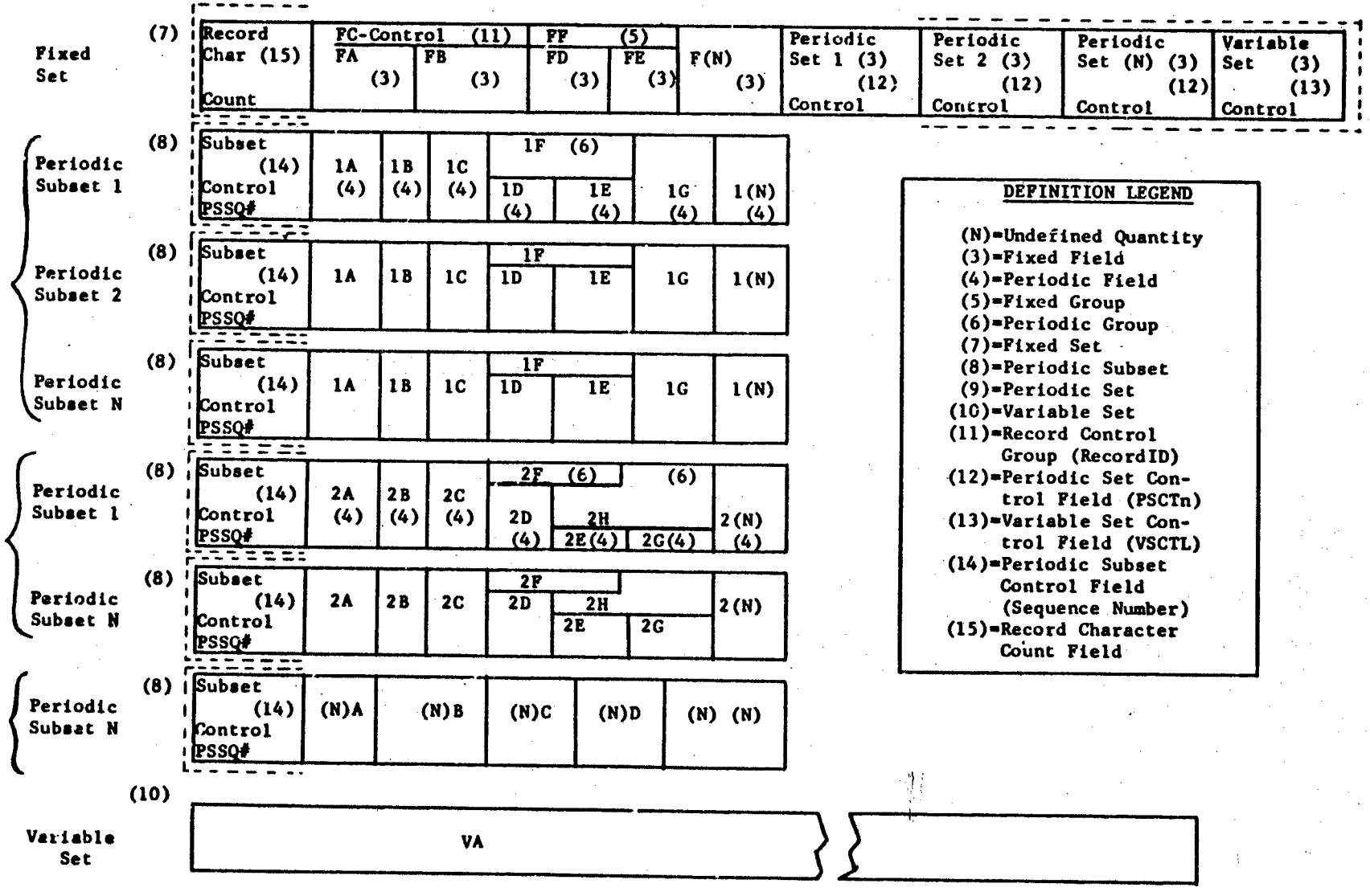


Figure 4-1. 1410 FFS File Record Layout.

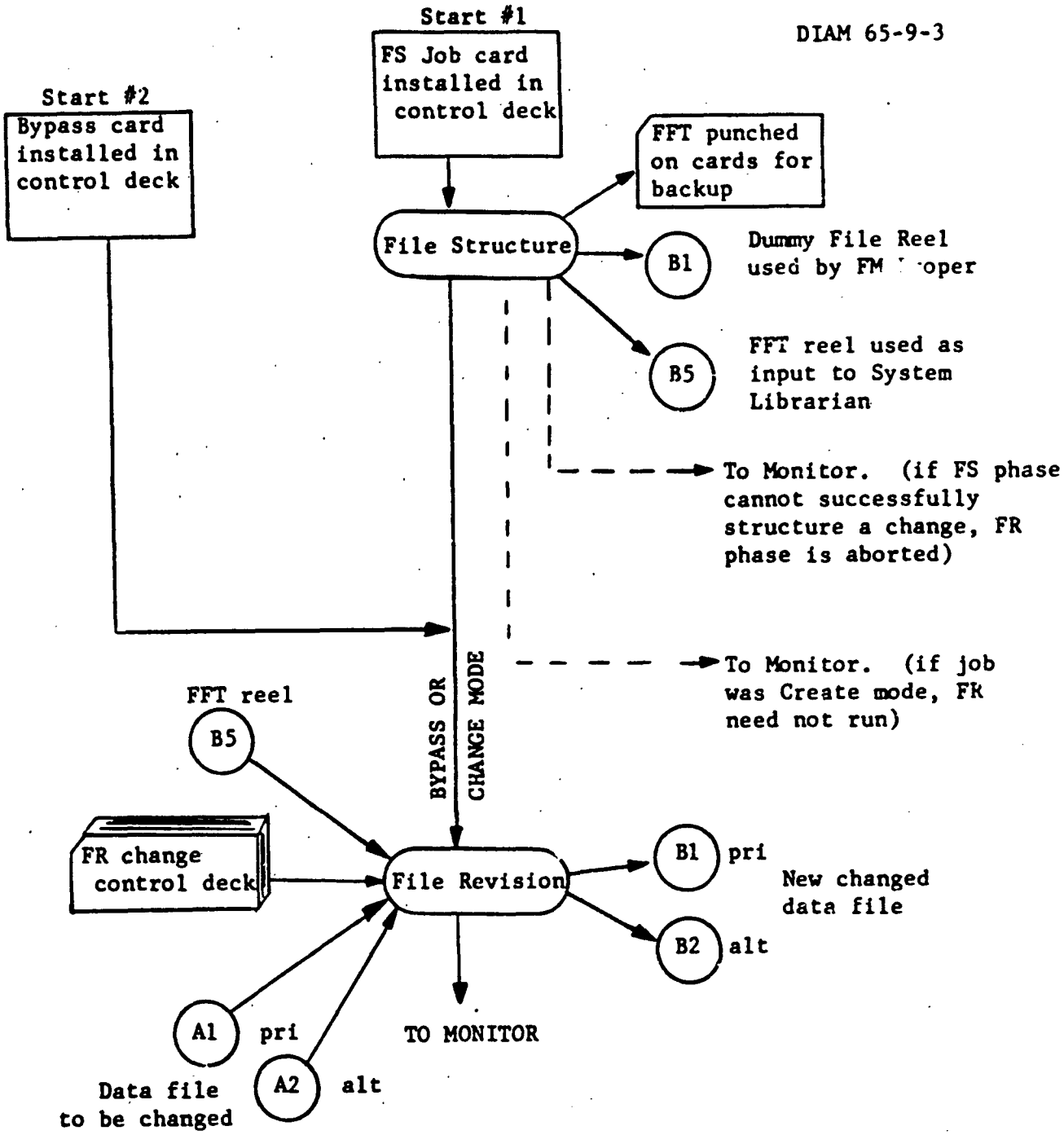


Figure 4-2. File Generation Operator Flow Diagram.

(4) The "bypass" card is used when, for some reason, it is desired to run only file revision phase; for instance, if the FFT for a "change" mode job were structured previously but there wasn't enough time to allow file revision to operate.

(5) The operation of file generation is initiated by operator receipt of an FG run initiation card (figure 4-3). Note that mode information should be checked. If bypass is checked, the serial number of the FFT reel to be used as input to file revision must be on the card. Also listed should be the reel serial numbers of the data file to be changed. If "change" is checked, only the reel serial number of input data file is needed. If create is checked, no input reels are needed. The operator must fill out the output tape reel serial numbers as listed on the card.

(6) Figure 4-4 shows construction of the FG run deck. Figure 4-5 is an example of file generation job batching. Included in this portion are the messages that the operator may receive from the file generation program. The meaning of the messages and the action required by the operator are also given.

b. <u>Start #1 (Create Mode)</u>.

Receive from Originator	FS DATA DESCRIPTION DECK FS JOB CARD (CREATE) END FS CARD
Prerun Setup	Build a run deck. See figure 4-4 and 4-5.
Run Setup	Run deck in 1402 reader. Ready the 1402 Punch with cards. Scratch on B5 and B1.
Special Instructions	Save cards punched (if any). Save and label B5 and B1.

c. <u>Start #1 (Change Mode)</u>.

Receive from Originator	FS DATA DESCRIPTION DECK FS JOB CARD (CHANGE) END FS CARD File Revision Change Control Deck. Serial number of data file reel.
Prerun Setup	Build a run deck. Figure 4-4 and 4-5. Pull data file reel from tape library.

Run Setup	Run deck in 1402 reader. Ready the 1402 punch. Scratch on B1, B2, B5. Data file reel to be changed on A1 and A2 if multi-reel inputs.
Special Instructions	If File Structure is successful (see console printer), return all inputs and outputs to originator.

d. Start #2.

Receive from Originator	File revision change control deck. File format table reel serial number. Data file to be changed reel serial number. BYPASS FS CARD
Prerun Setup	Build a run deck. Figure 4-4 and 4-5. Pull input reels from tape library.
Run Setup	Run deck in 1402 reader. Scratch on B1 and B2. File format table reel on B5. Data file to be changed on A1 and A2 if multireel inputs.

FILE GENERATION RUN INITIATION CARD

ORIGINATOR _____ DATE _____ RUN NO. ____ PRIORITY ____

☐ CREATE ☐ CHANGE ☐ BYPASS

INPUT FFT REEL SERIAL NO. (IF ANY) _____

REEL SERIAL # OF INPUT DATA FILE (IF ANY) _____

OUTPUT TAPE REEL SERIAL NUMBERS:

DUMMY FILE ____ FFT TABLE ___ NEW DATA FILE _____

ERROR TAPE _____

SPECIAL INSTRUCTIONS: (Action for error or hangup, what reels to save or scratch)

FRONT

OPERATOR COMMENTS:

BACK

Figure 4-3 File Generation Run Initiation Card

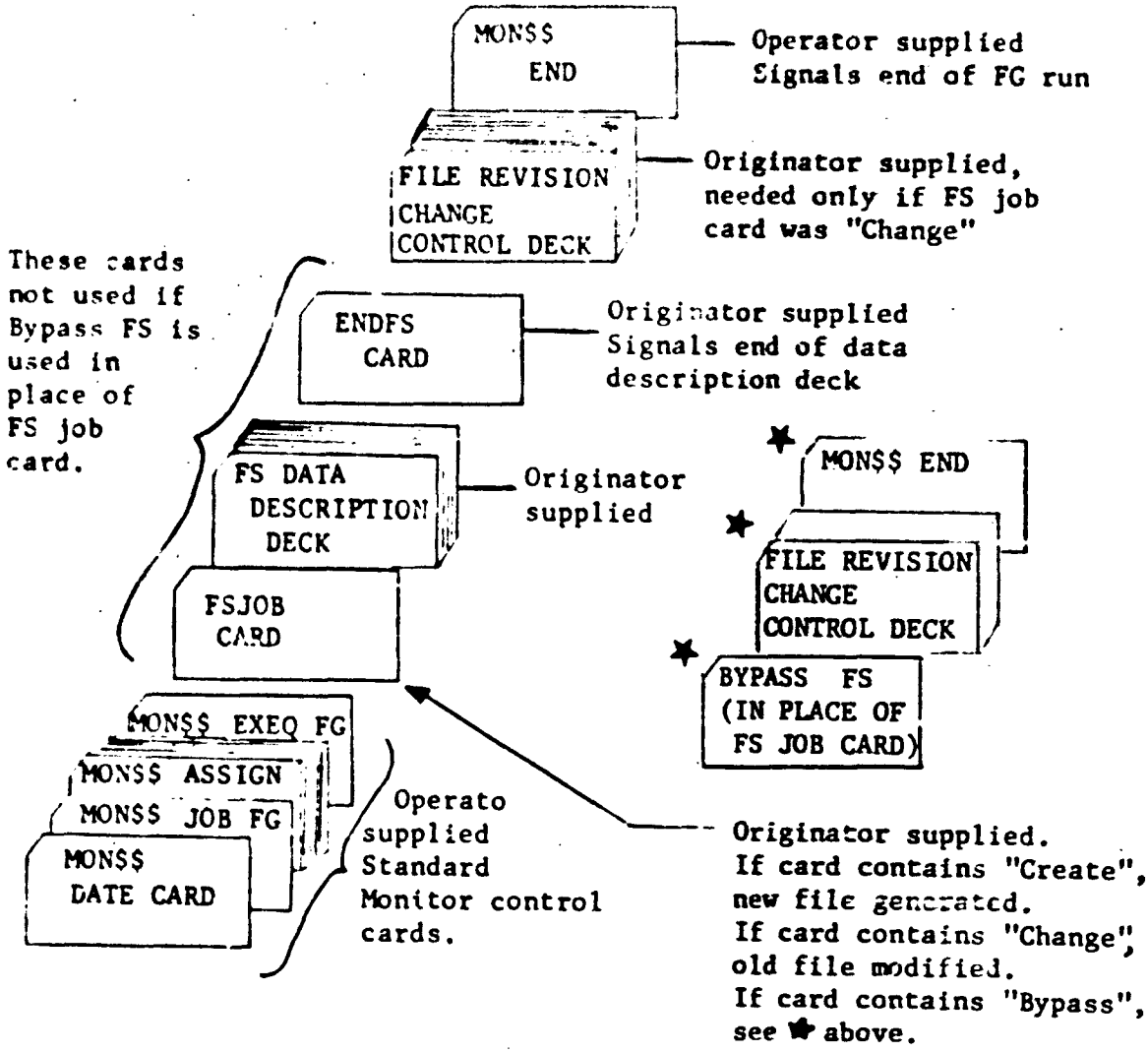


Figure 4-4. File Generation Run Deck.

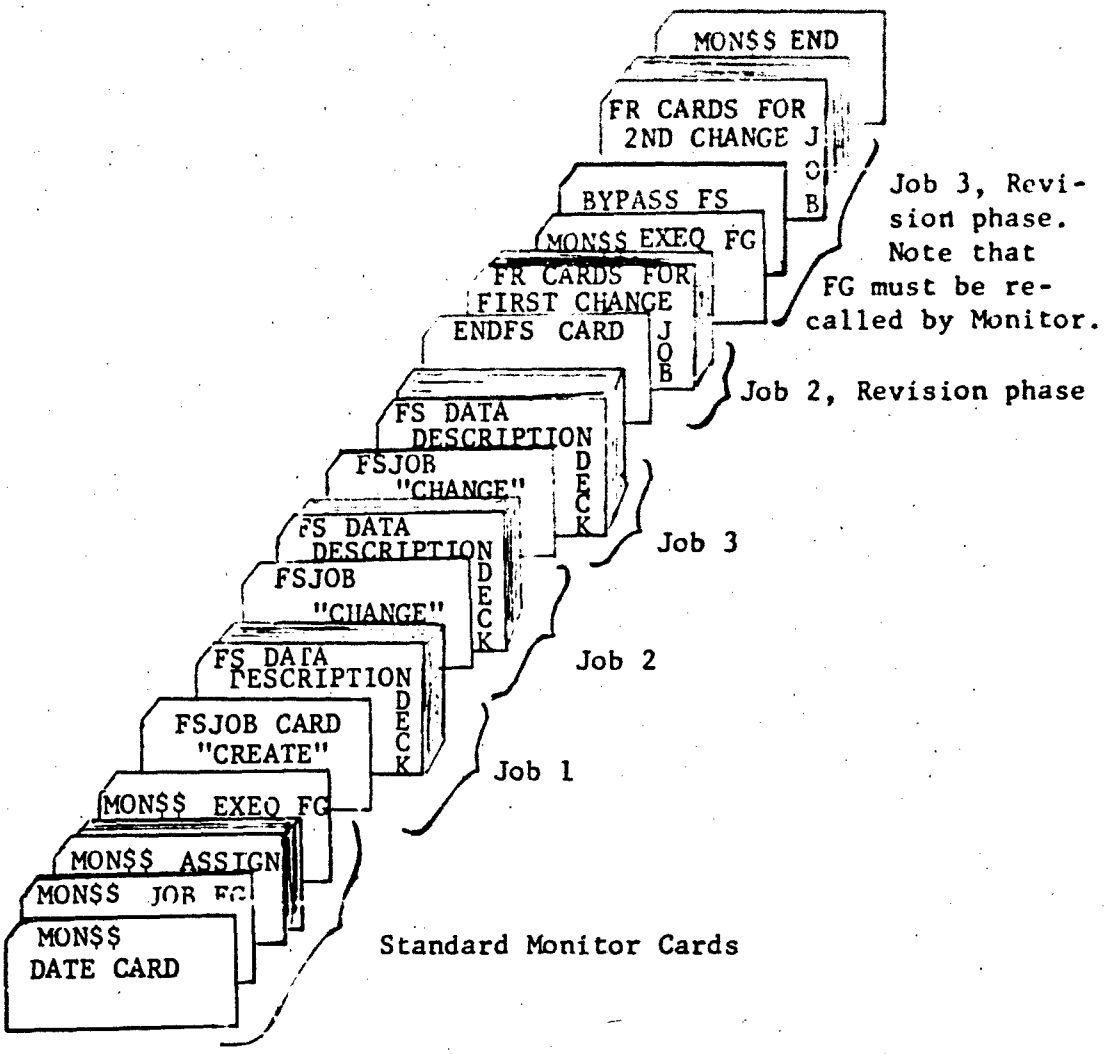


Figure 4-5. Example of FG Job Batching.

e. File Generation Operator Messages.

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
THE STRUCTURED FFTS ARE ON TAPE B5. LABEL REEL AND SAVE FOR INPUT TO SYSTEM LIBRARIAN. THE FILES ARE ..... xxxxx xxxxx etc.	The file structure phase has completed the format tables for all job inputs of this run. The names of the files involved in this run are listed. This message does not appear if job unsuccessful.	Label and save reel on B5.
DUMMY FILE ID/S ARE REPLACE B1, LABEL REEL AND SAVE. xxxxx xxxxx etc.	This message is printed only if job was "create" mode.	Information message Dismount B1, label and save, mount scratch on B1.
REPLACE DUMMY FILE ON TAPE B1, LABEL REEL AND SAVE FOR FILE MAINTENANCE	File structure phase will write each dummy file on a separate reel. This printout will occur for each "create" job in the FG run.	Remove dummy file reel from B1, label and save. Mount a scratch tape on B1. Enter $50 to continue
DISMOUNT B5, MOUNT SCRATCH ON B3.	File revision phase must write some recorded errors for this run. Machine is in a wait loop.	Dismount B5, switch the tape unit to B3, mount a scratch. Type $50 to continue.
NOGO SWITCH SET BY FFS	No FFTs successfully completed. No more runs in the job will be executed unless TEST mode has been specified. There is no core dump.	Scrap the job. Scratch all output tapes. Return all printouts to the originator.

4-5. FILE MAINTENANCE OPERATIONS: The file maintenance program consists of several program phases that operate under control of the file maintenance supervisor phase:

Input processor
Sort
FM Proper
Cross-Index Updater
Subset Purge

a. Input Processor Phase. IP phase gets the input data ready for insertion into the specified file. It handles 2 types of data input, data in an external format or data in an internal format. Internal format data is defined as data already having the format characteristics of the file to be modified. External format must be accompanied by an Input Descriptor Deck (IDD).

b. Sort Phase. The sort phase sorts transaction records in the sequence which permits file maintenance proper to merge the transactions into the data files.

c. File Maintenance Proper. FM proper reads the sorted transaction tape and processes the transaction records to either create records in a new file or update records in an existing file.

d. Cross-Index Updater Phase.

(1) The cross-index updater is responsible for updating the cross-indexed files with the cross-index file transactions generated by file maintenance proper. This update function includes both creation of new cross-index files and addition or deletion to existing cross-index files.

(2) The operation of file maintenance is initiated by operator receipt of a file maintenance run initiation card, figure 4-6. Note that the format for input data should be checked. The control card to be inserted in the deck should be listed as well as each phase of FM that is to operate. By referring to figure 4-7a/b it may be seen that FM may be started in 4 ways:

(a) From the beginning of FM

(b) Beginning with Sort

(c) Beginning with FM Proper

(d) Beginning with Subset Purge

Also note that FM may be stopped in two different places:

(e) After Input Processor

(f) After Sort

The operator is warned of these options by a message on the I/O Printer.

e. Start #1 (Starts With FMIP).

Receive from Originator	Reel serial numbers of input reels if applicable. Output control cards if applicable. IDD if applicable. Data cards if applicable.
Prerun Setup	Pull input tapes from library. Build a run deck. See figure 4-8.
Run Setup	Run deck in 1402 reader. Scratch tape on B1 and B2. If job is tape input, mount first reel of first input source on A3. Mount second reel of same input on A1. Further input reels of same input should be alternated between A3 and A1.
Special Instructions	If multireel output: At the end of each output reel during IP phase, the operator should: Remove the reel. Label in order TRANSØ, 1, 2, etc. Mount a scratch reel. Console printer gives unit and TRANS tape sequence number. Prior to continuing to SORT: Mount scratch on B3, B4, A3, and A4. Be sure TRANSØ is on B1.

FILE MAINTENANCE RUN INITIATION CARD

ORIGINATOR: _____ DATE: _____ RUN NO. _____ PRIORITY: _____

☐ Internal Format ☐ External Format ☐ Not Applicable

Control Card For:

☐ IP ☐ SORT ☐ FM Proper

☐ Subset Purge ☐ 2 Way ☐ 3 Way Merge

☐ Control Cards Inserted with Data

Run to include: ☐ IP ☐ Sort ☐ FM Proper ☐ Output ☐ Subset Purse

Input Tape Reel Serial No's: 1. _____ 2. _____ 3. _____

4. _____ 5. _____ 6. _____

Special Instruction: (Action for error or hangup; what reels to save or scratch)

FRONT

Operator Comments:

BACK

Figure 4-6 File Maintenance Run Initiation Card

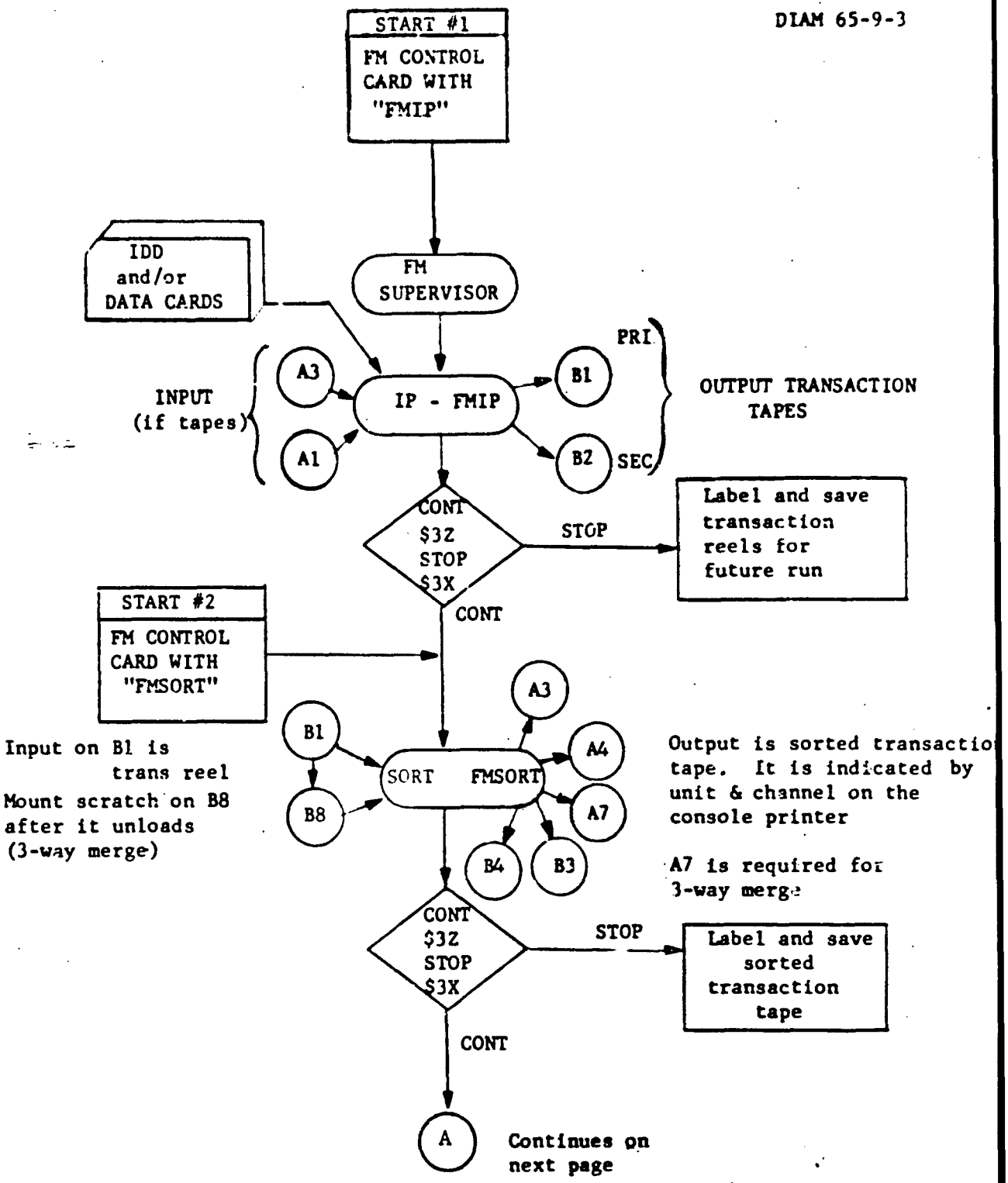


Figure 4-7a. File Maintenance Operator Flow Diagram Part I.

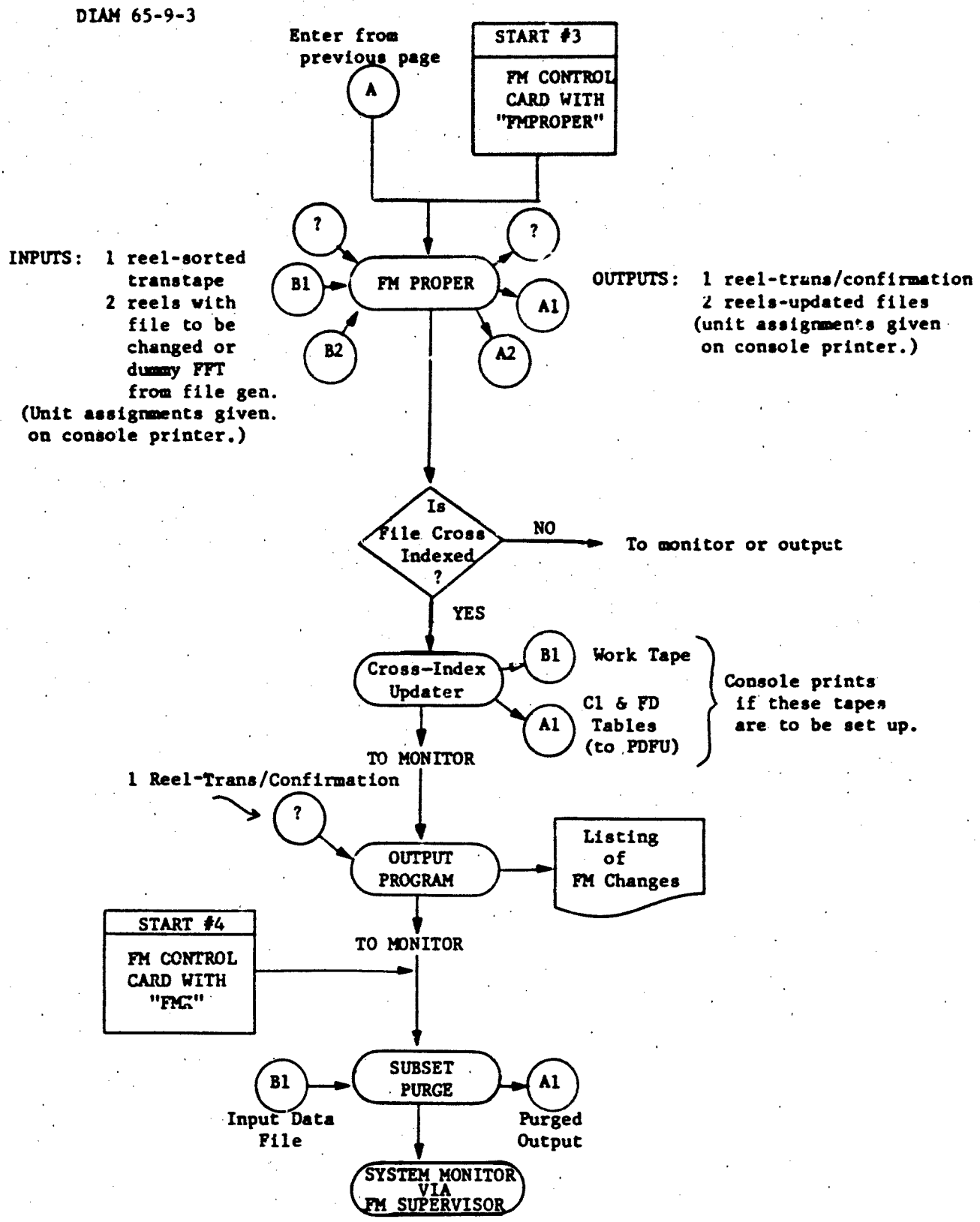


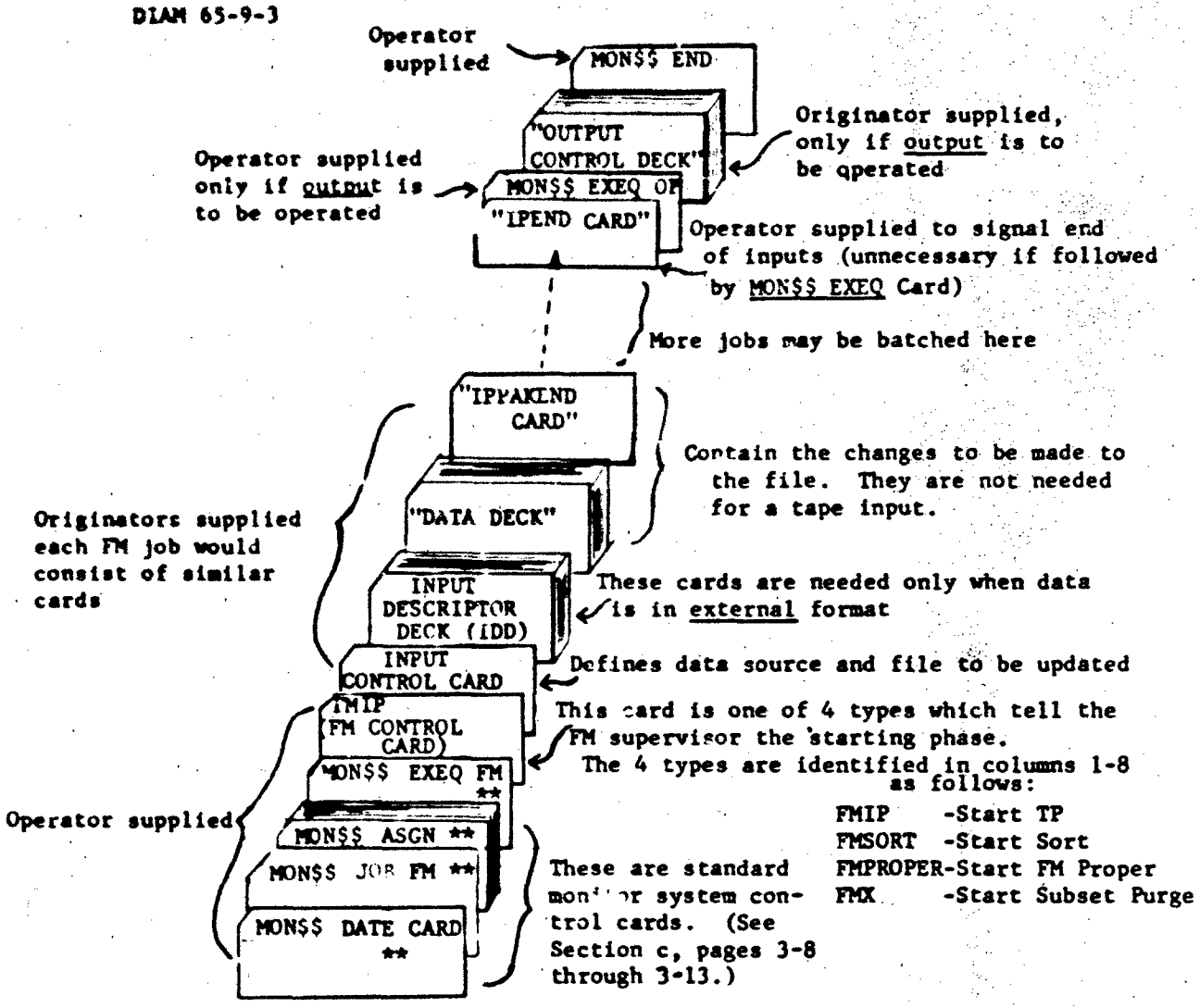
Figure 4-7b. File Maintenance Operator Flow Diagram Part II.

f. Start #2 (Starts With FMSORT) (2/3 Way Merge).

Receive from Originator	Reel serial numbers of unsorted input transaction tapes. Output control cards if applicable.
Prerun Setup	Pull Trans tapes from library. Build a run deck. See figure 4-8.
Run Setup - Two Way Merge	Run deck in 1402 reader. Scratch tape on A3, A4, B3, B4. Trans Ø tape on B1.
Add Setup for Three Way Merge:	Scratch tape on B8 and A8.
Special Instructions	See run initiation card.

g. Start #3 (Starts With FMPROPER).

Receive from Originator	Reel serial numbers of sorted input transaction tapes. Output control cards if applicable.
Prerun Setup	Pull transaction tapes from library. Build a run deck. See figure 4-8.
Run Setup	Run deck in 1402 reader. Scratch tapes on A1, A2 and B3. Mount transaction tape on A3. Note: These instructions will also be printed on the console.
Special Instructions	See run initiation card.



Note: If the FM Run is initiated with either phase "FM SORT" or "FM PROPER", the only control cards required are those marked with **.

Figure 4-8. File Maintenance Run Deck.

h. FILE MAINTENANCE OPERATOR MESSAGES

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
NOGO SWITCH SET BY FFS	Special end of program. No more runs in the job will be executed unless TEST mode has been specified. There is no core dump.	The job is scrapped but some tapes should be saved depending upon the phase last executed. (1) Before end of IP, scratch all tapes. (2) After end of IP, save transaction tape on B1. (3) Save the output tapes of all files whose updates are completed.
BEGIN FILE MAINTENANCE RUN	File Maintenance Supervisor has started processing	Info - - None
CONTROL CARD ERROR	Processing has stopped.	Error - - Rerun the job with corrected or proper control card.
IP PHASE - FMIP	Input processor is now operating in core.	Info - - None
PROCESSING SOURCE n, DATA FOR FILE "xxxxx"	Input processor is using input data from source n and preparing this data to modify file xxxxx.	Info - - None

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
IF THERE ARE MORE REELS TO THIS CHANGE FILE, ENTER # 3 YES. IF NOT, ENTER # 3 No.	This message comes out when Input processor is finished with each individual input reel.	Info request -- Operator should insure that input reels are mounted in the following manner: A3 A1 1st Reel 2d Reel 3d Reel 4th Reel 5th Reel 6th Reel etc. etc.
xxxxxxxxx TRANSACTIONS, yyyyyyyyy DATA ERRORS	IP accomplished xx transactions, out of these there were yy transactions in error. This message is always printed with tapes as input. With card input it is printed only if an IP PAK END card was present.	Info - - None

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
RUN DELETED, SCRATCH OUTPUT TAPES. SCRATCH TRANS "n"	Entire run has been scrapped. IP has found many errors, it is back-tracking through the job.	Info -- Return all inputs to originator. Instructional - Self-explanatory.
LOAD TRANS REEL "n" on "cu"	Machine is in a wait loop. IP has back tracked far enough to find beginning of errors.	Self explanatory Enter $5Ø to continue
DISMOUNT "cu" MOUNT TRANS REEL "n"	No alternate output is available Machine is in a wait loop.	Self explanatory. Enter $5Ø after changing reels.
FM JOB BEING DELETED	Here only a job within the run is being scrapped. Name of file and source has already been printed.	Info - - None

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
SAVE xx, TRANS REEL nn	IP has filled an output reel with transaction records.	Instructional - Remove and label trans reel. Replace a scratch on the unit.
END of IP PHASE	All transactions are complete, IP is leaving core.	Info - - None.
IF CONTINUE TYPE $3Z IF STOP $3X.	This message occurs after IP phase, and after SORT Phase.	Control request SEE FM Operator Flow Diagram.
RETYPE MESSAGE	The operator was in error when typing in $3X or $3Z	Error - Self explanatory.
RUN ENDED BY OPERATOR	Occurs when operator types in $3X to stop the FM run.	Info - Self explanatory.
BEGIN FILE MAINTENANCE SORT	FM SORT is in core and operating.	Info - - None.

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
END FILE MAINTENANCE SORT	Transaction tapes are sorted, SORT is leaving core.	Info - Self explanatory.
MOUNT TRANSACTION TAPE ON A3, MOUNT SCRATCH TAPES ON A1, A2, AND B3. TYPE $5Ø TO CONTINUE	Computer is in a wait loop. This message is printed when job is initiated with FM Proper (Ø4Ø).	Info - - Mount tapes as printed.
MOUNT INPUT FILE TAPES THE FIRST ON xx, THE SECOND ON yy, WHEN FIRST IS READY OPERATOR SHOULD TYPE $5Ø TO CONTINUE PROCESSING FILE ID ----- SER. NO. --------	Self Explanatory	Reels should be mounted in following sequence: UNIT xx Unit yy 1st Reel 2d Reel 3d Reel 4th Reel 5th Reel etc. etc. NOTE: As each new file called for is mounted, the first reel of that file <u>must</u> go on xx.
BEGIN UPDATE FILE xxxxx	xxxxx is the name of the file now being updated.	Info - - None.

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
END UPDATE FILE XXXXX	xxxxx is the name of the file that has just been updated.	Info - - None.
PUT NEXT REEL FOR THIS FILE ON yy, OLD REEL IS BACKUP.	FM Ø4Ø has finished processing a reel of the file being updated.	Instructional -- Dismount reel on yy and save. Mount next input reel on same unit. If there are no further input reels, disregard.
PUT NEW WORK TAPE ON xx, REEL REMOVED IS NEW FILE TAPE, SAVE, LABEL. MOUNT ZZZZZ FILE TAPE ON xx, REMOVE AND SAVE NEW FILE TAPE FROM yy, AND MOUNT NEW WORK TAPE HERE. WHEN NEW FILETAPE IS MOUNTED TYPE $5Ø.	FM Ø4Ø has filled an output reel with new file data. Updating is complete on all tapes of one file.	Instructional - Replace this reel with a scratch. Remove reel from xx, save. Remove reel from yy, label, save. Mount scratch on yy. Mount first reel of next file on xx.

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
PUT NEW WORK TAPE ON xx, REEL REMOVED IS NEW FILE TAPE, SAVE, LABEL. MOUNT ZZZZZ FILE TAPE ON xx, REMOVE AND SAVE NEW FILE TAPE FROM yy, AND MOUNT NEW WORK TAPE HERE. WHEN NEW FILE TAPE IS MOUNTED TYPE ØØØØ.	FM ØØØØ has filled an output reel with new file data. Updating is complete on all tapes of one file.	Instructional -- Replace this reel with a scratch. Remove reel from xx, save. Remove reel from yy, label, save. Mount scratch on yy. Mount first reel of next fill on xx.
END FM PROPER. SAVE FILE TAPE ON xx, AND TRANS TAPE ON yy. AS BACKUP TAPES. REMOVE RING FROM NEW FILE ON ss, LABEL AND SAVE. TAPE ON tt IS INPUT TO OUTPUT PHASE. ØØØØØ TRANS PROC.	The last tape of the last file to be updated has been processed.	Output program may be executed immediately to process the tape on tt unless further messages on console printer indicate that Cross Index Update is to be operated phase ØØØØ.
INACCURATE CI TABLE FOR FILE ZZZZZ.	Program Error.	Error - Scrap the job
TRANSACTION FILE MESSAGE BLANK	Transaction tape contains bad data.	Check for proper transaction tape on input unit. File maintenance must be rerun starting with IP (Phase ØØØØ).

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
CROSS INDEX FIELD CANNOT BE BLANK	Program Error.	Error - Scrap job.
SUBROUTINE CANNOT FIT IN CORE.	Program Error.	Error - Scrap job.
NO DISK AVAILABLE FOR FDT.	Program Error.	Error - Scrap job.
NO SET TABLE FIRST TRANS RECORD FOR FILE ZZZZZ.	Transaction tape is not in correct format.	Error - See if wrong reel is mounted on drive where transaction tape should be. Dump transaction tape and scrap job if tape error.
NEW RECORD CHAR COUNT ERROR	Program Error.	Error - Scrap job.
CROSS INDEX SUBROUTINE WILL NOT ACCEPT DATA	Program Error.	Error - Scrap Run.

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
ERROR HAS BEEN SENSED BY THE SEOF/ ROUTINE WHILE TRYING TO CLOSE THE FIRST (SECOND) CROSS INDEX FILE.	Program Error.	Error - Scrap Run.
FOR TWO WAY MERGE, TYPE $32, FOR THREE WAY MERGE, TYPE $33.	Self explanatory.	See run initiation card.
REPEAT MERGE ORDER SPECIFICATION	Incorrect input from console.	Repeat merge request using correct characters ($32 or $33 as appropriate)
REASSIGN SYMBOLIC UNIT	Symbolic units needed for two way merge incorrectly or not assigned.	Check ASGN Deck to ensure inclusion of: MON$$ ASGN MRB, B3, B4, B8. MON$$ ASGN MRD, A3, A4, A8.
READY DATA FILE ON MRE/B1/SCR ON MRC/A1/.	Set up for subset purge	Information - Mount tapes as indicated.

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
xxxxx - HAS NO FFT, ENTER $3T TO TRY ANOTHER OR $3S TO END JOB.	File Format Table of file on B1 is not on the library.	Mount another file (whose FFT is on the library) or scrap run. Return to initiator for possible library update.
END FM - PURGE	Subset purger is complete	Information - None
WRONG FORM SET ID TBL HAS NO RECORD MARK.	Logical record 4 of the FFT has been improperly structured.	Scrap Job - return to initiator.
(PRINTER MESSAGE) xxxxx WARNING xxxxx RECORD CONTROL CHANGED: -FROM -/xxx----- xx/ -TO - /xxxx ----- xx/ -FILE MAY NEED SORT --- INFORM USER	The given record control has been changed.	Inform Run Initiator

4-6. PERIODIC PRESORT: The periodic presort sets up sort keys on the records of the file or answer tape against which it is run. Periodic presort is followed by a retrieval sort run which performs the actual sort on the periodic fields. Input is on tape. The run instructions and console message follow. Figure 4-9 illustrates the run deck and figure 4-10 is the operator flow diagram.

a. Start PS.

Receive from Originator	PS SORT control deck, serial number of data file or retrieval answer tape.
Prerun Setup	Build a run deck as shown in figure 4-9 which follows. Pull data file or answer tape from tape library.
Run Setup	Run deck into 1402 reader. Mount scratch tapes on B3 and B4. Mount data file or answer tape on B1 (and B2 if multireel file).

b. PS Console Message.

Console Message	Meaning	Operator Action
XXXXX RECS OUTPUT ON XX, YY	End of successful run	NONE

4-7. RESTORING AFTER FM - FILESORTER:

a. Upon completion of a File Maintenance run which has made changes to Record ID's of the file, the file, normally, should be resorted. No automatic sort is available; however, the FILESORTER program has been generated to perform this job. FILESORTER uses the 1410/7010 Operating System Generalized Tape Sort Program. The FILESORTER program will be entered in the System Operating File (SOF) at the time each Mark II FFS is implemented. It should be executed after each FM job which may have made changes to record ID's of the data file. The run setup instructions, flow diagrams (figure 4-11) and card deck sketch (figure 4-12) are provided for operator convenience.

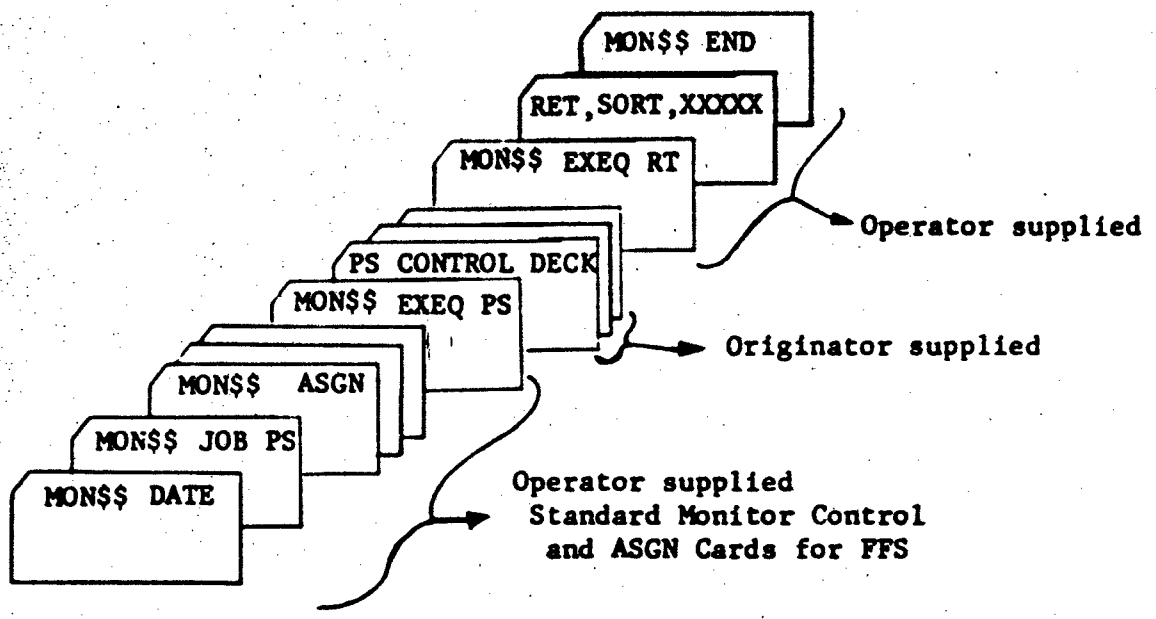


Figure 4-9. Periodic Presort Run Deck.

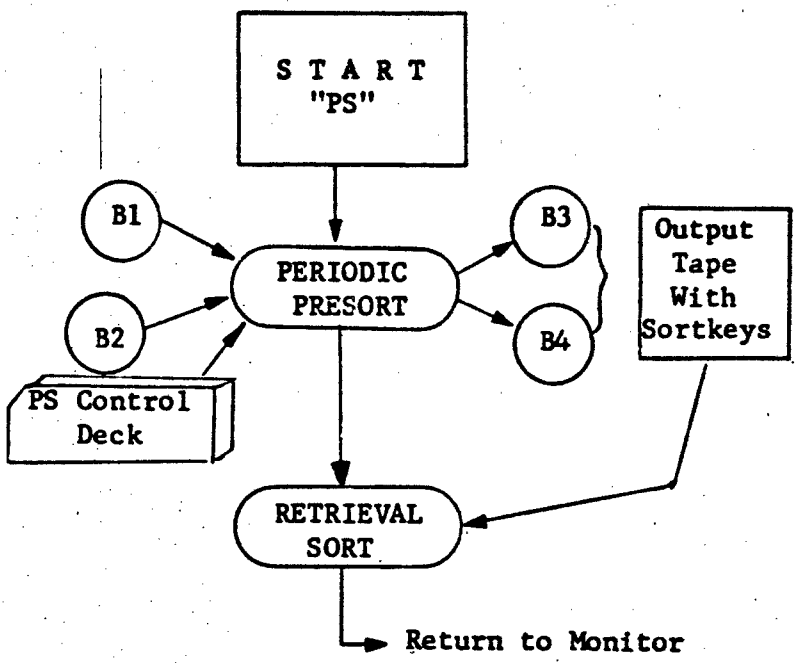


Figure 4-10. Periodic Presort Operator Flow Diagram.

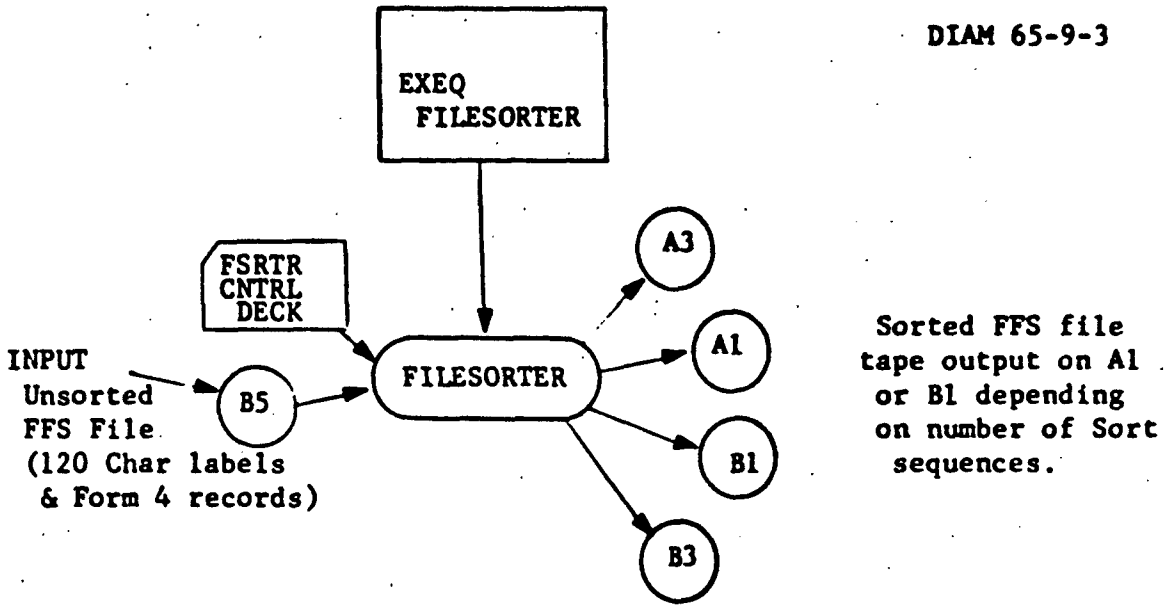


Figure 4-11. Filesorter Operator Flow Diagram.

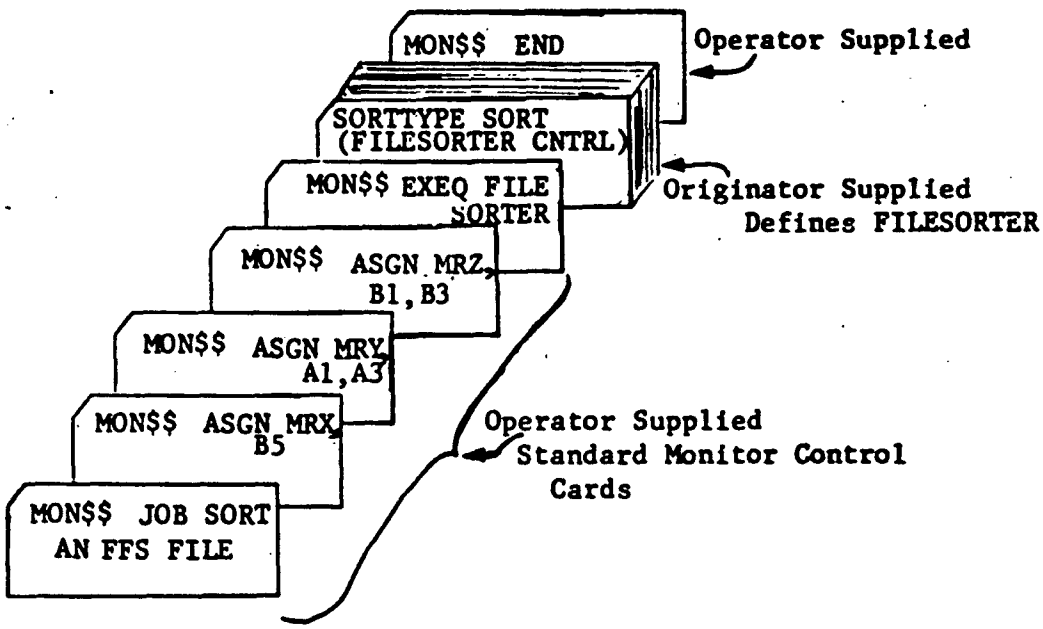


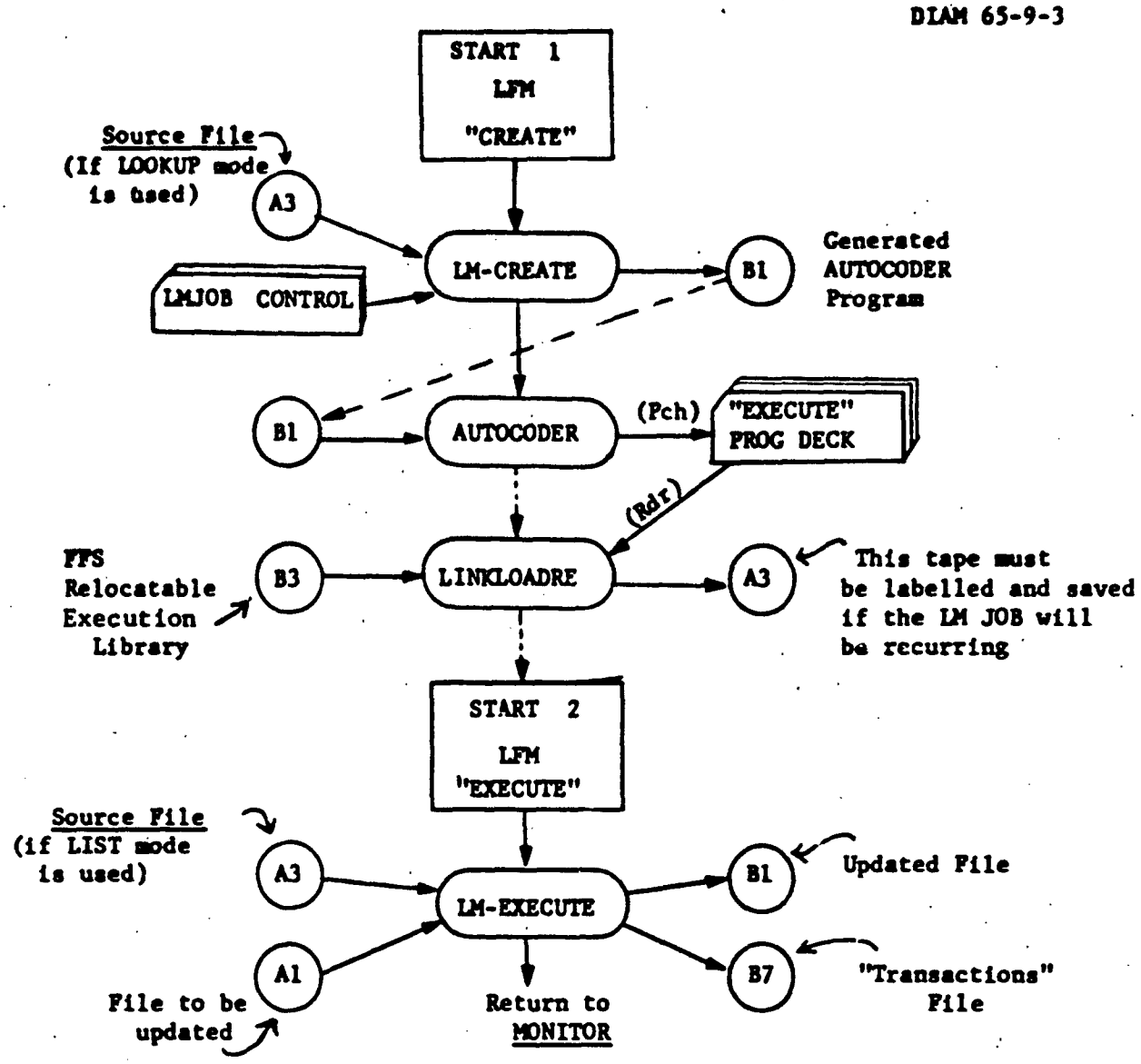
Figure 4-12. Filesorter Run Deck.

b. FILESORTER Run Setup

Receive from Originator	FILESORTER control deck. Reel serial number of input data file tape. (If FILE-SORTER is run immediately following FM the data file to be input will be the output of FM.)
Prerun Setup	Build a run deck (figure 4-12). Pull input data file tape(s) from library.
Run Setup	Run deck in 1402 reader. Mount tapes as follows: Input on B5. Scratch tapes (output) on A1, A3, B1, B3.
Special Instructions	Label sorted (output) data file (in accordance with console instructions) and save. Return input data file to originator along with deck of control cards. Ignore console message "CPT nnc" which identifies check points only. FILESORTER can be used to sort any file of "Form 4" records.

4-8. LOGICAL FILE MAINTENANCE (LFM): The logical file maintenance module provides a capability to update portions of one file with data from another file without involving tedious, time consuming regular file maintenance (FM) procedures. It allows data within a file to be manipulated quicker and with less effort. It makes possible using "verified" data in a "Master" file to update fields or records in a "subordinate" file(s) thereby reducing volume of input data and the probability of erroneous or dissimilar data occurring in the "subordinate file.

a. LFM Run Types. The LFM module is performed in two phases. During the first phase, the LFM execution program and any necessary tables are generated. This program is assembled and placed in the FFS Execution Library. The second phase is begun when the LFM supervisor calls in the generated LFM execution program (and associated tables) and causes it to be executed. The two phases may be run together or separately in response to the requirements of the job to be performed.



Note: If LM is to be a complete run of both phases, a scratch tape may be placed on B1 at the beginning and left throughout. It will be used twice as a work tape and then will be used for the final UPDATED DATA FILE.

Figure 4-13. Operator Flow Diagram - LFM.

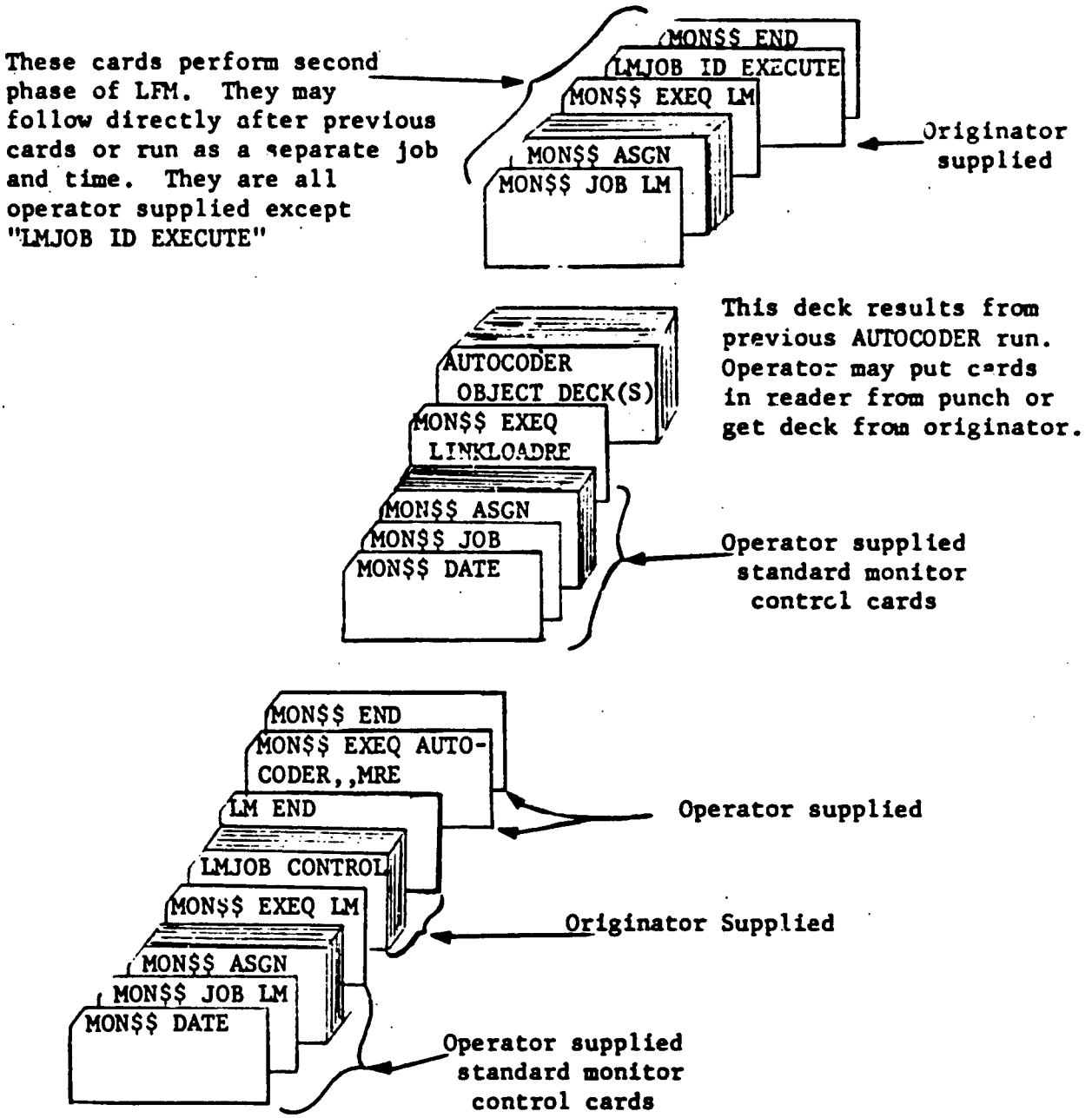


Figure 4-14. LFM Run Deck.

If an LFM job is recurrent, the first phase need only be run once and the resultant program and tables saved in the relocatable library. Succeeding runs can then begin at the second phase starting point (execute). When a job is a one time job, the first and second phases normally will be performed in sequence. The program and tables would not be saved. The run setups, flow diagram (figure 4-13) and run deck(s) (figure 4-14) follow.

b. LFM Run Instructions.

Receive from Originator	LFM control card deck(s). Reel number(s) of data file(s) needed for job. Input data card deck or tape reel number as required.
Prerun Setup	Pull tapes from library. Build card deck(s) as shown in figure 4-14.
Run Setup	Run LFM cards in 1402 reader. Mount tapes in conformance with operator flow diagram, figure 4-13.
Special Instructions	If the job is to be run with both phases and will be a recurring job, label and save the tape containing the execution program and tables. Label and save the "transaction" tape on B7. Standard LINKLOADRE tape assignments apply for the library updates.

c. LFM CONSOLE MESSAGES.

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
NO LMJOB CARD RESTART JOB	Originator has not provided a proper LM JOB card	Correct and restart job
BAD LM JOB CARD RESTART JOB	Originator has not provided a proper LM JOB card	Correct and restart job

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
NO EXECUTION PROGRAM ON LIBRARY JOB SCRAPPED	Self-explanatory Originator has probably furnished wrong ID on the LM JOB ID EXECUTE card	Return to originator
NO LOOKUP TABLE FOR THIS JOB	Advisory only (could be of significance to originator in case of serious trouble in the run)	None
xxxxx NOT AVAILABLE	Advisory only This is name of last table looked for	None
NO FILE CARD, RELOAD PUSH START	Originator has not furnished a proper FILE SOURCE card	Scrap job and inform originator
NO TABLE ARGUMENT IN SOTAB	Noncorrectable error, possibly from bad control card deck	Scrap job and inform originator
ERROR IN SOURCE TAB	Noncorrectable error, possibly from bad control card deck	Scrap job and inform originator

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
NEW DATA FILE RESORTING MAY BE REQUIRED	Advisory only	Originator should be informed.
ILLEGAL INPUT TYPE JOB SCRAPPED	A source file is required yet it is neither a file, an answer tape, nor on cards	Inform originator
TAPE LABEL READS xxxxx. SCRAP JOB	The tape label ID does not match the source file specified in the control cards	Mount proper tape and restart job
CARD INPUT - TABLE CREATION	Advisory only	None
ILLEGAL CODE IN INSTRUCTION TABLE. JOB JUNKED	Indicates probable program problem in LG1A1	Inform originator
A - FIELD MOVE ERROR	Same as above	Same as above
B - FIELD MOVE ERROR	Same as above	Same as above

4-9. RETRIEVAL OPERATIONS: Retrieval may be operated using cards or magnetic tape as the input. The card input is called a logic or query deck, the tape input is called a QTAPE. (The QTAPE is generated directly from the logic deck.) The logic or query deck contains cards with "statements" employing English words:

```
IF,AIRCRAFT-TYPE,EQUALS,DC8,
OR,AIRCRAFT-TYPE,EQUALS,707
AND,DEPARTURE-CITY,EQUALS,NEW YORK,
```

In this example, the inquirer is looking for all flights meeting the specifications of aircraft type DC8 or 707 and departing from New York City. The Retrieval Program would proceed to check the proper file to find all flight plans meeting these specifications and bring them to the inquirer's attention. A QTAPE input produces essentially the same results. A retrieval run is initiated upon operator receipt of a run initiation card (figure 4-15).

The retrieval program consists of several phases under control of the retrieval supervisor:

Retrieval Input Editor (Phase Ø2Ø)
Retrieval Input Processor (Phase Ø3Ø)
Retrieval Cross-Index Processor (Phase Ø4Ø)
Retrieval Proper (Phase Ø5Ø)
Retrieval Sort (Phase Ø6Ø)

a. Retrieval Input Editor. This phase accepts requests and/or reports against existing data files from card input. It checks the cards for error and completeness. Any report or request found in error is deleted. The acceptable cards are written on the QTAPE.

b. Retrieval Input Processor. This phase interprets the search criteria specified in each query and converts them into logic tables.

c. Retrieval Cross-Index Processor. Using the logic tables created by the previous phase, retrieval cross-index processor searches the cross-indexes to obtain a list of access numbers to those data records which are to be searched in depth by retrieval proper.

d. Retrieval Proper. Retrieval proper searches the data files specified for a retrieval run with the search criteria defined in the logic tables.

e. Sort Phase.

(1) Sort phase rearranges the answers to queries (contents of the answer tape) into the order specified by the user.

RETRIEVAL RUN INITIATION CARD

Originator: _____ Date: _____ Run No: _____ Priority: _____

Run Type: 1 2 3
(circle one)

Save QTAPE ◯ Yes ◯ No
Execute SORT ◯ Yes ◯ No
Execute OUTPUT ◯ Yes ◯ No

Input Tape Reel Serial No's: QTAPE _____ ANSWER _____

Output Tape Reel Serial No's: QTAPE _____ ANSWER _____

Input Data Files Required: _____ _____ _____

_____ _____ _____ _____

Special Instructions: (Action for error or hangup, what reels to save or scratch)

FRONT

Input Data File Required (continued from front) _____ _____

_____ _____ _____ _____

_____

Special Instructions (continued from front) _____

_____

Operator's Comments: _____

BACK

Figure 4-15. The Retrieval Run Initiation Card

(2) The operator may utilize three different run types as can be observed in the "Operator's Flow Diagram," figure 4-16. Run type 1 is used when a logic deck (cards) is the input. Run type 2 is used when the input is a QTAPE. Note that either run can be stopped before going on to SORT. Run type 3 is used to begin with SORT. The operator's flow diagram may be referenced for operator actions, options, input and output units as well as general program flow. The option is provided to have the retrieval program proceed to the output program in order to structure and print the answers found during the retrieval run.

f. Retrieval Run Type 1 (Card Input).

Receive from Originator	Deck of logic cards Retrieval control card Output control cards if applicable.
Prerun Setup	Build a run deck (figure 4-17).
Run Setup	Run deck in 1402 reader. Scratch on A9, B3, B1[1].
Special Instructions	If SORT is to be executed, the following must be done prior to responding to SORT message in phase Ø5Ø with $3S. Remove input reels from A1 and A2. Remove QTAPE from B1. Scratch on A1, A2, B1, B2.

g. Retrieval Run Type 2 (Tape Input).

Receive from Originator	Retrieval control card. QTAPE serial number. Output control cards if applicable.
Prerun Setup	Build a run deck (figure 4-17). Pull QTAPE from library.
Run Setup	Run deck in 1402 reader. Scratch on B3[2]. QTAPE on B1.

[1] B3 and B1 should be scratch tapes with 120 character header labels.

[2] Scratch with 120-character header label.

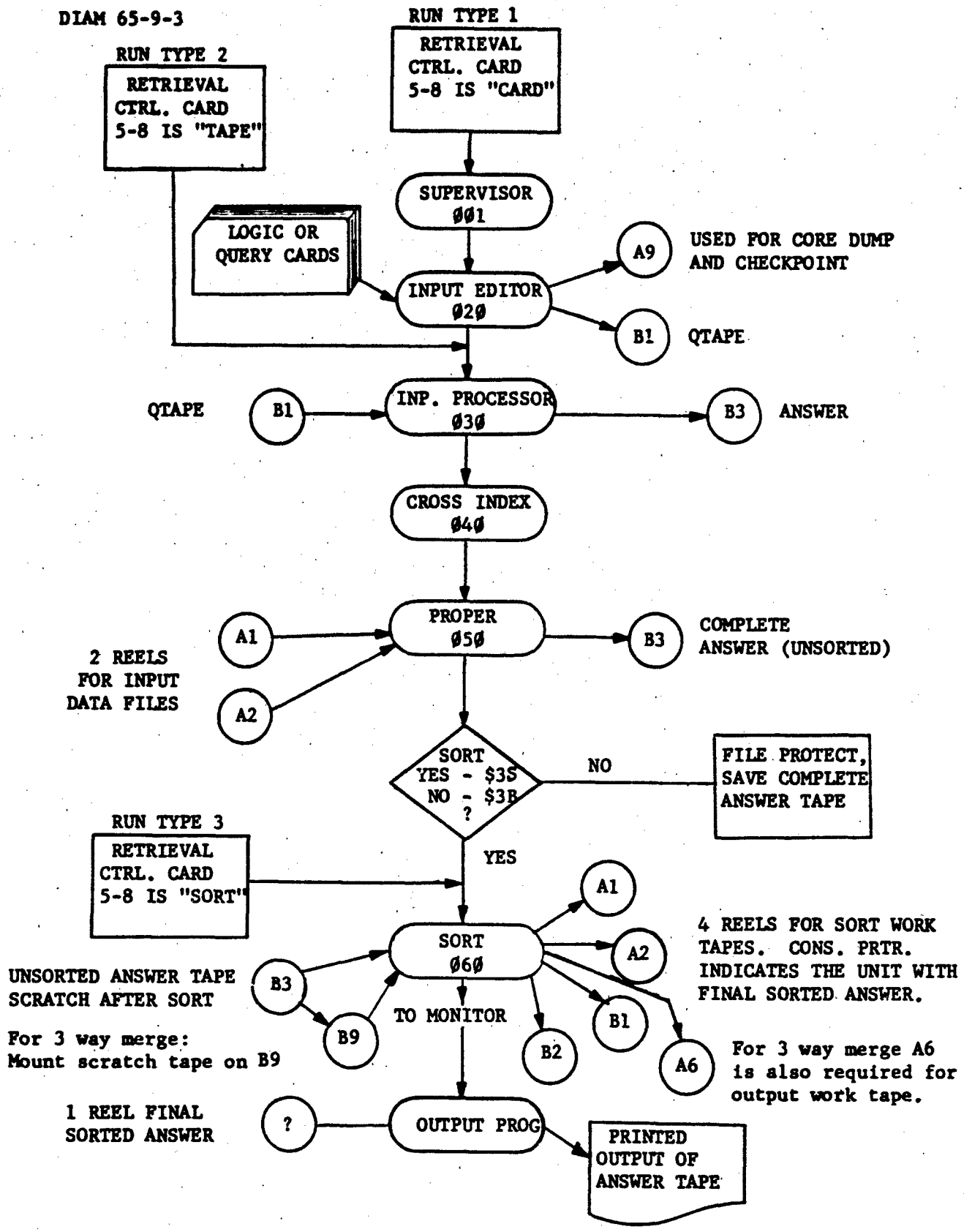


Figure 4-16. Retrieval Operator's Flow Di. gram.

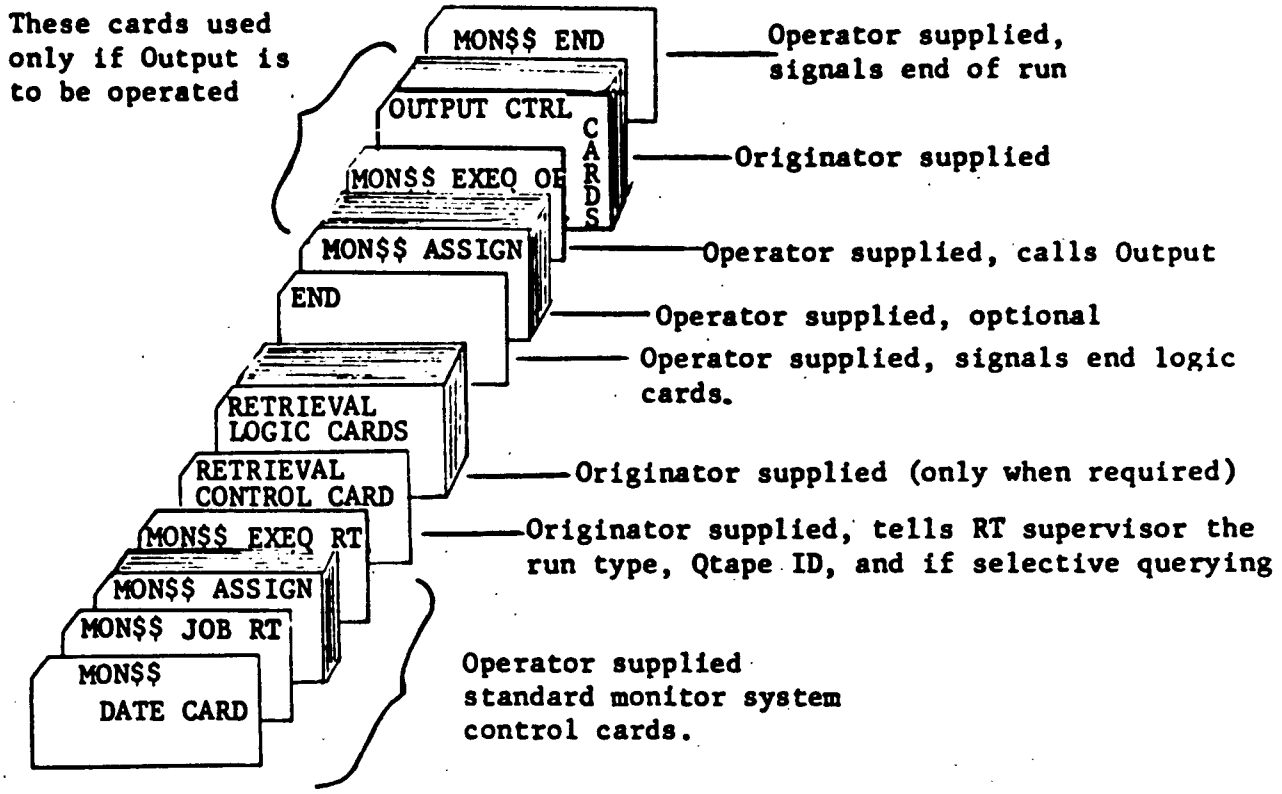


Figure 4-17. Retrieval Run Deck.

Special Instructions	If SORT is to be executed, the following must be done prior to responding to SORT message in phase Ø5Ø with $3S: Remove input reels from A1 and A2. Scratch on A1, A2, B1, B2. If output is to be executed, originator should specify which output tapes are needed. See "Output Operator's Guide" for run type 2.

h. Retrieval Run Type 3 (Execute Sort).

Receive from Originator	Answer tape serial number. Retrieval control card. Output control cards if applicable.
Prerun Setup	Build a run deck (figure 4-17). Pull unsorted answer tape from library.
Run Setup (Two Way Merge)	Run deck in 1402 reader. Scratch on A1, A2, B1, B2 Unsorted answer tape on B3.
Add Setup (Three Way Merge)	Scratch tapes on A6 and B6.
Special Instructions	See Run Initiation Card.

i. Retrieval Operator Messages.

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
NOGO SWITCH SET BY FFS	Special end of program. No more runs in the job will be executed unless TEST mode has been specified. There is no core dump.	Scrap the job. Scratch all output tapes. Return all printouts to the originator.
INCORRECT QTAPE MOUNTED ON B1, MOUNT QTAPE nnnnn ON B1 ENTER $5Ø TO PROCEED	Machine is in a wait loop. The QTAPE ID number does not agree with the ID number of the RT control card.	Error - Mount proper QTAPE on B1 and type $5Ø.
MOUNT REELS INDICATED BELOW FILE *11111*. ALL REELS ARE TO BE SEARCHED. MOUNT IN SEQUENCE ALTERNATELY ON A1 AND A2. ENTER $5Ø TO PROCEED.	Machine is in a wait loop. Retrieval Proper is telling the operator what input files it needs to search and on what tape units to mount them. All reels of the file will be searched.	Manual Intervention Mount first input tape on A1, second on A2. Further input file reels should be alternated between A1 and A2. Type $5Ø.

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
MOUNT REELS INDICATED BELOW FILE *xxxxx* SERIAL NO. *nnnnn* REEL SEQ NOS. *nnnn*A1 *nnnn*A2 *nnnn*A1 (etc) ENTER $5Ø TO PROCEED	Machine is in a wait loop. Retrieval Proper is telling the operator what selected input file reels it wants to search and on what type units they should be mounted.	Manual Intervention - Mount reels in sequence shown on console printer. Type $5Ø.
TO EXEQ SORT*, MOUNT TAPES ENTER $3S, TO BYPASS SORT* ENTER $3B	Retrieval Supervisor has given the operator the option of continuing the retrieval run to obtain a sorted answer tape or to stop and use the unsorted answer tape as input at a later time	Info Request - at decision of operator, or as instruced on retrieval Run Initiation Card.

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
RETRIEVAL CONTROL CARD ABSENT OR INCORRECT	This card follows the MON $$ EXEQ. RT CARD. See diagram of Retrieval Run Deck. Machine is in a wait loop.	Error - Run out reader, correct or add Ret Control Card. Reinsert run deck in reader beginning with Ret Control Card.
MORE THAN 100 SEARCHES	Retrieval logic card deck is incorrect.	Error - Return job to originator.
MORE THAN 20 FILES IN RUN	Retrieval logic card deck is incorrect.	Error - Return job to originator.
MORE THAN 34 GROUPS IN ERROR	Retrieval logic card deck is incorrect.	Error - Return job to originator.
DISCREPANCY IN FFT*xxxxx* OR DISK TRACKS NOT AVAILABLE OR EOF IN DISK OUTPUT OR EOF IN QTAPE OR ALL SEARCHES REJECTED	Program communication error.	Error - Scrap the run, return all printouts to originator or programmer.

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
RETRIEVAL RUN SCRAPPED_ *nnnnn*	nnnnn is the address of the instruction following the branch to scrap routine.	Error - Turn job over to programmer.
FOR TWO WAY MERGE, TYPE $32, FOR THREE WAY MERGE, TYPE $33	Self-explanatory	See Run Initiation Card.
REPEAT MERGE ORDER SPECIFICATION	Incorrect Input to console.	Repeat merge request using correct characters ($32 or $33 as appropriate).
REASSIGN SYMBOLIC UNIT	Symbolic units needed for three way merge incorrectly or not assigned.	Check ASSIGN Deck to ensure inclusion of: MON $$ ASGN MRC, A1, A2, A6 MON $$ ASGN MRE, B1, B2, B6.

4-10. SUPPLEMENT TO RETRIEVAL OPERATIONS: As this manual is being written, job descriptions and job functions have not yet been defined. In order to insure that the following information or procedure is documented in some fashion, it has been included in this section. A personnel gap exists between the analyst or user and the computer operator. The analyst is normally concerned (in regard to retrieval) with what questions or queries he wants passed against the desired files. As can be observed from the diagrams, the operator is concerned with receiving a query deck from the originator. He may then cause the 1410 System to perform the requested query. The personnel between analyst and operator must perform the following procedure:

1. Receive one or more retrieval requests and/or one or more retrieval reports from an analyst or several analysts written on the proper forms.

2. Assign a 2-digit file numeric number to the forms. This number is obtained from the file specification sheet.

3. Assign a group ID (two digits) to each form. This number is chosen arbitrarily for the run.

4. Assign a search number to each form. Search number is arbitrarily chosen for the run.

5. Keypunch query cards from the forms, or have them keypunched.

6. Sort the cards in the 083 sorter and assemble the deck.

Sort from column 80 through 71:

71 File number (high order)
| Group ID number
↓ Search number
80 card sequence number (low order)

In Retrieval, there are two types of formats. The request and the report. The request format is a single question passed against a single file. The report format is one or more questions passed against one or more files.

a. File Numeric.

(1) The file numeric number on request forms ties together all cards that are involved with a file. Example:

Three Request forms are received:

The first is to be passed against file DPFBA
The second is to be passed against file BTCFA
The third is to be passed against file DPFBA

(2) Due to the file numeric number, all cards concerning one file would be grouped together during the EDPM sort mentioned in step 6 of the procedure.

(3) The file numeric number is used for the same purpose in report querying.

b. Group ID (Report/Request number). The group ID is a 2-digit number that ties together all cards involved with a particular report or request. For example, if there were three reports involved in a run, there would be three unique group ID's. Each card of a report would have the report's group ID number punched in it. These two characters identify one report or request from another and can be used for selective query.

c. Search Number.

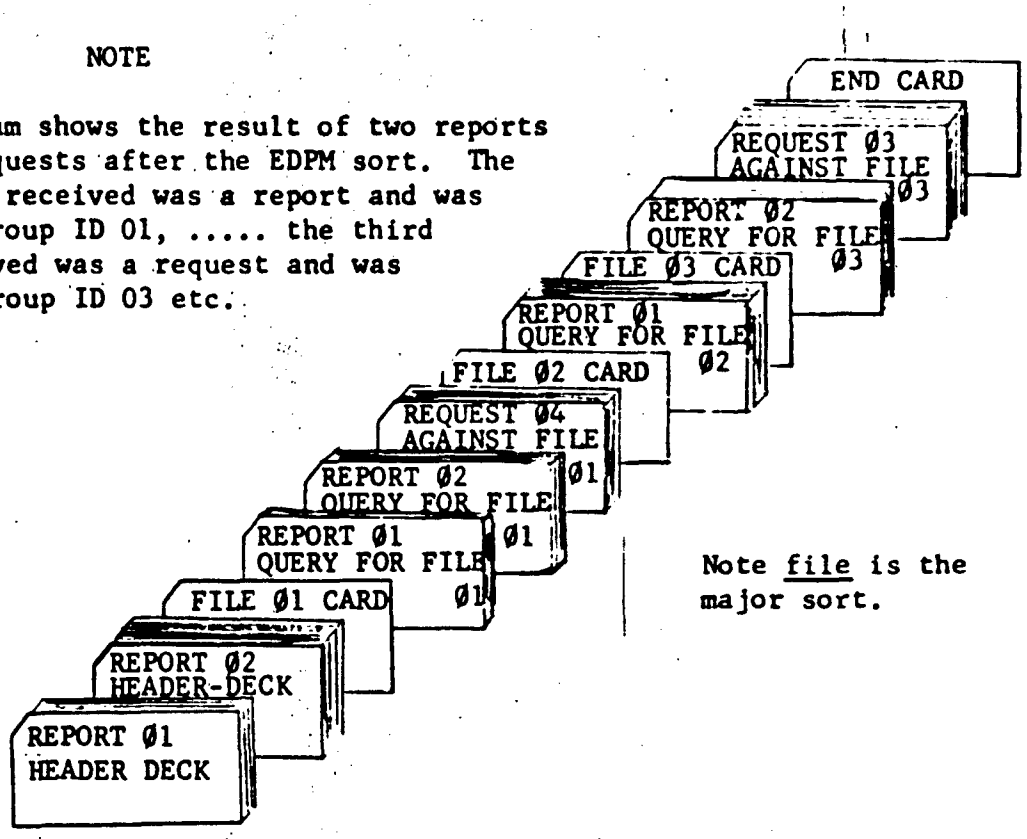
(1) The search number identifies all cards involved with a particular question. For example, a question requires five cards in order to be complete, all five cards would have the same search number.

(2) A file card must be punched for each file involved in the query. See Retrieval and Output Techniques Manual for file card format.

(3) Finally, an end card must be punched for the entire query deck. See Retrieval and Output Techniques Manual for end card format. The following diagram shows the complete logic deck for a typical retrieval run.

NOTE

This diagram shows the result of two reports and two requests after the EDPM sort. The first deck received was a report and was assigned Group ID 01, ... the third deck received was a request and was assigned Group ID 03 etc.



Note file is the major sort.

4-11. OUTPUT OPERATIONS: The output program consists of several phases under control of the output supervisor:

Output Execution (phase 2)
Offline Tape Output (phase 3)
Report Structuring (phase 4)

Output (OP) is capable of producing reports on paper, punched cards, or magnetic tape. Inputs consist of report specifications in the form of report instruction tables and data which could be an answer tape from the retrieval program, a transaction confirmation tape from the file maintenance program, or a full data file (phase 4). Printed or punched reports may be placed on a worktape for later output by the offline tape output (phase 3). Printed reports consist of page headers and trailers, body lines, page numbering and security classification. Body lines may consist of data fields, constants, computed values or a combination of all three. Fields may be edited to remove leading zeroes, insert punctuation and other standard editing functions. Control of spacing between lines, skipping to line positions and ejecting full pages is also provided (phase 2).

OP uses all standard system monitor messages and procedures unless specifically stated by the console printer. An output run is initiated upon operator receipt of a run initiation card (figure 4-18).

The output program may be operated with five distinct run types. Two of these have been included in another portion of this manual. One is in file maintenance operations portion and the second is in retrieval operations portion of this section. Therefore, only three of these run types have been included here. There is a separate setup sheet, flow diagram and run deck illustration for each of the three output run types.

a. Run Type 1. Refer to figure 4-19. The purpose of run type 1 is to take the specifications concerning an output format and convert it from cards to tape. These specifications may now be read from tape by the FFS System Librarian (LINKLOADRE) and placed on disk for use by future output runs.

b. Run Type 2. Refer to figure 4-20. The purpose of run type 2 is:

(1) To print out the transactions from a file maintenance run as recorded on the FM transaction confirmation tape (control card FILE MAINT).

(2) To print out a retrieval answer tape (control card RETRIEVAL).

(3) To print out a file revision error tape (control card DIRECT).

(4) To print out the contents of a data file (control card DIRECT).

OUTPUT RUN INITIATION CARD

ORIGINATOR _____ DATE _____ RUN NO. _____ PRIORITY ____

Run Type (Circle one) 1. (CREATE) 2. (DIR, FM, RET.) (Requires Special Instructions) 3. (OFF LINE)

INPUT TAPE REEL SERIAL NUMBERS OFF LINE _____ ANS. ____ FR ERROR ____ FM CONF ____ FILE _____

OUTPUT TAPE REEL SERIAL NO's _____ _____ _____ _____ _____

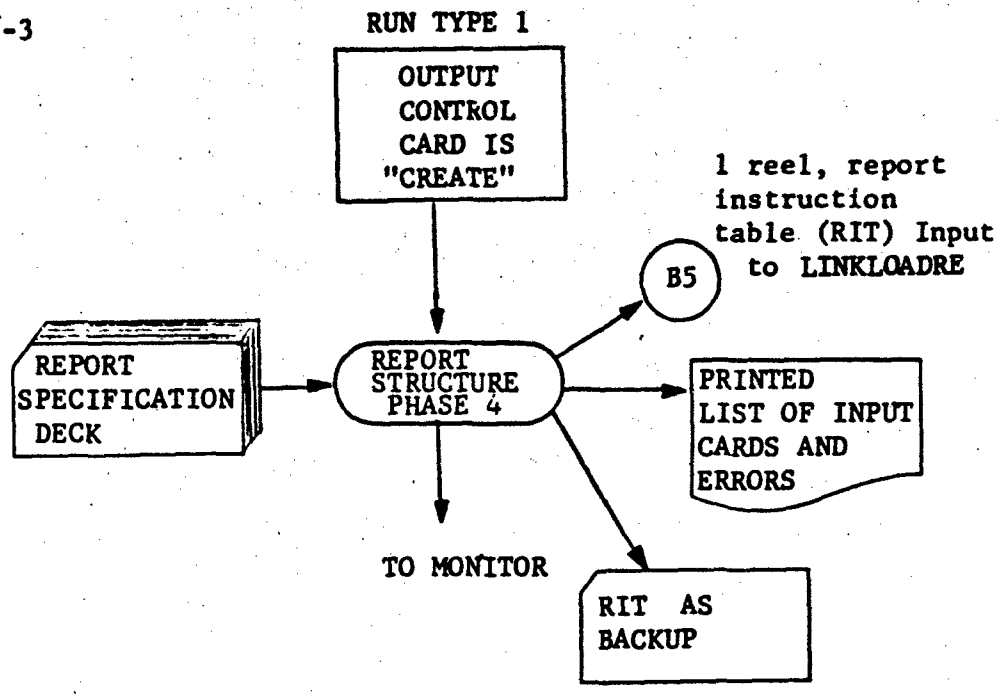
Special Instructions: (Action for error or hangup, what reels to save or scratch)

FRONT

Operator Comments:

BACK

Figure 4-18. Output Run Initiation Card



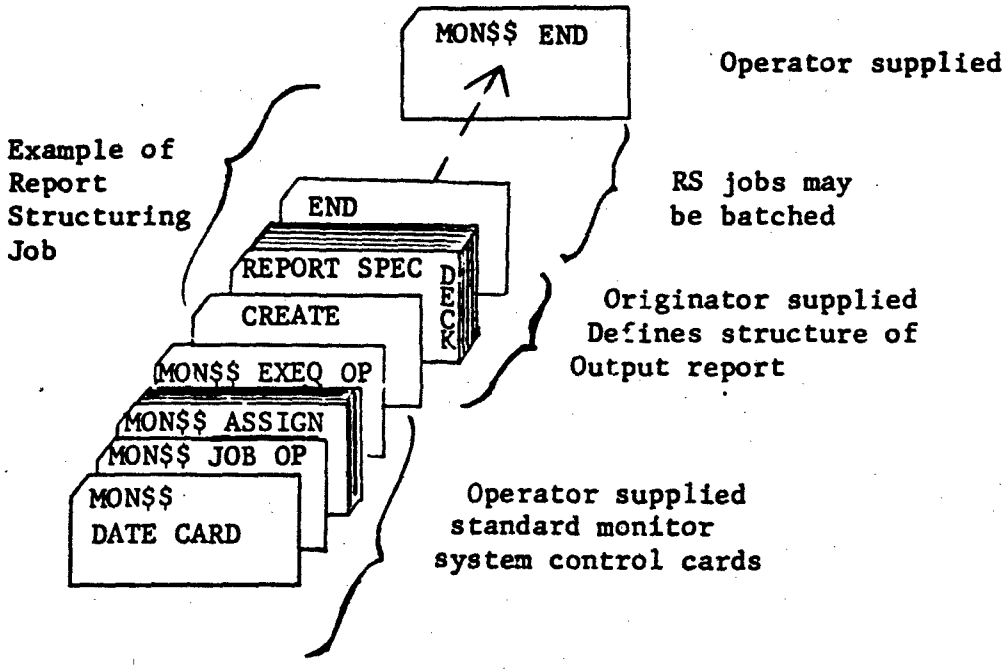


Figure 4-19. Output Operator Flow Diagram and Run Deck. (Run type 1)

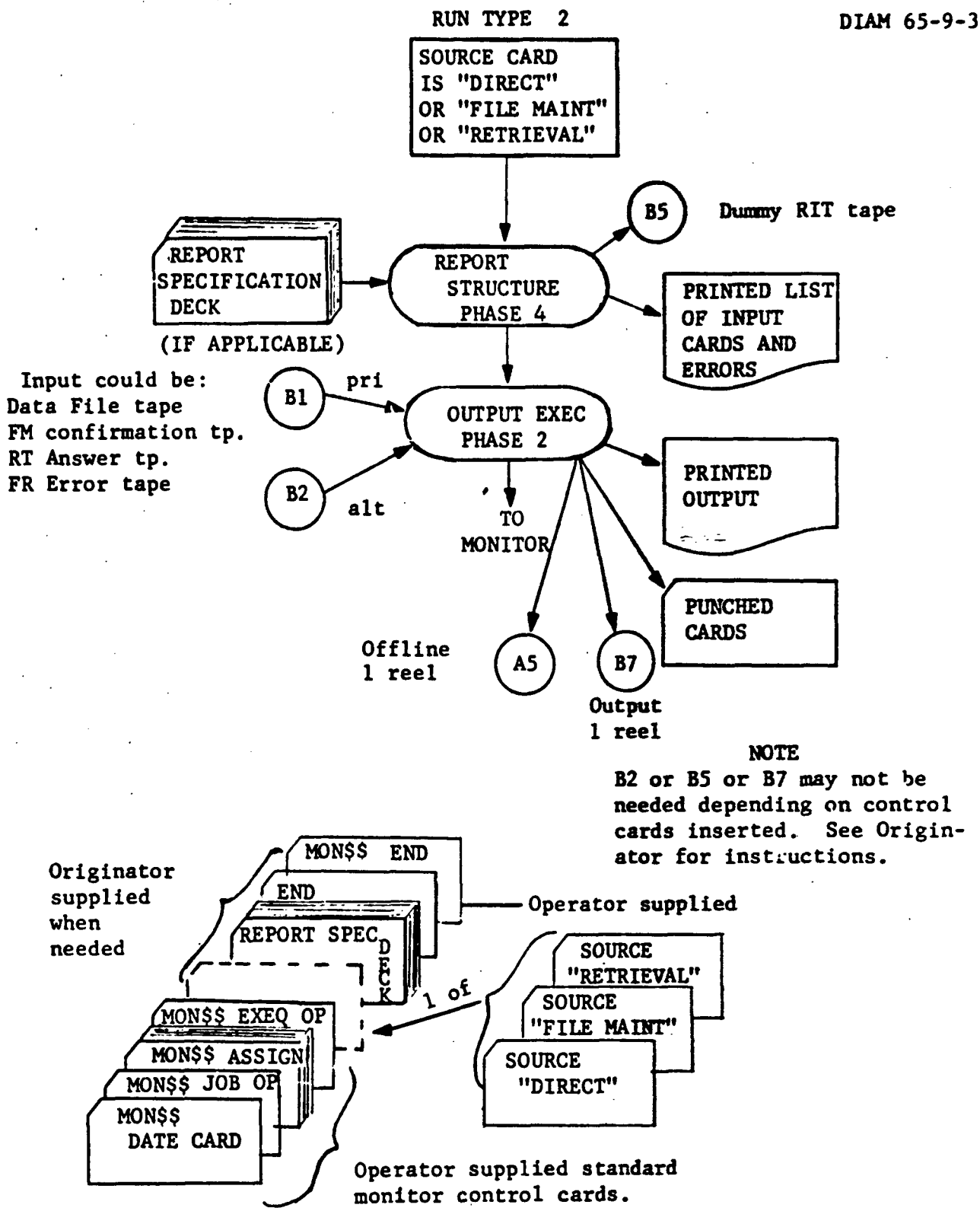
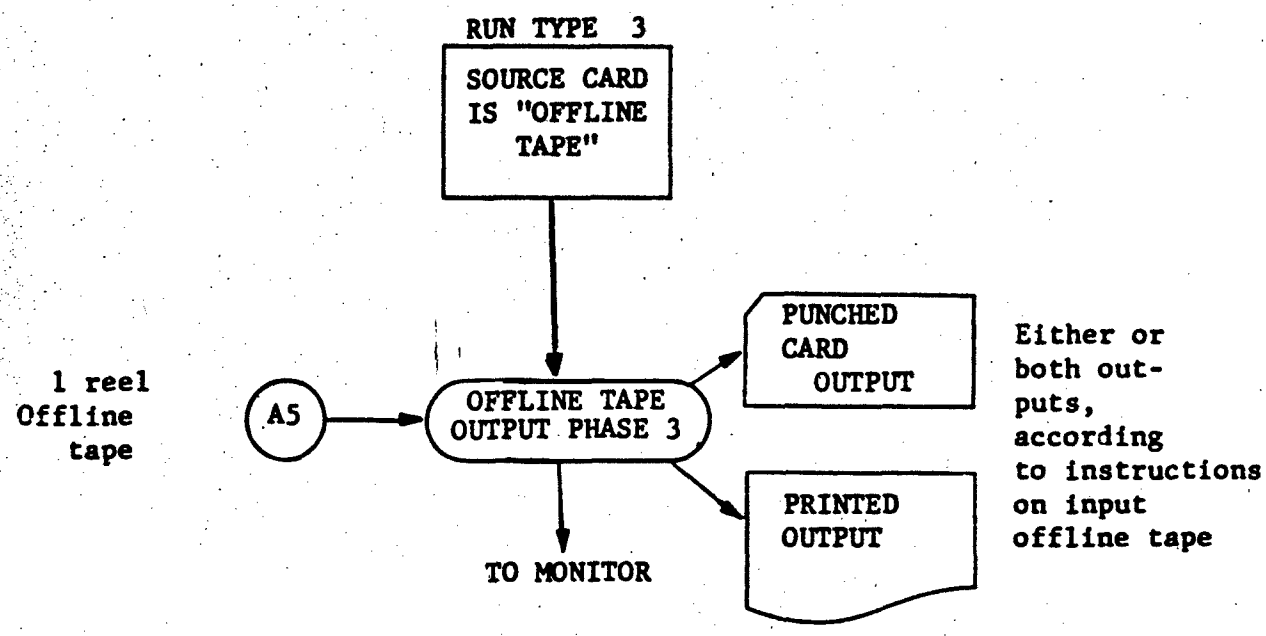


Figure 4-20. Output Operator Flow Diagram and Run Deck. (Run Type 2)



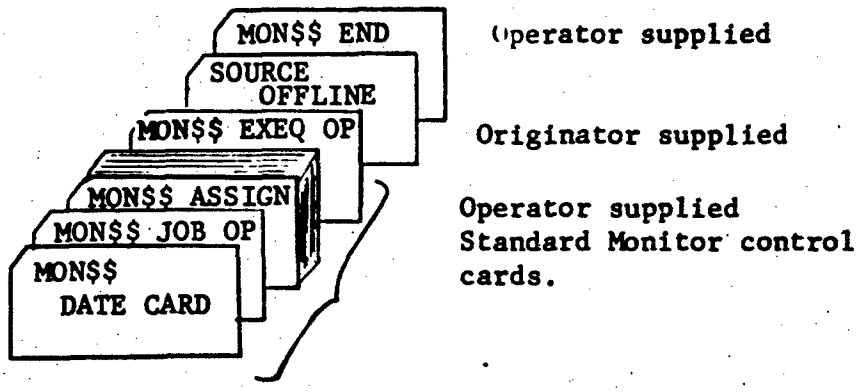


Figure 4-21. Output Operator Flow Diagram and Run Deck. (Run Type 3).

c. Run Type 3. Refer to figure 4-21. This run is set to print out an offline tape generated by the operation of a type 2 run.

d. Output Program Run Type 1.

Receive from Originator	CREATE Card. Report specification deck(s).
Prerun Setup	Build a run deck. See figure 4-19.
Run Setup	Run deck in 1402 reader. Ready the 1402 punch. Mount scratch on B5.
Special Instruction	Return inputs and all outputs to originator.

e. Output Program Run Type 2.

Receive from Originator	Report specification deck if applicable. Reel serial number of input tape. SOURCE card - "DIRECT" or "FILE MAINTENANCE" or "RETRIEVAL"
Prerun Setup	Build a run deck (figure 4-20). Pull input tapes from library.
Run Setup	Run deck in 1402 reader. Ready the 1402 punch. Mount input tape reel on B1 and B2 if multireel input. If multireel input, the following sequence should be B1 — B2 1st Reel — 2d Reel 3d Reel — 4th Reel etc — etc
Special Instructions	See console printer for tape reels to be labeled and saved. Always return punched cards and/or printed listings (if any) to originator. A manual interrupt is provided for this run type. $3 STOP will abandon current job and proceed to others.

	$3 REDO starts the job over. Do not use with multireel input runs. Originator should designate which tape units (B2 or B5 or B7) will not be needed.

f. Output Program Run Type 3.

Receive from Originator	SOURCE OFF-LINE card. Serial number of input off-line tape reel.
Prerun Setup	Build a run deck (figure 4-21). Pull tape reel from library.
Run Setup	Run deck in 1402 reader. Ready the 1402 punch. Mount input off-line tape reel on A5.
Special Instructions	Return all inputs and outputs to originator.

g. Output Program Operator Messages.

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
BAD TAPE ON "cu" JOB TERMINATED	Program has encountered parity errors on tape unit indicated. Current job has been scrapped, other jobs if any will be attempted.	Standard procedure for tape parity errors.
DISK ERROR ON WORK FILE, RUN TERMINATED	For some reason disk is not available, or disk parity error.	Check for disk not ready or check with maintenance personnel.

CONSOLE MESSAGE	MEANING	MESSACE TYPE & OPERATOR ACTION
SYSTEM OR PROGRAM ERROR, RUN TERMINATED	Machine or program error. Run scrapped.	Save all output for programmer.
REMOVE AND LABEL TAPE ON "cu"	End of job has been reached.	As instructed.
REMOVE AND LABEL TAPE ON "cu" MOUNT ANOTHER BLANK	Program is finished with one reel of tape, and is requesting another scratch on that drive.	Remove reel label and save. Mount scratch. Type $5Ø to proceed.
"cu" is channel and unit.		

4-12. PERMANENT DISK FILE UPDATE/SYSTEM LIBRARIAN OPERATION: The permanent Disk File Update Program and the System Librarian Program are closely related in that they both perform the job of updating the disk file. The difference between them is the area of disk file they maintain. Permanent Disk File Update is composed of 2 phases:

Updater Phase
Loader Phase

The updater phase, using input tapes, generates an output tape that contains the data and information as it should look on the disk file. The loader phase takes this tape containing the "disk image" and writes it on the disk file. The System Librarian Program is a single phase program used to put new report instruction tables, file format tables and/or program subroutines on the disk file. These tables and subroutines are then available to using programs.

Both permanent disk file update and system librarian use standard system monitor messages and procedures unless otherwise specifically stated via the console printer. With both programs a run is initiated upon receipt of a run initiation card. See figures 4-22 and 4-23.

PERM DISK UPDATER RUN INITIATION CARD

ORIGINATOR _____ DATE _____ RUN NO. _____ PRIORITY ____

RUN UPDATER PHASE ◯ LOAD PHASE ◯ BOTH PHASES ◯

INPUT REELS: CI REEL SERIAL _____, _____, _____

IF LOADER PHASE ONLY: DISK IMAGE REEL SERIAL _____

Special Instructions: (Action for error or hangup, what reels to save or scratch)

FRONT

Operator Comments:

BACK

Figure 4-22. Permanent Disk Updater Run Initiation Card

LIBRARIAN RUN INITIATION CARD

ORIGINATOR _____ DATE _____ RUN NO _____ PRIORITY _____

LOAD DISK ONLY ○ BACK UP TAPE WANTED ○ WITHOUT BACK UP TAPE ○

INPUT IS: RIT OR FFT ON TAPE ----- ○ REEL SERIAL _____ _____ _____

or ----- ○ REEL SERIAL OF FFS LIBRARY _____

ON CARD

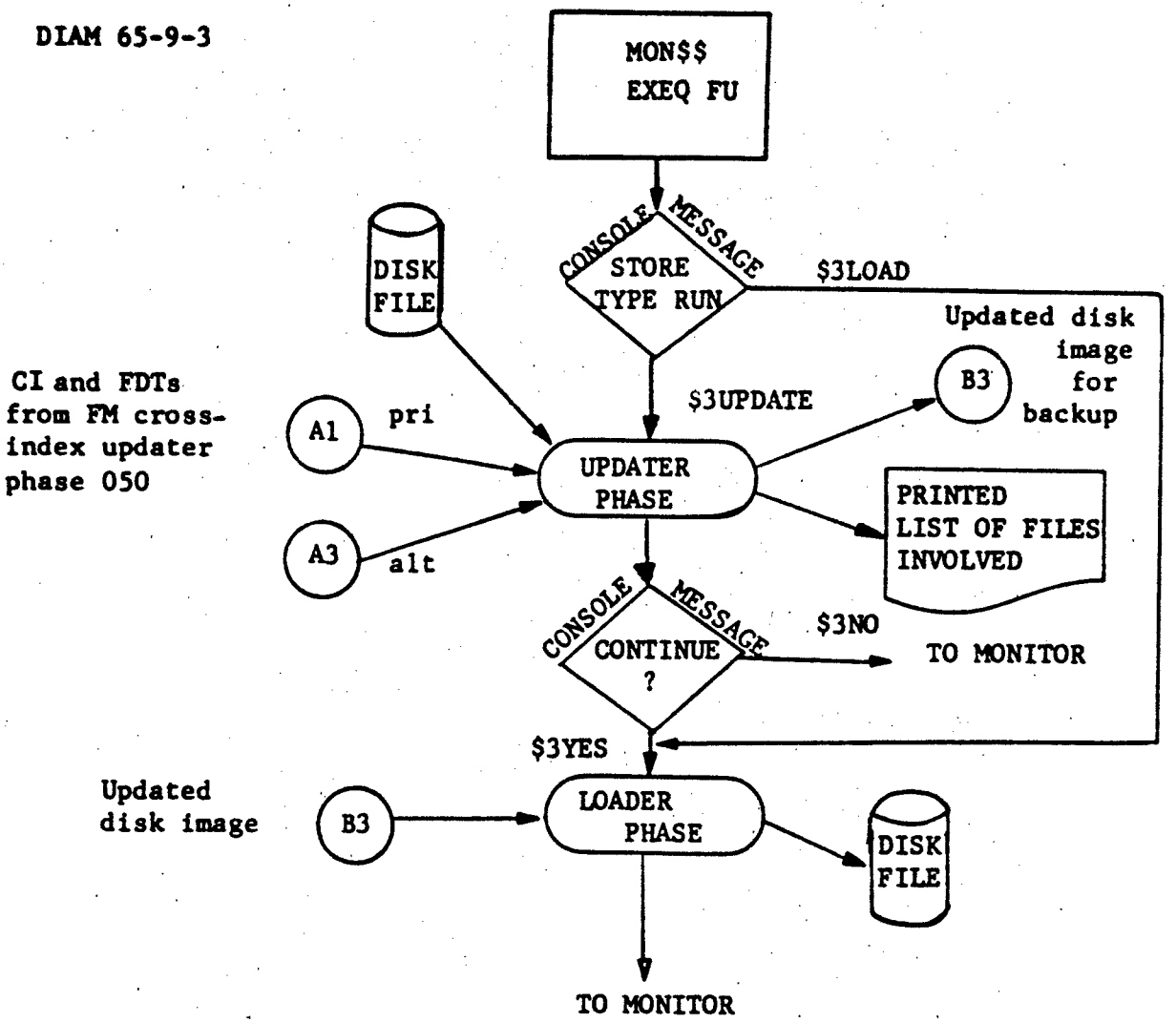
Special Instructions: (Action for errors on hangup, what reels to save or scratch)

FRONT

Operator Comments:

BACK

Figure 4-23. System Librarian Run Initiation Card



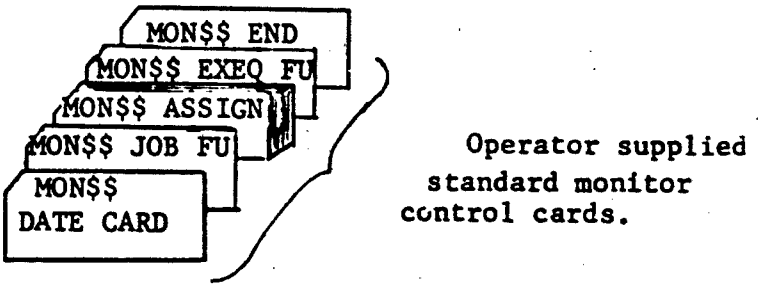


Figure 4-24. Permanent Disk File Updater Operator Flow Diagram and Run Deck.

An operator flow diagram and run deck are given so the operator may see his actions, options and general program flow throughout the job.

a. Permanent Disk File Update Run Setup.

Receive from Originator	Input reel serial numbers.
Prerun Setup	Pull input reels from library. Build a run deck (figure 4-24).
Run Setup	If updater phase is to be operated, mount scratch on B3, mount first input reel on A1, second on A3. Alternate input reels between A1 and A3. If loader phase only is to be operated, mount input reel of updated disk image on B3. Run deck in 1402 reader.
Special Instruction	Label and save B3.
When Console Message =	"STORE TYPE OF RUN:" Type $3UPDAT for update phase. or Type $3LOAD for loader phase only.

b. Permanent Disk File Update Operator Messages.

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
STORE TYPE OF RUN $3UPDAT OR $3LOAD	Program wants to know which phase to start in. This should be on run initiation card.	As indicated.
NOT ASSIGNED "XXX"	There is an invalid symbolic assignment.	Check Assign cards or scrap and return to Originator.

CONSOLE MESSAGE	MEANING	MESSAGE TYPE & OPERATOR ACTION
BAD HDR RCD ON INPUT TAPE, MODE, MODULE	Program has found incorrect tape label on an input drive.	Check input drives for proper reel serial on proper drive.
TOO MANY FILES ON DIRECTORY	The 145 file maximum has been exceeded.	Scrap job return to Originator.
NO ROOM FOR MODE "X" IN MODULES 0 or 1.	No space available on disk.	Scrap job return to Originator.
END OF RUN	As indicated.	None.
STORE NO. OF REEL FOR A1 AND A $3Ø1 THRU $399.	The program needs the number of input reels it should expect as input. This message comes from Updater phase.	Enter number of reels 01-99.
CALL LOAD PHASE $3YES or $3NO	Program is finished with Updater phase and wants to know if it should continue with loader phase.	As desired.

c. System Librarian Run Setup.

Receive from Originator	Input reel serial numbers if any. Input card decks if any.
Prerun Setup	Pull tapes from library. Build a run deck (figure 4-25).
Run Setup	Scratch on A1 and A3. FFs library on B3. RIT or FFT on B5. If multireel input, second reel on B6. Alternate between B5 and B6. Run deck in 1402 reader.
Special Instructions	Save and label A1, new backup tape. Save and label A3, new FFS library.

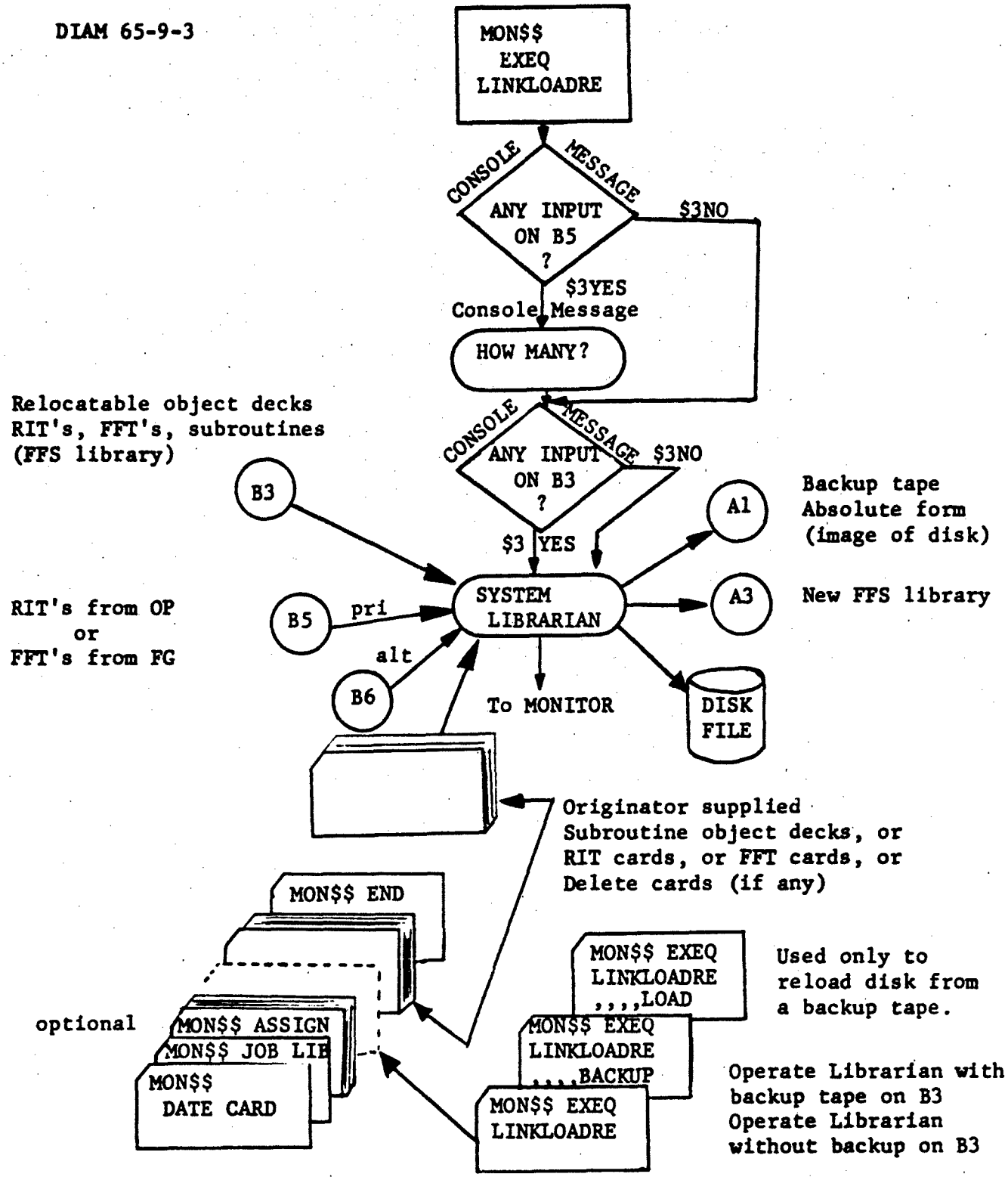


Figure 4-25. System Librarian Flow Diagram and Run Deck

d. System Librarian Program Operator Messages.

CONSOLE MESSAGE	MEANING	OPERATOR ACTION
ANY INPUT ON B5 - TYPE $3YES or $3NO	The librarian is asking if there are any RIT's or FFT's on tape as input.	As instructed.
STORE NUMBER OF REELS $31 - $39.	The librarian is asking how many reels of RIT or FFT input is involved. Number of reels could be 1 thru 9.	Type in $3 "X" where X = no. of input reels.
ANY INPUT ON B3 - TYPE $3YES or $3NO	The librarian is asking if there is an old FFS library tape present on B3.	As instructed.
ERROR READING B5 (B3) DATA - CORRECT AND RERUN.	Tape errors on RIT or FFT tape.	Check for correct reel mounted. Scrap job.
DUMP RUN DUE TO TAPE ERR ON B5 (B3). MAKE DELETE CARD FOR PROG XXXXX AND RERUN.	Run has been scrap parity errors. Tape error necessitating a rerun.	Standard procedure for tape parity. Scrap job, return to Originator.

INDEX

	Page
$BCVXYZ	3-17
$BX	3-18
$B4	3-17
$B5SS	3-17
$B6SS	3-17
$C1SS	3-18
$10	3-16
$20	3-16
$3X	3-17
$50	3-17
$70	3-17
$8X	3-17
A RING	2-16
A-CHARACTER SELECT	2-23
A-REGISTER SET	2-23
ABSOLUTE PROGRAM	3-19
ACCESS MECHANISMS	2-52
ADDRESS CHANNEL	2-23
ADDRESS CHECK	2-23
ADDRESS EXIT	2-23
ADDRESS SELECTION DIAL	2-48
ADDRESS SET	2-12
ADDRESS-ENTRY SWITCH	2-28
ALPHANUMERIC PRINTER	2-61
ALTER	2-14
ALTERNATE INPUT UNIT	3-19
ARITH	2-17
ASGN CARD	3-9
ASSEMBLY CHANNEL	2-22
ASSEMBLY LISTINGS	3-3
ASTERISK-INSERT SWITCH	2-28
AUTOCODER	1-3, 3-2
AUTOMATIC GRAPH PLOTTER	2-60
B-CHARACTER SELECT	2-23
B-REGISTER SET	2-23
BATCH	3-12, 3-1
BATCH PROCESSING	3-19
BITS	1-2
BRUSH INTERLOCK	2-39
BYPASS CARD	4-8
CANCEL KEY	2-2, 2-6
CARD READ-PUNCH LIGHTS	2-30
CARD-TO-CARD OFF-LINE	2-59
CARD-TO-PRINTER OFF-LINE	2-59
CARD-TRANSPORT SCHEMATIC	2-30
CARD/OUTPUT	1-1

CARRIAGE RESTORE ---------- 2-35
CARRIAGE SPACE ---------- 2-35
CARRIAGE STOP ---------- 2-35
CARRIAGE TAPE BRUSHES ---------- 2-42
CB TRIP ---------- 2-24
CHANGE MODE ---------- 4-8
CHECK RESET ---------- 2-34
CHECK-CONTROL SWITCH ---------- 2-27
CHIPS ---------- 2-33
CLASS A MESSAGES ---------- 3-16
CLASS B MESSAGES ---------- 3-17
CLASS C MESSAGES ---------- 3-18
CLOCK ---------- 2-16
CLOSING SYSTEM FILES ---------- 3-18
COBOL ---------- 1-3, 3-3
COMPATIBILITY SWITCH ---------- 2-27
COMPILE-AND-GO ---------- 3-19
COMPUTER RESET ---------- 2-11
COMT CARD ---------- 3-10
CONSOLE I/O PRINTER ---------- 2-1
CONSOLE INQUIRIES ---------- 3-16
CONSOLE REPLY ROUTINE ---------- 2-7
CONTROL CARD FORMATS ---------- 3-9
CONTROL CARD SEQUENCING ---------- 3-12
CONTROL KEYS ---------- 2-14
CONTROL SECTION ---------- 2-9
CONTROL TAPE ---------- 2-40, 2-43
COPY CONTROL LEVER ---------- 2-7
CPU PROCESSING ERROR ---------- 2-8
CREATE MODE ---------- 4-8
CROSS-INDEX UPDATER ---------- 4-14
CUSTOMER ENGINEER ---------- 2-11
CYCLE ---------- 2-16
CYCLE CONTROL SWITCH ---------- 2-28
DATA, THE ---------- 4-1
DATA CHECK ---------- 2-56
DATA FILE ---------- 4-1
DATA RECORD ---------- 4-1
DATE CARD ---------- 3-10
DC OFF ---------- 2-11
DELAYED RESTART ---------- 3-13
DENSITY SWITCH ---------- 2-48
DISK ---------- 1-2
DISK OFF-LINE ---------- 2-24
DISK STORAGE ---------- 2-51
DISK UPDATE ---------- 1-4
DISK-WRITE SWITCH ---------- 2-29
DISPLAY ---------- 2-12

DIVIDE OVERFLOW ---------- 2-18
ELECTROPLOTTER II ---------- 2-60
EMERGENCY POWER OFF ---------- 2-9
END CARD ---------- 3-10
END-OF-FILE ---------- 2-31
END-OF-FORMS ---------- 2-34
EQUAL ---------- 2-18
EQUIPMENT ---------- 2-1
ERROR CONDITION ---------- 2-2
EXEQ CARD ---------- 3-10
FEED CLUTCH ---------- 2-35
FIELDS ---------- 4-2
FILE ---------- 4-1
FILE CONTROL UNIT FUNCTIONS ---------- 2-53
FILE FORMAT ---------- 4-1
FILE GENERATION OPERATIONS ---------- 4-5
FILE GENERATION PROGRAM ---------- 1-4
FILE IDENTIFICATION ---------- 2-66
FILE MAINTENANCE PROGRAM ---------- 1-4
FILE NUMERIC ---------- 4-49
FILE RECORD ---------- 4-1, 4-2
FILE RECORD FORMAT ---------- 4-4
FILE SERIAL NUMBER ---------- 2-66
FILE STRUCTURING PHASE ---------- 4-5
FILE-PROTECTION LIGHT ---------- 2-49
FILE-PROTECTION RING ---------- 2-47
FILESORTER ---------- 4-31
FINE SCALE ADJUST ---------- 2-66
FIXED ---------- 4-1
FIXED FIELD ---------- 4-2
FIXED GROUPS ---------- 4-3
FIXED SET ---------- 4-4
FORMATTED FILES ---------- 4-1
FORMATTED FILE SYSTEM (FFS) ---------- 1-4
FORMS CHECK ---------- 2-34
FORMS INSERTION ---------- 2-44
FORTRAN ---------- 1-3, 3-4
FREE RUN ---------- 2-64
FUSE ---------- 2-31
FUSE LIGHT ---------- 2-49
GATE INTERLOCK ---------- 2-39
GROUP ID ---------- 4-50
GROUPS ---------- 4-3
HIGH ---------- 2-18
HIGH SPEED START ---------- 2-39
HIGH SPEED STOP ---------- 2-40
HORIZONTAL ADJUSTMENT ---------- 2-38
I RING ---------- 2-16

I/O CHANNEL CONTROL ---------- 2-18
I/O CHANNEL STATUS INDICATOR LIGHTS ---------- 2-20
I/O CHECK STOP SWITCH ---------- 2-27
I/O INTERLOCK ---------- 2-23
I/O OFF-LINE ---------- 2-24
I/O PRINTER ---------- 2-1
I/O PRINTER ERROR ---------- 2-8
IDHS 1410 INSTALLATION ---------- 1-3
IMMEDIATE RESTART ---------- 3-13
INDEX SELECTOR LEVER ---------- 2-7
INDICATOR LIGHT PANEL ---------- 2-15
INDICATOR PANEL LIGHTS ---------- 2-39
INITIALIZATION AND REINITIALIZATION ---------- 3-6
INITIALIZATION CARDS ---------- 3-6
INITIALIZATION PROCEDURE ---------- 3-7
INITIALIZATION STATUS CHARACTER ---------- 3-7
INPUT DESCRIPTOR DECK IDD ---------- 4-14
INPUT PROCESSOR PHASE ---------- 4-14
INPUT/OUTPUT CONTROL SYSTEM ---------- 3-4
INQUIRY ---------- 2-5
INQUIRY REQUEST ---------- 2-2
INSTRUCTION CHECK ---------- 2-23
INTERLOCK ---------- 2-19
IOCS ---------- 1-4
JOB ---------- 3-19
JOB BATCHING ---------- 3-14
JOB CARD ---------- 3-12
KEYS AND LIGHTS ---------- 2-47
I/E CYCLE ---------- 2-11
LABEL PROCESSING ---------- 3-3
LATERAL PRINT VERNIER ---------- 2-36
LFM ---------- 4-34
LFM RUN TYPES ---------- 4-34
LIB ---------- 3-19
LINE DRAWING INTERPOLATOR ---------- 2-61
LINKAGE LOADER ---------- 3-2
LOAD REWIND KEY ---------- 2-49
LOAD WRITE OPERATION ---------- 2-9
LOCK KEY ---------- 2-7
LOGICAL FILE MAINTENANCE (LFM) ---------- 4-34
LOW ---------- 2-17
LOW SPEED START ---------- 2-40
LOW SPEED STOP ---------- 2-40
MACRO LIBRARY ---------- 3-19
MACRO SYSTEM ---------- 3-3
MAGNETIC DISK STORAGE ---------- 1-2
MAGNETIC TAPE ---------- 1-2
MAGNETIC TAPE STORAGE ---------- 1-2

MAGNETIC-TAPE UNITS ---------- 2-46
MARGIN SET LEVERS ---------- 2-7
MASTER FILE ---------- 3-19
MDM ---------- 3-19
METHOD OF PRINTING ---------- 2-33
MGO ---------- 3-19
MJB ---------- 3-19
MNEMONIC OPERATING CODES ---------- 3-3
MODE SWITCH ---------- 2-11
MONITOR CONTROL CARDS ---------- 3-9
NOT OVERLAP IN PROCESS ---------- 2-20
NULL DETECTOR ADJUST ---------- 2-66
OFF NORMAL LIGHT ---------- 2-25
OFF SCALE-RESET ---------- 2-63
OP-MODIFIER SET ---------- 2-23
OP-REGISTER SET ---------- 2-23
OPERATING POINTERS ---------- 2-50
ORIGIN ---------- 2-63
ORIGIN ADJUST ---------- 2-66
ORIGIN LOCATION ---------- 2-62
ORIGIN OFFSET ---------- 2-62
OUTPUT OPERATIONS ---------- 4-52
OUTPUT PROGRAM ---------- 1-4
OVERFLOW ---------- 2-18
OVERLAP IN PROCESS ---------- 2-20
PAPER ADVANCE KNOB ---------- 2-35
PAPER RELEASE LEVER ---------- 2-7
PAPER STACKER ---------- 2-45
PAUSE CARD ---------- 3-12
PEN SELECTION ---------- 2-63
PERIODIC ---------- 4-1
PERIODIC FIELD ---------- 4-2
PERIODIC GROUPS ---------- 4-3
PERIODIC PRESORT ---------- 4-31
PERIODIC SETS ---------- 4-3
PERIODIC SUBSETS ---------- 4-3
POINTS ---------- 2-63
POWER ---------- 2-31
POWER INDICATOR LIGHTS ---------- 2-23
POWER OFF ---------- 2-10
POWER ON ---------- 2-9
PRINT CHECK ---------- 2-34
PRINT READY ---------- 2-34
PRINT START ---------- 2-34
PRINT STOP ---------- 2-34
PRINT-DENSITY CONTROL LEVER ---------- 2-36
PRINT-LINE INDICATOR AND RIBBON SHIELD ---------- 2-36
PRINT-OUT CONTROL SWITCH ---------- 2-28

PRINT-TIMING DIAL ---------- 2-36
PRINT-UNIT RELEASE LEVER ---------- 2-36
PRINTED OUTPUT ---------- 1-2
PRINTER INDICATOR PANEL ---------- 2-39
PRINTER KEYS AND LIGHTS ---------- 2-34
PRIORITY ALERT ---------- 2-25
PROCESSOR ---------- 3-19
PROGRAM RESET KEY ---------- 2-15
PROGRAMMING SYSTEMS ---------- 3-1
PUNCH CHECK ---------- 2-33
PUNCH READY ---------- 2-33
PUNCH START ---------- 2-33
PUNCH STOP ---------- 2-33
PUNCH UNIT KEYS AND LIGHTS ---------- 2-33
PUNCHING THE TAPE ---------- 2-41
R H TRACTOR VERNIER ---------- 2-38
RBC INTERLOCK ---------- 2-19, 2-23
READER CHECK ---------- 2-32
READER KEYS AND LIGHTS ---------- 2-31
READER READY ---------- 2-32
READER START ---------- 2-31
READER STOP ---------- 2-31, 2-32
READY LIGHT ---------- 2-11, 2-48
RECORD CONTROL GROUP (RECORD ID) ---------- 4-4
REEL DOOR INTERLOCK ---------- 2-50
REEL RELEASE KEY ---------- 2-50
REEL SEQUENCE NUMBER ---------- 2-68
REEL SERIAL NUMBER ---------- 2-66
REFLECTIVE SPOTS ---------- 2-46
RELEASE KEY ---------- 2-5
RELOCATABLE OBJECT PROGRAMS ---------- 3-3
RELOCATABLE PROGRAM ---------- 3-20
REQUEST KEY ---------- 2-2
RESET KEY ---------- 2-50
RESIDENT MONITOR ---------- 3-2
RESTARTS ---------- 3-13
RETRIEVAL CROSS-INDEX PROCESSOR ---------- 4-39
RETRIEVAL INPUT EDITOR ---------- 4-39
RETRIEVAL INPUT PROCESSOR ---------- 4-39
RETRIEVAL OPERATIONS ---------- 4-39
RETRIEVAL PROGRAM ---------- 1-4
RETRIEVAL PROPER ---------- 4-39
RETRIEVE ---------- 1-4
RIBBON CHANGING ---------- 2-43
RUN ---------- 2-12, 3-2
SCALE ---------- 2-62
SCALE NUMBER ---------- 2-65
SCALE SELECTION AND ORIGIN CHANGE ---------- 2-61

SCAN ---------- 2-16
SEARCH NUMBER ---------- 4-50
SELECT LIGHT ---------- 2-48
SENSE-BIT SWITCHES ---------- 2-27
SERVICE PROGRAMS ---------- 3-1
SERVO ON ---------- 2-63
SHIFT INTERLOCK ---------- 2-39
SHIFT KEYS ---------- 2-6
SINGLE CYCLE ---------- 2-35
SNAPSHOT ---------- 3-5
SOF ---------- 4-31
SORT PHASE ---------- 4-39
SPACING ---------- 2-42
SPARE ---------- 2-63
STACKER ---------- 2-31
STANDARD INPUT UNIT (SIU) ---------- 3-20
STANDARD PRINT UNIT (SPR) ---------- 3-20
STANDARD PUNCH UNIT (SPU) ---------- 3-20
START KEY ---------- 2-14, 2-49
START PRINT-OUT SWITCH ---------- 2-28
STATUS INDICATOR LIGHTS ---------- 2-17
STATUS LIGHTS ---------- 2-17
STOP ---------- 2-25
STOP KEY ---------- 2-15
STORAGE PRINT ---------- 3-5
SUBPROGRAM ---------- 3-20
SUBSCAN ---------- 2-16
SYMBOL SELECTION ---------- 2-63
SYNC CHECK ---------- 2-34
SYNCHRONIZER ---------- 1-1
SYNCHRONIZER KEYS AND SWITCHES ---------- 2-58
SYSTEM CHECK INDICATOR LIGHTS ---------- 2-22
SYSTEM CONTROLS INDICATOR LIGHTS ---------- 2-25
SYSTEM GENERATION ---------- 3-5, 3-15
SYSTEM GENERATION FLOW ---------- 3-6
SYSTEM GENERATOR FILE (SGF) ---------- 3-20
SYSTEM LIBRARIAN ---------- 1-4
SYSTEM LIBRARY ---------- 3-20
SYSTEM MONITOR ---------- 3-2, 3-20
SYSTEM MONITOR PROGRAM ---------- 1-3
SYSTEM OPERATING FILE (SOF) ---------- 3-20
SYSTEMS CHECK INDICATOR LIGHTS ---------- 2-21
TAPE CHECKING ---------- 2-47
TAPE DENSITY LIGHTS ---------- 2-49
TAPE HANDLING ---------- 2-68
TAPE INDICATE ON LIGHT ---------- 2-48
TAPE OFF-LINE ---------- 2-24
TAPE PRINT ---------- 3-5

TAPE PUNCH ---------- 2-41
TAPE SORTING PROGRAM ---------- 3-4
TAPE SPLICING ---------- 2-69
TAPE-CONTROLLED CARRIAGE ---------- 2-40
THERMAL ---------- 2-24
THERMAL INTERLOCK ---------- 2-39
TRACTOR SLIDE BAR ---------- 2-38
TRANSITIONAL MONITOR ---------- 3-2
TRANSPORT ---------- 2-31
UNLOAD KEY ---------- 2-49
UTILITY PROGRAMS ---------- 3-5
VAC ---------- 2-63
VALIDITY ---------- 2-32
VARIABLE SET ---------- 4-4
VERTICAL PRINT ADJUSTMENT ---------- 2-36
WORD MARK KEY ---------- 2-6
WRITE FORMAT TRACK SWITCH ---------- 2-54
WRITE-DISK-CHECK ---------- 2-29
WRONG LENGTH RECORD ---------- 2-6
X COORDINATE ---------- 2-60
X SCALE ---------- 2-62
Y COORDINATE ---------- 2-60
Y SCALE ---------- 2-62
ZERO BALANCE ---------- 2-18
1301 ---------- 2-51
1301 PRINT ---------- 3-5
1302 ---------- 2-51
1401 COMPATIBILITY LIGHT ---------- 2-25
1402 CARD READ-PUNCH ---------- 1-1, 2-29
1402 CARD READ-PUNCH KEYS, LIGHTS, AND SWITCHES ---------- 2-31
1403 CARRIAGE CONTROLS ---------- 2-34
1403 MANUAL CONTROLS ---------- 2-35
1403 PRINTER ---------- 1-2, 2-33
1410 CONFIGURATION ---------- 1-1
1410 OPERATING SYSTEM ---------- 3-1
1410/7010 OPERATING SYSTEM ---------- 1-3
1411 CENTRAL PROCESSOR UNIT ---------- 1-1
1414 I/O SYNCHRONIZER ---------- 2-57
1414 PANEL ---------- 2-58
1415 CONSOLE ---------- 1-2, 2-1
1415 CONSOLE CE TEST PANEL ---------- 2-25
7330 TAPE UNITS ---------- 2-51
7631 FILE CONTROL ---------- 2-53