

**HANDBOOK  
OF  
OPERATING PROCEDURES  
FOR THE  
BURROUGHS**

**205**

**ELECTRONIC DATA-PROCESSING SYSTEMS**

**Burroughs Corporation**  
DETROIT, MICHIGAN

## TABLE OF CONTENTS

Section	Title	Page
1	INTRODUCTION .....	1-1
1-1	General .....	1-1
1-3	Description .....	1-1
1-5	The Computer .....	1-1
1-8	The Control Console .....	1-1
1-11	Supervisory Printer .....	1-1
1-14	Paper-Tape System .....	1-1
1-18	Punched-Card System .....	1-2
1-21	Magnetic-Tape System .....	1-2
1-24	Scope of Handbook .....	1-2
2	THE COMPUTER .....	2-1
2-1	General .....	2-1
2-3	Supervisory Control Panel .....	2-1
2-6	DC On-Off Indicator and Buttons .....	2-1
2-9	Register Displays .....	2-1
2-19	Clear Push Button .....	2-4
2-21	Timing Toggle .....	2-4
2-26	Operation Controls .....	2-4
2-32	Computer-Stop Indicators and Controls .....	2-4
2-42	Sub-Maintenance Control Panel .....	2-6
2-43	General .....	2-6
2-45	D-to-C Push Button .....	2-6
2-47	Ignore-Sign-Column Switch .....	2-6
2-52	Operating Procedures .....	2-6
2-53	Manual Operation .....	2-6
2-60	Continuous Operation .....	2-7
3	CONTROL CONSOLE .....	3-1
3-1	General .....	3-1
3-4	Control Panel .....	3-1
3-5	General .....	3-1
3-7	Register Displays .....	3-1
3-9	Clear Push Button .....	3-1
3-11	Timing-Toggle Indicators .....	3-1
3-13	Operation Controls and Indicators .....	3-1
3-18	Breakpoint Controls .....	3-1
3-21	Input Selector .....	3-2
3-26	Output Selector .....	3-2
3-31	P. O. Suppress .....	3-3
3-33	Computer-Stop Indicators and Control .....	3-3
3-38	Decimal Keyboard .....	3-3
3-39	Characteristics .....	3-3
3-42	Operation .....	3-4
3-47	Console .....	3-4
4	PHOTOELECTRIC READER AND HIGH-SPEED PAPER-TAPE PUNCH.....	4-1
4-1	General .....	4-1
4-3	Photoelectric Reader .....	4-1
4-4	Characteristics .....	4-1
4-8	Mounting the Loop Adapter.....	4-1

## TABLE OF CONTENTS (Cont)

Section	Title	Page
4-12	Mounting the Reel Adapter .....	4-1
4-16	Reading Paper Tape .....	4-2
4-18	Rewinding Paper Tape .....	4-2
4-20	High-Speed Paper-Tape Punch .....	4-2
4-21	Characteristics .....	4-2
4-23	Loading Procedure .....	4-4
5	SUPERVISORY PRINTER .....	5-1
5-1	Flexowriter .....	5-1
5-2	Function .....	5-1
5-5	Keyboard and Controls, Standard Model .....	5-1
5-15	Keyboard and Controls, CARDATRON-Code Model .....	5-1
5-17	Typewriter Control Unit .....	5-2
5-18	Function .....	5-2
5-21	Control Panel .....	5-3
5-32	Patch Panel .....	5-5
5-37	Operating Procedures .....	5-6
5-38	Format Control .....	5-6
5-40	Tape Preparation .....	5-6
5-42	Tape Duplication and Listing .....	5-6
6	THE PAPER-TAPE PREPARATION SYSTEM .....	6-1
6-1	Characteristics .....	6-1
6-3	Controls and Indicators .....	6-1
6-4	Control Unit .....	6-1
6-16	Keyboard .....	6-1
6-21	Tape Punch .....	6-2
6-24	Tape Reader .....	6-2
6-27	Tape Punching .....	6-2
6-29	Tape Verification and Correction .....	6-3
6-30	Verification .....	6-3
6-34	Error Correction .....	6-3
6-39	Verification of Special Tapes .....	6-4
6-41	Tape Duplication and Correction .....	6-4
6-42	Duplication .....	6-4
6-44	Error Correction .....	6-5
6-49	Duplication of Special Tapes .....	6-6
6-52	Miscellaneous Operating Information .....	6-6
6-53	Marking Tape .....	6-6
6-55	Power Switches .....	6-6
6-57	Resetting .....	6-6
7	THE CARDATRON SYSTEM .....	7-1
7-1	Characteristics .....	7-1
7-2	CARDATRON System .....	7-1
7-6	Card-Handling Devices .....	7-1
7-10	Designation of CARDATRON Input-Output Units .....	7-1
7-14	Controls and Indicators .....	7-1
7-15	Control-Unit Control Panel .....	7-1
7-26	Output-Unit Control Panel .....	7-2
7-35	Input-Unit Control Panel .....	7-4
7-47	Operating Procedures .....	7-6

## TABLE OF CONTENTS (Cont)

Section	Title	Page
7-48	Preparation of Card-Handling Units .....	7-6
7-50	Clearing the CARDATRON .....	7-6
7-52	Starting the Card-Handling Machines .....	7-6
7-58	Run-Out Procedure for the 089 Collator .....	7-8
7-60	Clearing Card Jams .....	7-8
8	THE PUNCHED-CARD CONVERTER .....	8-1
8-1	Characteristics .....	8-1
8-2	General .....	8-1
8-4	Control Switches .....	8-1
8-9	Operating Procedures .....	8-1
8-10	Pre-Start .....	8-1
8-12	Start .....	8-1
9	THE MAGNETIC-TAPE SYSTEM .....	9-1
9-1	General .....	9-1
9-5	Magnetic-Tape Control Unit .....	9-1
9-6	Physical Description .....	9-1
9-10	Read Subpanel .....	9-1
9-15	Designate Subpanel .....	9-1
9-20	T Register .....	9-2
9-25	Control Subpanel .....	9-2
9-31	Write Subpanel .....	9-3
9-38	Operating Controls .....	9-4
9-46	Tape Storage Unit .....	9-4
9-47	Control Panel .....	9-4
9-58	Unloading Procedures .....	9-5
9-60	Loading Procedures .....	9-7
9-61	DATAFILE .....	9-9
9-62	Designated Indicator .....	9-9
9-64	Not-Ready Indicator .....	9-9
9-66	Not-Write Indicator .....	9-9
9-68	Control Panel .....	9-9
9-83	File-Protect Tabs .....	9-12
9-85	Designate Switch .....	9-12
9-87	Drive-Roller Retracting Handles .....	9-12
9-89	Preparing for Remote Operation .....	9-12
10	MAGNETIC-TAPE CALIBRATION .....	10-1
10-1	General .....	10-1
10-5	Tape Storage Unit .....	10-1
10-6	Even Lane .....	10-1
10-11	Odd Lane .....	10-2
10-14	DATAFILE .....	10-2
10-15	All Odd Lanes .....	10-2
10-19	All Even Lanes .....	10-3
11	OPERATING SUGGESTIONS .....	11-1
11-1	General .....	11-1
11-3	Before and After Operation .....	11-1
11-6	The Computer .....	11-1
11-7	Checking Manually Stored Words .....	11-1

## TABLE OF CONTENTS (Cont)

<b>Section</b>	<b>Title</b>	<b>Page</b>
11-9	Storage Drum .....	11-1
11-11	Power Failure .....	11-2
11-13	Air-Conditioning Failure .....	11-2
11-15	Cycling Down the Computer .....	11-2
11-19	The Magnetic-Tape System .....	11-2
11-20	DATAFILE .....	11-2
11-23	Tape Storage Unit .....	11-3
11-31	Paper-Tape System .....	11-4
11-32	Manually Rewinding Paper Tape .....	11-4
11-34	Splicing Paper Tape .....	11-4
11-36	Sample Forms .....	11-4
11-37	Computer Log .....	11-4
11-39	Control Console Stop Sheet .....	11-4
11-41	Pre-Run Check Sheets .....	11-4
11-43	Console Notebook .....	11-4

### TABLES

<b>Table</b>	<b>Title</b>	<b>Page</b>
2-1	Effects of Various Settings of the Lock-Normal and Continuous-Step Switches .....	2-5
5-1	Patch-Panel Connections .....	5-6
7-1	CARDATRON System Row-Counter Settings .....	7-5

### FIGURES

<b>Figure</b>	<b>Title</b>	<b>Page</b>
2-1	Burroughs 205 Computer .....	2-2
2-2	Supervisory Control Panel .....	2-3
2-3	Neon Indicators and Set Buttons .....	2-4
2-4	Sub-Maintenance Control Panel .....	2-6
3-1	Control Console .....	3-2
3-2	Control-Console Control Panel .....	3-3
3-3	Decimal Keyboard .....	3-3
3-4	The Consolette .....	3-4
4-1	Photoelectric Reader .....	4-2
4-2	Loop Adapter .....	4-3
4-3	Reel Adapter .....	4-3
4-4	Position of Paper Tape in Photoelectric Reader .....	4-4
4-5	High-Speed Paper-Tape Punch .....	4-4
5-1	Flexowriter and Typewriter Control Unit .....	5-2
5-2	Flexowriter Keyboard, Standard Model .....	5-3
5-3	Flexowriter Keyboard, CARDATRON-Code Model .....	5-4
5-4	Typewriter Control Unit Panel .....	5-5
5-5	Patch Panel .....	5-5
5-6	Mechanical Reader and Punch .....	5-7
6-1	Tape-Preparation System .....	6-2
6-2	Control Unit .....	6-2

## TABLE OF CONTENTS (Cont)

<b>Figure</b>	<b>Title</b>	<b>Page</b>
6-3	Tape-Preparation System Keyboard .....	6-3
6-4	Tape Punch .....	6-4
6-5	Tape Reader .....	6-5
6-6	Verified Tape .....	6-5
7-1	CARDATRON System .....	7-2
7-2	CARDATRON Unit Designation .....	7-3
7-3	CARDATRON Control Unit Control Panel .....	7-4
7-4	CARDATRON Output Unit Control Panel .....	7-4
7-5	CARDATRON Input Unit Control Panel .....	7-7
7-6	089 Control Panel .....	7-7
8-1	Punched-Card Converter Control Panel .....	8-2
9-1	Reel-Type Tape Storage Units .....	9-2
9-2	DATAFILE's .....	9-3
9-3	Tape Control Unit Control Panel .....	9-4
9-4	Tape Storage Unit Control Panel .....	9-5
9-5	Indicators Above Control Panel .....	9-10
9-6	DATAFILE Control Panel .....	9-10
9-7	File-Protect Tabs .....	9-11
9-8	Vacuum Manifold and Drive-Roller Assembly .....	9-12
11-1	Sample Computer Log .....	11-5
11-2	Console Stop Sheet .....	11-6
11-3	Control Console and Supervisory Control Panel Set-Up Sheet .....	11-7
11-4	Peripheral-Equipment Set-Up Sheet .....	11-8

**TYPICAL BURROUGHS 205 COMPUTING SYSTEM INSTALLATIONS**



**BOSTON NAVAL SHIPYARD**



**MINNESOTA MUTUAL LIFE INSURANCE COMPANY, AT ST. PAUL, MINNESOTA**



# INTRODUCTION

## 1-1. GENERAL

1-2. The Burroughs 205 Electronic Data-Processing System is a medium-scale computing system. Burroughs 205 systems may consist of one of a number of different configurations, since a variety of input-output equipment is available and not every installation has all of this equipment. It is not the purpose of this handbook to discuss possible variations of the system configuration, but, rather, to describe each of the units available. The operator will, of course, select the information he needs from that which is presented here.

## 1-3. DESCRIPTION

1-4. A maximum Burroughs 205 Electronic Data-Processing System includes the computer, the Control Console, a supervisory printer, paper-tape and punched-card input and output systems, and magnetic-tape auxiliary storage.

### 1-5. THE COMPUTER

1-6. The computer is the data-processing and control center of the Burroughs 205 system. (Refer to section 2.) It automatically executes internally stored, sequential programs of single-address instructions. Instructions and data are stored in static registers and on a magnetic drum. The computer accepts data and instructions from punched paper tape, or—through the CARDATRON\* system or the Punched-Card Converter—from punched cards, or from magnetic-tape auxiliary storage. It is also possible to insert data and instructions manually.

1-7. The supervisory control panel on the computer contains indicators which show the operator the contents of the static registers, the mode in which the computer is operating, and some of the reasons for computer stops. The controls enable him to place the computer under program control or to operate it manually when he wishes to make insertions in storage, inspect data, compare words, and so forth. The operator may also use a few of the controls on the sub-maintenance control panel on the computer, although most of these controls are intended for the use of the field engineer (paragraphs 2-45 through 2-51).

### 1-8. THE CONTROL CONSOLE

1-9. The computer may also be operated from the Control Console, a separate desk-sized unit (section 3). The Control Console includes a control panel and a decimal keyboard for manual entry of information into storage.

Many of the controls and indicators duplicate those on the supervisory control panel. There is provision on the Control Console, however, for breakpoint control, the suppression of printout, and the selection of one of three devices for providing input in response to a PAPER-TAPE READ instruction, as well as selection of printout or punchout in response to a PAPER-TAPE WRITE instruction. None of these facilities is available at the supervisory control panel.

1-10. The operations of the supervisory control panel and the Control Console are closely interdependent, and the operator is cautioned that he must be familiar with the implications of this interdependence before attempting to operate the system. Refer to sections 2 and 3.

### 1-11. SUPERVISORY PRINTER

1-12. The supervisory printer is used to print out small quantities of data, such as interim results of program runs and program-control information (program identification, date, and so forth). It may also be used to print out directions to the operator coincident with error or program-control stops.

1-13. The supervisory printer used with the Burroughs 205 system is a Flexowriter modified to operate under control of the Typewriter Control Unit (section 5). Under program control, the supervisory printer can type or punch—or simultaneously type and punch—numeric or alphanumeric information from the computer. The Flexowriter is also used off-line to duplicate a paper tape or to punch a new tape. The mechanical reader that is part of the Flexowriter can be used as an input device to the computer, but rarely is, in actual practice, since it is relatively slow.

### 1-14. PAPER-TAPE SYSTEM

1-15. PHOTOELECTRIC READER AND HIGH-SPEED PAPER-TAPE PUNCH. The Photoelectric Reader and the High-Speed Paper-Tape Punch are the primary paper-tape input and output devices used with the Burroughs 205 Data-Processing Systems (section 4). The Photoelectric Reader reads information from paper tape under the control of instructions from the computer. It is selected as the paper-tape input device from the Control Console.

1-16. The High-Speed Paper-Tape Punch operates through the Control Console to reproduce information from the computer in paper tape.

---

\*Trade-mark of the Burroughs Corporation



## **Introduction**

1-17. PAPER-TAPE PREPARATION SYSTEM. The Paper-Tape Preparation System is an off-line device used to punch, verify, and duplicate paper tape for later use as input to the computer through the Photoelectric Reader. It consists of a control unit, a keyboard, a tape punch, and a tape reader (section 6).

### **1-18. PUNCHED-CARD SYSTEM**

1-19. CARDATRON SYSTEM. Punched-card input and output to the computer is from and to standard IBM card-handling equipment through the CARDATRON system, which consists of a CARDATRON Control Unit and up to a total of seven CARDATRON input and output units (section 7). Each of the input and output units is connected to an IBM device. Input usually is from an IBM card reader and output is to a card punch or line printer. The CARDATRON input and output units provide buffering of information passing between the computer and the card-handling devices. This buffering enables simultaneous multiple-input-output operation.

1-20. PUNCHED-CARD CONVERTER. Card input to the computer may also be through the Punched-Card Converter. This is a relatively slow device, which provides no buffering and can handle only numeric information. However, it provides an economical means of communication between card-handling machines and the computer. The punched-card converter will handle as many as 40 positions of alphabetic printed output, when it is coupled with the Type 407 line printer and special plugboard wiring is employed.

### **1-21. MAGNETIC-TAPE SYSTEM**

1-22. Magnetic tape is used as auxiliary storage for the Burroughs 205 Electronic Data-Processing Systems. Information is written on or read from magnetic tape under computer control. It may consist of data or instructions, or both.

1-23. Two types of magnetic-tape storage units may be used with the computing system, a conventional reel-type unit or the multiple-tape bin-type DATAFILE\*. The DATAFILE is a large-capacity storage device containing 50 tapes and having a total capacity of 100,000

20-word blocks, as opposed to the 20,000 20-word block capacity of the reel-type units. Up to ten DATAFILE's or reel-type storage units—or any combination totaling ten—may be used with a single Burroughs 205 system. Refer to section 9. One tape control unit is necessary to control and operate each ten-unit group or any part thereof.

## **1-24. SCOPE OF HANDBOOK**

1-25. This handbook is intended for the use of two types of persons: first, the operator; and second, the programmer and coder, who must understand system operation in order to provide intelligent instructions to the operator. Instructions are given for operating the units of the system—procedures for starting and stopping, for entering information into storage, for examining information in storage, and for loading and unloading paper tape and magnetic tape, and so forth. No attempt is made to describe the IBM equipment in detail, since IBM manuals are available which contain this information (paragraph 7-9).

1-26. The book was written on the assumption that the logic and coding of the program have been checked out as completely as possible by the coder before the operating instructions for the program are given to the operator and that the operator has been supplied with stop listings (error stops, breakpoint stops, program stops, and so forth), a pre-run check sheet, Control Console and supervisory control panel set-up sheets, peripheral-equipment set-up sheet, and other standard operating aids. It is suggested that the operator compile a console notebook to organize this material (paragraphs 11-44 through 11-54).

Please address queries or comments concerning this handbook to:

Manager, Product Support, 205  
Burroughs Corporation  
6071 2nd Ave.  
Detroit 2, Michigan

---

\*Trade-mark of the Burroughs Corporation

# THE COMPUTER



## 2-1. GENERAL

2-2. The Burroughs 205 is a general-purpose stored-program electronic digital computer. It is the central controlling and processing unit of the data-processing system. The computer is designed to solve a wide variety of data-reduction and data-handling problems. It stores information on a magnetic drum and in static registers (groups of bi-stable electronic devices commonly called flip-flops or toggles). It automatically carries out sequential programs of single-address instructions.

## 2-3. SUPERVISORY CONTROL PANEL

2-4. The supervisory control panel is located in the top third of the central section of the computer (figure 2-1). It is used by the operator, for program checking and for operating the computer, and by the field engineer for maintenance purposes. (The system may also be operated from the Control Console. Refer to section 3.)

### NOTE

When the supervisory control panel is to be used for operating the system, the stop button on the Control Console *must* first be depressed.

2-5. The supervisory control panel has five register displays and one control display, plus test-system, d-c, computer-stop, clear, timing-toggle, operation, and memory-control subpanels (figure 2-2). The operator is concerned only with the following displays and subpanels:

- Registers (paragraphs 2-9 through 2-18)
- D-c (paragraphs 2-6 through 2-8)
- Computer-stop (paragraphs 2-32 through 2-41)
- Clear (paragraph 2-19)
- Timing-toggle (paragraphs 2-21 through 2-25)
- Operation (paragraphs 2-26 through 2-31)

He uses the zero push button on the test system subpanel for one operation only (paragraph 2-13). Otherwise, the test-system, control, and memory-control subpanels are solely for the use of the field engineer.

## 2-6. DC ON-OFF INDICATOR AND BUTTONS

2-7. Depressing the DC ON button causes direct current to be supplied to the computer and the d-c indicator to come on, provided that the field engineer has started the computer from the Power Control Unit. Depressing the OFF button causes dc to be cut off.

### CAUTION

In using any of the controls near the DC buttons (figure 2-2), be very careful not to press the

red DC OFF button accidentally, since all information in the quick-access bands will be lost, and the program currently in operation must be restarted from the first restart point which does not require retention of data in the quick-access bands.

2-8. If dc should be cut off accidentally, wait 4 or 5 seconds and then proceed as follows:

1. Turn off the CARDATRON core-voltage switches. (These switches are located inside the input, output, and units on the side panels.)
2. Press the DC ON pushbutton.
3. Press the clear buttons on the supervisory control panel and the Tape Control Unit.
4. Turn on the CARDATRON core-voltage switches.
5. Restart the program from the first restart point which does not require retention of data in the quick-access bands.

## 2-9. REGISTER DISPLAYS

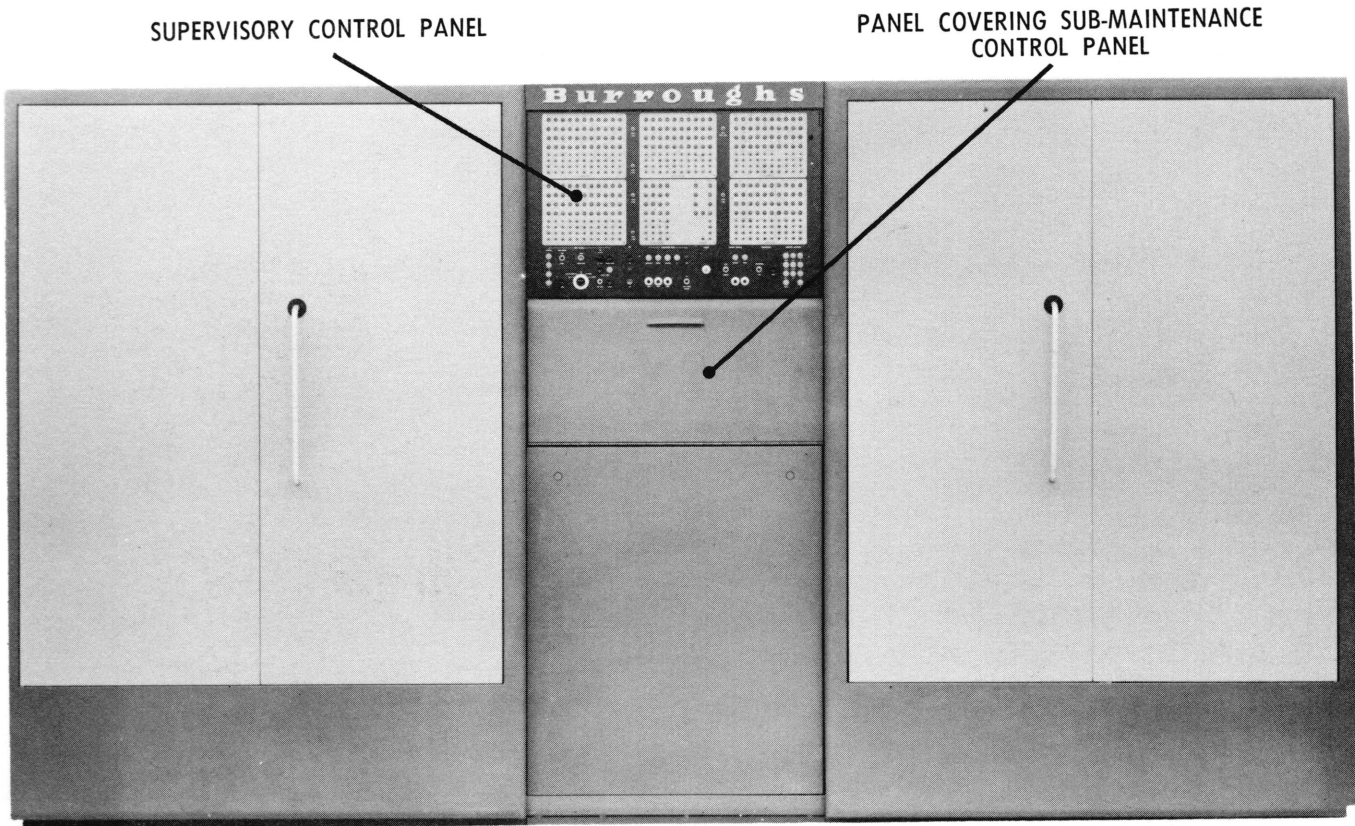
2-10. GENERAL. The static registers of the Burroughs 205 use flip-flops as the principal numerical and logical elements. These electronic devices are always in one of two stable states; the logic of the machine uses one state to indicate zero and the second state to indicate one. The two states are sometimes spoken of as off (zero) and on (one), because when a flip-flop is in the zero state, the corresponding neon on the control panel is off, and when the flip-flop is in the one state, the corresponding neon is on. Actually, the bi-stable devices themselves are never off.

2-11. The registers are represented on the supervisory control panel by banks of neon lamps. Each vertical column of neons represents the four bits of a decimal digit; the value of this decimal digit is the sum of the values of the lighted neons. Reading from top to bottom, the neons represent the values 8, 4, 2, and 1. No value greater than 9 should appear in any decade. For example:

	Decades			
8	0	●	0	0
4	●	0	0	0
2	●	0	0	0
1	●	●	0	●
	—	—	—	—
	7	9	0	1
	Decimal-digit values			

Legend: ● on  
0 off

## The Computer



**Figure 2-1. Burroughs 205 Computer.**

If a value greater than 9 should appear, the FC (forbidden-combination) indicator will come on. Refer to paragraph 2-34.

2-12. For each of the four neons in a column there is a corresponding red set button in the same column, below the neons. A neon indicator in a column may be turned on manually by depressing the corresponding set button. (The neon comes on, of course, because the flip-flop in the register changes state when the button is depressed.) For example, the 4-bit neon may be turned on by depressing the 4 set button (figure 2-3).

2-13. A register may be cleared by depressing the clear button for that register (figure 2-2). A single neon may be turned off by depressing the corresponding set button and the zero pushbutton on the test-system subpanel at the same time. All of the registers may be cleared by depressing the red clear button next to the lock-normal switch (paragraph 2-19).

2-14. **A REGISTER.** This register contains 11 decimal-digit positions. Ten positions are for the data or instruction, and one position is for the sign. This register acts as an accumulator, and the results of most operations appear here. The decimal-digit positions are marked A-SG, and A-1 through A-10.

2-15. **R REGISTER.** This register contains 10 decimal-digit positions (no sign-digit position). In several opera-

tions, it serves as an extension of the A register, holding the least-significant digits of a number contained in the combined A and R registers. The digit positions are marked R-1 through R-10. The sign of the R register is the sign of the A register.

2-16. **D REGISTER.** This register contains 11 decimal-digit positions, marked D-SG, and D-1 through D-10. All words entering the C register or the A register, from an input medium or from storage, first pass through the D register. Although it is not used directly for programming, the D register contains one of the operands during an arithmetic operation. All skip, breakpoint, unit-designation, and sign-control digits of an instruction are sensed as the word passes from the D register to the C register. Data entering the B register also passes through the D register.

2-17. **C REGISTER.** This register contains 10 decimal-digit positions. The first two positions (high-order positions C-1 and C-2) contain the order or operation code, and the next four (C-3 through C-6) contain the address of the operand, if there is an operand. The last four digit positions (C-7 through C-10) comprise the control counter; these positions hold the storage address of the instruction to be executed following the instruction now in the first six digit positions of the C register (the order register and address register). The C register receives each instruction from storage through the D register. Any word entering the C register is treated as an instruction.

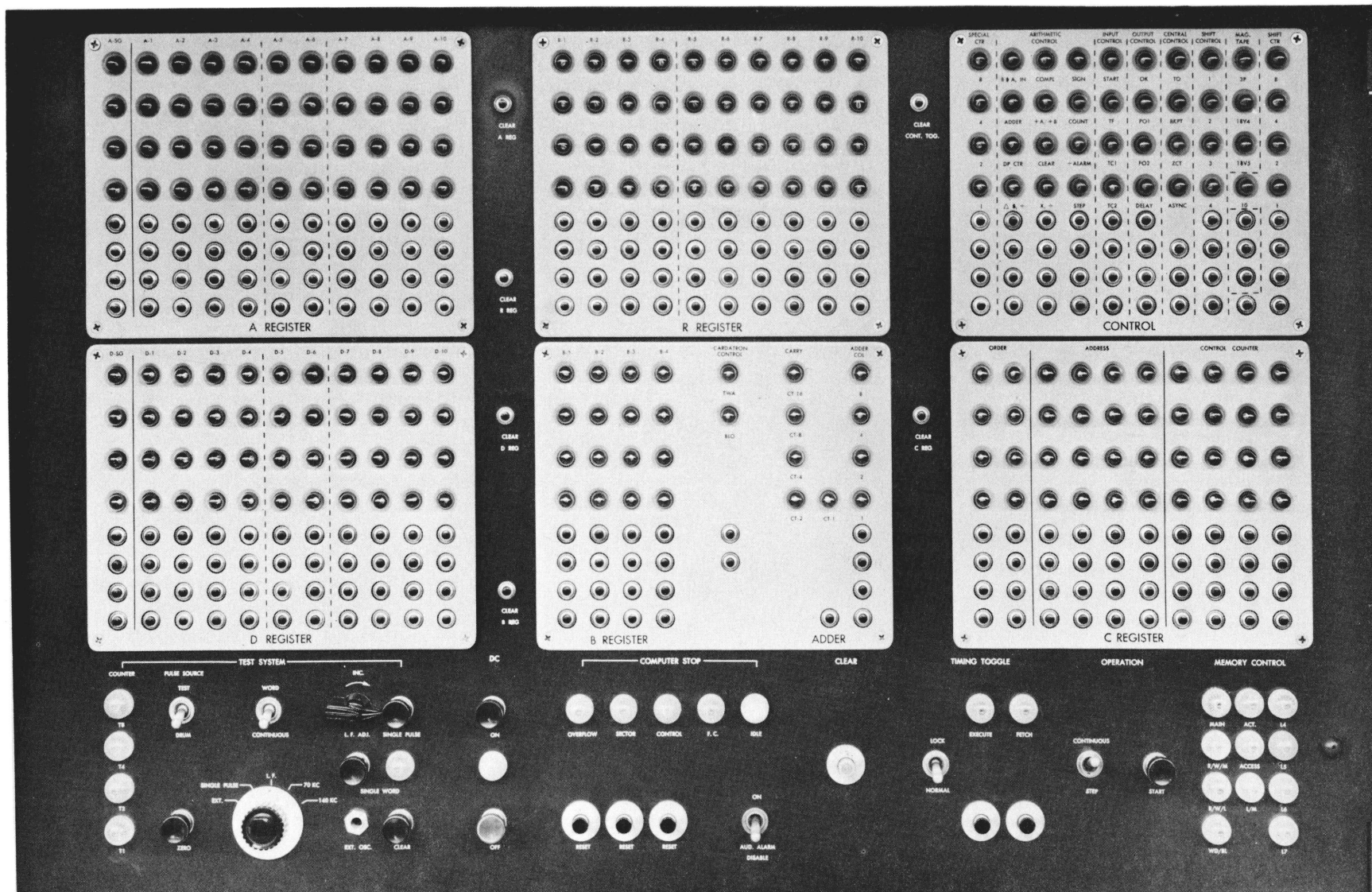


Figure 2-2. Supervisory Control Panel.

## The Computer

2-18. B REGISTER. This register contains four decimal-digit positions marked B-1 through B-4. It is used for tallying and automatic address modification of instruction words. Under program control, the contents of the B register can be added to the address part of any instruction word, as the instruction passes from the D register to the C register, thus leaving the word unchanged in storage.

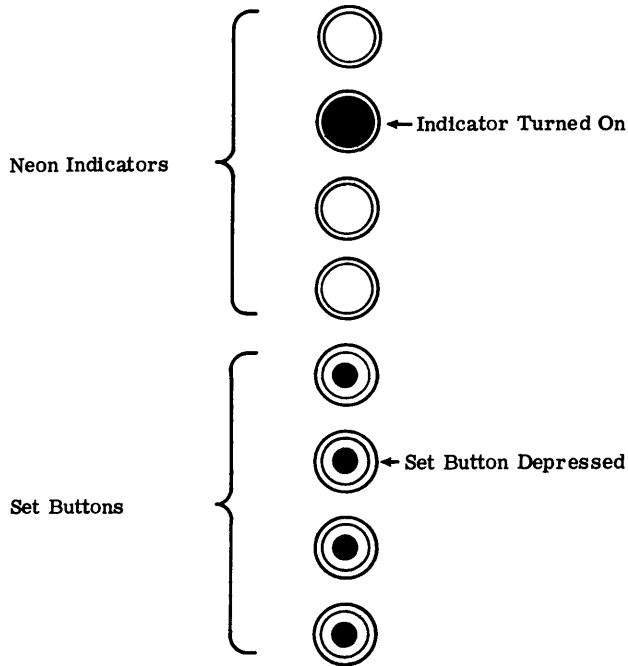


Figure 2-3. Neon Indicators and Set Buttons.

### 2-19. CLEAR PUSH BUTTON

2-20. The general-clear push button is the red button next to the lock-normal switch (figure 2-2). When this button is depressed, all registers and indicators will be cleared (set to zero or off), except that the timing-toggle execute indicator will be on. (The cleared state of the timing-toggle is always execute.) Information in storage is not affected. The clear push button may be used for emergency stops.

#### NOTE

Clearing the registers actually inserts the PA-PER-TAPE READ instruction (00 0000 0000) in the C register.

### 2-21. TIMING TOGGLE

2-22. INDICATORS. The timing-toggle indicators are labeled FETCH and EXECUTE. They indicate the phase of the timing cycle that the computer will enter next. If the computer is in the fetch phase—fetching an instruction from storage—the execute indicator is on. If the computer is in the execute phase—executing an instruction that has previously been fetched from storage—the fetch indicator is on.

2-23. INDICATOR CONTROLS. The state of the timing toggle may be changed manually from fetch to execute by depressing the push button under the indicator that is off.

2-24. LOCK-NORMAL SWITCH. During normal operation, this two-position switch is in the NORMAL position. When this switch is in the LOCK position, the computer will be locked in the execute phase; that is, it will be prevented from changing from the execute to the fetch phase of the timing cycle. If the computer is in the fetch phase at the time the switch is set to LOCK, depressing the clear button will lock the computer in the execute phase. The execute indicator will remain on because the only phase of the timing cycle that can be entered in the lock state is execute.

2-25. Various modes of computer operation are based on the combined settings of the lock-normal and continuous-step switches. Refer to table 2-1.

### 2-26. OPERATION CONTROLS

2-27. START. This button is used to start processing of data. It can be used to initiate operation in either continuous or step mode. Note that if the computer is to be operated from the supervisory control panel, the stop button on the Control Console must be depressed before the start button on the supervisory control panel is pushed.

2-28. The phase of the timing cycle that the computer will enter when the start button is pushed is indicated by the timing-toggle indicator that is on (paragraph 2-22). Either the next instruction will be fetched, or the contents of the C register will be executed.

2-29. CONTINUOUS-STEP. With this switch in the continuous position, the computer will automatically execute instructions in program sequence when the start button is depressed.

2-30. The step setting has two functions. One function is to enable step-by-step program debugging. With the switch in the step position, one phase of the timing cycle will be completed each time the start button is depressed. The second function of the step setting is to enable operation from the Control Console. Always check to be sure that the switch is set to step before attempting to operate the computer from the Control Console.

2-31. The computer can be locked in the execute phase with the continuous-step switch in either position by setting the lock-normal switch (paragraph 2-24) to lock. Refer to table 2-1.

### 2-32. COMPUTER-STOP INDICATORS AND CONTROLS

2-33. IDLE INDICATOR. This indicator is on whenever the computer is not operating in the continuous mode.

2-34. FC INDICATOR. This indicator comes on whenever a forbidden combination (a binary-coded decimal digit greater than 9) is detected in one of the registers. Since digits enter the register from right to left, the forbidden combination is detected in the lowest-order position (A-10, R-10, B-4, D-10, C-6, or C-10). Refer to paragraph 2-11.

2-35. The FC indicator is turned off by clearing the supervisory control panel (paragraph 2-19) or by changing

**Table 2-1. Effects of Various Settings of the Lock-Normal and Continuous-Step Switches**

Switch Settings		Operations
Lock-Normal	Continuous-Step	
Lock	Step	Computer locked in execute phase. Each time the start button is depressed, the instruction in the C register will be executed.
Lock	Continuous	Computer locked in execute phase. Can continuously execute instruction in C register after start button is depressed once.
Normal	Step	Supervisory control panel setting for operation from the Control Console. Also, setting for step operation from the supervisory control panel (providing the stop button on the Control Console has been depressed).
Normal	Continuous	Can operate in continuous mode from the supervisory control panel. Cannot step through a problem.

the bit combination that causes the stop to a permissible combination. For example, the operator may change a binary-coded 15 (all bits on) to a binary-coded 7 by turning off the 8 bit. If this procedure is followed, the computer resumes continuous operation without any further intervention; however, garbled information may have been introduced into the processing. To avoid the latter condition and also to determine the cause of the forbidden combination, the operator should stop the computer by manually depressing the stop button on the Control Console or by setting the continuous-step switch on the supervisory control panel to the STEP position, prior to correcting the forbidden combination. Not only does this reduce the possibility of misinformation being processed by the system, but it also permits detailed analysis of the situation by the Field Engineer, if necessary.

2-36. CONTROL INDICATOR. This indicator comes on whenever a STOP (08) instruction is executed or whenever the computer stops on an overflow condition. (In the latter case the overflow indicator also comes on.) The control indicator is turned off after a STOP instruction, and continuous operation is resumed, by depressing the start button; it is turned off after an overflow stop by depressing the reset push button under the control indicator.

2-37. SECTOR INDICATOR. This indicator comes on and the computer stops whenever the checking circuitry detects a sector alarm. A sector-alarm stop indicates that the computer's checking circuits have lost count of word positions on the drum. The stop prevents information from being read from or written into incorrect storage locations. If the sector indicator comes on during a program run, depress the reset button under the indicator and restart the program. If the sector indicator comes on

again, call the field engineer.

2-38. OVERFLOW INDICATOR. This indicator is turned on if any of the following conditions occurs:

1. Arithmetic overflow (a result exceeding the capacity of the A register) during the execution of the various addition and subtraction instructions, or during division, extracting, or rounding.
2. Sign difference during the execution of an OVERFLOW ON SIGN DIFFERENCE (OSGD) instruction.
3. An attempt to execute a magnetic-tape instruction while tape is in motion or while the designated tape unit is not ready.

2-39. If any of the instructions that cause overflow is not followed immediately by the CHANGE CONDITIONALLY (CC) instruction, the computer will stop with the overflow, idle, and control indicators on. The fractional sum or difference remains in the A register after an overflow on addition or subtraction. After an overflow on division, however, the A and R registers are cleared.

2-40. The conditional change-of-control instructions CHANGE ON NON-ZERO (CNZ), DECREASE B (DB), and NORMALIZE (NOR) turn on the overflow indicator momentarily when the change of control is to be executed. The computer does not stop, however.

2-41. AUDIBLE-ALARM TOGGLE SWITCH. When this two-position switch is in the ON position, a buzzer will sound whenever the computer stops, provided that the audible-alarm switch on the Control Console is also set to ON. The alarm can be turned off with either switch, or when continuous operation is resumed.

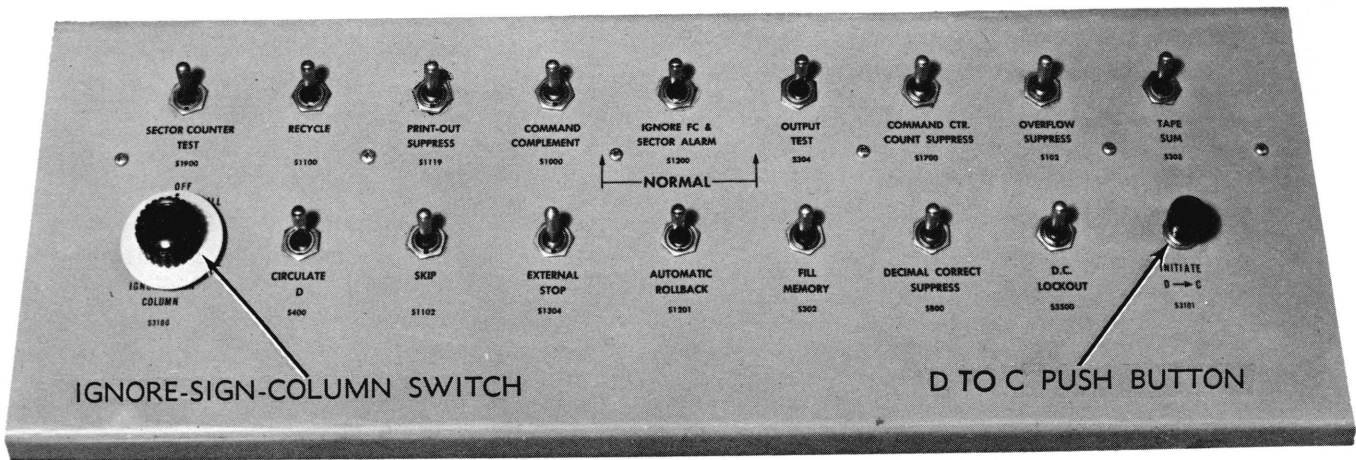


Figure 2-4. Sub-Maintenance Control Panel.

## 2-42. SUB-MAINTENANCE CONTROL PANEL

### 2-43. GENERAL

2-44. The sub-maintenance control panel (figure 2-4) is located behind the panel directly beneath the supervisory control panel. It is used by the field engineer for maintenance purposes. However, there are two switches on the panel that are important to the operator: the D-to-C push button and the ignore-sign-column dial switch.

### 2-45. D-TO-C PUSH BUFTON

2-46. During a fetch phase, all control digits in an instruction are recognized in the D register, and the controls are set from the D register. Under program control, this function automatically takes place when the instruction is fetched from storage and brought to the D register. To enable recognition of control digits when an instruction is inserted manually, proceed as directed in paragraph 2-55.

### 2-47. IGNORE-SIGN-COLUMN SWITCH

2-48. This three-position rotary switch is used on input with the photoelectric and mechanical paper-tape readers, and with the keyboard (paragraphs 3-23 through 3-25). It is not effective on either card or magnetic-tape input.

2-49. **NORMAL.** When the switch is in this position, all sign arithmetic will be observed concerning input data; that is, control words will be recognized as such and specified B-register address modification will occur.

2-50. **IGNORE ALL.** When the switch is in this position, no sign arithmetic will be observed, that is, control words will not be recognized as such and no B-register address modification will occur. All sign digits will be stored as punched, or as entered from the keyboard.

2-51. **IGNORE 2.** With the switch in this position, operations performed when digits 2 and 3 appear in the sign-digit position of any word during input are ignored. Digits 2 and 3 remain in the sign-digit position of the word when the word is sent to storage. (When reading

format bands into computer storage via paper tape, the ignore-sign-column switch must be set to the IGNORE 2 position, if there are 2's in the sign positions of any words of the format band.)

## 2-52. OPERATING PROCEDURES

### 2-53. MANUAL OPERATION

2-54. **INSERTIONS IN STORAGE.** To store data or instruction words:

1. Depress the stop button on the Control Console.
2. Set the lock-normal switch to LOCK (paragraph 2-24).
3. Set the continuous-step switch to STEP and press the clear button. Pressing the clear button sets the timing toggle to the execute phase (paragraph 2-19).
4. Insert in the A register the data or instruction word to be stored by depressing the red set buttons to form the binary-coded decimal digits desired (paragraph 2-12).
5. Insert into the order register the STORE CLEAR (02) instruction.
6. Insert into the address register the address of the storage location where the number in the A register is to be stored.
7. Press the start button. The STORE CLEAR (02) instruction will be executed and the computer will immediately stop.
8. To inspect the information now stored, change the 02 in the order register to 64 (CLEAR ADD) and depress the start button.

2-55. **INSERTION OF INSTRUCTIONS FOR IMMEDIATE EXECUTION.** Most instructions may be inserted in the C register and executed by depressing the start button. On certain occasions, however, the operator may wish to enter manually and execute an instruction in which the control digits are significant (paragraph 2-16). Since these digits are sensed as they pass from the D to the C register, an instruction in which they are significant

must be inserted in the D register. To do so, proceed as follows:

1. Depress the stop button on the Control Console.
2. Set the lock-normal switch to LOCK.
3. Set the continuous-step switch to STEP.
4. The instruction to be executed is entered into the D register by depressing the red set buttons on the Supervisory Control Panel.
5. Depress the D-to-C push button on the sub-maintenance control panel (paragraph 2-45). The ASYNC neon on the control subpanel of the supervisory control panel will come on.
6. Return the lock-normal switch to NORMAL. The instruction will be transferred to the C register, and all control digits will be recognized.
7. Depress the start button. The instruction will be executed.

2-56. TRANSFER OF CONTROL. To transfer control to a stored instruction:

1. Press the stop button on the Control Console.
2. Press the clear button on the supervisory control panel.
3. Set the continuous-step switch to whichever mode of operation is desired, after the transfer.
4. Set the lock-normal switch to NORMAL.
5. Insert a transfer-of-control instruction in the order register (for example, CU, CUB, etc). Insert in the address register the location of the instruction to which control is to be transferred.
6. Press the start button.

2-57. STEP-BY-STEP OPERATION. Assuming that an instruction is in the C register, the timing toggle is set to EXECUTE, and the control counter contains the address of the next instruction to be executed:

1. Set the continuous-step switch to STEP and the lock-normal switch to NORMAL.
2. Press the stop button on the Control Console.
3. Press the start button. The instruction in the C register will be executed.
4. Press the start button again. The instruction in the location specified by the control counter will be fetched and inserted into the order and address registers.
5. Press the start button again. The instruction in the order and address registers will be executed.

The start button must be depressed once for each fetch phase and once for each execute phase. As each execute phase is completed, the progress of the problem may be observed in the A, R, B, C, and D registers.

2-58. INSPECTION OF DATA. Occasionally it is necessary to inspect a series of data or instruction words stored on the drum. To do this:

1. Press the clear button.
2. Set the continuous-step switch to STEP and depress the stop button on the Control Console.
3. Set the lock-normal switch to LOCK.

4. Insert a CLEAR ADD (64) instruction in the order register.
5. Insert in the address register the address of the location of the data to be displayed.
6. Press the start button.
7. Repeat steps 5 and 6 until all words in question have been examined.

### CAUTION

Make certain that the instruction inserted in the C register is one that fetches, such as CLEAR ADD, rather than one that stores, such as STORE or STORE CLEAR. Otherwise, the contents of the location specified will be destroyed.

2-59. WORD COMPARISON. To compare two words visually, that is, to bring a word into the D register without destroying the contents of the A register:

1. Press the stop button on the Control Console.
2. Press the clear button on the supervisory control panel.
3. Set the continuous-step switch to STEP.
4. Set the lock-normal switch to LOCK.
5. Insert 64 (CLEAR ADD) in the order register and the address of the first word in the address register.
6. Press the start button. This puts the first word in the A register.
7. Insert 71 (EXTERNAL CONTROL) in the order register and the address of the second word in the address register.
8. Press the start button. This puts the second word in the D register.

This operation can be used either by operators who don't have an external switch connected to the Punched-Card Converter or by those who have an external switch but to whom it is not important if the present setting is disturbed. (The external switch is a black box used with the Punched-Card Converter for automatically switching between punched-card and printed-line output, for example, switching between the 528 and the 407.)

### 2-60. CONTINUOUS OPERATION

2-61. To initiate or resume continuous operation, there must be an instruction in the C register, and the control counter must contain the address of the next instruction to be executed, unless it is a transfer-of-control instruction, such as a CU or CUB instruction.

1. Set the continuous-step switch to CONTINUOUS and the lock-normal switch to NORMAL.
2. Press the start button.

To initiate continuous operation at the beginning of a program, the C register is loaded manually, unless a paper-tape read instruction is the first instruction in the program. (Clearing the supervisory control panel automatically inserts a paper-tape read instruction in the C register.) At the beginning of a program, the timing toggle must be set to execute.



# CONTROL CONSOLE



## 3-1. GENERAL

3-2. The Control Console (figure 3-1) is a desk-sized operation center from which the operator can supervise (and intervene in) the operation of the Burroughs 205 Data-Processing System.

3-3. The indicators and controls are grouped on a control panel mounted on a pedestal at the rear of the Control Console. A decimal keyboard is provided for manual input of data (paragraphs 3-38 through 3-46).

## 3-4. CONTROL PANEL

### 3-5. GENERAL

3-6. The register displays and many of the indicators of the supervisory control panel are duplicated on the Control Console panel. In addition, there is provision for the selection of paper-tape or manual keyboard input and paper-tape or character-at-a-time printer output, the suppression of printout, breakpoint control, and skipping the execute phase of an instruction when desired (figure 3-2).

#### NOTE

When the system is operated from the Control Console, the continuous-step switch on the supervisory control panel must be set to STEP and the lock-normal switch to NORMAL.

### 3-7. REGISTER DISPLAYS

3-8. The register displays are identical to those on the supervisory control panel. Individual registers can be cleared or bits changed only from the supervisory control panel (paragraphs 2-10 through 2-18). Since manual entry to the registers on the Control Console is from the keyboard, there are no set buttons under the displays.

### 3-9. CLEAR PUSH BUTTON

3-10. Depressing this push button clears the registers and sets the timing toggle so that the next phase of the timing cycle will be execute (paragraph 2-19).

### 3-11. TIMING-TOGGLE INDICATORS

3-12. The timing-toggle indicators function simultaneously with those on the supervisory control panel (paragraph 2-22). They cannot be set from the Control Console. During normal operation, the phases of the timing cycle alternate so rapidly that the indicators do not convey any useful information to the operator.

## 3-13. OPERATION CONTROLS AND INDICATORS

3-14. CONTINUOUS PUSH BUTTON AND INDICATOR. When this button is depressed, the computer is placed in the continuous mode of operation, automatically fetching and executing instructions in program sequence. The indicator is on whenever the computer is set to run continuously or is actually in continuous operation.

3-15. NOT-READY INDICATOR. This indicator is on whenever a switch on the supervisory control panel is in a position that would prevent successful operation from the Control Console (the continuous-step switch set to CONTINUOUS, or the lock-normal switch to LOCK, for example). It is also on when any of the switches on the sub-maintenance panel is not in the normal (up) position, or when the test-drum switch on the supervisory control panel is set to TEST.

3-16. STOP. Depressing this push button causes a computer stop after completion of the phase of the timing cycle during which the button was pushed (fetch or execute). Information in the registers will not be lost. Operation can be continued from the supervisory control panel, or the computer can be operated in the step mode from the Control Console. The continuous indicator goes off and the idle and control indicators come on.

3-17. STEP. After the computer has been taken out of continuous operation by depressing the stop button, depressing the step button repeatedly will cause the computer to first fetch and then execute one instruction of the program at a time, thus enabling the operator to follow the progress of the program by examining the contents of the registers after each step. The button must be pushed once for each fetch and once for each execute phase of the timing cycle. The phase that the computer will enter first (or next) is indicated by the timing-toggle indicators (paragraph 2-22).

## 3-18. BREAKPOINT CONTROLS

3-19. BREAKPOINT SELECTOR. This four-position dial switch is just below the B-register display. When it is set to:

- OFF, breakpoint codes in the program will be ignored.
- 4, breakpoint digit 4, 5, 6, or 7 will stop the computer.
- 2, breakpoint digit 2, 3, 6, or 7 will stop the computer.
- 1, breakpoint digit 1, 3, 5, 7, or 9 will stop the computer.

## Control Console

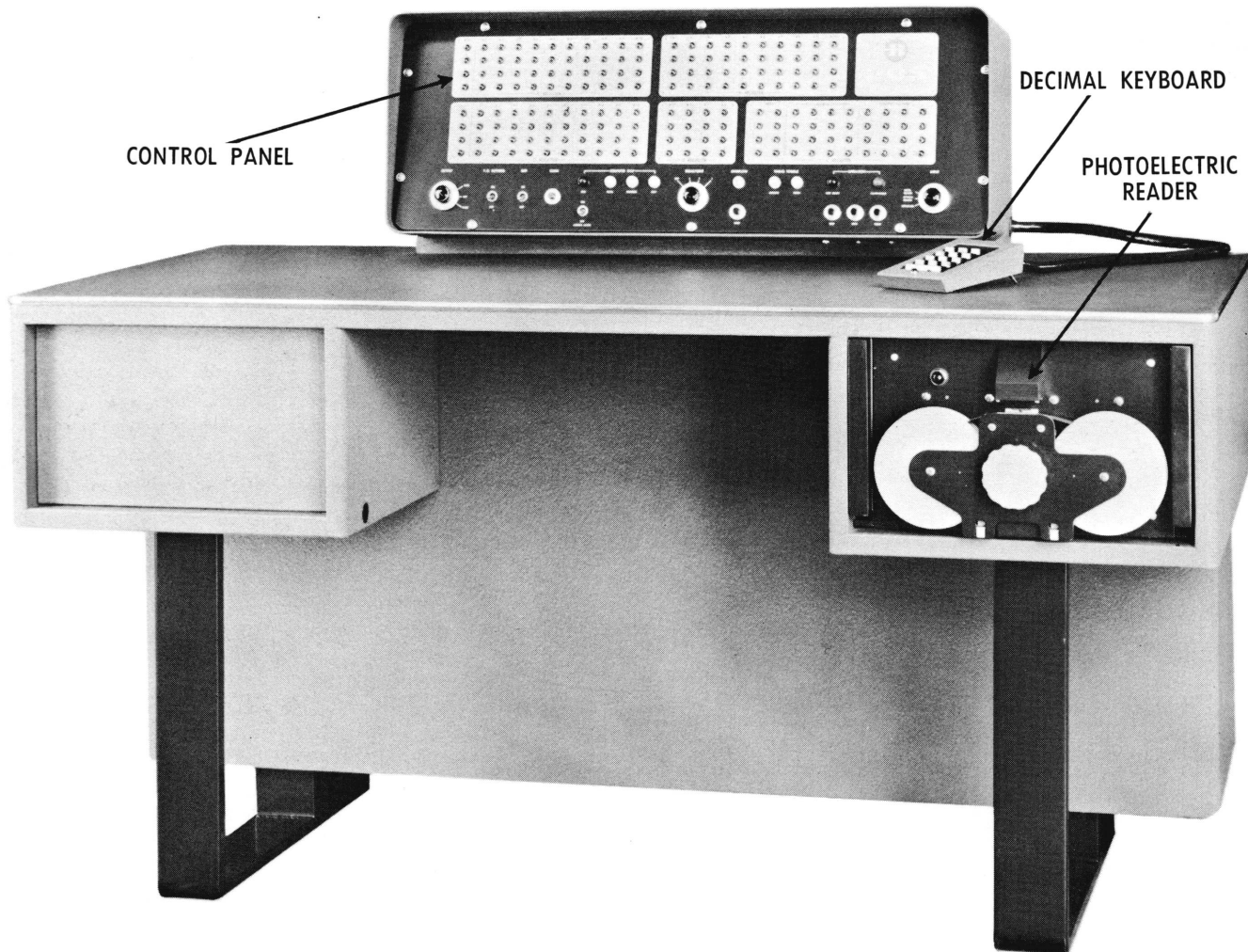


Figure 3-1. Control Console.

The computer will always stop *after* executing the instruction that contains the breakpoint digit.

### NOTE

A new operator is sometimes confused by the fact that some instructions appear in the C register on a breakpoint stop in a form other than that in which they were originally written. For systems which include magnetic tape, all blocking instructions appear in the C register with 20 added to the address. (Some systems even add 200 to the address.) The CHANGE ON NON-ZERO, NORMALIZE, and DECREASE B instructions will appear in the C register with an operation code of 28 on a breakpoint stop.

3-20. SKIP SWITCH. When the skip switch is in the ON position, the computer will skip the execute phase of any instruction with the digit 8 or 9 in the breakpoint position of the instruction. When the skip switch is off, the computer will ignore skip codes. If the skip code is a 9 (binary digits 8 and 1), the 9 can also be used as a breakpoint code. (Refer to paragraph 3-19.)

3-21. INPUT SELECTOR

3-22. This is a three-position switch on the extreme right-hand side of the control panel. The three positions are MECH. READER, OPTICAL READER, and KEYBOARD.

3-23. MECH. READER. This position selects the paper-tape reader attached to the Flexowriter as the means of reading paper tape.

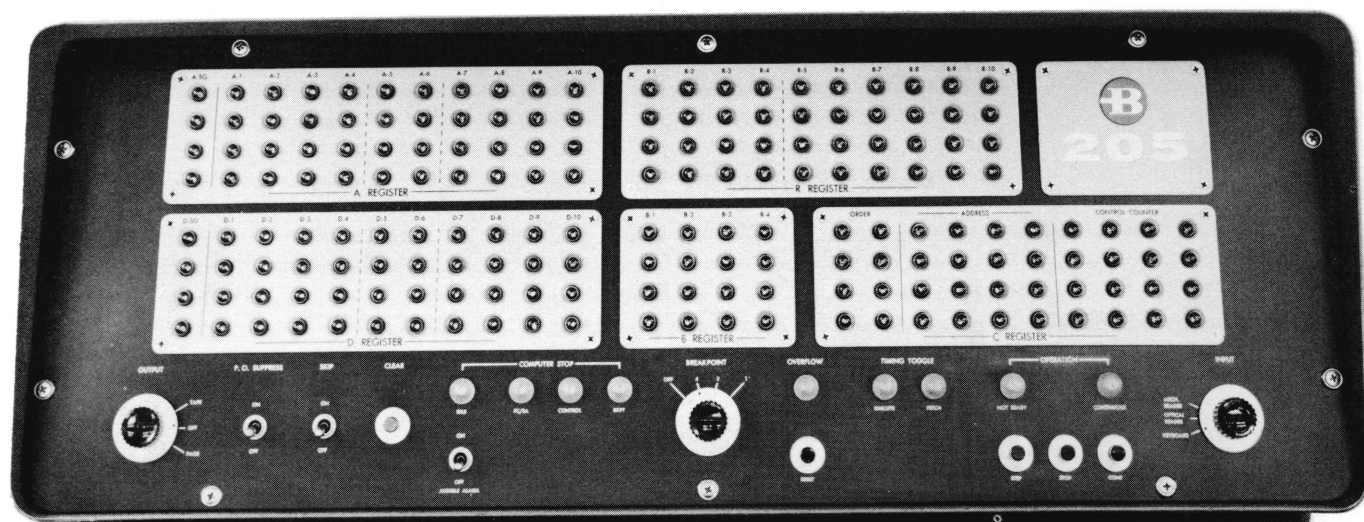
3-24. OPTICAL READER. This position selects the Photoelectric Reader as the means of reading paper tape.

3-25. KEYBOARD. This position selects the decimal keyboard for manual input.

3-26. OUTPUT SELECTOR

3-27. This three-position dial switch is at the extreme left of the control panel. The three positions are TAPE, OFF, and PAGE.

3-28. TAPE. The High-Speed Paper-Tape Punch is selected as the means of output.



**Figure 3-2. Control-Console Control Panel.**

3-29. OFF. Neither of the two paper-tape output devices is selected. If a paper-tape write instruction comes up for execution while this switch is in the OFF position, the computer will stop and the idle indicator will go on.

3-30. PAGE. The Flexowriter is selected to print or punch output data or to do both simultaneously (table 5-1). If the Flexowriter is not turned on, a print instruction will cause the information to shift out of the A register, but no printout will occur.

3-31. P. O. SUPPRESS

3-32. When this switch is in the ON position, the computer will ignore paper-tape system print-out instructions.

3-33. COMPUTER-STOP INDICATORS AND CONTROL

3-34. IDLE, FC/SA, AND CONTROL. The IDLE, FC/SA, and CONTROL indicators operate simultaneously with the IDLE, F.C., SECTOR, and CONTROL indicators on the supervisory control panel (paragraphs 2-33 through 2-37), the only difference being that on the Control Console a single indicator (FC/SA) comes on for both forbidden-combination and sector alarms.

3-35. BREAKPOINT INDICATOR. The BKPT. indicator comes on when the computer stops after executing an instruction containing a breakpoint code.

3-36. OVERFLOW INDICATOR AND RESET BUTTON. The overflow indicator functions in the same manner as the overflow indicator on the supervisory control panel (paragraphs 2-38 through 2-40). If the reset button is depressed, the indicator will go off and the overflow toggle will be cleared. To accomplish this, depress the continuous button on the Control Console.

3-37. AUDIBLE-ALARM SWITCH. The function of this switch is the same as the function of the audible-alarm switch on the supervisory control panel. Both audible-

alarm switches must be set to ON for the switch on the Control Console to be effective. The alarm can be turned off with either switch or when continuous operation is resumed.

### 3-38. DECIMAL KEYBOARD

3-39. CHARACTERISTICS

3-40. The keyboard is generally used to enter a few words at a time—to insert corrections, add words to a program, or to insert or delete breakpoint codes in stored instructions (paragraph 3-19). Keyboard input automatically goes to the D register.

3-41. The keyboard (figure 3-3) has 13 keys, one for each of the decimal digits from zero through nine, two blank keys, and one key, designated F, which is used to generate a finish pulse. The finish pulse indicates the end of a Burroughs 205 word. The F key is always depressed to complete the entry of a word into the computer.



**Figure 3-3. Decimal Keyboard.**

## Control Console

### 3-42. OPERATION

3-43. ENTERING INSTRUCTIONS. To insert an instruction into the C register:

1. Press the clear button on the Control Console to put a PAPER-TAPE READ (PTR) instruction (00 0000 0000) into the C register and to set the computer in the execute phase.
2. Set the input-selector switch on the Control Console to KEYBOARD.
3. Set computer operation to the step mode by pressing the stop button and setting the continuous-step switch on the supervisory control panel to STEP.
4. Press the step button to initiate the execution of the PTR instruction, to activate the keyboard and to prepare the computer to receive (in the D register) the information entered from the keyboard.
5. Enter, by depressing the appropriate keys, the 11-digit instruction into the D register. (Each digit entered appears first in the low-order digit position and is shifted left one digit position as each succeeding digit is entered.)
6. If input is a single instruction or the final instruction of a series, enter a 6 followed by the control digits, operation code, and the address part of the instruction. This places the 6 in the sign-digit position of the D register.
7. If input is a series of instructions for individual execution (for example, a series of CLEAR ADD instructions entered to permit examination of the contents of various storage locations), enter a 4 in the sign-digit position of each instruction. The sign-digit 4 will keep the keyboard activated to accept the subsequent instructions.
8. After the 11 digits have been entered, examine the D-register display to see if the entry has been made correctly.
9. Depress the F key (end of word). The last six digits of the instruction will be transferred to the C register.

3-44. LOADING STORAGE LOCATIONS. To load one storage location or consecutive storage locations from the keyboard:

1. Press the clear button on the Control Console.
2. Set the input-selector switch to KEYBOARD.
3. Set computer operation to continuous by pressing the continuous button. (Be sure the continuous-step switch on the supervisory control panel is set to STEP and the lock-normal switch to NORMAL.)
4. Enter in the D register through the keyboard the input instruction (4 0000 00 xxxx), where xxxx is the storage location into which the first word is to be inserted. Press the F key to transfer the instruction to the C register.
5. Enter the first word to be stored in the D register through the keyboard, using the standard 0 or 1

(+ or -) in the sign-digit position.

6. Subsequent words are inserted into consecutive storage locations by repeating steps 5 and 6.
7. On completion of all entries into storage, destroy the 4 0000 00 xxxx instruction by pressing the clear button.

3-45. INSERTING BREAKPOINT DIGITS. To insert a breakpoint digit in a program instruction, from the keyboard, follow the procedure described above for inserting a single word into storage.

3-46. STARTING AT A GIVEN LOCATION. To start the computer at the beginning of, or at a point within, a program already loaded on the drum:

1. Following the procedure for inserting a single instruction in the C register (paragraph 3-43), insert 20 (CHANGE UNCONDITIONALLY) into the order register and xxxx into the address register, where xxxx is the address of the storage location of the first instruction to be executed.
2. Press the continuous button for automatic sequential operation or the step button if step-at-a-time operation is desired.

### 3-47. CONSOLETTTE

3-48. The Consolette is a desk-top control unit that can be used instead of the Control Console, if the installation does not have a paper-tape system. The register displays and those controls having to do with the paper-tape system (input- and output-selector and printout-suppress switches) have been eliminated from the Consolette. Like the Control Console, the Consolette has skip, breakpoint, clear, audible-alarm, and overflow-reset controls, and not-ready and idle indicators. It also has

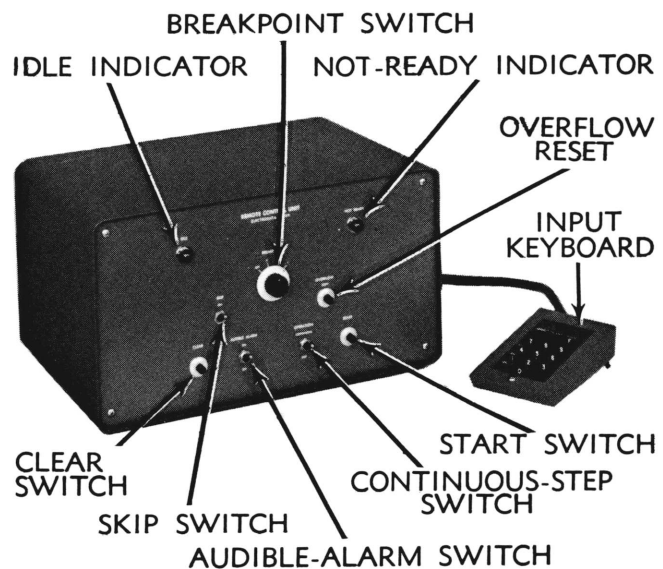


Figure 3-4. The Consolette

a keyboard. The functions of these controls and indicators, and of the keyboard, are identical for the console and the Consolette.

3-49. The Control Console operation switches have been replaced by a start button and a two-position continuous-step switch on the Consolette. Since there is no stop button, these switches necessarily function somewhat differently from those on the Control Console. The settings for various models of operation are given in paragraphs 3-50 through 3-54.

3-50. To operate the computer in the step mode from the Consolette, set the continuous-step switches on the supervisory control panel and the Consolette to STEP. Depress the start button on the Consolette once for each phase-fetch and execute-of each instruction.

3-51. To operate the computer in the continuous mode, set either the Consolette or the computer continuous-step switch to CONTINUOUS.

3-52. To enable operation of the computer from the supervisory control panel, set the continuous-step switch on the Consolette to STEP. To enable operation from the Consolette, set the continuous-step switch on the supervisory control panel to STEP.

3-53. To stop the computer from the Consolette, set the continuous-step switch on the Consolette to STEP.

3-54. To enter information manually from the Consolette keyboard:

1. Set the continuous-step switches on the supervisory control panel and the Consolette to STEP.
2. Depress the clear button on the Consolette.
3. Set the continuous-step switch on the Consolette to CONTINUOUS. Depress the start button to prepare the computer for input. The computer will idle, waiting for the first entry from the keyboard.
4. Enter the desired data or instructions in storage, following the procedures given in paragraph 3-43, steps 5 through 9, and in paragraph 3-44, steps 4 through 7. Data will pass from the D register through the adder, without entering the C register, the 0 0000 00 0000 instruction inserted when the clear button was depressed will remain in the C register, and the computer will remain under keyboard control.
5. To return control to the computer, enter a "D-to-C" instruction, that is, an instruction with a 6 in the sign position.

# PHOTOELECTRIC READER AND HIGH-SPEED PAPER-TAPE PUNCH



## 4-1. GENERAL

4-2. The Photoelectric Reader and the High-Speed Paper-Tape Punch are the primary paper-tape input and output devices in the Burroughs 205 system.

## 4-3. PHOTOELECTRIC READER

### 4-4. CHARACTERISTICS

4-5. The Photoelectric Reader (figure 4-1) is installed in the right-hand pedestal of the Control Console. It reads information from perforated paper tape at the rate of 540 characters per second. The Photoelectric Reader is under the control of instructions from the computer or instructions punched in the paper tape. The instruction that initiates tape movement comes from the computer; the instruction that stops the Photoelectric Reader is punched into the paper tape.

4-6. Two types of assemblies are available to hold paper tape and to guide it over the read head; a loop adapter (figure 4-2) and a reel adapter (figure 4-3). The loop adapter is used if the paper tape is short enough to be held by the tape bin mounted below the Photoelectric Reader. The reel adapter is used for longer sections of paper tape, up to 3200 words.

4-7. Hinge pins at the base of each assembly enable easy mounting or interchange of adapters. Either assembly is conveniently handled by a knob which serves to lock it into place on the reader chassis.

### 4-8. MOUNTING THE LOOP ADAPTER

4-9. If the reel adapter is on the Photoelectric Reader chassis:

1. Turn the knob on the reel adapter (figure 4-3) counterclockwise and lower the adapter from the ready position.
2. Lift the reel adapter, releasing the hinge pins from the brackets, and remove it from the reader chassis.
3. Follow steps 1 through 5, paragraph 4-11.

4-10. If the loop adapter is already on the Photoelectric Reader chassis, but not loaded:

1. Turn the knob counterclockwise (figure 4-2) and lower the loop adapter from the ready position.
2. Follow steps 2 through 5, paragraph 4-11.

4-11. To mount the loop adapter on the Photoelectric Reader chassis:

1. Place the hinge pins of the loop adapter in the brackets on the reader chassis. Leave the adapter open.

2. Position the tape over the read head of the Photoelectric Reader. The movement of the tape is from left to right, with the C punches toward the operator (the side of the tape which is wider from the sprocket holes to the edge, figure 4-4). Place the tape evenly over the rubber guide rollers and drop the excess length of tape on the left side into the tape bin below the reader.
3. When the tape is in position, turn the knob on the front of the adapter counterclockwise (figure 4-2) and lift the adapter forward over the tape.
4. Turn the knob clockwise to lock the adapter in place.
5. Give a light tug on the tape on the left side to take out the slack, then gently move the tape back and forth in the adapter to make sure it is positioned correctly.

### 4-12. MOUNTING THE REEL ADAPTER

4-13. If the loop adapter is on the Photoelectric Reader chassis:

1. Turn the knob on the loop adapter (figure 4-2) counterclockwise and lower the adapter from the ready position.
2. Lift the loop adapter, releasing the hinge pins from the brackets, and remove it from the reader chassis.
3. Follow steps 1 through 7, paragraph 4-15.

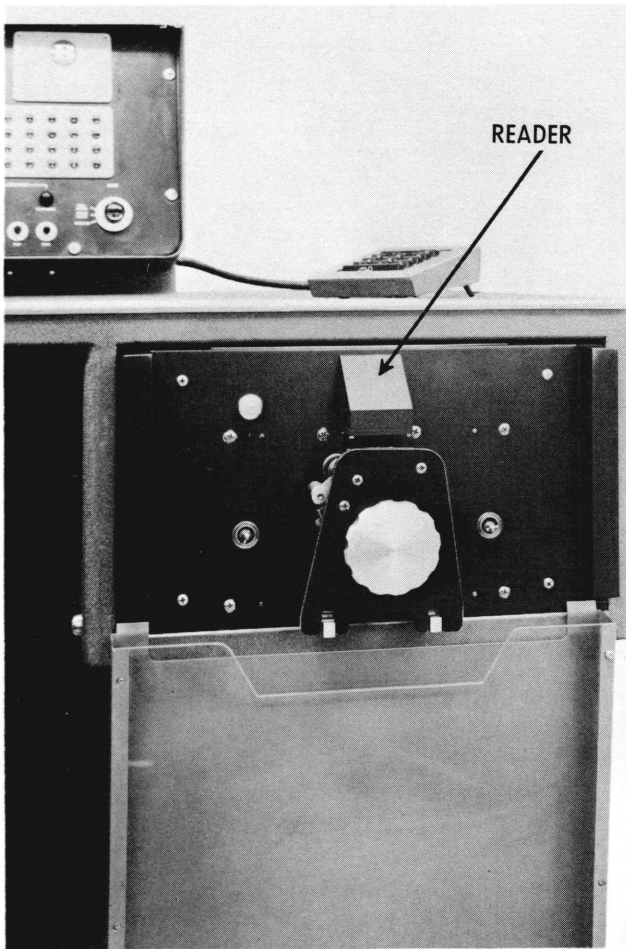
4-14. If the reel adapter is already on the Photoelectric Reader, but not loaded:

1. Turn the knob (figure 4-3) counterclockwise and lower the loop adapter from the ready position.
2. Follow steps 2 through 7, paragraph 4-15.

4-15. To mount the reel adapter on the Photoelectric Reader chassis:

1. Place the hinge pins of the reel adapter in the brackets on the reader chassis. Leave the adapter open.
2. Fit the loaded reel on the left hub of the adapter so that the tape comes off the top of the reel to the right (when the reel adapter is open). Then fit the take-up reel on the right hub of the adapter.
3. Thread the tape from the loaded reel over the pivoted tape supports and insert the end of the tape into the take-up reel so that the tape goes onto the reel from the left side at the top.
4. Give the take-up reel one or two turns clockwise.
5. Turn the knob counterclockwise (figure 4-3) and raise the adapter into position.

## Photoelectric Reader and High-Speed Paper-Tape Punch



**Figure 4-1. Photoelectric Reader.**

6. Turn the knob clockwise to lock the adapter in place.
7. Gently turn the reels in one direction until they click into place onto two pins on the chassis.

### 4-16. READING PAPER TAPE.

4-17. To initiate reading of paper tape after loading (paragraph 4-8 or 4-12):

1. Press the top button on the Control Console.
2. Press the clear button on the Control Console.
3. Set the input-selector switch on the Control Console to OPTICAL READER. The indicator light on the chassis of the Photoelectric Reader comes on.
4. Set the continuous-step switch on the supervisory control panel to STEP.
5. Set the lock-normal switch on the supervisory control panel to NORMAL.
6. If the first word punched in the paper tape is a PAPER-TAPE READ instruction with a 4 or 5 in the sign-digit position, press the continuous button on the Control Console.

If the first word punched in the paper tape is not a control word, insert into the address register on the supervisory control panel the address of the

first location into which the paper-tape information is to be read. Then press the continuous button.

The instruction to read paper tape may have been stored previously. In this case, transfer control to the location containing the PAPER-TAPE READ instruction.

(Operating instructions with the program to be run should specify which of these three procedures is to be used.)

### 4-18. REWINDING PAPER TAPE

4-19. To rewind paper tape, assuming the computer program is already running and the tape to be rewound is on the reel adapter, having previously been read:

1. Pull out the Photoelectric Reader chassis and turn off the two switches on the right side labeled MOTOR and LAMP. (Down is off.)
2. Interchange the two tape reels on the reel adapter.
3. Turn on the start toggle at the top of the fifth decade from the left in the upper right subpanel on the supervisory control panel.
4. Turn on the motor switch *only* on the Photoelectric Reader. The tape will now rewind.
5. When rewind is complete, turn off the start toggle using the zero button on the supervisory control panel.
6. Turn on the lamp switch on the Photoelectric Reader.
7. Set the input-selector switch on the Control Console to KEYBOARD, if further use of the Photoelectric Reader is not expected in the program.

### CAUTION

This rewind procedure can be used only if the program which is running does not call for a read-in which might occur while the rewind is in process. If this situation exists, however, a breakpoint stop could be used prior to the read-in instruction, to allow rewinding without the possibility of interfering with the program. If a breakpoint is used, remember to restore the breakpoint switch to the proper condition when rewind is complete (paragraph 3-19).

## 4-20. HIGH-SPEED PAPER-TAPE PUNCH

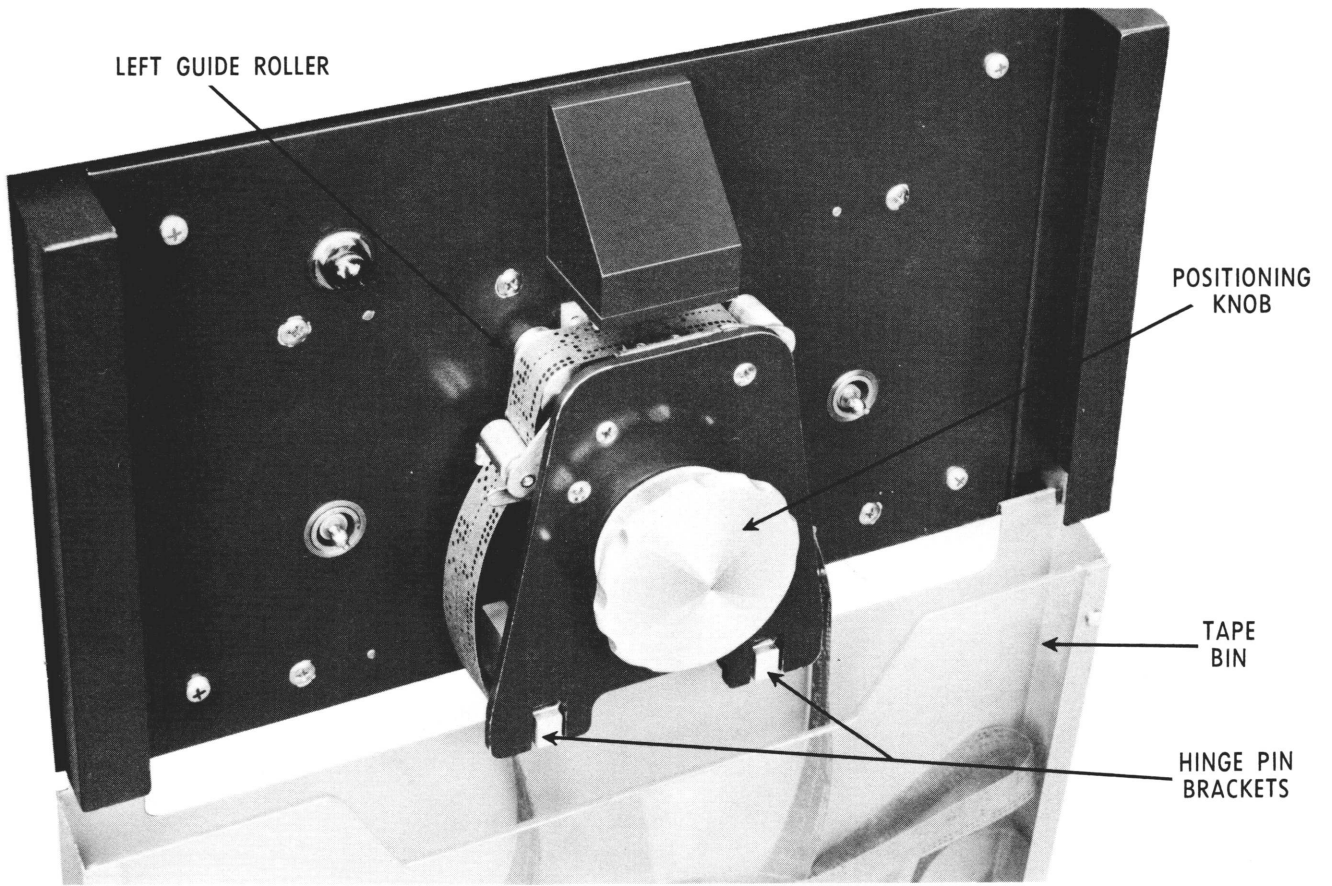
### 4-21. CHARACTERISTICS

4-22. The High-Speed Paper-Tape Punch (figure 4-5) operates through the Control Console to reproduce information from the A register of the Burroughs 205 in paper tape. It punches information at the rate of 60 characters per second. Tapes so produced can be used as input tapes to:

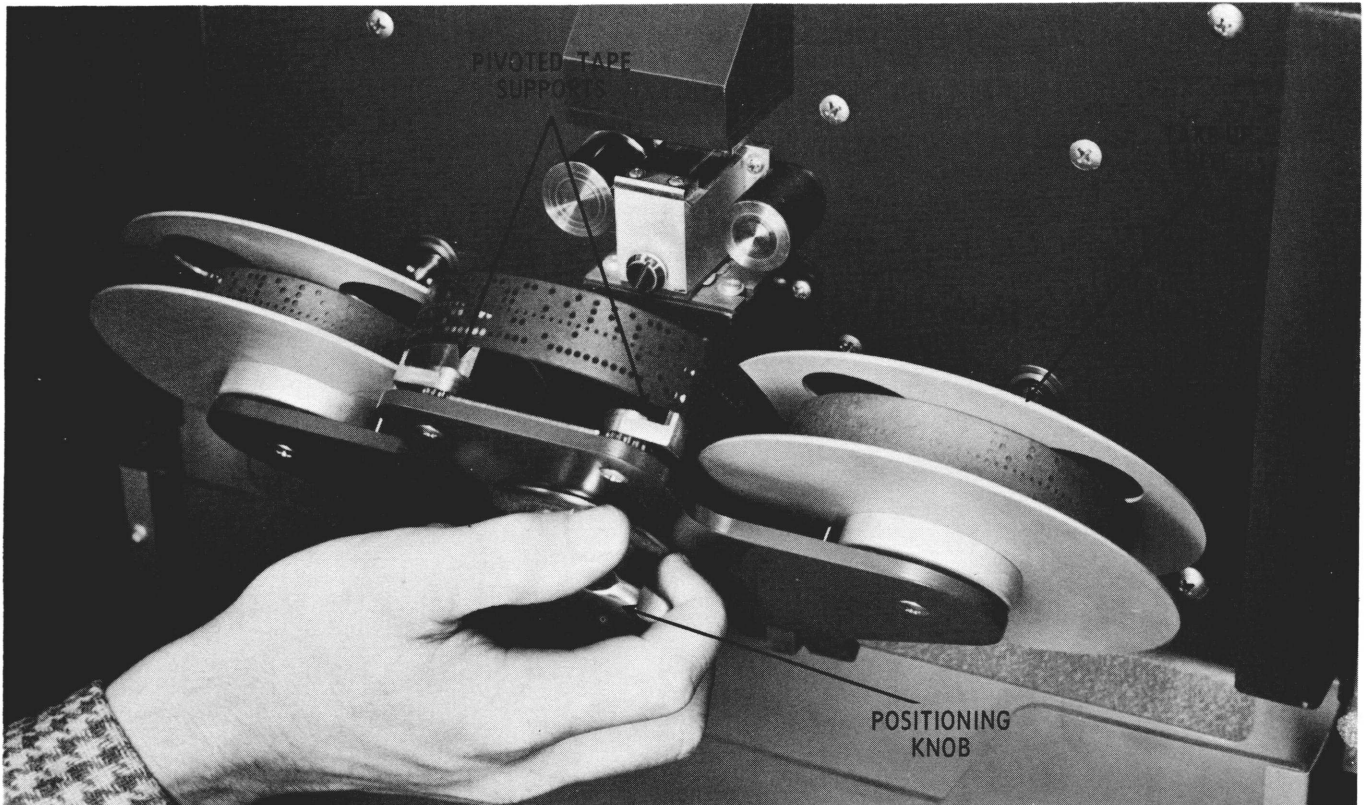
The Flexowriter, for obtaining a listing of the contents of the tape.

The computer, via the Photoelectric Reader or the mechanical reader that is attached to the Flexowriter.

**Photoelectric Reader and High-Speed Paper-Tape Punch**



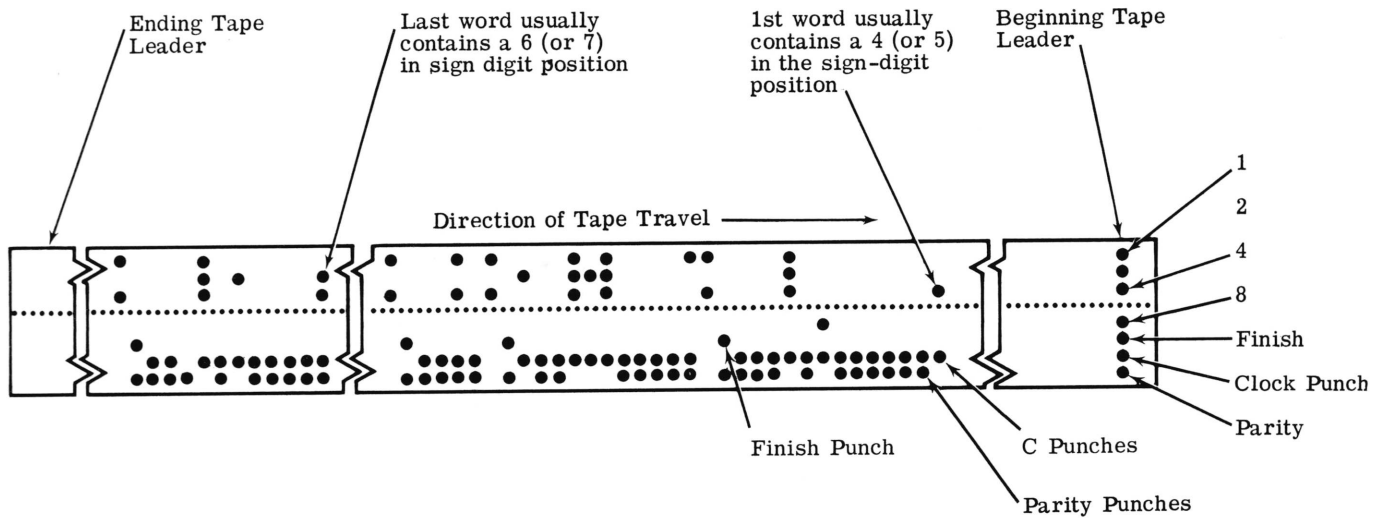
**Figure 4-2. Loop Adapter.**



**Figure 4-3. Reel Adapter.**



## Photoelectric Reader and High-Speed Paper-Tape Punch



Side of Paper Tape Toward Person Loading Photoelectric Reader. This Tape Contains Both "C" Punches and Parity Punches.

**Figure 4-4. Position of Paper Tape in Photoelectric Reader.**

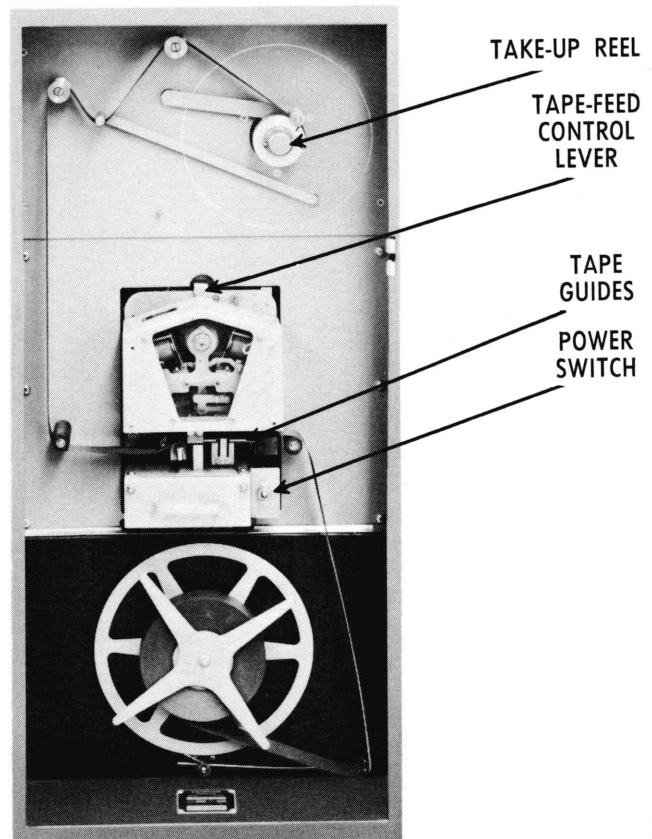
### 4-23. LOADING PROCEDURE

4-24. To load the paper-tape punch, proceed as follows:

1. Set the output-selector switch on the Control Console to TAPE.
2. Set the power switch on the front of the chassis of the paper-tape punch to ON.
3. Mount the roll of paper tape on the lower hub and thread the tape up to the punch mechanism as shown in figure 4-5.
4. Insert the tape into the tape guides leading into the punch mechanism and gently push the tape into the mechanism while depressing the tape-feed control button.

(The first inch or so of tape to come through the punch mechanism may be split where the sprocket holes should be. Continue inserting the tape into the punch mechanism until the punch catches and the tape comes out with the sprocket holes punched. Often it helps to gently pull the end of the tape as it comes out of the punch mechanism.)

5. Depress the tape-feed control button and feed out enough blank tape leader to reach the take-up reel.
6. Thread the tape over the guides to the take-up reel (figure 4-5). If no take-up reel is to be used, the tape will fall freely on the output side of the punch mechanism.



**Figure 4-5. High-Speed Paper-Tape Punch.**

# 5 SUPERVISORY PRINTER

## 5-1. FLEXOWRITER

### 5-2. FUNCTION

5-3. A Flexowriter (figure 5-1) is the supervisory printer for the Burroughs 205 Data-Processing System. It is an electric typewriter with paper-tape punch and a mechanical paper-tape reader. The rate of punching and printing is approximately 10 characters per second. As modified for use with the Burroughs 205, the Flexowriter operates through the Typewriter Control Unit under control of the computer (paragraph 5-17). It can be used to perform any of the following functions:

Type, or simultaneously punch and type, numeric and alphanumeric information, received from the A register of the computer.

Punch numeric and alphanumeric information from the A register of the computer.

Reproduce a paper tape automatically, with or without translation from Burroughs 205 code to the Flexowriter code.

Punch paper tape in either Burroughs 205 or Flexowriter code.

5-4. It is not the function of the Flexowriter to print large volumes of data. As a supervisory printer, the Flexowriter is used to print small quantities of data, interim results of program runs, and program-control information such as program identification, date, and other information used for log record keeping. The Flexowriter may also be used to print messages or directions to the operator. These may coincide with programmed control stops or with error conditions within a program. For example:

1. STOP 0006-LOAD INPUT WITH DECK 2.
2. REPLACE TAPE ON UNIT 3 WITH TAPE NO. 046.
3. CARD OUT OF SEQUENCE. READ NEXT CARD -TRANS CTL TO LOC 2000.

### 5-5. KEYBOARD AND CONTROLS, STANDARD MODEL

5-6. GENERAL. The Flexowriter four-bank keyboard (figure 5-2) has a total of 50 key positions. There are 42 keys for character operation and eight keys for functional operation. In addition to these, there are seven control switches and a space bar.

5-7. START READ. When this switch is depressed, a pre-punched paper tape will move through the mechanical reader.

5-8. STOP READ. When this switch is depressed, the mechanical reader stops.

5-9. PUNCH ON. When this switch is depressed, each character or function typed on the keyboard or read by the mechanical reader is punched into paper tape by the punch unit.

5-10. TAPE FEED. When this switch is depressed, blank paper tape will feed through the punch unit, provided the punch-on switch is in the ON position.

5-11. CODE DELETE. When this switch is depressed, a delete punch is recorded in the paper tape indicating that the associated digit is to be ignored. When the delete code is read by the mechanical reader, no character or operation will occur on the typewriter or be punched by the punch unit for that digit.

5-12. The delete punch is an instruction to the Flexowriter *only*, and is not sensed by the Photoelectric Reader. A paper tape containing a delete punch should not be read into the computer via the Photoelectric Reader, because an extra digit would be added to the word, causing the correct sign digit to be shifted out of the D register. (A paper tape containing a delete punch may be read into the computer via the mechanical reader.)

5-13. STOP CODE. When this switch is depressed, a stop code is punched in the paper tape. When read by the mechanical reader, the paper tape will stop at this point, and will move forward again only when the start-read switch is depressed. Such a stop code is not recognized by the Photoelectric Reader.

5-14. POWER. This two-position switch, labeled ON OFF, must be on for all Flexowriter operations.

### 5-15. KEYBOARD AND CONTROLS, CARDATRON-CODE MODEL

5-16. A Flexowriter that has been modified to use the same two-digit code as the CARDATRON is available for use with those Burroughs 205 systems that include the CARDATRON. This Flexowriter has 43 character keys and 4 keys for functional operations (figure 5-3). Upper case, lower case, and color shifts have been eliminated. Special characters available are the comma, period, dash, %, &, \$, and /. The control switches are the same as for the earlier model (paragraphs 5-7 through 5-14).

## Supervisory Printer



**Figure 5-1. Flexowriter and Typewriter Control Unit.**

### 5-17. TYPEWRITER CONTROL UNIT

#### 5-18. FUNCTION

5-19. The Typewriter Control Unit is housed in the Flexowriter desk. It performs the following functions in connection with output from the Burroughs 205 to the paper-tape system:

- Automatically translates necessary codes.
- Counts words, lines, and groups of lines.
- Governs page format independently of, or in conjunc-

tion with, computer instructions.

Receives and interprets instructions directly from the computer or indirectly via punched paper tape.

5-20. The operation of the Typewriter Control Unit is automatic. The operator need be concerned only with the control-panel settings and the patch-panel connections (paragraph 5-32). The unit has its own power supply and can be operated independently of the computer (off-line) for paper-tape preparation, duplication, or transcription.

**5-21. CONTROL PANEL**

5-22. The Typewriter Control Unit panel (figure 5-4) is located on the front of the Flexowriter desk and contains switches that govern page format and increase the format flexibility available to the programmer. Use of the control panel is optional; printouts can be obtained without it. The switches on the typewriter control panel and their various functions are described in paragraphs 5-23 through 5-31.

5-23. **RESET PUSH BUTTON AND INDICATOR.** The reset push button is used to set the counters and relays of the Typewriter Control Unit to the initial zero positions. When the reset button is pressed, the reset indicator comes on. The reset button should always be pressed before starting a program which calls for output to the Flexowriter.

5-24. **ZERO SUPPRESS SWITCH.** When this two-position toggle is in the ON position, the first digit to be printed will be the first non-zero digit. Only the leading

zeros are suppressed; a space is substituted for each leading zero. If this switch is in the OFF position, leading zeros are not suppressed. If, however, the print-out instruction calls for a decimal point to replace the sign, there will be no zero suppression for that printout, even though the zero suppress switch may be in the ON position.

5-25. **SPACE-TAB SWITCH.** This toggle has three positions: SPACE, OFF, and TAB. Its setting determines the horizontal spacing between printouts. When it is set to:

SPACE, one space will occur after each word;

OFF, there will be no spacing between words, except for spacing under program control;

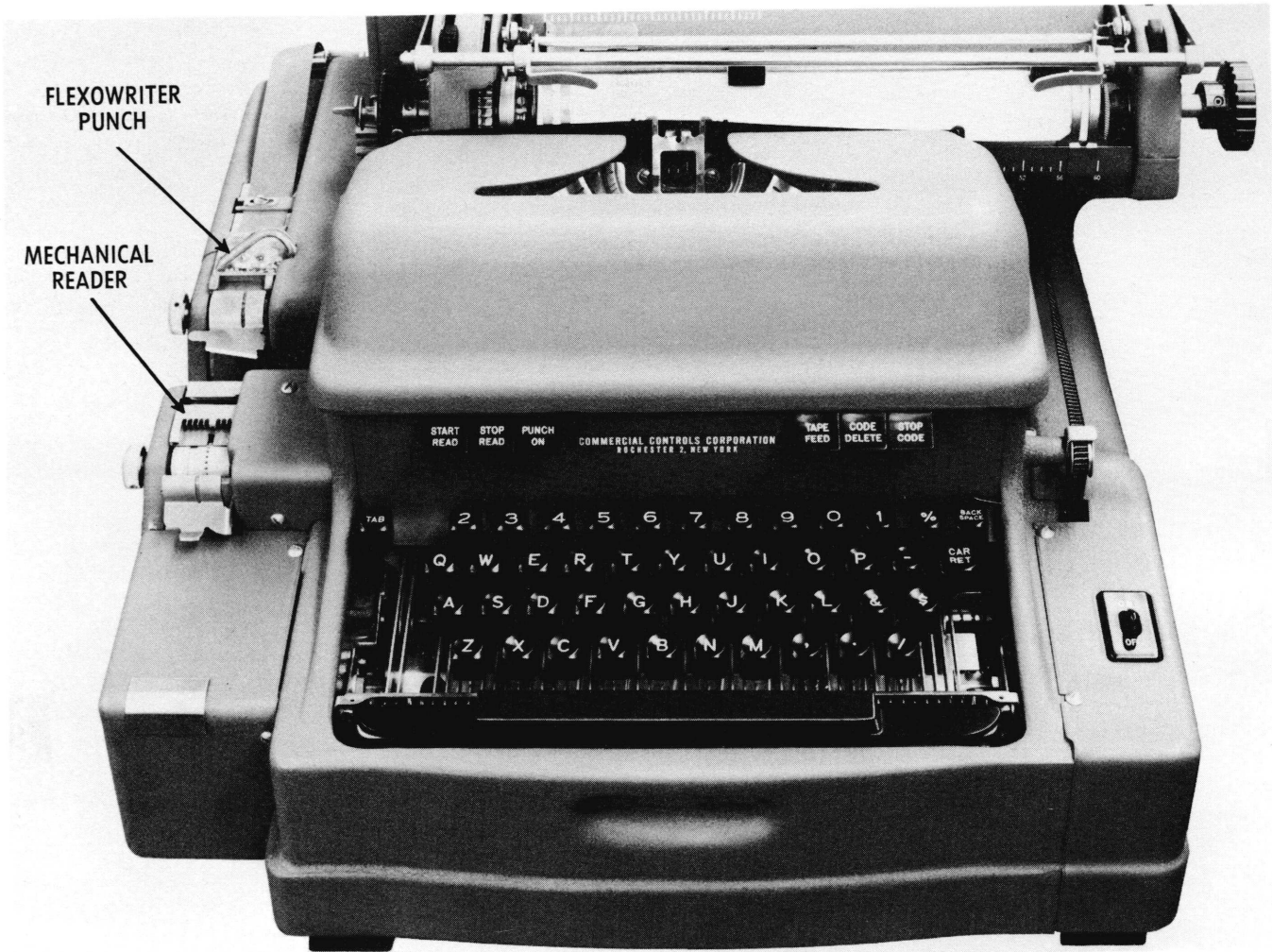
TAB., the spacing between words will be determined by the tab settings (removable tab markers behind the Flexowriter carriage).

5-26. **WORDS/LINE SWITCH.** This dial switch has 20 positions numbered 1 through 20. It determines the number of words to be typed on one horizontal line. When



**Figure 5-2. Flexowriter Keyboard, Standard Model.**

## Supervisory Printer



**Figure 5-3. Flexwriter Keyboard, CARDATRON-Code Model.**

the predetermined number of words has been typed, the carriage returns automatically, ready for the next line of printing. (The higher settings are used for printout of partial words.)

5-27. LINES/GROUP SWITCH. This dial switch has 20 positions, numbered 1 through 20. It determines the number of equally spaced lines to be typed in one group on the page. When the predetermined number of lines has been typed in one group, the typewriter will execute two automatic carriage returns, resulting in a double space after each group.

5-28. GROUPS/PAGE SWITCH. This dial switch has 20 positions, numbered 1 through 20. It determines the number of groups to be typed on a page. When the predetermined number of groups has been typed, printout will stop (provided that the automatic stop switch is on, paragraph 5-30) and the computer will idle, if a print-out instruction comes up for execution before the reset button is pressed. This arrangement provides a delay for changing paper or format in the typewriter after the predetermined number of groups has been typed.

5-29. GROUPING COUNTERS SWITCH. This switch has three positions: ON-ON, OFF-OFF, and OFF-ON. When it is set to:

ON-ON, the counters that determine the number of words to be printed per line, the number of lines to be printed per group, and the number of groups to be printed per page are active.

OFF-OFF, all three counters are inactive.

OFF-ON, the counters that determine the number of words to be printed per line are active. The counters that determine the number of lines to be printed per group and the number of groups per page are inactive.

5-30. AUTO STOP SWITCH. This two-position switch operates in conjunction with the groups/page counter. With the automatic stop switch in the ON position, printout will stop after the predetermined number of groups per page has been typed. It is necessary to press the reset button before printout can be resumed. If the automatic stop switch is in the OFF position, printout will not stop at the end of a page.

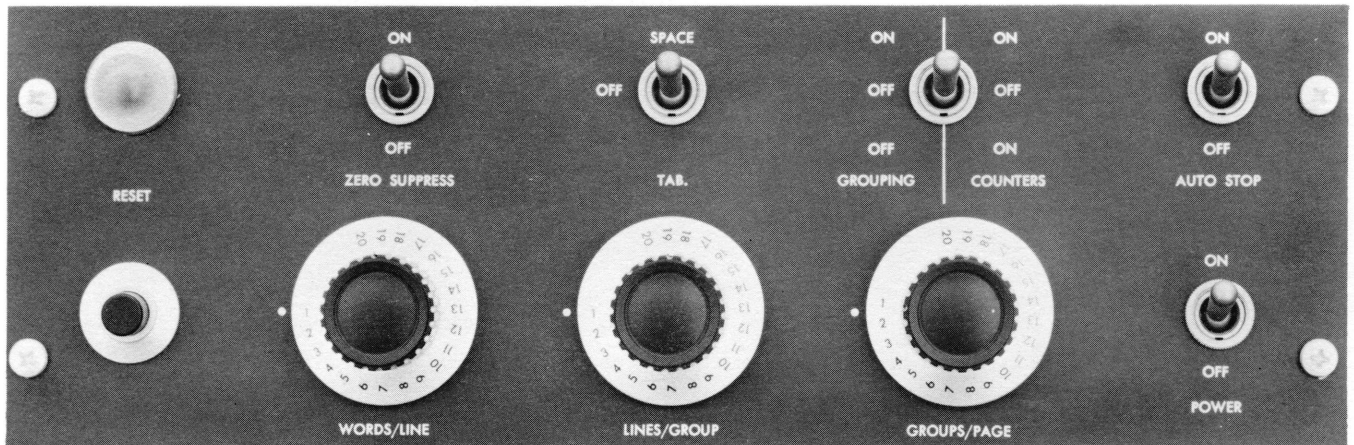


Figure 5-4. Typewriter Control Unit Panel.

5-31. **POWER SWITCH.** This two-position switch controls the power to the Typewriter Control Unit.

5-32. **PATCH PANEL**

5-33. The patch panel (figure 5-5) is located on the back of the Typewriter Control Unit, directly behind the typewriter control panel. It is used to set up the Flexowriter facilities for various types of input or output operations.

**WARNING**

The power to the Typewriter Control Unit must be off when the patch panel is being plugged. Do not pull plugs out by the cords.

5-34. The patch panel contains eight plugs, divided into two groups of four; one set of four is labeled FROM, the other TO. Labels over each plug indicate the source (FROM) or destination (TO) of information. (The label FORMAT refers to the device that translates computer code to Flexowriter code.) The plugs are connected by

patch cords, according to the function required.

5-35. All paper-tape system information going into or coming from the computer must pass through the Control Console. The plugs labeled FROM CONSOLE and TO CONSOLE refer to information in the binary-coded decimal form of the Burroughs 205. Any information going to and coming from the plugs labeled FORMAT is translated from Burroughs 205 code to Flexowriter code; actual printed format arrangement is determined by the settings on the typewriter control panel. The plugs labeled PUNCH and READER refer to the Flexowriter punch and reader.

5-36. The most common patch-panel connection activates output on the typewriter from the Burroughs 205; patch cords are connected from CONSOLE to FORMAT and from FORMAT to FLEXOWRITER (figure 5-5). There are several other configurations available to the operator, however. Refer to Table 5-1.

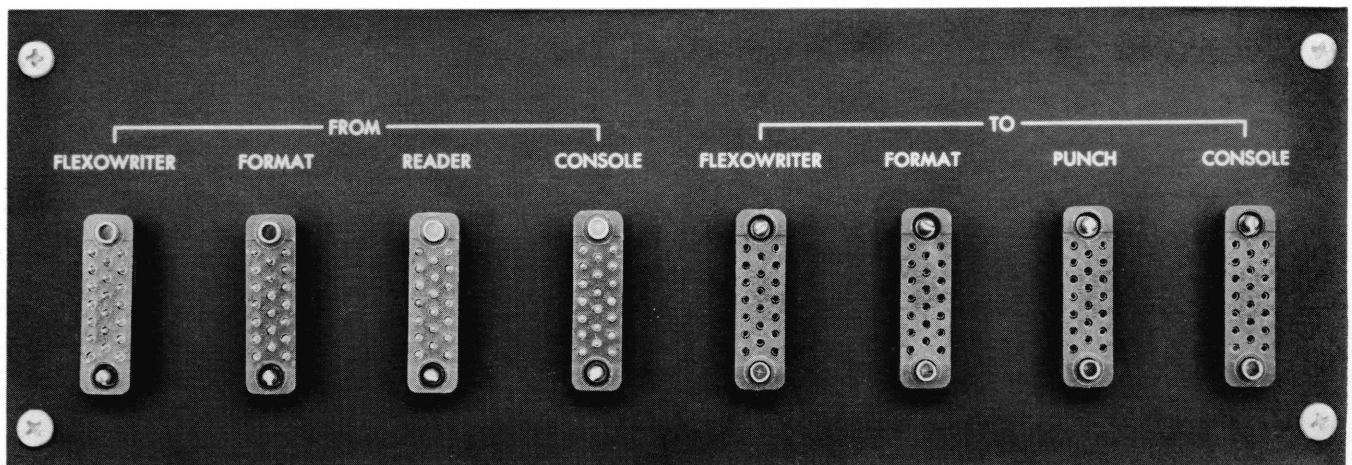


Figure 5-5. Patch Panel.

## Supervisory Printer

**Table 5-1. Patch-Panel Connections**

From	To	Description
Console Format	Format Flexowriter	For Flexowriter output from computer.
Console Format Flexowriter	Format Flexowriter Punch	For output from the computer to be printed and punched at the same time.
Reader	Flexowriter	To type information being transcribed from a tape by the reader, off-line.
Reader	Punch	To duplicate tape off-line.
Reader Flexowriter	Flexowriter Punch	To type information being transmitted by the reader and also produce a paper tape on the punch unit off-line.
Console Format Reader	Format Flexowriter Console	To allow input to the computer with the mechanical reader. (The input-selector switch on the Console must be set at MECH. READER.) This arrangement also allows printed output on the Flexowriter.
Console	Punch	To punch information from the computer on the Flexowriter punch.

### 5-37. OPERATING PROCEDURES

#### 5-38. FORMAT CONTROL

5-39. To use the Typewriter Control Unit to govern page format, proceed as follows:

1. Turn power on.
2. Press the reset button. The reset indicator will go on.
3. Set the zero suppress switch (paragraph 5-24).
4. Set the space-tab switch (paragraph 5-25).
5. Set the grouping counters switch as required (paragraph 5-29). If this switch is set to OFF-OFF, ignore steps 6 through 9.
6. Set the words/line switch to the number of words to be printed on each line (paragraph 5-26).
7. Set the lines/group switch to the number of lines to be printed in each group (paragraph 5-27).
8. Set the groups/page switch to the number of groups to be printed on each page (paragraph 5-28).
9. Set the automatic stop switch if required (paragraph 5-30).

#### 5-40. TAPE PREPARATION

5-41. This description is for a Flexowriter that is connected to a Typewriter Control Unit, but is not being used on-line with the computer. If a Flexowriter is used which is not connected to a Typewriter Control Unit, steps 1 and 2 should be ignored. (Steps 3 through 7 apply.)

1. Connect the patch-panel plug labeled FROM FLEXOWRITER to the plug labeled TO PUNCH.
2. Be sure there is an adequate supply of blank tape and that the tape is properly threaded into the punch mechanism (paragraph 5-47).
3. Turn the Flexowriter power on.
4. Depress one of the two Flexowriter keys labeled LOWER CASE. (Ignore this step when using a CARDATRON-code Flexowriter.)
5. Depress the punch-on switch.
6. Depress the tape-feed switch until about 15 inches of tape feed through the punch.
7. Punch the program as required. Each computer word (sign digit plus ten digits) must be followed by a finish pulse. A finish pulse is supplied by depressing the key for the lower-case letter a (or the hyphen on a Flexowriter modified for CARDATRON code). It is often desirable to punch a carriage return before starting the next word, for convenience later in reading a tape listed on the Flexowriter.

#### 5-42. TAPE DUPLICATION AND LISTING

5-43. This description is for a Flexowriter that is connected to a Typewriter Control Unit but is not being used on-line with the computer. If a Flexowriter is used which is not connected to a Typewriter Control Unit, step 1 should be ignored. (Steps 2 through 8 apply.)

5-44. To prepare listings—that is, print the contents of a paper tape off-line—and duplicate the tape simultaneously:

1. Make patch-panel connections FROM READER-TO FLEXOWRITER, and FROM FLEXOWRITER-TO PUNCH.
2. Be sure that there is an adequate supply of blank tape and that the tape is properly threaded into the punch mechanism (paragraph 5-47).
3. Insert the tape to be duplicated in the mechanical reader (paragraph 5-46).
4. Turn the Flexowriter power on.
5. Depress one of the Flexowriter keys labeled LOWER CASE. (Ignore this step when using the CARDATRON-code Flexowriter.)
6. Depress the punch-on switch.
7. Depress the tape-feed switch until about 15 inches of tape feed through the punch.
8. Depress the start-read switch. The tape passing through the reader will automatically be listed on the Flexowriter and a duplicate of this tape will be punched.

**NOTE**

When the mechanical reader encounters blank tape, stop the read operation by depressing the stop-read switch, and feed an equivalent amount of blank tape through the punch by depressing the tape-feed switch. Characters deleted from the original tape by means of the code-delete switch will not be reproduced on the new tape.

5-45. When listing only, either do not make the Flexowriter-to-punch connection, or else leave the punch-on switch turned off. Otherwise, proceed as for listing and duplicating.

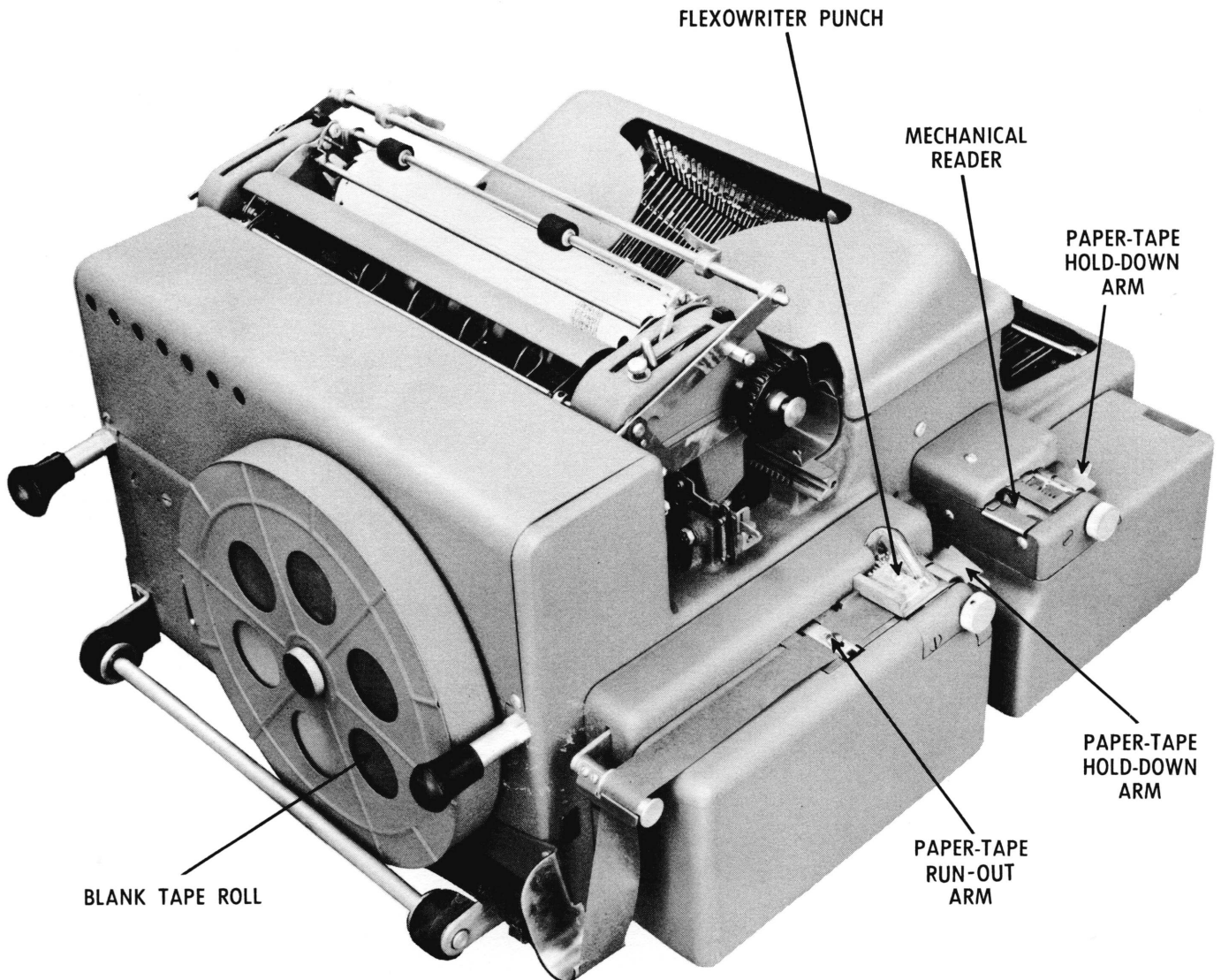
5-46. **LOADING THE READER.** When the operator faces the mechanical reader from the side of the Flexowriter, the movement of tape is from left to right, with the C punches on the side of the tape toward the operator. To load the mechanical reader (figure 5-6) :

1. Raise the paper-tape hold-down arm.

2. Slide the paper tape under the guide block and engage the feed pinwheel in the paper-tape feed holes (sprocket holes).
3. Lower the paper-tape hold-down arms.
4. Thread the paper tape through the guide bracket and underneath the guide lip.

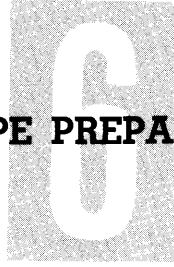
5-47. **LOADING THE PUNCH.** To load the Flexowriter punch (figure 5-6) with a new roll of paper tape:

1. Install the roll of tape on the back of the Flexowriter and thread it through the guides to the punch.
2. Move the tape hold-down arm forward. This lifts the paper-tape run-out arm, permitting free insertion of the paper tape, edgewise, into the correct position.
3. Replace tape hold-down arm and turn on Flexowriter power.
4. Run out blank paper tape by depressing the punch-on switch, and then pressing the tape-feed switch.



**Figure 5-6. Mechanical Reader and Punch.**





## THE PAPER-TAPE PREPARATION SYSTEM

### 6-1. CHARACTERISTICS

6-2. The Tape Preparation System (figure 6-1) is used for punching, verifying, and duplicating punched paper tape off-line. It consists of a control unit (figure 6-2), keyboard (figure 6-3), tape punch (figure 6-4) and tape reader (figure 6-5). It operates at a rate of 20 characters per second.

### 6-3. CONTROLS AND INDICATORS

#### 6-4. CONTROL UNIT

6-5. POWER SWITCH. This switch turns on power to the system.

6-6. WORD COUNTER. This counter has a capacity of five digits and counts up 1 for each word completed during punching, verifying, or duplicating. It is reset manually by the knurled wheel at the left of the word-counter display.

6-7. WORD-POSITION INDICATOR. This indicator consists of 11 neons corresponding to the 10 digits and the sign of a computer word. Only one neon is on at a time, showing which digit is to be read, punched, or duplicated *next*. The indicator may be reset to the sign position by depressing the reset button.

6-8. TAB-SET SWITCHES. These switches are located under the word-position indicators. They control the automatic punching of zeros. When the tab key on the keyboard is pressed, zeros will be punched automatically in the digit positions up to the first tab-set switch that is on; pressing the tab key again will cause automatic punching of zeros in the digit positions between the first and the second tab switches that are on, and so forth.

6-9. RESET BUTTON. Depressing this button resets the word-position indicator and prepares the unit for operation. If a tape is to be read, depressing this button causes the tape to advance to the first punched character.

6-10. FUNCTION-SELECTOR SWITCH. This switch can be set to PUNCH, VERIFY, or DUPLICATE as required by the operation.

6-11. FUNCTION-MODIFIER SWITCH. This switch can be set to NORMAL, SPEC. VERIFY, or SPEC. DUPLICATE; the second and third settings modify the action of the function selector. The special-verify setting is used

to verify paper tapes punched on other equipment, such as the High-Speed Paper-Tape Punch and the Flexowriter; the special-duplicate setting is used when such tapes are to be duplicated.

6-12. CORRECTION PUSH BUTTON. This button is used to correct digit errors during verification (paragraph 6-35). After it has been depressed, the first digit entered from the keyboard will be stored in the reader storage relays, as if it had been read from tape. When the next digit is entered, the keyboard resumes its usual function.

6-13. WORD ADVANCE-AUTO DUPLICATE SWITCH. This switch has three positions: AUTO DUPLICATE, OFF, and WORD ADVANCE. It is used to initiate duplicating and to advance the tape in the reader one word without affecting other units of the system.

6-14. OPERATOR-ERROR INDICATOR. This indicator comes on during verification if a keyboard entry does not agree with the character being read by the tape reader. It indicates either an operator error or an error in a tape being verified.

6-15. FUNCTION-ERROR INDICATOR. This indicator comes on when a parity error is detected; that is, when a parity punch (or the absence of a parity punch) makes the number of holes punched for a character odd, instead of even. The indicator is turned off by depressing the feed key on the keyboard.

#### 6-16. KEYBOARD

6-17. The Tape Preparation Unit keyboard has 10 keys numbered from 0 through 9, and three control keys: FEED, TAB, and F (figure 6-3).

6-18. FEED KEY. Depressing this key feeds blank tape through the tape punch and resets the word-position indicator to the sign position. (To feed tape without resetting the control unit, use the tape-feed switch on the punch.)

6-19. TAB KEY. Depressing this key causes zeros to be punched to fill out a word. If a tab switch is set, zeros will be punched until the digit position established by the tab switch setting is reached (paragraph 6-8).

6-20. F KEY. Depressing this key causes a word to be filled out with zeros and causes the punching of finish and carriage-return codes.

## The Paper-Tape Preparation System



Figure 6-1. Tape-Preparation System.

### 6-21. TAPE PUNCH

6-22. POWER SWITCH. This on-off switch controls power to the punch.

6-23. TAPE-FEED SWITCH. This switch causes the feeding of blank tape while it is held in the ON position.

### 6-24. TAPE READER

6-25. POWER SWITCH. This on-off switch controls power to the reader.

6-26. READER SWITCH. When this switch is on, the reader is under control of the control unit.

## 6-27. TAPE PUNCHING

6-28. To punch a paper tape from a source document:

1. Turn the control unit power on.
2. Set the function-selector switch to PUNCH.
3. Set the function-modifier switch to NORMAL.
4. Turn on the punch power.
5. Reset the word counter (paragraph 6-6).
6. Depress the reset button.
7. Set the tab-set switches as required for the program or data to be punched (paragraph 6-8).
8. Depress the feed key to feed 15 inches or more of leader.
9. Attach the free end of the tape to the take-up reel of the tape punch.
10. Punch the information from the source document by using the keyboard. Finish and carriage-return codes will be punched automatically after each word is punched. If the operator realizes that an error

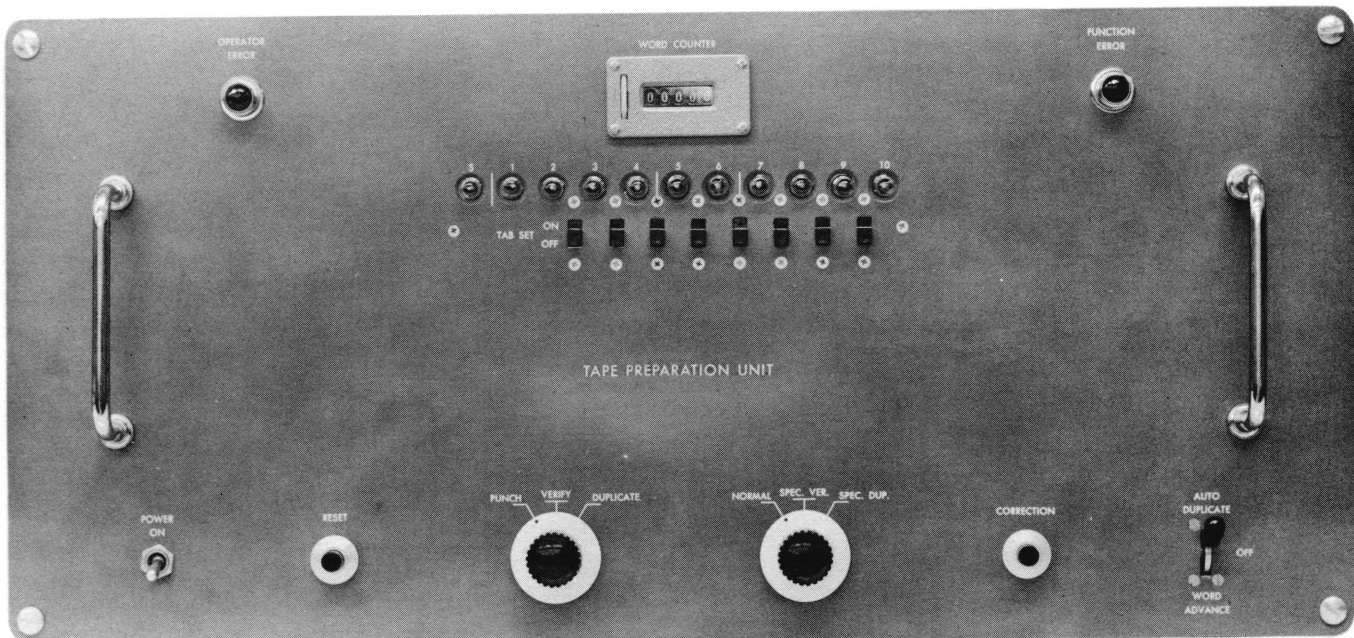


Figure 6-2. Control Unit.



**Figure 6-3. Tape-Preparation System Keyboard.**

has been made, he should depress the F key to fill out the word with zeros. Then the word should be repunched and the word-counter setting and the fact that the tape now contains an extra (and erroneous) word should be noted for the operator who will verify the tape. The word-counter setting will tell the verifying operator where the extra word appears in the tape.

### 6-29. TAPE VERIFICATION AND CORRECTION

#### 6-30. VERIFICATION

6-31. Tapes are verified by manually punching a new tape from the source document and comparing the new tape to the tape already punched. This comparison is made automatically by the Tape Preparation System and reveals incorrect digits, extra words, missing words, and tape-unit malfunctions. For verification of "special" tapes—that is, tapes prepared on a unit other than the Tape Preparation System—refer to paragraph 6-39.

6-32. To verify a tape:

1. Turn the control unit power on.
2. Set the function-selector switch to VERIFY.
3. Set the function-modifier switch to NORMAL.
4. Turn the punch power on
5. Turn the reader power on.
6. Turn the reader switch on the reader on.
7. Reset the word counter (paragraph 6-6).
8. Set the tab-set switches as required (paragraph 6-8).
9. Mount the tape to be verified on the tape reader with the wide side of the tape, measured from the sprocket holes, toward the operator.

10. Depress the reset button to advance the tape in the reader to the first punched character.
11. Attach the leading ends of the tapes in the punch and the reader to the take-up reels.
12. Punch the tape in the same way as the original tape was punched—from the source document.

The tape punched during the verifying operation will include punches in the 2 and 8 channels (figure 6-6) as part of the finish code. These extra punches enable visual identification of verified tapes.

6-33. There is always a remote chance of error from two operators making the same mistake or from a machine malfunction. For a double check, the new tape can be listed on the Flexowriter (paragraph 5-44) and the printed copy compared, word for word, with the source document.

#### 6-34. ERROR CORRECTION

6-35. DIGIT ERROR. If the operator-error indicator comes on during verification, re-enter the digit. If the indicator stays on, there is an error in the original tape. Depress the correction button and enter the correct digit from the source document twice. If the correct digit is entered the same way both times, it will be punched correctly into the new tape, the original tape will advance to the next character, and the operator-error indicator will be turned off.

6-36. PARITY ERROR. When the function-error indicator comes on, it indicates a parity error, which may be corrected in the same manner as a digit error (paragraph 6-35).

6-37. EXTRA WORD. If, during the verifying operation, the operator discovers an extra word in the tape being read (from notes on the source document or from the failure of digit comparison), the word-advance switch on the control unit can be used to move the tape to the next word before continuing with verification.

6-38. MISSING WORD. If, during verification, the operator discovers that a word is missing in the tape being read, the function-selector switch on the control unit should be set to PUNCH and the word entered from the keyboard. Then the function-selector switch should be set back to VERIFY, the tape backspaced in the reader one digit manually, and the reset button depressed before continuing the verifying operation.

#### NOTE

When the reset button is pressed before beginning a duplicating or verifying operation, the tape in the reader will advance until one character has been read. Since a character must be read before it can be compared to the character

## The Paper-Tape Preparation System

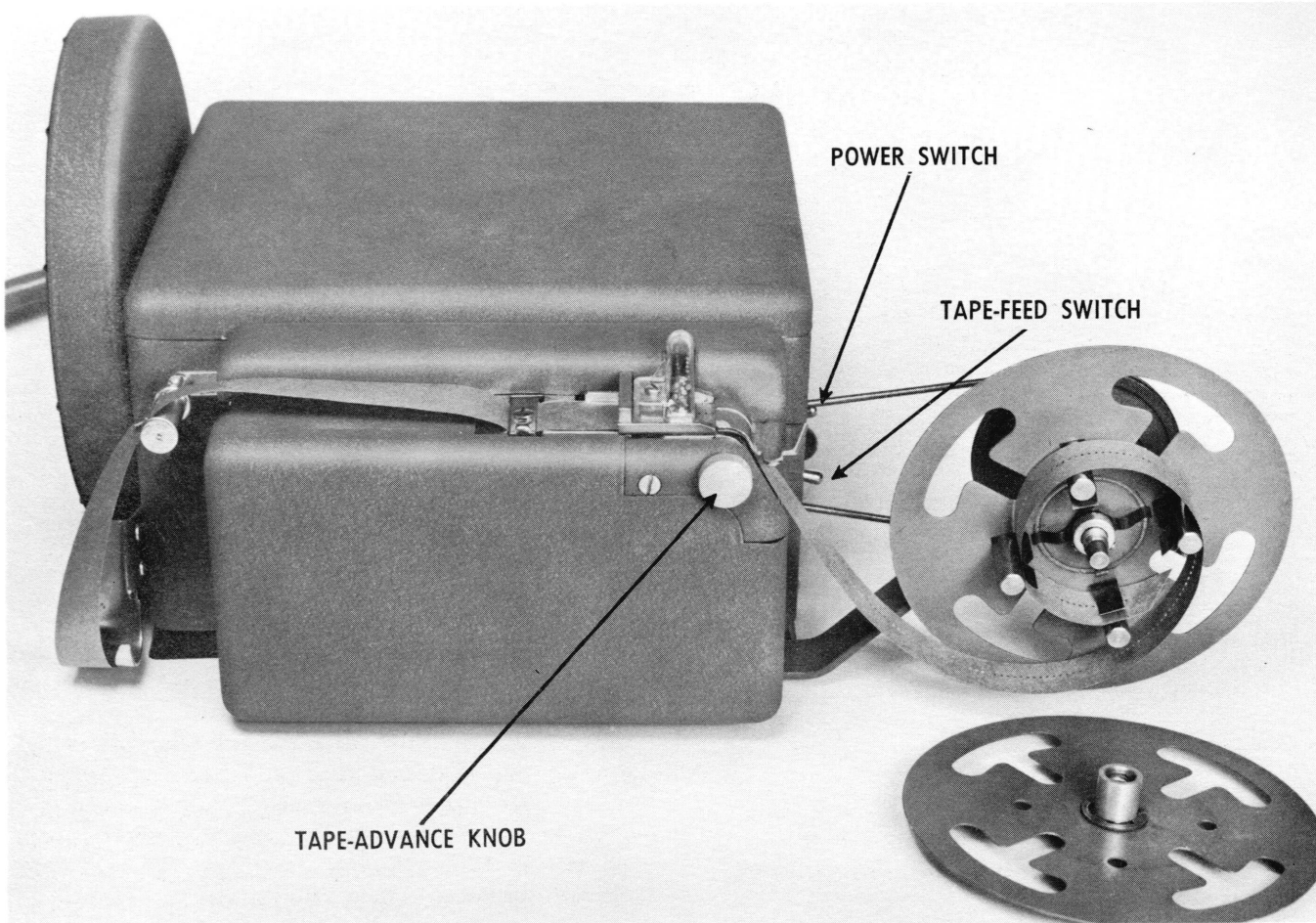


Figure 6-4. Tape Punch.

entered from the keyboard, the reader is always one character ahead of the punch. This should be taken into consideration when adjusting the tape manually in the reader.

### 6-39. VERIFICATION OF SPECIAL TAPES

6-40. To verify tapes produced on other equipment using a six-channel code without a parity punch (the Flexo-writer or the High-Speed Punch) the controls of the Tape Preparation System should be set as follows:

1. Turn on power to the control unit.
2. Set the function-selector switch to **VERIFY**.
3. Set the function-modifier switch to **SPECIAL VERIFY**.
4. Turn on the tape-punch power.
5. Turn on the tape-reader power.
6. Set the reader switch to **ON**.
7. Follow the same procedure as for normal verifying (paragraph 6-30). The tape produced will contain parity punches.

### 6-41. TAPE DUPLICATION AND CORRECTION

#### 6-42. DUPLICATION

6-43. For duplication of special tapes, refer to paragraph 6-49. To duplicate a tape prepared by the Tape Preparation System:

1. Turn power on to the unit.
2. Set the function-selector switch to **DUPLICATE**.
3. Set the function-modifier switch to **NORMAL**.
4. Turn the tape-punch power on.
5. Turn the tape-reader power on.
6. Turn the reader switch to **ON**.
7. Reset the word counter (paragraph 6-6).
8. Depress the reset button.
9. Mount the tape to be duplicated on the tape reader.
10. Set the word advance-automatic duplicate switch to **AUTO DUPLICATE**. This starts the duplicating operation. The tape in the reader will be duplicated exactly, including unpunched areas. The duplicating operation can be stopped at any time by setting the word advance-automatic duplicate switch to **OFF**.

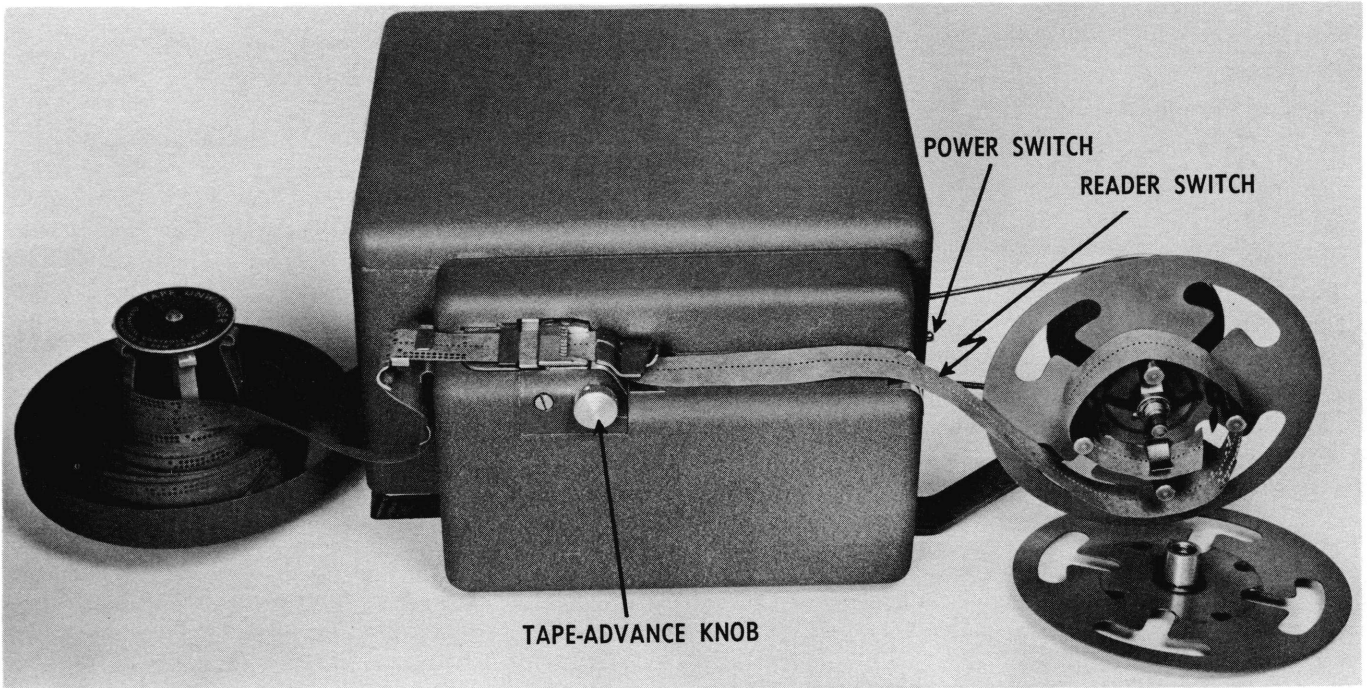


Figure 6-5. Tape Reader.

6-44. ERROR CORRECTION

6-45. ERROR INDICATION. If a parity error or a word of incorrect length appears in the tape being read, the error will be duplicated, but the punch will stop immediately afterwards. The function-error indicator will come on, if a parity error is detected; the operator-error indicator will come on, if a word is of incorrect length.

6-46. ERROR IN KNOWN LOCATION. During duplication, as the word counter approaches the word known to be in error, change the switch setting from AUTO DUPLICATE to OFF. Leaving the function-selector switch set to DUPLICATE, advance the tape one word at a time by repeatedly setting the word advance-automatic duplicate switch to WORD ADVANCE, until the word to be corrected is in position to be read. Change the function-selector switch setting to PUNCH and enter the correct word from the keyboard. Set the function-selector switch to VERIFY and set the word advance-automatic duplicate switch to WORD ADVANCE once to skip the erroneous word in the reader. Set the function-selector switch back to DUPLICATE and manually backspace the tape in the reader one digit. Depress the reset button, return the word advance-automatic duplicate switch to AUTO DUPLICATE, and automatic duplication will continue.

6-47. PARITY ERROR. If the function-error indicator comes on during duplication, depress the feed key to feed blank tape and to turn off the error indicator. Then

check both tapes to see which contains the error. If a parity hole appears where there should be none (that is, there is already an even number of holes punched for the character), it should be covered with black tape. If there is no parity hole and there should be, the hole can be added with a hand punch. Then the tape in the punch should be turned back manually to the next character to be punched. The tape in the reader is already stationed at the next character to be read.

6-48. WORD DELETION. During duplication, use the word counter to locate the word to be deleted. Set the function-selector switch to VERIFY, advance the tape in the reader past the unwanted word by depressing the word advance-automatic duplicate switch, backspace the tape one digit, and press the reset button. Set the function-selector switch to DUPLICATE and set the word advance-automatic duplicate switch, to AUTO DUPLICATE to continue automatic duplication.

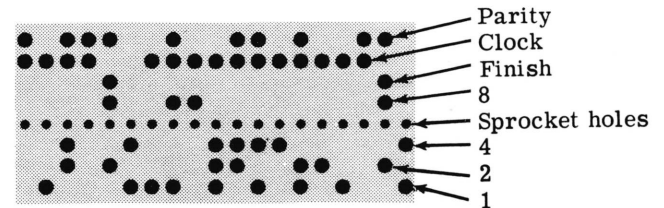


Figure 6-6. Verified Tape.

## **The Paper-Tape Preparation System**

### 6-49. DUPLICATION OF SPECIAL TAPES

6-50. To duplicate a tape prepared on other equipment:

1. Turn the unit power on.
2. Set the function-selector switch to **DUPLICATE**.
3. Set the function-modifier switch to **SPECIAL DUPLICATE**.
4. Turn on power to the punch and the reader.
5. Set the reader switch to **ON**.
6. Follow the same procedure as for normal duplicating (paragraph 6-42).

#### **NOTE**

There is no verification during special duplication: the word-position indicator and the parity-checking circuits are disconnected.

6-51. When the function-modifier switch is set to **SPECIAL DUPLICATE**, the control unit is not operating except as a power supply for the punch and reader. Thus *any* paper tape having seven channels or less can be duplicated.

## **6-52. MISCELLANEOUS OPERATING INFORMATION**

### 6-53. MARKING TAPE

6-54. As soon as a tape has been prepared and removed from the machine, it should be labeled. (Colored pencil marks are easiest to read.) The label may include contents of the tape, whether it is an original or verified tape, and any other information useful at the installation. An arrow, showing the direction of tape feeding, will save time when the tape is used later.

### 6-55. POWER SWITCHES

6-56. Most operators leave the punch and reader power switches on all the time. The control-unit power switch then acts as a master switch.

### 6-57. RESETTING

6-58. Before starting any operation, it is advisable to depress the reset button to be sure that the unit will be ready to operate properly.



## THE CARDATRON SYSTEM

### 7-1. CHARACTERISTICS

#### 7-2. CARDATRON SYSTEM

7-3. The CARDATRON system is designed for applications which deal with volume punched-card input and printed-report and punched-card output. Numeric or alphanumeric information is handled with equal facility.

7-4. The CARDATRON system buffers both card input from the card readers and computer output to the card punches and line-at-a-time printers. This buffering results in independent and simultaneous multiple-input-output operation.

7-5. The CARDATRON system is built around the CARDATRON Control Unit (figure 7-1), which controls any combination of up to seven CARDATRON input and output units, each of which is connected to one punched-card device. For example, a full CARDATRON system could consist of a CARDATRON Control Unit, four input units connected to four card readers, and three output units connected to two line printers and a card punch.

#### 7-6. CARD-HANDLING DEVICES

7-7. Standard IBM card-handling equipment is used to supplement the CARDATRON system. The 089 collator is used for card reading on input, the 407 tabulator for printing on output, and the 523 summary punch for reading on input or punching on output. (A single 523 may be used for only one of these applications at a time. In practice, it usually is used for output.) On input, information pulses from the 089 or the 523 go to a CARDATRON Input Unit, from the input unit to the control unit, and from the control unit to the computer. On output, information pulses go from the computer to the control unit and then to a CARDATRON Output Unit, and from the output unit to a 407 line printer or a 523 punch to cause these units to print and punch respectively.

7-8. The IBM machines are differentiated as 9-edge or 12-edge machines, depending on whether the edge of the card with the 12 row or the edge of the card with the 9 row is fed into the machine first. The 089 and the 407 are 9-edge machines. The 523 is a 12-edge machine.

7-9. No attempt is made in this manual to describe the IBM equipment. IBM manuals are available as follows:

IBM Electric Punched Card Accounting Machines, Principles of Operation: Reproducing Punches 513 and 514. International Business Machines Corporation, 590

Madison Avenue, New York. Form 22-3180-3, New York, 1945. Revised, 1952.

IBM Electric Punched Card Accounting Machines, Principles of Operation: IBM 89 [sic] Alphabetic Collator. International Business Machines Corporation, 590 Madison Avenue, New York. Form 22-5692-1, New York, 1949.

IBM 407 Accounting Machine Manual of Operation. International Business Machines Corporation, 590 Madison Avenue, New York. Form 22-5765-7, New York, 1953.

Note that the 523 punch circuitry and plugboard are identical to those for the 513.

#### 7-10. DESIGNATION OF CARDATRON INPUT-OUTPUT UNITS

7-11. The seven left-hand Cannon connectors at the bottom of the control unit are used to connect the CARDATRON input and output units to the control unit and to designate their numbers. These connectors are located on the front of the control unit at the bottom and are covered by a removable panel. Since the same connectors are used for either input or output, and the connectors are not labeled, the following numbering system has been established:

For input units, connectors are numbered from 1 through 7, from left to right.

For output units, connectors are numbered from 1 through 7, from right to left.

Thus an input unit attached to the first connector on the left becomes input-unit 1. If the same unit were, instead, attached to the second connector from the left, it would become input-unit 2 (figure 7-2).

7-12. The same numbering system applies to output units, but starting from the right. An output unit attached to the first connector on the right becomes output-unit 1. The second connector from the right would designate output-unit 2.

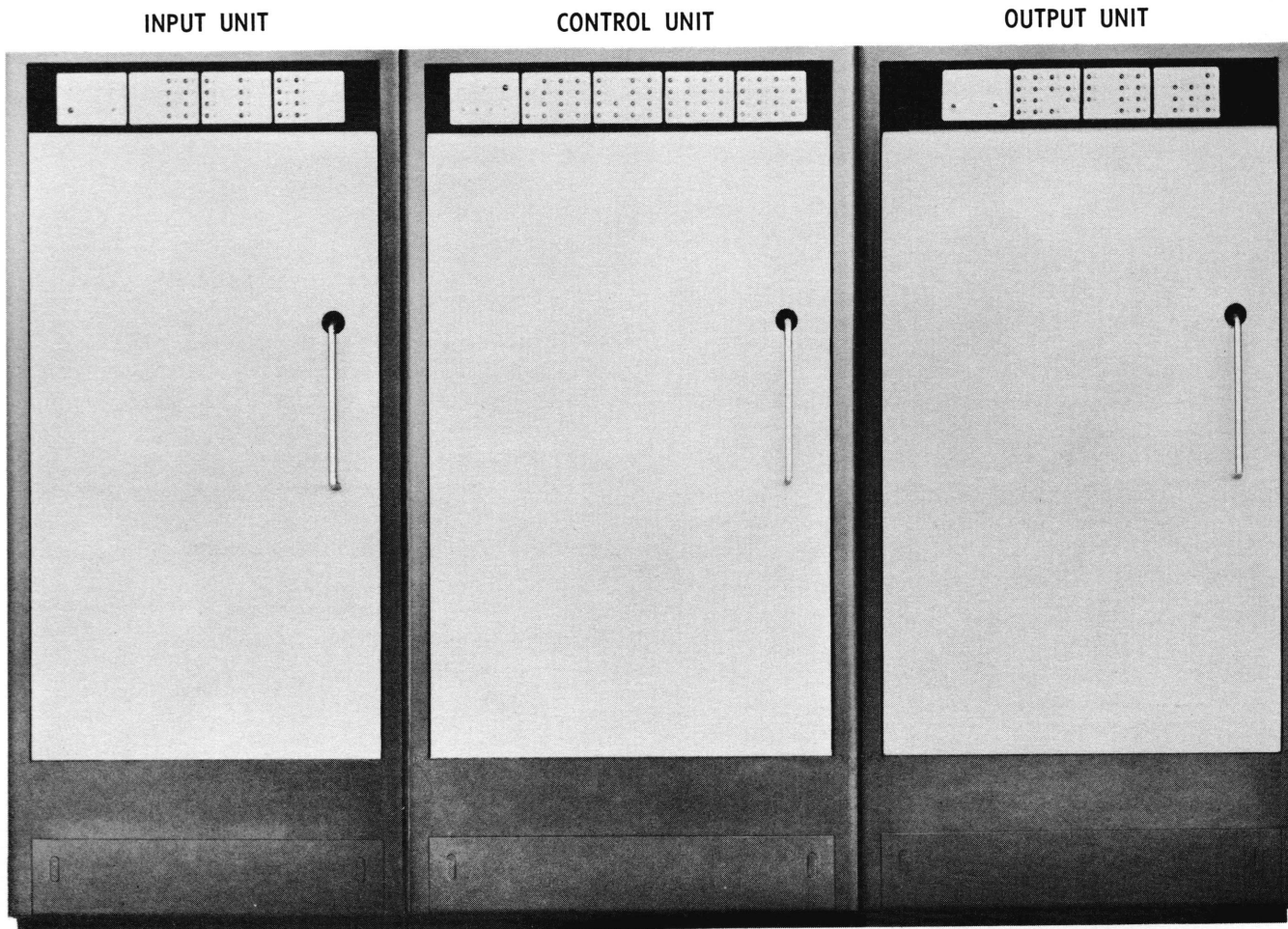
7-13. Once set up, the designation of units can not be changed except by a field engineer. Redesignation of a unit takes about eight hours.

### 7-14. CONTROLS AND INDICATORS

#### 7-15. CONTROL-UNIT CONTROL PANEL

7-16. GENERAL CLEAR BUTTON. The general-clear button on the CARDATRON Control Unit (figure 7-3)

## The CARDATRON System



**Figure 7-1. CARDATRON System. Shown are the control unit and one input and one output unit.**

clears the control unit and the computer, but does not clear any of the input or output units. The general-clear button on the computer also clears the CARDATRON Control Unit.

7-17. DC ON INDICATOR. This indicator is on whenever d-c voltage is applied to the CARDATRON system.

7-18. DC LOCKOUT SWITCH. This switch turns off d-c power. It is *not* used by the operator. Direct current cannot be brought on until the DC lockout switch is returned to the normal position.

7-19. SET READ BUTTON. Depressing this button turns on the buffer read (BR) toggle. This button can be used to restart a card-reading operation (for example, if a card jam or misfeed occurs during reading, format will not be selected). Thus, the reader will stop with a CDR instruction in the C register. The read unit should then be cleared and the defective card corrected. After the remaining cards are loaded into the reader, the set button can then be depressed, thus allowing continuation of the read operation. When this button is depressed, the buffer read light (BR) goes on, indicating that reading is taking place between the input unit and the data processor. Therefore, when this light is off, it indicates that some type of error has occurred.

7-20. INPUT SETUP BUTTON. Depressing this button causes 44 0000 to be inserted in the C register and selects an input unit. The unit activated by this button is predetermined during CARDATRON installation. Generally, it is the most frequently used of the input units.

7-21. ZERO BUTTON. When this button and a set button are pressed simultaneously, the toggle corresponding to the set button is cleared.

7-22. UNIT DESIGNATE. The UD indicators display the unit number designated by the digit u in a CARDATRON instruction.

7-23. LOOP ADDRESS. The LA indicator is on when the address portion of any CARDATRON instruction being executed refers to an address in a quick-access band (addresses 4000 through 7999).

7-24. OUTPUT UNIT. The OU indicator is on when an output unit has been designated by the program; it is off when an input unit has been designated.

7-25. RELAY DESIGNATE. The RD toggles (and the corresponding indicators) are turned on as specified by the digit t in the CARD WRITE (CDW) instruction; they remain on during the execution of the instruction.



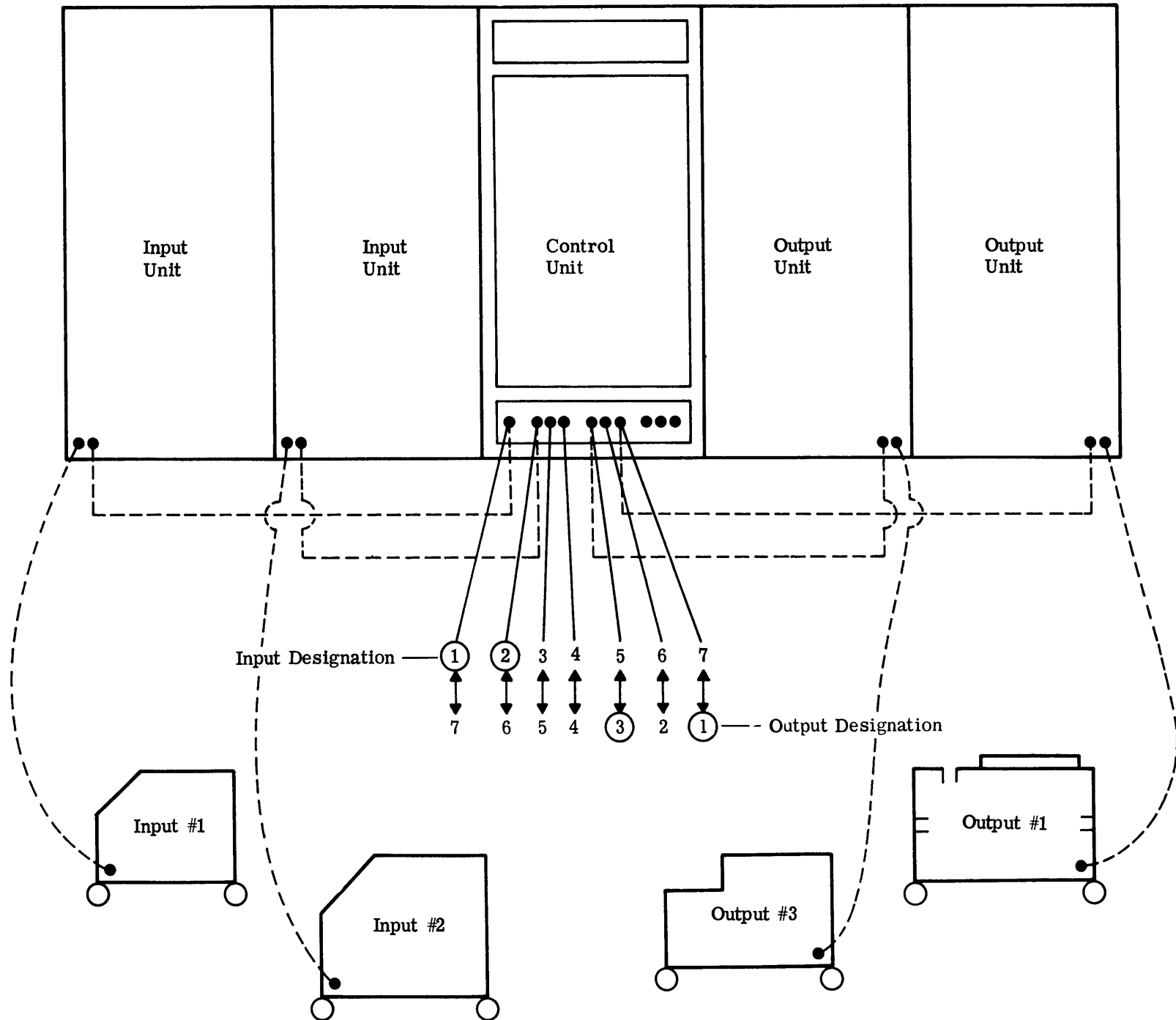


Figure 7-2. CARDATRON Unit Designation.

## The CARDATRON System

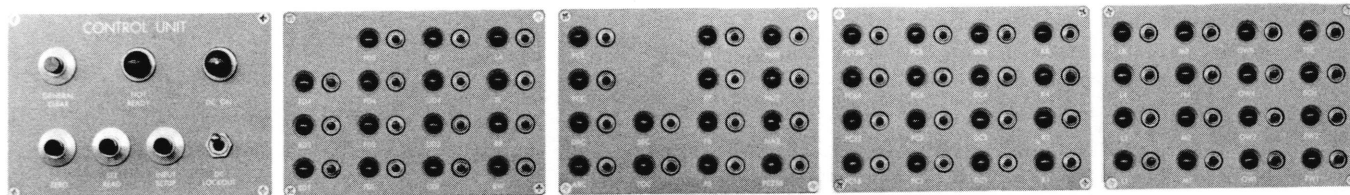


Figure 7-3. CARDATRON Control Unit Control Panel.

The RD toggles cause the corresponding tab-select relays to transfer and remain transferred during the execution of the CDW instruction. The points of these relays, which are available on the 407 control panel, can control specific functions, such as carriage control or selector operation.

### 7-26. OUTPUT-UNIT CONTROL PANEL

7-27. The controls and indicators described in paragraphs 7-28 through 7-34 are shown in figure 7-4.

7-28. CLEAR BUTTON. This button sets the row counter to 13 for a 9-edge machine or to 10 for a 12-edge machine, allowing the output buffer drum to accept information from the computer. This button also sets the format-select (FS) toggles to 0.

7-29. ZERO BUTTON. This button is used in the same way as the zero button on the CARDATRON Control Unit (paragraph 7-21).

7-30. ROW COUNTER. The row counter is a binary decade. The state of the toggles associated with the indicators is used to control the CARDATRON cycle. An understanding of the significance of the row-counter settings is necessary to enable the operator to be sure that the output unit is cleared properly before starting an operation, and to analyze stops caused by program or machine errors.

7-31. When the clear button is depressed, the row counter on an output unit connected to a 9-edge-first machine will be set to 13. On an output unit connected to a 12-edge-first machine, the row counter will be set to 10. For the significance of row-counter settings, refer to table 7-1.

7-32. The operator does not normally use the buttons associated with the row-counter indicators.

7-33. START MACHINE. The SM indicator is turned on when the output unit calls for a line to be printed or a card to be punched.

7-34. FORMAT SELECT. The FS indicators show which format band was selected by the f digit in the CARD

WRITE instruction being executed; the corresponding buttons are not used by the operator.

### 7-35. INPUT-UNIT CONTROL PANEL

7-36. The controls and indicators described in paragraphs 7-37 through 7-46 are shown in figure 7-5.

7-37. CLEAR BUTTON. This button:

1. Sets RC (row counter) to 10 for a 9-edge machine or to 13 for a 12-edge machine (paragraph 7-30), allowing the buffer drum to accept information from a card in the card reader.
2. Sets FS (format select) toggles to 7 (reject format).
3. Clears all other toggles except IW (information write).

7-38. OVERLAP ALARM. This indicator goes on if the card reader begins to reload the buffer drum in the input unit before it is completely unloaded.

7-39. NO FORMAT ALARM. This indicator will go on if any card in the 089 or the 523 fails to select a format band.

7-40. ZERO BUTTON. This button is used in the same way as the zero button on the CARDATRON Control Unit (paragraph 7-21).

7-41. RELOAD LOCKOUT. The RLO indicator will go on if the digit f in a CARD READ FORMAT (CDRF) instruction is odd or if format 8 is selected from the card on input. In either case, the machine will not start (SM indicator will be off) and automatic reloading of the buffer drum will be prevented.

7-42. FORMAT LOCKOUT. The FLO indicator will go on if a card selects format 8. The format-lockout toggles turn on the reload-lockout toggle, which prevents the next card from feeding by inhibiting the transfer of the start-machine relay. The FLO indicator shows that the lockout signal came from the card.

7-43. FORMAT SELECT. The FS indicators show which format band was selected by the card.

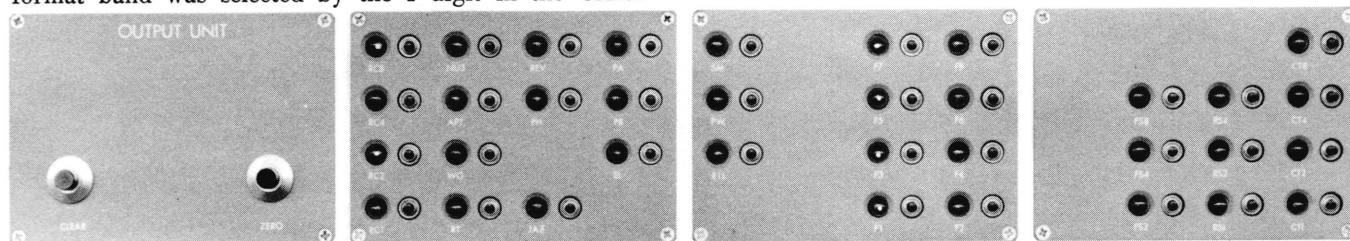


Figure 7-4. CARDATRON Output Unit Control Panel.

Table 7-1. CARDATRON System Row-Counter Settings.

Row-Counter Setting	Significance	Remarks	Row-Counter Setting	Significance	Remarks			
<i>Input Unit, 9-Edge-First Machine</i>								
10	Buffer unloaded, ready for reader	Set to 10 with clear button	6	Read 6 row of card	Set to 10 at beginning of CDRF			
9	Read 9 row of card		7	Read 7 row of card				
8	Read 8 row of card		8	Read 8 row of card				
7	Read 7 row of card		9	Read 9 row of card				
6	Read 6 row of card		10 <sup>b</sup>	Buffer loaded ready for computer				
5	Read 5 row of card		11	Transfer information to computer if CDR, or erase format band if CDRF				
4	Read 4 row of card		12	Erase information band if CDR		At 12 if RLO on and no CDR or CDRF has been executed.		
3	Read 3 row of card							
2	Read 2 row of card							
1	Read 1 row of card							
0	Read 0 row of card							
15	Read 11 row of card							
14	Read 12 row of card							
13 <sup>a</sup>	Buffer loaded ready for computer		Set to 13 at beginning of CDRF	<i>Output Unit, 9-Edge-First Machine</i>				
12	Transfer information to computer if CDR, or erase format band if CDRF			13			Print 12 row; buffer unloaded ready for computer	Set to 13 with clear button Set to 13 with CDWF
11	Erase information band if CDR	12		Erase information band if CDW. Erase format band if CDWF.				
		11	Transfer information from computer to buffer					
		10	Buffer loaded ready for printer					
		9	Transfer 9's to cores	At 8 if buffer loaded and IBM machine off				
		8	Transfer 8's to cores Print 9 row					
		7	Transfer 7's to cores Print 8 row					
		6	Transfer 6's to cores Print 7 row					
		5	Transfer 5's to cores Print 6 row					
		4	Transfer 4's to cores Print 5 row					
		3	Transfer 3's to cores Print 4 row					
		2	Transfer 2's to cores Print 3 row					
<i>Input Unit, 12-Edge-First Machine</i>								
13	Buffer unloaded, ready for reader	Set to 13 with clear button						
14	Read 12 row of card							
15	Read 11 row of card							
0	Read 0 row of card							
1	Read 1 row of card							
2	Read 2 row of card							
3	Read 3 row of card							
4	Read 4 row of card							
5	Read 5 row of card							

<sup>a</sup>To execute a CDRF command, RC must be set to 11 or 13, and FS to 7.

<sup>b</sup>To execute a CDRF command, RC must be set to 12 or 10, and FT to 7.

## The CARDATRON System

**Table 7-1. CARDATRON System Row-Counter Settings. (cont.)**

Row-Counter Setting	Significance	Remarks
1	Transfer 1's to cores Print 2 row	
0	Transfer 0's to cores Print 1 row	
15	Transfer 11's to cores Print 0 row	
14	Transfer 12's to cores Print 11 row	
<i>Output Unit, 12-Edge-First Machine</i>		
10	Punch 9 row; buffer unloaded ready for computer	Set to 10 with clear button Set to 10 with CDWF
11	Erase information band for CDW. Erase format band if CDWF.	
12	Transfer information from computer to buffer	
13	Buffer loaded ready for punch	
14	Transfer 12's to cores	SM selector is dropped out
15	Transfer 11's to cores Punch 12 row	At 15 if buffer loaded and IBM machine off
0	Transfer 0's to cores Punch 11 row	
1	Transfer 1's to cores Punch 0 row	
2	Transfer 2's to cores Punch 1 row	
3	Transfer 3's to cores Punch 2 row	
4	Transfer 4's to cores Punch 3 row	
5	Transfer 5's to cores Punch 4 row	
6	Transfer 6's to cores Punch 5 row	
7	Transfer 7's to cores Punch 6 row	
8	Transfer 8's to cores Punch 7 row	
9	Transfer 9's to cores Punch 8 row	

7-44. START MACHINE. The SM indicator is on when the input unit calls for a card feed.

7-45. ROW TOGGLE. During the reading of information from a card on input the RT indicator will be on when any one of rows 1 through 9 is being read, and off during the reading of rows 0, 11, or 12.

7-46. ROW COUNTER. The RC buttons control the setting of the row counter; the indicators show the row-counter setting (table 7-1). The buttons are not used by the operator.

### 7-47. OPERATING PROCEDURES

#### 7-48. PREPARATION OF CARD-HANDLING UNITS

7-49. Proceed as follows:

1. If necessary, insert the required plugboard panels in the readers, punches, and printers.
2. Check the main-line power switch in each punched-card device to be used and the cable connections between these devices and the input or output units. If the power is not on, or if the punched-card devices are not connected to the correct CARDATRON units, the core-voltage switch in each buffer unit should be turned off before switching power on or making cable connections. (There is a core-voltage switch inside each input unit and output unit; it is mounted on the left side panel approximately two feet from the bottom.) After completion of these two operations, the core-voltage switch may be turned on.
3. If each punched-card device is already connected to the correct input or output unit, and power is on in the device, it is then necessary to check to see that each core-voltage switch is on.

#### 7-50. CLEARING THE CARDATRON

7-51. Clear the control unit, and the input and output units as follows:

1. Clear the control unit by depressing the general-clear button on either the computer or the control unit. (This action also clears the computer.)
2. Clear the input units by depressing the clear buttons. This will set the row counter on the input-unit control panel to a ready-for-reader setting (10 for the 089 or 13 for the 523). The format-select decade will be set to the reject-format setting of 7. All other toggles in the input unit will be cleared.
3. Clear the output units by depressing the clear buttons. This will set the row counter on the output-unit control panel to the ready-for-computer setting of 13 for the 407 or 10 for the 523. All other toggles in the output unit will be cleared.

#### 7-52. STARTING THE CARD-HANDLING MACHINES

7-53. GENERAL. Always clear all CARDATRON units before starting any card-handling machines (paragraph 7-50).

7-54. 407 LINE PRINTER. Although the 407 is used



## The CARDATRON System

are punched in the cards), depress the input-setup button on the CARDATRON Control Unit (paragraph 7-20). This will place a CARD READ instruction (44) in the order portion of the C register. (Note that depressing the input set-up button is only one way to set up the C register for the bootstrap readin.) The C register will contain 44 0000 0000. Depending on the setup of the bootstrap operation, the operator may or may not need to insert an address into the address register. Instructions concerning this procedure should be included in the coder's list of operating instructions.

6. Manually set the B register to the value specified by the coder's instructions, if information in the card deck is to be B-register address-modified on input, and if the deck does not contain a set-B card (paragraphs 2-11, 2-12, and 2-18).
7. Push the stop button on the Control Console, set the lock-normal and continuous-step switches on the supervisory control panel to NORMAL and CONTINUOUS, and depress the start button on the supervisory control panel. This will cause the CARD READ instruction in the C register to be executed, thus starting the loading operation. (This is only one of several procedures for starting operation.)

### 7-58. RUN-OUT PROCEDURE FOR THE 089 COLLATOR

7-59. The 089 may stop during a program run while reading a card deck. The stop may be caused by a key-punching error, a program malfunction, a failure to load format bands, a failure to select format, and so forth. To run out the cards left in the 089 and start again:

1. Remove the remaining portion of the card deck from the primary feed hopper.
2. Wire a connection from PLUG-TO-C to PRIMARY FEED on the plugboard or depress the start-machine (SM) set button on the CARDATRON Control Unit.
3. Hold down the run-out button (figure 7-6) on the 089 until all cards within the device have dropped into the second pocket.
4. Some systems have a special button installed on the right side of the 089, above the plugboard for run-out operation. If this is the case, depress this button simultaneously with the run-out button instead of following steps 2 and 3.
5. Reload and restart (paragraph 7-57).

### 7-60. CLEARING CARD JAMS

7-61. 089 COLLATOR. If the computer stops on a CARD READ instruction and the 089 has stopped:

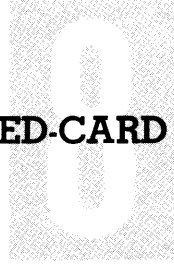
1. Record the contents of the B and C registers.
2. Switch off the core voltage in the CARDATRON Input Unit.
3. Turn the 089 power off.

4. Remove the portion of the card deck remaining in the primary feed hopper.
5. Remove the upper side panel on the right side of the 089.
6. Check to see if any cards are jammed under the retractable brush assembly. If there is a card jam under the assembly, unlock the assembly, and remove the damaged cards. Relock the assembly.
7. Turn the power on in the 089.
8. Run out any remaining cards (paragraph 7-58).
9. Turn on the core-voltage power.
10. Check the run-out cards for nicked or damaged cards.
11. Punch duplicate cards for all nicked or damaged cards and place them in the correct order in the card deck.
12. If the point of error can be determined exactly, restart from the first remade card. If not, reload and restart from the beginning. In either case, follow the procedure given in paragraph 7-57.

7-62. 407 LINE PRINTER. Although it is possible, it is not probable that a card jam will be encountered on the 407 during on-line operation, because the 407 is not continually feeding cards. In case a jam does occur (on-line or off-line) and the machine stops:

1. Remove cards from the hopper and the stacker of the 407.
2. Lift the cover which is over the stacker and the brush holder assemblies (left end of 407) toward the back of the machine. (There is a recessed hand hold on the front of the cover just below the hopper ledge.)
3. Depress the stacker lock button (just behind the top of the hopper) and raise the stacker itself toward the back of the machine.
4. Grasp the far end of the brush holder (away from the operator) and raise the brush holder toward the front of the machine.
5. The cards at the first and second reading stations are now exposed to the operator and can be removed by hand.
6. To restart the 407 close up the stacker and the brush holder assemblies and place cards in the hopper. Depress the start key on the 407.

# THE PUNCHED-CARD CONVERTER



## 8-1. CHARACTERISTICS

### 8-2. GENERAL

8-3. The Punched-Card Converter (figure 8-1), like the CARDATRON system, links the Burroughs 205 to card machines for input and output of information. However, it is a much simpler—and slower—device; it does not provide the editing facilities of the CARDATRON nor does it allow simultaneous and independent operation of the card-handling machines through the use of buffers. Only numeric information is handled by the Punched-Card Converter (except under special conditions described in The Compleat Programmer, Number 6). For input, the IBM 514 reproducing punch, the 523 summary punch, or the 528 accumulating reproducer may be used; output can be to the 514, 523, 528, or to the 402 tabulator, or the 416 or 419 numerical accounting machine. A single instruction can cause up to 1000 cards to be read or punched.

### 8-4. CONTROL SWITCHES

8-5. WORDS/CARD IN. This switch, the left-hand dial of the two on the front of the unit, has settings numbered from 1 through 8 (figure 8-1). It controls the number of fields to be read from each card.

8-6. WORDS/CARD OUT. This switch, the right dial of the two on the front of the unit, has settings numbered from 1 through 8. It controls the number of words to be read from computer storage and punched or printed in one cycle.

8-7. PUNCH-WRITE. This switch is located inside the right front door of the Punched-Card Converter, on the right side panel about four inches from the bottom. It has two positions: ALL OTHERS and PUNCH 528 ONLY. When using the 528 for output, this switch must be down, in the PUNCH 528 ONLY position. It may be down for 528 input; it must be up, in the ALL OTHERS position, when using any other output device.

8-8. READ-SPEED. This switch is located inside the Punched-Card Converter on the back panel about one foot from the bottom. It has two positions: 200 CPM and 100 CPM. When using the 528 for input, this switch must be up, in the 200 CPM position. For all other means of input, the switch must be down, in the 100 CPM position.

## 8-9. OPERATING PROCEDURES

### 8-10. PRE-START

8-11. Before starting the Punched-Card Converter:

1. Check cable connections between the punched-card machines and the Punched-Card Converter to make certain that the equipment is properly connected. Check to see that the snake-head connection of the desired input device is connected to the READ receptacle of the converter, and that the snake-head connection of the desired output device is connected to the WRITE receptacle of the converter. The READ and WRITE receptacles are located on the right end of the converter, at the bottom.

If an Output-Selector Switch Unit is used, it will be connected to the WRITE receptacle of the Punched-Card Converter instead, with the snake-head connector of the two output units (punch and printer) connected to the PUNCH and PRINT receptacles respectively on the Output-Selector Switch Unit. If the External Switch Unit is used, it is connected to the plug nearest the back of the computer to the right of the drum assembly, as the operator faces the back of the computer.

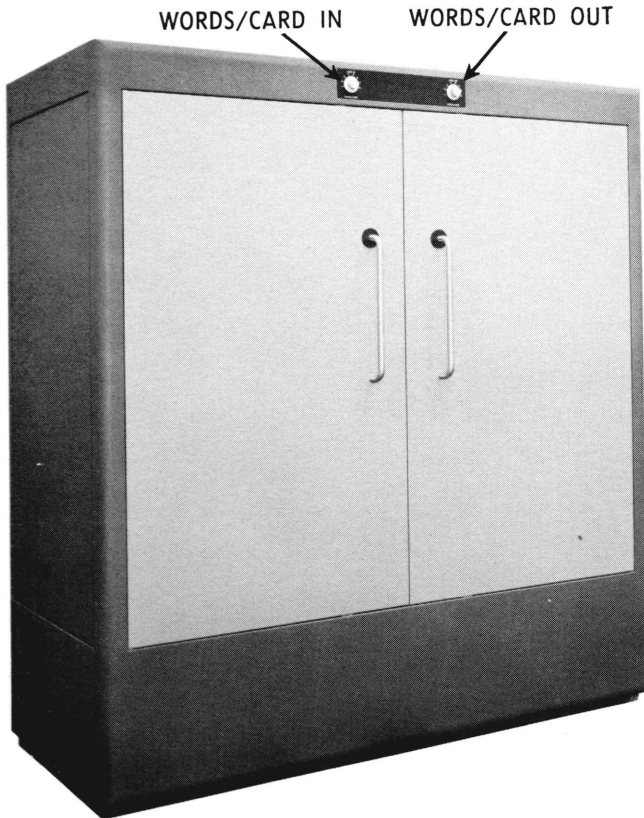
2. Check to see that the WORDS/CARD IN switch on the converter designates the desired number of 10-column fields to be read from a card. Verify that the WORDS/CARD OUT switch on the converter designates the desired number of words to be read from the computer to the output device.
3. If the 528 is to be used, check the setting of the read-speed switch and the punch-write switch.

### 8-12. START

8-13. INPUT DEVICE. To start the input card device; (the 528 is used as an example) :

1. Carry out the pre-start procedure (paragraph 8-10).
2. Insert the plugboard panel.
3. Check that power is on to the 528.
4. Place the cards into the read-feed hopper face down and 12-edge leading. (Check to see that two blank cards follow the card deck.)
5. Place several blank cards in the punch feed hopper.
6. Depress the start button.
7. Hold down the read button until the first card feeds past the first read station and is resting in

## The Punched-Card Converter



**Figure 8-1. Punched-Card Converter Control Panel.**

front of the second read station. The 528 is now idling and ready to operate. (To observe the read station brushes and the movement of the card, lift the cover on top of the 528.)

8-14. OUTPUT DEVICE. To start the output card device; (the 407 is used as an example):

1. Carry out the pre-start procedure (paragraph 8-10).
2. Insert the plugboard panel.

3. Check that the power is on to the 407.
4. Place blank cards in the 407 hopper, face down, 9-edge leading, and hold down the start key for three card cycles. The 407 is now in an idling state of readiness (commonly called MLR). If the 407 stops instead of idling, the key was not depressed for three full cycles. Depress the key again.

8-15. PUNCHED-CARD CONVERTER. Load other desired input data, if any, into the computer—by paper tape, for example. If the card deck is to be read in under program control, clear the computer, set the lock-normal and the continuous-step switches on the supervisory control panel to NORMAL and CONTINUOUS, insert 20 aaaa into the first six digit positions of the C register, where aaaa is the address of the location containing the first instruction of the card-loading routine, set the timing toggle to EXECUTE, and depress the start button on the supervisory control panel.

8-16. If the card deck is to be bootstrapped in from the 528, proceed as follows:

1. From the supervisory control panel, insert in the A register the CARD READ instruction xxx0 44 aaaa where xxx equals 1000 less the number of cards to be read, 44 is the CARD READ operation code, and aaaa is the first of the consecutively addressed locations where card information is to be stored.
2. Insert in the first six digit positions of the C register 44 aaaa (the operation code and address of the instruction in the A register). In the control counter, insert the address of the location to which the computer will transfer control after the card deck is read in.
3. Examine the contents of the A and C registers. If the contents are correct, depress the start button on the supervisory control panel, causing the CARD READ instruction in the C register to be executed.





# THE MAGNETIC-TAPE SYSTEM

## 9-1. GENERAL

9-2. Magnetic tape is used as auxiliary storage for the Burroughs 205 Data-Processing System. Both data and instructions can be stored on magnetic tape so as to be available to the computer when needed.

9-3. Two types of magnetic-tape units may be used with the Burroughs 205 system: a conventional reel-type Tape Storage Unit or the multiple-tape, bin-type DATAFILE® (figures 9-1 and 9-2). The DATAFILE is a large-capacity storage device containing 50 tapes, each tape falling freely in its own static-free bin. The DATAFILE has a total capacity of 100,000 20-word blocks. Each reel-type unit has a capacity of 20,000 20-word blocks. Up to ten Tape Storage Units or DATAFILE's—or any combination totalling ten—may be used with a single Burroughs 205 Data-Processing System.

9-4. The third element of the magnetic-tape system is the Magnetic-Tape Control Unit, which controls both the Tape Storage Units and the DATAFILE's. The Magnetic-Tape Control Unit is itself controlled by instructions from the computer.

## 9-5. MAGNETIC-TAPE CONTROL UNIT

### 9-6. PHYSICAL DESCRIPTION

9-7. The control panel of the Magnetic-Tape Control Unit is made up of five subpanels plus a group of operating controls (figure 9-3). From left to right, the subpanels may be thought of as the read and designate subpanels, the T register, and the control and write subpanels, since the indicators and controls that the operator uses during read operation are on the first subpanel, those that he uses for manual designation of units and lanes are on the second, and so forth. Note that the BC indicator on the write subpanel functions during search and read, as well as during write. The parity-error (D) indicator, which functions only during read, also is on this subpanel.

9-8. With the exception of the parity-bit indicator (IP5), the subpanel indicators described in paragraphs 9-10 through 9-37 may be turned on by depressing the set buttons to the right of the indicators. (There is a button for each indicator.) The indicators may also be turned off manually (paragraphs 9-40 and 9-41).

9-9. Only those controls and indicators that the operator uses are described in the following paragraphs. The state of the indicators is significant only during magnetic-tape operation.

### 9-10. READ SUBPANEL

9-11. The read subpanel is the first subpanel from the left.

9-12. Y INDICATORS. The Y indicators from top to bottom are: Y5, Y8, Y4, Y2, and Y1. Y5 is on when a parity bit is being read and Y8, Y4, Y2, and Y1 are on as required to display the decimal value of a digit being read from magnetic tape.

#### NOTE

If an odd decimal digit is displayed in Y8, Y4, Y2, and Y1, then Y5 should be on. If an even digit is displayed, Y5 should be off. If Y5 is off when it should be on, or on when it should be off, the D indicator on the fifth (write) subpanel will be on to indicate a parity error.

9-13. MX6 INDICATOR. The MX6 indicator flickers when block markers are read from channel 6. If it is flickering, this is an indication to the operator that the block markers exist.

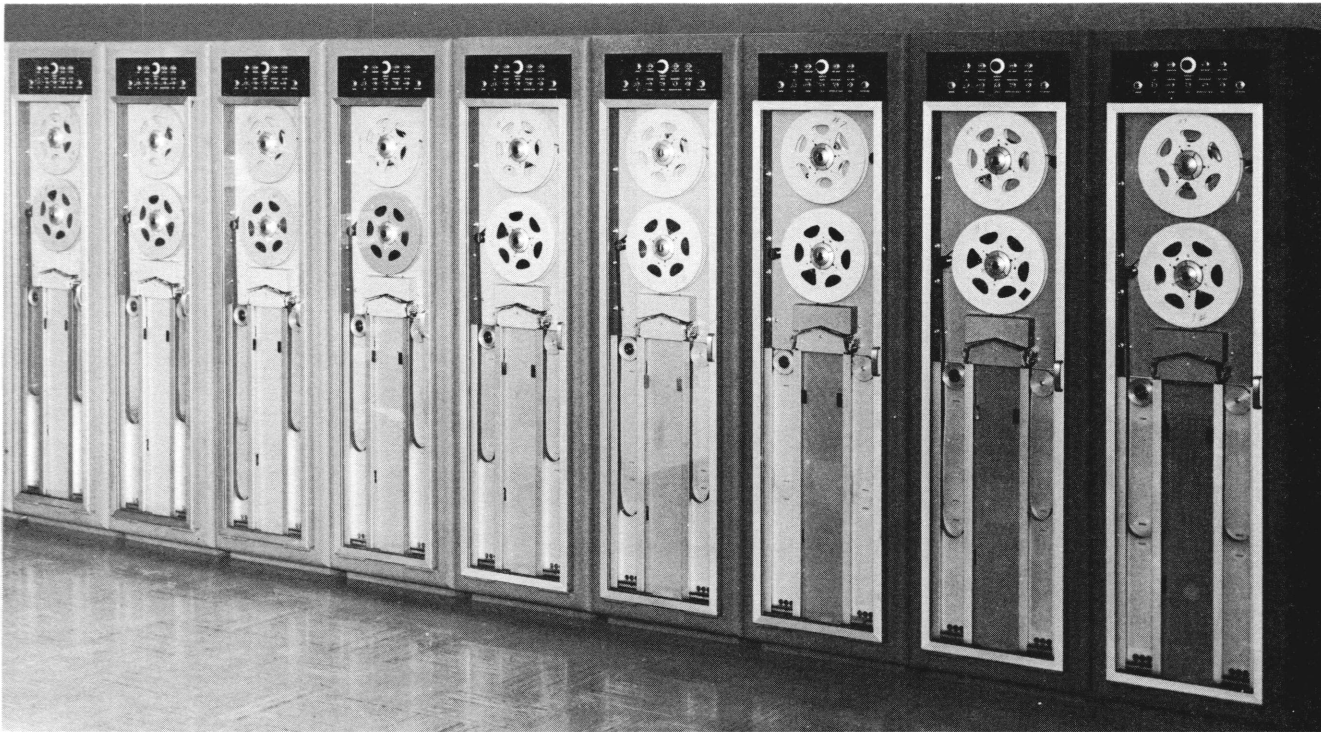
9-14. MCL INDICATOR. The MCL indicator flickers when information is being read from the information channels. This is an indication to the operator that information is being read.

### 9-15. DESIGNATE SUBPANEL

9-16. The designate subpanel is the second subpanel from the left.

9-17. BZ INDICATORS. These indicators comprise the first decade on the left, plus the upper three indicators of the middle decade of the second subpanel. The BZ indicators display the specified lane number of a designated DATAFILE during a search operation. (Each of the fifty DATAFILE tapes has two lanes; the lanes are numbered 00 through 99.) For example, if a search for lane 79 is initiated, BZ40, BZ20, BZ10, BZ8, and the E/O indicator would be turned on. The E/O indicator is located in the 1-bit position of the second BZ decade, and, in this case, functions as the BZ1 bit.

## The Magnetic-Tape System



**Figure 9-1. Reel-Type Tape Storage Units.**

9-18. E/O INDICATOR. If, during a search operation, this indicator is turned on, the odd read-write head on the Tape Storage Unit is selected. If, during a search operation, the indicator is turned off, the even read-write head on the Tape Storage Unit is selected. During a search operation on the DATAFILE, this indicator goes on during search for an odd-numbered lane.

9-19. Z INDICATORS. These four indicators show which tape unit has been selected for operation. The indicators have the values 8, 4, 2, and 1, from top to bottom. A setting of zero (all Z indicators off) indicates that unit 10 has been selected.

### 9-20. T REGISTER

9-21. This register is the third (middle) subpanel of the control panel.

9-22. MAGNETIC-TAPE SEARCH. During a magnetic-tape search operation, the T register contains the address portion of the MAGNETIC-TAPE SEARCH instruction. As tape passes the read-write head, each block address is compared with the address in the T register. When the desired block on tape is found (the one with an address that matches the contents of the T register), the contents of the T register will have been shifted and circulated one place to the right. For example:

<i>Instruction</i>	<i>Contents of T Register at Conclusion of Search Operation</i>
MTS 1234	4123
MTS 8431	1843

9-23. MAGNETIC-TAPE READ OR WRITE. At the beginning of a magnetic-tape read or write operation, the T register will contain the three most significant digits (first three control digits) of the MAGNETIC-TAPE READ or WRITE instruction in the last three digit positions: 0 nnu. (The most significant digit position of the T register is always 0.) The number of blocks to be read or written (nn) will be located in the second and third digit positions and the unit designation (u) of the Tape Storage Unit or DATAFILE in operation will be in the fourth digit position. For example:

<i>Instruction</i>	<i>Contents of T Register After a MAGNETIC-TAPE READ or WRITE Instruction Has Been Fetched</i>
0 1030 MTW 1000	0103
1 3510 MTR 2550	0351

9-24. Once the MAGNETIC-TAPE READ or WRITE instruction is executed, the second and third digit positions (nn) will be decreased by 1 as each block is read or written. Should the read or write operation stop before the desired number of blocks has been read or written, the number of blocks still to be read or written will be shown in the second and third digit positions of the T register.

### 9-25. CONTROL SUBPANEL

9-26. The control subpanel is the fourth subpanel from the left.

**NOTE**

The S, B, R, or F indicators will not go on unless the designated tape unit is ready to operate.

9-27. **S INDICATOR.** This indicator is on while a search operation is in process. The S indicator remains on until the instruction following the MAGNETIC-TAPE SEARCH instruction is fetched in the computer.

9-28. **B INDICATOR.** This indicator is on when tape is moving in a backward direction.

9-29. **R INDICATOR.** This indicator is on during a write operation and goes off at the completion of the write operation.

9-30. **F INDICATOR.** This indicator is on when tape is moving in a forward direction.

**NOTE**

If the F and B indicators are on at the same time, tape cannot be driven.

9-31. **WRITE SUBPANEL**

9-32. The write subpanel is the fifth subpanel from the left.

9-33. **BC INDICATOR.** During read, write, or search, the BC (block-check) indicator comes on when the fourth digit of the block marker has been sensed. It goes off when all eight digits of the block marker have been sensed. During read or write, if eight block marker digits have not been sensed, the BC indicator stays on, the forward (F) indicator goes off, and the computer

idles with an MTR or MTW instruction in the C register. During search, if eight block marker digits have not been sensed, the BC indicator stays on, but the computer idles only if the block marker error is in the block for which the search was initiated.

9-34. **E6 INDICATOR.** If a unit which is ready has been designated and the R (write) indicator is on, a block marker is written each time the state of the E6 indicator changes.

9-35. **IP5 INDICATOR.** If a unit which is ready has been designated and the R indicator is on, a parity bit is written each time the state of the IP5 indicator changes. This indicator cannot be set manually.

9-36. **E INDICATORS.** Each time the state of one of these indicators changes, a change of flux is recorded in the corresponding information channel on the tape. For example:

<i>Before</i>		<i>After</i>
E8 ●		E8 ●
E4 0		E4 ●
E2 0		E2 0
E1 ●		E1 0
Legend: ● on		
0 off		

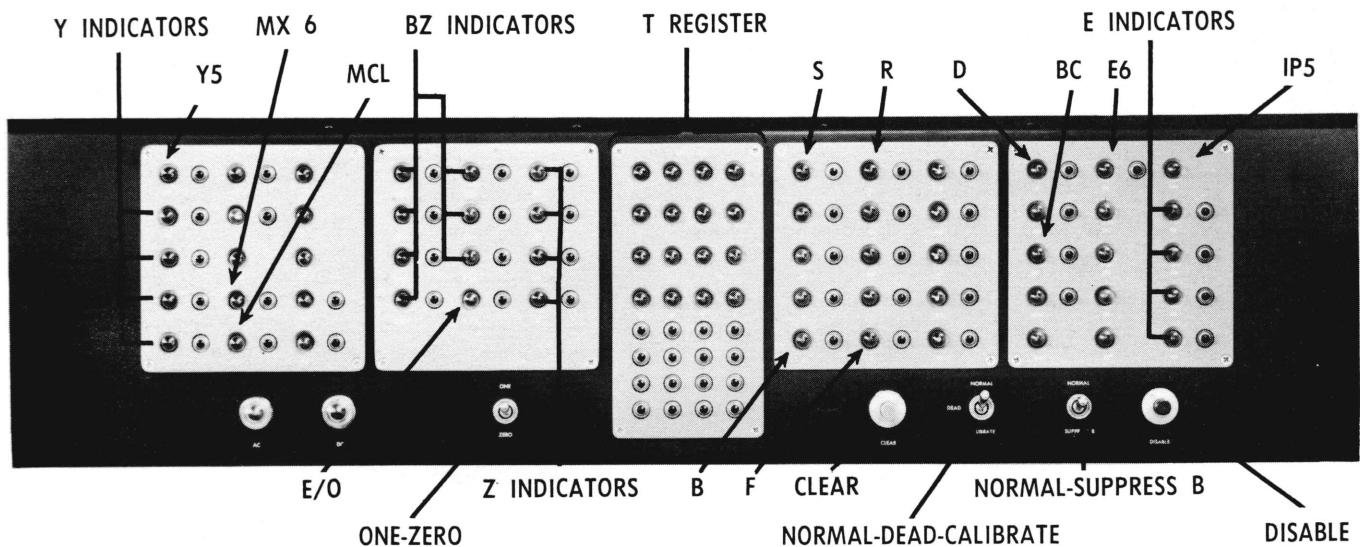
The digit five was recorded on the tape.

9-37. **D INDICATOR.** This indicator comes on whenever a parity error has been detected; that is, three



**Figure 9-2. DATAFILE's.**

## The Magnetic-Tape System



**Figure 9-3. Tape Control Unit Control Panel.**

automatic retries have been made to read a block with a parity defect and each try has failed. Such an error results in an audible alarm from the Tape Control Unit.

### 9-38. OPERATING CONTROLS

9-39. In addition to the subpanels, the control panel of the Tape Control Unit contains a group of switches that are used by the operator (paragraphs 9-40 through 9-45).

9-40. **ONE-ZERO SWITCH.** This spring-loaded switch is used to turn off a lighted indicator. To turn off an indicator, the switch is held in the ZERO position while the set button corresponding to the indicator is depressed. The ONE position is the normal position for the one-zero switch.

9-41. **CLEAR PUSH BUTTON.** Depressing the clear button turns off all indicators with the exception of the Y decade and IY6, the U counter (continues counting and thus flickers all the time), and ICO (also continues flickering).

9-42. **NORMAL-DEAD-CALIBRATE SWITCH.** When this three-position switch is in the NORMAL position, the Tape Control Unit is ready for operation under computer control. With the switch in the DEAD position, the Tape Control Unit and the associated Tape Storage Units or DATAFILE's are not under control of the computer. When the switch is in this position, the contents of the Tape Control Unit control panel are not affected by tape instructions from the computer. The DEAD position is used during the premagnetizing portion of tape calibration (section 10).

9-43. With the switch in the CALIBRATE position, the Tape Control Unit and associated Tape Storage Units and DATAFILE's are not under control of the computer. The Tape Control Unit and associated units may operate as a tape system for calibration purposes, under control of the Tape Control Unit. When this switch is turned to the CALIBRATE position, the calibration of a designated Tape Storage Unit or DATAFILE is initiated.

9-44. **NORMAL-SUPPRESS B SWITCH.** This two-position switch is set according to program requirements. If the switch is set to the NORMAL position, any word read from magnetic tape with a 2 or a 3 in the sign-digit position will be B-register address-modified before being sent to computer storage: the sign digits of such words are transferred to storage as 0's or 1's, respectively. If the switch is set to the SUPPRESS B position, a 2 or a 3 in the sign-digit position of a word is left unchanged, and the word is stored without modification. The SUPPRESS B setting is often used when reading format bands into storage from magnetic tape.

9-45. **DISABLE PUSH BUTTON.** This push button enables the operator to stop tape movement for as long as the button is depressed. The Tape Control Unit toggles or indicators will not be disturbed. This button is used most frequently to stop the tape when a search has been in progress for an address which cannot be found on the tape.

## 9-46. TAPE STORAGE UNIT

### 9-47. CONTROL PANEL

9-48. The Tape Storage Unit control panel consists of four indicator lights, a ten-position unit-designate switch, two push buttons, and five toggle switches (figure 9-4).

9-49. **DESIGNATE SWITCH.** This ten-position dial switch has settings numbered 1 through 10. It enables the operator to designate a Tape Storage Unit as any one of the ten possible units, according to the specifications of a particular program. A tape unit designation may be changed, when required. However, no two units should be given the same designation, if both units are to be used during the same operation, since in this case the designate function will not operate.

9-50. **DESIGNATED INDICATOR.** This indicator comes on when the Tape Storage Unit is selected by a magnetic-tape instruction. It is turned off at the completion of the execution of the instruction. During a rewind opera-

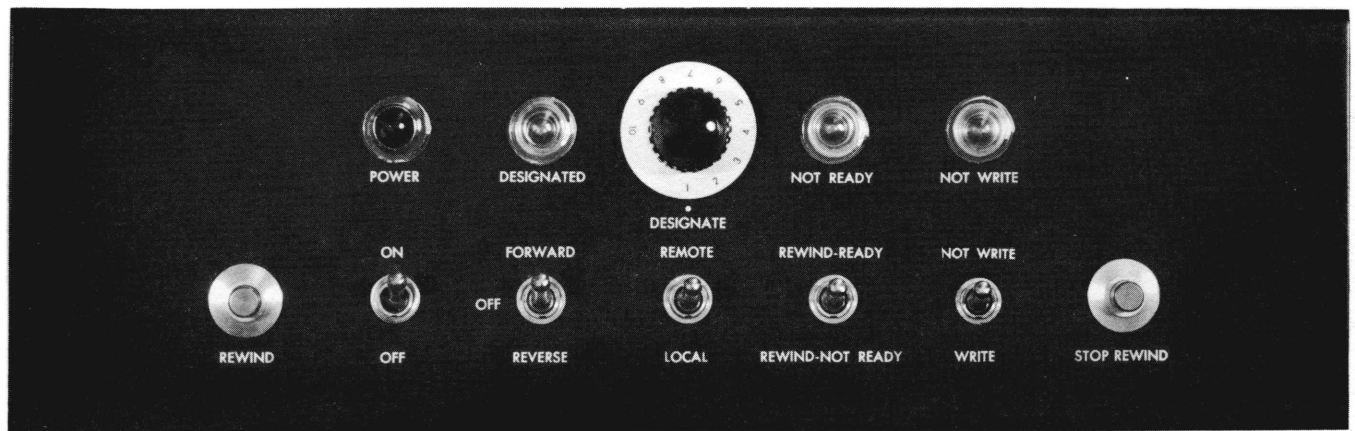


Figure 9-4. Tape Storage Unit Control Panel.

tion, the designated indicator does not stay on. (The designated indicator flashes during the execution of some instructions other than magnetic-tape instructions.)

9-51. NOT READY INDICATOR. This indicator is on whenever the unit is not ready to operate under remote (program) control. The indicator comes on under any of the following conditions:

1. The power switch is turned off on the Tape Storage Unit.
2. The plug is pulled from the electrical outlet socket.
3. A tape is broken.
4. A tape has run off the reel.
5. The vacuum system has failed.
6. The main door is not closed.
7. The unit is set for local control.
8. A rewind operation is proceeding.
9. After a rewind operation, when the rewind ready-rewind not ready switch is in the REWIND-NOT READY position.

9-52. REWIND-READY-REWIND NOT-READY SWITCH. This two-position toggle switch is used during remote operation. If the switch is set to REWIND-READY, normal tape operations can be resumed when rewinding is completed. If the switch is set to REWIND NOT-READY, the unit will not respond to computer instructions after a rewind operation. This fact gives the operator additional protection against writing over information on a good tape.

9-53. FORWARD-REVERSE SWITCH. This three-position switch controls tape movement only when the remote-local switch is set to LOCAL. With the switch in the FORWARD position, the tape moves from the bottom reel to the top reel. When the switch is in the REVERSE position, the tape moves in the opposite direction. Setting the switch to OFF stops tape movement.

9-54. REMOTE-LOCAL SWITCH. When this two-position switch is in the REMOTE position, the Tape Storage Unit operates entirely under control of the Tape Control Unit, and the forward-reverse switch is inoperative. With the remote-local switch set to LOCAL, the forward-reverse switch becomes operative. The LOCAL setting is used

during loading and unloading operations and when tape must be manually positioned, using the forward-reverse switch.

9-55. NOT WRITE-WRITE SWITCH AND INDICATOR. The two-position toggle switch controls the write operation. When the switch is in the WRITE position, the unit will write information as directed by the computer. When the switch is in the NOT WRITE position, the not-write indicator is on, and writing is inhibited on the unit. If a MAGNETIC-TAPE WRITE instruction is transmitted to a unit when the not-write indicator on the unit is on, the computer will stop with the instruction in the C register, and the first word to be written in the D register; tape will not move.

9-56. REWIND PUSH BUTTONS. The rewind and stop-rewind buttons enable the operator to initiate or stop a tape-rewind operation, regardless of the remote-local switch setting. A rewind operation may be stopped by depressing the stop-rewind push button, even if the rewind was initiated under program control.

9-57. POWER INDICATOR AND CONTROL. This indicator comes on when the Tape Storage Unit power is on. Tape Storage Unit power is turned on by placing the off-on toggle switch beneath the power indicator in the ON position.

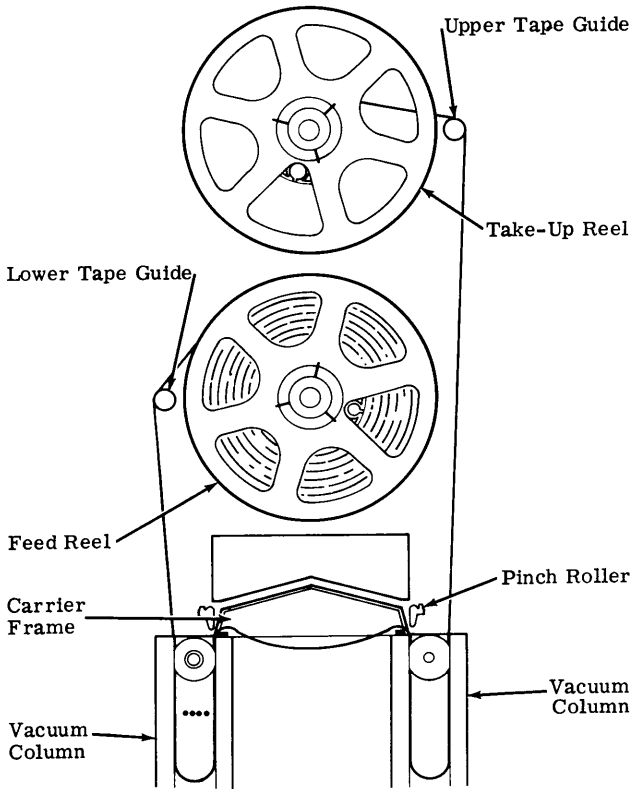
9-58. UNLOADING PROCEDURES

9-59. To unload the Tape Storage Unit, proceed as follows:

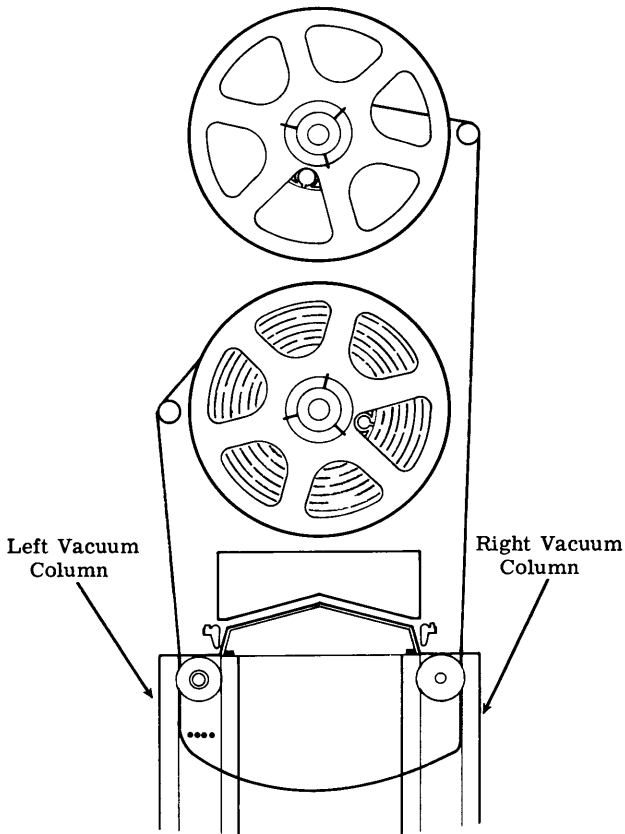
1. Set remote-local switch to LOCAL.
2. If rewind has not been performed under program control, depress the rewind button on the Tape Storage Unit to be unloaded. The rewind operation will stop when the physical beginning of tape (perforated tape) has passed over a slot in the upper tape guide (tape-sensing manifold).
3. When rewind is completed, turn the power switch on the unit to OFF. Allow the vacuum to dissipate in the unit.
4. Open the main door and the vacuum-column doors.

# The Magnetic-Tape System

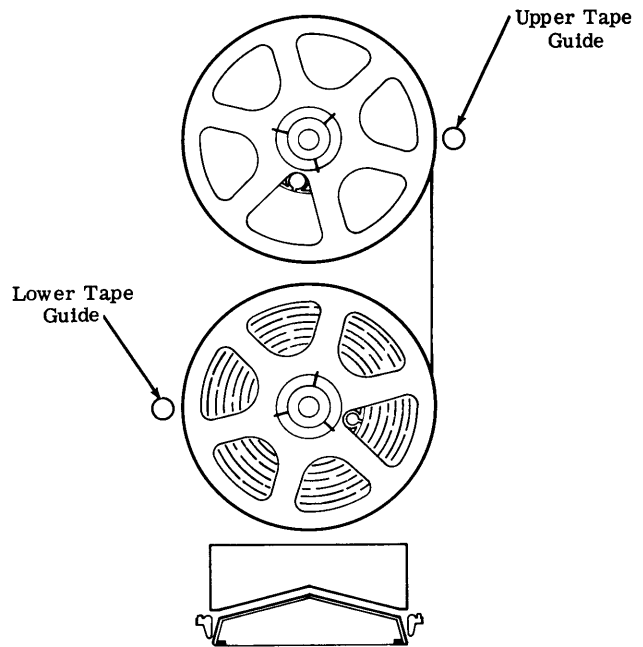
5. Withdraw the tape from the pinch roller and carrier frame, then wind the slack tape onto the feed reel.



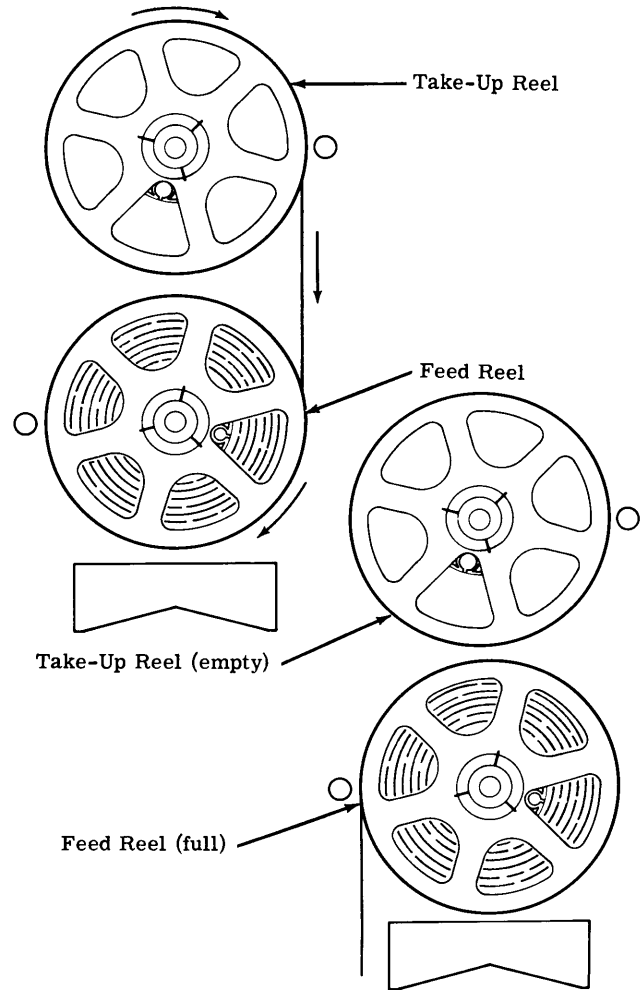
6. Withdraw the tape from the vacuum columns; wind slack tape onto the feed reel.



7. Withdraw tape from upper and lower tape guides.

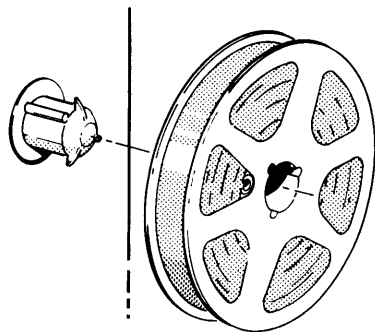
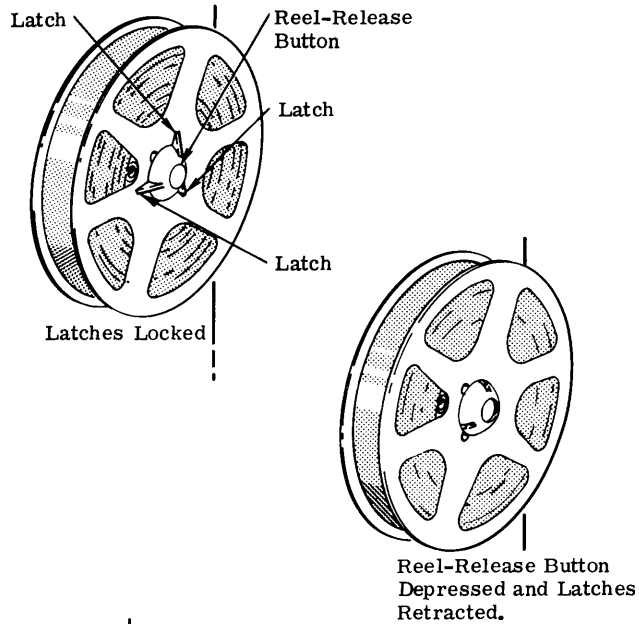


8. Wind all of the remaining tape from the take-up reel onto the feed reel. Do not let tape brush floor.



## The Magnetic-Tape System

- Depress the reel-release button in the center of the hub for the feed reel and remove the full reel; the latches holding the reel are automatically unlocked when the reel-release button is depressed.

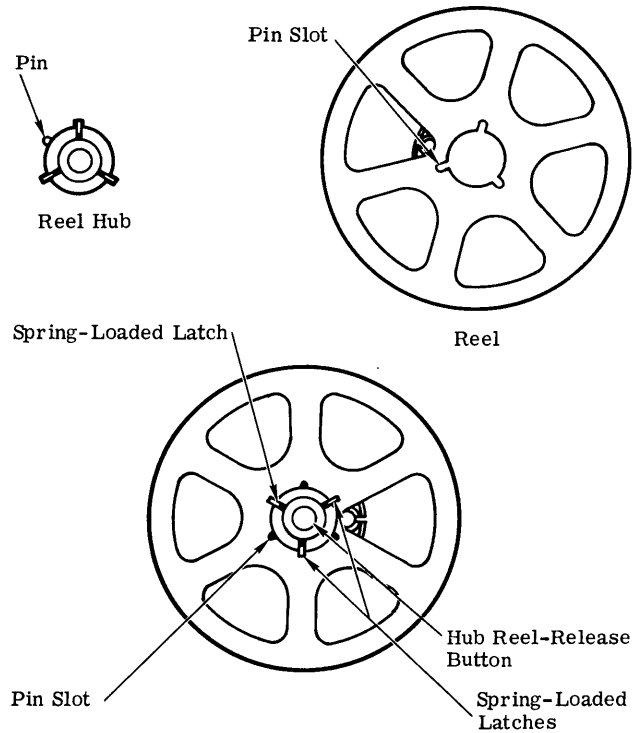


Reel Removed, Reel-Release Button Allowed to Return to Normal, Latches Locked.

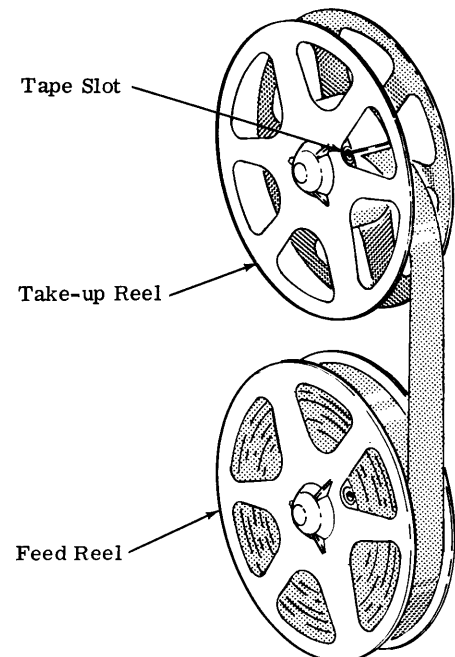
### 9-60. LOADING PROCEDURES

To load the Tape Storage Unit, proceed as follows:

- Check to see that the forward-reverse switch is turned to OFF, the remote-local switch is turned to LOCAL, and the power switch is turned to OFF. If the power switch is on, turn it off, and allow the vacuum in the Tape Storage Unit to dissipate.
- Open the main door. Place the take-up reel on the upper tape-reel hub by depressing the reel-release button in the center of the hub and slipping the reel over the hub. The hub is fitted with a pin that slides into a slot in the reel to prevent the reel from slipping. When the reel-release button is allowed to return to the normal position, three spring-loaded latches lock the reel to the hub. The full reel is placed on the lower tape hub in the same manner.

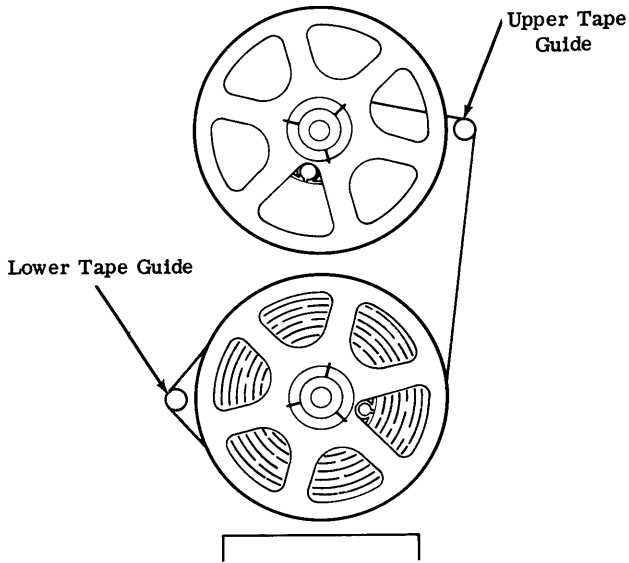


- Open the vacuum-column doors.
- Unroll lower feed reel; the tape feeds counterclockwise off the top with the shiny (non-oxide) side up.
- Feed the free end of the tape into the slot in the center of the take-up reel. (If the newer reels with no slots are being used, simply wind the free end of the tape around the center of the take-up reel.) Turn the take-up reel until all of physical end-of-tape (perforated tape) plus four or five feet of usable tape have been wound onto the take-up reel.

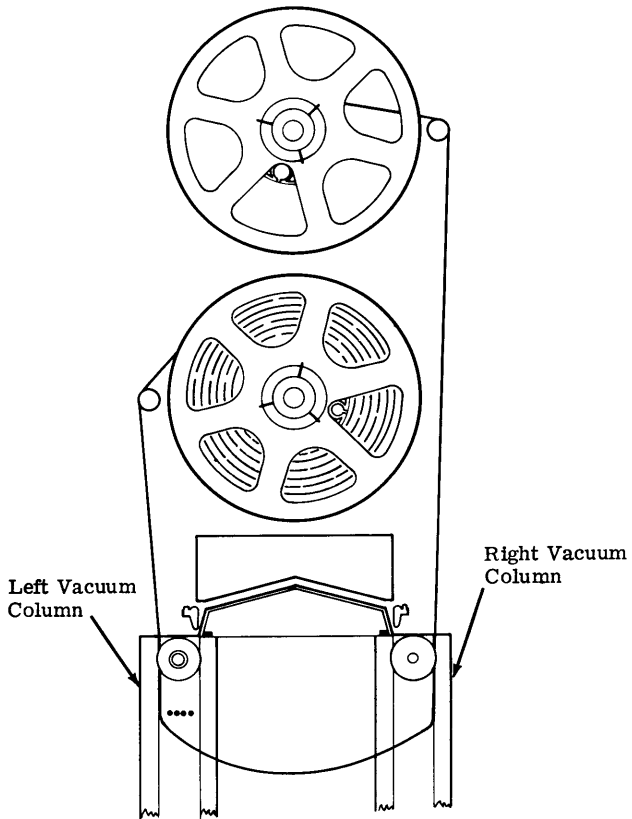


## The Magnetic-Tape System

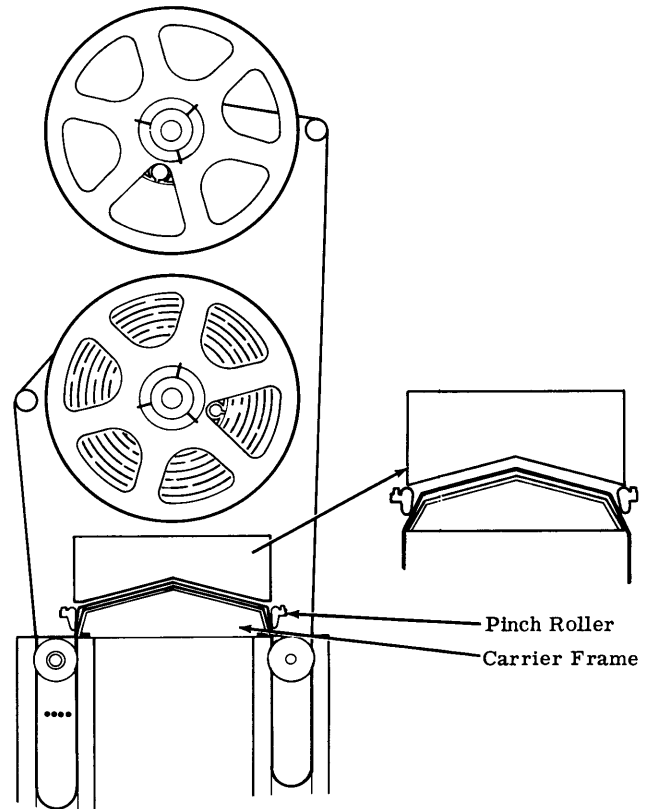
6. Unwind the feed and take-up reels, so that the tape may be looped over the lower and upper tape guides.



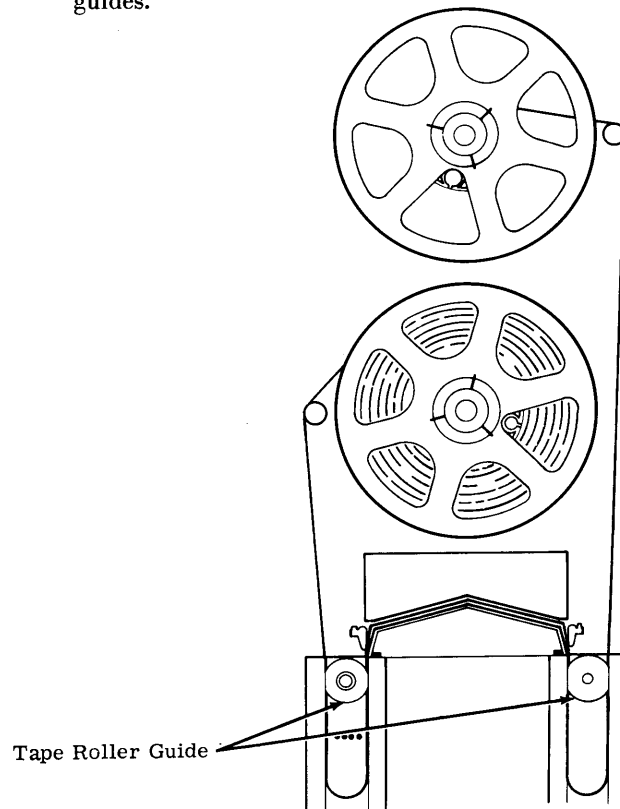
7. Unwind the tape on the take-up reel until enough tape is free to hang in a large loop in front of both vacuum columns.



8. Feed the loop of tape between the pinch rollers and over the carrier frame.

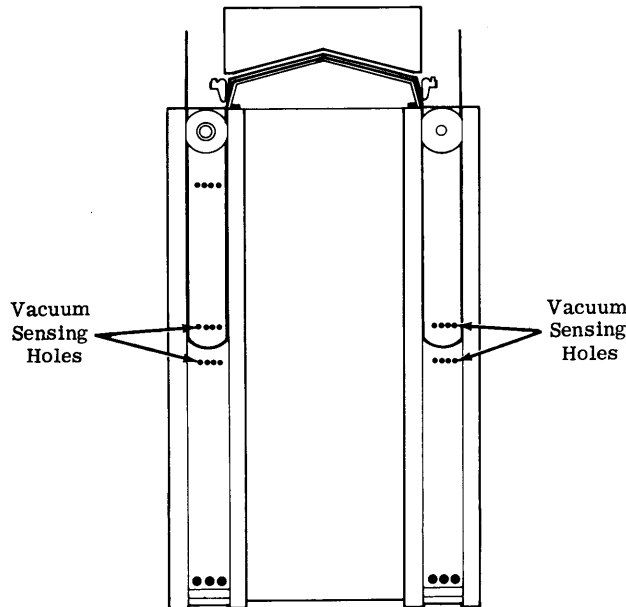


9. Insert a loop of tape into the right and left vacuum columns so that the loop hangs below the tape roller guides.





10. Adjust the tape in the vacuum columns so that the bottom of the loop in each column is positioned between the sets of vacuum-sensing holes. The vacuum-sensing holes are located about midway between the top and bottom of each column, and appear as four small holes in the back plate of the vacuum column.



11. Make sure that all of the perforated tape (indicating physical beginning of tape) is wound onto the take-up reel.
12. Close the vacuum-column doors and the main door. Make sure that these doors are closed securely.
13. Turn the power switch on. Allow the vacuum in the Tape Storage Unit to build up before activating tape. Tape reels will automatically take up unnecessary tape slack and make minor adjustments to position the tape in the vacuum columns.
14. Turn the forward-reverse switch to FORWARD. Allow the tape to wind in the forward direction for several seconds. Then, turn the forward-reverse switch to REVERSE. Allow the tape to travel in the reverse direction for several seconds. Perform this forward-reverse operation several times to verify that tape is moving properly and is correctly positioned in the vacuum columns.

### NOTE

When turning the forward-reverse switch from FORWARD to REVERSE, and vice versa, allow the switch to halt momentarily at the OFF position.

When this step has been completed, turn the switch to the OFF position.

15. Check that the unit-designate dial switch on the Tape Control Unit is set to the desired unit designa-

tion and that no two Tape Storage Units are designated the same (paragraph 9-49).

16. Check to see that the rewind ready-rewind not ready switch is set as required (paragraph 9-52).
17. Check to see that the not-ready indicator is off.
18. Check to see that the not write-write switch is set as required (paragraph 9-55).
19. Set the remote-local switch to REMOTE.

The Tape Storage Unit is now ready to accept magnetic-tape instructions from the computer.

## 9-61. DATAFILE

### 9-62. DESIGNATED INDICATOR

9-63. This indicator (figure 9-5) is located just above the control panel. It comes on when the DATAFILE is selected by a magnetic-tape instruction and is turned off at the completion of the execution of the instruction.

### 9-64. NOT-READY INDICATOR

9-65. This indicator is directly above the control panel, next to the DESIGNATED indicator. It comes on to indicate that the unit is not ready to operate under remote (program) control. It will be on under any of the following conditions:

1. The power switch is set to OFF.
2. A rewind operation is in progress.
3. A tape is at either physical beginning of tape.
4. The vacuum system has failed.
5. The remote-local switch is set to LOCAL.
6. The plug is pulled from the electrical outlet.

### 9-66. NOT-WRITE INDICATOR

9-67. Refer to paragraph 9-75.

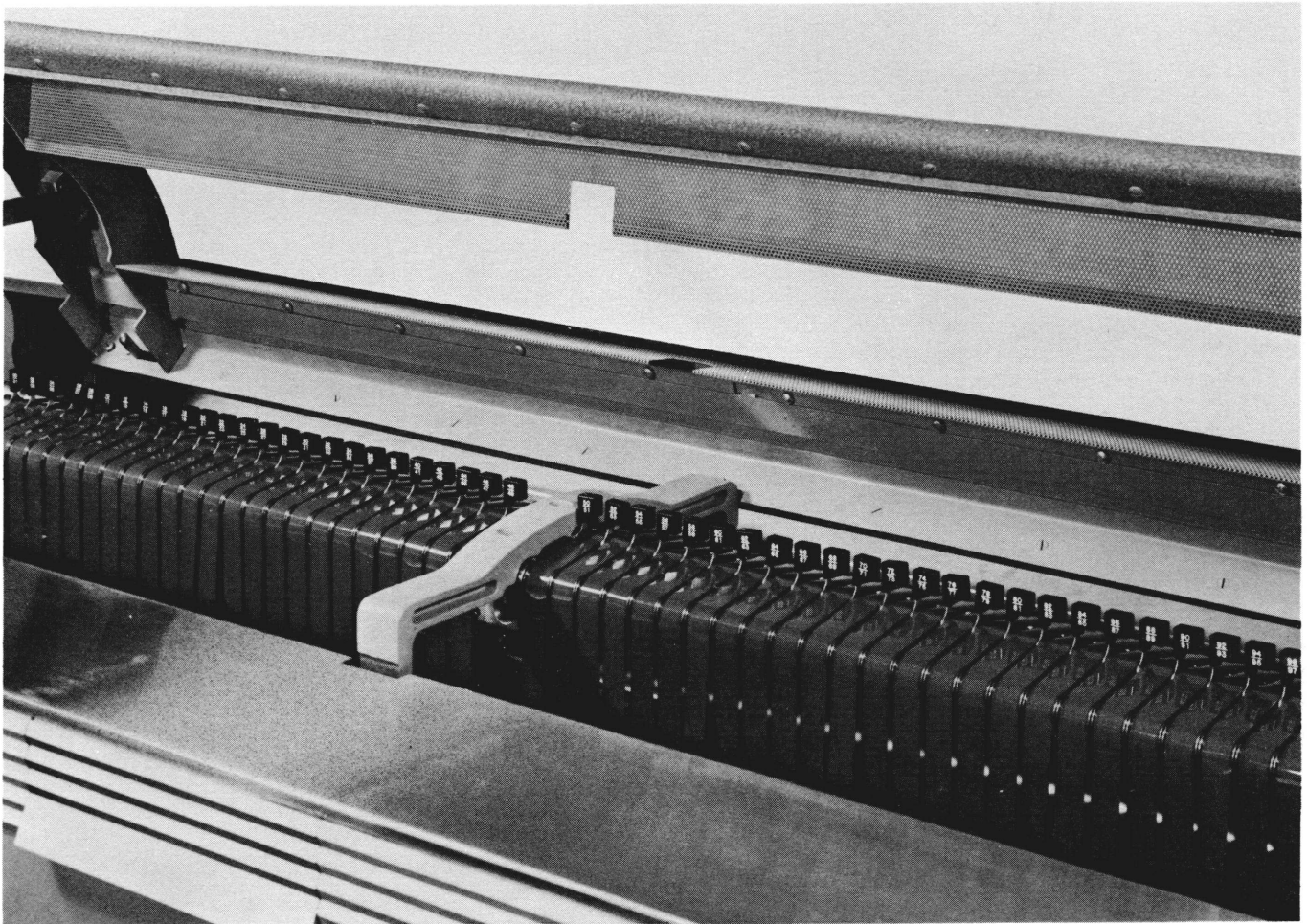
### 9-68. CONTROL PANEL

9-69. The control panel (figure 9-6) is located under the cover on the top at the right end of the DATAFILE (paragraphs 9-70 through 9-82).

9-70. VACUUM INDICATOR. This indicator comes on when the power switch has been turned on and enough vacuum has built up to enable the DATAFILE to operate.

9-71. REWIND-STOP PUSH BUTTON. This button enables the operator to stop a rewind operation. When the rewind-stop button is depressed, the rewind operation will stop and the read-write head will move to the lane specified by the setting of the lane-designate switches (tens- and units-select switches, paragraphs 9-79 and 9-80).

9-72. REWIND-START PUSH BUTTON. This button enables the operator to initiate a tape-rewind operation, regardless of the remote-local switch setting. When the rewind-start button is depressed, the carriage assembly (containing the read-write heads) is positioned under the tape containing lanes 00 and 01. This tape will be rewound to physical beginning of tape (the end-of-tape holes farthest from the operator). Once physical beginning of this tape is reached, the carriage assembly is



**Figure 9-7. File-Protect Tabs.**

hibited and the not-write indicator just above the control panel comes on. The not-write indicator will also come on if the file-protect tab above the tape on which the read-write head is positioned has been set to prevent writing (figure 9-7). If a MAGNETIC-TAPE WRITE instruction is transmitted to a unit which has the not-write indicator on, the computer will stop with the instruction in the C register; the tape will not move.

9-76. REMOTE-LOCAL SWITCH. If this two-position switch is in the REMOTE position, DATAFILE operation is entirely under the control of the Tape Control Unit: the forward-reverse switch, the tens- and units-select switches, and the bin-select push button are inoperative.

9-77. If this switch is in the LOCAL position, the forward-reverse switch, the tens- and units-select switches, and the bin-select push button control the movement of the tape, selection of the heads, and positioning of the read-write heads.

9-78. FORWARD-REVERSE SWITCH. This three-position switch (OFF, FORWARD, REVERSE) can be used only when the remote-local switch is set to LOCAL. If this switch is in the FORWARD position, the tape will be moved forward (away from the operator). If

this switch is in the REVERSE position, tape will be moved backward (toward the operator).

9-79. TENS-SELECT SWITCH. This ten-position dial switch has settings numbered, in increments of ten, from 0 through 90. Its purpose is to allow the operator to designate the first digit of the number of the lane to be selected.

9-80. UNITS-SELECT SWITCH. This ten-position dial switch has settings numbered from 0 through 9. It allows the operator to designate the second digit of the number of the lane to be selected.

9-81. BIN-SELECT PUSH BUTTON. When this push button is depressed, the read-write heads will be positioned under the tape containing the lane specified by the tens- and units-select switches; the remote-local switch must be in the LOCAL position during this operation. To position the read-write heads under the tape containing lane 53, for example, the operator would set the tens switch to 50, the units switch to 3, and depress the bin-select push button.

9-82. If a specific tape is to be moved in a forward or backward direction, the read-write head must be positioned under that tape before the forward-reverse switch is turned to the desired position.

## The Magnetic-Tape System

### 9-83. FILE-PROTECT TABS.

9-84. These tabs are two-position levers located on the top guide rod, one over each tape position or tape bin (figure 9-7). When a file-protect tab is in the vertical position, information may be written on the corresponding tape, as directed by the computer. When a file-protect tab is pushed back, writing on the corresponding tape will be inhibited. Should an attempt be made to write on a tape for which the file-protect tab is in the not-write position, the computer will stop with the MAGNETIC-TAPE WRITE instruction in the C register; tape will not be moved. When the head is positioned at a tape where the file-protect tab is in the not-write position, the not-write indicator will be on, even if the write-not write switch is in the WRITE position.

### 9-85. DESIGNATE SWITCH

9-86. This ten-position dial switch is on the left end of the DATAFILE, behind the end panel. (The end panel is hinged and can be opened by means of a finger hole on the right side.) The designate switch has 10 settings, numbered 0 through 9. It enables the operator to designate a DATAFILE as being any one of 10 units, according to the specification of a particular program. No two units should be given the same designation, if both units are to be used during the same system run, since neither unit will operate properly.

### 9-87. DRIVE-ROLLER RETRACTING HANDLES

9-88. These handles are located under covers on the front and on the back of the DATAFILE (figure 9-5). When the front drive-roller retracting handle is turned to the left, the front vacuum manifold and drive-roller

assembly are moved away from the tape (figure 9-8). When the same handle is turned back to the right—the original position—the front vacuum manifold and drive-roller assembly are positioned against the tape and locked in that position (figure 9-8). The rear drive-roller retracting handle is used in the same way to position the rear vacuum manifold and drive-roller assembly.

### CAUTION

Ensure that the tapes are hanging freely and that none of the tapes is at either physical beginning of tape before returning a drive-roller retracting handle to the original position to lock the vacuum manifold and drive-roller assembly against the tape. If the tapes are not hanging freely, they may be torn at this time; if they are at the beginning of tape, the unit will not be ready and there will be no vacuum.

### 9-89. PREPARING FOR REMOTE OPERATION

9-90. To prepare the DATAFILE for remote operation, proceed as follows:

1. Turn the power switch on.
2. Verify that the vacuum indicator is ON.
3. Set the not write-write switch as required.
4. Set the forward-reverse switch to OFF.
5. Check to see that the designate switch is set to the desired unit designation.
6. Depress the clear button on the Tape Control Unit.
7. Set the remote-local switch to REMOTE.

The DATAFILE is now ready to accept magnetic-tape instructions from the computer.

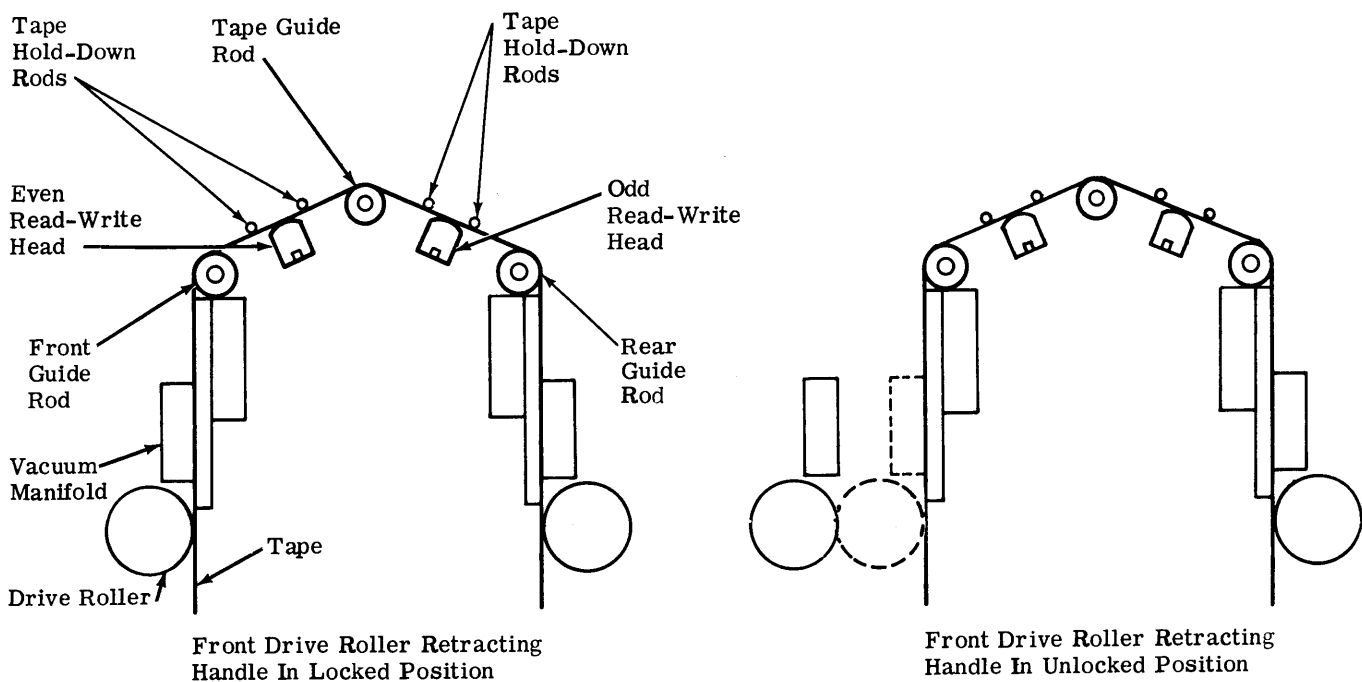


Figure 9-8. Vacuum Manifold and Drive-Roller Assembly



## MAGNETIC-TAPE CALIBRATION

### 10-1. GENERAL

10-2. Calibration is the process of inspecting magnetic tape for flaws and writing an address at the beginning of each flaw-free area of tape that is long enough to accommodate a 20-word block of information.

10-3. The even read-write head inspects and addresses the even tape lane and the odd read-write head inspects and addresses the odd tape lane. Each lane must be inspected and addressed separately.

10-4. Magnetic tape is magnetized with a constant flux pattern, to prepare it for calibration. This operation is known as premagnetization. During calibration, any change in the pattern that was written during premagnetization is detected as a flaw.

#### NOTE

Tapes should be degaussed prior to performing the premagnetization process. This will cause information on both lanes of a tape to be destroyed, and will place the magnetized bits in random order on the tape. All controls and indicators used during calibration are on the units of the magnetic-tape system. The computer should be in a halt condition when Tape Control Unit controls are to be manipulated during premagnetization and calibration.

### 10-5. TAPE STORAGE UNIT

#### 10-6. EVEN LANE

10-7. PREMAGNETIZATION. Either lane may be premagnetized first. The even lane was chosen arbitrarily in the procedure that follows. To prepare the Tape Storage Unit:

1. Turn the power switch on.
2. Set the remote-local switch to REMOTE.
3. Depress the rewind button. (Tape will rewind.)
4. Set the rewind-ready-rewind-not-ready switch to REWIND-READY.
5. Set the write-not write switch to WRITE.

10-8. To prepare the Tape Control Unit:

1. Set the normal-dead-calibrate switch to DEAD (paragraph 9-42).
2. Depress the clear button.
3. Designate the Tape Storage Unit in the Z indicators (paragraph 9-19).

4. Check the designated Tape Storage Unit to see if the even (right-hand) read-write head was selected. (The selected head is closer to the tape.) If the even head was not selected, turn the S indicator on to select the even head. Turn the S indicator off.
5. Turn the R (write) indicator on.
6. Turn the F (forward) indicator on. Tape will start moving in the forward direction and the even lane will be premagnetized. Tape stops when the end-of-tape holes are reached.

10-9. CALIBRATION. To calibrate the even lane:

1. Depress the clear button on the Tape Control Unit.
2. Designate the Tape Storage Unit in the Z indicators (paragraph 9-19) and turn the B (backward) indicator on, causing the tape to be driven backwards. Depress the clear button almost immediately (after the tape has been driven backward for 2 or 3 feet).
3. Insert the number of blocks to be calibrated plus 5 into the T register on the Tape Control Unit (10,005 if 10,000-block calibration is required). The first two digits of 10,005 appear in the first decade of the T register.
4. Again designate the Tape Storage Unit in the Z indicators.
5. Set the normal-dead-calibrate switch to CALIBRATE.

10-10. Setting this switch starts tape moving in the backward direction. Each time a flaw-free length of tape long enough to contain 20 computer words is read, the direction of the tape is reversed. It is driven forward long enough to write a block address, then the direction is reversed again. After block addresses 10005 through 0000 (for 10,000 block calibration) are written, tape is re-wound to the right-hand end-of-tape holes and the T register is counted down to 15999. (After any specified number of block addresses is written in the calibration process, the T register contains 15999.)

#### CAUTION

If there is not enough flaw-free tape to accommodate the number of block addresses entered in the T register at the beginning of calibration, tape will oscillate on and off the right-hand end-of-tape holes, while block addresses are written on top of each other. This action will stop when the T register reaches 15999. Generally, the operator will wish to calibrate a new

## Magnetic-Tape Calibration

tape in these circumstances. However, he can estimate the number of blocks that have not been written, by observing the contents of the T register when oscillation begins.

The heads should always be cleaned after calibration (paragraph 11-24).

### 10-11. ODD LANE

10-12. PREMAGNETIZATION. Follow steps 1 through 3 of the procedure used to premagnetize the even lane (paragraph 10-8), then proceed as follows:

1. Turn the E/O (even-odd) indicator on the Tape Control Unit on.
2. Turn the S indicator on.
3. Turn off the S indicator and the E/O indicator.
4. Turn the R and F indicators on.

### 10-13. CALIBRATION. To calibrate the odd lane:

1. Depress the clear button on the Tape Control Unit.
2. To match the first block address of the odd lane with the first block address of the even lane perform steps 3 through 18. Otherwise, perform steps 1 through 5 of paragraph 10-9.
3. Designate the unit in the Z indicators (paragraph 9-19).
4. Turn the S indicator on to select the even head.
5. Turn the B (backward) indicator on and allow the tape to be driven backwards, until the area of tape that is calibrated passes under the head. (Calibrated tape is indicated by the flickering of the MX6 and MCL indicators.)
6. Depress the clear button. This stops tape movement.
7. Set the normal-dead-calibrate switch to NORMAL.
8. Insert the actual number of blocks that were laid down during calibration in the even lane in the T register.
9. Designate the Tape Storage Unit in the Z indicators.
10. Turn the S indicator on.
11. Turn the F (forward) indicator on. This causes the tape system to search for the first block address written in the even lane. When the block address is found, tape stops with the number of the address sought shifted right and circulated one place in the T register (paragraph 9-22). The first block address of the odd lane has now been matched to the first block address of the even lane.
12. Set the normal-dead-calibrate switch to DEAD.
13. Depress the clear button.
14. Re-select the odd head by designating the Tape Storage Unit in the Z indicators and turning the E/O (even-odd) and S indicators on.
15. Depress the clear button.
16. Insert in the T register the actual number of blocks that were laid down during calibration of the even lane.

17. Designate the Tape Storage Unit in the Z indicators.
18. Set the normal-dead-calibrate switch to CALIBRATE to initiate calibration of the odd lane. After all block addresses are written, tape is rewound to the right-hand end-of-tape holes and the T register is counted down to 15999.

## 10-14. DATAFILE

### 10-15. ALL ODD LANES

10-16. PREMAGNETIZATION. All odd-numbered (or all even-numbered) lanes are premagnetized first to avoid rewinding each tape before magnetizing the next lane. To prepare the DATAFILE:

1. Check to see that power is on.
2. Set the remote-local switch to LOCAL.
3. Set the tens and units switches to 01.
4. Depress the rewind-start button. All 50 tapes will be rewound to the end-of-tape holes farthest from the operator, and the carriage assembly will be under the tape containing lanes 00 and 01 when rewinding is completed. The odd head will be selected.
5. Set the write-not write switch to WRITE.
6. Check to see that the S indicator on the Tape Control Unit is off and set the remote-local switch to REMOTE.
7. Check to see that all file-protect tabs are in the normal (vertical) position. See figure 9-7.

### 10-17. To prepare the Tape Control Unit:

1. Set the normal-dead-calibrate switch to DEAD.
2. Depress the clear button.
3. Designate the DATAFILE unit in the Z indicators (paragraph 9-19) and turn the E6 indicator on.
4. Turn the R (write) indicator on.
5. Turn the F (forward) indicator on. The tape starts moving forward and lane 01 is premagnetized. When the end-of-tape holes closest to the operator are sensed, tape is backed off the end-of-tape holes and stopped.
6. Turn the BZ2 and E/O indicators on. (In this case, the E/O indicator functions as a one-bit in the second BZ decade. Refer to paragraphs 9-17 and 9-18.)

### NOTE

After the first tape has been calibrated, the E/O indicator remains on throughout odd-lane calibration.

7. Turn the F indicator off.
8. Turn the S indicator on to cause the carriage assembly to be driven to lane 03 and latch.
9. Turn the S indicator off.
10. Turn the F indicator on again. Tape starts forward and lane 03 is premagnetized.
11. Repeat steps 6 through 10 using odd lanes numbered successively higher by changing the setting

of the BZ indicators by 2 each time to drive the carriage to the next tape. The E/O indicator must be used to ensure selection of the odd head.

10-18. CALIBRATION. With premagnetization of the 50 odd lanes complete, and the odd head selected and positioned at the end of the tape containing lanes 98 and 99, all odd lanes can be calibrated.

1. Turn the F indicator off and the E/O indicator on.
2. Insert the number of blocks to be calibrated plus 5 in the T register (1005 if 1000-block calibration is required).
3. Set the normal-dead-calibrate switch to CALIBRATE. Tape will start moving in the backward direction. Each time a flaw-free length of tape long enough for 20 computer words is found, tape is driven in the forward direction long enough to write a block address. After block addresses 1005 through 0000 are written, the T register is counted down to 15999 and tape stops. This completes the calibration of lane 99.
4. Set the normal-dead-calibrate switch to DEAD.
5. Depress the clear button.
6. Designate lane 96 in the BZ indicators (paragraph 9-17).
7. Designate the DATAFILE unit in the Z indicators.
8. Turn the S indicator on. This will cause the carriage assembly to be driven to lane 97 and latch.
9. Turn the S indicator off.
10. Repeat steps 2 and 3 to calibrate lane 97.
11. Repeat steps 4 through 10 followed by 2 and 3 to calibrate the remaining odd-numbered lanes in successively lower order.

### 10-19. ALL EVEN LANES

10-20. PREMAGNETIZATION. The procedure for premagnetizing all 50 even lanes of the DATAFILE is the same as the procedure for premagnetizing all odd lanes (paragraph 10-16), except that the units and tens switches on the DATAFILE are set to 00, and the E6 and E/O switches remain off throughout the procedure.

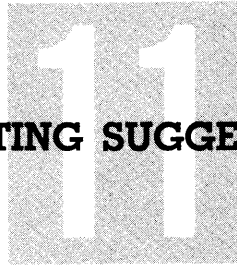
10-21. CALIBRATION. The procedure for calibrating all even lanes is the same as the procedure for calibrating all odd lanes (paragraph 10-18), except that the E/O indicator is not turned on, with the result that calibration begins with lane 98.

10-22. CALIBRATION OF ONE LANE. To calibrate a single lane of the DATAFILE, depress the Tape Control Unit clear button and prepare the DATAFILE as follows:

1. Turn the power switch on.
2. Set the remote-local switch to LOCAL.
3. Set the units and tens switches to the lane to be calibrated.
4. Depress the bin-select button. The carriage assembly will be driven to the lane selected.
5. Set the forward-off-reverse switch to REVERSE. Tape will be driven backward to the end-of-tape holes farthest from the operator. When the end-of-tape holes are sensed, tape is backed off end-of-tape and stopped.
6. Set the remote-local switch to REMOTE.
7. Set the write-not write switch to WRITE.

10-23. To prepare the Tape Control Unit:

1. Set the normal-dead-calibrate switch to DEAD.
2. Designate the unit in the Z indicators (paragraph 9-19).
3. Turn the R (write) and E6 indicators to ON.
4. Turn the F (forward) indicator on. Tape will start moving forward and the selected lane will be premagnetized. When the end-of-tape holes closest to the operator are sensed, tape is backed off the end-of-tape holes and stopped.
5. Turn the F indicator off and the E/O indicator on.
6. Insert the number of blocks to be calibrated plus 5 into the T register (1005 if 1000-block calibration is required).
7. Set the normal-dead-calibrate switch to CALIBRATE.
8. Tape starts moving in the backward direction. Each time a flaw-free length of tape long enough for 20 computer words is found, tape is driven in the forward direction long enough to write a block address. After block addresses 1005 through 0000 are written, the T register is counted down to 15999 and tape stops. This completes the calibration of the selected lane.



## OPERATING SUGGESTIONS

### 11-1. GENERAL

11-2. Preceding sections of this handbook have described standard operating procedures for the Burroughs 205 computing system. This section, however, is a collection of miscellaneous suggestions, operating procedures, and facts worth knowing that reflect the experience of programmers and operators who have used the Burroughs 205 regularly. These experienced people have discovered some operating short cuts and formed some opinions about what an operator should be expected to do—and what an operator can do—to simplify the job of running the computer. It is suggested, therefore, that the users of this handbook consider the contents of this section as an aid in devising both general operating rules for the installation and specific operating procedures to be supplied by the programmer or coder with each program submitted to an operator.

### 11-3. BEFORE AND AFTER OPERATION

11-4. The users of an installation may find it useful to compile standard procedures for computer operation, including a check list of things to do before starting to run a program. Such a check list might include the following procedures:

1. Fill out the computer log (paragraph 11-37).
2. Check all connections and clear all units of the system.
3. Set all switches to the normal positions. (It is easier to remember when to change the switch settings as required by the program, if all settings are known to start with.)
4. If the Flexowriter is to be used by the program to be run, be certain that the power switch is on. If it is not, the program will run on past the Flexowriter print-out instructions; a PTW instruction will cause the information in the A register to shift out, but no printout will occur and the computer will not stop. If the standard model (not CARDATRON-code) Flexowriter is being used, be sure the lower-case shift key has been depressed; if it has not, an instruction calling for numeric printout will instead produce the special characters that appear above the numbers on the Flexowriter keyboard.
5. Make sure that no two magnetic-tape units have been designated alike, that those to be used are properly designated, and that the Tape Storage Units are loaded with the correct reels.

6. Check that the required plugboards have been put in the card machines and that they are locked in place.
7. Remember that the controls on the supervisory control panel and those on the Control Console can affect each other. To operate from the supervisory control panel, the stop button on the Control Console must be pressed first. To operate from the Control Console, the lock-normal switch on the supervisory control panel must be set to NORMAL and the continuous-step switch must be set to STEP.
8. Check that the switches on the sub-maintenance control panel (figure 2-4) are in the normal positions (up); they may have been used during the engineer's maintenance procedures.

11-5. When leaving the computer room, the operator should:

1. Return all switches to the normal positions. Restore any abnormal patch-panel or plugboard connections to the normal configurations.
2. Depress the stop and clear buttons on the Control Console. (If this is not done, the next operator, seeing that the continuous indicator is on, may assume that the system is still in use.)
3. Before leaving, gather up all paper tapes, cards, program sheets, 407 and Flexowriter printouts, and so forth, so that they will not be lost and so that the next operator will have a clear space to work. Be sure that all cards have been run out of the card machines.
4. Complete the computer log (paragraph 11-37).

### 11-6. THE COMPUTER

#### 11-7. CHECKING MANUALLY STORED WORDS

11-8. Whenever a word is entered into the A register and sent to a location in storage by manual operation from either the Control Console or the supervisory control panel, it is always a good idea to read the word back into the A register to ensure that it was entered and stored properly. This is done by replacing the 02 (STORE CLEAR) instruction, which was inserted in the C register to store the word, with a 64 (CLEAR ADD) instruction (paragraph 2-54).

#### 11-9. STORAGE DRUM

11-10. The drum must be left running all the time, even if the computer is not to be used for two or three days.

## Operating Suggestions

### 11-11. POWER FAILURE

11-12. If there is a power failure, the field engineer should be advised immediately. The operator should also consult the field engineer about procedures to follow, if there should be a power failure when an engineer is not available. If the power failure caused the drum to stop, the engineer will need to know the exact time that power went off, because he must wait a definite period of time before the drum can be started again.

### 11-13. AIR-CONDITIONING FAILURE

11-14. Check with the field engineer about what operating temperatures he recommends. Although the computer will be shut off automatically by excessively high temperatures, the engineer will want to know if there is reason to think that a critically high temperature might be reached. If there is an air-conditioning failure and the temperature rises in the computer room to a certain point (generally about 90°F), the engineer will cycle down the computer until the operating temperature can be restored.

### 11-15. CYCLING DOWN THE COMPUTER

11-16. If it is the practice of an installation to cycle down the computer when it is not being used, this operation is generally the responsibility of the field engineer. However, if an operator is scheduled to work an off shift when an engineer is not on duty, the engineer might instruct the operator to cycle down the computer before he leaves. The cycling down (shutdown) procedure is as follows:

1. Depress the red button labeled SHUTDOWN on the Power Supply Unit; hold it down until a loud click indicates that the cycling down has begun (about 10 seconds).
2. One by one all indicator lights except the blue one labeled DRUM will go off.
3. At the completion of the cycling down, the white indicator light labeled READY above the shutdown button comes on. This indicates that the computer is ready to be restarted at any time.

11-17. If the operator comes on duty when the computer is in the shutdown state, the following procedure should be followed to restart it:

1. Turn the d-c lockout switch on the Power Supply Unit to the down position, and turn off the core-voltage switches in all of the CARDATRON input and output units.
2. Depress the black button labeled START above the shutdown button on the Power Supply Unit; hold it down until the white light labeled READY goes out.
3. One by one the other indicator lights on the Power Supply Unit will come on.
4. Wait about two minutes until the blue light labeled Power Supply turns on.
5. After the Power Supply light comes on, wait a minimum of five minutes to allow stabilization of

voltages.

6. Turn the d-c lockout switch to the up position and depress the black d-c on button; hold it down until the blue light labeled DC goes on. Clear the computer and turn the CARDATRON core-voltage switches on. The computer is now ready for use.

11-18. When the computer is shut down, everything goes off except the drum, which is never turned off, and, possibly, the CARDATRON drum blower.\* If the CARDATRON blowers do not cycle down with the rest of the system, and if the system is to be shut down for more than eight hours, the field engineer must turn the blowers off, as they may overheat and constitute a fire hazard, if they are permitted to run for a long period when the rest of the system is shut down.

## 11-19. THE MAGNETIC-TAPE SYSTEM

### 11-20. DATAFILE

11-21. If the DATAFILE is not in use, the tapes should be moved weekly. Because the tapes fall freely in the bins, instead of being wound on reels, they may become creased and thus damaged if left in the same folds for long periods of time. There are two methods for preventing the creasing of the tapes. The first method is to write a program which will provide the desired tape movement. This method eliminates a considerable amount of operator time but necessitates tying up the computer for about two hours a week.

11-22. The second method is done under local control and requires about two hours of operator time bi-weekly. If for example, the DATAFILE were to be idle for one month, all 50 tapes could be rewound in the reverse direction the first week, in the forward direction the second week, and so forth. The first week, the operation would be quite simple. The operator need only set the remote-local switch to LOCAL and depress the rewind-start push button, causing all 50 tapes to be rewound to the end-of-tape holes farthest from the operator. However, the second week, the following procedure must be followed to rewind the 50 tapes to the front end-of-tape holes:

1. Set the remote-local switch to LOCAL.
2. Set the units and tens dial switches to select lane 01 (paragraphs 9-79 and 9-80).
3. Depress the bin-select push button. This causes the read-write head assembly to be stationed beneath the tape containing the lane specified by the units and tens switch settings.
4. Push the forward-off-reverse switch to the FORWARD position. This causes the tape over the read-write head assembly to be rewound to the front end-of-tape holes.
5. Increase the units and tens dial switches setting by 02.
6. Repeat steps 3 through 5 until all fifty tapes have been rewound to the front end-of-tape holes.

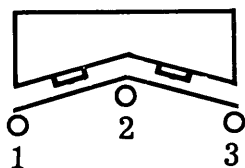
\*Field Change Notice 2302 provides a modification that causes the CARDATRON drum blowers to cycle down with the rest of the system. The change became a production change with Power Control Unit Serial No. 205.



### 11-23. TAPE STORAGE UNIT

11-24. **READ-WRITE HEADS.** The read-write heads and the tape guides on the Tape Storage Unit should be cleaned regularly. If a Tape Storage Unit is in constant use, it is suggested that the heads and tape guides be cleaned every three or four hours; the heads and tape guides should always be cleaned after calibration. The field engineer may prefer to do this himself or he may recommend that cleaning methods similar to those following be used by the operators:

1. Remove the magnetic tape from the tape guides and let it hang in a loop in front of the two vacuum columns.
2. Soak a Kimwipe with cleaner. (Audio Recording Head Cleaner is recommended, Burroughs 205 Part No. 56236).
3. Clean thoroughly the three tape guides on the tape-carrier frame:



4. Clean the right and left end-of-tape sensing manifolds.
5. Insert the tissue under the right and left read-write heads in turn, and gently pull it back and forth.

#### NOTE

Be careful not to get any cleaner on the magnetic tape. The cleaner is highly volatile, and so dries quickly. Therefore, the magnetic tape can be replaced and the program run restarted after three or four minutes.

11-25. **REELS.** All reels of magnetic tape should be labeled clearly to identify their contents. If there is no information recorded on the tape, the reel label should show whether the tape has been calibrated or not. Preferably, reels should be stored in individual slots to further reduce the possibility of an operator getting the wrong one. In addition to labeling each reel of magnetic tape and assigning it an individual storage area, a record should be kept of the history of the tape. The record of each tape might be kept in a tape log book and could contain the following:

1. The date of initial calibration.
2. The dates of subsequent uses of the tape.
3. A description of information recorded on the tape, which blocks were used, and so forth.
4. The date and nature of any trouble involving that tape.
5. The date and approximate location of any splices.

6. The date of any re-calibration.

11-26. The reels of tape should always be kept in dust-proof cases when not in use and returned immediately to storage when removed from a tape transport. The habit of setting reels on top of the Tape Storage Units has often resulted in the wrong reel being picked up later—with disastrous results to the program being run.

11-27. The screws on the reel itself should be tightened regularly; this is particularly important for a take-up reel which has been on a Tape Storage Unit for a long period of time. Occasionally these screws have fallen out while a program was being run and damage to the tape or to the equipment has occurred. Avoid touching the surface of the tape or allowing it to brush against the floor.

11-28. **SPLICING MAGNETIC TAPE.** Place the two ends of magnetic tape to be spliced in the splicing jig so that they overlap. The glossy (non-oxide) side of the tape must be up. After putting the two clamps in place to hold the tape, cut through both pieces with a razor blade along the perpendicular slot in the splicing jig. Then remove the clamps, brush away the two loose edges cut away, slide the two pieces of tape apart to leave a gap of about 1/8 inch, and replace the clamps. Use Scotch splicing tape No. 41 to tape the two pieces together; trim the excess splicing tape from each side, using the edges of the splicing jig as a guide.

#### CAUTION

Be sure that a spliced tape is recalibrated. The 1/8-inch gap left between the two edges of the spliced tape ensures that the splice will be sensed as a flawed area during calibration.

11-29. **PERFORATED BEGINNING AND END OF MAGNETIC TAPE.** If a magnetic tape should tear in such a way that the perforated beginning or end of the tape is lost, or if a large reel of magnetic tape is to be divided into two or more smaller reels, a new perforated area will be required. Most installations will stock reels of perforated tape to be used for this purpose. In this case, the operator need only take a long enough strip of this perforated tape and splice it onto the end of the tape, following the splicing procedure described in paragraph 11-28. If, however, perforated tape is not stocked or if the stock has run out, the operator may find that he must prepare a strip of perforated tape for himself. In this case, the Flexowriter can be used to perforate the tape, as follows:

1. Connect the plug labeled FROM FLEXOWRITER to the plug labeled TO PUNCH on the patch panel (paragraphs 5-33 through 5-36).
2. Turn the Flexowriter power on.
3. Insert the magnetic tape into the Flexowriter punch over an equal length of paper tape (paragraph 5-47). The paper tape must be under the magnetic tape, because the magnetic tape alone is not strong enough to suspend the paper-tape run-out arm on the punch.

## Operating Suggestions

4. Depress the lower-case typewriter key (if using the standard model Flexowriter).
5. Depress the punch-on switch.
6. Repeatedly depress the typewriter key labeled Q until four or five feet of perforated tape have been produced.
7. The tape can then be removed from the Flexowriter and spliced onto the end of a reel of magnetic tape. Follow the splicing procedure described in paragraph 11-28.

11-30. **NOT-WRITE RING.** The not-write, or file-protect, ring is a small plastic ring that can be attached to the back of the lower (feed) reel on a Tape Storage Unit. This ring causes a small push button on the Tape Storage Unit below the lower tape-reel hub to be depressed, thus inhibiting any writing on that unit. This is a double check on the write-not write switch to ensure protection of a master tape. Reading on the unit is not prohibited by use of the not-write ring.

### 11-31. PAPER-TAPE SYSTEM

#### 11-32. MANUALLY REWINDING PAPER TAPE

11-33. When rewinding paper tape after using the loop adapter (paragraph 4-19) be careful not to start rewinding with the beginning of the tape. After punching a paper tape, mark the beginning with an arrow or label it with colored pencil; this will make it simpler to load the tape properly.

#### 11-34. SPLICING PAPER TAPE

11-35. When splicing or deleting a punch from paper tape, be sure to use black splicing tape. If transparent tape is used, the Photoelectric Reader may sense light through the tape.

### 11-36. SAMPLE FORMS

#### 11-37. COMPUTER LOG

11-38. The sample computer log (figure 11-1) is used by the Burroughs Corporation Data Processing Services in Pasadena. It is designed to give a full record of the use of peripheral equipment as well as of the computer itself. By subtracting the total hours of use of each part of the system from 24, the idle time can be computed. These times are useful in scheduling production time on the system and in planning preventive maintenance.

#### 11-39. CONTROL CONSOLE STOP SHEET

11-40. The Control Console stop sheet (figure 11-2) is offered as a sample of the kind of form operators and coders may find useful. It is filled out when an unexpected stop occurs in the program being run. The operator records the contents of all registers and the settings of the pertinent switches and indicators. Such a form can be most useful to the coder in later evaluation of the program run.

#### 11-41. PRE-RUN CHECK SHEETS

11-42. The sample pre-run check sheets (figures 11-3

and 11-4) are offered as a suggested means of helping the operator to plan machine setup before entering the data-processing room. These sheets together contain a listing of all equipment that might be used in a program run, and the set-up configuration for the equipment. If the operator prepares a set of these sheets for each program, he will save time and avoid trouble.

#### 11-43. CONSOLE NOTEBOOK

11-44. **GENERAL.** An operator might prepare a console notebook with a separate section for each debugging and production run on the computer. Once assembled, a section could be used each time the run is repeated. A section of the notebook could contain the items mentioned in paragraphs 11-45 through 11-54.

11-45. **STOP LIST.** This would be prepared for the operator by the coder and would contain a sequential list of all programmed and error stops in the program, the cause of each stop, and the action to be taken following the stop for correction or to continue. For example, the address portion of all programmed STOP instructions might be coded with certain digit configurations to permit the operator to recognize the instruction in the C register. In this case, the stop list might appear as follows:

<i>STOP Instruction in the C Register</i>	<i>Message and Action to Be Taken</i>
08 8888	Program deck loaded into computer. Set B to 3900 and start.
08 9999	Card reader ready. Load deck No. 2.
08 7777	Program tape loaded. Read cards from 089.
08 2222	Check interim results. If A reg. 0 0000 47 1310, insert data p. 10 by Keyboard. If not, CU 2069.
08 9669	End of job. Load cards job No. 2 in 089.

An example of a list of error stops which might occur if internal checks within a program revealed that error conditions had arisen, is shown below:

<i>Location</i>	<i>STOP Instruction in C Register</i>	<i>Message and Action to Be Taken</i>
1000	08 1000	Punched card out of sequence. CU 2075.
3054	08 3054	Tried to take sq. rt. of neg. x. Restart at loc. 1050.
2530	08 2530	Non-existent account number. Read next card. CU to 2000.



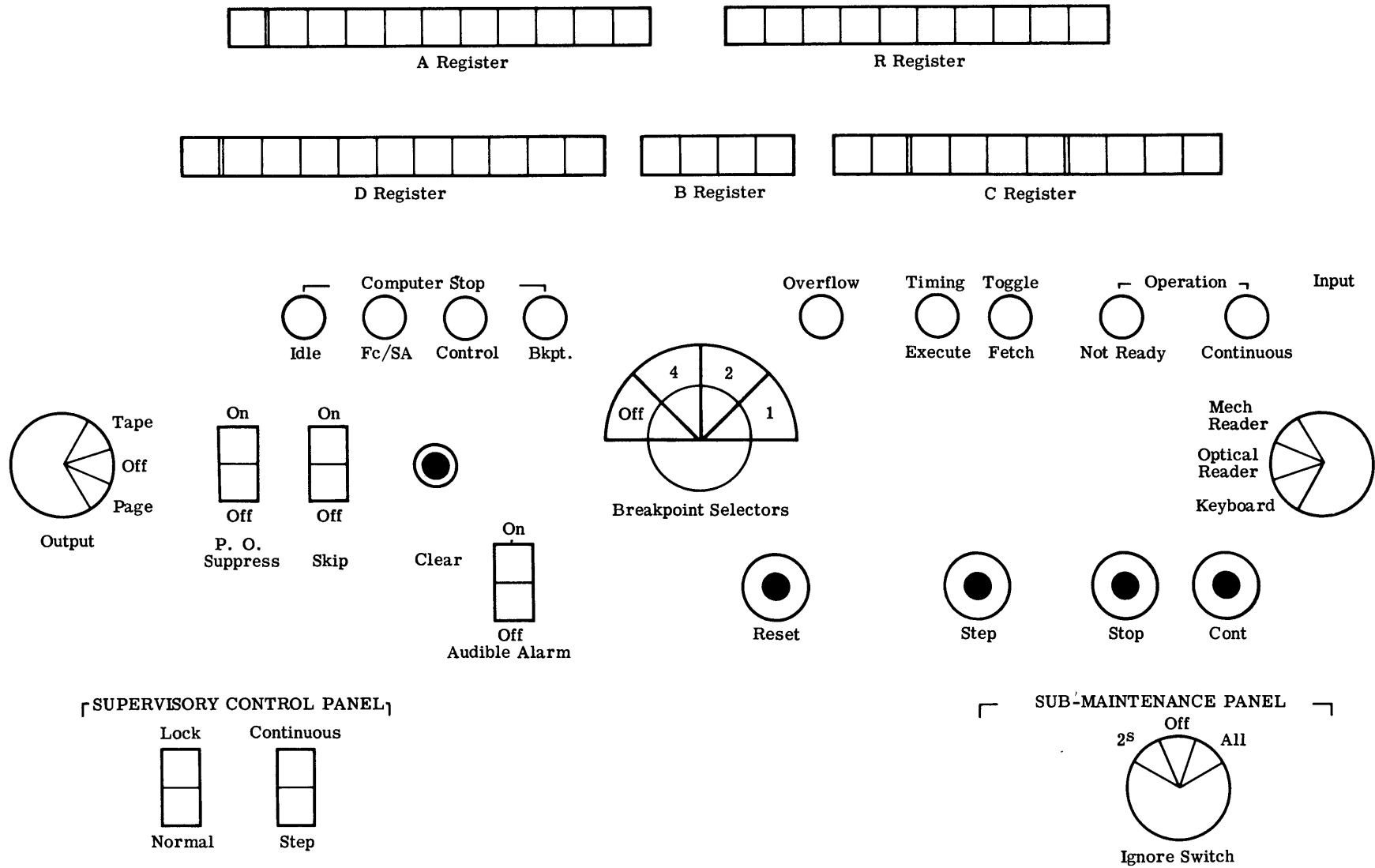


Figure 11-2. Console Stop Sheet.

CONSOLE AND SUPERVISORY CONTROL PANEL SET-UP SHEET

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

A REGISTER

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

R REGISTER

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

D REGISTER

--	--	--	--	--	--

B REGISTER

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

C REGISTER

SUPERVISORY CONTROL PANEL

A. MAIN PANEL

- 1. LOCK-NORMAL SWITCH: L  N
- 2. FETCH-EXECUTE : F  E
- 3. STEP-CONTINUOUS : S  C
- 4. EXCEPTION CONDITIONS

B. SUB-MAINTENANCE PANEL

- 1. INPUT SIGN CONTROL DIAL  
IGNORE ALL  2  OFF
- 2. ALL TOGGLE SWITCHES OFF
- 3. EXCEPTION TOGGLE CONDITIONS

CONTROL CONSOLE SWITCHES

- 1. OUTPUT SELECTOR SWITCH - TAPE  OFF  PAGE
- 2. PRINT-OUT (P/O) SUPPRESS - ON  OFF
- 3. SKIP SWITCH - ON  OFF
- 4. BREAK-POINT SWITCH - ON  1/2/4  OFF
- 5. INPUT SELECTOR DIAL - M R  OPT  K B

FLEXOWRITER

A. PATCH PANEL

FX	FT	R	C
FX	FT	P	C

B. CONTROL PANEL

- 1. RESET  5. WORDS/LINE  /
- 2. ZERO SUPPRESS  6. LINES/GROUP  /
- 3. SPACE - TAB  7. GROUPS/PAGE  /
- 4. GROUPING-CTRS.  8. AUTO STOP

C. KEYBOARD\*

- 1. U/L CASE  2. COLOR  3. TAB

INITIAL BOOTSTRAP:

- 1. INPUT SET-UP
- 2. PAPER-TAPE
- 3. \_\_\_\_\_

DATE: / /

PROGRAM:

OPERATOR:

\*Standard Model Flexowriter

Figure 11-3. Control Console and Supervisory Control Panel Set-Up Sheet.

**Operating Suggestions**

PERIPHERAL EQUIPMENT SETUP SHEET

**A. PAPER-TAPE SYSTEM**

1. INPUT

- PHOTOREADER
- LOOP ADAPTER
- REEL ADAPTER
- MECHANICAL READER

2. OUTPUT

- HIGH-SPEED PUNCH  
(CHECK PAPER TAPE, ETC.)
- FLEXOWRITER PUNCH  
(CHECK PAPER TAPE, ETC.)

**B. CARDATRON SYSTEM**

1. INPUT

UNIT	DESCRIPTION OF INPUT	PLUGBOARD

2. OUTPUT

UNIT	OUTPUT	TYPE OF CARD OR PAPER FORM	PLUGBOARD

**C. MAGNETIC-TAPE SYSTEM**

1. TAPE CONTROL UNIT  
B-SUPPRESS SWITCH

ON  OFF

NORMAL/DEAD/CALIBRATE

N  D  C

CLEAR

UNIT	D/* T	FILE DESCRIPTION	WRITE/ NOT WRITE	REWIND READY/ NOT READY	DATAFILE- PROTECT TABS

\*D = DATAFILE; T = TAPE STORAGE UNIT

DATE: / /	PROGRAM:	OPERATOR:
-----------	----------	-----------

Figure 11-4. Peripheral-Equipment Set-Up Sheet.

11-46. CONTROL CONSOLE STOP SHEETS. The operator should have a sufficient supply of these forms for recording all unexpected program stops (paragraph 11-39).

11-47. CODING FORMS. An operator may want to have the actual program sheets prepared by the coder, especially during a debugging run.

11-48. PROGRAM LISTINGS. If a listing of the program has been prepared either on the Flexowriter (from a paper-tape program) or on the 407 (from a punched-card program), the operator may want to include it in his notebook. He might use the listing to check against the coding forms for errors in transcription or in place of the coding forms for a more legible reference.

11-49. If a program is on punched cards in the one-instruction-per-card form, there are two listings that an operator may want to prepare, for his own benefit or for the benefit of the coder in checking interim results from a debugging session.

11-50. He may wish to prepare a listing of the entire program in location sequence. If remarks had been punched on the cards they would also be a part of this listing. For example:

<i>Location</i>	<i>Instruction</i>	<i>Alpha Code</i>	<i>Remarks</i>
2000	0 0000 64 1050	CAD	Gross wages.
2001	0 0000 75 1071	SUB	Less deductions.
2002	1 0000 02 3000	STC	Net pay.

11-51. A listing of the entire program in address order, called a cross-reference listing, is a valuable checking aid to the coder. With a cross-reference listing, a coder can more easily detect storage-reference errors and can more easily correct instructions which are affected by such errors. For example, suppose location xxxx is referenced

by ten instructions. A change which affects location xxxx would require that the ten instructions in question be changed. This is a simple matter when using a cross-reference listing which groups the instructions that refer to a specific location:

<i>Location of Instruction</i>	<i>Instruction</i>
2000	0000 64 1000
2010	0000 02 1000
3000	0000 24 1000
0500	0000 36 1020
2300	0000 44 1020
3002	0000 75 1020
3500	0000 60 1020

11-52. TEST CASES. The operator should be provided with several sets of test data for a debugging run. Each set of test data should include correct results to be expected by the operator for that particular test case.

11-53. PRE-RUN CHECK SHEETS. If the operator finds these forms useful, he would include them in his console notebook. Refer to paragraph 11-42.

11-54. CHECK-OUT ROUTINES. Each installation might have its own library of program check-out routines, such as selective automonitors, traces, storage dumps, and so forth. Some of these routines would be standard routines obtainable from the Burroughs Corporation. Others would have been written at the installation. An operator's console notebook might contain a list of all such routines available, which would include the particular situation in which each routine could be used and the operating instructions for its use.