

Systems Reference Library

IBM 1800 Operating Procedures

This publication is a guide for operators using the IBM 1800 System console and data processing input/output devices. It covers in detail operator duties normally encountered when using the system console or operating the data processing input/output devices. No specific programming system is assumed.

Functions of the system console keys, lights, and switches are included in this publication, as well as descriptions of the operator keys and lights, manual controls, setup procedures, and principles of operation for the data processing input/output devices. Procedures for clearing conditions that require operator intervention are given.

Preface

This publication is intended for use as a guide for operators using the data processing (DP) input/output (I/O) devices attached to the IBM 1800 System. It is for operators who have had only a minimum amount of training on stored-program computer systems. This publication covers in detail the usual duties of an operator in conjunction with the DP I/O devices and the IBM 1800 System.

The practices and techniques given are approved methods based on the preference of IBM and the practices of many experienced operators. The user must remember, however, that the employer has the prerogative of determining the operator's procedures and responsibilities.

This publication contains a section on the processor-controller and each DP I/O device. Each section is designed as a stand-alone unit containing the pertinent operator information necessary for each device. Pictorial illustrations are included for their value in clarifying procedures.

Second Edition (January 1970)

This is a major revision of and makes obsolete, GA26-5753-0 and Technical Newsletter GN26-0237. The format of this manual has been changed and the entire manual has been rewritten. No major technical changes have been made.

Manuals referred to in this publication that have a form number with a four digit prefix are identical in content to the same manual without the initial prefix character. (e.g. GA26-xxxx is the same in content as A26-xxxx.)

The illustrations in this manual have a code number in the lower corner. This is a publishing control number and is not related to the subject matter.

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A form is provided at the back of this publication for your comments.

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The IBM 1800 Data Acquisition and Control System was developed to meet the needs for real-time data acquisition, analysis, and control. Real-time applications normally require *continuous* on-line communication between the system and some process or operation occurring outside the computer system. These real-time applications, with continuous operation, require little operator intervention once started.

In many installations, however, the real-time control system does not utilize all the computer time. Through time-sharing, idle computer time can be used to perform background jobs such as data processing or scientific computations. It is in this area that the operator exhibits his abilities.

In most installations, the tasks of the operator are divorced from those of the programmer, system analyst, and keypunch operator. In some installations, however, one individual performs more than one of these tasks. The subjects treated in this manual will help the operator learn to operate the data processing input/output devices and processor-controller console used in an 1800 system installation.

In most cases, the operator works directly with the machine. In data processing applications, he must understand that he cannot allow the machine to remain idle. The operator should not attempt to supply data which should have been provided by the programmer. In such cases, the operator should terminate the job and return it to the programmer for correction. This action minimizes or eliminates idle computer time.

The Program and Run Book

The system analyst initiates the first steps in developing a program. He analyzes the information supplied by the user, decides upon the most efficient means of instructing the computer to process the information, and divides the problem into segments. Each problem segment is then solved by the programmer, who lists the specific steps required to instruct the computer to solve that segment. The programmer writes the instructions for the computer in a special programming language. This list of instructions is called a *program*.

The program is then punched into IBM cards (called a source program deck) by keypunch operators. The com-

puter cannot execute a source program because a source program is in a programming language and not in machine language. The source deck is then translated during a computer run by a program called an *assembler* or a *compiler*, which produces an object program in machine language. For simplicity, we will refer to the executable program as the "program." An executable program may be in cards as a program deck, or it may be on a disk.

The programmer also supplies a series of instructions and notes (called a run book), which gives the operator specific information regarding the particular program. The program deck and the run book are delivered to the operator, who depends on the run book to tell him what he must know to proceed with the processing operation. For example, the programmer includes error messages in his program to describe errors that would occur because of incorrect input data or an incorrect operational procedure. The operator refers to the run book to determine what corrective action to take when an error occurs. The run book also tells him which program deck or disk to use, which forms to use in the printer, and how to continue with the processing when departures from conventional procedures are necessary.

To this extent the operator works with the programmer. The run book, which has been prepared by the programmer for each specific program, is used by the operator as one of his tools while running the program through the computer. The operator uses the program and the machine to complete the processing of data. He does not explore all of the factors that determine the structure of the program.

Operator Responsibilities

During the processing of data, the operator is responsible for all on-line and off-line system components. On-line devices attach to the system and operate according to instructions in the program. At times it is desirable to make one or more of these components temporarily unavailable to the system (while preventive maintenance is being performed, for example). While the component is unavailable to the system, it is considered to be off-line. Equipment that is never attached to a particular computer system is also termed off-line. Key punches, sorters, collators, and reproducers are typical examples of off-line equipment.

Introduction

The IBM 1800 Data Acquisition and Control System handles a wide variety of real-time applications such as process control and data acquisition. Each system is individually tailored with modular building blocks that are easily integrated to meet specific system requirements.

Components of the 1800 system are functionally separated into four categories: Processor-controller, data processing input/output (DP I/O), communications input/output, and process input/output. Processor-controller is the name given to the computer subsystem which includes the central processing unit (CPU), main storage, and I/O channel controls.

The 1800 system offers a wide variety of highly flexible input/output (I/O) devices:

- IBM 1053 Printer
- IBM 1054 Paper Tape Reader
- IBM 1055 Paper Tape Punch
- IBM 1442 Card Read Punch

- IBM 1443 Printer
- IBM 1627 Plotter
- IBM 1810 Disk Storage
- IBM 1816 Printer-Keyboard
- IBM 2311 Disk Storage Drive (via IBM 2841 Storage Control)
- IBM 2401 Magnetic Tape Unit

This manual describes only the data processing I/O devices in the preceding list and the processor-controller (1801/1802).

In addition to these data processing I/O devices, the 1800 system offers communications devices such as 2790 Adapters, System 360 Adapter, and Communications Adapters as well as process I/O devices. These devices are described in *IBM 1800 Functional Characteristics*, Form GA26-5918. Operator information for 2790 components can be found in *IBM 2790 Data Communications System Components Description*, Form GA27-3015.

INPUT/OUTPUT CONTROL

Data processing (DP) I/O operations involve the transfer of information to or from main storage and DP I/O devices. I/O device operation is regulated by a control (adapter) function. All DP I/O devices, except the 1810 and 2311, require an adapter and/or controls in the processor-controller. The 1810 contains its own adapter(s). The 2311 operates via a 2841 Storage Control which is in turn controlled by a selector channel located in an IBM 1826 Data Adapter Unit.

In all cases, the control function provides the logical and buffering capabilities necessary to operate the associated device.

The 1800 system uses two methods to control I/O devices:

- Data channel control (cycle steal)
- Direct program control

Data Channel Control

High-speed I/O devices, such as magnetic tape units and disk storage devices, must be able to control transmission of data to and from main storage on a cycle-steal basis. The complex of registers, data paths, and control required for this function is called a data channel.

Data channels give the processor-controller the ability to delay the execution of a program while an I/O device communicates with main storage. For example, if an input device requires a main storage cycle to store data, the data channel with its cycle stealing capability makes it possible to delay the program during execution of an instruction and store the data word without changing the logical condition of the processor-controller. After the data is stored, the processor-controller continues executing the program which was delayed by the cycle stealing.

When several data channels require main storage cycles at the same time, the sequence of transmission is handled automatically according to priorities previously established by the user.

The following DP I/O devices are under data channel control:

- IBM 1442 Card Read Punch
- IBM 1443 Printer
- IBM 1810 Disk Storage
- IBM 2311 Disk Storage Drive (via 2841 Storage Control and selector channel)
- IBM 2401 Magnetic Tape Unit

Direct Program Control

Direct program control transfers individual words of data between processor-controller main storage and the I/O device at a rate controlled by the program and maximum speed of the I/O device. The processor-controller program is interrupted for each word transfer and must branch to a routine which services the I/O device. Therefore, the logical condition of the processor-controller is changed.

The following DP I/O devices are under direct program control:

- IBM 1053 Printer
- IBM 1054 Paper Tape Reader
- IBM 1055 Paper Tape Punch
- IBM 1627 Plotter
- IBM 1816 Printer-KeyBoard

Input/Output Interrupts

Interrupt is described as an automatic branch in the normal program sequence based upon an external condition.

Input/output interrupts are initiated by such conditions as:

1. Termination of an I/O operation by certain error conditions.
2. Completion of the programmed instruction.
3. Operator intervention at the I/O devices.
4. I/O unit operating under direct program control requires service.

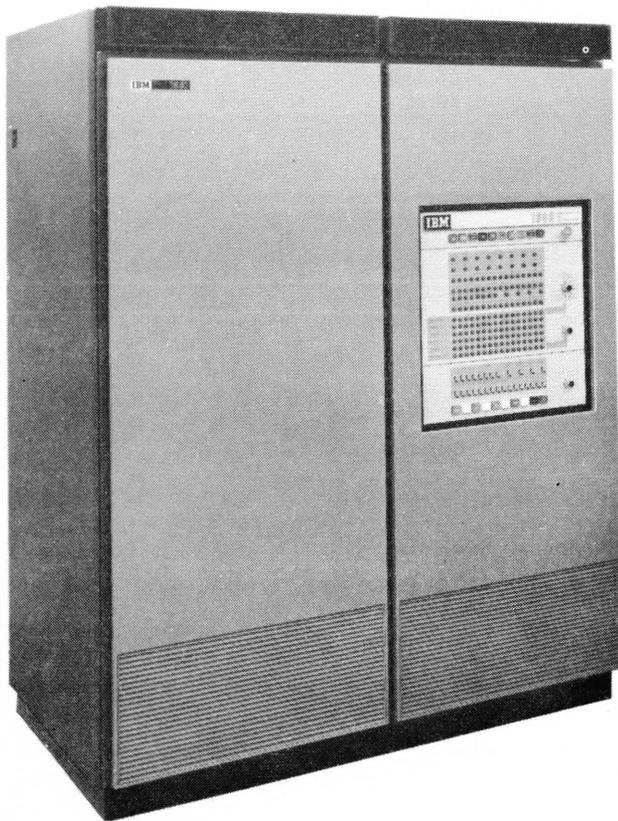
Input/output interrupts enable the processor-controller to provide appropriate programmed responses to conditions that occur in I/O devices.

Input/output interrupts are assigned a priority sequence similar to the data channels. This priority sequence arrangement allows most efficient use of all I/O devices.



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IBM



1801/1802

Processor-Controller

IBM 1801/1802 Processor - Controller

The IBM 1801 and 1802 Processor-Controllers are stored program computers, composed of a central processing unit (CPU), main storage, and channel control circuits.

Either the 1801 or 1802 may be used in the 1800 system. The 1802 includes circuitry and control for connection and operation of the IBM 2401 Magnetic Tape Unit. The 1801 has no standard provisions for magnetic tape units.

Each processor-controller is available with five main storage capacities: 4,096; 8,192; 16,384; 24,576; or 32,768 words. Total system main storage capacity can be expanded in 8,192 word increments to 65,536 words with the addition of an IBM 1803 Core Storage Unit. In systems with main storage capacities above 32,768 words, 24,576 words are located in the processor-controller. The remaining main storage words are located in the 1803 Core Storage Unit.

Standard features of the processor-controller include three hardware index registers, 12 levels of priority interrupt (expandable to 24 by special feature), three data channels (expandable to 15 by special feature), three interval timers, an operations monitor, and an operator's console.

The processor-controller contains a binary stored-program CPU. Within its basic design, the CPU has interrupt and cycle-stealing capabilities which are used in controlling the various I/O devices to be attached to the using system. Index registers and indirect addressing are provided to facilitate address modification and programming.

A complete instruction set with powerful options gives the computer very high performance for tasks normally encountered in data acquisition and process control applications.

PROCESSOR-CONTROLLER CONSOLE

The processor-controller console (Figure 1) provides the means for manual control of the processor-controller during debugging or operation phases.

The basic operating features and controls provide the facility to:

1. Start or stop instruction execution.
2. Address main storage.
3. Set up and store data or instructions.
4. Communicate with the program via sense or program select switches.
5. Control the cycling rate in the run, single main storage cycle, single instruction, or single step modes.
6. Interrupt the program manually.
7. Trace each instruction.
8. Reset all control circuitry and main storage.
9. Turn power on and off.
10. Indicate basic machine conditions and status.
11. Display main storage words and register data.
12. Write or clear storage protect bits.
13. Clear main storage.
14. Allow program execution with an internal error such as invalid operation, parity, or storage protect.

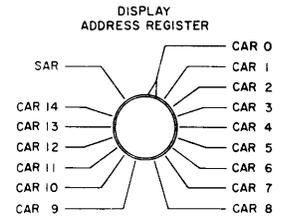
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1800 DATA ACQUISITION AND CONTROL SYSTEM

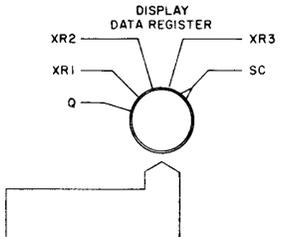
CLEAR STOR PROG LOAD READY ON OFF POWER ON LAMP TEST WAIT RUN ALARM



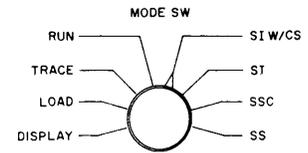
ARITH CTL	SHIFT CTL	ADD	ARITH SIGN	ZERO REM	BRANCH	STOR PROT BIT	PTY BIT														
INTR SERV	CS SERV		AUX STOR		OP CODE CHECK	STOR PROT CHECK	PTY CHECK														
CLOCK				CYCLE				TIMERS													
0	1	2	3	4	5	6	7	I1	I2	IA	E	E1	A	B	C						
INTERRUPT LEVELS																					
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15						
16	17	18	19	20	21	22	23	CHECK			TRACE			CE							
OP CODE																					
0	1	2	3	4	F	5	TAG	6	7	IA	BO	8	9	10	11	12	13	CAR	OFL	14	15



ADDRESS REGISTER	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
I REGISTER	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
B REGISTER	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
D REGISTER	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A REGISTER	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DATA REGISTER	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



SENSE				PROGRAM				OPERATIONS MONITOR	DISABLE INTERRUPT	CHECK STOP	WRITE STOR PROT BITS				
0	1	2	3	4	5	6	7	ON	ON	ON	YES				
								OFF	OFF	OFF	NO				
DATA ENTRY SWITCHES															
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15



CONSOLE INTR LOAD I RESET IMMED STOP START STOP

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Figure 1. Processor-Controller Console

FUSHBUTTON SWITCHES AND LIGHTS, TOP ROW (Figure 2)

The *Clear STOR (Storage) Switch* has four functions as shown in Table 1. These four functions are enabled by first holding CLEAR STOR down and then pressing START. This dual action requirement prevents accidental clearing of main storage. Note in Table 1 that each clear storage function is dependent on the positions of two console switches: the mode switch and write storage protect bits switch.

The processor-controller cycles completely through all main storage addresses during execution of each clear storage function.

The *PROG (Program) Load Switch* is used to load the first 1442 card or 1054 tape record into main storage. This first card or tape record must contain instructions that initiate the loading of the remaining cards or tape records. (The processor-controller must be in run mode for program operation.) Only one input device can be used for initial program load (IPL) and it must be in ready status. The first 1442 on the system is used for IPL. The 1054 is used for IPL if there is no 1442 on the system.

The first card or tape record is read into main storage beginning at the location specified by the I-register. Normally, RESET is pressed prior to pressing PROG LOAD. This resets the I-register to 0000. After RESET is pressed, the I-register may be manually altered to some address other than 0000. This allows the first card or tape record to be placed at any location in main storage.

In any case, the processor-controller branches to location 0000 to begin instruction execution after the first card or tape record has been transferred to main storage. Therefore, location 0000 should contain a valid instruction.

The *Ready Light* being on indicates that the processor-controller is in an operative condition.

The *Power On Switch* is used to turn on the power supplies within the processor-controller.

Function	Mode Switch	WSPB Switch
1. Store contents of data entry switches in all core storage locations. Storage-protect bits are removed and parity is corrected as required because of bit removal. If all data entry switches are off, only parity bits are left in storage.	Run	Yes
2. Store contents of data entry switches in each core storage location that is unprotected. Locations having protect bits are unchanged.	Run	No
3. Clear storage protect bits. All other data remains unchanged. Parity is automatically corrected in each word in storage.	Display	Yes
4. Search for parity errors. The P-C cycles through storage until stopped by the stop key or a parity error. The check stop switch must be on for a parity error to cause a stop.	Display	No

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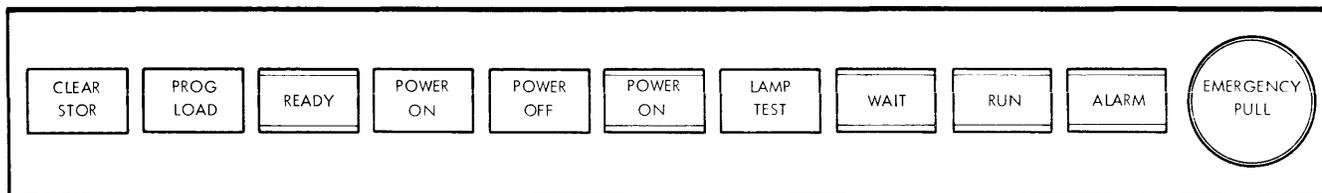
Table 1. Clear Storage Functions

The *Power Off Switch* is used to turn off the power supplies within the processor-controller.

The *Power On Light* being on indicates that the processor-controller power supplies are operative.

The *Lamp Test Switch* applies lamp voltage to all console lamps when it is pressed. It is used to verify operation of all console lamps.

The *Wait Light* being on indicates that the processor-controller is in the stopped or wait state. The stopped or



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Figure 2. Console Pushbutton Switches and Lights, Top Row

wait state occurs when:

1. The processor-controller is in load or display mode.
2. The processor-controller has been halted by a wait instruction from the program.
3. STOP or IMMED STOP has been pressed.

The Run Light being on indicates that the processor-controller is operating under program control.

The Alarm Light being on indicates that the operations monitor has timed out. The alarm light remains on until

the operations monitor switch is turned off. The customer may install an audible alarm to operate in conjunction with the alarm light.

Emergency Pull Switch is for emergency use only. If pulled out, all electrical power within the processor-controller is turned off, including power to the blowers that cool the electronic circuitry. Repeatedly turning the blowers off in this manner may damage some of the circuitry. Therefore, use this switch only in emergencies. The switch must be reset by a customer engineer.

PUSHBUTTON SWITCHES, BOTTOM ROW (Figure 3)

The Console Interrupt Switch enables the operator to signal the program by causing an interrupt. Normally, the program and sense switches are used in conjunction with console interrupt to allow operator communication to the program.

The Load I (Instruction) Switch is used with the mode switch positioned at LOAD to transfer the contents of the data entry switches into the I-register. The processor-controller is in the stopped condition when it terminates the load I operation.

The Reset Switch is used to reset all I/O devices, basic timing controls, and registers (except index registers and address registers). Digital input and digital-analog output registers are not reset. RESET is effective only when the processor-controller is not in a run state as indicated by the run light being off.

The IMMED (Immediate) Stop Switch stops the processor-controller at the end of the main-storage cycle in progress

when the switch contacts close. All I/O devices, basic timing controls, and registers (except index registers and address registers) are reset. IMMED STOP also stops data channel (cycle steal) operations which can cause loss of information due to premature termination of a data transfer operation.

The Start Switch initiates processor-controller operation as specified by the mode switch. The processor-controller must be ready as indicated by the ready light being on.

The Stop Switch stops the processor-controller at the end of the main-storage cycle in progress when the switch contacts close. The processor-controller registers and I/O devices are not reset and data channel (cycle steal) operations will continue until completed.

If an interrupt occurs on an interrupt level with higher priority than any in progress at the same time STOP is pressed, STOP must be pressed again to be effective. Once the processor-controller has been stopped, pressing START causes the program to resume operation.

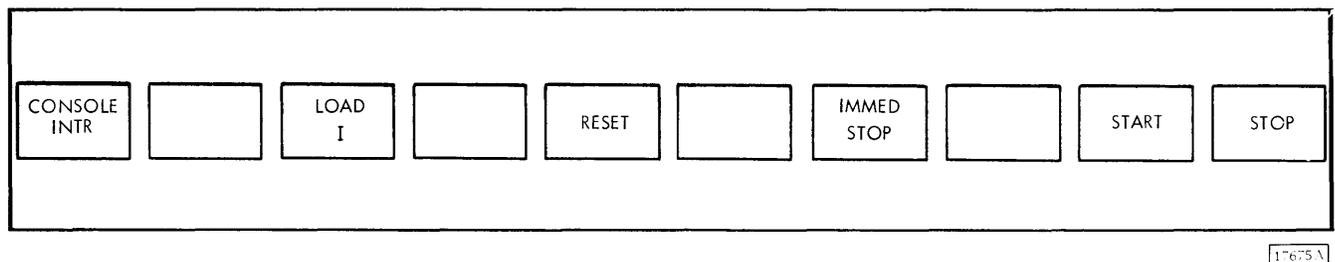


Figure 3. Console Pushbutton Switches and Lights, Bottom Row

ROTARY SWITCHES (Figure 4)

The *Display Address Register Switch* is used to select a channel address register or storage address register for display in the address register lights.

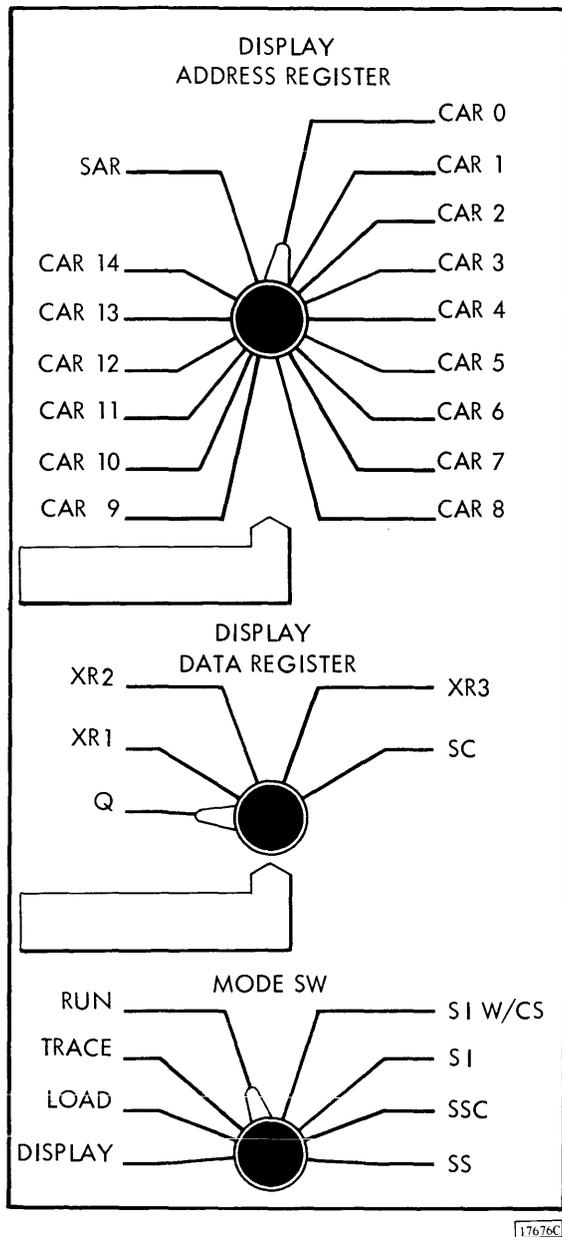


Figure 4. Console Rotary Switches

The *Display Data Register Switch* is used to select the Q-register (which is the A-register extension), and index register, or the shift counter for display in the data register lights.

The *Mode SW (Switch)* is used in conjunction with START to extend operator control of the processor-controller. The function of each position of the mode switch is described in the following paragraphs.

DISPLAY is used to display the contents of main storage.

Pressing START with the mode switch on DISPLAY causes the data at the address specified by the I-register to be displayed in the B-register lights. The I-register is incremented after each display. Pressing START successively displays the data in ascending main storage locations.

LOAD is used to load main storage locations or the I-register. Pressing START with the mode switch on LOAD causes the contents of the data entry switches to be stored at the address specified by the I-register. (The processor-controller must be in a stopped condition.) The I-register is incremented following each load operation. Pressing START successively loads the contents of the data entry switches into ascending main storage locations.

Pressing LOAD I with the mode switch on LOAD causes the contents of the data entry switches to be stored in the I-register.

TRACE is used to initiate an interrupt on the lowest priority level after the execution of each instruction (except execute I/O instructions). This position of the mode switch is usually used for program debugging.

RUN is used for normal program operation. Pressing START with the mode switch on RUN initiates program operation of the processor-controller.

SI W/CS (Single Instruction With Cycle Steal) allows execution of one instruction each time START is pressed. Data channel (cycle steal) operations can occur during execution of the instruction.

SI (Single Instruction) allows execution of one instruction each time START is pressed. Data channel (cycle steal) operations are prevented.

SSC (Single Storage Cycle) allows one main storage cycle each time START is pressed. Single storage cycle operations (usually called single cycle operations) can be used in conjunction with the cycle lights to step through instructions and analyze processor-controller operation.

SS (Single Step) allows one basic processor-controller clock cycle each time START is pressed.

TOGGLE SWITCHES (Figure 5)

The *Sense and Program Switches* are normally used for communication with the program. The contents of these eight switches may be stored in bit positions 0 through 7 of the A-register or a main storage location as directed by the stored program.

The *Operations Monitor Switch*, when on, enables the operations monitor. The off position disables the operations monitor.

The *Disable Interrupt Switch* is used to mask or disable all interrupt levels. It is used to choose the time at which the program may be interrupted during program analysis.

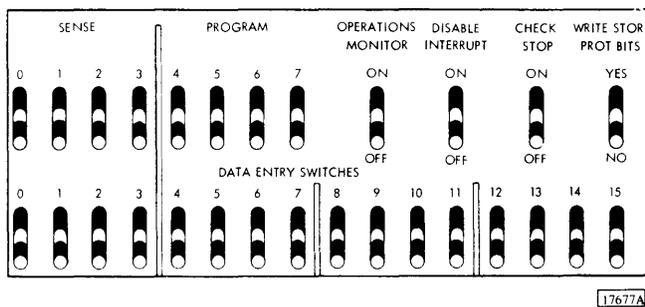


Figure 5. Console Toggle Switches

The highest priority level on and unmasked (not disabled) is serviced when the switch is turned off.

The *Check Stop Switch* is used to stop processor-controller operation when one of the following conditions occurs: operation code check, storage protect check, or parity check. The stop occurs at the end of the main-storage cycle in which the check is detected. The appropriate error light will be on. START must be pressed to restart the system.

The preceding check conditions initiate an internal (check) interrupt if the check stop switch is off.

A clear storage function is stopped when the check stop switch is on and a parity check is detected.

The *Write STOR PROT (Storage Protect) Bits Switch* enables the writing or clearing of storage protect bits when the switch is on. A parity error may occur if the position of this switch is changed while the processor-controller is running.

The *Data Entry Switches* provide a means of entering data under either manual or program control. Under program control, the contents of the switches can be stored in main storage or the A-register. Under manual control, the contents of the switches can be stored at the address specified by the I-register by pressing START, or loaded into the I-register by pressing LOAD I provided the mode switch is on LOAD.

STATUS INDICATORS (Figure 6)

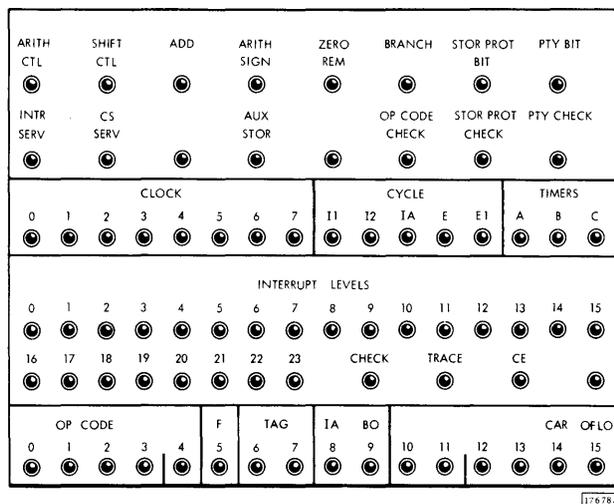


Figure 6. Status Indicators

The *ARITH CTL (Arithmetic Control) Indicator* turns on during arithmetic operations.

The *Shift CTL (Control) Indicator* turns on during shift operations.

The *Add Indicator* is on during add operations.

The *ARITH SIGN (Arithmetic Sign) Indicator* turns on when bit position 0 in the A-register does not initially equal bit position 0 in the B-register.

The *Zero REM (Remainder) Indicator* is on when the A-register contains a 0 balance during a divide instruction.

The *Branch Indicator* is on during branch instructions.

The *STOR PROT (Storage Protect) Bit Indicator* is on when a storage protect bit is transferred with the 16 data bits between the B-register and main storage.

The *PTY (Parity) Bit Indicator* turns on when a parity bit is transferred with the 16 data bits between the B-register and main storage.

The *INTR SERV (Interrupt Service) Indicator* turns on when a hardware forced branch instruction is being executed to enable service of the highest priority interrupt level that is on.

The *CS SERV (Cycle Steal Service) Indicator* is on during cycle steal operations of a data channel.

The *AUX STOR (CE Storage) Indicator* is on when CE storage is being used. CE storage is provided for Customer Engineering use.

The *OP (Operation) Code Check Indicator* turns on when an invalid operation code is detected in the OP register. This indicator is turned off and the check indicator is turned on when the next main storage cycle is initiated. This allows the OP code check indicator to indicate any subsequent error.

The *STOR PROT (Storage Protect) Check Indicator* is turned on when an attempt is made to write into a read-only location of main storage. This indicator is turned off and the check indicator is turned on when the next main storage cycle is initiated. This allows the STOR PROT check indicator to indicate any subsequent error.

The *PTY (Parity) Check Indicator* is turned on when a parity check (even number of bits on) is detected in the 18-bit word transfer between the B-register and main storage. This indicator is turned off and the check indicator is turned on when the next main storage cycle is initiated. This allows the PTY check indicator to indicate any subsequent error.

The *Clock Indicators* (0 through 7) show the advance of the basic processor-controller clock during single step operations.

The *Cycle Indicators* (I1, I2, E, and E1) show the progress of an instruction during single step or single cycle operations.

The *Timers Indicators* (A, B, and C) show the status of their respective interval timers. An on condition indicates that the timer is in operation.

The *Interrupt Levels Indicators* (0 through 23, check, trace, and CE) show the status of their respective interrupt levels. The indicator being on indicates that the level is requesting service.

The *OP (Operation) Code Indicators* (0 through 4) display the operation code of each instruction.

The *F (Format) Indicator* is on when a two-word instruction is being executed.

The *Tag Indicators* reflect the index registers used in modification of the address portion of an instruction.

The *IA (Indirect Addressing) Indicator* (bit 8) is on when bit 8 of the instruction is also on. This bit only indicates indirect addressing if the F-bit is on.

The *BO (Branch Out) Indicator* is on when there is a bit in position 9 of an instruction.

The *Carry and Overflow Indicators* are turned on individually when their respective conditions occur in the A-register.

DATA FLOW INDICATORS (Figure 7)

The *Address Register Indicators* display the data in the register selected by the display address register switch. The selected register is displayed each time the processor-controller comes to a stop or wait condition.

The *I (Instruction) Register Indicators* display the contents

ADDRESS REGISTER	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
I REGISTER	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
B REGISTER	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
D REGISTER	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
A REGISTER	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
DATA REGISTER	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Figure 7. Data Flow Indicators

of the I-register. The I-register holds the address of the next sequential instruction and is automatically incremented for sequential instruction operation.

The *B (Storage Buffer) Register Indicators* display the contents of the B-register. The B-register is used to buffer all word transfers with main storage.

The *D (Arithmetic Factor) Register Indicators* display the contents of the D-register. The D-register is used to hold one operand of any arithmetic or logical operation. The A-register provides the other operand.

The *A (Accumulator) Register Indicators* display the contents of the A-register. The A-register contains the results of any arithmetic and logical operation. It can be loaded from or stored into main storage, shifted right or left, and otherwise manipulated by specific arithmetic and logical instructions.

The *Data Register Indicators* display the contents of the register selected by the display data register switch. The selected register is displayed each time the processor-controller comes to a stop or wait condition.

MAIN STORAGE DISPLAY (Single Instruction Operations)

The following procedure may be used to display main storage data between execution of single instructions. The processor-controller must be in a stopped condition before starting this procedure.

1. Position the mode switch to SI.
2. Press START repeatedly to step program to point at which data display is desired.
3. Record address in I-register. This address is needed to return to next instruction in program.
4. Enter address of main storage location to be displayed in data entry switches.
5. Position mode switch to LOAD.
6. Press LOAD I.
7. Position mode switch to DISPLAY.
8. Press START. The selected data is now displayed in B-register indicators.
9. To display other main storage locations, repeat steps 4 through 8. To resume program, continue with step 10.
10. Enter address recorded in step 3 in data entry switches.
11. Position mode switch to LOAD.
12. Press LOAD I.
12. Position mode switch to RUN.
14. Press START.

MAIN STORAGE DISPLAY (Single Cycle Operations)

To display main storage data between single cycle operations, use the following procedure. The processor-controller must be in a stopped or wait condition.

1. Position mode switch to SSC.
2. Press START repeatedly until desired cycle of instruction is reached.
3. Perform steps 3 through 14 of preceding procedure.

MAIN STORAGE LOAD

To manually load data into main storage, the following procedure is recommended. The processor-controller must be in a stopped or wait condition.

1. Enter main storage address at which data is to be stored in data entry switches.
2. Position mode switch to LOAD.
3. Press LOAD I.
4. Enter data to be stored in data entry switches.
5. Press START. The data in the data entry switches is stored in main storage at address contained in I-register. The I-register is then incremented by one.
6. Repeat steps 4 and 5 until all data has been entered.



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IBM

1054

Paper Tape Reader



IBM 1054 Paper Tape Reader

The IBM 1054 Paper Tape Reader provides paper tape input for the 1800 system. The 1054 (maximum of one per system) operates under direct control of the stored program and reads 1-inch, eight-track paper tape. The maximum reading rate is 14.8 characters per second.

Paper tape reading under program control is initiated by a control command issued to the 1054. This command loads a character into an input buffer and then moves the paper tape one character position. When the buffer has been loaded with a character, an interrupt is generated signalling the stored program that a character is available for reading into main storage. A subsequent read command from the program reads the character into main storage from the buffer.

Paper Tape Initial Program Load

If there is no 1442 on the system, the 1054 is used for initial program load (IPL). The 1054 is forced into run condition as a result of pressing PROG LOAD and operates at its maximum speed of 14.8 characters per second. Data words are read into main storage, starting at the location

specified by the I-register.

Paper tape channels 1 through 4 of each tape character are used as data bits for assembly into a 16-bit word during IPL. The 16-bit word is assembled in the paper tape reader for transmission to main storage. When a word is assembled, the I/O channel is signalled and the word is transferred to main storage. The I-register is then incremented by one.

IPL continues in this manner until a channel-5 punch, in other than a delete character, is detected in the paper tape. When this channel-5 punch is detected, IPL is terminated and the 1054 is stopped. The I-register is then reset to 0000 and the processor-controller commences execution of the loaded program. The paper tape character with a channel-5 punch is not read into main storage.

During program load, delete characters are recognized by the 1054 and are not loaded into the assembly buffer. Delete characters are not recognized nor handled in any special manner by the 1054 except in IPL mode. This allows a leader of delete characters to facilitate loading the tape.

OPERATOR CONTROLS (Figure 8)

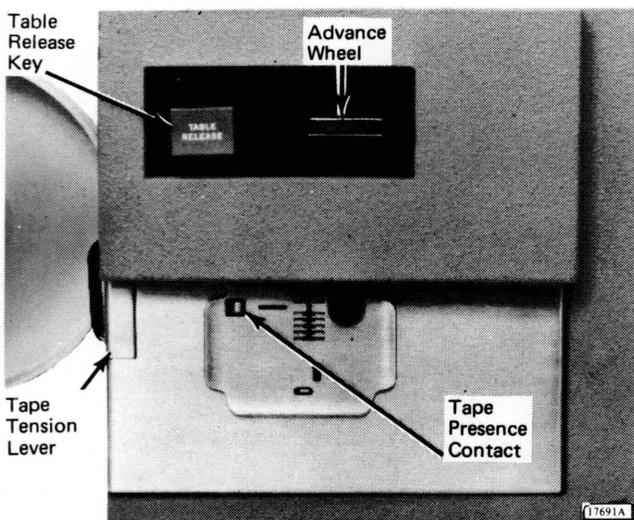


Figure 8. 1054 Operator Controls

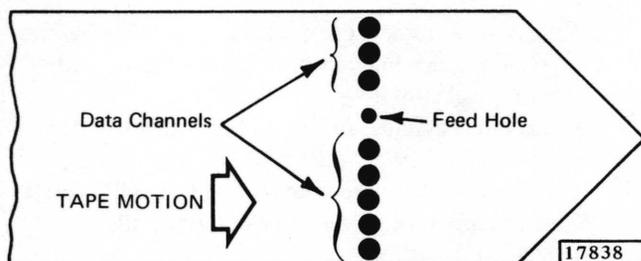
The Table Release Key, when pressed, causes the tape guide to raise, permitting insertion or removal of previously punched tape.

The Advance Wheel permits tape to be moved forward or backward while maintaining proper registration. Reading does not occur during this movement.

The Tape Tension Lever actuates a switch which signals a not ready condition if too much tension is placed on the tape as it feeds through the unit.

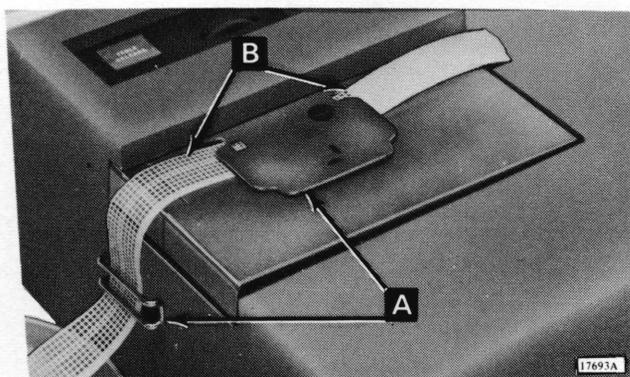
The Tape Presence Contact signals a not ready condition when the reader runs out of tape.

IDENTIFYING START OF TAPE

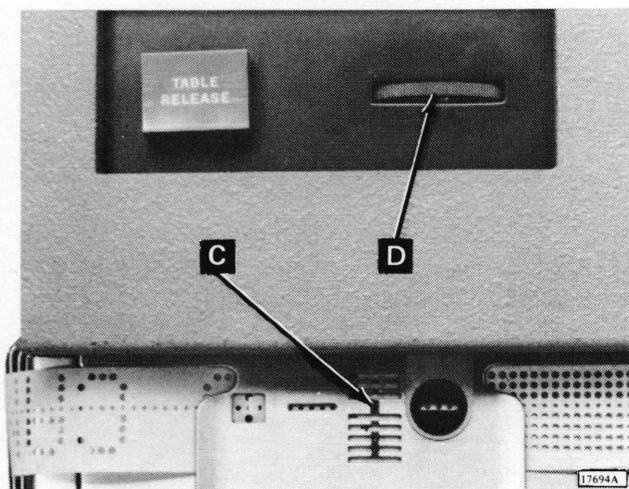


1. Start of tape is identified by either the pointed end of the tape or a mark made to identify start of tape.
2. When loading tape, start of tape should be pointing in the direction of tape movement and the channels should appear as shown at the left. If the channels are reversed, the tape is upside down and must be turned over.

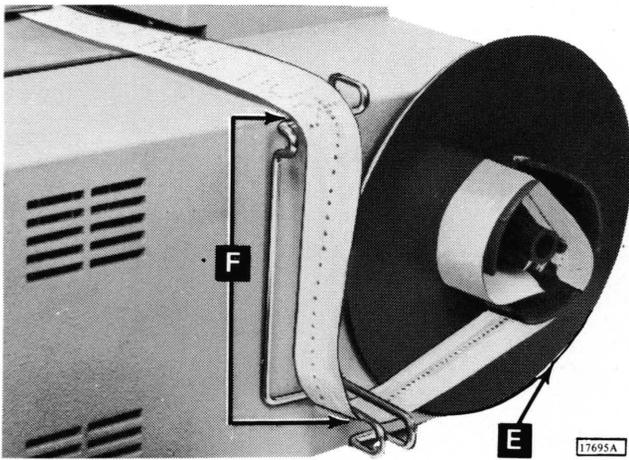
LOADING PUNCHED TAPE



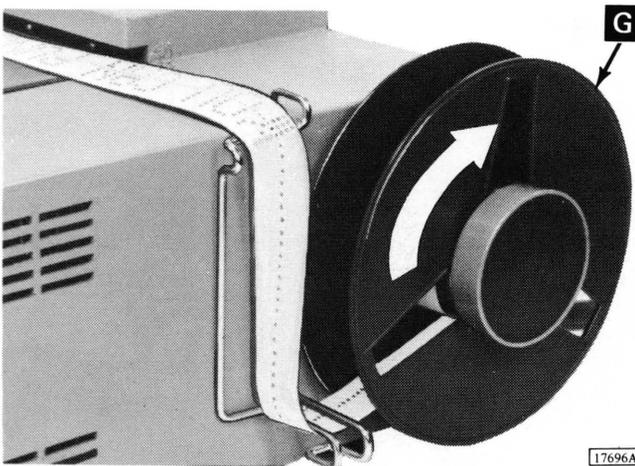
1. Press TABLE RELEASE.
2. Lightly push tape across table toward back of reader, inserting it under tape guides (A). Make sure that top edge of tape is aligned against registration rail (B) at back of table.



3. Move tape either right or left to position a tape column under red line (C) of guide.
4. Press table down to latch it in position. Using advance wheel (D), move tape right or left to ascertain that tape moves freely under guide.
5. Using advance wheel, position first data character under red line on guide.

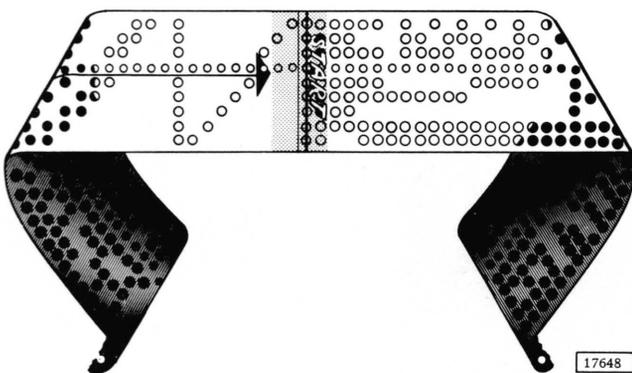


6. Hold inner cylinder (E) of take-up reel. Although reel is free-running while power is on, any slight hand pressure will stop it.
7. Grasp outer cylinder of reel and turn slightly counter-clockwise.
8. Pull outward on outer cylinder and reel will separate.
9. Thread tape through guides (F) on right side of reader.
10. Insert tape in slot of take-up reel.



11. Replace outer cylinder (G), turning it slightly clockwise to lock it in place.

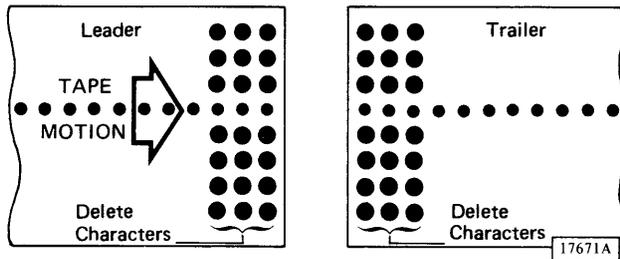
LOADING A TAPE LOOP



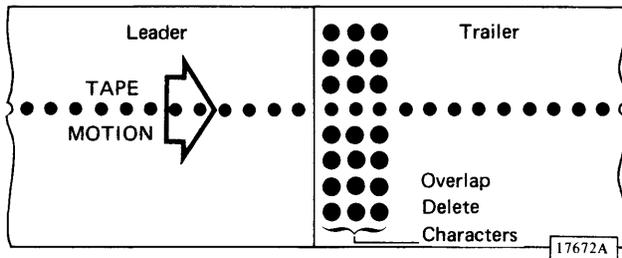
A tape loop requires the same loading procedure as normal punched tape. The following suggestions permit loading a tape loop with a minimum of effort.

1. The tape loop should be long enough to feed freely around the tape guides without dragging on the guide edges. However, it should not be long enough to drag on the floor.
2. The loop should also be very clearly marked for:
 - a. Starting position of the loop.
 - b. The direction of tape movement as it is read.

SPLICING PAPER TAPE



1. Prepare a leader of at least three delete characters.
2. Prepare a trailer containing the same number of delete characters as leader.
3. Make straight-edge cut to terminate both leader and trailer.
4. If tape is Mylar* Tape, remove glaze from bottom of trailer and top of leader with ink eraser to provide a better bonding surface.



5. Apply tape glue (IBM part 221030) to either top of leader or bottom of trailer and allow glue to become tacky.
6. Lap leader edge under trailer edge, aligning delete characters and feed holes for registration.
7. Press tape firmly together to form a proper bond and then allow glue to dry.

CLEARING ERROR CONDITIONS

1. Verify that tape is aligned against registration rail. Occasionally it is not properly registered and feeding is accomplished by the feed pins actually using the data holes as feed holes.
2. Verify that tape is not inserted backwards.
3. Verify that a tape jam has not occurred.
4. Verify that tape tension lever has not been actuated by too much tension on tape.
5. Verify that tape presence contact is not actuated.

*Trademark of E.I. duPont de Nemours & Co. (Inc.)

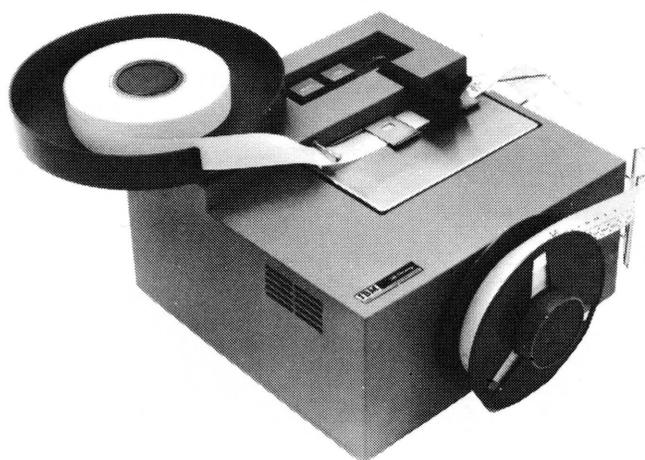


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IBM

1055

Paper Tape Punch



The IBM 1055 Paper Tape Punch provides paper tape output for the 1800 system. The 1055 (maximum of one per system) operates under direct control of the stored program and punches 1-inch, eight-track chad paper tape (holes completely punched). The punching speed is 14.8 characters per second.

Paper tape punching is initiated by a write command

issued to the 1055. The write command causes the data in the main storage location specified by the command to be punched into the paper tape. The tape is then moved one character position.

Characters are punched in the paper tape as an image of the data contained in main storage locations. One tape character is punched from each main storage location.

OPERATOR CONTROLS (Figure 9)

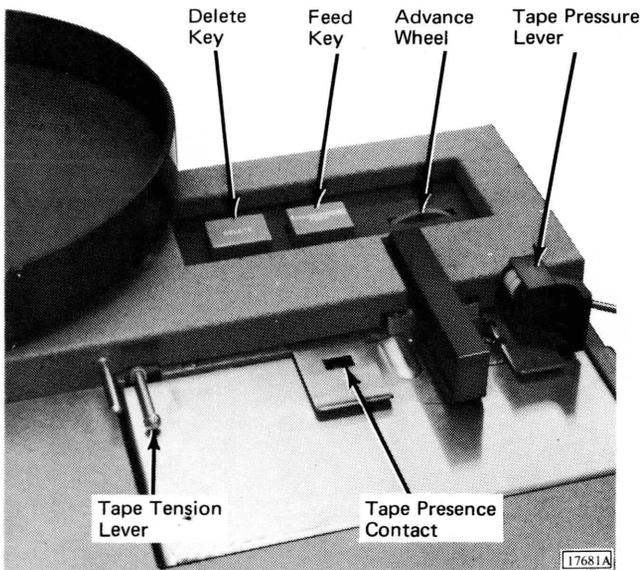


Figure 9. 1055 Operator Controls

The Delete Key is used to advance the tape by punching a delete character and a feed hole. Delete characters are punched continuously by pressing and holding DELETE and FEED.

The Feed Key is used to advance the tape by punching feed holes. Feed holes are continuously punched by holding FEED down.

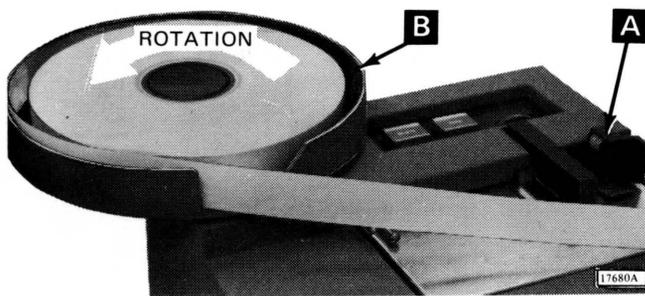
The Advance Wheel permits the tape to be moved forward or backward without punching. If the tape is moved forward, exercise care since no feed holes are punched with this operation.

The Tape Tension Lever actuates a switch which signals a not ready condition if too much tension is placed on the tape as it feeds from the tape supply pan.

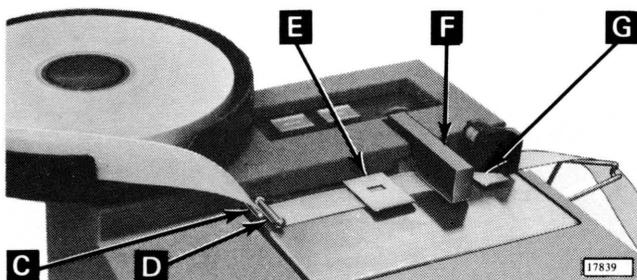
The Tape Presence Contact signals a not ready condition when the punch runs out of tape.

The Tape Pressure Lever holds the tape against the feed wheel to ensure proper feeding. During tape punching, this lever is in the down position (active). When tape is being inserted, this lever must be raised until the tape is properly positioned, then lowered. While in the raised position, a not ready condition is signalled to the processor-controller.

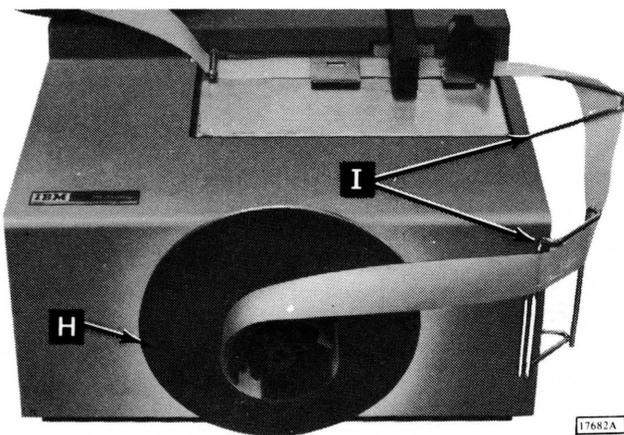
LOADING BLANK TAPE



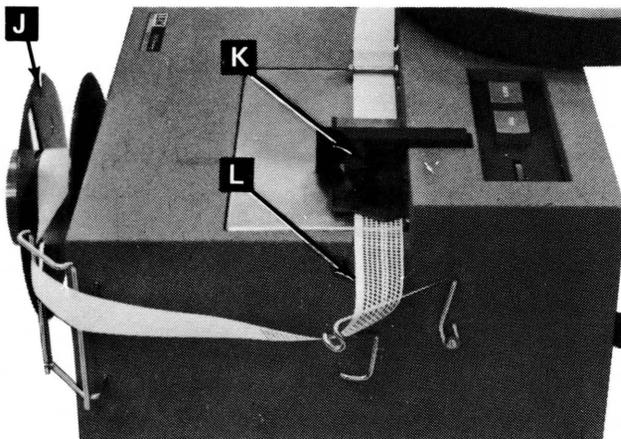
1. Lift tape pressure lever (A) clockwise 90 degrees. (System power should be on.)
2. Place reel of blank tape in tape supply pan (B). Supply pan should turn counterclockwise when tape is pulled.
3. Pull tape until about 30 inches extend beyond tape supply pan.



4. Thread leading edge of blank tape over guide pin (C) and under tape tension lever (D). Outside surface of tape in supply pan should be face up under tape tension lever.
5. Slide blank tape under tape guide (E), punch die (F), and tear guide (G). If punch has a take-up reel – a special feature – continue with following steps. If punch does not have take-up reel, proceed to step 11.

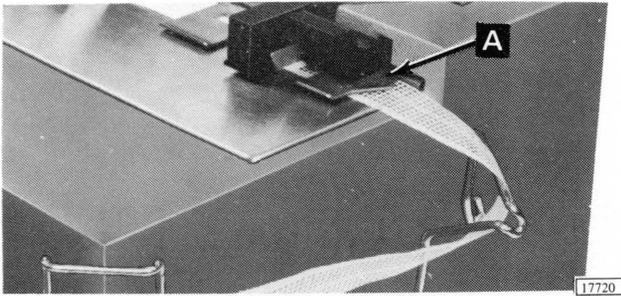


6. Hold inner cylinder (H) of take-up reel. Although reel is free-running while power is on, any slight hand pressure stops it.
7. Grasp outer cylinder and turn slightly counterclockwise. Pull outward on outer cylinder and reel will separate.
8. Thread tape around two guides (I) on right side of punch.
9. Thread tape onto inner cylinder of take-up reel. (Outer surface of tape should still be face up.)

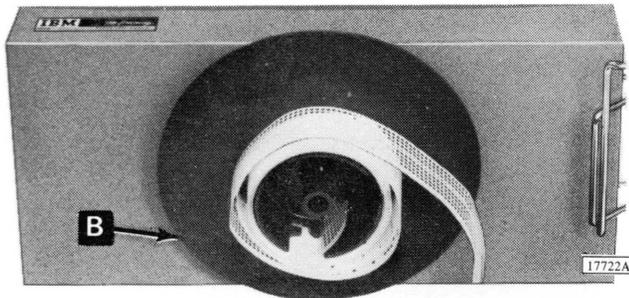


10. Replace outer cylinder (J) of take-up reel, turning it slightly clockwise to lock it in place.
11. Lower tape pressure lever (K) – counterclockwise 90 degrees.
12. Press and hold feed key until 4 to 6 inches of tape have been punched. (If delete characters are desired, press and hold DELETE and FEED.) This action permits self-alignment of tape for proper punching registration.
13. Verify that vertical columns of punched holes (L) in tape are evenly spaced. (If not, press and hold FEED until holes are evenly spaced.)

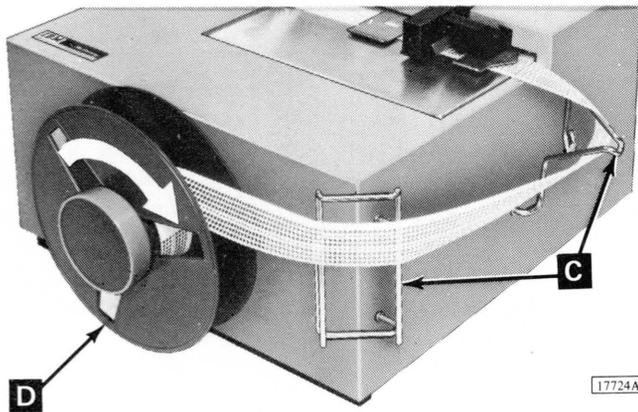
REMOVING PUNCHED TAPE



1. Press FEED to prepare a trailer of at least 6 inches of tape. (If delete characters are desired, press and hold FEED and DELETE.)
2. Tear tape at tape tear guide (A) with upward motion. This identifies start of next tape and end of previous tape. If tear guide is not used, make sure end of punched tape and start of next tape are identified by some sort of marking. If punch has a take-up reel, continue with step 3.

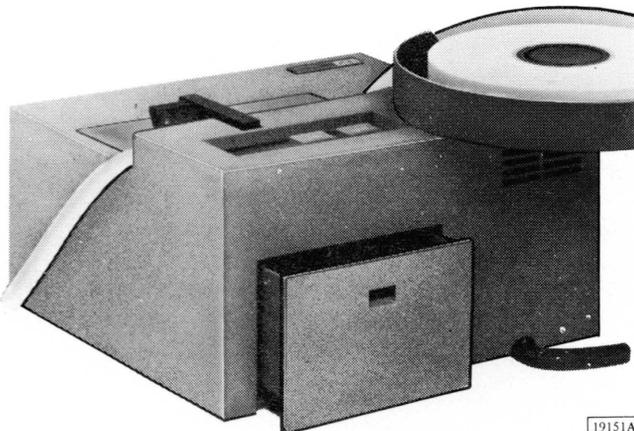


3. Hold inner cylinder (B) of take-up reel. Although reel is free-running while power is on, any slight hand pressure stops it.
4. Grasp outer cylinder and turn it slightly counter-clockwise. Pull outward on outer cylinder and reel will separate. Punched tape can now be removed.



5. After punched tape has been removed, press FEED to feed enough tape for threading through guides on side of punch. (If delete characters are desired, press and hold FEED and DELETE.)
6. Thread tape through guides (C) on right side of unit and onto inner cylinder. Outer surface of tape in tape supply pan should be face up on inner cylinder of take-up reel.
7. Replace outer cylinder (D) of take-up reel, turning it slightly clockwise to lock it in place.

EMPTYING THE CHAD BOX



1. Turn 1055 so that rear is easily accessible.
2. Pull chad box outward and empty.
3. Replace chad box.

CLEARING A NOT READY CONDITION

1. Verify that tape tension lever is not actuated. When actuated, tape tension lever is up and forward from its normal position.
2. Verify that tape pressure lever is down and holding tape against feed wheel.
3. Verify that no tape jams have occurred.
4. Verify that tape is present in unit and that tape presence contact is not actuated.

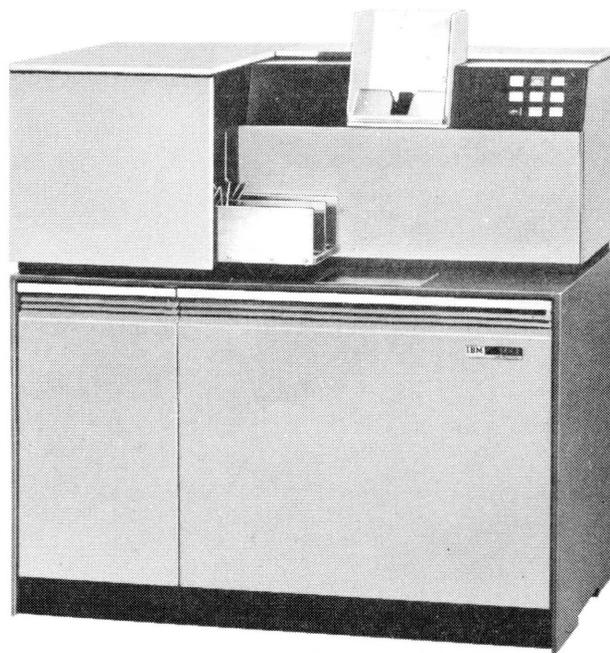


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IBM

1442

Card Read Punch



IBM 1442 Card Read Punch

The IBM 1442 Card Read Punch provides card input/output for the 1800 system. The 1442's (maximum of two per system) operate under data channel control. They transport the cards through the unit and accomplish reading and punching as directed by the stored program. Maximum machine speeds are:

<i>Operation</i>	<i>Model</i>	<i>Speed</i>
Read	6	300 cards per minute
	7	400 cards per minute
Punch	6	80 columns per second
	7	160 columns per second

Cards are placed in the hopper face down, 9-edge first. The hopper holds approximately 1,200 cards. Cards are fed from the hopper 9-edge first. Figure 10 illustrates the path cards follow during reading and/or punching operations.

Card Reading

Card reading is initiated by a program read command. If the 1442 is in ready status, the card at the read station is registered and fed through the read station. This feed causes columns 1 through 80 of the card to be read in one continuous motion. The card is read serially - that is, column by column - beginning with column 1. Reading is

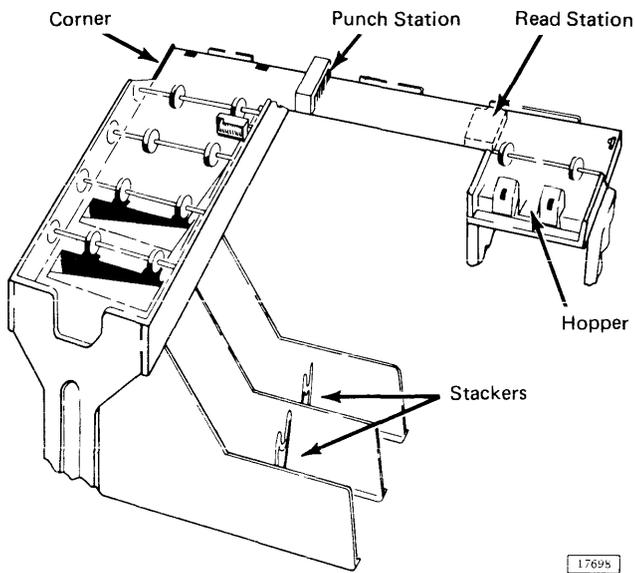


Figure 10. 1442 Card Path

accomplished through photocell sensing. Each column is read twice by the photocells, and the readings are compared for agreement. As each column is read, the data is transferred to the processor-controller via data channel (cycle steal) operation.

After a read operation is completed, the card is registered at column 1 in the punch station.

Card Punching

Card punching is initiated by a program write command. If the 1442 is in ready status and a card is registered at the punch station, a column of data is requested and transferred to the 1442 via data channel (cycle steal) operation. An incremental punch drive causes the card to be punched and then incremented one column. The cards in the hopper and read station are not moved. The data transfer and punch operation continues until a signal indicating last column is received from the program. Upon receiving this signal, the 1442 punches and then increments the card one more column. An interrupt is generated which signals the program that punching is complete. Once punching is terminated in this manner, it cannot be restarted in this card.

If a write command is received when the 1442 is in ready status but a card is not registered at the punch station, a feed cycle is taken to move the card from the read to the punch station. Punching then proceeds as described in the preceding paragraph.

Punch checking is accomplished by comparing punch echo data (created by the actual punching motion) with the character sent to be punched.

Card Feed

Cards are moved through the 1442 in cycles. During a feed cycle, the card at the punch station is transported through the punch station to the stacker, a card at the read station is transported through the read station and registered at the punch station, and the bottom card in the hopper is fed into the read area. All cards pass through the read and punch stations, but reading and/or punching occurs only by program command.

A feed cycle is initiated by a write command (if no card is present at the punch station), a feed command, or a read command.

Initial Program Load

Initial program load (IPL) is initiated by pressing PROG

LOAD on the processor-controller console. During IPL, one card is read into 40 main storage locations beginning with the location specified by the I-register. Following this

load action, the processor-controller branches to location 0000 to begin program execution. The mode switch should be on RUN or SI/CS for program operation. The 1442 designated as first on the system is used for IPL.

OPERATOR CONTROLS (Figure 11)

The Power On Light is on when operating power is being supplied to the 1442 control circuits.

The Ready Light is on when the 1442 is able to accept commands from the program. The following conditions are required:

1. Power on.
2. Card properly registered at read station.
3. Either cards in the hopper or the 1442 is in last-card routine.
4. Stacker not full.
5. Check light off.
6. Chip box light off.

The Chip Box Light turns on when the chip box is either

full or has been removed. This condition removes the 1442 from ready status.

The Check Light turns on when one of the eight error conditions exists as indicated by the backlighted panel on the 1442. Any one of these error conditions removes the 1442 from ready status and can be reset only by pressing NPRO with the hopper empty.

The HOPR (Hopper) Light turns on when a card fails to pass properly from the hopper to the read station.

The Feed CLU (Clutch) Light, when on, indicates that a feed cycle was taken that was not requested.

The Read REG (Registration) Light turns on when a read error has occurred due to incorrect registration of the card

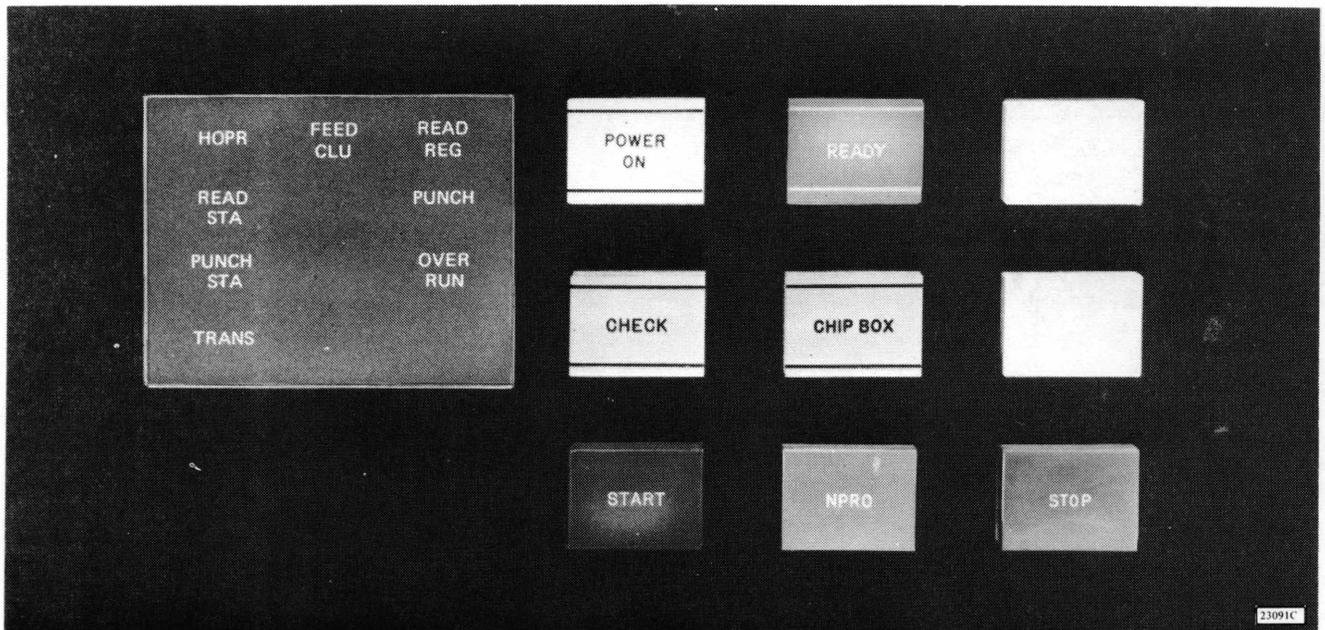


Figure 11. 1442 Keys and Lights

or failure of the first and second reading of a column to compare equally.

The Read STA (Station) Light, when on, indicates that a card was not properly positioned (feed check) at the read station.

The Punch Light turns on when a punch check occurs due to failure of the punch echo data and punch character to compare equally. Punching into prepunched columns does not cause a punch check.

The Punch STA (Station) Light, when on, indicates that a card was not properly positioned (feed check) at the punch station.

The Overrun Light turns on when data overrun occurs. That is, data was lost because the data channel failed to transfer data to or from main storage within the time the 1442 required service.

The TRANS (Transport) Light, when on, indicates that a card is out of position in the card transport area between the punch station and stackers.

The Start Key is used to perform the following functions:

1. To start initial card run-in. The bottom card in the hopper moves to the read area and ready status is restored to the 1442.
2. To restore ready status after manually stopping the 1442.
3. To initiate a last card sequence.

The Stop Key removes the 1442 from ready status when it is pressed. If a 1442 operation is in progress, it is necessary to hold STOP down until the operation is complete; otherwise the 1442 will not recognize that STOP has been pressed.

The NPRO (Nonprocess Runout) Key is used to eject cards from the serial path without processing them. Pressing NPRO also resets the eight error conditions. This key is effective only if the hopper is empty. During card operations, NPRO should not be held down at the time the hopper goes empty, as the signal to the program indicating that the operation is complete for the last card processed will not be given.

READYING THE 1442

1. With system power on, press NPRO to clear any error condition and eject any cards left in card path.
2. Place cards face down in hopper, 9-edge first.
3. Press START. When ready light comes on, 1442 is in ready status.

INITIATING LAST CARD SEQUENCE

When the hopper goes empty during a feed cycle, the 1442 is removed from ready status. This signals the program that operator intervention is required.

Processing may be continued by loading more cards into the hopper and pressing START. A last card sequence may be initiated by pressing START without loading more cards

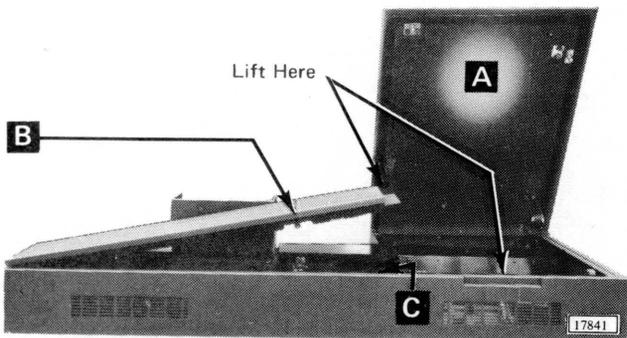
in the hopper.

The last card sequence places the 1442 in ready status and allows two more feed cycles to be taken. The last two feed cycles allow processing of the last card and ejects it into the stacker. The program is also signalled that the last card has been processed.

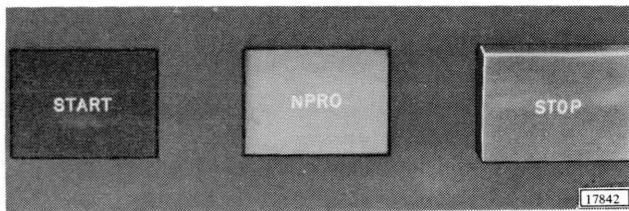
CLEARING CARD JAMS

The check light, along with a read station, punch station, or transport light, indicates a card jam condition. A card saw should not be used to remove a jam in the punch station as

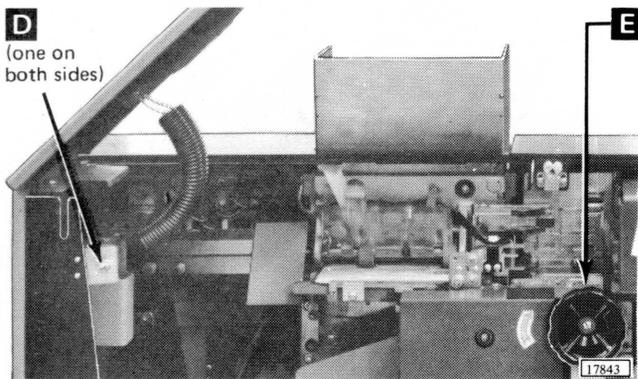
the punch mechanism could be damaged. The following steps are recommended to remove jammed cards.



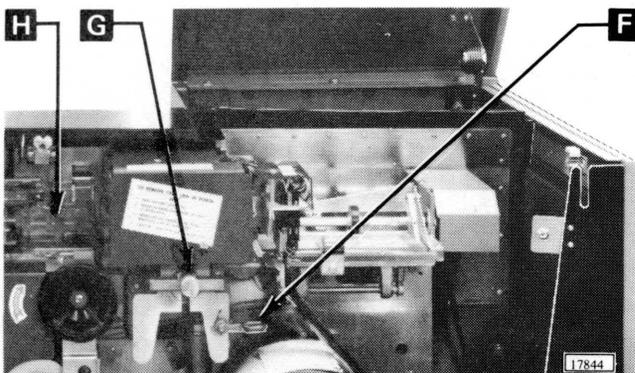
1. Remove cards from hopper.
2. Raise two top covers. (Raise cover on right (A) first, then cover on left (B).)
3. Locate card jam. If card jam is not in punch station (C), remove jammed cards and proceed with steps 4 through 6. If card jam is in punch station, proceed with step 7.



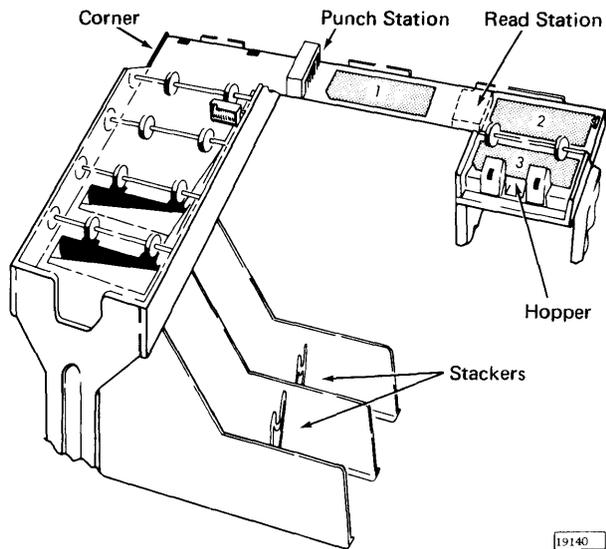
4. Close covers and press NPRO to reset error condition and run out any cards in card feed or transport areas.
5. Reconstruct any damaged cards and place card deck back into hopper.
6. Press START. This places 1442 in ready status by initiating a run in cycle.



7. Turn two twist-type fasteners (D) on inside of rear cover counterclockwise and lower cover.
8. With power on, rotate punch unit handwheel (E) in direction of arrow at least one-half revolution.



9. Push down on punch feed release lever (F) and pull out card. If card remains jammed, loosen lower punch guide holding screw (G) and remove lower punch guide. If necessary, raise plastic card guide (H). The card should now be easily removed.
10. Replace lower punch guide if it was removed.
11. Close rear and top covers.

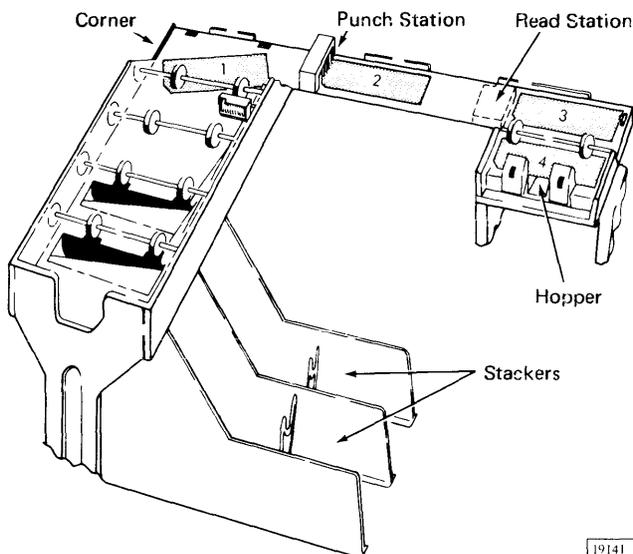


Feed Check (punch station) indicates that card 1 is improperly positioned in punch station at completion of its feed cycle.

Error Indication: PUNCH STA and CHECK.

Card Positions After Error: Shown at left.

- Procedure:
1. When program halts, empty hopper and clear 1442 card path.
 2. Place cards 1 and 2 in front of card 3 and return deck to hopper.
 3. Press START to ready 1442.

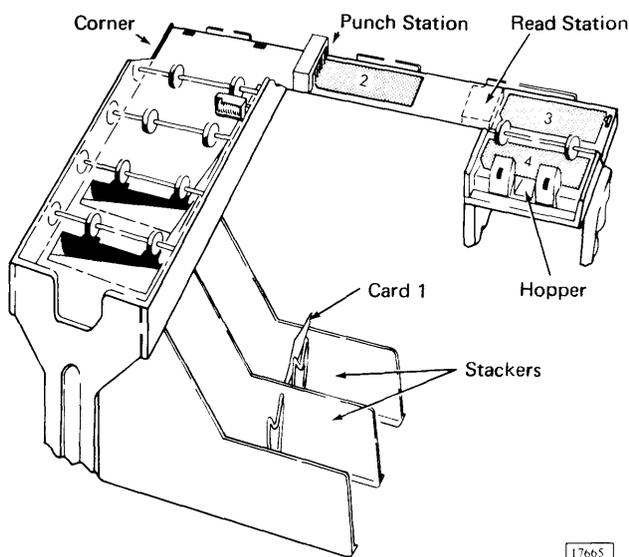


Transport indicates that card 1 has jammed in area between punch station and stacker during feed cycle for card 2.

Error Indication: TRANS and CHECK.

Card Positions After Error: Shown at left.

- Procedure:
1. When program halts, empty hopper and clear 1442 card path.
 2. Place cards 2 and 3 in front of card 4 and return deck to hopper.
 3. Press START to ready 1442.

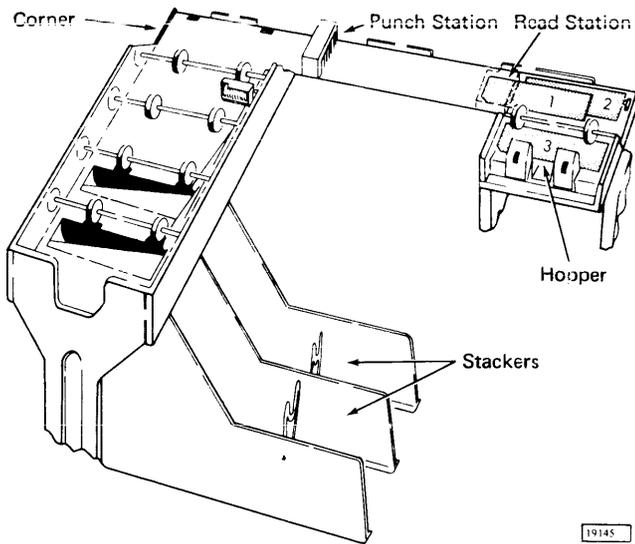


Feed Cycle indicates that 1442 took an unrequested feed cycle and, therefore, cards 1, 2, and 3 are each one station farther ahead in 1442 card path than they should be.

Error Indication: FEED CLU and CHECK.

Card Positions After Error: Shown at left.

- Procedure:
1. When program halts, empty hopper and press NPRO to eject cards 2 and 3.
 2. Place cards 1, 2, and 3 in front of card 4 and return deck to hopper.
 3. Press START to ready 1442.

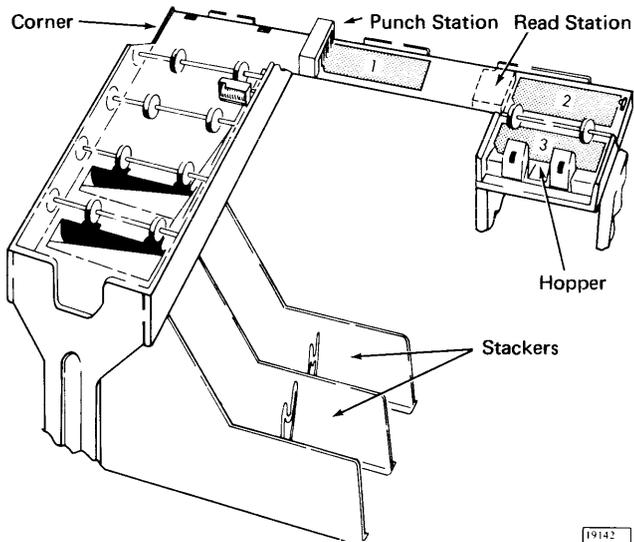


Feed Check (read station) indicates that card 1 failed to eject from read station during its feed cycle.

Error Indication: READ STA and CHECK.

Card Positions After Error: Shown at left.

- Procedure:
1. When program halts, empty hopper and clear 1442 card path.
 2. Place cards 1 and 2 in front of card 3 and return deck to hopper.
 3. Press START to ready 1442.

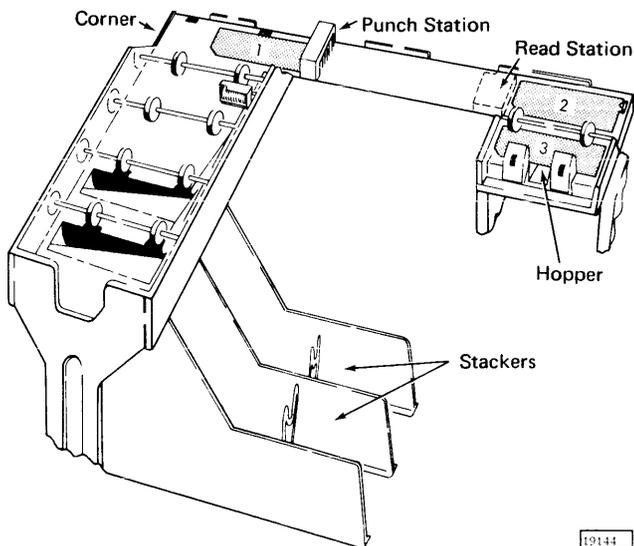


Read Registration indicates incorrect card registration or a difference between first and second reading of a card column.

Error Indication: READ REG and CHECK.

Card Positions After Error: Shown at left.

- Procedure:
1. When program halts, empty hopper and clear 1442 card path.
 2. Place cards 1 and 2 in front of card 3 and return deck to hopper.
 3. Press START to ready 1442.

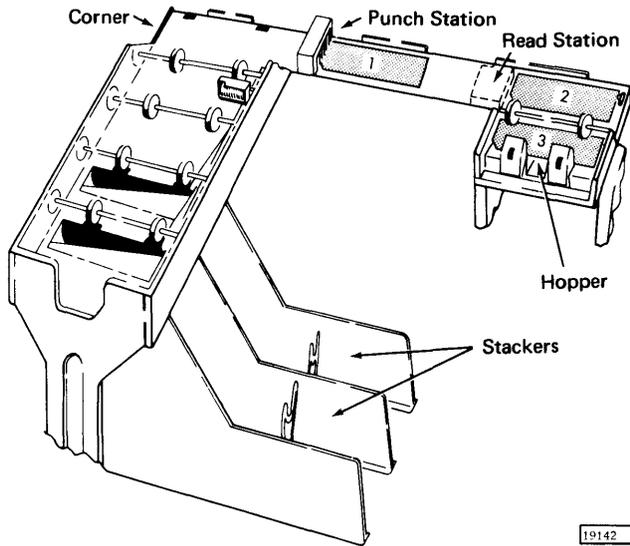


Punch Check indicates an error in output punching.

Error Indication: PUNCH and CHECK.

Card Positions After Error: Shown at left.

- Procedure:
1. When program halts, empty hopper and press NPRO to eject cards 1 and 2.
 2. If necessary, reconstruct card 1 to pre-punched state.
 3. Place reconstructed card 1 and card 2 in front of card 3 and return deck to hopper.
 4. Press START to ready 1442.

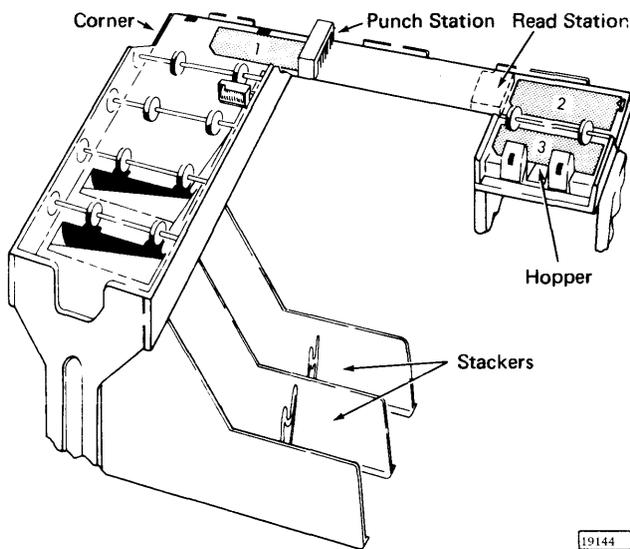


Overrun (read operation) indicates that data was lost because the data channel failed to transfer data to main storage within the time the 1442 required service.

Error Indications: **OVERRUN** and **CHECK**.

Card Positions After Error: Shown at left.

- Procedure:
1. When program halts, empty hopper and press **NPRO** to eject cards 1 and 2.
 2. Place cards 1 and 2 in front of card 3 and return deck to hopper.
 3. Press **START** to ready 1442.

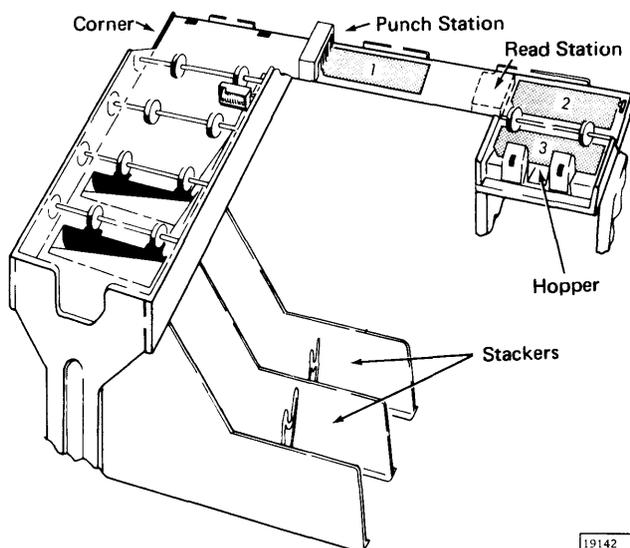


Overrun (punch operation) indicates that data was lost because the data channel failed to transfer data from main storage within the time the 1442 required service.

Error indication: **OVERRUN** and **CHECK**.

Card Positions After Error: Shown at left.

- Procedure:
1. When program halts, empty hopper and press **NPRO** to eject cards 1 and 2.
 2. If necessary, reconstruct card 1 to pre-punched state.
 3. Place reconstructed card 1 and card 2 in front of card 3 and return deck to hopper.
 4. Press **START** to ready 1442.

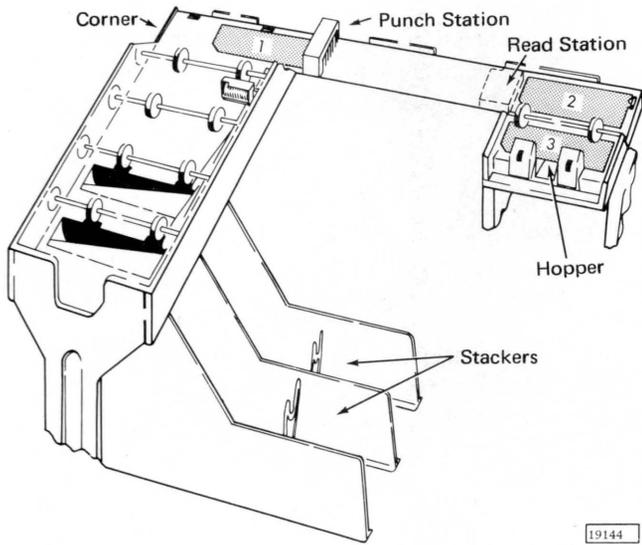


Parity (read operation) indicates incorrect (even) parity detected on data transfer to processor-controller.

Error Indication: No 1442 error lights will be on.

Card Positions After Error: Shown at left.

- Procedure:
1. When program halts, empty hopper and press **NPRO** to eject cards 1 and 2.
 2. Place cards 1 and 2 in front of card 3 and return deck to hopper.
 3. Press **START** to ready 1442.

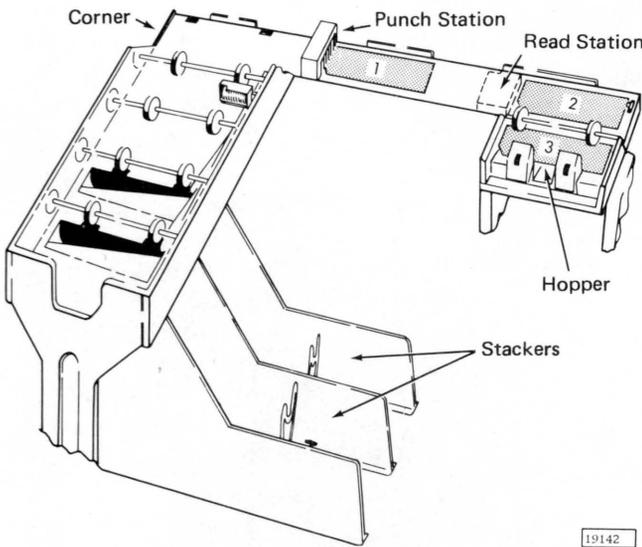


Parity (punch operation) indicates incorrect (even) parity detected on data transfer from processor-controller.

Error Indication: No 1442 error lights will be on.

Card Positions After Error: Shown at left.

- Procedure:
1. When program halts, empty hopper and press NPRO to eject cards 1 and 2.
 2. If necessary, correct card 1 to pre-punched state.
 3. Place corrected card 1 and card 2 in front of card 3 and return deck to hopper.
 4. Press START to ready 1442.

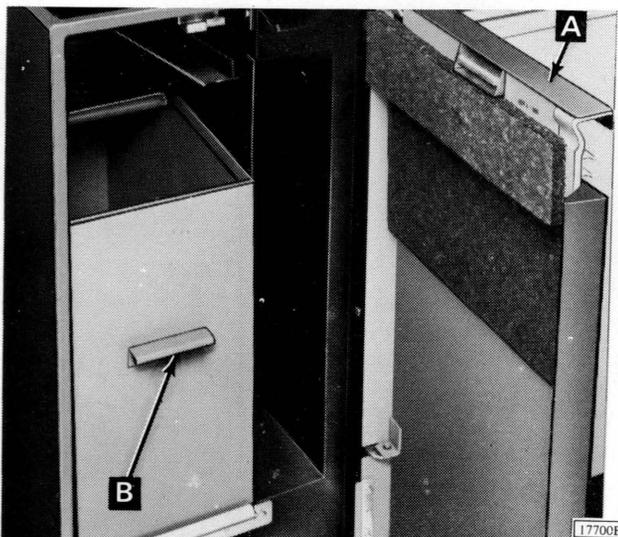


Storage Protect indicates attempt to read a column into a storage-protected location.

Error Indication: No 1442 error lights will be on.

Card Positions After Error: Shown at left.

- Procedure:
1. When program halts, empty hopper and press NPRO to eject cards 1 and 2.
 2. Place cards 1 and 2 in front of card 3 and return deck to hopper.
 3. Press START to ready 1442.



Chip Box indicates that chip box is full or has been removed from the machine.

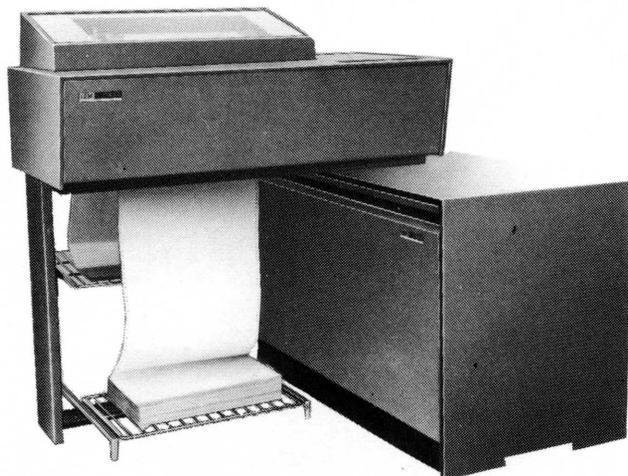
Error Indication: CHIP BOX.

- Procedure:
1. Open front left door (A) of 1442.
 2. Using handle (B), pull box from unit and empty.
 3. Replace box and close door.
 4. Press START to return 1442 to ready status.

IBM

1443

Printer



IBM 1443 Printer

The IBM 1443 Printer provides high-speed on-line printing capabilities for the 1800 system. The 1443 (maximum of one per system) is a buffered printer and operates under data channel control.

The data to be printed must be edited and arranged in main storage in the exact form that it is to be printed. One complete line of data is transferred via a data channel to the 1443 print buffer for each write operation. When a complete line is transferred to the buffer, the 1443 prints the line.

Alphabetic, numeric, and special characters are located on a bar that travels back and forth in a horizontal plane. To print, a magnet releases a spring-loaded hammer at the proper time so the desired character is pressed against the ribbon and paper (Figure 12).

Four distinct character sets are available. The character set and 1443 Model (1 or 2) determine the printing speed as shown in the following table.

Character Set	Lines per Minute	
	1443 - 1	1443 - 2
13	430	600
39	190	300
52	150	240
63	120	200

15565C

The 52-character set is standard. A selective character feature must be ordered for any other character set.

Carriage

The carriage is tape controlled and advances the form as indicated by the stored program. Vertical spacing is manually set for either six or eight lines to the inch. The carriage can be single, double, or triple spaced. These operations are planned in the program when spacing operations are required.

The carriage commands give flexibility to spacing operations by providing linespacing and forms skipping on an immediate or delayed basis. The commands are used with a control tape which is arranged to identify the format of the form being used.

The carriage is a tractor-feed type with no provisions for pressure feeding documents. Therefore, the forms must be continuous with marginal punching on both edges. Forms can be from 4 to 16-3/4 inches in overall width. Maximum form depth is 22 inches at six lines per inch vertical spacing or 16-1/2 inches at eight lines per inch vertical spacing.

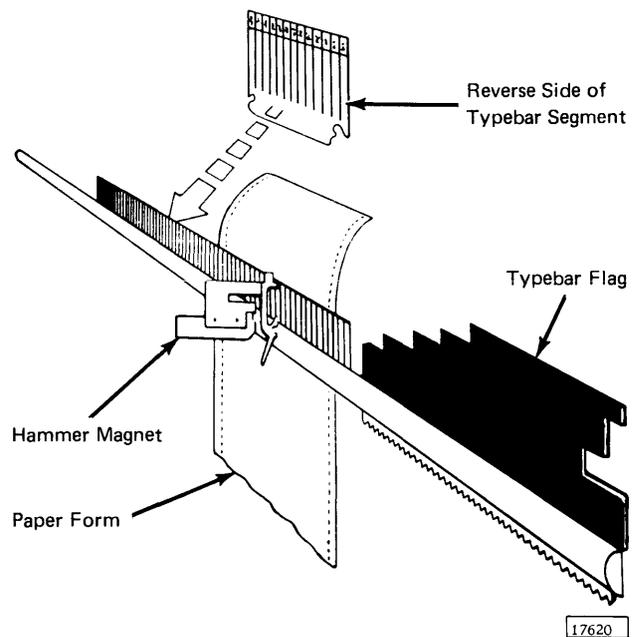


Figure 12. 1443 Printing Schematic

OPERATOR CONTROLS (Figure 13)

The Power On Light indicates when power is applied to the printer control circuits.

The Ready Light indicates that the printer has been conditioned to accept commands from the system. READY is turned off when:

1. STOP or CARRIAGE STOP is pressed.
2. The printer runs out of forms and control tape channel-1 punch is sensed.
3. The typebar motor switch is turned to OFF.
4. Control tape-brush assembly is opened.
5. Six-to-eight line drive cover is opened.
6. A form check switch on form tractor is actuated.

The SYNC (Synchronization) Check Light turns on when the typebar is out of synchronism with the printer. When this occurs, the printer is removed from ready status. Pressing RESET turns the light off.

The Parity Check Light turns on when a parity error

is detected by the error checking circuits. It is reset by pressing console RESET, printer RESET, or when the parity error indicator is program tested by a branch-if-indicator on instruction.

The Form Check Light turns on when a form-check switch on a form tractor is actuated to indicate improper feeding, or the form guide plates are not in operating position.

The End-of-Form Light turns on when approximately 4 inches of the last form remains to be printed. The printer continues to operate until ready status is reset by sensing the next control tape channel-1 punch. Pressing START places the printer in ready status and allows printing to continue until another channel-1 punch is sensed. Ready status will again be reset.

The Carriage Interlock Light turns on if the typebar motor is on and the tape-brush assembly is not closed or the cover over the six-to-eight line drive is open.

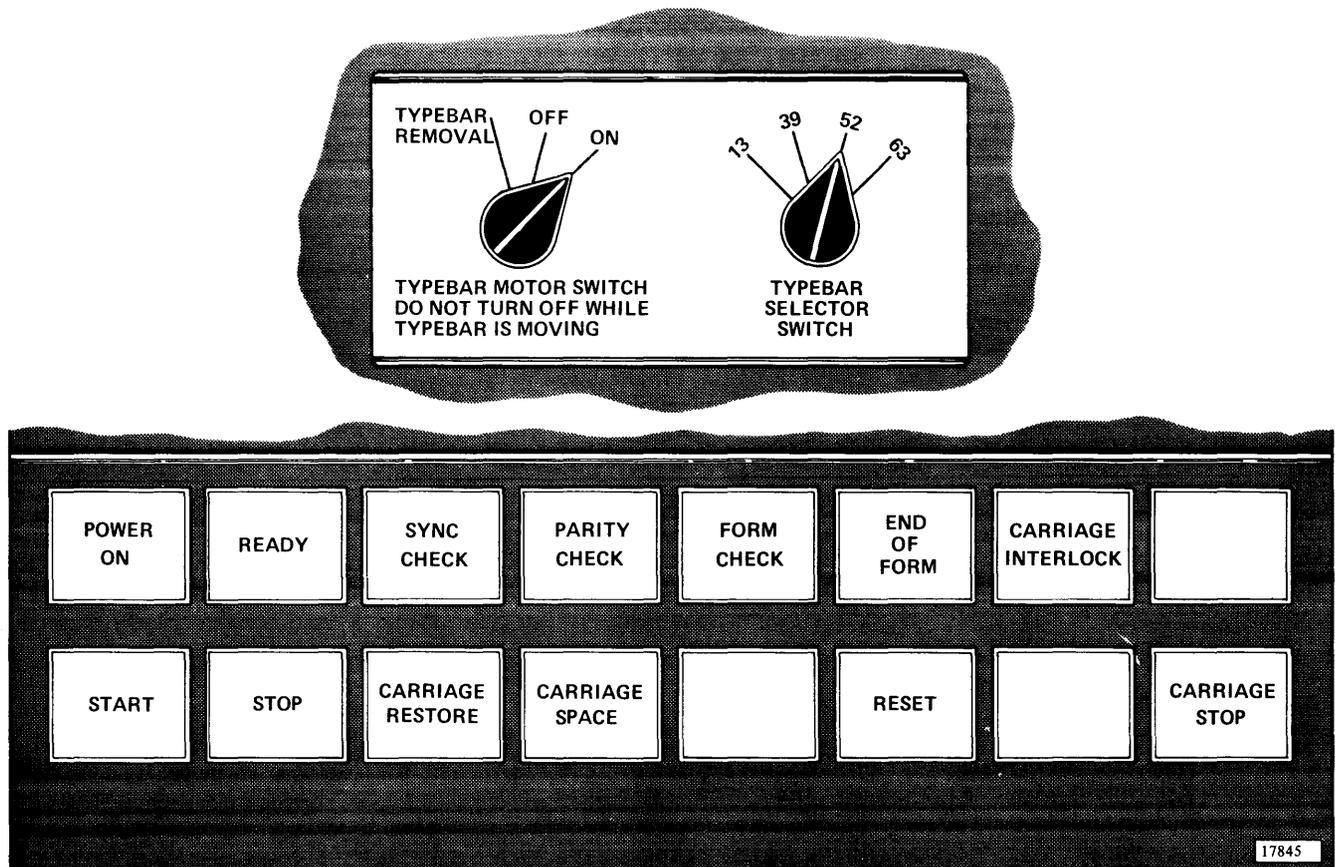


Figure 13. 1443 Keys, Switches, and Lights

The *Start Key*, when pressed, places the 1443 in ready status providing the following conditions are met:

1. Ac and dc power are on.
2. Form guide plates are closed.
3. Typebar is in position.
4. Typebar removal switch is set to ON.
5. Carriage brush assembly is closed.
6. Six-to-eight line drive cover closed.
7. End-of-form switch not actuated.
8. No error condition exists.

The *Stop Key*, when pressed, removes the printer from ready status and turns off the ready light. If a print or control operation is already in progress, it is completed. If a print or control operation is not in progress, all further action is prevented until START is pressed.

The *Carriage Restore Key* is effective only when the ready light is off. Pressing this key causes the carriage to advance to the next channel-1 punch in the control tape. If the carriage clutch is disengaged, the form does not move.

The *Carriage Space Key* is effective only when the ready light is off. Pressing this key causes the carriage to advance one line space. If the carriage clutch is disengaged, the form does not move.

The *Reset Key*, when pressed, causes all printer check

circuit indicators to be reset.

The *Carriage Stop Key*, when pressed, stops carriage operation and turns off the ready light. Do not press CARRIAGE STOP to stop printer operations; upon restarting, overprinting may occur.

The *Typebar Motor Switch* is located under the top cover and behind the operator panel. This switch is turned to ON for normal operation. With the switch at OFF, the ribbon motor, typebar motor, and ready light are turned off; however, ribbon and typebar control circuits remain active. With the switch at TYPEBAR REMOVAL, the ribbon motor, typebar motor, and ready light are turned off. Ribbon and typebar control circuits are also turned off to permit typebar removal. Use this position when removing or installing a typebar.

Do not turn this switch to OFF or TYPEBAR REMOVAL while the typebar is in motion.

The *Typebar Selector Switch* is located under the top cover behind the operator panel. This switch has four positions (13, 39, 52, and 63) and is used to select the character bar being used. The switch must be set to the position indicating the typebar being used or a sync check occurs.

This switch is installed only if the selective character feature is installed.

MANUAL CONTROLS, LEFT SIDE (Figure 14)

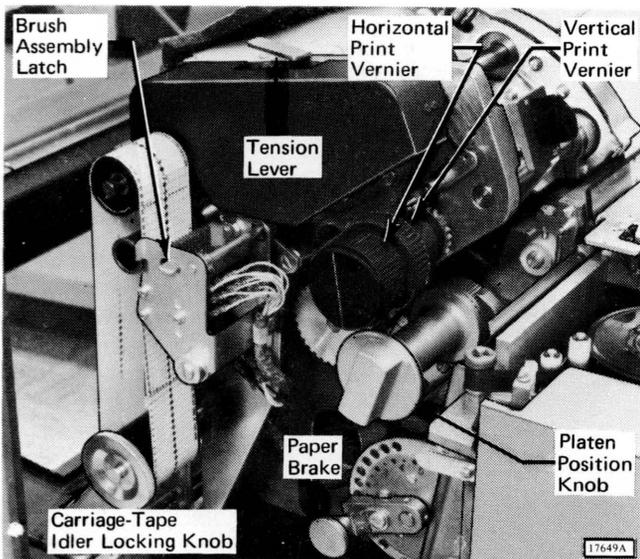


Figure 14. 1443 Manual Controls, Left Side

The *Paper Brake Control* is used to maintain a horizontal print line by providing drag on the forms. The control has 11 positions: 0 through 5 in half-step increments. The higher positions increase the amount of drag exerted on the forms. Excessive pressure results in tearing the forms. Too little pressure results in a wavy print line or unequal spacing.

Suggested paper brake settings are:

Parts Per Form	Setting
1	1-1/2 or 2
2	1-1/2 or 2
4	2-1/2 or 3
6	2-1/2 or 3

The *Carriage-Tape Idler Locking Knob* is used to remove excess slack from control tapes up to 132 lines in length.

The *Platen Positioning Knob* is used to compensate for different thickness of forms by adjusting the platen toward or away from the typebar. Sixteen positions are provided

by the control. Setting 3 is in the standard position for average one-part form of regular weight paper.

Suggested platen settings are:

Parts Per Form	Thickness	Setting
1	.002-.005	3
2	.006-.012	4 or 5
4	.014-.026	6 to 10
6	.022-.030	8 to 11
Regular Card		
Stock	.007-.015	6

The Brush Assembly Latch is used to facilitate removal and insertion of control tapes. Lifting on the latch releases the brush assembly and it swings forward. The carriage inter-

lock light turns on when the latch is released and the type-bar motor is running. The ready light is also turned off.

The Tension Lever provides tension on the six-to-eight line drive belt and is used when switching from six to eight or eight to six line spacing.

The Horizontal Print Vernier is used to align forms in the printer such that printing is aligned with previously printed material. The forms tractor can be positioned to the approximate position and locked to the guide. Final adjustment is then made with the horizontal print vernier. This control is capable of moving the forms tractor a maximum of 1/2 inch.

The Vertical Print Vernier is used to position forms such that printing is in a straight line with previously printed material.

MANUAL CONTROLS, FRONT (Figure 15)

The Manual Clutch Knob controls the carriage tape drive and tractor mechanisms. With the knob positioned at OUT, the form tractor is disengaged so forms do not move with the carriage. With the knob positioned at IN, the form tractor is engaged and forms move in synchronization with the carriage.

The Tractor Doors keep marginal-punched holes in the forms feeding properly on the carriage drive pins. One

tractor door is located on each carriage tractor. Both doors open to allow insertion of forms.

The Form Guide Plates help guide forms to the stacker area. Each guide plate has a form check switch, which is actuated if the guide is lifted a small amount.

The Print Position Indicator is used to locate any print position on the printed line.

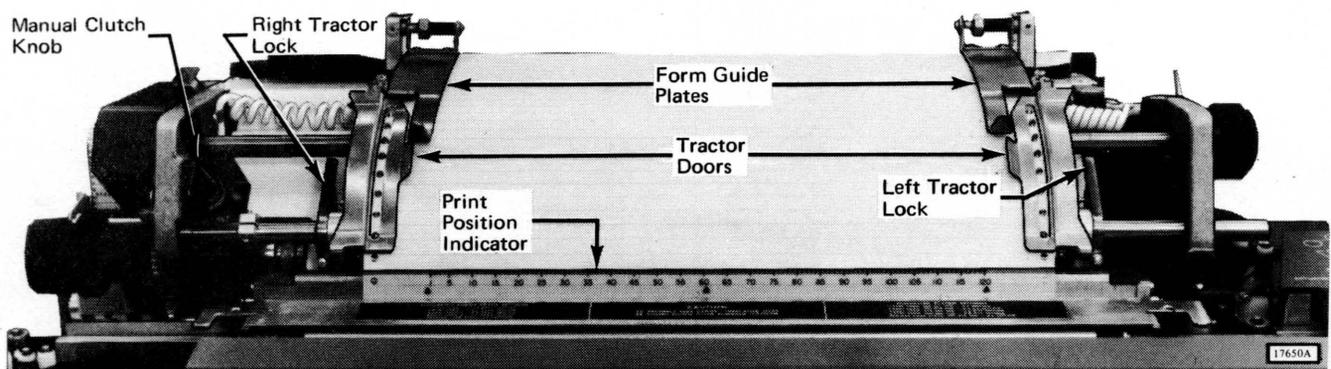


Figure 15. 1443 Manual Controls, Front

MANUAL CONTROLS, RIGHT SIDE (Figure 16)

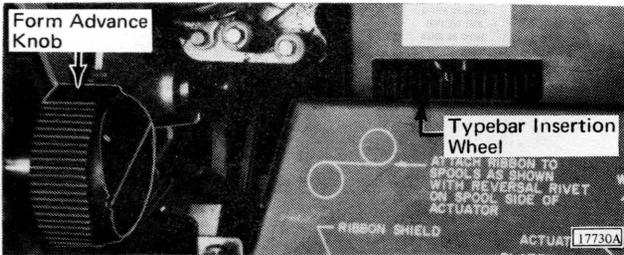
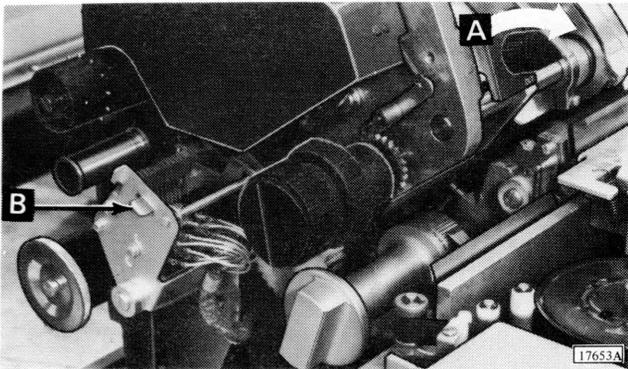


Figure 16. 1443 Manual Controls, Right Side

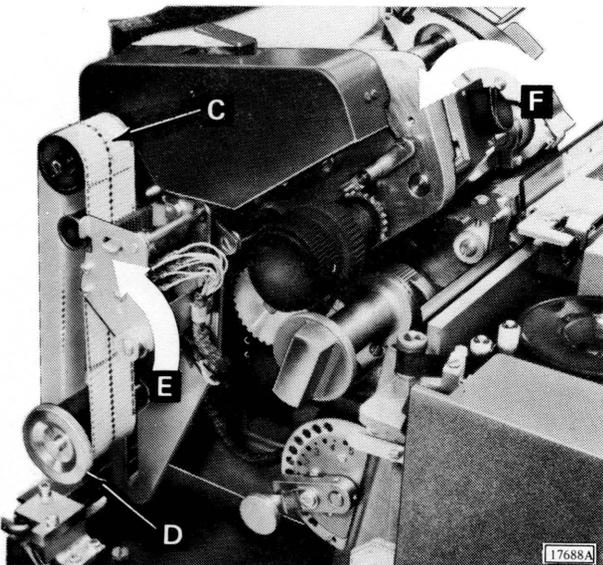
The *Form Advance Knob* is used to manually advance forms in the printer. To use the form advance knob, the manual clutch knob should be set to OUT.

The *Typebar Insertion Wheel* is used to manually position the typebar.

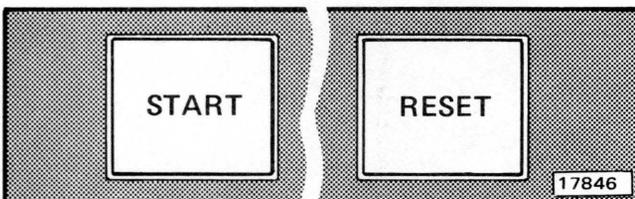
INSERTING A CONTROL TAPE



1. Raise top cover of printer to gain access to control tape reading mechanism.
2. Turn manual clutch knob (A) to OUT.
3. Raise brush assembly by lifting brush assembly latch (B).

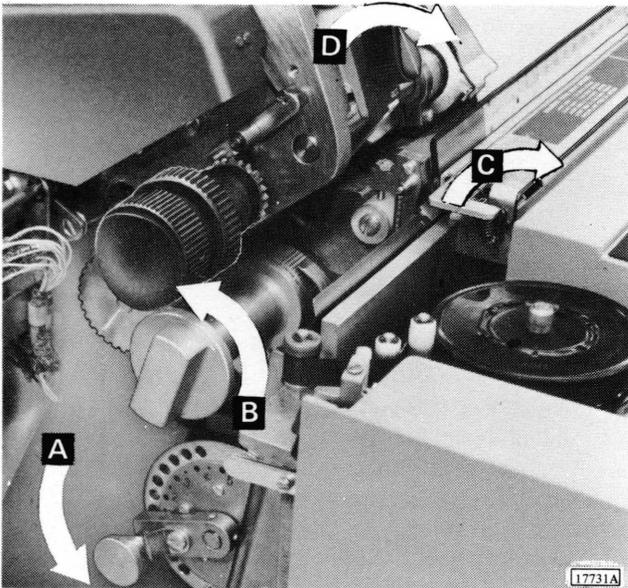


4. Place one end of control tape, held so printed captions can be read, over pin-feed drive wheel (C) and engage pins in center drive holes of control tape.
5. Place opposite end of loop around adjustable carriage tape idler (D).
6. Remove excess slack from tape by loosening carriage tape idler locking knob (D) and moving idler in its track.
7. Tighten carriage idler locking knob when desired tension is reached. Tape should give slightly when middle portions of loop are pressed together.
8. Press brushes (E) into operating position.
9. Press CARRIAGE RESTORE to bring tape to channel-1 punch (home position).
10. With forms located at first print line, turn manual clutch knob (F) back to IN.

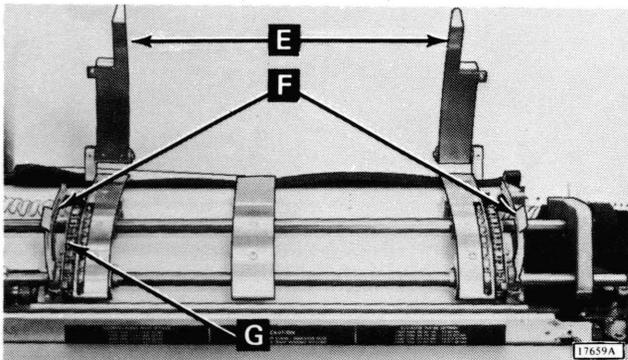


11. Close top cover of printer and press START to ready printer.

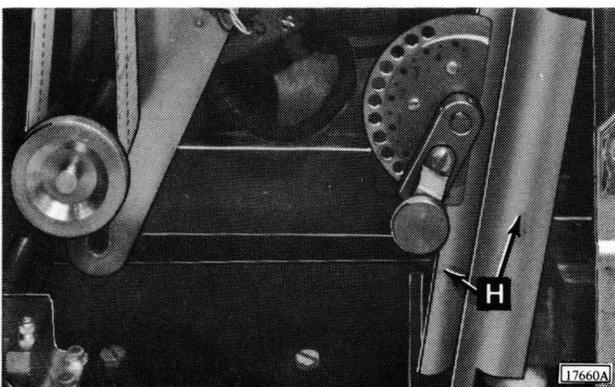
INSERTING FORMS



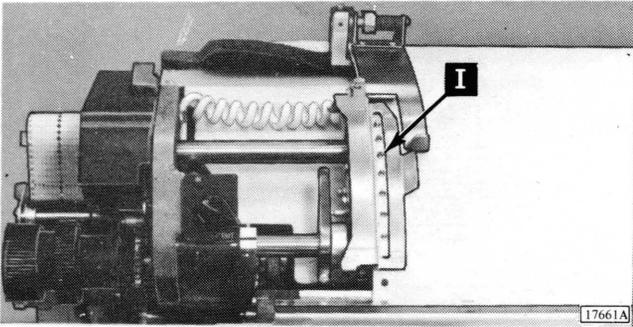
1. Raise top cover of printer to gain access to carriage and form controls.
2. Turn paper brake control (A) counterclockwise as far as possible and lock.
3. Turn platen positioning control (B) fully counterclockwise.
4. Lift print position indication (C).
5. Turn manual clutch knob (D) to OUT.



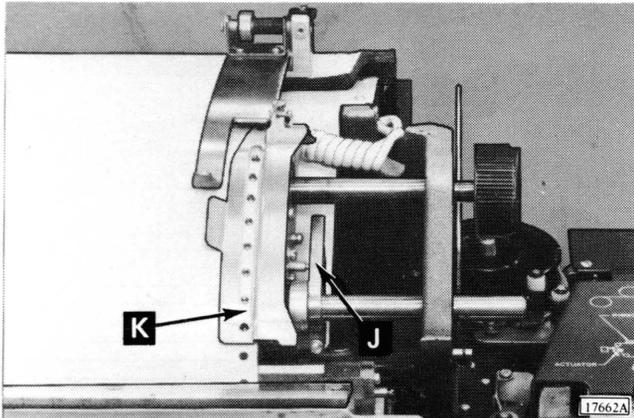
6. Lift form guide plate (E) and tractor door (F) on each tractor.
7. Position left form tractor slightly to left of first printing position. This is done by pressing down on left tractor lock (G) and sliding tractor to desired location.



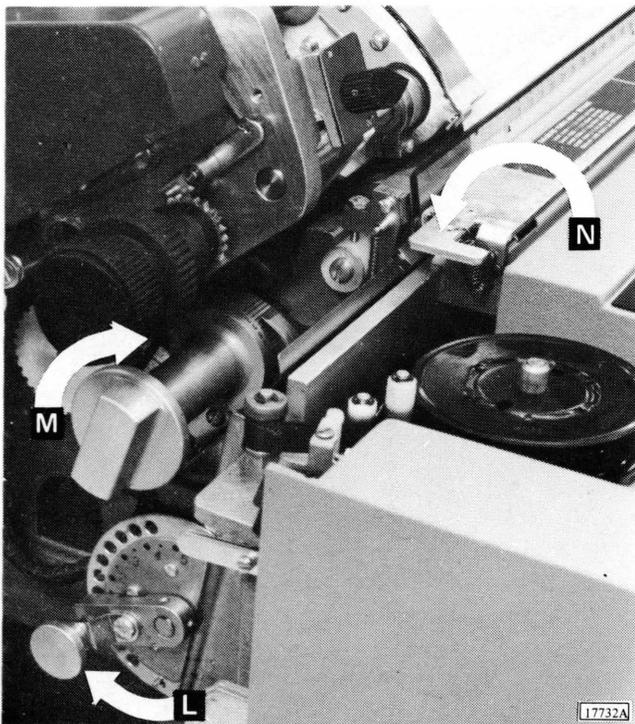
8. Slide forms between form guides (H) on left side of printer and into position in front of carriage.



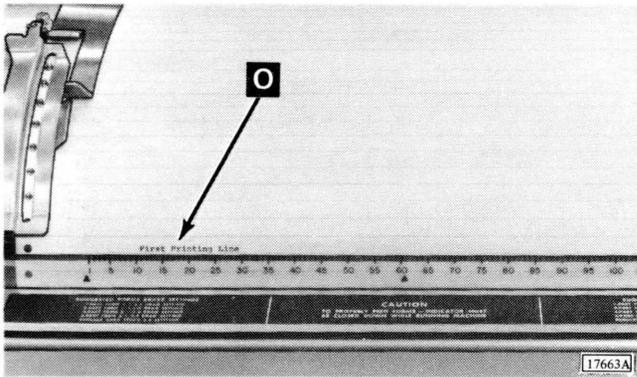
9. Place marginal punched holes over left tractor drive pins (I). Close tractor door and left guide plate.
10. Move left form tractor and form until first printing position on form is approximately aligned with desired print position on 1443. Lock tractor at desired location by pulling up on tractor lock lever.



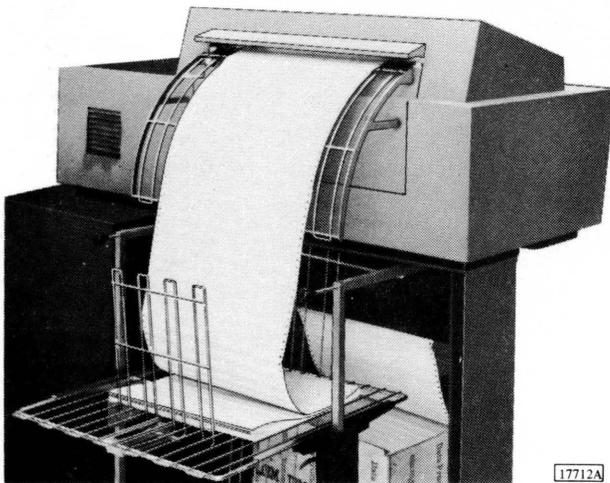
11. Move right form tractor to coincide with marginal punched holes on right side of forms. This is done by pressing down on tractor lock lever (J) and sliding tractor to desired position.
12. Place marginal punched holes on right side of forms over drive pins (K) on right tractor. Close tractor door and right guide plate.
13. Remove slack in form by sliding tractor on right side. Lock it at desired position by pulling up on lock lever.



14. Adjust paper brake control (L) and platen positioning control (M) to desired settings.
15. Lower print position indicator (N).
16. Set carriage drive to either six or eight lines per inch, depending on form to be used.

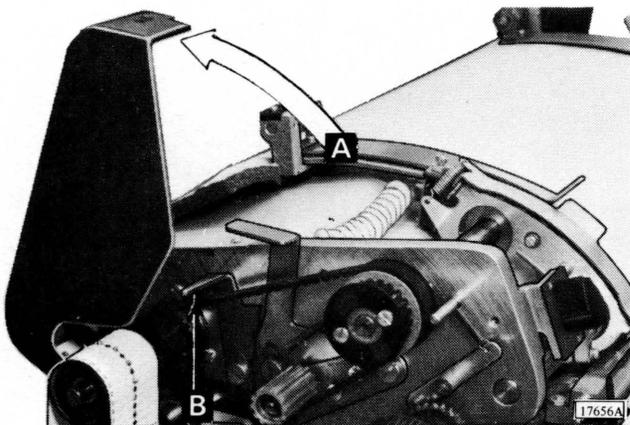


17. Turn form advance knob until block, line or area on which first line of print is to occur is just visible above print position indicator (O).
18. Align desired print position to form with horizontal print vernier.
19. Release paper brake, turn platen positioning control fully counterclockwise, and raise print position indicator.
20. Turn form advance knob backward ten line spaces if in six-line drive, or 12 line spaces if in eight-line drive.

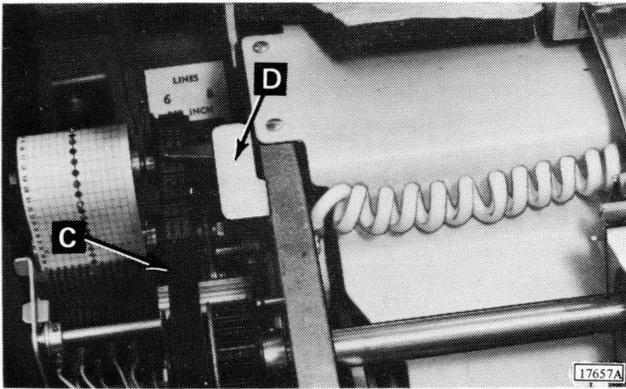


21. Reset paper brake and platen positioning controls to desired settings. Lower print position indicator.
22. Restore carriage tape to first printing line by pressing CARRIAGE RESTORE.
23. Set manual clutch to IN.
24. Close top cover on printer.
25. Position paper supply so forms feed straight up into machine.
26. Press RESET and then START to place printer in ready status.
27. When printing begins, attention is required behind printer. The first forms must be adjusted in stacker so they fold flatly.

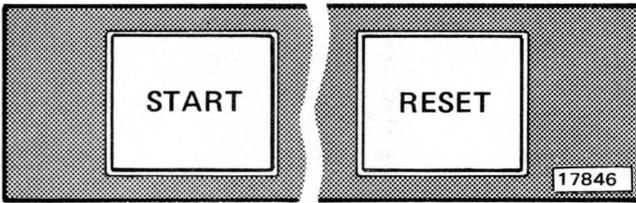
SWITCHING THE SIX-TO-EIGHT LINE DRIVE



1. Raise top cover of printer to gain access to drive shift controls.
2. Raise six-to-eight line drive cover (A).
3. Release tension lock release lever (B) by pressing back on lever.

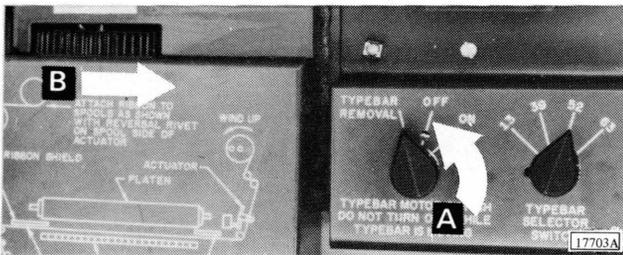


4. Move drive belt (C) to pulleys corresponding to desired line drive. Pulleys on left are six line drive. Pulleys on right are eight line drive.
5. Verify that ribs on belt and gears on pulleys are meshed.
6. Press down on tension lever (D) to remove slack from belt. Drive belt should be snug on pulleys.
7. Release pressure on tension lever. Tension on drive belt should be automatically locked by tension lock mechanism.

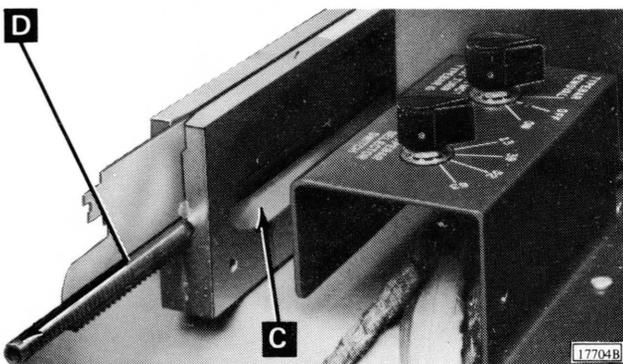


8. Close cover of six-to-eight line drive and top cover of printer.
9. Press RESET and then START to place printer in ready status.

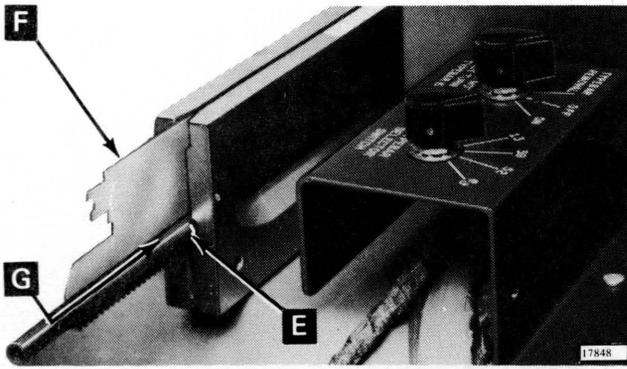
REMOVING OR INSERTING A TYPEBAR



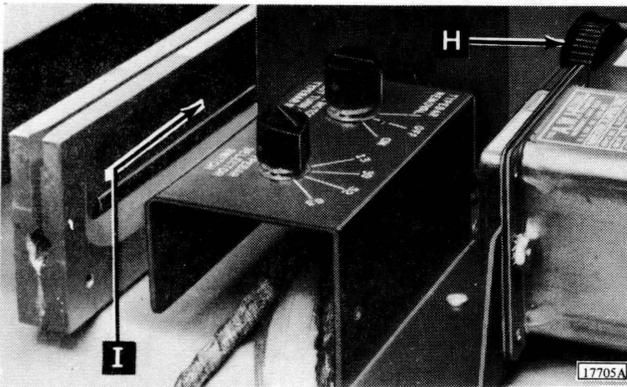
1. Raise top cover of printer to gain access to typebar and controls.
2. Turn typebar motor switch (A) to TYPEBAR REMOVAL. If inserting typebar, continue with step 7.
3. Manually rotate typebar insertion wheel (B) in clockwise direction until typebar is disengaged from drive wheel.



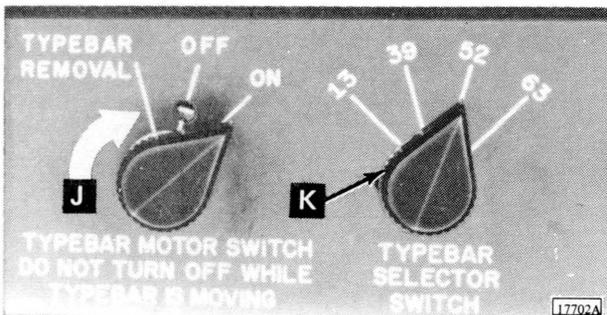
4. Grasping typebar at cutaway portion of typebar guide (C), move typebar to right until it protrudes from guide.
5. Pull typebar (D) in straight line parallel to the guide. Use caution when pulling typebar from machine as any bending force may result in damage to typebar.
6. Place typebar in its case and store on flat surface.



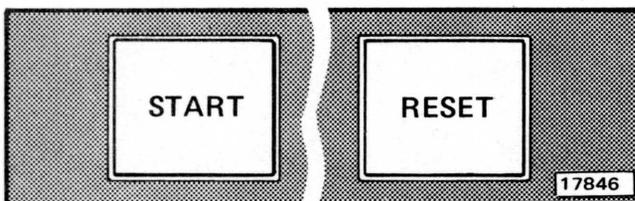
7. Remove new typebar from its case.
8. Place pointed end of typebar into opening in right side of typebar guide (E).
9. Line up flag (F) and type segments on typebar with slot in typebar guide and push typebar (G) slowly into guide. Push in straight line parallel to typebar guide.



10. While rotating typebar insertion wheel (H) in counter-clockwise direction, grasp typebar at cutaway portion of guide (I) and push it in to engage drive wheel.
11. Using typebar insertion wheel, align typebar flag with decal on typebar guide. Left edge of top portion of flag is alignment position for 39, 52, and 63 character typebars. Right edge of top portion of flag is alignment position for 13 character typebar.

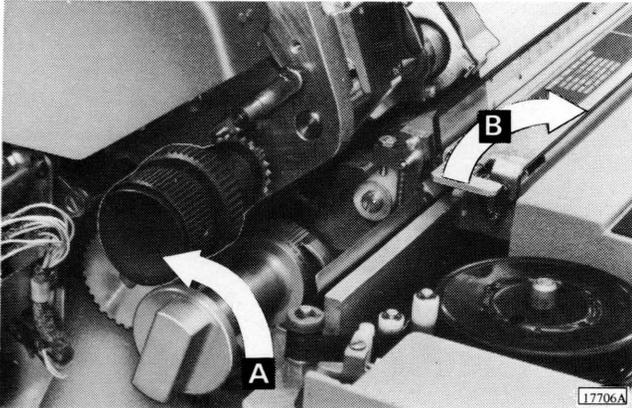


12. Turn typebar motor switch (J) to ON.
13. Turn typebar selector switch (K) to correspond with typebar inserted.

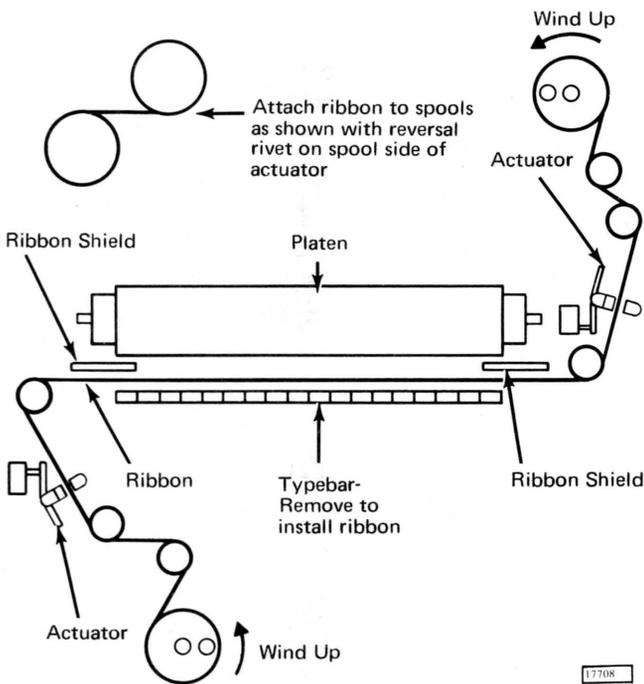


14. Close cover of printer.
15. Press RESET and then START to place printer in ready status.

REPLACING A RIBBON



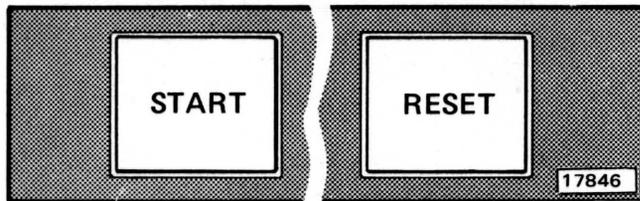
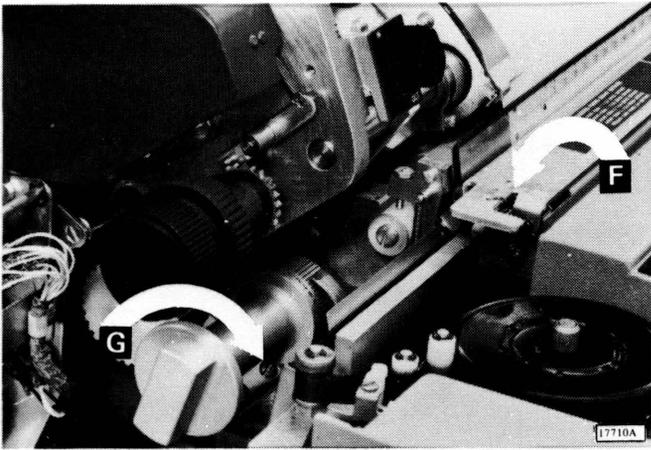
1. Raise top cover of printer to gain access to typebar and ribbon mechanisms.
2. Turn typebar motor switch to TYPEBAR REMOVAL and remove typebar.
3. Turn platen positioning control (A) fully counter-clockwise.
4. Raise print position indicator (B).



5. Lift ribbon spool from each ribbon drive. Save one empty spool and discard the other with the ribbon.
6. Install new ribbon as shown at left.



7. Verify that leading end of ribbon is firmly hooked onto empty spool and metal eyelet (C) on ribbon is somewhere between spool (D) and ribbon reversing mechanism (E).



8. Insert typebar and turn typebar motor switch to ON.
9. Lower print position indicator (F).
10. Reset platen positioning control (G) to desired setting.

11. Close cover of printer.
12. Press RESET and then START to place printer in ready status.

CLEARING A SYNC CHECK CONDITION

1. Raise cover of printer to gain access to typebar and typebar controls.
2. Using typebar insertion wheel, align typebar flag with decal on typebar guide. Left edge of top portion of flag is alignment position for 39, 52, and 63 character typebars. Right edge of top portion of flag is alignment position for 13 character typebar.
3. Verify that typebar selector switch is set to correspond with typebar in machine.
4. Close cover of printer.
5. Press RESET and then START to return printer to ready status.
6. If sync check persists, notify a customer engineer.

CLEARING A PARITY CHECK CONDITION

A parity check can be cleared by the program. A branch-if-indicator-on instruction testing the parity indicator causes the parity check to be reset. If a parity check is not reset by the program, it can be reset manually using

the following steps.

1. Press RESET to clear parity check condition.
2. Press START to place printer in ready status.
3. If parity check persists, notify a customer engineer.

CLEARING A FORMS CHECK CONDITION

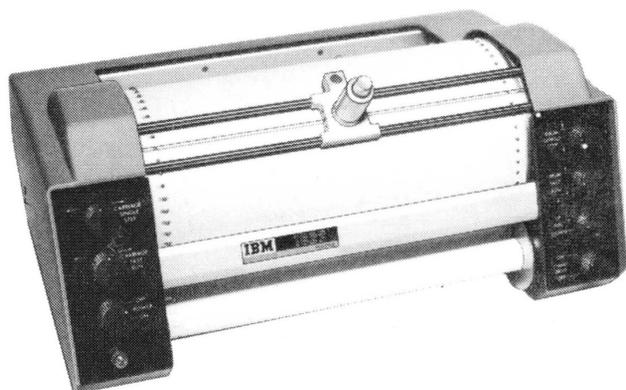
1. Raise cover of printer to gain access to form and carriage controls.
2. Clear any form jams that have occurred.
3. Verify that form guide plates and tractor doors are seated correctly.
4. Verify that form tractors are set properly.
5. Verify that paper brake control is set to recommended position for forms being used.
6. Close cover of printer.
7. Verify that forms being fed into printer are not restricted.
8. Press RESET and then START to place printer in ready status.

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IBM

1627

Plotter



IBM 1627 Plotter

The IBM 1627 Plotter provides an exceptionally versatile, and easy-to-operate plotting system for the 1800 system. One 1627 (model 1 or 2) can be attached to the 1800 system and operates under direct program control.

Plotting is initiated by a write command issued to the 1627, causing one word of data to be sent to the 1627. The data word is converted to incremental pen movement on the paper surface (y-axis) and/or incremental paper movement under the pen (x-axis).

The pen is mounted in a carriage that travels horizontally (in 1/100-inch increments) across the paper. Vertical plotting is achieved by rotation (in 1/100-inch increments) of the pin-feed drum, which also acts as a platen (Figure 17).

The drum and pen carriage are bidirectional; that is, the paper moves up or down and the pen moves right or left. Control is also provided to raise or lower the pen in relation to the chart surface.

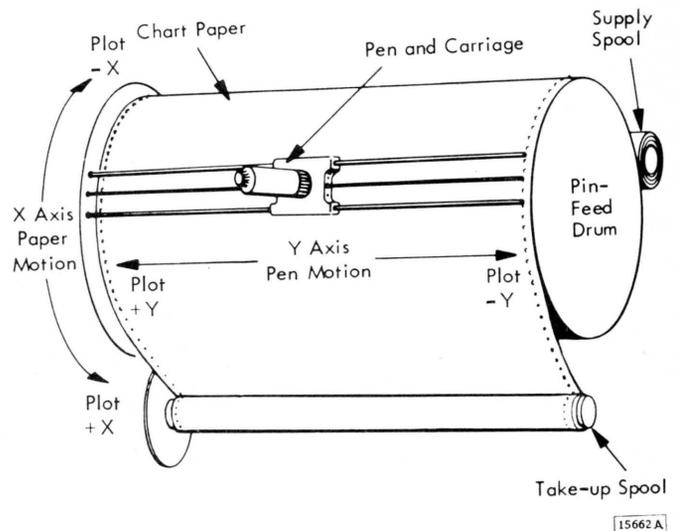


Figure 17. 1627 Pen and Paper Motions

OPERATOR CONTROLS, LEFT PANEL (Figure 18)



Figure 18. 1627 Switches, Left Panel

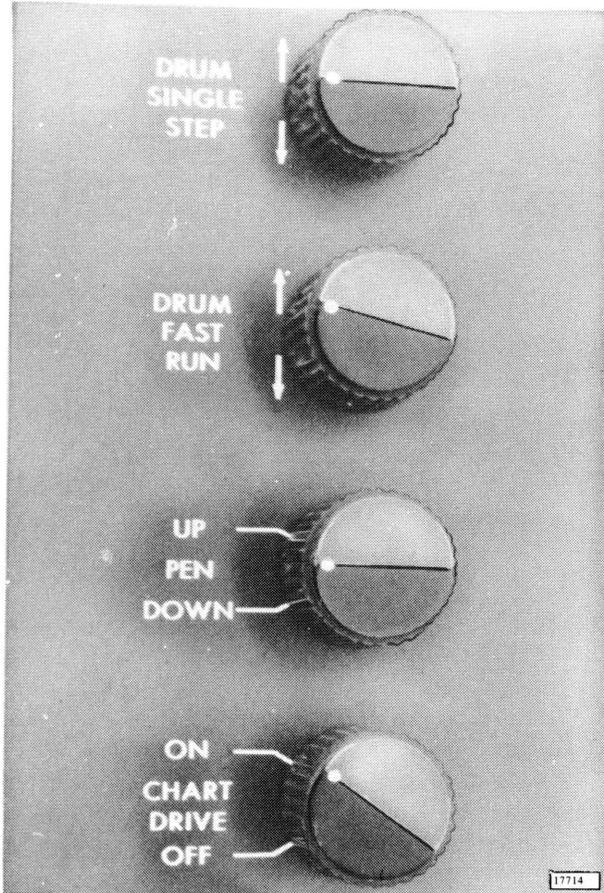
The Vernier Control is provided on the 1627 model 2 to vary the size of pen carriage increments. In this way, the pen traverse is adjusted to match the printed scale on the chart paper which may vary due to high or low humidity. For work with nonscale paper, the control should be centered at the zero position.

The Carriage Single Step Switch allows the pen carriage to be moved in single-step increments (1/100-inch) either left or right. This allows accurate manual alignment of carriage along the y-axis of the graph.

The Carriage Fast Run Switch allows the pen carriage to be stepped rapidly to the left or right at a rate of 120 steps per second. This switch is used to manually position the carriage.

The Power On/Off Switch is used to turn power on or off in the 1627. The power on light indicates when power is on in the 1627.

OPERATOR CONTROLS, RIGHT PANEL (Figure 19)



The *Drum Single Step Switch* allows the drum to move paper in single-step increments (1/100-inch) in either direction. This switch is used in conjunction with the carriage single step switch to permit accurate alignment of the pen on a point or fixed coordinate on the graph.

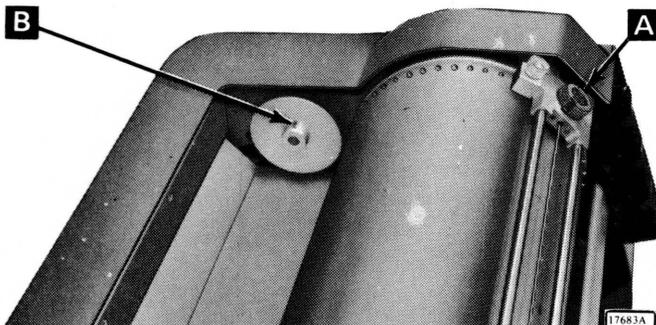
The *Drum Fast Run Switch* allows the drum to move paper rapidly up or down at a rate of 120 steps per second. This switch is used to manually position the drum.

The *Pen Up/Down Switch* provides a means for manually raising or lowering the pen in respect to the surface of the drum.

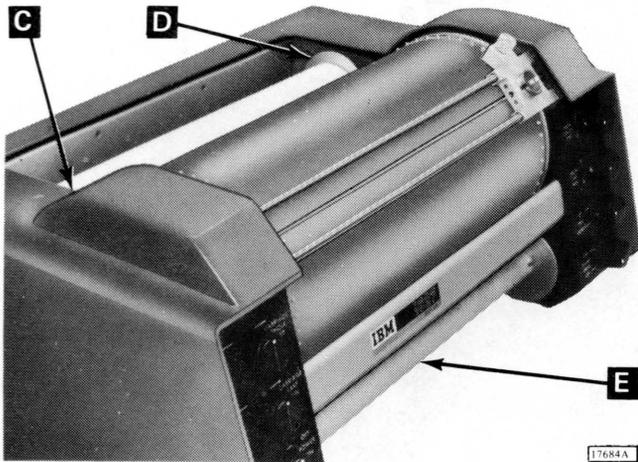
The *Chart Drive On/Off Switch* allows the supply and take-up spools to be disabled when plotting on single sheets of graph paper. This switch should be on when using roll paper.

Figure 19. 1627 Switches, Right Panel

INSTALLING A ROLL OF GRAPH PAPER

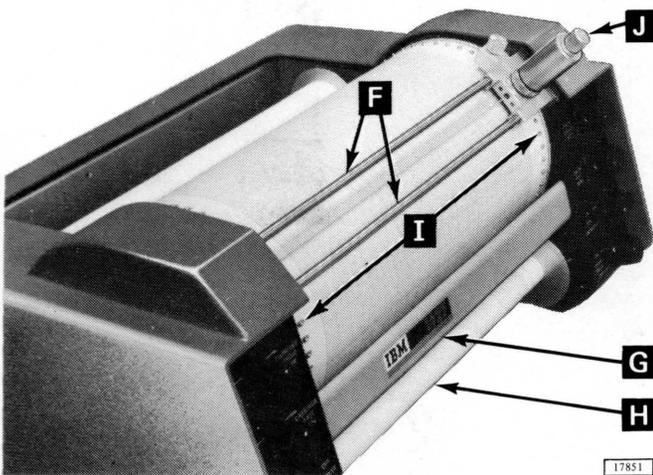


1. Turn power switch to OFF.
2. Loosen knurled knob at bottom of pen holder and lift pen assembly out of carriage (A). Use care when handling pen assembly as it is manufactured to close tolerance for optimum performance.
3. Rotate right rear chart spool by hand until drive key (B) is pointing upward.



17684A

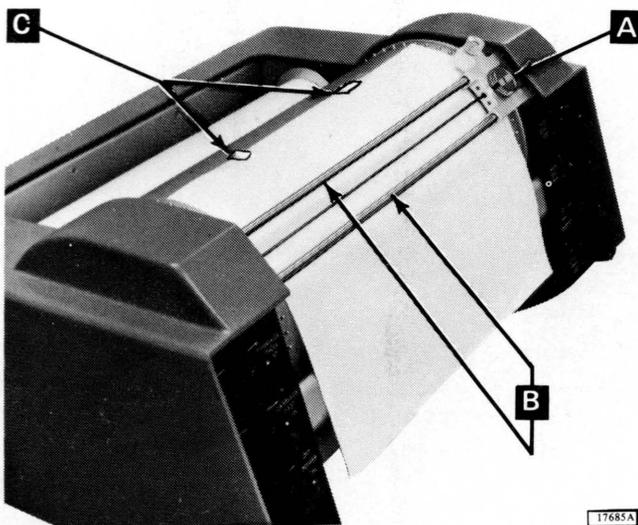
4. Holding new roll of graph paper so that key slot is pointing upward, place roll against left rear idler spool (C) and force spool to left.
5. Lower paper roll into paper well and slide right end onto drive spool (D).
6. Verify that drive key engages key slot in roll of graph paper.
7. Install paper roll core (E) on take-up spools below drum in same manner as the roll of graph paper.



17851

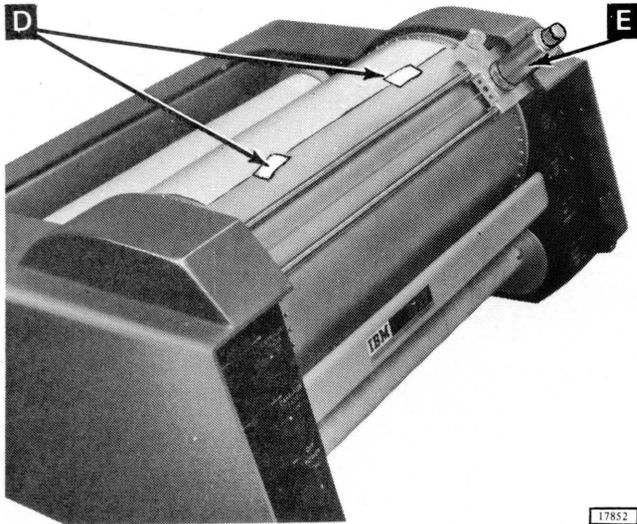
8. Pull short length of paper from roll, slide end under carriage rods (F), tearbar (G), and behind take-up spool (H).
9. Fasten paper to take-up spool with two or three short pieces of cellophane tape.
10. Wind one or two turns of paper onto take-up spool, while making certain that drum sprockets (I) are properly meshed with sprocket holes on both sides of paper.
11. Reinstall pen assembly (J) using reverse procedure outlined in step 2. Note that pen is down when power is off. Therefore, pen should be installed with carriage not in plotting area.
12. Turn power switch to ON. If pen does not raise when power is turned on, turn pen switch to DOWN, then to UP.

INSTALLING A SHEET OF GRAPH PAPER



17685A

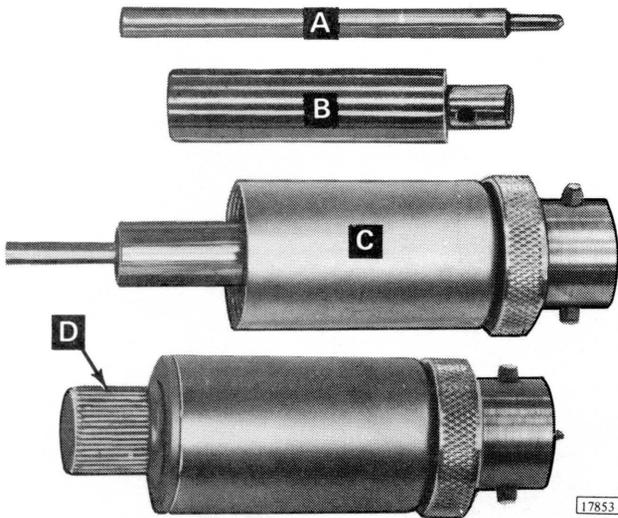
1. Turn power and chart drive switches to OFF.
2. Loosen knurled knob at bottom of pen holder and lift pen assembly out of carriage (A). Use care when handling pen assembly as it is manufactured to close tolerance for optimum performance.
3. Slide graph paper sheet under carriage rods (B) and onto drum surface.
4. Fasten top edge of paper to drum (C) with two or three short pieces of cellophane tape.



17852

5. Rotate drum by hand, keeping paper smooth and flat against drum surface.
6. Fasten bottom edge of paper (D) in same manner as top edge.
7. Reinstall pen assembly (E).
8. Turn power switch to ON. If pen does not raise when power is turned on, turn pen switch to DOWN, then to UP.

ASSEMBLING THE PEN



17853

1. Unscrew cap from holder.
2. Insert pen (A) into plunger (B).
3. Insert pen and plunger into holder (C).
4. Screw cap (D) onto holder.

Note: Since the life span of the pen is approximately 5 to 7 hours of writing, it may be desirable to replace the pen before plotting a critical project. Cleaning the pen tip after each hour of use is also recommended, to prevent blotting.

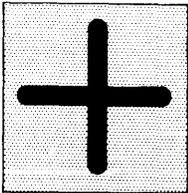
CHECKING PLOTTER OPERATION

1. Install graph paper and pen assembly.
2. Turn power and chart drive switches to ON.
3. Turn pen switch to DOWN and drum fast run switch to UP. Verify that pen traces a vertical line.
4. Turn pen switch to UP and verify that pen lifts off surface of paper.
5. Turn pen switch to DOWN and drum fast run switch to DOWN. Verify that pen retraces vertical line drawn in step 3.
6. Turn carriage fast run switch to left and verify that pen traces a horizontal line. When carriage reaches its limit of travel, turn carriage fast run switch to right, and verify that pen retraces horizontal line.

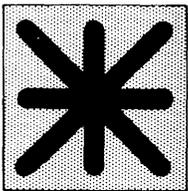
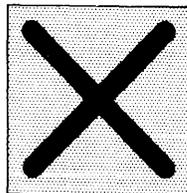
7. Alternately operate carriage single step and drum single step switches. Verify that both carriage and drum move only one step each time the respective switch is operated.
8. With carriage positioned near right side, set carriage fast run switch to left and drum fast run switch to DOWN. Allow pen carriage to run until it reaches left side; then turn both switches to off (center) position. Verify that pen traces a 45° line.
9. Operate drum single step switch several times in same direction. Turn carriage fast run switch to right and drum fast run switch to UP. When carriage reaches right side, turn both switches off. Verify that pen traces another 45° line parallel to the line previously traced.
10. Repeat steps 8 and 9, changing switch settings to produce two 45° lines at right angles to first two lines.

PROGRAM CHECKOUT ROUTINE

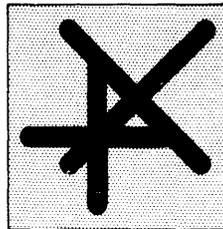
Step 1.



Step 2.



Final Result
Properly Aligned



Final Result
Improperly Aligned

23089

Many plotter programs contain a checking routine which provides a graphic representation to replace feedback checks used in other output units.

The logic of a program check is simple:

1. Plot a plus symbol (+) at the start of the program (outside the graph area).
2. Return to this location at the end of the program to superimpose an (x) over the plus symbol.

IBM

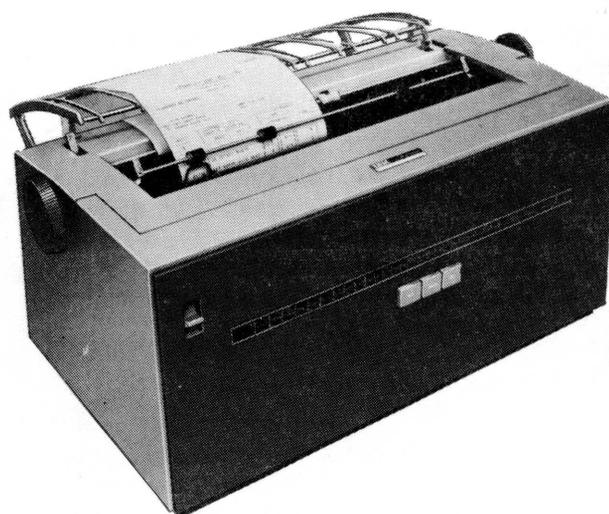


1816

Printer-Keyboard

1053

Printer



IBM 1816 Printer-Keyboard and IBM 1053 Printer

The IBM 1816 Printer-Keyboard provides console-keyboard entry and console-printer output for the 1800 system. The IBM 1053 Printer provides additional output typewriter printers for the 1800 system. A maximum of two 1816's and six 1053's, or one 1816 and seven 1053's, or eight 1053's can be attached to the 1800 system.

The printer portion of the 1816 is physically and functionally the same as the 1053 Printer. Therefore, the printer description is the same for these two units.

Printer

The printers provide output at a maximum rate of 14.8 characters per second and operate under direct program control. Data and control characters (space, tabulate, etc.) are sent to the printer by means of a write command issued to the printer. One data or control character is transferred to the printer by each write command. When

a character is received, the printer either prints the character or performs the control function specified by the character.

Keyboard

The input speed of the keyboard is 20 characters per second. The keyboard is also under direct program control.

When a key is struck, a coded character representing the key struck and a keyboard service interrupt are emitted by the keyboard. The keyboard service interrupt signals the program that a character is ready to be read into main storage. The character will be read into main storage by a subsequent read command from the stored program.

Keyboard entries are not automatically printed. The processor-controller must be programmed to provide a printed output for each keyboard entry.

OPERATOR CONTROLS, KEYBOARD (Figure 20)

The Tab Key causes the print-element carrier to move to the next tab stop when pressed.

The REST KBD (Restore Keyboard) Key, when pressed, unlocks the keyboard, releasing any key that is down. Pressing processor-controller console RESET also unlocks the keyboard.

The KBD REQ (Keyboard Request) Key, when pressed, causes an interrupt which signals the program that a keyboard entry is desired. The proceed light is turned off when this key is pressed.

The EOF (End-Of-Field) Key is effective only when the proceed light is on. Pressing this key enters a character indicating that no further characters are to be sent in this message.

The ER FLD (Erase Field) Key is effective only when the proceed light is on. Pressing this key enters a character indicating that the message being entered is to be deleted and replaced by a corrected message.

The Return Key, when pressed, causes the carrier to return to the left margin stop and advances the form a single or double space depending on the line-space lever setting.

The NUM (Numeric) Key is effective only when the proceed light is on. Pressing this key places the keyboard in numeric (upper case) mode. The keyboard remains in this mode until changed by pressing ALPHA.

The ER CHR (Erase Character) Key is effective only when the proceed light is on. Pressing this key enters a character indicating that the last character entered is to be replaced by the next character entered.

The ALPHA (Alphabetic) Key is effective only when the proceed light is on. Pressing this key places the keyboard in alphabetic (lower case) mode. The keyboard remains in this mode until changed by pressing NUM.

The Space Bar is effective only when the proceed light is on. Pressing the space bar moves the print-element one space to the right.

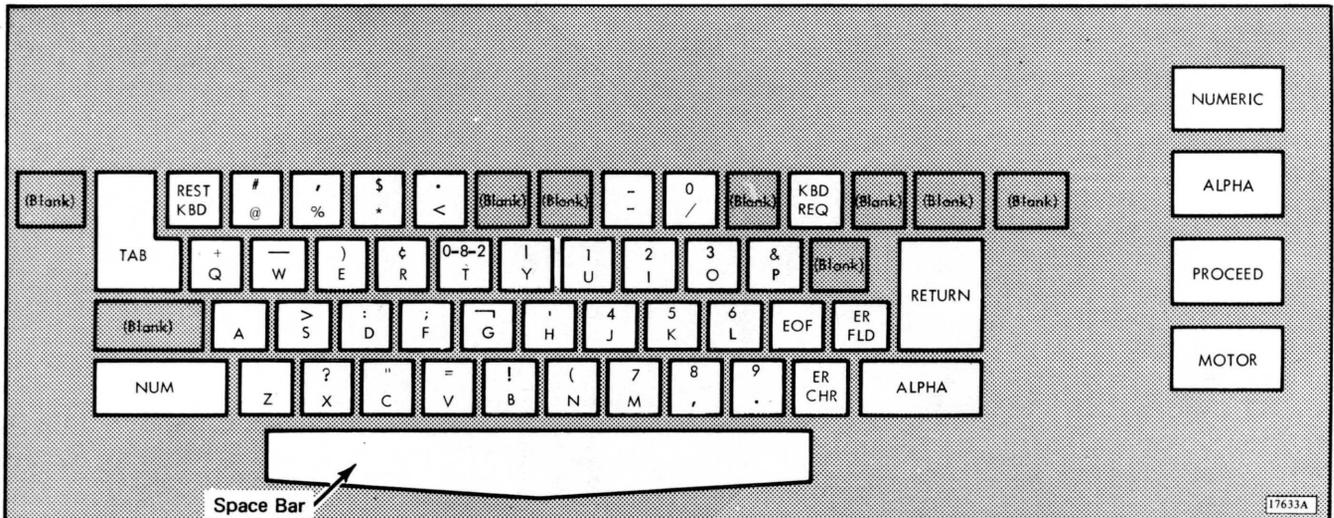


Figure 20. 1816 Keyboard Keys and Lights

The Numeric Light is on when the keyboard is in numeric (upper case) mode.

The ALPHA (Alphabetic) Light is on when the keyboard is in alphabetic (lower case) mode.

The Proceed Light turns on when the program places the keyboard in proceed status so that a character can be entered. The light turns off when a read command is performed or when a key is pressed (keyboard service interrupt is signaling the program that a character is ready to be read into main storage). With the exception of TAB, REST KBD, KBD REQ, and RETURN, the keys on the keyboard are not effective unless the proceed light is on.

The Motor Key provides a means to turn the printer motor

on once it is turned off by the idle control circuit. The printer motor remains on only during the time the switch is pressed down. This switch is used primarily by customer engineers.

The Tab Set and Clear Switch is located on the left side of the front panel on the 1816. Pressing this switch down sets a tab stop at the position at which the print-element carrier is located. Pushing this switch up clears any tab stop at the position at which the print-element carrier is located.

The Motor On/Off Switch is located on the right side of the front panel on the 1816. This switch turns the power to the printer motor on or off. This switch *must* always remain *on*. Damage can result if the switch is off and the program issues a write or control command to the 1816.

OPERATOR CONTROLS, 1053 PRINTER (Figure 21)

The Tab Set and Clear Switch, when pressed down, sets a tab stop at the position at which the print-element carrier is located. Pushing this switch up clears any tab stop at the position at which the print-element carrier is located.

The Tab Key, when pressed, causes the print-element carrier to move to the next tab stop to the right.

The Space Key, when pressed, moves the print-element carrier one space to the right. The 1053 has a motor idle

control that removes power from the printer motor after approximately 2 minutes if the unit is not in use. Once power has been removed, the space key is not effective. TAB or RETURN must be pressed to make SPACE effective in this case.

The Return Key, when pressed, returns the carrier to the left margin stop and advances the form a single or double space depending on the line-space lever setting.

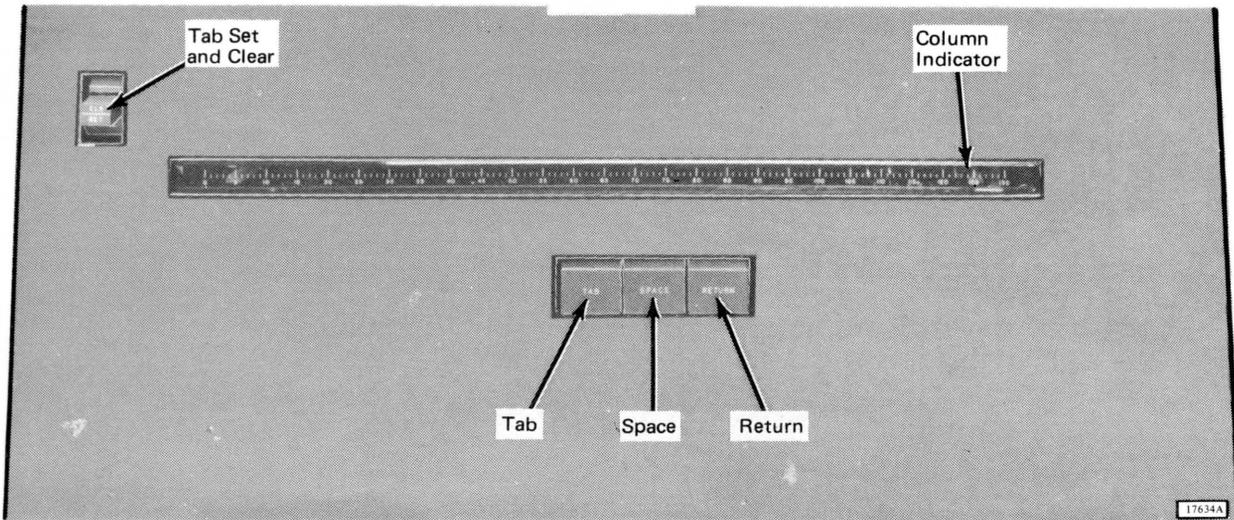


Figure 21. 1053 Printer Keys

MANUAL CONTROLS, PRINTER (Figure 22)

The Platen Knobs rotate the platen forward or backward for manual positioning of forms. Pressing in on the left platen knob allows the platen to be rotated freely (without detent) for variable registration of forms. When a pin-feed platen is installed, the right platen knob must be used for variable registration of forms.

The Multiple-Copy Lever permits adjusting the clearance between the print element and platen to provide best printing results. For three-carbon form, set this lever to the second mark. Set the lever to the third mark for five-carbon forms.

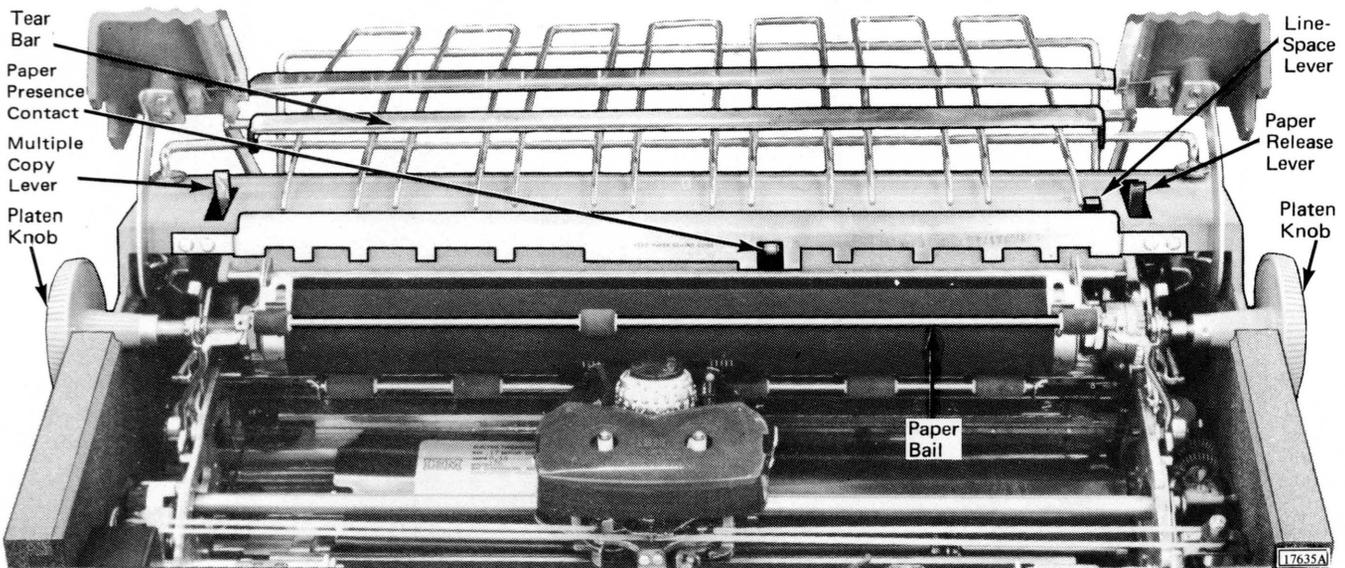


Figure 22. Printer Manual Controls

The *Line-Space Lever* controls vertical line spacing of the platen. In the forward position, the platen is single spaced with each line-space operation. In the rear position, the platen is double spaced with each line-space operation.

The *Paper Release Lever* controls the roller tension on the

platen. In the forward position, roller tension is removed from the platen permitting removal or repositioning of the forms. This lever should be left in forward position for pin-feed platen. In the rear position, roller tension is placed on the platen permitting pressure-feeding of forms.

PRINT ELEMENT AND RIBBON CONTROLS (Figure 23)

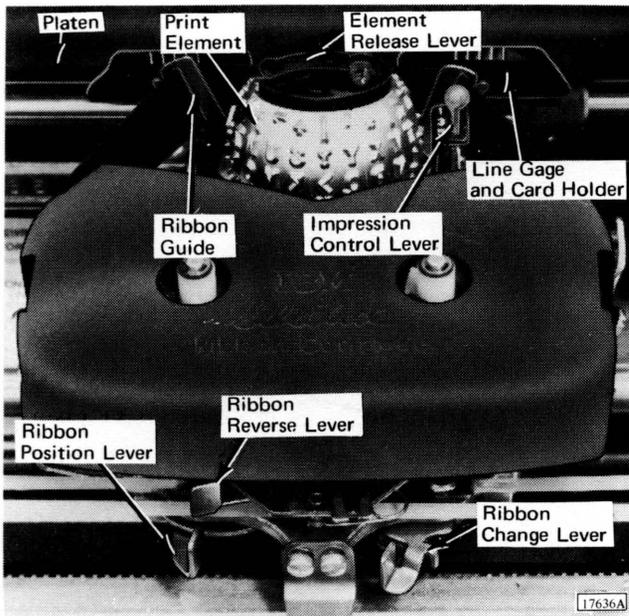


Figure 23. Print Element and Ribbon Controls

The *Ribbon Position Lever* has four positions permitting the ribbon to be positioned so that either the bottom (red), middle (red-black), or top (black) section of the ribbon is used. The fourth position (extreme right) is used for stencil operation. Periodic repositioning of this lever extends the life of the ribbon.

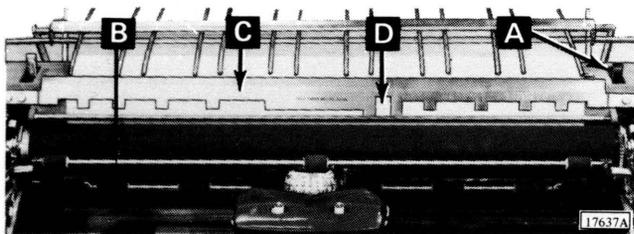
The *Ribbon Reverse Lever* allows the direction of the ribbon to be manually reversed. The ribbon automatically reverses when either end of the ribbon is reached.

The *Ribbon Change Lever* is used in changing ribbons. Moving this lever to the extreme right lifts the ribbon guides and permits easy removal of the ribbon cartridge.

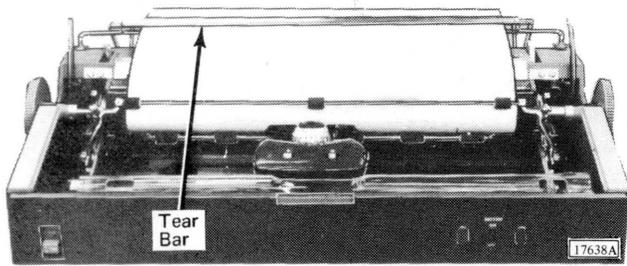
The *Print-Element Release Lever* is used to remove or exchange print elements.

The *Impression Control Lever* controls the striking force of the print element. Stencils require light impression; multiple copies require heavy impression. To change the setting, push the lever to the right and slide it to the desired number. Settings 1 through 5 vary the impression from light to heavy respectively. For most routine typing, a setting of 3 is satisfactory.

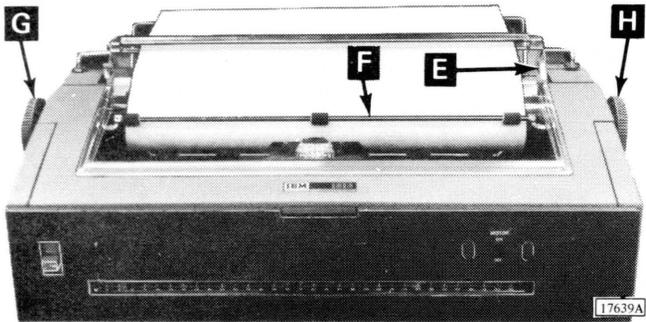
INSERTING FORMS



1. Place continuous form on lower rack of forms stand. If roll paper is used, place paper roll on paper roll rod at rear of unit.
2. Raise top cover of printer until latched.
3. Move paper release lever (A) and paper bail (B) forward.
4. Insert leading edge of paper between paper guide (C) and paper presence contact (D).

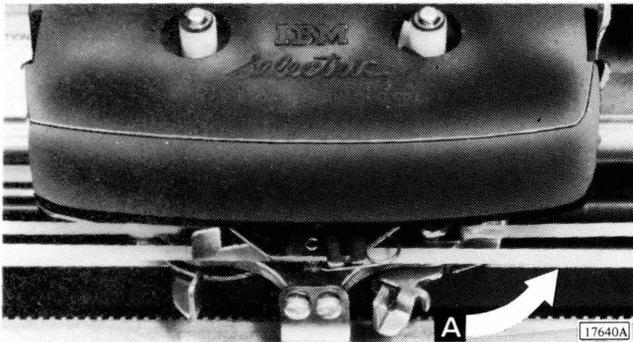


- Slide paper around platen and align for straight feeding by using left or right edge of upper form (in front of platen) with lower form. If paper resists sliding around platen, move paper release lever to rear and use platen knobs to roll paper around platen. (If pin-feed platen, place form on pins with left edges of form aligned.)

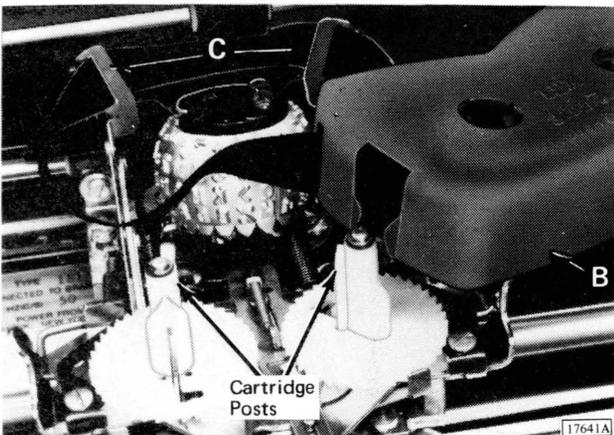


- Move paper release lever (E) and paper bail (F) toward rear of unit. (If pin-feed platen, leave release lever open.)
- Position form for proper registration by using line gage as guide. Press left platen knob (G) in and rotate for vernier adjustment. (Use right platen knob (H) if pin-feed platen.)
- Close cover of printer.
- As printing occurs, the first several forms should be guided for proper stacking.

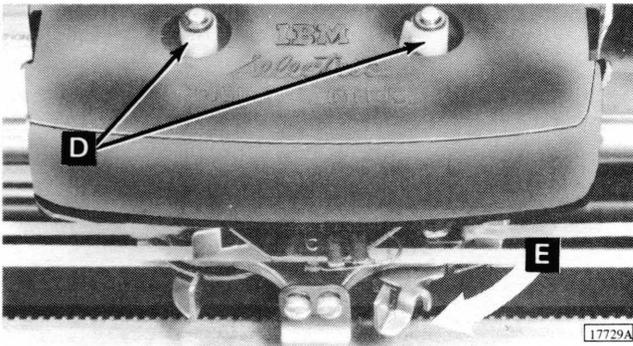
CHANGING THE RIBBON



- Position the print-element carrier to center of line by using TAB or SPACE.
- Raise top cover of printer to latched position. (If 1816, also tilt hinged front panel forward.)
- Move ribbon change lever (A) to extreme right.

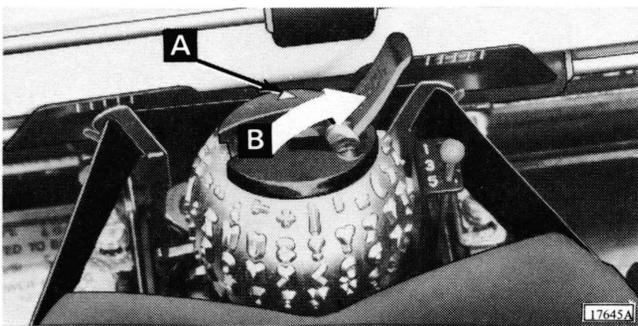


- Lift ribbon cartridge (B) straight up and ease ribbon out of slots in ribbon guides (C). Excess ribbon can be rewound by inserting a pencil in either cartridge hole and turning in direction of arrow.
- Position new cartridge with exposed ribbon facing platen.
- Slide ribbon through slots in ribbon guides (C).

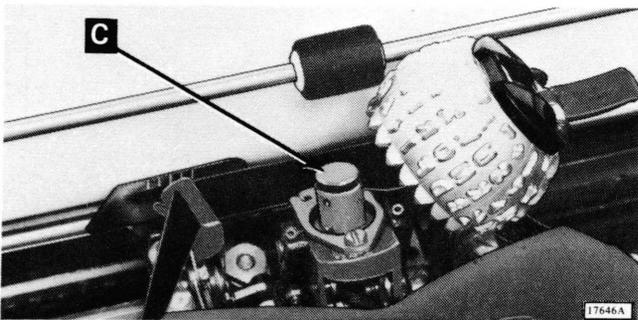


7. Position cartridge on cartridge posts (D) and press down evenly and firmly. Rewind excess ribbon by turning either cartridge post in direction of arrow.
8. Move ribbon change lever (E) to extreme left position.
9. Close hinged front panel (1816 only) and top cover of printer.

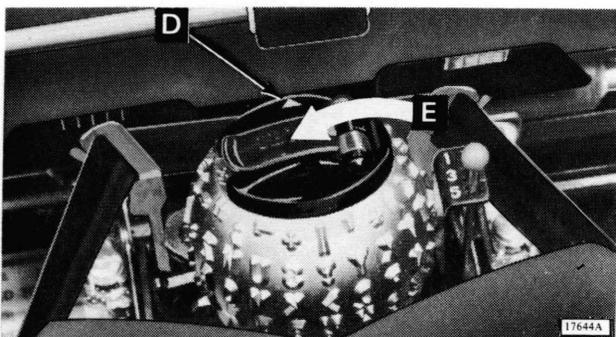
CHANGING THE PRINT ELEMENT



1. Raise top cover of printer. If installing an element, proceed with step 5.
2. Verify that printer is in lower-case shift. Printer is in lower-case shift when arrow (A) on top of print element points toward platen.
3. Lift up on print element release lever (B). The release lever locks in released position when fully open.

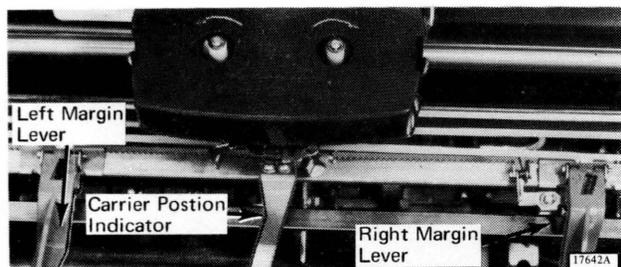


4. Lift print element from element post (C).



5. Lift up on print element release lever located on top of print element to be installed. The release lever locks in released position when fully open.
6. Place print element on element post. Arrow (D) on print element should point to platen.
7. Lower print element release lever (E) and press down lightly to lock it in place.
8. Visually test by typing.

SETTING MARGINS



1. Raise top cover of printer.
2. Press back on margin lever to be adjusted and slide it to desired location.
3. Release margin lever and close top cover of printer.
4. Verify accuracy of margin setting by using TAB and RETURN.

CLEARING A NOT READY CONDITION

1. Verify that paper is properly inserted between paper presence contact and nylon guide roller.
2. If step 1 does not clear condition, remove paper and
3. reinsert it in printer.
3. Verify that 1816 print motor switch on front panel is on.

CLEARING AN OVERPRINT CONDITION

1. Overprinting is usually caused by incorrect margin setting resulting in a printing line shorter than formatted output. Verify that margins are set correctly.
2. Overprinting may also occur if stored program fails to return carrier. This can be detected by moving both margins to extreme left and right positions. If overprinting still occurs at right margin, stored program has probably failed to return carrier.

CLEARING DOUBLE KEY ERRORS

During the process of entering messages, two keyboard keys may inadvertently be pressed simultaneously causing them to lock down. If this condition occurs:

1. Press REST KBD. This unlocks keyboard and releases keys that are locked down.
2. Reenter character.

EXAMPLE OF KEYBOARD OPERATION

The following example describes a typical use of the keyboard. It should be noted that the sequence of events given in this example occur so quickly that they cannot be detected.

1. Press KBD REQ. This initiates an interrupt to program signaling that keyboard entry is desired. The keyboard locks and proceed light turns off.
2. Keyboard is placed in proceed status by stored program. This causes proceed light to turn on and keyboard to unlock.
3. Enter character by pressing desired key.
4. When key is pressed, proceed light turns off and keyboard is locked. Keyboard service interrupt signals program that character is ready to be read into main storage.
5. Stored program reads character into main storage.
6. Stored program places keyboard in proceed status. The proceed light turns on and keyboard unlocks.
7. Steps 3 through 6 are repeated until message is complete, as indicated by pressing EOF (end-of-field). This indicates to stored program that message is complete.

IBM



1810

Disk Storage

IBM 1810 Disk Storage

The IBM 1810 Disk Storage provides random-access storage capabilities for the 1800 system. One 1810 (model A1, A2, A3, B1, B2, or B3), providing up to three disk storage drives, can be attached to the system. The 1810 operates under data channel control and functions as both an input and output device.

The disk storage recording medium is an oxide-coated disk in an interchangeable 2315 Disk Cartridge (Figure 24.)

The access mechanism consists of two parallel horizontal arms that straddle the disk. Each arm has a magnetic read/write head, positioned to read or write on the corresponding disk surface. The entire assembly moves horizontally, allowing the heads to have access to the entire recording area (two surfaces).

Writing or reading of disk information occurs as the disk surface revolves (at 1,500 rpm) past the read/write heads. Information is written by magnetizing small discrete areas in a circular pattern around the disk. Information is read by sensing the presence or absence of the magnetized spots around the circular pattern on the disk.

The circular patterns of data on the disk are called tracks. The track on the upper surface of the disk and the corre-

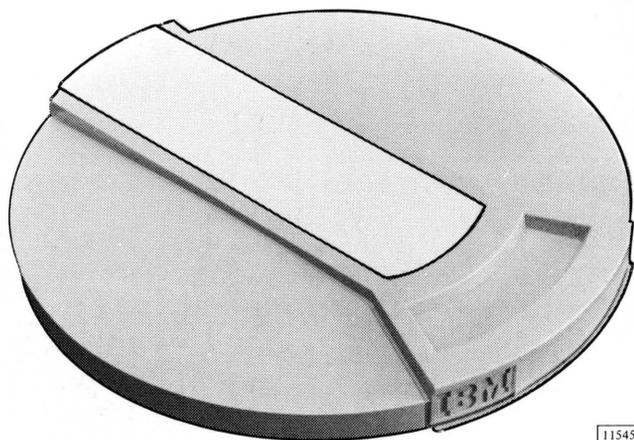


Figure 24. 2315 Disk Cartridge

sponding track on the lower surface of the disk are called a cylinder. The total number of cylinders is 203; three cylinders are used as spares to ensure that 200 cylinders are available for use.

OPERATOR CONTROLS (Figure 25)

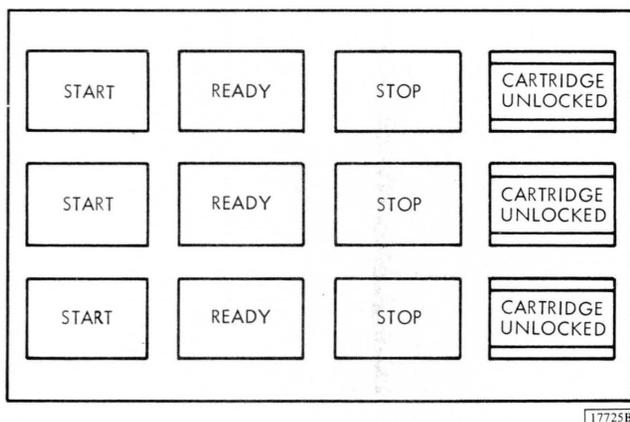


Figure 25. 1810 Keys and Lights

Each 1810 provides up to three disk storage drives. Individual sets of controls are provided for each drive. Each set (top, center, or bottom) controls the corresponding disk drive (top, center, or bottom).

The Start Key, when pressed, applies power to the drive motor and initiates a cycle up (start) sequence provided the disk cartridge is fully into position and the disk is locked to the drive spindle. The cycle up sequence consists of:

1. A 90-second delay while the disk is being cleaned and coming up to speed.
2. The loading of the heads after the 90-second delay.
3. The ready light turning on indicating that the drive is ready for use.

The Ready Light turns on when the drive is in a ready status; that is:

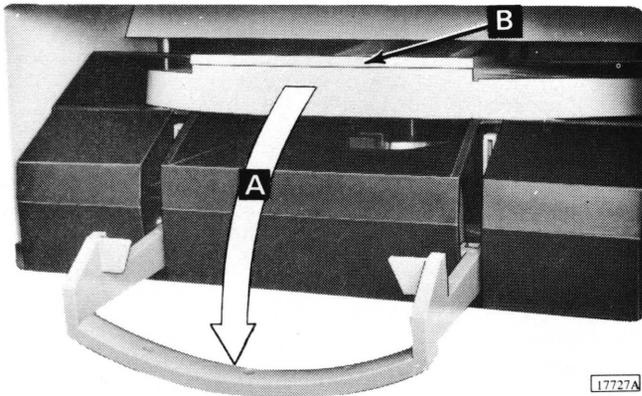
1. Cycle-up sequence has been completed.
2. No write select error condition exists.

The Stop Key, when pressed, removes power from the drive motor and starts a cycle down (stop) sequence. The cycle down sequence consists of:

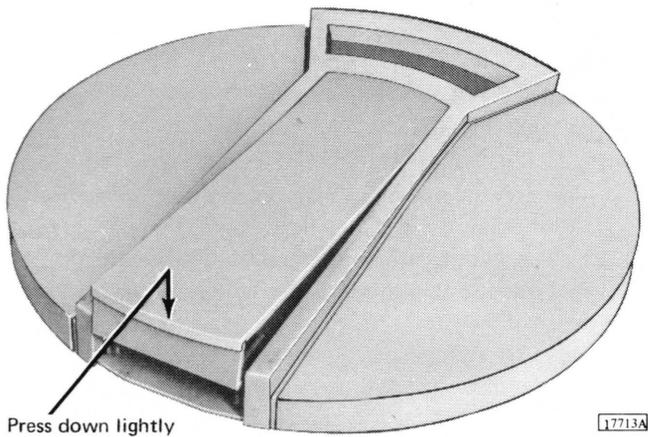
1. Unloading the heads.
2. A delay of approximately 60 seconds while the disk is coming to a stop.
3. The cartridge unlock light turning on, indicating that the cartridge can be removed.

The Cartridge Unlocked Light turns on when the access release/lock mechanism is unlocked. When this light is on, the cartridge may be removed.

REMOVING A DISK CARTRIDGE

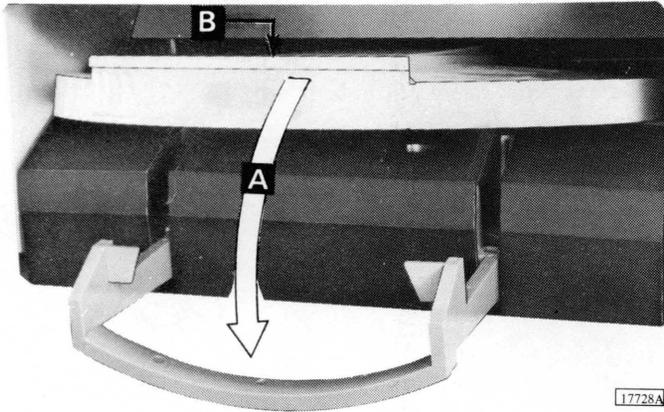


1. Press STOP.
2. After cartridge unlock light turns on, open hinged cover of 1810.
3. Pull down on release/lock handle (A).
4. Using handle provided in cartridge (B), pull it from disk drive. (An interlock prevents removal of cartridge unless system power is on and disk has stopped rotating.)

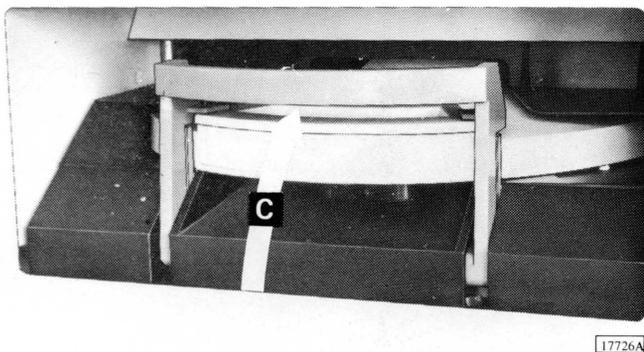


5. Close cartridge door by pressing down on it. This step is important because it creates a positive dust seal and immobilizes disk in cartridge.

INSERTING A DISK CARTRIDGE



1. Open hinged cover of 1810.
2. Pull down on release/lock handle (A).
3. Insert cartridge into aperture (B). Read/write heads are automatically positioned as cartridge is inserted.



4. Raise release/lock handle (C) to lock cartridge in place.
5. Close hinged cover on 1810 and press START. An interlock prevents motor from starting unless cartridge is correctly inserted and disk is in place.

CLEARING A WRITE SELECT ERROR CONDITION

If the program indicates a write select error has occurred, intervention is required to clear the error condition. Use the following procedure:

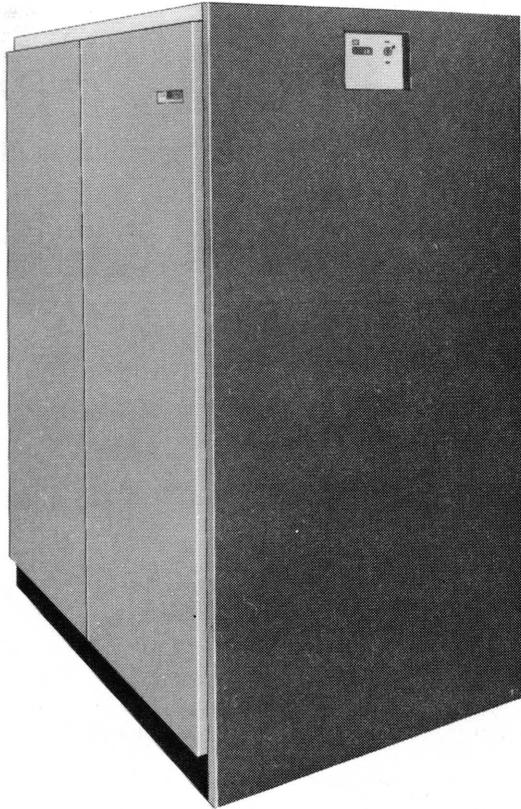
1. Press STOP.
2. When cartridge unlocked light turns on, press START. This resets the write select error condition.
3. If a write select error persists, notify a customer engineer.

DISK CARTRIDGE HANDLING

The disk cartridge is a precision instrument which requires careful handling and housekeeping procedures to ensure data integrity. The following practices result in a normal trouble-free life for the disk cartridge.

1. When removing a cartridge from the 1810 always close the cartridge door by pressing down on it. This should be done so dust and dirt do not accumulate inside the cartridge. Closing the cartridge door also immobilizes the disk in the cartridge.
2. Clean the cartridge protective covers periodically to remove any buildup of dust. Use a soft lint-free cloth or paper wipe.
3. Have cracked, distorted, or otherwise damaged covers replaced.
4. Keep hands, pencils, or other objects off the disk surfaces. The disk surfaces can be distorted or damaged through impact or excessive pressure or abrasion. Should a cartridge be suspected of damage, have it inspected by a customer engineer before attempting to use it on a device.
5. Coffee and other beverages spilled on the cartridge may require that the cartridge be reconditioned. Keep all beverages off the drive and away from the cartridge storage area.
6. On the disk storage drive, the disk cartridge is supplied with air that is taken from the room and filtered at the intake of the drive unit. The cover of the disk drive should always be kept closed while the drive is in operation to keep dust from bypassing the filter.
7. The disk cartridge should always be placed on a table or other flat surface that is free of other objects. If the cartridge is dropped on a small, hard object, the die cast aluminum hub can be damaged.
8. Remember, the disk cartridge may contain information that is vital to the installation. It is advantageous to protect it as much as possible.

IBM



2841
Storage Control

2311
Disk Storage Drive



IBM 2841 Storage Control and 2311 Disk Storage Drive

The IBM 2841 Storage Control provides attachment and control facilities for connecting IBM 2311 Disk Storage Drives to the 1800 system. A single 2841 provides for attachment of up to eight 2311, Model 1, Disk Storage Drives.

2841 Storage Control

The 2841 is connected to the 1800 system via a selector channel which in turn operates under data channel control. The 2841 interprets and executes commands, provides a data path between the selector channel and 2311's, translates data, and furnishes status information to the selector channel.

A two-channel switch special feature for the 2841 allows the 2841 to be shared by two separate channels and also allows individual devices to be reserved for exclusive use of either channel. The two channels may be selector channels from separate 1800 systems or a selector channel from an 1800 system and a channel from System/360. Channel switching and device reservation in the 2841 are performed under control of the stored program.

2311 Disk Storage Drive

The 2311 is a random access storage device that functions as both an input and output device.

The storage medium is the IBM 1316 Disk Pack (Figure 26). Each disk pack consists of six 14-inch disks, mounted a half-inch apart on a central hub. Data is recorded on the inside ten disk surfaces. The two outer surfaces are covered by protective plates and serve as protectors for the inside disk surfaces. The entire pack of



Figure 26. 1316 Disk Pack

disks is covered by a two-piece plastic cover.

Information is written on and read from the ten disk surfaces as they revolve (at 2,400 rpm) past ten read/write heads. The read/write heads are mounted in pairs, between each two disks, on a movable comb-like access mechanism. An actuator moves the access mechanism horizontally allowing the read/write heads to have access to the entire recording surface on each of the ten disk surfaces.

As the access mechanism is moved horizontally, it may be stopped at any of 203 positions. This provides 203 data tracks on each surface. Since all ten read/write heads are moved by a single access mechanism, a cylinder of ten data tracks is available at each access mechanism position.

OPERATOR CONTROLS, 2841 (Figure 27)

The Enable/Disable Switch enables or disables communication between the 2841 and the 1800 system. It also enables or disables the 2841 usage meter.

If the 2841 has the two-channel switch feature, a separate switch is provided for each channel; however, there is still only one usage meter. Providing two switches allows each channel to be disabled independently. While in the disabled state, the 2841 will not be selected by that channel.

In order to disable a channel, the following conditions

must exist:

1. The enable/disable switch for that channel must be in the disabled position.
2. The channel selection switch in the 2841 must not be selected to the disabled channel (two-channel switch feature only.)
3. The processor-controller must be in the stopped or wait state.

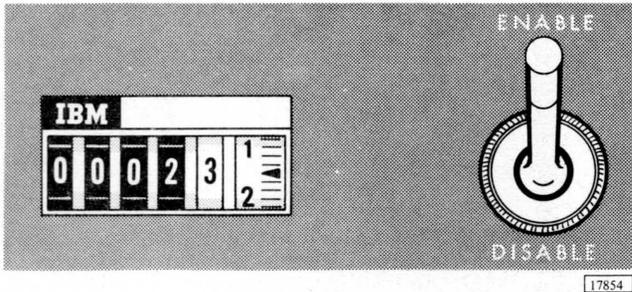


Figure 27. 2841 Switch

To allow a channel to be returned to the enabled state, the following conditions must exist:

1. The enable/disable switch for that channel must be in the enable position.
2. The processor-controller must be in the stopped or wait state.

Note: If a 2841 with the two-channel switch feature is shared by two processors and one is to be powered down, the corresponding enable/disable switch on the 2841 must be placed in the disable position before turning off the processor power.

OPERATOR CONTROLS, 2311 (Figure 28)

The Ready Light is the green light with the drive number imprinted on it. It turns on when the 2311 is in ready status and able to access data. The following conditions must exist before the ready light will turn on:

1. Cover closed.
2. Disk pack properly installed on drive.
3. START has been pressed and cycle up sequence has been completed.

The Select Lock Light, when on, indicates a machine condition which requires Customer Engineering attention. This condition causes the disk storage drive to be disabled and stops the usage meter. The condition can be reset by turning the start/stop switch to STOP and then to START.

The Enable/Disable Switch enables or disables communication between the 2311 and the 1800 system. It also enables or disables the 2311 usage meter.

If the processor-controller is running when the switch setting is changed, the 2311 status and usage meter status remain unchanged until the processor-controller is placed in the wait state.

The Start/Stop Switch, when moved to START, applies power to the disk drive motor and initiates a cycle up (start) sequence provided system power is on, a disk pack is properly loaded, and the 2311 cover is closed. The cycle up sequence consists of:

1. A delay of approximately 60 seconds while the disks are being cleaned and coming up to speed.
2. The loading of the heads after the disks are cleaned and up to speed.
3. An automatic seek to cylinder 000.
4. The ready light turning on, indicating that the drive is ready for use.

Moving this switch to STOP removes power from the disk drive motor and initiates a cycle down (stop) sequence. The cycle down sequence consists of:

1. Unloading of the heads and retraction of the access mechanism from the disk pack.
2. A delay of approximately 30 seconds while the disk pack stops.

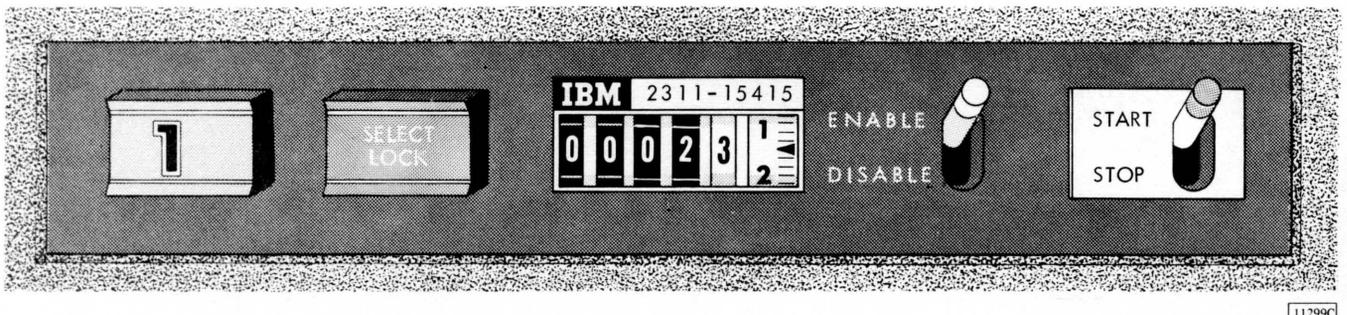
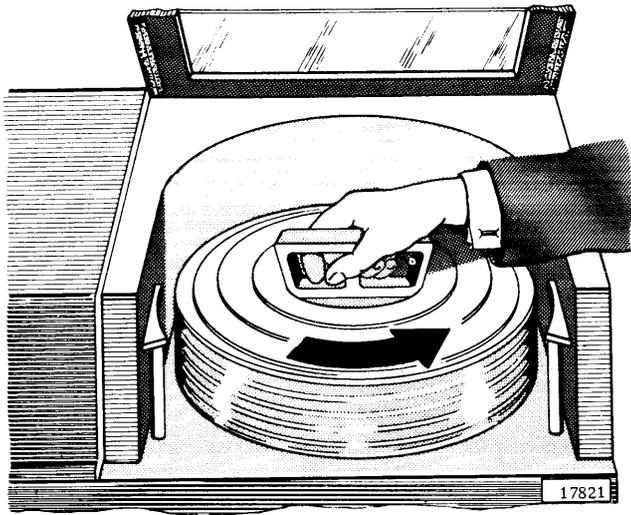


Figure 28. 2311 Switches and Lights

REMOVING A DISK PACK

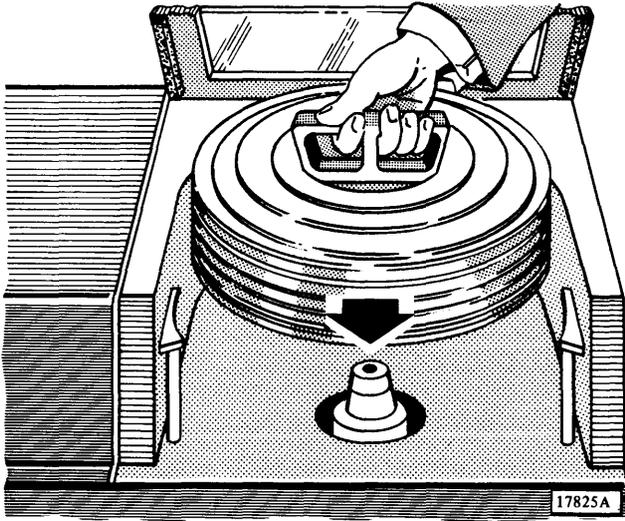


1. Move start/stop switch to **STOP** and wait for disk pack to stop rotating.
2. Raise cover on 2311.
3. Carefully lower disk pack top cover over disk pack. Do not hit cover against disk pack.
4. With cover resting evenly on disk pack, rotate cover at least two full turns counterclockwise. The rotating action fastens cover to disk pack and releases pack from spindle.

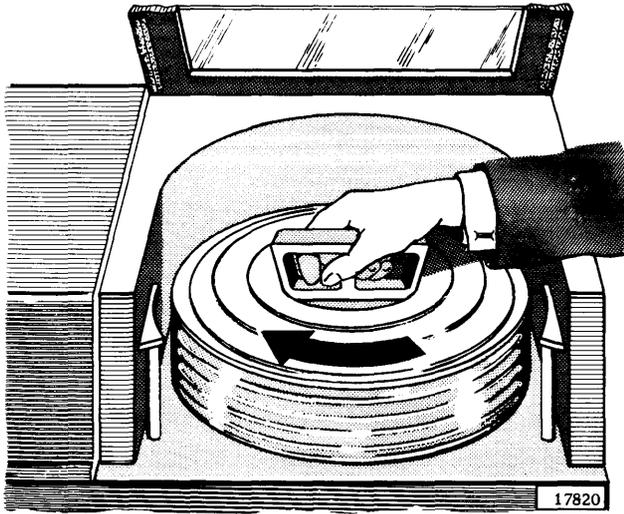


5. Lift cover containing disk pack from spindle.
6. Fasten bottom cover firmly to disk pack, and return pack to proper storage location.
7. If another disk pack is not to be loaded, close cover on 2311 to prevent accumulation of dust and contaminants.

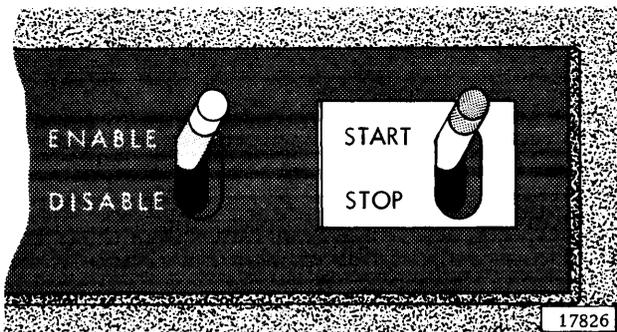
LOADING A DISK PACK



1. While holding disk pack firmly by top handle, turn locking knob on bottom cover and remove cover.
2. With disk drive stopped and cover open, place disk pack (still in cover) on spindle and lower disk pack until it comes to rest.



3. Rotate cover clockwise until firm resistance is met, and then lift cover off. Be careful not to hit cover against disk pack.
4. Reassemble empty container sections (top and bottom covers) and store them.



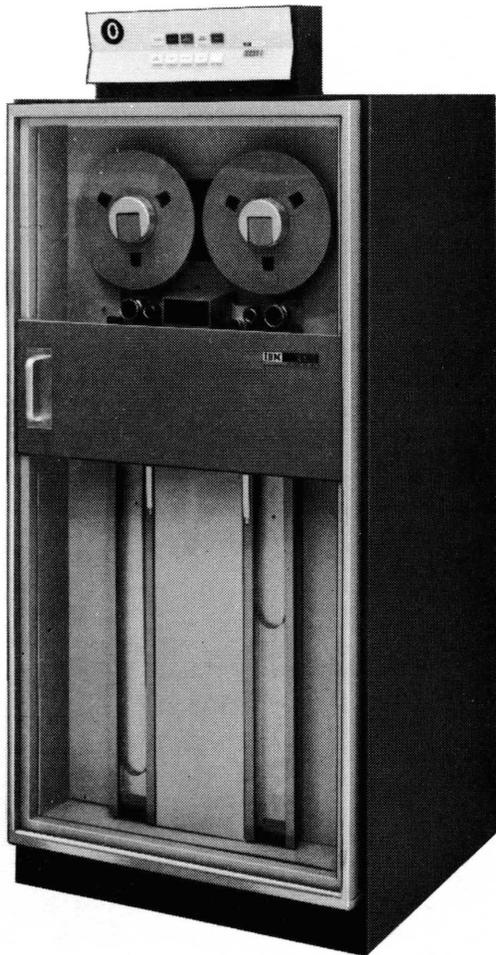
5. Close cover on 2311 and move start/stop switch to START. The ready light turns on when 2311 is ready for use.
6. Verify that enable/disable switch is set to ENABLE. This makes 2311 available to the system.

DISK PACK HANDLING

Disk packs are precision devices that require careful handling to ensure data integrity. The following precautions are recommended to maintain quality and lengthen the life of the disk pack.

1. Reassemble the disk pack bottom and top covers. This should be done even when no disk pack is contained in the covers so dust and dirt do not accumulate inside the covers.
2. Clean the protective cover periodically to remove any buildup of dust. Use a soft lint-free cloth or paper wipe.
3. Replace cracked, distorted, or otherwise damaged covers.
4. Keep hands, pencils, or other objects off the disk surfaces. The disk surfaces can be distorted or damaged through impact or excessive pressure or abrasion. Should a pack be suspected of damage, have it inspected by a customer engineer before attempting to use it.
5. Don't stop the pack from turning by pressing on the top disk. This can be dangerous and can damage the disk.
6. Coffee or other beverages spilled on the pack and/or covers may require that the pack be reconditioned. Keep beverages off the drive and away from the pack storage area.
7. Ashes and tobacco are a prime source of disk pack contamination. Tobacco and all smoking should be kept away from areas where disk packs are in use or disk drives in operation.
8. Pack air filters should be replaced at least once a year when operated in a normal environment. For filter and/or replacement contact your local IBM Branch Office.

IBM



2401

Magnetic Tape Unit

IBM 2401 Magnetic Tape Unit

The IBM 2401 Magnetic Tape Unit provides magnetic tape input and output capabilities for the 1800 system. A maximum of two 2401's (model 1, 2, or 3) can be connected to the 1800 system.

A limited number of IBM 2404 Magnetic Tape Units were used on 1800 systems. The 2401 and 2402 are functionally the same. Therefore, the descriptions in this section apply to both units.

The 2401 operates under data channel control and functions as both an input and output device. It performs reading, writing, and control functions as directed by the stored program.

The recording medium for the 2401 is 1/2 inch wide magnetic tape. Magnetic tape is wound on plastic reels 10-1/2 inches in diameter. A full reel contains approximately 2,400 feet of usable tape, but lengths as short as 50 feet can be used. A miniature reel, 8-1/2 inches in diameter, is available and holds 1,200 feet of tape.

Writing and Reading Magnetic Tape

During reading or writing operations, magnetic tape moves from the file reel through the left vacuum column, across the read/write head, and through the right vacuum column to the machine reel (Figure 29). The loop in each vacuum column acts as a buffer for sudden start and stop motion of the tape. Tape may be backspaced over a tape block or rewound to beginning of the reel. Reading, but not writing, may occur while tape is moving backward.

Information is written by magnetizing small discrete areas in parallel channels called tracks. Information is read by sensing the presence or absence of the magnetized spots. During a write operation, the tape passes an erase head prior to reaching the read/write head. Information previously written on the tape is erased by the erase head during write operations.

File Protection Device

Since information is erased during write operations, a file protection device is provided to prevent accidental erasure. A plastic ring (Figure 30) fits in a circular groove molded in the back (machine side) of the tape reel. This ring must be in place to enable write operations. When the ring is removed, writing is suppressed and only reading can take place; the file is protected from accidental writing, which could erase valuable information.

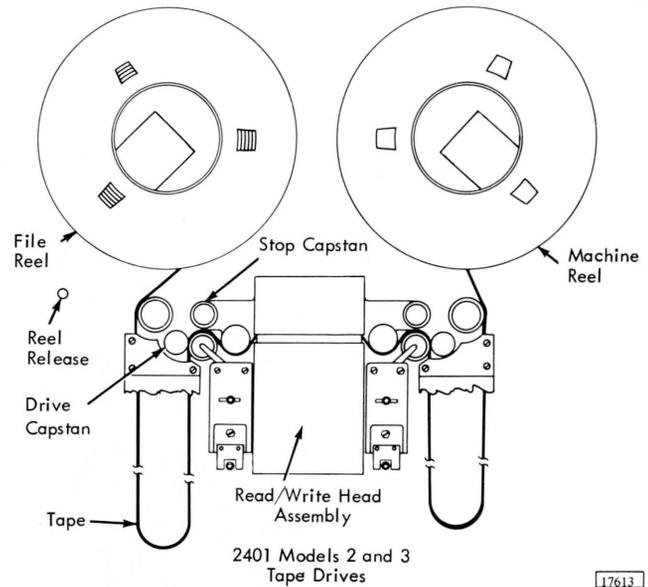


Figure 29. 2401 Tape Feed Path

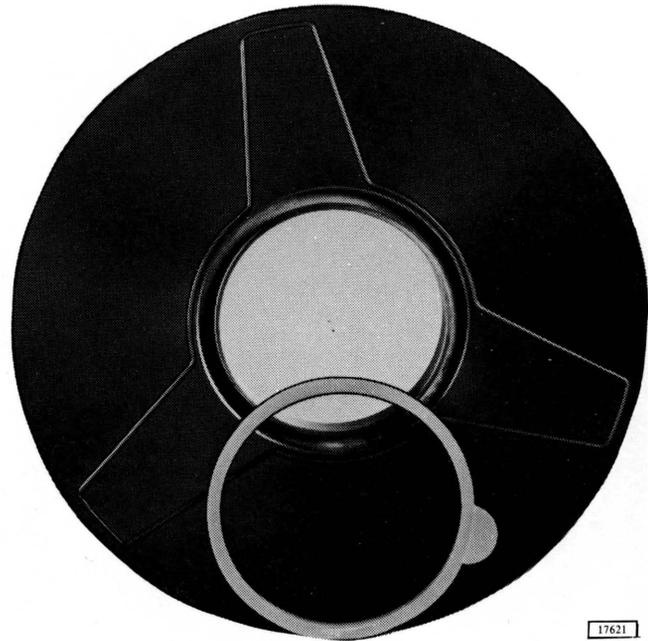


Figure 30. File Protection Ring

OPERATOR CONTROLS (Figure 31)

The Select Light turns on automatically when the unit is addressed by the program. The addressed tape unit must be ready before it can operate under program control.

The Ready Light, when on, indicates that the tape unit is ready to accept commands from the program. The ready light is turned on by pressing START provided:

1. Tape is loaded into the vacuum columns.
2. The reel door is closed. (The reel door should not be opened while the ready light is on.)
3. The tape unit is not in process of rewinding tape.

Pressing START while tape is in motion, as in a load-rewind operation, does not turn on the ready light until the operation is completed.

When the ready light is off, manual control of the tape unit is indicated provided the tape unit is not rewinding tape or searching for load point, and the reel door is closed.

The File Protect Light, when on, indicates that the loaded tape unit is file protected. Neither writing nor erasing can take place on this tape unit. The file protect light turns on when:

1. No file reel is mounted.
2. A file-protected tape reel is mounted.
3. A load-rewind operation is in process.
4. An unload operation is in process.

The light is turned off by mounting a tape reel that is not file protected. If the file protection ring has been removed and this light fails to turn on, notify a customer engineer.

The Tape Indicate Light, when on, indicates that end-of-tape marker has been sensed during a forward motion tape operation. The tape indicate light is turned off by pressing UNLOAD or when the tape unit receives a rewind, rewind/unload, or backward motion tape operation command.

The CB (Circuit Breaker) Light, when on, indicates that a power circuit breaker has been turned off. The tape unit cannot operate until the circuit breaker has been reset by a customer engineer.

The Load Rewind Key, when pressed, initiates a tape load-rewind or a rewind operation. LOAD REWIND is effective only when the reel door is closed and the ready light is off. Pressing LOAD REWIND after tape is properly mounted lowers tape into the vacuum columns, lowers the head assembly, and rewinds tape until the load point marker is sensed. This positions the tape at load point, ready for either reading or writing.

If the machine reel contains more than 1/2 inch of tape when LOAD REWIND is pressed, high-speed rewind operation is initiated. Tape is removed from the vacuum columns, the head assembly is raised, and tape is rewound at high speed until less than 1/8 inch of tape remains on

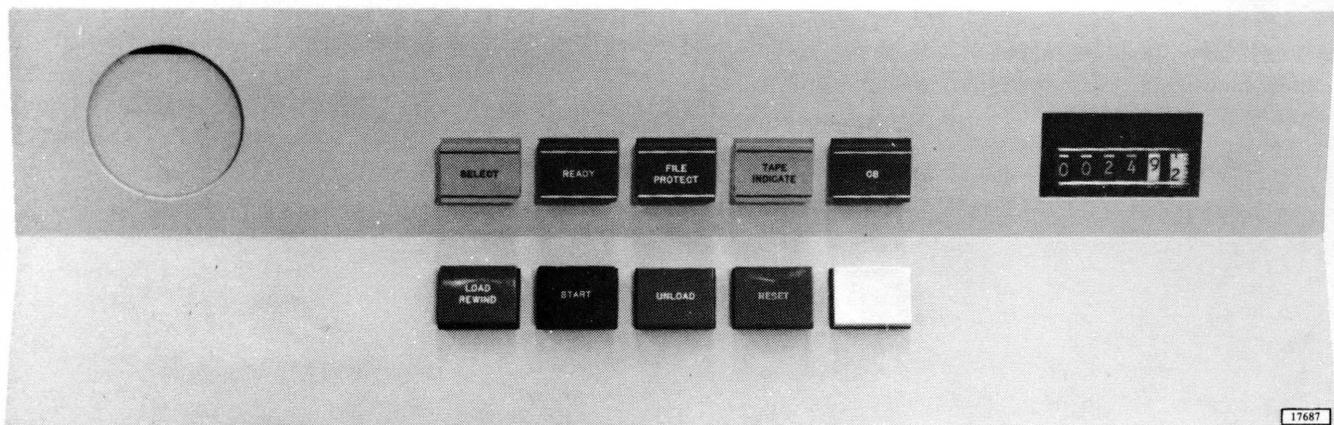


Figure 31. 2401 Keys and Lights

the machine reel. Tape is then lowered into the vacuum columns, the head assembly is lowered, and a low-speed rewind continues until the load point marker is sensed.

If the machine reel contains less than 1/2 inch of tape when LOAD REWIND is pressed, a low-speed operation is initiated. The rewind continues until load point marker is sensed.

CAUTION

Do not open the reel door during rewind or load-point search operations. This could cause the tape to break or be damaged.

The Start Key, when pressed, places the tape unit in ready status and turns on the ready light if:

1. The reel door is closed.
2. Tape is loaded into the vacuum columns.
3. The tape unit is not in process of rewinding tape.

The Unload Key, when pressed, initiates a tape unload

operation. UNLOAD is effective only when:

1. The ready light is off.
2. Tape is in the vacuum columns.
3. The reel door is closed.

Pressing UNLOAD turns off the tape indicate light, raises the head assembly, and removes the tape from the vacuum columns, regardless of the distribution of tape on the two reels. If the tape is not at load point when a tape reel is to be changed, a load point search should be initiated first by pressing LOAD REWIND.

The Reset Key, when pressed, removes the tape unit from ready status and returns the tape unit to manual control. Pressing RESET stops all tape unit operations in progress, except unload with a high-speed rewind operation. A high-speed rewind operation is shifted into low-speed rewind. After tape is loaded into the vacuum columns and low-speed rewind is in progress, pressing RESET again stops the rewind operation.

OPERATING THE POWER WINDOW

The reel door on the 2401 includes a tape access window that automatically opens following a tape unload operation and closes prior to a tape load operation. LOAD REWIND, UNLOAD, and RESET are used to control the power window, in addition to the operator functions previously described.

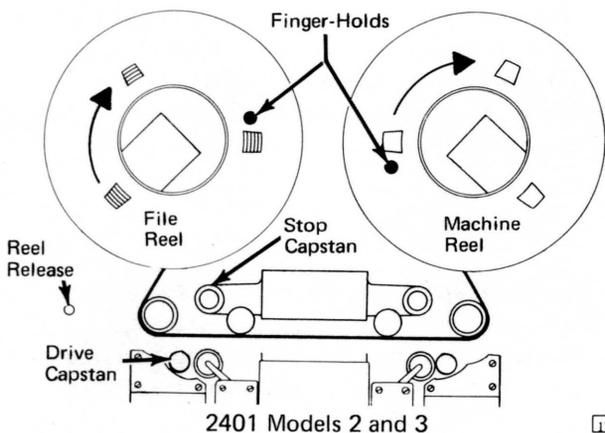
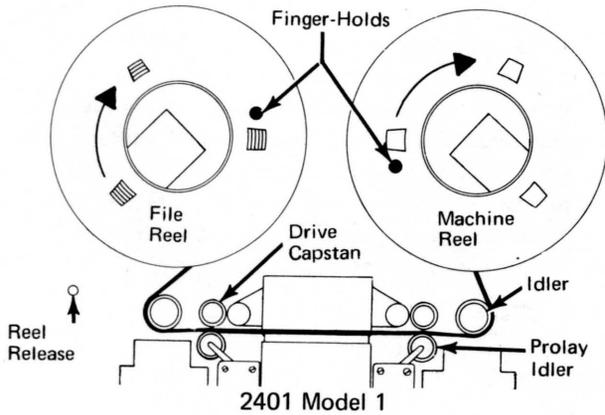
The Load Rewind Key, when pressed, causes the power window to raise and close before starting the load-rewind operation. If any object prevents the power window from

closing, it will operate a safety bail at the top of the reel door, which causes the window to reverse direction and open.

The Unload Key, if pressed when the tape unit is loaded and not ready, will cause the power window to open after the tape has been removed from the vacuum columns.

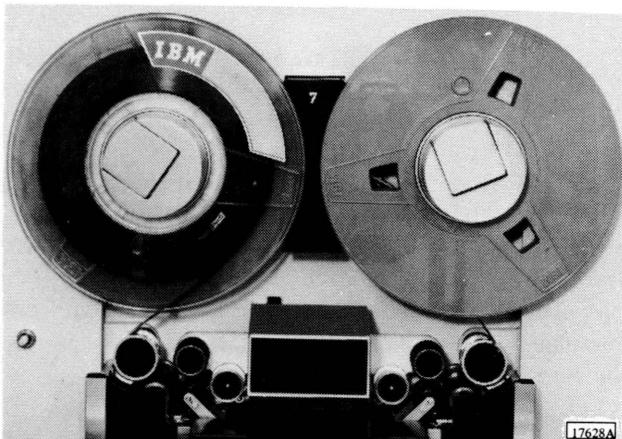
The Reset Key may be used to close the power window when the tape unit is unloaded and not being used. The window cannot be closed if the reel door is open.

LOADING MAGNETIC TAPE



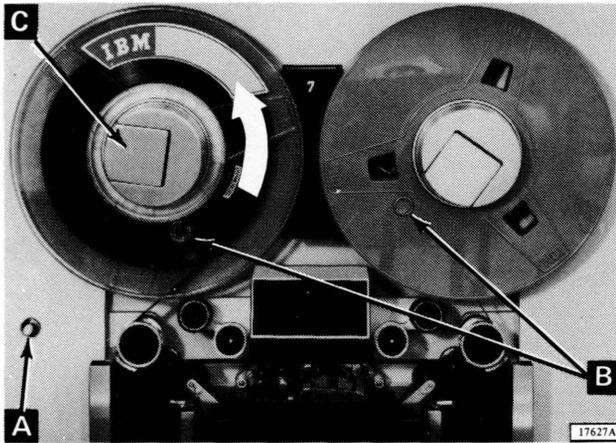
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1. Determine if reel to be loaded should have file protection. Remove file protect ring if reel is to be file protected. Insert ring if reel is not to be file protected.
2. Open left hub latch by pulling tab forward.
3. Mount file reel on left mounting hub. To ensure proper alignment, place hub of reel firmly against stop on machine mounting hub and close hub latch.
4. Verify that hub latch is closed.
5. Hold reel release down and rotate file reel clockwise, unwinding about 4 feet of tape.
6. Thread tape as shown in diagrams at left.
7. Place and hold end of tape between index finger and hub of machine reel.
8. Press reel release and wind one or two turns of tape clockwise on machine reel. Then use finger hold on machine reel and wind tape clockwise until at least two turns beyond load point marker.



9. Close reel door, if open.
10. Press **LOAD REWIND**. This closes power window, loads tape into vacuum columns, lowers head assembly, and rewinds tape to load point.
11. Press **START** to place tape unit in ready status.

UNLOADING MAGNETIC TAPE



1. Press RESET, if ready light is on.
2. Press LOAD REWIND.
3. When load point is reached, press UNLOAD. This raises head assembly, removes tape from vacuum columns, and lowers power window.
4. Press reel release (A) and manually rewind file reel counterclockwise using finger hold (B) on tape reel.
5. Open left hub latch (C) and remove file reel. If resistance is encountered in removing reel, exert pressure from rear of reel with hands as near to hub as possible. Never rock reel using outer edge of reel.

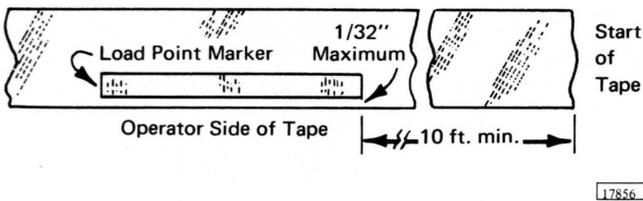
PLACING TAPE MARKERS ON MAGNETIC TAPE

Magnetic tape must have some blank space at the beginning and end of the reel to allow threading through the transport mechanism. Reflective strips called tape markers are placed on the tape to enable the tape unit to sense the beginning and end of the usable portion of the tape. The tape unit senses the markers as either a load-point marker, where reading or writing is to begin, or as the end-of-tape

marker, approximately where writing is to stop.

The markers are small pieces of transparent plastic with a thin film of aluminum on one side which is covered with pressure sensitive adhesive. The markers are placed on the base (uncoated) side of the tape. New reels of tape obtained from IBM have these markers in position. However, an operator should know how to put them on.

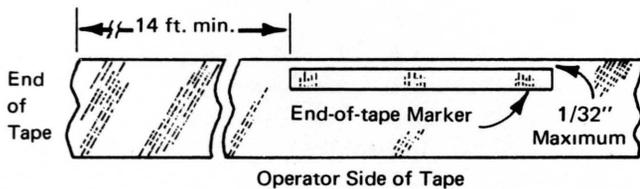
Machine Side of Tape



17856

The Load Point Marker must be positioned a minimum of 10 feet from the start of the tape to allow enough tape for threading on the tape unit. More than 10 feet may be allowed if desired. To indicate load point, the marker must be parallel to and not more than 1/32 inch from the operator side of the tape when the reel is mounted as shown at the left.

Machine Side of Tape



17855

The End-Of-Tape Marker is usually placed about 14 feet from the end of the tape. This allows at least 10 feet of trailer and 4 feet for writing data after end-of-tape marker is sensed. To indicate end of tape, the marker must be placed parallel to and not more than 1/32 inch from the machine side of the tape when the reel is mounted as shown at the left.

CLEANING THE TAPE TRANSPORT

The tape transport should be thoroughly cleaned after:

1. Eight hours of operation.
2. Ten full-reel passes of IBM Dynexcel or HD tape.
3. Four hours of operation or the equivalent of two full-reel passes of Mylar tape.

For efficient cleaning, tools are available in a tape transport cleaning kit (IBM part 352465).

CAUTION

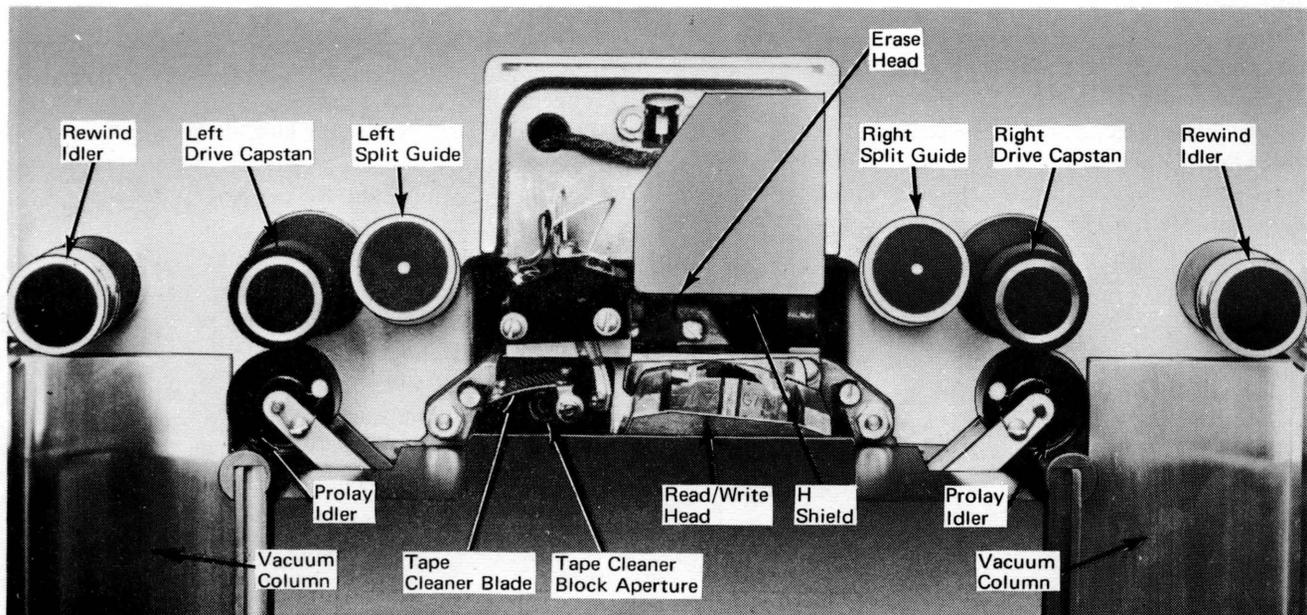
When cleaning the transport area, care must be taken to prevent any IBM tape cleaner (IBM part 517960) from coming in contact with the skin as a toxic effect may result. Also, prevent any tape cleaner from getting on bearings or bushings because it leaches oil from them. Do not use any metal instrument to clean the vacuum columns.

Use the following procedure as a guide in cleaning the tape transport. Refer to Figures 32 and 33 for location of items named.

1. Unload magnetic tape from tape drive.
2. Remove dust from reel and transport area with lint-free cloth.
3. Clean split guides with small brush (IBM part 556945) or clean typewriter brush. Remove accumulated

oxide from surface of guides and between elements with lint-free cloth moistened with tape transport cleaner.

4. Clean H-shield and erase head with lint-free cloth moistened with tape transport cleaner.
5. Clean tape cleaner blade with small brush (IBM part 556945), using light pressure to avoid damaging cleaner blade. If necessary, moisten brush slightly with tape transport cleaner to remove stubborn oxide clumps. Clean out tape cleaner block aperture with cotton swab. Be sure that no cotton fibers remain.
6. Clean rewind idlers with lint-free cloth moistened with tape transport cleaner. Use a wooden toothpick to remove stubborn oxide clumps.
7. Clean capstans with lint-free cloth moistened lightly with tape transport cleaner. Use very little transport cleaner as excessive amounts may deteriorate capstan material.
8. Clean prolay idlers with lint-free cloth moistened with tape transport cleaner.
9. Clean read/write head with cotton swab moistened lightly with tape transport cleaner.
10. Clean vacuum columns weekly, using a lint-free cloth or pad moistened with tape transport cleaner. Use wooden toothpick to remove stubborn oxide clumps.



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Figure 32. 2401 Tape Transport Models 2 or 3

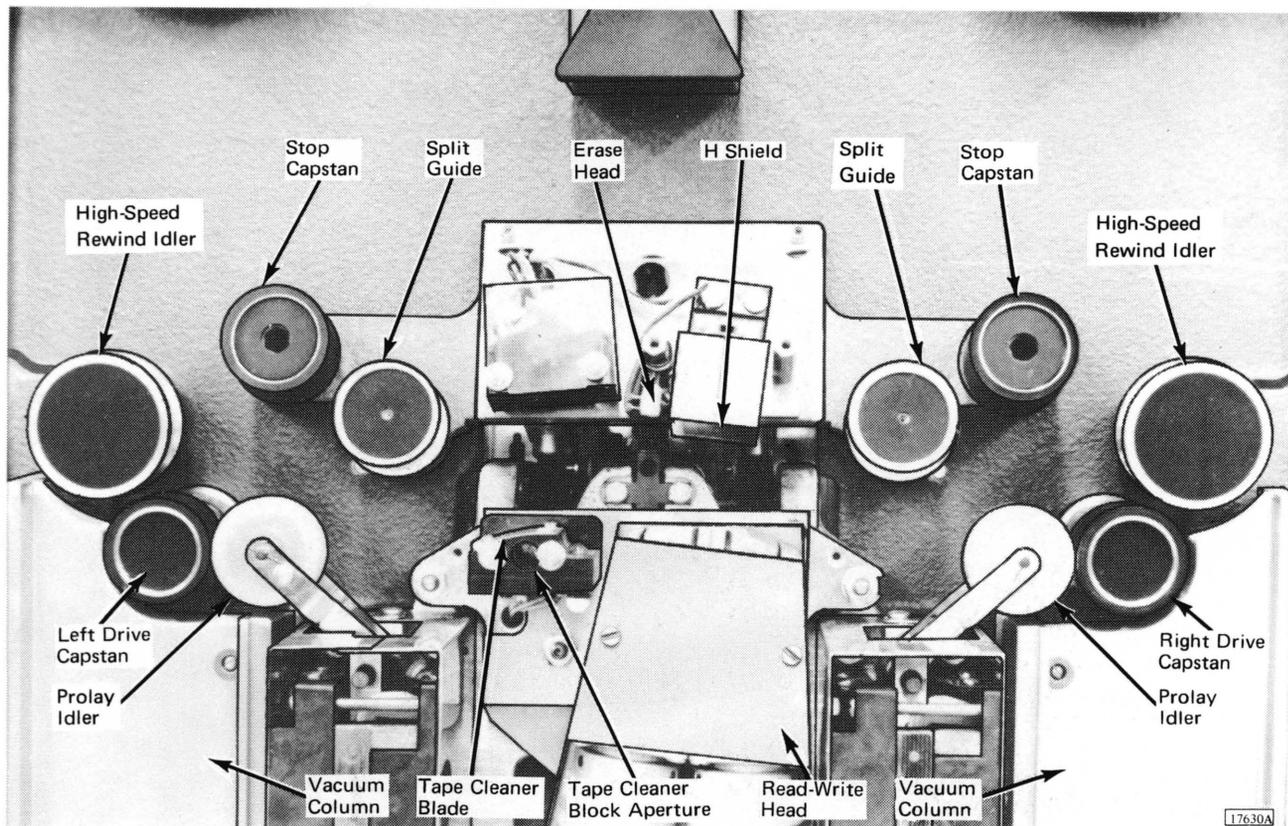


Figure 33. 2401 Tape Transport Model 1

MAGNETIC TAPE HANDLING

IBM magnetic tape is a precision engineered product and tested under carefully controlled conditions to assure highest quality and reliability. However, dust, dirt, or damage to the tape can reduce signal strength, and recorded information may be completely obliterated.

The following suggestions are offered to minimize this potential problem:

1. While a reel of tape is on the tape unit, reassemble its container and place where it is not exposed to dust and dirt. When a reel of tape is removed from the tape unit, immediately place it in its container. Use tape retainers to prevent the free end from unwinding in the container.
2. Never place tapes or containers on top of tape units.
3. To label a reel of tape for identification, other than by means of the card holder provided, use a material that can be removed without leaving a residue. Never use an eraser to alter the identification on a label.
4. Do not expose tapes that contain useful information to magnetic fields.
5. Tobacco and all smoking should be kept away from areas where tape reel are in use or tape drives in operation.
6. Handle tape reels near the hub whenever possible.
7. Always verify that the tape reel is mounted flush on the mounting hub. Never use reels that are warped or damaged.
8. Periodic inspection of reel containers should be established. Replace any cracked containers and remove any accumulation of dust by washing containers with a household detergent.
9. To clean IBM Mylar tape, wipe it gently with a clean, lint-free cloth moistened with tape transport cleaner (IBM part 517960). Carbon tetrachloride and vythene must not be used for cleaning magnetic tape under any circumstances. Clean IBM Dynexcel or HD tape by wiping with a clean, dry, lint-free cloth.

CAUTION

Tape transport cleaner should never be allowed to come in direct contact with IBM Dynexcel or HD tape because of interaction between them.

Appendix A. Carriage Control Tape

The carriage control tape (Figure A-1) has 12 columns indicated by vertical lines. These columns are called control channels. One hole per horizontal line can be punched in each channel throughout the length of the tape. A maximum of 132 lines may be used to control a form although, for convenience, control tapes are slightly larger. The horizontal lines are spaced six per inch.

Round holes in the center of the tape are pre-punched for the pin-feed drive which advances the tape in synchronism with form movement through the carriage. The effect is exactly the same as though control holes were punched along the edge of each form.

Considerations to be made when punching a tape are as follows:

1. A channel-1 punch is required for each form to define the location of the first printing line. It is also required to reset a channel-12 punch, if used.
2. A channel-9 punch or channel-12 punch is used to indicate an overflow position. If a channel-9 punch is used, a channel-12 punch must also be used in the same form to reset the channel-9 condition. A channel-12 punch may be used without a channel-9 punch and is reset by the next channel-1 punch.

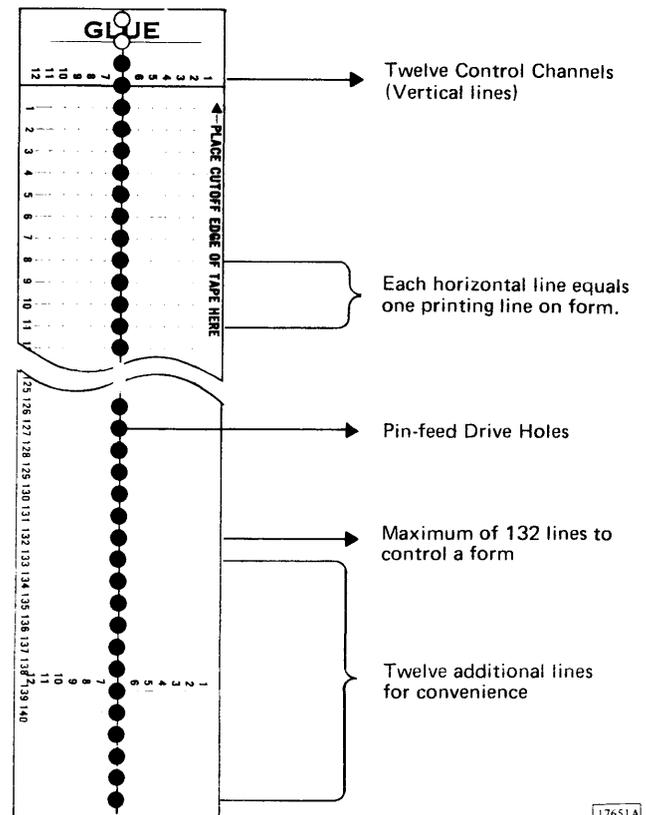
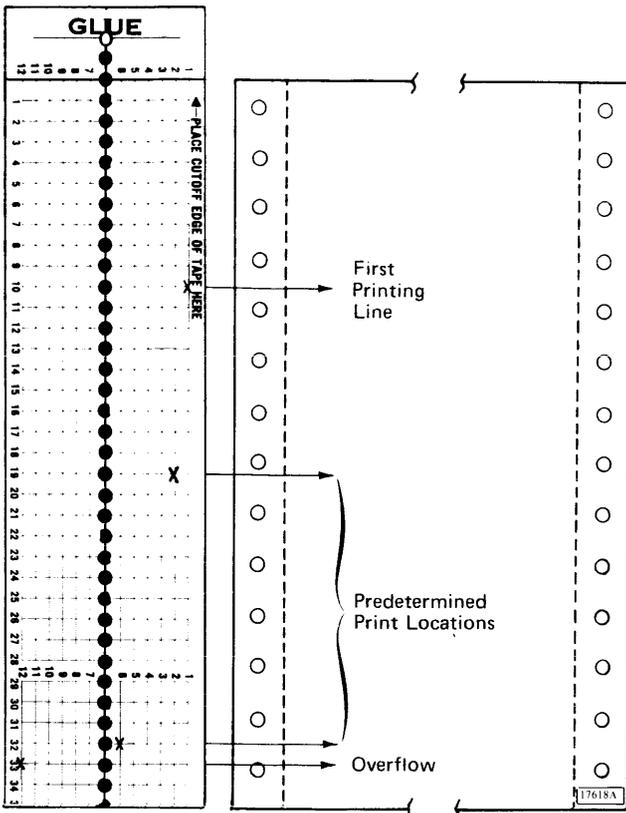
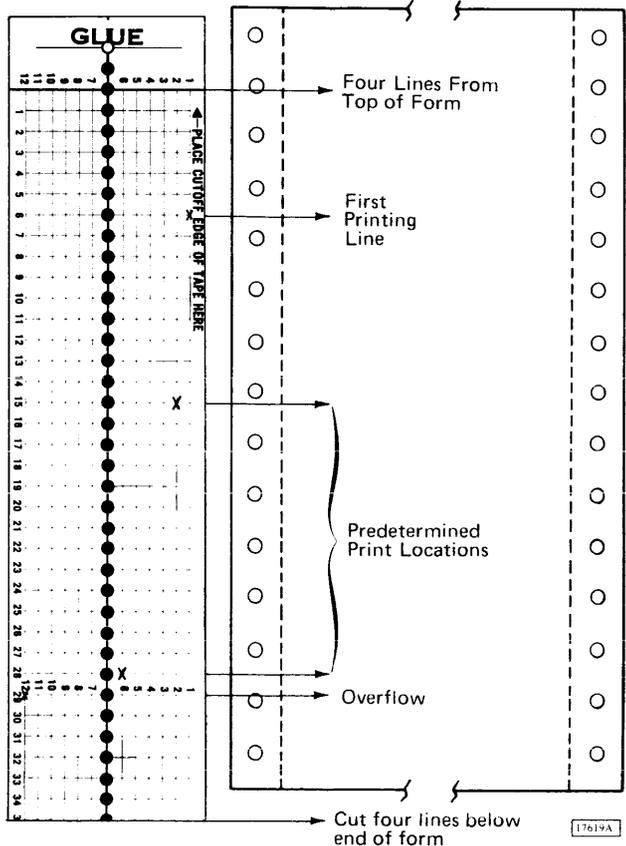


Figure A-1. Carriage Control Tape

MARKING A TAPE FOR PUNCHING (Six Lines Per Inch)

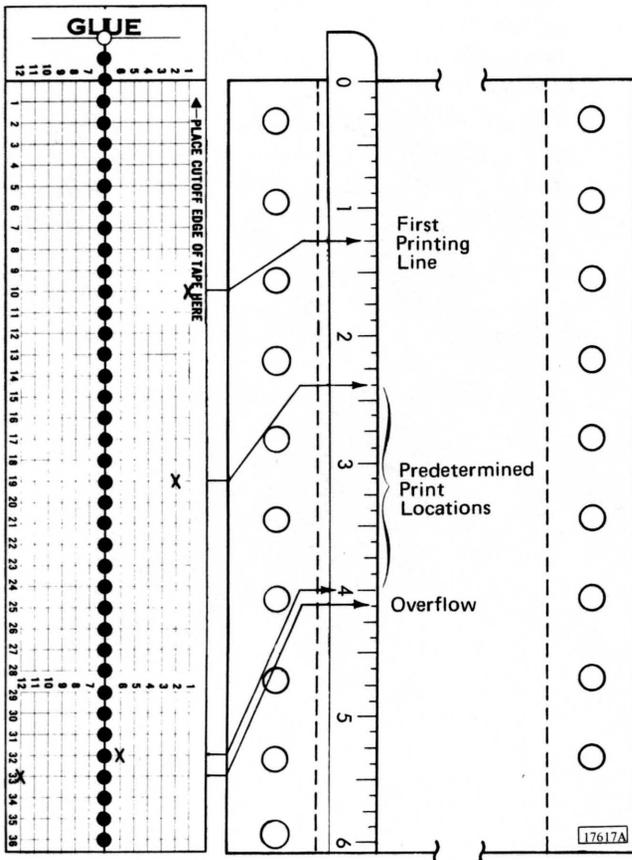


1. Lay tape next to left side of form it is to control, with first heavy line under glue portion even with top edge of form.
2. Check bottom edge of form and verify that punches are not required in last four lines on tape. If punches are required in last four lines, proceed with step 8. Otherwise, continue with step 3.
3. Mark first channel on line that corresponds to first line to be printed on form.
4. Mark additional channel for each skip stop required on form.
5. Mark channel 9 or 12 for last printing line on form if overflow is required.
6. Repeat steps 3 through 5 for as many additional forms that will fit in 132 line spaces of control tape. This extends life of tape by reducing number of revolutions tape must make.
7. Mark line corresponding to bottom edge of last form for cutting after tape is punched. The tape is now ready for punching.



8. Place tape next to left edge of form it is to control, with first heavy line under glue portion four lines lower than top edge of form.
9. Mark channels to be punched as in steps 3 through 6.
10. Mark line for cutting tape four lines lower than bottom edge of last form. This compensates for four lines lost at top of tape. The tape is now ready for punching.

MARKING A TAPE FOR PUNCHING (Eight Lines Per Inch)



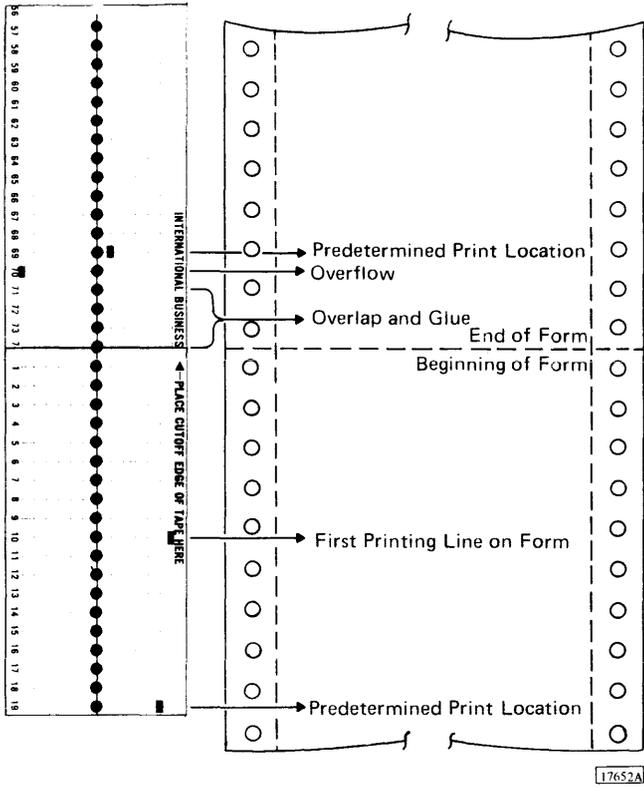
Each line on tape always equals one line on form, regardless of line spacing. In measuring a control tape for eight lines per inch spacing, every 1/8 inch on the form represents one line on the tape.

1. Place ruler calibrated in 1/8 inches on form to be controlled.
2. Count number of 1/8 inch increments from top of form to first printing line.
3. Count down tape same number of lines and mark desired channel.
4. Count down number of 1/8 inch increments from top of form to each predetermined print location.
5. Count down tape same number of lines for each print location and mark desired channel.
6. Mark overflow and bottom edge of form in manner described in steps 4 and 5.

PUNCHING A TAPE



1. Insert tape in punch and place line to be punched over guide line on base of punch.
2. Place center feed holes of tape over pins projecting from base.
3. Turn dial (or indicator slide) until arrow points to number of channel to be punched.
4. Press down on top-rear of punch.
5. Repeat steps 1 through 4 for each marked channel on tape.



6. Cut tape at line marked for cutting.
7. Using an ink eraser, remove glaze from tape where two ends are to be joined.
8. Loop tape and glue bottom end to top section marked "GLUE." Be sure that bottom edge lines up with first line, and center feed holes coincide.
9. Allow tape to dry before using.

In the interest of safety, all IBM machines are designed to meet stringent safety requirements. These safety requirements are met if all machine covers are kept closed.

In addition to improving appearance, the covers of IBM machines have been designed to safeguard personnel against possible injury during operation. While some hazards (such as moving mechanical parts) are obvious, others are not. Electrical potentials and acoustical noise are in the latter category.

While IBM maintains vigorous attention to safety on all of its machines, the effectiveness of safeguards is decreased by failure to keep the covers closed when the machines are running.

The frames of all IBM equipment have been made electrically safe by recommended grounding practices, and the covers have been designed to reduce noise below any possible hearing damage level. Operation with the covers open, however, causes needless exposure to these unseen hazards. Because of this fact, IBM strongly recommends that all personnel associated with the equipment follow the simple safety-first procedure of keeping the covers closed whenever the machine is operating. In addition to the safety aspects of this procedure, the visual and aural environments of the installation are significantly enhanced.

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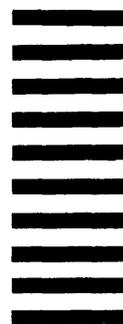
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