IBM **Maintenance Library**

SYSTEM/32 Introduction and Maintenance

SY31-0373-4

PREFACE

This manual contains introductory and maintenance information, and installation instructions for IBM System/32. The maintenance information includes checks, adjustments, and removals and replacements.

Other manuals to be used with this one are:

- *IBM System/32 Operator's Guide,* GC21-7591
- *IBM Diskette For Standard Data Interchange,* GA21-9182
- *IBM System/32 Functions Reference Manual,* GA21-9176
- *IBM System/32 System Control Program Reference Manual,* GC21-7593

For theory of operation and circuit detail, see *IBM Maintenance Library, System/32 Theory Diagrams,* SY31-0346.

In addition, refer to the *System/32 Diagnostic User's Service Guide* for further information on system diagnostic procedures.

Fifth Edition (May 1977)

This is a major revision of, and obsoletes, SY31-0373-3. Extensive changes have been made throughout, and this publication should be reviewed in its entirety. Changes are periodically made to the information herein; any such change will be reported in subsequent revisions or technical newsletters.

A Reader's Comment Form is at the back of this publication. If the form is gone, address your comments to IBM Corporation, Publications, Department 245, Rochester, Minnesota 55901.

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List Of Abbreviations

μs	Microsecond
ac	Alternating current
adr	Address
adv	Advance
AGC	Automatic gain control
ALD	Automated logic diagram
ALU	Arithmetic and logic unit
AM	Address marker
bfr	Buffer
BH	Behind home
bksp	Backspace
BPC	Block processor check
BSCA	Binary synchronous communications adapter
C	Celcius
CE	Customer engineer
CEM	Customer engineering memorandum
chk	Check
ckt	Circuit
COMM	Communications
comp	compare
cps	Characters per second
CPU	Central processing unit/processing unit
CRC	Cyclic redundancy check
CRT	Cathode ray tube
CS	Control storage
db	Decibel
DBI	Data bus in
DBO	Data bus out
dc	Direct current
DCP	Diagnostic control program
DE	Disk enclosure
dec	Decimal
displ	Display
DPLY	Display
dsply	Display
dup	Duplicate
EBCDIC	Extended binary coded decimal interchange code
EOF	End of forms/End of file
ERAP	Error recording and analysis procedure
EWG	End write gap
F	Fahrenheit
FC	File control
FET	Field effect transistor
FRU	Field replaceable unit
FSL	Field service logics
func	Function/functional
GB	Guard band
gnd	Ground
hex	Hexadecimal
Hz	Hertz
I/O	Input/output
ID	Identification
IDB	Identification buffer
IMPL	Initial microprogram load
IMPSS	Impression singleshot
ind	Indicator
inh	Inhibit
init	Initialization
insn	Instruction
IOCL	Input/output control load
IOCS	Input/output control sense
IOL	Input/output load
IOS	Input/output sense
IPL	Initial program load
IR	Incident report
irpt	Interrupt
kbd	Keyboard
Kg	Kilogram
lb	Pound
LED	Light emitting diode
lpm	Lines per minute
LSR	Local storage register
lvl	Level
LZ	Landing zone
MAB	Microprogram address backup (register)
MAR	Microprogram address register/memory address register
max	Maximum
MCU	Magnetic card unit
MLM	Maintenance library manual
mm	Millimeter
MOR	Micro operation register
MS	Main storage/millisecond
MST	Monolithic system technology
N/A	Nonapplicable
N/C	Normally closed
N/O	Normally open
nom	Nominal
OC	Overcurrent
OP	Operating point
OV	Overvoltage
P/N	Part number
PC	Parity check/printed circuit
PCR	Process condition register
PG	Parity generation
PID	Programming information distribution
PM	Preventive maintenance
POR	Power on reset
PP	Parity predict/program product
pres	Present
prev	Previous
proc	Process
PSR	Program support representative
PSS	Print subscan
PTF	Program temporary fix
pwr	Power
R/W	Read/write
rdy	Ready
reg	Register
rep	Repeat
RPG	Report program generator
rpm	Revolutions per minute
S	Second
SAR	Storage address register
SBI	System bus in
SBO	System bus out
SCP	System control program
SDR	Storage data register
SDLC	Synchronous data link control
SEL	Select/selector
SS	Singleshot
stor	Storage
sw	Switch
SWG	Start write gap
sys	System
TB	Terminal board
TH	Thermal
TP	Test point
tr	Trigger

UV	Undervoltage
V	Volt
VFC	Vertical forms control
VFO	Variable frequency oscillator
vol	Volume
VOL-ID	Volume identification
VOM	Volt-ohm meter
VTL	Vendor technology logic
VTOC	Volume table of contents
WR	Work register
WTC	World Trade Corporation (IBM)

CE SAFETY PRACTICES

All customer engineers are expected to take every precaution possible and observe the following safety practices while maintaining IBM equipment:

1. Do not work alone under hazardous conditions or around equipment with dangerous voltage.

   Note: Always advise your manager if you MUST work alone.

2. Remove all power, ac and dc, when you are removing or assembling major components, working in the immediate area of power supplies, performing mechanical inspection of power supplies, and installing changes in machine circuitry.

3. Lock or tag the wall box power switch after you turn it off. Attach "DO NOT OPERATE" tags, form 229-1266, when applicable.

4. Pull the power supply cord whenever possible.

5. When it is absolutely necessary to work on equipment having exposed operating mechanical parts or exposed live electrical circuitry anywhere in the machine, take the following precautions:
   a. Ensure that another person, familiar with the power off controls, is present.
   b. Do not wear rings, wristwatches, chains, bracelets, metal cuff links, or any other metal personal jewelry.
   c. Use only insulated pliers, screwdrivers, and probes.
   d. Keep one hand in your pocket.
   e. Be certain that the controls are set correctly and that you have the proper capacity probes when using test instruments.
   f. Avoid contacting a ground potential (metal floor strips, machine frame, metal lamps, etc); use rubber mats purchased locally, if necessary.

6. Wear safety glasses when you are:
   a. Using a hammer to drive pins, rivets, stakes, etc.
   b. Using power tools for drilling, reaming, grinding, and other metal work.
   c. Attaching springs with a spring hook.
   d. Soldering, cutting wire, or removing steel bands.
   e. Cleaning parts or using solvents, sprays, cleaners, or any other chemicals.
   f. Working under any other condition that might be hazardous to your eyes. SAFEGUARD YOUR EYES.

7. Follow the special safety instructions outlined in the CEMs and in the safety section of the maintenance manuals when handling cathode ray tubes and high voltage.

8. Do not use solvents, chemicals, grease, or oil that are not approved by IBM.

9. Do not use tools or test equipment that is not approved by IBM.

10. Replace worn or broken tools and test equipment.

11. Do not lift a load that you and your manager feel would jeopardize your health and well-being or that of other employees.

12. Restore all guards, shields, signs, ground wires, and other safety devices after maintenance.

13. Avoid touching moving mechanical parts when lubricating, checking for gap, etc.

14. Do not touch ANYTHING while using the stroboscope; parts could be moving even though the strobe light makes them appear to be stopped.

15. Do not wear loose clothing that might catch in the machinery.

16. Keep your shirt sleeves buttoned or roll them above the elbow.

17. Tuck your tie in your shirt or wear a nonconductive tie clasp attached approximately 3 inches from the end of your tie. Do NOT use a tie chain.

KNOWING SAFETY IS NOT ENOUGH. AN UNSAFE ACT INEVITABLY LEADS TO AN ACCIDENT. USE GOOD JUDGEMENT—ELIMINATE UNSAFE ACTS.

Be sure that your actions do not render the product unsafe or expose customer personnel to unsafe conditions. Practice the following precautions to protect customer personnel:

1. Maintain good housekeeping in the machine area during and after maintenance.
   a. Place removed machine covers in an out-of-the-way place where no one can trip over them.
   b. Place the CE tool kit away from walk areas (under a desk or table) so no one can trip over it.

2. Make sure that fellow CEs and customer personnel are not in a hazardous position before starting the equipment.

3. Replace all machine covers before returning the machine to the customer.

DANGERS

Resistors and solenoids become extremely hot after prolonged use. Be sure the components have cooled before performing maintenance in these areas:

2.2.2	Disk Enclosure Removal
2.2.4	Disk Brake Assembly Adjustment
3.2.12	33FD Drive Motor Removal and Replacement
4.2.3	Printer Thermal Switch Removal and Replacement
4.2.9	Motor and Paper Clamp Resistor Removal and Replacement
4.2.10	Print Unit Removal and Replacement
4.2.30	Ribbon Drive Clutch Removal and Replacement
4.2.32	Ribbon Solenoid Adjustment, Removal and Replacement
5.2.2	Display Assembly Removal and Replacement
5.2.3	Display Assembly Yoke Adjustment
8.0.0	Power Supplies

1.0.0 Introduction

1.1.0 DESCRIPTION

This system is a desk-size business system with the following features:

- Programs are written in system instructions and converted to machine language by a microprogram.
- Large storage capacity is provided by an integrated disk storage facility.
- Operating instructions and prompting messages are displayed on a display screen.
- Input/output and processing unit errors are recorded and can be retrieved.
- Diagnostic programs are automatically run after the initial microprogram load.
- Whenever possible, instructions are automatically retried after an error.

The IBM System/32 can be ordered with either the serial printer or the belt printer.

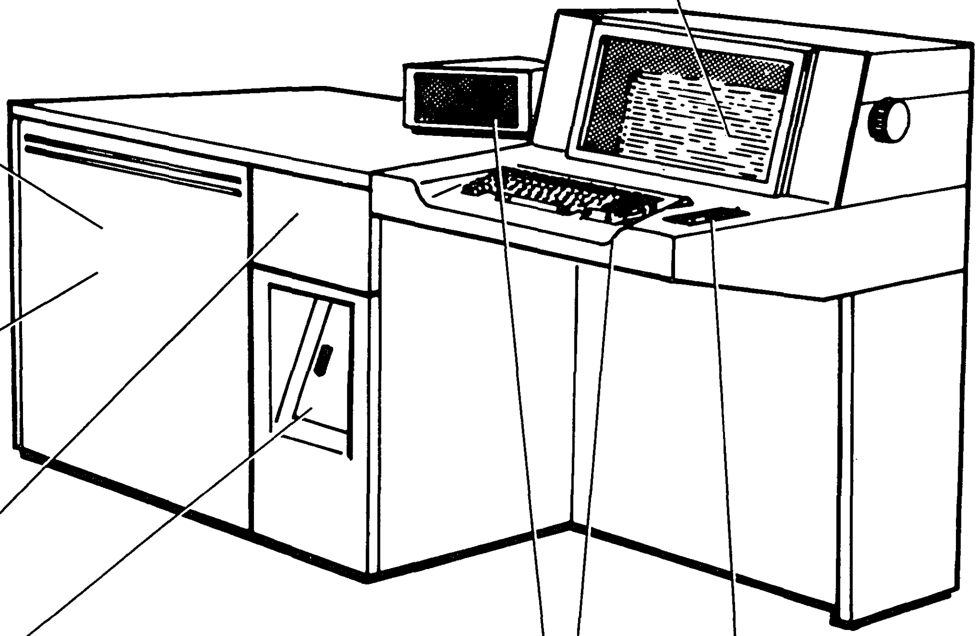
The **serial printer** has 132 print positions and uses a 64-character set. It is a 7 x 7 wire matrix printer. The serial printer is available in four models:

120 CPS (characters per second) bidirectional
80 CPS bidirectional
40 CPS bidirectional
40 CPS unidirectional

The two models of the 40 CPS printer are identical. The attachment circuitry controls whether they print only left-to-right or in both directions.

The **belt printer** has 132 print positions and a 48-character set, a 64-character set, or a 96-character set. The printing speed is 50, 100, 155, or 285 lines per minute with a 48-character set.

The **communications adapter (BSCA/SDLC)** is an optional feature that allows the System/32 to function as a point-to-point or a multipoint terminal Data is transmitted or received serially-by-bit and serially-by-character over voice grade communication networks (switched or nonswitched network). The system can be connected to a half-duplex or a full-duplex facility; however, the communications adapter operates in half duplex only. That is, transmission of data is only in one direction at a time.



The **disk drive** provides 3.2, 5.0, 9.1, or 13.7 million bytes of accessible storage depending on the system model number. In addition, various diagnostic programs reside on the 62GV.

The **processing unit** contains 16K, 24K, or 32K (K = 1024 bytes) addressable positions of main storage and 4K or 8K addressable positions of control storage. FET (field effect transistor) technology is used for both main and control storage.

The processing unit also contains registers, gates, and ALUs that are controlled by the microprogram.

The **CE control panel** contains lights and switches used for maintenance of the system. See Section 7 for detail.

The **33FD diskette drive** provides input/output capabilities by IBM diskettes. For example, data can also be entered on the diskettes by key entry devices such as the IBM 3740 Data Entry System.

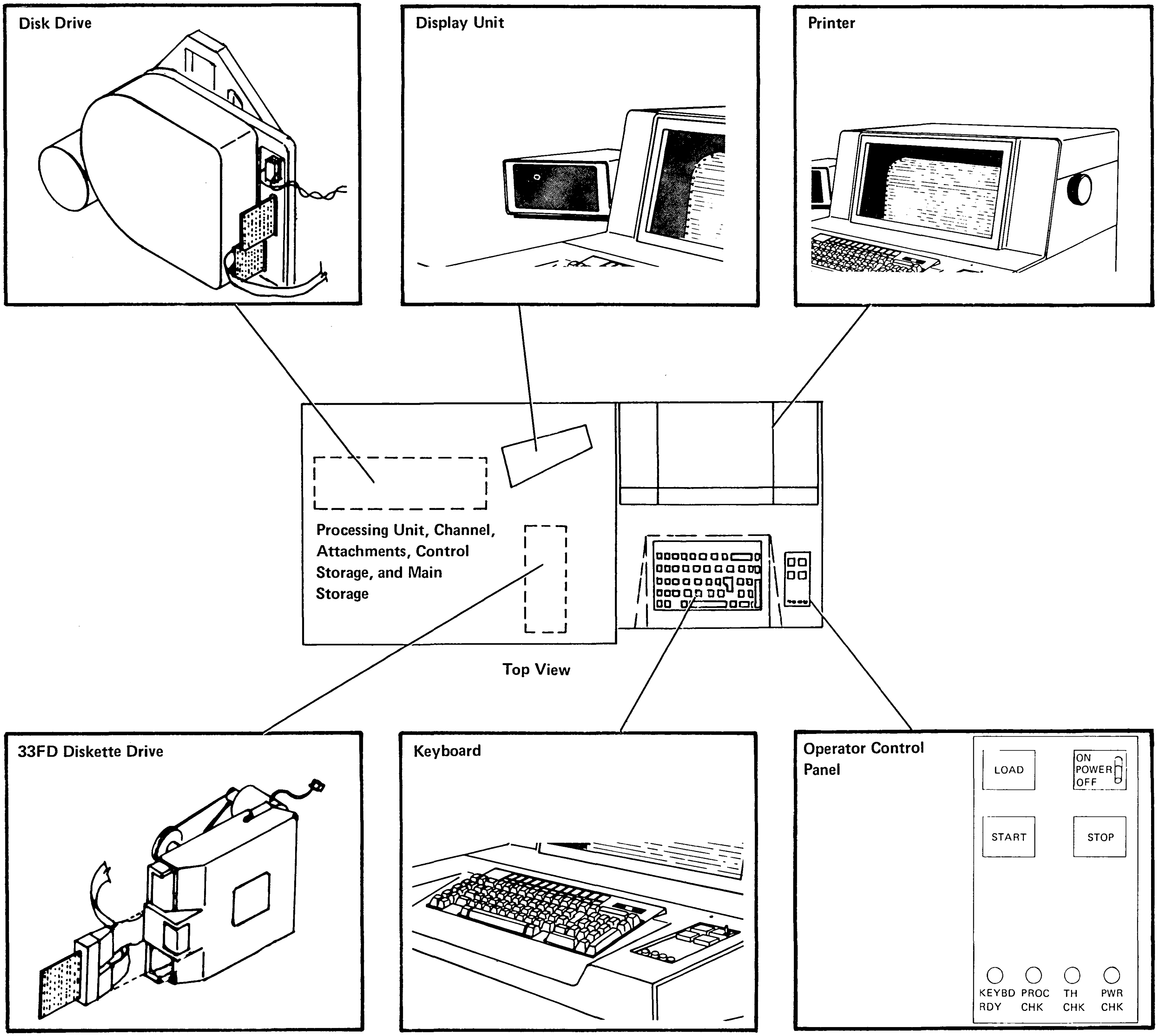
Various diagnostic programs reside on the diskettes.

The **display unit** is used for prompting, job output, and error messages. Up to six lines of 40 characters per line can be displayed at one time.

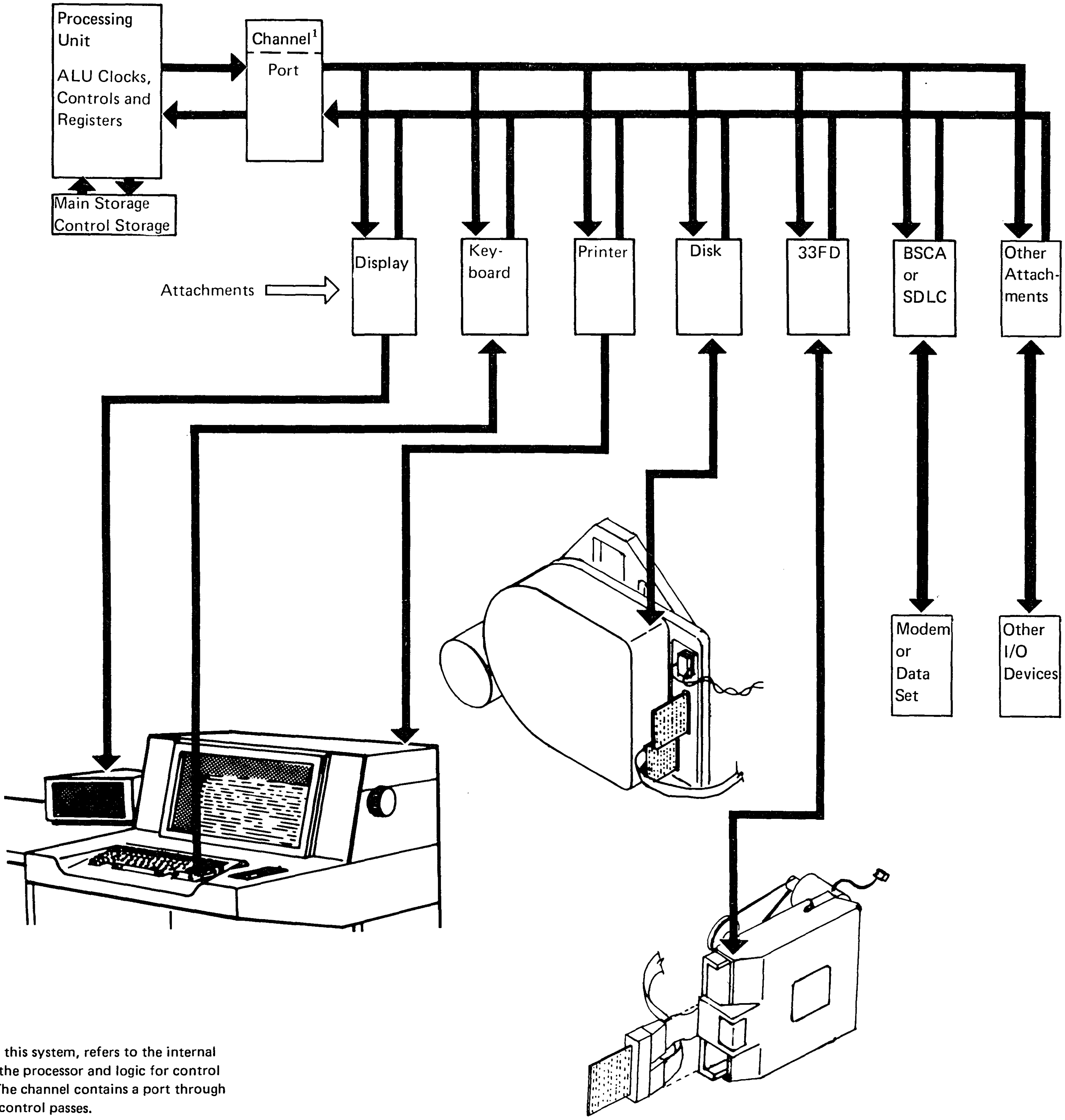
The **keyboard** controls system functions. It is the key entry device for diagnostic programs and is also used as a data input device.

The **operator control panel** is used to turn the power OFF and ON, load the diagnostic programs and control programs, and start and stop the processing. The keyboard ready, processor check, thermal check, and power check indicator lights are also on the operator console.

1.2.0 BASIC CONFIGURATION



1.3.0 SYSTEM DATA FLOW



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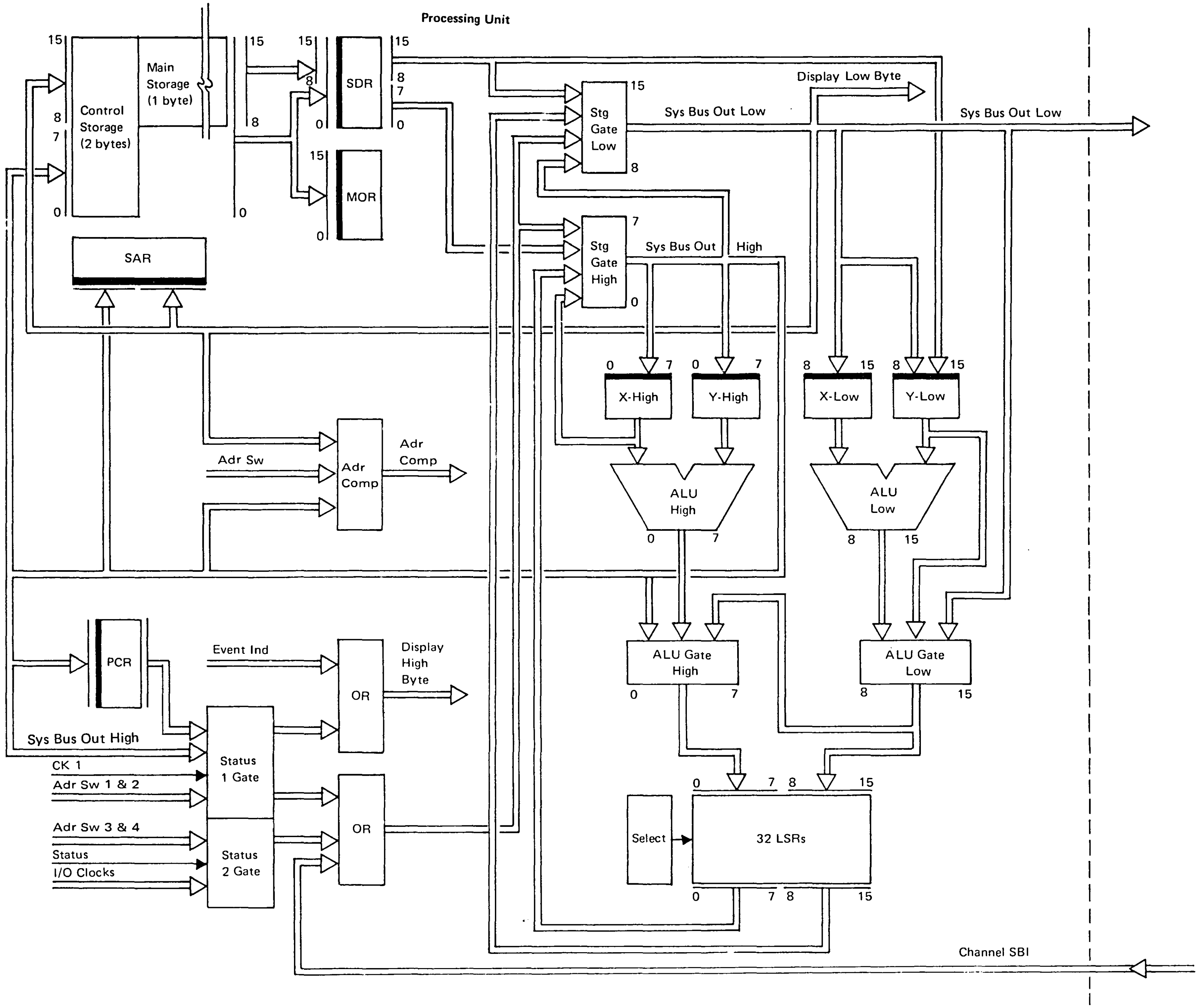
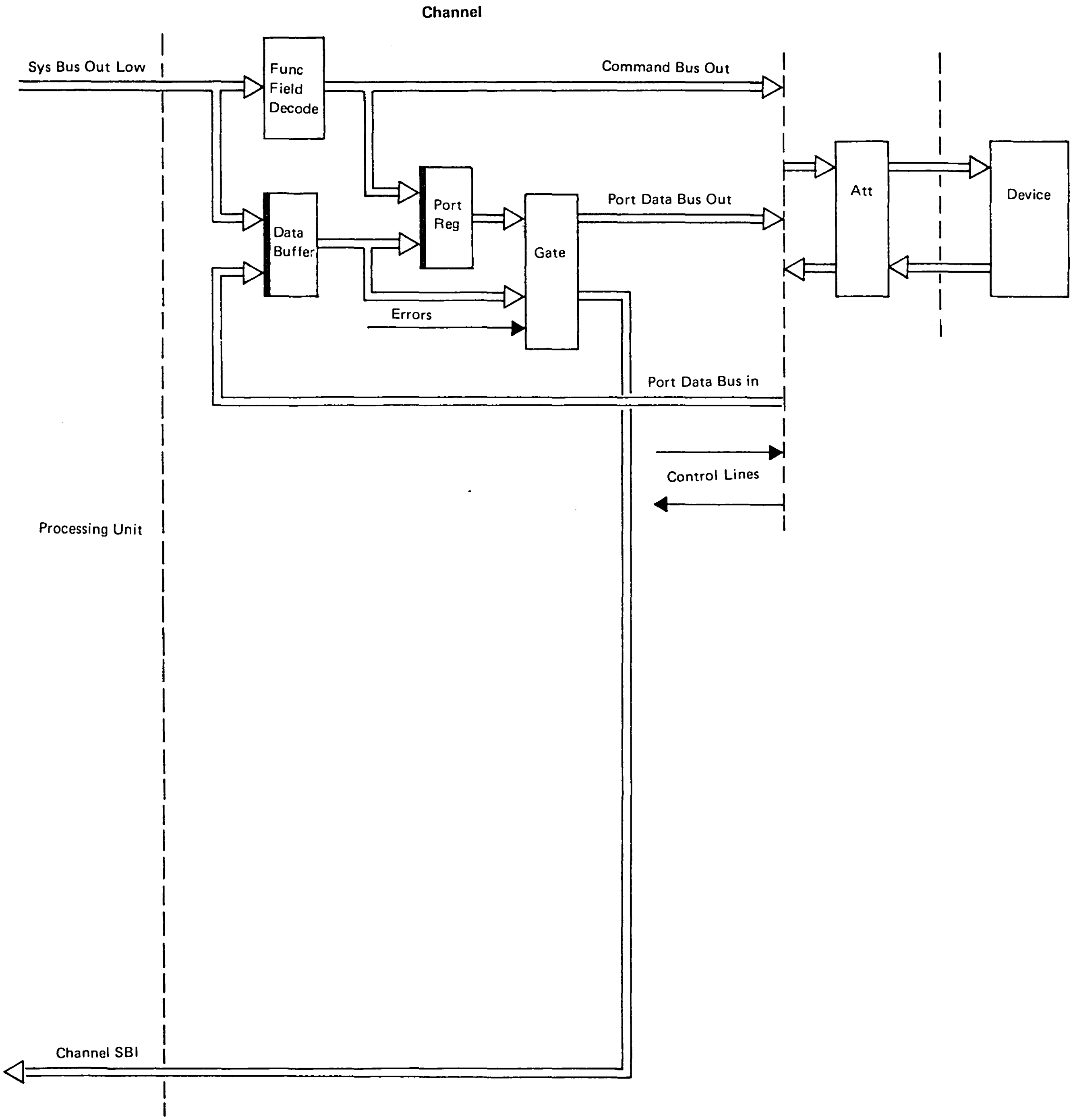
[1] Channel, as used in this system, refers to the internal interface between the processor and logic for control of I/O function. The channel contains a port through which part of this control passes.

1.4.0 PROCESSING UNIT DATA FLOW



1.5.0 CHANNEL DATA FLOW



1.6.0 SYSTEM MICROPROGRAM

All the functions performed by the system are controlled by the microprogram.

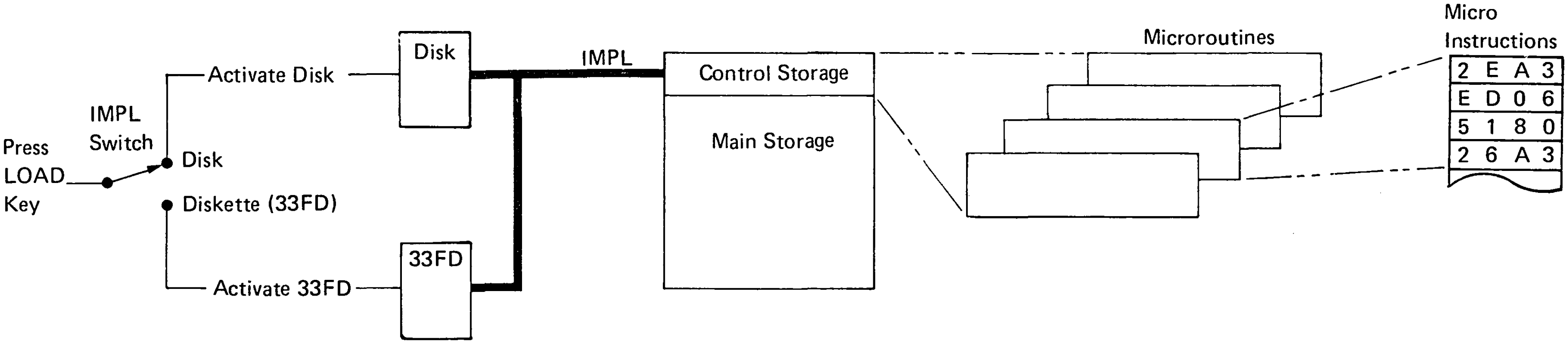
The system microprogram is composed of *microroutines* of varying sizes, each having a specific task to perform. Each microroutine is composed of bit-significant micro instructions that are machine language instructions.

The microprogram handles:

- System instructions
- Data in main storage
- Channel operations

The microprogram must be loaded into control storage (initial microprogram load) before any processing can begin. The microprogram can be loaded from either the disk or the 33FD (CE only) depending on the setting of the IMPL switch on the CE control panel.

To begin the initial microprogram load operation, press the LOAD key on the operator control panel.



1.7.0 CONTROL STORAGE

Control storage on the basic System/32 consists of 4K addressable positions. On machines with the Control Storage Increment feature, control storage contains 8K addressable positions. Because the additional 4K word increment of control storage does not directly affect hardware operations, it is not discussed in further detail.

Control storage contains part of the system control program and microroutines to process the system instructions. The illustration shows the areas where the microroutines reside after they are loaded into control storage from the disk.

The system emulator classifies system instructions as processing unit instructions or as input/output instructions. When the system instruction is classified as a processing unit instruction, the emulator also executes the instruction. If the system instruction is classified by the emulator as an input/output instruction, it is executed by the appropriate I/O area of control storage.

After the emulator classifies a system instruction as an I/O instruction for one of the devices, control is passed to the appropriate area of control storage. For example, a disk instruction is executed by the disk I/O area of control storage, printer instructions by the printer I/O area, and keyboard and display screen instructions by the keyboard/CRT I/O area.

The I/O interrupt handler processes micro interrupts.

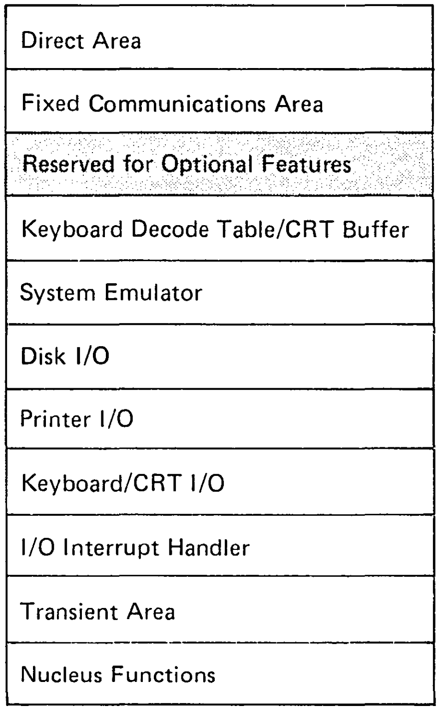
The keyboard decode table in the keyboard/CRT I/O area translates the data bits coming from the keyboard into a standard code. The CRT buffer in this area assembles the message for the display screen. This buffer is then transferred to the buffer in the display attachment. If the message is to be printed, the printer takes the information from the CRT buffer.

The transient area is used for devices whose microroutines are not loaded into control storage at IMPL. For example, the 33FD microroutines are loaded from the disk into the transient area of control storage when that device is called.

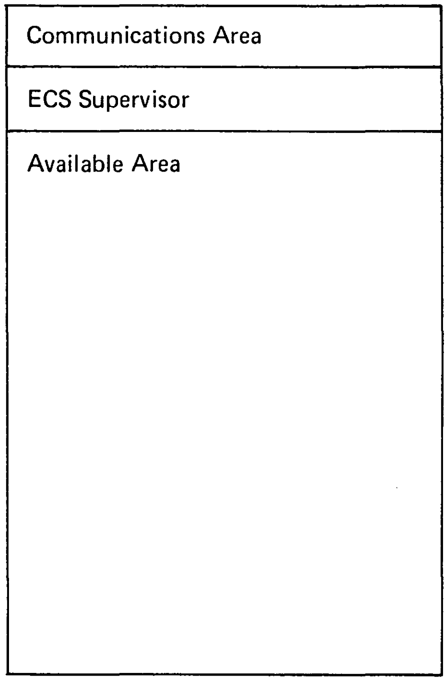
The nucleus functions area is used with the system control program.

The direct area and fixed communications area contain system registers, machine check log, and interrupt branch tables. These areas are common areas used by all the microroutines.

Control Storage



Control Storage Increment (4K Words)



1.8.0 FUNCTIONAL UNITS

1.8.1 Main Storage (MS)

Main storage contains 16K, 24K, or 32K addressable positions; each position is 1 byte.

1.8.2 Control Storage (CS)

Control storage contains 4K addressable positions (8K positions on machines with the Control Storage Increment feature): each position is 2 bytes long. Control storage is loaded from the disk in normal customer operations or from the 33FD when running the diagnostic programs. The loading of control storage occurs during the IMPL (initial microprogram load) sequence. When loaded, control storage contains the microprogram used to control the processing unit and I/O devices. See Section 1.7.0 *Control Storage* for more information about the areas of control storage.

1.8.3 Storage Address Register (SAR)

SAR is a 16-bit register used to address both main storage and control storage.

1.8.4 Micro Operation Register (MOR)

The MOR is a 16-bit register that holds each micro instruction as it is fetched from control storage. From here the micro instruction is analyzed to control the data flow such as gate selection, ALU operation, and LSR selection.

1.8.5 Process Condition Register (PCR)

The PCR is an 8-bit register that contains information to be tested by branch instructions. For example, from the PCR, the result of a previous arithmetic instruction can be determined to be positive, negative, or zero. The PCR also contains results from compare or test mask instructions.

1.8.6 Storage Data Register (SDR)

The SDR is a 16-bit register that serves as an intermediate buffer for all micro instructions and data bytes fetched from storage. Each micro instruction, being 2 bytes, uses all 16 bit positions. Data from main storage, being only 1 byte, uses bit positions 8-15.

1.8.7 X and Y Registers

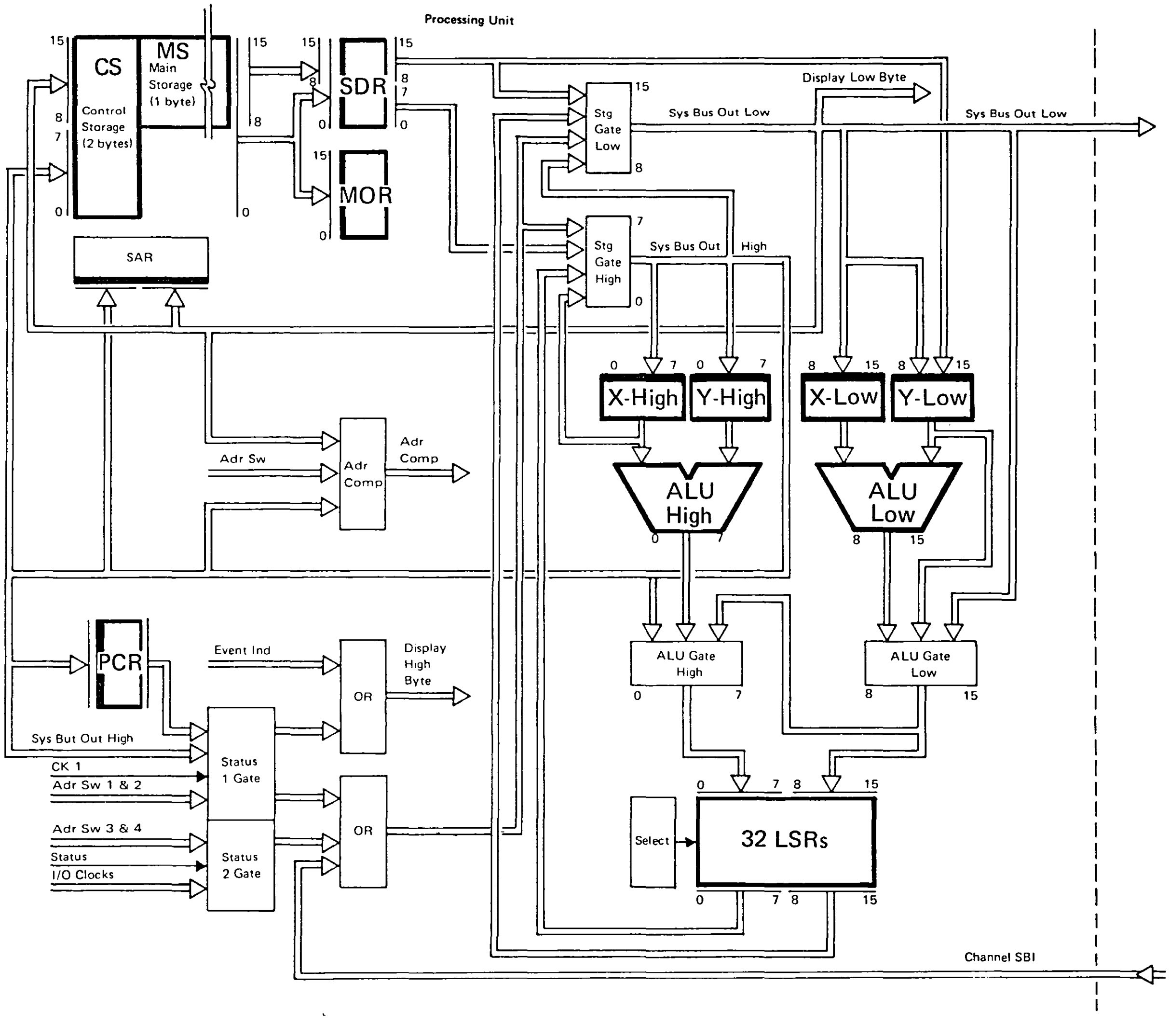
These four registers are 8-bit registers that provide the input into the two ALUs. The X-high and Y-high registers provide input to ALU high: The X-low and Y-low registers provide input to ALU low. The data for these registers comes from the local storage registers or the immediate data field of some micro instructions.

1.8.8 Arithmetic Logical Unit (ALU)

There are two ALUs in the system; ALU high and ALU low. ALU high operates on bits 0-7 when 2-byte data fields are involved. ALU low operates on bits 8-15 when either a 1-byte or 2-byte data field is involved.

When 2-byte data fields are involved in the ALU operation, each ALU sends its single byte output to the corresponding LSR input. ALU high sends bits 0-7 through ALU gate high, and ALU low sends bits 8-15 through ALU gate low.

When 1-byte data fields are involved in the ALU operation, only ALU low is used. However, the output of ALU low is sent via the ALU gates to both LSR inputs.



1.8.9 Local Storage Registers (LSR)

The LSR stack contains 64 LSRs; the first 32 are used by the base system and the remaining 32 are reserved for optional features. Each LSR contains 16 bits, bits 0-7 are the high LSR and bits 8-15 are the low LSR. The LSRs are called work registers (WR) and are used as data buffers and address registers for both main and control storage. In addition, the LSRs are used as operand registers for calculations and as I/O control data registers that can be loaded from or sent to the I/O attachments.

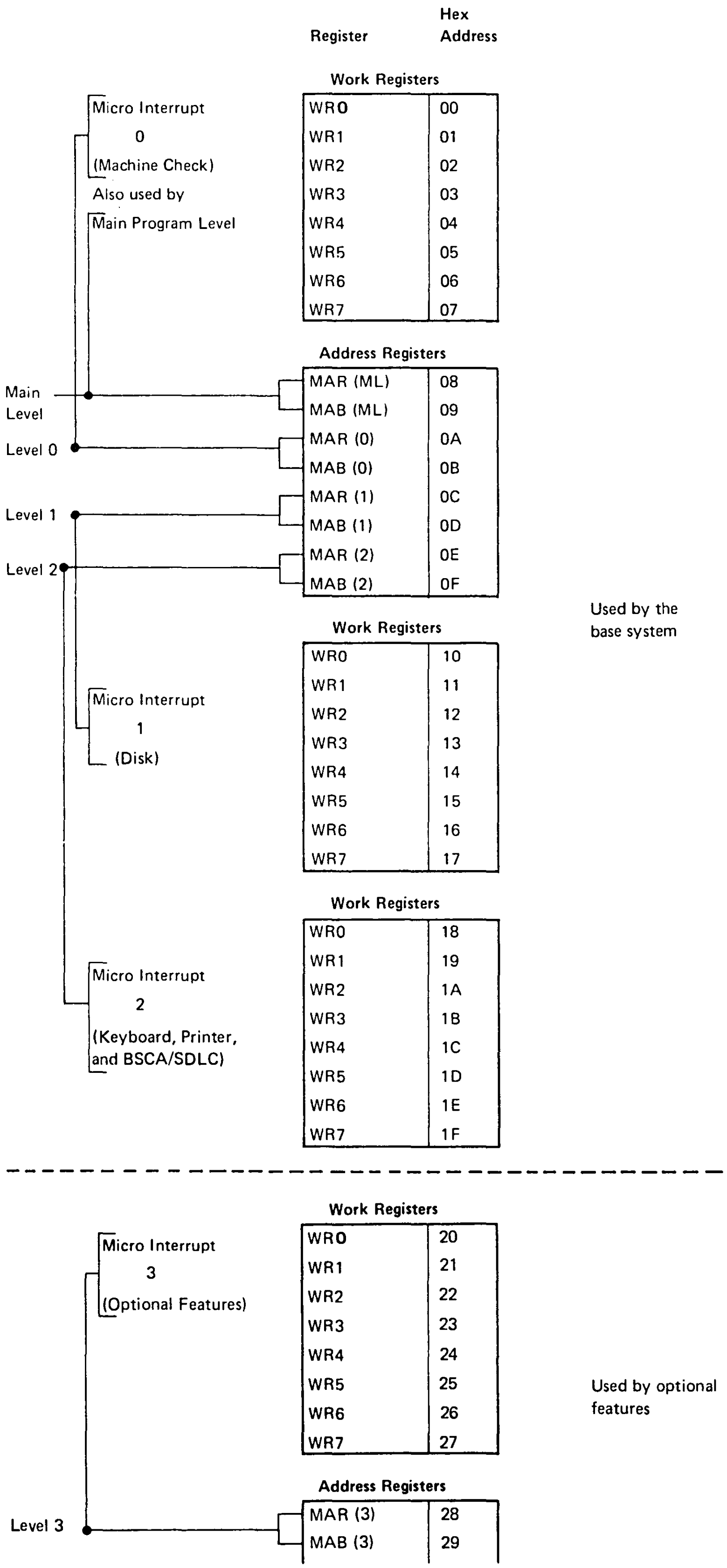
The first 32 LSRs are subdivided into four groups as shown in the LSR stack. The group of LSRs being used depends on the current micro interrupt level. The first group (hex address 00-07) is used by micro interrupt level 0 (machine check interrupt) and also by main program level.

The second group of LSRs (hex address 08-0F) contains the MAR/MAB (microprogram address register/microprogram address backup). MAR contains the address of the next micro instruction to be executed. MAB contains the return address when a branch and link instruction is executed.

The third group (hex address 10-17) is used by micro interrupt level 1 (disk), and the fourth group (hex address 18-1F) is used by micro interrupt level 2 (printer, keyboard, and BSCA/SDLC).

Optional features use 10 of the remaining 32 LSRs. The first group (hex address 20-27) is used by micro interrupt level 3 as work registers. The second group (hex address 28-2F) contains the MAR/MAB for micro interrupt level 3 (hex address 28-29).

LSR Stack



Register	Hex Address
Work Registers	
WR0	00
WR1	01
WR2	02
WR3	03
WR4	04
WR5	05
WR6	06
WR7	07
Address Registers	
MAR (ML)	08
MAB (ML)	09
MAR (0)	0A
MAB (0)	0B
MAR (1)	0C
MAB (1)	0D
MAR (2)	0E
MAB (2)	0F
Work Registers	
WR0	10
WR1	11
WR2	12
WR3	13
WR4	14
WR5	15
WR6	16
WR7	17
Work Registers	
WR0	18
WR1	19
WR2	1A
WR3	1B
WR4	1C
WR5	1D
WR6	1E
WR7	1F
Work Registers	
WR0	20
WR1	21
WR2	22
WR3	23
WR4	24
WR5	25
WR6	26
WR7	27
Address Registers	
MAR (3)	28
MAB (3)	29

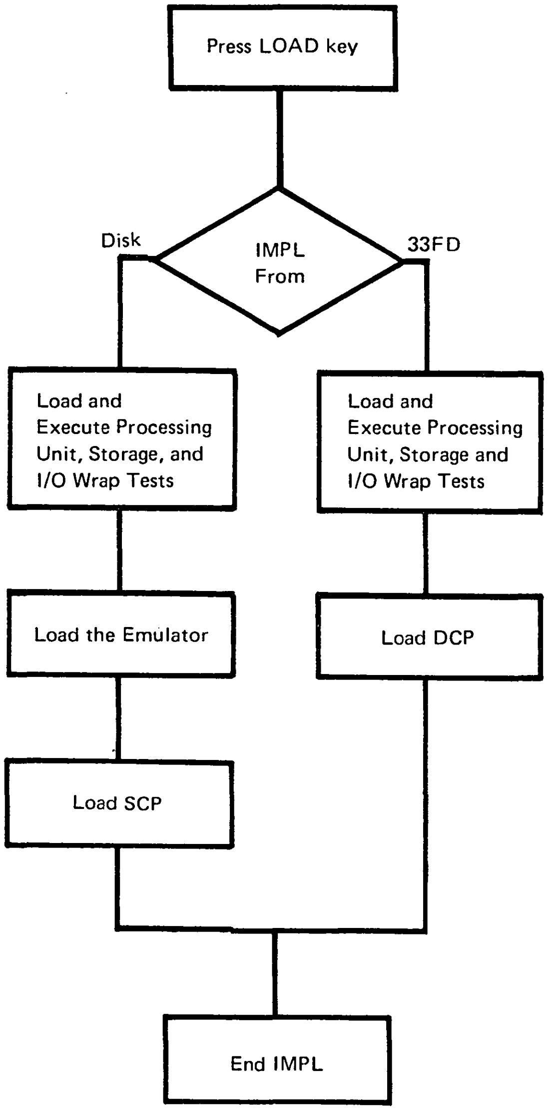
1.9.0 INITIAL SYSTEM CHECKOUT

To ensure that the system circuitry is functioning properly, a series of diagnostic tests are run each time the LOAD key is pressed. These tests fall into two groups. The first group checks the processing unit, main storage, and control storage. The second group, called *I/O wrap tests,* checks the I/O attachments; however, the I/O wrap tests do not operate the I/O device (level 3 I/O attachments are not wrap tested during IMPL). Individual diagnostic programs can be run later to exercise the selected I/O device.

Diagnostic tests are loaded from either the disk or the 33FD as shown in the flowchart depending on the setting of the IMPL switch on the CE control panel (7.2.0).

To help isolate a failing area, an event register is displayed in the high order display byte on the CE control panel. When the LOAD key is pressed, all nine indicators turn on. As each portion of the system checkout is completed, an event indicator turns off; thus, it is possible to narrow the area of failure. A more detailed description of the event indicators is found in 1.10.0.

After the tests are successfully completed, the emulator and SCP (system control program) are loaded from the disk if the IMPL switch is in the DISK position; if the switch is in the DISKETTE position, the DCP (diagnostic control program) is loaded from the 33FD. When the DCP is loaded, additional diagnostic programs can be run to exercise the I/O devices.



1.10.0 EVENT INDICATOR SEQUENCE

The LOAD light and all nine event indicator lights (high byte display on CE panel) are turned on when LOAD is pressed. When LOAD is released, the IMPL sequence starts and 2K words are transferred into control storage (from either 33FD or disk). At the same time, the LOAD light and all the event indicators turn off (these lights may flash intermittently). If IMPL is not completed successfully, the lights that represent the incomplete portion of IMPL turn back on and stay on. The MODE SELECTOR switch must be in the PROC RUN position for the event indicators to be displayed.

Each event indicator is turned off and stays off as follows:

P[1]	Adapter received the load signal and initiated action in response (BPC).
0[1]	First cycle steal request received, data transfer has started (write trigger).
1[1]	Transfer of 4096 bytes of data was completed (ALU bit 4 AND write trigger).
LOAD[1]	Data transfer completed with no data check (ALU bit 4 AND write trigger AND (not) processor check).
2	Branching and conditional branching routines complete. LSRs are cleared of bad parity. Reset occurs during routine 2.
3	Load 1 complete. The loader is invoked to load the second 2K words of test.
4	First micro instruction of load 2. This indicated that load 2 transferred correctly. Reset occurs during routine 36.
5	First instruction of the control storage test (routine 64). Indicates all previous routines (36-63) ran correctly.
6	Last instruction of control storage test (routine 64). Indicates the control storage test ran correctly.
7	First instruction of IMPL load 3 (wrap test load). Indicates that load 1 and load 2 ran correctly and that the third load has started execution.

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[1] Reset by hardware controls. The other lights are reset by micro instructions.

1.11.0 MICRO INTERRUPTS

The processing unit performs computations in a step-by-step procedure; one micro instruction is executed followed by the next sequential micro instruction. This sequence of micro instructions can be changed by a branch instruction; or the main program level might be interrupted by a micro interrupt.

The system has four levels of micro interrupts: level 0, level 1, level 2, and level 3. Level 0 has the highest priority and level 3 the lowest. Interrupts having a higher priority take precedence over those having a lower priority. For example, a micro interrupt on level 0 interrupts the processing of a micro interrupt on level 1.

The micro interrupt levels are assigned as follows:

Level	**Description**
0	Machine check
1	Disk drive
2	Keyboard, BSCA/SDLC, and printer
3	MCU, magnetic character reader, or data recorder attachments

The display screen and 33FD cannot cause micro interrupts

A machine check interrupt (level 0) occurs whenever the system detects a processing unit parity check, invalid address, or microprogram check. A machine check interrupt can also be initiated by a port check. The preceding checks are described in 7.2.0.

A level 1 micro interrupt occurs whenever the disk drive requires attention.

The BSCA/SDLC, keyboard, and printer operate on micro interrupt level 2. Further priorities are set within level 2; the priorities are :

1. BSCA/SDLC
2. Keyboard
3. Printer

Micro interrupt level 3 can be used by the mag card unit, magnetic character reader, or data recorder attachment features.

Micro interrupt level 0 shares a set of work registers with the main program level microroutines. Levels 1, 2, and 3 each have a unique set of work registers in the LSR stack.

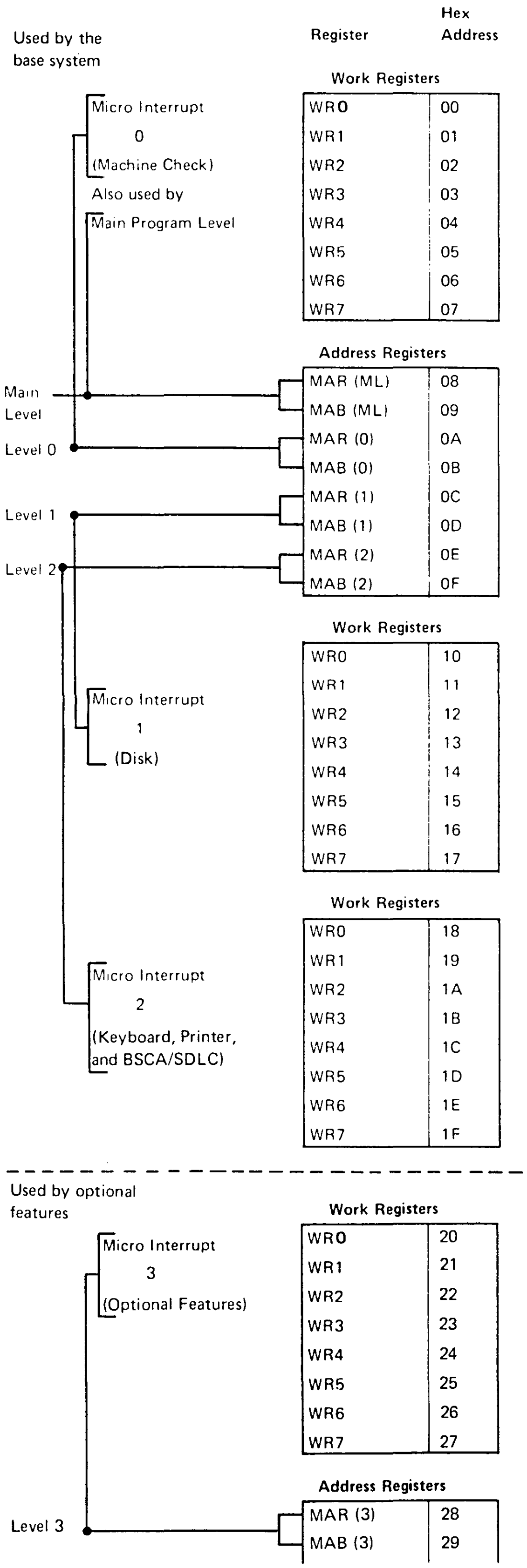
Micro interrupt level 3 uses the first 10 LSRs of the reserved 32 LSR group for its work and MAR/MAB registers.

Interrupt levels 4 and 5 are reserved. Registers 2A through 3F of the additional 32 LSR group are reserved to support interrupt levels 4 and 5.

The set of LSRs for each micro interrupt level consists of:

8 16-bit work registers
1 MAR (microprogram address register) to store the address of the next micro instruction to be executed.
1 MAB (microprogram address backup) to store the return address when a branch and link instruction is executed

LSR Stack



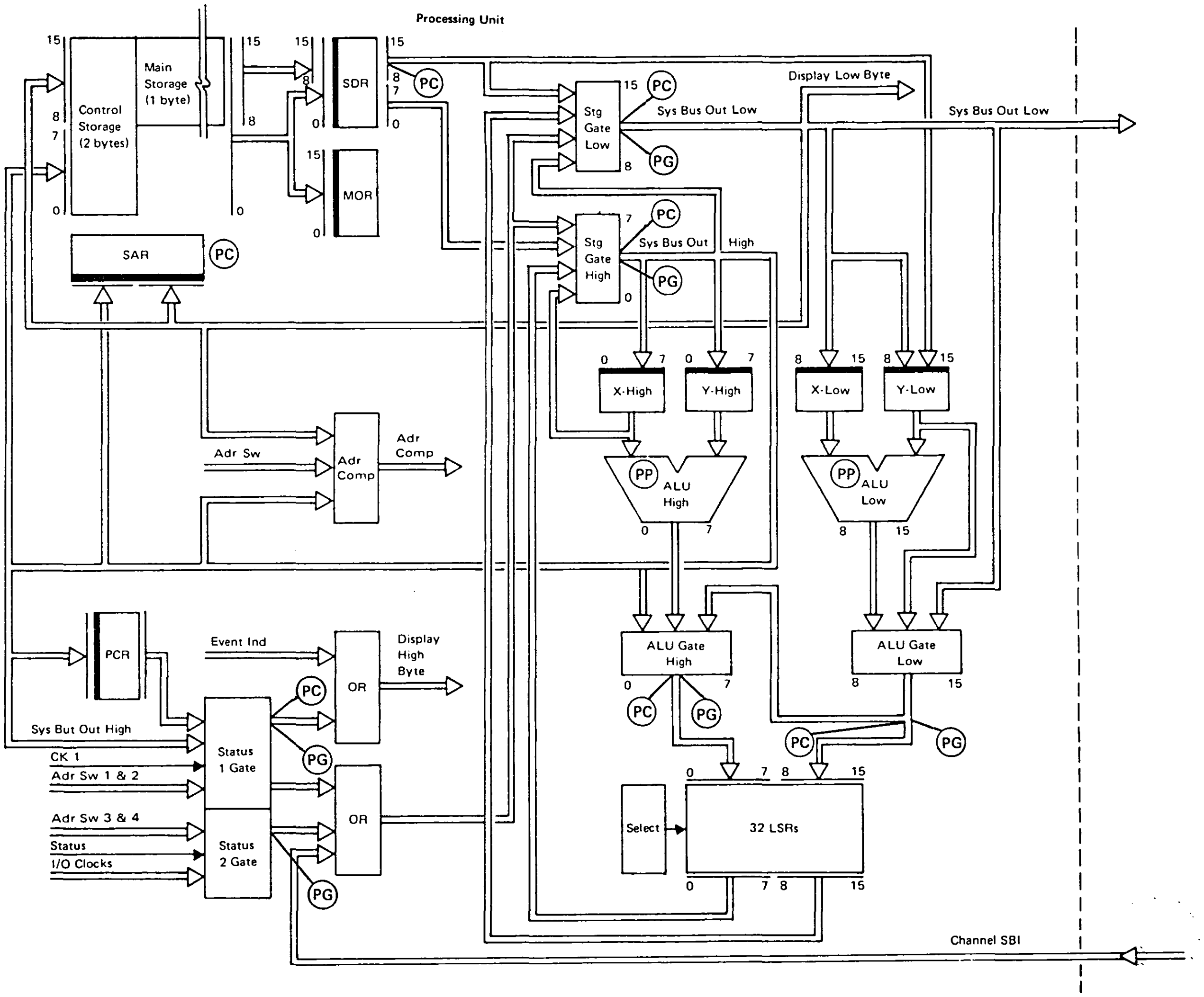
Register	Hex Address
Work Registers	
WR0	00
WR1	01
WR2	02
WR3	03
WR4	04
WR5	05
WR6	06
WR7	07
Address Registers	
MAR (ML)	08
MAB (ML)	09
MAR (0)	0A
MAB (0)	0B
MAR (1)	0C
MAB (1)	0D
MAR (2)	0E
MAB (2)	0F
Work Registers	
WR0	10
WR1	11
WR2	12
WR3	13
WR4	14
WR5	15
WR6	16
WR7	17
Work Registers	
WR0	18
WR1	19
WR2	1A
WR3	1B
WR4	1C
WR5	1D
WR6	1E
WR7	1F
Work Registers	
WR0	20
WR1	21
WR2	22
WR3	23
WR4	24
WR5	25
WR6	26
WR7	27
Address Registers	
MAR (3)	28
MAB (3)	29

1.12.0 SYSTEM PARITY CHECKING AND PARITY GENERATION

Various errors that occur in the system are recorded in the processing unit error byte and in the port error byte. These errors can be displayed on the CE control panel and are described in 7.2.1. Parity checking and parity generation throughout the system are described here.

Odd parity (by byte) is maintained in the processing unit data flow. To ensure correct parity, parity checking stations and parity generating stations are provided throughout the processing unit. These checking and parity generating stations are illustrated in the diagram on this page.

Parity predict circuits check the ALU portion of the processing unit. By analyzing the operation being performed and the input data, parity predict circuits predict whether the output of ALU requires a parity bit or not. Parity predict circuits generate the parity bit if it is required. The parity at the output of ALU is compared to the output of the parity predict circuits to determine whether the ALU is working correctly.



PC = Parity Check
PG = Parity Generate
PP = Parity Predict

1.13.0 I/O PARITY CHECKING AND GENERATION

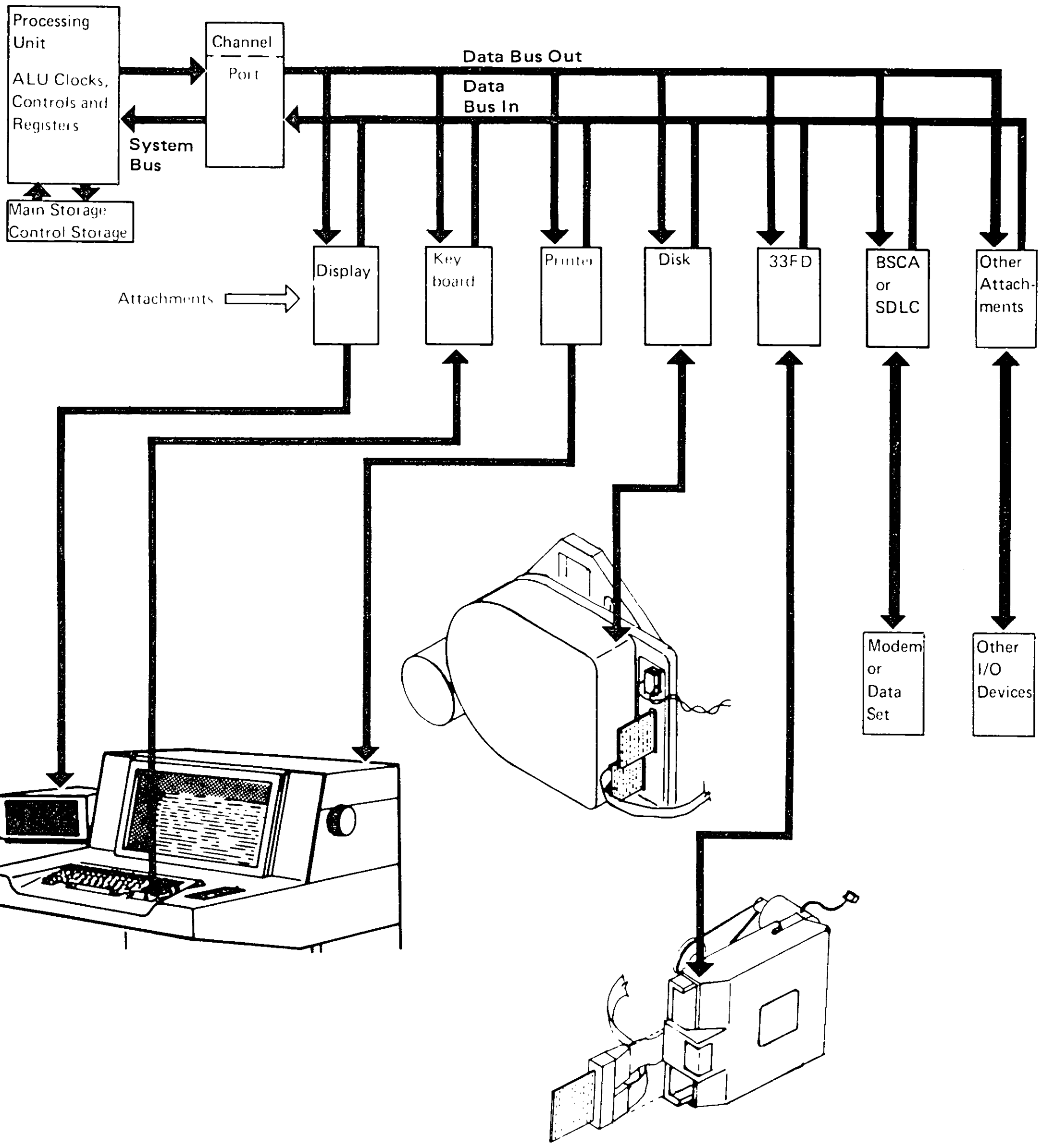
Parity errors can be detected between the port and the processing unit, or the port and an I/O device. Normally, the port operates in odd parity. However, some diagnostic programs use even parity. See the parity checking and generating chart below.

Unit	IOL & IOCL	IOS & IOCS	Sense Int LVL Status	Cycle Steal In	Cycle Steal Out
Channel	PG	PC	No PC—PG in Channel	PC	PC from CPU PG to DBO
Display	PC	PC	–	N/A	N/A
Keyboard	PC	PG	–	N/A	N/A
Belt or Serial Printer	PC	[1]	–	N/A	N/A
33FD	PC	PG[1] on Data Transfer Only	–	PG[2]	N/A
Disk	PC	PG[1] on Data Transfer Only	–	PG	PC
BSCA/SDLC	PC	PG	–	N/A	N/A

PC = Parity checked
PG = Parity generated

Note: Attachments generate a parity bit on the DBI when responding to a Jump I/O command whether or not the condition true response (CBI-4) is met.

System Data Flow



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[1] Attachment activates the CBI-4 line to the CPU, which denotes that parity is not generated on DBI for transfers to the channel.

[2] 33FD cycle steals on IMPL only.

1.14.0 OPERATION RETRY AND ERROR LOGGING

If errors occur during some operations, the operation is retried. The following operations are retried at the system instruction level:

1. Operations that cause errors while the emulator is analyzing system instructions.
2. Some operations that cause errors during the execution of the system instructions.

Error logging is used by the system to help the CE analyze intermittent errors. All errors that retry the operations are recorded on the disk and, where possible, errors that stop the processor are also recorded. Errors that are recorded can be retrieved and printed by using the ERAP (error recording and analysis procedure) program that resides on the CE diskette.

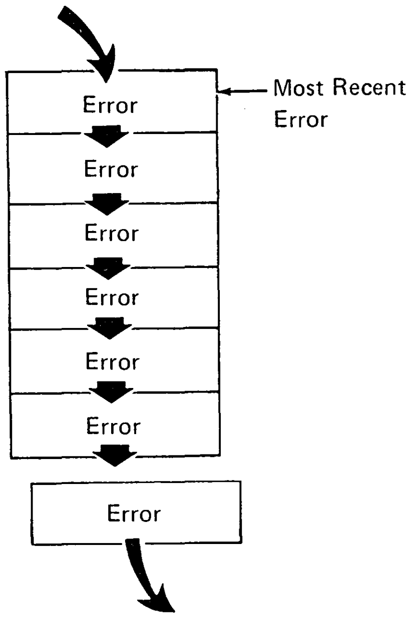
Essentially, two types of error information are recorded for each device and the processing unit—error history and error count. In addition to the error information, the number of I/O operations performed by each device is also recorded.

Each device, except the display screen, has an error history table in which to record data about each error. If the table becomes full, the most recent entries are retained as shown in the illustration.

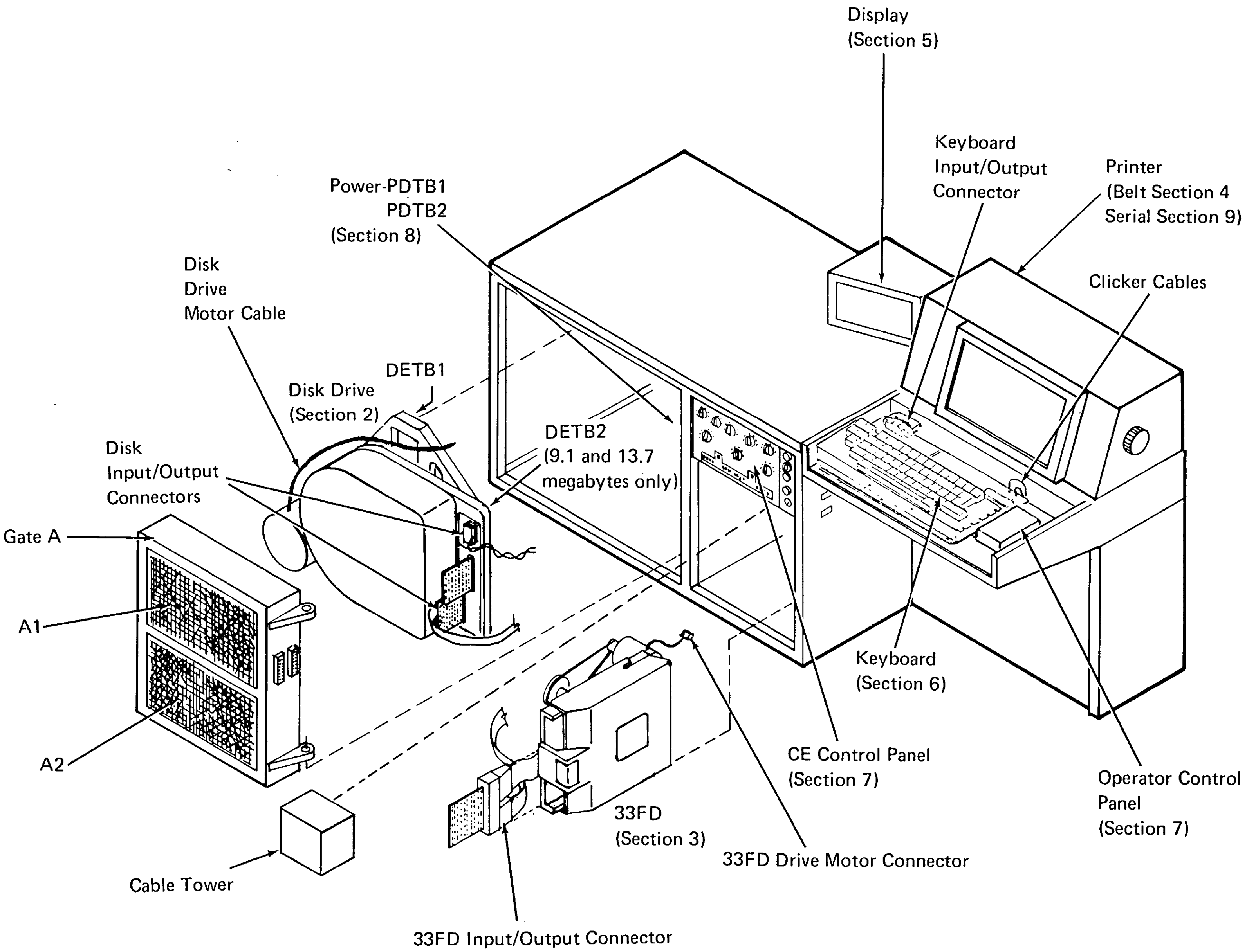
Error count tables contain the number of times a specific error occurs. When these tables reach their maximum value, this value is retained until cleared by the CE.

Details of the error history and error count tables *are in the Diagnostic Service Guide* (MAP section 3000).

Error History Table

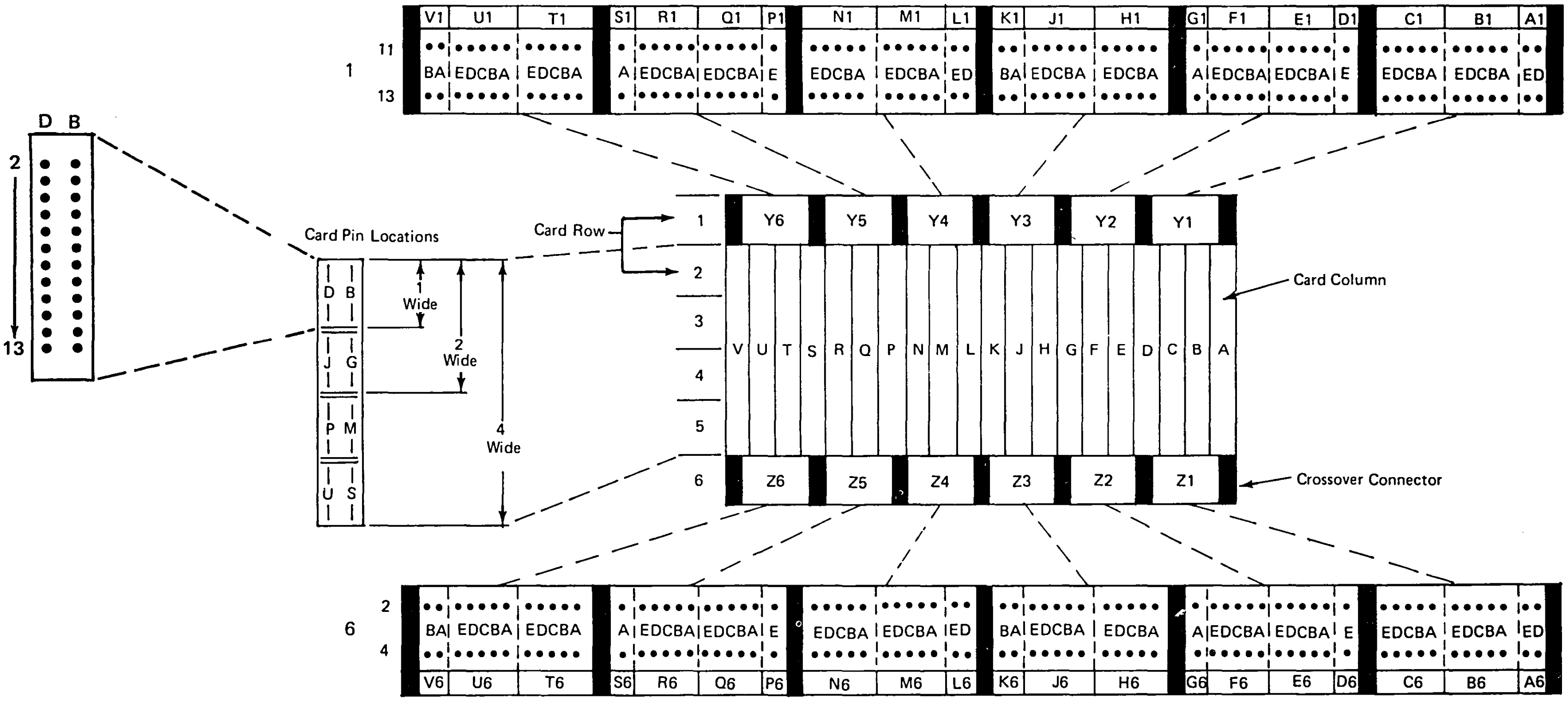


1.15.0 LOCATIONS



Front View

1.16.0 BOARD PIN LOCATIONS



Pin Side View

2.0.0 Disk Drive

2.1.0 THEORY

2.1.1 Introduction

The Disk Drive is permanently mounted in the system. It has one permanently mounted magnetic-coated disk. Data is written and read from the disk by data heads attached to a swinging actuator.

2.1.2 Subframe

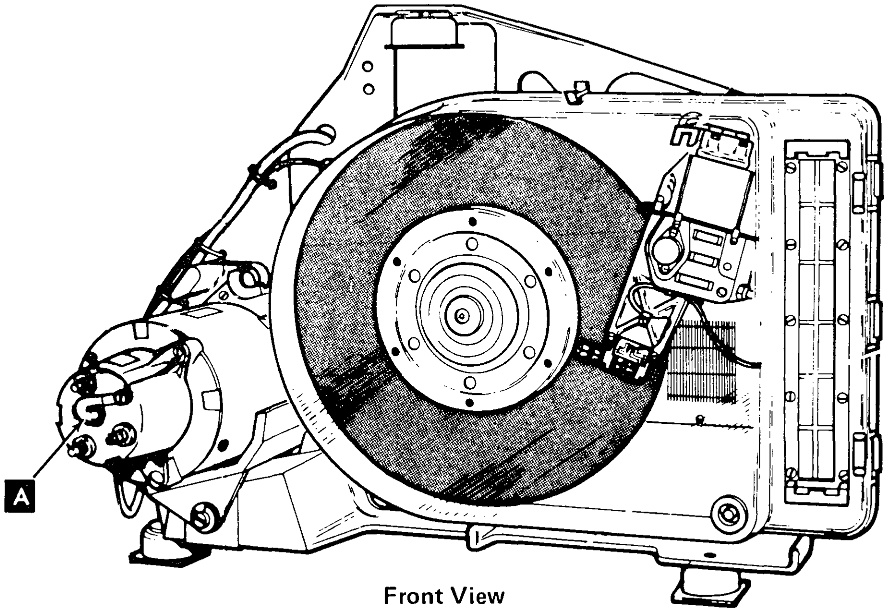
The subframe is mounted vertically using three shock mounts. The shock mounts isolate the disk drive from the machine frame. Mounted on the subframe are the disk enclosure (DE) and drive motor.

Note: Two styles of subframe are used. The main difference between the two styles is in the way wires and cables are guided across the subframe. In the old style subframe, wires and cables are guided with screws and plastic clamps; in the new style subframe, the wires and cables are guided with slots and guides that are integral parts of the subframe casting.

2.1.3 Grounding

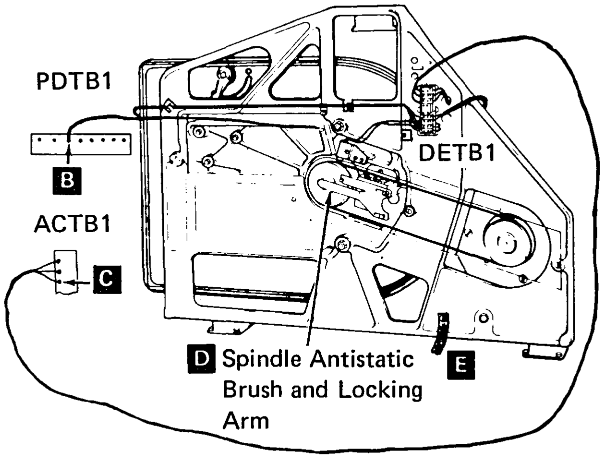
The subframe is grounded by a ground strap **E** to the machine frame. The drive motor is grounded by the system ac ground **C** . The spindle is grounded to the subframe by a spindle antistatic brush **D** , which is part of the spindle locking arm. The motor armature is grounded by the motor antistatic brush **A** mounted on the brake housing. Old-style disk enclosures are grounded to the system ground at **B** . New style ground has disk enclosures grounded to the system ground as shown below at **F** .

Disk Drive



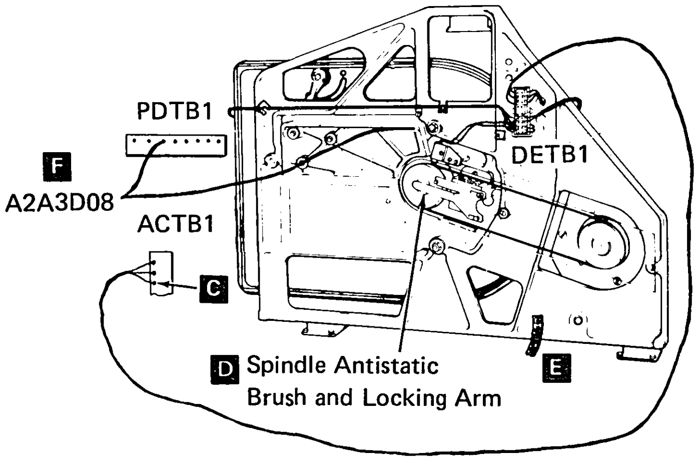
Front View

Old Style Grounding



Back View

New Style Grounding



Back View

2.1.4 Disk Enclosure

The disk enclosure (DE) is the unit that houses the disk, spindle, and actuator. These components are visible through the clear plastic cover, but are not accessible by the customer or the CE.

Note: The DE is sealed at the factory and is not opened in the field.

The disk enclosure has a closed-loop air circulation system that uses blades on the spindle hub to continuously circulate air through the air filter. A breather filter equalizes the air pressure during startup and surrounding temperature changes.

2.1.5 Disk Spindle

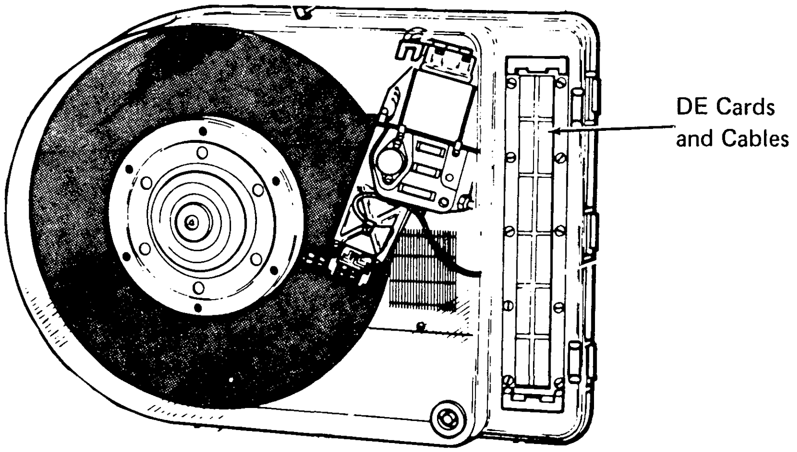
The disk spindle assembly is mounted in a housing in the back of the disk enclosure. The housing is sealed to prevent contaminants from being drawn into the disk enclosure through the bearings.

The disk is clamped to a mounting hub on the disk spindle. A pulley is mounted on the other end of the spindle, and is driven by a motor mounted on the subframe.

2.1.6 Transducer

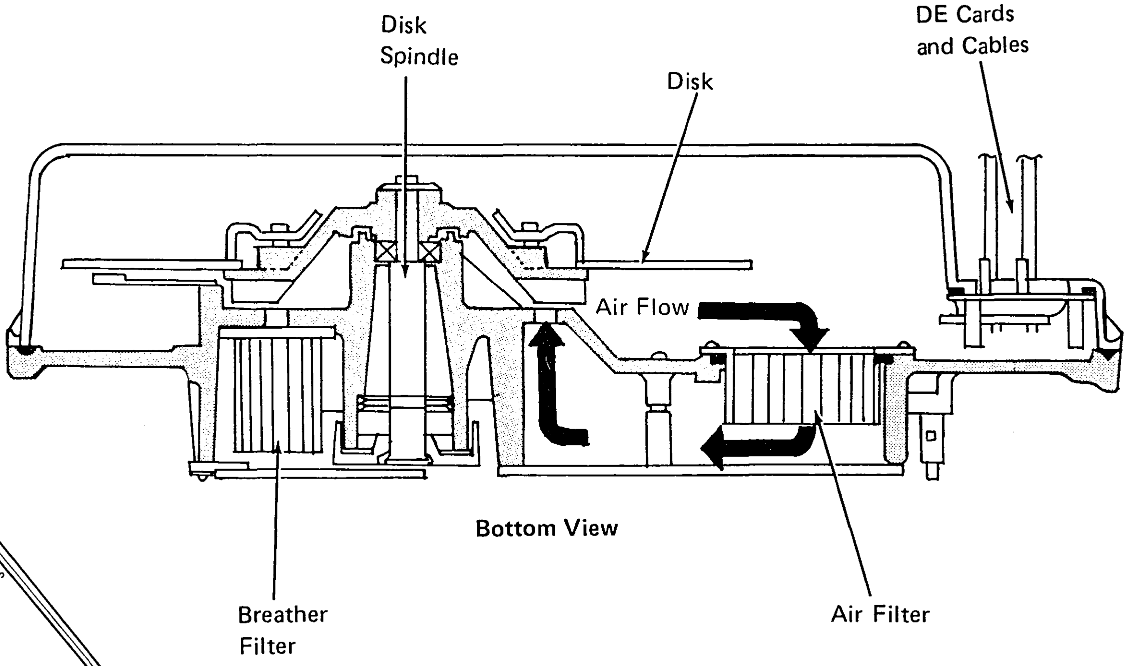
An electromagnetic transducer mounted on the disk enclosure senses a slot in the spindle pulley to indicate disk speed.

Disk Enclosure

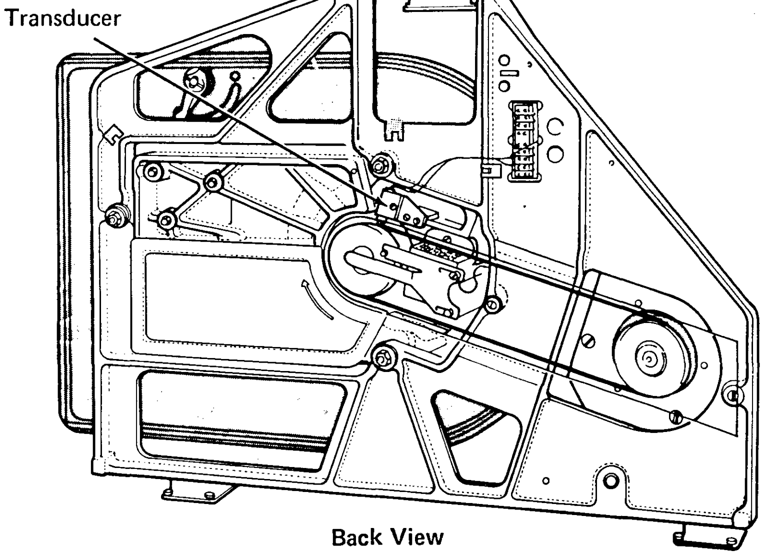


Front View

Cross-Section of Disk Enclosure (DE)



Bottom View



Back View

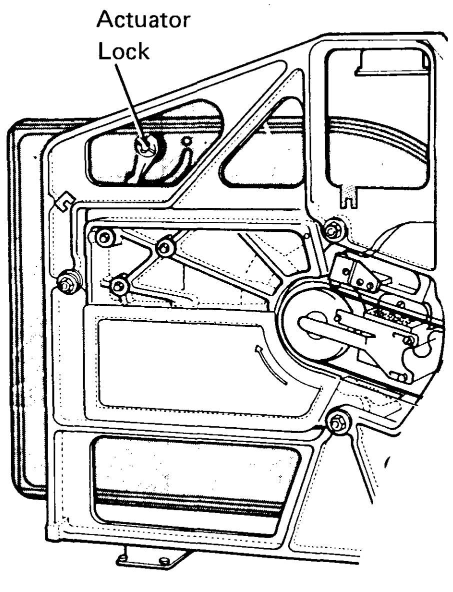
2.1.7 Actuator

The actuator is mounted on a pivot beside the disk and carries the heads across the disk to the specified track. The data heads and the servo head are attached to one end of the actuator and a coil is wound on the other end. The coil, which is located in the field of a permanent magnet, moves when current passes through it. This moves the servo and data heads in an arc across the disk surface. Track crossing and track following information is obtained from the servo tracks and picked up by the servo head to position the data heads over the required data track. An output preamplifier for the servo head is mounted on the actuator close to the servo head.

During all power down conditions, the actuator retracts against the inner (spindle) stop. A magnetic catch holds the actuator in the retracted position. Therefore, the heads are over the landing zone after power down.

2.1.8 Actuator Lock

The actuator lock in the ON position, locks the actuator in the landing zone position. The lock prevents the actuator from moving during shipping, installation, or removal of the disk enclosure.



Back View

2.1.9 Actuator Position Indicator

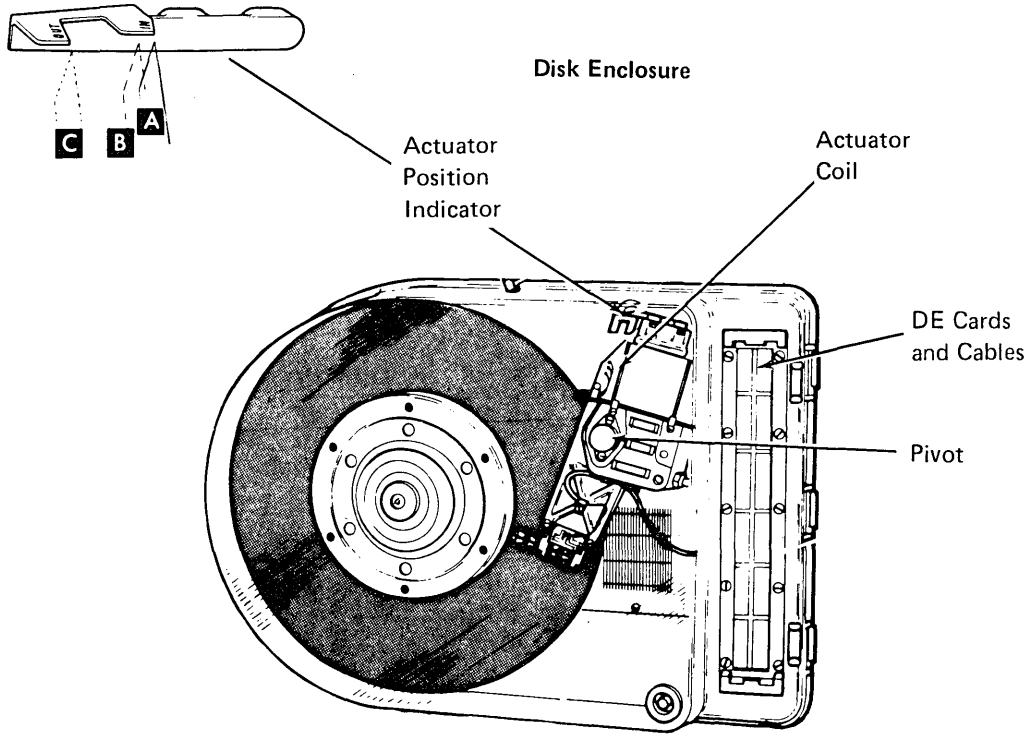
When the edge of the actuator coil former is in line with the IN edge of the indicator **A**, the actuator is at the inner stop and behind home.

When the edge of the actuator coil former is in line with the middle of the IN tab **B**, the actuator is at home (track 0).

When the edge of the actuator coil former is in line with the OUT edge of the indicator **C**, the actuator is at the outer stop.

2.1.10 Circuitry Location

The disk drive circuitry is housed in two separate areas. The cards and cables for the servo head output preamplifier and for the data heads, write driver, and read preamplifier are mounted on the disk enclosure; they are not enclosed within the sealed cover. The servo head output preamplifier is mounted on the actuator. Part of the head selection circuitry is mounted on the disk enclosure. The remainder of the disk drive circuitry is mounted on the 01A2 board (I/O board).



Front View

2.1.11 Disk Description

Data Tracks

Data heads record the data on (and read the data from) the data tracks. Each track is divided into 60 sectors. The data stored in one sector is called a record. Each record consists of 256 bytes; therefore, it is possible to store 15,360 bytes per track.

The tracks that can be read without moving the actuator are called a cylinder. Cylinder 0 is the cylinder toward the center of the disk. Each track is divided into 60 sectors. The data stored in one sector is called a record. Each record consists of 256 bytes; therefore, it is possible to store 15,360 bytes per track.

The capacities of the various models are shown in the following chart:

Disk Capacity in Megabytes	**3.2**	**5.0**	**9.1**	**13.7**
Number of Tracks	218	338	606	909
Data Heads- Tracks per Cylinder	2			3
Bytes per Sector/Record	256			
Sectors/Records per Track	60			

Because the disk is formatted into cylinders and sectors, each record on the disk has a definite address consisting of cylinder, head, and sector numbers. This address (part of the identification field) is recorded at the physical location of the record on the disk.

Some areas of the disk reserved; are shown in the *Diagnostic Service User's Guide.*

Servo Tracks

The servo tracks of the disk contain prewritten patterns on the outer half of the disk. These patterns correspond to each data track location and consist of missing clock pulses and position pulses in a specific sequence. The clock pulses, every 2.1 µs, develop the 140 ns write clock pulses in the attachment. The position pulses keep the data heads over the specified track (*Servo Track Following,* 2.1.19).

Specific combinations of clock and position pulses define either the beginning of a track (index pulse that indicates sector 00) or the beginning of sectors 01 through 59 (sector pulse).

The servo tracks are used by the servo head to keep the data heads on track and to perform seek operations.

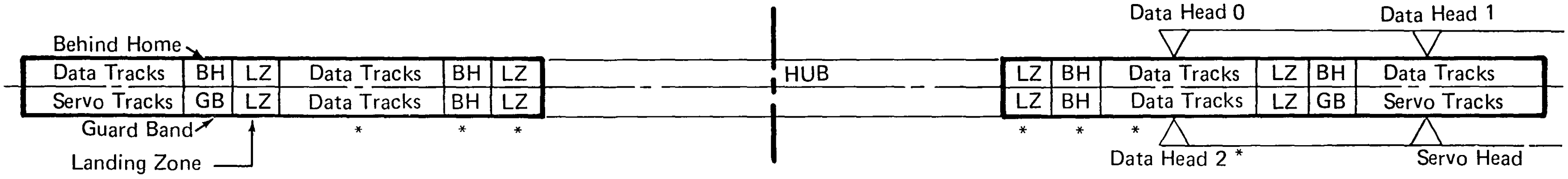
2.1.12 Landing Zone (LZ)

Because the heads touch the disk when it slows to less than 400 rpm, the heads are retracted to a landing zone to avoid destruction of data. No information is written in the landing zone.

2.1.13 Guard Band* (GB)

Between the servo tracks and the landing zone is the guard band. The guard band is a servo track area that contains clock and position pulses but no prewritten patterns. When the servo head is in the guard band position, the data heads are behind home (BH).

Cross Section of Disk



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*13.7 megabyte files only.

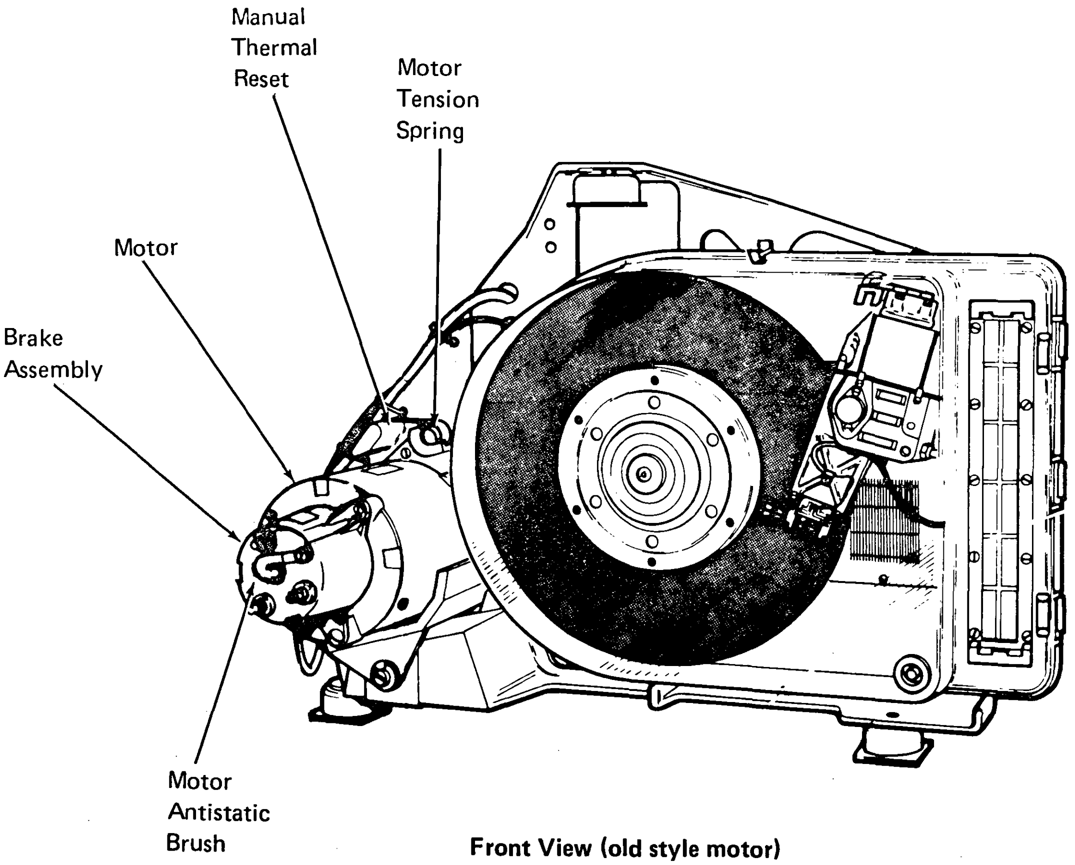
2.1.14 Motor and Brake

The motor is a high-torque motor that increases the disk speed quickly. The disk speed during start and stop operation is important only because the time that the data heads touch the rotating disk must be limited.

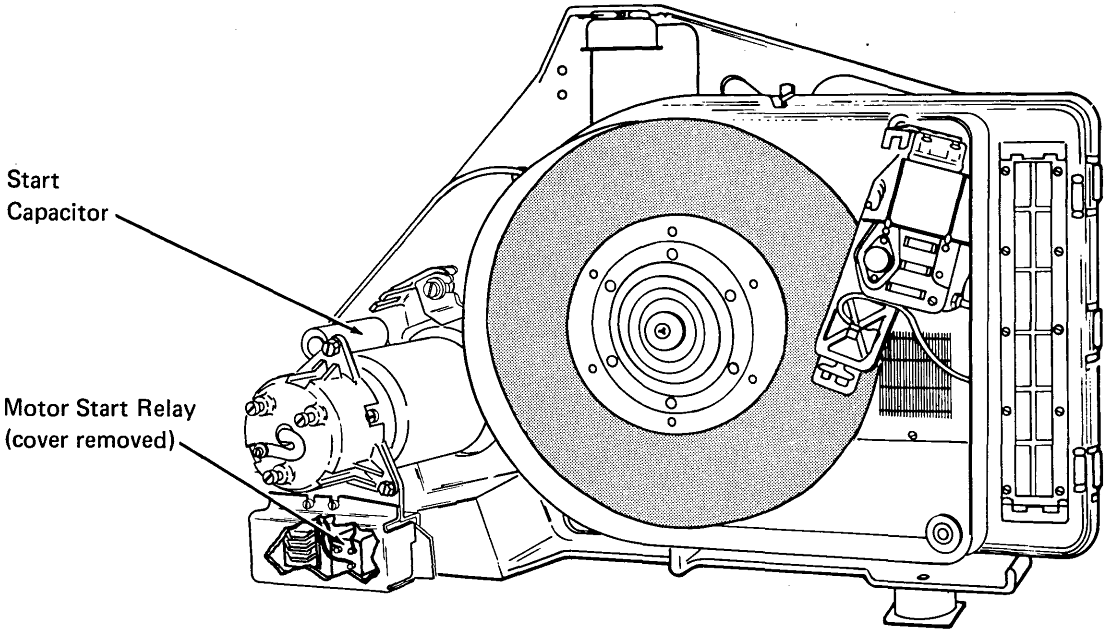
The motor has a manual thermal reset. A motor tension spring pivots the motor to keep tension on the drive belt. There is also a motor antistatic brush located on the brake assembly.

The brake is activated when the power goes off. When current stops flowing through the brake coil assembly, a spring-loaded pad is released that engages the brakeplate and stops the motor.

There are two motor styles; the new style motor has a capacitor on the top, a motor start relay on the bottom, and is smaller than the old style.



Front View (old style motor)



Front View (new style motor)

Sector Format

Before writing in the data field, the ID field must be read to verify that the data is being written in the correct sector. The recovery time from the write operation to the read operation is too long to allow writing of consecutive sectors because the channel requires time to stabilize. For this reason, the sectors are numbered: 00, 30, 01, 31 . . . 06, 36, 07, 37, etc, as shown in the illustration.

Sector 06		Sector 36		Sector 07		Sector 37	
ID	Data	ID	Data	ID	Data	ID	Data
Recovery Time		Rd	Write	Recovery Time		Rd	Write

VFO sync is 12 bytes of hex FF used to synchronize the read clock with data bits from the disk. When the 12 VFO sync bytes are being written on the disk, the attachment forces 8 bytes of hex FF, and then cycle steals the other 4 bytes from a 10 byte field of hex FFs in storage.

Note: If a sector defect occurs within the ID region (VFO sync through the ID field CRC), this VFO sync is extended 64 bytes (12 plus 64 equals 76 bytes).

ID field is 7 bytes as described below.

Flag Byte:

Bits	**Meaning**	
0-4	Unassigned	
5	Data in sector has possible error	
6-7	00	Good primary sector
	10	Defective primary sector
	01	Good alternate sector
	11	Defective alternate sector

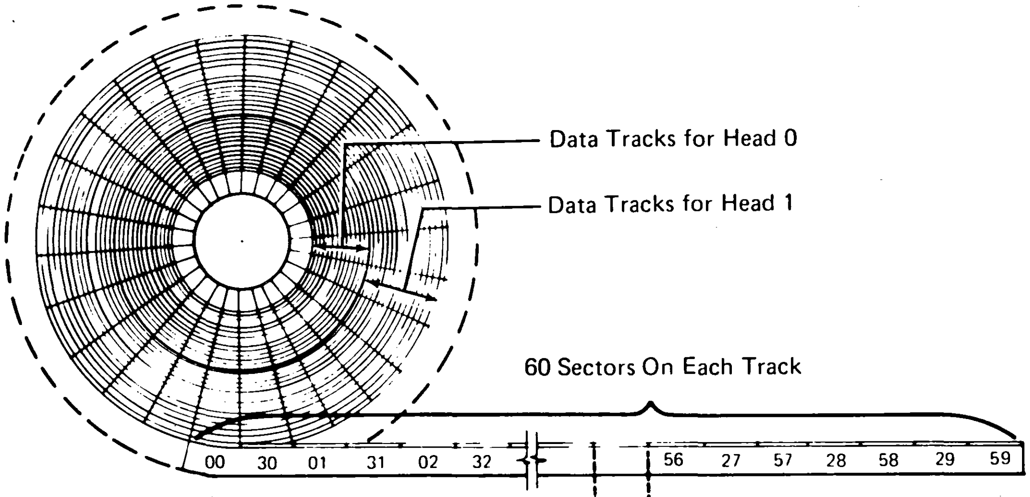
The cylinder address is 2 bytes.

Disk Capacity	**Cylinder Address**
3.2 Megabytes (62GV)	0 to 108
5.0 Megabytes (62GV)	0 to 168
9.1 Megabytes (62TM)	0 to 302
13.7 Megabytes (62EH)	0 to 302

The head address is one byte; hex 00 for head 0, hex 01 for head 1, and hex 02 for head 2.

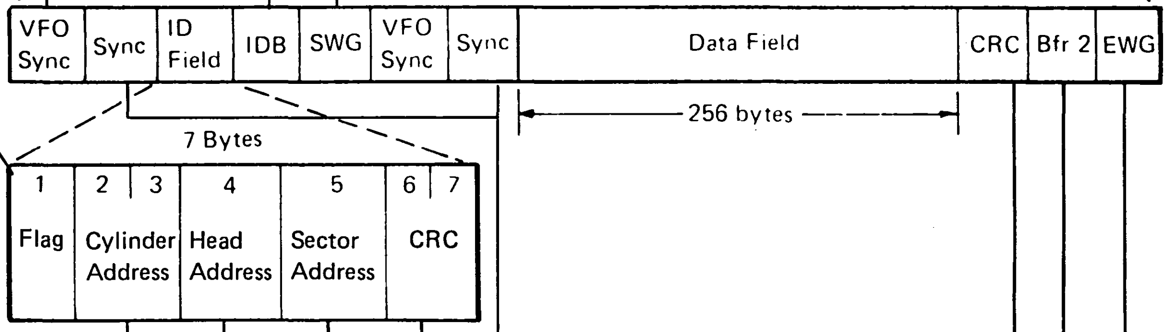
The sector address is one byte, 0 to 59.

CRC (cyclic redundancy check) is 2 bytes of check characters to verify that the data was read correctly from the ID field.



Identification buffer (IDB) is 1 byte (hex FF) of space allowed after reading the ID field CRC before switching the circuits from read to write.

Start write gap (SWG) is 2 bytes of hex FF that allows time to switch the circuits from read to write.



Sync is 1 byte, hex 0E, used to synchronize the bit ring. The bit ring gates the bits read from the disk into the serializer-deserializer to be formed into recognizable bytes.

CRC (cyclic redundancy check) is 2 bytes of check characters to verify that the data was read correctly from the data field.

Buffer 2 (Bfr) is 4 bytes (hex FF) of space allowed after writing the data field CRC before switching the circuits back to read.

End write gap (EWG) is 2 bytes of hex FF to allow time to switch the circuits from write to read.

2.1.15 Write Safety

Data Unsafe Conditions

Circuits in the disk drive protect data from being destroyed in the disk drive or the attachment. The unsafe conditions that can occur are:

1. Write selected and no write transitions detected.
2. Write current source on but write not selected.
3. Write selected and more than one or no heads selected.
4. Write selected and off track detected.
5. Write selected and disk not synchronized with attachment.
6. An open card interlock circuit.
7. Disk drive going not ready while writing.

When any of the preceding unsafe conditions occur, write current is inhibited, accessing is inhibited, and the heads are deselected. A data unsafe line signals the attachment of the condition. A recalibrate operation is required to bring the disk drive to ready after resetting data unsafe. However, if a data unsafe condition cannot be reset, the disk drive cannot seek or recalibrate. In this case, if power is dropped, the actuator retracts.

File Ready

The disk drive either fails to go ready or goes not ready after power up for any of the following reasons:

1. Interlock circuitry failure.
2. Electrical failure in motor brake.
3. Disk speed below 1,100 rpm.
4. Ac power failure.
5. Data unsafe condition.

Disk Speed

If the disk speed falls to 1,800 rpm ± 700 because of motor failure or belt failure, the disk drive goes not ready. The actuator then retracts and holds at the inner stop until the disk stops. A magnetic catch holds the actuator at the inner stop when the retract capacitor is fully discharged after power off.

Power Up

During power up, the actuator is held against the inner stop until the disk is up to speed. This ensures:

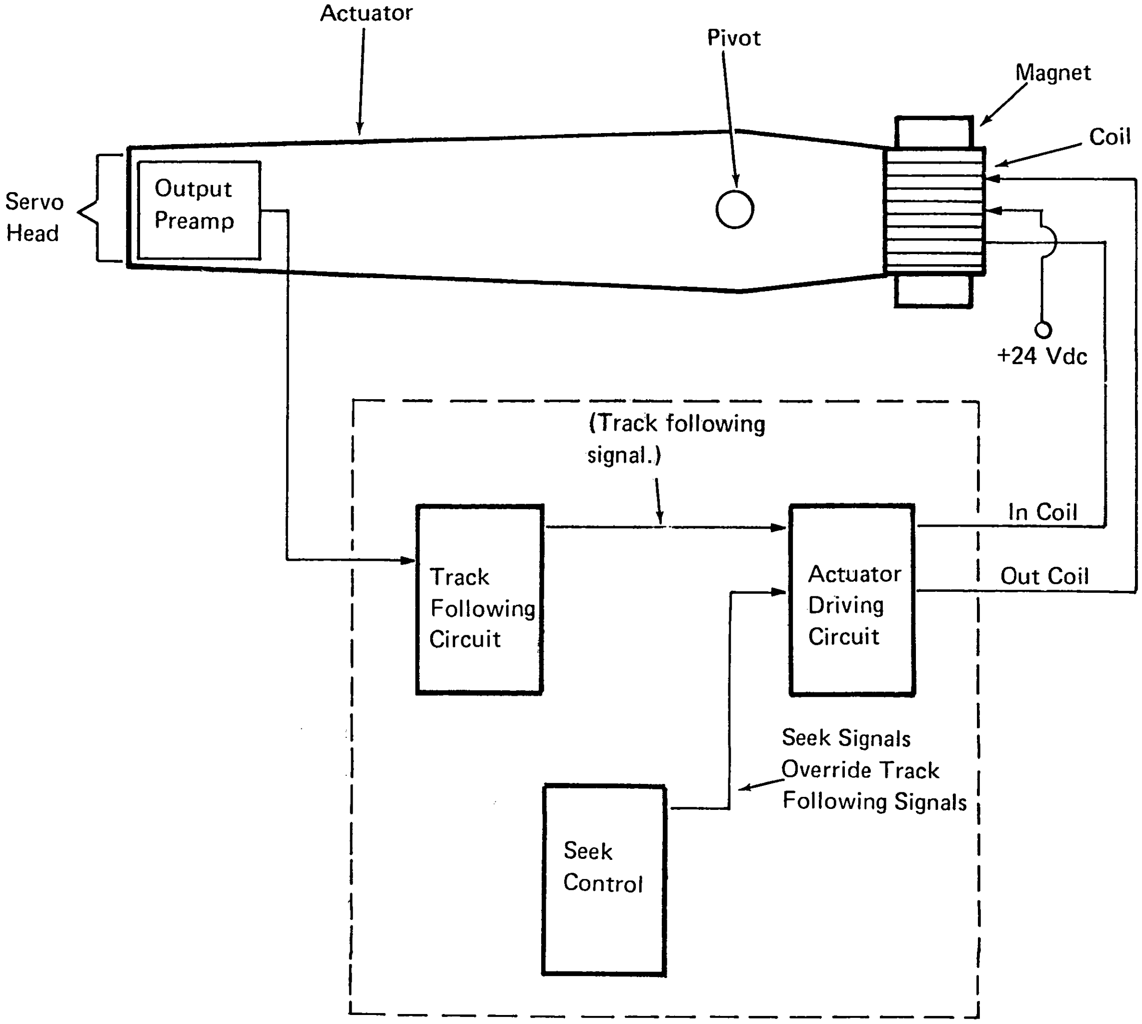
1. That the disk and control circuitry can synchronize.
2. That the heads are flying before they move out of the landing zone.

When the disk is up to speed, and a 32 second timeout elapses, the actuator seeks home (track 0). Ready is then indicated in the attachment.

2.1.16 Seek Operation

During a seek operation, the track following signal to the actuator driving circuits is overridden by signals from the seek controls. A seek is executed by activating the drivers to move the actuator at the correct velocity to the specified track. At the end of a seek, the seek lines to the drivers are deactivated; this allows the track following circuits to hold the actuator at the selected track.

Seek control causes the actuator to leave track following mode, and accelerates the actuator over a specified number of tracks. Seek control then drives the actuator at a constant velocity until it is a specified number of tracks from the required destination. Then the actuator is decelerated and stops at the required destination. At this point, track following signals take control.



Disk Drive Circuit on 01A2 (I/O board)

2.1.17 Recalibrate Operation

The recalibrate operation moves the heads across the tracks into the guard band area, then out to data track 0 (home).

Recalibrate is initiated:

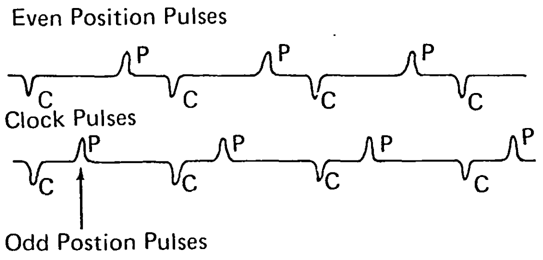
1. During a normal power on sequence.
2. When an invalid sector identifier (ID) is read.
3. After data unsafe is reset.

2.1.18 Behind Home

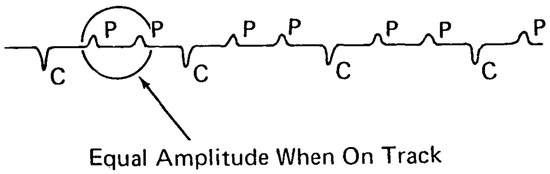
If the data heads attempt to seek a track that is farther in than track 0, the seek in command is dropped. When the heads stop, the actuator seeks to track 0 and home is indicated.

2.1.19 Servo Track Following

When the moving data heads are in position to read or write a data track, the servo head is positioned so that it picks up signals of equal strength from two adjacent servo tracks to produce the following wave forms:

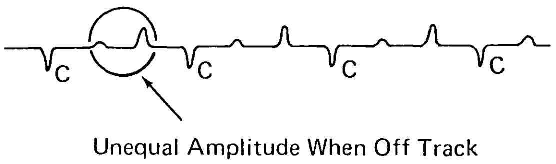


Because the clock pulses are in the same position on both tracks, they merge when the head is centered between two servo tracks. The position pulses, however, are displaced and the following wave form results when the signals from both tracks are combined:

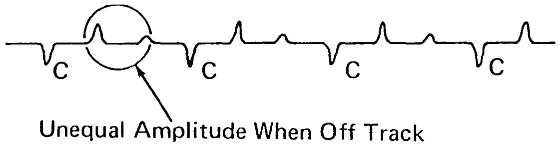


The preceding wave form, therefore, shows the signal received from the servo tracks when the data heads are correctly positioned over a data track.

If the data heads move off track, the servo track generates an error signal proportional to the difference between the two pulse heights. When the heads are off in one direction, the servo track signal is:

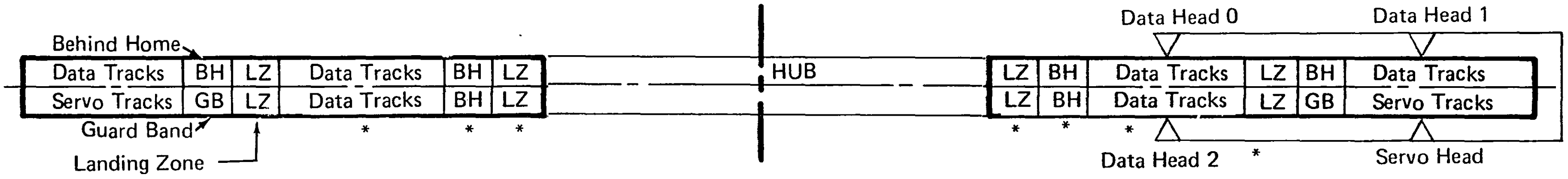


When they are off in the other direction, the servo track signal is:



The error signal constantly corrects the position of the heads by controlling the current to the actuator coil, thus forming a closed loop track following system. (See Seek Operation diagram on previous page.)

Cross Section of Disk



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*13.7 megabyte (62EH) files only.

2.2.0 MAINTENANCE

The maintenance philosophy for the disk drive is:

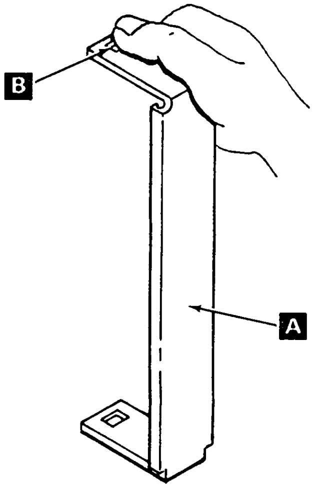
1. No preventive maintenance.
2. Repairs are made by adjustment or replacement of field replaceable units (FRUs).
3. Fault diagnosis to FRUs is done by diagnostic programs and MAPs.
4. Repair is verified by rerunning the diagnostic programs.

CAUTION
Do not turn the spindle unless specifically told to do so. Head damage could occur.

2.2.1 Card Sockets

CAUTION
Take extreme care not to bend or break the pins when removing or inserting cards. Bent or broken pins make it necessary to replace the entire disk enclosure.

The card sockets are located on the front right of the disk enclosure. To remove or replace cards, remove the card socket cover **A** by pressing down at **B** and gently pulling out.



The disk enclosure card sockets are arranged as follows:

	A	B
1	Speed Transducer, Brake Sense, and Actuator Drive Coil Cable	Servo Preamp Cable (coaxial)
2	☒	☒
3		Read Preamp and Write Select Card
4	☒	
5	Data AGC and Detector Card	R/W Logic Cable (tape)
6		R/W Data Cable (coaxial)

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2.2.2 Disk Enclosure (DE)

Removal

Note: If possible, before removing the disk enclosure, initialize the disk to remove customer data.

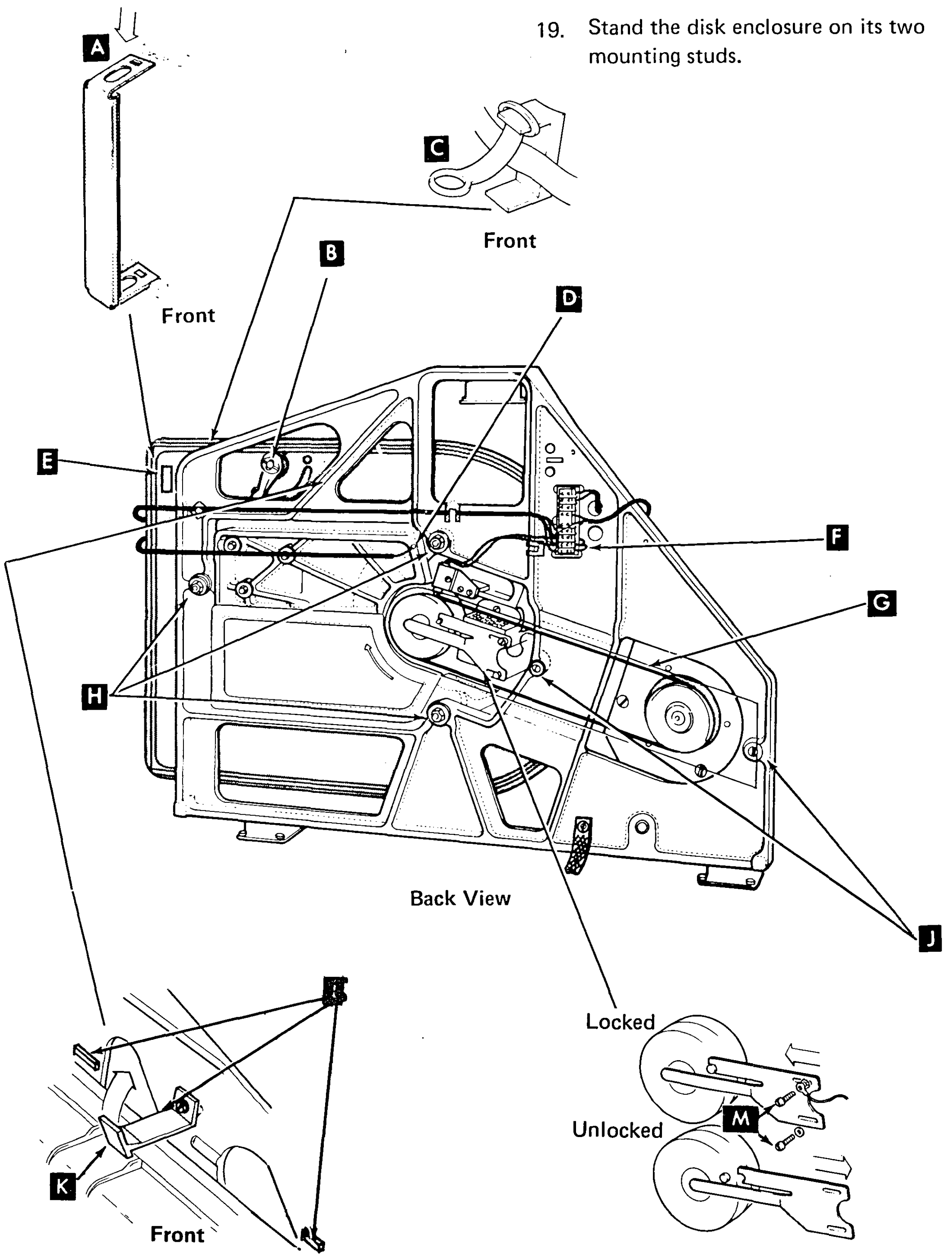
> **DANGER**
> The disk enclosure weighs 27 lbs (12.5 kg). Clear a space for the disk enclosure before removing it from the machine.

CAUTION
Do not rotate the disk spindle counterclockwise; head damage can occur.

1. Turn power off at the operator control panel. After power is sequenced down, turn the mainline power off at the back of the machine.
2. Unclip the disk enclosure card socket cover **A** by gently pressing the top of the cover.
3. Release the cable straps **C** .
4. Note the sockets, the cards and cables are plugged into, and remove the cards and cables from the disk enclosure card sockets.
5. Lock the actuator with the actuator lock **B** by moving the handle to ON.
6. Remove the belt guard by loosening the two screws **J** and lifting it off.
7. Loosen the two screws **M** that hold the spindle locking arm and slide the locking arm toward the disk spindle.
8. Turn the motor pulley clockwise until the stud on the disk spindle sits in the slot in the locking arm.
9. Tighten the screws on the spindle locking arm.
10. Move the motor toward the DE to release the tension on the belt, and remove the belt **G** .
11. Disconnect the disk speed transducer at DETB1 **F** – terminal 7 (black wire) and terminal 8 (white wire).
12. Unscrew the transducer cable clamp .
13. Disconnect the two wires from DETB2 (9.1 and 13.7 megabytes only) **E** .
14. Disconnect the DE ground wire **D** .
15. Make sure the DE holding clip **K** is engaged.
16. Remove three nuts and washers **H** .

CAUTION
When removing the DE, do not drop it on the gate stop.

17. Go to the front of the machine. Lift the DE holding clip **K** . Note the three DE locating guides **L** ; you must use them when you replace the DE.
18. Ease the disk enclosure away from the subframe.
19. Stand the disk enclosure on its two mounting studs.



Replacement

1. Lift the disk enclosure onto the subframe using the locating guides **M** to position the DE, and push the studs firmly into the nylon bushings. Check that the holding clip **L** is in place. Make sure the disk speed transducer and the DE ground wire are free.

2. Replace the three washers, springs, and nuts **K** (in that order).

   CAUTION
   Overtightening can cause the washer to bind on the stud; subsequently, the stud might unscrew from the subframe when the nut is loosened.

   When tightening the nuts, there is some resistance as pressure is applied to the nylon bushing. Stop tightening when the spring washer is compressed.

3. Connect the DE ground wire **D** (star washer between the ground wire and the frame).

4. Reconnect the two wires DETB2 to **E** (9.1 and 13.7 megabytes only).

5. Connect the disk speed transducer DETB1 at **F** — terminal 7 (black wire) and terminal 8 (white wire).

6. Install the transducer cable clamp **G** (if present).

7. Install the safety cover on TB1 (holes to the left).

8. Check the disk speed transducer for a gap of 0.006 inch ± 0.002 inch (0.1524 mm ± 0.0508 mm). Refer to *Disk Speed Transducer, Replacement and Adjustment* (2.2.8).

9. **CAUTION**
   Make sure the belt does not contact the disk speed transducer.

   Replace the belt **H** (smooth side against the pulleys). Center the belt on the pulleys.

10. Loosen the two screws holding the spindle locking arm **N**, and slide the locking arm away from the disk spindle.

11. Make sure that the antistatic brush is contacting the center pin of the spindle.

    Note: If there is a wear crater on the spindle antistatic brush, realign the crater to the spindle.

12. Tighten the screws on the spindle locking arm.

13. Check that the antistatic brush has a pressure of 60 + 25 - 20 grams on the center pin of the spindle. Adjust, if necessary, by removing and forming the brush.

14. Install the belt guard **J**. Take care not to catch the disk speed leads beneath the belt guard. Slide the belt guard all the way to the left and tighten the screws.

15. **CAUTION**
    Take extreme care not to bend or break the pins when plugging in the cables and cards. Bent or broken pins make it necessary to replace the disk enclosure.

    Connect the cables to the card sockets; replace the cards in the card sockets.

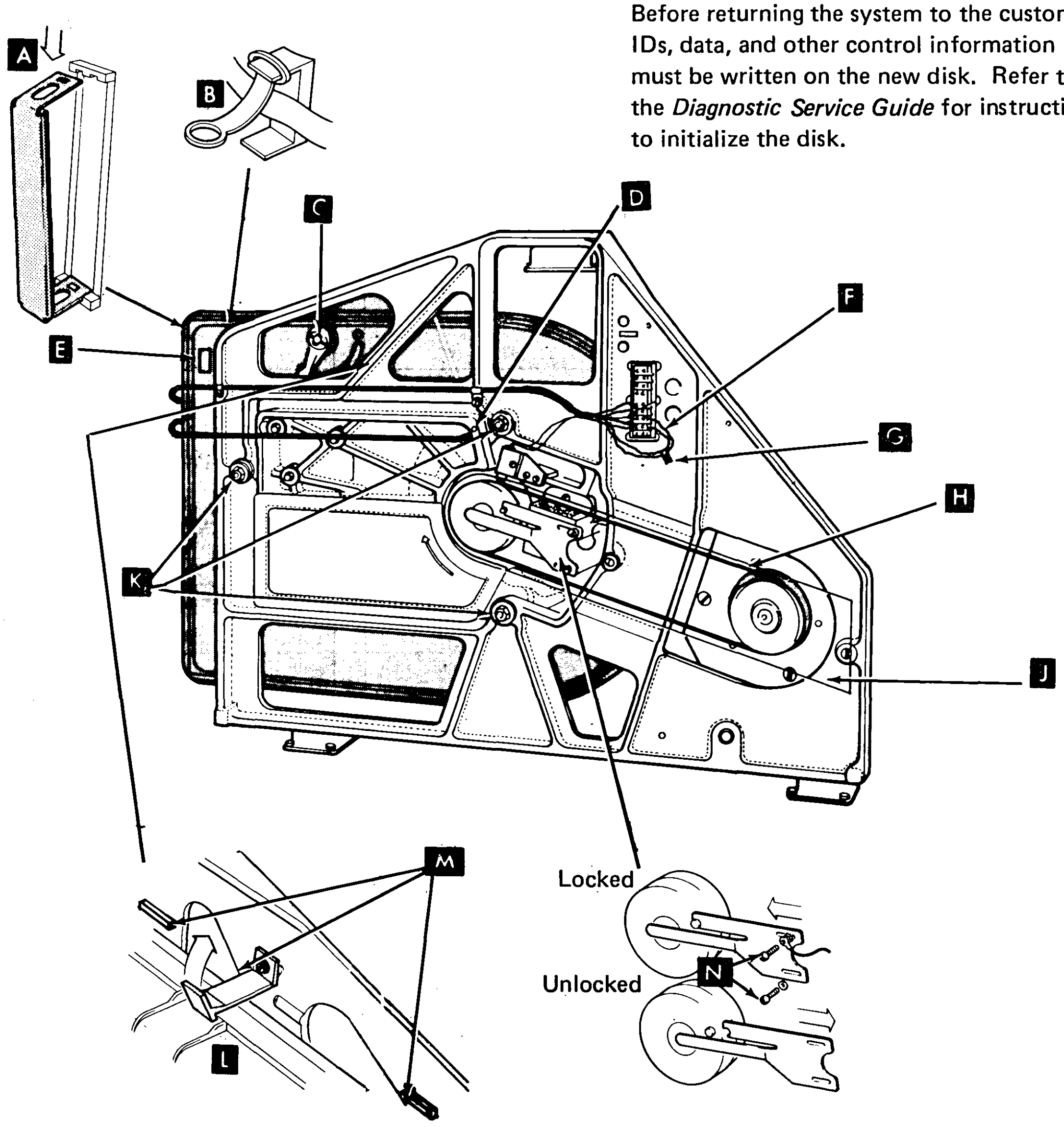
16. Strap the cables **B**.

17. Replace the card socket cover **A**.

18. Unlock the actuator lock **C** by moving the handle to OFF.

19. **CAUTION**
    Before operating the disk, allow 30 minutes for it to reach room temperature.

    Before returning the system to the customer, IDs, data, and other control information must be written on the new disk. Refer to the *Diagnostic Service Guide* for instructions to initialize the disk.



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*See 2.1.3, *Grounding.*

2.2.3 Disk Drive Motor

Note: See 2.1.14 to determine whether your motor is the new or old style.

2.2.3.1 Old Style Motor

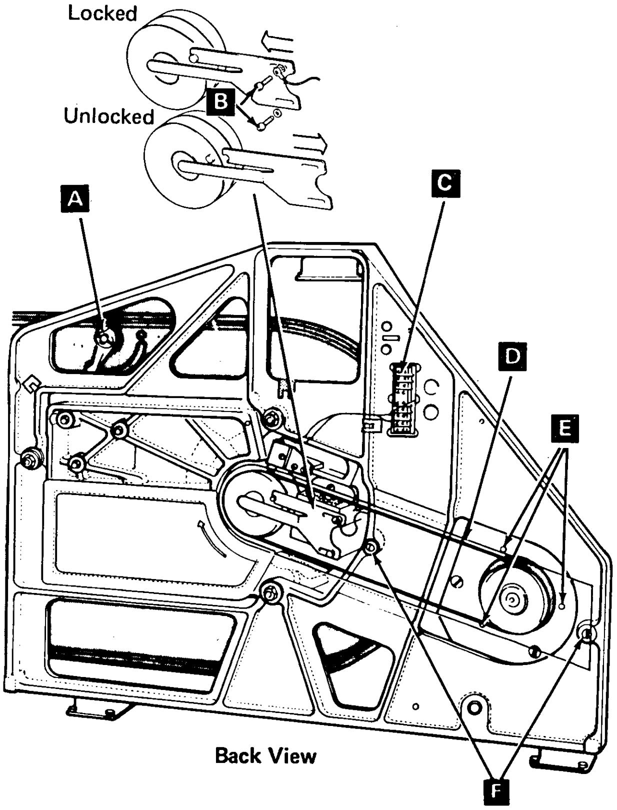
Removal

CAUTION
Do not rotate the disk spindle counterclockwise; head damage can occur.

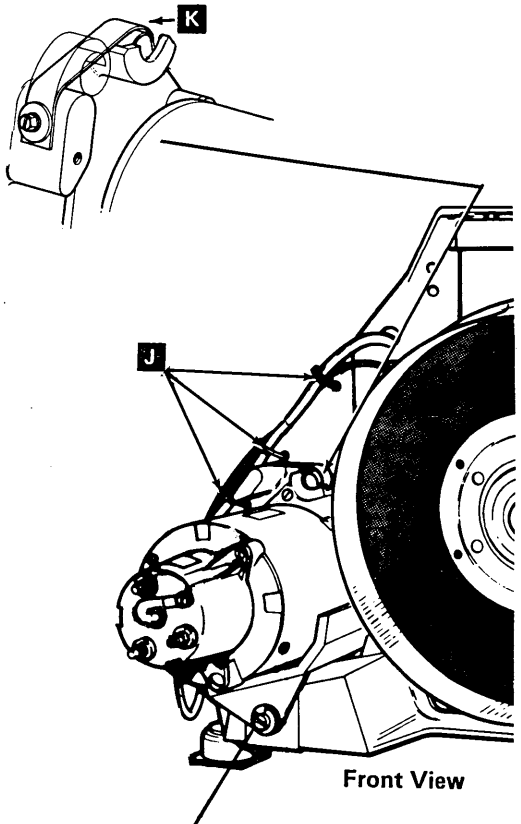
1. Turn power off at the operator control panel. After the power is sequenced down, turn the mainline power off at the back of the machine.
2. Lock the actuator with the actuator lock **A** by moving the handle to ON.
3. Remove the belt guard by loosening the two screws **F** and lifting it off.
4. Loosen the two screws **B** holding the spindle locking arm, and slide the locking arm toward the disk spindle.
5. Turn the motor pulley clockwise until the stud on the disk spindle sits in the slot in the locking arm.
6. Tighten the screws on the spindle locking arm.
7. Lift the motor to release tension on the belt, and remove the belt **D** .
8. Remove the motor wires from DETB1 **C** – terminal 1 (blue wire), terminal 2 (white wire), and terminal 3 (two green/yellow wires).
9. Remove the brake wires from DETB1 **C** – terminal 5 (black wire) and terminal 6 (yellow wire).
10. Remove the cable straps **J** (if present) that hold the motor, brake, and ac cables.
11. Release the motor tension spring **K** by lifting it off the motor mounting bracket.

DANGER
Wear safety glasses while doing the following step.

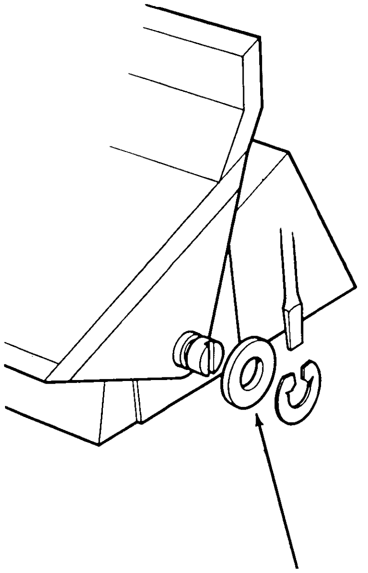
12. Remove the retaining clip and washer by turning the clip to the position shown in **G** ; push the lugs into the slot of the pivot, release the clip by positioning the blade of a screwdriver on top of the clip **H** , and pushing off the clip.
13. Pivot the motor tôward the disk enclosure. Slide the motor away from the main frame and lift it upward to clear the pivot and subframe.
14. Remove the motor from its mounting bracket by removing the three screws **E** .

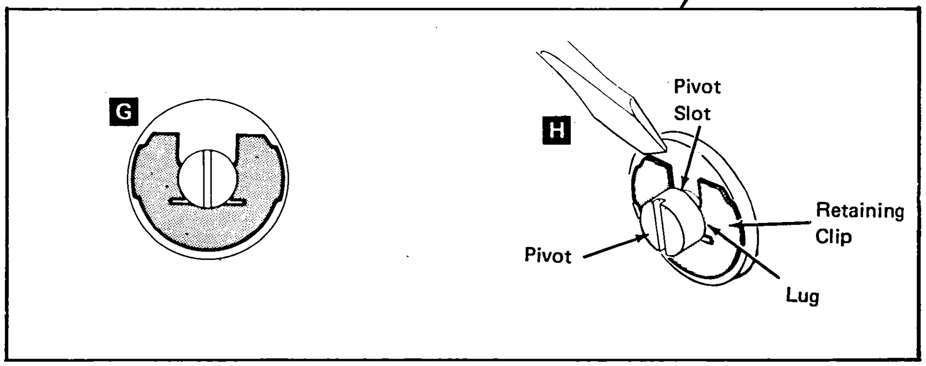


Back View



Front View





Replacement

1. Install the motor in its mounting bracket. Make sure the vents on the motor are facing upward and the motor cable is at the bottom left. Install the three screws **D** that hold the motor in the mounting bracket.

2. Smear a light film of grease on the pivot points of the motor assembly.

3. Lift the motor assembly into position and slip the tapered pin on the mounting bracket into the hole in the subframe. At the same time, lift the brake end of the motor assembly onto the pivot.

   DANGER
   Wear safety glasses during step 4.

4. Replace the washer and retaining clip **H**, and tighten the pivot **J**.

5. Lift the loop end of the tension spring into place on the motor mounting bracket **F**.

6. Pivot the motor against the tension springs to ensure correct seating of the spring loop.

7. Install the motor wires on DETB1 **B** – terminal 1 (blue wire) terminal 2 (white wire), and terminal 3 (two green/yellow wires).

8. Install the brake wires from DETB1 **B** – terminal 5 (black wire) and terminal 6 (yellow wire).

9. Install the safety cover on DETB1 (holes to the left).

10. Install the cable straps **G** (if present) that hold the motor, brake, and ac cables.

11. **CAUTION**
    Make sure the belt does not contact the disk speed transducer.

    Replace the belt **K** (smooth side of the belt against the pulleys). Center the belt on the pulleys.

12. Loosen the two screws **C** that hold the spindle locking arm. Slide the locking arm away from the disk spindle.

13. Make sure that the antistatic brush is contacting the center of the disk spindle.

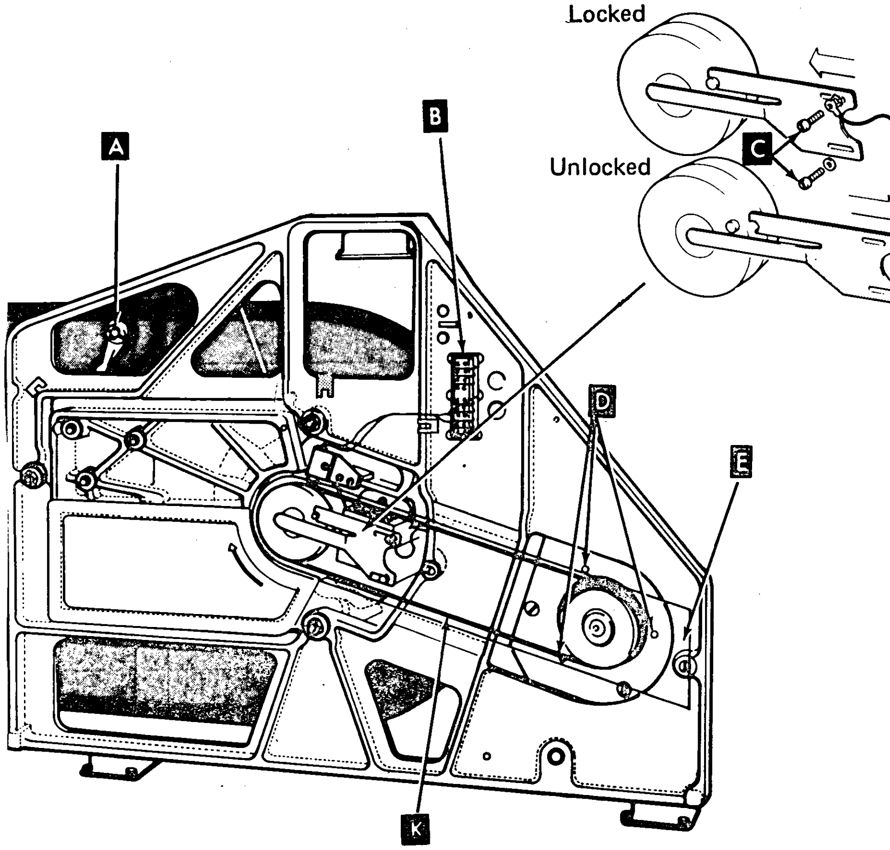
    Note: If there is a wear crater on the spindle antistatic brush, realign the crater to the spindle.

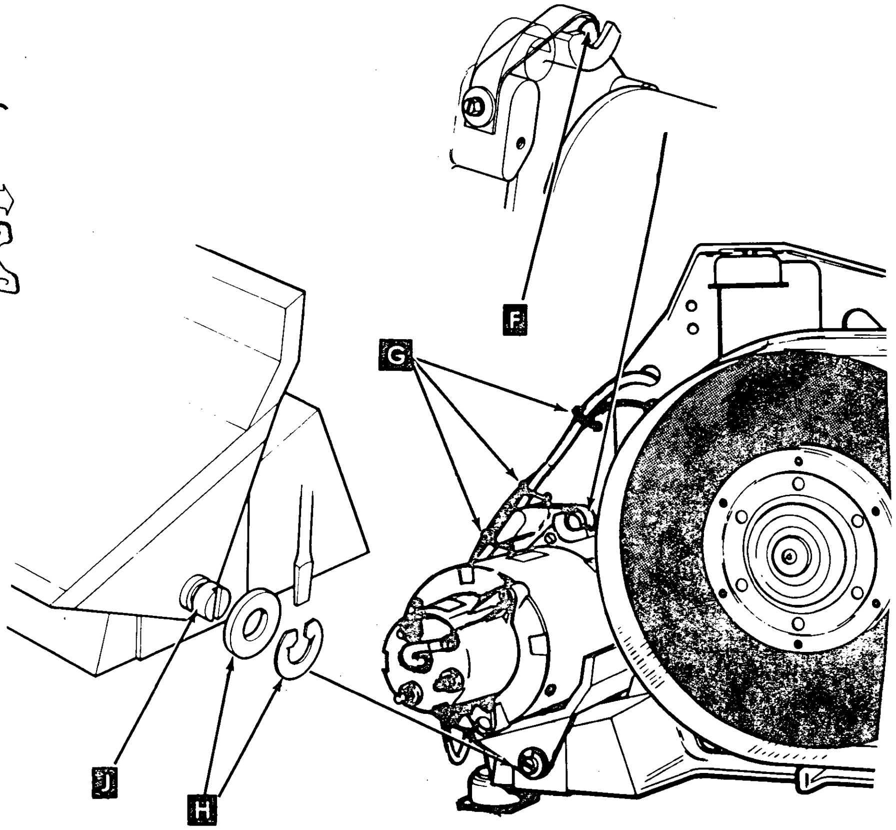
14. Tighten the screws on the spindle locking arm.

15. Check that the spindle antistatic brush has a pressure of 60 + 25 - 20 grams on the center of the disk spindle. Adjust the brush, if necessary, by removing and forming the brush.

16. Install the belt guard **E**. Slide the belt guard all the way to the left and tighten the screws.

17. Unlock the actuator lock **A** by moving the handle to OFF.





2.2.3.2 New Style Motor

Removal

CAUTION
Do not rotate the disk spindle counterclockwise; head damage can occur.

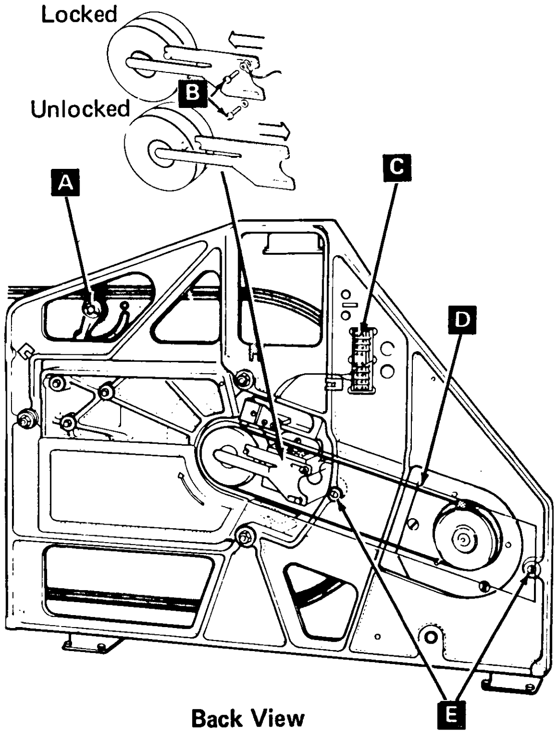
1. Turn power off at the operator control panel. After the power is sequenced down, turn the mainline power off at the back of the machine.

2. Lock the actuator with the actuator lock **A** by moving the handle to ON.

3. Remove the belt guard by loosening the two screws **E** and lifting it off.

4. Loosen the two screws **B** holding the spindle locking arm, and slide the locking arm toward the disk spindle.

5. Turn the motor pulley clockwise until the stud on the disk spindle sits in the slot in the locking arm.



Back View

6. Tighten the screws on the spindle locking arm.

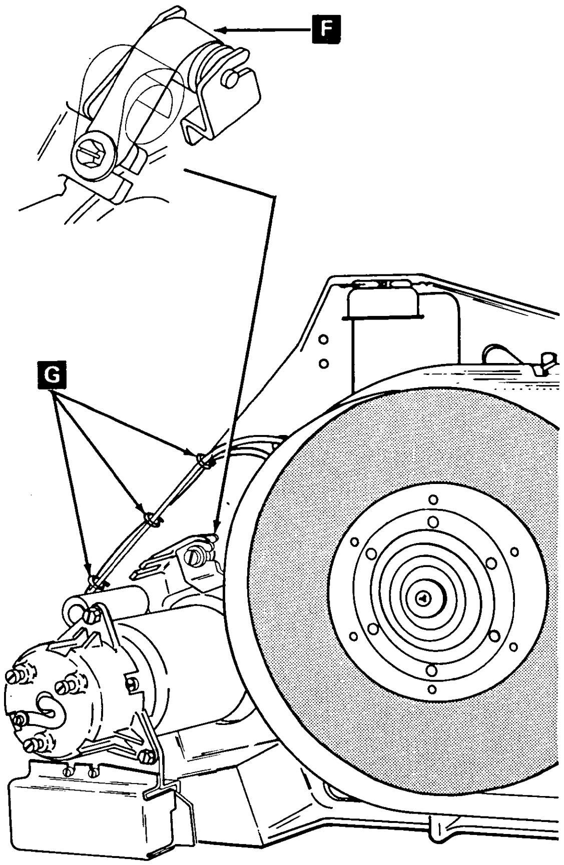
7. Lift the motor to release tension on the belt, and remove the belt **D** .

8. Remove the motor wires from DETB1 **C** – terminal 1 (blue wire), terminal 2 (white wire), and terminal 3 (two green/yellow wires).

9. Remove the brake wires from DETB1 **C** – terminal 5 (black wire) and terminal 6 (yellow wire).

10. Remove the cable straps **G** (if present) that hold the motor, brake, and ac cables.

11. Release the motor tension spring **F** by lifting it off the motor mounting bracket.



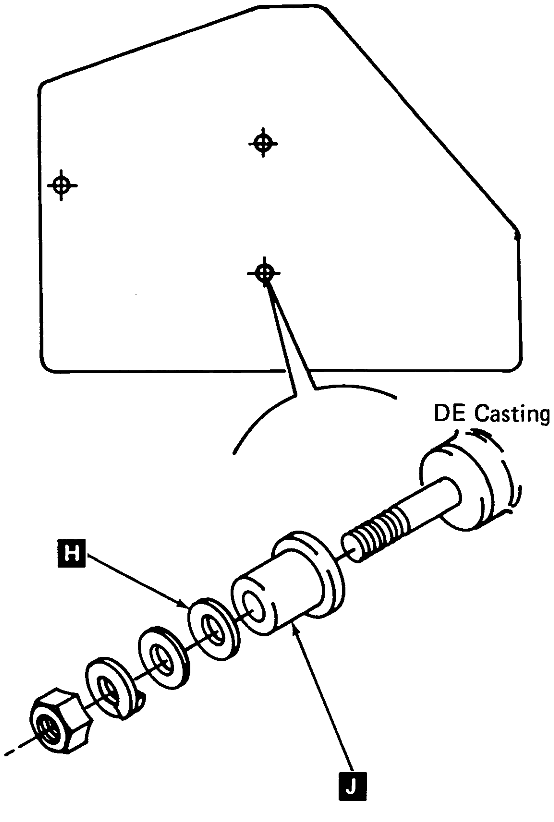
Front View

12. Remove the nut, lock washer, flat washer and insulating washer **H** on the motor pivot at the back of the subframe.

    Note: The motor mounting plates form part of the motor assembly and should not be removed.

    Note: Keep the two plastic bushings **J** (one located in the motor pivot hole in the subframe, and one located in the motor mounting plate).

13. Pivot the motor toward the disk enclosure. Slide the motor away from the main frame and lift it upward to clear the pivot and subframe.



Replacement

1. Check that the two plastic insulating bushings **K** are installed in the motor pivot holes of the subframe casting and the motor mounting plate.

2. Lift the motor onto the pivot points and slide it into position.

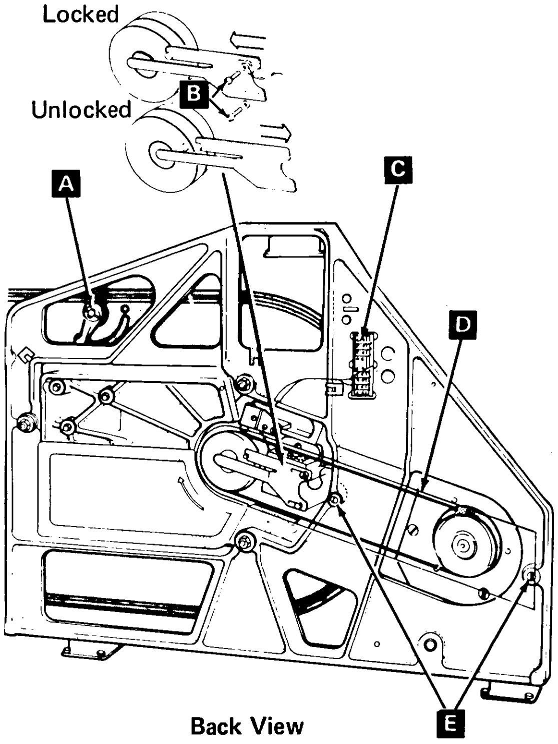
3. Install the plastic insulating washer **J**, flat washer, lock washer, and fixing nut on the pivot at the back of the subframe. Tighten the nut until the lock washer is just compressed, then unscrew the nut one-half turn.

4. Lift the loop end of the tension spring into place on the motor mounting bracket **G**.

5. Pivot the motor against the tension springs to ensure correct seating of the spring loop.

6. Install the motor wires on DETB1 **C** – terminal 1 (blue wire) terminal 2 (white wire), and terminal 3 (two green/yellow wires).

7. Install the brake wires from DETB1 **C** – terminal 5 (black wire) and terminal 6 (yellow wire).



Back View

8. Install the safety cover on DETB1 (holes to the left).

9. Install the cable straps **H** (if present) that hold the motor, brake, and ac cables.

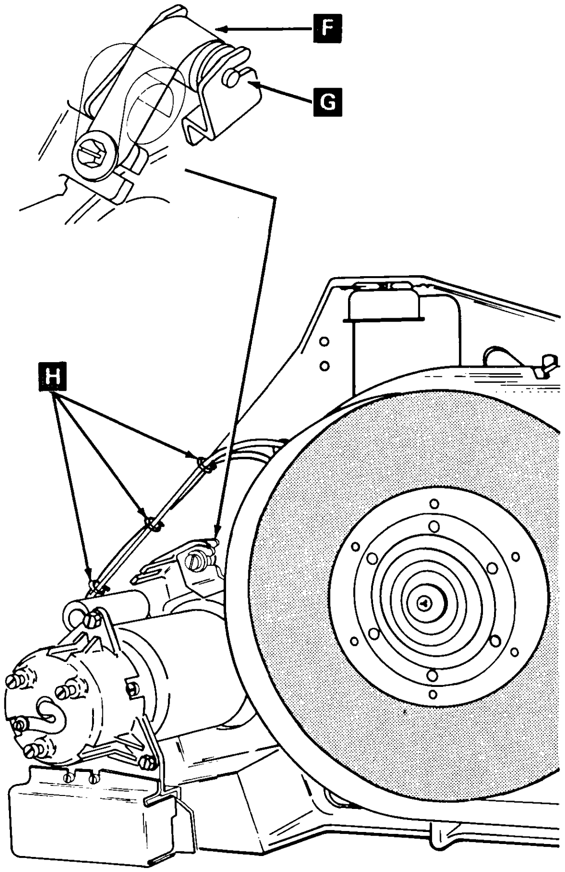
10. **CAUTION**
    Make sure the belt does not contact the disk speed transducer.

    Replace the belt **D** (smooth side of the belt against the pulleys). Center the belt on the pulleys.

11. Loosen the two screws **B** that hold the spindle locking arm. Slide the locking arm away from the disk spindle.

12. Make sure that the antistatic brush is contacting the center of the disk spindle.

    Note: If there is a wear crater on the spindle antistatic brush, realign the crater to the spindle.



Front View

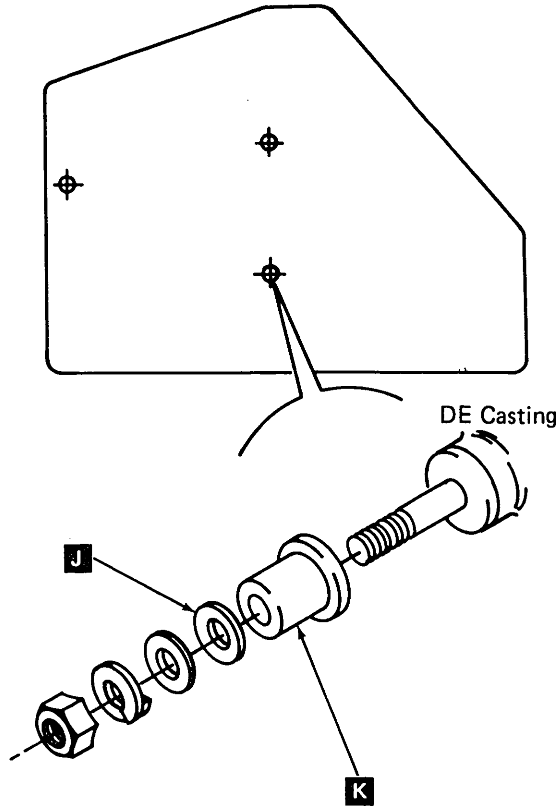
13. Tighten the screws on the spindle locking arm.

14. Check that the spindle antistatic brush has a pressure of 60 + 25 - 20 grams on the center of the disk spindle. Adjust the brush, if necessary, by removing and forming the brush.

15. Install the belt guard and tighten the two screws **E**. Slide the belt guard all the way to the left and tighten the screws.

16. Unlock the actuator lock **A** by moving the handle to OFF.

CAUTION
New style and old style motor tension springs are not interchangeable. The part number is etched on the new style spring.



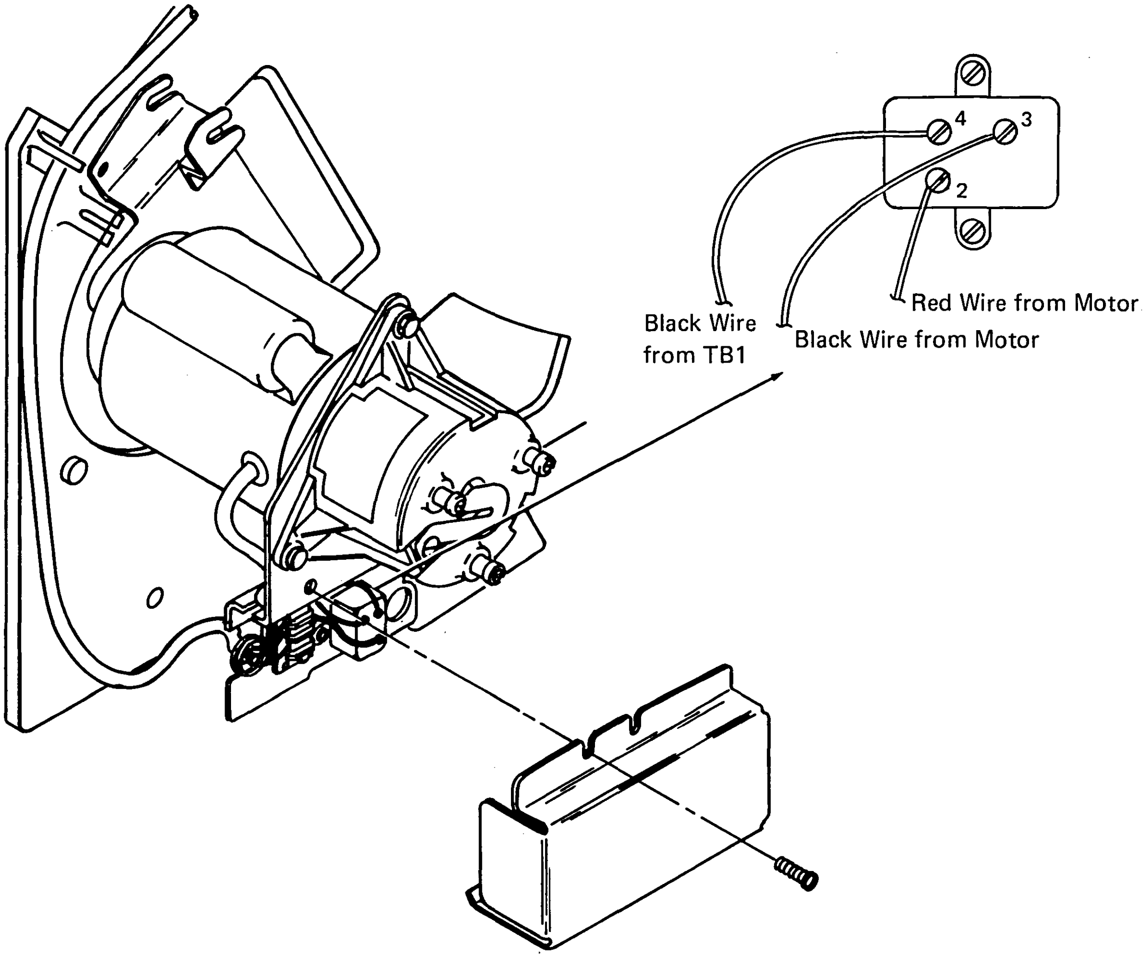
2.2.3.3 Motor Start Relay

Removal

1. Disconnect all power.
2. Loosen the two holding screws of the start relay cover and slide the cover down, disengaging it from the motor assembly.
3. Mark the wires, then disconnect them from the relay.
4. Remove the two relay holding screws, and lift out the relay.

Replacement

1. Install the motor start relay and holding screws.
2. Connect the wires to the relay.
3. Install the start relay cover and tighten the two holding screws.



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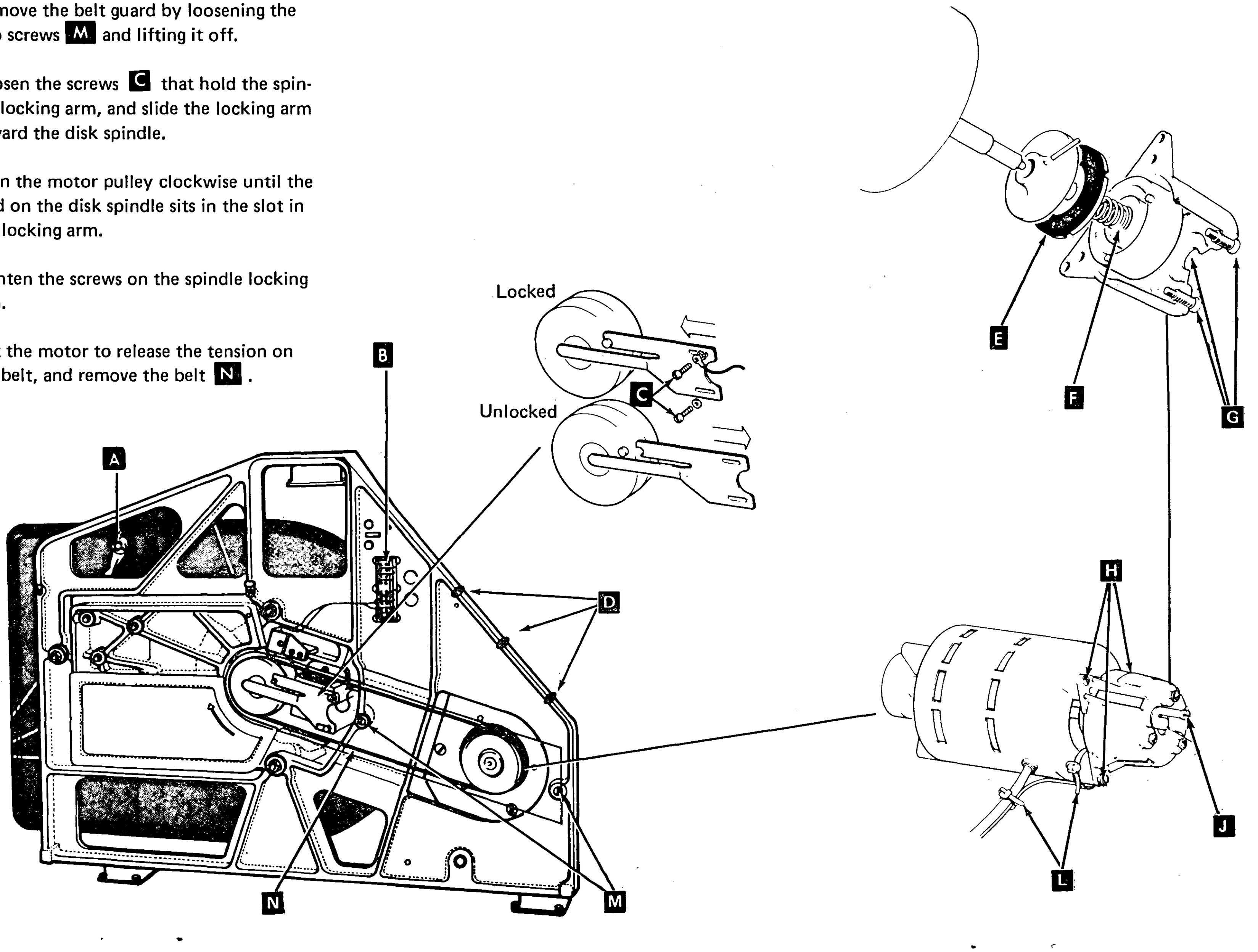
2.2.4 Brake Assembly and Brake Coil Assembly

Removal

CAUTION
Do not rotate the disk spindle counterclockwise; head damage can occur.

1. Turn power off at the operator control panel. After power is sequenced down, turn the mainline power off at the back of the machine.
2. Lock the actuator with the actuator lock **A** by moving the handle to ON.
3. Remove the belt guard by loosening the two screws **M** and lifting it off.
4. Loosen the screws **C** that hold the spindle locking arm, and slide the locking arm toward the disk spindle.
5. Turn the motor pulley clockwise until the stud on the disk spindle sits in the slot in the locking arm.
6. Tighten the screws on the spindle locking arm.
7. Lift the motor to release the tension on the belt, and remove the belt **N** .
8. Remove the brake wires from the right side DETB1 **B** – terminal 5 (black wire) and terminal 6 (yellow wire).
9. Remove the cable straps **D** (if present) that hold the motor, brake, and ac cables.
10. Cut the cable strap that holds the motor and brake cables together, and also the one that holds the brake cable to the brake moulding **L** .
11. Remove the screw **J** that holds the brake antistatic brush to the brake moulding.
12. Remove the three screws **H** that hold the brake assembly to the motor.
13. Remove the complete brake assembly, including the brake pad **E** and spring **F** from the back of the motor.
14. To remove the brake coil assembly, remove the three brake adjustment locking screws **G** , and remove the brake coil assembly from the brake housing.



Replacement

1. If the brake coil assembly was removed, insert the brake coil H into the brake housing and secure it with the three brake adjustment locking screws E .

2. Loosen the brake adjustment locking screws E . Turn the brake adjusting studs F counterclockwise until the brake coil is against the brake housing G .

3. Check that the brake plate C that is pinned to the motor shaft is not loose.

4. Check the brake pad D for uneven or excessive wear; replace it, if needed.

5. Install the brake pad and spring onto the motor shaft.

6. Install the brake assembly onto the back of the motor. Make sure that the three slots K in the brake pad D are aligned with the three studs J on the brake coil.

   Note: The hazard label should be up and to the right, and the cables from the motor and brake should run together at the bottom left when viewed from the back of the motor.

7. Install the three screws L that hold the brake housing to the motor. Before tightening the screws, the motor shaft must be located centrally in the brake housing.

8. Tighten the three screws that hold the brake housing to the motor.

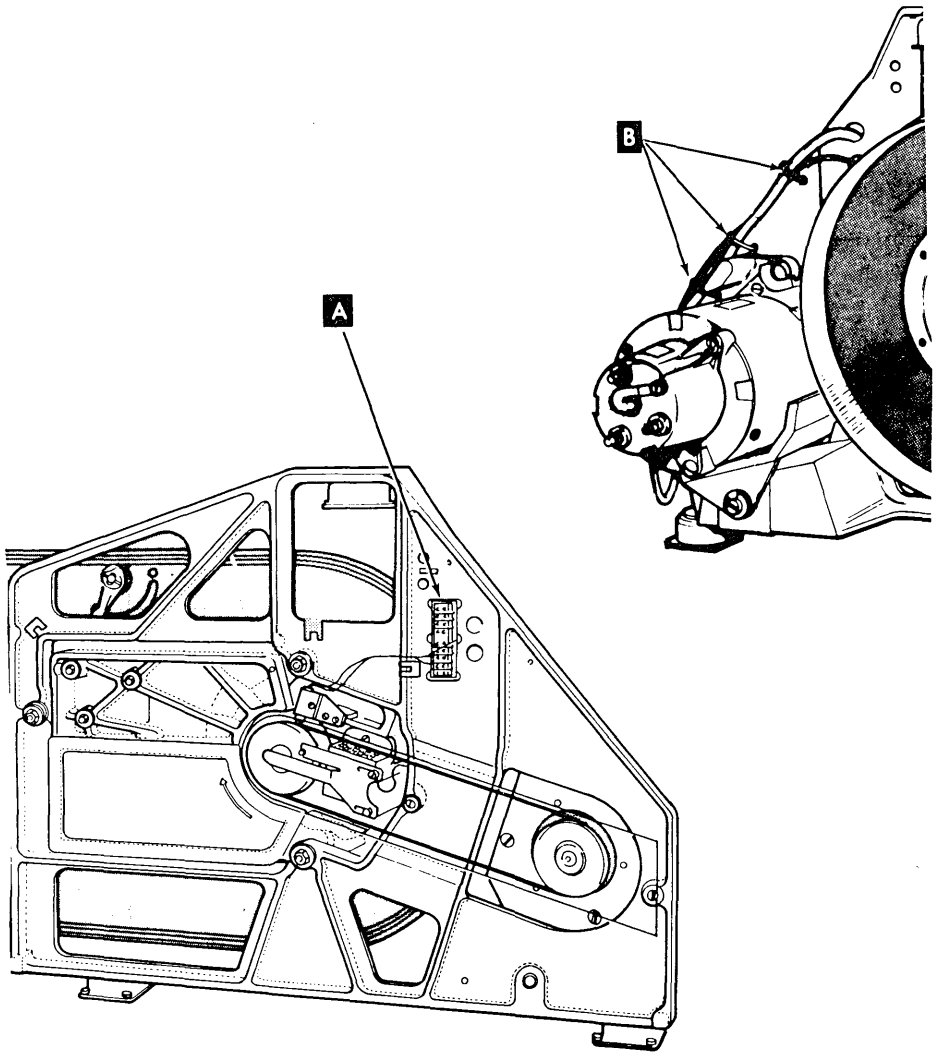
9. Strap the motor and brake cables N with replacement straps or insulating tape.

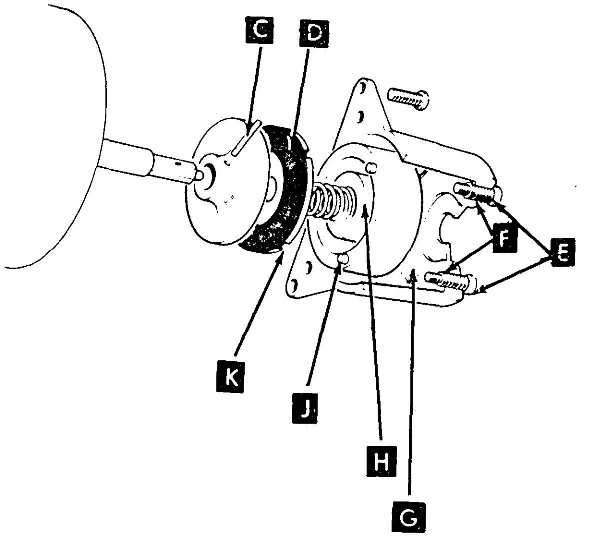
10. Install the cable straps B (if present) that hold the motor, brake, and ac cables.

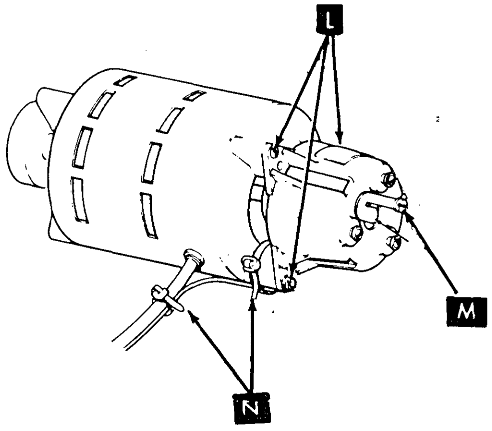
11. Install the brake wires from DETB1 A – terminal 5 (black wire) and terminal 6 (yellow wire).

12. Install the motor antistatic brush M.

13. Do the brake adjustment (next page), beginning with step 7.







2.2.5 Brake Assembly

Service Check

CAUTION
Do not rotate the disk spindle counterclockwise; head damage can occur.

1. Turn power off at the operator control panel. After the power is sequenced down, turn the mainline power off at the back of the machine.

2. Check for 0.008 inch ± 0.005 inch (0.203 mm ± 0.127 mm) at gap **K** .

Adjustment

1. Lock the actuator with the actuator lock **A** by moving the handle to ON.

2. Remove the belt guard by loosening the two screws **E** and lifting it off.

3. Loosen the two screws **B** holding the spindle locking arm, and slide the locking arm toward the disk spindle.

4. Turn the motor pulley clockwise until the stud on the disk spindle sits in the slot in the locking arm.

5. Tighten the screws on the spindle locking arm.

6. Lift the motor to release tension on the belt, and remove the belt **D** .

7. Remove the motor wires from DETB1 **C** – terminal 1 (blue wire), terminal 2 (white wire), and terminal 3 (two yellow/green wires).

   DANGER
   Make sure the disconnected wires are away from TB1.

8. Unplug the fan above the motor.

9. Loosen the brake adjustment locking screws **H**

10. Turn the adjusting studs **J** clockwise, one turn at a time, each time tightening the locking screws until the brake pad **G** is tight against the brake plate **F** .

11. Back off the studs as evenly as possible (keep locking screws tight), and adjust for a 0.008 inch ± 0.002 inch (0.203 mm ± 0.051 mm) gap **K** between the brake pad and the coil. Check at the three gaps in the brake housing moulding.

12. Tighten the locking screws **H** and check that the adjustment **K** is now 0.008 inch ± 0.002 inch (0.203 mm ± 0.051 mm).

13. Turn power on at the mainline switch and at the operator control panel.

14. **DANGER**
    220 Vac present on TB1. With the brake coil energized, the gap **L** between the brake pad and the brake plate should be 0.008 inch ± 0.002 inch (0.203 mm ± 0.051 mm).

15. Turn the motor pulley to check if the motor is free from binds. Gap **L** can now be 0.008 inch ± 0.005 inch (0.203 mm ± 0.127 mm).

16. Turn power off at the operator control panel. After the power is sequenced down, turn the mainline power off at the back of the machine.

17. Install the motor wires from DETB1 **C** – terminal 1 (blue wire), terminal 2 (white wire), and terminal 3 (two green/yellow wires).

18. Install the safety cover on TB1 (holes to the left).

19. **CAUTION**
    Make sure the belt does not contact the disk speed transducer.

    Replace the belt (smooth side of the belt against the pulley).

20. Check that the belt is centered on the pulleys.

21. Replug the fan above the motor.

22. Adjust the motor antistatic brush.

    Note: If there is a wear crater on the motor antistatic brush, realign the crater to the motor shaft. Check for 60 ± 20 grams. Adjust, if necessary, by removing and forming the brush.

23. Loosen the two screws **B** holding the spindle locking arm. Slide the locking arm away from the disk spindle.

24. Make sure the spindle antistatic brush is contacting the center of the spindle.

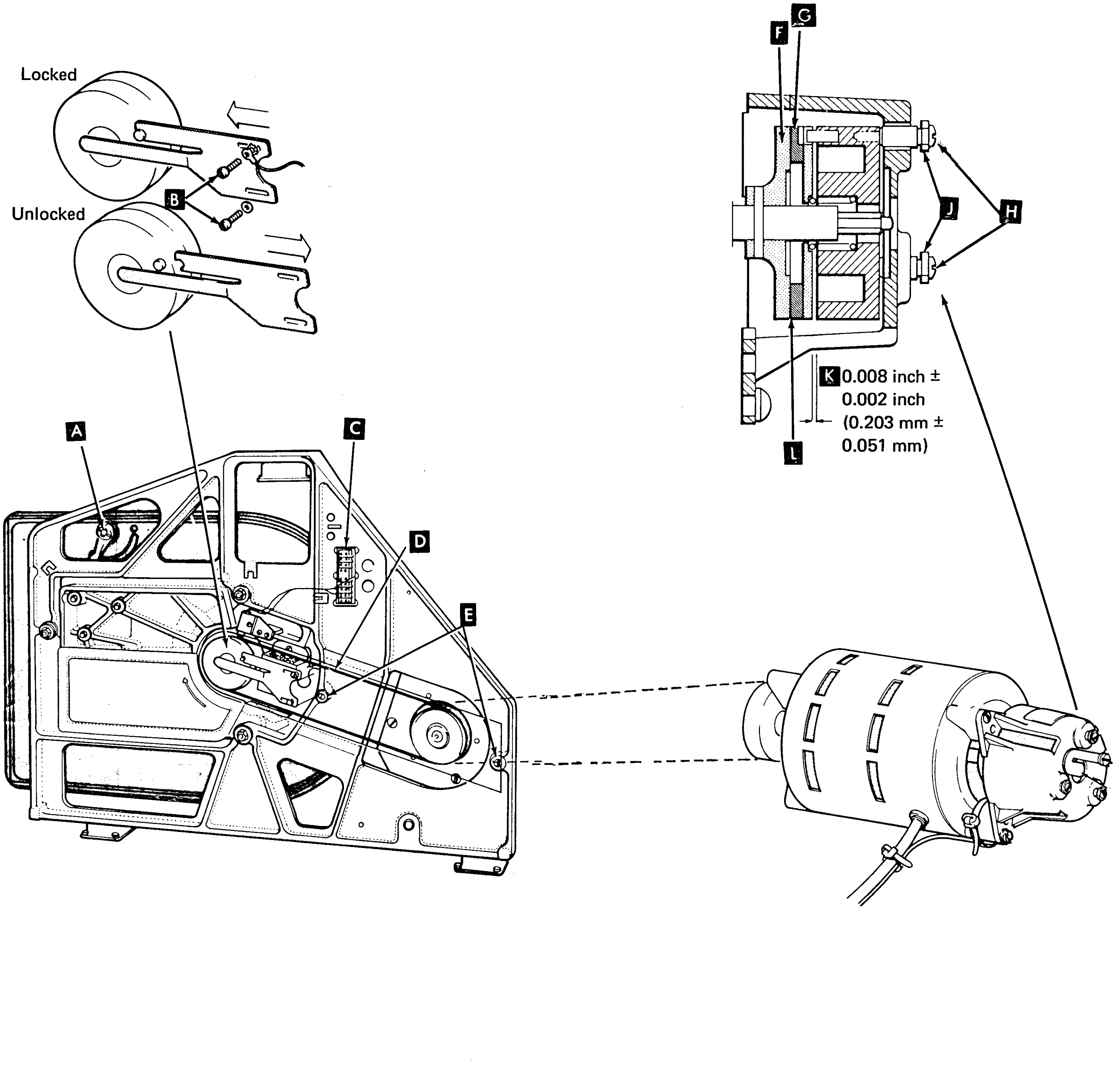
    Note: If there is a wear crater on the antistatic brush, realign the crater to the spindle.

25. Tighten the screws on the spindle locking arm.

26. Check that the spindle antistatic brush has a pressure of 60 + 25 – 20 grams on the center of the spindle. Adjust, if necessary, by removing and forming the brush.

27. Install the belt guard. Slide the belt guard all the way to the left, and tighten the screws **E** .

28. Unlock the actuator by moving the handle **A** to OFF.


Locked
Unlocked
B
A
C
D
E
F
G
H
J
K 0.008 inch ± 0.002 inch (0.203 mm ± 0.051 mm)
L

2.2.6 Motor Antistatic Brush

Removal

CAUTION
Do not rotate the disk spindle counterclockwise; head damage can occur.

1. Turn power off at the operator control panel. After the power is sequenced down, turn the mainline power off at the back of the machine.

2. Remove the motor antistatic brush by removing the screw **E** that holds it to the brake moulding.

Replacement and Adjustment

1. Install the motor antistatic brush **F** .

   Note: If there is a wear crater on the motor antistatic brush, realign the crater with the motor shaft.

2. Check the motor antistatic brush for 60 ± 20 grams **F** . Adjust, if necessary, by removing and forming the brush.

2.2.7 Spindle Antistatic Brush

CAUTION
Do not turn the disk spindle during the following procedures.

Removal

1. Turn power off at the operator control panel. After the power is sequenced down, turn the mainline power off at the back of the machine.

2. Lock the actuator with the actuator lock **C** by moving the handle to ON.

3. Remove the belt guard by loosening the two screws **D** and lifting it off.

4. Remove the two screws **B** holding the spindle locking arm; at the same time, disconnect the ground wire from under one of the screws.

5. Lift off the spindle antistatic brush.

Replacement and Adjustment

1. Install the spindle locking arm with the spindle antistatic brush centered over the center pin **A** on the disk spindle pulley.

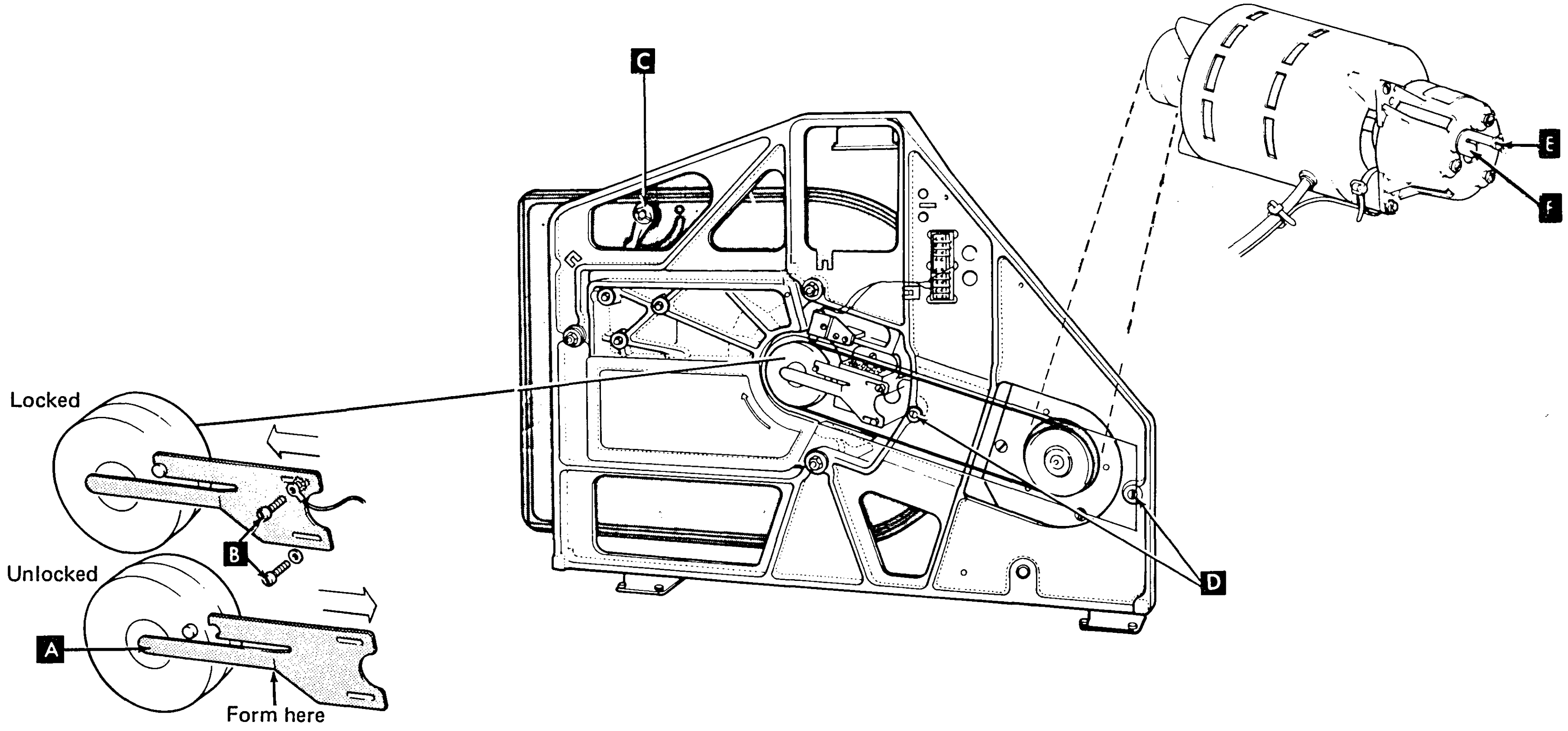
2. Install the two screws that hold the spindle locking arm. At the same time, connect the ground wire to the antistatic brush with one of the screws.

   Note: If there is a wear crater on the antistatic brush, realign the crater to the spindle.

3. Check that the spindle antistatic brush has a pressure of 60 + 25 - 20 grams on the center of the spindle. Adjust, if necessary, by removing and forming the brush.

4. Install the belt guard. Slide the belt guard all the way to the left and tighten the screws **D** .

5. Unlock the actuator by moving the handle **C** to OFF.



2.2.8 Disk Speed Transducer

Removal

CAUTION
Do not rotate the disk spindle counterclockwise; head damage can occur.

Note: If the disk enclosure is being replaced, a new speed transducer is furnished. The disk speed transducer can, however, be replaced separately.

1. Turn power off at the operator control panel. After the power is sequenced down, turn the mainline power off at the back of the machine.
2. Lock the actuator with the actuator lock **D** by moving the handle to ON.
3. Remove the belt guard by loosening the two screws **H** and lifting it off.
4. Loosen the two screws **G** holding the spindle locking arm, and slide the locking arm toward the disk spindle.
5. Turn the motor pulley clockwise until the stud on the disk spindle sits in the slot in the locking arm.
6. Tighten the screws on the spindle locking arm.
7. Lift the motor to release tension on the belt, and remove the belt **J** .
8. Remove the disk speed transducer wires from DETB1 **F** – terminal 7 (black wire) and terminal 8 (white wire).
9. Remove the disk speed transducer assembly by removing the two screws **C** .

Replacement and Adjustment

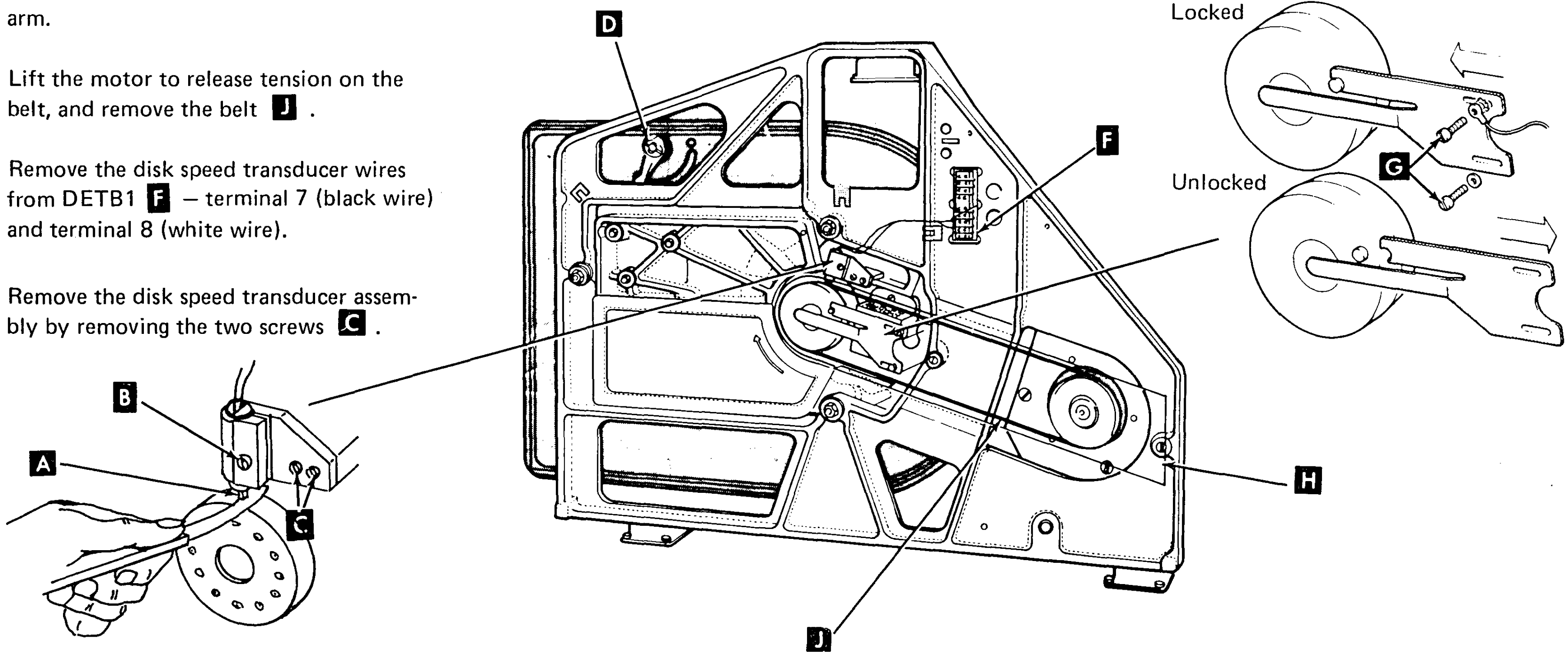
CAUTION
Be careful not to damage the disk speed transducer tip during replacement.

1. Loosen the transducer clamping screw **B** . Make sure the tab on the transducer is in the slot in the bracket.
2. Replace the transducer assembly with the two mounting screws **C** .
3. Adjust the transducer for a gap of 0.006 inch ± 0.002 inch (0.1524 mm ± 0.051 mm) **A** .

   Note: The transducer assembly might have to be adjusted to obtain the correct gap between the transducer and the spindle pulley.
4. Tighten the transducer clamping screw.
5. Connect the transducer cable to DETB1 **F** – terminal 7 (black wire) and terminal 8 (white wire).
6. Install the safety cover on DETB1 (holes to the left).
7. **CAUTION**
   Make sure the belt does not contact the disk speed transducer.

   Replace the belt (smooth side of the belt against the pulleys). Center the belt on the pulleys.
8. Loosen the two screws **G** holding the spindle locking arm, and slide the locking arm away from the disk spindle.
9. Make sure the antistatic brush is contacting the center of the spindle.

   Note: If there is a wear crater on the spindle antistatic brush, realign the crater to the spindle.
10. Tighten the screws on the locking arm.
11. Check that the antistatic brush has a pressure of 60 + 25 - 20 grams on the center of the spindle. Adjust, if necessary, by removing and forming the brush.
12. Install the belt guard **H** . Slide the belt guard all the way to the left and tighten the screws.
13. Unlock the actuator lock **D** by moving the handle to OFF.



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2.2.9 Motor Tension Spring

Note: New style and old style motor tension springs are not interchangeable. The part number is etched on the new style spring.

Removal

CAUTION
Do not rotate the disk spindle counterclockwise; head damage can occur.

1. Turn power off at the operator control panel. After the power is sequenced down, turn the mainline power off at the back of the machine.

2. Lift the motor tension spring **C** off the motor mounting bracket.

3. **CAUTION**
   Take care that the nut and lock washer do not fall into the motor.

   Remove the nut and lock washer from the end of the screw **B**.

4. Press the tension spring firmly against the mounting stud, and remove the screw and flat washer.

5. Lift the spring off the stud.

6. For new style motor tension springs only:

   Remove one of the insulating washers from the roller end of the spring assembly and slide off the spring.

Replacement

1. For new style motor tension springs only:

   Slide the spring onto the roller, place the insulating washer on the shaft, flat side first, and hand press into position.

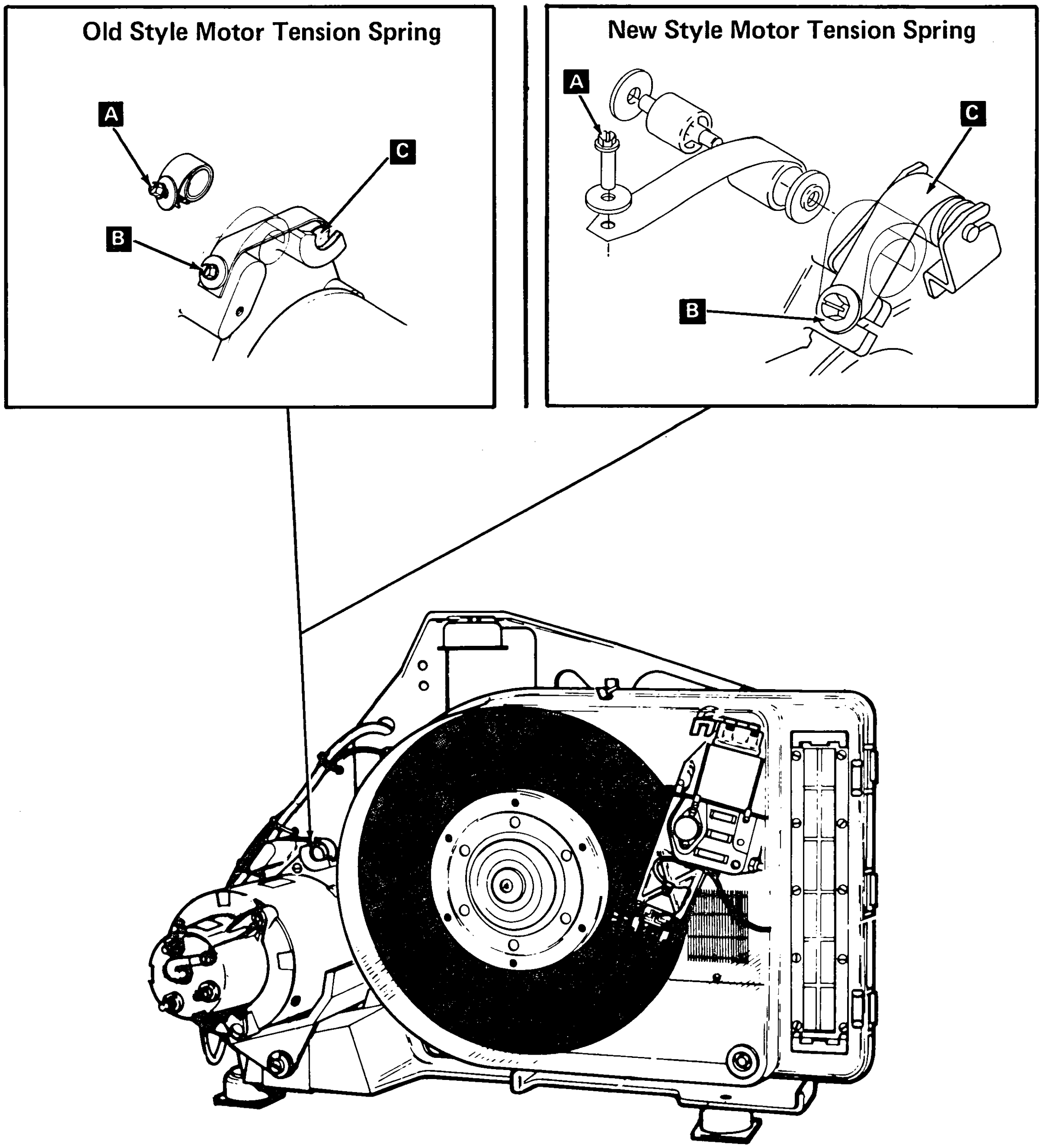
2. Ease the spring open slightly and press the screw with the flat washer on it through the hole **A** in the spring.

3. Press the screw onto the hole in the mounting stud.

4. Lift the loop of the tension spring into its seat on the motor mounting bracket.

5. Install the lock washer and nut, and tighten the spring on the mounting stud.

6. Pivot the motor against the tension spring to ensure correct seating of the spring loop.



Old Style Motor Tension Spring

New Style Motor Tension Spring

2.2.10 Shock Mount (Top One)

CAUTION
Do not rotate the disk spindle counterclockwise; head damage can occur.

Removal

Note: Do not remove more than one shock mount at a time unless you are removing the subframe.

1. Turn power off at the operator control panel. After the power is sequenced down, turn the mainline power off at the back of the machine.
2. Lock the actuator with the actuator lock by moving the handle A to ON.
3. Remove the belt guard by loosening the two screws J and lifting it off.
4. Loosen the two screws K holding the spindle locking arm, and slide the locking arm toward the disk spindle.
5. Turn the motor pulley clockwise until the stud on the disk spindle sits in the slot in the locking arm.
6. Tighten the screws on the spindle locking arm.
7. **CAUTION**
   Do not remove the three eccentrics and screws D.
8. Remove the four bracket mounting screws E (two on each side).
9. Remove the top screw C .
10. Slide out the bracket and remove the four shock mount bolts, nuts, and washers B .

Replacement

1. Install the bracket and the four shock mount screws, bolts, nuts, and washers B .
2. Position the shock mount bracket in the machine with the shock mount toward the front of the machine.
3. Install the top screw C .
4. While holding the bracket to the top of the machine against the three eccentrics D , install the four bracket mounting screws.
5. Loosen the two screws K that hold the spindle locking arm, and slide the locking arm away from the disk spindle.
6. Make sure the antistatic brush is contacting the center of the spindle.

   Note: If there is a wear crater on the spindle antistatic brush, realign the crater to the spindle.
7. Tighten the screws that hold the spindle locking arm.
8. Check that the antistatic brush has a pressure of 60 + 25 - 20 grams on the center of the spindle. Adjust, if necessary, by forming the brush.
9. Install the belt guard F . Slide the belt guard all the way to the left and tighten the screws.
10. Unlock the actuator by moving the handle A to OFF.

2.2.11 Shock Mounts (Bottom Two)

CAUTION
Do not rotate the disk spindle counterclockwise; head damage can occur.

Removal

Note: Do not remove more than one shock mount at a time unless you are removing the subframe.

1. Turn power off at the operator control panel. After the power is sequenced down, turn the mainline power off at the back of the machine.
2. Lock the actuator with the actuator lock A by moving the handle to ON.
3. Remove the belt guard by loosening the two screws J and lifting it off.
4. Loosen the two screws K holding the spindle locking arm, and slide the locking arm toward the disk spindle.
5. Turn the motor pulley clockwise until the stud on the disk spindle sits in the slot in the locking arm.
6. Tighten the screws on the locking arm.
7. Remove the screws, nuts, and washers H that hold the shock mount to the machine frame.
8. Remove the top screw G from the shock mount.
9. Remove the shock mount.

Replacement

1. Install the replacement shock mount on the subframe using the top screw **G** . Make sure that the shock mount has the correct part number (the disk drive uses two types of shock mounts).

2. Make sure the shock mount is upright and install the screws, nuts, and washers **H** to hold the mount to the machine frame.

3. Loosen the two screws **K** that hold the spindle locking arm, and slide the locking arm away from the disk spindle.

4. Make sure the spindle antistatic brush is contacting the center of the spindle.

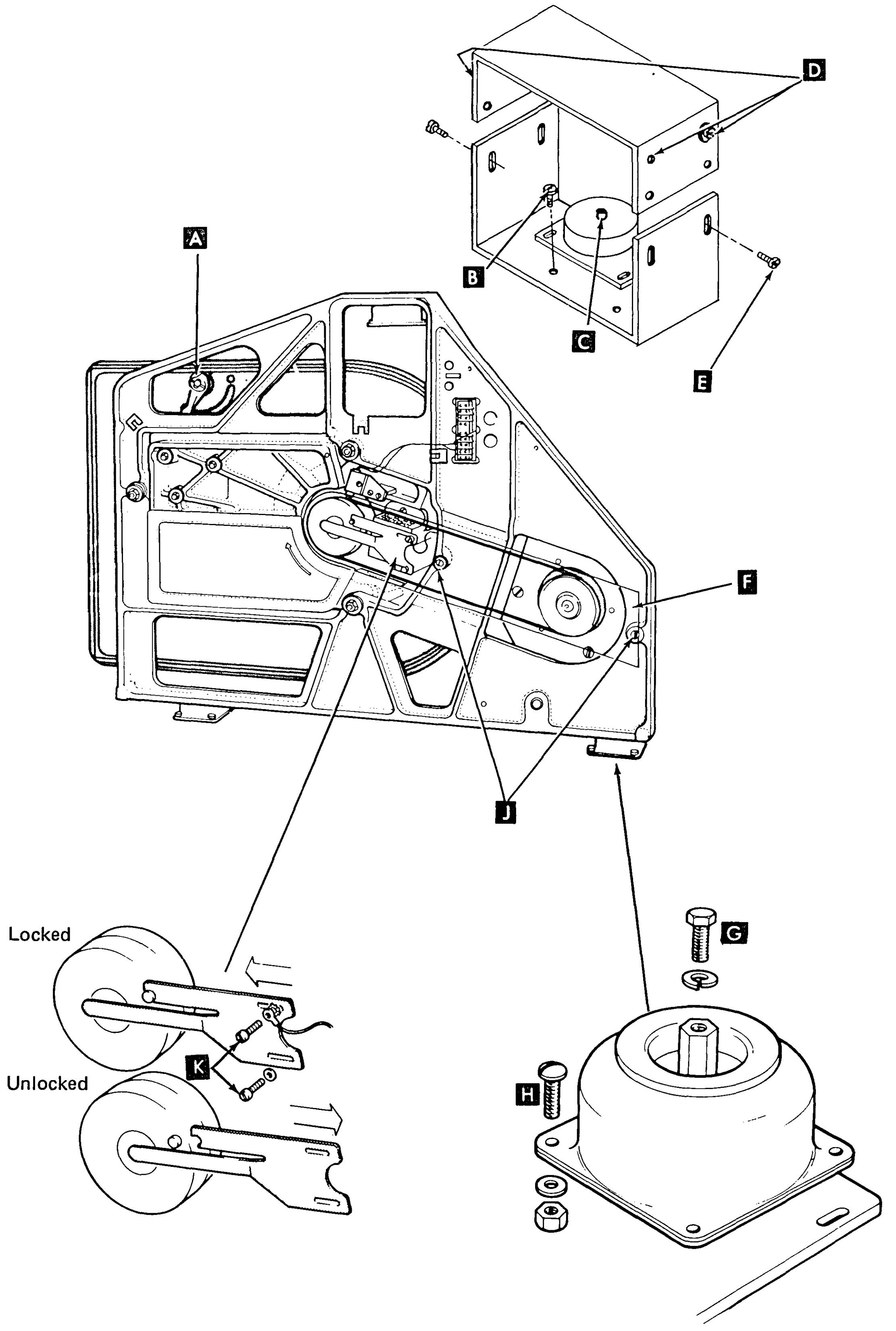
   Note: If there is a wear crater on the spindle antistatic brush, realign the crater to the spindle.

5. Tighten the two screws that hold the locking arm.

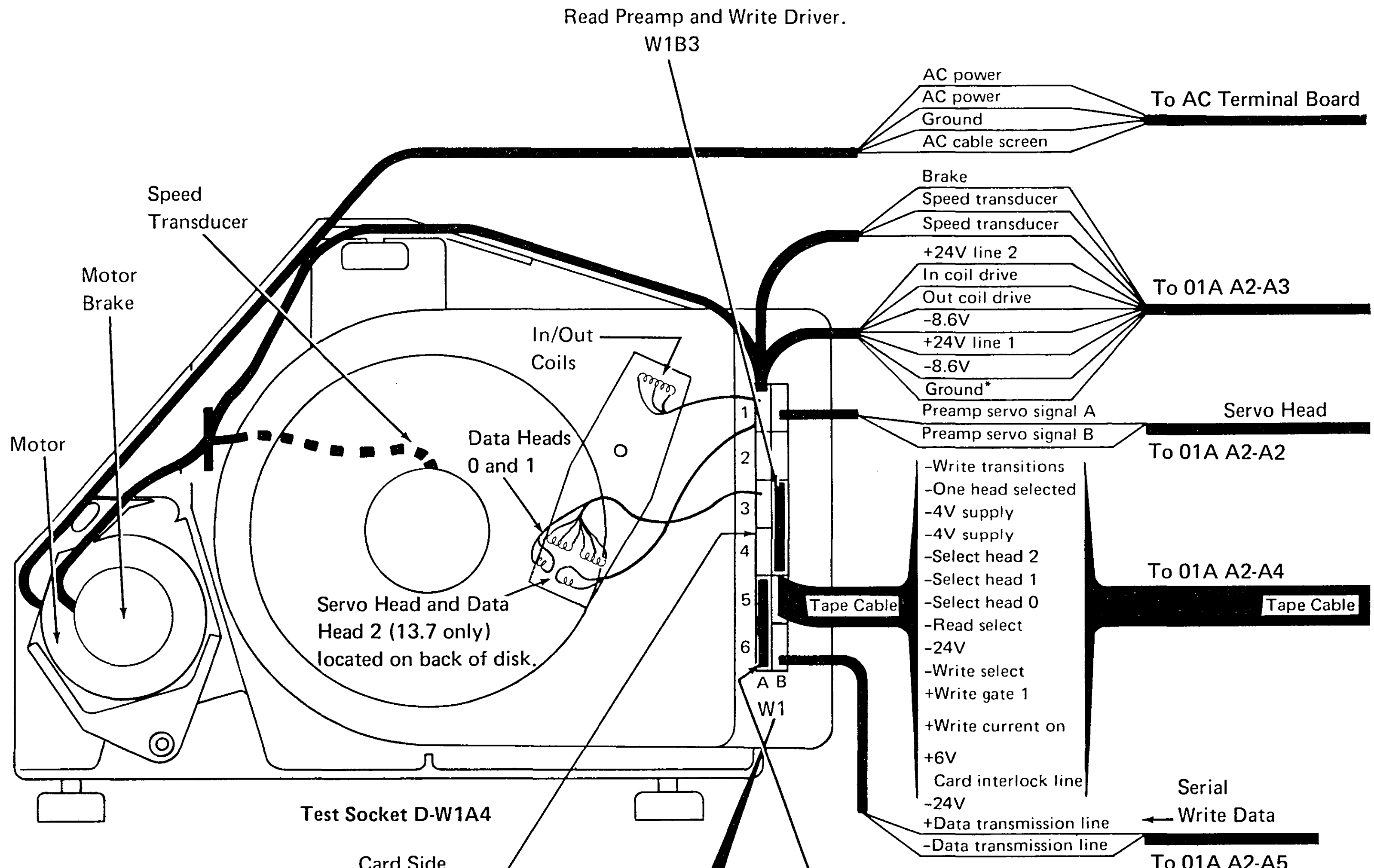
6. Check that the spindle antistatic brush has a pressure of 60 + 25 - 20 grams on the center of the spindle. Adjust, if necessary, by removing and forming the brush.

7. Install the belt guard **F** . Slide the belt guard all the way to the left and tighten the screws.

8. Unlock the actuator by moving the handle **A** to OFF.



2.3.0 CABLE AND CARD LOCATIONS



Test Socket D-W1A4

Card Side
A

B	D
+	+02
+	+03
+	+04
+	+05
+	+06
+	+07
+	+08
+	+09
+	+10
+	+11
+	+12
+	+13

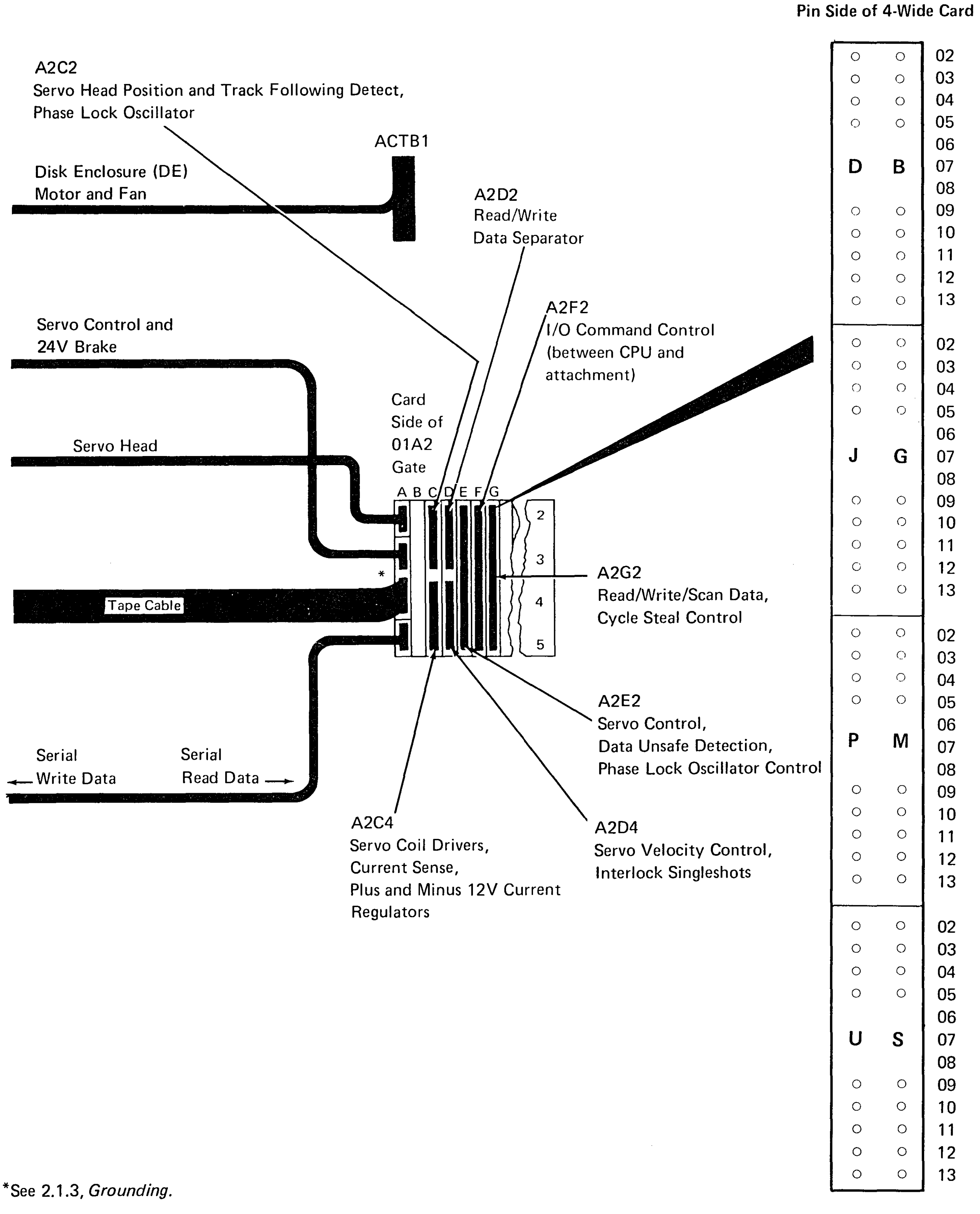
For example, ground pin is D-W1A4D08.

Inaccessible pins on other cards are connected to pins on D-W1A4, to allow testing (see logic page GV270).

W1A5
Read data automatic gain control and data detector. Write data trigger.

CAUTION
Do not use card extenders because they increase noise pick-up and cause wave-form distortion on the W1 cards.

*See 2.1.3, *Grounding*.



*See 2.1.3, *Grounding.*

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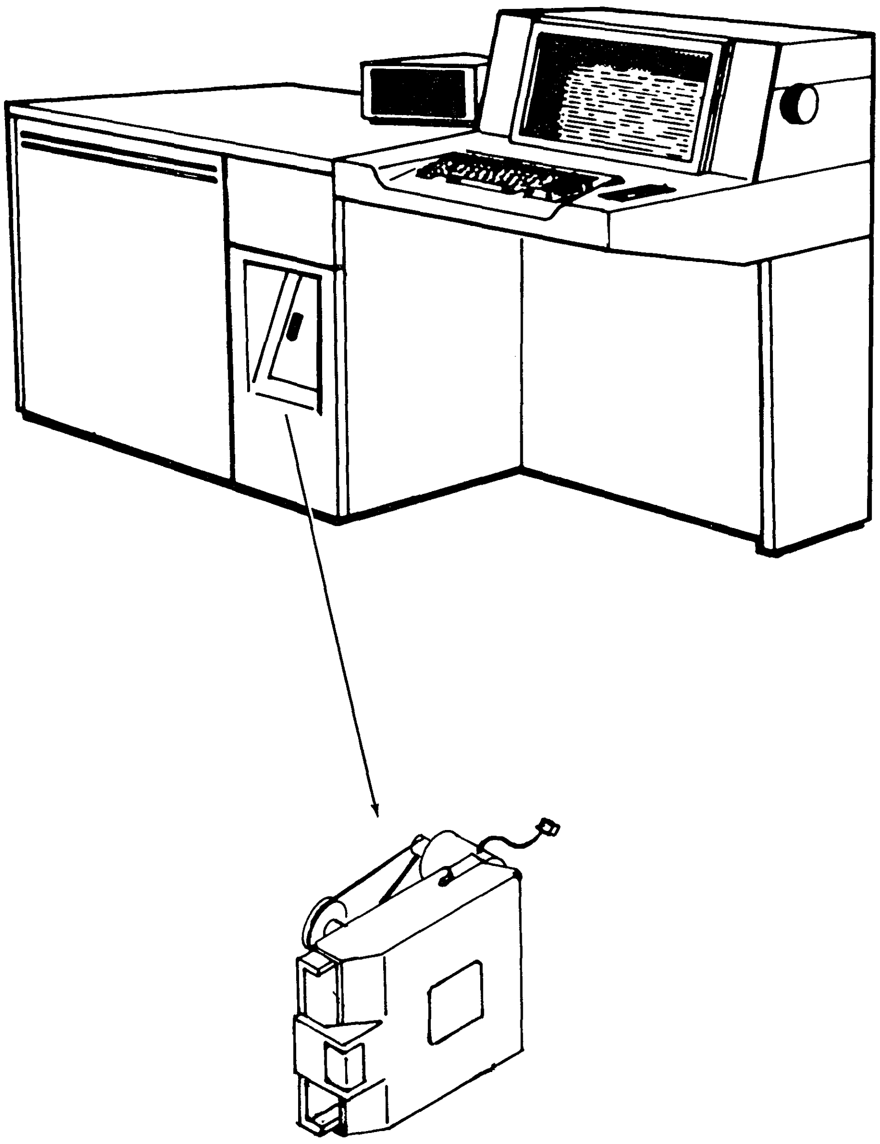
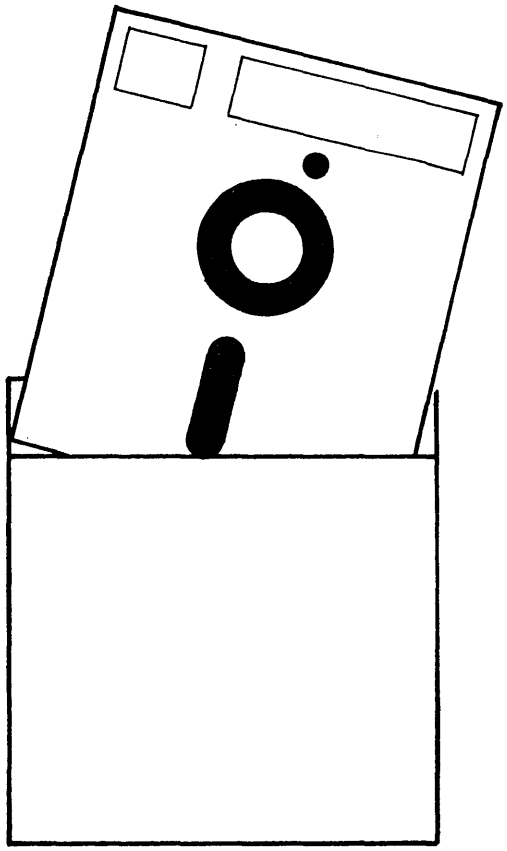
3.0.0 33FD Diskette Drive

3.1.0 THEORY

The 33FD Diskette Drive is a data storage facility that uses a flexible magnetic diskette enclosed in an 8 inch x 8 inch (203.2 mm x 203.2 mm) plastic cartridge. The 33FD reads data from the diskette or writes data on the diskette. The diskette drive positions the read/write head to any of the 77 tracks on the diskette. Characters are written on the tracks serially by bit.

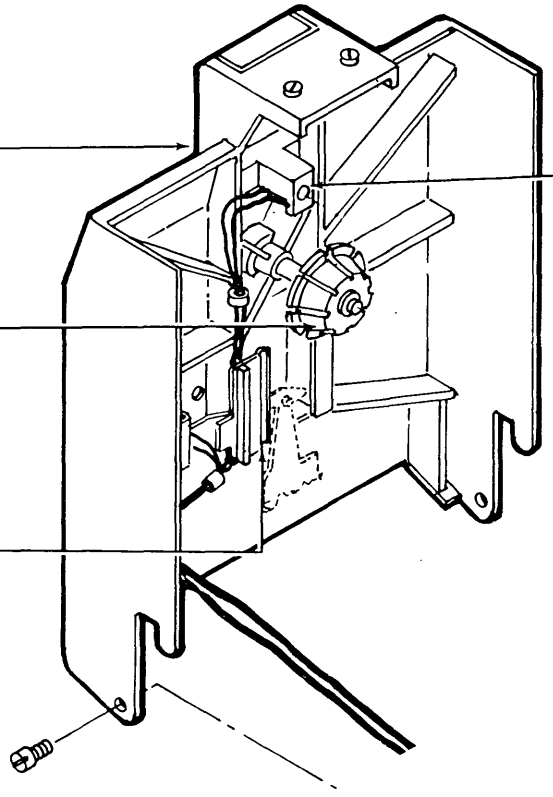


33FD Diskette Drive



IBM Diskette

3.1.1 33FD Description



Cover

The 33FD cover permits insertion and removal of the diskette.

Collet Assembly

When the cover is closed, the spring-loaded collet centers and clamps the diskette to the drive hub.

Head Load Actuator Assembly

The head load actuator assembly consists of a magnet and an armature. During a read or write operation, the magnet is energized and allows the pressure pad arm to push the diskette against the read/write head. At the same time, the diskette is cleaned when the armature forces the diskette envelope against the diskette. While not reading or writing, the head load actuator is deenergized and holds the pressure pad assembly away from the diskette to reduce wear to the diskette surface and/or the read/write head.

Light Emitting Diode (LED) and Phototransistor

When the cover is closed, the continuous light emitted from the LED is directed toward the phototransistor. Once every revolution, the index hole in the diskette allows light from the LED to reach the phototransistor. The phototransistor sends index pulses to the processing unit via the 33FD attachment.

Preload Spring

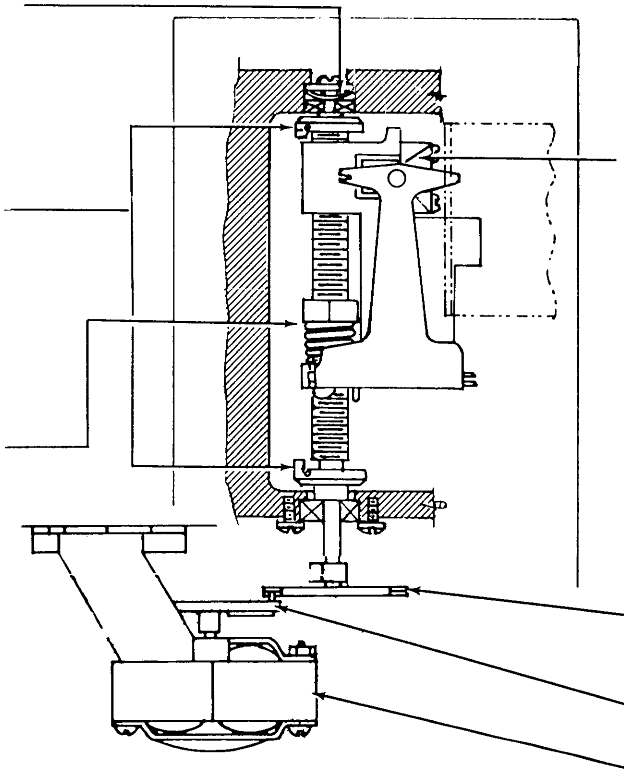
The preload spring loads the leadscrew to ensure head alignment with the diskette.

Limit Stops

The upper limit stop prevents the head from being driven beyond track 77. The lower limit stop prevents the head from being driven lower than track 00.

Leadscrew Nut and Spring

The leadscrew nut and spring load the head and carriage assembly to ensure head alignment with the diskette.



Read/Write Head

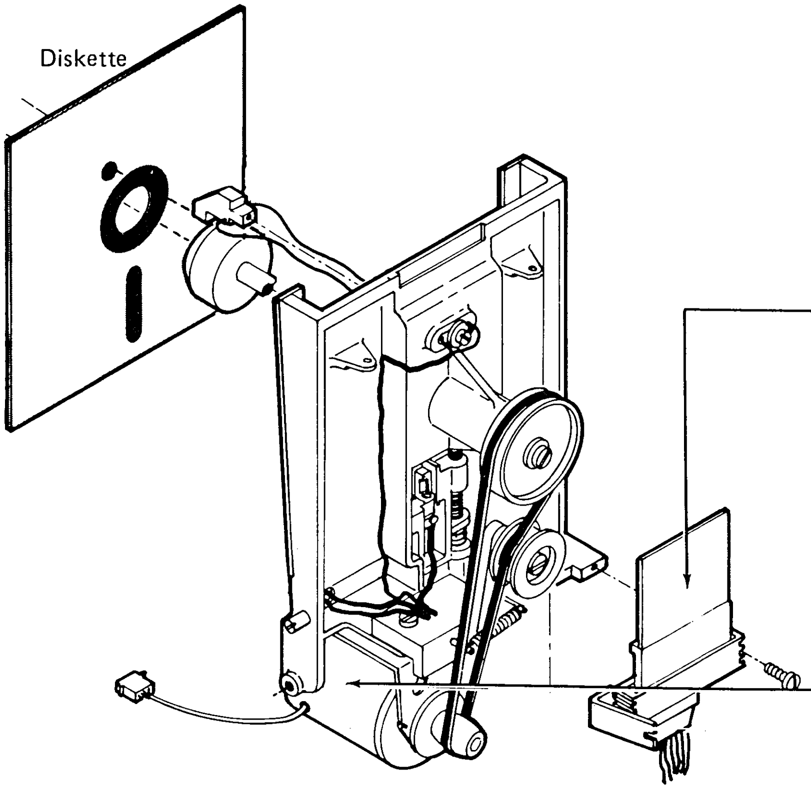
The read/write head provides the read, write, and erase functions.

Leadscrew Wheel

Stepper Motor Wheel

Stepper Motor Assembly

The stepper motor wheel is permanently mounted on the end of the stepper motor shaft. The stepper motor shaft turns in increments of 90 degrees in either direction under the control of access pulses. The stepper motor wheel engages the leadscrew wheel. When the stepper motor wheel rotates 90 degrees, it rotates the leadscrew wheel 90 degrees. The head carriage assembly then moves up or down one track on the diskette.



File Control Card

The FC card provides drive circuits for the stepper motor, head load actuator, and write and erase heads. It also provides the amplifiers for the phototransistor and read head.

The file control card is oriented with the components and the test pins face out. The card does not have to be removed to service the machine.

Drive Motor

The motor rotates the diskette at a speed of 360 rpm ± 2.5% with the head loaded.

3.1.2 Diskette Format

There are 77 tracks on the diskette surface; a track is a circular path on the surface of the diskette. The tracks are numbered 00 through 76. Track 00 is the outside track and track 76 is the inside track. Of the 77 tracks, only 74 tracks are data tracks. Track 00 is a label track and tracks 75 and 76 are reserved as alternates for tracks that become defective. Some diskettes that are interchanged with other systems might contain only 73 data tracks, track 74 is not used.

Each track is divided into either eight or 26 sectors. The content of each sector is described in the illustration on the facing page.

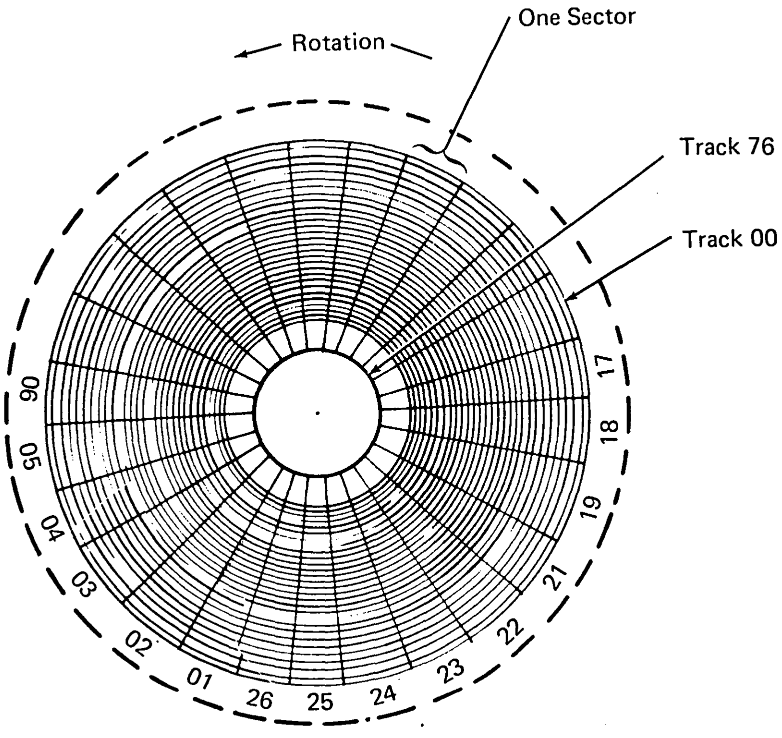
The data stored in one sector is called a record. When the tracks are divided into eight sectors, each record contains 512 bytes; when the tracks are divided into 26 sectors, each record contains 128 bytes. Thus, diskettes that contain 74 data tracks divided into eight sectors per track have a capacity of 303,104 bytes of data; those divided into 26 sectors have a capacity of 246,272 bytes of data.

In some diagnostic programs, only one sector is written on a track. Each sector contains 4096 bytes of data.

Because the diskette is formatted into tracks and sectors, each record on the diskette has a definite address consisting of a track and sector address. The address is recorded at the physical location of the record on the diskette.

Diskettes that contain prerecorded record addresses are called initialized diskettes. Initialized diskettes contain an ID field for each record.

Each record on the diskette consists of two parts; the first part contains identification information, and the second part contains data.



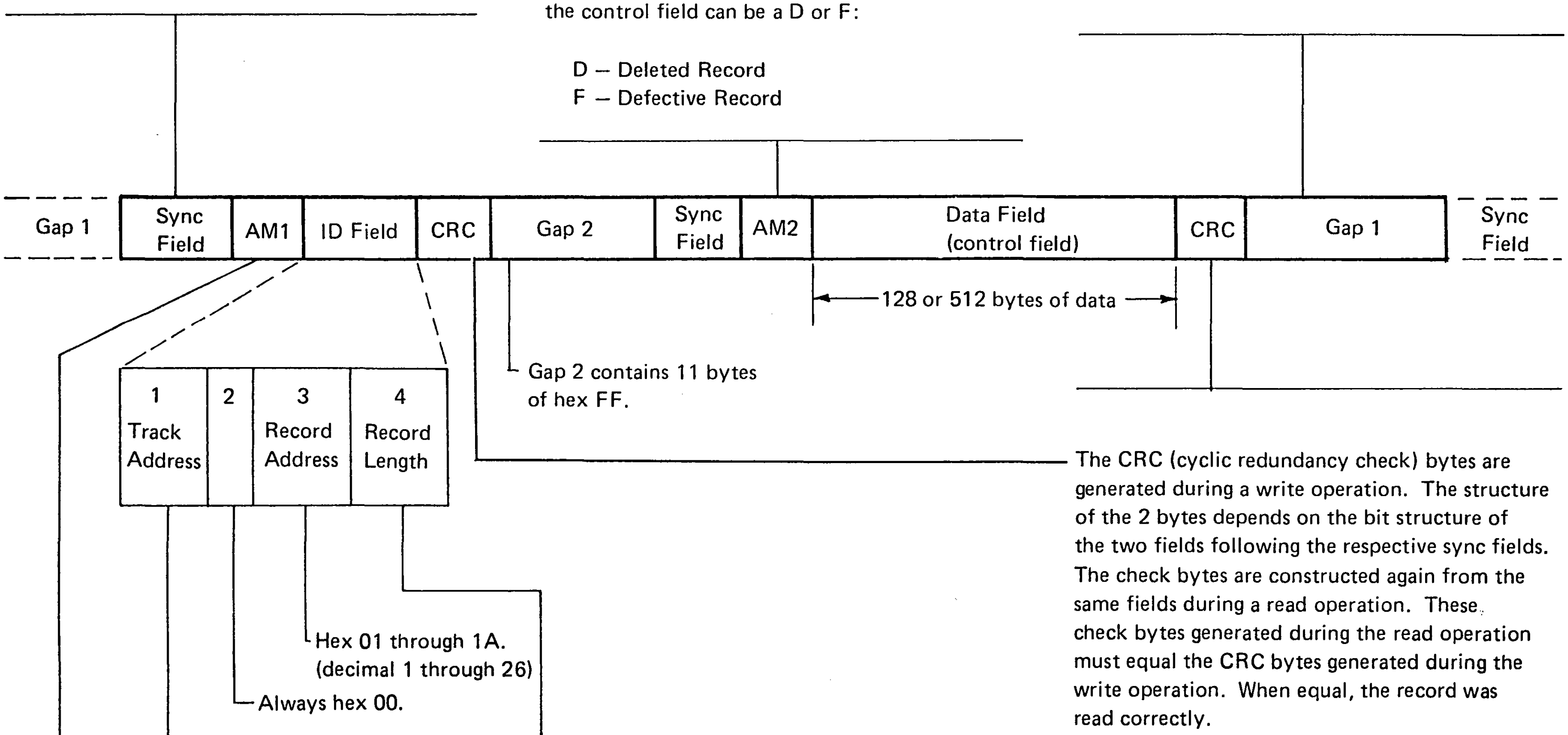
26 Sector Diskette

Each sync field contains 6 bytes of hex 00. This field synchronizes the attachment circuitry to the information being read from the diskette.

AM2 is either a hex FB or hex F8. Hex FB identifies the information that follows as a data field and hex F8 identifies the field that follows as a control field. The first byte of the control field can be a D or F:

D – Deleted Record
F – Defective Record

Gap 1 contains a variable number of 0's or 1's; the number depends on the diskette speed. The last gap before index contains hex 00; the rest of the gaps contain hex FF.



Gap 2 contains 11 bytes of hex FF.

The CRC (cyclic redundancy check) bytes are generated during a write operation. The structure of the 2 bytes depends on the bit structure of the two fields following the respective sync fields. The check bytes are constructed again from the same fields during a read operation. These check bytes generated during the read operation must equal the CRC bytes generated during the write operation. When equal, the record was read correctly.

Hex 01 through 1A. (decimal 1 through 26)

Always hex 00.

Hex 00 through 4A. (decimal 0 through 74)

AM1 is always hex FE and identifies the information that follows as the ID field.

N	Record Length
0	128
1	256
2	512
3	1024
4	2048
5	4096

3.1.3 Operating Sequences

Initialization

1. The drive motor turns continuously while the system power is up.
2. Insert the diskette and close the cover to engage the collet assembly B in the drive hub A and clamp the diskette in place. With the system power up, the diskette turns.
3. Index pulses G are read every 166.6 ms nominal when the diskette is up to speed.

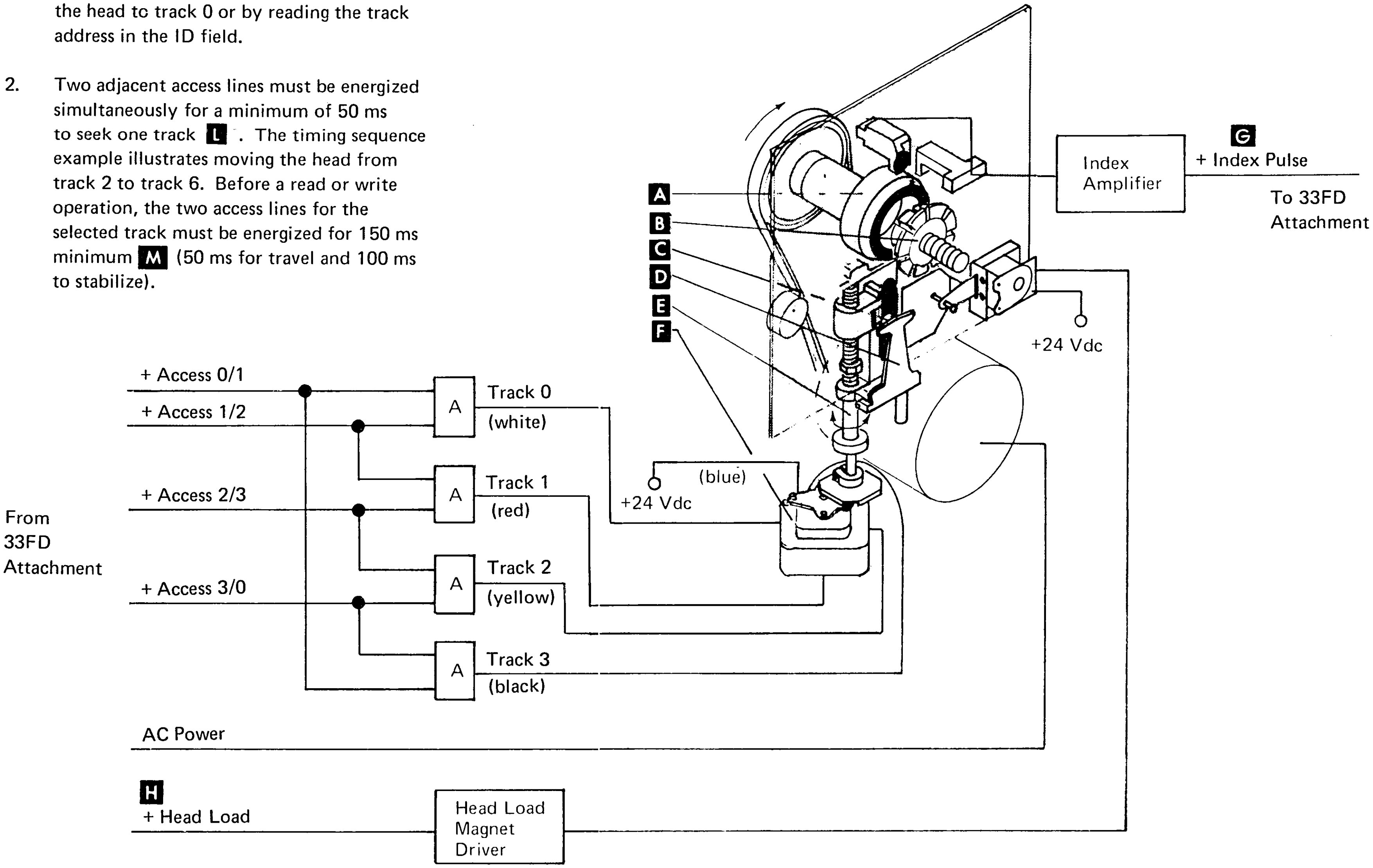
Seek

1. Head location is determined by returning the head to track 0 or by reading the track address in the ID field.
2. Two adjacent access lines must be energized simultaneously for a minimum of 50 ms to seek one track L. The timing sequence example illustrates moving the head from track 2 to track 6. Before a read or write operation, the two access lines for the selected track must be energized for 150 ms minimum M (50 ms for travel and 100 ms to stabilize).
3. For each access command, the stepper motor F rotates the leadscrew E 90 degrees clockwise or counterclockwise. This moves the read head one track position. (Clockwise rotation of the leadscrew, looking down on the unit, moves the carriage up.)

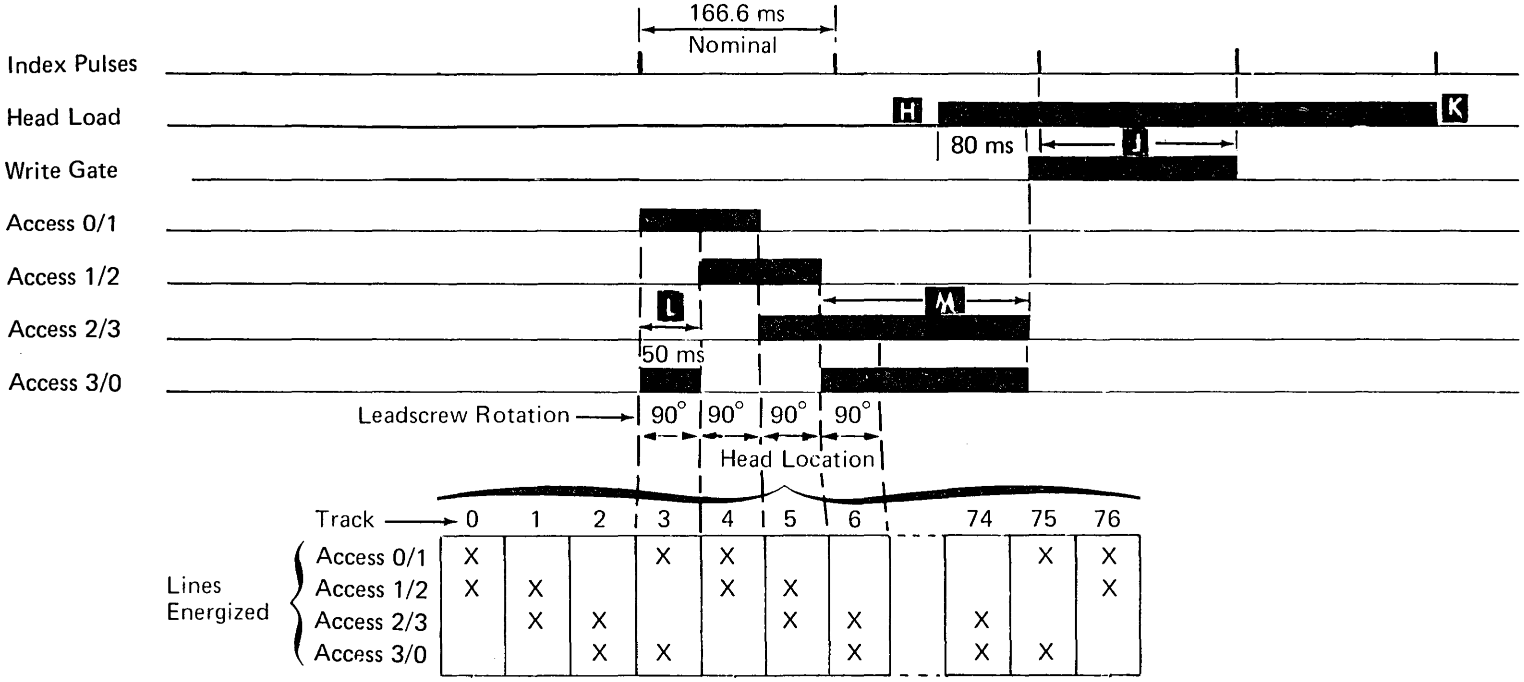
   An explanation of the stepper motor is in Appendix B-1.

Read or Write

1. The head load line H is activated before and during any read or write operation. This causes the pressure pad D to push the flexible diskette against the read/write head C. After 80 ms, data can be read or written J.
2. Reading or writing occurs.
3. The pressure pad is lifted as soon as possible after completion of the last read or write operation to reduce diskette and head wear.



Typical Timing Sequence



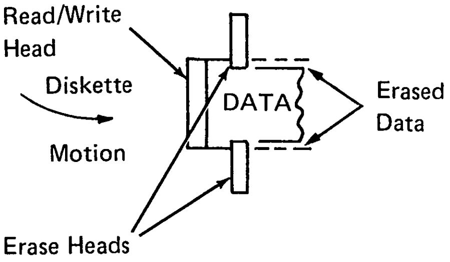
Track	0	1	2	3	4	5	6	74	75	76
Access 0/1	X			X	X				X	X
Access 1/2	X	X			X	X				X
Access 2/3		X	X			X	X	X		
Access 3/0			X	X			X	X	X	

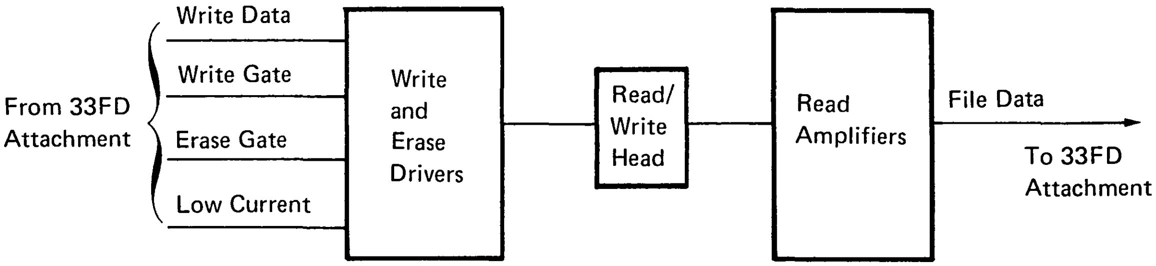
3.1.4 Read/Write Circuit Principles

Write gate activates the read/write head and degates the read circuits during a write operation.

When the write gate line is inactive, the write circuits are deconditioned and the read circuits are conditioned to read.

The erase gate line, active during a write operation, erases the edges of the data track, as shown in the following illustration. The edges are erased to prevent reading adjacent tracks during a read operation.





Low current line is under microprogram control and is active from logical track 42 through 76. When this line is active, the current through the write head is reduced.

3.2.0 MAINTENANCE

3.2.1 Machine Safety

The 33FD can be damaged by improper operation or servicing techniques. Caution notices throughout the section warn of hazard areas.

The 33FD contains plastic materials that could be damaged by a wide variety of chemicals; for example, IBM cleaning fluid.

To avoid damage to the leadscrew and carriage:

- Lubricate the leadscrew only with a light film IBM No. 6 oil when the head carriage is replaced.

To avoid damage to the head:

- Clean only with isopropyl alcohol and a clean cloth after removing the diskette (3.2.10).

3.2.2 Tools

CE Alignment Tool (P/N 2200698)

The CE alignment tool is used for the following:

- Alignment of the read head by adjusting the read head to track 0.
- Adjustment of the phototransistor assembly by mechanical alignment.

3.2.3 Head Cleaning Tools (3.2.10)

- Brush (P/N 2200106)
- Isopropyl alcohol (P/N 2200200)
- Cloth (P/N 2108930)

3.2.3.1 Pressure Pad Replacement Kit

- FBM 2200751

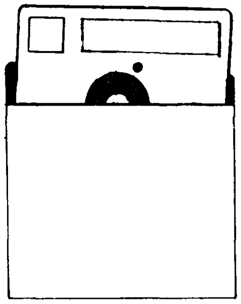
3.2.4 Diskette Care

Handling

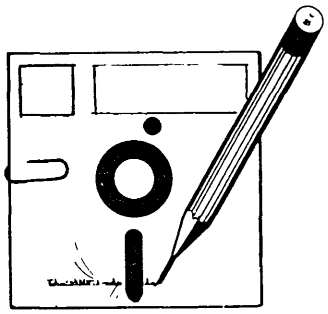
Damaged diskettes should not be inserted into the diskette drive. Diskettes that are physically damaged (torn, creased, warped) or contaminated with foreign materials (eraser dust, fingerprints, cleaning fluid, etc) might cause the diskette to lift from the head resulting in operation errors, equipment errors, or head damage.

Placing heavy objects on diskettes might damage the diskettes.

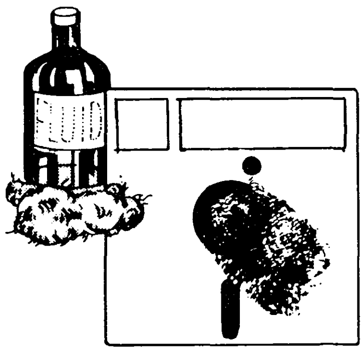
Return diskette to envelope whenever it is removed from the 33FD.



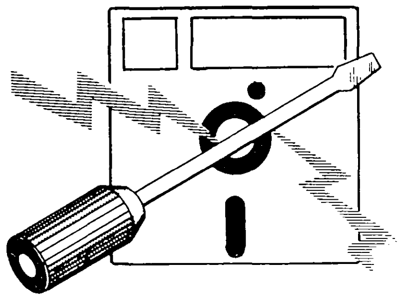
Do not use clips. Also, never write on the diskette with erasable pencil.



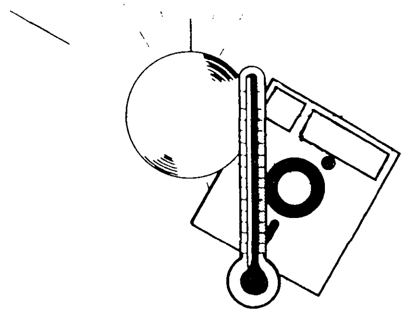
Do not touch or clean the diskette surface. Contaminated diskettes must be discarded.



Keep diskette away from magnetic fields and ferromagnetic materials that might be magnetized. Any diskette exposed to a magnetic field could lose information.



Do not expose diskette to excessive heat (125°F or 51.5°C) or direct sunlight.



Long Term Storage

Place diskettes in their envelopes and store in the following environment:

Temperature: 50° to 125°F (10.0° to 51.5°C)
Relative humidity: 8% to 80%
Maximum wet bulb: 85°F (29.4°C)

If a diskette was exposed to temperatures outside of the machine's environmental range, allow five minutes acclimation time before use. The diskette should be removed from its shipping container during this time, but should be kept in its envelope.

Shipping and Receiving

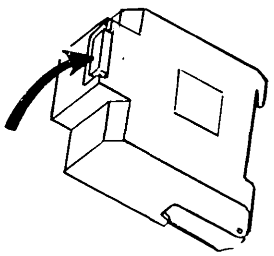
Ship diskettes inside the original shipping carton. An ordinary mailing envelope does not provide sufficient protection.

Be sure to label the package: DO NOT EXPOSE TO EXCESSIVE HEAT (125°F or 51.5°C) OR DIRECT SUNLIGHT.

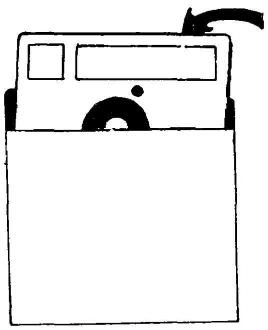
Upon receiving diskettes, check for carton and diskette damage. Save the carton for storing the diskette and for later shipment.

Inserting and Removing the Diskette

1. Open cover.

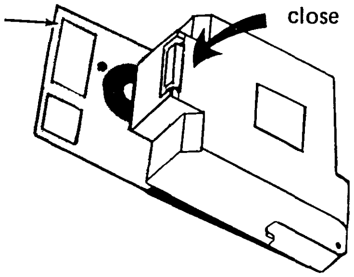


2. Remove diskette from the envelope. Grasp diskette by upper edge.



3. Slide the diskette squarely into the 33FD.

CAUTION
Do not insert damaged diskettes.



4. Close cover after diskette is fully inserted.
5. Place the empty envelope in a clean storage area.
6. To remove, reverse the above procedure.

3.2.5 33FD Diskette Drive

Removal and Replacement

The 33FD and its mounting frame should be removed from the machine when making adjustments, removals, and replacements.

1. Turn power off at the operator control panel.

2. Remove the ground strap **B** .

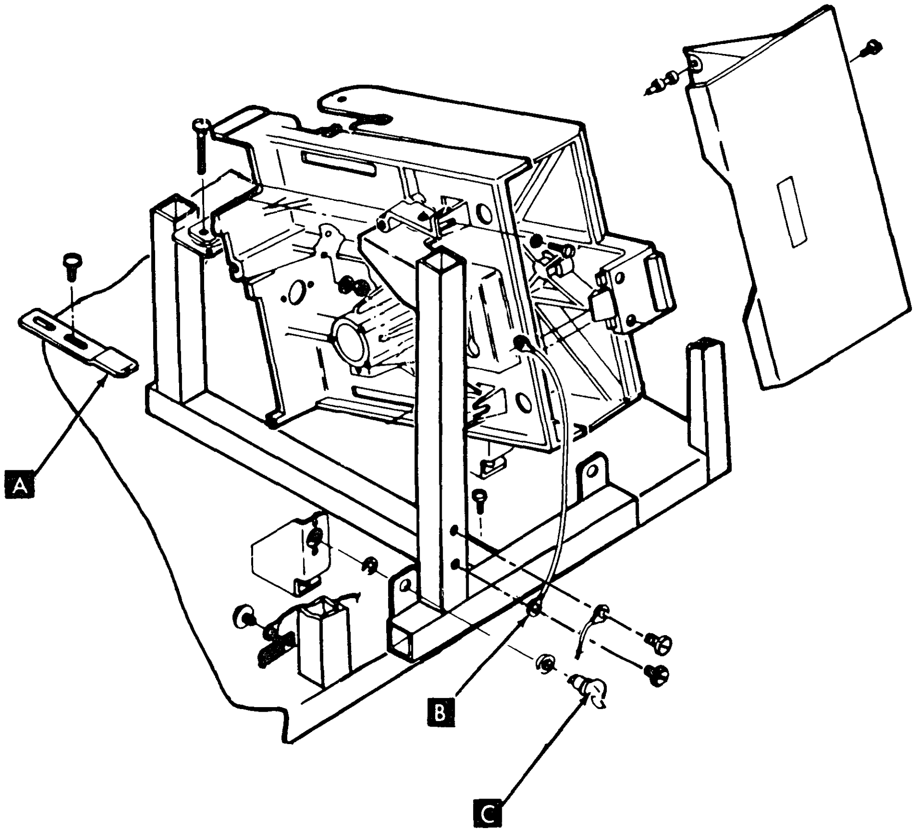
   DANGER
   Be aware of the screws protruding through the plate at the left side of the 33FD near the drive pulley.

3. Turn the locks **C** ; remove the 33FD and mounting frame from the machine.

4. Disconnect the cables if power is not required so unit can be moved to a convenient location.

   CAUTION
   Be sure cables are clear of the bracket **A** when replacing 33FD and mounting frame.

5. To replace, reverse the above procedure. Be sure the ground strap is reattached.



3.2.6 Latch Assembly

Removal and Replacement

1. Unlatch the 33FD and slide it forward on the base.
2. Loosen the top cover mounting screws A and remove the cover.
3. Remove the two latch mounting screws C .
4. Pull latch B out toward front of cover.
5. To replace, reverse the above procedure.

3.2.7 Collet

Removal and Replacement

1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Remove the covers (3.2.8).
4. Remove mounting screw and washer G .
5. Remove collet assembly E , spring, and washer D .
6. Remove collet F .
7. To replace, reverse above procedure.

3.2.8 Cover Assembly

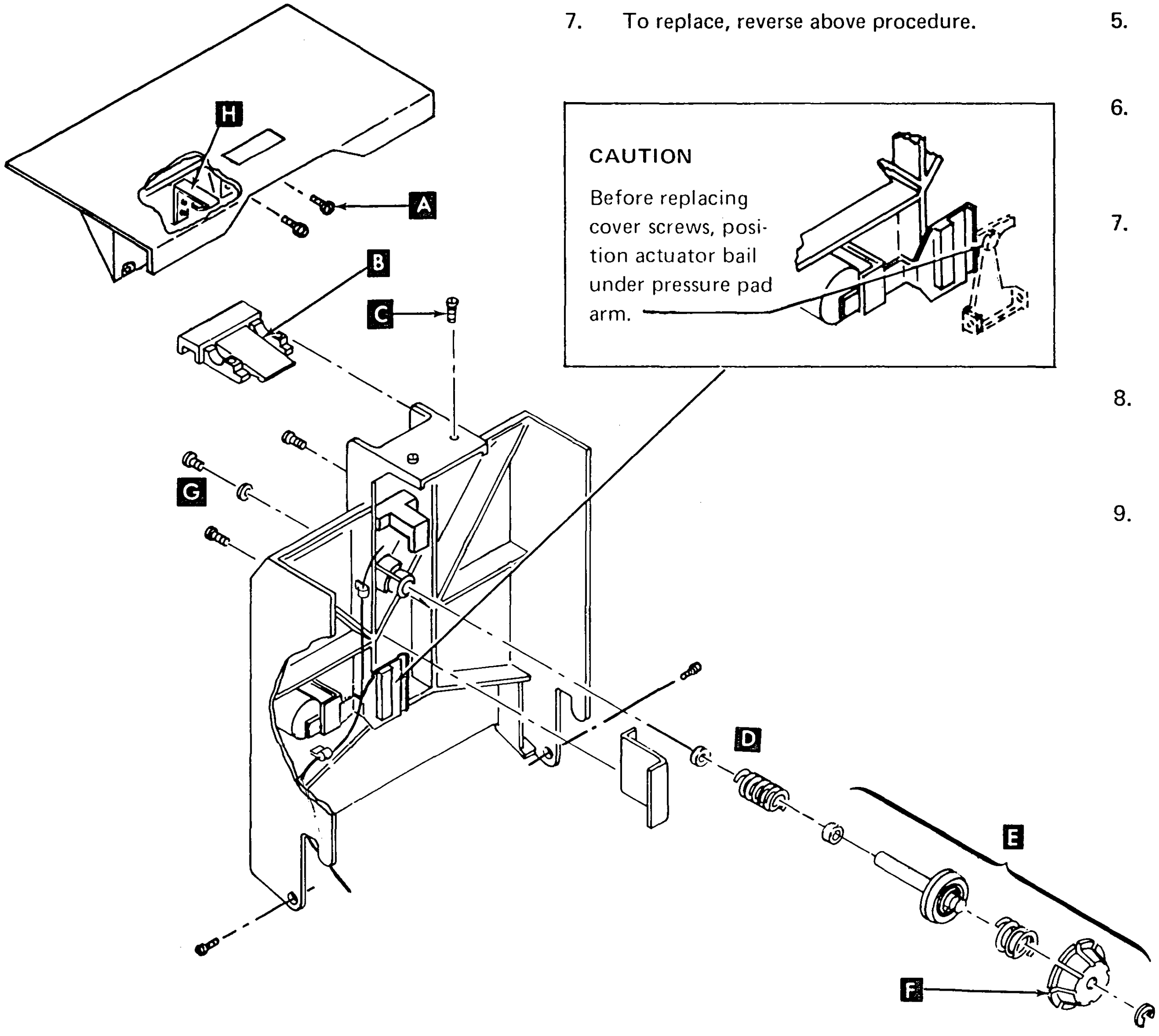
Removal and Replacement

CAUTION
Do not allow pressure pad arm to snap against the head.

1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Loosen top cover mounting screws A and remove top cover.
4. Remove two screws while holding side cover.
5. Remove cover carefully to avoid damage to wires.
6. Remove wires from LED and actuator. (Yellow wire goes to LED terminal marked Y.)
7. Remove wires from the clip on the cover.

   CAUTION
   Before replacing cover screws, position actuator bail under pressure pad arm.

8. Adjust the nudger H so that it lightly contacts the diskette when the diskette is fully inserted and the cover is closed.
9. To replace, reverse the above procedure.



CAUTION

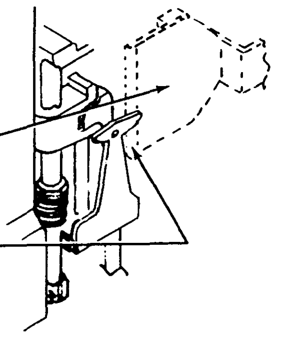
Before replacing cover screws, position actuator bail under pressure pad arm.

3.2.9 Pressure Pad Actuator

Removal and Replacement

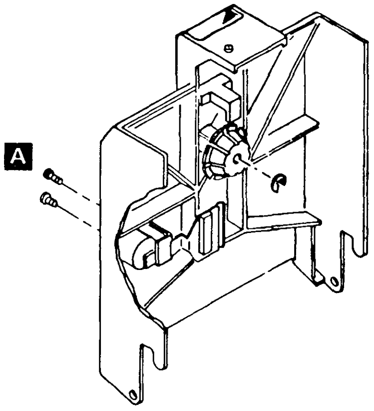
1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Remove the covers (3.2.8).
4. Remove two screws **A** .
5. Remove leads.
6. Replace actuator, leads, and cover, and do adjustment.

CAUTION
Before replacing cover screws, position actuator bail, located on cover, under pressure pad arm.

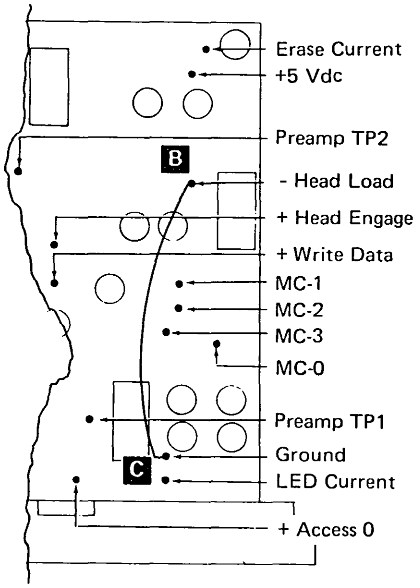


Adjustment

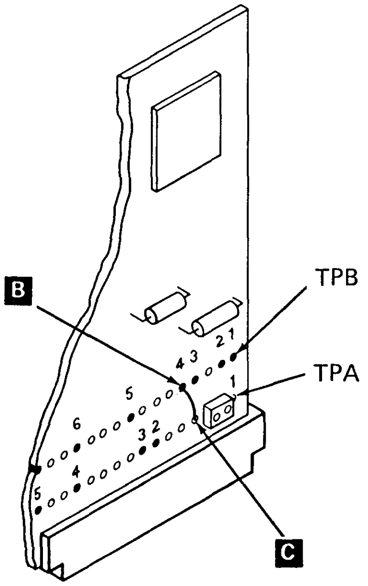
1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5); then turn the power on.
3. Insert a diskette.
4. Energize the head load coil by installing a jumper between the ground **C** and head load **B** test points on the file control card located on the 33FD.
   a. On the old style file control card (2 wide, 3 high), test points are located randomly on the component side of the card.
   b. On the new style file control card (2 wide, 2 high), test points are brought out to two rows of pins labeled TPA and TPB. For the location of other test points, see 3.2.24.
5. Adjust the screw **E** until the pressure pad arm and bail just touch **D** .
6. Rotate adjusting screw clockwise 1/2 to 3/4 turn and check for clearance between the arm and bail at all tracks **F** .
7. Install the 33FD in the machine.



Old Style File Control Card



New Style File Control Card



3.2.10 Head and Pressure Pad Cleaning

CAUTION
Use only the materials listed below to clean head and pressure pad.

1. Turn power off at the control operator panel.
2. Remove the 33FD from the machine (3.2.5).
3. With cover open, manually rotate the stepper motor wheel until the carriage assembly is at the upper limit stop. Remove the leadscrew dust cover (if installed) (3.2.10.1).
4. **CAUTION**
   Do not allow pressure pad arm to snap against the head.

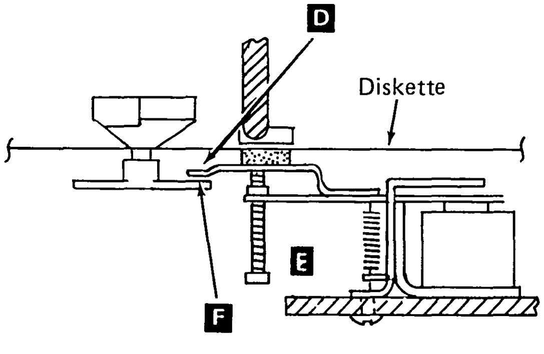
   Pivot the pressure pad arm away from the head and check pad for contamination. If contaminated, use dry brush (P/N 2200106) to remove caked deposits and to fluff pad.
5. **CAUTION**
   Fluid treated cloth should not contact the pressure pad.

   While holding the pressure pad arm out, clean polished head surface with isopropyl alcohol (P/N 2200200) applied to a clean cloth (P/N 2108930). Replace the leadscrew dust cover (if previously removed) (3.2.10.1).

3.2.10.1 Leadscrew Dust Cover (if installed)

Removal

1. Remove the file control card.
2. Remove the dust cover, retainer spring and wires.
3. Remove the dust cover.



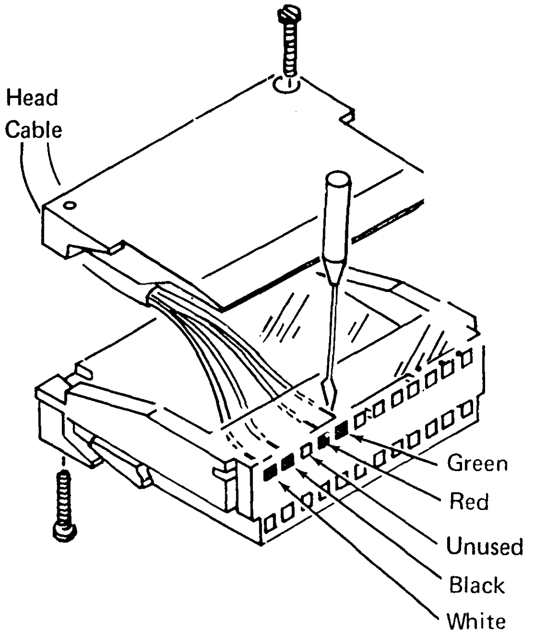
Replacement

1. Move the head to track 74 (uppermost position).
2. Place the head wires between the dust cover and the foam.
3. Replace the dust cover, spring, and wires.
4. Ensure that there is no tension on the head wires.
5. Replace the file control card.

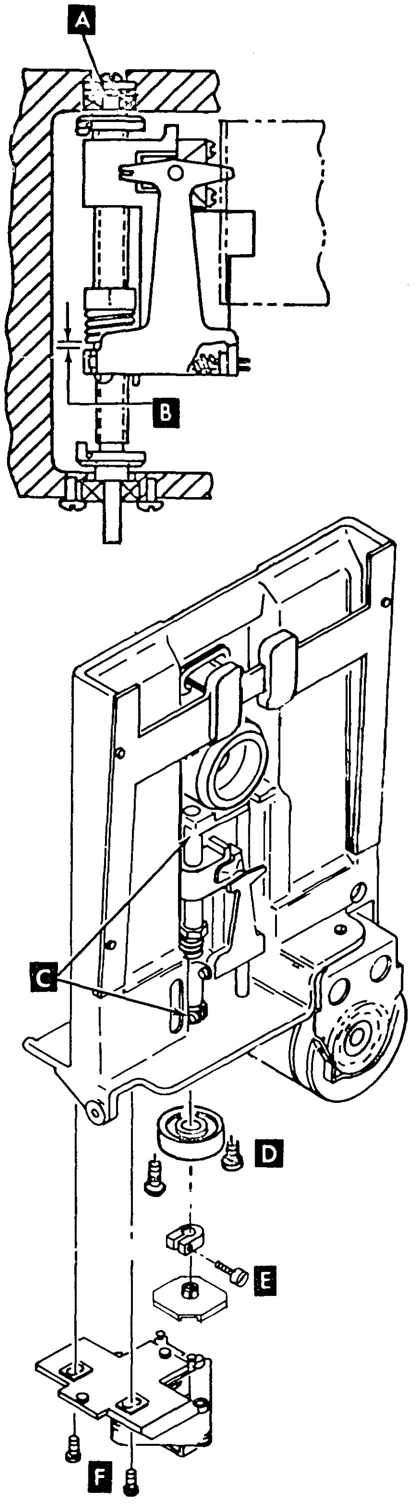
3.2.11 Leadscrew and Head Carriage Assembly

Removal

1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Note routing of the head cable.
4. Remove the leads from the connector by pushing down with small screwdriver as shown:



5. Center the head carriage on the leadscrew by turning the stepper motor wheel. Remove the leadscrew dust cover (if installed) (3.2.10.1).



6. Remover stepper motor **F** and leadscrew wheel **E** .
7. Remove covers (3.2.8).
8. Loosen clamping screws on upper and lower stops **C** .
9. Remove bottom bearing **D** .

   CAUTION
   Watch for preloaded spring **A** when removing the shaft.

10. Slide leadscrew assembly down until top clears baseplate, then slide assembly out.

    CAUTION
    Do not allow pressure pad arm to snap against the head.

11. Remove top bearing and both stops from leadscrew.

Replacement

Note: If the leadscrew and the head carriage are disassembled, replace by threading the leadscrew into the bottom portion of the head carriage assembly and into the carriage nut and spring. There should be approximately 0.020 inch (0.51 mm) gap **B** .

1. Center the head carriage assembly on the leadscrew and install upper and lower limit stops.
2. Replace top bearing and preloaded spring (concave side up).
3. Replace head carriage assembly into baseplate, bottom end first.
4. Replace bottom bearing and check for about 0.030 inch (0.76 mm) up and down movement of the leadscrew against the preloaded spring.
5. Replace leadscrew wheel, leadscrew wheel clamp, and stepper motor.

   Note: Route head cable as noted under removal.

6. Connect wires (see *Removal* for wire locations). Check that wire leads are properly seated and securely fastened in connector.
7. Do stepper motor adjustment (3.2.21) and read/write head adjustment (3.2.17).

8. Replace covers (3.2.8). Replace the leadscrew dust cover (if previously removed) (3.2.10.1)

9. Install the 33FD in the machine.

3.2.12 Drive Motor

Removal

1. Turn power off at the operator control panel.

2. Remove the 33FD from the machine (3.2.5).

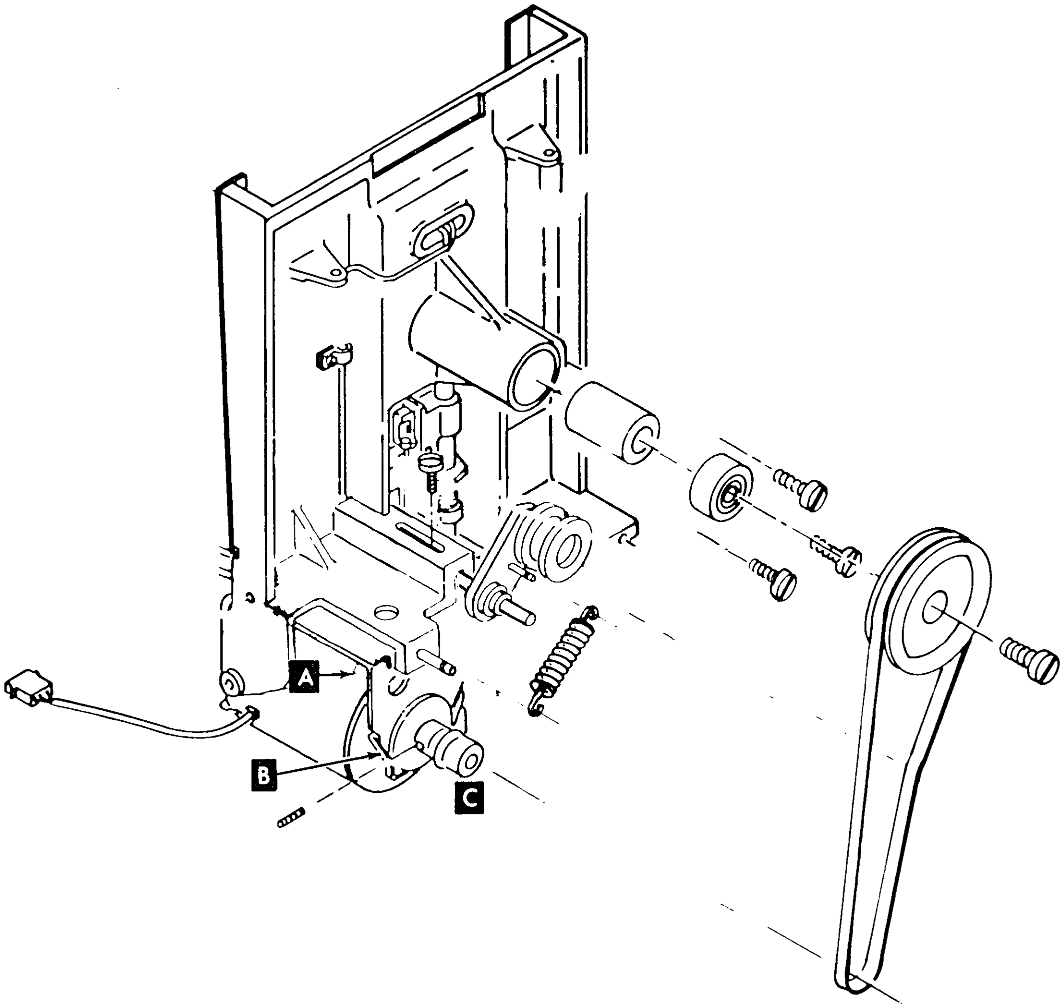
3. Remove the belt.

4. Remove the cable clamp on the back of the mounting frame.

> **DANGER**
> Motor case temperature might exceed safe handling limits.

5. Loosen two motor mounting clamps and remove the drive motor **B** .

6. Remove the drive pulley **C** .



Replacement

1. Replace the drive pulley. (Align setscrew with flat surface on shaft and tighten.)

> **DANGER**
> To prevent personal injury, position the two large holes in the motor frame so the holes are under the bracket **A** . The holes are large enough for a finger to go through.

2. Clamp motor to mounting bracket.

3. Replace the belt.

4. Connect cables to the 33FD.

5. Check belt tracking and adjust, if necessary (3.2.15).

6. Install the 33FD in the machine.

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3.2.13 Hub Assembly

Removal and Replacement

1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Remove covers (3.2.8).
4. Remove the drive belt.
5. Remove screw F and pulley.
6. Remove hub A .
7. Remove three bearing retaining screws, back bearing, and spacers C .
8. Remove three bearing retaining screws and bearing B .
9. To replace, reverse above procedure. Check belt tracking and adjust if necessary (3.2.15).

CAUTION
The front bearing B must be flush with the front surface of the baseplate. To do this, tighten front bearing retaining screws first. Seal on bearings should face outside.

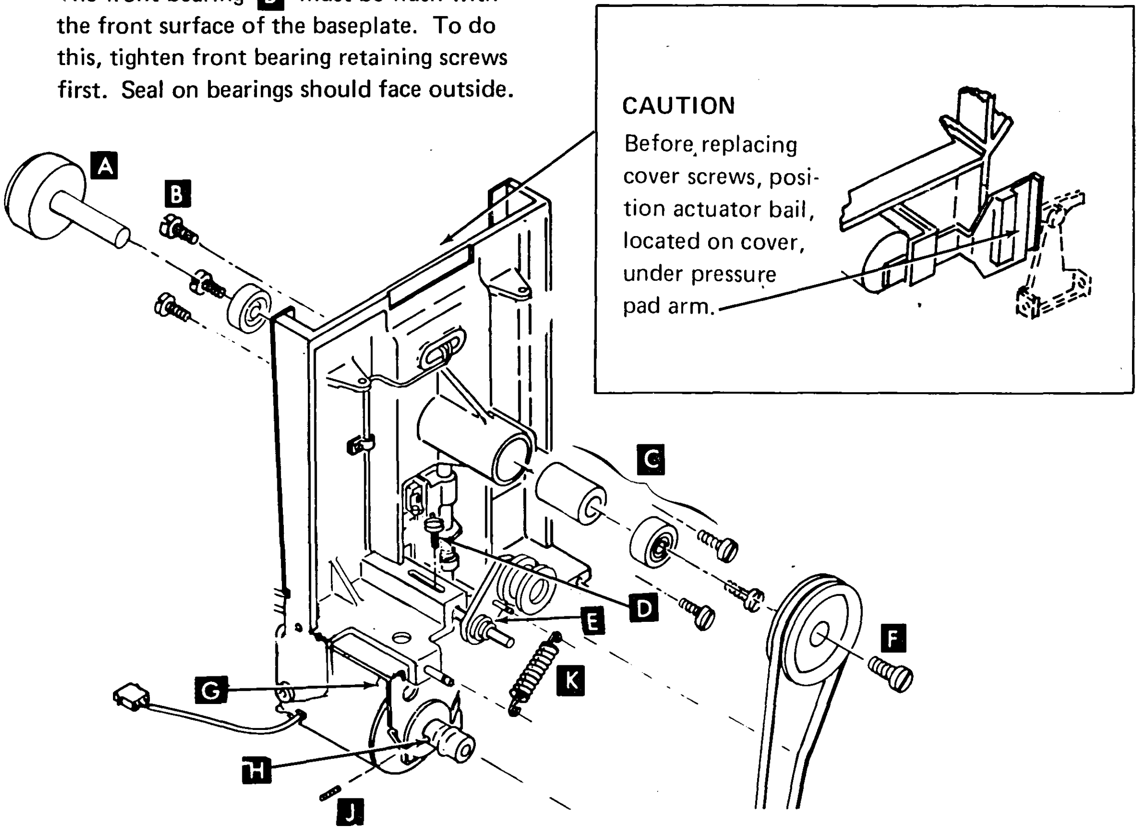
3.2.14 Drive Pulley

Removal

1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Remove the drive belt.
4. Loosen setscrew J and remove drive pulley H .

Replacement

1. Position the pulley on the shaft.
2. Align the setscrew with flat surface of the shaft and tighten.
3. Replace the belt.
4. Check belt tracking and adjust, if necessary (3.2.15).
5. Install the 33FD in the machine.



CAUTION
Before replacing cover screws, position actuator bail, located on cover, under pressure pad arm.

3.2.15 Belt Tracking

Belt must be riding in center of the drive pulley and hub pulley.

Adjustment

1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Deactivate the idler by removing the spring K .
4. Position the drive pulley so the belt rides on the center of the drive pulley and hub pulley.
5. Activate the idler and adjust so it does not change belt tracking. Loosen screw D and slide assembly in or out to adjust. Screw D must be tight to check tracking.
6. Install the 33FD in the machine.

3.2.16 Idler Assembly

Removal and Replacement

1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Remove belt and spring K .
4. Remove idler assembly E .
5. To replace idler assembly spring and belt, reverse above procedure and check belt tracking. Loosen screw D and slide assembly in or out to adjust. Screw D must be tight to check tracking.

3.2.17 Read/Write Head

To adjust the read/write head, you must obtain three simultaneous conditions:

- Correct clearance from head to CE tool.
- Correct relationship between the stepper motor wheel and leadscrew wheel.
- Correct clearance between the stepper motor and leadscrew wheels.

Adjustment

This adjustment procedure aligns the read/write head at track 00.

1. Turn power off at the operator control panel and remove the 33FD from the machine (3.2.5).

2. Remove covers (3.2.8). Remove the leadscrew dust cover (if installed) (3.2.10.1).

3. Rotate the stepper motor wheel until the head carriage is against the lower stop.

4. Loosen the mounting screw and move the phototransistor assembly **A** to the left.

   Note: If phototransistor assembly is not moved, the accuracy of the head adjustment might be affected.

5. Loosen the clamping screws on the lower limit stop **H** and leadscrew wheel **J** .

6. With the stepper motor wheel and leadscrew wheel oriented as in view **S** , insert 0.020 inch (0.508 mm) feeler gauge between the wheels as shown by **L** in view **S** . Slightly tighten screw **J** .

   Note: The purpose of this step is to provide maximum stepper motor wheel to leadscrew wheel pin penetration with no binds.

7. Locate the white dot label or the indentation on the outer circumference of the hub. If hub has both, always use white dot. Rotate hub to position this mark 180 degrees away from the read/write head.

   Note: This ensures that any hub eccentricity is located in the same spot and that all head adjustments use the same reference point.

8. CAUTION
   Avoid any contact of CE tool with highly polished surface of head.

   Install CE tool on hub **B** . Clamp into place with thumbscrew and rotate CE tool so it contacts surface **D** .

9. Rotate leadscrew by gripping upper limit stop **C** ; adjust for gap **E** . This gap is a number found on the front of the head assembly **F** . This number represents thousandths. Example: 3 equals 0.003 inch (0.076 mm). Adjust for a very light drag on a 0.003 inch (0.076 mm) gauge. A 0.002 inch (0.051 mm) gauge must be free.

   Note: Remove the feeler gauge from the pack to make this adjustment.

10. Make sure the stepper motor wheel and leadscrew wheel remain oriented as in **S** ; then securely tighten the leadscrew wheel clamping screw **J** . The top of the clamping collar should be approximately even with the top of the metal clamping surface of the leadscrew wheel.

    CAUTION
    If the clamping collar is not securely tightened, machine operation causes the head to go out of adjustment.

11. Recheck gap **E** setting.

12. Adjust the phototransistor **A** so that the raised edge is in contact with CE tool **B** , and tighten the mounting screw.

13. Remove CE tool and perform lower limit stop adjustment (3.2.19).

14. Rotate stepper motor wheel at least one full revolution and check for binds.

15. Do upper limit stop adjustment (3.2.20).

16. If a new leadscrew wheel was installed, the slot should be 25% to 40% full with IBM No. 23 grease.

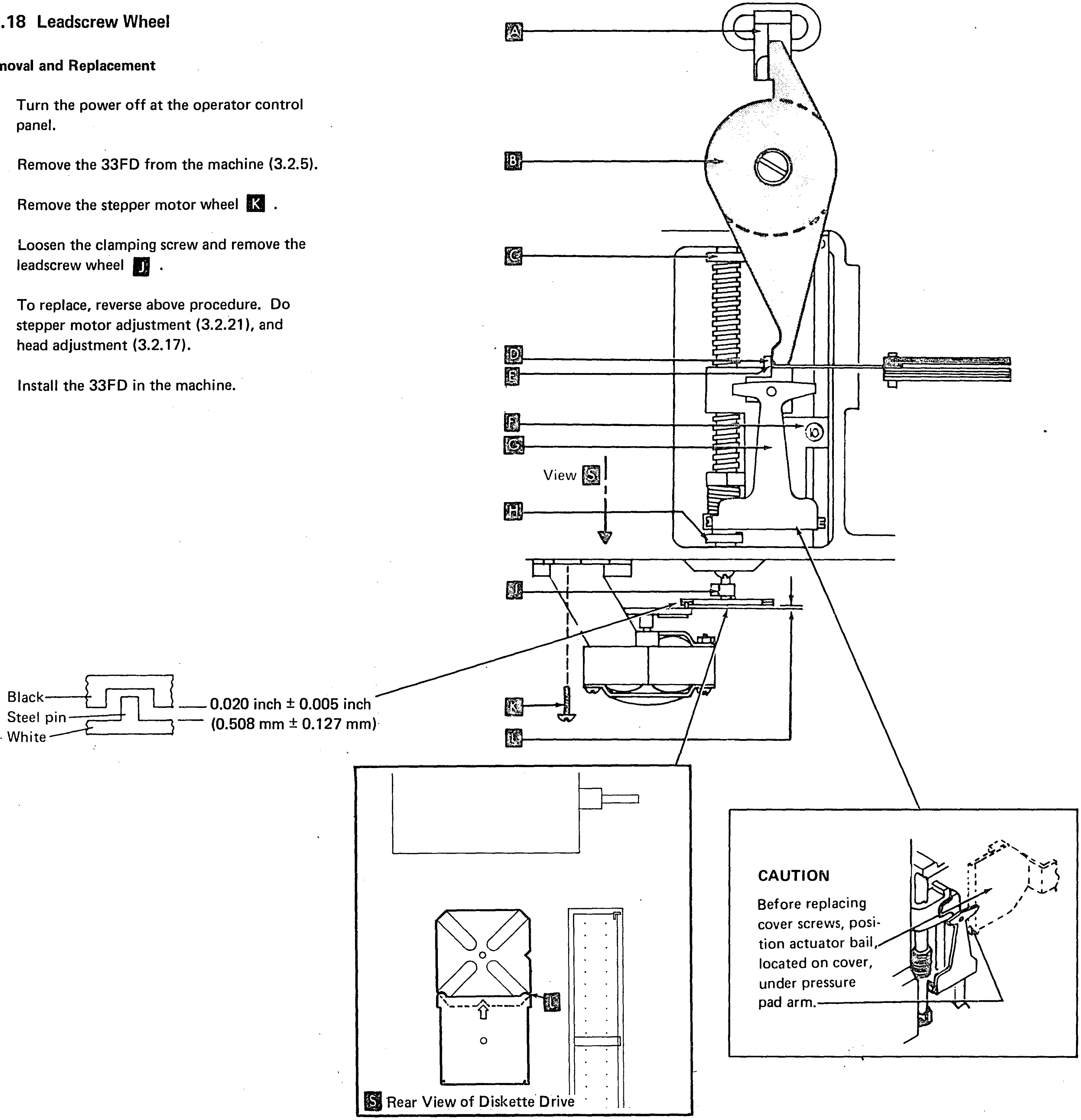
17. Replace covers. Replace the leadscrew dust cover (if previously removed) (3.2.10.1).

18. Install the 33FD in the machine (3.2.5).

3.2.18 Leadscrew Wheel

Removal and Replacement

1. Turn the power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Remove the stepper motor wheel **K** .
4. Loosen the clamping screw and remove the leadscrew wheel **J** .
5. To replace, reverse above procedure. Do stepper motor adjustment (3.2.21), and head adjustment (3.2.17).
6. Install the 33FD in the machine.



CAUTION

Before replacing cover screws, position actuator bail, located on cover, under pressure pad arm.

3.2.19 Lower Limit Stop

Adjustment

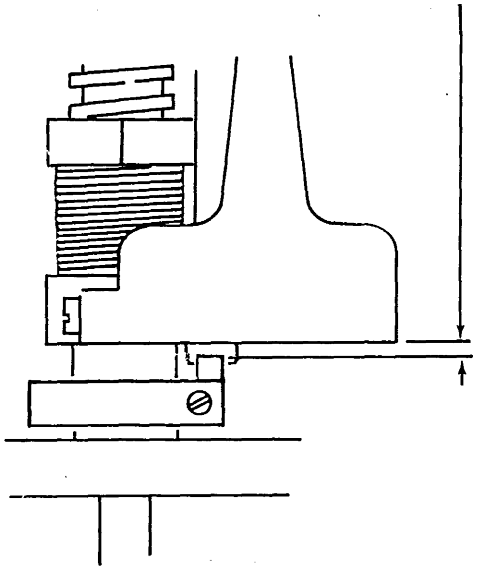
1. Turn power off at the operator control panel.

2. Remove the 33FD from the machine (3.2.5). Remove the leadscrew dust cover (if installed) (3.2.10.1).

3. Loosen clamp screw **C** . Make sure that the leadscrew is 80° to 90° below track 0 in a downward direction. Wheels must be in position shown **A** .

4. Position the limit stop so the projection on the lower limit stop is in front of and against the projection on the carriage.

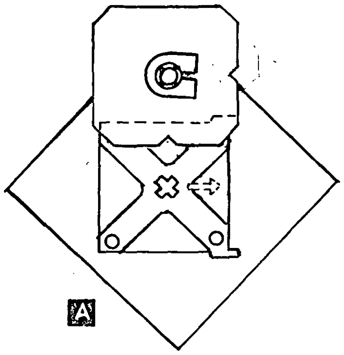
5. Adjust for 0.012 inch to 0.018 inch (0.3 mm to 0.46 mm) between top of projection on the lower limit stop and bottom of the carriage.

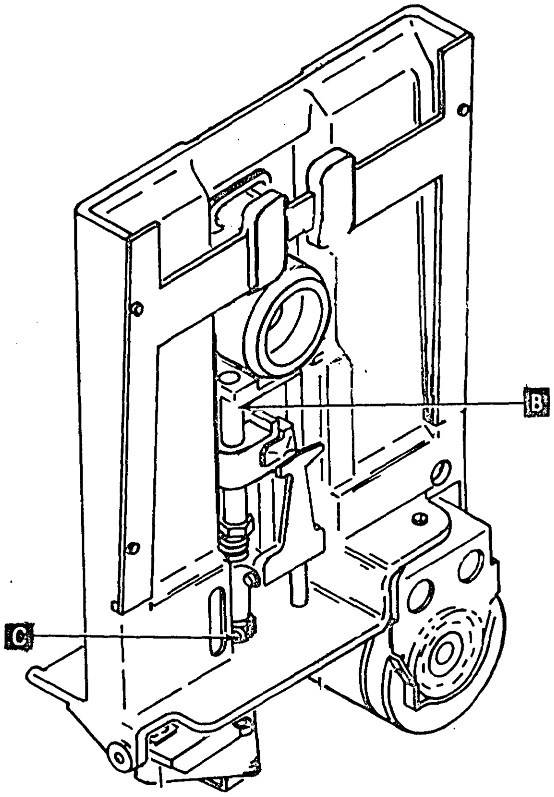


6. **CAUTION**
   Do not overtighten the screw.

   Tighten the screw. Replace the leadscrew dust cover (if previously removed) (3.2.10.1).

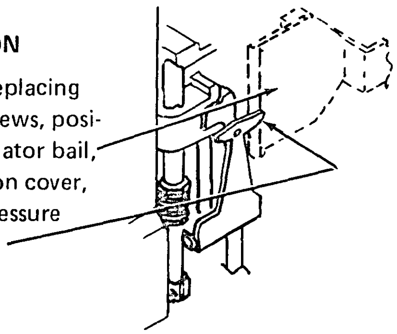
7. Install the 33FD in the machine (3.2.5).





CAUTION

Before replacing cover screws, position actuator bail, located on cover, under pressure pad arm.



3.2.20 Upper Limit Stop

Adjustment

1. Turn power off at the operator control panel.

2. Remove the 33FD from the machine (3.2.5). Remove the leadscrew dust cover (if installed) (3.2.10.1).

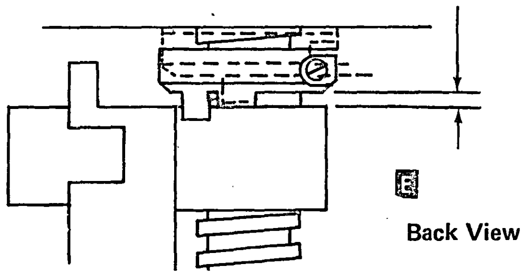
3. Loosen clamp screw and slide the stop **B** up as far as possible.

4. Starting at track 0, rotate the stepper motor wheel 19 complete revolutions to track 76. The wheels must be aligned as shown at **D** .

5. Position the upper limit stop so its projection is behind the head carriage assembly, and the clamping screw faces directly back as shown in **E** below.

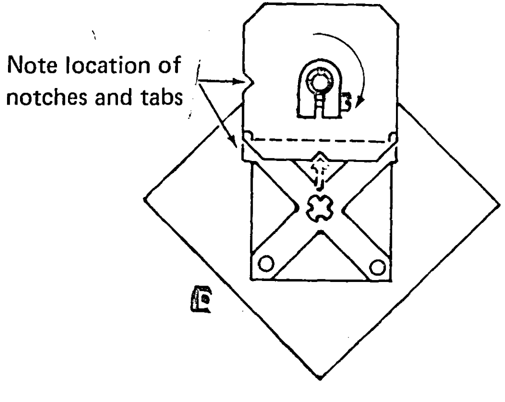
6. **CAUTION**
   Do not overtighten the screw.

   Tighten the clamping screw while maintaining 0.030 inch ± 0.005 inch (0.76 mm ± 0.13 mm) between upper limit stop and top of the head carriage assembly.



   Replace the leadscrew dust cover (if previously removed) (3.2.10.1).

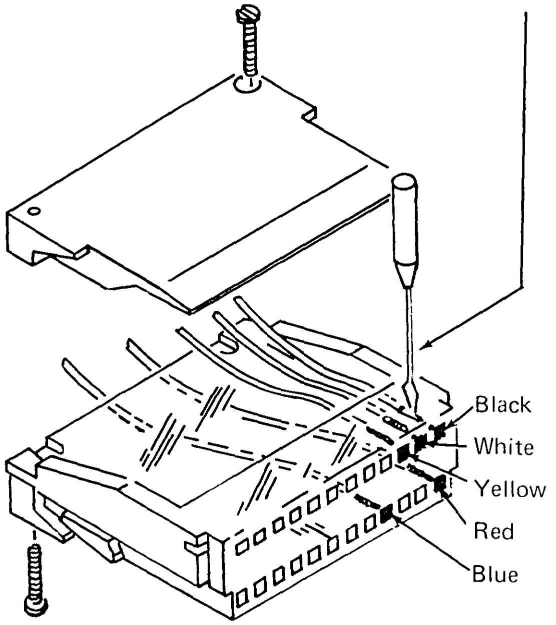
7. Install the 33FD in the machine (3.2.5).



3.2.21 Stepper Motor and Bracket

Removal and Replacement

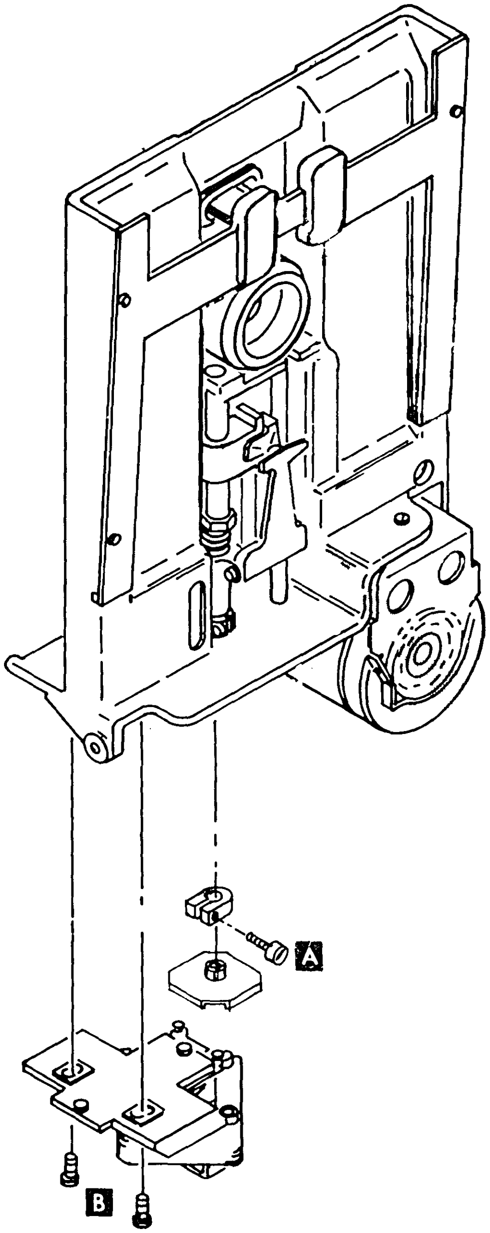
1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Remove the five leads from the connector.



4. Remove two screws **A**

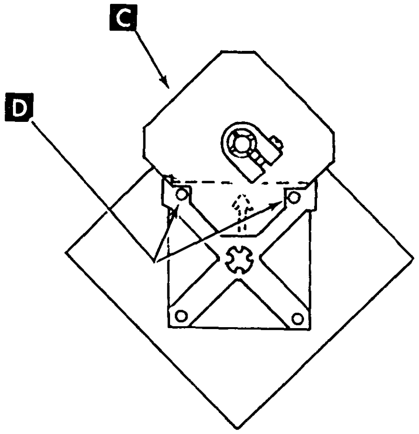
   CAUTION
   Make sure pins are in slots of the leadscrew wheel when replacing the stepper motor to avoid breaking parts.

5. To replace, reverse above procedure and do stepper motor adjustment.
6. Install the 33FD in the machine.

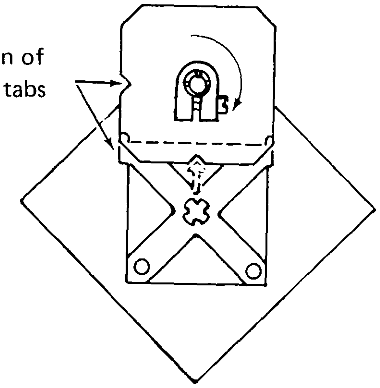


Adjustment

1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Loosen the two screws **B**.
4. Move stepper motor away from leadscrew.
5. Loosen clamping screw **A** and move leadscrew wheel up until it rotates freely.
6. Position wheel as shown in **C**.
7. Pull leadscrew wheel down until pins on stepper motor wheel fit into notches on the leadscrew wheel **D**.



8. Slide the stepper motor wheel toward the leadscrew until pins contact notches. No clearance is allowed.
9. Tighten the two stepper motor mounting screws **B**.
10. Move the leadscrew wheel up until it rotates freely.
11. Rotate the leadscrew wheel and slide it down on the drive pins in the position shown below.



Note location of notches and tabs

12. Do head adjustment (3.2.17).
13. Install the 33FD in the machine.

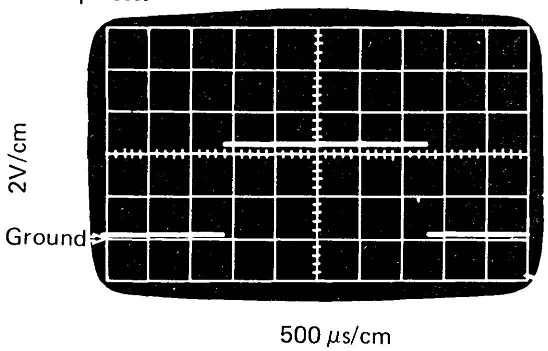
3.2.22 Phototransistor

Service Check

1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine and disconnect the drive motor plug (3.2.5).
3. Attach the positive probe of VOM (15 Vdc scale) to the +5 Vdc test point and the negative probe to the phototransistor current test point on the file control card located on the 33FD (facing page).
4. Insert a diskette, close the cover, and turn the power on.

   Note: Always perform the following procedure with the diskette loaded; otherwise, surrounding light causes an improper reading on the VOM.
5. With head unloaded, rotate the hub until the index hole switches the phototransistor on or off. (When the phototransistor is aligned with the index hole, the VOM reads approximately +5.0 Vdc; when it is not aligned, the VOM reads approximately 0.0 Vdc).

   The shift will be from approximately +5.0 Vdc to approximately 0.0 Vdc. However, a minimum shift of 0.5 Vdc (from +5.0 Vdc to +4.5 Vdc) will switch the circuit.
6. Connect the drive motor plug.
7. If scope is available, connect probe to '+Index' (see card probe points on facing page). Check for an index pulse width of 1.7 to 8.0 ms. Check for approximately 160 ms between index pulses.



7. Turn the power off, check that cables are connected; then install the 33FD in the machine.

Adjustment

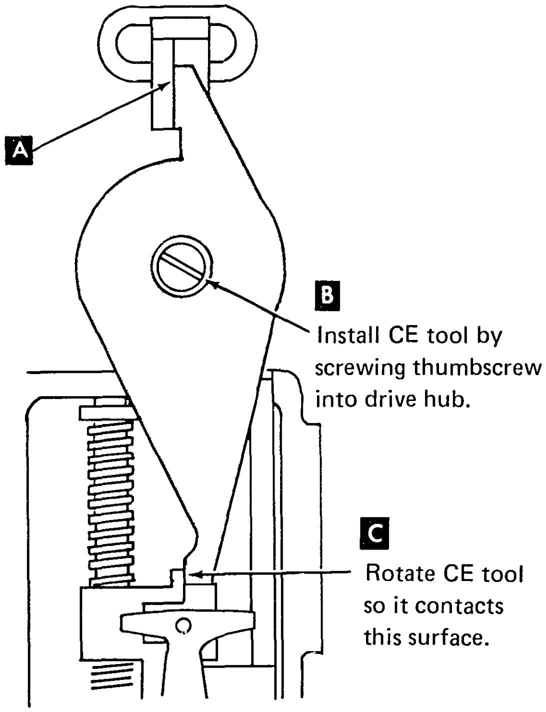
1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Access to track 0.
4. Remove the covers (3.2.8).
5. Loosen the mounting screw **E** , and move the phototransistor to the left.
6. Install CE tool **D** by screwing the thumbscrew into the drive hub **B** . Rotate tool until it contacts surface **C** .
7. Adjust phototransistor so that raised edge is in contact with the CE tool **A** .
8. Tighten the mounting screw.
9. Remove CE tool.
10. Replace covers (3.2.8).
11. Install the 33FD in the machine.

Removal

1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Access to track 0.
4. Remove covers, if necessary (3.2.8).
5. Remove mounting screw **E** .
6. Remove leads.

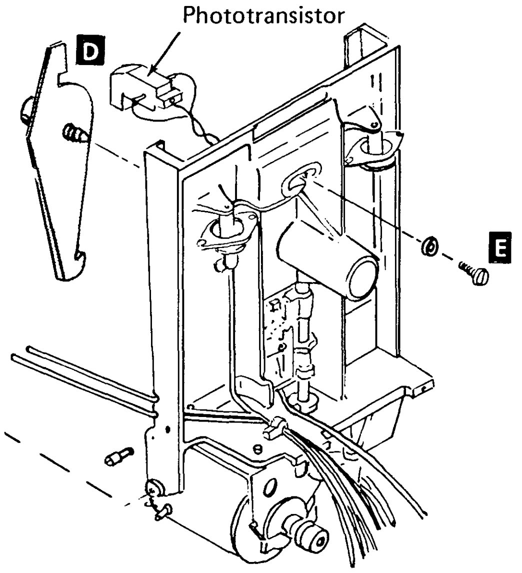
Replacement

1. Replace leads. (Yellow wire goes to terminal marked Y.)
2. Replace mounting screw, but do not tighten.
3. Complete replacement by doing adjustment starting at step 4.



Install CE tool by screwing thumbscrew into drive hub.

Rotate CE tool so it contacts this surface.



3.2.23 Light Emitting Diode (LED)

Service Check

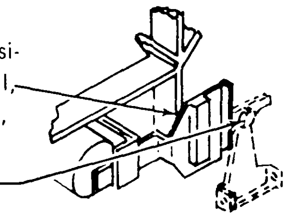
1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Turn the power on.
4. Attach the positive probe of VOM to the LED current test point and the negative probe to the ground test point on the file control card located on the 33FD. Voltage should measure +1.0 Vdc to +1.6 Vdc.
5. Turn the power off and install the 33FD in the machine.

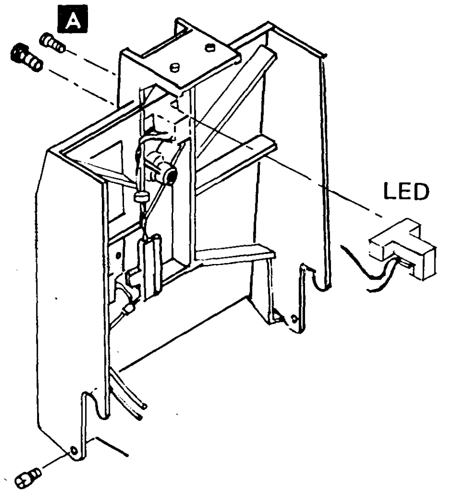
Removal and Replacement

1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Remove covers (3.2.8).
4. Remove two mounting screws **A** .
5. Remove leads. (Yellow wire goes to terminal marked Y.)
6. To replace, reverse above procedure.

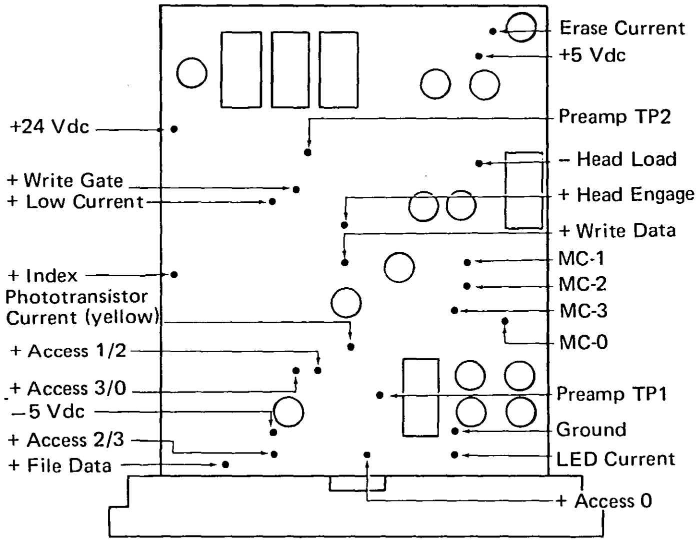
CAUTION

Before replacing cover screws, position actuator bail, located on cover, under pressure pad arm.

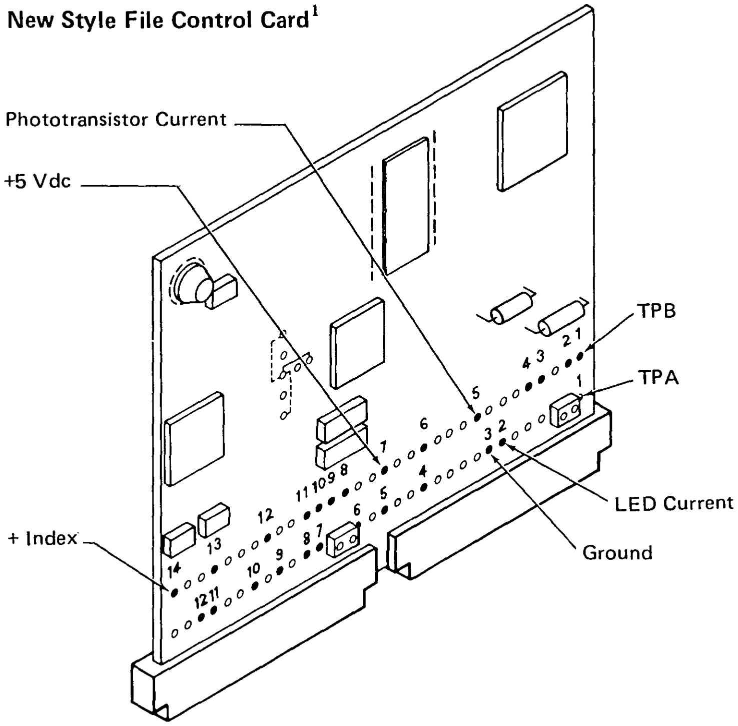




Old Style File Control Card[1]



New Style File Control Card[1]



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[1] On the old style file control card (2 wide, 3 high), test points are located randomly on the component side of the card. On the new style file control card (2 wide, 2 high), test points are brought out to two rows of pins labeled TPA and TPB. For the location of other test points, see 3.2.24.

3.2.24 File Control Card

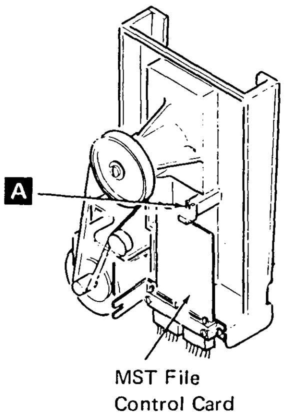
Removal and Replacement

1. Turn power off at the operator control panel.
2. Remove the 33FD from the machine (3.2.5).
3. Loosen screw **A** and turn bracket 90°. Tighten screw.
4. Remove the file control card.
5. To replace, reverse above procedure. Be sure card is properly seated in socket and retaining bracket.

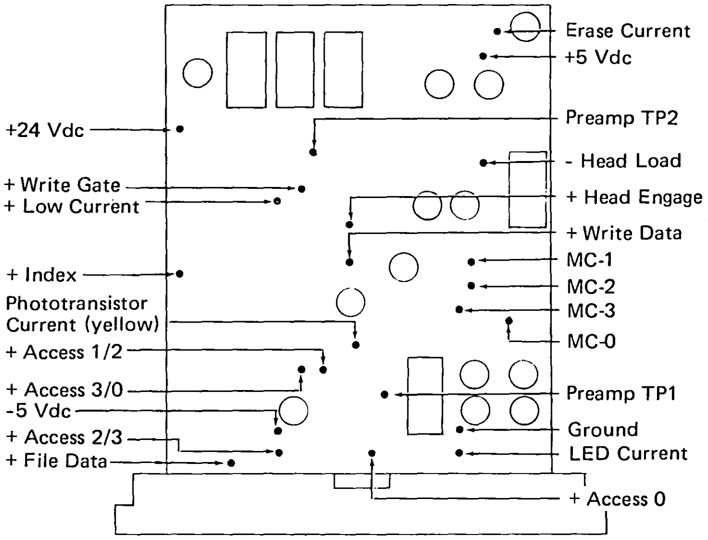
Test Points

On the old style file control card (2 wide, 3 high), test points are located randomly on the component side of the card. On the new style file control card (2 wide, 2 high), test points are brought out to two rows of pins labeled TPA and TPB.

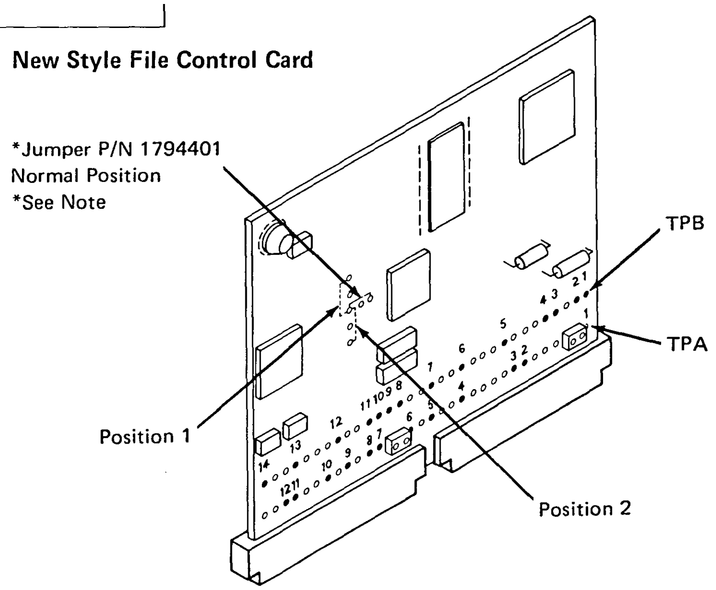
Only the major components are shown as an aid in locating pins.



Old Style File Control Card



New Style File Control Card



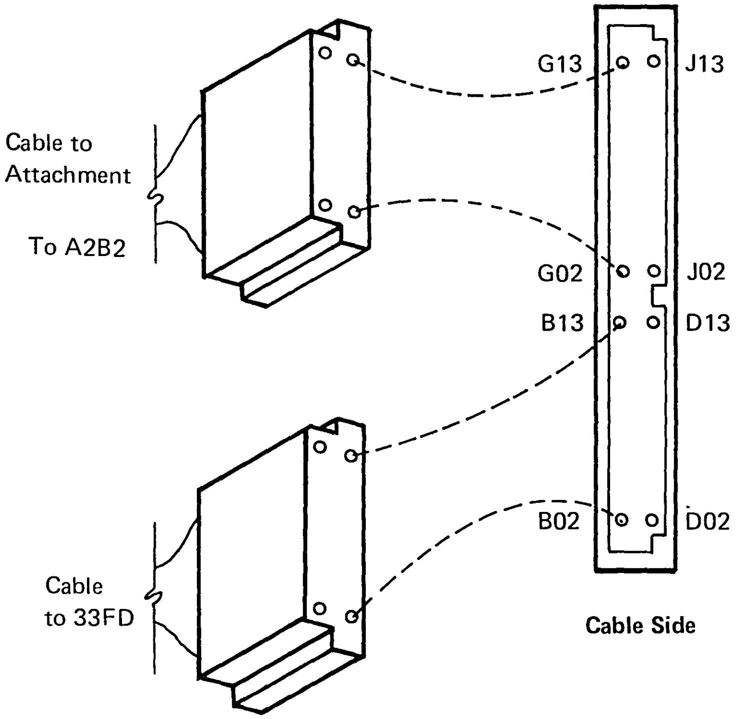
Note: If a problem is experienced with multiple index due to shine-through, the threshold level of the index amplifier can be increased by paralleling input resistance. Position 1 will increase the threshold by a factor of 5; position 2 will increase the threshold by a factor of 25. The threshold level should not be raised more than is necessary to ensure proper operation.

File Card Pin Assignment

Name	Color	Pin	New Style File Card Test Pin
Stepper Motor MC-0 (track 0)	White	B03	TPB2
Stepper Motor MC-1 (track 1)	Red	D02	TPA1
Stepper Motor MC-2 (track 2)	Yellow	B04	TPB3
Stepper Motor MC-3 (track 3)	Black	B02	TPB1
Stepper Common +24 Vdc	Blue	D05	TPA11
Head Magnet +24 Vdc	Yellow	D04	TPA11
– Head Load	Black	B05	TPB4
LED Return	Black	D06	
LED Current	Yellow	D07	TPA2
Phototransistor Return	Black	D09	
Phototransistor Current	Yellow	B08	TPB5
Head Input	Black	B12	
Head Input	White	B13	
Erase Current	Red	B10	
Head Ground and Shield	Green	B09	
Preamp TP1		D12	TPA4
Preamp TP2		D13	TPA5
Ground	Black	D08	TPA3/TPA10
+ Access 0/1		G02	TPB8
+ Access 1/2		G03	TPB9
+ Access 2/3		G04	TPB10
+ Access 3/4		G05	TPB11
+ Raw Read Data		G07	TPB12
+ Head Engage		G10	TPB13
+ Write Data		J02	TPA6
+ Erase Gate		J04	TPA7
+ Write Gate		J05	TPA8
+ Low Current		J06	TPA9
+ Index		G13	TPB14
+24 Vdc		J10	TPA11
+18 Vdc			TPB6
+5 Vdc		J03	TPB7
–5 Vdc		J11	TPA12
Ground		J08	TPA10/TPA3

File Control Card Socket Pins

The file control card is mounted upside down from the normal way of mounting cards. Therefore, the pin numbering starts at the bottom of the socket. The pin numbers, as seen from the cable side, are shown in the following illustration:



Cable Side

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4.0.0 Belt Printer

4.1.0 THEORY

The standard printer uses an endless steel belt with four identical 48-character type sets (standard). The type belt is interchangeable by the customer. However, changing the type belt requires a corresponding change in the print image in main storage to match the character set on the belt.

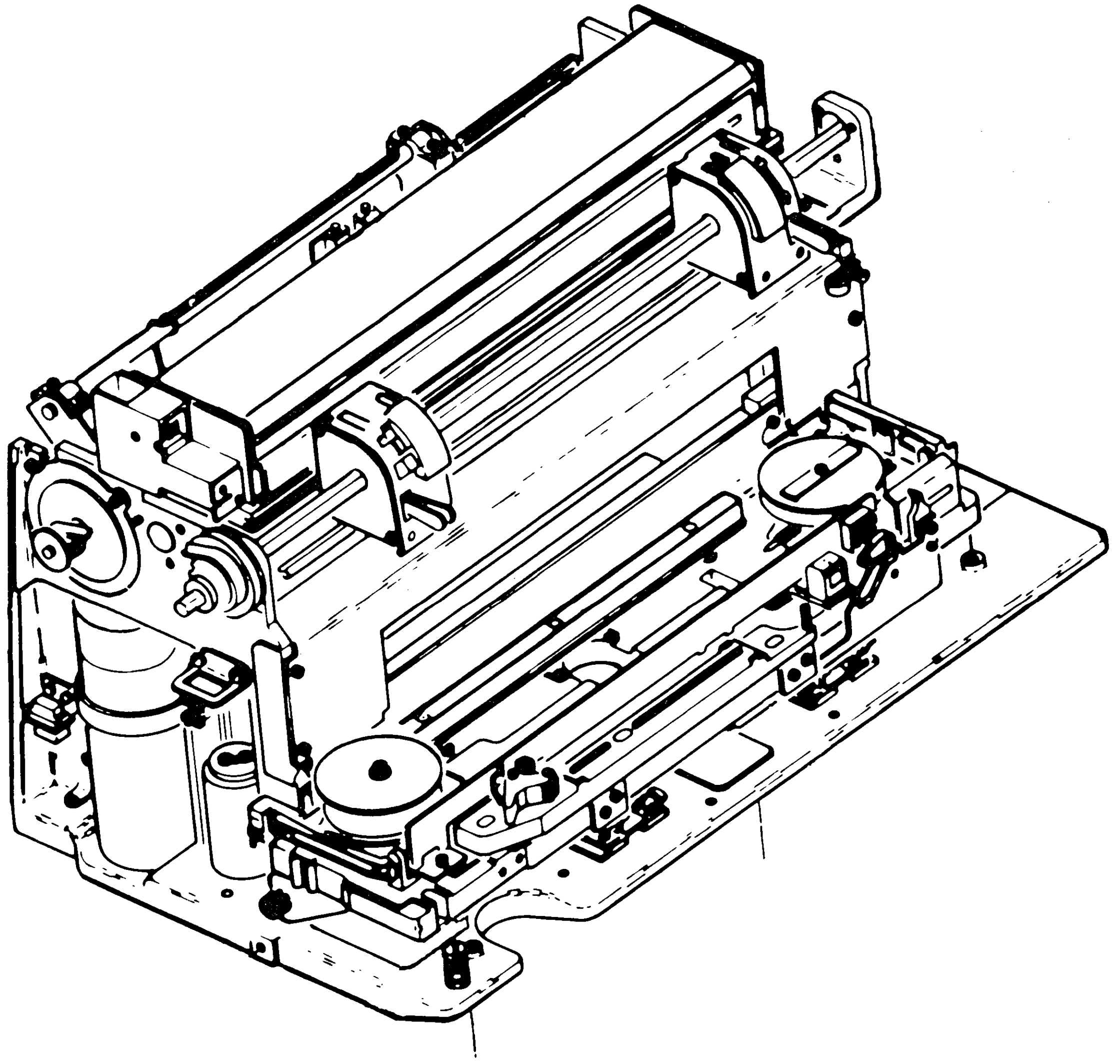
The pinfeed carriage allows the use of continuous forms of varying widths and up to six parts thick.

Note: To interchange forms between the serial printer and the belt printer, the maximum distance from the center line of the left margin holes to the center line of print position 1 must be 0.5 inch (12.7 mm) for correct print alignment. See *Form Design Reference Guide for Printers,* GA24-3488.

The printer also has the following:

132 print positions
Interchangeable 48-character, 64-character, or 96-character set type belts
50, 100, 155, or 285 lines per minute nominal printing speed
Six lines per vertical inch
Single and multiple line spacing
Vertical forms control (VFC)
Forms jam detect

The 50-, 100-, and 155-lines-per-minute printers share common theory and maintenance information. However, due to extensive electrical and mechanical differences in the 285-lines-per-minute printer, a separate subsection has been written for its theory and maintenance. This subsection begins at paragraph 4.5.1.



4.1.1 Principles of Printing (50, 100, and 155 lpm)

The belt printer has 66 hammers, one hammer for each two print positions. Therefore, to print one line of 132 positions, each hammer is fired twice. The print operation is separated into these functions:

- *Subscan.* A subscan is the time required to option every tenth print position to every fourth belt position. Five subscans make one print scan.
- *Print scan.* A print scan is the time required to option one character to all odd print positions or all even print positions.
- *Print line.* A print line is 48 odd print scans and 48 even print scans for a 48-character set[1] (standard). That is, every character on the set is optioned to every print position.

Each print position can print only one character per print line (when the print position is optioned and the character specified for that position is equal to the character aligned at that position). See page 4-4.

During a subscan, the hammers selected for firing are buffered in the attachment, and they are gang-fired at the start of the next subscan. Odd or even print scans are stopped early if all optioned hammers are fired.

To synchronize the type belt to the attachment, two types of pulses are required—a home pulse and the subscan pulses.

The home pulse is generated from the type belt by the transducer **A** sensing the missing timing mark **B** that identifies the home position. The home pulse occurs one subscan before the first character of each character set is aligned to print in position 1. Sensing the first home pulse initiates a continuing check of the synchronism of the home pulse with the belt position counter.

The subscan pulses are generated by the transducer detecting the raised timing marks on the type belt. Two subscan pulses are developed from each timing mark.

Because the printer has a continuously moving type belt, the attachment must determine when to fire a hammer to print the specified character. Using the illustration **C** as a reference, observe the relationship between the moving type belt and the hammer positions. This shows the character A aligned with hammer 1 in print position 1.

Print optioning can start when a character is aligned with print position 1. The belt position counter keeps track of what character is aligned to print in print position 1. This value is set into the scan register at the beginning of each print scan. During the first hammer option cycle, the character specified for position 1 is compared to the character aligned at position 1. During this first subscan, every tenth position (1, 11, 21, 31, 41, etc) is compared with its respectively aligned character (every fourth belt character). If the character specified and the character aligned compare equal, the hammer is fired at the beginning of the next subscan. This sequence, starting at print position 1, is called subscan 1.

At the end of subscan 1, the type belt movement aligns the character B with print position 3 and hammer 2, as shown in the illustration **D** . Print optioning now continues with print position 3 and proceeds through every tenth print position until the character aligned with print position 123 is optioned. This sequence, starting with print position 3, is called subscan 2.

Belt movement has now aligned the character C with print position 5, as shown in the illustration **E** . Print optioning continues for every tenth position until the character aligned with print position 125 is optioned. This sequence, starting with print position 5, is called subscan 3.

Subscans 4 and 5 follow the same pattern (illustration **F** and **G**). Subscan 4 starts optioning with print position 7 and every tenth position through print position 127. Subscan 5 starts optioning with print position 9 and every tenth position through print position 129. These five subscans make the first odd print scan.

During this first odd print scan, each of the odd print positions was optioned to print one character, but only those hammers are fired that had the aligned character compare equal with the specified character.

The first print scan started with the character A aligned at print position 1. Now, the character B is aligned with print position 1 to start the second print scan.

After the second five subscans, all odd positions are now optioned to print a second character. To option the 46 remaining characters to each odd print position, 46 more odd print scans are taken.

Hammers are fired for the optioned print positions that compare equal on each succeeding subscan. To reduce the hammer power requirements, only five hammers are allowed to fire on one subscan. If more than five optioned print positions compare equal, optioning starts again with 48 new print scans. Scanning starts again at print position 1 and positions not printed are optioned again.

After the 48 odd print scans, there is a delay (18 dummy subscans) to allow the hammers to fire and settle. Then the even positions are scanned starting with the first character in print position 2 and every tenth position through print position 132 on subscan 1. Subscan 2 starts with print position 4 and every tenth position through print position 124. Subscan 3 starts with print position 6 and every tenth postion through print position 126; subscan 4 starts with print position 8 and every tenth position through print position 128; subscan 5 starts with print position 10 and every tenth postion through print position 130. This sequence continues through 48 even print scans to option every character on the type belt to every even print position. An additional print scan (49) is taken to fire hammers selected during subscan 5 of print scan 48.

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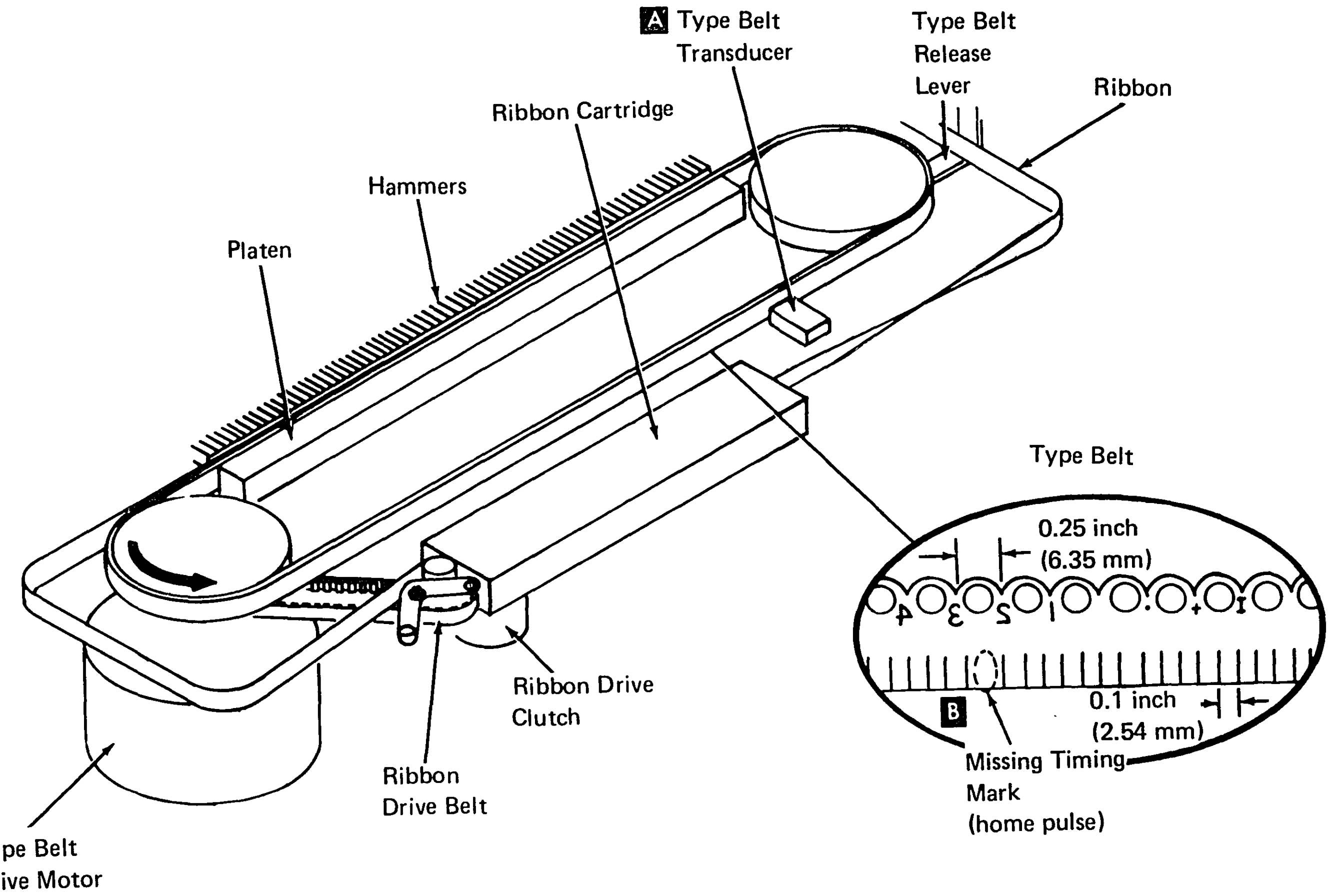
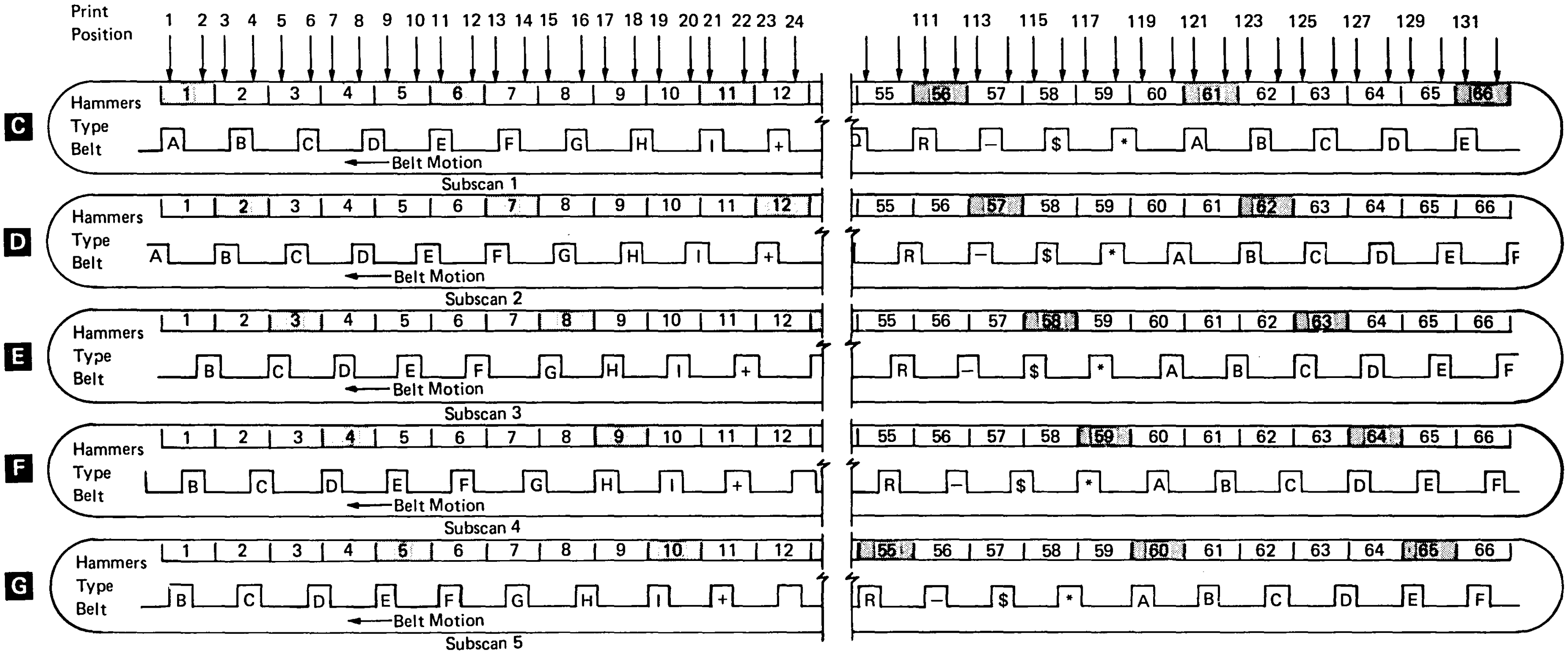
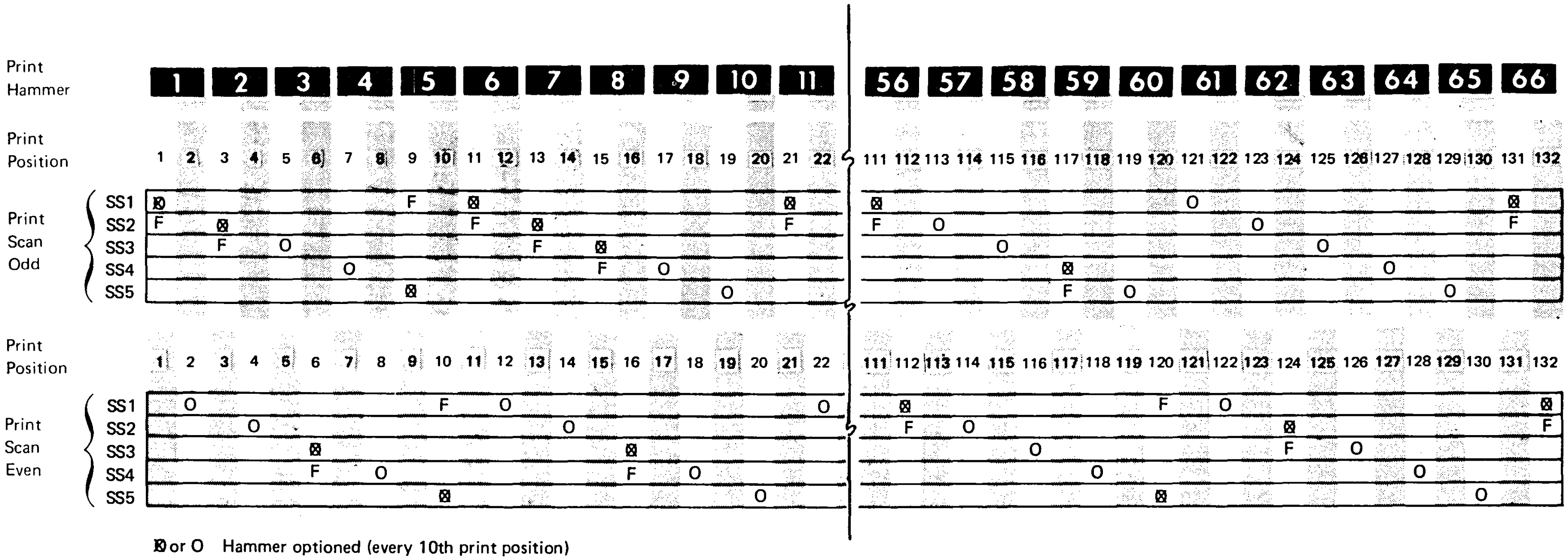
[1] The 64-character set takes 64 odd print scans and 64 even print scans. The 96-character set takes 96 odd print scans and 96 even print scans.


A Type Belt Transducer
Type Belt Release Lever
Ribbon
Ribbon Cartridge
Hammers
Platen
Type Belt
0.25 inch (6.35 mm)
0.1 inch (2.54 mm)
B
Missing Timing Mark (home pulse)
Ribbon Drive Clutch
Ribbon Drive Belt
Type Belt Drive Motor


Print Position
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
111 113 115 117 119 121 123 125 127 129 131
C
Hammers
Type Belt
1 2 3 4 5 6 7 8 9 10 11 12
55 56 57 58 59 60 61 62 63 64 65 66
A B C D E F G H I +
R – $ * A B C D E
Belt Motion
Subscan 1
D
Subscan 2
E
Subscan 3
F
Subscan 4
G
Subscan 5



Ø or O Hammer optioned (every 10th print position)

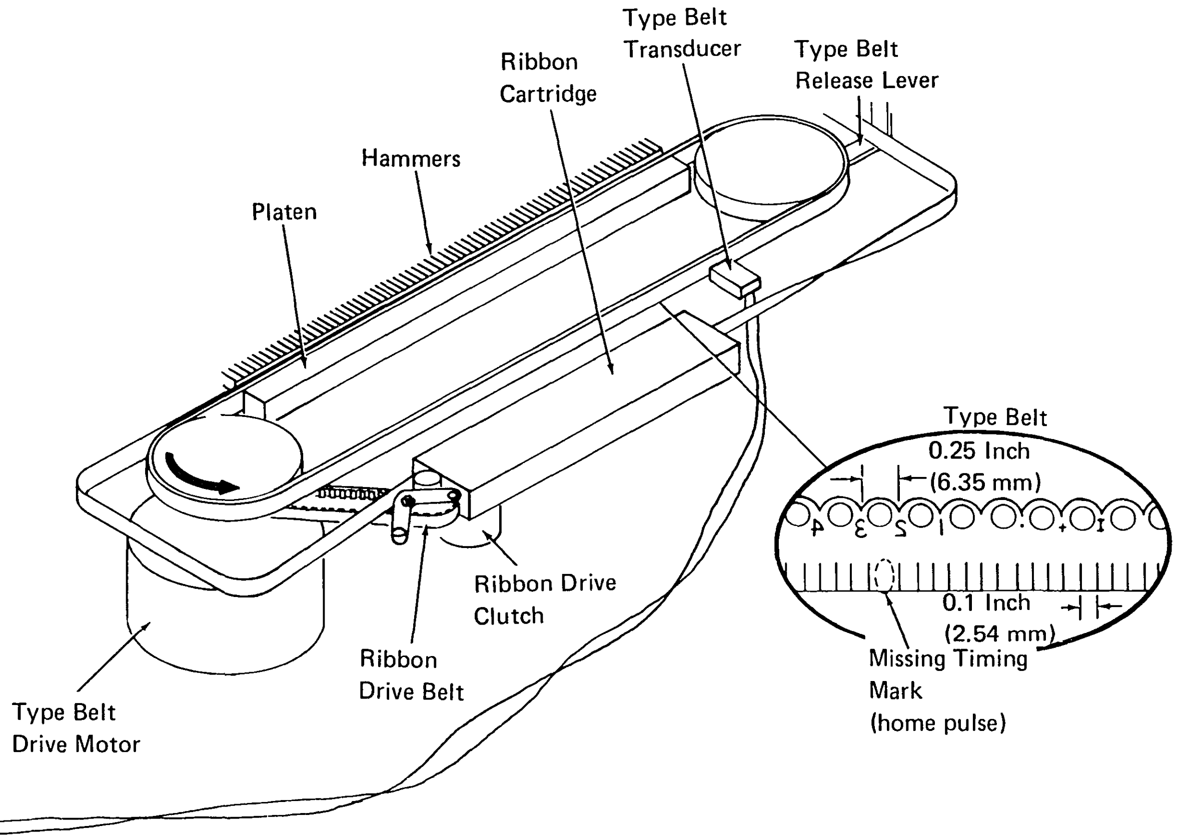
⊠ Hammer optioned and compare equal

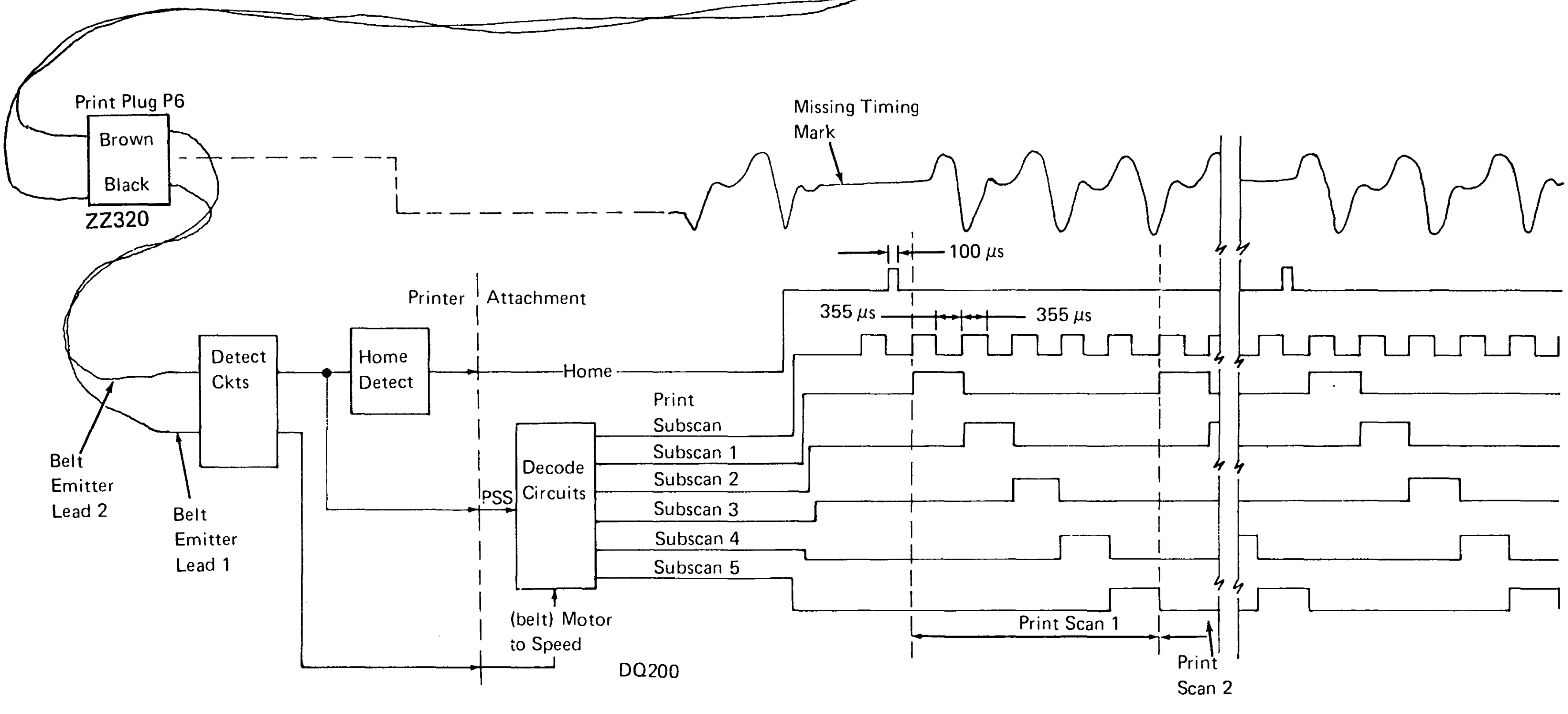
F Hammer fired (fired on subscan after compare equal)

4.1.2 Functional Components (50, 100, and 155 lpm)

Type Belt Transducer

The type belt transducer detects the raised timing marks on the type belt. Thses marks are converted to emitter pulses in the transducer and sent to the control card. The control card uses these pulses to generate the home pulse, the subscan pulses, and the belt up-to-speed signal. The home pulse and subscan pulses are used to synchronize the mechanical and electrical portions of the print operation. The belt up-to-speed signal is sent to the attachment to indicate that the belt is up to operating speed.





Ribbon Drive

The ribbon is driven by a belt mounted on the type belt drive pulley. The drive mechanism also includes a solenoid-driven clutch to disengage the drive from the ribbon when no printing is taking place. Disengaging the clutch prevents smudging the paper while the printer is idle.

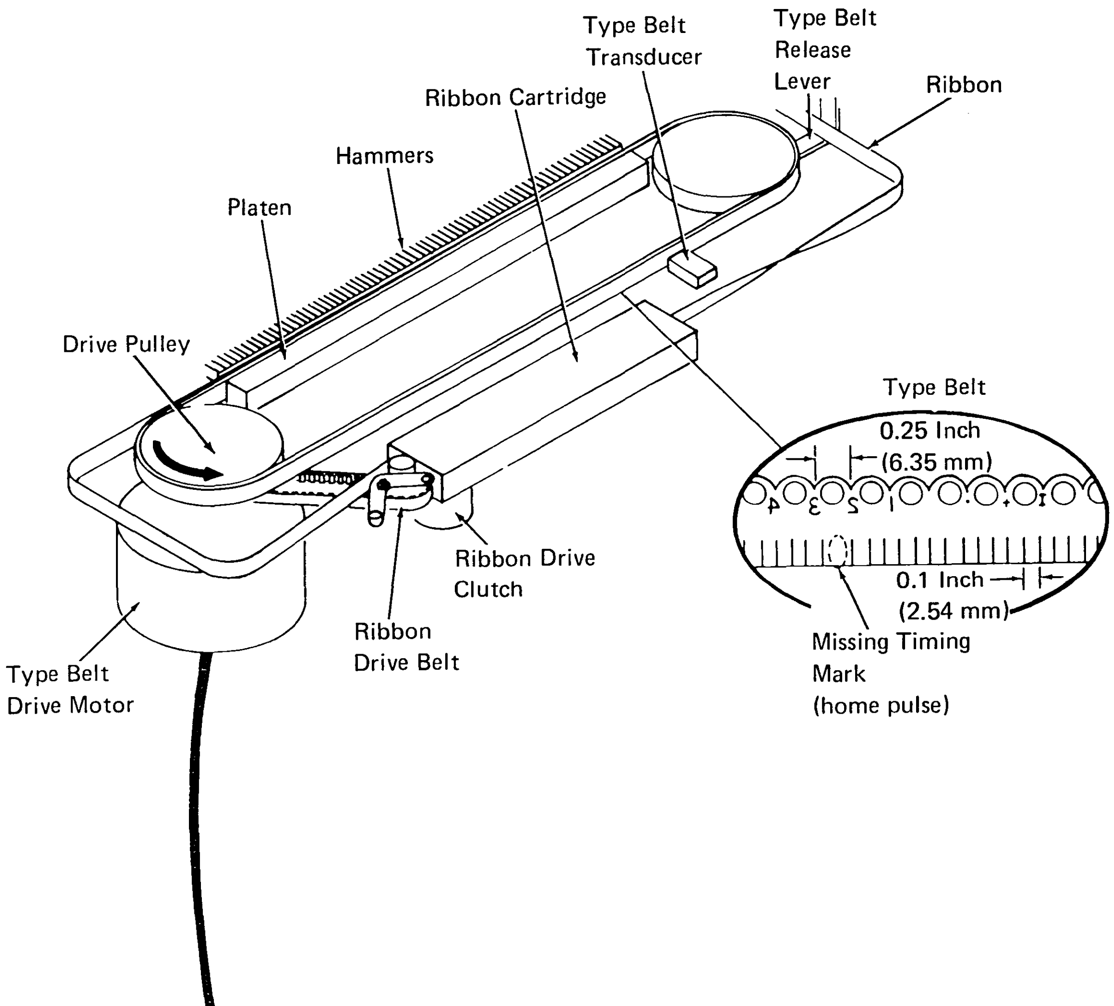
The ribbon is a continuous 1/2 inch wide fabric ribbon contained in a cartridge mounted on the front of the printer. The ribbon is fed into the left side of the cartridge and pulled out the right side (as viewed from the front of the machine).

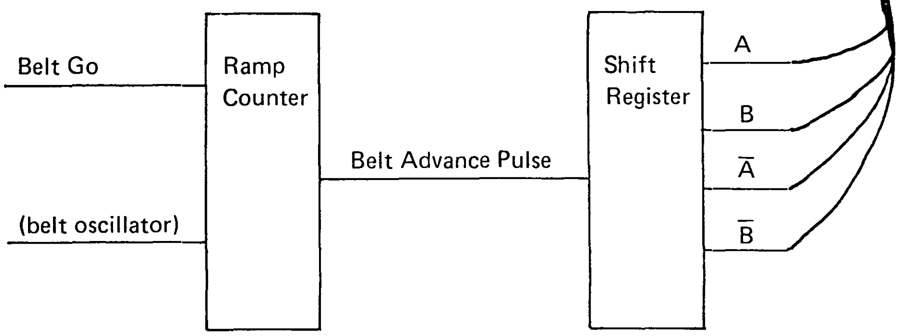
Type Belt Drive

The type belt is driven directly by a stepper motor mounted under the left pulley.

When belt go is activated, the belt oscillator is gated and ramps the stepper motor up to speed.

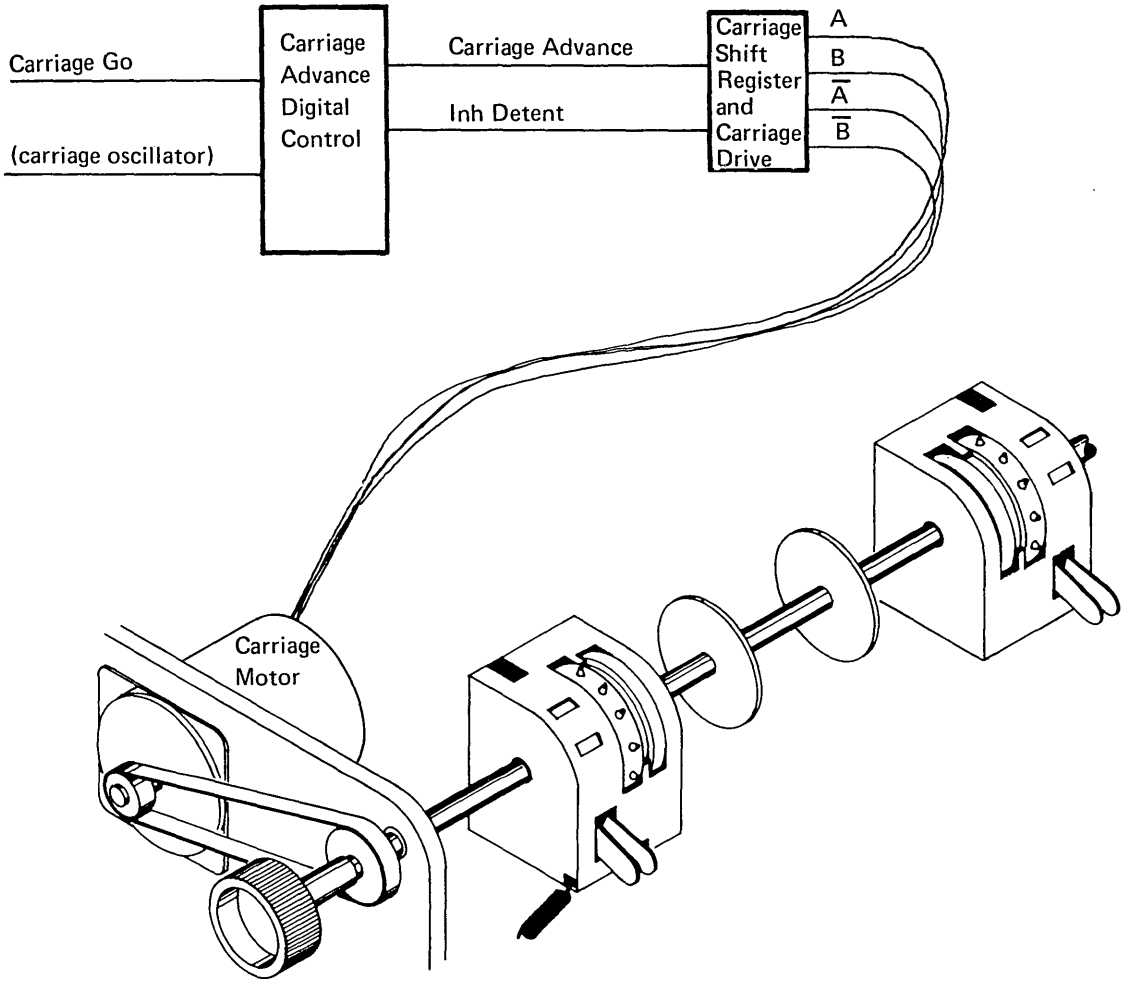
The right pulley has a release lever mounted on it to remove tension from the type belt. When the release lever is operated, the type belt can be removed.





Carriage

Line Space Operation



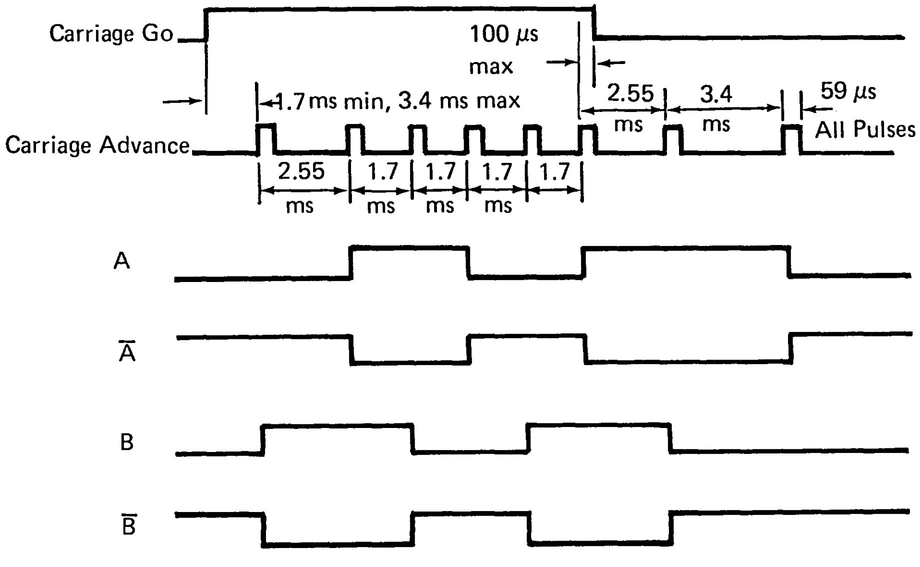
The printer has a pin feed carriage driven by a stepper motor (general stepper motor operation is described in Appendix B). The carriage spaces six lines per inch. Skipping and spacing are controlled by the attachment circuitry.

The carriage go line gates the carriage oscillator. The carriage oscillator, in turn, generates the carriage advance pulses. The carriage advance pulses generate the drive lines (A, Ā, B, B̄) that control the carriage motor. Each carriage advance pulse advances the drive by one increment. Eight increments are required to advance the carriage one space.

When carriage go goes inactive, after six carriage advance pulses, two more advance pulses are generated. The carriage is allowed to come to a stop without overshooting by delaying the last two carriage advance pulses.

The keyboard functions that control the carriage are:

- Carriage restore
- New line
- Reset line counter to 1

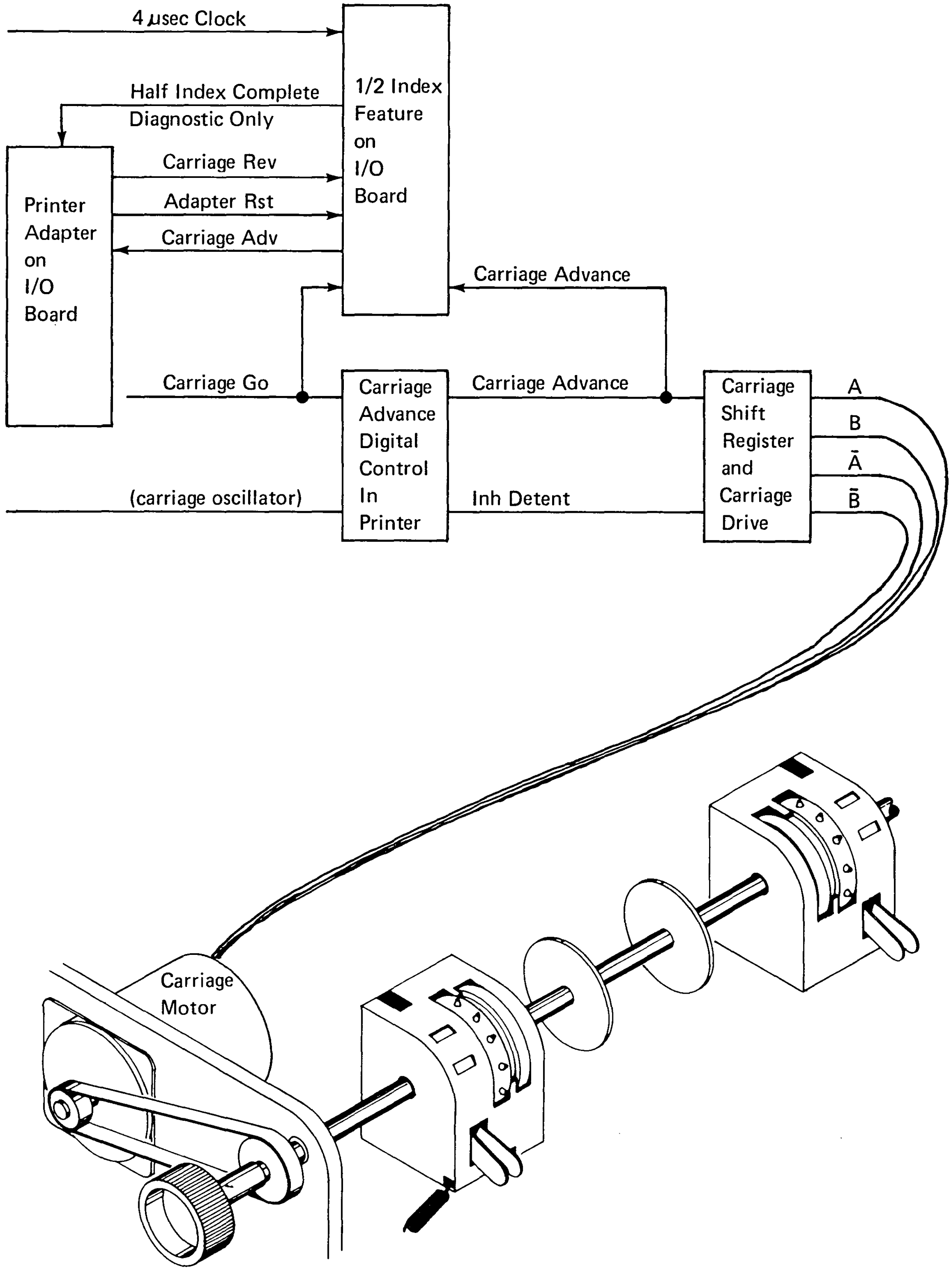


Note: ±10% tolerance on all times unless otherwise note.

Half Line Space Operation

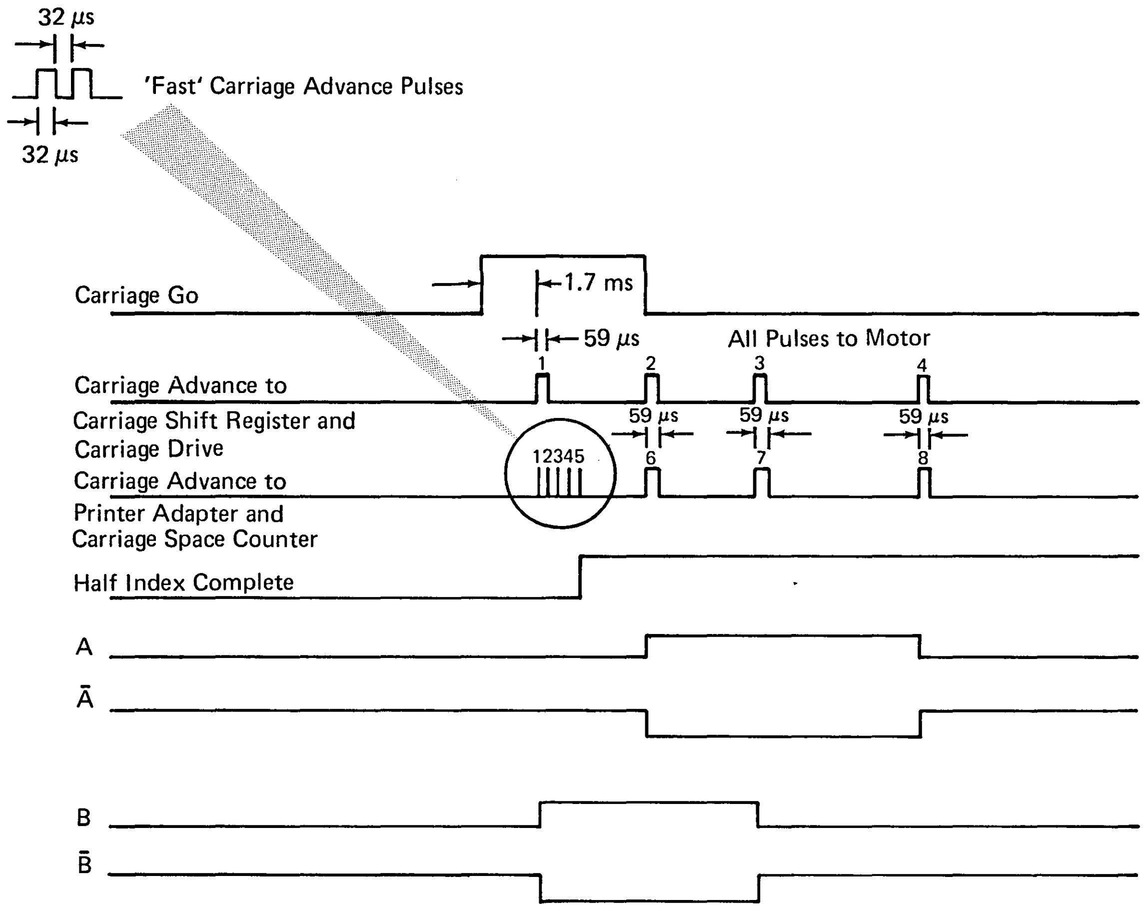
The half line space print feature permits indexing of the printer one half space above or below the normal print line. This spacing can be used to superscript or subscript any of the characters on the the print belt.

The half line space print feature supplies the printer attachment with 8 carriage advance pulses when only 4 carriage advance pulses are sent by the printer to the carriage advance shift register. During the half line space operation, when the first carriage advance pulse is received by the half index card, 5 short (64 μs) carriage advance pulses are generated from the 4 μs clock and sent to the printer attachment before the second carriage advance pulse is received from the printer. When the second pulse is received from the printer, it is passed unaltered to the printer attachment. This pulse becomes the sixth carriage advance pulse to the printer attachment and carriage go is dropped. The deceleration function begins and the third and fourth carriage advance pulses from the printer are received by the printer attachment. These are the seventh and eighth pulses in the carriage line position counter (count to 8). Because the printer attachment has received 8 pulses in the carriage line position counter, the acceleration and deceleration timing of a full index is retained and forms jam and carriage sync checking are performed.



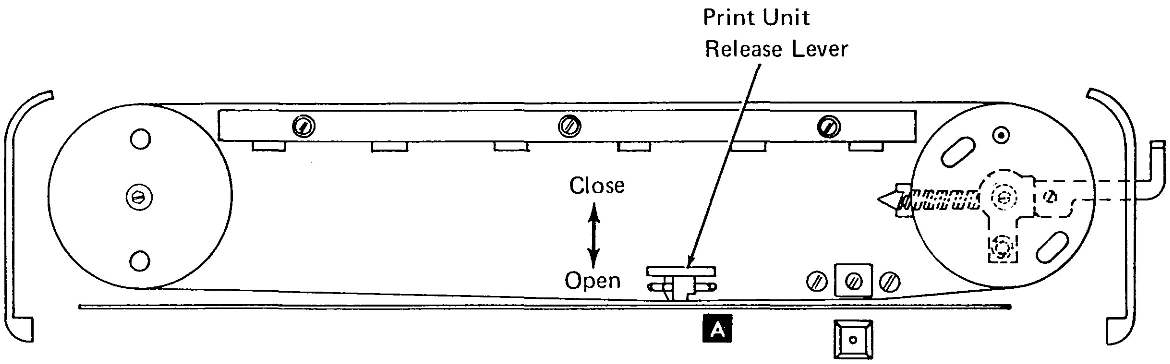
A half line space operation is initiated by setting the carriage reverse bit (bit 4) in a control load command (IOCL) with a modifier of A. Half index mode is reset by bit 5 of the command and the half index feature card is reset by bit 5 of the command, dropping carriage go, or resetting the printer attachment.

Half index complete indicates that the 5 'fast' pulses to the printer attachment have been generated and the completion of the index operation is under control of the carriage advance digital control in the printer.



Throat

The throat must be opened to insert the paper and must be closed before the printer is ready. The throat is controlled by the print unit release lever **A**. Pull the lever toward the front of the machine to move the print unit forward and open the throat; push the lever toward the back of the machine to move the print unit back into place and close the throat. When the print unit is back in place, the print unit interlock switch signals the attachment that the throat is closed.



Paper Clamps

There are two paper clamps in the printer. The upper paper clamp is used only to suppress the noise of the paper. When the clamp solenoid is energized, it closes the air gap where the paper passes through to reduce the noise level at the back of the printer. (*Upper Paper Clamp Assembly* 4.2.43.)

The lower paper clamp is located just below the print line to prevent horizontal skewing of the paper. The print belt is turning continuously and has a tendency to pull the paper along with it. Because there are no feed rolls in the lower portion of the printer, the lower paper clamp holds the paper in position. (*Lower Paper Clamp* 4.2.44.)

4.1.3 Checking (50, 100, and 155 lpm)

Forms Jam Check

The forms jam check indicates that the carriage tractor was told to move, but the paper did not move. A light emitting diode detects the time between holes in the paper. If no hole is detected in eight lines, the forms jam check is set.

Note: A false forms jam check or a false printer check can occur when chads (chips) are not completely punched out of two successive holes in the paper.

Belt Speed Check

This check indicates that either the type belt failed to move within two seconds after the start time, or the type belt lost motion after being up-to-speed. Motion is considered lost if there is a 25% reduction in operating speed. The speed is determined by sensing the time between timing marks on the type belt.

Carriage Sync Check

Two conditions can set this check:

1. If a carriage feedback pulse (carriage advance pulse) occurs when no carriage motion was initiated.

2. If a carriage feedback pulse (carriage advance pulse) fails to occur within 8 ms, during carriage spacing.

Coil Current Check

An 8 ms timer is started when a hammer driver is fired. The driver gates current through its associated hammer coil. The 8 ms timer is used to check for the possibility of a hammer driver being on longer than 8 ms. If this condition is detected, power is dropped to the printer, and the coil current check is set. The status of the three coil current lines that are the input to the coil current check is saved until the check is cleared. This indicates which one of the three hammer driver cards is failing.

Note: If an even number of hammers on one of the three hammer driver cards is on longer than 8 ms, the coil current check is not set. This is because the hammer drivers are checked for an odd number of hammer drivers on within any one of three hammer driver cards.

Belt Sync Check

This check is set by three possible conditions:

1. If a home pulse occurs when not expected.

2. If a home pulse fails to occur when expected.

3. If more than 1 bit is generated from the bit ring at one time.

The timing for the home pulse is determined by counting the number of print scans. This count is compared with the character set size (only one home pulse per character set).

Emitter Check

Once the type belt motor is up-to-speed, the print subscan line is monitored to verify that it is oscillating. If no change occurs during any 2 ms period, emitter check is set. This check supplements the belt sync check, which cannot detect a broken or stopped belt.

Data Check

Parity is maintained on the data in the print buffer. If invalid parity is detected during a print cycle, data check is set.

Hammer Parity Check

This check compares the number of hammers selected to fire with the number actually fired. If a mismatch occurs the hammer parity check latch is set.

End of Forms Check

End of forms is checked on the first line printed of each new form. If end of forms line is active, the printer goes not ready.

Throat Closed Check

The printer is not ready if the print unit is not latched in place to close the throat.

Cover Closed Check

The printer is not ready if the cover is open.

Unprintable Character Check

One or more of the characters requested to print were not in the print image. Unprintable character is checked entirely by the microprogram. There is no hardware checking involved. Setting this check is a programmer option.

4.1.4 Input/Output Lines (50, 100, and 155 lpm)

A = From attachment
P = From printer

POR/Printer Reset (A)

POR/printer reset line is initiated during the power up sequence to reset the printer circuits to their starting condition. It is also activated if a carriage sync check is detected.

Close (+24V) Contactor (A)

Close contactor line must be activated to switch the +24 voltage into the printer. This line is deactivated when a hammer parity check is sensed to protect the hammer coils.

Belt Go (A)

Belt go line is activated to start the belt oscillator. The belt oscillator furnishes pulses to run the type belt drive circuits.

Belt Motion (P)

The belt motion signal is active when the type belt reaches operating speed. It becomes inactive when the belt speed decreases to approximately 10% below the operating speed. The home pulse and the subscan pulses become active when the belt is up to speed.

PSS (Subscan) (P)

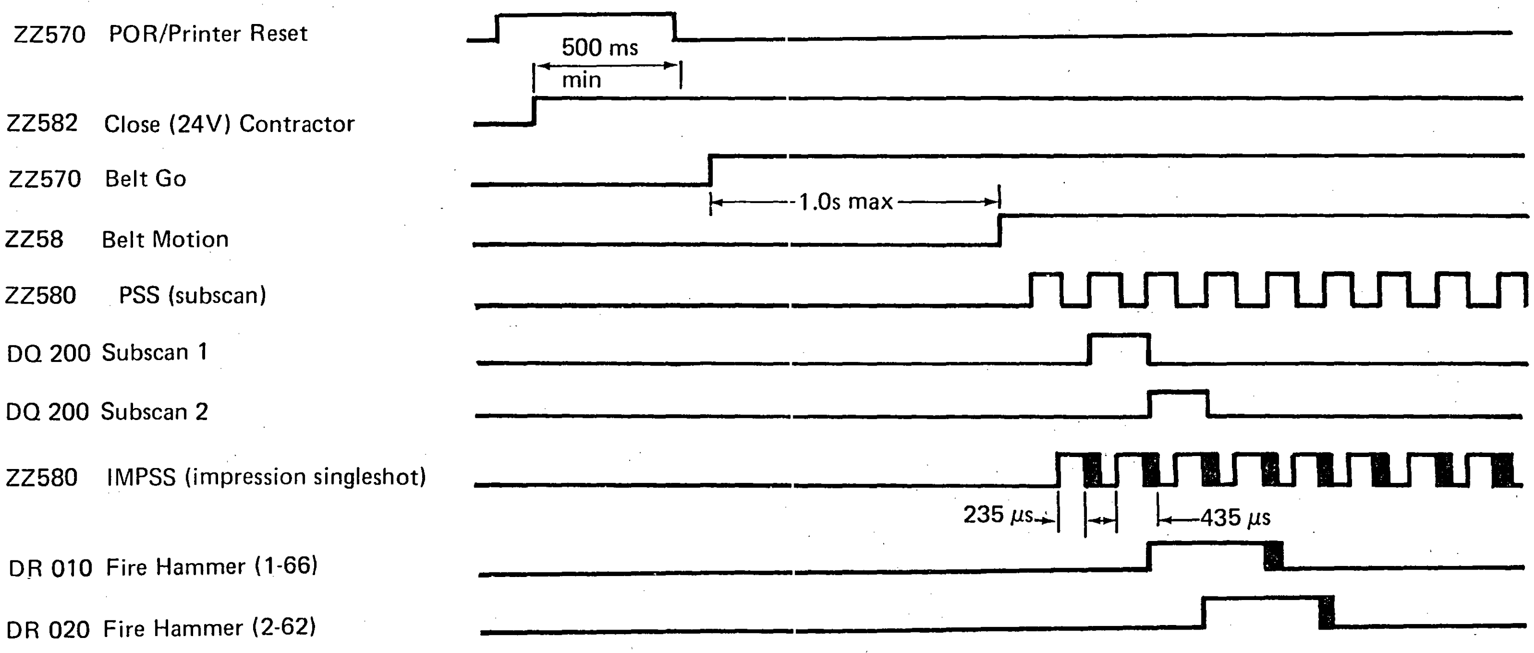
The PSS pulses are generated from the raised timing marks on the type belt. The subscan pulses synchronize the print controls between the attachment and the printer. When the home pulse is detected, a dummy pulse is generated because of the missing timing mark.

IMPSS (Impression Singleshot) (P)

IMPSS is added to the hammer fire pulse to control the time the hammers are fired for different forms thickness. This signal is activated when the subscan pulse goes inactive (halfway into a subscan) and remains active 235 µs to 435 µs depending on the setting of the forms thickness control.

Fire Hammer (A)

Fire hammer lines are activated to fire the corresponding print hammers (fire hammer 1 = print hammer 1, etc).



Carriage Go (A)

The carriage go line is activated to start the carriage oscillator. The carriage oscillator furnishes pulses to run the carriage drive circuits.

Stop Ribbon (A)

The stop ribbon line is activated if the printer is idle for 5 seconds. When the signal is activated, the ribbon stops moving to prevent smudging the paper.

Hammer Check 1-22 (also 23-44 and 45-66 (P)

The hammer check lines determine if each group has an odd number of hammers on. They are used as input for the hammer parity check and the coil current check.

Activate Paper Clamps (A)

This signal energizes the upper and lower paper clamps during printing. It is deactivated during a spacing operation and when the printer is idle.

Carriage Advance (P)

The carriage go line activates the carriage advance digital control circuits. These circuits generate the carriage advance pulses. Each carriage advance pulse advances a shift register pulse, which advances the print carriage motor one increment or eight increments per line. Therefore, eight carriage advance pulses decrease the space count once per line. When the space count reaches zero, the carriage operation is complete, which resets carriage go. The carriage advance pulse is also used to detect carriage sync check.

Home Pulse (P)

On the type belt there is a double space between two of the timing marks. This space (missing timing mark) generates the home pulse that signals the start of the type set on the type belt. The home pulse is used to synchronize the type belt and the belt position counter (additional information on page 4-3).

Throat Closed Switch (P)

This line sends the condition (open or closed) of the print unit interlock switch to the attachment. The switch must be closed to make the printer ready.

Cover Closed Switch (P)

The cover must be closed to make the printer ready.

Forms Sensed Switch (P)

This line indicates to the attachment whether or not there are forms in the printer.

Printer Thermal Switch (P)

This line signals that the temperature in the printer circuitry is too high. It turns on the TH CHK light on the operator control panel in case of overheating. The switch opens at 145°F ± 5°F (63°C ± 3°C).

4.1.5 Circuit Cards (50, 100, and 155 lpm)

Hammer Driver

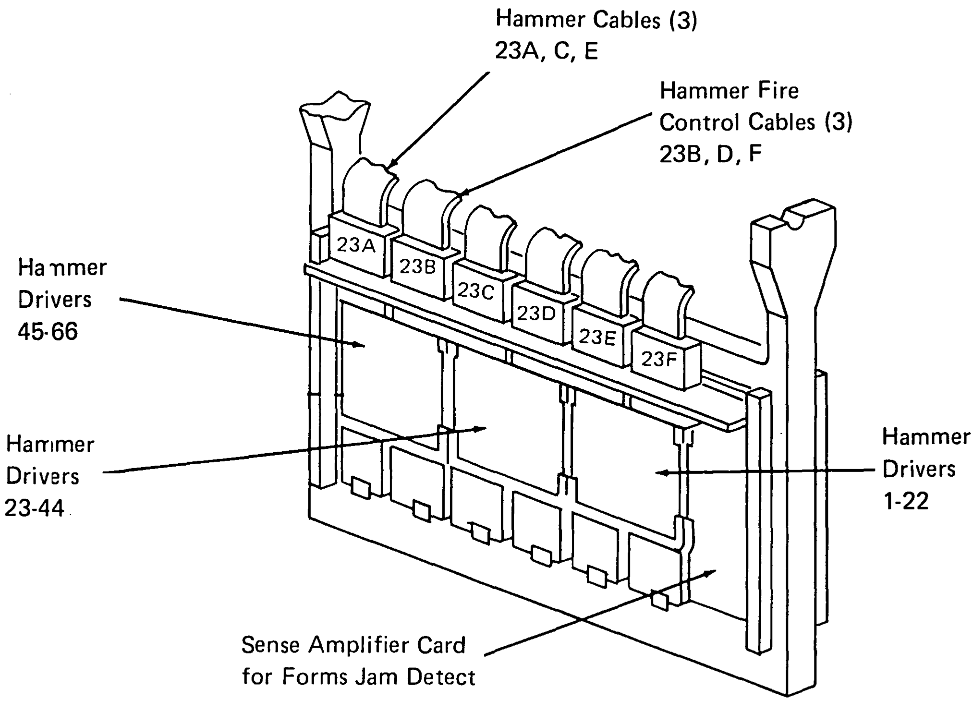
The hammer driver cards (3) each contain 22 hammer drivers and predrivers. This card also determines if an odd number of hammers is on to develop the hammer check lines.

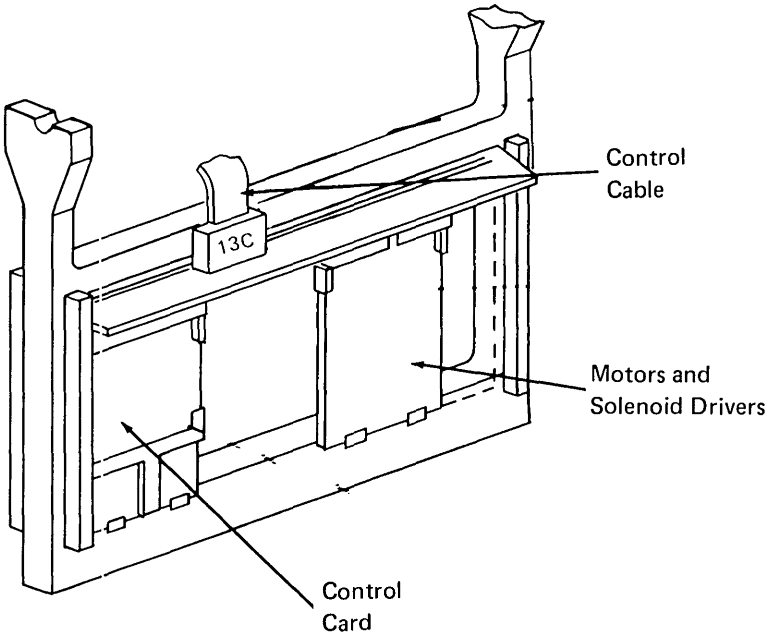
Motors/Solenoid Driver

This card contains the drivers for the carriage motor and belt motor. This card also contains solenoid drivers for the upper and lower paper clamp solenoids, and the ribbon drive clutch solenoid.

Control Card

This card contains digital logic for generating belt up-to-speed, home pulse, and subscans. Also included are the impression control single-shot, the oscillators for the carriage advance pulses, and the voltage regulator that generates the +8.5 voltage and +5 voltage for the printer.





4.1.6 Card Gate Connector Details (50, 100, and 155 lpm)

The illustration is a view of the connector pins as viewed from the card side of the boards (gate raised). For ease in determining pin designations, all probing should be done from the back of the machine.

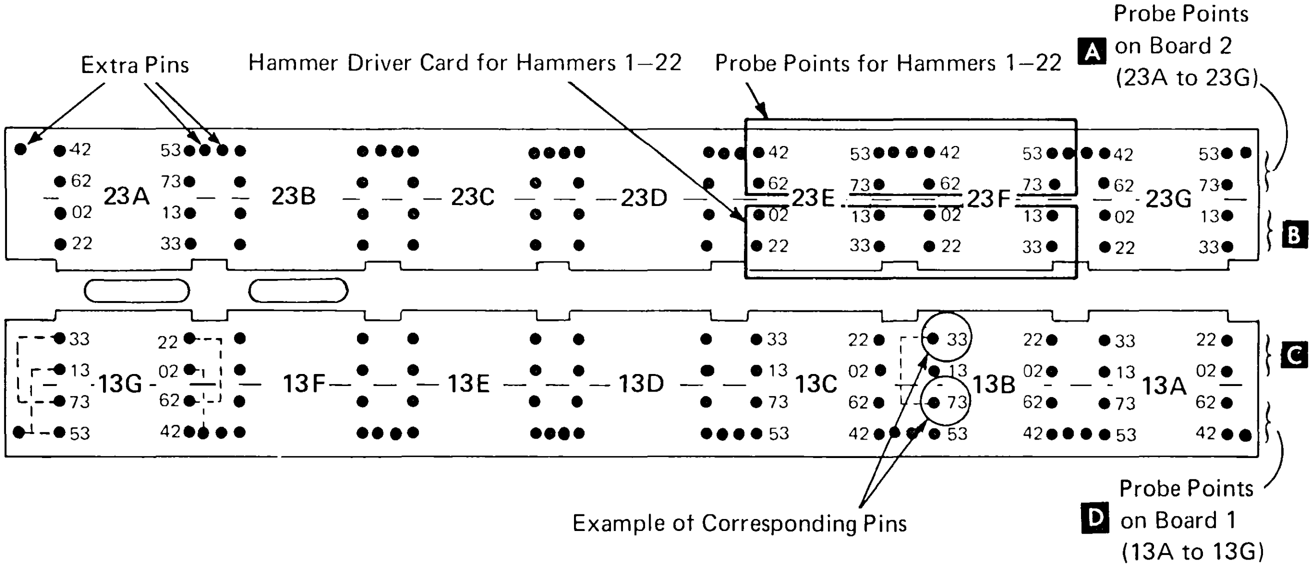
Cards are plugged into rows B and C . The outside two rows, A and D , are for probing. Pins 02 through 13 are connected one for one with pins 42 through 53; pins 22 through 33 are connected one for one with pins 62 through 73. Therefore, the outside two rows A and D are used for probing without removing the cards.

Note: The extra pins between rows prevent the cards from being *plugged* incorrectly.

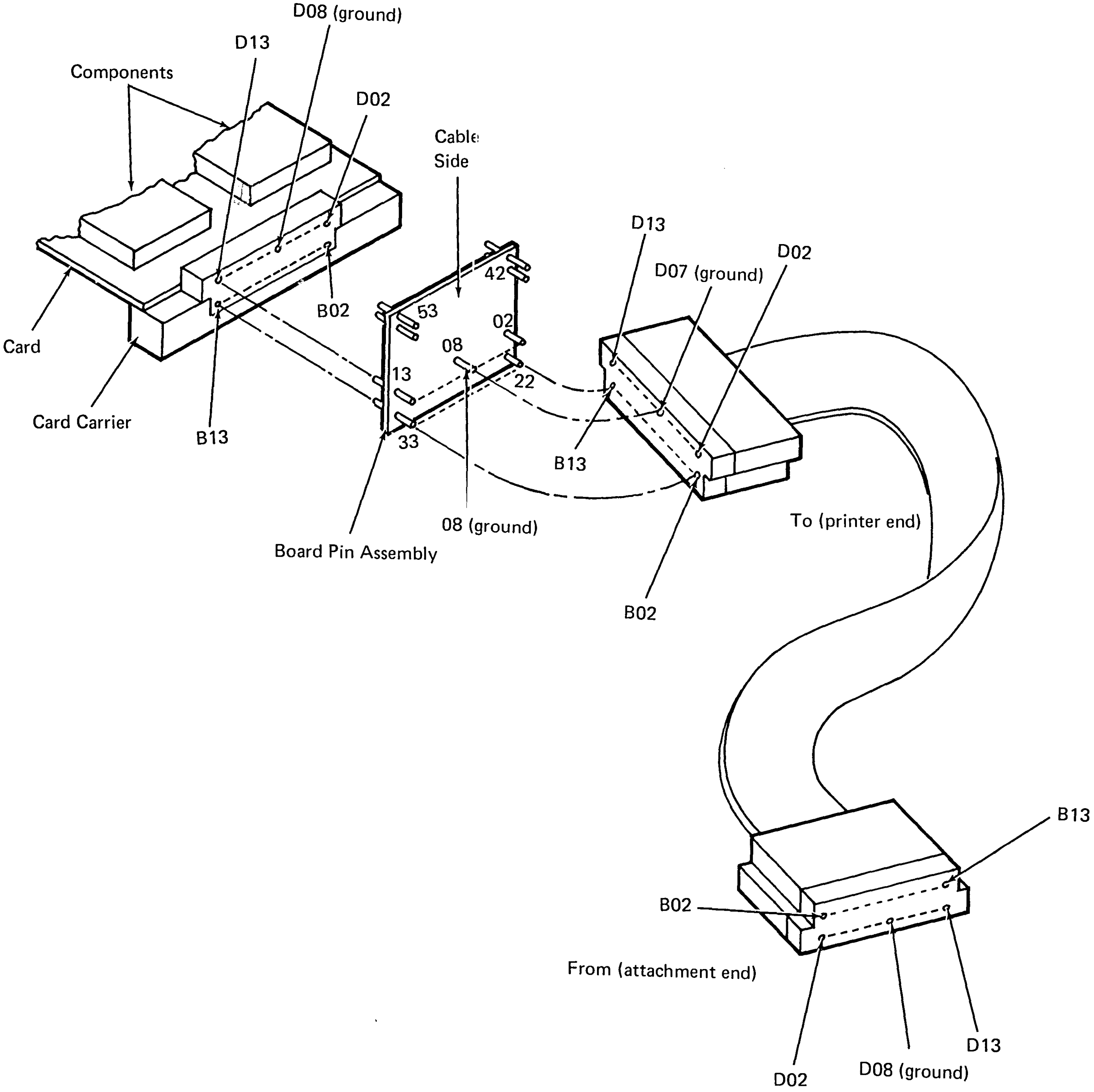
4.1.7 Printer Power Plugs (50, 100, and 155 lpm)

Plug	Description	Positions	Location
P1	Ribbon Solenoid	2	Front
P3	Lower Paper Clamp Solenoid	4	Front
P4	Belt Motor	9	Left Side
P5	Emitter and Impression Control	4	Front
P6	Contactor	2	Rear
P7	Carriage 1	9	Rear
P8	Upper Paper Clamp Solenoid	4	Top
P11	Fan	6	Left Side

Boards Viewed from Card Side



4.1.8 Pin Reversal In Cables



4.2.0 MAINTENANCE (50, 100, and 155 lpm)

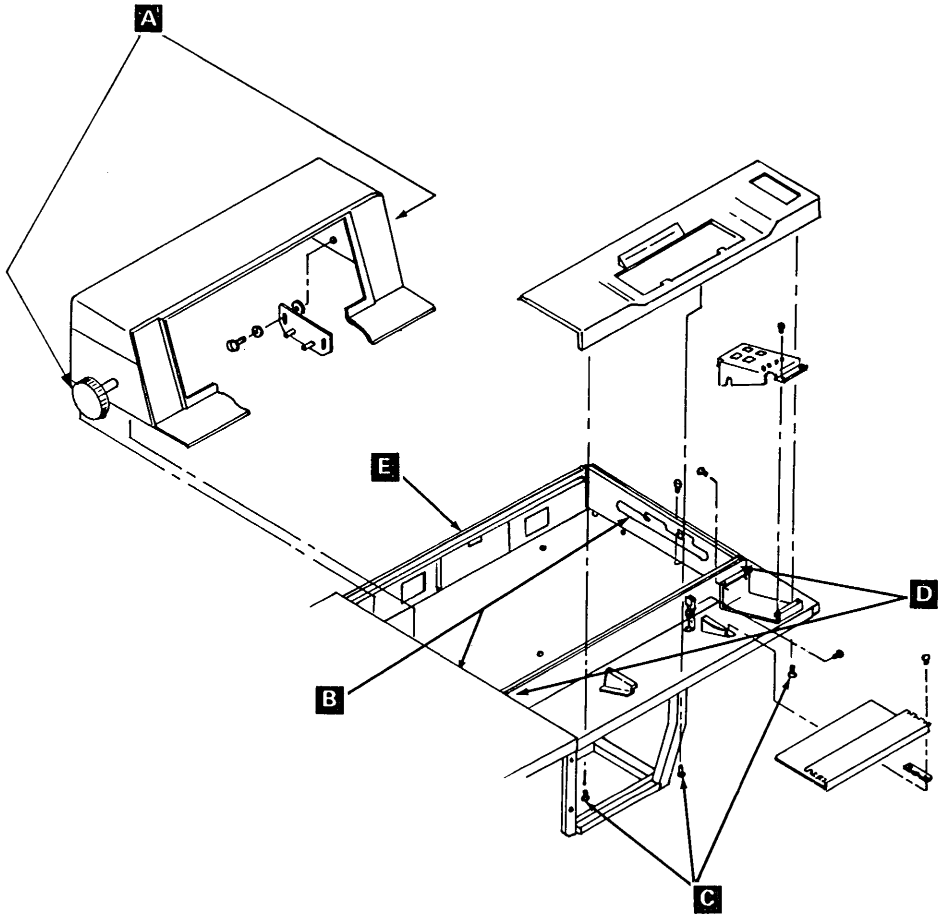
4.2.1 Printer Cover and Divider Removal and Replacement

Removal

1. Remove the left and right knobs **A** by pulling them from the shaft.
2. Open the printer cover.
3. Pull forward on the left and right sliding latches **B** and remove the printer cover.
4. Remove the three screws **C** under the keyboard, slide the cover forward slightly to disengage tabs, and remove the keyboard cover.
5. Remove the two divider screws **D** and remove the divider.
6. The back cover **E** is held on by two ears on the cover; therefore, it can be lifted off.

Replacement

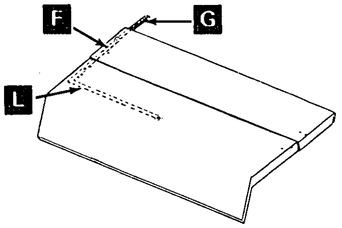
1. Replace in the reverse order of removal.
2. Do the *Cover Interlock Switch* service check (4.2.2.1).

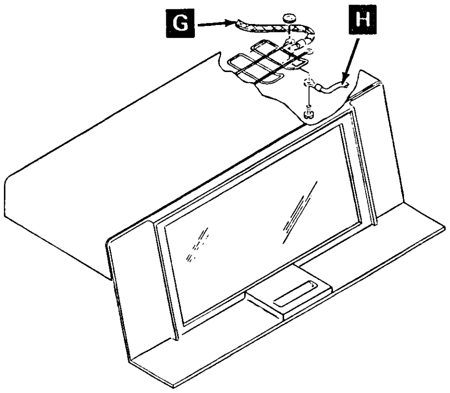


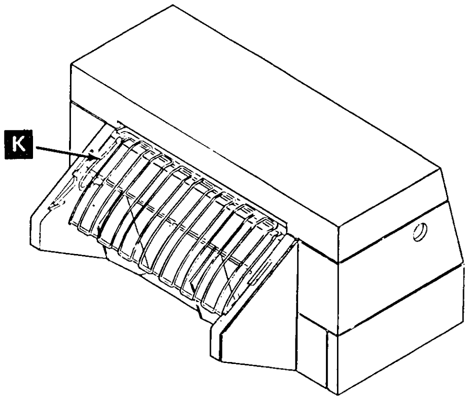
4.2.1.1 Printer Cover Grounding

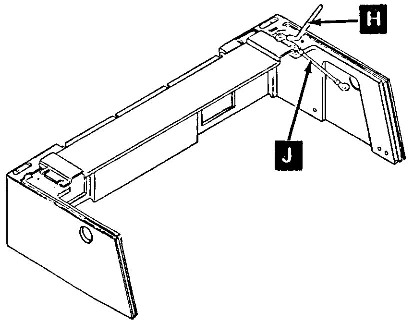
F	Cable
G	Cable
H	Jumper
J	Jumper (connect to frame of printer behind right tractor)
K	Jumper
L	Jumper

Ground forms stand at grounding blocks.









4.2.2 Interlock Switch Description

CAUTION
Do not use meter on resistance scale. Damage to switch might result.

The interlock switches are electronic switches consisting of a module **A**, a magnet **B**, a spring **C**, and a plunger **D**. The switch assembly has no contacts. When the plunger is pushed in, the magnet passes over the module and switches the signal level to 0 volts. A spring within the mechanism returns the plunger to the extended position.

Note: Two styles of switches are available; both are electronic switches.

4.2.2.1 Cover Interlock Switch

A cover interlock switch disable mechanism allows the printer to be serviced when the covers are open. To operate the switch with the covers open, push the armature **L** toward the switch body; then insert a small screwdriver at point **J** to compress the spring. A magnet within the switch assembly attracts the armature and keeps the switch activated. When the cover is closed, a block on the cover presses against the plunger and deactivates the disable mechanism.

Service Check

Load program ID PRT2. This displays the status of the three interlock switches. Open and close the cover; the display should change accordingly. Adjust or replace as necessary.

DANGER
After performing the service check, operate the interlock override. Ensure that closing the cover will reset the interlock override.

Adjustment

1. Loosen the switch assembly mounting screws **K** slightly and slide the assembly back and forth until the switch transfers between 1 inch (25.4 mm) and 2 inches (50.8 mm) from the closed position.

   Note: When the switch is adjusted properly, the display indicates cover open and cover closed within that inch **M**.

2. Tighten screws **K**.

Cover Interlock Switch (Continued)

Removal

1. Open the printer cover and unplug the switch cable:
   a. If old style, pull the plug.
   b. If new style, observe the color code and disconnect the wires.

2. Remove two screws **K** and the switch assembly **H**.

3. Remove two screws **G**.

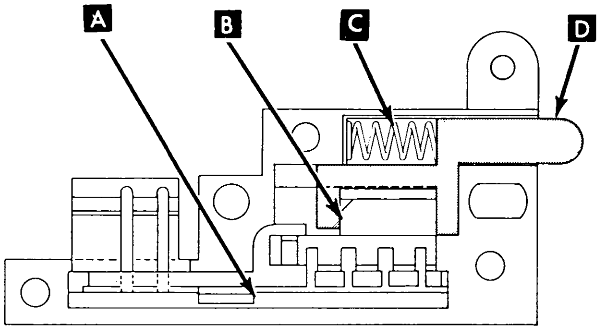
   Note: If switch is new style, skip step 4 and do step 5.

4. Remove clip **E** and pin **F**.

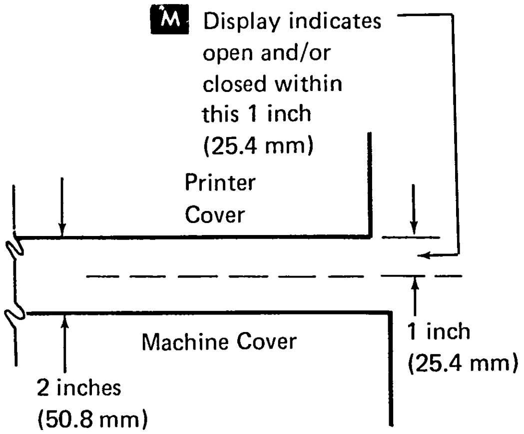
5. Remove the switch.

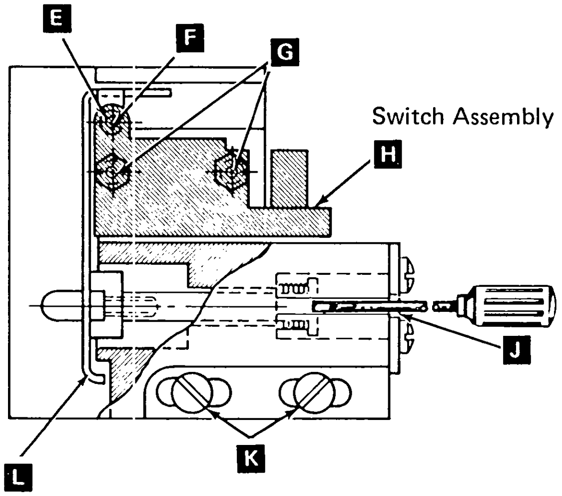
Replacement

Install in reverse order of removal and perform the cover interlock switch adjustment (4.2.2.1)

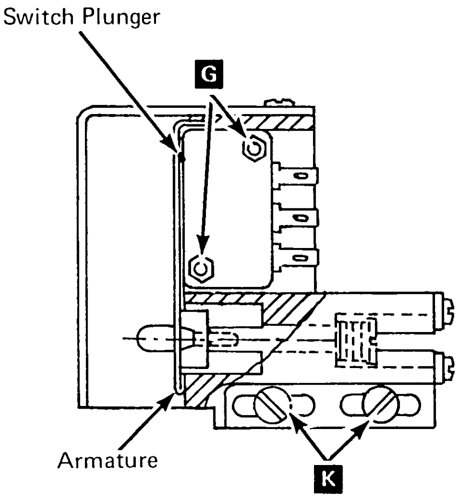


Interlock Switch





Old Style Switch Assembly



New Style Switch Assembly

4.2.2.2 Print Unit (Throat) Interlock Switch

Service Check

Load program ID PRT2 to display the status of the three interlock switches. Set the forms thickness control on 6. Open and close the print unit; the display should change accordingly. Adjust or replace as necessary.

Adjustment

1. Open the printer cover.
2. Close the print unit and set forms thickness control on 6.
3. Loosen the switch mounting screws **A** , position the switch body to approximately 0.025 inch (0.64 mm) from the print unit and tighten the screws.
4. Perform the service check with the forms thickness control in both the 1 and 6 positions.

Removal

1. Open the printer cover and disconnect the switch:
   a. If old style switch, disconnect the plug.
   b. If new style switch, note color code and disconnect switch leads.
2. Remove two screws **A** and the switch assembly.
3. Remove two screws **B** and the switch.

Replacement

Replace in reverse order of removal and perform the print unit interlock switch adjustment (4.2.2.2).

4.2.2.3 End-of-Forms Interlock Switch

Service Check

Load program ID PRT2 to display the status of the three interlock switches. Insert and remove single-part forms in the forms chute; the display should change accordingly. Adjust or replace as necessary.

Adjustment

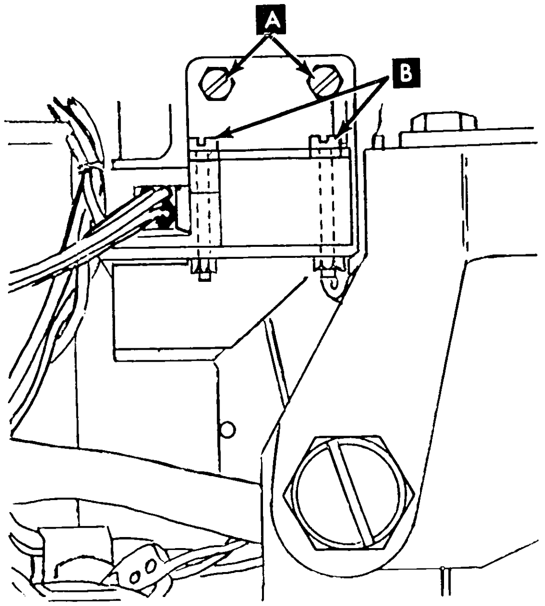
1. With forms removed, use a voltmeter on probe points 13C53 and 13C48 (4.1.6).
2. Loosen the mounting screws **C** , and position the switch to press the plunger until the voltage changes from 0V to 5V. Continue moving the switch to allow a minimum of 0.005 inch (0.13 mm) overtravel and still not bottom on the switch body.
3. Tighten the screws.
4. Perfom the service check.

Removal

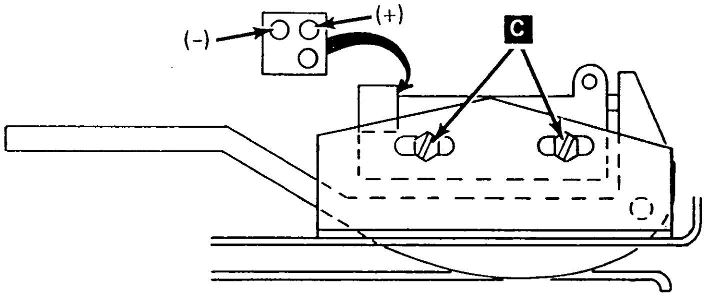
1. Remove the printer covers (4.2.1) and unplug the switch cable.
2. Remove two screws **C** and the switch assembly.

Replacement

Replace in reverse order of removal and perform the end-of-forms interlock switch adjustment (4.2.2.3).

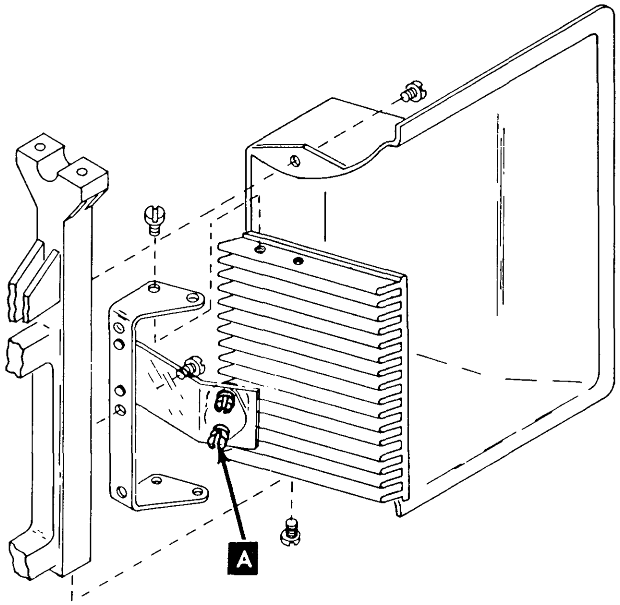


D Connect meter.
(wire end of plug)



4.2.3 Thermal Switch

> **DANGER**
> The heat sink and resistor assembly becomes very hot. Be sure the assembly is cool before performing maintenance near the thermal switch.



Removal

1. Power down.
2. Remove the printer covers (4.2.1) steps 1 through 3.
3. Unsolder the thermal switch leads.
4. Remove two nuts **A** and the thermal switch (SW4).

Replacement

Replace in reverse order of removal, and restore power to printer.

4.2.4 Fan Assembly

Removal

1. Turn the power off.
2. Remove the printer covers (4.2.1) steps 1 through 3.
3. Press the card gate release latch, open the gate, and lock it in the raised position.
4. Using a small pointed tool, disconnect the two motor leads from the fan plug (P11) and the ground wire from the printer frame (screwdriver can be inserted through the cable hole just above the power sequence card). Remove the wire leads from the cable clamps.
5. Remove two screws holding the fan assembly to the card gate.
6. Remove the plastic fan guard by lifting one of the tabs from the fan housing.
7. Remove the two screws that hold the motor to the duct assembly **A** .
8. Remove the fan blade (two screws).

Replacement

Replace in reverse order of removal and restore power to the printer.

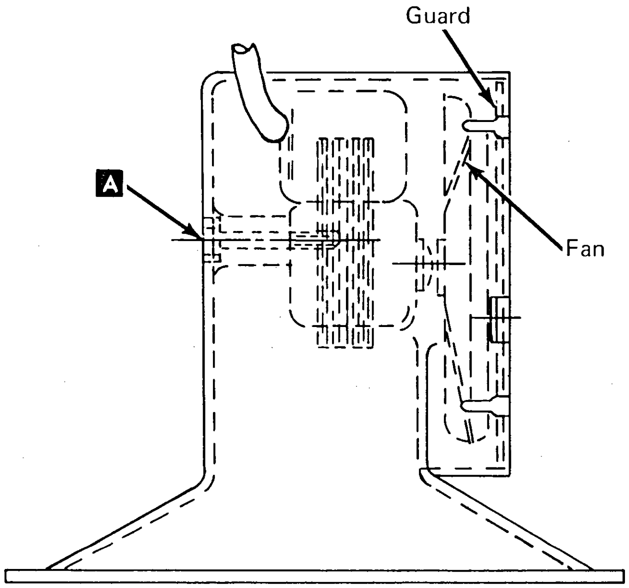
4.2.5 24V Relay (Contactor K1)

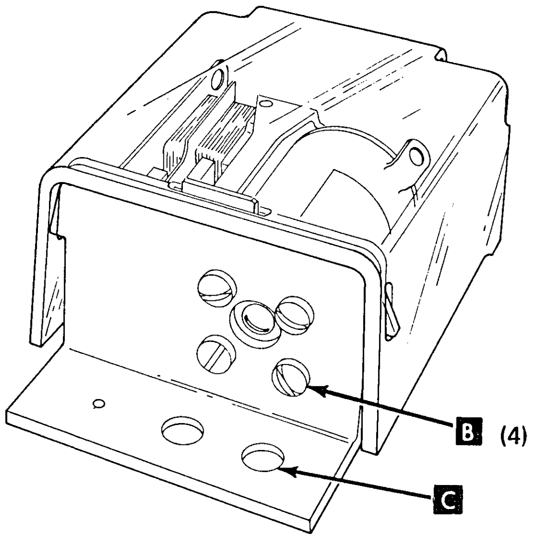
Removal

1. Remove the printer covers.
2. Remove the contactor plug (P6).
3. Remove two mounting bracket screws **C** .
4. Remove wires at TB1-10 and 12.
5. Remove the four contactor mounting screws **B** .

Replacement

Replace in reverse order of removal.

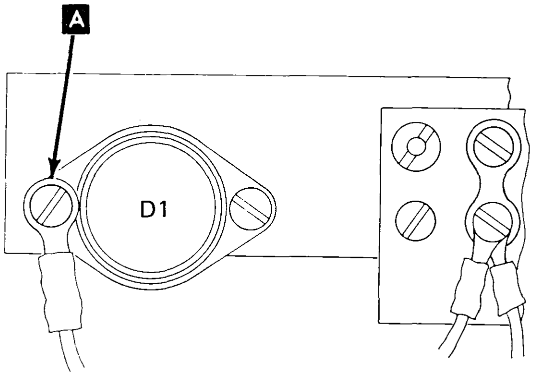


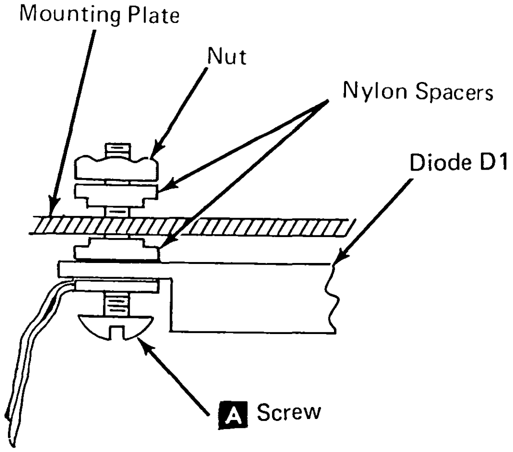


Relay is mounted on outside of right side frame.

4.2.6 Diode D1 Service Check

1. Turn the power off.
2. Remove the printer covers (4.2.1) steps 1 through 3.
3. Open the card gate and remove the diode cover.
4. Disconnect the wire on the side of the diode **A**. *Do not lose the two nylon spacers* and nut when disassembling.
5. Using an ohmmeter (X10 scale), measure the resistance between TB1-2 and the metallic case of the diode. The readings should be:
   a. Forward resistance 180 ohms, ±20%.
   b. Backward resistance near infinity. (To check, reverse the meter leads.)
6. Reconnect the wire and mounting screw after the diode is checked and restore power.





4.2.7 Motor Checkout Procedure (50, 100, and 155 lpm)

Note: Perform the following procedures when checking either the type belt motor or the carriage motor. A chart is shown for each motor. The resistance values are nominal values and might vary because of the ohmmeter. A comparison between the components in the circuit being checked is the best indication of a defective component.

1. Turn power off and remove the printer covers.
2. Open the printer card gate and lock it in the open position. Remove the bottom cover.
3. Remove the driver card 13E.
4. Set the ohmmeter to the X1 scale.
5. Disconnect the plug from the motor to be checked. Measure the resistance between the plug pins as shown in the charts on this page.
6. Check continuity of phase lines from driver card to motor plugs.
7. See the following list of removals and replacements and replace any defective component.

   Type belt motor removal and replacement (4.2.15).

   Carriage motor removal and replacement (4.2.40).

   Motor resistor removal and replacement (4.2.9).

   Motor phase capacitor removal and replacement (4.2.8).

Type Belt Motor (50, 100, and 155 lpm)

Motor End Plug Pins	**Resistance Values[1]**		**Component Description**
	A	**B**	
5 and 1	2.6 ohms	1.2 ohms	A-phase
5 and 2	2.6 ohms	1.2 ohms	Not A
6 and 3	2.7 ohms	1.2 ohms	B-phase
6 and 4	2.7 ohms	1.2 ohms	Not B

Cable End Plug Pins	**Resistance Values[1]**		**Component Description**
	A	**B**	
7 and 5	6 ohms R2	4 ohms R2	A-phase common resistor
8 and 6	6 ohms R3	4 ohms R3	B-phase common resistor
1 and 2	C3[2]	C3[2]	A-phase capacitor
3 and 4	C3[2]	C3[2]	B-phase capacitor

Phase Checked	**Plug No.**	**Driver**
A	P4-1	13F42
(not) A	P4-2	13F49
B	P4-3	13F44
(not) B	P4-4	13F45
A (com)	P4-7	13F62
B (com)	P4-8	13F64

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[1] If your printer has 3 μf capacitors C3 and C4 and type belt motor, part 1800535, use column A.
If your printer has 10 μf capacitors C3 and C4 and type belt motor, part 1816039, use column B. For location of C3 and C4, see 4.3.3.

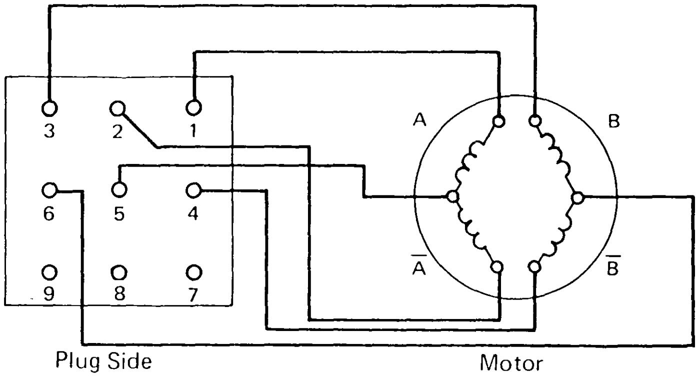
[2] Set ohmmeter to 1K scale. The ohmmeter needle must go toward zero and back to infinity. Failure to do so indicates a defective capacitor.

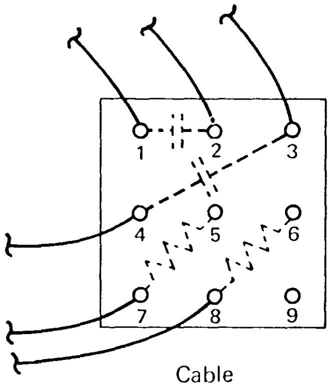
Carriage Motor (50, 100, and 155 lpm)

Motor End Plug Pins	Resistance Values	Component Description
5 and 1	1.3 ohms	A-phase
5 and 2	1.3 ohms	Not A
6 and 3	1.3 ohms	B-phase
6 and 4	1.3 ohms	Not B

Cable End Plug Pins	Resistance Values	Component Description
7 and 5	7 ohms R1	A-phase common resistor
8 and 6	7 ohms R4	B-phase common resistor
1 and 2	C1[1]	A-phase capacitor
3 and 4	C2[1]	B-phase capacitor

Phase Checked	Plug No.	Driver
A	P7-1	13E42
(not) A	P7-2	13E49
B	P7-3	13E44
(not) B	P7-4	13E45
A (com)	P7-7	13F62
B (com)	P7-8	13F64





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[1] Set ohmmeter to 1K scale. The ohmmeter needle must go toward zero and back to infinity. Failure to do so indicates a defective capacitor.

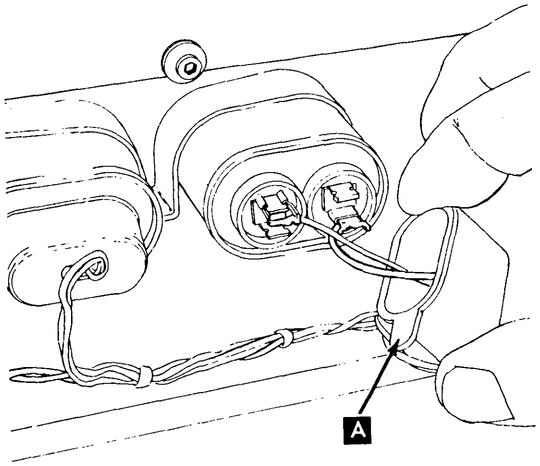
4.2.8 Motor Phase Capacitor (50, 100, and 155 lpm)

Removal

1. Remove the printer covers (4.2.1) steps 1 through 3.
2. Raise the printer card gate.
3. Remove the cover **A** over the capacitor terminals and remove the slip-on leads.
4. Pull the capacitor out of the mounting bracket.

Replacement

Replace in the reverse order of removal.



4.2.9 Motor and Paper Clamp Resistor (50, 100, and 155 lpm)

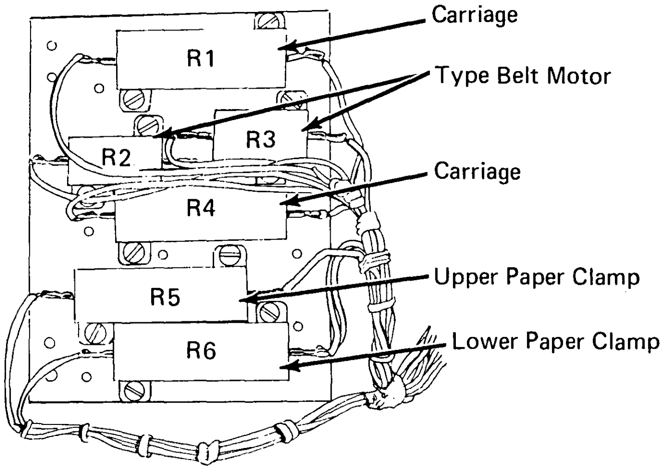
DANGER
After extended use, the resistors might become extremely hot. Be sure the resistors are cool before performing maintenance near resistor panel.

Removal

1. Remove the printer covers (4.2.1) steps 1 through 3.
2. Raise the printer card gate.
3. Remove the air duct (remove two screws; loosen one screw).
4. Unsolder the resistor leads.
5. Remove the resistor by removing the two mounting screws.

Replacement

Replace in the reverse order of removal.



4.2.10 Print Unit Assembly (50, 100, and 155 lpm)

4.2.10.1 Print Units With Pivot Screws

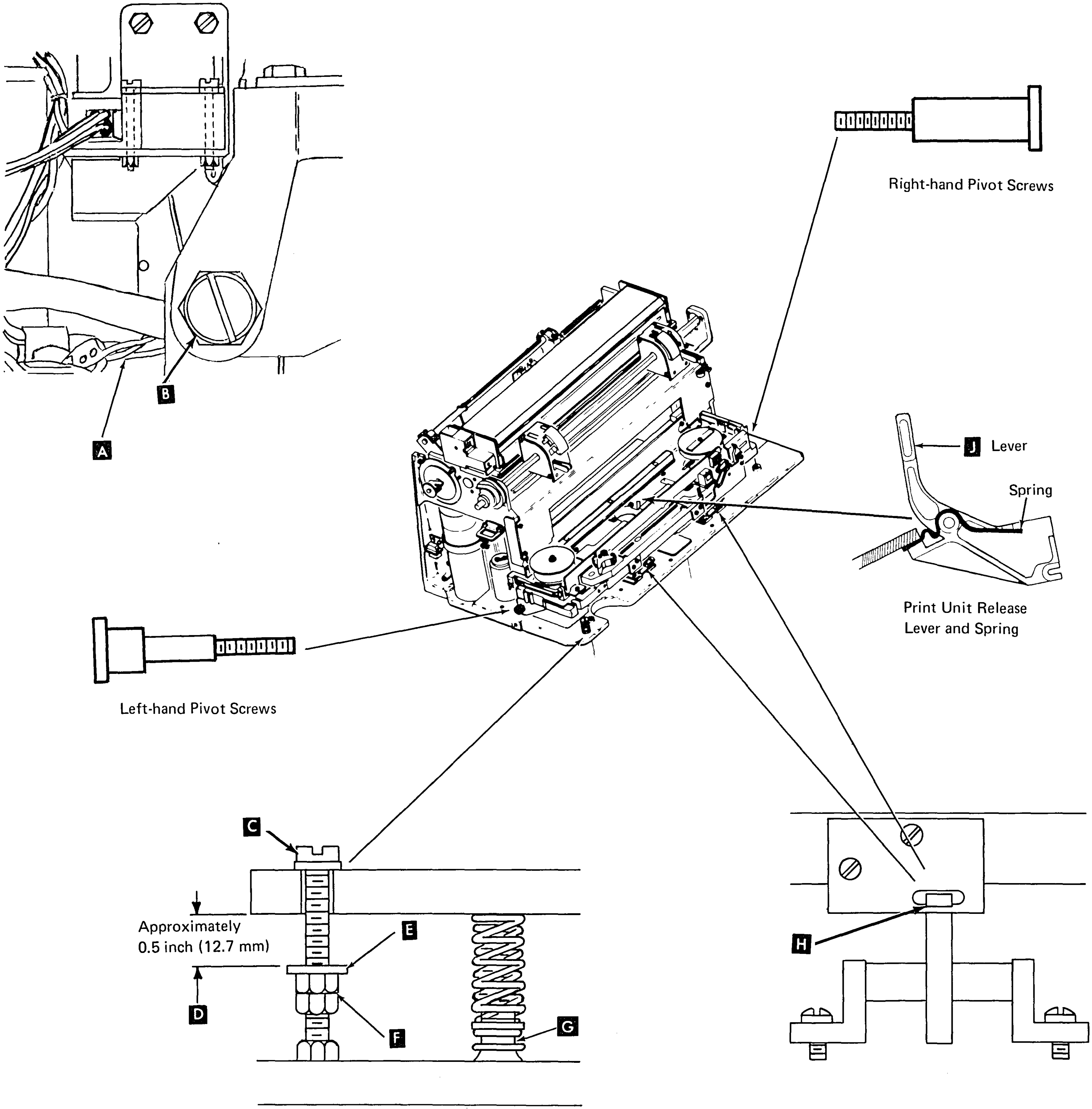
DANGER
The ribbon clutch solenoid becomes very hot after use. Be sure it is cool before performing maintenance.

Removal

1. Remove the printer covers (4.2.1) steps 1 through 3.
2. Remove the rear forms guide.
3. Remove the two printer mounting screws under the frame.
4. To make removing the print unit easier, the printer can be lifted, slid forward, and rested on the keyboard cover.
5. Unplug all printer cable plugs to the print unit (P1, P4, P5). Unplug P13 and remove the ground wire, if installed.
6. Loosen the bottom locknut and remove the print unit stop screw located at the left front of the printer **C** .
7. Loosen both print unit pivot screws **B** .
8. Support the print unit assembly and remove the pivot screws.
9. Remove the print unit by pulling forward until the guides disengage the paper clamp levers **H** .

Replacement

1. Raise the paper clamp levers **H** .
2. Tip the print unit backward slightly and place the levers into the guides.
3. While checking that the print unit clears the interlock switch, ribbon shield, and the hammer unit, carefully lower the print unit into position. Also check that the type belt drive motor cable **A** is located behind the print unit.
4. Install the pivot screws. Tighten the right screw slightly to be sure the print unit locates properly, then tighten both screws.
5. Plug in all cable plugs. Install ground wire, if removed.
6. Install two print unit return springs on each stud **G** .
7. Install and tighten the print unit stop screw **C** , then tighten the bottom locknut against the base.
8. Lower nuts **F** and washer **E** to touch the bottom nut. Open the print unit.
9. Adjust the upper nut upward until the washer **E** just touches the bottom of the print unit, then continue to turn the nut 3/4 ± 1/4 turn. Tighten the center nut against the upper nut. This adjustment results in approximately 0.5 inch (12.7 mm) **D** clearance between the bottom of the print unit and the spacer when the print unit is closed.
10. Close the print unit and ensure that the release lever **J** operates properly.
11. Make sure all printer cable plugs are in their sockets.
12. Replace cover, rear forms guide, and printer mounting screws.


B
A
Right-hand Pivot Screws
J Lever
Spring
Print Unit Release
Lever and Spring
Left-hand Pivot Screws
C
Approximately
0.5 inch (12.7 mm)
E
D
F
G
H

Print Unit Assembly (Continued)

4.2.10.2 Print Units With Pivot Pins

DANGER
The ribbon clutch solenoid becomes very hot after use. Be sure it is cool before performing maintenance.

Service Check

Make sure print unit is to the right to prevent print cut off.

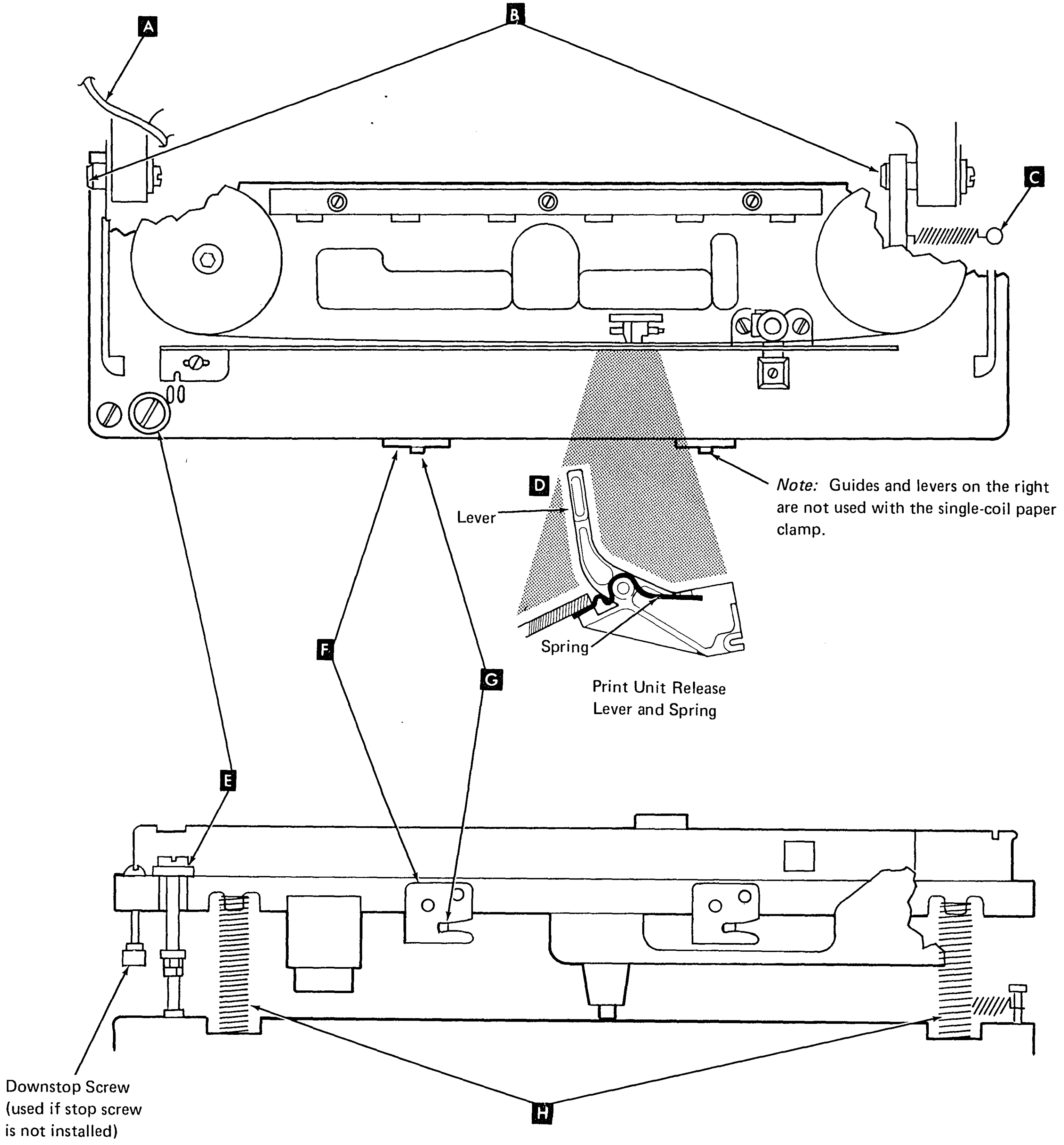
Removal

1. Remove the printer covers, keyboard cover, and divider (4.2.1).
2. If installed, remove print unit stop screw E by loosening the bottom locknut.
3. Unplug connectors P1 and P4. Remove the ground wire, if installed (near spring C).
4. Unhook spring C from the right end at the screw. Remove two springs H from under the print unit.
5. Open the print unit. Raise both ribbon guides.
6. **CAUTION**
   When removing the print unit, note that P5 and P13 are still connected.

   While supporting the print unit from both ends, slide the assembly to the left until the print unit clears the pivot pins B , and the guide(s) F clear the paper clamp lever(s) G .
7. Unplug connectors P5 and P13.

Replacement

1. Raise paper clamp lever(s) G .
2. Raise both ribbon guides.
3. Place the print unit on the base so that the pivot holes are aligned to the left of the pivot pins B . Be sure the motor cable (P4) is placed behind the print unit as shown A .
4. Replug connectors P5 and P13. Install the ground wire under the clamp.
5. While supporting the print unit, open the print unit release lever D . Move the assembly to the right until stopped by the left pivot. Be sure the unit pivots on both pins B and the paper clamp lever(s) G are in the guide(s) F .
6. Hook spring C on the screw.
7. Replug connectors P1 and P4.
8. Install print unit support springs H .
9. Perform print unit stop screw adjustment (4.2.10.3).
10. Install the print unit covers.



Note: Guides and levers on the right are not used with the single-coil paper clamp.

Print Unit Release Lever and Spring

Downstop Screw (used if stop screw is not installed)

4.2.10.3 Print Unit Stop Screw (50, 100, and 155 lpm)

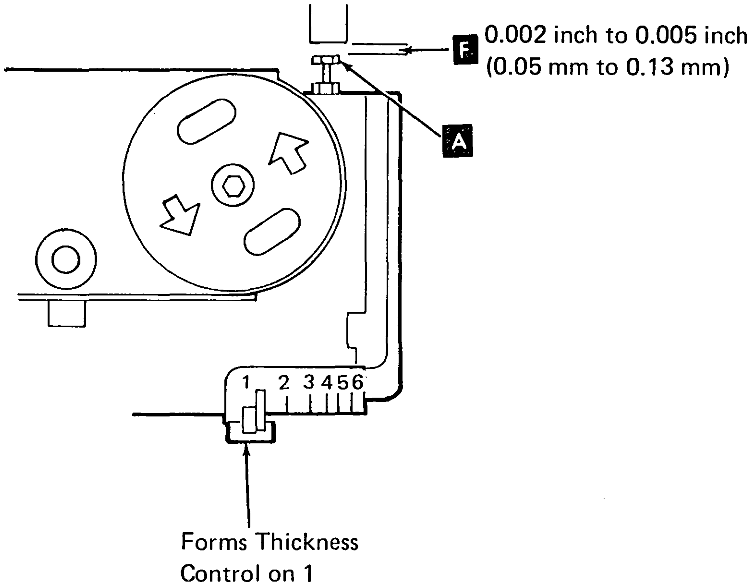
Machines with stop screw **A** .

Service Check

1. Open the cover and close the print unit.
2. Move the forms thickness control to 1.
3. Check for 0.002 inch to 0.005 inch (0.05 mm to 0.13 mm) at **F** .

Adjustment

Loosen the locknut and adjust screw **A** for 0.002 inch to 0.005 inch (0.05 mm to 0.13 mm).



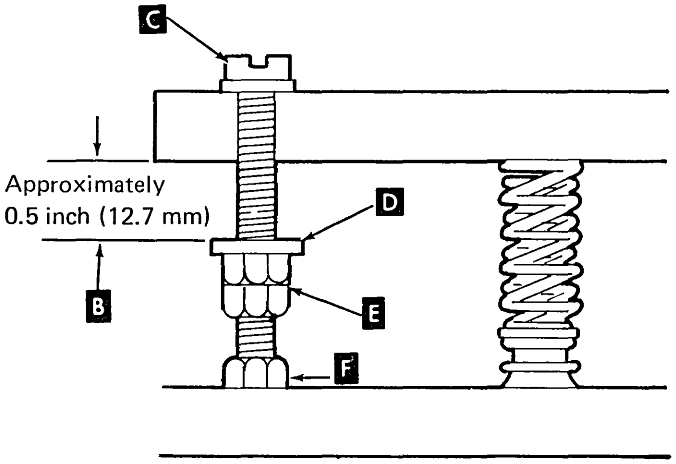
Machines with stop screw **C** .

Service Check

1. Open the cover and close the print unit.
2. Check for about 0.5 inch (12.7 mm) at **B** .

Adjustment

1. Remove the printer covers (4.2.1).
2. Loosen the bottom locknut **B** . Be sure stop screw **C** is tight in the base. Tighten the bottom locknut.
3. Lower nuts **E** and washer **D** to touch the bottom nut.
4. Open the print unit.
5. Adjust the upper nut upward until the washer **D** just touches the bottom of the print unit, then continue to turn the nut 3/4 ± 1/4 turn. Tighten the center nut against the upper nut.
6. Close the print unit.
7. Check for about 0.5 inch (12.7 mm) at **B** .
8. Install the printer covers.



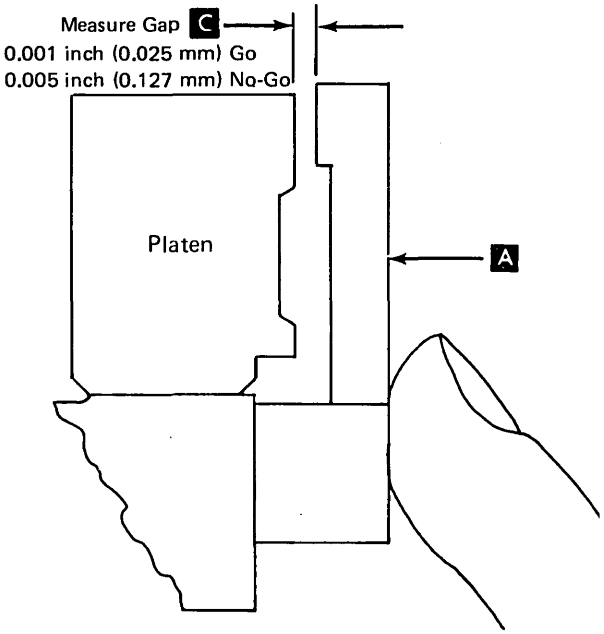
4.2.11 Platen Gap (50, 100, and 155 lpm)

Service Check

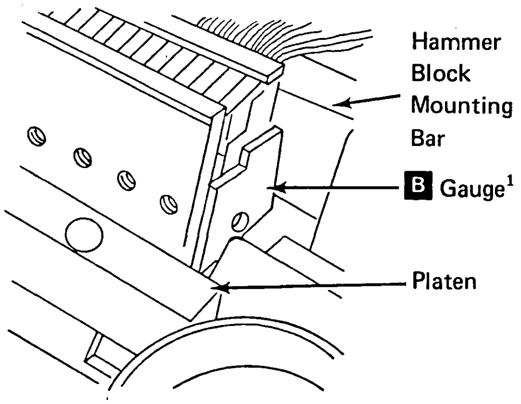
Note: Special tools are required. Gauge set B/M 1815365 includes:

Platen-to-Casting Gauge **A** (2) P/N 1815362
Platen Gap Gauge **B** (1) P/N 1814638[1]
4-40 Screws (2)

1. Remove the type belt (4.2.13).
2. Remove the print unit (4.2.10).
3. Remove the ribbon shield (4.2.36).
4. Hold the platen-to-casting gauge **A** near the right end of the platen as shown. Measure for a gap **C** between the platen and the gauge. Repeat for the left end of the platen. If the gap is not correct, do step 5 only; if the gap is correct, skip step 5.



5. Do the platen gap adjustments. (Omit the remaining steps in this service check.)
6. Replace the ribbon shield (4.2.36) and the print unit (4.2.10).
7. Remove the paper guide from around the hammers (four screws).
8. Close the print unit. Push down on the center of the print unit to remove any play in the support mechanism.
9. Move the forms thickness control to 6. Hold the platen gap gauge **B** [1] (hole side down as shown) against the hammer bar and the right hammer block assembly.



10. Lift the gauge about 0.060 inch (1.52 mm) from the edge of the forms guide, and set the forms thickness control on 1 to clamp the gauge.
11. Slowly, and with no downward pressure, move the forms thickness control toward 6. Observe the position on the forms thickness scale when the gauge drops (drop point). Repeat several times until a constant drop point is observed.
12. Place the gauge on the left side, then repeat steps 8, 9, 10, and 11.
13. The drop points in steps 11 and 12 should occur when the forms thickness control is between 2 and 4 with a maximum end-to-end difference of 1. If the drop point on either end is outside this range, the platen gap is wrong.
14. If the platen gap is not correct, do the forms path gap adjustment; then do the platen alignment.

---

[1] To ensure accurate adjustment, the printer *must* be in its normal operating position whenever this gauge is used.

4.2.11 50, 100, and 155 lpm Platen Gap (Continued)

Adjustments

To establish the correct platen gap, the following adjustments must be performed in sequence:

a. *Platen to Casting:* Locates the platen on the print unit casting using two gauges.
b. *Forms Path Gap:* Locates the print unit casting to the hammer bar by adjusting the eccentric in the support arm.
c. *Platen Alignment:* Aligns the platen so that it is parallel to the hammer bar.

Platen-to-Casting

Note: Use platen-to-casting gauges P/N 1815362 **A**

1. Remove the print unit (4.2.10).
2. Remove the ribbon shield (4.2.36).
3. Install special gauges **A** as shown:
   a. Ensure that the mounting surface is clean and flat.
   b. Install the gauges, using the two screws supplied in B/M 1815365.
4. Measure at both ends for a gap between the platen and the gauge as shown **D**. If both gaps are correct, go to step 5; otherwise, do steps a through f.
   a. The platen mounting screws **G** are located under the print position scale **H**. To expose the screws, cut away the parts of the scale that cover the platen screw recesses.
   b. Remove the sealant (if present) from the screw heads, then loosen the platen mounting screws.
   c. Place a 0.004 inch (0.10 mm) gauge between the platen and the right gauge, then push the platen against the gauges. Tighten the right screw slightly.
   d. Repeat step c for the left side.
   e. Measure gap **D** at both ends. Adjust again if necessary.
   f. Gradually tighten all mounting screws, then measure gap **D** again. Adjust again if necessary.
5. Remove the gauges **A**, then replace the ribbon shield (4.2.36).
6. Replace the print unit (4.2.10).
7. Do the forms path gap adjustment next.

Forms Path Gap

Note: Use platen gap gauge part number 1814638 **B**.

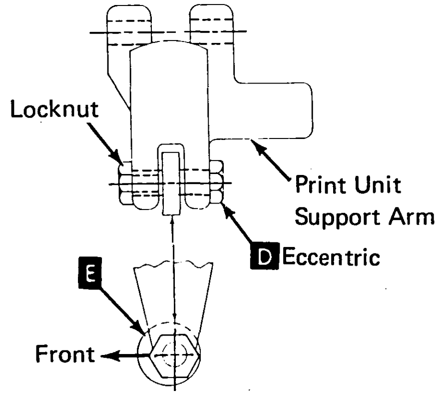
1. Remove the paper guide (four screws) from around the hammers, if not done before.
2. Close the print unit. Push down on the center of the print unit to remove any play in the support mechanism.
3. Move the forms thickness control to 6. Hold the gauge **B**[1] (hole side down as shown) against the hammer bar and the right hammer block assembly.
4. Lift the gauge about 0.060 inch (1.52 mm) from the edge of the forms guide and set the forms thickness control on 1 to clamp the gauge.
5. Carefully, and with no downward pressure, move the forms thickness control toward 6. Observe the position on the forms thickness scale when the gauge drops (drop point). Repeat several times until a constant drop point is observed.
6. Place the gauge on the left side, then repeat steps 2, 3, 4, and 5.
7. Determine the average of the right and left drop points.

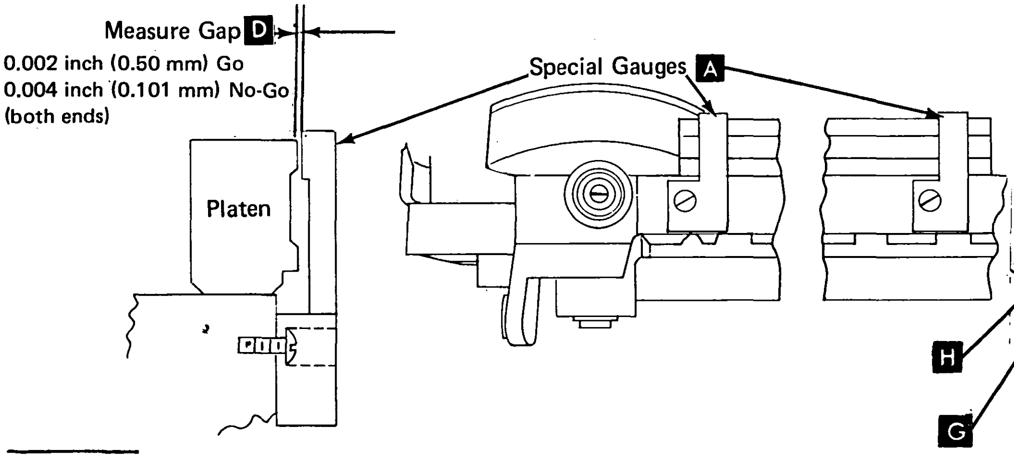
   For example:
   Right drop point = 3-1/2
   Left drop point = 5-1/2
   Average = 4-1/2

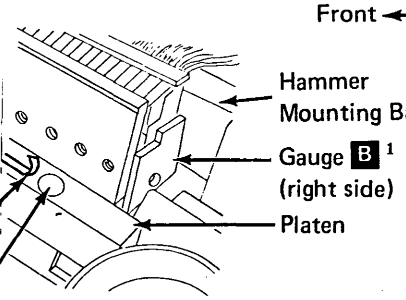
   a. Adjust the eccentric **E**, then repeat steps 3 through 7 until the average of the right and left drop points is 3 ± 1/2.

   Note: When adjusting, ensure that the high side of the eccentric is toward the front (operator side) **F**.

   b. If the difference between the right and left drop points is 1/2 or less, the platen gap is correct; replace the paper guide, type belt, and ribbon.
   c. If the difference between the right and left drop point is more than 1/2, do the platen alignment.







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[1] To ensure accurate adjustment, the printer *must* be in its normal operating position whenever this gauge is used.

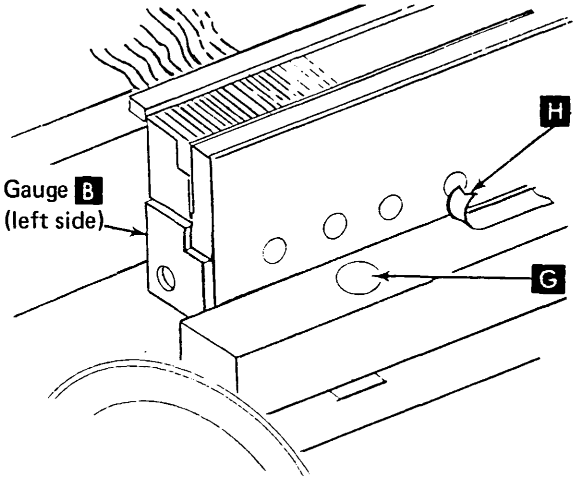
4.2.11 50, 100, and 155 lpm Platen Gap (Continued)

Adjustments (continued)

Platen Alignment

Note: Use platten gap gauge P/N 1814638 **B**[1].

1. Loosen the platen:
   a. The platen mounting screws **G** are located under the print position scale **H** . To expose the screws, cut away the parts of the scale that cover the platen screw recesses.
   b. Remove the sealant (if present) from the screw heads, then loosen the two end mounting screws **G** .



2. Close the print unit and set the forms thickness control on 3.

3. Place the gauge **B**[1] against the hammer bar and the left hammer block assembly. The hole side of the gauge should be on the upper edge of the rear forms guide. If needed, move the platen toward you until the gauge drops into position. Move the platen against the gauge and tighten the left mounting screw slightly.

4. Move the forms thickness control to 6 and remove the gauge. Place the gauge **B** (hole side down as shown) against the hammer bar and the hammer block on the right. If needed, move the platen toward you until the gauge drops into position. Move the control to 3. Carefully push the right end of the platen against the gauge and tighten the right mounting screw slightly.

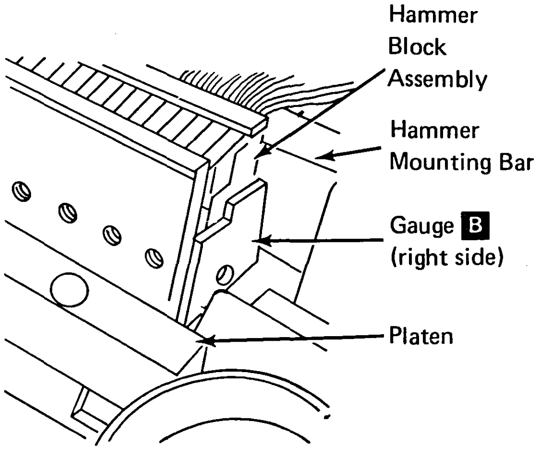
5. Move the forms thickness control to 6 and remove the gauge. Place the gauge on the left side (same as step 3) and move the control to 3. Loosen the left mounting screw. Carefully push the left end of the platen against the gauge and tighten the left mounting screw slightly.

6. Lift the gauge (still on the left side) approximately 0.060 inch (1.52 mm) off the upper edge of the rear forms guide and move the forms thickness control to 1. Ensure that the gauge is against the side of the hammer block assembly. Carefully, and with no downward pressure, move the forms thickness control toward 6. Observe the position on the forms thickness scale when the gauge drops (drop point). Repeat several times until a constant point is observed. The gauge should drop when the forms thickness control is between 2-1/2 and 3-1/2.

7. Remove the gauge and repeat step 6 with the gauge on the right side.

8. Gradually tighten the screws slightly until all screws are tight.

9. Verify the drop points again. The drop points in steps 6 and 7 should occur when the forms thickness control is between 2-1/2 and 3-1/2, with a maximum end-to-end difference of 1/2. If the drop point on either end is outside this range, repeat steps 2 through 6. Do not adjust with the support arm eccentric.



Note: If the difference from end-to-end is more than 1/2 division on the forms thickness scale, loosen the center platen mounting screw and the screw on the end needing adjustment. Adjust the platen for the correct drop points and tighten the screws. (See steps 6, 7, 8, and 9.)

10. If necessary, install a new print position scale **H** on the platen as shown. Align the print positions with the matching hammer positions.

11. Replace the paper guide (four screws), ribbon, type belt, and covers.

4.2.12 Platen (50, 100, and 155 lpm)

Removal

1. Turn the power off.

2. Open the printer covers.

3. Remove the type belt (4.2.13) and remove the ribbon from the ribbon guide.

4. Open the print unit.

5. The platen mounting screws **G** are located under the print position scale **H** . To expose the screws, cut away the parts of the scale that cover the platen screw recesses.

6. Remove the sealant (if present) from the screw heads, then remove the screws **G** and the platen.

7. If necessary, remove the ribbon shield from the platen (4.2.36).

Replacement

1. Replace ribbon shield if it was removed.

2. Install the platen with the mounting screws and washers. Tighten the screws slightly (so that the platen can be moved easily).

3. Adjust the platen by doing all of the *Platen Gap Adjustments* (4.2.11).

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[1] To ensure accurate adjustment, the printer *must* be in its normal operating position whenever this gauge is used.

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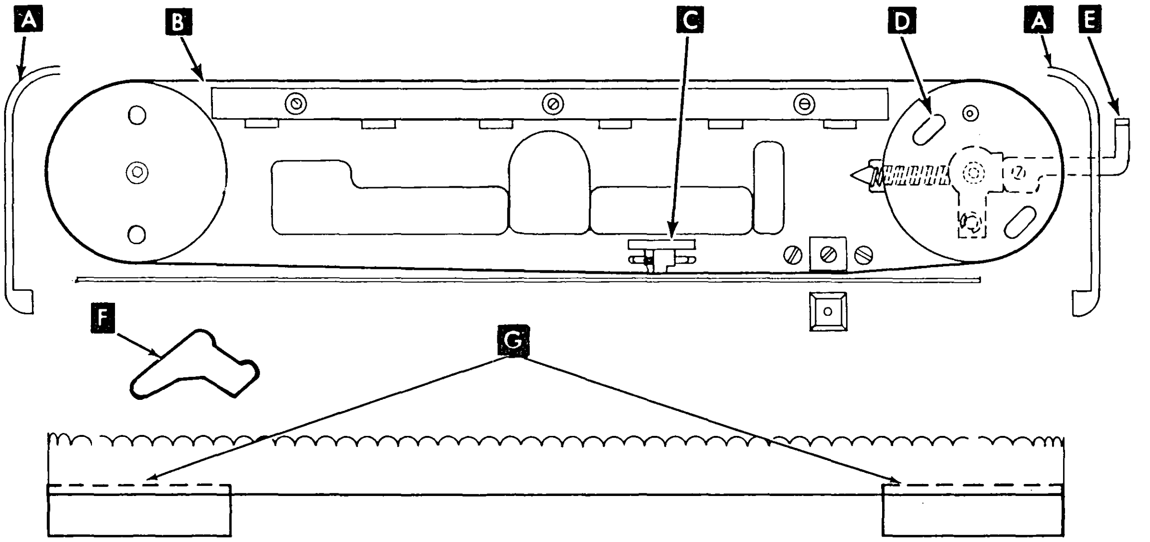
4.2.13 Type Belt (50, 100, and 155 lpm)

Removal

1. Turn the power off.
2. Open the printer covers.
3. Pull the print unit release lever **C** toward the front of the machine to open the print unit (the print unit pivots down).
4. Raise both ribbon guides **A**. Remove the ribbon from the guides and place it on top of the cassette.
5. Open the ribbon drive release lever **F**.
6. Pull the type belt release lever **E** toward the front of the machine.
7. Remove the type belt **B**.

Replacement

1. Raise both ribbon guides **A**.
2. Push the type belt release lever **E** toward the back of the machine.
3. Install the type belt evenly around the top of the pulleys **G**. Make sure the type belt is positioned between the ribbon shield and the platen.
4. Using the finger hole in the pulley **D**, turn the pulley counterclockwise until the belt rides down to the positioning rollers located underneath the platen.
5. Place the ribbon on the ribbon guides **A** then close the ribbon drive release lever **F**.
6. Lower the ribbon guides and turn the type belt pulley to ensure that the ribbon tracks properly.
7. Press the print unit release lever **C** toward the back of the machine, close the cover, and restore power.



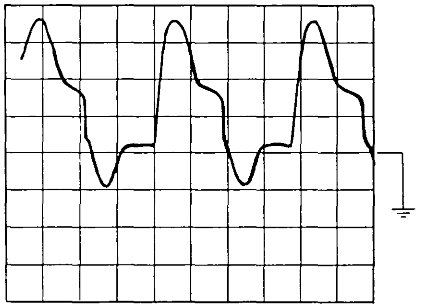
Static Test for Type Belt Binds

1. Turn the power off.
2. Use the gram gauge to pull the belt. If more than 150 grams is needed to keep the belt moving, there is too much drag.

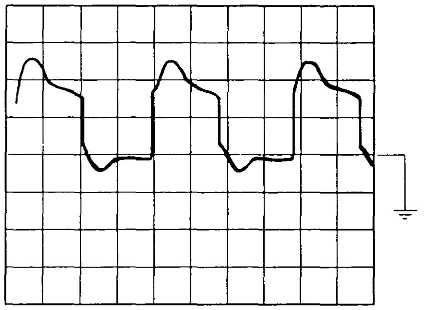
Dynamic Test for Type Belt Binds

1. Connect a X10 scope probe to P-4 pins 1, 2, 3, or 4 (double yellow or double black wires).
2. Set the scope for internal sync, 20 volts/division, and 1 ms/division.

   You should see a picture similar to the one below.



If there is excessive drag, the scope picture will look like this.



Note the loss of amplitude in the negative portion of the waveshape.

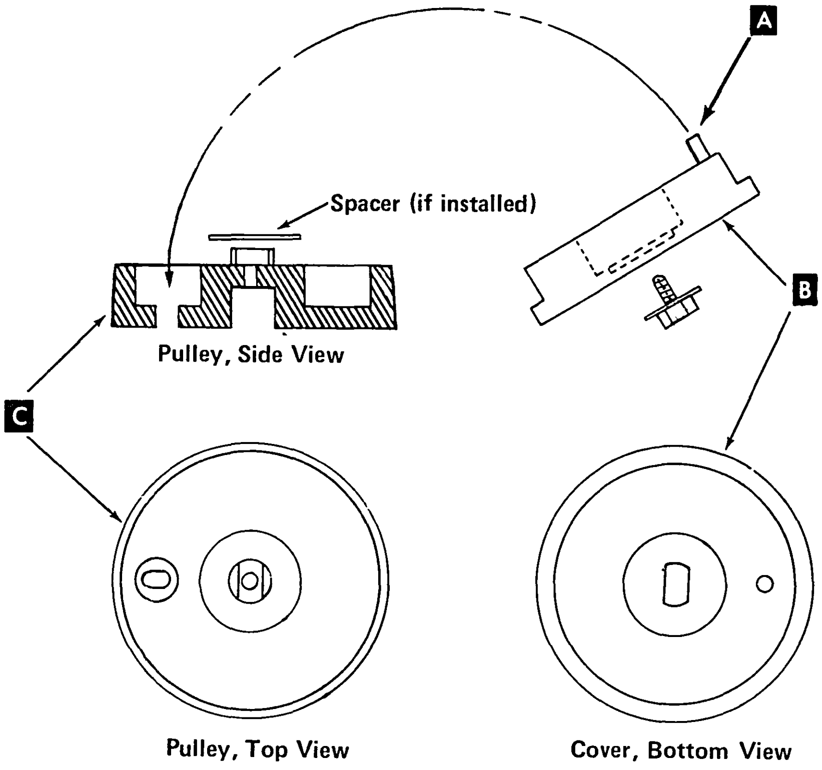
4.2.14 Type Belt Drive Pulley Assembly

Removal

1. Remove the type belt (4.2.13) and the ribbon cassette.
2. Remove the cover **B** by removing the screw and washer.
3. Remove the spacer (if installed).
4. Remove the pulley **C** by pulling it straight up.
5. **CAUTION**
   Cleaning fluid and tape transport cleaners contain trichlorethane that will melt plastic parts. Use only isopropyl alcohol (PN 2200200) to clean the belt drive and idler pulleys.

Replacement

1. Install the pulley on the motor shaft.
2. If a spacer was removed, install and align it on the motor shaft.
3. Install the cover **B** :
   a. Ensure that the pin **A** engages the hole in the pulley, and that the hole in the cover aligns with the motor shaft.
   b. Install the washer and the screw.
4. After installing the pulley assembly, verify that the pulley can be moved up and down on the motor shaft. To verify, hold the outside of the pulley from opposite sides and lift it evenly. The pulley should move up and down freely.
5. Install the type belt and ribbon cassette.



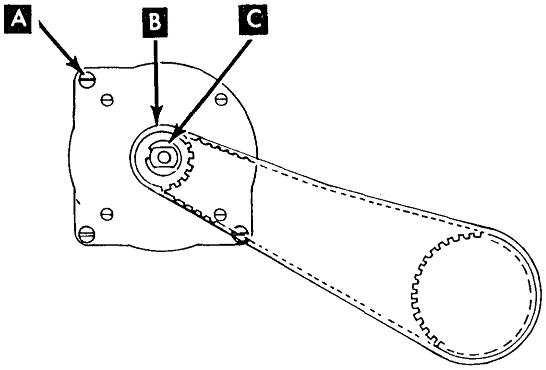
4.2.15 Type Belt Motor

Removal

1. Remove the printer covers (4.2.1) steps 1 through 3.
2. Remove the print unit assembly (4.2.10).
3. Remove the type belt (4.2.13) and ribbon cassette.
4. Remove the type belt drive pulley assembly (4.2.14).
5. Loosen tension on the ribbon drive belt by loosening three screws holding the ribbon drive assembly.
6. Disconnect the belt motor plug (P4).
7. Remove the clip **C**, and the gear **B**. (Do not lose the key in the motor shaft.)
8. Remove the motor end of the ribbon drive belt.
9. Remove the three mounting screws **A** and turn the motor so the cable lines up with the slot.
10. Remove the motor through the top of the print unit.

Replacement

1. Install the motor (wires toward back of machine), ribbon drive gear, clip, and ribbon drive belt.
2. Reconnect the belt motor plug (P4).
3. Adjust the ribbon drive belt tension (4.2.31).
4. Install the type belt drive pulley assembly.
5. Install the ribbon cassette, type belt, ribbon, and printer covers.



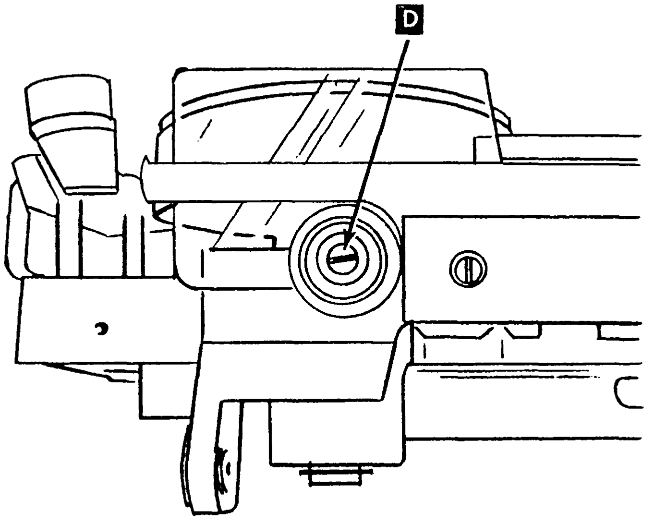
4.2.16 Type Belt Positioning Rollers

Removal

1. Remove the print unit assembly (4.2.10).
2. Remove the positioning roller mounting screw(s) **D** and the roller(s).

Replacement

Replace in the reverse order of removal.



4.2.17 Type Belt Idler Pulley

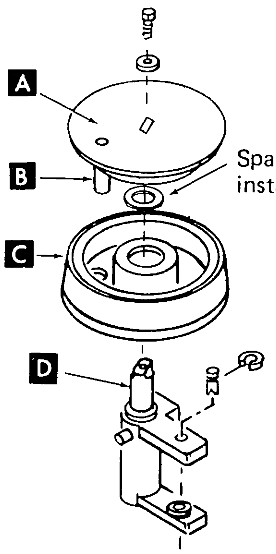
Removal

1. Remove the type belt (4.2.13).
2. Remove the cover **A** by removing the screw and washer.
3. Remove the spacer (if installed).
4. Remove the pulley **C** .

CAUTION
Cleaning fluid and transport cleaners contain trichlorenthane that will melt plastic parts. Use only isopropyl alcohol (PN 2200200) to clean the belt drive and idler pulleys.

Replacement

1. Install the pulley **C** on the motor shaft.
2. If a spacer was removed, install and align it on the shaft.
3. Install the cover **A** :
   a. Ensure that the pin **B** engages the hole in the pulley, and that the hole in the cover aligns with the motor shaft **D** .
   b. Install the washer and screw.
4. To verify that the pulley can be moved up and down on the shaft, hold the outside rim of the pulley from opposite sides and lift evenly; the pulley should move up and down freely.
5. Install the type belt (4.2.13).



4.2.18 Type Belt Idler Pulley Pivot Assembly

4.2.18.1 Without Clevis (Old Style)

Removal

1. Remove the printer covers (4.2.1) steps 1 through 3.
2. Remove the print unit (4.2.10).
3. Remove the ribbon cassette (4.2.28) and type belt (4.2.13).
4. Remove the type belt idler pulley (4.2.17).

   Note: Do not lose the plastic spacer on the bottom of the pulley.

5. **CAUTION**
   The type belt release lever is under spring pressure.

   Remove type belt release lever **G** .

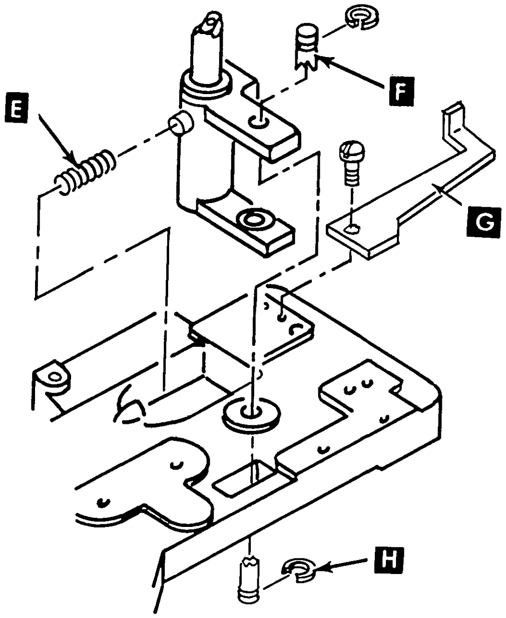
6. **DANGER**
   Spring **E** compression is high; use caution when removing.

   Remove the compression spring from the stud **E** .

7. Remove the bottom C-clip **H** that holds the pivot shaft to the mounting block.
8. Remove the pivot shaft **F** through the top.
9. Remove the pivot assembly through the hole in the top of the print unit.

Replacement

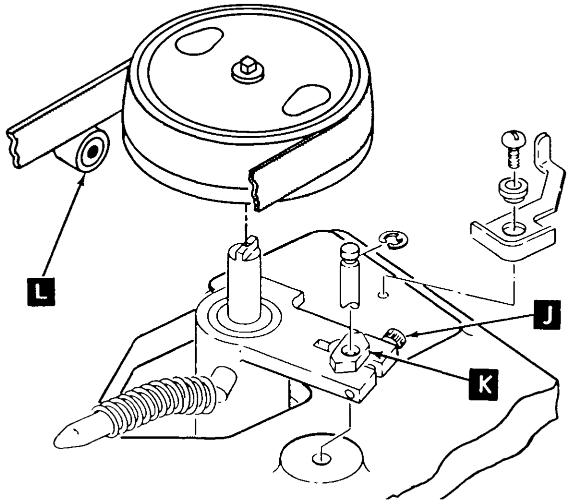
Install the plastic spacer on the shaft and replace in the reverse order of removal.



4.2.18.2 With Clevis (New Style)

Adjustment

Loosen screw **J** and adjust eccentric **K** to prevent the idler pulley **C** from touching the pulley cover **A** . While turning the pulley cover with the belt installed, you should see the belt riding on the front roller bearing **L** .



4.2.19 Transducer Assembly (50, 100, and 155 lpm)

Service Check

1. Be sure the roller **B** is clean, and the cleaning blade **A** is positioned as shown. Loosen the screw in the roller and reposition the blade if needed. Ensure that the plastic pad is fastened to the blade.

   Note: Older machines have a metal blade with a plastic pad, newer machines have a plastic blade and no pad.

2. While rotating the type belt, ensure that the type belt turns the roller **B** and the roller is not worn.

3. Turn the power off.

4. Check for 0.004 inch ± 0.002 inch (0.10 mm ± 0.05 mm) gap between the transducer tip **D** and a timing mark on the type belt **C**.

5. The resistance of the transducer is 465 nominal measured on pins 1 and 2 of P5 (emitter and impression control).

   Note: For oscilloscope setup, see 4.4.0.

Adjustment

CAUTION
The transducer can be damaged if the timing marks on the type belt strike the transducer tip while the belt is moving.

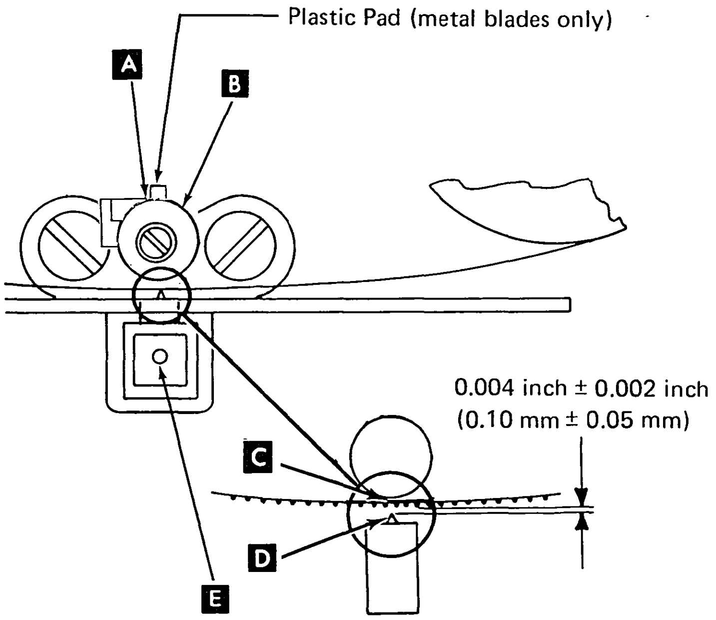
1. Remove the type belt (4.2.13).

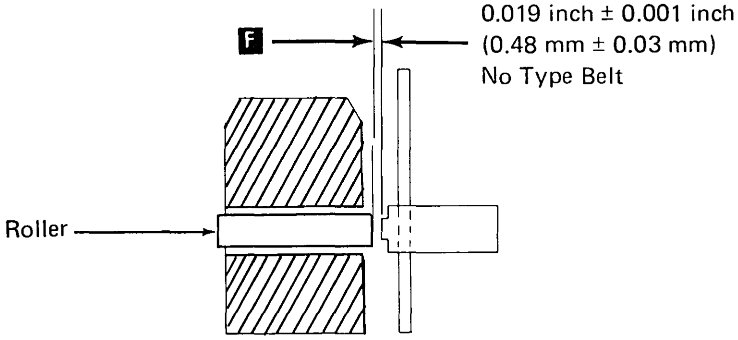
   CAUTION
   Do not overtighten the transducer clamping screws.

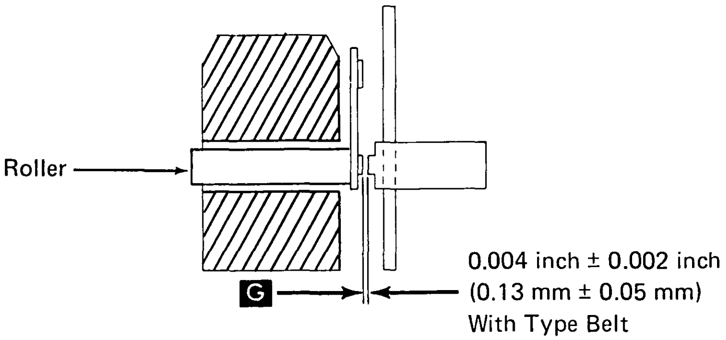
2. Loosen screw(s) **E** and adjust the transducer in the mounting block to obtain 0.019 inch ± 0.001 inch (0.48 mm ± 0.03 mm) clearance **F** between the transducer tip and the guide roller.

3. Install the type belt (4.2.13). Rotate the type belt pulley until a timing mark is in line with the transducer tip.

4. Adjustment steps 2 and 3 should result in a clearance of 0.004 inch ± 0.002 inch (0.13 mm ± 0.05 mm) **G** between the transducer tip and a timing mark on the type belt. If clearance is not correct, repeat adjustment.







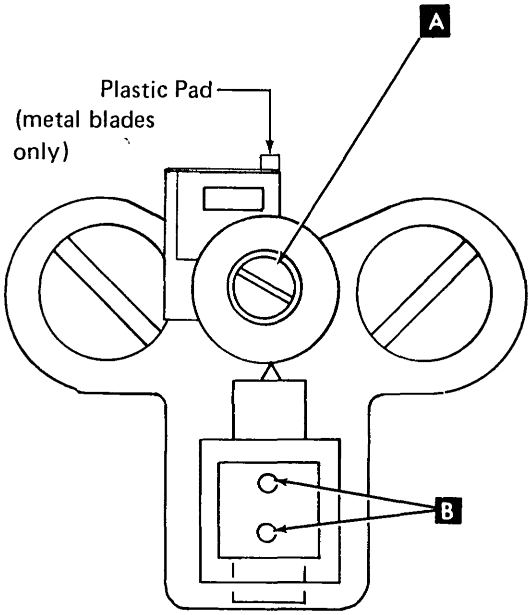
4.2.20 Transducer

Removal

1. Open the printer cover.
2. Remove the type belt (4.2.13).
3. Unplug the transducer plug (P5). If P5 is a 4-position plug, remove transducer terminals 1 and 2.
4. Remove the type belt guide roller by removing one screw **A** .
5. Loosen the transducer mounting screw(s) **B** and remove the transducer from the rear of the belt guard.

Replacement

1. Replace in the reverse order of removal. Place the brown wire in 1, black in 2 on P5.
2. Perform the transducer adjustment (4.2.19).



4.2.21 Impression Singleshot Potentiometer (50, 100, and 155 lpm)

Adjustment

1. Set the forms thickness control to 4.
2. Load Program ID PRT3, and select option 2.
3. Loosen the screw **F** and adjust the potentiometer **G** to indicate between 427 μs and 443 μs.
4. Check adjustment by setting the forms thickness control to 3; the display should indicate between 327 μs and 361 μs.
5. Set the forms thickness control to 1; the display should indicate between 221 μs and 302 μs. Readjust as necessary to obtain the values in steps 3 and 4.
6. If the potentiometer cannot be adjusted within the tolerance, replace the potentiometer and adjust it.

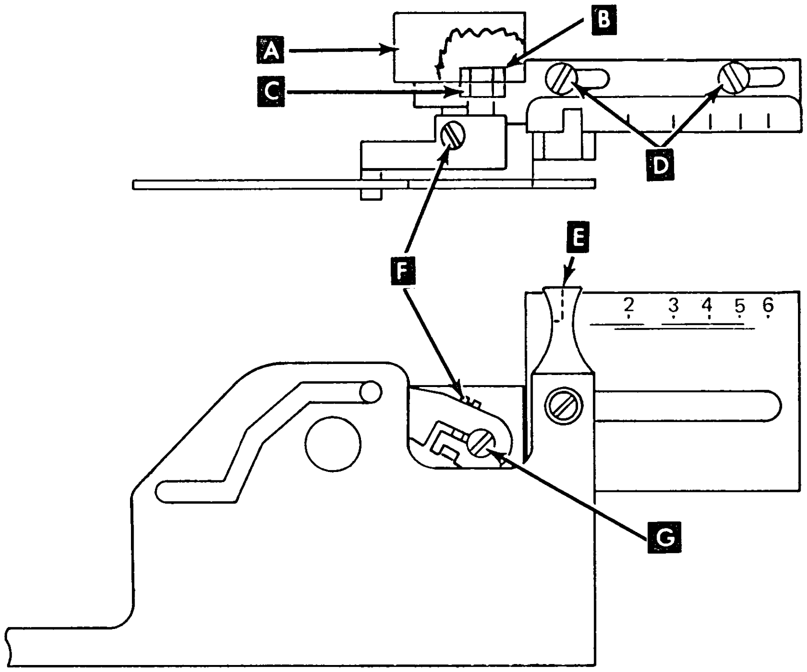
Removal

1. Turn the power off. Open the printer covers.
2. Loosen the nut **C** and pull the cover **A** off the potentiometer shaft.
3. Unplug the impression potentiometer plug P5 or P13.

   Note: Some potentiometers use P13; others use P5-3 and 4. If P5, remove potentiometer terminals 3 and 4.
4. Loosen screw **F** and remove two screws **D** .
5. Remove the potentiometer and bracket assembly.
6. Slide the arm off the shaft. Remove nut **B** and remove the potentiometer from the bracket assembly.

Replacement

1. Assemble the potentiometer to the bracket assembly and the arm to the shaft.
2. Move the forms thickness control to the extreme left.
3. Install the bracket assembly and align number 1 on the scale to the forms thickness control **E** and tighten the two mounting screws **D** .
4. Move the forms thickness control to 4.
5. Connect an ohmmeter to leads 3 and 4 and adjust the potentiometer **G** for 5000 ohms. Tighten the screw **F** slightly.
6. Install the terminals in the plug if needed. Replug the connector.
7. Perform the potentiometer adjustment (4.2.21). After the adjustment is made, check for a gap between the arm and bracket and tighten the screw **F** .

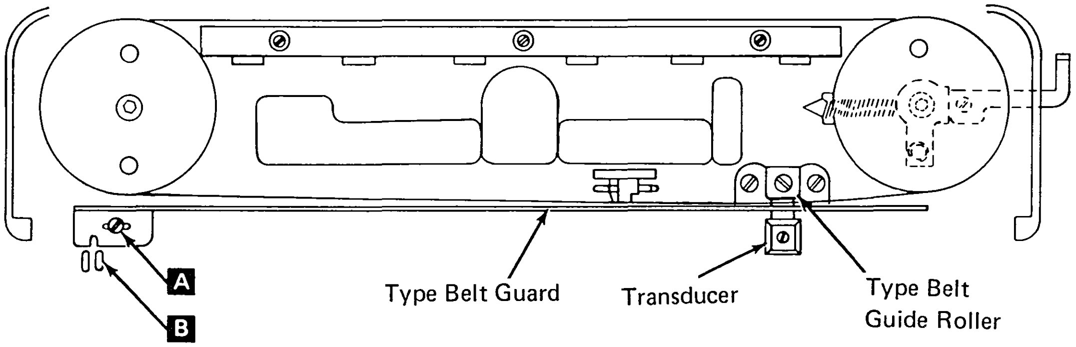


4.2.22 Transducer Position (Character Cutoff)

Adjustment

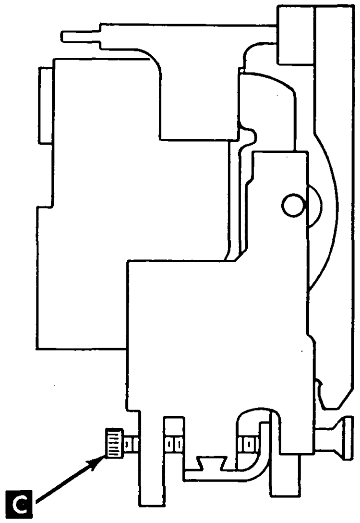
The type belt guard, transducer mounting block, and the type belt guide roller are separate parts but move as one unit when assembled. The right end of the assembly is spring loaded to the print unit. The left end is fastened to the print unit with a mounting screw **A**. When an adjustment is made, loosen only the left mounting screw. If the screw in the type belt guide roller is loosened, move the roller toward the transducer and tighten the screw firmly.

1. Perform the transducer assembly service check (4.2.19).
2. Check the potentiometer adjustment (4.2.21).
3. Install six-part forms if available; if not, use any multiple-part forms and set forms thickness control accordingly.
4. Print a pattern of Hs by running program ID PRT9. Check for general character cutoff on every other position across the entire print line.
5. Make adjustment by loosening the screw **A**, inserting a screwdriver at **B**, and adjusting the assembly minimum cutoff across the print line.



4.2.23 Hammer Flight Time (50, 100, and 155 lpm)

1. Remove the printer covers.
2. Raise the card gate.
3. Set the forms thickness control to 6 and install six-part forms if available; if not, use any multiple-part forms and set control accordingly.
4. Print a test pattern of Hs by running program ID PRT9.
5. Check for character cutoff on the sixth copy.
6. Adjust the hammer stop screw **C** until the hammer prints without character cutoff on the last sheet.
7. Close the card gate and replace the covers.



4.2.24 Hammer Coil (50, 100, and 155 lpm)

Removal

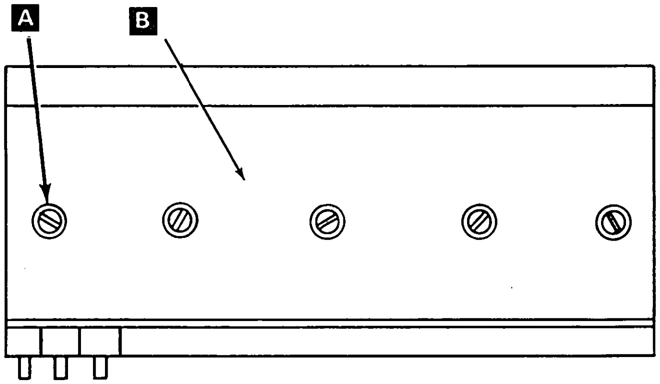
Note: Leave the print unit closed in coil removal and replacement.

1. Open the printer covers and remove the paper guide around the hammer unit (four screws).
2. Remove five screws **A** and the hammer retainer plate **B** .

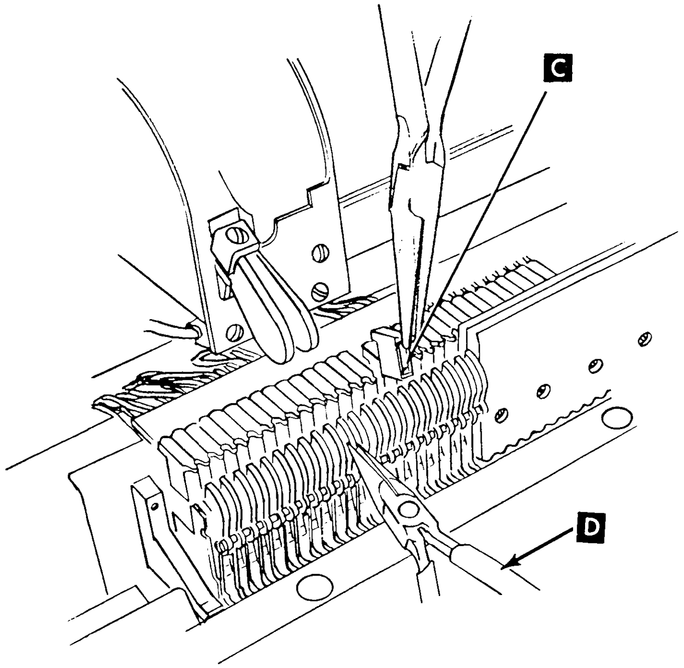
   Note: The hammer springs and plungers are captive and cannot fly out.
3. Each hammer block assembly has one pivot pin. While holding the lower end of the hammers in toward the comb bar, use duck bill pliers and slowly work the hammers out evenly from the top **D** .
4. Carefully tilt the tops of the group of hammers toward you until they rest against the type belt.
5. While holding adjacent coils in position, remove the defective coil **C** from the connector with needle nose pliers.
6. Check the appearance of adjacent coils. If adjacent coils appear damaged, replace the coils.

Replacement

1. Check the resistance of the new coil for approximately 4 ohms or compare it with a known good coil in the printer.
2. Check that the pins on the new coil are straight to prevent damage when inserted in the connector, and install the coil.
3. Carefully position the hammers back into the comb bar and coils.
4. The hammer retainer plate has a small hole on the left end and an oblong hole on the right end. Install the plate with the two end screws and tighten slightly, still allowing for plate movement.
5. Install the remaining three screws and tighten the screws from left to right toward the oblong hole to eliminate any bow in the hammer retainer plate.
6. Press each hammer face of the group removed with a pencil, spring hook, or similar object. If a hammer(s), is noticeably recessed (offset), the bumper strip between the hammer and the hammer stop screw might be out of location. If so, remove the hammer block (4.2.26) and tuck the bumper strip in place with a small screwdriver.
7. Install the hammer block and plug the connectors with the labels facing upward.
8. Install the paper guide with four screws.
9. Check hammer flight time for character cutoff (4.2.23, step 4).



Hammer Block, Front View



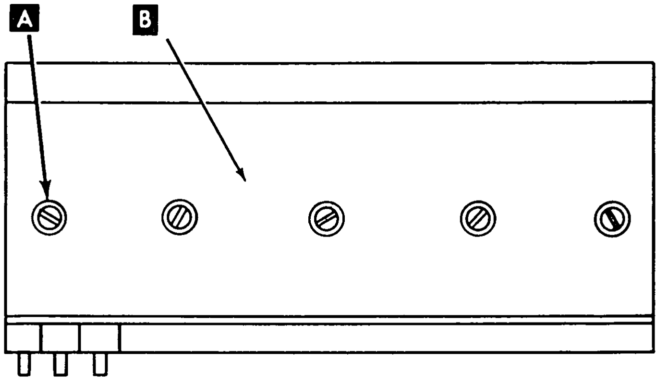
4.2.25 Hammer (50, 100, and 155 lpm)

Note: Interchanging hammers might change flight time. Keep hammers in original positions.

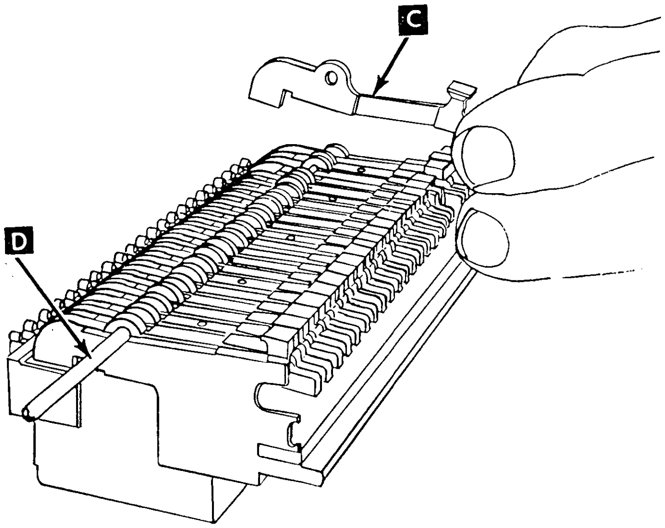
Removal

1. Remove the hammer block assembly (4.2.26).
2. Remove five screws **A** and the hammer retainer plate **B**.

   Note: The hammer springs and plungers are captive and cannot fly out.
3. Each hammer block assembly has one pivot pin. With the hammers facing upward, use a pointed object such as the tip of a pencil to start the pivot pin out of the hammer block assembly. Pull the pivot pin **D** just past the defective hammer and remove the hammer **C** .



Hammer Block, Front View



Replacement

1. Install the new hammer and slide the pivot pin back into location. (Check that the bumper strips between the back of the hammers and the hammer adjusting screws are still in their proper location.)
2. The hammer retainer plate has a small hole on the left end and an oblong hole on the right end. Install the plate with the two end screws and tighten slightly, still allowing for plate movement.
3. Install the remaining three screws and tighten the screws from left to right toward the oblong hole to eliminate any bow in the retainer plate.
4. Install the hammer block assembly and plug the connectors with the label facing upward.
5. Install the paper guide with four screws.
6. Check hammer flight time (4.2.23).

4.2.26 Hammer Block Assembly (50, 100, and 155 lpm)

Removal

1. Remove the printer covers (4.2.1) steps 1 through 3 and open the print unit.
2. Remove the paper guide (four screws).
3. Remove the two cables B from the hammer block.
4. Remove the three screws A (accessible from the back of the printer) that hold the hammer block assembly to the mounting bar, and remove the hammer block assembly from the front of the printer.

Replacement

1. Replace in the reverse order of removal.
2. Perform the hammer flight time adjustment (4.2.23) for any print position displaying character cutoff.

Disassembly

1. Remove the printer covers.
2. Remove the hammer block assembly (4.2.26).
3. **CAUTION**
   Hold the two halves D and E of the hammer block together during removal of the screws to avoid losing hammer return springs and plungers C .

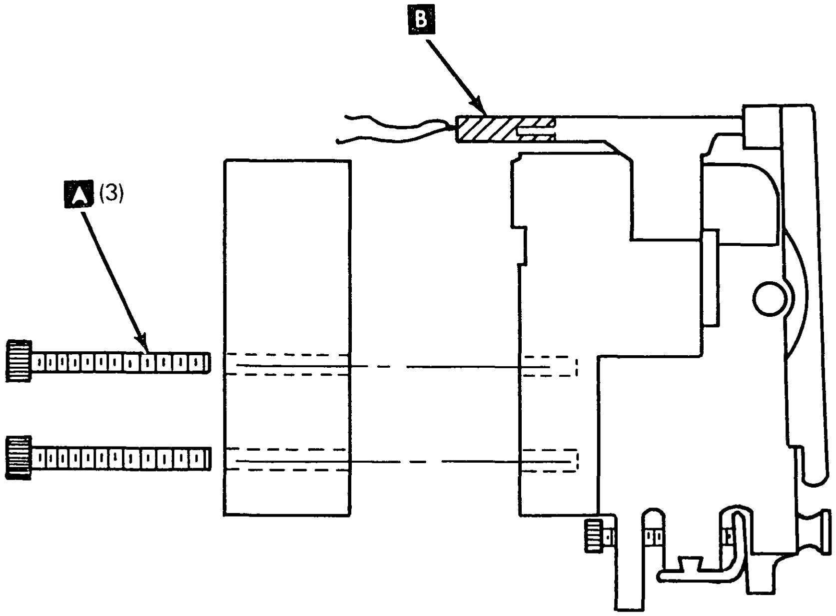
   Remove two screws F holding the two halves of the hammer block assembly together.
4. *Note:* While disassembling, watch for the hammer return springs. The springs can stick to the hammers and fall off.

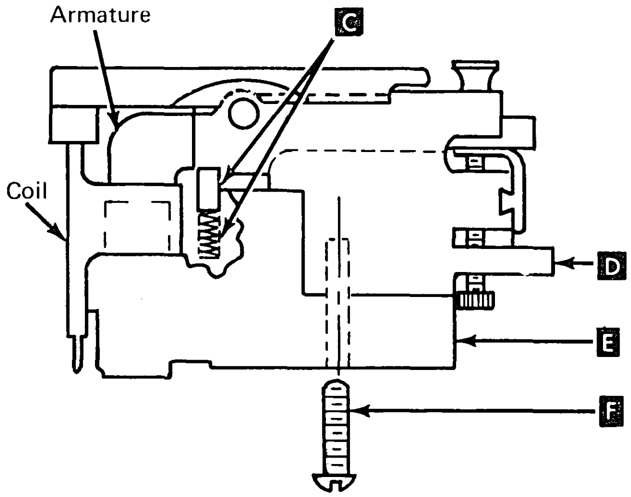
   While holding pressure on the two halves, lay the assembly, hammer side up, on a flat surface. Carefully lift and separate the armature pivot assembly from the magnet assembly.

Reassembly

1. Lay the magnet portion down on a flat surface with the springs and plunger facing upward. Check that all springs and plungers are in place.
2. Insert armature end of hammers into the coils to aid in horizontal alignment.
3. Slowly push the hammers down against the spring tension.
4. Check movement of hammers for proper hammer engagement with plungers.
5. While holding the assembly together, turn it over so that the hammer section faces down. Fasten the two halves together (two screws).
6. Check the movement of each hammer to verify that all hammers, springs, and plungers were assembled properly.
7. Loosen each of the two screws F one full turn. Mount the hammer block assembly onto the hammer bar (4.2.26).

   Note: Loosening the screws allows for heat expansion.

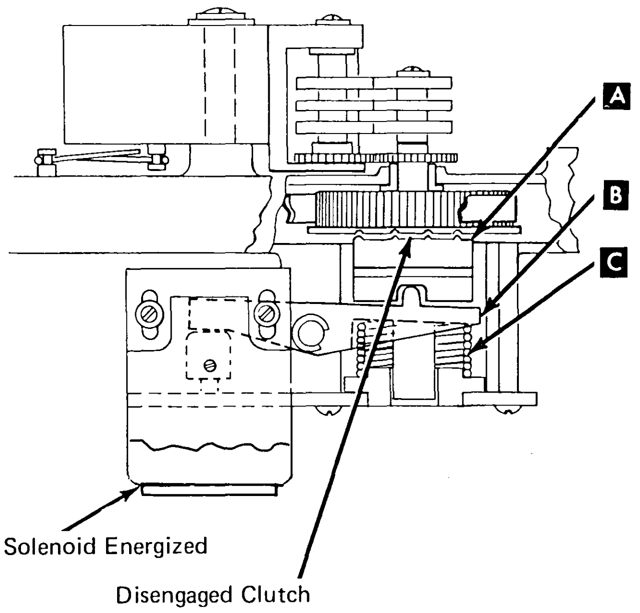


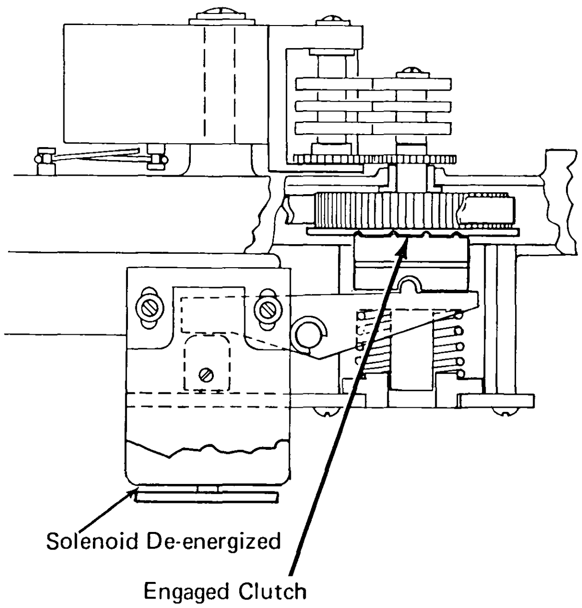


4.2.27 Ribbon Drive Description

The printer uses an inked endless fabric ribbon contained in a sealed cassette and fed by a clutch drive mechanism. The clutch wheel is operated by a toothed belt connected to the type belt drive motor that advances the ribbon only during printing.

The clutch engages by spring action and disengages by solenoid action. When the solenoid is energized (print unit closed and no print operation), the solenoid pivots the lever **B** and compresses the spring **C** within the mechanism allowing the toothed section of the clutch **A** to disengage from the drive wheel. During printing, the solenoid is de-energized and the spring tension engages the teeth in the clutch to turn the ribbon drive shaft.





4.2.28 Ribbon Cassette (50, 100, and 125 lpm)

Removal

1. Open the printer covers.
2. Open the print unit.
3. Raise both ribbon guides.
4. Open the ribbon drive release lever **A** .
5. Press the ribbon cassette release button **C** located at the right end of the ribbon cassette and slide the ribbon cassette to the right, off the drive roll assembly, and out of the mounting bracket.
6. Remove the ribbon from the guides and remove the ribbon cassette from the machine.

Replacement

1. Pull about 6 inches (152.4 mm) of ribbon from the left end of the cassette and place the ribbon between the drive roll release lever **A** .
2. Place the ribbon cassette in the printer so that the left end of the cassette is about 1 inch (25.4 mm) from the ribbon drive roll. (The right end of the cassette will cover the release button.)
3. Press down on the cassette and slide it to the left until it latches.
4. Raise the ribbon guides, and feed the ribbon through the slot in the bottom of the left guide, then on around the guide.
5. Close the ribbon drive release lever **A** .
6. Pull about 12 inches (304.8 mm) of ribbon out of the right end of the cassette and feed the ribbon from the left guide on around the right guide.
7. Take up any extra ribbon slack by rotating the right pulley counterclockwise. When the ribbon is tight, it should be twisted at the place shown **D** .
8. Lower the ribbon guides.
9. Turn the right pulley counterclockwise to feed the ribbon down between the type belt and the ribbon shield. Continue rotating the pulley to make sure the ribbon is feeding properly.
10. Close the print unit; then close the printer covers.

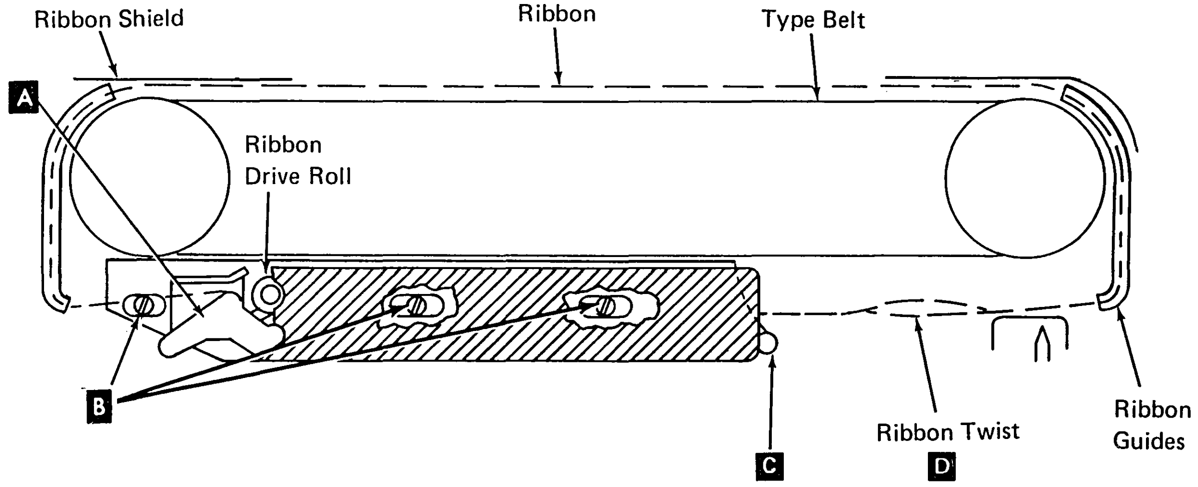
4.2.29 Ribbon Drive Assembly

Removal

1. Open the printer covers.
2. Remove the type belt (4.2.13).
3. Remove the type belt drive pulley assembly (4.2.14).
4. Remove the ribbon cassette (4.2.28).
5. Remove the ribbon drive assembly by removing the three mounting screws **B** .

Replacement

1. Install the ribbon drive assembly and perform the ribbon drive belt tension adjustment (4.2.31).
2. Install the type belt drive pulley assembly and type belt.
3. Check the ribbon solenoid adjustment (4.2.32).
4. Install the ribbon cassette and check that the ribbon is tracking properly (4.2.28).
5. Close the cover.



4.2.30 Ribbon Drive Clutch

DANGER
A spring within the clutch mechanism can fly out when disassembling the clutch. Hold the bracket toward the floor and release the spring tension slowly.

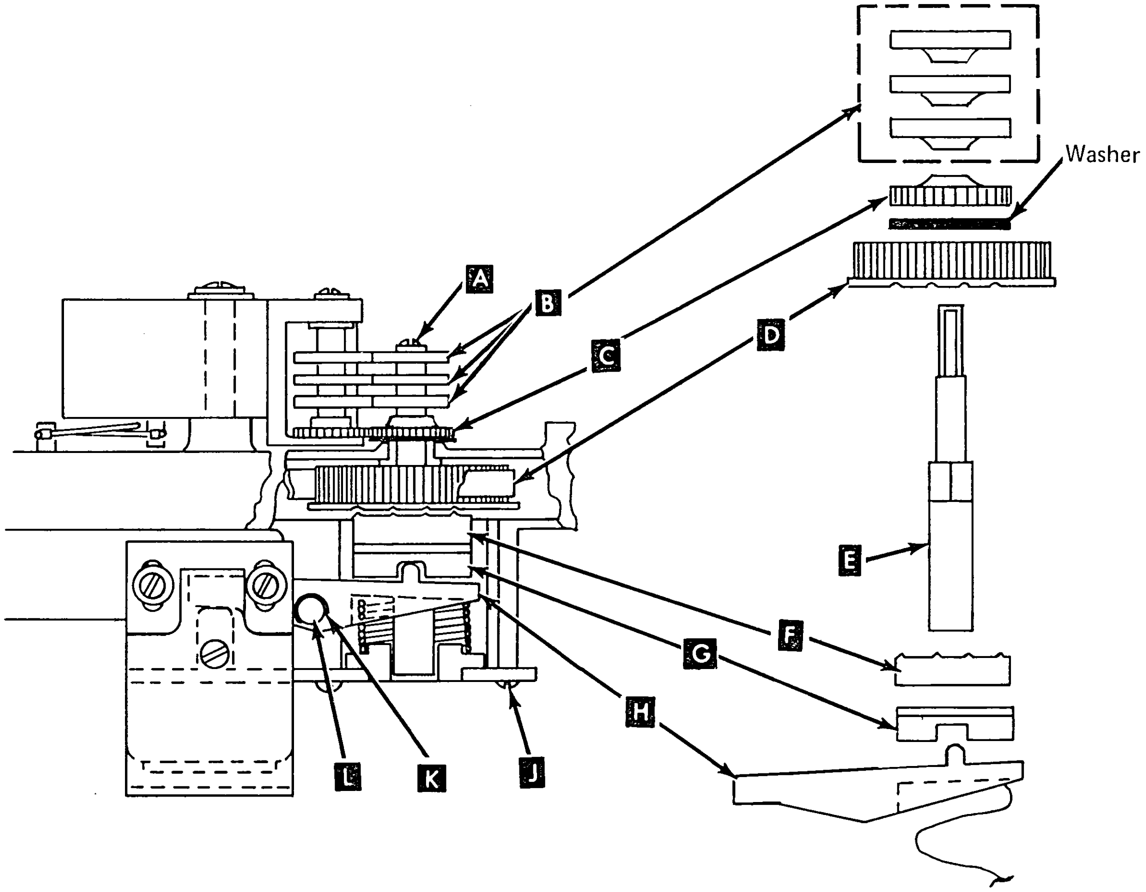
Removal

1. Remove the printer covers (4.2.1) steps 1 through 3.
2. Remove the ribbon (4.2.28) and type belt (4.2.13).
3. Remove the type belt drive pulley assembly (4.2.14).
4. Remove the ribbon drive assembly (4.2.29).
5. Remove the screw A from the drive shaft.
6. Remove three rollers B , the gear C , and the washer beneath the gear.
7. A long spring is compressed between the lever and the lower bearing assembly. While grasping the assembly tightly to keep the spring from flying out, remove three screws J and slowly remove the bearing.
8. Tip the ribbon drive unit sideways to keep the units within the clutch from falling out, and remove the C-clip K and pivot shaft L.
9. Remove the spacer G, clutch face F , drive shaft E , and the drive pulley and belt D .

Replacement

1. Install the bottom half of the clutch onto the square part of the shaft.
2. Install the ribbon drive belt onto the new drive pulley and place them in the clutch housing.
3. Insert the drive shaft and bottom half of the clutch up from the bottom and through the drive pulley, washer and bearing.
4. Place the clutch spacer on the lever H and install the lever with the pin and C-clip.
5. Fit the bottom of the spring onto the brass bushing in the plate (the top of the spring presses into the pivot arm). Install the plate with three screws.
6. Install the washer, gear, and three drive rolls, and tighten the screw while holding onto the drive rolls.

   Note: Screw A must be tight, or drive rolls may slip on drive shaft.
7. Check for proper reassembly by lifting on the lever H and turning the drive pulley. The drive pulley should turn freely. When the lever is released, the clutch should engage when the drive gear is turned.
8. Install the ribbon drive assembly (4.2.29) and perform the ribbon drive belt tension adjustment (4.2.31).
9. Install the type belt pulley assembly, type belt, and ribbon.
10. Adjust the ribbon solenoid (4.2.32).
11. Install the covers.

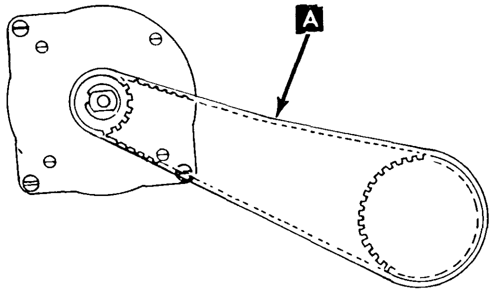


4.2.31 Ribbon Drive Belt

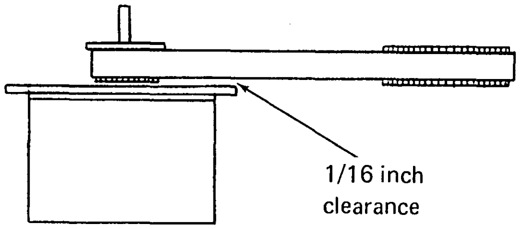
Adjustment

Note: Too much tension on the belt causes excessive wear on the bearings.

1. Remove the printer covers (4.2.1) steps 1 through 3.
2. Remove the type belt (4.2.13), the type belt drive pulley assembly (4.2.14), and the ribbon cassette.
3. Using a gram gauge, check that a 100 gram force causes 0.120 inch ± 0.030 inch (3.05 mm ± 0.76 mm) deflection midway between the pulleys **A** .
4. Adjust by loosening the three ribbon drive mounting screws and moving the assembly right or left.
5. Tighten the screws, then verify the deflection in step 3.
6. Install the pulley, type belt, ribbon cassette, and cover(s).



7. The ribbon drive belt should track on the pulley so that there is at least one sixteenth of an inch between the belt and the motor top plate. To increase the clearance, add shims under the rear edge of the ribbon mounting bar assembly.



Removal

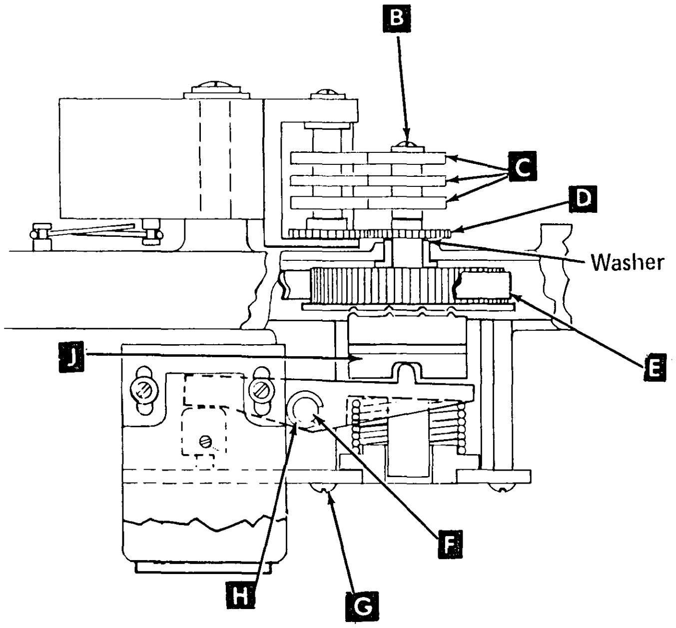
> **DANGER**
> A spring within the clutch mechanism can fly out when disassembling the clutch. Hold the bracket toward the floor and release the spring tension slowly.

1. Remove the printer covers.
2. Remove the ribbon cassette (4.2.28) and type belt (4.2.13).
3. Remove the type belt drive pulley assembly (4.2.14).
4. Remove the ribbon drive assembly (4.2.29).
5. Remove the screw **B** from the top of the drive shaft.
6. Remove the drive rolls **C** , gear **D** , and the washer beneath the gear from the shaft.
7. Remove the plate by removing three screws **G** .
8. Remove the C-clip **H** , and slide the clutch pivot shaft **F** out of the clutch arm.
9. Remove the bottom half of the clutch **J** and the washer from the drive shaft.
10. Remove the drive shaft from the bottom.
11. Remove the pulley, washer, and belt **E** .

Replacement

1. Place the washer on top of the ribbon drive pulley. Use a small amount of grease to keep the washer in place.
2. Place the belt around the ribbon drive pulley, and insert it in the ribbon drive assembly.
3. Insert the drive shaft through the bottom of the ribbon drive assembly and through the ribbon drive pulley.
4. Replace remaining ribbon assembly parts in the reverse order of removal.

   Note: Screw **B** must be tight, or drive rolls may slip on drive shaft.
5. Install the ribbon drive assembly on the print unit. Do not tighten mounting screws.
6. Perform ribbon drive belt tension adjustment (4.2.31).
7. Install remaining units in reverse order (steps 3 through 1) of removal.



4.2.32 Ribbon Solenoid

Adjustment

> **DANGER**
> The ribbon clutch solenoid becomes very hot after use. Be sure it is cool before performing maintenance.

1. Turn the power off.
2. Remove the printer covers (4.2.1) steps 1 through 3.
3. Remove the solenoid safety cover **C** .
4. Loosen the solenoid bracket screws **D** .
5. Check that the clutch faces are fully engaged by holding the shaft **A** and turning the pulley.
6. With the solenoid de-energized, place a 0.045 inch (1.143 mm) feeler gauge between the solenoid housing and the residual **B** , then position the bracket until the lever just touches the top of the solenoid armature shaft.
7. Tighten the solenoid bracket screws.
8. After the adjustment is made, manually pick the solenoid to disengage the clutch, and turn the shaft. The shaft should turn freely and independently of the pulley.
9. Install the solenoid safety cover, the divider, and the main covers.
10. Turn the power on.

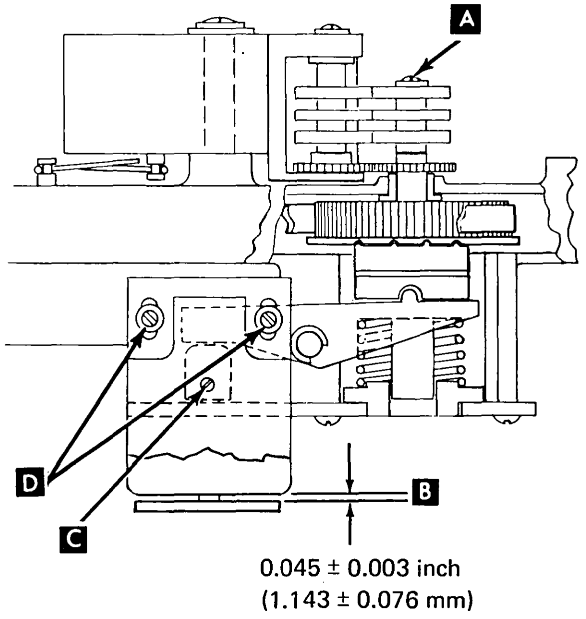
Removal

> **DANGER**
> The ribbon clutch solenoid becomes very hot after use. Be sure it is cool before performing maintenance.

1. Turn the power off.
2. Remove the covers and the divider between the keyboard and the printer (4.2.1).
3. Remove the solenoid safety cover (one screw) **C** .
4. Remove the solenoid mounting bracket screws **D** and unplug the ribbon solenoid leads (P1).
5. Remove two nuts and the solenoid assembly (not shown).

Replacement

1. Replace in the reverse order of removal and perform the ribbon solenoid adjustment (4.2.32).
2. Turn the power on.

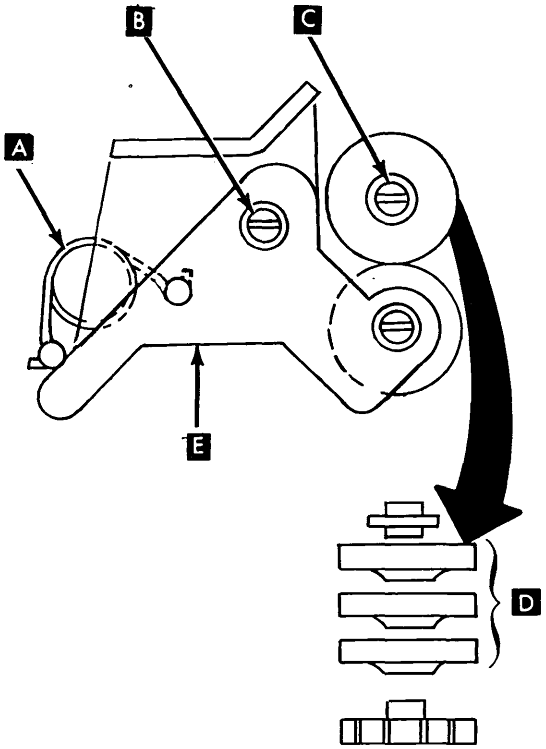


4.2.33 Ribbon Drive Rolls and Idler Rolls (50, 100, and 155 lpm)

Removal

Note: Both the ribbon drive rolls **D** and the pressure roll bracket assembly **E** should be replaced at the same time.

1. Remove the screw **B** on the pressure roll bracket assembly.
2. Remove the spring **A** and the bracket assembly **E** .
3. Remove screw **C** and lift the drive rolls **D** from the drive shaft.



Replacement

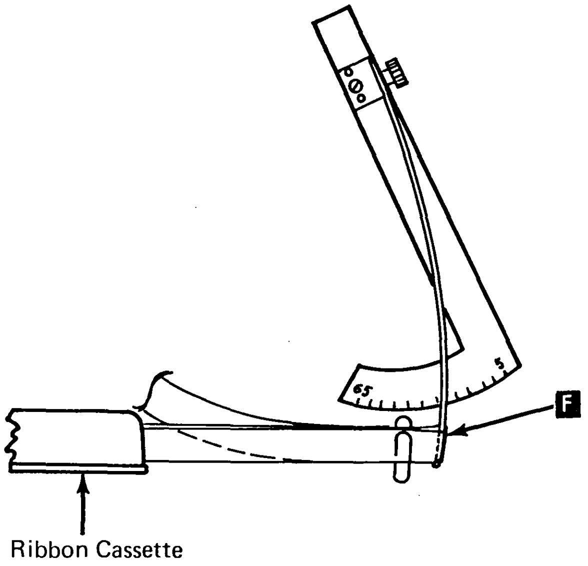
1. Install the pressure roll bracket assembly **E** .
2. Install spring **A** and screw **B** .
3. Install the drive roll as shown at **D** and tighten screw **C** .

   Note: Screw **C** must be tight, or drive rolls may slip on drive shaft.

4.2.34 Ribbon Drag (50, 100, and 155 lpm)

Service Check

1. Remove the ribbon cassette and pull about 7 inches (177.8 mm) of ribbon from the right end of the cassette.
2. Make a loop in the ribbon as shown at **F** and place a paper clip toward the end of the loop.
3. Insert the gram gauge blade in the loop, hold it at the angle shown, and slowly move the gauge to the right. The ribbon should start pulling out of the cassette when between 45 and 65 grams of pressure is applied. If more than 65 grams or less than 45 grams is required to pull the ribbon, install a new cassette.



4.2.35 Ribbon Tracking (50, 100, and 154 lpm)

4.2.35.1 For Ribbon Shields Without Guides

Note: The ribbon guide **B** is actually a slot cut in the plastic part of the ribbon shield.

Service Check

1. With power off, turn the right type belt pulley and verify that the ribbon **D** tracks even with the top of the platten **C** .
2. If the ribbon shield has metal strip(s), the ribbon should track between the plastic and metal strip(s) of the ribbon shield.
   If the ribbon shield does not have metal strip(s), the ribbon should track between the plastic strip and the type belt.

Adjustment

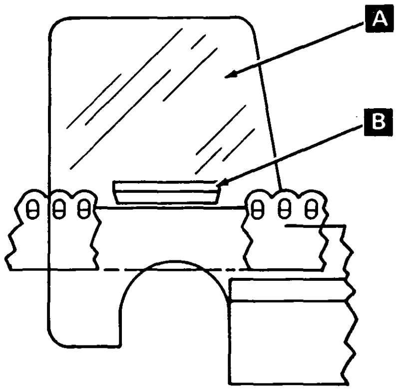
1. Insert paper that is wider than the platen.
2. With power off, turn the right type belt pulley and observe the space between the top of the platen and the top of the holes in the type belt. The ribbon should track even with the top of the platen **C** .

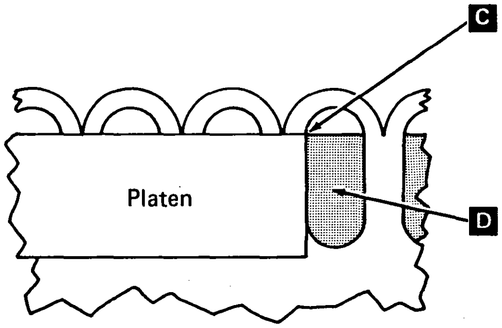
   Note: If the machine has a bracket as shown at **F** , do step 3 only. If the machine has a screw and locknut as shown at **G** , do step 4 only.
3. Adjust by loosening screws **E** and move the bracket toward the platen to raise, or away from the platen to lower the ribbon. Adjust both sides evenly and tighten the screws.
4. Loosen locknut **H** and turn screw **G** clockwise to lower the ribbon or counterclockwise to raise the ribbon. Tighten the locknut.

4.2.35.2 For Ribbon Shields With Guides

Service Check

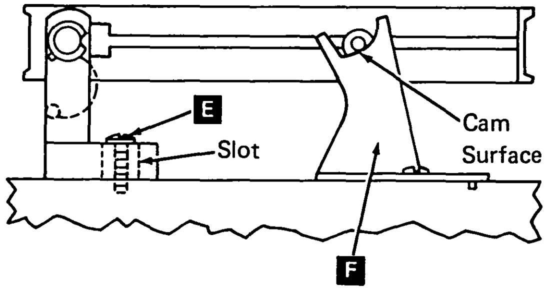
1. With power off and the print unit closed, turn the right type belt pulley and verify that the ribbon tracks slightly below the guides **B** in the ribbon shield (even with the top of the platen).
2. Open the print unit. The ribbon should not stay under the guides on the ribbon shield, but should move forward with the print unit.
3. Close the print unit. The ribbon should be located under the guides **B** on the ribbon shield **A** .

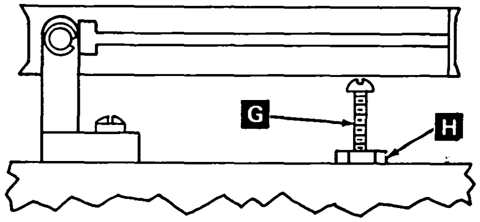




Adjustment

1. Insert paper that is wider than the platen.
2. Adjust by loosening screws **E** and move the bracket toward the platen to raise, or away from the platen to lower the ribbon. Adjust both sides evenly and tighten the screws.





4.2.36 Ribbon Shield
(50, 100 and 155 lpm)

Ribbon Shields Mounted as in View A.

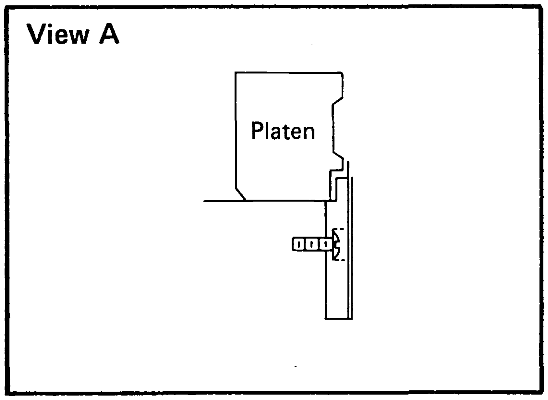
Removal

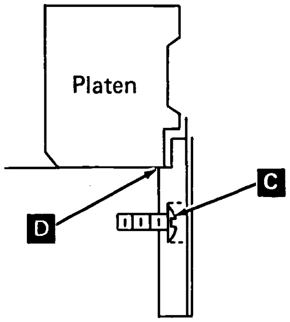
1. Remove the printer covers.
2. Remove the print unit (4.2.10).
3. Remove four screws **C** and the ribbon shield assembly.

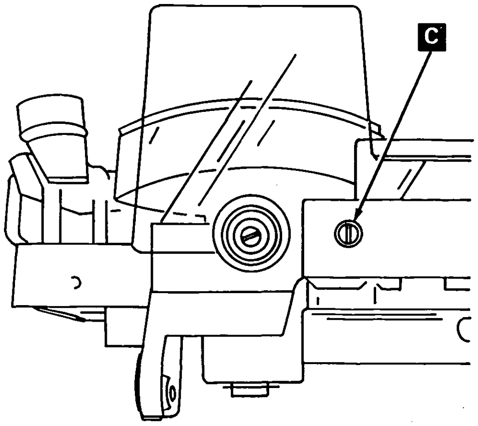
Replacement

1. Install the ribbon shield with the four screws (do not tighten).

   Hold the ribbon shield up against the platen as shown at **D**, and tighten the screws.
2. Install the print unit.
3. Do the Ribbon Tracking Service Check (4.2.35).
4. Install the covers.



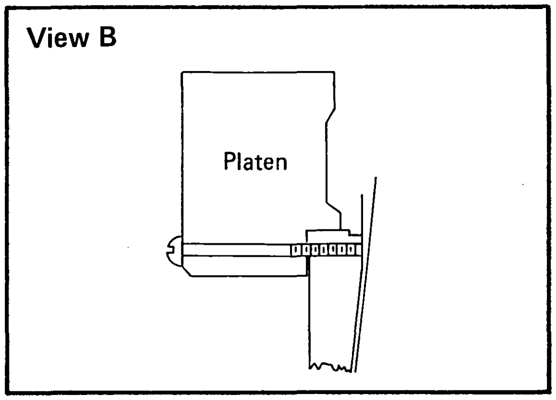


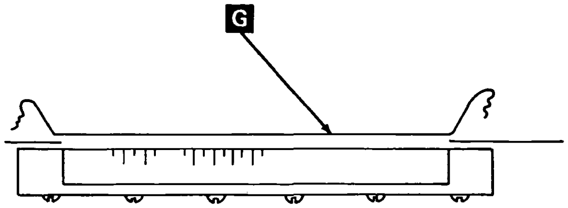


Ribbon Shield Mounted as in View B

Removal

1. Open the print unit.
2. Remove the ribbon (4.2.28) and the type belt (4.2.13).
3. Remove the print unit (4.2.10).
4. Remove 6 screws **F** from the front of the platen.
5. Remove the ribbon shield **G** .

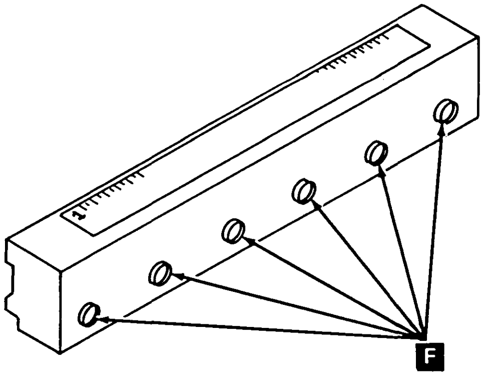


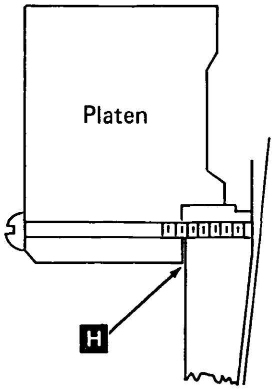


Replacement

1. Install the ribbon shield using 6 screws **F** (do not tighten).

   Hold the ribbon shield up against the platen as shown **H** , then tighten the screws.
2. Replace the print unit (4.2.10).
3. Replace the ribbon and the type belt.
4. Replace the covers.





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4.2.37 Tractor Drive Shaft

Note: Verify that the paper guides on the paper entry chute are located correctly before performing this adjustment (front forms alignment scale aligned with rear alignment scale).

Adjustment

To align the print line with the margin holes in the paper:

1. Insert wide single-part forms and print several lines in all print positions.
2. Place a straight edge (ruler or paper) tangent to the margin holes and determine whether the line slopes up or down in relation to the holes.
3. If the line slopes, remove the printer covers and loosen three retainer screws **A** on the right end of the tractor drive shaft.
4. Turn the eccentric **B** to either raise or lower the right tractor.
5. Tighten the screws, run another sample of printing, and recheck the adjustment.
6. Install the covers.

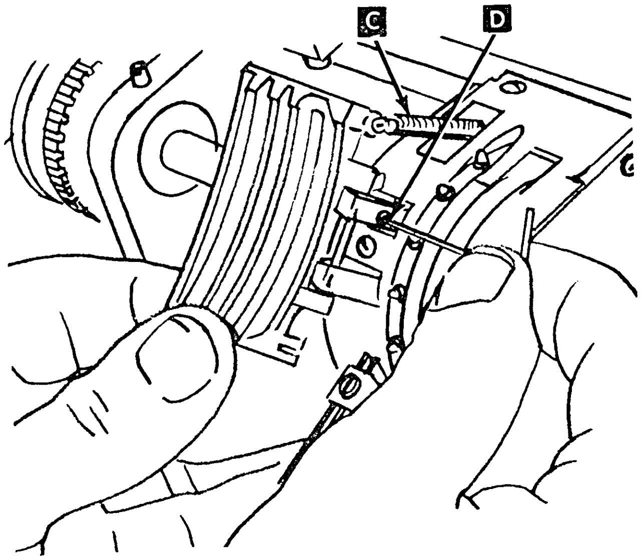
4.2.38 Tractor Cover

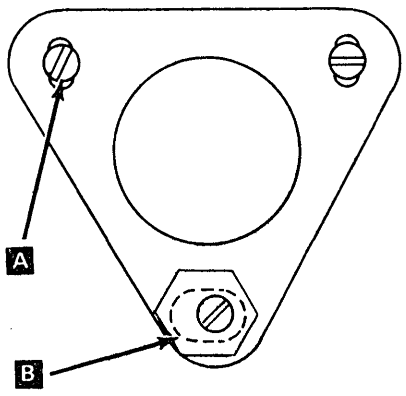
Removal

1. Loosen one setscrew **D** and remove the shaft that holds the cover onto the tractor assembly.
2. Remove the spring **C** from the cover.
3. Remove the cover.

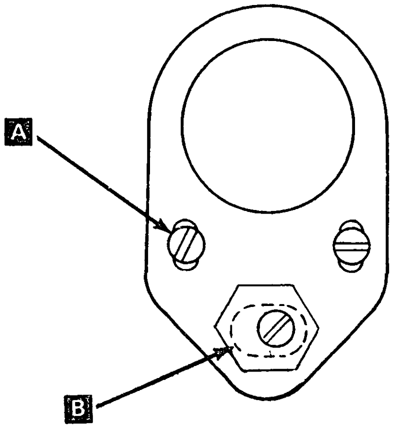
Replacement

Replace in reverse order of removal.





Old Style



New Style

4.2.39 Carriage Tractor/Vernier/Tractor Drive Shaft

Notes:

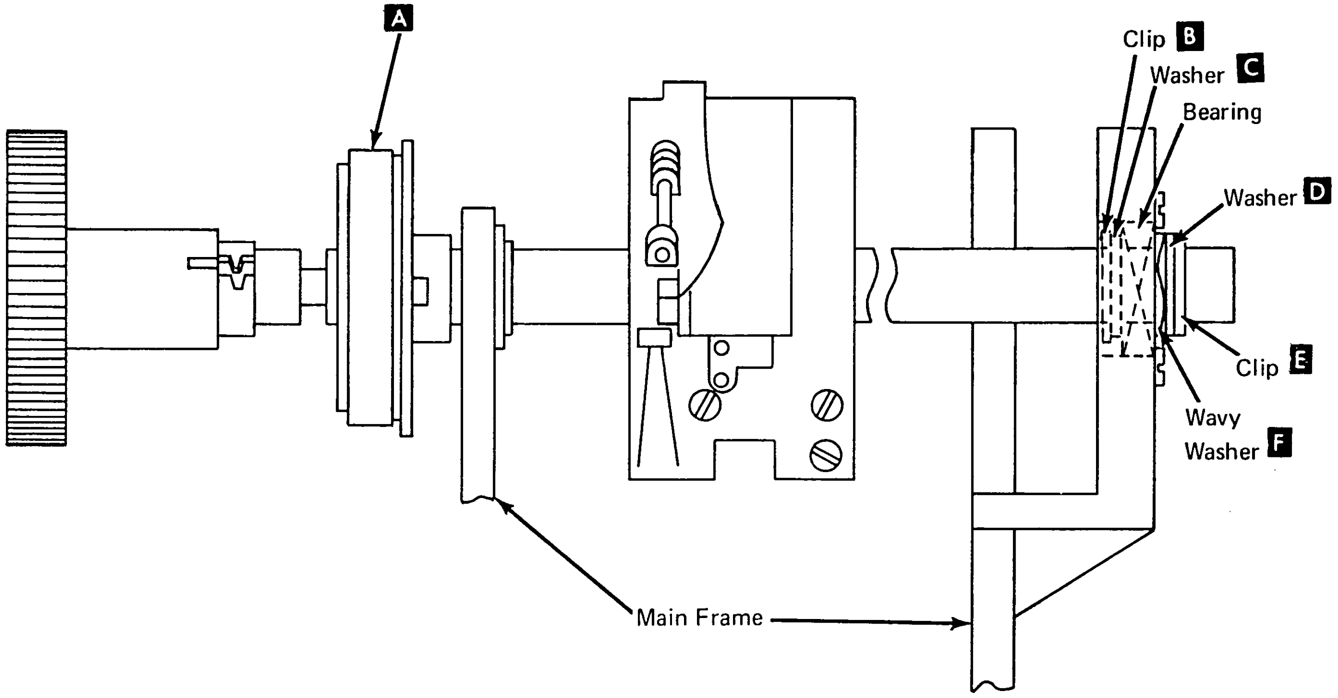
1. Tractor drive shaft verniers are factory adjusted. If the verniers become worn or defective, replace the complete drive shaft and vernier assembly.
2. Use pliers, P/N 9900317, to remove retainer clips.

Removal

1. Remove the printer covers (4.2.1) steps 1 through 3.
2. Loosen the carriage motor (four screws) and remove the carriage drive belt **A** .
3. Remove the retainer clip **E** , the washer **D** , and the wavy washer **F** .
4. Move the shaft to the left and remove the retainer clip **B** and washer **C** .
5. Squeeze the tractor release lever together, slide the tractor to the right off the drive shaft and pull the tractor forward from the slot.

Replacement

1. Replace in the reverse order of removal but do not tighten the carriage drive motor mounting screws.
2. Adjust the carriage drive belt to produce 0.100 inch ± 0.025 inch (2.54 mm ± 0.64 mm) deflection with 200 grams force applied midway between the pulleys.
3. Perform tractor drive shaft adjustment (4.2.37).



4.2.40 Carriage Motor

Removal

1. Remove the printer covers (4.2.1) steps 1 through 3.
2. Unplug the carriage motor plug (P7).
3. Remove the four motor mounting screws **A** .
4. Remove the belt from the motor pulley **B** .
5. Remove the motor.

Replacement

1. Replace in the reverse order of removal but do not tighten the four motor mounting screws.
2. Adjust the carriage drive belt tension to produce 0.100 inch ± 0.025 inch (2.54 mm ± 0.64 mm) deflection with 200 grams force applied midway between the pulleys. Tighten the screws.

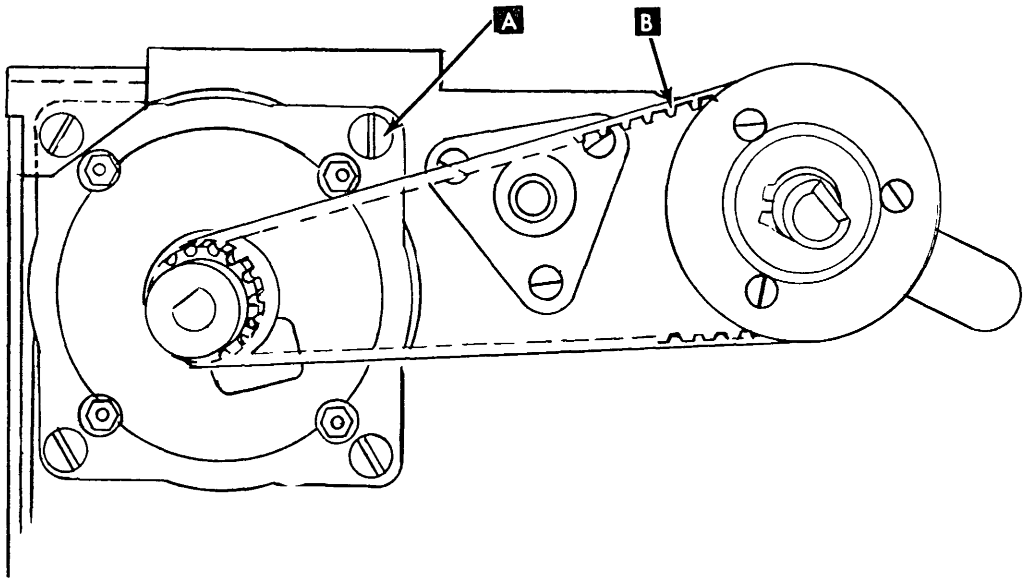
4.2.41 Carriage Drive Belt

Removal

1. Remove the printer covers.
2. Loosen the four carriage motor mounting screws **A** .
3. Remove the belt from the motor pulley **B** .

Replacement

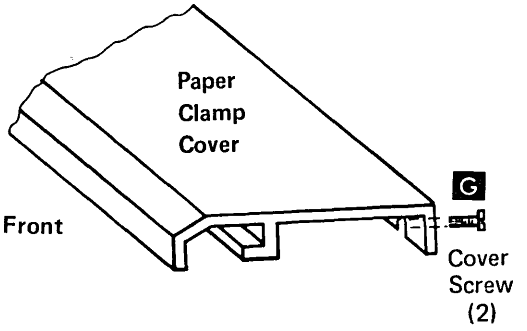
1. Install the belt.
2. Adjust the carriage drive belt tension to produce 0.100 inch ± 0.025 inch (2.54 mm ± 0.64 mm) deflection with 200 grams force applied midway between the pulleys. Tighten the screws.

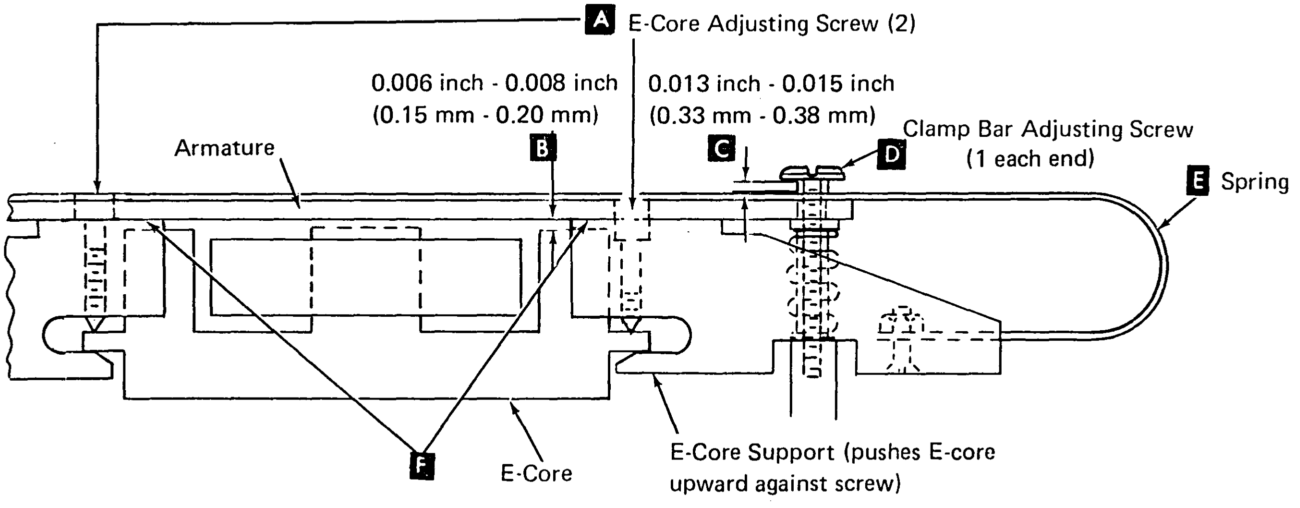


4.2.42 Upper Paper Clamp

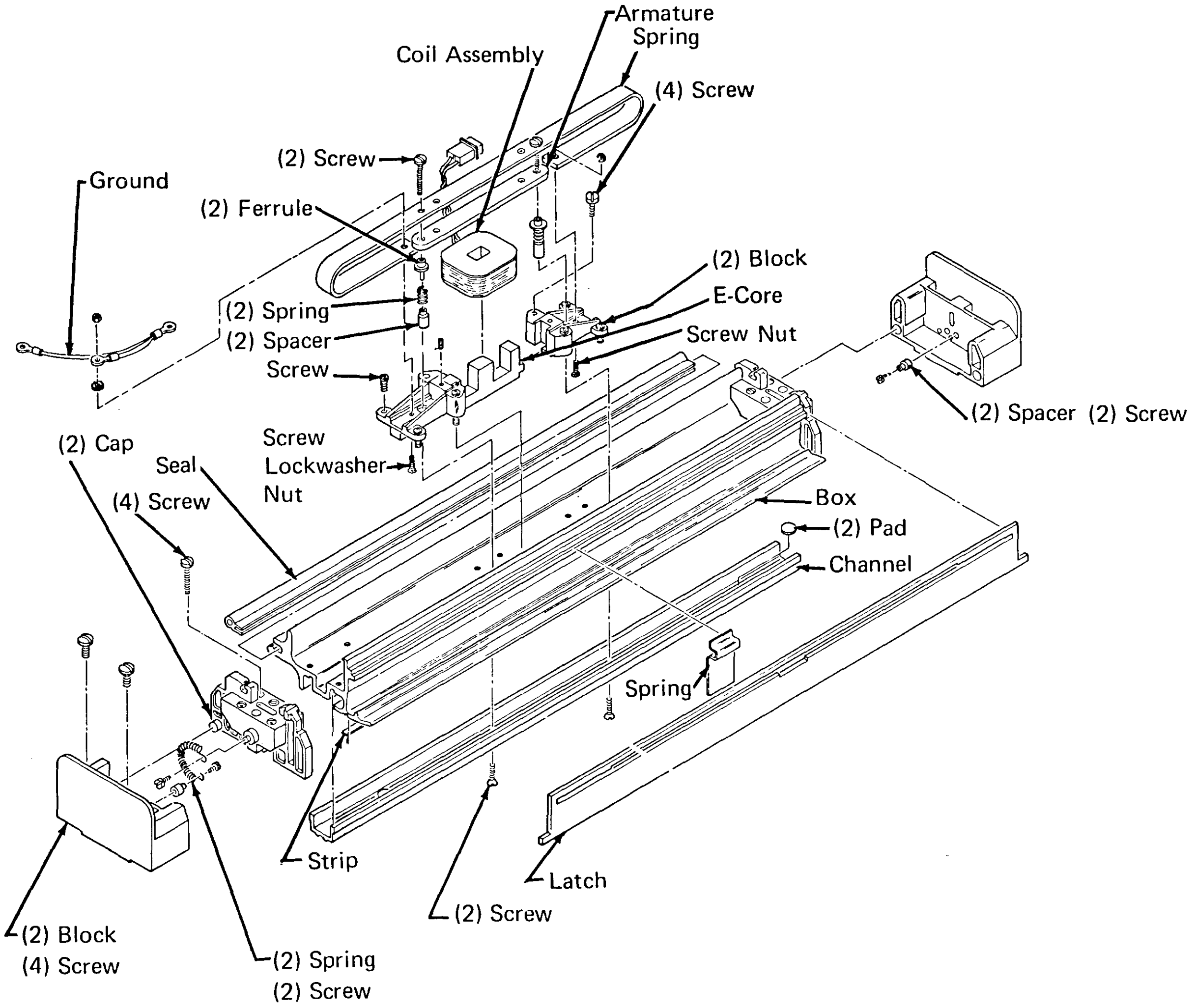
Adjustment

1. Remove the printer covers (4.2.1) steps 1 through 3 and forms.
2. Loosen, but do not remove, the two screws **G** from the back of the paper clamp cover. Remove the cover by sliding it to the back and upward.
3. Press the forms guide release bar that opens the upper paper clamp assembly. Operate the upper paper clamp manually, by moving the armature against the plastic end blocks **F**. Make sure the clamp mechanism moves freely.
4. Close the upper paper clamp assembly.
5. Load program ID PRT1; this program allows you to open and close the paper clamps each time you press the ENTER key.
6. Close the paper clamps. Tighten the clamp bar adjusting screws **D** until the spring is snug against the armature on both sides (spring might already be snug).
7. Open or close the paper clamp as necessary. Insert 0.007 inch (0.178 mm) feeler gauge between the armature and one of the outer legs of the E-core **B**. Make sure the gauge is not between the plastic end block **F** and the armature. Close the paper clamps. With the armature seated on the plastic end blocks, check for 0.006 inch to 0.008 inch (0.15 mm to 0.20 mm) gap at **B**. Check each end, and adjust screws **A** as required.
8. With the armature seated on the plastic end blocks, adjust each clamp bar adjusting screw **D** for 0.013 inch to 0.015 inch (0.33 mm to 0.38 mm) at point **C** (both ends). Make sure the spring **E** is contacting the armature when checking measurement **C**.
9. After the adjustment is correct, turn each clamp bar adjusting screw 1/2 turn clockwise.
10. Open the paper clamps and install the paper clamp cover and the main covers.





4.2.43 Upper Paper Clamp Assembly



4.2.44 Lower Paper Clamp (50, 100, and 155 lpm)

4.2.44.1 Two Coil Clamp with Two Engaging Levers **G**

Service Check

1. Install single-part forms that are wide enough to cover the print line. Close the print unit.

2. Load program ID PRT1. This program allows you to open or close the paper clamps each time you press the ENTER key.

3. Close the paper clamps.

4. Grip the forms and try to pull them upward. The forms must be held tightly on both ends. If forms are not held tightly, do the adjustment.

5. Open the paper clamps.

6. Pull the forms upward. The clamp should not hold the forms.

Adjustment

1. Power down.

2. Remove the printer cover (4.2.1) steps 1 through 3, and forms.

3. Close the print unit and set forms thickness control to 1.

   > **DANGER**
   > The ribbon clutch solenoid becomes very hot after extended use. Be sure it is cool before attempting maintenance.

4. For machines with pivot pins, remove the keyboard cover and divider (4.2.1) steps 4 through 6.

   For machines with pivot screws, remove the rear forms guide. Remove the two printer mounting screws under the frame and place the printer in the service position.

5. While holding levers **G** up, adjust guide plates for 0.000 inch to 0.003 inch (0.00 mm to 0.08 mm) at **F**.

6. Do service check. If OK, omit remaining adjustments.

7. Remove the print unit (4.2.10).

8. Engage the paper clamp mechanism by lifting levers **G** up.

   Note: Hold levers up with folded paper between levers and print base.

9. Loosen screws **C**, then turn adjusting nuts **D** 1/2 turn clockwise to move the clamp away from the lower forms guide **H**.

10. Load program ID PRT1. This program allows you to open or close the paper clamps each time you press the ENTER key.

11. Close the paper clamps.

12. Make sure the clamp bar **B** is straight. Form bar carefully, if needed.

13. Check between the two outer tension springs (both ends) for condition **A**. If the clearance is incorrect, turn adjusting nut(s) **D** until correct. When the clearance is correct, check to be sure that the armature is sealed against the residual on the solenoid case **E**. Check clearance **A** again.

    Note: If the adjustment cannot be made with the adjusting nut, rotate the solenoid and bracket to vary the adjustment:
    a. Tighten screws **C**.
    b. Power down, and do lower paper clamp removal, steps 5 and 6.
    c. Rotate the solenoid bracket one turn around the adjusting nut (clockwise to increase **A**).
    d. Install solenoids and brackets. Loosen screw **C**, then repeat adjustment, steps 8 through 13.

14. Open the paper clamps. Turn both adjusting nuts **D** 1/2 turn counterclockwise to move the clamp toward the lower forms guide **H**; then tighten both screws **C**.

15. Remove the support material used to hold the levers up **G**, then unlatch the clamp mechanism.

16. Install single-part forms that are wide enough to cover the print line.

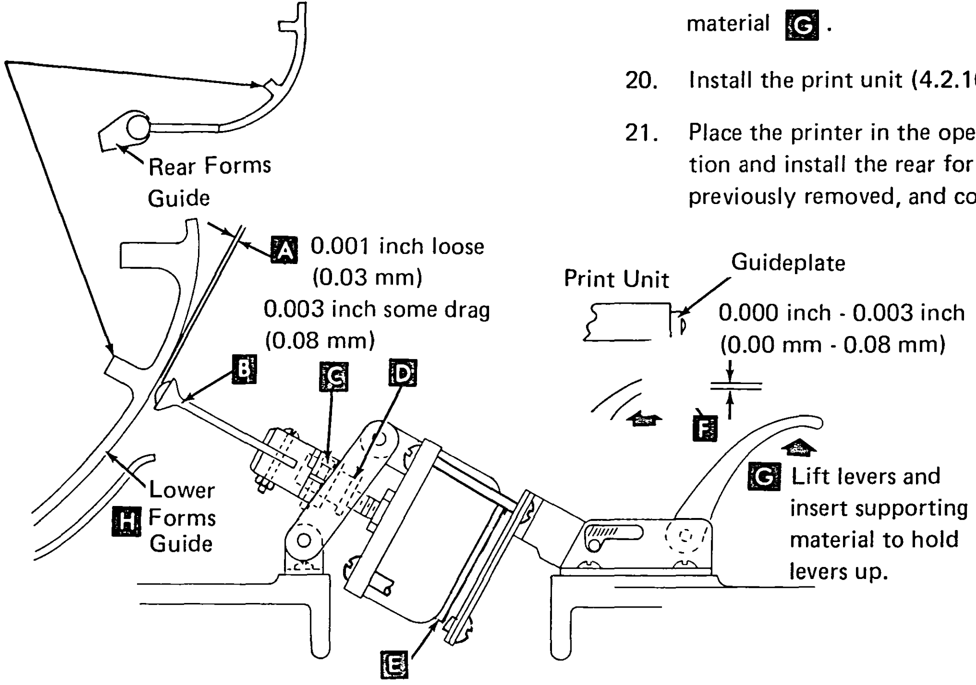
17. Latch the clamp mechanism, and hold the levers up as before.

18. Close the paper clamps again. Check for even forms clamping by trying to pull up on each end of the form. The form should be held tightly across its width. Repeat adjustment if form is not held tightly.

19. Power down and remove the support material **G**.

20. Install the print unit (4.2.10).

21. Place the printer in the operating position and install the rear forms guide if previously removed, and covers.



4.2.44 50, 100, and 155 lpm Lower Paper Clamp (Continued)

4.2.44.1 Two Coil Clamp with Two Engaging Levers D (Continued)

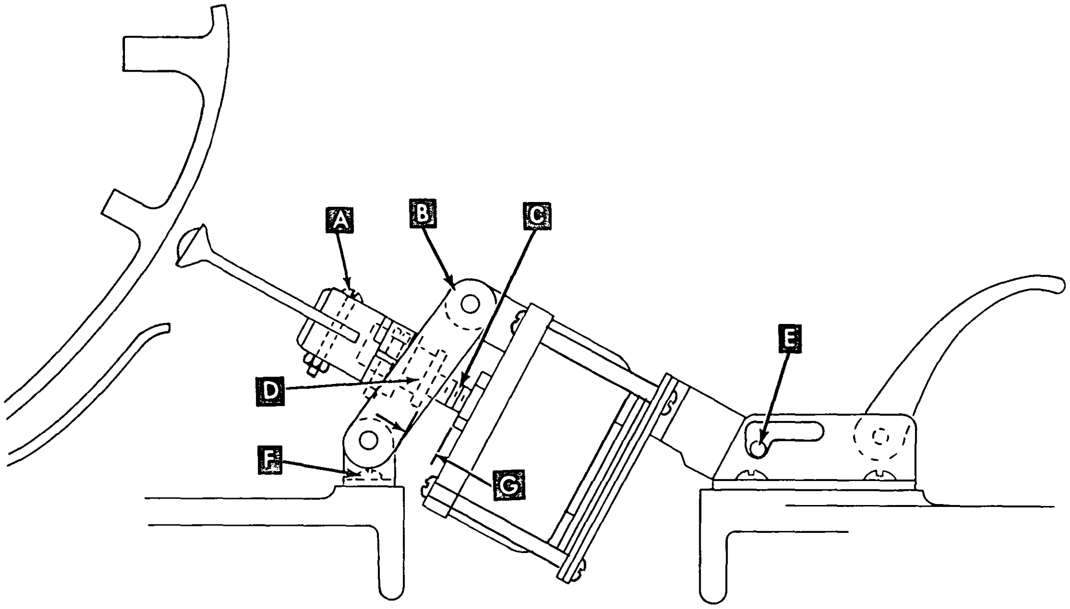
Removal

1. Power down.
2. Remove the printer covers (4.2.1) steps 1 through 3, and forms.
3. For machines with pivot pins, remove the keyboard cover and divider (4.2.1 steps 4 through 6).

   For machines with pivot screws, remove the rear forms guide. Remove the two printer mounting screws under the frame. Place the printer in the service position.
4. Remove the print unit assembly (4.2.10).
5. Remove four screws F (two from each solenoid bracket).
6. Remove one clip, washer, and pin E, from each bracket.
7. If only the clamp bar is to be removed, remove two screws A and lift out bar.
8. Disconnect the lower paper clamp solenoid plug (P3) and remove the two solenoid terminals from the plug.
9. Measure the gap G, then unscrew the solenoid assembly C from the nut D in the nylon clamp.
10. Remove bracket B from the solenoid.

Replacement

1. Install the bracket B onto the solenoid and turn the solenoid assembly into the nylon clamp leaving about the same gap G noted in step 9 of removal.
2. Replace the remaining parts in reverse order of removal.
3. Do the lower paper clamp adjustment (4.2.44.1).



4.2.44 50, 100, and 155 lpm Lower Paper Clamp (Continued)

4.2.44.2 Single Coil Clamp With One Engaging Lever A

Service Check

1. Install single-part forms that are wide enough to cover the print line. Close the print unit.

2. Load program ID PRT1; this program allows you to open or close the paper clamps each time you press the ENTER key.

3. Close the paper clamps.

4. Grip the forms and try to pull them upward. The forms must be held tightly on both ends. If forms are not held tightly, do the adjustment.

Adjustment

1. Power down.

2. Remove the printer covers (4.2.1) and forms.

3. Remove the print unit (4.2.10.2).

4. Manually latch the paper clamp mechanism by lifting lever A up.

   Note: Hold the lever up with folded paper between the lever and print base.

5. Check mechanical action by engaging the armature. Be sure parts move easily and the clamp bar returns to the bumpers K when the armature is released.

6. Check between the two outer tension fingers (both ends) for 0.068 to 0.084 inch (1.73 to 2.13 mm) gap B . The maximum difference between both gaps B should not exceed 0.010 inch (0.25 mm). If correct, go to step 7.

   To adjust:
   a. Remove the seal from screws C , if needed. Loosen two screws in each stop plate.
   b. Loosen four holding screws D in the clamp assembly.
   c. Move the clamp assembly to obtain gap B , then tighten the screws D . Check the gap again.
   d. Hold stop plates against the clamp assembly, and then tighten screws C .

7. Load program ID PRT1; this program allows you to open or close the paper clamps each time you press the ENTER key.

8. Close the paper clamps. Be sure the armature is seated on the end blocks E .

   a. Check for 0.006 to 0.008 inch (0.15 to 0.20 mm) gap F (both ends). Adjust, if needed, by turning screw(s) with a small six-fluted wrench G .

   Note: Turning clockwise increases the gap.

   b. Check for 0.004 to 0.006 inch (0.13 to 0.03 mm) gap H (both ends). Adjust, if needed, by turning screw(s) J .

   Note: Turning clockwise increases the gap.

   Check both gaps H again after adjusting.

9. Open the paper clamp, then do the lower paper clamp service check (4.2.44.2).

10. Do forms tension service check (4.2.45) steps 4 through 7.

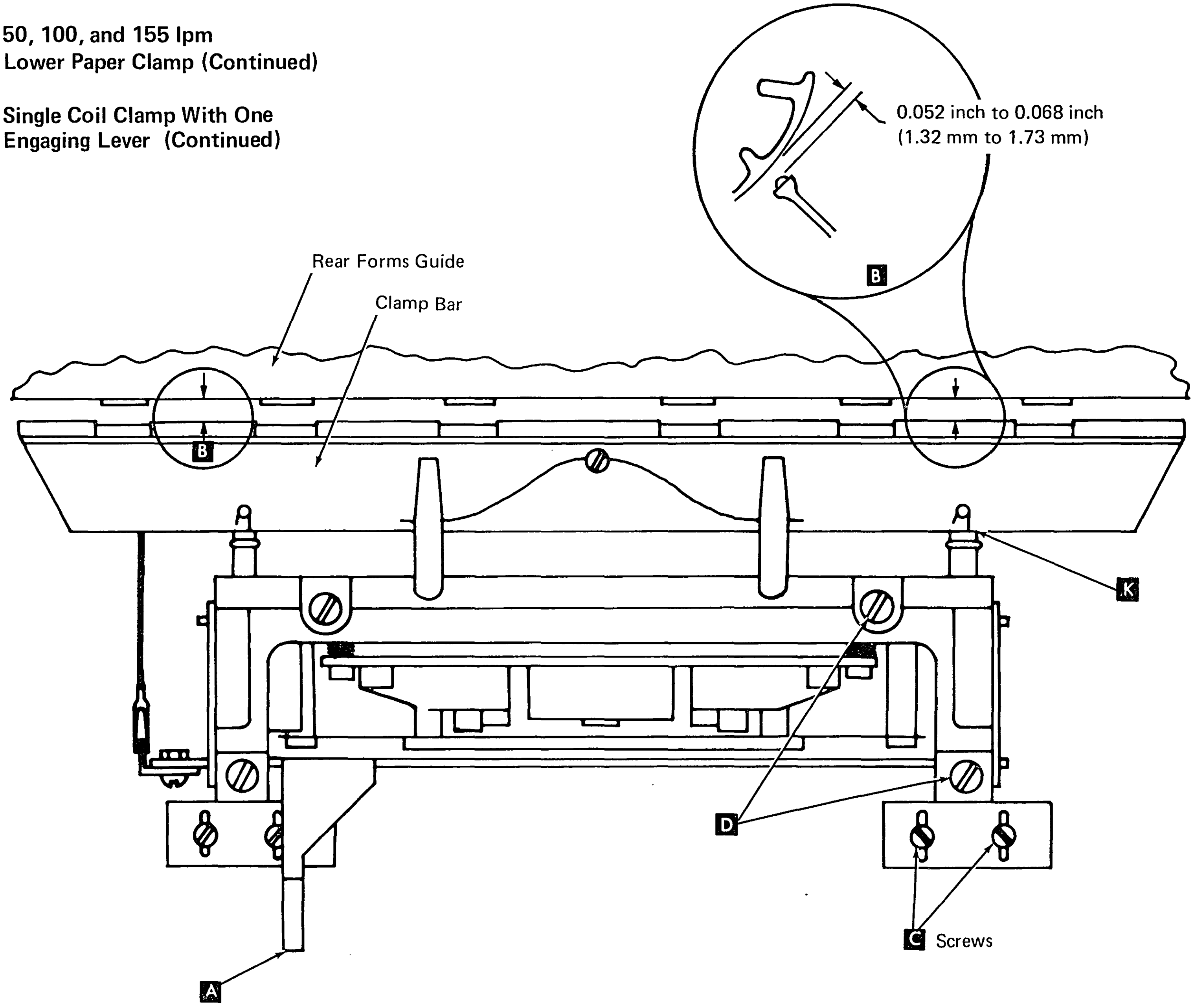
11. Power down and remove the support material under lever A .

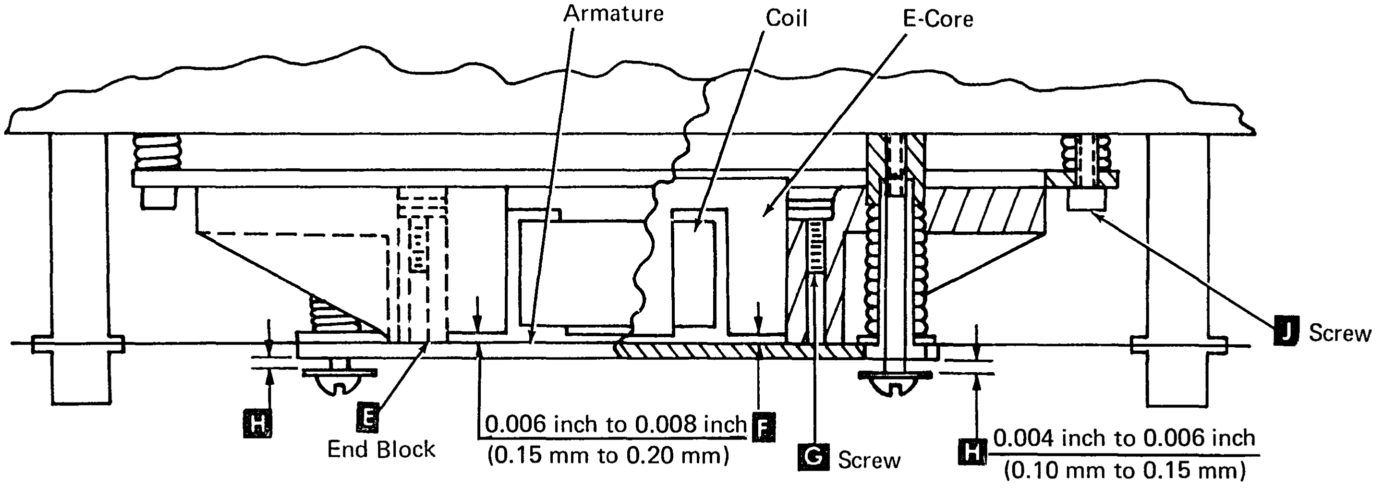
12. Install the print unit (4.2.10.2).

13. Install the printer covers.

4.2.44 50, 100, and 155 lpm Lower Paper Clamp (Continued)

4.2.44.2 Single Coil Clamp With One Engaging Lever (Continued)





4.2.44 50, 100, and 155 lpm Lower Paper Clamp (Continued)

4.2.44.3 Clamp Assembly Removal (Single Coil Clamp With One Engaging Lever D)

Removal

1. Power down.
2. Remove the printer covers (4.2.1) and forms.
3. Remove the print unit (4.2.10.2).
4. Unhook clip C . Disconnect P3.
5. Remove four screws F (two each end), then remove assembly.

Replacement

1. Place clamp assembly in position. Place P3 cable as shown and connect plug.
2. Start the four screws F , but do not tighten. Hold the assembly against the stop plates G , and tighten the four screws F .
3. Install the clip C .

   Do lower paper clamp service check (4.2.44.2).

   Do forms tension service check (4.2.45) steps 4, 5, and 6.

   Install print unit and covers.

4.2.44.4 Clamp Bar Removal (Single Coil Clamp With One Engaging Lever D)

Removal

1. Remove lower paper clamp assembly (4.2.44.3).
2. Loosen screw, and remove retainer wire A from both rods B .
3. Unhook spring and remove support pins E from clamp bar at both ends.
4. Remove clamp bar from rods B .

Replacement

1. Slide the clamp bar into the slot in rods B .

   Note: Ensure that the clamp bar is installed correctly (tension springs mesh with clamp bar slots).
2. Insert the support pin E and hook the spring on the pin.
3. Install retainer wire A . Center as shown, then tighten screw.
4. Install lower paper clamp assembly (4.2.44.3).

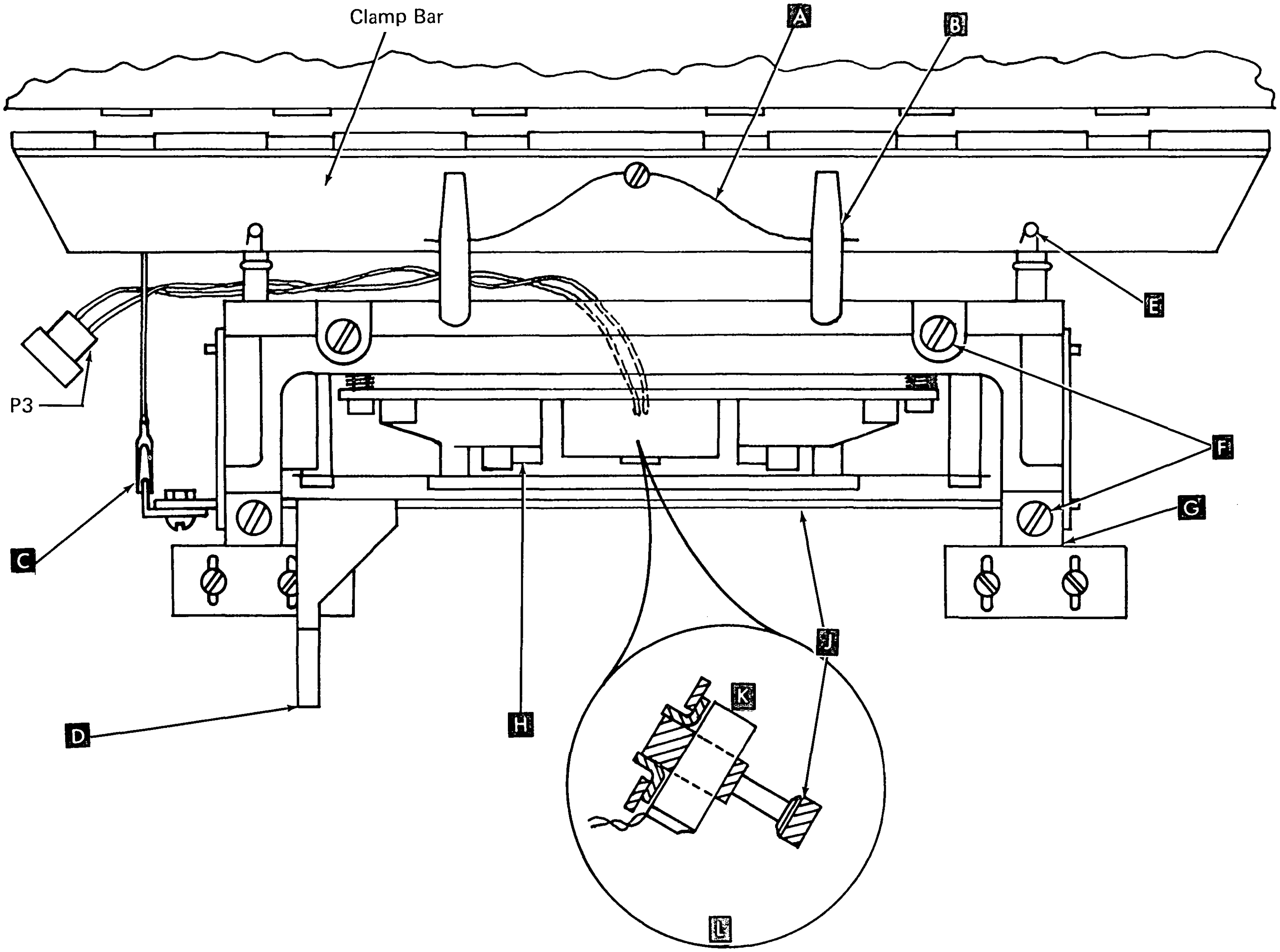
4.2.44.5 Coil Assembly Removal (Single Coil Clamp With One Engaging Lever D)

Removal

1. Remove lower paper clamp assembly (4.2.44.3).
2. Loosen screw, and remove retainer wire A from both rods B .
3. Move armature J away from coil.
4. Loosen screw and remove coil retainer H.
5. Remove coil K by pulling it off the core.

Replacement

1. Place coil on core as shown L .
2. Install coil retainer H and tighten screw.
3. Hold armature J toward core, and install retainer wire A . Center as shown, then tighten screw.
4. Replace paper clamp assembly (4.2.44.3).


Clamp Bar
A
B
E
P3
F
G
C
J
K
D
H
L

4.2.45 Forms Tension Assembly (50, 100, and 155 lpm)

4.2.45.1 Print Units with Pivot Screws and Two Paper Clamp Engaging Levers

Note: The levers and guideplates for the lower paper clamp affect the forms tension. See 4.2.44.1 *Adjustment*, step 5.

Service Check

1. Power down.

2. Remove the printer covers (4.2.1 steps 1 through 3) forms, and rear forms guide. Remove the two printer mounting screws under the frame.

3. Place the printer in the service position.

4. Remove the print unit assembly (4.2.10.1).

5. Load about 35 inches (900 mm) of single-part forms that are wide enough to contact all six tension springs.

6. Operate the tension springs against the forms by lifting the levers G until the assembly locks.

   Note: Hold levers up by inserting folded paper or other supporting material between the levers and the printer base.

7. Check for 100 to 125 grams tension C while pulling the forms upward.

   Note: With the print unit installed, the maximum tension is 250 grams.

8. If the tension is not OK, do the adjustment.

Adjustment

1. Operate the tension springs against the forms by lifting the levers G until the assembly locks. Check that all tension springs touch the lower forms guide at the same time. Form each spring B as needed.

2. Unhook clevis F and turn it on the link to adjust the tension. Hook the clevis.

3. Repeat the service check, steps 5, 6 and 7.

4. Install the print unit assembly (4.2.10.1).

5. Place the printer in the operating position and install the rear forms guide and covers. Install the two printer mounting screws under the frame.

Removal

1. Power down.

2. Remove the printer covers (4.2.1 steps 1 through 3), forms, and rear forms guide. Remove the two printer mounting screws under the frame.

3. Place the printer in the service position.

4. Remove the print unit assembly (4.2.10.1).

5. Unhook the two return springs from the clamp bar.

   Note: Nylon studs might fall out.

6. Remove four screws A and pivot up the lower paper clamp.

7. Remove two screws D, and remove the bracket from the printer base.

8. Disconnect the clevis F.

9. Lift the forms tension assembly out of the machine.

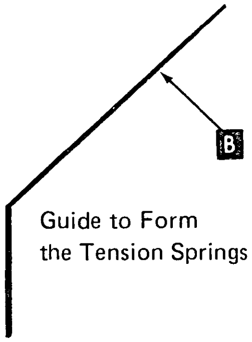
10. Remove the tension springs E as required.

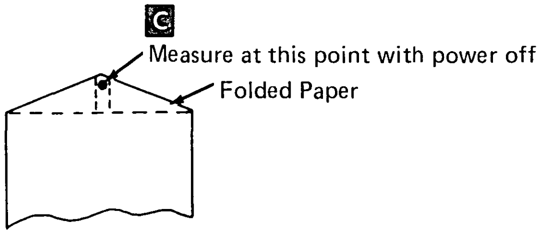
4.2.45 50, 100, and 155 lpm Forms Tension Assembly (Continued)

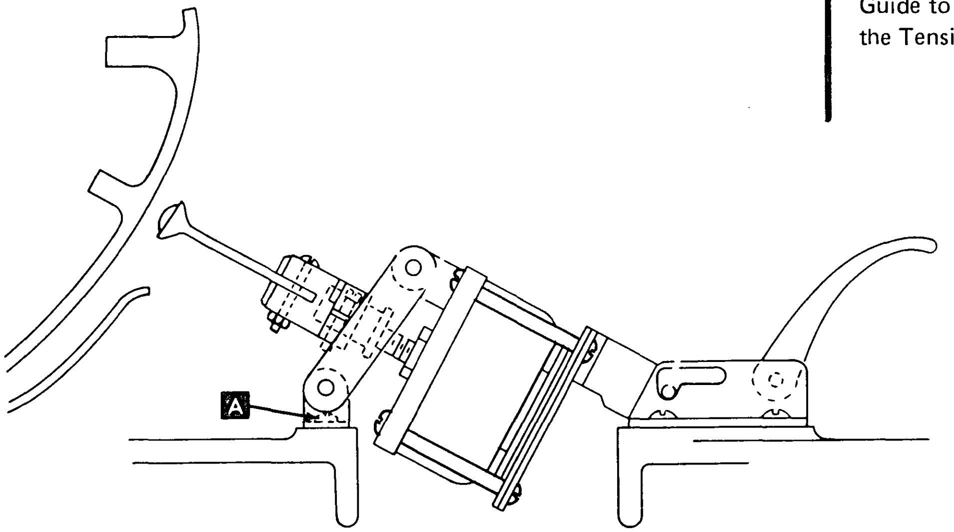
4.2.45.1 Print Units with Pivot Screws and Two Paper Clamp Engaging Levers (Continued)

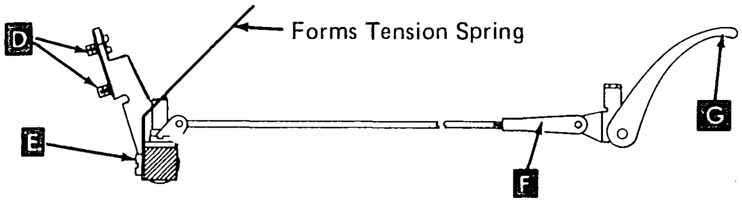
Replacement

1. Install the assembly in reverse order of removal.
2. Perform the service check steps 5, 6, and 7.
3. Install the print unit assembly.
4. Place the printer in the operating position and install the rear forms guide and covers.
5. Install the two printer mounting screws under the frame.









4.2.45 50, 100, and 155 lpms Forms Tension Assembly (Continued)

4.2.45.2 Print Units with Pivot Pins and Two Paper Clamp Engaging Levers

Note: The levers and guideplates for the lower paper clamp affect the forms tension. See 4.2.44.1 *Adjustment*, step 5.

Service Check

1. Power down.
2. Remove the printer covers (4.2.1), and forms.
3. Remove the print unit assembly (4.2.10.2).
4. Load about 35 inches (900 mm) of single-part forms that are wide enough to contact all six tension springs.
5. Operate the tension springs against the forms by lifting the levers C until the assembly locks.

   Note: Hold levers up by inserting folded paper or other supporting material between the levers and the printer base.

6. Check for 100 to 125 grams tension M while pulling the forms upward.

   Note: With the print unit installed, the maximum tension is 250 grams.

7. If the tension is not OK, do the adjustment.

Adjustment

1. Operate the tension springs against the forms by lifting the levers C until the assembly locks. Check that all tension springs touch the lower forms guide at the same time. Form each spring N as needed.
2. Unhook clevis A and turn it on the link to adjust the tension. Hook the clevis.
3. Repeat the service check, steps 5, 6 and 7.
4. Install the print unit assembly (4.2.10.2).
5. Install the rear forms guide and covers.

Removal

1. Remove the printer covers (4.2.1) and print unit (4.2.10.2).
2. Unhook the spring from the right end of the clamp bar.

   Note: Nylon pin might fall out.

3. Unhook the clip A and remove the link and clip assembly from the shaft.
4. Raise both levers C, then remove pin E from each lever.

   Note: The right pin is part of the pin and lever assembly B.

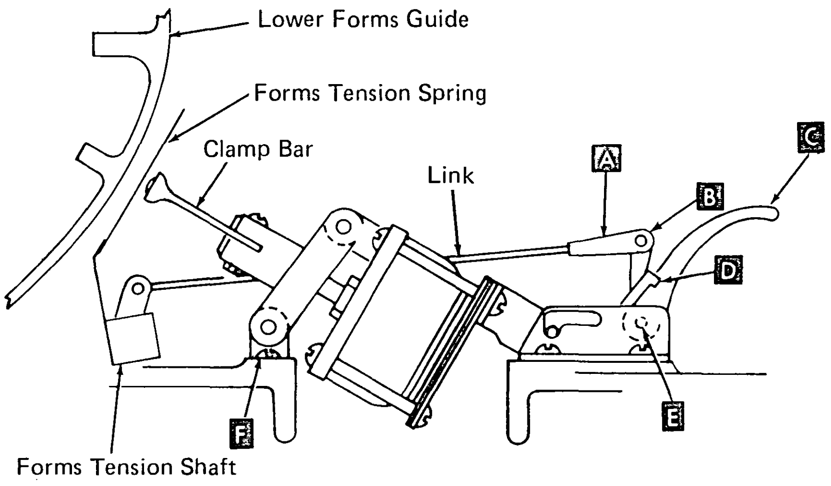
5. Remove two screws F from each solenoid bracket.
6. Loosen screw L, then remove retainer plate G.
7. Carefully raise the clamp bar, then rotate the forms tension shaft J forward and slide the shaft to the left until the right end is clear of the right pivot. Remove bushing H from the left end.
8. With the clamp bar raised, lift the right end of the shaft up and to the right until clear of the left pivot. Lift the shaft up between the rear forms guide and the clamp bar. If more clearance is needed, loosen the cable clamps.

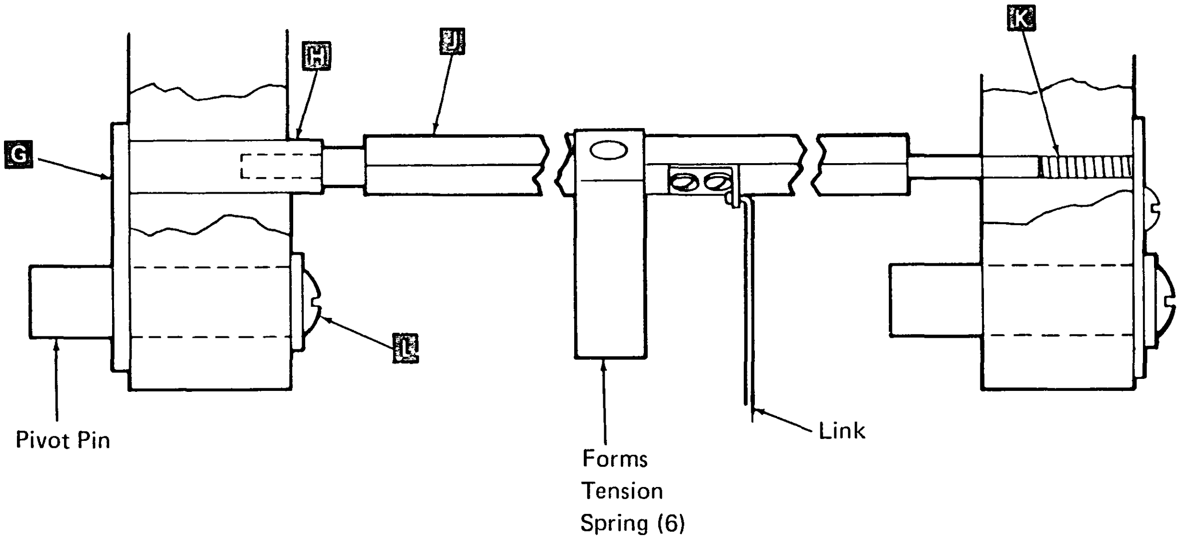
4.2.45 50, 100, and 155 lpm Forms Tension Assembly (Continued)

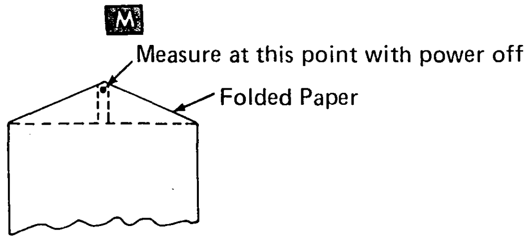
4.2.45.2 Print Units with Pivot Pins and Two Paper Clamp Engaging Levers (Continued)

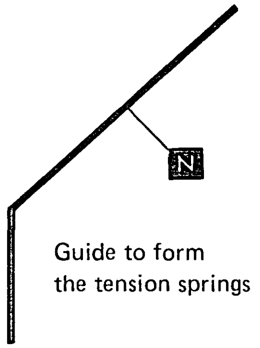
Replacement

1. Raise the clamp bar, then lower the shaft between the clamp bar and the rear forms guide.
2. Install the shaft by inserting the left end, then the right end. Push the shaft to the right. You should feel the tension from spring K.
3. Install bushing H . Install plate G on the left pivot pin. Hold the plate down and tighten screw L .
4. Install pin and lever assembly B in the right engaging lever C . Be sure the bracket D on the right lever operates the lever assembly B when the lever C is moved.
5. Install pin E in the left lever.
6. Raise both levers C , then replace two screws F in each solenoid bracket. Tighten cable clamps if loosened.
7. Install the link on the shaft, then attach clip A on lever B . Attach the spring to the right end of the clamp bar.
8. Do the forms tension service check steps 5, 6, and 7. Adjust if needed.
9. Do the lower paper clamp service check (4.2.44). If adjustment is needed, do adjustment steps 8-19.
10. Install the print unit (4.2.10.2) and printer covers.









4.2.45 50, 100, and 155 lpm Forms Tension Assembly (Continued)

4.2.45.3 Print Units With Pivot Pins and One Paper Clamp Engaging Lever C

Note: The lever and guide plate for the lower paper clamp affect the forms tension. See 4.2.44.1 *Adjustment,* step 5.

Service Check

1. Power down.
2. Remove the printer covers (4.2.1) and forms.
3. Remove the print unit assembly (4.2.10.2).
4. Load about 35 inches (900 mm) of single-part forms that are wide enough to contact all six tension springs.
5. Operate the tension springs against the forms by lifting the lever C until the assembly locks.

   Note: Hold lever up by inserting folded paper or other supporting material between the lever and the printer base.
6. Check for 100 to 125 grams tension M while pulling the forms upward.

   Note: With the print unit installed, the maximum tension is 250 grams.
7. If the tension is not OK, do the adjustment.

Adjustment

1. Operate the tension springs against the forms by lifting the lever C until the assembly locks. Check that all tension springs touch the lower forms guide at the same time. Form each spring N as needed.
2. Unhook the clevis A and turn it on the link to adjust the tension. Hook the clevis.
3. Repeat the service check, steps 5, 6, and 7.
4. Install the print unit assembly (4.2.10.2).
5. Install the rear forms guide and covers.

Removal

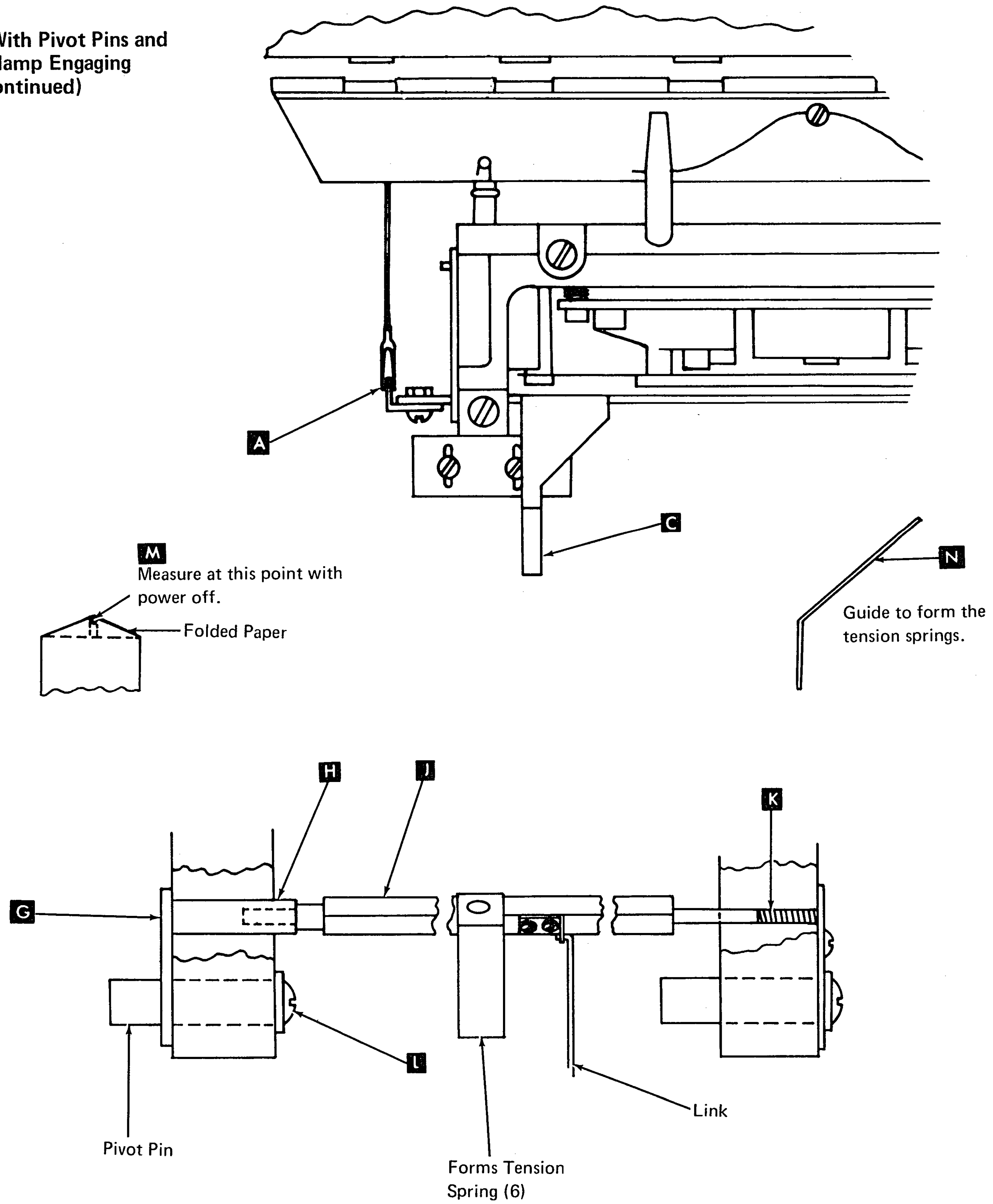
1. Power down.
2. Remove the printer covers (4.2.1) and forms.
3. Remove the print unit (4.2.10.2).
4. Remove the lower paper clamp assembly (4.2.44.3).
5. Loosen screw L , then remove retainer plate G .
6. Rotate the forms tension shaft J forward and slide the shaft to the left until the right end is clear of the right pivot. Remove the bushing H from the left end.
7. Lift the right end of the shaft up and to the right until clear of the left pivot.

Replacement

1. Install the shaft by inserting the left end, then the right end. Push the shaft to the right. You should feel the tension from the spring K .
2. Replace the bushing H on the shaft. Install plate G on the left pivot pin. Hold the plate down and tighten screw L .
3. Replace the lower paper clamp assembly (4.2.44.3).
4. Do the lower paper clamp service check and adjust if needed (4.2.44.2).
5. Do forms tension service check (4.2.45) and adjust, if needed.
6. Remove the support material from under the engaging lever. Install the print unit (4.2.10.2) and the covers (4.2.1).

4.2.45 50, 100, and 155 lpm Forms Tension Assembly (Continued)

4.2.45.3 Print Units With Pivot Pins and One Paper Clamp Engaging Lever **C** (Continued)

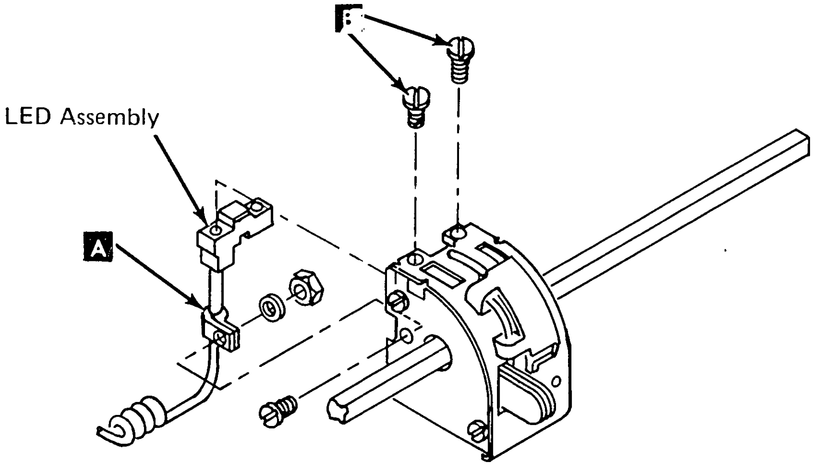


4.2.46 Forms Jam Detection Device

The forms jam detection device consists of a light emitting diode (LED) assembly installed in the left tractor. The device indicates forms jams by sensing the movement of margin holes.

Removal

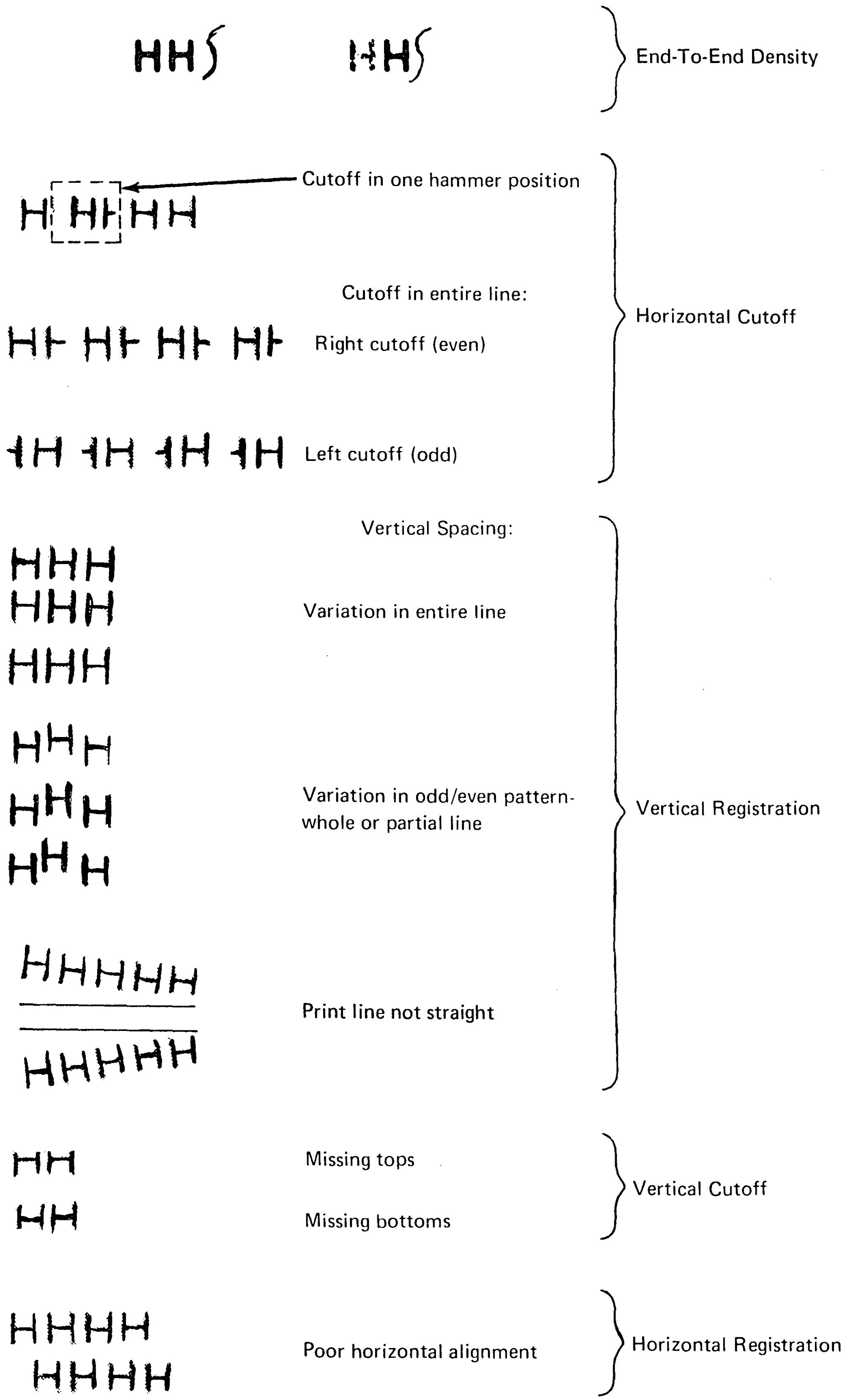
1. Unplug the forms jam plug (P9) and remove the cable clamp **A**.
2. Raise the upper paper clamp, move the tractor toward the center of the printer, remove two back screws **B**, and the LED assembly.



Replacement

Replace in reverse order of removal.

4.2.47 Examples of Incorrect Printing (50, 100, and 155 lpm)



4.2.48 Lower Forms Guide To Hammer Bar Adjustment

Notes:

1. This guide does not normally need adjusting. Be sure other related adjustments, such as platen gap, lower paper clamp, and forms tension springs are checked first.
2. Obtain special gauge IBM P/N 1794549 (office tool) before doing this adjustment.

Service Check

1. Open the printer cover and the print unit.
2. Remove the front paper guide from around the hammers.
3. Check the left end of the lower forms guide by holding the gauge B against the left hammer block and the hammer mounting bar as shown, then check for the *go* and *no-go* conditions.
4. Move the gauge to the right end of the hammer block and check the right end of the lower forms guide.

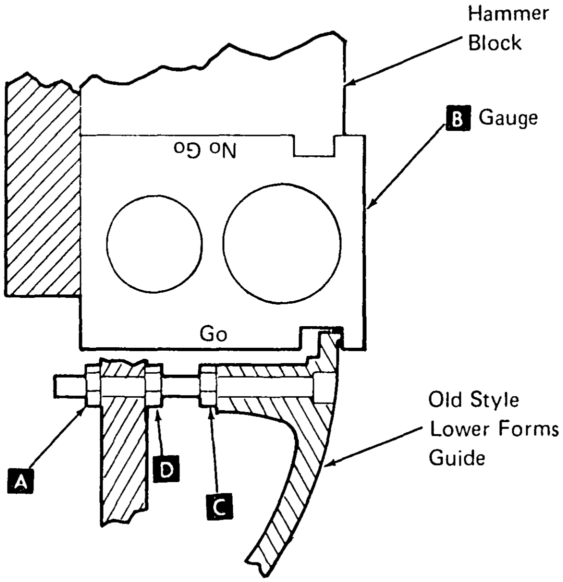
   Note: If the *go* and *no-go* conditions are correct at both ends of the hammers, the lower forms guide is adjusted correctly. If correct, go to step 5 under the adjustment.

Adjustment of Old Style

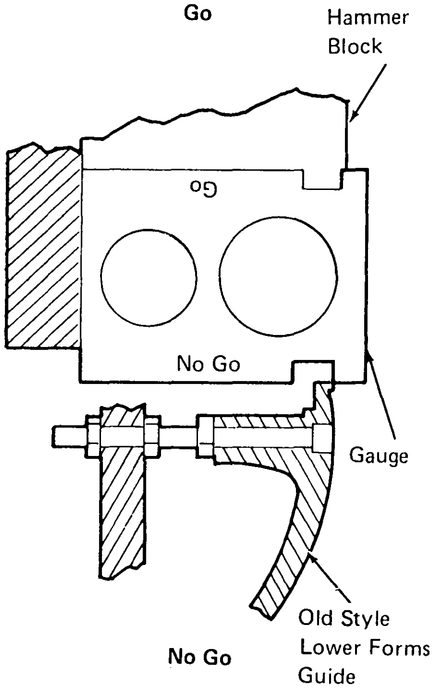
1. Be sure nut C is tight.
2. Loosen nut D, then with fingers, turn nut A a small amount.

   Note: Turning nut A clockwise moves the guide toward the front.

3. Tighten nut D, then check the *go* and *no-go* conditions at both ends.
4. If the adjustment is changed, do the lower paper clamp service check (4.2.44).
5. Replace the front paper guide. Close the print unit and cover.



Go



No Go

Adjustment of New Style

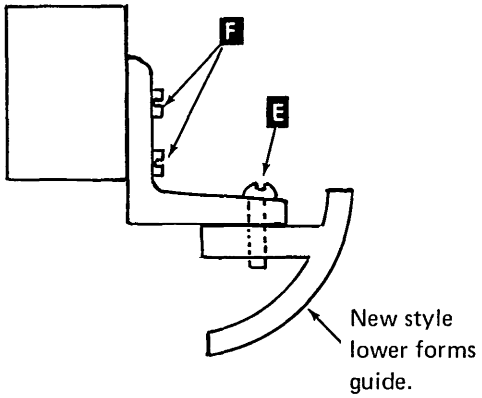
1. Loosen the two allenhead screws F.
2. Using the gauge B at each end of the hammer block, position the lower forms guide.
3. Tighten the two allenhead screws F.
4. Check again with the gauge B.

   CAUTION
   If the four screws E are loosened, it is necessary to adjust the lower paper guide to hammer clearance (4.2.49).

5. If the positioning is correct, replace the front paper guide. Close the print unit and the cover.

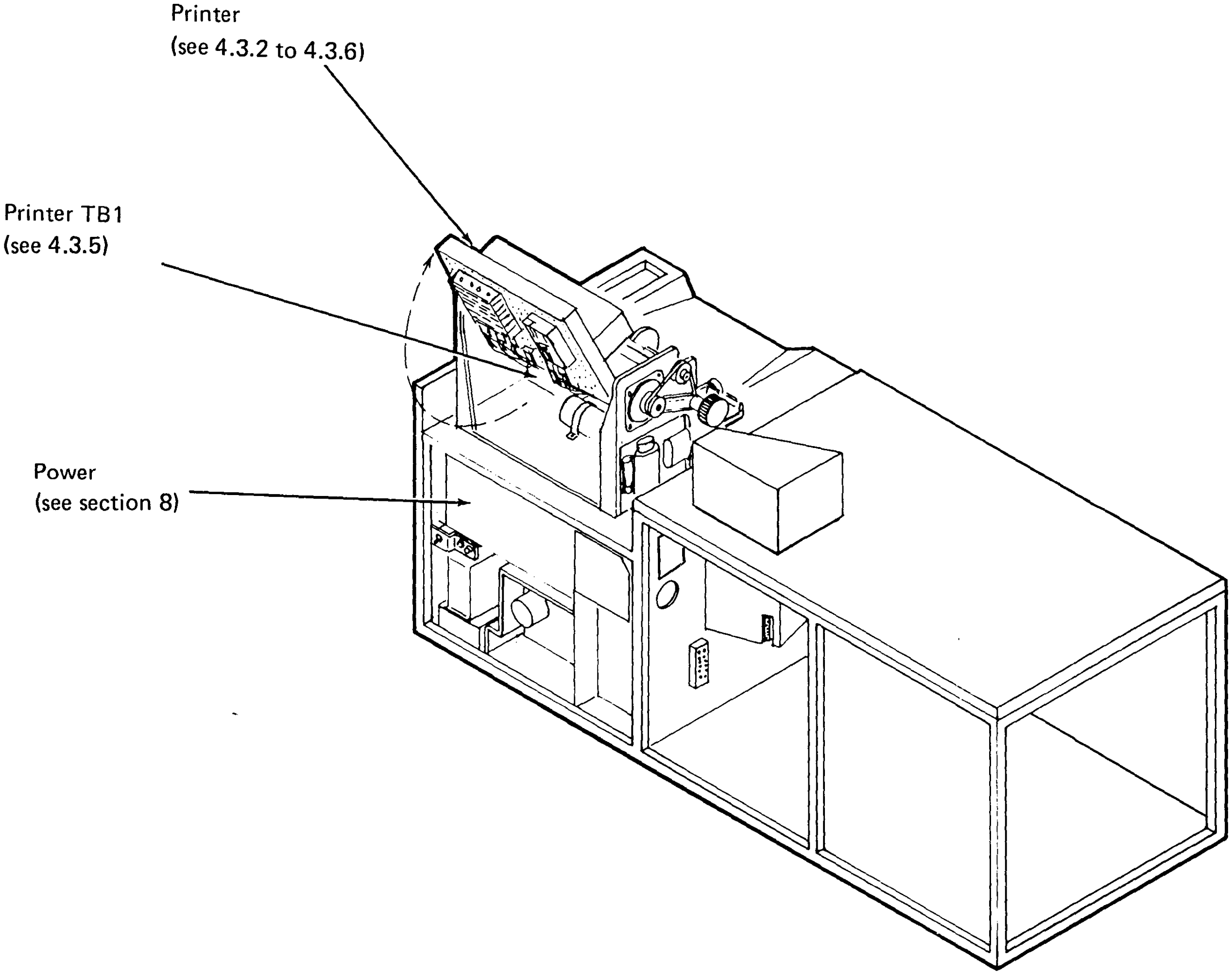
4.2.49 Lower Paper Guide To Hammer Clearance

1. Open the printer cover and remove the print unit (4.2.10).
2. Measure the clearance between the lower paper guide and the lowest hammer. The clearance should be 0.005 inch ± 0.002 inch.
3. If adjustment is necessary, remove the front paper guide.
4. Loosen the four screws E, and position the lower paper guide for a clearance of 0.005 inch ± 0.002 inch.
5. Reinstall all removed parts.

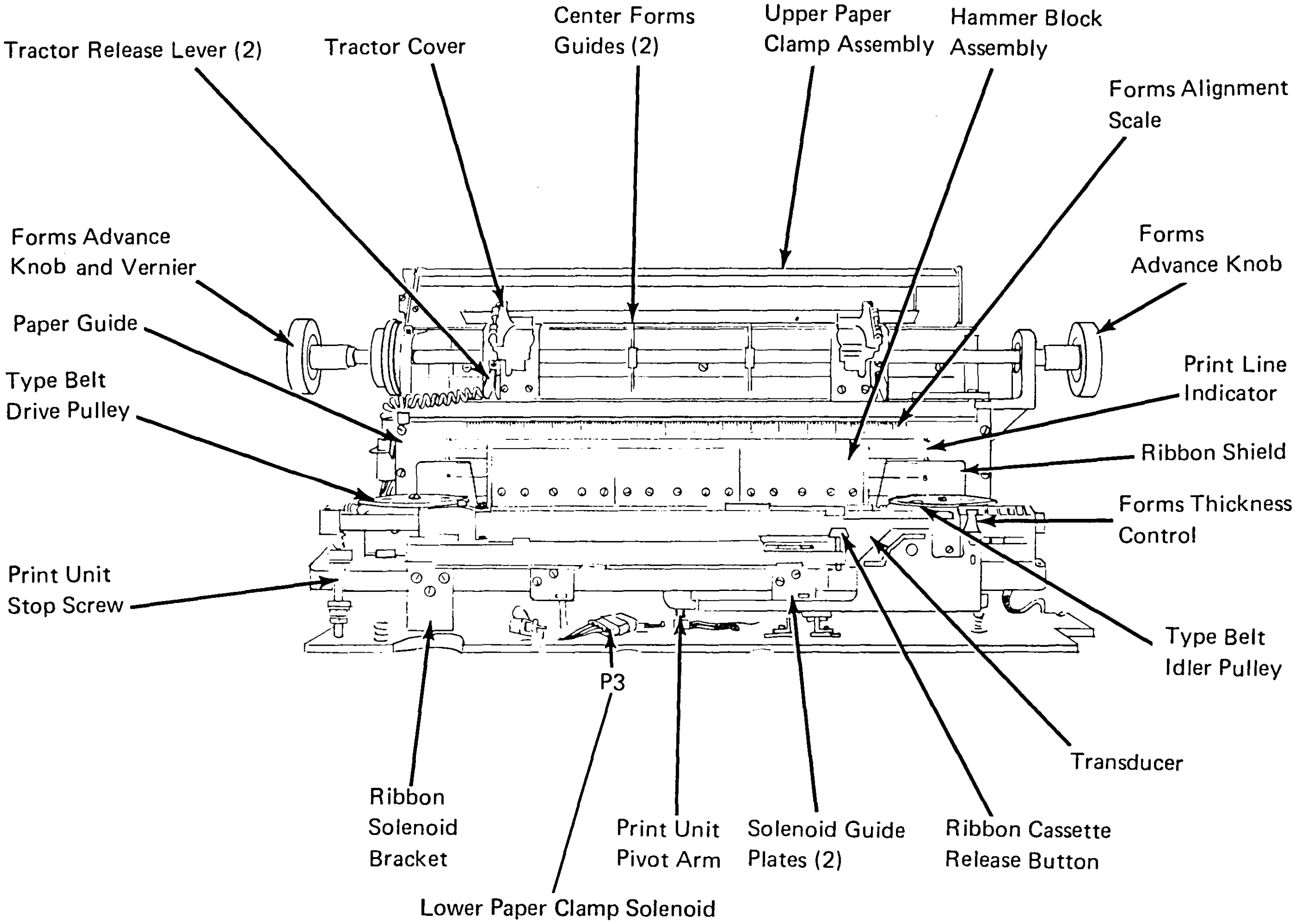


4.3.0 LOCATIONS (50, 100, and 155 lpm)

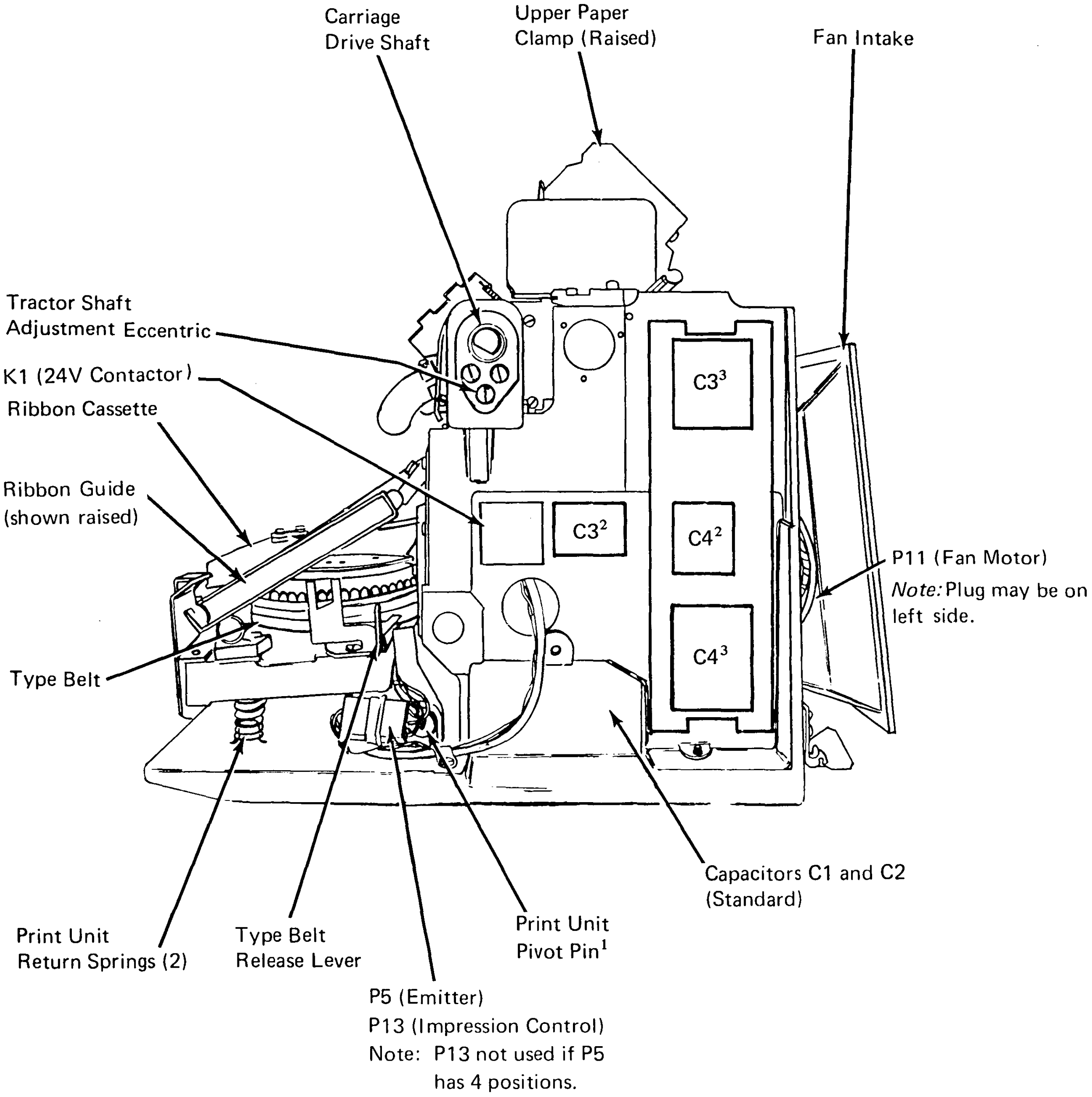
4.3.1 Back View



4.3.2 Front View



4.3.3 Right Side



Note: C1 through C4 are located under the logic gate on some early machines with 3 μf capacitors C3 and C4. See 4.3.5.

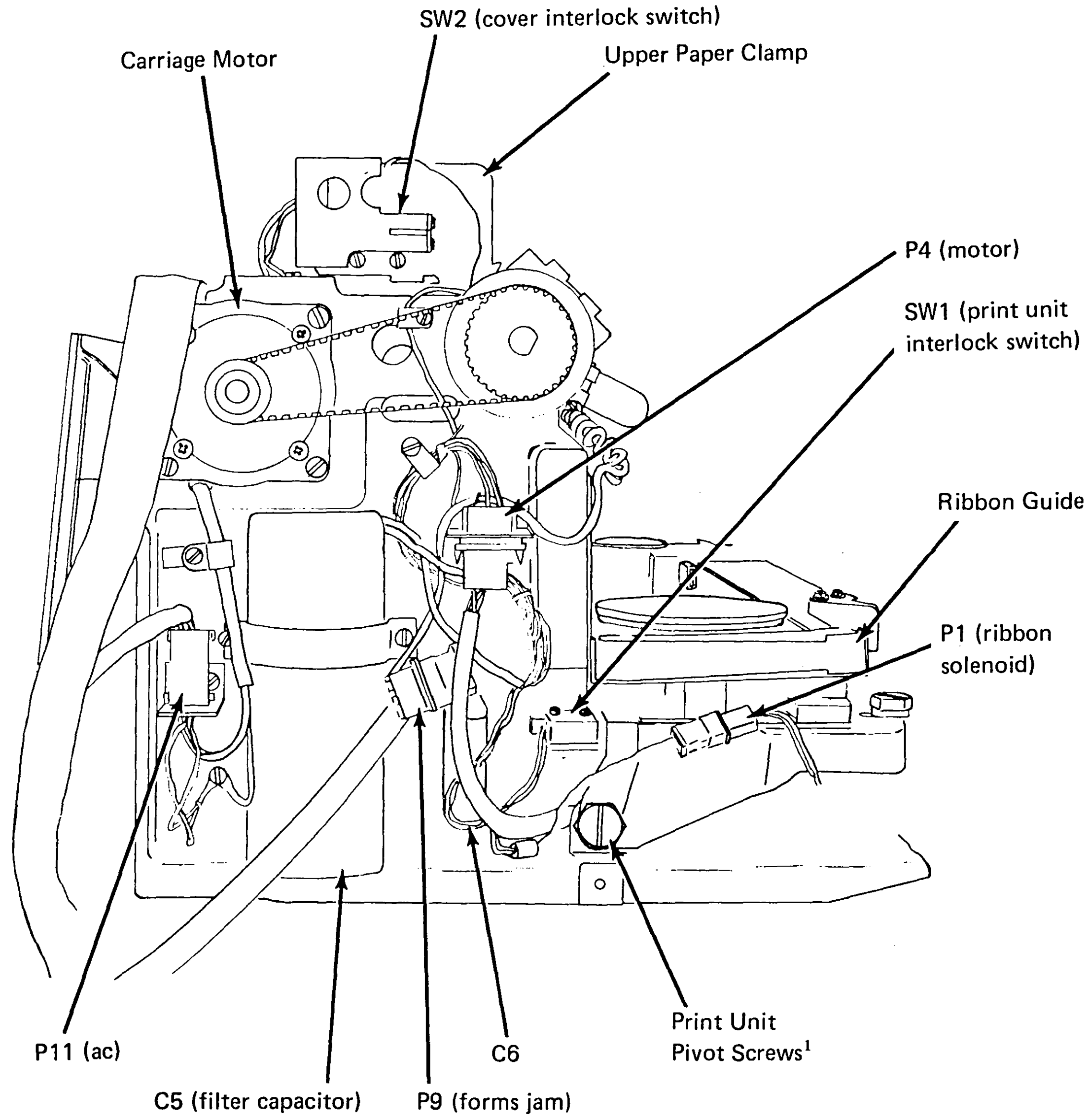
---

[1] Old style print units mount with pivot screws. New style print units mount with pivot pins.

[2] Location of C3 and C4 on printers with 3 μf capacitors.

[3] Location of C3 and C4 on printers with 10 μf capacitors.

4.3.4 Left Side



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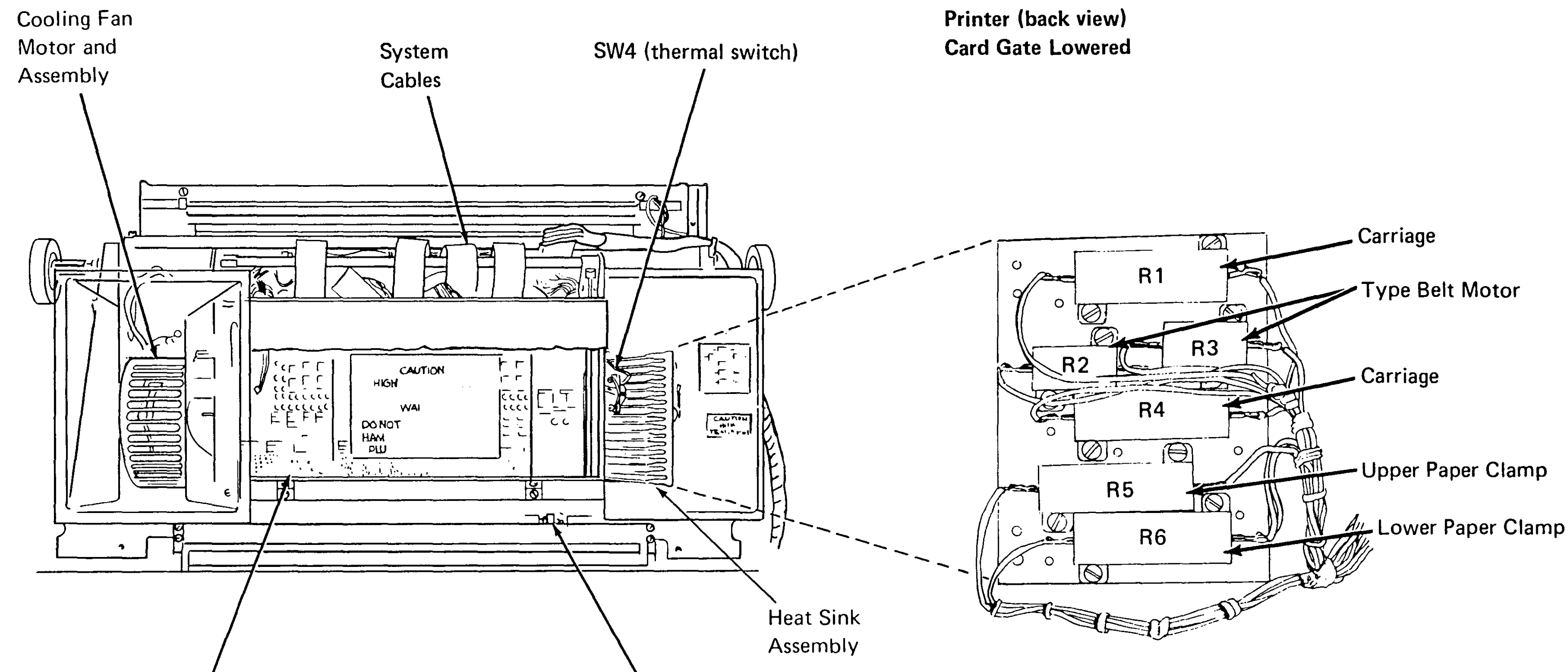
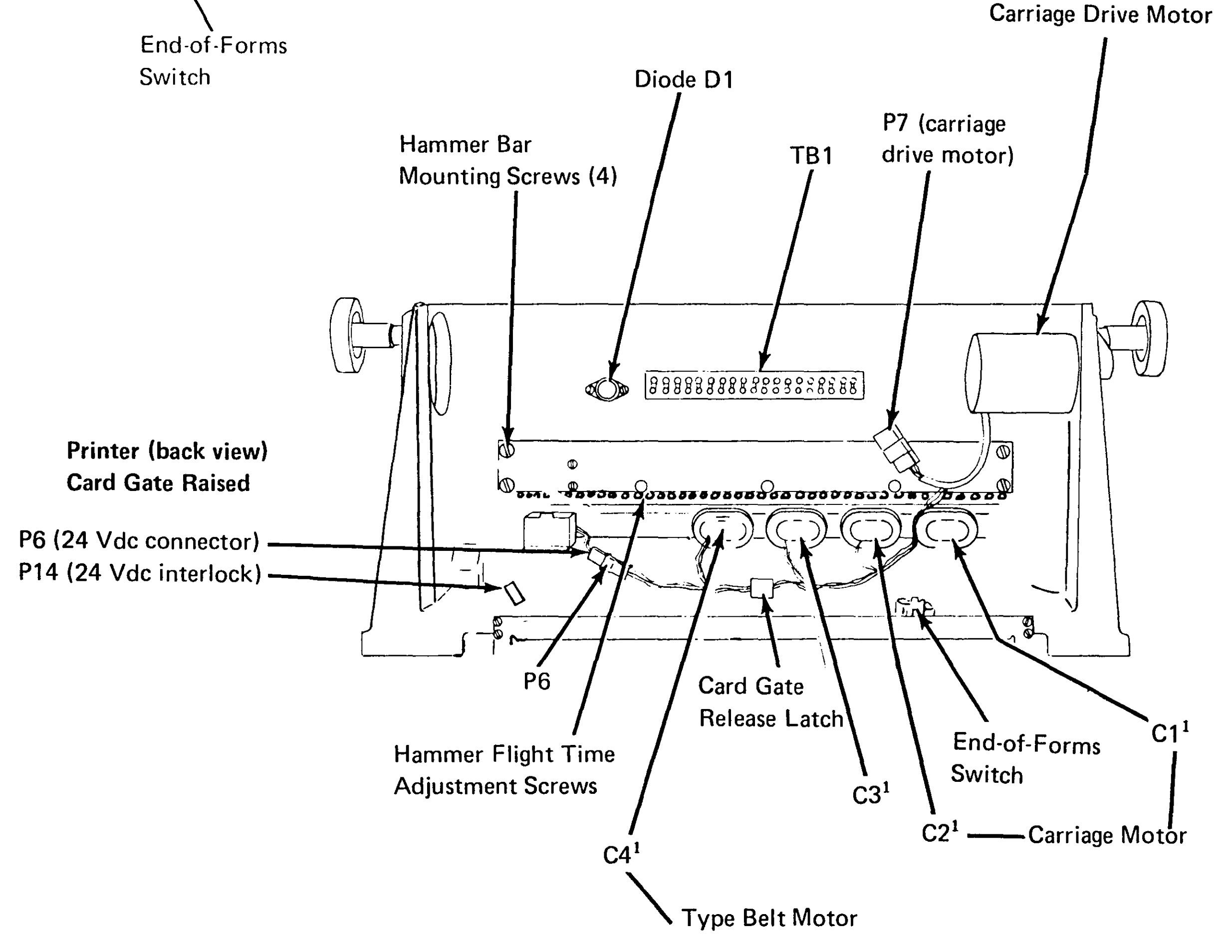
[1] Old style print units mount with pivot screws. New style print units mount with pivot pins.

4.3.5 Card Gate (50, 100, and 155 lpm)


Printer (back view)
Card Gate Lowered


Printer (back view)
Card Gate Raised

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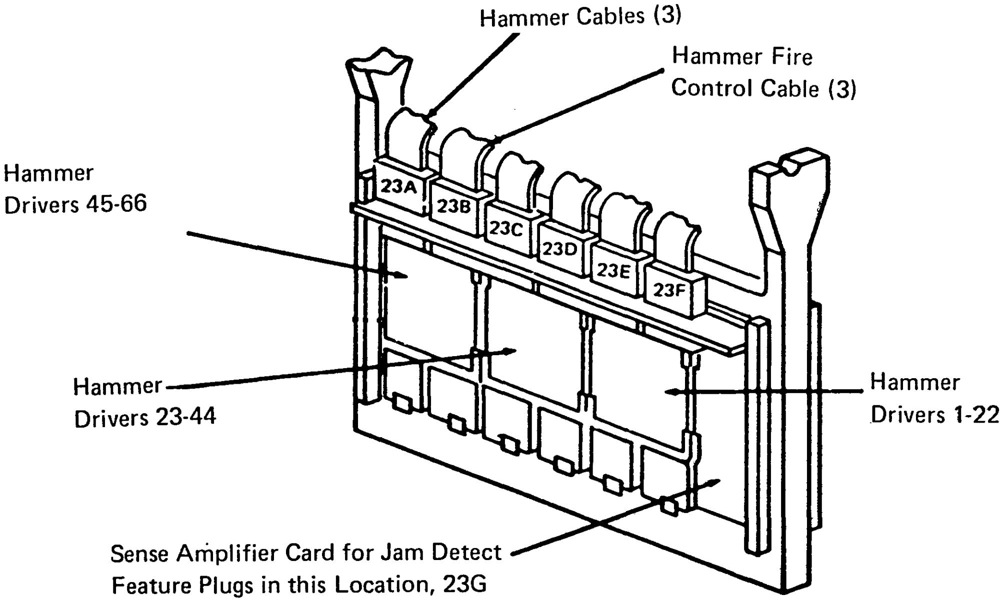
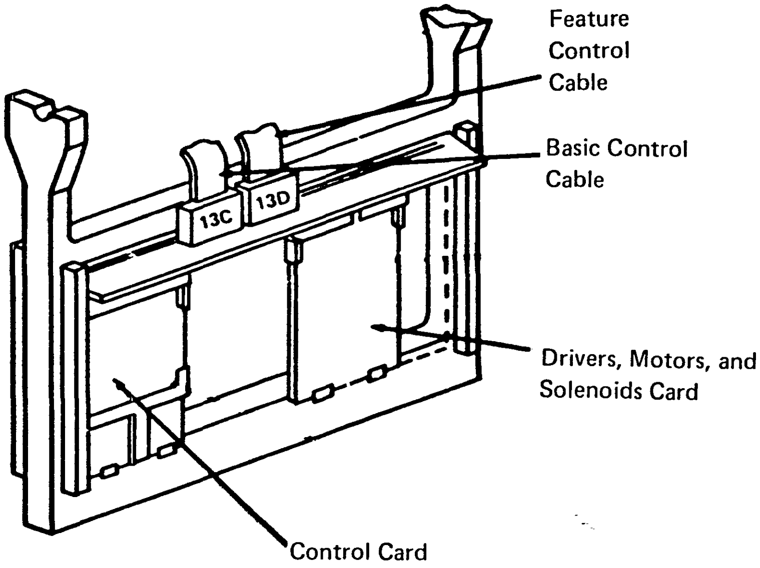
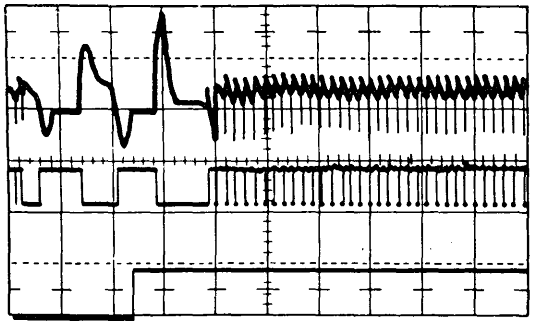
[1] C1 through C4 are located on the right end of some printers (see 4.3.3).

4.3.6 Card and I/O Cables (50, 100, and 155 lpm)

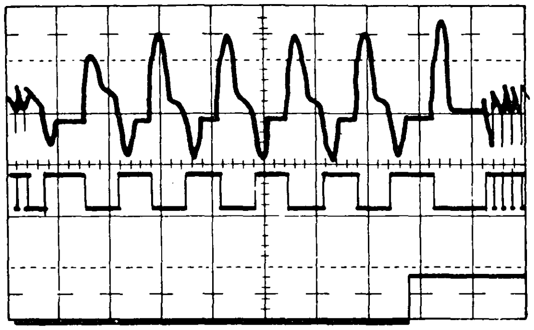




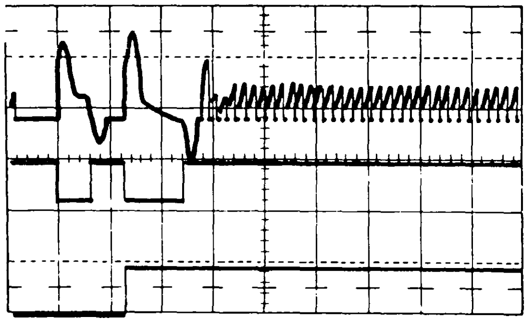
4.4.0 OSCILLOSCOPE FIGURES (50, 100, and 155 lpm)



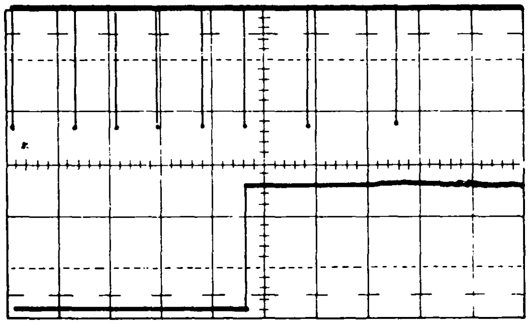
Carriage Motor Drive Pulse
One line space operation, detent on phase
Horizontal 5 ms/div
Vertical top trace 50V/div
Middle and bottom trace 5V/div
Top trace — Carriage Motor Phase A (P7-1 or 13E42)
Middle trace — Input to driver card (13E50)
Bottom trace — Carriage go (13B63)
Sync negative on carriage go



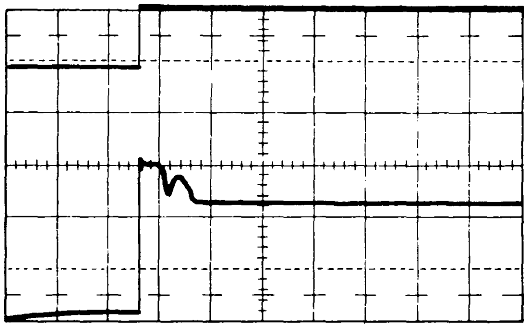
Carriage Motor Drive Pulse
Three line space operation.
Horizontal 5 ms/div
Vertical top trace 50V/div
Middle and bottom trace 5V/div
Top trace — Carriage Motor Phase A (P7-1 or 13E42)
Middle trace — Input to driver card (13E50)
Bottom trace — Carriage go (13B63)
Sync negative on carriage go



Carriage Motor Drive Pulse
One line space operation, detent off phase
Horizontal 5 ms/div
Vertical top trace 50V/div
Middle and bottom trace 5V/div
Top trace — Carriage Motor Phase Not B (P7-4 or 13E45)
Middle trace — Input to driver card (13E53)
Bottom trace — Carriage go (13B63)
Sync negative on carriage go

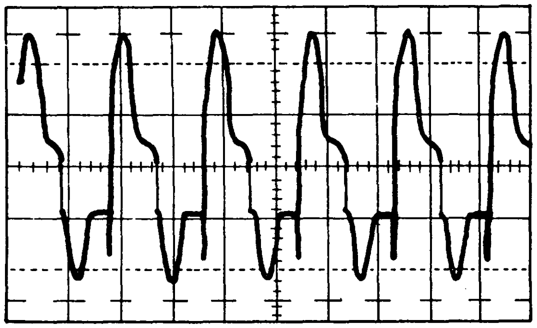


Carriage Advance Pulses
Six lines/inch
Horizontal 2 ms/div
Vertical 2V/div
Top trace — Carriage Advance Pulses (13B46)
Bottom trace — Carriage go (13B63)
Sync negative on carriage go

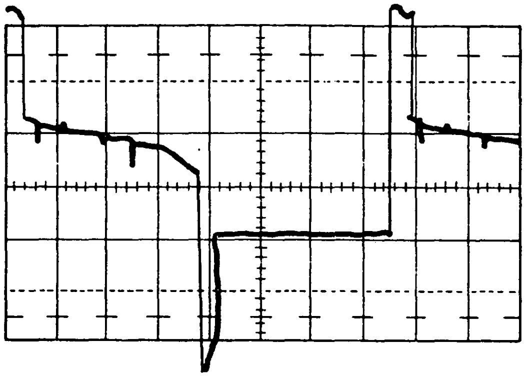


Hammer Fire Pulse
Horizontal .5 ms/div
Vertical 5V/div
Top trace — Input to hammer driver card
Bottom trace — Fire hammer pulse to hammer coil
Sync internal on fire hammer pulse

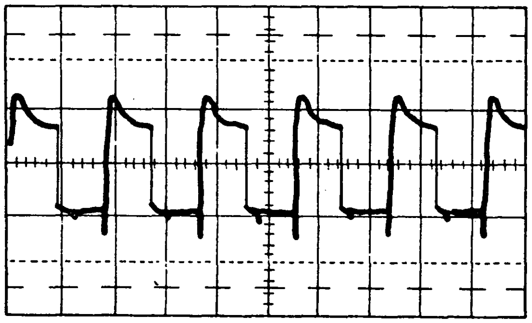
4.4.0 50, 100, and 125 lpm OSCILLOSCOPE FIGURES (Continued)



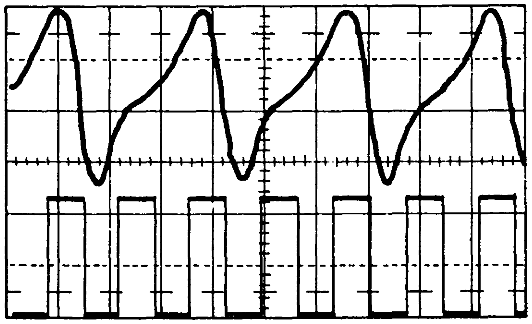
Good Belt Motor Drive Pulse
Horizontal 2 ms/div
Vertical 20V/div
Channel 1 – Belt Motor Phase A
(P4-1 or 13F42)



Bad Belt Motor Drive Pulse
Phase capacitor removed
Horizontal 500 us./div
Vertical 20V/div
Channel 1 – Belt Motor Phase A
(P4-1 or 13F42)



Bad Belt Motor Drive Pulse
High load
Horizontal 2 ms/div
Vertical 20V/div
Channel 1 – Belt Motor Phase A
(P4-1 or 13F42)



Emitter Pulse
Horizontal 500 us./div
Vertical Top trace .5V/div
Bottom trace .2V/div
Channel 1 Emitter Pulse
Positive input (13A44)
Negative input (13A42)
Do not ground either lead.
1000 mV minimum peak-to-peak
Channel 2 Print Subscans (13A47)

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4.5.1 Principles of Printing (285 lpm)

The belt printer has 132 hammers, one hammer for each print position. The print operation is separated into these functions:

- *Subscan.* A subscan is the time required to option every fifth print position to every second belt position. Five subscans make one print scan.
- *Print scan.* A print scan is the time required to option one character to all print positions.
- *Print line.* A print line is 48 print scans for a 48-character set[1] (standard). That is, every character on the set is optioned to every print position.

Each print position can print only one character per print line (when the print position is optioned and the character specified for that position is equal to the character aligned at that position). See page 4-84.

During a subscan, the hammers selected for firing are buffered in the attachment, and they are gang-fired at the start of the next subscan. Print scans are stopped early if all optioned hammers are fired.

To synchronize the type belt to the attachment, two types of pulses are required—a home pulse and the subscan pulses.

The home pulse is generated from the type belt by the transducer **A** sensing the missing timing mark **B** that identifies the home position. The home pulse occurs one subscan before the first character of each character set is aligned to print in position 1. Sensing the first home pulse initiates a continuing check of the synchronism of the home pulse with the belt position counter.

The subscan pulses are generated by the transducer detecting the raised timing marks on the type belt. Two subscan pulses are developed from each timing mark.

Because the printer has a continously moving type belt, the attachment must determine when to fire a hammer to print the specified character. Using the illustration **C** as a reference, observe the relationship between the moving type belt and the hammer positions. This shows the character A aligned with hammer 1 in print position 1.

Print optioning can start when a character is aligned with print position 1. The belt position counter keeps track of what character is aligned to print in print position 1. This value is set into the scan register at the beginning of each print scan. During the first hammer option cycle, the character specified for position 1 is compared to the character aligned at position 1. During this first subscan, every fifth position (1, 6, 11, 16, 21, 26, 31, etc) is compared with its respectively aligned character (every second belt character). If the character specified and the character aligned compare equal, the hammer is fired at the beginning of the next subscan. This sequence, starting at print position 1, is called subscan 1.

At the end of subscan 1, the type belt movement aligns the character B with print position 3, as shown in the illustration **D**. Print optioning now continues with print position 3 and proceeds through every fifth print position until the character aligned with print position 128 is optioned. This sequence, starting with print position 3, is called subscan 2.

Belt movement has now aligned the character C with print position 5, as shown in the illustration **E**. Print optioning continues for every fifth position until the character aligned with print position 125 is optioned. This sequence, starting with print position 5, is called subscan 3.

Subscans 4 and 5 follow the same pattern (illustration **F** and **G**. Subscan 4 starts optioning with print position 2 and every fifth position through print position 127. Subscan 5 starts optioning with print position 4 and every fifth position through print position 129. These five subscans make the first print scan.

During this first print scan, each of the print positions was optioned to print one character, but only those hammers are fired that had the aligned character compare equal with the specified character.

The first print scan started with the character A aligned at print position 1. Now, the character B is aligned with print position 1 to start the second print scan.

After the second five subscans, all positions are now optioned to print a second character. To option the 46 remaining characters to each print position, 46 more print scans are taken.

Hammers are fired for the optioned print positions that compare equal on each succeeding subscan. To reduce the hammer power requirements, only five hammers are allowed to fire on one subscan. If more than five optioned print positions compare equal, optioning starts again with 48 new print scans. Scanning starts again at print position 1 and positions not printed are optioned again.

After the 48 print scans, an additional print scan (49) is taken to fire hammers selected during subscan 5 of print scan 48.

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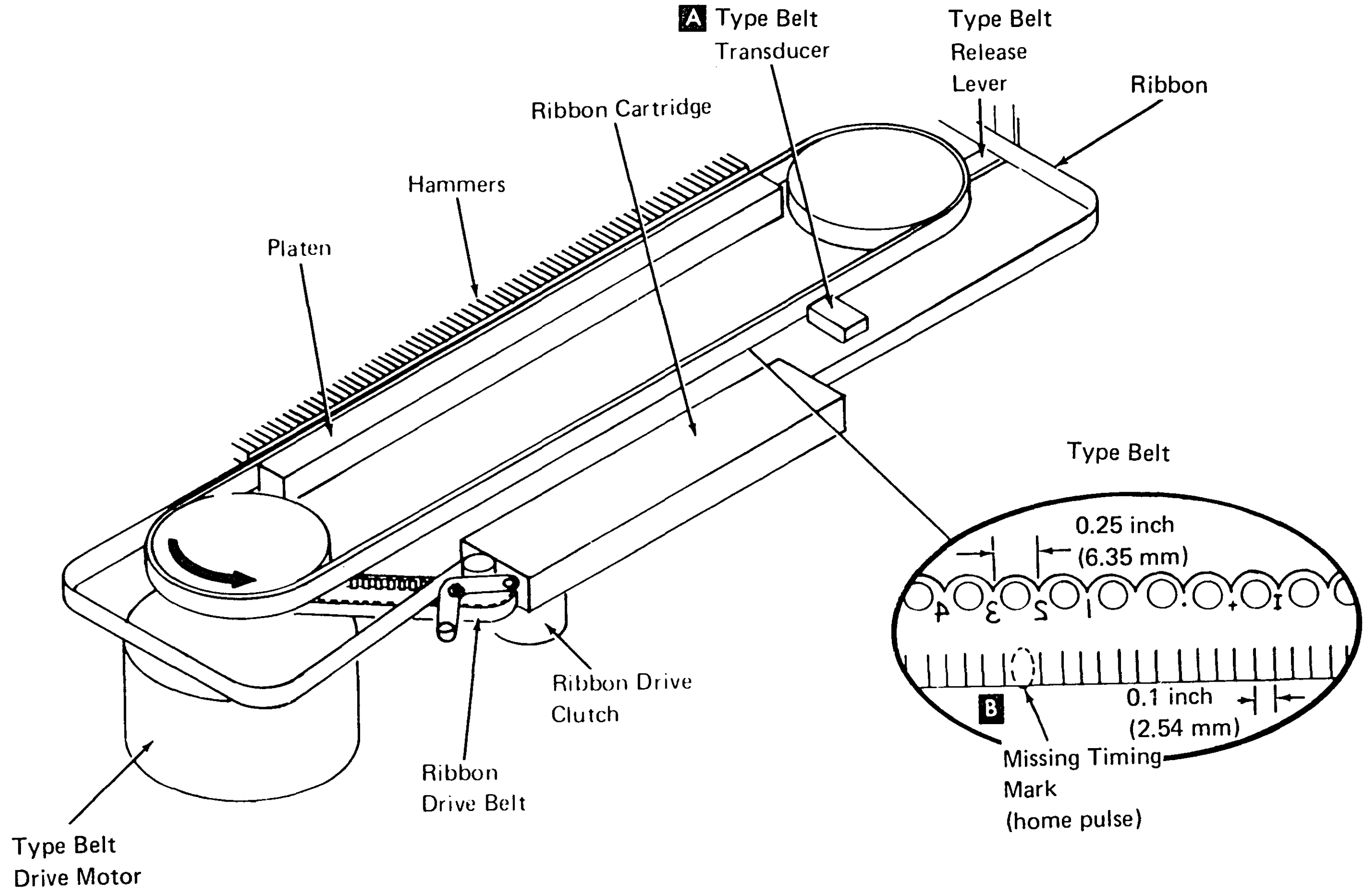
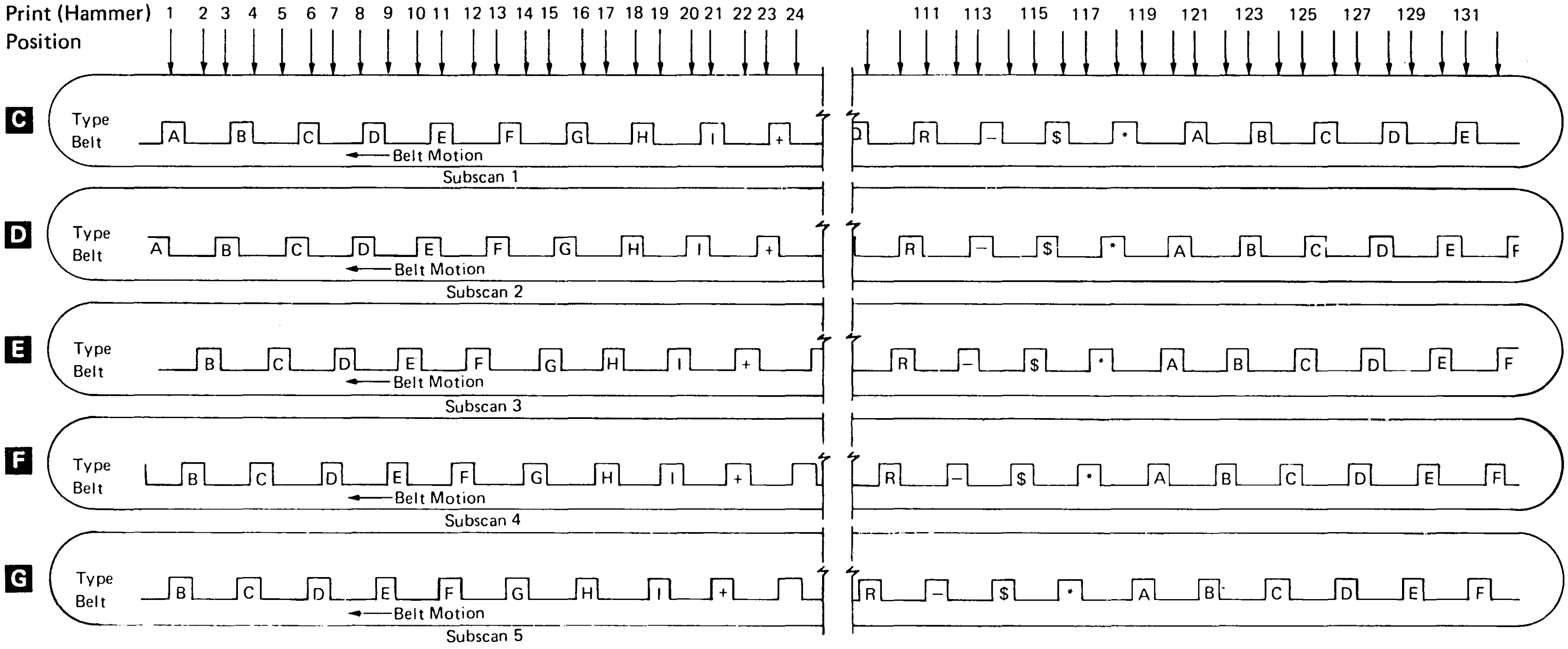
[1] The 64-character set takes 64 print scans. The 96-character set takes 96 print scans.


A Type Belt Transducer
Type Belt Release Lever
Ribbon
Ribbon Cartridge
Hammers
Platen
Type Belt
0.25 inch (6.35 mm)
0.1 inch (2.54 mm)
B Missing Timing Mark (home pulse)
Ribbon Drive Clutch
Ribbon Drive Belt
Type Belt Drive Motor


Print (Hammer) Position
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
111 113 115 117 119 121 123 125 127 129 131
C Type Belt
D Type Belt
E Type Belt
F Type Belt
G Type Belt
Belt Motion
Subscan 1
Subscan 2
Subscan 3
Subscan 4
Subscan 5
A B C D E F G H I + R – $ *

Print(Hammer) Position	1	2	3	4	5	6	7	8	9	10	11	122	123	124	125	126	127	128	129	130	131	132
SS1	⊠					⊠					O					⊠					O	
SS2	F		⊠			F		O					O			F		⊠				
SS3			F		O					⊠					O			F		⊠		
SS4		O					O			F		⊠					O			F		⊠
SS5				⊠					O			F		⊠					O			F

⊠ or O Hammer optioned (every fifth position)

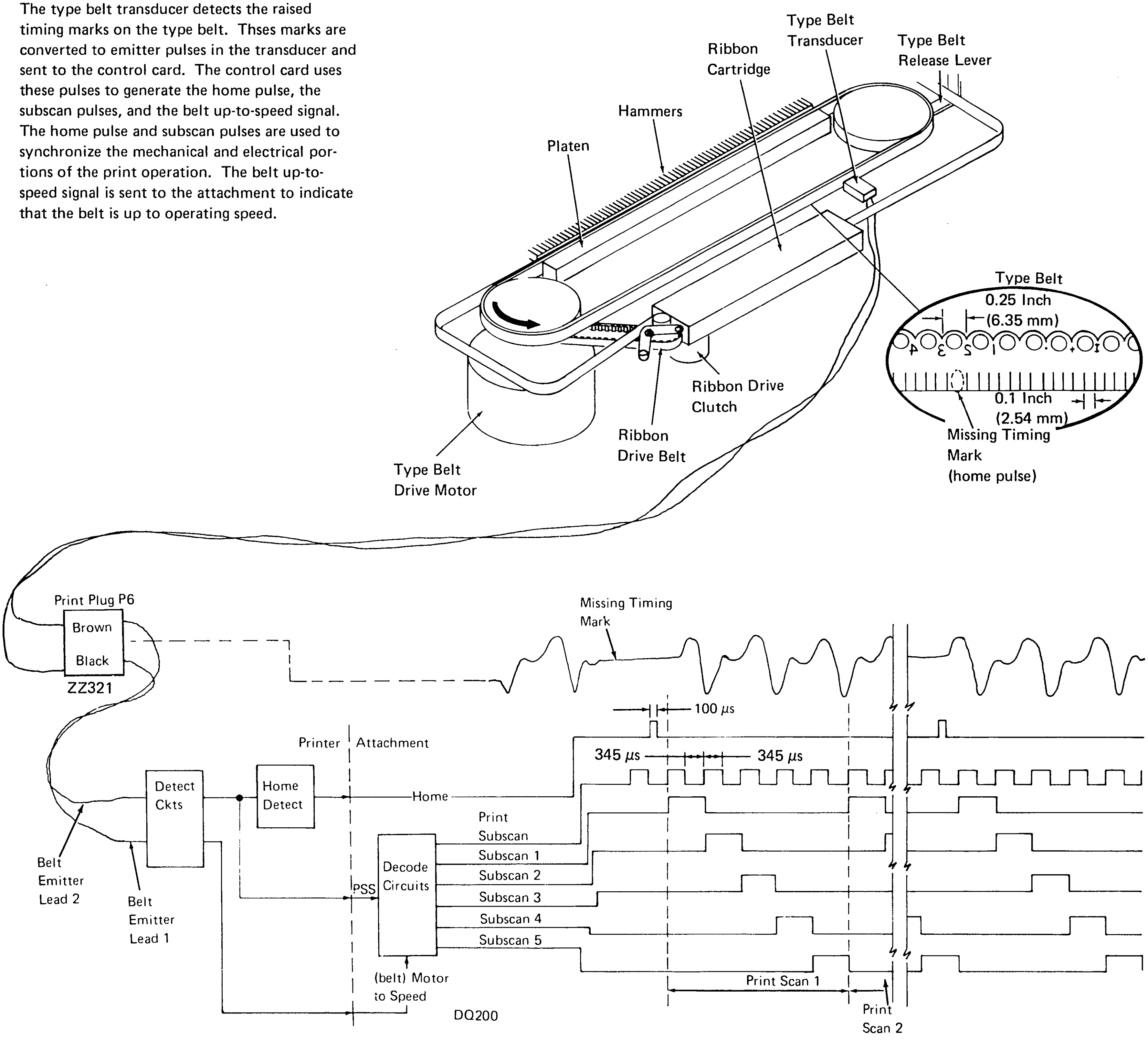
⊠ Hammer optioned and compare equal

F Hammer fired (fired on subscan after compare equal)

4.5.2 Functional Components (285 lpm)

Type Belt Transducer

The type belt transducer detects the raised timing marks on the type belt. Thses marks are converted to emitter pulses in the transducer and sent to the control card. The control card uses these pulses to generate the home pulse, the subscan pulses, and the belt up-to-speed signal. The home pulse and subscan pulses are used to synchronize the mechanical and electrical portions of the print operation. The belt up-to-speed signal is sent to the attachment to indicate that the belt is up to operating speed.



Ribbon Drive

The ribbon is driven by a belt mounted on the type belt drive pulley. The drive mechanism also includes a solenoid-driven clutch to disengage the drive from the ribbon when no printing is taking place. Disengaging the clutch prevents smudging the paper while the printer is idle.

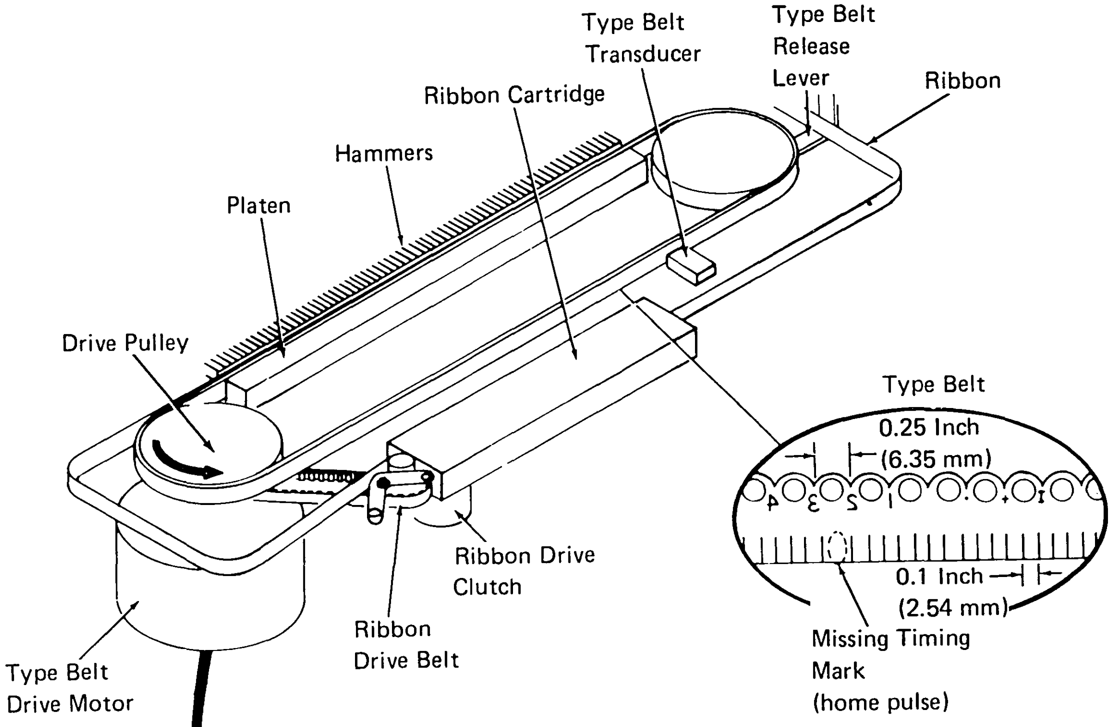
The ribbon is a continuous 3/4 inch wide fabric ribbon contained in a cartridge mounted on the front of the printer. The ribbon is fed into the left side of the cartridge and pulled out the right side (as viewed from the front of the machine).

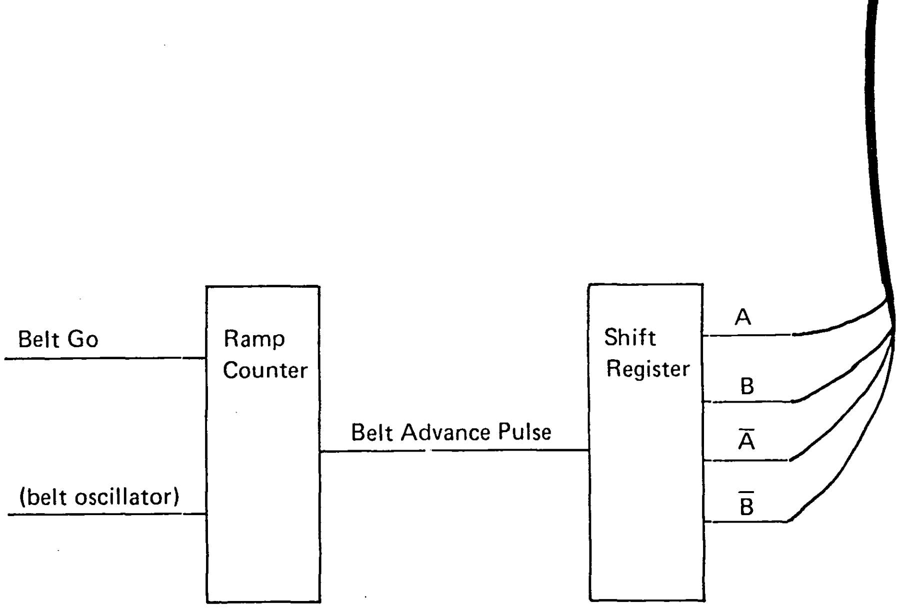
Type Belt Drive

The type belt is driven directly by a stepper motor mounted under the left pulley.

When belt go is activated, the belt oscillator is gated and ramps the stepper motor up to speed.

The right pulley has a release lever mounted on it to remove tension from the type belt. When the release lever is operated, the type belt can be removed.





Carriage

Line Space Operation

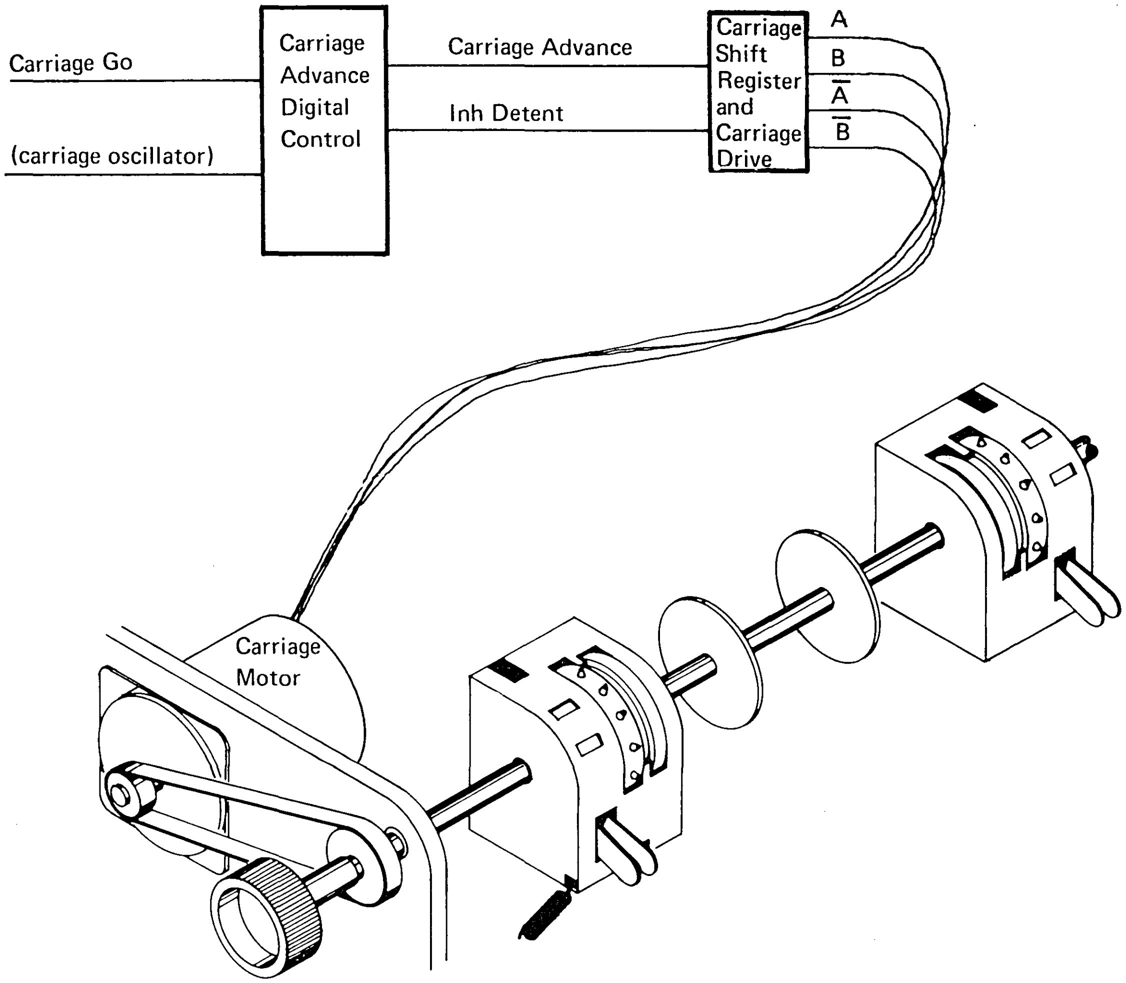
The printer has a pin feed carriage driven by a stepper motor (general stepper motor operation is described in Appendix B). The carriage spaces six lines per inch. Skipping and spacing are controlled by the attachment circuitry.

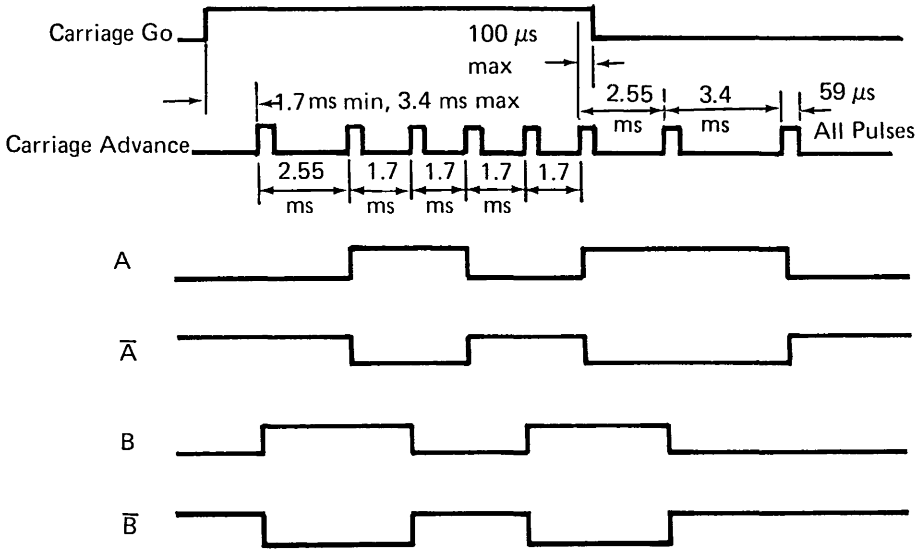
The carriage go line gates the carriage oscillator. The carriage oscillator, in turn, generates the carriage advance pulses. The carriage advance pulses generate the drive lines (A, Ā, B, B̄) that control the carriage motor. Each carriage advance pulse advances the drive by one increment. Eight increments are required to advance the carriage one space.

When carriage go goes inactive, after six carriage advance pulses, two more advance pulses are generated. The carriage is allowed to come to a stop without overshooting by delaying the last two carriage advance pulses.

The keyboard functions that control the carriage are:

- Carriage restore
- New line
- Reset line counter to 1



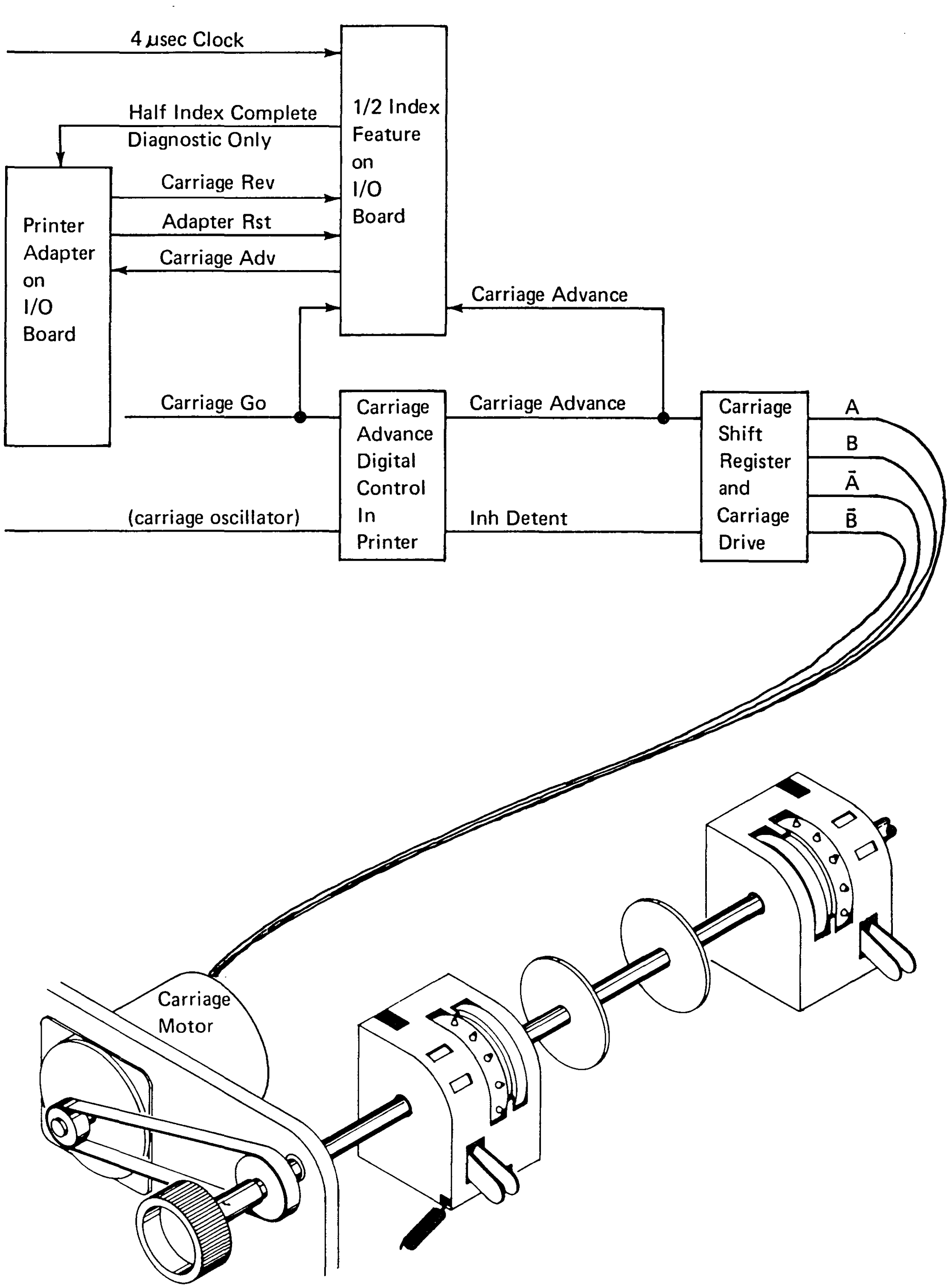


Note: ±10% tolerance on all times unless otherwise note.

Half Line Space Operation

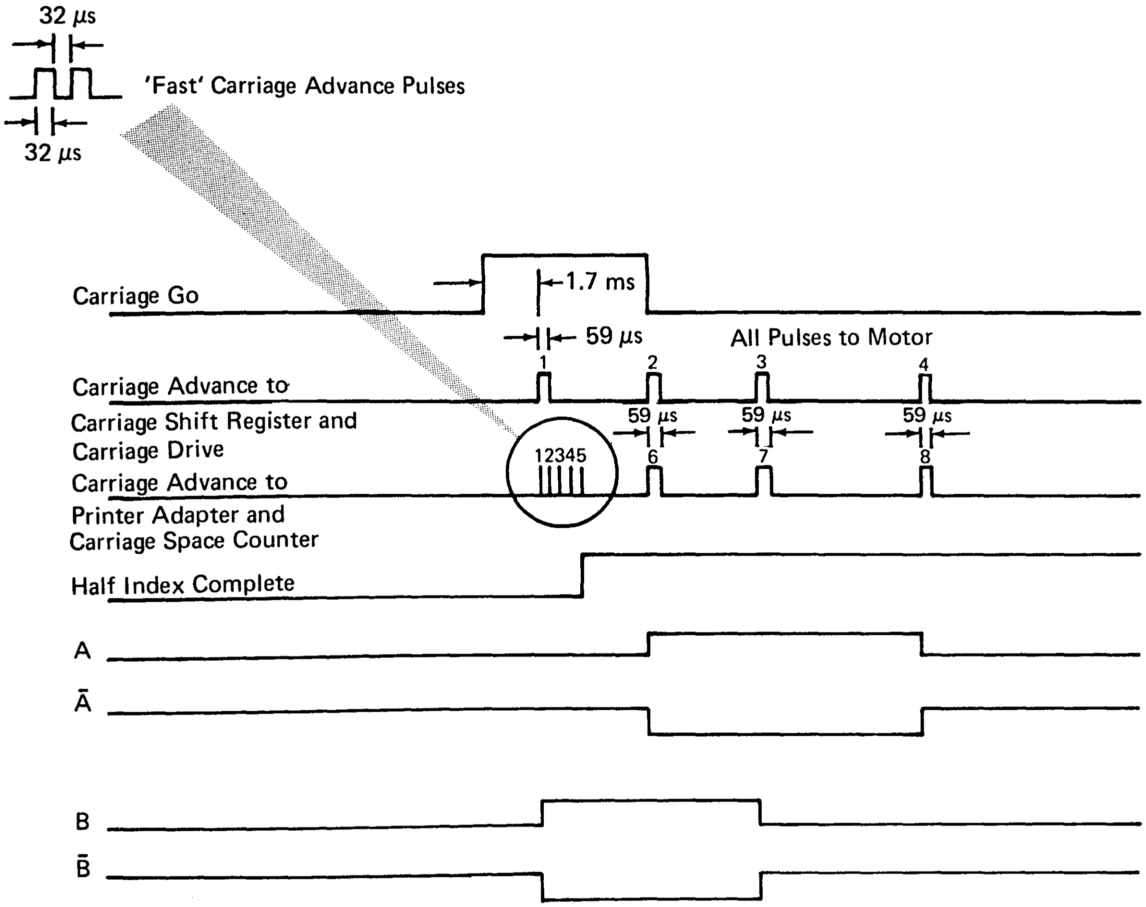
The half line space print feature permits indexing of the printer one half space above or below the normal print line. This spacing can be used to superscript or subscript any of the characters on the the print belt.

The half line space print feature supplies the printer attachment with 8 carriage advance pulses when only 4 carriage advance pulses are sent by the printer to the carriage advance shift register. During the half line space operation, when the first carriage advance pulse is received by the half index card, 5 short (64 µs) carriage advance pulses are generated from the 4 µs clock and sent to the printer attachment before the second carriage advance pulse is received from the printer. When the second pulse is received from the printer, it is passed unaltered to the printer attachment. This pulse becomes the sixth carriage advance pulse to the printer attachment and carriage go is dropped. The deceleration function begins and the third and fourth carriage advance pulses from the printer are received by the printer attachment. These are the seventh and eighth pulses in the carriage line position counter (count to 8). Because the printer attachment has received 8 pulses in the carriage line position counter, the acceleration and deceleration timing of a full index is retained and forms jam and carriage sync checking are performed.



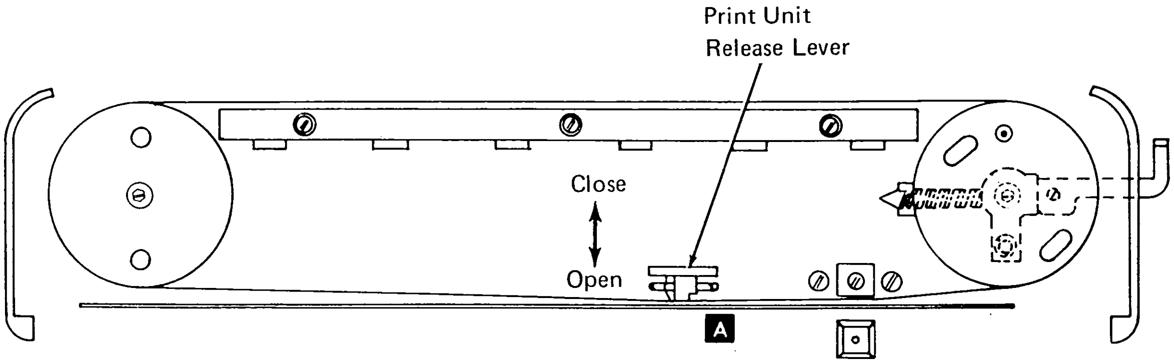
A half line space operation is initiated by setting the carriage reverse bit (bit 4) in a control load command (IOCL) with a modifier of A. Half index mode is reset by bit 5 of the command and the half index feature card is reset by bit 5 of the command, dropping carriage go, or resetting the printer attachment.

Half index complete indicates that the 5 'fast' pulses to the printer attachment have been generated and the completion of the index operation is under control of the carriage advance digital control in the printer.



Throat

The throat must be opened to insert the paper and must be closed before the printer is ready. The throat is controlled by the print unit release lever **A**. Pull the lever toward the front of the machine to move the print unit forward and open the throat; push the lever toward the back of the machine to move the print unit back into place and close the throat. When the print unit is back in place, the print unit interlock switch signals the attachment that the throat is closed.



Paper Clamps

There are two paper clamps in the printer. The upper paper clamp is used only to suppress the noise of the paper. When the clamp solenoid is energized, it closes the air gap where the paper passes through to reduce the noise level at the back of the printer. (*Upper Paper Clamp Assembly* 4.6.43.)

The lower paper clamp is located just below the print line to prevent horizontal skewing of the paper. The print belt is turning continuously and has a tendency to pull the paper along with it. Because there are no feed rolls in the lower portion of the printer, the lower paper clamp holds the paper in position. (*Lower Paper Clamp* 4.6.44.)

4.5.3 Checking (285 lpm)

Forms Jam Check

The forms jam check indicates that the carriage tractor was told to move, but the paper did not move. A light emitting diode detects the time between holes in the paper. If no hole is detected in eight lines, the forms jam check is set.

Note: A false forms jam check or a false printer check can occur when chads (chips) are not completely punched out of two successive holes in the paper.

Belt Speed Check

This check indicates that either the type belt failed to move within two seconds after the start time, or the type belt lost motion after being up-to-speed. Motion is considered lost if there is a 25% reduction in operating speed. The speed is determined by sensing the time between timing marks on the type belt.

Carriage Sync Check

Two conditions can set this check:

1. If a carriage feedback pulse (carriage advance pulse) occurs when no carriage motion was initiated.

2. If a carriage feedback pulse (carriage advance pulse) fails to occur within 8 ms, during carriage spacing.

Coil Current Check

An 8 ms timer is started when a hammer driver is fired. The driver gates current through its associated hammer coil. The 8 ms timer is used to check for the possibility of a hammer driver being on longer than 8 ms. If this condition is detected, power is dropped to the printer, and the coil current check is set. The status of the three coil current lines that are the input to the coil current check is saved until the check is cleared. This indicates which two of the six hammer driver cards is failing.

Note: If an even number of hammers on one of the six hammer driver cards is on longer than 8 ms, the coil current check is not set. This is because the hammer drivers are checked for an odd number of hammer drivers on within any two of six hammer driver cards.

Belt Sync Check

This check is set by three possible conditions:

1. If a home pulse occurs when not expected.

2. If a home pulse fails to occur when expected.

3. If more than 1 bit is generated from the bit ring at one time.

The timing for the home pulse is determined by counting the number of print scans. This count is compared with the character set size (only one home pulse per character set).

Emitter Check

Once the type belt motor is up-to-speed, the print subscan line is monitored to verify that it is oscillating. If no change occurs during any 2 ms period, emitter check is set. This check supplements the belt sync check, which cannot detect a broken or stopped belt.

Data Check

Parity is maintained on the data in the print buffer. If invalid parity is detected during a print cycle, data check is set.

Hammer Parity Check

This check compares the number of hammers selected to fire with the number actually fired. If a mismatch occurs the hammer parity check latch is set.

End of Forms Check

End of forms is checked on the first line printed of each new form. If end of forms line is active, the printer goes not ready.

Throat Closed Check

The printer is not ready if the print unit is not latched in place to close the throat.

Cover Closed Check

The printer is not ready if the cover is open.

Unprintable Character Check

One or more of the characters requested to print were not in the print image. Unprintable character is checked entirely by the microprogram. There is no hardware checking involved. Setting this check is a programmer option.

4.5.4 Input/Output Lines (285 lpm)

A = From attachment
P = From printer

POR/Printer Reset (A)

POR/printer reset line is initiated during the power up sequence to reset the printer circuits to their starting condition. It is also activated if a carriage sync check is detected.

Close (+24V) Contactor (A)

Close contactor line must be activated to switch the +24 voltage into the printer. This line is deactivated when a hammer parity check is sensed to protect the hammer coils.

Belt Go (A)

Belt go line is activated to start the belt oscillator. The belt oscillator furnishes pulses to run the type belt drive circuits.

Belt Motion (P)

The belt motion signal is active when the type belt reaches operating speed. It becomes inactive when the belt speed decreases to approximately 10% below the operating speed. The home pulse and the subscan pulses become active when the belt is up to speed.

PSS (Subscan) (P)

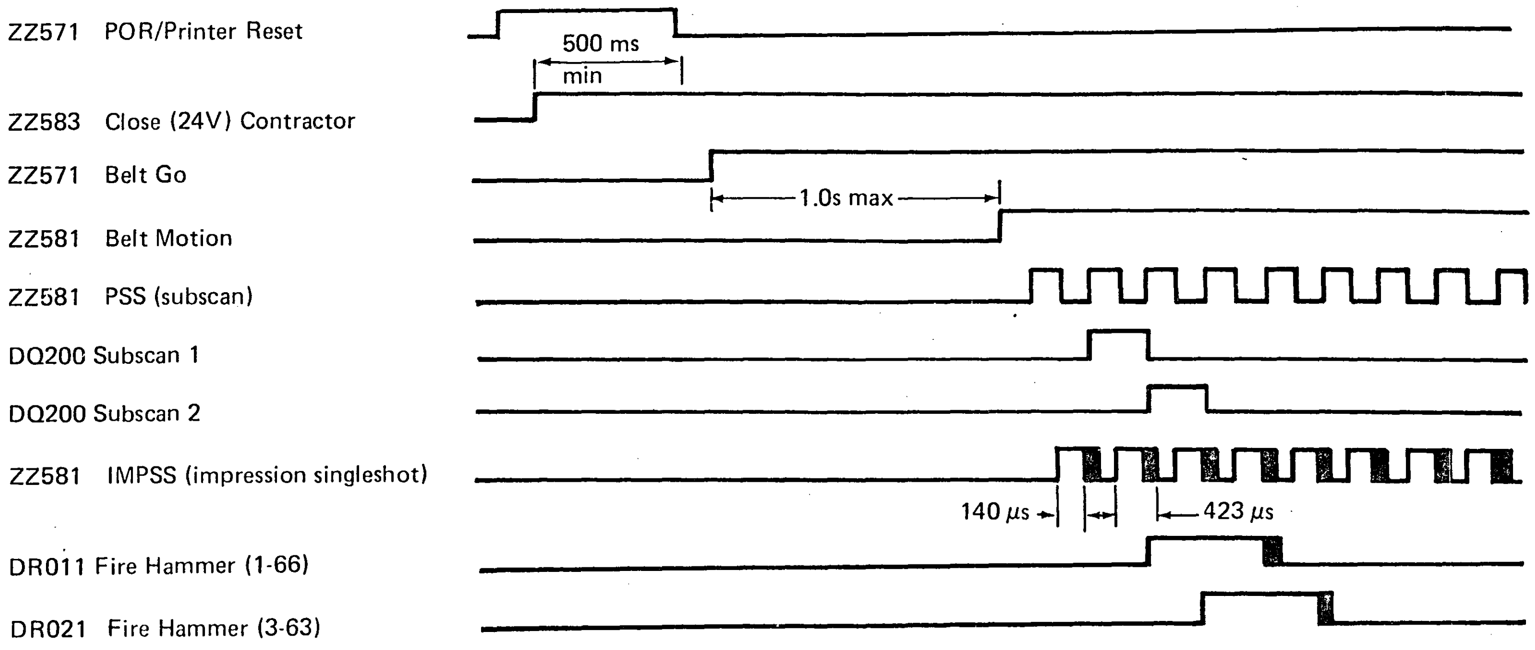
The PSS pulses are generated from the raised timing marks on the type belt. The subscan pulses synchronize the print controls between the attachment and the printer. When the home pulse is detected, a dummy pulse is generated because of the missing timing mark.

IMPSS (Impression Singleshot) (P)

IMPSS is added to the hammer fire pulse to control the time the hammers are fired for different forms thickness. This signal is activated when the subscan pulse goes inactive (halfway into a subscan) and remains active 140 µs to 423 µs depending on the setting of the forms thickness control.

Fire Hammer (A)

Fire hammer lines are activated to fire the corresponding print hammers (fire hammer 1 = print hammer 1, etc).



Carriage Go (A)

The carriage go line is activated to start the carriage oscillator. The carriage oscillator furnishes pulses to run the carriage drive circuits.

Stop Ribbon (A)

The stop ribbon line is activated if the printer is idle for 5 seconds. When the signal is activated, the ribbon stops moving to prevent smudging the paper.

Hammer Check 1-44, 45-88, 89-132 (P)

The hammer check lines determine if each group has an odd number of hammers on. They are used as input for the hammer parity check and the coil current check.

Activate Paper Clamps (A)

This signal energizes the upper and lower paper clamps during printing. It is deactivated during a spacing operation and when the printer is idle.

Carriage Advance (P)

The carriage go line activates the carriage advance digital control circuits. These circuits generate the carriage advance pulses. Each carriage advance pulse advances a shift register pulse, which advances the print carriage motor one increment or eight increments per line. Therefore, eight carriage advance pulses decrease the space count once per line. When the space count reaches zero, the carriage operation is complete, which resets carriage go. The carriage advance pulse is also used to detect carriage sync check.

Home Pulse (P)

On the type belt there is a double space between two of the timing marks. This space (missing timing mark) generates the home pulse that signals the start of the type set on the type belt. The home pulse is used to synchronize the type belt and the belt position counter (additional information on page 4-83).

Throat Closed Switch (P)

This line sends the condition (open or closed) of the print unit interlock switch to the attachment. The switch must be closed to make the printer ready.

Cover Closed Switch (P)

The cover must be closed to make the printer ready.

Forms Sensed Switch (P)

This line indicates to the attachment whether or not there are forms in the printer.

Printer Thermal Switch (P)

This line signals that the temperature in the printer circuitry is too high. It turns on the TH CHK light on the operator control panel in case of overheating. The switch opens at 145°F ± 5°F (63°C ± 3°C).

4.5.5 Circuit Cards (285 lpm)

Hammer Driver

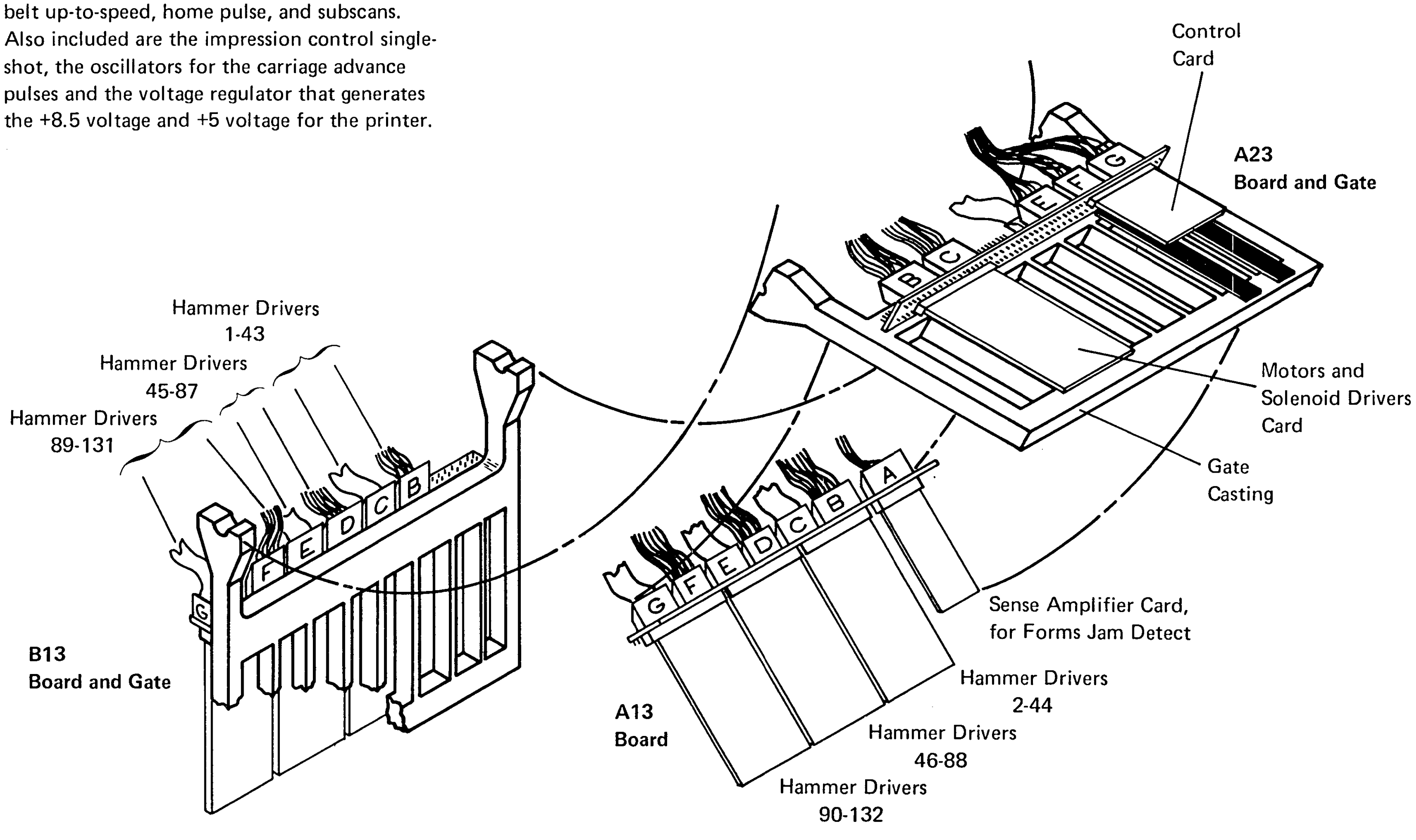
The hammer driver cards (6) each contain 22 hammer drivers and predrivers. This card also determines if an odd number of hammers is on to develop the hammer check lines.

Motors/Solenoid Driver

This card contains the drivers for the carriage motor and belt motor. This card also contains solenoid drivers for the upper and lower paper clamp solenoids, and the ribbon drive clutch solenoid.

Control Card

This card contains digital logic for generating belt up-to-speed, home pulse, and subscans. Also included are the impression control single-shot, the oscillators for the carriage advance pulses and the voltage regulator that generates the +8.5 voltage and +5 voltage for the printer.



4.5.6 Card Gate Connector Details (285 lpm)

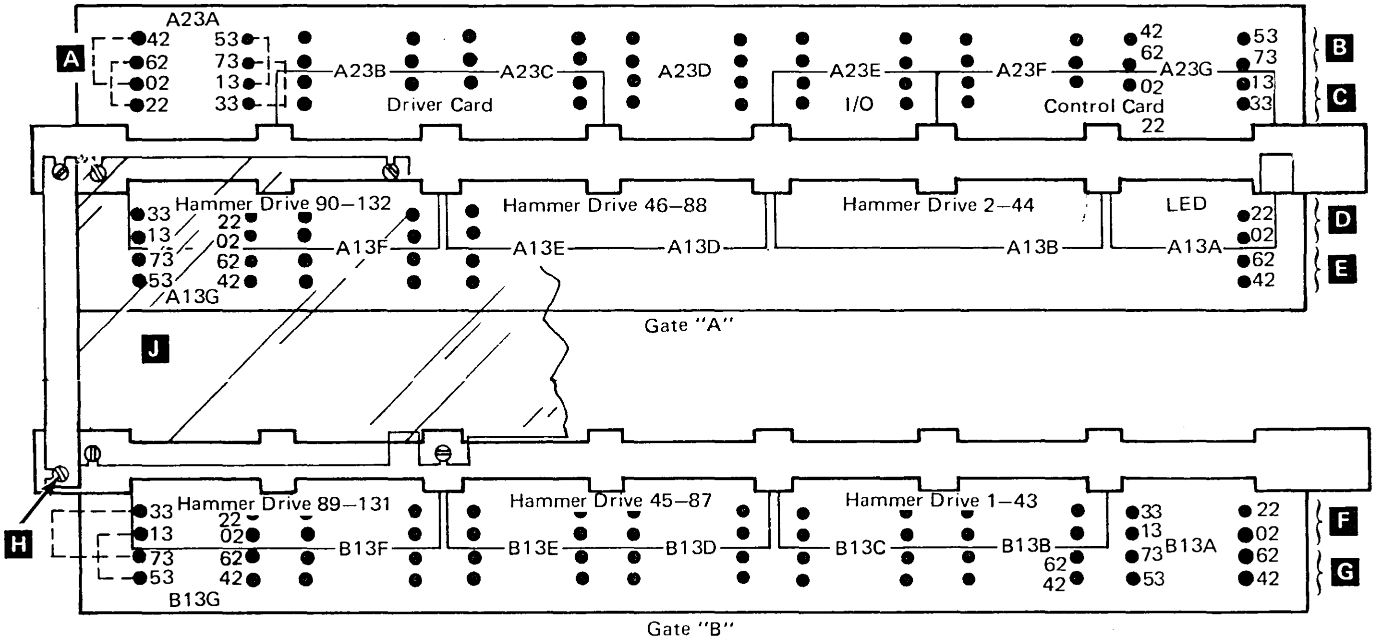
This illustration is the card side view of the card gate assembly, in the raised position, as seen from the rear of the machine. For ease in determining pin designations, all probing should be done from the rear.

Cards are plugged into rows C, D, and F. The outside rows B, E, and G are for probing. Pins 02 through 13 are connected one-for-one with pins 42 through 53; pins 22 through 33 are connected one-for-one with pins 62 through 73 A.

To separate the gates, loosen four screws in the A gate that hold the plastic cover J, then loosen screw H. While supporting the B-gate, move the link until the gates separate.

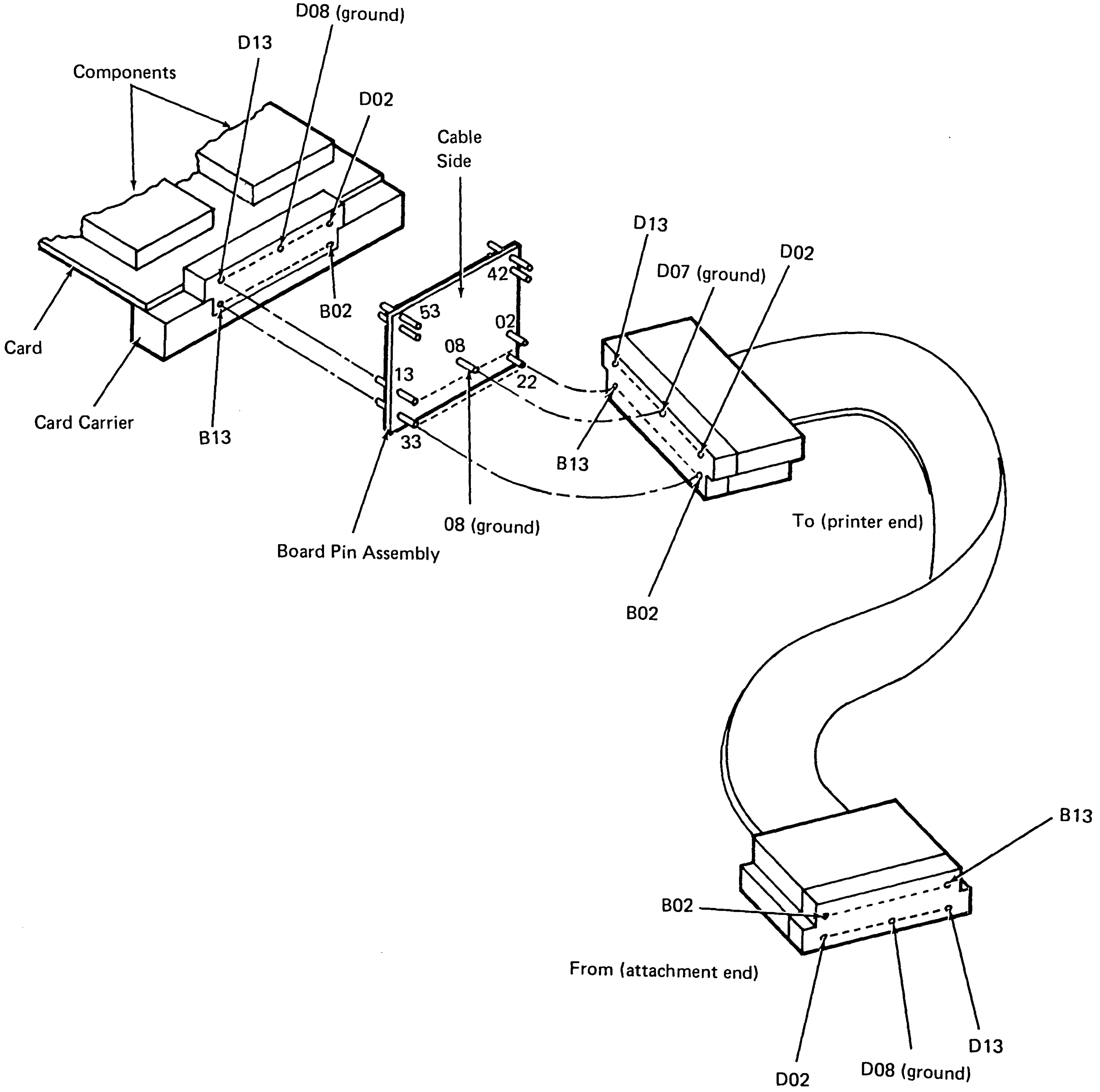
4.5.7 Printer Power Plugs (285 lpm)

Plug	Description	Positions	Location
P1	Ribbon Solenoid	2	Front
P3	Lower Paper Clamp	4	Front
P4	Belt Motor	9	Left Side
P5	Emitter	2	Right Side
P6	Contactor	2	Rear
P7	Carriage	9	Rear
P8	Upper Paper Clamp	4	Top
P9	Jam	4	Left Side
P11	Fan	6	Left Side
P13	Potentiometer	3	Right Side
P14	Contactor/Interlock	2	Rear



Boards Viewed from Card Side

4.5.8 Pin Reversal In Cables



4.6.0 MAINTENANCE (285 lpm)

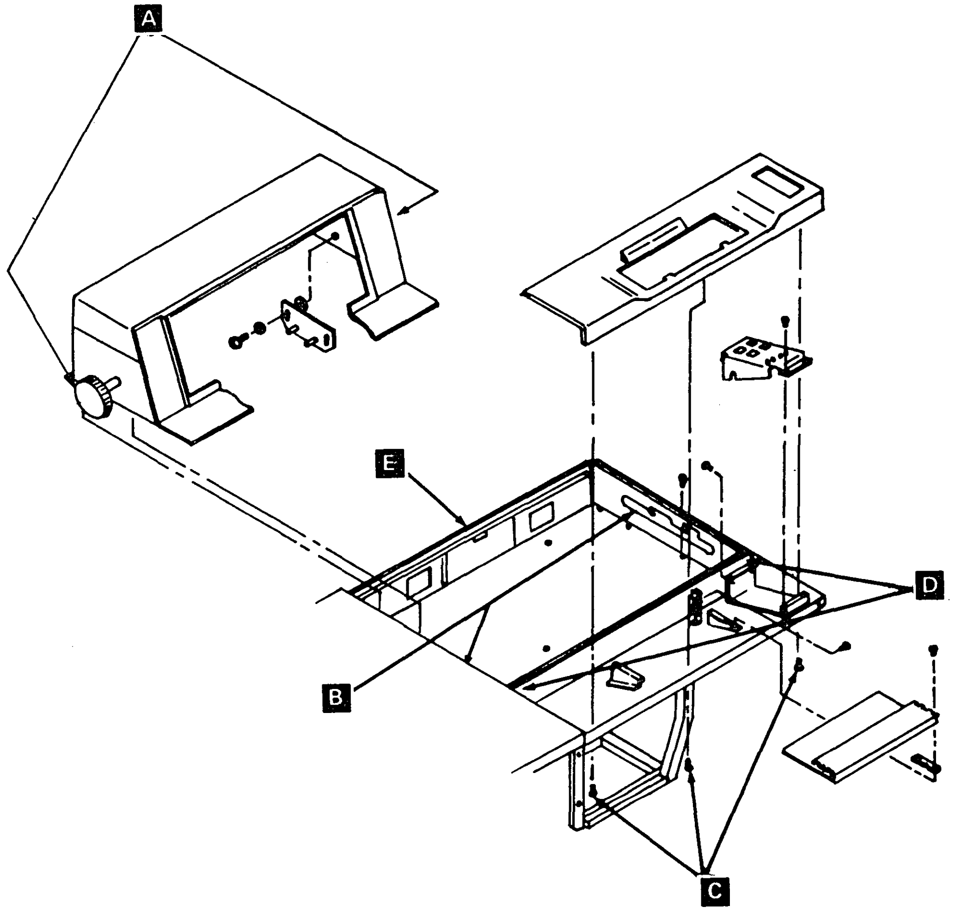
4.6.1 Printer Cover and Divider Removal and Replacement

Removal

1. Remove the left and right knobs **A** by pulling them from the shaft.
2. Open the printer cover.
3. Pull forward on the left and right sliding latches **B** and remove the printer cover.
4. Remove the three screws **C** under the keyboard, slide the cover forward slightly to disengage tabs, and remove the keyboard cover.
5. Remove the two divider screws **D** and remove the divider.
6. The back cover **E** is held on by two ears on the cover; therefore, it can be lifted off.

Replacement

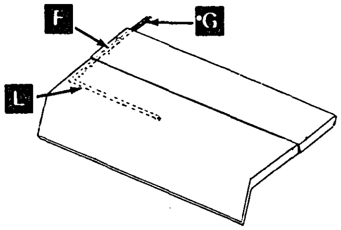
1. Replace in the reverse order of removal.
2. Do the *Cover Interlock Switch* service check. (4.6.2.1).

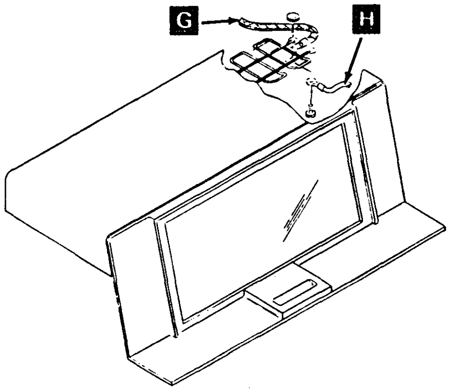


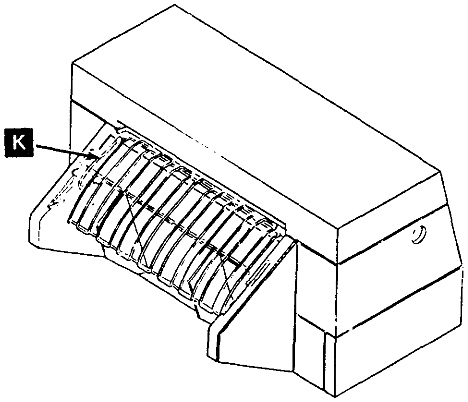
4.6.1.1 Printer Cover Grounding

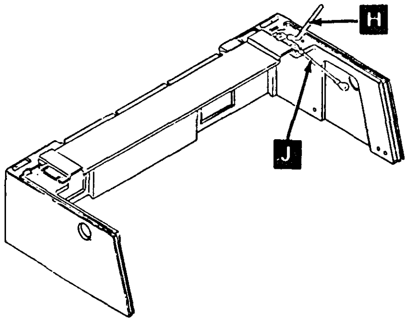
F Cable
G Cable
H Jumper
J Jumper (connect to frame of printer behind right tractor)
K Jumper
L Jumper

Ground forms stand at grounding blocks.









4.6.2 Interlock Switch Description

CAUTION
Do not use meter on resistance scale. Damage to switch might result.

The interlock switches are electronic switches consisting of a module **A**, a magnet **B**, a spring **C**, and a plunger **D**. The switch assembly has no contacts. When the plunger is pushed in, the magnet passes over the module and switches the signal level to 0 volts. A spring within the mechanism returns the plunger to the extended position.

Note: Two styles of switches are available; both are electronic switches.

4.6.2.1 Cover Interlock Switch

A cover interlock switch disable mechanism allows the printer to be serviced when the covers are open. To operate the switch with the covers open, push the armature **L** toward the switch body; then insert a small screw driver at point **J** to compress the spring. A magnet within the switch assembly attracts the armature and keeps the switch activated. When the cover is closed, a block on the cover presses against the plunger and deactivates the disable mechanism.

Service Check

Load program ID PRT2. This displays the status of the three interlock switches. Open and close the cover; the display should change accordingly. Adjust or replace as necessary.

DANGER
After performing the service check, operate the interlock override. Ensure that closing the cover will reset the interlock override.

Adjustment

1. Loosen the switch assembly mounting screws **K** slightly and slide the assembly back and forth until the switch transfers between 1 inch (25.4 mm) and 2 inches (50.8 mm) from the closed position.

   Note: When the switch is adjusted properly, the display indicates cover open and cover closed within that inch **M**.

2. Tighten screws **K**.

Cover Interlock Switch (Continued)

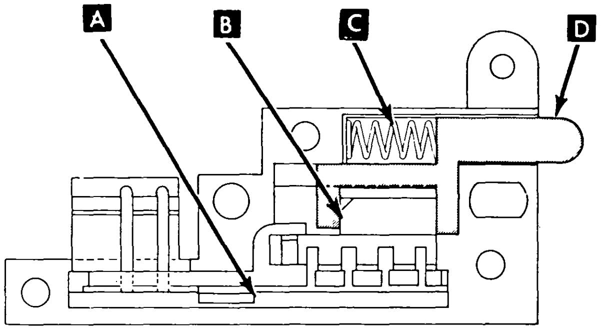
Removal

1. Open the printer cover and unplug the switch cable:
   a. If old style, pull the plug.
   b. If new style, observe the color code and disconnect the wires.
2. Remove two screws **K** and the switch assembly **H**.
3. Remove two screws **G**.

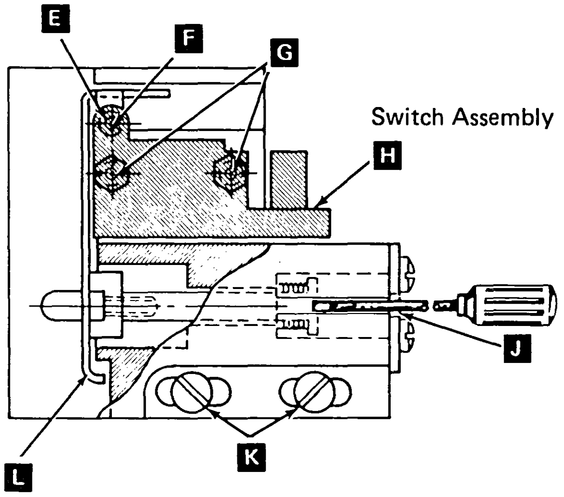
   Note: If switch is new style, skip step 4 and do step 5.
4. Remove clip **E** and pin **F**.
5. Remove the switch.

Replacement

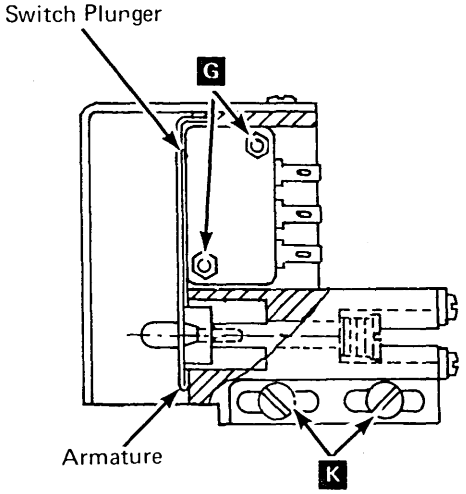
Install in reverse order of removal and perform the cover interlock switch adjustment (4.6.2.1)



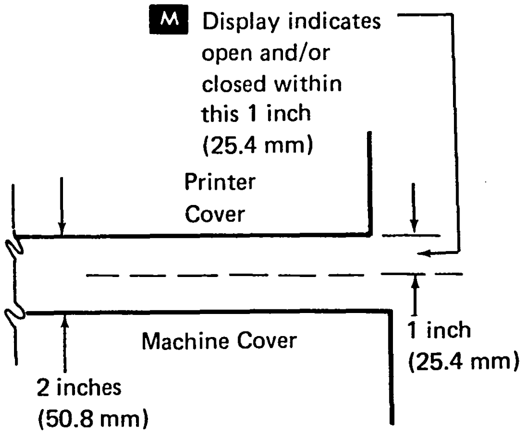
Interlock Switch



Old Style Switch Assembly



New Style Switch Assembly



4.6.2.2 Print Unit (Throat) Interlock Switch

Service Check

Load program ID PRT2 to display the status of the three interlock switches. Set the forms thickness control on 6. Open and close the print unit; the display should change accordingly. Adjust or replace as necessary.

Adjustment

1. Open the printer cover.
2. Close the print unit and set forms thickness control on 6.
3. Loosen the switch mounting screws **A** , position the switch body to approximately 0.025 inch (0.64 mm) from the print unit and tighten the screws.
4. Perform the service check with the forms thickness control in both the 1 and 6 positions.

Removal

1. Open the printer cover and disconnect the switch.
   a. If old style switch, disconnect the plug.
   b. If new style switch, note color code and disconnect switch leads.
2. Remove two screws **A** and the switch assembly.
3. Remove two screws **B** and the switch.

Replacement

Replace in reverse order of removal and perform the print unit interlock switch adjustment (4.6.2.2).

4.6.2.3 End-of-Forms Interlock Switch

Service Check

Load program ID PRT2 to display the status of the three interlock switches. Insert and remove single-part forms in the forms chute; the display should change accordingly. Adjust or replace as necessary.

Adjustment

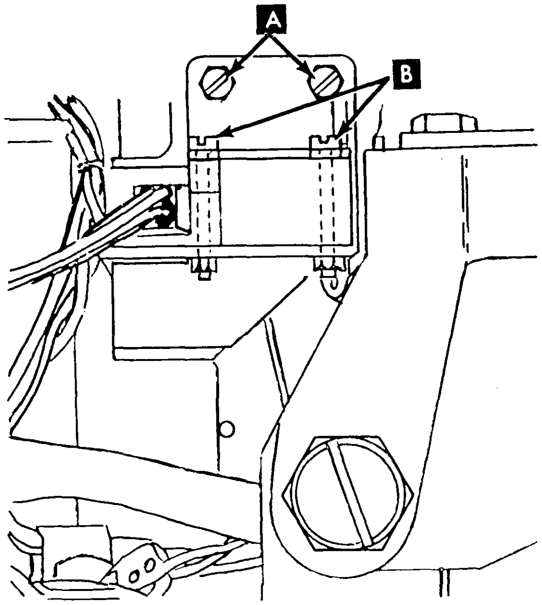
1. With forms removed, use a voltmeter on probe points 13C53 and 13C48 (4.5.6).
2. Loosen the mounting screws **C** , and position the switch to press the plunger until the voltage changes from 0V to 5V. Continue moving the switch to allow a minimum of 0.005 inch (0.13 mm) overtravel and still not bottom on the switch body.
3. Tighten the screws.
4. Perfom the service check.

Removal

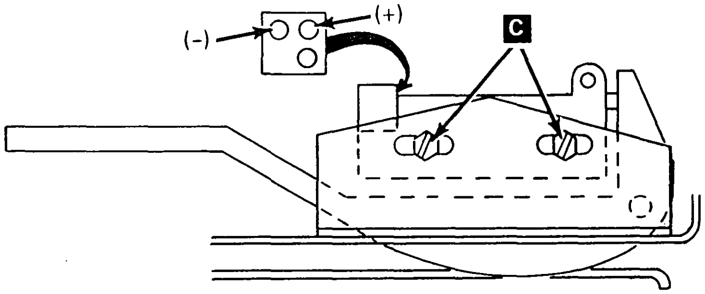
1. Remove the printer covers (4.6.1) and unplug the switch cable.
2. Remove two screws **C** and the switch assembly.

Replacement

Replace in reverse order of removal and perform the end-of-forms interlock switch adjustment (4.6.2.3).



D Connect meter. (wire end of plug)



4.6.3 Thermal Switch

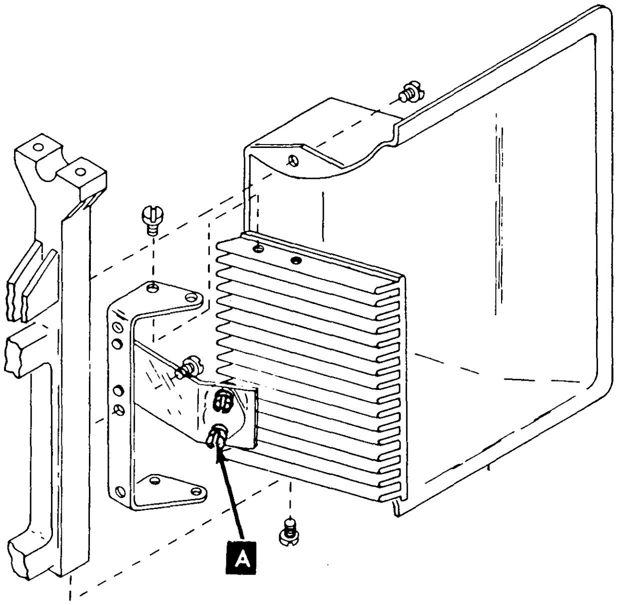
DANGER
The heat sink and resistor assembly becomes very hot. Be sure the assembly is cool before performing maintenance near the thermal switch.

Removal

1. Power down.
2. Remove the printer covers (4.6.1) steps 1 through 3.
3. Unsolder the thermal switch leads.
4. Remove two nuts **A** and the thermal switch (SW4).

Replacement

Replace in reverse order of removal, and restore power to printer.



4.6.4 Fan Assembly

Removal

1. Turn the power off.
2. Remove the printer covers (4.6.1) steps 1 through 3.
3. Press the card gate release latch, open the gate, and lock it in the raised position.
4. Using a small pointed tool, disconnect the two motor leads from the fan plug (P11) and the ground wire from the printer frame (screwdriver can be inserted through the cable hole just above the power sequence card). Remove the wire leads from the cable clamps.
5. Remove two screws holding the fan assembly to the card gate.
6. Remove the plastic fan guard by lifting one of the tabs from the fan housing.
7. Remove the two screws that hold the motor to the duct assembly **A** .
8. Remove the fan blade (two screws).

Replacement

Replace in reverse order of removal and restore power to the printer.

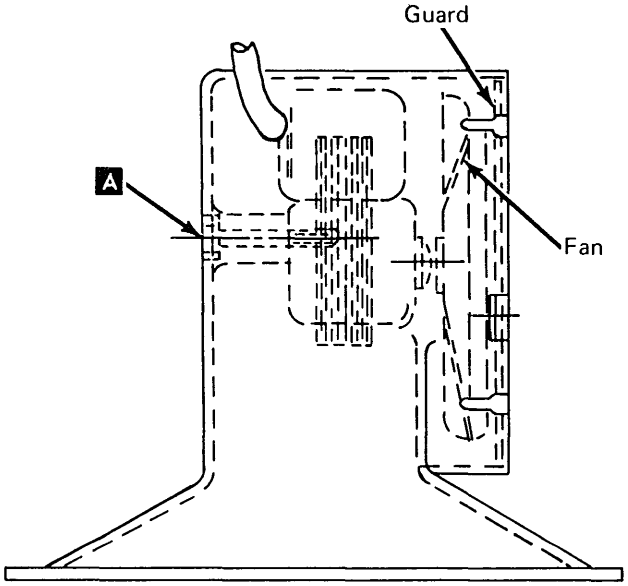
4.6.5 24V Relay (Contactor K1)

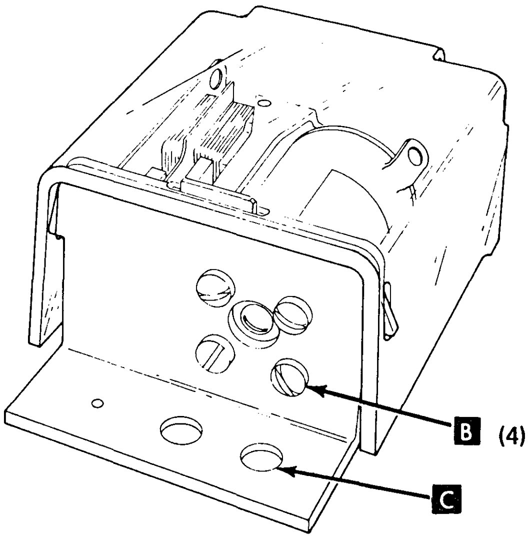
Removal

1. Remove the printer covers.
2. Remove the contactor plug (P6).
3. Remove two mounting bracket screws **C** .
4. Remove wires at TB1-10 and 12.
5. Remove the four contactor mounting screws **B** .

Replacement

Replace in reverse order of removal.

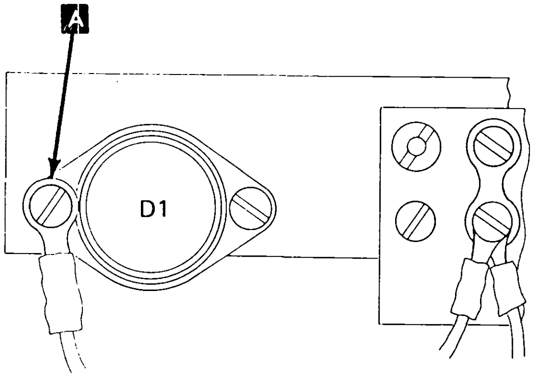


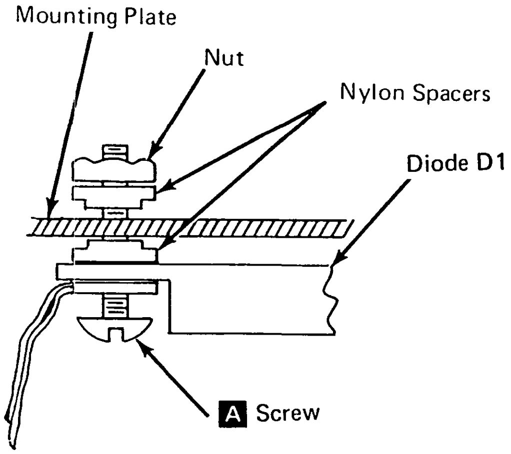


Relay is mounted on outside of right side frame.

4.6.6 Diode D1 Service Check

1. Turn the power off.
2. Remove the printer covers (4.6.1) steps 1 through 3.
3. Open the card gate and remove the diode cover.
4. Disconnect the wire on the side of the diode **A** . *Do not lose the two nylon spacers* and nut when disassembling.
5. Using an ohmmeter (X10 scale), measure the resistance between TB1-2 and the metallic case of the diode. The readings should be:
   a. Forward resistance 180 ohms, ±20%.
   b. Backward resistance near infinity. (To check, reverse the meter leads.)
6. Reconnect the wire and mounting screw after the diode is checked and restore power.





4.6.7 Motor Checkout Procedure (285 lpm)

Note: Perform the following procedures when checking either the type belt motor or the carriage motor. A chart is shown for each motor. The resistance values are nominal values and might vary because of the ohmmeter. A comparison between the components in the circuit being checked is the best indication of a defective component.

1. Turn power off and remove the printer covers.
2. Open the printer card gate and lock it in the open position. Remove the card gate cover.
3. Remove the driver card A23B (see 4.5.5).
4. Set the ohmmeter to the X1 scale.
5. Disconnect the plug from the motor to be checked. Measure the resistance between the plug pins as shown in the charts on this page.
6. Check continuity of phase lines from driver card to motor plugs.
7. See the following list of removals and replacements and replace any defective component.

   Type belt motor removal and replacement (4.6.15).

   Carriage motor removal and replacement (4.6.40).

   Motor resistor removal and replacement (4.6.9).

   Motor phase capacitor removal and replacement (4.6.8).

Type Belt Motor (285 lpm)

Motor End Plug Pins	**Resistance Values**	**Component Description**
5 and 1	1.2 ohms	A phase motor coil
5 and 2	1.2 ohms	Not A phase motor coil
6 and 3	1.2 ohms	B phase motor coil
6 and 4	1.2 ohms	Not B phase motor coil

Cable End Plug Pins	**Resistance Values**	**Component Description**
7 and 5	4 ohms R2	A-phase common resistor
8 and 6	4 ohms R3	B-phase common resistor
1 and 2	C3[1]	A-phase capacitor
3 and 4	C3[1]	B-phase capacitor

Phase Checked	**Plug No.**	**Driver**
A	P7-1	A23C42
(Not) A	P7-2	A23C49
B	P7-3	A23C44
(Not) B	P7-4	A23C45
A Com	P7-7	A23C62
B Com	P7-8	A23C64

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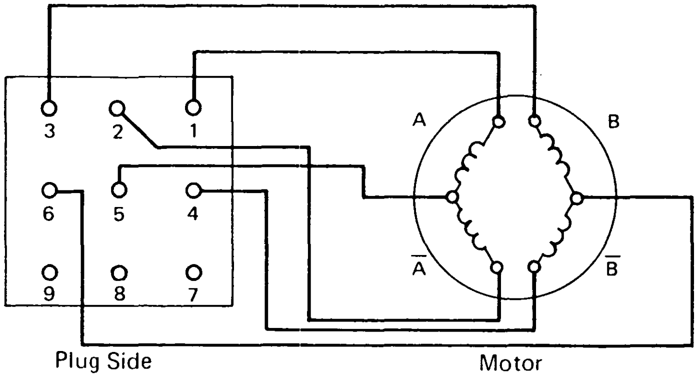
[1] Set ohmmeter to 1K scale. The ohmmeter needle must go toward zero and back to infinity. Failure to do so indicates a defective capacitor.

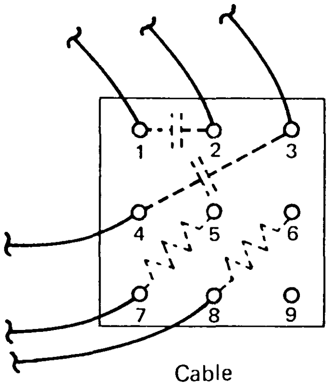
Carriage Motor (285 lpm)

Motor End Plug Pins	Resistance Values	Component Description
5 and 1	1.3 ohms	A-phase
5 and 2	1.3 ohms	Not A
6 and 3	1.3 ohms	B-phase
6 and 4	1.3 ohms	Not B

Cable End Plug Pins	Resistance Values	Component Description
7 and 5	7 ohms R1	A-phase common resistor
8 and 6	7 ohms R4	B-phase common resistor
1 and 2	C1[1]	A-phase capacitor
3 and 4	C2[1]	B-phase capacitor

Phase Checked	Plug No.	Driver
A	P7-1	A23B42
(not) A	P7-2	A23B49
B	P7-3	A23B44
(not) B	P7-4	A23B45
A (com)	P7-7	A23B62
B (com)	P7-8	A23B64





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[1] Set ohmmeter to 1K scale. The ohmmeter needle must go toward zero and back to infinity. Failure to do so indicates a defective capacitor.

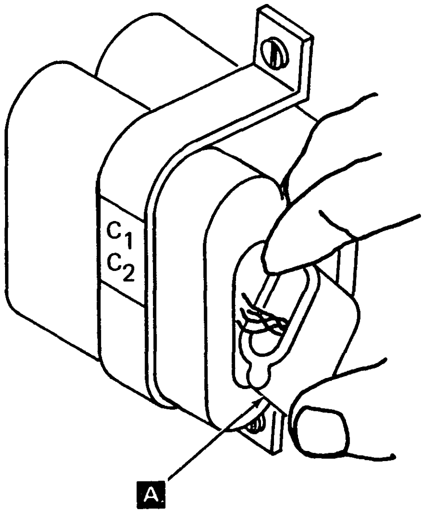
4.6.8 Motor Phase Capacitor (285 lpm)

Removal

1. Remove the printer covers (4.6.1) steps 1 through 3.
2. Remove the cover **A** over the capacitor terminals and remove the slip-on leads.
3. Pull the capacitor out of the mounting bracket.

Replacement

Replace in the reverse order of removal.



4.6.9 Motor and Paper Clamp Resistor (285 lpm)

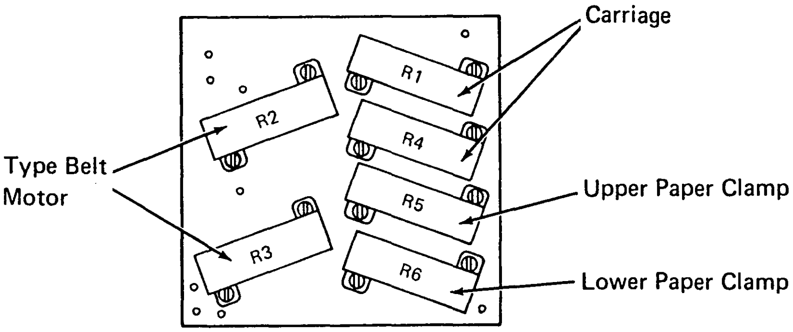
DANGER
After extended use, the resistors might become extremely hot. Be sure the resistors are cool before performing maintenance near resistor panel.

Removal

1. Remove the printer covers (4.6.1) steps 1 through 3.
2. Raise the printer card gate.
3. Remove the air duct (remove two screws; loosen one screw).
4. Unsolder the resistor leads.
5. Remove the resistor by removing the two mounting screws.

Replacement

Replace in the reverse order of removal.



4.6.10 Print Unit Assembly (285 lpm)

> **DANGER**
> The ribbon clutch solenoid becomes very hot after use. Be sure it is cool before performing maintenance.

Service Check

Make sure print unit is to the right to prevent print cut off.

Removal

1. Remove the printer covers, keyboard cover, and divider (4.6.1).

2. Unplug connectors P1 and P4. Remove the ground wire, if installed (near spring C).

3. Unhook spring C from the right end at the screw. Remove two springs H from under the print unit.

4. Open the print unit. Raise both ribbon guides.

5. **CAUTION**
   When removing the print unit, note that P5 and P13 are still connected.

   While supporting the print unit from both ends, slide the assembly to the left until the print unit clears the pivot pins B , and the guide(s) E clear the paper clamp lever(s) F .

6. Unplug connectors P5 and P13.

Replacement

1. Raise paper clamp lever(s) F .

2. Raise both ribbon guides.

3. Place the print unit on the base so that the pivot holes are aligned to the left of the pivot pins B . Be sure the motor cable (P4) is placed behind the print unit as shown A .

4. Replug connectors P5 and P13. Install the ground wire under the clamp.

5. While supporting the print unit, open the print unit release lever D . Move the assembly to the right until stopped by the left pivot. Be sure the unit pivots on both pins B and the paper clamp lever(s) E are in the guide(s) F .

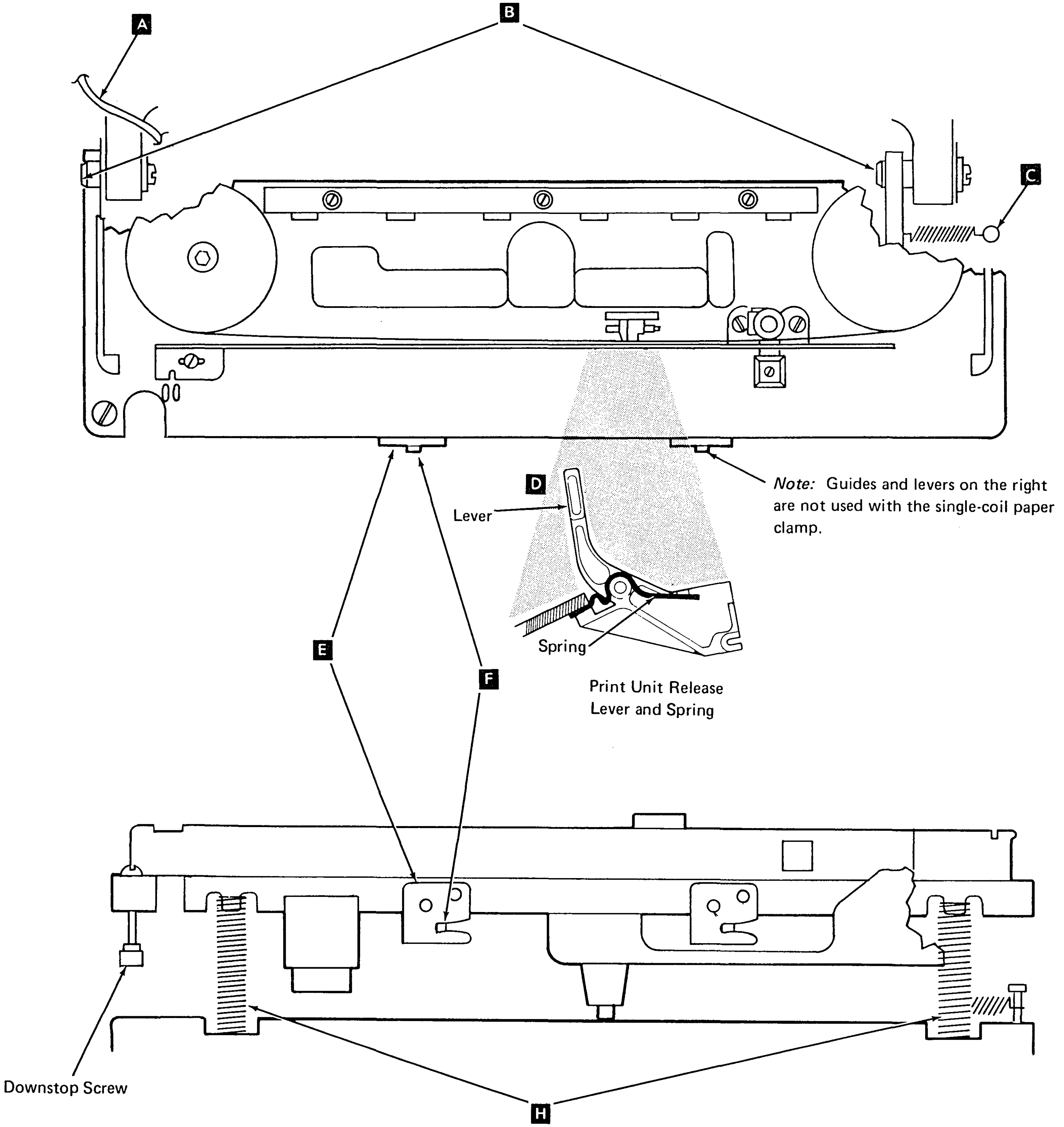
6. Hook spring C on the screw.

7. Replug connectors P1 and P4.

8. Install print unit support springs H .

9. Perform print unit stop screw adjustment (4.6.10.1).

10. Install the print unit covers.


A
B
C
D
Lever
Spring
Print Unit Release Lever and Spring
Note: Guides and levers on the right are not used with the single-coil paper clamp.
E
F
Downstop Screw
H

4.6.10.1 Print Unit Stop Screw (285 lpm)

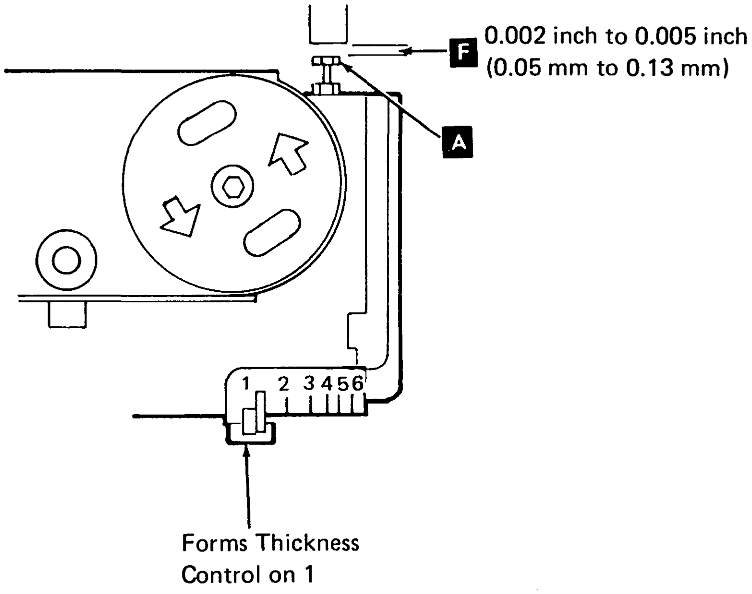
Machines with stop screw **A** .

Service Check

1. Open the cover and close the print unit.
2. Move the forms thickness control to 1.
3. Check for 0.002 inch to 0.005 inch (0.05 mm to 0.13 mm) at **F** .

Adjustment

Loosen the locknut and adjust screw **A** for 0.002 inch to 0.005 inch (0.05 mm to 0.13 mm).



4.6.11 Platen Gap (285 lpm)

Service Check

Note: Special tools are required. Gauge set B/M 1815365 includes:
Platen-to-Casting Gauge **A** (2) P/N 1815362
Platen Gap Gauge **B** (1) P/N 1814638*

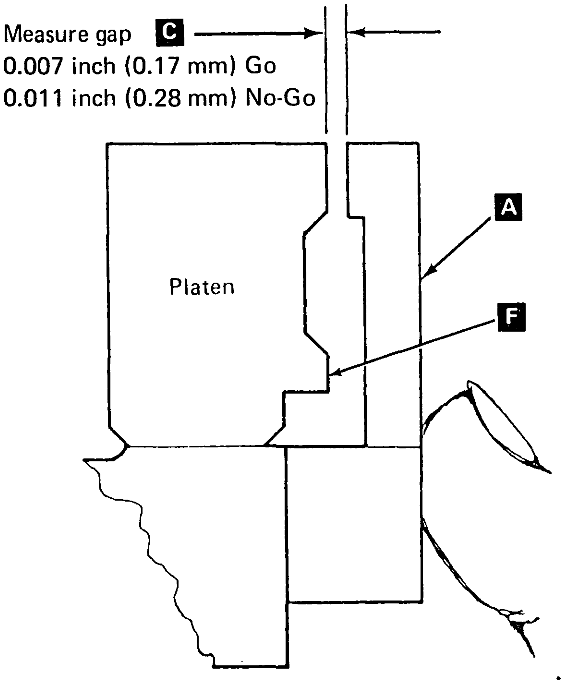
1. Remove the type belt (4.6.13).

2. Remove the print unit (4.6.10).

3. Remove the lower ribbon shield (4.6.36).

4. Open the upper ribbon shield.

5. Hold the platen-to-casting gauge **B**, as shown, near the right end of the platen. Measure for a gap **C** between the platen and the gauge. Repeat this check at the left end of the platen. If the gaps at the right and left ends are not correct, do step 6 only; if the gaps are correct, skip step 6.



6. Do the platen gap adjustments. (Omit the remaining steps in this service check.)

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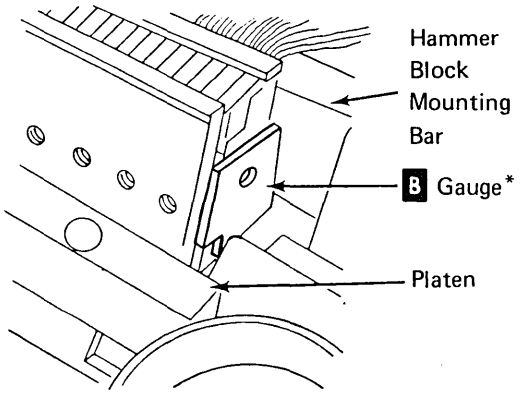
*The printer *must* be in its normal operating position whenever this gauge is used.

7. Replace the lower ribbon shield and the print unit.

8. Remove the paper guide from around the hammers (four screws).

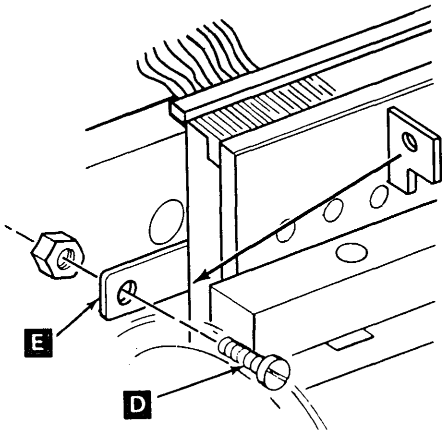
9. Close the print unit. Push down on the center of the print unit to remove any play in the support mechanism.

10. Move the forms thickness control to 6. Hold the platen gap gauge **B** * (hole side up as shown) against the hammer bar and the right hammer block assembly.



11. Lift the gauge about 0.060 inch (1.52 mm) above the bottom lip of the platen **F**, and set the forms thickness control on 1 to clamp the gauge.

12. Slowly, and with no downward pressure, move the forms thickness control toward 6. Observe the position on the forms thickness scale when the gauge drops to the bottom lip (drop point). Repeat several times until a constant drop point is observed.



13. Remove screw **D** from the left end of the hammer block mounting bar, and slide the hammer position scale **E** to the right.

14. Place the gauge on the left side, then repeat steps 9, 10, 11, and 12.

    Note: Since the left end of the hammer block assembly does not provide a flat surface for gauge alignment, hold the gauge slightly to the left of the hammer block assembly when you repeat step 10.

15. The drop points for the right and left sides should occur when the forms thickness control is between 1-1/2 and 3-1/2, with a maximum ent-to-end difference of 1. If the drop point on either end is outside this range, the platen gap is wrong.

16. If the platen gap is not correct, do the forms path gap adjustment; then do the platen alignment (skip platen-to-casting and forms path gap adjustments). If the gap is correct, do steps 17 and 18.

17. Slide the hammer position scale **E** to the left and install screw **D**.

18. Replace the paper guide (4 screws), the typebelt, the ribbon, and the covers.

4.6.11 285 lpm Platen Gap (Continued)

Adjustments

To establish the correct platen gap, the following adjustments must be performed in sequence:

a. *Platen to Casting:* Locates the platen on the print unit casting using two gauges.

b. *Forms Path Gap:* Locates the print unit casting to the hammer bar by adjusting the eccentric in the support arm.

c. *Platen Alignment:* Aligns the platen so that it is parallel to the hammer bar.

Platen-to-Casting

Note: Use platen-to-casting gauges P/N 1815362 **A**.

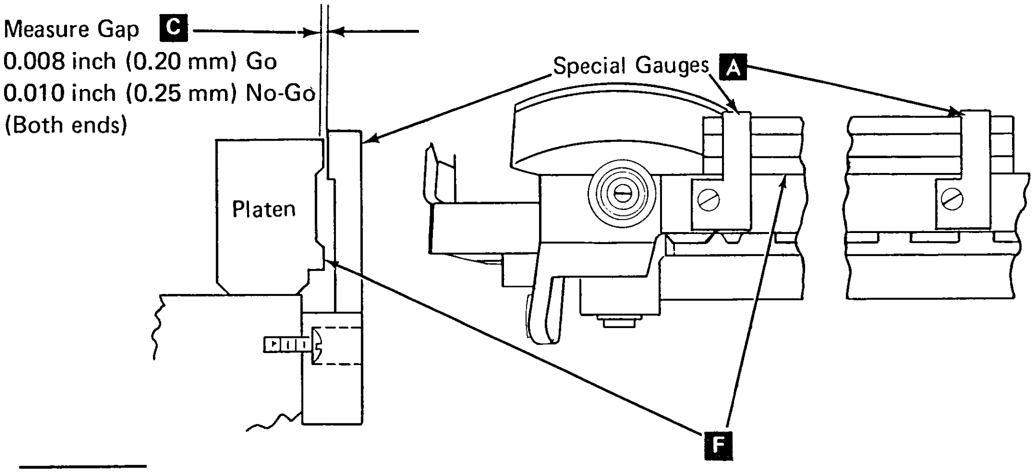
1. Remove the print unit (4.6.10).
2. Remove the ribbon shield (4.6.36).
3. Install special gauges **A** as shown:
   a. Ensure that the mounting surface is clean and flat.
   b. Install the gauges, using two of the screws from the lower ribbon shield. Tighten the screws.
4. Measure at both ends for a gap between the platen and the gauge as shown **C**. If both gaps are correct, go to step 5; otherwise, do steps a through f.
   a. The platen mounting screws are located under the upper ribbon shield. See *Platen Removal* (4.6.12), step 5, for removal of the ribbon shield.
   b. Remove the sealant (if present) from the screw heads, then loosen the platen mounting screws.
   c. Place a 0.010 inch (0.25 mm) gauge between the platen and the right gauge, then push the platen against the gauges. Tighten the right screw slightly.
   d. Repeat step c for the left side.
   e. Measure gap **C** at both ends. Adjust again if necessary.
   f. Gradually tighten all mounting screws, then measure gap **C** again. Adjust again if necessary.
5. Remove the gauges **A**, then replace the ribbon shields.
6. Replace the print unit (4.6.10).
7. Do the forms path gap adjustment next.

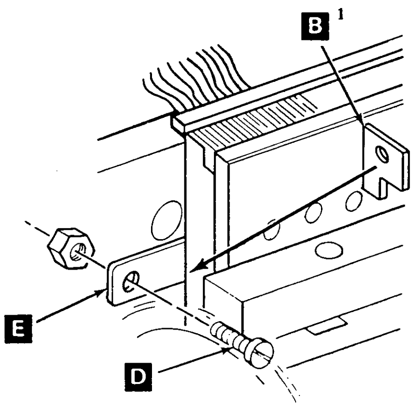
Forms Path Gap

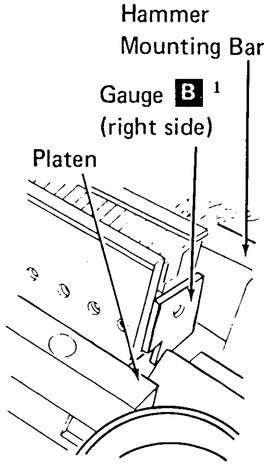
Note: Use platen gap gauge part number 1814638 **B**[1].

1. Remove the paper guide (four screws) from around the hammers, if not done before.
2. Close the print unit. Push down on the center of the print unit to remove any play in the support mechanism.
3. Move the forms thickness control to 6. Hold the gauge **B**[1] (hole side up as shown) against the hammer bar and the right hammer block assembly.
4. Lift the gauge about 0.060 inch (1.52 mm) above the bottom lip of the platen **F** and set the forms thickness control on 1 to clamp the gauge.
5. Slowly, and with no downward pressure, move the forms thickness control toward 6. Observe the position on the forms thickness scale when the gauge drops to the bottom lip (drop point). Repeat several times until a constant drop point is observed.
6. Remove screw **D** from the left end of the hammer block mounting bar, and slide the hammer position scale **E** to the right.
7. Place the gauge on the left side, then repeat steps 2, 3, 4, and 5.

Note: Since the left end of the hammer block assembly does not provide a flat surface for gauge alignment, hold the gauge slightly to the left of the hammer block assembly when you repeat step 3.







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[1] The printer *must* be in its normal operation position whenever this gauge is used.

4.6.11 285 lpm Platen Gap (Continued)

Adjustments (continued)

Forms Path Gap (continued)

8. Determine the average of the right and left drop points.

   For example:

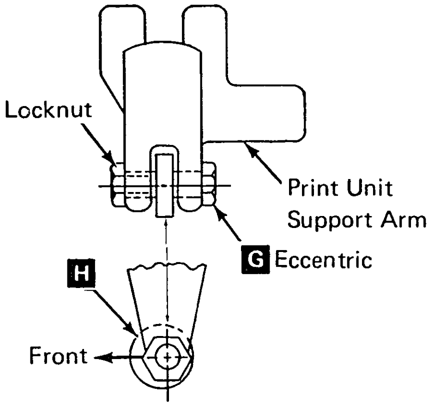
Right drop point	= 3-1/2
Left drop point	= 5-1/2
Average	= 4-1/2

   a. Adjust the eccentric **G**, then repeat steps 3 through 8 until the average of the right and left drop points is 3 ± 1/2.

   Note: When adjusting, ensure that the high side of the eccentric is toward the front (operator side) **H**.

   b. If the difference between the right and left drop points is 1/2 or less, the platen gap is correct; replace the paper guide, type belt, and ribbon. Slide the hammer position scale to the left and replace screw **D**.

   c. If the difference between the right and left drop point is more than 1/2, do the platen alignment.



Platen Alignment

Note: Use platen gap gauge part number 1814638 **B**[1].

1. Loosen the platen:
   a. The platen mounting screws are located under the upper ribbon shield. See *Platen Removal* (4.6.12), step 5, for removal of the ribbon shield.
   b. Remove the sealant (if present) from the heads of the two end platen mounting screws.
   c. Loosen the two end platen mounting screws.

2. Close the print unit and set the forms thickness control on 2-1/2.

3. Place the gauge **B**[1] against the hammer bar and the hammer block assembly on the right side. The hole side must be up. The bottom of the guage must be against the upper edge of the lower ribbon shield. If needed, move the platen toward you until the guage drops into position. Move the platen against the gauge and tighten the two end mounting screws.

   Note: Do not use seal on the screws after adjusting the platen.

4. Set the forms thickness control to 6.

5. Lift the gauge about 0.060 (1.52 mm) above the bottom lip of the platen **F** and set the forms thickness control on 1 to clamp the gauge.

6. Slowly, and with no downward pressure, move the forms thickness control toward 6. Observe the position on the forms thickness scale when the gauge drops (drop point). Repeat several times until a constant drop point is observed. The gauge should drop when the forms thickness control is between 2 and 3.

   Note: The drop points of 1-1/2 and 3-1/2 are used for the service check only.

7. Remove screw **D** and slide the hammer number strip **E** to the right (if not done before).

8. Place the gauge alternately on both sides of the hammer block assembly and verify that the drop points on both sides are between 2 and 3 on the forms thickness control, with a maximum end-to-end difference of 1/2.

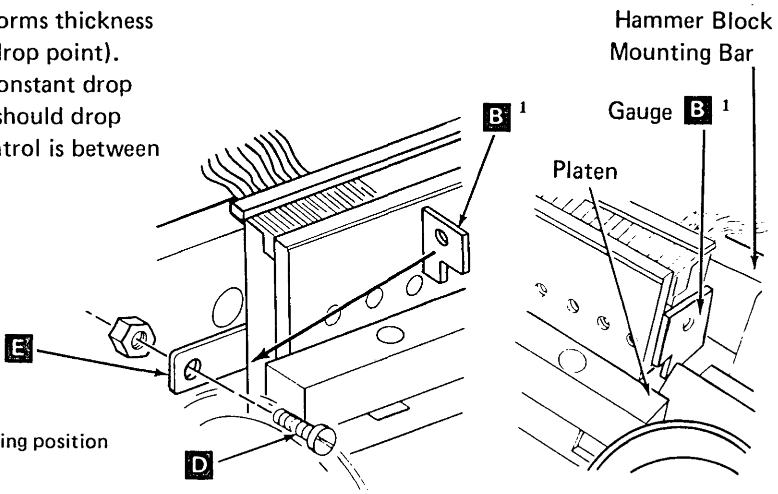
   Note: Since the left end of the hammer block assembly does not provide a flat surface for gauge alignment, hold the gauge slightly to the left of the hammer block assembly when you repeat step 5 for the left side.

9. If the end-to-end difference is more than 1/2 or if the drop point of either side of the platen is outside the 2 to 3 forms thickness control setting, repeat steps 2 through 9.

10. If the adjustment is correct, slide the hammer number strip to the left and install the holding screw **D**.

11. Install the upper ribbon shield (4.6.36), if removed. Install a new print position scale if needed.

12. Install the paper guide (four screws), type belt, and covers.



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[1] The printer must be in its normal operating position whenever this gauge is used.

4.6.12 Platen (285 lpm)

Removal

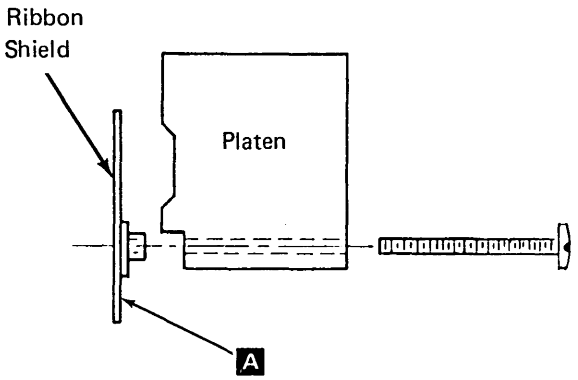
1. Turn the power off.
2. Remove the print unit.
3. Remove the type belt and remove the ribbon from the ribbon guides.
4. Remove the lower ribbon shield **A** (4.6.36).
5. To remove the upper ribbon shield **C**, lift the print position scale approximately 1.5 inch (38.1 mm) at both ends, then remove the two holding screws.
6. Remove the seal from the screw heads **D**, then remove the screws and the platen.

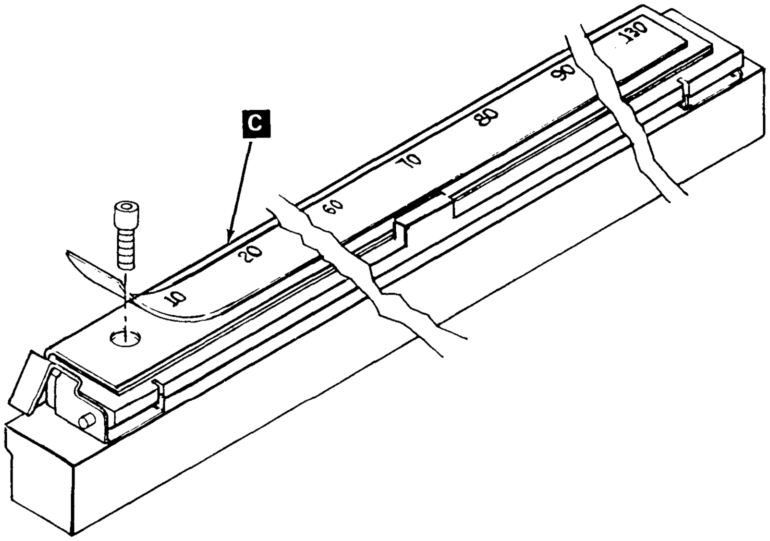
Replacement

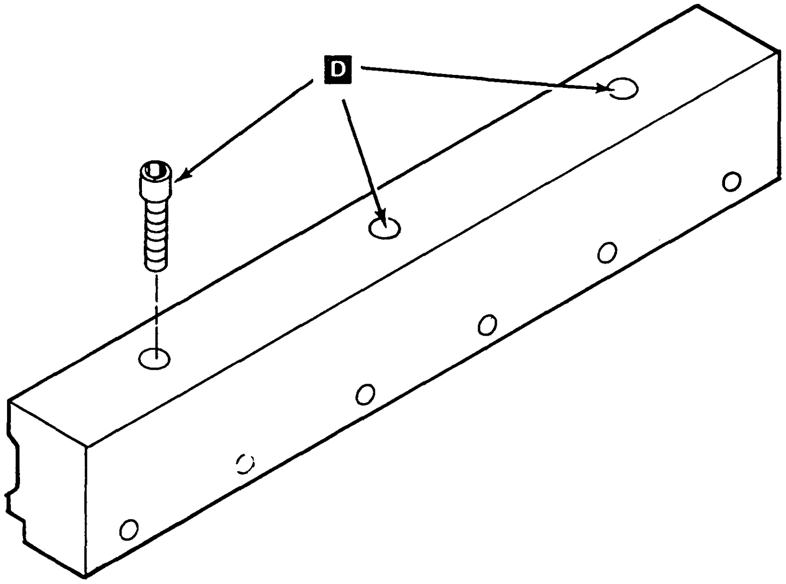
1. Install the platen with the mounting screws and washers, do not tighten.

   Note: Do not use seal after installing the new platen.

2. Do the platen gap adjustment (4.6.11).







4.6.13 Type Belt (285 lpm)

Removal

1. Turn the power off.

2. Open the printer covers.

3. Pull the print unit release lever **C** toward the front of the machine to open the print unit (the print unit pivots down).

4. Open the upper ribbon shield, then raise both ribbon guides **A**. Remove the ribbon from the guides and place it on top of the cassette.

5. Open the ribbon drive release lever **F**.

6. Pull the type belt release lever **E** toward the front of the machine.

7. Remove the type belt **B**.

Replacement

1. Open the upper ribbon shield, then raise both ribbon guides **A**.

2. Push the type belt release lever **E** toward the back of the machine.

3. Install the type belt evenly around the top of the pulleys **G**. Make sure the type belt is positioned between the ribbon shield and the platen.

4. Using the finger hole in the pulley **D**, turn the pulley counterclockwise until the belt rides down to the positioning rollers located under the lower ribbon shield.

5. Place the ribbon on the ribbon guides **A** then close the ribbon drive release lever **F**.

6. Lower the ribbon guides and turn the type belt pulley counterclockwise to verify that the ribbon tracks between the metal and plastic guides in the lower ribbon shield. Close the upper ribbon shield. Turn the pulley again to ensure that the ribbon tracks under the upper ribbon shield.

7. Press the print unit release lever **C** toward the back of the machine, close the cover, and restore power.

Static Test for Type Belt Binds

1. Turn the power off.

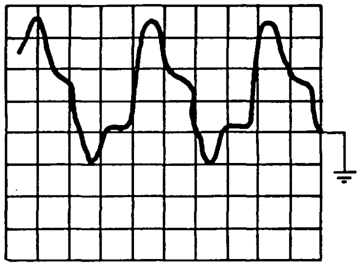
2. Use the gram gauge to pull the belt. If more than 300 grams is required to start the belt moving, there is a static bind.

Dynamic Test for Type Belt Binds

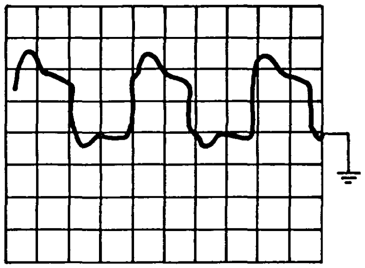
1. Connect a X10 scope probe to P-4 pins 1, 2, 3, or 4 (double yellow or double black wires).

2. Set the scope for internal sync, 20 volts/division, and 1 ms/division.

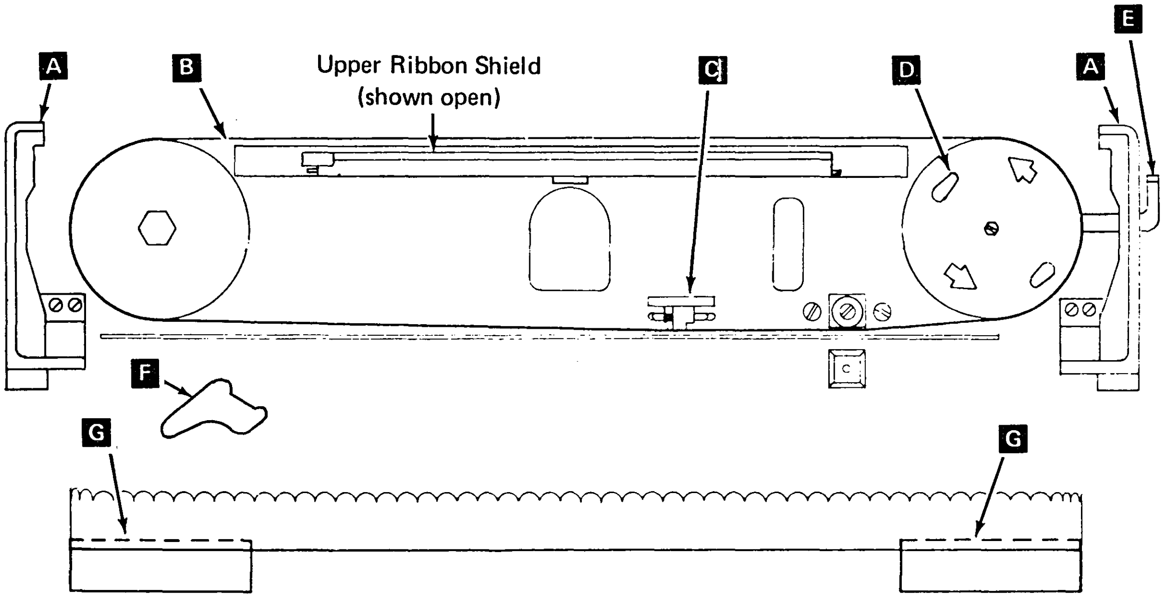
   You should see a picture similar to the one below.



If there is excessive drag, the scope picture will look like this.



Note the loss of amplitude in the negative portion of the waveshape.



4.6.14 Type Belt Drive Pulley Assembly

Removal

1. Remove the type belt (4.6.13) and the ribbon cassette.

2. Remove the cover **B** by removing the screw and washer.

3. Remove the spacer (if installed).

4. Remove the pulley **C** by pulling it straight up.

5. **CAUTION**
   Cleaning fluid and tape transport cleaners contain trichlorethane that will melt plastic parts. Use only isopropyl alcohol (PN 2200200) to clean the belt drive and idler pulleys.

Replacement

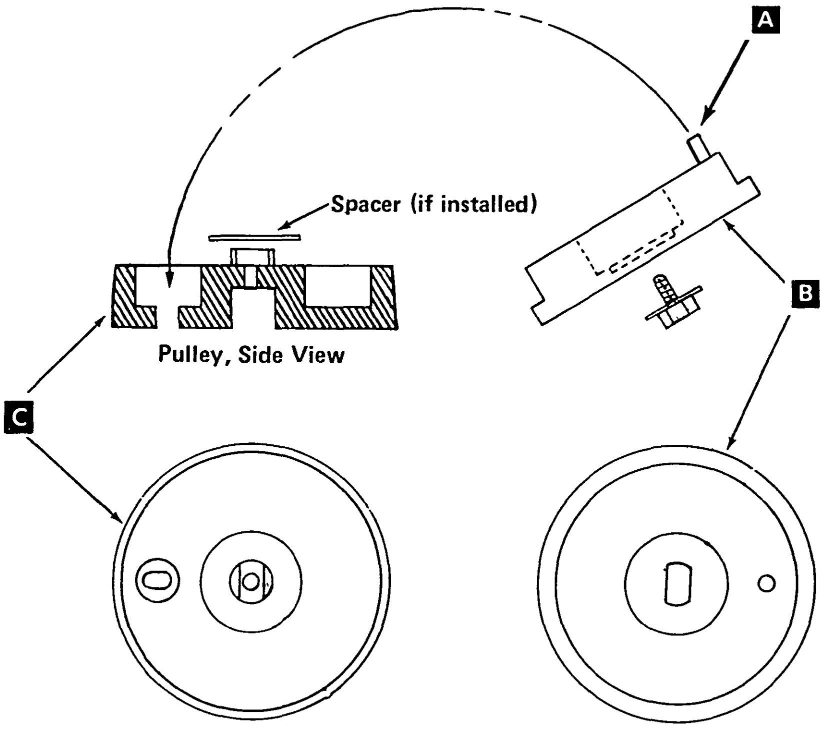
1. Install the pulley on the motor shaft.

2. If a spacer was removed, install and align it on the motor shaft.

3. Install the cover **B** :
   a. Ensure that the pin **A** engages the hole in the pulley, and that the hole in the cover aligns with the motor shaft.
   b. Install the washer and the screw.

4. After installing the pulley assembly, verify that the pulley can be moved up and down on the motor shaft. To verify, hold the outside of the pulley from opposite sides and lift it evenly. The pulley should move up and down freely.

5. Install the type belt and ribbon cassette.



Pulley, Side View

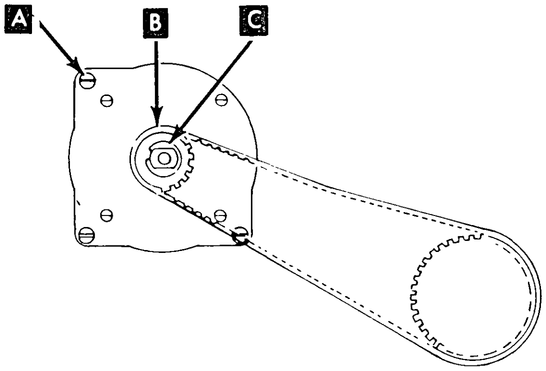
Pulley, Top View

Cover, Bottom View

4.6.15 Type Belt Motor

Removal

1. Remove the printer covers (4.6.1) steps 1 through 3.
2. Remove the print unit assembly (4.6.10).
3. Remove the type belt (4.6.13) and ribbon cassette.
4. Remove the type belt drive pulley assembly (4.6.14).
5. Loosen tension on the ribbon drive belt by loosening three screws holding the ribbon drive assembly.
6. Disconnect the belt motor plug (P4).
7. Remove the clip **C** , and the gear **B** . (Do not lose the key in the motor shaft.)
8. Remove the motor end of the ribbon drive belt.
9. Remove the three mounting screws **A** and turn the motor so the cable lines up with the slot.
10. Remove the motor through the top of the print unit.



Replacement

1. Install the motor (wires toward back of machine), ribbon drive gear, clip, and ribbon drive belt.
2. Reconnect the belt motor plug (P4).
3. Adjust the ribbon drive belt tension (4.6.31).
4. Install the type belt drive pulley assembly.
5. Install the ribbon cassette, type belt, ribbon, and printer covers.

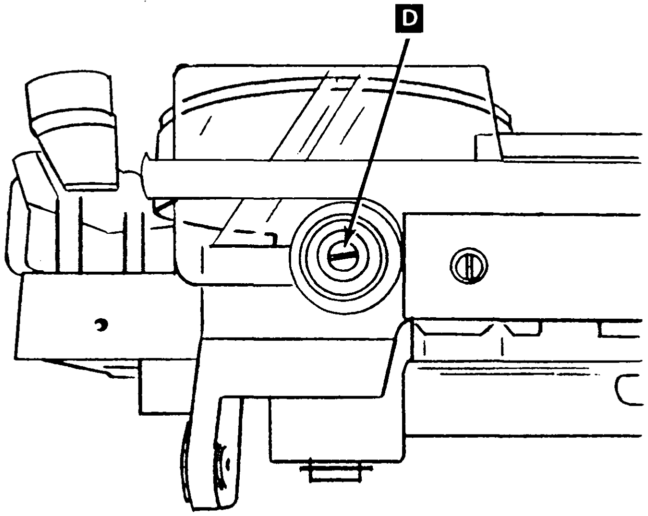
4.6.16 Type Belt Positioning Rollers

Removal

1. Remove the print unit assembly (4.6.10).
2. Remove the positioning roller mounting screw(s) **D** and the roller(s).

Replacement

Replace in the reverse order of removal.



4.6.17 Type Belt Idler Pulley (285 lpm)

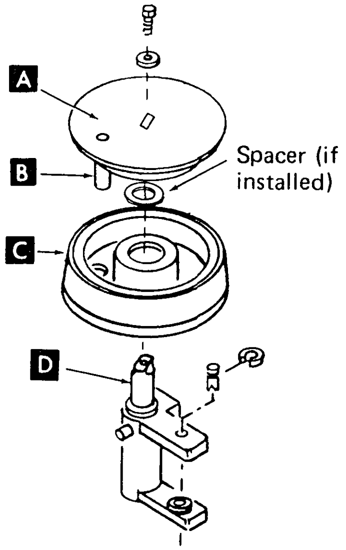
Removal

1. Remove the type belt (4.6.13).
2. Remove the cover **A** by removing the screw and washer.
3. Remove the spacer (if installed).
4. Remove the pulley **C** .

CAUTION
Cleaning fluid and transport cleaners contain trichlorenthane that will melt plastic parts. Use only isopropyl alcohol (PN 2200200) to clean the belt drive and idler pulleys.

Replacement

1. Install the pulley **C** on the motor shaft.
2. If a spacer was removed, install and align it on the shaft.
3. Install the cover **A** :
   a. Ensure that the pin **B** engages the hole in the pulley, and that the hole in the cover aligns with the motor shaft **D** .
   b. Install the washer and screw.
4. To verify that the pulley can be moved up and down on the shaft, hold the outside rim of the pulley from opposite sides and lift evenly; the pulley should move up and down freely.
5. Install the type belt (4.6.13).



4.6.18 Type Belt Idler Pulley Pivot Assembly

Removal

1. Remove the printer covers (4.6.1) steps 1 through 3.
2. Remove the print unit (4.6.10).
3. Remove the ribbon cassette (4.6.28) and type belt (4.6.13).
4. Remove the type belt idler pulley (4.6.17).

   Note: Do not lose the plastic spacer on the bottom of the pulley.
5. **CAUTION**
   The type belt release lever is under spring pressure.

   Remove type belt release lever **G** .
6. **DANGER**
   Spring **E** compression is high; use caution when removing.

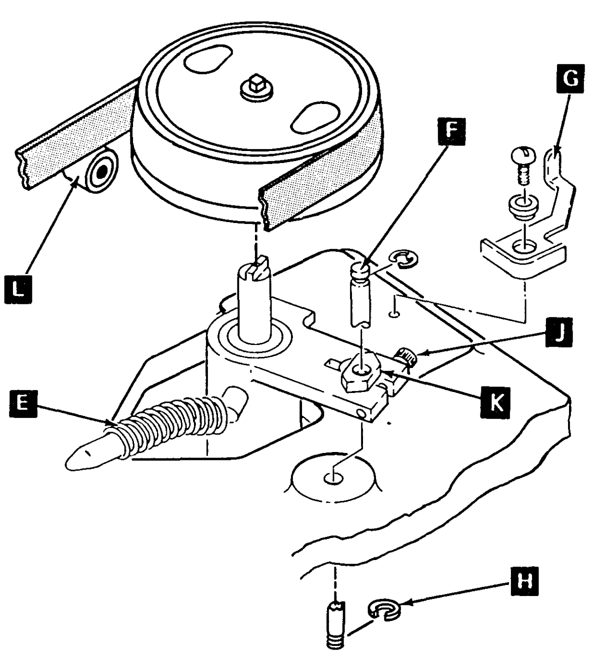
   Remove the compression spring from the stud **E** .
7. Remove the bottom C-clip **H** that holds the pivot shaft to the mounting block.
8. Remove the pivot shaft **F** through the top.
9. Remove the pivot assembly through the hole in the top of the print unit.

Replacement

Install the plastic spacer on the shaft and replace in the reverse order of removal.

Adjustment

Loosen screw **J** and adjust eccentric **K** to prevent the idler pulley **C** from touching the pulley cover **A** . While turning the pulley cover with the belt installed, you should see the belt riding on the front roller bearing **L** .



4.6.19 Transducer Assembly (285 lpm)

Service Check

1. Be sure the roller **B** is clean, and the cleaning blade **A** is positioned as shown. Loosen the screw in the roller and reposition the blade if needed. Ensure that the plastic pad is fastened to the blade.

   Note: Older machines have a metal blade with a plastic pad, newer machines have a plastic blade and no pad.

2. While rotating the type belt, ensure that the type belt turns the roller **B** and the roller is not worn.

3. Turn the power off.

4. Check for 0.004 inch ± 0.002 inch (0.10 mm ± 0.05 mm) gap between the transducer tip **D** and a timing mark on the type belt .

5. The resistance of the transducer is 465 nominal measured on pins 1 and 2 of P5 (emitter and impression control).

   Note: For oscilloscope setup, see 4.8.0.

Adjustment

CAUTION
The transducer can be damaged if the timing marks on the type belt strike the transducer tip while the belt is moving.

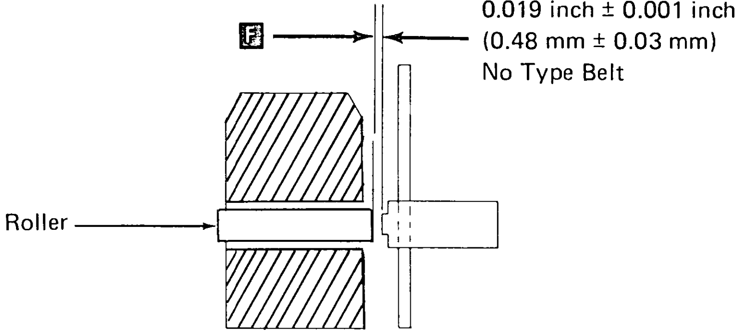
1. Remove the type belt (4.6.13).

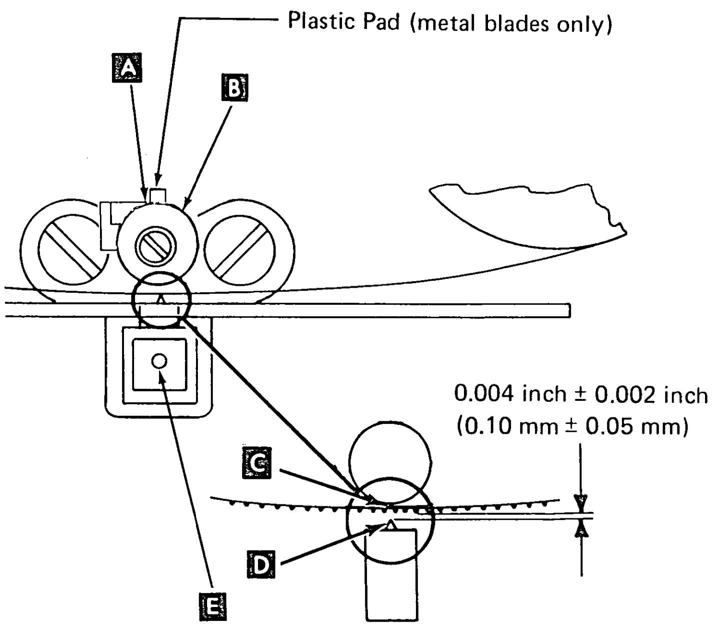
   CAUTION
   Do not overtighten the transducer clamping screws.

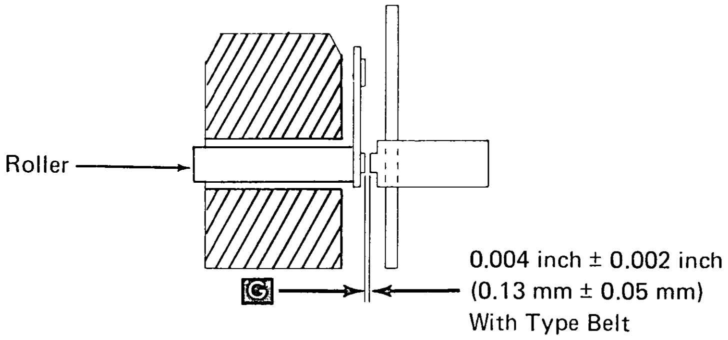
2. Loosen screw(s) **E** and adjust the transducer in the mounting block to obtain 0.019 inch ± 0.001 inch (0.48 mm ± 0.03 mm) clearance **F** between the transducer tip and the guide roller.

3. Install the type belt (4.6.13). Rotate the type belt pulley until a timing mark is in line with the transducer tip.

4. Adjustment steps 2 and 3 should result in a clearance of 0.004 inch ± 0.002 inch (0.13 mm ± 0.05 mm) **G** between the transducer tip and a timing mark on the type belt. If clearance is not correct, repeat adjustment.



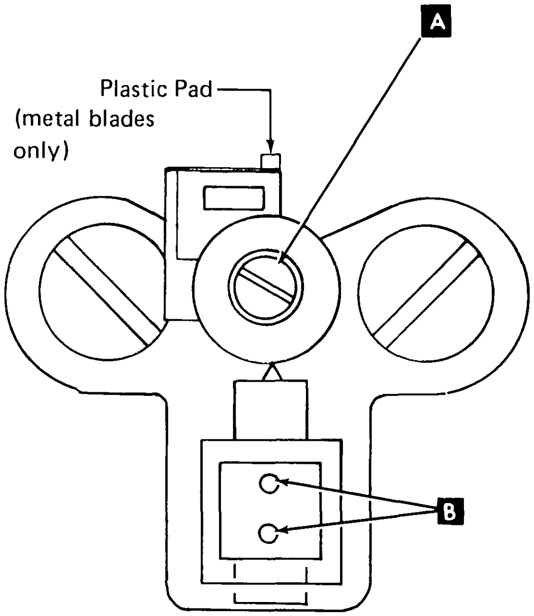




4.6.20 Transducer

Removal

1. Open the printer cover.
2. Remove the type belt (4.6.13).
3. Unplug the transducer plug (P5). If P5 is a 4-position plug, remove transducer terminals 1 and 2.
4. Remove the type belt guide roller by removing one screw **A**.
5. Loosen the transducer mounting screw(s) **B** and remove the transducer from the rear of the belt guard.



Replacement

1. Replace in the reverse order of removal. Place the brown wire in 1, black in 2 on P5.
2. Perform the transducer adjustment (4.6.19).

4.6.21 Impression Singleshot Potentiometer (285 lpm)

Adjustment

1. Set the forms thickness control to 6.
2. Load Program ID PRT3, and select option 2.
3. Loosen the screw **F** and adjust the potentiometer **G** to indicate a high between 407 μs and 423 μs.
4. Set the forms thickness control to 1; the display should indicate a low between 140 μs and 225 μs.
5. Readjust as necessary to obtain the values in steps 3 and 4. If the potentiometer cannot be adjusted within the tolerances, replace the potentiometer, then adjust it.

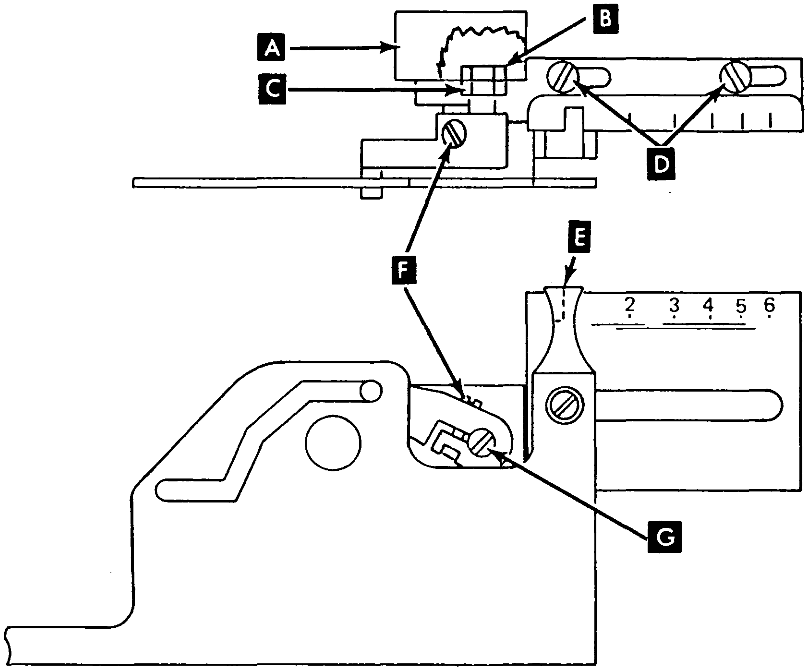
Removal

1. Turn the power off. Open the printer covers.
2. Loosen the nut **C** and pull the cover **A** off the potentiometer shaft.
3. Unplug the impression potentiometer plug P5 or P13.

   Note: Some potentiometers use P13; others use P5-3 and 4. If P5, remove potentiometer terminals 3 and 4.
4. Loosen screw **F** and remove two screws **D** .
5. Remove the potentiometer and bracket assembly.
6. Slide the arm off the shaft. Remove nut **B** and remove the potentiometer from the bracket assembly.

Replacement

1. Assemble the potentiometer to the bracket assembly and the arm to the shaft.
2. Move the forms thickness control to the extreme left.
3. Install the bracket assembly and align number 1 on the scale to the forms thickness control **E** and tighten the two mounting screws **D** .
4. Move the forms thickness control to 4.
5. Connect an ohmmeter to leads 3 and 4 and adjust the potentiometer **G** for 5000 ohms. Tighten the screw **F** slightly.
6. Install the terminals in the plug if needed. Replug the connector.
7. Perform the potentiometer adjustment (4.6.21). After the adjustment is made, check for a gap between the arm and bracket and tighten the screw **F** .



4.6.22 Transducer Position (Character Cutoff)

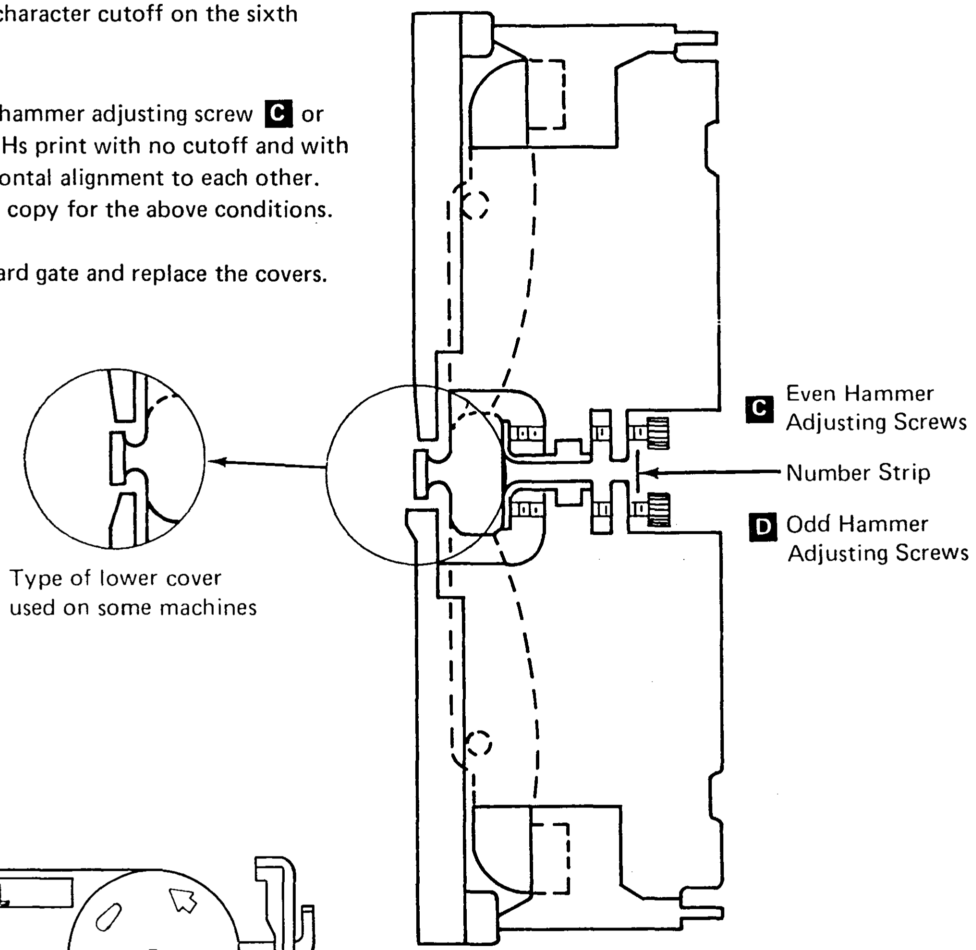
Adjustment

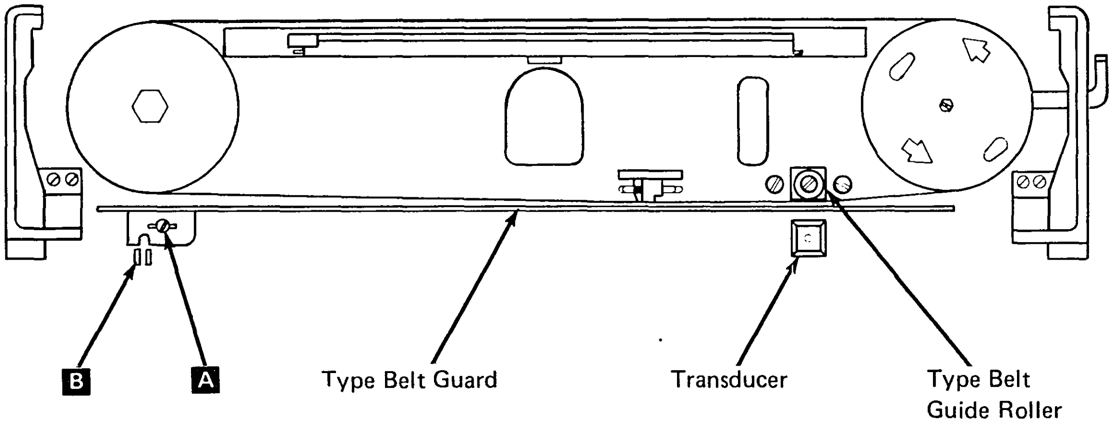
The type belt guard, transducer mounting block, and the type belt guide roller are separate parts but move as one unit when assembled. The right end of the assembly is spring loaded to the print unit. The left end is fastened to the print unit with a mounting screw **A**. When an adjustment is made, loosen only the left mounting screw. If the screw in the type belt guide roller is loosened, move the roller toward the transducer and tighten the screw firmly.

1. Perform the transducer assembly service check (4.6.19).
2. Check the potentiometer adjustment (4.6.21).
3. Install six-part forms if available; if not, use any multiple-part forms and set forms thickness control accordingly.
4. Print a pattern of Hs by running program ID PRT9. Check for general character cutoff across the entire print line.
5. Make adjustment by loosening the screw **A**, inserting a screwdriver at **B**, and adjusting the assembly minimum cutoff across the print line.

4.6.23 Hammer Flight Time (285 lpm)

1. Remove the printer covers.
2. Raise the card gate.
3. Set the forms thickness control to 6 and install six-part forms if available; if not, use any multiple-part forms and set control accordingly.
4. Print a test pattern of Hs by running program ID PRT9.
5. Check for character cutoff on the sixth copy.
6. Adjust the hammer adjusting screw **C** or **D** so that Hs print with no cutoff and with equal horizontal alignment to each other. Inspect last copy for the above conditions.
7. Close the card gate and replace the covers.





4.6.24 Hammer Coil (285 lpm)

Even (Upper) Coil Removal

Note: Leave the print unit closed in coil removal and replacement.

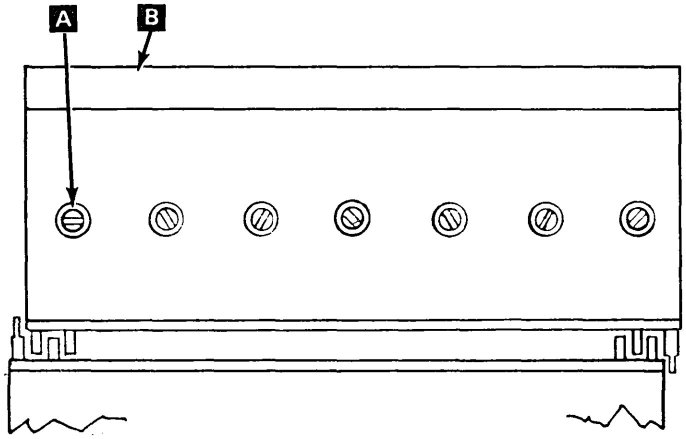
1. Open the printer covers and remove the paper guide around the hammer unit (four screws).
2. Close the print unit.
3. Determine which block contains the faulty coil (4.6.26).
4. Remove seven screws **A** and the hammer retainer plate **B** .

   Note: The hammer springs and plungers are captive and cannot fly out.
5. Each hammer block assembly has one pivot pin. While holding the lower end of the hammers in toward the comb bar, use duck bill pliers and slowly work the hammers out evenly from the top **D** .

CAUTION
Do not allow dirt or dust to get into the hammer guide or the coils.

6. Carefully tilt the tops of the group of hammers toward you until they rest against the type belt.
7. While holding adjacent coils in position, remove the defective coil **C** from the connector with needle nose pliers.

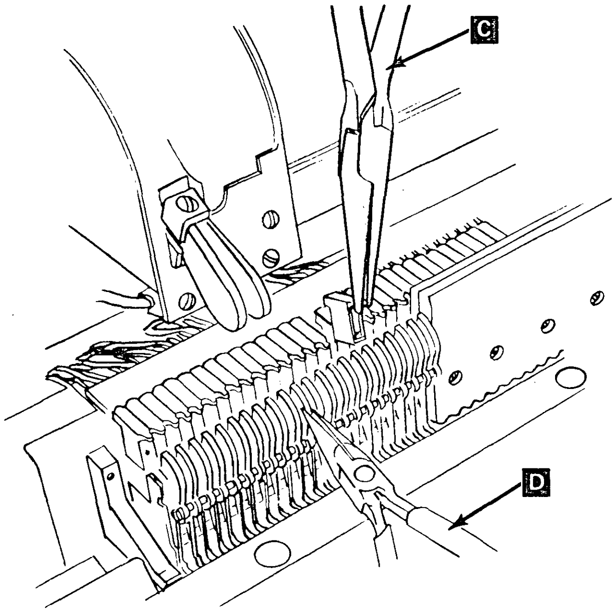
HAMMER BLOCK,UPPER, FRONT VIEW



8. Check the appearance of adjacent coils. If adjacent coils appear damaged, replace the coils.

Replacement

1. Check the resistance of the new coil for approximately 4 ohms or compare it with a known good coil in the printer.
2. Check that the pins on the new coil are straight to prevent damage when inserted in the connector, and install the coil.
3. Carefully position the hammers back into the comb bar and coils.
4. The hammer retainer plate has a small hole on the left end and an oblong hole on the right end. Install the plate with the two end screws and tighten slightly, still allowing for plate movement.
5. Install the remaining screws and tighten the screws from left to right toward the oblong hole to eliminate any bow in the hammer retainer plate.
6. Press each hammer face of the group removed with a pencil, spring hook, or similar object. If a hammer(s) is noticeably recessed (offset), the bumper strip between the hammer and the hammer stop screw might be out of location. If so, remove the hammer block (4.6.26) and tuck the bumper strip in place with a small screwdriver.
7. Install the hammer block and plug the connectors with the labels facing upward.
8. Install the paper guide with four screws.
9. Check hammer flight time for character cutoff (4.6.23, step 4).



Odd (Lower) Coil Removal

1. Open the covers and remove the print unit (4.6.10).

2. Remove the paper guide around the hammer unit (four screws).

3. Determine which block contains the faulty coil (4.6.26).

4. Remove the screws **A**, and the hammer plate **B**.

5. Place two strips of electrical tape on the hammers at **C** and **D**. This aids in keeping the hammers in alignment.

6. While holding the upper end of the hammers back toward the guide bar, use pliers, and carefully move the hammers out from the coils.

CAUTION
Do not allow dirt or dust to get into the hammer guide bar or the coils.

7. Use pliers **E** and carefully pull the faulty coil out from the front of the hammer block.

8. Check the appearance of adjacent coils. If adjacent coils appear damaged, replace the coils.

Replacement

1. Check the resistance of the new coil for approximately 4 ohms or compare it with a known good coil in the printer.

2. Check that the pins on the new coil are straight to prevent damage when inserted in the connector, and install the coil.

3. Carefully position the hammers back into the comb bar and coils. Remove the tape from the hammers.

4. The hammer retainer plate has a small hole on the left end and an oblong hole on the right end. Install the plate with the two end screws and tighten slightly, still allowing for plate movement.

5. Install the remaining screws and tighten the screws from left to right toward the oblong hole to eliminate any bow in the hammer retainer plate.

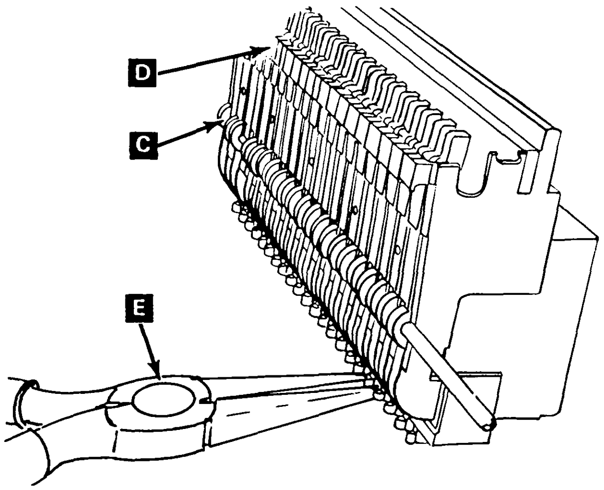
6. Press each hammer face of the group removed with a pencil, spring hook, or similar object. If a hammer(s) is noticeably recessed (offset), the bumper strip between the hammer and the hammer stop screw might be out of location. If so, remove the hammer block (4.6.26) and tuck the bumper strip in place with a small screwdriver.

7. Install the hammer block and plug the connectors with the labels facing upward.

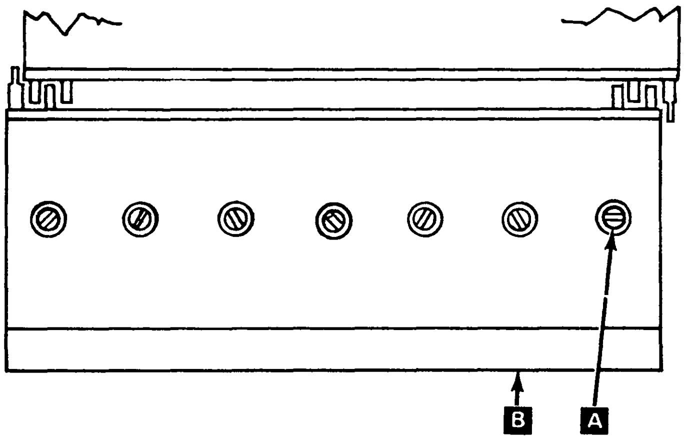
8. Install the paper guide with four screws.

9. Replace the print unit (4.6.10).

10. Check hammer flight time for character cutoff (4.6.23, step 4).



HAMMER BLOCK, LOWER, FRONT VIEW



4.6.25 Hammer (285 lpm)

Note: When replacing odd hammers (lower blocks), both the upper and lower blocks must be removed. See *Hammer Block Assembly* (4.6.26).

Removal

1. Remove the hammer block assembly (4.6.26).
2. Remove seven screws **A** and the hammer retainer plate **B** .

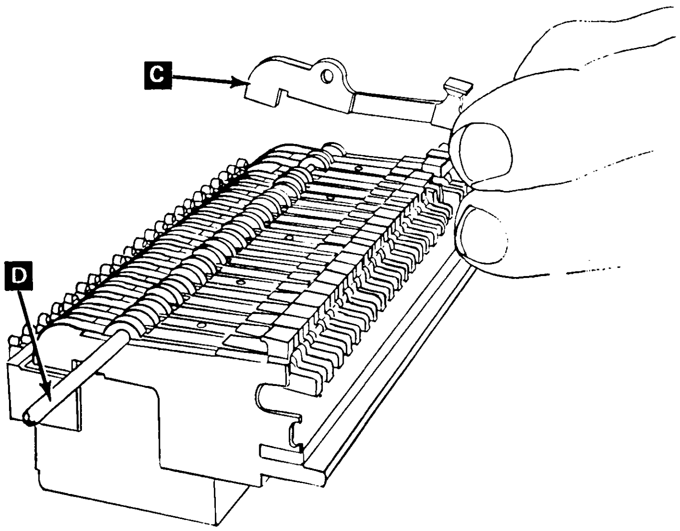
   Note: The hammer springs and plungers are captive and cannot fly out.

3. Each hammer block assembly has one pivot pin. With the hammers facing upward, use a pointed object such as the tip of a pencil to start the pivot pin out of the hammer block assembly. Pull the pivot pin **D** just past the defective hammer and remove the hammer **C**.

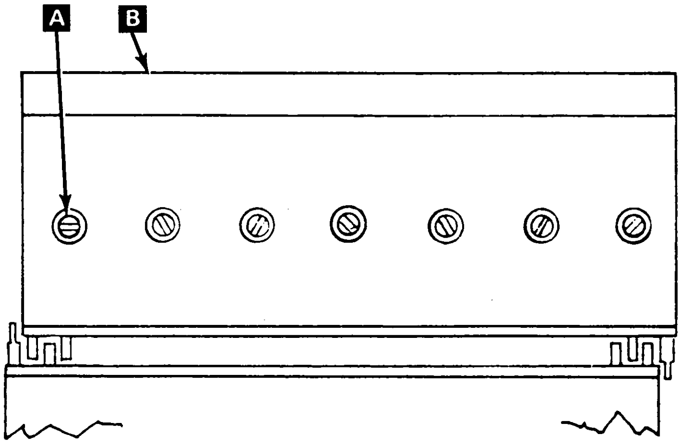
   Note: Interchanging hammers may change flight time. Keep hammers in original positions.

Replacement

1. Install the new hammer and slide the pivot pin back into location. (Check that the bumper strips between the back of the hammers and the hammer adjusting screws are still in their proper location.)
2. The hammer retainer plate has a small hole on the left end and an oblong hole on the right end. Install the plate with the two end screws and tighten slightly, still allowing for plate movement.
3. Install the remaining five screws and tighten the screws from left to right toward the oblong hole to eliminate any bow in the retainer plate.
4. Install the hammer block assembly (4.6.26) and plug the connectors with the label facing upward.
5. Install the paper guide with four screws.
6. Check hammer flight time (4.6.23).



HAMMER BLOCK, UPPER, FRONT VIEW



4.6.26 Hammer Block Assembly (285 lpm)

Removal

Note: The hammer blocks are designed so that the hammers are interlocked with each other. Therefore, a block cannot be removed until other specific blocks have been loosened or removed. For example, to remove block 3, you must first loosen block 2 and remove block 4. See chart:

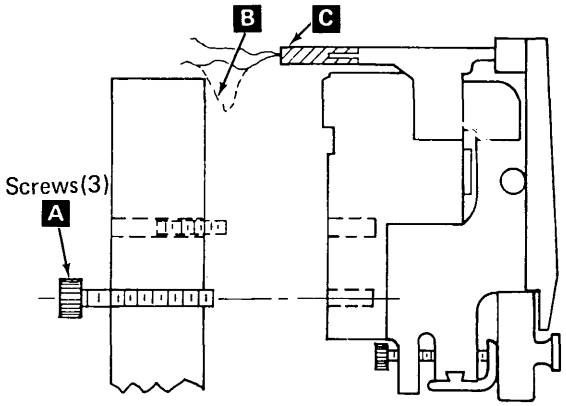
1. Remove the covers and the print unit (4.6.10).
2. Remove the paper guide (four screws).
3. Open the card gate, and latch it in the open position.
4. From the rear of the machine, remove three screws **A** from each hammer block(s) that must be loosened or removed.
5. Remove the upper hammer block, as needed, from the front. Disconnect two plugs **G**.

   Note: Mark the location of each block you remove so that they will not be exchanged.
6. If needed, remove the lower hammer block from the front. Disconnect two plugs **C**.

Replacement

CAUTION
Be careful not to pinch wire **B** when replacing blocks.

1. If removed, replace the lower hammer block first.
   a. Connect the lower plugs to the lower hammer block, then install the block.
   b. Do not tighten screws.
2. Replace the upper block.
   a. Connect the upper plugs to the upper block, then install the block.
   b. Tighten the screws in all blocks that were loosened or removed.
3. Close the card gate.
4. Replace the paper guide.
5. Replace the print unit (4.6.10) and the covers.



Disassembly

1. Remove the printer covers.
2. Remove the hammer block assembly (4.6.26).
3. **CAUTION**
   Hold the two halves **E** and **F** of the hammer block together during removal of the screws to avoid losing hammer return springs and plungers **D**.

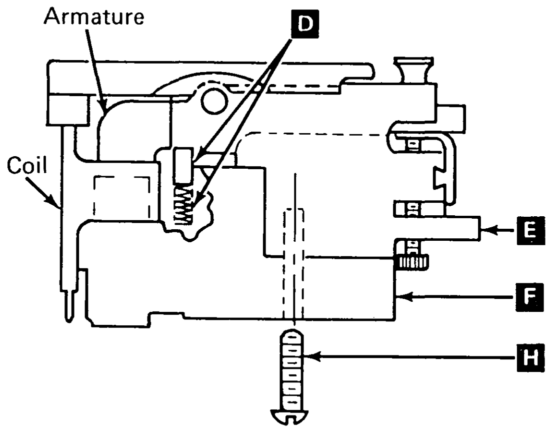
   Remove two screws **H** holding the two halves of the hammer block assembly together.
4. *Note:* While disassembling, watch for the hammer return springs. The springs can stick to the hammers and fall off.

   While holding pressure on the two halves, lay the assembly, hammer side up, on a flat surface. Carefully lift and separate the armature pivot assembly from the magnet assembly.

Reassembly

1. Lay the magnet portion down on a flat surface with the springs and plunger facing upward. Check that all springs and plungers are in place.
2. Insert armature end of hammers into the coils to aid in horizontal alignment.
3. Slowly push the hammers down against the spring tension.
4. Check movement of hammers for proper hammer engagement with plungers.
5. While holding the assembly together, turn it over so that the hammer section faces down. Fasten the two halves together (two screws).
6. Check the movement of each hammer to verify that all hammers, springs, and plungers were assembled properly.
7. Loosen each of the two screws **H** one full turn. Mount the hammer block assembly onto the hammer bar (4.6.26).

   Note: Loosening the screws allows for heat expansion.

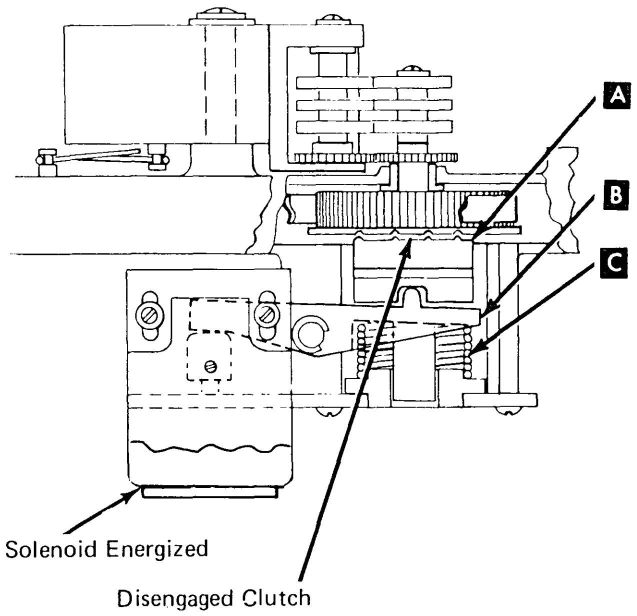


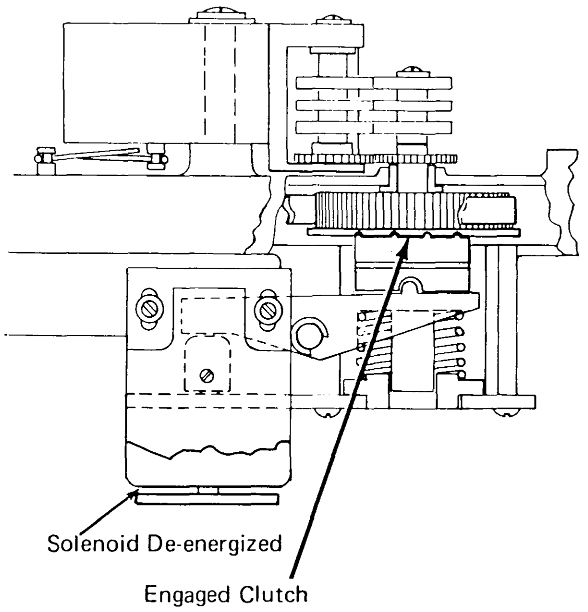
Hammers 2–44 Block 2 Driver Card A13C Loosen block 1	Hammers 46–88 Block 4 Driver Card A13E Loosen block 3	Hammers 90–132 Block 6 Driver Card A13G Loosen block 5
Hammers 1–43 Block 1 Driver Card B13C Remove block 2	Hammers 45–87 Block 3 Driver Card B13E Remove block 4 Loosen block 2	Hammers 89–131 Block 5 Driver Card B13G Remove block 6 Loosen block 4

4.6.27 Ribbon Drive Description

The printer uses an inked endless fabric ribbon contained in a sealed cassette and fed by a clutch drive mechanism. The clutch wheel is operated by a toothed belt connected to the type belt drive motor that advances the ribbon only during printing.

The clutch engages by spring action and disengages by solenoid action. When the solenoid is energized (print unit closed and no print operation), the solenoid pivots the lever **B** and compresses the spring **C** within the mechanism allowing the toothed section of the clutch **A** to disengage from the drive wheel. During printing, the solenoid is de-energized and the spring tension engages the teeth in the clutch to turn the ribbon drive shaft.





4.6.28 Ribbon Cassette (285 lpm)

Removal

1. Open the printer covers.
2. Open the print unit. Open the upper ribbon shield.
3. Raise both ribbon guides.
4. Open the ribbon drive release lever **A** .
5. Press the ribbon cassette release button **C** located at the right end of the ribbon cassette and slide the ribbon cassette to the right, off the drive roll assembly, and out of the mounting bracket.
6. Remove the ribbon from the guides and remove the ribbon cassette from the machine.

Replacement

1. Pull about 6 inches (152.4 mm) of ribbon from the left end of the cassette and place the ribbon between the drive roll release lever **A** .
2. Place the ribbon cassette in the printer so that the left end of the cassette is about 1 inch (25.4 mm) from the ribbon drive roll. (The right end of the cassette will cover the release button.)
3. Press down on the cassette and slide it to the left until it latches.
4. Raise the ribbon guides, and feed the ribbon through the slot in the bottom of the left guide, then on around the guide.
5. Close the ribbon drive release lever **A** .
6. Pull about 12 inches (304.8 mm) of ribbon out of the right end of the cassette and feed the ribbon from the left guide on around the right guide.
7. Take up any extra ribbon slack by rotating the right pulley counterclockwise.
8. Lower the ribbon guides.
9. Turn the right pulley counterclockwise to feed the ribbon down between the type belt and the ribbon shield. While still turning the pulley, verify that the ribbon tracks between the metal and plastic guides in the lower ribbon shield. Close the upper ribbon shield. Turn the pulley again to ensure that the ribbon tracks under the upper ribbon shield.
10. Close the print unit; then close the printer covers.

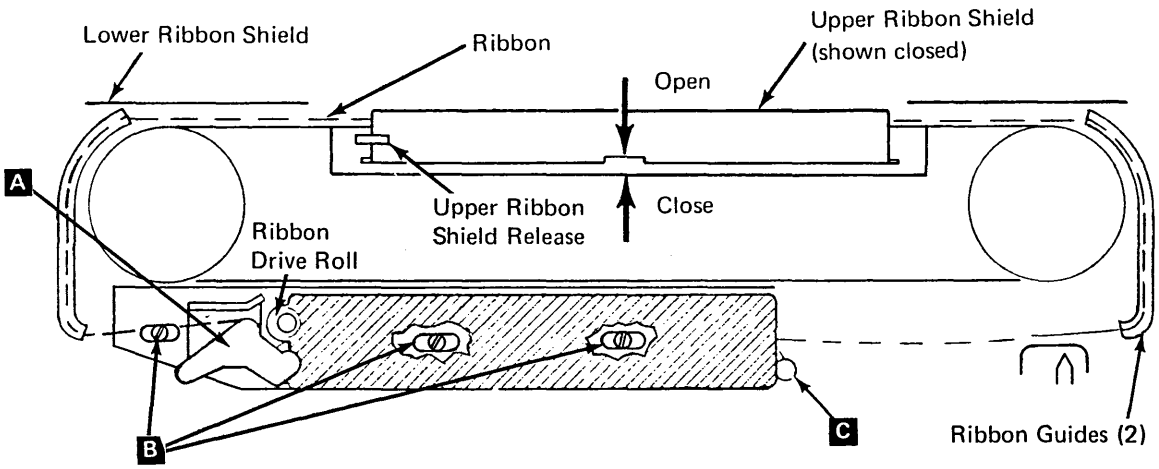
4.6.29 Ribbon Drive Assembly

Removal

1. Open the printer covers.
2. Remove the type belt (4.6.13).
3. Remove the type belt drive pulley assembly (4.6.14).
4. Remove the ribbon cassette (4.6.28).
5. Remove the ribbon drive assembly by removing the three mounting screws **B** .

Replacement

1. Install the ribbon drive assembly and perform the ribbon drive belt tension adjustment (4.6.31).
2. Install the type belt drive pulley assembly and type belt.
3. Check the ribbon solenoid adjustment (4.6.32).
4. Install the ribbon cassette and check that the ribbon is tracking properly .
5. Close the cover.



4.6.30 Ribbon Drive Clutch

DANGER
A spring within the clutch mechanism can fly out when disassembling the clutch. Hold the bracket toward the floor and release the spring tension slowly.

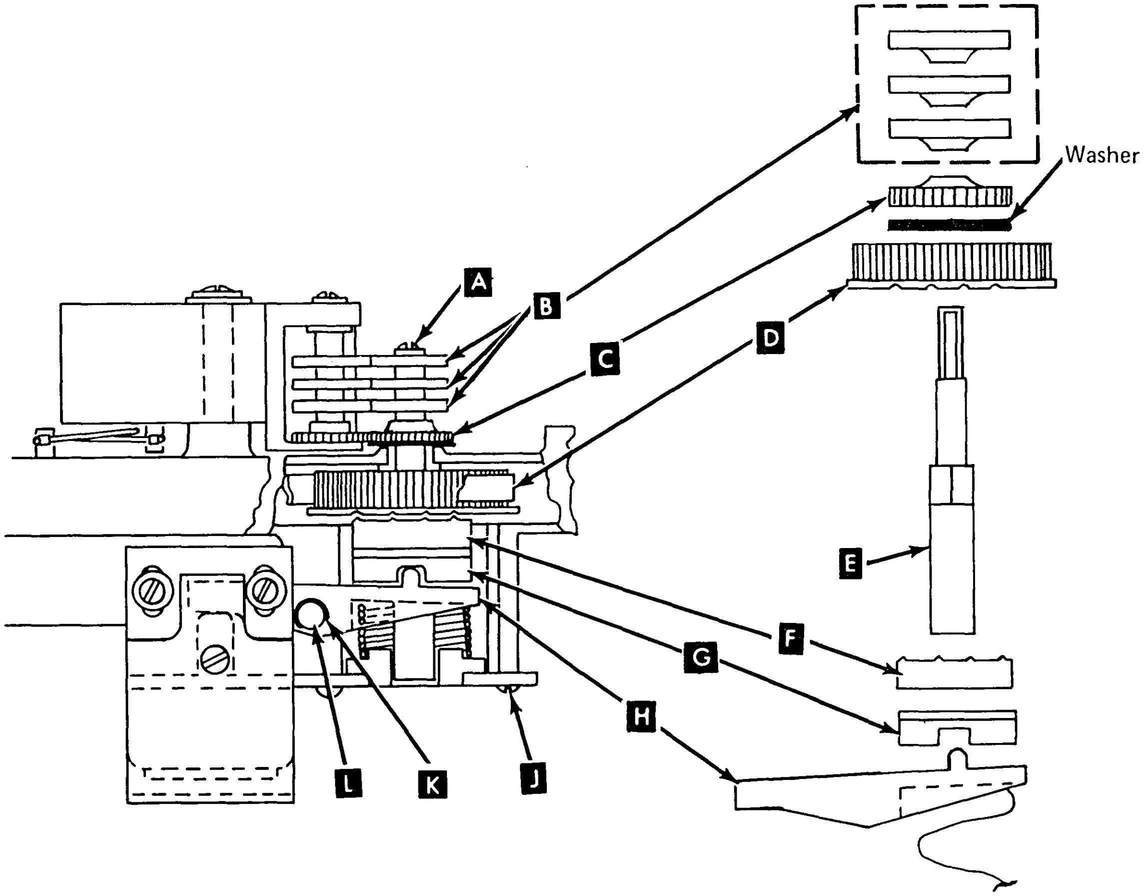
Removal

1. Remove the printer covers (4.6.1) steps 1 through 3.
2. Remove the ribbon (4.6.28) and type belt (4.6.13).
3. Remove the type belt drive pulley assembly (4.6.14).
4. Remove the ribbon drive assembly (4.6.29).
5. Remove the screw **A** from the drive shaft.
6. Remove three rollers **B** , the gear **C** , and the washer beneath the gear.
7. A long spring is compressed between the lever and the lower bearing assembly. While grasping the assembly tightly to keep the spring from flying out, remove three screws **J** and slowly remove the bearing.
8. Tip the ribbon drive unit sideways to keep the units within the clutch from falling out, and remove the C-clip **K** and pivot shaft **L** .
9. Remove the spacer **G** , clutch face **F** , drive shaft **E** , and the drive pulley and belt **D** .

Replacement

1. Install the bottom half of the clutch onto the square part of the shaft.
2. Install the ribbon drive belt onto the new drive pulley and place them in the clutch housing.
3. Insert the drive shaft and bottom half of the clutch up from the bottom and through the drive pulley, washer and bearing.
4. Place the clutch spacer on the lever **H** and install the lever with the pin and C-clip.
5. Fit the bottom of the spring onto the brass bushing in the plate (the top of the spring presses into the pivot arm). Install the plate with three screws.
6. Install the washer, gear, and three drive rolls, and tighten the screw while holding onto the drive rolls.

   Note: Screw **A** must be tight, or drive rolls may slip on drive shaft.
7. Check for proper reassembly by lifting on the lever **H** and turning the drive pulley. The drive pulley should turn freely. When the lever is released, the clutch should engage when the drive gear is turned.
8. Install the ribbon drive assembly (4.6.29) and perform the ribbon drive belt tension adjustment (4.6.31).
9. Install the type belt pulley assembly, type belt, and ribbon.
10. Adjust the ribbon solenoid (4.6.32).
11. Install the covers.

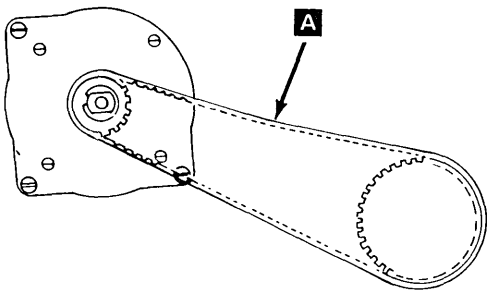


4.6.31 Ribbon Drive Belt

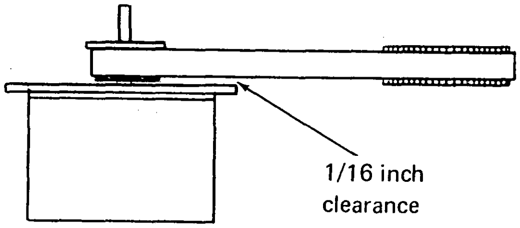
Adjustment

Note: Too much tension on the belt causes excessive wear on the bearings.

1. Remove the printer covers (4.6.1) steps 1 through 3.
2. Remove the type belt (4.6.13), the type belt drive pulley assembly (4.6.14), and the ribbon cassette.
3. Using a gram gauge, check that a 100 gram force causes 0.120 inch ± 0.030 inch (3.05 mm ± 0.76 mm) deflection midway between the pulleys **A** .
4. Adjust by loosening the three ribbon drive mounting screws and moving the assembly right or left.
5. Tighten the screws, then verify the deflection in step 3.
6. Install the pulley, type belt, ribbon cassette, and cover(s).



7. The ribbon drive belt should track on the pulley so that there is at least one sixteenth of an inch between the belt and the motor top plate. To increase the clearance, add shims under the rear edge of the ribbon mounting bar assembly.



Removal

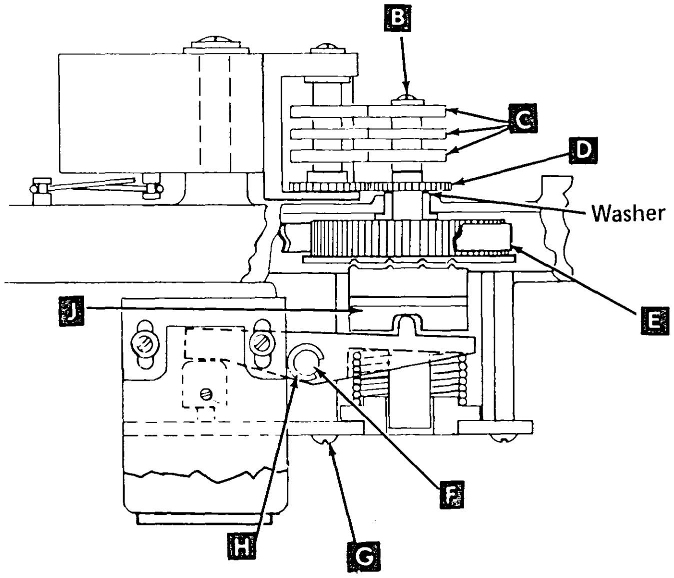
DANGER
A spring within the clutch mechanism can fly out when disassembling the clutch. Hold the bracket toward the floor and release the spring tension slowly.

1. Remove the printer covers.
2. Remove the ribbon cassette (4.6.28) and type belt (4.6.13).
3. Remove the type belt drive pulley assembly (4.6.14).
4. Remove the ribbon drive assembly (4.6.29).
5. Remove the screw **B** from the top of the drive shaft.
6. Remove the drive rolls **C** , gear **D** , and the washer beneath the gear from the shaft.
7. Remove the plate by removing three screws **G** .
8. Remove the C-clip **H** , and slide the clutch pivot shaft **F** out of the clutch arm.
9. Remove the bottom half of the clutch **J** and the washer from the drive shaft.
10. Remove the drive shaft from the bottom.
11. Remove the pulley, washer, and belt **E** .

Replacement

1. Place the washer on top of the ribbon drive pulley. Use a small amount of grease to keep the washer in place.
2. Place the belt around the ribbon drive pulley, and insert it in the ribbon drive assembly.
3. Insert the drive shaft through the bottom of the ribbon drive assembly and through the ribbon drive pulley.
4. Replace remaining ribbon assembly parts in the reverse order of removal.

   Note: Screw **B** must be tight, or drive rolls may slip on drive shaft.
5. Install the ribbon drive assembly on the print unit. Do not tighten mounting screws.
6. Perform ribbon drive belt tension adjustment (4.6.31).
7. Install remaining units in reverse order (steps 3 through 1) of removal.



4.6.32 Ribbon Solenoid

Adjustment

DANGER
The ribbon clutch solenoid becomes very hot after use. Be sure it is cool before performing maintenance.

1. Turn the power off.
2. Remove the printer covers (4.6.1) steps 1 through 3.
3. Remove the solenoid safety cover **C** .
4. Loosen the solenoid bracket screws **D** .
5. Check that the clutch faces are fully engaged by holding the shaft **A** and turning the pulley.
6. With the solenoid de-energized, place a 0.045 inch (1.143 mm) feeler gauge between the solenoid housing and the residual **B** , then position the bracket until the lever just touches the top of the solenoid armature shaft.
7. Tighten the solenoid bracket screws.
8. After the adjustment is made, manually pick the solenoid to disengage the clutch, and turn the shaft. The shaft should turn freely and independently of the pulley.
9. Install the solenoid safety cover, the divider, and the main covers.
10. Turn the power on.

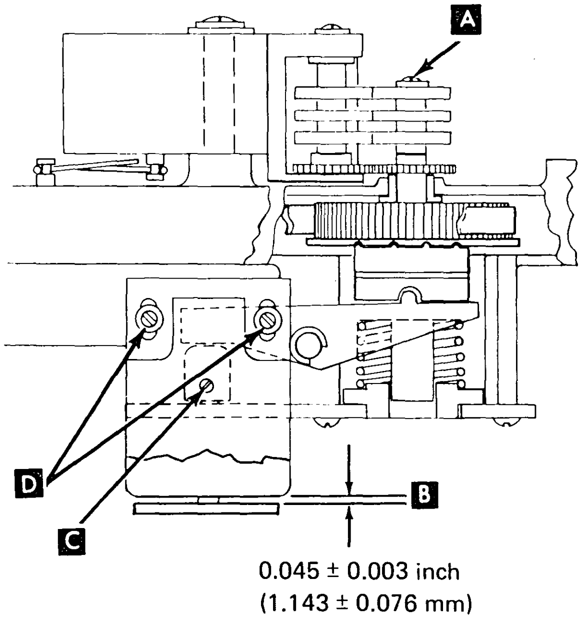
Removal

DANGER
The ribbon clutch solenoid becomes very hot after use. Be sure it is cool before performing maintenance.

1. Turn the power off.
2. Remove the covers and the divider between the keyboard and the printer (4.6.1).
3. Remove the solenoid safety cover (one screw) **C** .
4. Remove the solenoid mounting bracket screws **D** and unplug the ribbon solenoid leads (P1).
5. Remove two nuts and the solenoid assembly (not shown).

Replacement

1. Replace in the reverse order of removal and perform the ribbon solenoid adjustment (4.6.32).
2. Turn the power on.



4.6.33 Ribbon Drive Rolls and Idler Rolls (285 lpm)

Removal

Note: Both the ribbon drive rolls **D** and the pressure roll bracket assembly **M** should be replaced at the same time.

1. Remove the idler rolls:
   a. Remove the screw **B** .
   b. Remove the spring **A** and bracket **M** .
   c. Remove the lower screw **K** .
   d. Remove the upper spring clip **E** .
   e. Remove the upper spacer **F** .
   f. Remove the lower clip **J** .
   g. Push upper bearing **G** off the upper end of the shaft.
   h. Remove the idler roll shaft assembly **L** with the lower spacer **H** .

   Note: The lower bearing should stay in the bracket.

2. Remove the drive rolls **D** .
   a. Remove screw **C** .
   b. Slide the rolls off the drive shaft.

Replacement

1. Replace the drive rolls **D** :
   a. Install the drive rolls on the drive shaft.
   b. Tighten the screw **C** .

   Note: Screw **C** must be tight, or drive rolls may slip on shaft.

2. Replace the idler rolls:
   a. Install the lower spacer **H** on the shaft. Be sure the shoulder is up.
   b. Install the pressure roll shaft assembly into the lower bearing.
   c. Install the upper bearing **G** .
   d. Install the lower clip **J** under spacer **H** .
   e. Install the upper spacer **F** with the shoulder down.
   f. Install the upper clip **E** .
   g. Install screw **K** .
   h. Install the bracket **M** , spring **A** , and screw **B** .

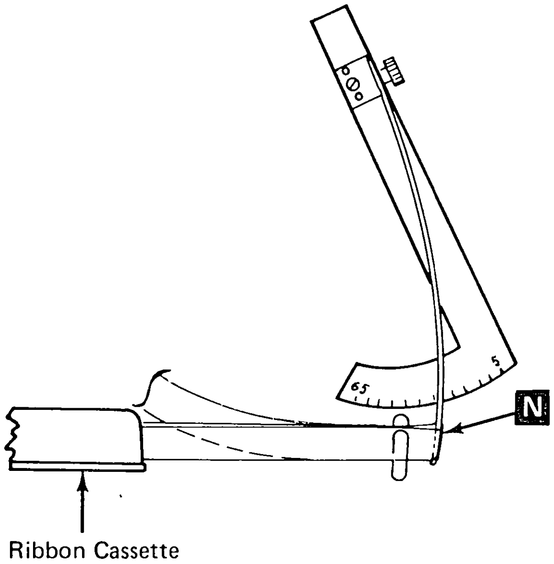
4.6.34 Ribbon Drag (285 lpm)

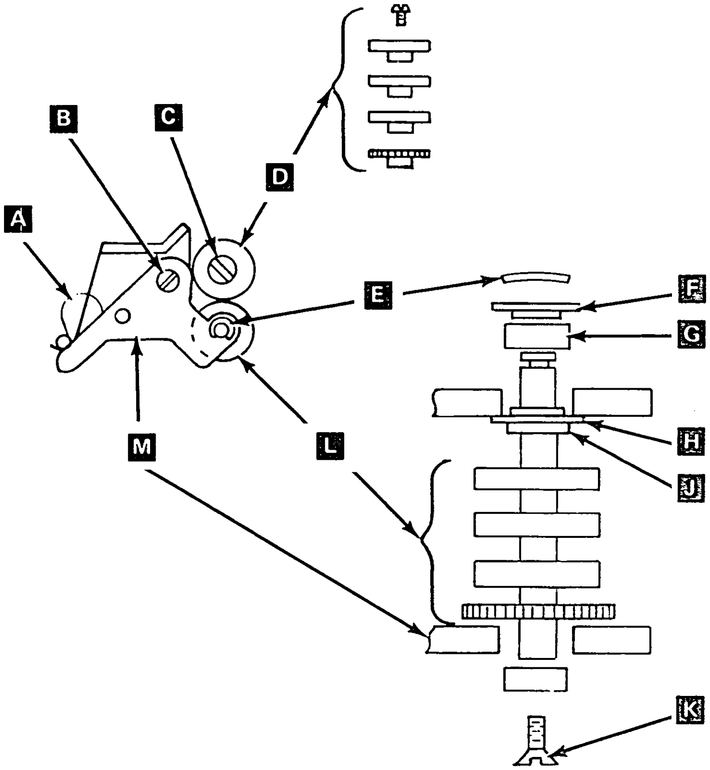
Service Check

1. Remove the ribbon cassette and pull about 7 inches (177.8 mm) of ribbon from the right end of the cassette.

2. Make a loop in the ribbon as shown at **N** and place a paper clip toward the end of the loop.

3. Insert the gram gauge blade in the loop, hold it at the angle shown, and slowly move the gauge to the right. The ribbon should start pulling out of the cassette when 25 to 35 grams of pressure is applied. If more than 35 grams or less than 25 grams is required to pull the ribbon, install a new cassette.





4.6.35 Ribbon Tracking (285 lpm)

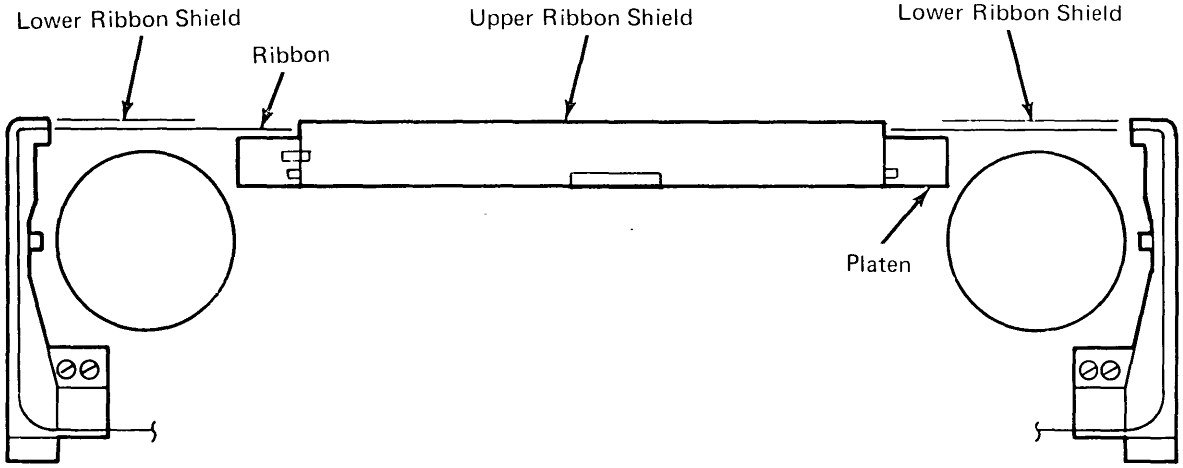
Note: A new ribbon must be installed before you check or adjust ribbon tracking. Do not perform this check or adjustment unless tracking problems are obvious.

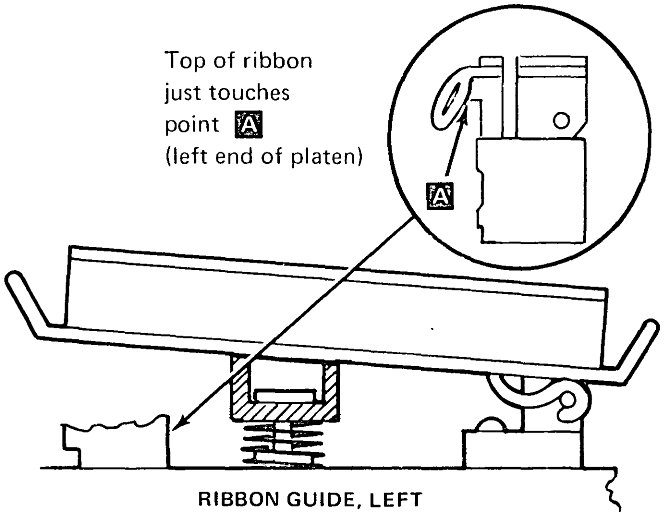
Service Check

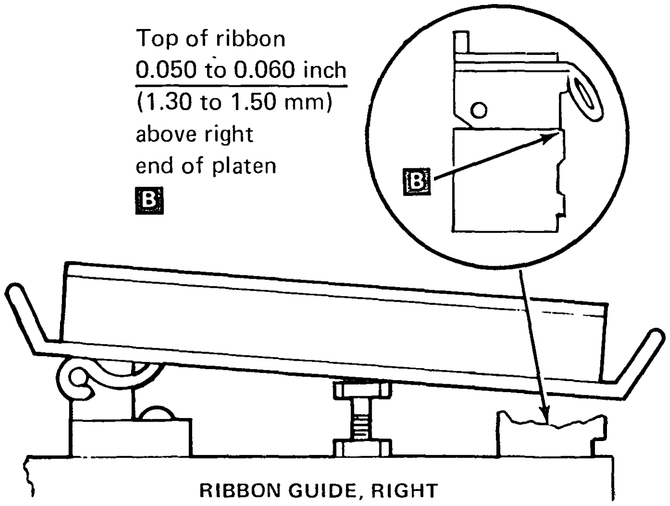
1. With the power off and the print unit closed, manually turn the right type belt pulley counterclockwise and check that the top of the ribbon just touches the bottom of the step at the left end of the ribbon shield **A** .
2. While turning the right type belt pulley, check that the top of the ribbon is 0.050 to 0.060 inch (1.30 to 1.50 mm) above the right end of the platen **B** .

Adjustment

1. Open the cover and the print unit.
2. Remove the type belt (4.6.13).
3. Lower the ribbon guides.
4. Turn the pulley counterclockwise and verify that the ribbon tracks between the metal and plastic guides in the lower ribbon shield. Close the upper ribbon shield. Turn the pulley again and ensure that the ribbon tracks under the upper ribbon shield.
5. The ribbon should track so that the top of it just touches the bottom of the step at the left end of the ribbon shield **A** , and the top of the ribbon is 0.050 to 0.060 inch (1.30 to 1.50 mm) above the right end of the platen **B** . If not correct, adjust the stopscrew under each ribbon guide as needed.
6. Replace the type belt. Close the print unit and the cover.







4.6.36 Ribbon Shields (285 lpm)

Lower Shield

Removal

1. Remove the printer covers.
2. Remove the print unit (4.6.10).
3. Remove six screws **A** from the front of the platen.
4. Remove the ribbon shield.

Replacement

1. Install the ribbon shield using the six screws **A** (do not tighten).
2. Hold the ribbon shield up against the platen as shown **B**, then tighten the screws.
3. Replace the print unit (4.6.10).
4. Replace the ribbon (4.6.28).
5. Replace the covers.

Upper Shield

Removal

1. The screws are located under the print position scale near print positions 4 and 129. Break the scale at these points to expose the screws **C**.
2. Remove the mounting screws from the pivot brackets **D**.
3. Remove the upper ribbon shield **E** and the pivot brackets.

Replacement

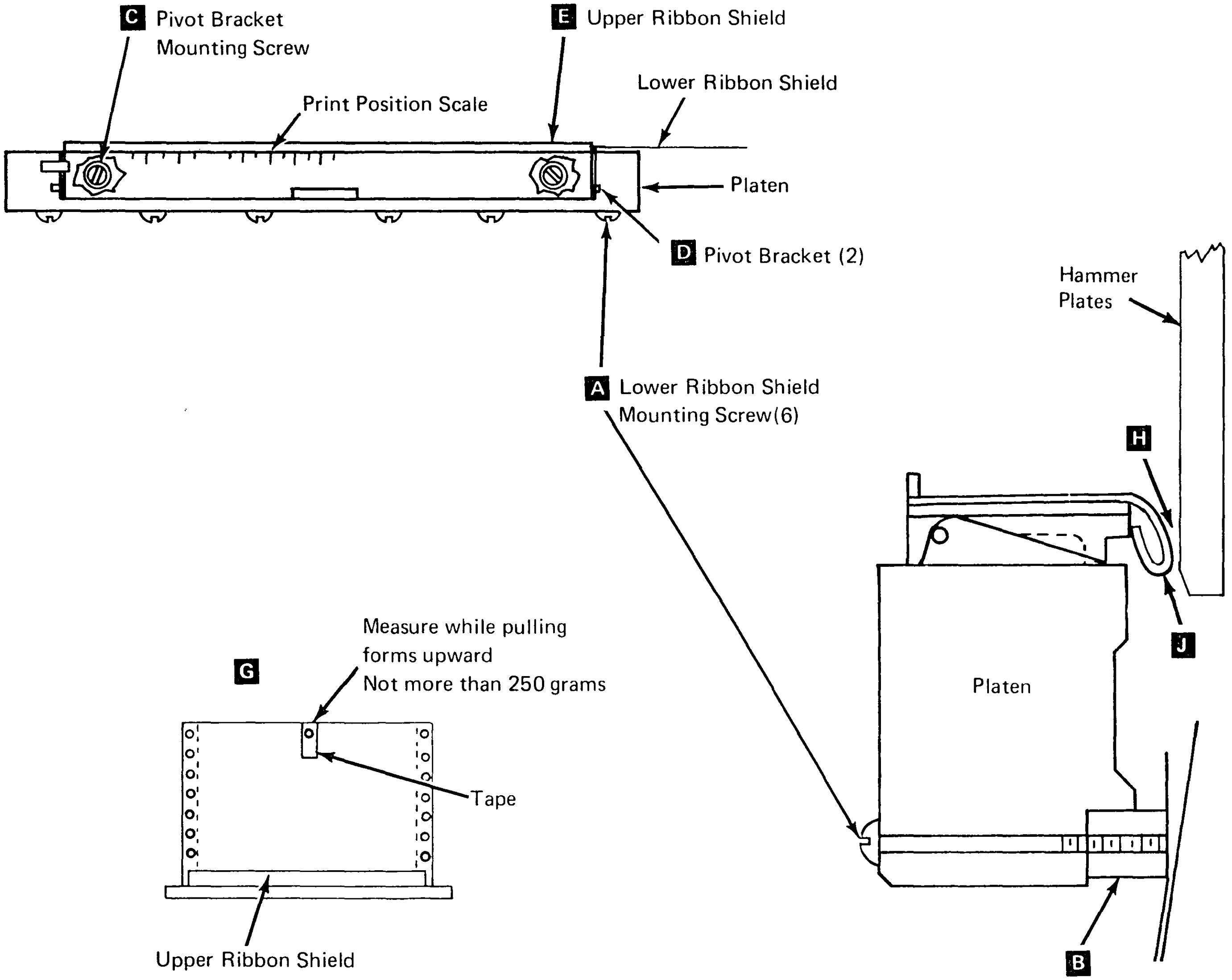
1. Place the pivot brackets **D** on the shield assembly **E**.
2. Locate the shield and pivots on the platen. Start the screws in the pivot brackets, but do not tighten.
3. Do the upper ribbon shield adjustment.

Service Check

1. Set forms thickness control on 1.
2. Open the print unit, then slowly lift it until the upper ribbon shield comes near the hammer plates. At this point, ensure that the upper ribbon shield is parallel to the hammer plates **H**.
3. Open the upper ribbon shield and verify that there are no damaged edges on the shield **J**.

Adjustment

1. Remove the paper, ribbon, and type belt.
2. Close the print unit and set the forms thickness control to 6.
3. Loosen the upper ribbon shield mounting screws **C**.
4. Push the upper shield toward the paper path until the lip of the shield **J** just contacts, and is parallel with, the hammer plate at **H**. Tighten the mounting screws.
5. Load approximately 22 inches (550 mm) of one-part forms that are wide enough to cover the print line.
6. Close the print unit and set the forms thickness control to 1.
7. Measure the tension while pulling the forms upward **G**. The tension should not be more than 250 grams. If the tension is correct, go to step 7.
8. If the tension measured in step 5 is more than 250 grams:
   a. Open the upper ribbon shield, then measure the tension **G** again. The tension should not be more than 250 grams. If correct, go to step 6d.
   b. If not correct, the extra tension is from the forms path below the upper ribbon shield. Inspect the forms tension assembly (4.6.45), lower ribbon shield, and lower forms path.
   c. Close the upper ribbon shield. Measure the tension again (same as step 5). If correct, go to step 7.
   d. Close the upper ribbon shield. Loosen the mounting screws, then move the upper ribbon shield 0.005 inch (0.13 mm) toward the front of the machine. Measure the tension again. If not correct, repeat step 6c, but make the gaps **F** 0.005 inch (0.13 mm) smaller each time until the tension is correct.
   e. Tighten the mounting screws in the pivot brackets.
9. Replace the type belt and the ribbon.


C Pivot Bracket Mounting Screw
E Upper Ribbon Shield
Lower Ribbon Shield
Print Position Scale
Platen
D Pivot Bracket (2)
Hammer Plates
A Lower Ribbon Shield Mounting Screw(6)
H
J
Platen
B
G
Measure while pulling forms upward Not more than 250 grams
Tape
Upper Ribbon Shield

4.6.37 Tractor Drive Shaft

Note: Verify that the paper guides on the paper entry chute are located correctly before performing this adjustment (front forms alignment scale aligned with rear alignment scale).

Adjustment

To align the print line with the margin holes in the paper:

1. Insert wide single-part forms and print several lines in all print positions.
2. Place a straight edge (ruler or paper) tangent to the margin holes and determine whether the line slopes up or down in relation to the holes.
3. If the line slopes, remove the printer covers and loosen three retainer screws **A** on the right end of the tractor drive shaft.
4. Turn the eccentric **B** to either raise or lower the right tractor.
5. Tighten the screws, run another sample of printing, and recheck the adjustment.
6. Install the covers.

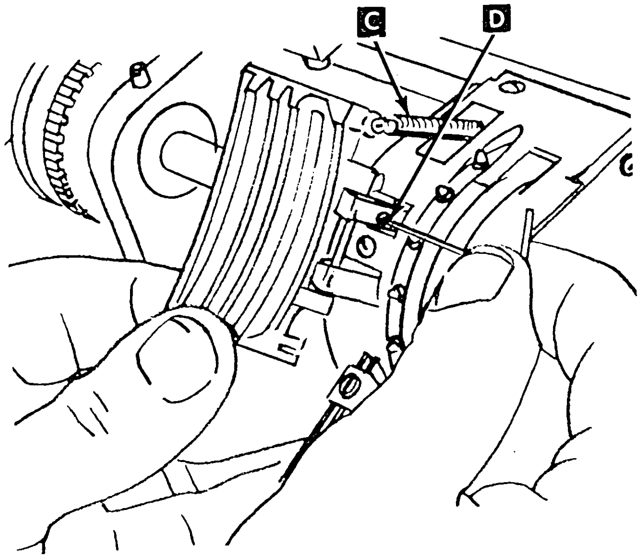
4.6.38 Tractor Cover

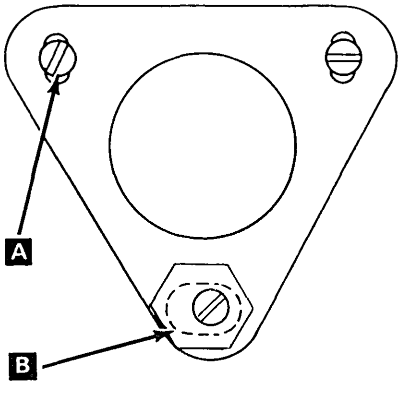
Removal

1. Loosen one setscrew **D** and remove the shaft that holds the cover onto the tractor assembly.
2. Remove the spring **C** from the cover.
3. Remove the cover.

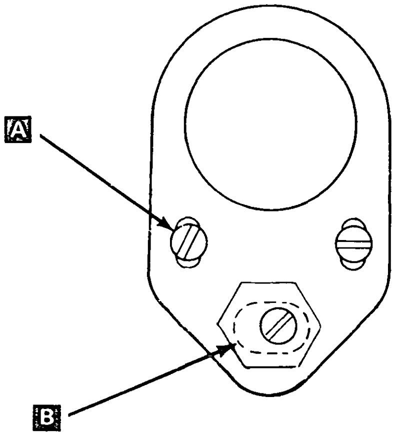
Replacement

Replace in reverse order of removal.





Old Style



New Style

4.6.39 Carriage Tractor/Vernier/Tractor Drive Shaft

Notes:

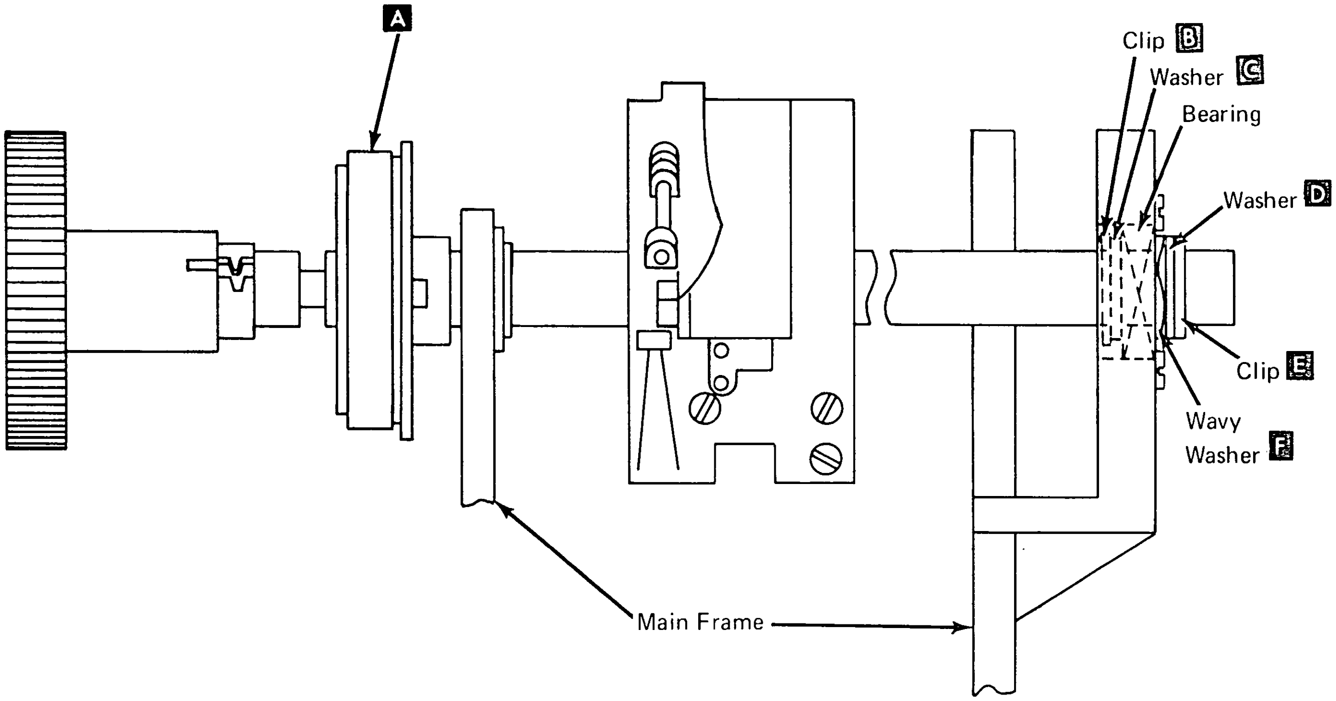
1. Tractor drive shaft verniers are factory adjusted. If the verniers become worn or defective, replace the complete drive shaft and vernier assembly.
2. Use pliers, P/N 9900317, to remove retainer clips.

Removal

1. Remove the printer covers (4.6.1) steps 1 through 3.
2. Loosen the carriage motor (four screws) and remove the carriage drive belt **A** .
3. Remove the retainer clip **E** , the washer **D** , and the wavy washer **F** .
4. Move the shaft to the left and remove the retainer clip **B** and washer **C** .
5. Squeeze the tractor release lever together, slide the tractor to the right off the drive shaft and pull the tractor forward from the slot.

Replacement

1. Replace in the reverse order of removal but do not tighten the carriage drive motor mounting screws.
2. Adjust the carriage drive belt to produce 0.100 inch ± 0.025 inch (2.54 mm ± 0.64 mm) deflection with 200 grams force applied midway between the pulleys.
3. Perform tractor drive shaft adjustment (4.6.37).



4.6.40 Carriage Motor

Removal

1. Remove the printer covers (4.6.1) steps 1 through 3.
2. Unplug the carriage motor plug (P7).
3. Remove the four motor mounting screws **A** .
4. Remove the belt from the motor pulley **B** .
5. Remove the motor.

Replacement

1. Replace in the reverse order of removal but do not tighten the four motor mounting screws.
2. Adjust the carriage drive belt tension to produce 0.100 inch ± 0.025 inch (2.54 mm ± 0.64 mm) deflection with 200 grams force applied midway between the pulleys. Tighten the screws.

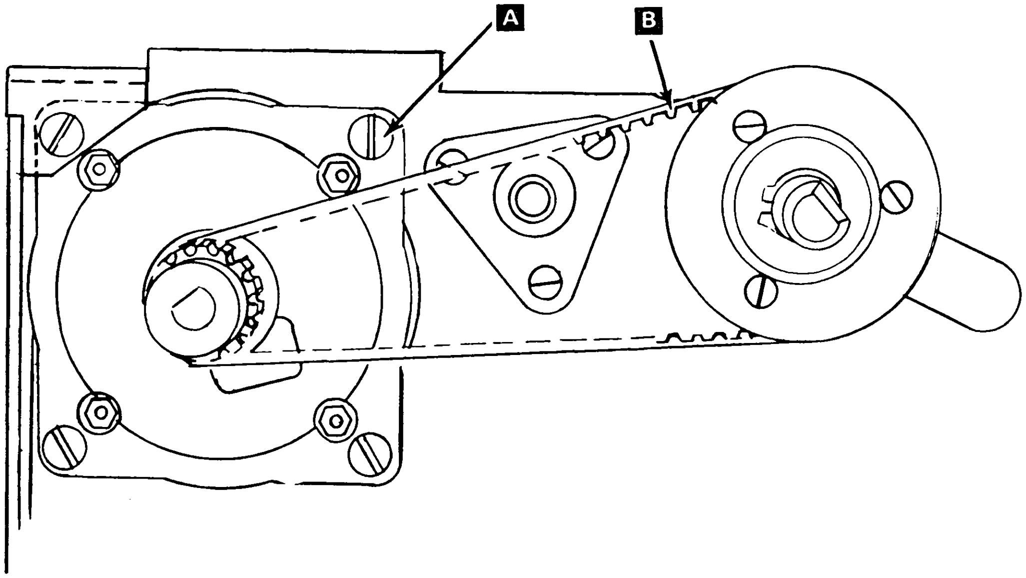
4.6.41 Carriage Drive Belt

Removal

1. Remove the printer covers.
2. Loose the four carriage motor mounting screws **A** .
3. Remove the belt from the motor pulley **B** .

Replacement

1. Install the belt.
2. Adjust the carriage drive belt tension to produce 0.100 inch ± 0.025 inch (2.54 mm ± 0.64 mm) deflection with 200 grams force applied midway between the pulleys. Tighten the screws.



4.6.42 Upper Paper Clamp

Adjustment

1. Remove the printer covers (4.6.1) steps 1 through 3 and forms.

2. Loosen, but do not remove, the two screws **G** from the back of the paper clamp cover. Remove the cover by sliding it to the back and upward.

3. Press the forms guide release bar that opens the upper paper clamp assembly. Operate the upper paper clamp manually, by moving the armature against the plastic end blocks **F** . Make sure the clamp mechanism moves freely.

4. Close the upper paper clamp assembly.

5. Load program ID PRT1; this program allows you to open and close the paper clamps each time you press the ENTER key.

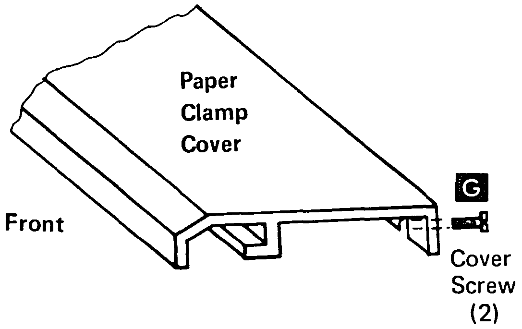
6. Close the paper clamps. Tighten the clamp bar adjusting screws **D** until the spring is snug against the armature on both sides (spring might already be snug).

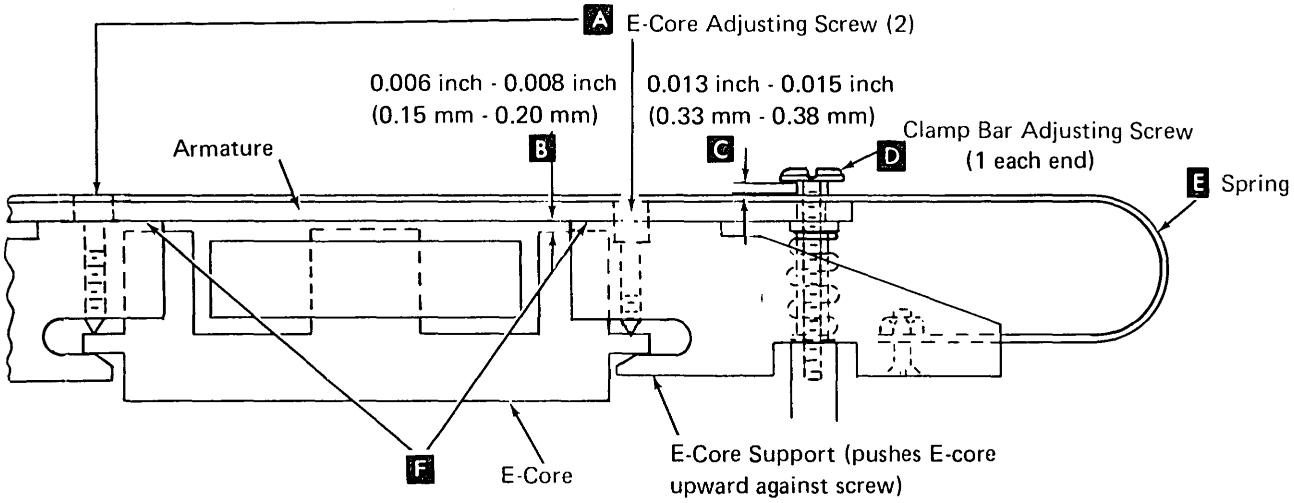
7. Open or close the paper clamp as necessary. Insert 0.007 inch (0.178 mm) feeler gauge between the armature and one of the outer legs of the E-core **B** . Make sure the gauge is not between the plastic end block **F** and the armature. Close the paper clamps. With the armature seated on the plastic end blocks, check for 0.006 inch to 0.008 inch (0.15 mm to 0.20 mm) gap at **B** . Check each end, and adjust screws **A** as required.

8. With the armature seated on the plastic end blocks, adjust each clamp bar adjusting screw **D** for 0.013 inch to 0.015 inch (0.33 mm to 0.38 mm) at point **C** (both ends). Make sure the spring **E** is contacting the armature when checking measurement **C** .

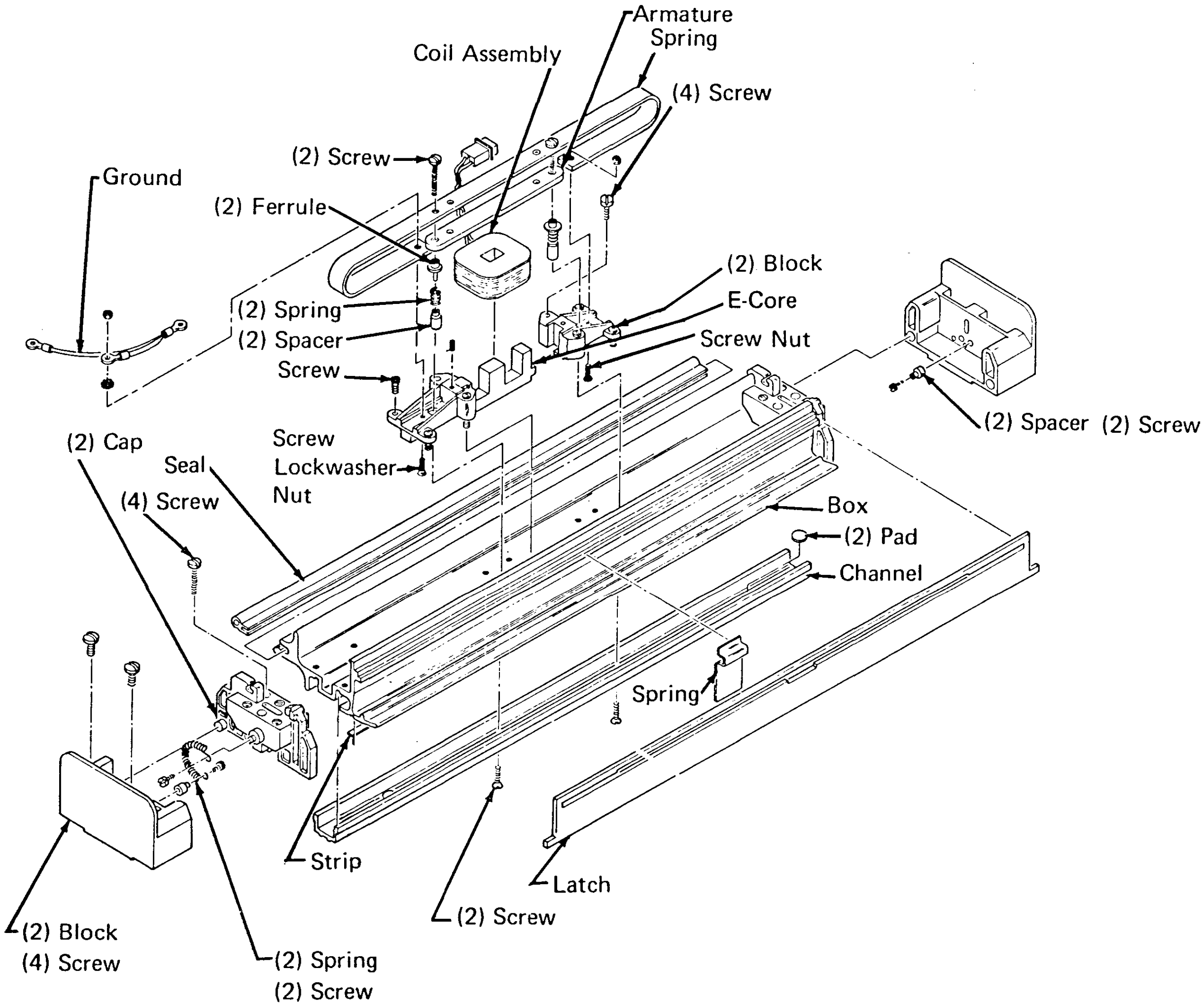
9. After the adjustment is correct, turn each clamp bar adjusting screw 1/2 turn clockwise.

10. Open the paper clamps and install the paper clamp cover and the main covers.





4.6.43 Upper Paper Clamp Assembly



4.6.44 Lower Paper Clamp (285 lpm)

4.6.44.1 Two Coil Clamp with Two Engaging Levers G

Service Check

1. Install single-part forms that are wide enough to cover the print line. Close the print unit.

2. Load program ID PRT1. This program allows you to open or close the paper clamps each time you press the ENTER key.

3. Close the paper clamps.

4. Grip the forms and try to pull them upward. The forms must be held tightly on both ends. If forms are not held tightly, do the adjustment.

5. Open the paper clamps.

6. Pull the forms upward. The clamp should not hold the forms.

Adjustment

1. Power down.

2. Remove the printer cover and divider (4.6.1) and forms.

3. Close the print unit and set forms thickness control to 6.

> **DANGER**
> The ribbon clutch solenoid becomes very hot after extended use. Be sure it is cool before attempting maintenance.

4. While holding levers G up, adjust guide plates for 0.000 inch to 0.003 inch (0.00 mm to 0.08 mm) at F.

5. Do service check. If OK, omit remaining adjustments.

6. Remove the print unit (4.6.10).

7. Engage the paper clamp mechanism by lifting levers G up.

   Note: Hold levers up with folded paper between levers and print base.

8. Loosen screws C, then turn adjusting nuts D 1/2 turn clockwise to move the clamp away from the lower forms guide H.

9. Load program ID PRT1. This program allows you to open or close the paper clamps each time you press the ENTER key.

10. Close the paper clamps.

11. Make sure the clamp bar B is straight. Form bar carefully, if needed.

12. Check between the two outer tension springs (both ends) for condition A. If the clearance is incorrect, turn adjusting nut(s) D until correct. When the clearance is correct, check to be sure that the armature is sealed against the residual on the solenoid case E. Check clearance A again.

    Note: If the adjustment cannot be made with the adjusting nut, rotate the solenoid and bracket to vary the adjustment:
    a. Tighten screws C.
    b. Power down, and do lower paper clamp removal, steps 5 and 6.
    c. Rotate the solenoid bracket one turn around the adjusting nut (clockwise to increase A).
    d. Install solenoids and brackets. Loosen screw C, then repeat adjustment, steps 7 through 12.

13. Open the paper clamps. Turn both adjusting nuts D 1/2 turn counterclockwise to move the clamp toward the lower forms guide H; then tighten both screws C.

14. Remove the support material used to hold the levers up G, then unlatch the clamp mechanism.

15. Install single-part forms that are wide enough to cover the print line.

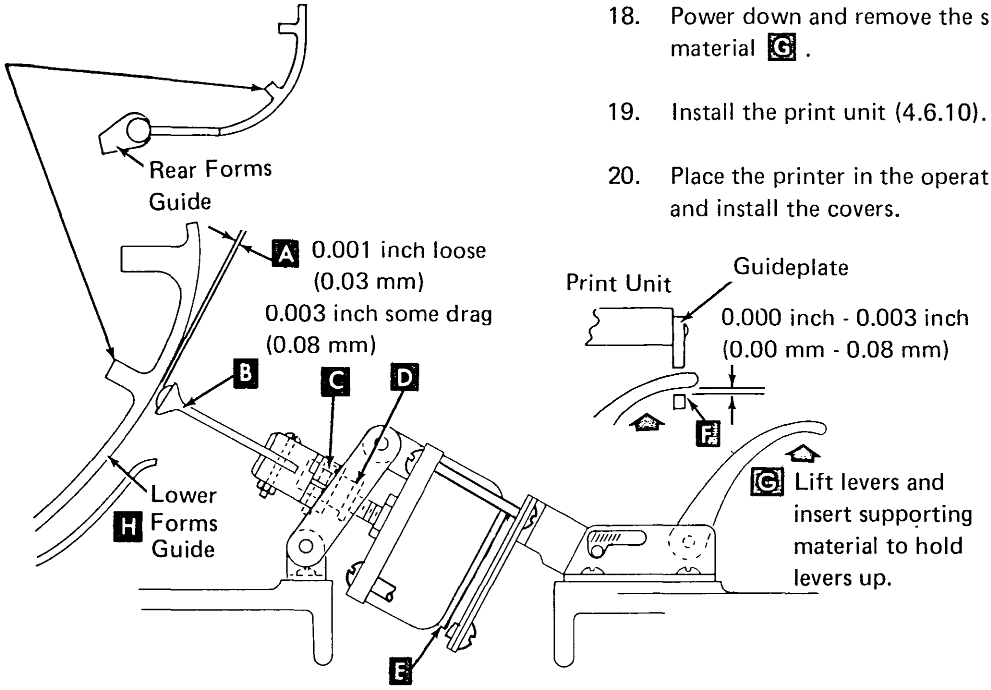
16. Latch the clamp mechanism, and hold the levers up as before.

17. Close the paper clamps again. Check for even forms clamping by trying to pull up on each end of the form. The form should be held tightly across its width. Repeat adjustment if form is not held tightly.

18. Power down and remove the support material G.

19. Install the print unit (4.6.10).

20. Place the printer in the operating position and install the covers.



4.6.44 285 lpm Lower Paper Clamp (Continued)

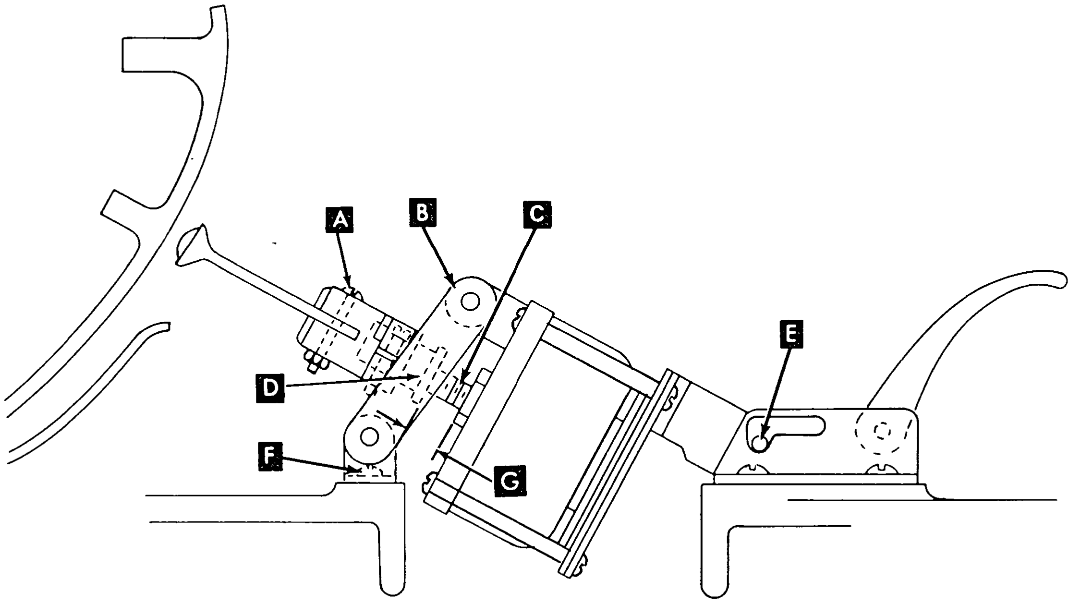
4.6.44.1 Two Coil Clamp with Two Engaging Levers **D** (Continued)

Removal

1. Power down.
2. Remove the printer covers (4.6.1) steps 1 through 3, and forms.
3. Remove the keyboard cover and divider (4.6.1 steps 4 through 6).
4. Remove the print unit assembly (4.6.10).
5. Remove four screws **F** (two from each solenoid bracket).
6. Remove one clip, washer, and pin **E**, from each bracket.
7. If only the clamp bar is to be removed, remove the two screws **A** and lift out bar.
8. Disconnect the lower paper clamp solenoid plug (P3) and remove the two solenoid wires from the plug.
9. Measure gap **G**, then unscrew the solenoid assembly from the nut **D** in the nylon clamp.
10. Remove bracket **B** from the solenoid.

Replacement

1. Install the bracket **B** onto the solenoid and turn the solenoid assembly into the nylon clamp leaving about the same gap **G** measured in step 9 of removal.
2. Replace the remaining parts in reverse order of removal.
3. Do the lower paper clamp adjustment (4.6.44.1).



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4.6.44 285 lpm Lower Paper Clamp (Continued)

4.6.44.2 Single Coil Clamp With One Engaging Lever A

Service Check

1. Install single-part forms that are wide enough to cover the print line. Close the print unit.

2. Load program ID PRT1; this program allows you to open or close the paper clamps each time you press the ENTER key.

3. Close the paper clamps.

4. Grip the forms and try to pull them upward. The forms must be held tightly on both ends. If forms are not held tightly, do the adjustment.

Adjustment

1. Power down.

2. Remove the printer covers (4.6.1) and forms.

3. Remove the print unit (4.6.10).

4. Manually latch the paper clamp mechanism by lifting lever A up.

   Note: Hold the lever up with folded paper between the lever and print base.

5. Check mechanical action by engaging the armature. Be sure parts move easily and the clamp bar returns to the bumpers K when the armature is released.

6. Check between the two outer tension fingers (both ends) for 0.052 to 0.068 inch (1.32 to 1.73 mm) gap B. The maximum difference between both gaps B should not exceed 0.010 inch (0.25 mm). If correct, go to step 7.

   To adjust:
   a. Remove the seal from screws C, if needed. Loosen two screws in each stop plate.
   b. Loosen four holding screws D in the clamp assembly.
   c. Move the clamp assembly to obtain gap B, then tighten the screws D. Check the gap again.
   d. Hold stop plates against the clamp assembly, and then tighten screws C.

7. Load program ID PRT1; this program allows you to open or close the paper clamps each time you press the ENTER key.

8. Close the paper clamps. Be sure the armature is seated on the end blocks E.

   a. Check for 0.006 to 0.008 inch (0.15 to 0.20 mm) gap F (both ends). Adjust, if needed, by turning screw(s) with a small six-fluted wrench G.

      Note: Turning clockwise increases the gap.

   b. Check for 0.004 to 0.006 inch (0.13 to 0.03 mm) gap H (both ends). Adjust, if needed, by turning screw(s) J.

      Note: Turning clockwise increases the gap.

      Check both gaps H again after adjusting.

9. Open the paper clamp, then do the lower paper clamp service check (4.6.44.2).

10. Do forms tension service check (4.6.45) steps 4 through 7.

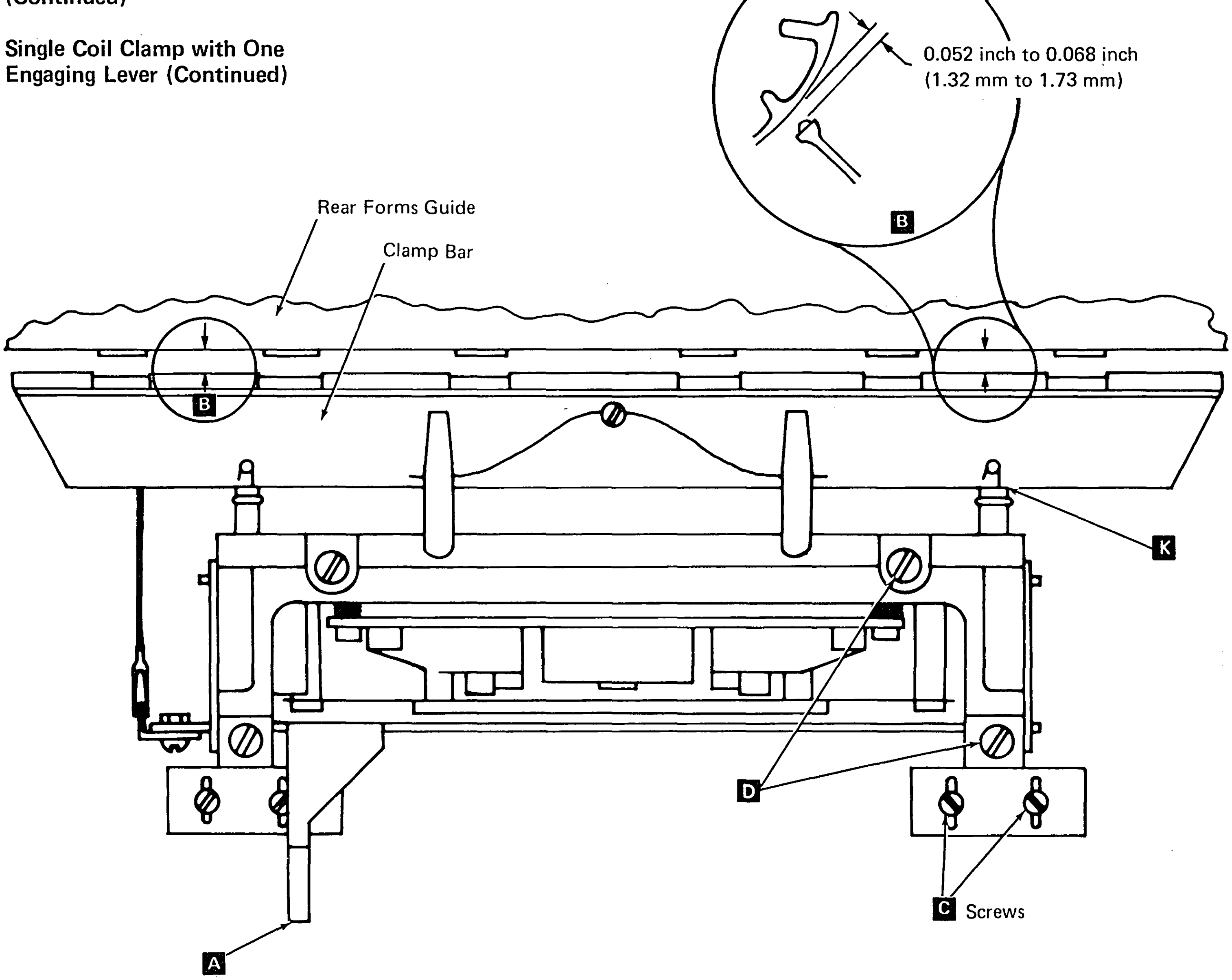
11. Power down and remove the support material under lever A.

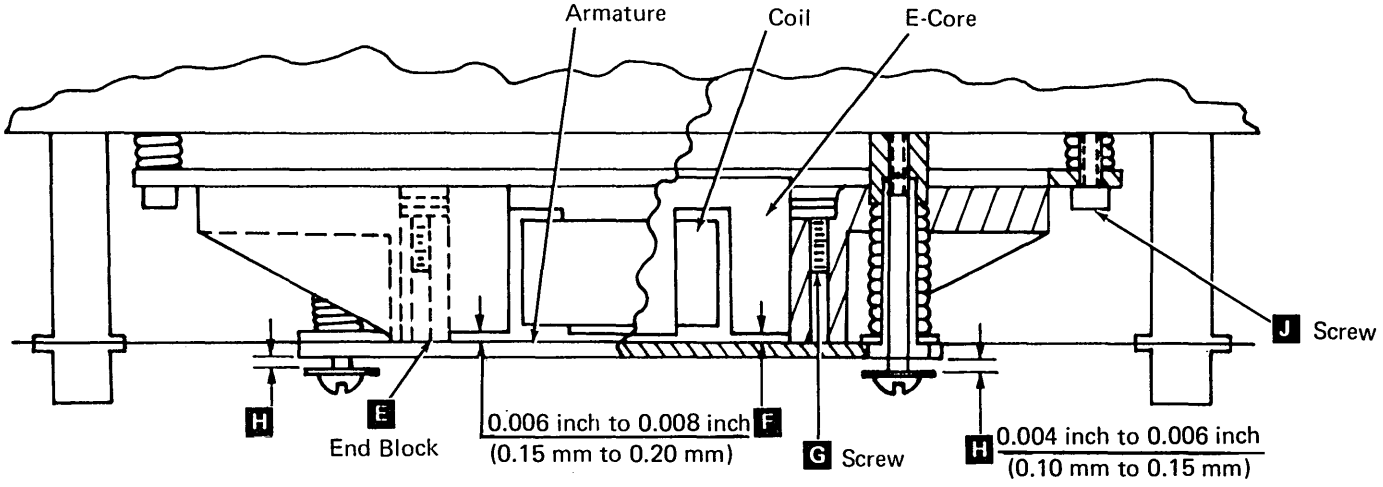
12. Install the print unit (4.6.10).

13. Install the printer covers.

4.6.44 285 lpm Lower Paper Clamp (Continued)

4.6.44.2 Single Coil Clamp with One Engaging Lever (Continued)





4.6.44 285 lpm Lower Paper Clamp (Continued)

4.6.44.3 Clamp Assembly Removal (Single Coil Clamp with One Engaging Lever D)

Removal

1. Power down.
2. Remove the printer covers (4.6.1) and forms.
3. Remove the print unit (4.6.10).
4. Unhook clip C . Disconnect P3.
5. Remove four screws F (two each end), then remove assembly.

Replacement

1. Place clamp assembly in position. Place P3 cable as shown and connect plug.
2. Start the four screws F , but do not tighten. Hold the assembly against the stop plates G , and tighten the four screws F .
3. Install the clip C .

   Do lower paper clamp service check (4.6.44.2).

   Do forms tension service check (4.6.45) steps 4, 5, and 6.

   Install print unit and covers.

4.6.44.4 Clamp Bar Removal (Single Coil Clamp with One Engaging Lever D)

Removal

1. Remove lower paper clamp assembly (4.6.44.3).
2. Loosen screw, and remove retainer wire A from both rods B .
3. Unhook spring and remove support pins E from clamp bar at both ends.
4. Remove clamp bar from rods B.

Replacement

1. Slide the clamp bar into the slot in rods B .

   Note: Ensure that the clamp bar is installed correctly (tension springs mesh with clamp bar slots).
2. Insert the support pin E and hook the spring on the pin.
3. Install retainer wire A . Center as shown, then tighten screw.
4. Install lower paper clamp assembly (4.6.44.3).

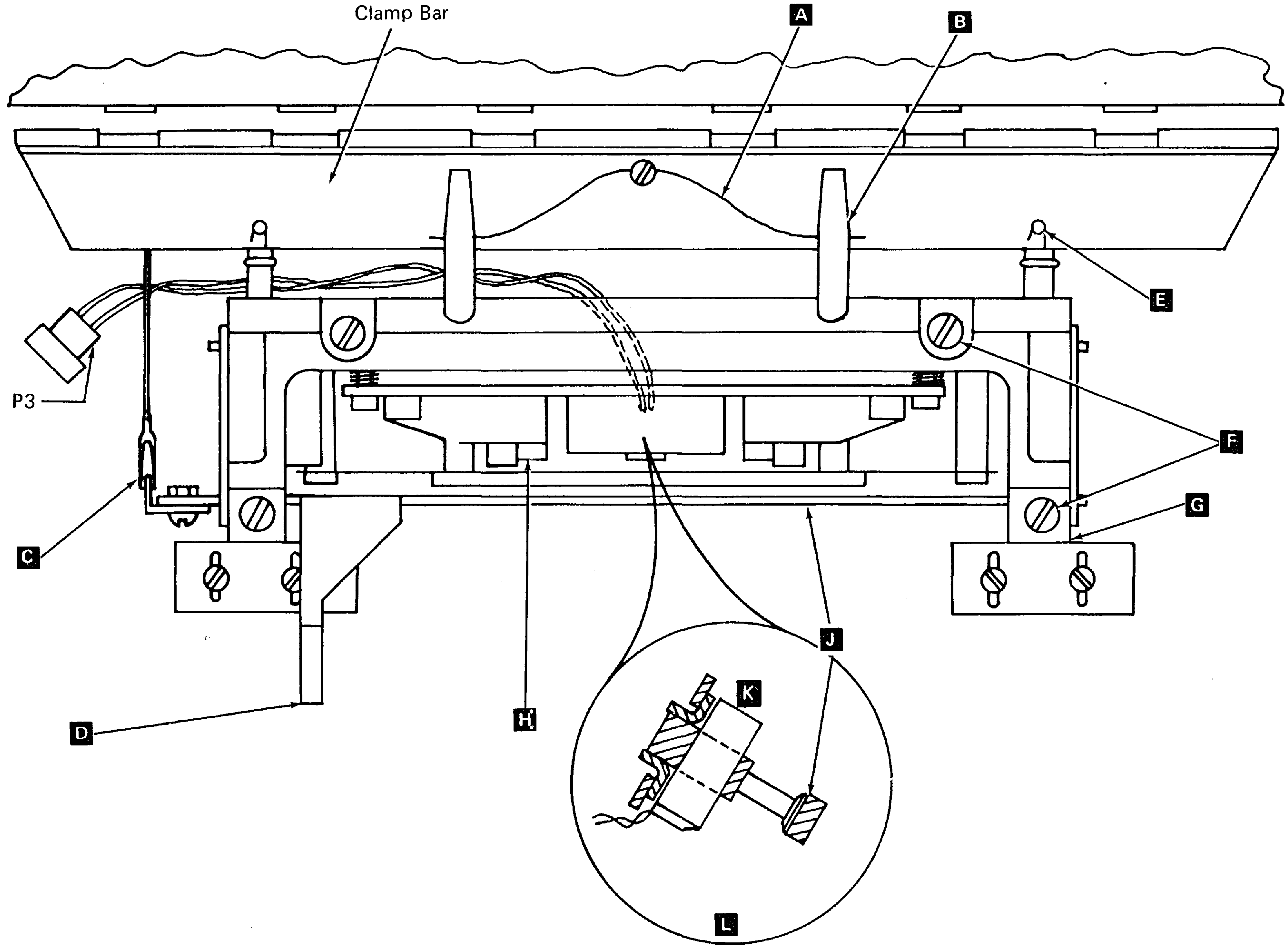
4.6.44.5 Coil Assembly Removal (Single Coil Clamp with One Engaging Lever D)

Removal

1. Remove lower paper clamp assembly (4.6.44.3).
2. Loosen screw, and remove retainer wire A from both rods B .
3. Move armature J away from coil.
4. Loosen screw and remove coil retainer H.
5. Remove coil K by pulling it off the core.

Replacement

1. Place coil on core as shown L.
2. Install coil retainer H and tighten screw.
3. Hold armature J toward core, and install retainer wire A . Center as shown, then tighten screw.
4. Replace paper clamp assembly (4.6.44.3).


Clamp Bar
A
B
E
P3
F
G
C
D
H
J
K
L

4.6.45 Forms Tension Assembly (285 lpm)

4.6.45.1 Print Units with Two Paper Clamp Engaging Levers

Note: The levers and guideplates for the lower paper clamp affect the forms tension. See 4.6.44.1 *Adjustment*, step 5.

Service Check

1. Power down.
2. Remove the printer covers (4.6.1), and forms.
3. Remove the print unit assembly (4.6.10).
4. Load about 35 inches (900 mm) of single-part forms that are wide enough to contact all six tension springs.
5. Operate the tension springs against the forms by lifting the levers C until the assembly locks.

   Note: Hold levers up by inserting folded paper or other supporting material between the levers and the printer base.

6. Check for 100 to 125 grams tension M while pulling the forms upward.

   Note: With the print unit installed, the maximum tension is 250 grams.

7. If the tension is not OK, do the adjustment.

Adjustment

1. Operate the tension springs against the forms by lifting the levers C until the assembly locks. Check that all tension springs touch the lower forms guide at the same time. Form each spring N as needed.
2. Unhook clevis A and turn it on the link to adjust the tension. Hook the clevis.
3. Repeat the service check, steps 5, 6 and 7.
4. Install the print unit assembly (4.6.10).
5. Install the rear forms guide and covers.

Removal

1. Remove the printer covers (4.6.1) and print unit (4.6.10).
2. Unhook the spring from the right end of the clamp bar.

   Note: Nylon pin might fall out.

3. Unhook the clip A and remove the link and clip assembly from the shaft.
4. Raise both levers C , then remove pin E from each lever.

   Note: The right pin is part of the pin and lever assembly B .

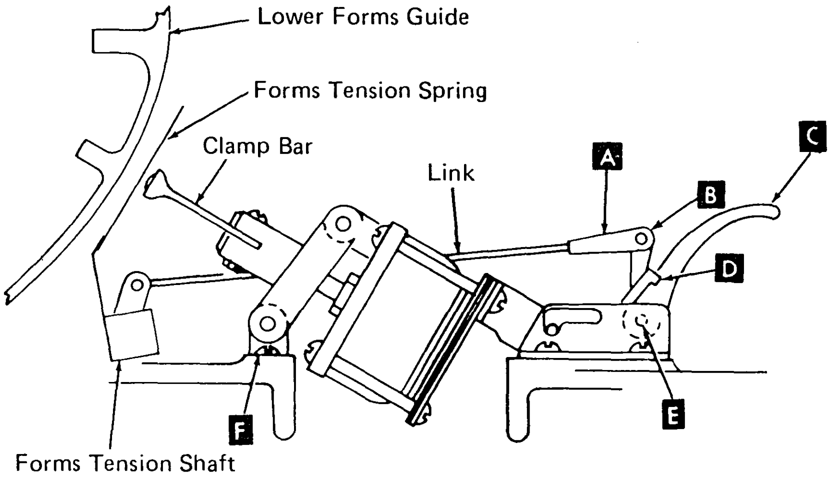
5. Remove two screws F from each solenoid bracket.
6. Loosen screw L , then remove retainer plate G .
7. Carefully raise the clamp bar, then rotate the forms tension shaft J forward and slide the shaft to the left until the right end is clear of the right pivot. Remove bushing H from the left end.
8. With the clamp bar raised, lift the right end of the shaft up and to the right until clear of the left pivot. Lift the shaft up between the rear forms guide and the clamp bar. If more clearance is needed, loosen the cable clamps.

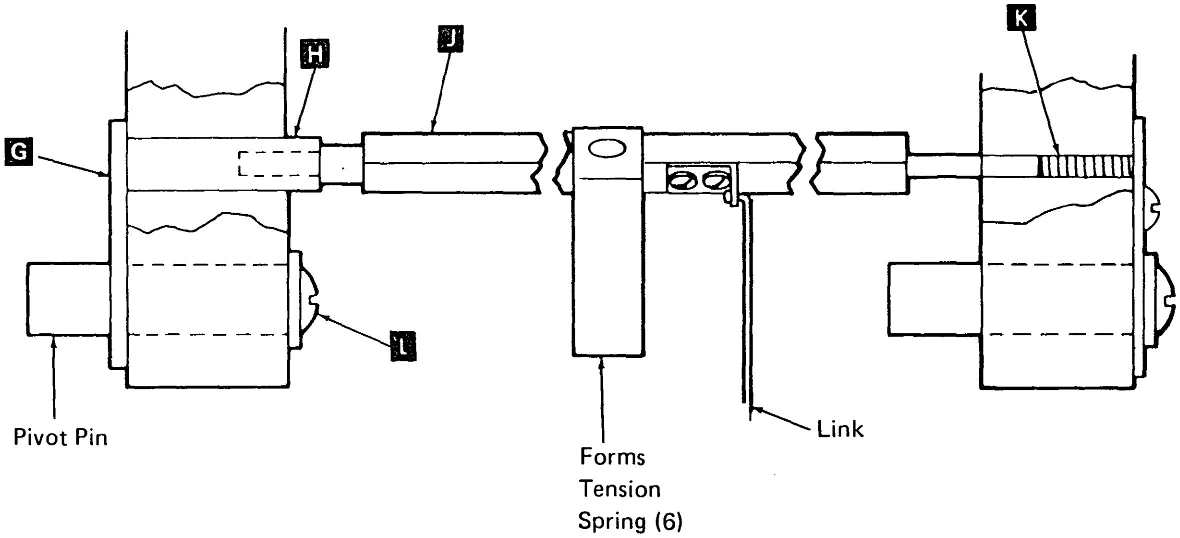
4.6.45 285 lpm Forms Tension Assembly (Continued)

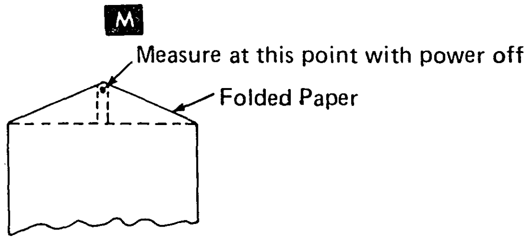
4.6.45.1. Print Units with Two Paper Clamp Engaging Levers (Continued)

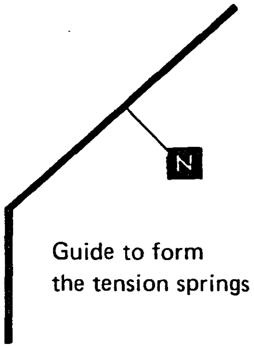
Replacement

1. Raise the clamp bar, then lower the shaft between the clamp bar and the rear forms guide.
2. Install the shaft by inserting the left end, then the right end. Push the shaft to the right. You should feel the tension from spring **K**.
3. Install bushing **H**. Install plate **G** on the left pivot pin. Hold the plate down and tighten screw **L**.
4. Install pin and lever assembly **B** in the right engaging lever **C**. Be sure the bracket **D** on the right lever operates the lever assembly **B** when the lever **C** is moved.
5. Install pin **E** in the left lever.
6. Raise both levers **C**, then replace two screws **F** in each solenoid bracket. Tighten cable clamps if loosened.
7. Install the link on the shaft, then attach clip **A** on lever **B**. Attach the spring to the right end of the clamp bar.
8. Do the forms tension service check steps 5, 6, and 7. Adjust if needed.
9. Do the lower paper clamp service check (4.6.44). If adjustment is needed, do adjustment steps 8 through 18.
10. Install the print unit (4.6.10) and printer covers.









4.6.45 285 lpm Forms Tension Assembly (Continued)

4.6.45.2 Print Units with One Paper Clamp Engaging Lever C

Note: The lever and guide plate for the lower paper clamp affect the forms tension. See 4.6.44, *Adjustment,* step 4.

Service Check

1. Power down.
2. Remove the printer covers (4.6.1) and forms.
3. Remove the print unit assembly (4.6.10).
4. Load about 35 inches (900 mm) of single-part forms that are wide enough to contact all six tension springs.
5. Operate the tension springs against the forms by lifting the lever C until the assembly locks.

   Note: Hold lever up by inserting folded paper or other supporting material between the lever and the printer base.
6. Check for 100 to 125 grams tension M while pulling the forms upward.

   Note: With the print unit installed, the maximum tension is 250 grams.
7. If the tension is not OK, do the adjustment.

Adjustment

1. Operate the tension springs against the forms by lifting the lever C until the assembly locks. Check that all tension springs touch the lower forms guide at the same time. Form each spring N as needed.
2. Unhook the clevis A and turn it on the link to adjust the tension. Hook the clevis.
3. Repeat the service check, steps 5, 6, and 7.
4. Install the print unit assembly (4.6.10).
5. Install the rear forms guide and covers.

Removal

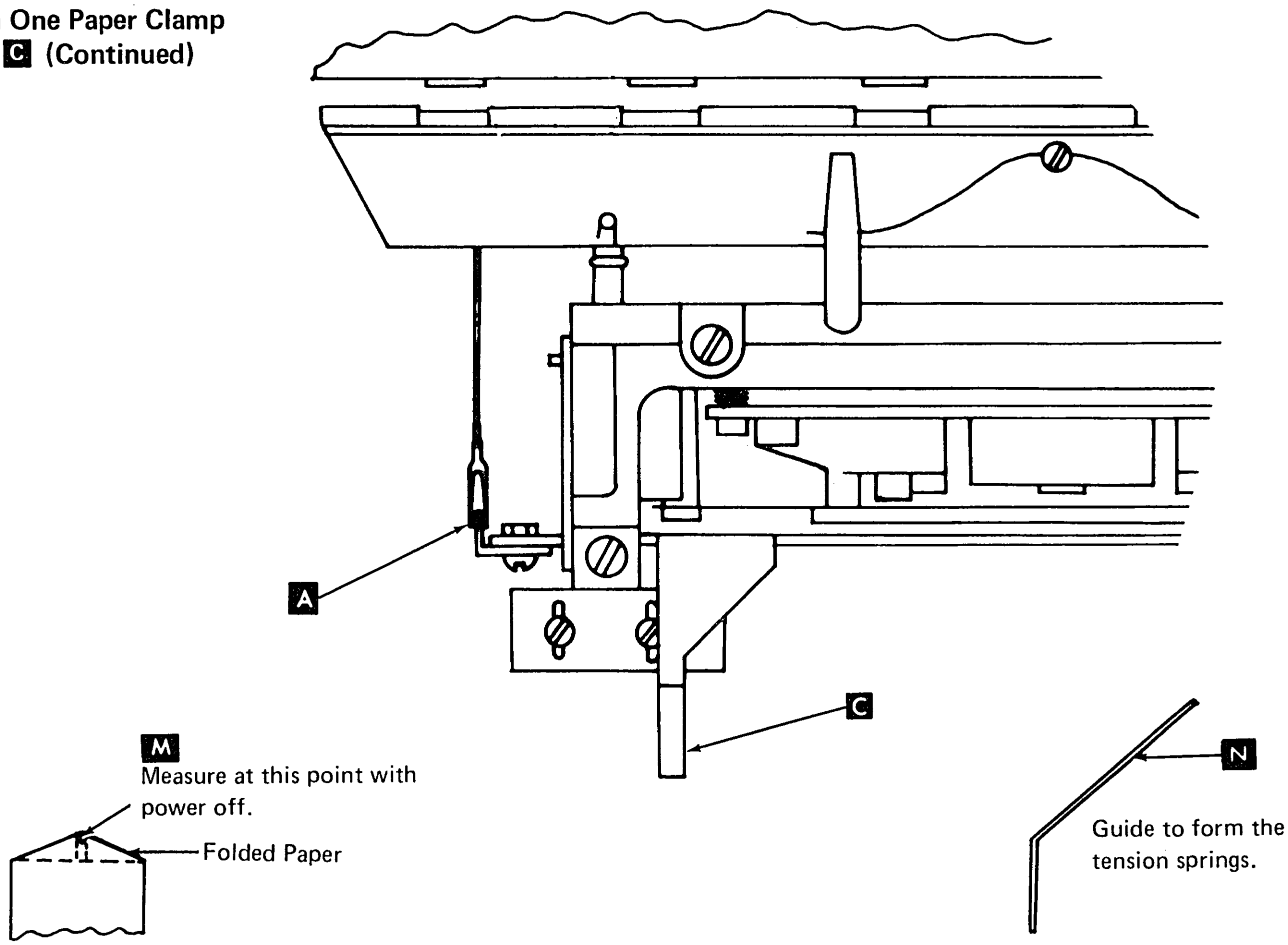
1. Power down.
2. Remove the printer covers (4.6.1) and forms.
3. Remove the print unit (4.6.10).
4. Remove the lower paper clamp assembly (4.6.44.3).
5. Loosen screw L , then remove retainer plate G .
6. Rotate the forms tension shaft J forward and slide the shaft to the left until the right end is clear of the right pivot. Remove the bushing H from the left end.
7. Lift the right end of the shaft up and to the right until clear of the left pivot.

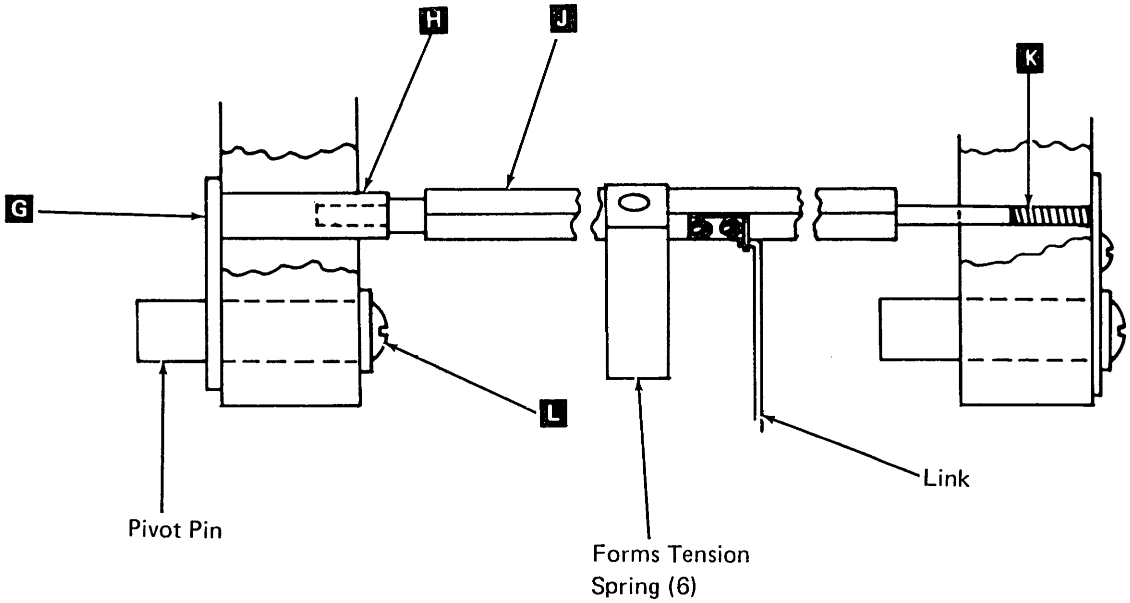
Replacement

1. Install the shaft by inserting the left end, then the right end. Push the shaft to the right. You should feel the tension from the spring K .
2. Replace the bushing H on the shaft. Install plate G on the left pivot pin. Hold the plate down and tighten screw L .
3. Replace the lower paper clamp assembly (4.6.44.3).
4. Do the lower paper clamp service check and adjust if needed (4.6.44.2).
5. Do forms tension service check (4.6.45) and adjust, if needed.
6. Remove the support material from under the engaging lever. Install the print unit (4.6.10) and the covers (4.6.1).

4.6.45 285 lpm Forms Tension Assembly (Continued)

4.6.45.2 Print Units With One Paper Clamp Engaging Lever **C** (Continued)





4.6.46 Forms Jam Detection Device

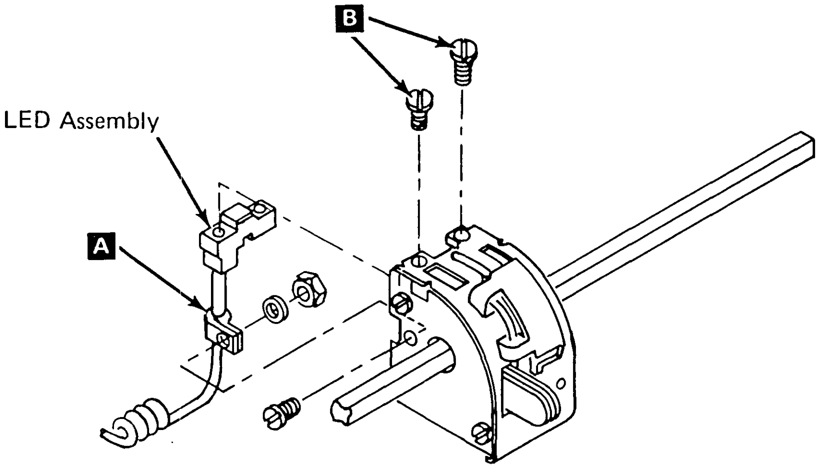
The forms jam detection device consists of a light emitting diode (LED) assembly installed in the left tractor. The device indicates forms jams by sensing the movement of margin holes.

Removal

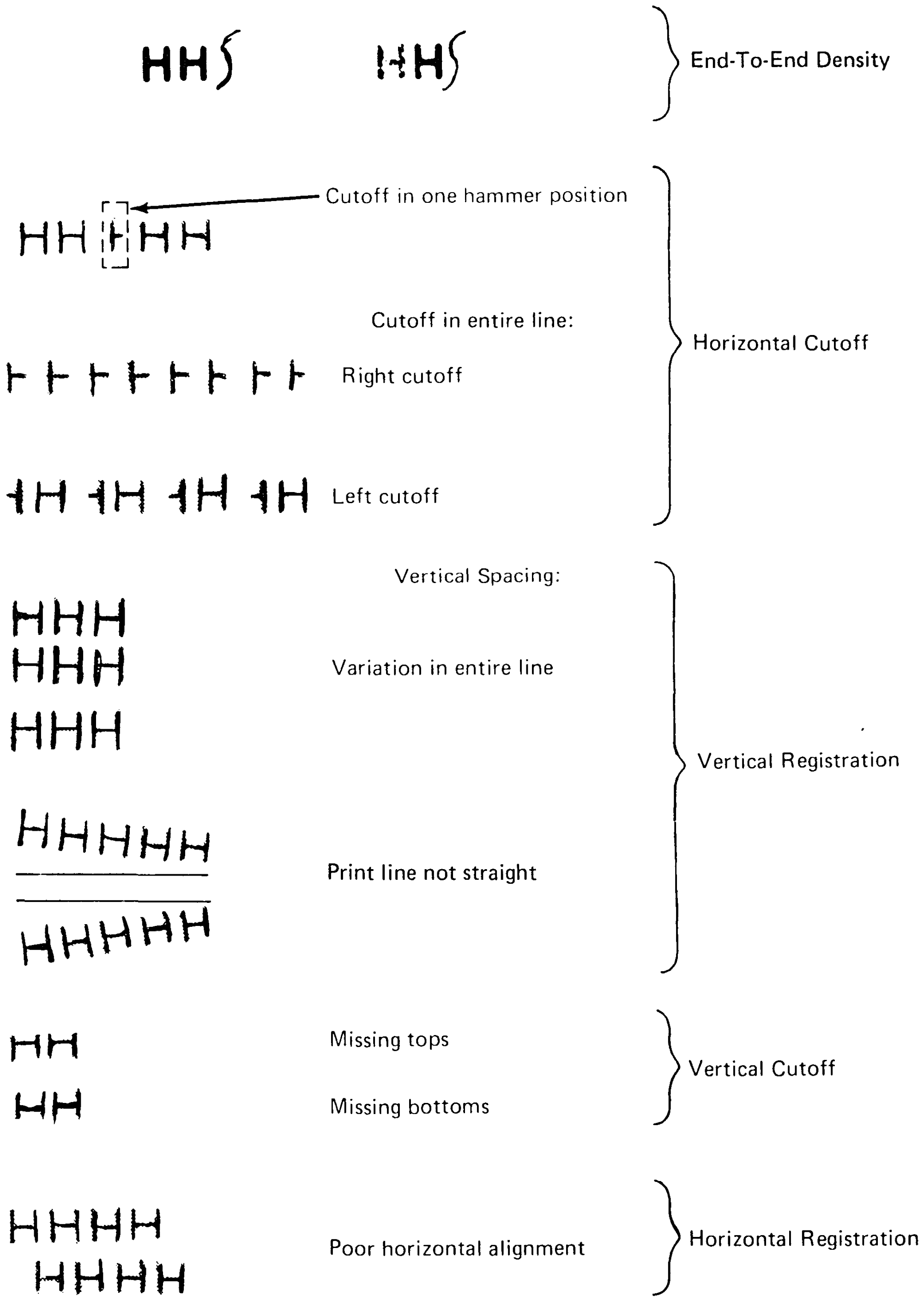
1. Unplug the forms jam plug (P9) and remove the cable clamp **A**.
2. Raise the upper paper clamp, move the tractor toward the center of the printer, remove two back screws **B**, and the LED assembly.

Replacement

Replace in reverse order of removal.



4.6.47 Examples of Incorrect Printing (285 lpm)



4.6.48 Lower Forms Guide To Hammer Bar Adjustment

Notes:

1. This guide does not normally need adjusting. Be sure other related adjustments, such as platen gap, lower paper clamp, and forms tension springs are checked first.
2. Obtain special gauge IBM P/N 1794549 (office tool) before doing this adjustment.

Service Check

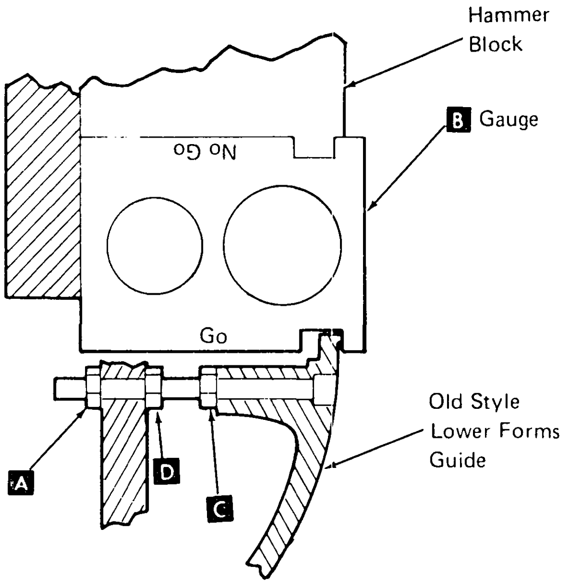
1. Open the printer cover and the print unit.
2. Remove the front paper guide from around the hammers.
3. Check the left end of the lower forms guide by holding the gauge **B** against the left hammer block and the hammer mounting bar as shown, then check for the *go* and *no-go* conditions.
4. Move the gauge to the right end of the hammer block and check the right end of the lower forms guide.

   Note: If the *go* and *no-go* conditions are correct at both ends of the hammers, the lower forms guide is adjusted correctly.
   If correct, go to step 5 under the adjustment.

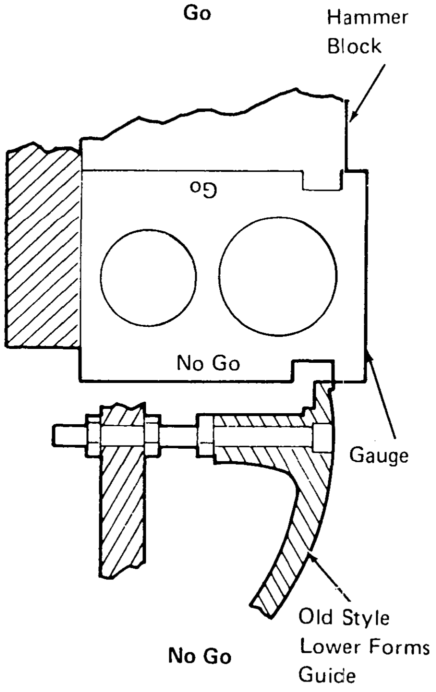
Adjustment of Old Style

1. Be sure nut **C** is tight.
2. Loosen nut **D**, then with fingers, turn nut **A** a small amount.

   Note: Turning nut **A** clockwise moves the guide toward the front.
3. Tighten nut **D**, then check the *go* and *no-go* conditions at both ends.
4. If the adjustment is changed, do the lower paper clamp service check (4.6.44).
5. Replace the front paper guide. Close the print unit and cover.



Go



No Go

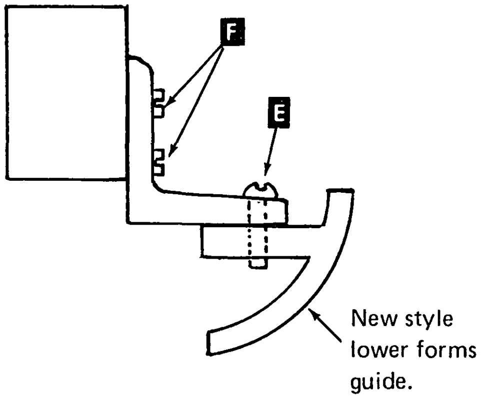
Adjustment of New Style

1. Loosen the two allenhead screws **F**.
2. Using the gauge **B** at each end of the hammer block, position the lower forms guide.
3. Tighten the two allenhead screws **F**.
4. Check again with the gauge **B**.

   CAUTION
   If the four screws **E** are loosened, it is necessary to adjust the lower paper guide to hammer clearance (4.6.49).
5. If the positioning is correct, replace the front paper guide. Close the print unit and the cover.

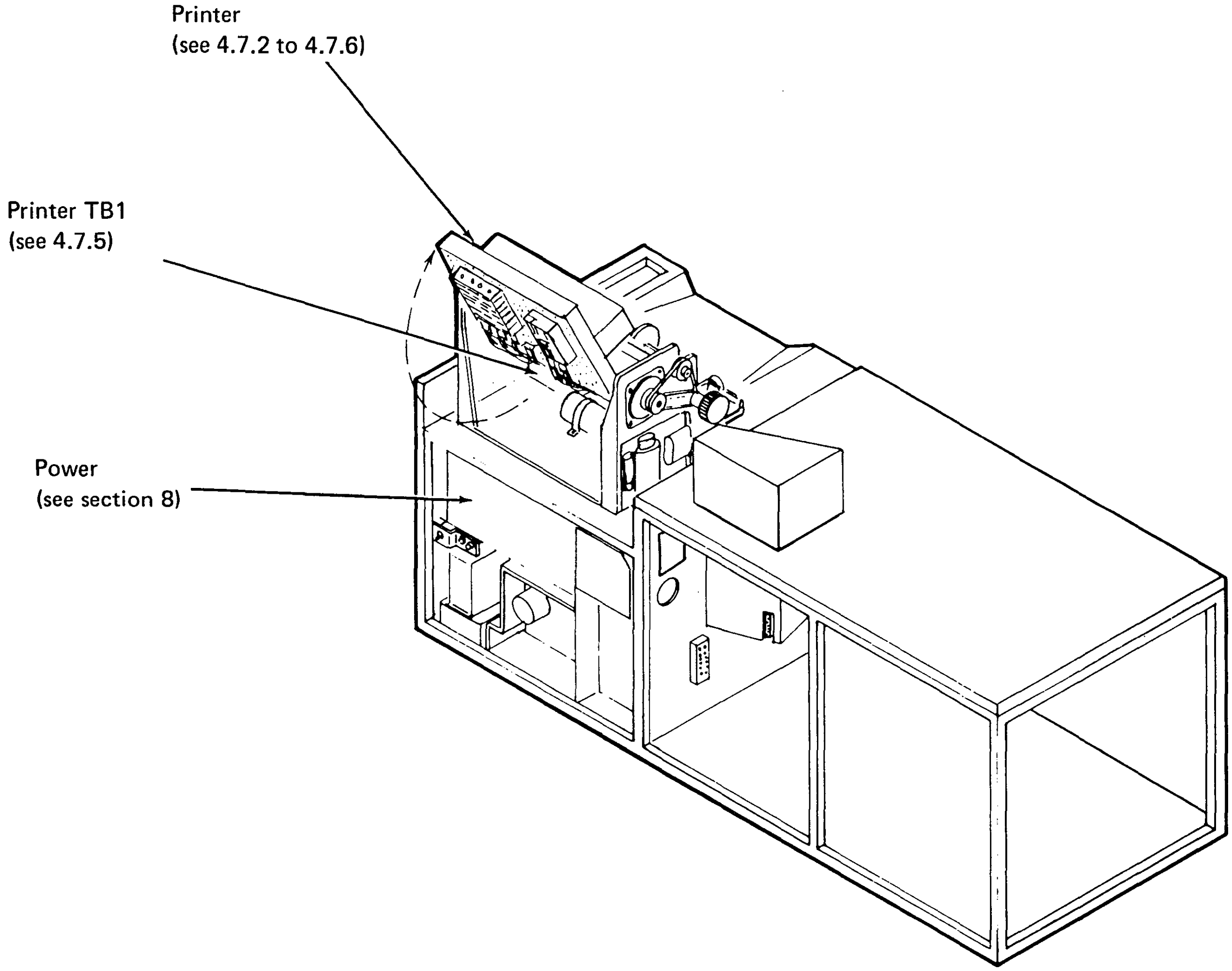
4.6.49 Lower Paper Guide To Hammer Clearance

1. Open the printer cover and remove the print unit (4.6.10).
2. Measure the clearance between the lower paper guide and the lowest hammer. The clearance should be 0.005 inch ± 0.002 inch.
3. If adjustment is necessary, remove the front paper guide.
4. Loosen the four screws **E**, and position the lower paper guide for a clearance of 0.005 inch ± 0.002 inch.
5. Reinstall all removed parts.

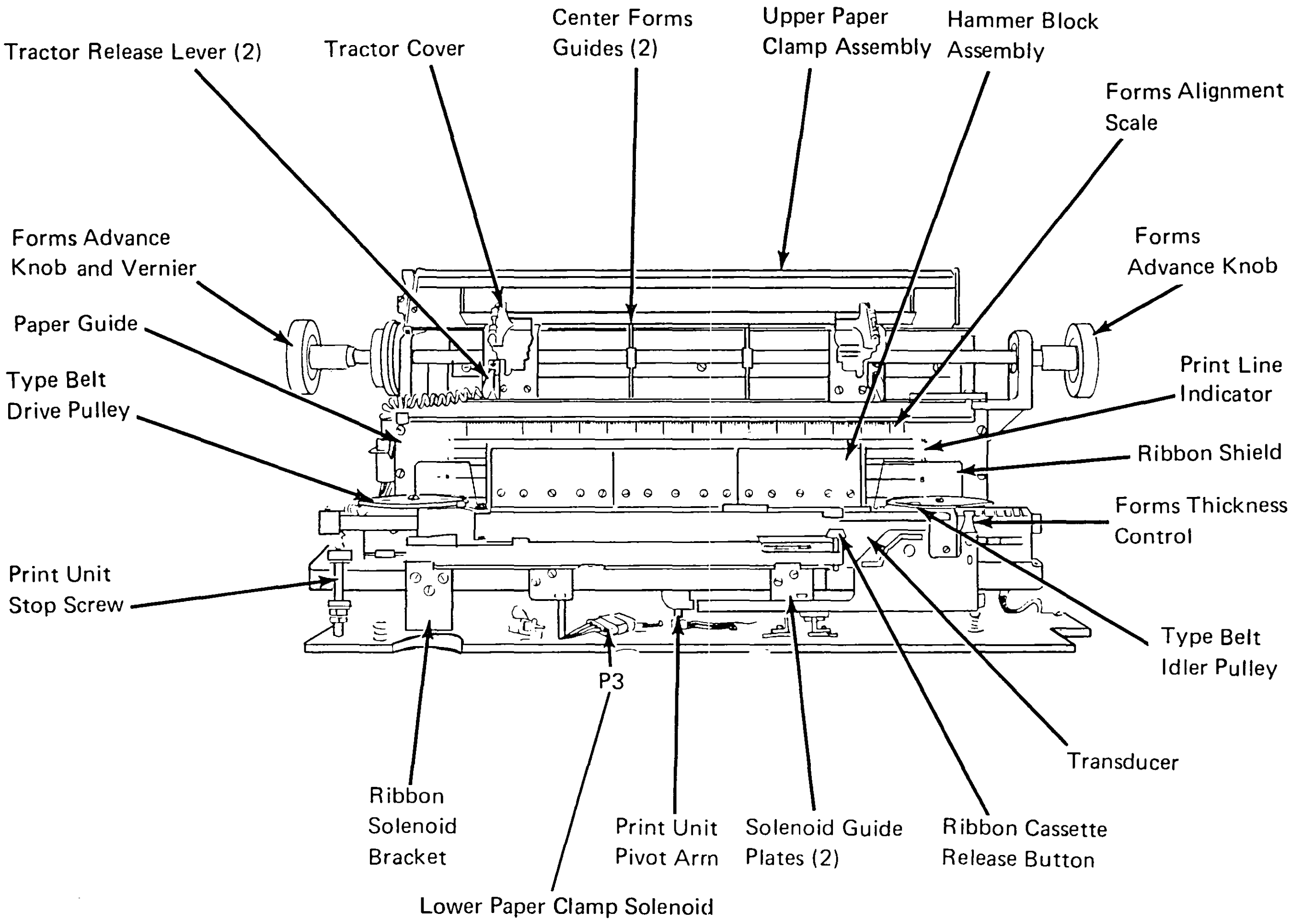


4.7.0 LOCATIONS (285 lpm)

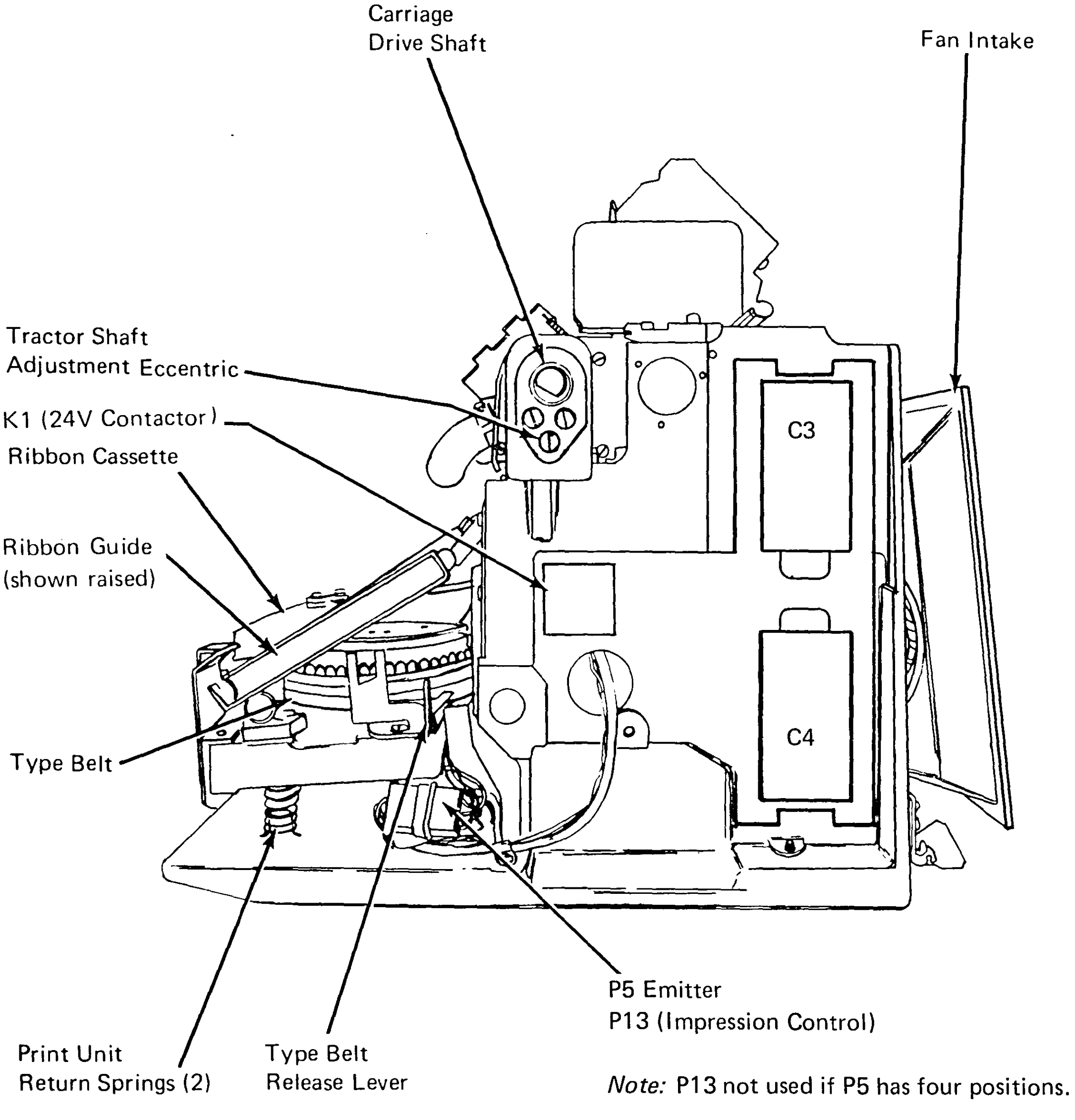
4.7.1 Back View



4.7.2 Front View

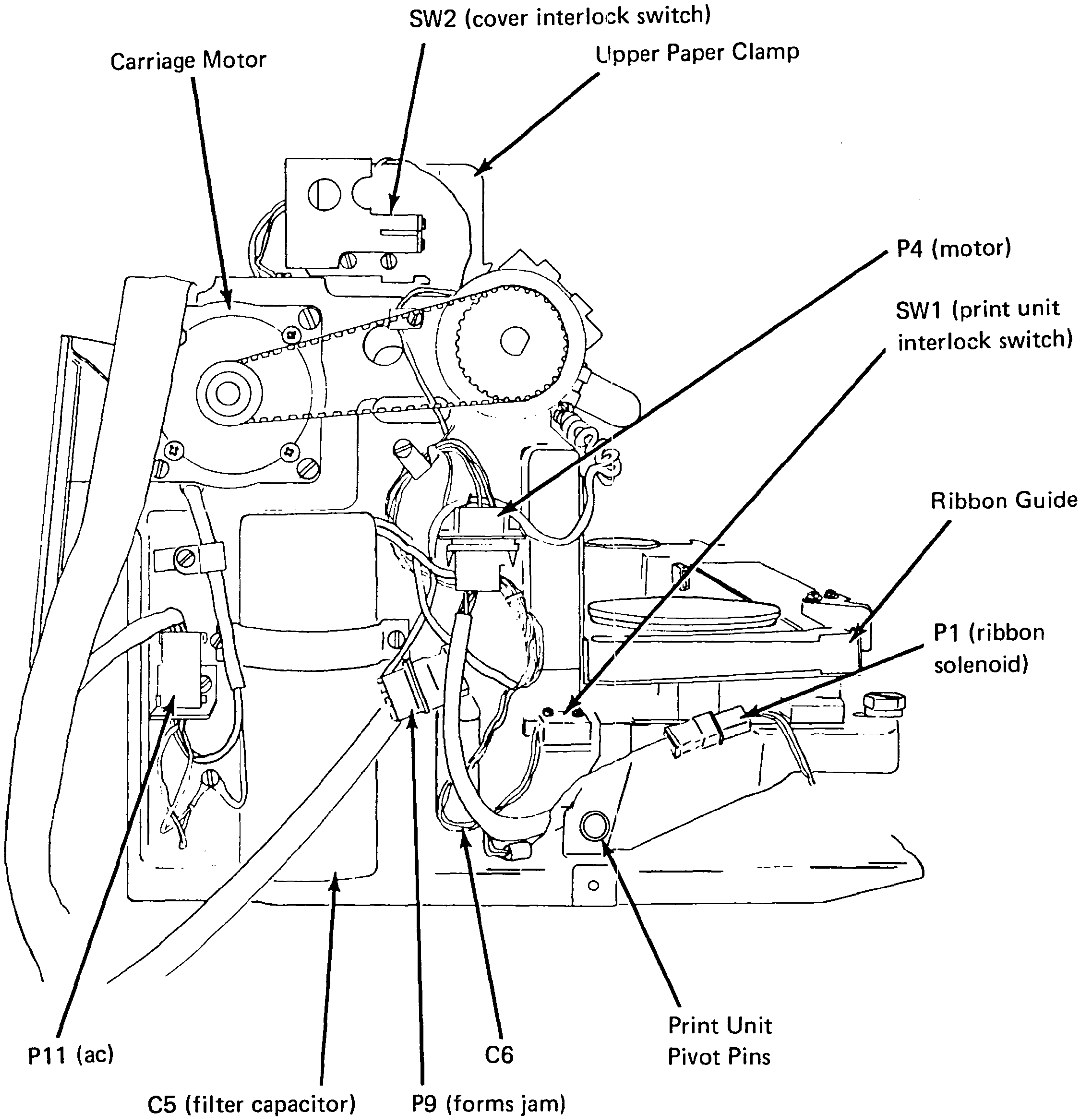


4.7.3 Right Side

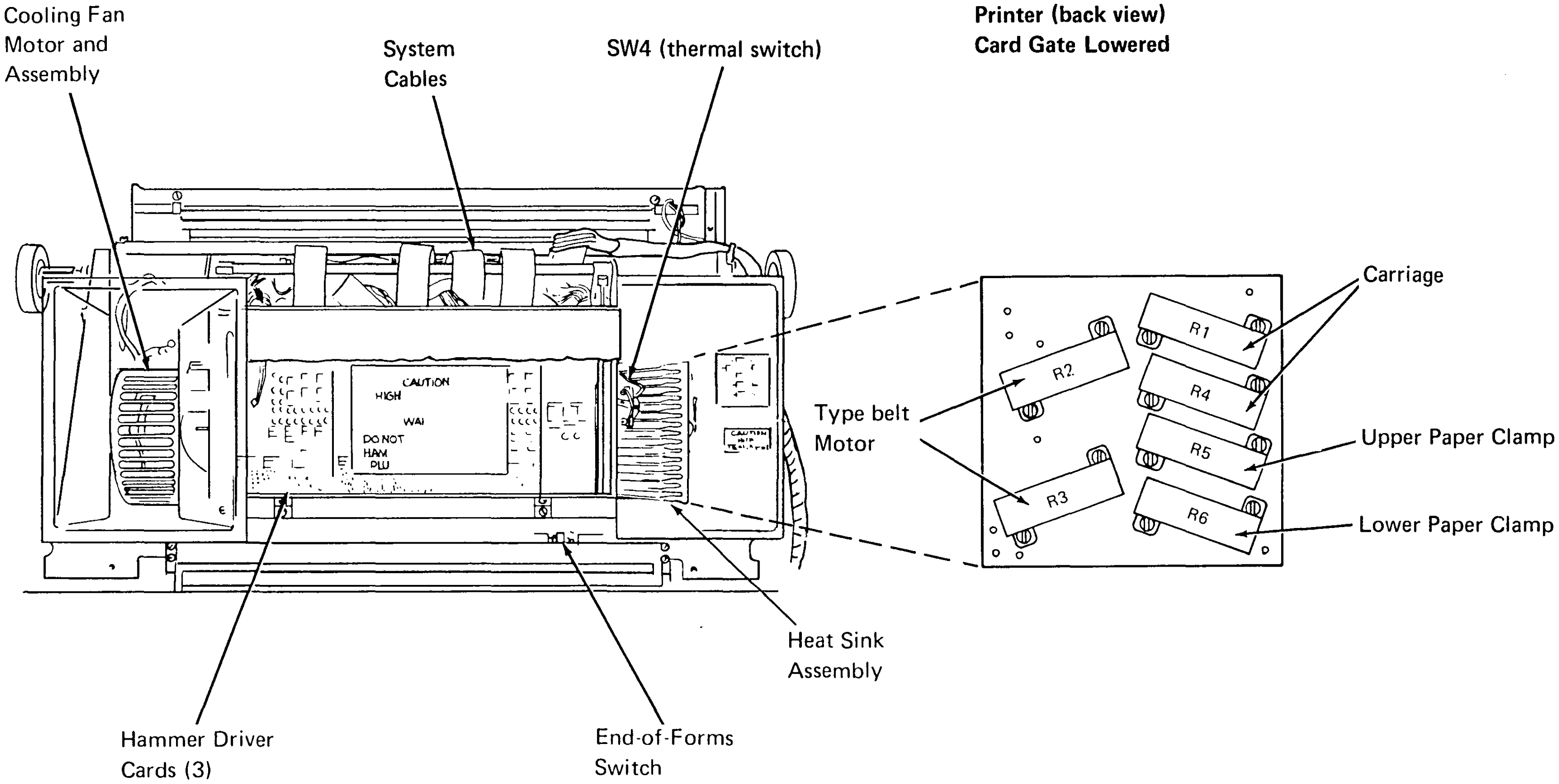


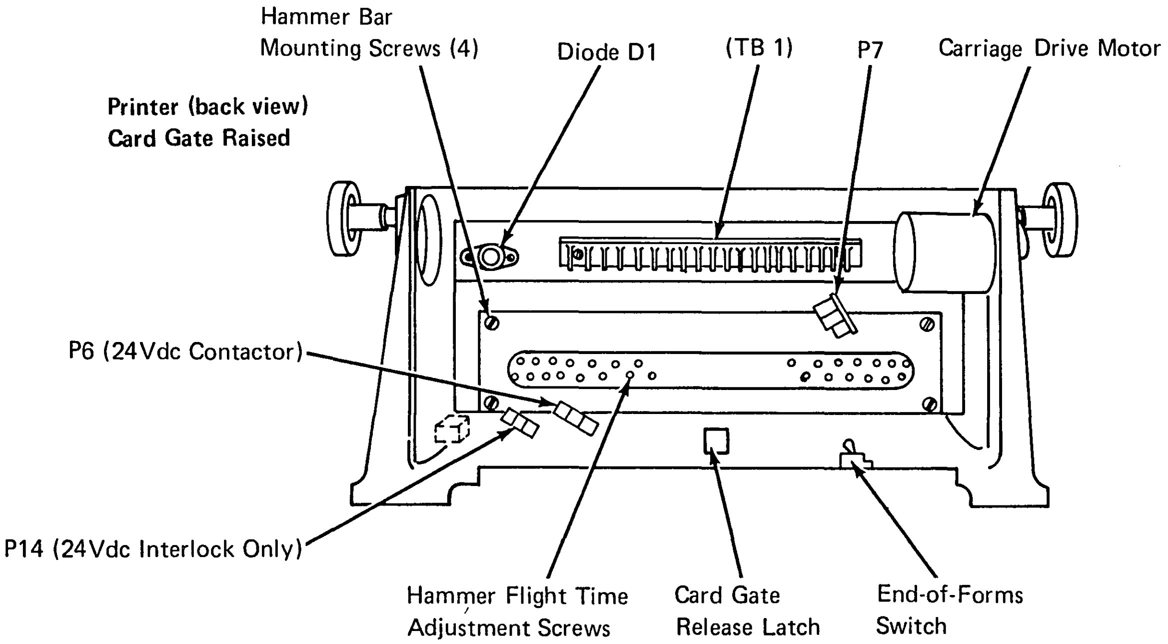
Note: P13 not used if P5 has four positions.

4.7.4 Left Side

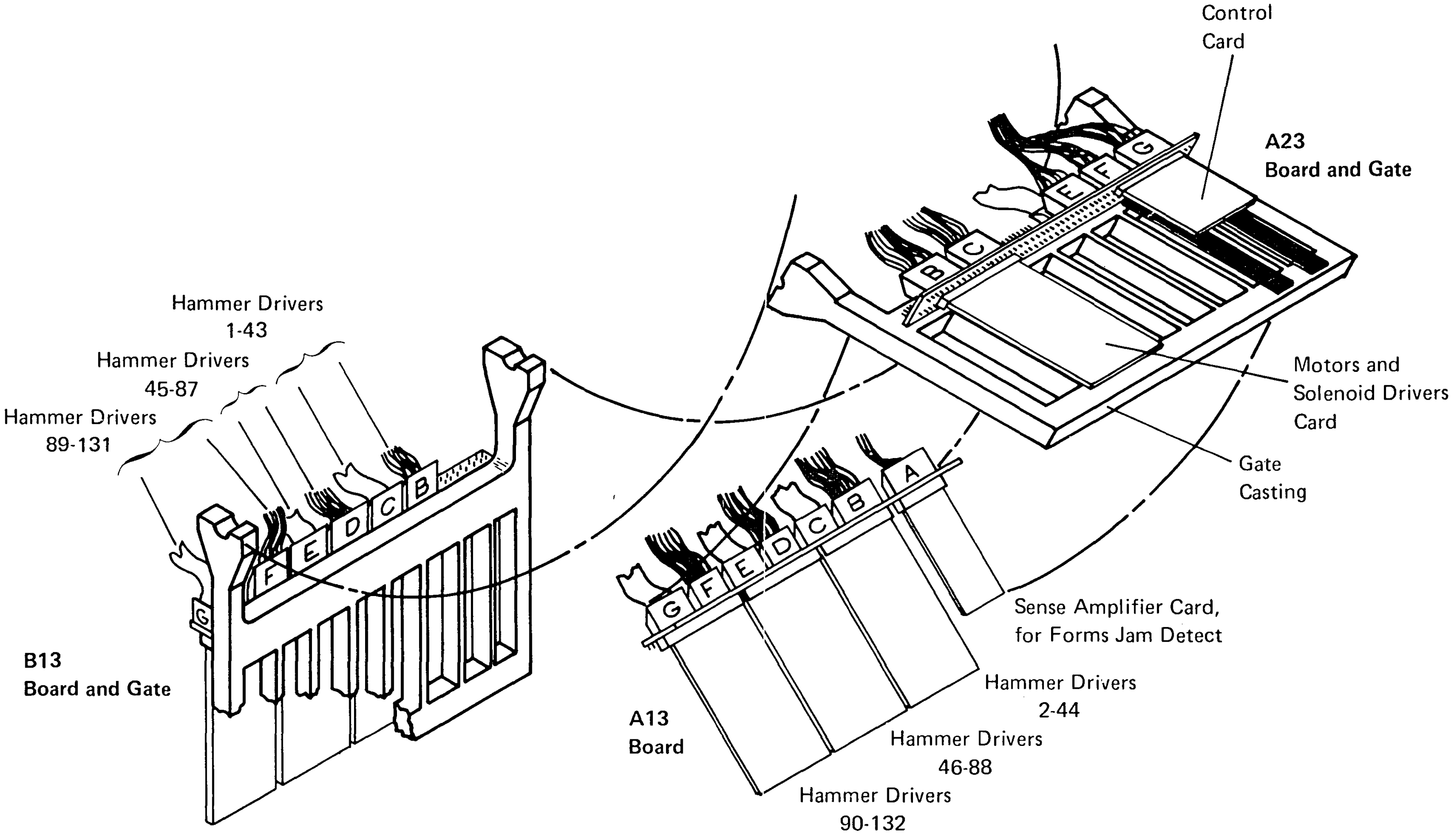


4.7.5 Card Gate (285 lpm)

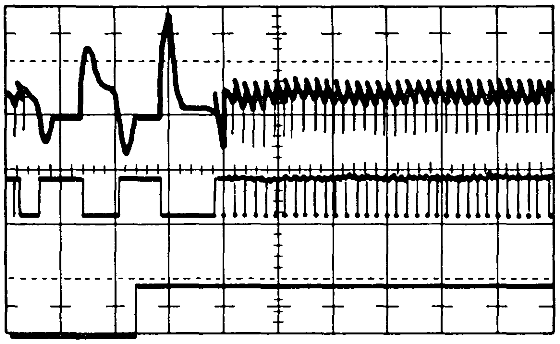

Printer (back view)
Card Gate Lowered


Printer (back view)
Card Gate Raised

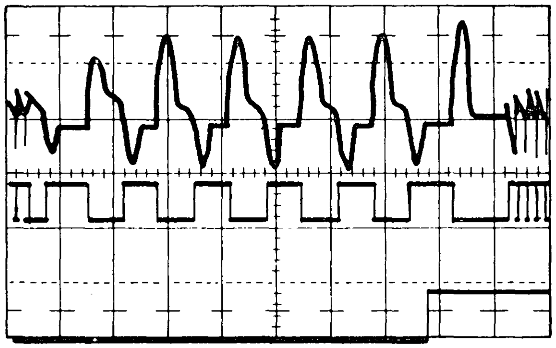
4.7.6 Card and I/O Cables (285 lpm)



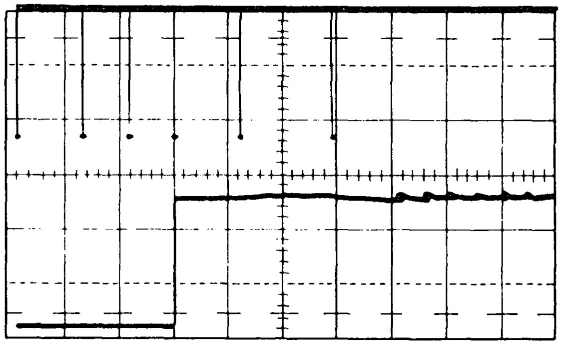
4.8.0 OSCILLOSCOPE FIGURES (285 lpm)



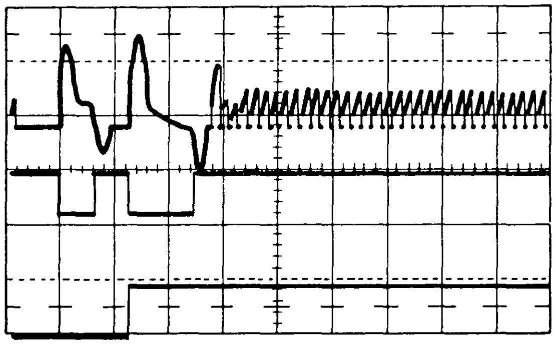
Carriage Motor Drive Pulse
One line space operation, detent on phase
Horizontal 5 ms/div
Vertical top trace 50V/div
Middle and bottom trace 5V/div
Top trace — Carriage Motor Phase A (P7-1 or A23B42)
Middle trace — Input to driver card (A23B50)
Bottom trace — Carriage go (A23G63)
Sync negative on carriage go



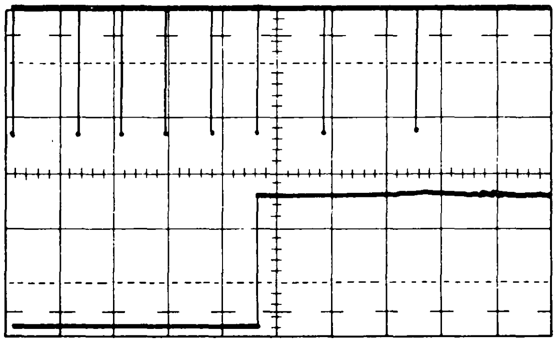
Carriage Motor Drive Pulse
Three line space operation
Horizontal 5 ms/div
Vertical top trace 50V/div
Middle and bottom trace 5V/div
Top trace — Carriage Motor Phase A (P7-1 or A23B42)
Middle trace — Input to driver card (A23B50)
Bottom trace — Carriage go (A23G63)
Sync negative on carriage go



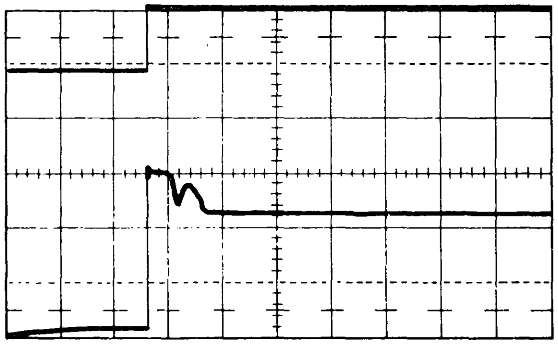
Carriage Advance Pulses
Eight lines/inch
Horizontal 2 ms/div
Vertical 2V/div
Top trace — Carriage Advance Pulses (A23G46)
Bottom trace — Carriage go (A23G63)
Sync negative on carriage go



Carriage Motor Drive Pulse
One line space operation, detent off phase
Horizontal 5 ms/div
Vertical top trace 50V/div
Middle and bottom trace 5V/div
Top trace — Carriage Motor Phase Not B (P7-4 or A23B45)
Middle trace — Input to driver card (A23B50)
Bottom trace — Carriage go (A23G63)
Sync negative on carriage go

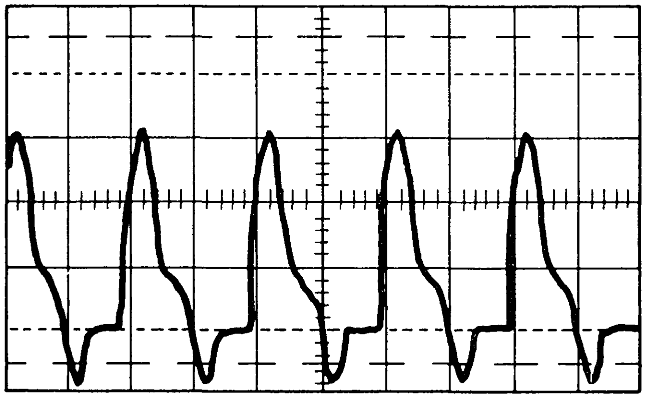


Carriage Advance Pulses
Six lines/inch
Horizontal 2 ms/div
Vertical 2V/div
Top trace — Carriage Advance Pulses (A23G46)
Bottom trace — Carriage go (A23G63)
Sync negative on carriage go

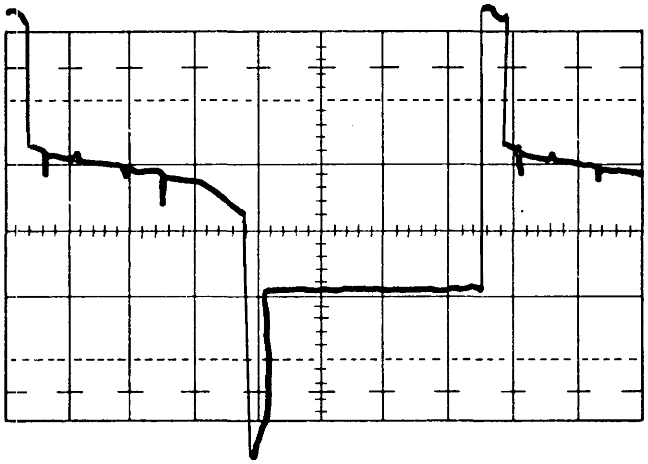


Hammer Fire Pulse
Horizontal 5 ms/div
Vertical 5V/div
Top trace — Input to hammer driver card
Bottom trace — Fire hammer pulse to hammer coil
Sync internal on fire hammer pulse

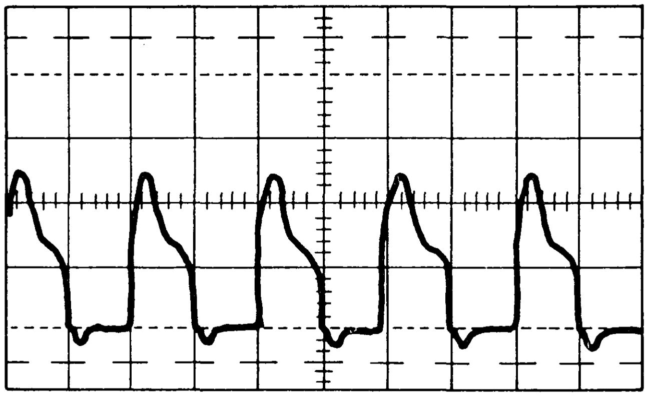
4.8.0 285 lpm OSCILLOSCOPE FIGURES (Continued)



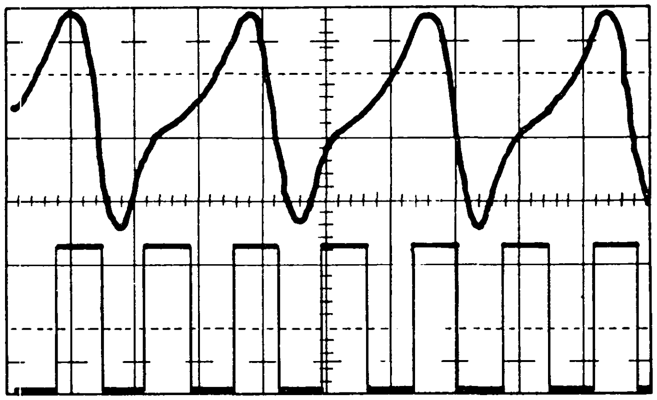
Good Belt Motor Drive Pulse
Horizontal 2 ms/div
Vertical 20V/div
Channel 1 Belt Motor Phase A
(P4-1 or A23C42)



Bad Belt Motor Drive Pulse
Phase capacitor removed
Horizontal 500 μs./div
Vertical 20V/div
Channel 1 Belt Motor Phase A
(P4-1 or A23C42)



Bad Belt Motor Drive Pulse
High load
Horizontal 2 ms/div
Vertical 20V/div
Channel 1 Belt Motor Phase A
(P4-1 or A23C42)



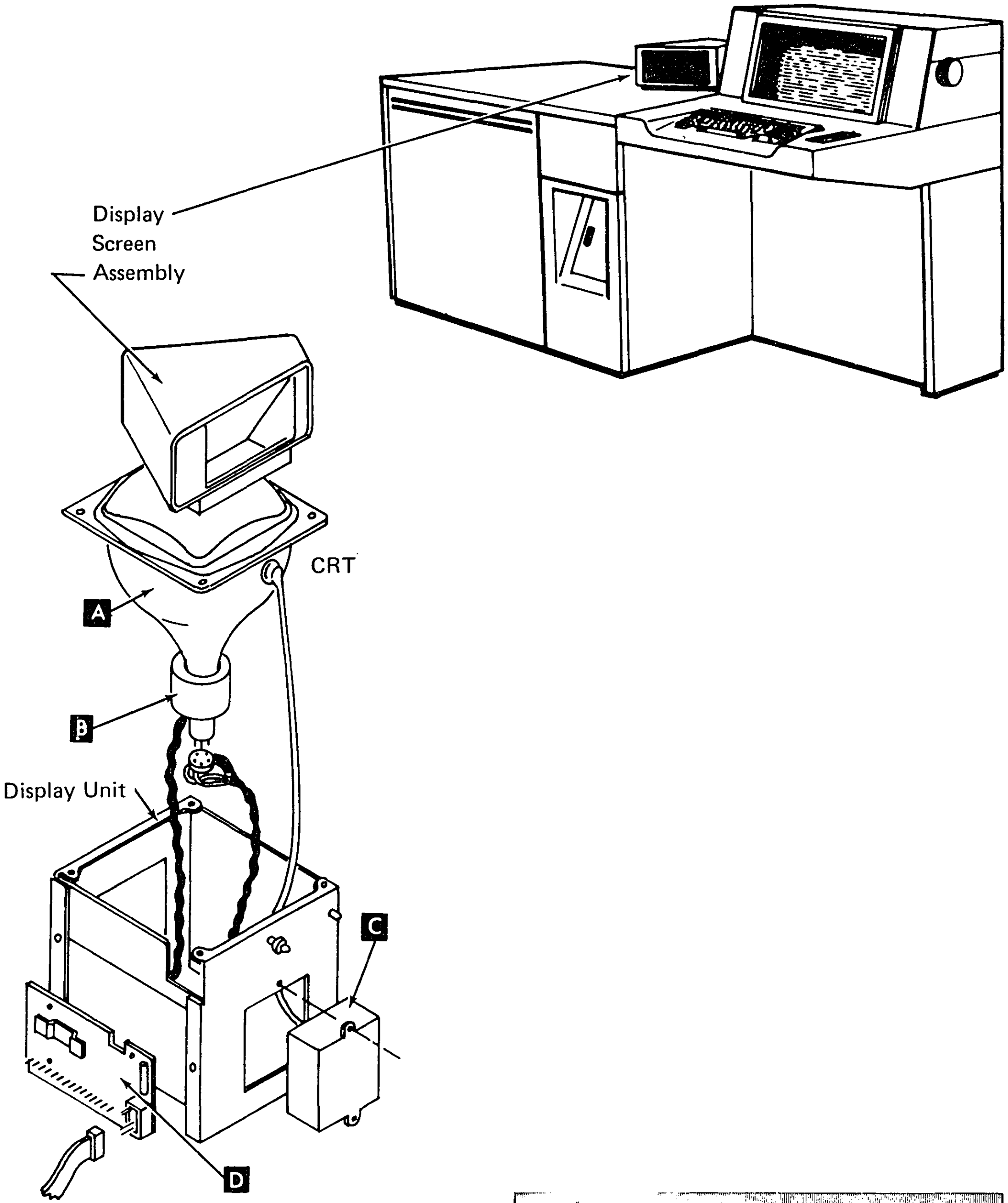
Emitter Pulse
Horizontal 500 μs./div
Vertical Top trace .5V/div
Bottom trace .2V/div
Channel 1 Emitter Pulse
Positive input (A23F44)
Negative input (A23F42)
Do not ground either lead.
1100 mV minimum peak-to-peak
Channel 2 Print Subscans (A23F47)

5.0.0 Display Unit

5.1.0 THEORY

The display unit gives the operator and CE visual communication with the system. The CRT in the display unit is mounted vertically in the machine and can display six lines of data at 40 characters per line for a total of 240 characters.

The cursor is a horizontal line on the display screen, under microprogram control, that normally indicates the next character position.



5.1.1 Formation of Characters

The display PC (printed circuit) board **D** contains the amplifiers and drivers to generate, accelerate, deflect, and intensify the beam in the CRT **A** .

The display attachment synchronizes the amplifiers and drivers so that the character is displayed on the display screen.

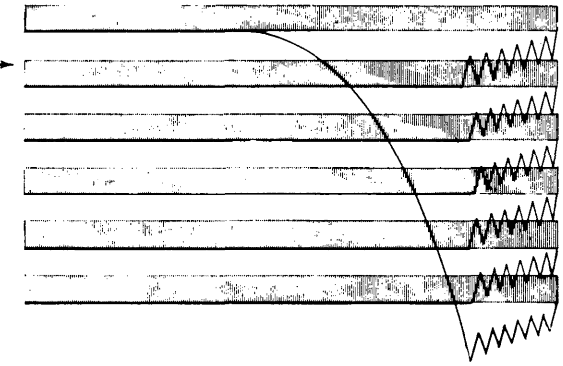
The electron beam, created by the cathode and the high voltage converter **C** is deflected by a yoke **B** assembly. The yoke contains four separate coils:

1. The vertical coil deflects the beam sequentially to the six display lines.

2 and 3 Two horizontal coils (master and slave) deflect the beam across the CRT on the line selected by the vertical coil.

4. The character coil deflects the beam up and down over the height of the character as the beam moves across the screen.

The beam pattern formed on the screen by the four coils is called a raster.



Characters appear on the display screen when the attachment sends video (dot) pulses synchronized with the movement of the electron beam to the display unit. These pulses are applied to the cathode and intensify dots on the screen to form characters.

5.2.0 FUNCTIONAL CIRCUITS

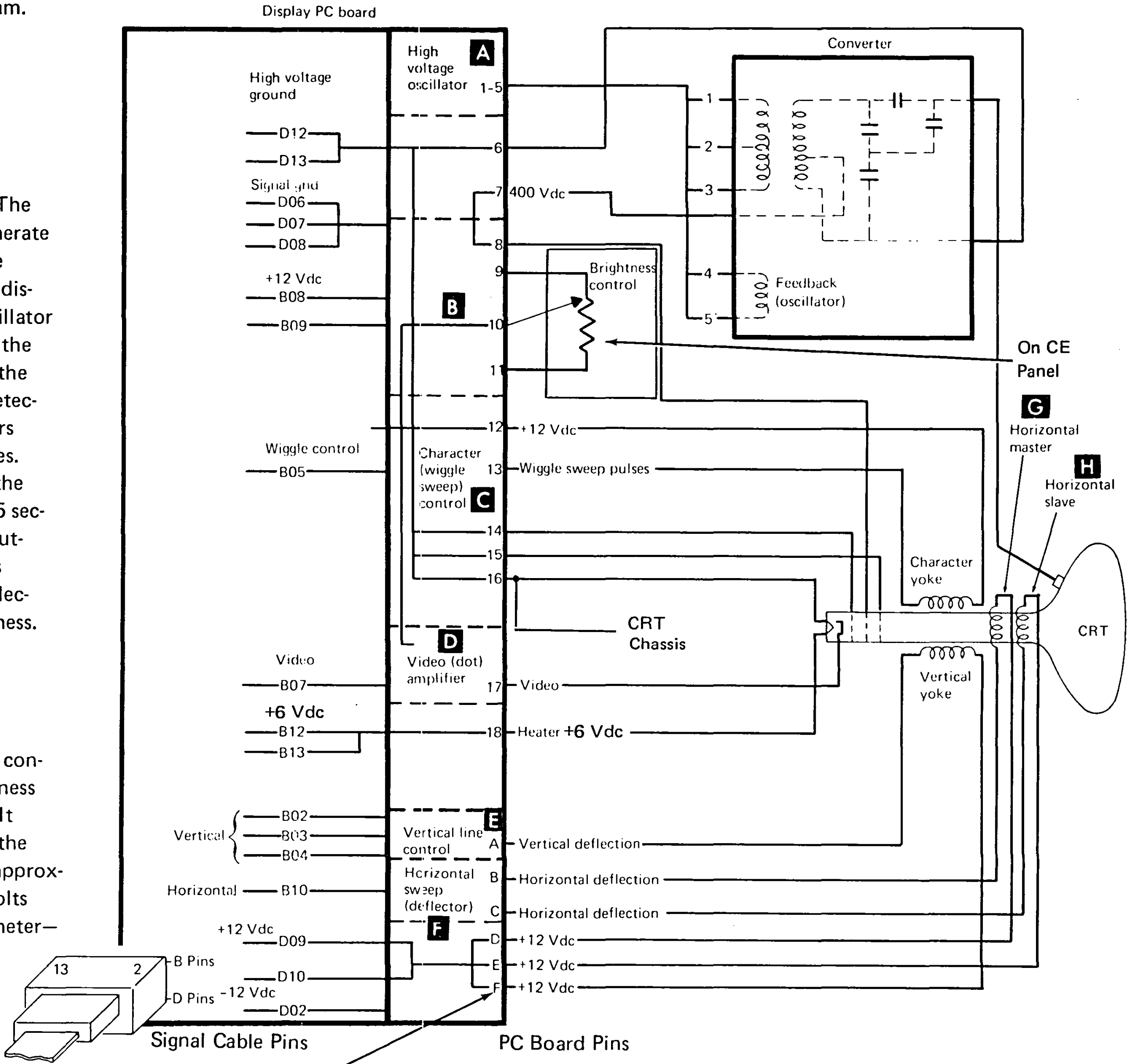
Circuits on the display PC board generate, accelerate, deflect, and intensify the electron beam. These circuits are described in the following paragraphs.

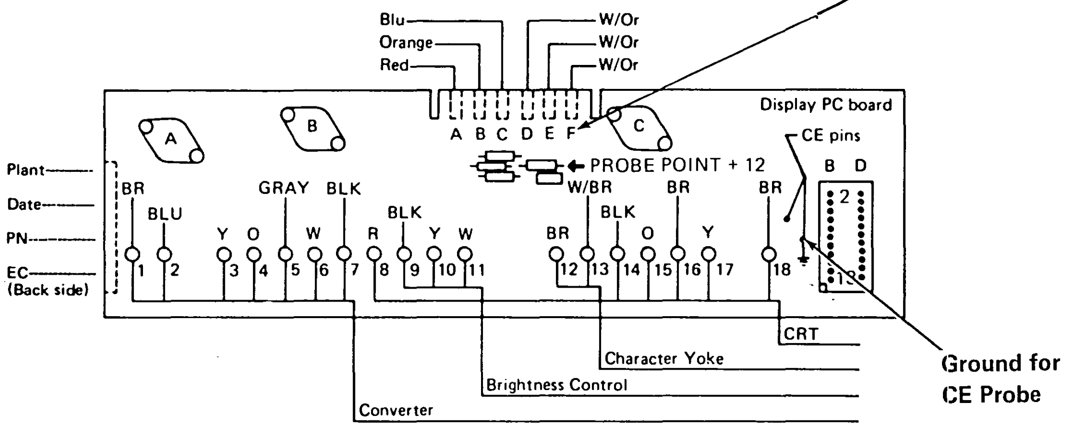
5.2.1 High Voltage Oscillator **A**

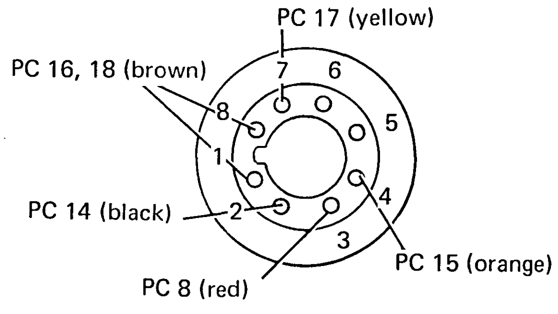
The high voltage oscillator is free running. The oscillator and the high voltage converter generate the 400-volt and 12,000-volt levels from the 12-volt supply. A time delay circuit on the display PC board prevents the high voltage oscillator starting for approximately 15 seconds after the machine is truned on to prevent damage to the CRT during filament warmup. A current detecting circuit on the display PC board monitors the high voltage oscillator current at all times. If the oscillator current exceeds the limits, the oscillator is turned off for approximately 15 seconds. The high voltage converter has two outputs; one output is 12,000 Vdc, the other is 400 Vdc. The 12,000 volts accelerate the electron beam; the 400 volts control the brightness.

5.2.2 Brightness Control **B**

The brightness control is located on the CE control panel. The center tap voltage of brightness control is fed to the video (dot) amplifier. It controls the bias voltage on the cathode of the CRT. The bias voltage can be varied from approximately +30 volts to approximately +120 volts by turning the brightness control potentiometer—the lower the voltage, the greater the light intensity on the CRT.







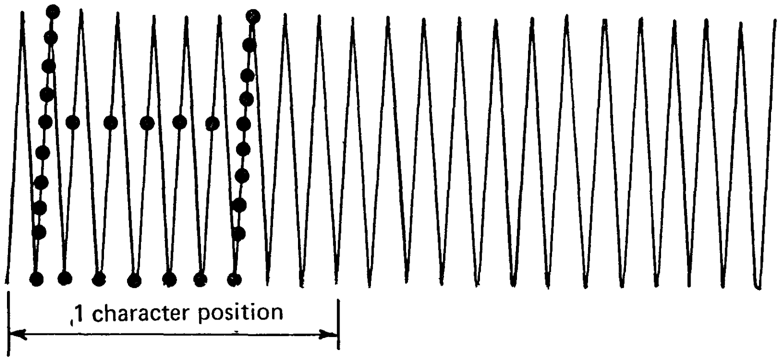
CRT Socket

5.2.3 Video Dot Amplifier

The video (dot) amplifier **D** amplifies the video pulses sent by the attachment. When a dot is indicated on the CRT, the attachment issues a negative signal for 444 nanoseconds to the video (dot) amplifier. The negative pulse is amplified and sent to the cathode of the CRT. The negative pulse forces the positive bias on the cathode to a negative level, sending the electron beam to the CRT. The attachment holds the video line at a positive level during horizontal retrace to block out video.

5.2.4 Wiggle Sweep Circuit

A wiggle sweep circuit **C** controls the height of the characters on the display screen. The attachment controls the duration of each wiggle sweep cycle. The electron beam is deflected (by the character coil) upward and downward 10 times for each character displayed. Wiggle sweep pulses and video pulses are synchronized by the attachment to form the characters. The dot pattern for an H and the cursor is shown in the following diagram.



5.2.5 Horizontal Deflection Control

Horizontal sweep **F** (deflection) of the electron beam is accomplished by two horizontal coils (master **G** and slave **H**). These deflection coils work together in a push/pull fashion as follows.

Assume the initial location of the electron beam is at the extreme left side of the CRT.

1. The attachment sends a minus (-) horizontal pulse to the display PC board.

2. The horizontal deflection amplifier increases the current to the master coil and decreases the current to the slave coil. When the current in the two coils is approximately equal, the electron beam is in the center of the CRT. When the master coil is maximum, the slave coil current is minimum and the electron beam is on the extreme right side of the CRT.

3. The attachment now sends a plus (+) horizontal pulse to the display PC board (retrace command).

4. The horizontal deflectiom amplifier decreases the master coil current and increases the slave coil current. When the slave coil current is maximum and the master coil current is minimum, the electron beam is at the extreme left side of the CRT screen.

The total time to trace one horizontal line and return the electron beam to the left (retrace) is approximately 4 ms. Therefore, the time required to trace or display six lines is approximately 24 ms.

5.2.6 Vertical Line Control **E**

The vertical line control controls the vertical location of the display line on the CRT. Three vertical input lines control the vertical location of a line. These input lines from the attachment are added by the vertical line control circuitry on the display PC board. The resulting output is sent to the vertical coil, which moves the electron beam to the specified location on the CRT. Below is a chart that identifies the status of the three signal lines for each of the six display lines on the display screen.

Display Line	Vertical Input		
	1	2	4
1	0	0	0
2	1	0	0
3	0	1	0
4	1	1	0
5	0	0	1
6	1	0	1

1 = Active
0 = Inactive

5.3.0 OPERATION

All functions except the high voltage oscillator and brightness control are directly synchronized by the attachment.

The display attachment controls the CRT circuits as described below.

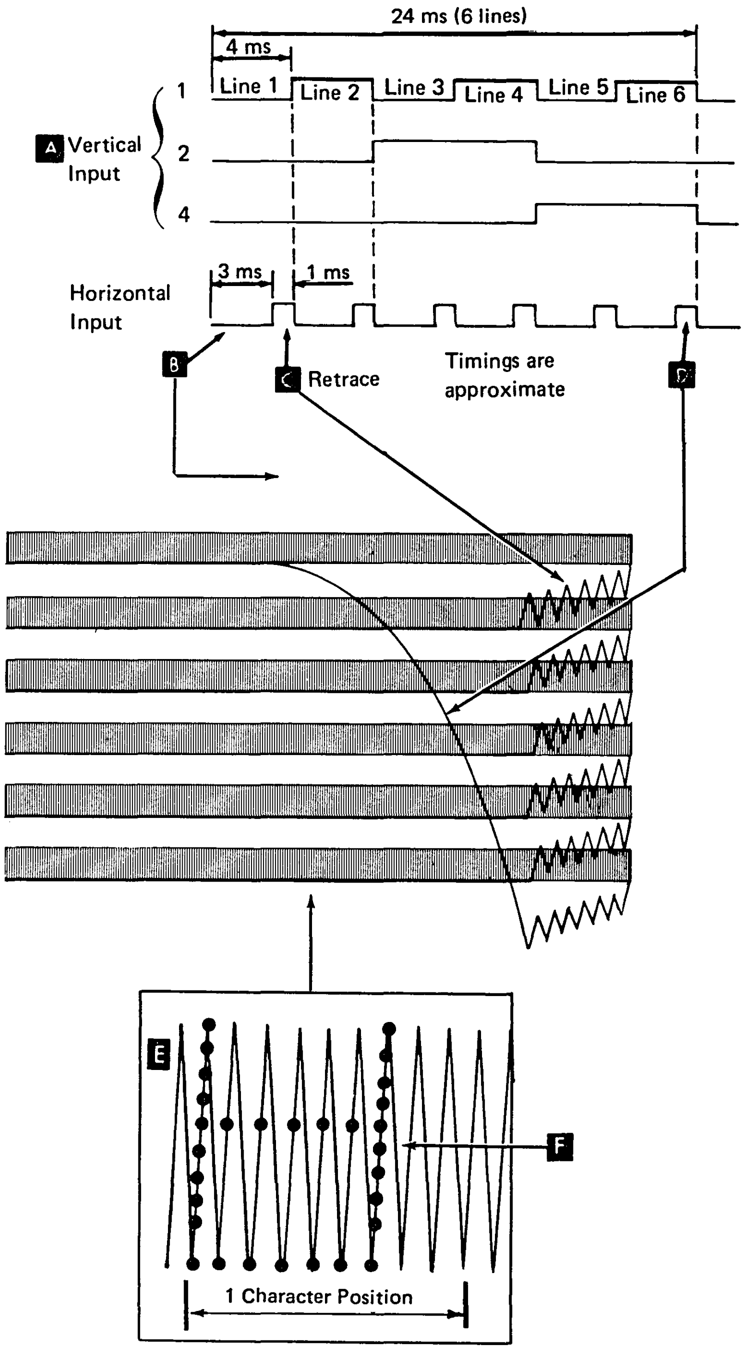
To move the electron beam vertically and horizontally across the CRT to form a continuous raster:

1. The attachment activates three vertical input lines in a continuous binary sequence to select one of the six display lines **A** .
2. The attachment activates horizontal deflection circuits that move the beam left to right across the screen **B** , then retraces **C** right to left to begin the next line **D** .
3. The attachment activates character control (wiggle sweep) pulses **E** . Ten wiggle sweep pulses are one character time. The vertical distance equals the height of the character plus the cursor. Wiggle sweep is blanked out during most of the retrace time **C** .

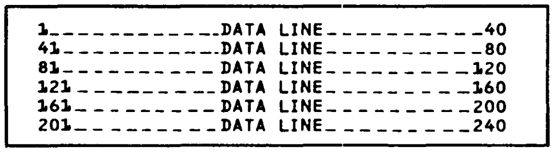
To intensify the raster with dots to form a character, the attachment activates the video line with a combination of pulses to control the video amplifier. These pulses, combined with the electron beam wiggle sweeps across the CRT, form the character **F** .

The preceding description assumes that you are looking at the display **G** . After taking the mirror off the machine, or the display unit out of the machine, the display appears upside down (line 1 at the bottom of the CRT) as shown **H** .

Display Line	Vertical Input		
	1	2	4
1	0	0	0
2	1	0	0
3	0	1	0
4	1	1	0
5	0	0	1
6	1	0	1
1	0	0	0
2	1	0	0
3	0	1	0

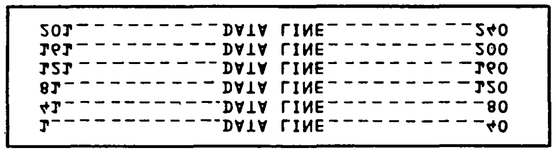


G



```
1_____________DATA LINE____________40
41____________DATA LINE____________80
81____________DATA LINE___________120
121___________DATA LINE___________160
161___________DATA LINE___________200
201___________DATA LINE___________240
```

H



5.4.0 MAINTENANCE

5.4.1 CRT Safety

DANGER
All persons handling tubes or in the vicinity of exposed CRTs under vacuum must wear safety glasses.

To ensure personal safety and the safety of coworkers, each CE should make it a practice to observe safety precautions at all times.

The CE must be especially aware of the dangerous voltages present and the potential hazard presented by an unprotected cathode ray tube (CRT); thus, the following DANGER notice appears here:

DANGER
12,000 Vdc. Exercise extreme caution when working in the area of the high-voltage power supply and CRTs. Do not remove the high-voltage lead from the CRT following power-off until the high voltage lead and anode have been grounded.

All CEs should become familiar with the general safety practices and the procedures for applying artificial respiration that are outlined in *CE Safety Practices* (Form S229-1264). In addition, each CE should review general safety CEM No. 45 on CRT safety.

Protective Equipment

Persons handling or working with or near unprotected CRTs must wear safety glasses.

Cathode Ray Tubes — Safe Handling

Cathode ray tubes contain a high vacuum and are subject to implosion. Such an implosion can propel flying glass, thus presenting a source of personal injury. Therefore, when handling CRTs, exercise extreme caution.

Transportation Handling

1. Cathode ray tubes must be enclosed when received, transported, or otherwise moved from area to area. If they are shipped in a carton, they must be in the original carton or one of equivalent strength and securely sealed to prevent accidental opening. Also, original or equivalent packing materials and/or forms must be placed inside the carton to properly support and protect the tube. If tubes are transported in a piece of equipment, the equipment must be able to contain the glass fragments if an implosion occurs.

2. Each CRT carton must be identified with a *DANGER Cathode Ray Tube Implosion Hazard* label.

Storage

1. Tubes must be kept in the carton or unit except when exposure is required for inspection or test.

2. Adequate storage area must be provided for all CRTs. Tubes should be stacked in such a manner that they cannot easily be tipped over and will not be difficult to handle when removed from the stack. It is recommended that the storage area be away from the normal flow of internal trucking and pedestrian traffic.

Testing

Personnel involved in testing CRTs must be instructed in the hazards involved and precautions to be observed.

Defective CRT Disposition

No attempt should be made to repair defective CRTs in the field. A defective CRT should be properly packed and disposed of in accordance with CRT disposition procedures.

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5.4.2 Display Assembly

Removal and Replacement

Never remove the CRT from the assembly box it is mounted in.

1. Preparation for removal:

   DANGER
   12,000 Volts

   a. Power down.
   b. Ground both the CRT high voltage anode and the anode wire to the frame. This is done by grounding a screwdriver against the display assembly box, then inserting the tip of the screwdriver under the protective cap and touching the tip of the screwdriver to the anode cap and wire **C** .

      Note: The display unit is safely grounded only if the mounting screws **B** are tight.

   c. If the anode wire is disconnected from the CRT, touch the shorting tool against the anode wire connector to ground it again.

2. Disconnect the signal cable **E** .

3. Disconnect the brightness control leads from pins 9, 10, and 11 **A** on the display PC board.

4. Loosen the mounting screws **B** . If replacement of the assembly is required, retain the mounting screws for installation of the new assembly.

5. Remove the display unit from the machine.

6. To replace, reverse the above procedure.

5.4.3 Yoke Adjustment

The objective is to align and center the display in the viewing mirror.

DANGER
12,000 Vdc and 400 Vdc in the display unit.

1. Power down.

2. Ground the CRT anode **C** .

3. Loosen the clamping screw and slide the yoke **F** into contact with the fat part of the CRT.

4. Orient the yoke with the wires away from the display PC board.

5. Using just your fingers on the screwdriver handle, tighten the clamping screw. Then tighten the screw 1/8 of a turn more. The yoke can now be rotated around the CRT neck, but stays in any position.

6. Turn the power on.

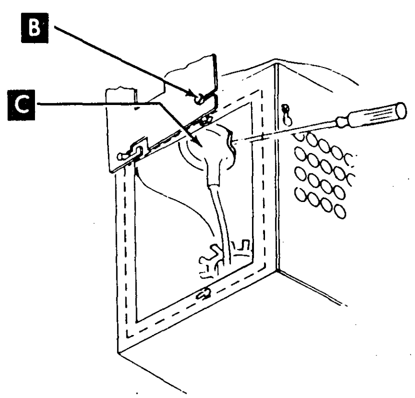
7. Adjust the brightness control on the CE control panel to get a raster that is clearly visible but is not too bright and is not enlarged.

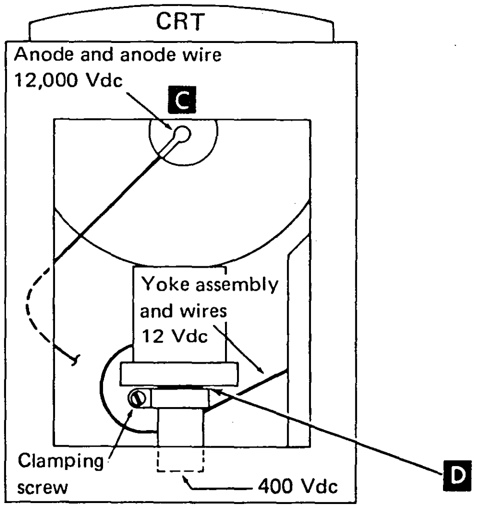
8. Rotate the yoke to straighten the display on the viewing mirror.

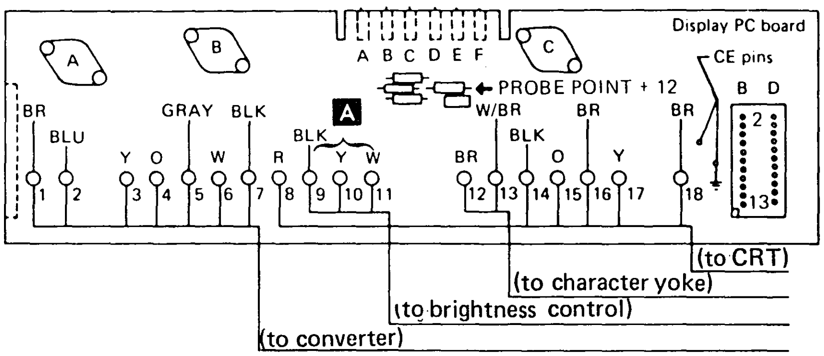
   Note: The voltage on the yoke is 12 Vdc.

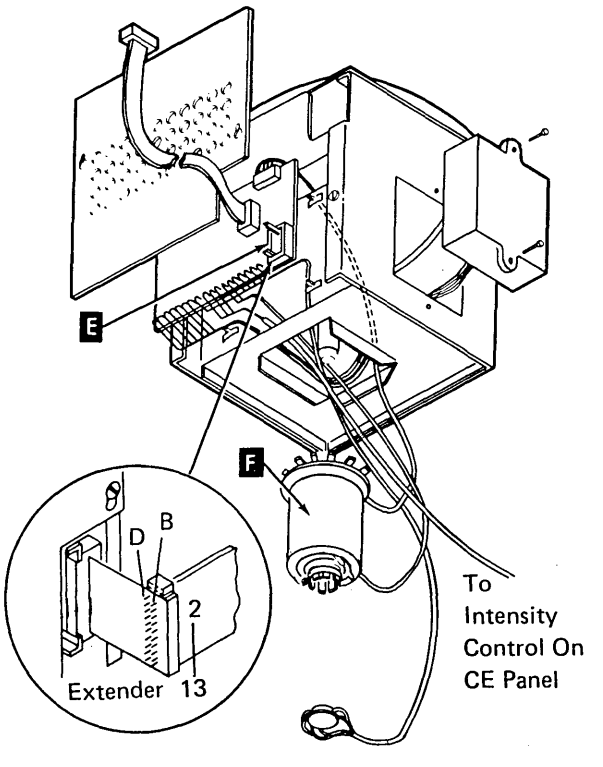
9. Rotate the centering rings **D** in relation to each other to center the display on the viewing mirror.

   Note: Sit in the operator's chair to observe the display screen. The center of the viewing mirror can be judged only when seen from the operator's view.









5.4.4 MAP/Diagnostic Test Display Patterns (Part 1 of 8)

The patterns on this and the following pages represent display screen patterns referred to by the MAPs. For an illustration of the signal cable pins and PC board pins, see 5.2.0.

1. Figures 1 through 5 are messages and prompting displays generated by the diagnostic programs.

2. Figure 6 shows a normal raster with the intensity turned up and no characters displayed.

3. Figures 7 through 14 show abnormal rasters with intensity turned up and no characters displayed.

4. Figures 15 through 20 and 22 show abnormal patterns with normal intensity and characters displayed.

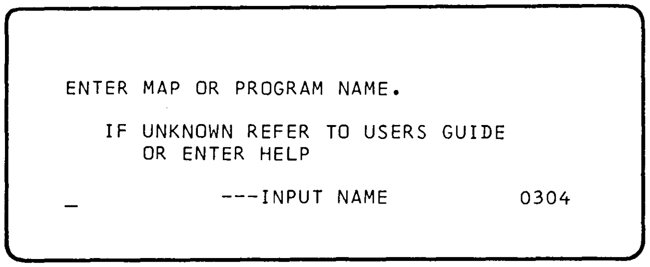
5. Figure 21 shows a normal pattern with characters blurred because the intensity is too high.

6. Figure 23 shows the system reset with the intensity turned up.

7. Figures 24 through 36 are patterns displayed using the display screen diagnostic test CRT3. Each figure shows the particular 64-character set that is generated by the keyboard/display attachment.

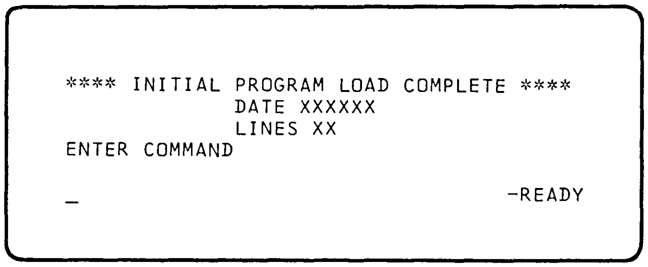
   A system with the dual case keyboard/display feature can display the upper case character set (Figure 24) and the lower case character set (Figure 38). Alternate depressions of the CODE key on the keyboard cause alternate displays of the character sets.

8. Figure 37 shows the pattern displayed using display screen diagnostic test CRT4.



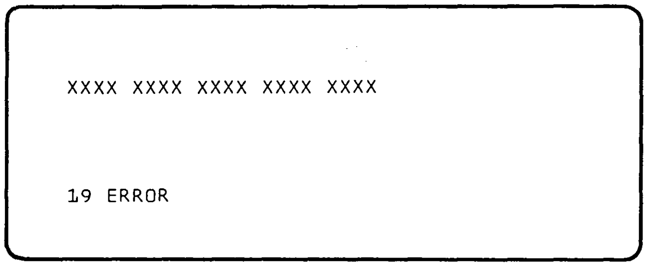
```
ENTER MAP OR PROGRAM NAME.

   IF UNKNOWN REFER TO USERS GUIDE
      OR ENTER HELP

_            ---INPUT NAME          0304
```

Figure 1



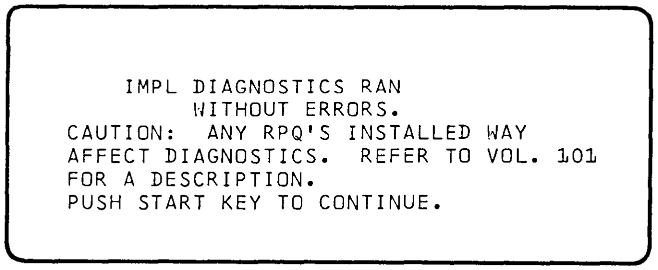
```
**** INITIAL PROGRAM LOAD COMPLETE ****
             DATE XXXXXX
             LINES XX
ENTER COMMAND

_                                  -READY
```

Figure 2



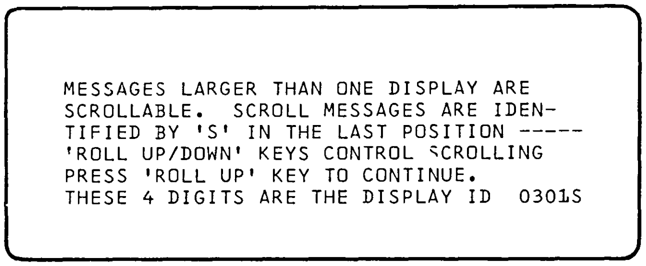
```
XXXX XXXX XXXX XXXX XXXX




19 ERROR
```

Figure 3



```
     IMPL DIAGNOSTICS RAN
          WITHOUT ERRORS.
CAUTION:  ANY RPQ'S INSTALLED MAY
AFFECT DIAGNOSTICS.  REFER TO VOL. 101
FOR A DESCRIPTION.
PUSH START KEY TO CONTINUE.
```

Figure 4



```
MESSAGES LARGER THAN ONE DISPLAY ARE
SCROLLABLE.  SCROLL MESSAGES ARE IDEN-
TIFIED BY 'S' IN THE LAST POSITION -----
'ROLL UP/DOWN' KEYS CONTROL SCROLLING
PRESS 'ROLL UP' KEY TO CONTINUE.
THESE 4 DIGITS ARE THE DISPLAY ID  0301S
```

Figure 5

5.4.4 MAP/Diagnostic Test Display Patterns (2 of 8)

The vertical patterns on this page show the display when the vertical 1, vertical 2, or vertical 4 lines are open or grounded. The only difference in the display between ground or an open would be the position of the display on the screen.

Normal raster with intensity up and no characters displayed.

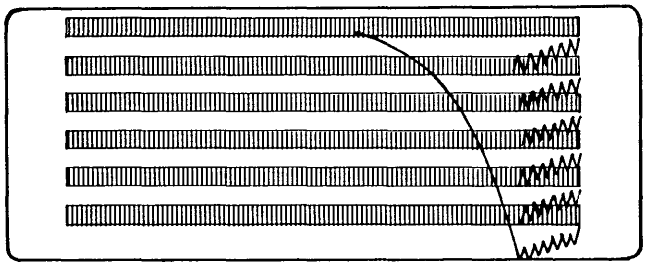


Figure 6

Vertical 2 (display signal cable pin B03) is open or grounded.

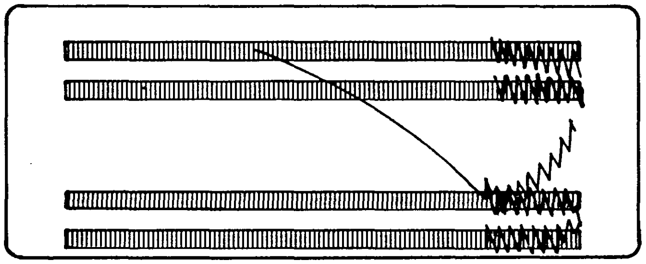


Figure 8

Vertical 1 (display signal cable pin B02) is open or grounded.

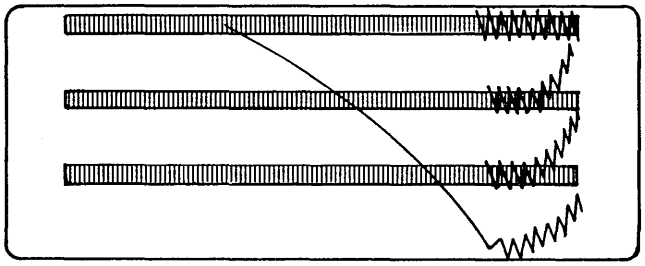


Figure 7

Vertical 4 (display signal cable pin B04) is open or grounded.

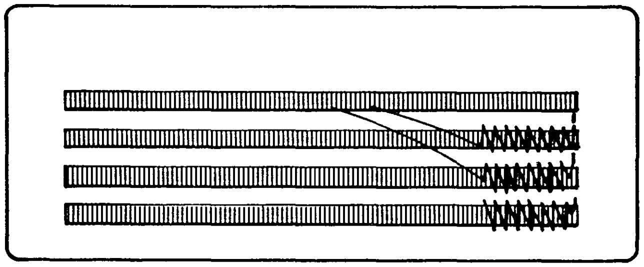


Figure 9

5.4.4 MAP/Diagnostic Test Display Patterns (Part 3 of 8)

Horizontal (display signal cable pin B10) is open or grounded.

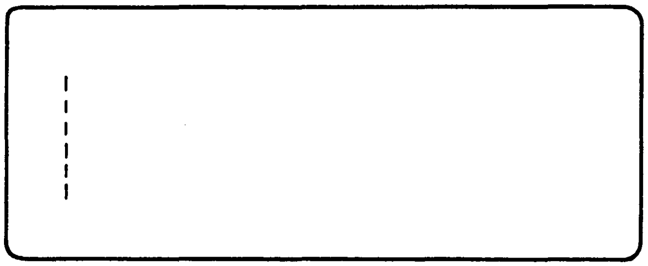


Figure 10

Wiggle control (display signal cable pin B05) is open or grounded, or character yoke (PC board pins 12 or 13) is open.

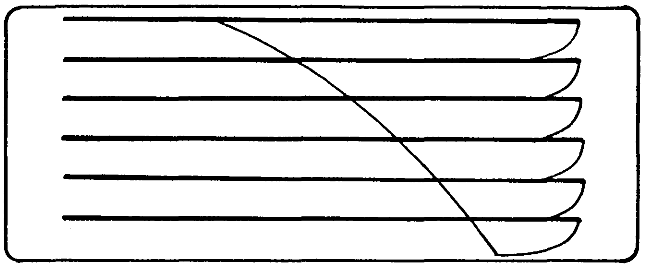


Figure 11

Horizontal slave yoke (PC board pins C or E) is open.

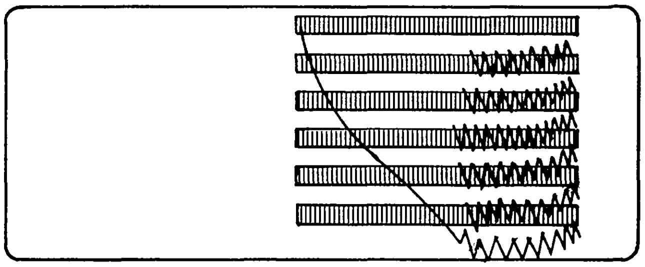


Figure 12

Horizontal master yoke (PC board pins B or D) is open.

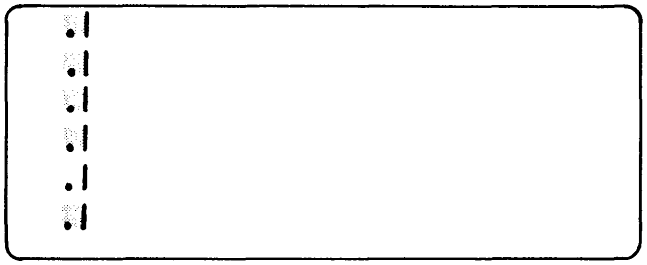


Figure 13

Vertical deflection yoke (PC board pins A or F) is open.

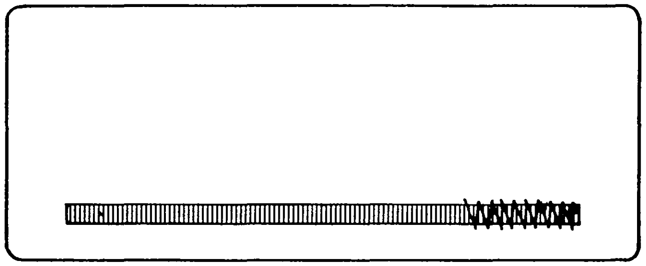
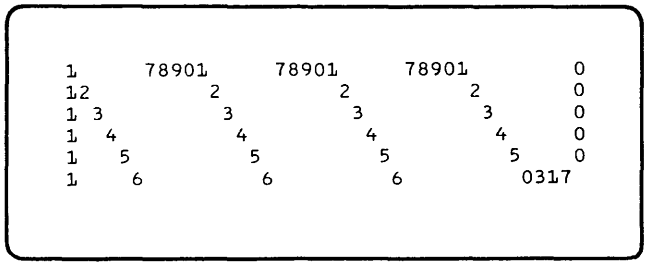


Figure 14

5.4.4 MAP/Diagnostic Test Display Patterns (Part 4 of 8)

The vertical patterns on this page show the display when the vertical 1, vertical 2, or vertical 4 lines are open or grounded. The only difference in the display between ground or an open would be the position of the display on the screen.

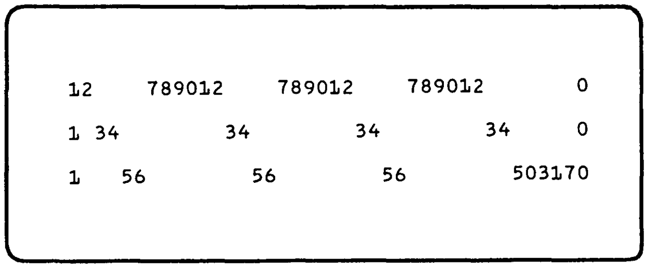
Normal



```
1     78901     78901     78901        0
12         2         2         2       0
1 3         3         3         3      0
1  4         4         4         4     0
1   5         5         5         5    0
1    6         6         6         0317
```

Figure 15

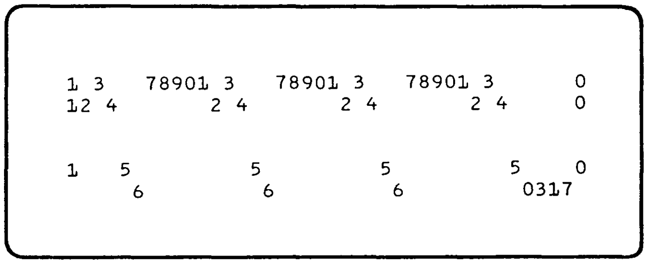
Vertical 1 (display signal cable pin B02) is open or grounded.



```
12    789012    789012    789012       0

1 34        34        34        34     0

1   56        56        56        503170
```

Figure 16

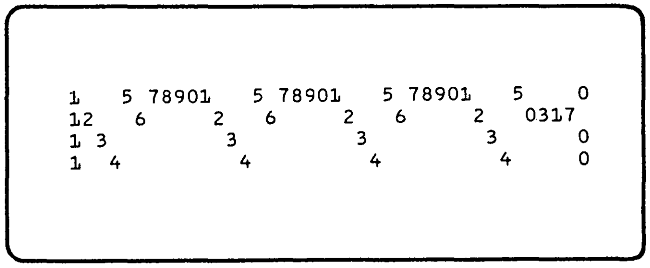
Vertical 2 (display signal cable pin B03) is open or grounded.



```
1 3   78901 3   78901 3   78901 3      0
12 4       2 4       2 4       2 4     0


1   5         5         5         5    0
     6         6         6         0317
```

Figure 17

Vertical 4 (display signal cable pin B04) is open or grounded.



```
1   5 78901   5 78901   5 78901   5    0
12   6     2   6     2   6     2   0317
1 3         3         3         3      0
1  4         4         4         4     0
```

Figure 18

5.4.4 MAP/Diagnostic Test Display Patterns (Part 5 of 8)

Horizontal (display signal cable pin B10) is open or grounded.

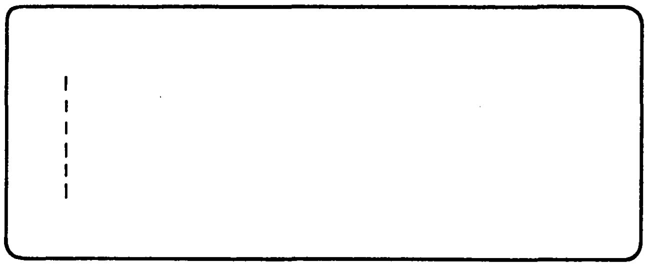


Figure 19

Wiggle control (display signal cable pin B05) is open or grounded, or character yoke (PC board pins 12 or 13) is open.

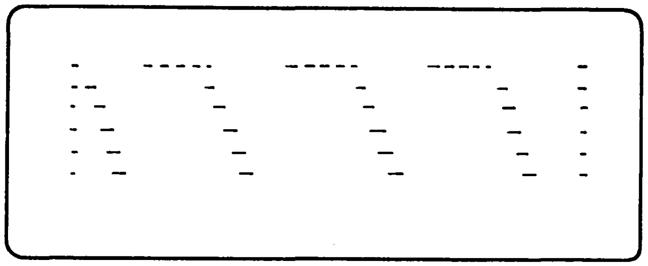
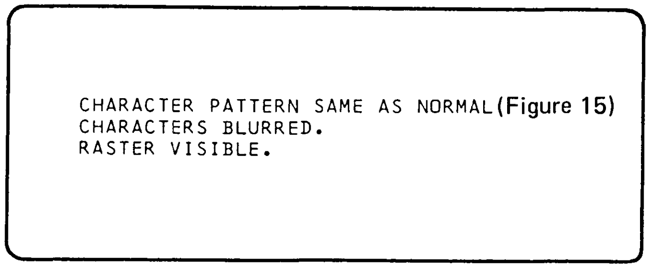


Figure 20

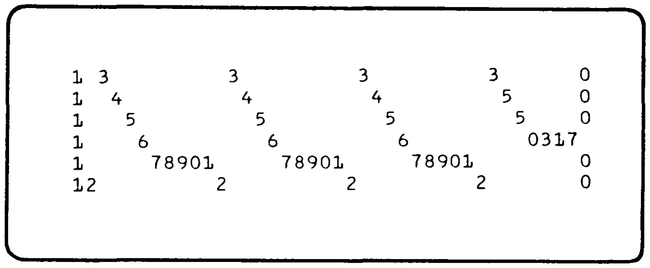
Intensity too bright.



CHARACTER PATTERN SAME AS NORMAL (Figure 15)
CHARACTERS BLURRED.
RASTER VISIBLE.

Figure 21

Video out of sync.



```
1 3          3          3          3      0
1  4          4          4          5     0
1   5          5          5          5    0
1    6          6          6        0317
1     78901      78901      78901         0
12         2          2          2        0
```

Figure 22

System reset (with intensity up).

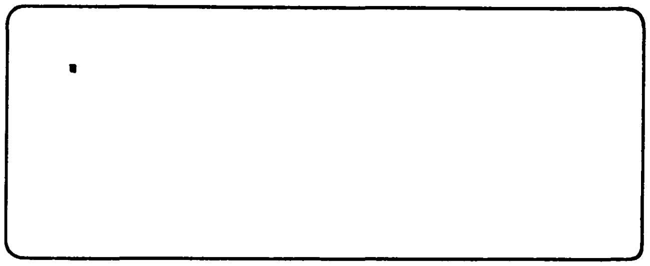
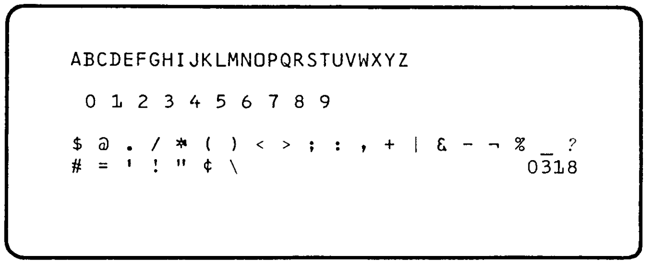


Figure 23

5.4.4 MAP/Diagnostic Test Display Patterns (Part 6 of 8)

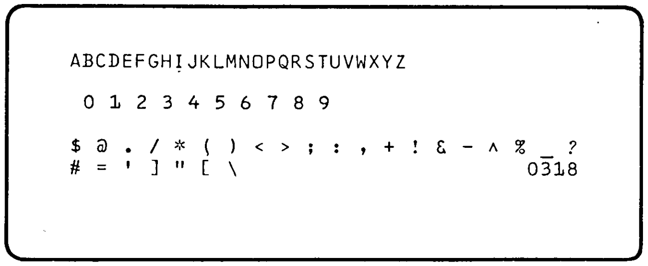
USA, Austria/Germany (QUERTY)



```
ABCDEFGHIJKLMNOPQRSTUVWXYZ

 0 1 2 3 4 5 6 7 8 9

$ @ . / * ( ) < > ; : , + | & - ¬ % _ ?
# = ' ! " ¢ \                       0318
```

Figure 24

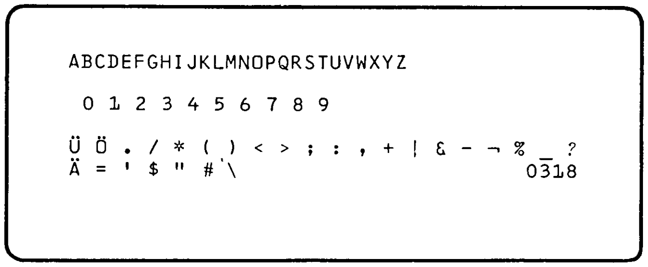
ASCII



```
ABCDEFGHIJKLMNOPQRSTUVWXYZ

 0 1 2 3 4 5 6 7 8 9

$ @ . / * ( ) < > ; : , + ! & - ^ % _ ?
# = ' ] " [ \                       0318
```

Figure 25

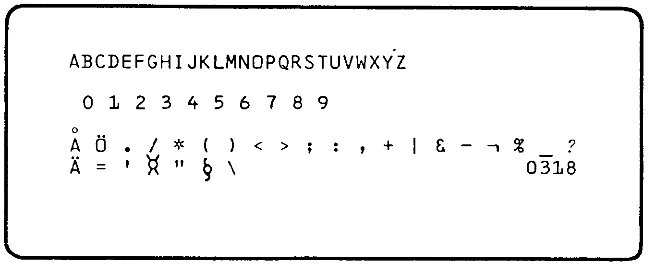
Austria/Germany (QUERTZ)



```
ABCDEFGHIJKLMNOPQRSTUVWXYZ

 0 1 2 3 4 5 6 7 8 9

Ü Ö . / * ( ) < > ; : , + ¦ & - ¬ % _ ?
Ä = ' $ " # \                       0318
```

Figure 26

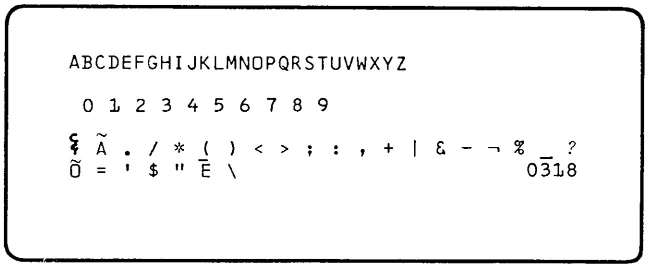
Finland/Sweden



```
ABCDEFGHIJKLMNOPQRSTUVWXYZ

 0 1 2 3 4 5 6 7 8 9

Å Ö . / * ( ) < > ; : , + | & - ¬ % _ ?
Ä = ' ¤ " § \                       0318
```

Figure 27

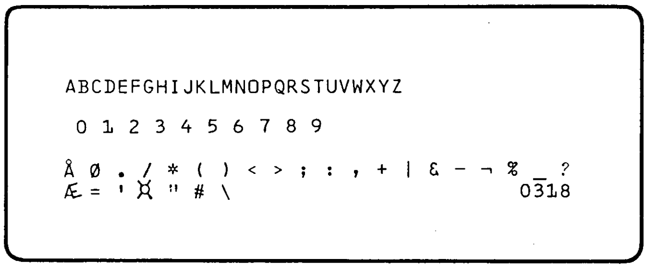
Brazil



```
ABCDEFGHIJKLMNOPQRSTUVWXYZ

 0 1 2 3 4 5 6 7 8 9

Ç Ã . / * ( ) < > ; : , + | & - ¬ % _ ?
Õ = ' $ " Ē \                       0318
```

Figure 28

Denmark/Norway

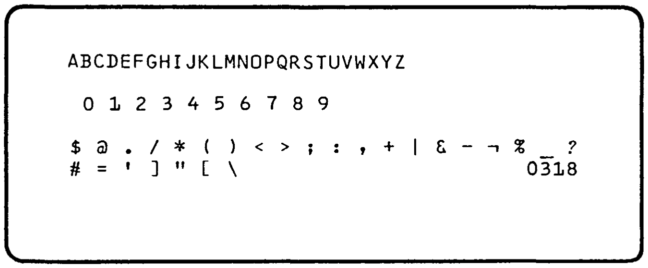


```
ABCDEFGHIJKLMNOPQRSTUVWXYZ

 0 1 2 3 4 5 6 7 8 9

Å Ø . / * ( ) < > ; : , + | & - ¬ % _ ?
Æ = ' ¤ " # \                       0318
```

Figure 29

5.4.4 MAP/Diagnostic Test Display Patterns (Part 7 of 8)

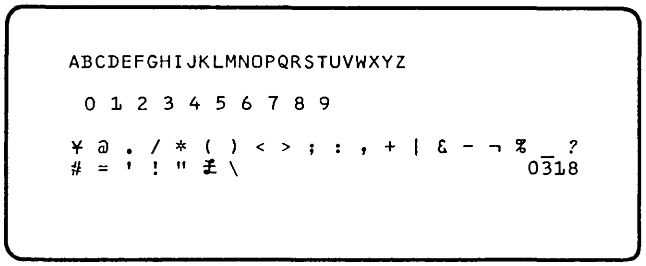
France/Belgium/Italy



```
ABCDEFGHIJKLMNOPQRSTUVWXYZ

 0 1 2 3 4 5 6 7 8 9

$ @ . / * ( ) < > ; : , + | & - ¬ % _ ?
# = ' ] " [ \                       0318
```

Figure 30

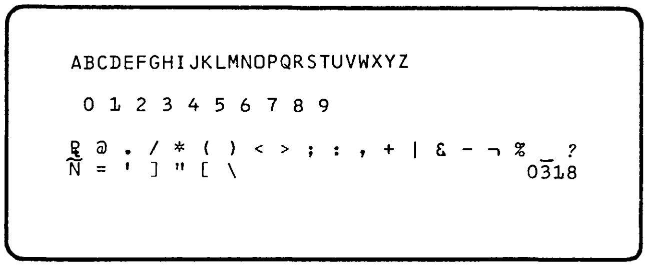
Japan



```
ABCDEFGHIJKLMNOPQRSTUVWXYZ

 0 1 2 3 4 5 6 7 8 9

¥ @ . / * ( ) < > ; : , + | & - ¬ % _ ?
# = ' ! " £ \                       0318
```

Figure 31

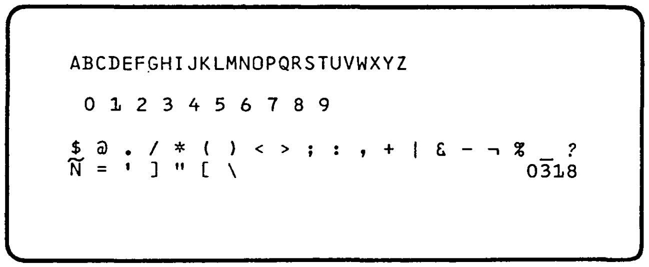
Spain



```
ABCDEFGHIJKLMNOPQRSTUVWXYZ

 0 1 2 3 4 5 6 7 8 9

₧ @ . / * ( ) < > ; : , + | & - ¬ % _ ?
Ñ = ' ] " [ \                       0318
```

Figure 32

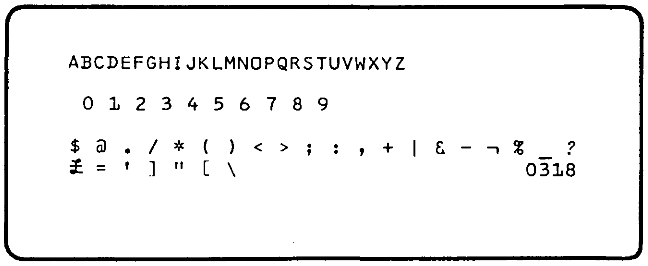
Spanish speaking countries



```
ABCDEFGHIJKLMNOPQRSTUVWXYZ

 0 1 2 3 4 5 6 7 8 9

$ @ . / * ( ) < > ; : , + | & - ¬ % _ ?
Ñ = ' ] " [ \                       0318
```

Figure 33

United Kingdom



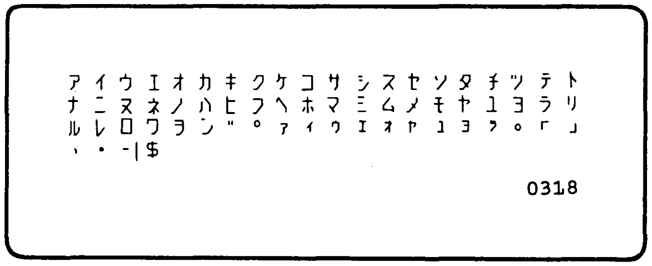
```
ABCDEFGHIJKLMNOPQRSTUVWXYZ

 0 1 2 3 4 5 6 7 8 9

$ @ . / * ( ) < > ; : , + | & - ¬ % _ ?
£ = ' ] " [ \                       0318
```

Figure 34

5.4.4 MAP/Diagnostic Test Display Patterns (Part 8 of 8)

Katakana

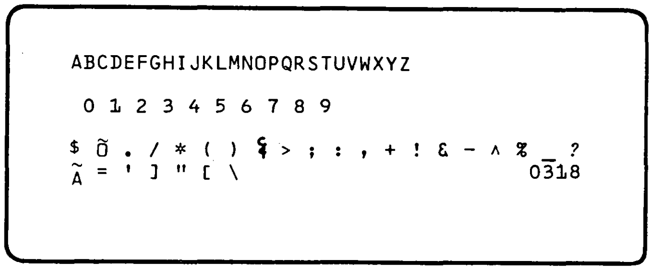
The Katakana machine has both the Katakana character set (Figure 35) and the Japan character set (Figure 31). The Japan character set is normally displayed. The Katakana character set can be displayed by pressing the KANA ON key on the keyboard. To return the display to the Japan character set, press the KANA OFF key.



```
アイウエオカキクケコサシスセソタチツテト
ナニヌネノハヒフヘホマミムメモヤユヨラリ
ルレロワヲン゛゜ァィゥェォャュョッ。「」
、・-|$
                                    0318
```

Figure 35

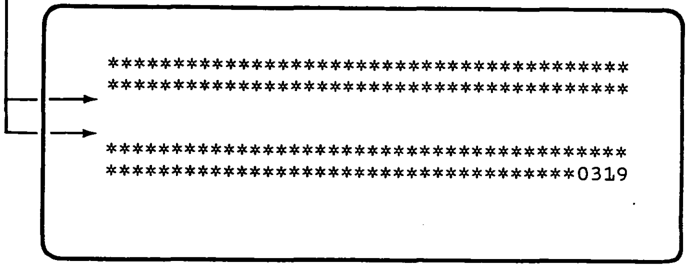
Portugal



```
ABCDEFGHIJKLMNOPQRSTUVWXYZ
 0 1 2 3 4 5 6 7 8 9
$ Õ . / * ( ) § > ; : , + ! & − ∧ % _ ?
Ã = ' ] " [ \                       0318
```

Figure 36

These two lines are continuously changing from an * (asterisk), to a / (slash), to an _ (underscore), to a . (period), to a blank display for 0.5 seconds. The two lines then continue repeating the same sequence starting with an *, to a /, to an _, etc.



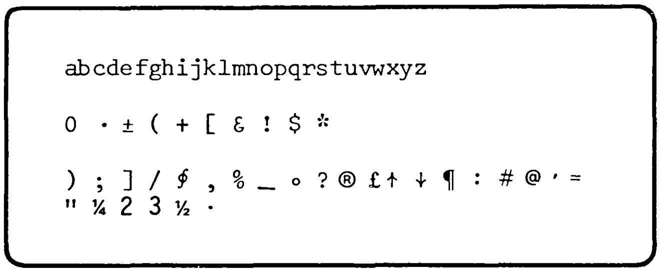
```
****************************************
****************************************

****************************************
************************************0319
```

Figure 37

Lower Case Feature Patterns

A system with the dual case keyboard/display feature can display the upper case character set (Figures 24 through 36) and the lower case character set (Figures 38 through 43). Alternate depressions of the CODE key on the keyboard cause alternate displays of the character sets.

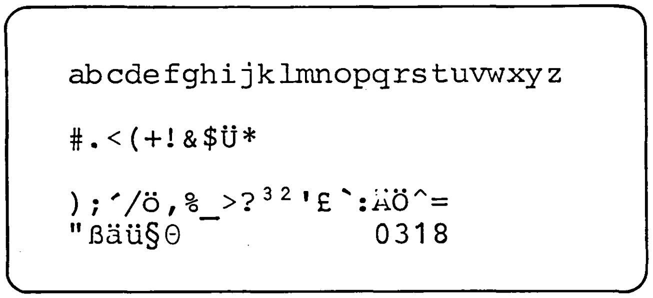
USA



```
abcdefghijklmnopqrstuvwxyz
0 · ± ( + [ & ! $ *
) ; ] / ¢ , % _ ° ? ® £ ↑ ↓ ¶ : # @ ' =
" ¼ 2 3 ½ ·
```

Figure 38

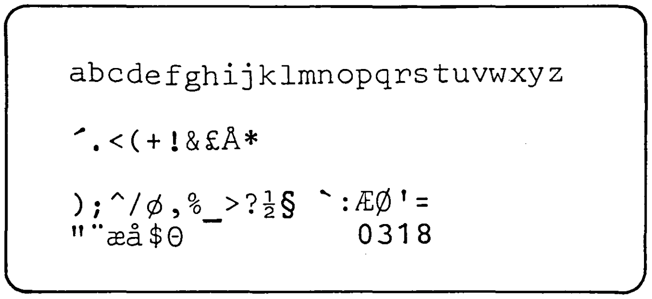
Germany



```
abcdefghijklmnopqrstuvwxyz

#.<(+!&$Ü*

);´/ö,%_>?³²'£`:ÄÖ^=
"ßäü§Θ‾           0318
```

Figure 39

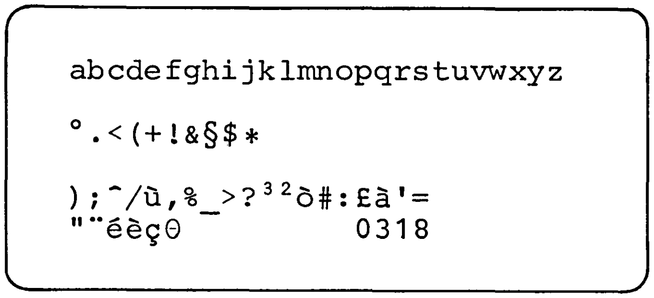
Denmark



```
abcdefghijklmnopqrstuvwxyz

´.<(+!&£Å*

);^/ø,%_>?½§ `:ÆØ'=
"¨æå$Θ‾         0318
```

Figure 40

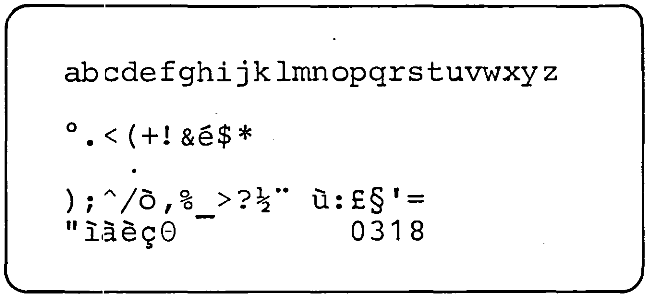
France



```
abcdefghijklmnopqrstuvwxyz

°.<(+!&§$*

);ˆ/ù,%_>?³²ò#:£à'=
"¨éèçΘ‾         0318
```

Figure 41

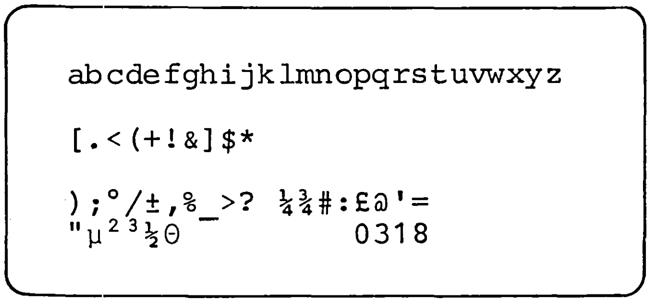
Italy



```
abcdefghijklmnopqrstuvwxyz

°.<(+!&é$*

);^/ò,%_>?½¨ ù:£§'=
"ìàèçΘ‾         0318
```

Figure 42

United Kindom



```
abcdefghijklmnopqrstuvwxyz

[.<(+!&]$*

);°/±,%_>? ¼¾#:£@'=
"µ²³½Θ‾         0318
```

Figure 43

6.0.0 Keyboard

6.1.0 THEORY

6.1.1 Introduction

The keyboard provides operator interface to the system. It provides a means of controlling the system and a means for data entry.

Key Modules

The keyboard contains key modules mounted into an all keys assembly. Each key module contains a flyplate that rests on two etched pads on the keyboard PC (printed circuit) board. When the key is pressed, the flyplate moves away from the PC board and causes a capacitance change that allows the key stroke to be sensed. Releasing the key returns the flyplate to its normal position. The keyboard PC board contains logic to perform the following functions:

1. Key detection and decode control
2. Clicker (audio feedback control)
3. Character storage control
4. Shift
5. Character repeat

Key Detection

The design of the keyboard is based upon key detection through capacitive coupling. The detection of a pressed key (flyplate up) is the same for all keys on the keyboard. The keys are sampled one position at a time until all the keys are sampled. This sampling takes place as long as power is on. The scanning of all the key positions take 16.128 ms. The scanning of each key takes 144 μs.

Clicker

The clicker is an electromechanical device that clicks each time a key is pressed.

An attachment detected error, such as an operator error or a keyboard overrun error prevents clicker operation and also turns off the KEYBD RDY light on the operator control panel. The clicker is deactivated by the error line from the attachment to the keyboard. The ERROR RESET key on the keyboard resets the clicker.

Keying out of the limits of a defined field or keying alphabetic data in a numeric field are two types of operator errors. Operator errors are monitored in the system control program or the microprogram.

A keyboard overrun occurs when a character in the keyboard buffer (in the attachment) is not serviced by the time another key is pressed. The overrun error is monitored in both the attachment circuits and in the microprogram.

Shift

The SHIFT keys are sensed the same as all other keys but the shift key bit code is never sent to the attachment by itself. The shift bit is added to the bit code of the character or function key.

Character Repeat

This function provides the operator with a quick method of repetitively entering the same character. When a REP key is pressed concurrently with a character or function key, the bit code of the character or function key is sent to the attachment, and on to the system, every 131 ms.

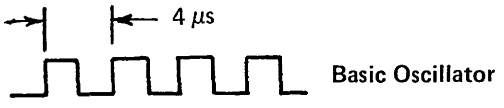
Character Storage Control

Circuitry within the keyboard prevents a character from being transmitted more than once for each time a key is pressed.

6.1.2 Input Lines

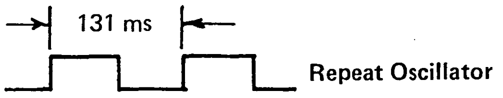
Basic Oscillator

This line contains oscillator pulses. The oscillator pulses are on this line as long as power is on the system.



Repeat Oscillator

This line contains oscillator pulses. The oscillator pulses are on this line as long as power is on the system.



Error

The error line active prevents clicker operation, but does not prevent data from appearing on the bit lines. This line is activated by the attachment whenever an operator error occurs or a keyboard overrun occurs (see *Clicker,* 6.1.1).

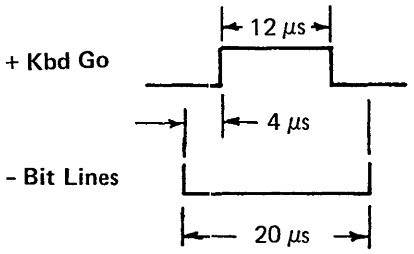
Busy Tone

Some keys always operate the clicker regardless of the status of the error line or the KEYBD RDY light. The attachment accomplishes this by activating the busy tone line for 8.19 ms. The busy tone line overrides the error line and allows a click. The keys that always operate the clicker are PAGE/LINE, PRINT/RESET, and ERROR RESET. In addition to the preceding keys, the INQ key also operates the clicker regardless of the status of the error line. However, this click is generated in the keyboard and does not depend on the busy tone line from the attachment.

6.1.3 Output Lines

Kbd Go

This line signals the attachment that a character is available on the bit lines. This line is generated by all keys except the SHIFT key and the REP key. Its relationship to the bit lines is shown in the following illustration:



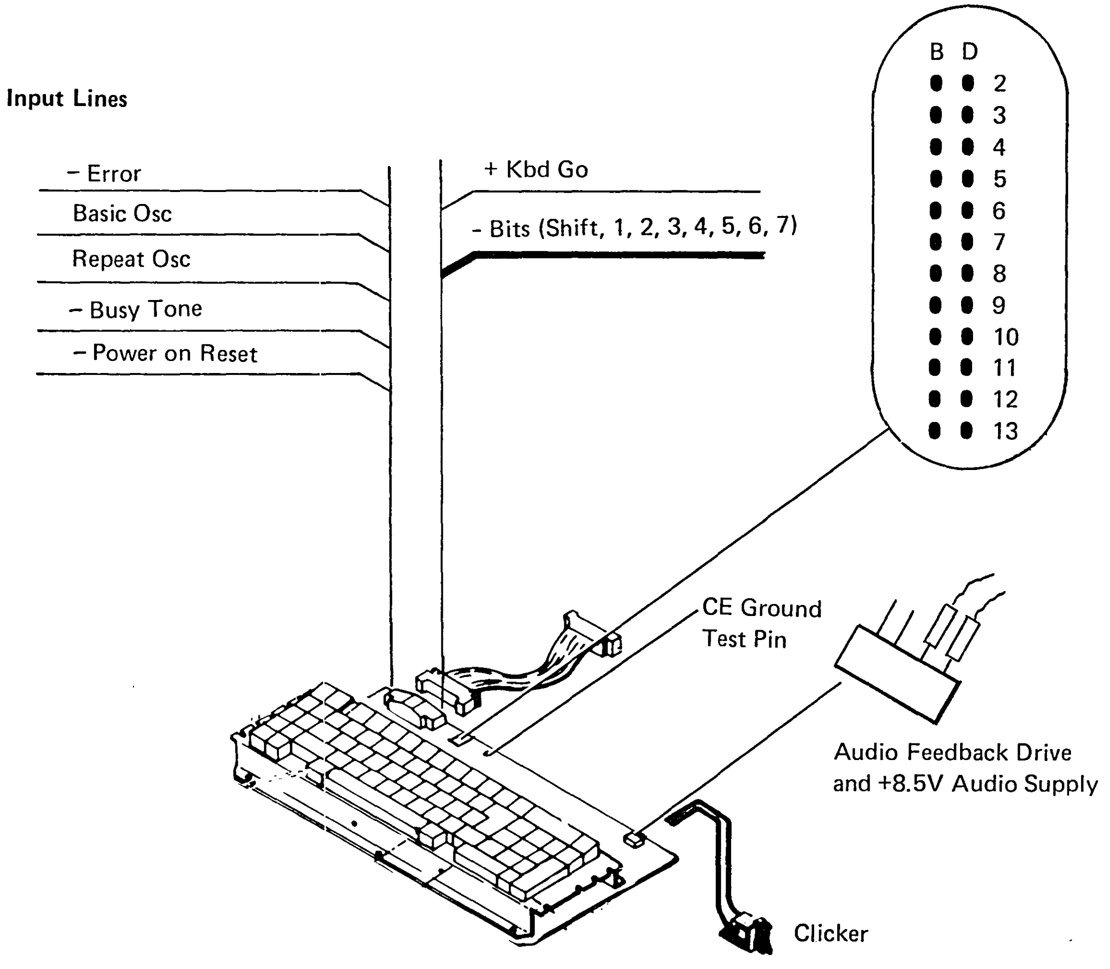
This pattern is repeated every 131 ms by pressing a REP key concurrently with a character or function key.

Bit Lines

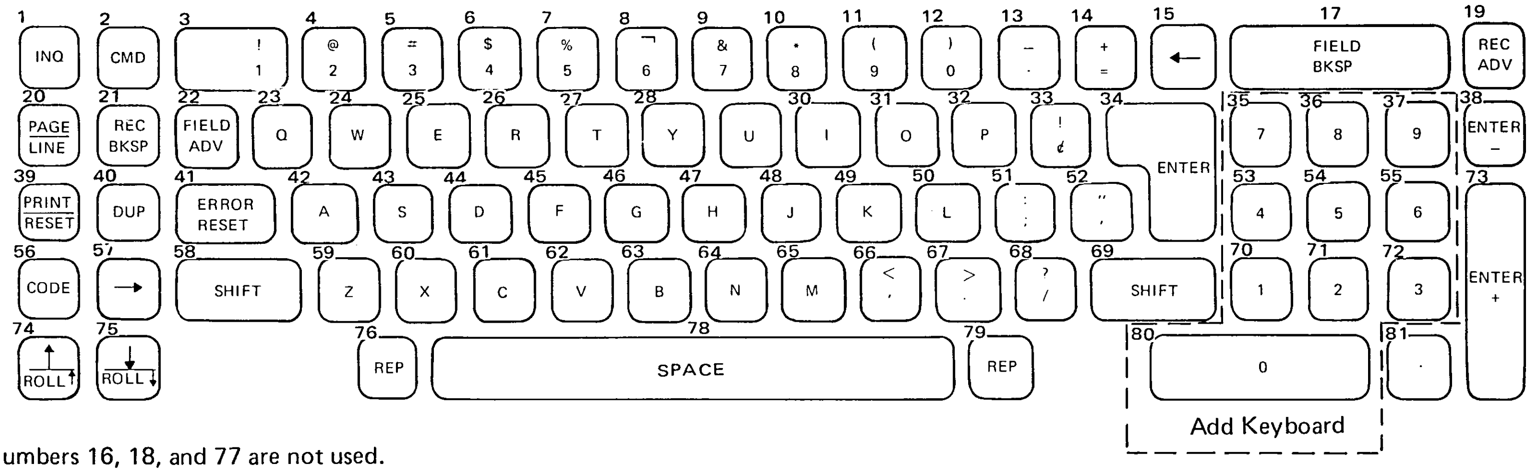
Data is placed on the bit lines within 16.15 ms after a key is pressed. The relationship between these lines and the kbd go line is shown in the preceding illustration.

Data placed on the bit lines leaving the keyboard is not in a standard code but is in a code unique to this keyboard. Translation of this data to EBCDIC is done by the microprogram.

The keys and the bits they generate, are shown in the illustration (6.1.4).



6.1.4 Key Bit Codes



Note: Numbers 16, 18, and 77 are not used.

Key #	U.S. Symbol or Function		Shift							
	Shift Bit 0	Shift Bit 1		1	2	3	4	5	6	7
1	INQ			0	1	1	0	0	1	0
2	CMD			0	1	1	1	1	1	1
3	1	|		0	1	1	0	1	0	0
4	2	@		0	1	1	1	1	0	1
5	3	#		0	1	1	1	0	0	0
6	4	$		0	1	1	1	1	1	0
7	5	%		0	1	1	1	0	0	1
8	6	¬		0	1	1	0	1	0	1
9	7	&		0	1	1	1	0	1	0
10	8	*		0	1	1	0	0	0	1
11	9	(		0	1	1	1	1	0	0
12	0	)		0	1	1	0	1	1	1
13	-	—		0	1	1	0	1	1	0
14	=	+		0	1	1	0	0	0	0
15	←			1	1	0	0	0	0	0
16	(not used)									
17	FIELD BKSP			1	0	0	0	0	1	0
18	(not used)									
19	REC ADV			1	0	0	0	1	1	1
20	LINE PAGE			0	1	0	0	0	1	0
21	REC BKSP			0	1	0	0	0	1	1
22	FIELD ADV			0	1	0	0	1	0	0
23	Q	Q		0	1	0	1	1	0	1
24	W	W		0	1	0	1	0	0	0
25	E	E		0	1	0	1	1	1	0
26	R	R		0	1	0	1	0	0	1
27	T	T		0	1	0	0	1	0	1
28	Y	Y		0	1	0	1	0	1	0
29	U	U		0	1	0	0	0	0	1
30	I	i		0	1	0	1	1	0	0
31	O	O		0	1	0	0	1	1	1
32	P	P		0	1	0	0	1	1	0
33	¢	!		0	1	0	0	0	0	0
34	ENTER			0	1	0	1	1	1	1
35	7			1	0	1	0	0	0	0
36	8			1	0	1	0	0	1	0
37	9			1	0	1	0	1	0	0
38	ENTER –			1	0	1	0	1	1	1
39	RESET PRINT			0	0	1	0	0	1	0
40	DUP			0	0	1	0	0	1	1
41	ERROR RESET			0	0	1	0	1	0	0
42	A	A		0	0	1	1	1	0	1
43	S	S		0	0	1	1	0	0	0
44	D	D		0	0	1	1	1	1	0
45	F	F		0	0	1	1	0	0	1
46	G	G		0	0	1	0	1	0	1
47	H	H		0	0	1	1	0	1	0
48	J	J		0	0	1	0	0	0	1
49	K	K		0	0	1	1	1	0	0
50	L	L		0	0	1	0	1	1	1
51	;	:		0	0	1	0	1	1	0
52	'	"		0	0	1	0	0	0	0
53	4			1	0	1	0	0	0	1
54	5			1	0	1	0	0	1	1
55	6			1	0	1	0	1	0	1
56	CODE			0	0	0	0	0	1	0
57	→			0	0	0	0	0	1	1
58	SHIFT		|							
59	Z	Z		0	0	0	1	1	0	1
60	X	X		0	0	0	1	0	0	0
61	C	C		0	0	0	1	1	1	0
62	V	V		0	0	0	1	0	0	1
63	B	B		0	0	0	0	1	0	1
64	N	N		0	0	0	1	0	1	0
65	M	M		0	0	0	0	0	0	1
66	,	<		0	0	0	1	1	0	0
67	.	>		0	0	0	0	1	1	1
68	/	?		0	0	0	0	1	1	0
69	SHIFT		|							
70	1			1	0	0	0	0	0	1
71	2			1	0	0	0	0	1	1
72	3			1	0	0	0	1	0	1
73	ENTER +			1	0	1	0	1	1	0
74	ROLL ↑ ↑			0	1	1	1	0	1	1
75	ROLL ↓ ↓			0	0	1	1	0	1	1
76	REP									
77	(not used)									
78	SPACE			0	0	1	1	1	1	1
79	REP									
80	0			1	1	0	0	0	0	1
81	.			1	0	0	0	1	1	0

6.2.0 FUNCTION KEYS

The PAGE, LINE, PRINT, RESET, and ERROR RESET keys always perform the functions indicated. The other function keys *usually* perform the function indicated but might depend on the program being run.

INQ

SCP and DCP – (STOP light off) provides a display allowing the operator to choose one of the following:

1. Return to interrupted program.
2. Terminate program and close files.
3. Continue inquiry request.

(STOP light on) executes an alter storage routine.

CMD

SCP – Indicates that the next key pressed is used as a command key. Redefines the upper row of data keys on the keyboard as command keys. Pressing the CMD key twice consecutively cancels the command definition.

DCP – Not used.

REC BKSP

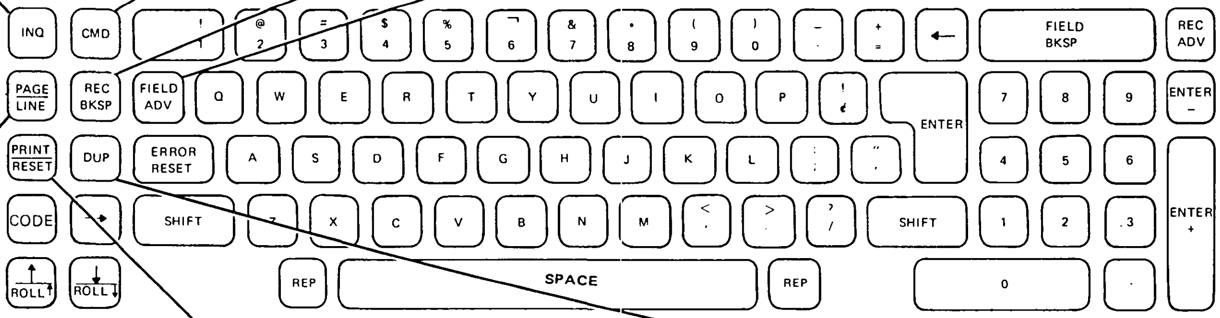
SCP – Moves the cursor to the first position of the current record. (No shift) any data already keyed to this record is ignored. (Shift) any data already keyed to this record is destroyed.

DCP – Not used.

FIELD ADV

SCP – Signals the end of input for the current field. The entire field is accepted independent of the cursor position.

DCP – Not used.



PAGE

SCP and DCP – Skips form in printer to next page.

LINE[1]

SCP and DCP – Moves printer carriage one line.

PRINT[1]

SCP and DCP – Prints the contents of the CRT buffer in the same format as it appears on the display screen.

RESET[1]

SCP – Resets the printer current line value to one.

DCP – Not used.

DUP

SCP – (No shift) duplicates data from the corresponding position of the preceding record to the position indicated by the cursor in the current record. (Shift) duplicates the character above the cursor. The DUP key can be used with the REP key.

DCP – Not used.

---

[1] See Serial Printer 9.1.2.3 for serial printer single forms usage.

FUNCTION KEYS (Continued)

→

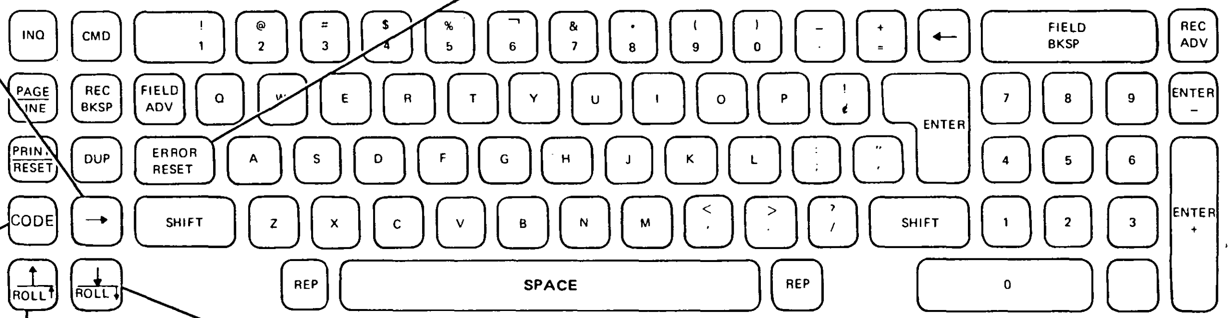
SCP – (No shift) moves the cursor to the right one position if the new position is within the current record. (Shift) moves the current display right one position.

DCP – (No shift) moves the cursor to the right one position if the new position is within the current record. (Shift) blanks current cursor position and moves the cursor one position to the right.

ERROR RESET

SCP – Resets keyboard overrun or operator error.

DCP – Not used.



↑

SCP and DCP – Moves cursor from the current position to the same position in the preceding line if the new position is within the current record.

ROLL ↑

SCP and DCP – Moves the lines of data on the display up one record.

↓

SCP and DCP – Moves the cursor from the current position to the same position in the following line if the new position is within the current record.

ROLL ↓

SCP and DCP – Moves the lines of data on the display down one record.

CODE

SCP – Used in conjunction with another data key will perform a function defined by the word processing application program.

DCP – Not used.

FUNCTION KEYS (Continued)

←

SCP — (No shift) moves the cursor to the left one position if the new position is within the current record. (Shift) moves the current display left one position.

DCP — (No shift) moves the cursor to the left one position if the new position is within the current record. (Shift) blanks current cursor position and moves cursor one position to the left.

FIELD BKSP

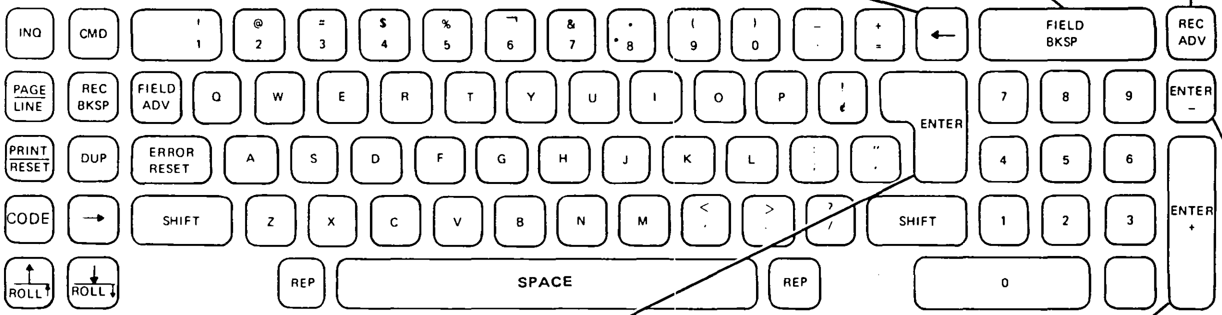
SCP — The cursor is moved to the first position of the current field. Any data already keyed to this field is ignored (no shift) or destroyed (shift).

DCP — Not used.

REC ADV

SCP — Signals the end of input for the current record. The entire field is accepted independent of the cursor position.

DCP — Not used.



ENTER

SCP and DCP — Performs identical to ENTER+.

ENTER–

SCP and DCP — Signals the end of input for a numeric field and defines the field as negative.

ENTER+

SCP and DCP — Signals the end of input for a field and, if numeric, defines the field as positive.

6.3.0 MAINTENANCE

6.3.1 Keyboard Assembly

Removal and Replacement

1. Power down.
2. Remove top cover (three screws under leading edge).
3. Disconnect cables.
4. Remove four mounting screws; then remove the keyboard.
5. To replace, reverse the above procedure.

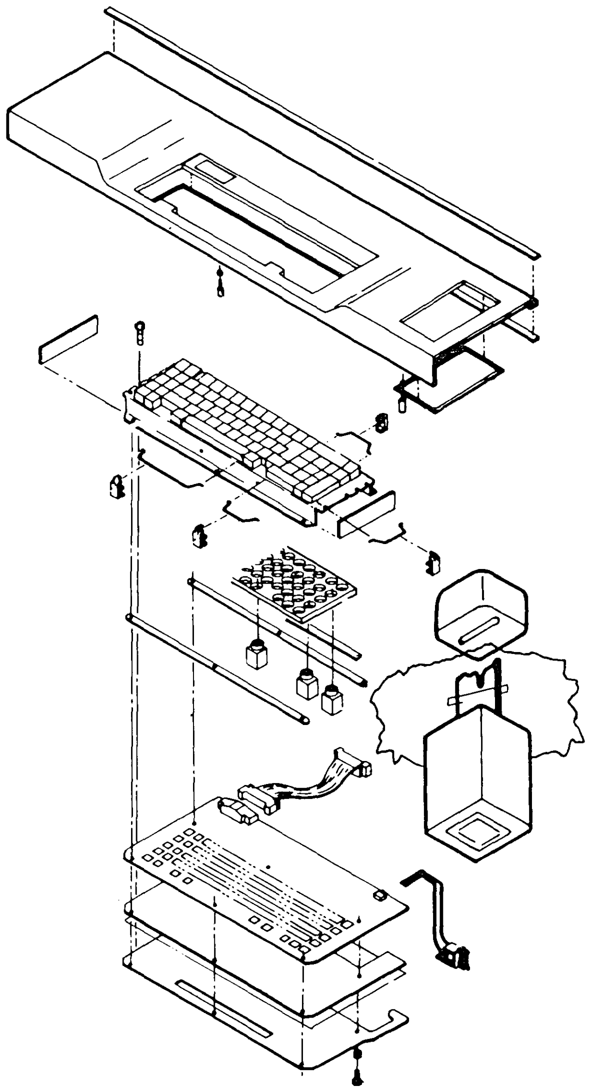
   Note: When replacing the keyboard, retain the CODE key button (if installed) for use on the new keyboard. See Section 6.3.5.

Disassembly

CAUTION
The keyboard assembly must be kept clean.

1. Remove the keyboard assembly and place it upside down in a clean work area.
2. Loosen, but do not remove, the six screws holding the baseplate and the PC board to the all keys assembly.

   Note: Do not disassemble the keyboard assembly yet. If a key is pressed, the flyplate jumps out of the key module. If this happens, refer to the flyplate replacement procedure (6.3.4).
3. Place the keyboard assembly right side up and slide one corner off the edge of the work surface to expose one holding screw. Remove the remaining holding screws in this same manner.
4. Lift the all keys unit and lay it right side up on a smooth clean surface.
5. To reassemble, reverse the above procedure.



6.3.2 Key Module

Removal

1. Disassemble the keyboard (6.3.1).
2. Use the key button pulling tool (P/N 627953) to lift the key buttons from the key modules to be removed.
3. Lift one edge of the all keys unit about 1/2 inch and push the key modules being removed down until they snap free.

   CAUTION
   Be sure no keys are pressed.
4. Lift the all keys unit, leaving the loosened modules.

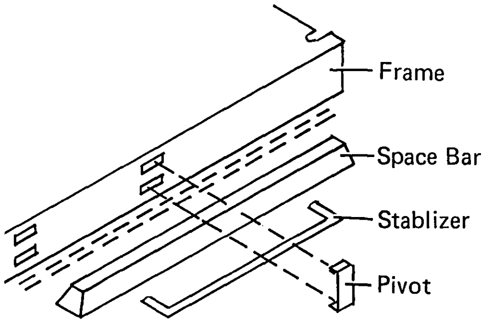
Replacement

1. Set the key module upright and place the all keys unit in position over it. Align the slot in the module with the orientation lug on the mounting hole.
2. For the FIELD BKSP, ENTER, and 0 (zero) key, guide the stabilizer into the slot in the pivots.
3. Press down on the ends of the all keys unit to snap the module into place.

6.3.3 Space Bar

Removal

1. Hold the ends of the space bar and pull up to slide the bar off the key stems.
2. If pivots need to be removed, insert a screwdriver tip in the slot in the side of the frame and twist the screwdriver until the pivot is removed.



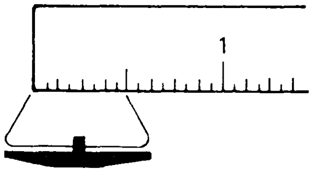
Replacement

1. Press the pivots into place in the frame.
2. Position the space bar over the key stems.
3. Guide the stabilizer into the slots in the pivots.
4. Press the space bar down onto the key stems.

6.3.4 Flyplate Replacement

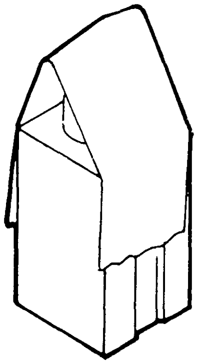
Replacing a dislodged flyplate in a key module is not recommended. However, if replacement is necessary because a new key module is not available, inspect the flyplate to make sure the joint between the spring and flyplate is not loose or the flyplate is not cracked or damaged.

1. Form the spring on the flyplate so that there is 0.5 inch (12.7 mm) between the ends of the spring.



2. Remove the key button from the key module and remove the module from the keyboard.

3. Tape the key stem down as shown.



4. Holding the key module and flyplate as shown, line up the ends of the flyplate spring **A** with the tips of the flat spring **B** attached to the key stem.

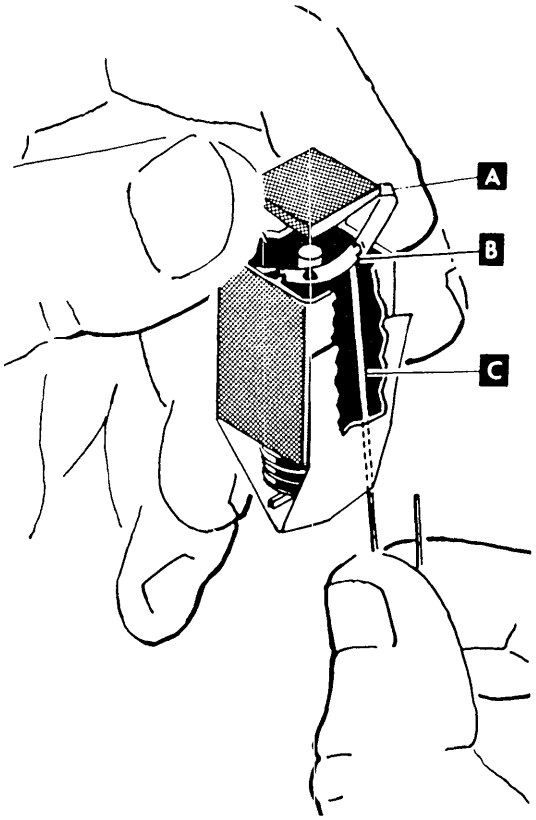
5. Insert a small stylus or straightened paper clip through one of the access holes in the key module **C**.

6. Push the tip of the flat spring up on the inside of the flyplate spring.

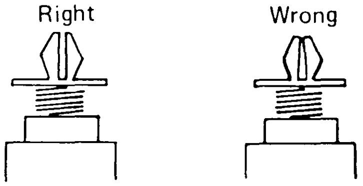
7. Ease the flat spring down until the tab drops into the slot of the flyplate spring.

8. Attach the other end of the spring in the same way.

9. Carefully remove the tape holding the key stem.



10. Check the key stem ears for taper in the center slot and form the ears if necessary.



11. Install the key module in the keyboard (6.3.2).

6.3.5 CODE Key

Enabling

Note: If the dual case feature is installed, when replacing the keyboard retain the CODE key button for use on the new keyboard.

1. Remove key button numbers 56 (blank button) 57, 74, and 75 (see 6.1.4) using the key button pulling tool (P/N 627953).

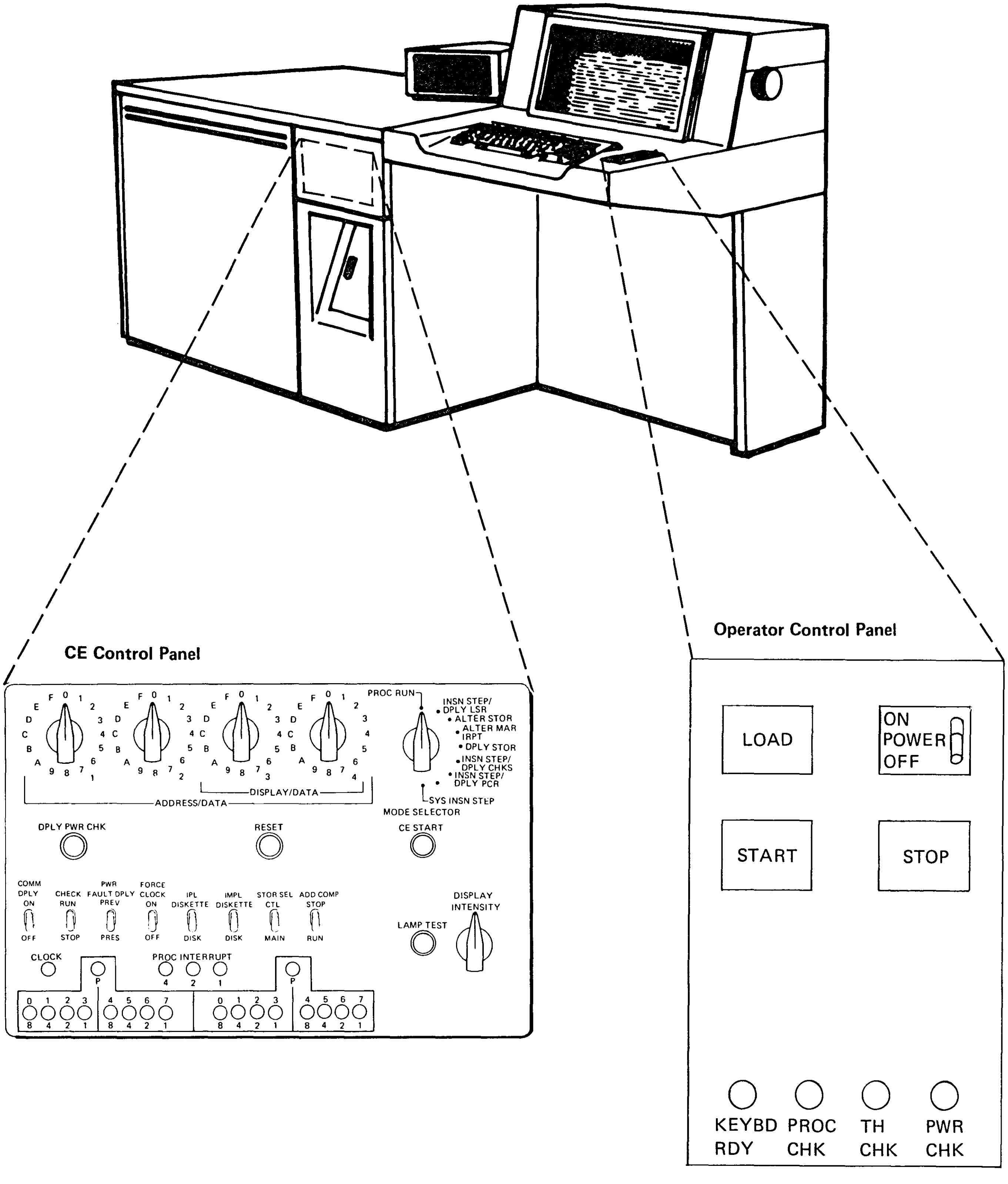
2. Lift the black vinyl liner from the key stems.

3. Remove the keylock from key position 56 by turning the keylock 90°and lifting it off the key stem.

4. Reposition the black vinyl liner over the key stem.

5. Replace the keys removed in step 1 using the CODE key button in position 56.

7.0.0 Consoles



7.1.0 OPERATOR CONTROL PANEL CONTROLS

7.1.1 LOAD Key/Light

This key is pressed to start the initial program loading, IMPL followed by IPL.

The LOAD light turns on when the switch is pressed and remains on until the first 4096 bytes of the microprogram are successfully loaded.

7.1.2 START Key/Light

This micro instruction controlled switch is turned on at IPL time. It is turned off when:

1. The STOP key is pressed.
2. The MODE SELECTOR switch on the CE control panel is in the SYS INSN STEP position.
3. A main storage address compare stop occurs.

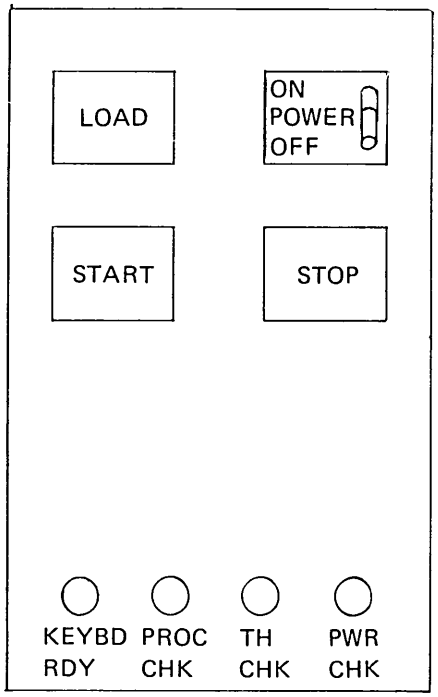
When the STOP light is on, the microprogram is looping and interrogating the START switch. When the START switch is pressed, the START light turns on and the STOP light turns off. Processing of the system instructions then continues.

7.1.3 POWER ON/OFF Switch

This switch initiates a power on or power off sequence. As part of the power on sequence a system reset is performed to initialize the system. At the completion of the power on sequence (approximately 35 seconds), the STOP light is turned on.

The contents of the registers and storage are destroyed when the power is turned off.

Operator Control Panel



7.1.4 STOP Key/Light

When this microprogram instruction controlled switch is pressed, the system is stopped at the end of the current system instruction and the STOP light is turned on. At the end of each system instruction, the STOP switch is interrogated by the microprogram and if the switch is pressed, the microprogram loops in a stopped state.

This light turns on when the power on sequence is complete. It turns off when the LOAD key is pressed.

The STOP light also turns on if the microprogram is loaded and a main storage address compare stop occurs or the MODE SELECTOR switch is placed in the SYS INSN STEP position.

7.1.5 KEYBD RDY (Keyboard Ready) Light

This light is on whenever the keyboard is ready to operate.

7.1.6 PROC CHK (Processor Check) Light

This light is turned on whenever an unrecoverable error is detected by the processing unit. Whenever this occurs, the only way to restart is by initiating an IMPL by pressing the LOAD key.

7.1.7 PWR CHK (Power Check) Light

This light indicates that a check in the power system occurred and that power is removed. However, voltage necessary to display the check condition is still on.

7.1.8 TH CHK (Thermal Check) Light

This indicator is turned on whenever the temperature is too hot in the A-gate, power supplies, or printer. Power is turned off in the system when a thermal check occurs. After the thermal condition is cooled, system power can again be brought up.

7.2.0 CE CONTROL PANEL

7.2.1 MODE SELECTOR Switch

PROC RUN

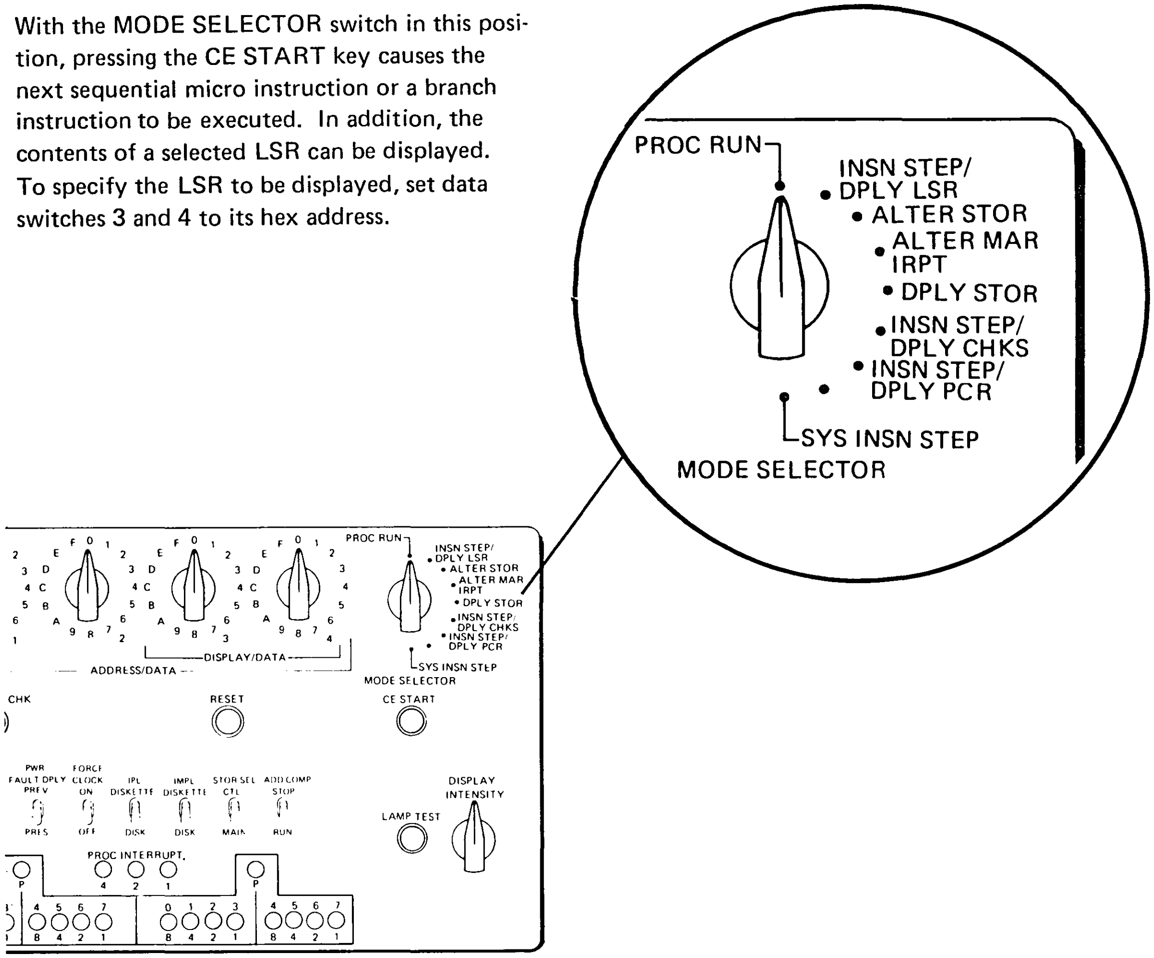
The MODE SELECTOR switch must be in this position when the system is running.

When this switch is moved from the PROC RUN position, the processing unit clock stops after executing the current micro instruction.

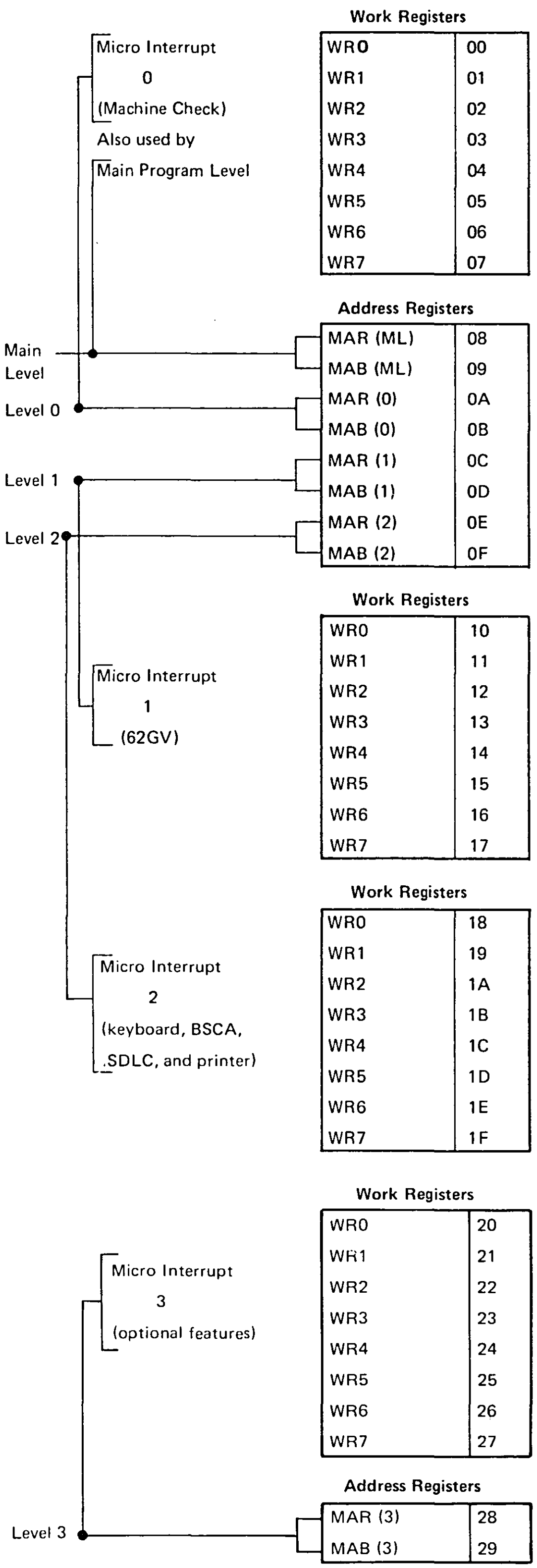
To restart the processing unit, return the switch to PROC RUN and press CE START. The processing unit starts at the micro instruction addressed by MAR.

INSN STEP/DPLY LSR

With the MODE SELECTOR switch in this position, pressing the CE START key causes the next sequential micro instruction or a branch instruction to be executed. In addition, the contents of a selected LSR can be displayed. To specify the LSR to be displayed, set data switches 3 and 4 to its hex address.



LSR Subdivision and Micro Interrupt Levels



Register	Hex Address
Work Registers	
WR0	00
WR1	01
WR2	02
WR3	03
WR4	04
WR5	05
WR6	06
WR7	07
Address Registers	
MAR (ML)	08
MAB (ML)	09
MAR (0)	0A
MAB (0)	0B
MAR (1)	0C
MAB (1)	0D
MAR (2)	0E
MAB (2)	0F
Work Registers	
WR0	10
WR1	11
WR2	12
WR3	13
WR4	14
WR5	15
WR6	16
WR7	17
Work Registers	
WR0	18
WR1	19
WR2	1A
WR3	1B
WR4	1C
WR5	1D
WR6	1E
WR7	1F
Work Registers	
WR0	20
WR1	21
WR2	22
WR3	23
WR4	24
WR5	25
WR6	26
WR7	27
Address Registers	
MAR (3)	28
MAB (3)	29

Mode Selector Switch (Continued)

ALTER MAR IRPT

This position of the MODE SELECTOR switch allows you to alter the MAR for the current interrupt level.

When altering this register for the display or alter function, the initial contents of this register must be noted. This register must be reinitialized to its original value before returning to the microprogram.

With the switch in this position, the 16 binary bits from the data switches 1, 2, 3, and 4 are entered into the current MAR when the CE START key is pressed. Data switch settings are displayed in the display lights.

ALTER STOR

This position is used to alter the contents of main storage or control storage. It is used with the STOR SEL switch, MAR, and the data switches.

The STOR SEL switch controls whether main storage or control storage is accessed. MAR contains the address of the location to be altered.

If main storage is being altered, the contents of data switches 3 and 4 are stored in the addressed location. If control storage is being altered, the contents of data switches 1, 2, 3, and 4 are stored. Data switch settings are displayed in the display lights.

Pressing the CE START key initiates the alter storage operation cycle. During this cycle the address in MAR is increased by one. Thus, it is possible to alter several sequential positions of storage without entering a new address in MAR each time.

DPLY STOR

This position is used to display the contents of SDR, or the contents of main storage or control storage. When displaying main storage or control storage, the switch is used with the STOR SEL switch and MAR.

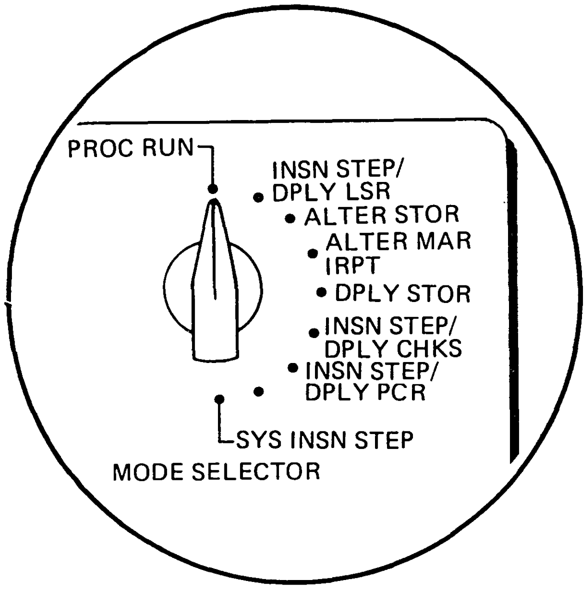
Turning the MODE SELECTOR switch to this position displays the current contents of SDR.

To display the contents of a location of main storage or control storage, it is necessary to do the following:

1. Set the address in MAR of the location you wish to display (alter MAR IRPT).
2. Select main storage or control storage by setting the STOR SEL switch.
3. Turn the MODE SELECTOR switch to the DPLY STOR position; then press CE START to initiate the operation.

During the storage cycle, which is initiated by the CE START key, the contents of storage is set into the SDR and displayed in the lights. MAR is increased by one. Thus, sequential bytes can be displayed without setting a new address into MAR each time.

When control storage is displayed, all 18 bits appear in the display lights. When main storage is displayed, 9 bits are displayed in the low-order byte of the display lights. The high-order byte of the display lights are all on but mean nothing.



Mode Selector Switch (Continued)

INSN STEP/DPLY CHKS

With the MODE SELECTOR switch in this position, pressing CE START executes the next sequential micro instruction or a branch. At the end of each step, the processing unit error byte and the port error byte are displayed in the display lights.

The following charts, one for the processing unit errors and one for port errors, list the error and cause for each bit:

Processing Unit Error Byte (High-Order)

Bit	Error	Cause
0	SDR parity check	Parity is incorrect in the SDR.
1	SAR parity check	Parity is incorrect in the SAR.
2	Storage gate parity check	Parity is incorrect at the output of the storage gate in the data flow.
3	ALU gate parity check	Parity predicted does not agree with the parity generated at the ALU gate.
4	Invalid control storage address/SAR[1]	Indicates that control storage was addressed outside its boundaries.
5	Invalid main storage address/SAR[1]	Indicates that the main storage address exceeds the system main storage size.
6	Not used	
7	Microcode check	Indicates that the microprogram was lost in a loop for 6 seconds.

Port Error Byte (Low-Order Byte)

Bit	Error	Cause
0	DBO parity check	Incorrect parity was detected by an attachment on the data bus out.
1	Invalid device assignment	Indicates that the port put an address on the DBO but no response was received from an attachment within the required time. (Port raised the control out line to address an attachment and the attachment did not respond by activating the service in line within 5.4 μs.) This check can also occur if the DBO has incorrect parity during the transmission of an address.
2	DBI parity check	Incorrect parity was detected by the port during the transfer of data from an attachment.
3	Timeout check	The channel detected an error in the normal channel sequence. This check occurs if an attachment does not deactivate the service in line within 5.4 μs after the rise of the service out line.
4	CBI/DBI not zero	The I/O lines were not cleared in time. The check is made after the service out line falls during T6 time after transferring a byte of data to or from an attachment.
5	System bus parity check	Incorrect parity was detected on the data sent from the processing unit to the port (the check is made when the service out line is active), or when data is being sent to the 62GV attachment during a burst mode operation.
6	Burst mode operation check	Any processing unit or port parity check was detected during a burst mode operation.
7	Invalid port	Bits 4-7 of work register 0 (high byte) were not 0000.

INSN STEP/DPLY PCR

With the MODE SELECTOR switch in this position, pressing CE START executes the next sequential micro instruction or a branch instruction. At the end of each step, the eight bits of the PCR are displayed in the high-order byte of the display lights.

SYS INSN STEP

When the MODE SELECTOR switch is turned to this position, the STOP light comes on. Each time the CE START key is pressed and released, one system instruction is executed. One exception to this is the supervisor call (SVC) instruction; it will not be executed.

If the processing unit is running when the MODE SELECTOR switch is moved to the SYS INSN STEP position, the CE START key must be pressed and released to complete the system instruction that was in progress.

---

[1] Bits 4 and 5 both on indicates parity is incorrect in the SAR.

7.2.2 IMPL-IPL Switches

The IMPL and IPL switches select the IMPL (initial microprogram load) and IPL (initial program load) devices. The IMPL and IPL devices are the 62GV (disk) and the 33FD (diskette).

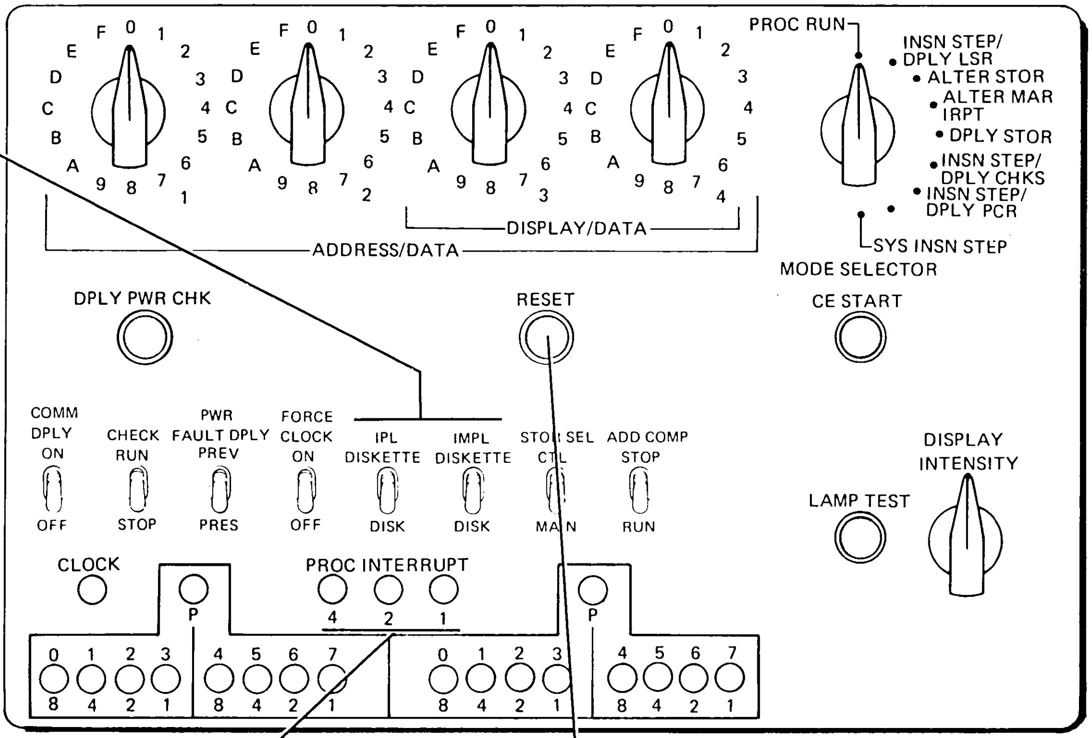
During normal operations both IMPL and IPL are from the 62GV. When the LOAD switch is pressed and released, control storage is loaded with system diagnostic tests from the IMPL device. After successful completion of these tests, the emulator and SCP (system control program) are loaded. The microprogram then loads main storage from the selected IPL device.

IMPL Switch

This switch selects the IMPL device. In the DISK position, control storage is loaded from the 62GV when the LOAD key on the operator control panel is pressed. In the DISKETTE position, control storage is loaded from the 33FD.

IPL Switch

The DISK position of this switch selects the 62GV as the IPL device. In the DISKETTE position, IPL is from the 33FD.



7.2.3 PROC INTERRUPT Lights

These lights indicate the current interrupt level in progress. The interrupt is indicated in the lights as follows:

Lights			Interrupt Level
4	2	1	
X	X	X	0 (machine check)
		X	1
	X		2
			Main[1]
X	X	3	(optional features)

---

[1] All lights off indicate main level.

7.2.4 RESET Key

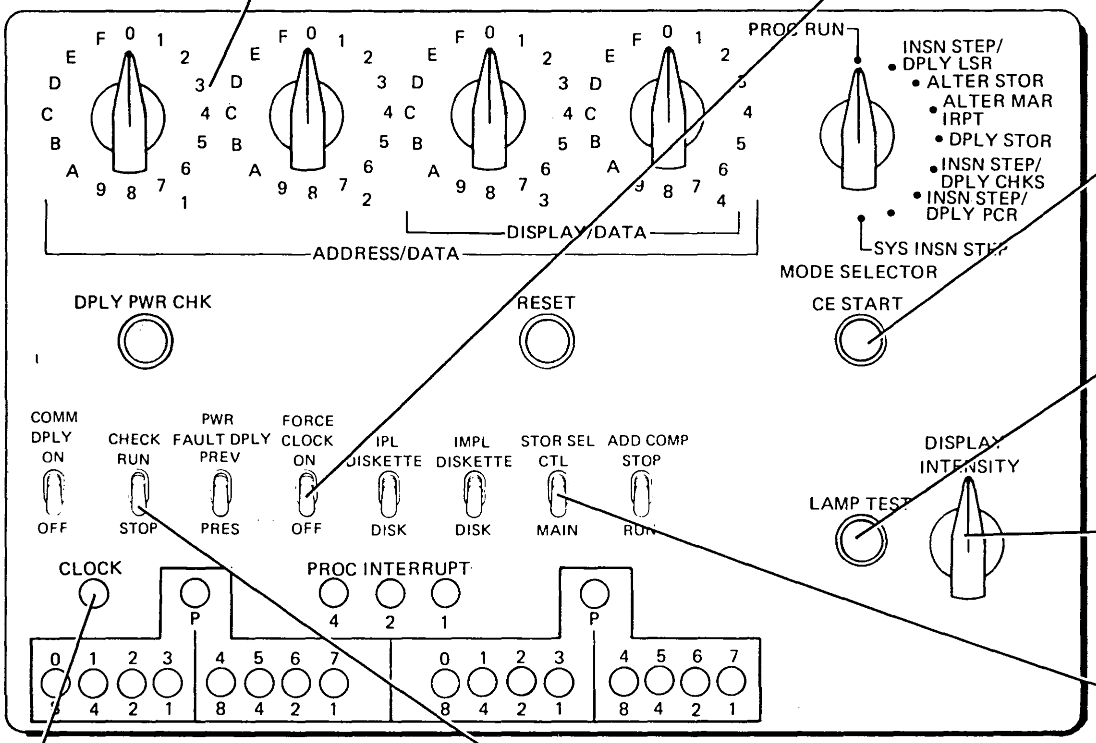
Pressing this key causes the following to occur:

1. The microprogram address register (MAR) is initialized to hex 0000.
2. Present power fault latches are transferred to previous power fault latches and the present power fault latches are reset.
3. The processing unit timing circuitry is initialized.
4. Error and status indicators are reset.
5. The PCR is initialized to the equal condition.
6. The 62GV is returned to track 0.

To restart the system, press either the CE START key or the LOAD key.

7.2.5 ADDRESS/DATA DISPLAY/DATA Switches

These four switches are used with several positions of the MODE SELECTOR switch to enter addresses and data into main storage or control storage. Also, the DISPLAY/DATA switches (3 and 4) are used to display the LSRs. Their specific use is covered under the various positions of the MODE SELECTOR switch.



7.2.6 CLOCK Light

This indicator is turned on by the run latch or the block processor clock signal from an I/O attachment.

7.2.7 FORCE CLOCK Switch

This switch initiates continuous processing unit cycles (processing unit clocks run). With the MODE SELECTOR switch in the ALTER STOR position, the contents of the data switches are transferred consecutively to all main storage or control storage locations when the FORCE CLOCK switch is on. The starting address is contained in MAR. Turning the switch off terminates the operation.

This switch also forces the system into run mode overriding the stop condition of the CHECK (RUN/STOP) switch.

7.2.8 CHECK Switch

This switch controls whether the system continues to run or stops when a parity error occurs. When the switch is in the STOP position, the system stops at the end of the current micro instruction when a parity error occurs. When the switch is in the RUN position, the error is retained but the system continues to run.

The STOP position of this switch is overridden when the FORCE CLOCK switch is on.

7.2.9 CE START Key

Pressing this key executes instructions beginning at the address specified by the current microprogram address register.

7.2.10 LAMP TEST Switch

When this switch is pressed, all system lights are turned on unless the lamps or the lamp circuits are defective.

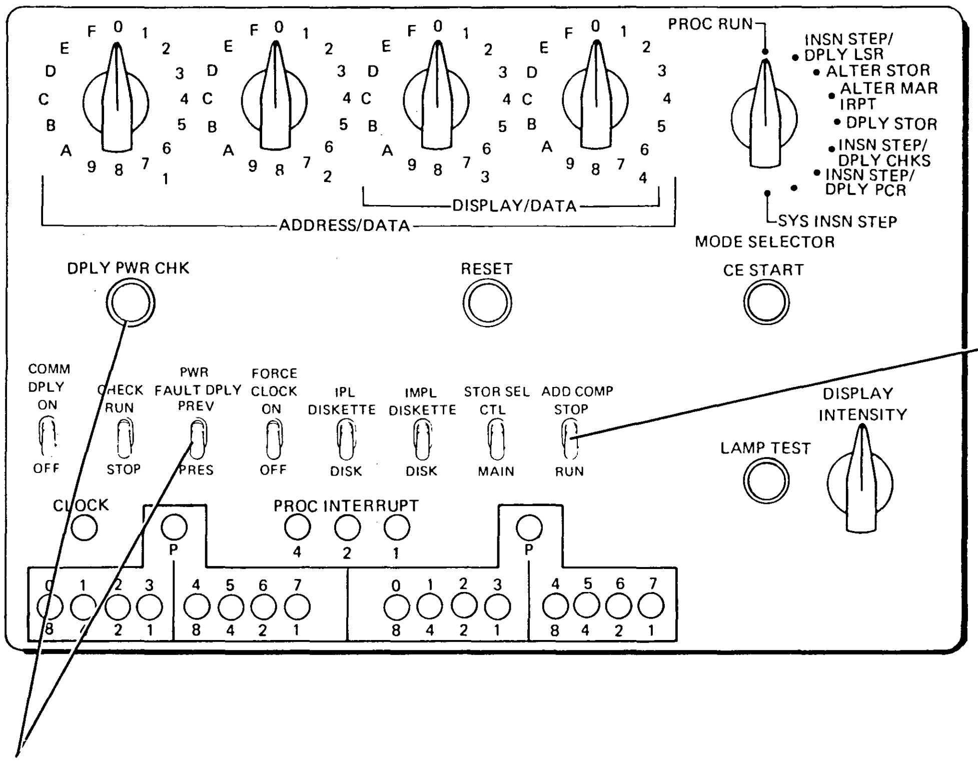
7.2.11 DISPLAY INTENSITY Control

This control adjusts the intensity of the display screen.

7.2.12 STOR SEL Switch

The storage select switch controls whether main storage or control storage is addressed on manual operations and address compare operations.

When addressing main storage on a manual operation or address compare operation, the switch must be in the MAIN position. To address control storage on a manual operation or address compare operation, the switch must be in the CTL position.



7.2.13 PWR FAULT DPLY Switch and DPLY PWR CHK Key

When a system power failure occurs, the power supply at fault and the type of failure are stored in latches. These latches are on the power sequence card and retain their information as long as the mainline switch is kept on. These latches are called the present power fault latches. When the RESET key is pressed and power turned on, the information recorded in the present power fault latches is transferred to another set of latches called the previous power fault latches. Thus, it is possible to store the reason for a current power failure and the reason for a preceding power failure in latches. The contents of the power fault latches can be displayed even though power is down on the operator control panel.

To display the present power fault latches, switch PWR FAULT DPLY to the PRES position, then press DPLY PWR CHK key. If the PWR FAULT DPLY switch is in the PREV position, the previous power fault latches are displayed.

The power fault conditions are displayed in the high-order byte on the CE control panel. The meaning of the specific bits is as follows:

Bits 0 and 1

01	Undervoltage
10	Overvoltage
11	Overcurrent

Bits 2 and 3

01	Multilevel filter assembly
11	Dual level filter assembly

Bits 4 through 7

0001	-4V at fault	Multilevel filter assembly
0010	+5V at fault	
0011	-5V at fault	
0100	+6V at fault	
0101	+8.5V at fault	
0110	+12V at fault	
0111	-12V at fault	
1000	+24V at fault	Dual level filter assembly
1001	-24V at fault	
1111	Both level failing in the dual level filter assembly or +5V, +8.5V, and -12V failing in the multilevel filter assembly.	

7.2.14 ADD COMP Switch

RUN Position

The ADD COMP switch in the RUN position is used with the STOR SEL switch and the data switches. An address compare synchronization signal (A-A1J2D12) is provided whenever the address switches match an address in SAR. The STOR SEL switch determines if main storage or control storage is used for the compare.

STOP Position

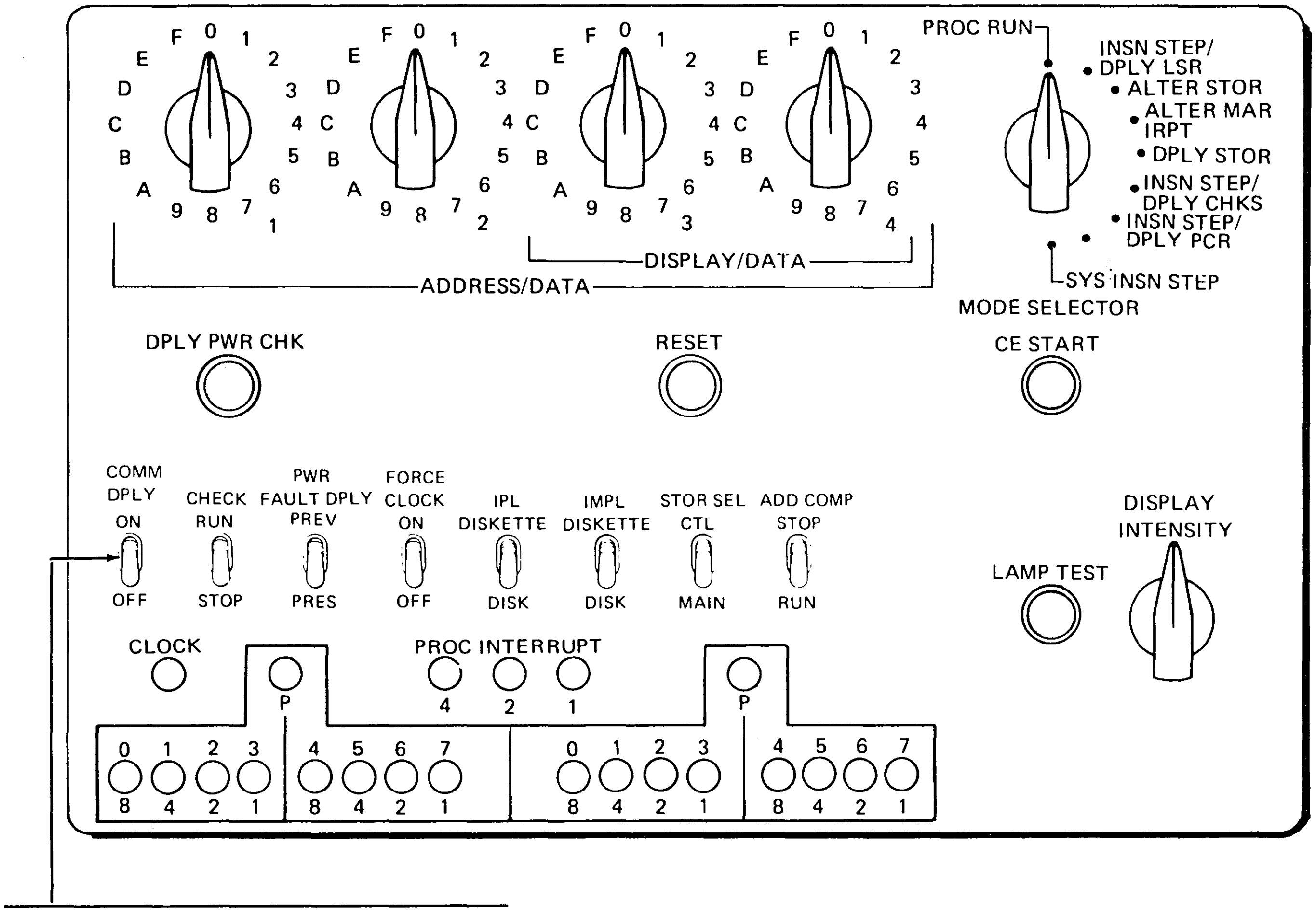
The ADD COMP switch in the STOP position is used with the STOR SEL switch and the data switches. The system stops and an address compare synchronization signal is provided whenever the data switches match an address in SAR. The STOR SEL switch determines if main storage or control storage is used for the compare. The time when the system stops is determined by the following considerations:

1. If the address compare is on a main storage address, the emulator completes the current system level instruction being executed and then enters a stop microprogram loop. The STOP light turns on. The microprogram remains in this loop until the START key is pressed.

2. With the exception of I/O operations, an address compare on a control storage address stops the processing unit clock after executing the micro instruction at that address. To restart, the CE START key must be pressed.

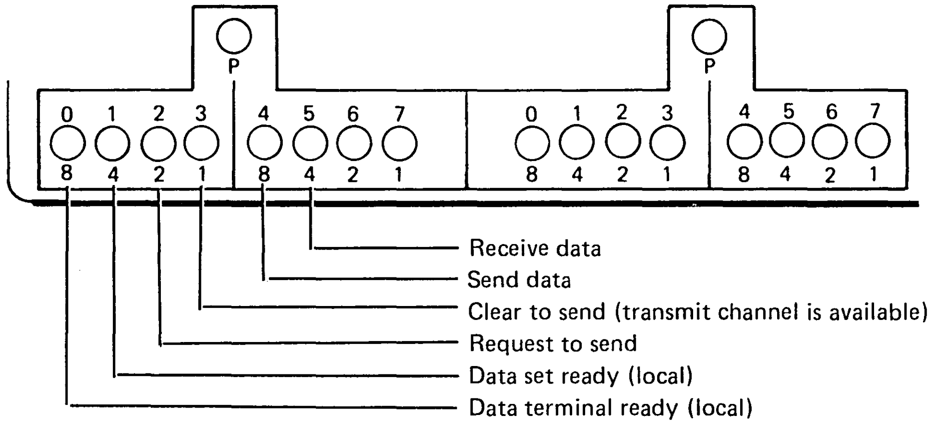
   If an address compare stop is made on a control storage address during the execution of a system instruction, the results of that instruction are unpredictable.

7.2.15 Feature Switches



COMM DPLY Switch

The COMM DPLY switch is on the panel only if a telecommunications adapter is installed on the system. When set ON, the switch activates the leftmost six lights at the bottom of the CE panel. The lights indicate the following lines are active when they are on:



Receive data
Send data
Clear to send (transmit channel is available)
Request to send
Data set ready (local)
Data terminal ready (local)

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8.0.0 Power Supplies

Note: Maintenance information for the high frequency and trilevel power supplies is given in paragraphs 8.1.0 through 8.1.12; maintenance information for the ferro-resonant power supply is given in paragraphs 8.2.0 through 8.2.12. To determine which power supplies your machine has, compare your power supply with the drawings on Appendix page C-1.

8.1.0 HIGH FREQUENCY AND TRILEVEL POWER SUPPLIES

DANGER
With the mainline switch on: Control voltages are present at the power sequence card, the ac board, the multilevel supply, the dual level supply or trilevel supply, and the CE control panel.

When the power switch on the operator control panel is turned on:
1. Approximately 300 Vdc unreferenced is on the ac board, the multilevel supply, and the dual level or trilevel supply.
2. AC line voltage is present at the disk drive, 33FD, the fans, ACTB1, and the trilevel supply.
3. DC voltages from the power supplies to the logic gate and printer are present.

8.1.1 Introduction

All power supplies for the system are located at the back right side of the machine. AC power enters the system at the primary power area, which contains the mainline switch, two fuses, and a line filter. The mainline switch controls all power to the system.

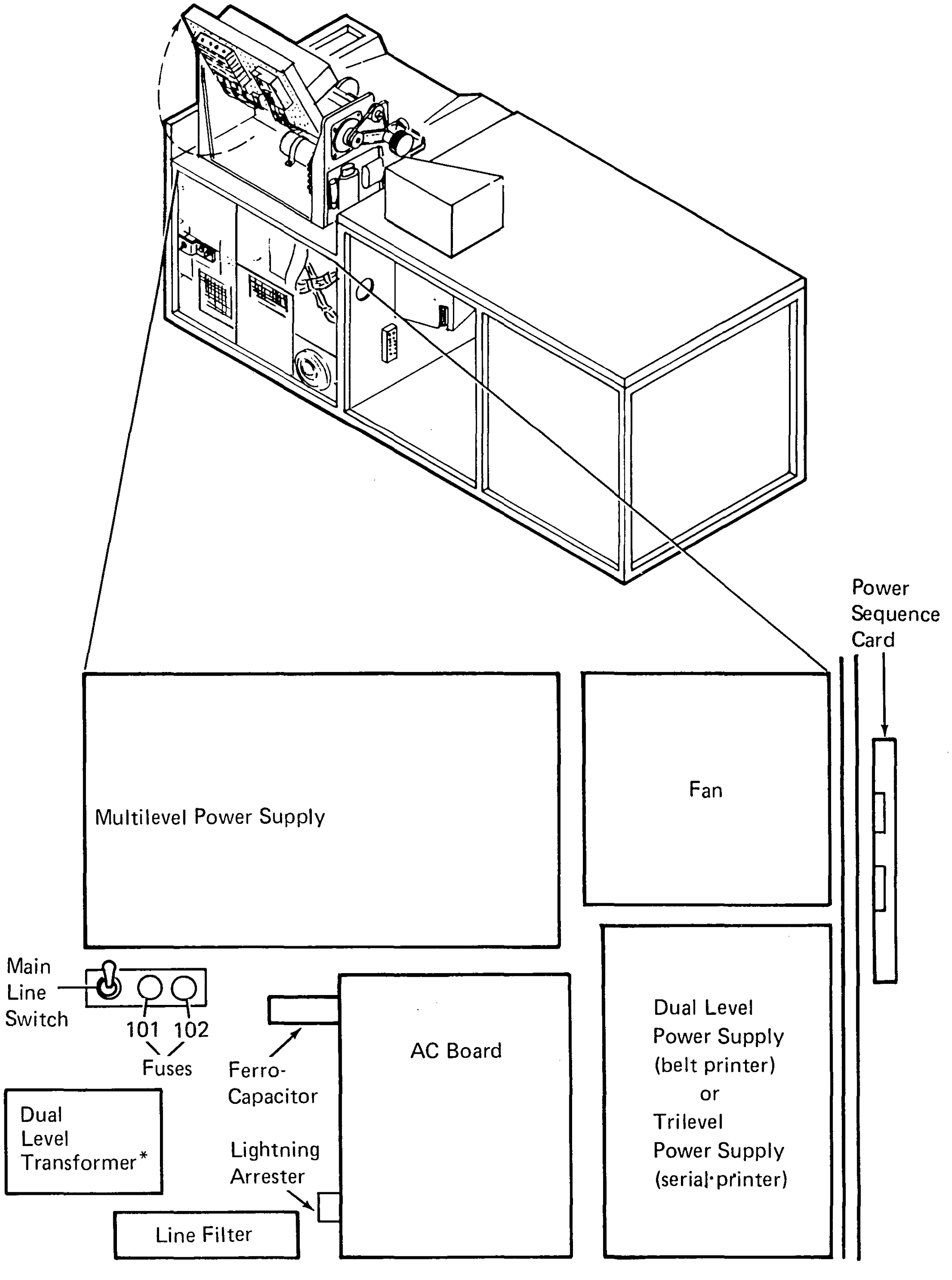
When the mainline switch is on, the sequence control voltages of +24 Vdc, -24 Vdc, +5 Vdc, +6 Vdc, and -6 Vdc are present. These voltages originate on the ac board. Further power sequencing and distribution is controlled by the power switch on the operator control panel.

The ac board distributes ac power and sequence voltage, and contains the motor relays for the system.

The multilevel power supply provides the +12 Vdc, -12 Vdc, +8.5 Vdc, +6 Vdc, +5 Vdc, -5 Vdc, and -4 Vdc.

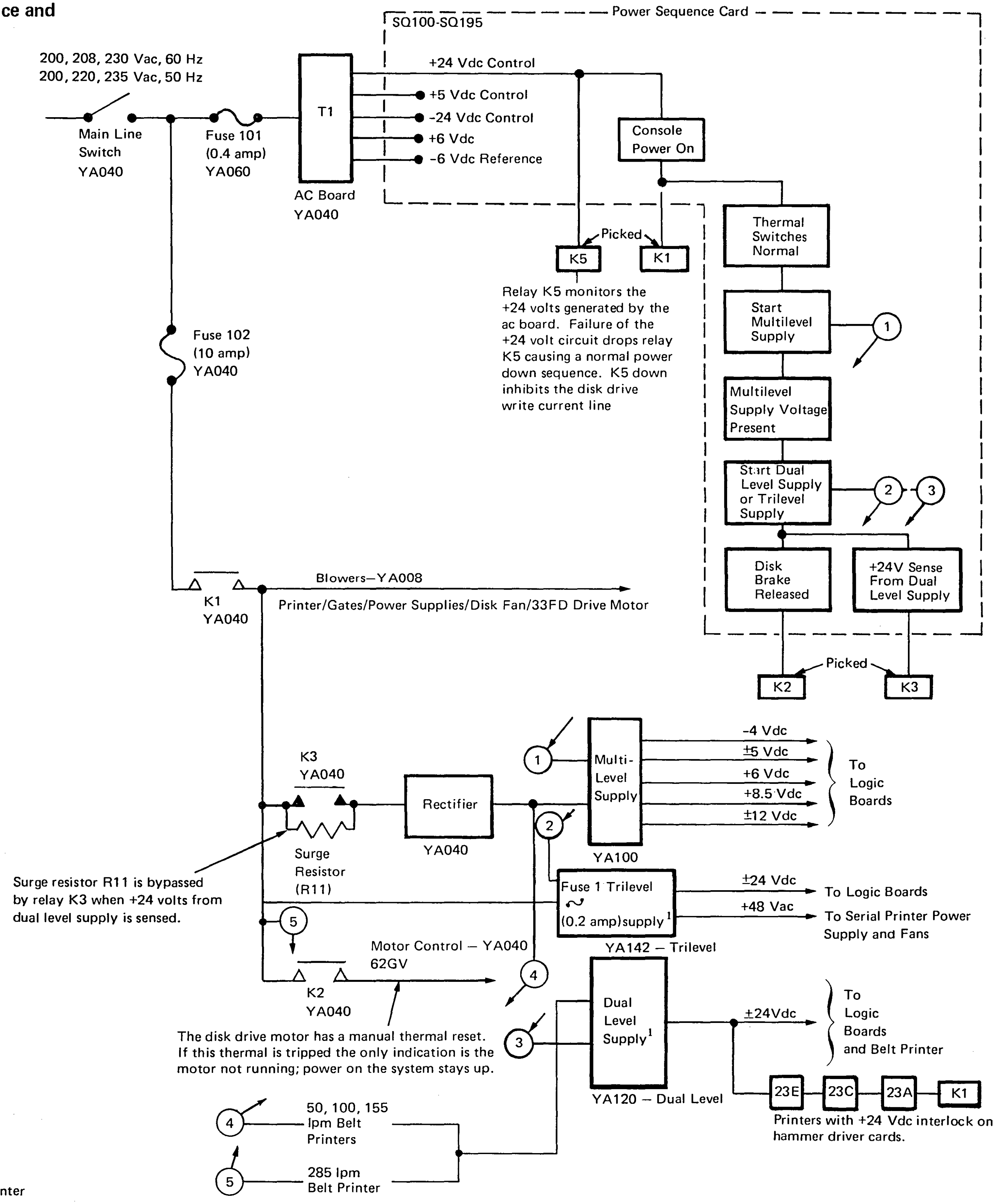
Either a dual level or a trilevel power supply is installed. The dual level power supply provides the +24 Vdc and –24 Vdc, when a belt printer is installed. The trilevel power supply provides the +24 Vdc, –24 Vdc, and 48 Vac when a serial printer is installed.

The power sequence card provides both power sequence control and power fault retention capabilities. The source and reason for dropping power is retained in a set of latches on the sequence card and can be displayed by the CE (7.2.13).



*285 lpm printer only.

8.1.2 Power Sequence and Distribution



Relay K5 monitors the +24 volts generated by the ac board. Failure of the +24 volt circuit drops relay K5 causing a normal power down sequence. K5 down inhibits the disk drive write current line

Surge resistor R11 is bypassed by relay K3 when +24 volts from dual level supply is sensed.

The disk drive motor has a manual thermal reset. If this thermal is tripped the only indication is the motor not running; power on the system stays up.

Printers with +24 Vdc interlock on hammer driver cards.

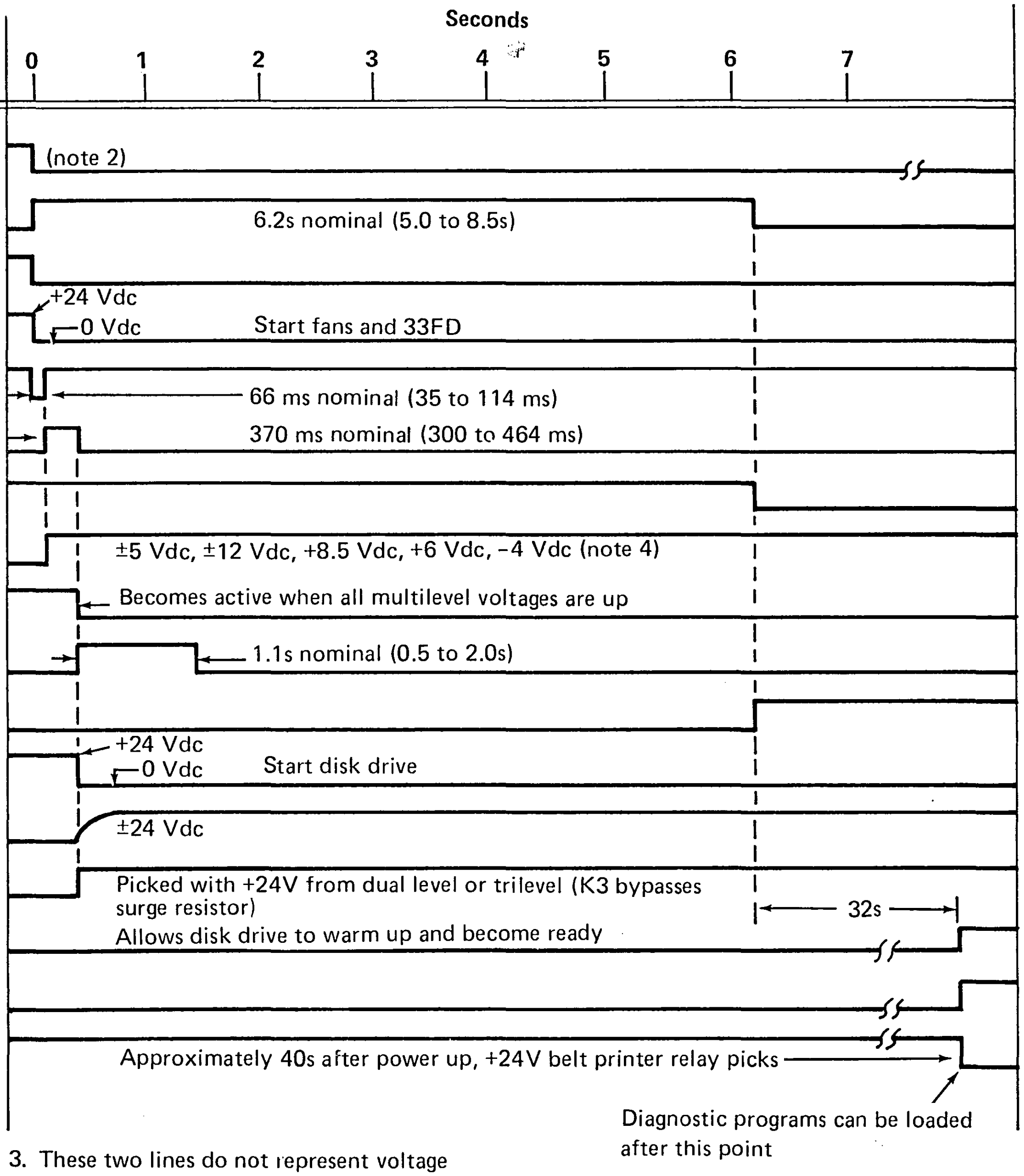
---

[1] Dual Supply – Belt Printer
Trilevel Supply – Serial Printer

8.1.3 Power On Sequence

Sync—On Test Point B09 (+ Off)

	Line Name or Function	Test Point (note 1)	ALD
1	- Power On		SQ180
2	+ On SS	D06	SQ100
3	- Start Multilevel	D12	SQ110
4	- Pick K1	D03	SQ115
5	- Delay SS	B07	SQ130
6	+ Start Multilevel SS	D08	SQ115
7	+ Inhibit UV Multilevel	None	SQ110
8	Bring Up Multilevel Voltages (note 3)		
9	-Start Dual Level[1]	B10	SQ110
10	+Start Dual Level SS[1]	D07	SQ115
11	-Inhibit UV Dual Level[1]	None	SQ110
12	- Pick K2	B03	SQ115
13	Bring Up Dual Level Voltages (note 3)[1]		
14	Pick K3	None	
15	-Power On Delay (in disk drive)	A2F2M04	DG100
16	- Channel Data Protect	A2Q2J12	DQ050
17	+ Hammer Fault	A2Q2G08	DQ090



Notes:

1. These are power sequence card test points except for the bottom three.
2. The levels of the signals on this chart are normal logic levels except where otherwise indicated.
3. These two lines do not represent voltage levels but indicate the time the indicated voltages are present.
4. The -5 Vdc and +8.5 Vdc outputs are monitored following the time out of the start multilevel SS. System power is dropped immediately if the +8.5 Vdc is present without the -5 Vdc.

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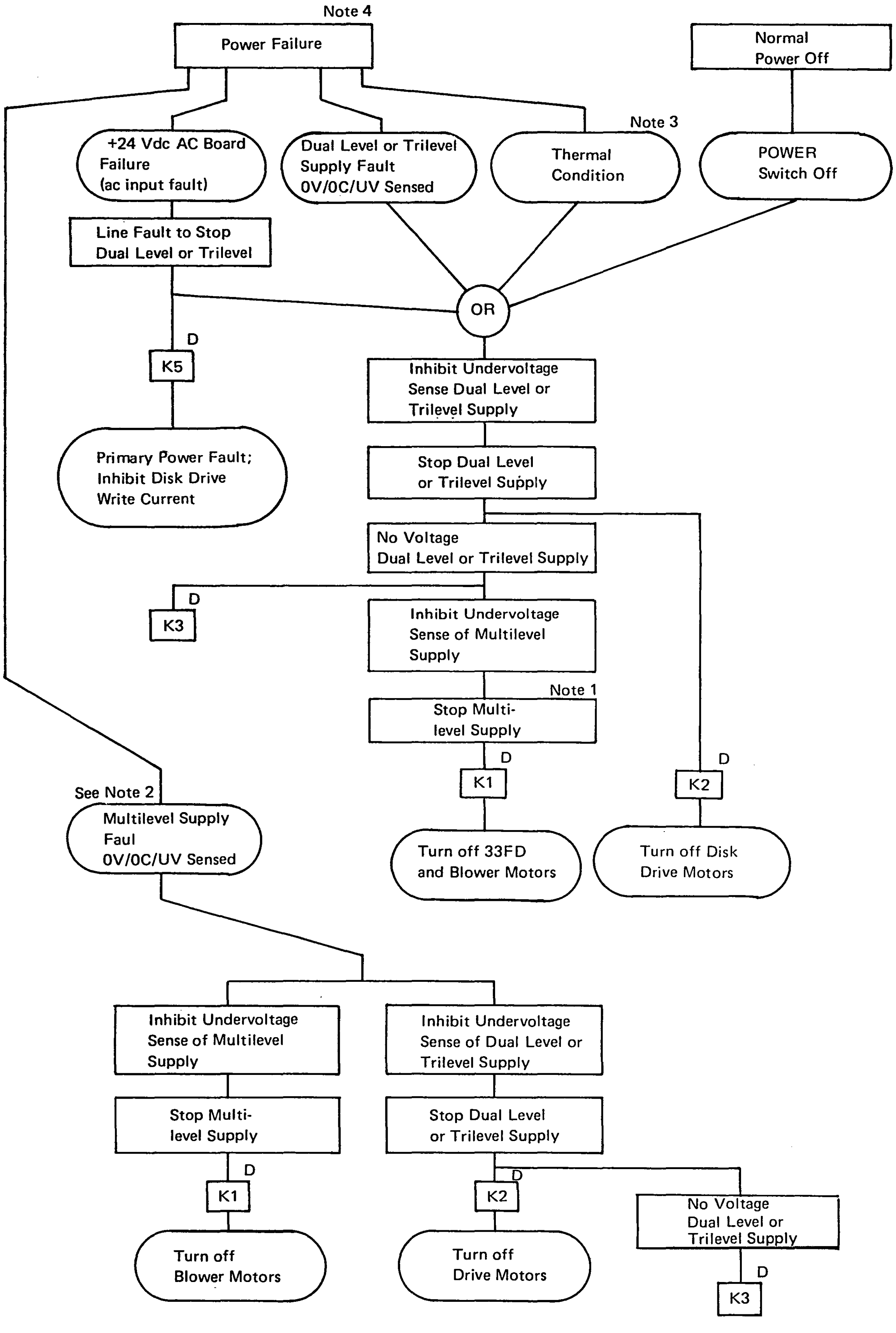
[1] Also refers to trilevel supply when serial printer is installed.

8.1.4 Power Off Sequence

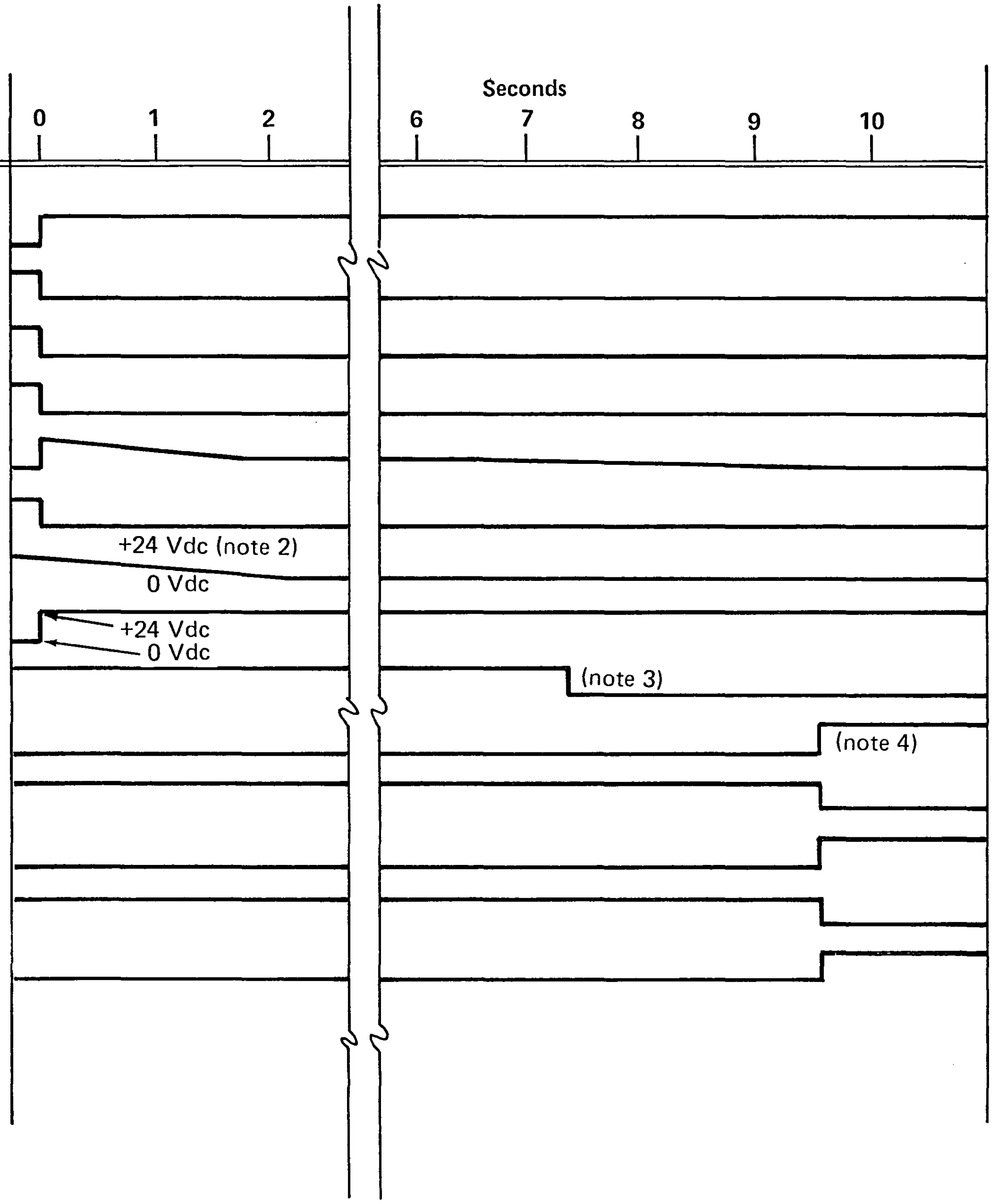


Notes:

1. Plus and minus 24 volts must decrease to +4.6 volts and -2.1 volts, respectively, before dropping the multilevel supply.
2. A multilevel supply failure simultaneously turns off the multilevel and dual or trilevel level supplies.
   A multilevel supply fault or dual level or trilevel supply fault turns on the PWR CHK light on the operator control panel.
3. Temperature too high in the power supply, belt printer, or gate turns on the TH CHK light on the operator control panel.
4. A loss of ac input power (fuse 101 blown, mainline switch turned off, or line cord pulled) is not indicated by the PWR CHK light.
   To restore system power following a power fault condition:
   a. Turn operator control panel POWER switch to OFF.
   b. Press RESET switch on CE control panel.
   c. Turn operator control panel POWER switch to ON.

Sync + On Test Point B09 (+ Off)

	Line Name or Function	Test Point (Note 1)	ALD
1	- Power On		SQ180
2	- Stop Dual Level[1]	B13	SQ115
3	- Power on Delay (in disk drive)	A2F2M04	DG100
4	- Channel Data Protect	A2Q2J12	DQ050
5	+ Hammer Fault	A2Q2G08	DQ090
6	- Inhibit UV Dual Level[1]	None	SQ110
7	Drop Dual Level Voltages[1]		
8	- Pick K2	B03	SQ115
9	Drop K3	None	
10	+ No Voltage Dual Level[1]	G13	
11	- Stop Multilevel	D13	SQ115
12	+ Inhibit UV Multilevel	None	SQ110
13	Drop Multilevel Voltages		
14	- Pick K1	D03	SQ115



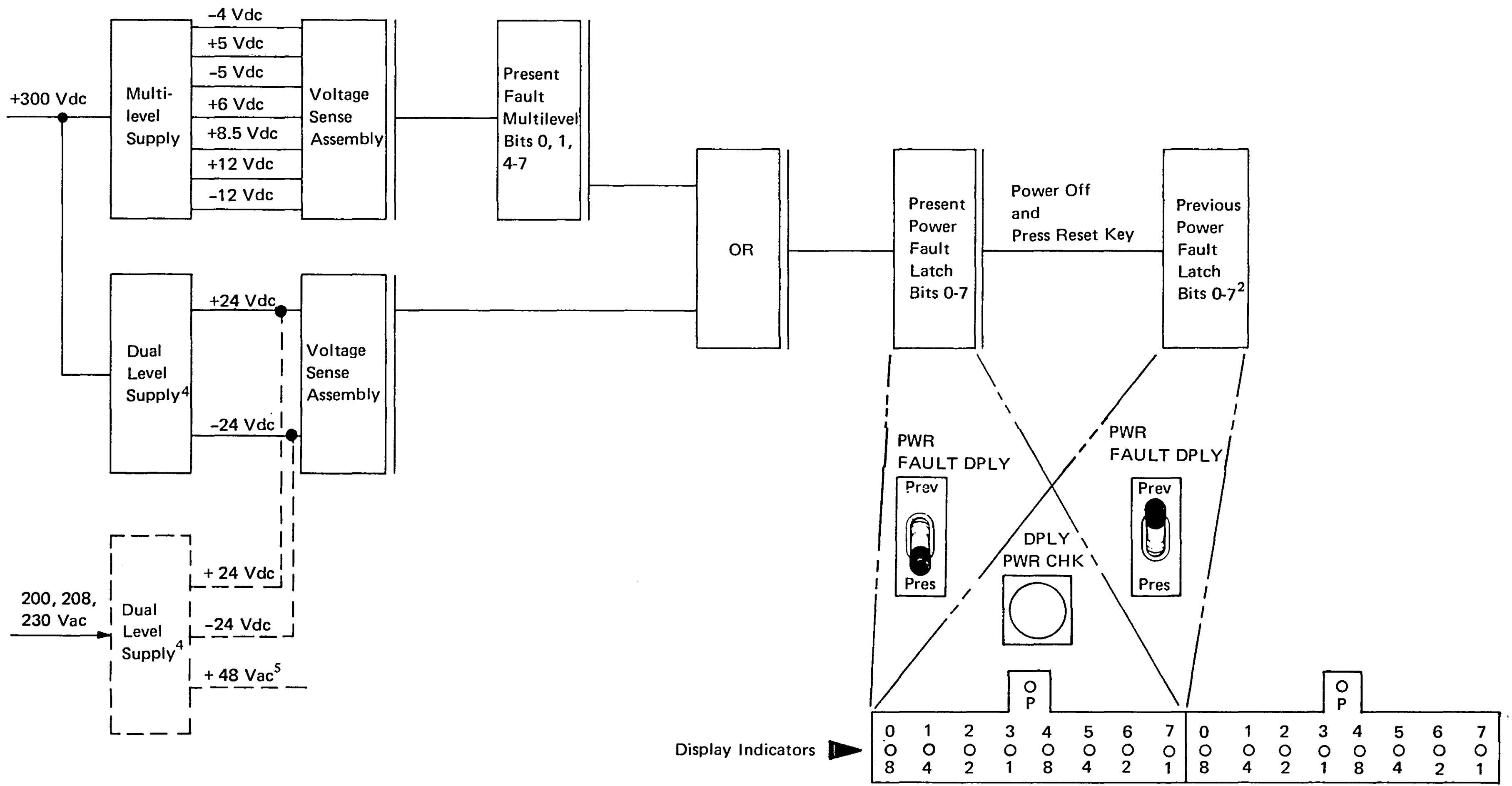
Notes:

1. These are sequence card test points except for lines 3, 4, and 5.
2. The +24 Vdc decays slowly as shown. The -24 Vdc decays in approximately 0.1s.
3. Time for power down depends on the decay of +24 Vdc to a level where K3 no longer stays picked.
4. Becomes plus when +24 Vdc decays to +4.6 and -24 Vdc decays to -2.1. This prevents the functioning of the disk drive write circuits.

---

[1] Also refers to trilevel supply when serial printer is installed.

8.1.5 Voltage Sense And Power Fault Display



Type Of Failure Bit Code

01 — Undervoltage
10 — Overvoltage
11 — Overcurrent

Failing Supply Bit Code

01 — Multilevel Supply

11 — Dual Level Supply or Trilevel Supply[5]

Failing Voltage Level Bit Code

0000[1]
0001 — -4 Vdc
0010 — +5 Vdc
0011 — -5 Vdc
0100 — +6 Vdc
0101 — +8.5 Vdc
0110 — +12 Vdc
0111 — -12 Vdc

1000 — +24 Vdc[3]
1001 — -24 Vdc

1111 — Plus and minus 24 Vdc failing or dual level or trilevel supply or +5 Vdc, +8.5 Vdc and -12 Vdc failing on multilevel supply

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[1] If the voltage level that causes a fault is near the trip point of the respective monitoring circuit, the specific voltage level at fault is not indicated; only the type of failure and the failing supply are indicated.

[2] A previous power fault indication of 1111 1111 might be indicated when the mainline switch is switched from off to on.

[3] If power is up when a short occurs in the +24 Vdc distribution, the fault indications are as shown in the chart. If the short exists when power is brought up, an undervoltage indication will probably occur.

[4] Dual level — belt printer, Trilevel — serial printer.

[5] When the trilevel supply is installed, the indication refers to the +24 Vdc or -24 Vdc. No error indication for the 48 Vac errors.

8.1.6 Power Faults

8.1.6.1 Thermal Switches and Faults

There are thermal switches in the system at the following locations:

1. In the disk drive motor.
2. On top of the front logic card gate.
3. On top of the multilevel power supply.
4. On the belt printer card gate by the resistor heat sink. Thermal protection is not provided for the serial printer.

When an over temperature condition is sensed in the disk drive motor, the thermal switch is activated and the motor will not run; power stays up. This thermal switch must be manually reset.

When an over temperature condition is sensed in the disk drive motor, the thermal switch is acti-thermal check latch is set, the TH CHK light is turned on, and a normal power down is initiated. To reset the thermal check latch, the thermal detector must be cool, the operator control panel POWER switch turned to OFF, and the RESET switch on the CE control panel pressed.

8.1.6.2 Overvoltage Fault

When an overvoltage condition is detected on any voltage level, the power check latch is set, the fault is set into the present fault latches PWR CHK light is turned on, and the correct power down operation initiated. To reset the power check latch and move the encoded byte into the previous fault latches, the operator control panel POWER switch must be turned to OFF and the RESET switch on the CE panel pressed. After the fault condition is cleared, system power can be restored by turning the POWER switch to ON.

8.1.6.3 Undervoltage Fault

An undervoltage condition on any level responds the same as an overvoltage as described in the preceding paragraph.

However, undervoltage conditions are not detected during power up and power down.

8.1.6.4 Overcurrent Fault

An overcurrent condition on any level responds the same as an overvoltage as previously described.

8.1.7 Control Voltage Checkout

To check the ac board output control voltages, do the following:

1. Turn the mainline switch off.
2. Remove the power sequence card. (The control voltages are measured at the power sequence card socket.)
3. Turn the mainline switch on.
4. Measure the voltages at the following points on the power sequence card socket:

Voltages	Measuring Points Measured At	Reference
+24 Vdc	P13	D08
-6 Vdc	P12	D08
+6 Vdc	M12	D08
-24 Vdc	M10	D08
+5 Vdc	M07	D08

8.1.8 Manual Bring-Up Of The Multilevel, Dual Level, And Trilevel Supplies

In troubleshooting some power supply problems, it might be advantageous to bring up the power supplies manually. In this way the multilevel supply can be brought up and its voltages checked before bringing up the dual level or trilevel supply. However, the following precautions must be observed when manually bringing up the supplies:

CAUTIONS

- If your problem is overcurrent or overvoltage, do not use this procedure.
- If the system has a belt printer, disconnect P6 to prevent possible damage to the hammer driver cards. For P6 location, see page 4-77.
- Do not unload the +8.5 Vdc or -5 Vdc singly; they must be unloaded together to prevent damage to the FET logic.
- With the power supplies up and the stop lines (stop multilevel and stop dual level or trilevel) removed, any error detected will not sequence down the power supplies.
- Leave at least one load on each level for voltage regulation.
- Do not use the mainline switch to power down.
- Always ensure that the dual level supply is down before bringing the multilevel supply down.

To manually bring up the supplies, follow this sequence. The pins referred to are on the power sequence card socket.

1. Turn power off at the operation control panel. After the power is sequenced down, turn the mainline switch off.
2. Remove the power sequence card.
3. Connect a jumper wire from M08 to P05 (-K1 driver) on the power sequence card socket.
4. Turn the mainline switch on. The fans should start.
5. To bring up the multilevel supply, touch a jumper wire momentarily (at least 2 seconds) from P08 (ground) to U02 (start multilevel) on the power sequence card.

   Note: You will hear a hum when the multilevel supply comes up.

6. Measure the multilevel voltages.

Trilevel Power Supply (Serial Printer)

7. To bring up the trilevel supply, touch a jumper wire momentarily (at least 2 seconds) from P08 (ground) to U03 (start dual level [trilevel]).
8. Measure the trilevel voltages.
9. If a short in the load is suspected, the trilevel supply is capable of operating with all load connections removed (that is, E3, E4, E5).

   Note: The multilevel and dual level supplies must have the loads connected for proper operation.

   CAUTION
   The trilevel supply must be powered down before the multilevel supply is powered down.

   Connect a meter from E4 (+24 Vdc) to ground. Power down the trilevel by connecting a jumper from P08 (ground) to S03 (stop dual level [trilevel]) on the power sequence card. When the +24 Vdc reaches 0 Vdc, remove the jumper.

Dual Level Power Supply (Belt Printer)

7. To bring up the dual level supply, touch a jumper wire momentarily (at least 2 seconds) from P08 (ground) to U03 (start dual level) on the power sequence card socket.

   Note: You will notice a difference in [illegible] hum.

8. Measure the dual level voltages.
9. **CAUTION**
   The dual level supply must be powered down before the multilevel supply is powered down.

   Power down the dual level by touching a jumper wire momentarily (at least 2 seconds) from P08 (ground) to S03 (stop dual level) on the power sequence card socket.

10. Power down the multilevel supply by touching a jumper wire momentarily (at least 2 seconds) from P08 (ground) to S02 (stop multilevel) on the power sequence card socket.
11. Turn the mainline switch off.
12. Remove the jumper wire from M08 to P05.
13. Reinstall the power sequence card in the socket.
14. If the system has a belt printer, reconnect P6.

8.1.9 Power Supply Voltages

		Voltage	Tolerance	Test Measuring Points Measured At	Reference	Overvoltage Sense[1]		Undervoltage Sense[1]	
						Lower Limit	Upper Limit	Lower Limit	Upper Limit
Multilevel Supply Voltages	Input Voltages	+300 Vdc	+230 to +365 Vdc	E2	E1				
		+24 Vdc (control)	±10%	J3-14	J3-10				
	Output Voltages	-4 Vdc	+4% -2%	PDTB2-4	PDTB1-1	-4.18	-6.0	-3.88	-3.0
		+5 Vdc	+10% -8%	PDTB1-5	PDTB1-1	+5.5	+6.1	+4.7	+3.8
		-5 Vdc	+10% -8%	PDTB1-8	PDTB1-1	-5.5	-6.1	-4.7	-4.0
		+6 Vdc	+10% -8%	PDTB2-3	PDTB1-1	+6.6	+7.6	+5.64	+4.6
		+8.5 Vdc	+10% -8%	PDTB2-1	PDTB1-1	+9.35	+10.5	+7.99	+6.5
		+12 Vdc	+10% -8%	PDTB2-5	PDTB1-1	+13.2	+16.0	+11.28	+9.2
		-12 Vdc	+10% -8%	PDTB2-6	PDTB1-1	-13.2	-16.0	-11.28	-9.2

		Voltage	Tolerance	Test Measuring Points Measured At	Reference	Overvoltage Sense[1]		Undervoltage Sense[1]	
						Lower Limit	Upper Limit	Lower Limit	Upper Limit
Dual Level Supply Voltages (belt printer)	Input Voltage	+300 Vdc	+230 to +365 Vdc	E2	E1				
		+24 Vdc (control)	±10%	J1-5	J1-3				
	Output Voltage	+24 Vdc	+10% -10%	PDTB2-8	PDTB1-1	+26.4	+29.25	+22.56	+18.25
		-24 Vdc	+10% -8%	PDTB2-7	PDTB1-1	-26.4	-30.0	-22.56	-18.25

		Voltage	Tolerance	Test Measuring Points Measured At	Reference	Overvoltage Sense[1]		Undervoltage Sense[1]	
						Lower Limit	Upper Limit	Lower Limit	Upper Limit
Trilevel Supply Voltages (serial printer)	Input Voltage	204 Vac	±12%	E2	E1				
		230 Vac	±10%	E2	E1				
	Output Voltage	+24 Vdc	+10% -10%	PDTB2-8	PDTB1-1	+26.4	+29.25	+22.56	+18.25
		-24 Vdc	+10% -8%	PDTB2-7	PDTB1-1	-26.4	-30.0	-22.56	-18.25

		Voltage	Tolerance			Test Measuring Points
			Min	Nom	Max	
48 Vac (serial printer)	Output Voltage	48 Vac	41.5	46.5	51.15	E3 and E6

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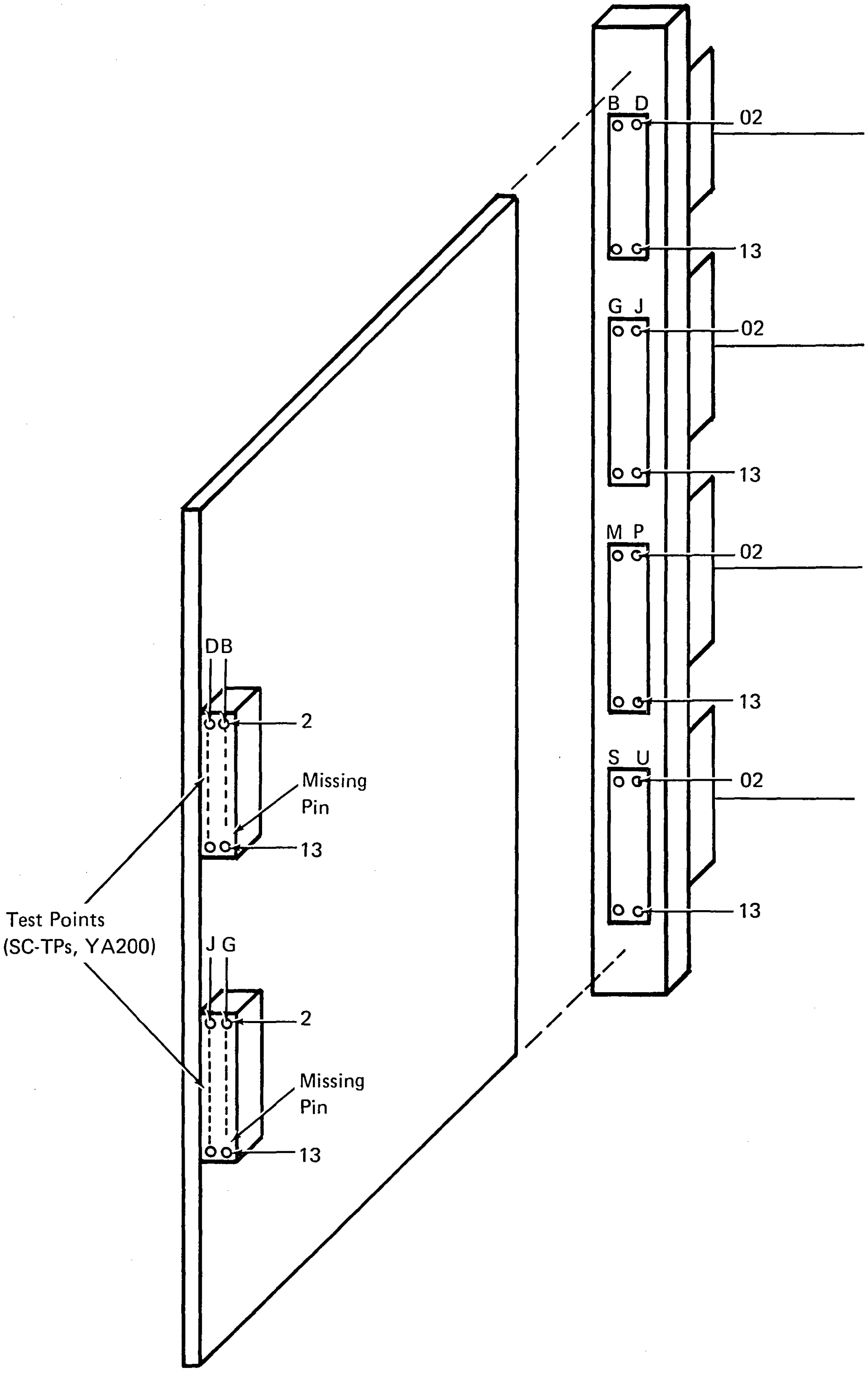
[1] The overvoltage or undervoltage condition does not trip the power down sequence before the lower limit is reached, but does definitely trip before the upper limit.

8.1.10 Power Sequence Card Pins And Test Points



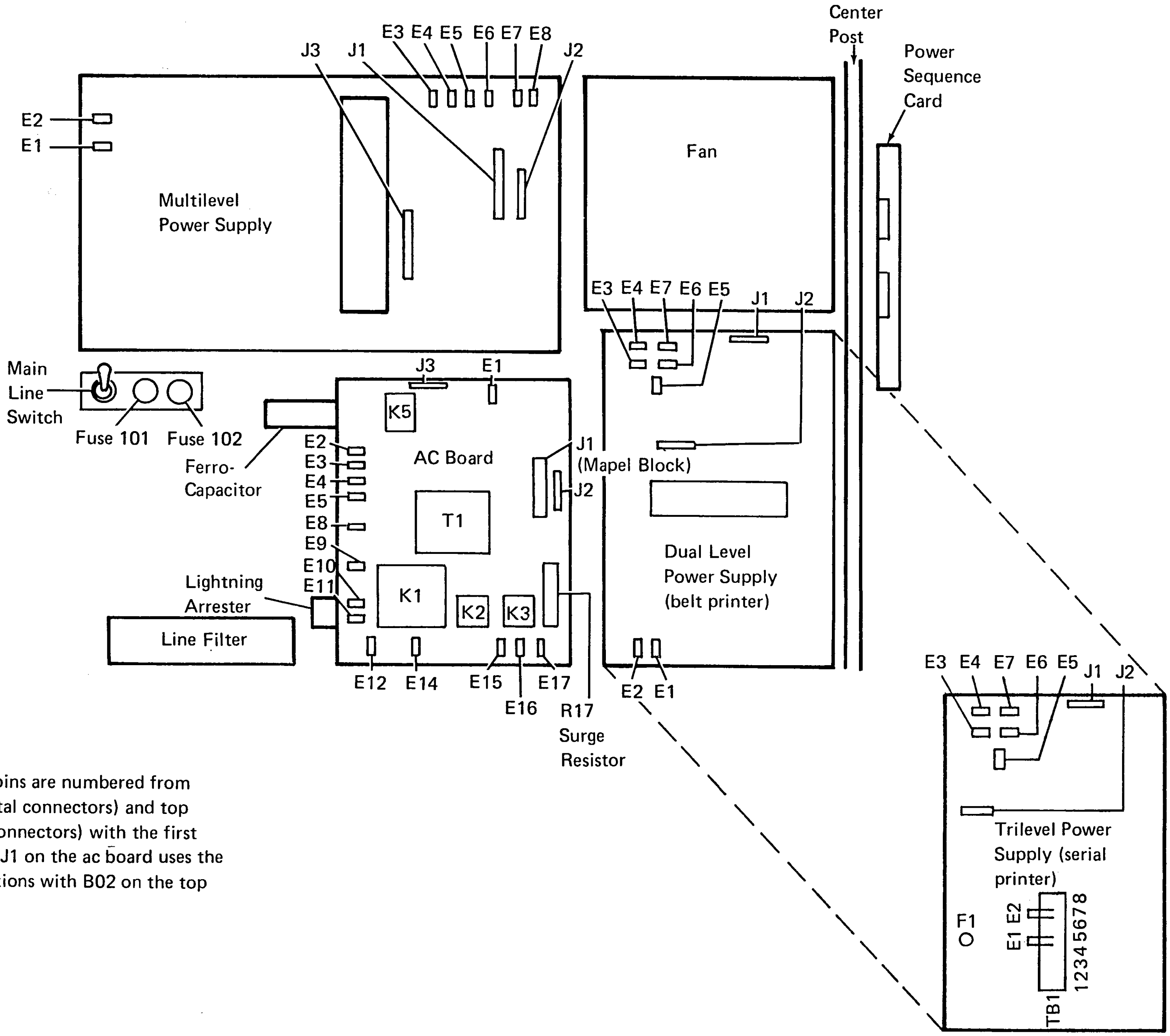
Flat cable going to 01A-A1A2 for CE panel display lights and operator panel switches (SQ100-SQ195).

Jumper card for testing. Ties all the singleshot outputs back to the sequence card.

Flat cable to ac board. Contains control voltages, K1 and K2 drivers, thermal sense, channel data protect (YA040, YA060, YA070).

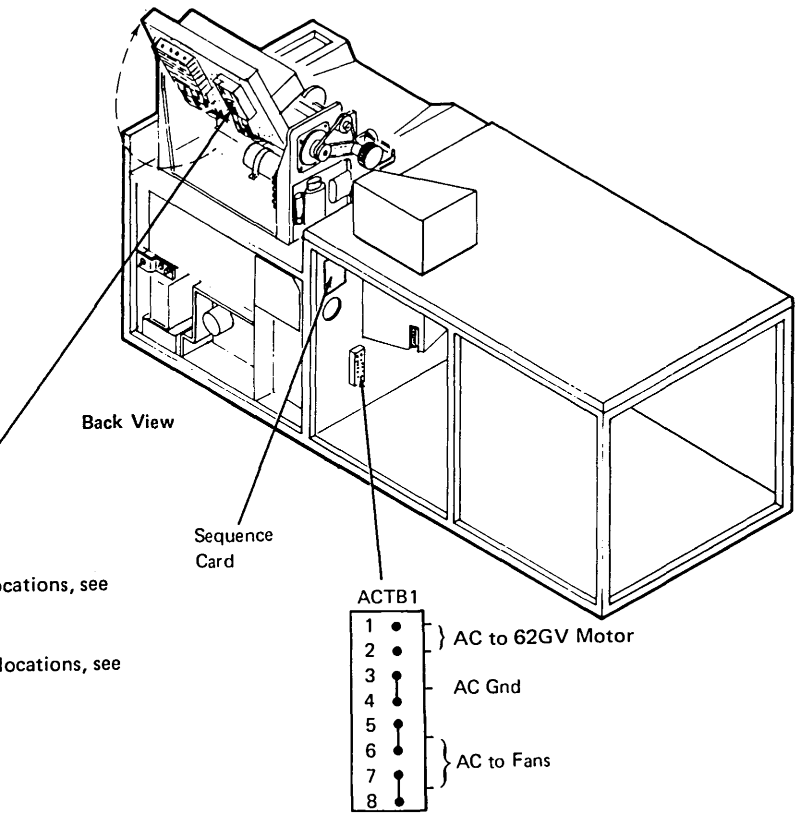
Discrete wire cable from multilevel and dual level or trilevel power supplies. Controls the start and stop of the multilevel and dual level or trilevel supplies, and senses voltages for overvoltage, undervoltage, and overcurrent.

8.1.11 Power Supply Plug And Pin Locations



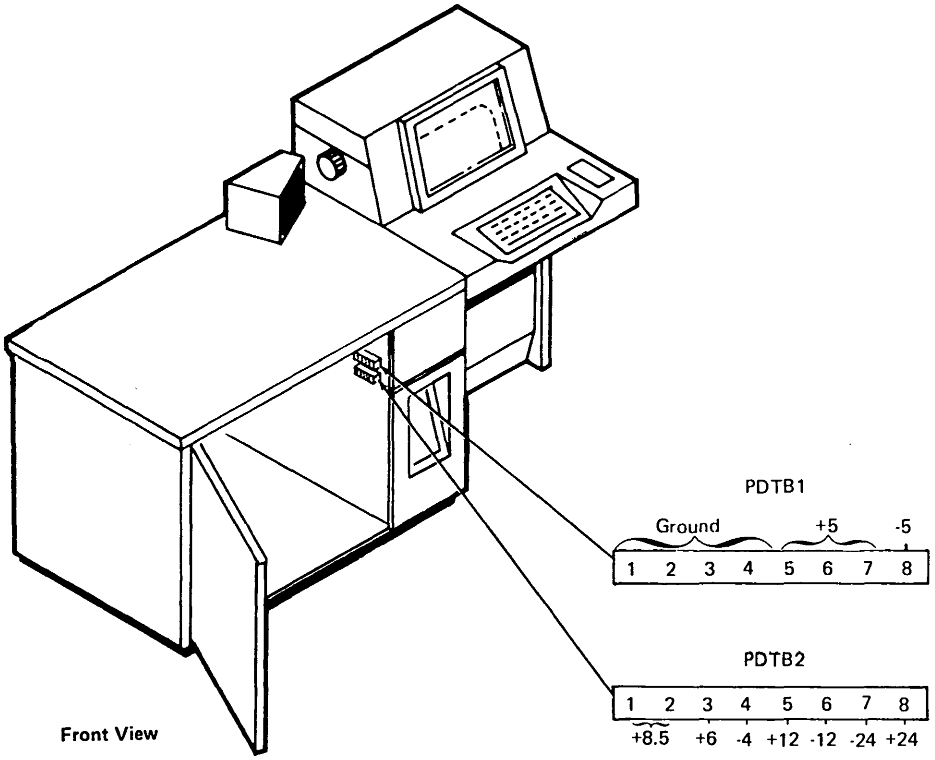
Note: The J socket pins are numbered from left to right (horizontal connectors) and top to bottom (vertical connectors) with the first pin being number 1. J1 on the ac board uses the conventional designations with B02 on the top left.

8.1.12 Terminal Board Locations And Pins



For belt printer locations, see paragraph 4.3.0.

For serial printer locations, see paragraph 9.3.0.



8.2.0 FERRO RESONANT POWER SUPPLIES

DANGER
With the mainline switch on: Control voltages are present at the power sequence card, the ac board, the dual level filter assembly, and the CE and operator control panels.

With the operator control panel power switch on:
1. AC line voltage is present at the disk, diskette, fans, ac board, and the ferro transformer.
2. DC voltages from the power supplies to the logic gate and printer are present.

8.2.1 Introduction

All power supplies for the system are located at the back right-hand side of the machine. AC power enters the system at the primary power area, which contains the mainline switch, two fuses, and a line filter. The mainline switch controls all power to the system. When this switch is off, all the power is off.

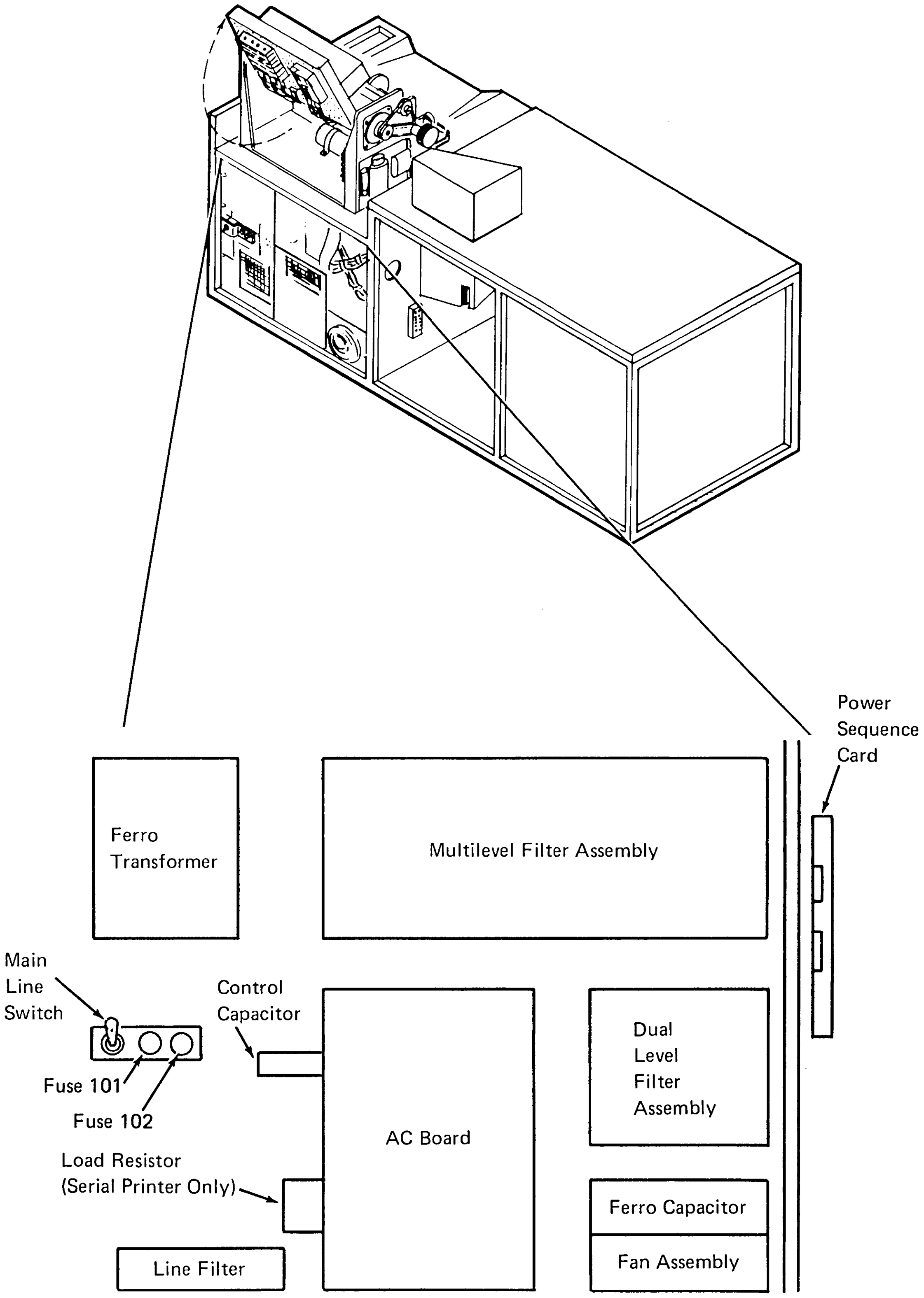
When the mainline switch is on, the sequence control voltages of +24 Vdc, -24 Vdc, +5 Vdc, +6 Vdc, and -6 Vdc are present. These voltages originate on the ac board. Further power sequencing and distribution is controlled by the power switch on the operator control panel.

The ac board distributes ac power and sequence voltage, and contains the motor relays for the system.

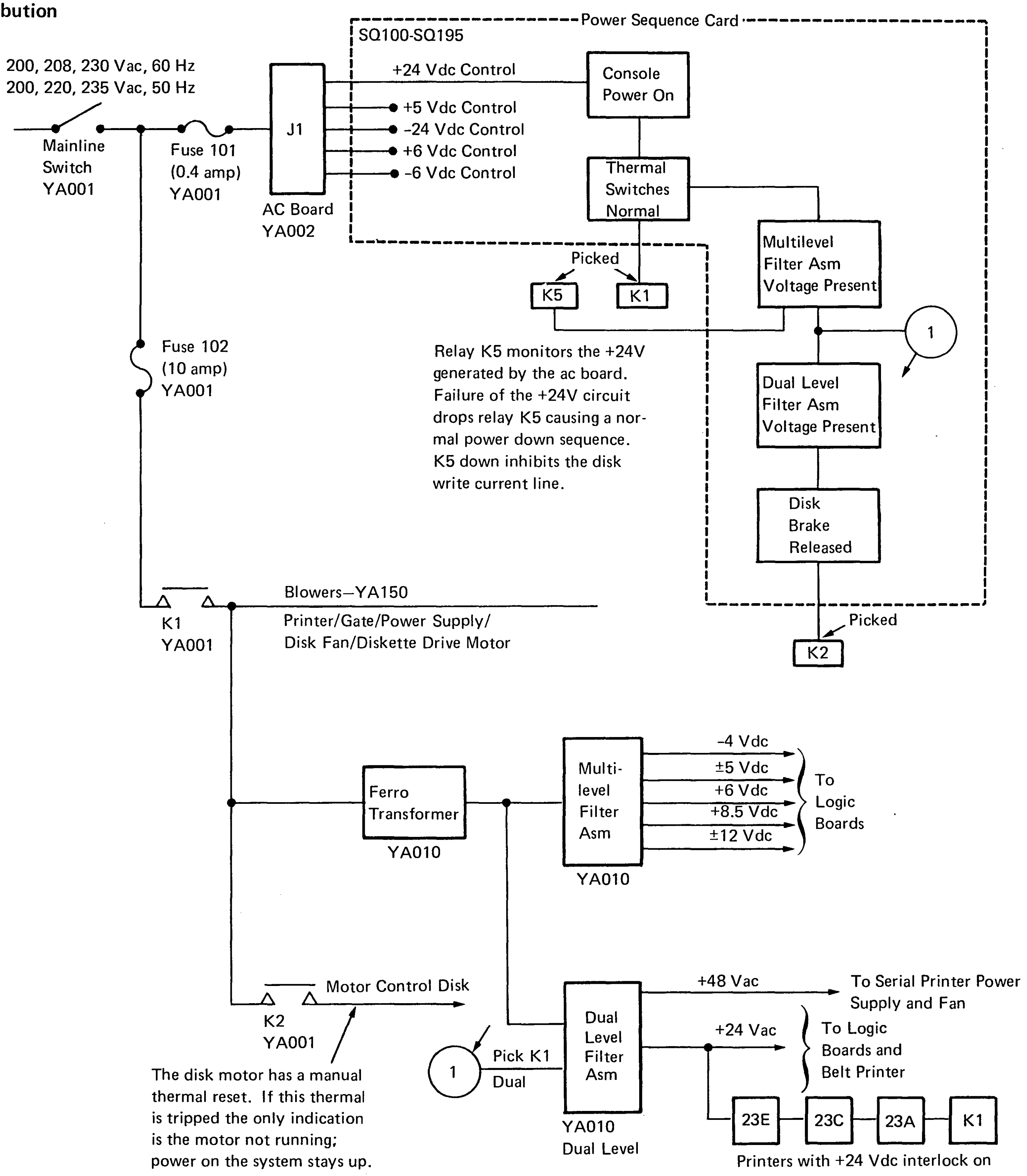
The multilevel filter assembly provides the +12 Vdc, -12 Vdc, +8.5 Vdc, +6 Vdc, +5 Vdc, -5 Vdc, and -4 Vdc.

The dual level filter assembly provides the +24 Vdc, -24 Vdc, and 48 Vac. The 48 Vac is used only if a serial printer is installed.

The power sequence card provides both power sequence control and power fault retention capabilities. The source and reason for dropping power is retained in a set of latches on the sequence card and can be displayed by the CE (7.2.13).



8.2.2 Power Sequence and Distribution



Relay K5 monitors the +24V generated by the ac board. Failure of the +24V circuit drops relay K5 causing a normal power down sequence. K5 down inhibits the disk write current line.

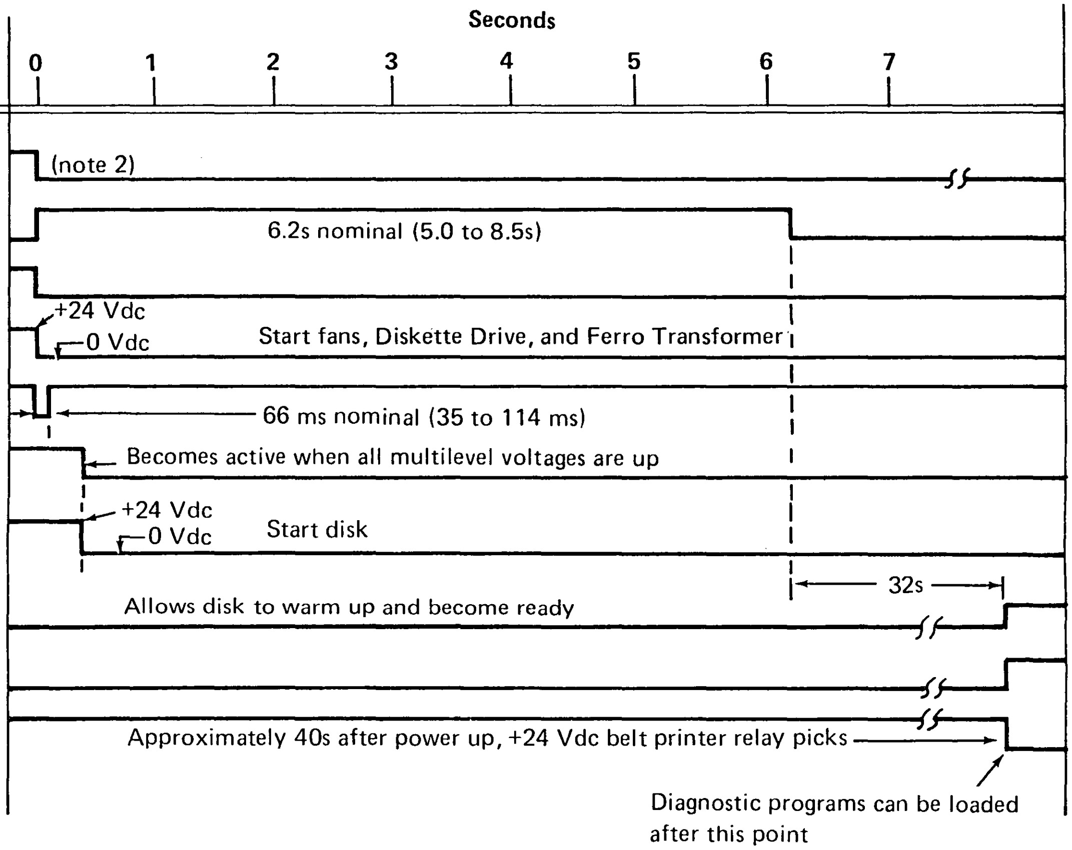
The disk motor has a manual thermal reset. If this thermal is tripped the only indication is the motor not running; power on the system stays up.

Printers with +24 Vdc interlock on hammer driver cards

8.2.3 Power On Sequence

Sync—On Test Point B09 (+ Off)

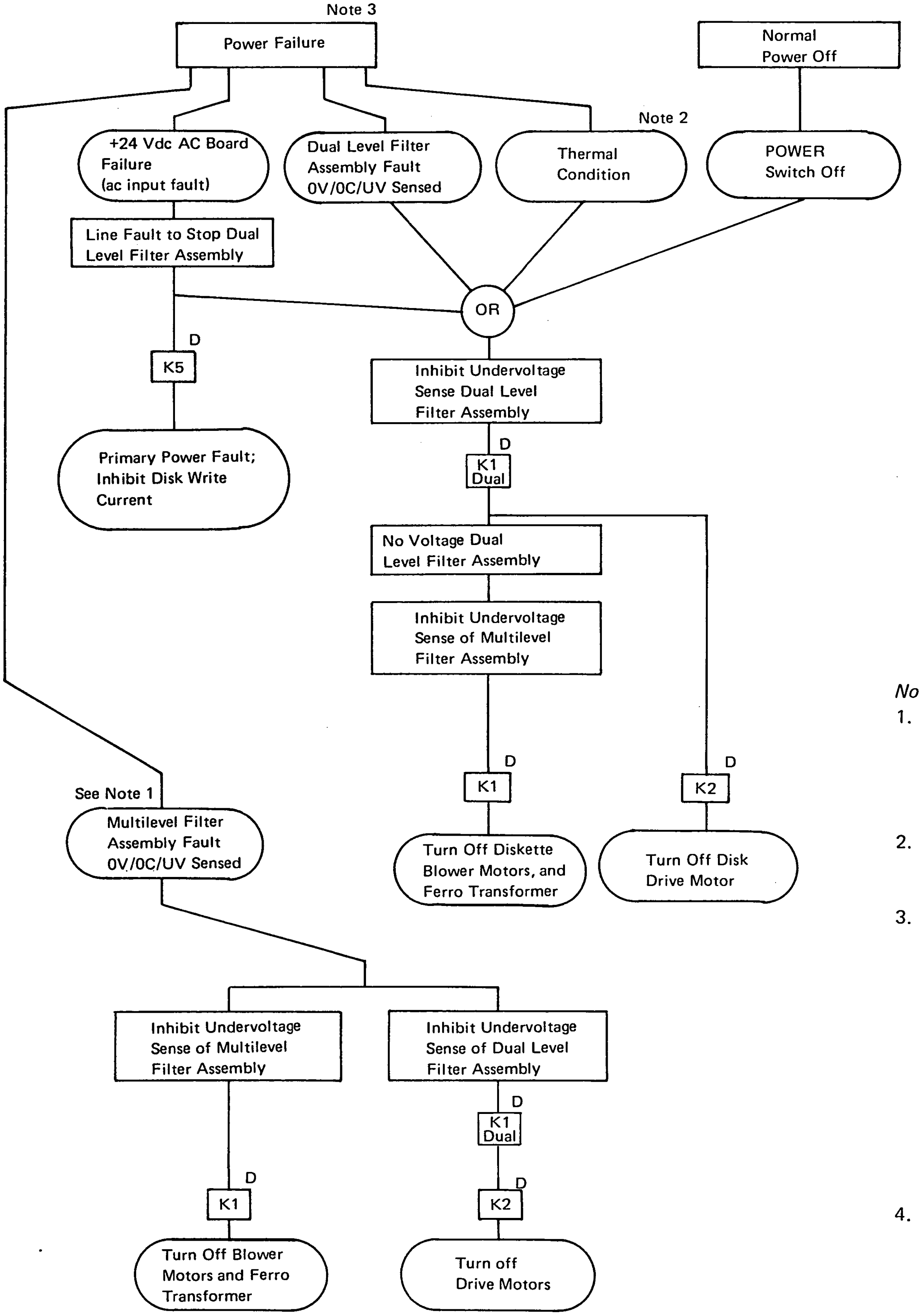
	Line Name or Function	Test Point (note 1)	ALD
1	- Power On		SQ180
2	+ On SS	D06	SQ100
3	- Start Multilevel	D12	SQ110
4	- Pick K1	D03	SQ115
5	- Delay SS	B07	SQ115
6	-Start Dual Level[1]	B10	SQ110
7	- Pick K2	B03	SQ115
8	-Power On Delay (in Disk)	A2F2M04	DG100
9	- Channel Data Protect	A2Q2J12	DQ050
10	+ Hammer Fault	A2Q2G08	DQ090



Notes:

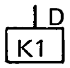
1. These are power sequence card test points except for the bottom three.
2. The levels of the signals on this chart are normal logic levels except where otherwise indicated.

8.2.4 Power Off Sequence



Notes:

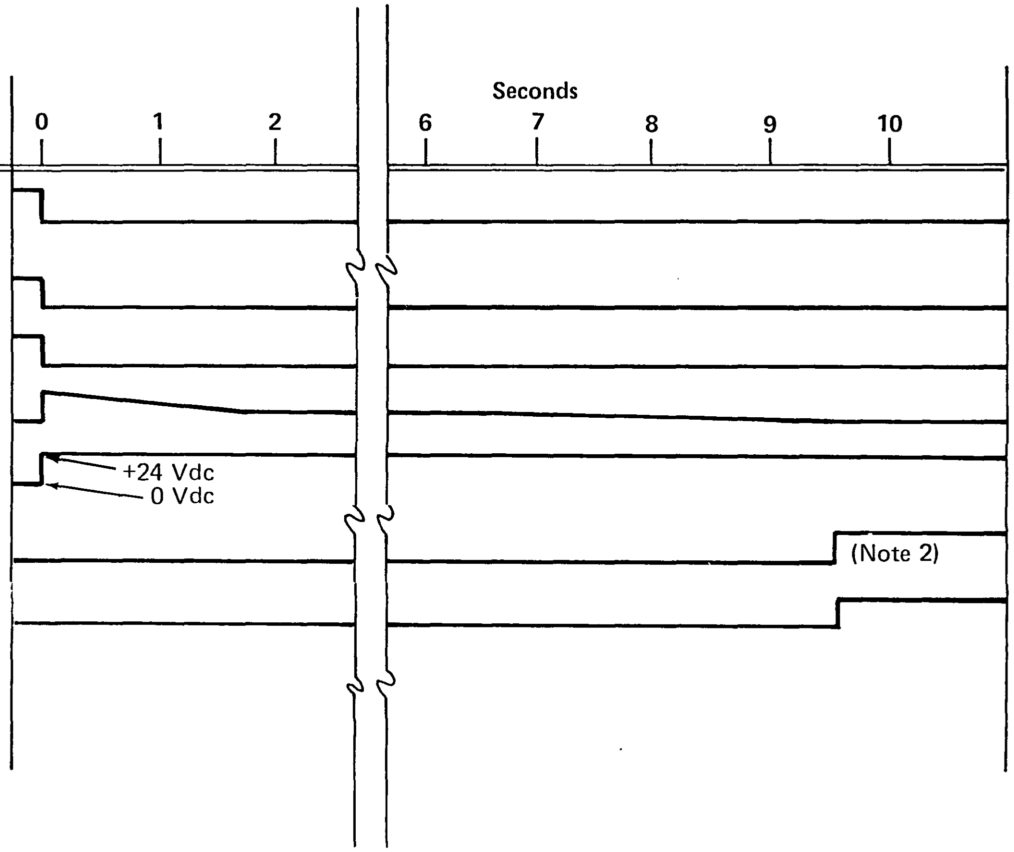
1. A multilevel filter assembly failure simultaneously turns off the multilevel and dual level voltages. A multilevel or dual level filter assembly fault turns on the PWR CHK light on the operator control panel.
2. Temperature too high in the power supply, belt printer, or gate turns on the TH CHK light on the operator control panel.
3. A loss of ac input power (fuse 101 blown, main-line switch turned off, or line cord pulled) is not indicated by the PWR CHK light.
   To restore system power following a power fault condition:
   a. Turn operator control panel POWER switch to OFF.
   b. Press RESET switch on CE control panel.
   c. Turn operator control panel POWER switch to ON.



4. Relay is dropped.

Sync + On Test Point B09 (+ Off)

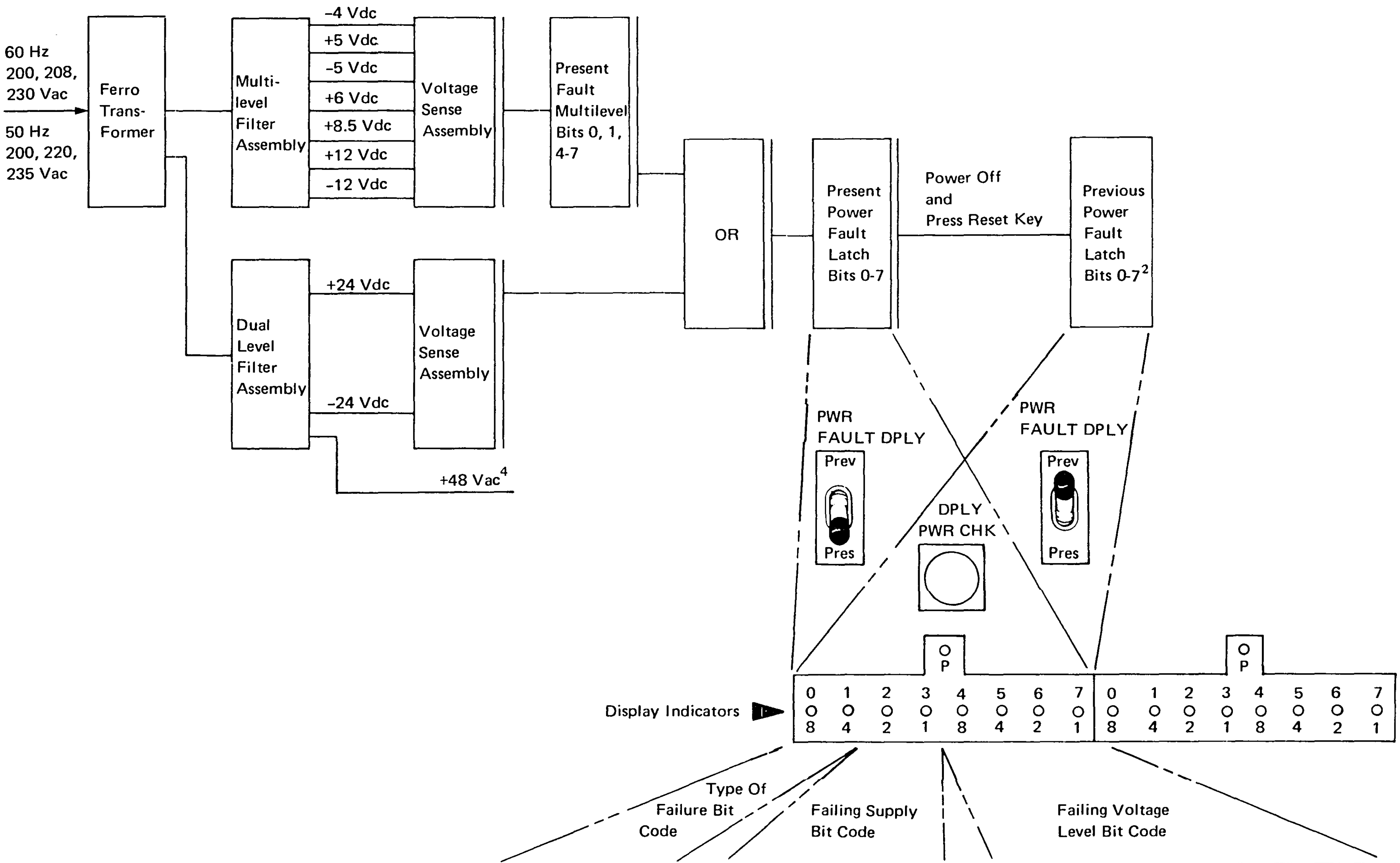
	Line Name or Function	Test Point (Note 1)	ALD
1.	+Pick K1 Dual	B13	SQ115
2.	-Power on Delay (in Disk)	A2F2M04	DG100
3.	-Channel Data Protect	A2Q2J12	DQ050
4.	+Hammer Fault	A2Q2G08	DQ090
5.	-Pick K2	B03	SQ115
6.	+No Voltage Dual Level	G13	
7.	-Pick K1	D03	SQ115



Notes:

1. These are sequence card test points except for lines 2, 3, and 4.
2. Becomes plus when +24 Vdc decays to +4.6 and -24 Vdc decays to -2.1. This prevents the functioning of the disk write circuits.

8.2.5 Voltage Sense and Power Fault Display



01 – Undervoltage
10 – Overvoltage
11 – Overcurrent

01 – Multilevel Filter Assembly

11 - Dual Level Filter Assembly[4]

0000[1]
0001 – -4 Vdc
0010 – +5 Vdc
0011 – -5 Vdc
0100 – +6 Vdc
0101 – +8.5 Vdc
0110 – +12 Vdc
0111 – -12 Vdc

1000 – +24 Vdc[3]
1001 – -24 Vdc

1111 – Plus and minus 24 Vdc failing on dual level filter assembly of +5 Vdc, +8.5 Vdc, and -12 Vdc failing on multilevel filter assembly.

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[1] If the voltage level that causes a fault is near the trip point of the respective monitoring circuit, the specific voltage level at fault is not indicated; only the type of failure and the failing supply are indicated.

[2] A previous power fault indication of 1111 1111 might be indicated when the mainline switch is switched from off to on.

[3] If power is up when a short occurs in the +24 Vdc distribution, the fault indications are as shown in the chart. If the short exists when power is brought up, an undervoltage indication will probably occur.

[4] The indication refers to the +24 Vdc or -24 Vdc. No error indication for the 48 Vac errors.

8.2.6 Power Faults

8.2.6.1 Thermal Switches and Faults

There are four thermal switches in the system at the following locations:

1. In the disk drive motor.
2. On top of the front logic card gate.
3. On top of the dual level filter assembly.
4. On the belt printer card gate by the resistor heat sink. Thermal protection is not provided for the serial printer.

When an over temperature condition is sensed in the disk drive motor, the thermal switch in the disk drive motor is activated, and the motor will not run; power stays up. This thermal switch must be manually reset.

When an over temperature condition is sensed by one of the other thermal switches, the thermal check latch is set, the TH CHK light is turned on, and a normal power down is initiated. To reset the thermal check latch, the thermal detector must be cool, the operator control panel POWER switch turned to OFF, and the RESET switch on the CE control panel pressed.

8.2.6.2 Overvoltage Fault

When an overvoltage condition is detected on any voltage level, the power check latch is set, the fault is set into the present fault latches PWR CHK light is turned on, and the correct power down operation initiated. To reset the power check latch and move the encoded byte into the previous fault latches, the operator control panel POWER switch must be turned to OFF and the RESET switch on the CE panel pressed. After the fault condition is cleared, system power can be restored by turning the POWER switch to ON.

8.2.6.3 Undervoltage Fault

An undervoltage condition on any level responds the same as an overvoltage as described in the preceding paragraph.

However, undervoltage conditions are not detected during power up and power down.

8.2.6.4 Overcurrent Fault

An overcurrent condition on any level responds the same as an overvoltage as previously described.

8.2.7 Control Voltage Checkout

To check the ac board output control voltages, do the following:

1. Turn the mainline switch off.
2. Remove the power sequence card. (The control voltages are measured at the power sequence card socket.)
3. Turn the mainline switch on.
4. Measure the voltages at the following points on the power sequence card socket:

	Measuring Points	
Voltages	Measured At	Reference
+24 Vdc	P13	D08
-6 Vdc	P12	D08
+6 Vdc	M12	D08
-24 Vdc	M10	D08
+5 Vdc	M07	D08

8.2.8 Manual Bring-Up Of The DC Power Supply

In troubleshooting some power supply problems, it might be advantageous to bring up the dc power supply manually.

However, the following precautions must be observed when manually brining up the dc power supply.

CAUTIONS

- If your problem is overcurrent or overvoltage, do not use this procedure.
- If the system has a belt printer, disconnect P6 to prevent possible damage to the hammer driver cards. For P6 location, see page 4-77.
- Do not unload the +8.5 Vdc or -5 Vdc singly; they must be unloaded together to prevent damage to the FET logic.
- With the power supply up, any error detected does not bring down the power supply.

To manually bring up the dc power supply sequence:

1. Turn power off at the operator control panel. After the power is sequenced down, turn the mainline switch off.
2. Remove the power sequence card.
3. Connect a jumper wire from M08 to P05 (-pick K1) on the power sequence card socket.
4. Turn the mainline switch on. The fans should start and K1 should energize, bringing up the dc power supply.
5. Measure filter assembly voltage levels.

Notes:

1. If a short in the load is suspected, the filter assemblies are capable of operating with all load connections removed (that is, E3, E4, and E5).
2. With all load connections removed, a filter assembly voltage levels may vary approximately ±20% from normal voltage.

6. Turn the mainline switch off.
7. Remove the jumper wire from pin M08 to pin P05.
8. Reinstall the power sequence card in the socket.
9. If the system has a belt printer, reconnect P6.

8.2.9 Power Supply Voltages

		Voltage	Tolerance	Test Measuring Points Measured At	Reference	Overvoltage Sense[1]		Undervoltage Sense[1]	
DC Power Supply Voltages	Input Voltages YA001	200 Vac, 60 Hz 203 Vac, 60 Hz 230 Vac, 60 Hz	±10%	Ferro TB1-2 Ferro TB1-3 Ferro TB1-4	Ferro TB1-1	Lower Limit	Upper Limit	Lower Limit	Upper Limit
		200 Vac, 50 Hz 220 Vac, 50 Hz 235 Vac, 50 Hz	±10%	Ferro TB1-2 Ferro TB1-3 Ferro TB1-4	Ferro TB1-1				
	Output Voltages	-4 Vdc	+4% -2%	PDTB2-4	PDTB1-1	-4.18	-6.0	-3.88	-3.0
		+5 Vdc	+10% -8%	PDTB1-5	PDTB1-1	+5.5	+6.1	+4.65	+3.8
		-5 Vdc	+10% -8%	PDTB1-8	PDTB1-1	-5.5	-6.1	-4.7	-4.0
		+6 Vdc	+10% -8%	PDTB2-3	PDTB1-1	+6.6	+7.6	+5.64	+4.6
		+8.5 Vdc	+10% -8%	PDTB2-1	PDTB1-1	+9.35	+10.5	+7.99	+6.5
		+12 Vdc	+10% -8%	PDTB2-5	PDTB1-1	+13.2	+16.0	+11.28	+9.2
		-12 Vdc	+10% -8%	PDTB2-6	PDTB1-1	-13.2	-16.0	-11.28	-9.2
		+24 Vdc	+10% -8%	PDTB2-8	PDTB1-1	+26.4	+29.25	+22.10	+18.25
		-24 Vdc	+10% -8%	PDTB2-7	PDTB1-1	-26.4	-30.0	-22.56	-18.25

		Voltage	Tolerance			Test Measuring Points
48 Vac (serial printer)	Output Voltage	48 Vac	Min	Nom	Max	Dual Level Filter Assembly E2.0 and E2.1
			41.5	46.5	51.15	

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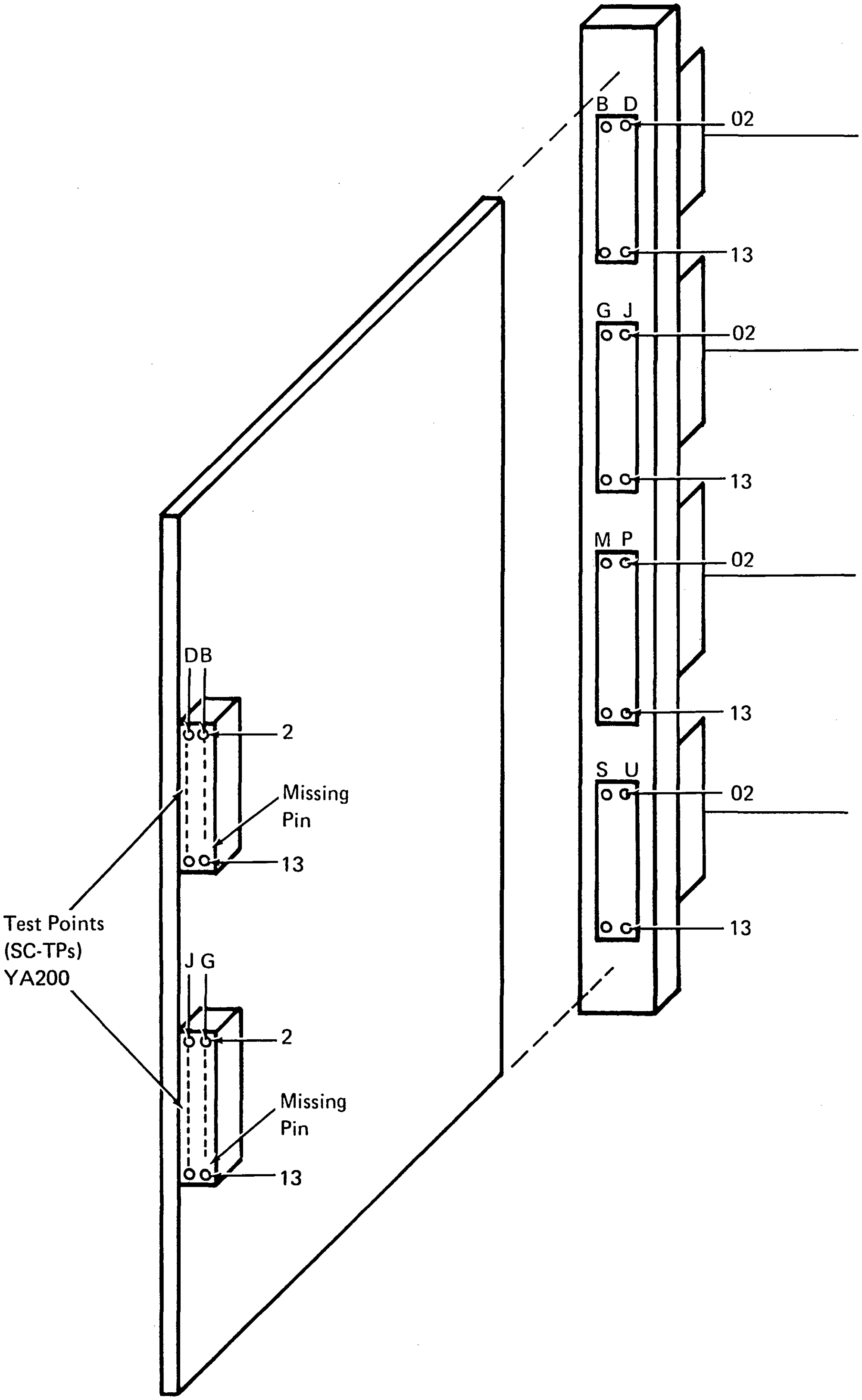
[1] The overvoltage or undervoltage condition does not trip the power down sequence before the lower limit is reached, but trips before the upper limit.

8.2.10 Power Sequence Card Pins and Test Points



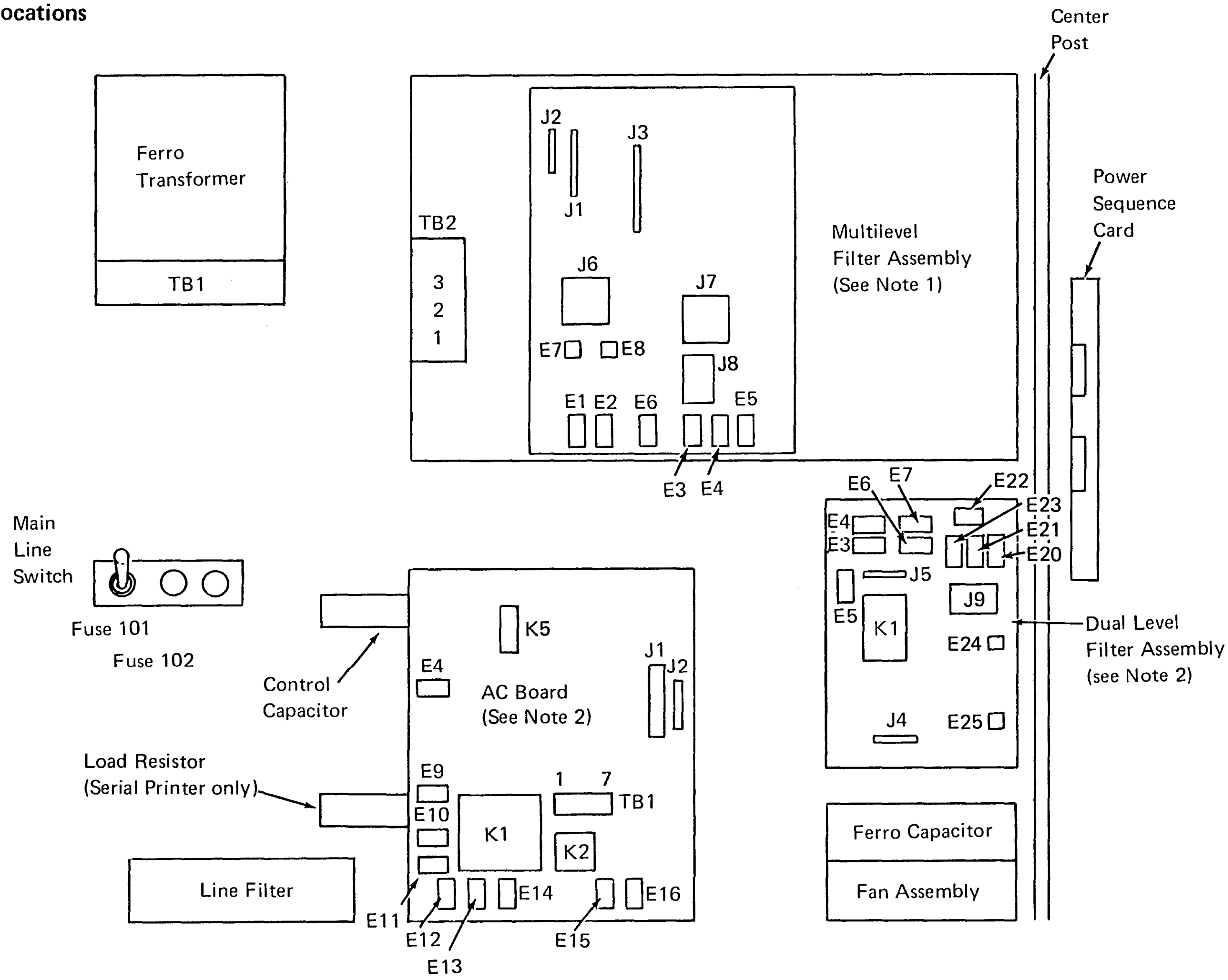
Flat cable going to 01A-A1A2 for CE panel display lights, operator panel switches, and use meter.
SQ100-195

Jumper card for testing. Ties all the singleshot outputs back to the sequence card.

Flat cable to ac board. Contains control voltages, K1 and K2 drivers, thermal sense, channel data protect.
YA001, YA002, YA070

Discrete wire cable from multilevel and dual level filter assemblies. Controls the start and stop of the multilevel and dual level filter assemblies, +24V to disk, and sense voltages for overvoltage, undervoltage, and overcurrent.
YA014

8.2.11 Power Supply Plug and Pin Locations

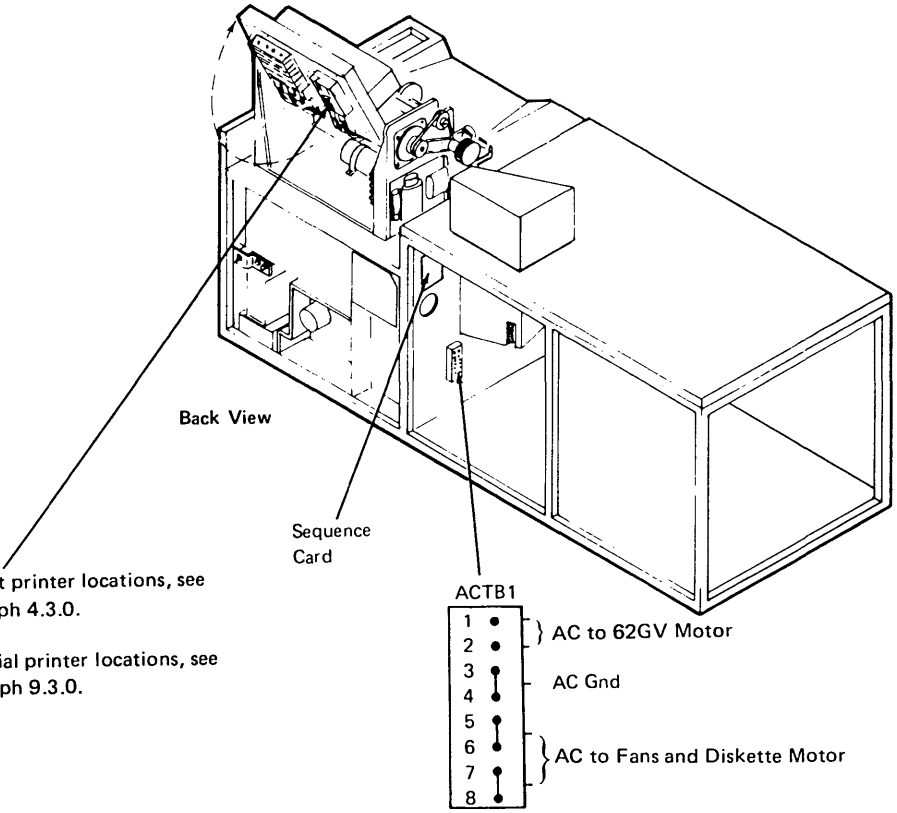


Notes:

1. The multilevel filter assembly J socket pins are numbered from bottom to top (vertical connectors with the first pin being number 1.

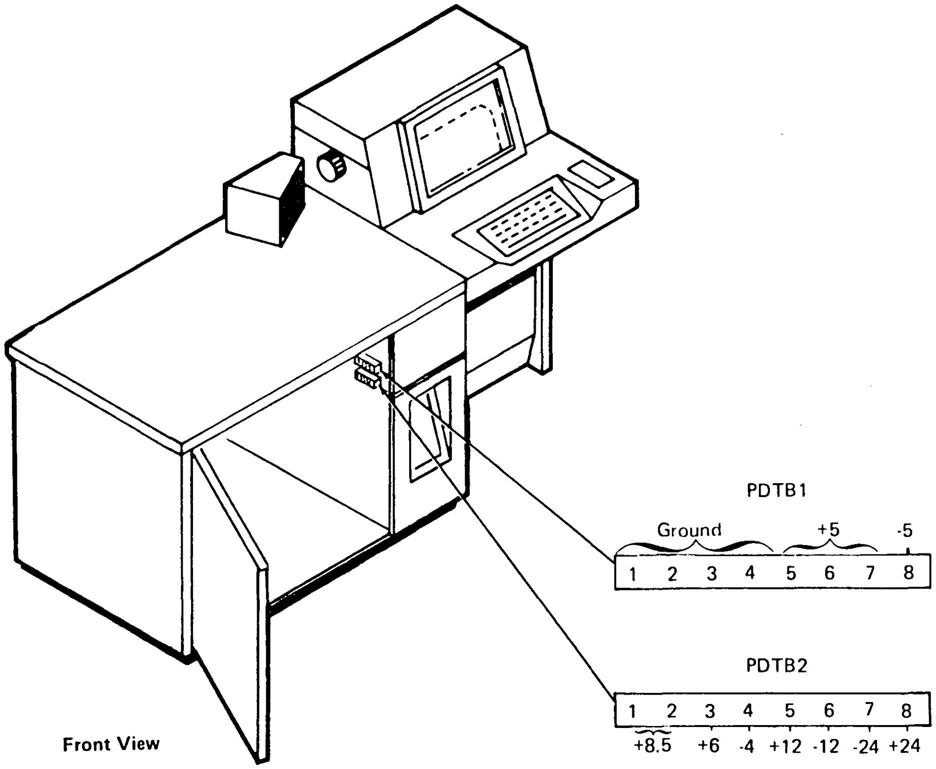
2. The AC board and dual level filter assembly J socket pins are numbered from left to right (horizontal connectors) and top to bottom (vertical connectors) with the first pin being number 1. J1 on the ac board uses the conventional designations with B02 on the top left.

8.2.12 Terminal Board Locations and Pins



For belt printer locations, see paragraph 4.3.0.

For serial printer locations, see paragraph 9.3.0.



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9.0.0 Serial Printer

9.1.0 THEORY

9.1.1 Introduction

Serial printers produce printed characters by a series of dots within a matrix. Characters are formed by printing a pattern of dots that correspond to a stored image in the attachment. The character pattern is 7-high by 7-wide. The print head contains eight vertically mounted print wires; one through seven to print the characters and the eighth to print an underscore. Signals from the system move the print head along the print line and selectively fire the print wires against the ribbon.

Printer control, power, and data signals are provided by the system. Printing occurs while the print head is moving either right or left (bidirectional). Through variations of moving the print head and advancing the forms, the system can make the printer space, line feed, and restore the print head carrier to the forms loading position.

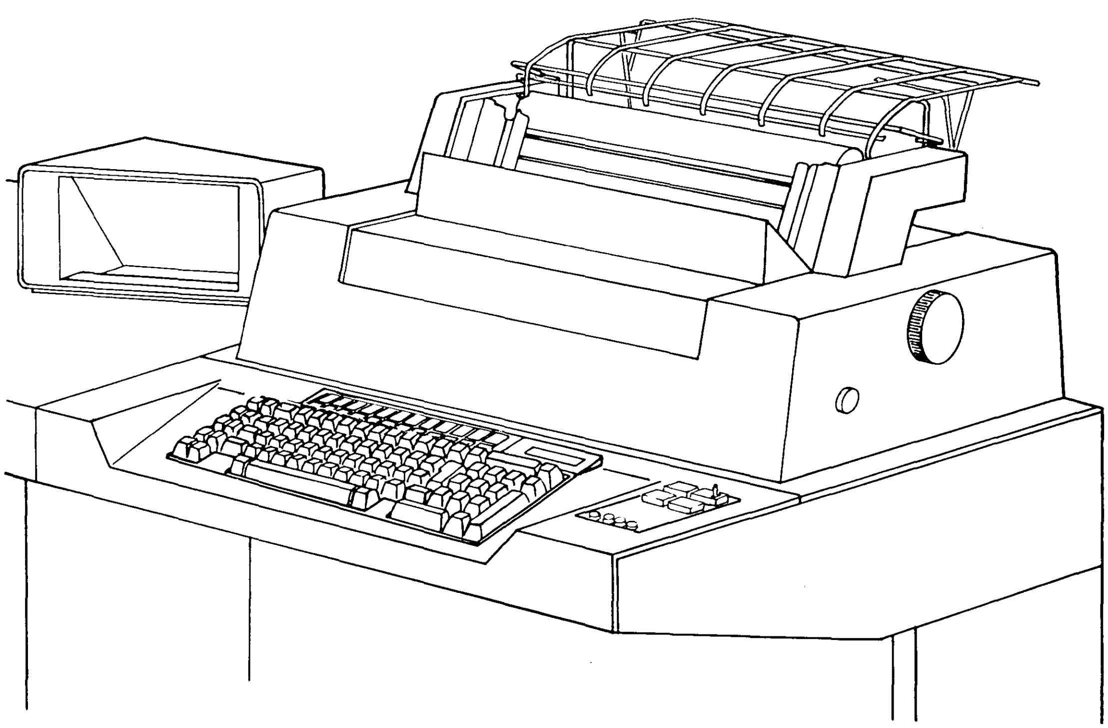
Note: To interchange forms between the serial printer and the belt printer, the maximum distance from the center line of the left margin holes to the center line of print position 1 must be 0.5 inch (12.7 mm) for correct print alignment. See *Form Design Reference Guide for Printers,* GA24-3488.

The serial printer is available in four models:

120 CPS (characters per second) bidirectional
80 CPS bidirectional
40 CPS bidirectional
40 CPS unidirectional

The two models of the 40 CPS printer are identical. The attachment circuitry controls whether they print only left to right or, in both directions. All four models provide the following capabilities:

- As many as 128 different characters can be printed.
- The print line is up to 132 characters long.
- Horizontal spacing is 10 characters per inch (25.4 mm).
- Vertical spacing is six lines per inch (25.4 mm).
- Cut forms are advanced by a 15-inch (381.0 mm) pressure feed platen.
- A forms tractor unit can be attached to print continuous forms.
- The print head is moved to the left margin and retracted after two minutes of idle time or under program control at end of job.



9.1.2 Functional Components

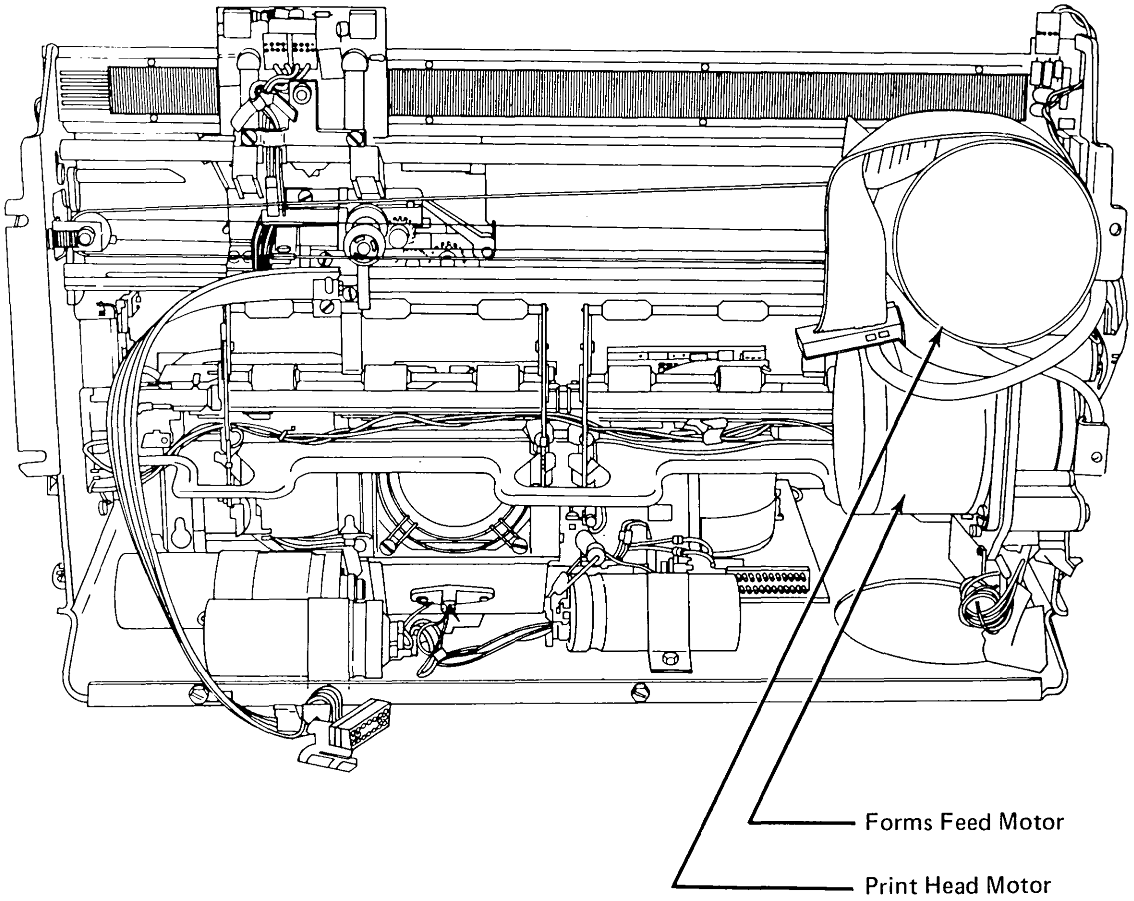
9.1.2.1 Stepper Motors

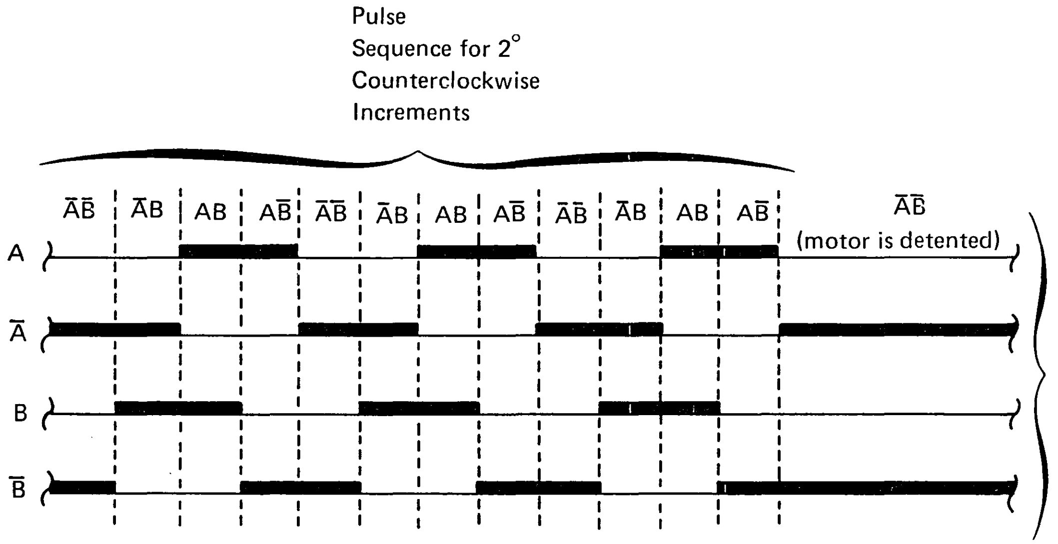
The forms feed motor and the print head motor are sealed, dc stepper motors consisting of a permanent magnet rotor and two pairs of bifilar stator windings.

CAUTION
Stepper motors require no maintenance; they should not be opened or disassembled because the magnetic flux of the rotor will be reduced, which reduces the torque.

Each stepper motor is controlled by four direct-current control lines. The direction the motor turns is determined by the sequence of the control pulses; each time the phases are shifted, the motor shaft rotates 2 degrees.

The timing chart shows the sequence of pulses to step the motor counterclockwise. The combination of the not A line and not B line at the end of the sequence hold the motor detented during settle time.

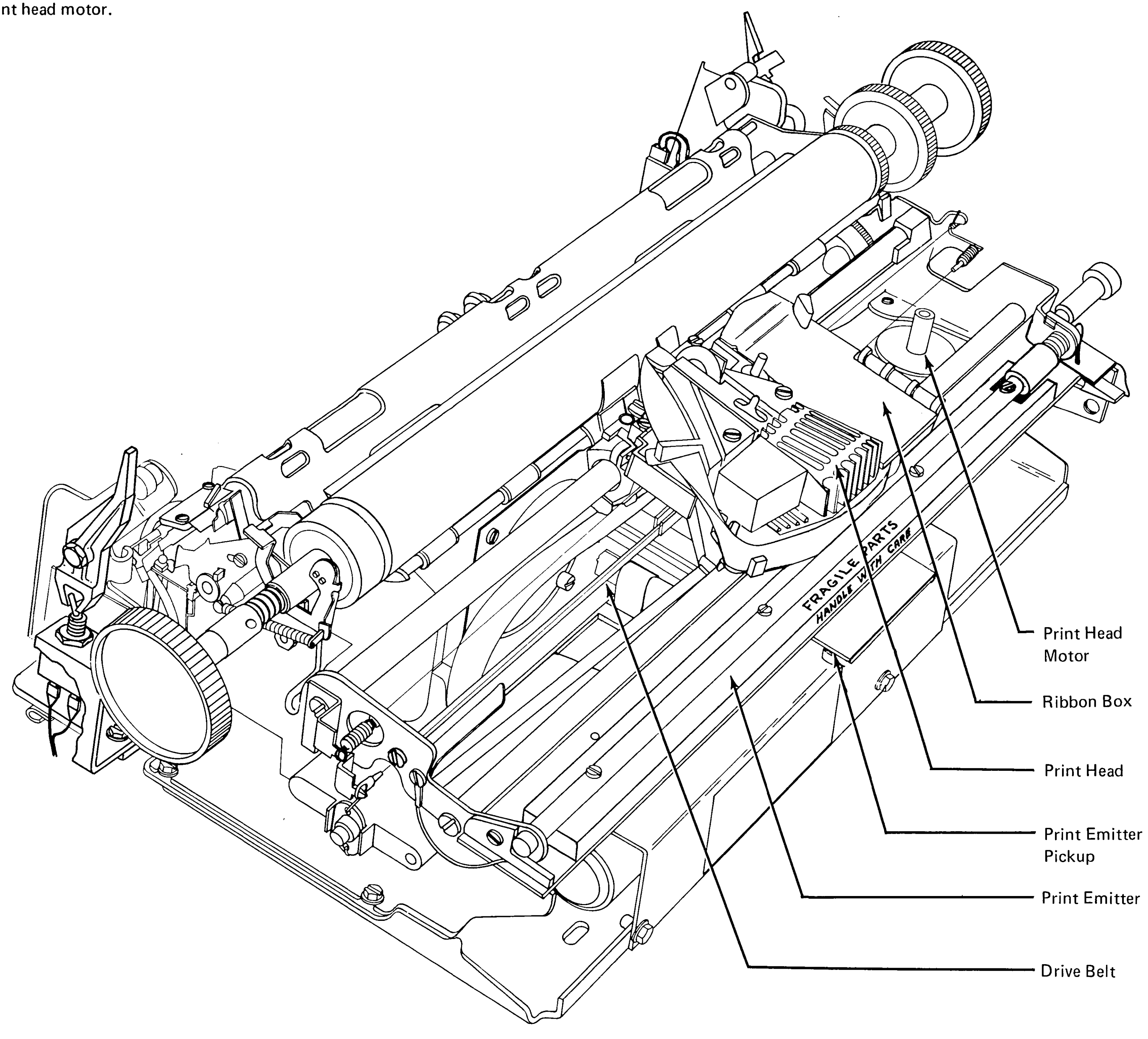




A reverse motor direction or power off sequence can be initiated at this time.

9.1.2.2 Print Head Carrier

The print head carrier supports and transports the print head, print emitter pickup, and ribbon box horizontally along the print line. The print head carrier is moved by a drive belt, coupled to the print head motor.



Print Emitter

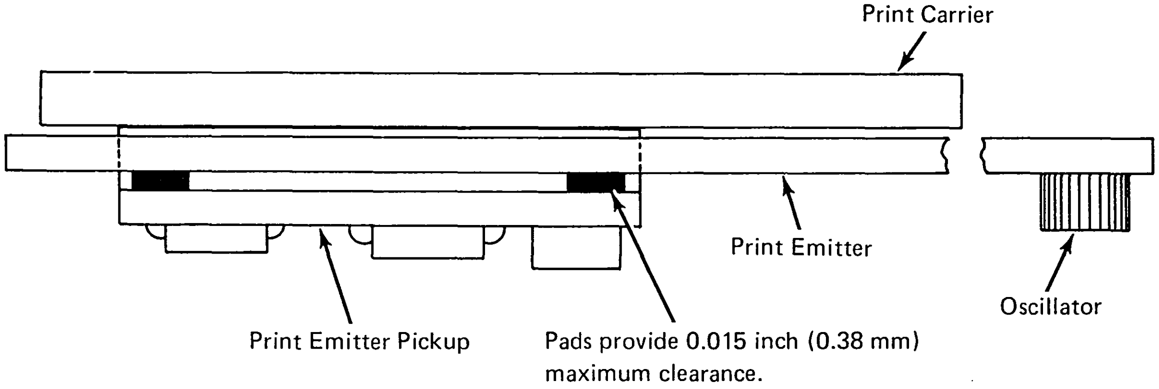
The print emitter is a stationary board with a land pattern and a 4.25 MHz oscillator. The land pattern simulates the primary winding of an air core transformer.

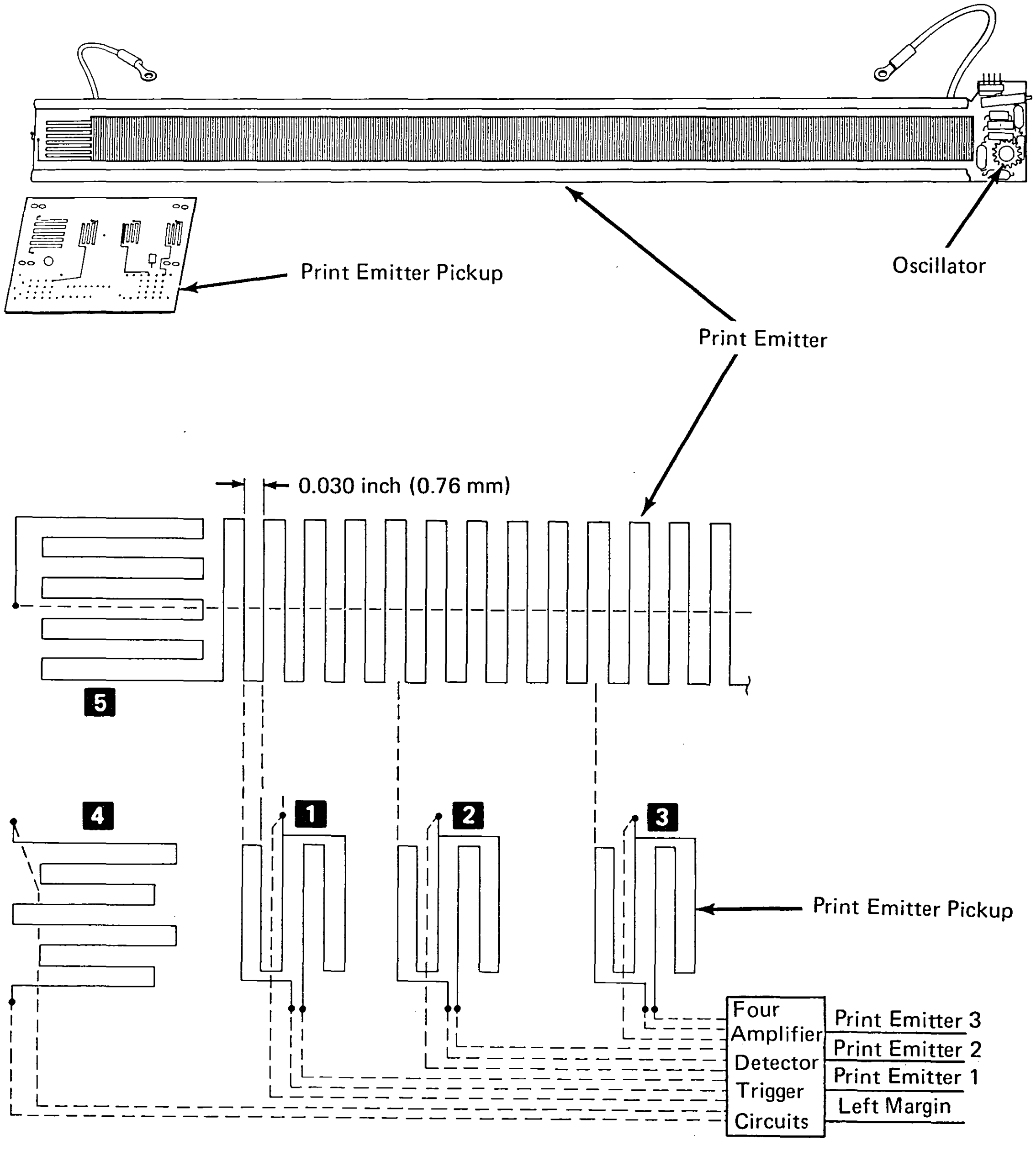
The print emitter pickup is mounted on the bottom of the print carrier and slides along the length of the print emitter. The pickup consists of four separate land patterns and associated amplifier detector trigger circuits. The land patterns of the print emitter pickup simulate the secondary windings of an air core transformer.

Print emitter signals are used by the system to determine:

- When the print head is in the left margin.
- How far the print head is from the left margin.
- Which direction the print head is moving.
- When to fire the print magnets.

Land patterns denoted by **4** and **5** are at right angles to the patterns denoted by **1**, **2** and **3**. When the print emitter pickup enters the left margin area, land pattern **4** of the print emitter pickup moves directly underneath land pattern **5** of the print emitter. As a result of this alignment, energy is coupled from the primary winding of the print emitter into the secondary winding of the print emitter pickup and causes a level change at the output of the amplifier detector trigger circuit. This level change signals the system that the print head is in the left margin area.



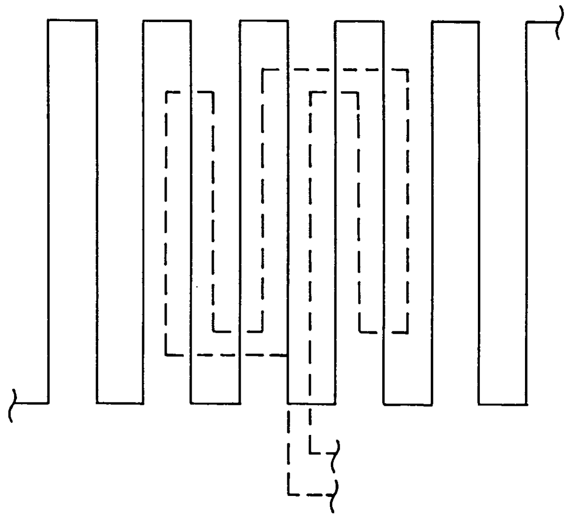


Print Emitter Pickup in Left Margin

The amplifier detector trigger circuit of patterns **1** , **2**, and **3** is set to trigger at the null position (where minimum energy is coupled from the print emitter winding). This occurs at the maximum misalignment of the land patterns of the print emitter and land patterns of the print emitter pickup. When the print emitter pickup is moved left or right, land patterns **1**, **2**, and **3** each produce an output pulse every 0.030 inch (0.76 mm) of motion. When the pulses from the three circuits are ORed, a pulse is produced every 0.010 inch (0.25 mm) of motion.

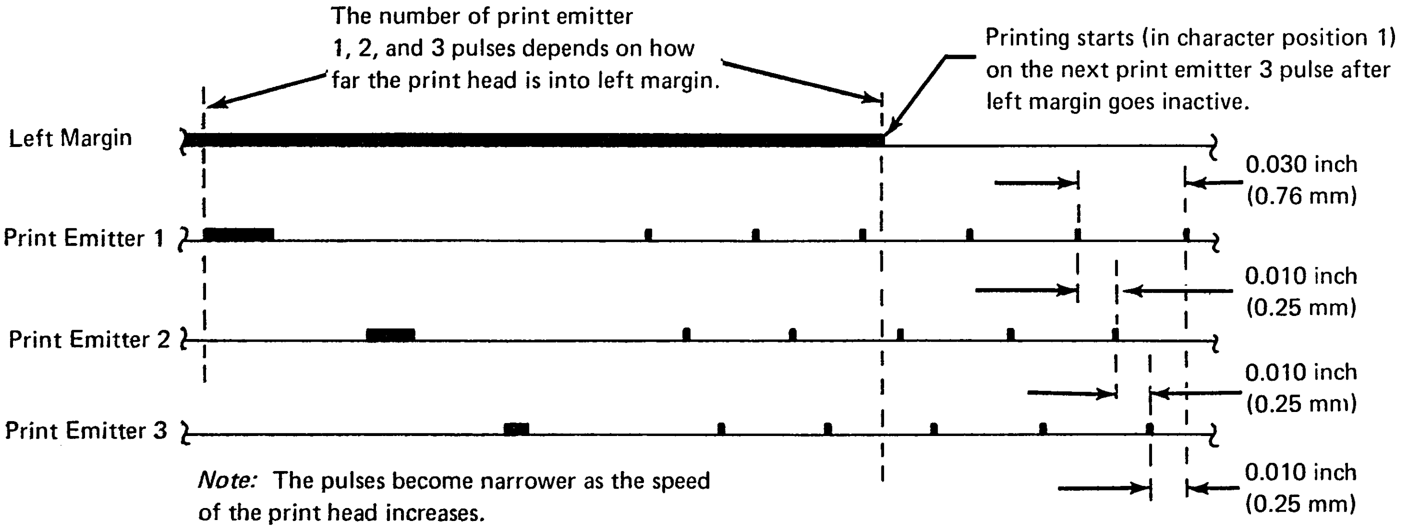
Because character spacing is 10 characters per inch, there is 0.100 inch (2.54 mm) for each character. With the seven dot positions for each character and three positions between characters, there is 0.010 inch (0.25 mm) between print positions and an emitter pulse for each position.

Outputs of the amplifier detector trigger circuits are left margin, print emitter 1, print emitter 2, and print emitter 3. Motion of the print emitter pickup moving from left to right produces a sequence of emitter pulses – **1**, **2**, and **3**; motion from right to left produces a sequence of emitter pulses – **1**, **3**, **2**. The left margin signal and the emitter pulses provide the system with enough information to determine (1) the firing time for the wires, (2) where the print head is on the print line, and (3) which direction the print head is moving.



This illustrates the null position of the print emitter land pattern. The land pattern of the print emitter pickup is shown in phantom.

Print Head Moving Left to Right

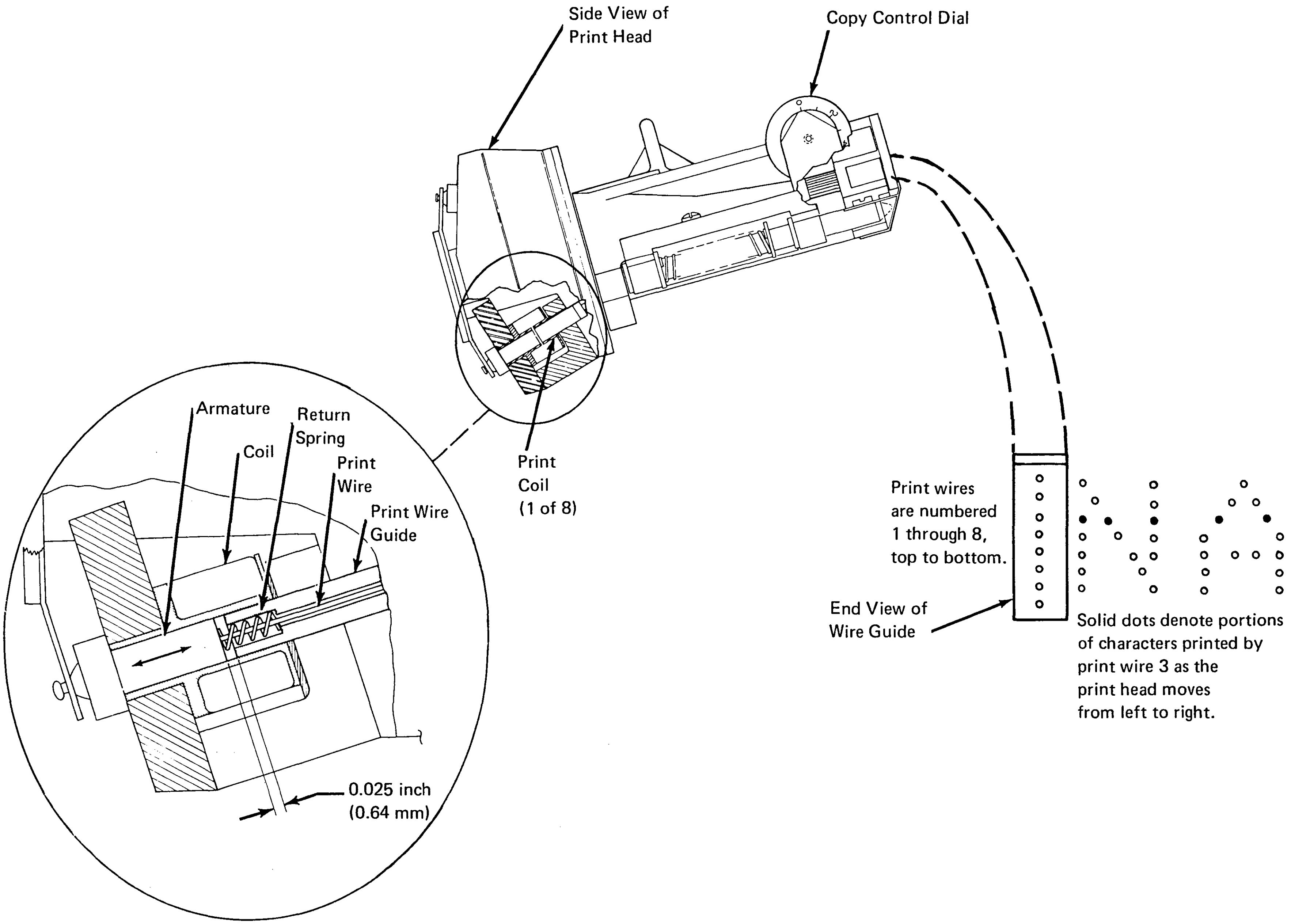


Print Head

Illustrated below is a side view of the print head and an end view of the wire guide. The print head has eight print wires arranged vertically 1 through 8, from top to bottom. The character image dots are made by the print wires as they strike the ribbon.

The circled area is a cross section of a print magnet. The print wire is attached to the armature. When the coil is energized by the print wire driver, the armature is driven forward against the print wire guide, driving the print wire against the ribbon. The system pulses the print wire driver to fire the print magnet. When the pulse ends and the coil is de-energized, the return spring restores the armature and print wire.

The copy control dial on the printer adjust the distance form the print head to the platen to allow for the thickness of the form. The dial is used by the operator to optimize print quality.

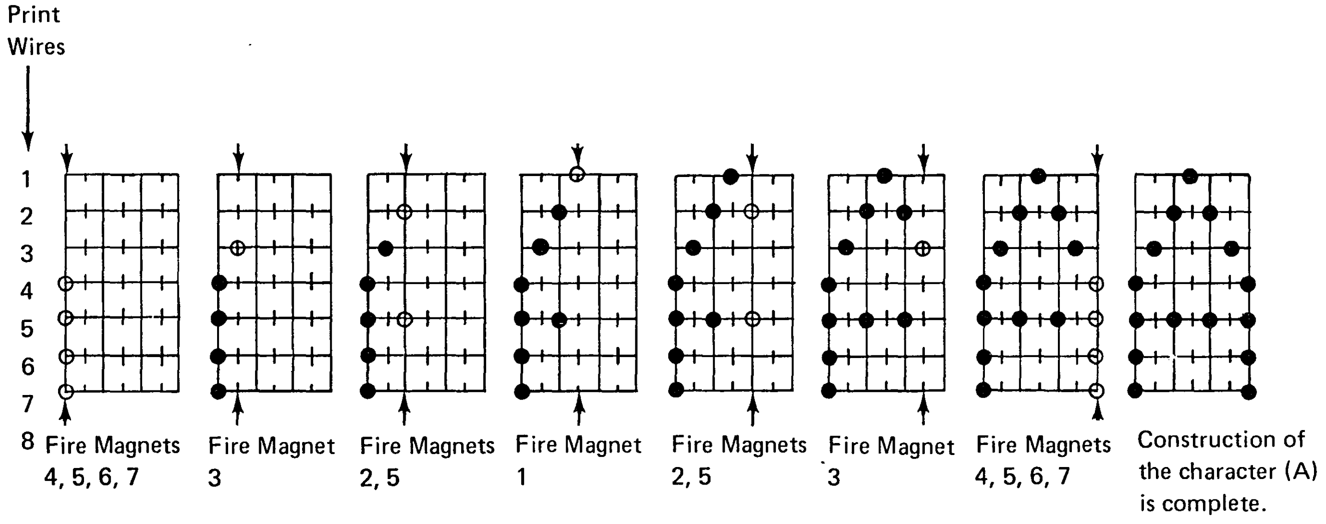


Solid dots denote portions of characters printed by print wire 3 as the print head moves from left to right.

As required by the character pattern, each wire can strike the ribbon up to four times per character (for example, print wire 5 when printing the character A).

When printing, magnets are not fired at successive emitter pulses (because time is required to restore the magnet armatures—at least one emitter pulse must intervene between firings of the same wire), and no more than 25 dots are allowed per character.

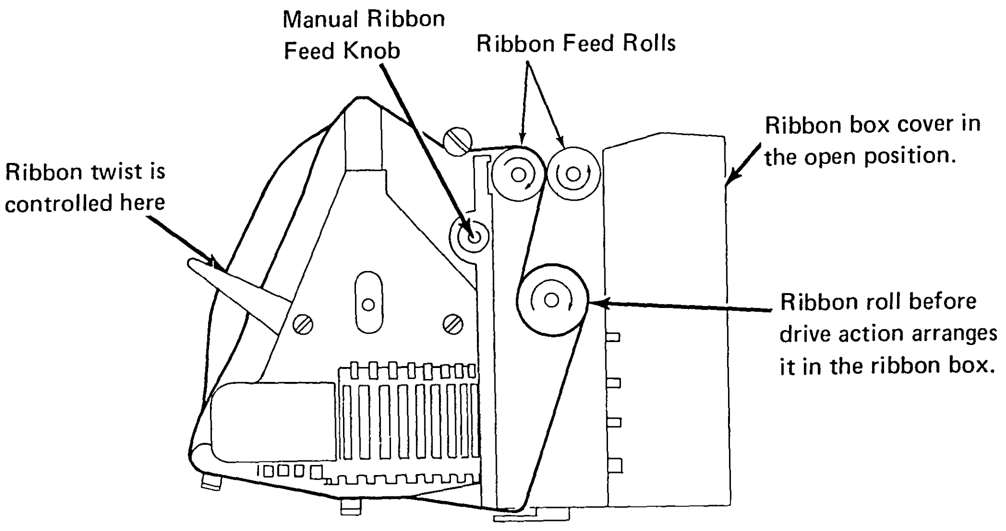
Three emitter pulses are used for the space between the characters.

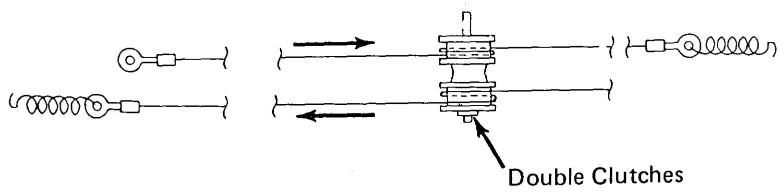


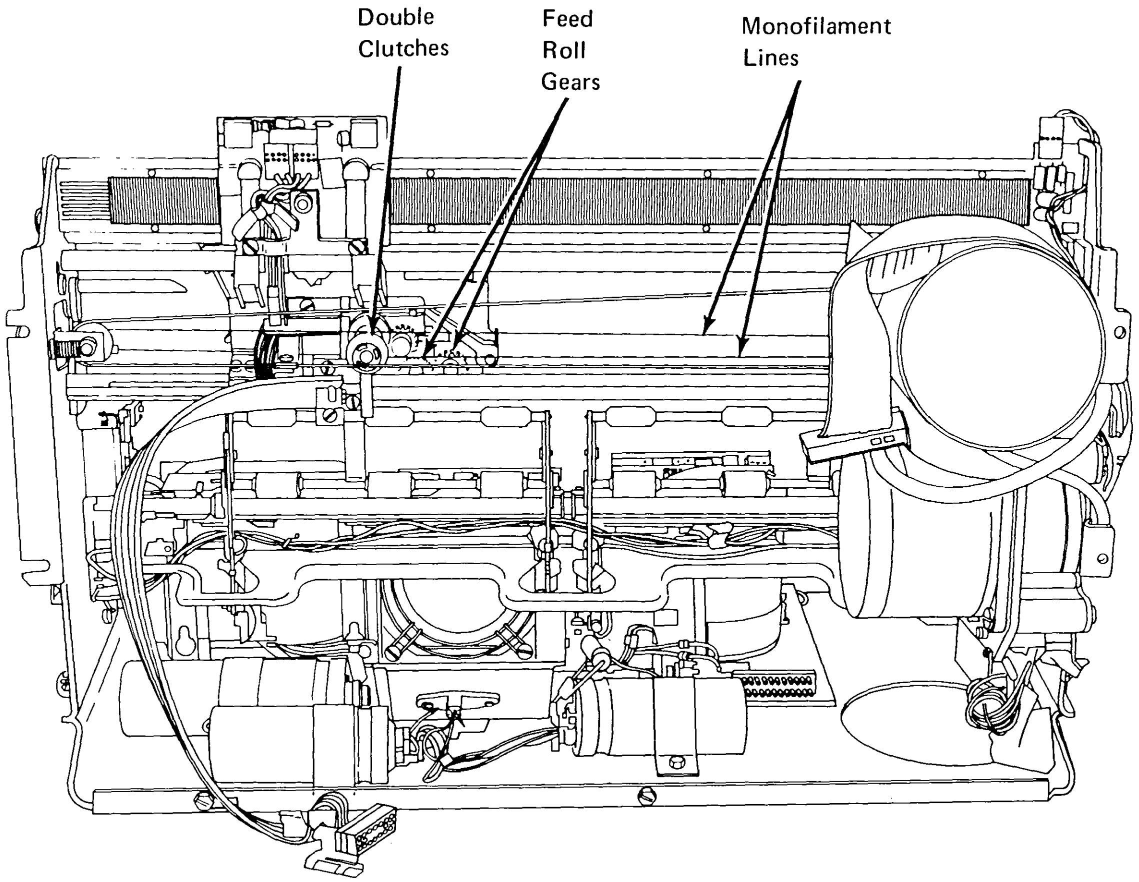
Ribbon Drive

A continuous loop ribbon that can be replaced by the operator is used in the printer. Two ribbon feed rolls pull the ribbon through a slot from one end of the ribbon box, around the print head, past the print wires, and feed it into the other end of the box. A half twist is placed in the ribbon during manufacturing so that, as the ribbon passes the print wires, the top half of the ribbon prints on one pass and the bottom half prints on the next pass.

The print head, ribbon box, and ribbon drive mechanism are mounted on the print head carrier and move left or right under control of the print head stepper motor. The ribbon feed rolls are driven by two monofilament lines through a series of idler gears. The lines are looped around a double clutch, located underneath the print carrier, that drives the ribbon feed rolls. The clutches drive in one direction and free wheel in the other. The lines are looped so they both drive in the same direction, providing a clockwise ribbon path whether the print head carrier is moving left or right.





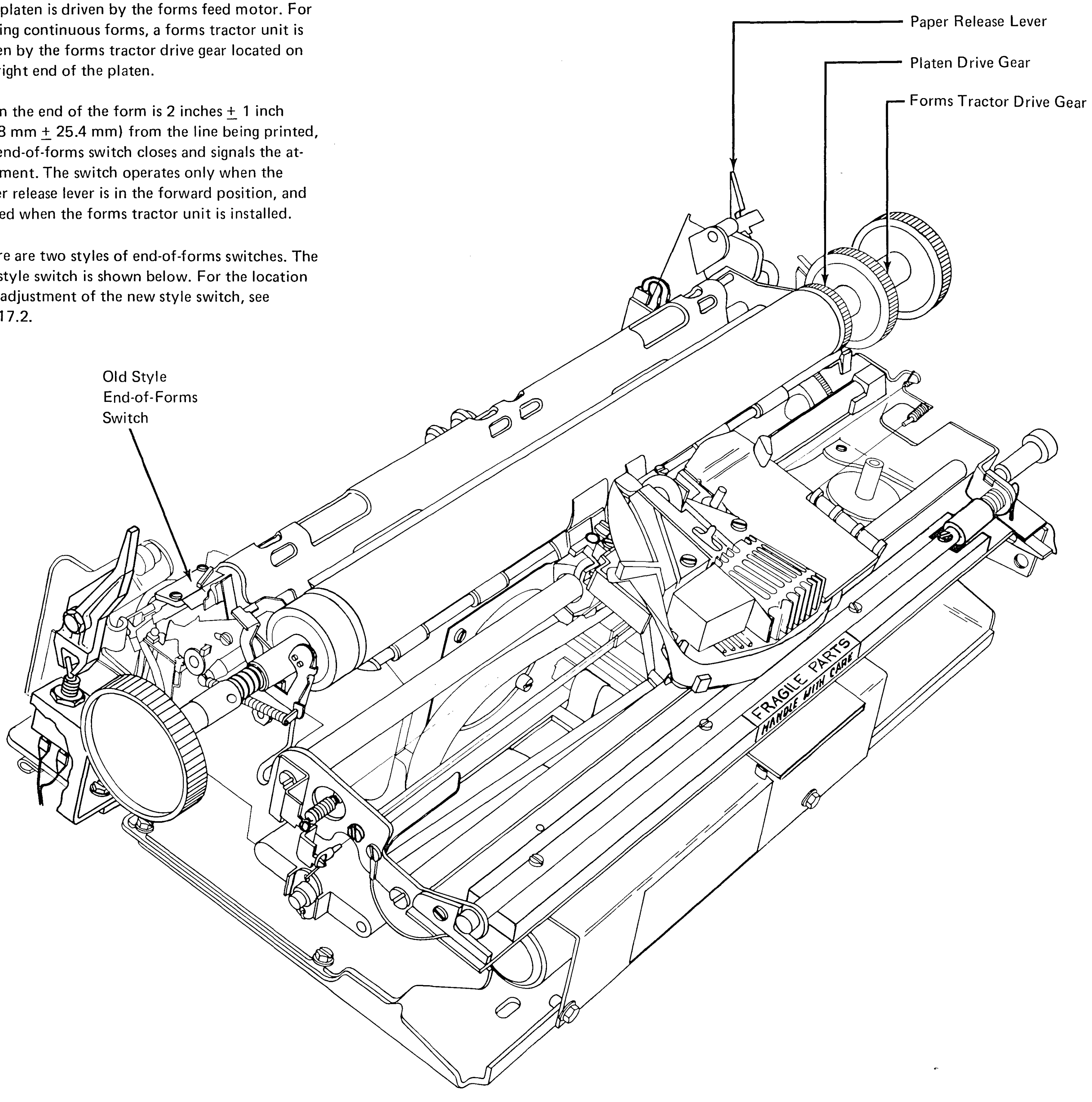


9.1.2.3 Forms Feed

The platen is driven by the forms feed motor. For feeding continuous forms, a forms tractor unit is driven by the forms tractor drive gear located on the right end of the platen.

When the end of the form is 2 inches ± 1 inch (50.8 mm ± 25.4 mm) from the line being printed, the end-of-forms switch closes and signals the attachment. The switch operates only when the paper release lever is in the forward position, and is used when the forms tractor unit is installed.

There are two styles of end-of-forms switches. The old style switch is shown below. For the location and adjustment of the new style switch, see 9.2.17.2.



Forms Feed Emitter

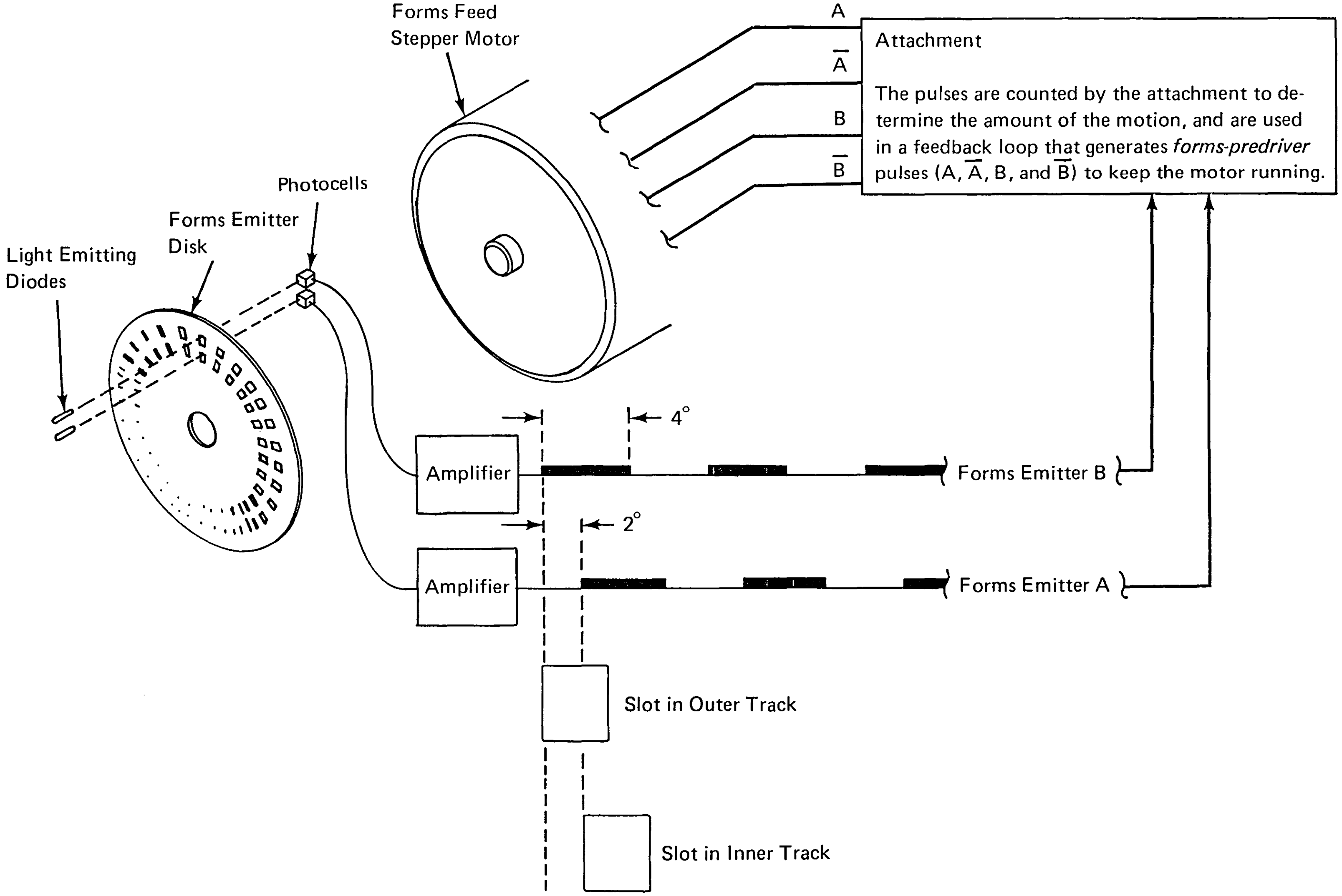
Below is a conceptual illustration of the forms feed emitter used in the serial printer. An emitter disk is driven by the forms feed stepper motor. The emitter disk has 90 slots, 45 on an outer track, and 45 on an inner track. The slots of the outer track are positioned 2 degrees in advance of the inner track. Each slot is 4 degrees of one emitter disk revolution.

Two LEDs (light emitting diodes) are positioned opposite the two tracks. Two photocells face the diodes on the opposite side of the disk. The disk turns freely between the LEDs and the photocells so that light from the LEDs can be sensed by the photocells. When the disk is rotating and a slot appears in front of the LED, light passes through the slot, the photocell senses it, and current is conducted. The photocells drive two amplifiers. The amplifiers convert the low level current signal from the photocells to a VTL logic level. The signals from the printer to the attachment are forms emitter A and forms emitter B.

As the forms feed stepper motor rotates, the forms feed emitter produces one pulse for each 2 degrees of rotation. For every 16 pulses the paper advances 1/6 inch (or one line). These pulses signal the attachment that a line feed is occurring. (The attachment uses these pulses to control forms movement.)

This is a closed loop system:

- *Forms emitter A* is used by the attachment to control *forms-predriver A* and *forms-predriver* $\overline{A}$.
- *Forms emitter B* is used by the attachment to control *forms-predriver B* and *forms-predriver* $\overline{B}$.



The pulses are counted by the attachment to determine the amount of the motion, and are used in a feedback loop that generates *forms-predriver* pulses (A, $\overline{A}$, B, and $\overline{B}$) to keep the motor running.

Forms Tractor Unit

The forms tractor unit is required for printing on continuous forms. The unit snaps into place on top of the printer frame and can be removed to use cut forms. The right tractor is adjustable to handle forms from 3 inches to 15 inches (76.20 mm to 381.00 mm) wide. The left tractor can be moved approximately one print position and is used in conjunction with the horizontal fine adjustment knob for proper positioning of print position one on the forms.

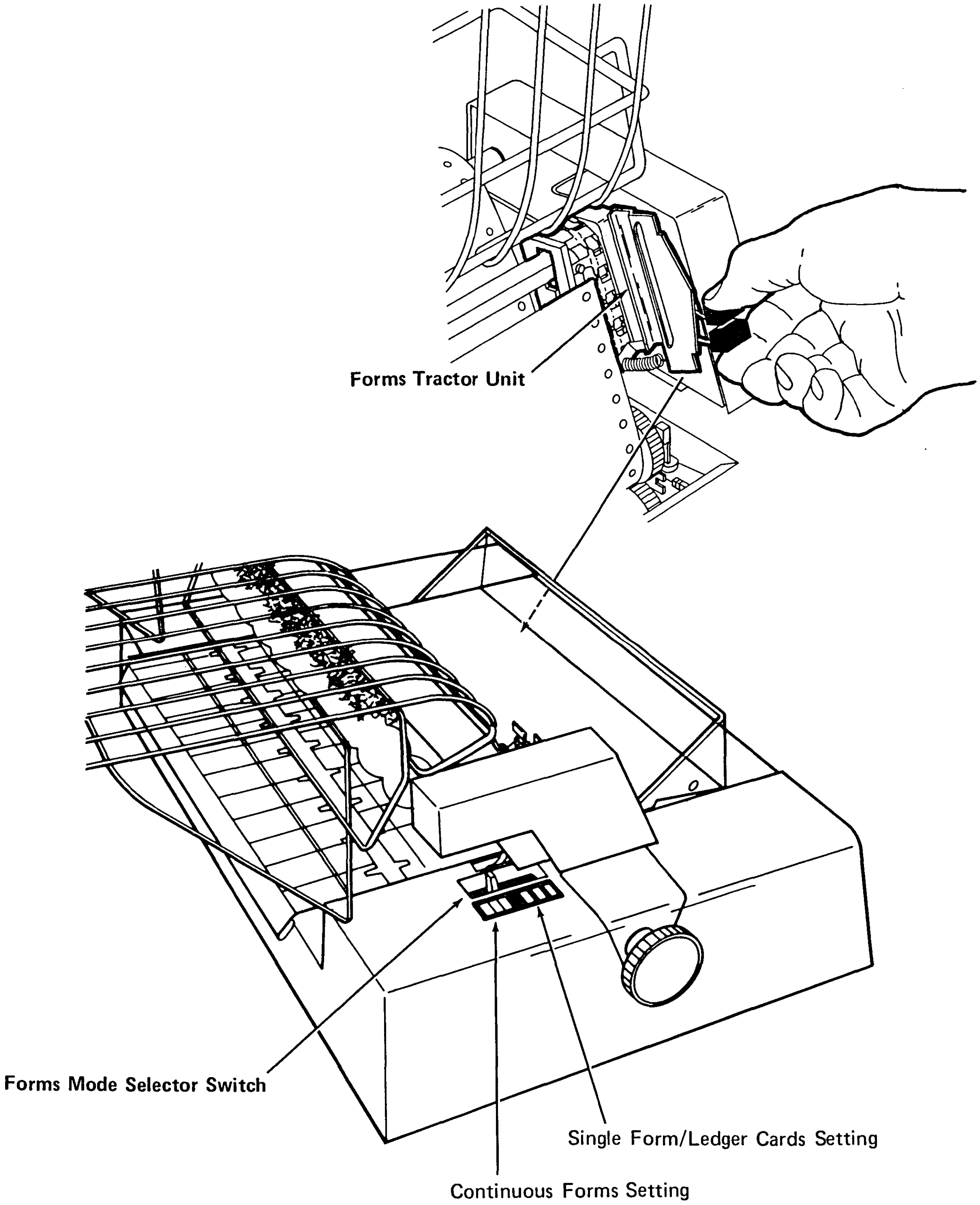
Forms Mode Selector Switch

Document selection is controlled by a two-position switch on the printer cover. When the switch is in the continuous forms position, continuous forms can be processed and the end-of-forms switch senses the presence of forms in the printer.

When the switch is in the single form/ledger cards position, cut forms can be processed and the end-of-forms switch is inactive. In the single form/ledger cards position, it is the operator's responsibility to align the document at line 1 before pressing RESET. The RESET key then resets the attachment line counter to 1. When the document is complete, it is ejected by skipping to the last line on the form and the print head is restored to the left margin.

When using cut forms, the function keys have a different usage:

- LINE Key. This key operates as before except that spacing is not executed past forms length minus 3.
- PRINT Key. This key operates as before except that printing terminates when the current line equals the forms length minus 3.
- RESET Key. The operator uses this key to signal the system that the next form is loaded. The line counter in the attachment is set to line 1.
- PAGE Key. This key is inoperative when using cut forms.



9.1.2.4 Circuit and Power

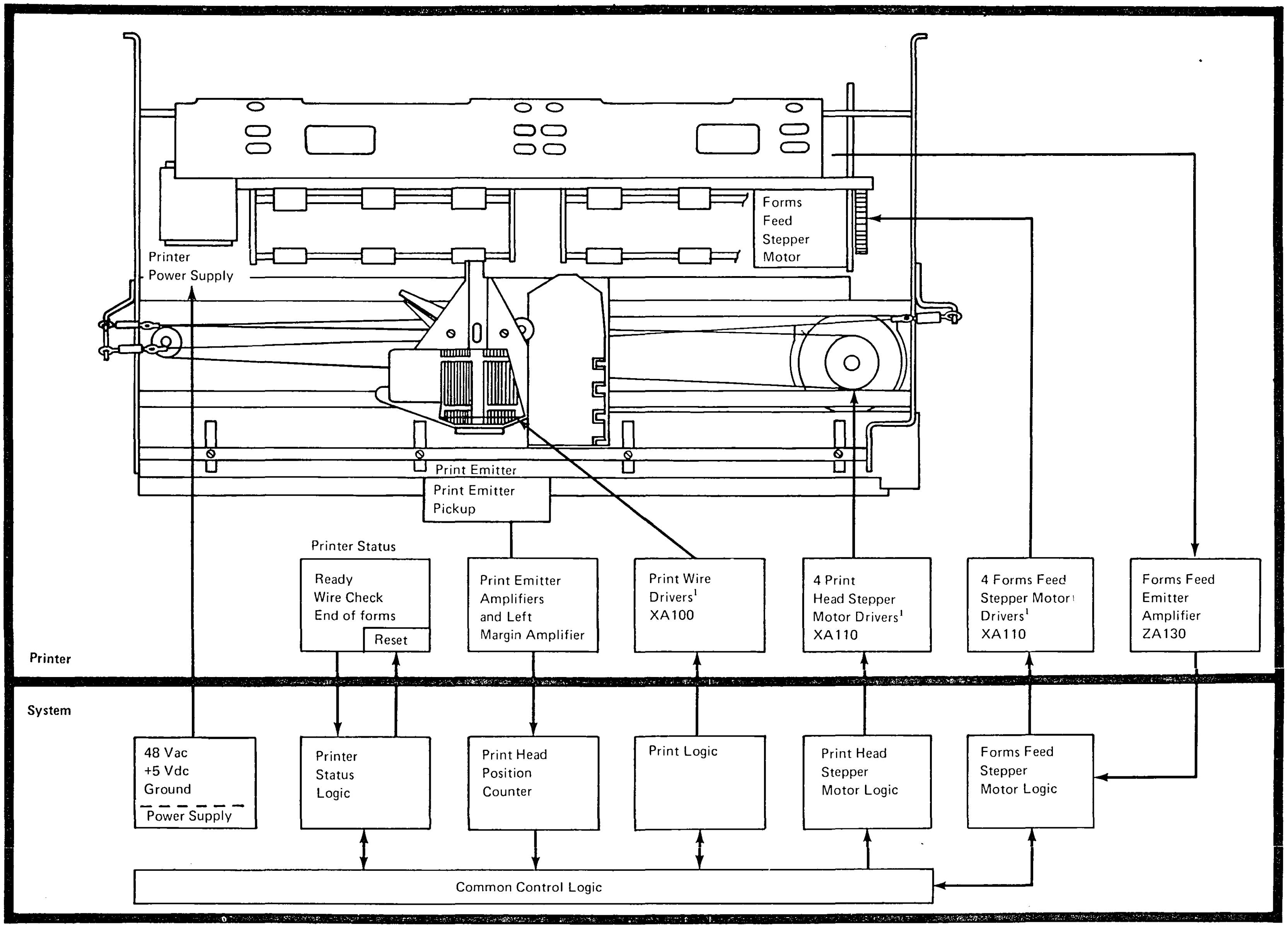
The printer contains one print magnet card and one motor driver card, one voltage regulator and sense amplifier card, print emitter and forms emitter circuits, a power supply that produces 24, 30, and 10.8 Vdc, and an end-of-forms switch.

The system supplies the printer with the following:

- 48 Vac, +5 Vdc, and ground.
- A signal to reset the wire check latch in the printer.
- Signals to fire the print wire magnets.
- Signals to move the print head left and right along the print line.
- Signals to advance the forms to the next line or eject the form.

The printer supplies the system with the following:

- A signal that the printer is ready.
- A signal that a print magnet driver is on too long (wire check).
- Left margin and print emitters 1, 2, and 3 signals so the system can determine the position of the print head and the direction it is moving.
- A signal that determines how far the forms have advanced.
- A signal that forms are not present.



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[1] The printer has driver cards that plug into a printed circuit board at the back of the printer.

9.2.0 MAINTENANCE

9.2.1 Printer Cover

Adjustment

1. Center the platen knobs vertically and maintain a gap of 1/8 inch to 5/32 inch (3.18 mm to 3.96 mm) between the top cover and the forms tractor by adjusting the pads in back **D** and the double nuts in front **B**.

2. Position the printer horizontally on the double nut studs **B** to center the paper release lever and forms mode selector lever.

Removal

1. Turn power off at the operator control panel.

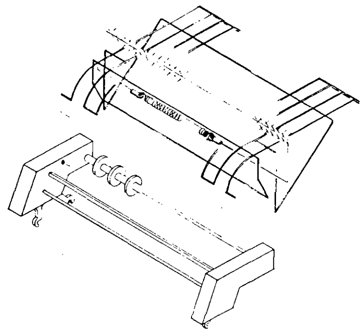
2. Remove the forms tractor unit (9.2.7).

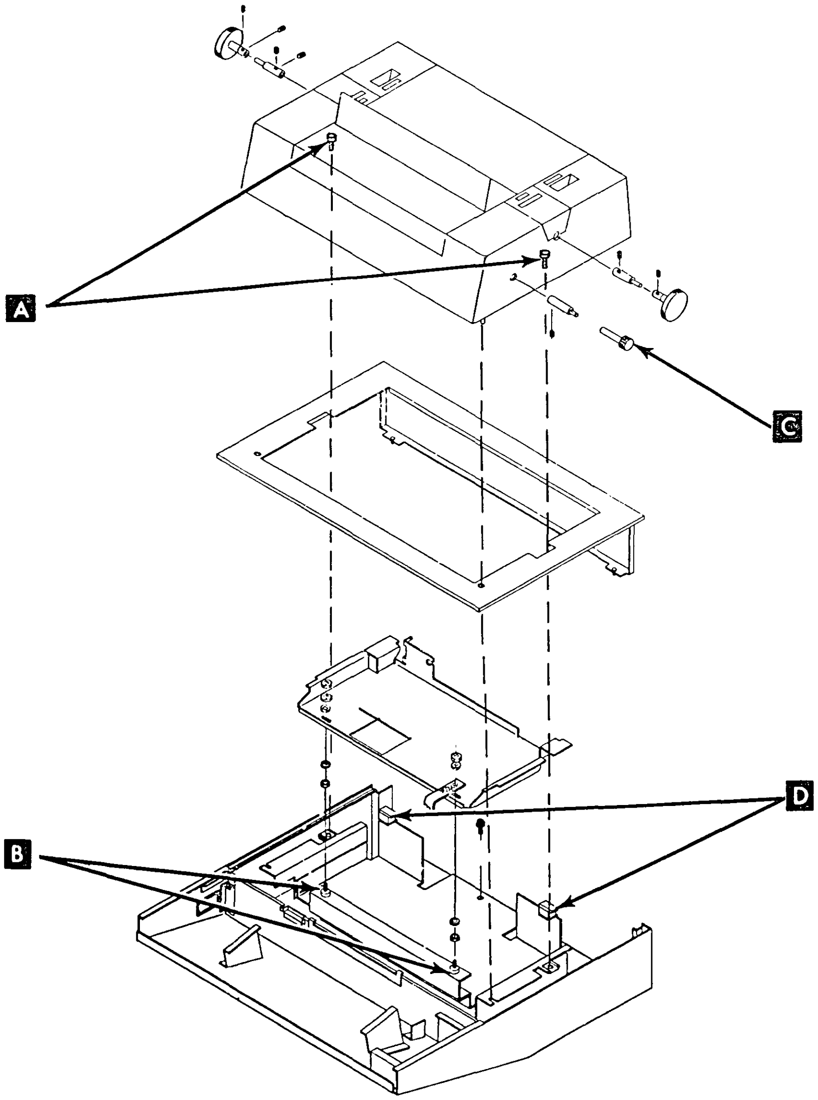
3. Remove the platen (9.2.3).

4. Pull off the horizontal fine adjustment knob **C**.

5. Loosen the fasteners **A** and remove the covers.

6. To replace, reverse this procedure.

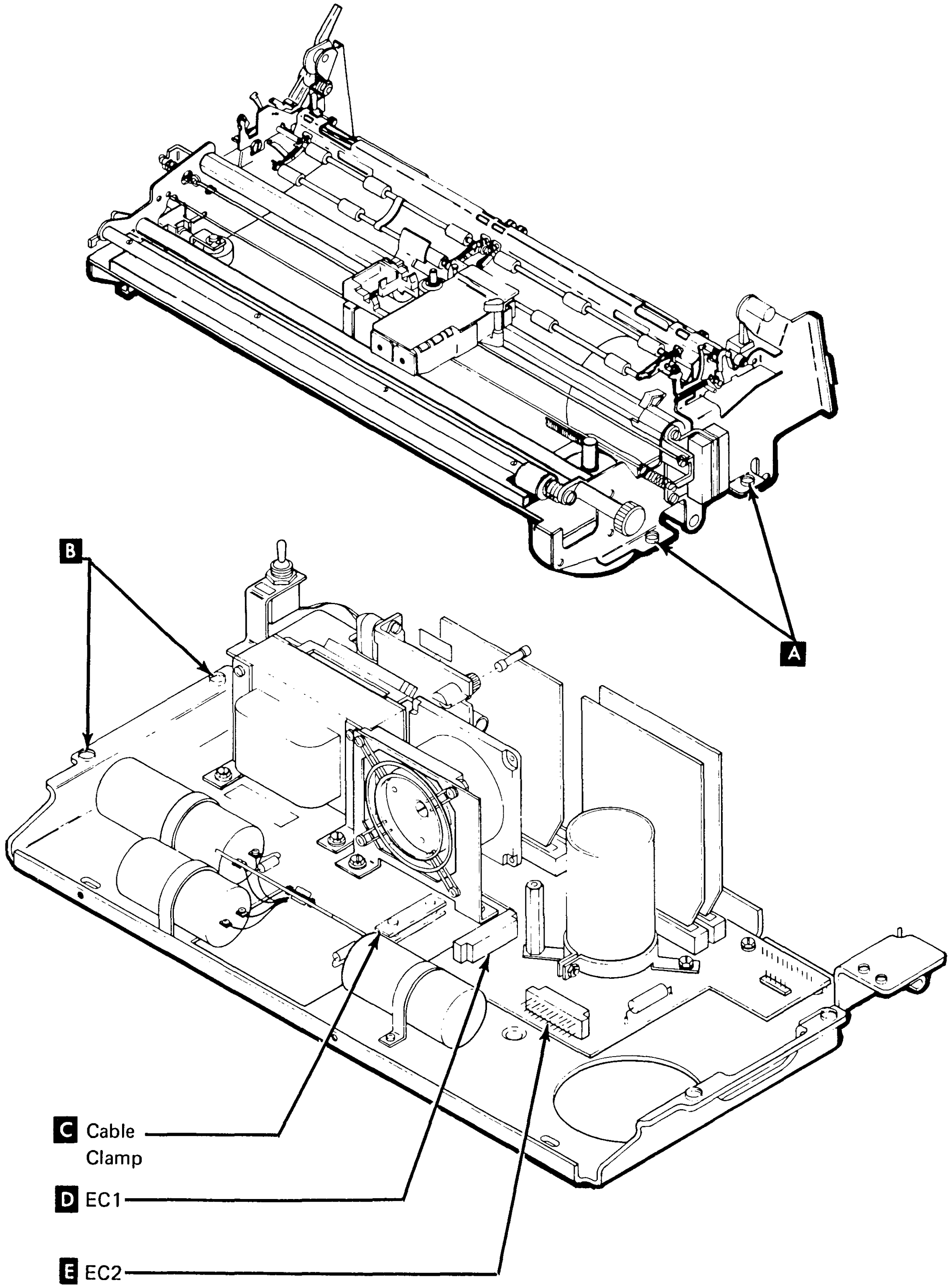




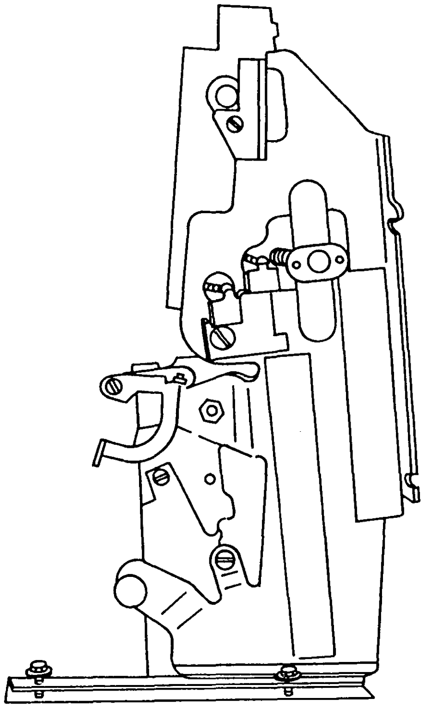
9.2.2 Separating The Printer From The Power Supply

1. Turn power off at the operator control panel.
2. Remove the printer cover (9.2.1).
3. Remove the cable clamp **C** near EC1.
4. Unplug EC1 **D** and EC2 **E**. For installation, be sure the print head cable is against the flat spring.
5. Remove two screws on the right end of the printer **A** (when CE is facing the printer).
6. Loosen two screws **B** on the left end of the printer.
7. Lift the right end of the printer slightly and slide the printer to the right to clear the screws **B**.
8. Lift the printer from the power supply. If the underside of the printer is to be serviced, remove the paper deflector and set the printer into the service position **F** on the base (so that the print emitter points upward). Secure the printer in this position with a base screw **B** on the left side and a base screw **A** on the right side.

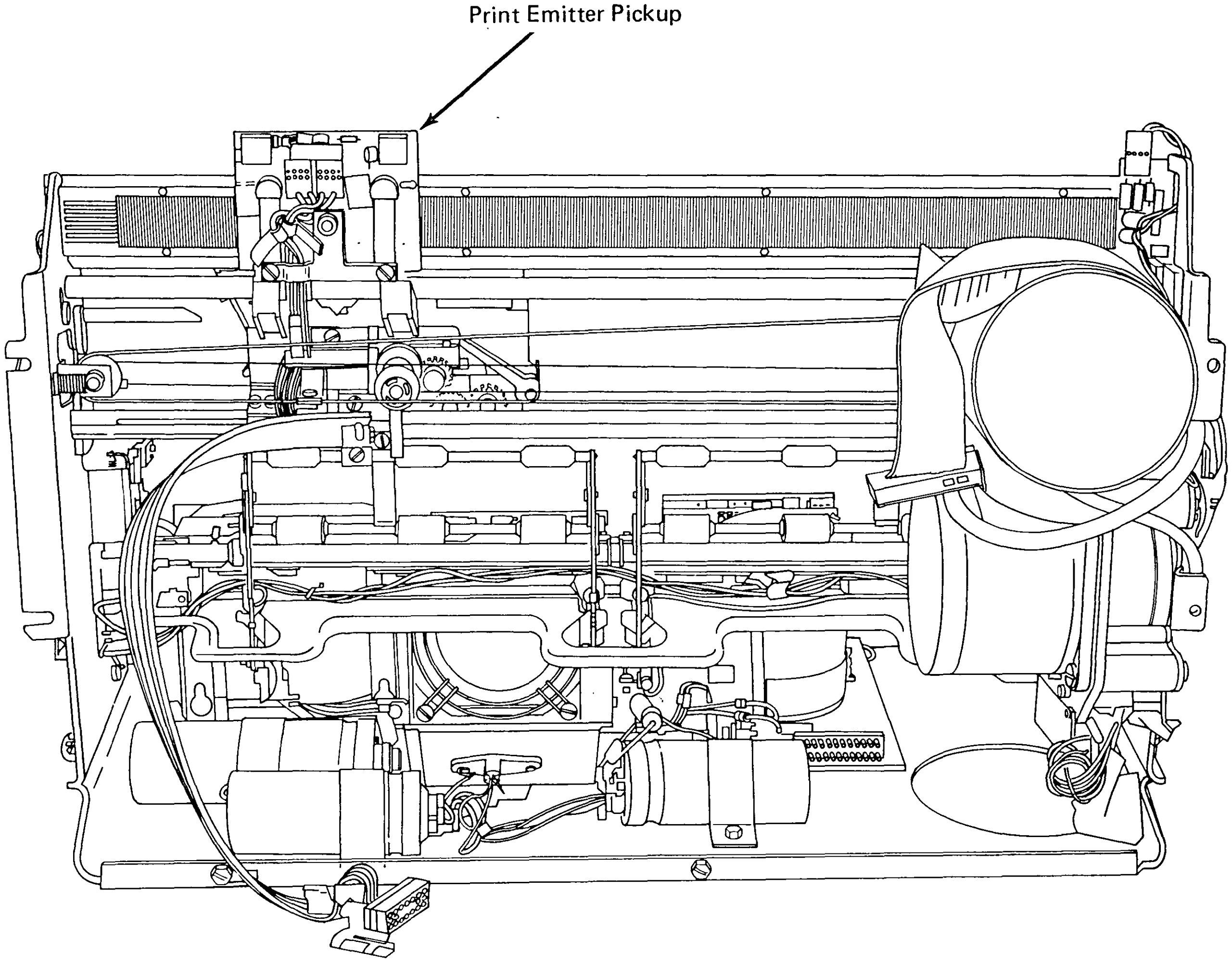
   Note: Open the ribbon feed rolls and make sure the ribbon box cover remains closed.
9. To reassemble the printer on the power supply, reverse this procedure.



F Printer in Service Position



Left End View



Front View

9.2.3 Platen and Paper Deflector

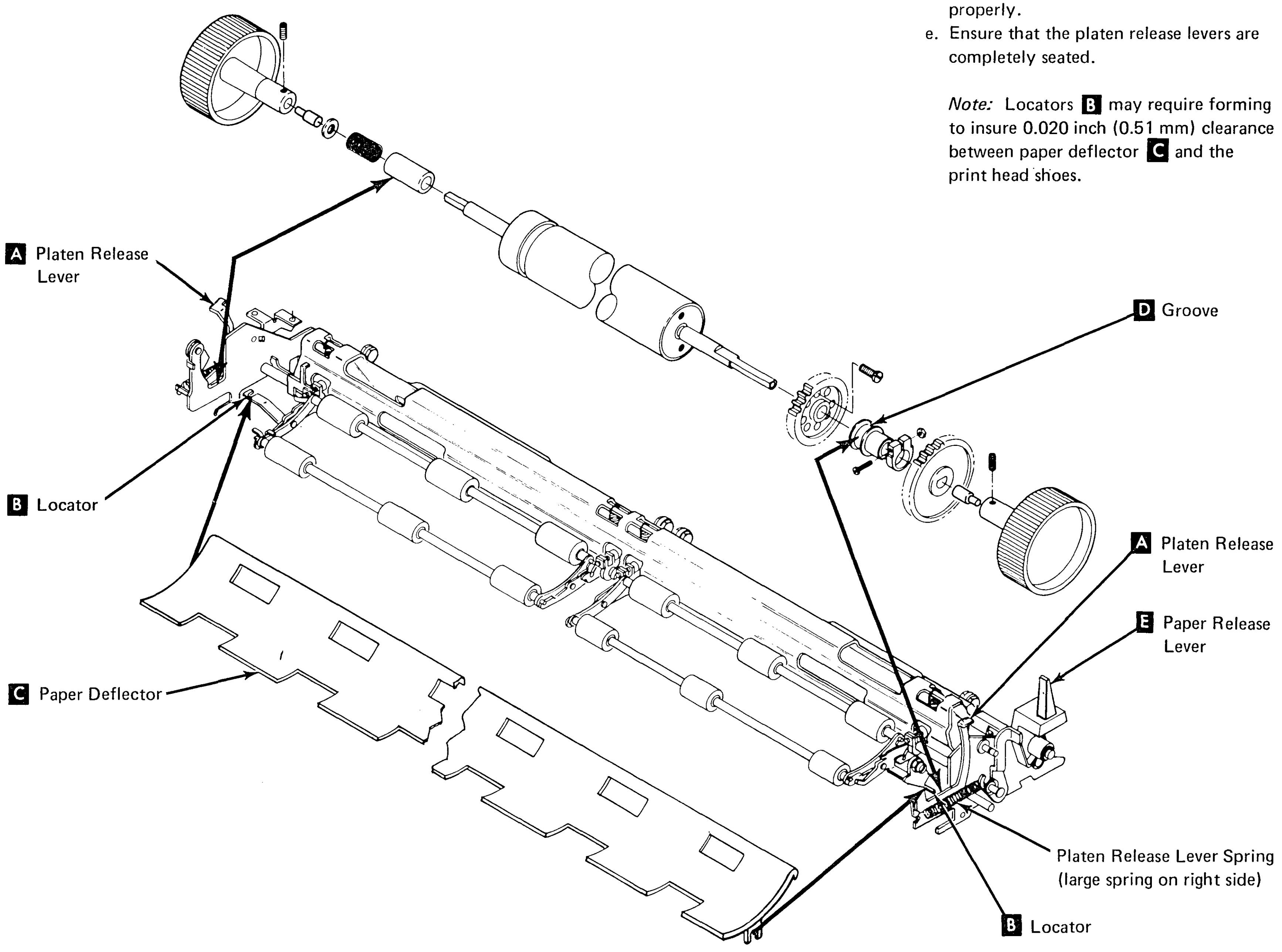
Removal

1. Turn power off at the operator control panel.
2. Center the print head on the platen.
3. Remove the forms tractor unit (9.2.7).
4. To remove the platen, open the cover platen saddles and lift up on the platen knobs while pressing down on the platen release levers **A**

   Note: To prevent possible damage to the print head forms guide, move the print head out of the left margin before depressing the platen release levers.

5. To install the platen:
   a. If the paper release lever **E** is back, pull it forward.
   b. Ensure that the paper deflector **C** is seated correctly with slotted tabs engaging locators **B**.
   c. Center the print head on the platen.
   d. Align the groove in the gear end of the platen shaft **D** with the sideplate. Then, press down on both ends of the platen. Ensure that the gears mesh properly.
   e. Ensure that the platen release levers are completely seated.

   Note: Locators **B** may require forming to insure 0.020 inch (0.51 mm) clearance between paper deflector **C** and the print head shoes.



9.2.4 Platen Release Eccentrics

Adjustment

This procedure adjusts both the left and right eccentrics. However, when adjusting the left eccentric, ensure that the platen release lever does not touch the print head forms guide when the carrier moves to the extreme left.

1. Turn power off at the operator control panel.

2. Remove the printer cover (9.2.1).

3. Loosen the screw **C** that locks the eccentric nut **B** until the screw is finger tight.

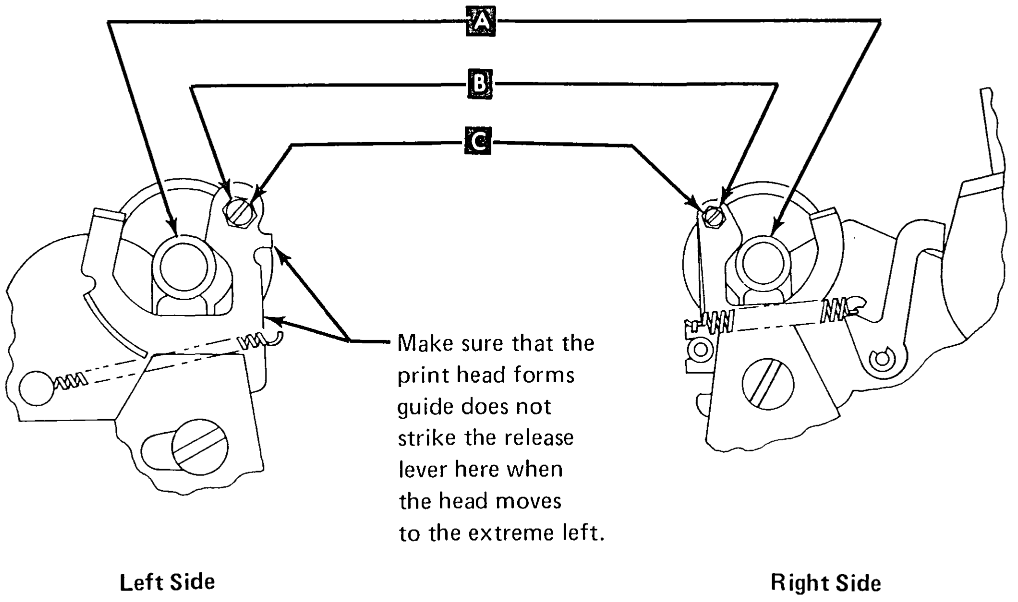
   Note: When adjusting the right side, remove the platen knob and forms tractor drive gear. When replacing, adjust clearance to bushing **H**.

4. Press the platen bushing **A** down and turn the eccentric nut so that when released, the lever holds the bushing firmly against the frame.

5. Hold the eccentric nut in this position and tighten the locking screw.

6. Check the platen gear backlash adjustment (9.2.10).

7. Reinstall the printer cover (9.2.1).



Make sure that the print head forms guide does not strike the release lever here when the head moves to the extreme left.

9.2.5 Platen Gears

Removal

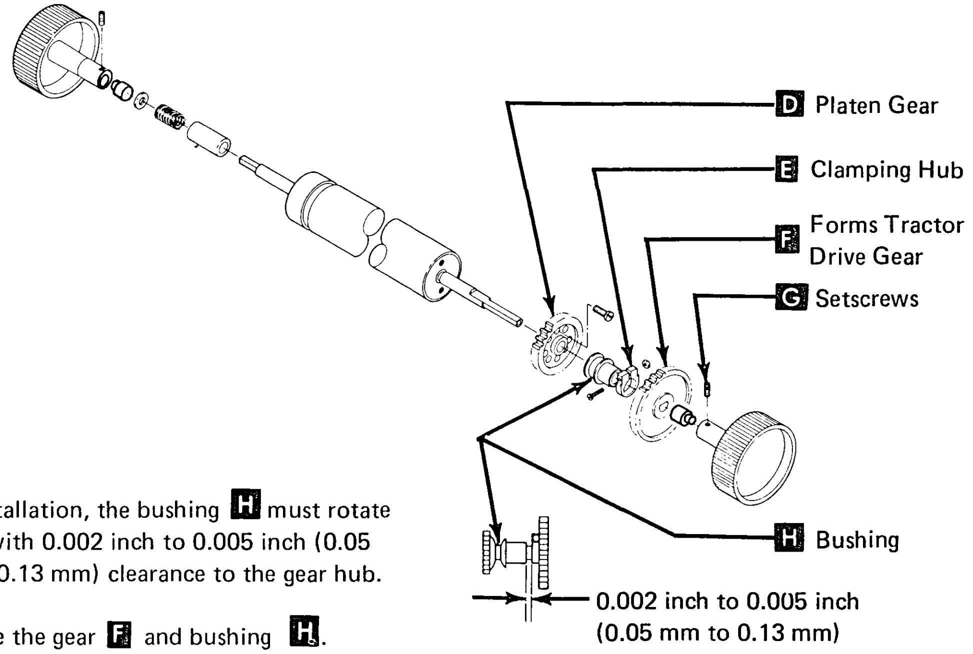
1. Turn power off at the operator control panel.

2. Remove the forms tractor unit.

3. Open the cover platen saddles and remove the platen.

4. Remove the knob from the gear end of the platen (two setscrews **G**).

5. Loosen the clamping hub **E** on the forms tractor drive gear.



6. For installation, the bushing **H** must rotate freely with 0.002 inch to 0.005 inch (0.05 mm to 0.13 mm) clearance to the gear hub.

7. Remove the gear **F** and bushing **H**.

8. Remove the screws that hold the platen gear **D**.

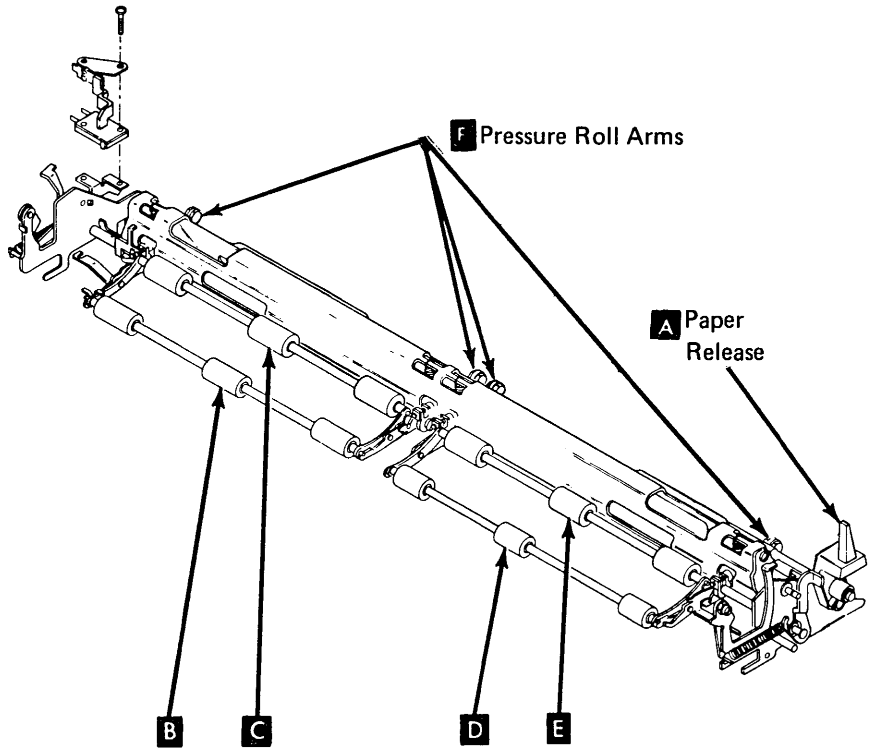
9. Remove the gear.

10. To reinstall the gears, reverse this procedure.

9.2.6 Platen Pressure Rolls

Adjustment

1. Remove the printer cover, the platen, and the paper deflector.
2. Reinstall the platen.
3. Open the pressure rolls with the paper release A (push the lever to the rear).
4. Check for a minimum of 0.040 inch (1.02 mm) between the platen and the pressure rolls at points B , C, D and E .
5. If there is insufficient clearance at any of the points (B , C, D , or E), adjust the pressure roll arm F nearest to the out-of-tolerance point.
6. Check the adjustment of the end-of-forms switch (9.2.17).
7. Remove the platen.
8. Reinstall the paper deflector, platen, and printer cover (9.2.1).

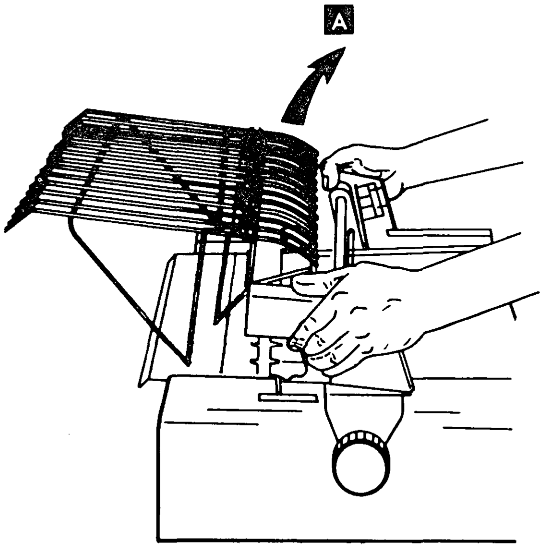


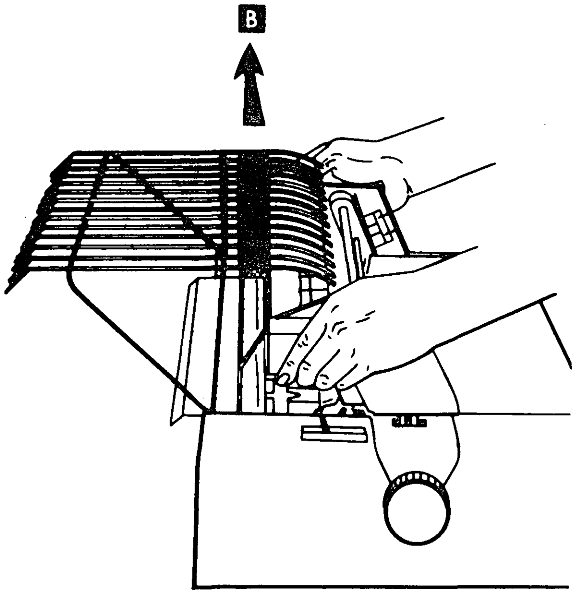
9.2.7 Forms Tractor Unit

Removal

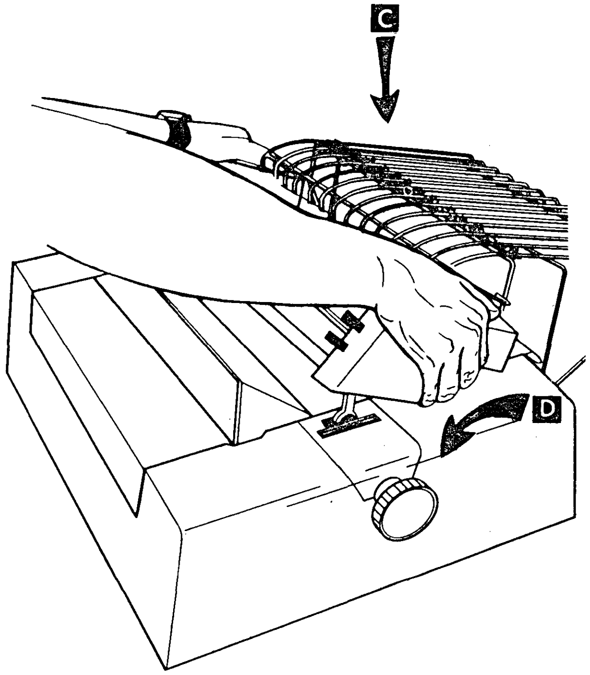
CAUTION
When removing the forms tractor unit, take care to avoid twisting it.

1. Remove the forms tractor unit by pivoting it forward **A** , until the rear legs snap free; then lift straight up on the unit **B** .

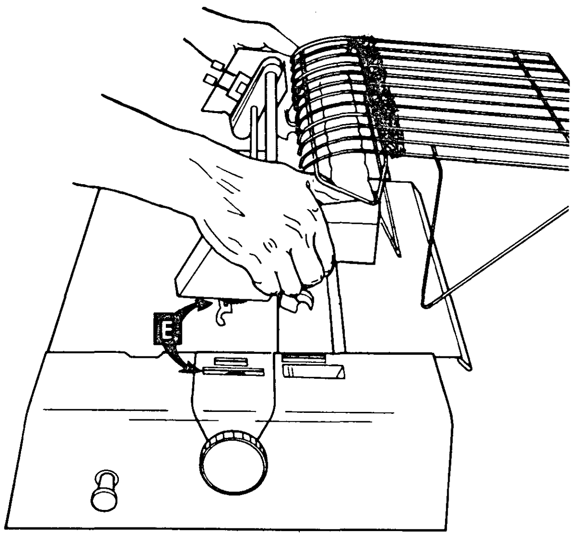




2. Reinstall the unit by snapping the rear legs in place **C** and then pivoting it forward **D** . Ensure that all four legs are firmly in place.

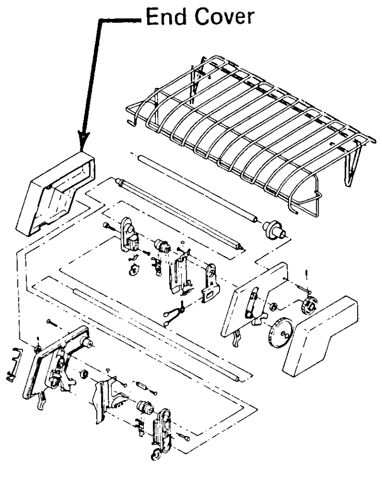


Note: When reinstalling, make sure that the gears **E** mesh properly, the platen knobs turn, and the forms tractors rotate.



Disassembly

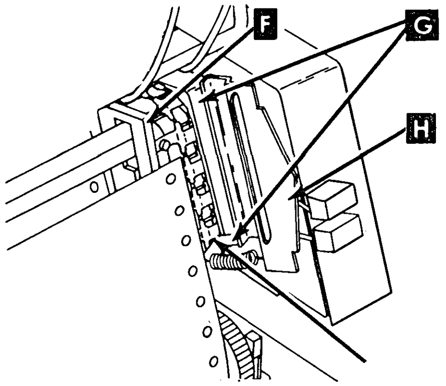
Disassemble according to the illustration as needed. The end covers are removed by just pulling them off. When the chain gears are replaced, slide the gears together and ensure the teeth on each gear line up with each other.

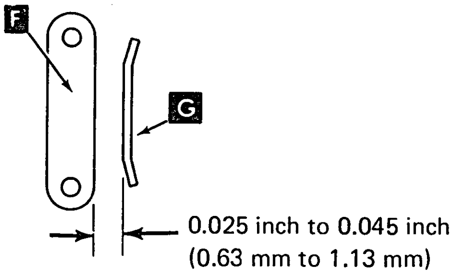


9.2.8 Forms Tractor Unit Chain Cover

Adjustment

Form the cover stops **G** so that the gap between the chain guide **F** and cover **H** is 0.025 inch to 0.0.45 inch (0.63 mm to 1.13 mm). It might be necessary to reposition the hinge brackets **J** to obtain this clearance.

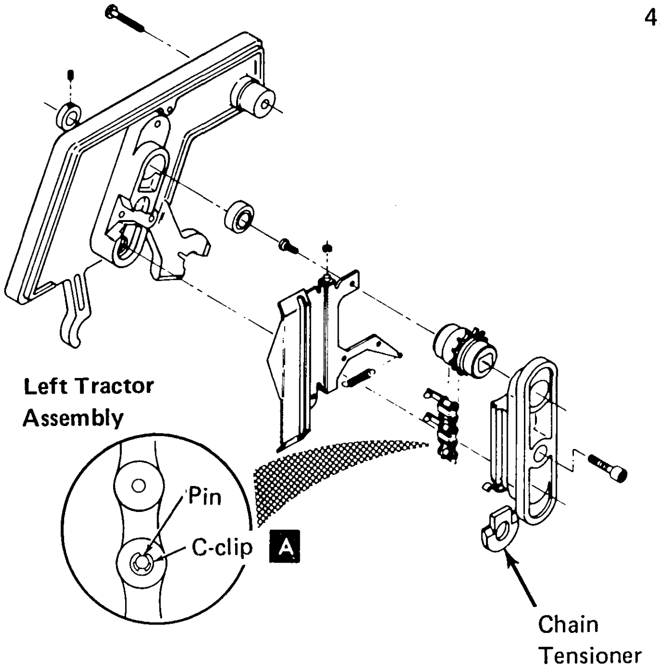




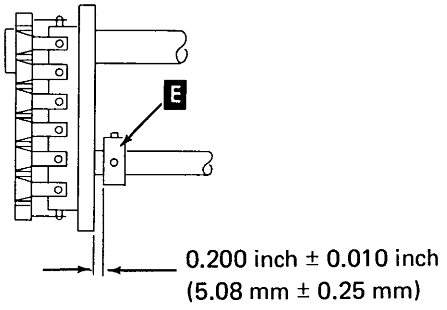
9.2.9 Forms Tractor Unit Chain

Removal

1. Remove the forms tractor unit (9.2.7).
2. Locate the pin that holds the chain together. Move the pin to the back side and remove the C-clip **A**.
3. Slide the removable pin from the chain. The chain tensioner and spring might fall out.
4. To reinstall a chain, reverse the procedure.



5. Machines equipped with an adjustable left tractor should follow this procedure. With the left tractor in the leftmost position, adjust the collar **E** to allow 0.200 inch ± 0.010 inch (5.08 mm ± 0.25 mm) movement of the tractor.

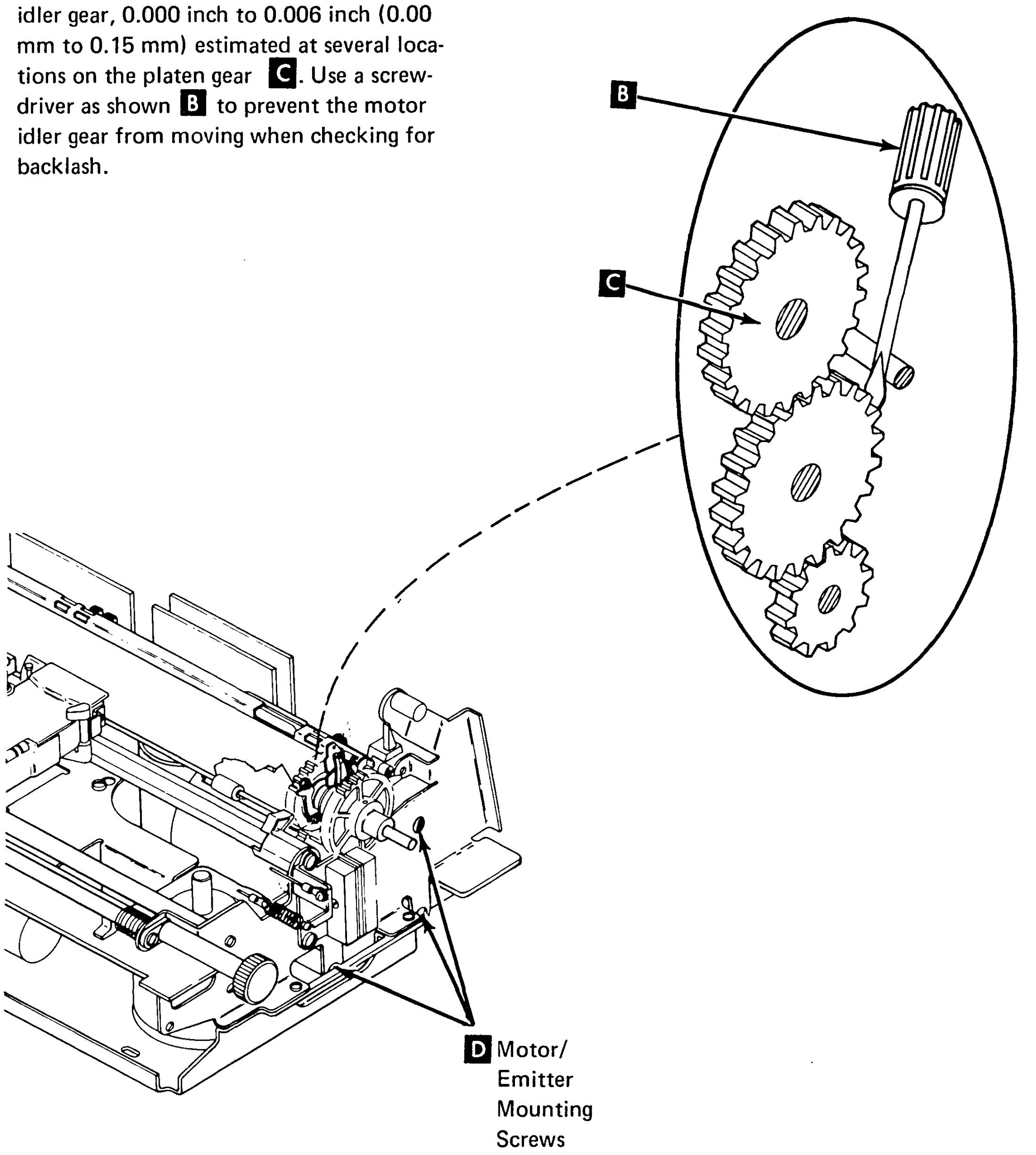


9.2.10 Platen Gear Backlash

Adjustment

Idler and platen gears should have a slight backlash throughout their rotation.

1. Turn power off at the operator control panel.
2. Remove the printer cover (9.2.1).
3. Loosen the forms feed motor/emitter mounting screws **D**.
4. Position the stepper motor up and back to provide slight backlash from platen gear to idler gear, 0.000 inch to 0.006 inch (0.00 mm to 0.15 mm) estimated at several locations on the platen gear **C**. Use a screwdriver as shown **B** to prevent the motor idler gear from moving when checking for backlash.
5. Tighten the mounting screws and check for binds and minimum backlash at several locations on the platen gear.
6. Reinstall the printer cover (9.2.1).

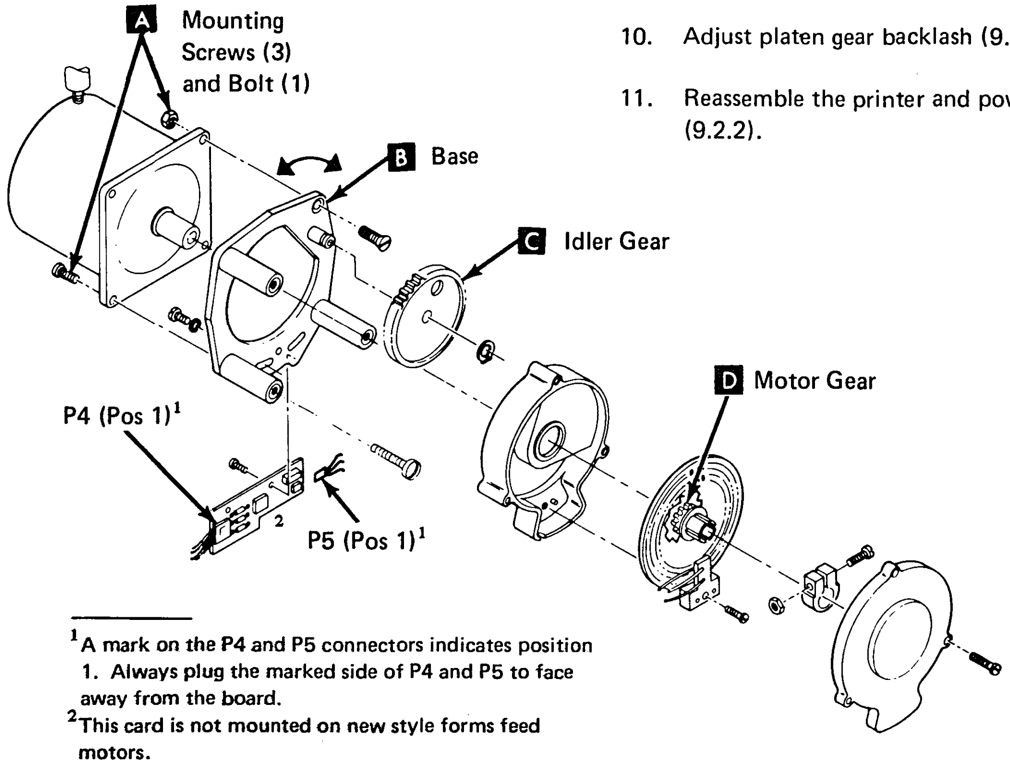


9.2.11 Forms Feed Motor Gear Backlash

Adjustment

1. Turn power off at the operator control panel.
2. Separate the printer from the power supply and place the printer in the service position (9.2.2).
3. Remove the forms feed motor/emitter assembly (9.2.12).
4. Loosen the screws and the nut (bolt head access through hole in the idler gear) that holds the emitter base on the stepper motor **A**.
5. Rotate the base **B** on the motor to obtain slight backlash, 0.001 inch to 0.006 inch (0.025 mm to 0.15 mm) estimated, between idler gear **C** and the motor gear **D** .

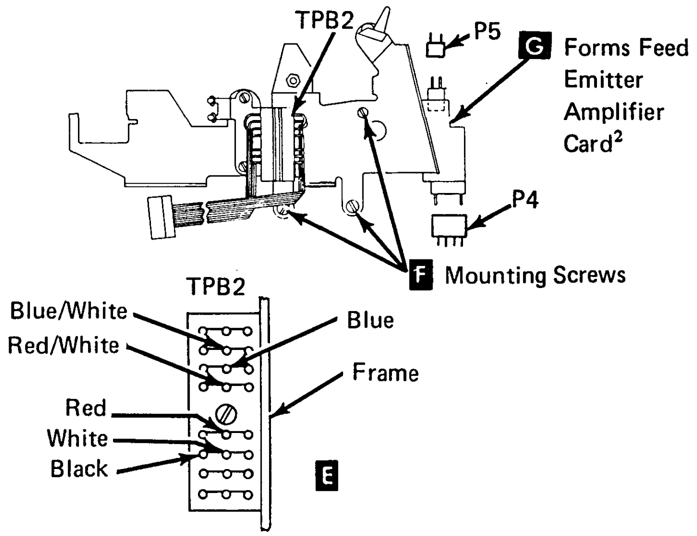
   CAUTION
   Too little backlash can cause breakage of the mounting stud for idler gear **C** .
6. Check backlash in several positions of the idler gear.
7. Tighten screws and nut.
8. Check backlash and readjust if necessary.
9. Reinstall the forms feed motor/emitter assembly.
10. Adjust platen gear backlash (9.2.10).
11. Reassemble the printer and power supply (9.2.2).



9.2.12 Forms Feed Motor/Emitter

Removal

1. Turn power off at the operator control panel.
2. For installation, if the motor/emitter was disassembled, perform the forms feed motor/emitter timing (9.2.15).
3. For installation, adjust the platen gear backlash (9.2.10).
4. Unplug the forms feed emitter amplifier card **G**.
5. Unplug the motor leads from TPB2 **E**.
6. Separate the printer from the power supply and place the printer in the service position (9.2.2).
7. While supporting the forms feed motor/emitter assembly, remove three mounting screws **F** from the right side frame.
8. Remove the motor/emitter assembly. To remove any parts from the motor/emitter assembly, disassemble it, as required (9.2.13).
9. To reinstall the motor/emitter assembly, reverse the procedure.



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[1] A mark on the P4 and P5 connectors indicates position 1. Always plug the marked side of P4 and P5 to face away from the board.

[2] This card is not mounted on new style forms feed motors.

9.2.13 Forms Feed Motor/Emitter

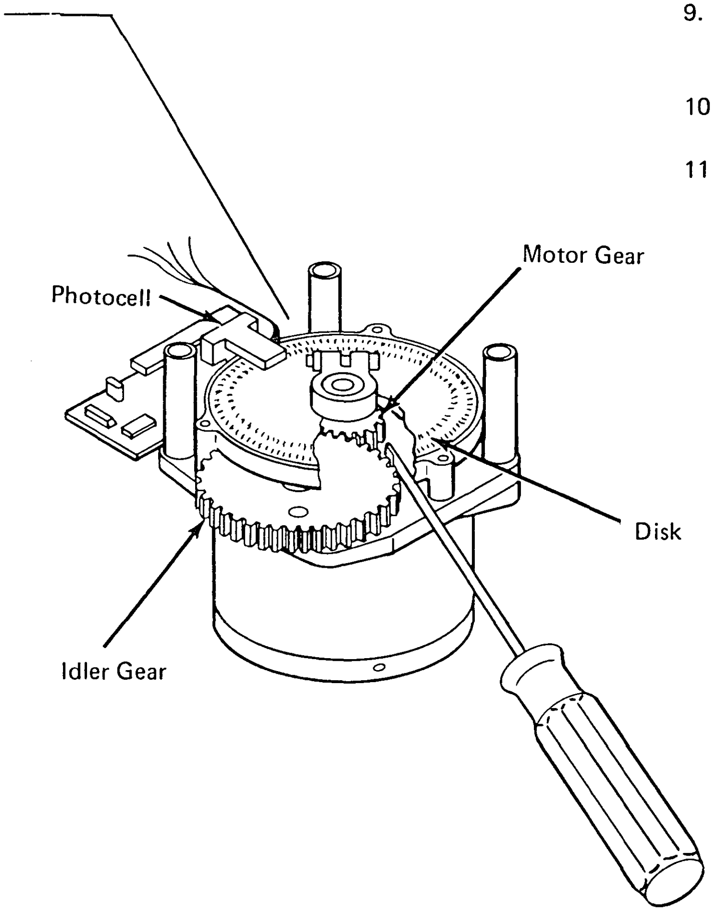
Disassembly

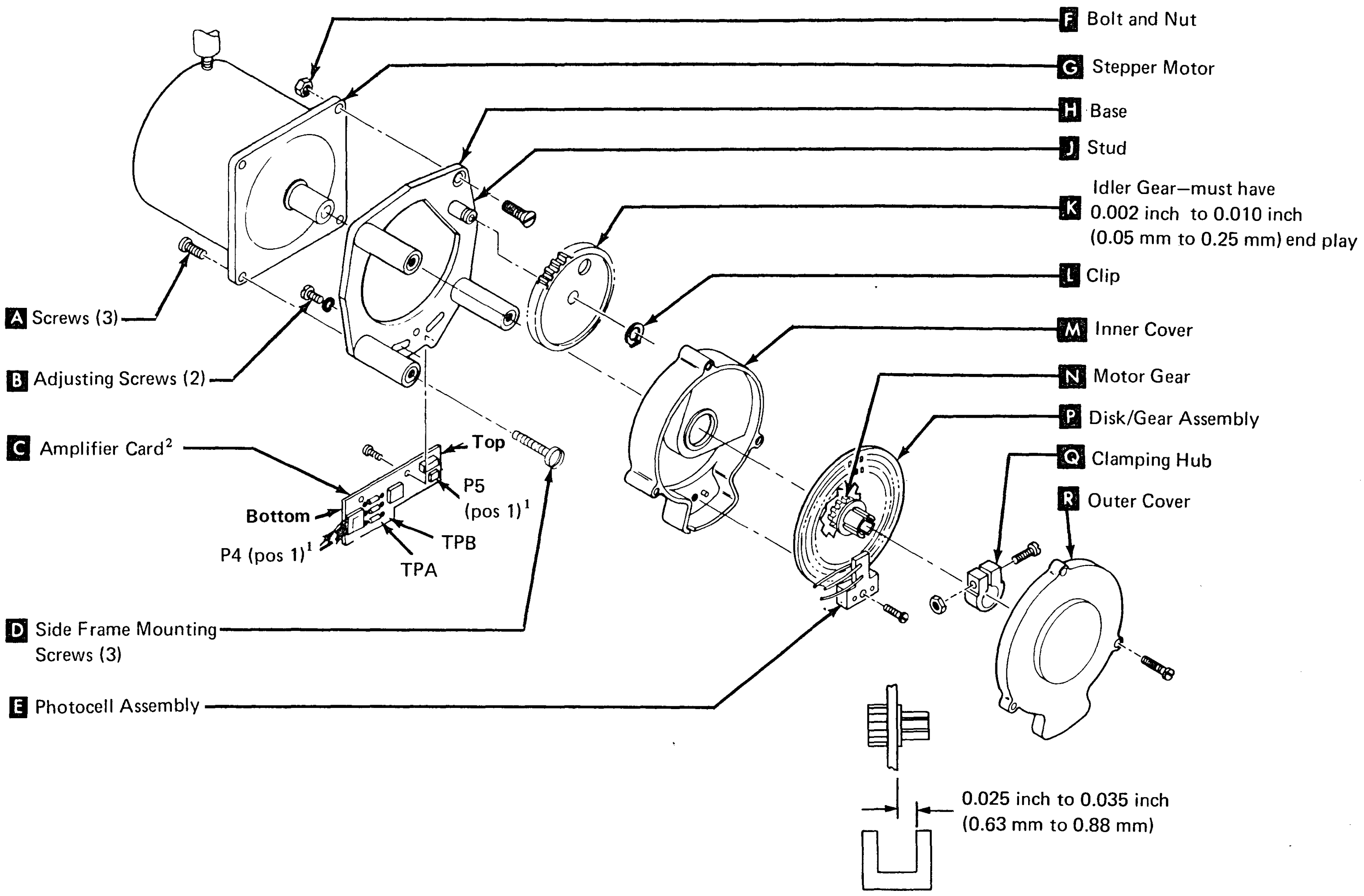
1. Turn power off at the operator control panel.
2. Remove the forms feed motor/emitter from the side frame (9.2.12).
3. Remove the emitter outer cover R.
4. Loosen the disk/gear clamping hub Q.
5. Remove the two adjusting screws B from the back of the base.
6. Remove the screw that holds the photocell assembly E.
7. **CAUTION**
   Do not pry on the slotted disk; doing so will bend or scratch it.

   Remove the inner cover M and the disk/gear assembly from the motor shaft by prying up on the motor gear as illustrated.
8. Remove the clip L that holds the idler gear K and lift off the gear.
9. Remove the three screws A plus one bolt and nut F that fasten the base H to the stepper motor G.
10. To reassemble the motor/emitter, use the reassembly procedure.

Reassembly

1. Install the three screws A plus one bolt and nut F that fasten the base H to the stepper motor G. Do not tighten the screws and bolt now.
2. Install the idler gear K and the retaining clip L so that the idler has 0.002 inch to 0.010 inch (0.05 mm to 0.25 mm) end play.
3. Install the inner cover M with the two adjusting screws B finger tight.
4. Place the photocell assembly E on the disk/gear assembly P and slide them onto the motor shaft.
5. Secure the photocell assembly with its mounting screw.
6. Center the forms feed emitter disk in the slot. Avoid scratching the black paint from around the disk slots. A 0.030 inch (0.76 mm) feeler gauge should slide freely on the upper side of the disk. Check clearance at several points on the disk.
7. Tighten the clamping hub Q and recheck the clearance.
8. Rotate the base H on the motor to obtain a slight backlash between the idler gear K and motor gear N, flush to 0.006 inch (0.15 mm) estimated.
9. Tighten the screws and nut, and check backlash in several positions of the idler gear.
10. Install the outer cover R.
11. Install the motor/emitter assembly in the printer (9.2.12).




Forms Feed Stepper Motor
(rotated 90° clockwise)

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[1] A mark on the P4 and P5 connectors indicates position 1. Always plug the marked side of P4 and P5 to face away from the board.

[2] This card is not mounted on new style forms feed motors.

9.2.14 Forms Feed Emitter Disk

Adjustment

The disk should be centered in the photocell assembly slot for all positions of the disk.

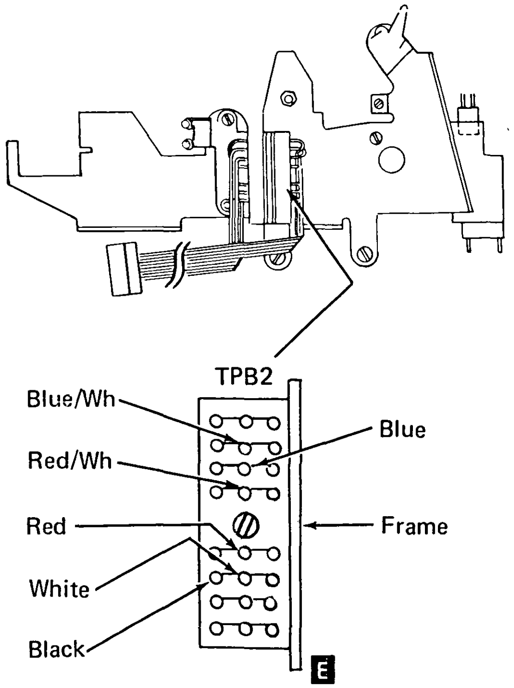
1. Remove the forms feed motor/emitter assembly (9.2.12).
2. Remove the outer cover R.
3. Loosen the clamping hub Q and center the disk in the slot. A 0.030 inch (0.76 mm) feeler gauge should slide freely on the upper side of the disk. Avoid scratching the black paint from around the disk slots. Check the clearance at several points on the disk.
4. Tighten the clamping hub and recheck the clearance.
5. Reinstall the outer cover.
6. Reinstall the motor/emitter assembly (9.2.12).

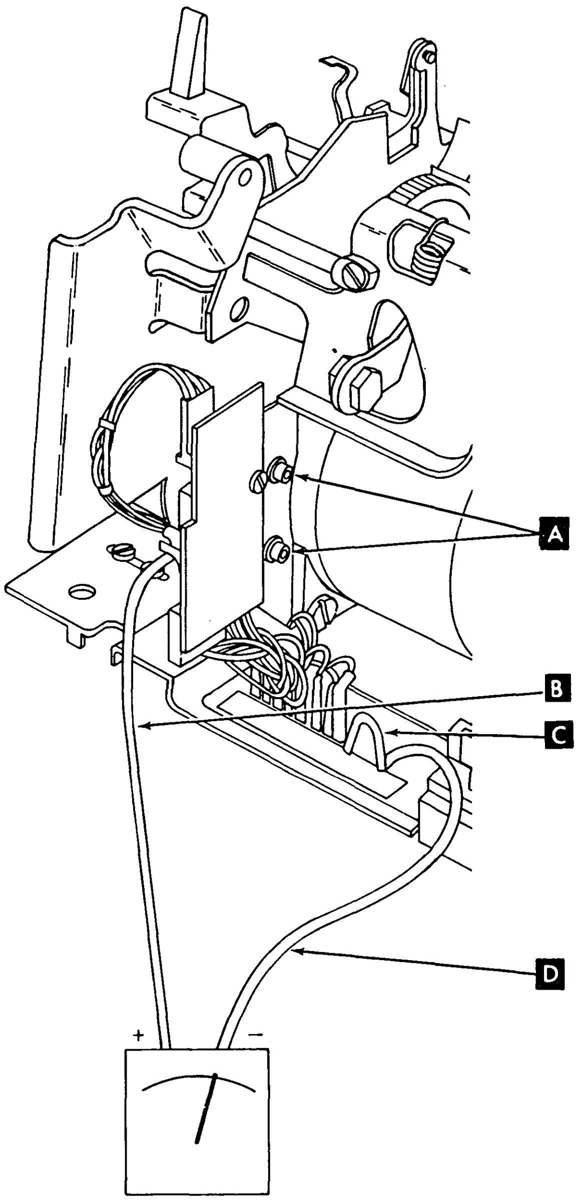
9.2.15 Forms Feed Motor/Emitter

1. Turn off power to printer.
2. Remove printer cover (9.2.1).
3. Connect a jumper wire between test points FMA and G7 C (forms driver A to ground).
4. Move the BLACK wire from TPB2-6C to TPB2-3C E .
5. Move the RED wire from TPB2-5B to TPB2-6C E .
6. Loosen photocell assembly (two screws A behind motor) so that assembly will slide but not fall of its own weight.
7. Set up a voltmeter to read 5 Vdc.
8. Connect the negative lead D to G8 (ground).
   a. If your machine has an emitter amplifier card, connect the positive lead B to TPA (forms emitter A) on the amplifier card.
   b. If your machine has no emitter amplifier card, connect the positive lead B to the system I/O board 01A-A2-V3D07 (forms emitter A).
9. Turn on power to printer.
10. Slide the photocell down as far as possible.
11. Slowly slide or gently pry the assembly up until meter first shifts to +5 Vdc (up level). Keep the assembly as close to this point as possible.

    Note: Ignore the initial reading if it is at an up level.
12. Hold photocell assembly firmly in place and tighten the two screws.
13. Replace the platen and verify the adjustment as follows:
    a. Put a small amount of force on the platen knob in the forward direction. The meter should stay at +5 Vdc (up level) when you remove your hand from the knob.
    b. Put a small amount of force on the platen knob in the reverse direction. The meter should shift to 0 Vdc (down level), then rise something less than +5 Vdc when you release the platen knob.
14. Readjust if necessary.
15. Turn power off to printer.
16. Remove meter and jumper wire.
17. Move the RED wire from TPB2-6C back to TPB2-5B E .
18. Move the BLACK wire from TPB2-3C back to TPB2-6C E .
19. Remove the platen and reinstall printer cover.
20. Check adjustment by running diagnostic SPRT7: readjust if necessary.

    Note: If adjusted incorrectly, the forms motor may run backwards.



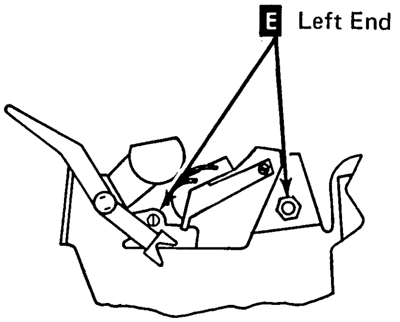


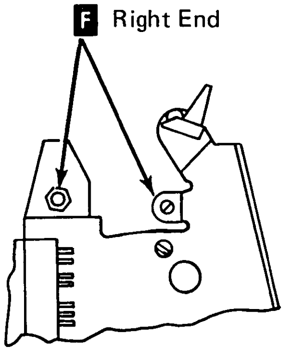
9.2.16 A-Frame

Alignment

A-frame alignment to the platen is set at the factory and mounting screws are secured with Loctite[1]. Further alignment should not be required in normal printer use. However, if alignment is required, use the following procedure.

1. Turn power off at the operator control panel.
2. Remove the printer cover (9.2.1).
3. Set the copy control dial to 0.
4. Measure the clearance between the platen and the print head at both ends of the platen. Clearance should be 0.012 inch to 0.014 inch (0.30 mm to 0.36 mm). If the left end dimension is wrong, go to the next step; if the right end dimension is wrong, go to step 9.
5. If the left end dimension is wrong, slightly loosen the A-frame mounting screws in the left side frame **E**.
6. With a brass drift punch and a hammer, tap on the A-frame left side plate to obtain the specified clearance.
7. Securely tighten the A-frame mounting screws (Loctite is unnecessary), check the clearance, and readjust if necessary.
8. Check the clearance at the right end of the platen. If the clearance is not correct, continue on to the next step. If the clearance is correct, install the printer cover (9.2.1), turn power on, and set the copy control dial for proper printing.
9. If the right end dimension is wrong, slightly loosen the A-frame mounting screws in the right side frame **F**.
10. With a brass drift punch and a hammer, tap on the A-frame right side plate to obtain the specified clearance.
11. Securely tighten the A-frame mounting screws (Loctite is unnecessary), check the clearance, and readjust if necessary.
12. Check the clearance at the left end of the platen. If the clearance is not correct, return to step 5. If the clearance is correct, install the printer cover (9.2.1), turn on power, and set the copy control dial for proper printing.
13. Check platen gear backlash (9.2.10) and adjust, if necessary.
14. Check end-of-forms switch adjustment and correct if necessary (9.2.17).





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[1] Trademark of Loctite Corp.

9.2.17.1 End-of-Forms Switch (Old Style)

Note: The old style end-of-forms switch actuator is behind the platen; the new style actuator is under the platen.

Adjustment

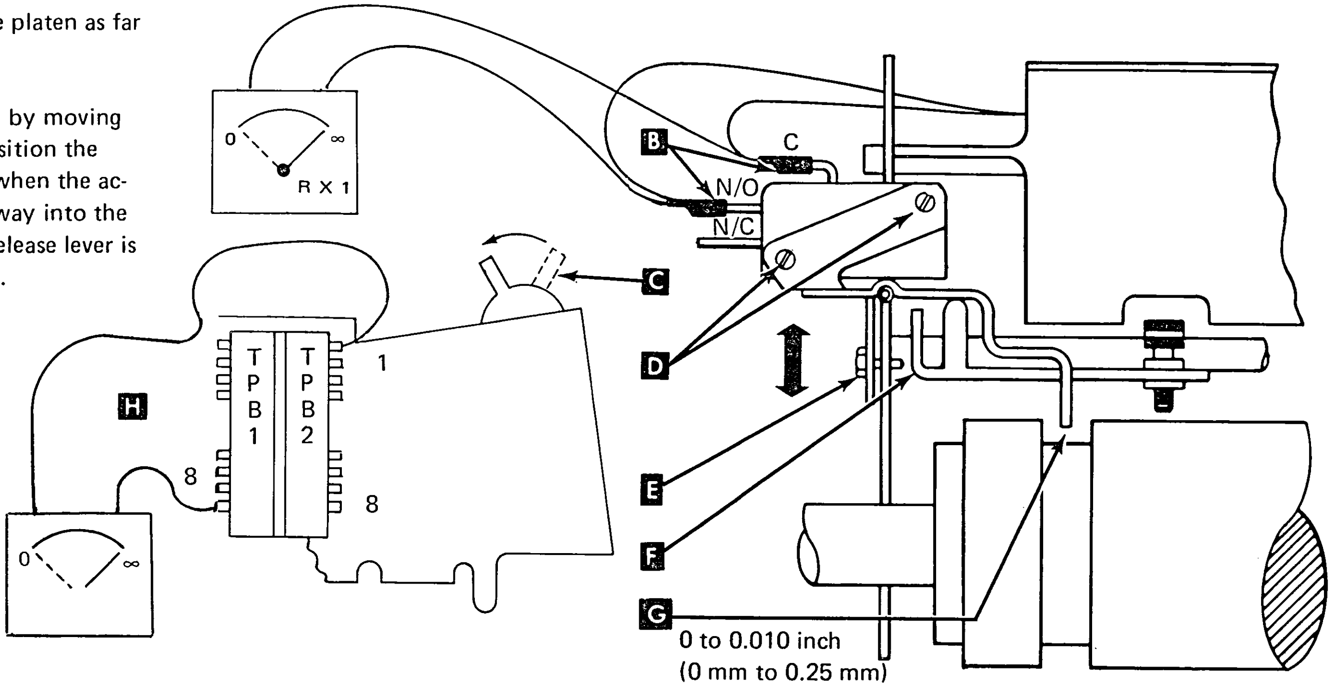
The switch points should open when the actuator tip is 1/2 to 3/4 of the way into the platen slot G and the paper release lever C is forward. If they do not, perform the following adjustment. Check with power off.

1. Turn power off at the operator control panel.
2. Remove the printer cover (9.2.1).
3. Set up an ohmmeter to the RX1 scale.
4. If your machine has a forms emitter amplifier card, connect the meter leads to the End-Of-Forms switch terminals B.

   If your machine has no emitter amplifier card, connect the meter leads between TPB2-1 and TPB1-8 H.
5. Slightly loosen the switch bracket mounting screw E.
6. Slide the switch away from the platen as far as possible.
7. In this step, operate the switch by moving the paper release lever C. Position the switch so that its points close when the actuator tip is 1/2 to 3/4 of the way into the platen slot G and the paper release lever is being pulled toward the platen.
8. Tighten the switch assembly mounting screw E.
9. Pull the paper release lever toward the platen and leave it there.
10. Form the switch override bracket F by twisting it so that it lifts the switch actuator 0.000 inch to 0.010 inch (0.00 mm to 0.25 mm) from the platen slot bottom G.
11. Check the adjustment by operating the paper release lever several times. The switch contacts should open when the actuator tip is 1/2 to 3/4 of the way out of the platen slot and the paper release lever is being pushed backward. Readjust if necessary.
12. Install the printer cover and the forms tractor unit.

Removal

1. Turn power off at the operator control panel.
2. Remove the forms tractor unit (9.2.7).
3. Remove the printer cover (9.2.1).
4. Remove the switch and actuator by removing two screws D.
5. Transfer the switch leads B from the old switch to the new switch.
6. Reinstall the switch and actuator with screws D.
7. Adjust the switch.



9.2.17.2 End-of-Forms Switch (New Style)

Note: The new style end-of-forms switch actuator lever is *under* the platen; the old style actuator lever is *behind* the platen.

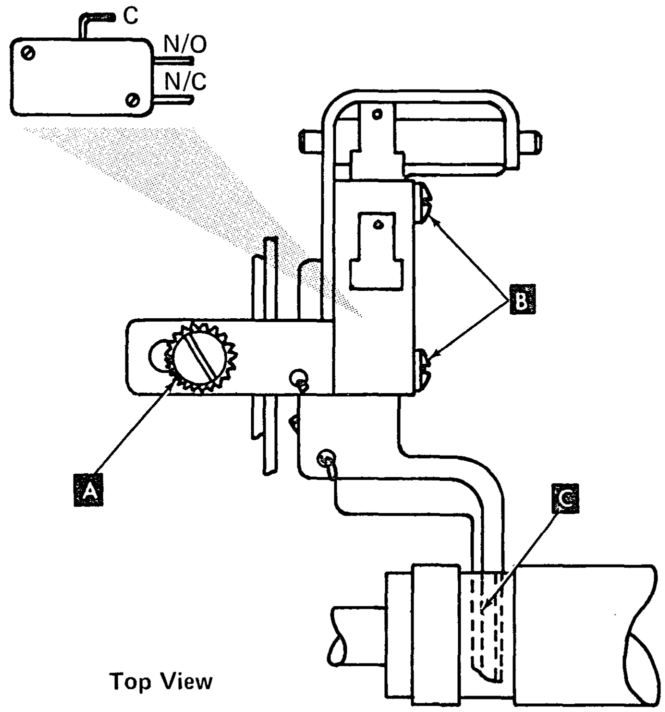
Adjustment

1. Turn power off at the operator control panel.
2. Remove the printer cover (9.2.1).
3. Remove the paper delfector, then move the paper release lever to the forward position.
4. Reinstall the platen.
5. Check to ensure that the switch actuator lever is centered in the platen groove **C** . If it is not centered. loosen the switch assembly mounting screw **A** and reposition the switch assembly.
6. Set your CE meter to the Rx1 scale. Remove the wire at the common (C) terminal of the switch.
7. Connect the meter leads to the normally closed (N/C) and common (C) terminals of the switch.
8. Loosen the switch mount holding screws **D** , then pivot the switch mount **E** toward the front of the printer.
9. Insert a 0.030 inch (0.76 mm) feeler gauge between the top of the actuator lever and the bottom of the platen groove. Slowly pivot the switch mount toward the rear until the meter indicates that the switch has transferred.

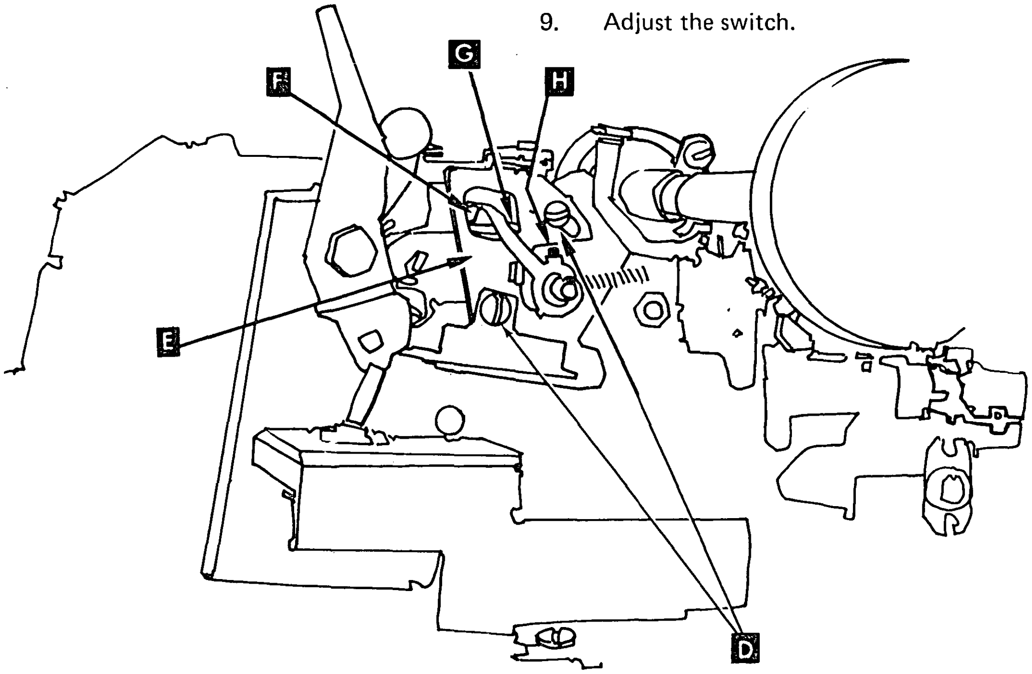
   Note: Ensure that the feeler gauge is held in the horizontal position during this step.
10. Tighten the switch mount holding screws, then recheck the adjustment.
11. Remove the platen.
12. Reinstall the paper deflector and the platen.
13. Move the paper release lever backward and forward to check that the switch override arm transfer the switch contacts. If the contacts transfer, skip steps a through d. Otherwise:
    a. Move the paper release lever to its rear-most position.
    b. Loosen set screw **H** .
    c. Place 0.012 inch to 0.020 inch (0.30 mm to 0.50 mm) of paper or card stock between the switch actuator lever and the bottom of the platen groove.
    d. Pivot the override arm **F** so that the end of the arm comes to rest on, without moving, the end-of-forms switch actuator lever **G** .
    e. Tighten the set screw.
    f. Recheck the adjustment.
14. Disconnect your CE meter and reconnect the wire that you removed in step 6.
15. Replace the printer cover.

Removal

1. Turn power off at the operator control panel.
2. Remove the forms tractor unit (9.2.7).
3. Remove the printer cover (9.2.1).
4. Remove the end-of-forms switch assembly by removing the screw and lockwasher **A** .
5. Remove the switch from the assembly by removing the two screws **B** .
6. Transfer the switch leads from the old switch to the new switch (N/C and C).
7. Install the new switch on the switch assembly.
8. Reinstall the end-of-forms switch assembly.
9. Adjust the switch.



Top View



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9.2.18 Print Emitter Pickup

Adjustment

Note: Old style emitters have four plastic feet between the emitter board and the emitter support shaft **L**. New style emitters have a steel bar **M** instead of the four plastic feet, **L** and a course adjustment collar with two setscrews **H**. If your machine has the old style emitter, ignore steps 3 and 8.

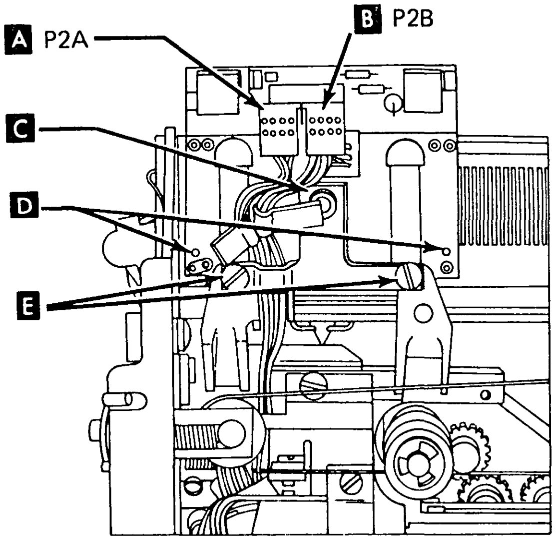
1. Separate the printer from the power supply (9.2.2).
2. Turn the fine adjustment knob **K** full counterclockwise (emitter in the full left position).
3. Loosen the coarse adjustment setscrews **H** (new style emitter only).
4. Slide the emitter board as far to the right as possible.
5. Move the print head carrier to the right.
6. Insert code plate aligning tool, P/N 460028, into the left hole **F** in the emitter.
7. Locate the printer serial number. It is stamped on the right front corner of the printer. If the serial number is below xxxx47984, do step 7a only. If the serial number is above xxxx47984 do step 7b.
   a. Slide the emitter to the left until the gap between the left side frame and the aligning tool is 0.065 inch ± 0.005 inch (1.65 mm ± 0.13 mm) **G**.
   b. Perform the adjustment in step 7a, but use a clearance of 0.097 inch ± 0.005 inch (24.64 mm ± 0.013 mm) instead of the clearance shown in 7a.
8. Tighten the coarse adjustment setscrews (new style emitter only).
9. Use the fine adjustment knob to set a gap of 0.128 inch ± 0.005 inch (3.25 mm ± 0.13 mm) between the alignment tool and the left side frame **J**.
10. Remove the aligning tool.
11. Loosen the pickup mounting screws **E**.
12. Move the print head to the left against the side frame.
13. Insert code plate aligning tools **D**. Do not touch the fine adjustment knob.
14. **CAUTION**
    Do not pinch the wires to the emitter pickup board.

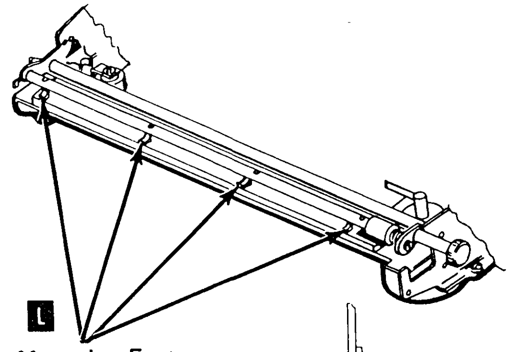
    Tighten the pickup mounting screws with the carrier against the left side frame.
15. Remove the alignment tools and adjust the left margin (9.2.21).
16. Place the printer in the operating position (9.2.2).

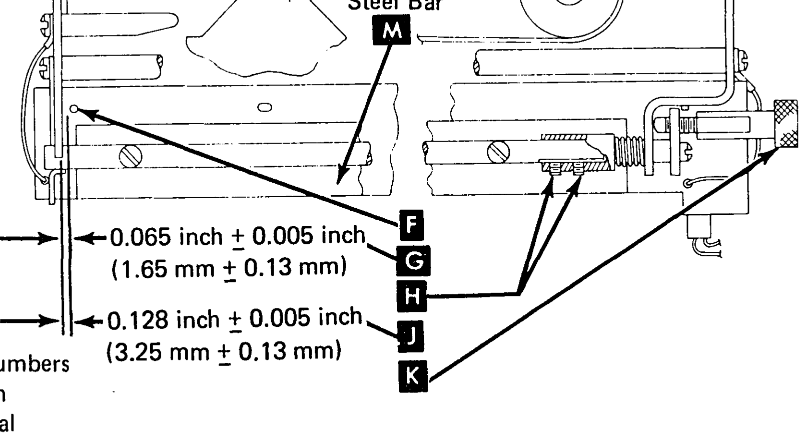
Removal

1. Turn power off at the operator control panel.
2. Remove the printer cover (9.2.1).
3. Separate the printer from the power supply (9.2.2) and place the printer in the service position.
4. For installation, adjust the left margin (9.2.21).
5. Verify that P2A **A** and P2B **B** are plugged as shown on the safety cover decal; if they are not, record the plugging.
6. Unplug P2A and P2B.
7. For installation, adjust the print emitter pickup.
8. **CAUTION**
   The coil spring **C** may fly out when the pickup mounting screws are removed.

   Remove two screws **E** that hold the pickup to the carrier.
9. Reinstall the pickup by reversing this procedure.







Note: Adjust printers with serial numbers below xxxx47984 to the 0.065 inch clearance. Adjust printers with serial number xxxx47984 or higher to 0.097 inch ± 0.005 inch (24.64 mm ± 0.013 mm).

9.2.19 Print Emitter

Removal

CAUTION

Old Style Emitters Only (four plastic feet between the emitter board and the support shaft): Do not loosen the four screws in the top of the print emitter support shaft. Doing so may destroy the flatness of the board.

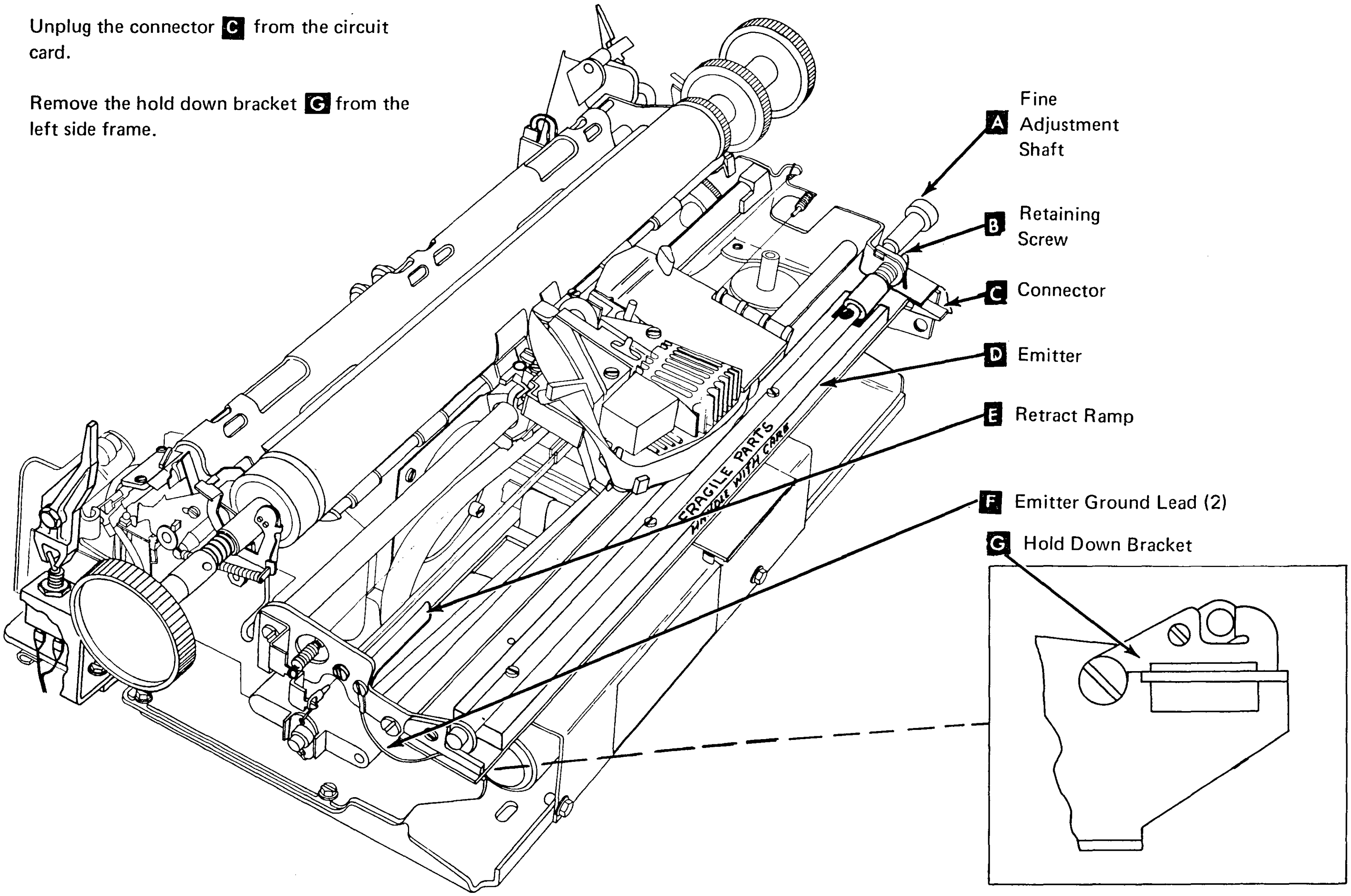
1. Turn power off at the operator control panel.
2. Remove the printer cover (9.2.1).
3. Remove an emitter ground lead **F** from each side frame (the print head retract ramp **E** will come off with the left ground wire on old style machines).
4. Unplug the connector **C** from the circuit card.
5. Remove the hold down bracket **G** from the left side frame.
6. Remove the print emitter support shaft retaining screw **B** from the right end of the shaft. (The fine adjustment shaft **A** will come off also.)
7. Remove the emitter **D** by pulling the left end out.
8. Reinstall the emitter by reversing this procedure.
9. Lubricate the emitter as shown in 9.5.0.
10. Adjust the print emitter pickup (9.2.18), left margin (9.2.21), and the print emitter hold down bracket (9.2.20).

9.2.20 Print Emitter Hold Down Bracket

Adjustment

Position the hold down bracket **G** for two conditions:

1. There must be no vertical movement of the print emitter board **D**.
2. The board must slide freely when the horizontal fine adjustment knob **A** is rotated in either direction.

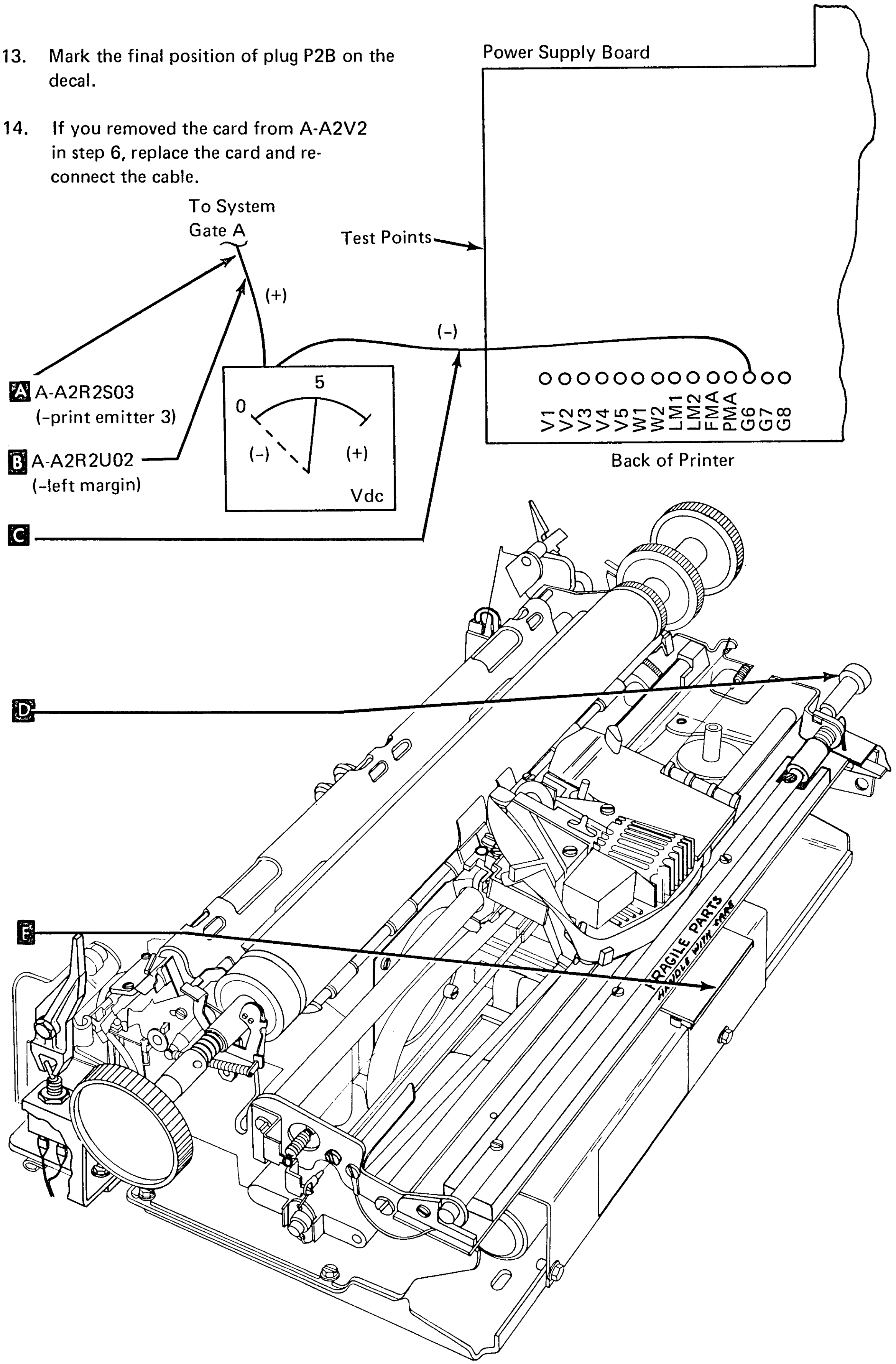


9.2.21 Left Margin

Adjustment

This adjustment is to ensure that the fall of the left margin signal is as far as possible from the print emitter 3 signals.

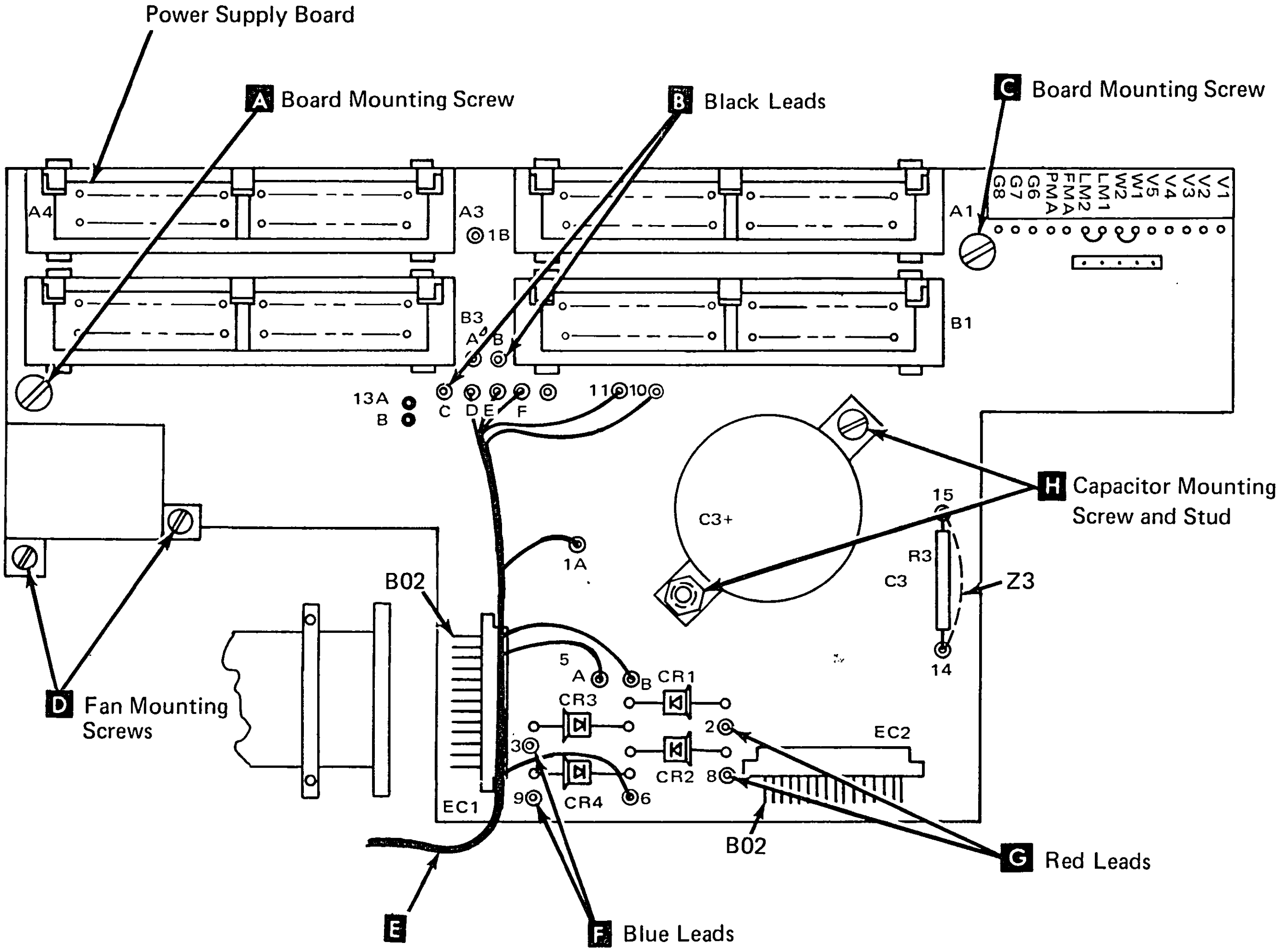
1. Turn power off at the operator control panel.
2. Remove the printer cover (9.2.1).
3. Rotate the horizontal fine adjustment knob **D** to the center of its travel.
4. Push the print head carrier against the left side frame.
5. Set up a meter to read +5 Vdc.
6. Monitor the left margin signal by connecting the meter between A-A2R2U02 (+) **B** and test point G6 (-) **C** .
   Note: If your machine has a card in location A A2V2, remove the card, disconnect the cable from the card, and plug the cable into the V2 socket.
7. Turn power on at the operator control panel.
8. Slowly move the carrier to the right (by rotating the motor pulley) until the meter indicates a shift to an up level. (Use the fine adjustment knob to get as near to the shift point as possible).
9. Mark a point on the knob **D**.
10. Monitor the -print emitter 3 signal by connecting the meter between A-A2R2S03 (+) **A** and G6 (-) **C**.
11. Check that the signal is not negative initially, but shifts negative when the fine adjustment knob is rotated 1/4 turn or more in each direction from the mark.
12. If the signal shifts as indicated above, go to the next step. If the meter shows negative initially or does not shift as indicated in the previous step, move plug P2B **E** to another position (see decal on safety cover) and return to step 3.
13. Mark the final position of plug P2B on the decal.
14. If you removed the card from A-A2V2 in step 6, replace the card and reconnect the cable.



9.2.24 Power Supply Board

Removal

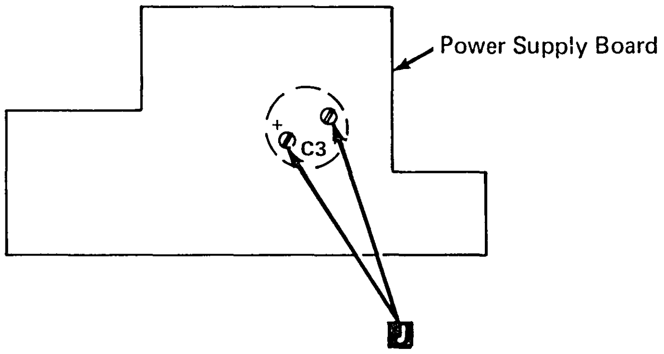
1. Turn power off at the operator control panel.
2. Separate the printer from the power supply (9.2.2).
3. Unplug the transformer leads from the board:
   a. Black from points 4B (lead 12) and 4C (lead 15) **B**.
   b. Blue from points 3 (lead 14) and 9 (lead 16) **F**.
   c. Red from points 2 (lead 11) and 8 (lead 13) **G**.
4. Unplug and label the capacitor cable leads **E** as shown.
5. Remove the screw and stud from capacitor C3 **H**.
6. Remove two fan mounting screws **D** and move the fan aside.
7. Remove two board mounting screws **A** and **C** lift the board out.
8. For installation, locate capacitor C3 as far to the rear of the board as possible and locate the board as far to the rear of the machine as possible.
9. To reinstall board, reverse this procedure.
10. Be careful to install the cable **E** correctly.



9.2.25 Capacitor C3

Removal

1. Remove the power supply board (9.2.24).
2. Note the polarity connections and remove the two capacitor connecting screws **J** on the underside of the power supply board.
3. To replace the capacitor, reverse this procedure. Position the capacitor as far to the rear as possible.



9.2.26 Power Transformer

Removal

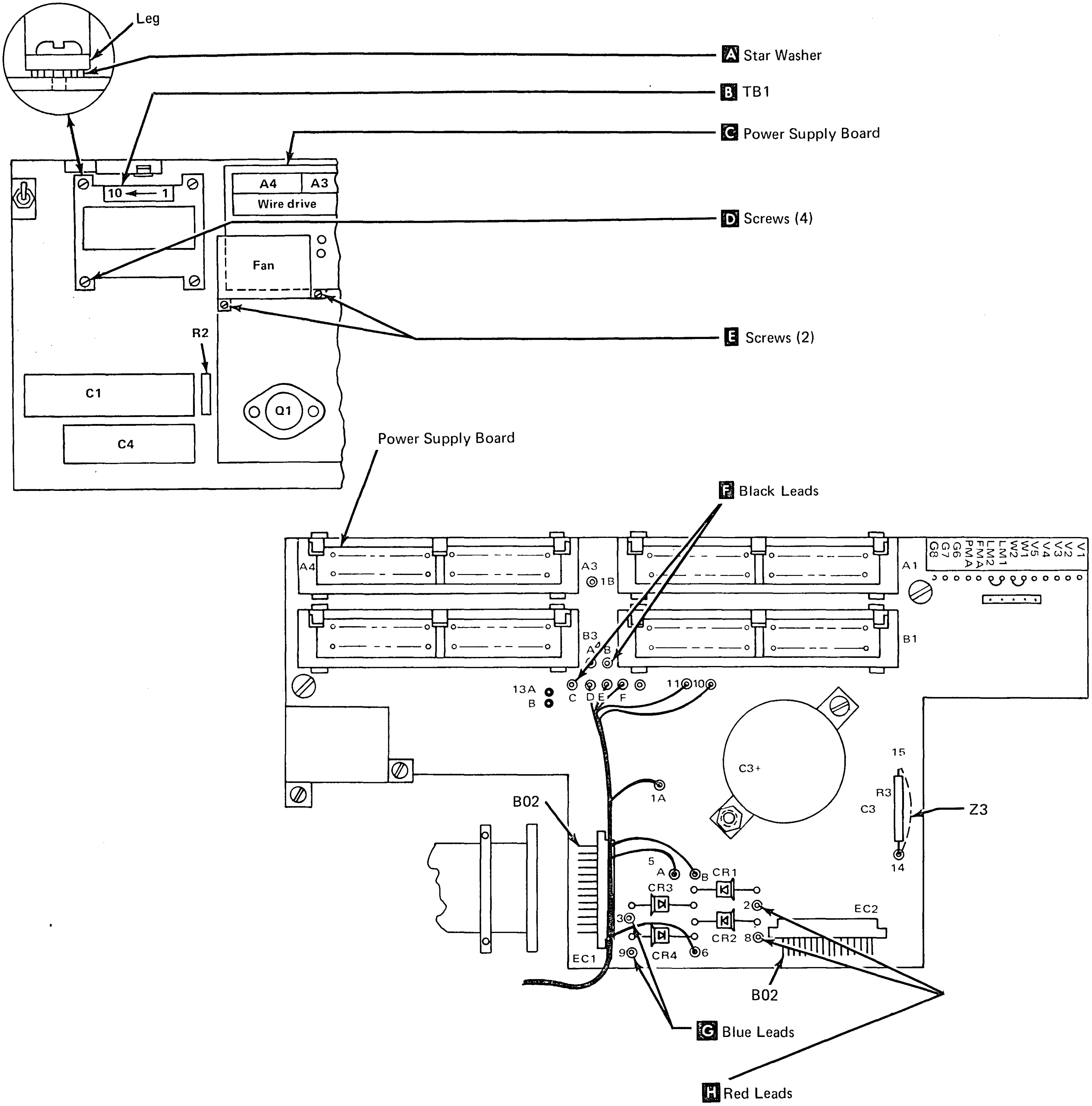
1. Turn power off at the operator control panel.
2. Separate the printer from the power supply (9.2.2).
3. Remove the following leads from TB1:
   a. Neutral TB1-4 and 48 Vac TB1-1 B. (Remove the leads from the bottom side of TB1.)
   b. Fan leads TB1-7 and TB1-10 B.
4. Remove the four transformer mounting screws D.
5. Remove the two screws from the fan mounting bracket E.
6. Unplug the secondary leads from the power supply board.
7. Lift out the transformer and fan.
8. Connect the fan leads to the new transformer.
9. Set the transformer in place being sure that the star washer A is under the left rear leg of the transformer (viewed from the front of the printer).
10. Install the four mounting screws D in the transformer legs.
11. Plug the secondary leads into the power supply board as follows:
   a. Black into 4B (lead 12) and 4C (lead 15) F.
   b. Blue into 3 (lead 14) and 9 (lead 16) G.
   c. Red into 2 (lead 11) and 8 (lead 13) H.
12. Install the fan (two screws) E.
13. Connect the neutral lead to TB1-4 and the 48 Vac lead to TB1-1.
14. Complete the procedure by reassembling the printer on the power supply (9.2.2).

Note: Transformers with an internal shield have a ground lead that must be connected under a transformer leg when installing the transformer.

9.2.27 Fan

Removal

1. Turn power off at the operator control panel.
2. Remove the printer covers and separate the printer from the power supply (9.2.2).
3. Remove the two fan leads from the transformer side of TB1-7 and TB1-10 B.
4. Remove the two fan bracket mounting screws E.
5. Lift the fan assembly out. (Make sure that the bracket clears the power supply board.)
6. Remove the fan from the bracket. When reinstalling the bracket, be sure that the air flow direction arrow on the fan points toward the bracket.
7. Reinstall the fan by reversing this procedure.

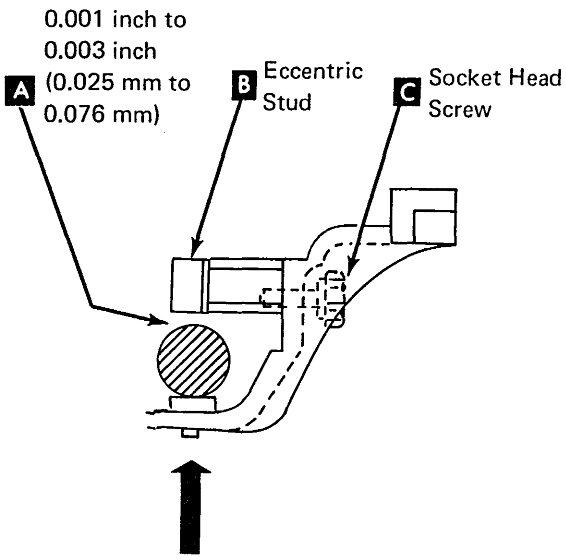

Leg
A Star Washer
B TB1
C Power Supply Board
D Screws (4)
E Screws (2)
10 ← 1
A4
A3
Wire drive
Fan
R2
C1
C4
Q1
Power Supply Board
F Black Leads
A4
A3
1B
A1
B3
B1
V1
V2
V3
V4
V5
W1
W2
LM1
LM2
FMA
PMA
G6
G7
G8
A
B
13A
B
C
D
E
F
11
10
C3+
15
R3
C3
Z3
14
1A
B02
5
A
B
CR1
CR3
2
EC2
3
CR2
8
9
CR4
6
EC1
B02
G Blue Leads
H Red Leads

9.2.28 Carrier Main and Support Shafts

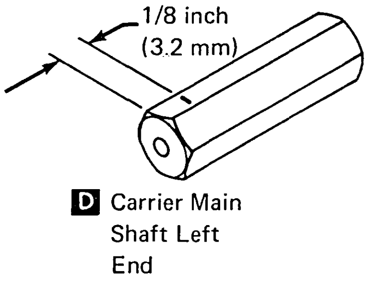
Adjustment

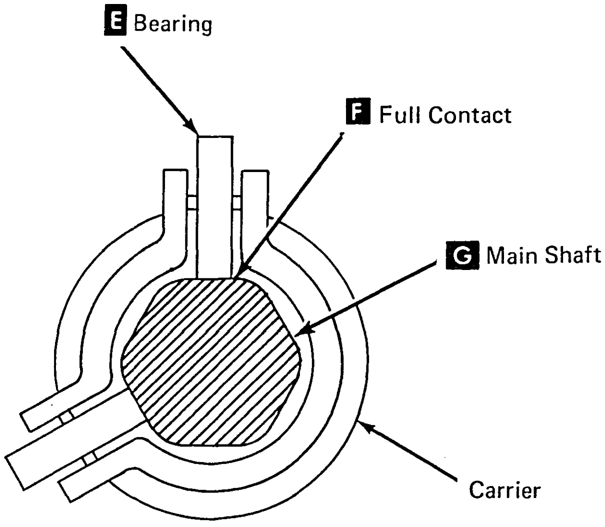
Two adjustments are required for the carrier. The main shaft is adjusted for full contact of the carrier bearing on the shaft. The carrier bracket support bearing is adjusted for 0.001 inch to 0.003 inch (0.025 mm to 0.076 mm) clearance to the support shaft.

1. Remove the printer cover (9.2.1).
2. Adjust the carrier support shaft bearing as follows:
   a. Separate the printer from the power supply (9.2.2).
   b. Slightly loosen the socket head screw **C** at the end of the bearing eccentric stud **B** . Remove the ribbon drive clutches to gain access.
   c. Rotate the eccentric stud to obtain 0.001 inch to 0.003 inch (0.025 mm to 0.076 mm) mm) between the bearing and shaft **A** while pushing on the bottom of the carrier as shown by the directional arrow.
   d. Tighten the socket screw **C** on the end of the bearing eccentric stud.
   e. Recheck clearance and adjust, if necessary.
   f. Reassemble the printer and power supply.



3. Adjust the carrier main shaft (hexagonal) as follows:
   a. Loosen the retaining screws at the shaft ends.
   b. Rotate the shaft until the full width of the bearing **E** rolls on the shaft flat **F** . The mark **D** on the left end of the main shaft must be up.
   c. Hold the shaft in this position with an adjustable wrench (take care not to damage the flats) and tighten the screws in the shaft ends.
4. Check adjustment as follows:
   a. Insert a strip of carbon paper about 3/16 inch (4.70 mm) wide and 5 inches (127.0 mm) long between the bearing and shaft **F** .
   b. Push the carrier over the carbon paper.
   c. Check for a smooth, even mark; readjust if necessary.
5. Reinstall the printer cover.





9.2.29 Carrier and Main Shaft

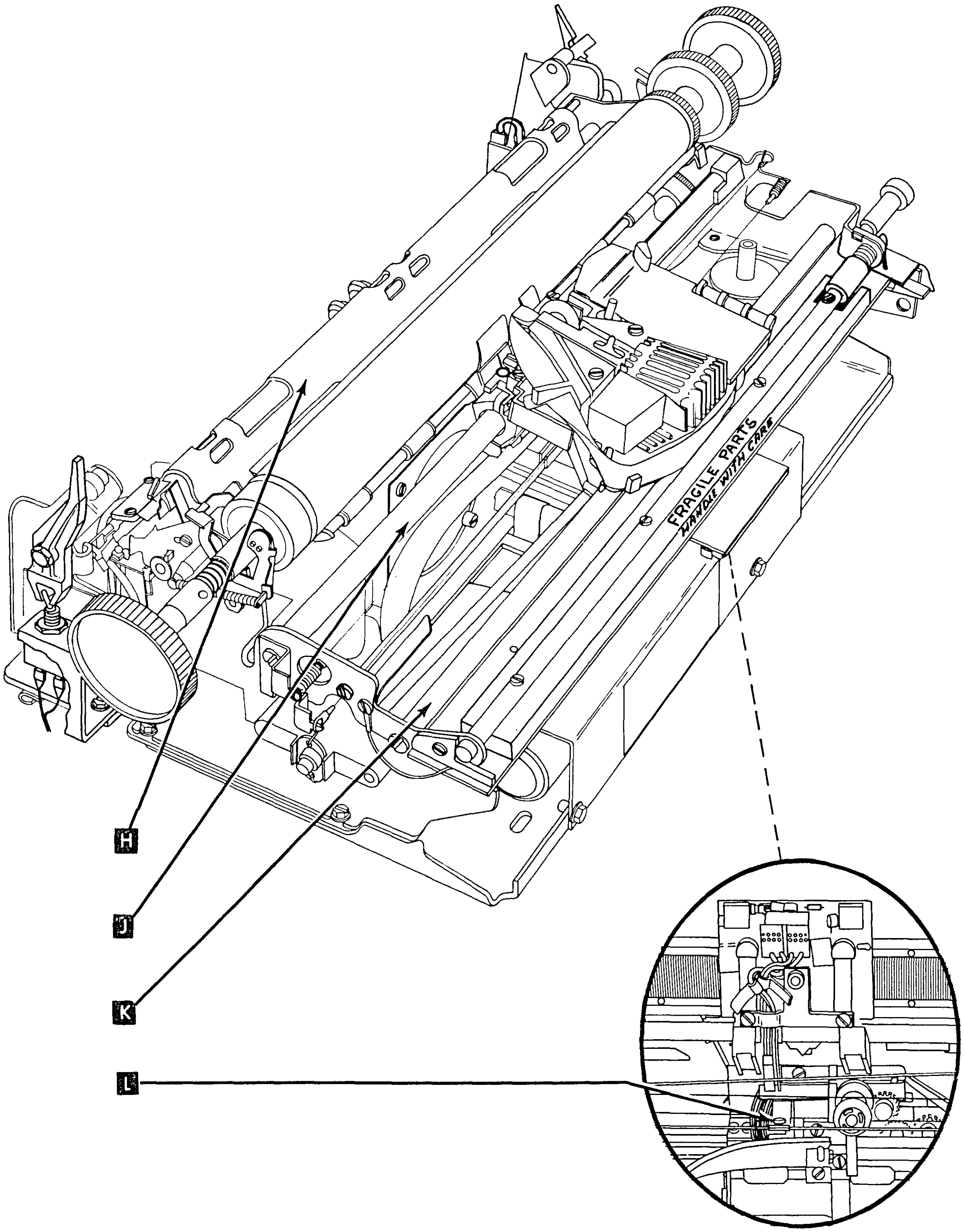
Removal

1. Turn power off at the operator control panel.
2. Remove the covers (9.2.1).
3. Remove the print emitter (9.2.19).
4. Remove the print head (9.2.34).
5. Separate the printer from the power supply (9.2.2).
6. Loosen the belt clamp **L** and remove the belt from the motor. For installation, be sure the belt alignment is correct.
7. Remove the print emitter pickup (9.2.18).
8. Remove the ribbon drive lines (9.2.44).
9. Remove the screws from each end of the carrier main shaft **J** .
10. Pivot the carrier and main shaft around the carrier support shaft **K** to clear the A-frame **H** .
11. Lift the carrier out. For installation, be sure the mark **D** on the left end of the main shaft is up.
12. Remove the ribbon drive assembly (9.2.40).
13. To reinstall the carrier, reverse this procedure. Be sure to perform the following checks and/or adjustments.
    a. Carrier main shaft and carrier support shaft (9.2.28).
    b. Print head (9.2.34).
    c. Print emitter pickup (9.2.18).
    d. Left margin (9.2.21).

9.2.30 Carrier Support Shaft

Removal

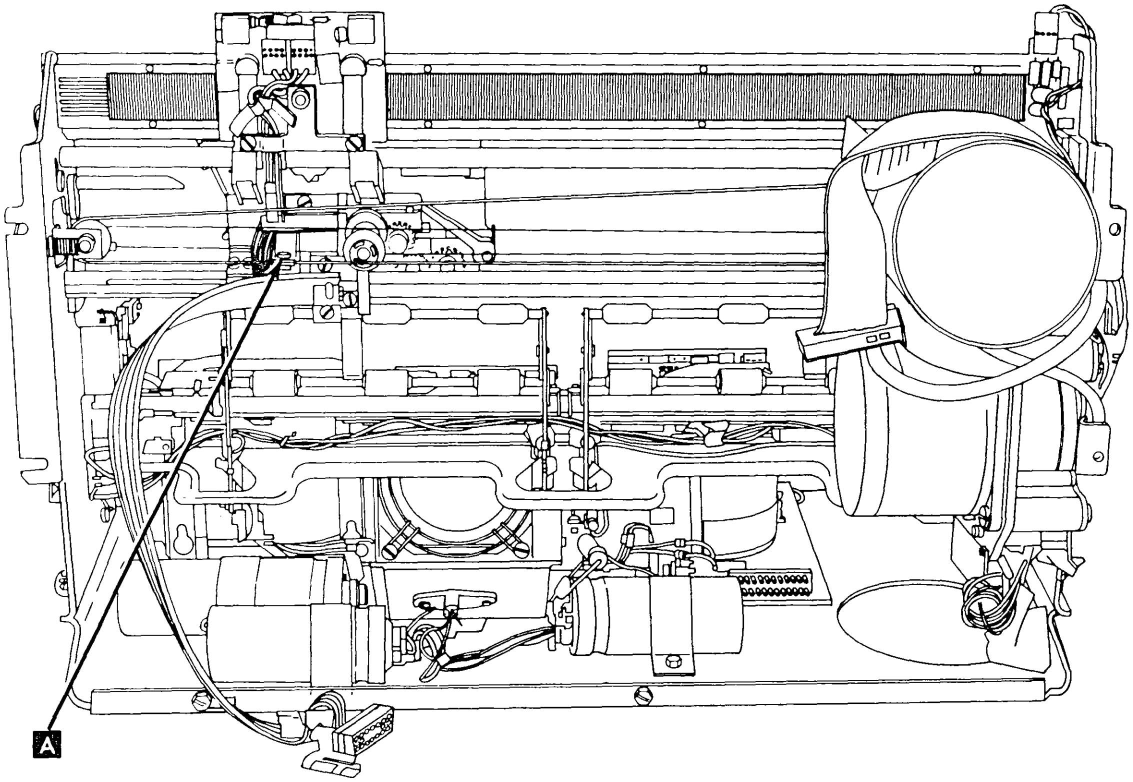
1. Turn power off at the operator control panel.
2. Separate the printer from the power supply (9.2.2).
3. Remove the print emitter (9.2.19).
4. Remove the print carrier drive belt from the motor.
5. Loosen the screws on the ends of the carrier main shaft **J**.
6. Remove the screws from the ends of the carrier support shaft **K**.
7. Spread the side frames enough to free the support shaft.
8. To reinstall the shaft, reverse this procedure.
9. Perform adjustments for the print emitter pickup (9.2.18), the left margin (9.2.21) and the carrier main shaft (9.2.28).

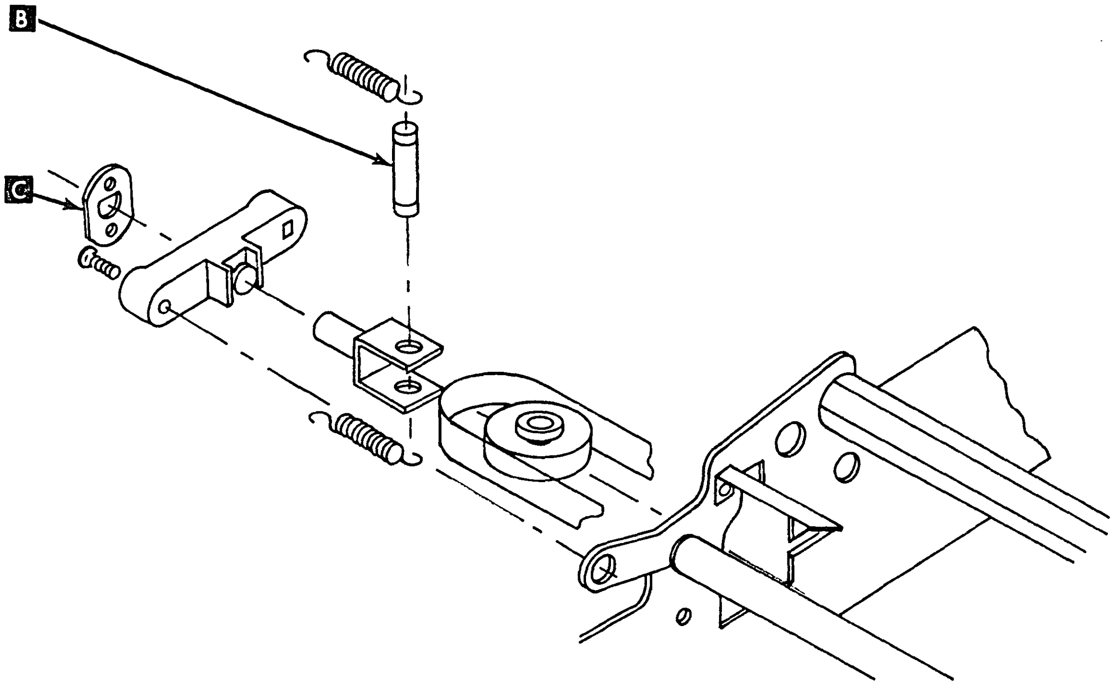


9.2.31 Carrier Drive Belt

Removal

1. Turn power off at the operator control panel.
2. Remove the printer cover (9.2.1).
3. Loosen the carrier belt clamp **A** and slip the belt out of the clamp. For installation, be sure belt aligns with the pulleys before tightening the clamp.
4. Remove the belt from the motor pulley.
5. Remove the two springs from the belt tension bracket **C** outside the left side frame.
6. Remove the pulley and belt together.
7. Remove the pulley from the yoke by removing the shaft **B**.
8. To reinstall the belt, reverse this procedure. Apply a light film of IBM No. 23 grease to the shaft **B** before reassembling the yoke and belt.

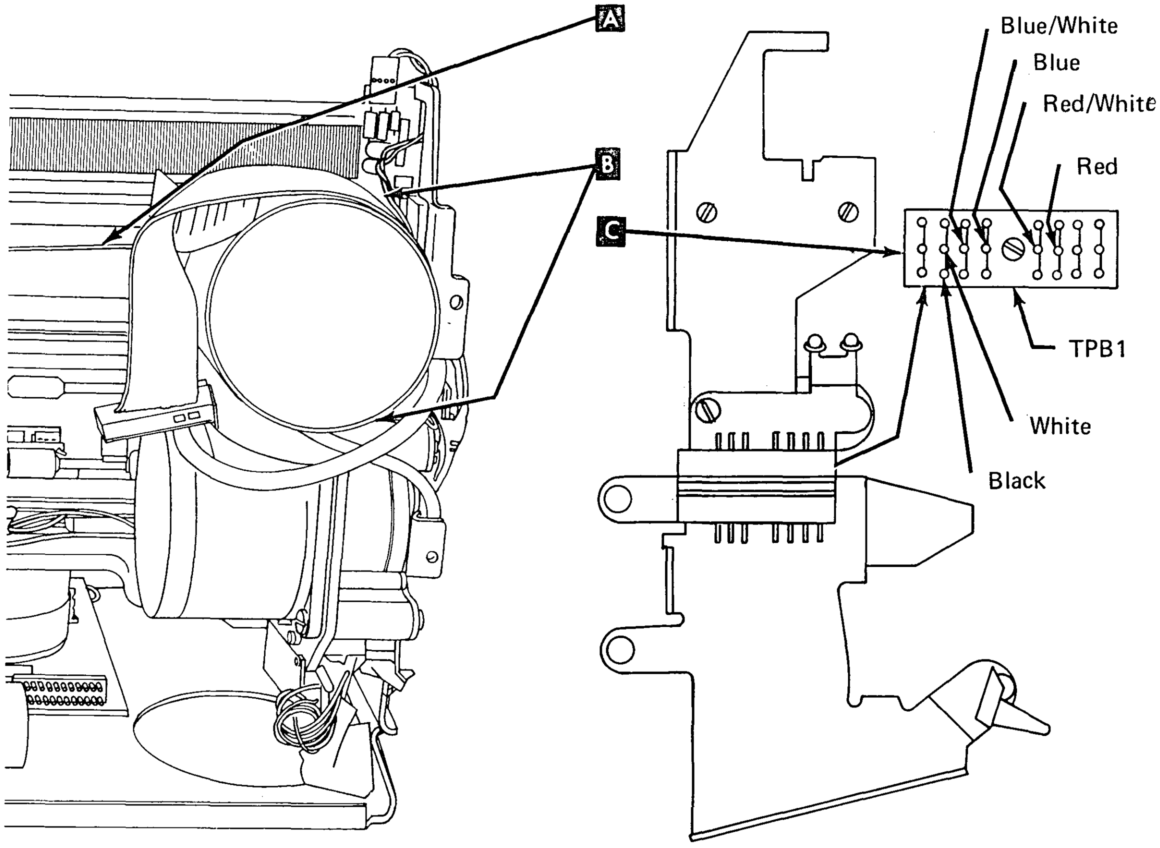




9.2.32 Print Stepper Motor

Removal

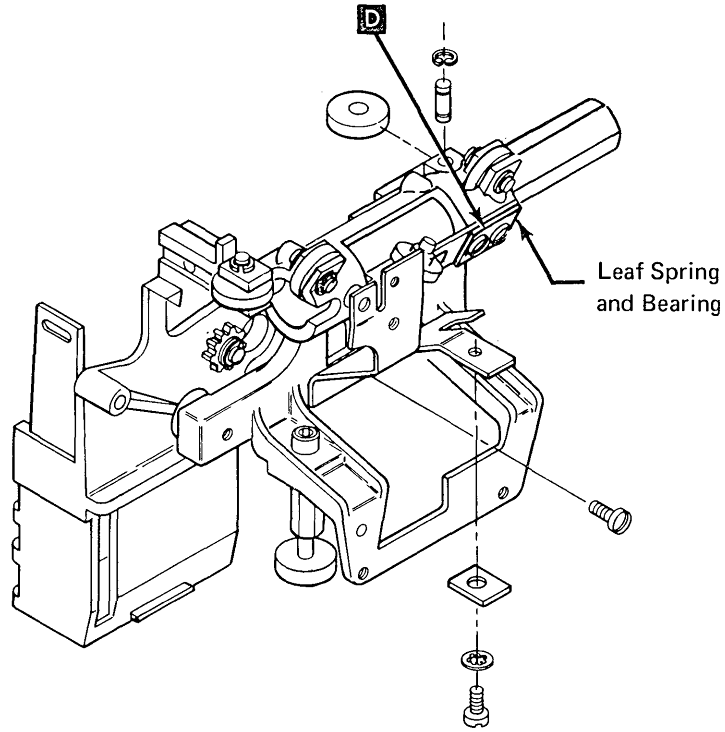
1. Turn power off at the operator control panel.
2. Separate the printer from the power supply (9.2.2) and place the printer in the service position.
3. Unplug the motor leads from TPB1 C.
4. Slip the belt off the motor pulley A.
5. Remove the two screws holding the stepper motor to the motor mount B.
6. To reinstall the motor, reverse this procedure.



9.2.33 Carrier Leaf Spring and Bearing

Removal

1. Turn power off at the operator control panel and remove the printer cover.
2. Separate the printer from the power supply and place the printer in the service position (9.2.2).
3. Remove the two screws from the leaf spring and bearing D and remove the assembly.
4. Reinstall the assembly by reversing this procedure. Be sure that bearing sides are parallel to the shaft flats. (Sight through holes in the left side frame to verify parallelism.)



9.2.34 Print Head

Adjustment

1. Remove the printer cover (9.2.1).
2. Move the print head to the center of the printer.
3. Remove the print head cover A and lay the cover and ribbon to the right.
4. Install the platen and rotate it so that the midpoint between the two setscrews that hold the right hand platen knob points straight up.
5. Position the print head so that the ends of the wires are 0.012 inch to 0.014 inch (0.30 mm to 0.35 mm) from the platen as follows:
   a. Loosen the hold down stud F and screw D on the right of the print head.
   b. Set the copy control dial E on zero.
   c. Place a 0.014 inch (0.35 mm) feeler gauge between the platen and print head wires C
   d. Position the print head in the center of the printer and push the head lightly toward the platen.
   e. Tighten the hold down screw and stud.
6. Check the adjustment and readjust if necessary.
7. Reinstall the print head, cover, and the printer cover (9.2.1).

Removal

DANGER
The print head may be very hot after continued use. Always allow the head to cool before removing it.

1. Turn power off at the operator control panel.
2. Remove the printer cover (9.2.1).
3. For new print head installation, saturate the two felt washers on the right bar, the bronze block, and rear slide points on the left bar with IBM No. 6 oil.
4. For installation, adjust the print head.
5. For installation, push the print head in and out of the forms loading position to ensure the head retracts properly.
6. Unthread the ribbon from the print head and its cover, and lay the ribbon to the right.
7. Open the ribbon feed rolls N and remove the print head cover A.
8. Unplug the print head cable from EC3 K.
9. To the right of the print head, remove the screw D and hold down stud F that hold the bronze tabs.
10. To the left of the print head, remove the screw J that holds the bronze block.
11. Remove the oil resevoir cover and pull the oil wick from the felt reservoir B. For installation, if there is no oil in the felt, add IBM No. 6 oil and check that the wick touches all eight print wires M.
12. Lift off the print head.
13. For installation, tilt the tip of the head down so that it will slide under the print head forms guide.
14. To reinstall the print head, reverse this procedure.

9.2.35 Print Head Forms Guide

Removal

The print head forms guide should be as far as possible from the platen and centered within the limits of the mounting slots.

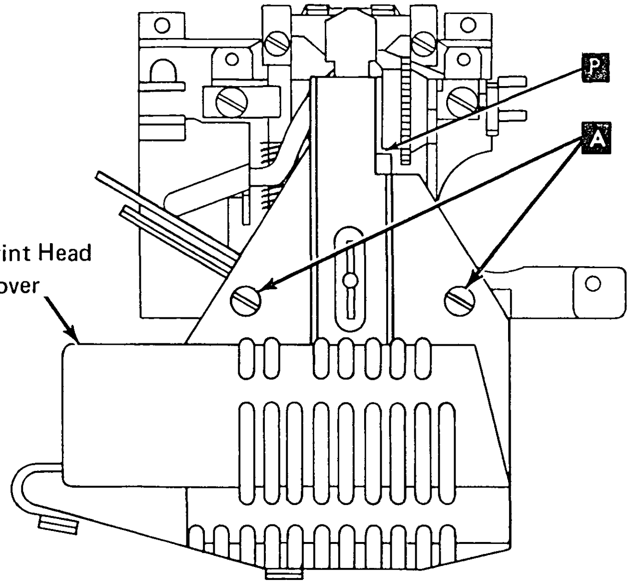
1. Turn power off at the operator control panel.
2. Remove the forms tractor unit and printer covers.
3. Snap out the flat bronze spring L between the platen pressure roll shafts.
4. Spread the pressure roll arms and move the end of the left roll shaft G away from the platen area.
5. Remove the guide mounting screws H and remove the guide.
6. Install the new guide with the screws loose.
7. Center the guide in the mounting slots and tighten the screws.
8. Complete the operation by reversing steps 1 through 4.

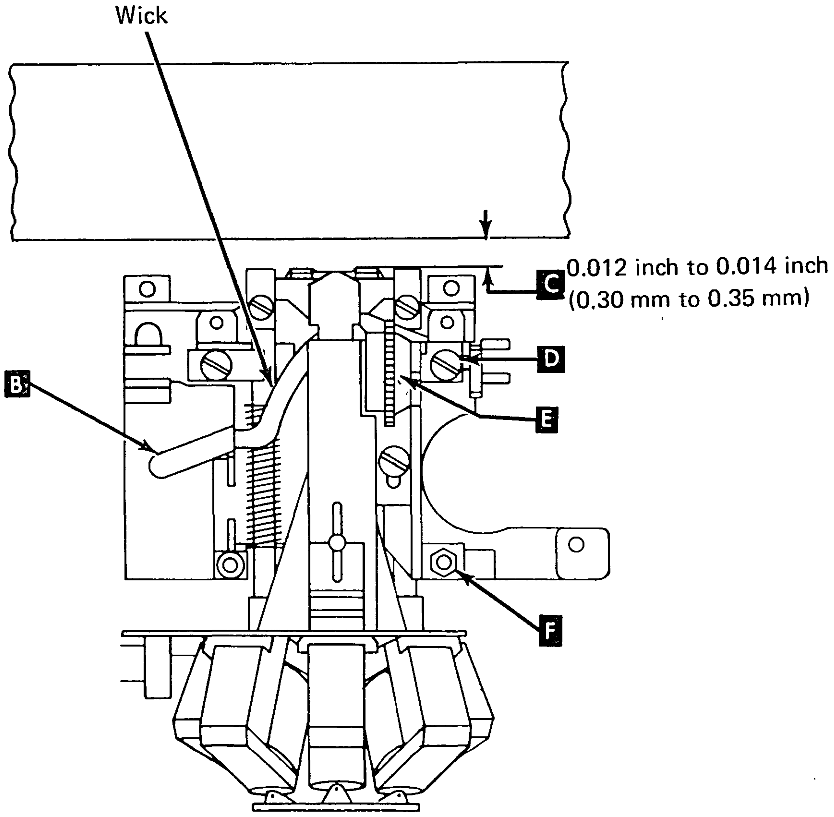
9.2.35.1 Print Head Retract Ramp

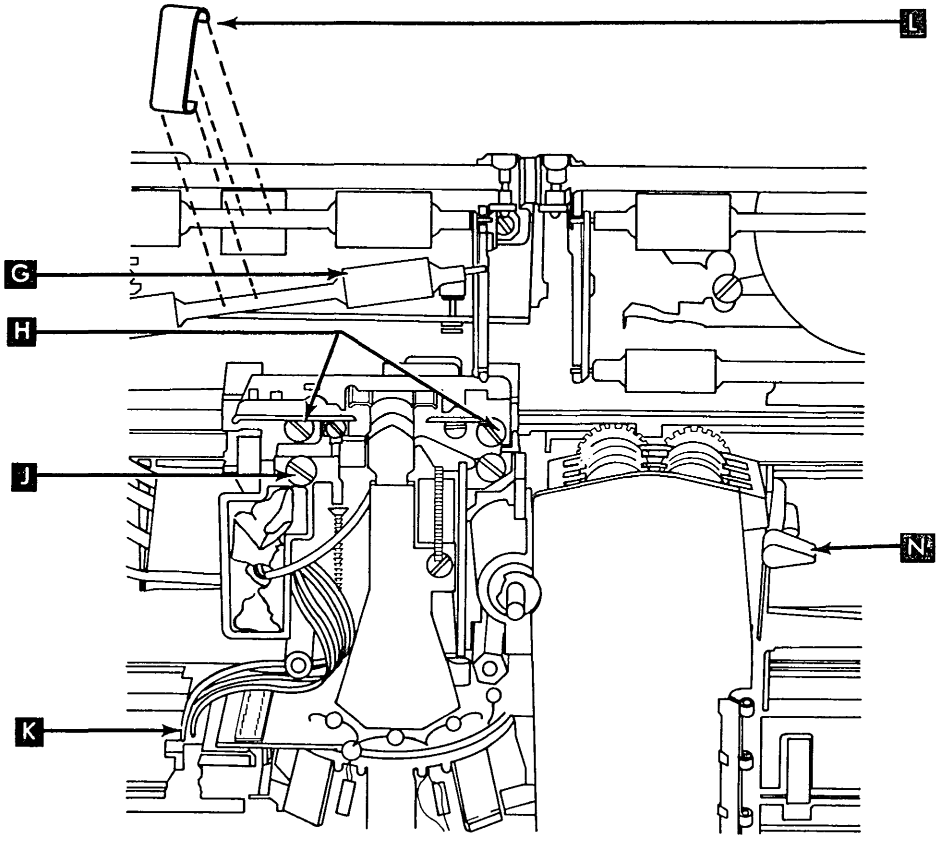
Adjustment

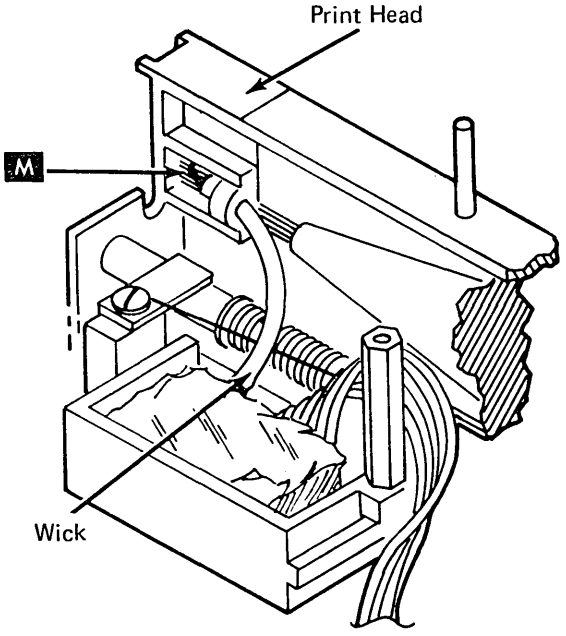
Adjust the retract ramp so that when the print head is at the left side frame, there is 0.095 inch ± 0.005 inch (2.41 mm ± 0.13 mm) between the print head housing and the copy control dial.

1. Loosen the two retract ramp mounting screws (on the left side frame), move the ramp as far toward the front of the machine as possible, and tighten the screws for a snug fit.
2. Set the copy control dial to 0.
3. Move the print head to the left side frame.
4. Insert the code plate aligning tool, P/N 460028, between the copy control dial and the print head housing P (on page 9-39).
5. Tap gently on the retract ramp to move it toward the rear of the machine until the code plate aligning tool is snug between the copy control dial and the print head housing P (on page 9-39).
6. Tighten the retract ramp mounting screws.


P
A
Print Head Cover


Wick
C 0.012 inch to 0.014 inch (0.30 mm to 0.35 mm)
D
B
E
F


L
G
H
J
N
K

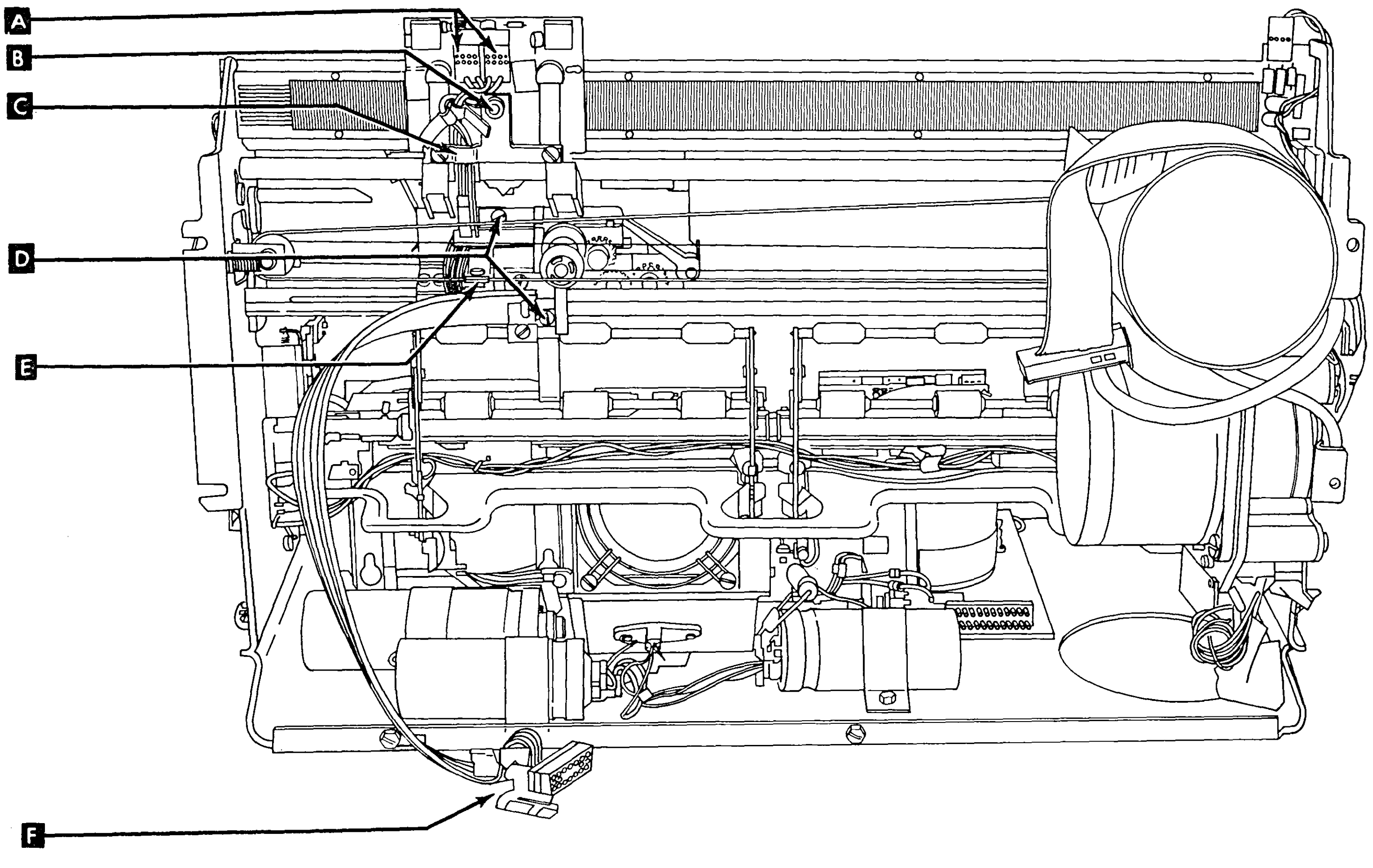

Print Head
M
Wick

9.2.36 Print Head Cable

Removal

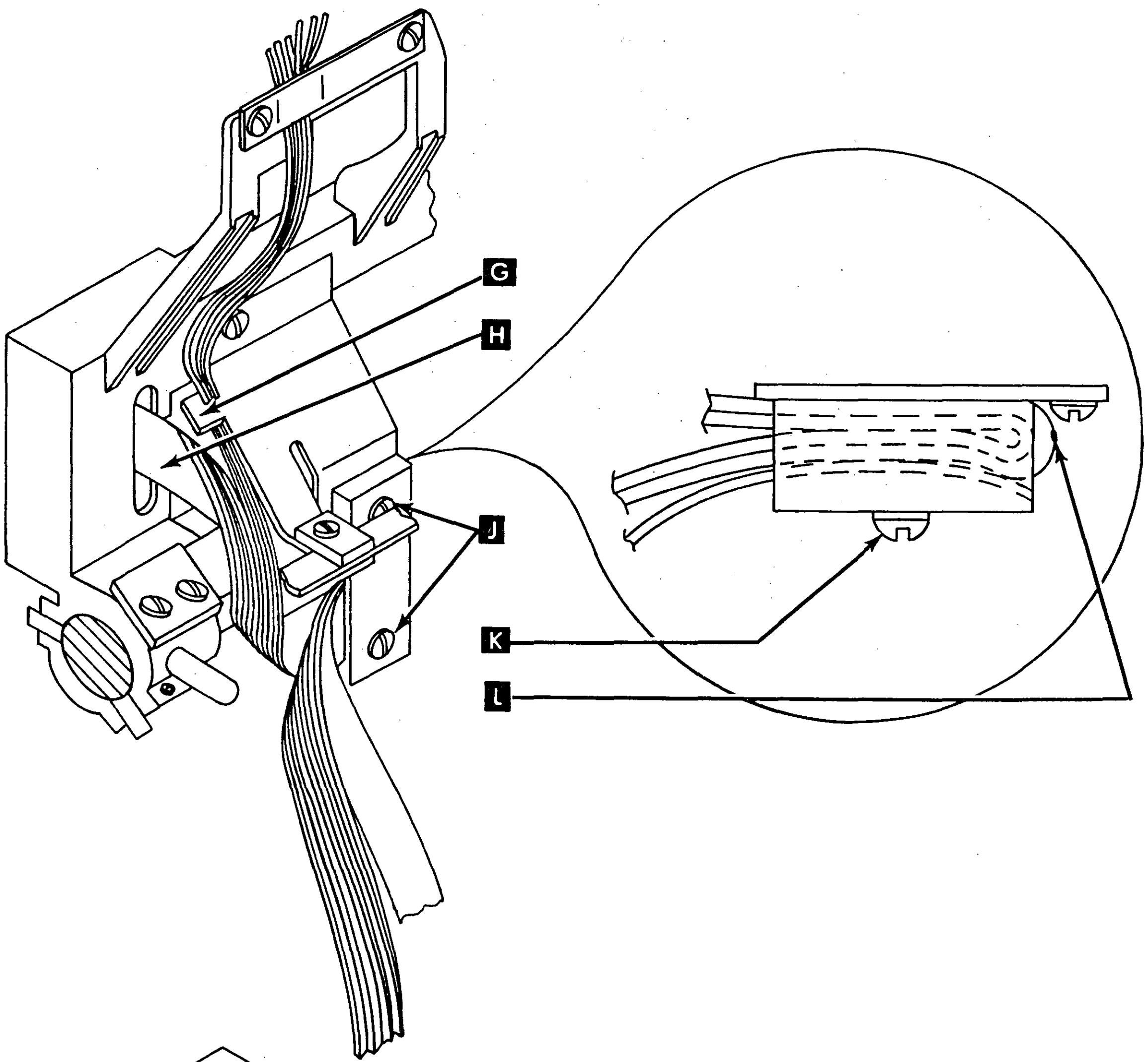
1. Turn power off at the operator control panel and remove the printer covers.
2. Remove the print head (9.2.34). Adjust the print head on installation.
3. Separate the printer from the power supply (9.2.2). Observe the cable routing to aid in replacing the cable.
4. Remove P2A and P2B **A** . Note how P2B is plugged.
5. **CAUTION**
   When loosening the print emitter pickup mounting screws, the coil spring **B** might fly out.

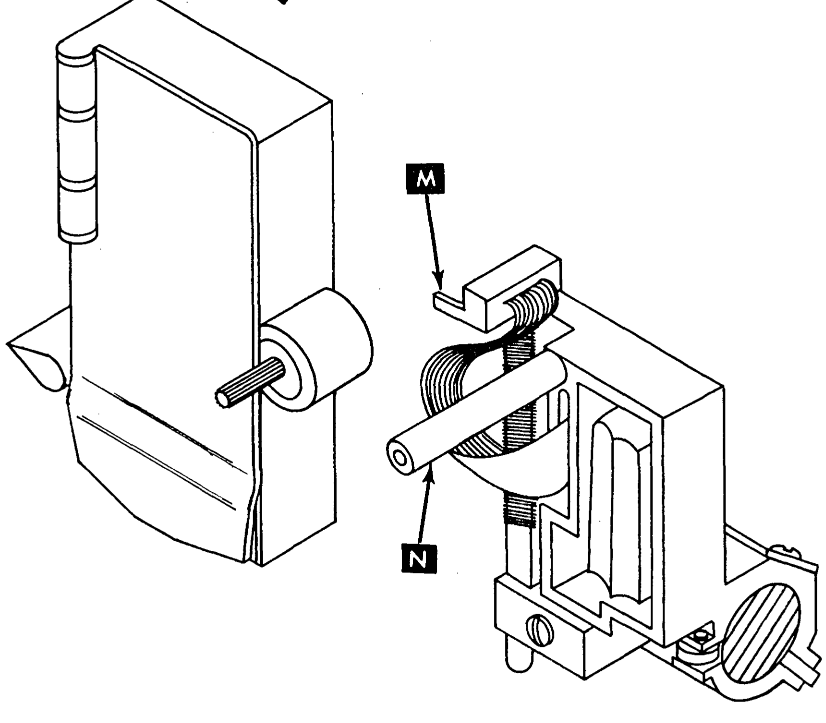
   Loosen the print emitter pickup cable clamp **C** . Remove the clamp screw on the left side and remove the wires from under the clamp.
6. Loosen the belt clamp **E** . Remove the cable clamp bracket **D** (two screws).
7. Work the cable out of the slots in the casting **H** and push the connector through the hole.
8. Remove two screws from the cable clamp assembly **J** (long flat spring with plastic on ends) and remove the old cable.



Replacement

1. Fold the new cable on the mark L .
2. Attach the cable clamp assembly and cable to the bracket K .
3. Make a 90° counterclockwise twist in the cable and fold the cable at right angles to the long part of the cable.
4. Place the two small parts of the cable in the bracket notch G and fold them back.
5. Push the large plug through the hole in the casting and fasten the cable clamp bracket in place (two screws) D .
6. Work the cable into the slots so that the locking arms M are at the left.
7. Place the two small cables under the clamp for the print emitter pickup and install the screws loosely.
8. Form the cable to the flat spring.
9. Form a loop in the cable F at the end of the flat spring.
10. Form the print head cable around the head mounting stud N before plugging it into EC3. The loop must be large enough here so the cable will not restrict print head movement.
11. Install the print head (9.2.34).
12. Replace the printer on the power supply (9.2.2).
13. Plug P2A and P2B A .
14. Adjust the emitter pickup (9.2.18).
15. Adjust the left margin (9.2.21).





9.2.37 Felt and Wick Service

1. Turn power off at the operator control panel.
2. Remove the forms tractor unit.
3. Remove the printer top cover.
4. Unthread the ribbon from its guides and lay it on top of the ribbon in the ribbon box.
5. Remove the print head cover (two screws) **C** .
6. Remove the plastic cover on the felt reservoir **A** .
7. Saturate the felt with IBM No. 6 oil.
8. Complete by reversing the first six steps.

9.2.38 Print Head Ribbon Shield

Adjustment

To ensure that the ribbon shield is properly aligned with the platen, use the following procedure:

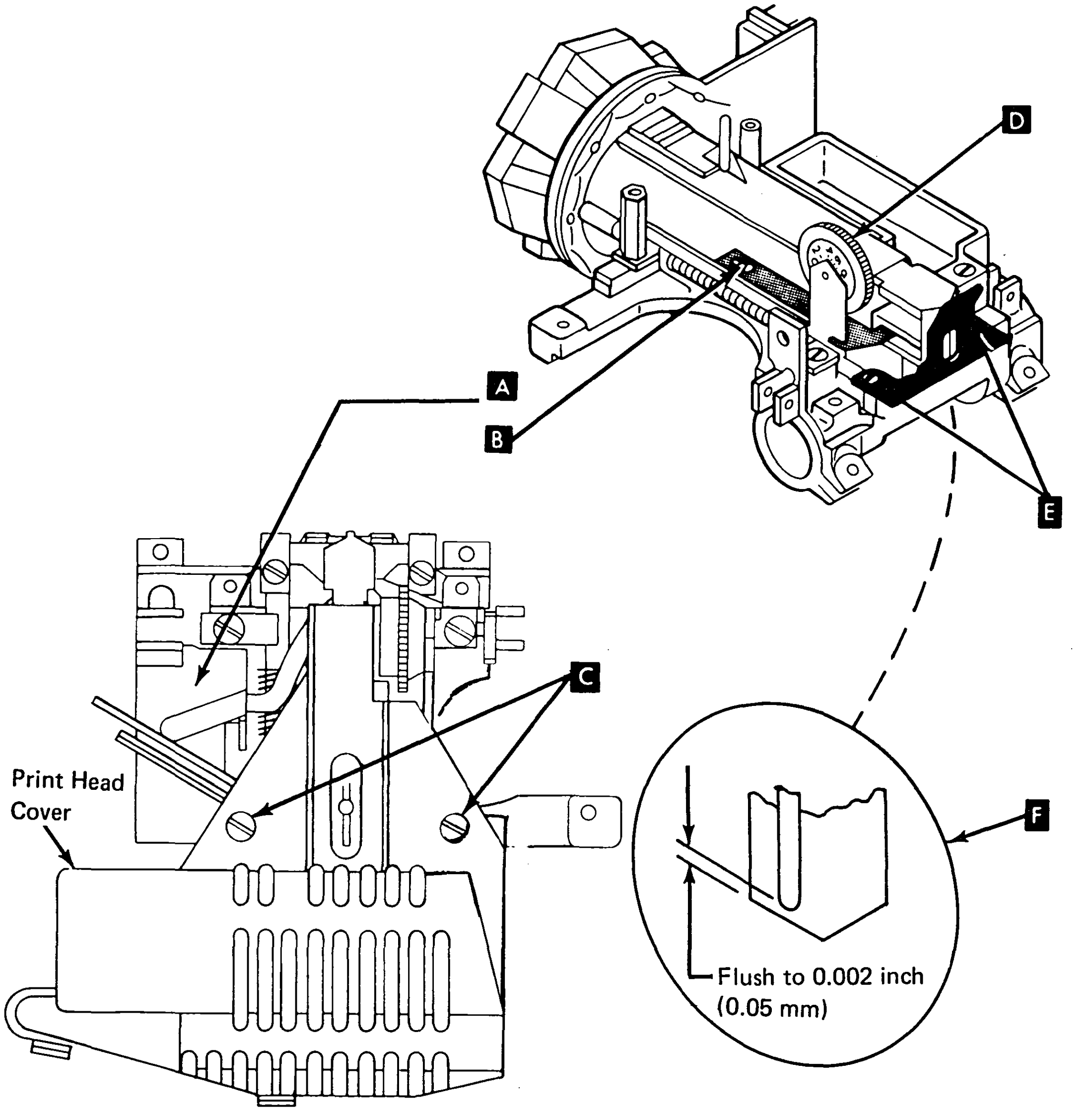
1. Turn power off at the operator control panel and remove the printer covers.
2. Remove the print head forms guide (9.2.35).
3. Loosen the two screws **E** .
4. Remove the platen and paper deflector.
5. Reinstall the platen.
6. A feeler gauge may be difficult to use on this adjustment due to platen curve; however, three IBM cards or five pieces of single part forms can be used. Three cards are approximately 0.0195 inch (0.49 mm) and five pieces of paper are approximately 0.015 inch to 0.020 inch (0.38 mm to 0.51 mm).

   Place the cards or paper between the ribbon guide and the platen, press the shield toward the cards or paper, and tighten the two screws **E** .
7. Clearances should be:
   a. Enough space for the ribbon to pass freely between the print head and the shield.
   b. A minimum of 0.008 inch (0.20 mm) between the shield and the platen after the cards or paper are removed.

9.2.39 Print Head Ribbon Lifter

Removal

1. Turn power off at the operator control panel and remove the printer covers.
2. Remove the print head (9.2.34). Adjust the print head on installation.
3. Remove the screw **B** and remove the ribbon lifter.
4. When installing, adjust flush to 0.002 inch (0.05 mm) **F** when knob **D** is set at the highest mark.
5. Complete the procedure by reversing the first four steps.



9.2.40 Ribbon Drive

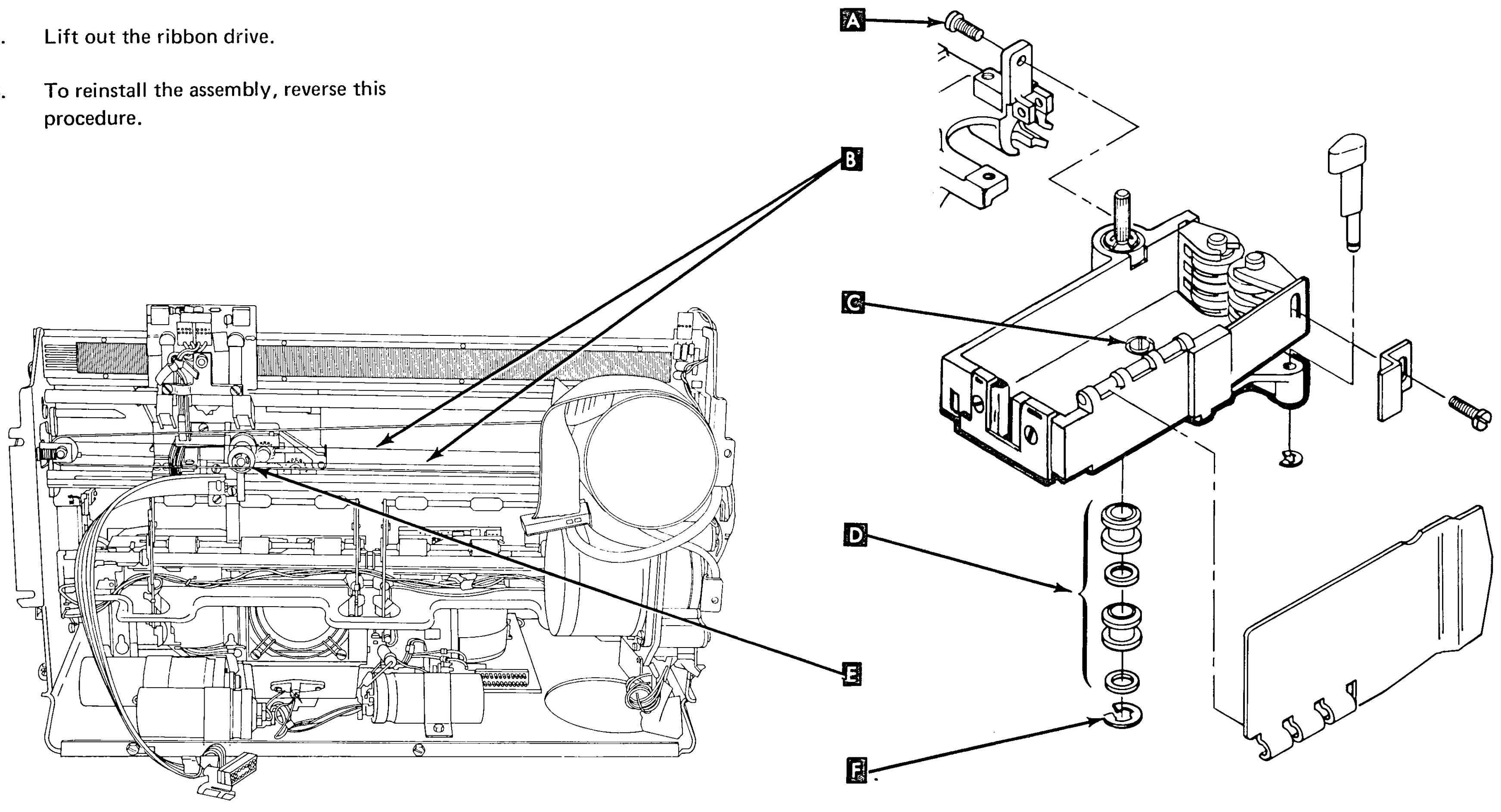
Removal

1. Turn power off at the operator control panel and remove the printer covers.
2. Remove the print head (9.2.34). Adjust the print head for installation.
3. Separate the printer from the power supply (9.2.2) and place the printer in the service position.
4. Remove the drive lines **B** (9.2.44).
5. Remove the retaining screw from the inside of the ribbon box **C**.
6. Remove the retaining screw from the left side of the ribbon box beside the feed rolls **A** .
7. Lift out the ribbon drive.
8. To reinstall the assembly, reverse this procedure.

9.2.42 Ribbon Drive Clutches

Removal

1. Turn power off at the operator control panel and remove the printer covers.
2. Separate the printer from the power supply and place the printer in the service position (9.2.2).
3. Remove the ribbon lines **B** (9.2.44).
4. Remove the C-clip from the bottom of the ribbon clutch shaft **F**
5. For installation, you should be able to turn both clutches clockwise (when viewed from the clutch end of the shaft) **E** when the shaft is held.
6. Remove the clutches and washers **D**
7. To reinstall the clutches, reverse this procedure. Apply a light film of IBM No. 23 grease to the clutch end of the shaft before installing the clutches.



9.2.43 Ribbon Drive Shaft

Removal

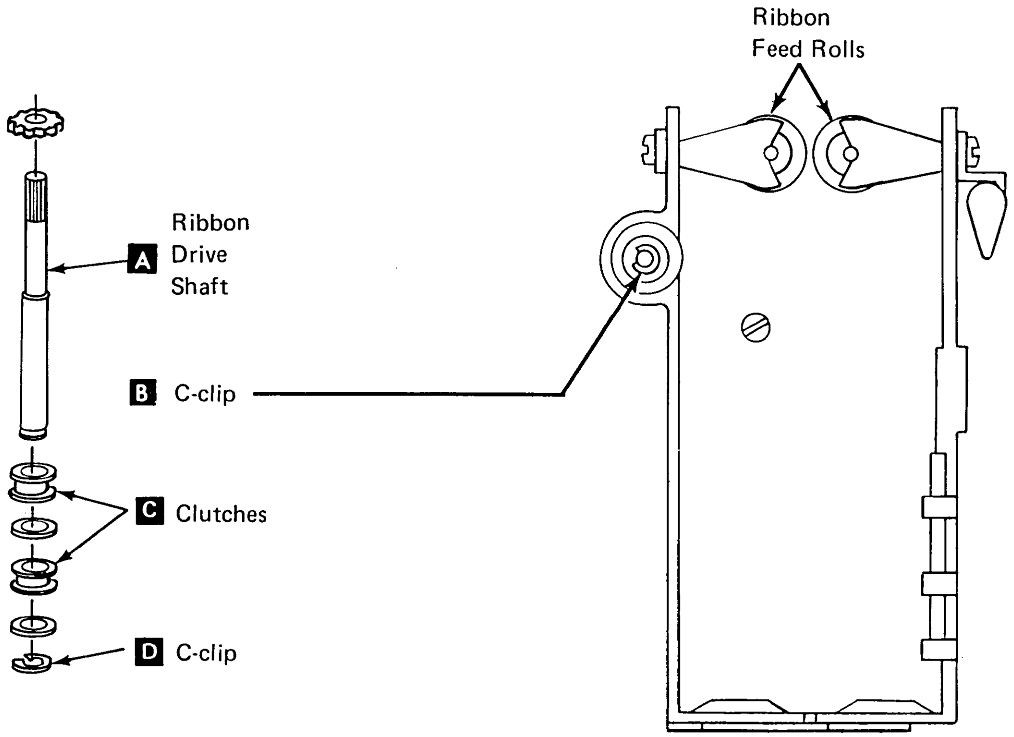
1. Turn power off at the operator control panel and remove the printer covers.
2. Remove the ribbon (9.2.47).
3. Remove the C-clip at the ribbon advance knob **B** .
4. Separate the printer from the power supply and place the printer in the service position (9.2.2).
5. Remove the ribbon drive lines (9.2.44) and slip the carrier drive belt off the motor pulley.
6. Remove the clutches **C** and shaft **A** .
7. Remove the remaining C-clip **D** and slide the clutches off the shaft.
8. For installation, you should be able to turn both clutches clockwise (when looking at the clutch end of the shaft) when the shaft is held.
9. To reinstall the shaft, reverse this procedure.

9.2.44 Ribbon Drive Lines

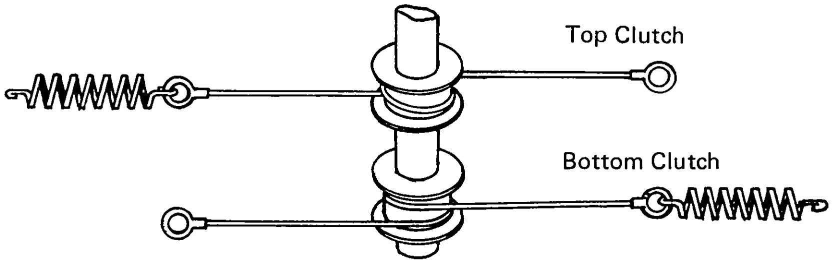
Removal

1. Separate the printer from the power supply and place the printer in the service position (9.2.2).
2. Unthread the lines from the clutches but leave the springs attached to the tabs on the right and left bracket.
3. To reinstall, thread the lines so that they are parallel to each other and to the carrier main shaft. The line crossovers must be as shown **E** .
4. Reassemble the printer and power supply (9.2.2).

Note: It helps, when stringing the upper line, to use a small piece of pressure sensitive tape to secure the loop around the clutch while attaching the ends to the side frame.



E
Line Crossovers



9.2.45 Ribbon Feed Rolls

Adjustment

1. Turn power off at the operator control panel.

2. Remove the forms tractor unit (9.2.7).

3. Remove the printer cover (9.2.1).

4. Adjust the feed rolls as follows:
   a. Loosen the screw that holds the right hand feed roll **C** .
   b. Open the feed rolls by pushing the flat spring to the right **E** .
   c. Position the right hand feed roll so that the right feed roll aligns with the left roll **A** .
   d. Tighten the screw.

Removal

1. Turn power off at the operator control panel.

2. Remove the forms tractor unit (9.2.7).

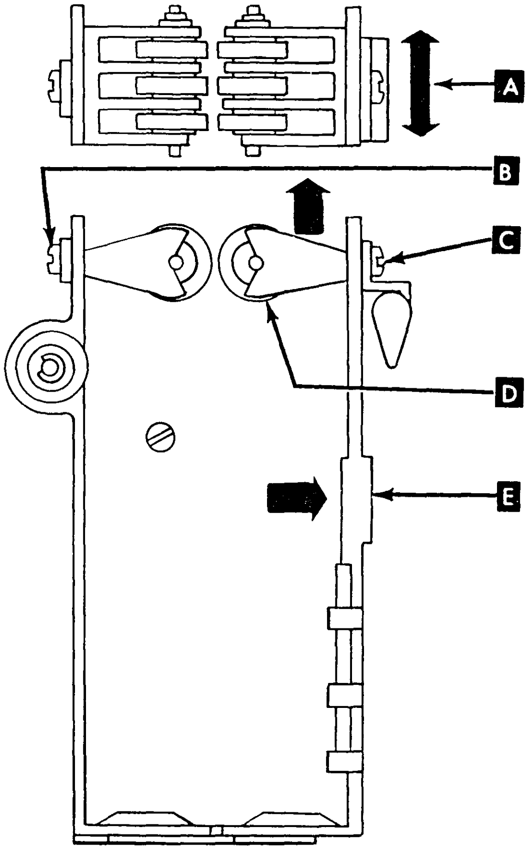
3. Remove the printer covers (9.2.1).

4. Remove the ribbon (9.2.47).

5. Remove the right feed roll as follows:
   a. Remove the screw **C** .
   b. Hold the flat spring **E** to the right and rotate the feed roll **D** toward the platen area to free it from the spring.

6. Remove the left feed roll as follows:
   a. For installation, install the platen and adjust the print head.
   b. Remove the print head (9.2.34).
   c. Remove the screw **B** from the left side of the ribbon box.
   d. If the right feed roll is in place, hold the flat spring **E** to the right and rotate the left feed roll toward the platen.

7. To reinstall the feed rolls, reverse this procedure. Be sure to align the right feed roll vertically to the left roll **A**.



9.2.46 Ribbon Box and Cover

Removal

The ribbon box cover can be separated from the box at the hinge.

1. Press STOP on the operator panel.

   Note: Two minutes after the STOP key is pressed, the print head will restore to the left margin.

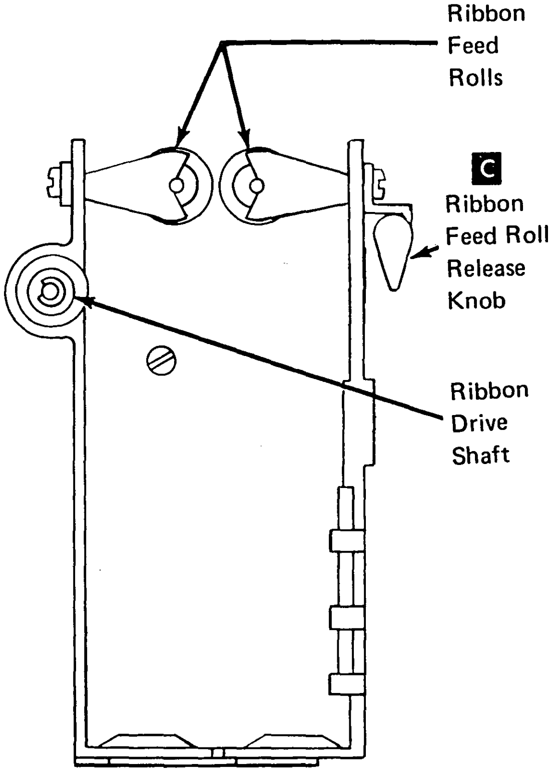
2. Remove the printer cover. Separate the printer from the power supply and place the printer in the service position (9.2.2).

3. Remove the ribbon drive assembly (9.2.40).

4. Remove the following parts:
   a. Ribbon feed rolls (9.2.45).
   b. Ribbon drive shaft (9.2.43).
   c. Ribbon feed roll release knob (C-clip on bottom).

4. Reassemble the ribbon box and cover by reversing this procedure.

5. Press START on the operator panel.



9.2.47 Ribbon Changing

1. Press the STOP key on the operator panel.

   Note: Two minutes after the STOP key is pressed, the print head will restore to the left margin.

2. Tilt the forms tractor unit back.

3. Open the top cover.

4. Open the ribbon feed rolls **B** by rotating the release knob **C**.

5. Remove and discard the old ribbon (see decal **D** on ribbon box cover).

6. Eject a new ribbon into the box by pressing on the disk in the holder. Discard the holder and disk.

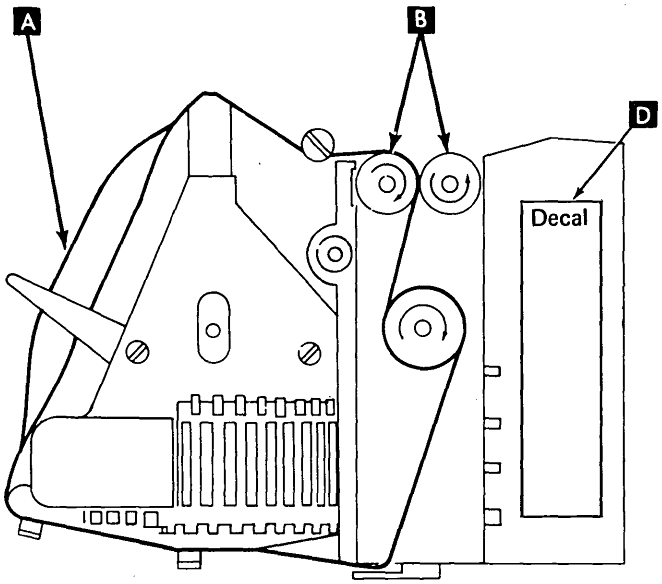
7. Pull about 10 inches (254 mm) of ribbon from the coil and form a loop **A**.

8. Thread the side of the loop nearest the platen as shown on the ribbon box decal. Thread this end just past the print head. Close the feed rolls.

9. Thread the other end of the ribbon as shown. The half twist should now be beside the horizontal guides.

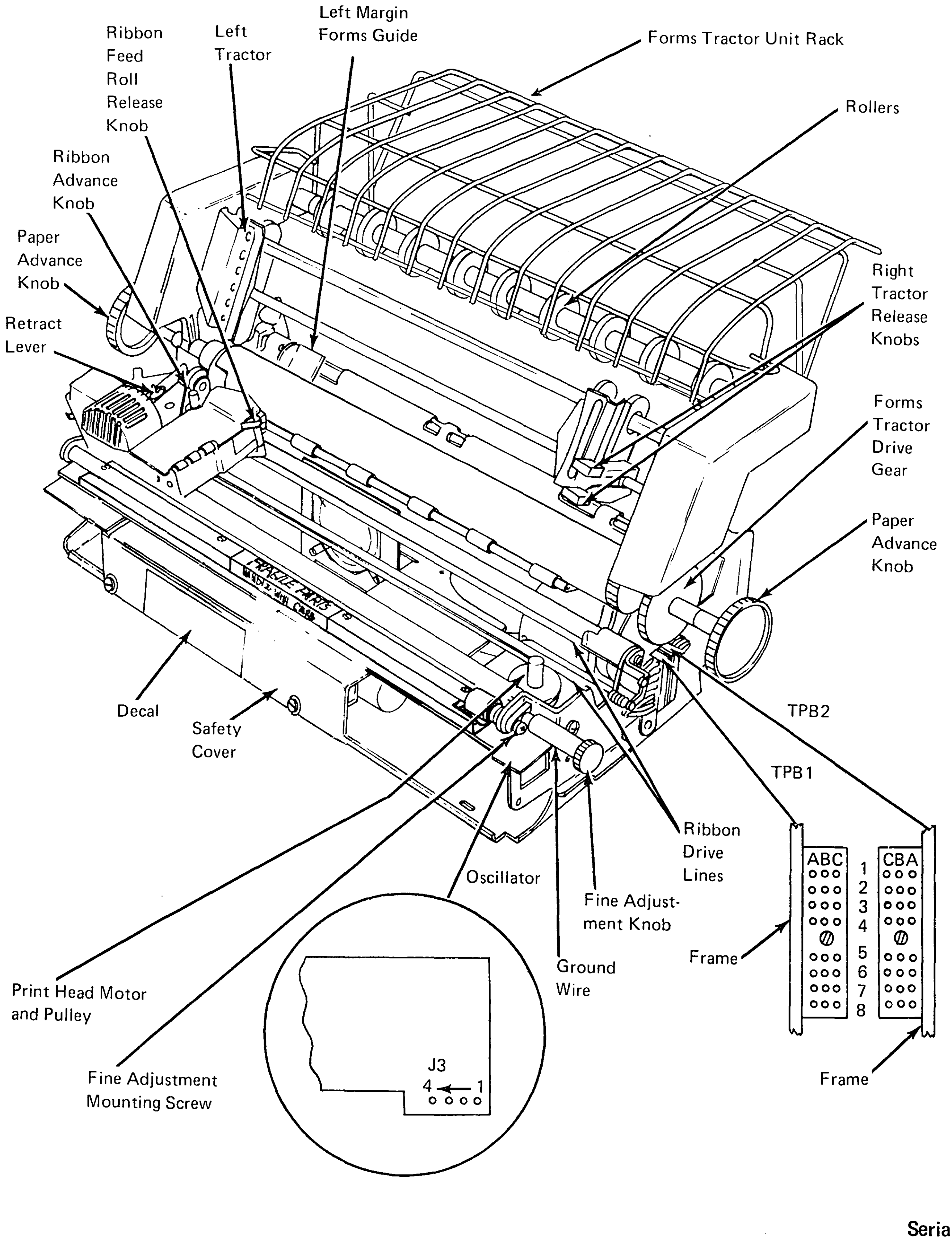
10. Take up ribbon slack by rotating the knurled knob. Guide the ribbon between the horizontal guides so that 1/4 turn counterclockwise is on each side of the guide.

11. Close the cover, restore the forms tractor to operating position, and press the START key on the operator panel.

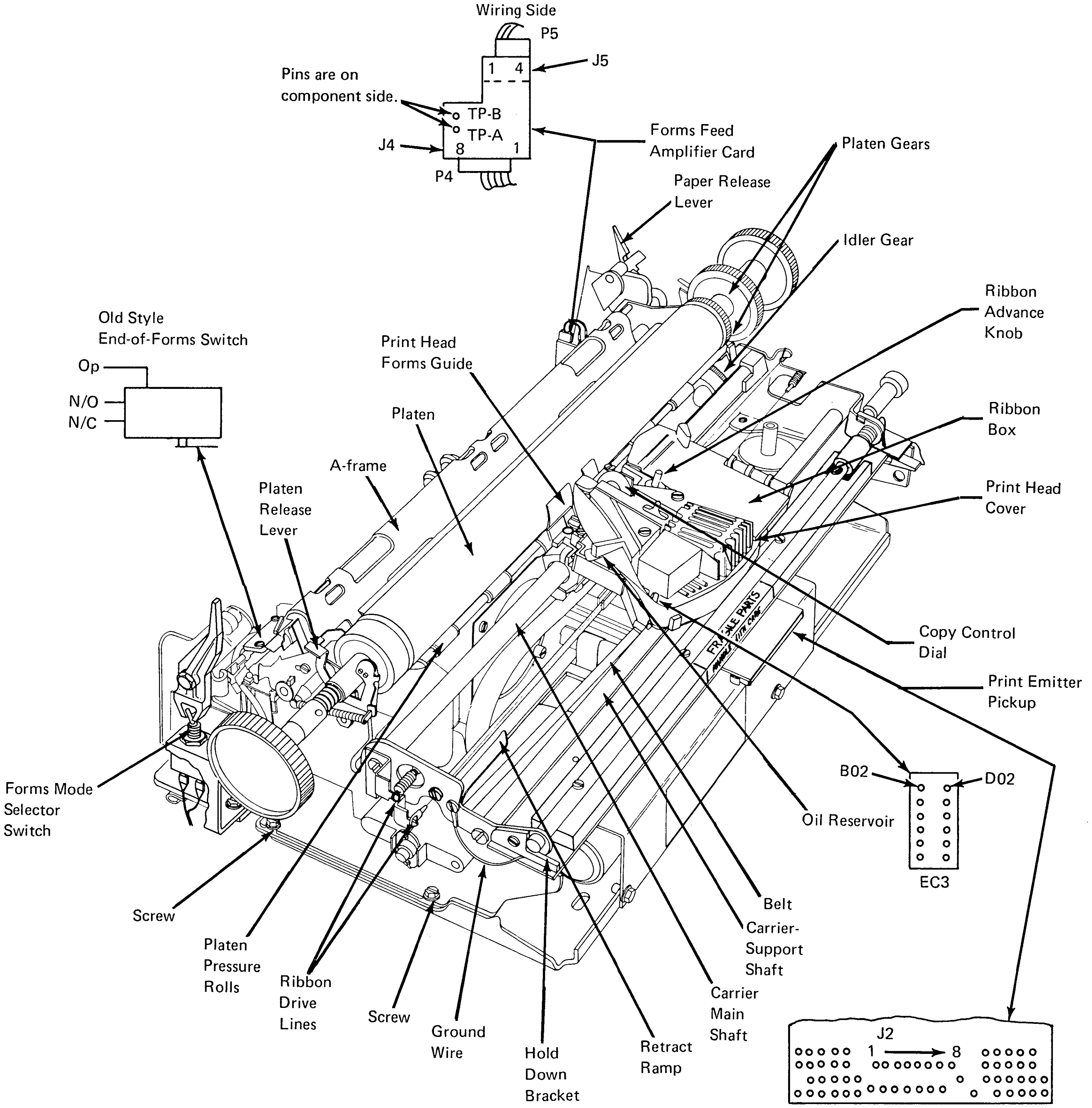


9.3.0 LOCATIONS

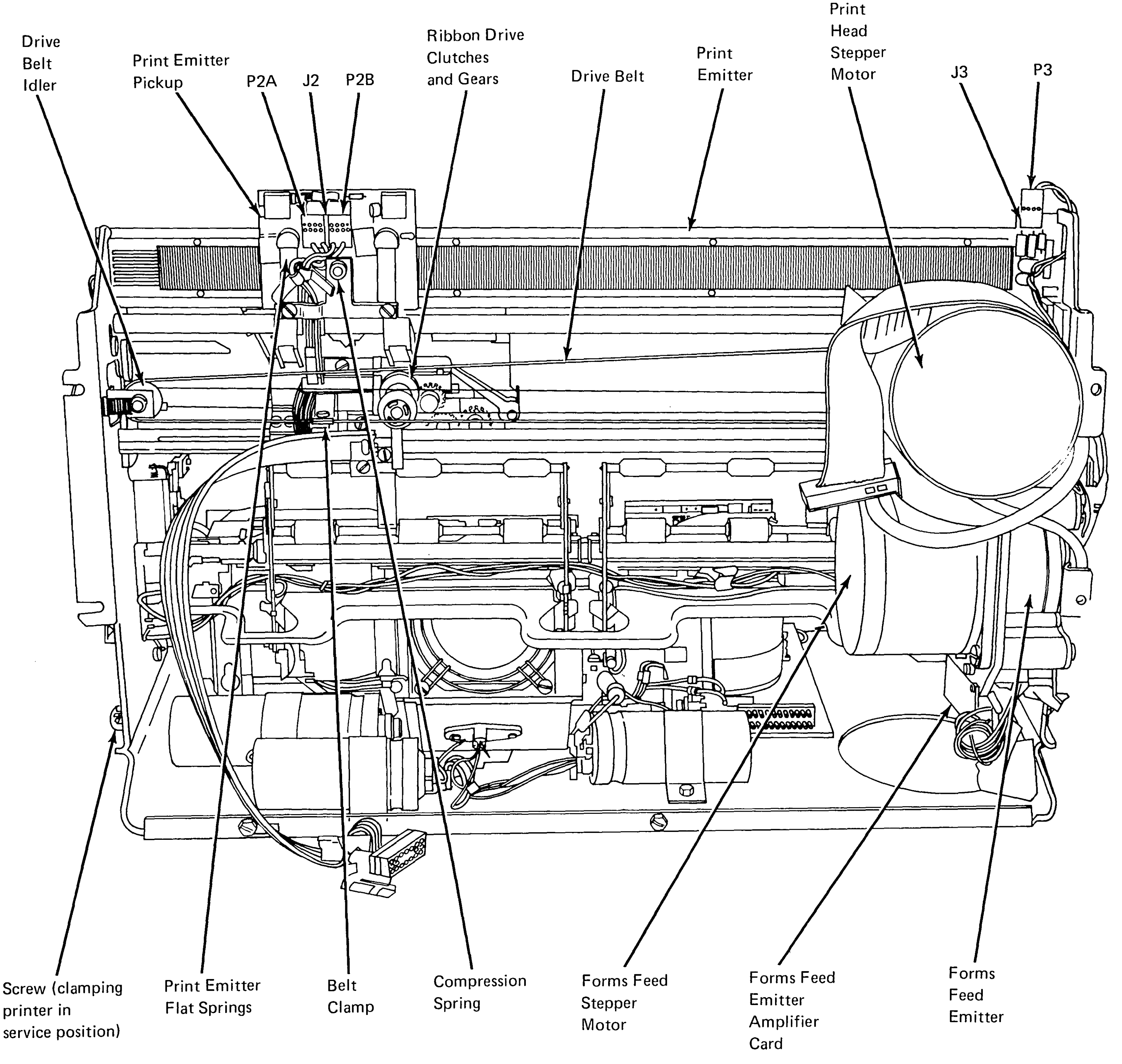
9.3.1 Front and Right Side Locations



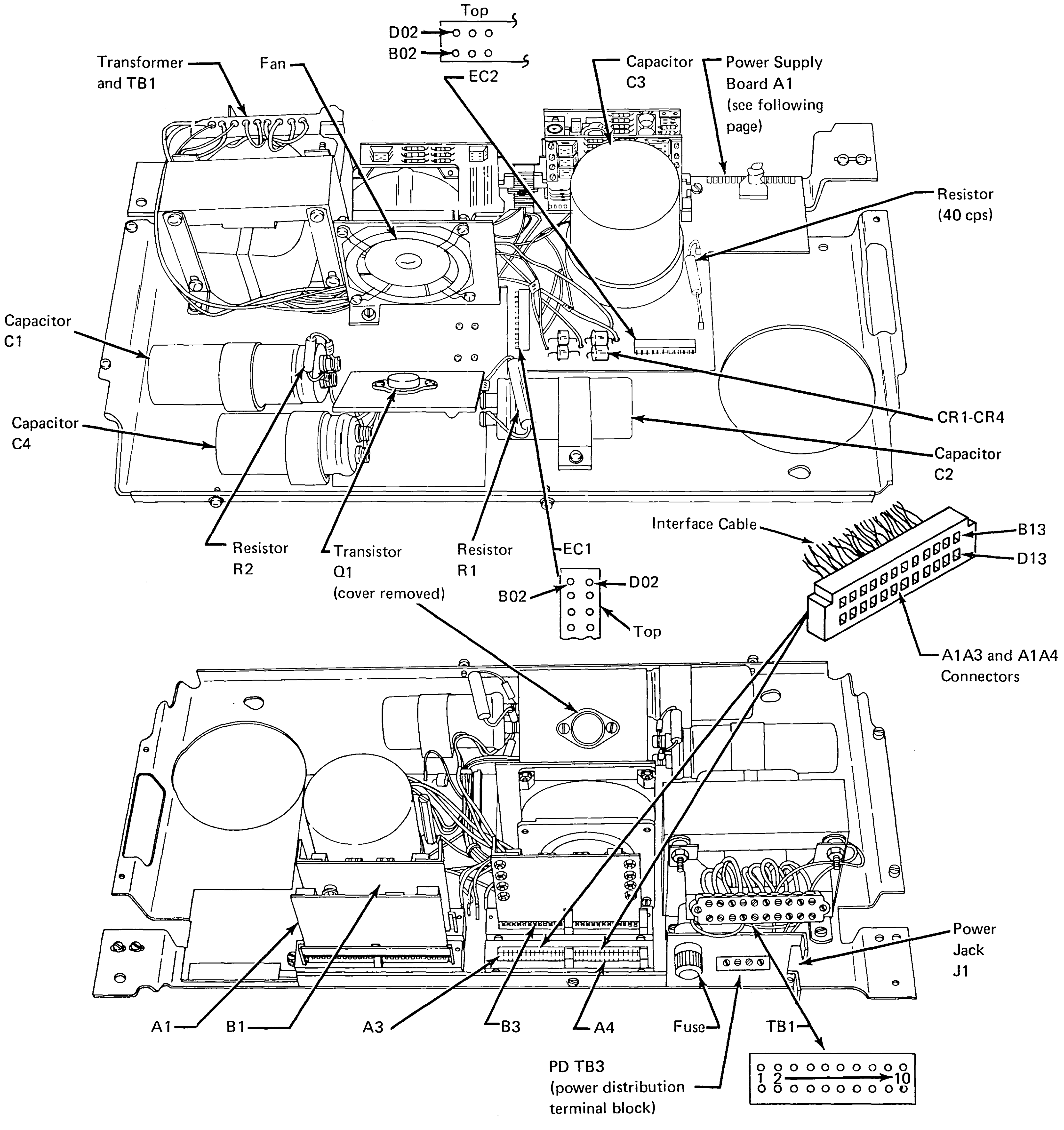
9.3.2 Front and Left Side Locations



9.3.3 Bottom Locations

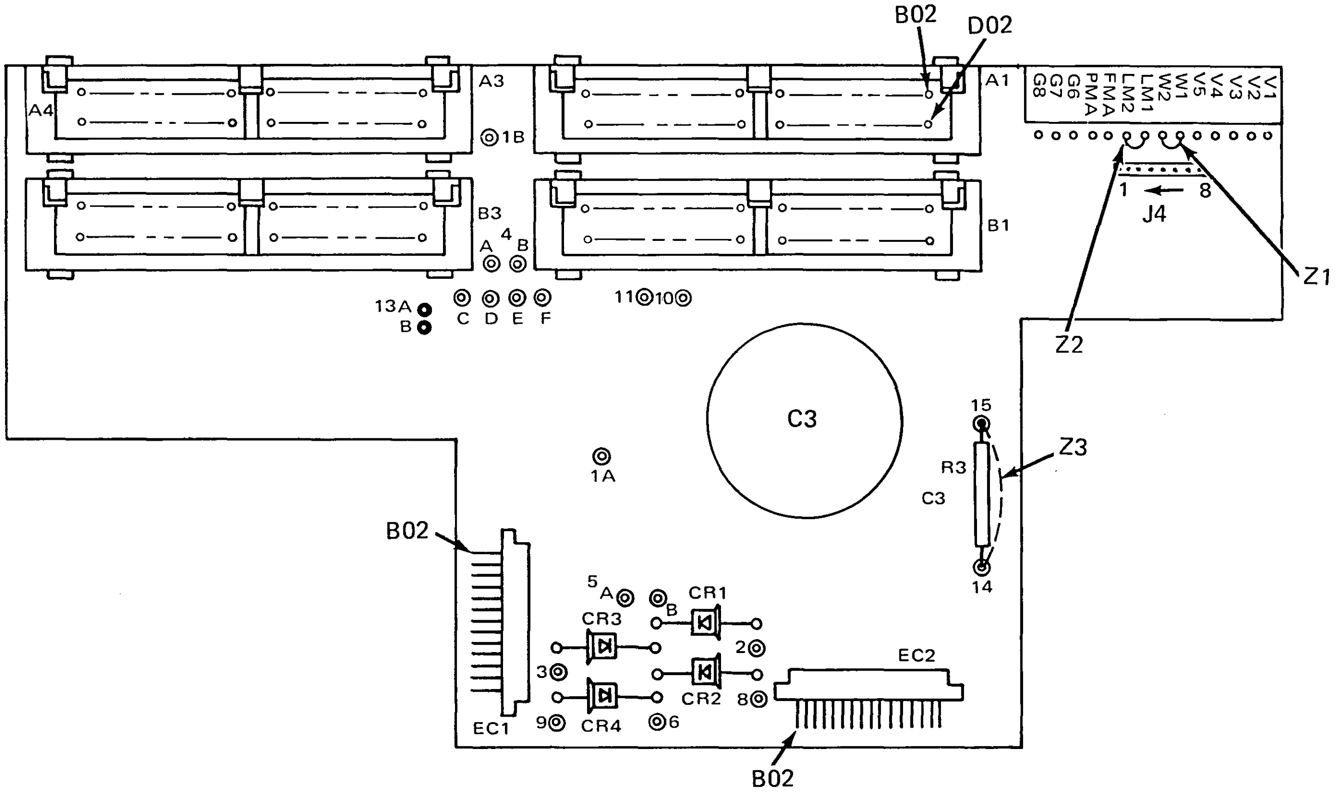


9.3.4 Base Locations



9.3.5 Power Supply Board Locations

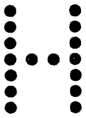
Power Supply Board A1



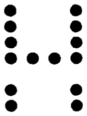
9.4.0 PRINT QUALITY PROBLEMS

These print quality problems are used with the MAPs.

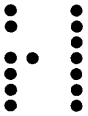
Character printed correctly.



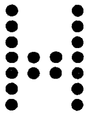
Missing horizontal row of dots.



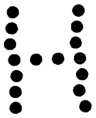
Random missing dots.



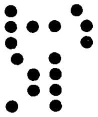
Extra dots.



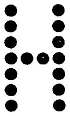
Dots within a character are not aligned vertically.



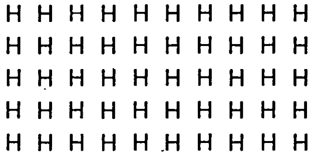
Unintelligible printing.



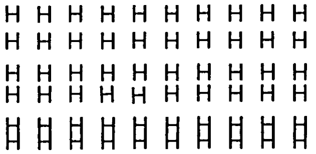
Wrong character width.



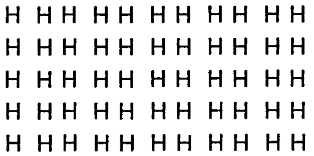
Correct printing.



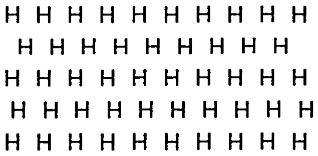
Incorrect line spacing.



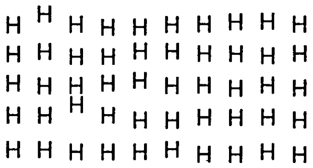
Incorrect character spacing.



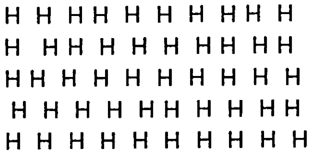
Printing misaligned vertically.



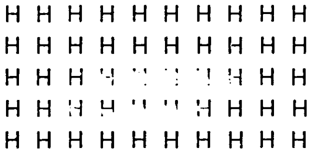
Printing misregistered vertically.



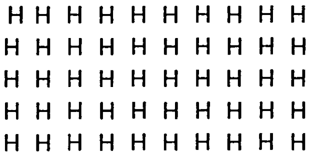
Printing misregistered horizontally.



Defective ribbon.
Oil spot on ribbon.
Defective platen.



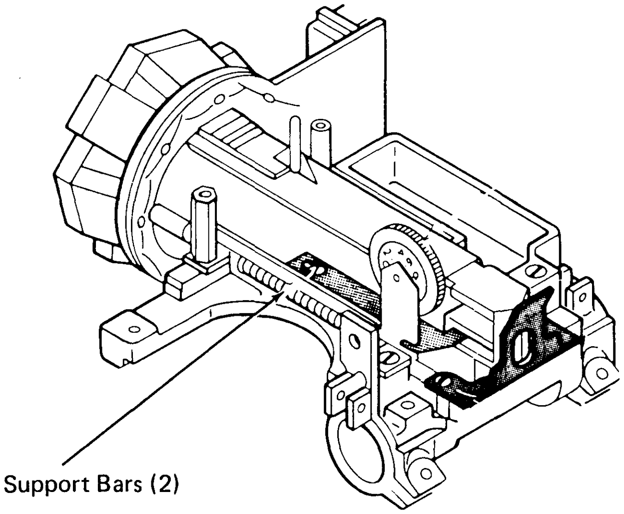
Printing not aligned with the forms (crooked printing).

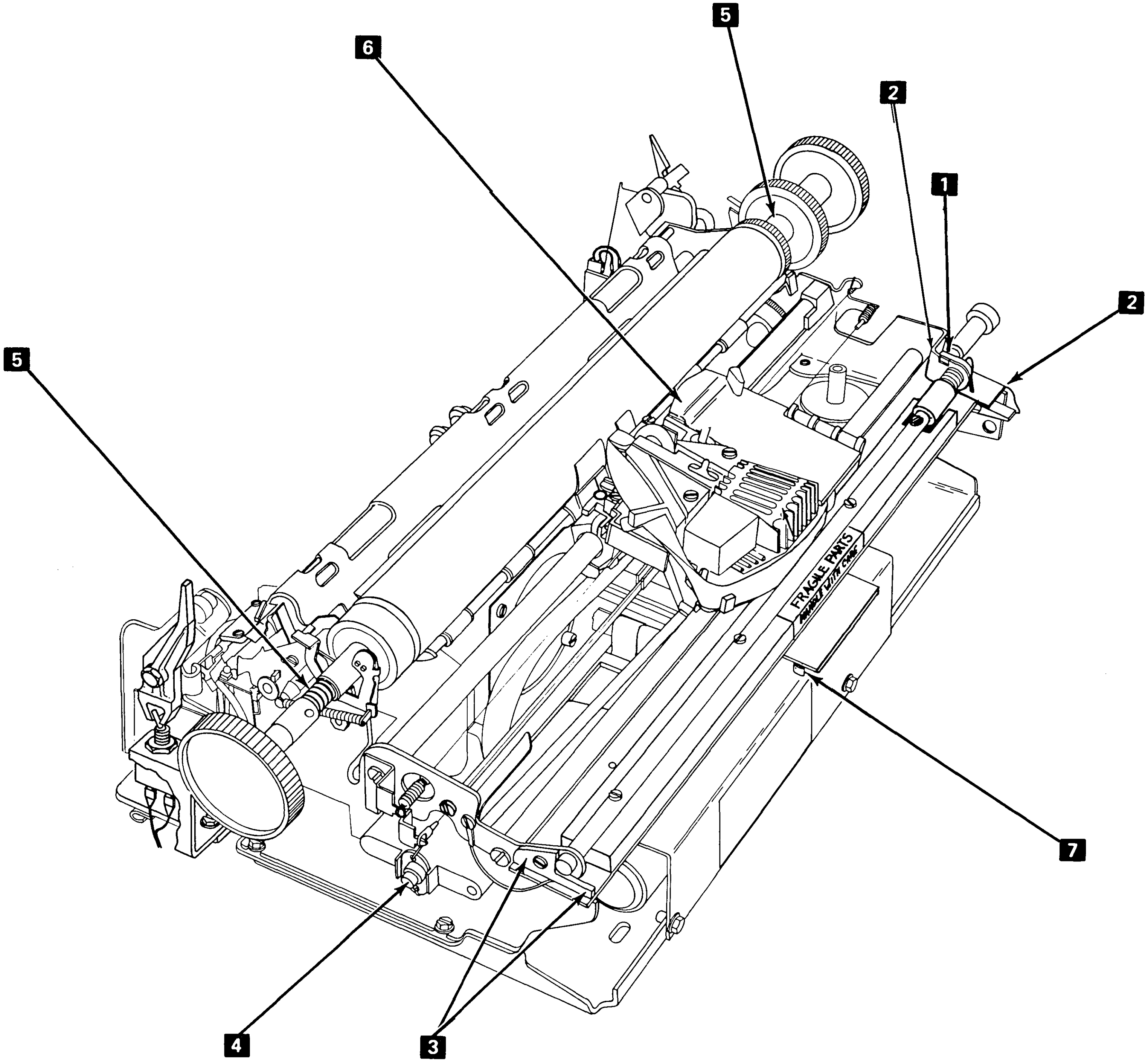


9.5.0 PREVENTIVE MAINTENANCE

Perform preventive maintenance for the printer on any 01 (unscheduled) call if a check of the incident reports shows that more than a year has passed since the last PM.

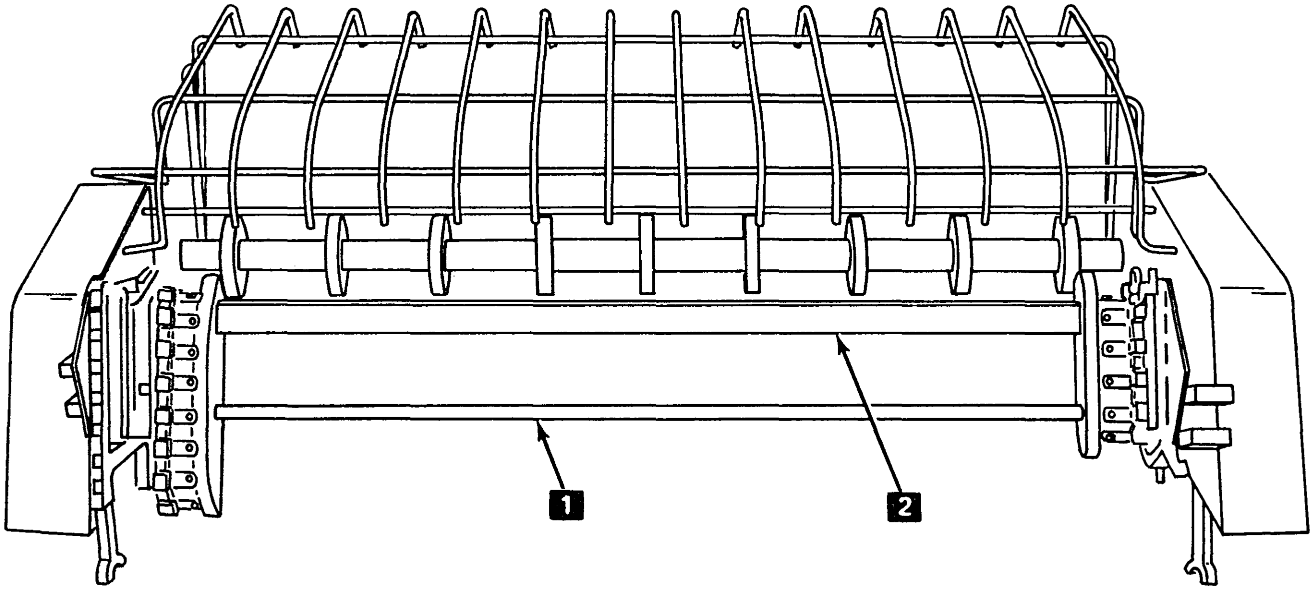
Unit	Operation	Lubricant	Notes
Ribbon drive	Replace lines.		Procedure 9.2.44.
	Lubricate feed roll shafts.	IBM No. 23	Light film.
	Clean ink from ribbon guides.		
	CAUTION Excess oil will bleed to the ribbon and cause light and dark printing.		
Print head	Clean wire guide tip and side grooves.		
	Check printing for variations in density.		Variations may indicate print wire wear.
	Oil felt.	IBM No. 6	Procedure 9.2.37.
	Lubricate support bars.	IBM No. 6	Drop.
Forms tractor unit	Lubricate shafts.	IBM No. 23	Light film.
Print emitter	Lubricate:		
	Pickup pads.	IBM No. 23	Light film.
	Contact points between emitter board and side frame (7).	IBM No. 23	Light film.
	Horizontal fine adjustment threads and shaft slides.	IBM No. 23	Light film.
Carrier drive	Lubricate belt tensioner guide shaft	IBM No. 23	Light film.
Forms feed drive	Lubricate idler gear stud.	IBM No. 6	Drop
Platen	Lubricate bushings.	IBM No. 23	Light film.
Power supply	Check fan operation.		





IBM No. 23 Grease

1 Horizontal find adjustment threads
2 Contact points between emitter board and right side of frame (3)
3 Contact points between emitter board and left side of frame (4)
4 Belt tensioner guide shaft
5 Platen bushings (2)
6 Feed roller shafts
7 Pickup pads (4)



IBM No. 23 Grease

1 Bottom forms tractor shaft (light film)
2 Top forms tractor shaft (light film)

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10.0.0 Data Communications

10.1.0 INTRODUCTION

The communications adapter (BSCA/SDLC) is an optional feature that gives the System/32 the ability to function as a point-to-point or multipoint processor terminal. Data is transmitted or received serial-by-bit and serial-by-character over voice grade communication channels (switched or nonswitched). The system can be connected to a half-duplex or full-duplex facility but the adapter operates in half-duplex mode only; that is, transmission of data is only in one direction at a time.

During transmit operations, each byte to be transmitted is sent to the communications adapter where the data is serialized and then sent one bit at a time to the modem. The modem, in turn, sends each bit to the receiving terminal over the communications network.

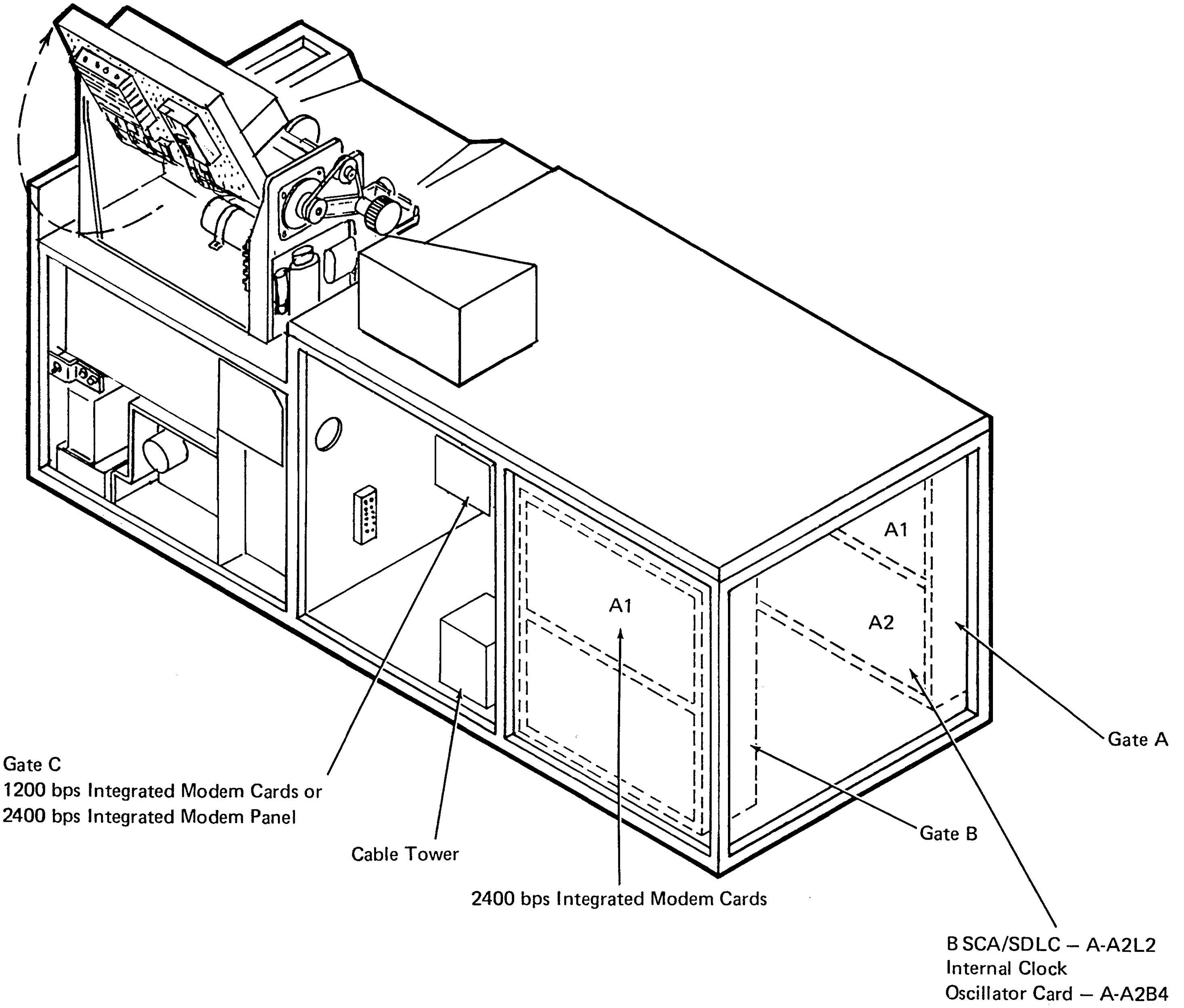
During receive operations, the communications adapter receives each bit from the modem and assembles the bits into bytes (deserializes). Each byte of data is then sent to the processing unit as a result of a character micro interrupt.

10.1.1 Data Communications Abbreviations

The following abbreviations are used with BSCA:

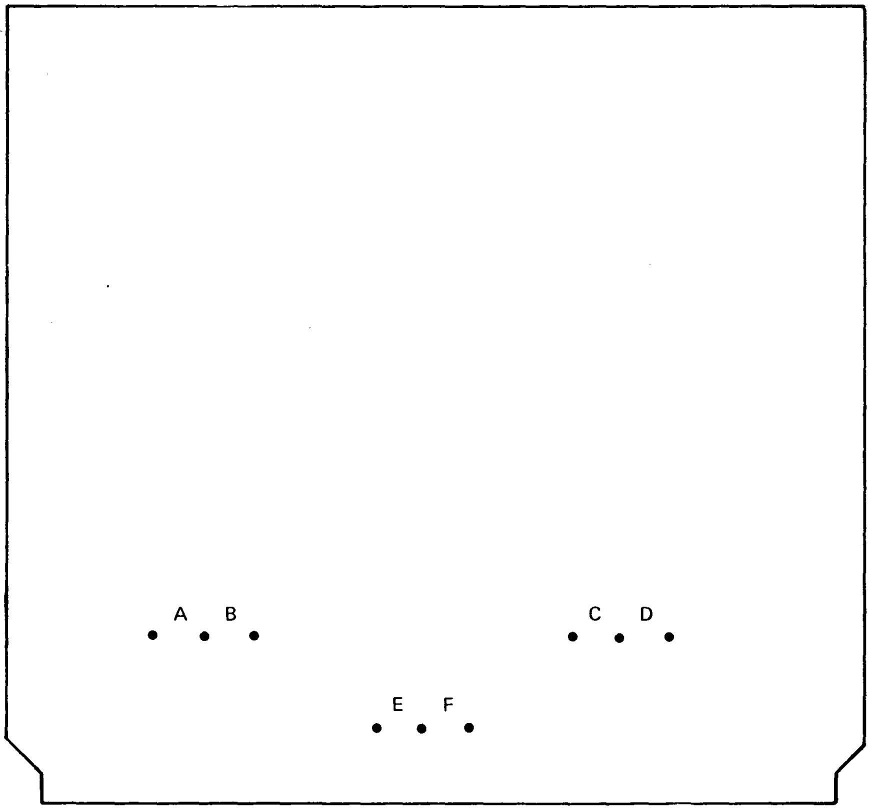
AA	Automatic answering
AAC	Automatic answering, automatic calling
ACO	Automatic call origination
AEQ/AEL	Automatic equalizer
AEQ Seq	Automatic equalization sequence
bps	Bits per second
BSCA	Binary synchronous communications adapter
CBS	Data coupler for modem with AA
CCITT	International Telephone and Telegragh Consultative Committee
CCT	Coupler cut through
CD	Carrier detect
CDT	Data access arrangement for manual calling and answering
CSCD	Clear to send, carrier detect
CTS or CS	Clear to send
C1	Adjustable equalizer for use with type 3002 LL channel with C1 conditioning
DA	Data modem ready
DAA	Data access arrangement
db	Decibel
DPSK	Differential phase shift keying
DR	Data ring
DSR	Data set ready
DT	Data tip
DTE	Data terminal equipment (business machine)
DTR	Data terminal ready
EC	Edge connector or engineering change
EIA	Electronic Industries Association
FET	Field effect transistor
F-O	Fan-out
LL	Leased line (dedicated channel)
M-P	Multipoint (not M-P implies point-to-point, P-P)
N/C	Normally closed
NRZI	Nonreturn to zero inverted
PC1	Printed circuit power supply board
Preamp	Preamplifier card
PSN	Public switch network
PTT	Post telephone and telephone
Rcv	Receive
RI	Ring indicate
RS or RTS	Request to send
SDLC	Synchronous data link control
SG	Signal ground
SH	Switch hook
SN	Switched network
SNBU	Switched network backup (standby)
Standby	Card at D6 (single modem)
Sw	Switch or switched network
TB	Terminal board
T1	Test 1
T2	Test 2
T3	Test 3
T4	Test 4
Wrap	Local loop within modem
WT	World Trade
XMT	Transmit
2W	Two-wire line connection (implies half duplex)
4W	Four-wire line connection (implies duplex, but actual duplex depends on DTE and telephone company equipment)

10.1.2 BSCA/SDLC Locations



10.2.0 BSCA/SDLC CARD STRAPPING

BSCA Card
Location A-A2L2

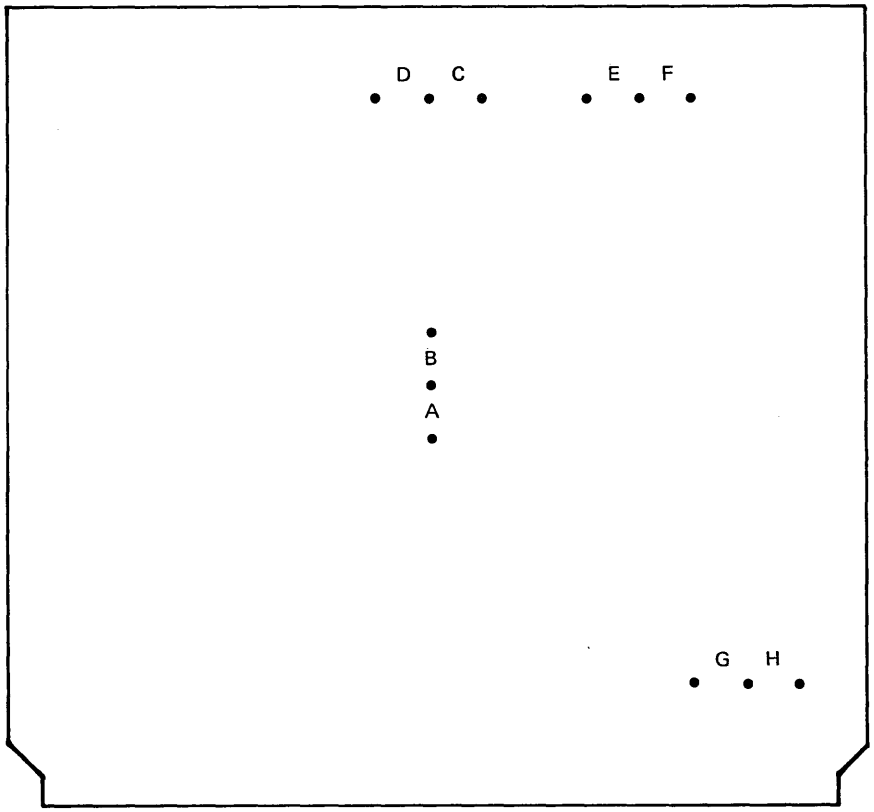


A-A2L2 strapping is done to agree with customer facilities:

A – Required (provides ring indicate)
B – Not used
C – Not continuous carrier
D – Continuous carrier
E – Required (EIA standby)
F – Not used

Note: If continuous carrier is required with SNBU (switched network backup), attach a jumper from M2G02 to T2B09 on the B-A1 board.

SDLC Card
Location 1A-A2L2



1A-A2L2 strapping is done to agree with customer facilities:

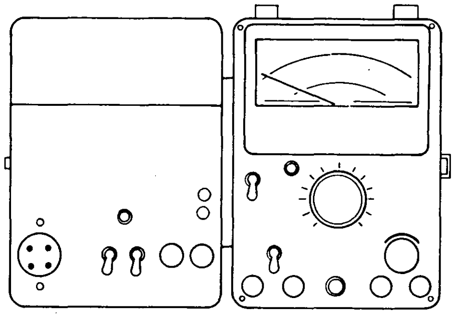
A – Not continuous carrier
B – Continuous carrier (note 1)
C – NRZI (note 2)
D – Not NRZI (note 2)
E – Not used
F – Required (interrupt status request)
G – Required (device address)
H – Not used

Notes:

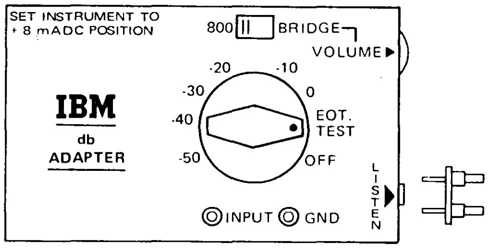
1. If continuous carrier is required with SNBU (switched network backup), attach a jumper from M2G02 to T2B09 on the B-A1 board.
2. All data terminal equipment communicating with each other must select the same coding option (NRZI or not NRZI). Contact your IBM marketing representative for identification of those modems which have pattern sensitive synchronization problems and to determine which coding option should be used.

10.3.0 1200 BPS INTEGRATED MODEM

10.3.1 Transmit Level Adjustment Using db Meter P/N 453545[1] or db Adapter P/N 1749299



db Meter P/N 453545[1]



db Adapter P/N 1749299

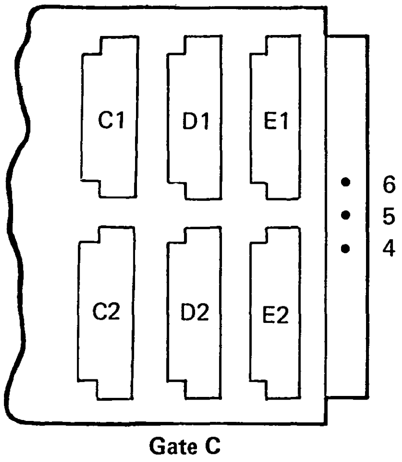
Use the db meter or adapter to adjust both leased line and switched networks. For a wider range of adjustment, there is a 0 db jumper on the transmit card. The 0 db jumper must be removed for World Trade leased line installation.

Jumper on = Full adjustment range (U.S.A. and Canada)
Jumper off = Adjustment to approximately −2 db maximum (WT use).

Direct attachment to a leased line normally requires a 0 dbm transmit level. (In WT, adjust to a minimum db value; in the U.S.A. and Canada, adjust to 0 db.) If attachment is by a switched line with CBS automatic data coupler, or equivalent, adjust the transmit level to the value marked on the common carrier equipment.

To set the appropriate transmit level, use one of the following procedures:

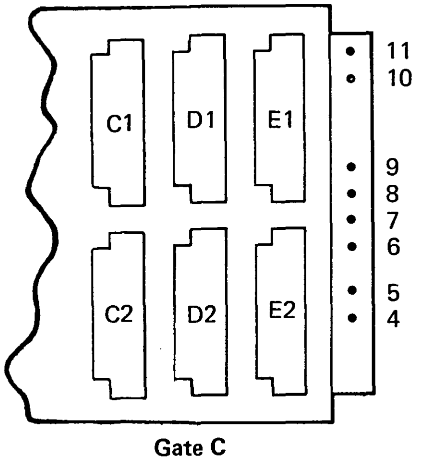
Leased Board



Leased Line:

1. Turn off system power.
2. Disconnect communication line plug.
3. If you are using the db meter, insert the plug in the TRANS/REC jack of the db meter. If you are using the db adapter, connect the meter leads to the wide pair of plug prongs.
4. If you are using the db meter, place 2W-4W TRANS/REC switch in TRANS and attach a jumper from line terminals on cover to line terminals on meter.
5. Place the BRDG-600 (324) switch in the 600 position.
6. Connect pins 4, 5, and 6 together (with jumper P/N 5159491) on the modem board (see leased board illustration). This unclamps the transmitter and turns on 'request to send'.
7. Turn on system power.
8. While reading dbm scale on meter, adjust R3 potentiometer on the transmit card (C1) to the correct level. (In WT, adjust to a minimum db value; in the U.S.A. and Canada, adjust to 0 db.)
9. Remove the board jumper that was installed in step 6.

Switched Board (U.S.A. and Canada)



Switched Lines (U.S.A. and Canada):

1. Turn off system power.
2. Disconnect cable from modem (socket E2).
3. On db meter, place the BRDG-600 (324) switch in the 600 position.
4. Remove automatic answering interface card (socket B2).
5. Connect pins 6, 7, 8, and 9 together (use P/N 5159491, see switched board illustration). This causes the DT to be grounded, 'request to send' to come on, and the transmitter to be unclamped.

   Attach a jumper from pin 4 to pin 5 (use jumper P/N 816645) to turn on 'data set ready'.
6. Connect pin 10 to black line terminal on db meter.
7. Connect pin 11 to red line terminal on db meter.
8. Turn on system power.
9. While reading dbm scale, adjust R3 potentiometer on the transmit card (C1) to the correct level. (Correct level is indicated on cover of CBS or equivalent type cover.)
10. Remove the board jumpers that were installed in step 5.
11. Replace card in B2 and cable in E2.

---

[1] Branch office tool

Transmit Level Adjustment (Continued)

Switched Lines (World Trade):

World Trade note for switched lines: Before adjusting the transmit card, it is necessary to complete the line plate strapping. The line plate, located above the cable tower inside the back cover of the system, is shipped from the plant strapped for the lowest dc current (strapped between U11 and U10).

CAUTION
Voltage is present on the line plate from the telephone lines.

To adjust the line plate for the proper strapping:

1. Remove the card from the B2 socket on the 1200 bps integrated modem board. Removal of this card activates the line 'connect data set to line' and also activates the relay on the line plate.

2. Connect a dc voltmeter across TP1 (+) and TP2 (-) on the line plate. (Refer to 10.3.1.1, *WT PSN Line Plate and Cable Connections,* for the locations of TP1 and TP2.)

3. Change the strapping on the line plate by moving the jumper from U11-U10 to successive adjacent positions (U10-U09, U09-U08, etc) until the voltage is within the range of 0.5 Vdc to 1.7 Vdc.

4. If the installation does not use a handset, attach a jumper from U2 to U3 on the line plate; if it does use a handset, attach a jumper from U1 to U2. (See the WT PSN line plate illustration for the location of the pins.)

After the line plate strapping has been completed, the transmit level adjustment can be made by:

1. Turning off system power.

2. Remove PSN card from socket B2.

3. Connect pins 6, 7, and 9 together with jumper P/N 5159491. (See the switched board [PSN] illustration for the location of the pins.) This turns on 'request to send' and unclamps the transmitter.

   Attach a jumper from pin 4 to pin 5 with jumper P/N 816645 to turn on 'data set ready'.

4. Connect TB1-3 on the line plate to the black line terminal on the db meter.

5. Connect TB1-4 on the line plate to the red line terminal on the db meter.

6. Place the BRDG, 600, 324 switch in the BRDG position.

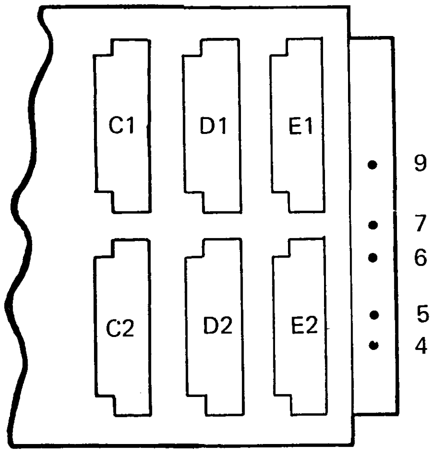
7. Turn on system power.

8. Adjust R3 potentiometer on the transmit card for -9 dbm unless otherwise specified by the local telephone company. Add +1 dbm to the PTT value for loss of amplitude in the line plate.

9. Remove the board jumpers that were installed in step 3.

10. Replace card in B2.

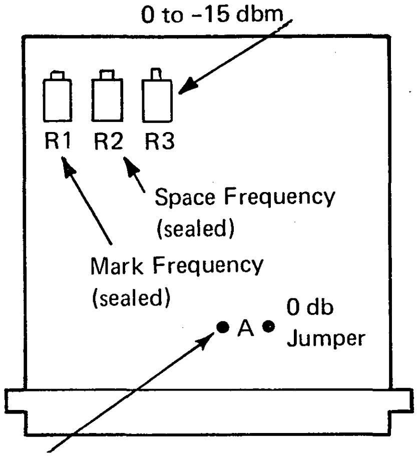
Switched Board (PSN)



Gate C

Transmit Card (C1)

Transmit level has an adjustment range from 0 to -15 dbm



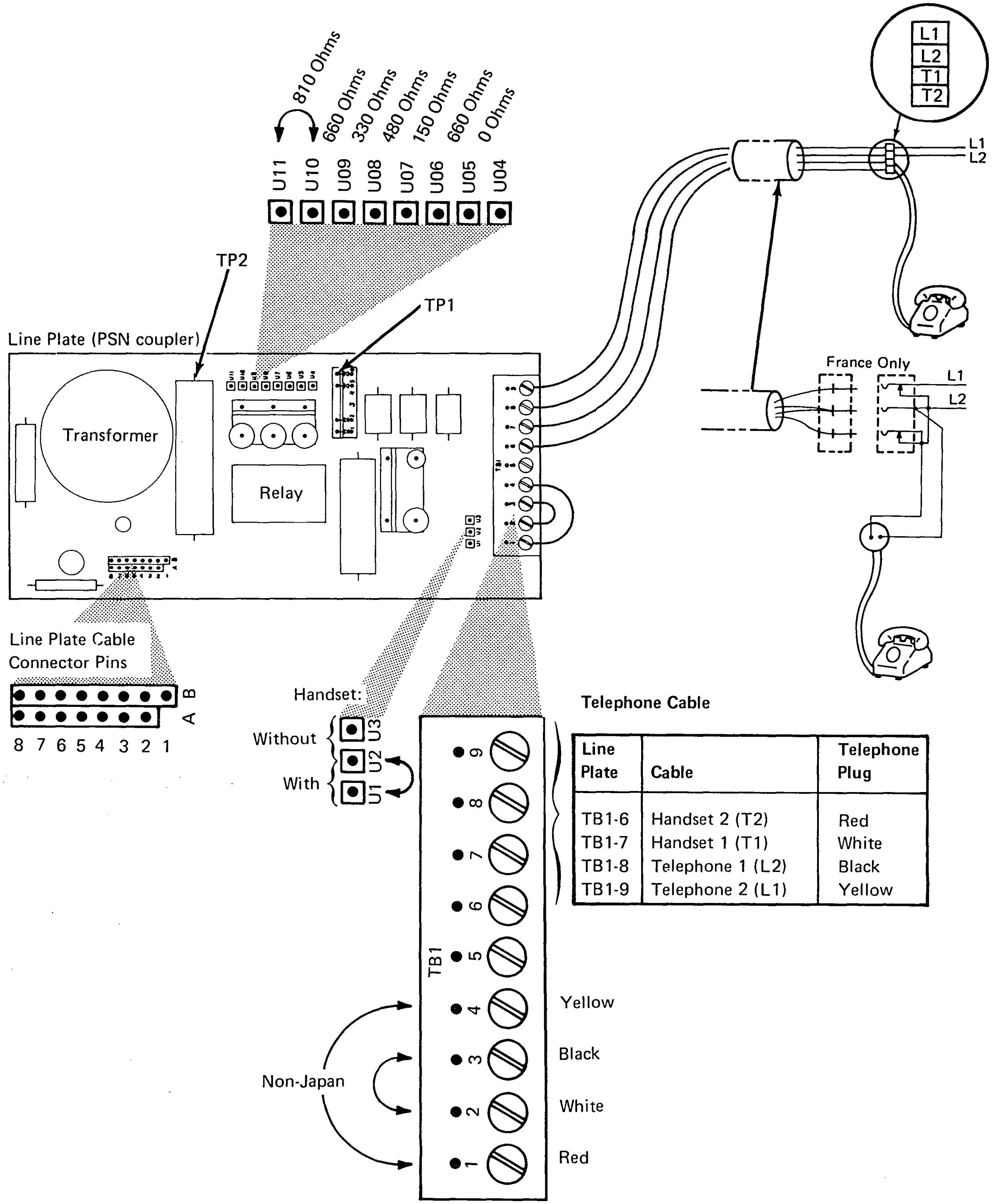
Space Frequency (sealed)

Mark Frequency (sealed)

0 db Jumper

Jumper A is required for full adjustment range. Remove the jumper for networks that restrict the transmit level attenuation to a level of less than -2 db (WT).

10.3.1.1 WT PSN Line Plate and Cable Connections

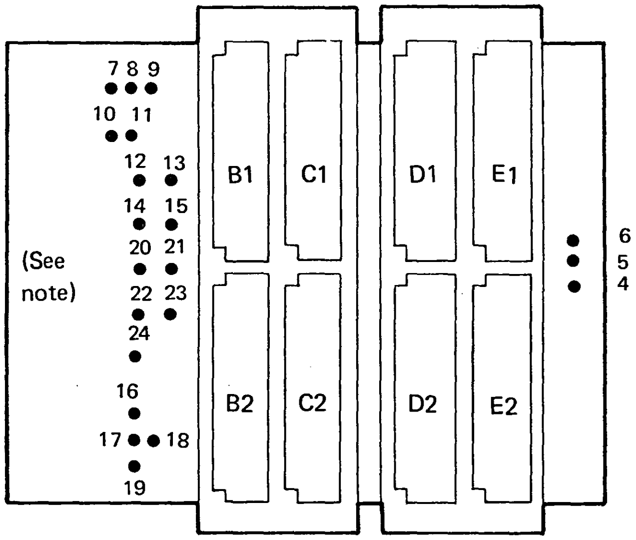


Telephone Cable

Line Plate	Cable	Telephone Plug
TB1-6	Handset 2 (T2)	Red
TB1-7	Handset 1 (T1)	White
TB1-8	Telephone 1 (L2)	Black
TB1-9	Telephone 2 (L1)	Yellow

10.3.2 Board Strapping

Leased Line Board



Note: Some 1200 bps modems do not have pins 20 through 24.

Switched Network Board

No straps are required on board for a switched network.

For 2-wire, attach jumpers from:	**For 4-wire, attach jumpers from:**
8 to 9	7 to 8
12 to 13	10 to 11
14 to 15	

Clear-To-Send Delay[1]		**Echo Clamp**[2]	
For:	**Strap:**	**For:**	**Strap:**
200 ms	17 to 19 ←→	130 ms	20 to 21 and 22 to 23
75 ms	17 to 18 ←→	50 ms	20 to 21 and 22 to 24
25 ms	17 to 16 ←→	0 ms	22 to 23

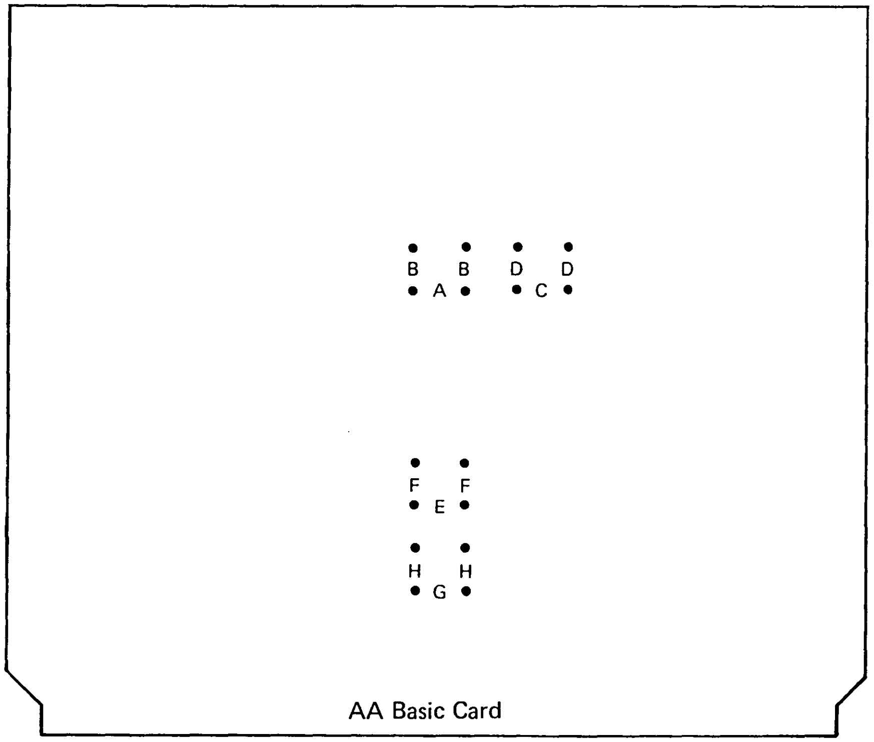
---

[1] The clear-to-send delay selected must be the same for all modems on a network. For 2-wire networks, the clear-to-send delay is normally 200 ms. The 75 ms clear-to-send delay can be used on 2-wire networks only when the network is short; turnaround is critical, and the network characteristics are suitable (minimum echo).

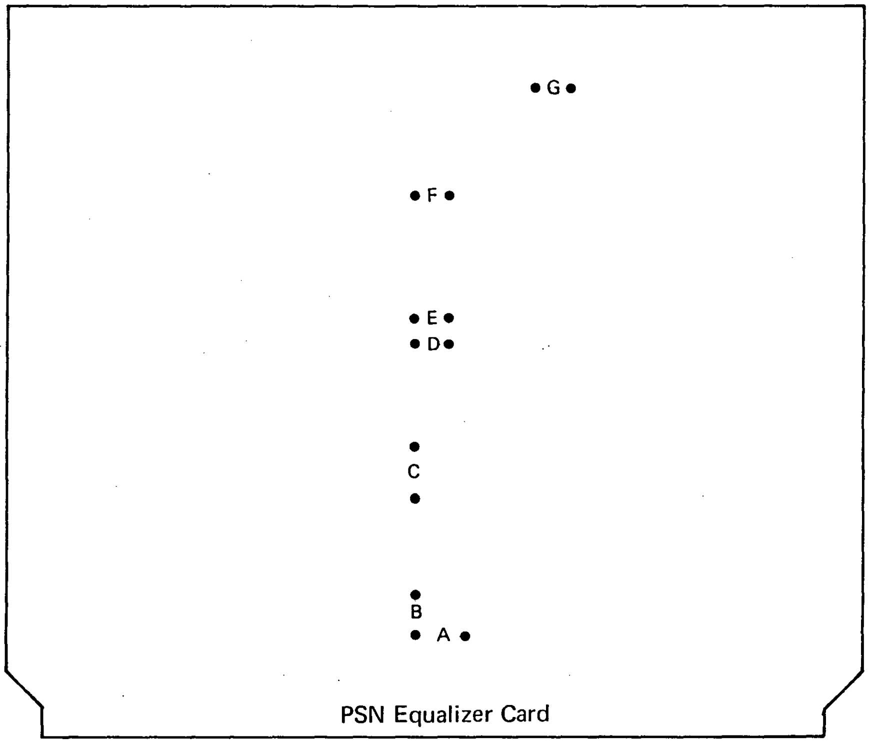
[2] The echo clamp must be compatible with the clear-to-send delay (200 and 130, 75 and 50, or 25 and 0).

10.3.3 Card Strapping

The following strapping is required for auto answer. For db attenuation selection, refer to common-carrier equipment.



Location A1 (U.S. and Canada)



Location A1 (World Trade)

Auto-Answer Basic Card (A1)

Answer tone transmit level attenuation from 0 db (level specified in data coupler) (A, C, E, G – 1 location each; B, D, F, H, – 2 locations each)

0 – A, C, E, G
1 – B, C, E, G
2 – A, D, E, G
3 – B, D, E, G
4 – A, C, F, G
5 – B, C, F, G
6 – A, D, F, G
7 – B, D, F, G
8 – A, C, E, H
9 – B, C, E, H
10 – A, D, E, H
11 – B, D, E, H
12 – A, C, F, H
13 – B, C, F, H
14 – A, D, F, H
15 – B, D, F, H

Equalizer Card (A1)

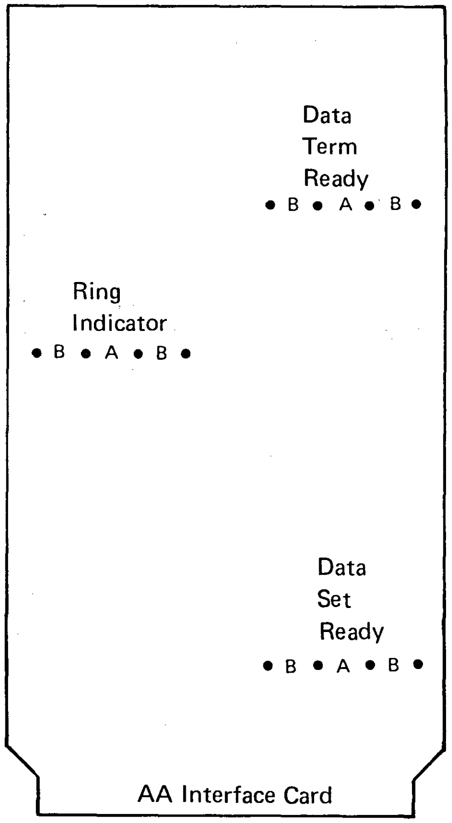
A – Not used
B – Required (amplitude equalization)
C – Required (low band disabled)
D
E
F
G
Not used

Auto-Answer Interface Card (B2)

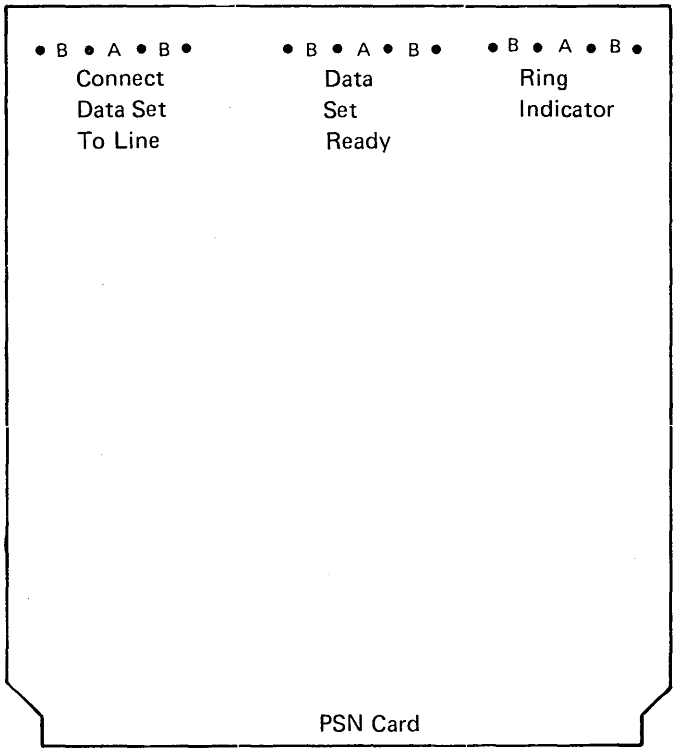
Business Machine Interface Levels:

A – EIA RS-232-C/CCITT–V.24; on at + level, off at - level (3 places).

B – Not used.



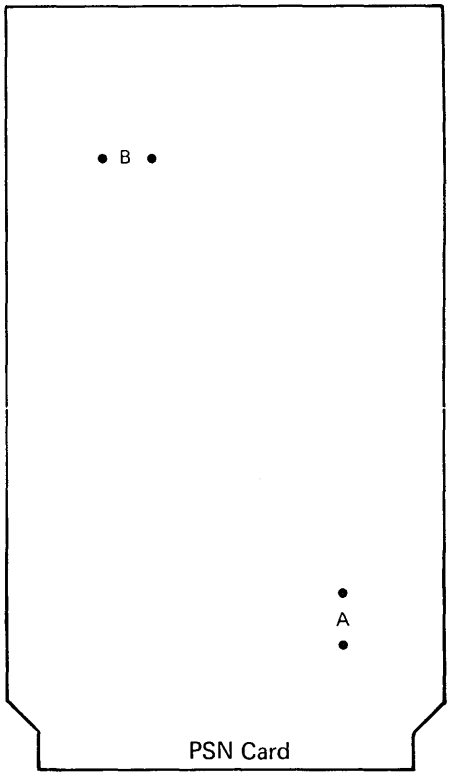
Location B2
(U.S. and Canada)



Location B2
(World Trade)

Ring Integrity Card (E2)

A – Required for ring integrity.
B – If installed, RI is turned on after one ringing pulse.
– If removed, RI is turned on after two ringing pulses.



Location E2
(World Trade)

10.4.0 2400 BPS INTEGRATED MODEM

10.4.1 Controls And Indicators

OPERATE Indicator

Shows that power is on. When the test/operate switch is set on OPERATE, the OPERATE indicator is on for a received mark signal and off for a received space signal.

When the test/operate switch is set on test (T1, T3, T4), indicator turns off for 150 ms when an error (space) is detected.

SIGNAL Indicator

When the test/operate switch is set on OPERATE, the SIGNAL indicator turns on with the 'data carrier detected' interface line.

READY Indicator

When the test/operate switch is set on OPERATE, the READY indicator turns on with the 'data set ready' interface line.

When the test/operate switch is set on test (T1-T4), the READY indicator is off to alert the operator that the modem is not ready for normal operation.

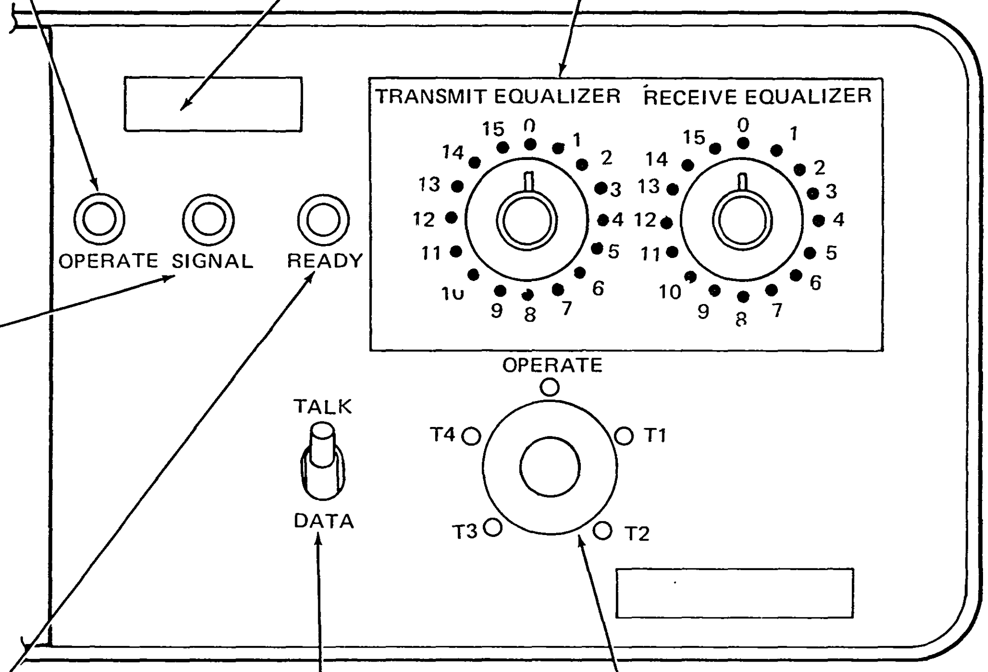
When the test/operate switch is set on T3, this indicator is off when the modem is not receiving data.

Signal Quality Meter

Indicates signal quality by a relative reading. Low reading determined during equalization is recorded for dedicated lines. Poor signal quality drives reading up on dedicated or switched lines.

TRANSMIT/RECEIVE Equalizer Switches

These are the equalizer switches on a leased-line modem. Only a multipoint tributary modem has transmit equalization.



TALK/DATA Switch

Normally set on DATA for all operations; set to TALK when using the DAA handset. On TALK, automatic answering is inhibited and the modem ignores 'data terminal ready' if it is up.

Test/Operate Switch

Normally set on OPERATE; set to one of the test positions for problem determination. There is a reset, but a switched network connection is retained between OPERATE and T4 and T3. Other changes cause reset. See the following test descriptions.

Refer to the MAPs for tests using the test/operate switch during modem checkout and troubleshooting procedures.

Proper Indicator Action for Test/Operate Switch Positions

Test/Operate Switch Position	READY Indicator (On when 'data set ready' is active) Note 1	SIGNAL Indicator (On when 'carrier detect' internal is active)	OPERATE Indicator (On for 'receive data' mark)	Signal Quality Meter (Note 4)
OPERATE	On (note 3)	On when receiving signal above threshold	On or flickering	0-50
Reset (intermediate positions)	Off	On when receiving signal above threshold	On	0
T1	Off	On (wrap signal)	On (note 2)	0 +
T2 (or interface 'test')	Off (note 1)	On if 'request to send' is active (wrap signal)	Depends on data; off for space, on for mark	0 +
T3 (2-wire system with remote modem on T4)	Off	Off	On	0
T3 (4-wire system with remote modem on T3 or T4)	Off	On (remote signal)	On (note 2)	0-50
T4 (remote modem on T3)	Off	On (remote signal)	On (note 2)	0-50

Notes:

1. 'Data set ready' is active in T2 mode, but the READY indicator is off. (Interface test, otherwise identical to T2, does not inhibit the indicator.)
2. The scramble pattern is being transmitted with input data clamped to mark. Therefore, the unscrambled data should be a steady mark and the OPERATE indicator should be on steady. Test circuits provide a 200 ms off period if even a single space is received so that the erroneous space can be observed.
3. The READY indicator blinks on and off.
4. The signal quality meter should read 0 when the signal indicator is off.

Test/Operate Diagnostic

This test provides a status chart for the several modem machine functions controlled by the positions of the test/operate switch. Using the normal status of each function at each position of the test/operate switch as a basis, a failure of any function or any position of the switch can be located by following the logic in the corresponding diagram. These are the functions shown:

- **A** '-RS' (request to send)
- **B** '-send data'
- **C** '-2W' (2-wire, half-duplex)
- **D** '-wrap relay'
- **E** '+equalizers out'
- **F** '+clamp interface'
- **G** '+AEL ready'
- **H** '-force DTR (data terminal ready) off'
- **I** '-force DTR (data terminal ready) on'

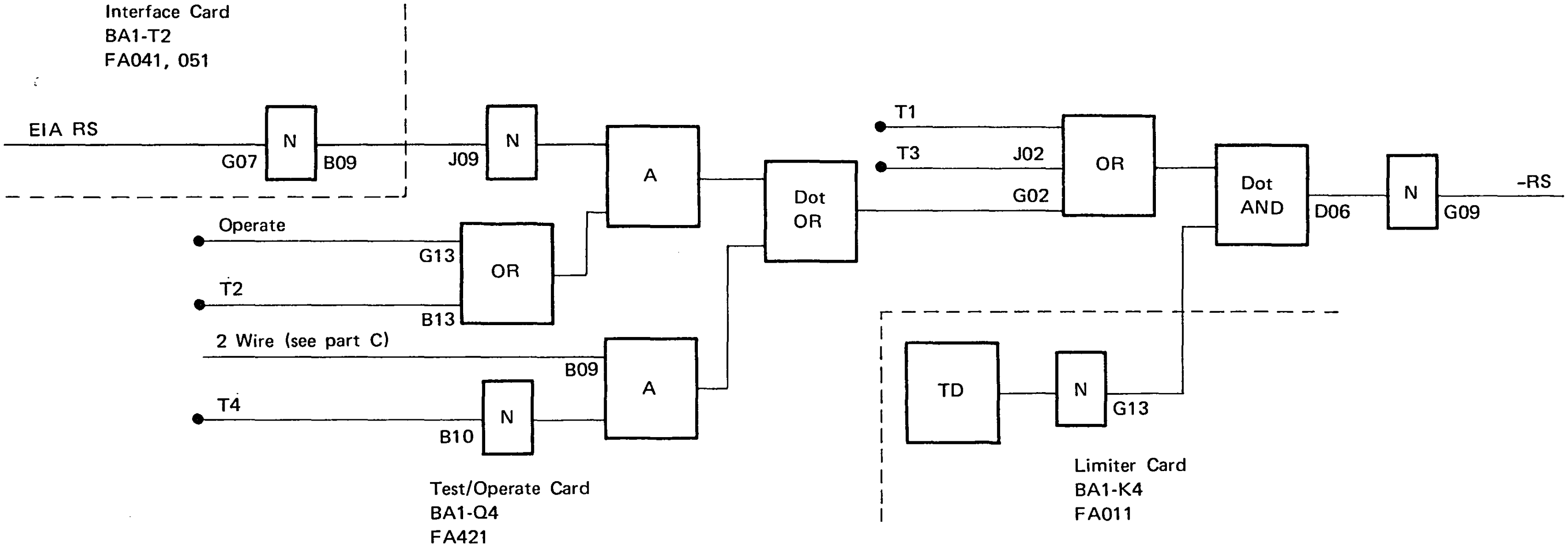
To use the diagrams in this diagnostic test for problem determination, first check all functions controlled by the failing position of the test/operate switch, according to the chart. Then go to the logic diagram for the failing functions to locate the source of the problem.

To use the diagrams in this diagnostic test to verify correct operation of the modem, check each function of each switch position, according to the chart. Use the MAPs to diagnose and repair any function that fails.

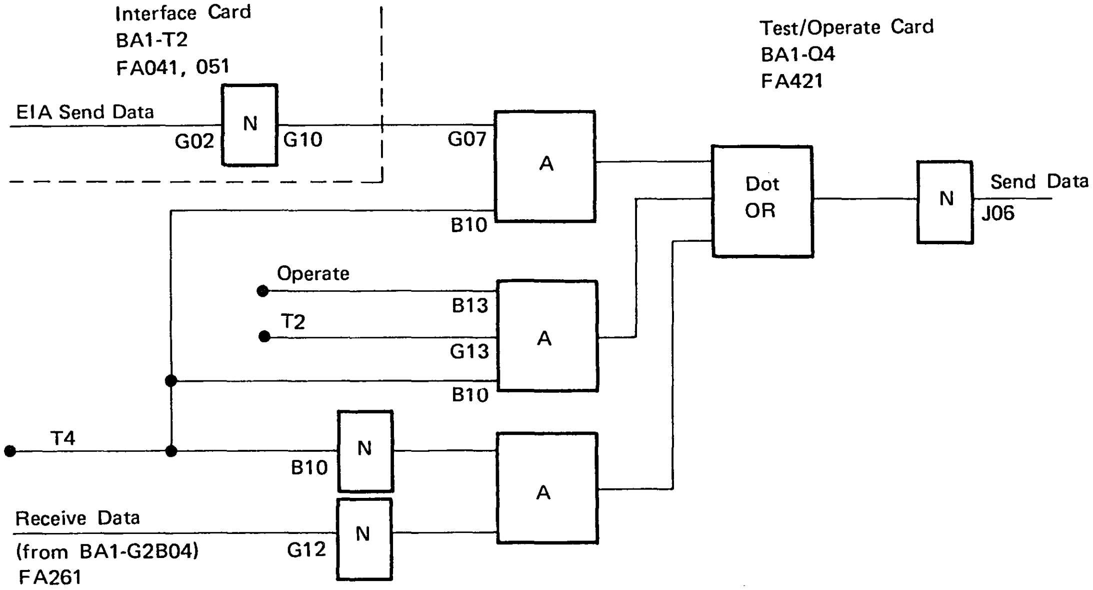
The following lines are controlled by the test/operate switch: 'Operate', '-T1', '-T2', '-T3', '-T4', and '-Reset'.

	Line Controlled	**A** '-RS' BA1-Q4G09	**B** '-Send Data' BA1-Q4J06	**C** '-2W' BA1-K4D09	**D** '-Wrap Relay' BA1-K4B09	**E** '+Equalizers Out' BA1-K4G07	**F** '+Clamp Interface' BA1-Q4D09	**G** '+AEL Ready' BA1-K4D13	**H** '-Force DTR Off' BA1-K4B13	**I** '-Force DTR On' BA1-Q4D13
Test/Operate Switch Position	OPERATE	DTE	DTE	Strap	Off	Off	Off	DSR	Off	Off
	Reset	Off	Off (mark)	Strap	Off	Off	On	Off	On	Off
	T1	On	Off (mark)	Off (4W)	On	On	On	+Clamp -Resync	On	Off
	Reset	Off	Off (mark)	Strap	Off	Off	On	Off	On	Off
	T2	DTE	DTE	Off (4W)	On	On	Off	+Clamp -Resync	On	Off
	Reset	Off	Off (mark)	Strap	Off	Off	On	Off	On	Off
	T3	On	Off (mark)	Strap	Off	On for 1200 bps	On	DSR	Off	On
	Reset	Off	Off (mark)	Strap	Off	Off	On	Off	Off	On
	T4	On for 4-wire	Received Data	Strap	Off	On for 1200 bps	On	DSR	Off	On
	Reset	Off	Off (mark)	Strap	Off	Off	On	Off	Off	On
	EIA Interface Test On	DTE	DTE	Off (4W)	On	On	Off	+Clamp -Resync	On	Off

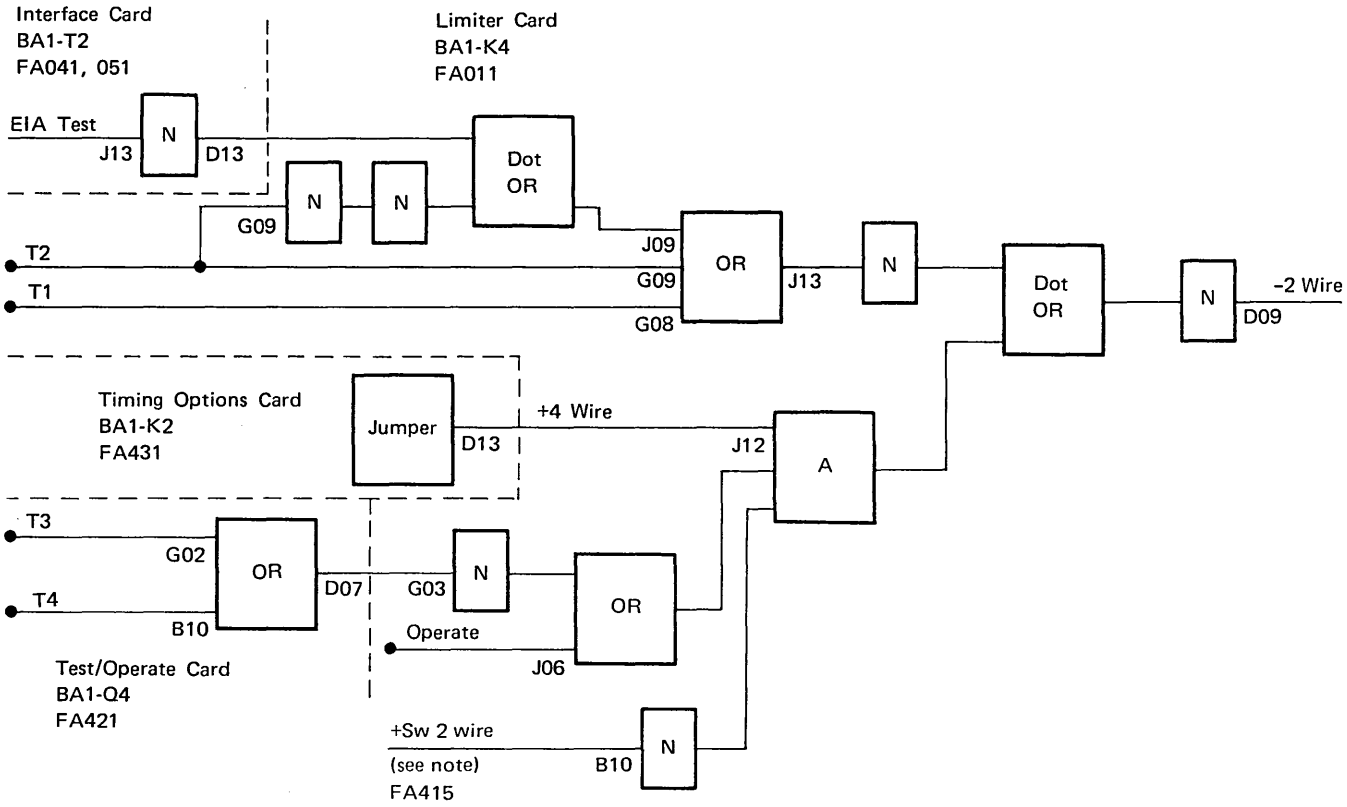
A -RS



B -Send Data



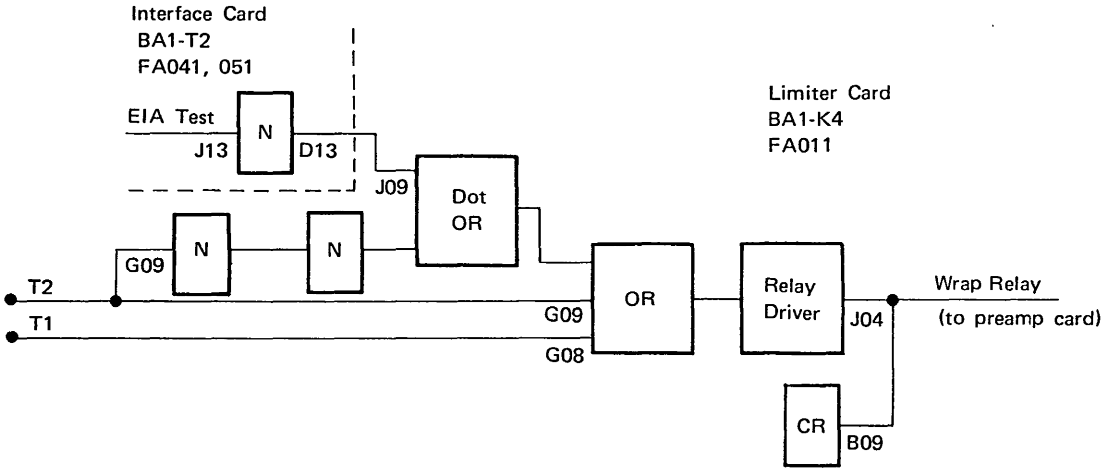
C -2W



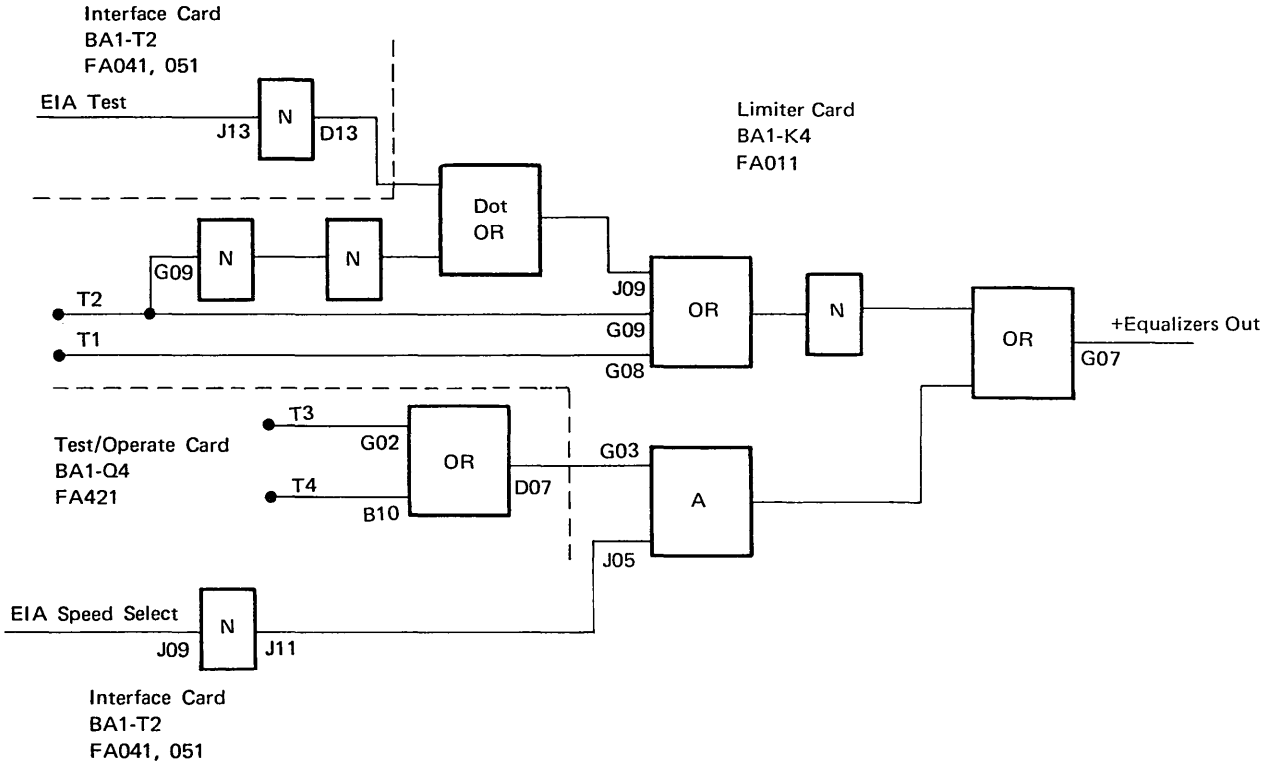
Note: The '+Sw 2 wire' line is connected as follows:

1. Signal ground (-) for leased line
2. +12V for switched network
3. '+ select standby interface' line for SNBU

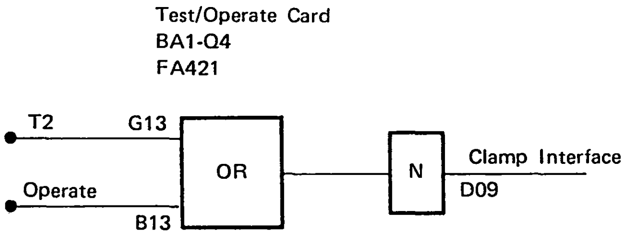
D Wrap Relay



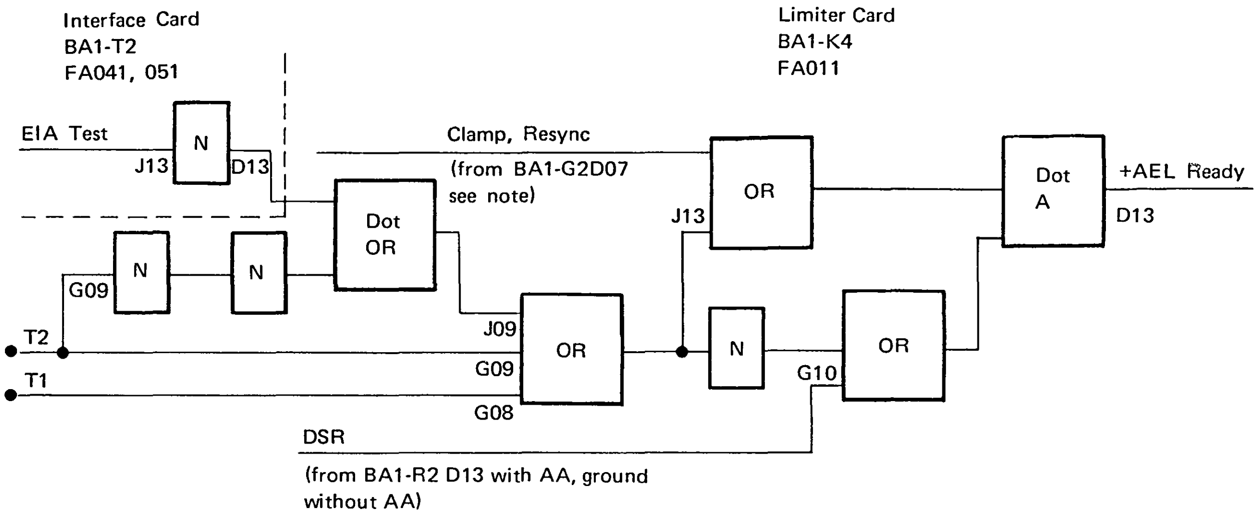
E +Equalizers Out



F Clamp Interface

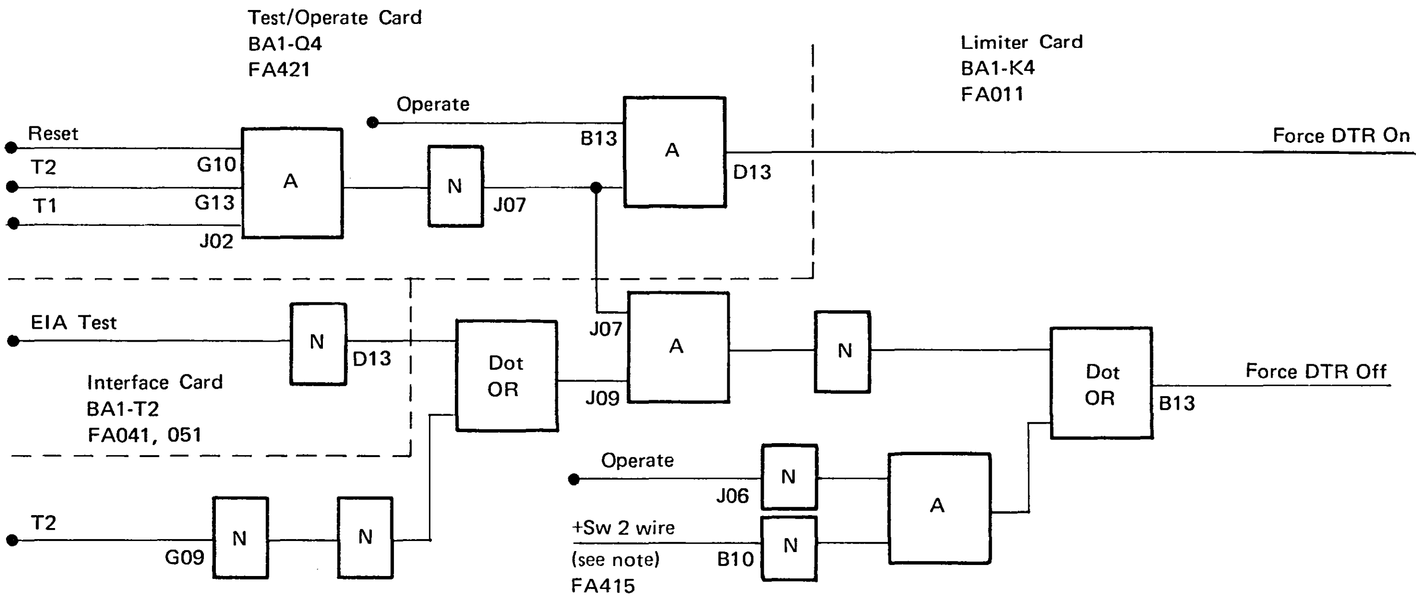


G +AEL Ready



Note: The '-resync' level is equivalent to internal carrier detect (FA261).

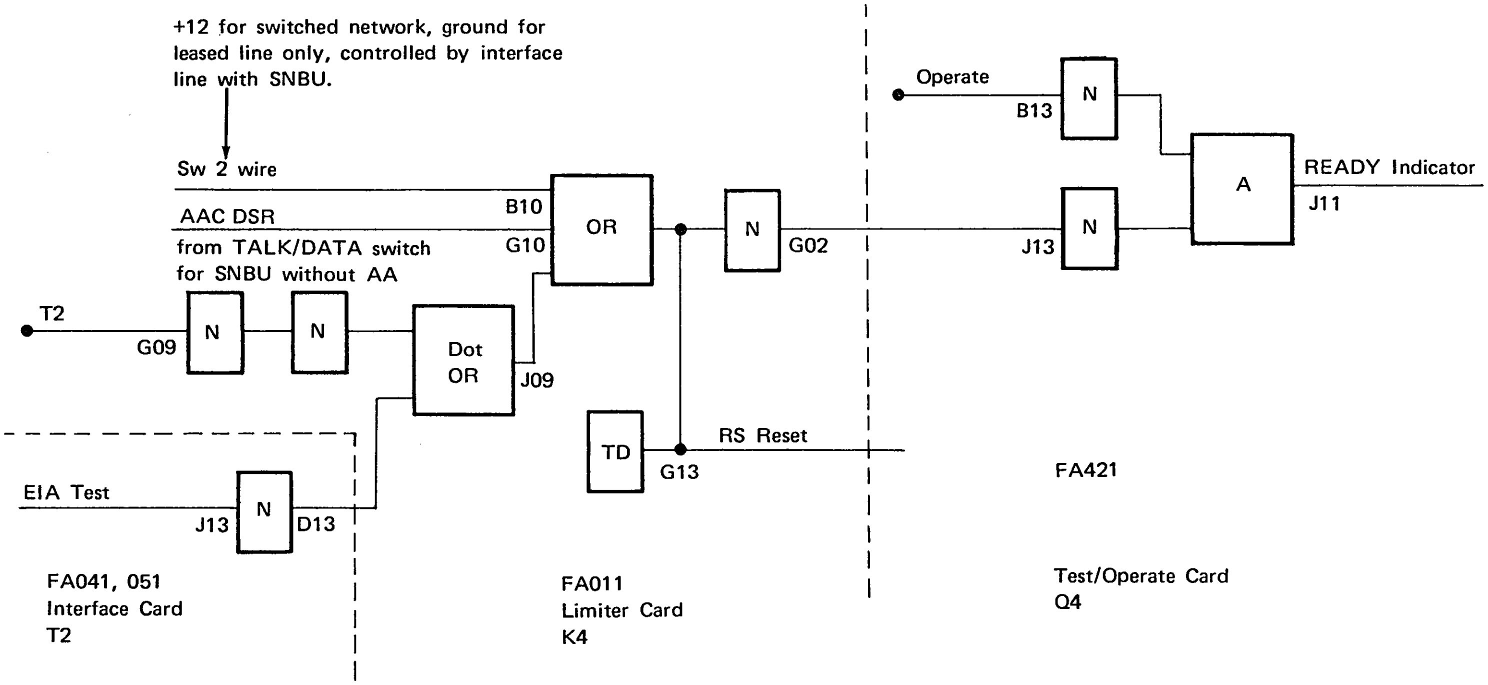
H and I -Force DTR On/Off



Note: The '+Sw 2 wire' line is connected as follows:

1. Signal ground for leased line
2. +12V for switched network
3. '+ select standby interface' line for SNBU

READY Indicator Diagram for Interface Diagnostics



OPERATE Switch

Test 1 (T1, Local Loop)

Transmit data is internally clamped to mark, and the scramble pattern is transmitted. The line driver is internally connected to the receive preamplifier and the transmit pattern is demodulated and descrambled. The result is a steady mark, shown by the OPERATE indicator remaining on steadily. If a space is detected (failure), the OPERATE indicator turns off for 150 ms.

Test 2 (T2, Local Loop)

This test loops the transmitter to the receiver with the DTE controlling the modem interface. Data must be sent and checked by the DTE. (The function of the DTE interface 'test' line is identical to the test 2 function.)

Test 3 (T3, Transmit)

This is a communications channel test and should be used only if the local loop test was successful. Transmit data is internally clamped to mark and the scramble pattern is transmitted. The remote receiving modem descrambles the data and should produce a steady mark (see test 4).

A duplex modem on test 3 can simultaneously check a received signal for erroneous spaces.

Test 4 (T4, Receive, Remote Loop)

This is a communications channel test and should be used only if the local loop test was successful. The signal received from the remote modem on test 3 is demodulated and descrambled and should produce a steady mark. If a space is detected, the OPERATE indicator turns off for 150 ms.

A duplex modem on test 4 rescrambles and retransmits the data, providing the capability for a remote loop from the transmitting modem. The transmitting modem (remote from the modem on test 4) can be set on test 3 or can be set on OPERATE with the DTE sending marks. In the latter case, sending spaces indicates errors at the receiving modem.

Note: The DTE interface of the modem is clamped off by tests 1, 3, or 4. There is no interaction between the DTE and the modem when the interface is clamped.

CADUCEE Feature

A compromise equalizer is part of the CADUCEE attachment feature. It is disabled in T1, T2, or DTE test operation; it is active in T3 or T4 operation (except at 1200 bps).

Transmit Level Limiting and Signal Meter Adjustment

Transmit Signal Level Limiting and Receive Sensitivity Adjustments

The level control circuit of the CBS (or equivalent) data coupler can be set to a lower signal level than the transmit level that is strapped on the modem. When this is the case, saturation of the level control circuit causes slow recovery after turnaround, and the first part of the received signal might be lost. The modem transmit level (normal, SNBU, and answer tone) must be attenuated enough to avoid saturation in the CBS coupler.

To check for transmit level limiting, proceed as follows:

1. Connect a db meter (P/N 453545) across the DT (data tip) and DR (data ring) terminals of the modem at the CBS coupler interface. Set the meter to BRIDGING (no termination resistance).
2. Set this modem to T4 (receive) and establish a telephone connection to another modem set to T3 (transmit).
3. Switch this modem to T3 (transmit) and watch the db meter. If the reading goes down from the initial value (which should be the level strapped on the preamp or SNBU card) within about three seconds, the coupler is limiting the transmit level. If the reading remains at the initial level, that level is being transmitted to the line.
4. If the coupler is limiting the transmit signal level, increase the attenuation on the preamp or SNBU card until the transmit level is below the controlled level in the coupler (limiting no longer takes place). (One db lower than the final steady level in step 3 should be the proper adjustment.) Strap the answer tone to the same level.
5. Check to see that an appropriate signal level is received by another modem when this modem transmits.

Signal Quality Meter Adjustment

When the post-processor card N4 is replaced, readjust the signal quality meter as follows:

1. Turn modem power on and turn the test/operate switch to T1.
2. Assuming that there are no other indications of failure in test 1, adjust the potentiometer on the post-processor card until the meter reads perceptibly above zero (half of the smallest division on the meter scale).
3. Recheck the meter reading against the benchmark measurement made at installation time. Make this measurement with the modem in operate mode.

10.4.2 Dial Tone Detect

The dial tone detect circuitry prevents the dial tone received by a modem from being decoded as random data.

The dial tone detect circuit should be activated only if both of the following conditions are present:

1. If the 2400 bps modem automatically answers incoming calls, and
2. If the DTE does not time out and does not automatically disconnect when the dial tone is detected, thereby causing false data to be decoded.

For example, assume the DTE is set up for unattended operation and an incoming call is a wrong number. When the calling party hangs up, the modem will decode the dial tone as data. Dial tone detect will prevent this error but it will not disconnect the line. Disconnecting the line must be done through programming.

Note: Normally, the dial tone detect circuit will not be activated in the modem because if it is adjusted incorrectly, the 'receive data' line may be incorrectly clamped to a mark level. Further, this clamping may be intermittent and cause confusion during troubleshooting. Such clamping could occur if the dial tone detect potentiometer is adjusted to be too sensitive (too far clockwise), which could cause the 'receive data' line to be clamped when valid data is being received.

Adjustment

To activate the dial tone detect circuit, attach a jumper from H3D09 to G2B04 on the B-A1 board.

This adjustment is very sensitive and could need to be repeated before proper operation is attained. The dial tone adjustment procedure is as follows:

1. Set the test/operate switch to the T4 position.
2. Set the TALK/DATA switch to the data position.
3. Lift the telephone handset, pull up the exclusion key, and listen for the dial tone.

Service Check

If there is a dial tone:

Cradle the handset. Check to see that the SIGNAL indicator comes on and the OPERATE indicator starts blinking. (The OPERATE indicator should stop blinking [comes on steady] within three to 10 seconds.)

If there is no dial tone:

The previous call has not been disconnected. Either hang up and try again or call last caller and ask them to disconnect.

Does the OPERATE indicator stop blinking (comes on steady) within three to 10 seconds after the SIGNAL indicator comes on?

If yes:

Dial tone detect is working correctly.

If no:

The dial tone detect adjustment must be made.

Note: If the OPERATE indicator stops blinking in less than three seconds, then 'receive data' could be intermittently clamped to a mark level during normal data transfer. (The potentiometer is adjusted too far clockwise and the dial tone detect adjustment must be made.)

Adjustment

Important: The potentiometer adjustment must be made within 20 to 25 seconds because on some telephone systems, a prerecorded message is put on the line after an inactivity period of from 20 to 30 seconds.

To adjust the dial tone detect circuit do the following:

1. If the OPERATE indicator is not blinking, turn the potentiometer on card H3 counterclockwise (CCW) until the OPERATE indicator starts to blink.
2. Adjust the potentiometer clockwise (CW) very slowly, until the OPERATE indicator stops blinking (comes on steady), then turn the potentiometer 1/8 of a turn farther, clockwise.
3. Lift the handset, momentarily, and replace it in the cradle. The OPERATE indicator should stop blinking within three to 10 seconds. Since this adjustment is very sensitive, the adjustment procedure might have to be repeated.

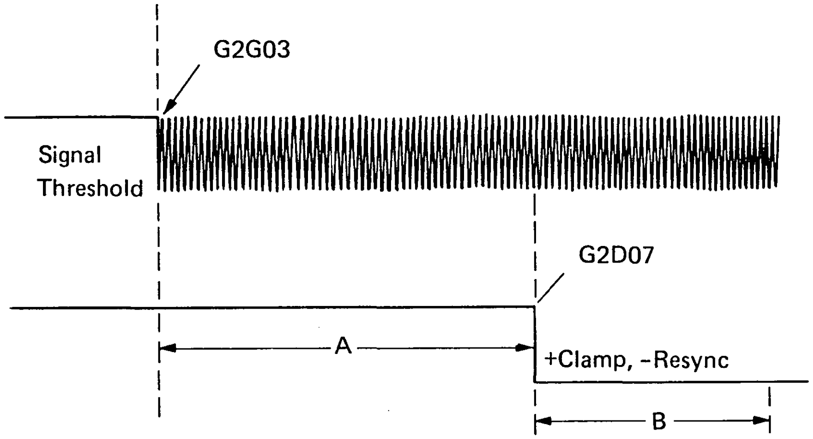
If satisfactory results cannot be obtained from the adjustment procedure, replace card H3.

10.4.3 Interface Signal Timings

The timings described below are approximations that will help to determine whether the timing circuits are working. These timing circuits are located on the FET card (G2), the AEQ digital card (E2), and SNBU timing card (K3).

The signals shown here are generated by turning the test/operate switch to T1 from an adjacent reset position. Sync (minus) the oscilloscope on 'request to send' at Q4G09.

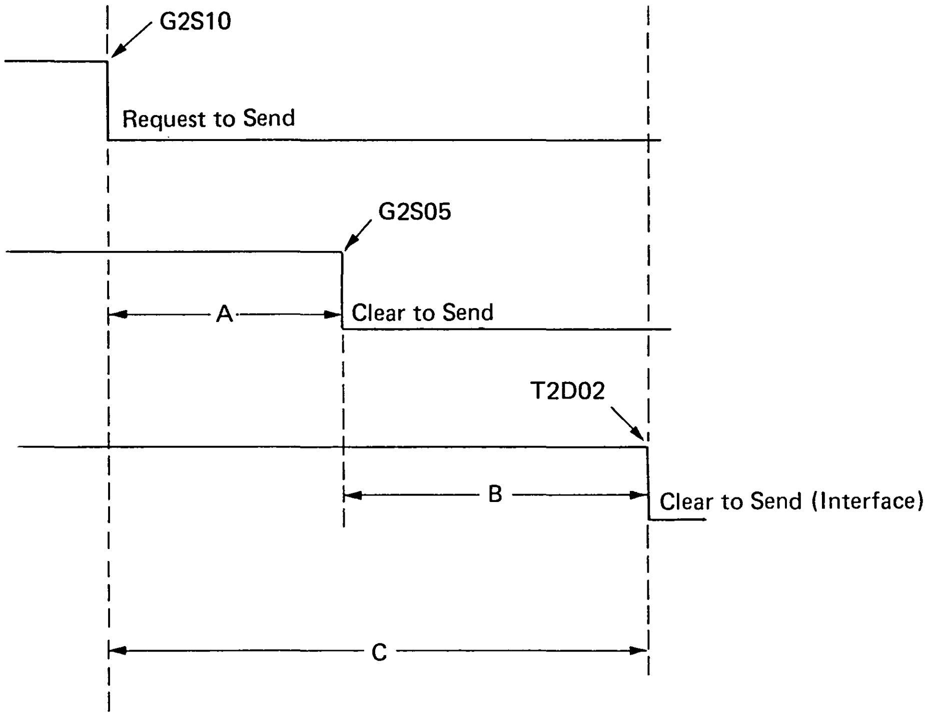
Receiver Unclamp Time



A – Determined by CSCD strapping options. (See strapping charts 10.4.5 through 10.4.11.)

B – Extra delay of about 800 ms appears in machines with auto equalizer at G2D07 ('+clamp, -resync) before the signal settles at the '-resync' level.

Clear-to-Send Time



A – Determined by CSCD strapping options. (See strapping charts in this section.)

B – Extra delay with long initial clear to send, 980 ms (AEQ) or 1500 ms (SNBU). This delay is 30 ms for SNBU without long initial clear to send.

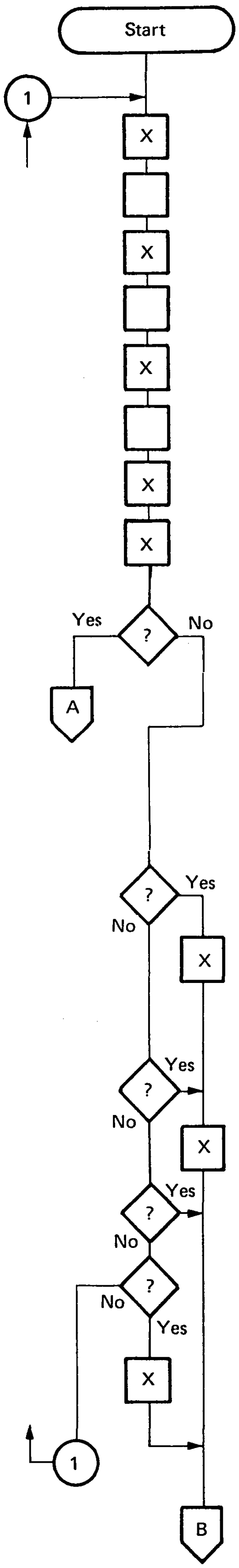
C – Clear to send delay as seen by DTE.

10.4.4 Card Population Check and Card Strapping Procedure

The accompanying charts give the proper locations of all cards required for a given configuration of the 2400 bps integrated modem. Cards that might require strapping have an X in the square block that represents each card. Refer to the appropriate diagram (10.4.5 through 10.4.11) for strapping instructions. When placing straps (P/N 816645), connect the two pins on opposite sides of the appropriate letter (vertically and horizontally). Do not use uninsulated strip-type program cap jumpers.

Notes:

1. The modem is internally set for 0 dbm transmit levels. Attenuate this level by strapping if a lower level is specified by the common carrier. The transmit level may be marked on the common carrier line coupler box (1000-B, CDT, CBS).
2. For modem with CADUCEE feature (WT):
   a. Switched network feature not on the machine.
   b. If unconditional continuous carry is required, attach a jumper from K4D11 to T2G03.
   c. This is not a multipoint tributary modem; it is not a point-to-point network. The card installed at P2 is the CADUCEE feature card. Card strapping is shown in Section 10.4.11.



Preamp, Q2 (see note 1).

Limiter, K4.

Transmitter, J4.

Post-Processor, N4.

Interface (DTE), T2.

Modem Digital Logic (FET), G2. (Check that capacitor, P/N 2772926 or P/N 5182456, is connected between G5B07 (+) and H5D08.)

Test/Operate Logic, Q4.

Basic timing options, K2.

Is the switched network feature on the machine (do not confuse with SNBU, see note 2)?

Is this a multipoint tributary modem (see note 2)?

C1 Transmit Equalizer, S4.

Is this modem on a point-to-point network?

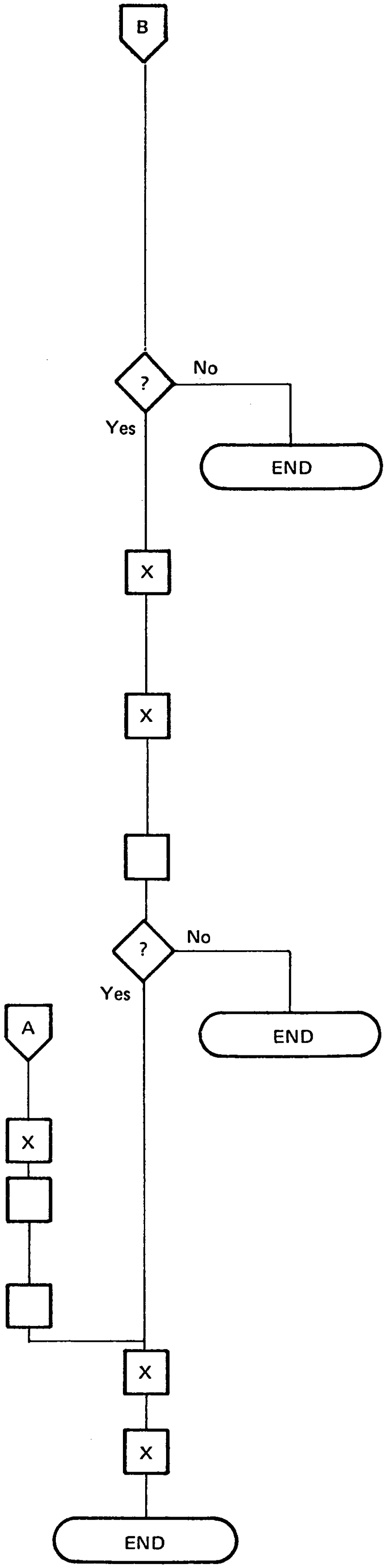
C1 Receive Equalizer T4.

Is this a multipoint control modem?

Does this have CADUCEE feature?

CADUCEE card, P2.

No such configuration, start over.



Is the SNBU feature on the machine?

SNBU (standby), M2 (see note 1). For auto-request-to-send (continuous carrier), add jumper from M2G02 to T2B09.

Standby (SNBU) Timing, K3.

Compromise Equalizer, L2.

Is the auto answer option on SNBU?

Switched Timing (echo clamp, H3).

AEQ Digital Logic, E2. Check that diode (P/N 5182401 or P/N 2772927) is connected between E2G09 (cathode) and E2J07 (anode).

AEQ Analog, D2.

AA Coupler Interface, S3.

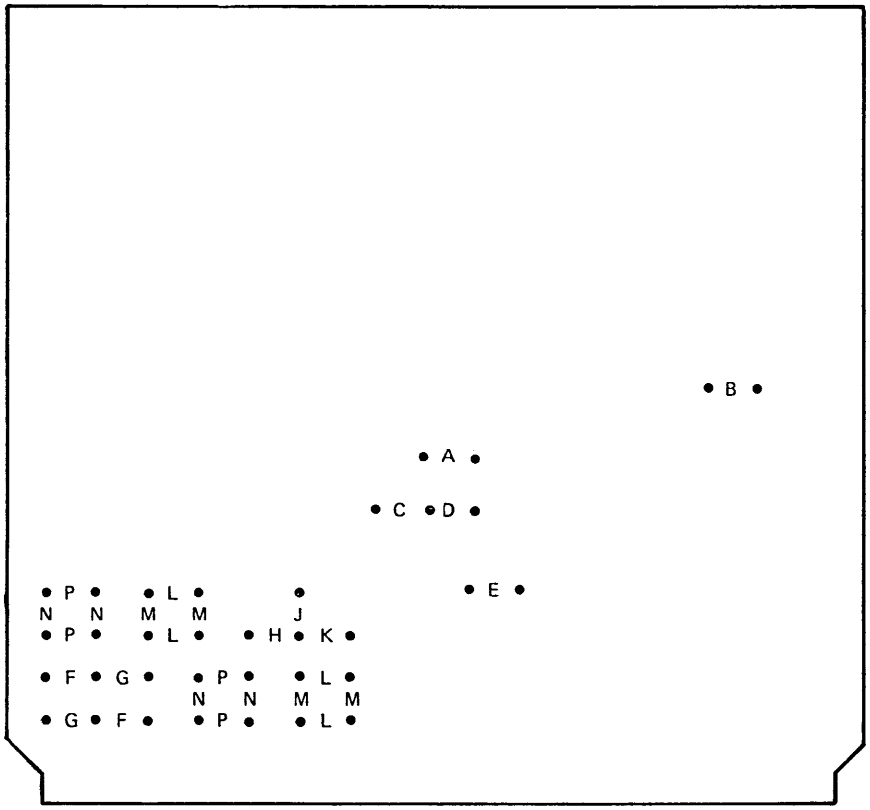
AA Basic, R2 (see note 1).

Notes:

1. The modem is internally set for 0 dbm transmit levels. Attenuate this level by strapping if a lower level is specified by the common carrier. The transmit level might be marked on the common carrier line coupler box (1000-B, CDT, CBS).
2. For modem with CADUCEE feature (WT):
   a. Switched network feature is not on the machine.
   b. If unconditional continuous carrier is required, attach a jumper from K4D11 to T2G03.
   c. This is not a multipoint tributary modem; it is not a point-to-point network. The card installed at P2 is the CADUCEE feature card. Card strapping is shown in Section 10.4.11.

10.4.5 Preamplifier Strapping

Preamplifier Basic Jumpers



Location Q2

A – Jumper required for switched network (-40 db) or leased network with SNBU; jumper removed for leased network without SNBU (-27 db) and for French CADUCEE networks

B – Jumper required for 4-wire without SNBU; jumper removed for 2-wire or SNBU.

C – Not used.

D – Required.

E – Required.

F – Required for 2-wire (two locations).

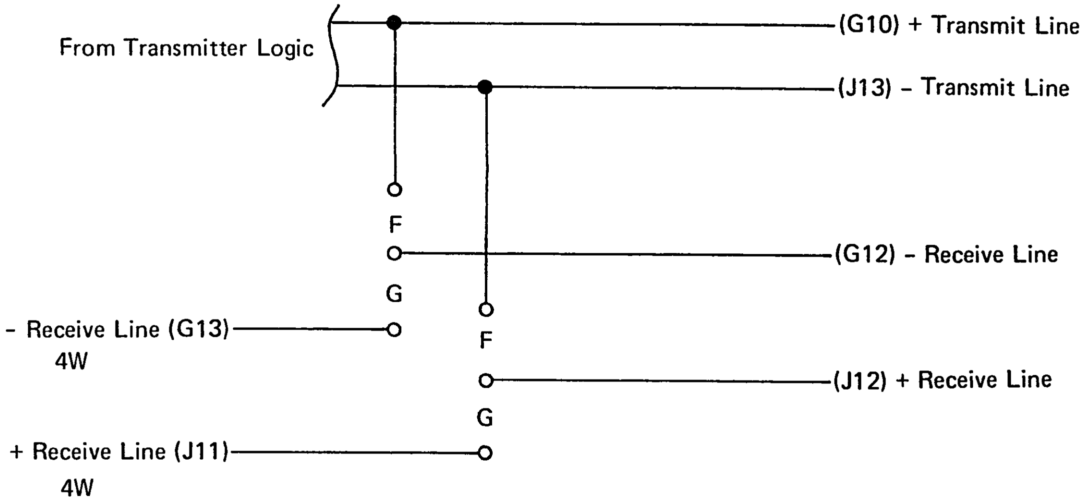
G – Required for 4-wire (two locations).

Note: Refer to the schematic on this page for an explanation of jumpers F and G.

Attenuation from 0 db (H, J, K – one location each; L, M, N, P – four locations each)

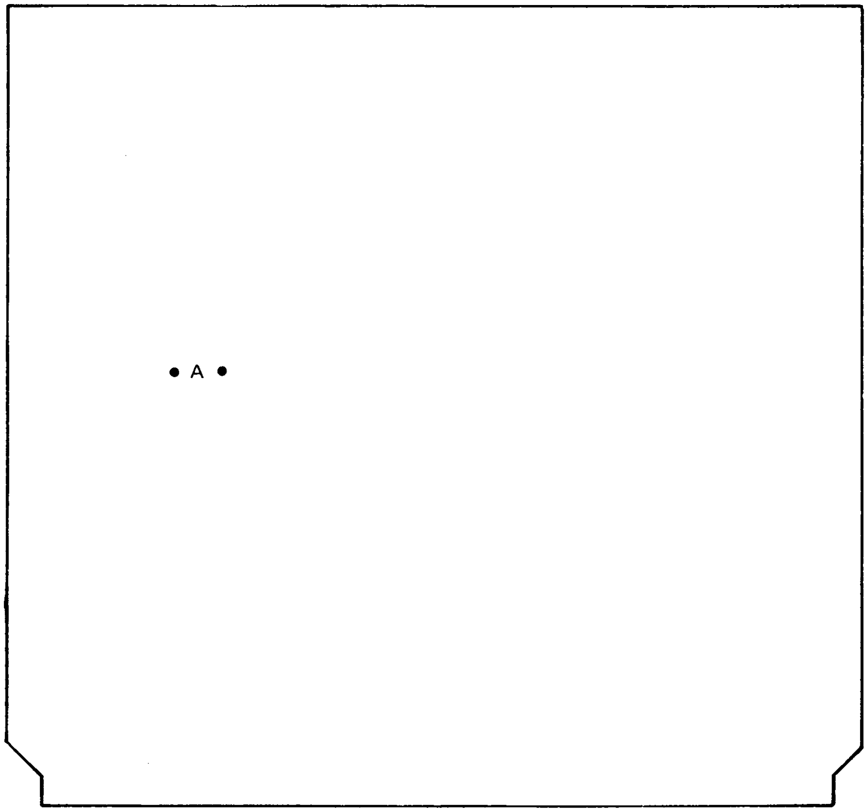
0 – M, P
1 – H, M, P
2 – J, M, P
3 – K, M, P
4 – L, P
5 – H, L, P
6 – J, L, P
7 – K, L, P
8 – M, N
9 – H, M, N
10 – J, M, N
11 – K, M, N
12 – L, N
13 – H, L, N
14 – J, L, N
15 – K, L, N

Note: Transmit level is jumpered for 0 db for leased (dedicated) lines in the U.S. and Canada; it is jumpered for -6 db for French CADUCEE lines.



10.4.6 Transmitter Interface Strapping

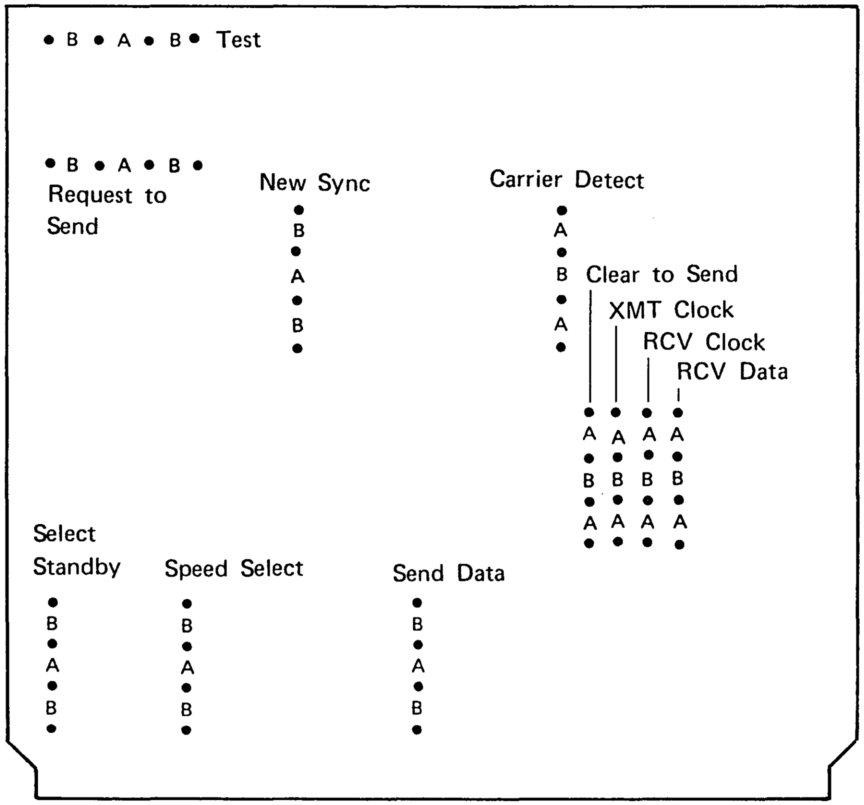
Transmitter Basic Jumpers



Location J4

A – Jumper required for leased network without SNBU (-27 db) and for French CADUCEE; Jumper removed for switched network (-40 db) or leased network with SNBU.

Interface Basic Jumpers



Location T2

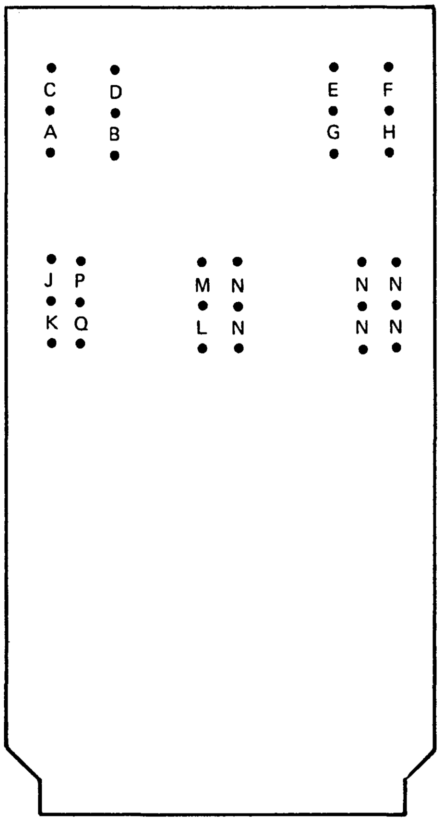
A – Required (16 locations). See note.

B – Not used (17 locations).

Note: Do not jumper 'new sync' unless the new sync function is used and controlled by the multipoint control station.

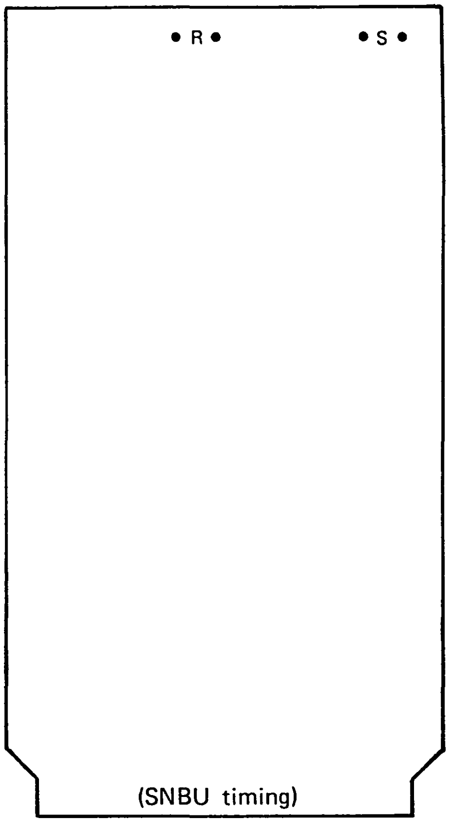
10.4.7 Test/Operate, Timing Options Strapping

Basic Timing Options



Location K2

Feature Timing Options



Location K3

Clear to Send (see facing page)

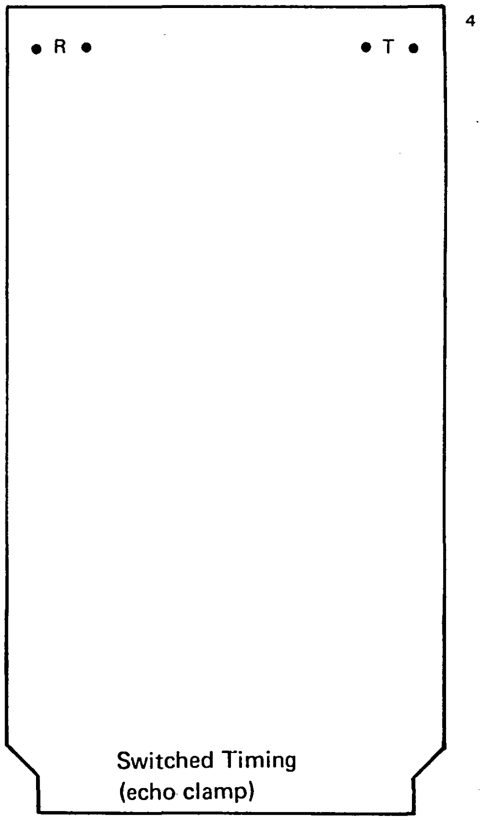
A, B — 8.5 ms
A, D — 25 ms
B, C — 75 ms
C, D — 147 ms
L — 75 ms SNBU
M — 147 ms SNBU

Carrier Detect Bridge

G, H — Required for every option

Jumper Functions (see facing page)

J — 4 wire
K — 2 wire
P — Short carrier detect, no echo clamp
Q — 56 or 123 ms carrier detect, no echo clamp
R — 50 ms echo clamp (100 ms if not strapped)
S — No echo clamp during leased line operation



Location H3

Modem	Echo Suppressors?	LL Clear To Send (ms)	SNBU/Sw Network Clear To Send (ms)	Timing Options Strapping
4WLL-$\overline{\text{SNBU}}$	–	8.5[2]		A, B, G, H, J, P
		25		A, D, G, H, J, P
4WLL-SNBU	–	8.5[2]	75[1]	A, B, G, H, J, L, R, S
			147	A, B, G, H, J, M, S
		25	75[1]	A, D, G, H, J, L, R, S
			147	A, D, G, H, J, M, S
2WLL-$\overline{\text{SNBU}}$	NO	75[3]		B, C, G, H, K, Q
		147		C, D, G, H, K, Q
	YES	75[3]		B, C, G, H, K, P
		147		C, D, G, H, K, P
2WLL-SNBU	–	75[3]	75[1]	B, C, G, H, K, L, R
			147	B, C, G, H, K, M, R
		147	147	C, D, G, H, K, M
Switched Network	–		75[3]	B, C, G, H, K, R, T[4]
			147	C, D, G, H, K, T[4]
CADUCEE	–	25		A, D, G, H, J, P

2W – 2 wire
4W – 4 wire
LL – Leased line
SNBU – With SNBU
$\overline{\text{SNBU}}$ – Without SNBU

---

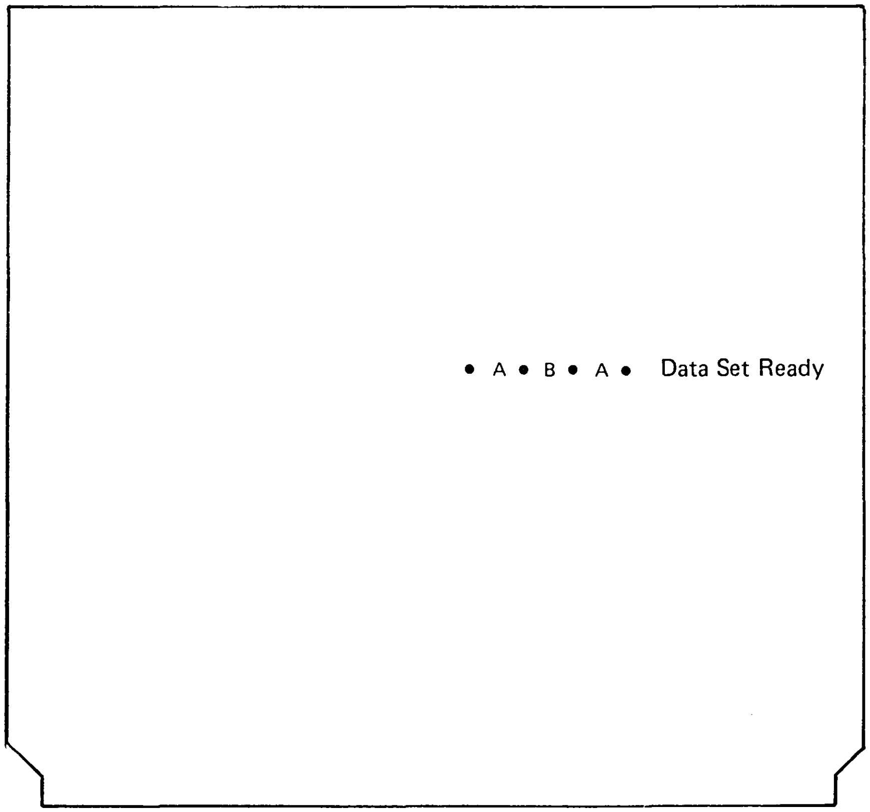
[1] Permissible only if SNBU operation is in the local area.

[2] Used only on multipoint tributary modems when 'new sync' is used at the control station.

[3] Used only on short lines, where turnaround is critical and the communications facility characteristics are suitable (minimum echo).

[4] This jumper is installed if any modem in the TP system does not have the switched network sequence engineering change.

Test/Operate Basic Jumpers



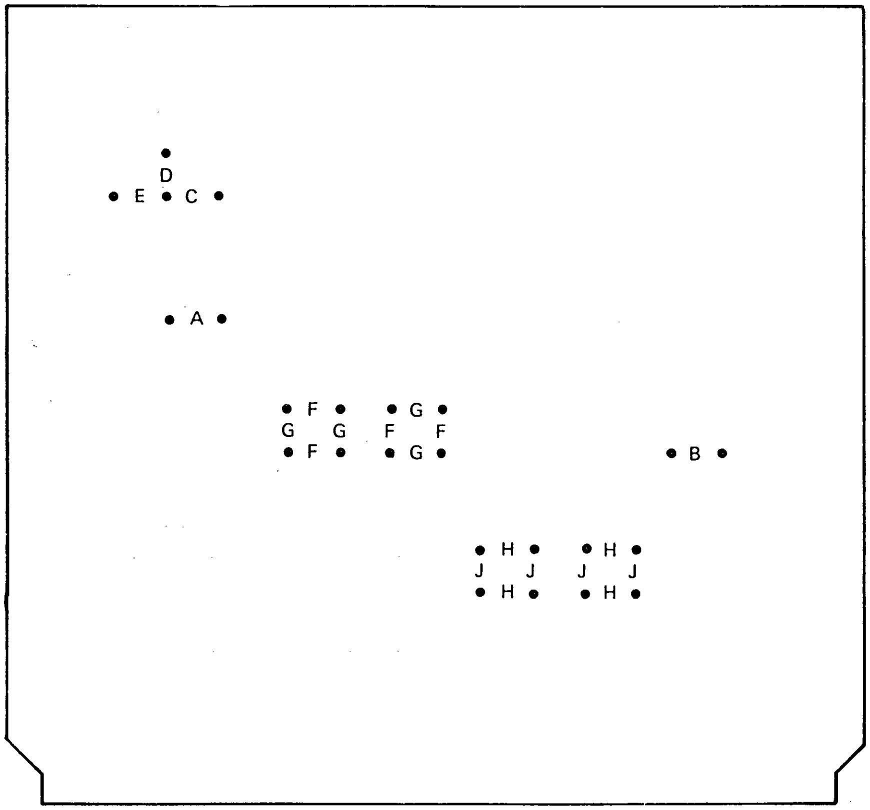
Location Q4

A — Required

B — Not used

10.4.8 SNBU Strapping

Standby Feature Jumpers



Location M2

A – Required

B – Required for 4 wire (not used for 2-wire leased line)

SNBU Transmit Level Attenuation Strapping

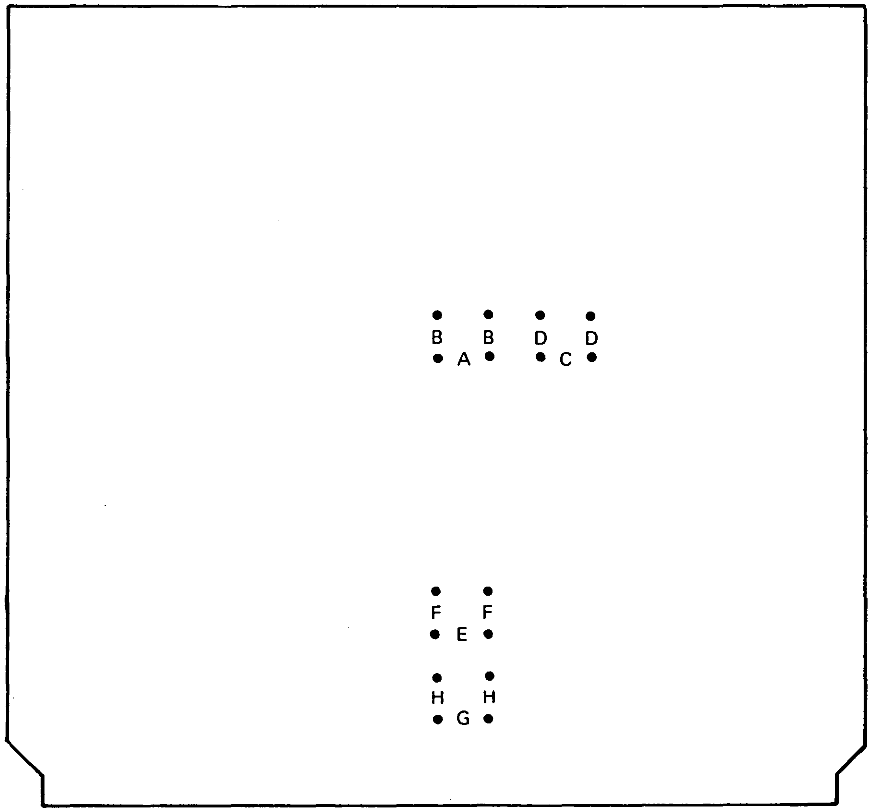
Note: Transmit level should be marked on coupler.

If jumper location C, D, or E is listed, attach one jumper; if jumper location F, G, H, or J is listed, attach all four jumpers.

0 db	– G, J
1 db	– C, G, J
2 db	– D, G, J
3 db	– E, G, J
4 db	– F, J
5 db	– C, F, J
6 db	– D, F, J
7 db	– E, F, J
8 db	– G, H
9 db	– C, G, H
10 db	– D, G, H
11 db	– E, G, H
12 db	– F, H
13 db	– C, F, H
14 db	– D, F, H
15 db	– E, F, H

10.4.9 Auto-Answer Interface and Strapping

AA Common Feature Jumpers



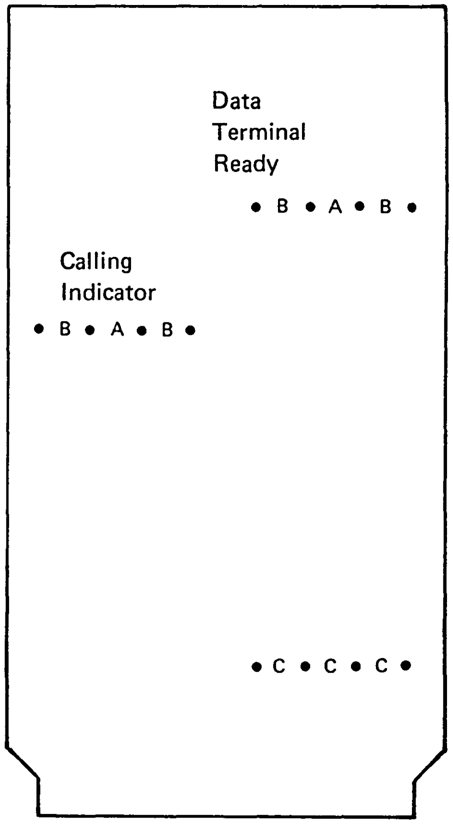
Location R2

Answer tone transmit level attenuation from 0 db (level specified on data coupler)

If jumper location A, C, E, or G is listed, attach one jumper; if jumper location B, D, F, or H is listed, attach both jumpers.

0 – A, C, E, G
1 – B, C, E, G
2 – A, D, E, G
3 – B, D, E, G
4 – A, C, F, G
5 – B, C, F, G
6 – A, D, F, G
7 – B, D, F, G
8 – A, C, E, H
9 – B, C, E, H
10 – A, D, E, H
11 – B, D, E, H
12 – A, C, F, H
13 – B, C, F, H
14 – A, D, F, H
15 – B, D, F, H

AA Interface Feature Jumper



Location S3

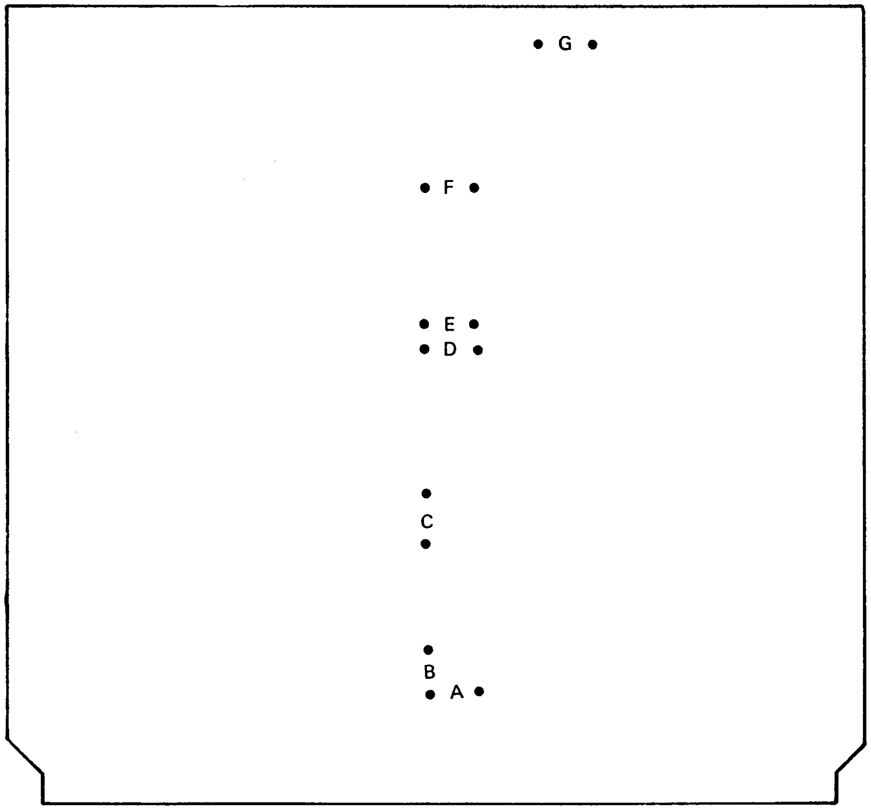
A – Required (2 locations)

B – Not used

C – Not used

10.4.10 Leased Line, Multipoint Or Point-To-Point Strapping

C1-A Equalizer Basic Jumpers



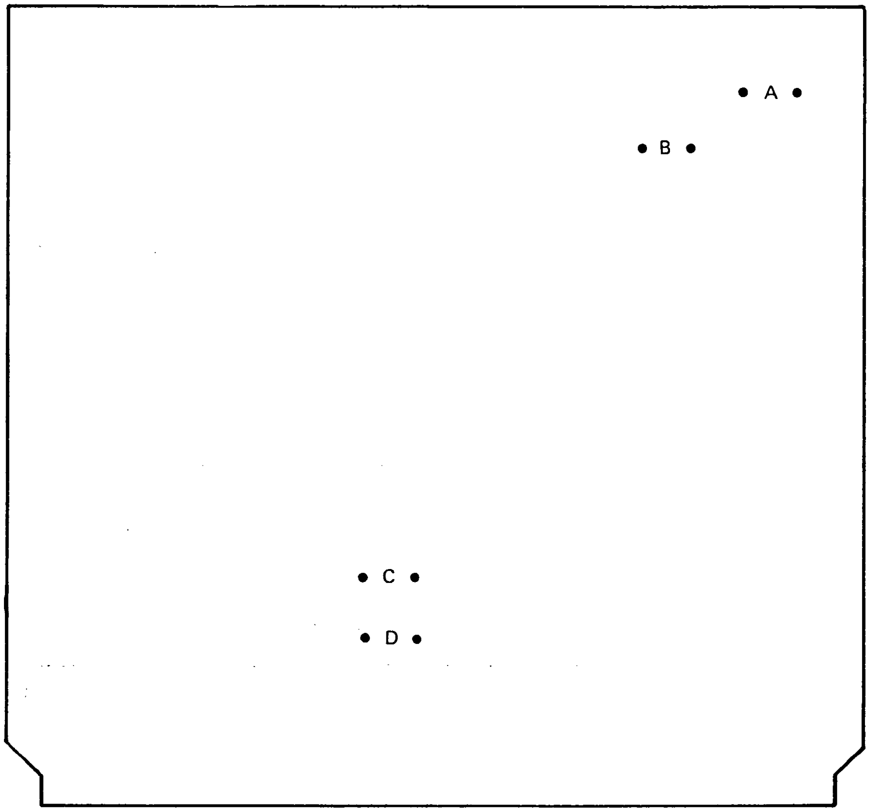
Location T4 (Receive)
Location S4 (Transmit)

A – Not used

B – Required (amplitude equalization)

C-G – Not used

10.4.11 CADUCEE Feature Card Strapping



Location P2

A – Not used (In the CADUCEE feature, the 0.25 ms delay filter remains active for equalization.)

B – Required (disables 0.50 ms delay filter)

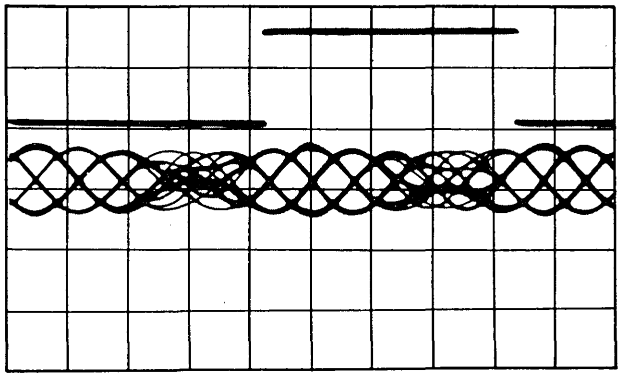
C – Not used

D – Not used

10.4.12 Wave Forms

These wave forms are referenced from the MAPs.

Wave Form 014A

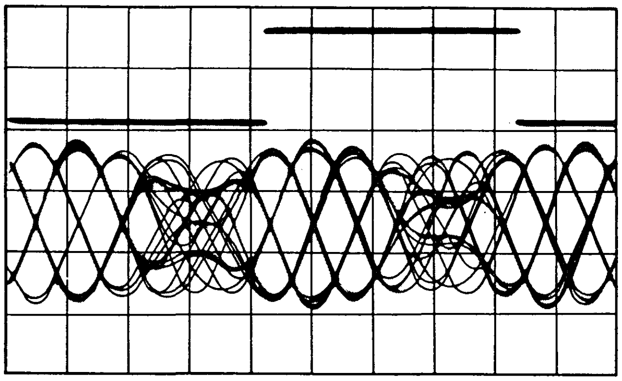


G2S04
Ramp Clock A

Q2D13
Preamp Output—switched network or leased line with SNBU (strapped for -40 db received sensitivity; that is, the A jumper on the Q2 card is attached and the A jumper on the J4 card is not attached).

Sync -internal, 0.2 ms/div
Channel 1, 0.5 V/div
Channel 2, 50 mV/div

Wave Form 014B

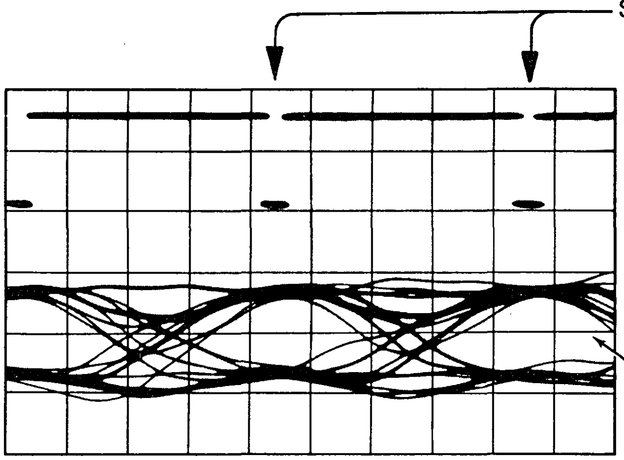


G2S04
Ramp Clock

Q2D13
Preamp Output—leased line (strapped for -27 db receiver sensitivity; that is, the A jumper on the J4 card is attached and the A jumper on the Q2 card is not attached).

Sync -internal, 0.2 ms/div
Channel 1, 0.5 V/div
Channel 2, 100 mV/div

Wave Form 030



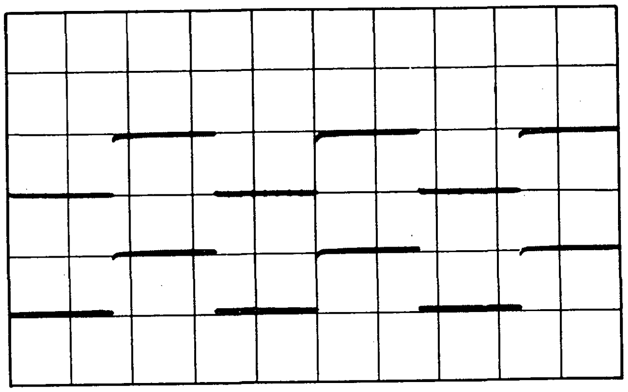
Sample Pulse Time

N4B05
Sample Pulse

N4B09
Channel B Eye
Ground Reference

Sync -internal, 0.2 ms/div
Channel 1, 0.5 V/div
Channel 2, 2 V/div

Wave Form 070

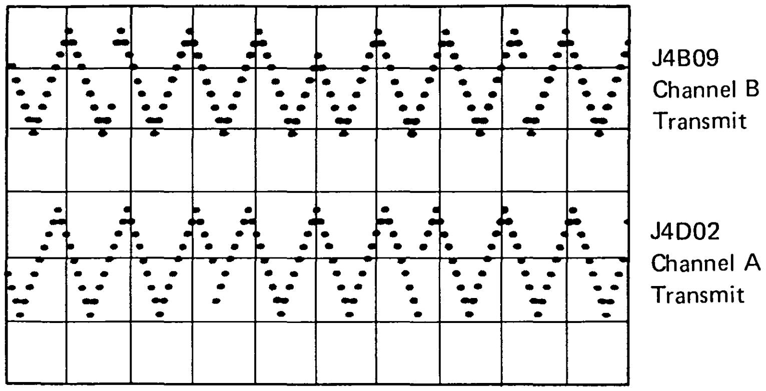


J4J12
Ramp Clock A

J4G10
Ramp Clock B

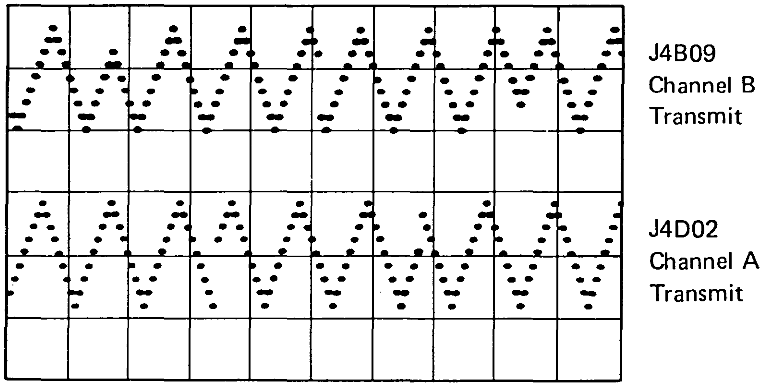
Sync -internal, 0.5 ms/div
Channel 1, 10 V/div
Channel 2, 10 V/div

Wave Form 072A



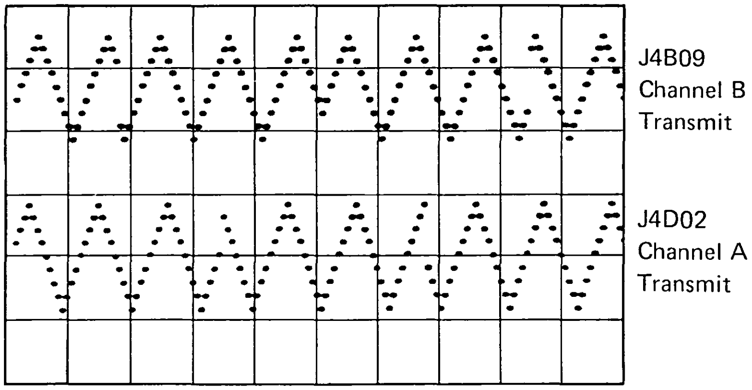
Sync -G2S04, 0.5 ms/div
Channel 1, 0.5 V/div
Channel 2, 0.5 V/div

Wave Form 072B



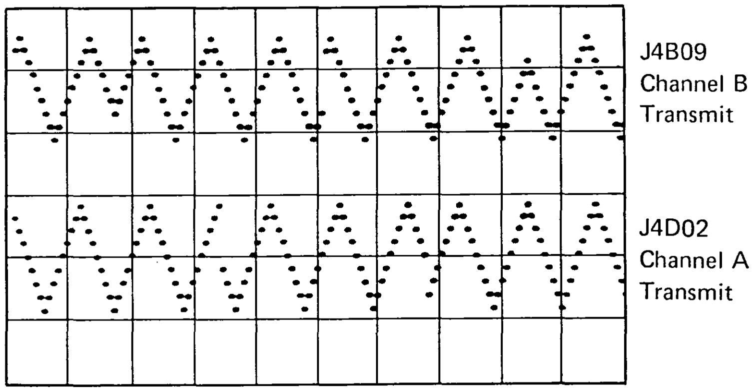
Sync -G2S04, 0.5 ms/div
Channel 1, 0.5 V/div
Channel 2, 0.5 V/div

Wave Form 072C



Sync -G2S04, 0.5 ms/div
Channel 1, 0.5 V/div
Channel 2, 0.5 V/div

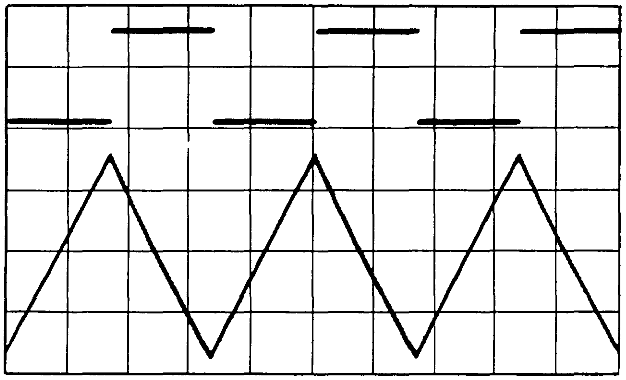
Wave Form 072D



Sync -G2S04, 0.5 ms/div
Channel 1, 0.5 V/div
Channel 2, 0.5 V/div

Note: Observe the oscilloscope carefully. Depending upon how sync actually triggers the sweep, wave forms 072A, 072B, 072C or 072D may be displayed. *A correct wave form always has nine dots vertically, and phase changes always appear as a compressed wave form with four dots omitted.* At 2400 bps, three full cycles appear between phase changes; at 1200 bps, six cycles appear between changes. Phase changes are staggered.

Wave Form 076

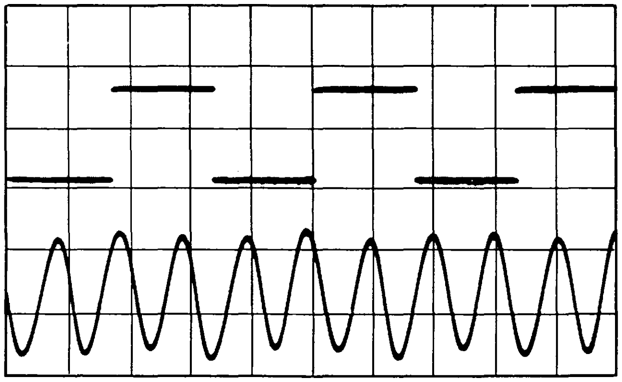


G2S04
Ramp Clock A

J4D11
Ramp Test Point

Sync -internal, 0.5 ms/div
Channel 1, 0.5 V/div
Channel 2, 0.1 Vac/div

Wave Form 078

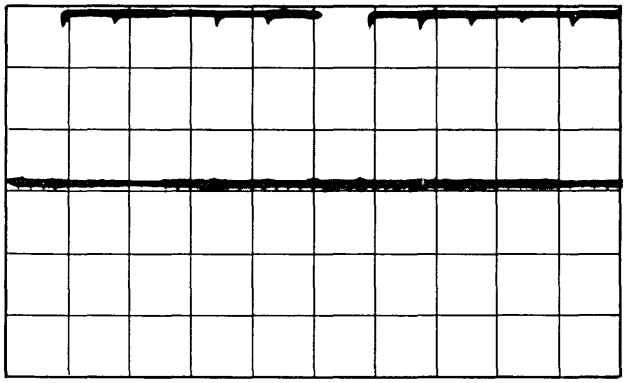


G2S04
Ramp Clock A

J4D05
Analog Transmit
Signal

Sync -internal, 0.5 ms/div
Channel 1, 0.5 V/div
Channel 2, 1 V/div

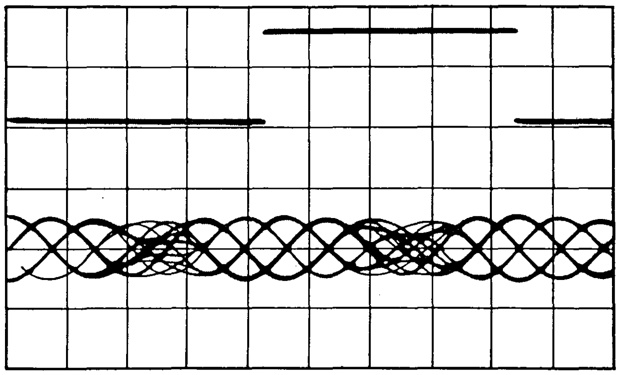
Wave Form 081



G2G09
Scrambler Output

Sync -internal, 0.5 ms/div
Channel 1, 2 V/div

Wave Form 088

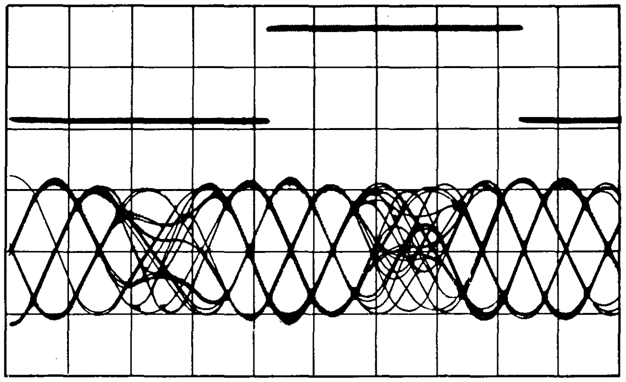


G2S04
Ramp Clock A

J4G09 or
S4J09
Line Driver Input

Sync -internal 0.2 ms/div
Channel 1, 0.5 V/div
Channel 2, 2 Vac/div

Wave Form 090

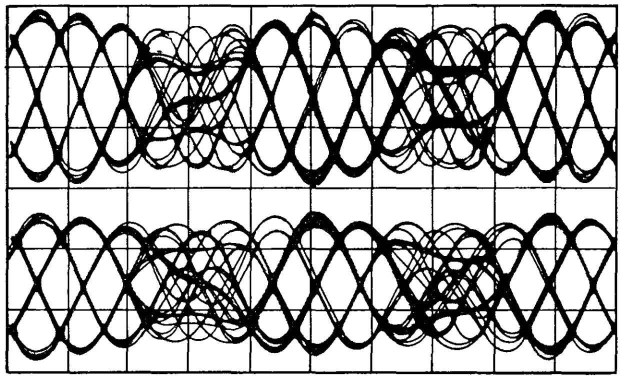


G2S04
Ramp Clock A

Q2B02
Preamp Wrap
Signal Input

Sync -internal, 0.2 ms/div
Channel 1, 0.5 V/div
Channel 2, 5 V/div

Wave Form 160

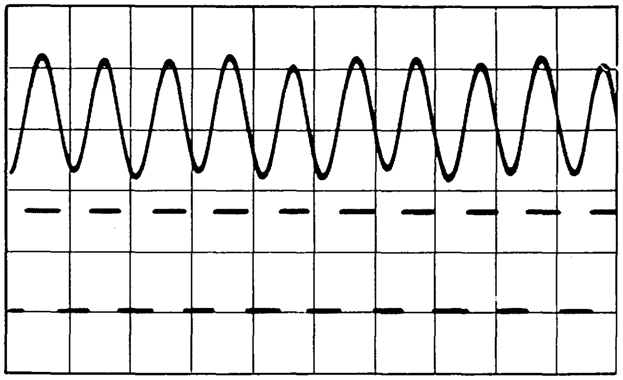


Q2D13
Preamp Output
(strapped -27 db on
Q2 and J4)

K4D05
Limiter Input
(strapped -27 db on
Q2 and J4)

Sync -G2S04, 0.2 ms/div
Approximate signal amplitude:
Channel 1, 300 mV (60 mV if strapped -40 db)
Channel 2, 250 mV with C1 equalizer (-27 db)
or automatic equalizer (-40 db)
50 mV with C1 equalizer (-40 db)
60 mV with compromise equalizer
(SNBU wrap) (-40 db)

Wave Form 163



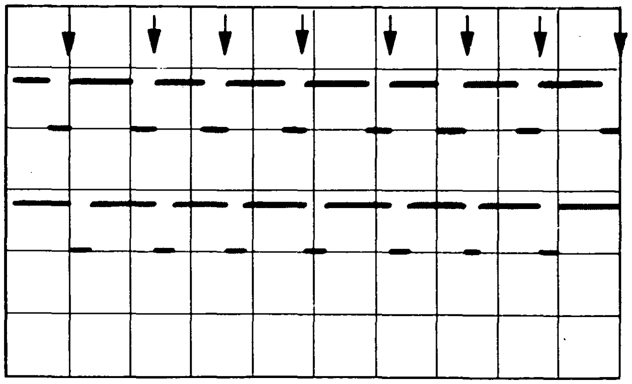
K4D05
Limiter Input
(strapped -27 db
on Q2 and J4)

K4B02
Limiter Output

Sync -G2S04, 0.5 ms/div
Channel 1, see wave form 160
Channel 2, 5 V/div

Wave Form 166

Note: The arrows in this wave form show the relationship between the two signals; channel B signal drops as channel A signal rises.

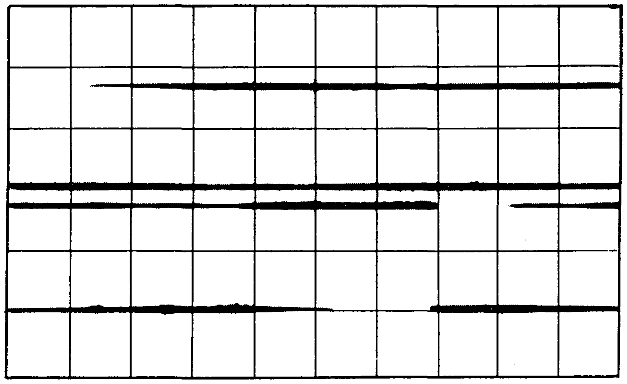


N4D05
Channel A Filter

N4B02
Channel B Filter

Sync -G2S04, 0.2 ms/div
Channel 1, 1 V/div
Channel 2, 1 V/div

Wave Form 173A

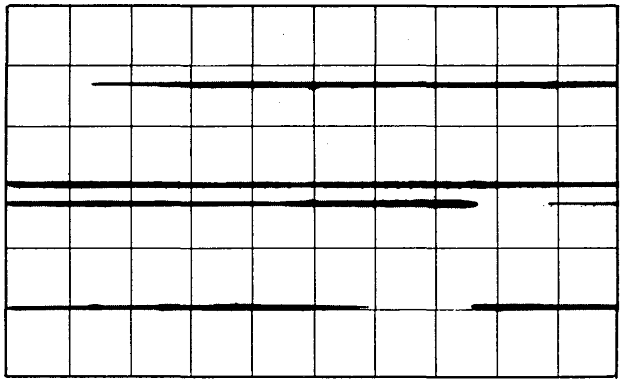


K4B02
Limiter Output

K4D02
Limiter Output
Delayed 450°
(2400 bps)
(shift register
bit 80)

Sync -internal, 0.1 ms/div
Channel 1, 5 V/div
Channel 2, 5 V/div

Wave Form 173B

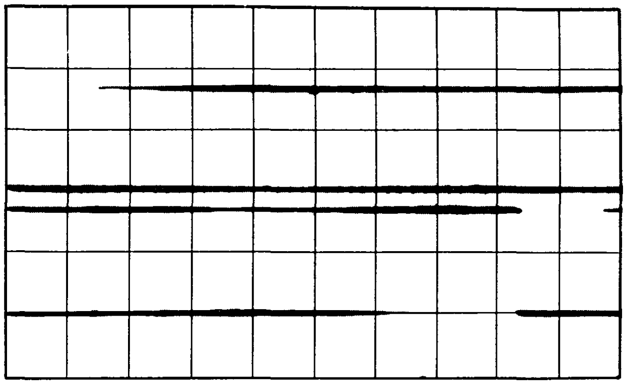


K4B02
Limiter Output

K4D04
Limiter Output
Delayed 990°
(1200 bps)
(shift register
bit 88)

Sync -internal, 0.1 ms/div
Channel 1, 5 V/div
Channel 2, 5 V/div

Wave Form 173C



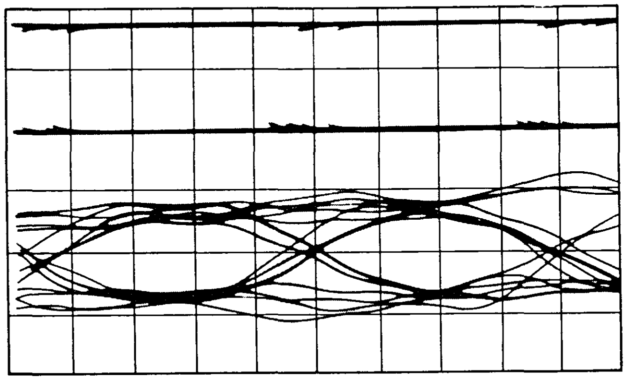
K4B02
Limiter Output

K4B05
Limiter Output
Delayed 540°
(2400 bps) or
1080° (1200 bps)
(shift register bit
96)

Sync -internal, 0.1 ms/div
Channel 1, 5 V/div
Channel 2, 5 V/div

Wave Form 183

Note: Maladjust the channel 1 scope probe compensation to observe the blips on the receive data trace. Recompensate the probe before proceeding.

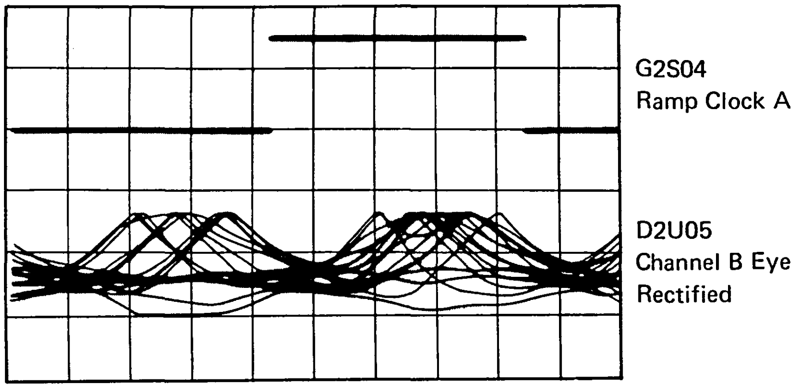


N4D04
Channel A Receive
Data
N4D06
Channel B Receive
Data

N4G02
Channel A Eye
N4B09
Channel B Eye

Sync -G2S04, 0.2 ms/div
Channel 1, 5 V/div
Channel 2, 2 V/div

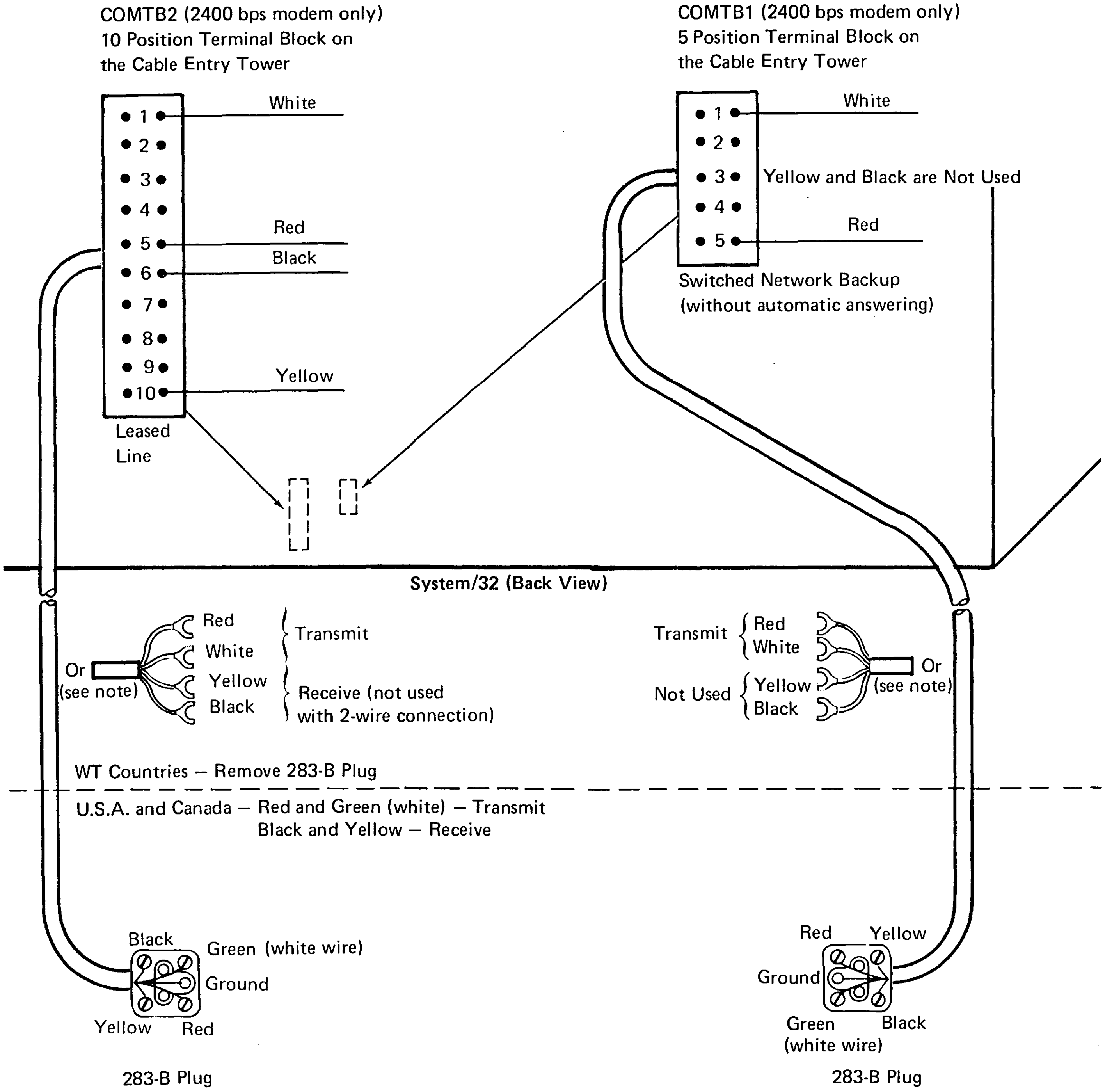
Wave Form 248



Sync—internal, 0.2 ms/div
Channel 1, 0.5 V/div
Channel 2, 5 V/div

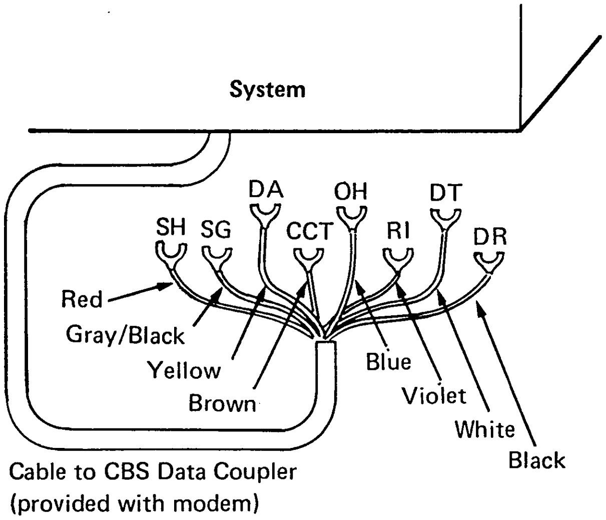
10.5.0 MODEM CABLING TO COMMON CARRIER

Leased Line or Leased Line and Switched Network Backup Connector



Note: There is only one cable to the common carrier from each terminal block. The 283-B plug is used in the U.S.A. and Canada; it is removed for WT countries.

Switched Line or Switched Backup with Auto-Answer Connector



System to Carrier

Refer to paragraph 10.3.1.1 in this section for the WT PSN cable connections.

10.6.0 MODEM CONTROL LINES

The modem control lines (see illustration) are active during the up level. The following paragraphs describe eight of these lines:

'RTS' (request to send) controls the transmit and receive functions of the modem. When on, the modem is in transmit mode; when off, it is in receive mode. On a 2-wire leased line, 'RTS' is switched by the System/32. On a 4-wire leased line, 'RTS' can be (1) switched by the System/32, (2) held permanently on by the System/32, or (3) held permanently on by the modem. On a switched line, 'RTS' is switched by the System/32. 'RTS' is on for the duration of each block or frame transmitted.

'Standby' selects the switched network backup line.

'Test' selects the modem wrap function. When the modem wrap test is running, the transmitter is looped back to the receiver.

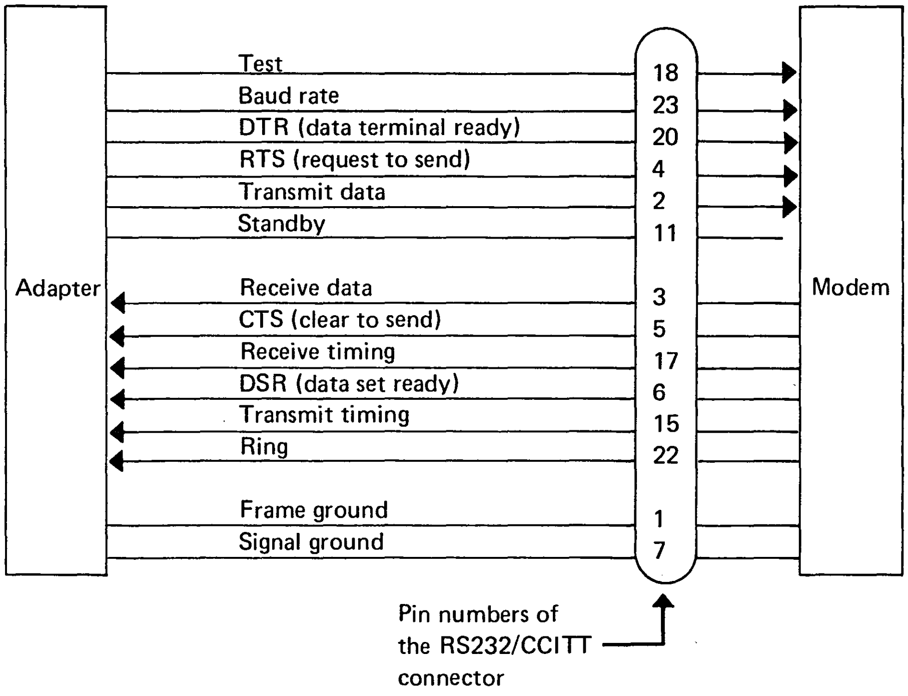
'DTR' (data terminal ready) signals the modem that the terminal is ready to send or receive data. On a switched line, 'DTR' initiates and holds the line connection. On World Trade 'CDSTL' (connect data set to line) modems, 'DTR' is down initially, and is brought up when a ringing signal is received in auto-answer mode or when 'DSR' is brought up in manual mode.

'Baud rate' selects the bit rate on modems with the half-speed option. When this line is down, the half-speed option is selected.

'CTS' (clear to send) indicates that the modem is ready to transmit data. On a 4-wire leased line, 'CTS' can be permanently wired on. On a 2-wire leased line, 'CTS' is turned on and off by 'RTS'.

'DSR' (data set ready) indicates that the modem is ready. The modem is ready when power is on, when the modem is connected to the line, and when the modem is not in test mode; all three conditions must be satisfied.

'Ring' indicates that the modem is receiving a call.



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Appendix A. Numbering Systems

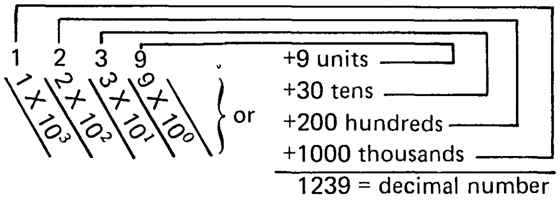
BINARY AND HEXADECIMAL CONVERSION

Binary Number Notation

The binary numbering system uses a base of two. The concept of using a base two can be compared with the base ten for the (decimal) numbering system. The following table shows the binary equivalents for decimal numbers from 0 through 9:

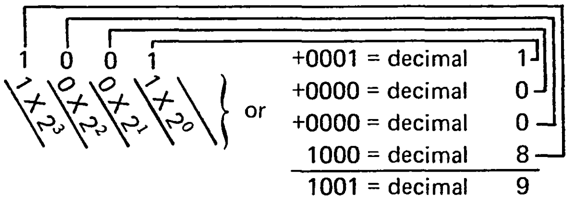
Decimal Number	Binary Number
0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001

Example of a decimal number:



As shown above, the decimal numbering system allows counting to ten in each position—from units to tens to hundreds to thousands, etc. The binary system allows counting to two in each position. Register displays are binary: a bit light on is a 1; a bit light off is a 0.

Example of a binary number:



Hexadecimal Numbering System

Binary numbers require about three times as many positions as decimal numbers to express the equivalent number. This is not much of a problem for the computer; however, in talking and writing or in communicating with the computer, binary numbers are bulky.

A long string of 1's and 0's cannot be effectively transmitted from one individual to another. Some shorthand method is necessary. The hexadecimal numbering system fills this need.

Because of the simple relationship of hexadecimal to binary, numbers can be converted from one system to another by inspection. The base of the hexadecimal system is 16. This means there are 16 symbols: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F. The letters A, B, C, D, E, and F represent the base 10 (decimal) values of 10, 11, 12, 13, 14, and 15, respectively.

Four binary positions are equivalent to one hexadecimal position. The following table shows the comparable values of the three number systems:

Decimal	Binary	Hex
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

At this point, all 16 symbols were used, and a carry to the next higher position of the number is necessary. For example:

Decimal	Binary	Hex
16	0001 0000	10
17	0001 0001	11
18	0001 0010	12
19	0001 0011	13
20	0001 0100	14
21	0001 0101	15

—and so on—

The internal circuitry of the computer understands only binary. But an operator can look at a series of lights showing binary 1's and 0's, for example: 0001 1110 0001 0011, and interpret the lights to represent the hex value 1E13, which is easier to state than the string of 1's and 0's.

Hexadecimal and Decimal Conversion

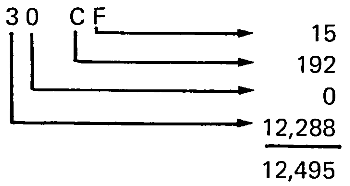
Hexadecimal Columns											
6		5		4		3		2		1	
Hex = Dec		Hex = Dec		Hex = Dec		Hex = Dec		Hex = Dec		Hex = Dec	
0	0	0	0	0	0	0	0	0	0	0	0
1	1,048,576	1	65,536	1	4,096	1	256	1	16	1	1
2	2,097,152	2	131,072	2	8,192	2	512	2	32	2	2
3	3,145,728	3	196,608	3	12,288	3	768	3	48	3	3
4	4,194,304	4	262,144	4	16,384	4	1,024	4	64	4	4
5	5,242,880	5	327,680	5	20,480	5	1,280	5	80	5	5
6	6,291,456	6	393,216	6	24,576	6	1,536	6	96	6	6
7	7,340,032	7	458,752	7	28,672	7	1,792	7	112	7	7
8	8,388,608	8	524,288	8	32,768	8	2,048	8	128	8	8
9	9,437,184	9	589,824	9	36,864	9	2,304	9	144	9	9
A	10,485,760	A	655,360	A	40,960	A	2,560	A	160	A	10
B	11,534,336	B	720,896	B	45,056	B	2,816	B	176	B	11
C	12,582,912	C	786,432	C	49,152	C	3,072	C	192	C	12
D	13,631,488	D	851,968	D	53,248	D	3,328	D	208	D	13
E	14,680,064	E	917,504	E	57,344	E	3,584	E	224	E	14
F	15,728,640	F	983,040	F	61,440	F	3,840	F	240	F	15
0123		4567		0123		4567		0123		4567	
Byte				Byte				Byte			

From hexadecimal to decimal: Locate each hexadecimal digit in its corresponding column position and note the decimal equivalents. Add these to obtain the decimal value.

Example:

Hexadecimal Value **Decimal Equivalent**

Columns
43 21

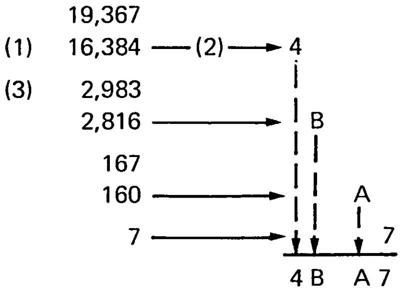


From decimal to hexadecimal: (1) Locate the largest decimal value in the table that will fit into the decimal number to be converted, and (2) note its hexadecimal equivalent and hexadecimal column position. (3) Find the decimal remainder. Repeat the process on this and subsequent remainders.

Example:

Decimal Value **Hexadecimal Equivalent**

Columns
43 21



Appendix B. Stepper Motors

PRINTER STEPPER MOTORS

Stepper Motor Characteristics

- The stepper motor is a sealed unit.
- The stepper motor is phase controlled by direct current.
- The sequence of the phase pulses from the logic circuits controls the direction of rotation.

The dc stepper motor consists of a permanent-magnet rotor (armature) and a pair of two-phase stator windings. The motor is a sealed unit having no gears or commutators and requiring no maintenance.

Shaft rotation is not continuous unless the stepper motor is continually pulsed. When current flows through the stator windings, a magnetic field set up in the stator pole acts on the permanent-magnet rotor to produce torque in the rotor shaft. This torque turns the rotor shaft only part of a revolution; then locks it in an electrically detented position.

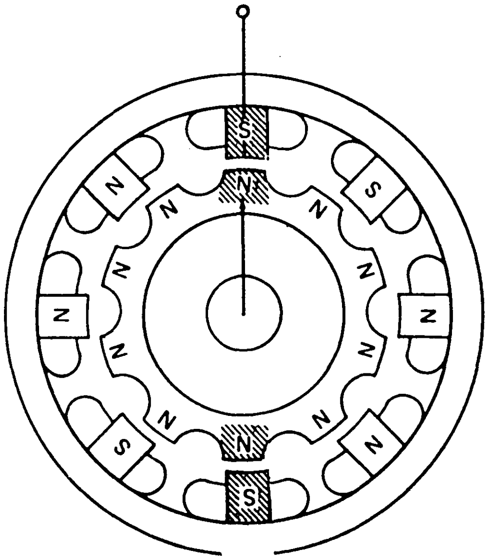
Electrical detenting is due to direct current in the stator windings action on the permanent-magnet rotor. The motors on the belt printer cannot be easily turned manually with the system power on because they are electrically detented. Serial printer stepper motors are not detented (after they have been stopped for 50 ms) and *can* be turned manually.

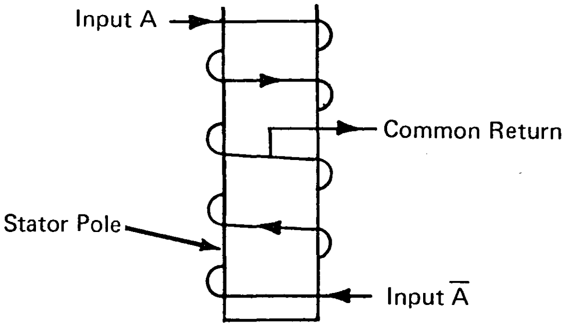
Note: When the system power is off, the residual detenting due to the permanent magnet can be felt as a slight drag or roughness, and heard as a clicking sound when the shaft is turned. If a motor is removed from either printer, ensure that none of the wires in the cable touch each other. When the wires touch, a back electromotive force is created that retards shaft movement.

Stepper Motor Operation

For ease of understanding, the motor used in this example turns nine degrees per step.

This simplified stepper motor consists of eight coil-wound stator poles and a ten-pole permanent-magnet rotor.

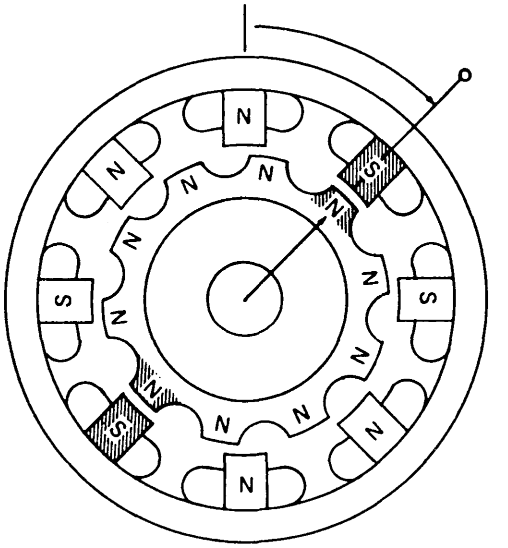




Stator-Pole Winding

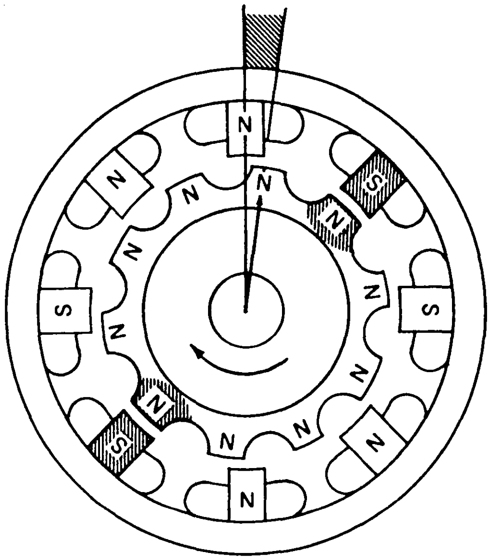
CAUTION
The permanent-magnet rotor is magnetized after assembly at the plant. Do not open or disassemble the motor. Disassembling the stepper motor reduces the magnetic flux of the rotor, which reduces the torque of the motor. If a motor *is* disassembled, do not reinstall it in the machine.

If we physically rotate the stator (in either direction), the rotor maintains its detented position and follows the stator as shown. (Both the stator poles and the rotor rotated clockwise 45 degrees.)



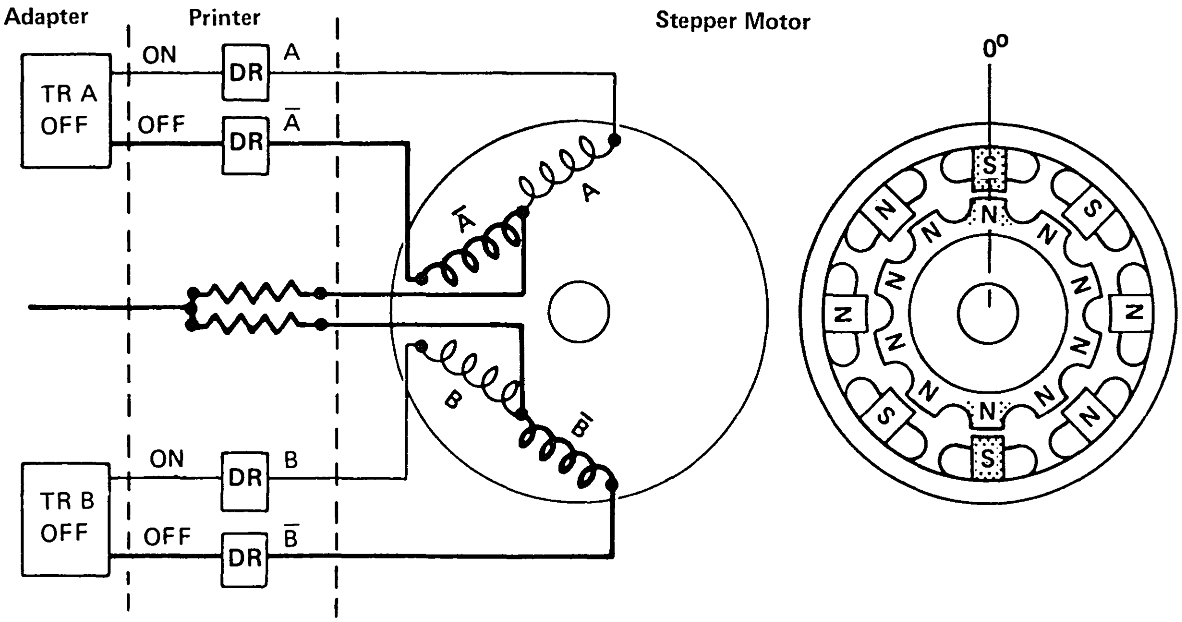
Note: Current flows only in one-half of the winding at a time. Polarity of the stator pole is determined by which half of the winding has current.

If, instead of physically rotating the stator, we electrically rotate its magnetic field (by switching current in the stator winding), the stator remains stationary and the rotor turns until the closest opposite-polarity (shaded) magnet poles attract each other into alignment. Note that polarity of the stator poles has rotated one position clockwise from that shown in the first illustration.



Home Position $\overline{A}\,\overline{B}$ (Reset)

The rotor is in its static detented condition when triggers $\overline{A}$ and $\overline{B}$ are active. This results in the stator polarity shown. The stepper motor is stopped.



The stepper motor is advanced by pulses provided by two triggers in the adapter.

The two triggers (A and B) provide four pulses to step the motor: ($\overline{A}\,\overline{B}$, $A\overline{B}$, AB, $\overline{A}B$).

Direction of rotation depends on the sequence of stator magnet switching. This, in turn, depends on the triggers.

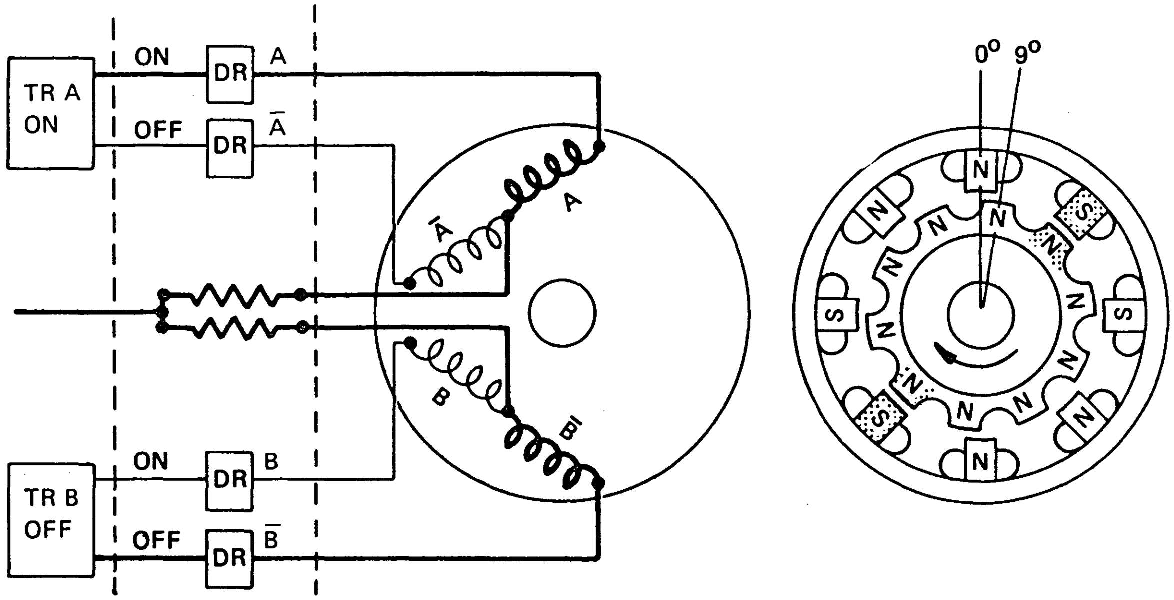
Clockwise	Counterclockwise
$\overline{A}\,\overline{B}$	$\overline{A}\,\overline{B}$
$A\overline{B}$	$\overline{A}B$
AB	AB
$\overline{A}B$	$A\overline{B}$
$\overline{A}\,\overline{B}$	$\overline{A}\,\overline{B}$

Note: Current flows only in one-half of the winding at a time. Polarity of the stator pole is determined by which half of the winding has current.

First Advance Pulse $A\overline{B}$ (Generated by Adapter)

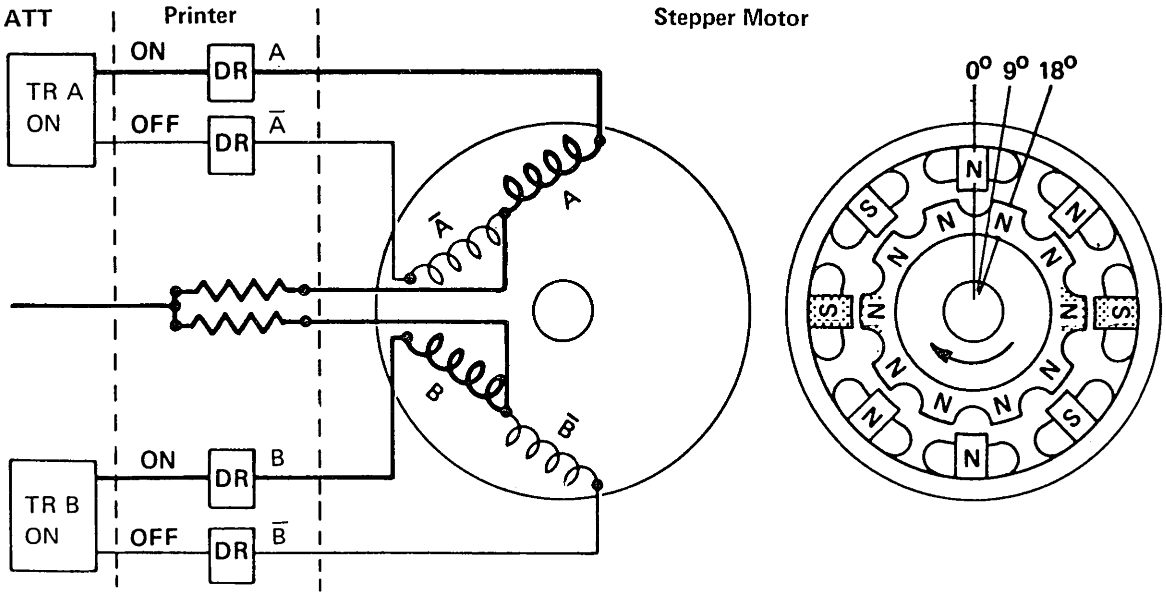
When the triggers advance to the $A\overline{B}$ condition, the polarity of the stator magnets is rotated clockwise.

Because the rotor segment (shaded) is near the next stator pole to its right, the rotor moves nine degrees until the rotor and stator poles align with each other; then stops.



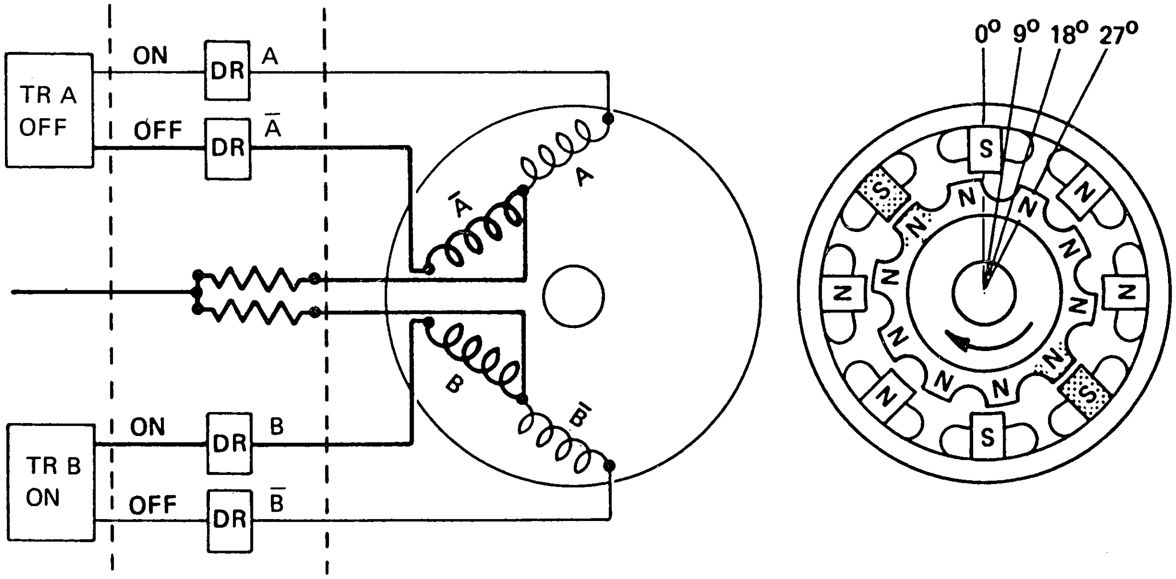
Second Advance Pulse AB

As the triggers continue to advance, the rotor turns in nine degree increments.



Third Advance Pulse $\bar{A}$ B

Clockwise rotation continues as long as the triggers continue to advance in this sequence.



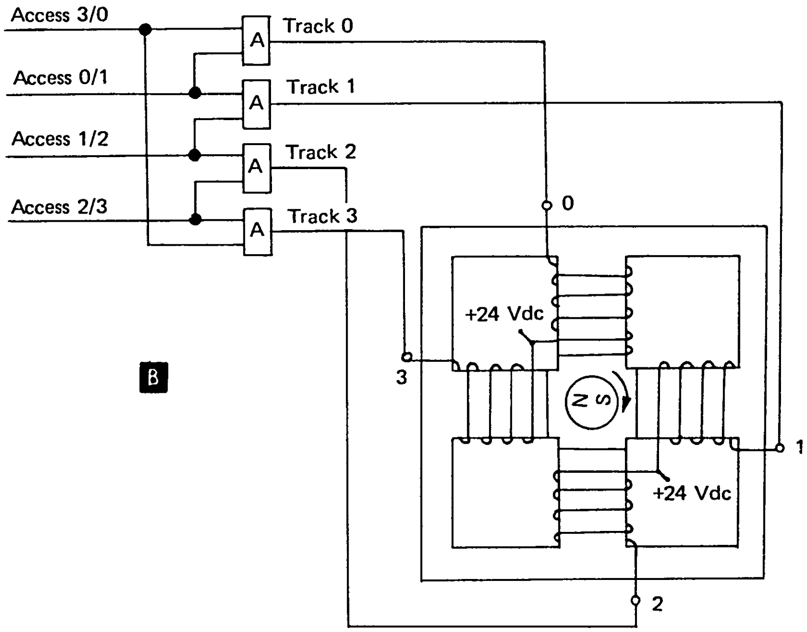
33FD STEPPER MOTOR

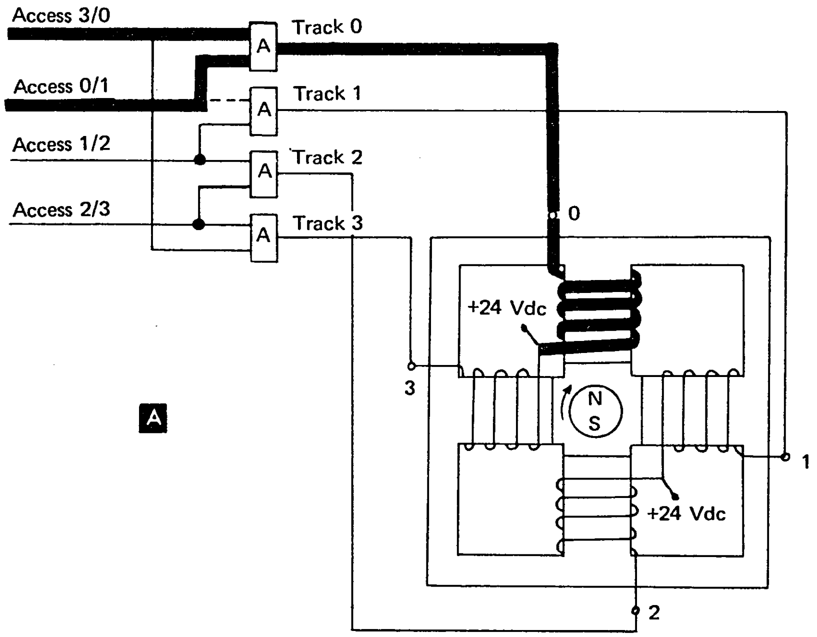
The 33FD stepper motor is different from the printer stepper motors in two respects:

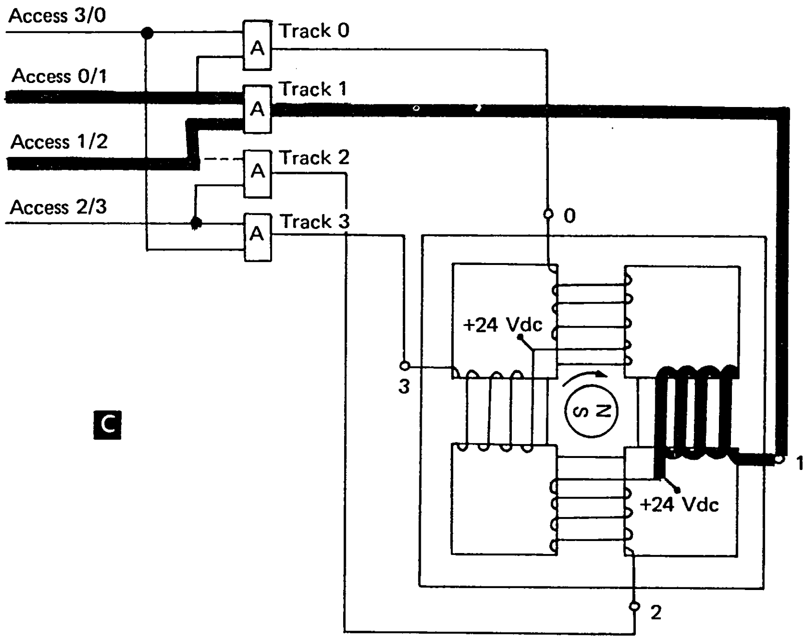
1. The 33FD motor has only four poles and turns 90 degrees for each step.
2. The 33FD motor is not detented electrically but is detented by the geneva mechanism it drives.

The motor consists of four pole windings and a rotor that is a permanent magnet. As shown in the accompanying diagrams, two access lines must be active to energize one phase line.

The first illustration **B** shows the motor in the phase 3 position. By energizing the track 0 line, the rotor rotates 90 degrees and aligns with the phase 0 pole **A**. Then, by energizing the track 1 line, the rotor again rotates 90 degrees and aligns with the phase 1 pole **C**. The phase windings are energized for a minimum of 50 ms.







Appendix C. Installation Instructions

SYSTEM/32 INSTALLATION AND CONFIGURATION

The following procedure is a guide for installing the IBM System/32. For basic system installation, only one person is required and no special tools are necessary. If you are installing a system with an integrated modem, a db meter (P/N 453545), db adapter (P/N 1749299), or equivalent, is required.

This system was tested and working properly when shipped. All voltages were adjusted and no further adjustments are necessary while installing.

- Check off each step as it is performed.
- Be sure to report any problems encountered using the appropriate major, minor and cause codes on your IR.
- Make safety a habit. Notice the safety rules listed on page x.

☐ If system is crated, follow the unpacking instructions attached to the crate.

☐ Remove all shipping braces as described in the unpacking instructions (attached to the system).

☐ Locate the power rating and serial number plate **A**. Make sure the customer's power and power receptacle are installed and grounded correctly (verify by asking customer) and they match the system requirements. If they are installed correctly but do not match, wire the machine according to the chart below.

Type of Input	Control Voltage Transformer TB1 **C** Tap Setting	Serial Printer Trilevel Supply Transformer TBE **E** Tap Setting[1] (high frequency power supply only)	Power Supply **F** Ferro Transformer	AC Board **D** to Autotransformer **B** Tap Setting [2]
100 Vac 50 Hz	TB1-1			E4-3 E12-7
110 Vac 50 Hz	TB1-2			E4-4 E12-7
123.5 Vac 50 Hz	TB1-3			E4-6 E12-7
200 Vac 50 Hz	TB1-4	TB1-2		
220 Vac 50 Hz	TB1-5	TB1-3		
235 Vac 50 Hz	TB1-6	TB1-4		
100 Vac 60 Hz[2]	TB1-1			E4-3 E12-8
200 Vac 60 Hz	TB1-3	TB1-2		
208 Vac 60 Hz	TB1-3	TB1-2	TB1-3	
230 Vac 60 Hz	TB1-4	TB1-3	TB1-4	

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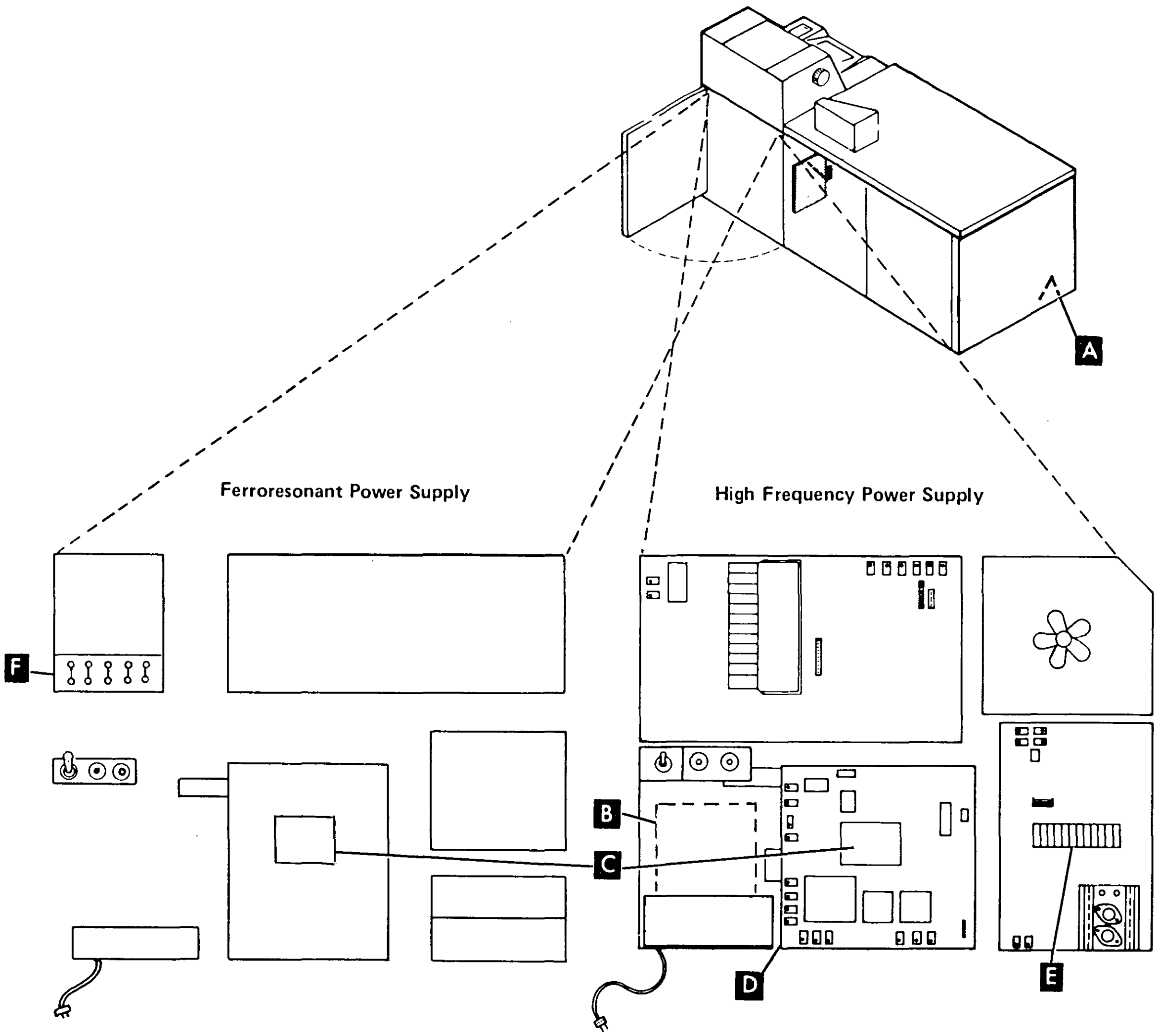
[1] Two leads with yellow tape.

[2] World Trade only.



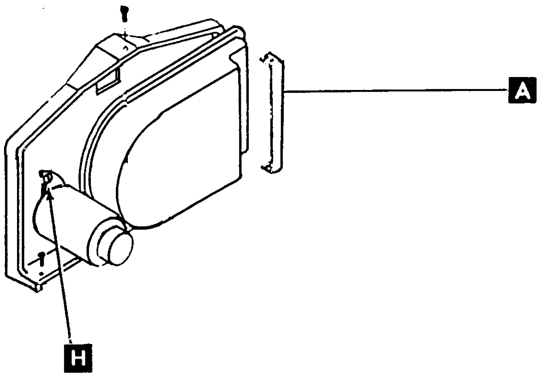
Disk Drive

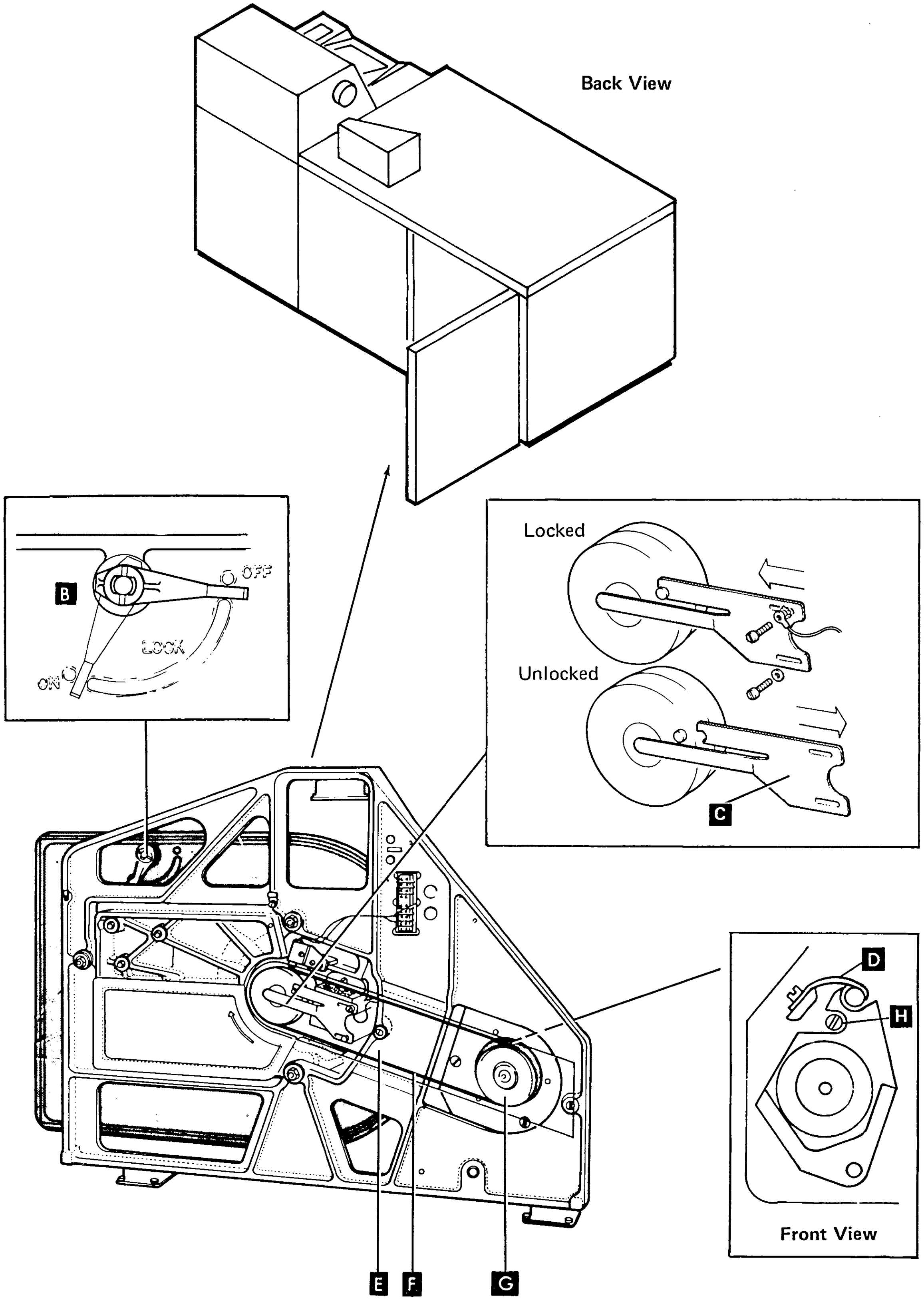
☐ 1. Remove the drive belt cover **E** on the rear of the disk unit. Carefully remove the tape from the spindle locking arm **C** (pull tape *away* from the mounting screws). Loosen the screws holding the spindle locking arm, then move it to the right so that the long finger now acts as the spindle ground. Tighten the screws.

☐ 2. Loosen the motor lockout screw **H**. Pivot the motor toward the disk drive and tighten the lockout screw **H** into the disk casting so that the screw no longer restricts motor movement. Install drive belt **F** smooth side toward the pulley **G** and ensure that the motor tension spring **D** is seated in its plastic socket. Reinstall the drive belt cover **E**.

☐ 3. Rotate actuator lock handle **B** from vertical (on) to horizontal (off) position.

☐ 4. Ensure that all connectors, cables and cards are seated. Remove retainer brace **A** on disk drive to check cables and cards. Then replace the retainer brace.



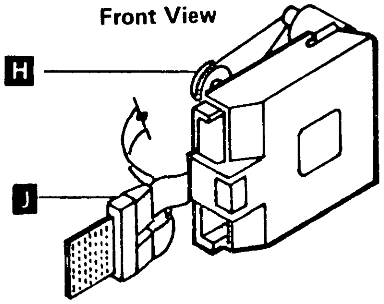


33FD Diskette Drive

☐ 1. Observe that card and all cables and connectors **J** are in place.

☐ 2. Rotate drive pulley **H** manually to check for free rotation.

☐ 3. If the protective shield was removed during unpacking, reinstall it.



Belt Printer

CAUTION
Wire paper guide **R** on bustle **K** must be below wire paper guide on printer before sliding bustle into position.

☐ 1. Install bustle **K** which mounts by sliding into place on the three studs **N** on rear of printer and install knobs **O**. Install ground wire **T**.

☐ 2. Install bustle cover **L** with 4 screws. Adjust cover to match contour of the bustle. Install ground wire at **M** and **P**.

☐ 3. Install forms guide **Q** and set right-hand movable guide to 0.

☐ 4. Install ribbon by following the diagram on the inside of printer cover.

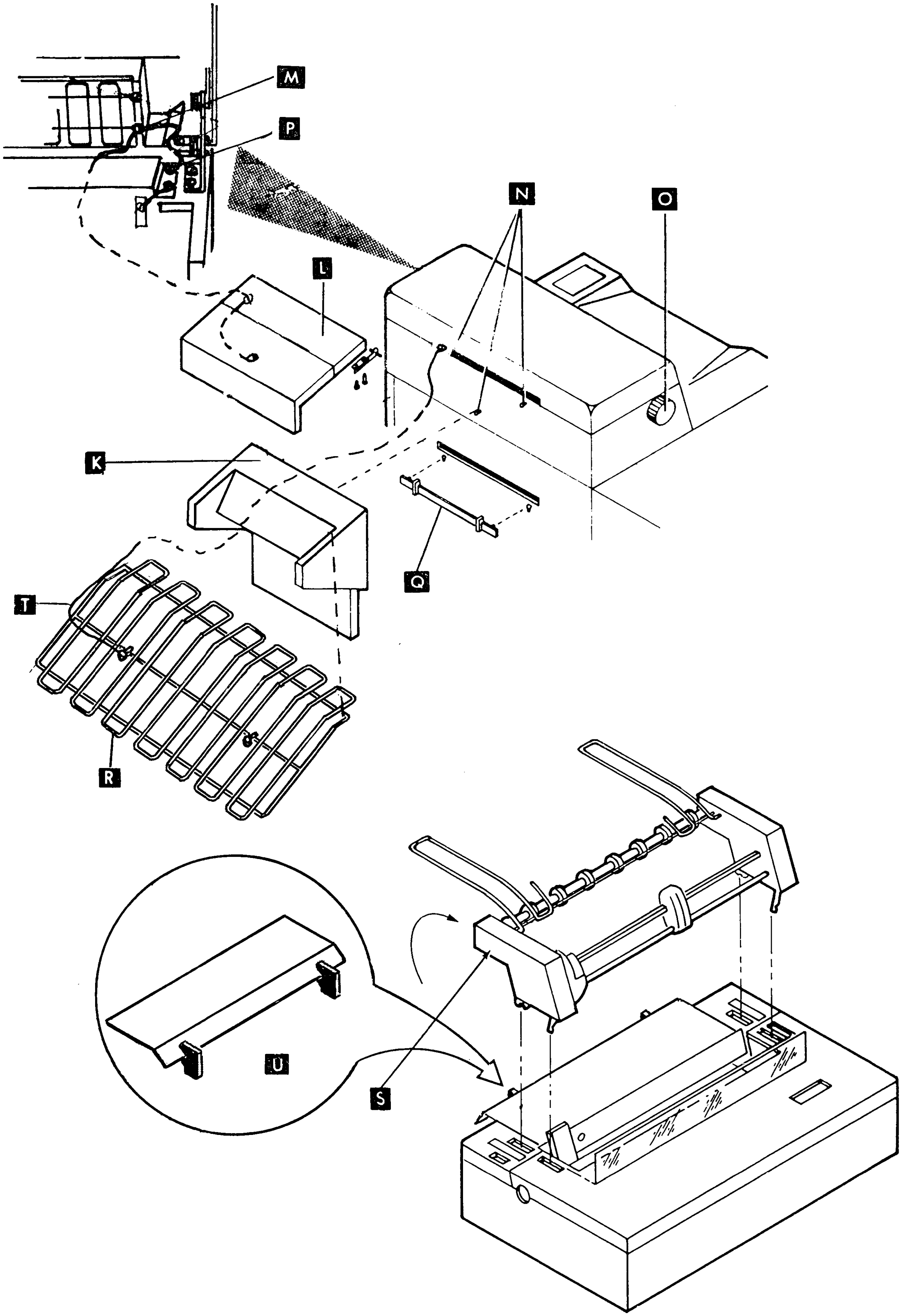
☐ 5. Do the *Cover Interlock Switch* service check (4.2.2.1)

Note: Be sure the ribbon does not jam between the ribbon drive roll and the ribbon cassette. For more details, see *IBM System/32 Operator's Guide*, GC21-7591.

Serial Printer

☐ 1. Install the forms tractor assembly **S** complete with wire paper guide, on printer.

☐ 2. Slide the two plastic paper guides **U** onto the paper entry plate.



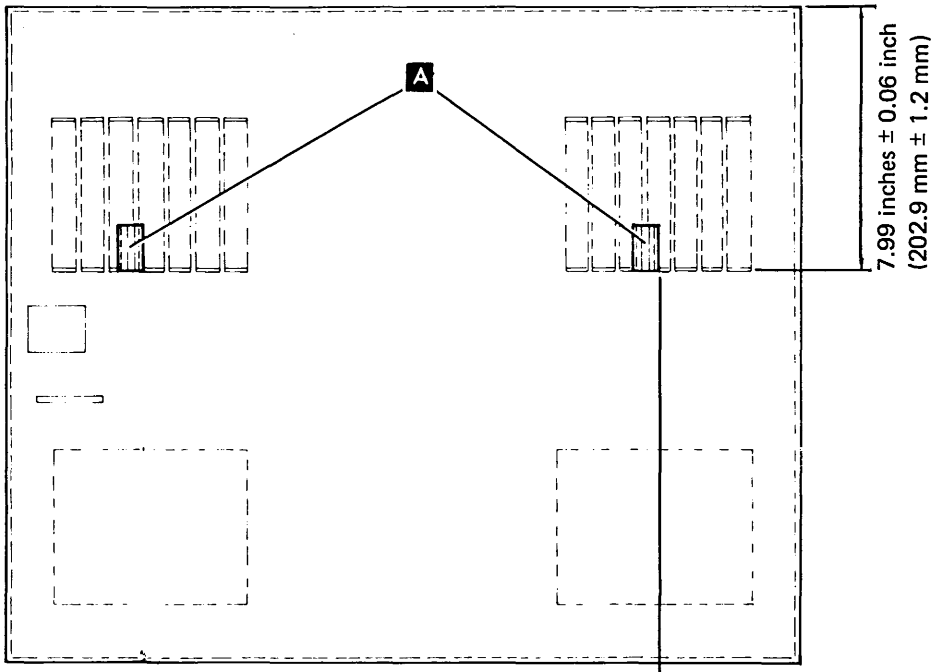
Forms Stand

☐ 1. Mount forms stand positioning and grounding blocks **A** as shown.

☐ 2. Install paper rack using positional and grounding blocks.

☐ 3. Insert paper in the printer.

☐ 4. Place one of the wire caster blocks under each caster.

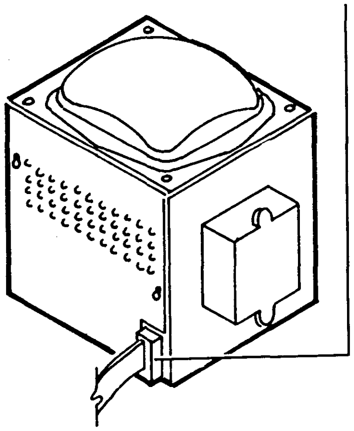


Lower Cover — Right Rear

Display Unit

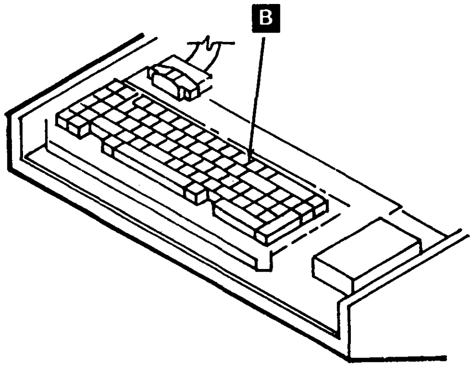
☐ Ensure that the cable to the display printed circuit board is properly seated.

☐ Install mirror and green plastic filter assemblies.



Keyboard

☐ Check that the keys are not binding on the cover **B**



Power Sequence

☐ 1. The power sequence card is located under the CRT.

☐ 2. Ensure all cables and cards are properly seated.

☐ 3. If the System/32 does not have the BSCA or SDLC feature, go to *Power on Checks and Testing* (page C-8).

BSCA/SDLC

A db meter (P/N 453545, P/N 1749299, or equivalent) is required if you are installing a system with an integrated modem.

☐ 1. Check or install the required card strapping for BSCA/SDLC card A-A2L2. Refer to Section 10.2.0 of this MLM for strapping definitions.

☐ 2. Verify that the modem circuit cards and cables are secure **A** .

Do the power on checks and testing on page C-8 now. When they are complete, continue the BSCA/SDLC installation with step 3 following:

1200 bps Integrated Modem

☐ 3. To assist in strapping selection, fill out the installation data table on page C-7. If the communication line is on a switched network, perform the 1200 bps integrated modem transmit level adjustment for switched lines in Section 10.3.1 of this MLM. Record the level in the data table on page C-7. Use Section 10.3.3 for the 1200 bps switched network card strapping.

If the communication line is on a leased network, check or install the jumpers on the 1200 bps board per Section 10.3.2 of this MLM.

If a leased network, perform the 1200 bps modem transmit level adjustment for leased line in Section 10.3.1 of this MLM. Record the level in the data table on page C-7.

2400 bps Integrated Modem

☐ 3. To assist in strapping selection, fill out installation data table on page C-7. Perform the card population and strapping procedure in Section 10.4.4 of this MLM.

Note: If required, the modem card P/Ns and locations can be found in the plug chart on page AY060 of the ALDs. The modem board feature wiring can be found in the ALDs page FA621. It should not be necessary to do any board feature wiring because it was done in manufacturing to match the system order requirements.

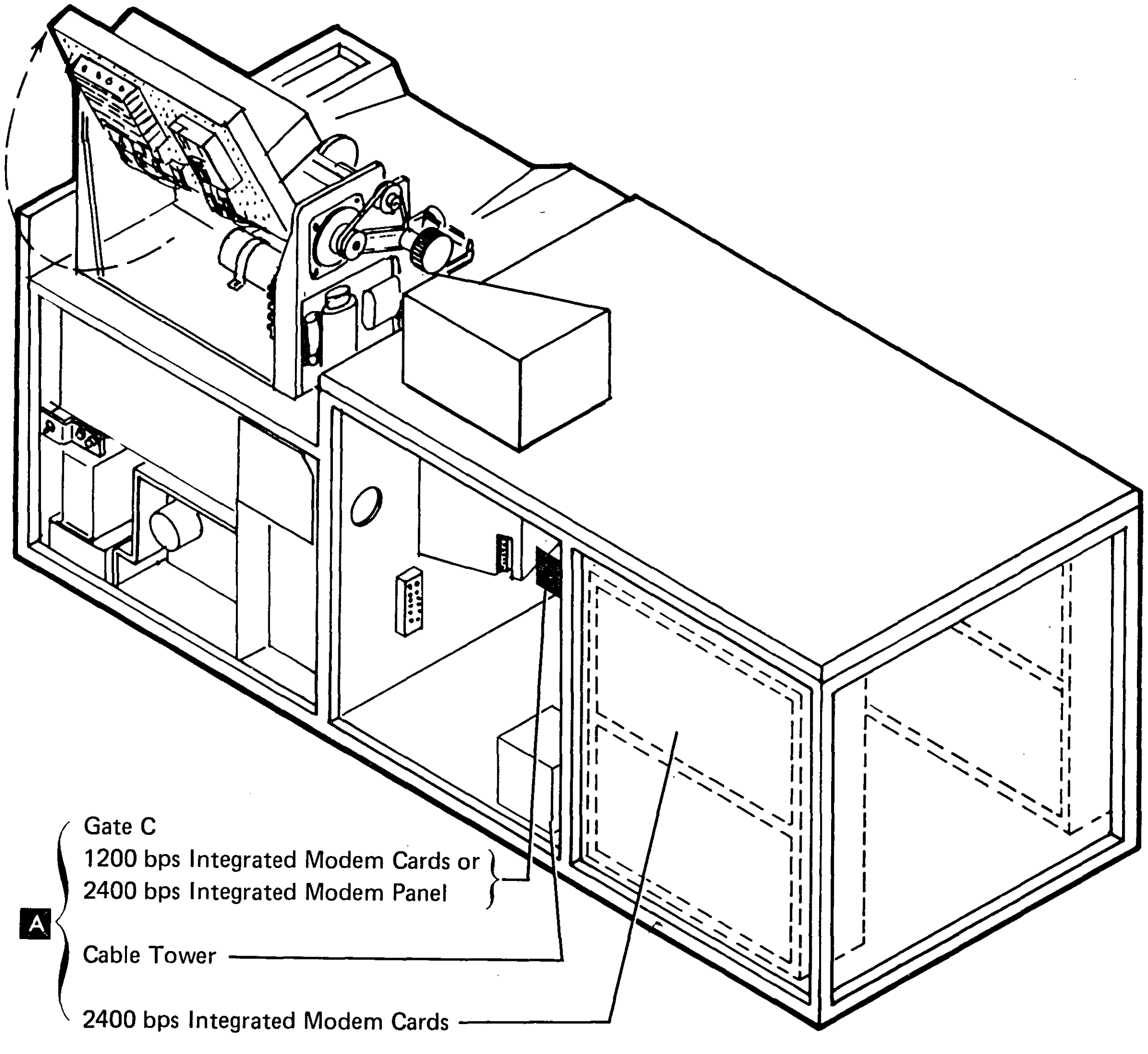
External Modem EIA/CCITT Connection

☐ 3. Install the external modem EIA/CCITT cable from the system to the modem. It is the customer's responsibility to have the external communications facilities available for connection to the system.

Testing BSCA/SDLC

☐ 4. Check the configuration of the system by running the program *config*. If you need assistance, refer to the BSCA/SDLC section of the diagnostic service guide.

☐ 5. Run the BSCA/SDLC diagnostic tests. Use diagnostic diskette DIAG03 and run diagnostic program *BSCA/SDLC*. The screen message directing you to page 1400-1 of the MAPs means that the hardware diagnostic tests ran OK. (You need not go to the MAPs at this time.)



Completion of BSCA/SDLC Installation

It is the customer's responsibility to have the communications line cable connected to the common-carrier facility. Make the connection at this time. Refer to Section 10.5.0 of this MLM for leased line and switched line connections.

2400 bps Integrated Modem

☐ 6. For leased or multipoint line modems, perform the following transmit/receive checkout.

   a. Disconnect the 283-B plug on the end of the exit cable from the communication line. See Section 10.5.0 for location.

   b. To strap a two-wire leased modem for four-wire operation, attach or remove the following jumpers:
      - If SNBU is not installed, add jumper B on card B-A1Q2 (see Section 10.4.5).
      - Remove jumpers F (two locations) and add jumpers G (two locations) (see Section10.4.5).
      - Remove jumper K and add jumper J on card B-A1K2 (see Section 10.4.7).
      - Add jumper B on card B-A1M2 (if installed) (see Section 10.4.8).

   c. Set the test/operate switch to T3 (on the 2400 modem operator panel).

   d. At the 283-B plug, short the transmit pins to the receive pins:
      - Connect a jumper from the red wire pin to the yellow wire pin.
      - Connect a jumper from the white wire pin to the black wire pin. (See Section 10.5.0 for plug description.)

   e. Check for the following modem operation indicators:
      - Operate light is on continuously
      - Signal light is on continuously
      - Ready light is off.
      - Signal meter reads less than 50. (Zero is not a bad reading.)

   f. Set the test/operate switch to T4 and check for the modem operation indicators listed in step e.

   g. Remove the jumpers at the 283-B plug.

   h. Restore all card jumpers to their original positions.

   j. Set the test/operate switch to operate.

   k. Connect the 283-B plug to the communication line.

   l. If all modem operation indicators listed in step e were not present in T3 and T4 switch positions, perform the diagnostics. (See MAP Sections 3100 or 3200.)

☐ 7. For leased line installation, perform the equalization procedure. This is a customer responsibility after installation, and should be done at this time by the customer engineer with the customer observing the procedure.

   a. *Point to point:* Set the local test/operate switch on T3 and the remote modem switch on T4. Have the remote modem receive equalizer adjusted for a minimum reading on the remote modem signal quality meter.

   Set the local test/operate switch on T4 and the remote modem switch on T3. Adjust the local modem receive equalizer for a minimum reading on the local modem signal quality meter. Leave equalizer set at minimum reading and return the test/operate switches to OPERATE.

   b. *Multipoint:* Set the local test/operate switch on T3 and the remote modem switch on T4. Adjust the local modem transmit equalizer for a minimum reading on the remote modem signal quality meter.

   Set the local modem test/operate switch to T4 and the remote switch to T3. Adjust the local receive equalizer for a minimum reading. Leave the equalizers set at the minimum reading and return the test/operate switches to OPERATE.

☐ 8. Run the BSCA/SDLC online test. Refer tc the *Diagnostic Service Guide* (P/N 2547690) online test section. For a leased line connection, the remote system must have online test capability.

Integrated Modem Installation Data Table

This table is useful in determining the proper strapping. (See note 1 for CADUCEE networks–World Trade only.)

Serial Number______________

Installation Date ____________

Feature Configuration, Options, and Parameters			2400 bps Integrated Modem	1200 bps Integrated Modem
Configuration Check One (see order card)	Switched network		☐ 1	☐ 1
	Point-to-point		☐ 2	☐ 2
	Multipoint tributary		☐ 3	☐ 3
	CADUCEE (World Trade)		☐ 4	
	With SNBU (switched network back up), auto (with auto answer)		☐ 5	
Receiver Sensitivity	-27 dbm for leased line without SNBU		☐ 6	
	-40 dbm for switched network or leased line with SNBU		☐ 7	
Commu-nications Facilities	2-wire		☐ 8	☐ 4
	4-wire		☐ 9	☐ 5
	2-wire with echo suppressors on leased line without SNBU		☐ 10	
Transmit Level (See note 2)	Leased line (with or without SNBU feature) 0 dbm (U.S.A. and Canada)		☐ 11	☐ 6
	Switched network 0 dbm to -15 dbm (enter for SN or SNBU)		____ dbm 12	____ dbm 7
	Auto-answer tone 0 dbm to -15 dmb (same as transmit level, switched network)		____ dbm 13	____ dbm 8
Clear-to-Send Delay (see Section 10 of this MLM)	Leased line	8.5 ms	☐ 14	
		25 ms	☐ 15	☐ 9
		75 ms	☐ 16	☐ 10
		147 ms	☐ 17	
		200 ms		☐ 11
	Switched network	75 ms	☐ 18	
		147 ms	☐ 19	
		200 ms		☐ 12 (see note 3)
Continuous Carrier (see customer)	Unconditional (DTE will not control 'request to send')		☐ 20	☐ 13
	SNBU, auto request to send (DTE controls 'request to send')		☐ 21	

Notes:

1. Use the following data if the modem includes the CADUCEE feature (World Trade):
   Check boxes 4, 6, 9, 15 and 20
   Enter -6 dbm in blank 12
   For CADUCEE:
   Do not connect the signal and frame ground in the coffret.
2. Transmit level is specified by the common carrier. It may be marked on the line coupler box (1000-B, CDT, CBS). LL with SNBU has two transmit level attenuation settings:
   Leased line – Q2 card
   SNBU – M2 card
3. The 200 ms clear-to-send delay for a 1200 bps integrated modem on a switched network is not selectable.

Power On Checks and Testing

☐ 1. Make sure the mainline switch **E** and the console POWER switch (keylock switch if keylock feature is installed) **B** are in the off position, then connect the power cord to the customer's ac receptacle.

☐ 2. Turn on the mainline switch. Turn on the console POWER switch.

☐ 3. Observe the entire system for any signs of arcing, smoking, or unusual mechanical noise. If any of these occur, power down and investigate the problem.

☐ 4. As power sequences up:
  - the disk drive starts rotation.
  - the 33FD starts rotation.
  - the printer and gate blowers operate.
  - the STOP key/light **C** comes on.
  - after approximately one minute of power on, the disk actuator seeks to the data area of the disk.

☐ 5. Press LAMP TEST **H**. All LEDs and keys should light.

Three diskettes are shipped with each basic system—DIAG01, DIAG02, and a scratch diskette. (Systems with optional features will have additional diskettes.)

☐ 6. Insert DIAG01 diskette.
Set switches:
  - data switches **D** to 0000.
  - IMPL and IPL **G** to the diskette position.
  - Mode selector **F** to the PROC RUN position.
  - All others to the down position.

☐ 7. Press the LOAD key **A** (on the operator console). The system steps through the IMPL diagnostic tests. The following message should be displayed on the display.

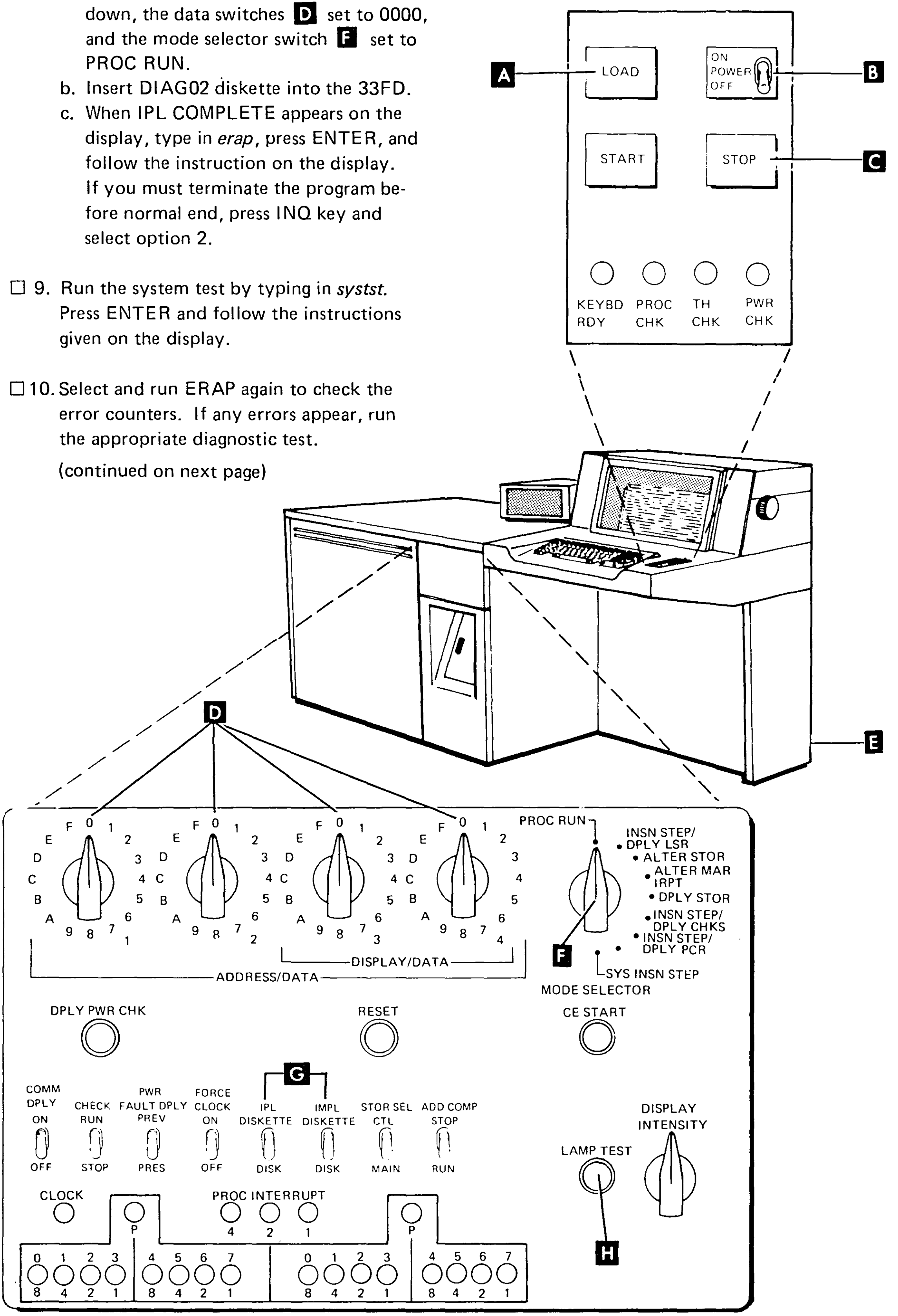
```
        IMPL DIAGNOSTICS RAN
           WITHOUT ERRORS.
CAUTION:  ANY RPQ'S INSTALLED MAY
AFFECT DIAGNOSTICS.  REFER TO VOL. 101
FOR A DESCRIPTION.
PUSH START KEY TO CONTINUE.
```

☐ 8. Select and run the ERAP program to ensure that all the error counters are reset.
  a. IMPL from the disk with all toggle switches down, the data switches **D** set to 0000, and the mode selector switch **F** set to PROC RUN.
  b. Insert DIAG02 diskette into the 33FD.
  c. When IPL COMPLETE appears on the display, type in *erap*, press ENTER, and follow the instruction on the display. If you must terminate the program before normal end, press INQ key and select option 2.

☐ 9. Run the system test by typing in *systst.* Press ENTER and follow the instructions given on the display.

☐ 10. Select and run ERAP again to check the error counters. If any errors appear, run the appropriate diagnostic test.

(continued on next page)



☐ 11. If the half line space print feature is installed, all printer diagnostics should be run at this time.

☐ 12. If the dual case keyboard/display feature is installed, run diagnostics CRT-1 to CRT-4. While diagnostic CRT-3 is running, you should be able to display upper and lower case characters by pressing the CODE key.

I/O Features

If your System/32 has the Mag Card Unit (IBM 5321) feature, go to the installation instructions (Appendix A-1) in the *System/32 Mag Card Unit Attachment Theory-Diagrams Manual,* SY34-0068.

If your System/32 has the Data Recorder (IBM 129/IBM 5496) feature, go to the installation instructions in the *System/32 Data Recorder Attachment Theory-Diagrams Manual,* SY31-0452, Appendix.

If your System/32 has the Magnetic Character Reader (IBM 1255) feature, go to the installation instructions in Appendix A of the *System/32 1255 Attachment Feature Theory-Diagrams,* SY31-0468.

To Complete the Installation

CAUTION

Please alert the customer to the following procedures:

a. The System/32 should not be moved without prior preparation by a customer engineer. This applies to moves within the installation such as room to room, by elevator, etc, as well as by truck or other conveyance. The primary area of damage would be the disk drive if the actuator lock and the spindle lock were not in the locked position. Contact your CE for details.
b. To prevent diskette damage, show the System/32 operator how to properly insert a diskette into the diskette drive.
c. At this time, a system configuration should be performed. Go to page C-10.

☐ 1. Turn the system over to the customer.

☐ 2. Fill out any locally required systems installation logs.

☐ 3. Record on your IR all problems encountered and notify your branch office that the installation is complete according to local procedures.

SCP SYSTEM CONFIGURATION AND INSTALLATION

This section describes configuration and installation of the initial version of IBM System/32 system control programming. For installation of subsequent versions of IBM System/32 system control programming, see the *IBM System/32 System Control Programming Reference Manual,* GC21-7593.

Diskettes Required

The diskettes required to perform system configuration are:

- PID (program information department) distribution diskettes that contain the system control program (SCP). They are called SCP diskettes. There are either 4 or 5 SCP diskettes, depending on the SCP release level that was shipped with the system.
- A diskette containing PTFs (program temporary fix) for the system control program and/or program products.
- Two diskettes on which a backup of the system control program can be made. They are called backup diskettes.

Other Requirements

During the building of SCP, you will be prompted for the following information:

- Print belt image for the system
- The number of lines per page
- The date format to use
- Optional SCP support for data communications, if desired
- Optional SCP support for RPG II, if desired
- Optional BSCA support for RPG, if desired
- Whether or not a PTF diskette is available
- Optional I/O features support

Using the information supplied by the prompts, an SCP will be built that contains the support requested. If a PTF diskette is available, the PTFs are applied to the SCP on the disk.

System Configuration Steps

The following steps create an SCP on the disk using the PID distribution diskettes. The SCP diskettes received from PID are used only during these system configuration steps, and should then be stored until the next SCP release is available.

CAUTION
The system configuration steps remove the current library (if any) from the disk. Save all library members the customer wants to retain (see index entry: *FROMLIBR procedure* in the *IBM System Control Programming Reference Manual,* GC21-7593) before executing the following steps.

The system configuration steps are:

1. Set the IPL switch on the CE control panel to DISKETTE and set the IMPL switch to DISK.
2. Insert the first SCP diskette.
3. Press the LOAD key on the operator panel. The following display appears:

```
---> LIBRARY DIRECTORY SECTORS = 0037
     INCLUDE INQUIRE/OFFLINE   = NO
     TOTAL LIBRARY BLOCKS      = 0281
```

4. The values displayed are those of the PID diskette. If an error message is displayed, read the following procedures:

Error Procedure FOR INVALID VTOC/LIBRARY

It will be necessary to save all of the disk data files if you have not already done so (see index entry: *SAVE procedure* in the *IBM System Control Programming Reference Manual,* GC21-7593). After the files have been saved, go back to step 1.

If you have already saved, or if you do not want to save the data files, the following action deletes them and corrects the INVALID VTOC/LIBRARY condition:

CAUTION
The following action deletes all data files from the disk.

- Hold down the SHIFT key and press the DUP key.
- Key a hyphen (-), then a plus (+); press the REC ADV key and check any other error messages. If there are none, go to step 5.

Error Procedure When the Library is too Large

You can do (or repeat) any part of the INVALID VTOC/LIBRARY error procedure, or you can decrease the library size by going to step 5.

Error Procedure For Any Other Error Message

Note: The errors covered by this procedure probably are the result of an error made in step 5.

Go to step 5. If you have already been to step 5, adjust your allocations for directory sectors and library blocks and press the REC ADV key after each entry until the error messages no longer appear; then go to step 7.

5. If you want a larger library or if you plan to apply PTFs to any program products, you should now allocate enough directory sectors and library blocks to contain the program products, the SCP, and any other programs. See index entry: *system modification,* in the *IBM System/32 System Control Programming Reference Manual,* GC21-7593, for a description of how to allocate directory sectors and library blocks. See index entry: *library requirements,* in the *IBM System/32 System Control Programming Reference Manual,* GC21-7593, to determine the number of directory sectors and library blocks required by the program products. Press the REC ADV key after each entry.

6. If any error messages are displayed, go back to step 4.

7. If no error messages are displayed, press the ENTER key to copy the SCP to the disk.

8. When the following display appears, remove the first PID SCP diskette and insert the second PID SCP diskette.

```
INSERT DISKETTE WITH FILE LABEL-#LIBRARY
      DATE- date, SEQUENCE NUMBER 02
---> PRESS ENTER KEY AFTER INSERTING
WARNING-LIBRARY MAY BECOME UNUSABLE
        IF CORRECT VOLUME NOT INSERTED
```

The second PID SCP diskette is copied to the disk when you press the ENTER key.

9. When the following display appears, set the IPL and IMPL switches to DISK and press the LOAD key.

```
RELOAD COMPLETE - REMOVE LAST
DISKETTE AND IPL FROM DISK
```

10. When the ENTER COMMAND message appears, enter CNFIGSCP.

11. The system will prompt you for the variable information needed. Follow the instructions displayed on the display screen. The final message is SYSTEM CONFIGURATION COMPLETE.

The system has now been configured. If necessary, PTFs have been applied to the SCP. The SCP PID distribution diskettes should now be stored for safekeeping until the next SCP release.

At this time, a backup copy should be made of the system. This backup copy can then be used when building unique systems (see index entry: *system installation steps* in the *IBM System Control Programming Reference Manual,* GC21-7593).

To make the backup copy of the SCP, it is necessary to initialize two diskettes on which a copy of the SCP can be kept. Use the INIT procedure to accomplish this. After the two diskettes have been initialized, you are ready to backup the SCP system onto the diskettes. Use the BACKUP procedure to make the backup copy.

INIT Procedure

The INIT procedure prepares (initializes) a diskette for use. It does this by performing some or all of the following functions:

- Writing sector addresses on the diskette
- Checking for defective tracks
- Assigning new track numbers when a track has a defective sector
- Writing a name on each diskette to identify the diskette
- Formatting track 0

This procedure evokes the $INIT utility (see index entry: *$INIT utility program* in the *IBM System Control Programming Reference Manual,* GC21-7593).

INIT Command Statement Format

```
                                     ┌,RENAME ┐
INIT  ┌vol-id      ┐ ┌owner-id ┐     │,DELETE │
      │system-date │ │OWNER-ID │     │,FORMAT │
      └            ┘ └         ┘     │,FORMAT2│
                                     └        ┘
```

INIT Parameters

vol-id system-date	If specified, it consists of one to six alphameric characters. The vol-id will be left-adjusted and padded with blanks when placed in the volume label. When DELETE is specified, vol-id is checked for a match. If no value is specified, the system date is used as a default value.

owner-id OWNER-ID	Up to eight alphameric characters may be specified. These are placed (left-justified and padded with blanks) in the owner identification field of the volume label of the diskette. If owner-id is omitted and RENAME or FORMAT is specified, owner-id is written as OWNER-ID.
RENAME	Allows the diskette to be renamed (vol-id and owner-id). Files and their labels are not affected.
DELETE	Deletes active files, thereby freeing up all space on the diskette (initializes track 0 on the diskette).
FORMAT	Formats the entire surface of the diskette in the standard interchange format. Tracks are renumbered for each track with a surface defect. If track 0 or more than two tracks have defects, the diskette is not initialized and no label of any kind is written. *Note:* If FORMAT is specified for one diskette in a multivolume file, it must be specified for all diskettes in the file.
FORMAT2	Formats the surface of the diskette in the extended format. Extended format diskettes have eight 512-byte sectors per data track. The index track is formatted in twenty-six 128-byte sectors; the data tracks are 1 through 74. Position 76 of the volume label (VOL1) contains a 2 if a diskette is formatted in 512-byte data sectors. The physical record length field (position 34) of the data set labels for a diskette also contains a 2 if the diskette is formatted in 512-byte data sectors. (The formats of the diskette volume labels and data set labels are given in *The IBM Diskette for Standard Data Interchange,* GA21-9182. However, diskettes formatted in 512-byte data sectors cannot be used for standard data interchange.) Tracks are renumbered for each track with a surface defect. If track 0 or more than two tracks have defects, the diskette is not initialized, and no label of any kind is written. *Note:* If FORMAT2 is specified for one diskette in a multivolume file, it must be specified for all diskettes in the file.

INIT Examples

In order to place a volume identification of 934613 and an owner identification of JOESDISK on a diskette you would enter:

```
INIT 934613,JOESDISK
```

RENAME is the default and the diskette would be labeled (volume label) but not initialized. An example of initializing follows:

```
INIT 843163,,FORMAT
```

BACKUP Procedure

BACKUP creates a diskette file that contains:

- A standalone program that can change the directory and library size.
- The reorganized library contents—unused space between members is collected at the end of the library.

To return the library to the disk, an IPL must be performed from the diskette(s) containing the backed up library, or the RELOAD procedure must be used. The vol-id of the first diskette containing the library becomes the vol-id of the disk file during the RELOAD operation. The BACKUP procedure evokes the $BACK utility.

BACKUP Command Statement Format

```
                ┌              ┐ ┌           ┐
BACKUP vol-id,  │retention-days│ │,filename  │
                │1             │ │,#LIBRARY  │
                └              ┘ └           ┘
```

BACKUP Parameters

vol-id	Volume identification of the diskette(s). One to six alphameric (alphabetic or numeric) characters.
retention-days 1	Length of the retention period (0 to 999 days) for the diskette file. The default is one day. *Note:* A retention value of 999 makes a diskette file a permanent file.
filename	Specifies the name of the single file that is created on the diskette(s).
#LIBRARY	#LIBRARY is the name assigned to the created diskette file.

APPLYPTF Procedure

The APPLYPTF procedure applies PTFs to the library. It is called by the CNFIGSCP procedure, described following, or directly, by the APPLYPTF command statement.

PTFs applied by the APPLYPTF are read from a PTF diskette.

The APPLYPTF procedure evokes the $MAINT utility (see index entry: *$MAINT utility program* in the *IBM System Control Programming Reference Manual,* GC21-7593).

APPLYPTF Command Statement Format

```
           ┌SC1nn┐ ┌,ALL            ┐
APPLYPTF   │RG1nn│ │,PTF log number │
           └UT1nn┘ └                ┘
```

APPLYPTF Parameters That are Not Prompted

SC1nn	PTFs that change the SCP are applied; nn is the version number (release number) of the system.
RG1nn	PTFs that change the RPG II program product are applied; nn is the version number (release number) of the product.
UT1nn	PTFs that change the IBM System/32 utilities program product (DFU/SEU/Sort) are applied; nn is the version number (release number) of the utility.
ALL	Apply all PTFs from the selected PTF file.
PTF log number	Apply only the PTF corresponding to the number given. This number is the PTF log number and is indicated on the cover letter for each PTF. It is also indicated in the PTFXREF source member on each PTF diskette.

Prompted Parameters for APPLYPTF

Translation Required?

YES	PTFs were applied to a translated (non-English) version of a system.
NO	PTFs were applied to a system that has not been translated.

SCP PTFs Applied?

If the response to the translation required prompt was yes, a prompt inquires whether the PTFs applied were SCP PTFs.

YES	The PTFs applied were from the SC1nn file.
NO	The PTFs applied were not from the SC1nn file.

$MASPC Replaced?

If the response to the SCP PTFs prompt was yes, a prompt inquires whether the load member $MASPC was replaced. The PTF cover letter distributed with each PTF diskette lists the members that will be replaced by the PTFs on the diskette.

YES	The PTFs applied replaced $MASPC.
NO	The PTFs applied did not replace $MASPC.

#RDML Replaced

If the response to the SCP PTFs prompt was yes, a prompt inquires whether the load member #RDML was replaced.

YES	The PTFs applied replaced #RDML.
NO	The PTFs applied did not replace #RDML.

CNFIGSCP Procedure

The CNFIGSCP procedure is used for system configuration. It is distributed with each version of the system on an SCP diskette and is removed from the system once system configuration is complete. The CNFIGSCP procedure prompts the user for the print belt image, the date format, RPG II SCP support required, and the existence of a PTF diskette.

The CNFIGSCP procedure evokes the $MAINT and $SETCF utilities (see index entries: *$MAINT utility program* and *$SETCF utility program* in the *IBM System Control Programming Reference Manual,* GC21-7593).

CNFIGSCP Command Statement Format

```
CNFIGSCP
```

Prompted Parameters for CNFIGSCP

Belt Image Option

48 64 96	Sets the print belt image and its length in the system configuration record, a record in the library directory that defines the system in terms of its components. A length of 48, 64, or 96 can be specified.

Note: The serial printer requires a response of 64.

Date Format Option

YMD MDY DMY	Sets the system data format in the system configuration record: year-month-day (YMD), month-day-year (MDY), or day-month-year (DMY).

SCP Support For Data Communications

YES	Data communication SCP support is copied.
NO	Data communication SCP support is not copied.

Note: The CNFIGSCP procedure prompts you for data communication options (clocking, tone, and wrap test) if you specify SCP support for data communication.

SCP Support For RPG II

YES	Copies the optional SCP support for RPG II from the SCP PID diskette to the system.
NO	RPG II SCP support is not copied.

MRJE Support Option

YES	Copies the optional MRJE work station support.
NO	MRJE work station support is not copied.

Batch Work Station Support Option

YES	Copies the option Batch Work Station support.
NO	Batch Work Station support is not copied.

Data Communication Support For RPG

YES	Copies the data communication RPG support.
NO	Data communication support for RPG is not copied.

PTF Diskette Available

YES	Prompts user to insert the PTF diskette and then issues the APPLYPTF command statement to copy SCP PTFs to the system (APPLYPTF SCP01, ALL).
NO	PTFs are not applied.

INDEX

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IBM System/32 Introduction and Maintenance

This technical newsletter provides replacement pages for the subject publication. These replacement pages remain in effect unless specifically altered. Pages to be inserted and/or removed are:

iii through vi
2-5, 2-6
2-13 through 2-16
2-16.1 through 2-16.4
2-23, 2-24
3-17, 3-18
4-31 through 4-34
4-51, 4-52
4-52.1, 4-52.2
5-15, 5-16
C-5, C-6
X-1 through X-4
X-7 through X-10

Changes to text and illustrations are indicated by a vertical line at the left of the change.

Summary of Amendments

- New style disk drive motor
- Changes to printer adjustments
- Changes to installation instructions

Note: Please file this cover letter at the back of the manual to provide a record of changes.

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Summary of Amendments

This TNL reflects the new adjustment of the leadscrew from 45° below track 0 to 80° or 90° below track 0.

Note: Please file this cover letter at the back of the manual to provide a record of changes.

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System
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