IBM Maintenance Library

5213

Printer Stage II

Model 1 (Serial Numbers 12001 and above)
Model 2 (Serial Numbers 21001 and above)
Model 3 (Serial Numbers 31001 and above)

Theory—Maintenance

SY24-3587-1

PREFACE

This publication for service personnel contains theory and maintenance information for the IBM 5213 Printer Models 1, 2, and 3 attached to the IBM System/3 Model 6 Data Processing System. The information presented is for Stage II machines (Model—serial numbers 12001 and above, Model 2—serial numbers 21001 and above, Model 3—serial numbers 31001 and above).

Theory and maintenance information are combined and, where applicable, are presented graphically. Block letters in the text refer to correspondingly marked points in the illustrations. Functional units are treated in this order: description (theory and/or operation), adjustment, removal, and replacement.

Associated publications for reference are: *Form Design Reference Guide for Printers,* Order No. GA24-3488, and *IBM System/3 Model 6 System/3 Basic Operator's Guide,* GC34-0003.

Second Edition (January 1972)

This is a major revision of, and obsoletes, SY24-3587-0. The manual should be reviewed in its entirety.

Changes are continually made to the information herein; any such changes will be reported in subsequent revisions or supplements.

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ABBREVIATIONS

$\bar{A}$	not A
ac	alternating current
$\bar{B}$	not B
C	capacitor
CCW	counterclockwise
CW	clockwise
D	diode
dc	direct current
Hz	hertz
in.	inch
k	kilo (1000)
m	milli (.001)
ms	millisecond
mm	millimeter
n/c	normally closed
n/o	normally open
nfd	nanofarad
Ω	ohm
o/p	operating point
PE	print emitter
R	resistor
R-C	resistor-capacitor
sec	second
SLT	solid logic technology
T	transistor
TB	terminal block
TMA	territory maintenance analysis
uf	microfarad
us.	microsecond
V	volt
VFC	vertical forms control
W	watt

SAFETY

DANGER

After prolonged use, the print magnets may become extremely hot. Be sure the print head has cooled before attempting to remove it. (Pages 2-14 and 2-15.)

CONTENTS

CHAPTER 1. INTRODUCTION

GENERAL CHARACTERISTICS and DESCRIPTION

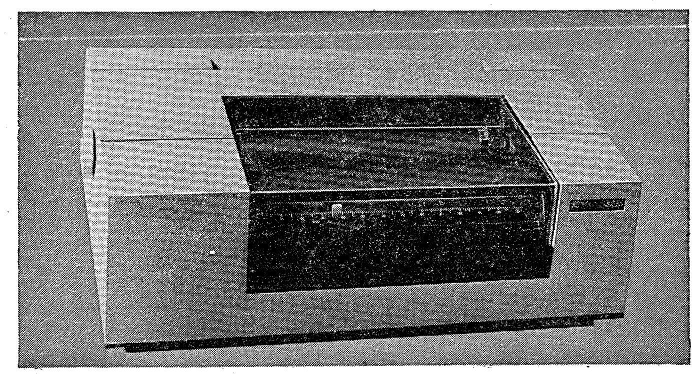
- The IBM 5213 is a table-top, serial matrix output printer.
- Available in three models, the 5213 provides printed output for the system at 85 characters per second. Horizontal spacing is 10 characters to the inch (25,4 mm). Vertical spacing is six lines per inch. All models have fixed margin stops in positions 1 and 132 and electronic tab control. Tab operations (skipping horizontal print positions) are performed by the using system.

Printer

A stepper motor turns a leadscrew that moves the print head back and forth along the print line. The leadscrew is threaded through two nuts in the carrier on which the print head is mounted. The left end of the motor shaft has feedback emitters that generate pulses to control the printer; the right end is coupled to the leadscrew.

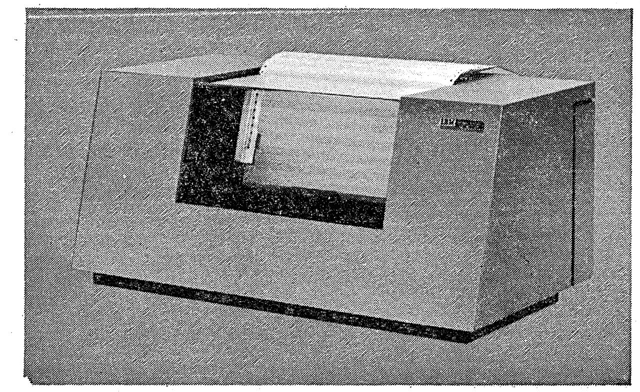
Except for driver cards that provide current to the stepper motor and to the printer magnet coils, the printer contains no electronics (logic circuits). All logic and character pattern generating circuitry, as well as the electrical interface with the system, is provided by the attachment feature (adapter) of the system or by the control unit to which the printer is attached.

PIN-FEED PLATEN, MODEL 1



The Model 1 uses a pin-feed platen, 13 7/8 in. (352,4 mm) hole to hole. Pins in each end of the platen engage margin holes in the paper to ensure positive feeding.

VERTICAL FORMS CONTROL (VFC), MODELS 2 and 3



The Model 2 printer performs tab operations at low speed and carrier return at high speed.
The Model 3 printer prints in either direction (left to right or right to left). It performs tab operations of more than 8 character spaces to the left or right at high speed and performs a carrier return to the left at high speed.

Electronic Carriage

An electromagnetically operated helical spring clutch engages a continuously running clutch shaft to drive a pair of pin-feed tractors that advance the forms. This clutch is program controlled by the system. A carriage emitter, consisting of an emitter wheel attached to the tractor shaft and a transducer, emits one pulse every time the forms tractors advance one line space. These pulses are sent to the system to signal the line counting circuitry that a line space has occurred. The system uses these pulses to control skipping operations.

Forms-Design Considerations

For limitations on forms used with both types of carriages, refer to SRL *Form Design Reference Guide for Printers,* GA24-3488.

FEATURES

The following chart shows the 5213 features.

Printer Model	Max. No. Print Positions	Vertical Spacing	Char Per Sec	Carrier Speed (In. or mm/sec) Print	Carrier Speed (In. or mm/sec) Return	Standard Forms-Handling Equipment	Margin Stops	Tab Stops	Special Features
Model 1	132	6 lines per inch	85	8.5 (216)	16 (406)	Pin-Feed Platen (13 7/8 in. (352,4mm)	Fixed	Elec-tronic	Forms Stand
Model 2	132	6 lines per inch	85	8.5 (216)	16 (406)	VFC (Vertical Forms Control) Electronic Carriage	Fixed	Elec-tronic	None
Model 3	132	6 lines per inch	85	8.5 (216) Both Direc-tions)	16 (406)	VFC Electronic Carriage	Fixed	Elec-tronic	None

MACHINE FUNCTIONS

Besides printing, the 5213 performs the following machine functions initiated from the system:

Space

Moves the print head one character-space to the right or left without printing.

New Line

Upon completion of printing for a line, a line space can be initiated by program control. Otherwise the print head returns to print position 1 for a new line.

PRINTING PRINCIPLES

As the print head moves across the print line, a character is printed by a series of dots within a 7 by 4 matrix. The ends of seven vertically mounted magnetically operated print wires in a column strike the ribbon to make the dots. **A**

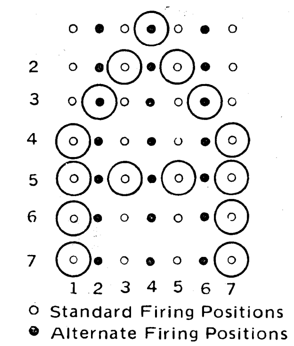
For characters having curved or diagonal elements, the wires can optionally strike at three alternate (halfway) positions to obtain better character definition and improved legibility. This produces a theoretical 7 by 7 dot matrix. **B**

These seven firing positions correspond to the seven teeth in each character group on the print emitter wheel. **C** The space between characters corresponds to the section between the seven-tooth groups. **D**

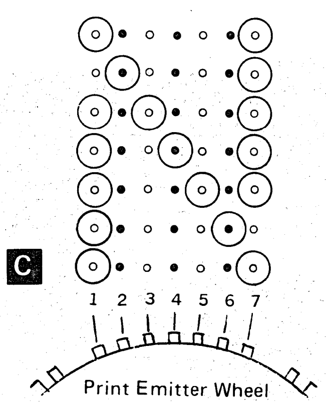
When printing from right to left on Model 3, characters are formed from right to left.

Note: Because time is required to restore the magnet armatures, magnets may not be fired at successive firing points; at least one firing position must intervene between firings.

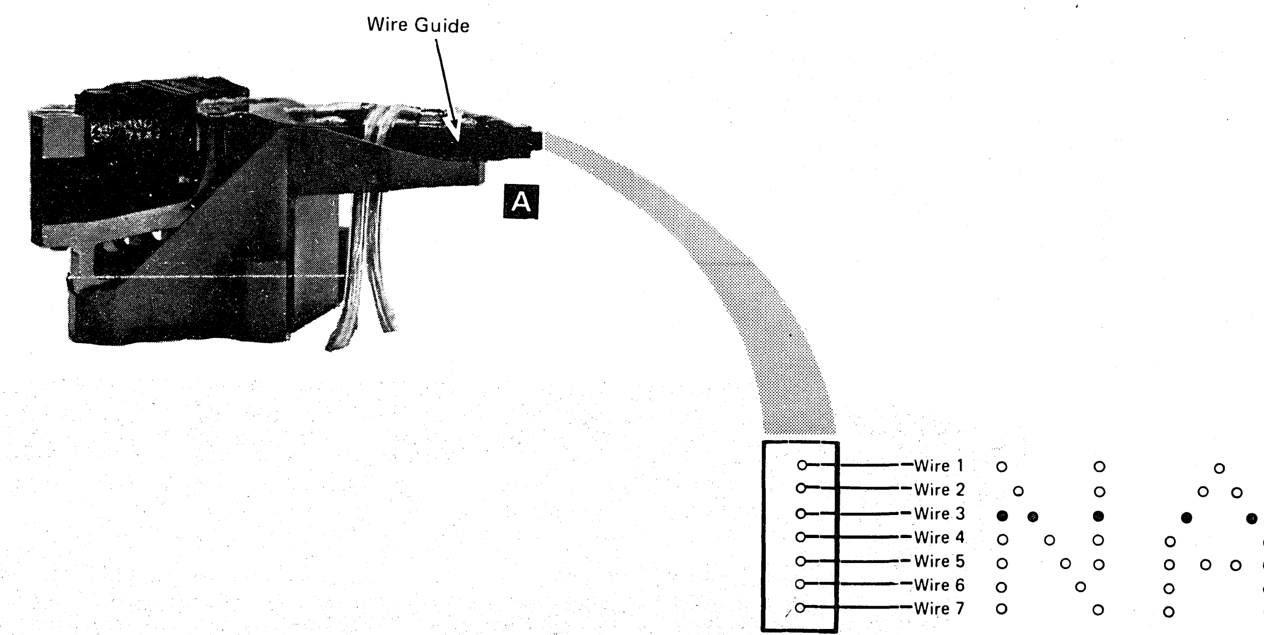
B



C

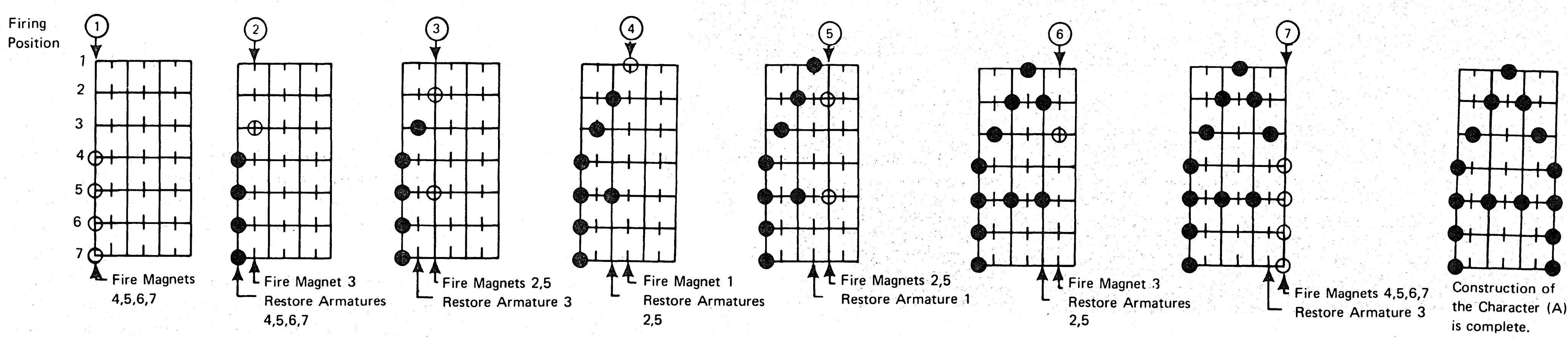


A



Solid dots denote portions of characters printed by print wire 3 as print head moves from left to right.

D Printing a Character

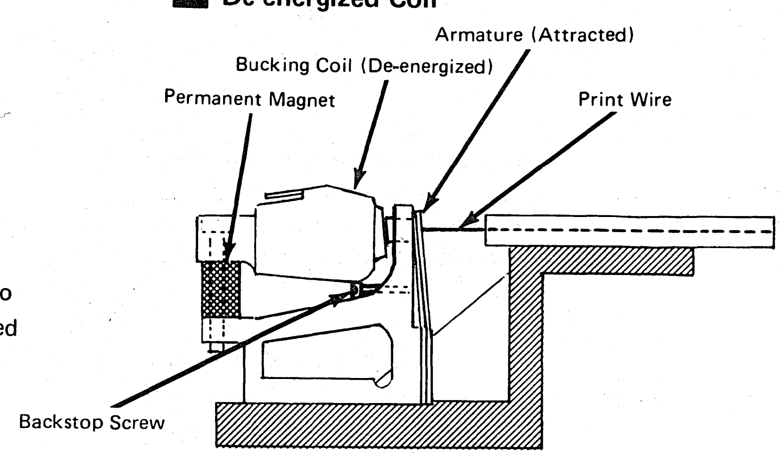


Print Magnet Operation

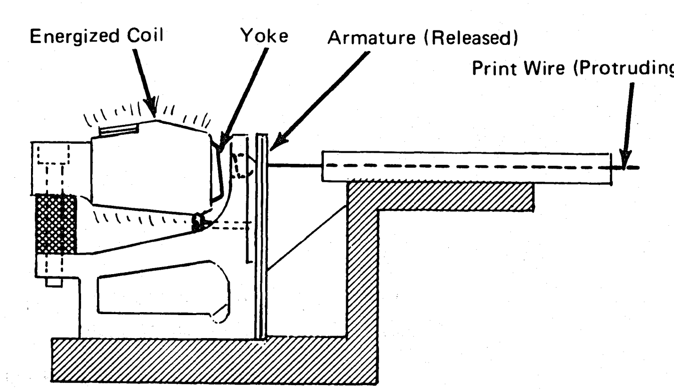
Permanent magnets on the print unit cause the armatures to attract to their yokes. **E**

Energizing an individual bucking coil cancels the magnetic field in the yoke. This allows the armatures to snap forward due to its spring tension to drive the attached print wire against the ribbon, paper, and platen. **F**

E De-energized Coil



F Energized Coil



PRINTER COMPONENTS

Stepper Motor A

- To turn the leadscrew and move the print head, the stepper motor must receive a continuous series of pulses. Each pulse turns the motor two degrees.
- To start rotation in either direction, the first pulse is supplied by the system.
- To keep the stepper motor rotating, an emitter provides feedback pulses to the stepper-motor logics in the system. The emitter wheel is attached to the stepper motor shaft and has forward and reverse transducers. These transducers produce feedback pulses for left-to-right (forward) and right-to-left (reverse) print-head movement. High-speed return (right to left) occurs when the adapter inserts an extra reverse-feedback pulse between normal pulses to the stepper-motor logic.
- To stop print-head motion, the stop signal from the system or from a margin switch interrupts the normal gating of feedback pulses and substitutes a decelerating sequence of four pulses that stops the stepper motor.

Print Emitter B

Models 1 and 2

A print emitter, consisting of a print-right transducer and an emitter wheel having groups of seven teeth, produces pulses that time the firing of the print magnets and enables the system to keep track of the print head.

Model 3

The print emitter has a print-right and a print-left transducer. These transducers provide timing pulses to determine when the print wires are fired when printing in either direction.

Leadscrew C

The stepper motor drives the leadscrew (coupled to stepper-motor shaft) and the emitters. The leadscrew moves the print head left or right. The emitters send signals to the system for control of the stepper motor and print magnets.

Ribbon Drive Gear

Models 1 and 2

A gear on the print-head carrier meshes with the flexible drive rack stretched across the front of the machine. This gear operates a one-way clutch that advances the ribbon only when printing (print head moving left to right).

Model 3

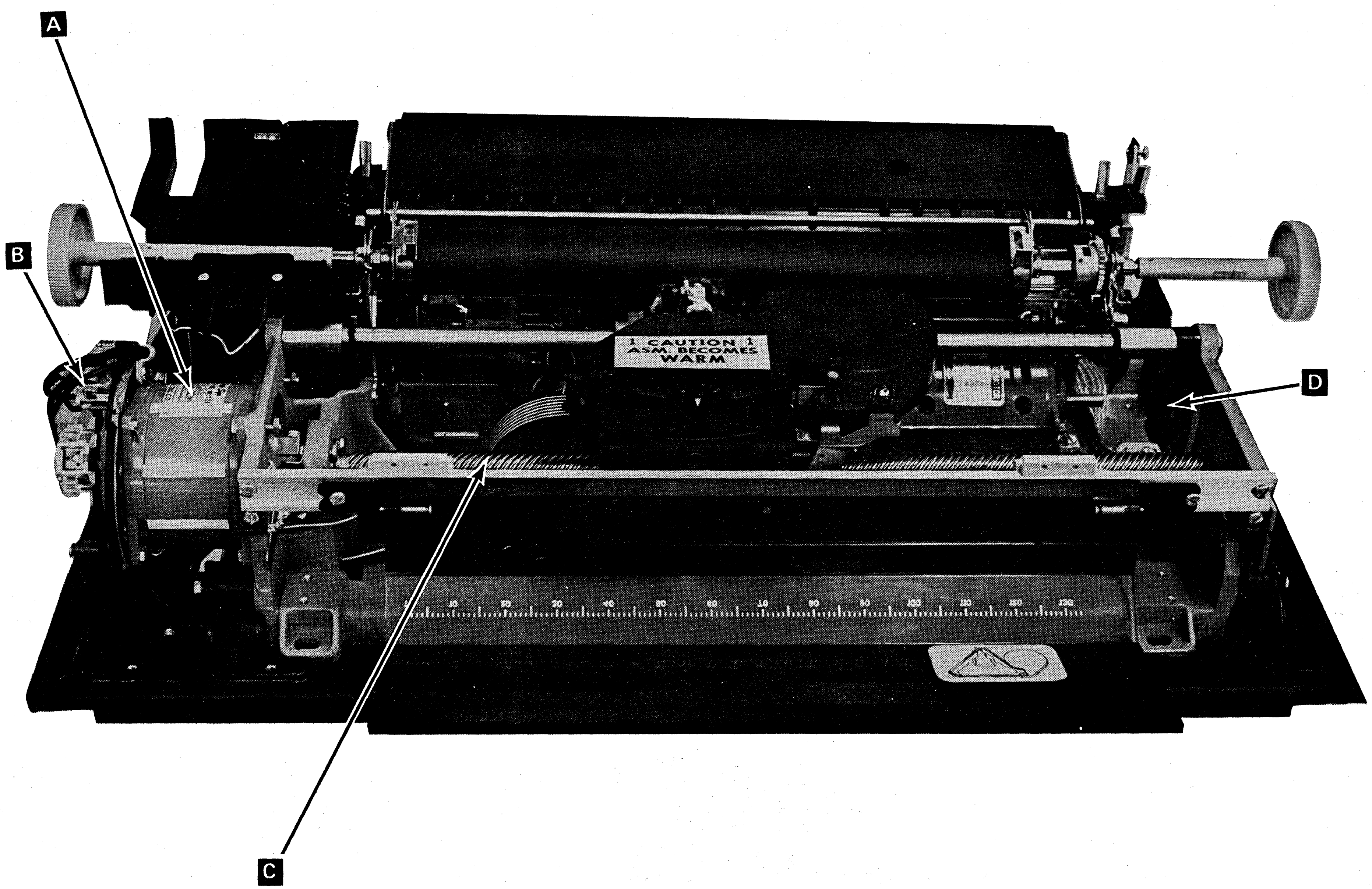
A second drive gear and ribbon drive rack advance the ribbon when printing right to left.

Platen Feed Clutch (Model 1) D

Signals provided by the system energize the platen-clutch solenoid. When the solenoid is energized, the forms-moving switch signals the system that the platen is moving.

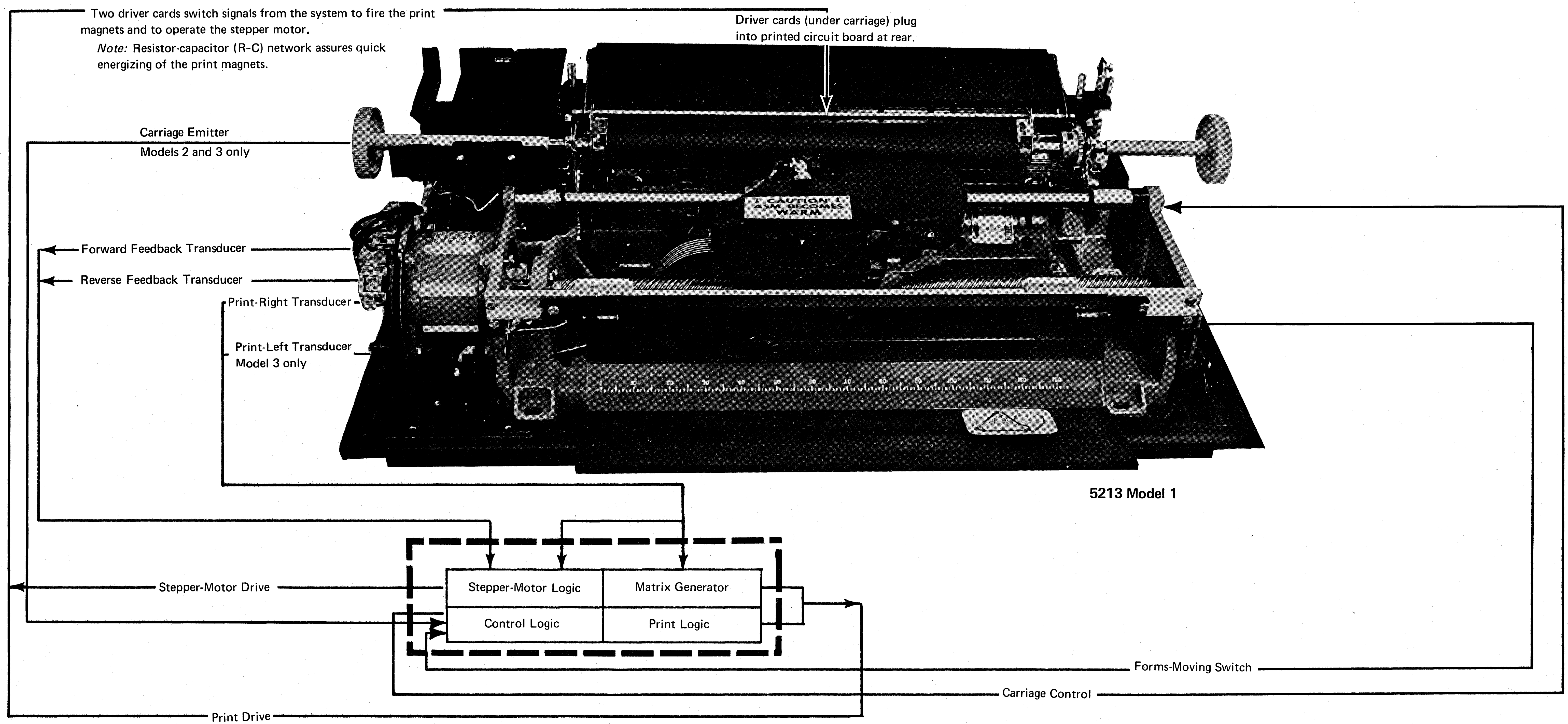
Stepper-Motor Transducer Shield (Model 1)

The shield prevents noise (generated by print-magnet firing) from being injected into the stepper-motor drive circuitry.



Control Lines

The portion of the diagram within the broken lines represents the logic in the system for control of the printer and carriage.



5213 Model 1

CHAPTER 2. FUNCTIONAL UNITS

2.0 STEPPER-MOTOR CHARACTERISTICS

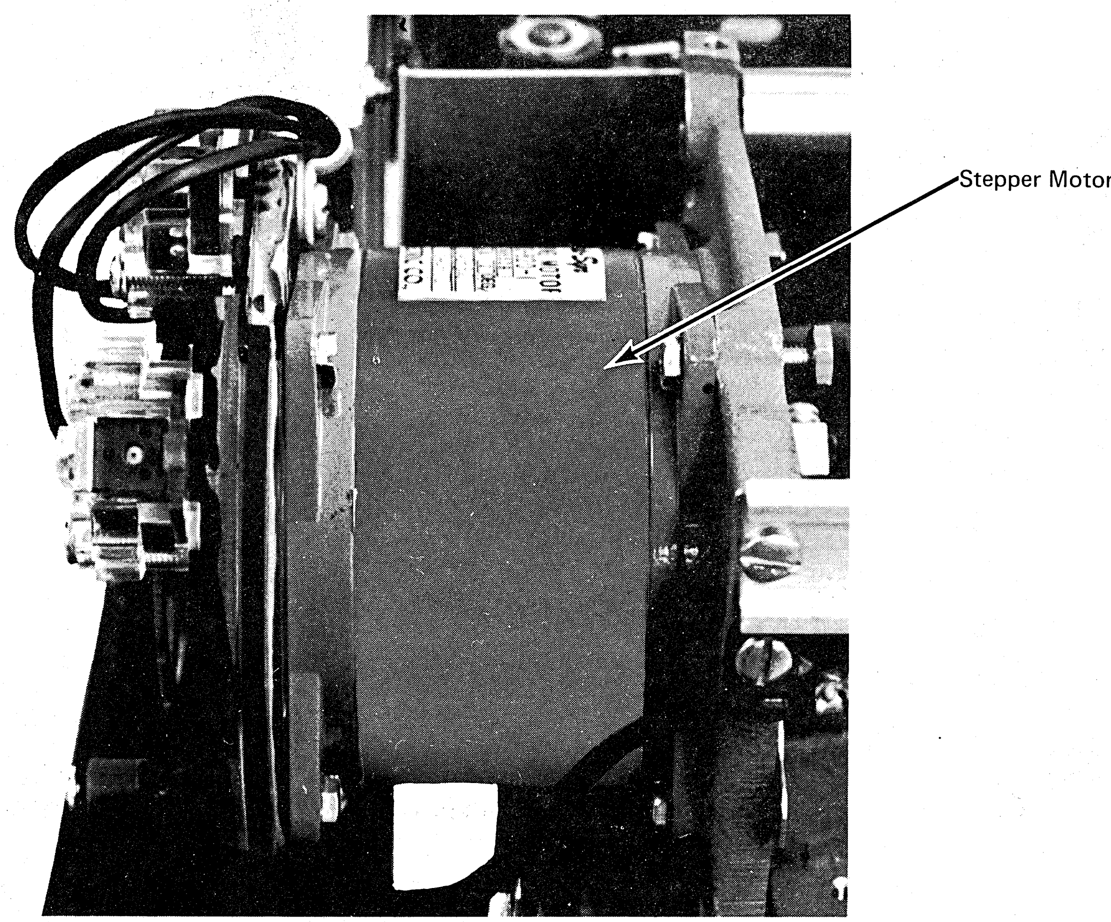
- The stepper motor is a sealed unit.
- The stepper motor is phase-controlled with direct current.
- When not turning, the stepper motor locks in an electrically detented position.
- The sequence of the phase pulses from the system controls direction of rotation.

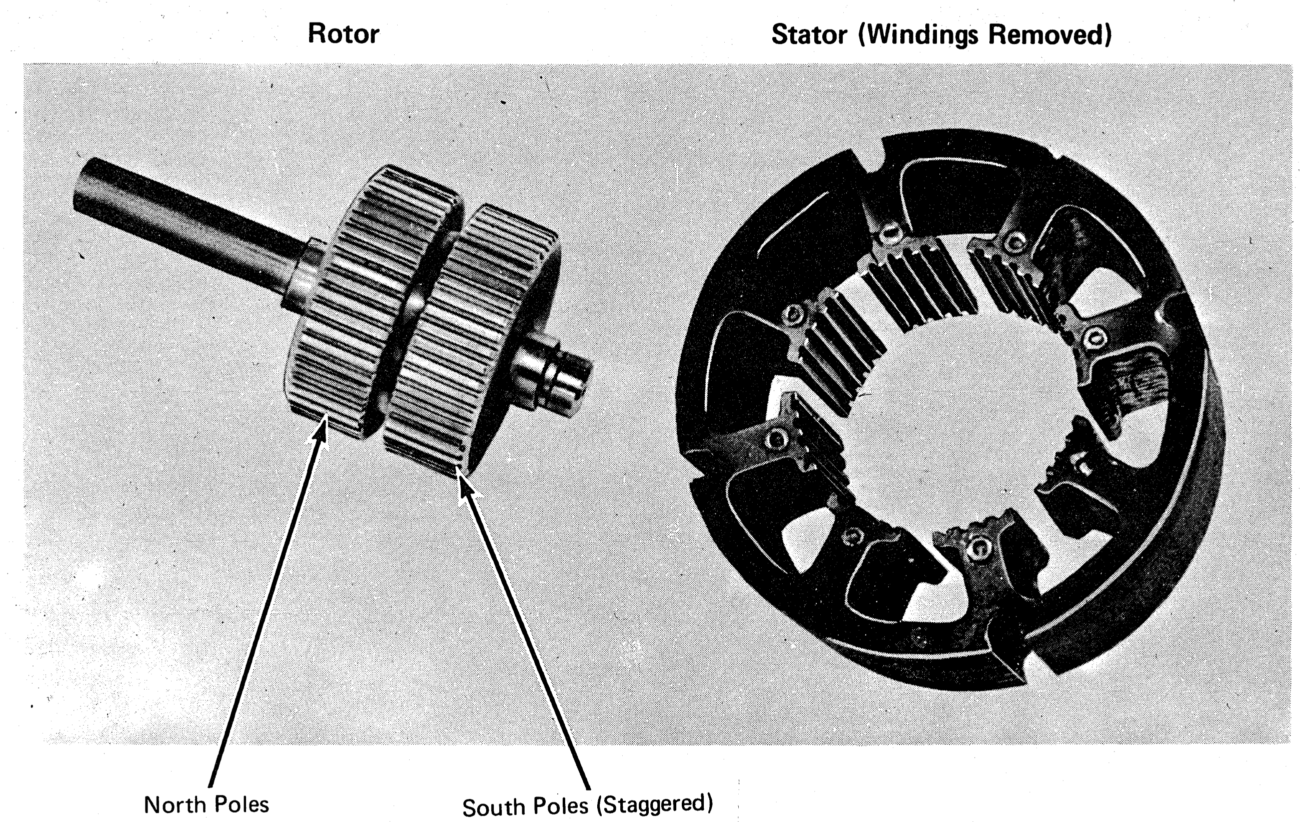
The printer drive motor is an enclosed dc stepper motor consisting of a permanent-magnet rotor (armature) and a pair of two-phase stator windings. The motor is a sealed unit having no gears or commutators and requiring no maintenance.

Note: The permanent-magnet rotor is magnetized at the plant after assembly. 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.

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 acts on the permanent-magnet rotor to produce torque in the rotor shaft. This torque turns the rotor shaft only a fraction of a revolution; then locks it in an electrically detented position. (The amount of rotation of this stepper motor is two degrees per step.) Electrical detenting is due to direct current in stator windings acting on permanent-magnet rotor.

Note: The motor cannot be easily turned by hand with power on. When power is off, the residual detenting due to the permanent magnet may be felt as a drag or roughness, and heard as a clicking sound when the shaft is turned.

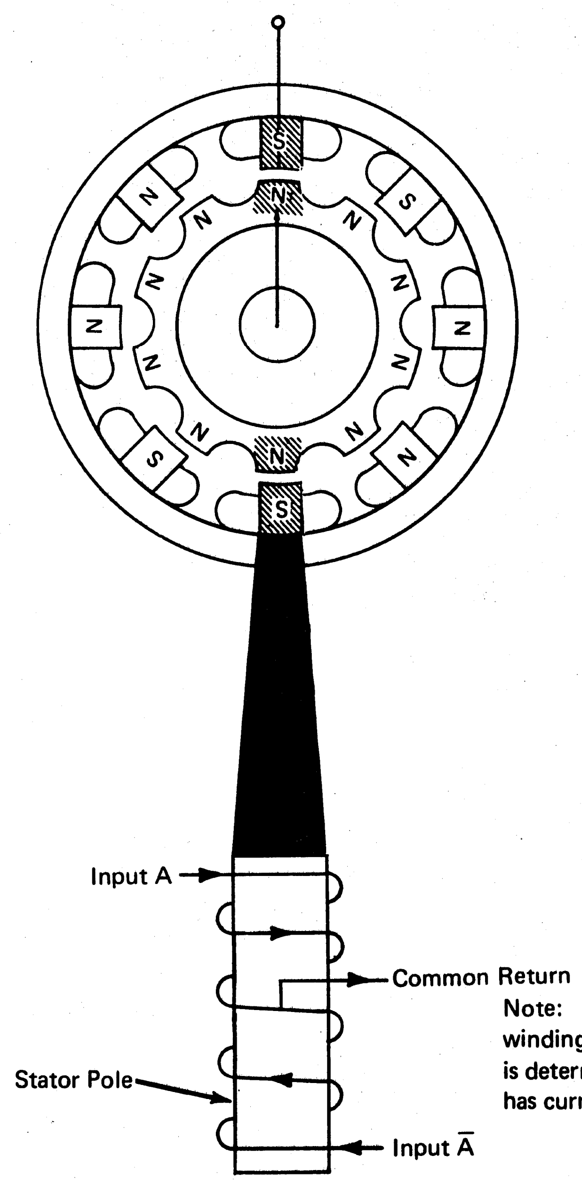




2.1 STEPPER-MOTOR OPERATION

For ease of understanding, the motor used in this example turns nine degrees per step. The 5213 stepper motor operates the same, except that it turns two degrees per step.

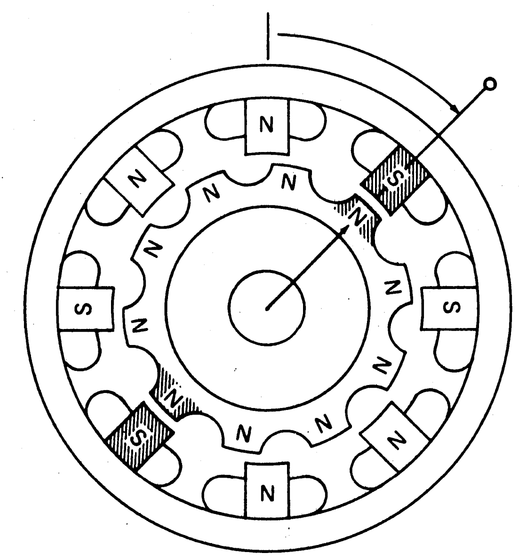
1 This simplified stepper motor consists of eight coil-wound stator poles and a ten-pole permanent-magnet rotor.



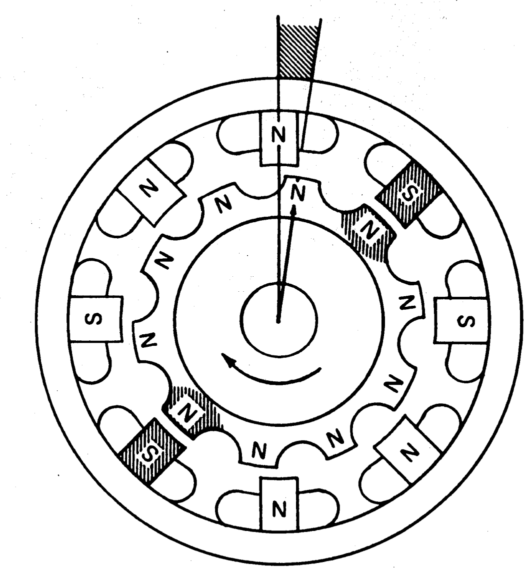
Stator-Pole Winding

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.

2 If we physically rotate the stator (in either direction), the rotor maintains its detented position and follows the stator as shown. (Both stator and rotor rotated clockwise 45 degrees.)



3 If, instead of physically rotating 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 Step 1.



4 The stepper motor is advanced by pulses provided by two triggers in the adapter.

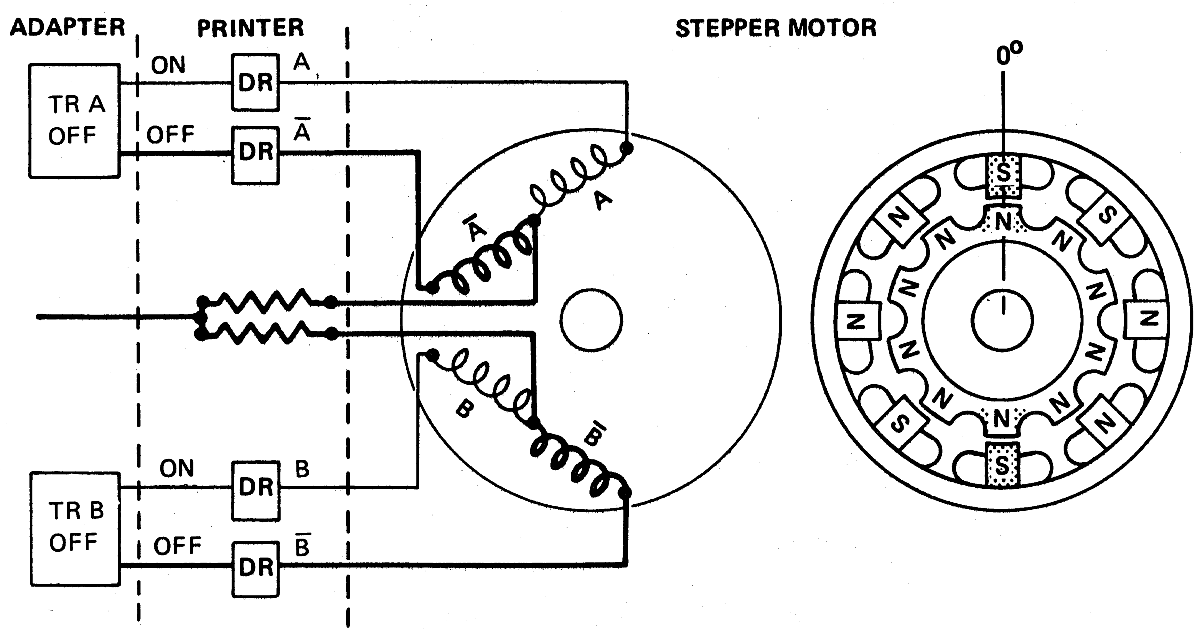
The two triggers (A and B) provide four pulses to step the motor: ($\overline{A}\overline{B}$, $A\overline{B}$, AB, $\overline{A}B$).

Direction of rotation depends on the sequence of stator magnet switching. This, in turn, depends on the triggers.

Condition of Triggers	
Clockwise	**Counterclockwise**
$\overline{A}\overline{B}$	$\overline{A}\overline{B}$
$A\overline{B}$	$\overline{A}B$
AB	AB
$\overline{A}B$	$A\overline{B}$
$\overline{A}\overline{B}$	$\overline{A}\overline{B}$

5 Home Position $\overline{A}$ $\overline{B}$ (Reset)

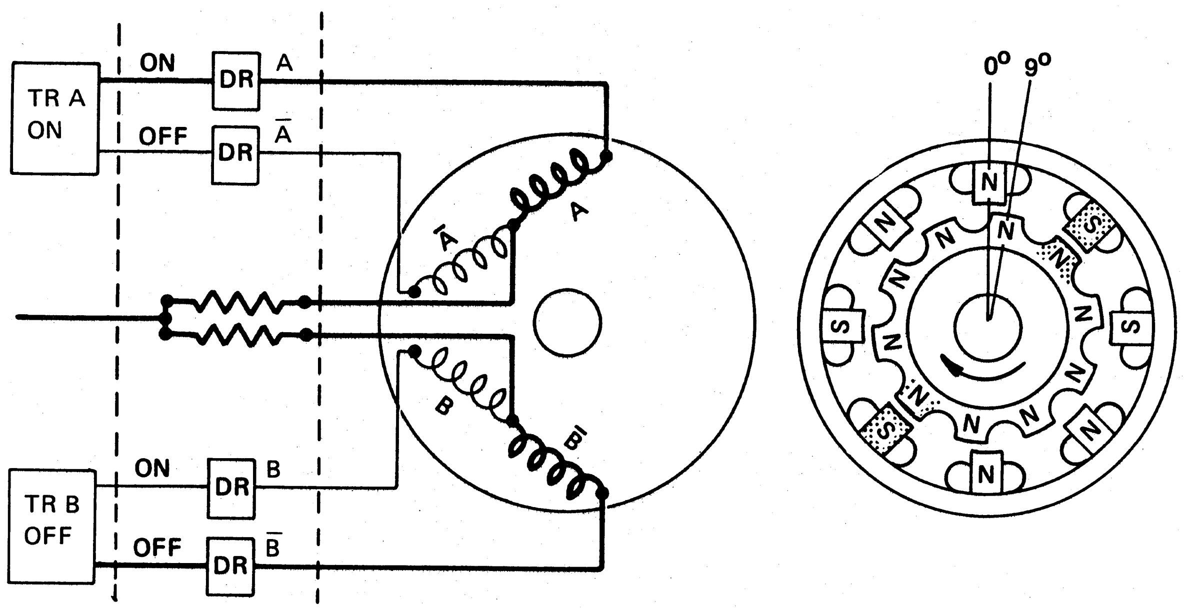
The rotor is in its static (detented) condition when trigger $\overline{A}$ and $\overline{B}$ are active. This results in the stator polarity shown. The stepper motor is stopped.



6 First Advance Pulse A $\overline{B}$ (Generated by Adapter)

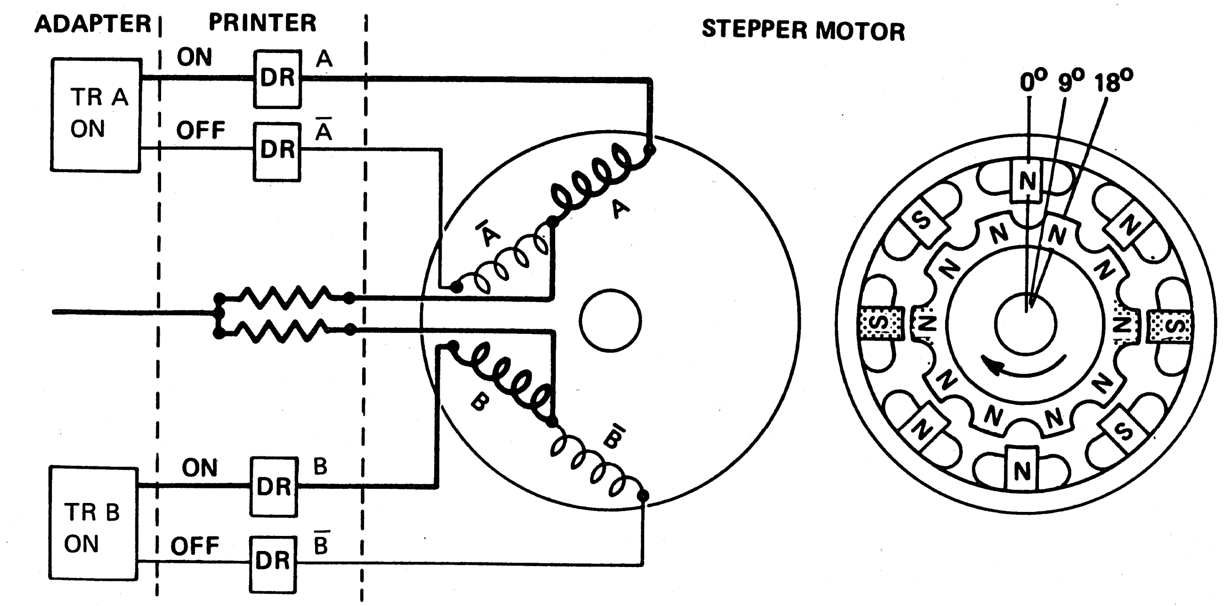
When the triggers advance to the A$\overline{B}$ condition, the polarity of the stator magnets (due to bifilar windings) is rotated clockwise.

Because the rotor segment (shaded) is near the next stator pole to its right, the armature rotates nine degrees until the rotor and stator poles align with each other; then stops.



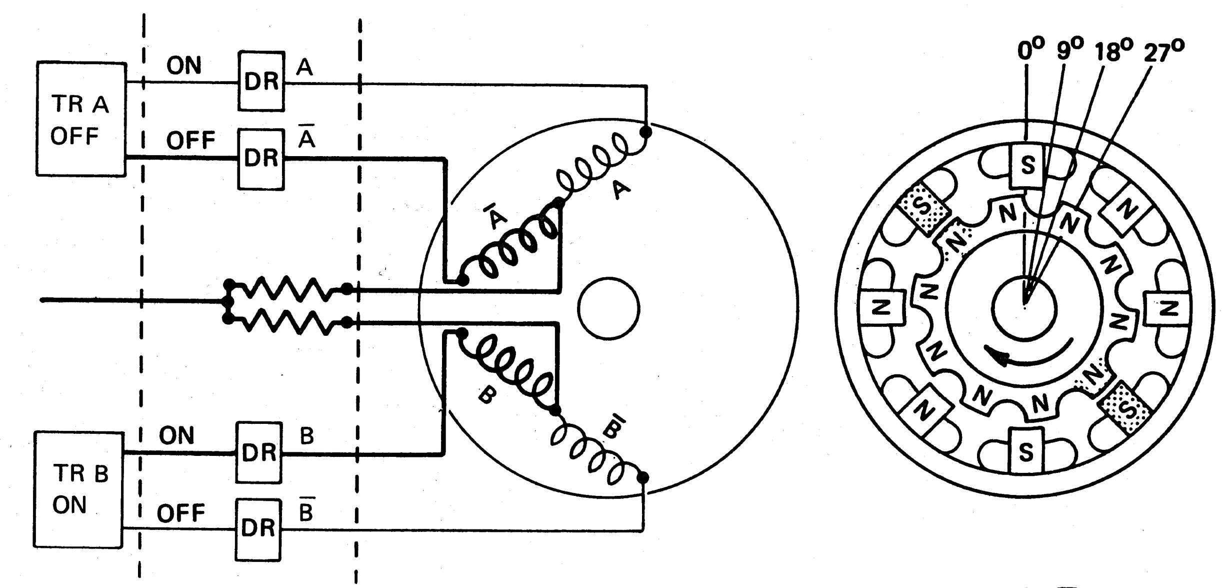
7 Second Advance Pulse A B (First feedback pulse from Forward Drive Transducer)

As the triggers continue to advance, the rotor turns in nine-degree increments.



8 Third Advance Pulse $\overline{A}$ B (Second feedback pulse from Forward Drive Transducer)

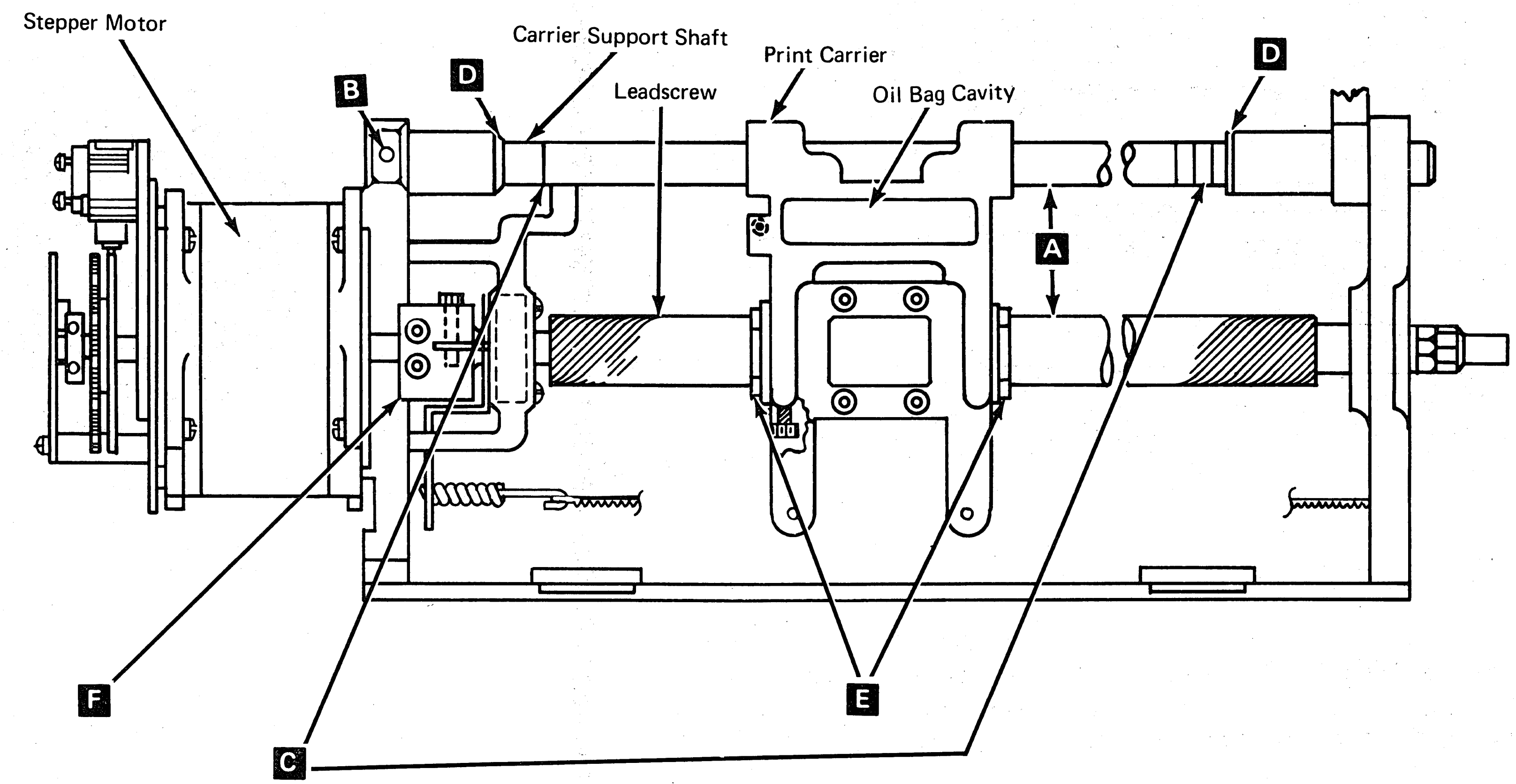
Rotation continues as long as the triggers continue to advance in this sequence.



2.2 PRINT-HEAD DRIVE DESCRIPTION

- The print-head drive consists of the stepper motor, leadscrew, carrier support shaft, and print carrier.
- The print head is mounted on the print carrier.

1. The print carrier is supported by a fixed support shaft and a leadscrew. A Carrier contains an oil bag for print-wire lubrication.
2. The carrier support shaft is positioned flush with the left side frame by a setscrew. B Four milled rings C provide references for print carrier timings.
3. Two rubber bumpers D prevent the carrier from striking the side frames.
4. The leadscrew, threaded through two nuts E in the print carrier, moves the print carrier right or left, depending on the turning direction of the leadscrew.
5. A coupling F connects the leadscrew to the stepper motor.



2.3 EMITTERS and TRANSDUCERS (DESCRIPTION)

Three pulse emitters provide signals for controlling printing and print-head movement:

- Forward Feedback Emitter
- Reverse Feedback Emitter
- Print Emitter

The emitters consist of transducers and toothed emitter wheels mounted on the left end of the stepper motor. Emitter-wheel teeth passing the tips of the transducers generate electrical pulses in the transducers. These pulses are transmitted to the system, amplified, shaped, and timed to operate the printer stepper motor and print magnet coils.

The emitters that provide signals to the adapter in response to other signals from the system are called *feedback emitters.*

Forward Feedback Emitter

This emitter consists of a transducer and a feedback emitter wheel that it shares with the reverse feedback transducer. This wheel (inner position on the stepper motor shaft) has 180 teeth, equally spaced at 2° intervals around its circumference. Pulses generated by this emitter are sent to the system to keep the stepper motor running in the forward direction (left to right).

Reverse Feedback Emitter

This emitter consists of a transducer and the feedback emitter wheel used by the forward feedback emitter. The reverse feedback emitter supplies pulses to the system to operate the stepper motor in the reverse direction.

Print Emitter

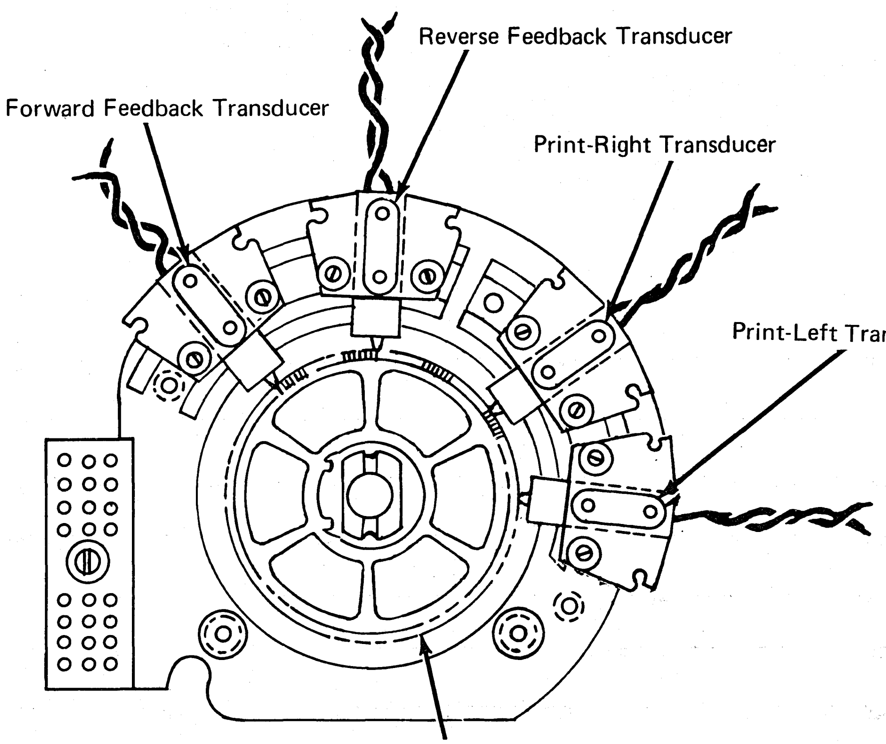
Models 1 and 2

A print emitter, consisting of a print-right transducer and an emitter wheel having groups of seven teeth, produces pulses that time the firing of the print magnets and enables the system to keep track of the print head.

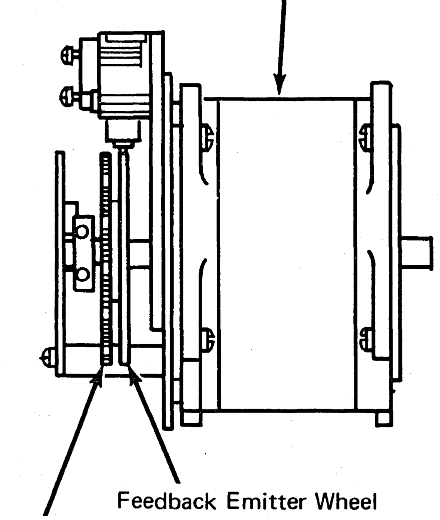
Model 3

The print emitter has a print-right and a print-left transducer. The print-left transducer provides timing pulses to determine when the print wires are fired when printing right to left.

Note: Regardless of the direction of emitter-wheel rotation, the pulse generated by the first tooth to pass the transducer is called PE-1.



LEFT END VIEW



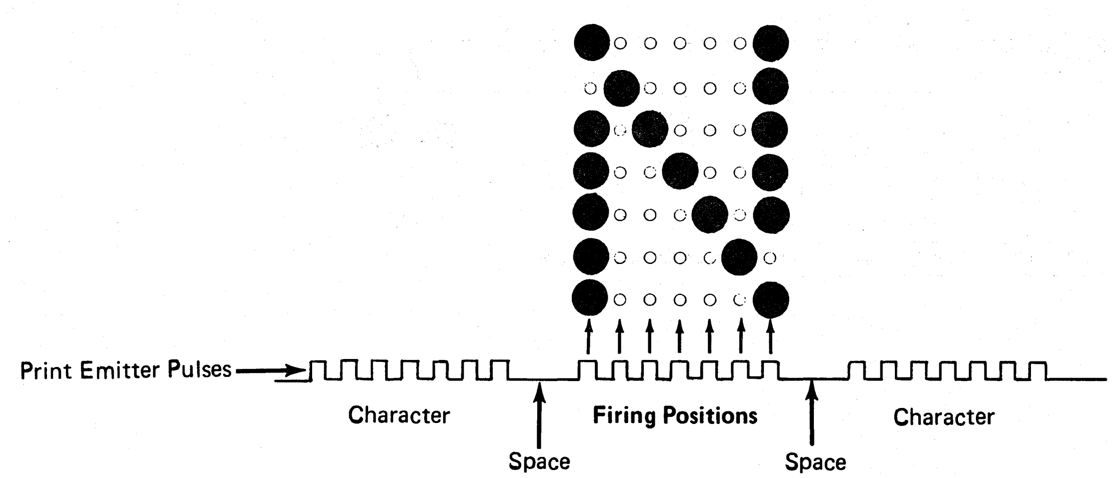
FRONT VIEW

2.4 PRINT-EMITTER-to-CHARACTER RELATIONSHIP

The 7 by 7 dot matrix pattern is the theoretical maximum number of dots that could be printed by a column of seven print wires firing at all seven firing positions. However, because of the time required to restore the armature, no print wire can fire in successive firing positions. At least one firing position must intervene between firings. This limits to four the actual number of times each print magnet can fire for any one character.

The seven teeth in a group on the print emitter wheel correspond to the seven possible firing positions; the space between the groups of teeth corresponds to the space between characters. A character space is produced by advancing the print head without firing any print magnets.

The pulses generated by the teeth as the emitter wheel passes the transducer are squared off by the adapter circuitry and sent to the appropriate print magnets according to the bits in the buffer image of the character stored in the adapter.



2.5 CARRIAGE EMITTER MODELS 2 and 3

A carriage emitter, consisting of an emitter wheel attached to the tractor shaft and a transducer, emits one pulse every time the forms tractors advance one line space. These pulses are sent to the system to signal the line counting circuitry that a line space has occurred. The system uses these pulses to control skipping operations.

2.6 PRINTER OPERATION TIMING, LEFT TO RIGHT, TWO POSITIONS

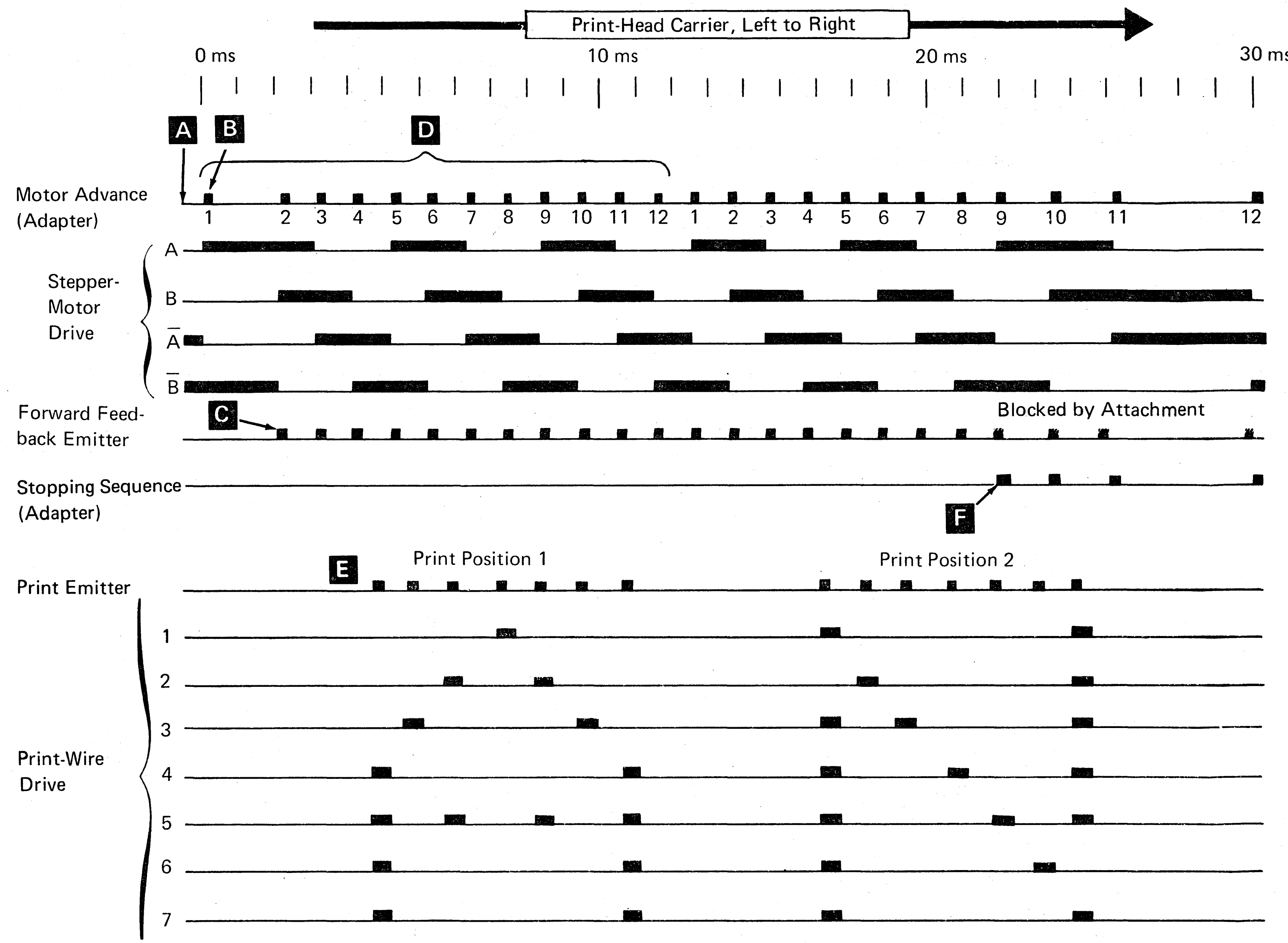
OBJECTIVE:
To start print-head motion, print two characters (beginning in print position 1), and stop the print head in print position 3.

Operation

1. Stopped position **A**. Stepper-motor drive lines $\bar{A}$ and $\bar{B}$ active; A and B inactive.
2. Adapter starts print-head carrier forward motion by generating a motor advance pulse **B** to activate stepper-motor drive line A and deactivate drive line $\bar{A}$.
3. Turning stepper motor generates forward feedback emitter pulses **C**. These pulses, sent to adapter, time motor-advance pulses to maintain carrier motion.
4. Print-head carrier moves one character position every 12 motor-advance pulses. **D**
5. Print emitter pulses **E**, sent to adapter, control timing of print driver control lines. These lines are selected by the character pattern generator in the adapter.
6. After motor-advance 8-time of last character printed, adapter initiates stopping sequence. Four timing pulses **F** generated by adapter, control timing of motor-advance pulses 9, 10, 11, and 12 to stop print-head carrier.

Model 3

Note: When printing from right to left, timing and speed are the same as when printing from left to right. PE pulses are generated by the print-right transducer when the print head is moving to the right, and by the print-left transducer when the print head is moving to the left.
Carrier return (no printing) is at high speed. Tabulation of more than eight spaces (either direction) is at high speed.



2.7 PRINTER OPERATION TIMING, RIGHT TO LEFT, TWO POSITIONS

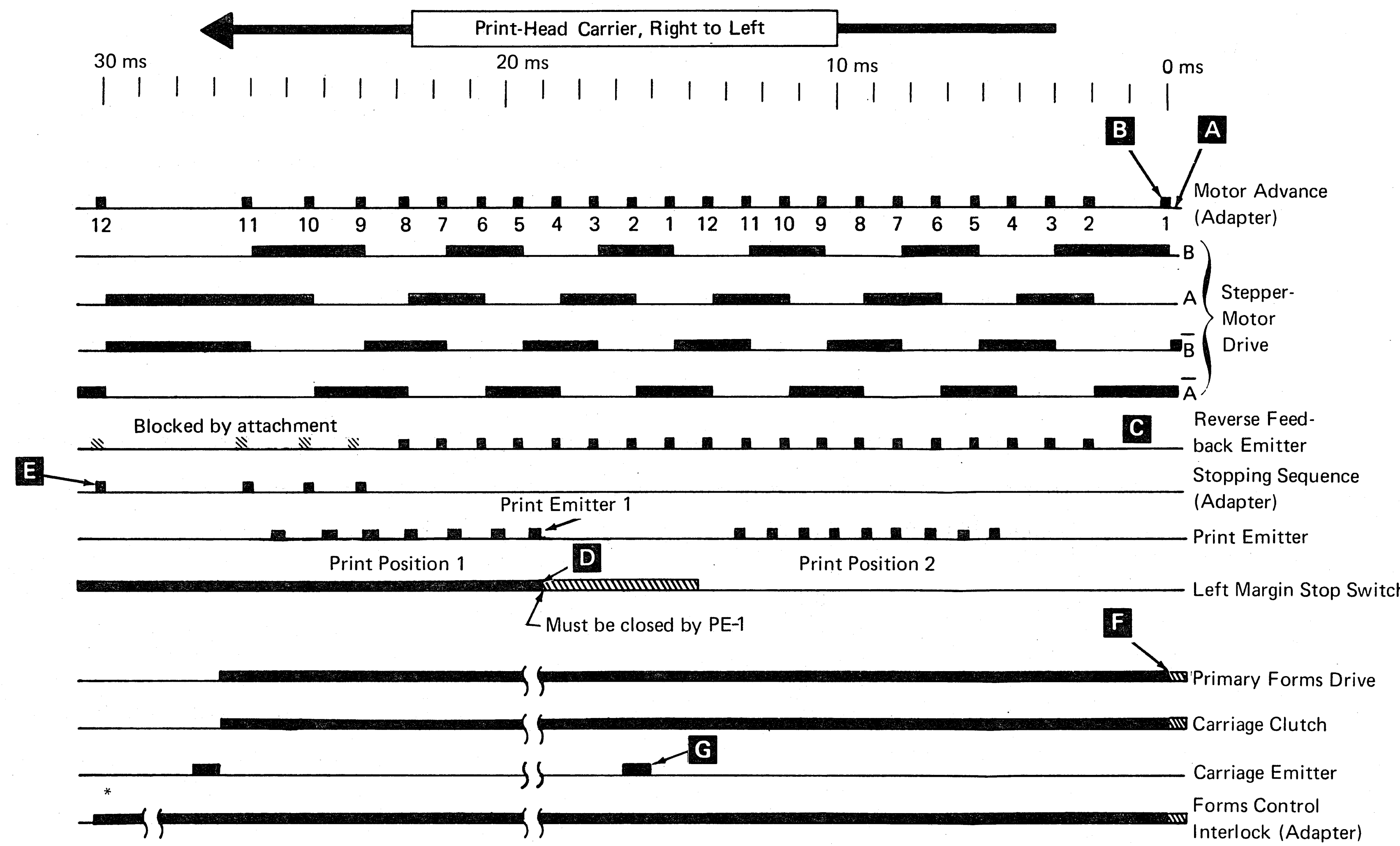
Objectives:

1. To start reverse print-head motion to return the print head to position 1, close the left margin switch, and stop the print head in print position 1.
2. For Models 2 and 3, to start carriage skip and to stop carriage skip.

Note: Carriage functions may be performed during a print-head carrier-return operation.

Operation

1. Print-head carrier stopped in position 3. A
2. Adapter starts print-head carrier reverse motion by generating a motor-advance pulse B to activate motor drive line B and deactivate line $\overline{B}$.
3. Turning the stepper motor generates reverse feedback emitter pulses. C These pulses, sent to adapter, time motor-advance pulses to maintain carrier motion.
4. Left margin stop switch must be closed by print emitter 1-time D of print position 1.
5. After motor advance 8-time of print position 1, the adapter initiates the stopping sequence. Four timing pulses E generated by adapter, control timing of motor-advance pulses 9, 10, 11, and 12 to stop print-head carrier.
6. Adapter activates primary forms drive line F to energize carriage clutch.
7. Carriage emitter pulses G signal each line skipped. Adapter stops skip operation after desired number of lines are skipped.



* Timing of the forms control interlock is controlled by the adapter to ensure that forms movement has stopped before printing starts.

2.8 MARGIN SWITCH OPERATION

The fixed margin stops consist of reed switches. The contacts close when a magnet on the front of the print carrier moves past.

Left Margin Switch

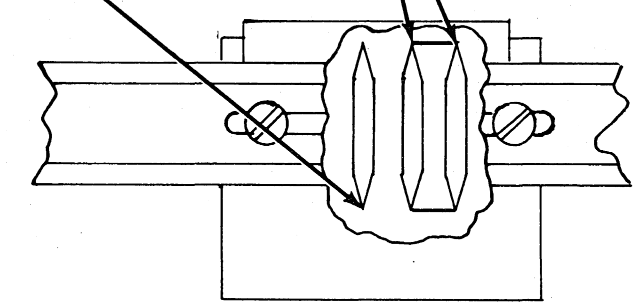
Objectives:

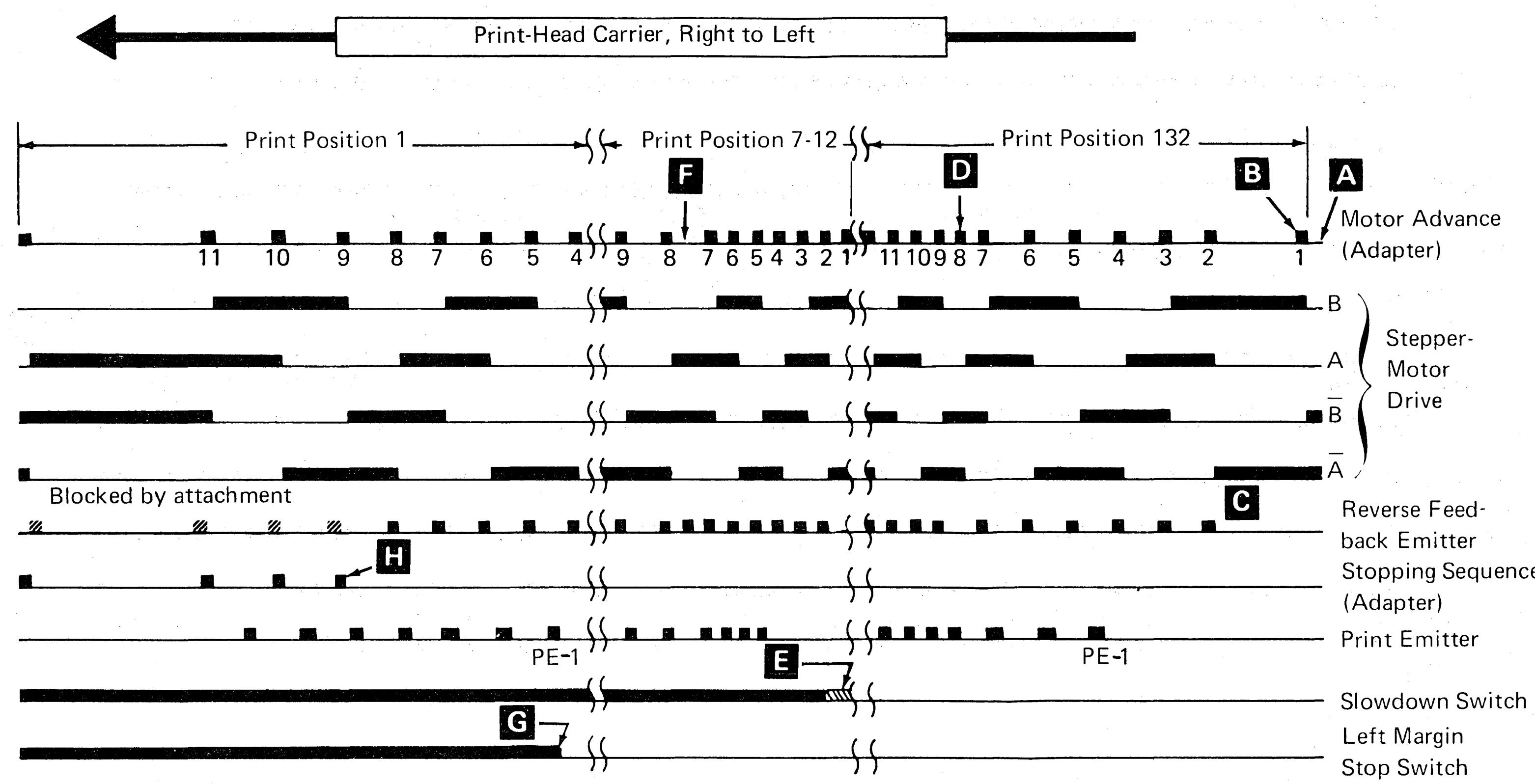
To start print-head motion to the left, maintain carrier-return speed, close the slow-down and stop reed switches, and stop the print head in print position 1.

Operation

1. Print-head carrier stopped after print position 132. **A**
2. Adapter starts print-head carrier reverse motion by generating a motor advance pulse **B** to activate motor drive line B and deactivate drive line $\overline{B}$.
3. Turning the stepper motor generates reverse feedback emitter pulses **C**. These pulses, sent to the adapter, time motor-advance pulses to maintain carrier motion.
4. Reverse motion (with slowdown switch not made) signals adapter to initiate high speed. If slowdown switch is closed **D**, the adapter does not generate an early motor-advance 8-pulse and carrier returns at low speed: 8.5 in. (216 mm) per second. When an early motor-advance 8-pulse is generated by the adapter, print head carrier speed changes, over several print positions, from 8.5 to over 15 in. (216 to 381 mm) per second. Actual speed change is not as rapid as shown on the timing chart. Reverse feedback emitter pulses, at more than double their previous rate, control motor-advance timing to maintain high speed.
5. The slowdown switch makes **E** between print positions 15 and 6 to signal adapter to slow stepper motor speed.
6. The next motor-advance pulse after 7-time **F** is blocked by adapter. This causes print-head carrier to slow, over several print positions, to normal speed.
7. Left margin stop switch must be closed by print emitter-1-time **G** of print position 1.
8. After motor-advance 8-time of print position 1, adapter initiates stopping sequence. Four timing pulses **H** generated by adapter, control timing of motor-advance pulses 9, 10, 11, and 12 to stop print-head carrier.

- Two reed switches (slowdown) wired in parallel signal adapter to slow the print head as it moves from right to left at high speed.
- One reed switch signals adapter to stop print-head movement.





Right Margin Switch

Objective:

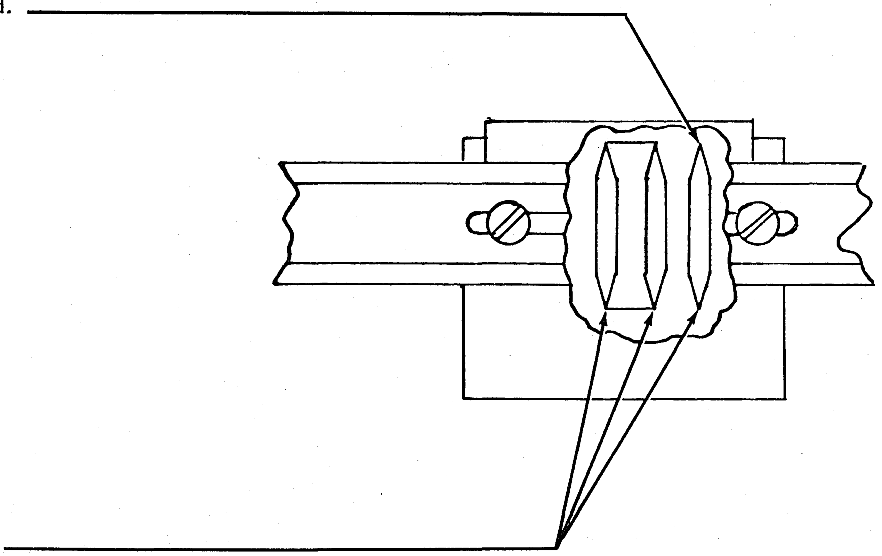
To close the stop reed contact in the right margin stop switch as the print head moves from left to right.

Operation

1. Model 3 only--The slowdown switch closes **A** between print position 121 to 126 to signal adapter to slow print-head speed to 8.5 in. (216 mm) per second.
2. Right margin stop switch must close by print emitter 1-time (PE-1) **B** of print position 132 to signal the adapter to stop the print head.
3. After motor-advance 8-time of print position 132, the adapter generates four stopping sequence pulses **C**. These pulses control motor-advance timing to stop print head after position 132.
4. Approximately 25 ms after the start of motor-advance 8-time **D** carrier-return/line-feed operations may be initiated by the adapter.

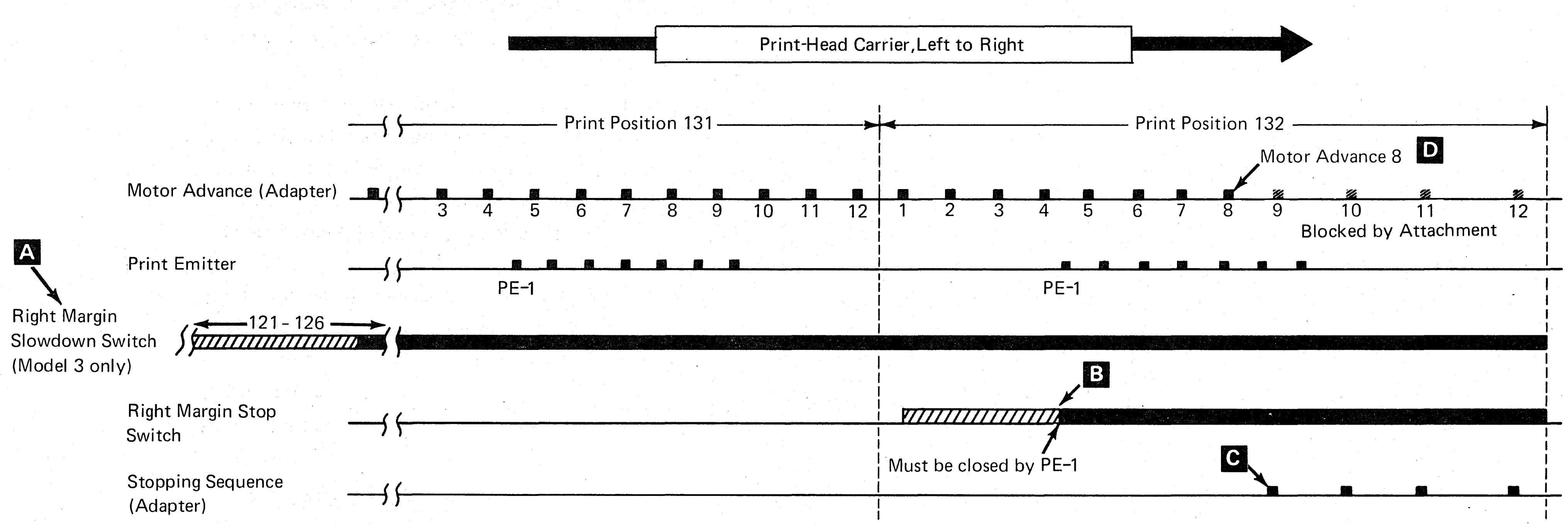
Models 1 and 2

The print head moves to the right at slow speed and uses only the stop reed switch to signal the adapter to stop the print head.



Model 3

The print head tabs to the right at high speed and uses the two slowdown reed switches and the stop reed switch to signal the adapter to stop the print head.



2.9 REPLACEMENT AND ADJUSTMENT SEQUENCE GUIDE

Check these adjustments in the sequence shown if any of the following is removed or replaced.

Stepper Motor

1. Printer Carrier and Print Emitter Adjustment	2.20
2. Margin Switch Adjustments	2.21
3. Stepper-Motor Speed Adjustments	2.22

Leadscrew

1. Leadscrew-Nut-Backlash Adjustment	2.18
2. Print Carrier and Print Emitter Adjustment	2.20
3. Margin Switch Adjustments	2.21
4. Stepper-Motor Speed Adjustments	2.22

Margin Switch

1. Margin Switch Adjustments	2.21

Print Head or Print-Wire-Magnet Assembly

1. Print-Head-to-Platen Clearance and Ribbon Guide Assembly Adjustment.	2-29

Drive Emitter or Print Emitter Wheel

1. Print Carrier and Print Emitter Adjustment	2.20
2. Margin Switch Adjustments	2.21
3. Stepper-Motor Speed Adjustments	2.22

Carriage Motor

1. Belt tension

Spring Clutch, Models 2 and 3

1. Spring Clutch Adjustment	2.60

Print-Right and Print-Left Transducers

1. Print Carrier and Print Emitter Adjustment	2.20
2. Emitters and Transducers Adjustments	2.19
3. Stepper-Motor Speed Adjustments	2.22
4. Margin Switch Adjustments	2.21

Forward and Reverse Feedback Transducers

1. Print Carrier and Print Emitter Adjustment	2.20
2. Emitters and Transducers Adjustment	2.19
3. Stepper-Motor Speed Adjustments	2.22

Platen Removal and Replacement, Model 1

1. Check platen adjustments and adjust as necessary.

Carriage Emitter, Models 2 and 3

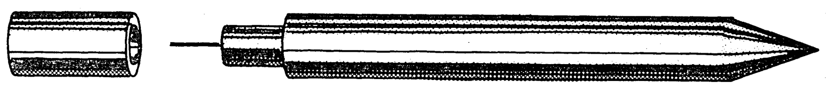
1. Electronic Carriage Emitter Adjustment	2.61

2.10 TOOLS AND SUPPLIES

Special tools used for servicing the printer are:

Shipped Tools

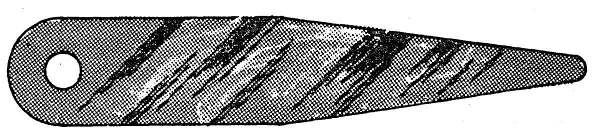
WIRE CLEANING and STRAIGHTENING TOOL, PART 2617969



a. The pointed end has a small hole to be used for straightening slightly bent print wires. Insert a print wire in the hole and form the wire until it is straight. Do not attempt to form a kinked wire.

b. The other end has attached a small wire protected by a cap. Use to clean debris from the tip of the wire guide and to guide the print wire through the tip of the wire guide.

NON-MAGNETIC FEELER GAUGE, .001 in. (0,03 mm), PART 2525953

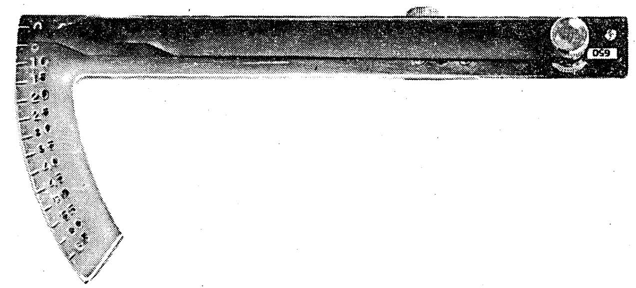


Use this feeler gauge in setting transducer adjustments. The brass prevents scarring emitter wheels and transducer tips during adjustment and also prevents accidental generation of pulses if dc power is not off.

Ordered Tool

GRAM GAUGE, PART 450459

Use this tool to adjust the carriage motor belt tension on Models 2 and 3 and the ribbon drive rack tension on all models.



Shipped Supplies

OIL BAG, PART 2642443

RIBBON CASSETTE, PART 1136970

2.11 STEPPER MOTOR AND EMITTER GROUP REMOVAL AND REPLACEMENT

Stepper Motor Removal

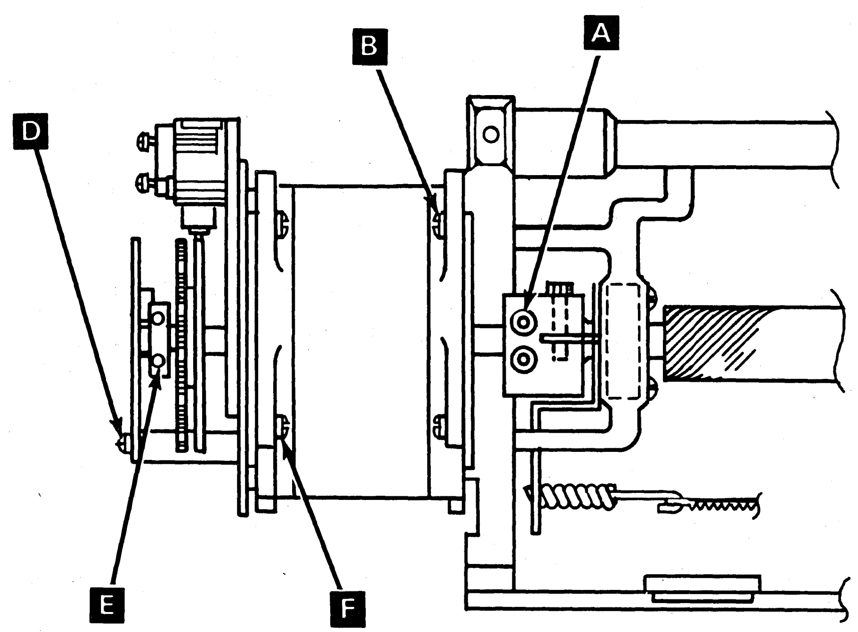
1. Remove system power. Remove covers and loosen the 2 clamping screws on the leadscrew coupling. **A**
2. Remove the four stepper-motor mounting screws. **B**
3. Carefully draw the stepper motor to the left until it clears its mounting frame. Shift the motor to the left and support it on the flat surface of the protective emitter cover.
4. At the rear of the machine, disconnect the end of the stepper-motor cable from connector **C** EC-4 (Model 1) or EC-1 (Models 2 and 3) and draw the cable out of the machine.

   Note: The slip-on connectors can easily be removed from their pins by first unplugging the connector from the printed-circuit card.

5. Remove the emitter group.

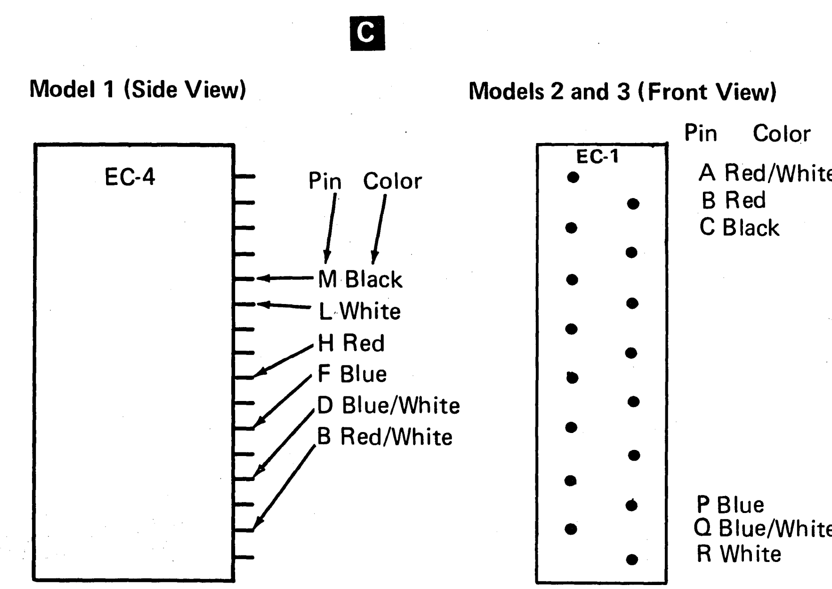
Emitter Group Removal

1. Remove the emitter wheel cover (2 screws). **D**
2. Loosen two screws in the emitter-wheel assembly clamping hub **E** and remove the assembly from the stepper motor shaft.
3. Remove the four screws **F** fastening the transducer plate molding to the stepper motor and remove the transducer molding assembly.
4. Install new parts as required. Perform the stepper motor and emitter group replacement procedure.



Stepper Motor and Emitter Group Replacement

1. Install the transducer assembly around the longer shaft of the stepper motor. Align the mounting holes so that, with reverse feedback transducer up, the stepper-motor lead is downward and to the rear of the machine when installed. Insert and tighten the four molding mounting screws. **F**
2. Install the stepper motor and transducer assembly to the machine frame (4 screws). **B**
3. Install the emitter wheel assembly onto the left end of the stepper-motor shaft. (The wheel with the solid ring of teeth goes next to the stepper motor.) Align the emitter wheel assembly with the transducer tips and tighten the emitter wheel hub screws. **E**
4. Thread the stepper-motor cable to **C** EC-4 (Model 1) or EC-1 (Models 2 and 3) and connect.
5. Perform :
   a. Emitters and transducers adjustments (2.19)
   b. Print carrier and print emitter adjustment (2.20)
   c. Margin switch adjustment (2.21)
   d. Stepper-motor speed adjustments (2.22).
6. Replace all covers.



2.12 LEADSCREW and LEADSCREW NUT REMOVAL and REPLACEMENT

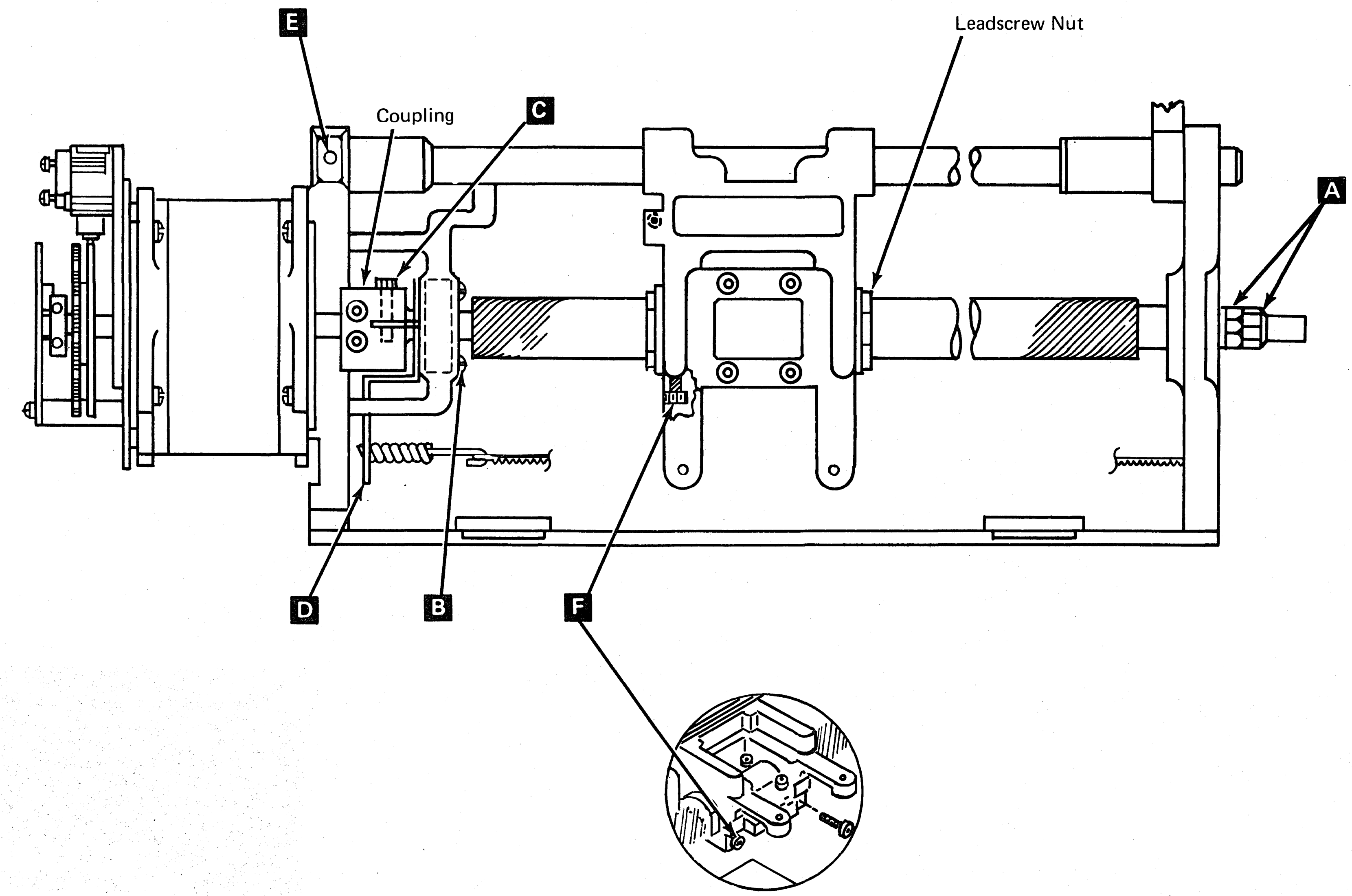
Removal

1. Remove system power. Remove the platen and machine cover.
2. Remove ribbon cassette.
3. While holding the coupling with a wrench, loosen the locknut and jam nut **A** on the right end of the leadscrew.
4. Remove the three bearing retainer screws **B** on the left end.
5. Loosen two screws **C** on the right side of the coupling.
6. Remove the ribbon drive rack and spring **D** (two racks on Model 3). To run the ribbon drive rack off the gear, apply downward pressure against the rack and move the carrier left.
7. Move the carrier assembly to the right.
8. Loosen the setscrew **E** and, while supporting the print head and carrier assembly, slide the carrier shaft to the left.
9. Move the leadscrew to the right and remove the bearing from the right end.
10. Raise the left end of leadscrew to clear the machine frame. Rotate the leadscrew clockwise to remove it from the carrier.

    Note: If the leadscrew nuts are to be replaced, do not allow the bushing between the nuts to come out when performing step 11. If the bushing is inadvertently removed, tilt the print carrier upward, loosen the leadscrew nut on the bottom of the carrier and slide the bushing into the carrier with the flat side upward. Tighten the screw.
11. Loosen the two print-carrier lock screws **F** and remove the leadscrew nuts.

Replacement

1. Replace the leadscrew in reverse order of removal.
2. Perform leadscrew-nut-backlash adjustment (2.18).
3. Perform print carrier and print emitter adjustment (2.20).
4. Perform margin switch adjustment (2.21).
5. Perform stepper-motor speed adjustment (2.22).
6. Run all printer diagnostics.



2.13 PRINT-HEAD REMOVAL and REPLACEMENT

DANGER

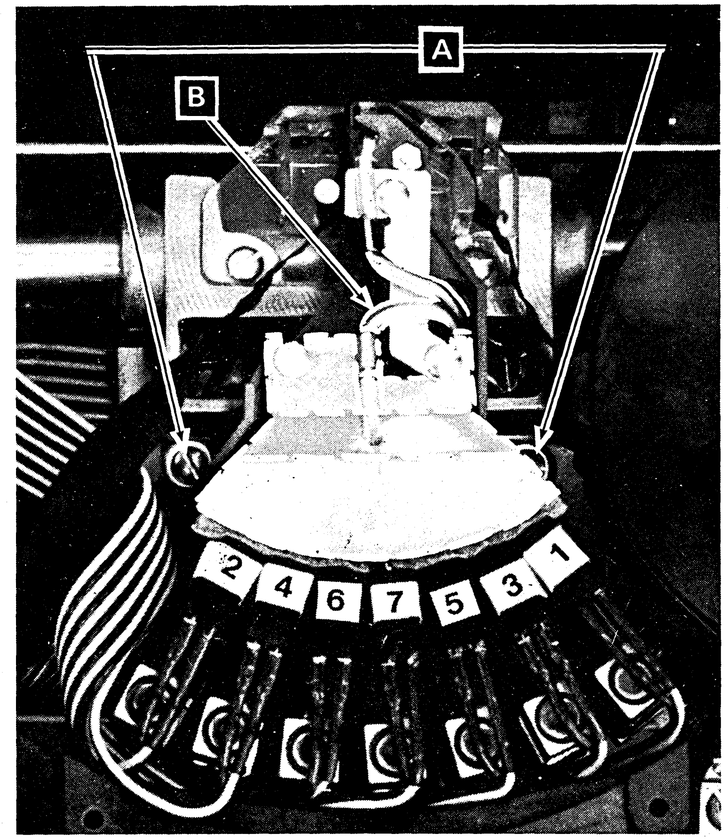
After prolonged use, the print magnets may become extremely hot. Be sure the print head has cooled before attempting to remove it.

Removal

1. Remove system power.
2. Remove ribbon cassette.
3. Loosen two screws and remove the print-head cover.
4. Carefully remove all leads from the print magnets.
5. Remove print-head mounting screws **A** and lift the print head from the print carrier.

Replacement

1. Install print head on the carrier assembly with two mounting screws. Do not tighten the screws.
2. Replace hammer magnet leads and the print-head cover.
3. Insert ends of oil wicks **B** into oil bag.
4. Perform print-head-to-platen clearance and ribbon guide assembly adjustments (2.28).
5. Install ribbon.



2.14 PRINT MAGNET REMOVAL and REPLACEMENT

DANGER

After prolonged use, the print magnets may become extremely hot. Be sure the print head has cooled before attempting to remove it.

Removal

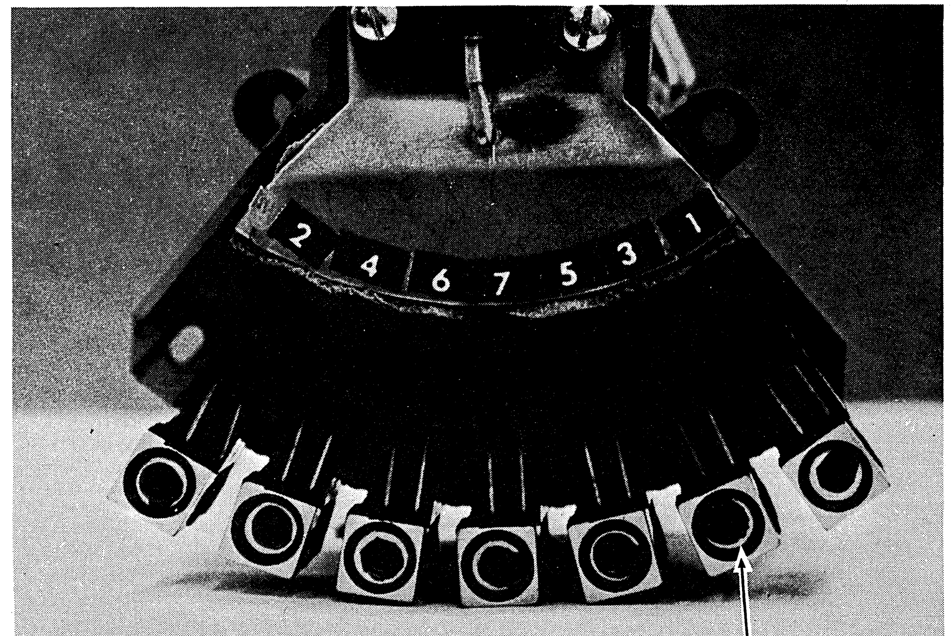
1. Remove system power. Remove the print head (2.13).
2. Each magnet assembly is mounted with two screws **A** accessible from the bottom of the print head. Remove the screws and slide the magnet assembly out of the print head.

   Note: Magnets 1 and 2 (outboard magnets) must not be interchanged with other magnets. Their part numbers, color, and characteristics are different.

Replacement

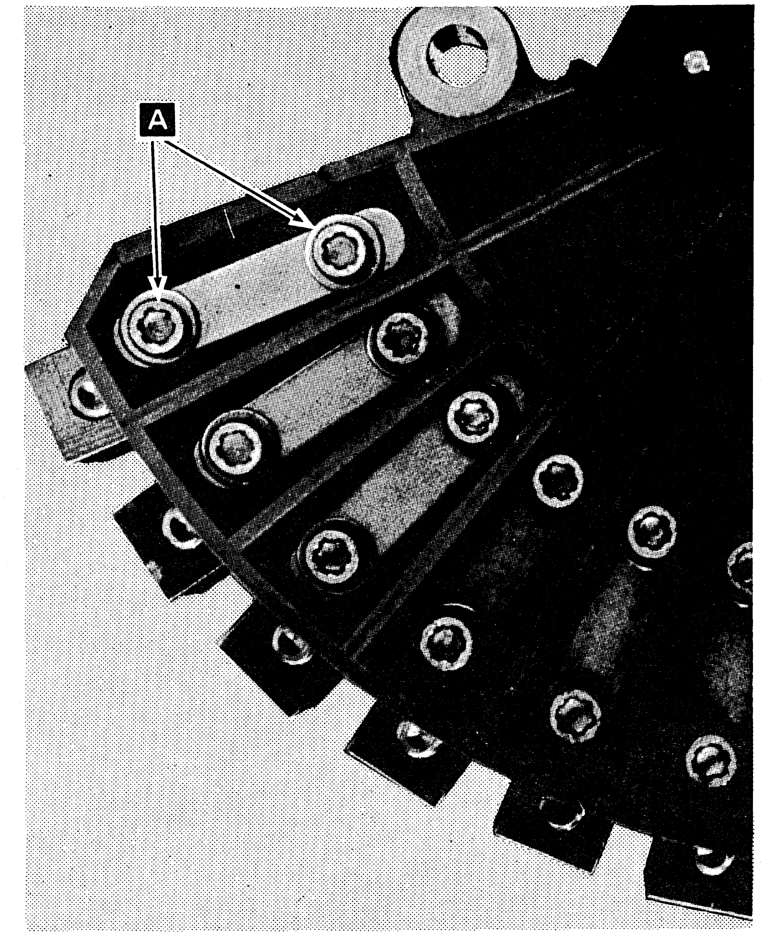
1. Loosen two screws **B** and remove the core oiler plate. The oil wick and tube is attached to the plate.
2. Lift the wick out of the wire guide and slide the wick tube **C** back until the wires in the wire guide are exposed.
3. Install the magnet assembly. Use the wire end of the wire straightening and cleaning tool (part 2617969) to guide the print wire across the hole in the wire guides. Adjust the magnet assembly front to back until the end of the print wire is flush within .003 in. (0,08 mm) inside the tip of the wire guide. (This is a visual check only.)

   Hold a .003-in. (0,08-mm) feeler gauge between the armature and core. Position the print magnet so that the end of the print wire just touches a flat object placed squarely against the tip of the wire guide.
4. Tighten the magnet mounting screws **A** and carefully extend the armature forward and slowly release it. Check to assure that the armature returns to its fully restored position. If the armature does not restore properly, remove and replace the armature assembly.
5. Slide the wick tube back and, using the wire cleaning and straightening tool (part 2617969), carefully insert the wick down alongside the print wires **D** so that the wick extends below the bottom of the wire guide.
6. Install the core oiler plate. Make sure that the back of the oiler pad rests on top of the magnet cores. **E**
7. Replace the print head (2.13). Run a sample line of printing and observe the replaced wire position. Adjust the magnet assembly to the rear as needed for uniform print density.

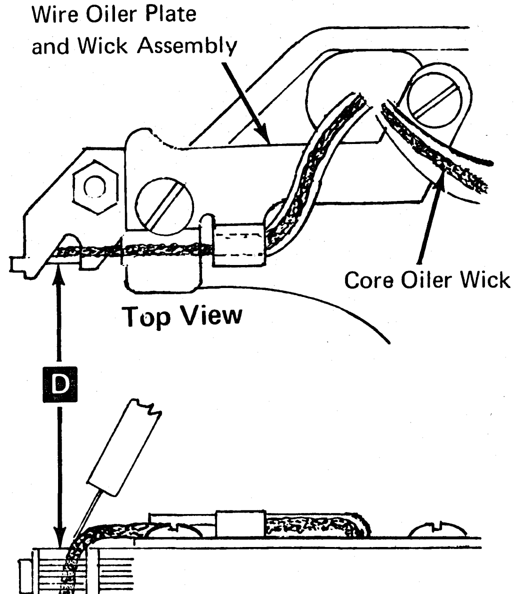


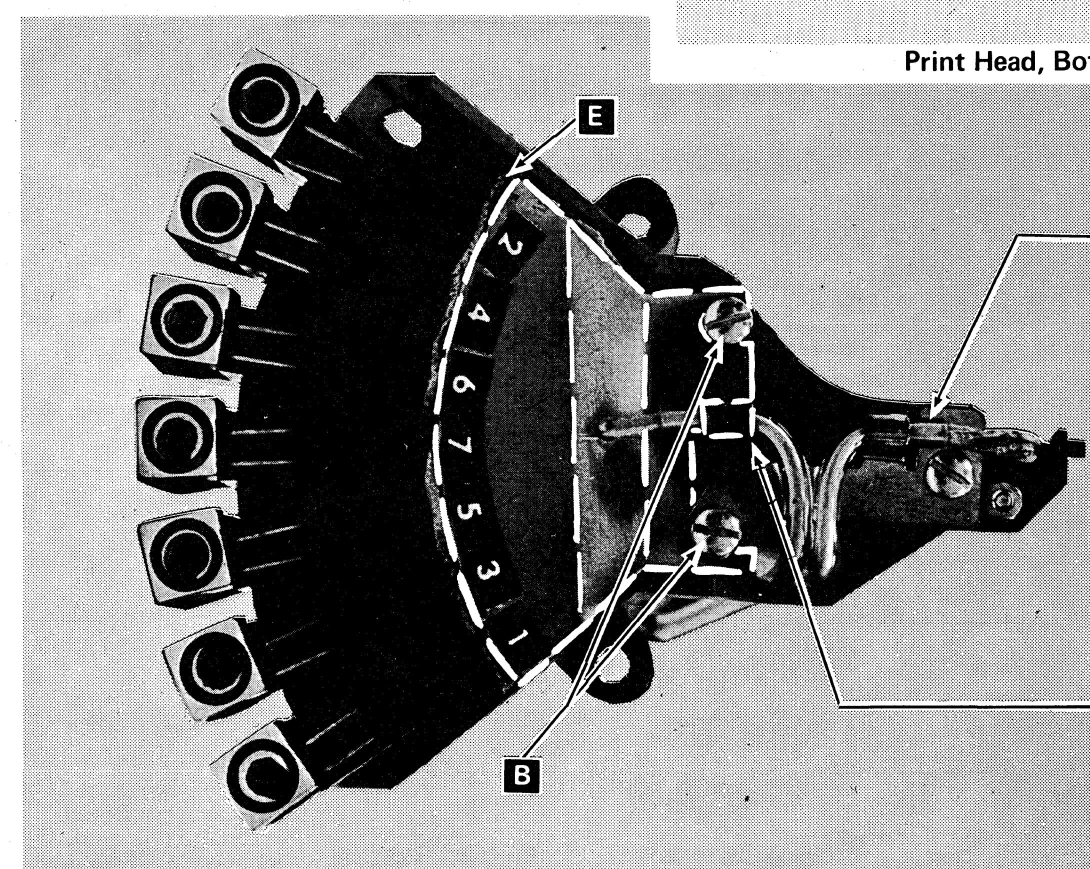
Print magnet numbering sequence as viewed from top of print head.

Note: Do not loosen the socket head screws. The screws are factory set and the position of the permanent magnet is critical to correct operation of the print magnet assembly.



Print Head, Bottom View





Top View

2.15 PRINT-HEAD CABLE ROUTING, REMOVAL and REPLACEMENT

Routing

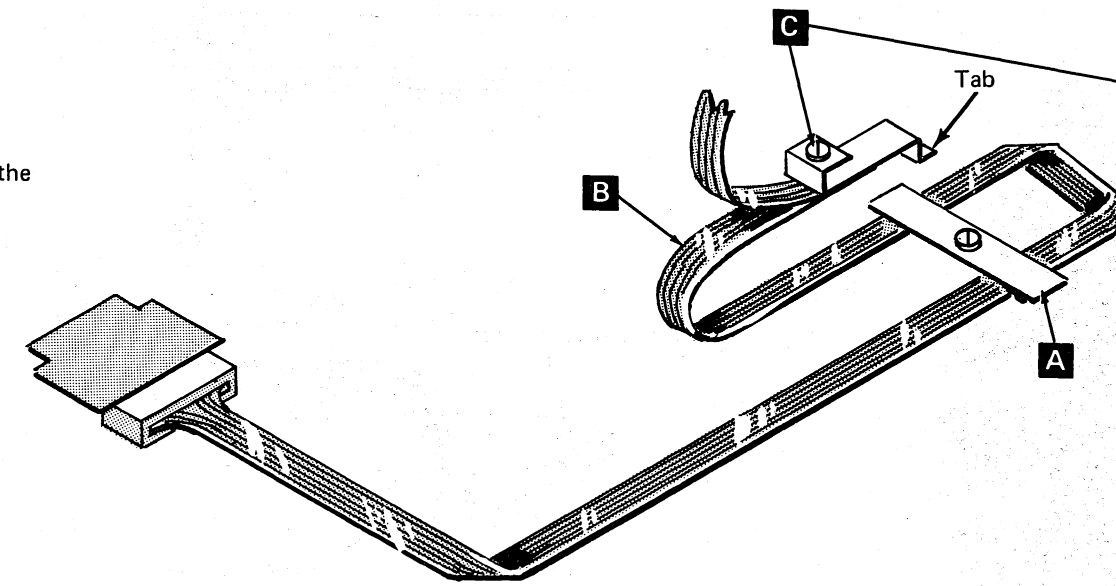
The print-head cable is routed from EC-3, (Model 1) or from the R-C network panel (Models 2 and 3), along the left side frame and through the bottom center of the printer. A bracket **A** screwed to the the frame clamps the cable. A flat spring **B**, mounted along the cable, guides the cable as the print head travels across the print line.

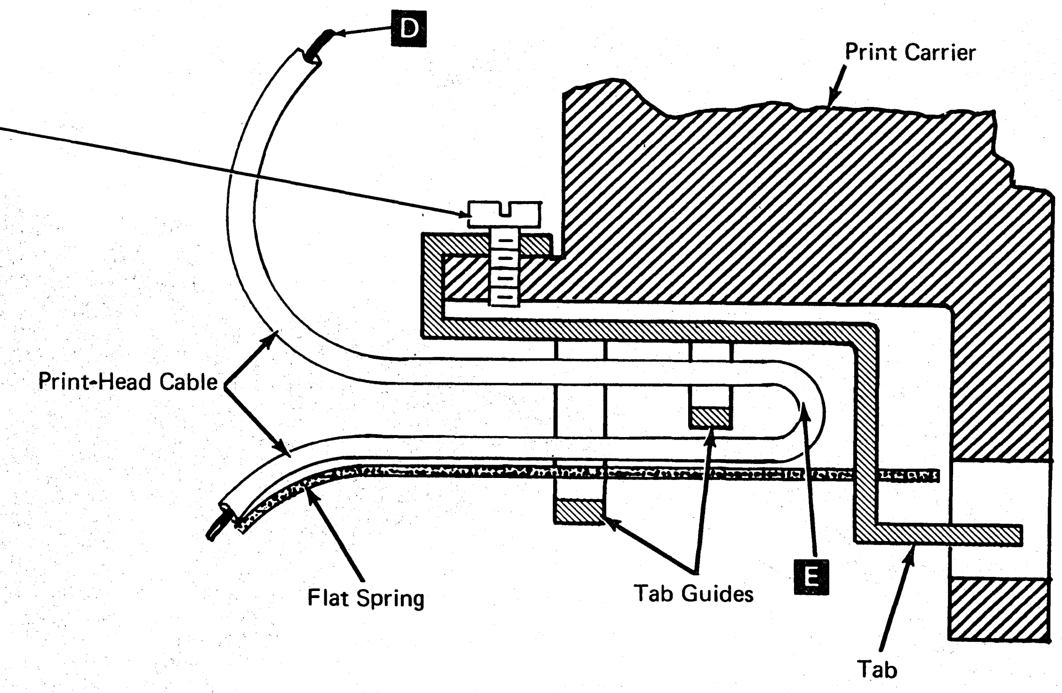
Removal

Loosen the screw **C** on the left side of the print carrier and slide the cable and bracket assembly to the left.

Replacement

Slide the metal tab on the bracket into the hole on the bottom right side of the carrier assembly. Hold the clamp tightly against the carrier and tighten the screw.

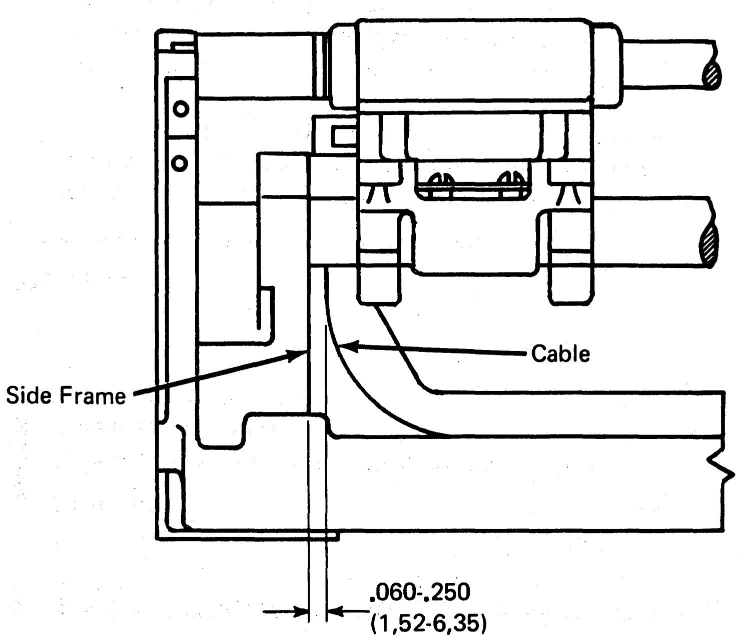




2.16 PRINT-HEAD CABLE ADJUSTMENT

If the cable is being replaced:

1. Form the cable in the bracket assembly so that the longest wire from point **D** and the bend at point **E** is 12 inches (305 mm).
2. Move the print carrier to the extreme left and position the cable for .060 to .250-in. (1.52 to 6.35-mm) clearance between the side frame and the cable.
3. Hold the cable in position and tighten the cable clamp **A**.
4. Move the carrier back and forth several times to be sure the cable does not touch the side frame.



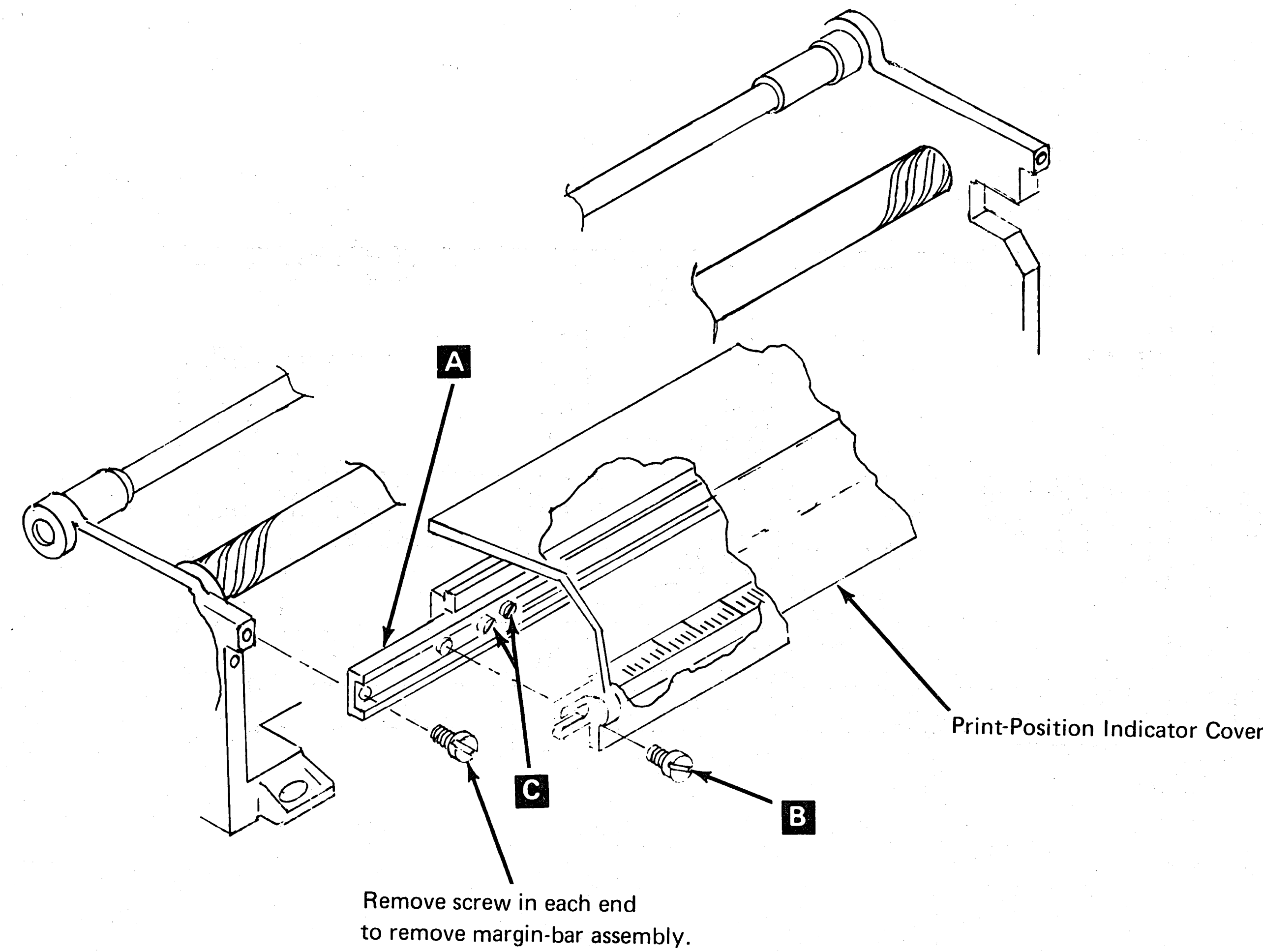
2.17 MARGIN SWITCH ASSEMBLY REMOVAL AND REPLACEMENT

Removal

1. Remove system power. Remove the platen (Model 1).
2. Scribe a mark on the left end of the margin bar **A** to mark the print-position indicator cover location (early machines) or ensure that the locating tab is flush with the cover (later machines).
3. Loosen the two screws **B** (one in each end of the print-position indicator cover) and remove the cover.
4. Disconnect the wires from the margin switch assembly.
5. Remove the two screws **C** from the margin switch.

Replacement

1. Replace the margin switch.
2. Connect the wires to the margin switch.
3. Perform the margin switch adjustments (2.21).
4. Replace all covers.



2.18 LEADSCREW-NUT-BACKLASH ADJUSTMENT

Objective:

To minimize backlash (clearance between threads on the lead-screw nuts and on the leadscrew). Excessive backlash may result in improper horizontal registration of the printed characters.

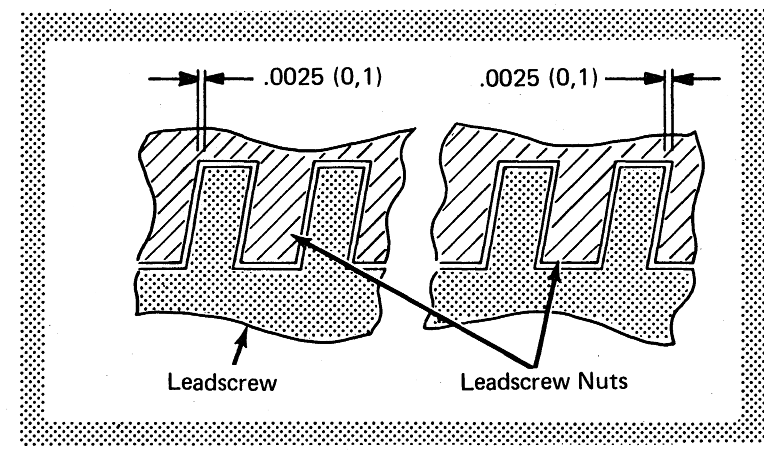
Backlash Service Check

1. Slide the print carrier entire length of leadscrew in both directions. Mechanism should be free of binds.
2. Check for excessive backlash by running diagnostic E8A. If the characters (Hs overprinting Is) are not centered, perform the adjustment.

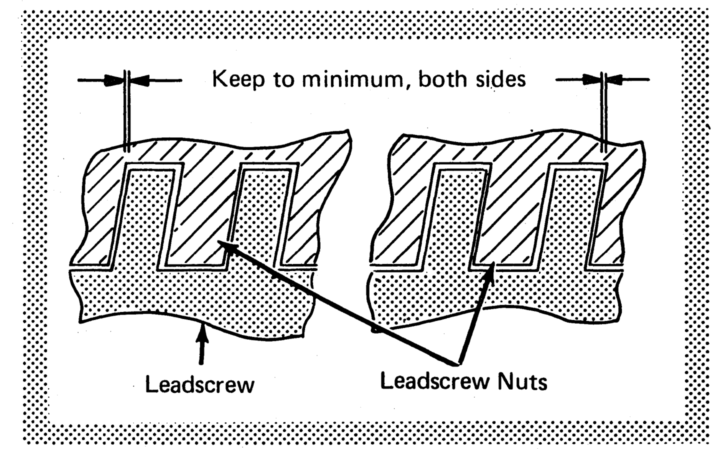
Adjustment

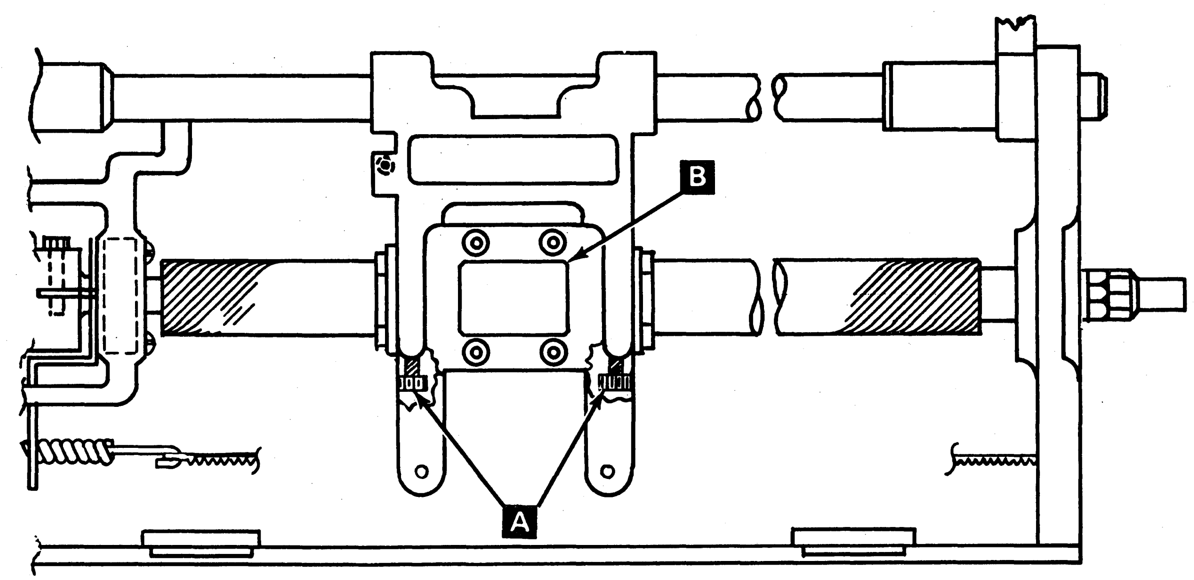
1. Remove system power. Place the print head approximately in the middle of the line.
2. Loosen clamping screws. **A**
3. Rotate both leadscrew nuts until they contact the center plate **B**. Then slightly turn each nut in the opposite direction (away from center plate). This ensures that the leadscrew nuts do not contact the center plate as the print head is moved.
4. Being careful not to rotate the leadscrew nuts, remove any excessive clearance by sliding the left leadscrew nut to the right, and the right leadscrew nut to the left. Tighten the clamping screws **A**
5. Check for binds by sliding print carrier the entire length of the leadscrew in both directions. If binding, move the print head to the bind, loosen the clamping screws slightly, and then tighten them.
6. Perform print carrier and print emitter adjustments and service check (2.20) and adjust if necassary. Run diagnostic E8A. If characters are still not in registration repeat adjustment until correct.
7. Run all printer diagnostics.

Maximum Clearance



Ideal Clearance





2.19 EMITTERS and TRANSDUCERS ADJUSTMENTS

Objective: To align the emitter wheels with transducer tips, and to obtain the proper air gap on all transducers.

Adjustment

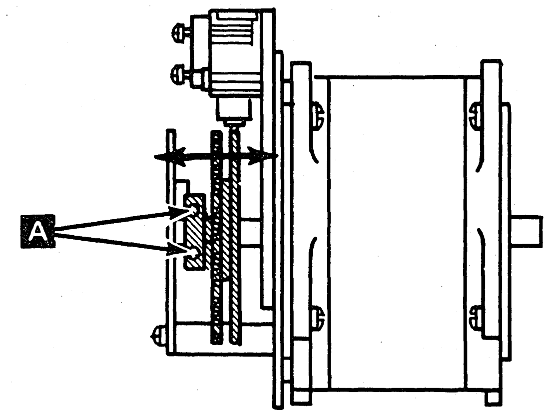
1. Remove system power. Loosen the emitter wheel screws **A** and position the assembly so that the emitter wheels align with the transducer tips. Tighten the screws.

   Note: The wheel may not be centered under the transducer; however, the alignment should be the same on both wheels.

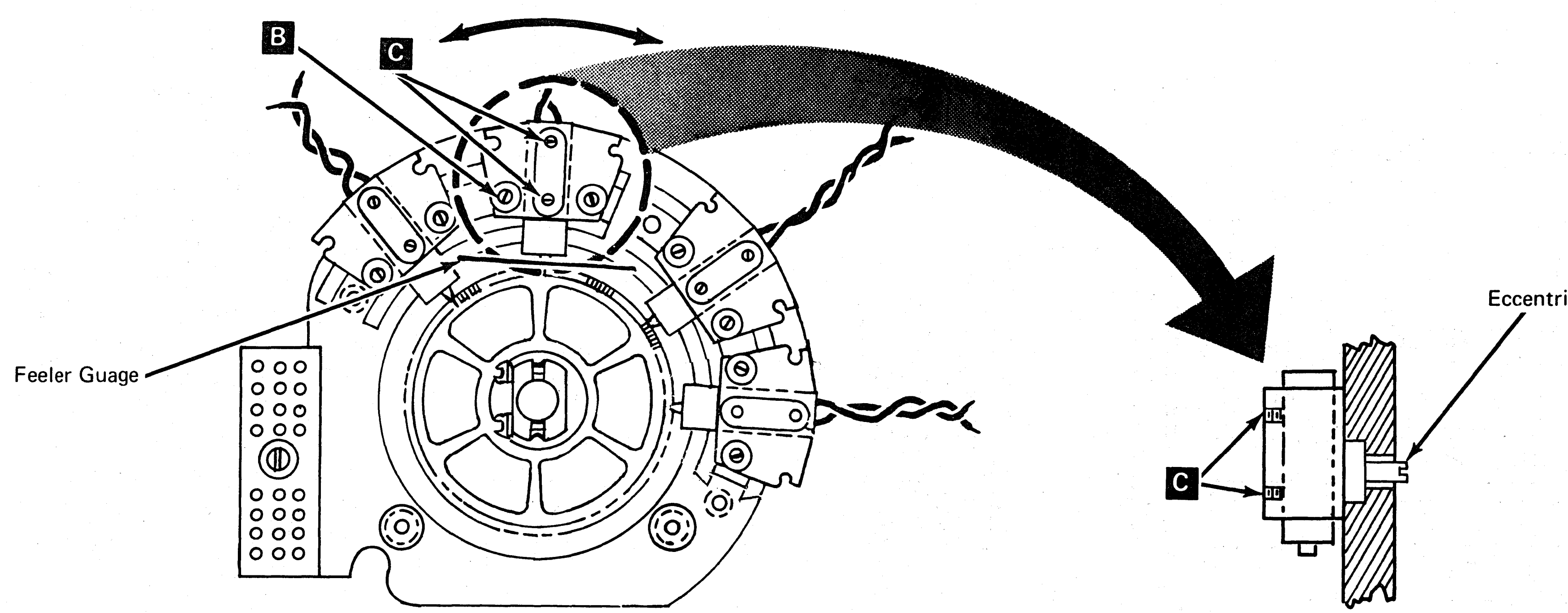
2. Loosen the transducer block clamping screws **B** and adjust the eccentrics to position each transducer block in the center of the mounting screw slots. Maintain downward pressure on the transducer block and tighten the screws.
3. Loosen the transducer clamp screws **C** and insert a .001-in. (0,03-mm) feeler gauge (part 2525953) between the transducer tip and the teeth of emitter wheel. Make this adjustment with highest point of the emitter wheel toward the transducer being adjusted.
4. Slide the transducer up or down gently to meet the gauge and turn the emitter wheel by rotating the leadscrew to the point of tightest contact with the gauge. Tighten the clamp screws.

   Note: Check several points on wheel with gauge to prevent possible damage to the emitters and transducers when power is turned on.

5. Perform stepper-motor speed adjustments (2.22).
6. Check print carrier and print emitter wheel adjustments (2.20).



Front View



Left Side View

Front View

2.20 PRINT CARRIER and PRINT EMITTER ADJUSTMENT

Objectives:

1. To position the left end of the carrier support shaft flush with the side casting and then to align the edge of the print carrier with the milled ring on the carrier support shaft.
2. To align the middle scribed line on the print emitter wheel to the print-right transducer tip (Models 1 and 2). To align the two outer scribed lines on the print emitter wheel to the print-left and print-right transducers (Model 3).
3. To position the print position pointer to indicate print postion 1.

Service Check

Return the carrier to print position 1 and check that:

1. Left edge of carrier aligns with milled ring **A** on left end of carrier support shaft.
2. For Models 1 and 2, print-right transducer tip **B** aligns to center scribe line on print emitter wheel. For Model 3, print-right and print-left transducers align to the two outer scribed lines **C** on the print emitter wheel.
3. Print position indicator indicates print position 1. If the carrier is off the milled ring **A** one print position (.100 in., 2,54mm) adjust the left margin switch. If the carrier is off the milled ring less than one print position (.100 in., 2,54mm), make the following adjustment.

Adjustment

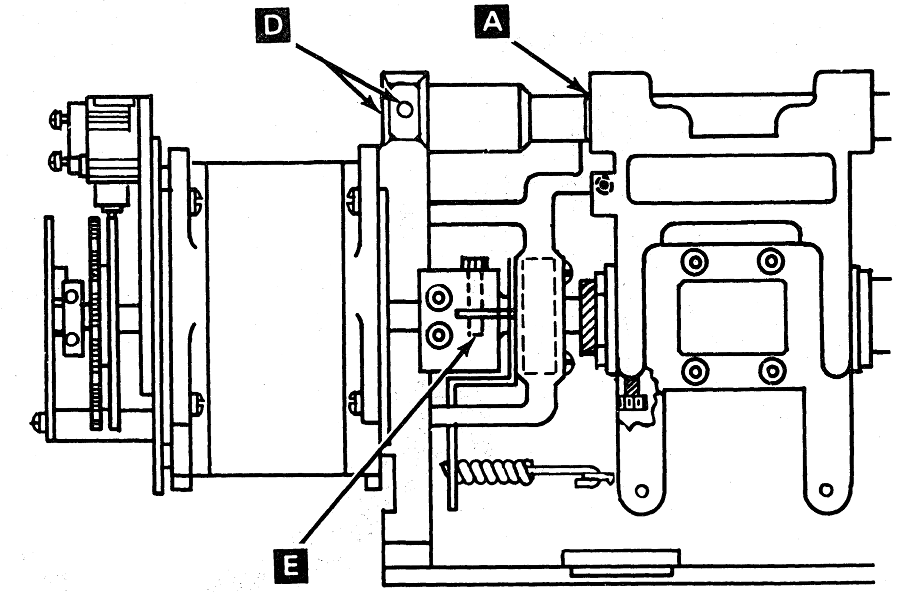
1. Loosen the setscrew and position the left end of the carrier support shaft flush with the side casting **D** . Tighten the setscrew.
2. Loosen the two coupling screws **E** to disconnect the leadscrew from the stepper motor.
3. Press the Check Reset and then the System Reset keys to lock the stepper motor in the detented position ($\overline{AB}$).
4. Remove the emitter cover (two screws).
5. For Models 1 and 2, loosen the two print-right transducer mounting block screws **F** , and, using the eccentric adjusting screw, position the mounting block to center the screws. While maintaining downward pressure on the transducer block, tighten the screws.

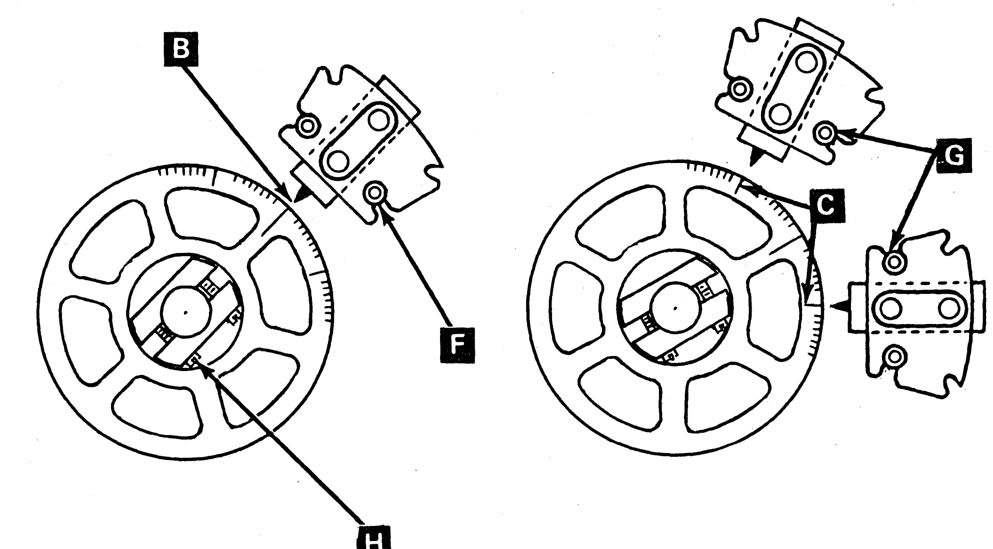
   For Model 3, loosen the print-right and print-left transducer mounting block screws **G** , and, using the eccentric adjusting screws, position both mounting blocks to center the screws. While maintaining downward pressure on each transducer block, tighten the screws.
6. Turn the leadscrew until the left edge of the print carrier aligns with the milled ring on the carrier support shaft. Ensure that the coupling flange is against the bearing and tighten the coupling screws.

   Note: Minor misalignment (within the limits of the eccentric may be corrected by positioning the print-right transducer (Models 1 and 2) or the print-right and print-left transducers (Model 3) relative to the print emitter wheel.
7. For Models 1 and 2, loosen the emitter wheel clamp screws (2) **H** and align the middle scribed line to print-right transducer tip. Tighten the screws.

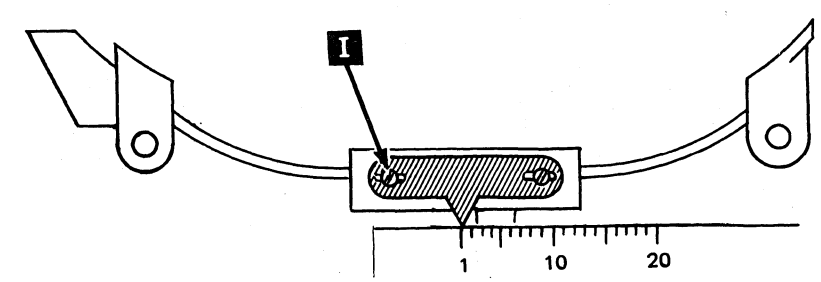
   For Model 3, loosen the emitter wheel clamp screws (2) and align the two outer scribed lines to the print-left and print-right transducer tips.
8. Loosen the two print-position pointer screws **I** and move the pointer left or right to indicate print position 1. Tighten the screws.
9. Check for .001 in. (0,03mm) air gap between the print-right transducer tip and the highest point on the emitter wheel (use non-magnetic feeler gauge, part 2525953). If adjustment is needed, loosen print-right transducer clamping screws, adjust as necessary, and tighten the screw. On Model 3, perform adjustment for the print-right and print-left transducers (2.19).

   Note: Check clearance on several points of the wheel to prevent possible damage to emitters when power is turned on.
10. Replace the emitter cover (2 screws).
11. Check margin switch adjustment (2.21).
12. Check stepper motor speed adjustment (2.22).





Models 1 and 2 | Model 3



REMEMBER

There is a Reader's Comment Form at the back of this publication.

2.21 MARGIN SWITCH ADJUSTMENTS

Caution

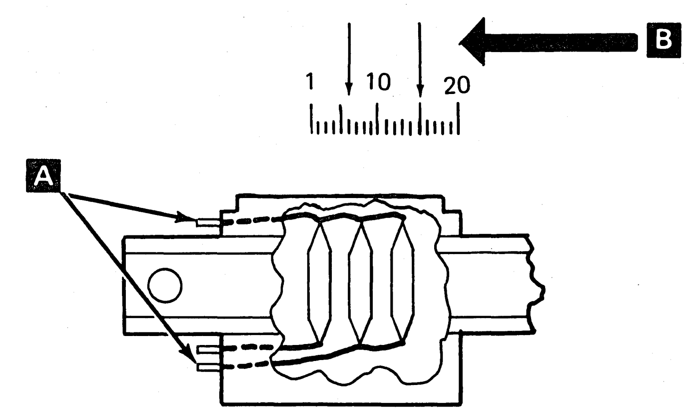
Use a volt-ohmmeter when checking margin circuits. Do not use a test light.

Objectives:

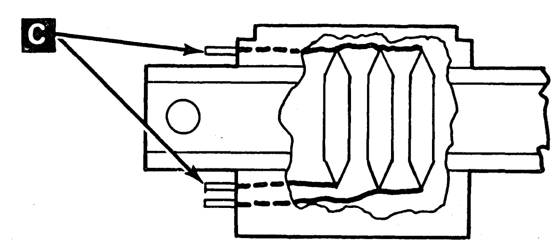
1. To obtain clearance between the margin switches and the magnet mounted on the front of the print carrier.
2. To close the slow reed switches as the print position pointer approaches print position ten and to close the stop reed switch in position one.
3. To close the stop reed switch when the print position indicator indicates position 132.

Service Check

1. Remove system power. Check margin switch magnet clearance (2.21).
2. Fasten the test leads to the top and bottom terminals A of the switch. Move print head (from beyond position 20) toward position 1. B The slow reed switches should close between 15 and 6 and remain closed at print position 1. If not, replace the center reed switch and proceed.



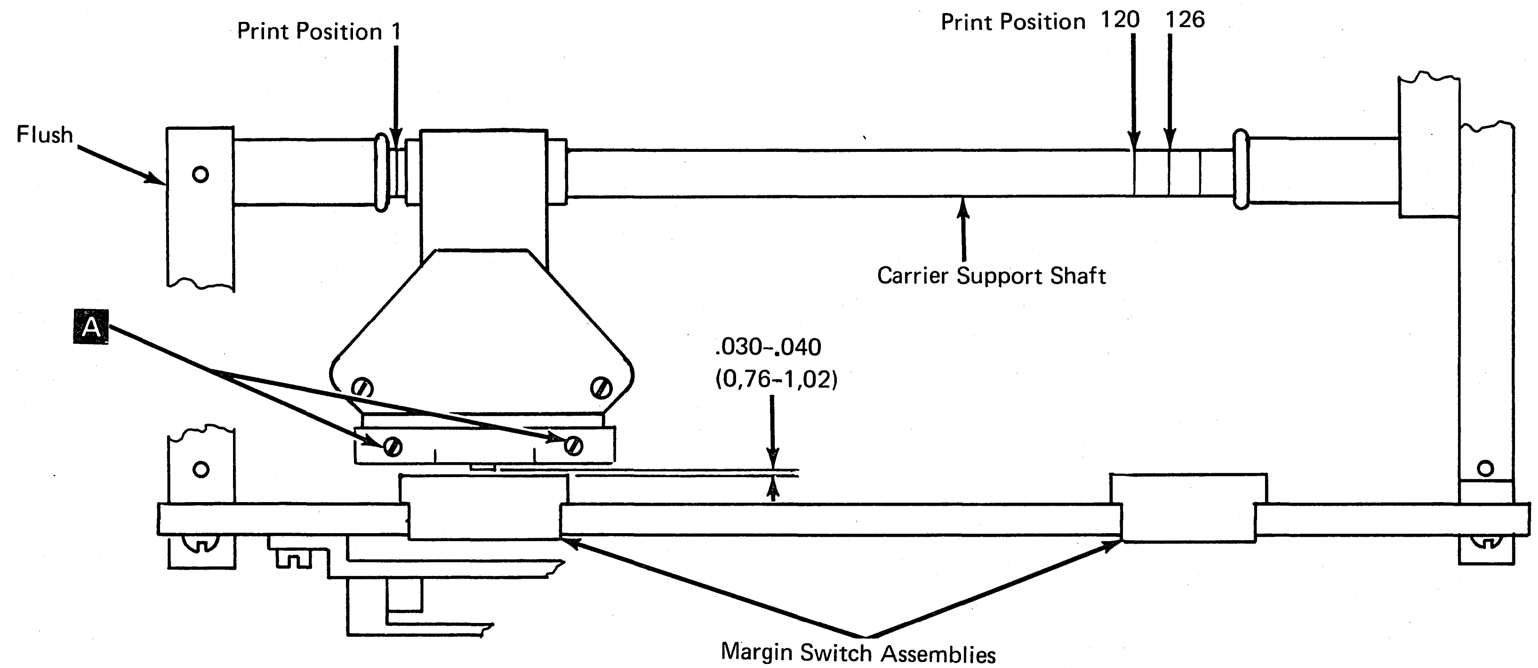
3. Move bottom test lead to middle terminal C. Stop reed switch should be closed in print position 1. If not closed, the adjustment is incorrect or the reed switch is defective. Correct as necessary.



Margin Switch Magnet Clearance

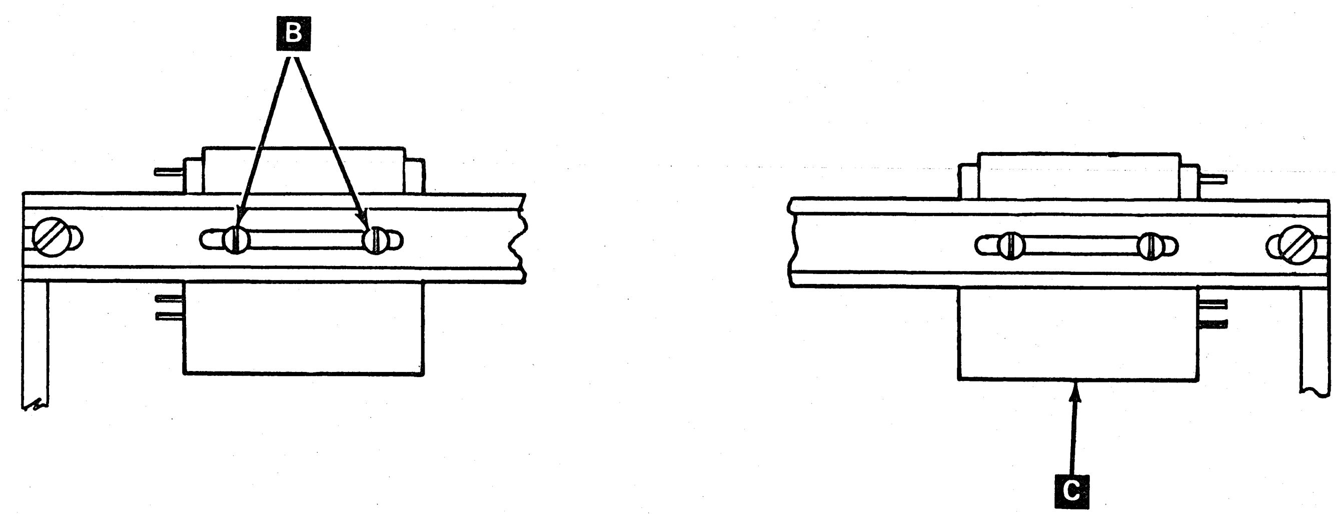
1. Loosen the two ribbon feed mounting bracket screws **A** on the front of the print carrier assembly.
2. Adjust for .030 to .040-in. (0,76 to 1,02-mm) clearance between the margin switch and the face of the magnet mounted on the ribbon cassette mounting assembly.
3. Tighten the screws.

Note: Before making the left and right margin switch timing adjustments, the print carrier and print emitter adjustment must be correct. See 2.20.



Left and Right Margin Switch Timing Adjustment

1. Check print carrier and print emitter adjustment. Adjust if necessary. (See 2.20.)
2. Press CHECK RESET and SYSTEM RESET. The print head should move to print position 1. If the print head is to the left of print position 1, loosen locking screws **B** and move the margin switch to the right. If the print head stops to the right of print position 1, move the margin switch to the left. Press and hold CHECK RESET and press SYSTEM RESET several times to cause the print head to clear the left margin. Tighten the screws. Repeat this procedure until the print head stops on position 1.
3. Run margin switch diagnostic E88.
4. Adjust the right margin switch **C** as directed on the printout.



2.22 STEPPER-MOTOR SPEED ADJUSTMENTS

CAUTION

Do not make transducer adjustments while printing.
Print wire damage may result.

Objective:

To obtain correct stepper motor speed by adjusting feedback transducer pulse timing.

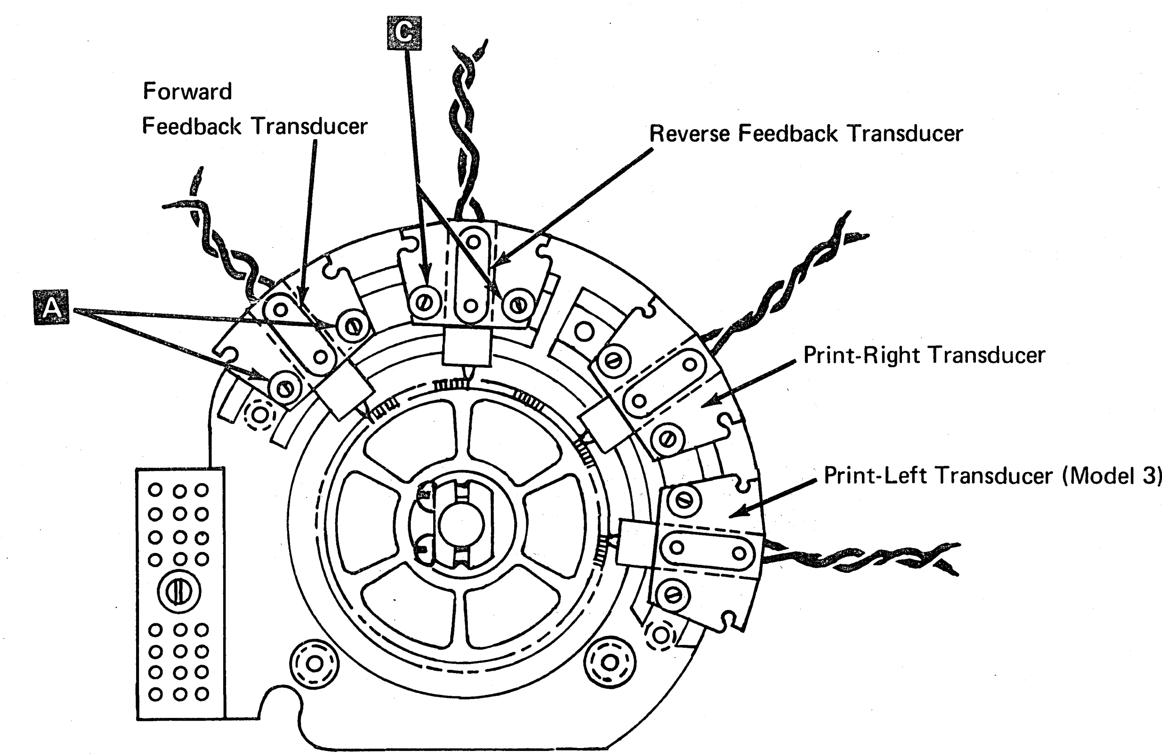
Stepper-Motor Forward-Speed Adjustment

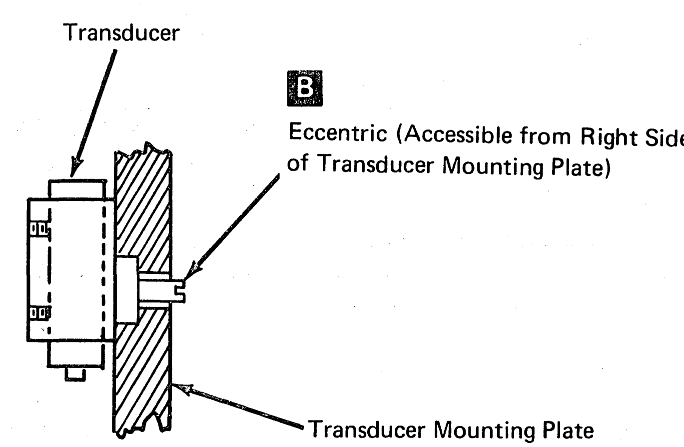
Note: Feedback transducer clearances must be .001 in. (0,03mm). See 2.19.

1. With ribbon installed, run diagnostic program E87.
2. If speed is incorrect, loosen two transducer block mounting screws A and adjust eccentric B (with machine running) until correct speed is obtained. This may require rotating the eccentric clockwise or counterclockwise. If the timing cannot be obtained in the direction chosen, turn the eccentric in the opposite direction. When speed is correct, tighten the mounting screws and check the stepper-motor reverse speed.

Stepper-Motor Reverse-Speed Adjustment

1. With a ribbon installed, run diagnostic program E87.
2. If speed is incorrect, loosen two transducer block mounting screws C and adjust the eccentric B until correct speed is obtained. This may require either rotating the eccentric clockwise or counterclockwise. If the timing cannot be obtained in the direction chosen, turn the eccentric in opposite direction. When speed is correct, tighten the mounting screws.





2.23 RIBBON DRIVE AND CASSETTE DESCRIPTION

The printer uses an inked endless fabric ribbon contained in a sealed cassette and fed by a drive mechanism under the cassette mounting. The ribbon has a built-in twist that allows printing on both halves–top and bottom–of the ribbon every two cycles of the loop.

A hole in the underside of the cassette fits snugly over a post on the print-head carrier. Two guide fingers on the cassette assure proper seating around the drive roll. A spring-loaded latch holds the cassette in place.

The drive roll or capstan simultaneously draws the ribbon out of the cassette exit and feeds it back into the entrance. A one-way clutch turns the drive roll to advance the ribbon only during printing.

2.24 RIBBON CASSETTE REMOVAL AND REPLACEMENT

Removal

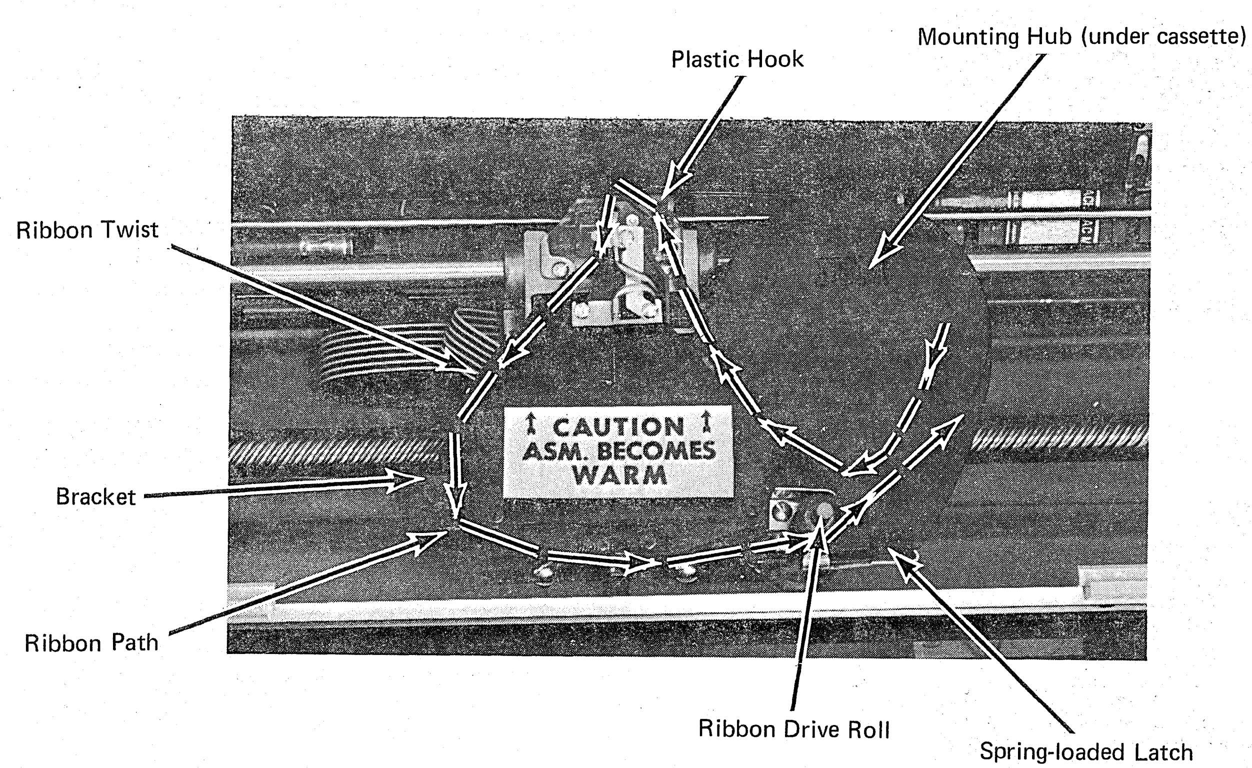
1. Pull the release latch towards you.
2. Rotate the cassette counterclockwise.
3. Lift off mounting post.

Replacement

Be sure the loading tab is in place in the cassette entrance.

1. Place cassette on the mounting hub.
2. While pulling the release latch towards the front of the printer, rotate the cassette clockwise into position and release the latch lever. The two fingers on the cassette should enter the slots in the drive roll, and the latch should seat onto the cassette.
3. Pull enough ribbon out of the cassette to allow threading it through the ribbon guides.
4. Following the schematic on the ribbon-path decal, thread ribbon from the cassette exit around the print head first. Be sure the ribbon gets under the plastic hook on the ribbon guide near the tip of the print head.
5. Remove loading tab and thread ribbon from that point to the left and around the corner bracket.

   Note: When replacing a ribbon without a loading tab pull out about 4 in. (101,6 mm) at the drive-roll opening (entrance) to prevent jamming of the ribbon at the roll. Rotating the ribbon drive roll manually rewinds slack in the ribbon back into the cassette.
6. Turn ribbon drive roll knob to wind ribbon slack back into the cassette. Be careful to keep the twist in the ribbon located between the bracket and print head.



2.25 RIBBON DRIVE MECHANISM DESCRIPTION

The ribbon drive mechanism consists of a drive roll (or capstan) on a shaft driven through a one-way clutch by a gear riding along a flexible toothed rack (two racks, gears, and clutches on Model 3). The rack goes between the gear and a roller, and is attached by a spring to the left side frame and held by a clamping block on the right. As the print head goes back and forth, the gear meshes with the rack and turns in both directions. The one-way clutch drive gear turns the drive roll to advance the ribbon only during printing. The entire ribbon drive assembly is supported by a plastic carrier by two screws.

2.26 RIBBON DRIVE REMOVAL AND REPLACEMENT

Removal

1. Disengage the ribbon drive rack(s) from the clutch gear(s).
2. Remove the two mounting screws.

Replacement

1. Mount the ribbon drive assembly on the print carrier (2 screws).
2. Position the rack(s) between the clutch gear(s) and the idler roll.
3. Adjust the position of the ribbon drive assembly molding (contains the margin switch operating magnet) so that the magnet-to-margin switch gap is .030 to .040 in. (0,76 to 1,02 mm). Check at both margin switches.
4. Adjust the ribbon drive rack tension for approximately 1/4-in. (6,35-mm) deflection from its normal position when a force of approximately 100 grams is applied at the middle.
   a. Move the print head all the way to the right.
   b. Loosen the two screws holding the clamping block.
   c. Pull the rack(s) between the clamping block and the right side casting.
   d. When the proper tension is obtained, tighten the two screws in the clamping block.

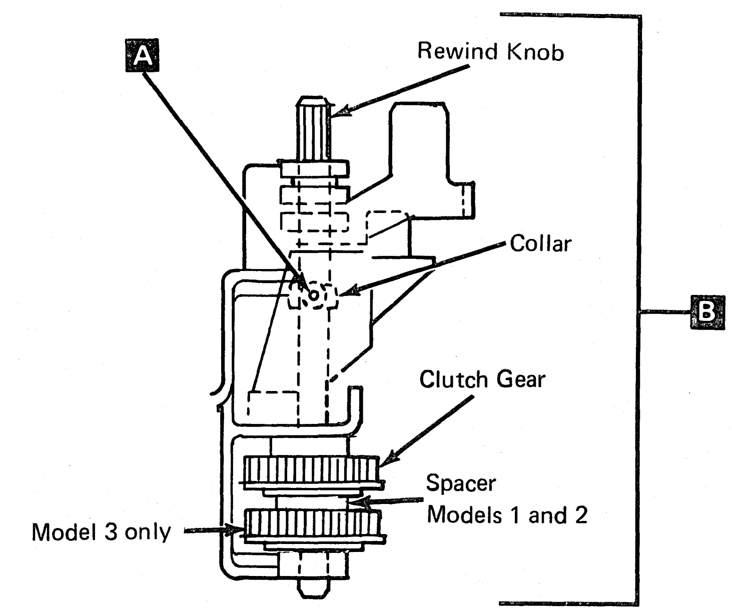
2.27 RIBBON DRIVE CLUTCH AND DRIVE RACK REMOVAL AND REPLACEMENT

Drive Clutch Removal

1. Loosen the setscrew. A
2. Slide the shaft up. Be careful not to lose any components.

Drive Clutch Replacement

1. Place the rewind knob, shaft, collar, clutch gear and spacer onto the molding as shown. B
2. Raise the collar to the top and tighten the setscrew. Turn the ribbon rewind knob to be sure it does not bind.
3. Place the ribbon drive rack(s) between the clutch gear(s) and roller(s).
4. Adjust the rack tension for approximately 1/4-in. (6,35-mm) deflection from its normal position when a force of approximately 100 grams is applied at the middle.



Drive Rack Removal

1. Unhook the spring at the left end of the rack(s).
2. Run the rack(s) off the gear(s).
3. Remove the 2 screws in the right end clamp.
4. Draw the rack out through the upper slot (Models 1 and 2) or the upper and lower slot (Model 3) in the clamping plate.

Drive Rack Replacement

1. Insert the rack(s) into the slot(s) and make the end flush with the side of the block.
2. Install the clamping plate.
3. Install and tighten the 2 clamping screws.
4. Run the rack(s) through the gear(s) and idler roll(s).
5. Hook the spring(s) at the left end.
6. Adjust the ribbon drive rack tension for approximately 1/4-in. (6,35-mm) deflection from its normal position when a force of approximately 100 grams is applied at the middle.

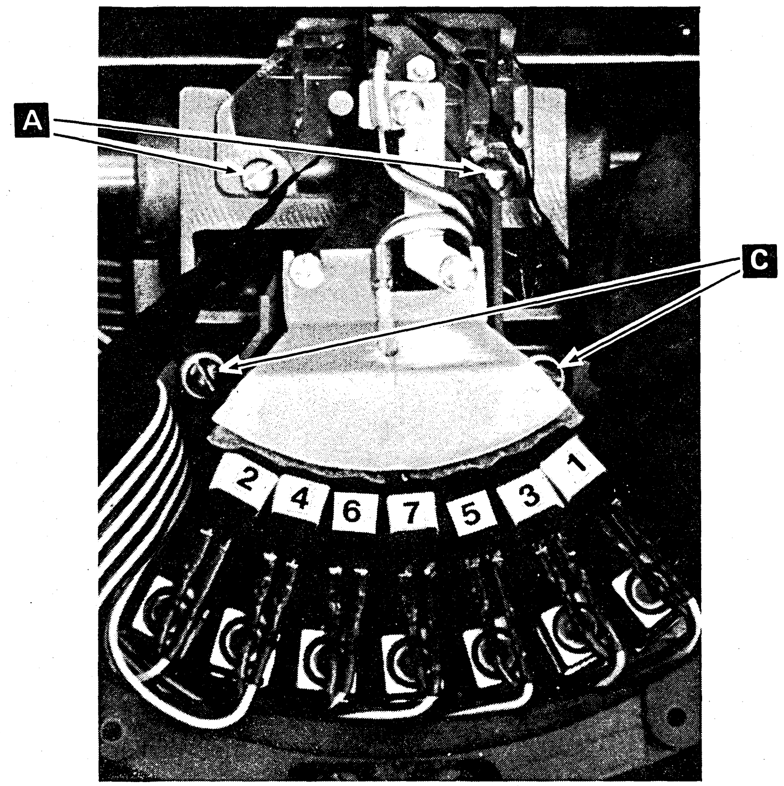
2.28 PRINT-HEAD-TO-PLATEN CLEARANCE AND RIBBON GUIDE ASSEMBLY ADJUSTMENT

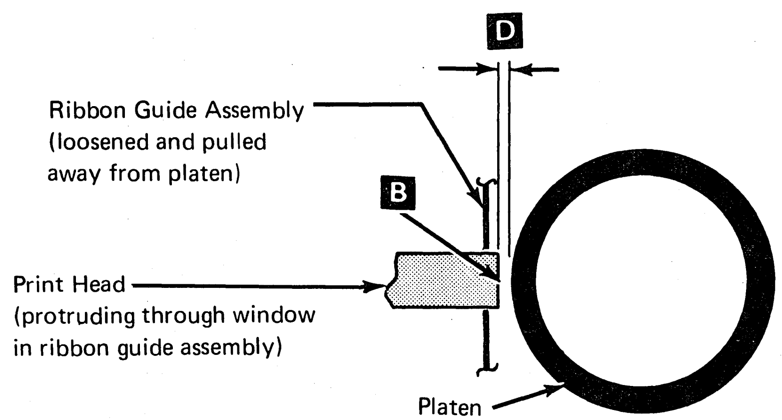
Objectives:

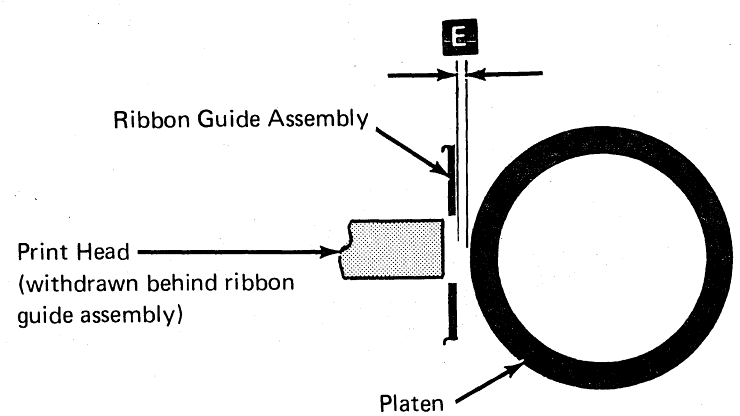
1. To provide correct operating clearance between the platen and the tip of the print head.
2. To position the ribbon guide assembly so that the ribbon clears both the paper and the print wires when not printing.

Adjustment

1. Check horizontal adjustment: 2.46 for pin-feed Model 1 or 2.69 for VFC Models 2 and 3.
2. Using the copy control lever (Model 1), move platen closest to the print head. On Models 2 and 3, set the forms thickness knob to 3.
3. Loosen the ribbon guide assembly mounting screws **A** and move the assembly toward the front of the machine until the print head protrudes through the ribbon guide. **B**
4. Move the print head to the middle of the platen. Loosen the two print head mounting screws **C** and adjust the print head (front to back) until the clearance **D** between the platen and the tip of the print head is .030 in. (0,76 mm). Because of platen eccentricity, slowly rotate the platen and set this clearance at the closest point. Tighten the mounting screws, and check the clearance at each end of the platen.
5. Move the ribbon guide assembly until the clearance **E** between the ribbon guide assembly and the platen is .025 in. (0,64 mm).
6. Tighten the two assembly mounting screws.







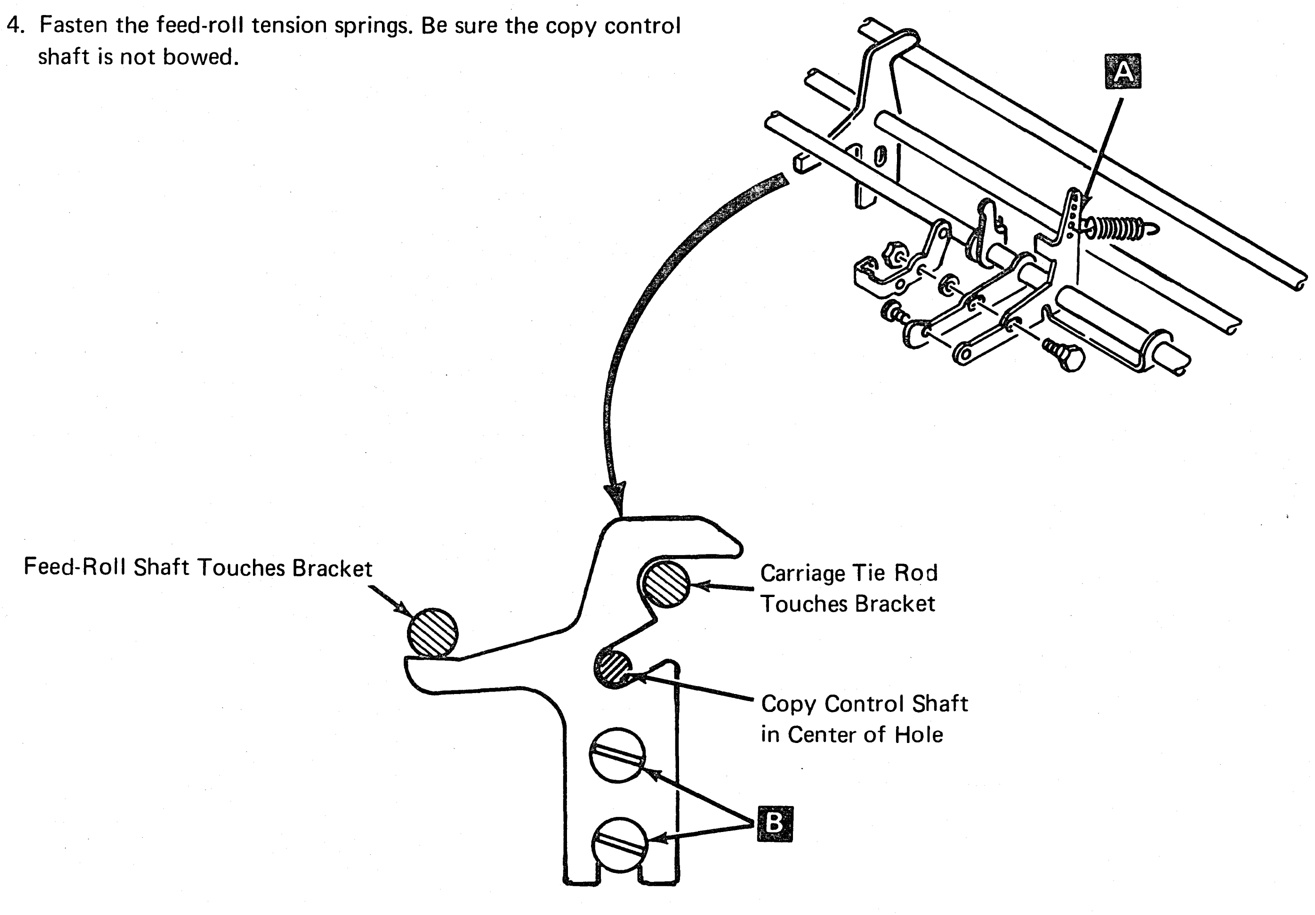
2.29 CENTER SUPPORT ADJUSTMENT

Objective:

To position the center support bracket so that the copy control shaft is not bowed by the tension springs.

Adjustment

1. Remove covers, platen, paper deflector, and move the paper release lever toward front of printer.
2. Disconnect the four feed-roll tension springs from the feed-roll arms. A
3. Loosen two center support bracket screws B and position the bracket so that the feed-roll shaft and the carriage tie rod just touch the bracket lugs as shown. Tighten the screws.
4. Fasten the feed-roll tension springs. Be sure the copy control shaft is not bowed.

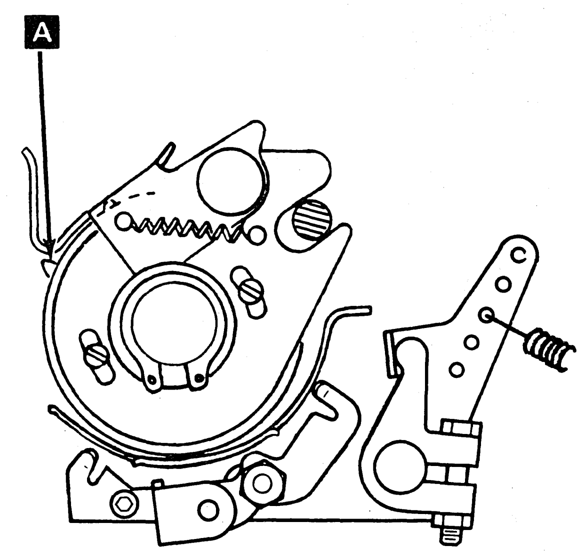


2.30 PIN-FEED PLATEN DESCRIPTION

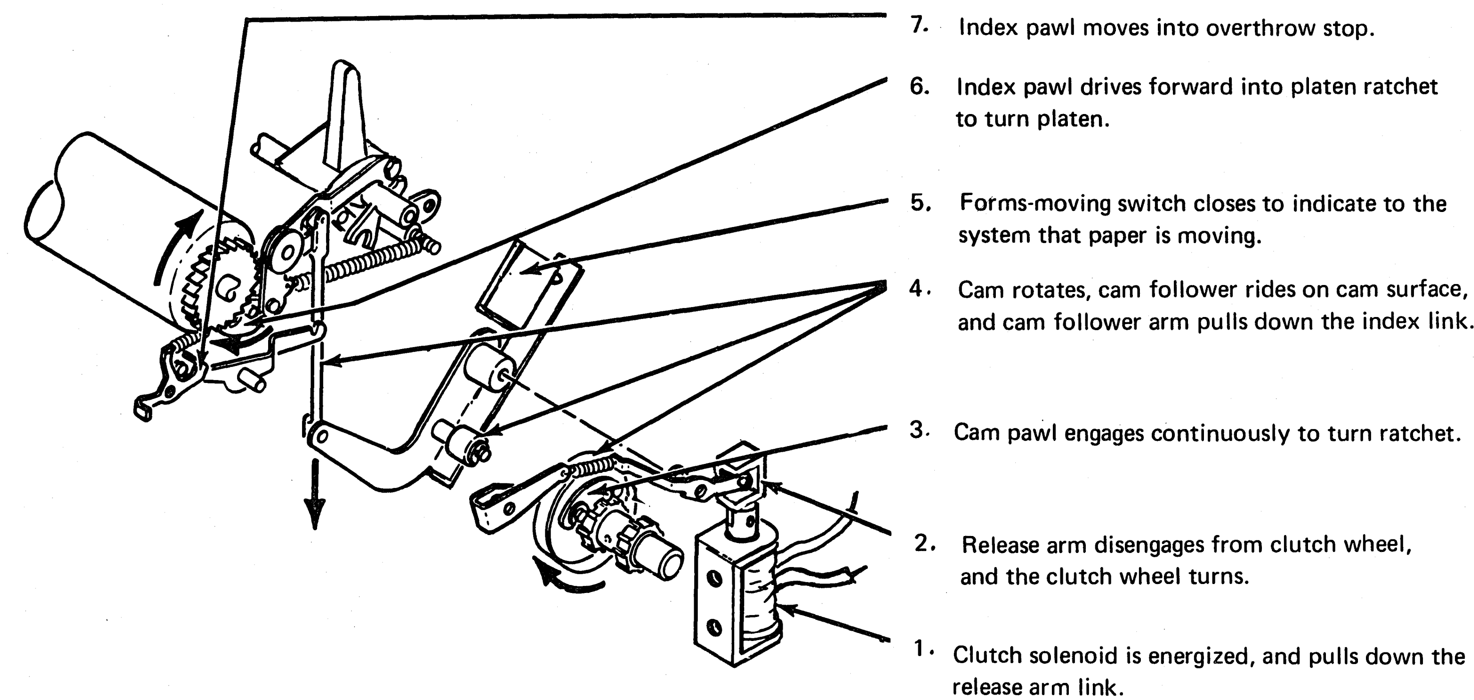
The pin-feed platen has pins in each end of the platen to engage marginal holes in paper. A

A copy control lever on the left side of the printer positions the platen forward or backwards for different thickness of forms.

Inward pressure on the right platen knob disengages the platen variable mechanism from the drive ratchet. This allows vernier rotation of the platen to position the forms vertically to the print line.



2.31 PLATEN MOVEMENT

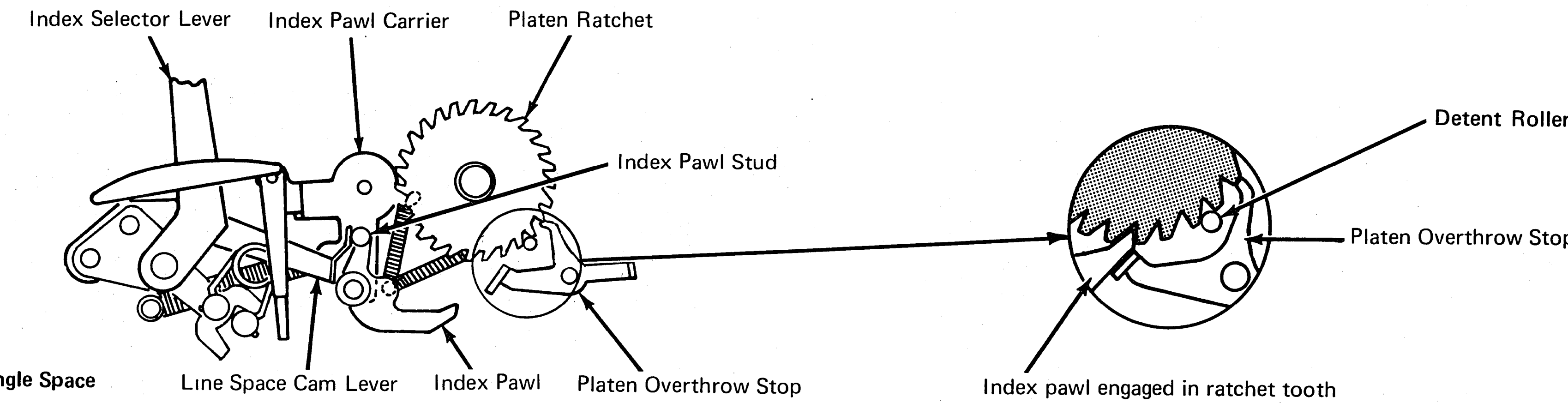


2.32 INDEX LEVER OPERATION

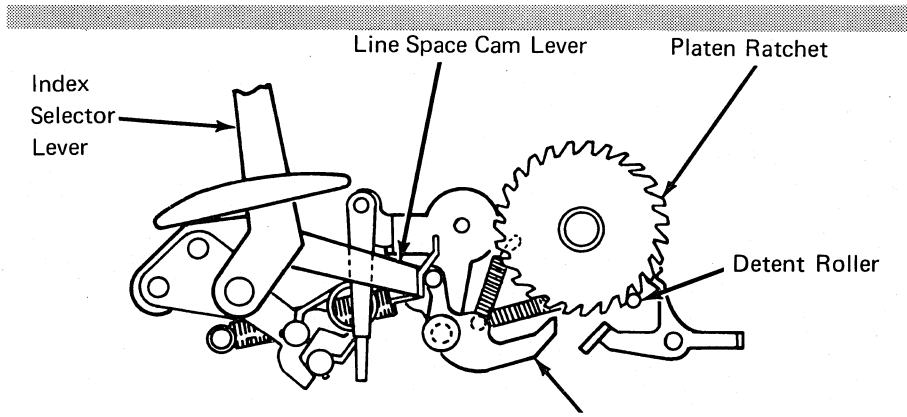
In the single-space position, the index pawl stud contacts the upper step of the cam lever to cause the index pawl to rest farther away from the platen. Thus, in the single-space position, the index pawl stud maintains contact with the line space cam lever longer and delays the entry of pawl into platen ratchet.

The index pawl is spring-loaded forward against ratchet tooth. As ratchet moves ahead of the index stroke, the pawl moves with it and reaches the overthrow stop at the same time the platen reaches the final position. The pawl then wedges into the ratchet and blocks any further rotation of the platen.

With the index selection lever in the double-space position, the index pawl stud contacts the lower step of cam lever to allow the pawl to rest closer to the platen ratchet.



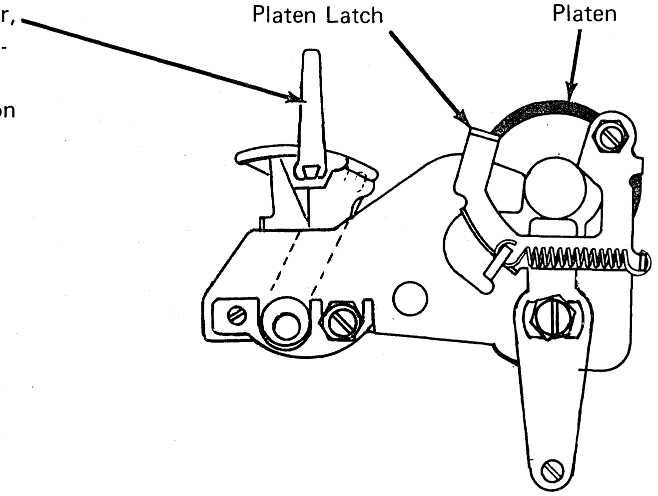
Single Space



Double Space

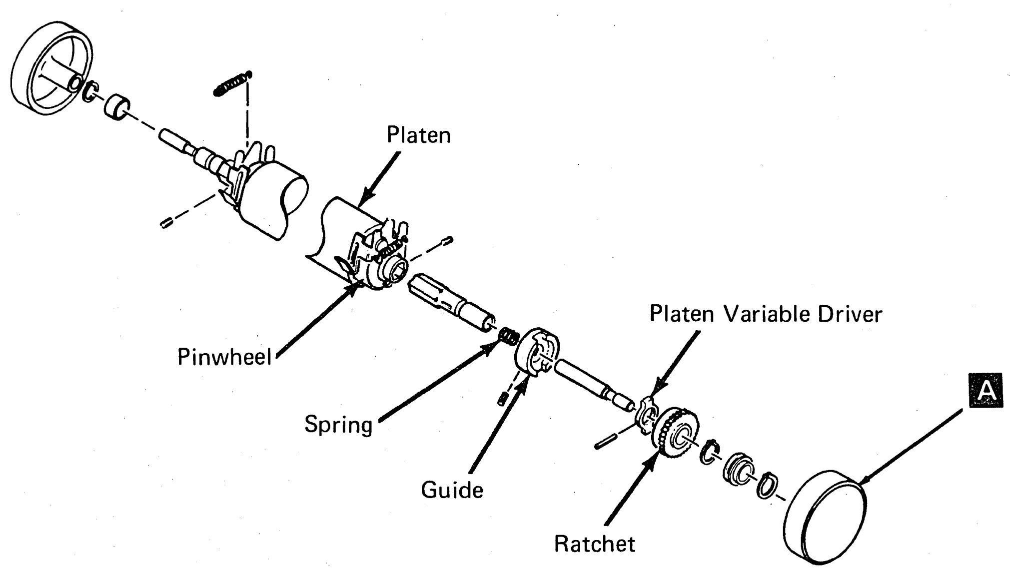
2.33 COPY CONTROL LEVER

The copy control lever, located on the left side of the printer, positions the platen forward or backward for different thicknesses of forms. Positioning the platen maintains correct relationship between the print wires and the point of impact on the paper.



2.34 PLATEN VARIABLE MECHANISM

1. The platen variable mechanism enables paper forms to be positioned to an exact vertical point on the writing line.
2. Pushing in the right-hand platen knob **A** disengages the driver from the ratchet. The platen can now be rotated freely as long as the knob is held in.
3. Releasing the spring-loaded knob engages the driver and ratchet.



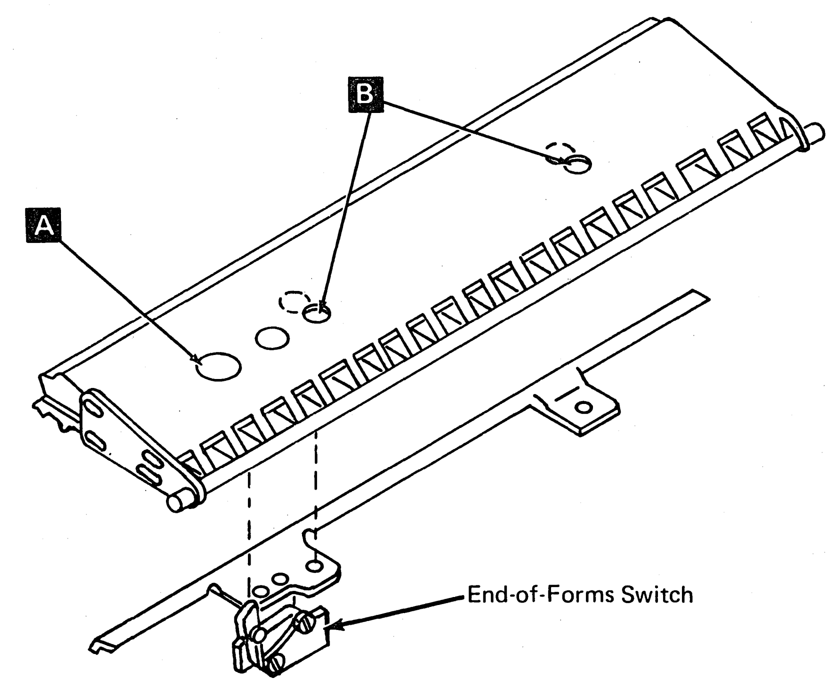
2.35 FORMS GUIDE ASSEMBLY REMOVAL AND REPLACEMENT

The forms guide assembly provides a path for the forms. A hole **A** in the left side of the assembly allows the end-of-forms switch actuator to enter the forms path.

To remove the forms guide assembly:

1. Loosen two screws. **B**
2. Slide the assembly in the keyhole slots.
3. Lift the assembly off the printer.

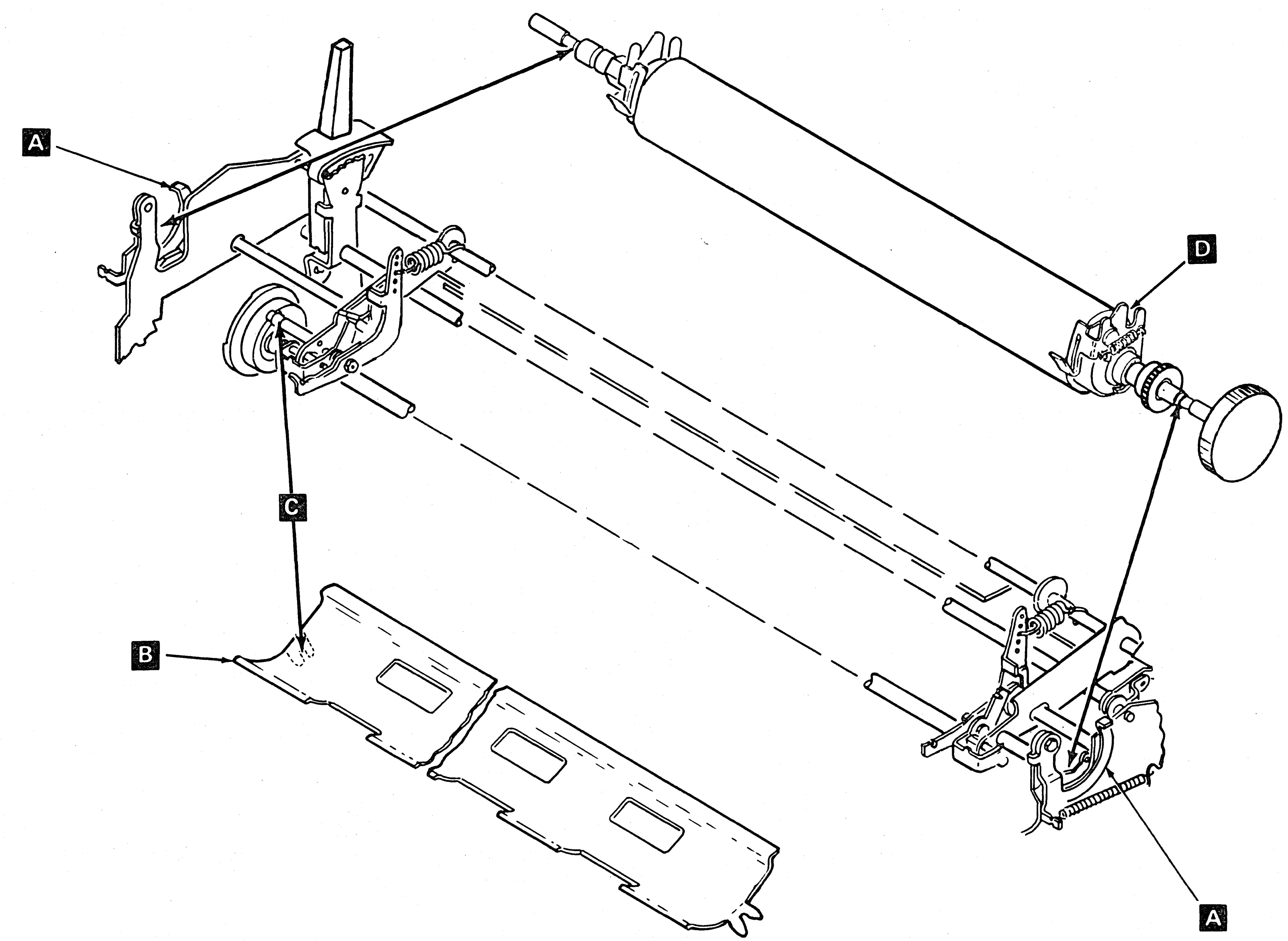
Replace the assembly in reverse order.



2.36 PLATEN AND PAPER-DEFLECTOR REMOVAL and REPLACEMENT

To remove the platen, press down on the platen release latches A (one on each end) and lift the platen upward. Lift out the paper deflector B beneath the platen. The ear of the deflector on the left end fits into a slot in the shaft C ; the right end is free-floating on a rod.

When replacing the platen, grasp the platen so that the notches D on the paper guide assemblies can be positioned onto the anchor rod across the front of the forms guide assembly. Press down on the platen to latch it in place.



2.37 CARRIAGE CAM-RELEASE ADJUSTMENT

Objectives:

1. To provide .005- .010-in. (0,13–0,25-mm) lateral clearance between the release lever and the clutch cam.
2. To provide .005–.010-in. (0,13–0,25-mm) clearance between the release lever and the clutch cam when the solenoid is picked.
3. To provide .005–.020-in. (0,13–0.51-mm) clearance between the cam pawl and the clutch ratchet teeth.

Adjustment

1. Turn the motor switch off. Loosen the setscrew **A** and laterally position the clutch assembly on the shaft so that, when the release lever is held toward the side frame (without being cocked), the clearance between the release lever and the side of the clutch cam is .005–.010 in. (0,13–0.25 mm).
2. Loosen 2 screws **B** on the ac switch mounting bracket and manually pick the solenoid so that the plunger bottoms on the residual.
3. Rotate the clutch cam **C** to the position shown and adjust the solenoid to provide .005–.010-in. (0,13–0,25-mm) clearance. (The bracket is keyhole-slotted to permit adjustment. Move the bracket vertically.) Tighten the screws and latch the clutch.
4. Check for .005–.020-in. (0,13–0,51-mm) clearance between the cam pawl **D** and the clutch ratchet teeth. To adjust:
   a. Remove the clutch assembly. (See 2.38.)
   b. Loosen two check-ring lock screws **E**
   c. Turn eccentric clockwise to increase or counterclockwise to decrease clearance.
   d. Reinstall clutch and perform step 1 of this procedure.

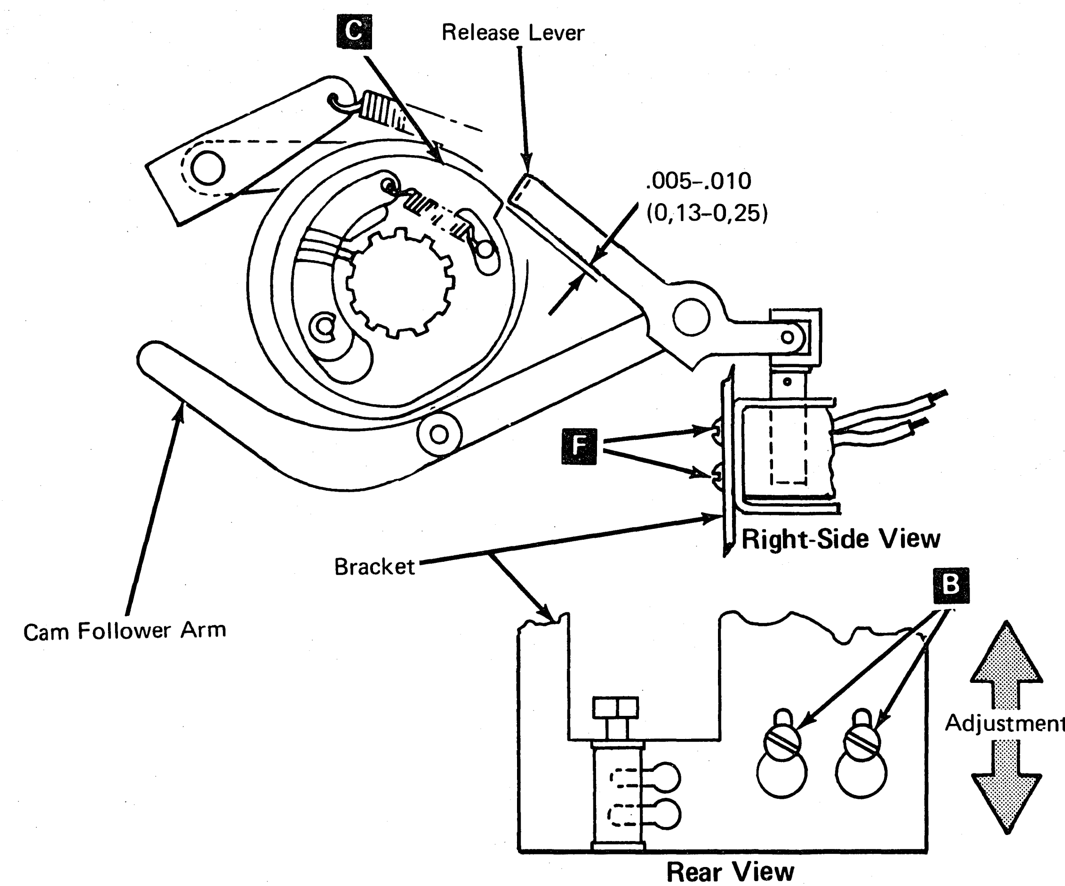
2.38 CARRIAGE CLUTCH ASSEMBLY REMOVAL AND REPLACEMENT

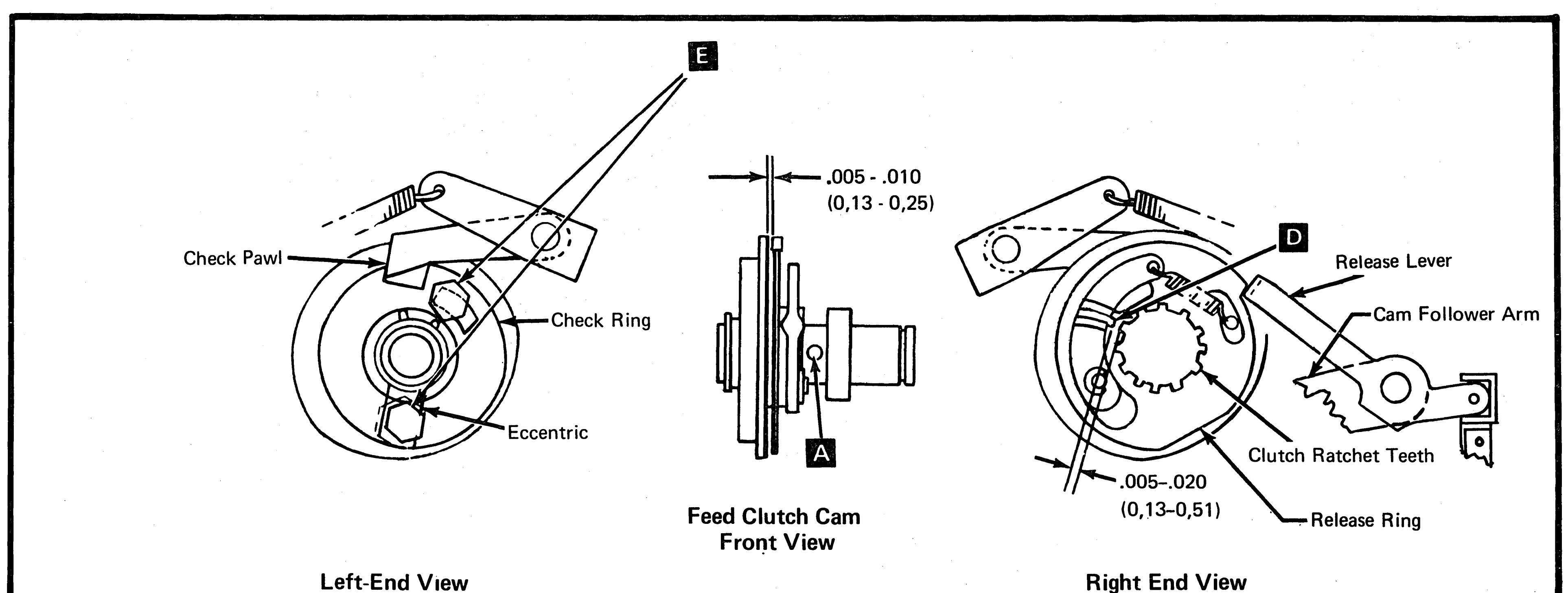
Removal

1. Loosen setscrew **A** far enough to clear flat cut in drive shaft.
2. Hold the release lever, cam follower arm, and check pawl out of the way, and slide the clutch off the shaft.

Replacement

1. See 2.37, Cam Release Adjustment, Step 4, to ensure proper clearance between the cam pawl and clutch ratchet teeth.
2. Replace in reverse order of removal.
3. Perform cam-release adjustment, steps 1-3 (2.37).





2.39 CARRIAGE SOLENOID REMOVAL AND REPLACEMENT

Removal

1. Unplug 2 solenoid wires and loosen 2 screws **F**.
2. Remove the solenoid assembly from the keyhole slots in the ac switch bracket.

Replacement

1. Install the solenoid and check cam-release adjustment, steps 2 and 3 (2.37).
2. Plug in the solenoid wires.

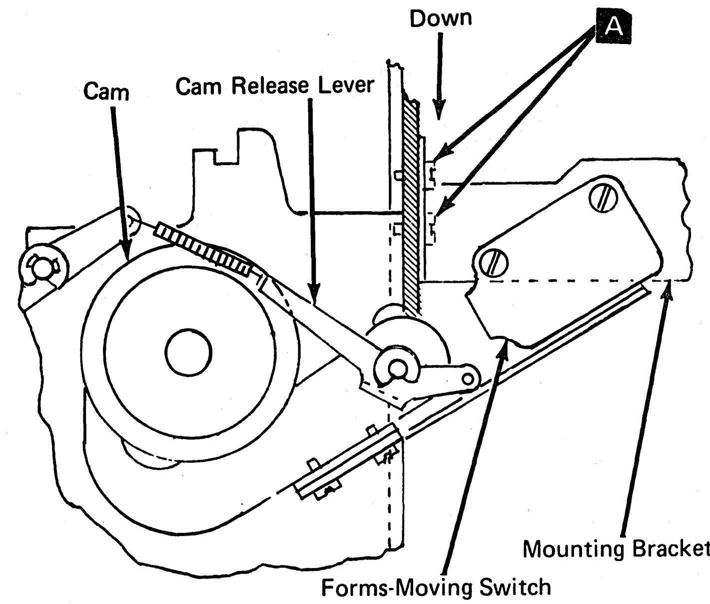
2.40 FORMS-MOVING SWITCH ADJUSTMENT

The forms-moving switch located on the right side of the printer, signals the system that forms are moving and that printing cannot take place.

CAUTION

Use only a volt-ohmmeter when checking the operation of this switch.

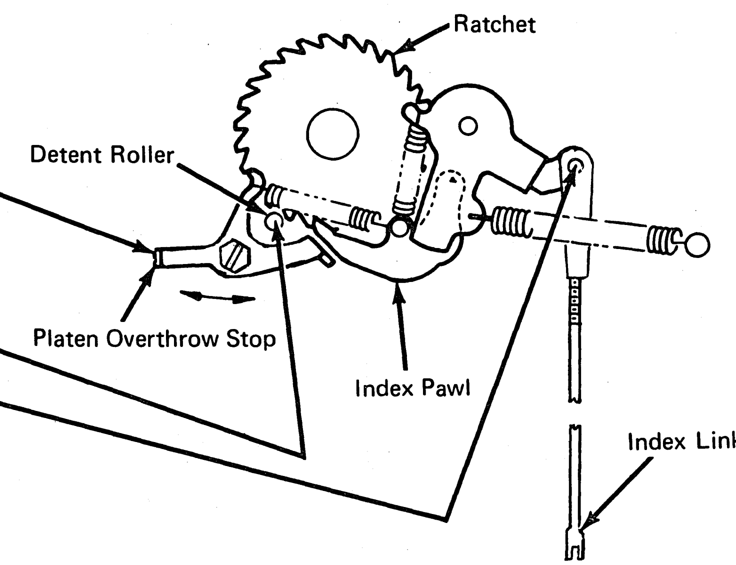
1. With power off, loosen the 2 screws A in the switch mounting bracket and trip the cam release lever.
2. Rotate the cam 1/4 turn and move the switch mounting bracket downward until the switch contact closes but does not bottom on the switch casing. With the cam rotated to latch up, the contacts must be open. If the contacts do not open, rotate the cam a little further (beyond 1/4 turn, but less than 1/2) until the switch opens on latch up.
3. Tighten the screws.

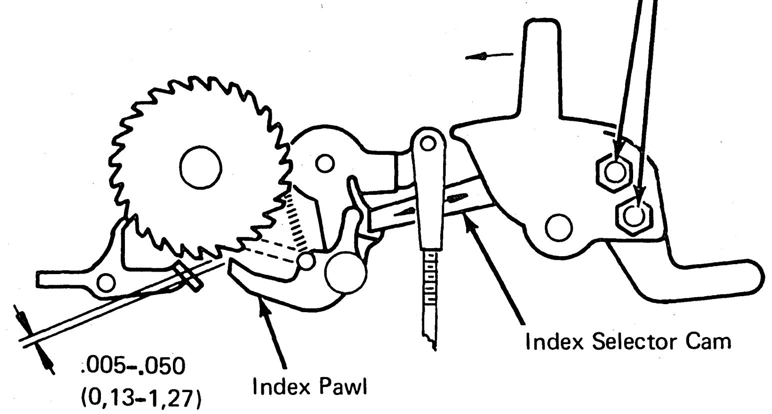


2.41 INDEX-PAWL AND SELECTOR ADJUSTMENT

1. Loosen screw and move platen overthrow stop away from platen.
2. With platen installed, use a spring hook to hold the detent roller disengaged from the platen ratchet.
3. Manually cycle an index operation and allow the detent roller to re-enter platen ratchet.
4. If the index link is properly adjusted, the detent roller seats between two ratchet teeth without rotating the platen. Adjust the link to obtain this condition with any one of the ratchet teeth.

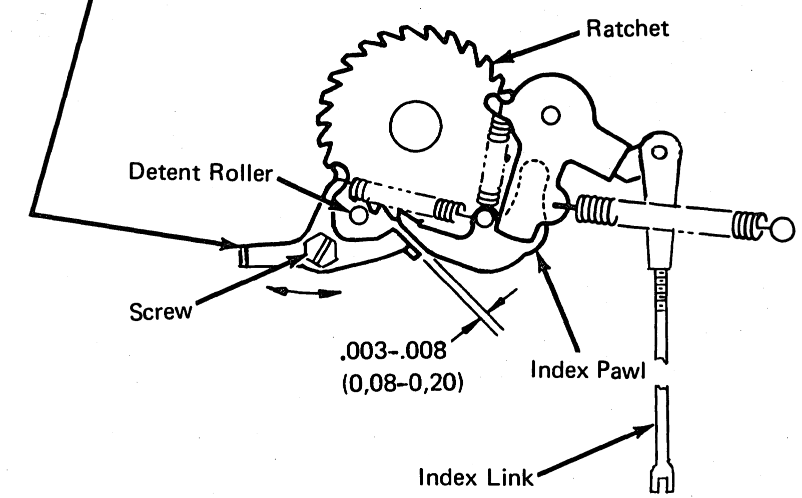
   Note: If the index link cannot be adjusted to eliminate rotating the platen, latch the clutch, set the selector lever in the double-space position, and make adjustment (step 5).
5. Loosen two nuts and move the index selector cam front to rear so that the index pawl clears the platen ratchet by .005 to .050 in. (0,13 to 1,27 mm). Tighten nuts.
6. Perform platen-overthrow-stop adjustment (2.42).





2.42 PLATEN-OVERTHROW-STOP ADJUSTMENT

With the index cam rotated to its high point, loosen screw and adjust the platen overthrow stop to clear the index pawl by .003 to .008 in. (0,08 to 0,20 mm). Tighten screw.



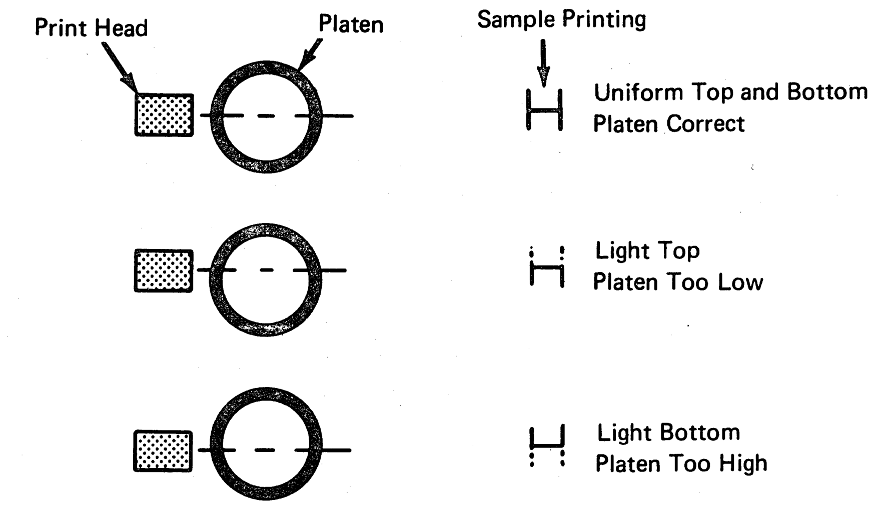
2.43 PLATEN-LATCH ADJUSTMENT

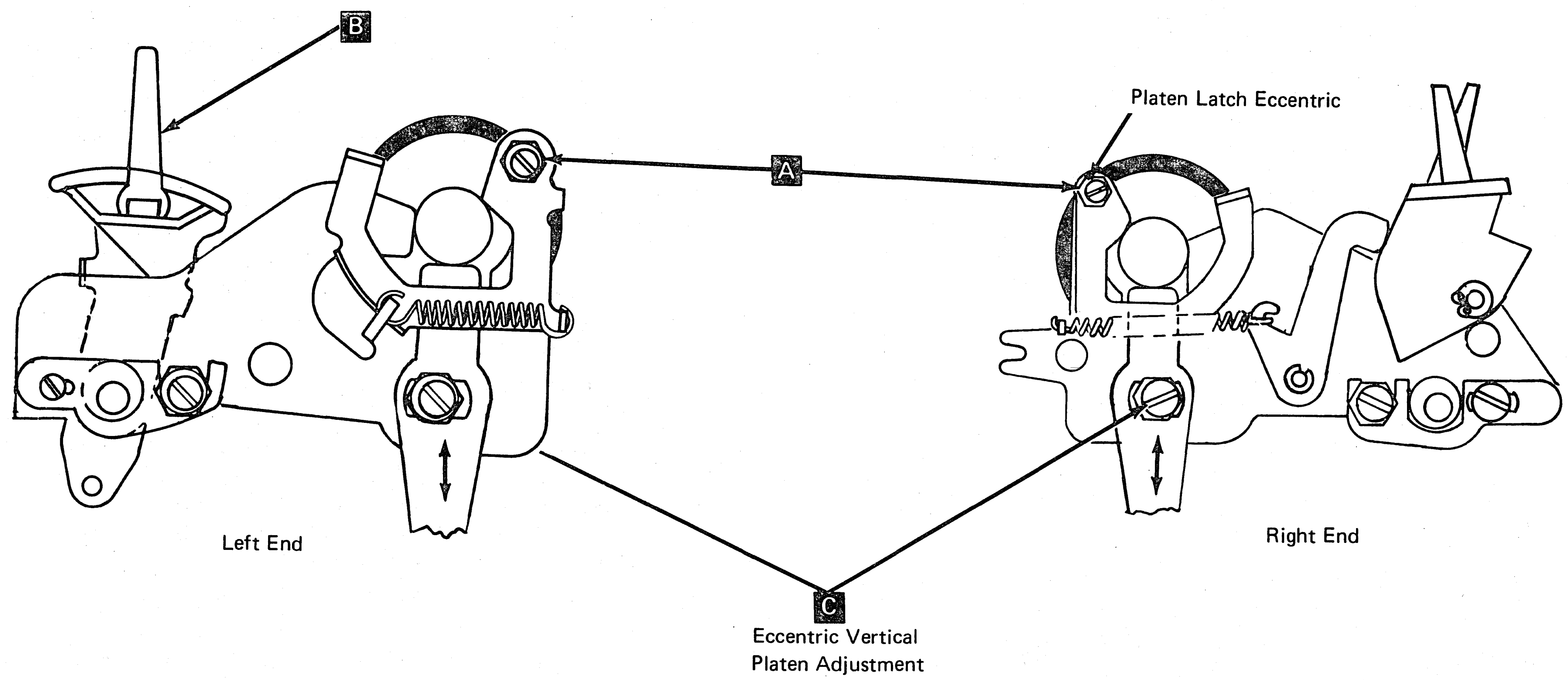
With platen installed, loosen screw A and adjust eccentrics (one on each end) so that platen locks firmly both vertically and horizontally. Tighten the screws.

2.44 PLATEN ADJUSTMENT, VERTICAL

1. Print a full line of E s or H s on single-part forms and move the copy control lever B to the point of lightest legible printing.
2. If the density of the characters is not uniform on the top and bottom across the print line, loosen the two eccentric lock screws C and rotate eccentrics either up or down to get uniform density. (Eccentrics raise or lower the platen with respect to the print head.) Tighten the screw.

2.45 VERTICAL ADJUSTMENT SERVICE HINT CHART



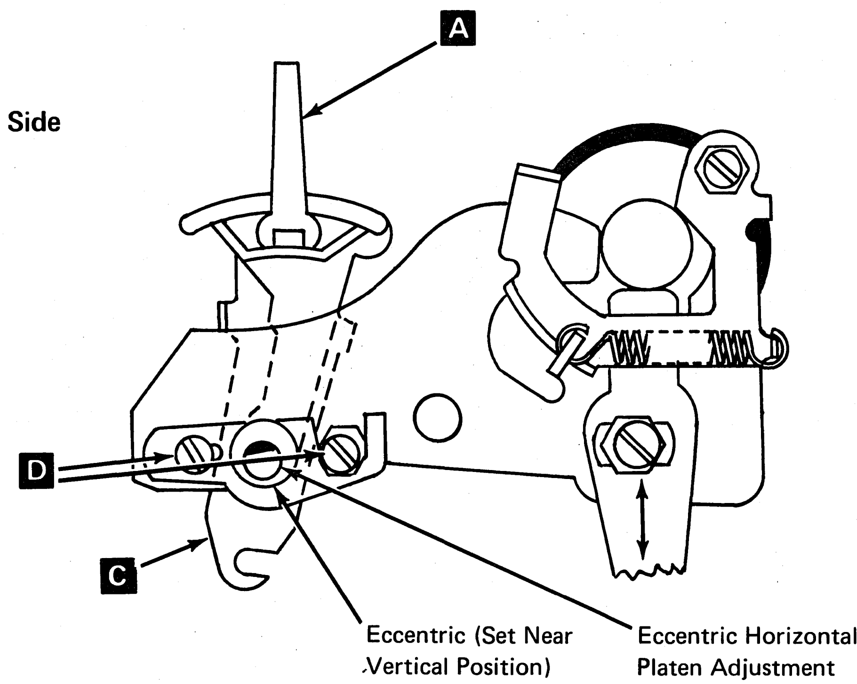


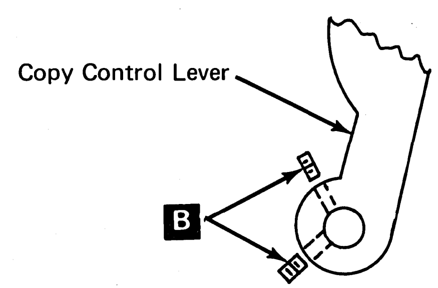
2.46 PLATEN ADJUSTMENT, HORIZONTAL (PIN FEED)

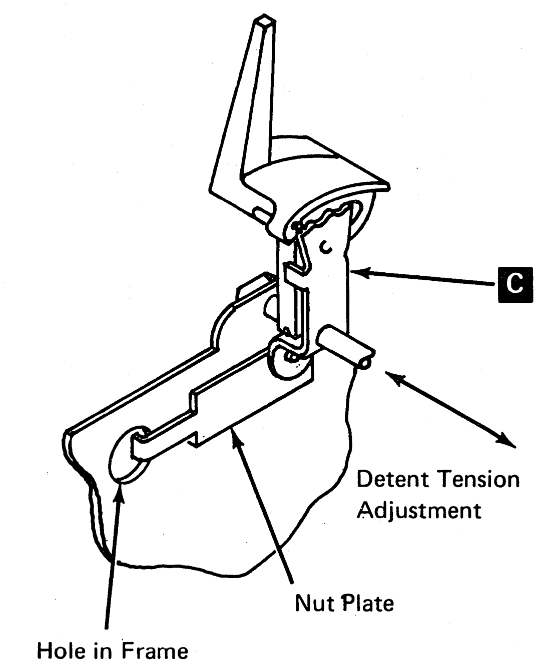
1. Position the copy control lever **A** so that the high side of the eccentrics on the ends of the shaft are in the up position.
2. Loosen two setscrews **B** on copy control lever handle.
3. Position the copy control lever in the forward detent position on the detent plate **C**. Fasten the detent plate to the frame and tighten the screw in the nut plate.
4. Move copy control lever axially along copy control shaft to allow free operation of lever but sufficient detent tension. Tighten the setscrews in the lever while it is in the middle detent position.
5. Move the copy control lever to the full forward position towards the platen.
6. Loosen four lock screws **D** (two on each end).
7. Loosen the ribbon guide mounting screws and move the ribbon guide to clear the tip of the print head.
8. Move the print head to print position 1.
9. Place a .030-in. (0,76-mm) feeler gauge between print head and platen **E** and adjust the eccentric screw on the eccentric plate until a slight drag is obtained with feeler gauge. When making this adjustment, applying light pressure to the eccentric plate may be necessary to hold it in position until the locking screws are secured.
10. Snug, but do not tighten, the two screws on the eccentric plate.

    Note: The platen may be slightly eccentric. When making this adjustment, be sure that the high side of the platen is toward the print head.
11. Move the print head to extreme right and follow the same procedure as in steps 9 and 10.
12. When the 030-in. (0,76-mm) clearance is obtained on both sides, tighten all screws securely and visually check for even motion of the platen when moving the copy control lever front to rear.
13. Adjust the ribbon guide assembly for .025-in. (0,64-mm) clearance between the ribbon guide and the platen.

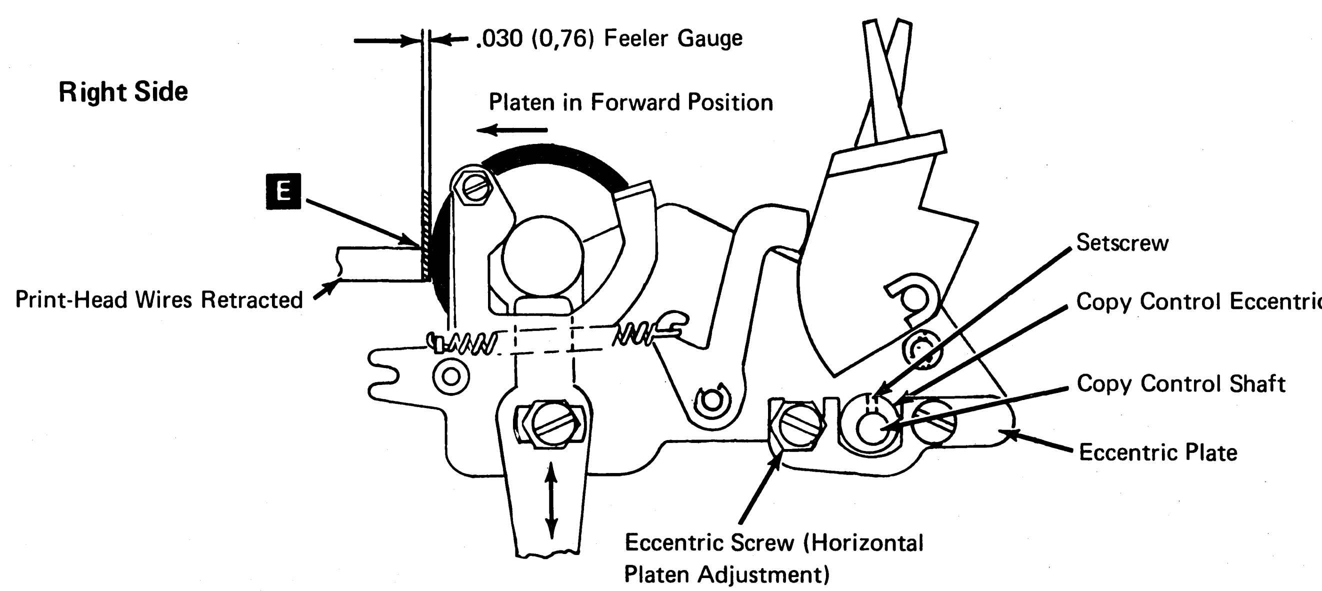
Left Side





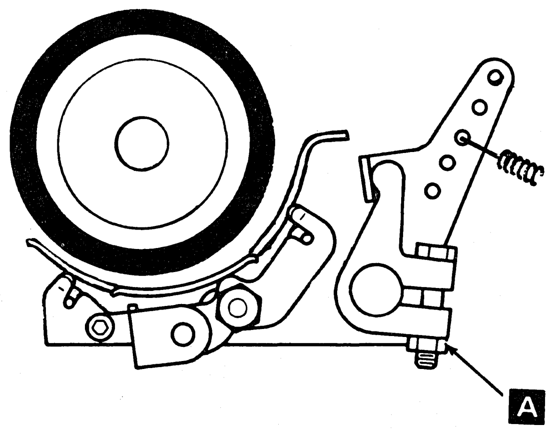


Right Side



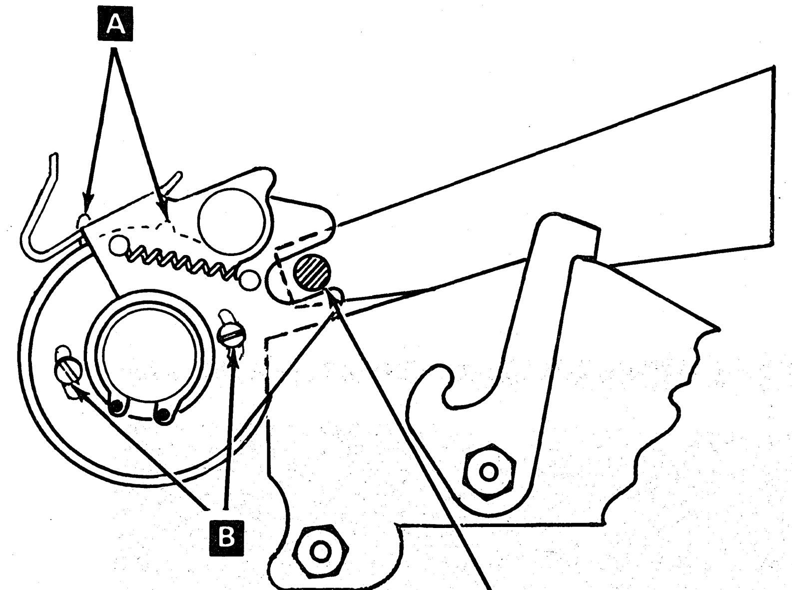
2.47 PAPER-RELEASE-ARM ADJUSTMENT

The feed roll release lever does not operate. However, be sure that the feed roll hangers do not interfere with the paper path. To obtain clearance, loosen the nut A locking the stop arm to the release shaft, and rotate the stop arm toward the platen. Tighten the nut. Repeat for the other three stop arms.



2.48 PLATEN PINWHEEL ADJUSTMENT

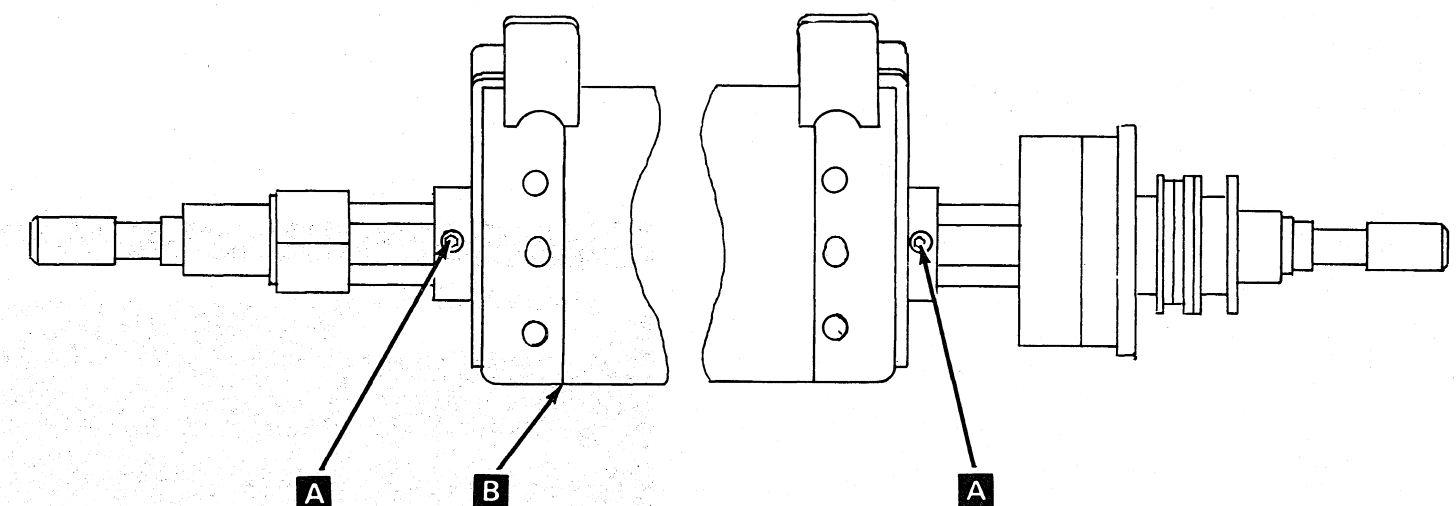
Two feed pins should be extended in positions as shown. A To adjust, loosen the lock screws B and rotate the platen. Rotating platen backward (with respect to normal forms movement) causes the pins to exit earlier; rotating the platen forward causes the pins to exit later. Tighten the lock screws. Repeat for the other pinwheel.



Cam anchor rod on the forms guide prevents the pinwheel cam from turning while the pinwheel adjustment is made and while paper is moving.

2.49 PLATEN ADJUSTMENT, LATERAL

1. Loosen the setscrew A in the hub on each end.
2. Move the print head to print position 1.
3. Shift the platen to where printing occurs only on the platen. B
4. While holding the platen, move the hubs against the platen, and tighten the setscrews.
5. Move the print head to print position 132 and check that the last print position is not beyond the platen. Readjust if necessary.



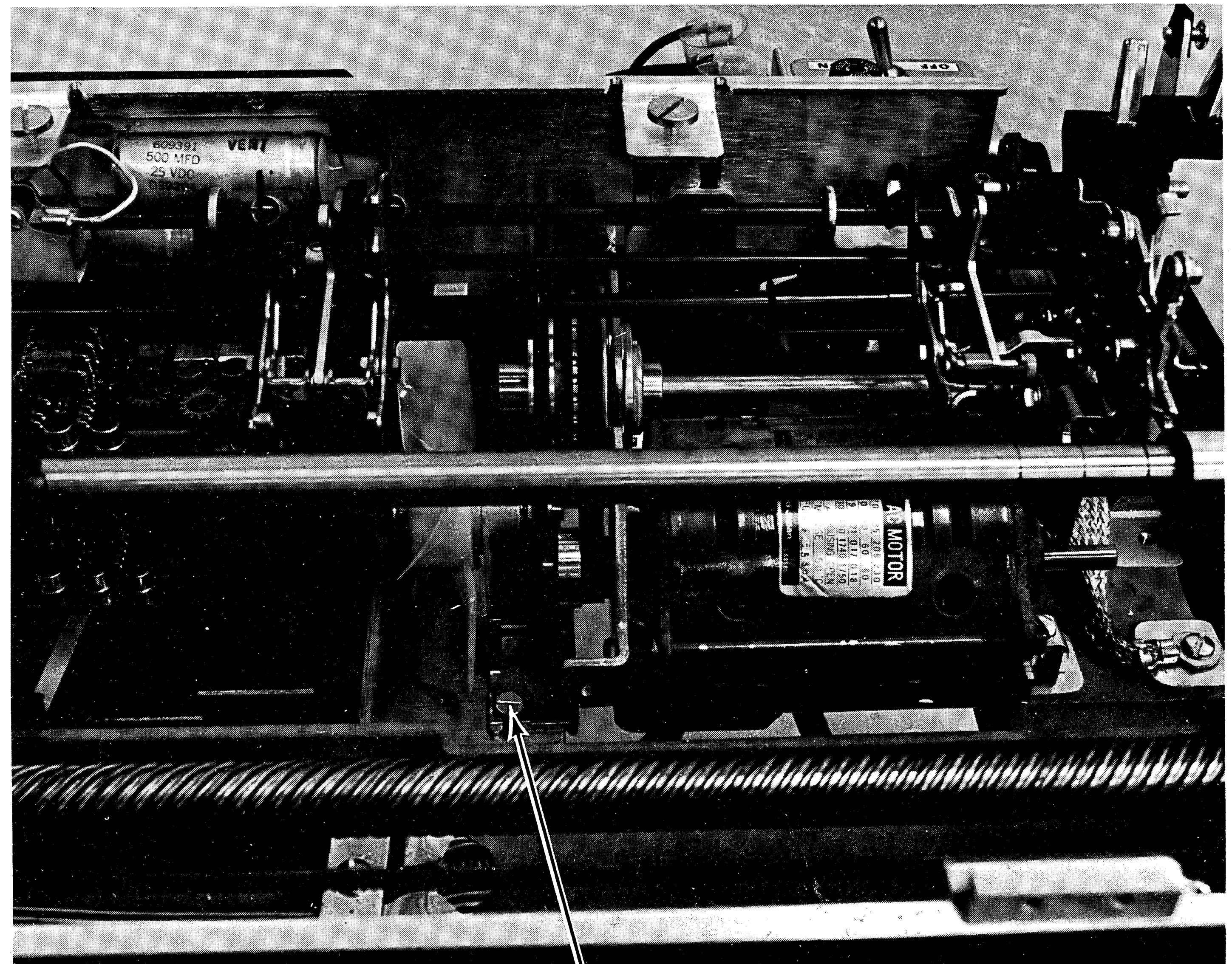
2.50 FAN BELT REMOVAL AND REPLACEMENT

Removal

1. Remove system power.
2. Remove the platen and main covers.
3. Remove the paper deflector.
4. Loosen the 2 screws in the forms guide assembly, slide and lift it out of its keyhole slots.
5. Move the print head to the extreme right. Remove top and front covers over SLT cards. Remove card holder and move the print head to the left.
6. Insert a screwdriver underneath the leadscrew and loosen the screw on the carriage motor cover. Remove the cover.
7. Loosen the screws located on the top left side over the fan blade assembly and the screw on the lower left front of the remaining cover. Remove the cover.
8. Loosen the 2 screws **A** that mount the fan blade bracket to the carriage support frame and remove the fan belt from the fan pulley.

Replacement

Replace in reverse order of removal. Adjust the belt tension by sliding the fan assembly bracket forward until the belt is taut without stress on the pulleys. Tighten the screws.



A

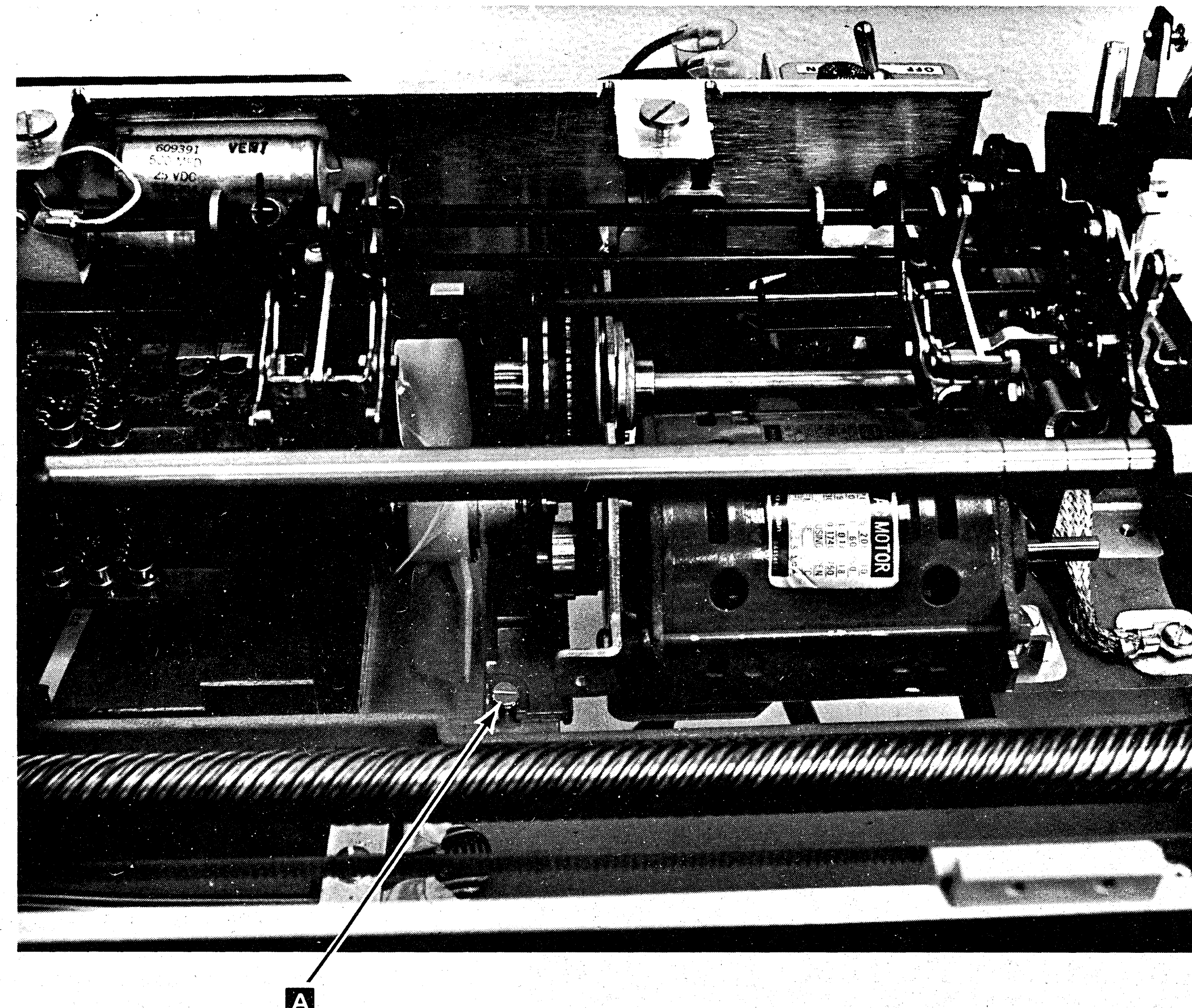
2.51 CARRIAGE DRIVE-MOTOR-BELT REMOVAL AND REPLACEMENT

Removal

1. Remove system power.
2. Remove the platen and main covers.
3. Remove the paper deflector (2.36).
4. Loosen the 2 screws in the forms guide assembly, slide and lift it out of its keyhole slots.
5. Move the print head to the extreme right. Remove top and front covers over SLT cards. Remove card holder and move the print head to the left.
6. Insert a screwdriver underneath the leadscrew and loosen the screw on the carriage motor cover. Remove the cover.
7. Loosen the screws located on the top left side over the fan blade assembly and the screw on the lower left front of the remaining cover. Remove the cover.
8. Loosen the 2 screws **A** that mount the fan blade bracket to the carriage support frame and loosen the fan belt from the fan pulley.
9. Remove the large capacitor (C1) on the rear of the machine.
10. Remove edge connector 2.
11. From the rear of the machine, loosen the carriage motor mounting screws. (The screws are located to the left of EC-1 and EC-2.)
12. With the motor loose, remove the drive belt.

Replacement

Replace the belt, adjust the drive motor until the belt is taut without stress on the motor bearings. Replace in reverse order of removal.



2.52 CARRIAGE DRIVE MOTOR REMOVAL AND REPLACEMENT (PIN FEED)

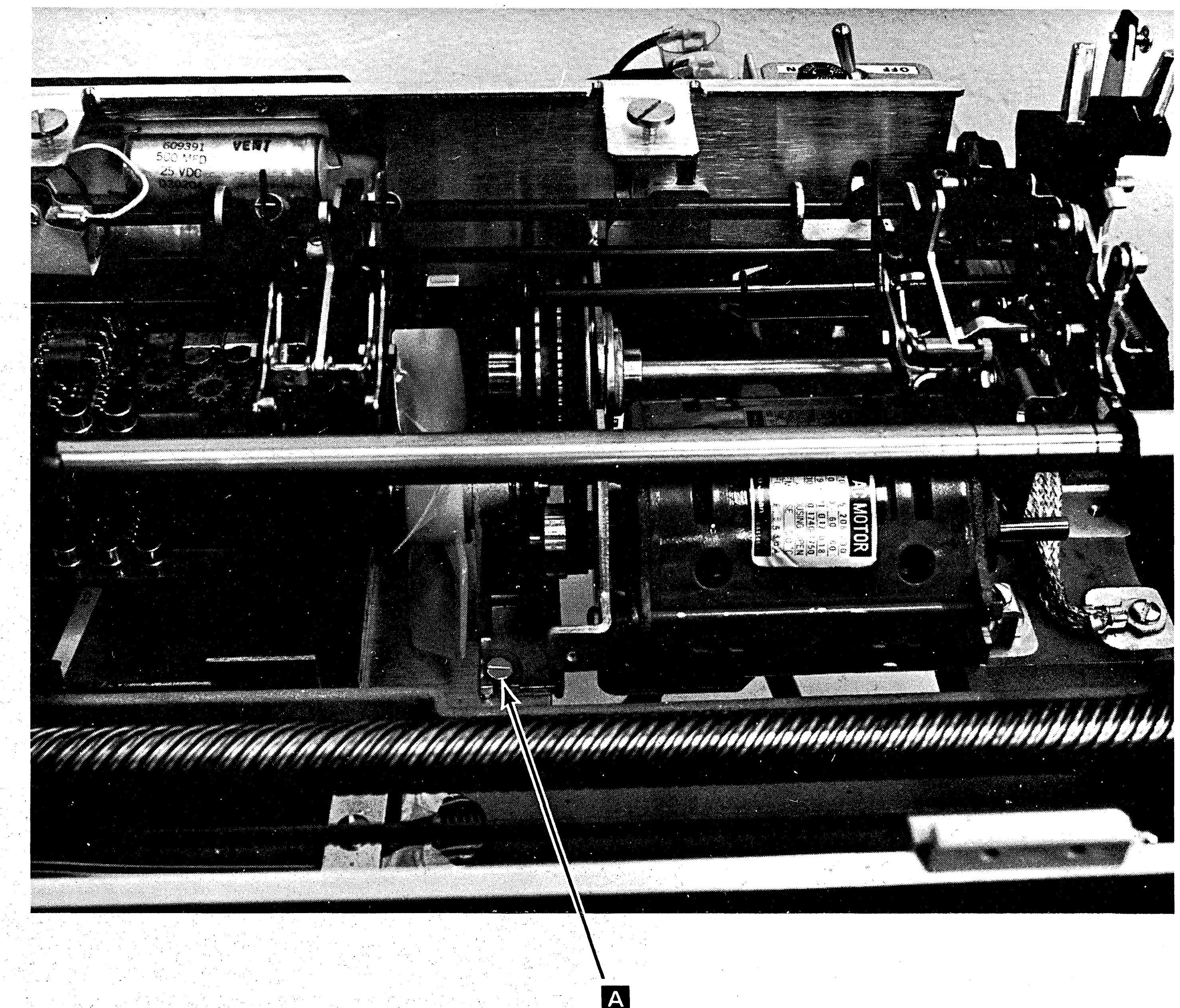
Removal

1. Remove system power.
2. Remove the platen and main covers.
3. Remove the paper deflector (2.36).
4. Loosen the 2 screws in the forms guide assembly and lift it out of its keyhole slots.
5. Move the print head to the extreme right. Remove top and front covers over SLT cards. Remove card holder and move the print head to the left.
6. Insert a screwdriver underneath the leadscrew and loosen the screw on the carriage motor cover. Remove the cover.
7. Loosen the screws located on the top left side over the fan blade assembly and the screw on the lower left front of the remaining cover. Remove the cover.
8. Loosen the 2 screws A that mount the fan blade bracket to the carriage support frame and loosen the fan blade belt from the fan blade pulley.
9. Loosen the nut on the right end of the tie rod and remove the nut on the left end of the tie rod. Remove the rod from the carriage assembly. Do *not* loosen the inward jam nuts.
10. Remove the large capacitor (C1) on the rear of the machine.
11. Remove edge connector 2.
12. From the rear of the machine, remove the carriage motor mounting bracket screws. (The screws are located on the left of EC-1 and EC-2.)
13. With the motor loose, remove the drive belt.
14. Disconnect the blue and red wires from C1. Remove the yellow wire from the carriage fuse by sliding the protective insulation downward and pulling the wire off the terminal with a pair of pliers.

    Note: To gain access to the yellow wire may require sliding the capacitor up out of its mounting bracket and then removing the bracket by squeezing it together.
15. Loosen the setscrew on the left end of the carrier support shaft. With the print head moved to the left, slide the carriage support shaft to the left far enough so that the motor can clear.
16. Remove the carriage drive motor and its mounting bracket.

Replacement

Replace in reverse order of removal and adjust the fan drive and motor drive belts until they are taut but without stress on the pulleys. Be sure the carrier support shaft is flush with the side frame.



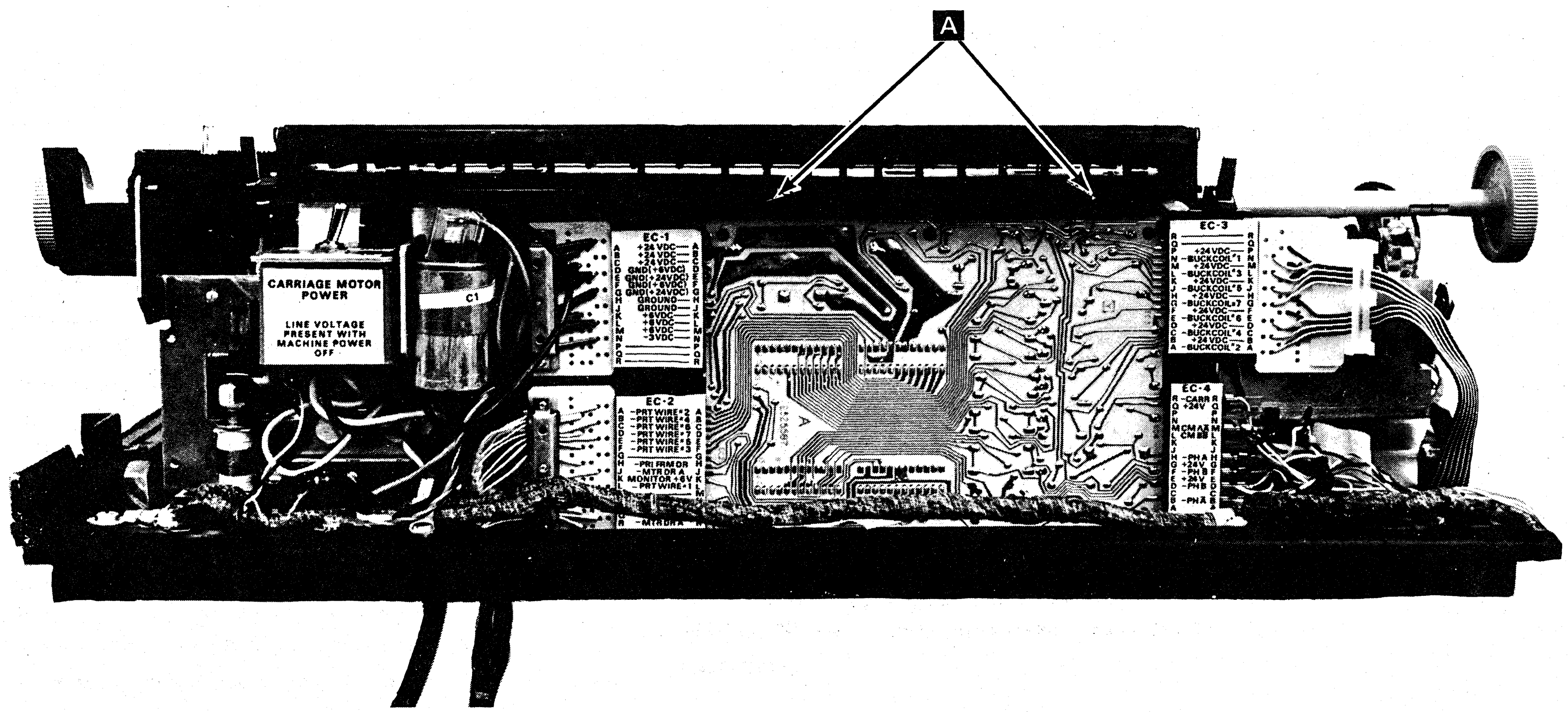
2.53 PRINTED CIRCUIT BOARD REMOVAL AND REPLACEMENT

Removal

1. Remove system power. Remove the platen and top cover.
2. Remove the forms guide assembly (2.35).
3. Remove capacitor C1 and the mounting clip.
4. Unplug paddle cards EC-1, EC-2, EC-3, and EC-4.
5. Remove the two board mounting plate screws **A** and remove the board.

Replacement

Replace in reverse order of removal.



2.54 CARRIAGE ASSEMBLY REMOVAL AND REPLACEMENT

Removal

Note: Before performing the carriage removal, note all switch wiring, capacitor wiring, etc. to assist you when reconnecting the wiring.

1. Remove system power. Remove the platen and top covers.
2. Remove the forms guide assembly (2.35).
3. Remove capacitor C1 and the mounting clip. Pull out paddle cards EC-1, EC-2, EC-3, and EC-4.
4. Remove the cover over the stepper-motor resistors. Use a screwdriver to release the tabs holding it onto the metal cover.
5. Remove the forms moving switch bracket (2 screws) (2.40).
6. Remove the 2 wires on the end-of-forms switch. Be sure the cable is free from the carriage assembly.
7. Remove EC-1 cable clamp (dc cable).
8. Remove the carriage drive switch and the fuse cable clamp (ac cable).
9. Remove the yellow wire from the fuse.
10. Remove the black wire from C1.
11. Remove the ground wire from the frame and remove the solenoid wires (taper pins) from TB2-A and TB2-B. Remove TB2.
12. Disconnect the wires from C2 and C3 at EC-4.
13. Loosen the 5 screws (3 on the left and 2 on the right) that hold the entire carriage assembly to the printer base. When all cables are free, lift out the assembly.

Replacement

1. Place the carriage on the printer base and (while facing rear of printer) push it all the way forward and to the right. Tighten the small screw on the side frame, position the four clamps, and then tighten the four remaining screws that clamp the frame onto the base.
2. Perform the remaining 12 steps in reverse order of removal.
3. Check the following adjustments and adjust as necessary:
   a. Print-head-to-platen clearance and ribbon guide assembly adjustment (2.28)
   b. End-of-forms switch adjustment, Model 1 (2.55)
   c. Forms-moving switch adjustment (2.40)
   d. Check all carriage adjustments.

2.55 END-OF-FORMS SWITCH ADJUSTMENT (MODEL 1)

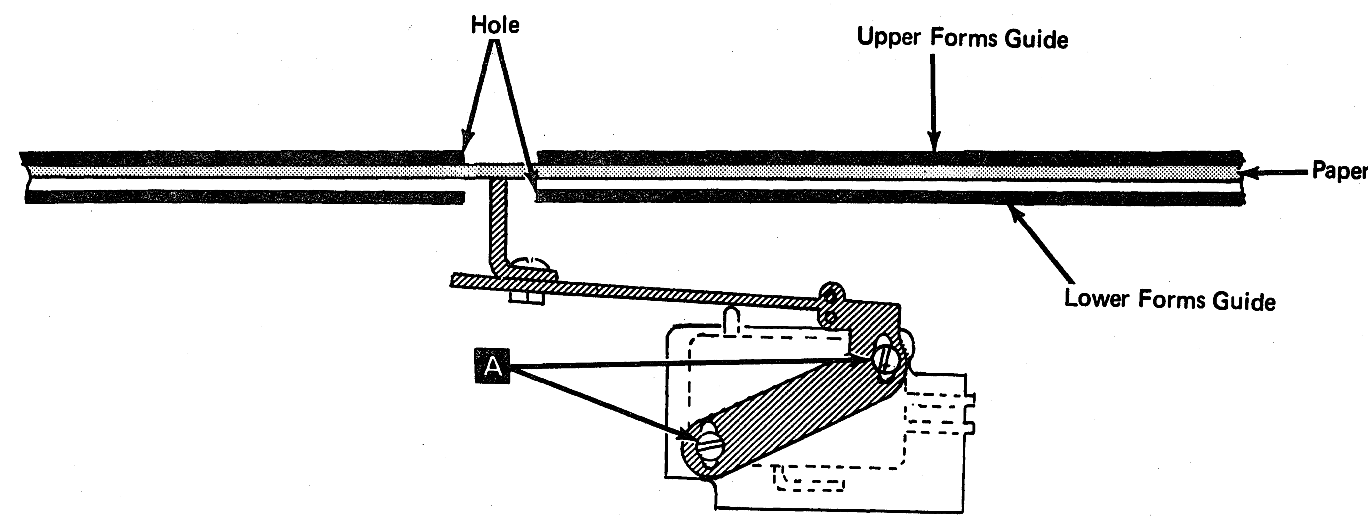
Objective:

To have the end-of-forms switch close with one thickness of paper in the forms guide.

Adjustment

1. Insert a paper into forms guide.
2. Loosen two mounting screws **A** and rotate the switch until the switch closes. Tighten the screws. With the paper in the forms guide, check for continuity between the normally open and operating point.

   Note: Adjust the switch to close, but not bottom, on the switch casing.

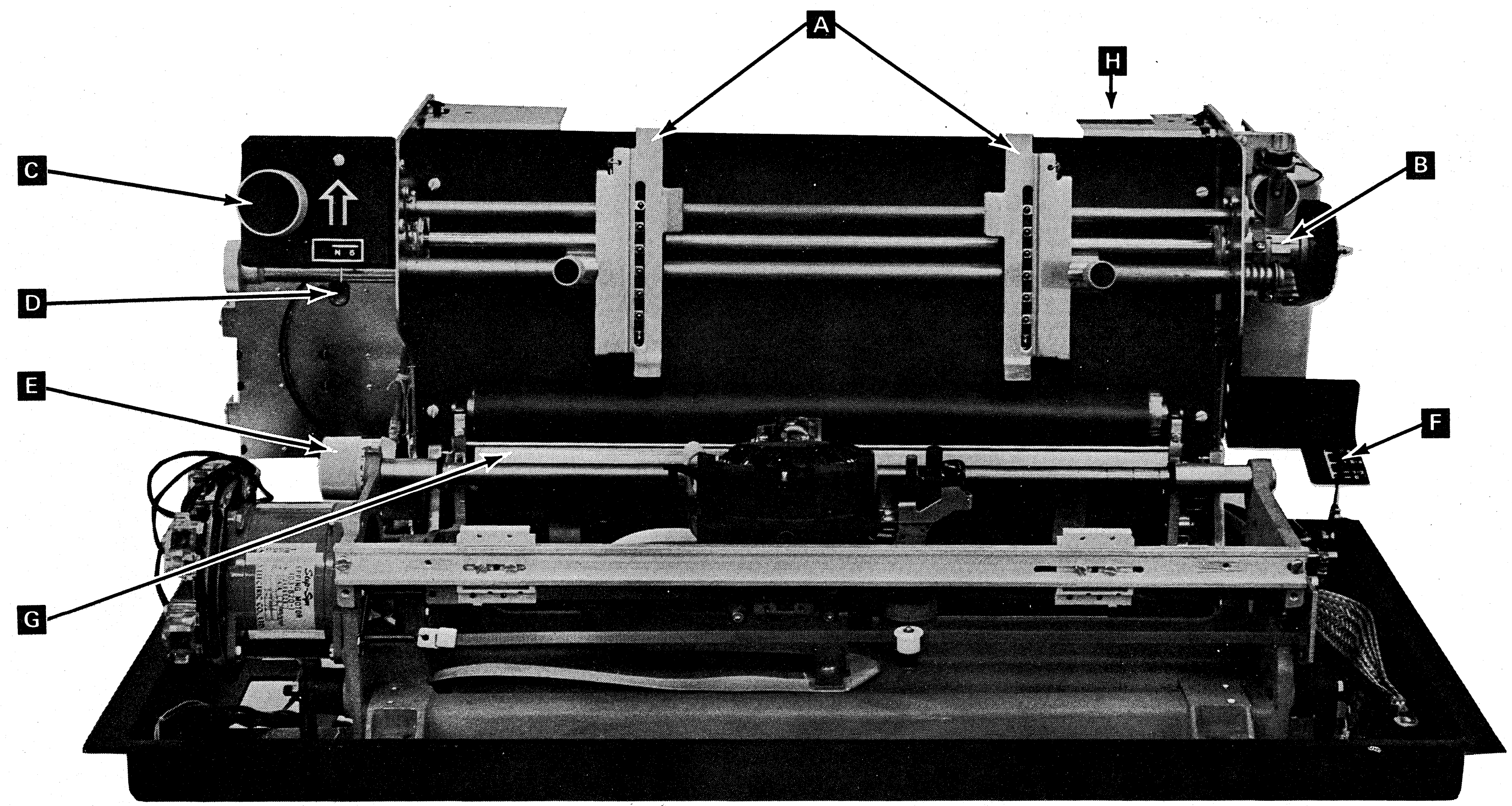


REMEMBER
There is a Reader's Comment Form at the back of this publication.

VERTICAL FORMS CONTROL CARRIAGE, ADJUSTMENTS, REMOVALS, and REPLACEMENTS (MODELS 2 and 3)

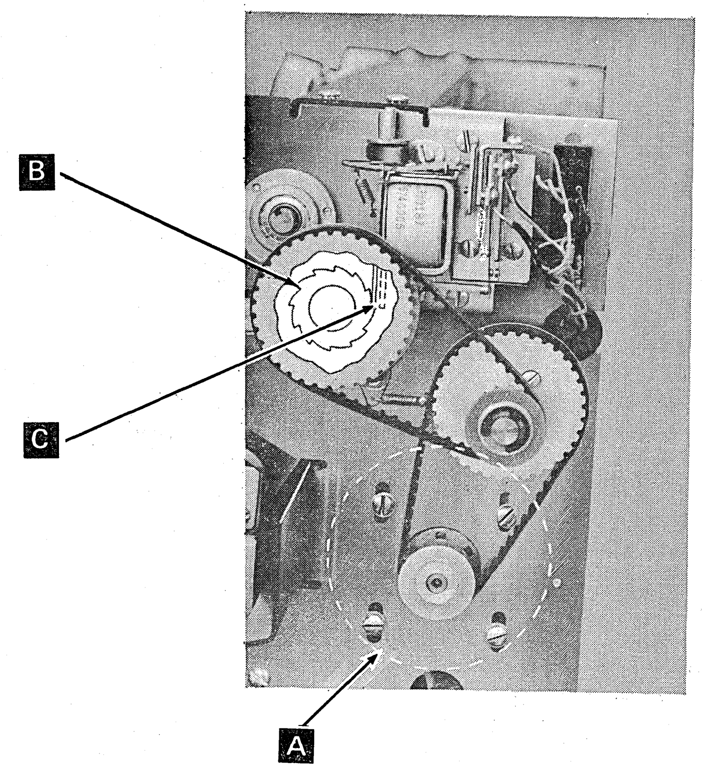
2.56 VERTICAL FORMS CONTROL CARRIAGE, DESCRIPTION

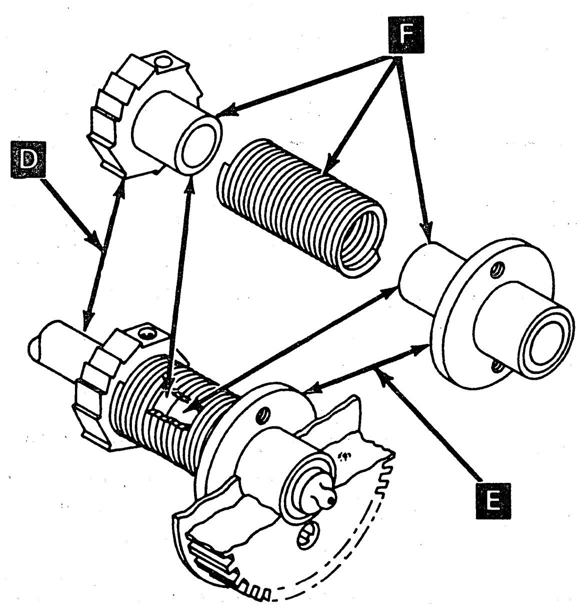
- The VFC (vertical forms control) carriage is an electronic carriage that advances the forms through the printer under programmed control of the system.
- Two pin-feed tractors **A** ensure positive feeding of the forms for either line-spacing or skipping.
- A continuously running motor drives the tractors through a magnetically operated spring clutch. **B**
- A carriage emitter sends a pulse to the adapter for every line space advanced.
- Paper advance knob **C** (push and turn) advances forms with line select lever **D** in neutral position.
- The forms thickness knob **E** moves the platen closer to or farther from the print head to compensate for the thickness of the forms used.
- Paper tension control lever **F** adjusts the drag on the paper according to the number of parts used.
- A metal rod **G** , extending the length of the forms entry slot, governs form overshoot to reduce blousing.
- Carriage drive-motor switch **H** (located on rear) disconnects ac power to the motor.



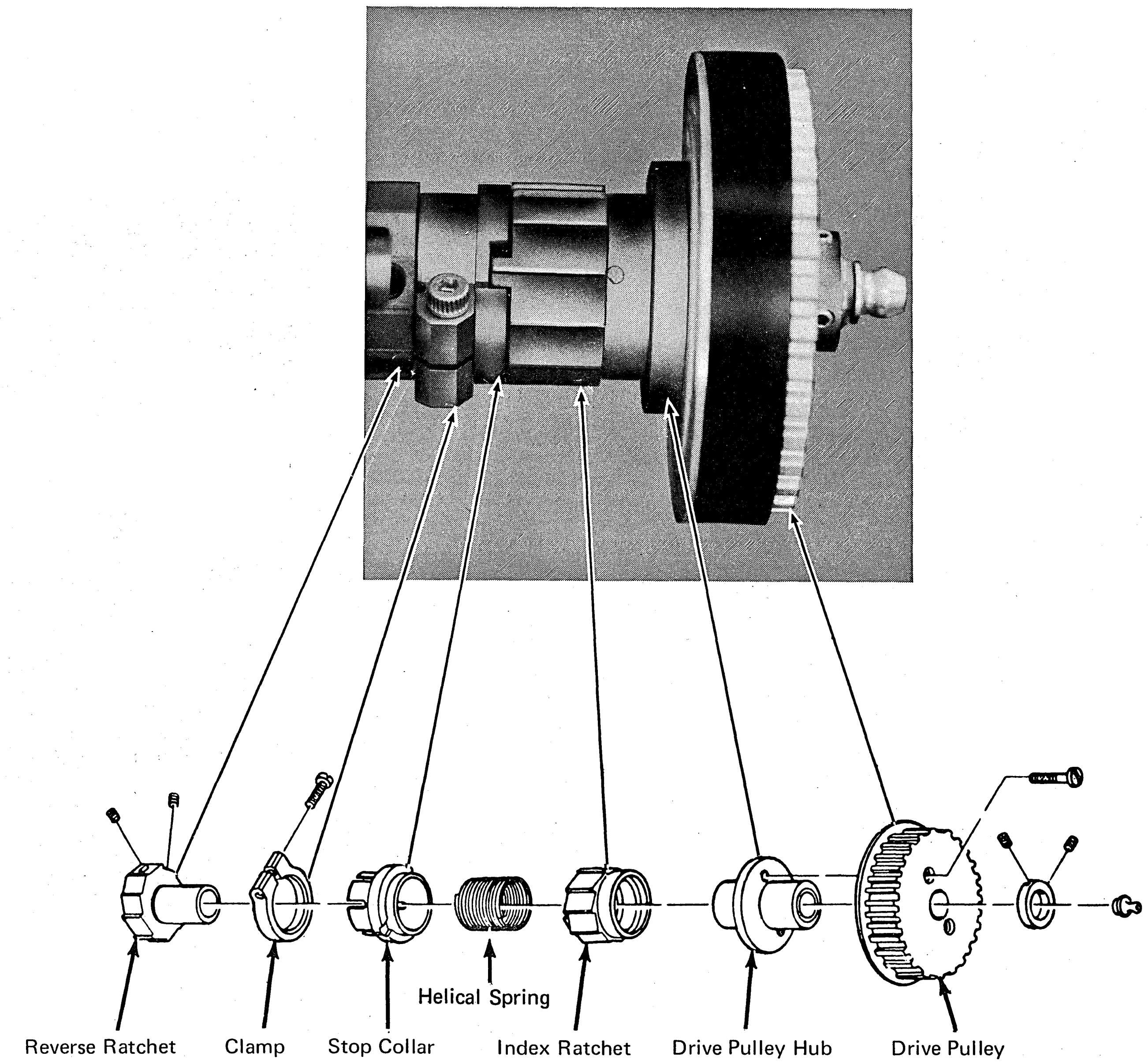
2.57 SPRING CLUTCH DESCRIPTION

1. A continuously running carriage drive motor A turns all the clutch gears counterclockwise.
2. A helical spring within the clutch assembly is latched in an expanded condition to allow the drive gear to turn without turning the tractor shaft. B
3. When the carriage-clutch magnet is energized, it pulls C the escapement armature out of the index ratchet tooth to allow the helical spring coils to collapse and grip the continuously turning shaft. As long as the magnet is energized, the driving shaft and the driven shaft are coupled by the helical spring coils, and the form tractors move.
4. The driven member D consists of a reverse ratchet and hub assembly connected by gears to the tractor drive shaft (driven shaft).
5. The driving member E consists of another hub attached to the drive pulley and free to spin on the tractor clutch drive shaft alongside the reverse ratchet hub. Both hubs are wrapped by a common helical spring.
6. When the spring is relaxed, it grips both hubs tightly and couples them together. F Driven by the pulley, both hubs then turn as a unit in the counterclockwise direction.





2.58 SPRING-CLUTCH ASSEMBLY



REMEMBER

There is a Reader's Comment Form at the back of this publication.

2.59 SPRING-CLUTCH ADJUSTMENTS AND SERVICE CHECKS

Service Checks

1. When the clutch is latched, the helical spring should be held expanded so that both the driving and driven hubs are free to rotate within it.
2. When the clutch is unlatched, the helical spring should collapse and grip both the driving and driven hubs without slipping. If slipping occurs, adjust the clutch.

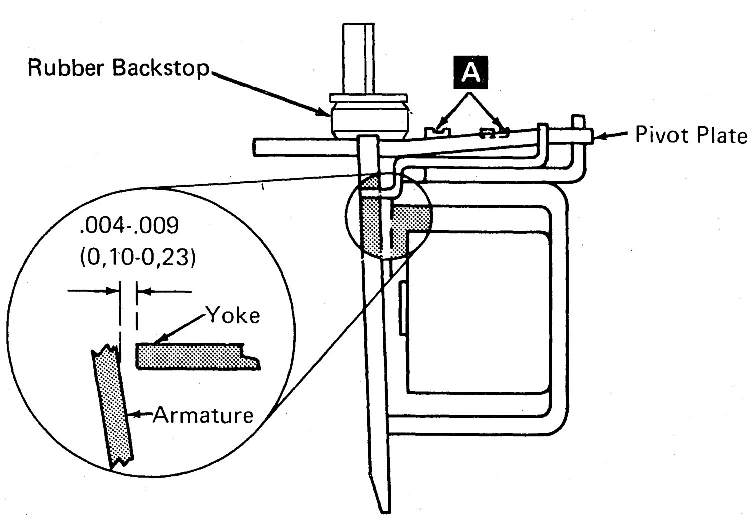
Pivot-Plate Adjustment

OBJECTIVE:

To ensure that the armature, when attracted, does not bind against the pivot side of the magnet yoke.

PROCEDURE

1. Loosen the rubber backstop mounting plate screws and the armature pivot plate mounting screws **A** and adjust the pivot plate to obtain .004 to .009-in.(0,10 to 0,23-mm) clearance between the armature and the pivot side of the magnet yoke.
2. Tighten the pivot plate mounting screws.
3. While holding the rubber backstop so that it just touches the pivot plate, tighten the mounting screws.



Armature-Core Clearance Adjustment

OBJECTIVE:

To ensure that the armature, when attracted, does not strike the magnet core.

PROCEDURE

1. Hold the armature squarely against the magnet yoke.
2. Clearance between the core and the armature should be .004 to .008 in. (0,10 to 0.20 mm). **B** Add or remove shims under the magnet to obtain this clearance.

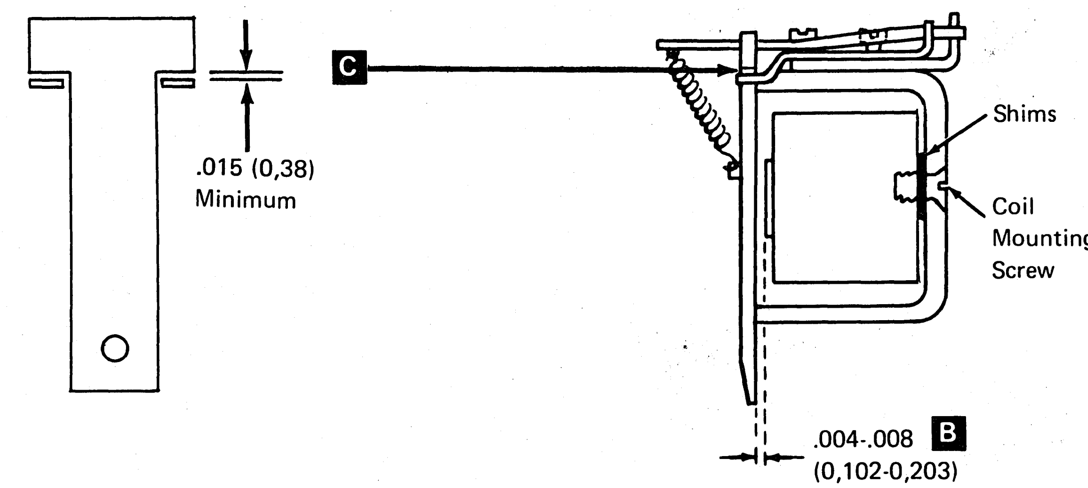
Magnet Assembly Positioning Adjustment

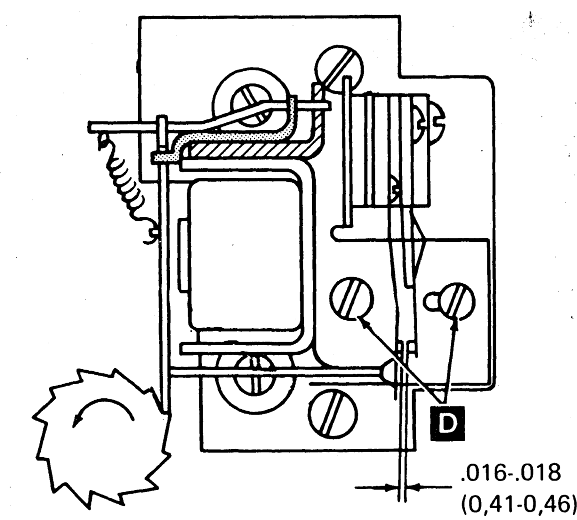
OBJECTIVE:

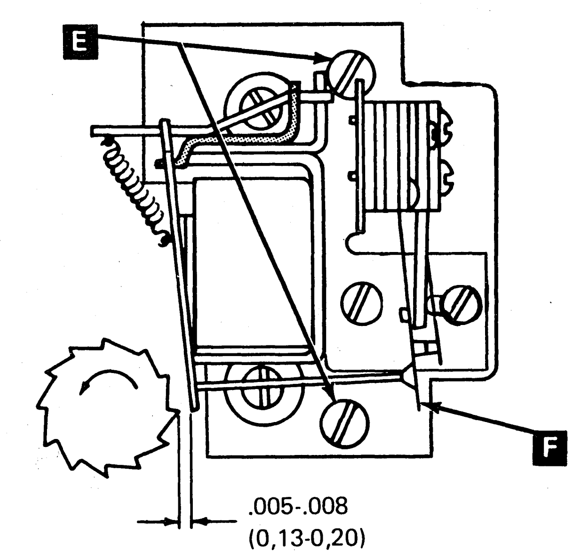
To ensure correct operation of the clutch magnet and the forms-moving contact.

PROCEDURE

1. Ensure a minimum of .015-in. (0,38 mm) clearance **C** between the armature and the retaining plate.
2. Loosen the contact assembly mounting screws **D** and shift the contact assembly to obtain .016 to .018 in. (0,41 to 0,46 mm) between the operating and the normally open contact points. Tighten the contact assembly mounting screws.
3. With the armature attracted by hand (unlatched), loosen slightly the magnet assembly mounting screws **E**, and pivot the assembly on the upper screw to obtain .005 to .008-in. (0,13 to 0,20-mm) unlatching clearance between the highest tooth of the index ratchet and the tip of the armature. Tighten the screws.
4. With the contact strap operating rod removed, form the operating strap until 100-110 grams applied at **F** closes the n/o contact.







Helical-Spring Positioning Adjustment

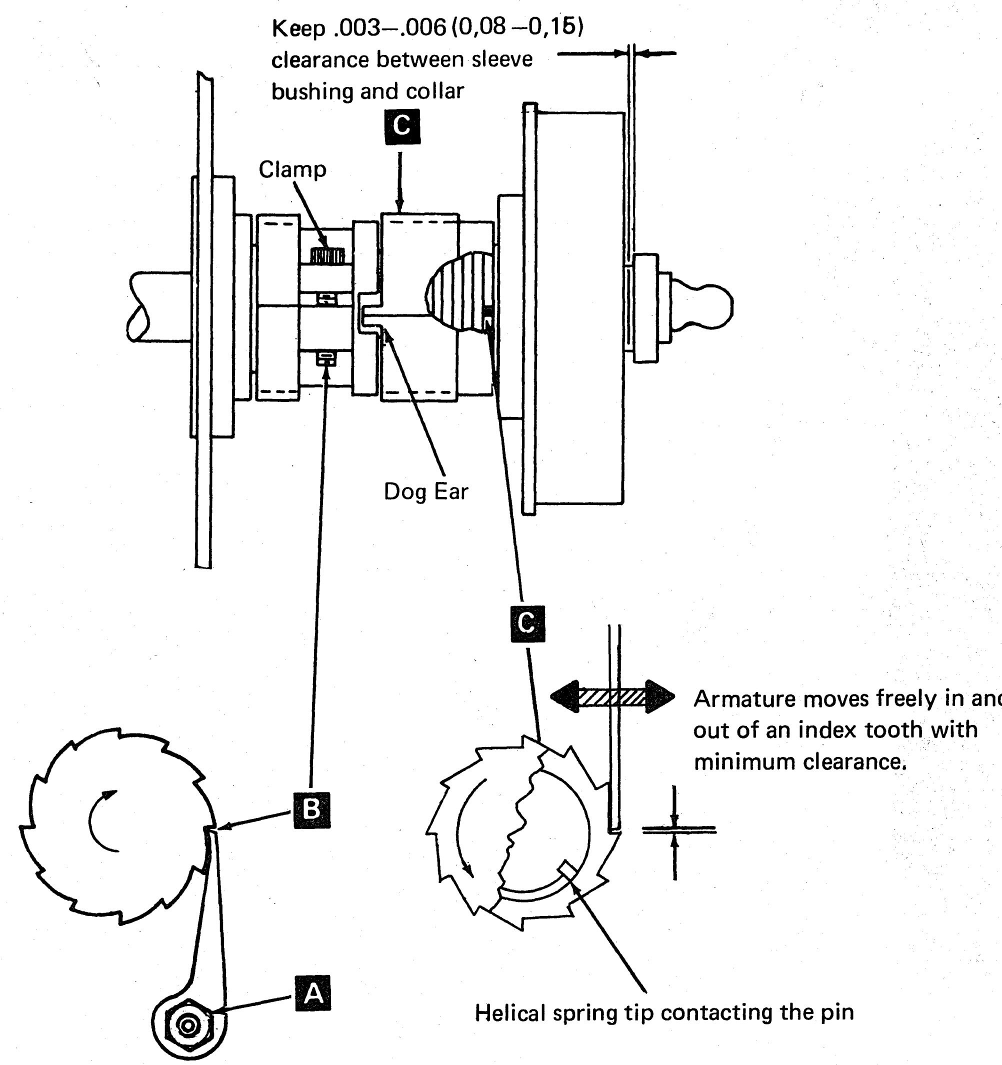
OBJECTIVE:

To ensure positive drive connection between the driving (input) hub and the driven (output) hub of the spring clutch, when the clutch is unlatched (engaged).

PROCEDURE

1. Remove the drive belt and disengage the carriage clutch (tractor drive in neutral).
2. Loosen the nut **A** and position the reverse ratchet detent pawl eccentric as shown (spot mark at approximately 5 o'clock), and tighten slightly.
3. Loosen the clamp and turn the drive pulley clockwise until the reverse ratchet is stopped by its detent pawl as shown. **B**
4. Rotate the index ratchet **C** clockwise (as viewed from the pulley end) until the helical spring slips over the reverse ratchet hub. Allow the index ratchet to return counterclockwise while maintaining the end of the helical spring in contact with the spring stop pin.

Repeat this procedure until the armature moves in and out of an index tooth without nipping and with minimum clearance.



Stop-Collar Positioning Adjustment

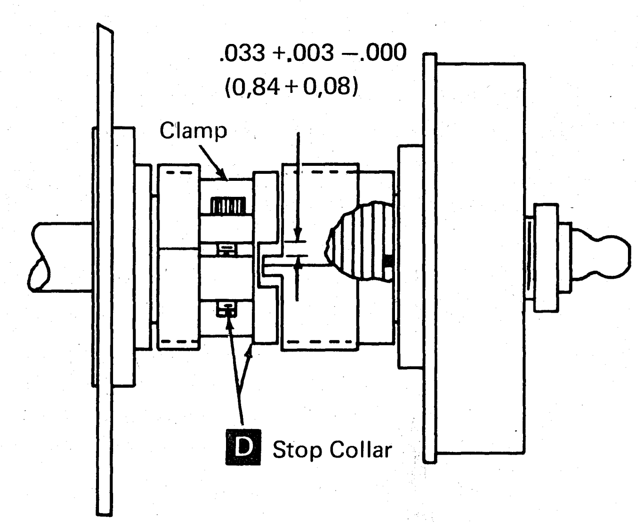
OBJECTIVE:

To ensure that:

1. The helical spring collapses completely and grips the hubs when the clutch is unlatched (engaged).
2. The helical spring is held expanded to permit free rotation of the hubs without friction when the clutch is latched (disengaged).

PROCEDURE

1. Loosen the clamp, position the stop collar **D** as shown, and tighten the clamp.
2. If, after making this adjustment, the clutch does not latch, loosen the reverse ratchet detent pawl eccentric **E** and adjust the overthrow clearance.



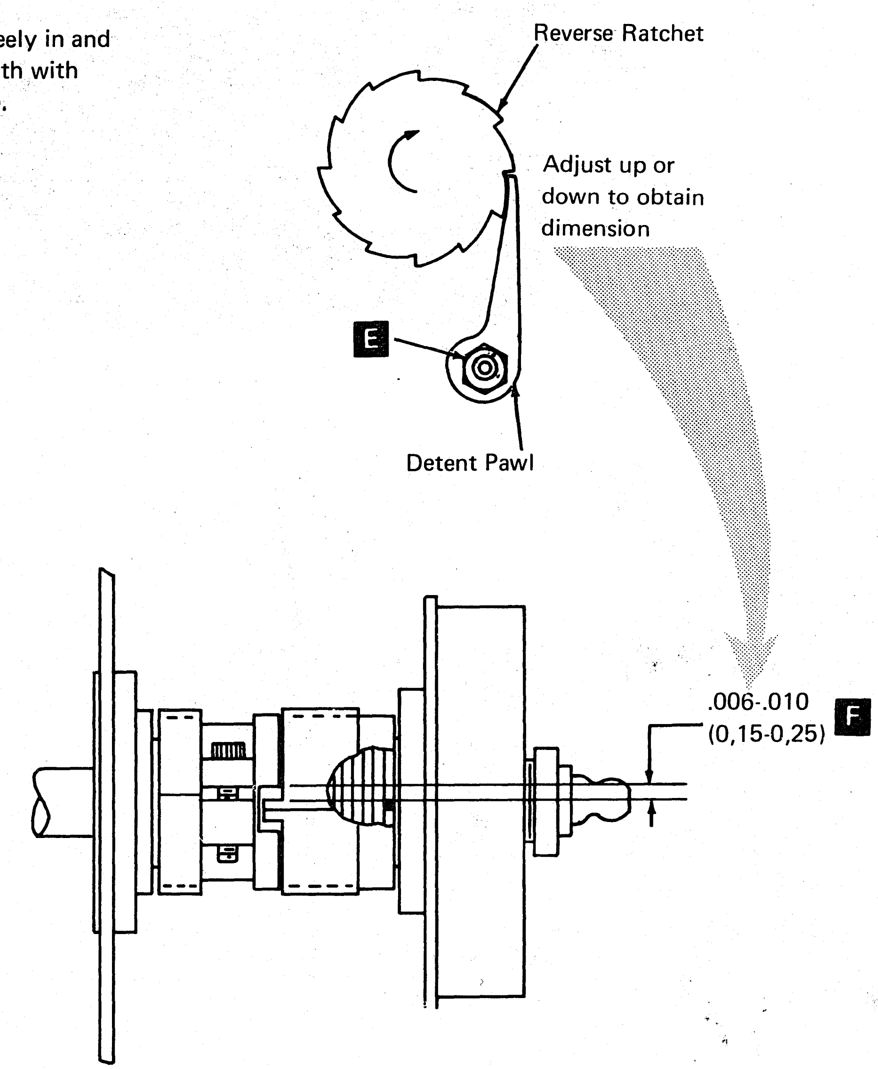
Stop-Pawl Overthrow Clearance Adjustment

OBJECTIVE:

To ensure that the detent pawl can engage the reverse ratchet with minimum overthrow.

PROCEDURE

1. With the clutch latched, loosen the lock nut **E** and rotate the reverse ratchet detent pawl eccentric **A** to obtain .006 to .010-in. (0,15 to 0,25 mm) clearance **F**.
2. Lubricate the clutch assembly and recheck the carriage emitter and transducer timing. (See 2.60).

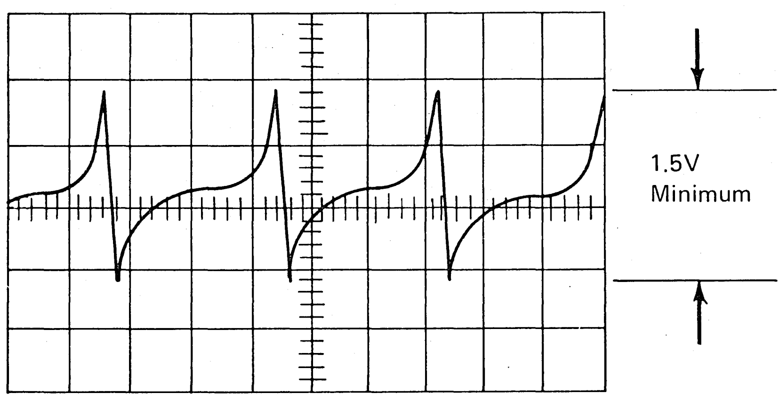


2.60 ELECTRONIC-CARRIAGE-EMITTER ADJUSTMENT

Electronic Carriage Emitter Output

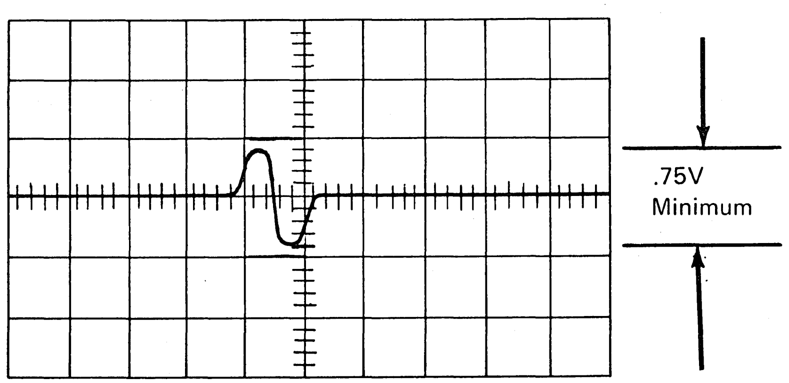
The carriage transducer minimum output readings are:

Continuous Skip Operation



Vertical .5V/cm
Horizontal 5 ms/cm

Single-Space Operation

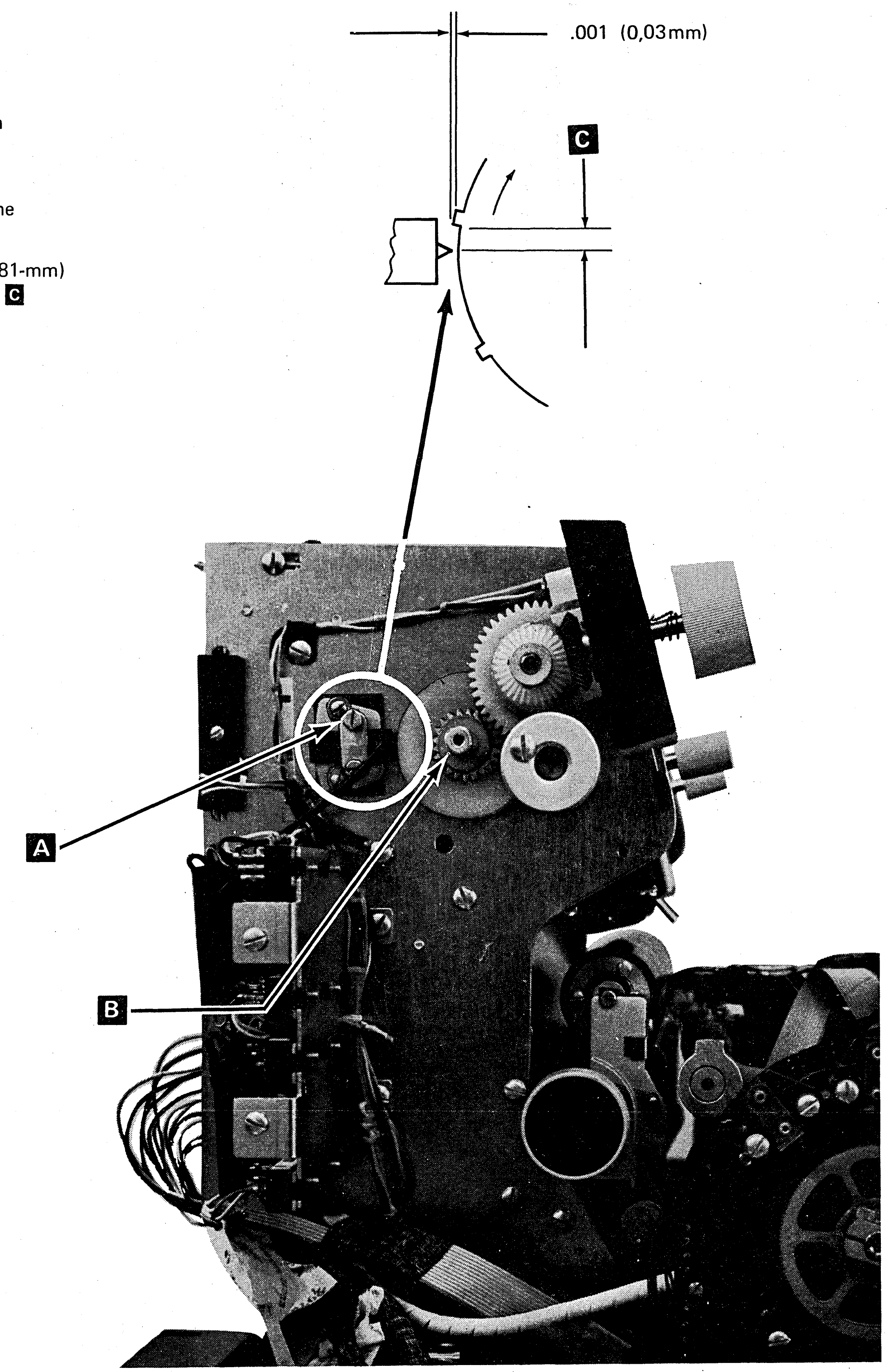


Vertical .5V/cm
Horizontal 5 ms/cm

Electronic Carriage Emitter Adjustment

If transducer outputs are under minimum requirements:

1. Loosen transducer mounting clamp screws **A** and adjust transducer to obtain an air gap of .001 in. (0,03mm) (minimum) between emitter teeth and transducer tip. Tighten screws.
2. Manually energize spring clutch magnet armature and turn the tractor shaft while checking for interference between emitter wheel teeth and transducer tip.
3. With the clutch latched up, loosen the screw **B** holding the emitter wheel to tractor shaft.
4. Position the emitter wheel for .100 to .150-in. (2,54 to 3,81-mm) clearance between the transducer tip and the trailing edge **C** of any tooth just passed.
5. Run Diagnostic E8B.

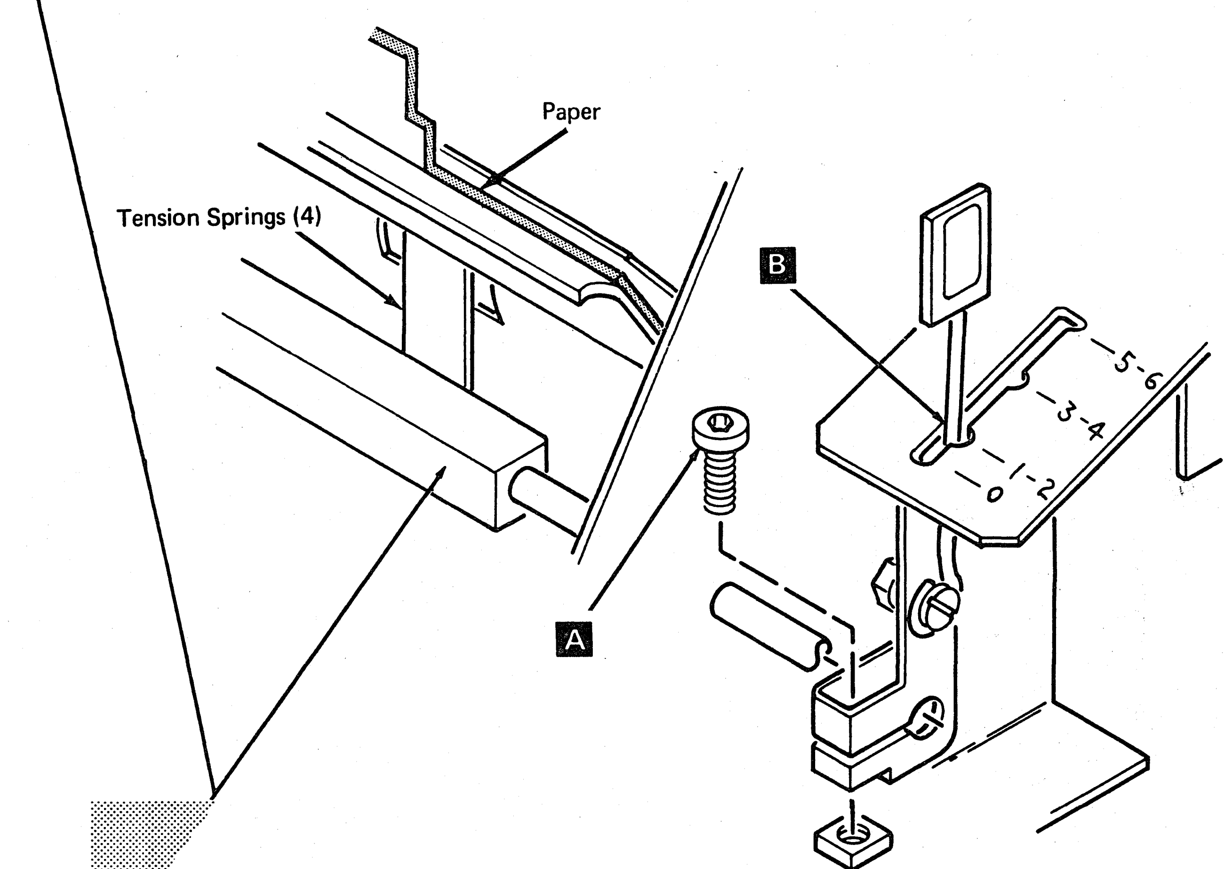


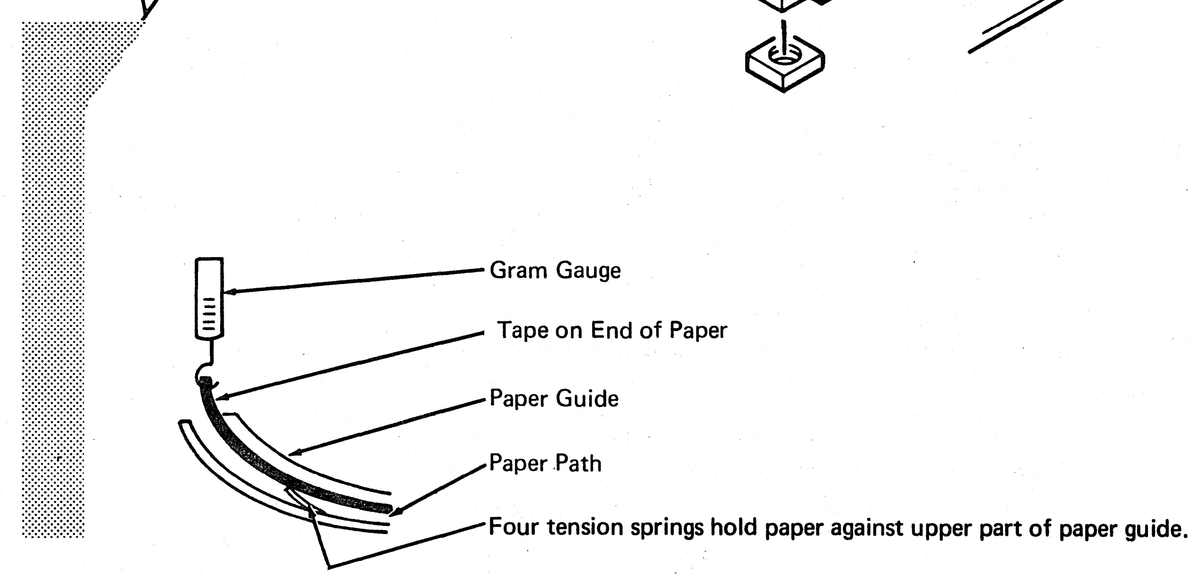
2.61 PAPER-TENSION CONTROL

The paper-tension control takes the slack out of forms and provides uniform feeding of forms. The paper-tension control can be adjusted to accommodate the number of parts in a form. Flat tension springs apply pressure or drag against the paper.

2.62 PAPER-TENSION-CONTROL ADJUSTMENT

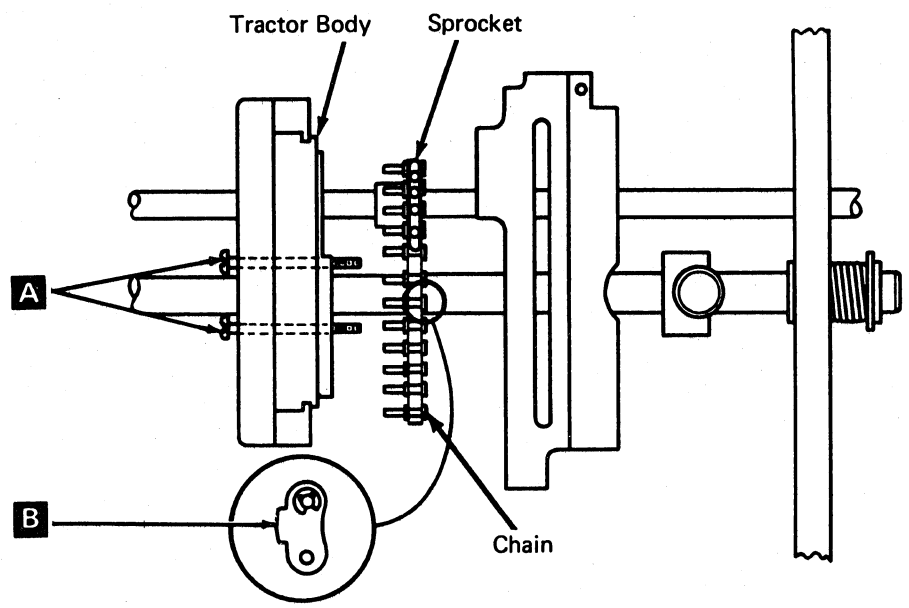
1. Loosen the clamp screw **A**.
2. Position the lever in the 1-2 slot **B**.
3. Rotate the square shaft so that tension springs provide a drag resistance of 90 to 110 grams when single-part paper is dragged between the tension springs and form guide.
4. Tighten the clamp screw.





2.65 TRACTOR-CHAIN REMOVAL AND REPLACEMENT

1. Remove two screws A from the inner tractor body.
2. Separate the tractor chain, sprocket, and guide from the tractor body.
3. One link on the chain is assembled with shaft and C-clip B. To remove the chain, position the chain to this point and remove the C-clip and shaft.
4. See 2.66 step 1 for the correct timing of chain. Reassemble the tractor and perform tractor adjustments (2.67).

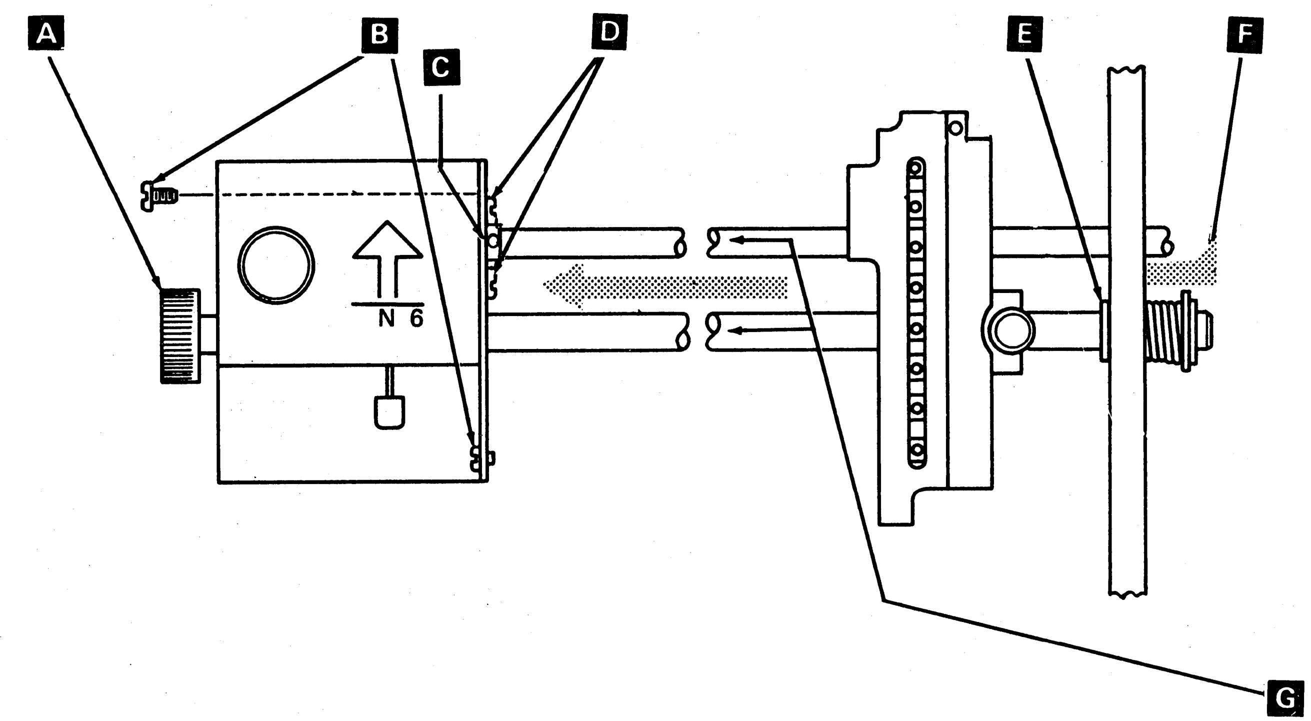


2.64 TRACTOR REMOVAL

1. Remove the knurled knob (counterclockwise). A
2. Remove two screws B and the cover.
3. Loosen the two collar screws C.
4. Remove two screws D and the switch assembly.
5. Remove the C-clip. E
6. Remove the C-clip, washer, and spring. F
7. Slide the tractor support shafts and gear assembly G to the left far enough to remove tractor.

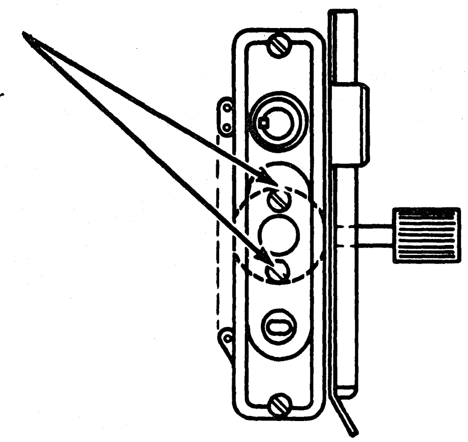
CAUTION

After removing tractor (or tractors), slide the shafts back into the right side frame to prevent damage to shafts.

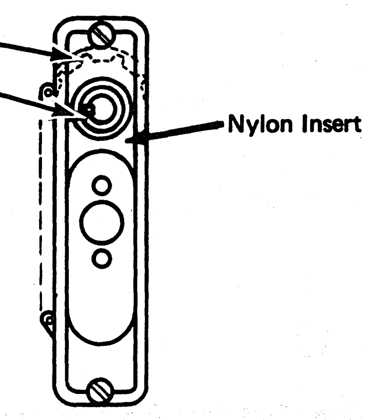


2.65 TRACTOR DISASSEMBLY

1. Hold the tractor firmly and remove the two screws. This releases the knob and hub.
2. Lift the tractor chain, hub, and sprocket from the tractor door and end frame.



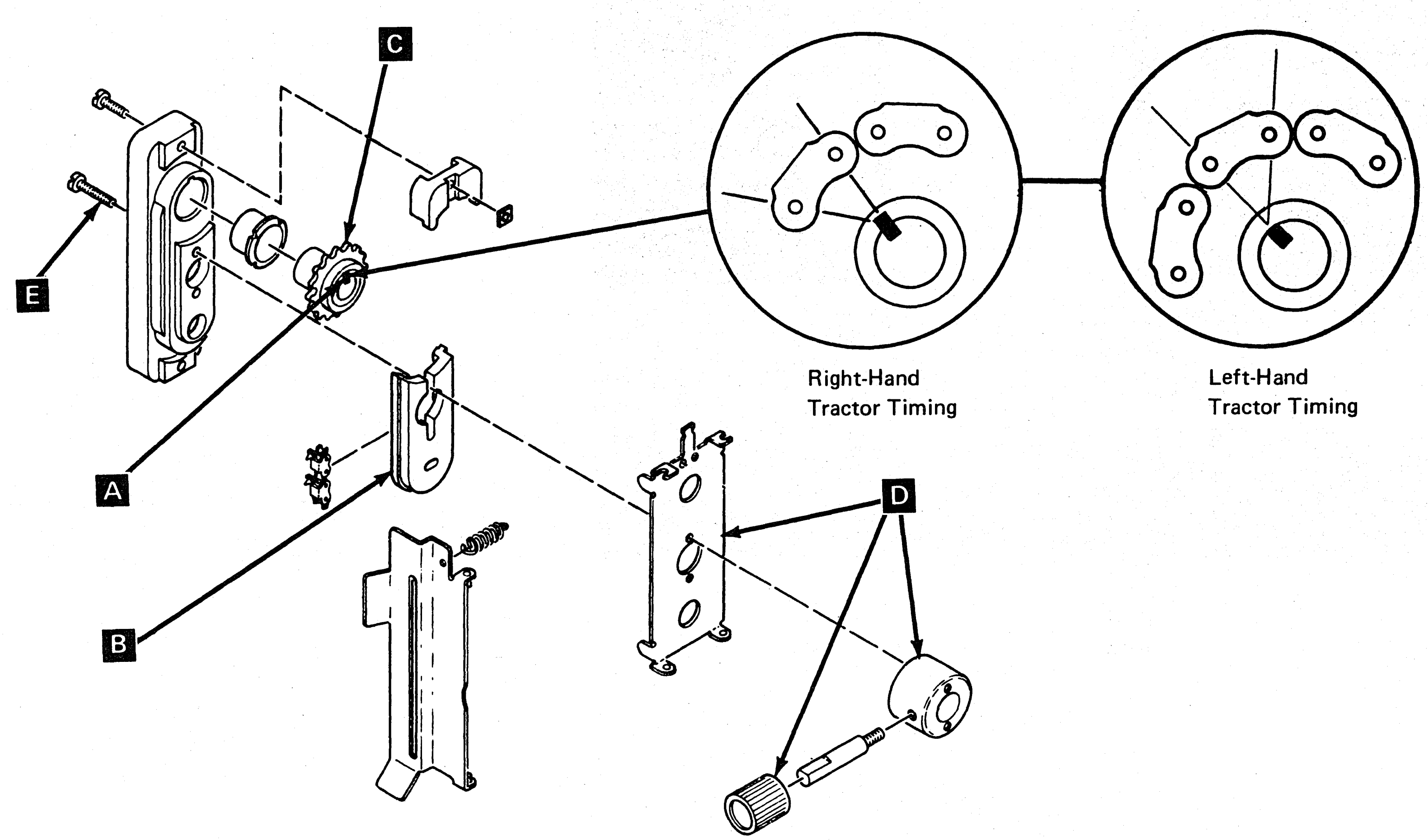
3. Position the tractor chain to clear the lips of nylon insert.
4. Press down on the sprocket hub for complete removal of sprocket, chain, and chain guide.



2.66 RIGHT-HAND TRACTOR REASSEMBLY

1. Before assembling either the left or right tractor, assemble the sprocket drive key as shown **A**. Any chain link can be used for this relationship.
2. Insert the track **B** into chain.
3. Slide the sprocket hub **C** into the main body frame. **D**
4. Install the tractor door end frame, knob, and hub.
5. While holding the tractor together, insert two screws **E** and slightly tighten them into the knob and hub assembly.

   Note: Recheck the sprocket drive key and chain relationship shown in step 1 before installing the tractor.
6. Install the tractor, see 2.64 steps 1 through 6 in reverse order.
7. Perform tractor adjustments (2.67).



2.67 TRACTOR ADJUSTMENTS

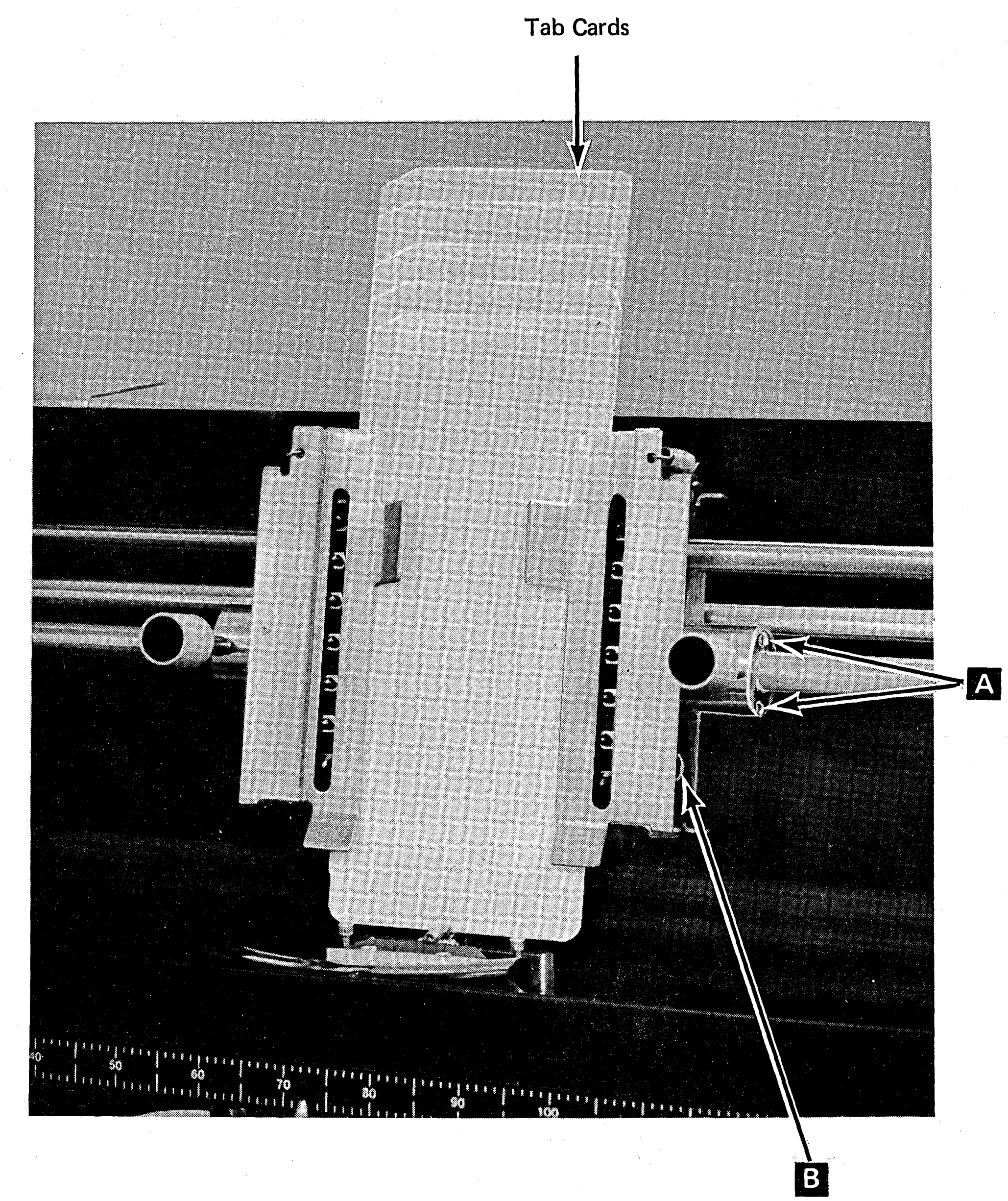
Three tractor adjustments are necessary:

- Tractor body pressure plate gap
- Tractor chain tension
- Alignment of tractors to each other

After making any one of the three tractor adjustments, check the remaining two. The adjustments given are for both tractors.

PROCEDURE

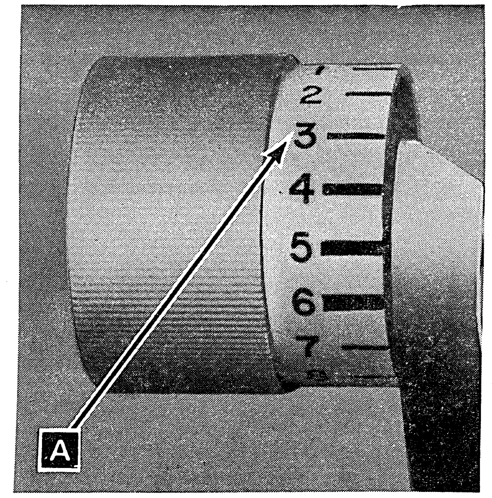
1. Loosen the two inner body screws **A** (head end of screws located inside tractor) and insert seven tab cards between the pressure plate (door) and the tractor body. The tab cards provide a parallel setting of .050 $\pm$ .005 in. (1,27 $\pm$ 0,13mm) between the tractor door and body.
2. While holding the tractor door tightly against the tab cards, insert a small screwdriver in the slot **B** and press down to remove excessive play from the tractor chain. Tighten the two inner body screws.
3. Loosen the two inner body screws on the opposite tractor and tighten them slightly. Slide the tractor over to the mating tractor (as shown in illustration). Hold the tractor door tightly against the tab cards and, with a small screwdriver, press down to remove the excessive play from the tractor chain. Hold the tractor firmly and, without rocking the tractor, slide the adjusted tractor away. Tighten securely the inner body screws.
4. Remove the tab cards and check for squareness of the tractors with each other. Move each tractor to the extreme right-hand and left-hand positions and check for binds. If binding, move the tractor to the point of tightest contact, loosen the two inner body screws slightly, and adjust the chain tension accordingly while checking for freedom of chain movement.

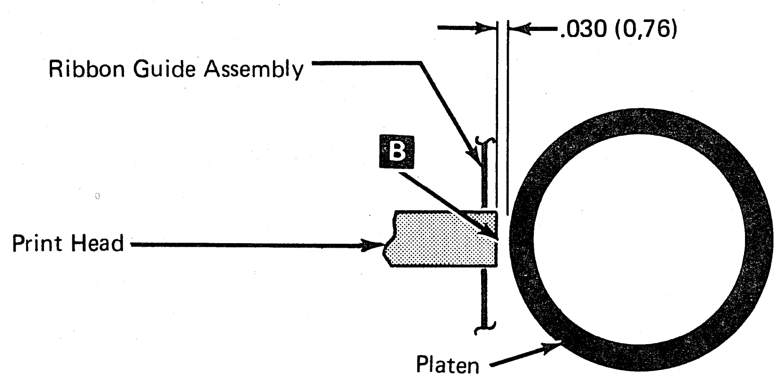


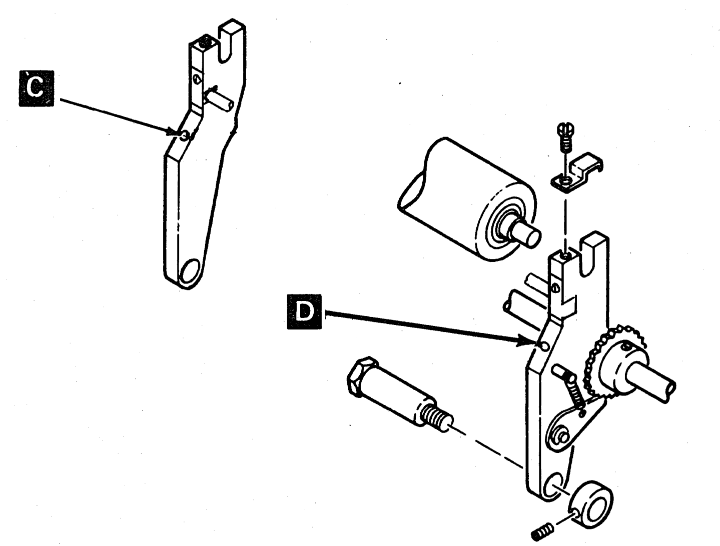
2.68 PLATEN ADJUSTMENT, HORIZONTAL (VFC)

1. Set forms-thickness knob to position 3 and manually move print head to extreme left. A

   Note: The forms-thickness knob is a press-fit on the eccentric shaft. A nylon pellet in the hole ahead of the adjusting screws rides on the eccentric portion of the shaft. Turning the forms-thickness knob causes the platen to move forward or backward.
2. Loosen 2 screws and move the ribbon guide to clear the wire guide tip.
3. Insert .030-in. (0,76-mm) feeler gauge between platen and tip of print wire guide. B
4. Adjust screw C in or out until a slight drag is felt on gauge.
5. Move print head to extreme right; repeat steps 3 and 4.
6. Recheck adjustment by holding the .030-in. (0,76-mm) gauge in front of the print wire guide and manually moving print head along entire length of platen. (Make adjustments to high side of platen.) D
7. Adjust for .025-in. (0,64-mm) clearance between the ribbon guide and platen. Tighten the screws.







2.69 CARRIAGE DRIVE MOTOR REMOVAL and REPLACEMENT (VFC)

Removal

1. Remove the cog belt.
2. Remove the four motor mounting screws.
3. Remove the motor.

Replacement

1. Replace in reverse order of removal.
2. Adjust the height of the motor so that the cog belt is taut, without placing a strain on the bearings.
3. Tighten the motor mounting screws.

2.70 END-OF-FORMS SWITCH ADJUSTMENT (VFC)

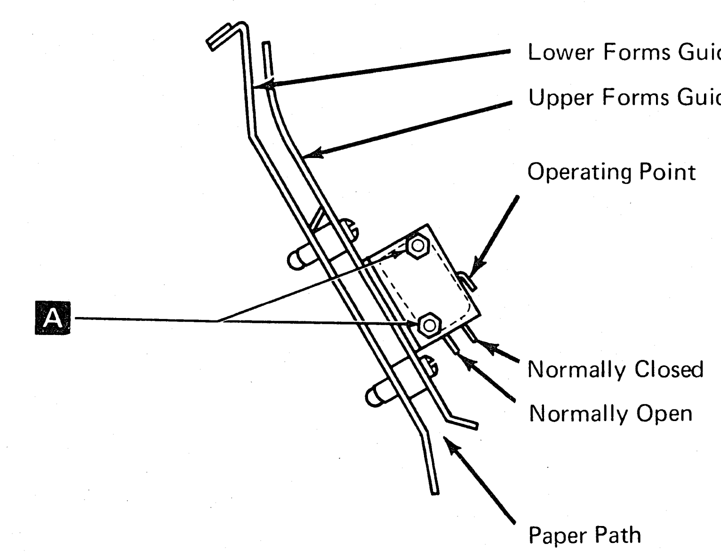
Objective:

To have the end-of-forms switch close with one thickness of paper in the forms guide.

Adjustment

1. Insert paper into forms guide.
2. Loosen two mounting screws A and rotate the switch until the switch closes. Tighten the screws. With the paper in the forms guide, check for no continuity between the normally closed and the operating point.

   Note: Adjust the switch to close, but not bottom on the switch casing.



REMEMBER

There is a Reader's Comment Form at the back of this publication.

COVER ADJUSTMENTS, REMOVALS, and REPLACEMENTS (Model 1)

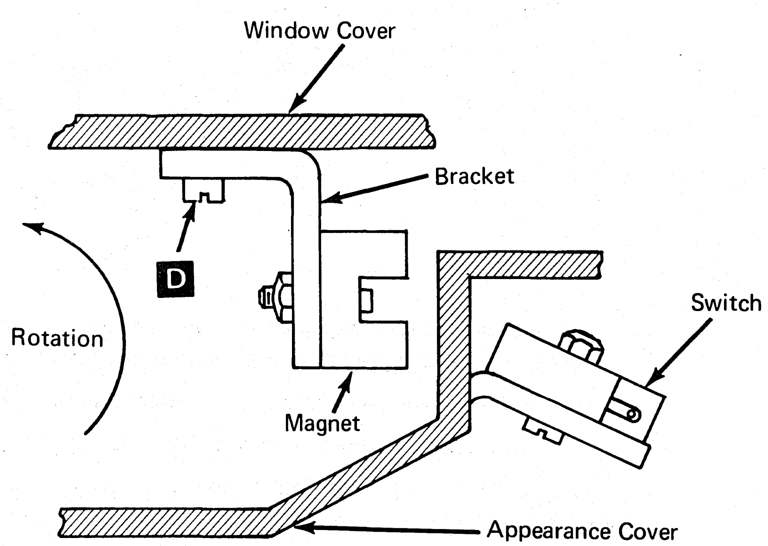
2.71 COVER INTERLOCK SWITCH ADJUSTMENT (MODEL 1)

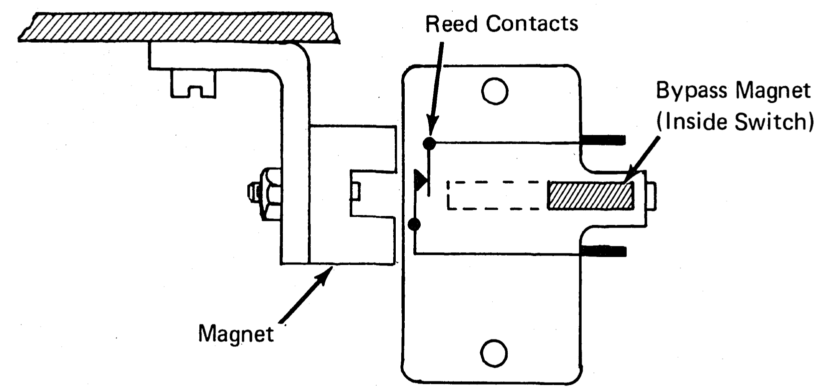
The cover interlock switch is a safety device to prevent printer operation when the cover is open.

1. With the cover closed **A**, an operating magnet attached to the cover closes the reed contacts and, at the same time, repells the bypass magnet to the end of its guide tube.
2. With the cover open **B** the reed contacts open under their own spring tension.
3. In the service position **C**, the bypass magnet is moved close to the reed contacts to close them. Do this (instead of shorting the contact leads) by sliding a screwdriver or other magnetic object along the side of the switch toward the front of the printer. The bypass magnet follows inside its guide tube, and remains until repelled by the cover operating magnet or drawn back by a reverse movement of the screw-driver.

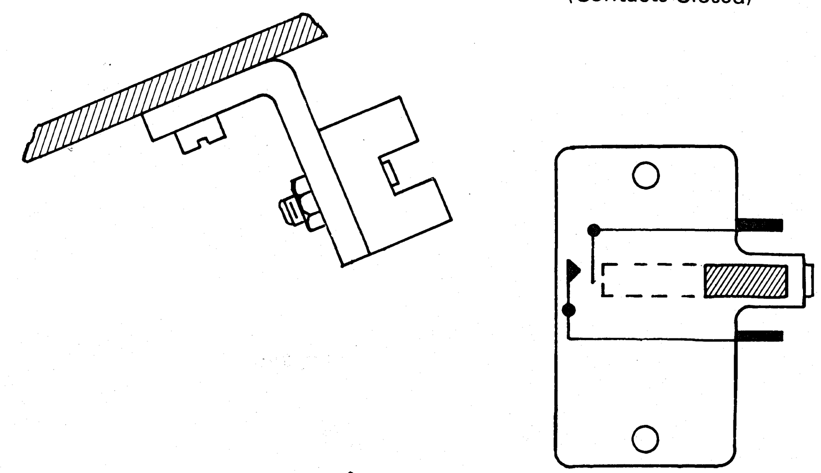
   Note: If the operating magnet is removed, replace it in the same polarity so that it repels the bypass magnet.

4. Loosen the screw **D** holding the magnet bracket on the top cover and position the magnet so that the reed switch closes when the cover is closed. Tighten the screw.

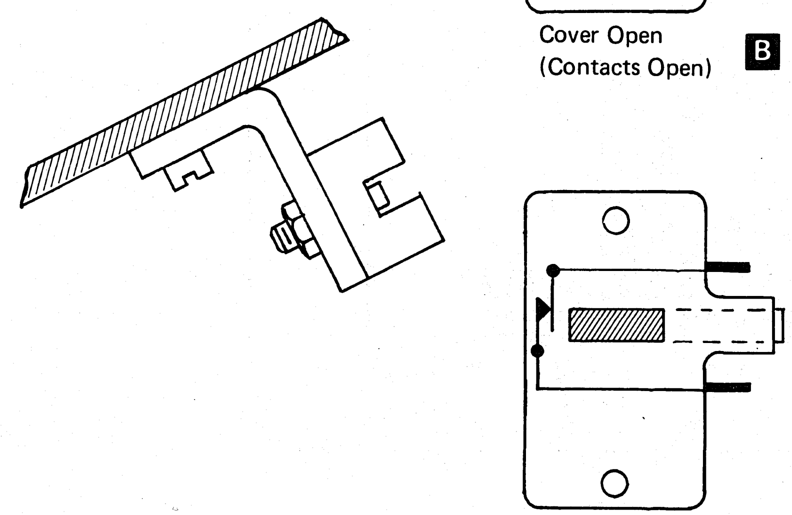




Cover Closed
(Contacts Closed) **A**



Cover Open
(Contacts Open) **B**



Service Position
(Contacts Closed) **C**

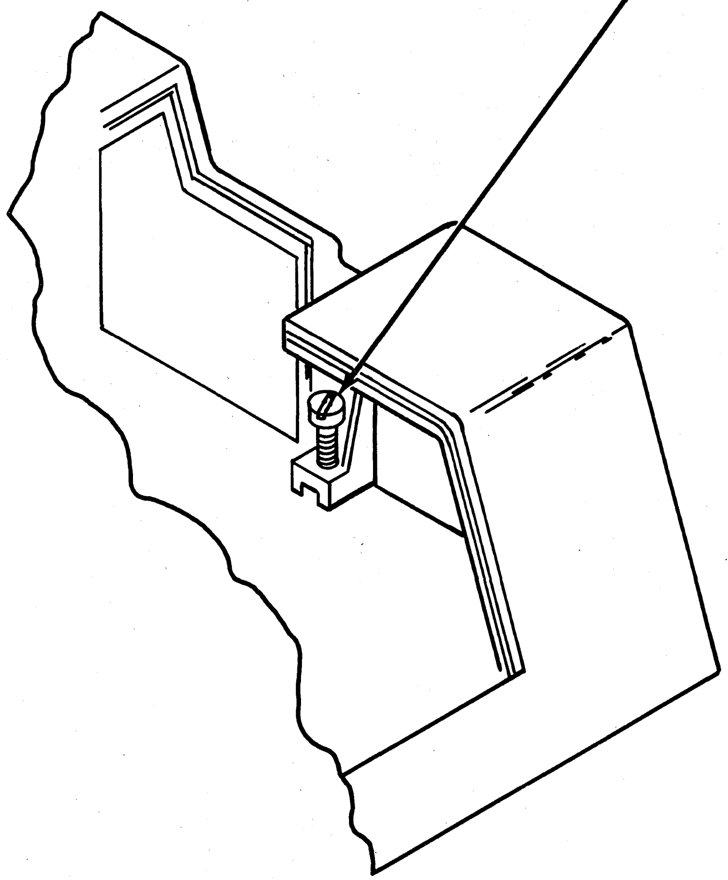
2.72 COVER ADJUSTMENT (MODEL 1)

Objective:

To position correctly the hinged cover within the main cover and provide a proper seal when covers are closed.

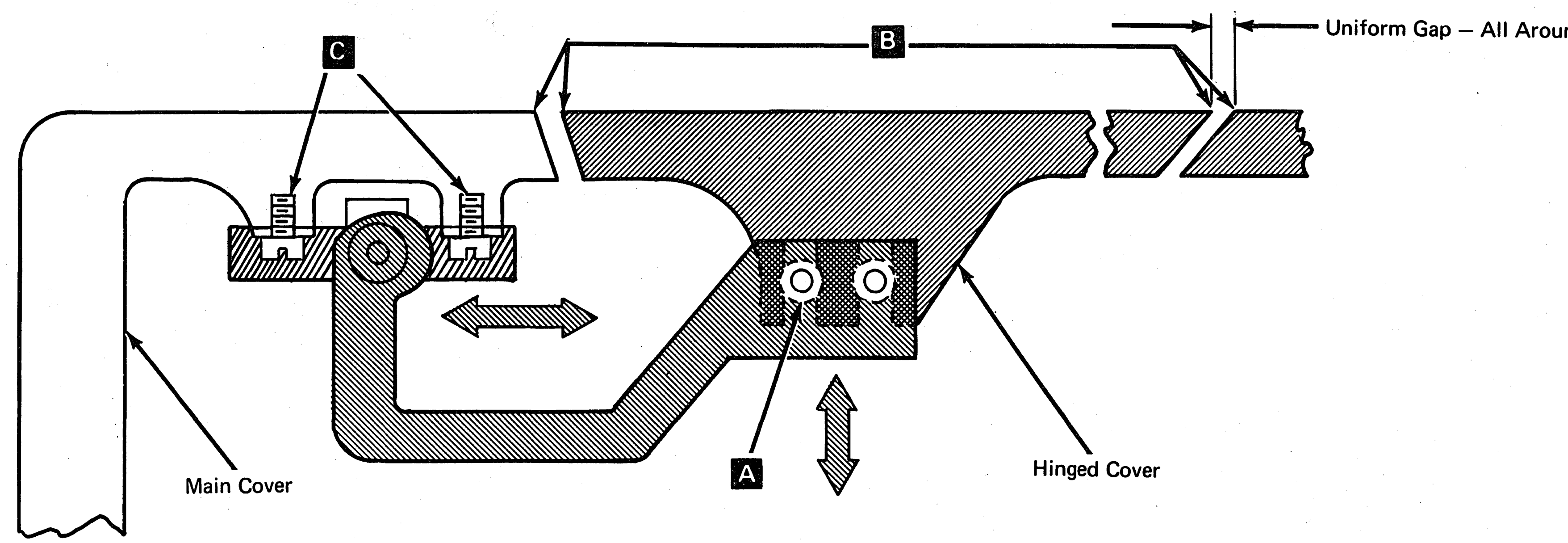
The main cover is self locating and is fastened to the frame by a screw on each side of the cover. To remove the cover:

1. Open the hinged cover and remove the platen.
2. Loosen both cover screws.
3. Remove the cover and place it upside down on a flat surface to make the adjusting screws accessible.



Adjustment

1. Loosen the screws **A** and shift the hinged cover until it is flush with the main cover **B**. Tighten the screws.
2. Loosen the screws **C** and adjust the hinge assembly so that the gap between the covers is uniform.



Side View

2.73 INTERNAL COVERS REMOVALS AND REPLACEMENTS

Five internal covers protect the components beneath the forms carriage and ensure proper air flow around the circuit components. The printer should not be operated for extended periods with these covers removed.

Removals

1. With the print head to the right, remove the center vertical cover **A** . This cover has two bottom tabs that slip over the carriage frame. Disengage the two formed tabs that grip the tie rod shaft (be careful not to break off the tabs), and lift out the cover.
2. Remove the small horizontal cover over the driver cards **B** . This cover slides into two slots molded into the larger horizontal cover and has two formed tabs that grip the tie rod shaft. First disengage the two formed tabs from the tie rod shaft, and then pull the small cover out of the slots in the larger cover.
3. Remove the vertical cover **C** with the sponge pad that holds in the two driver cards. This cover slips over the carriage frame at the bottom, and has two formed tabs at the top that grip the shaft.

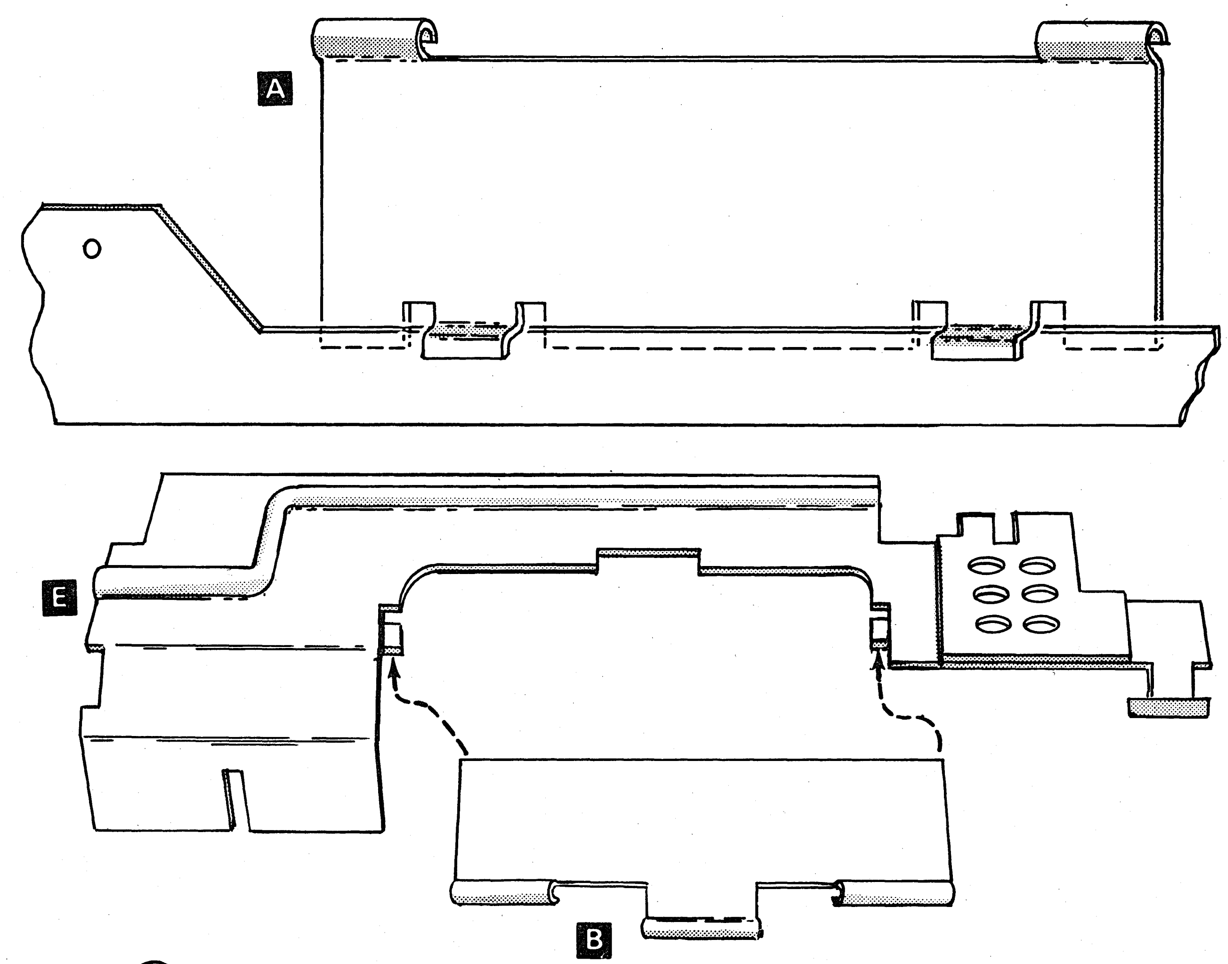
   Note: Driver cards can now be extracted from their sockets and readily replaced. If servicing other components, remove platen and machine outer cover before continuing.

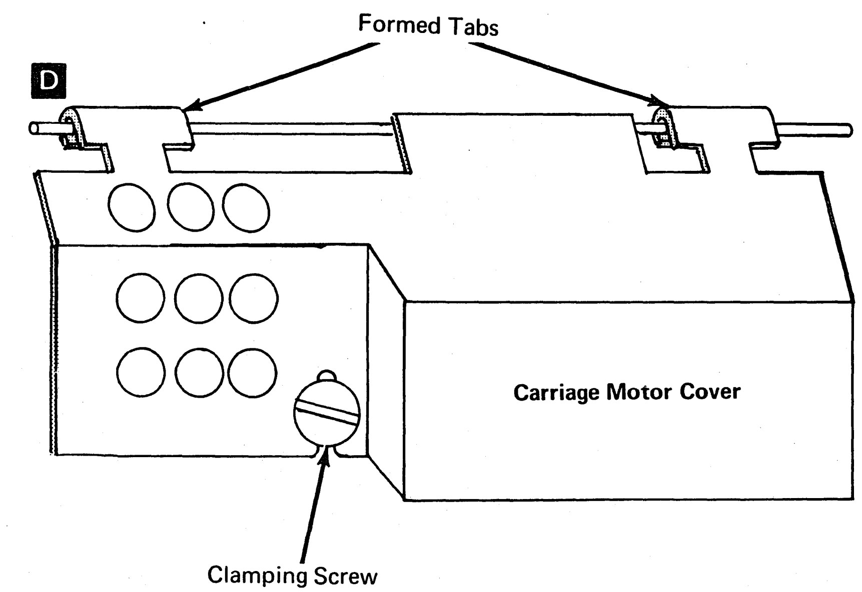
4. With the print head to the left, remove the vertical cover **D** over the carriage drive motor. Loosen the clamping screw in the slot in the front of this cover. Insert a screwdriver under the closed hinged cover, leadscrew, and support shaft. Disengage the two formed tabs from the tie-rod shaft. Be careful not to break off the tabs.
5. With the print head to the right, loosen the 2 screws that clamp the large horizontal cover **E** . Disengage the single formed tab from the tie rod. Lift the cover up, forward, and out.

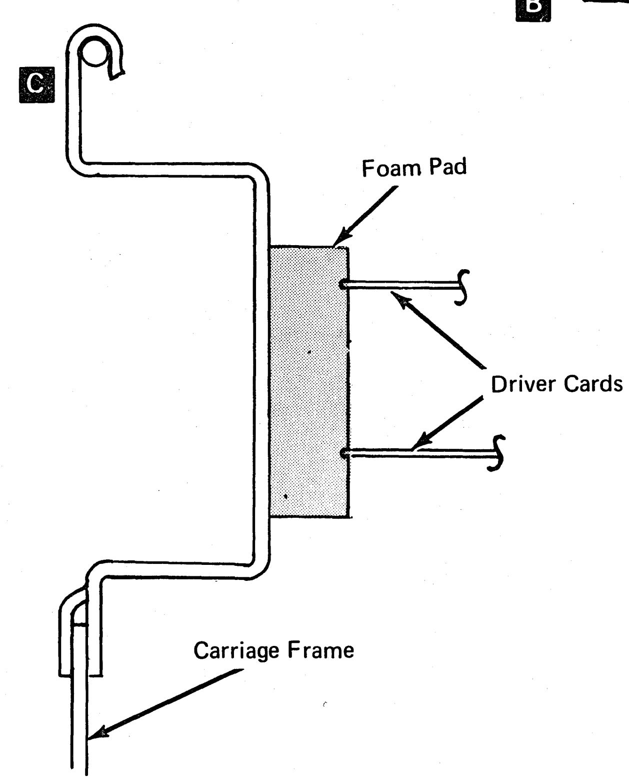
Replacements

Replace the covers by following the removal steps in reverse order.

1. Slide the screw slot in the carriage motor cover over the clamping screws and tighten the screws.
2. Slip the two tabs at the bottom of vertical covers over the carriage base frame.
3. Slip the tabs that were removed from the tie rod shaft over that shaft.







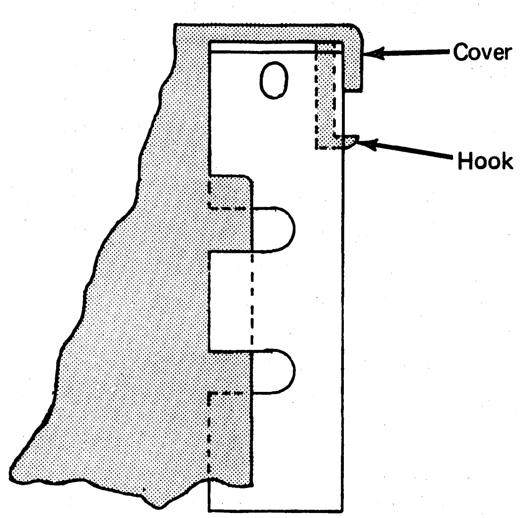
2.74 STEPPER-MOTOR RESISTOR COVER REMOVAL AND REPLACEMENT

Removal

1. Remove the platen and main cover.
2. Remove the molding assembly that houses the maintenance monitor and test switches (3 screws).
3. Pull out paddle card EC-3.
4. While gently lifting on the resistor cover, insert a screwdriver in each of the 3 holes in the metal bracket and release the plastic hooks. (2 on rear and 1 in front.)

Replacement

1. Slide the resistor cover over the metal bracket. Be sure all three plastic hooks protrude through the holes.
2. Replace the paddle card, and molding assembly.
3. Replace the main cover. Tighten the captive screws on each end of the cover.
4. Install the platen.

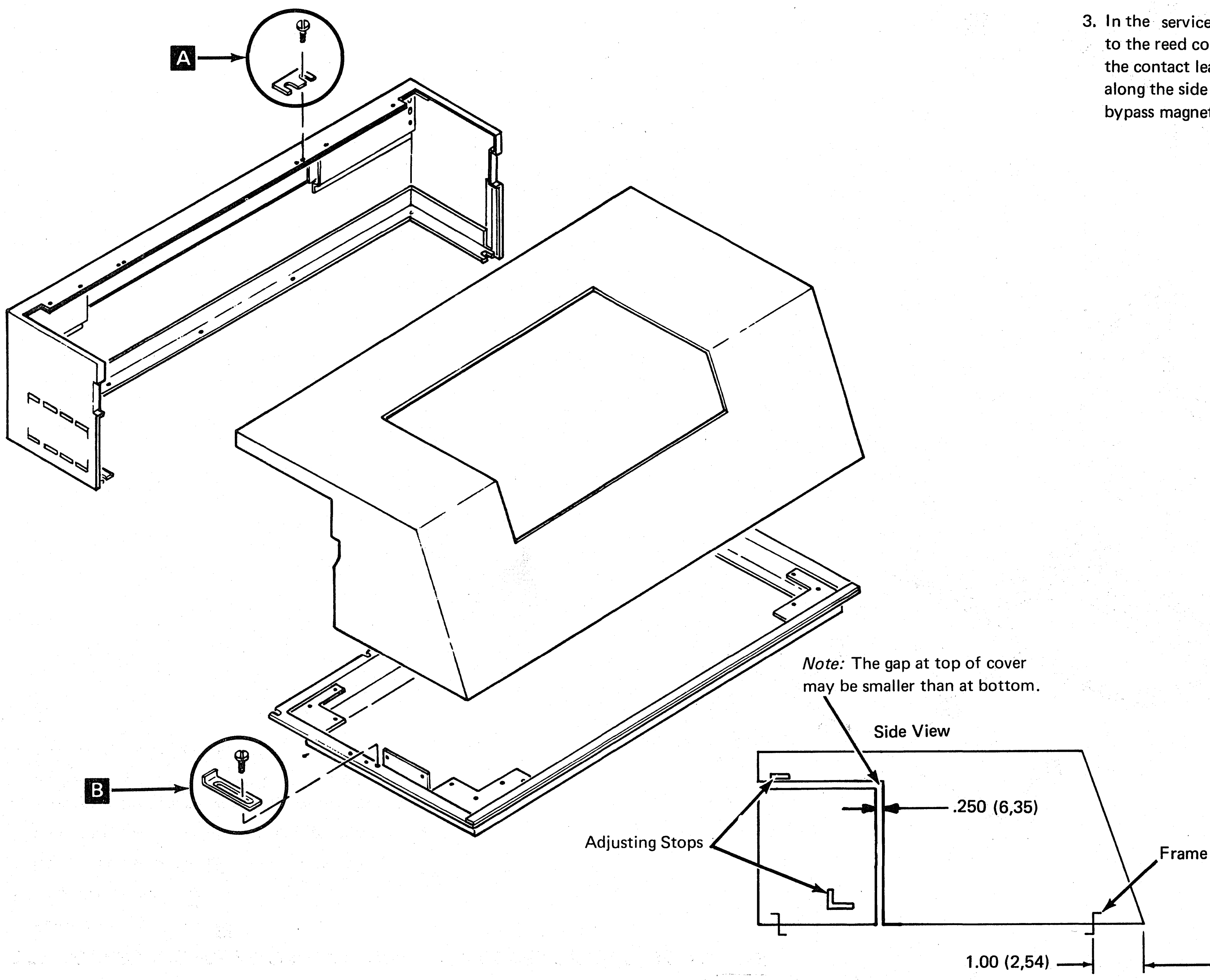


COVER ADJUSTMENTS, REMOVALS, and REPLACEMENTS (Models 2 and 3)

2.75 COVER ADJUSTMENTS (MODELS 2 and 3)

Covers are fastened to the base plate of the machine with six screws (four in back and one on each side). If covers have been removed, slide the covers all the way toward front of machine when reinstalling them (the gap at bottom of cover may be wider than at top after making cover adjustments).

1. Adjust the stops **A** (one on each end) to obtain .250 in. (6,35mm) clearance as shown.
2. Adjust the stops **B** (one on each side) to obtain 1.00 in. (2,54mm) clearance between the front of skirt and front of cover.

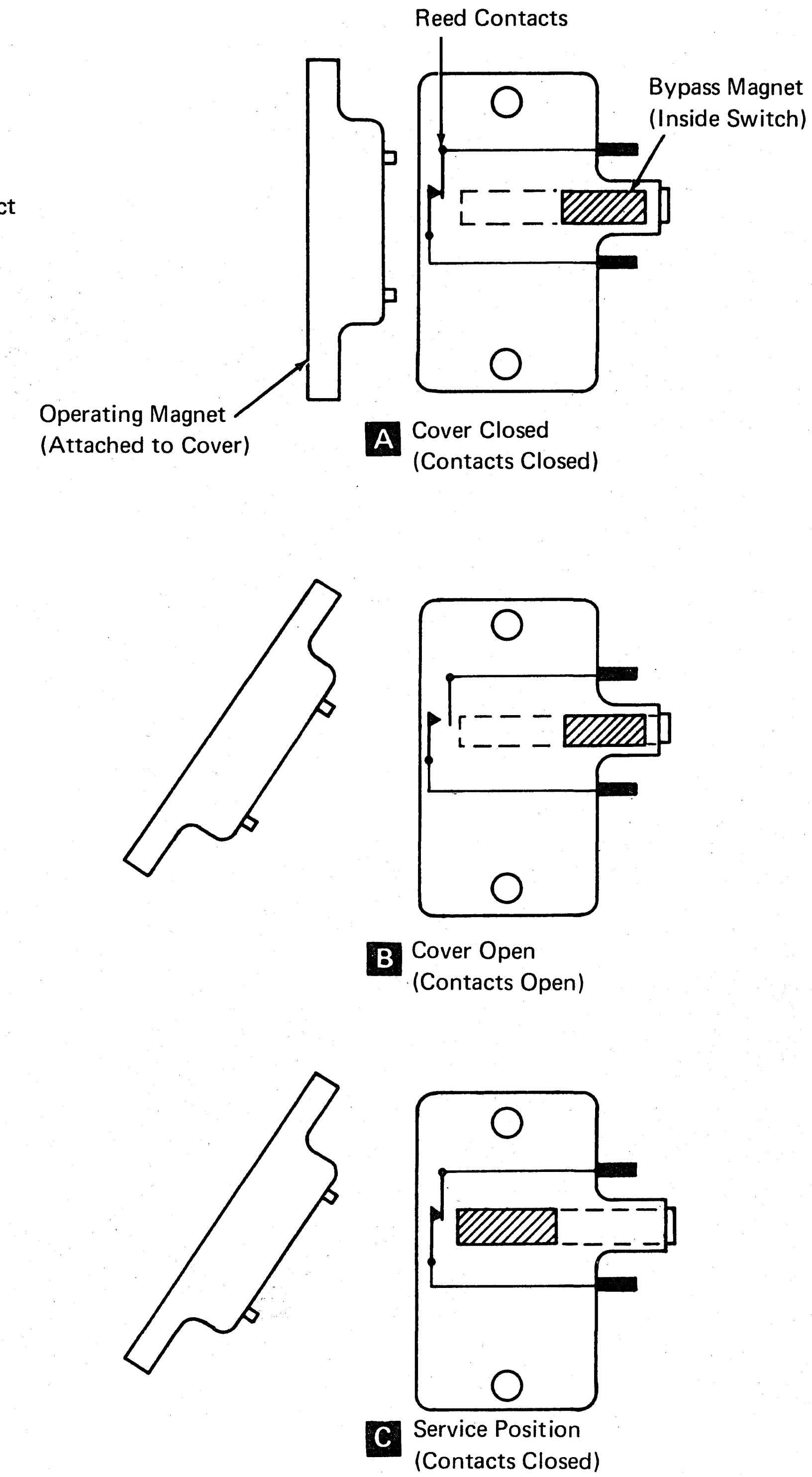


2.76 COVER INTERLOCK SWITCH ADJUSTMENT (MODELS 2 and 3)

The cover interlock switch is a safety device to prevent printer operation when the cover is open.

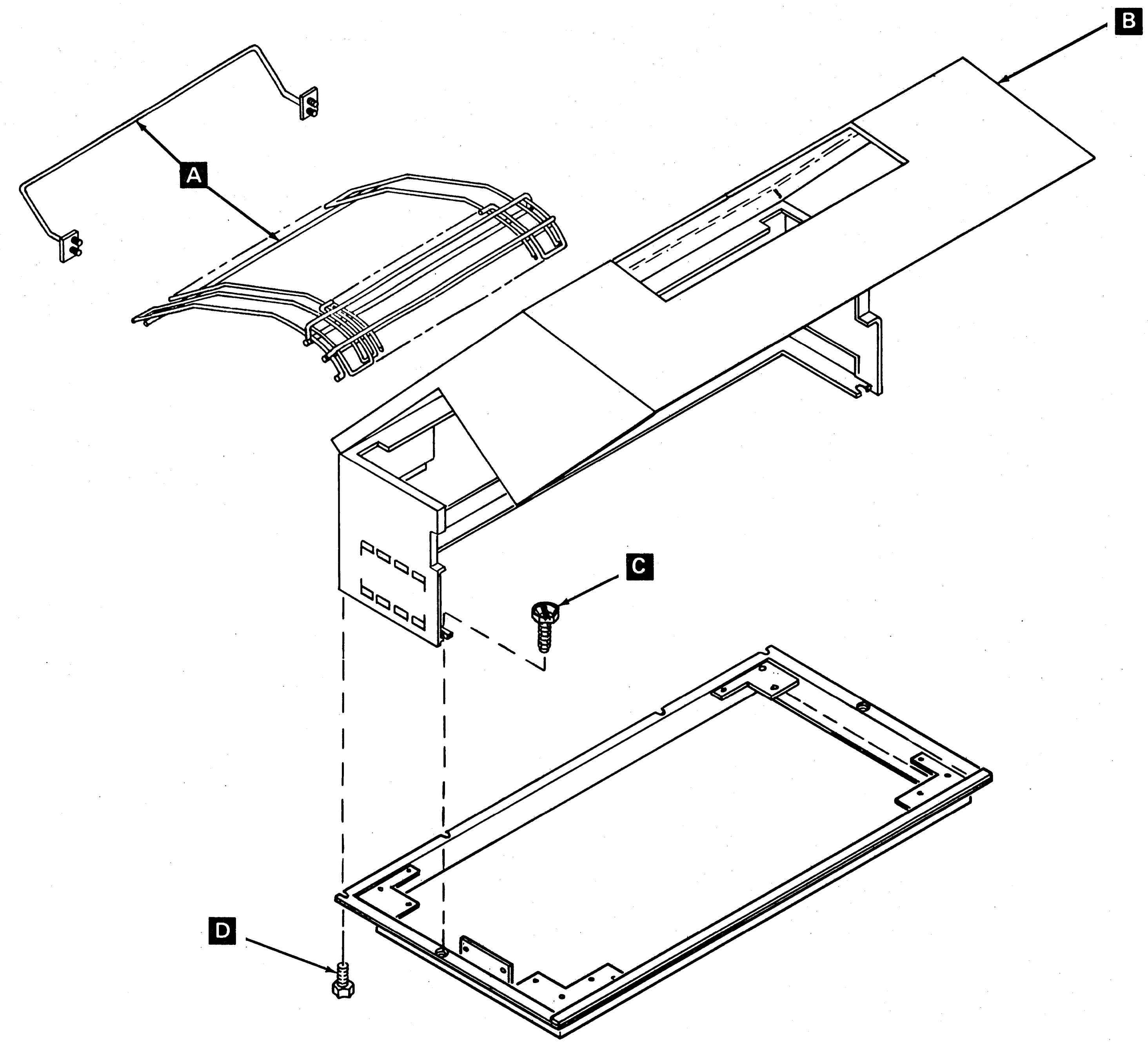
1. With the cover closed **A**, and operating magnet attached to the cover closes the reed contacts and, at the same time, repells the bypass magnets to the end of its guide tube.
2. With the cover open **B**, the reed contacts open under their own spring tension.
3. In the service position **C**, the bypass magnet is moved close to the reed contacts to close them. Do this (instead of shorting the contact leads) by sliding a screwdriver or other magnetic object along the side of the switch toward the front of the printer. The bypass magnet follows inside its guide tube, and remains until repelled by the cover operating magnet or drawn back by a reverse movement of the screwdriver.

   Note: If the operating magnet is removed, replace it in the same polarity so that it repels the bypass magnet.
4. Adjust the operating magnet forward or back in its mounting holes so that it does not strike the switch when the covers are closed.



2.77 COVER ASSEMBLY REMOVAL AND REPLACEMENT (MODELS 2 AND 3)

1. Remove the forms rack. A
2. Raise the top cover. B
3. Loosen the two screws C —one in each side.
4. Loosen the two screws at the rear of the machine. D
5. Slide the entire cover assembly to the rear far enough to clear the screw slots, and lift off the cover.
6. To replace, reverse the sequence.



CHAPTER 3. PREVENTIVE MAINTENANCE

MAINTENANCE MONITOR

The maintenance monitor indicates actual machine usage. The readings determine scheduling for preventive maintenance. The monitor is wired to a selected print magnet. Each time that magnet is fired, the electrolyte gap moves to the right.

CAUTION

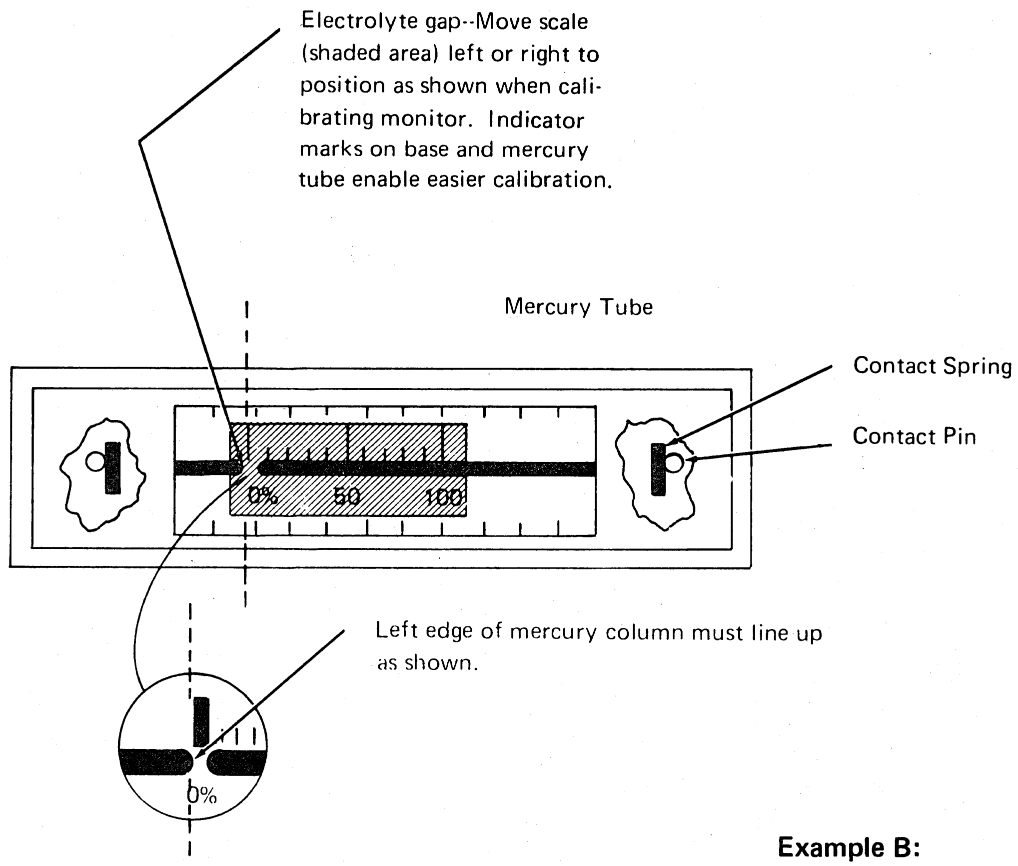
The monitor becomes permanently damaged if the electrolyte gap reaches the extreme end of tube. If the gap reaches the end of the tube, replace the mercury tube and housing (part 1149674) and recalibrate. Be careful when handling the monitor. A sharp impact may displace the electrolyte gap.

PREVENTIVE MAINTENANCE FREQUENCY PROCEDURE

Usage must be recorded on a label (part 2526585) located on the inside left logic binder cover. The vertical column indicates percent of use. The horizontal column indicates elapsed time in months. At the installation of a new machine or new print head, adjust the monitor calibration to zero.

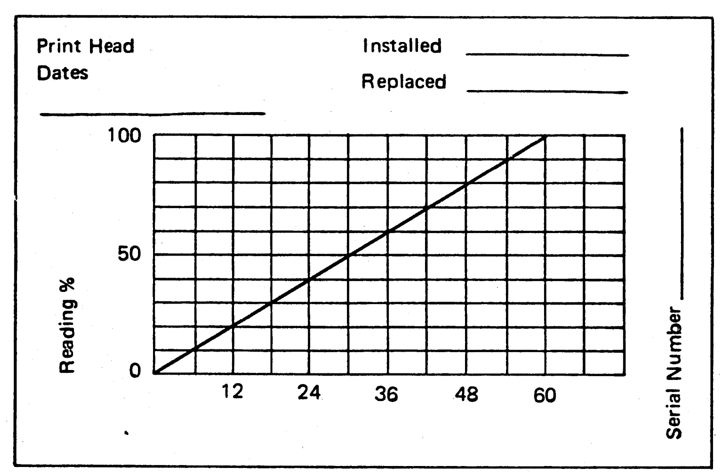
On the first preventive maintenance call (PM Unit 3), read the monitor scale, plot the point on the label, and draw a straight line from zero to the point plotted.

Record this estimate in the 'Change PM Frequency to' block on the incident report. Check for proper estimate by reading the scale on every PM Unit 3 call to determine the validity of PM frequency. The algorithm for calculating PM frequency is: Projected 100% Month X .25 = frequency for units 1 and 3.



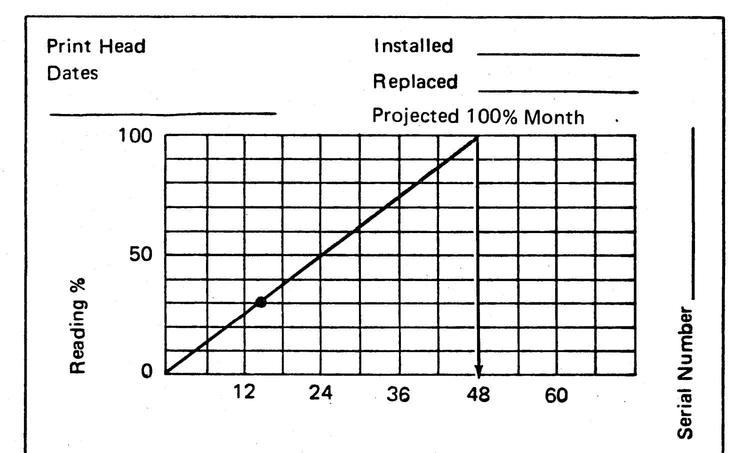
Example A:

This label represents average use (per PM chart Page 3-2) whereby 25% = 15 months, 50% = 30 months, and 100%=60 months.



Example B:

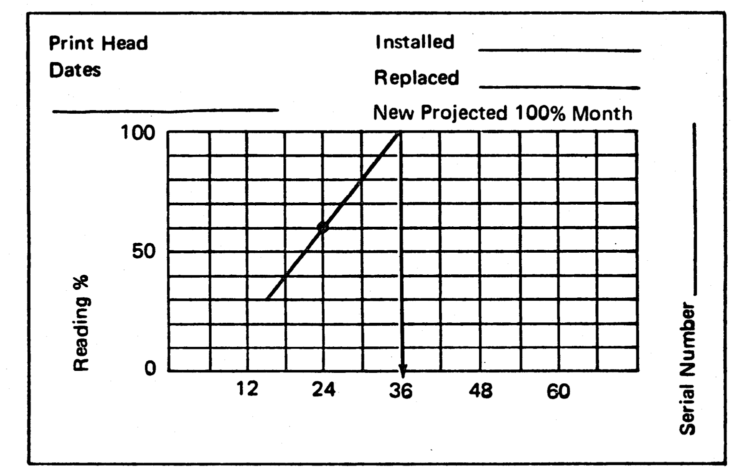
1. On first preventive maintenance call (PM Unit 3), reading on scale is approximately 30%.
2. Place a dot on the scale where the 30% and 15-month time period intersect and draw a line from 0 through the dot and to the 100% line.
3. This line across the month scale indicates that units 1 and 3 should be changed to 12 months and unit 4 to 24 months.



Example C:

1. On the next PM Unit call (9 months later), the monitor reads 60%. Place a dot where 60 and 24 months intersect and draw a line from the previous dot through the last dot plotted.
2. Where the line crossed the 100% scale indicates that the PM frequency for Units 1 and 3 should be changed to 9 months and unit 4 to 18 months.

Note: PM Units 1 and 3 are now past due (past 50%). Do PM Units 1, 3, and 4 now.



Monitor Recalibration

When the gap reaches the 100% mark, remove the top cover housing the mercury tube, turn the tube 180 degrees, and recalibrate the tube.

1. With a pointed instrument, move the scale in the base assembly left or right until the 0% mark on the scale aligns with the electrolyte gap in the tube.
2. Perform PM Units 1, 3, and 4 and continue as previously with a new usage label attached adjacent to the original label.

CAUTION

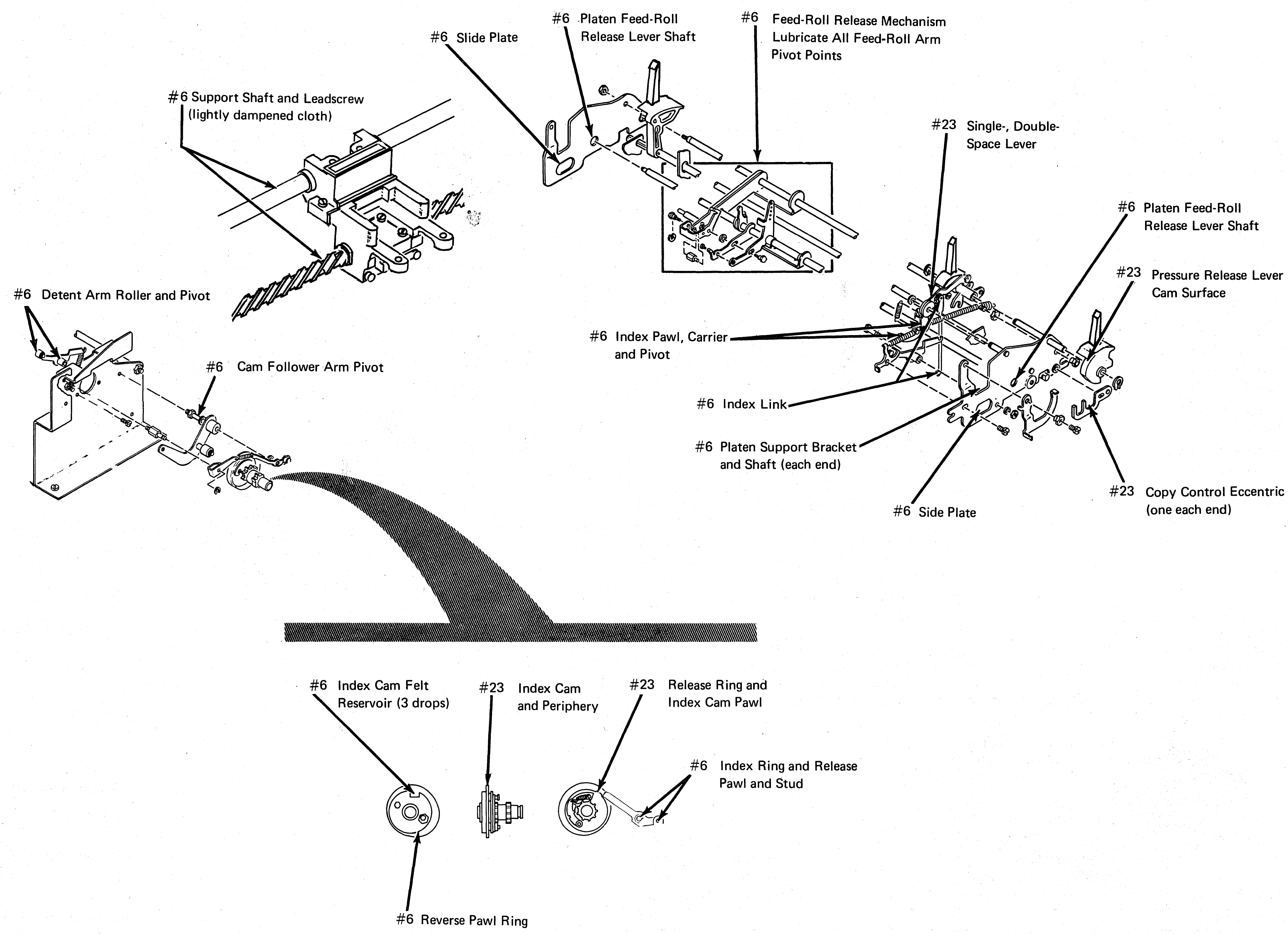
A print head used beyond its indicated PM Unit 4 period may result in less than normal ribbon life.

PREVENTIVE MAINTENANCE (MODEL 1)

- Check operation of the blower fan.
- Inspect the printer output for signs of print-density variations due to print-wire wear.
- Clean ink accumulation from the ribbon guide.
- Remove debris from the wire-guide tip and clean the side grooves in the wire-guide tip.
- Clean the carrier support shaft with a cloth dampened with IBM #6.
- Clean the leadscrew with cloth lightly dampened with IBM #6.

PM ROUTINE

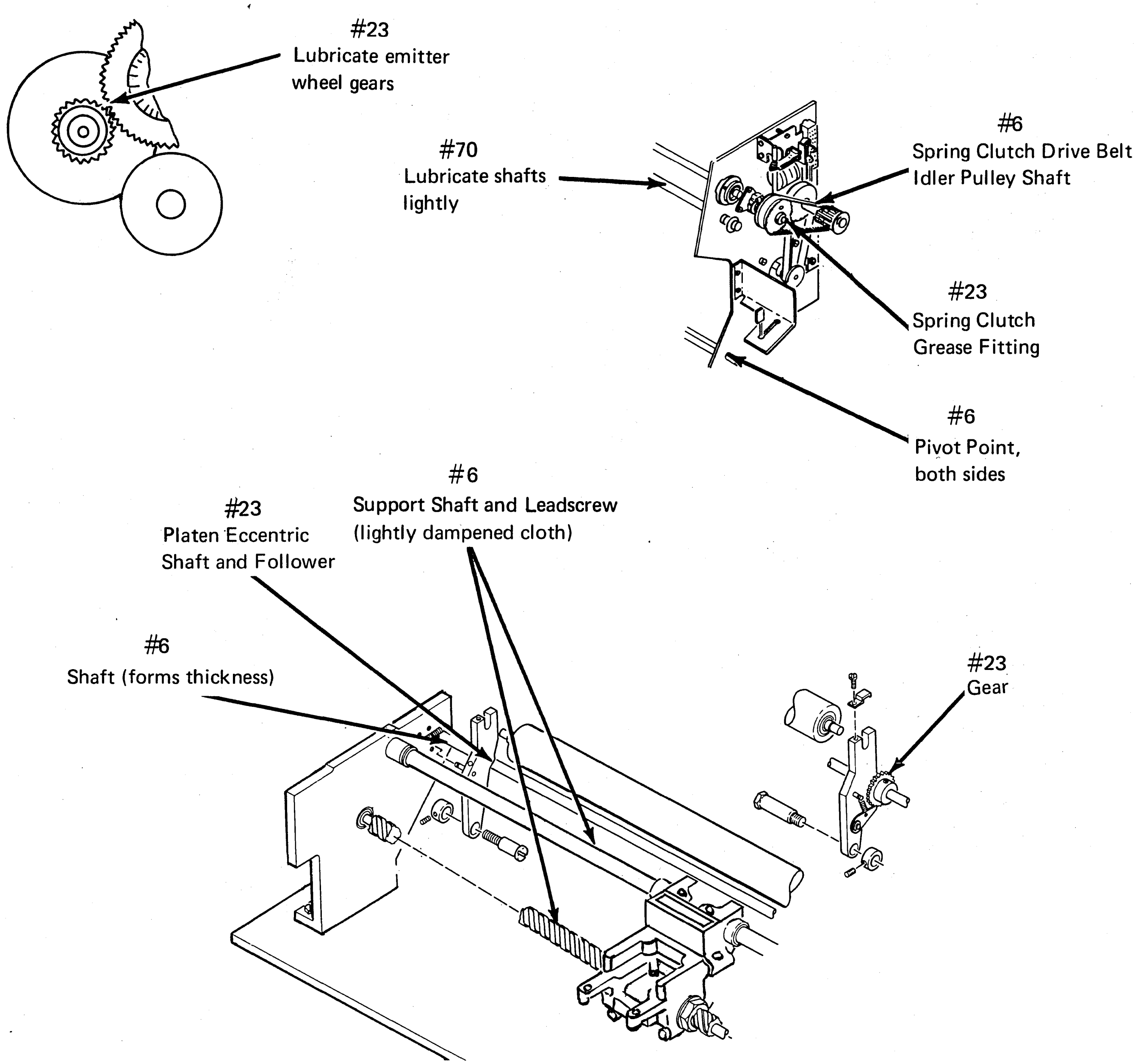
CODE U	CODE R	LOCATION OPERATION	MONTHLY FREQ.	CLEAN	LUBRICATE	OBSERVE
0						Check operation each service call.
1		Pin-Feed Carriage	15 or 25% change in MM scale		IBM #6 on: Feed roll release mechanism Index link Index pawl Index pawl carrier stud IBM #23 on: Feed roll release cam Platen motion escapement Index cam and follower	
3		Print Head Leadscrew and Support Shaft	15 or 25% change in MM scale	If necessary, brush debris from wire tip and wick groove. After reinstalling wick, saturate wick with IBM #6. Clean with cloth lightly dampened with IBM #6.		Calculate MM change since last PM. Update the usage label and PM frequency as required. See *Preventive Maintenance Frequency Procedure.*
4		Print Head	30 or 50% change in MM scale	See *Print-Head Cleaning, Stoning and Lubrication Procedure.*		Check for lubrication of wire guide and core oiler. Make sure wicks are properly installed in oil reservoir. Add IBM #6 if required. Calculate MM change since last PM Unit 4. If 50%, perform PM Unit 4. Update the MM usage label. Refer to *Preventive Maintenance Frequency Procedure.* Examine customer ribbon for shredding and/or excess wear. Check wire guide for accumulation of ribbon fibers and binding or sticking print wires. Correct these conditions. See *Print Head Cleaning, Stoning and Lubrication Procedure.* Recalibrate MM scale when MM reads 100% (every other stoning operation). See *Maintenance Monitor.*


#6 Slide Plate
#6 Platen Feed-Roll Release Lever Shaft
#6 Feed-Roll Release Mechanism Lubricate All Feed-Roll Arm Pivot Points
#6 Support Shaft and Leadscrew (lightly dampened cloth)
#23 Single-, Double-Space Lever
#6 Platen Feed-Roll Release Lever Shaft
#23 Pressure Release Lever Cam Surface
#6 Detent Arm Roller and Pivot
#6 Cam Follower Arm Pivot
#6 Index Pawl, Carrier and Pivot
#6 Index Link
#6 Platen Support Bracket and Shaft (each end)
#23 Copy Control Eccentric (one each end)
#6 Side Plate
#6 Index Cam Felt Reservoir (3 drops)
#23 Index Cam and Periphery
#23 Release Ring and Index Cam Pawl
#6 Index Ring and Release Pawl and Stud
#6 Reverse Pawl Ring

PREVENTIVE MAINTENANCE (MODELS 2 and 3)

- Check operation of blower fan.
- Inspect printer output for signs of print-density variations due to print-wire wear.
- Clean ink accumulation from ribbon guide.
- Remove debris from wire-guide tip and clean side grooves in wire-guide tip.
- Clean carrier support shaft with cloth dampened with IBM # 6 oil.
- Clean leadscrew with cloth lightly dampened with IBM #6 oil.

LUBRICATION POINTS (MODELS 2 and 3)



Code U	Code R	Location Operation	Monthly Freq.	Clean	Lubricate	Observe
0		Blower				Check operation each service call.
2		VFC Carriage (Models 2 and 3)	6 or 25% change in MM scale		IBM # 70 on: Support and drive shafts. Form tractor shafts. IBM #6 on: Spring clutch drive belt idler pulley shaft. IBM #23 on: Platen eccentric shaft detent and stud. Platen eccentric shaft and follower. Spring clutch (one grease fitting).	Check paper-tension adjustment.
3		Print Head Leadscrew and support shaft	15 or 25% change in MM scale	If necessary, brush debris from wire tip and wick groove. Saturate wick with IBM # 6 oil after reinstalling wick. Clean with cloth lightly dampened with IBM #6.		Calculate MM change since last PM. Update the usage label and PM frequency as required. Refer to "Preventive Maintenance Frequency Procedure."
4		Print Head	30 or 50% change in MM scale	Refer to "Print Head Cleaning, Stoning, and Lubrication Procedure."		Check for lubrication of wire guide and core oiler. Make sure wicks are properly installed in oil reservoir. Add IBM #6 oil if required. Calculate MM change since last PM Unit 4. If 50%, perform PM Unit 4. Update the PM Freq. Maint. Monitor usage label. Refer to "Preventive Maintenance Frequency Procedure." Examine customer ribbon for shredding and/or excess wear. Check wire guide for accumulation of ribbon fibers and binding/sticking print wires. Correct these conditions by performing the print-head cleaning, stoning, and lubrication procedure. Recalibrate MM scale when MM reads 100% (every other stoning operation). Refer to "Maintenance Monitor."

PRINT-HEAD CLEANING, STONING, and LUBRICATION

Perform print-head maintenance when 50% change is registered on the maintenance monitor.

Stoning Tools

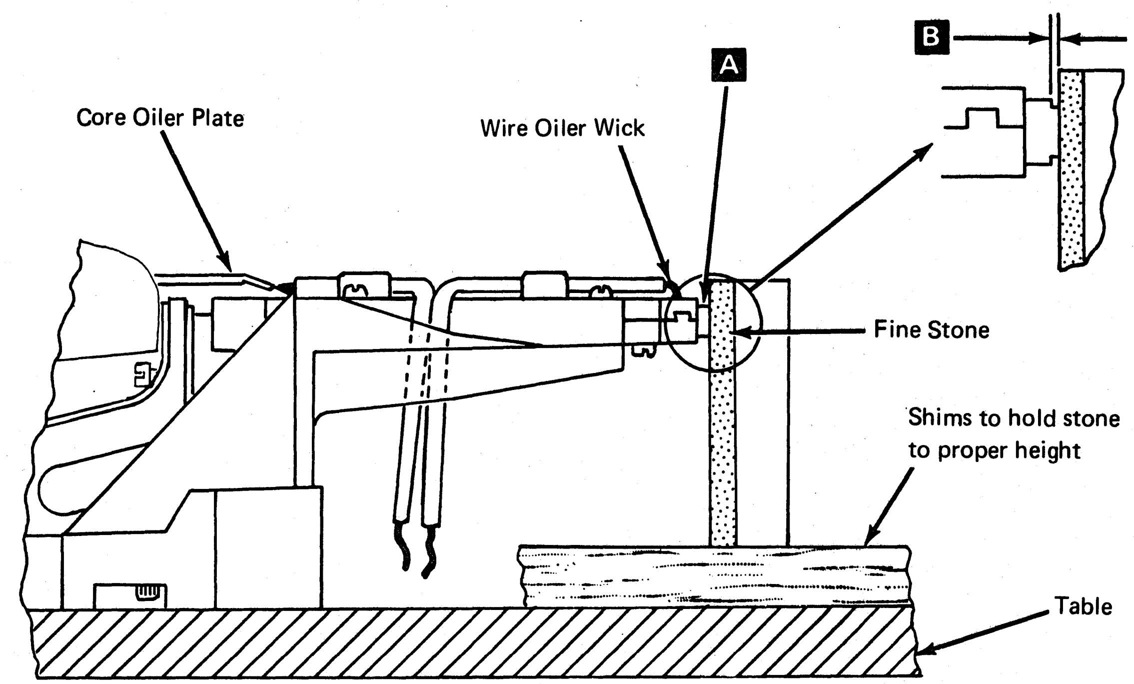
1. IBM # 6.
2. Stoning tool (part 18463)--free of gouges.

Stoning Procedure

1. Remove the print head. (See 2.13.)
2. Remove the core oiler plate and wick assembly (2 screws) and tighten the screws to prevent them from falling out when stoning. Lift the oiler wick out of the wire guide tip.
3. Brush debris from around wire guide and ribbon guide. Check for sticking or binding wires by carefully extending the armatures forward and slowly releasing them. Ensure that the armatures return to their fully restored position. If a print magnet armature does not restore properly, remove the magnet assembly (see 2.14) and clean the wire guide hole with straightening tool (part 2617969). Replace the print magnet assembly and recheck for binds.
4. Thoroughly wet both sides of the stone with IBM # 6.
5. Be sure that the end of the print head is square with the stone **A**. Gently slide the print head back and forth on the coarse side of the stone until the print wire tips are flat and flush with the wire guide. Removing a minimum amount of material (.005 in.; 0,13 mm) is usually sufficient.

   Note: A ledge **B** .010 in. (0,25 mm) from the tip of the wire guide provides a reference in maintaining squareness of the tip and a limit to avoid removing too much material.

6. When the wire tips appear flat and flush with the wire guide, turn the stone over and polish the tips with the fine side of the stone until the tips appear shiny.
7. Carefully clean the wire guide tip with a brush. Lift each armature from the core (thumbnail can be used), and brush the debris from each wire tip.
8. Saturate core oiler pad and install core oiler plate so that the back of the oiler pad rests on top of the magnet cores.
9. Slide the wick tube forward and, using the wire cleaning and straightening tool (part 2617969), carefully insert the wick alongside the print wires so that the wick extends below the bottom of the wire guide.
10. Install the print head. See 2.13.



CHAPTER 4. SWITCHES

ALL MODELS

1. Carriage drive-motor switch	Provides or removes 208/230 volts to carriage drive motor.
2. End-of-forms switch	Signals adapter when end-of-forms is reached.
3. Cover interlock switch	Signals adapter when covers are open.
4. Forms-moving switch	Signals the system that forms are moving, and printing cannot take place.

MODELS 2 and 3

6-line/Neutral Interlock switch	Signals adapter when selector lever is in neutral position.

CHAPTER 5. POWER SUPPLY and COOLING

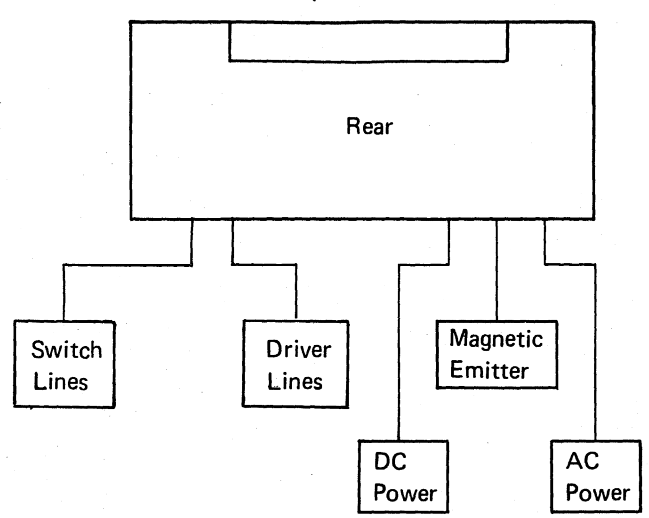
- Printer power is from the system by dc and ac power cables.
- One twisted pair (shielded) is an emitter cable.
- Two cables provide switch and driver signals.

WORLD TRADE POWER REQUIREMENTS

For WTC applications, primary power is 220 volts ac (± 10%), single-phase, 50 Hz ± 1/2 Hz.

Heat sinks and a fan operated by the carriage drive motor cool the machine components.

Printer Cables



CHAPTER 6. CIRCUIT DESCRIPTION

CIRCUIT CARDS

Driver Cards

The 2.2-ampere driver provides drive for print magnets, stepper motor (combination of four drivers), and carriage clutch solenoid.

The illustration shows a driver card in a print-magnet application. With the input at an UP level (driving block turned off), T1 and T2 are cut off and the output maintains an UP level. Bias resistor R2 and diode D1 maintain a reverse bias for T1. T2 is reversed-biased by R4 and D2. When the driving block is turned on, T1 is turned on with its base current limited by R1. T1 then provides base drive to T2 through R3. T2 saturates for a peak current up to 2.2 amperes. With a 100% duty cycle, this current must be limited to 1.66 amperes.

C1 delays the turn-off transistion of T2 to minimize the shift on the ground distribution system. C2 prevents oscillation in the output circuit if transistor T2 has a high gain and a broad frequency response. An additional function of D2 is to provide a clamp for the voltage that develops from current through C1 when a negative shift occurs on the collector of T2 after T2 has turned off.

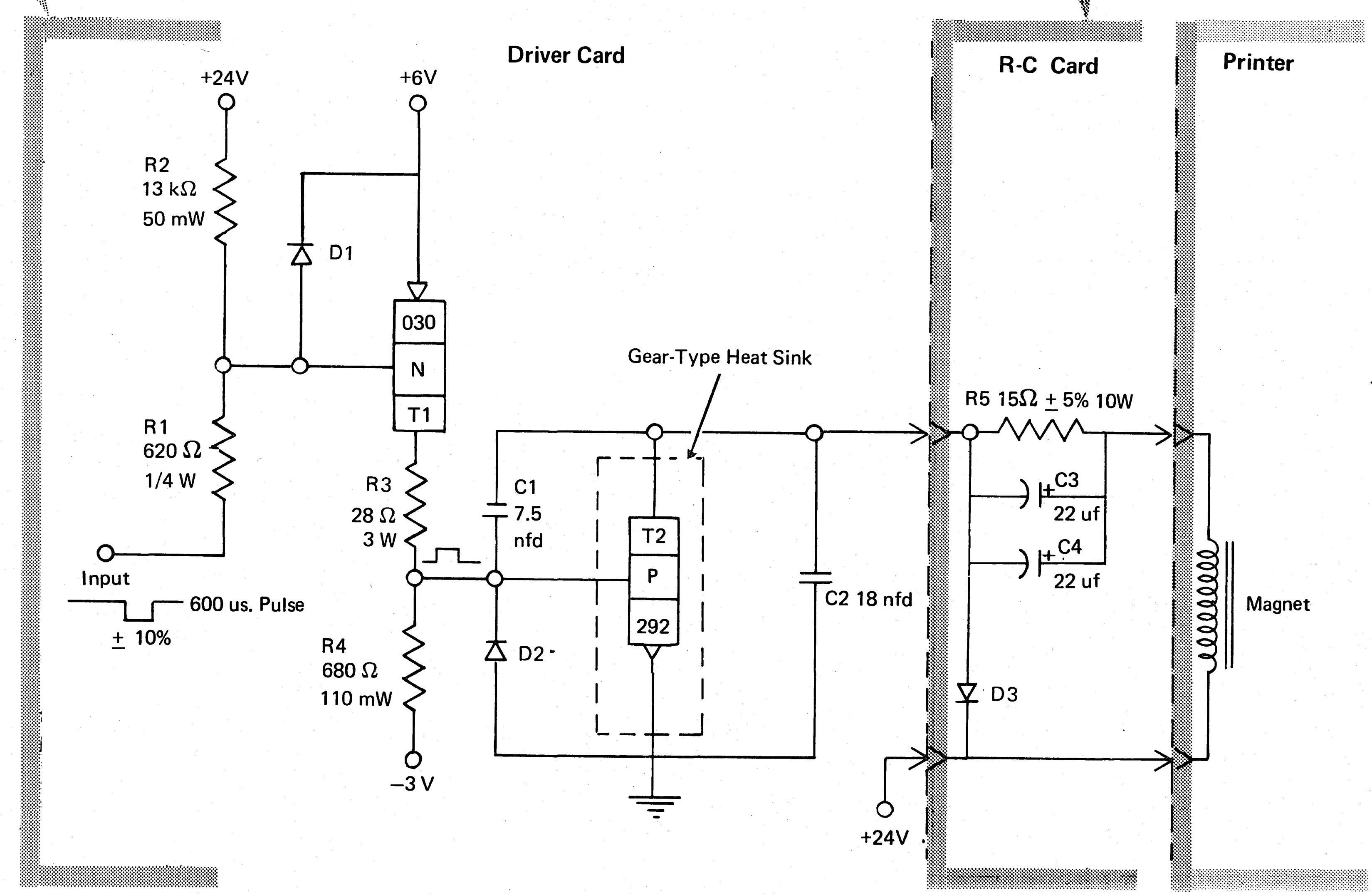
kΩ = 1000 Ω
mW = milliwatts
nfd = nanofarads
uf = microfarads

Resistor-Capacitor (R-C) Cards

The R-C network decreases the buck-out time of the print-magnet armature. A clamping action is also provided to suppress voltage transients during turn-off of the electromagnet. The network drives a print magnet and is driven by a transistor switch to ground.

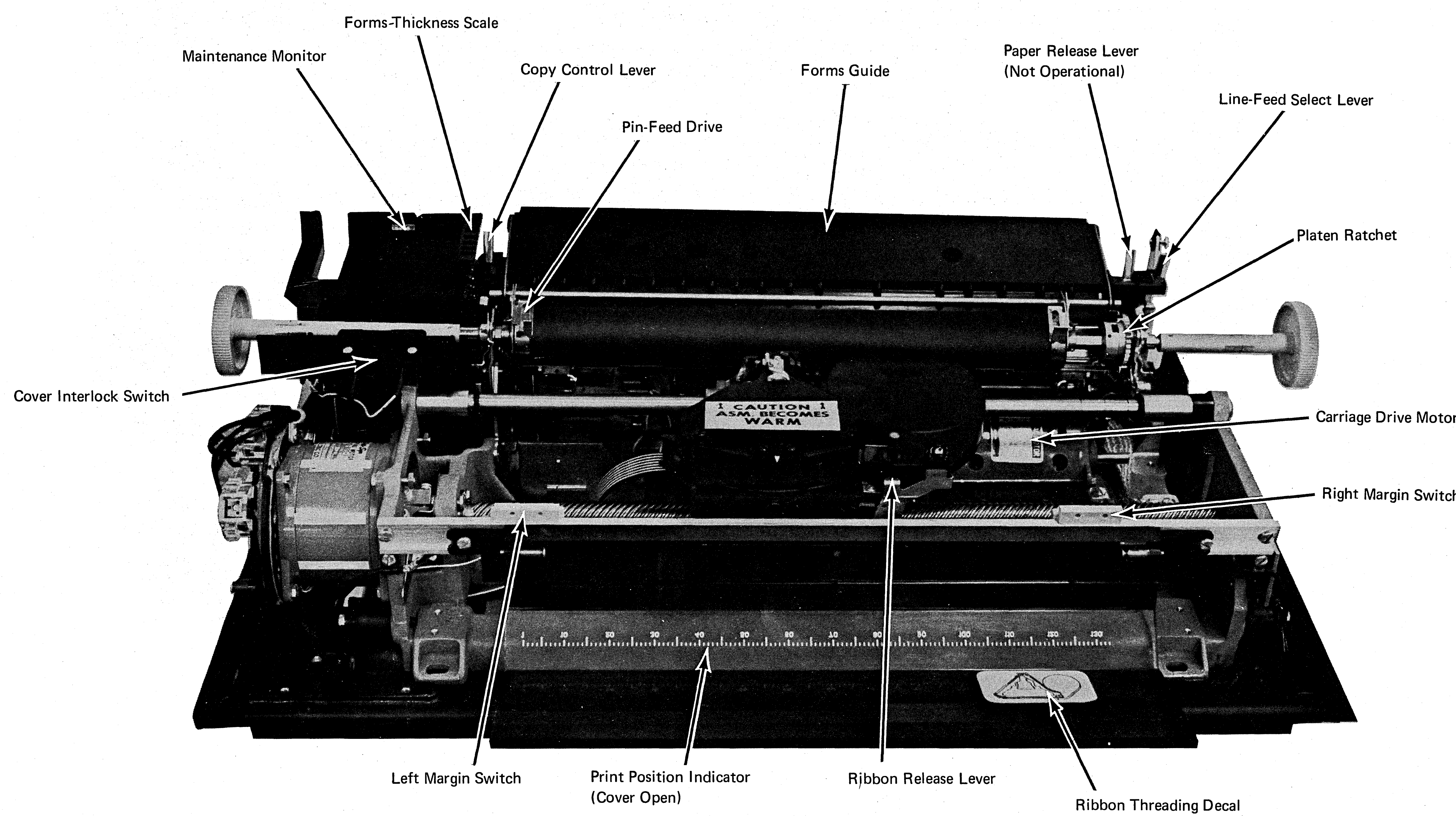
When the drive transistor is on and the network is driving the print magnet (bucking coil), parallel capacitors C3 and C4 allow speed-up current to flow. R5 limits the direct current through the coil. Diode D3 is reverse-biased.

When the drive transistor is turned off, R5 controls the discharge of parallel capacitors C3, C4, and of the print magnet through the clamp diode D3.

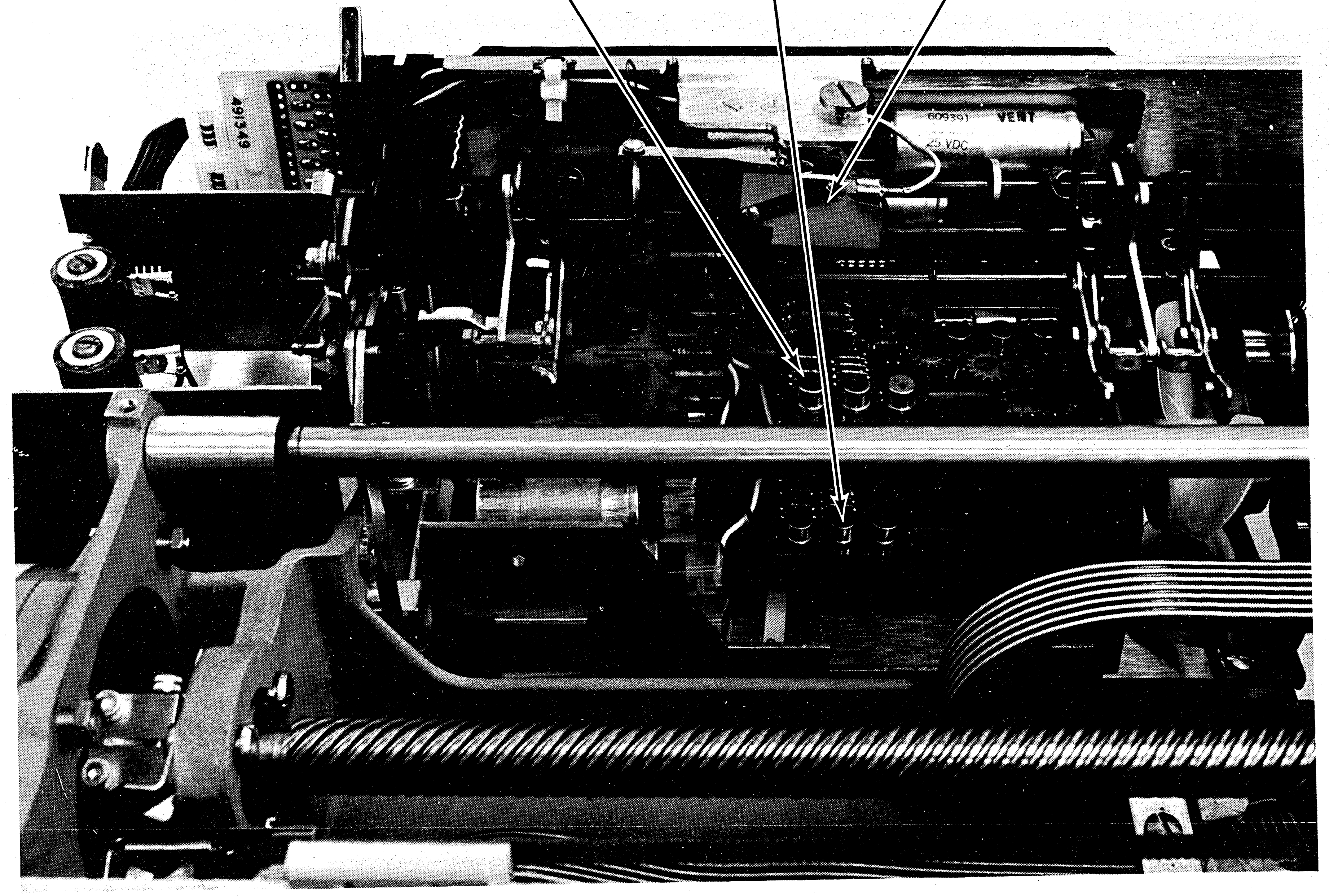


CHAPTER 7. LOCATIONS

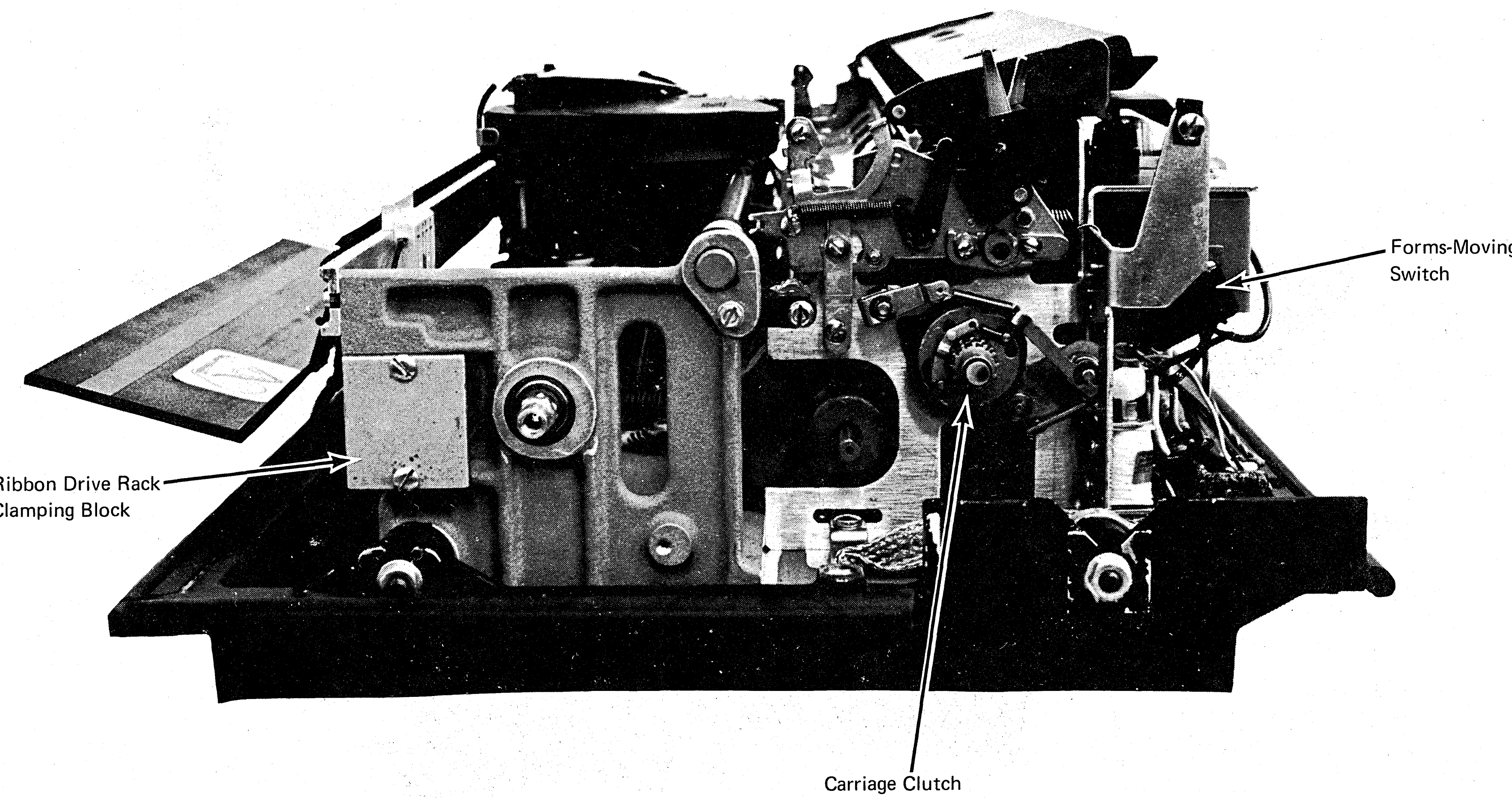
MODEL 1



Top Front

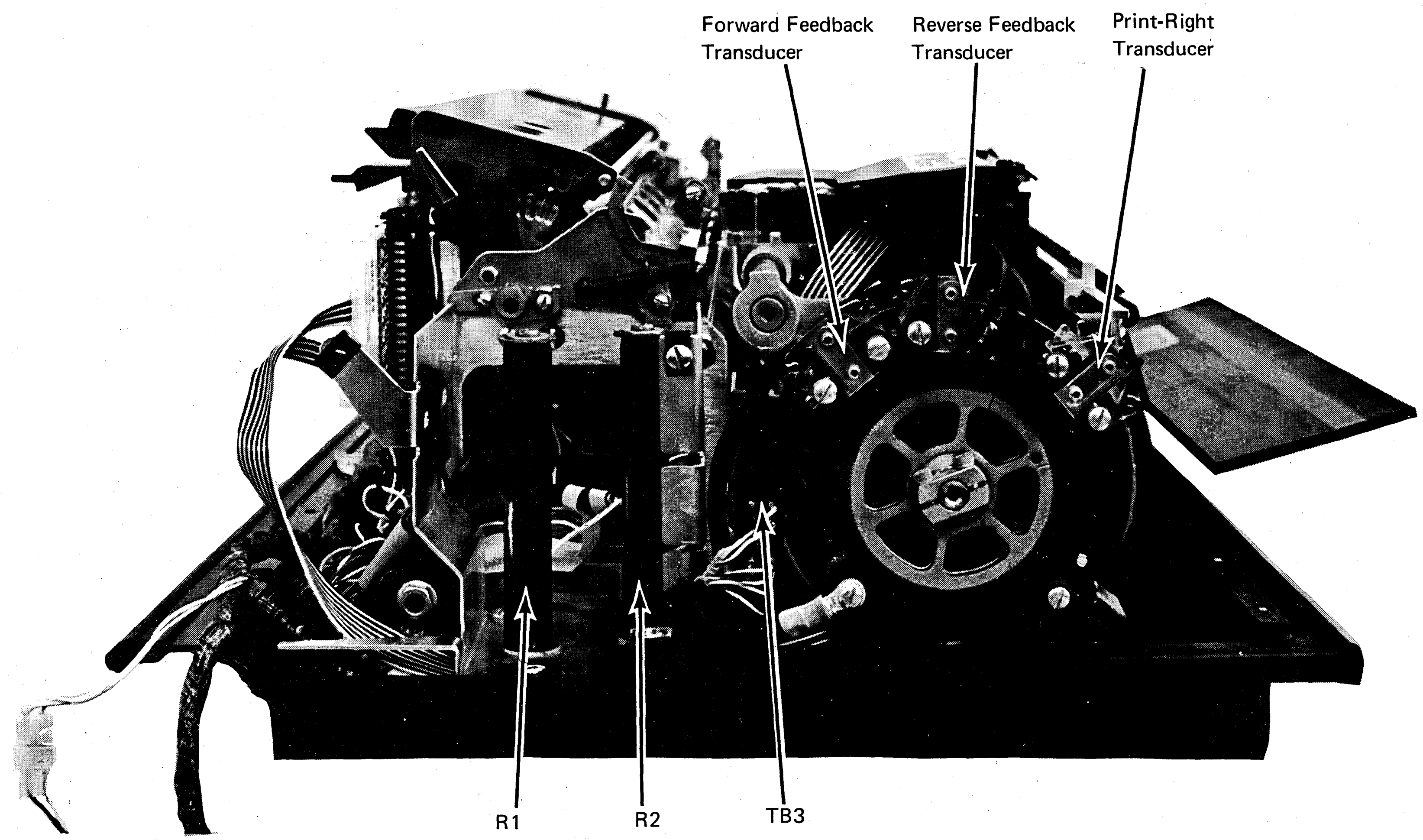


Top Left Front

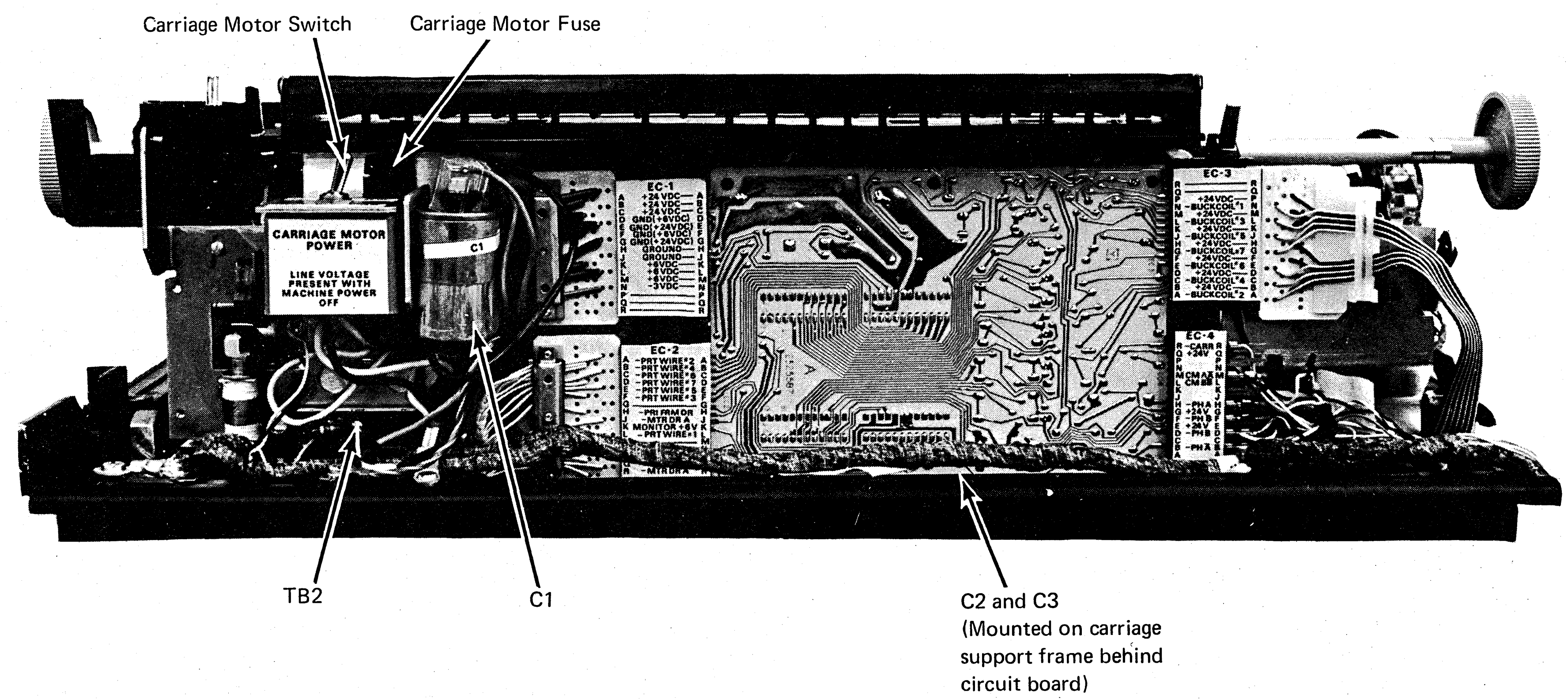


Forms-Moving
Switch
Ribbon Drive Rack
Clamping Block
Carriage Clutch

Right Side

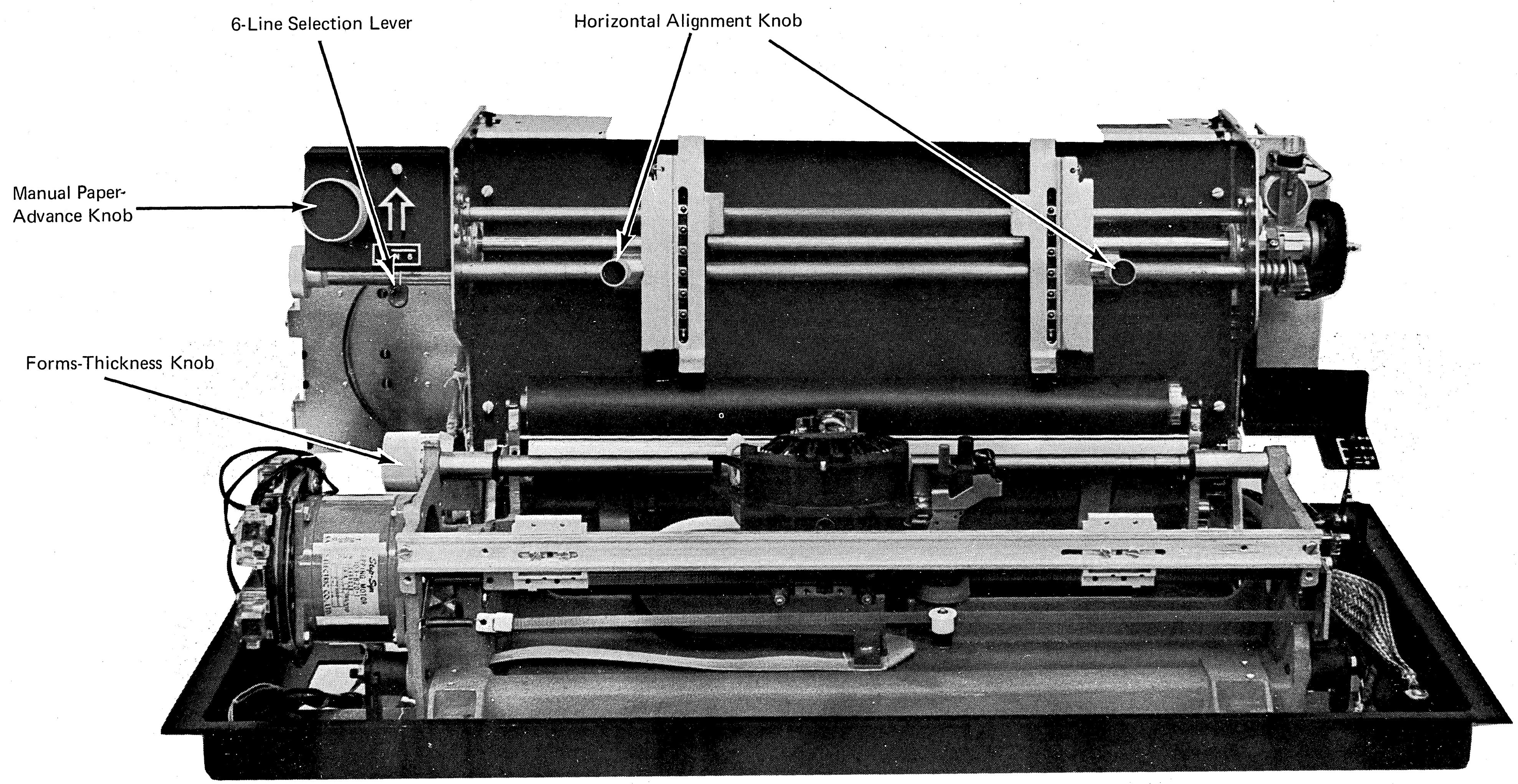

Forward Feedback Transducer
Reverse Feedback Transducer
Print-Right Transducer
R1
R2
TB3

Left Side

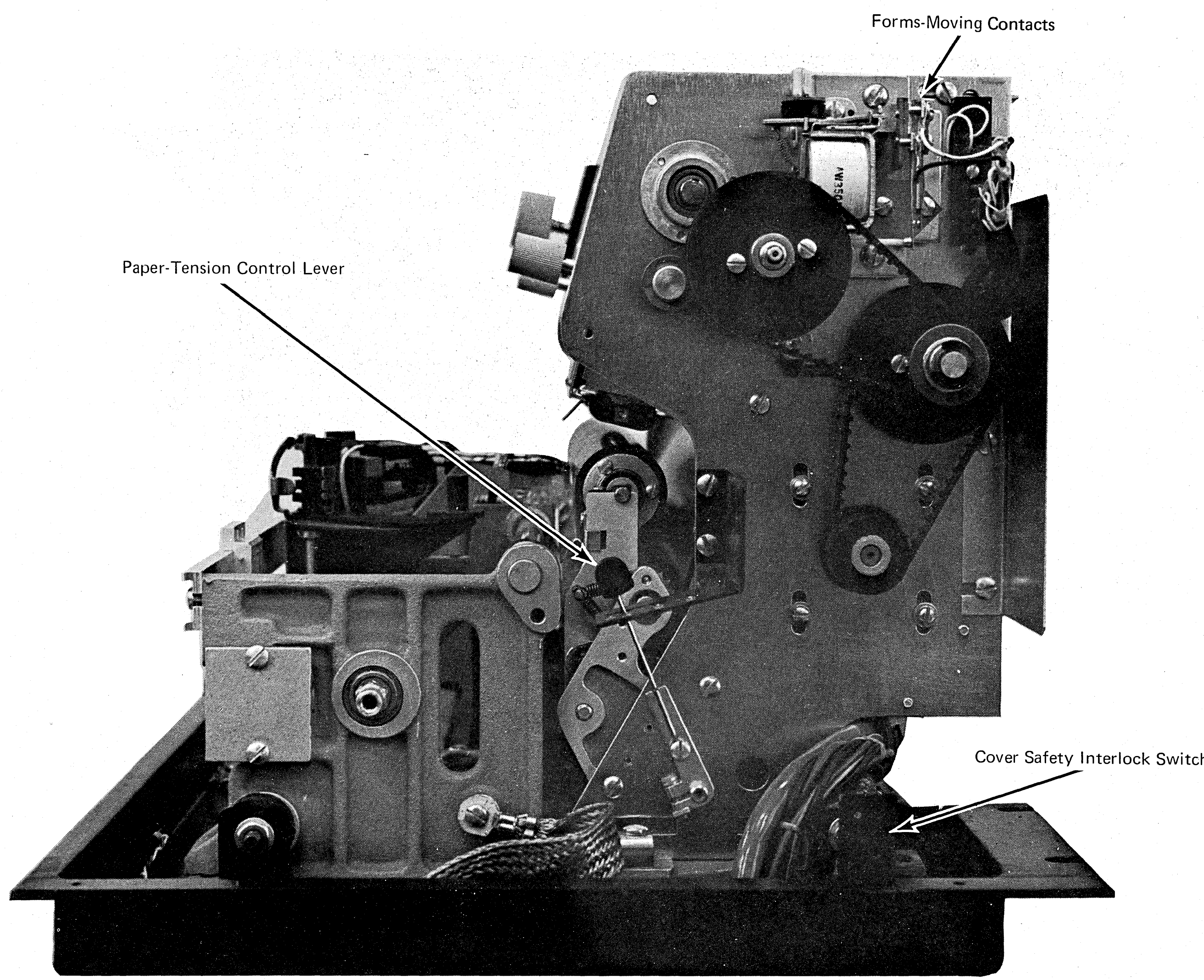

Carriage Motor Switch
Carriage Motor Fuse
CARRIAGE MOTOR POWER
LINE VOLTAGE PRESENT WITH MACHINE POWER OFF
C1
EC-1
EC-2
EC-3
EC-4
TB2
C1
C2 and C3
(Mounted on carriage support frame behind circuit board)

Rear

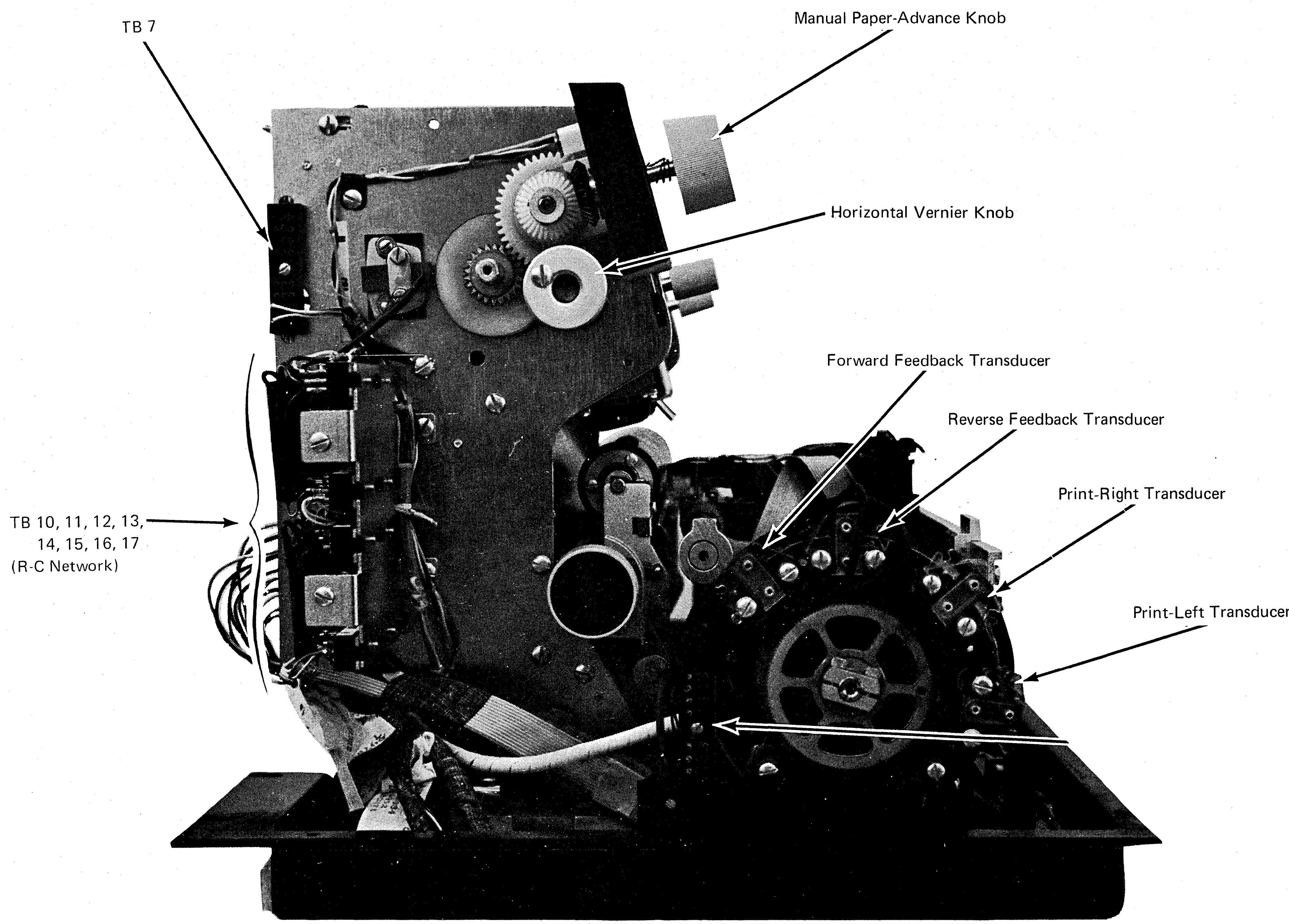
LOCATIONS, MODELS 2 and 3



Front

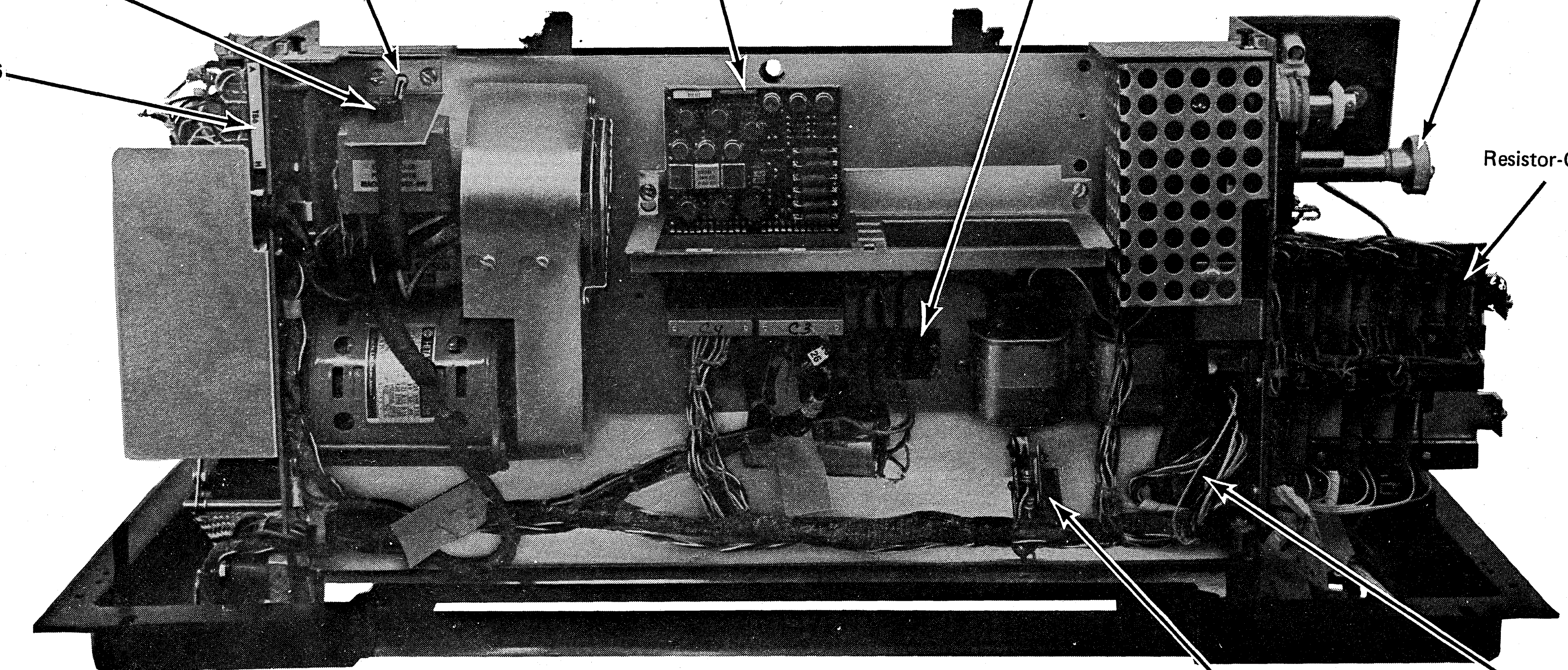

Forms-Moving Contacts
Paper-Tension Control Lever
Cover Safety Interlock Switch

Right Side



TB 7
Manual Paper-Advance Knob
Horizontal Vernier Knob
Forward Feedback Transducer
Reverse Feedback Transducer
Print-Right Transducer
Print-Left Transducer
TB 10, 11, 12, 13,
14, 15, 16, 17
(R-C Network)

Left Side


SLT Driver Cards (2)
Carriage Drive-Motor Switch
TB 5
Carriage Drive-Motor Fuse
Horizontal Vernier Knob
TB 6
Resistor-Capacitor Network
End-of-Forms Switch
EC-1

Rear

IBM Technical Newsletter

This TNL provides preliminary maintenance information for the A-frame carriage and the Stage II print head for matrix printers. Parts catalog pages for the A-frame, print head and keyboard assembly are included.

Final TNLs will be released at a later date.

International Business Machines Corp., Product Publications Dept., Endicott, N. Y.

PRINTED IN U.S.A. R24-1742-0

CENTER SUPPORT ADJUSTMENT

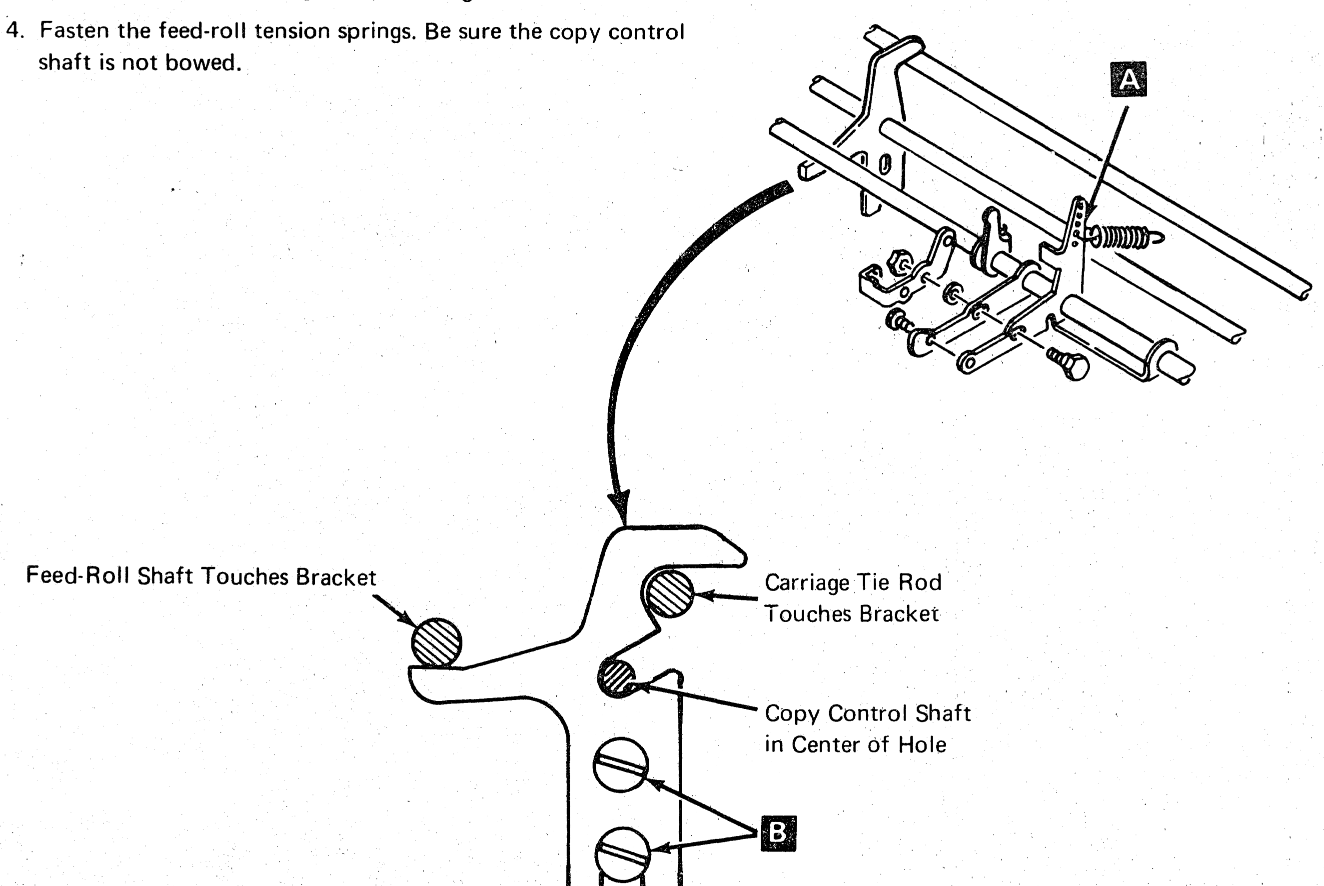
Old Style

Objective:

To position the center support bracket so that the copy control shaft is not bowed by the tension springs.

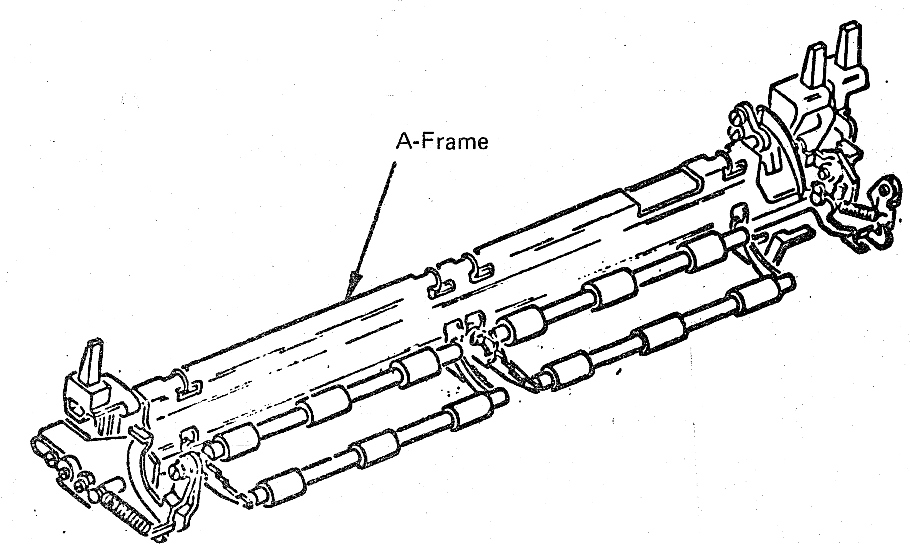
Adjustment

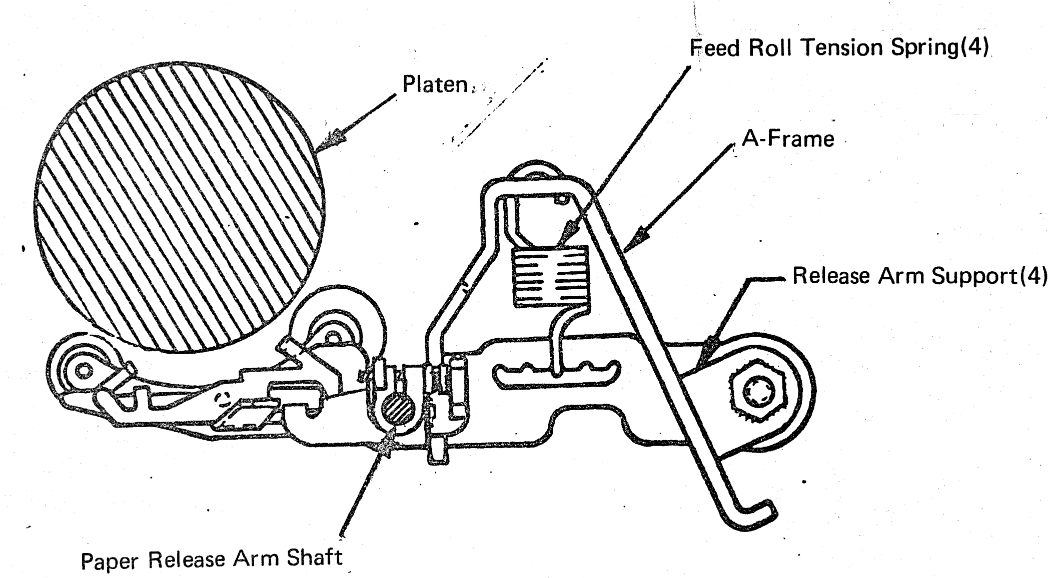
1. Remove covers, platen, paper deflector, and move the paper release lever toward front of printer.
2. Disconnect the four feed-roll tension springs from the feed-roll arms. **A**
3. Loosen two center support bracket screws **B** and position the bracket so that the feed-roll shaft and the carriage tie rod just touch the bracket lugs as shown. Tighten the screws.
4. Fasten the feed-roll tension springs. Be sure the copy control shaft is not bowed.



New Style

Note: The new style A frame is self-supporting and does not require this adjustment.



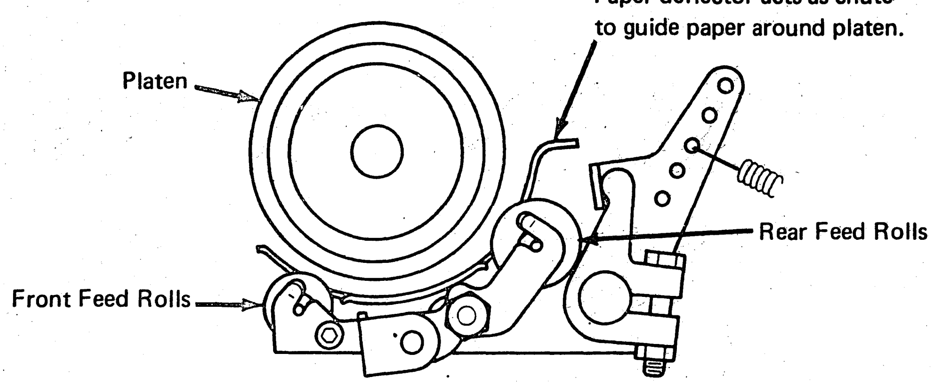


FRICTION-FEED PLATEN DESCRIPTION

On Model 1 printers, paper is fed by rolls that press paper tightly against the platen. As the platen turns, pressure of the rolls causes paper to feed (paper release lever must be toward back of printer).

A copy control lever on the left side of the printer positions the platen forward or backward for different thicknesses of forms.

Inward pressure on the left platen knob disengages the platen variable mechanism from the drive ratchet. This allows vernier rotation of the platen to position the forms vertically to the print line.

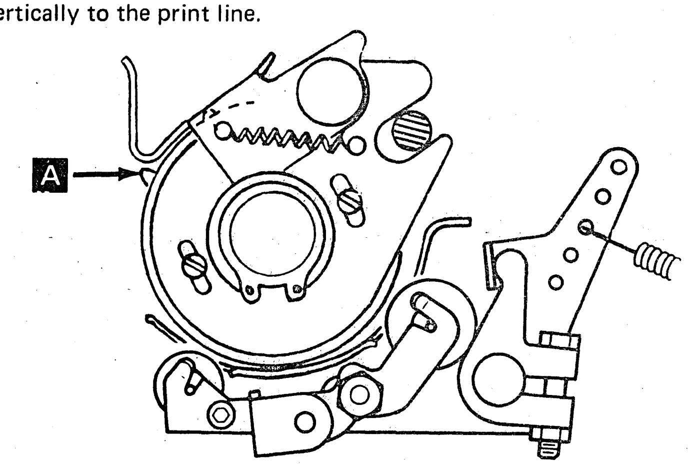


PIN-FEED PLATEN DESCRIPTION

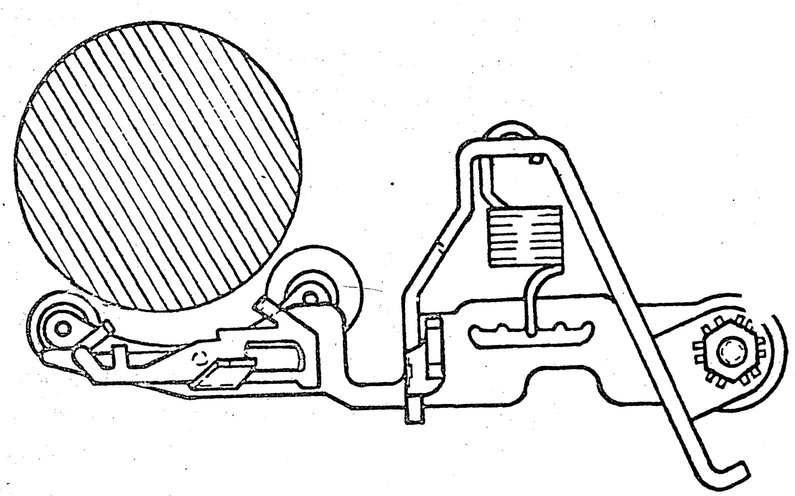
The pin-feed platen has pins in each end of the platen to engage marginal holes in paper A

A copy control lever on the left side of the printer positions the platen forward or backwards for different thickness of forms.

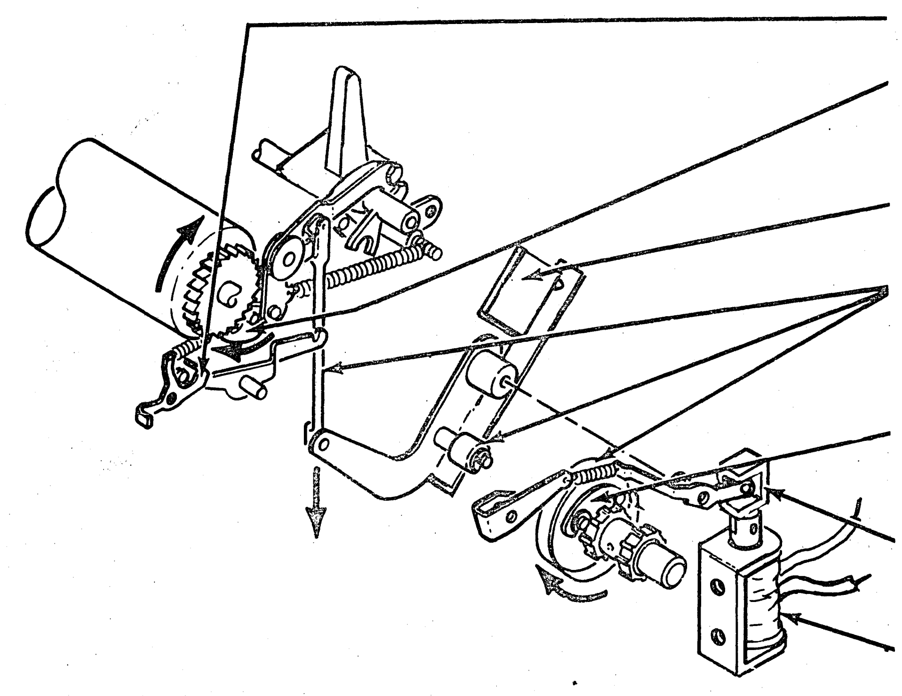
Inward pressure on the right platen knob disengages the platen variable mechanism from the drive ratchet. This allows vernier rotation of the platen to position the forms vertically to the print line.



This illustration is a side view of the A-frame carriage. Operating principles for both carriages are the same.



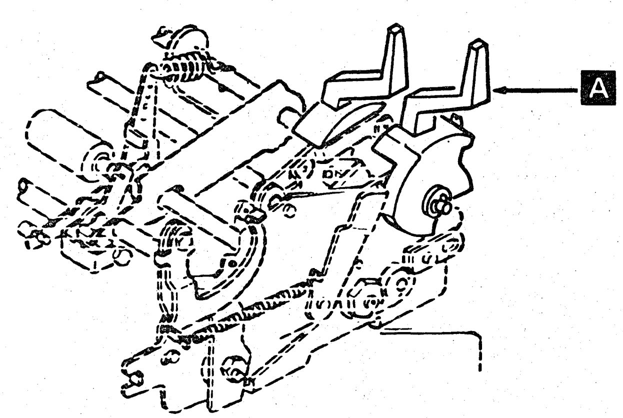
PLATEN MOVEMENT

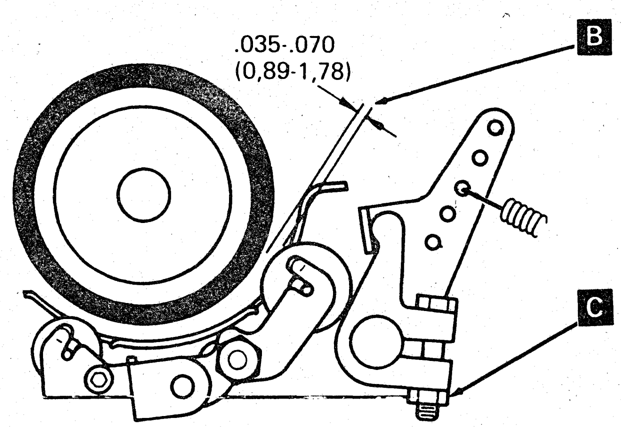


PAPER-RELEASE-ARM ADJUSTMENT (OLD STYLE)

1. Move the paper release lever A all the way toward the platen.
2. With the feed rolls released, there should be from .035 to .070 in. (0,89 to 1,78 mm) clearance B between the rear feed rolls and platen (five to ten tab cards can be used for checking clearance).
3. Make the adjustment by loosening the nut C and rotating the arm forward or backward. Check and adjust the four release arms.

Note: Both front and rear feed rolls should be parallel to within .010 in. (0,25 mm) for the length of the platen.

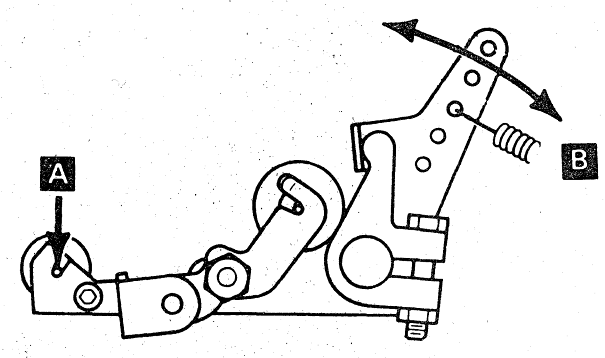




FEED-ROLL TENSION-SPRING ADJUSTMENT (OLD STYLE)

Friction Feed Machines Only

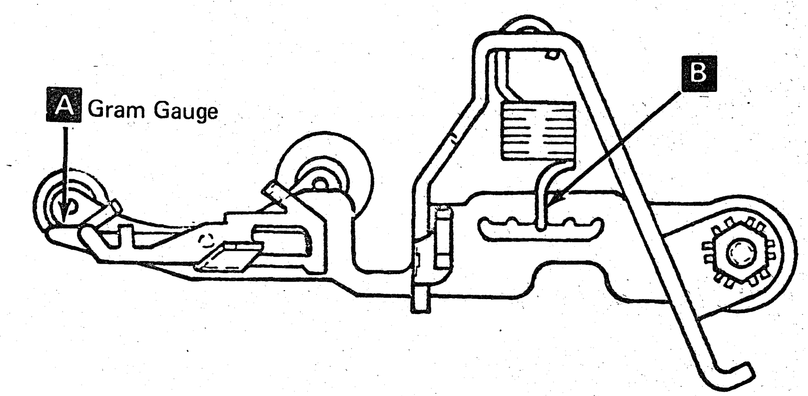
1. Remove the platen and the paper guide.
2. Place the X20 gram-gauge blade on front feed roll pivot points A .
3. Press down to measure for 2 to 2-1/2 lb. (0,91 to 1,13 kg) tension before the arm starts to move.
4. Hook the springs B in any one of five holes to provide proper tension. Adjust all four springs.



FEED ROLL TENSION SPRING ADJUSTMENT (NEW STYLE, A-FRAME)

Friction Feed Machines Only

1. With main covers off, remove the platen, deflector, and paper guide.
2. Using a gram gauge, press down on the front feed roll pivots (four places) A and check for 2--2 1/2 lb (0,91 to 1,13 kg) tension before the arm starts to move.
3. Make adjustment by placing the feed roll tension springs B in the notch that provides 2--2 1/2 lb (0,91 to 1,13 kg) when measured at the front feed roll pivots.



PAPER RELEASE ARM ADJUSTMENT (NEW STYLE A—FRAME)

PIN-FEED MACHINES

When pulled forward, the paper release arm (feed roll release) on pin-feed machines can be used to assist in loading forms. The feed rolls must be in the down (open) position for normal forms handling. On pin-feed machines, the feed rolls are adjusted so that they do not interfere with the paper path. If interference exists, perform the following service check and adjustments.

FRICTION-FEED MACHINES

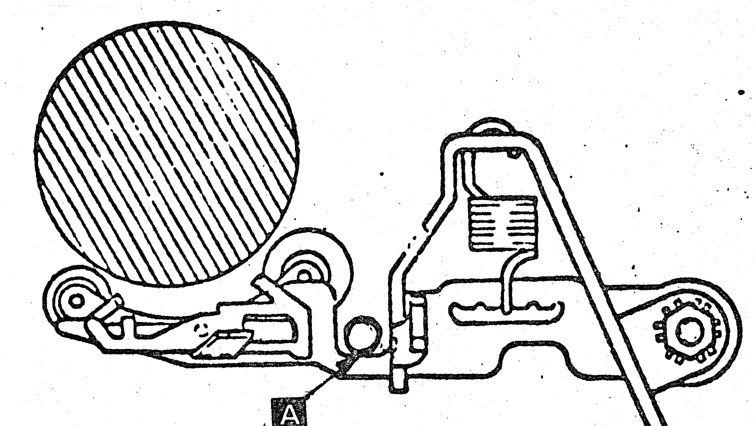
On friction-feed machines, the paper release arm must be in the rear position (away from platen) for forms feeding. The feed rolls are adjusted so that uniform pressure is exerted by the feed rolls against the platen when feeding forms. If the forms do not feed properly, perform the following service check and adjustments *and* the front feed roll adjustment on new style A-frames. See 2.58).

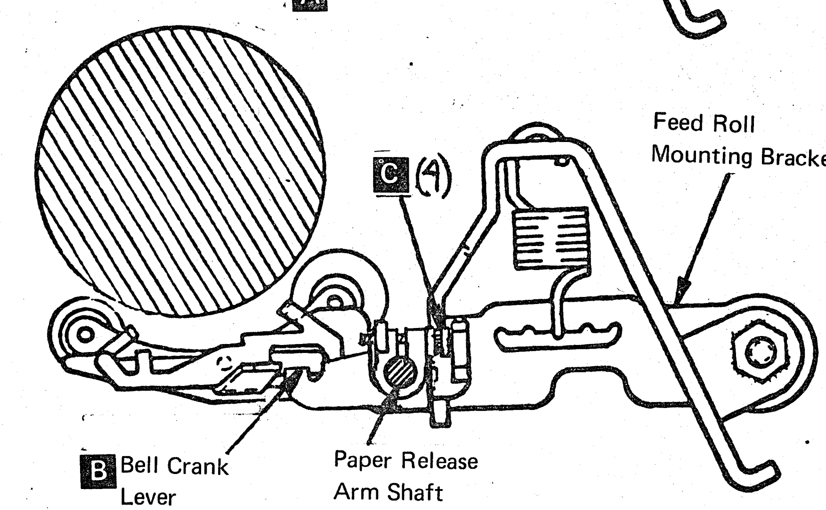
Service Check

1. Remove the platen and paper deflector, and position the paper release arm to the rear (away from platen).
2. Check to see that each bell crank lever bottoms on the paper release arm shaft A . At the same time, check that the lips on the bell crank levers B are resting on top of the feed roll mounting brackets.

Adjustments

1. Make adjustments by loosening the screw C and pivoting the bell crank lever to meet conditions in Service Check step 2. After each adjustment, tighten the screw. Repeat for each bell crank (4).
2. Install the platen and move the paper release arm to the forward position. Check for a minimum of .028 to .030 in. (0,71 to 0,76 mm) clearance (4 tab cards) between the platen and both the front and rear feed rolls. Readjust the bell crank levers (4) as necessary.



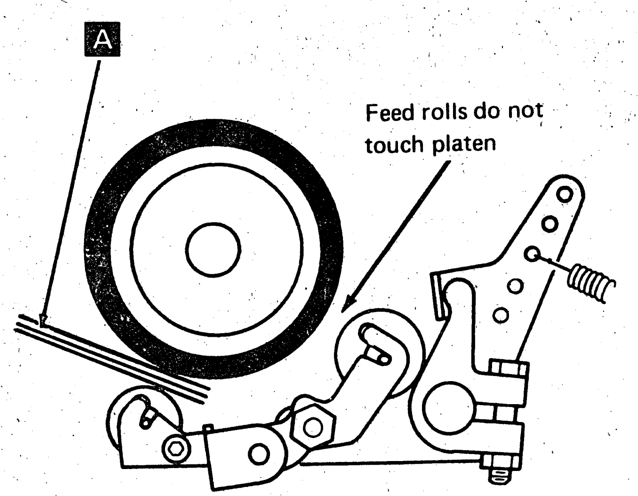


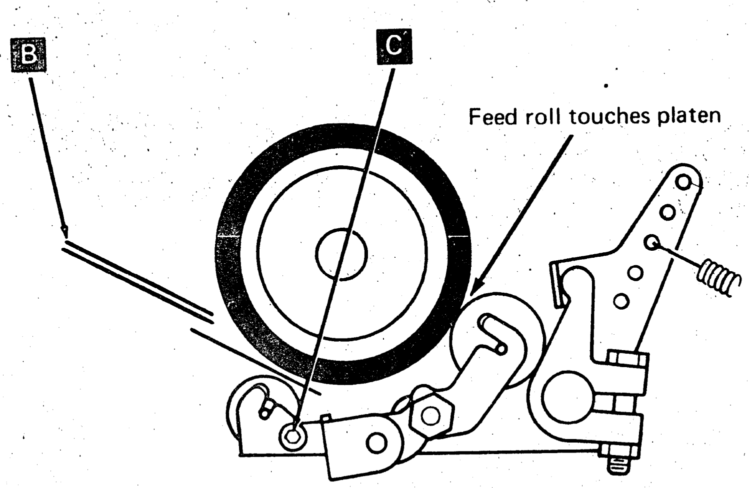
FRONT FEED-ROLL ADJUSTMENT (OLD STYLE)

Friction Feed Machines Only

Note: Remove the paper deflector before making this adjustment.

1. Place feed roll release lever away from the platen to engage the feed rolls.
2. Place three tab cards between the front feed rolls and **A** platen. The rear feed rolls should clear the platen enough to turn freely.
3. Remove two tab cards **B**. The rear feed rolls should touch the platen.
4. To obtain this adjustment, loosen the screw **C** and slide it up or down in its slot. Tighten the screw. Check and adjust all four front feed rolls.





FRONT FEED ROLL ADJUSTMENT (NEW STYLE A–FRAME)

FRICTION FEED MACHINES ONLY

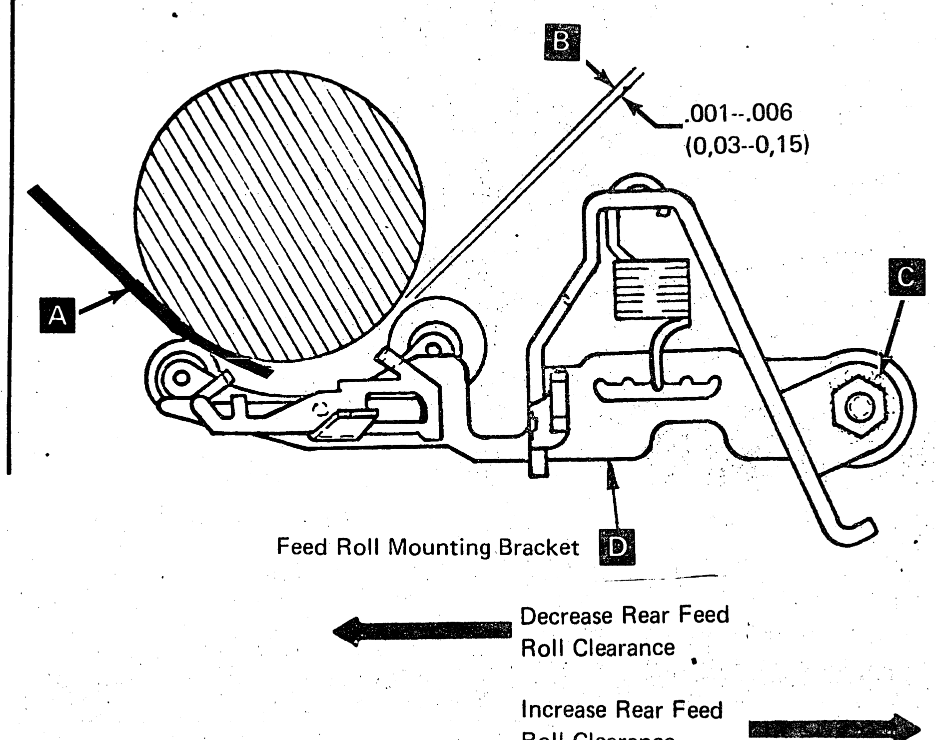
NOTE: The paper release arm adjustment must be correct before making this adjustment. See the service check and, if necessary, perform the adjustment.

Service Check

1. With main covers removed, remove the forms guide, platen, and paper deflector but put platen back in place.
2. Place the feed roll release lever in the rear position away from the platen. This engages the feed rolls against the platen.
3. Place four tab cards (.028 to .030 in. (0,71 mm–0,76 mm) between the platen and all front feed rolls **A** and check for .001 to .006 in. (0,03-0,15 mm) clearance between the platen and all rear feed rolls **B**. The clearance of all rear feed rolls must be parallel to the platen within .002 inches (0,05 mm). If necessary, perform the adjustment.

Adjustment

With the feed roll release lever in the rear position and four tab cards under each front feedroll, loosen the nut **C** and move the feed roll mounting bracket **D** front to rear for .001 to .006 in. (0,03 to 0,15 mm) clearance between the rear feed rolls and platen. Adjust 4 places and check for .002 inches (0,05 mm) parallelism. When adjustment is complete, install the paper deflector and platen. See forms guide installation.



CARRIAGE ASSEMBLY REMOVAL AND REPLACEMENT (OLD STYLE)

The following procedure is for removal and replacement of the complete carriage assembly from the printer frame for both style carriages. See for A-frame removal and replacement from main carriage frame.

Removal

Note: Before performing the carriage removal, note all switch wiring, capacitor wiring, etc. to assist you when reconnecting the wiring.

1. Remove system power. Remove the platen and top covers.
2. Remove the forms guide assembly (2.42).
3. Remove capacitor C1 and the mounting clip. Pull out paddle cards EC-1, EC-2, EC-3, and EC-4.
4. Remove the cover over the stepper-motor resistors. Use a screwdriver to release the tabs holding it onto the metal cover.
5. Remove the forms moving switch bracket (2 screws) (2.48).
6. Remove the 2 wires on the end-of-forms switch. Be sure the cable is free from the carriage assembly.
7. Remove EC-1 cable clamp (dc cable).
8. Remove the carriage drive switch and the fuse cable clamp (ac cable).
9. Remove the yellow wire from the fuse.
10. Remove the black wire from C1.
11. Remove the ground wire from the frame and remove the solenoid wires (taper pins) from TB2-A and TB2-B. Remove TB2.
12. Disconnect the wires from C2 and C3 at EC-4.
13. Loosen the 5 screws (3 on the left and 2 on the right) that hold the entire carriage assembly to the printer base. When all cables are free, lift out the assembly.

Replacement

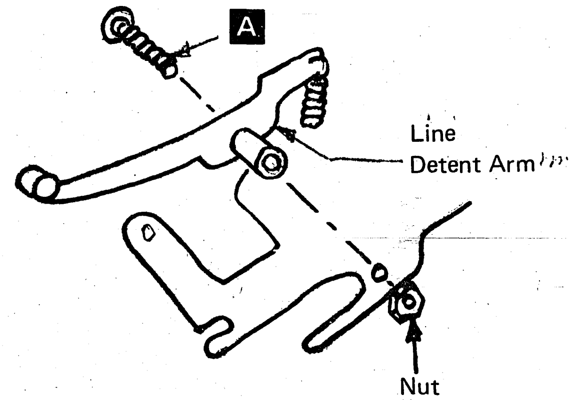
1. Place the carriage on the printer base and (while facing rear of printer) push it all the way forward and to the right. Tighten the small screw on the side frame, position the four clamps, and then tighten the four remaining screws that clamp the frame onto the base.
2. Perform the remaining 12 steps in reverse order of removal.
3. Check the following adjustments and adjust as necessary:
   a. Print-head-to-platen clearance and ribbon guide assembly adjustment
   b. End-of-forms switch adjustment
   c. Froms-moving switch adjustment
   d. Check all carriage adjustments.

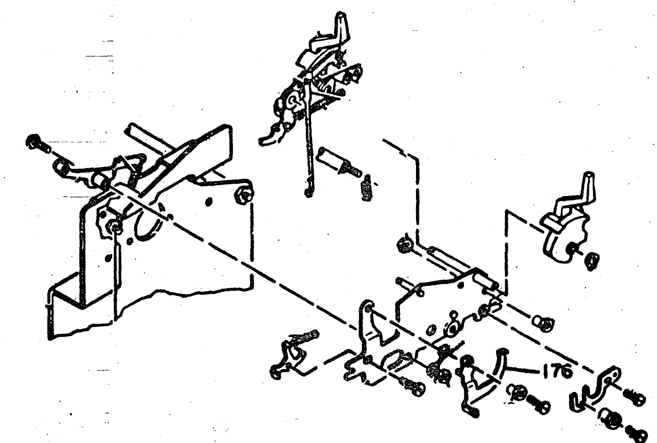
A-FRAME REMOVAL and REPLACEMENT (FROM MAIN CARRIAGE FRAME)

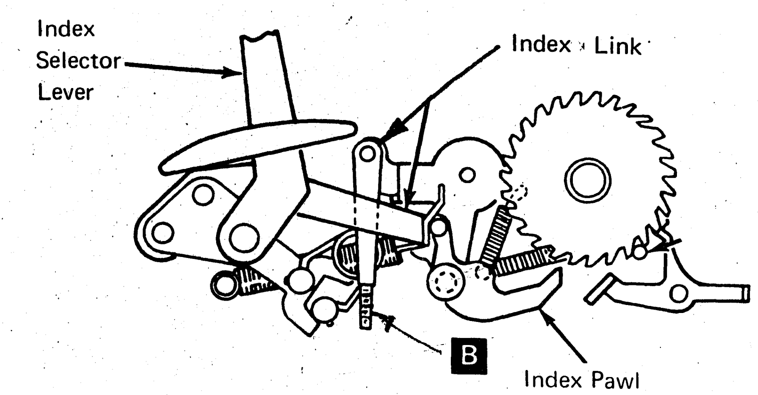
NOTE: This is a procedure to remove the carriage A-frame from the main frame. See 2.65A for complete removal of carriage assembly with the A-frame.

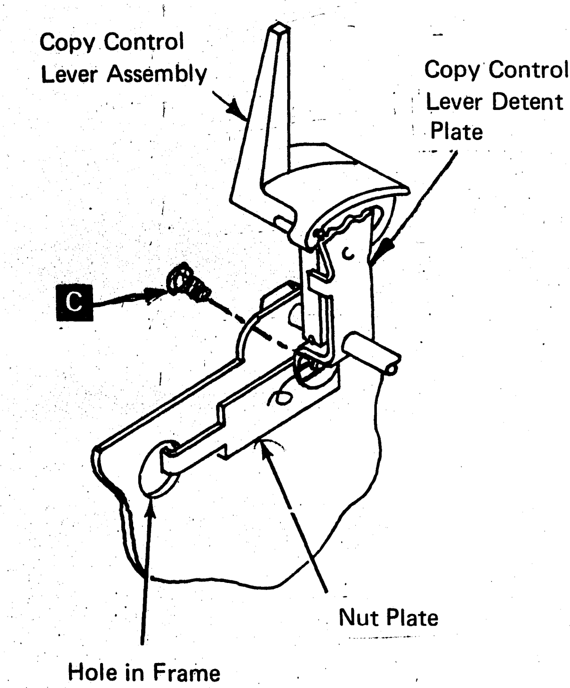
Removal

1. Remove the main covers, platen, paper deflector, forms guide, and internal covers on the right and left end.
2. As an optional step to provide optimum accessibility, the edge connectors may be unplugged and the printed circuit board and cards removed as an assembly (2 screws).
3. Disconnect the two heavy springs that holds the A-frame assembly to the carriage support frame.
4. Remove the detent arm pivot screw **A** (first remove the nut).
5. Mark or count the number of threads showing below the clevis on the index link (for reinstallation) **B** and remove the index link by spreading the link point at the top.
6. Loosen the copy control lever detent plate clamping screw **C**. The slotted end of the detent plate can now be rotated from between the side frame and the nut plate.
7. Mark the eccentric positions of the vertical adjustment arms (for reinstallation). Being careful not to lose the bushings and eccentric bushings, remove the two screws **D** and the vertical positioning arms on each side of the carriage.
8. Remove the A-frame by tilting it upward and out of the printer.







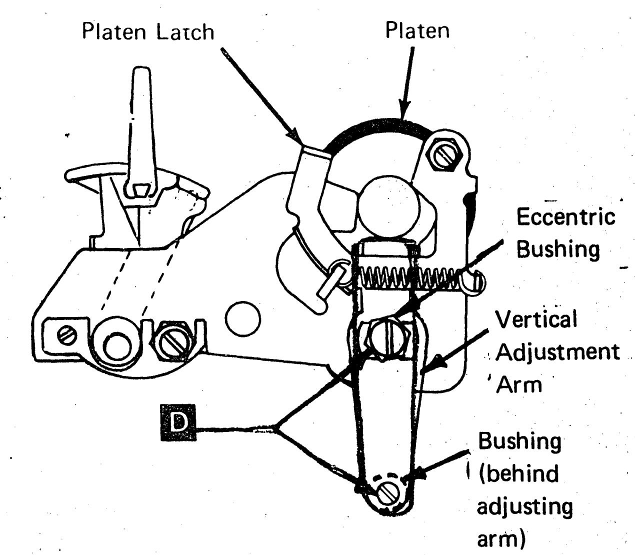


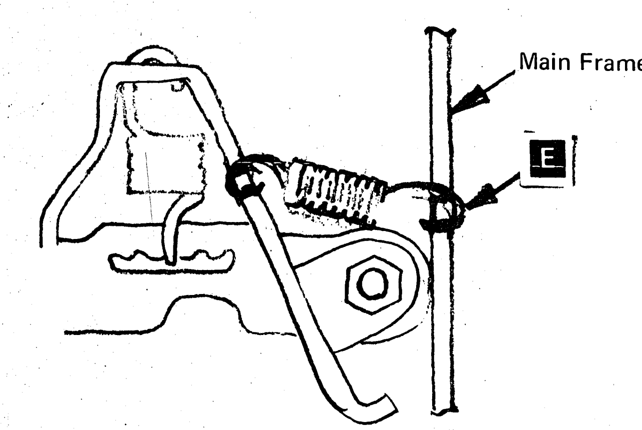
Replacement

1. Install the A-frame assembly onto the carriage support assembly. Guide the index link on the right side and the copy control lever detent on the left side into position. (See illustrations associated with removal, steps 5 and 6).
2. Install the vertical positioning arms, bushings, and eccentrics. Locate the eccentrics to their original position (as marked when they were removed) and tighten the screws.
3. Position the copy control lever detent plate fully in its slot and tighten the screw. See illustration with step 6 of removal.
4. Install the detent lever pivot screw and nut. See illustration with step 4 of removal.
5. If the index link turned after removing it, return it to its original position and connect.
6. Connect the two heavy springs on each end of the A-frame **E** to the main frame.
7. If removed, install the printed circuit board assembly and the edge connectors.
8. After installation is complete, the following adjustments must be checked. Adjust when necessary.

   Index Pawl and Selector Adjustment
   Platen Overthrow-Stop Adjustment
   Platen Adjustment, Vertical
   Paper Release Arm Adjustment (New Style A-Frame)
   Feed Roll Tension Spring Adjustment (New Style A-Frame)
   Front Feed Roll Adjustment (New Style A-Frame)
   Print Head to Platen Clearance and Ribbon Guide Assembly Adjustment

9. Install the paper deflector, platen, and internal covers. When installing the forms guide. See Forms Guide Assembly Removal and Replacement. (Two-types of forms guides are used and one requires an adjustment.)
10. Replace the top cover.





END-OF-FORMS SWITCH ADJUSTMENT (MODEL 1)

Objective:

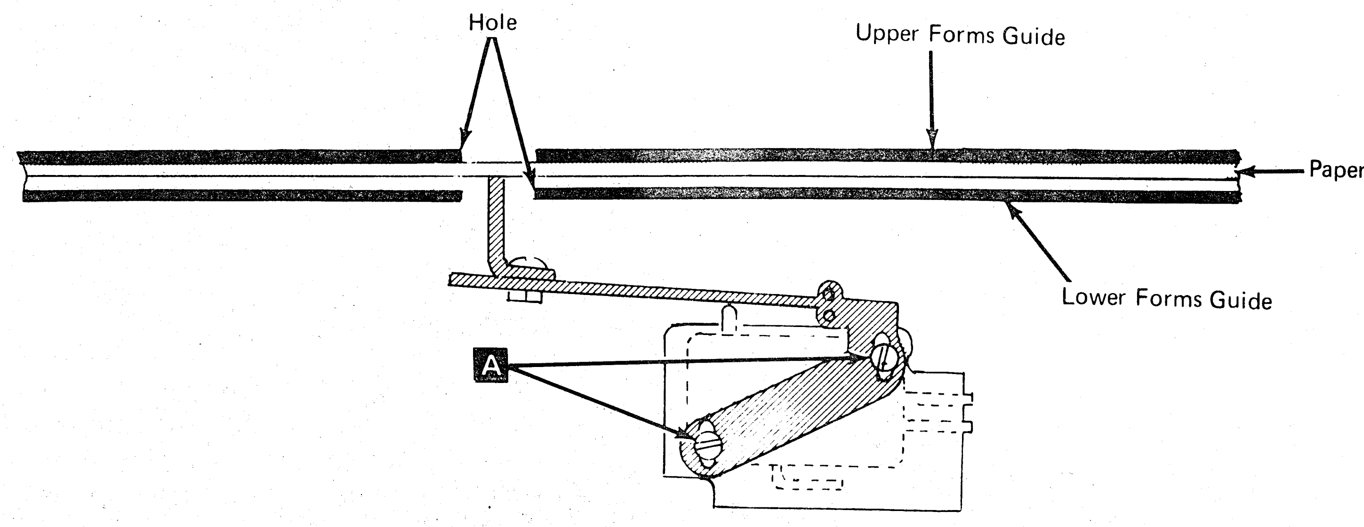
To have the end-of-forms switch close with one thickness of paper in the forms guide.

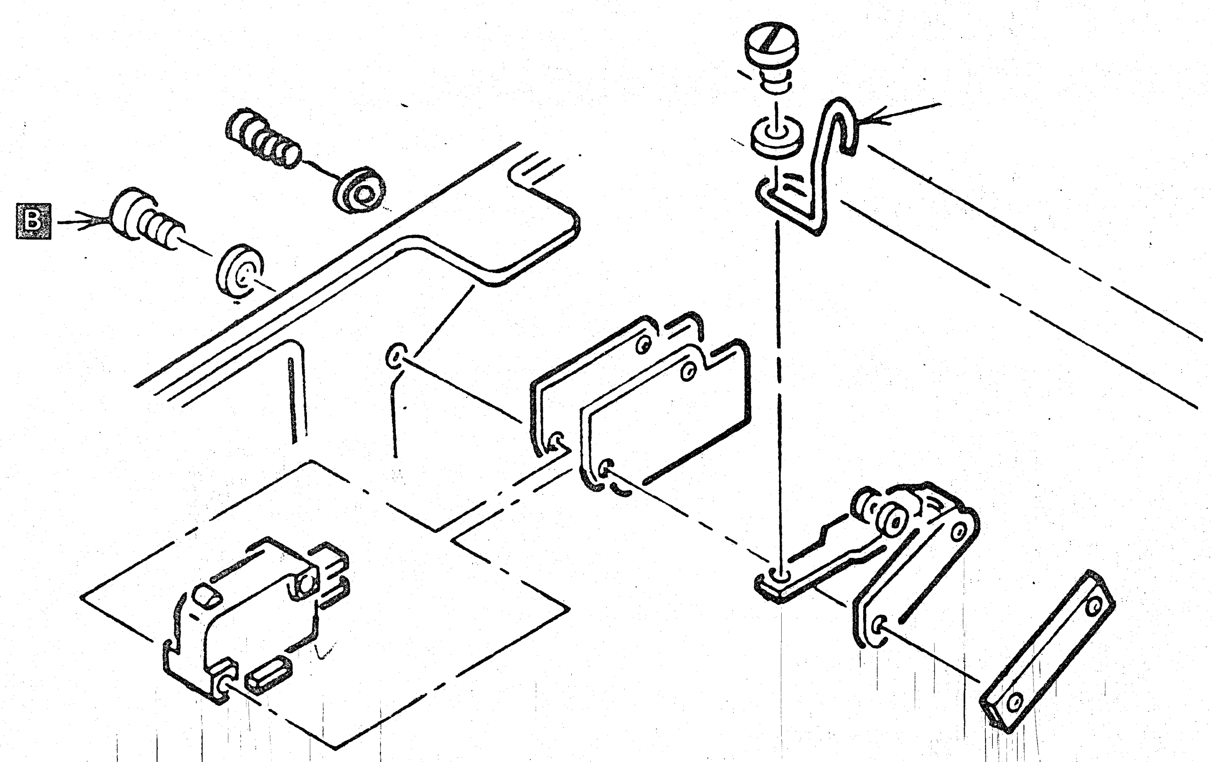
Adjustment

1. Insert a paper into forms guide.
2. Loosen two mounting screws **A** and position the switch until the switch closes*. Tighten the screws. With the paper in the forms guide, check for continuity between the normally open and the operating point.

   Note: Adjust the switch to close, but not bottom on the switch casing.

* Accessibility to the switch mounting screws **B** with the new style (A-frame) carriage is from the rear of the printer. Remove the four edge connectors (EC 1, 2, 3, and 4) and remove the printed circuit board which is mounted by a screw on each end.





DANGER

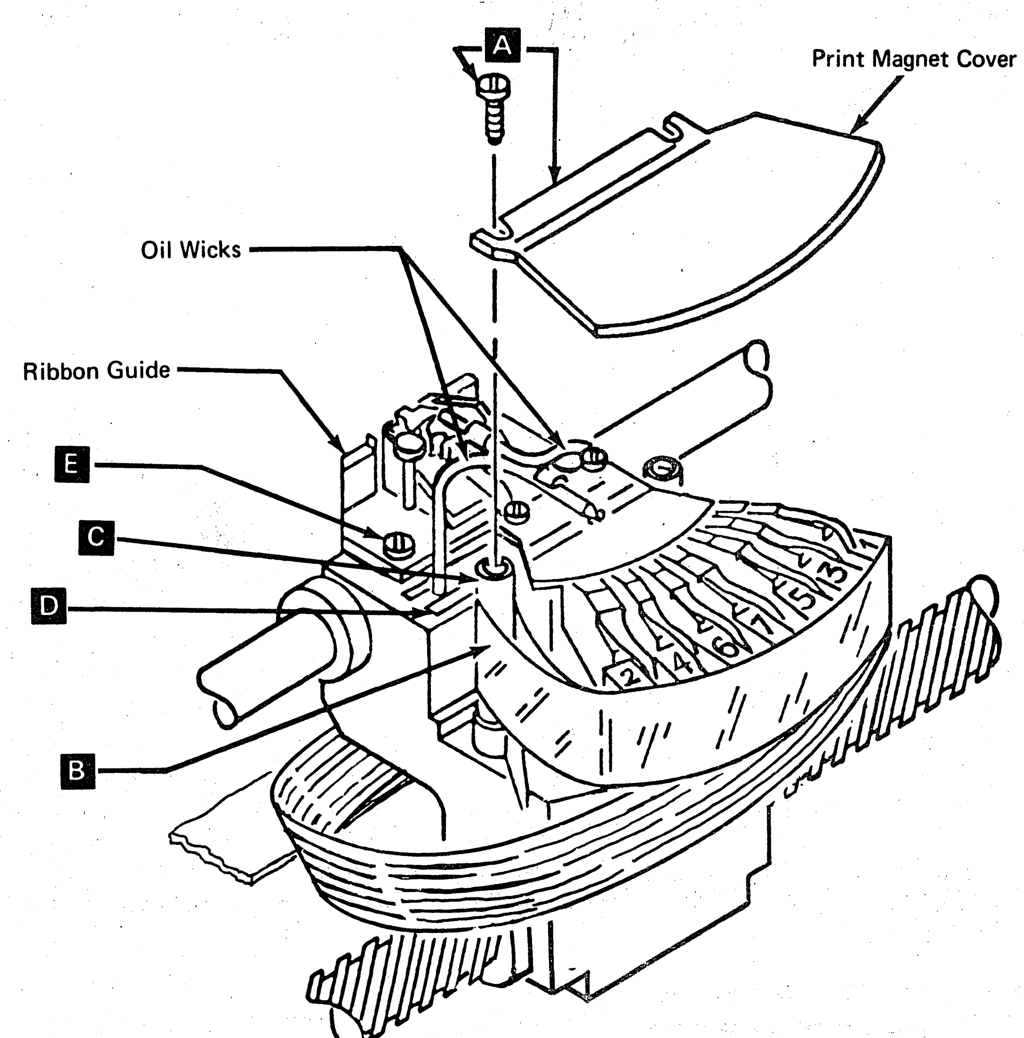
After prolonged use, the print magnets may become extremely hot. Be sure that the print head has cooled before attempting to remove it.

Removal

1. Shut off the electrical power from the machine.
2. Remove the ribbon.
3. Remove the lead screw cover by loosening two screws.
4. Loosen two screws and remove the magnet cover A
5. Remove the cable guard B by sliding it up off the magnets and print-head mounting studs C .
6. Carefully remove all leads from the print magnets by sliding off the connectors.
7. Remove the two mounting studs C and washers, and carefully lift the print head and oil-felt cover D off the print carrier. When putting down the print head, be careful not to damage the oil wicks.

Replacement

1. Install the oil wicks into the clamps and, using the wire cleaning and straightening tool (part 2526999), tuck one wick alongside the print wires and the other wick into the core oiler plate hole.
2. Install the wick retainer on the end of the print wire guide.
3. Hold the print head in position over the print carrier while placing the oil-felt cover D in the oil well and tucking the two oil wicks down into the slots at each end of the felt oiling pad. Use a slender tool such as a small allen wrench to tuck in the wicks.
4. Fasten the print head down loosely on the carrier with the two washers and mounting studs C . Do not tighten the studs as print-head-to-platen clearance must be adjusted.
5. Loosen the ribbon guide clamping screws E so that the guide may be moved toward the operator to permit adjusting the print-head-to-platen clearance without interference.
6. Install the print magnet cable leads, making sure that the black leads go on the left magnet terminals. Tuck the leads in between the magnets, bending the connectors slightly, if necessary.
7. Slide the cable guard B (plastic loop) down over the print magnets and the print head mounting studs, as shown.
8. With the forms thickness knob set to 3 (Model 2), and the copy control lever forward (closest to platen) on Model 1, adjust the print-head-to-platen clearance for .030 in. (0,76mm) at the right side as described in Platen Adjustment, Horizontal (Pin Feed) and VFC.
9. Install the print magnet cover A and tighten the two screws.
10. Set the ribbon guide to platen clearance as described under Print Head to Platen Clearance and Ribbon-Guide Assembly Adjustment, and tighten the ribbon guide screws E .
11. Reinstall the ribbon, making sure that it goes underneath the hook on the right side of the guide.



PRINT MAGNET REMOVAL and REPLACEMENT (Style B, Plastic Base)

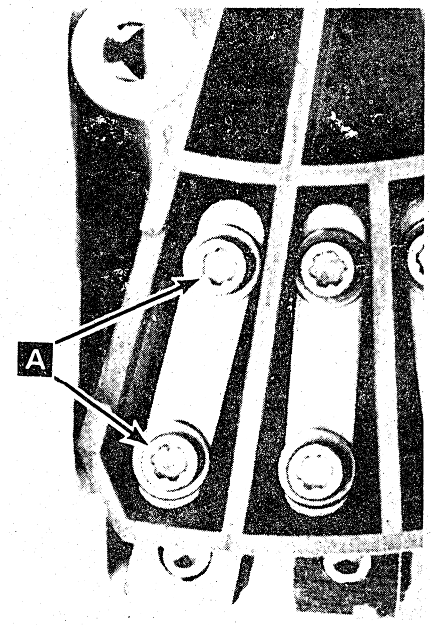
DANGER

After prolonged use, the print magnets may become extremely hot. Be sure the print head has cooled before attempting to remove it.

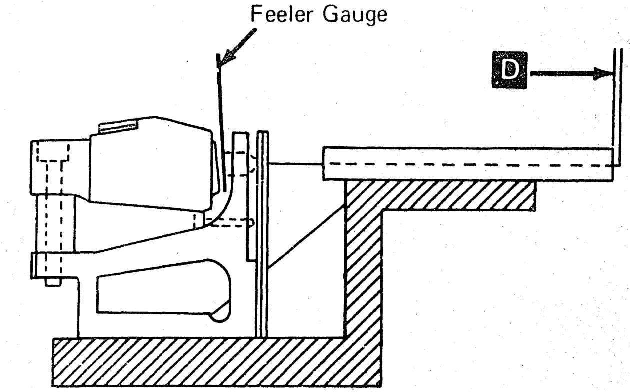
Removal

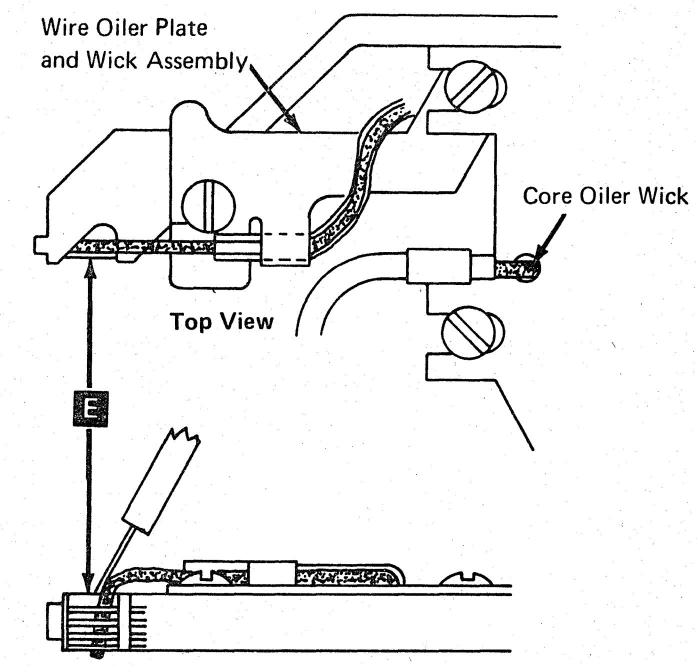
1. Remove the system power. Remove the print head (2.23).
2. Each magnet assembly is mounted with two screws **A** accessible from the bottom of the print head. Remove the screws and slide the magnet assembly out of the print head.

   NOTE: Magnets 1 and 2 (outboard magnets) must not be interchanged with other magnets. Their part numbers, color, and magnetic characteristics are different.



Print Head, Bottom View



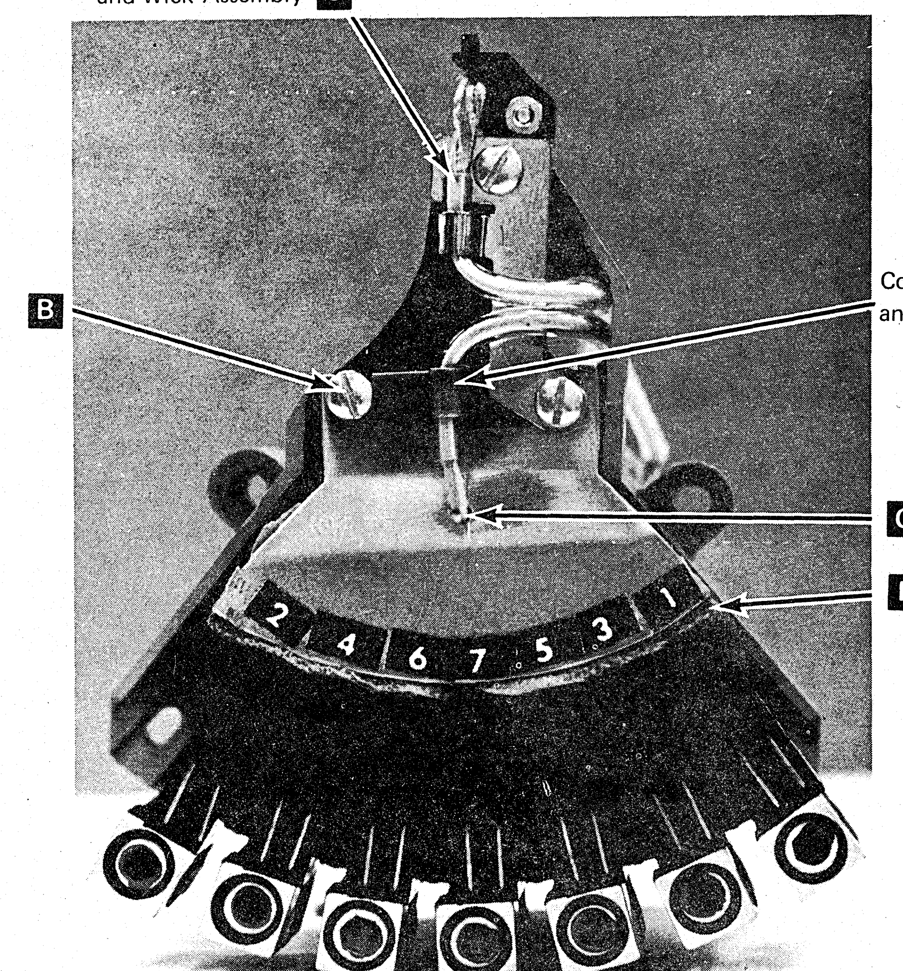


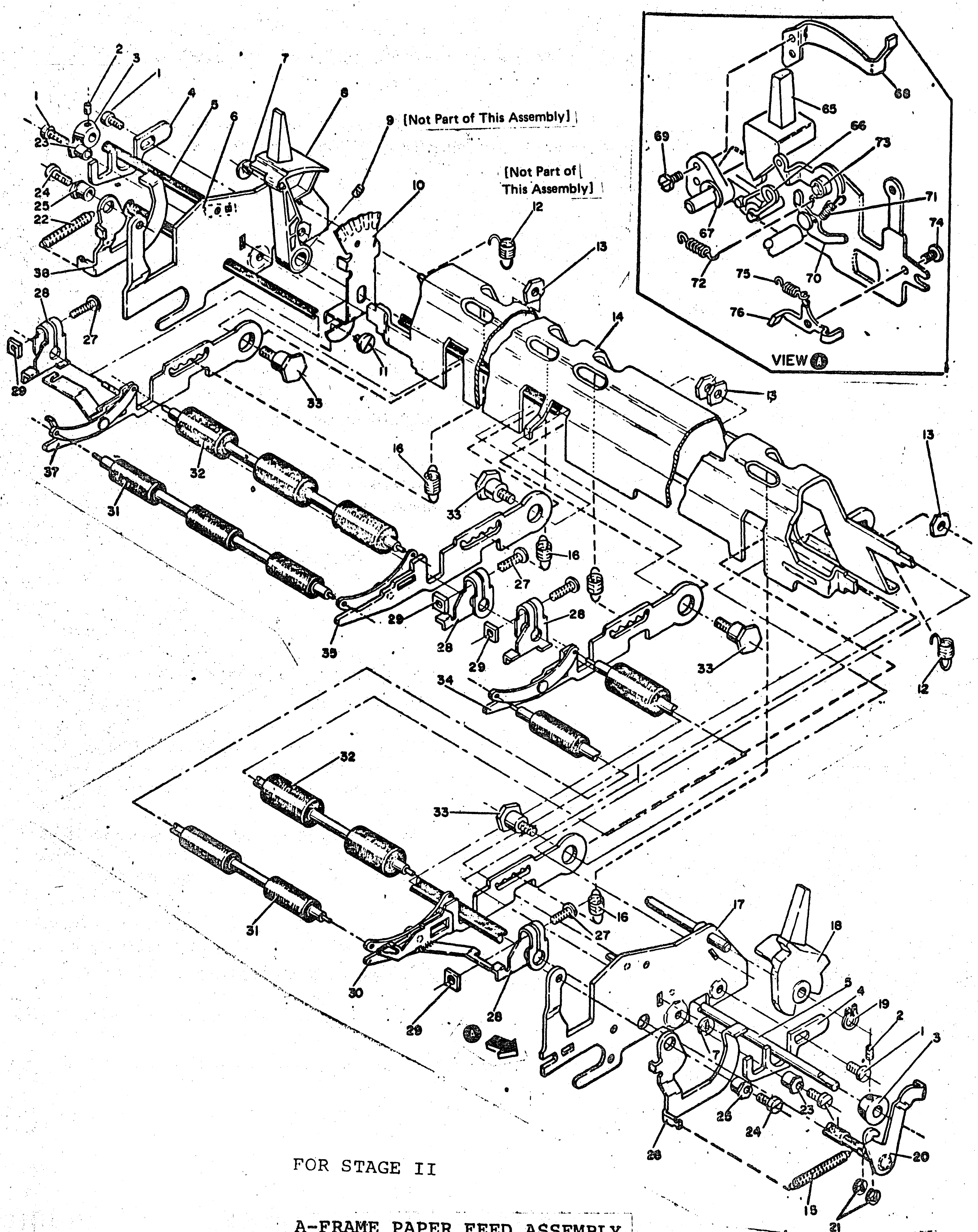
Replacement

1. Loosen two screws **B** and remove the core oiler plate and wick and tube assembly.
2. Lift the wick **C** out of the wire guide and slide the wick tube back until the wires in the wire guide are exposed.

IMPORTANT: When placing the new magnet assembly on the print head, hold the assembly firmly to prevent adjacent magnets from attracting and damaging the new assembly.

3. While holding the magnet assembly firmly, carefully place the print wire in the wire guide and slide the assembly forward using the wire straightening and cleaning tool (part 2526999) to guide the print wire across the hole in the wire guide. When the print wire is approximately flush with the tip of the wire guide, tighten the mounting screws slightly.
4. See the installation instructions packaged with each unit for individual magnet adjustment and perform the adjustment.
5. Position the assembly so that when the armature is sealed against the core the end of the print wire is flush with or recessed up to .003 in. (0,08 mm) into the wire guide tip. This is accomplished by placing a .003 in. (0,08 mm) feeler gauge between the armature and core and positioning the assembly until the print wire protrudes slightly out of the wire guide tip **D** . You can check this by sliding a flat object such as a scale or thumbnail across the tip.
6. Remove the feeler gauge and be sure the print wire recesses until it can no longer be felt at the wire guide tip. Tighten the mounting screws.
7. Slide the wick tube back and, using the wire cleaning and straightening tool (part 2526999), carefully insert the wick down alongside the print wires **E** so that the wick extends below the bottom of the wire guide.
8. Install the core oiler plate. Make sure that the back of the oiler pad rests on top of the magnet cores **F** and the core oiler wick is fully inserted between the plate and the oiler pad **G** .
9. Replace the print head, Run a sample line of printing and observe the replaced wire position. Adjust the magnet assembly to the rear as needed for uniform print density.

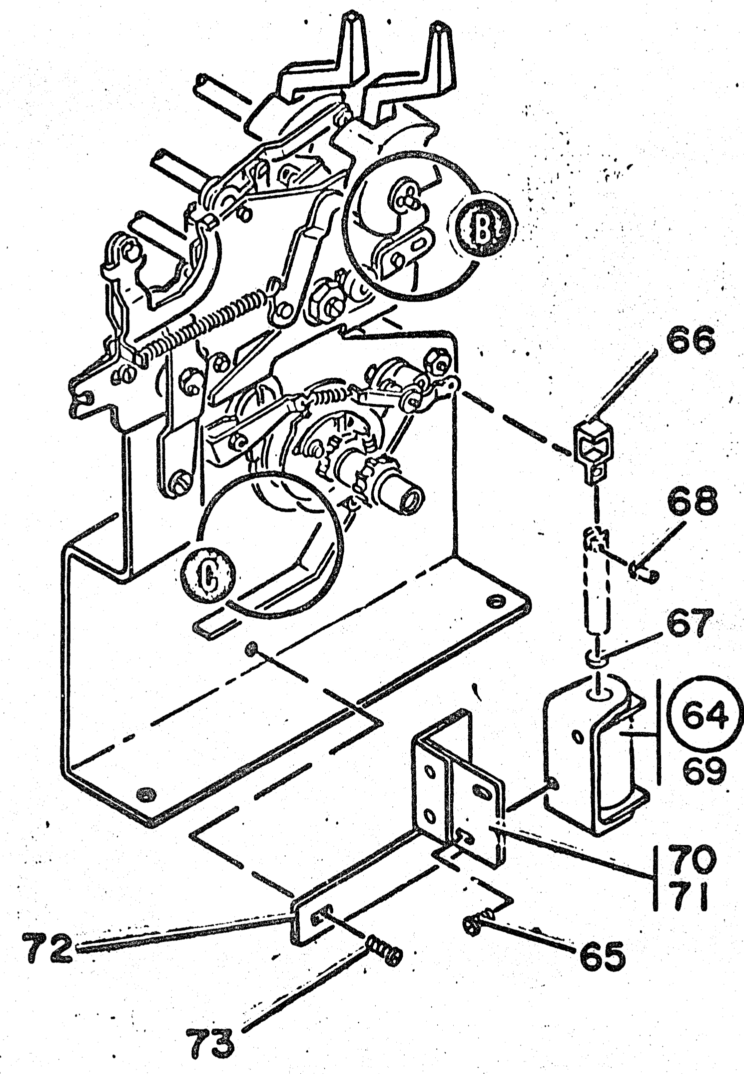




FOR STAGE II

A-FRAME PAPER FEED ASSEMBLY

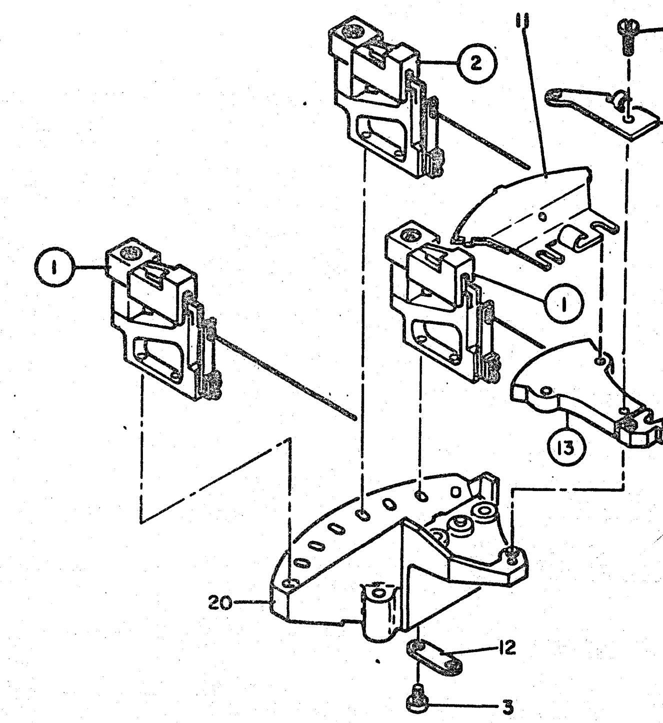
LIST AND INDEX NUMBER	PART NUMBER	1 2 3 4	DESCRIPTION
1 -	1205317		A-FRAME PAPER FEED ASM
- 1	1175237		. SCREW,FRONT
- 1	1115736		. SCREW,REAR
- 2	1117176		. SCREW
- 3	1175236		. ECCENTRIC
- 4	1124369		. PLATE
- 5	1128136		. SHAFT
- 6	1147599		. PLATE,LEFT
- 7	1147588		. RETAINER
- 8	1452491		. LEVER
- 9	257959		. SCREW
- 10	1124383		. DETENT PLATE
- 11	1117759		. SCREW
- 12	1147594		. SPRING
- 13	257187		. NUT
- 14	1147559		. FRAME
- 15	1138996		. SPRING,LATCH RIGHT
- 16	1147597		. SPRING
- 17	1205311		. PLATE
- 18	1205315		. LEVER
- 19	1115633		. RETAINER
- 20	1164499		. SHAFT
- 21	1103695		. CLIP
- 22	1134837		. SPRING,LATCH LEFT
- 23	1124370		. ECCENTRIC
- 24	38348		. SCREW
- 25	1124803		. ECCENTRIC
- 26	1205314		. LATCH,RIGHT
- 27	1128280		. SCREW
- 28	1147591		. LEVER,RIGHT
- 28	1147592		. LEVER,LEFT
- 29	1134829		. NUT
- 30	1147570		. BRACKET ASM
- 31	1147580		. FEEDROLL,FRONT
- 32	1128138		. FEEDROLL,REAR
- 33	1147586		. STUD
- 34	1147571		. BRACKET ASM
- 35	1147572		. BRACKET ASM
- 36	1147589		. BRACKET,LEFT
- 37	1147573		. BRACKET ASM
- 38	1204263		. LATCH,LEFT
- 65	1204283		. LEVER ASM,INDEX SELN
- 66	1124396		. SPRING,INDEX SELN LEVER
- 67	1115633		. RING,INDEX LVR
- 68	1128076		. LEVER LINE SP CAM
- 69	1141776		. SCREW,CAM LEVER
- 70	1128018		. CARRIER ASM,INDEX PAWL
- 71	1133668		. SPRING,INDEX PAWL
- 72	1133667		. SPRING,INDEX PAWL CARR
- 73	264641		. RETAINER,INDEX PAWL
- 74	63324		. SCREW,MACH BD HD- 6-40 X 0.188 LG
- 75	1107795		. SPRING,INDEX PAWL
- 76	1147605		. STOP,PLATEN

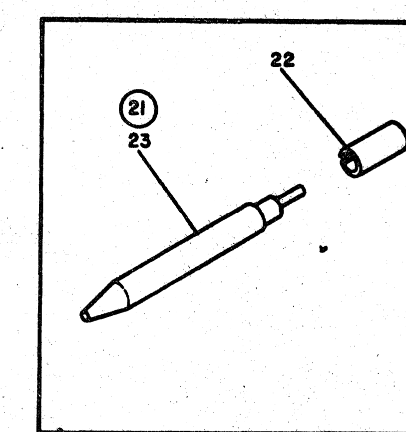


FOR STAGE I

Carriage Solenoid

INDEX No.	PART NUMBER	DESCRIPTION	
- 64	2642599	. SOLENOID ASSEMBLY	
- 65	438548	. SCREW,MACH BD HD- 4-40 X 0.188 LG	ATT PT
- 66	2495642	. . PULLER	
- 67	2495658	. . SPACER	
- 68	264998	. . ROLL PIN- 0.250 LG	ATT PT
- 69	2495641	. . SOLENOID	
- 70	2629850	. BRACKET	
- 71	438548	. SCREW,MACH BD HD- 4-40 X 0.188 LG	ATT PT
- 72	2629863	. BRACKET	
- 73	10170	. SCREW,MACH BD HD- 6-32 X 0.250 LG	ATT PT





FOR STAGE I

FIGURE 12. PRINT HEAD ASSEMBLY. SEE LIST 12.

LIST AND INDEX NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4	UNITS PER ASM.	USABLE ON CODE
		PRINT HEAD ASSEMBLY		
12 -	2495630	PRINT HEAD ASSEMBLY,7 POSITION	REF	
		FOR NEXT HIGHER ASM,SEE FIGURE 4-58 AND FOR ILLUSTRATION,SEE FIGURE 12		
- 1	2495578	. MAGNET AND HAMMER ASM,OUTER POSITIONS	2	
- 2	2495586	. MAGNET AND HAMMER ASM,INNER POSITIONS	5	
- 3	2161452	. SCREW,CAP SOC HD- 4-40 X 0.312 LG ATT PT	14	
- 11	2642587	. PLATE ASM,CORE OILER	1	
- 12	2495579	. SPACER	7	
- 13	2495588 NP	. WIRE GUIDE ASM	1	
- 14	438550	. SCREW,MACH BD HD- 4-40 X 0.500 LG ATT PT	3	
- 19	2495506	. BRACKET	1	
- 20	2495587	. SUPPORT	1	
		FOLLOWING PARTS NOT PART OF ABOVE ASM		
- 1	2617969	TOOL ASM	1	
- 22	2617968	. CAP	1	
- 23	2617959	. TOOL	1	

[redacted]

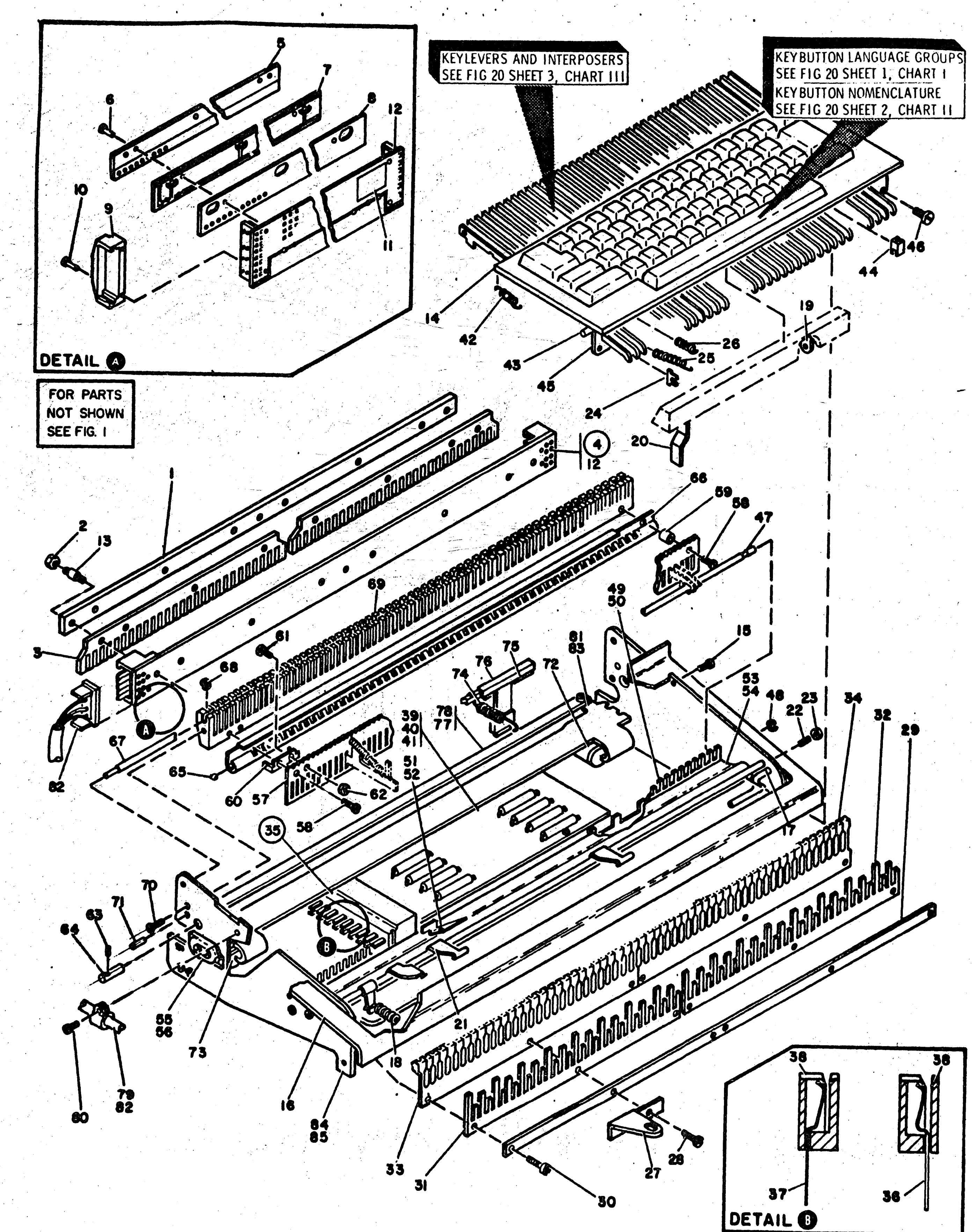


FIGURE 20A. KEYBOARD **ASSEMBLY-** STAGE I SEE LIST 20A

LIST AND INDEX NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4	UNITS PER ASM.	USABLE ON CODE
		KEYBOARD ASSEMBLY (LATE MODEL) 3215		
20A-	5993014	KEYBOARD ASSEMBLY-UNITED STATES	REF	
-	5993015	KEYBOARD ASSEMBLY-UNITED KINGDOM	REF	
-	5993016	KEYBOARD ASSEMBLY-AUSTRIA/GERMANY	REF	
-	5993017	KEYBOARD ASSEMBLY-BELGIUM/FRANCE	REF	
-	5993018	KEYBOARD ASSEMBLY-DENMARK	REF	
-	5993019	KEYBOARD ASSEMBLY-NORWAY	REF	
-	5993020	KEYBOARD ASSEMBLY-SPAIN	REF	
-	5993021	KEYBOARD ASSEMBLY-FINLAND/SWEDEN	REF	
-	5993022	KEYBOARD ASSEMBLY-PORTUGAL	REF	
-	5993023	KEYBOARD ASSEMBLY-ITALY FOR EARLY MODEL KEYBOARD ASM SEE FIG 20	REF	
		FOR LATE MODEL KEYBOARD ASM SEE FIG 20A FOR KEYBUTTON PART NUMBERS,SEE CHART I		
		FOR KEYBUTTON NOMENCLATURE SEE CHART II FOR INTERPOSER,KEYLEVER AND SPRING PART NUMBERS,SEE CHART III		
- 1	5996920	. BAR,CLAMP	1	
- 2	37913	. NUT,JAM HEX- 4-40 X 0.250 FL W ATT PT	6	
- 3	5996917	. LATCH,BOARD SWITCH	2	
- 4	5180564	. SWITCH ASM,BOARD- USA/UK/ITALY	1	
- 4	5180565	. SWITCH ASM,BOARD-FRANCE/BELGUIM	1	
- 4	5180566	. SWITCH ASM,BOARD-AUSTRIA/GERMANY	1	
- 4	5180567	. SWITCH ASM,BOARD-SPAIN	1	
- 4	5180568	. SWITCH ASM,BOARD-DENMARK	1	
- 4	5180569	. SWITCH ASM,BOARD-FINLAND/SWEDEN	1	
- 4	5180586	. SWITCH ASM,BOARD-NORWAY	1	
- 4	5180587	. SWITCH ASM,BOARD-PORTUGAL/BRAZIL	1	
- 5	5996921	. . PLATE,DIAPHRAGM RETAINING	1	
- 6	79925	. . EYELET,RIVET ATT PT	3	
- 7	5180571	. . DIAPHRAGM-USA/UK/ITALY	1	
- 7	5180572	. . DIAPHRAGM-AUSTRIA/GERMANY	1	
- 7	5180573	. . DIAPHRAGM-FRANCE/BELGUIM	1	
- 7	5180574	. . DIAPHRAGM-NORWAY	1	
- 7	5180575	. . DIAPHRAGM-SPAIN	1	
- 7	5180576	. . DIAPHRAGM-FINLAND/SWEDEN	1	
- 7	5180577	. . DIAPHRAGM-PORTUGAL/BRAZIL	1	
- 7	5180578	. . DIAPHRAGM-DENMARK	1	
- 8	5996919	. . SEPARATOR,DIAPHRAGM	1	
- 9	5996924	. . HOUSING,CONNECTOR	1	
- 10	5151438	. . EYELET,RIVET ATT PT	2	
- 11	5173404	. . LABEL	1	
- 12	5180570	. . BOARD ASM,270K ENCODE	1	
- 13	5996961	. STUD	1	
- 14	5996925	. COVER,KEYLEVER	1	
- 15	55726	. SCREW,MACH BD HD- 6-32 X 0.188 LG	4	
- 16	5996923	. BRACKET	1	
- 17	5993994	. BAIL	1	
- 18	1090175	. SPRING,EXTENSION- 0.151 OD X 0.720 LG	1	
- 19	1134899	. INSERT,SPACE BAR	1	
- 20	5993096	. STEM,SPACEBAR	1	
- 21	5993993	. SHAFT ASSEMBLY	1	
- 22	1123987	. SCREW,MACH BD HD- 6-32 X 0.500 LG ATT PT	1	
- 23	38051	. NUT,PLAIN HEX- 6-32 X 0.250 FL W ATT PT	1	
- 24	1141269	. SLEEVE	2	
- 25	1090404	. SPRING,EXTENSION- 0.125 OD X 0.663 LG	1	
- 26	1072703	. SPRING,EXTENSION- 0.134 OD X 0.367 LG	1	
- 27	5993095	. GUIDE	1	
- 28	81693	. SCREW,MACH BD HD- 6-32 X 0.375 LG ATT PT	1	
- 29	5151990	. PLATE,KL SPRING CODE	1	
- 30	81693	. SCREW,MACH BD HD- 6-32 X 0.375 LG ATT PT	5	
- 31	5994835	. COMB	1	
- 32	1133683	. COMB,RETURN-RIGHT	1	
- 33	5994836	. SPRING	1	
- 34	1133654	. SPRING,KL RETURN-RIGHT	1	
- 35	216075	. CONTACT ASSEMBLY	1	
- 36	216087	. . SPRING,CONTACT	8	
- 37	216088	. . SPRING,CONTACT	8	
- 38	216073	. . RECEPTANCE,CARD SINGLE POS	1	
- 39	375410	. CARD ASSEMBLY	1	
- 40	438550	. SCREW,MACH BD HD- 4-40 X 0.500 LG ATT PT	2	
- 41	2109292	. SPACER ATT PT	2	
- 42	1164080	. SPRING	46	
- 43	1133633	. ROD,UPSTOP	1	
- 44	5994922	. LOCKOUT,KEYLEVER HOLD UP	2	

LIST AND INDEX NUMBER	PART NUMBER	DESCRIPTION 1 2 3 4	UNITS PER ASM.	USABLE ON CODE
20A- 45	8112176	. UPSTOP,KEYLEVER,	1	
- 46	38235	. SCREW,MACH BD HD- 6-32 X 0.312 LG ATT PT	4	
- 47	1123963	. ROD,INTERPOSER FULCRUM	1	
- 48	1092125	. CLIP ATT PT	2	
- 49	8112178	. COMB,INTERPOSER	1	
- 50	10170	. SCREW,MACH BD HD- 6-32 X 0.250 LG ATT PT	4	
- 51	5151886	. BRACKET,SHIFT LOCK	1	
- 52	338238	. SCREW,MACH BD HD- 4-40 X 0.3125 LG ATT PT	2	
- 53	5151989	. SUPPORT,GUIDE COMB	1	
- 54	34512	. SCREW,MACH BD HD- 8-32 X 0.375 LG ATT PT	4	
- 55	5993941	. STOP	2	
- 56	10170	. SCREW,MACH BD HD- 6-32 X 0.250 LG ATT PT	4	
- 57	8112177	. PLATE	1	
- 58	438551	. SCREW,MACH BD HD- 4-40 X 0.625 LG ATT PT	5	
- 59	5996959	. SPACER,STUD ATT PT	1	
- 60	1148453	. SPACER	4	
- 61	438558	. SCREW,MACH BD HD- 4-40 X 0.500 LG ATT PT	4	
- 62	38214	. NUT,PLAIN HEX- 4-4- X 0.250 FL W ATT PT	4	
- 63	1175213	. SCREW,SET- 4-48 X 0.250 LG	2	
- 64	104699	. PIN,STRAIGHT DOWEL 0.1878 OD X 0.500 LG	2	
- 65	1124682	. BALL,COMPENSATOR	56	
- 66	5181007	. COMPENSATOR,KEYBOARD	1	
- 67	1132166	. ROD,FULCRUM	1	
- 68	264641	. RING,RETAINING EXT 0.114 ID X 0.025 THK ATT PT	1	
- 69	5996915	. FULCRUM,KEYLEVER	1	
- 70	34512	. SCREW,MACH BD HD 8-32 X 0.375 LG ATT PT	2	
- 71	343571	. PIN,ROLL- 0.101 O D X 0.438 LG	2	
- 72	5181029	. COIL ASSEMBLY- RH	1	
- 73	5181030	. COIL ASSEMBLY- LH	1	
- 74	58852	. SPRING,EXTENSION- 0.165 OD X 0.915 LG	2	
- 75	5152203	. FOAM	AR	
- 76	5151558	. BAIL ASM,COMPENSATOR	1	
- 77	5172367	. RETAINER,ARMATURE	1	
- 78	55726	. SCREW,MACH BD HD- 6-32 X 0.188 LG ATT PT	2	
- 79	356742	. CLAMP,LOOP 0.250 ID 0.177 DIA MTG HOLE	1	
- 80	58207	. SCREW,MACH BD HD- 6-32 X 0.250 LG ATT PT	1	
- 81	1159913	. CLAMP,STRAP CAM STAY	2	
- 82	5994844	. CABLE ASSEMBLY	1	
		FOR COMPONENT PARTS SEE FIGURE 21		
- 83	5993927	. YOKE- SHORT	1	
- 84	58207	. SCREW,MACH BD HD- 6-32 X 0.250 LG ATT PT	4	
- 85	5996918	. PLATE,SIDE	2	

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