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NOTE. ALL ITEMS FOLLOWING THE LAST ROW OF ASTERISKS ARE TO BE SHIPPED.

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System/36

IBM System/36
72MD Diskette Magazine Drive and Adapter
Maintenance Information Manual

Preface

This manual contains the maintenance information necessary to service the System/36 72MD diskette magazine drive and adapter. This manual includes maintenance procedures, FRU descriptions, interface descriptions, and sequence of events sections to aid in diagnosing machine failures not found by the MAPs.

This manual uses a specific range of words so that the text can be understood by customer engineers in countries where English is not the normal language.

It is assumed that the customer engineer (CE) or customer service representative (CSR) using this manual has been trained on System/36 as described in the System/36-5360 *New Product Planning Technical Service Letter*.

About This Manual

The service procedures in this manual are numbered.

- The MAPs can send you to a specific procedure in this manual.
- Other System/36 MIMs can send you to a specific procedure in this manual.
- Steps in a procedure in this manual can send you to another procedure in this manual or in other System/36 MIMs.
- The index can send you to procedures where key words can be found.

Related Publications

System/36 Hardware Publications

- *General Maintenance Information Manual, SY31-8999*
- *Processing Unit and Channel Maintenance Information Manual, SY31-9000*
- *Data Storage Attachment Maintenance Information Manual, SY31-9001*

Second Edition (April 1984)

This major revision makes obsolete SY31-9006-0. Changes or additions were made to reflect technical changes in the product.

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IBM has prepared this maintenance manual for the use of IBM customer engineers/customer service representatives in the installation, maintenance, or repair of the specific machines indicated. IBM makes no representations that it is suitable for any other purpose.

Information contained in this manual is subject to change from time to time. Any such change will be reported in subsequent revisions or Technical Newsletters.

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Safety

Danger and Caution Notices

In the System/36 maintenance manuals, the word *DANGER* informs you of conditions that could cause personal injury or death. (The word *HAZARDOUS* or *WARNING* may appear on labels on machines and field-supply items.) The word *CAUTION* informs you of an action that could cause damage to a program, to a device or system, or to data.

Danger Notices

Danger notices appear in the following procedures:

- 93-306 Cover Interlock Switch Service Check and Adjustment
- 93-307 72MD Removal and Replacement
- 93-327 Carriage Bed Assembly Orient Adjustment
- 93-370 Drive Control Card Output to Carriage Bed Stepper Motor Service Check
- 93-371 Drive Control Card Output to Picker/Cam Stepper Motor Service Check
- 93-380 Driver Board Output to Picker/Cam Stepper Motor Service Check
- 93-381 Driver Board Output to Carriage Bed Stepper Motor Service Check
- 93-391 Head/Carriage Service Check
- 93-393 Head/Carriage Adjustment
- 93-395 Head/Carriage Replacement
- 93-397 Head/Carriage Stepper Motor Replacement
- 93-399 Pulley and Clamp Replacement
- 93-414 Index Sense PTX Amplifier Service Check

Caution Notices

Caution notices appear in the following procedures:

- 93-307 72MD Removal and Replacement
- 93-342 Picker/Cam Casting Assembly Removal and Replacement
- 93-370 Drive Control Card Output to Carriage Bed Stepper Motor Service Check
- 93-371 Drive Control Card Output to Picker/Cam Stepper Motor Service Check
- 93-380 Driver Board Output to Picker/Cam Stepper Motor Service Check
- 93-381 Driver Board Output to Carriage Bed Stepper Motor Service Check
- 93-392 Head/Carriage Cleaning Procedure
- 93-395 Head/Carriage Replacement
- 93-396 Head/Carriage Stepper Motor Removal
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- 93-398 Pulley and Clamp Removal
- 93-399 Pulley and Clamp Replacement
- 93-401 Drive Band Adjustment
- 93-402 Drive Band Removal
- 93-403 Drive Band Replacement
- 93-414 Index Sense PTX Amplifier Service Check
- 93-416 Index Sense PTX Assembly Replacement

Rules for Safety

If you know the safety rules for working with electrical and mechanical equipment and you observe the rules, you can work safely with IBM equipment.

Do not fear electricity, but respect it.

While you are maintaining IBM equipment, observe every safety precaution possible and the following safety rules.

Work Environment

- Do not work alone in hazardous conditions or near equipment that has dangerous voltage. Always inform your manager if the conditions or voltages are a possible problem.
- Always look for possible hazards in your work environment. Examples of hazards are: moist floors, nongrounded extension cables, power surges, and missing grounds.
- Do not perform any action that makes the product unsafe or that causes hazards for customer personnel.
- Before you start the equipment, ensure that other CEs, and customer personnel, are not in a hazardous position.
- Do not wear loose clothing that can be trapped in the moving parts of a machine. Ensure that the sleeves of your clothing are fastened or are rolled above the elbow.
- Insert your necktie into your clothing or fasten it with a clip (preferably nonconductive) at approximately 8 centimeters (3 inches) from its end.
- Lift the equipment or parts by standing or pushing up with your stronger leg muscles; this action removes the strain from the muscles in your back. Do not lift any equipment or parts that are too heavy for you.
- Put removed machine covers in a safe place while you are servicing the machine. Reinstall the covers before returning the machine to the customer.

- Always keep your CE tool kit away from walk areas so that other persons cannot trip over it. For example, keep the kit under a desk or table.
- Observe good housekeeping practices in the area of the machines while you are performing maintenance and after completing it.
- After maintenance, reinstall all safety devices, such as guards, shields, labels, and grounding devices. Exchange safety devices that are worn or defective. Remember, the safety devices protect you from a hazard. You destroy their purpose if you do not reinstall them when you have completed the service call.

Electrical Safety

- If possible, always disconnect the power-supply cables before you work on a machine. When you switch off power at the wall box, lock the switch in the off position or attach a DO NOT OPERATE tag (Z229-0237) to the switch.

Note: A non-IBM attachment to an IBM machine may be powered from another source and may be controlled by a different switch or circuit breaker.
- Switch off all power before:
 - Removing or assembling the main units of the equipment
 - Working near power supplies
 - Inspecting power supplies
 - Installing changes in machine circuits
- If you really need to work on equipment that has exposed live electrical circuits, observe the following precautions:
 - Ensure that another person who understands the power off controls, is near you. Another person must be there to switch off the power, if necessary.
 - Do not wear jewelry, chains, metal-frame eyeglasses, or other personal metal objects. Remember, if the metal touches the machine, the flow of current increases because the metal is a conductor.

- Use only insulated probe tips or extenders. Remember, worn or cracked insulation is unsafe.
- Use only one hand while you are working on live equipment. Keep the other hand in your pocket or behind your back. Remember, there must be a complete circuit for an electrical shock to occur. This precaution prevents your body from completing the circuit.
- When you use a tester, set its controls correctly and use insulated probes that have the correct electrical specification.
- Do not touch objects that are grounded, such as metal floor strips, machine frames, or other conductors. Use suitable rubber mats obtained locally, if necessary.

- When you are working with machines having voltages more than 30 Vac or 42 Vdc, observe the special safety instructions given in customer engineering memorandums (CEMs).

- Never assume that power has been removed from a circuit. First, ensure that power has been removed.

- Do not touch live circuits with the surface of a plastic dental mirror. Remember, the surface of the dental mirror is conductive and can cause damage or personal injury.

- If an electrical accident occurs:
 - Use caution. Do not be a victim yourself.
 - Switch off the power.
 - Instruct another person to get medical aid.
 - If the victim is not breathing, perform mouth-to-mouth rescue breathing. See *Electrical Accidents—First Aid*.

Mechanical Safety

Do not touch moving mechanical parts when you are lubricating a part, checking for play, or doing other similar work.

Safety Glasses

Wear safety glasses when:

- Using a hammer to drive pins or other similar parts
- Using a power drill
- Using a spring hook to attach or remove a spring
- Soldering parts
- Cutting wire or removing steel bands
- Using solvents, chemicals, or cleaners to clean parts
- Working in any other conditions that could injure your eyes

Tools, Testers, and Field-Use Materials

- Do not use tools or testers that have not been approved by IBM. Ensure that electrical hand tools, such as Wire-Wrap¹ tools and power drills, are inspected regularly.
- Exchange worn or broken tools or testers.
- Do not use solvents, cleaners, or lubricants that have not been approved by IBM.

¹Trademark of the Gardner-Denver Co.

Summary

Prevention is the main aid to electrical safety. Always think about electrical safety and use good practice; for example:

- Ensure that the customer's power receptacle matches the IBM equipment specifications.
- Inspect power cables and plugs; check for loose, damaged, or worn parts.
- Review the procedures in the maintenance documents before you remove a part that can hold an electrical charge from the machine. Carefully discharge the necessary parts exactly as instructed by the procedure.

Never assume that a machine or a circuit is safe. No machine is always completely safe. You may not know the exact condition of a machine because, for example:

- The power receptacles could be wrongly wired.
- Safety devices or features could be missing or defective.
- The maintenance or machine level change history could be wrong or not complete.
- The design could have a problem.
- The machine could have been damaged, caused when it was shipped.
- The machine could have an unsafe change or attachment.
- An engineering change or a sales change could be wrongly installed.
- The machine could be deteriorated because it is old, or because it operates in an extreme environment.
- A part could be defective, therefore causing a hazard.
- A part could be wrongly assembled.

These are some of the ways that the condition of the machine could affect safety. Before you start a service call or procedure, have good judgment and use caution.

Electrical Accidents—First Aid

When performing rescue procedures for an electrical accident, do as follows:

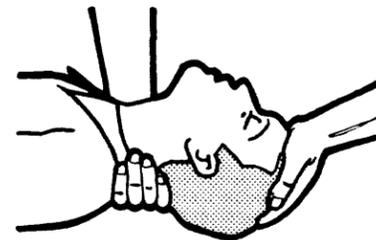
- **Use Caution:** If the victim is touching the electrical-current source, remove the power. To do this, you may need to operate the room emergency power-off switch or the disconnecting switch. If you cannot find the switch, use a dry wooden rod or other nonconductive object to pull or push the victim away so he or she is not touching the electrical-current source.
- **Work Quickly:** If the victim is unconscious, he or she may need mouth-to-mouth rescue breathing and possibly external cardiac compression if the heart is not beating.
- **Get Medical Aid:** Instruct another person to dial the rescue service (such as the ambulance or the hospital).

Determine if the victim needs mouth-to-mouth rescue breathing. If he or she does, perform the following steps:

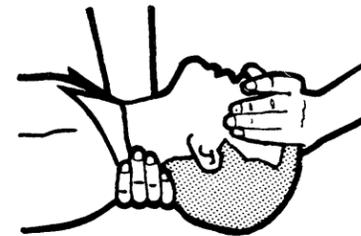
CAUTION

Use extreme care when you perform rescue breathing for a victim who may have breathed in toxic fumes. Do not breathe in air that the victim has breathed out.

1. Prepare for rescue breathing:
 - a. Ensure that the victim's airway is open and that it is not obstructed; check the mouth for objects that may be obstructing the airway, such as chewing gum, food, dentures, or the tongue.
 - b. Place the victim on his or her back, put one hand behind the victim's neck, and put the other hand on his or her forehead.
 - c. Lift the neck with one hand, and tilt the head backward by pressing on the forehead with the other hand.



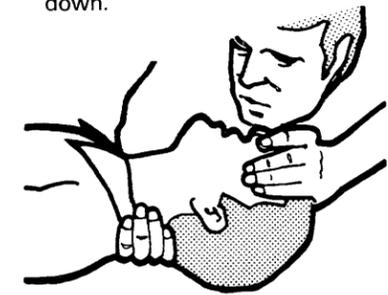
2. Look, listen, and feel to determine if the victim is breathing freely.
 - a. Put your cheek near the victim's mouth and nose.
 - b. Listen and feel for the breathing out of air. At the same time, look at the victim's chest and upper abdomen to see if they move up and down.
3. If the victim is not breathing correctly:
 - a. Keep the victim's head tilted backward. Continue to press on the forehead with your hand; at the same time, position the same hand so that you can pinch together the victim's nostrils with your thumb and finger.



- b. Open your mouth wide and take a deep breath. Make a tight seal with your mouth around the victim's and blow into the victim's mouth.



- c. Remove your mouth to let the victim breathe out, and check that the victim's chest moves down.



- d. Repeat steps b and c once every 5 seconds either until the victim breathes for himself or herself, or until medical aid comes.

Reporting Accidents

Report, to your field manager, all electrical accidents, possible electrical hazards, and accidents that nearly occurred. Remember, an accident that nearly occurs might be caused by a design problem; your immediate reporting ensures that the problem will be solved quickly.

Also report all small electrical shocks. Remember, a condition that causes a small shock need only differ slightly to cause serious injury.

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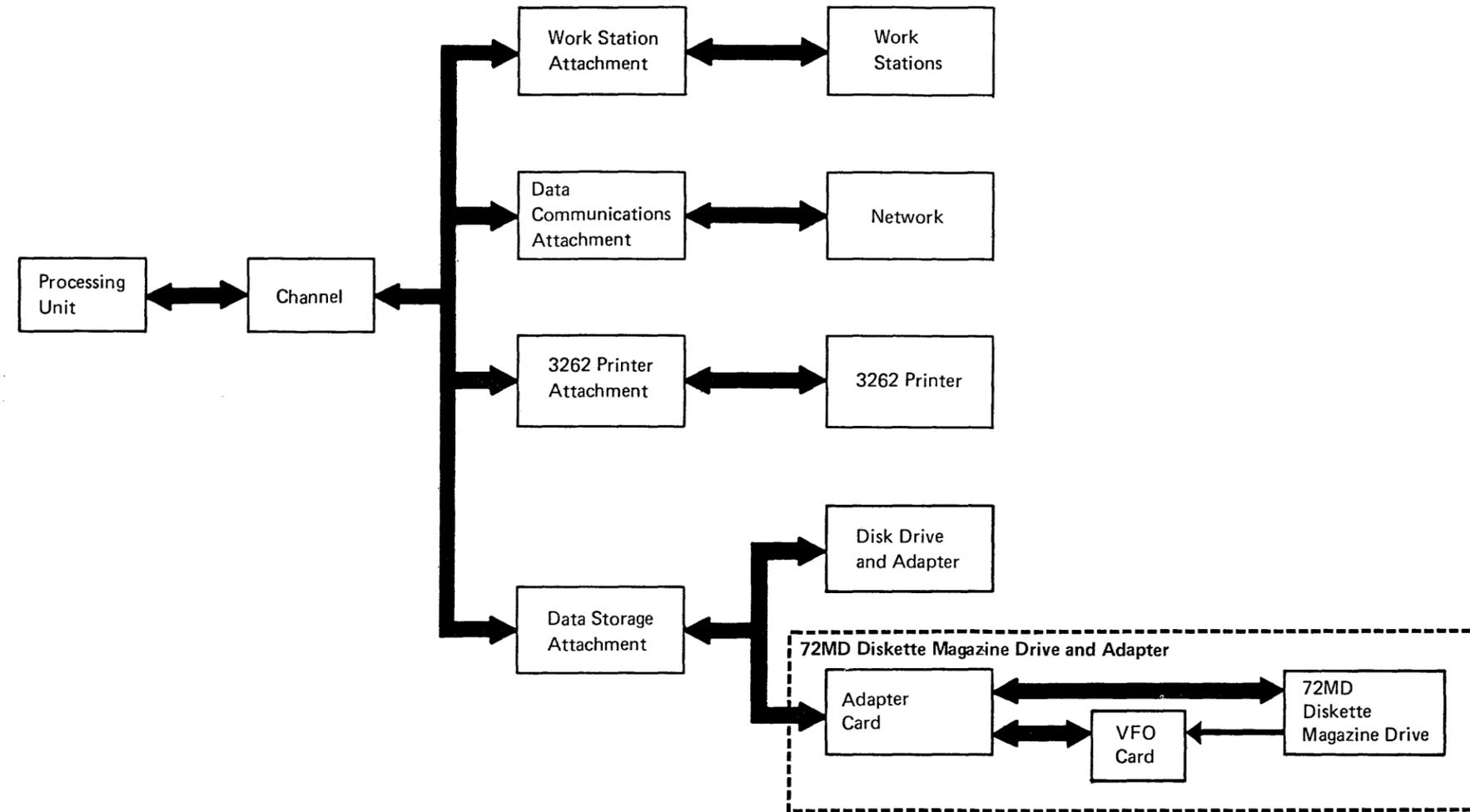
Overview

93-110 72MD Diskette Magazine Drive and Adapter

The 72MD diskette magazine drive is a read/write data storage device that uses the flexible magnetic diskette for data storage. The 72MD adapter is attached to the system channel through the data storage attachment. The data storage attachment is described in the *System/36 Data Storage Attachment MIM* (Section 90).

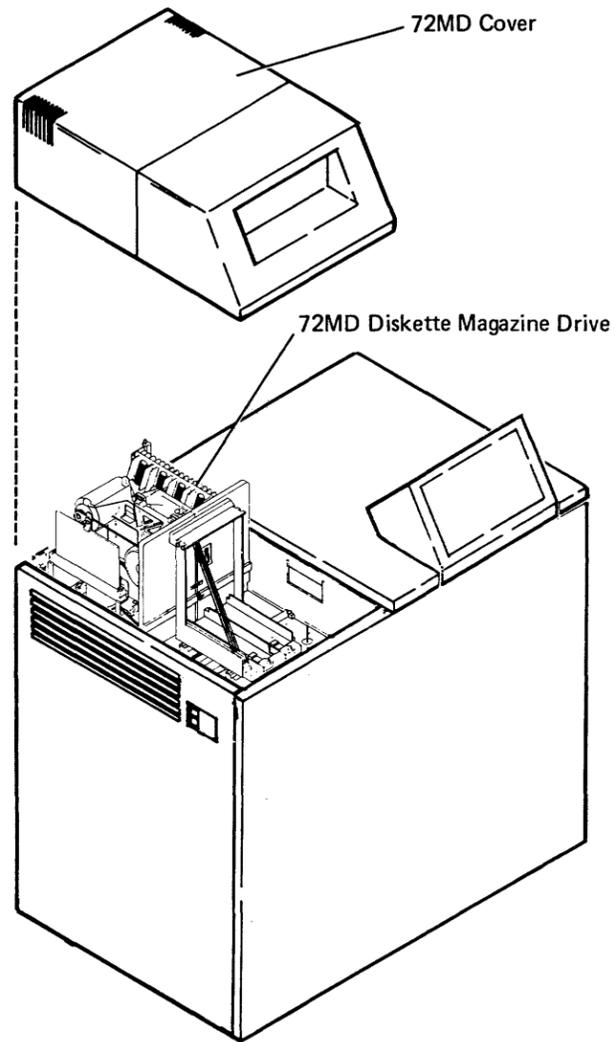
The 72MD diskette magazine drive and adapter have the following major field-replaceable units (FRUs):

- Adapter card
- VFO card
- 72MD diskette magazine drive
 - Drive control card
 - Driver board assembly
 - Autoloader carriage bed assembly
 - Autoloader picker/cam assembly
 - Drive assembly

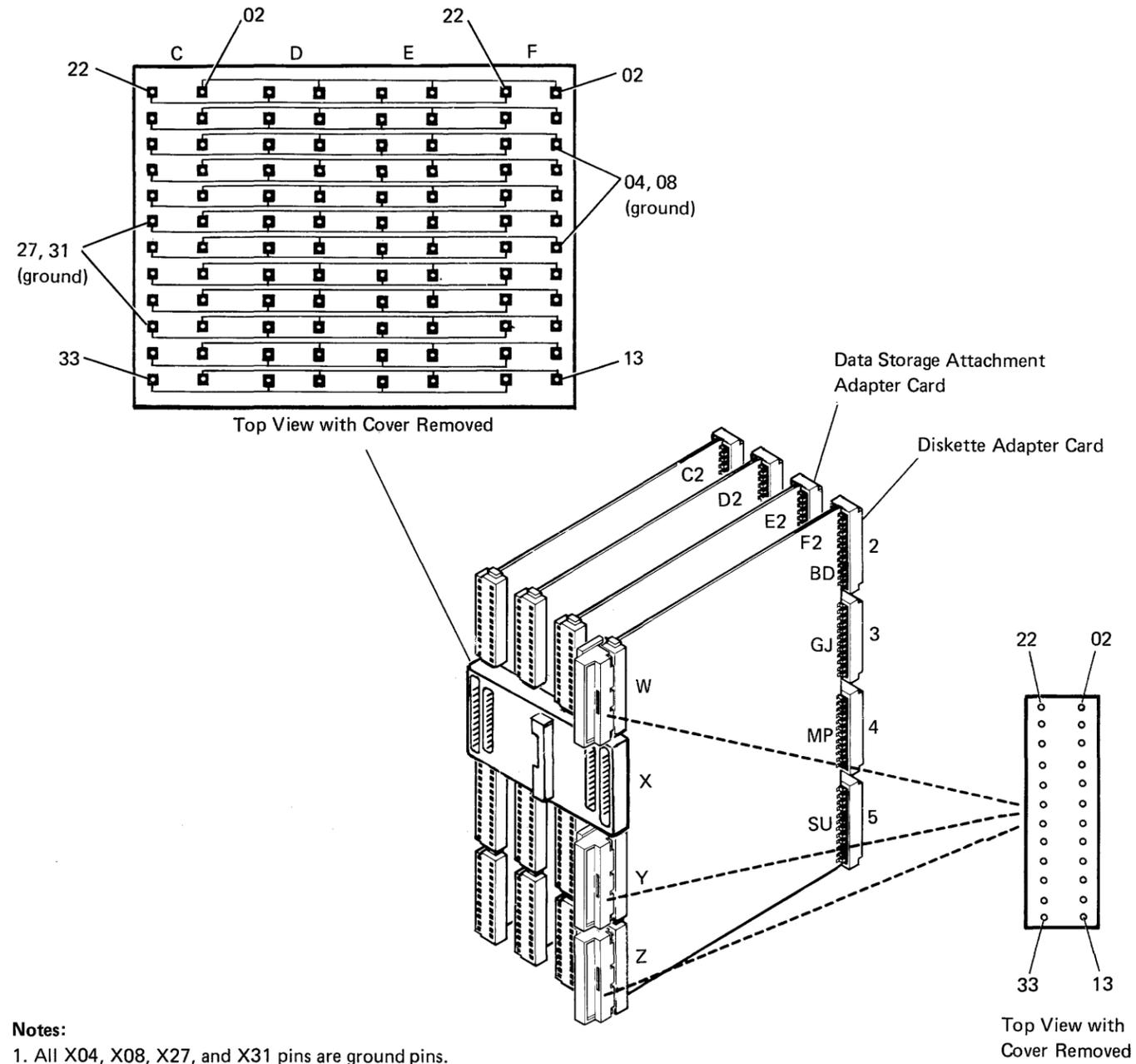


Locations

93-205
72MD Cover

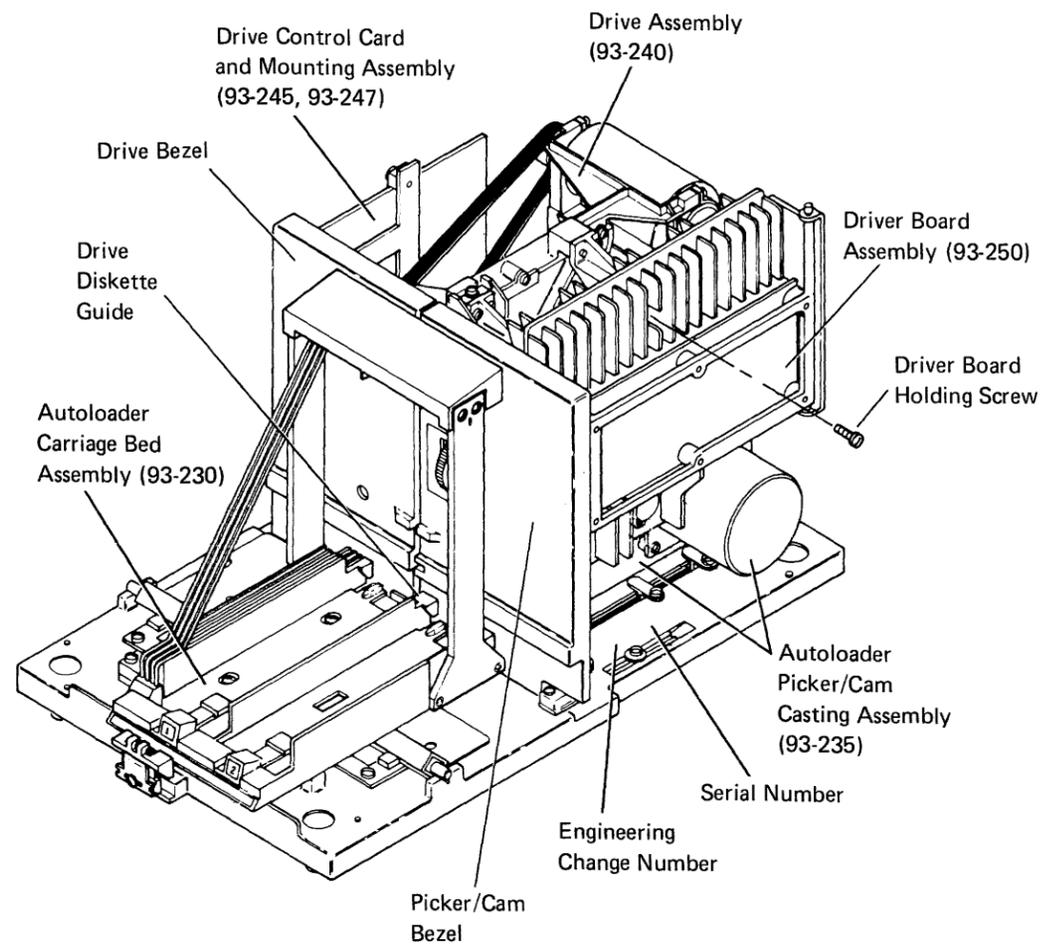


**93-215
Top Card Connector**



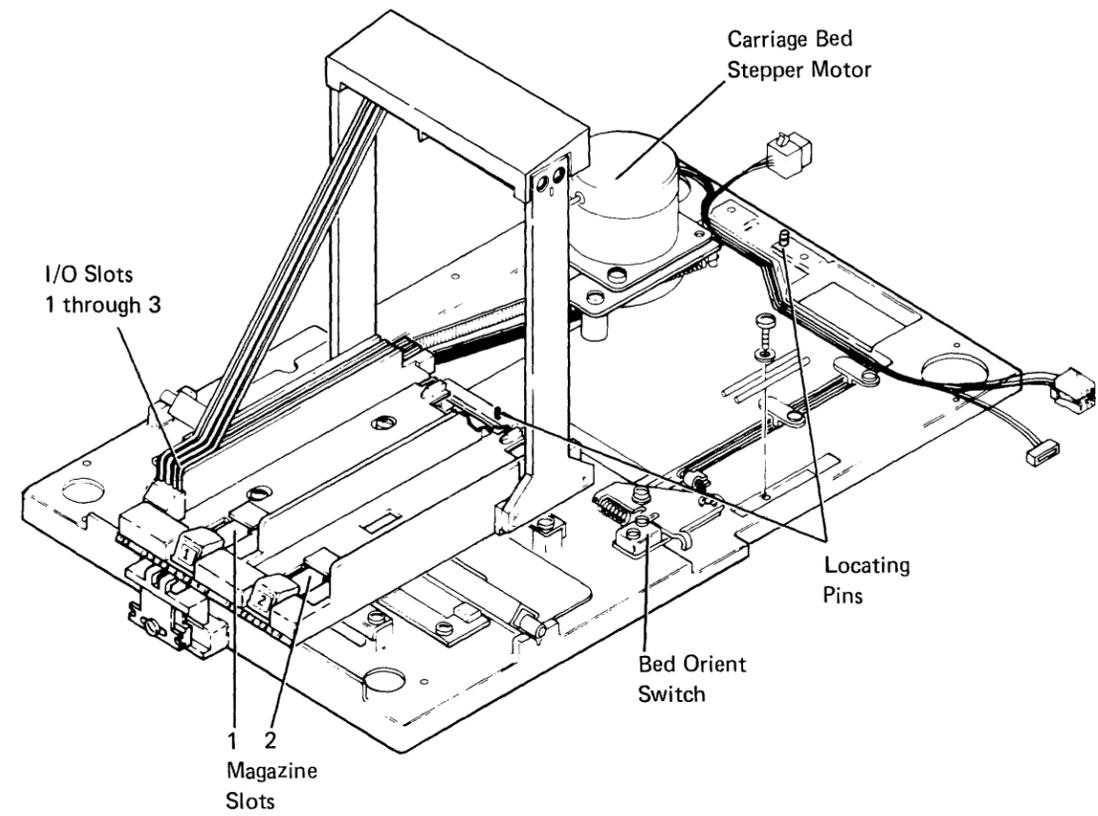
- Notes:**
1. All X04, X08, X27, and X31 pins are ground pins.
 2. The cards in C2 and D2 may be 2-wide instead of 4-wide as shown.

93-225
72MD Assembly

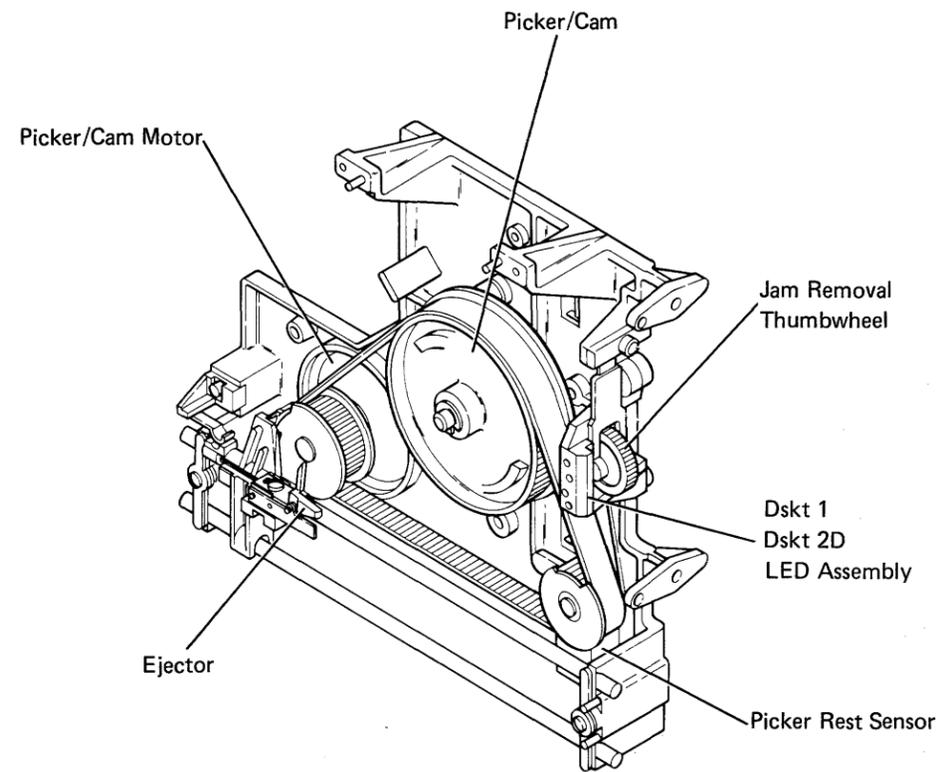


93-225/230

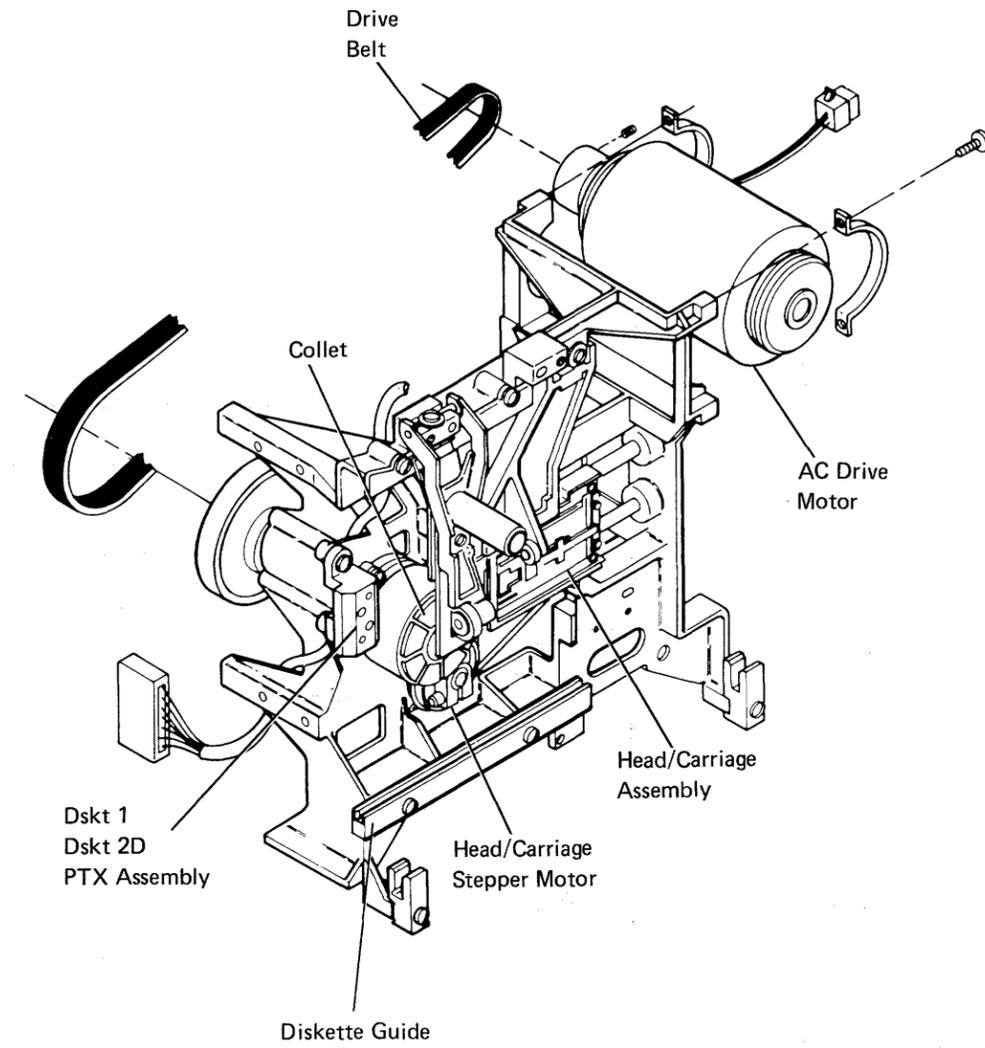
93-230
Autoloader Carriage Bed and Carriage
Bed Casting Assembly



**93-235
Autoloader Picker/Cam Casting
Assembly**



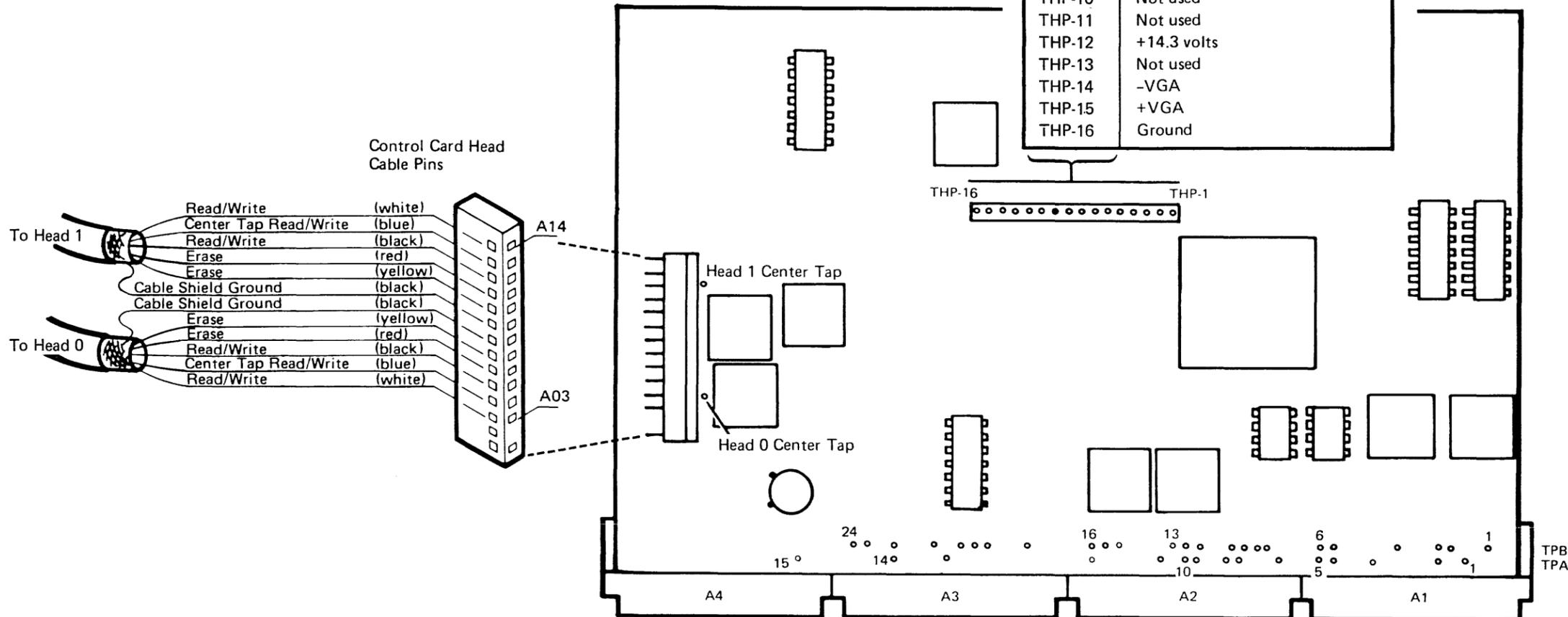
**93-240
Drive Assembly**



93-245
Drive Control Card Test Points

| Test Point | Name |
|------------|--------------------|
| THP-1 | Ground |
| THP-2 | Head reference |
| THP-3 | Single step picker |
| THP-4 | Single step bed |
| THP-5 | -Picker extended |
| THP-6 | -AGC out |
| THP-7 | +AGC out |
| THP-8 | Ground |
| THP-9 | Control voltage |
| THP-10 | Not used |
| THP-11 | Not used |
| THP-12 | +14.3 volts |
| THP-13 | Not used |
| THP-14 | -VGA |
| THP-15 | +VGA |
| THP-16 | Ground |

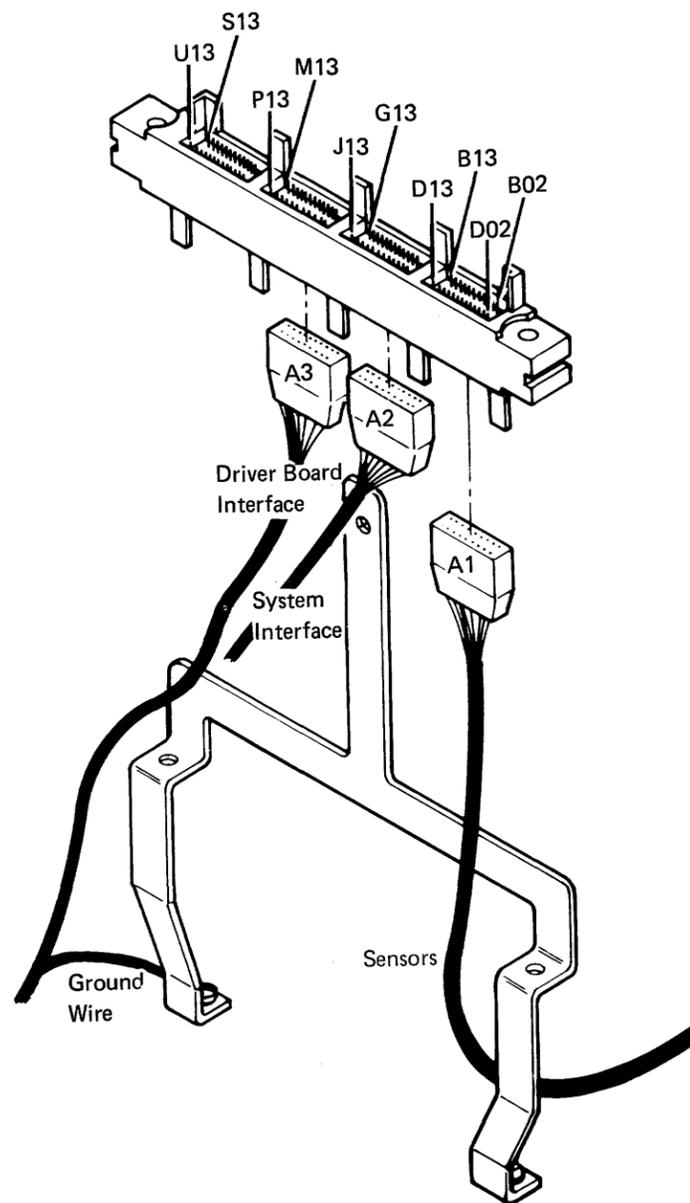
| Test Point | Name |
|------------|----------------------------|
| TPB-1 | Dskt 1 PTX emitter |
| TPB-2 | Dskt 2D PTX emitter |
| TPB-3 | Picker PTX collector |
| TPB-4 | Picker LED anode |
| TPB-5 | Head motor 0 (orange) |
| TPB-6 | Head moter 1 (red) |
| TPB-7 | + Access 0/+ command 0 |
| TPB-8 | + Access 1/+ command 1 |
| TPB-9 | + Access 2/+ command 2 |
| TPB-10 | + Access 3/+ command 3 |
| TPB-11 | + Enable autoloader |
| TPB-12 | + File data |
| TPB-13 | +Dskt 2D sense/status B |
| TPB-14 | +Status A |
| TPB-15 | +Switch filter/+ command 4 |
| TPB-16 | + Index |
| TPB-17 | -Bed Orient switch |
| TPB-18 | +Auto step 0 |
| TPB-19 | +Auto step 1 |
| TPB-20 | +Auto step 2 |
| TPB-21 | +Auto step 3 |
| TPB-22 | -Picker motor |
| TPB-23 | -Bed motor |
| TPB-24 | +Cover open |



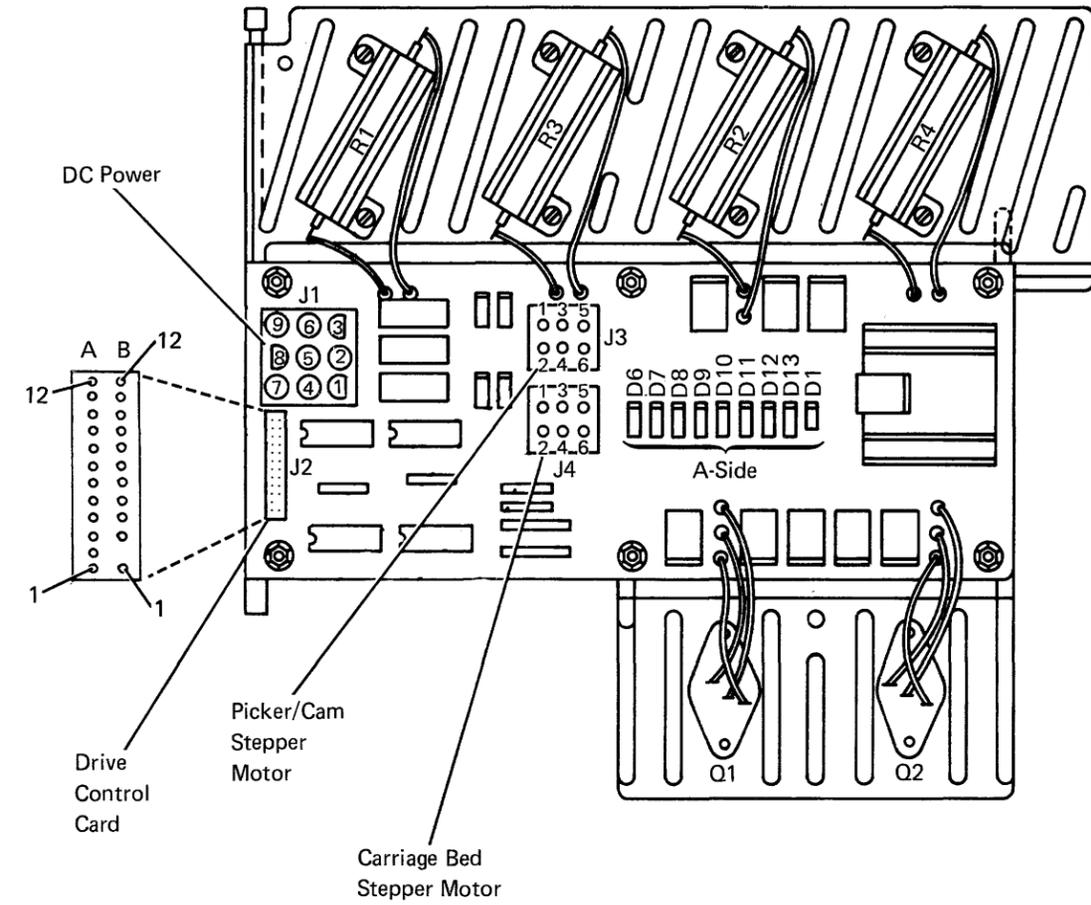
| Test Point | Name |
|------------|----------------------------|
| TPA-1 | Dskt 1 LED anode |
| TPA-2 | Dskt 2D LED anode |
| TPA-3 | +24 volts |
| TPA-4 | Head moter 2 (yellow) |
| TPA-5 | Head motor 3 (blue) |
| TPA-6 | +Write data/+ 500 kHz osc |
| TPA-7 | +Erase gate |
| TPA-8 | +Write gate |
| TPA-9 | + Inner tracks/+ command 5 |
| TPA-10 | +Head select/+ command P |
| TPA-11 | +Erase sense/+status C |
| TPA-12 | +Status D |
| TPA-13 | Ground |
| TPA-14 | -5 volts |
| TPA-15 | +5 volts |

Notes:
 1. Use test pin TPA-15 (+5 volts) for general logic probe power and test pin THP-16 (ground) for general logic probe ground.
 2. See 93-255 for connector wiring.

**93-247
Drive Control Card Mounting Assembly**

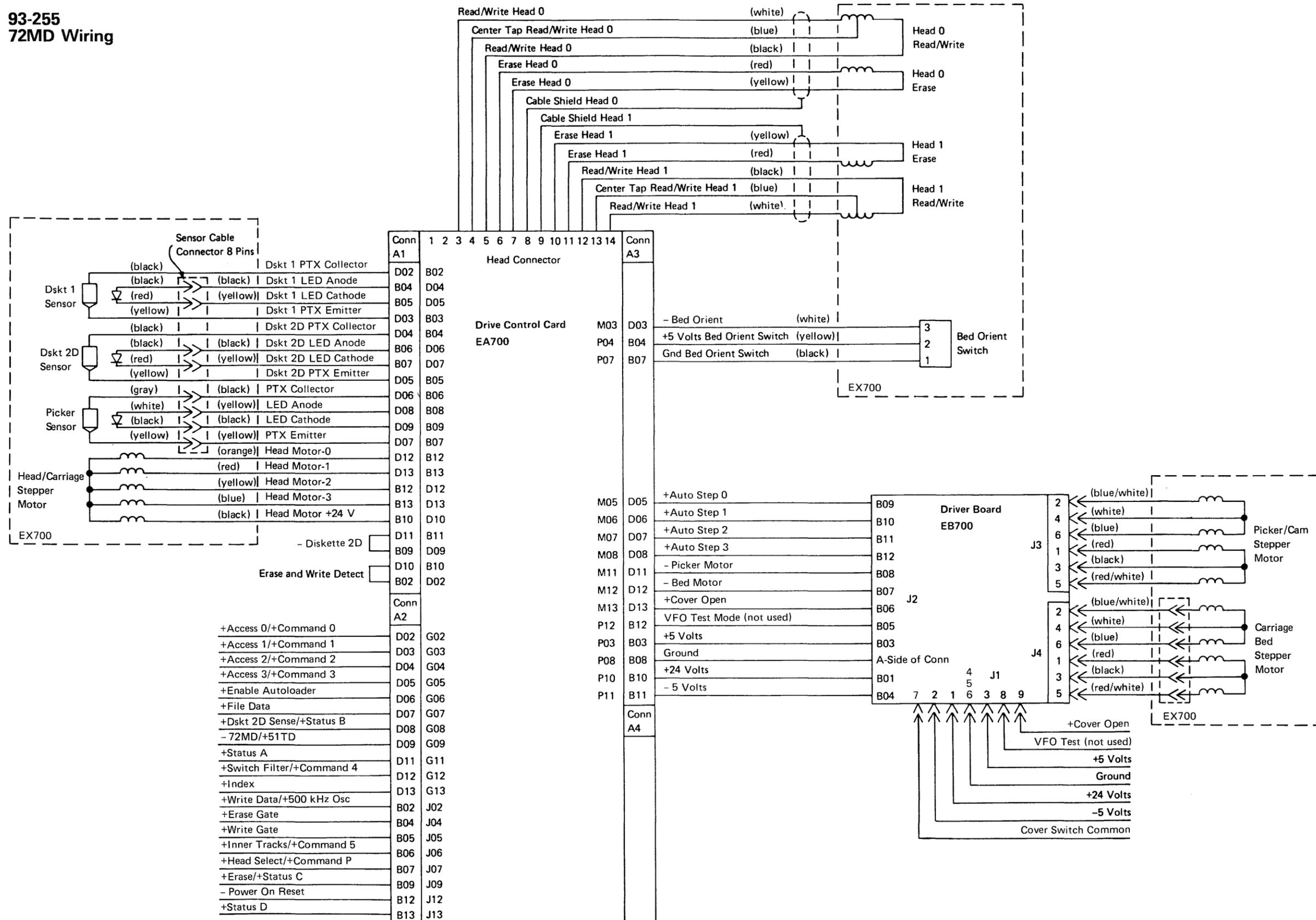


**93-250
Driver Board Assembly**

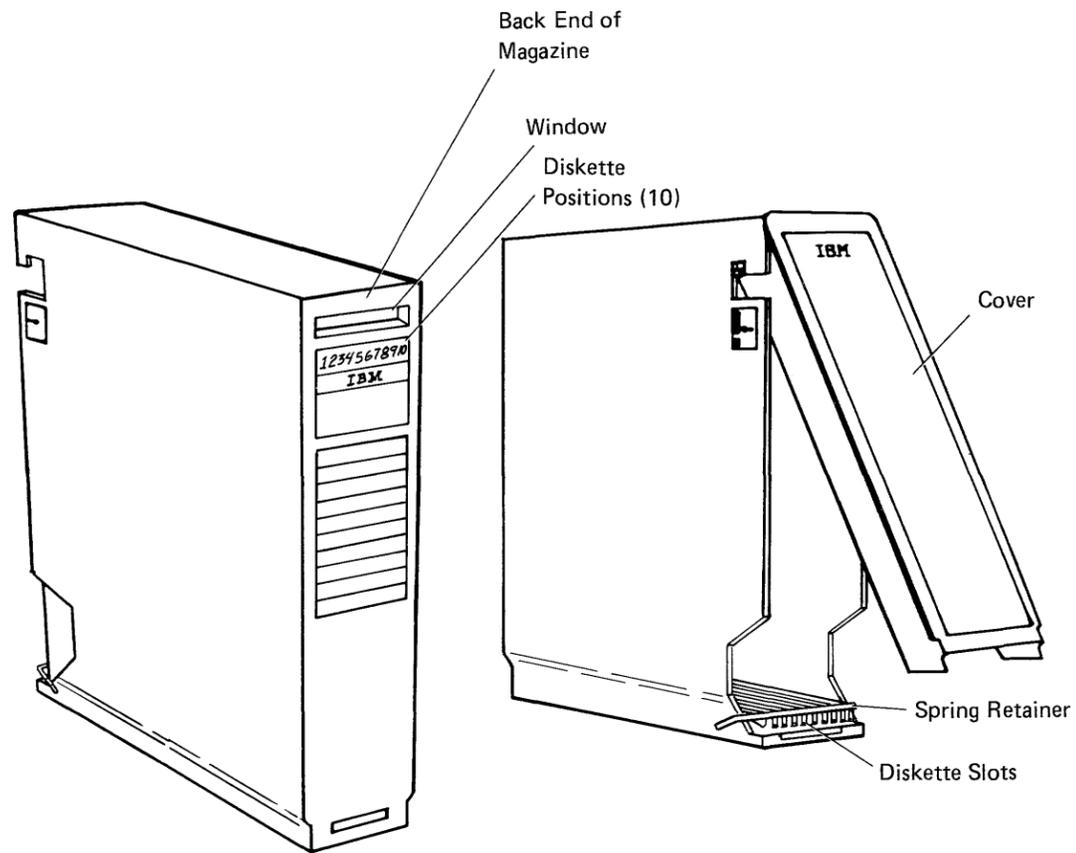


Note: See 93-255 for connector wiring.

93-255
72MD Wiring



93-260
72MD Magazine Assembly



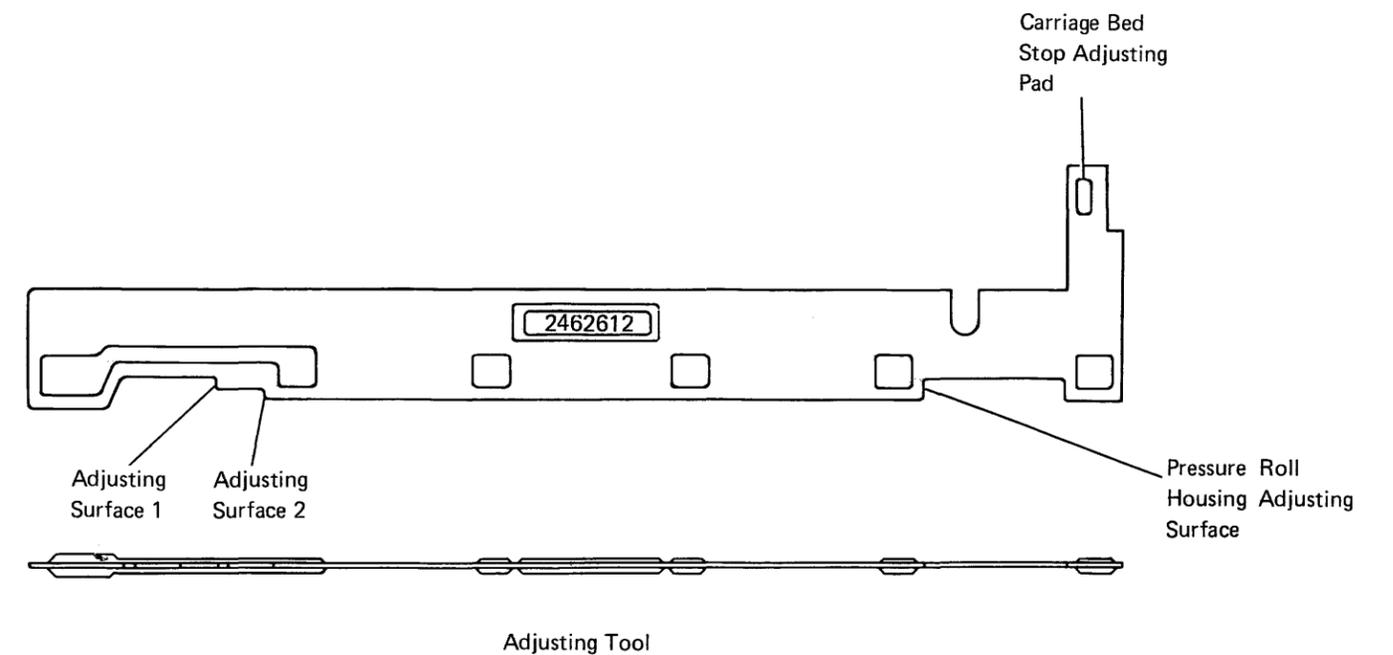
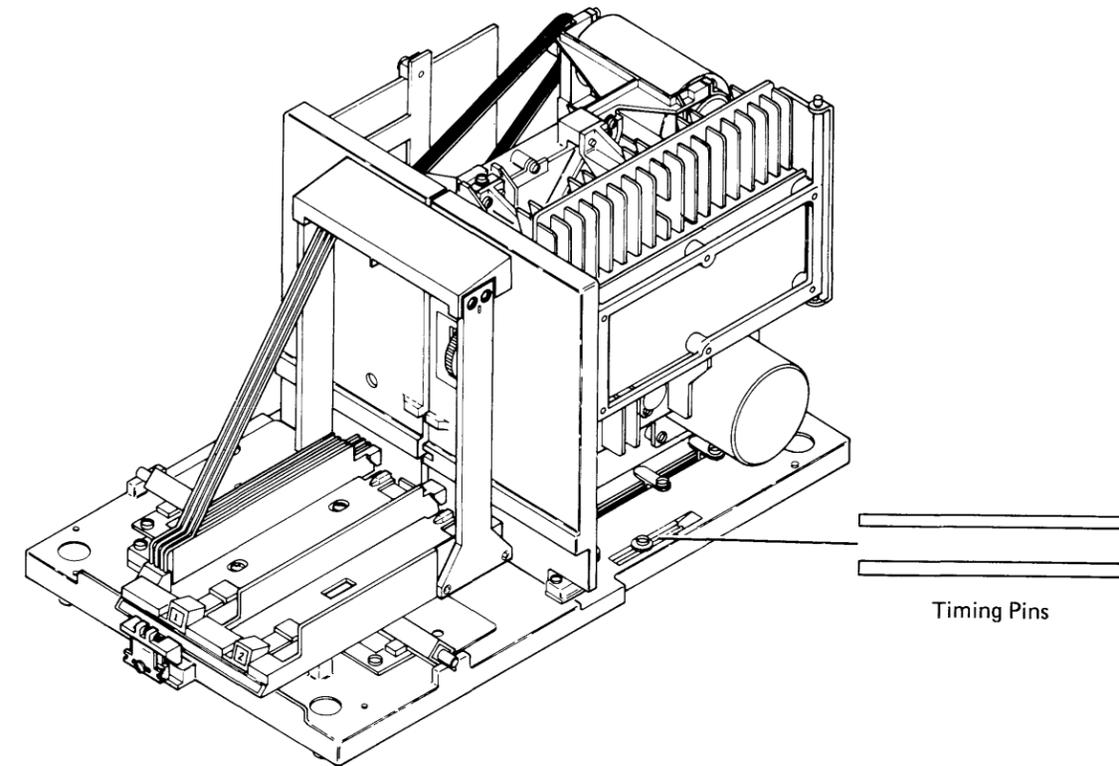
93-265
Special Tools

Two timing pins (part 5562019), located on the base of the 72MD unit, are used to align the following:

- The read/write head carriage stepper motor.
- The PTX-LED assembly.

The adjusting tool (part 2462612) is used for the following:

- The carriage bed adjustments and service checks.
- The picker finger adjustments and service checks.
- The picker/cam adjustments and service checks.



Maintenance Procedures

SERVICE CHECKS, ADJUSTMENTS, REMOVALS, AND REPLACEMENTS

93-300 **Preventive Maintenance**

No preventive maintenance is needed for the 72MD
diskette magazine drive.

93-301 Inserting and Removing Diskettes

See the System/36 manual *Operating Your Computer*, SC21-9026, for a description of how to perform the following tasks:

- Inserting the diskette into a magazine
- Removing the diskette from a magazine
- Inserting the diskette into the autoloader
- Removing the diskette from the autoloader
- Inserting the magazine into the autoloader
- Removing the magazine from the autoloader

Removing a Diskette from the Drive Station

1. Power off (01-115).

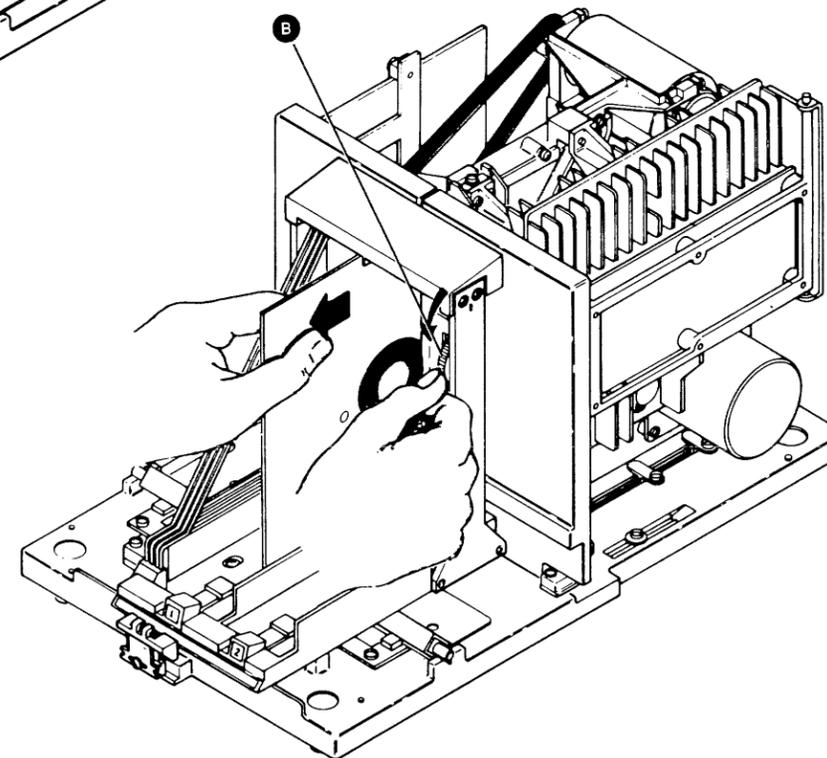
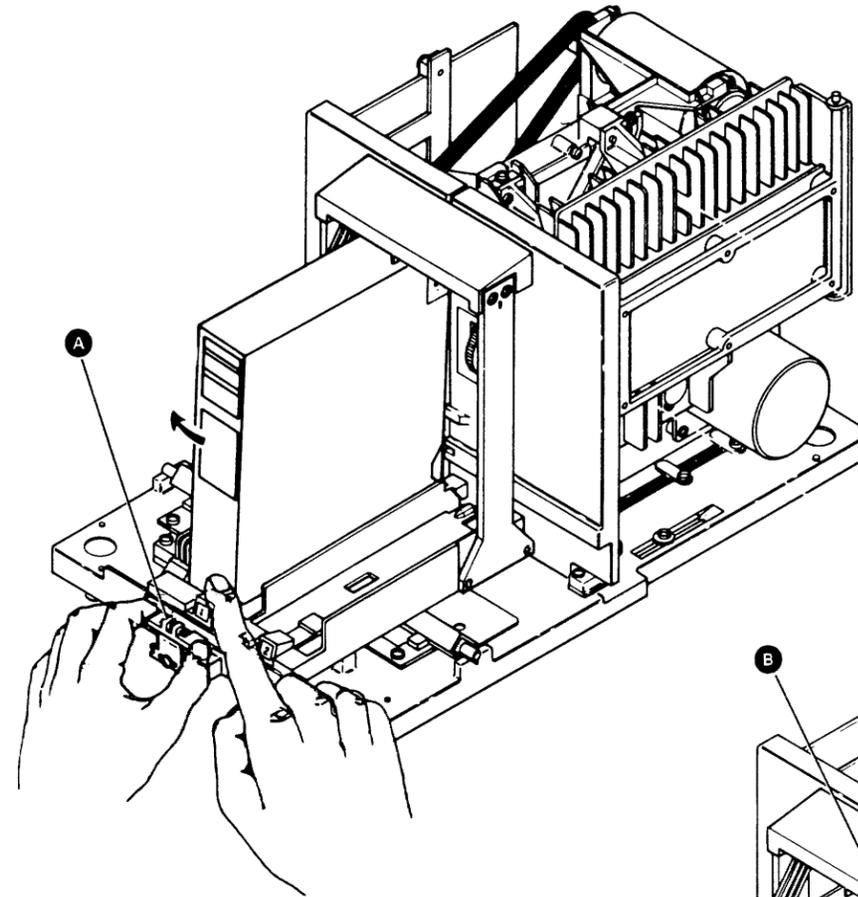
Is an I/O slot aligned with the drive diskette guide?

Y N

A magazine is aligned with the drive diskette guide.

- Move the magazine interlock/indicator **A** away from the carriage bed.
- Press the magazine retainer.
- Remove the magazine.

2. To release the collet and unload the heads, press the thumbwheel **B** and turn it in a downward direction.
3. Continue turning the thumbwheel until the diskette starts to move.
4. Release the thumbwheel and carefully pull the diskette from the drive station.

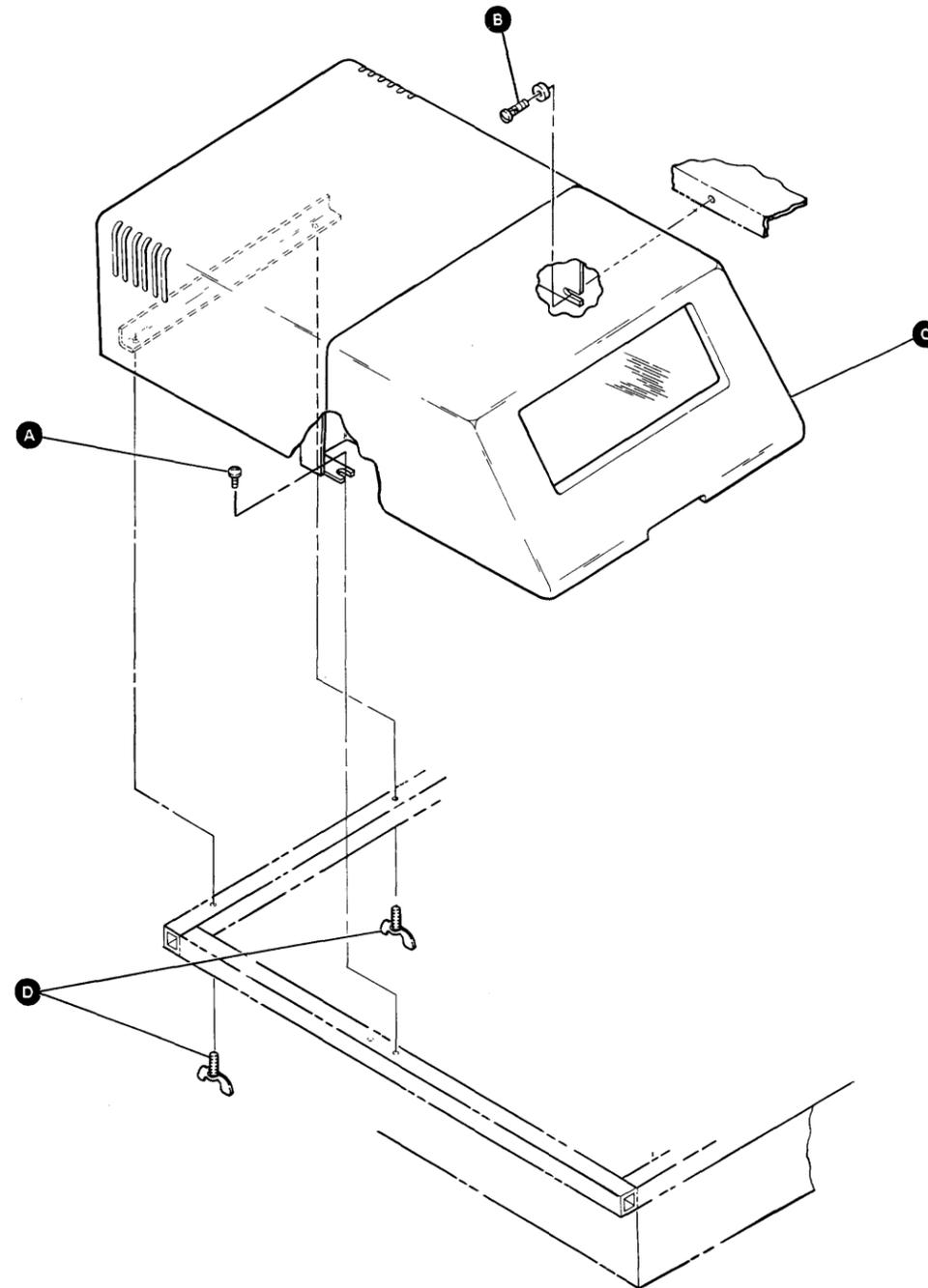


93-303 Read/Write Head Performance Test

To test the read/write ability of the diskette drive, go to MAP 0179, entry point B.

93-305
72MD Cover Removal and Replacement

1. Open the 72MD access cover **C**.
2. Loosen the screws **A** and **B** on the inside of the cover.
3. Remove the two wingbolts **D** that hold the back of the cover.
4. Lift up to remove the cover assembly.
5. Reinstall in reverse order.



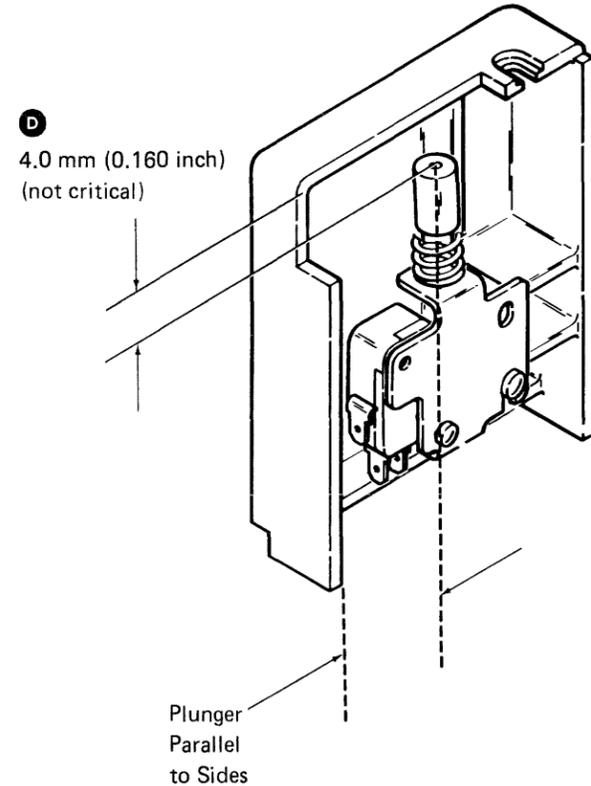
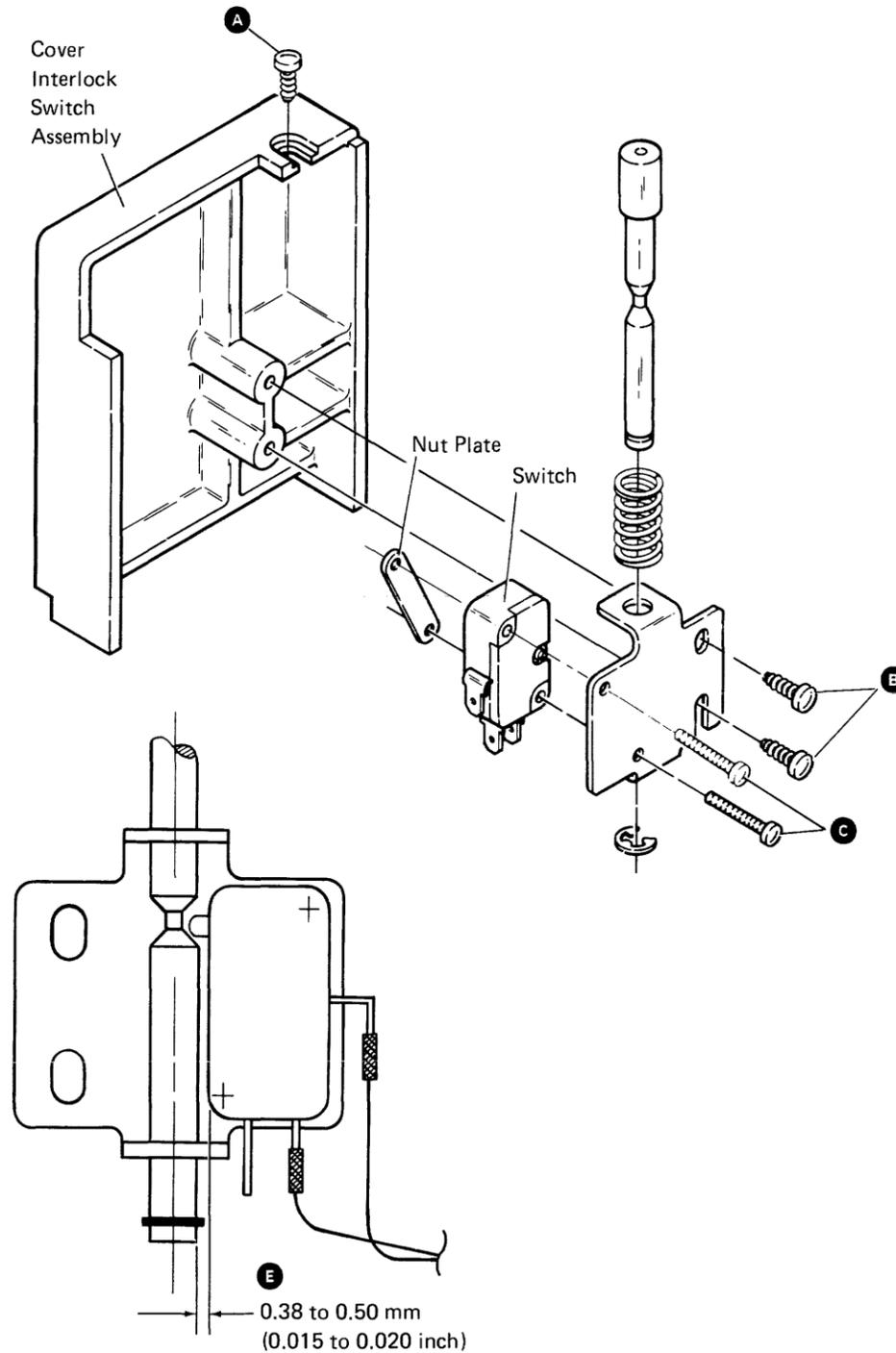
**93-306
Cover Interlock Switch Service Check
and Adjustment**

1. Open the 72MD cover.
2. Loosen the mounting screw **A** and remove the switch assembly.
3. Remove the leads from the switch.
4. Check the switch with a meter while operating the plunger.

Is the switch OK?

Y N
| - Exchange the switch.

5. Remove the switch bracket mounting screws **B** and the bracket assembly.
6. Loosen the screws **C** and adjust the gap **E** between the switch and the plunger.
7. Tighten the screws **C**.
8. Install the bracket assembly with the screws **B**. Do not tighten the screws.
9. Adjust the gap **D** between the top of the plunger and the interlock switch cover. Ensure that the plunger is parallel to the side of the interlock switch cover.
10. Tighten the screws **B**.
11. Connect the leads to the switch.
12. Install the cover interlock switch assembly using the mounting screw **A**.
13. If the failure is still present, use 93-255 and FLD page EX700 to isolate the failure.



Overriding the Cover Interlock Switch

DANGER

If it is necessary to override the cover interlock switch while diagnosing machine problems, be careful of sudden machine starts.

To override the cover interlock switch, lift the plunger to the override position with a small screwdriver, spring hook, or similar tool.

93-307 72MD Removal and Replacement

CAUTION

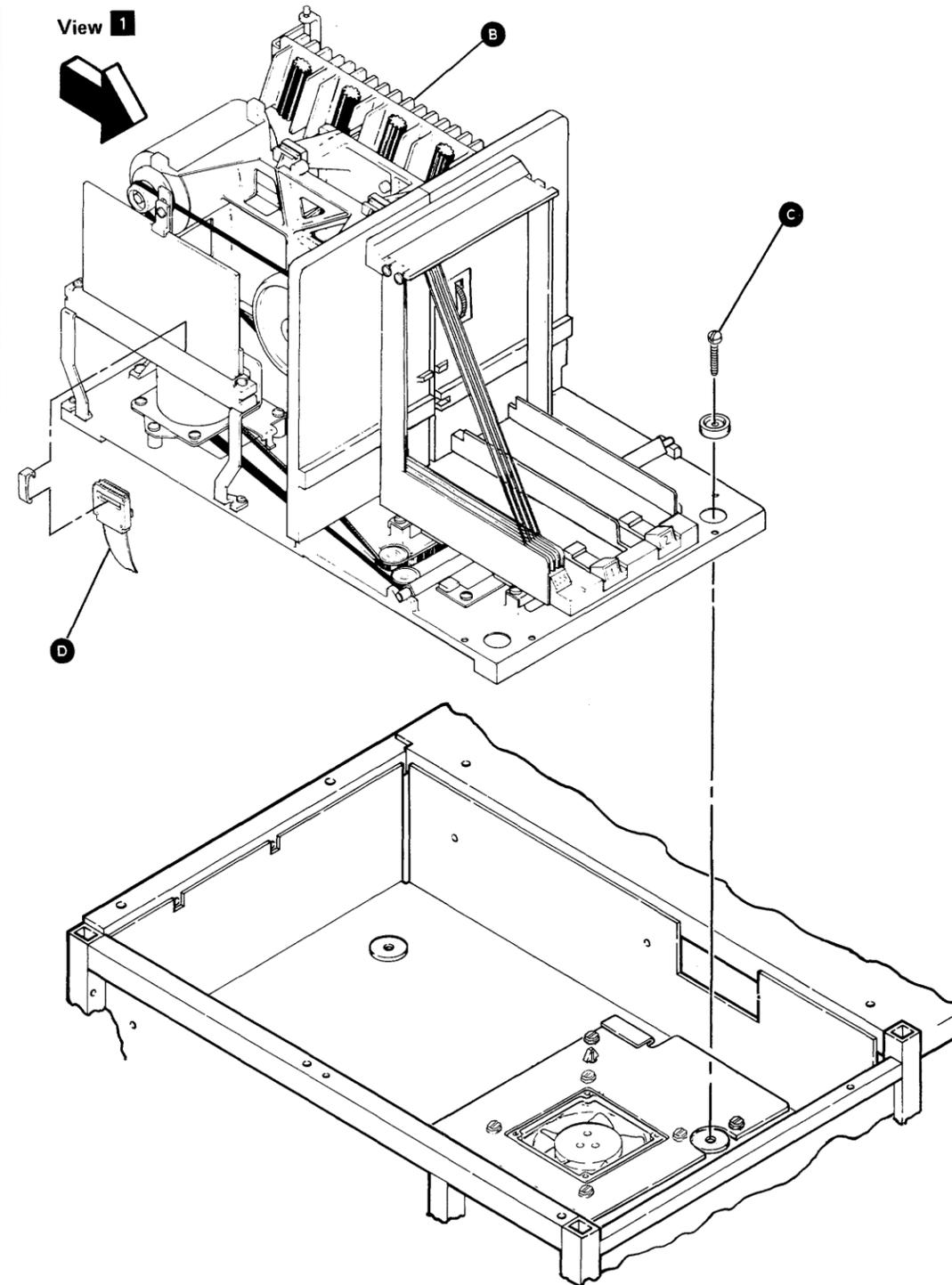
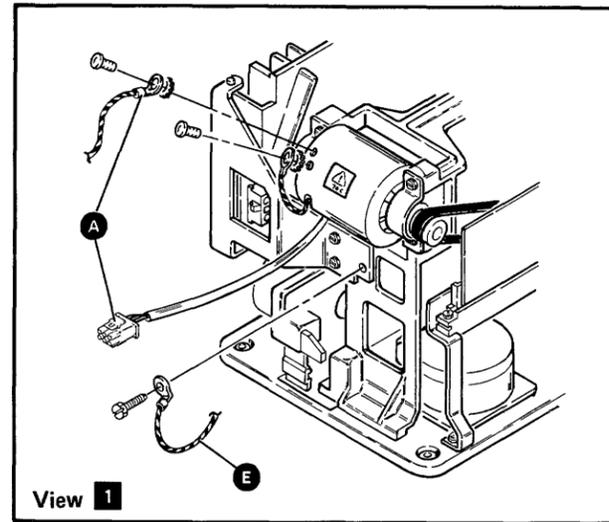
Radio frequency interference (RFI) can cause the diskette drive to fail when operated outside the system. If radio frequency interference is suspected, the diskette drive should be installed in the system for testing. All covers must be installed and closed.

1. Power off (01-115).

DANGER

The 72MD unit weight is 18 kilograms (40 pounds).

2. Remove the 72MD cover assembly (93-305).
3. Disconnect the drive motor AC power cable and cable ground wire to the motor **A**.
4. Disconnect the system interface cable **D** from position A2 of the drive control card mounting assembly (93-245).
5. Disconnect the DC power cable J1 from the driver board **B** (93-250).
6. Disconnect the ground wire **E** from the rear of the 72MD to the system frame.
7. Remove the four shock mount screws **C** (one at each corner of the base casting).
8. Carefully lift the 72MD out of the frame well.
9. Reinstall in reverse order.



93-310 Carriage Bed Stop Service Check

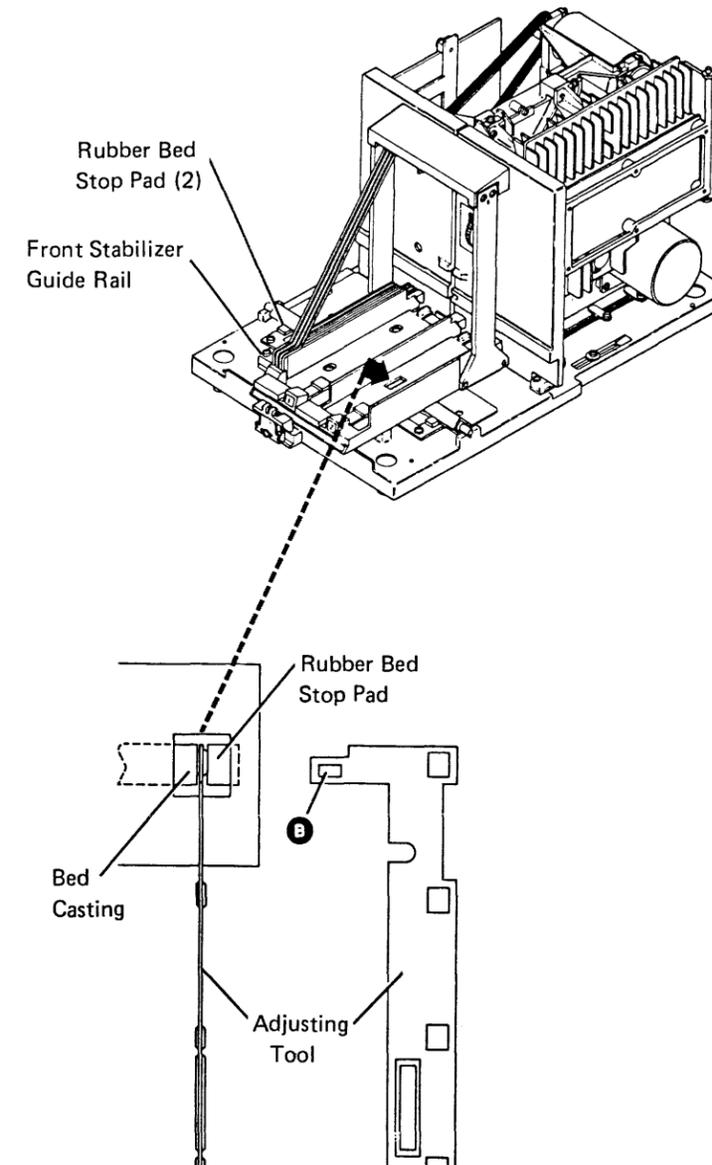
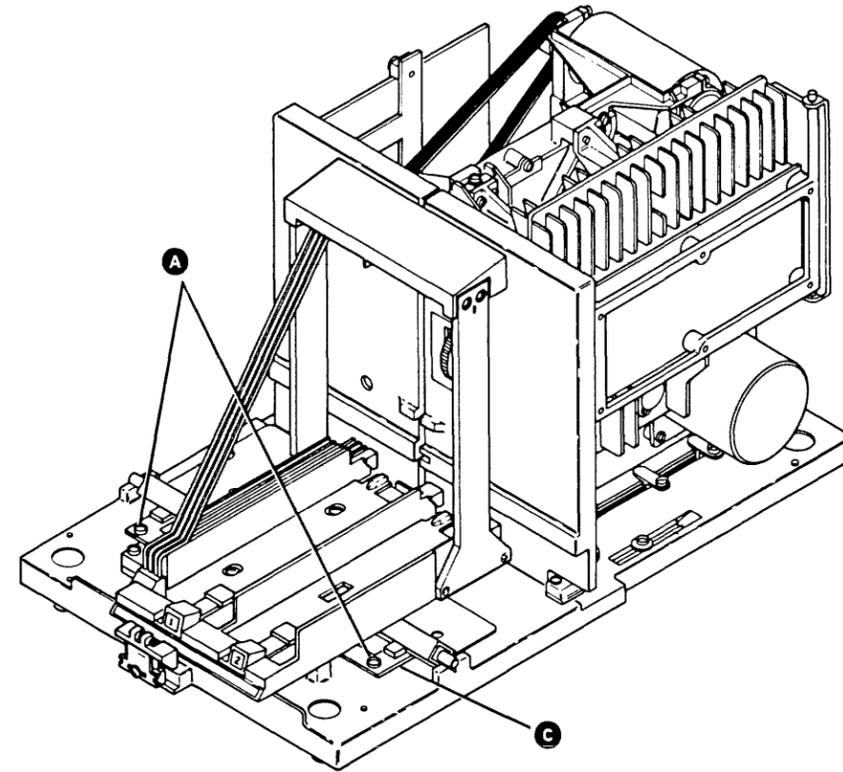
- Align I/O slot 1 with the drive diskette guide (93-225) by:
 - Powering on the system (01-110), or
 - Pressing the System Reset key.
- Visually check to ensure that I/O slot 1 is aligned with the drive diskette guide.
- Check the gap from the carriage bed casting to the rubber bed stop pad with the end **B** of the adjusting tool (part 2462612). Insert the tool through the hole in the tray. If the gap is not correct, perform the carriage bed stop adjustment (93-311).

- Disconnect J4 from the driver board.
- Move the carriage bed to the left and tighten the right bed stop mounting screw.
- Connect J4 to the driver board.

93-311 Carriage Bed Stop Adjustment

Note: The carriage bed assembly orient adjustment (93-327) must be correct before this adjustment can be made.

- Power on (01-110).
- Disconnect J4 (carriage bed stepper motor) from the driver board (93-250).
- Move the carriage bed so that the two screws **A** are visible.
- Loosen the two bed stop mounting screws **A** and slide the carriage bed stop **C** to the right.
- Connect J4 to the driver board.
- Press the System Reset key to align the carriage bed to I/O slot 1.
- Insert the end **B** of the adjusting tool (part 2462612) through the hole in the carriage bed, with the left surface of the tool against the bed casting.
- Slide the carriage bed stop **C** to the left until the rubber bed stop pad touches the adjusting tool.
- Tighten the left bed stop mounting screw.
- Remove the adjusting tool.

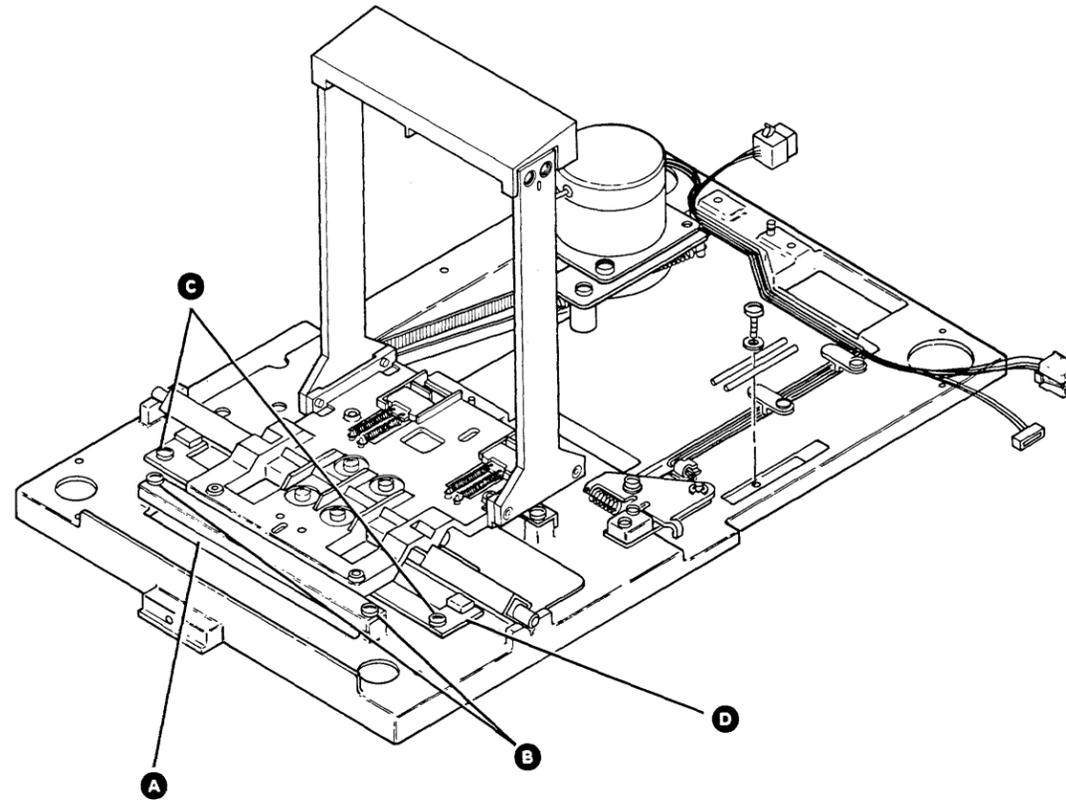


93-312 Carriage Bed Stop Removal

1. Remove the carriage bed assembly (93-328).
2. Remove the two mounting screws **B** from the carriage bed casting stabilizer guide rail **A** and remove the rail.
3. Remove the two bed stop assembly mounting screws **C**.
4. Carefully lift the bed casting and remove the bed stop assembly **D**.

93-313 Carriage Bed Stop Replacement

1. Carefully lift the bed casting, place the bed stop assembly **D** on the base casting, and reinstall the two mounting screws **C**. Do not tighten the screws.
2. Reinstall the carriage bed casting stabilizer guide rail **A** and the screws **B**.
3. Perform the carriage bed stop adjustment (93-311).
4. Reinstall the carriage bed assembly (93-329).



93-314 Carriage Bed Stepper Motor Resistance Service Check

1. Power off (01-115).
2. Disconnect the stepper motor cable from driver board connector J4 (93-250).
3. Use a multimeter to measure the resistance between the following cable pins: 2 and 4, 4 and 6, 1 and 3, 3 and 5.

Are all the resistances between 2.5 and 3.5 ohms?

- Y N**
- Exchange the bed motor (93-315 and 93-316)
4. Connect J4 to the driver board.

For additional carriage bed stepper motor service procedures:

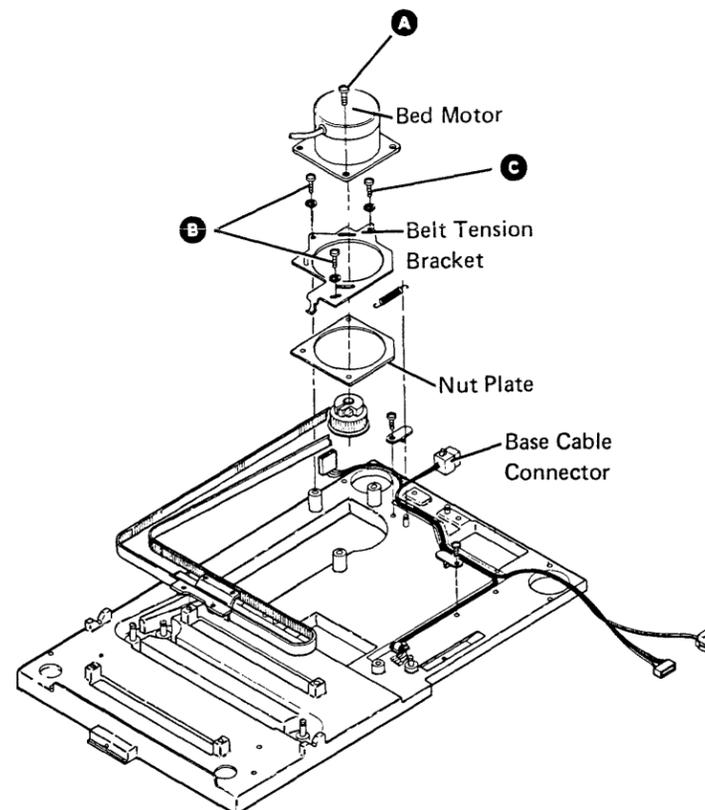
- See the drive control card output to carriage bed stepper motor service check (93-370) to check the output of the drive control card.
- See the driver board output to carriage bed stepper motor service check (93-381) to check the output of the driver board.

93-315 Carriage Bed Stepper Motor Removal

1. Power off (01-115).
2. Remove the drive control card mounting assembly.
3. Disconnect the bed motor connector from the base cable connector near the motor.
4. Loosen the three screws (B) and (C) that hold the belt tension bracket.
5. Turn the bed motor against the belt tension spring to release belt tension, and tighten the screw (C).
6. Remove the three bed motor screws (A) from the nut plate.
7. Lift the bed motor and attached pulley assembly clear of the belt and remove.
8. Remove the pulley assembly from the stepper motor shaft.

93-316 Carriage Bed Stepper Motor Replacement

1. Install the pulley assembly on the bed motor shaft. The pulley should be even with the end of the bed motor shaft.
2. Install the bed motor and pulley assembly on the base casting. At the same time, reinstall the belt around the bed motor pulley.
3. Reinstall the three bed motor screws (A) to the nut plate. Do not tighten the screws.
4. Loosen the screw (C) and let the spring set the belt tension.
5. Tighten the three screws (B) and (C).
6. Connect the bed motor connector to the base cable connector near the motor.
7. Reinstall the drive control card mounting assembly.
8. Power-on (01-110).
9. Go to 93-327, step 1.

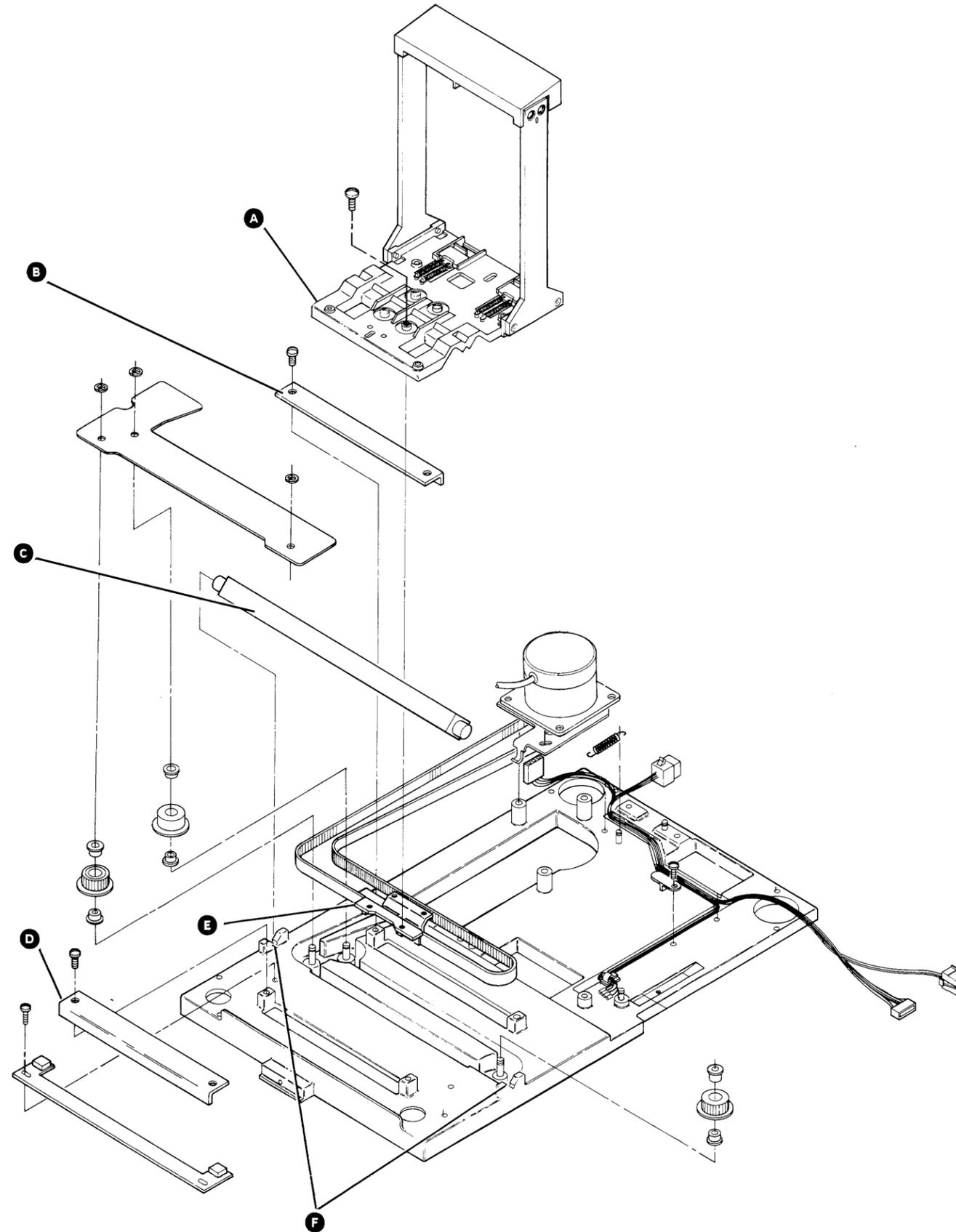


93-317 Carriage Bed Monorail Removal

1. Remove the carriage bed assembly (93-328).
2. Remove the two stabilizer guide rails (B) and (D) (two screws on each rail).
3. Lift the bed casting (A) slightly and remove the monorail (C).

93-318 Carriage Bed Monorail Replacement

1. Lift the bed casting slightly, insert the monorail (C) between the bed casting (A) and the bed belt yoke (E), and place the monorail into the V-slots (F) on the base casting.
2. Reinstall the two stabilizer guide rails (B) and (D).
3. Go to 93-329, step 1.

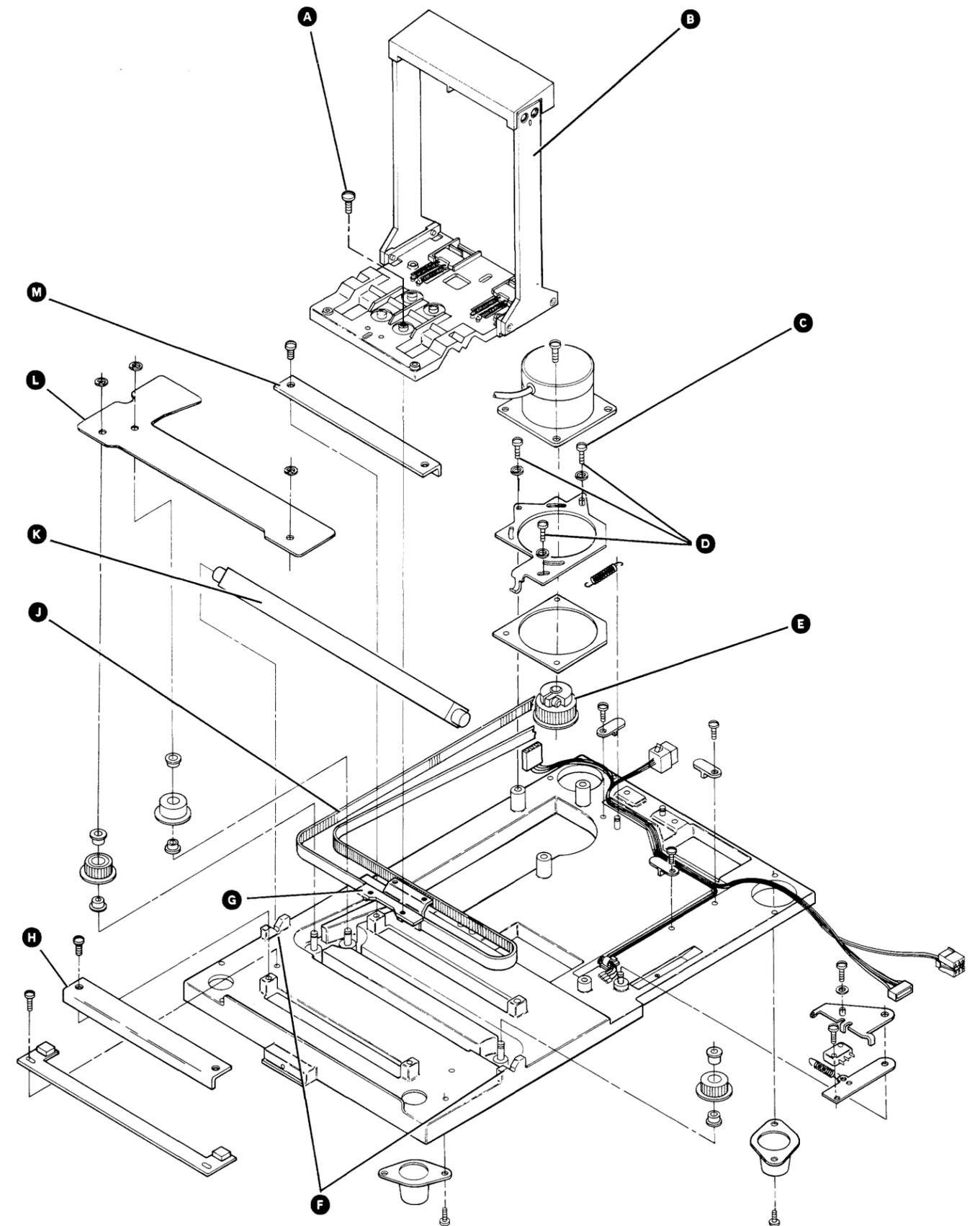


93-319 Carriage Bed Belt Removal

1. Remove the carriage bed assembly (93-328).
2. Remove the two stabilizer guide rails (H) and (M) (two screws on each rail).
3. Remove the four screws (A) to remove the carriage assembly (B) from the carriage bed belt yoke (G).
4. Remove the monorail (K) from the V-slots (F) in the base casting.
5. Remove the drive bezel (two screws, see 93-225).
6. Loosen the three belt tension bracket screws (D).
7. Turn the stepper motor against the belt tension spring to release belt tension, and tighten the bracket screw (C).
8. Remove the belt shield (L).
9. Lift the carriage bed belt yoke (G) and attached belt from the base.
10. Remove the belt (J) from around the stepper motor pulley (E).

93-320 Carriage Bed Belt Replacement

1. Reinstall the belt (J) around the stepper motor pulley (E).
2. Locate the carriage bed belt yoke (G) and attached belt on the base.
3. Reinstall the belt shield (L).
4. Loosen the tightened bracket screw (C) to permit the spring to set the tension.
5. Tighten the three belt tension bracket screws (D).
6. Reinstall the drive bezel (two screws).
7. Place the ends of the monorail (K) into the V-slots (F) in the base casting.
8. Attach the carriage bed belt yoke (G) to the carriage assembly (B) using the four screws (A).
9. Reinstall the two stabilizer guide rails (H) and (M) (two screws on each rail).
10. Go to 93-329, step 1.



93-321 Carriage Bed Orient Switch Output Service Check

1. Power on (01-110).
2. Disconnect J4 from the driver board (93-250).
3. Probe TPB-17 on the drive control card (93-245).
4. Move the bed assembly to the left stop.
5. Press the switch plunger to activate the switch. The Down light (minus level) should appear.
6. Release the switch plunger to deactivate the switch. The Up light (positive level) should appear.

Does the level change?

- | | |
|----------|--|
| Y | N |
| | |
| | - The switch is bad (93-323). |
| | - The logic or wiring is bad (93-255). |

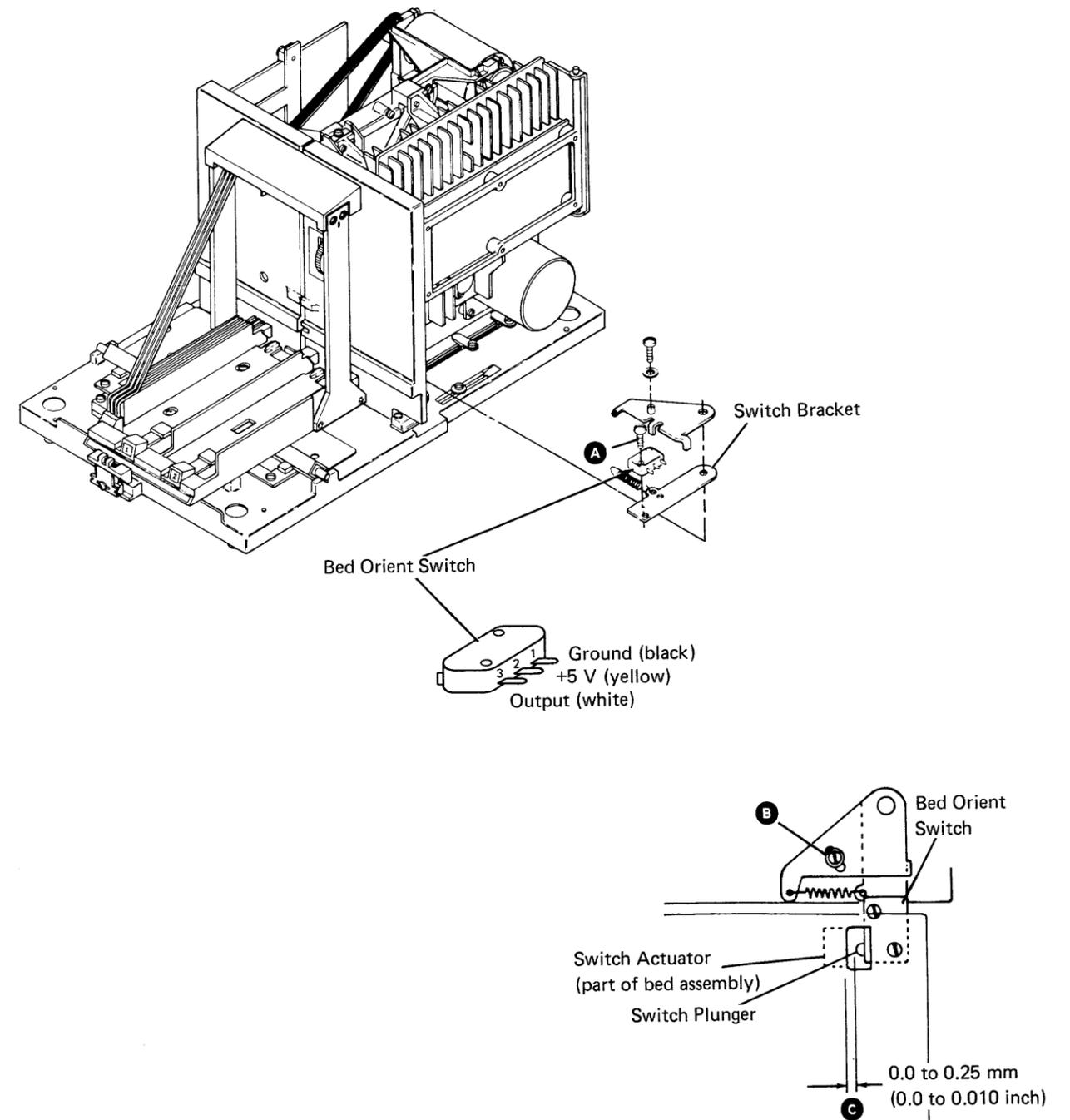
7. Connect J4 to the driver board.

93-322 Carriage Bed Orient Switch Adjustment

1. Power on (01-110).
2. Disconnect J4 from the driver board (93-250).
3. Move the carriage bed to align I/O slot 1 with the drive diskette guide (93-225).
4. Connect J4 to the driver board.
5. Loosen the screw **B**.
6. Adjust the bed orient switch for the correct gap **C** between the switch actuator and the switch plunger.
7. Tighten the screw **B**.
8. Visually check the magazine interlock/indicator. If the indicator slot is not centered on the I/O slot 1 position, loosen the mounting screw and center the indicator.

93-323 Carriage Bed Orient Switch Removal and Replacement

1. Power off (01-115).
2. Remove the leads from the switch.
3. Remove the two mounting screws **A** from the switch bracket, and remove the switch.
4. Reinstall in reverse order and adjust the switch (93-322).

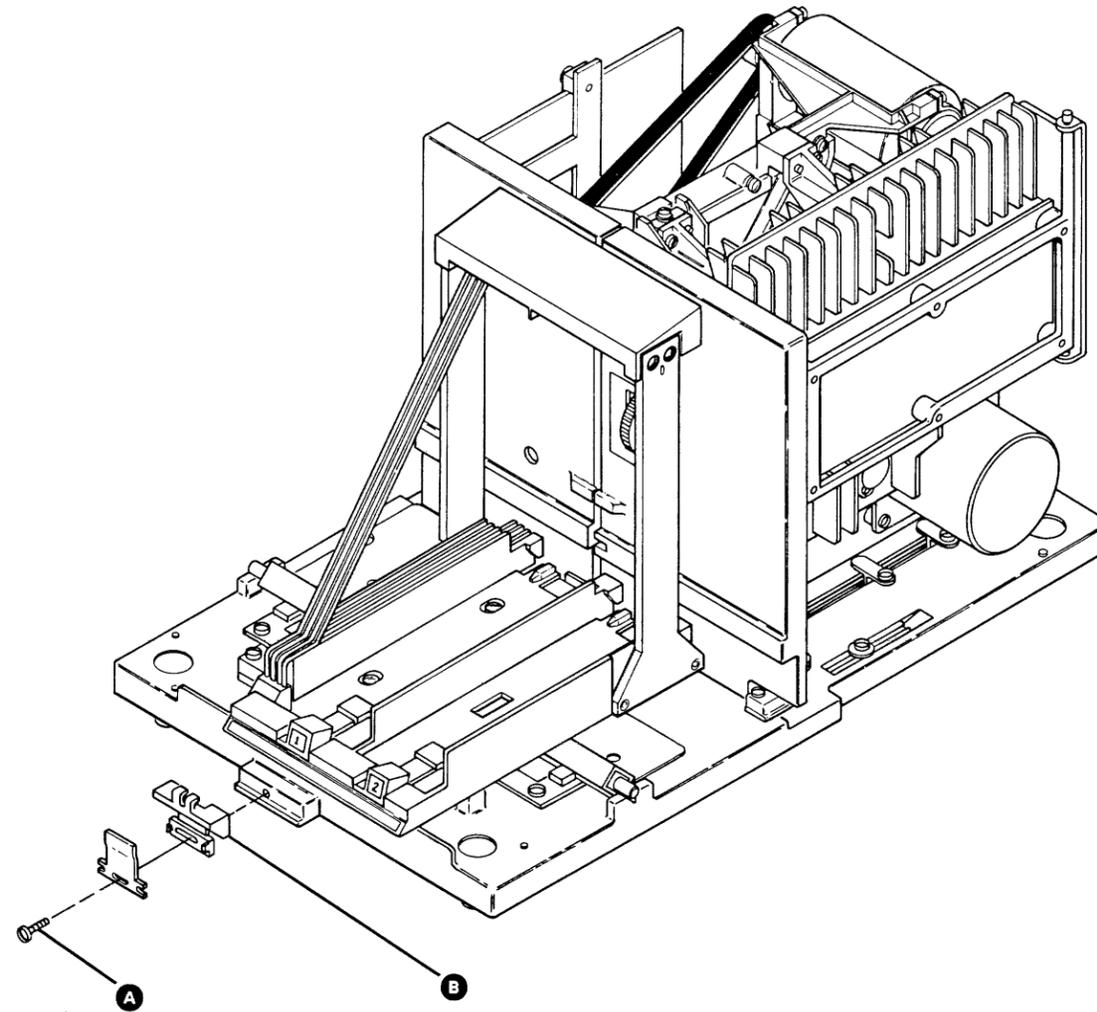


93-324 Magazine Interlock/Indicator Adjustment

1. Align I/O slot 1 with the drive diskette guide (93-225) by:
 - a. Powering on the system (01-110), or
 - b. Pressing the System Reset key.
2. Loosen the screw **A** on the interlock/indicator assembly and center the indicator slot **B** to the numeric 1 in the I/O positions.
3. Tighten the screw **A**.

93-325 Magazine Interlock/Indicator Removal and Replacement

1. Remove the screw **A** that holds the magazine interlock/indicator assembly **B**.
2. Remove the assembly.
3. Reinstall in reverse order and adjust (93-324).



93-326 Carriage Bed Assembly Orient Service Check

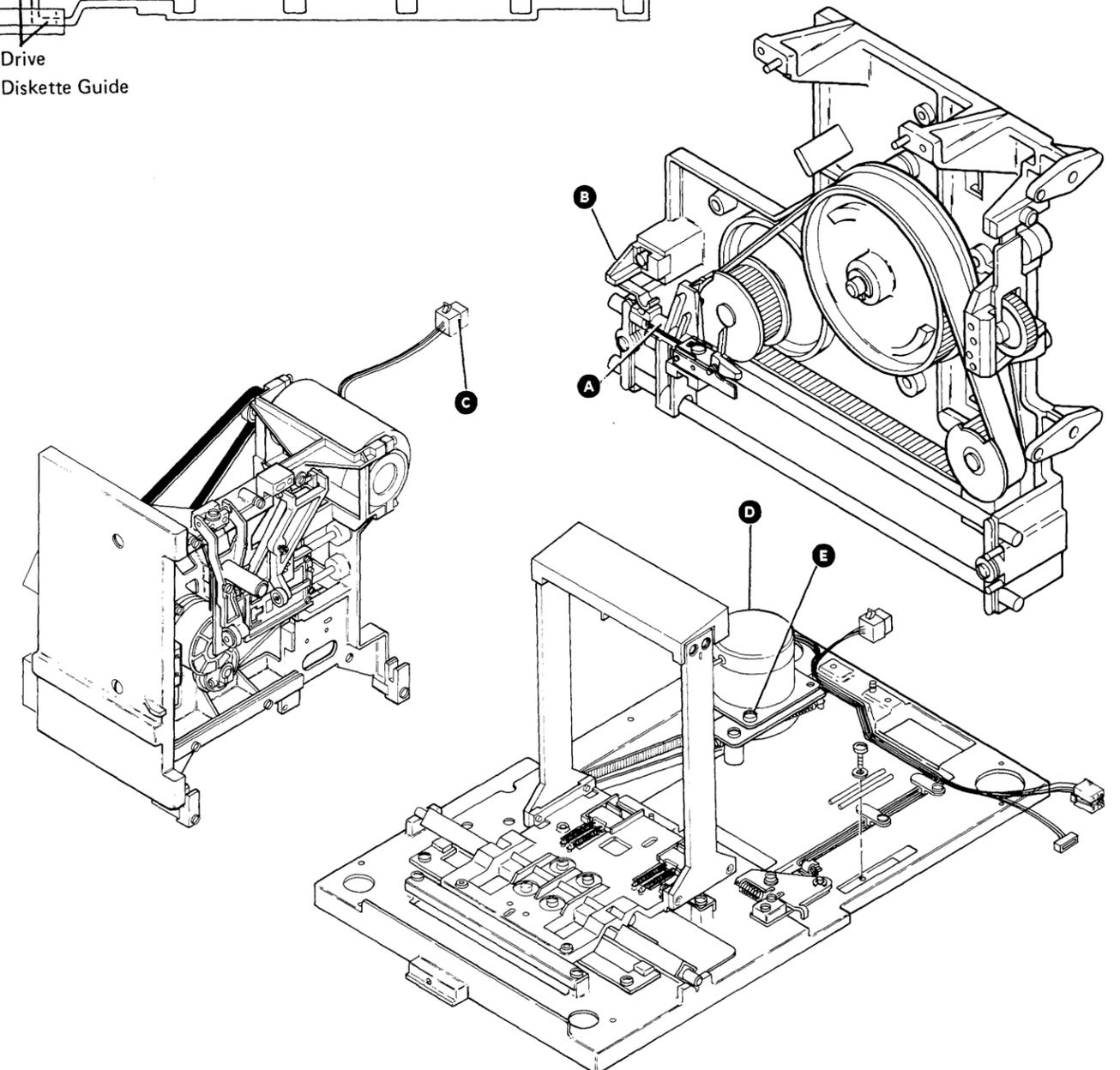
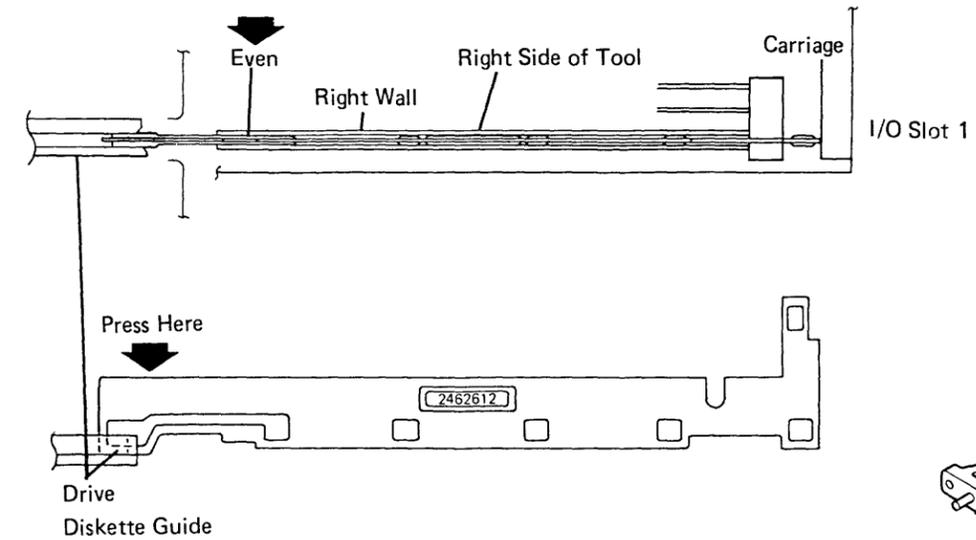
1. Align I/O slot 1 with the drive diskette guide (93-225) by:
 - a. Powering on the system (01-110), or
 - b. Pressing the System Reset key.
2. Disconnect J3 from the driver board (93-250).
3. Move the picker carriage assembly **A** near the picker carriage detent assembly **B**.
4. Connect J3 to the driver board.
5. Insert the adjusting tool (part 2462612) into the drive diskette guide and carefully put downward pressure to the top of the tool. This aligns the tool to the drive diskette guide.
6. Check for the following conditions:
 - a. Check that the right wall of I/O slot 1 and the right side of the tool touch.
 - b. Check that the carriage bed does not move when the tool is inserted and that the tool does not have to be forced into the I/O slot.
7. If both conditions are not correct, perform the carriage bed assembly orient adjustment (93-327).

93-327 Carriage Bed Assembly Orient Adjustment

DANGER

Voltage is present at the AC power connector when it is disconnected and power is on.

1. Disconnect the AC power cable from the drive motor power cable **C**.
2. Disconnect J1 from the driver board (93-250).
3. Move the carriage bed to align I/O slot 1 with the drive diskette guide (93-225).
4. Loosen the three screws **E** that fasten the bed motor **D** to the motor plate.
5. Move the picker carriage assembly **A** near the picker carriage detent assembly **B**.
6. Connect J1 to the driver board.
7. Insert the adjusting tool (part 2462612) into the drive diskette guide and carefully put downward pressure to the top of the tool. This aligns the tool to the drive diskette guide.
8. Turn the bed motor **D** clockwise until the right wall of I/O slot 1 touches the right side of the tool.
9. Tighten the three bed motor screws **E**.
10. Connect the AC power cable to the drive motor power cable.
11. Perform the carriage bed orient switch adjustment (93-322).

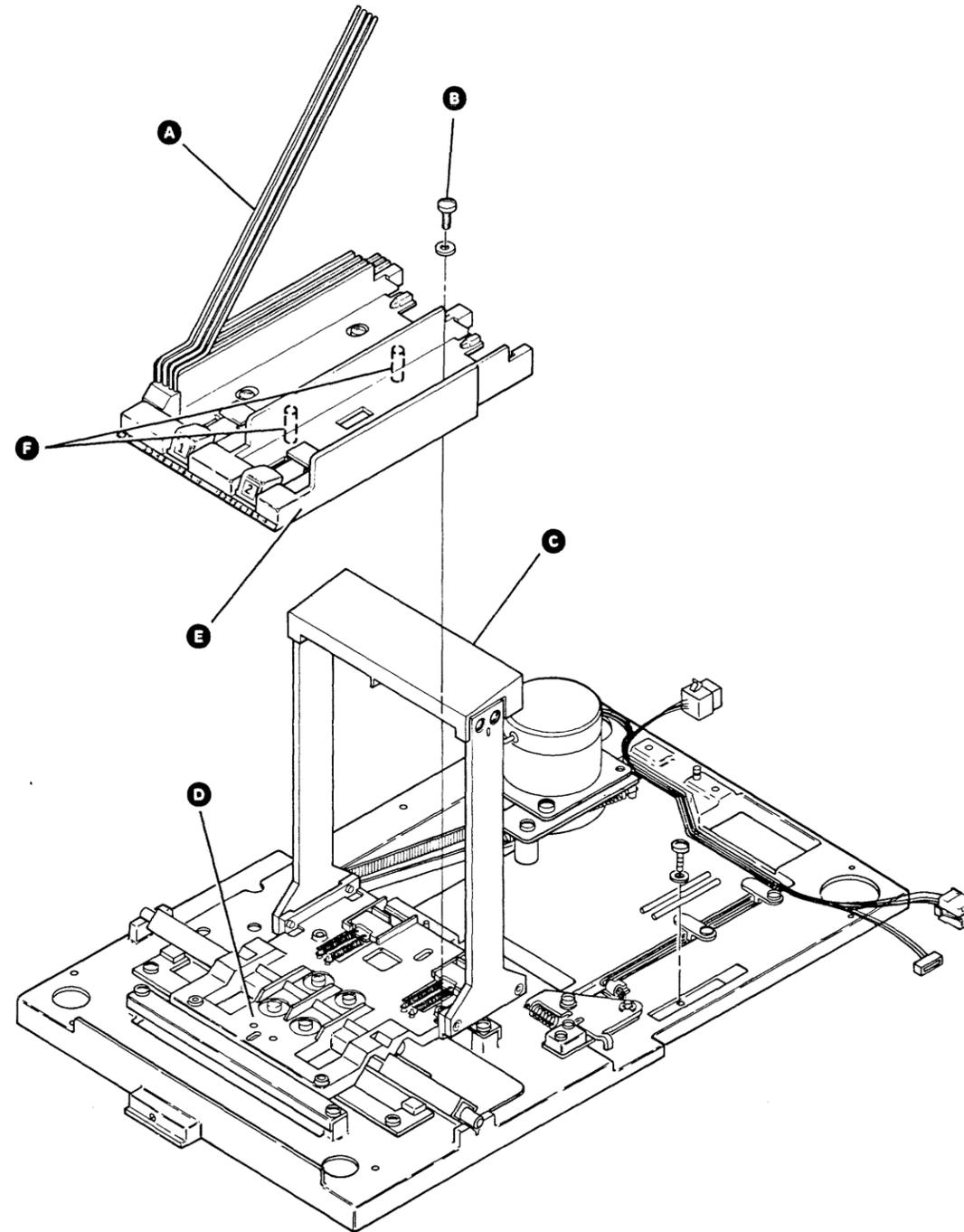


93-328 Carriage Bed Assembly Removal

1. Power off (01-115).
2. Remove the four mounting screws **B**.
3. Lift the carriage bed assembly **E** from the carriage bed casting **D**. Be careful not to damage the locating pins **F** on the bottom of the carriage bed.

93-329 Carriage Bed Assembly Replacement

1. Insert the I/O slot guide wires **A** into the slots in the housing **C**.
2. Align the carriage bed assembly **E** over the locating pin slots on the carriage bed casting and set the carriage bed assembly in place.
3. Fasten the carriage bed assembly with the four mounting screws **B**. Do not tighten the screws.
4. Perform the carriage bed-to-drive bezel adjustment (93-331) and return here.
5. Perform the carriage bed assembly orient service check (93-326).

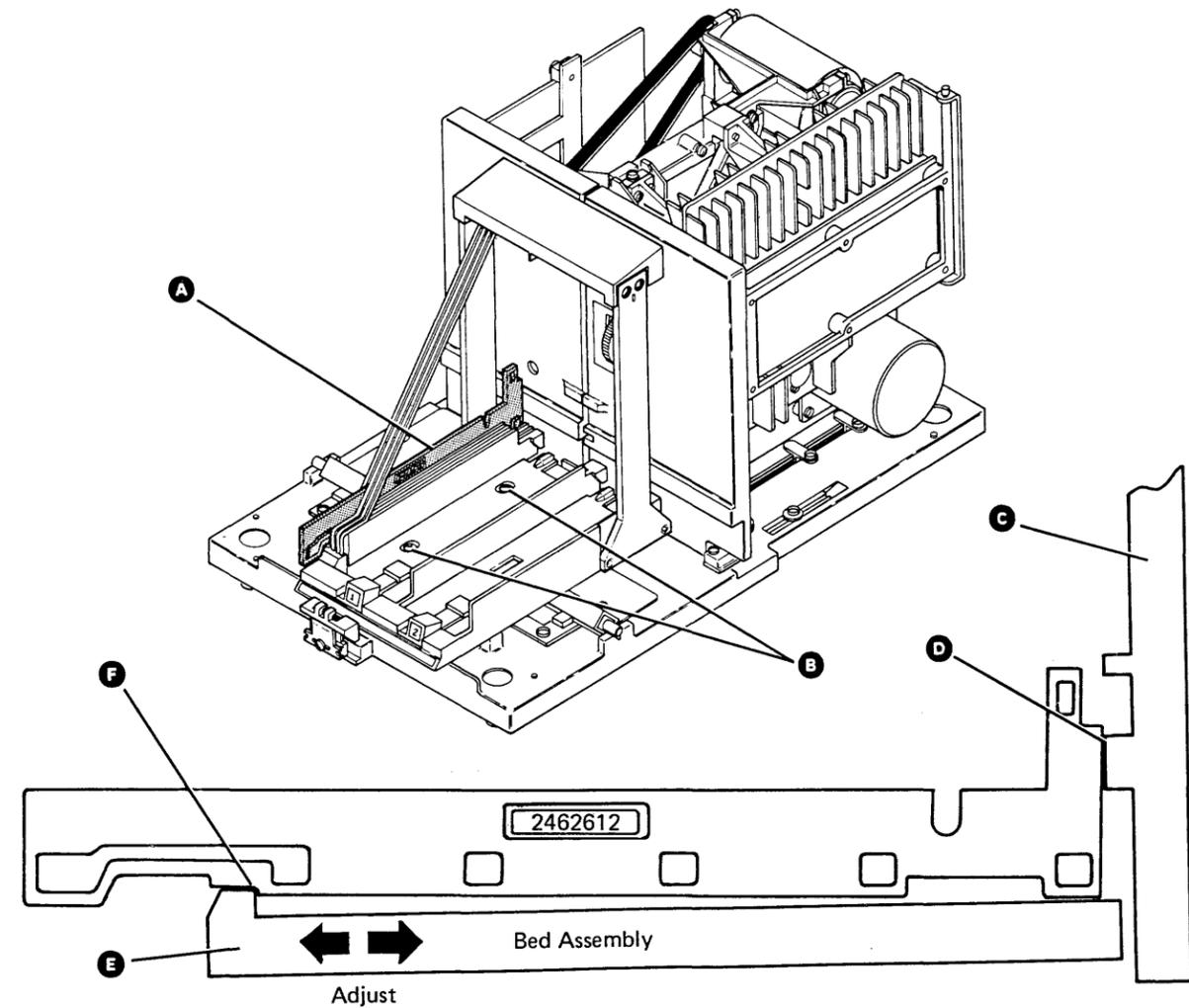


93-330 Carriage Bed-to-Drive Bezel Service Check

1. Power on (01-110).
2. Disconnect J4 from the driver board (93-250).
3. Move the bed assembly so that I/O slot 1 is near the center of the drive bezel.
4. Insert the adjusting tool **A** (part 2462612) into I/O slot 1 so that the second adjusting surface **F** touches the carriage bed **E**.
5. Check that the other end of the tool touches the drive bezel **D**. If it does not, perform the carriage bed-to-drive bezel adjustment (93-331).
6. Move the carriage bed assembly to align I/O slot 1 with the drive diskette guide.
7. Connect J4 to the driver board.
8. Perform the picker/cam bezel-to-carriage bed service check (93-343).

93-331 Carriage Bed-to-Drive Bezel Adjustment

1. Power on (01-110).
2. Disconnect J4 from the driver board (93-250).
3. Move the bed assembly so that I/O slot 1 is near the center of the drive bezel.
4. Loosen the four carriage bed screws **B** and slide the carriage bed **E** away from the bezel **C**.
5. Insert the adjusting tool **A** (part 2462612) into I/O slot 1 so that the second adjusting surface **F** of the tool touches the carriage bed **E**.
6. Slowly move the bed **E** toward the drive bezel **C** until the other end of the tool touches the drive bezel as shown at **D**.
7. Tighten the four carriage bed screws **B**.
8. Move the carriage bed assembly to align I/O slot 1 with the drive diskette guide.
9. Connect J4 to the driver board.
10. Perform the picker/cam bezel-to-carriage bed service check (93-343).



**93-340
Picker/Cam Timing Service Check**

1. Remove the picker/cam casting assembly (93-342) and return here.
2. Turn the cam **F** clockwise until it touches the cam stop pin **E**.

Is the belt pin **C** aligned with the timing indicator **D** on the casting?

Y **N**
 |
 | — Perform the picker/cam timing adjustment (93-341).

3. Turn the cam **F** counterclockwise and check that the belt pin **C** aligns with the notch **A** in the drive pulley flange and the notch **G** in the idler pulley flange.

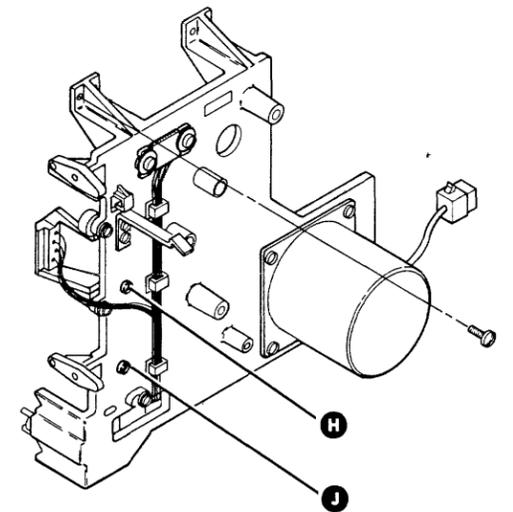
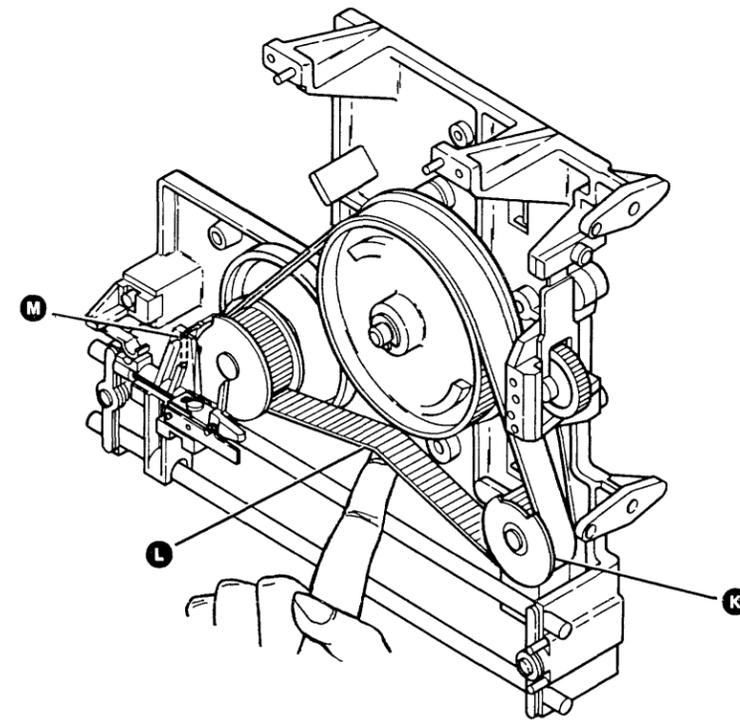
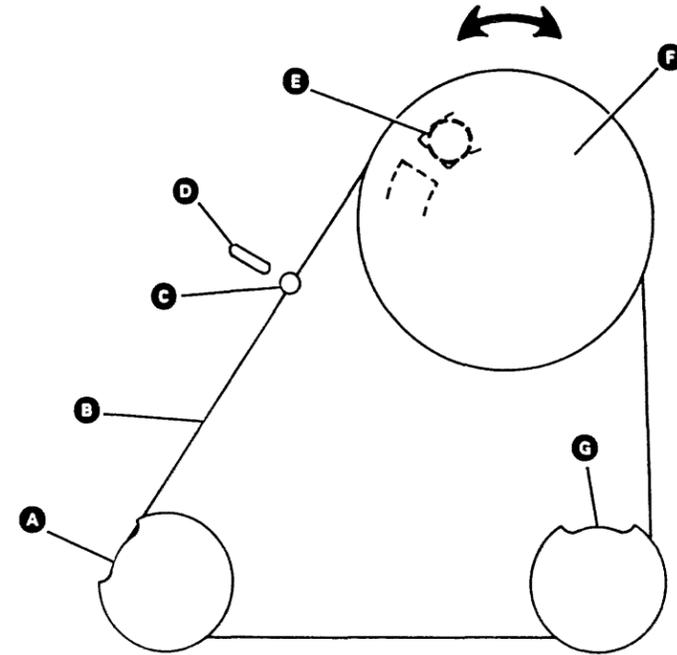
Is the picker timing OK?

Y **N**
 |
 | — Perform the picker/cam timing adjustment (93-341).

4. Perform the picker carriage detent service check (93-350).

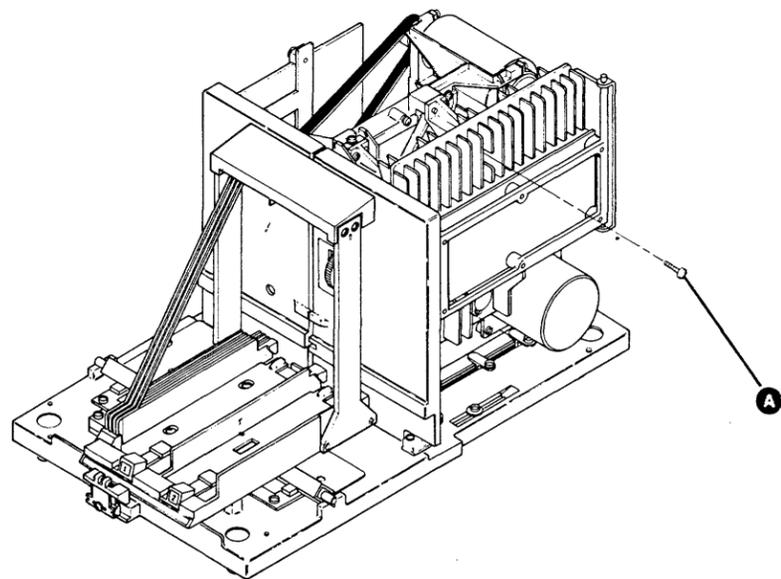
**93-341
Picker/Cam Timing Adjustment**

1. Remove the picker/cam casting assembly (93-342) and return here.
2. Loosen the screw **J** that holds the belt idler assembly **K**.
3. Loosen the pivot screw **H**.
4. Press on the belt **L** to move the belt idler pulley **K** to the end of its movement, and tighten the screw **H**.
5. Turn the cam **F** clockwise until it touches the cam stop pin **E**.
6. Keep the cam **F** against the cam stop pin **E** and slip the belt **B** until the pin **C** on the belt aligns with the timing indicator **D** on the casting. Place the notches (**G** and **A**) in the idler assembly pulley and the stepper motor pulley flanges as shown.
7. Loosen the belt idler assembly screw **H** to permit the spring to set the belt tension.
8. Tighten the holding screw **J** on the belt idler assembly.
9. Tighten the pivot screw **H**.
10. Turn the picker/cam and check that the belt pin aligns with the notch in the stepper drive pulley flange **A**, the notch in the idler pulley flange **G**, and the picker carriage slot **M**.
11. Reinstall the picker/cam casting assembly (93-342).



93-342 Picker/Cam Casting Assembly Removal and Replacement

1. Power off (01-115).
2. Remove the driver board holding screw **A**.
3. Remove the ground strap from the hinge side of the driver board gate.
4. Release the gate spring latch **H** and open the driver board gate **F** slightly.
5. Lift the driver board gate until the lower hinge is free. Tilt the gate slightly and remove it from the upper hinge.
6. Disconnect J3 from the driver board (93-250).
7. Carefully place the driver board gate on a flat surface with the cable connectors facing up.
8. Disconnect the sensor cable connector **D** located near the top of the picker/cam casting.
9. Move the carriage bed assembly to the left bed stop as shown at **B**.

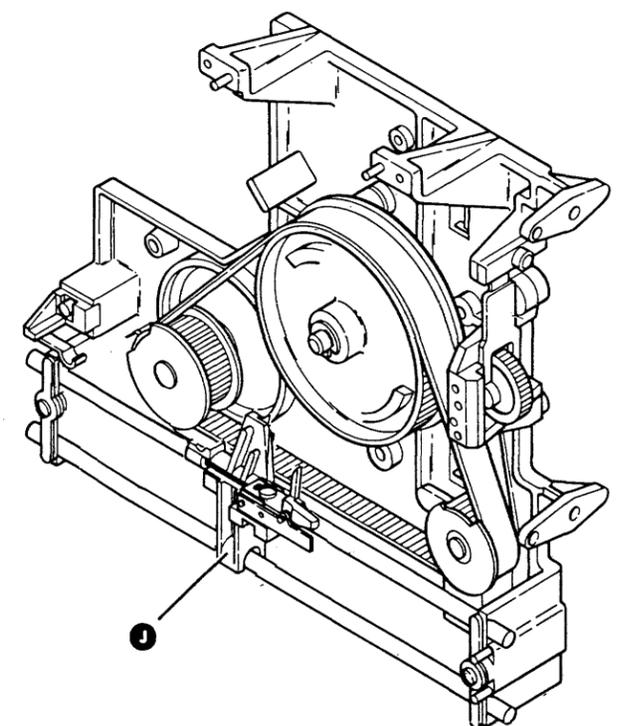
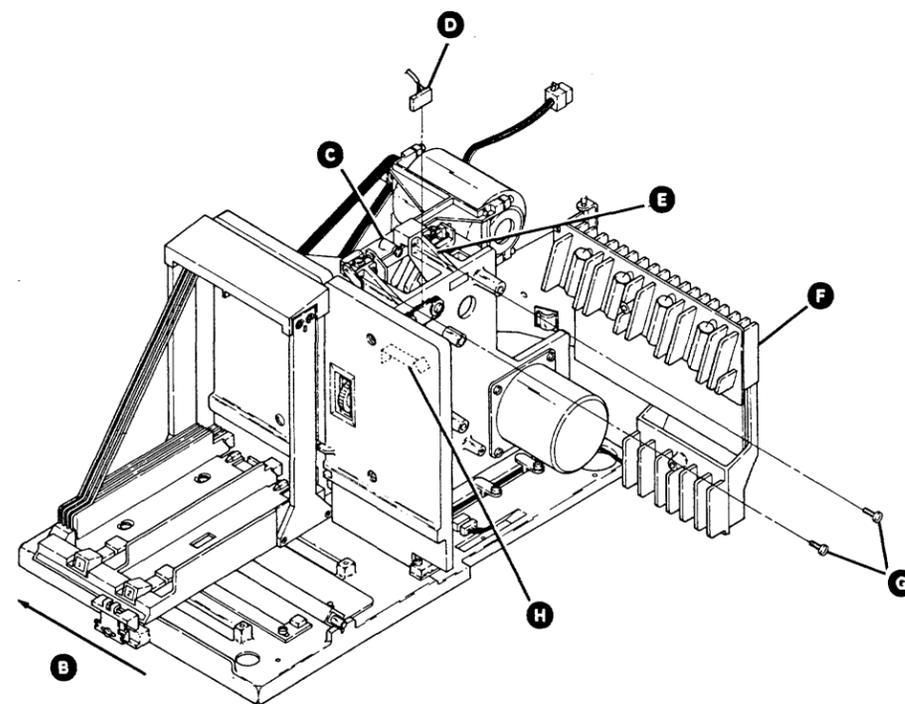


10. Turn the picker/cam to center the picker carriage assembly on the rails as shown at **J**.
11. Remove the two picker/cam casting holding screws **G**.

CAUTION

Be careful not to hit the head load bail assembly on the cam when you remove the picker/cam casting.

12. Separate the picker/cam casting **E** from the diskette drive casting **C** and lift it out.
13. To reinstall the picker/cam casting:
 - a. Center the picker carriage assembly as shown at **J** and replace in reverse order.
 - b. Perform the head load bail assembly service check (93-406) and return here.
 - c. Perform the picker/cam bezel-to-carriage bed adjustment (93-344).



93-343 Picker/Cam Bezel-to-Carriage Bed Service Check

1. Power off (01-115).
2. Move the carriage bed to align I/O slot 1 with the drive diskette guide.
3. Insert the adjusting tool **G** (part 2462612) into I/O slot 3 so that the second adjusting surface **F** touches the carriage bed.
4. Check that the other end **E** of the tool touches the picker/cam bezel **D**. If it does not, perform the picker/cam bezel-to-carriage bed adjustment (93-344).

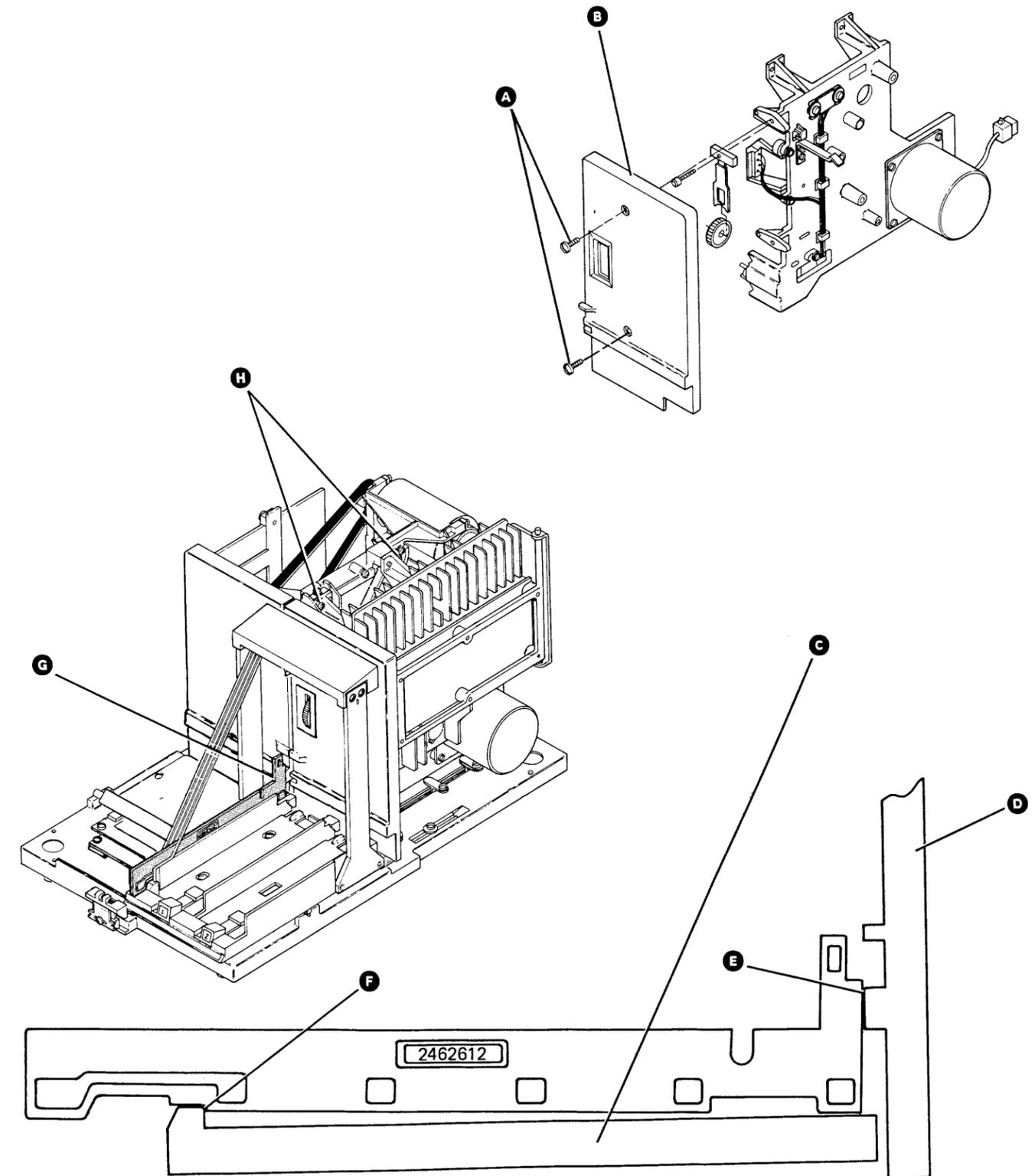
93-344 Picker/Cam Bezel-to-Carriage Bed Adjustment

Note: The carriage bed-to-drive bezel adjustment must be correct before this adjustment can be made. See 93-330.

1. Power off (01-115).
2. Move the carriage bed to align I/O slot 1 with the drive diskette guide.
3. Loosen the two picker/cam casting screws **H**.
4. Insert the adjusting tool **G** (part 2462612) into I/O slot 3 so that the second adjusting surface **F** touches the carriage bed.
5. Carefully move the picker/cam casting toward the carriage bed assembly **C** until the picker/cam bezel **D** touches the other end of the tool **E**.
6. Tighten the two picker/cam casting screws **H**.
7. Perform the picker extend service check (93-359).

93-345 Picker/Cam Bezel Removal and Replacement

1. Remove the two bezel mounting screws **A** and remove the bezel assembly **B**.
2. Reinstall in reverse order.



93-346 Picker/Cam Stepper Motor Resistance Service Check

1. Power off (01-115).
2. Disconnect the picker/cam stepper motor cable from driver board connector J3 (93-250).
3. Use a multimeter to measure the resistance between the following cable pins: 2 and 4, 4 and 6, 1 and 3, 3 and 5.

Are all the resistances between 2.5 and 3.5 ohms?

Y N

- | – Exchange the picker/cam motor (93-347).

4. Connect J3 to the driver board.

For additional service checks of the picker/cam stepper motor:

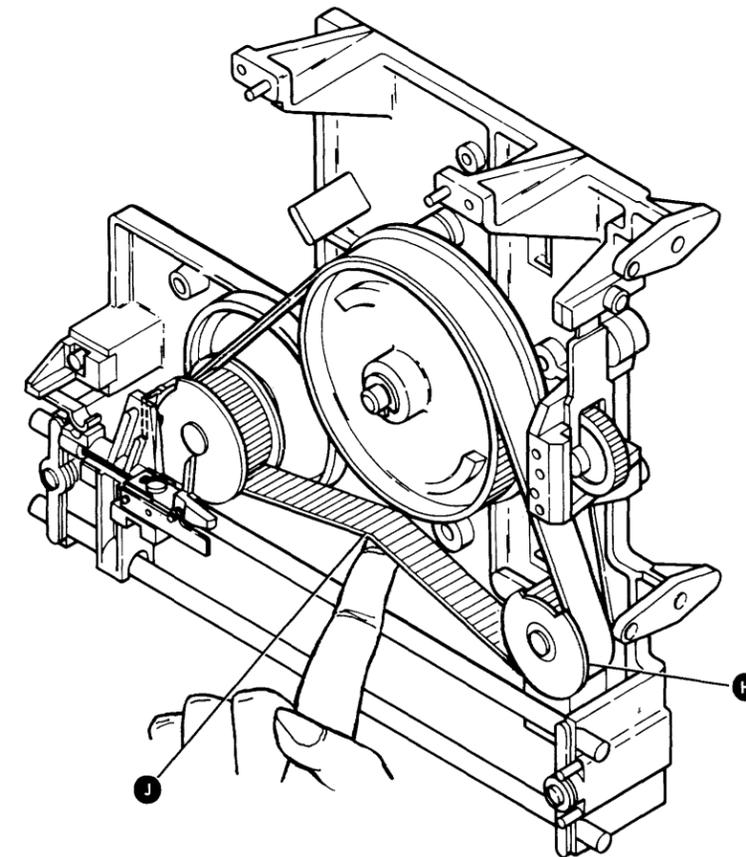
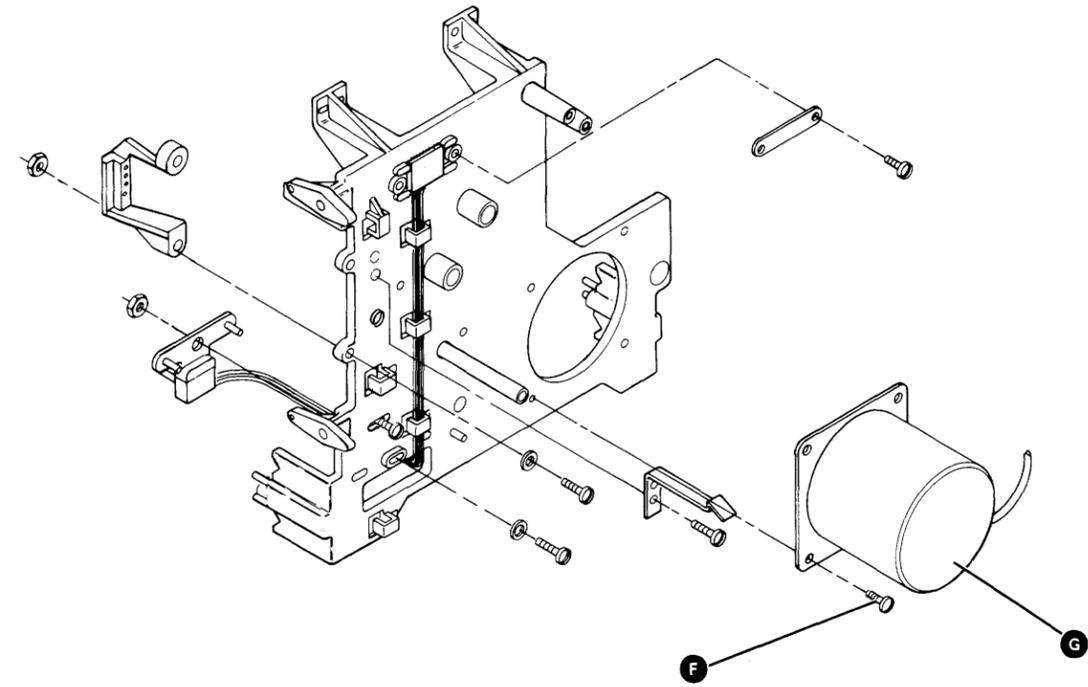
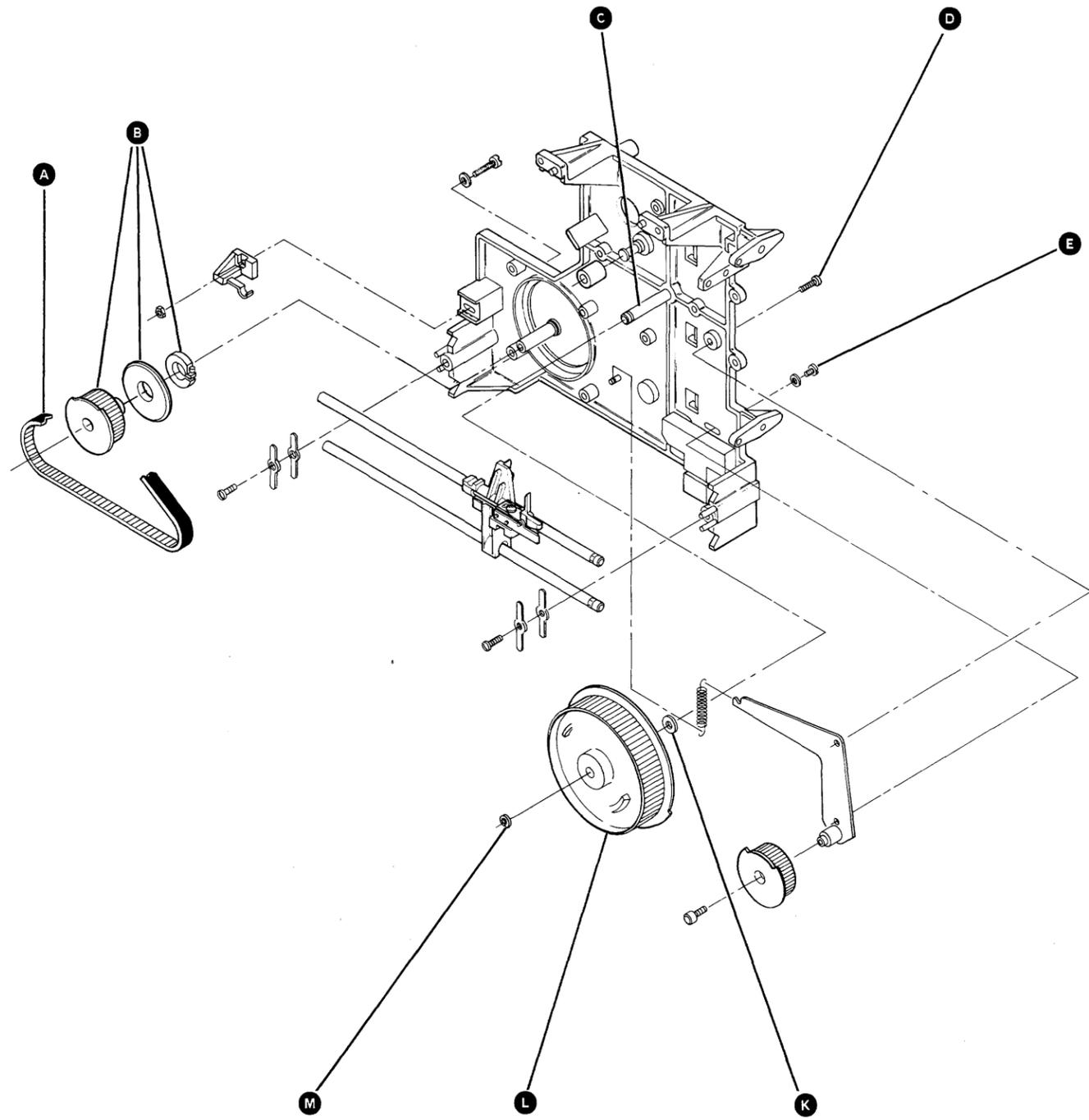
- See the drive control card output to picker/cam stepper motor service check (93-371) to check the output of the drive control card.
- See the driver board output to picker/cam stepper motor service check (93-380) to check the output of the driver board.

93-347 Picker/Cam Stepper Motor Removal and Replacement

1. Remove the picker/cam casting assembly (93-342).
2. Loosen the screw **E** in the belt idler assembly.
3. Loosen the pivot screw **D**.
4. Press on the belt **J** to move the belt idler pulley **H** to the end of its movement, and tighten the screw **E**.
5. Remove the belt **A**.
6. If the cam **L** is being removed, remove the clip **M** from the cam stud **C** and remove the cam. Note the spacer **K** behind the cam.
7. If the stepper motor **G** is being removed, remove the four stepper motor mounting screws **F** and remove the stepper motor.
8. Remove the pulley and the collar **B** from the motor shaft.
9. Reinstall in reverse order and perform the picker/cam timing adjustment (93-341, starting at step 5).

93-348 Picker Belt Removal and Replacement

1. Perform steps 1 through 5 of 93-347.
2. Reinstall in reverse order and perform the picker/cam timing adjustment (93-341, starting at step 5).

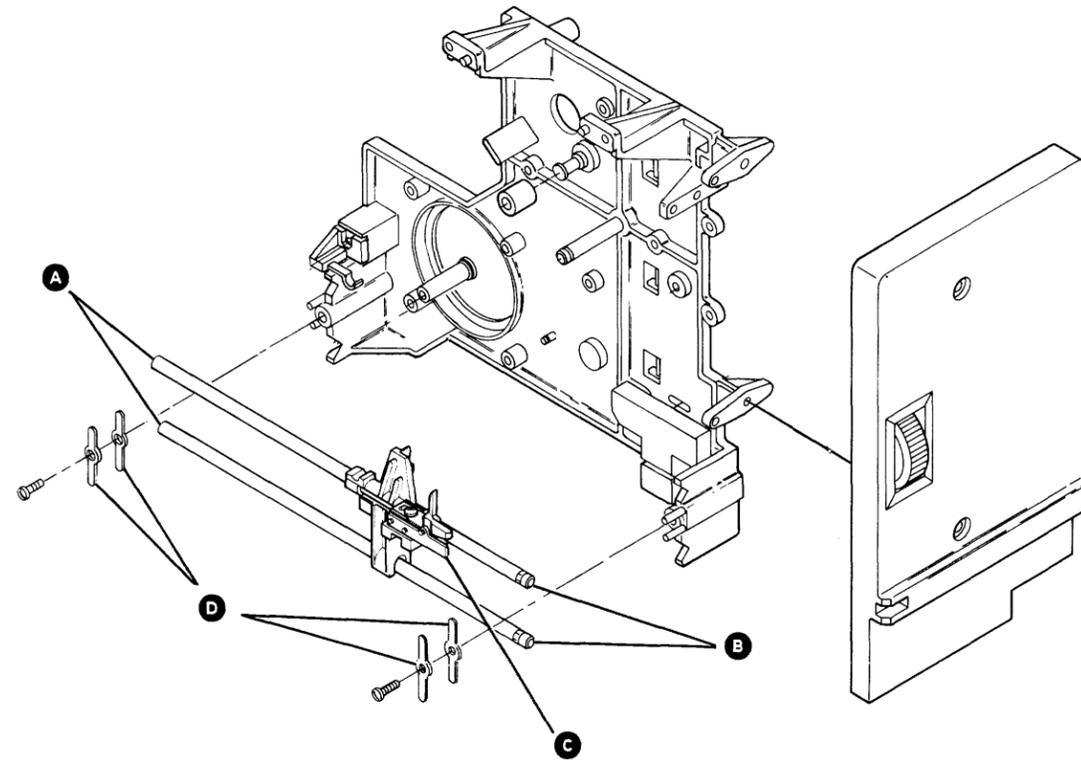


93-349 Picker Carriage Assembly Removal and Replacement

1. Remove the picker/cam casting assembly (93-342).
2. Remove the picker carriage assembly rail holding straps **D**.
3. Remove the rails **A** and the picker carriage assembly **C**.
4. Slide the picker carriage off the rails.

Note: The ends of the rails with the grooves **B** go toward the picker/cam bezel.

5. Reinstall in reverse order and perform the:
 - a. Picker finger adjustment (93-354)
 - b. Picker rest sensor adjustment (93-357).
 - c. Picker carriage detent service check (93-350).



93-350 Picker Carriage Detent Service Check

1. Power off (01-115).
2. Remove the picker/cam casting assembly (93-342) and return here.
3. Align the belt pin **A** with the timing mark **B** on the casting.
4. Move the picker carriage assembly **J** to where the lobe on the detent spring **H** touches the bottom of the dwell **K** on the picker carriage.
5. Turn the picker/cam **C** counterclockwise so that the belt pin **A** enters the belt pin slot on the picker carriage assembly.

Does the belt pin enter the center of the slot **F** in the picker carriage?

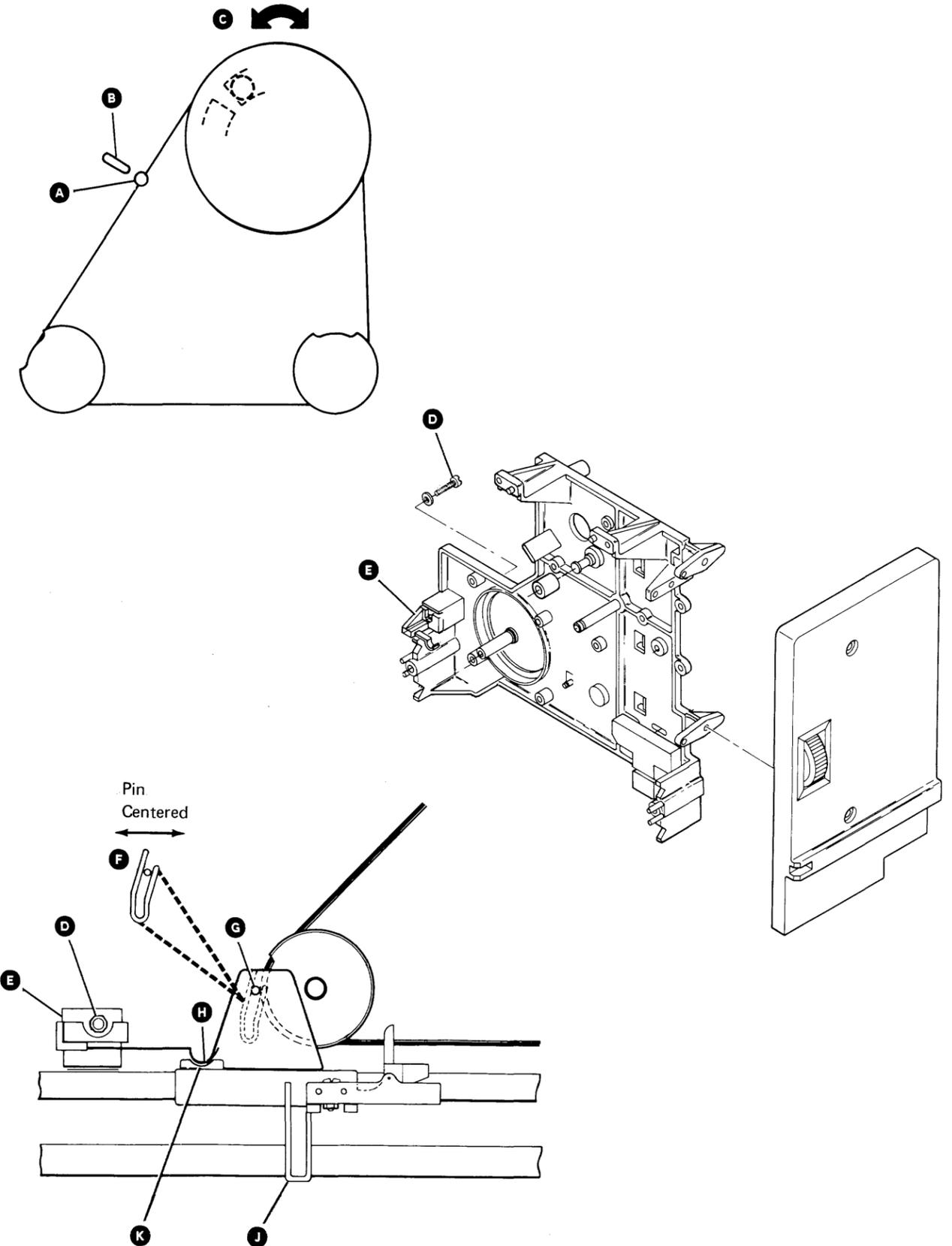
- Y** **N**
- Perform the picker carriage detent adjustment (93-351).
6. Reinstall the picker/cam casting assembly (93-342).

93-351 Picker Carriage Detent Adjustment

1. Power off (01-115).
2. Loosen the screw **D** on the detent assembly **E**.
3. With the belt pin **G** engaged in the slot **F** in the picker carriage, turn the picker/cam **C** clockwise until the picker carriage stops moving. The belt pin should still be touching the rear surface of the slot.
4. Carefully move the picker carriage to where the belt pin is centered inside the slot **F**.
5. Move the detent assembly to where the lobe on the detent spring **H** touches the bottom of the dwell **K** on the picker carriage.
6. Tighten the screw **D**.

93-352 Picker Carriage Detent Removal and Replacement

1. Power off (01-115).
2. Remove the fastening screw and nut **D** from the detent assembly.
3. Remove the detent assembly **E**.
4. Reinstall in reverse order and perform the picker carriage detent adjustment (93-351).



93-353 Picker Finger Service Check

Note: The following three adjustments must be correct before this service check can be made:

- Carriage bed-to-drive bezel adjustment (93-331)
- Picker extend adjustment (93-360)
- Picker finger adjustment (93-354)

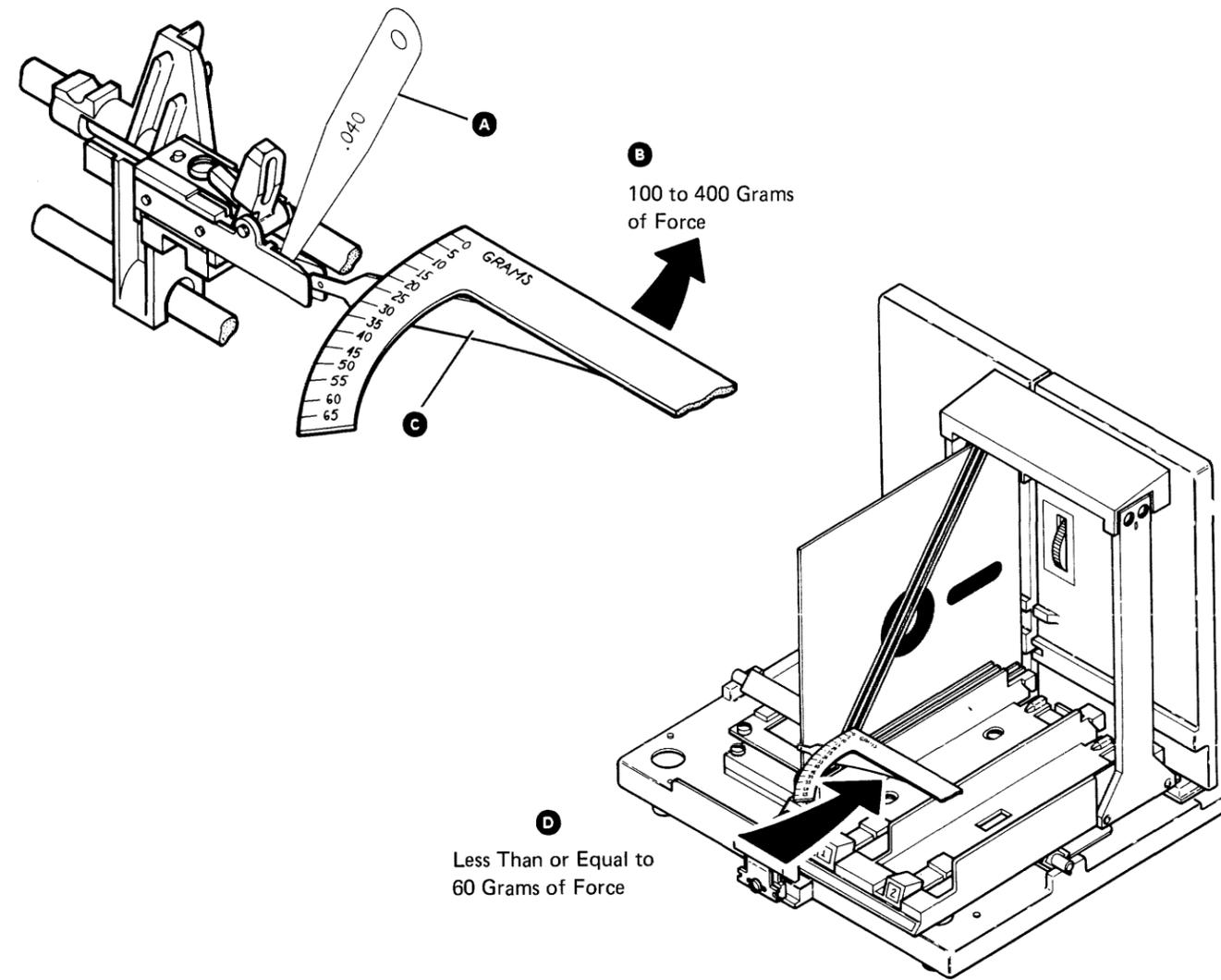
1. Disconnect the DC cable from driver board connector J1 (93-250).
2. Move the carriage bed so that magazine 2 position 2 (approximate) is aligned with the drive diskette guide.
3. Move the picker carriage assembly so that the picker finger assembly is completely extended.
4. Place a 1-millimeter (0.040-inch) gauge **A** between the picker fingers. Measure the force needed to make the gauge move or fall out of position. Use a gram gauge (part 450459) with a X10 blade **C**.

If the gauge does not remain in position, or if the force needed is less than 100 grams or more than 400 grams **B**, replace the picker spring finger.

5. Connect the DC cable to driver board connector J1.

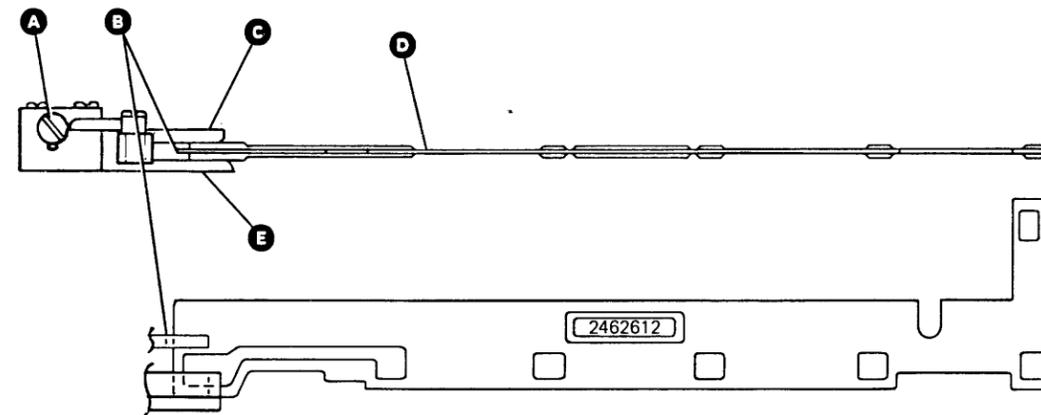
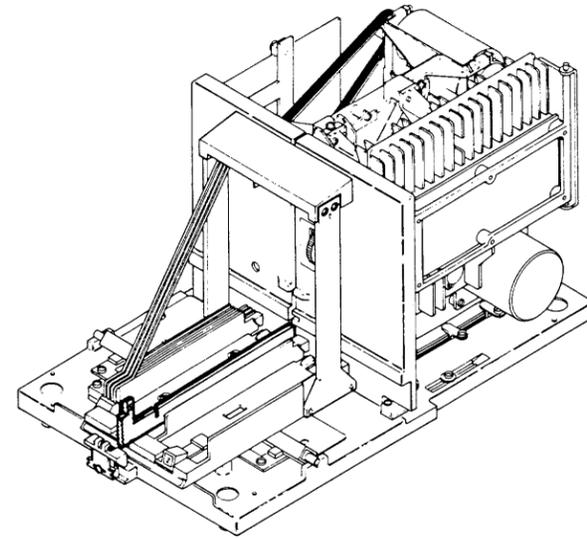
If the machine still fails to pick diskettes, check that the I/O slot guide wires are not bent and that the diskettes are not damaged. To check for damaged diskettes:

1. Place a failing diskette in the I/O slot that fails the most.
2. Use the gram gauge to measure the force needed to move the diskette out of the slot. If more than 60 grams of force is needed **D**, the diskette is damaged.



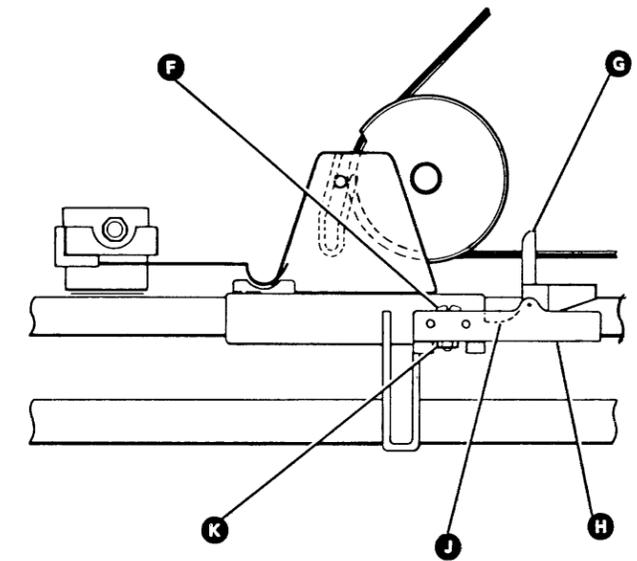
93-354 Picker Finger Adjustment

1. Power off (01-115).
2. Move the carriage bed so that magazine 1 position 5 aligns with the drive diskette guide (93-225).
3. Position the picker assembly so that the front tips of the picker fingers are even with the front guide surfaces of the bezels.
4. Push the collet assembly against the hub (this will permit you to access the picker finger mounting screw) and loosen the picker finger mounting screw **A**.
5. Lift the ejector assembly out of the way and install the adjusting tool **D** (part 2462612) between the picker fingers (**C** and **E**) and against the picker stop **B**.
6. Slide the tool approximately 13 millimeters (0.512 inch) into the drive. Keep the tool against the stop.
7. Carefully put downward pressure to the top of the tool. This will align the tool and the angle of the picker arms to the drive diskette guide.
8. Tighten the picker finger mounting screw **A** and remove the tool.
9. Perform the picker extend service check (93-359).



93-355 Picker Finger Removal and Replacement

1. Remove the picker/cam casting assembly (93-342).
2. Remove the picker finger assembly mounting screw **F** and nut **K**, then remove the diskette ejector **G**, the ejector detent spring **J**, and the picker finger assembly **H**.
3. Reinstall in reverse order and perform the picker finger adjustment (93-354).



93-356 Picker Rest Sensor Service Check

- Align I/O slot 1 with the drive diskette guide (93-225) by:
 - Powering on the system (01-110), or
 - Pressing the System Reset key.
- Disconnect the picker/cam stepper motor cable from driver board connector J3 (93-250).
- Disconnect the sensor cable connector **D**.
- Probe THP-5 (-picker extended) on the drive control card (93-245).

Is the output minus (down indicator light)?

Y N
| - Exchange the drive control card.

- Connect one end of a jumper to TPB-3 (picker PTX collector).
- Observe the probe and momentarily touch the other end of the jumper to THP-1 (ground).

Did the output change to positive (up indicator light)?

Y N
| - Exchange the drive control card.

- Remove the jumper from TPB-3 (picker PTX collector) and connect the sensor cable connector **D**.
- Observe the probe and turn the picker/cam to move the picker carriage from the back limit to the front limit.

Did the output change from a positive level (up indicator light) to a minus level (down indicator light)?

Y N
| - Exchange the picker rest sensor (93-358).

- Insert the adjusting tool **B** (part 2462612) into I/O slot 1 with the adjusting surface 1 against the carriage bed **A** and with the picker stop **C** against the tool.

- Observe the probe and slowly turn the picker/cam to move the picker carriage 0.5 to 1.5 mm (0.020 to 0.059 inch) away from the carriage bed.

Did the output change from a minus level to a positive level?

Y N
| Perform the picker rest sensor adjustment (93-357).

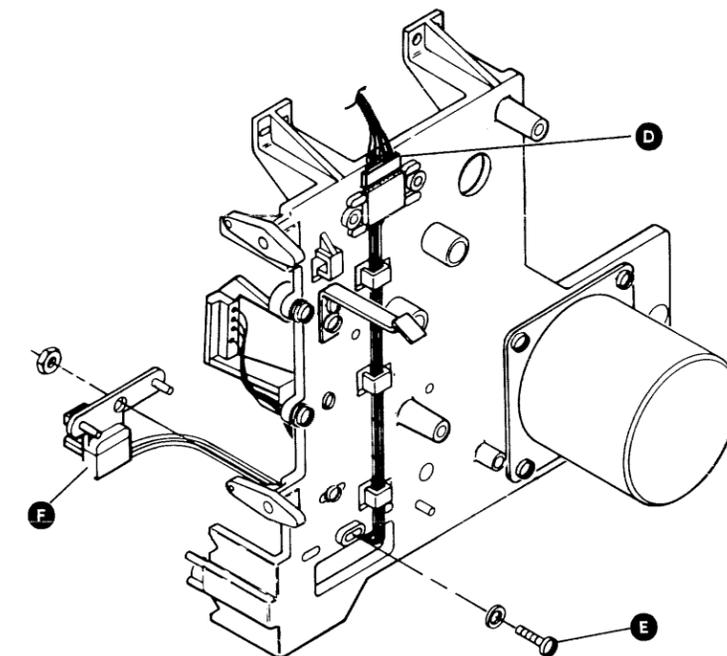
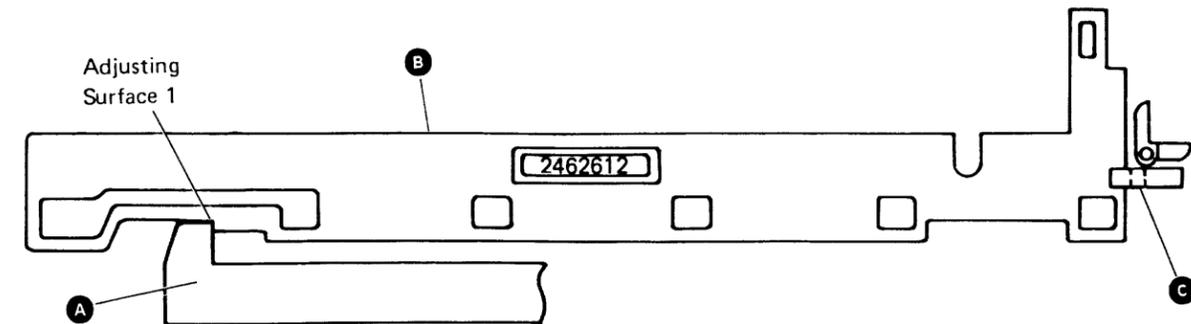
- Connect the picker/cam stepper motor cable to driver board connector J3.

93-357 Picker Rest Sensor Adjustment

- Perform the picker extend service check (93-359).

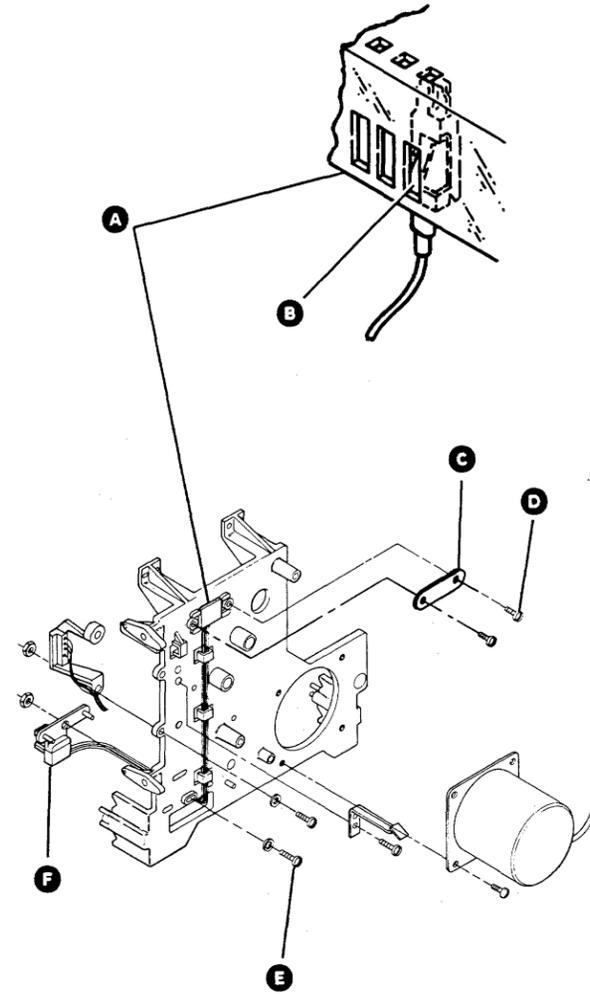
Note: The picker extend timing must be correct before the picker rest sensor can be adjusted correctly.

- Align I/O slot 1 with the drive diskette guide (93-225) by:
 - Powering on the system (01-110), or
 - Pressing the System Reset key.
- Disconnect the picker/cam stepper motor cable from driver board connector J3 (93-250).
- Insert the adjusting tool **B** (part 2462612) into I/O slot 1 and turn the picker by hand to place the picker stop **C** against one end of the tool and the carriage bed **A** against adjusting surface 1.
- Probe test pin THP-5 (-picker extended) (93-245).
- Loosen the sensor mounting screw **E** and adjust the sensor **F** so that the output is minus (down indicator light when using the general logic probe).
- Tighten the sensor mounting screw **E**. Turn the picker/cam to move the picker carriage 0.5 to 1.5 mm (0.020 to 0.059 inch) away from the carriage bed. Verify that the output at THP-5 is positive (up indicator light when using the general logic probe).
- Connect the picker/cam stepper motor cable to driver board connector J3.



93-358 Picker Rest Sensor Removal and Replacement

1. Remove the picker/cam casting assembly (93-342).
2. Remove the two screws **D** and the clamp **C** from the sensor cable connector **A**.
3. Remove the picker rest sensor leads from the connector **A** by pressing the tabs **B** in the connector with a small screwdriver.
4. Remove the mounting screw **E** from the bottom of the sensor **F** and remove the sensor.
5. Reinstall in reverse order and perform the picker rest sensor adjustment (93-357).

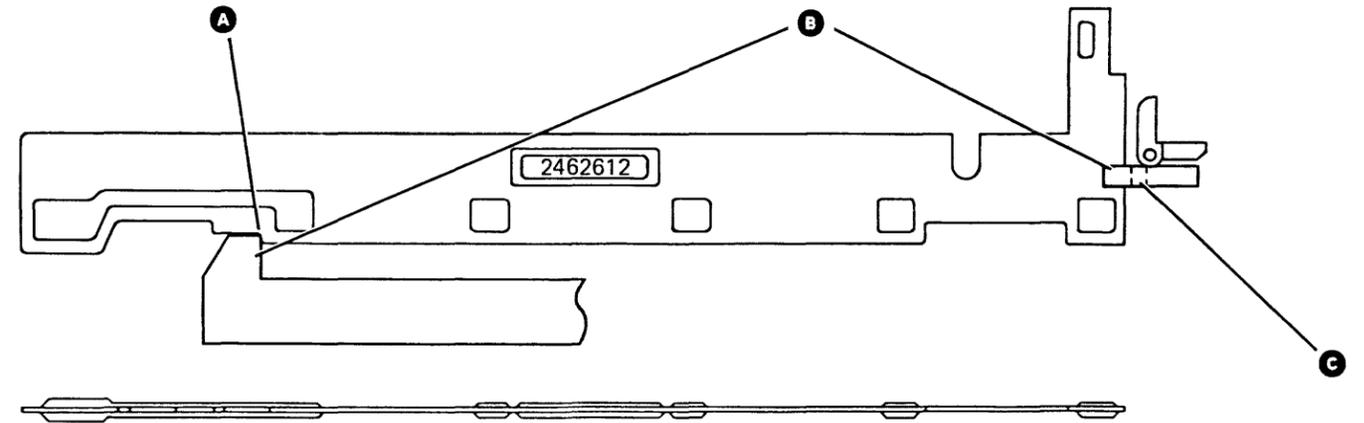


**93-359
Picker Extend Service Check**

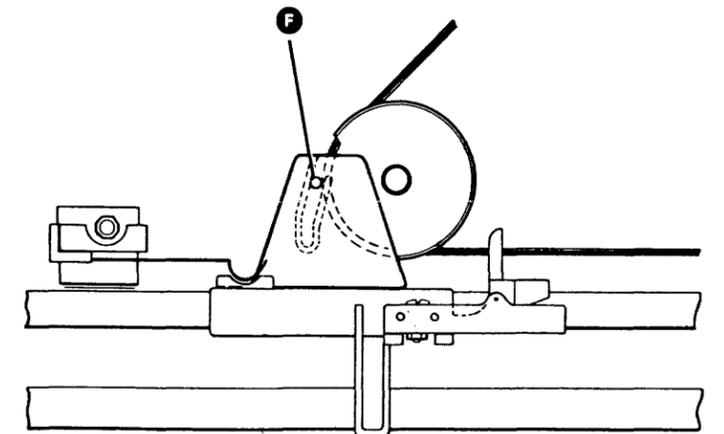
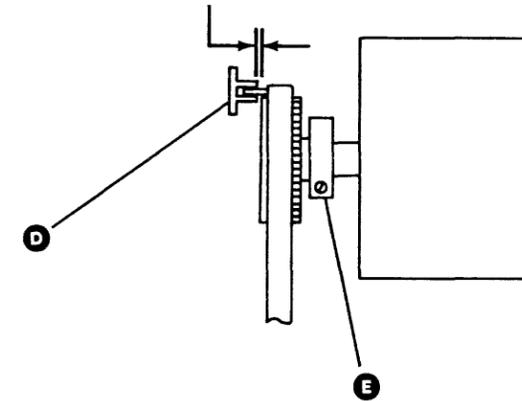
1. Align I/O slot 1 with the drive diskette guide (93-225) by:
 - a. Powering on the system (01-110), or
 - b. Pressing the System Reset key.
2. Disconnect the picker/cam motor cable from driver board connector J3 (93-250).
3. Insert the adjusting tool (part 2462612) into I/O slot 1 with the adjusting tool against the carriage bed **A**.
4. Turn the picker/cam by hand to place the picker stop **C** against the tool.
5. Remove the adjusting tool.
6. Connect the picker/cam motor cable to driver board connector J3 to detent the picker/cam motor.
7. Verify the position of the picker stop **C** using the adjusting tool. The tool should touch both the carriage bed and the picker stop as shown at **B**. If it is not correct, perform the picker extend adjustment (93-360).

**93-360
Picker Extend Adjustment**

1. Perform the carriage bed-to-drive bezel service check (93-330) and return here.
2. Align I/O slot 1 with the drive diskette guide (93-225) by:
 - a. Powering on the system (01-110), or
 - b. Pressing the System Reset key.
3. Disconnect the picker/cam motor cable from driver board connector J3 (93-250).
4. Turn the picker/cam until the pin on the belt starts to enter the slot **F** on the picker carriage.
5. Loosen the collar **E** on the stepper motor pulley and set the gap between the stepper motor pulley flange and the picker carriage **D** to 1.68 ± 0.13 millimeters (0.066 ± 0.005 inch).
6. Tighten the collar **E**.
7. Insert the adjusting tool (part 2462612) into I/O slot 1 with the adjusting tool against the carriage bed **A**, and move the picker stop **C** against the tool.
8. Connect the picker/cam motor cable to driver board connector J3.
9. Loosen the collar **E** and carefully turn the pulley until one end of the tool touches the picker stop **C** and the other end touches the back of I/O slot 1 **B**. Be careful when turning the pulley that the gap from step 5 is not changed.
10. Verify the adjustment from step 9 and tighten the collar **E**.
11. Remove the adjusting tool.
12. Check the gap from step 5.
13. Perform the picker rest sensor service check (93-356).

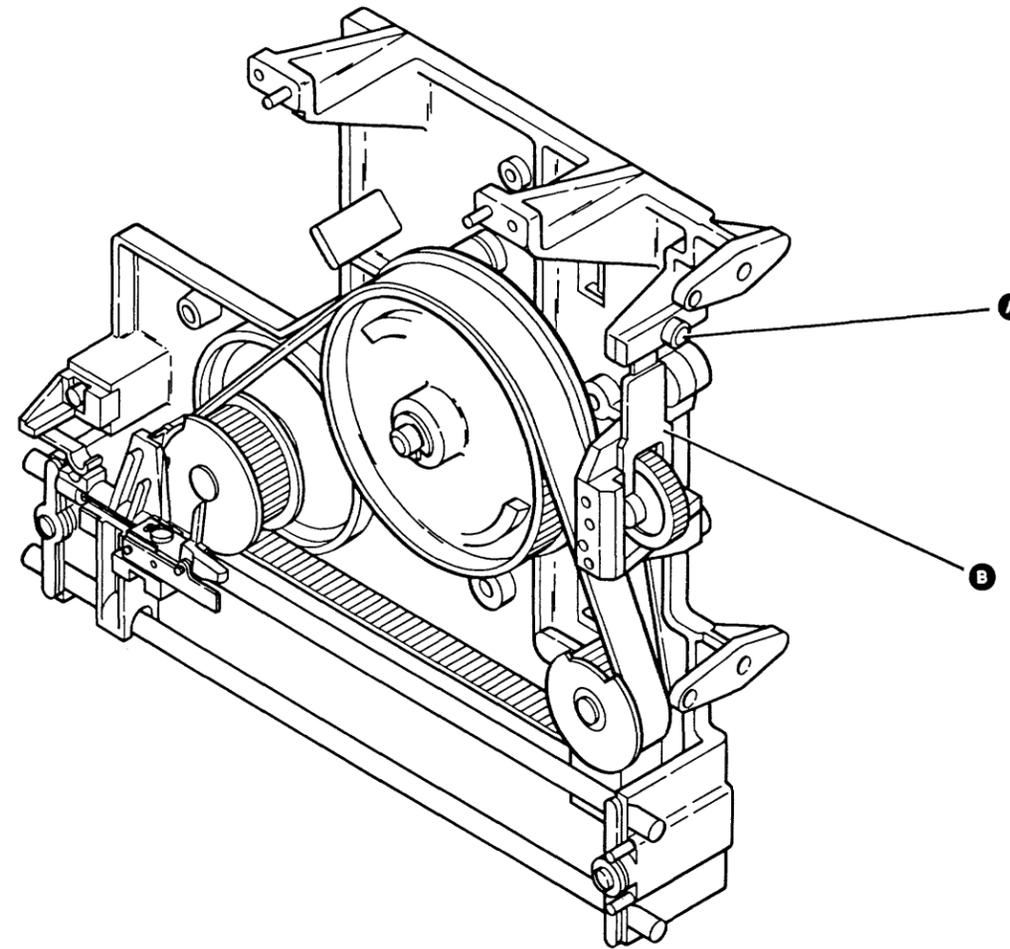


1.68 ± 0.13 mm
(0.066 ± 0.005 inch)



93-361
Jam Removal Wheel Removal and Replacement

1. Remove the picker/cam bezel assembly (two screws).
2. Remove the mounting screw **A** and the jam removal wheel assembly **B**.
3. Reinstall in reverse order.



**93-370
Drive Control Card Output to Carriage
Bed Stepper Motor Service Check**

This procedure permits you to use the read/write head access logic circuits to single step the carriage bed stepper motor. The output from the drive control card to the carriage bed stepper motor ('+auto step 0-3' lines) can then be checked at each increment step.

1. Power on (01-110).
2. Run the I/O exerciser (01-745).
3. Select the 72MD I/O exerciser from the device selection menu.
4. Select the Stepper Motor Test option.
5. Press the Enter key (read/write head seeks to cylinder 40).
6. Install a jumper from THP-4 (single step bed) to THP-1 (ground) on the drive control card (93-245).

CAUTION

This procedure uses the read/write head/carriage circuits to move the carriage bed stepper motor. Be careful not to damage the read/write head/carriage control circuits or read/write carriage assembly.

DANGER

Parts of the driver board become hot after continuous use.

7. Probe TPB-23 ('-bed motor' line) for a down level.
8. Probe TPB-18, 19, 20, and 21 ('+auto step 0-3' lines) for up levels. See the following chart for the correct level of the test points for each cylinder position.
9. Press the Enter key.

Note: Each time the Enter key is pressed, the head/carriage stepper motor increments to the next cylinder position.
10. Repeat steps 8 and 9 for all cylinder positions indicated on the following chart.

| Test Points | Read/Write Control Lines | Cylinder 40 | Cylinder 41 | Cylinder 42 | Cylinder 43 | Cylinder 44 |
|-------------|--------------------------|-------------|-------------|-------------|-------------|-------------|
| TPB-18 | Auto step 0 | Up | Down | Down | Up | Up |
| TPB-19 | Auto step 1 | Up | Up | Down | Down | Up |
| TPB-20 | Auto step 2 | Down | Up | Up | Down | Down |
| TPB-21 | Auto step 3 | Down | Down | Up | Up | Down |

Up level = +5 Vdc
Down level = Ground

Note: Only two lines should be active for each cylinder position.

11. Remove the jumper.

**93-371
Drive Control Card Output to
Picker/Cam Stepper Motor Service
Check**

This procedure permits you to use the read/write head access logic circuits to single step the picker/cam stepper motor. The output from the drive control card to the picker/cam stepper motor ('+auto step 0-3' lines) can then be checked at each increment step.

1. Power on (01-110).
2. Run the I/O exerciser (01-745).
3. Select the 72MD I/O exerciser from the device selection menu.
4. Select the Stepper Motor Test option.
5. Press the Enter key (read/write head seeks to cylinder 40).
6. Install a jumper from THP-3 (single step picker) to THP-1 (ground) on the drive control card (93-245).

CAUTION

This procedure uses the read/write head/carriage circuits to move the picker/cam stepper motor. Be careful not to damage the read/write head/carriage control circuits or read/write carriage assembly.

DANGER

Parts of the driver board become hot after continuous use.

7. Probe TPB-22 ('-picker motor' line) for a down level.
8. Probe TPB-18, 19, 20, and 21 ('+auto step 0-3' lines) for up levels. See the following chart for the correct level of the test points for each cylinder position.
9. Press the Enter key.

Note: Each time the Enter key is pressed, the head/carriage stepper motor increments to the next cylinder position.
10. Repeat steps 8 and 9 for all cylinder positions indicated on the following chart.

| Test Points | Read/Write Control Lines | Cylinder 40 | Cylinder 41 | Cylinder 42 | Cylinder 43 | Cylinder 44 |
|-------------|--------------------------|-------------|-------------|-------------|-------------|-------------|
| TPB-18 | Auto step 0 | Up | Down | Down | Up | Up |
| TPB-19 | Auto step 1 | Up | Up | Down | Down | Up |
| TPB-20 | Auto step 2 | Down | Up | Up | Down | Down |
| TPB-21 | Auto step 3 | Down | Down | Up | Up | Down |

Up level = +5 Vdc
Down level = Ground

Note: Only two lines should be active for each cylinder position.

11. Remove the jumper.

**93-380
Driver Board Output to Picker/Cam
Stepper Motor Service Check**

Note: The drive control card output (93-371) should be verified before performing this service check.

This procedure permits you to use the read/write head access logic circuits to single step the picker/cam stepper motor. The output from the driver board to the picker/cam stepper motor can then be checked at each increment step.

1. Power on (01-110).
2. Connect the negative meter lead of the multimeter to THP-1 (ground) on the drive control card (93-245). With the positive meter lead, measure the voltage on the A-side of diodes D7 and D9 (+3.5 Vdc to +4.7 Vdc) (93-250).
3. Run the I/O exerciser (01-745).
4. Select the 72MD I/O exerciser from the device selection menu.
5. Select the Stepper Motor Test option.
6. Press the Enter key (read/write head seeks to cylinder 40).
7. Install a jumper from THP-3 (single step picker) to THP-1 (ground) on the drive control card (93-245).

CAUTION

This procedure uses the read/write head/carriage circuits to move the picker/cam motor. Be careful not to damage the read/write head/carriage control circuits or the read/write carriage assembly.

DANGER

Parts of the driver board become hot after continuous use.

8. Probe TPB-22 ('-picker motor' line) for a down level.
9. Connect the negative meter lead of the multimeter to TPA-13 (ground). With the positive meter lead, measure the voltage on the A-side of diodes D6, D7, D8, and D9 (93-250). The voltages should compare with those shown in the following chart. When single stepping, the voltage measured for a not active level should be higher than the detent voltage measured in step 2.
10. Press the Enter key.
Note: Each time the Enter key is pressed, the picker/cam stepper motor increments to the next cylinder position.
11. Repeat steps 9 and 10 for all positions indicated in the following chart.

| Picker Motor Test Points | Cylinder 40 | Cylinder 41 | Cylinder 42 | Cylinder 43 | Cylinder 44 |
|--------------------------|-------------|-------------|-------------|-------------|-------------|
| D6-A | 1 | 0 | 0 | 1 | 1 |
| D8-A | 1 | 1 | 0 | 0 | 1 |
| D7-A | 0 | 1 | 1 | 0 | 0 |
| D9-A | 0 | 0 | 1 | 1 | 0 |

0 = Not active level (+5 Vdc or more), detent position (+3.5 Vdc to +4.7 Vdc)
1 = Active level (+0.5 Vdc to +1.1 Vdc)

12. Remove the jumper.

93-381 Driver Board Output to Carriage Bed Stepper Motor Service Check

Note: The drive control card output (93-370) should be verified before performing this service check.

This procedure permits you to use the read/write head access logic circuits to single step the carriage bed stepper motor. The output from the driver board to the carriage bed stepper motor can then be checked at each increment step.

1. Power on (01-110).
2. Connect the negative meter lead of the multimeter to THP-1 (ground) on the drive control card (93-245). With the positive meter lead, measure the voltage on the A-side of diodes D11 and D13 (+3.5 Vdc to +4.7 Vdc) (93-250).
3. Run the I/O exerciser (01-745).
4. Select the 72MD I/O exerciser from the device selection menu.
5. Select the Stepper Motor Test option.
6. Press the Enter key (read/write head seeks to cylinder 40).
7. Install a jumper from THP-4 (single step bed) to THP-1 (ground) on the drive control card (93-245).

CAUTION

This procedure uses the read/write head/carriage circuits to move the carriage bed motor. Be careful not to damage the read/write head/carriage control circuits or the read/write carriage assembly.

DANGER

Parts of the driver board become hot after continuous use.

8. Probe TPB-23 ('-bed motor' line) for a down level.
9. Connect the negative meter lead of the multimeter to TPA-13 (ground). With the positive meter lead, measure the voltage on the A-side of diodes D10, D11, D12, and D13 (93-250). The voltages should compare with those shown in the following chart. When single stepping, the voltage measured for a not active level should be higher than the detent voltage measured in step 2.
10. Press the Enter key.

Note: Each time the Enter key is pressed, the carriage bed stepper motor increments to the next cylinder position.
11. Repeat steps 9 and 10 for all positions indicated in the following chart.

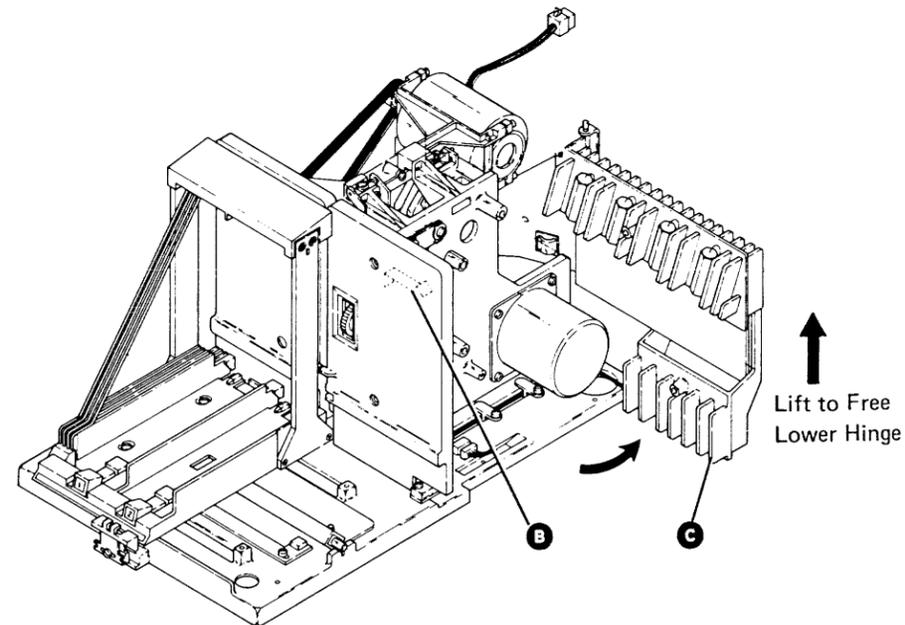
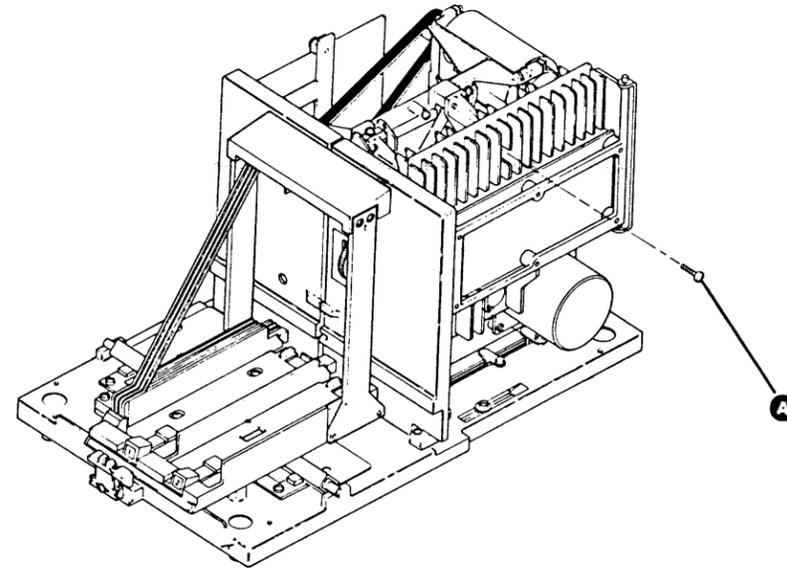
| Bed Motor Test Points | Cylinder 40 | Cylinder 41 | Cylinder 42 | Cylinder 43 | Cylinder 44 |
|-----------------------|-------------|-------------|-------------|-------------|-------------|
| D12-A | 1 | 0 | 0 | 1 | 1 |
| D10-A | 1 | 1 | 0 | 0 | 1 |
| D13-A | 0 | 1 | 1 | 0 | 0 |
| D11-A | 0 | 0 | 1 | 1 | 0 |

0 = Not active level (+5 Vdc or more), detent position (+3.5 Vdc to +4.7 Vdc)
1 = Active level (+0.5 Vdc to +1.1 Vdc)

12. Remove the jumper.

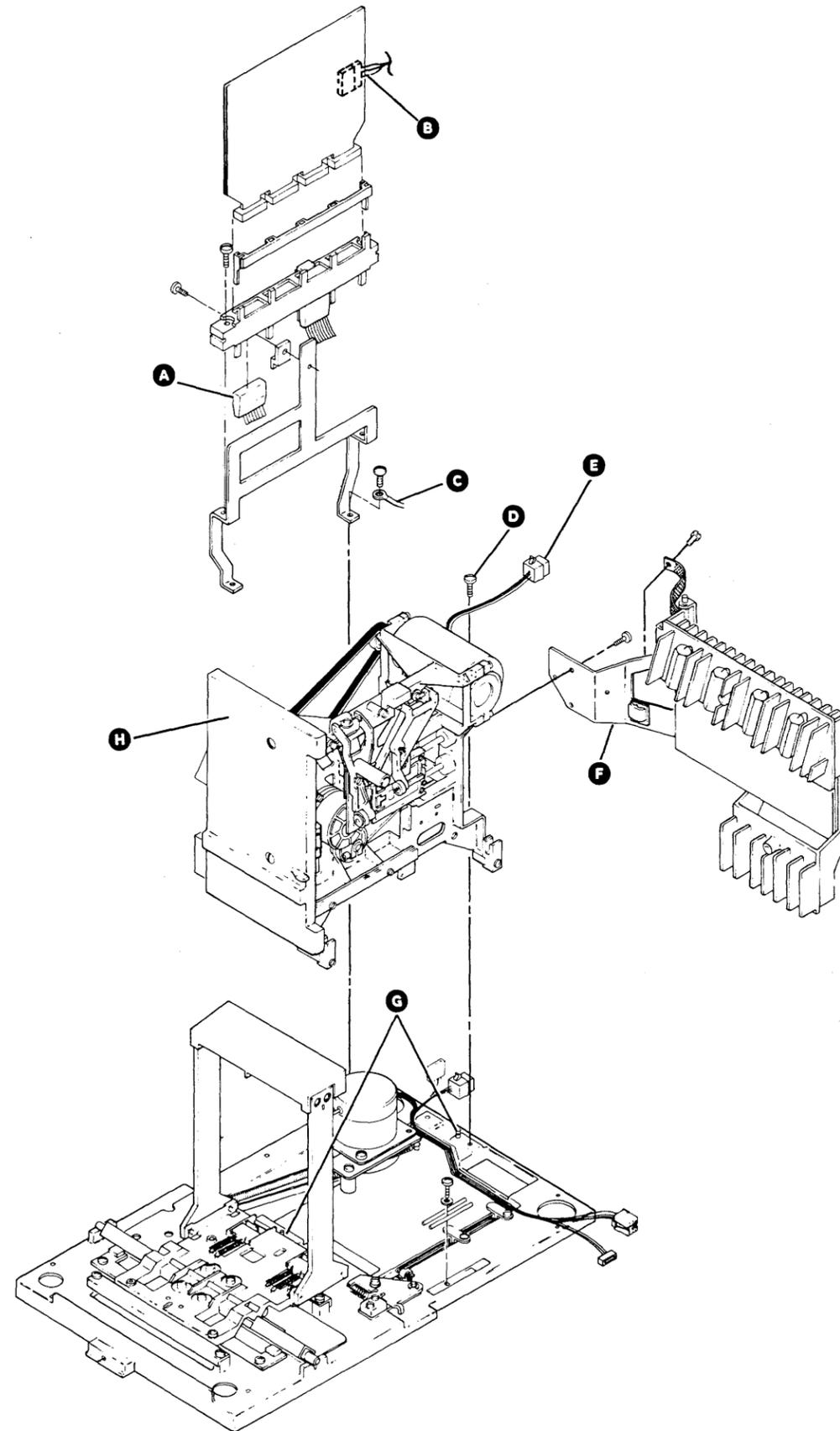
93-382 Driver Board Assembly Removal and Replacement

1. Power off (01-115).
2. Remove the screw **A** that holds the driver board.
3. Remove the ground strap from the hinge side of the gate.
4. Release the gate spring latch **B** and slightly open the driver board gate assembly **C**.
5. Lift the driver board gate assembly until the lower hinge is free. Tilt the gate slightly and remove from the upper hinge.
6. Disconnect the DC cable from driver board connector J1 (93-250).
7. Disconnect the control card cable from driver board connector J2 (93-250).
8. Disconnect the two stepper motor cables from driver board connectors J3 and J4 (93-250).
9. Reinstall in reverse order.



93-390
Drive Assembly Removal and Replacement

1. Power off (01-115).
2. Remove the picker/cam casting assembly (93-342).
3. Disconnect the drive motor AC power cable **E**.
4. Disconnect the head cable **B** from the drive control card.
5. Disconnect the diskette drive stepper motor/sensor cable (A1) **A** from the drive control card mounting assembly.
6. Remove the ground wire **C** from the drive control card bracket.
7. Remove the three screws from the driver board bracket **F** and remove the bracket.
8. Remove the drive bezel **H** (two screws).
9. Remove the three mounting screws **D** and star washers from the drive assembly (one at the carriage bed end and two in the rear).
10. Lift the drive assembly from the locating pins **G**.
11. Reinstall in reverse order.



**93-391
Head/Carriage Service Check**

1. Power off (01-115).
2. Remove the picker/cam casting assembly (93-342).
3. Insert a clean strip of paper between the heads to keep the head surfaces from touching.
4. Remove the two screws **D** and the wiper assembly.
5. Turn the stepper motor pulley to cylinder 40. Use the timing pin **C** to verify the alignment, but remove the timing pin before going to the next step.
6. Disconnect the AC power cable to the drive motor.

DANGER

Voltage is still present at the power connector when the head/carriage is disconnected and power is on.

7. Install a jumper from THP-2 (head reference) to THP-1 (ground) on the drive control card (93-245).
8. Power on (01-110).
9. Insert the timing pin **C** through the hole in the pulley and into the casting.

Does the timing pin pass freely through the stepper motor pulley into the timing slot in the casting?

- Y** **N**
- Remove the timing pin.
 - Remove the jumper.
 - Power off (01-115).
 - Go to 93-393, step 5.

10. Remove the timing pin.
11. Remove the jumper from THP-2 and THP-1.

12. Run the I/O exerciser (01-745).
13. Select the Diskette FRIENDs Test option.
14. Select the following commands and options:
 - a. Recalibrate
 - b. Seek (cylinder 39)
 - c. Seek (cylinder 40)
 - d. Execute selected commands
 - e. Step through commands
15. Press the Enter key (the head/carriage performs a recalibrate).
16. Press the Enter key (the head/carriage seeks to cylinder 39).
17. Verify that this is cylinder 39 by visually checking for no gap between the timing pointer and the timing block **E**.
18. Press the Enter key (the head/carriage seeks to cylinder 40).
19. Verify that this is cylinder 40 by visually checking that the timing hole in the pulley lines up with the timing slot in the casting. Do not use a timing pin.
20. Verify the head/carriage adjustment **B** as follows:
 - a. Insert thickness gauges measuring 0.495 millimeter (0.0195 inch) and visually check that the head/carriage assembly does not move.
 - b. Insert thickness gauges measuring 0.533 millimeter (0.021 inch) and visually check that the head/carriage moves slightly when you insert the 0.533 millimeter thickness gauges.

Note: Because of the torque of the stepper motor, this step can be performed only once. If it is necessary to verify the gap **B** again, go back to step 15 of this service check.

Is the adjustment correct?

- Y** **N**
- Loosen the two drive band clamp screws **A**.
 - Remove the jumper from THP-2 and THP-1 (if installed).
 - Go to 93-393, step 18.

21. Power off (01-115).
22. Reinstall the wiper assembly using the two screws **D**.
23. Remove the paper from between the heads.
24. Reinstall the picker/cam casting assembly (93-342).
25. Connect the drive motor AC power cable.

**93-392
Head/Carriage Cleaning Procedure**

The head/carriage cleaning procedure is not a normal maintenance routine. You should perform this procedure only if you suspect that the read/write heads are contaminated. Run the diskette utility (01-740) and select the Drive Test option to determine if the read/write heads need cleaning.

CAUTION

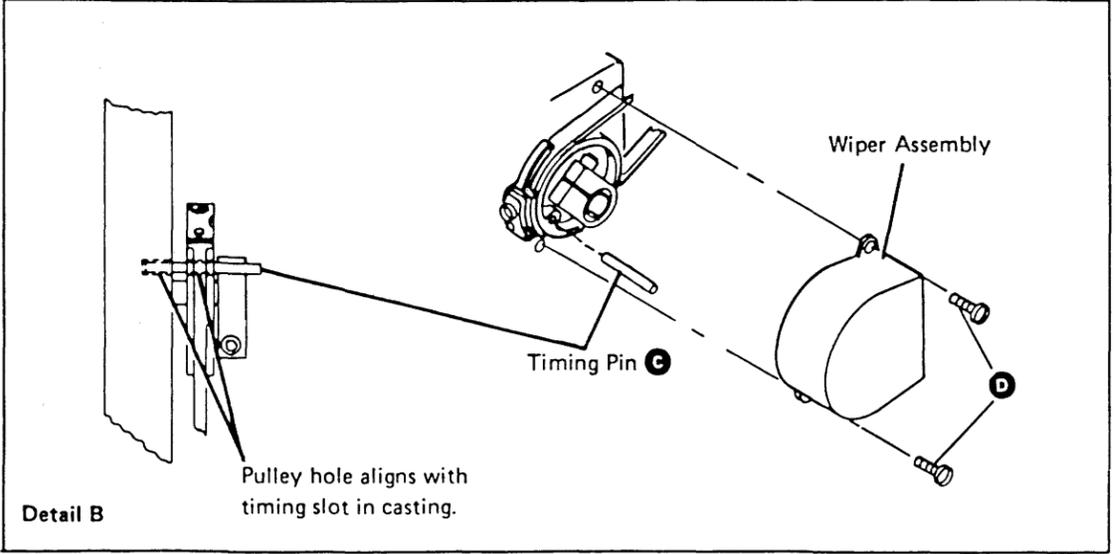
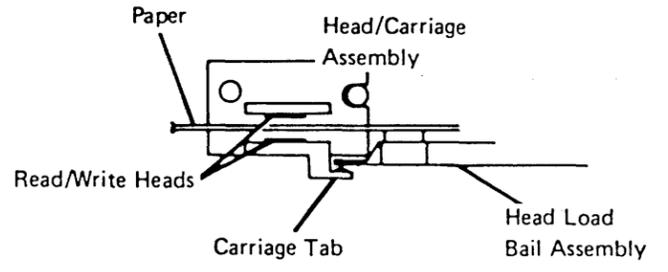
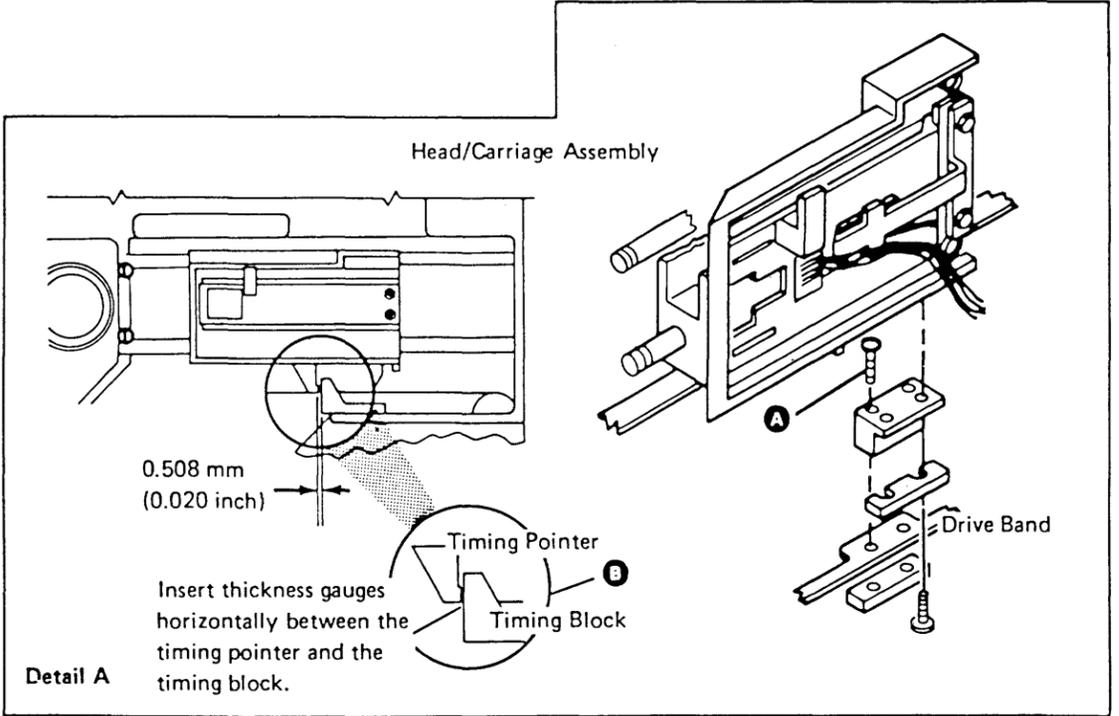
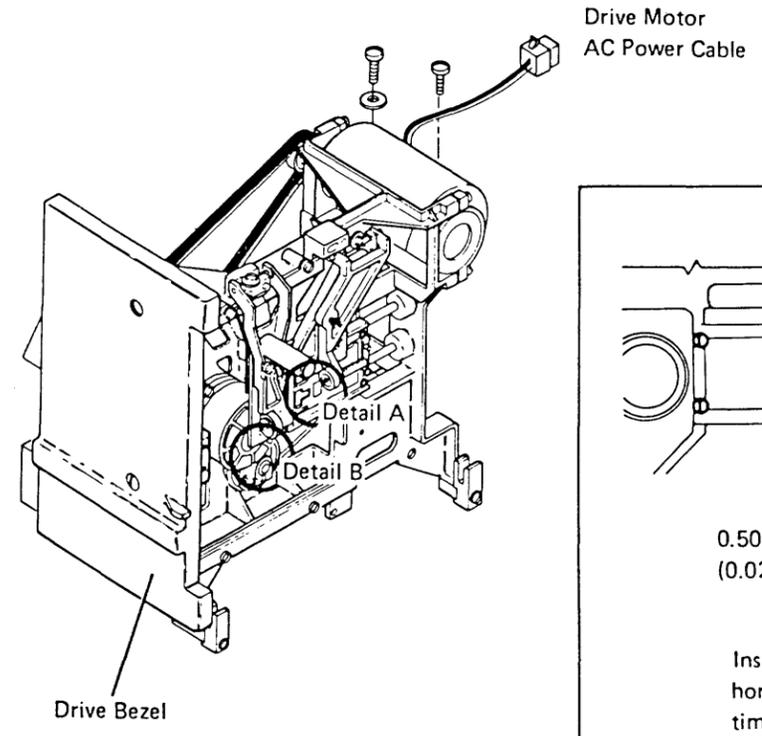
Read/write head damage may occur if you do not follow this procedure.

1. Power off (01-115).
2. Remove the picker/cam casting assembly (93-342).
3. Put a few drops of tape cleaner (part 453511) or isopropyl alcohol (part 2200200) on a clean strip of printer paper (or similar type of paper).
4. Insert the paper between the read/write heads.

CAUTION

To prevent damage to the read/write heads, always use the bail assembly to load the read/write heads.

5. Manually load the read/write heads by operating the bail assembly with your finger. Lightly rub the paper between the read/write head surfaces with a circular movement. Alternate between a clockwise and counterclockwise rotation.
6. Repeat steps 3 through 5 until the paper comes out clean.
7. Insert a dry strip of paper to remove excess fluid from the read/write heads.
8. Reinstall the picker/cam casting assembly (93-342).
9. Power on (01-110).
10. Initialize a scratch IBM diskette to ensure that all excess fluid is removed.
11. Run the diskette utility (01-740) and select the Drive Test option to check for correct operation of the diskette drive.
12. If the failure is still present, see the read/write head wear scoping procedure (93-419) before installing a new head/carriage assembly.



93-393 Head/Carriage Adjustment

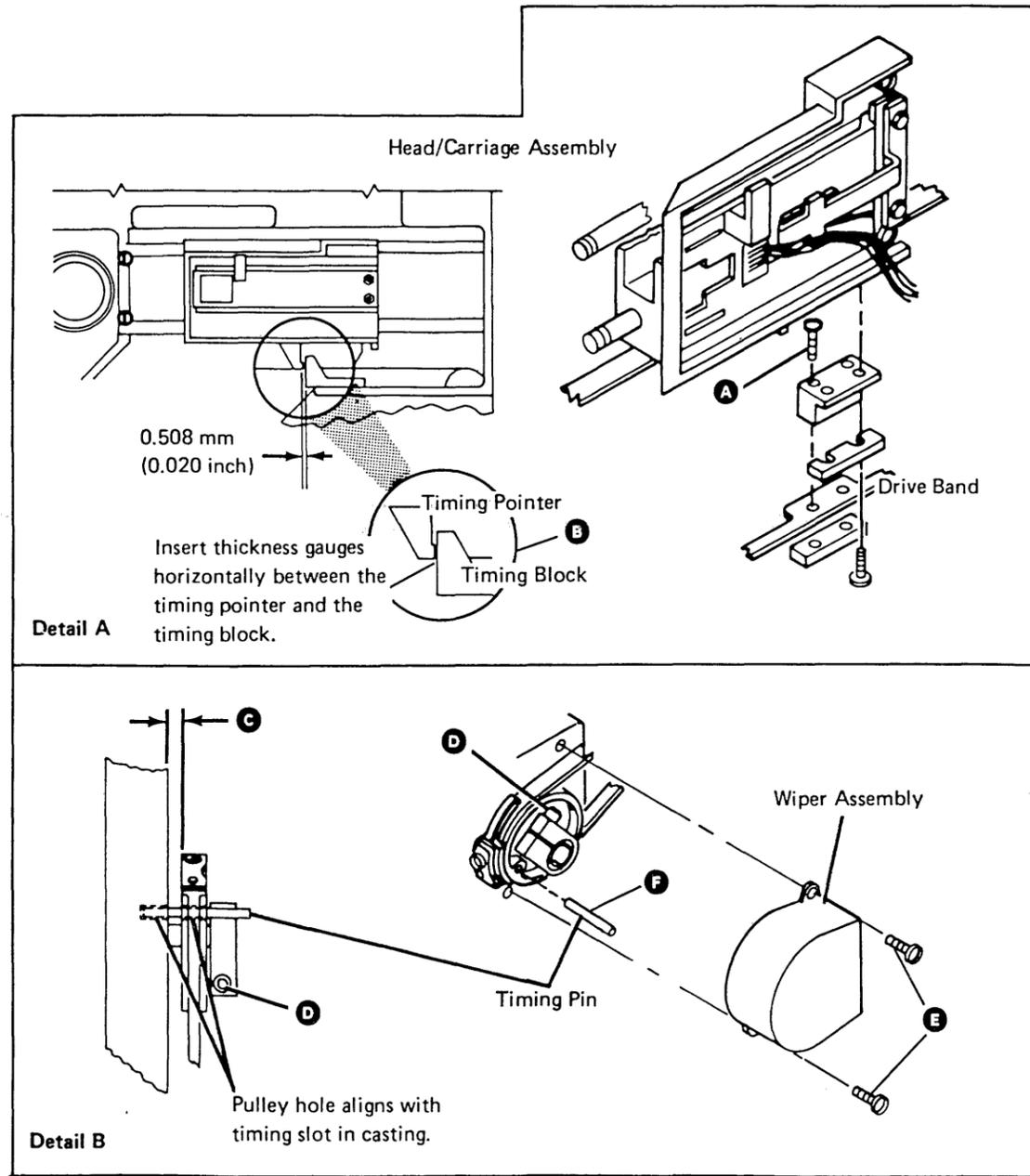
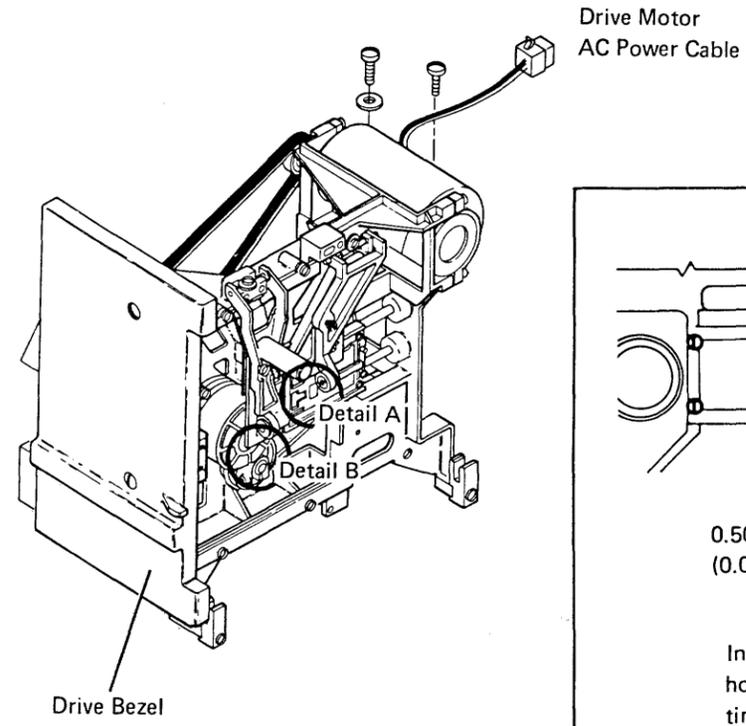
1. Power off (01-115).
2. Remove the picker/cam casting assembly (93-342).
3. Remove the two screws **E** and the wiper assembly.
4. Remove the drive bezel (two screws).
5. Measure and record the gap **C** between the stepper motor pulley and the casting.
6. Loosen the clamp screw **D** so that the stepper motor shaft can turn inside the pulley.
7. Turn the stepper motor pulley by hand to cylinder 40 and insert the timing pin **F**.
8. Disconnect the AC power cable to the drive motor.

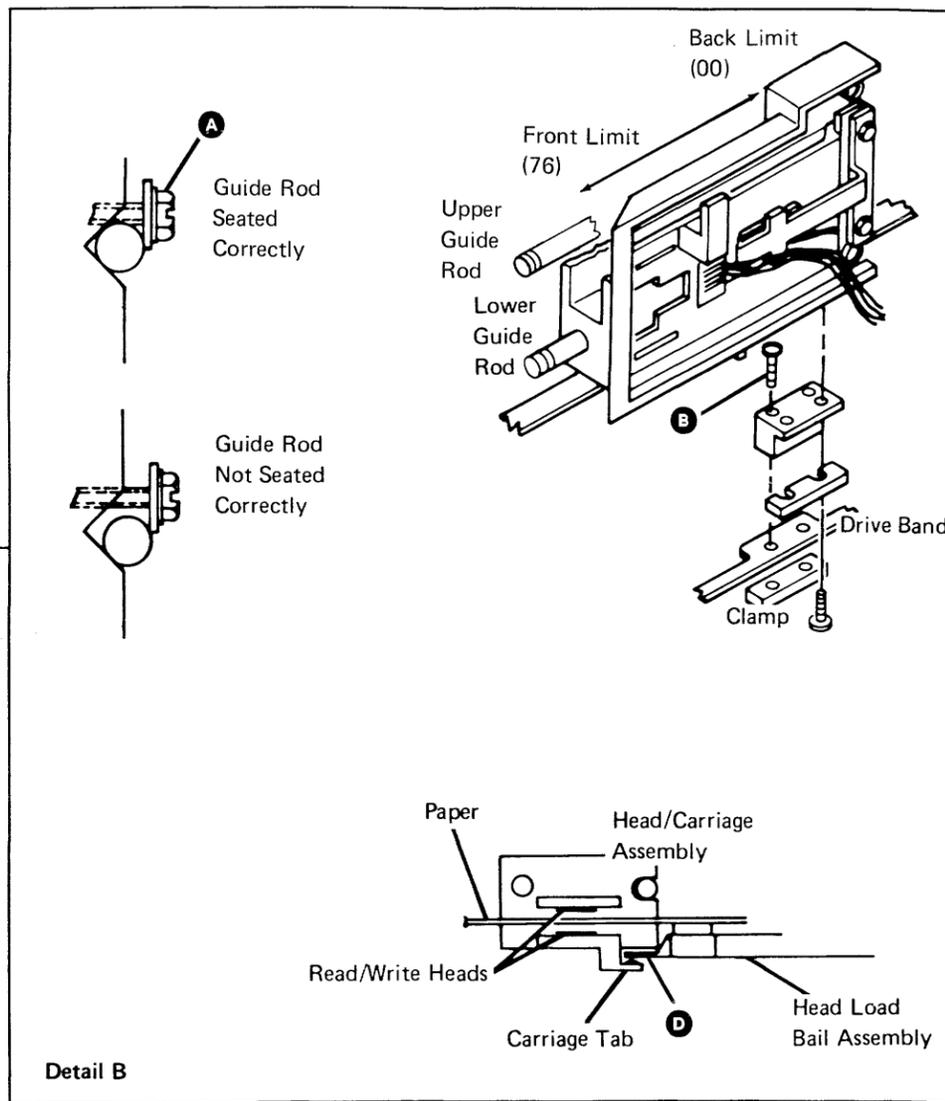
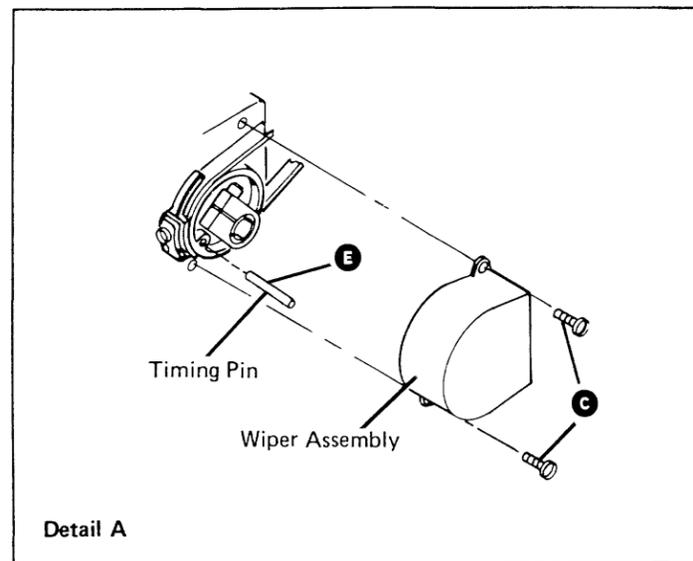
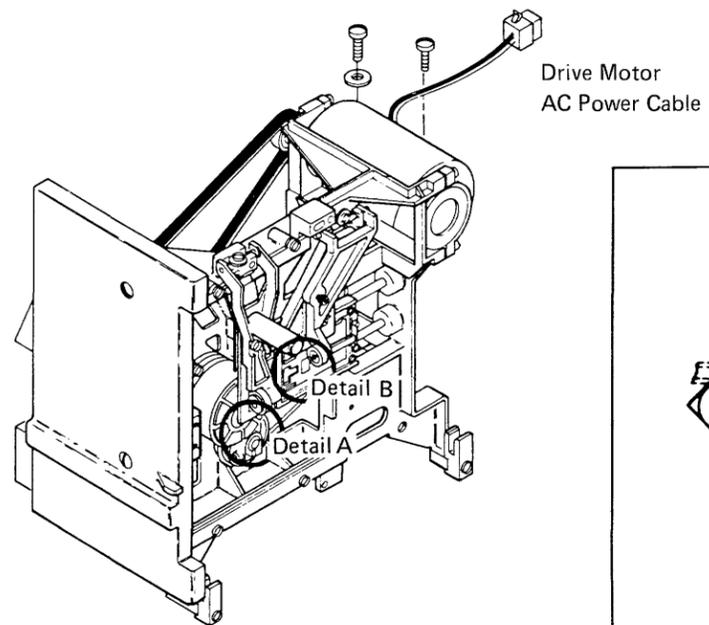
DANGER

Voltage is still present at the power connector when the head/carriage is disconnected and power is on.

9. Install a jumper from THP-2 (head reference) to THP-1 (ground) on the drive control card (93-245).
10. Power on (01-110).
11. Make the gap **C** the same size as the gap recorded in step 5 and tighten the clamp screw **D**. Ensure that the timing pin **F** passes freely through the stepper motor pulley into the timing slot in the casting.
12. Remove the timing pin.
13. Loosen the two drive band clamp screws **A**.
14. Remove the jumper from THP-2 and THP-1 (if installed).
15. Run the I/O exerciser (01-745).

16. Select the Diskette FRIENDs Test option.
17. Select the following commands and options:
 - a. Recalibrate
 - b. Seek (cylinder 39)
 - c. Seek (cylinder 40)
 - d. Execute selected commands
 - e. Step through commands
18. Press the Enter key (the head/carriage performs a recalibrate).
19. Press the Enter key. Observe that the display screen indicates that the head/carriage is at cylinder 39 (hex 27).
20. Press the Enter key. Observe that the display screen indicates that the head/carriage is at cylinder 40 (hex 28).
21. Verify that this is cylinder 40 by visually checking that the timing hole in the pulley lines up with the timing slot in the casting. Do not use the timing pin.
22. Insert a 0.508 millimeter (0.020-inch) thickness gauge between the timing pointer and the timing block **B**. Put light finger pressure to the top of the carriage to hold the thickness gauge in place.
23. Tighten the two band clamp screws **A**. Ensure that the drive band is straight.
24. Reinstall the drive bezel (two screws).
25. Go to 93-391, step 15 to verify the head/carriage adjustment.





**93-396
Head/Carriage Stepper Motor Removal**

1. Remove the picker/cam casting assembly (93-342).
2. Carefully disconnect the head cable from the drive control card (93-245).
3. Remove the drive control card and mounting assembly.
4. Remove the two screws **F** and the two connector covers **E** from the A1 cable.
5. Remove the stepper motor leads from the cable connector by pushing down on the terminal tabs with a small screwdriver.

CAUTION

While performing the following steps, be careful not to damage the drive band.

-
-
-
6. Remove the two screws **T** and the wiper assembly **S**.
 7. Loosen the two idler mounting screws **G**, push the idler assembly **A** against the spring tension, and tighten the screws **G**.
 8. Remove the drive bezel (two screws).
 9. Remove the clamp screw **K** and the band clamp **L**.
 10. Carefully remove the drive band ends **M** from the pulley pin **P**.
 11. Measure and record the gap **J** between the stepper motor pulley and the casting.
 12. Loosen the clamp screw **R** and remove the stepper motor pulley **N**.
 13. Remove the three stepper motor mounting screws **C** and then remove the stepper motor **B**.

**93-397
Head/Carriage Stepper Motor Replacement**

1. Reinstall the stepper motor **B** using the three mounting screws **C**. Place the motor cable at the rear of the unit.
2. Insert the stepper motor leads into the A1 cable connector. Ensure that the locking tabs on the terminals lock in the connector slots.
3. Reinstall the connector covers **E** and the two screws **F**.
4. Reinstall the stepper motor pulley **N**. Keep the clamp screw **R** loose so that the motor shaft can turn inside the pulley.

CAUTION

While performing the following steps, be careful not to damage the drive band.

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-
-
5. Carefully reinstall the drive band ends **M** on the pulley pin **P**. Reinstall the band clamp **L**, with the notch facing away from the stepper motor, and the screw **K**. Do not tighten the screw.
 6. Loosen the two idler mounting screws **G** and let the spring tension place the idler **A**.
 7. Tighten the mounting screws **G** and center the drive band on the idler pulley **H**.
 8. Reinstall the drive control card and mounting assembly.
 9. Carefully reinstall the head cable on the drive control card (93-245).
 10. Turn the stepper motor pulley to cylinder 40 and insert a timing pin **Q**.
 11. Disconnect the AC power cable **D** to the drive motor.

DANGER

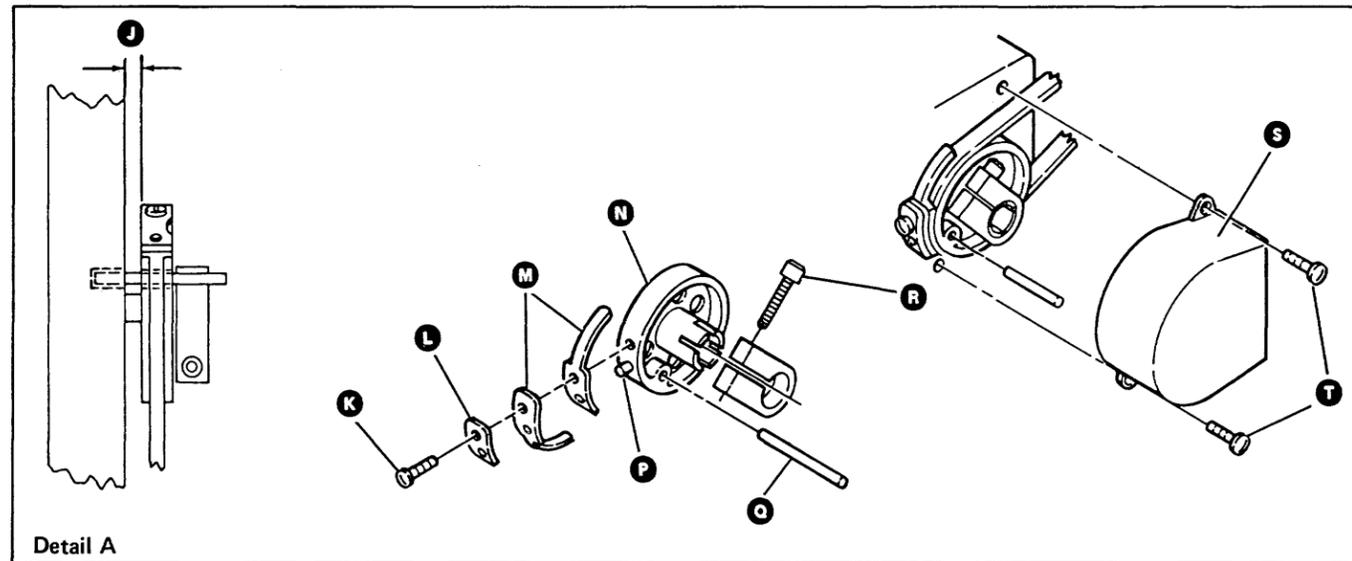
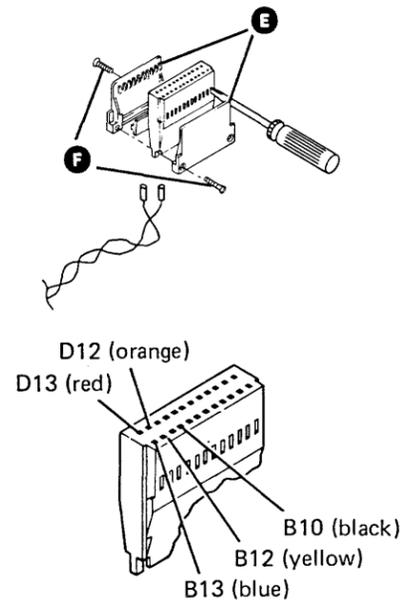
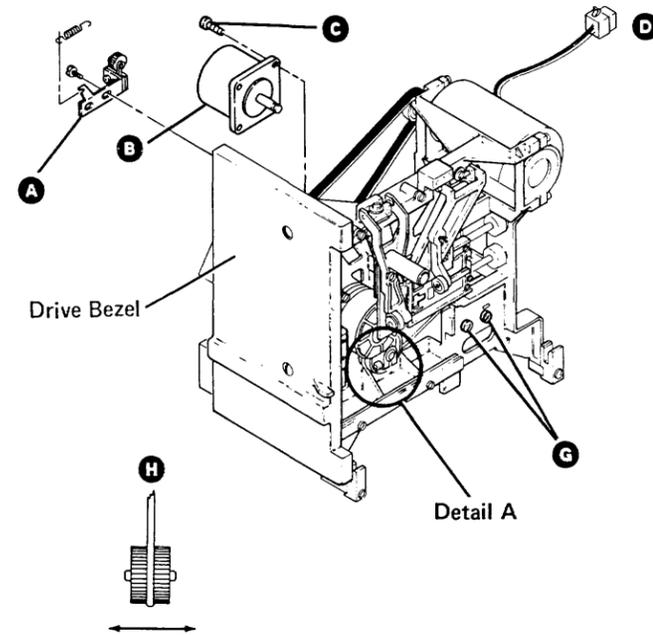
Voltage is present at the power connector when the head/carriage stepper motor is disconnected and power is on.

-
-
-
12. Install a jumper from THP-2 (head reference) to THP-1 (ground) on the drive control card (93-245).
 13. Power on (01-110).
 14. Make the gap **J** between the pulley and the casting the same size as the gap that was recorded in 93-396, step 11.
 15. Tighten the pulley clamp screw **R**.
 16. Remove the timing pin **Q**.
 17. Remove the jumper.
 18. Tighten the band clamp screw **K**. Ensure that the drive band is straight.
 19. Power off (01-115).
 20. Reinstall the drive bezel (two screws).
 21. Turn the stepper motor pulley by hand and check to see that the drive band is centered on the idler pulley in all of the head/carriage assembly movement (cylinder 00 to cylinder 76).

Is the band centered?

Y **N**
 | - Go to 93-401, step 4.

Go to 93-391, step 5.



**93-398
Pulley and Clamp Removal**

1. Remove the picker/cam casting assembly (93-342).

CAUTION

While performing the following steps, be careful not to damage the drive band.

2. Remove the two screws **N** and the wiper assembly **M**.
3. Loosen the two idler mounting screws **D**, push the idler assembly **B** against the spring tension, and tighten the screws **D**.
4. Remove the clamp screw **F** and the band clamp **G** from the pulley.
5. Carefully remove the drive band ends **H** from the pulley pin **Q**.
6. Measure and record the gap **E** between the stepper motor pulley and the casting.
7. Loosen the clamp screw **K** and remove the stepper motor pulley **J** and the clamp **L**.

**93-399
Pulley and Clamp Replacement**

1. Reinstall the pulley **J**, the clamp **L**, and the clamp screw **K**. Keep the screw loose so that the motor shaft can turn inside the pulley.

CAUTION

While performing the following steps, be careful not to damage the drive band.

2. Carefully reinstall the drive band ends **H** on the pulley pin **Q**, reinstall the band clamp **G** (with the notch facing away from the stepper motor) and the screw **F**. Do not tighten the screw.
3. Loosen the two idler mounting screws **D** and let the spring tension place the idler **B**.
4. Tighten the idler mounting screws **D**. Center the drive band on the idler pulley **A**.
5. Turn the stepper motor by hand to cylinder 40 and insert the timing pin **P**.
6. Disconnect the AC power cable **C** to the drive motor.
7. Install a jumper from THP-2 (head reference) to THP-1 (ground) on the drive control card (93-245).

DANGER

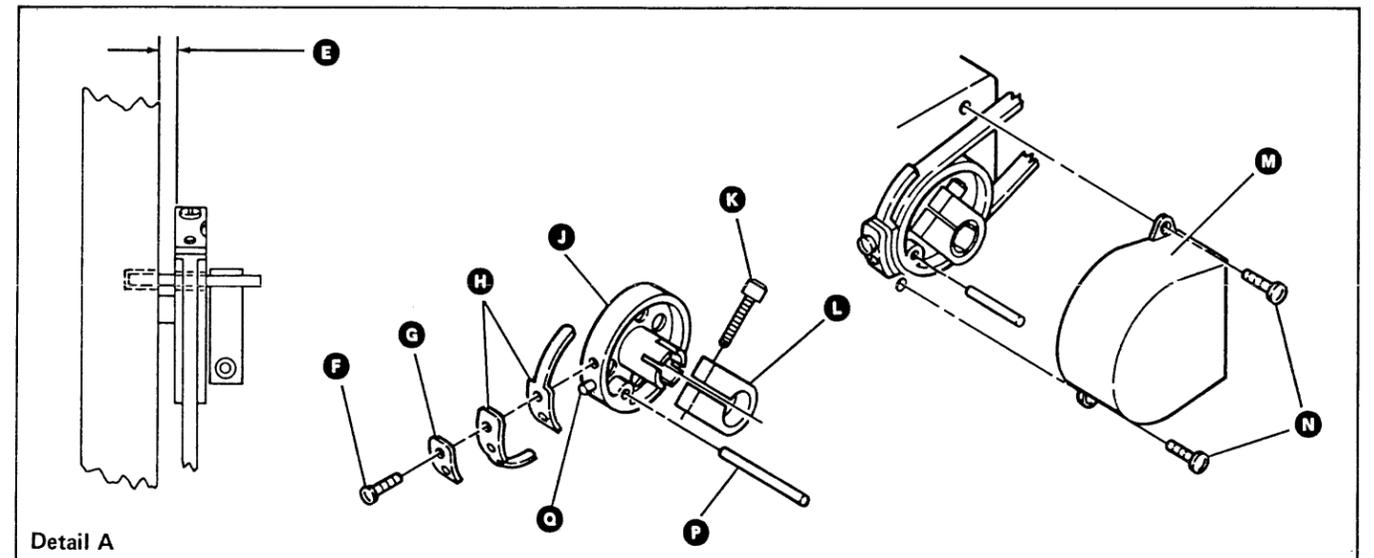
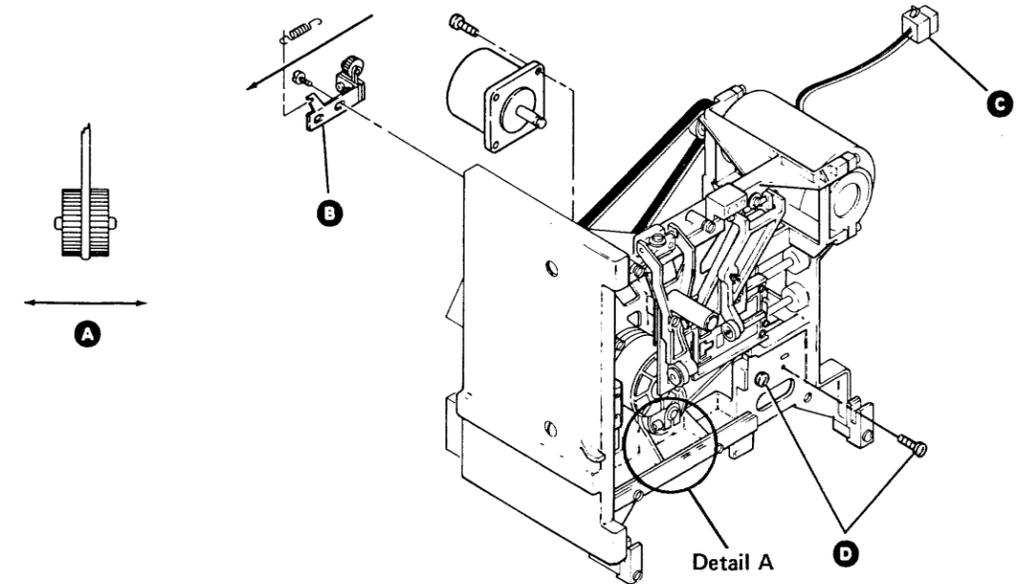
Voltage is present at the power connector when the AC power cable is disconnected and power is on.

8. Power on (01-110).
9. Make the gap **E** between the pulley and the casting the same as the gap that was recorded in 93-398, step 6.

10. Tighten the pulley clamp screw **K**.
11. Remove the timing pin.
12. Remove the jumper.
13. Tighten the band clamp screw **F**. Ensure that the drive band is straight.
14. Power off (01-115).
15. Turn the stepper motor pulley **J** by hand and check to ensure that the drive band is centered on the idler pulley in all of the head/carriage assembly movement (cylinder 00 through cylinder 76).

Is the drive band centered?

Y N
 | - Go to 93-401, step 4.
 |
 Go to 93-391, step 5.



**93-401
Drive Band Adjustment**

1. Power off (01-115).
2. Remove the picker/cam casting assembly (93-342).
3. Remove the two screws **M** and the wiper assembly **L**.
4. Place the head/carriage assembly **E** at the front limit (cylinder 76).

CAUTION

While performing the following steps, be careful not to damage the drive band.

5. Remove the two band clamp screws **N** and the clamp.
6. Loosen the two idler mounting screws **D** and let the spring tension place the idler **C**. Tighten the mounting screws.
7. Turn the stepper motor pulley by hand a few times to center the drive band **B** on the idler pulley **A**.
8. Move the head/carriage assembly **E** to approximately cylinder 40 (centered between the front and back limits). Check to see that the band mounting slots **P** are centered (left to right) over the mounting holes on the carriage pad.
9. Repeat steps 7 and 8 with the head/carriage assembly at the front limit (cylinder 76) and then at the back limit (cylinder 00).

Are the mounting slots centered?

- | | |
|---|---|
| Y | N |
|---|---|
- Loosen the screw **K**.
 - Loosen the screw **F**.
 - Position the stepper motor pulley to center the mounting slots **P** and then tighten the screws (**F** and **K**).
 - Go to step 7.
10. Move the head/carriage assembly **E** toward the hub to its front limit (cylinder 76).
 11. Reinstall the clamp and the two clamp screws **N**. Do not tighten the screws.
 12. Go to 93-393, step 4.

**93-402
Drive Band Removal**

1. Remove the picker/cam casting assembly (93-342).
2. Remove the two screws **M** and the wiper assembly **L**.
3. Move the head/carriage assembly **E** toward the hub to its front limit (cylinder 76).
4. Loosen the two idler mounting screws **D** and push the idler assembly **C** against the spring tension. Tighten the mounting screws.

CAUTION

While performing the following steps, be careful not to damage the drive band.

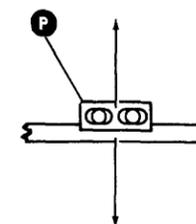
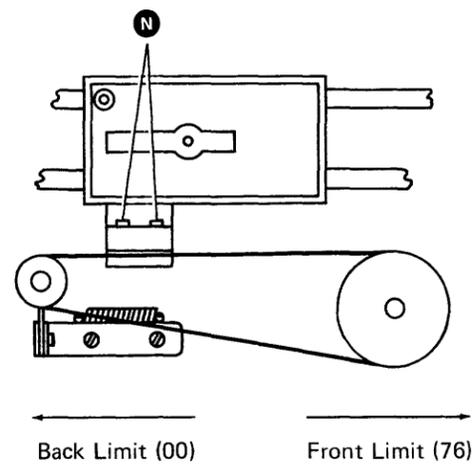
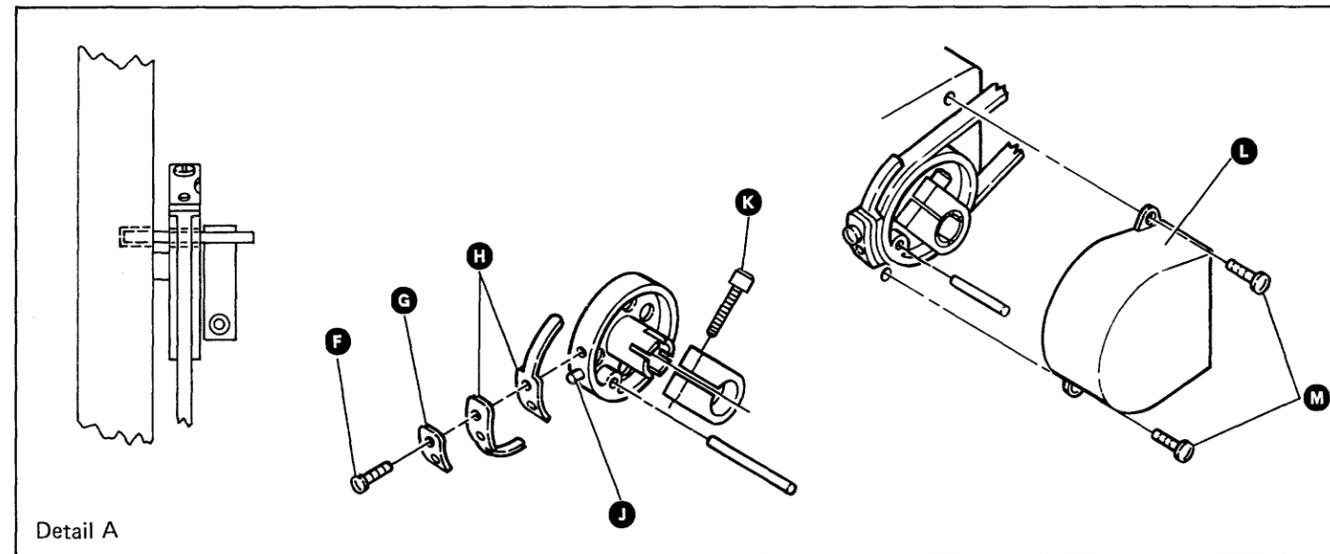
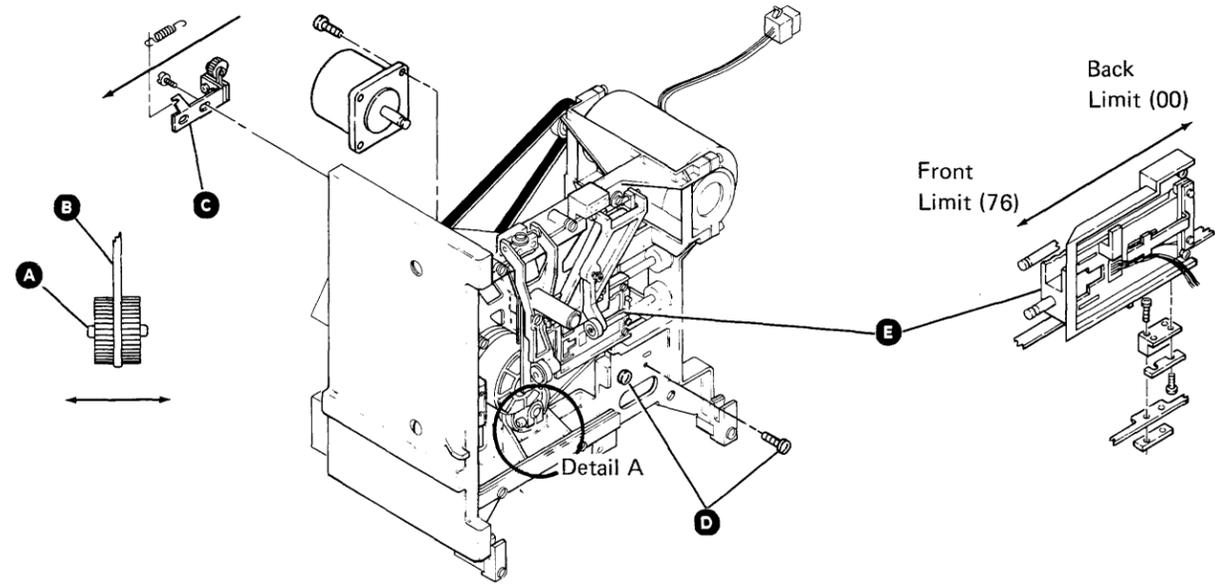
5. Remove the two band clamp screws **N** and the clamp and place the head/carriage assembly at the back limit (cylinder 00).
6. Remove the clamp screw **F** and the clamp **G**.
7. Carefully remove the drive band ends **H** from the pulley pin **J** and remove the band.

**93-403
Drive Band Replacement**

CAUTION

While performing the following steps, be careful not to damage the drive band.

1. Place the drive band **B** around the idler pulley **A**.
2. Carefully install the drive band ends **H** on the pulley pin **J**.
3. Reinstall the band clamp **G**, with the notch facing away from the stepper motor, and the clamp screw **F**. Ensure that the drive band is straight.
4. Go to 93-401, step 6.

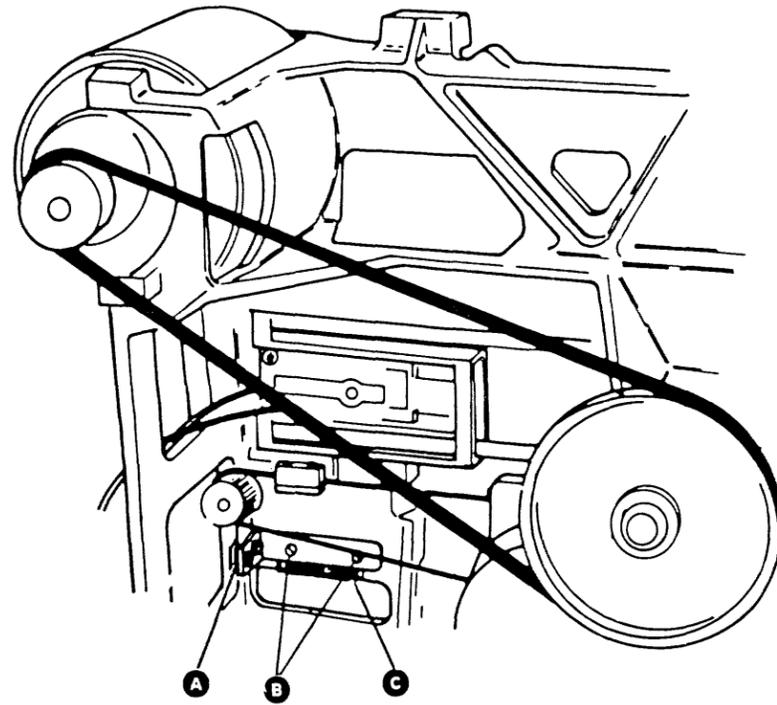


93-404
Idler Assembly Removal

1. Power off (01-115).
2. Remove the drive band (93-402).
3. Loosen the two mounting screws **B**.
4. Remove the idler spring **C**.
5. Remove the mounting screws **B** and the idler assembly **A**.

93-405
Idler Assembly Replacement

1. Reinstall the idler assembly **A** and the two mounting screws **B**. Do not tighten the screws.
2. Reinstall the idler spring **C**.
3. Push the idler assembly against the spring tension and tighten the mounting screws **B**.
4. Reinstall the drive band (93-403).



93-406 Head Load Bail Assembly Service Check and Adjustment

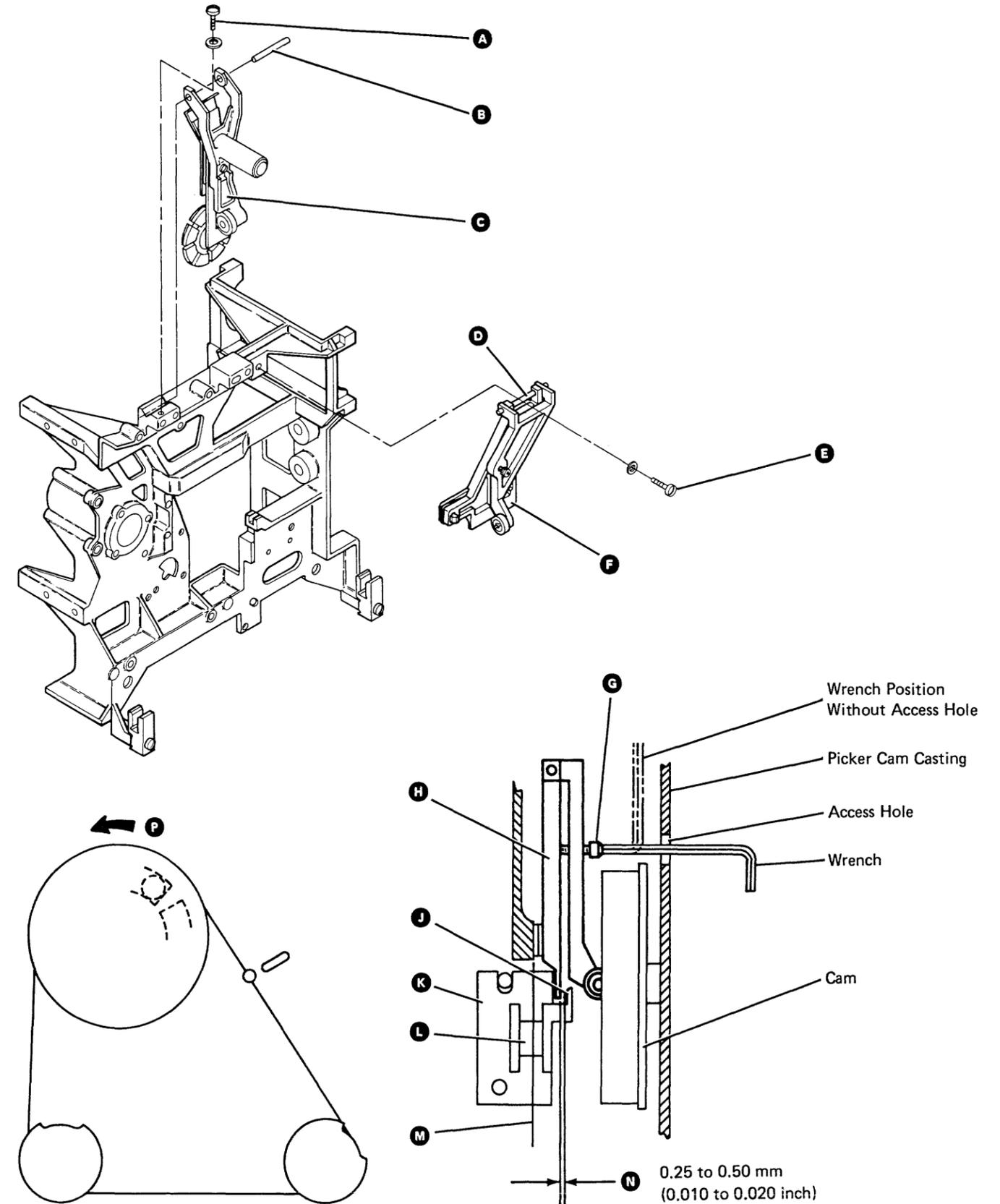
1. Power off (01-115).
2. Turn the cam **P** counterclockwise until the cam stops.
3. Move the head/carriage assembly **K** in both directions as far as it will go and ensure that there is always a gap between the head load bail assembly **H** and the head/carriage tabs **J**.
4. If the gap **N** is not correct, continue for the adjustment.
5. Turn the bail adjusting screw **G** until the head load bail assembly **H** just touches the head/carriage tab **J**.
6. Turn the bail adjusting screw clockwise 90 degrees to make a gap of 0.25 to 0.50 millimeters (0.010 to 0.020 inch) between the bail assembly **H** and the head/carriage tab **J**.
7. Repeat step 3 to check the gap **N**.

93-407 Head Load Bail Assembly Removal and Replacement

1. Remove the picker/cam casting assembly (93-342).
2. Insert a clean strip of paper **M** between the heads **L**.
3. Loosen the clamp screw **E** on the head load bail pivot shaft **D**.
4. Slide the pivot shaft **D** out and remove the head load bail assembly **F**.
5. Reinstall in reverse order. Ensure that the bail assembly **H** is on the correct side of the head/carriage tab **J**.

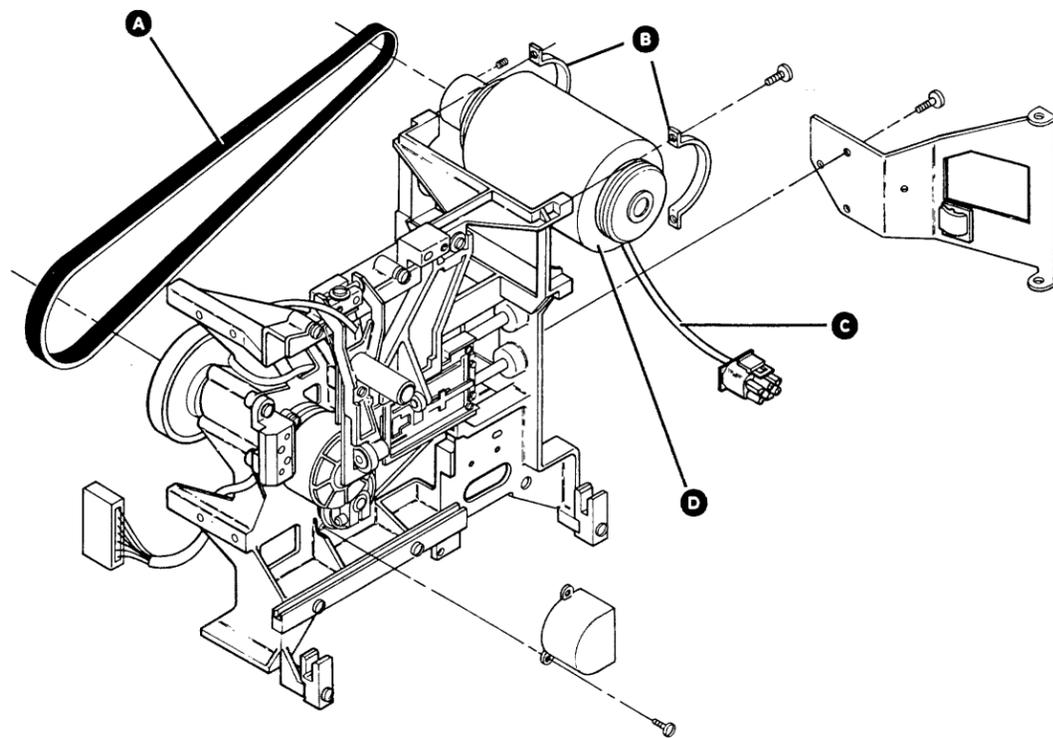
93-408 Collet Assembly Removal and Replacement

1. Remove the picker/cam casting assembly (93-342).
2. Loosen the clamp screw **A** on the collet assembly pivot shaft **B**.
3. Slide the pivot shaft **B** out.
4. Remove the collet assembly **C**.
5. Reinstall in reverse order.



93-409 AC Drive Motor Removal and Replacement

1. Power off (01-115).
2. Disconnect the drive motor AC power cable **C**.
3. Remove the drive belt **A**.
4. Remove the two motor mounting clamps **B**.
5. Remove the motor **D**.
6. Reinstall in reverse order.



93-410 Index Sense LED-to-PTX Alignment Adjustment

1. Remove the drive bezel (two screws).
2. Loosen the two LED mounting screws **F** that are located on the picker/cam casting assembly.
3. Insert the alignment pins **A** to align the LED assembly **C** to the PTX assembly **B**. Insert the pins from the diskette drive assembly side.
4. Tighten the two LED mounting screws **F**.
5. Remove the alignment pins **A**.
6. Reinstall the drive bezel (two screws).

93-411 Index Sense LED Output Service Check

There are two styles of LEDs:

- The old style LED has a lens diameter of 2 mm (0.079 inch).
- The new style LED has a lens diameter of 4 mm (0.157 inch); it also has a resistor on the back of the assembly.

1. Power on (01-110).
2. Connect the negative probe of a multimeter to TPA-13 (ground) on the drive control card (93-245).
3. Set the multimeter scale to 5 Vdc and connect the positive probe to TPA-2 (diskette 2D LED anode) on the drive control card (93-245).

Is the voltage level as follows?

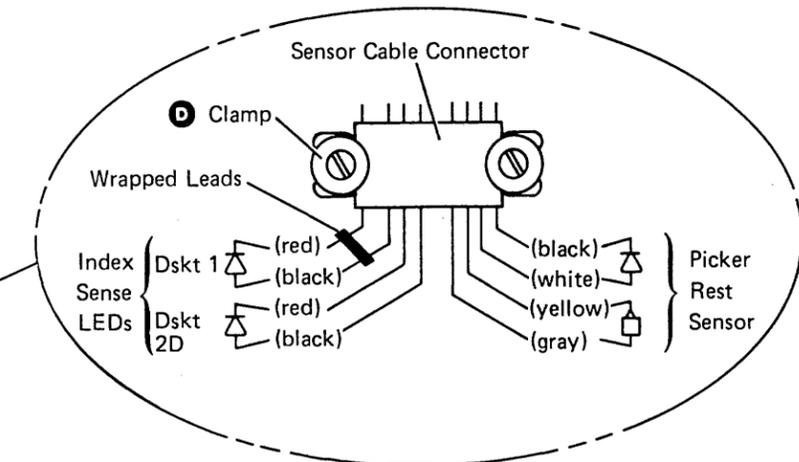
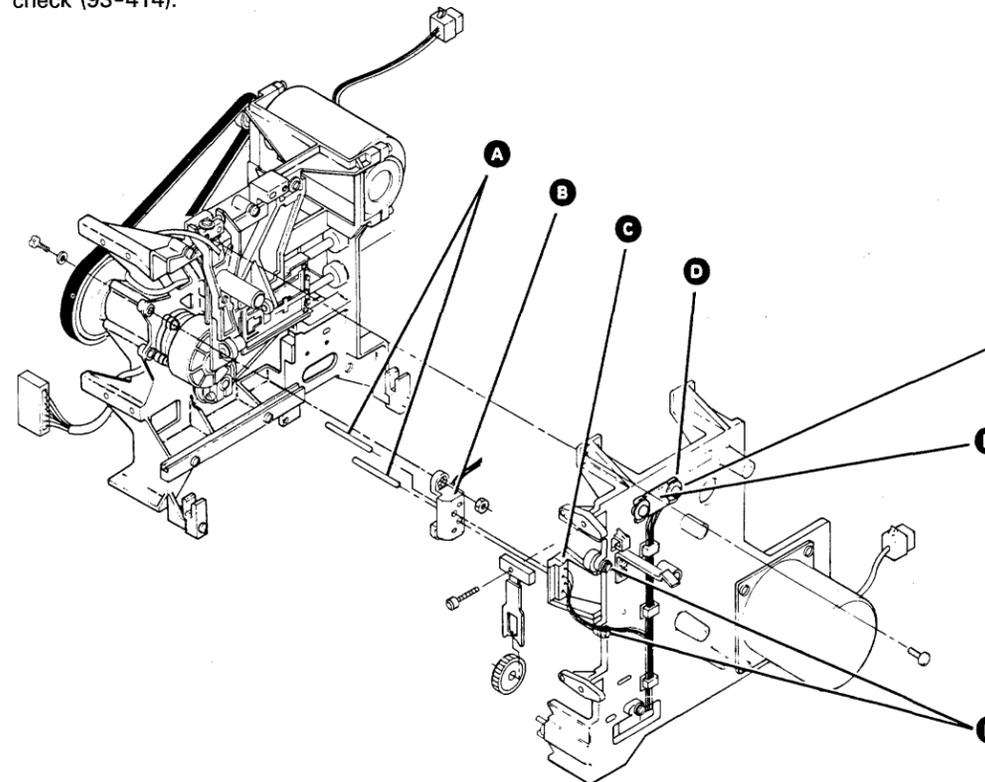
- Old style: 1 Vdc to 2 Vdc.
- New style: 3.5 Vdc to 4.75 Vdc; also at least 0.5 Vdc less than the +5 Vdc power supply voltage at TPA-15.

- Y N
- The LED assembly is bad (93-412).
 - The cable/connector to the drive control card is bad (93-255).
4. Move the positive probe to TPA-1 (diskette 1 LED anode) on the drive control card (93-245).

Is the voltage level as follows?

- Old style: 1 Vdc to 2 Vdc.
- New style: 3.5 Vdc to 4.75 Vdc; also at least 0.5 Vdc less than the +5 Vdc power supply voltage at TPA-15.

- Y N
- The LED assembly is bad (93-412).
 - The cable/connector to the drive control card is bad (93-255).
5. Perform the index sense PTX amplifier service check (93-414).



93-412 Index Sense LED Assembly Removal

1. Remove the picker/cam casting assembly (93-342).
2. Remove the drive bezel (two screws).
3. Remove the two screws **D** and the clamp **E** from the sensor cable connector located near the top of the picker/cam casting.
4. Remove the LED leads (the wrapped leads are for the diskette 1 LED) from the sensor cable connector (lift the tabs in the connector with a small screwdriver).
5. Remove the two mounting screws **F** and two nuts from the LED assembly.
6. Remove the LED assembly **C**.

93-413 Index Sense LED Assembly Replacement

1. Reinstall the index sense LED assembly **C** on the casting and fasten it with the two mounting screws **F** and two nuts. Do not tighten the screws.
2. Reinstall the picker/cam casting assembly (93-342).
3. Insert the alignment pins **A** to align the LED assembly **C** and the PTX assembly **B** and tighten the two screws **F**. Then remove the alignment pins.
4. Insert the LED leads (the wrapped leads are for the diskette 1 LED) into the cable connector. Ensure that the locking tabs on the terminals lock in the connector slots.
5. Reinstall the sensor cable connector, the clamp **E**, and the two screws **D** on the picker/cam casting.
6. Reinstall the drive bezel (two screws).

93-414
Index Sense PTX Amplifier Service
Check

CAUTION
 Always perform this service check with a diskette inserted backward (with the label facing the hub pulley), so that the LED (light-emitting diode) does not cause a wrong service check or destroy the PTX (phototransistor).

1. Power off (01-115).
2. Disconnect the drive motor AC power cable and driver board connector J3 (93-250).

DANGER
 Voltage is present at the power connector when it is disconnected and power is on.

3. Power on (01-110).
4. Place the picker assembly to the rear of the unit.
5. Insert a diskette backward until it touches the collet.

6. Connect the positive probe of a multimeter (15 Vdc scale) to TPB-16 (+index) on the drive control card (93-245).
7. Connect the negative probe of the multimeter to TPA-13 (ground) on the drive control card (93-245).

If the voltage level less than 1 Vdc?

Y N
 |
 - Exchange the drive control card.

8. Install one end of a jumper to TPB-2 (diskette 2D PTX emitter) on the drive control card (93-245).
9. While observing the multimeter, touch the other end of the jumper several times to TPA-15 (+5 volts) on the drive control card (93-245).

Is the voltage level 2.5 Vdc or more?

Note: A wrong reading can occur the first time TPA-15 is touched.

Y N
 |
 - Exchange the drive control card.

10. Move the end of the jumper from TPB-2 (diskette 2D PTX emitter) to TPB-1 (diskette 1 PTX emitter) on the drive control card and repeat step 9.
11. Power off (01-115).
12. Remove the jumper.
13. Remove the diskette.
14. Connect the drive motor AC power cable and driver board connector J3 (93-250).
15. The PTX amplifier on the drive control card is working correctly. If you were sent here by the MAPs, exchange the PTX and LED assemblies (93-415, 93-412).

93-415
Index Sense PTX Assembly Removal

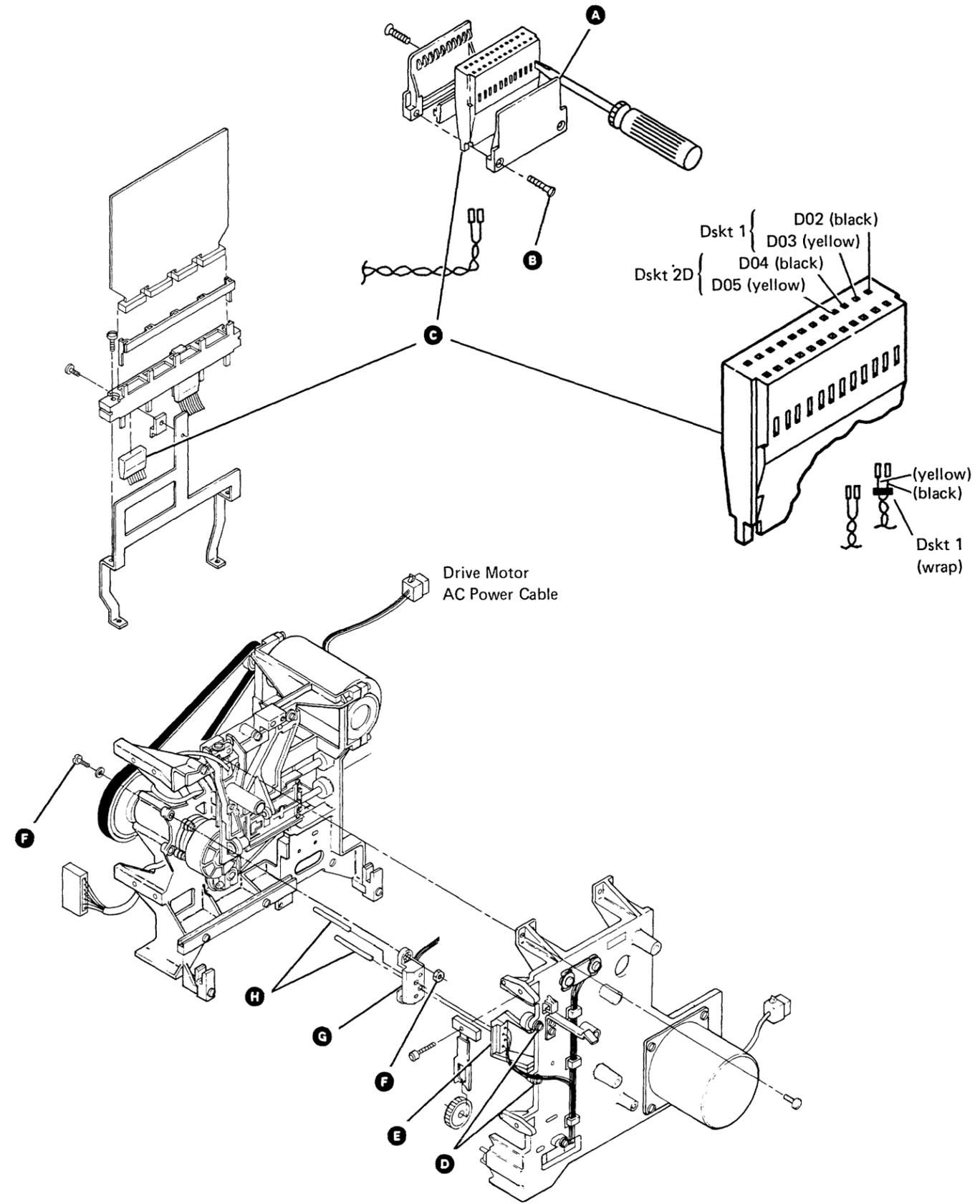
1. Remove the picker/cam casting assembly (93-342).
2. Remove the drive bezel (two screws).
3. Disconnect the diskette drive stepper motor/sensor cable (A1) **C** from the drive control card.
4. Remove the two screws **B** and the two connector covers **A**.
5. Remove the PTX leads (the wrapped leads are for the diskette 1 PTX) from the cable connector by pushing down on the terminal tabs with a small screwdriver.
6. Remove the two mounting screws **F** from the PTX assembly **G**.
7. Remove the PTX assembly **G**.

93-416
Index Sense PTX Assembly
Replacement

1. Reinstall the PTX assembly **G** on the casting and fasten it with the two mounting screws **F**.
2. Loosen the two mounting screws **D** for the LED assembly **E** on the picker/cam casting.
3. Reinstall the picker/cam casting assembly (93-342).
4. Insert the alignment pins **H** and align the LED assembly **E** to the PTX assembly **G**, tighten the two screws **D**, and remove the alignment pins.
5. Insert the PTX leads (the wrapped leads are for the diskette 1 PTX) into the cable connector. Ensure that the locking tabs on the terminals lock in the connector slots.
6. Reinstall the connector covers **A** and the two screws **B**.
7. Connect the diskette drive stepper motor/sensor cable (A1) **C** to the drive control card.

CAUTION
 Ensure that the cables are located in the slot in the casting when you install the drive bezel.

8. Reinstall the drive bezel (two screws).



**93-417
Alignment Test**

This procedure uses the alignment diskette (part 2455026) to verify the alignment of the read/write heads. To check the adjustment of the head/carriage assembly, see 93-391.

1. Power on (01-110).
2. Load dedicated DCP from disk using the bypass all wrap tests option, F800 (01-150).
3. Select the TU Select option.
4. Select the 72MD device.
5. Select the Alignment Test (TD260).
6. Insert the Alignment Test diskette (part 2455026) in I/O slot 1.
7. Select the option to run the test, stop, and display the results.

Is the head/carriage alignment OK?

Y N
| - Perform the head/carriage service check
| (93-391).

End

SCOPING PROCEDURES

93-418 Read Data Scoping Procedure

Note: Use a Tektronix¹ 453, 454, or 475 oscilloscope with X10 probes (this setup procedure uses the 475 oscilloscope).

This procedure can be used to look at the data that is written on a diskette. You can look at the data at the read head output or the drive control card output.

1. Power on (01-110).
2. Insert the diskette into I/O slot 1.
3. Run the I/O exerciser (01-745).
4. Select the Diskette FRIENDs Test option.
5. Select the following commands and options:
 - a. Select diskette (S1)
 - b. Recalibrate
 - c. Execute selected commands
 - d. Step through commands
6. Press the Enter key (the diskette in I/O slot 1 is inserted in the drive).
7. Press the Enter key to execute the recalibrate.
8. Press the Cmd 3 key to return to the preceding display. Repeat this step until the Diskette FRIENDs Test command menu appears.
9. Select the following commands and options:
 - a. Read (enter the requested information for the sector you want to look at on the oscilloscope)
 - b. Execute selected commands
 - c. Loop on commands and ignore error
10. Press the Enter key to loop on the read command. Use the following procedures to set up the oscilloscope.
11. Press the Cmd 5 key to end the read loop.

Read Head Output

Set up the oscilloscope as follows:

CH1 Input: THP-14 (-VGA)²
 CH2 Input: THP-15 (+VGA)²
 CH1 VOLTS/DIV: 50 mV
 AC-GND-DC: AC
 CH2 VOLTS/DIV: 50 mV
 AC-GND-DC: AC
 INVERT: Push in
 VERT MODE: ADD
 A and B
 TIME/DIV and DELAY Time: 1 millisecond
 HORIZ DISPLAY: A
 TRIG MODE: NORM
 COUPLING: DC
 SOURCE: Ext
 SLOPE: +
 EXT Input: TPB-16 (+index)²

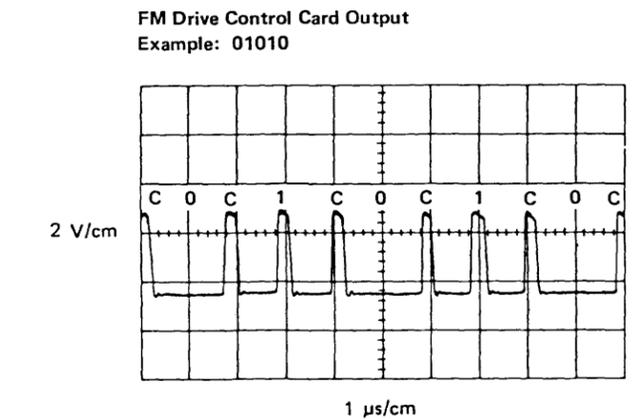
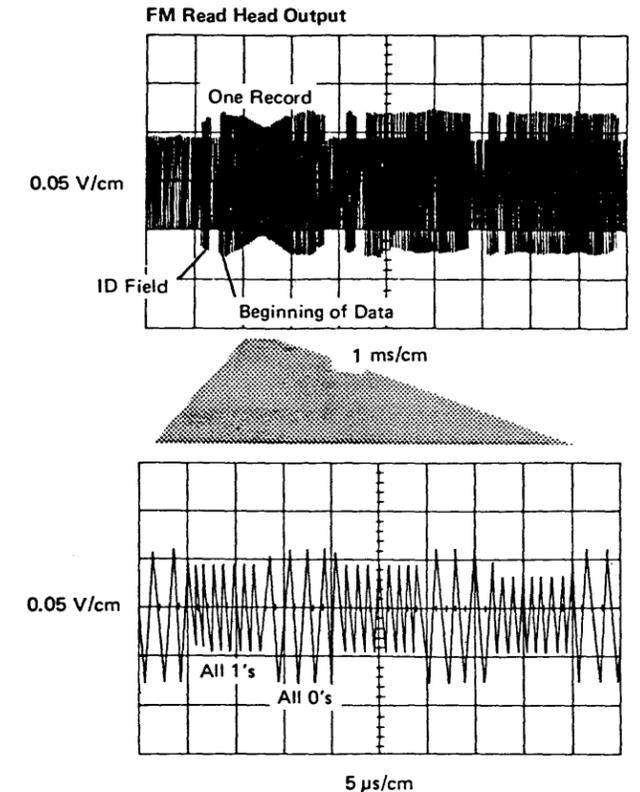
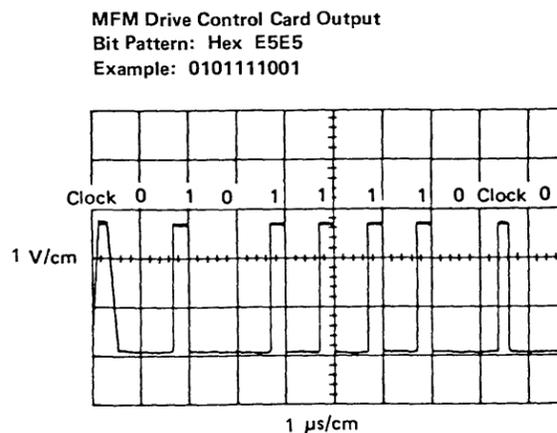
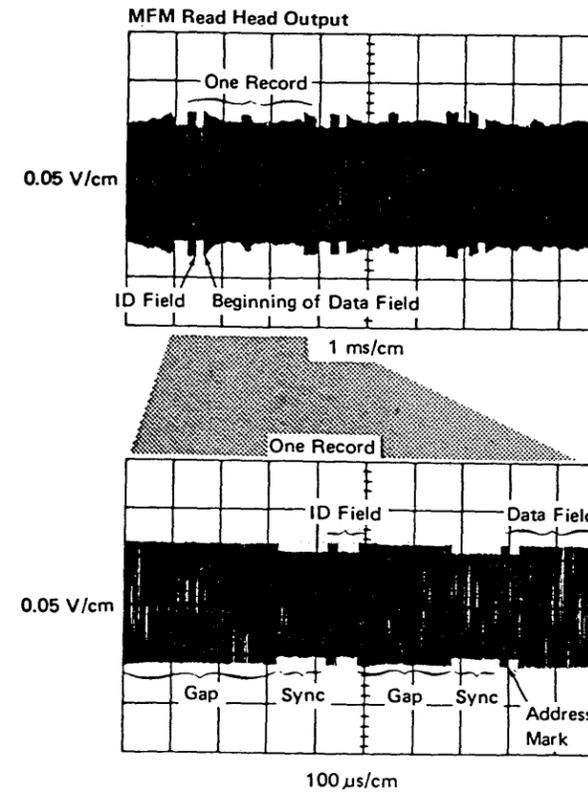
Observe: The amplitude of the read signal should be between 100 and 250 millivolts.

Drive Control Card Output

Set up the oscilloscope as follows:

CH1 Input: TPB-12 (+file data)²
 CH1 VOLTS/DIV: 2 volts
 AC-GND-DC: DC
 VERT MODE: CH1
 A and B
 TIME/DIV and DELAY Time: 1 microsecond
 HORIZ DISPLAY: A
 TRIG MODE: NORM
 COUPLING: DC
 SOURCE: EXT
 SLOPE: +
 EXT Input: TPB-16 (+index)²

Observe: The clock pulses should occur every 2 microseconds for FM. Pulse width should be between 100 and 250 nanoseconds. Pulse amplitude should be between 2.4 and 4.2 volts.



¹Trademark of Tektronix, Inc.

²See 93-245 for the drive control card test pin locations.

**93-419
Read/Write Head Wear Scoping
Procedure**

Read/write head wear is determined by observing the ERAP errors indicated on the inner tracks area of a diskette (cylinders hex 40 through hex 4C) and by measuring the read/write head resolution with an oscilloscope.

Note: The read/write head wear scoping procedure is the most accurate method to determine read/write head resolution and should be performed before you exchange a head/carriage assembly.

To scope read/write head resolution, perform the following:

1. Power on (01-110).
2. Insert the diagnostic magazine into magazine slot 1.
3. Run the I/O exerciser (01-745) under dedicated DCP.
4. Select the 72MD I/O exerciser from the device selection menu.
5. Select the Read/Write Head Wear Test option.
6. Press the Enter key.
7. Enter 7000 in the system control panel.

8. Set up the oscilloscope as follows:

Note: Use a Tektronix 453, 454, or 475 oscilloscope with X10 probes (this setup procedure uses the 475 oscilloscope).

CH1 Input: THP-14 (-VGA)¹
 CH2 Input: THP-15 (+VGA)¹
 CH 1 VOLTS/DIV: 50 mV
 AC-GND-DC: AC
 CH 2 VOLTS/DIV: 50 mV
 AC-GND-DC: AC
 INVERT: Push in
 VERT MODE: ADD
 A and B
 TIME/DIV and DELAY Time: 10 microseconds
 HORIZ DISPLAY: A
 TRIG MODE: NORM
 COUPLING: DC
 SOURCE: EXT
 SLOPE: -
 EXT Input: -CS address compare (see below)

Is a Stage identification number (Stage 2, for example) printed on the label inside the control panel cover?

Y N
 | Use A-A1M2S02.

Use the pin location shown on the label for -CS address compare.

9. Measure the amplitude of the FF and AA data displayed on the oscilloscope.

Note: Read/write head resolution is the ratio of the signal amplitude of FF in centimeters to the signal amplitude of AA in centimeters multiplied by 100.

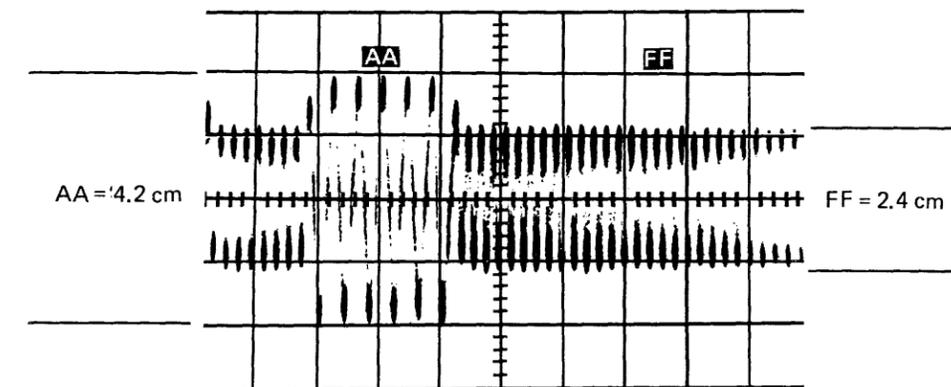
Is the read/write head resolution for both read/write heads more than 50?

Y N
 | **Is the read/write head resolution between 40 and 50?**

Y N
 | The read/write head is bad (the read/write head resolution is less than 40): Exchange the head/carriage assembly (93-394, 93-395).

Use the ERAP data and the results of the diskette drive test (MAP 0179, entry point point B) to determine if the head/carriage assembly should be exchanged. See 93-394 and 93-395 to exchange the head/carriage assembly.

The read/write heads are good.



$$\text{Head Resolution} = \frac{2.4}{4.2} \times 100 = 57$$

¹See 93-245 for the drive control card test pin locations.

93-420 Diskette Speed (Index) Scoping Procedure

The adapter card contains speed control logic that continuously checks the diskette speed and sets a bit (sense byte 5, bit 4, 5, or 6) to indicate the status of the diskette speed (index pulses). See 93-505.

This service check must have a diskette engaged to the hub and the read/write heads must be loaded.

1. Power on (01-110).
2. If the diskette is already engaged to the drive hub and the heads are loaded, skip to step 8. If you have to load a diskette, continue with step 3.
3. Insert the diagnostic magazine into magazine slot 1.
4. Run the I/O exerciser (01-745).
5. Select the Diskette FRIENDs Test option.
6. Select the following commands and options:
 - a. Select diskette
 - Enter M9 for diskette 1, or
 - Enter M10 for diskette 2D
 - b. Eject diskette
 - c. Execute selected commands
 - d. Step through commands

7. Press the Enter key (this selects a diskette from magazine 1, position 9 or 10).
8. Set up the oscilloscope as follows:

Note: Use a Tektronix 453, 454, or 475 oscilloscope with X10 probes (this setup procedure uses the 475 oscilloscope).

CH1 Input: TPB-16 (+index)¹
CH1 VOLTS/DIV: 1 volt
AC-GND-DC: DC
VERT MODE: CH1
A and B
TIME/DIV and DELAY Time: 10 milliseconds
HORIZ DISPLAY: A
TRIG MODE: NORM
COUPLING: DC
SOURCE: NORM
SLOPE: +

9. Observe the index pulse. A pulse should occur every 83.3 ± 2.1 milliseconds. The width of each pulse should be from 0.75 to 1.5 milliseconds. The amplitude of each pulse should be between 2.4 and 4.2 Vdc. If the index pulse width or amplitude is not correct, go to 93-411 to check the LED output.
10. Press the Enter key to eject the diskette.

¹See 93-245 for the drive control card test pin locations.

DIAGNOSTIC INFORMATION

**93-450
MDI Good Machine Path**

The 72MD adapter diagnostics are divided into four major groups. Each group has an MDI (MD201, MD202, MD205, or MD206) that calls stand-alone test units (TUs) to test a specific part of the adapter or device. The table below shows the sequential order that the MDIs use to run the TUs. To run the MDI MAPs, see 01-710.

By using this procedure, you can:

- Find the MDI good machine path
- Determine which part of the 72MD adapter and device is tested by each MDI
- Find a description of each MDI
- Find a list of the TUs that make up each MDI and the order in which the TUs are run
- Use the list of the TUs to find where in the good machine path a failure may have occurred

MDI Good Machine Path

| MDI | Description | TU Sequence |
|----------------|---|---|
| 1 MD201 | Tests the data storage attachment to adapter card interface | TD201 TD202 TD203 TD204 |
| 2 MD202 | Tests the autoloader interface and autoloader logic | TD210 TD211 TD212 TD213 TD214 |
| 3 MD205 | Tests the adapter card | TD215 TD216 |
| 4 MD206 | Tests the adapter and 72MD diskette drive operation | TD217 TD218 TD219 TD220 |

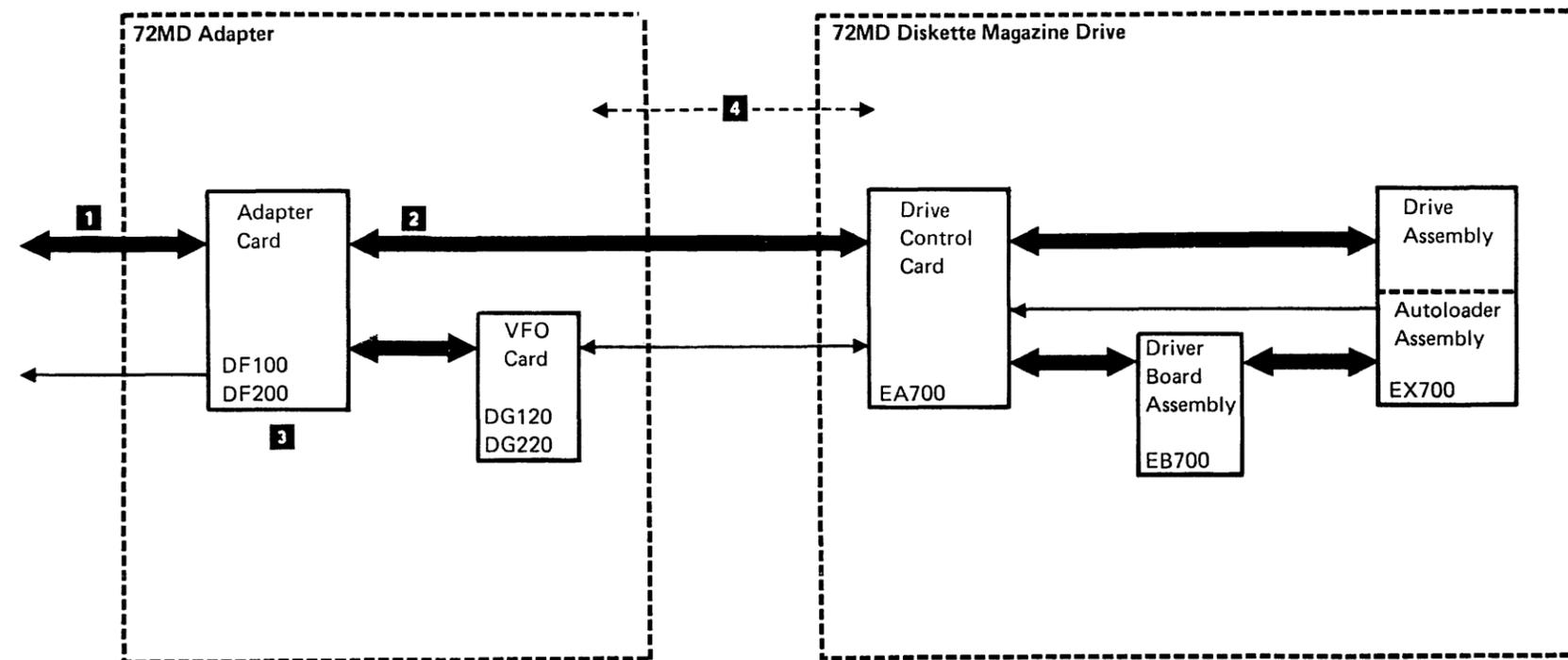
**93-455
IPL Good Machine Path**

The following table shows the 72MD adapter test units (TUs) that are run during the IPL sequence.

If an error occurs, a system reference code is displayed in the control panel display or on the system console. See MAPs 0113 through 0116 for a list of the system reference codes.

IPL Good Machine Path

| TU Sequence | Description |
|----------------------------------|---|
| 1 TD201 TD202 TD203 | Tests the data storage attachment to adapter card interface |
| 2 TD210 | Tests the adapter card to autoloader interface |



93-460 I/O Exerciser

The diskette I/O exerciser is a tool that can be used to test the diskette drive. Customer programs can be simulated or unique commands can be executed to aid you in problem determination. The I/O exerciser can be run under either concurrent DCP (01-155) or dedicated DCP (01-150). The I/O exerciser contains the following options:

- Diskette FRIENDs test
- Stepper motor test
- Read/write head wear test (dedicated DCP only)

Diskette FRIENDs Test

The diskette FRIENDs test lets you assemble a specific command or sequence of commands to test the 72MD. After a command is selected, a secondary screen lets you enter the necessary information for that command. The following commands are used by the FRIENDs test:

- Recalibrate
- Seek
- Read data
- Read data/CAM
- Read ID
- Write data
- Write CAM
- Write format
- Eject diskette
- Orient autoloader
- Abort autoloader
- Select diskette

Stepper Motor Test

The stepper motor test causes the head/carriage motor to seek to cylinders 40, 41, 42, 43, and 44. The seeks are done one at a time by pressing the Enter key. The stepper motor test is used to perform the following service checks:

- Drive control card output to carriage bed stepper motor (93-370)
- Drive control card output to picker/cam stepper motor (93-371)
- Driver board output to picker/cam stepper motor (93-380)
- Driver board output to carriage bed stepper motor (93-381)

Read/Write Head Wear Test

The read/write head wear test loops on a read data command. A pattern of hexadecimal characters (AA and FF) is written to a sector on a diskette and then read back by the test. See the read/write head wear scoping procedure (93-419) for information on how to use this test.

This test is available only under dedicated DCP.

93-465 Diskette Utility

The diskette utility lets you perform tests to determine if diskette data errors are caused by a diskette or by the diskette drive. The diskette utility also lets you recover data from a diskette or patch data on a diskette. See 01-740 for information on how to set up and run the diskette utility program.

The following options can be selected:

- Test diskette drive
- Scan diskette for errors
- Display diskette error log
- Recover data on a diskette
- Copy data from one diskette to another
- Display or change diskette sectors

Test Diskette Drive

This option performs a head cleaning operation and a worn head test and is run on the drive test diskette (part 4234002).

The diskette drive test performs the following routines.

Read Track 0

This routine reads track 0 to determine if the drive test diskette (part 4234002) has been inserted into the diskette drive. If the drive cannot read track 0, the routine loads the read/write heads on a group of selected cylinders and performs a seek to clean the read/write head surfaces. The routine repeats the cleaning cycle a maximum of five times while attempting to read track 0.

If the drive fails to read track 0, a display message is indicated.

Worn Read/Write Head

This routine is run on selected cylinders and performs the following functions:

- Writes a fixed pattern on each sector of the selected cylinders.
- Reads and compares the read data with the data that was written.

If the read errors are more than a specified number, a display message is indicated.

Scan Diskette for Errors

This option reads and verifies data from a selected diskette, records (but does not log) all errors by type and location, and displays or prints the results with probable causes.

For the physical location of any failures that are displayed, see 93-900.

Display Diskette Error Log

This option displays the diskette format and the information in the diskette media log.

Recover Data on a Diskette

This option:

- Attempts to read data from a selected sector.
- Displays a message if the read operation was acceptable or not. If the read operation fails and the diskette address was not cylinder 0, head 0, sectors 7 through 26, the write prompt is not displayed.
- Displays a prompt to write the data back to diskette.
- Attempts to write the data back to diskette.
- Displays a message to indicate if the write operation was acceptable or not.

The device error recovery procedures (ERP) and the error logging function (ELF) are inhibited during the recovery operation.

Copy Data from One Diskette to Another

This option lets you copy system diskettes and diagnostic diskettes. See 01-820 to run the copy option.

Display or Change Diskette Sectors

This option loads the patch procedure (01-850). This procedure lets you display and change the information on a diskette.

HOW TO INTERPRET ERAP

93-500 Error History Table

The error history table contains specific information describing each error that occurred in the 72MD diskette magazine drive or in the adapter. See 01-360 for information on how to run ERAP.

The error history table contains the following information.

| ERROR HISTORY TABLE FOR DISKETTE | | | | | | | | | | | | | | | | | | | | | |
|----------------------------------|--------|------|--------|--------|------|-----|-------------|----|----|-----------------------|----|----|----|-------|------------|----|----|----|--|----------|--|
| FROM: XX/XX/XX XX:XX:XX | | | | | | | | | | TO: XX/XX/XX XX:XX:XX | | | | | | | | | | CYLINDER | |
| DATE | | TIME | SRC | VOLUME | SLOT | CMD | SENSE BYTES | | | | | | | RETRY | ARRIVED AT | | | | | | |
| YYMMDD | HHMMSS | HEX | ID | NUM | R/Q | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | CNT | C | H | R | N | | | |
| XXXXXX | XXXXXX | XXXX | XXXXXX | XX | XX | XX | XX | XX | XX | XX | XX | XX | XX | XX | XX | XX | XX | XX | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |

| | | | | | | |
|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| 93-501 | 93-502 | 93-503 | 93-504 | 93-505 | 93-506 | 93-507 |
|---------------|---------------|---------------|---------------|---------------|---------------|---------------|

93-501 System Reference Code

This field contains the system reference code (SRC) that is generated when an error occurs. See MAPs 0113 through 0116 for a list of the system reference codes.

93-502 Volume ID

This field contains the volume identifier of the failing diskette with the following exceptions:

- The field is blank if an autoloader error is logged.
- The field contains \$INIT if an error is logged during diskette initialization.
- The field is not valid if an error is logged when running diagnostic tests, including SYSTEST.

93-503 Slot Number

This field contains the autoloader slot number of the failing diskette. Valid slot numbers are hex 01 through hex 17.

93-504 Command Code and Command Modifier

This field contains the command code (Q) and the command modifier (R) of the failing operation.

| Hex Code | Description | | | | | | | | | | |
|--|--|-----|-------------|---|--|---|------------------|---|---|---|---|
| 00 | Control seek | | | | | | | | | | |
| X1 | Read data | | | | | | | | | | |
| X2 | Read data/CAM | | | | | | | | | | |
| X3 | Read ID | | | | | | | | | | |
| X5 | Write data | | | | | | | | | | |
| X6 | Write CAM | | | | | | | | | | |
| X7 | Write format | | | | | | | | | | |
| 08 | Select diskette | | | | | | | | | | |
| 09 | Eject diskette | | | | | | | | | | |
| 0A | Orient autoloader | | | | | | | | | | |
| 0B | Abort autoloader | | | | | | | | | | |
| 0E | Allocate drive | | | | | | | | | | |
| 0F | Deallocate drive | | | | | | | | | | |
| <p>Note: X (bits 0 through 3) is the command modifier and has the following meaning:</p> <table border="1"> <thead> <tr> <th>Bit</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>If this bit is on, modified frequency modulation (MFM) is specified. If this bit is off, frequency modulation (FM) is specified.</td> </tr> <tr> <td>1</td> <td>Diagnostic mode.</td> </tr> <tr> <td>2</td> <td>If this bit is on, the operation uses the same data field repeatedly.</td> </tr> <tr> <td>3</td> <td>If this bit is on, the data transfer is to/from control storage. If this bit is off, the data transfer is to/from main storage.</td> </tr> </tbody> </table> | | Bit | Description | 0 | If this bit is on, modified frequency modulation (MFM) is specified. If this bit is off, frequency modulation (FM) is specified. | 1 | Diagnostic mode. | 2 | If this bit is on, the operation uses the same data field repeatedly. | 3 | If this bit is on, the data transfer is to/from control storage. If this bit is off, the data transfer is to/from main storage. |
| Bit | Description | | | | | | | | | | |
| 0 | If this bit is on, modified frequency modulation (MFM) is specified. If this bit is off, frequency modulation (FM) is specified. | | | | | | | | | | |
| 1 | Diagnostic mode. | | | | | | | | | | |
| 2 | If this bit is on, the operation uses the same data field repeatedly. | | | | | | | | | | |
| 3 | If this bit is on, the data transfer is to/from control storage. If this bit is off, the data transfer is to/from main storage. | | | | | | | | | | |

93-505
Sense Bytes 0-7

Sense Byte 0 (Byte 6, Bit 0 Off)

| Bit(s) | Description |
|--------|--|
| 0 | Not used. |
| 1 | Not used. |
| 2 | Not used. |
| 3 | Adapter Check The adapter sensed an error while performing the requested operation. See sense bytes 3, 4, and 5. |
| 4 | Device Check The autoloader control logic (drive control card) sensed an error while performing the requested operation. See sense byte 7. |
| 5 | Interface Controlled This bit indicates the adapter card is busy with a load or sense command. |
| 6 | Not used. |
| 7 | Not used. |

Sense Byte 0 (Byte 6, Bit 0 On)

| Bit(s) | Description |
|--------|---|
| 0-3 | Bits 0-3 have the following meaning: 0 1 2 3 0 0 0 0 The device address was not valid. 0 0 0 1 The command in the IOB was not valid. 0 0 1 0 The head number specified in the IOB was not valid. 0 0 1 1 The data repeat command modifier was on, and the command was not a write data or a write data control. 0 1 0 0 A diskette 1 was in the drive and the command given was for an MFM operation. 0 1 0 1 The slot number specified in the IOB was not valid. 0 1 1 0 The starting sector specified in the IOB was not valid. |
| 4-7 | Not used. |

Sense Byte 1

| Bit(s) | Description |
|--------|--|
| 0 | Attachment Data Bus Parity Check Even parity was sensed by the data storage attachment on the DSA data bus. |
| 1 | Not used. |
| 2 | Not used. |
| 3 | Storage Device End-Op The last byte of data on the data bus has been moved to or from the buffer in the data storage attachment. |
| 4 | Channel End-Op The last byte of data on the DBI and DBO lines has been moved to or from the buffer in the data storage attachment. |
| 5 | Not used. |
| 6 | Not used. |
| 7 | Not used. |

Sense Byte 2

| Bit(s) | Description |
|--------|---|
| 0 | Interrupt Time-Out The adapter card did not respond to a start command in the permitted time. |
| 1 | Not used. |
| 2 | Command/Sense Parity Check The data storage attachment sensed even parity on the DBO lines from the channel (command operation) or even parity on the data bus from a storage device (sense operation). |
| 3 | Cycle Steal Parity Check The data storage attachment sensed even parity on the DBI and DBO lines between the channel and the buffer. |
| 4 | Buffer Write Check The DSA sensed an error while the buffer was being loaded for a scan or write data repeat operation. |
| 5 | Interface Time-Out The storage device adapter card did not complete a sense or command operation in time. Sensed by microcode. |
| 6 | Not used. |
| 7 | Not used. |

Sense Byte 3

| Bit(s) | Description |
|--------|---|
| 0 | CRC Check The CRC character generated during a read data or a read ID operation did not match the CRC field read from the diskette. |
| 1 | Cylinder Mismatch The cylinder number in the seek parameters does not match the cylinder number read during an ID search. |
| 2 | Control Record Not Valid The control character was not hex D or hex F. |
| 3 | Overrun/Underrun The minimum data rate of the adapter card was not maintained during a data transfer. |
| 4 | Adapter Sensed Parity Check The adapter card sensed bad parity on the data storage attachment data bus during a data transfer. |
| 5 | Load Parity Check The adapter card sensed bad parity on the bus during a load command. |
| 6 | Write Gate Wrap Check The '+erase current' signal from the diskette drive is not active during a write operation. |
| 7 | Write Verify Not Equal The data read did not equal the data written. |

93-505 (continued)
Sense Bytes 0-7

Sense Byte 4

| Bit(s) | Description |
|--------|---|
| 0 | ECC invoked. |
| 1 | Not used. |
| 2 | Not used. |
| 3 | Unsafe The '+erase current' signal from the drive is active during a seek. |
| 4 | Not used. |
| 5 | Not used. |
| 6 | AM2 Not Found After the correct ID was found, the next address mark was not a data address mark or a control address mark. |
| 7 | ID not found. |

Sense Byte 5

| Bit(s) | Description |
|--------|--|
| 0 | Not used. |
| 1 | Command Reject The command was rejected by the adapter because the necessary setup information was missing. |
| 2 | 72MD wrap check. |
| 3 | 72MD parity check. |
| 4 | Diskette stopped or slow. |
| 5 | Diskette at speed. |
| 6 | Diskette fast. |
| 7 | Diskette Type Bit 7 on—diskette 2D Bit 7 off—diskette 1 |

Sense Byte 6

| Bit(s) | Description |
|--------|--|
| 0 | No-Op The command was rejected because it was not valid. See <i>Sense Byte 0 (Byte 6, Bit 0 On)</i> . |
| 1 | End of track. |
| 2 | Not ready. |
| 3 | Seek Reverse The last seek was in the direction of cylinder 0. |
| 4 | Head 01 selected. |
| 5 | Not used. |
| 6,7 | Drive Type 00—not valid 01—51TD 10—not valid 11—72MD |

Sense Byte 7

| Bit(s) | Description | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--------|--|-----|-------------|---|----------|---|---------------------------------------|---|--|---|-------------------------------------|---|----------------------------------|---|----------|---|---------------------------|------|----------|---|------------|---|----------|---|---------------------------|---|--------------|---|-----------------------------|---|----------|---|--------------|
| 0 | 72MD command reject. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 72MD motion check. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 72MD command not valid. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Not used. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4-7 | Bits 4 through 7 describe the error in bits 0 through 3. <table border="1"> <thead> <tr> <th>Hex</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Not used</td> </tr> <tr> <td>1</td> <td>Carriage bed failure (jammed at home)</td> </tr> <tr> <td>2</td> <td>Carriage bed failure (jammed off home)</td> </tr> <tr> <td>3</td> <td>Picker failure (jammed in magazine)</td> </tr> <tr> <td>4</td> <td>Picker failure (jammed in drive)</td> </tr> <tr> <td>5</td> <td>Not used</td> </tr> <tr> <td>6</td> <td>Failed to pick a diskette</td> </tr> <tr> <td>7, 8</td> <td>Not used</td> </tr> <tr> <td>9</td> <td>Cover open</td> </tr> <tr> <td>A</td> <td>Not used</td> </tr> <tr> <td>B</td> <td>Operation out of sequence</td> </tr> <tr> <td>C</td> <td>Not oriented</td> </tr> <tr> <td>D</td> <td>Write/erase current present</td> </tr> <tr> <td>E</td> <td>Not used</td> </tr> <tr> <td>F</td> <td>Parity check</td> </tr> </tbody> </table> | Hex | Description | 0 | Not used | 1 | Carriage bed failure (jammed at home) | 2 | Carriage bed failure (jammed off home) | 3 | Picker failure (jammed in magazine) | 4 | Picker failure (jammed in drive) | 5 | Not used | 6 | Failed to pick a diskette | 7, 8 | Not used | 9 | Cover open | A | Not used | B | Operation out of sequence | C | Not oriented | D | Write/erase current present | E | Not used | F | Parity check |
| Hex | Description | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | Not used | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | Carriage bed failure (jammed at home) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Carriage bed failure (jammed off home) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | Picker failure (jammed in magazine) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | Picker failure (jammed in drive) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Not used | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | Failed to pick a diskette | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7, 8 | Not used | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | Cover open | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| A | Not used | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| B | Operation out of sequence | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C | Not oriented | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| D | Write/erase current present | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| E | Not used | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| F | Parity check | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

93-506
Retry Count

This field records the number of times the failing operation was attempted.

93-507
Cylinder Arrived At

This is the hexadecimal address of the record in process when a diskette error was sensed. Each cylinder arrived at consists of 4 bytes (CHRN).

Cylinder Address (C)

The 1-byte logical address. Valid addresses are hex 00 through hex 4C.

Head Address (H)

The 1-byte address needed by all data transfer commands to address the desired head. Valid head addresses are:

| | |
|-----------|-------------|
| 00 | Diskette 1 |
| 00 and 01 | Diskette 2D |

Record Address (R)

The 1-byte record address. Valid addresses are hex 01 through hex 1A or hex 01 through hex 08.

Record Size (N)

The 1-byte record length indicator:

| | |
|----|-------------------|
| 00 | 128-byte records |
| 01 | 256-byte records |
| 02 | 512-byte records |
| 03 | 1024-byte records |

93-510 Error Counter Table

The error counter table logs the number of temporary and permanent errors recorded for each error. The sense bytes indicate the type of error that occurs. See 93-505 for additional information.

See 01-360 for information on selecting this option of ERAP.

| Error Type | Sense | |
|-----------------------------------|-------|-----|
| | Byte | Bit |
| Write verify not equal | 3 | 7 |
| CRC checks | 3 | 0 |
| Cylinder mismatch | 3 | 1 |
| AM2 not found | 4 | 6 |
| ID not found | 4 | 7 |
| Control record not valid | 3 | 2 |
| ECC invoked | 4 | 0 |
| No op | 6 | 0 |
| Command reject | 5 | 1 |
| 72MD command reject | 7 | 0 |
| 72MD command not valid | 7 | 2 |
| Cycle steal parity checks | 2 | 3 |
| Interface time-out | 2 | 5 |
| Interrupt time-out | 2 | 0 |
| Attachment data bus parity checks | 1 | 0 |
| Command/sense parity checks | 2 | 2 |
| Overrun/underrun | 3 | 3 |
| Adapter sensed parity checks | 3 | 4 |
| Load parity checks | 3 | 5 |
| Write gate wrap checks | 3 | 6 |
| Buffer write checks | 2 | 4 |
| Unsafe | 4 | 3 |
| 72MD wrap error | 5 | 2 |
| 72MD parity checks | 5 | 3 |
| 72MD motion checks | 7 | 1 |

93-520 I/O Counter Table

The I/O counter table indicates the number of I/O operations performed by the diskette adapter. See 01-360 for information on how to select this option of ERAP. The I/O counter table contains the following operations:

- FM blocks (128 bytes) read
- MFM blocks (256 bytes) read
- FM blocks (128 bytes) written
- MFM blocks (256 bytes) written
- Diskette seeks
- Autoloader operations
- Revolutions with heads loaded

FRU Descriptions

93-620 72MD Adapter

Adapter Card

The adapter card performs the following diskette control functions in response to commands executed by the system over the data storage attachment interface:

- Controls sense and status operations
- Controls seek operations
- Serializes and deserializes read/write data
- Generates and tests cyclic redundancy check (CRC) characters
- Performs speed checking
- Controls autoloader operations

VFO Card

The VFO card synchronizes the transmission of read data between the drive control card and the adapter card. The VFO card:

- Receives the read data from the drive control card
- Separates the serial data pulses from the clock pulses
- Transmits the serial data bytes to the diskette adapter

93-630 72MD Diskette Magazine Drive

Drive Control Card

The drive control card controls:

- Head/carriage stepper motor
- Read/write operations
- Index sensing
- Autoloader operations

Driver Board Assembly

The driver board assembly receives the output signal from the drive control card and drives the following stepper motors:

- Picker/cam stepper motor
- Carriage bed stepper motor

Autoloader Carriage Bed Assembly

The carriage bed holds two 10-diskette magazines and has three single diskette I/O slots. The carriage bed is moved by the carriage bed stepper motor to align the selected diskette (I/O slot or magazine slot) with the picker mechanism.

Autoloader Picker/Cam Assembly

The picker/cam stepper motor drives the picker/cam assembly. The picker/cam assembly:

- Moves the picker carriage to insert or eject diskettes
- Moves a collet to clamp the diskette to or release the diskette from the drive hub
- Loads and unloads the read/write heads

Drive Assembly

The drive assembly contains the following major FRUs:

- Read/write head and carriage assembly

Two read/write heads are attached to a common carriage assembly. The heads read data from a diskette or write data on a diskette.

- Read/write head and carriage access mechanism

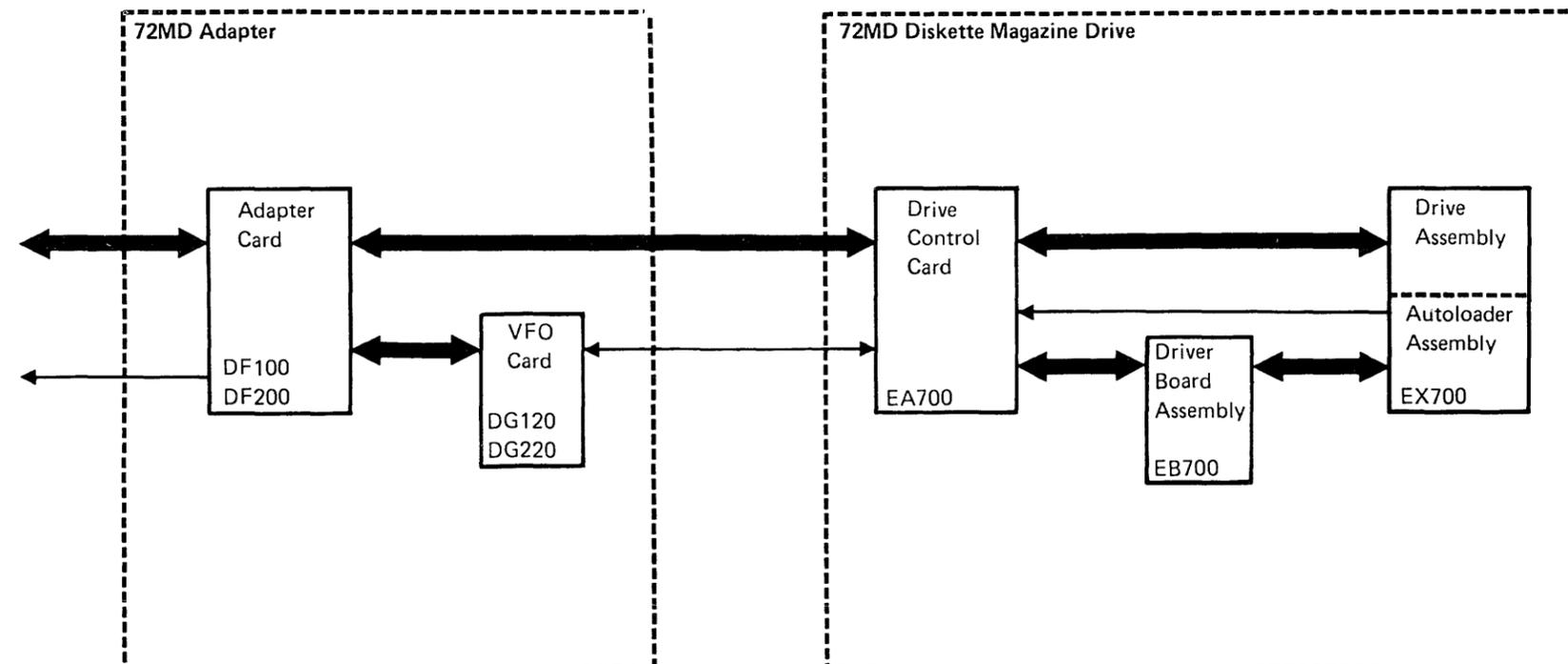
The head/carriage stepper motor moves the heads from cylinder to cylinder in either direction, one cylinder per step.

- Diskette sense mechanism

The two light-emitting diodes (LEDs) and two phototransistors (PTXs) work together to sense the diskette index hole and to identify the type of diskette inserted (diskette 1 or diskette 2D) in the drive.

- AC drive motor

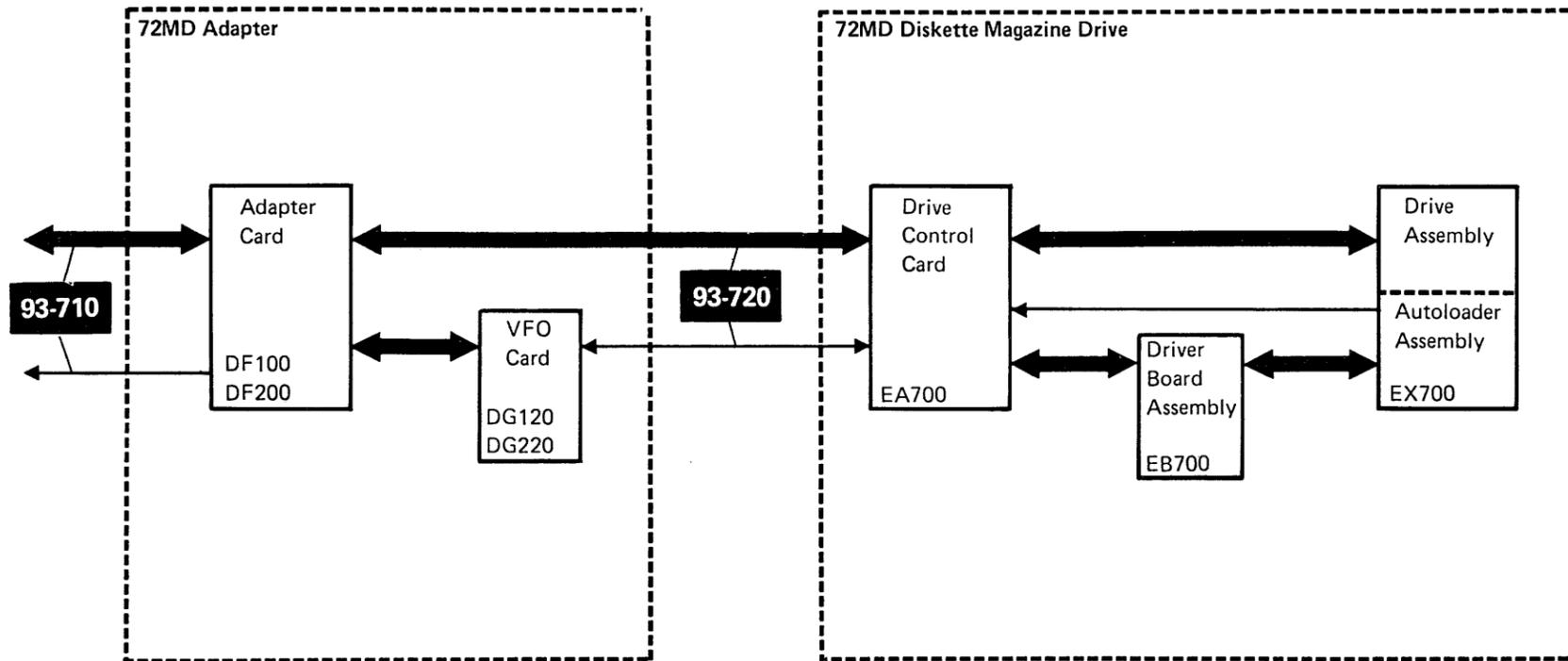
The drive motor turns the diskette at 720 revolutions per minute.



Interface Descriptions

93-700 Interface Locations

See the figure on this page to determine which interfaces are being described and where you can find the description for each interface.



**93-710
Adapter Interface**

In the following table, the TU column indicates a test unit to loop when probing the signal.

For a description of the lines to the data storage attachment, see 90-720.

| Signal Name | Description | TU |
|------------------|---|-------|
| -Diskette in use | This line activates the Diskette In Use light on the control panel whenever the drive is allocated to the system. | TD234 |

**93-720
72MD Interface**

In the following table, the TU column indicates a test unit to loop when probing the signal.

| Signal Name | Description | TU | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|-----------------|----|-----------------|---|---|----|-----|----|-----|--|--|--|---|---|---|---|---|---|----|----|----|----|----------|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|---|---|---|----------|---|---|---|---|---|---|---|---|---|---|-------|
| +Access 0 +Access 1 +Access 2 +Access 3 | When in drive mode, the four access lines cause the read/write heads to move to the selected cylinder. When in autoloader mode, the four access lines sequence the selected stepper motor (either the picker/cam or the carriage bed motor.) Activating any two sequential access lines turns the head stepper motor a distance equal to one cylinder. <table border="1"> <thead> <tr> <th>Line Name</th> <th>In</th> <th colspan="6">Cylinder Number</th> <th colspan="3">Out</th> </tr> <tr> <th></th> <th>0</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>40</th> <th>74</th> <th>75</th> <th>76</th> </tr> </thead> <tbody> <tr> <td>Access 0</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>Access 1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>Access 2</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>Access 3</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table> | Line Name | In | Cylinder Number | | | | | | Out | | | | 0 | 1 | 2 | 3 | 4 | 5 | 40 | 74 | 75 | 76 | Access 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | Access 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | Access 2 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | Access 3 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | TD216 |
| Line Name | In | Cylinder Number | | | | | | Out | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0 | 1 | 2 | 3 | 4 | 5 | 40 | 74 | 75 | 76 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Access 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Access 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Access 2 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Access 3 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Autoloader wrap | When in autoloader mode, the 'autoloader wrap' line ('status D' line) follows the level on the 'enable autoloader' line during all operations, except during the operations that occur during the sense commands. When the level of the 'autoloader wrap' line follows the level on the 'enable autoloader' line: <ol style="list-style-type: none"> 1. A 72MD is connected to the system, 2. The 72MD has +5 Vdc power, and 3. The 72MD driver board assembly and the cable to the drive control card are connected correctly. | TD210-TD214 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Command 0 +Command 1 +Command 2 +Command 3 +Command 4 +Command 5 +Command P | When in autoloader mode, the 'command 0-5,P' lines are the output of an encoded autoloader command received from the system. The autoloader control logic in the drive control card decodes the command and causes the autoloader to perform the desired operation. Parity (odd-numbered) for the command is placed on the 'command P' line. | TD210-TD214 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Signal Name | Description | TU | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------------|--|--------------|-----------------|----------|-------|--|--|--|--|-------|----------|-------|----------|-------|--|---------------|---|---|---|---|---|--|----------------|---|---|---|---|---|--|-------|
| -Drive sense | This line is normally minus which indicates that the diskette drive installed is a 72MD device. | TD204 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Dskt 2D sense | When in drive mode, the active level of this line indicates that a diskette 2D is being used. This line is not activated by a diskette 1. | TD218, TD220 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Enable autoloader | The active level (autoloader mode) indicates that the autoloader function to be performed (transfer commands to and read status information from the 72MD) is encoded on the 'command 0-5,P' lines. The not active level (drive mode) indicates that the functions performed by the drive station (head access, head select, read, and write) are enabled. | TD210-TD214 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Erase gate | When in drive mode, this line activates the erase circuits for a write operation. | TD217, TD230 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Erase sense | When in drive mode, this line indicates that either erase current or write current is active. | TD217, TD230 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +File data | File data is a series of clock and data pulses that represent the data read from the diskette surface. | TD215, TD231 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Index | This line indicates the start of a track. This 0.75 to 1.50 millisecond pulse occurs every 83.3 milliseconds (± 2.1 milliseconds). See 93-420 for scoping procedures. | TD215-TD220 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Inner tracks | When in drive mode and during a write operation, this line decreases the recording current in the write head at the inner cylinders. On a read operation, this line corrects for bit shifting on cylinders 42 through 76. <table border="1"> <thead> <tr> <th>Line Name</th> <th colspan="6">Cylinder Number</th> </tr> <tr> <th></th> <th>00-41</th> <th>42,43,44</th> <th>45-59</th> <th>60,61,62</th> <th colspan="2">63-76</th> </tr> </thead> <tbody> <tr> <td>+Inner tracks</td> <td>0</td> <td>x</td> <td>1</td> <td>1</td> <td colspan="2">1</td> </tr> <tr> <td>+Switch filter</td> <td>0</td> <td>0</td> <td>0</td> <td>x</td> <td colspan="2">1</td> </tr> </tbody> </table> Legend 1 = Plus level 0 = Minus level x = Level can be plus or minus | Line Name | Cylinder Number | | | | | | | 00-41 | 42,43,44 | 45-59 | 60,61,62 | 63-76 | | +Inner tracks | 0 | x | 1 | 1 | 1 | | +Switch filter | 0 | 0 | 0 | x | 1 | | TD219 |
| Line Name | Cylinder Number | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 00-41 | 42,43,44 | 45-59 | 60,61,62 | 63-76 | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Inner tracks | 0 | x | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Switch filter | 0 | 0 | 0 | x | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| -Power on reset | When the system is powered on, a minus pulse is put on the 'power on reset' line to clear the autoloader logic circuits. | TD202 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Select head 1 | When in drive mode, this line selects head 1. When not active, this line selects head 0. | TD218 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Status A +Status B | When in autoloader mode, these lines give feedback to the system as to the status of the autoloader logic. | TD210-TD214 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Status C +Status D | | TD214, TD215 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Switch filter | When in drive mode, this line is used with the 'inner tracks' line to correct for bit shifting on cylinders 60 through 76. This line is not used on a write operation. | TD220 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Write data | When in drive mode, each change of the 'write data' line causes the current to switch in the read/write head. This process records the data on the diskette surface. | TD217, TD230 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +Write gate | When in drive mode and during a write operation, this line activates the write circuits and deactivates the read circuits. | TD217, TD230 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| +500 kHz | When in autoloader mode, this line supplies the timing pulses to the autoloader logic. | TD210-TD214 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Sequence of Events

93-805 Attachment Operation

The 72MD operates in two modes: autoloader mode and drive mode. The '+enable autoloader' line determines which mode is used. If the line is active, autoloader mode is used. If the line is not active, drive mode is used.

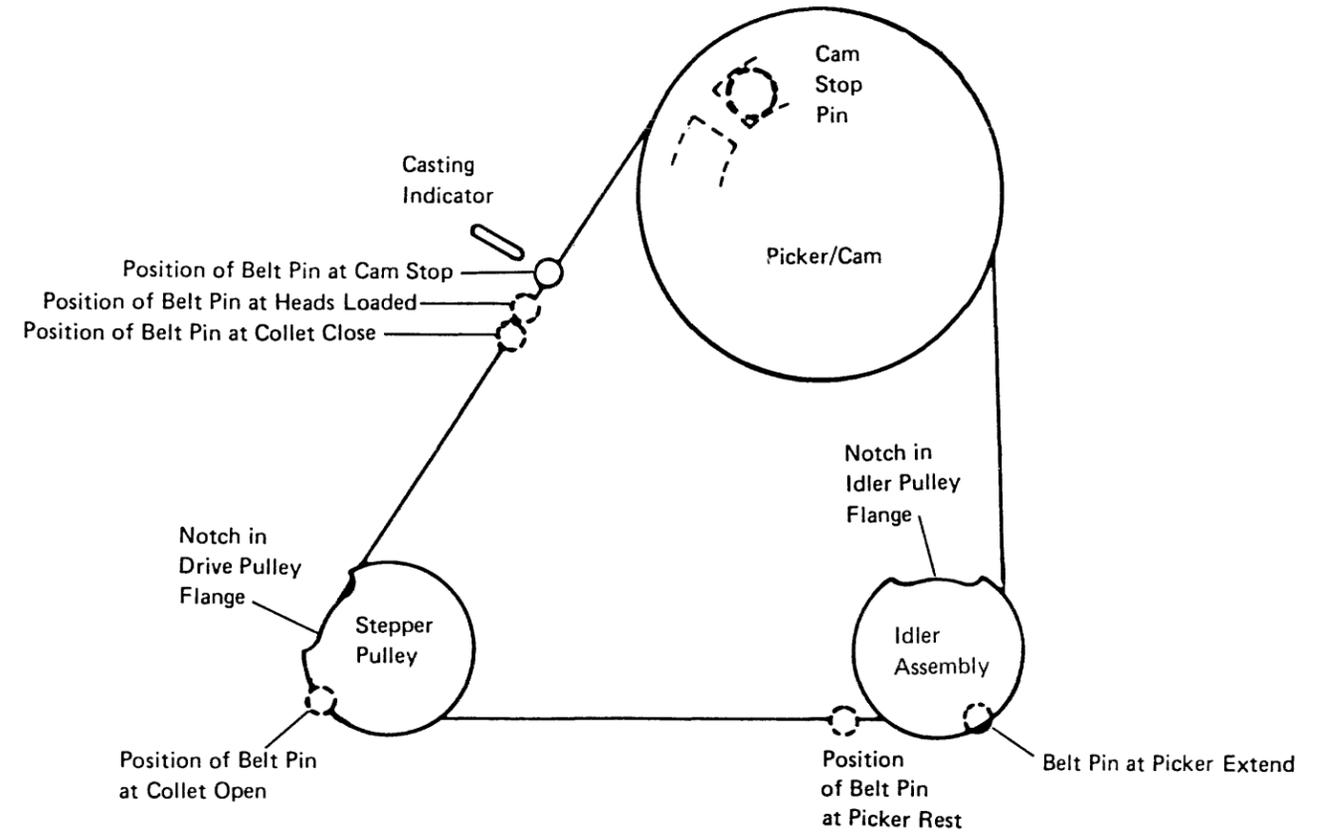
- Autoloader mode is used to:
 - Move the carriage bed
 - Insert or remove a diskette
 - Clamp or release a diskette
 - Load or unload the read/write heads
- Drive mode is used to:
 - Move the head/carriage assembly
 - Read or write data
 - Sense the index

| Processing Unit | Data Storage Attachment | 72MD Adapter and Drive |
|---|---|--|
| 1 The main storage program starts an operation to insert a diskette (autoloader operation), to seek, to write data, or to read data from the 72MD. See 10-820. | | |
| 2 The control storage program sends the necessary I/O commands. See 10-821. | | |
| | 3 The data storage attachment passes the commands to the 72MD adapter on the '+DSA data bus out bits 0-7' lines. | |
| | | 4 The adapter card decodes the commands. |
| | | 5 The 72MD performs the requested operation. <ul style="list-style-type: none"> • Autoloader operations <ul style="list-style-type: none"> – Abort 93-851 – Orient 93-852 – Select slot 93-853 – Load heads 93-854 – Unload heads 93-855 – Eject diskette 93-856 • Drive operations <ul style="list-style-type: none"> – Seek 93-861 – Write 93-862 – Write verify 93-863 – Read 93-865 – Find ID 93-867 |
| | | 6 The adapter card activates the '+dskt interrupt' line to indicate operation end to the data storage attachment. |

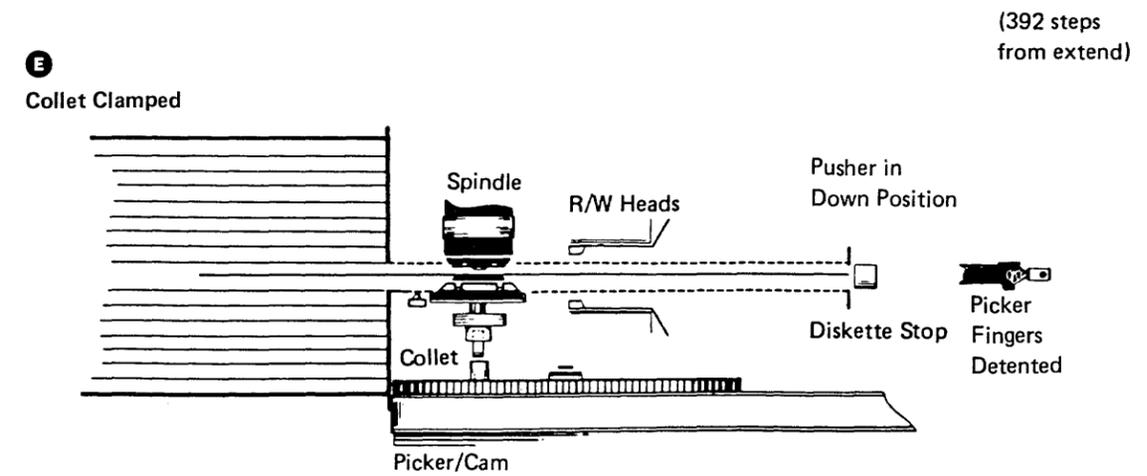
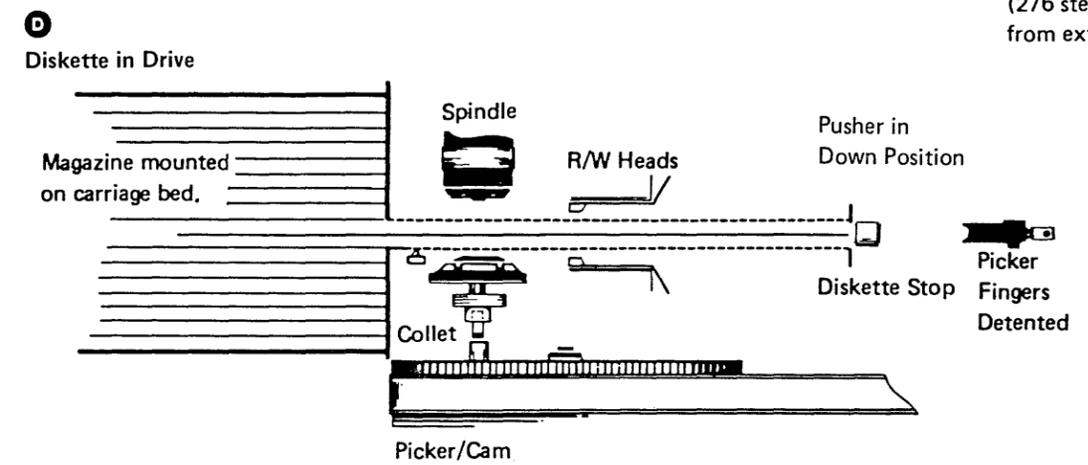
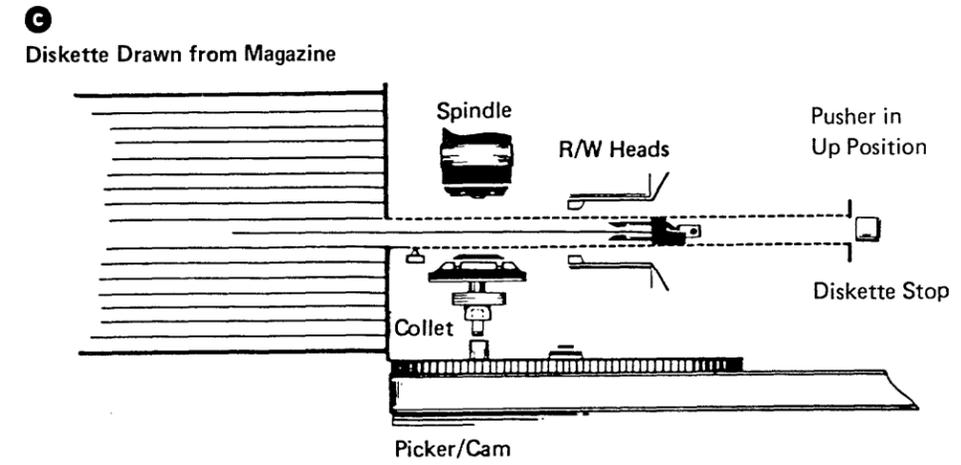
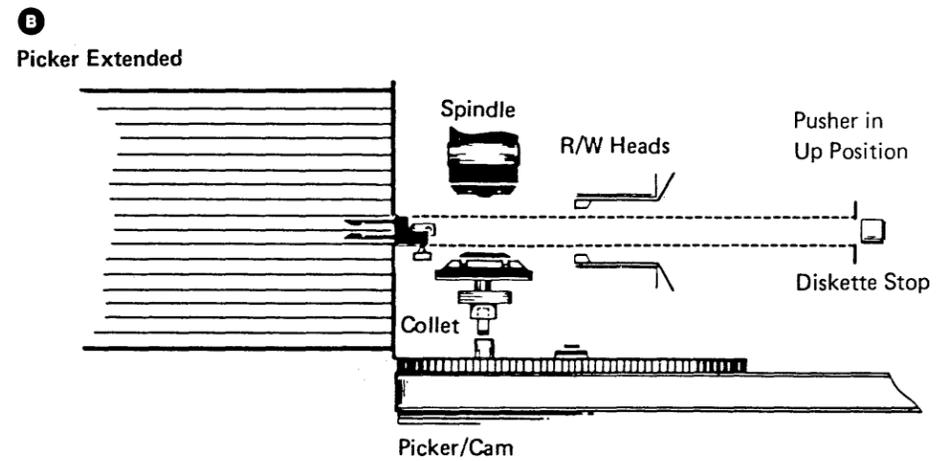
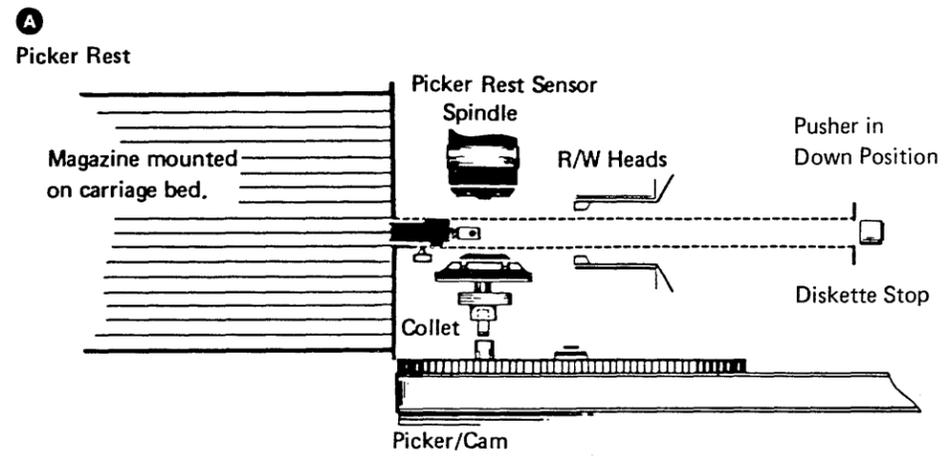
93-810
72MD Operation

The following chart shows the mechanical movement for a typical 72MD operation. See the pages that follow this chart for **A** through **K**.

| Autoloader Mode | Drive Mode |
|--|--|
| 1 Move the carriage bed. | |
| 2 Position the selected diskette at the drive station diskette guide. | |
| 3 Insert the diskette into the drive station (A , B , C , and D). | |
| 4 Clamp the diskette on the drive hub E . | |
| 5 Load the read/write heads F . | |
| | 6 Move the head/carriage assembly to a selected cylinder. |
| | 7 Locate the record. |
| | 8 Read or write the record. |
| | 9 Repeat steps 6 through 8 until the reading or writing sequence is complete. |
| 10 Unload the read/write heads G . | |
| 11 Unclamp the diskette from the drive hub H . | |
| 12 Remove the diskette from the drive station (J and K). | |

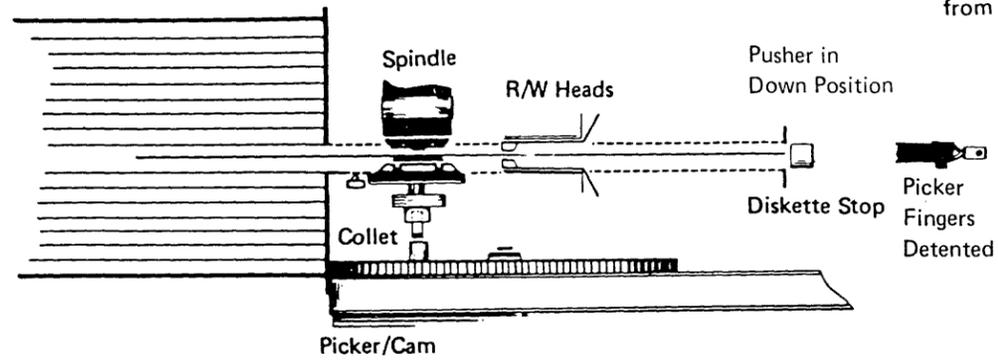


Mechanical Operations Chart



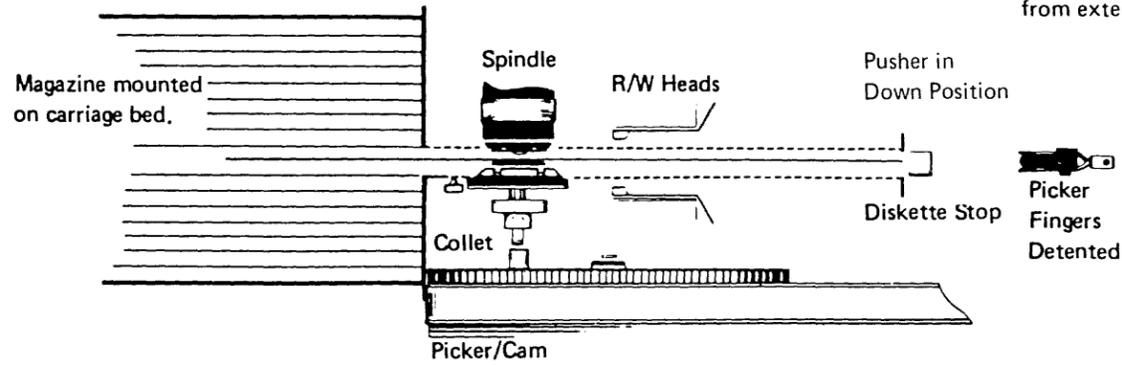
F
Heads Loaded

(452 steps
from extend)



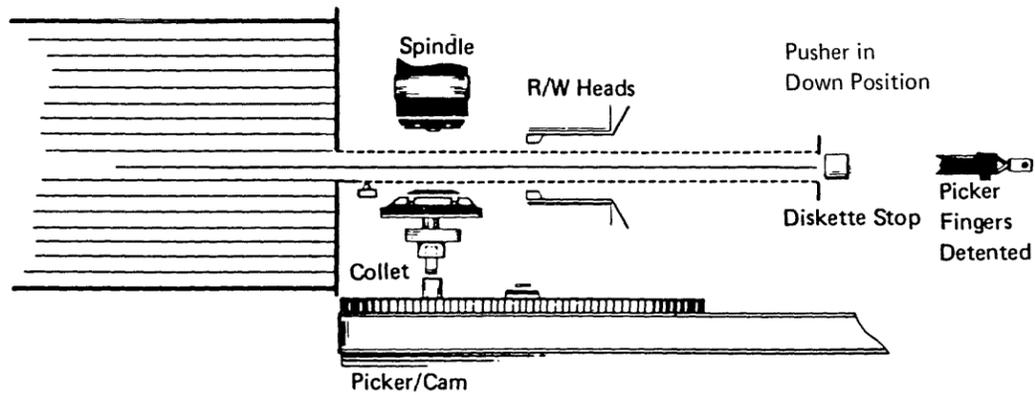
G
Heads Unloaded

(412 steps
from extend)

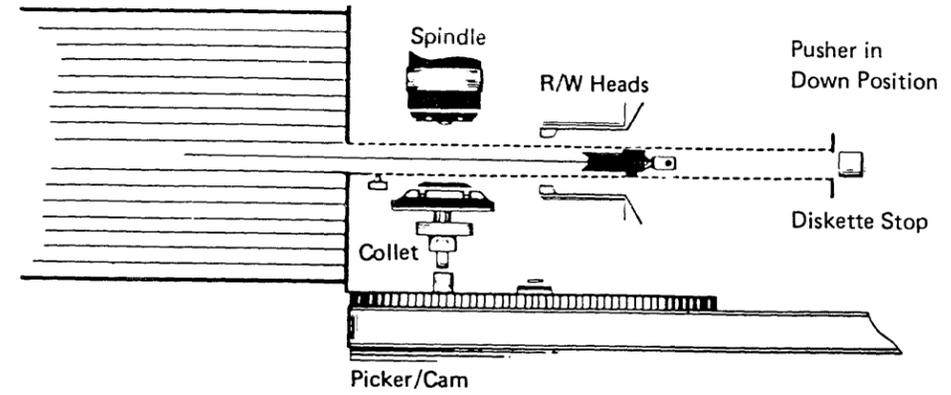


H
Collet Unclamped

(276 steps
from extend)

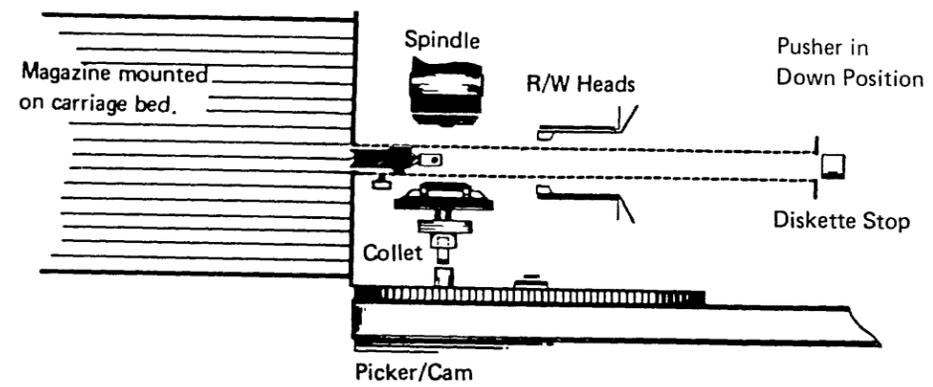


I
Diskette Pushed from Drive



K
Diskette Returned to Magazine

(20 steps
from extend)



AUTOLOADER MODE

93-851 Abort Autoloader

An abort autoloader operation causes the following to occur:

- The autoloader control logic is reset.
- Operation end is not returned.

An orient autoloader operation is performed automatically after the abort autoloader occurs.

93-852 Orient Autoloader

An orient autoloader operation moves the carriage bed to align I/O slot 1 with the drive diskette guide. If a diskette is in the drive, it is ejected.

| 72MD Adapter | 72MD Diskette Magazine Drive |
|--|---|
| 1 The adapter card receives the orient autoloader command on the '+DSA data bus out bits 0-7' lines. | |
| 2 The adapter card activates the '+enable autoloader' line and places the command on the '+command 0-5, P' lines. | |
| | 3 The drive control card activates the '-picker motor' line and the 'auto step 0 through 3' lines. |
| | 4 The picker/cam stepper motor: <ul style="list-style-type: none"> • Moves the picker fingers to the rest position. • Moves the picker fingers back past the diskette-in position to put the ejector in the down position. • Moves the picker fingers back to the rest position. |
| | 5 The drive control card activates the '-bed motor' line and the 'auto step 0 through 3' lines. |
| | 6 The carriage bed stepper motor aligns I/O slot 1 with the drive diskette guide. <ul style="list-style-type: none"> • The carriage bed is moved directly to I/O slot 1, or • The carriage bed is moved past I/O slot 1 to make the Bed Orient switch. The carriage bed is then moved back to I/O slot 1. This is necessary when an orient command is preceded by an abort or reset sense latches command. |
| | 7 The drive control card activates the '+status A' line to indicate operation end. |
| 8 The adapter card activates the '-dskt interrupt' line to the data storage attachment. | |

**93-853
Select Slot**

The select slot operation moves the diskette in the selected slot into the drive. Any one of the 23 slots (3 I/O slots, magazine 1 and magazine 2 slots 1 through 10) can be selected.

- If a diskette is in the drive, an eject diskette operation (93-856) is performed before the select slot operation.
- If the selected diskette is already in the drive and the heads are loaded, the heads are unloaded and the '+status A' line (operation end) is activated. No mechanical movement takes place if the heads are not loaded.

| 72MD Adapter | 72MD Diskette Magazine Drive |
|--|---|
| 1 The adapter card receives the select slot command on the '+DSA data bus bits 0-7' lines. | |
| 2 The adapter card activates the '+enable autoloader' line and places the command on the '+command 0-5, P' lines. | |
| | 3 The drive control card activates the '-bed motor' line and the 'auto step 0 through 3' lines. |
| | 4 The carriage bed stepper motor aligns the selected slot with the drive diskette guide. |
| | 5 The drive control card activates the '-picker motor' line and the 'auto step 0 through 3' lines. |
| | 6 The picker/cam stepper motor: <ul style="list-style-type: none"> • Operates the picker fingers to insert the diskette into the drive. • Clamps the diskette to the drive hub. |
| | 7 The 72MD senses the index hole to determine the type of diskette. |
| | 8 The drive control card: <ul style="list-style-type: none"> • Activates the '+diskette sense' line if the diskette is a 2D (not active level = diskette 1). • Activates the '+status A' line to indicate operation end. |
| 9 The adapter card activates the '-dskt interrupt' line. | |

**93-854
Load Heads**

The load heads operation is generated by the adapter card when a seek or read/write command is received.

| 72MD Adapter | 72MD Diskette Magazine Drive |
|---|--|
| 1 The adapter card places the load heads command on the '+command 0-5, P' lines. | |
| | 2 The drive control card activates the '-picker motor' line and the 'auto step 0 through 3' lines. |
| | 3 The picker/cam stepper motor loads the heads. If the heads are already loaded, no mechanical movement occurs. |
| | 4 The drive control card activates the '+status A' line to indicate operation end. |

93-855 Unload Heads

The adapter card generates the unload heads operation if three revolutions have occurred and the drive is not active.

| 72MD Adapter | 72MD Diskette Magazine Drive |
|---|--|
| 1 The adapter card places the unload heads command on the '+command 0-5, P' lines. | |
| | 2 The drive control card activates the '-picker motor' line and the 'auto step 0 through 3' lines. |
| | 3 The picker/cam stepper motor unloads the heads. If the heads are already unloaded, no mechanical movement occurs. |
| | 4 The drive control card activates the '+status A' line to indicate operation end. |

93-856 Eject Diskette

The eject diskette operation moves the diskette that is in the drive back into the I/O slot or magazine slot. If a diskette is not inserted in the drive, the picker/cam assembly does not move.

| 72MD Adapter | 72MD Diskette Magazine Drive |
|---|--|
| 1 The adapter card receives the eject diskette command on the '+DSA data bus out bits 0-7' lines. Note: The adapter card generates an eject operation if the heads are unloaded and the cover is opened. | |
| 2 The adapter card places the command on the '+command 0-5, P' lines. | |
| | 3 The drive control card activates the '-picker motor' line and the 'auto step 0 through 3' lines. |
| | 4 The picker/cam stepper motor: <ul style="list-style-type: none"> • Unloads the heads and releases the collet. • Moves the picker fingers to the picker rest position. |
| | 5 The drive control card activates the '+status A' line to indicate operation end. |
| 6 The adapter card activates the '-dskt interrupt' line if the system generated the operation. | |

DRIVE MODE

93-861
Seek Operation

There are two types of seek operations:

- Normal seek: Seek from the present known cylinder to a specified cylinder.
- Recalibrate: Seek from the present location (not known) to cylinder 00.

| 72MD Adapter | 72MD Diskette Magazine Drive |
|---|--|
| 1 The adapter card receives the seek parameters on the '+DSA data bus out bits 0-7' lines. | |
| 2 The adapter card compares the parameters with the present position of the head/carriage assembly and determines how far to move the head/carriage assembly. A recalibrate command causes an 80-track seek toward cylinder 0. | |
| 3 The adapter card activates the 'access 0 through 3' lines. | |
| | 4 The drive control card activates the 'head stepper motor phase 0 through 3' lines. |
| | 5 The head/carriage stepper motor moves the read/write heads to the specified cylinder. |
| 6 The adapter card stores the present position of the head/carriage assembly and activates the '-dskt interrupt' line. | |

93-862
Write Operation

The 72MD writes data in either FM (frequency modulation) or MFM (modified frequency modulation) mode. In FM mode, bits are written 2 microseconds apart. In MFM mode, bits are written 1 microsecond apart. There are three types of write operations:

- Write data: Writes the VFO sync field followed by a data field.
- Write CAM (control address mark): Writes the VFO sync field followed by a control field that identifies the type of record (deleted or damaged).
- Write format: Writes a full track of gaps, sync fields, ID fields, and data fields starting with the index.

| 72MD Adapter | 72MD Diskette Magazine Drive |
|---|------------------------------|
| <p>1 The adapter card receives the command and parameters for the write operation on the '+DSA data bus out bits 0-7' lines (cylinder, head, record number, record format, and number of records to be written).</p> | |
| <p>2 The adapter card generates a head load operation if the heads are not loaded (93-854).</p> | |
| <p>3 The adapter card generates a find ID operation (93-867) for all write operations except the write format.</p> | |
| <p>4 The adapter card activates the following lines: '+Write gate' '+Erase gate' '+Write data' '+Inner tracks' '+Select head 1' (active for head 1, not active for head 0)</p> | |

| 72MD Adapter | 72MD Diskette Magazine Drive |
|--------------|---|
| | <p>5 The drive control card:</p> <ul style="list-style-type: none"> • Activates the write circuits for the selected head. • Activates the tunnel erase circuits to erase data between tracks. • Controls current to the read/write head to write the data. <ul style="list-style-type: none"> – The '+write data' line determines the direction of current flow. – The '+inner tracks' line decreases the current used for the inner tracks (42 through 76). |
| | <p>6 The adapter card deactivates the following lines when the write operation is complete: '+Write gate' '+Erase gate' '+Write data'</p> |
| | <p>7 The adapter card activates the '-dskt interrupt' line for all operations except write format.</p> |
| | <p>8 If this is a write format, the adapter card generates a read verify operation (93-865).</p> |

93-863 Write Verify

The write verify operation is performed after every write data operation and every write data control operation. The verify is done by reading the data just written and comparing it to the original data in main storage.

| 72MD Adapter | 72MD Diskette Magazine Drive |
|---|---|
| <p>1 The adapter card receives the command and parameters for the write verify operation on the '+DSA data bus out bits 0-7' lines (cylinder, head, record number, format, and number of records to be verified).</p> | |
| <p>2 The adapter card generates a find ID operation (93-867).</p> | |
| <p>3 The adapter card activates the following lines:</p> <ul style="list-style-type: none"> '+Select head 1' (active for head 1, not active for head 0) '+Fast sync on zeros' '+MFM mode' (if MFM mode was used) '+Switch filter' and '+inner tracks' to correct for bit shifting on cylinders 42 through 76. | |
| | <p>4 The drive control card takes the data from the selected read/write head and puts it on the '+file data' line.</p> |
| <p>5 The VFO card:</p> <ul style="list-style-type: none"> • Activates the '+4F read clock phase 1 and 2' lines to strobe data and clock pulses to the adapter card. • Separates the data from the clock pulses: <ul style="list-style-type: none"> '+Standard read data' (data) '+Standard read clock' (clock pulses) | |
| <p>6 Data is moved from main storage to the adapter by cycle steal (10-825).</p> | |
| <p>7 The adapter card compares the data read from diskette to the data from main storage and activates the '-dskt interrupt' line when the operation is complete.</p> | |

93-865
Read Operation

When the 72MD adapter is not performing a write operation, the read/write heads are reading data from the diskette. This read data is available on the '+file data' line. There are four types of read operations:

- Read data: Reads the specified records into main storage. Control records flagged as deleted or defective are not read.
- Read ID: Reads the first available ID field using the selected head and sends it to main storage.
- Read data/CAM (control address mark): Reads the specified records, including control records, into main storage.
- Read verify: Reads the specified records and verifies their integrity. No data is transferred. The read verify is performed after a write format operation.

| 72MD Adapter | 72MD Diskette Magazine Drive |
|--|------------------------------|
| <p>1 The adapter card receives the command and parameters for the read operation on the '+DSA data bus out bits 0-7' lines:</p> <ul style="list-style-type: none"> • Read data and read data/CAM: Cylinder, head, record number, record format, and number of records to be read. • Read ID: Cylinder and head to be read. <p>Note: The read verify is generated by the adapter card after a write format operation.</p> | |
| <p>2 The adapter card activates the following lines:</p> <ul style="list-style-type: none"> '+Fast sync on zeros' '+MFM mode' (MFM mode only) '+Switch filter' and 'inner tracks' to correct for bit shifting on cylinders 42 through 76 '+Select head 1' (active for head 1, not active for head 0) | |

| 72MD Adapter | 72MD Diskette Magazine Drive |
|---|---|
| | <p>3 The drive control card takes the data from the selected read/write head and puts it on the '+file data' line.</p> |
| <p>4 The adapter card generates a find ID operation (93-867). A find ID operation is not generated for a read ID.</p> | |
| <p>5 When the correct ID is found (read data command only), the read operation starts.</p> | |
| <p>6 The VFO card:</p> <ul style="list-style-type: none"> • Activates the '+4F read clock phase 1 and 2' lines to strobe data and clock pulses to the adapter card. • Separates the data from the clock pulses: <ul style="list-style-type: none"> '+Standard read data' (data) '+Standard read clock' (clock pulses) | |
| <p>7 The adapter card sends the data to the data storage attachment (except for the read verify).</p> | |
| <p>8 The adapter card activates the '-dskt interrupt' line.</p> | |

93-867 Find ID

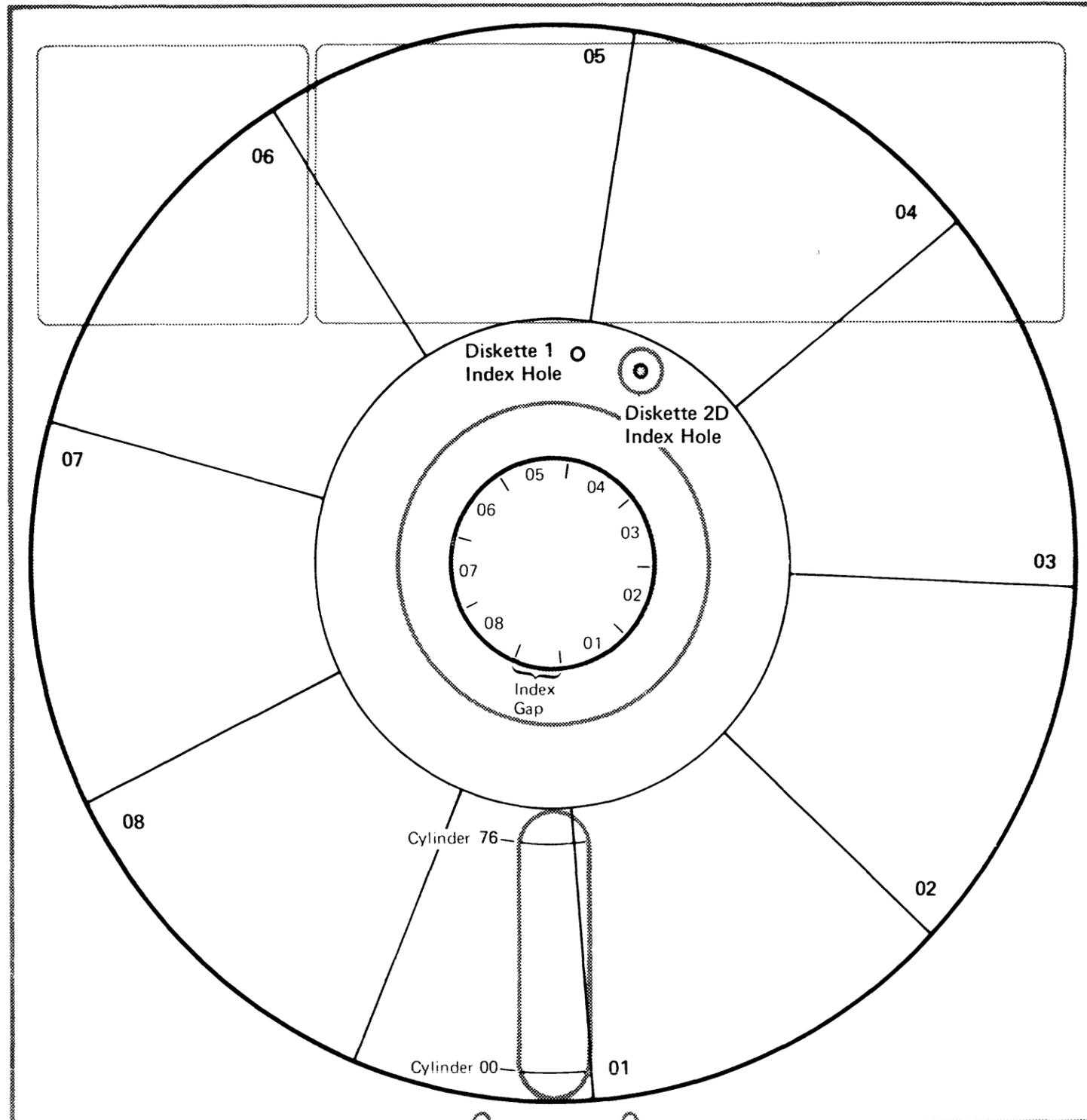
The find ID operation is generated for all read and write operations except write format and read ID. The find ID uses the read/write operation parameters (cylinder, head, record number, record format) to find the location where the data is to be read or written.

| 72MD Adapter | 72MD Diskette Magazine Drive |
|---|--|
| <p>1 The adapter card generates the find ID from the following operations:</p> <ul style="list-style-type: none"> • Write data (93-862) • Write CAM (93-862) • Write verify (93-863) • Read data (93-865) • Read data/CAM (93-865) • Read verify (93-865) | |
| <p>2 The adapter card activates the following lines:</p> <ul style="list-style-type: none"> '+Fast sync on zeros' '+MFM mode' (MFM mode only) '+Switch filter' and 'inner tracks' to correct for bit shifting on cylinders 42 through 76 '+Select head 1' (active for head 1, not active for head 0) | |
| | <p>3 The drive control card takes the data from the selected head and puts it on the '+file data' line.</p> |
| <p>4 The VFO card:</p> <ul style="list-style-type: none"> • Activates the '+4F read clock phase 1 and 2' lines to strobe data and clock pulses to the adapter card. • Separates the data from the clock pulses: <ul style="list-style-type: none"> '+Standard read data' (data) '+Standard read clock' (clock pulses) | |
| <p>5 The adapter card compares the IDs read from the diskette until the correct ID is found. When the correct ID is found, the main operation is started.</p> | |

Reference

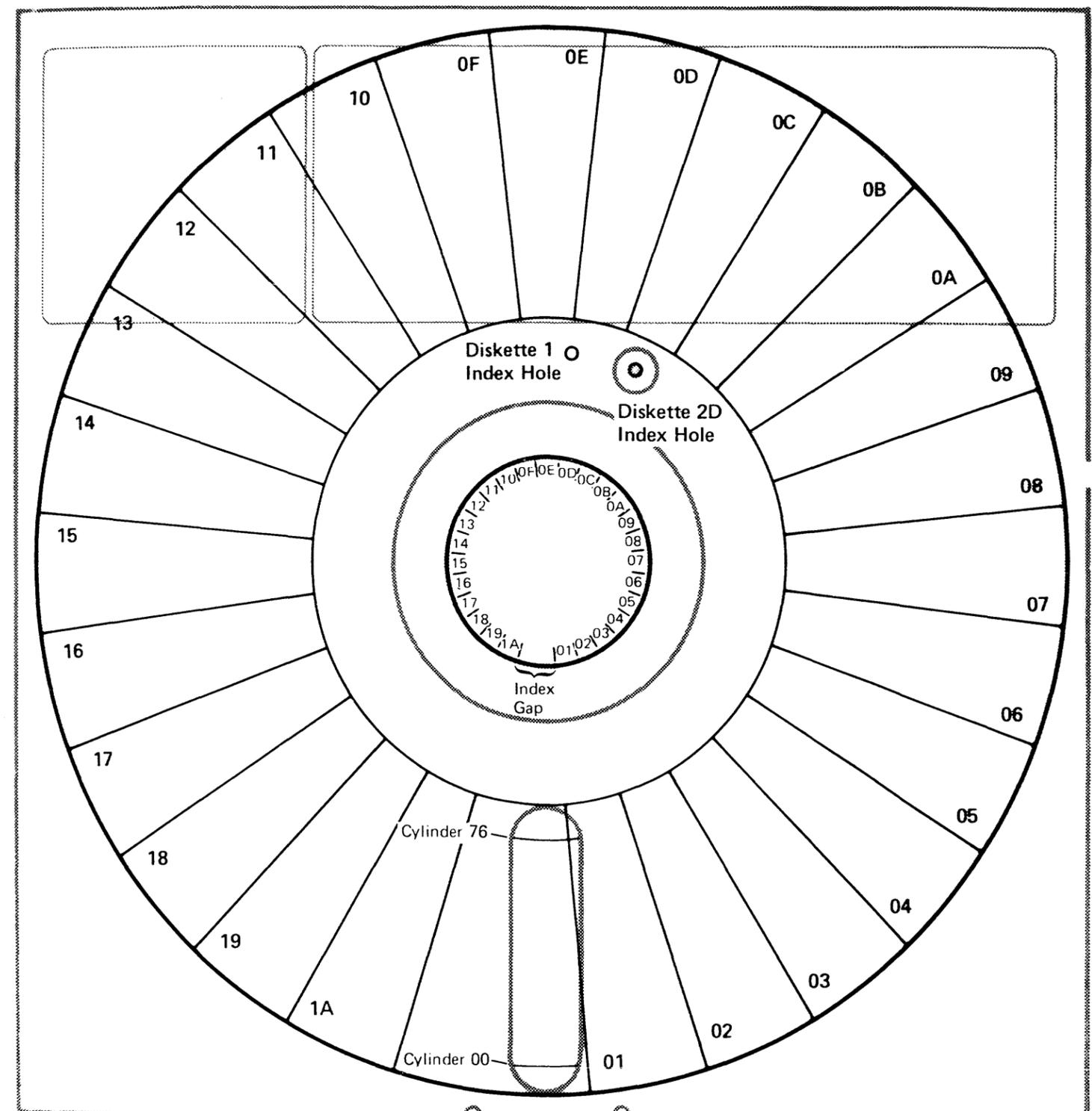
93-900 Diskette Formats

Note: The diskette is shown below as seen from the label side of the diskette jacket, which is also the head 1 side of the diskette.



Format: 512 bytes per sector (FM); 1024 bytes per sector (MFM)

▲ Diskette Index



Format: 128 bytes per sector (FM); 256 bytes per sector (MFM)

▲ Diskette Index

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Cut Along Line

Cut Along Line

Cut Along Line

Fold and tape

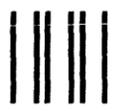
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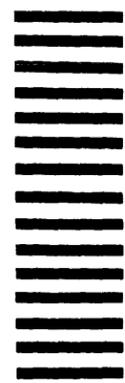


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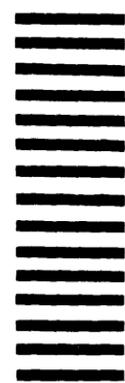


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**IBM System/36
72MD Diskette Magazine Drive and Adapter
Maintenance Information Manual**

Order Number
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