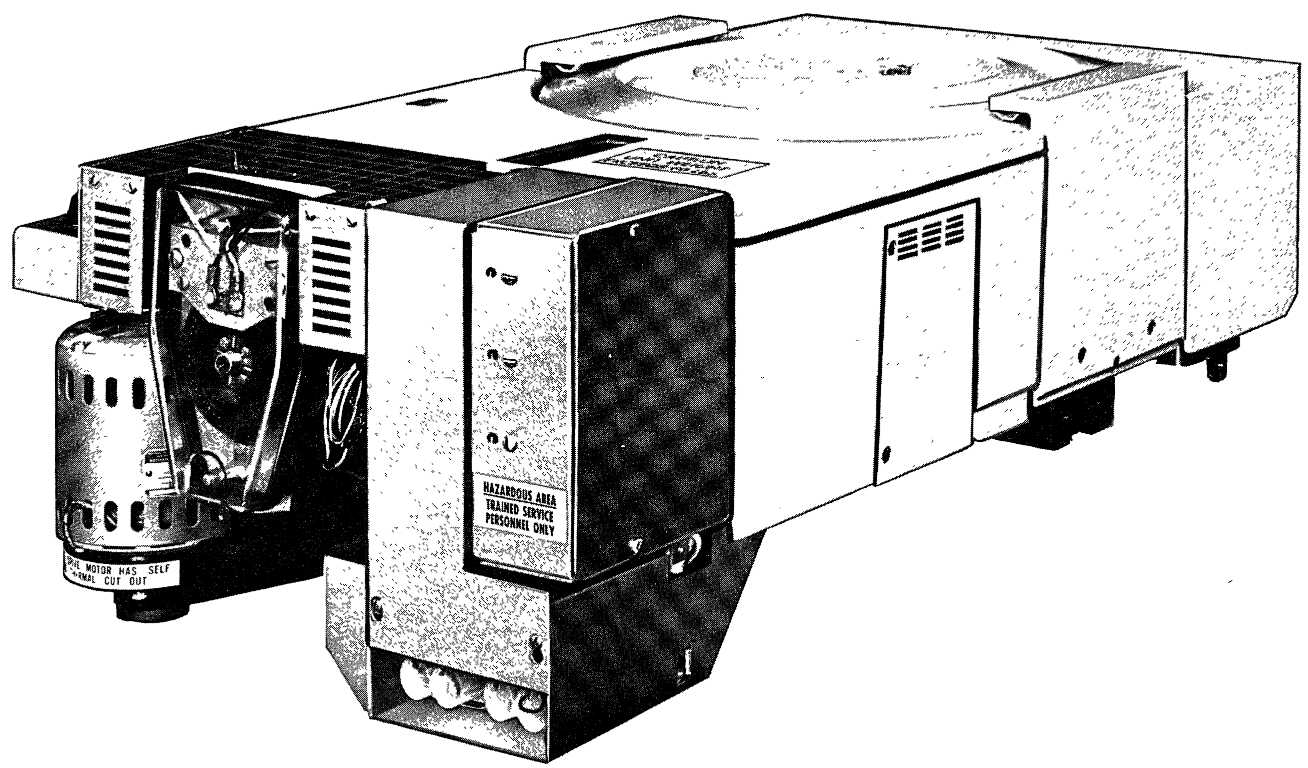
IBM Maintenance Library

5444 Disk Storage Drive
(Machines with serial numbers above 30100)
Theory-Maintenance

SY33-0029-1

IBM Maintenance Library



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(Machines with serial numbers above 30100)
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SY33-0029-1

Second Edition (November, 1971)

This is a major revision of, and obsoletes, SY33-0029-0 and Technical Newsletters SN31-0326 and SN31-0330. The information in Chapter 1 has been re-arranged. Other changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

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

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The illustrations in this manual have a code number at their lower right-hand corner. This is a publishing control number and is unrelated to the subject matter.

Preface

This manual provides, for maintenance personnel, instructional information on the IBM 5444 Disk Storage Drive (machines with serial numbers above 30100).

- Chapter 1 contains a brief introduction to the 5444 Disk Storage Drive, and describes the interface between the 5444 and its using system.
- Chapter 2 describes the approach to servicing the 5444, error recovery procedures, the maintenance facilities that are provided for servicing the 5444, together with details of the required preventive maintenance procedures.
- Chapter 3 contains a description of the individual units on the 5444, together with details of the various access operations (except CE access operations) that are performed by the machine. This chapter also contains all servicing information (checks, adjustments, alignments, removal and replacement procedures) for the 5444. For any unit, the descriptive information is given first, followed by the appropriate servicing information.
- Appendix A gives information on access to the 5444 in the IBM System/3 Model 10.
- Appendix B contains an abbreviations list, a glossary of terms, and other reference data.

This manual does not contain information on control circuits and power supplies that are located outside the machine.

For maintenance of the machine, it is assumed that the reader has had theoretical and practical training on the 5444, and that he is familiar with the using system to which the 5444 is attached. It is also assumed that he is familiar with the use of CE tools and with the servicing techniques that are employed in the maintenance of IBM equipment.

Safety See pages vi and vii for safety procedures for both personnel and equipment

Associated Publications

The following documentation is associated with this manual.

1. The manuals of the using system to which the 5444 is attached.
2. Automated logic diagrams (ALDs) and other engineering-controlled documents for the 5444. These are referred to in this manual and are shipped with each machine. ALD page numbers are prefixed FS and WK. Wiring diagrams and component location diagrams are prefixed ZA and ZZ respectively.
3. Installation instructions for the 5444. These are shipped with each machine.
4. Symptom indexes and service aids for the 5444. These are distributed by IBM technical operations departments as the need arises and are available from IBM branch offices.
5. IBM Maintenance Library, *5444 Disk Storage Drive (Machines with serial numbers above 30100), 5440 Disk Cartridge, Parts Catalog,* Order No. S135-0002.

Contents

Appendixes and Index

Safety Procedures

Personal Safety

Safety cannot be over-emphasized. To ensure personal safety and that of co-workers, follow safety precautions at all times.

General Safety Practices

Become familiar with the general safety practices and the procedures for artificial respiration that are outlined in *CE Safety Practices,* S229-1264. This card is obtainable from IBM Distribution Center, East Simpson Ferry Road, Mechanicsburg, Pennsylvania 17055, U.S.A.

Safety Practices at the 5444

AC and DC Power: AC power and dc power are present at terminals inside the machine while the using system remains powered up. Therefore, always turn off power *before* working on the machine.

Drive Motor: The motor is provided with a thermal cutout that restores power when the motor has cooled after overheating. Always turn off power, therefore, before working on the motor.

Isopropyl Alcohol: Use only IBM part 2200200 for cleaning parts as specified in the servicing procedures. *Isopropyl alcohol is a flammable liquid;* therefore observe strict precautions regarding its storage. Keep only the minimum quantity that is needed for immediate use, and store it in the original container whenever possible. Note the shipping regulations that are given on the container.

Equipment Safety

The machine can be easily damaged by incorrect operation and wrong servicing techniques. Cautionary notes are inserted in the text where necessary and are summarized here.

Brush Mechanism: If the arm that carries the brushes has to be manually retracted, first remove the spring clip securing the arm, otherwise the retraction mechanism can be permanently damaged.

Cartridge Removal: Before removing a cartridge during a fault condition, make sure that the carriage and cleaning brushes are fully retracted.

CE Cartridge – Restricted Tracks: Do not overwrite tracks 004, 005, 006, and 071 through 075. These are prewritten tracks for use during alignment and, once destroyed, must be factory recreated.

Cleanliness: In the 5444, cleanliness is of the utmost importance. Because the read/write heads fly clear of the disk surface by only 85 millionths of an inch, extremely small particles can be trapped in this gap; these particles can accumulate until they damage the disk surfaces or the head faces. When the machine is being worked on with the top cover removed, take care not to let tools or other equipment fall inside the machine.

Contamination of Other 5444's: If a head-to-disk interference occurs on a disk cartridge, particles may be generated that can damage other 5444's if the defective cartridge is placed on them. *If a disk cartridge is damaged, it must never be used on another 5444.*

Disk Cartridges: Never dismantle a disk cartridge. Return damaged cartridges to the factory.

Disk Damage:

1. If the 5444 produces tinkling or screeching sounds, immediately inspect the disks and the read/write heads.
2. Protect the coated surfaces of the disks from any damage. When installing a read/write head, first wrap a lint-free tissue, IBM part 2162567, around the head to prevent a head-to-disk contact.
3. When removing or replacing an actuator assembly, take careful note of the cautions given under item 3.7.1 in Chapter 3, so that the disk will not be damaged. The actuator assembly must stay in contact with the base and not be allowed to lift during the course of adjustment.

Encoder Disk: Do not clean the encoder disk while the machine is running.

Power Sequencing: Do not apply 24V dc without also applying other logic voltages; otherwise, the logic circuits can be damaged.

Precision Components: Handle and store with extreme care all components contributing to the accuracy of the actuator and carriage. In particular, keep the leadscrew, follower, and ball slides free from contamination. Store the head arm assemblies in transit boxes.

Read/Write Heads: Do not touch the faces of the read/write heads with your fingers, because skin oil can attract particles and erode the heads. Do not blow on the heads because saliva can damage them similarly.

Separated Grounds: Most of the 5444 is dc grounded; the using system enclosure is usually ac grounded. Therefore, make sure that the 5444 is always electrically isolated from the using system enclosure.

SLT Cards: Remove power before removing or replacing a card, to prevent damage to other cards in the circuit.

Stepping Motor Coupling: The relationship between the stepping motor and the leadscrew is fixed by the stepping motor coupling. Loosen only the stepping-motor half of the coupling.

CE SAFETY PRACTICES

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

1. You should not work alone under hazardous conditions or around equipment with dangerous voltage. Always advise your manager if you MUST work alone.
2. Remove all power AC and DC when removing or assembling major components, working in immediate area of power supplies, performing mechanical inspection of power supplies and installing changes in machine circuitry.
3. Wall box power switch when turned off should be locked or tagged in off position. "Do not Operate" tags, form 229-1266, affixed when applicable. Pull power supply cord whenever possible.
4. When it is absolutely necessary to work on equipment having exposed operating mechanical parts or exposed live electrical circuitry anywhere in the machine, the following precautions must be followed:
   a. Another person familiar with power off controls must be in immediate vicinity.
   b. Rings, wrist watches, chains, bracelets, metal cuff links, shall not be worn.
   c. Only insulated pliers and screwdrivers shall be used.
   d. Keep one hand in pocket.
   e. When using test instruments be certain controls are set correctly and proper capacity, insulated probes are used.
   f. Avoid contacting ground potential (metal floor strips, machine frames, etc. — use suitable rubber mats purchased locally if necessary).
5. Safety Glasses must be worn when:
   a. Using a hammer to drive pins, riveting, staking, etc.
   b. Power hand drilling, reaming, grinding, etc.
   c. Using spring hooks, attaching springs.
   d. Soldering, wire cutting, removing steel bands.
   e. Parts cleaning, using solvents, sprays, cleaners, chemicals, etc.
   f. All other conditions that may be hazardous to your eyes. REMEMBER, THEY ARE YOUR EYES.
6. Special safety instructions such as handling Cathode Ray Tubes and extreme high voltages, must be followed as outlined in CEM's and Safety Section of the Maintenance Manuals.
7. Do not use solvents, chemicals, greases or oils that have not been approved by IBM.
8. Avoid using tools or test equipment that have not been approved by IBM.
9. Replace worn or broken tools and test equipment.
10. Lift by standing or pushing up with stronger leg muscles — this takes strain off back muscles. Do not lift any equipment or parts weighing over 60 pounds (27,2 kilogrammes).
11. All safety devices such as guards, shields, signs, ground wires, etc. shall be restored after maintenance.
12. Each Customer Engineer is responsible to be certain that no action on his part renders product unsafe or exposes hazards to customer personnel.
13. Place removed machine covers in a safe out-of-the-way place where no one can trip over them.
14. All machine covers must be in place before machine is returned to customer.
15. Always place CE tool kit away from walk areas where no one can trip over it (i.e., under desk or table).
16. Avoid touching mechanical moving parts (i.e., when lubricating, checking for play, etc.).
17. When using stroboscope — do not touch ANYTHING — it may be moving.
18. Avoid wearing loose clothing that may be caught in machinery. Shirt sleeves must be left buttoned or rolled above the elbow.
19. Ties must be tucked in shirt or have a tie clasp (preferably nonconductive) approximately 3 inches from end. Tie chains are not recommended.
20. Before starting equipment, make certain fellow CE's and customer personnel are not in a hazardous position.
21. Maintain good housekeeping in area of machines while performing and after completing maintenance.

KNOWING SAFETY RULES IS NOT ENOUGH
AN UNSAFE ACT WILL INEVITABLY LEAD TO AN ACCIDENT
USE GOOD JUDGMENT — ELIMINATE UNSAFE ACTS

229-1264-1

Artificial Respiration

GENERAL CONSIDERATIONS

1. **Start Immediately, Seconds Count**
   Do not move victim unless absolutely necessary to remove from danger. Do not wait or look for help or stop to loosen clothing, warm the victim or apply stimulants.
2. **Check Mouth for Obstructions**
   Remove foreign objects — Pull tongue forward.
3. **Loosen Clothing — Keep Warm**
   Take care of these items after victim is breathing by himself or when help is available.
4. **Remain in Position**
   After victim revives, be ready to resume respiration if necessary.
5. **Call a Doctor**
   Have someone summon medical aid.
6. **Don't Give Up**
   Continue without interruption until victim is breathing without help or is certainly dead.

Reprint Courtesy Mine Safety Appliances Co.

Rescue Breathing for Adults
Victim on His Back Immediately

1. **Clear throat** of water, food, or foreign matter.
2. **Tilt head back** to open air passage.
3. **Lift jaw up** to keep tongue out of air passage.
4. **Pinch nostrils** to prevent air leakage when you blow.
5. **Blow** until you see chest rise.
6. **Remove your lips** and allow lungs to empty.
7. **Listen** for snoring and gurglings, signs of throat obstruction.
8. **Repeat mouth to mouth breathings** 10-20 times a minute.
   Continue rescue breathing until he breathes for himself.

CE Safety Practices Card, Form 229-1264

Chapter 1. Machine Description

This chapter contains a brief introduction to the IBM 5444 Disk Storage Drive, and describes the interface between the 5444 Disk Storage Drive and its using system

Introduction

- The IBM 5444 Disk Storage Drive is a direct-access disk file that provides up to 40 million bits of data storage. The unit provides auxiliary storage for small computer systems and is designed to be mounted within the frame of the using system.
- All machine operations are controlled by signals from the using system.
- Data is stored on both sides of magnetic recording disks. The disks are 14 in. (356 mm) in diameter, and are coated on both sides with magnetic iron oxide.
- Data is written onto, and read from, both recording surfaces of the disks, using read/write (R/W) heads.
- The 5444 can accommodate two disks, mounted on a common drive spindle. The lower disk is permanently mounted in an enclosure at the base of the drive spindle. The top disk forms part of the IBM 5440 Disk Cartridge and is removable.
- Data is stored in concentric tracks on the recording surfaces.
- The 5444 Disk Storage Drive Model 2 is described in this manual; any differences between models are dealt with where appropriate.

Any two corresponding tracks, one on each surface, are called a cylinder. Three cylinders on each disk are reserved for data transferred from defective cylinders. One further cylinder on each disk is reserved for use by the CE during maintenance.

The 5444 is available in six models; their characteristics are as follows:

Model of 5444	Access Speed	Storage facilities	Storage capacity	Cylinder reserved for CE	Cylinders reserved to replace defective tracks
1	Standard	Two disks, 104 tracks per side, numbered 0 through 103	20 million bits (nominal)	103	001 through 003
A01	High	Two disks, 104 tracks per side, numbered 0 through 103	20 million bits (nominal)	103	001 through 003
2	Standard	Two disks, 204 tracks per side, numbered 0 through 203	40 million bits (nominal)	203	001 through 003
A02	High	Two disks, 204 tracks per side, numbered 0 through 203	40 million bits (nominal)	203	001 through 003
3	Standard	One disk (removable), 204 tracks per side	20 million bits (nominal)	203	001 through 003
A03	High	One disk (removable), 204 tracks per side	20 million bits (nominal)	203	001 through 003

Note: Models 3 and A03 can only be installed as additional files to Models 2 and A02 respectively.

Possible Conversions

Model 1	to	Model 2
Model 1	to	Model A01
Model 2	to	Model 1
Model 2	to	Model 3
Model 2	to	Model A02
Model 3	to	Model 2
Model 3	to	Model A03
Model A01	to	Model A02
Model A02	to	Model A01
Model A02	to	Model A03
Model A03	to	Model A02

No other conversion is possible

Data Protection

The 5444 protects recorded data with safety devices that control the start/stop sequencing and actuator operations.

During read/write operations, sensors monitor the write circuits. If an unsafe condition occurs, a 'data unsafe' signal is sent to the using system to inhibit all further read/write operations until the cause of the unsafe condition is removed.

Machine Safety

Drawer and cartridge interlocks prevent the 5444 starting when the drawer is open, and also prevent access during operation. The CE can override the interlocks during maintenance.

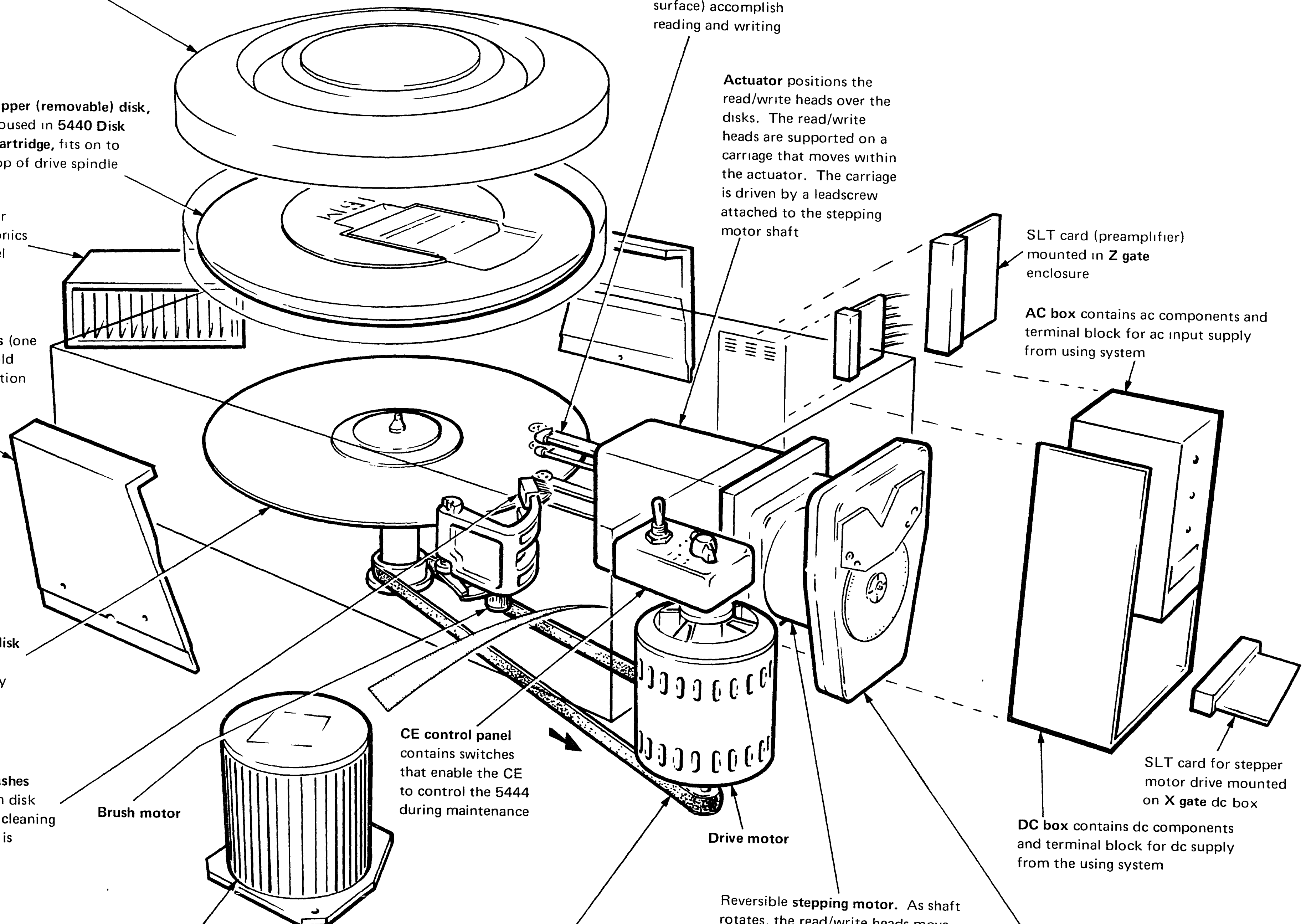
System Control

The 5444 contains access control logic and read/write logic that are activated by signals from the using system. The file/using system interface comprises 12 input lines (13 for Models A01, A02, and A03) and eight output lines.

Manual Control

The 5444 may be manually controlled from the CE control panel. The 5444 may be switched offline, and any head or track selected. The 5444 cannot write while it is under manual control.

Location of Major Units



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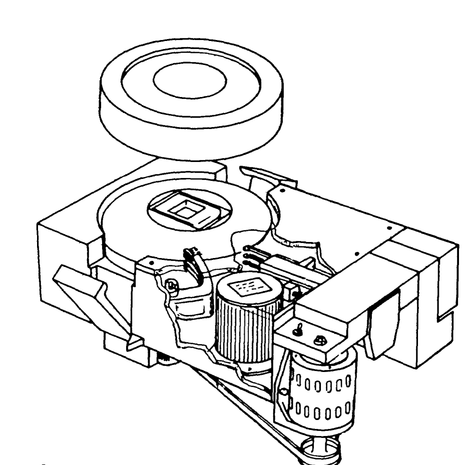
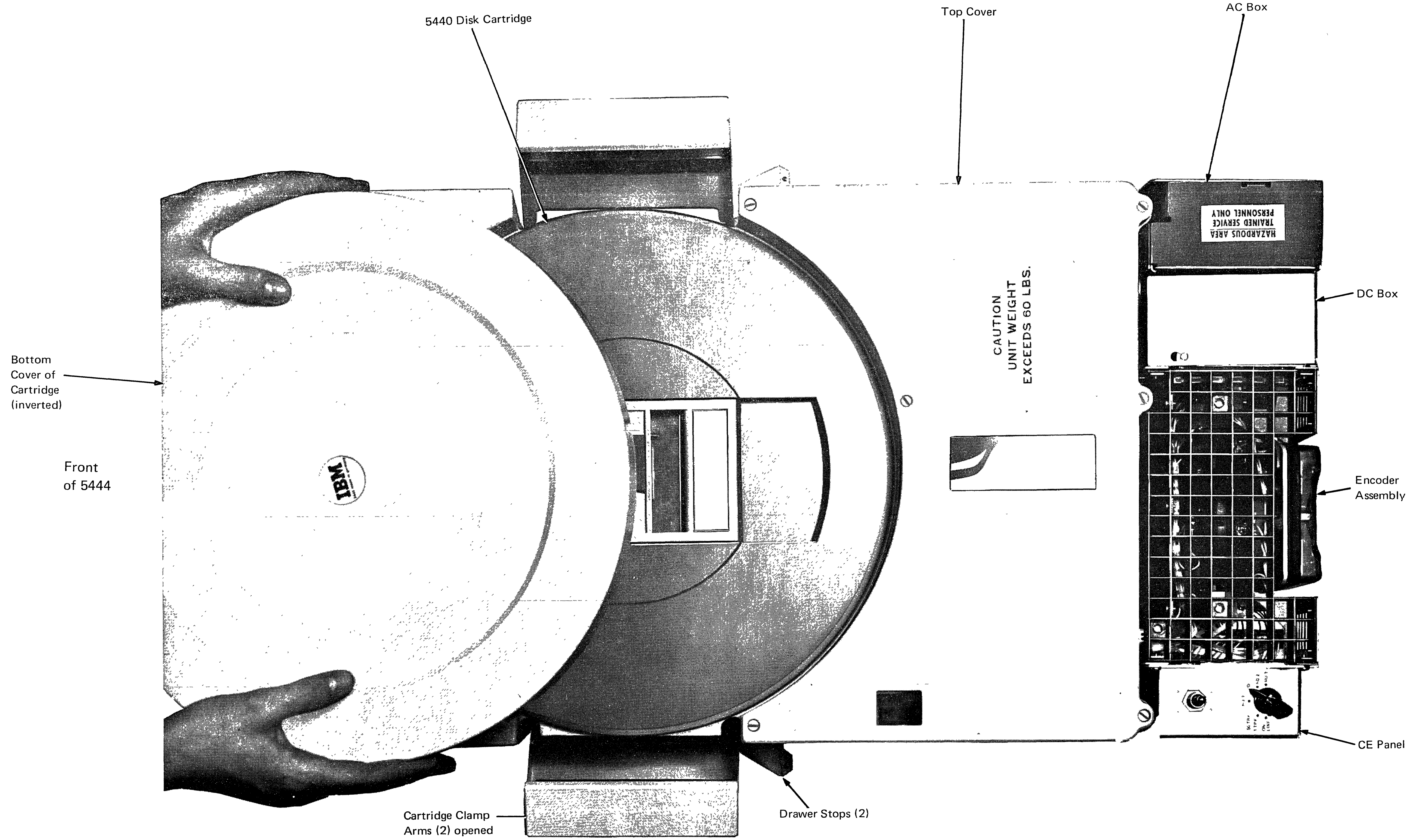


Assembled View

[08523]

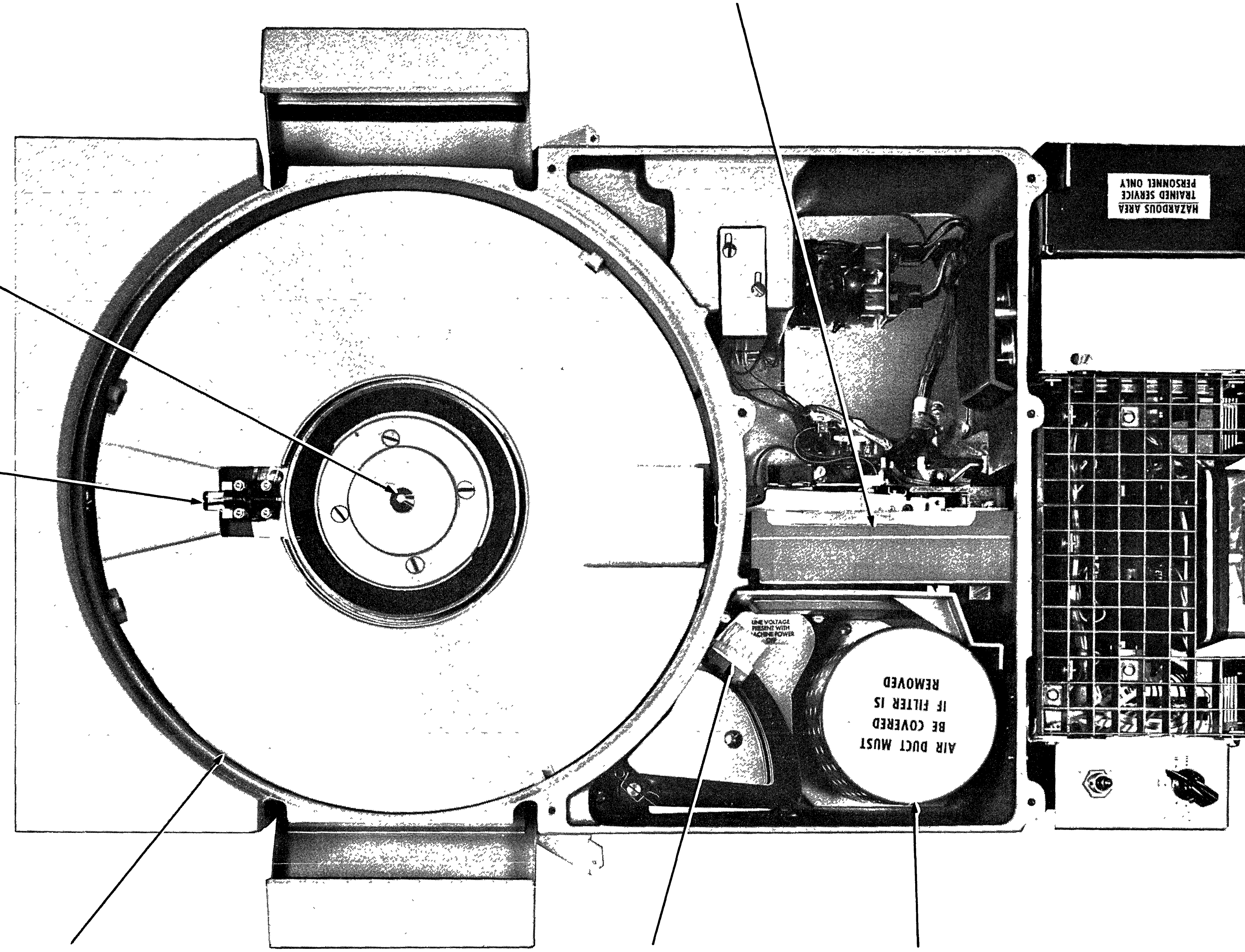
- The 5444 contains up to two magnetic recording disks, mounted on a drive spindle.
- The upper removable disk (the only disk on Models 3 and A03) is permanently enclosed in the 5440 Disk Cartridge. The cartridge may be easily removed from the 5444 and can be fitted to other 5444s. Models 1 and A01 read only the first 100 tracks of a disk and so read only *part* of a disk that has been written on a Model 2, 3, A02, or A03.

Locations



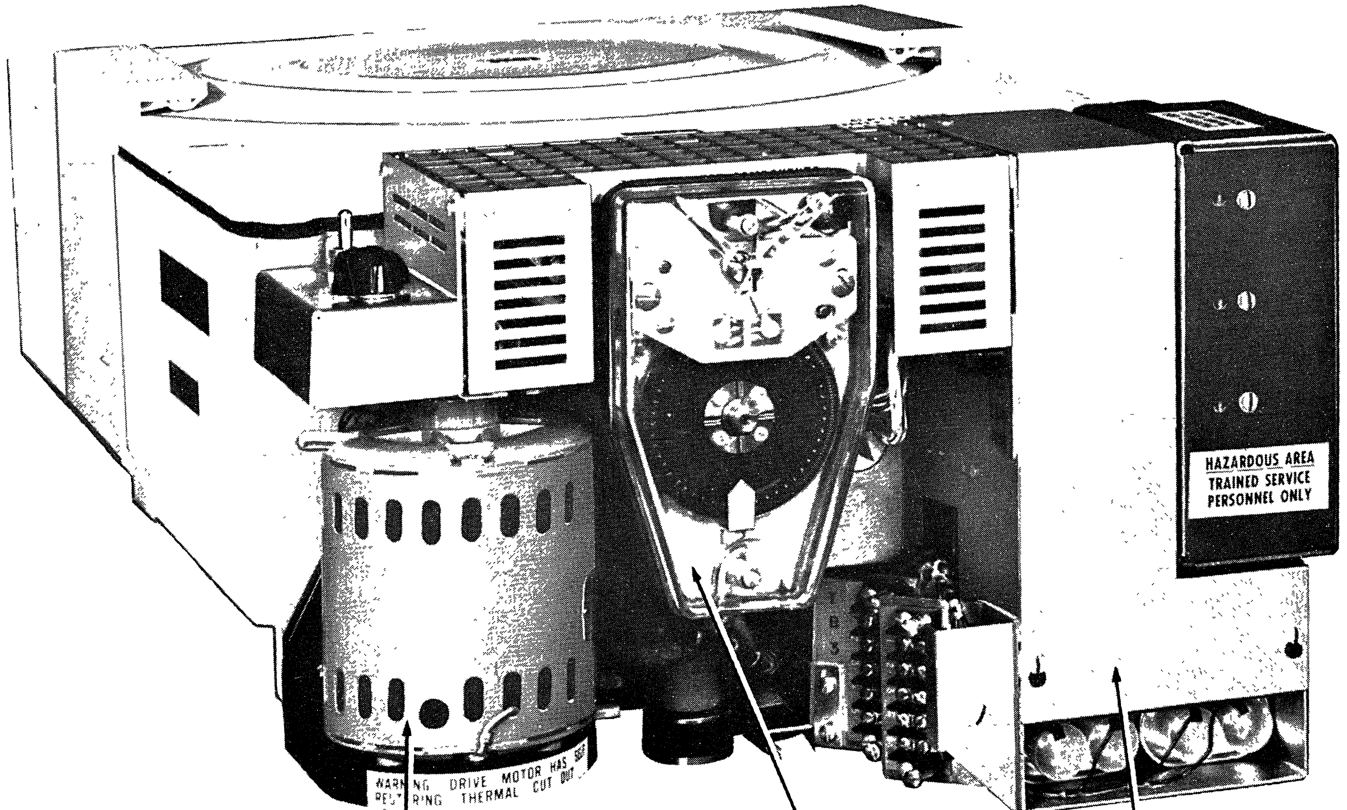
Plan View

[08510A]



Plan View (Top Cover and Cartridge Removed)

[08511A]



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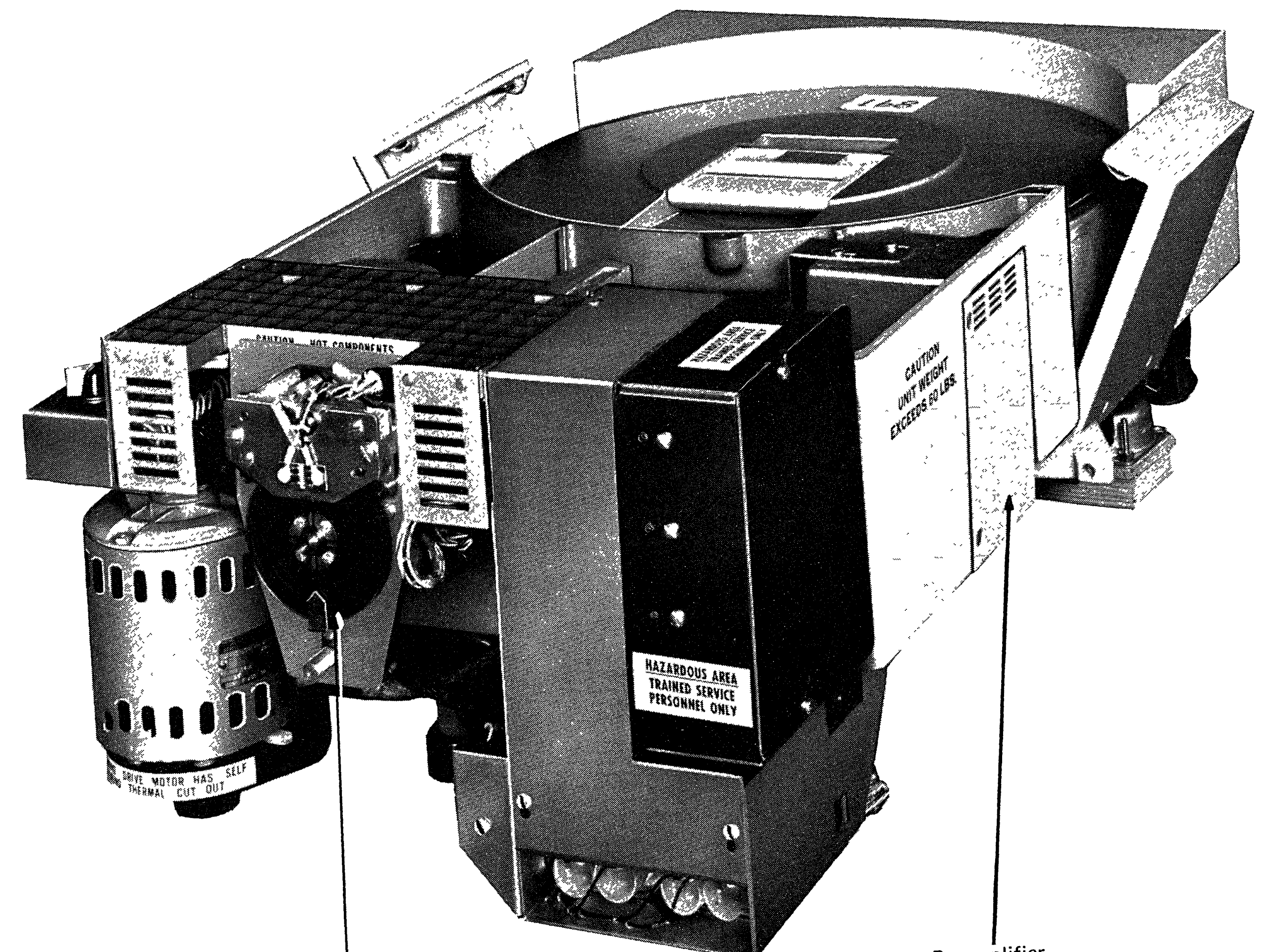

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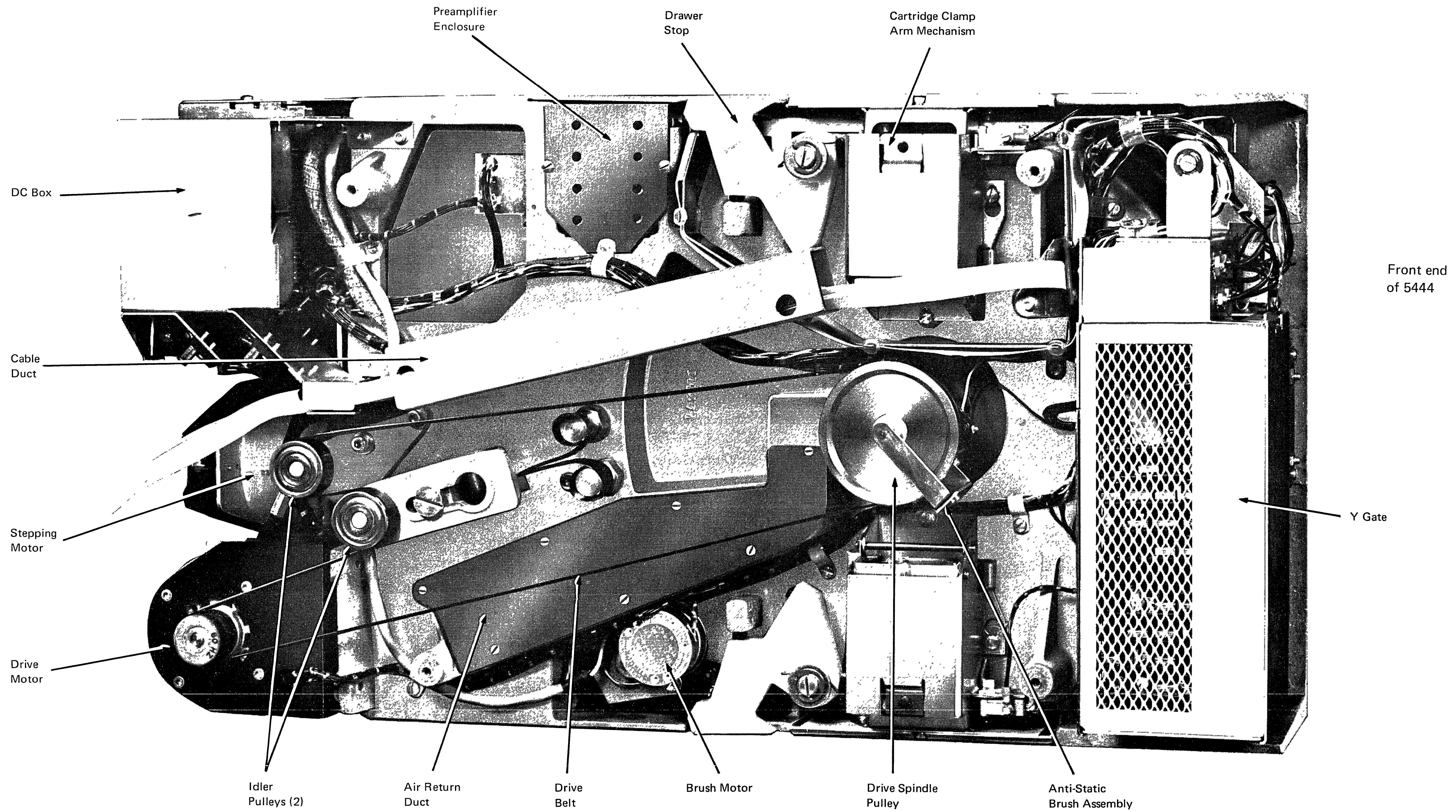
Top Rear Views



Underside View

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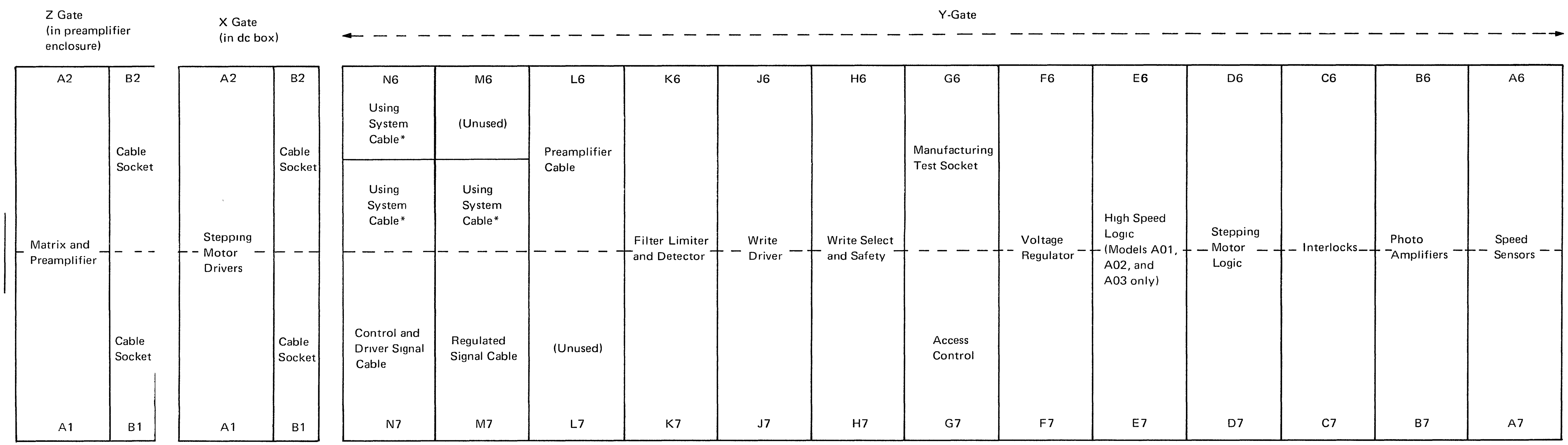

* TAPs line included in using system cables

Card Layout on X, Y, and Z Gates (Pin Side)

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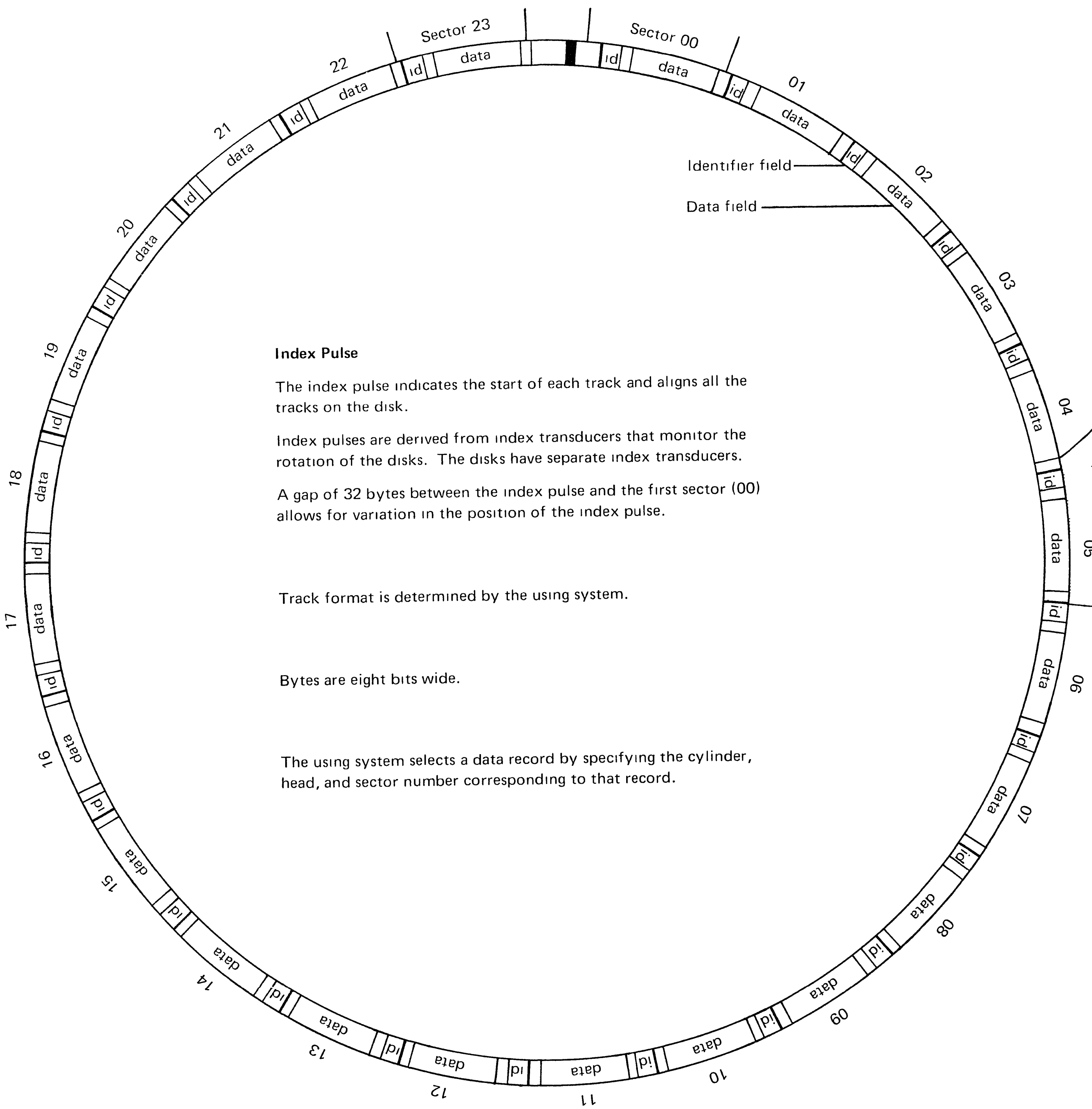
Data Organization

Track Format for IBM System/3



Index Pulse

The index pulse indicates the start of each track and aligns all the tracks on the disk.

Index pulses are derived from index transducers that monitor the rotation of the disks. The disks have separate index transducers.

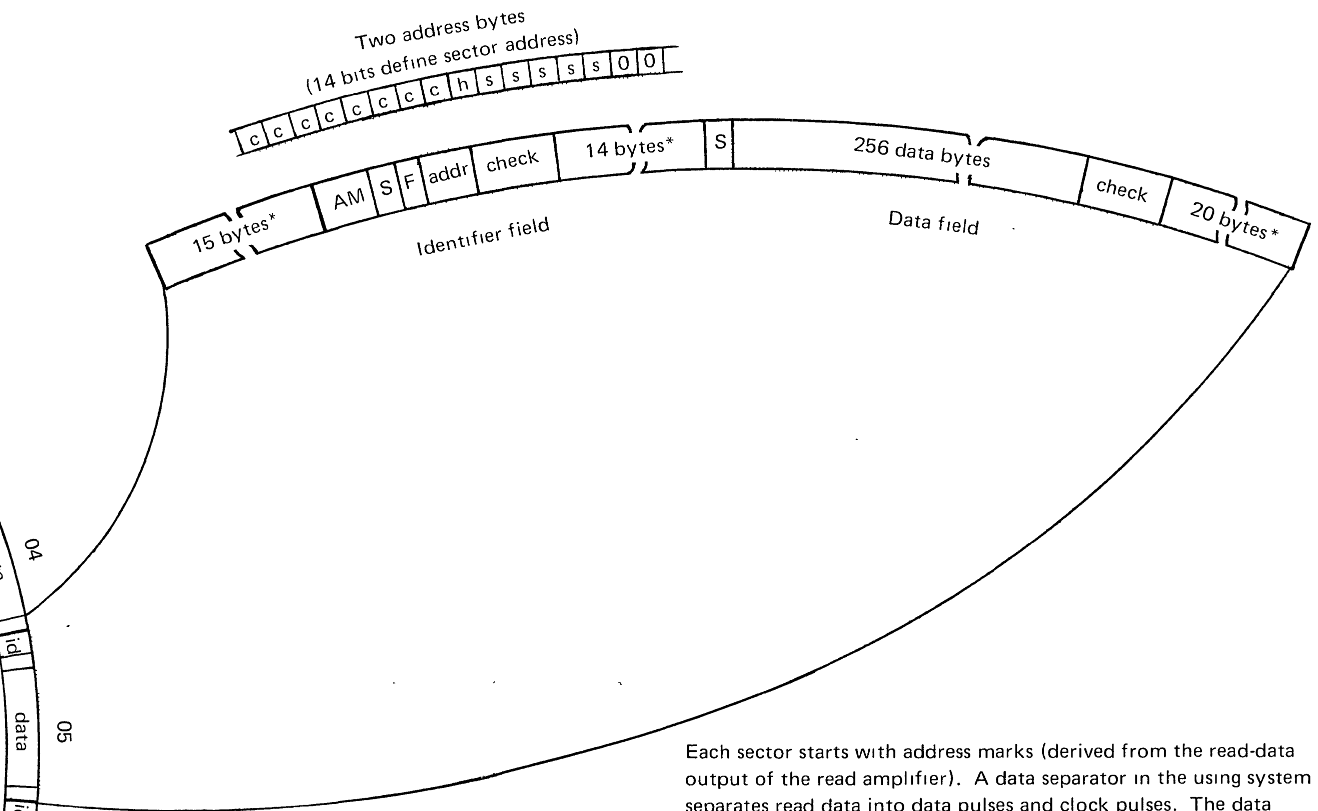
A gap of 32 bytes between the index pulse and the first sector (00) allows for variation in the position of the index pulse.

Track format is determined by the using system.

Bytes are eight bits wide.

The using system selects a data record by specifying the cylinder, head, and sector number corresponding to that record.

Sector Format for IBM System/3



Each sector starts with address marks (derived from the read-data output of the read amplifier). A data separator in the using system separates read data into data pulses and clock pulses. The data address marks are indicated by missing clock pulses.

Legend

AM	Address mark (two bytes)
S	Synchronizing byte
F	Flag byte. This identifies partially defective tracks or spare tracks replacing defective tracks
addr	Sector address (two bytes)
check	Three check bytes – generated by the using system to verify the identified field
c	cylinder (identification)
h	head (identification)
s	sector (identification)
*	approximate gap

Storage Capacity

Using a format of 256 data bytes in 24 sectors, the storage capacity is arranged as follows:

Each track: 6,144 bytes
Each cylinder: 12,288 bytes
Each disk: 2,45 million bytes

Machine Operations

Start/Stop Sequence

- Start and stop sequences are controlled by a '+24V file start' line from the using system.

Details of the stop and start sequences are given in Section 3.10.

Start Sequence

Operator action:

1. Switch on using-system power supplies; close cartridge interlocks and drawer

Machine actions (1-minute duration):

2. Line '+24V file start' is activated and start-up sequence commences
3. Disks start spinning
4. Four brushes clear dust from disk
5. 5444 electronics and temperature in disk enclosure stabilize
6. Disks reach speed of 1,500 rpm with read/write heads loaded over track 000
7. A 'ready' signal indicates to the using system that the 5444 can start operations

Stop Sequence

- Stop sequence commences when '+24V file start' drops. The read/write heads unload and retract from the disks. When the disks have stopped, the 5444 can be opened to remove the disk cartridge.

Note: When '+24V file start' is dropped, all dc power supplies remain on at the machine and ac power is still present in the ac box.

Access Operations

- The 5444 must be ready before accessing begins.

Access operations are controlled by signals from the using system. Activation of the 'access forward' or 'access reverse' signal alone causes the stepping motor to move the carriage at standard speed in the appropriate direction. Activation of the 'high speed' signal (Models A01, A02, and A03 only) causes an acceleration of the stepping motor; when 'high speed' is dropped, the motor reverts to standard speed. When the access command is dropped, the stepping motor stops. While the read/write heads are moving across the disk, 'track crossing' pulses are generated to enable the using system to determine the head position.

Read/Write Operations

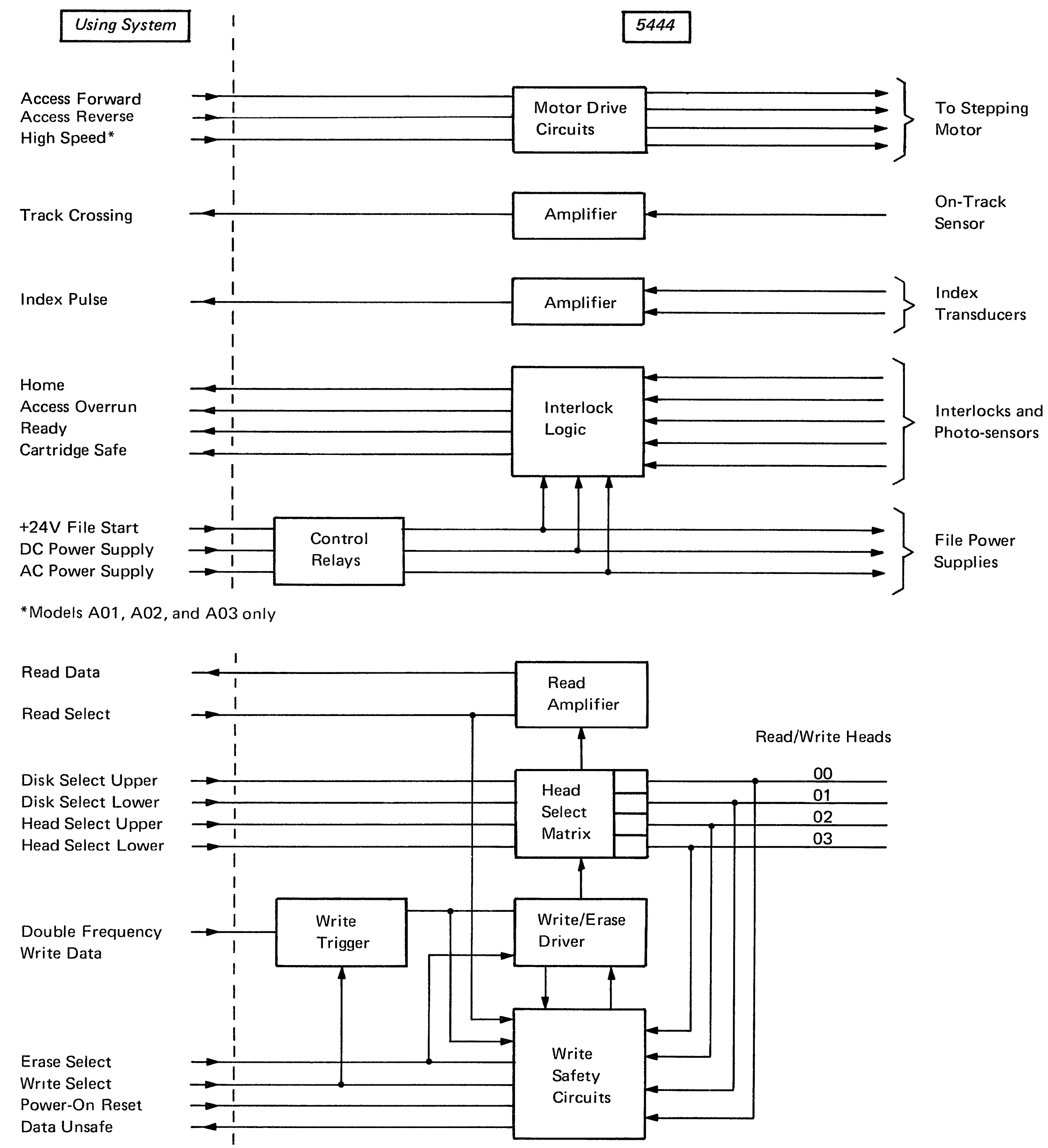
- The data transfer rate between the 5444 and the using system is 199,000 bytes per second.

Control signals from the using system define the appropriate head and disk. The read or write operation is defined by 'read select' or 'write select'. Each head contains a read/write coil and an erase coil. The erase coil is always energized during a write operation to trim the edges of the newly written data tracks; this technique is called "side erase".

Data bits are recorded on the disk surface as changes of flux. A data bit is written for every pulse that enters on the 'double frequency write data' line.

Read signals are activated whenever the read/write head detects a change of flux on the disk surface.

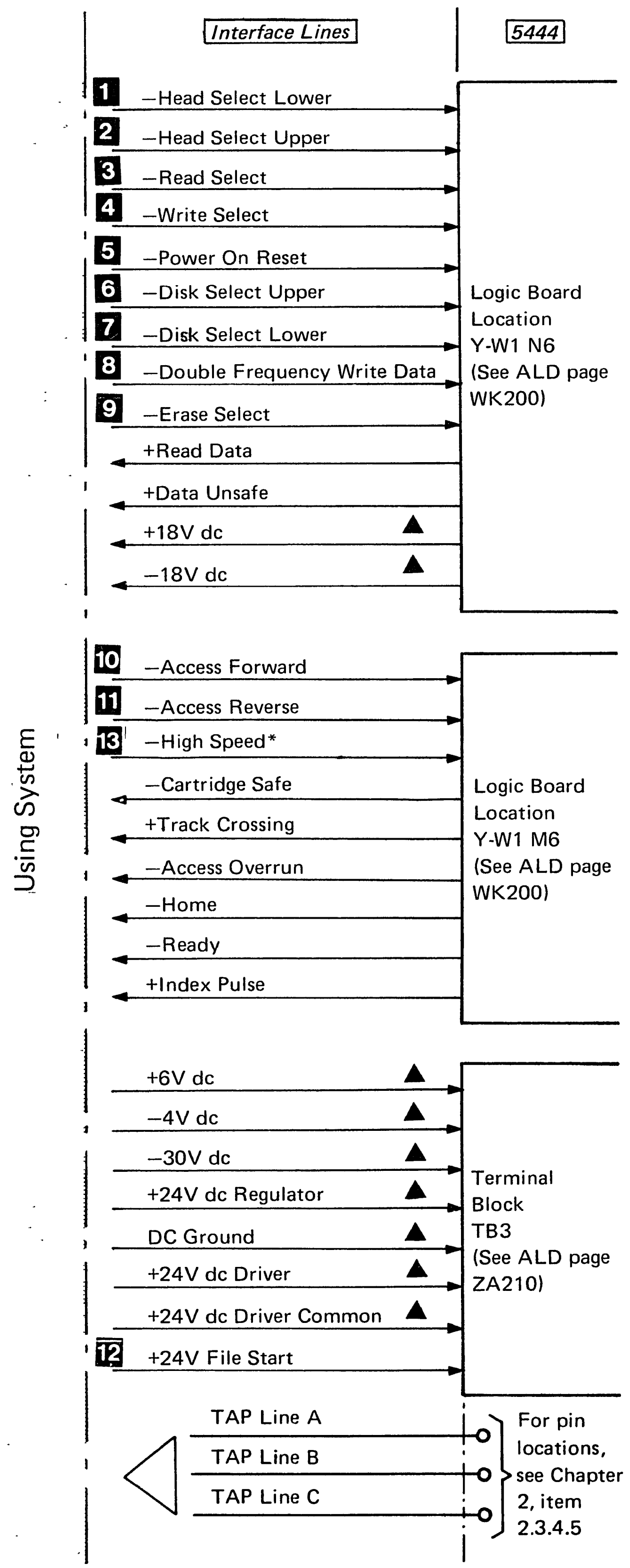
The read signals are amplified in the read circuits and passed to the using system on the 'read data' line.



Data Flow and Control

[08506A]

File/System Interface



* Models A01, A02, and A03 only [08508]

■ Twelve input lines (13 for Models A01, A02, and A03) supply signals to the 5444 from the system control circuits.

● Eight output lines supply signals from the 5444 to the system control circuits.

▲ Nine dc power lines supply power from the using system.

Three additional lines are available for timing analysis programs (TAPs).

The signal levels referred to in this section correspond to the standard SLD-100 logic levels, as follows:

Up level: +3.0V dc to +6.6V dc.
Down level: 0V dc to +0.3V dc.

All signal lines connect to the 5444 through three half-wide tape cables that plug into the 2 x 13-SLT board mounted in Y-gate.

Input Communication Lines

1 **2** *'Head select lower' and 'head select upper'* define which read/write head is to be used for read or write operations. Each line is activated at a down level. An up level on both lines deselects both heads; a down (active) level on both lines is an unsafe condition when 'write select' is activated. The lines must not be switched:

1. Following a write operation, until at least 1 microsecond (μs) after 'erase select' is dropped.
2. Following a read operation, until at least 1 μs after 'read select' is dropped.

3 *'Read select'* is activated at a down level and gated with the disk-select and head-select lines to select the read/write head for a read operation. Read signals from the selected head are then fed to the read amplifier circuits. 'Read select' must not be activated:

1. During the head settling time following an access operation.
2. Until at least 5 μs after the disk select lines are switched.
3. Until at least 1.2 μs after 'erase select' is dropped, following a write operation.

4 *'Write select'* is activated at a down level; write current is turned on in the write coil, provided 'erase select' is activated. Data on the 'double frequency write data' line is then written onto the selected disk surface. Write operations are inhibited when the 5444 is offline and under control of the CE control panel. The 'write select' line is activated within 1 μs of 'erase select' and must not be activated under the following circumstances:

1. During the head settling time following a head movement.
2. Until at least 5 μs after the disk-select and head-select lines are switched.
3. Following a read operation, until at least 1.2 μs after 'read select' is dropped.

5 *'Power on reset'* resets the machine safety latches when the using system dc supply is first switched on. 'Power on reset' provides the internal line 'data unsafe reset' to reset the three safety latches. The 'power on reset' switches to a down level for 1 millisecond (ms).

6 **7** *'Disk select upper' and 'disk select lower'* define the disk that is to be used for read or write operations. Each line is activated at a down level. An up level on both lines deselects both disks; a down (active) level on both lines is an unsafe condition when 'write select' is activated. The lines must not be switched:

1. Following a write operation, until at least 1 μs after 'erase select' is dropped.
2. Following a read operation, until at least 1 μs after 'read select' is dropped.

8 *'Double frequency write data'* carries the input write data to the 5444 and drives the 5444 write trigger. The leading edge of each pulse on the 'double frequency write data' line causes a magnetic flux reversal to be recorded on the selected disk surface. The line carries clock pulses interspersed with data pulses. When 'write select' is activated, the first pulse occurs on the 'double frequency write data' line within 315 nanoseconds (ns). 'Write select' drops between 300 and 600 ns after the leading edge of the last pulse.

9 *'Erase select'* is activated at a down level and is gated with the disk-select and head-select lines to select the head for a write (and erase) operation. Erase current flows in the erase coil (during a write operation, the erase coil is energized as well as the write coil). 'Erase select' is activated within 1 μs of 'write select', and is dropped 24 μs after 'write select' is dropped. Following a read operation, 'erase select' is not activated until at least 1.2 μs after 'read select' is dropped.

10 *'Access forward'* is activated at a down level and causes the stepping motor to turn, moving the carriage forwards, towards the disk center. 'Access forward' must not be activated at the same time as 'access reverse'.

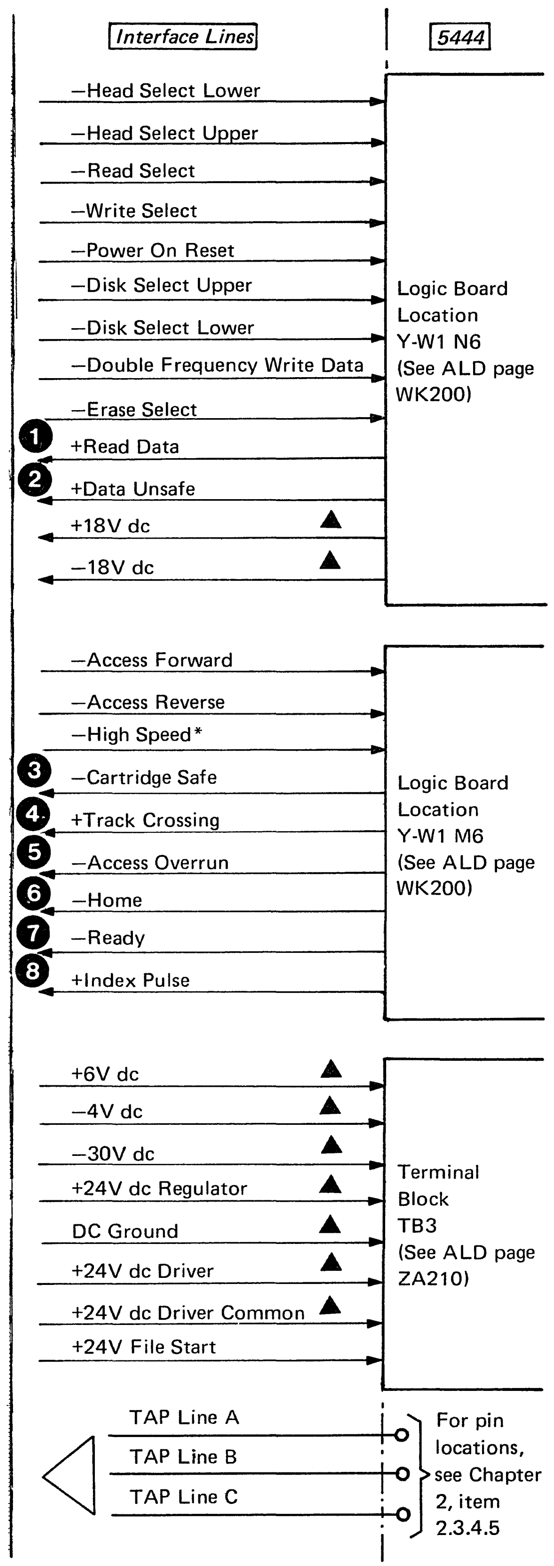
11 *'Access reverse'* is activated at a down level and causes the stepping motor to turn, moving the carriage backwards, away from the disk center. 'Access reverse' must not be activated at the same time as 'access forward'.

12 *'+24V file start'* is activated when switched to +24V dc. The line controls ac power to the drive motor and initiates the start-up sequence. The cartridge interlocks (operated by the cartridge clamp arms) are connected in series with the '+24V file start' line. These interlocks drop '+24V file start' to prevent start-up sequence if the cartridge is not in position on the machine.

The following line is used on Models A01, A02, and A03 only:

13 *'High speed'* is activated at a down level and, with either 'access forward' or 'access reverse', causes the stepping motor shaft to accelerate continuously during high speed access operations. At the end of a high speed access operation, 'high speed' is dropped before 'access forward' or 'access reverse', to allow the stepping motor shaft to slow to the standard speed, before stopping.

Timing charts, showing the relative times of the pulses described on this page, are included in Sections 3.10 and 3.11



* Models A01, A02, and A03 only

[08508]

Output Communication Lines

❶ *'Read data'* carries clock pulses interspersed with data pulses from the read amplifier circuits. Each 100-ns pulse corresponds to a magnetic flux reversal on the disk surface. (The up level depends on the type of data separator used by the using system.)

❷ *'Data unsafe'* is activated at an up level to indicate an unsafe condition in the 5444. Three safety latches detect unsafe conditions in the write circuits during read/write operations. If an unsafe condition is detected, further read/write operations are then inhibited.

❸ *'Cartridge safe'* is activated at down level to indicate when the operator can gain access to the machine and the disk cartridge. The following lines are required to give 'cartridge safe':

1. 'Brush cycle complete'.
2. 'Speed zero'.
3. Not 'speed OK'.
4. 'Carriage retracted'.

❹ *'Track crossing'.* The positive-going edge of each pulse indicates that a track has been crossed by the read/write heads. These pulses are derived from the photo sense circuit that monitors movement of the encoder disk. The pulses give the using system a continuous indication of read/write head position. At the start of an access operation, 'track crossing' is at a down level. As the carriage starts to move, a positive-going edge occurs, indicating that the first track has been crossed. Each subsequent track crossed produces a pulse approximately 300 μs wide. The pulses are at up level while the heads are crossing the tracks, but are at down level when the heads are stationary over a track.
Note: To stop the carriage, 'access forward' or 'access reverse' drops within 10 μs after the positive-going edge of the last 'track crossing' pulse.

❺ *'Access overrun'* indicates that the carriage has incorrectly moved beyond its inner limit of travel; that is, beyond track 103 for Models 1 and A01 and beyond track 203 for Models 2, 3, A02, and A03. The line is activated at a down level.

❻ *'Home'* indicates that the read/write heads are positioned over track 000. The line is activated (at a down level) only when the carriage is moved in reverse to track 000.

❼ *'Ready'* is activated at a down level under the following conditions:

1. Start-up delay time expired and brush cleaning cycle complete.
2. Disks running at full speed.
3. Heads stationary over track 000.
4. CE mode select switch set to ON LINE.

During normal operations, 'ready' remains down, but rises if any one of the following conditions occurs:

1. AC power fails.
2. Disk speed drops to an unsafe level (below 960 rpm).
3. Heads unloaded.
4. An unsafe condition exists (indicated by 'data unsafe' line).

❽ *'Index pulse'* measures the disk speed and indicates the start of each recording track, using one 43-μs positive-going pulse per disk revolution. This pulse, after amplification, is gated with the 'disk select upper' line to provide a datum for the upper disk. The lower index transducer signal always produces the index pulse unless the upper disk is selected.

Timing charts, showing the relative times of the pulses described on this page, are included in Sections 3.10 and 3.11

Chapter 2. Maintenance

This chapter describes the approach to servicing the 5444, error recovery procedures, and the maintenance facilities that are provided for servicing the 5444, together with details of the preventive maintenance procedures

2.1 Approach to Servicing

CAUTIONS
1. Switch off all dc power before removing or installing SLT cards.
2. Use the correct probe tips when connecting the oscilloscope or meter to the logic pins.

Note: To turn the 5444 offline, use the CE mode-select switch. AC and dc power remain on.

Take the following approach to servicing the 5444:
1. Obtain the operator's report.
2. Use any error printout routine that the program of the using system provides.
3. Run any available diagnostic programs.
4. Use the appropriate maintenance analysis procedure (MAP) charts, which are contained in the documentation of the using system. See item 2.3.4.4 in this chapter.

2.1.1 Major Functional Areas

2.1.1.1 Data Recording Area

Data-recording functions are provided by the following areas:
1. Read/write heads.
2. Read/write electronics (four cards).
3. Unsafe-condition latches (three latches).
4. Upper and lower index transducers and amplifiers.
5. Disk surfaces.

The 5444 can neither detect errors in the recording area nor recover from these errors, except to signal 'data unsafe' to the using system.

2.1.1.2 Access Area

Disk-accessing functions are provided by the following areas:
1. Electronic control of mechanical motion.
2. Drive mechanism.
3. Track-crossing detector.
4. Home detector.

Access errors occur when the actuator is directed to a track but fails to position correctly at this track. The 5444 can either signal 'access overrun' or stop at track 000 and signal 'home'. If the carriage is driven past the home position, a mechanical knock-off unloads the heads before the carriage is fully retracted.

2.1.1.3 Operational Control

Operational control is provided by the following areas:
1. Carriage interlock switches.
2. Head-load/unload controls.
3. Speed detectors.
4. Head-load interlock switches.
5. Cartridge interlocks.

Any errors in these areas de-activate the 'ready' line, or fail to supply index pulses. A failure of the speed detector stops setting of the 'cartridge safe' line.

2.1.2 Error Conditions

2.1.2.1 Unsafe Conditions

The unsafe condition is generated from the following latches (see ALD page FS230):
1. 'Write unsafe' latch.
2. 'Erase unsafe' latch.
3. 'Read/write select unsafe' latch.

Write Unsafe Latch: This is set by any one of the following conditions:
1. Write operation is selected but no write transitions are detected.
2. Write operation is selected and multiple R/W heads are selected.
3. Write operation is not selected but write current is on.

Erase Unsafe Latch: This is set by either of the following conditions:
1. Write operation is selected but erase current is not on.
2. Write operation is not selected but erase current is on.

Select Unsafe Latch: This is set by any one of the following conditions:
1. Read and write operations are selected together.
2. Read and erase operations are selected together.
3. Carriage is not detented and either a write or erase operation is selected.

2.1.2.2 Not-Ready Conditions

When the 5444 is ready, the 'file ready' line is activated. A not-ready state may be caused by one of the following faults:
1. One of the interlock switches has failed.
2. The rotational speed is less than 64% of full speed.
3. An incorrect head-loading sequence has occurred.
4. AC or dc power has failed.
5. An unsafe condition has arisen.
6. The CE mode-select switch is not set to ON LINE.

2.1.2.3 Access Overrun Condition

The access-overrun error condition is signaled by 'access overrun' to the using system. The signal is raised when the carriage overrun interlock switch senses that the carriage is too close to the center of the disk. The sensing occurs at track 204/205½ (5444 Models 2, 3, A02, and A03) or track 104/105½ (Models 1 and A01). The forward command is dropped, and the stepping motor stops at the next track.

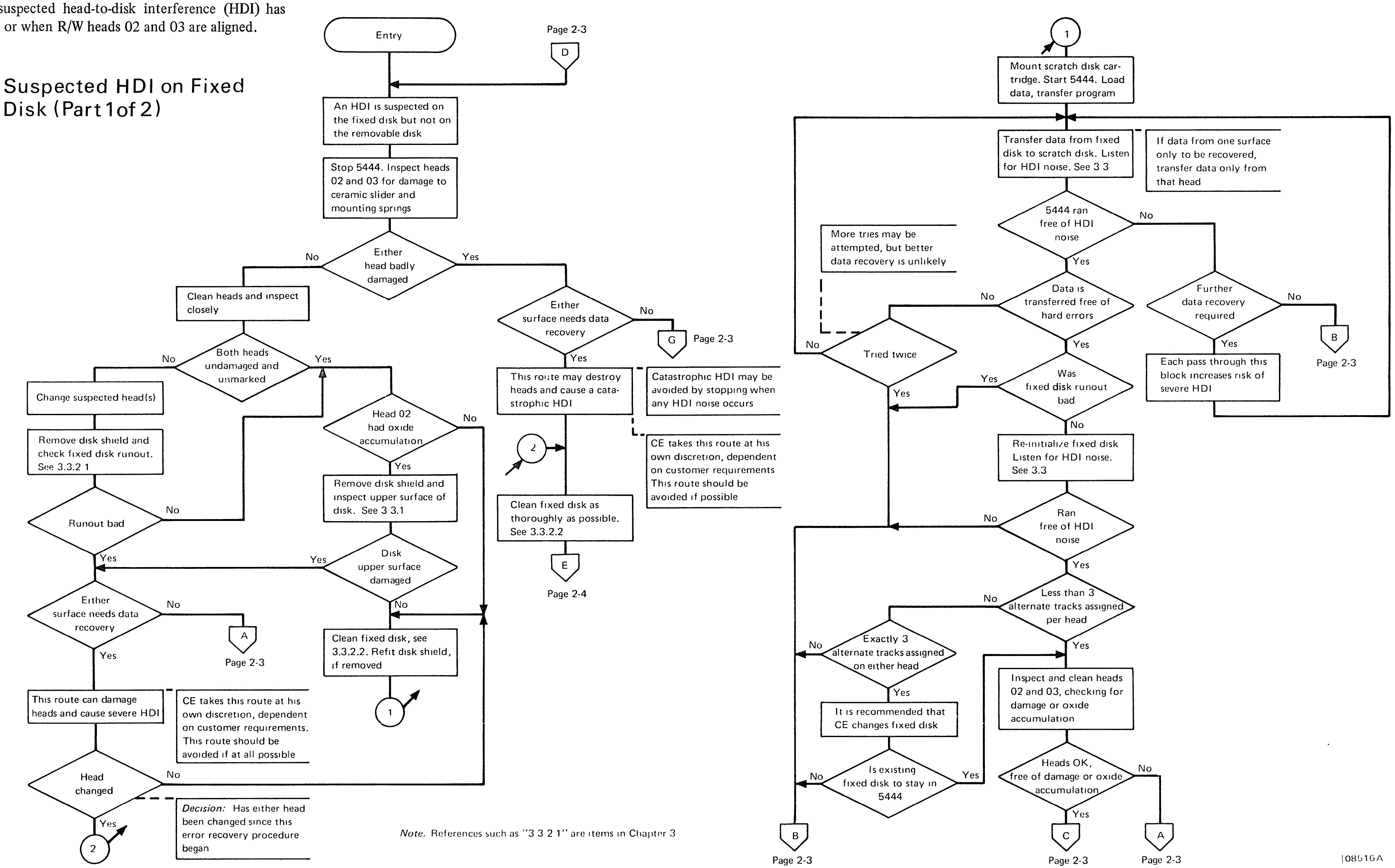
2.1.2.4 Read/Write Errors

Read/write errors can only be detected by the using system. The 5444 has no means of parity checking.

2.2 Error Recovery Procedures

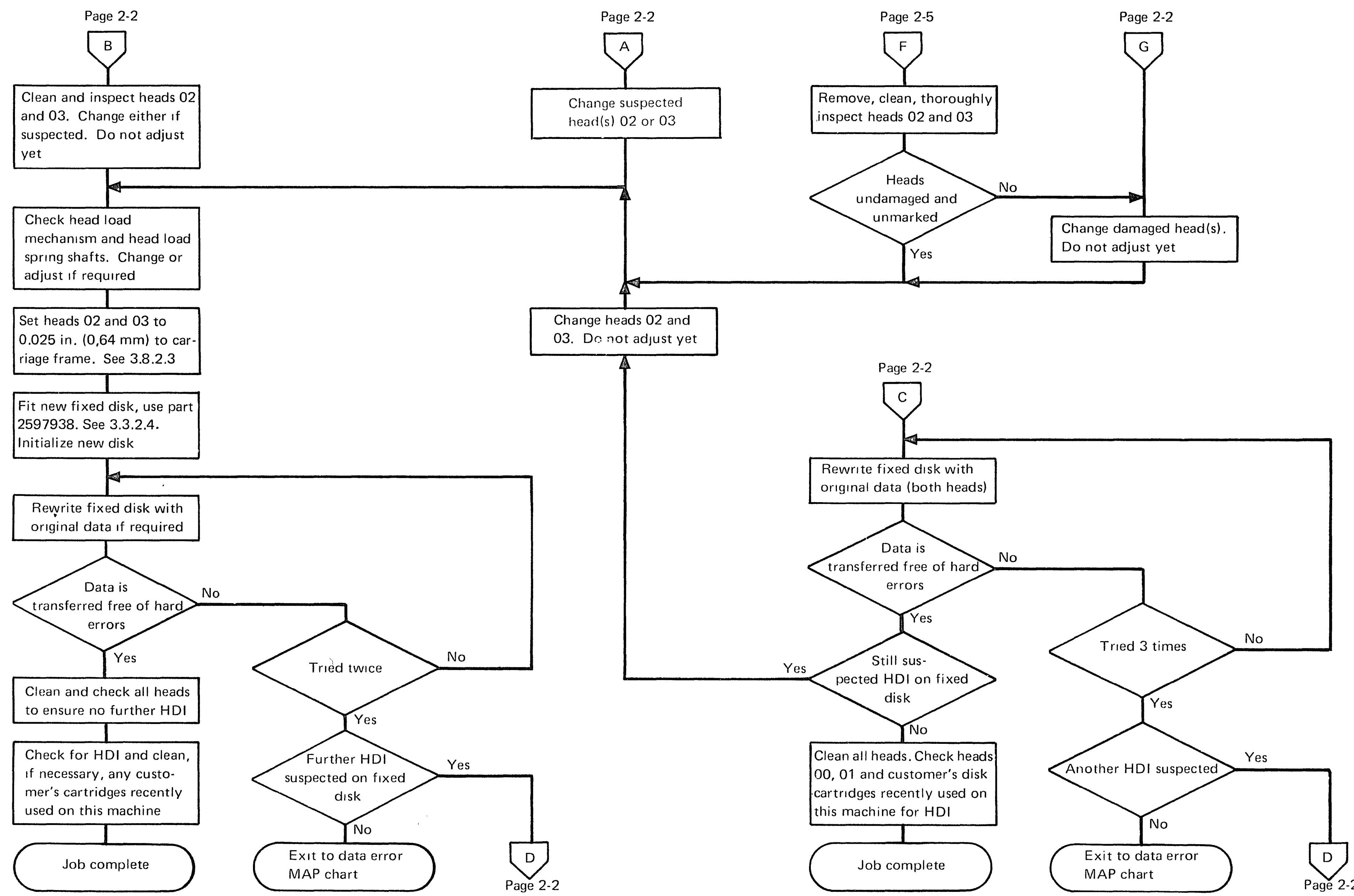
This section provides error recovery procedures for use when a suspected head-to-disk interference (HDI) has occurred, or when R/W heads 02 and 03 are aligned.

2.2.1 Suspected HDI on Fixed Disk (Part 1 of 2)



Note. References such as "3 3 2 1" are items in Chapter 3

2.2.1 Suspected HDI on Fixed Disk (Part 2 of 2)



Note: References such as "3.3.2.1" are items in Chapter 3.

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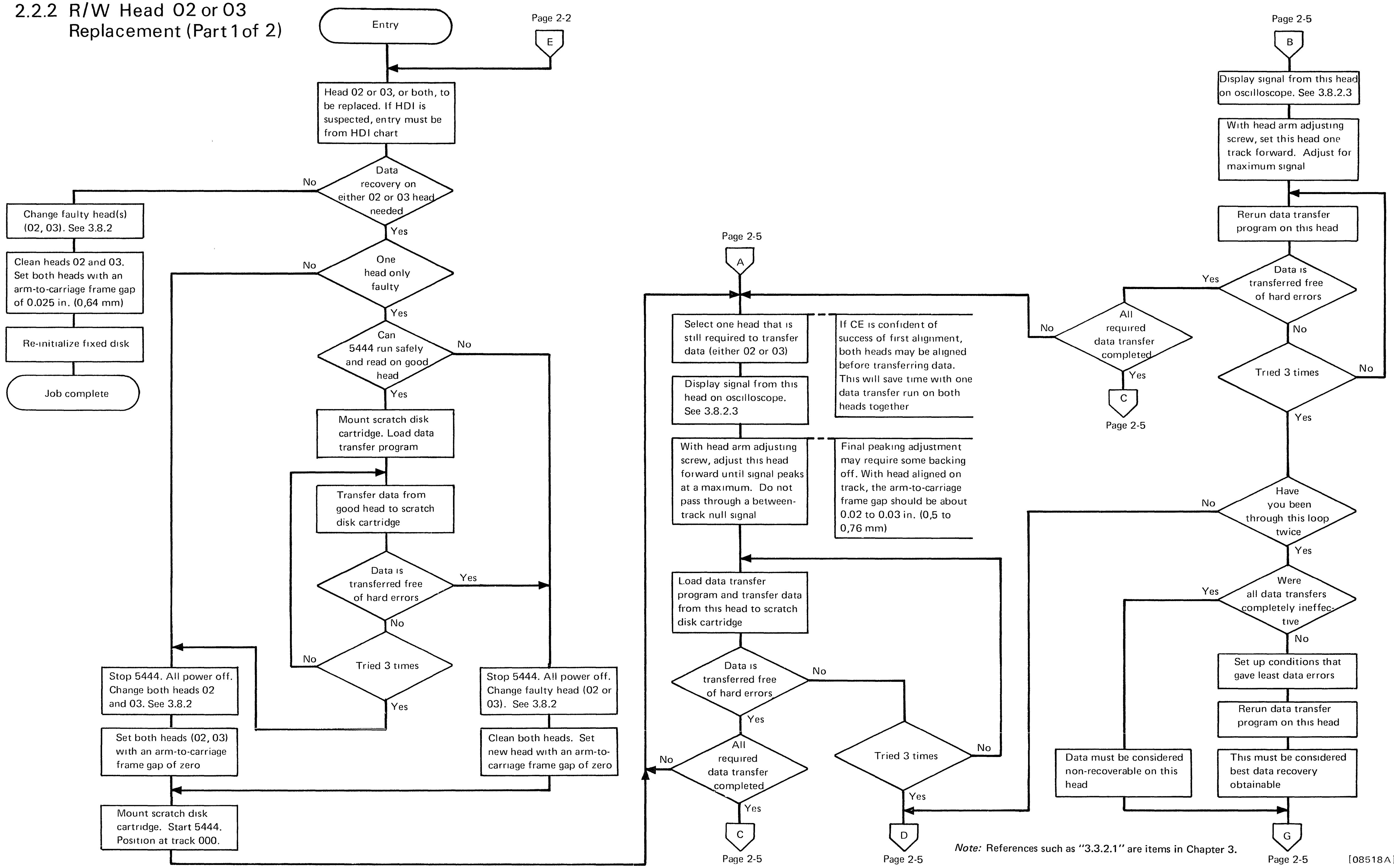
2.2.2 R/W Head 02 or 03 Replacement (Part 1 of 2)



Note: References such as "3.3.2.1" are items in Chapter 3.

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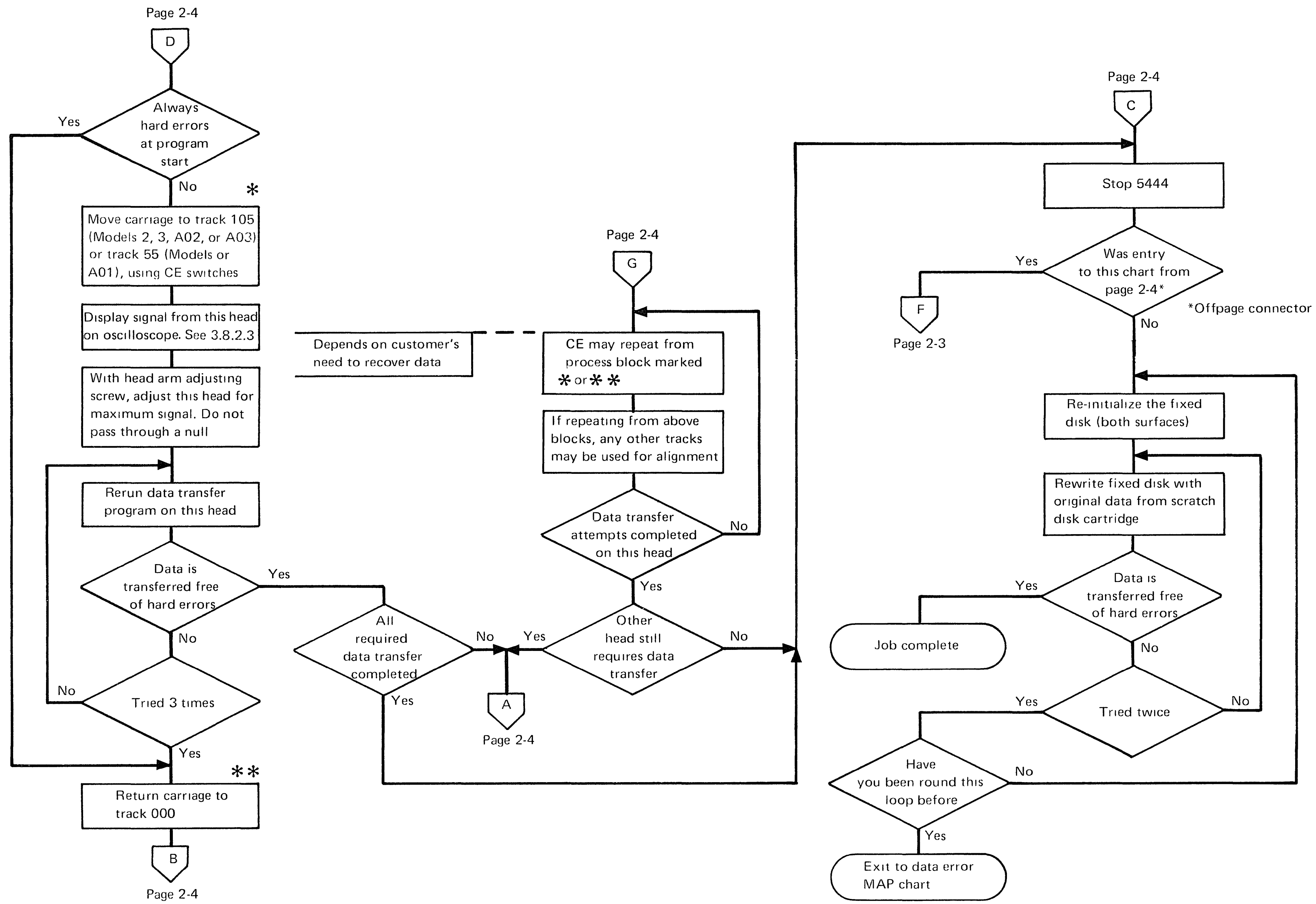
2.2.2 R/W Head 02 or 03 Replacement (Part 2 of 2)



Note: References such as "3.3.2.1" are items in Chapter 3

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2.3 Maintenance Facilities

2.3.1 CE Panel

When the 5444 is under control of the CE panel, the 'home' latch and the carriage overrun interlock switch limit the carriage travel to the recording area between tracks 000 and 203 (Models 2, 3, A02, and A03) or 000 and 103 (Models 1 and A01).

A

2.3.1.1 CE Mode-Select Switch

This switch has one online position and six offline positions. When the switch is set to ON LINE, the 5444 is controlled by the using system. When the switch is set to an offline position, the 'ready' signal is disabled, the write circuits are blocked, and the 5444 is selected for read operation. Individual offline settings are as follows:

1 TRK: Allows the carriage to move across one track for each operation of the forward/reverse switch (see 2.3.2.1).

50 TRKS: Allows the carriage to move across 50 tracks for each operation of the forward/reverse switch (see 2.3.2.2). The first forward/reverse operation may move across less than 50 tracks dependent on the carriage position.

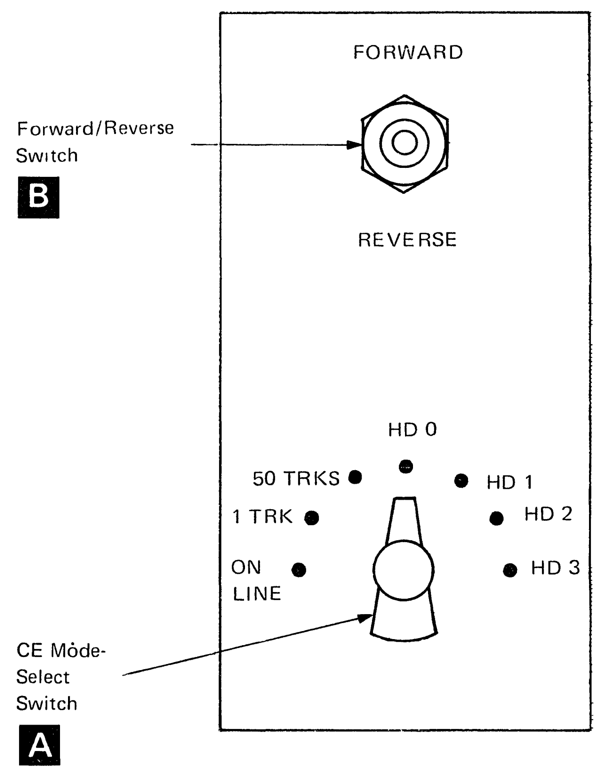
HD 0: Upper head, upper disk
HD 1: Lower head, upper disk
HD 2: Upper head, lower disk
HD 3: Lower head, lower disk
$\Bigg\}$ All heads are read selected

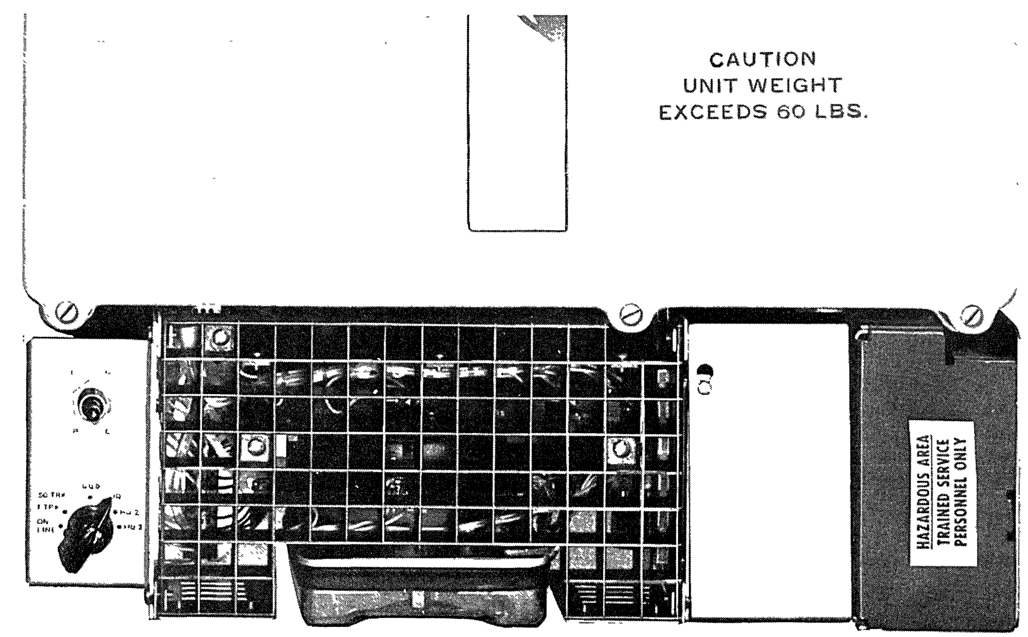
Head preamplifier output may be monitored at logic board pins Y-W1 K6J10 or Y-W1 K6J12.

B

2.3.1.2 Forward/Reverse Switch

The forward/reverse toggle switch is center biased, the center position being 'off'. The switch provides directional control for the carriage when the CE mode-select switch is set to either 1 TRK or 50 TRKS.





[08520]

2.3.1.3 Repetitive Carriage Movement

With the CE mode-select switch set to either 1 TRK or 50 TRKS, the action of connecting a jumper between Y-W1 F6G02 and ground causes the carriage to oscillate over 1 or 50 tracks respectively.

2.3.2 CE Access Operations

- This section describes 1-track and 50-track forward access operations under the control of the CE panel. Reverse operations are similar.
- When 'online' is dropped, 'ready' is deactivated. The 5444 is automatically switched to read and is write-inhibited.
- CE access operations are performed at standard speed on *all* models.

2.3.2.1 One-Track Access Forward Operation

Set the CE mode-select switch to 1 TRK and the forward/reverse switch to FORWARD. A pulse switches the 'CE direction' latch to forward and, at the same time, sets the 'CE go' latch. 'CE fwd' is activated, to initiate 'fwd seek'.

As the carriage moves forward, 'on track' drops and resets the 'CE go' latch, thereby removing 'CE fwd'. As for a normal single-track movement, the carriage continues to move until it reaches the next track (see "Access Operations" under "3.7 Actuator and Encoder Assemblies" in Chapter 3).

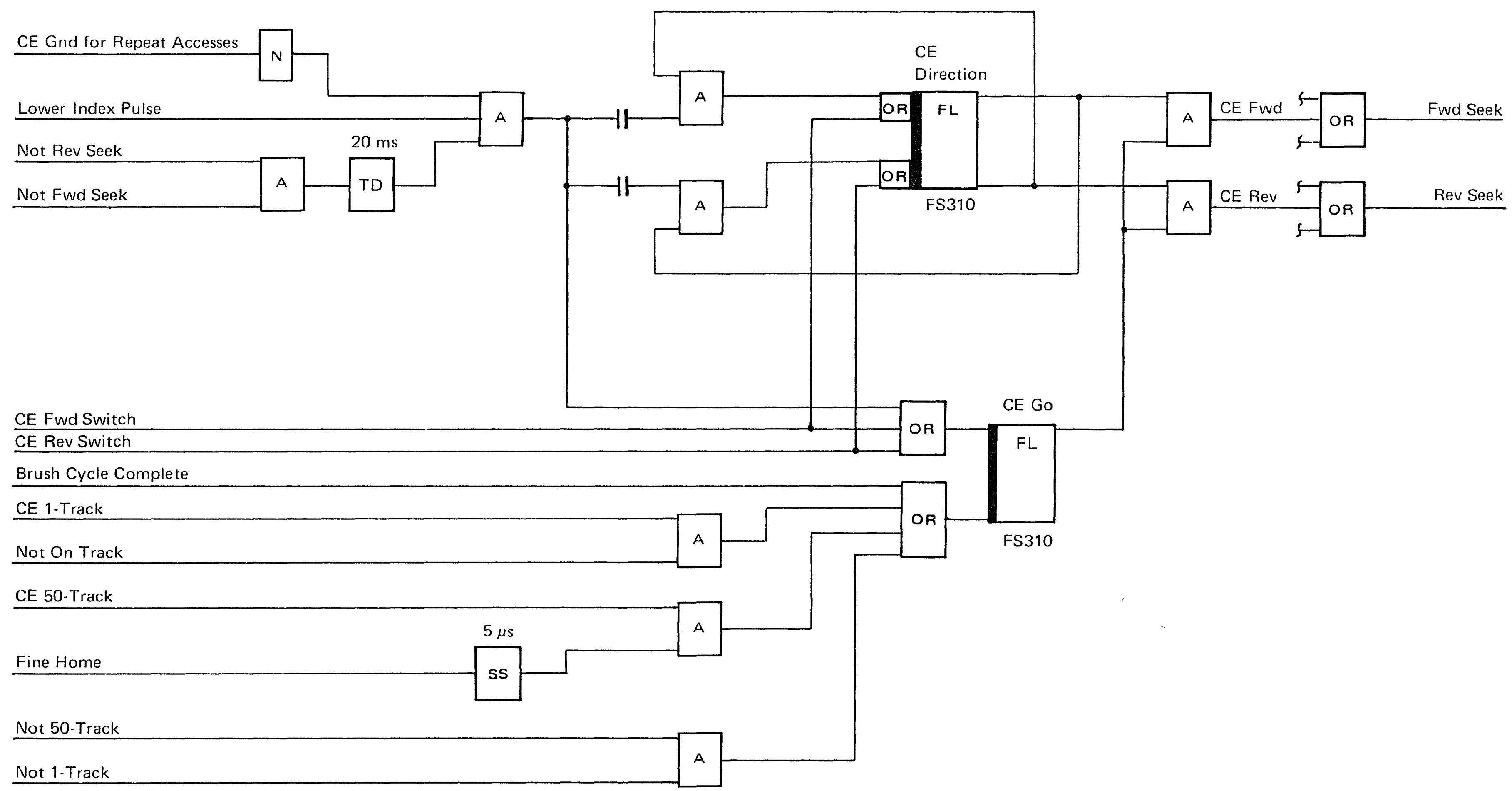
2.3.2.2 Fifty-Track Access Forward Operation

Set the CE mode-select switch to 50 TRKS. Operation of the forward/reverse switch sets the 'CE direction' and 'CE go' latches as for a 1-track movement. 'CE fwd' is activated, and the carriage moves forwards until 'fine home' is activated (at approximately track 049, 099, 149, or 199). The 'enter fine home' singleshot is fired, resetting the 'CE go' latch to remove 'CE fwd'. The carriage comes to rest at the next track, that is, track 050, 100, 150, or 200.

Note: During an access reverse operation, 'fine home' is activated at track 201, 151, 101, 051, or 001; the carriage halts at track 200, 150, 100, 050, or 000.

2.3.2.3 Repeat Accesses

Jumper Y-W1 F6G02 to ground. The first index pulse after the end of a delayed seek operation initiates another seek operation of the same length, in the opposite direction. The carriage therefore repeats alternate forward and reverse 50- or 1-track movements (according to the setting of the mode-select switch) until either the mode-select switch is turned to another setting or the jumper is removed.



CE Control Logic (ALD Page FS310)

[08521]

2.3.3 CE Tools and their Use

Special tools for servicing the 5444 are located at either the branch office or the customer installation.

2.3.3.1 Branch Office/Support Center Tools

Tool	*IBM Part*
Actuator alignment tool*	2598053 or 5831644
Base plate	5144386
Cartridge support clip (4 supplied)	2537562
Disk-clearance and head-load spring gage*	2600555 or 5144375
Head-clearance gage	5831638
Hub tool	2537550
Nylon gloves	461621
Oscilloscope, Tektronix** 453	453047
Runout gage	2536591
T-handle wrench, 3/16 in. hexagon	460947
Torque screwdriver, 10 lb in. (11,5 kg cm)	2597968
Torque wrench, 8 lb in. (9,2 kg cm)	2598187
6-flute adapter, size 4-40	2538009

The following items are required (from the using system inventory) for servicing the 5444:

Tool	*IBM Part*
Spring mounting tool (coupling)	5144438
Capacitor assembly	2600559
CE probe	817971
Tachometer	450976
Tachometer bracket assembly	2538137
Tachometer coupling assembly	2538084
Tachometer mounting screws (3 needed)	438538

2.3.3.2 Customer Installation Tools

Tool	*IBM Part*
CE cartridge	2537301
Disk and head cleaning paddle (2 supplied)	2108474
Feeler gages:	
0.003 in.	2536581
0.004 in.	2536582
0.005 in.	2536583
0.007 in.	2598179
0.010 in.	2598040
Head cleaning brush	2200106
Isopropyl alcohol, 6 oz	2200200
Lint-free tissues	2162567
Torque wrench, 4 lb in. (4,6 kg cm)	2597969
6-flute adapter, size 4-40	2597971

2.3.3.3 Use of Tools

CE Cartridge

The CE cartridge, part 2537301, is similar to the 5440 Disk Cartridge but is identified by a black top. The disk contains pre-written tracks at cylinders 005 and 073 (that is, the tracks 005 and 073 on both surfaces of the cartridge disk) that are used during the adjustment of the upper index transducer and the read/write head arm assemblies.

Note: Before making adjustments, run the CE cartridge for 15 minutes to allow it to reach the temperature of the 5444.

CAUTION
Do not, under any circumstances, write on the tracks at cylinders 004, 005, 006, 071, 072, 073, 074, and 075 of the CE cartridge. Overwriting on these tracks destroys the alignment data. Always check the track number before starting write operations.

Pre-Written Tracks 005 (Upper Index Transducer Adjustment): A recorded marker pulse, followed after ten microseconds by a train of pulses, is provided on tracks 005. The upper index transducer is adjusted, as described in item 3.5.2.2 of Chapter 3, until the marker pulse appears 30 microseconds after the index pulse.

Pre-Written Tracks 073 (Head Arm Alignment): Cylinder 073 of the CE cartridge has two circular concentric tracks that are spaced 0.010 in. (0,25 mm) apart and are 0.0015 in. (0,04 mm) eccentric to the disk; these tracks are written at slightly different frequencies. A head that is correctly centered over track 073 gives an oscilloscope trace with an equal two-lobed pattern. The pattern and adjustment procedure are described in item 3.8.2.3 of Chapter 3.

CE Probe

The MAP charts call for the use of the CE probe, part 817971. Details for using the tool are given in the manual of the using system.

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* Either of these part numbers may be used but, if ordering, use part 5831644 or 5144375.
** Trademark of Tektronix, Incorporated.

2.3.4 Maintenance Aids

2.3.4.1 CE Track

The tracks at cylinder 203 (5444 Models 2, 3, A02, and A03) or cylinder 103 (Models 1 and A01) are reserved for CE use. These tracks may be written on without customer data being disturbed.

2.3.4.2 Track Position Indication

Track position indicators show the exact location of the R/W heads over the recording area. Indication to the nearest ten tracks is provided by a pointer and scale on the actuator. Single-track indication between 000 and 049 is provided by a pointer and scale on the encoder (see "Encoder Assembly" under "3.7 Actuator and Encoder Assemblies" in Chapter 3).

2.3.4.3 Manual Operation of Carriage

When the 5444 is switched off, the carriage can be moved by hand by turning the stepping motor shaft at the encoder coupling.

CAUTIONS
1. Do not touch the encoder disk.
2. Do not attempt to move the carriage by pushing it.
3. Because the actuator is factory aligned, change it if it is forced out of alignment.

2.3.4.4 MAP Charts

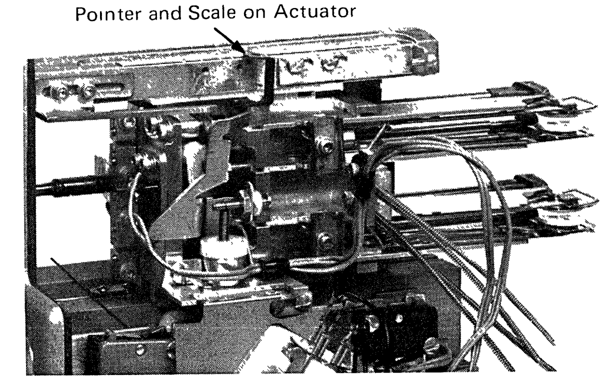
Maintenance analysis procedure charts are the primary tools for fault diagnosis. Presented as flowcharts, they guide the CE to the area of a failing component. The MAP charts are contained in the documentation of the using system, together with a description of their use.

2.3.4.5 TAP Lines

Jumpers are connected to the pins of the logic board in the 5444, from the timing analysis program lines, as follows:

	TAP Line Driver Pin		*Unsafe Latch Pin*
TAP Line A	Y-W1 B6D05	to	Y-W1 H6G03
TAP Line B	Y-W1 B6B04	to	Y-W1 H6B10
TAP Line C	Y-W1 B6B08	to	Y-W1 H6G04

Note: If the jumpers that are normally installed between the unsafe latches and the TAP line driver input pins are changed during the running of diagnostic programs, these jumpers must be returned to the proper pins or customer programming errors may occur.



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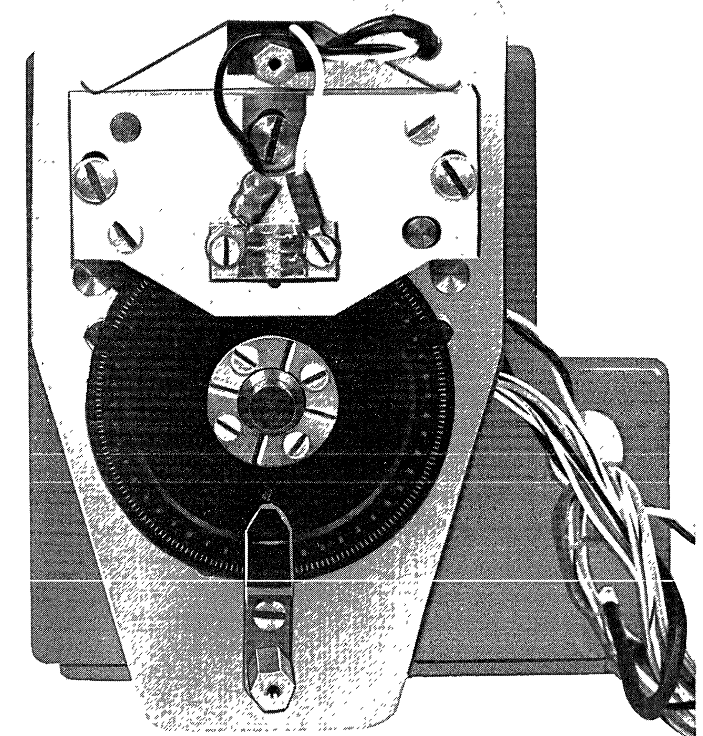

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2.4 Preventive Maintenance

2.4.1 Approach to Preventive Maintenance

Preventive maintenance (PM) allows the customer to use his 5444 for the maximum possible amount of time. Maintenance that does not reduce downtime is unnecessary.

2.4.1.1 Visual Inspection

Look for corrosion, dirt, wear, cracks, binding, and loose connections. Take remedial action.

2.4.1.2 Electronic Units

The program of the using system incorporates diagnostic programs. Use it regularly to assist in tracing intermittent faults and potential sources of trouble.

2.4.1.3 Mechanical Units

Clean, inspect, and lubricate mechanical units. Do not adjust or dismantle a correctly functioning unit, even if the tolerances vary from those given in Chapter 3.

2.4.1.4 Cleanliness

The 5444 is sensitive to dust particles. Always maintain strict cleanliness. If the top cover is removed from the machine, install the CE cartridge, part 2537301, before carrying out any work. Do not let lubricants accumulate inside the machine.

Disks and Heads

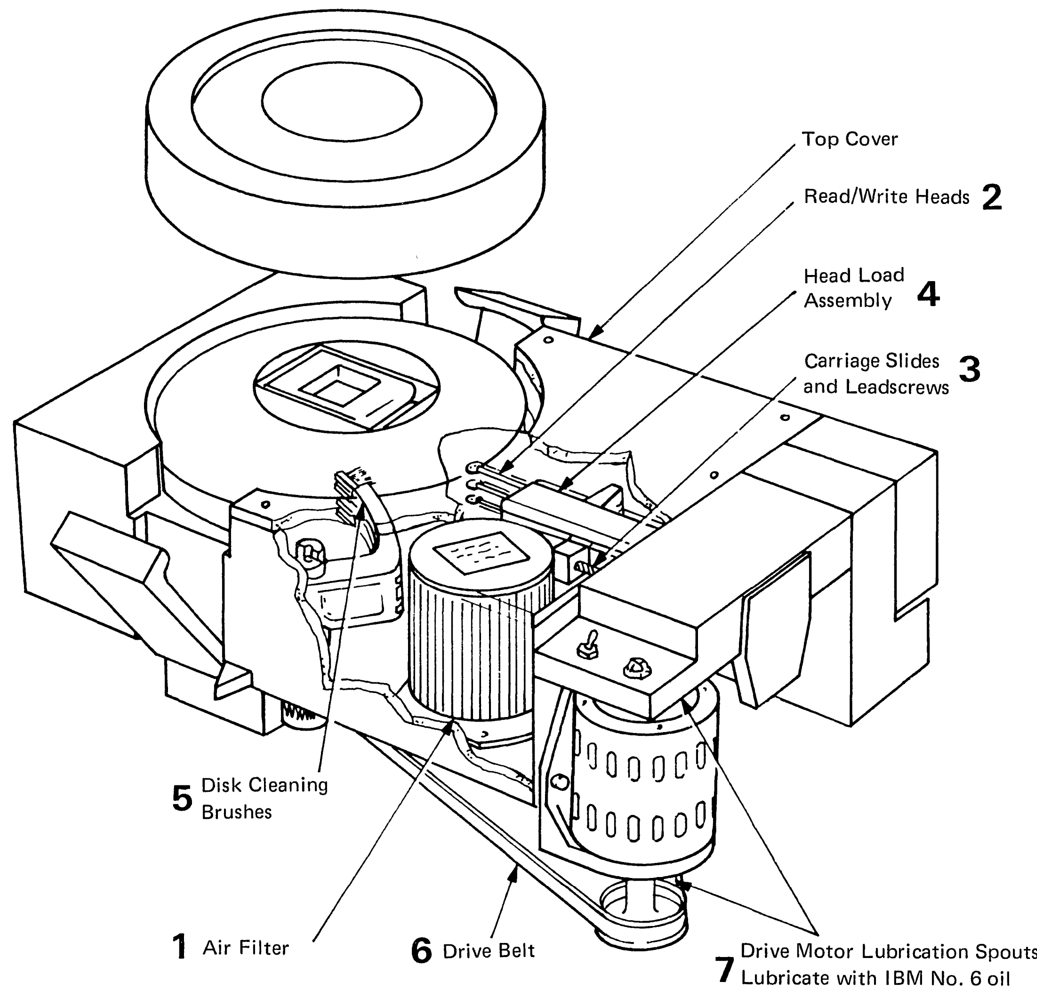
Very small dust particles, not visible to the eye, can cause dirt to accumulate on the head faces, and this accumulation can damage the disk and/or heads.

Actuator Assembly

Keep any removed parts in a dust-proof plastic bag.

2.4.2 PM Schedule

CAUTION
Do not allow tools or parts to fall into the machine when the top cover is removed. In particular, avoid damage to the disk.



[08523]

	Unit	Frequency (Months)	Observe	Lubricate/Clean
1	Air filter	12	Check that filter is not dirty or damaged (see 3.1.1.1)	
2	Read/write heads	3 (see Note)	Check that heads are free of scratches and oxide deposit (see 2.4.4.1)	Clean if necessary (see 2.4.4.2 or 2.4.4.3)
3	Leadscrew	6		Lubricate with Molykote 'G' Rapid* (see 2.4.3.1)
	Carriage slides	6		Lubricate with IBM no. 20 grease (see 2.4.3.1)
4	Head load assembly	12		Lubricate with IBM no. 20 grease and IBM no. 6 oil (see 2.4.3.3)
5	Disk cleaning brushes	6	Check that brushes are not worn (see 3.6.1.1)	
6	Drive belt	12	Check that belt is not frayed or cracked (see 3.2.2.1)	
7	Drive motor	12		Lubricate with IBM no. 6 oil (see 2.4.3.2)
	Power connections	12	Inspect	
	Diagnostics	3	Run	

* Trademark of Dow Corning Corporation

Note: Preventive maintenance of the read/write heads depends on usage. If the usage exceeds 198 power-on hours per month, perform the maintenance every 528 power-on hours.

[08524]

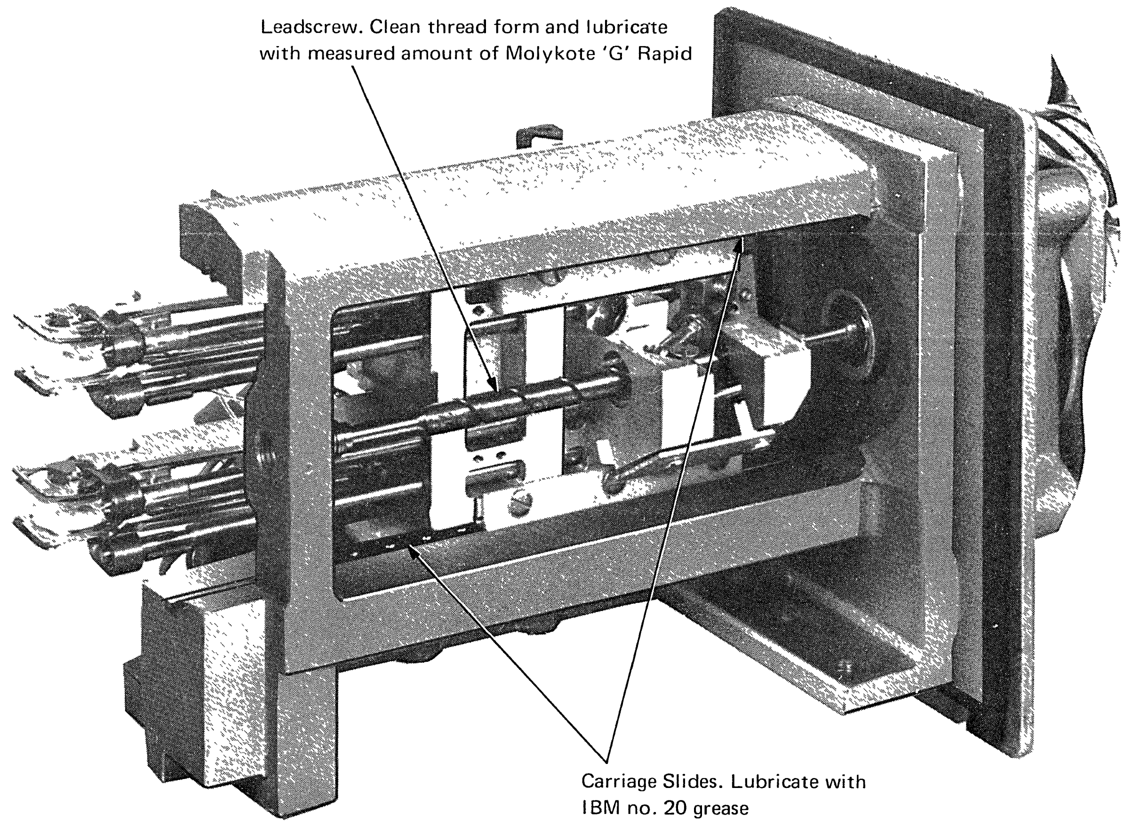
2.4.3 Lubrication

2.4.3.1 Leadscrew and Carriage Slide

1. Remove:
   a. Top cover.
   b. Air filter. (Block the air duct with a lint-free tissue.)
   c. Shield between air filter and carriage.
2. Manually move the carriage to the inner limit switch by rotating the stepping motor shaft.
   Note: Do not move the carriage by pushing on it. If the carriage is moved past either limit switch, it becomes disengaged from the leadscrew. To re-engage the carriage, refer to item 3.7.9.2 in Chapter 3.
3. Clean the carriage slides and leadscrew with lint-free tissues and isopropyl alcohol (see 2.3.3.2 for part numbers) to remove all traces of lubricant.
   Note: Do not move the carriage after lubricant has been removed.

CAUTION
In the following step, do not apply lubricant with the fingers because of the risk of contaminating other parts of the clean area. Use a lint-free tissue.

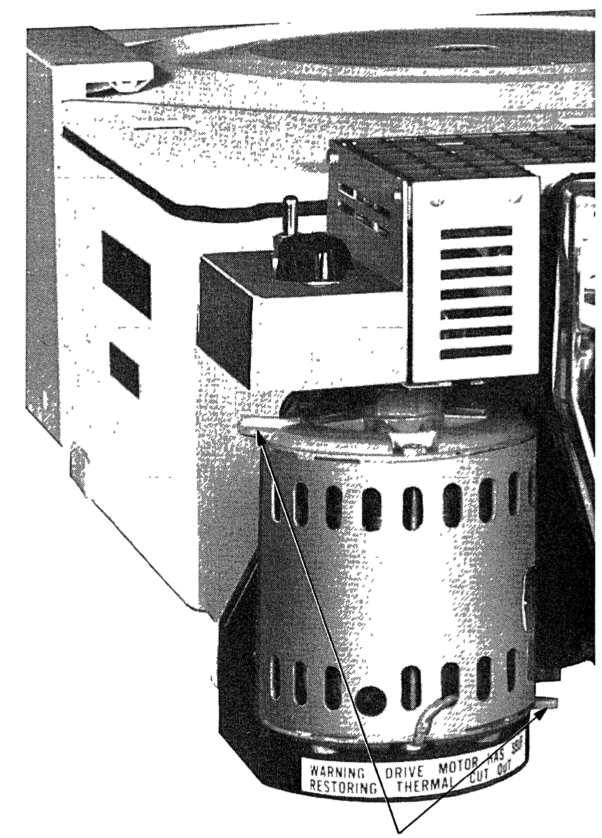
4. Lubricate the leadscrew thread form and outer diameter evenly over thread length with Molykote 'G' Rapid, part 5144304, by squeezing 1/8 to 1/4 in. of lubricant from a 0.150 in. nozzle fitted on tube (0,035 to 0,070 cc). Lubricate the carriage slides with IBM no. 20 grease; use a minimum amount.
5. Move the carriage back and forth to distribute the lubricant. Wipe off excess with a lint-free tissue.
6. Remove the tissue from the air duct and refit the air filter. Refit the shield and top cover.



[08525]

2.4.3.2 Drive Motor

1. Turn both lubricant spouts so that the hollow openings face upwards.
   Note: Some drive motors do not have lubrication spouts. For these motors, drip the oil into the coil holes.
2. Clean the spouts, then drip in IBM no. 6 oil.
3. After lubrication is completed, turn the spouts over, so that the hollows face downwards, to prevent dirt accumulating in them.



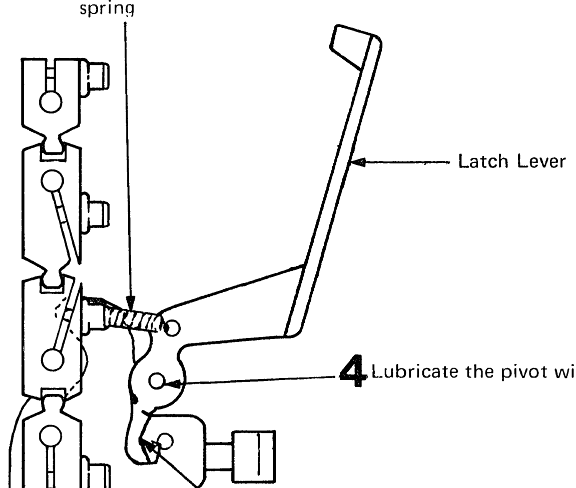
[08526]

2.4.3 Lubrication (continued)

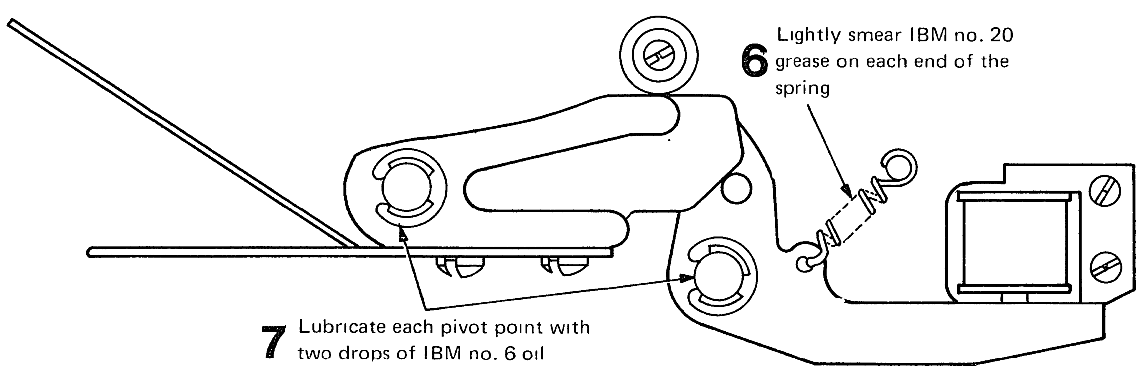
2.4.3.3 Head Load Assembly

1 Remove all power to the 5444

2 Remove the top cover



[08528A]



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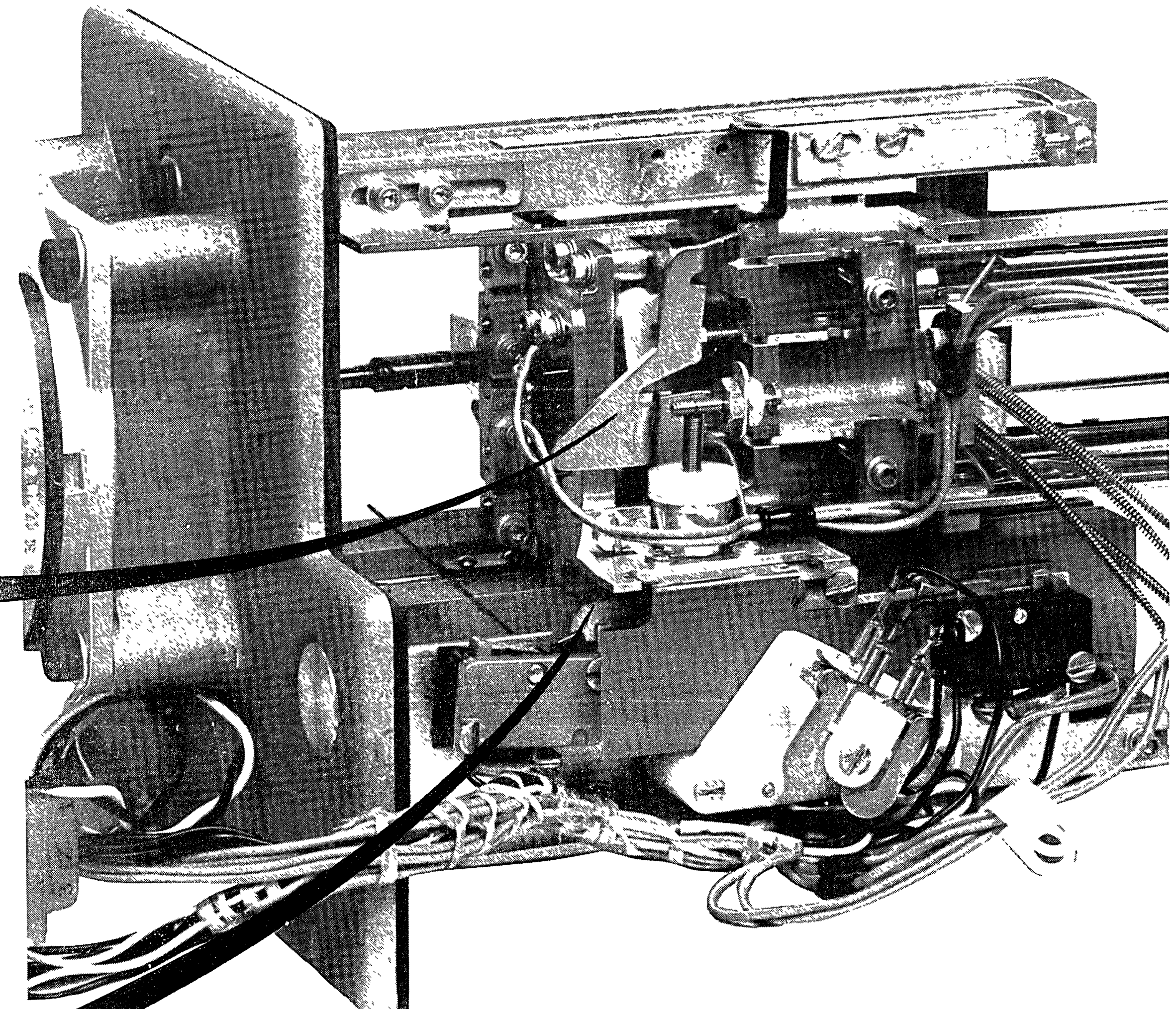


[09580]

8 Refit the top cover

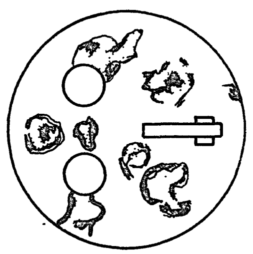
2.4.4 Read/Write Heads

2.4.4.1 Condition of Heads

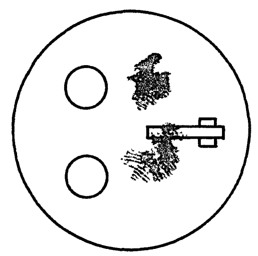
o If a large particle of dust is embedded in the disk surface, it may cut a groove or deep scratch in the head face, which will attract oxide deposits. If a head appears badly scratched, inspect and clean the disk (item 3.3.2).

Direction of disk rotation

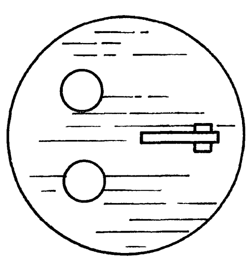
Clean Head (see 2.4.4.2) before use:



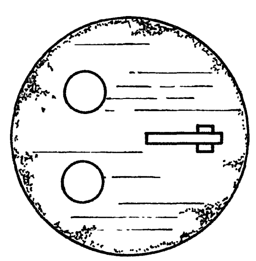
Alcohol residue: Dried in pools



Fingerprints or oily deposits



Light scratches



Slight oxide accumulation

[08529]

2.4.4.2 Cleaning R/W Heads (Light Oxide Deposits)

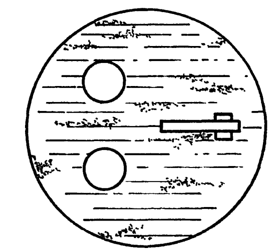
1. Remove the top cover. Check that the carriage is fully retracted.
2. Wrap a lint-free tissue around a disk and head cleaning paddle, and dampen with isopropyl alcohol (see 2.3.3.2 for part numbers). Carefully insert the paddle between the two R/W head faces, and insert a tissue between the heads that are not being cleaned.

CAUTION
Perform the following operation carefully. Do not touch the faces of the R/W heads with the fingers. Avoid leaving alcohol residue on the faces.

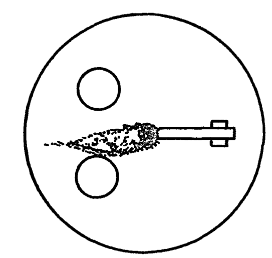
3. Partially close the heads by gently operating the latch lever, then drawing the paddle and tissue through the heads.
4. Repeat steps 2 and 3 until all oxide deposits are removed.
5. Dry the head with a dry tissue, in a similar manner to that for cleaning. Inspect with a dental mirror. If deposits of oxide still remain, clean as for heavy oxide deposits (see 2.4.4.3).
6. Repeat steps 2 through 5 for the other pair of heads.
7. Refit the top cover.

Direction of disk rotation

Change Head (see 3.8.2.4 and 3.8.2.5):



Grooves: Face has grooves 0.010 in. (0,25 mm) apart, and oxide deposits



Oxide accumulation: Heavy accumulation that cannot be removed in pole tip area

2.4.4.3 Cleaning R/W Heads (Heavy Oxide Deposits)

If cleaning as described in 2.4.4.2 is unsuccessful, continue as follows:

1. Wet the head cleaning brush, part 2200106, with isopropyl alcohol and shake off any excessive liquid.

CAUTIONS
a. In the following steps, avoid touching the face of the R/W head with the fingers. Do not leave pools of isopropyl alcohol on pieces of tissue on the head face. Never blow on R/W heads and do not use excessive force when supporting them. Discard worn head cleaning brushes.
b. Do not knock the head with the metal stem of the brush.

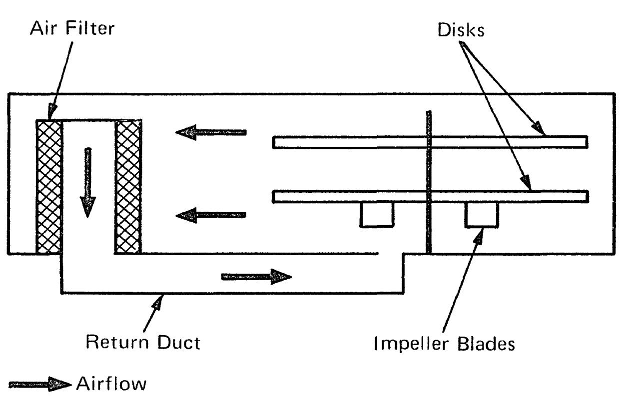
2. Supporting the back of the head with the disk and head cleaning paddle, scrub the face of the head with the brush, using a rotary motion. Give special attention to bleed holes and to the leading and trailing edges of the face.
3. Wrap a lint-free tissue around a paddle, dampen the tissue with isopropyl alcohol, and polish the face of the head.
4. Dry the head face with a dry tissue wrapped around a paddle.
5. Inspect the surface of the face, using a dental mirror, to make sure that all dirt and oxide deposits have been removed. If contamination still persists, change the head arm assembly (see items 3.8.2.4 and 3.8.2.5 in Chapter 3).

Chapter 3. Unit Description and Servicing

This chapter contains a description of the individual units on the 5444, together with details of the various access operations (except CE access operations) that are performed by the machine. The chapter also contains all servicing information (checks, adjustments, alignments, removal and replacement procedures) for the machine. For each unit, the descriptive information is given first, followed by the appropriate service information

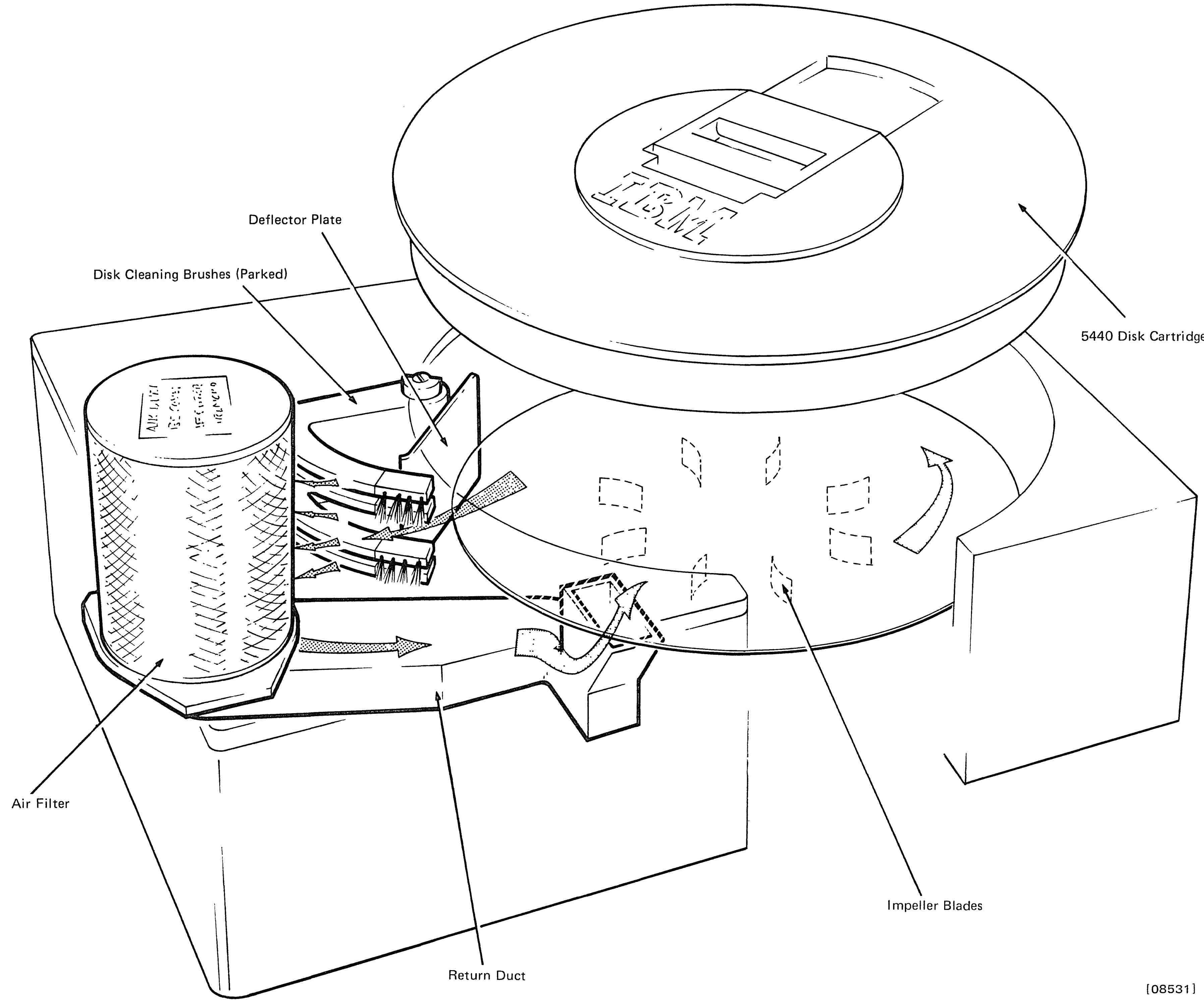
3.1 Air-Circulation System

- A closed air-circulation system keeps the disk chamber free from contamination. An air filter removes dust particles.
- Impeller blades on the rotating lower disk hub assist the flow of air.



Section View

[08530]



[08531]

3.1.1 Air Filter

3.1.1.1 Service Check

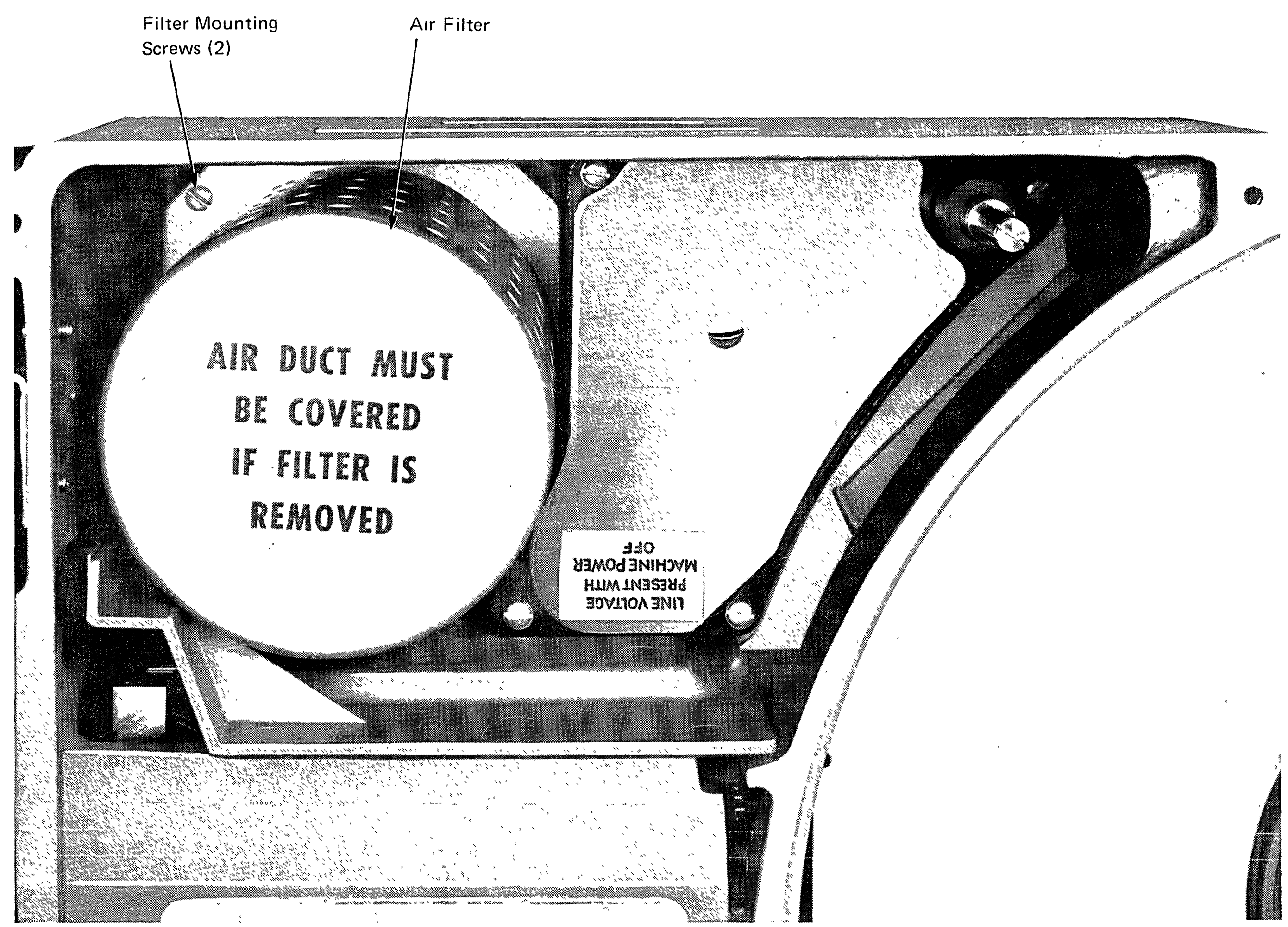
Examine the air filter regularly. Inspect for dirt and breaks in the material. Change a dirty or defective filter; do *not* attempt to clean or repair it.

3.1.1.2 Removal

1. Remove the machine top cover.
2. Unscrew the two filter mounting screws.
3. Lift out the filter.
4. Block the air duct beneath the filter assembly with a lint-free tissue, part 2162567.
5. If the filter is serviceable, store it in a polythene bag until refitting.

3.1.1.3 Replacement

1. Remove the tissue from the air duct.
2. Install the filter and fit the mounting screws.
3. Refit the machine top cover.



[08532]

3.2 Drive Mechanism

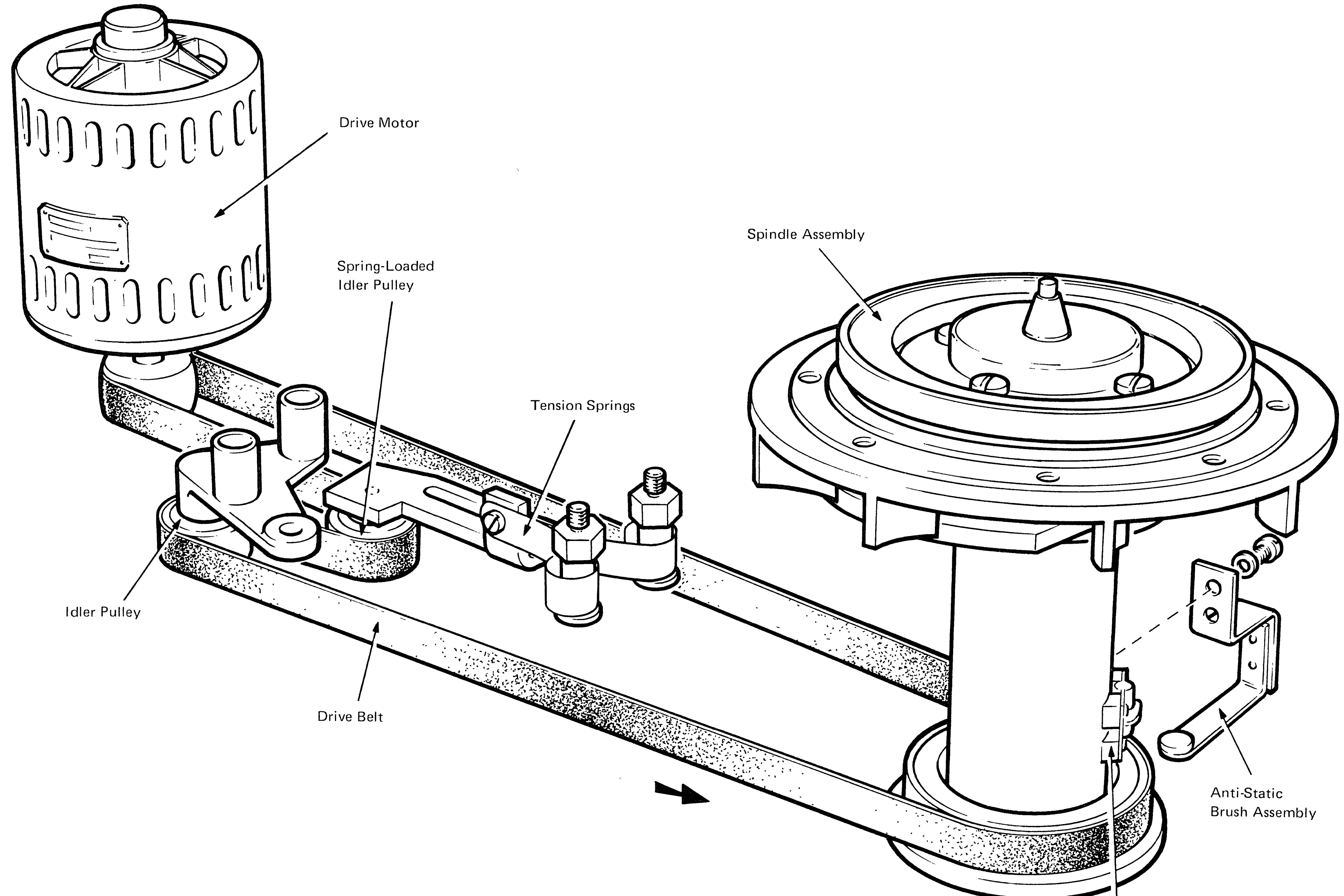
- The drive mechanism rotates the recording disk(s) (mounted on the spindle assembly) at 1,500 rpm.
- The drive belt tension is set automatically by a spring-loaded idler pulley. The pulley is free to move under the influence of two springs to take up any slackness in the drive belt.
- A flange on the drive spindle pulley provides manual control of the drive mechanism when power is removed from the 5444.

Drive Motor–Description

- Different drive motors and pulleys are used for 50-Hz and 60-Hz operations (see "3.12 Power Supplies" in this chapter).
- The drive motor is electrically isolated from the machine base.
- The motor contains a thermal cutout for switching off the motor ac supply, to protect the motor from overheating; operation of the cutout shuts down the 5444. The cutout resets automatically when the motor cools. Normal machine start-up procedure can then be performed, provided the cause of the thermal trip is rectified.
- DC braking is used to ensure that the disks stop rotating within 30 seconds during a file stop sequence. When '+24V file start' is dropped, relay K5 is energized to pass dc through the drive motor. K5 is de-energized when 'speed zero' is activated near the end of the machine stop sequence.

Spindle Assembly–Description

- The spindle assembly carries the recording disk(s).
- An anti-static brush grounds the spindle assembly to the machine base (logic ground).



3.2.1 Changing Drive Motor

DANGER
Always turn off power before working on the drive motor. The thermal cutout, which protects the motor from over-heating, is self-restoring.

Change the drive motor as follows:

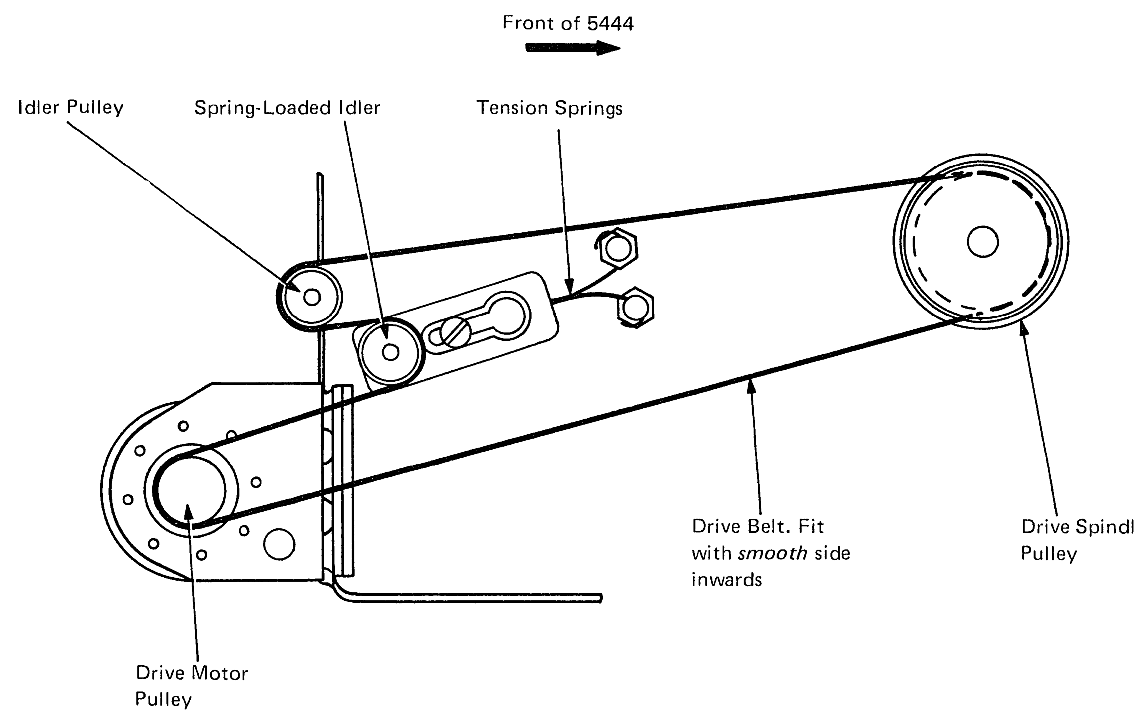
1. Remove all power supplies (at the using system) from the 5444.
2. Take off the drive belt (see 3.2.2).
3. Remove the ac box cover and the terminal block shield.
4. Disconnect the blue and red leads from capacitor C1, the yellow lead from TB1-4, and the two ground leads from the ac box ground bus.
5. Remove the motor mounting screws under the mounting bracket.
6. Withdraw the drive motor leads from the ac box, then lift the motor from its bracket.
   Note: Because replacement motors are supplied complete with leads and connectors, the old lead may be cut to facilitate removal of the motor.
7. Install the motor in the mounting bracket and secure with its mounting screws.
8. Route the motor leads into the ac box and connect the appropriate leads to TB1-4, C1, and the ac box ground bus (see ALD page ZA200).
9. Refit the drive belt (see 3.2.2).
10. Adjust the drive motor pulley so that the drive belt clears the motor fixing screws.
11. Replace the ac box terminal block shield and cover.

3.2.2 Changing Drive Belt

If the drive belt is cracked or frayed, change it as follows:

1. The belt is self-adjusting. To remove, first release tension from the spring-loaded idler by pulling against the tension springs, then lift off the belt.
2. Fit the belt with its *smooth* side inwards.
3. If necessary, adjust the drive motor pulley on its shaft by loosening the hexagon screw, so that the belt runs clear of the flanges on other pulleys. Tighten the motor pulley screw on completion.

Note: If the 5444 is mounted with limited accessibility to the underside, tape the drive belt to the spindle pulley with adhesive tape, then move to the other end of the machine and pull the belt through to the other pulleys. Remove the tape on completion.



View from Underside of 5444

[08534]

3.2.3 Spindle Assembly-Servicing

• Before commencing work on the spindle assembly, give the customer the opportunity to recover data from the fixed disk. Refer to 2.2.

3.2.3.1 Removal

1. Ensure that the carriage is fully retracted, then turn off power.
2. Remove the disk cartridge, the shield above the fixed disk, and the upper index transducer boom assembly (see 3.5.2.4).
3. Remove *and discard* the fixed disk (see 3.3.2.3).
4. Take off the drive belt (see 3.2.2).
5. Swing Y gate out of the way.
6. Remove the anti-static assembly, ground wire, and lower index transducer assembly (see 3.5.3).
7. Lift the ring magnet out of the chuck with a screwdriver, without damaging the magnet.
8. Turn the chuck until one of the three spindle mounting screws is visible through an access hole.
9. Unscrew the mounting screw, completely lifting it out with a screw-holding driver. Turn the chuck until another screw is visible and remove that screw in same way. Repeat for the third screw.

CAUTION
In the next step, do not "lever" the spindle assembly with a screwdriver or the machined base may be damaged.

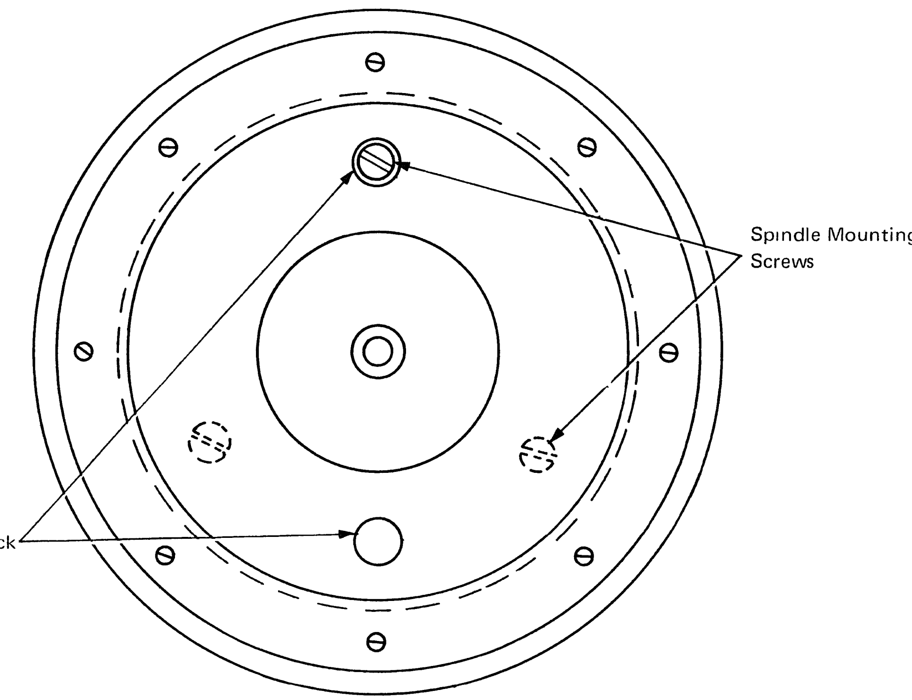
10. Lift out the spindle assembly by gripping the edges of the chuck.

3.2.3.2 Replacement

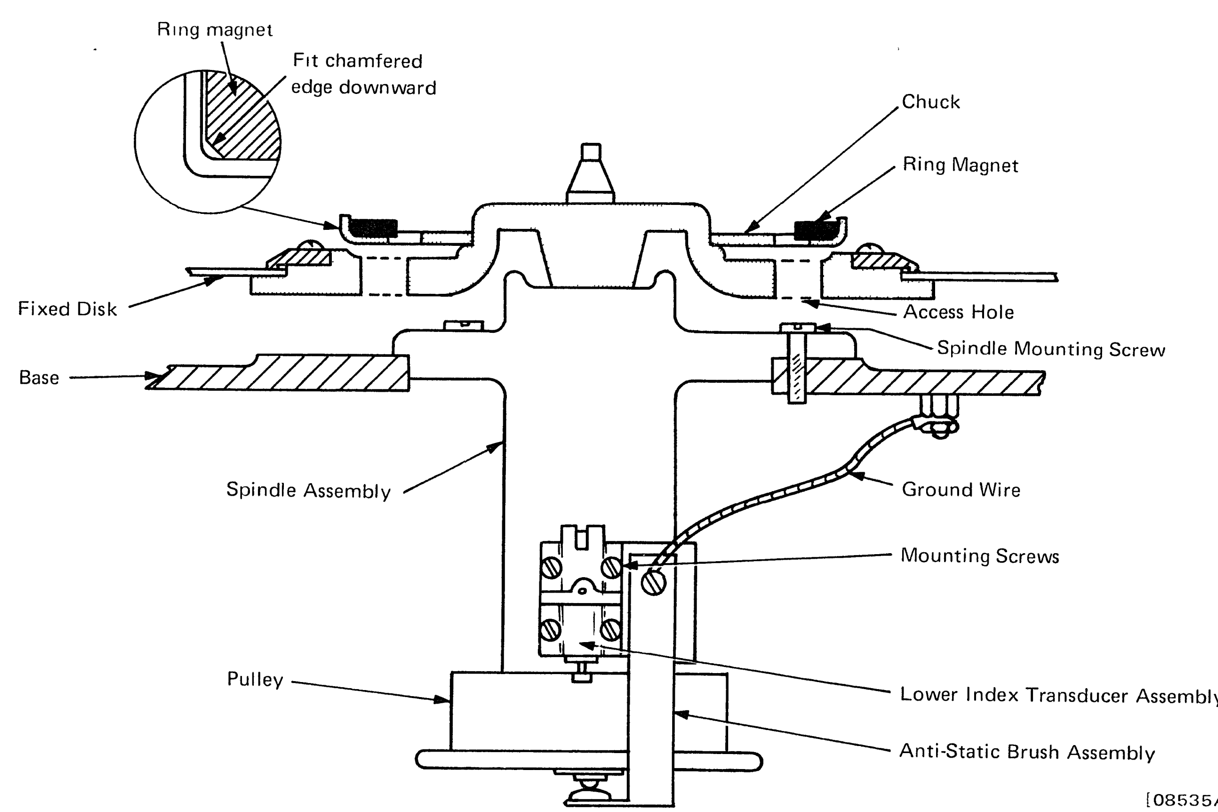
Replace the spindle assembly as a complete unit.

1. Insert the spindle assembly into the machine, with the lower transducer mounting facing towards Y gate.
2. Place the assembly firmly on the machined base. Turn the spindle chuck until the hole for one mounting screw is visible. Use a screw-holding driver to start the mounting screw and lightly tighten. Repeat this action to fit the other two mounting screws.
3. Tighten all three screws evenly.
4. Refit the ring magnet, with the chamfered edge downwards.
5. Refit the anti-static assembly and connect the ground wire.
6. Refit the lower index transducer assembly (see 3.5.3.3), then adjust it (see 3.5.3.1).
7. Refit the drive belt (see 3.2.2).
8. Fit a *new* fixed disk (see 3.3.2.4, steps 1 through 9).
9. Refit the upper index transducer boom (see 3.5.2.4).
10. Refit the shield above the fixed disk.
11. Check the upper index transducer clearances, and adjust if necessary (see 3.5.2.1).
12. Check the actuator alignment (see 3.7.1.3).
13. Align read/write heads 00 and 01 and set heads 02 and 03 to an initial setting of 0.025 in. (0,64 mm). See 3.8.2.3.
14. Install the disk cartridge.
15. Initialize the new fixed disk (except on 5444 Models 3 and A03).

Top View



Side Section



[08535A]

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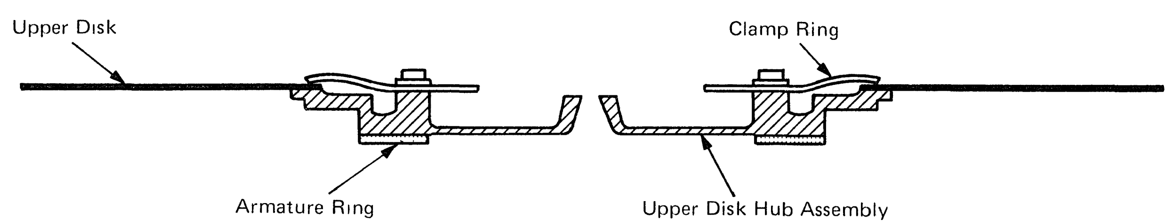
3.3 Recording Disks

- The disks, which are made of light alloy, are 14 in. (356 mm) diameter and 0.050 in. (1,3 mm) thick. They are coated, approximately 0.0001 in. (0,003 mm) thick, on each side with epoxy-bonded magnetic iron oxide.
- The usable section (that is, the amount traversed by the read/write heads) of each disk is 2 in. (50,8 mm) wide from track 000 to track 203. The inner track (203) is at 4.5 in. (114,3 mm) radius and the tracks are 0.010 in. (0,25 mm) apart.

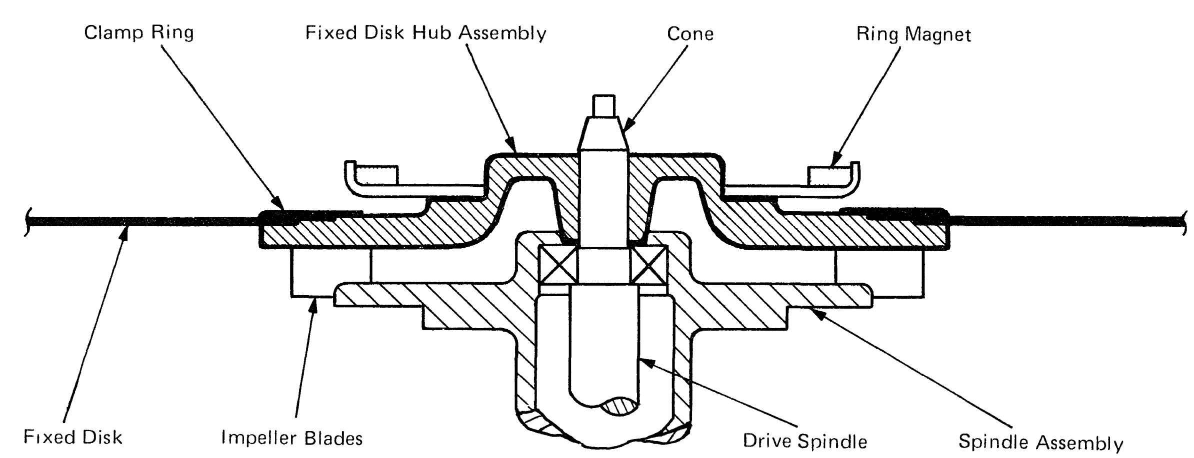
Removable Disk – Description

- The disk is attached to the upper disk hub assembly. This assembly seats on the drive spindle cone; the armature ring in the hub clamps to the ring magnet of the lower disk hub assembly, thereby locking together the two disks on the drive spindle.
- The upper disk and hub assembly is permanently enclosed in the 5440 Disk Cartridge to protect the recording surfaces.



Fixed Disk – Description

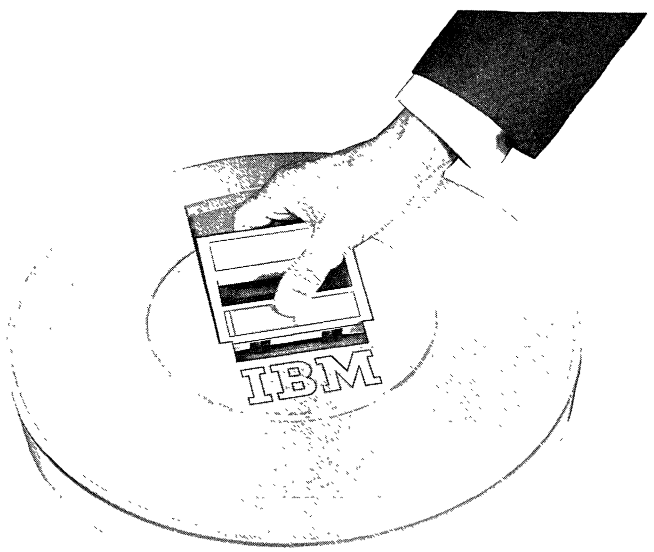
- The fixed (lower) disk is permanently clamped to a hub assembly, which is a push-fit on the drive spindle.
- A magnetic ring clamps the removable upper disk assembly to the fixed disk hub assembly.



[08536]

5440 Disk Cartridge – Description

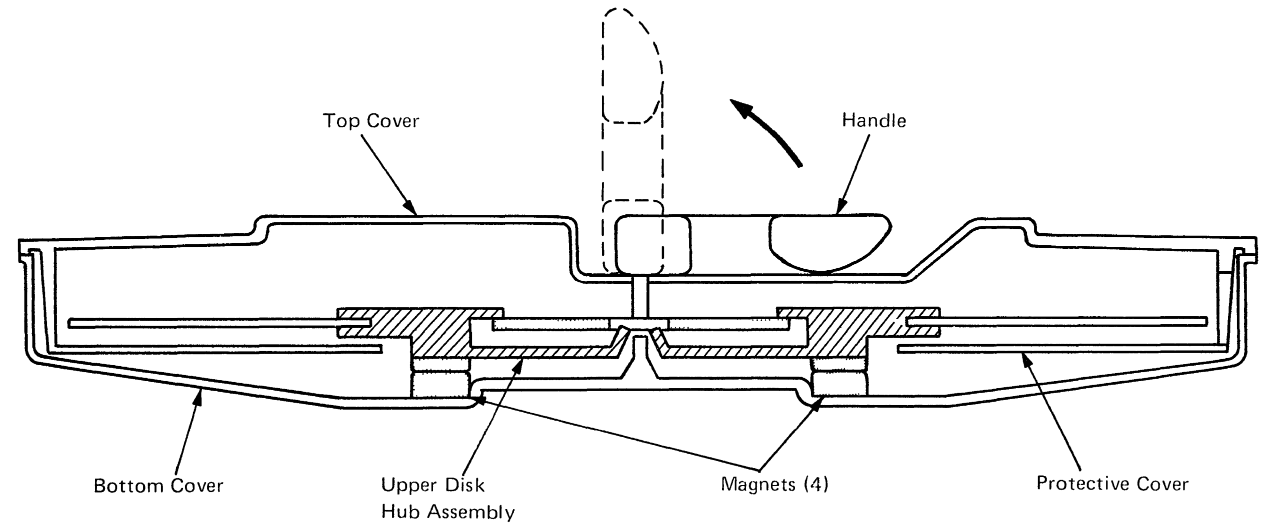
- The removable upper disk on its hub is enclosed between the top cover and the protective cover of the cartridge to form a top cover assembly. This assembly seats within a bottom cover; four magnets, set into the bottom cover, clamp the units together.
- Customer disk cartridges have a *blue* top cover. The cartridges may be used in any model of 5444.
- CE disk cartridges have a *black* top cover.
- To install the cartridge in the 5444, lift the handle and slide the release knob sideways. This releases the bottom cover. Place the cartridge in the 5444. Invert the bottom cover and place it on the cartridge. Close the cartridge clamps.



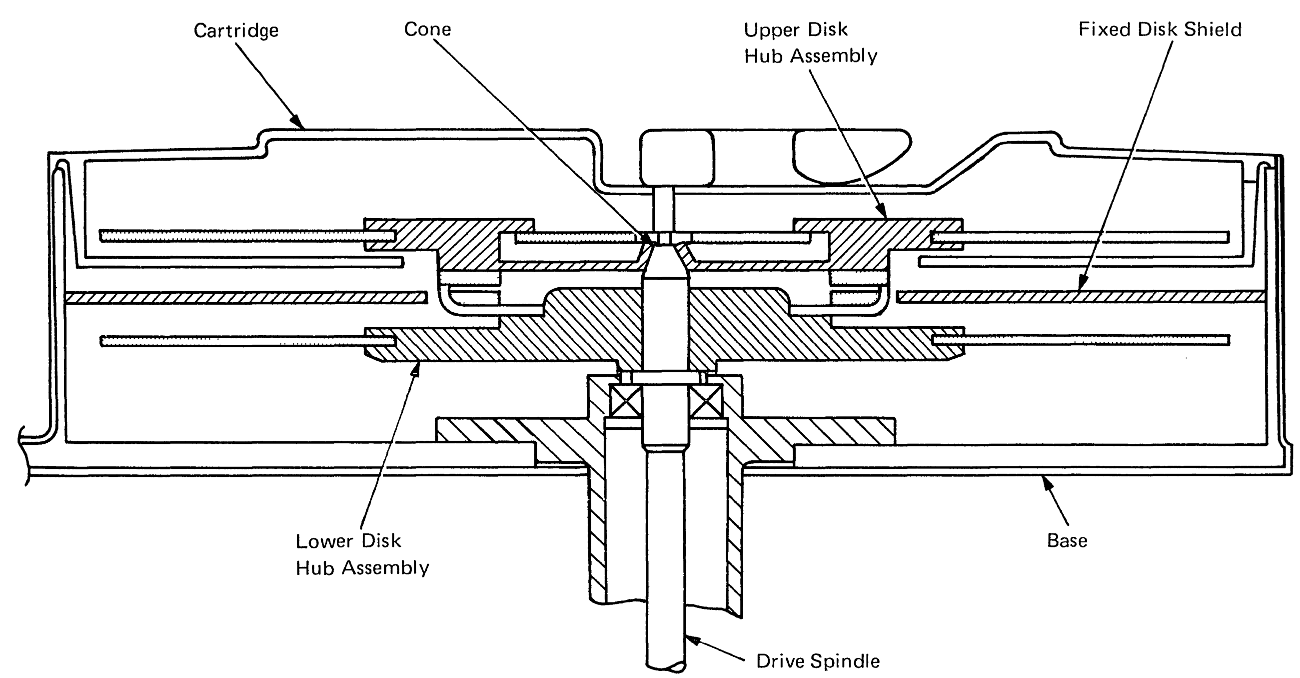
[04926]

- When the cartridge is installed in the 5444, the upper and lower disk hub assemblies are locked together on the drive spindle. The upper disk hub assembly seats on a cone at the top of the drive spindle.

  To allow the read/write heads and the cleaning brushes to enter the cartridge, a head entry port and a brush entry port are provided in the side wall of the top cover. Four slots in the side wall enable these ports to be accurately located.
- The cartridge and cover must be correctly clamped in position before the 5444 can be started.



[08537A]

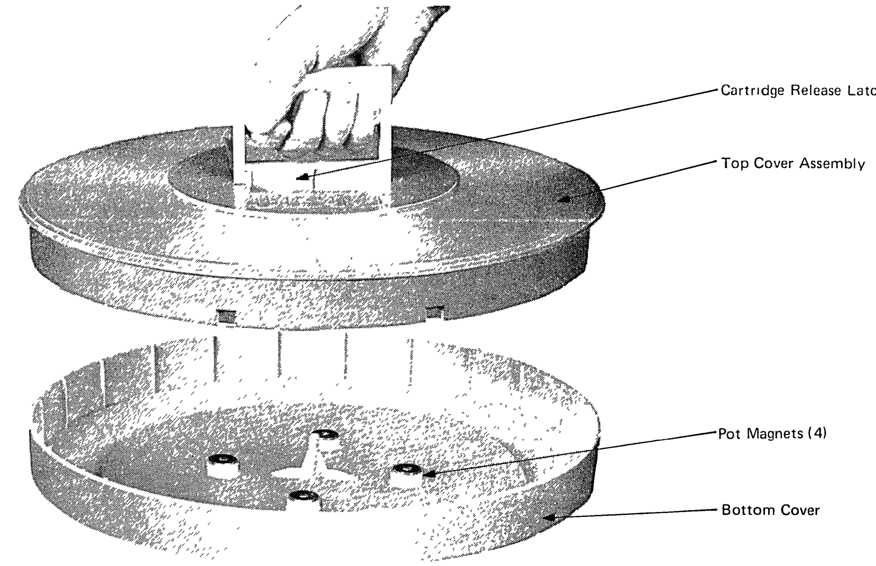


[08538]

Cartridge Handle

- For normal carrying purposes, the cartridge handle is lifted from its horizontal rest position.

- The handle is also used for removing the cartridge from the 5444 drive spindle, and for releasing the top cover assembly from the bottom cover.

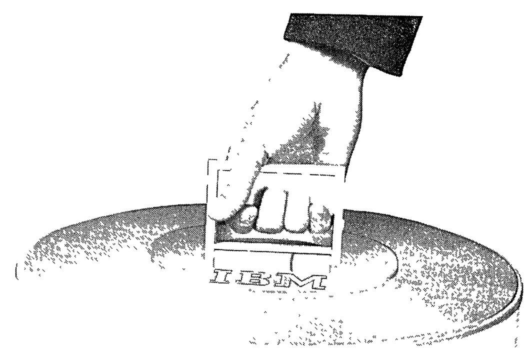


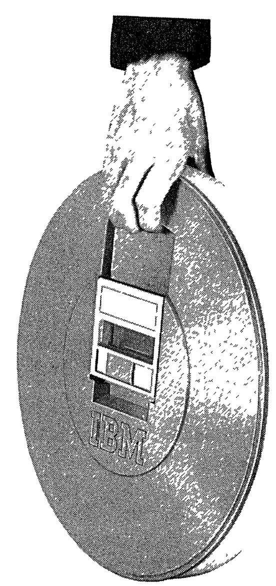
[07952]

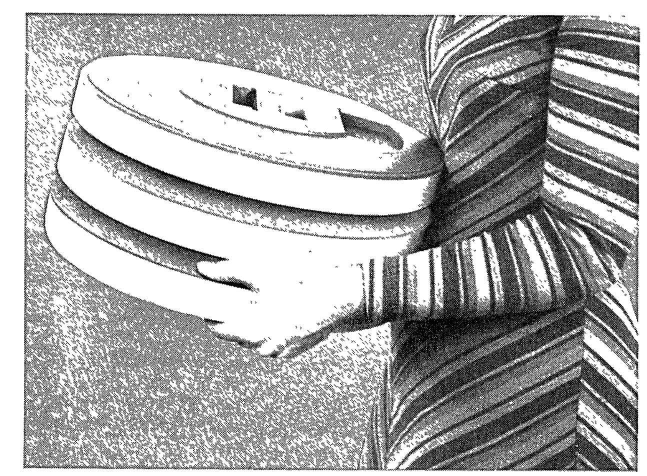
Carrying the Disk Cartridge

Carry the disk cartridge either horizontally or vertically. To carry it horizontally, use its handle. To carry it vertically, place the fingers in the handle recess and grip the beveled edge on the bottom cover with the thumb.

When carrying more than one disk cartridge, stack them on top of each other. Do not, however, carry more than *five* cartridges at a time.







[04923]

Storing Disk Cartridges

Store disk cartridges on top of each other or standing on edge in racks; do not stack more than *five* cartridges. To facilitate stacking, a raised portion in the top of one cartridge fits into a recessed area in the bottom of the next cartridge.

CAUTIONS

1. If the 5444 produces tinkling or screeching noises, immediately inspect the disk *and* the read/write heads (see "3.8 Head/Arm Assembly"). *Always* change the disk and *never* transfer it to another machine.
2. If the brushes are stopped over the disk for any reason, remove the brush arm and clip completely (see item 3.6.1.2) to safeguard the disk from damage if the cartridge is inadvertently removed.

3.3.1 Inspection-General

The condition of the faces of the read/write heads (see item 2.4.1.1 in Chapter 2) is a guide to the state of the disk surfaces. A clean head that rapidly accumulates oxide deposits indicates that the disk surface is dirty or scratched, or has embedded particles. If cleaning or changing the heads (see items 2.4.4.2 and 2.4.4.3 in Chapter 2) and cleaning the disks (see items 3.3.2.2 and 3.3.3.2 in this Chapter) do not rectify the condition, carefully examine the disk surfaces for scratches, embedded particles, and discolored spots on the oxide.

Error recovery and data dumping procedures are dealt with in the manuals of the using system. Basic error recovery procedures are given in item 2.2 in Chapter 2.

3.3.2 Fixed Disk

3.3.2.1 Inspection and Check

An indication of damage to the fixed disk may be gained from the condition of the lower R/W heads, persistent read or write errors, or noises from the machine. If head-to-disk interference is suspected, change the heads and the disk; refer to the error recovery procedure for HDI (item 2.2 in Chapter 2). Inspect disk cartridges that have been used before an HDI incident to make sure that they have not been dropping particles.

Remove the fixed disk shield and visually inspect the upper surface of the fixed disk. Look for:

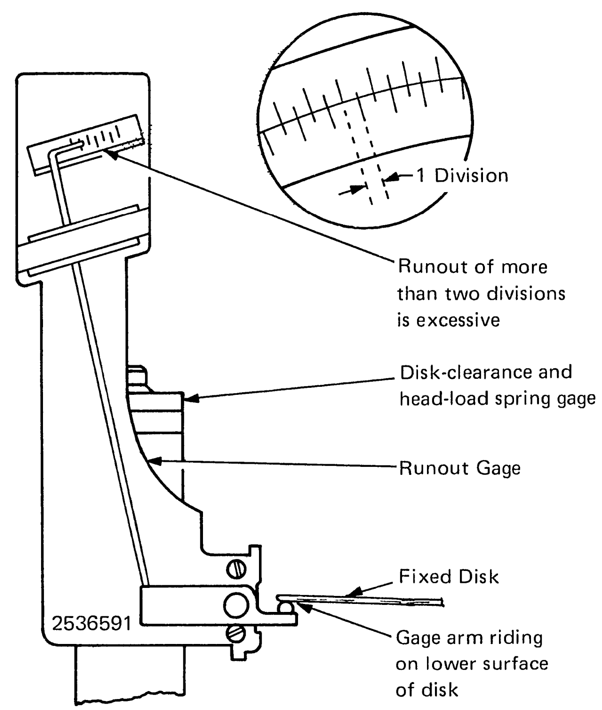
1. Spiral scratches.
2. Scratches that expose metal.
3. Embedded particles.

If damage to the lower surface is suspected, remove the disk to inspect it.

Before removing the fixed disk, give the customer an opportunity to recover the data that is written on it. Refer to item 2.2 if data transfer cannot be completed; if the disk is undamaged, see 2.2.2 (head 02, 03 replacement); for suspected HDI, see 2.2.1.

Carry out the disk height and runout check as directed by the error recovery procedure flowchart (see 2.2) or when fitting a new fixed disk, as follows:

1. Remove the top cover and the disk cartridge.
2. Remove the fixed disk shield, the pillar for the head cable clamp, and head connectors from Z gate.
3. Mount the disk-clearance and head-load spring gage, part 2600555 or 5144375, on the machined pad near the entry port, with the gage fingers of part 2600555 turned towards the stepping motor. Secure the tool with the captive screw in the hole vacated by the cable clamp pillar.
4. Refer to **A** when using gage, part 2600555.
   Refer to **B** when using gage, part 5144375.



Runout Check

[08539]

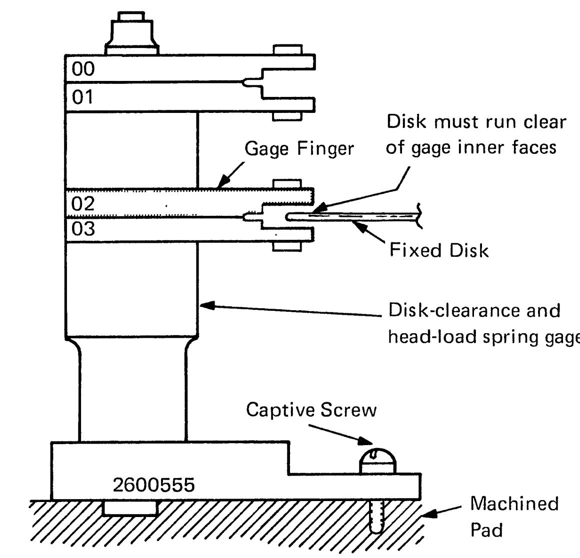
A Continue as follows:

a. Swing fingers 02 and 03 of the gage towards the head entry port so they overlap the edge of the disk.
b. Manually rotate the disk (by the drive motor pulley) through one revolution and observe if disk touches either finger.
   Note: If the disk touches a gage finger, the disk is warped and must be changed.
c. Swing the fingers away from the disk.
d. Clip the runout gage, part 2536591, onto the pillar of the disk-clearance and head-load spring gage, between 01 and 02 fingers. Adjust the height of the runout gage so that its arm rides on the lower surface of the disk with the pointer at mid-scale.
e. Slowly rotate the disk by the drive motor pulley through one revolution and check the disk runout. If the pointer moves more than two divisions on the scale, runout is excessive and the disk must be changed.
f. Remove the tools. Refit the cable clamp pillar, head connectors, and fixed disk shield.
g. Re-install the disk cartridge and top cover.

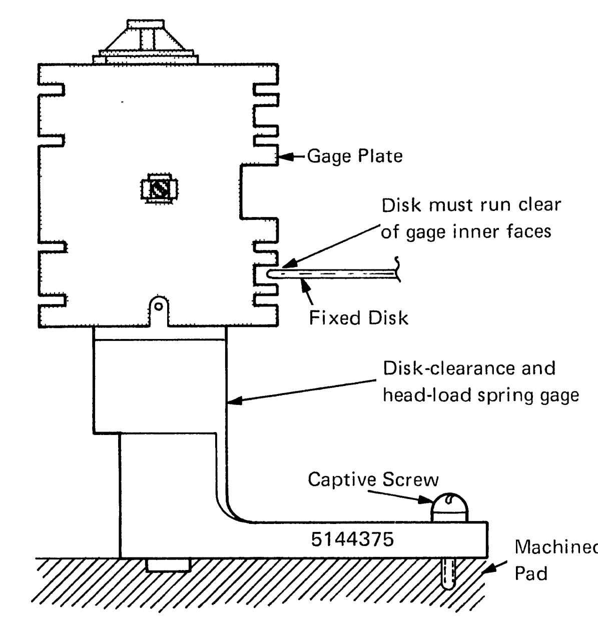
B Continue as follows:

a. Rotate the gage plate and pillar of the tool so that the gage plate overlaps the edge of the disk.
b. Manually rotate the disk (by the drive motor pulley) through one revolution and observe if the disk touches either side of the checking gap in the gage plate.
   Note: If the disk touches either side of the checking gap, the disk is warped and must be changed.
c. Remove the gage plate from the pillar of the tool.
d. Clip the runout gage, part 2536591, onto the pillar of the disk-clearance and head-load spring gage. Adjust the height of the runout gage so that its arm rides on the lower surface of the disk with the pointer at mid-scale.
e. Slowly rotate the disk by the drive motor pulley through one revolution and check the disk runout. If the pointer moves more than two divisions on the scale, runout is excessive and the disk must be changed.
f. Remove the tools. Refit the cable clamp pillar, head connectors, and fixed disk shield.
g. Re-install the disk cartridge and top cover.

Using Gage, Part 2600555



Using Gage, Part 5144375



Disk Height Check

[08540A]

3.3.2 Fixed Disk (continued)

3.3.2.2 Cleaning

Clean both surfaces of the fixed disk as follows:

1. Remove the top cover, the disk cartridge, and the fixed disk shield.
2. Wrap a lint-free tissue around a disk and head cleaning paddle and dampen with isopropyl alcohol. See item 2.3.3.2 in Chapter 2 for part numbers.
3. Insert the paddle through the head entry port, rotating the disk by turning the drive motor pulley. Keep the paddle horizontal and exert gentle pressure on the disk surfaces while rotating.
4. Withdraw the paddle while the disk is still rotating.
5. Dry the disk with a dry tissue in a similar manner to that for cleaning.

3.3.2.3 Removal

Before removing the fixed disk, give the customer an opportunity to recover data that is contained on it. Refer to "2.2 Error Recovery Procedures" in Chapter 2 if data transfer cannot be completed; if the disk is undamaged, see 2.2.2 (head 02, 03 replacement); for suspected HDI, see 2.2.1.

Remove the fixed disk as follows:

1. Ensure that the carriage and the disk cleaning brushes are fully retracted, and turn off power.
2. Open the cartridge clamp arms and take off the disk cartridge.
3. Remove the fixed disk shield by removing the screws and clips.
4. Take off the upper index transducer boom assembly (see 3.5.2.4).
5. Unscrew the eight screws around the clamp ring and remove it. Store it flat, protected by tissues, part 2200200.
6. Push down on one side of the disk, hold the other side, and lift out the disk.
7. Scrap the removed disk.

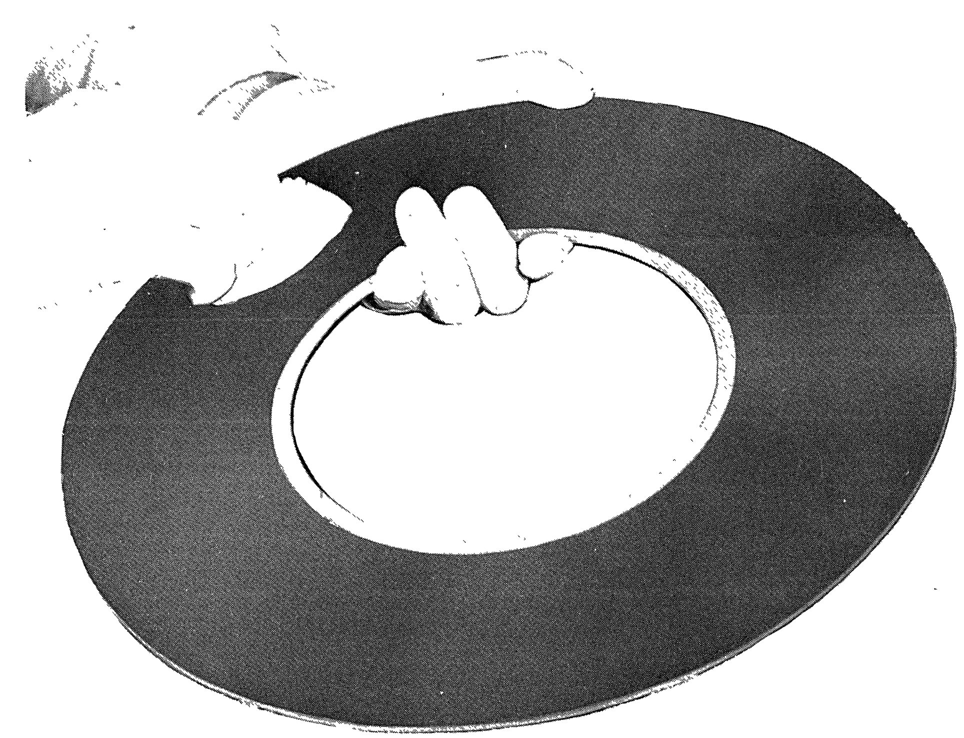
3.3.2.4 Replacement

New fixed disks are supplied in a pack, part 2597938, that also contains nylon gloves, plastic washers, and a paper protector for the disk surface.

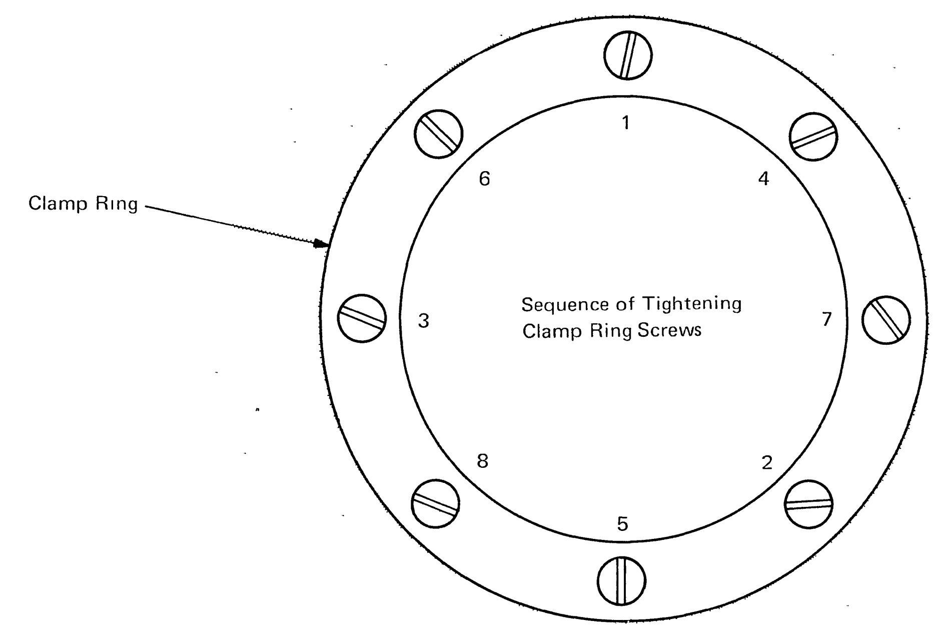
1. Thoroughly clean the cavity in the machine, using first a vacuum cleaner, then isopropyl alcohol-moistened tissues. (See item 2.3.3.2 in Chapter 2 for part numbers of tissues and alcohol.) Wipe the spindle chuck and clamp ring.
2. Open the disk-shipping container and put on the nylon gloves.
3. Moisten a lint-free tissue with isopropyl alcohol.
4. Clean the *lower* surface of the disk with the tissue, then dry the surface with dry tissues in a similar manner. (The disk has "TOP" written on the inner diameter to identify the upper surface.)
5. Still wearing the gloves, carefully place the disk on the spindle chuck without allowing the coated surface to touch any part of the machine.
6. Place the clamp ring in position and, fitting the new plastic washers provided, insert the eight screws. Do not trap the paper protector under the ring. Tighten the screws in sequence, as shown, with torque screwdriver, part 2597968.
   Note: Avoid dropping metal particles from the screw slots. Use a strip of adhesive tape for picking up particles.
7. Remove the paper protector from the disk. Remove the nylon gloves.
8. Check the disk height and runout, see 3.3.2.1. If the disk fails these checks, proceed as follows:
   a. Put on the nylon gloves.
   b. Take off the disk, rotate it through 90 degrees and reclamp as given in step 6. Remove the gloves.
   c. Re-check the disk height and runout. If these are still incorrect, fit a new disk.
9. Clean the *upper* surface of the disk with an isopropyl alcohol-moistened tissue. Dry with a dry tissue, then protect with a new tissue.
10. Re-install the upper index transducer boom assembly (see 3.5.2.3). Fit the fixed disk shield and adjust the upper index transducer (see 3.5.2.1).

Before the 5444 can be used, perform any disk initialization program (that is in use) *five* times without error or alternate track assignment. If any alternate tracks are assigned, change the disk. (Three alternate tracks on each surface must be available to the customer on a newly fitted fixed disk.)

Inspect heads 02 and 03 after initialization for accumulation of oxide, and clean as necessary (see item 2.4.4.2 in Chapter 2).



[07540]



[08541]

3.3.3 Removable Disk (5440 Disk Cartridge)

CAUTIONS
1. Always check that the carriage and brush arm are completely retracted before taking off the disk cartridge. The spring clip securing the brushes must be removed before attempting to retract brushes manually, otherwise the brush assembly may become permanently damaged.
2. Under no circumstances dismantle the disk cartridge.

3.3.3.1 Cartridge Cover Cleaning

Clean dirt and stains from the cartridge cover with lint-free tissue that has been dampened with isopropyl alcohol. See item 2.3.3.2 in Chapter 2 for part numbers of tissue and alcohol.

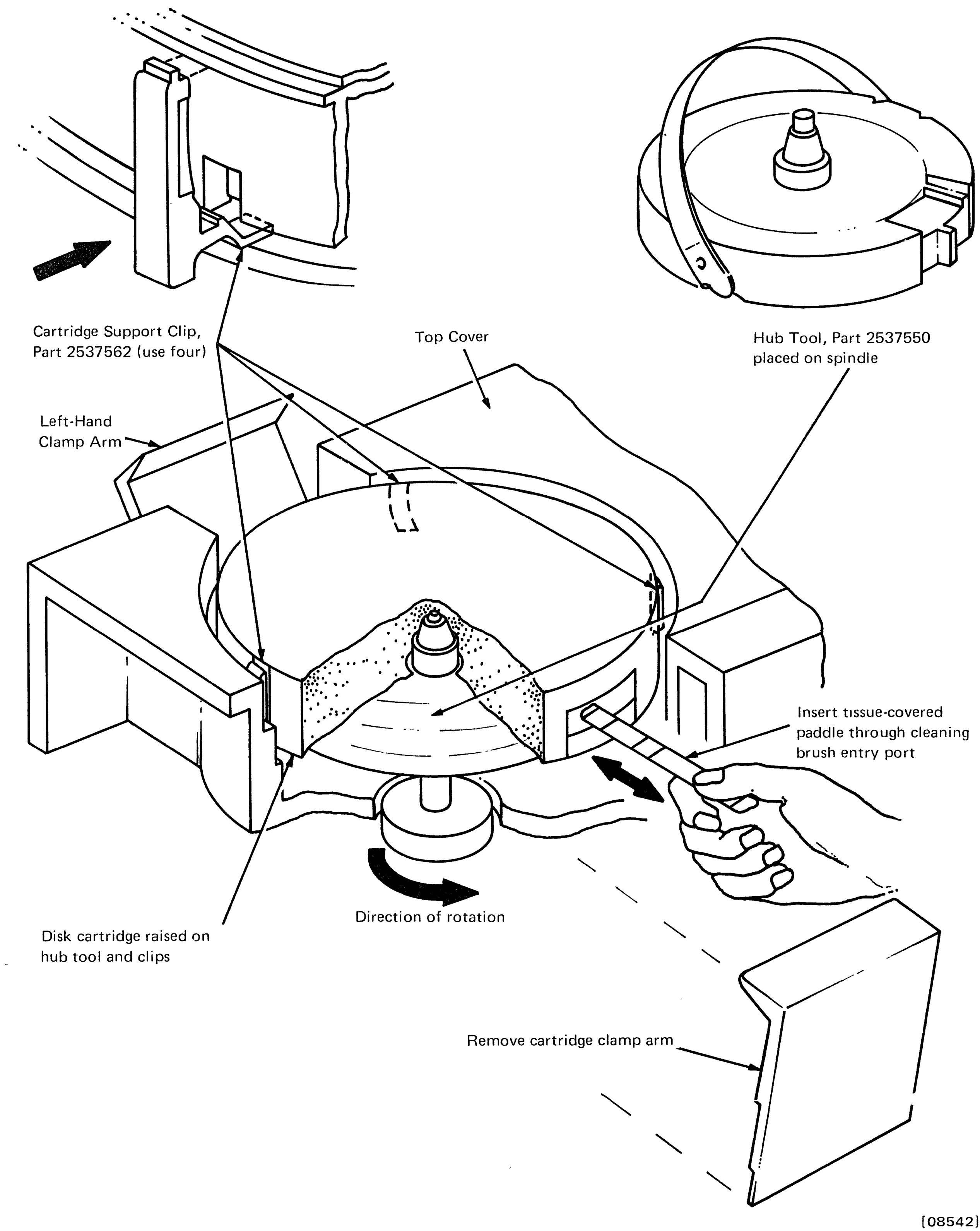
3.3.3.2 Inspection and Cleaning

No maintenance schedule is given for disk cartridges. Whenever read/write head surfaces show an accumulation of oxide or dirt, clean the disk cartridge as follows:

1. Turn off power and remove the top cover.
2. Open the cartridge clamp arms and lift off the disk cartridge.
3. Place the hub tool, part 2537550, on the spindle. *Note:* If the tool is not available, refer to the shortened procedure that follows step 17.
4. Fit four cartridge support clips, part 2537562, in the four slots around the rim of the cartridge.
5. Remove one cartridge clamp arm by removing the three attaching screws. If a runout check is to be made later (see 3.3.3.3), remove the left-hand clamp arm.
6. Place the cartridge on the spindle of the hub tool, aligning the cleaning brush entry port in the cartridge with the gap provided by removal of the clamp arm.
7. Open the logic gate to gain access to the disk spindle pulley.
8. Wrap a lint-free tissue around a disk and head cleaning paddle and dampen with isopropyl alcohol. *Note:* For part numbers of tissue, paddle, and alcohol, see item 2.3.3.2 in Chapter 2.
9. Insert the paddle and tissue through the cleaning brush entry port in the cartridge. Manually rotate the disk by the spindle pulley, and, at same time, press the tissue on the disk surface being cleaned.
10. Withdraw the paddle while the disk is still rotating.
11. Using another paddle with a dry tissue, dry the disk surface in a similar manner to steps 9 and 10. Ensure that no alcohol is left on the surface.
12. Examine the disk surface. If particles have been embedded such that they have not been removed by the cleaning, take the disk cartridge out of service.
13. Remove the disk cartridge and the hub tool.
14. Re-install the cartridge clamp arm.
15. Remove the clips from the disk cartridge.
16. Re-install the disk cartridge in the machine and close the clamp arms.
17. Refit the top cover to the machine.

If the hub tool and cartridge support clips are not available, use the following shortened method of cleaning; this method is, however, more likely to cause disk damage than by mounting the disk cartridge on a hub tool.

1. Turn off power.
2. Remove the top cover and air filter; block the air duct with a lint-free tissue.
3. Remove the cleaning brush arm. See 3.6.1.2.
4. Carry out steps 8 through 12. of the foregoing cleaning procedure, rotating the disk by turning the motor pulley. *Note:* The cleaning brush entry port is to the left of the actuator.
5. Remove the tissue from the air duct and re-install the air filter. Refit the top cover to machine.

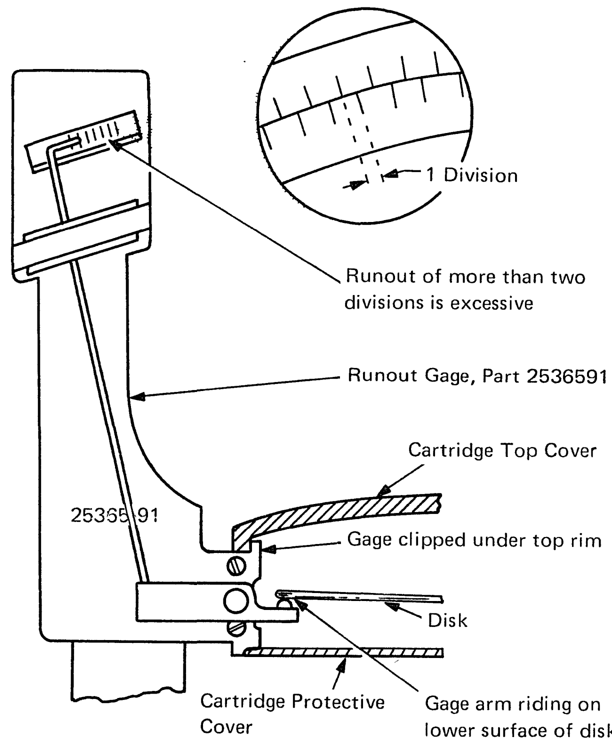


3.3.3 Removable Disk (5440 Disk Cartridge) [continued]

3.3.3.3 Disk Runout Check

The term *runout* means edge wobble, or up-and-down movement, while the disk is rotating. To check runout:

1. Turn off power and remove the top cover.
2. Open the cartridge clamp arms and remove the disk cartridge.
3. Place the hub tool, part 2537550, on the disk spindle.
4. Insert the disk runout gage, part 2536591, under the top rim of the disk cartridge so that the gage arm rides on the lower surface of the disk. Fit cartridge support clips, part 2537562, in the four slots around the rim of cartridge.
5. Remove the left-hand cartridge clamp arm by removing the three attaching screws.
6. Mount the disk cartridge on the spindle of the hub tool, aligning the cleaning brush entry port with the gap that has been provided by the removed clamp arm.
7. Slowly rotate the disk by turning the spindle pulley. If the pointer on the gage moves more than two divisions of the scale, runout is excessive and the disk cartridge must be taken out of service.
8. Remove the disk cartridge and all tools.
9. Re-install the cartridge clamp arm.
10. Remove the clips from the disk cartridge. If the cartridge is serviceable (see step 7), re-install it in the machine and close the clamp arms.
11. Refit the top cover.



[08543]

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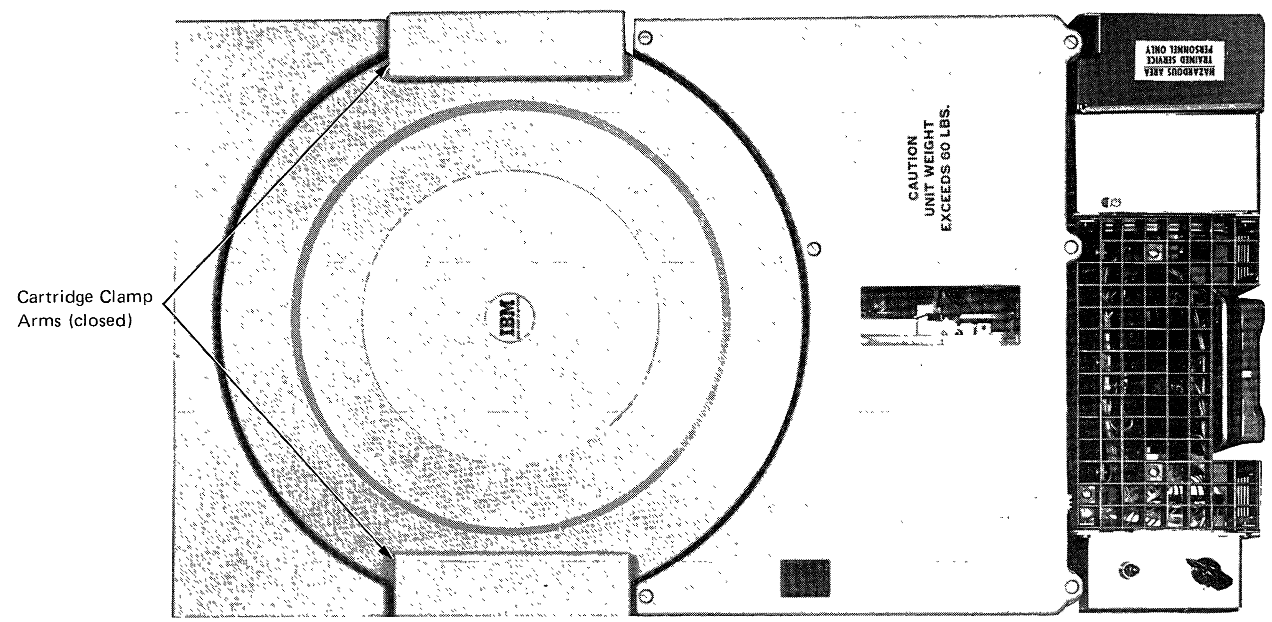
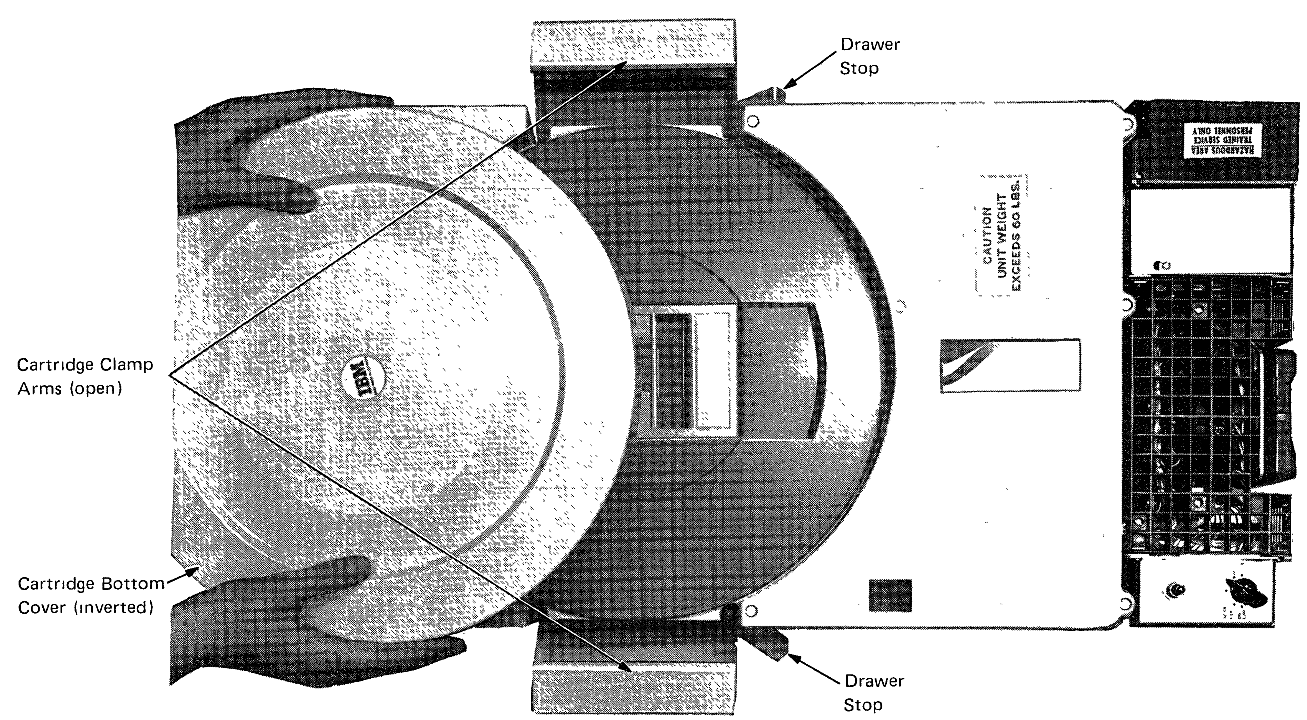
3.4 Cartridge Clamp Arms

• The clamp arms actuate two cartridge interlocks (part of the machine interlock circuits) to inhibit machine start-up if the cartridge or bottom cover is positioned incorrectly.



[08544]

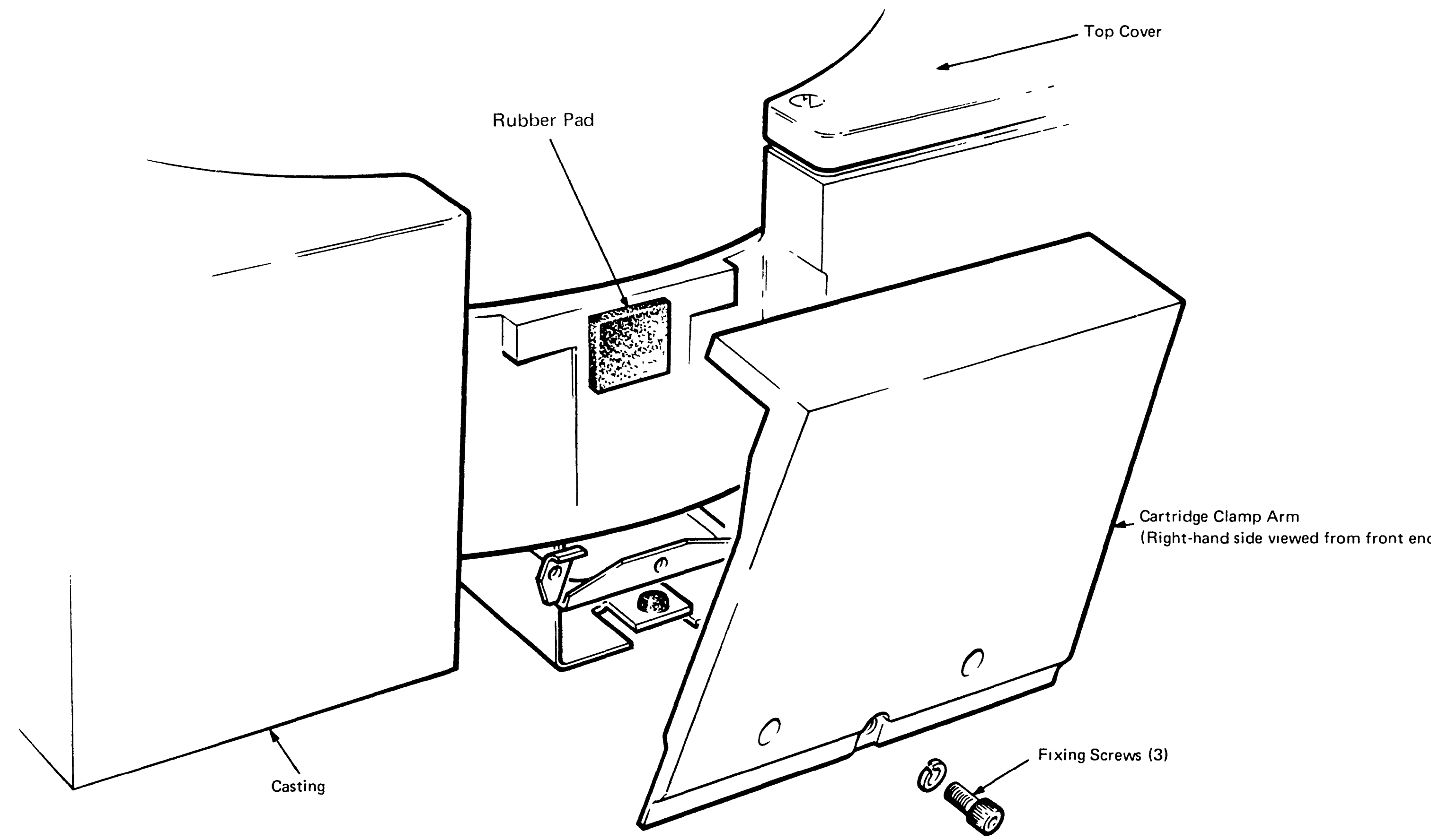
• The clamp arms, when swung away to permit cartridge removal, operate a drawer stop at each side of the machine. These stops prevent the machine being closed into the drawer while the clamp arms are open.



[08545]

3.4.1 Clamp Arm Removal and Replacement

1. Detach the cartridge clamp arm by removing the three screws.
2. Install the arm and secure with the screws.
3. Adjust the clamp mechanism (see 3.4.2.1).



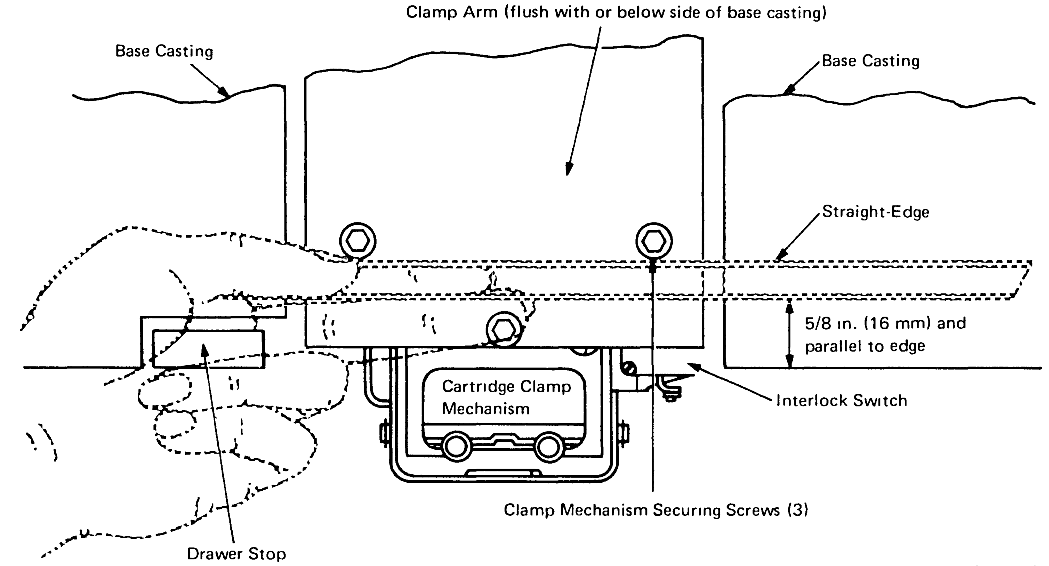
(08546)

3.4.2 Clamp Mechanism

3.4.2.1 Adjustment

The clamp mechanism should be adjusted only if its position on the base casting has been disturbed or if a clamp arm has been changed.

1. Install the disk cartridge and close the cartridge clamp arms.
2. Slacken the three screws that secure the clamp mechanism to the underside of the base casting.
   Note: On System/3 drawer/enclosure installations, obtain access to the screws by inserting a screwdriver, part 450495, through the file tray cutouts.
3. Hold a straight-edge parallel to the bottom edge of the base casting and 5/8 in. (16 mm) above the edge as shown.
4. Position the clamp mechanism so that the cartridge clamp arm touches or is clear of the straight-edge. If this condition cannot be obtained, position the mechanism inwards to the full extent of the mounting slots.
5. Tighten the three screws to secure the clamp mechanism without disturbing the position of the clamp arm.



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3.4.2 Clamp Mechanism (continued)

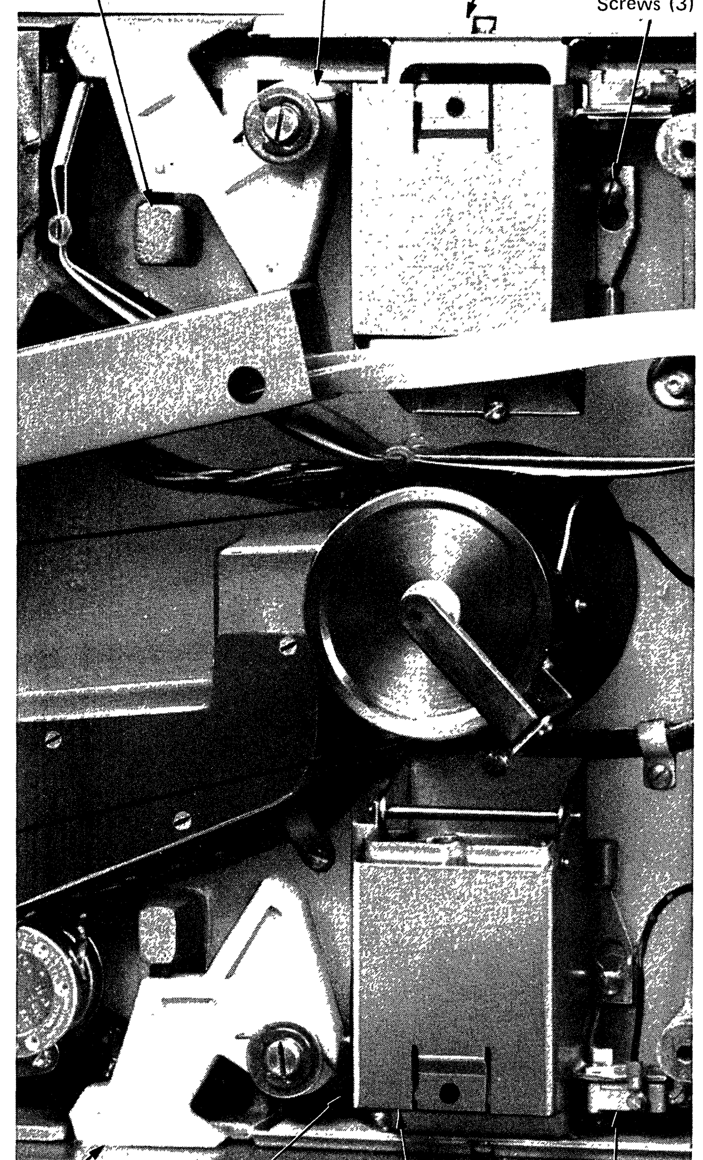
3.4.2.2 Removal and Replacement

1. Remove the clamp arm (see 3.4.1).
2. For System/3 drawer/enclosure installations with drawer slides, gain access to the mechanism as follows:
   a. Take the weight of the 5444 from the slide locator pins at the appropriate side of the drawer.
   b. Push back the drawer slide until it is just past the clamp mechanism, but *no further*. The 5444 will continue to be supported by the other side.
3. Completely remove the securing screws from the cartridge interlock switch and release the switch from the mechanism, but do not disconnect wires. Retain loose parts.
4. Unhook the fork end of the adjustment link that is connected to the drawer stop spring.
5. Slacken the three screws that hold the clamp mechanism to the underside of the base casting. Do not remove the screws.
   Note: On System/3 drawer/enclosure installations, obtain access to the screws by inserting a screwdriver, part 450495, through the file tray cutouts.
6. Slide the mechanism outwards until its keyhole slots are clear of the screws, and remove it.
7. Install the mechanism in the reverse order to removal. Also, on System/3 drawer/enclosure installations, return the drawer slide to its original position.
8. Adjust the mechanism (see 3.4.2.1).
9. Adjust the cartridge interlock switch (see 3.4.4).

3.4.3 Drawer Stop Adjustment

The spring tension of the drawer stop should be equal in both the fully retracted and the fully extended positions. With the tension correct and the clamp arm closed, the stop should not protrude beyond the base casting.

1. Install the disk cartridge and close the cartridge clamp arms.
2. Unhook the fork end of the adjustment link that is connected to the drawer stop spring.
3. Adjust the position of the fork end so that the bumper on the stop seats against the base casting.
4. Reconnect the fork end to the drawer stop spring and check that spring tension is equal in both directions of drawer stop movement and that the stop is flush with the base casting.



[08548]

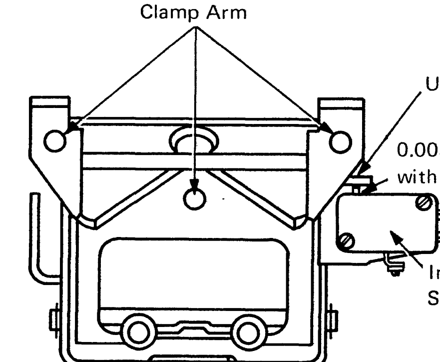
3.4.4 Adjustment of Cartridge Interlock Switches

Each cartridge clamp arm assembly contains an interlock switch.
Note: Later models may have an interlock switch on one cartridge clamp only.
To adjust the switches:

1. Open the cartridge clamp arms.
2. Remove the disk cartridge.
3. Detach the arms (see 3.4.1).

DANGER
The toggle spring assembly under each arm is under tension. Keep fingers clear when lifting, in the following step.

4. In turn, lift the toggle spring assembly for each arm and feel the free play of approximately 1/16 in. (1,6 mm).
5. Place a 0.005-in. feeler gage (0,13 mm) between the upper plate and switch plunger.
6. Lift up the assembly, ensuring that the slot above the upper plate bottoms on the nylon bushing.
7. Position the switch against the upper plate with the 0.005-in. feeler gage inserted and the switch fully depressed.



[08549]

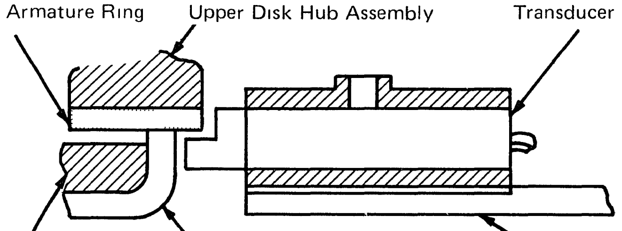
8. Remove the feeler gage and tighten the switch mounting screws.
9. Make sure that the switch transfers in both directions.
10. Refit the clamp arms, re-install the disk cartridge, and check that the 5444 starts.

3.5 Index Transducers

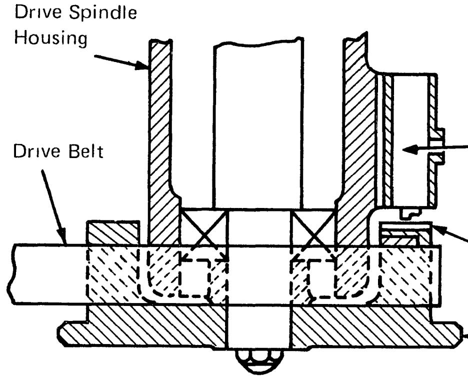
• To indicate the start of each recording track, an index transducer for each disk provides one index pulse per revolution.

• The index transducers sense fixed locations on the disk assemblies. Because the upper disk is removable and is not keyed to the drive spindle, the index locations for the two disks are not related.

• The upper index transducer senses a slot in the armature ring on the upper disk hub assembly.



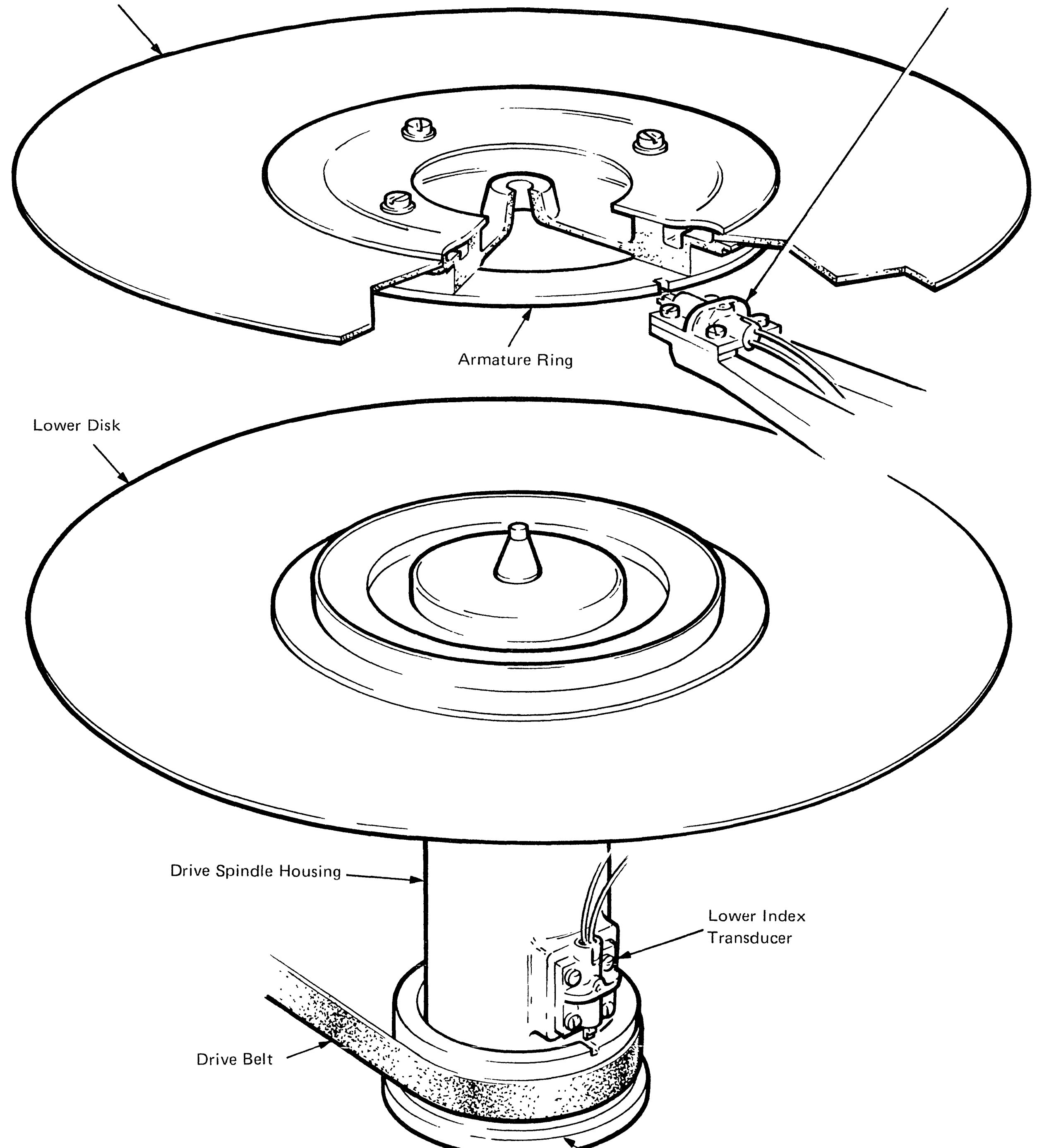
• The lower index transducer is fixed to the drive spindle housing, and senses a slot in the spindle pulley.



[08550]

• The transducer output pulses are fed into two index amplifiers (see "Circuit Descriptions" in "3.10 Auxiliary Electronics"), one of which is selected by the 'disk select' line to correspond with the disk in use. The index marker pulse thus obtained is passed to the using system by the 'index pulse' line.

• The output from both index transducers is used in the speed sensor circuits to monitor the disk speed.



[08551]

3.5.1 Electrical Checks

Output waveforms of the upper and lower index transducers are similar.

3.5.1.1 Upper Transducer

Measure the waveforms and index pulses as follows.

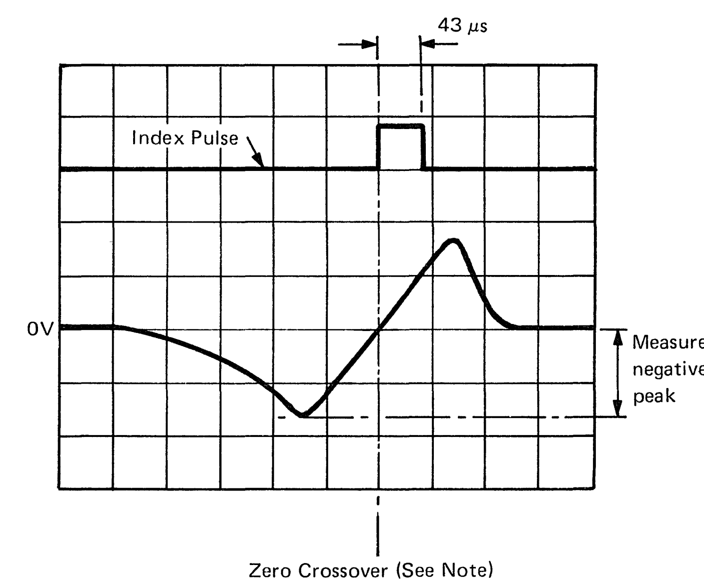
1. Set up a Tektronix 453 oscilloscope as follows:

Connect X10 probe	to	CH1
A SWEEP MODE	to	NORM TRIG
LEVEL	to	0 (A TRIGGERING)
Slope	to	– (A TRIGGERING)
COUPLING	to	DC (A TRIGGERING)
SOURCE	to	INT (A TRIGGERING)
MODE	to	CH1
TRIGGER	to	CH1 only
CH1 VOLTS/DIV	to	CAL 0.2V
INPUT	to	DC (CH1)
A TIME/DIV	to	CAL 0.5 ms
CH2 VOLTS/DIV	to	CAL 0.2

2. If available, select a disk cartridge with a 0.080 in. wide sense slot in the cartridge armature plate (see step 4), otherwise use one with a 0.040 in. slot.
3. Start the 5444 and display the upper index pulse on pin Y-W1 A6J02.
4. Check that the waveform has a negative peak of:
   a. –1.5V to –5.0V if using a disk cartridge with 0.080 in. slot.
   b. –1.0V to –4.0V is using a disk cartridge with 0.040 in. slot.
5. If the output is outside the voltage limits stated in step 4, stop the 5444 and remove the cartridge.
   Slacken the four screws holding the upper index transducer assembly. To increase output, add shims (in pairs) under the assembly; to decrease the output, remove shims (in pairs) from under the assembly. A 0.003 in. (0,08 mm) shim is approximately equivalent to a voltage difference of 2V.
   Note: Shims may have identification notches:
   Two notches indicate a 0.002 in. shim.
   Three notches indicate a 0.003 in. shim.
6. Before rechecking the output, carry out the mechanical checks (see 3.5.2.1).
7. Repeat steps 5 and 6 to obtain the limits stated in step 4. If the negative peak value cannot be obtained within the limits, change the transducer (see 3.5.2.3).
8. Change the oscilloscope setting to:
   MODE to CHOP
   A TIME/DIV to CAL 50 μs.
9. Leave CH1 probe on Y-W1 A6J02. Display the upper index pulse on CH2 pin Y-W1 A6D06 using a X 10 probe.
10. If the positive-going edge of the index pulse does not coincide with the waveform crossover point, change the index amplifier card Y-W1 A6. See ALD page FS340.

3.5.1.2 Lower Transducer

1. Set up the oscilloscope as in item 3.5.1.1 step 1.
2. Start the 5444 and display lower index pulse on pin Y-W1 A6D13.
3. Check that the waveform has a negative peak of –1.5V to –5.0V.
4. If the output is outside the voltage limits stated in step 3, stop the 5444, open the Y logic gate to gain access, slacken the locknut and setscrew, and move the transducer assembly towards the spindle to increase output or away to decrease output.
5. Check that the gap between transducer and the face of the spindle pulley is not less than 0.001 in. (0,025 mm). Check the setting on either side of the slot within 0.5 in. (12,7 mm) of the slot.
6. If the negative peak value is still not within the voltage limits stated in step 3, change the transducer (see 3.5.3.3).
7. Tighten the setscrew and locknut (do not overtighten) and repeat steps 2 and 3.
8. Change the oscilloscope setting to:
   MODE to CHOP
   A TIME/DIV to CAL
9. Leave CH1 probe on Y-W1 A6D13. Display the lower index pulse on CH2 pin Y-W1 J10 using X10 probe.
10. If the positive-going edge of the index pulse does not coincide with the waveform crossover point, change the index amplifier card Y-W1 A6 (see ALD page FS340).



Index Transducer	Output Waveform		Index Pulse (See Note)	
	Measure at	Negative Peak Value	Measure at	Width
Upper	Pin Y-W1 A6J02	More than 1.3V	Pin Y-W1 A6D06	Approx. 43 μs
Lower	Pin Y-W1 A6D13	More than 1.66V	Pin Y-W1 A6J10	Approx. 43 μs

Note: Positive-going edge of index pulse must coincide with zero crossover point of waveform

3.5.2 Upper Index Transducer

The following adjustments can be made to the upper index transducer assembly:

1. Vertical and horizontal (mechanical) adjustments.
2. Circumferential adjustments, using an oscilloscope.

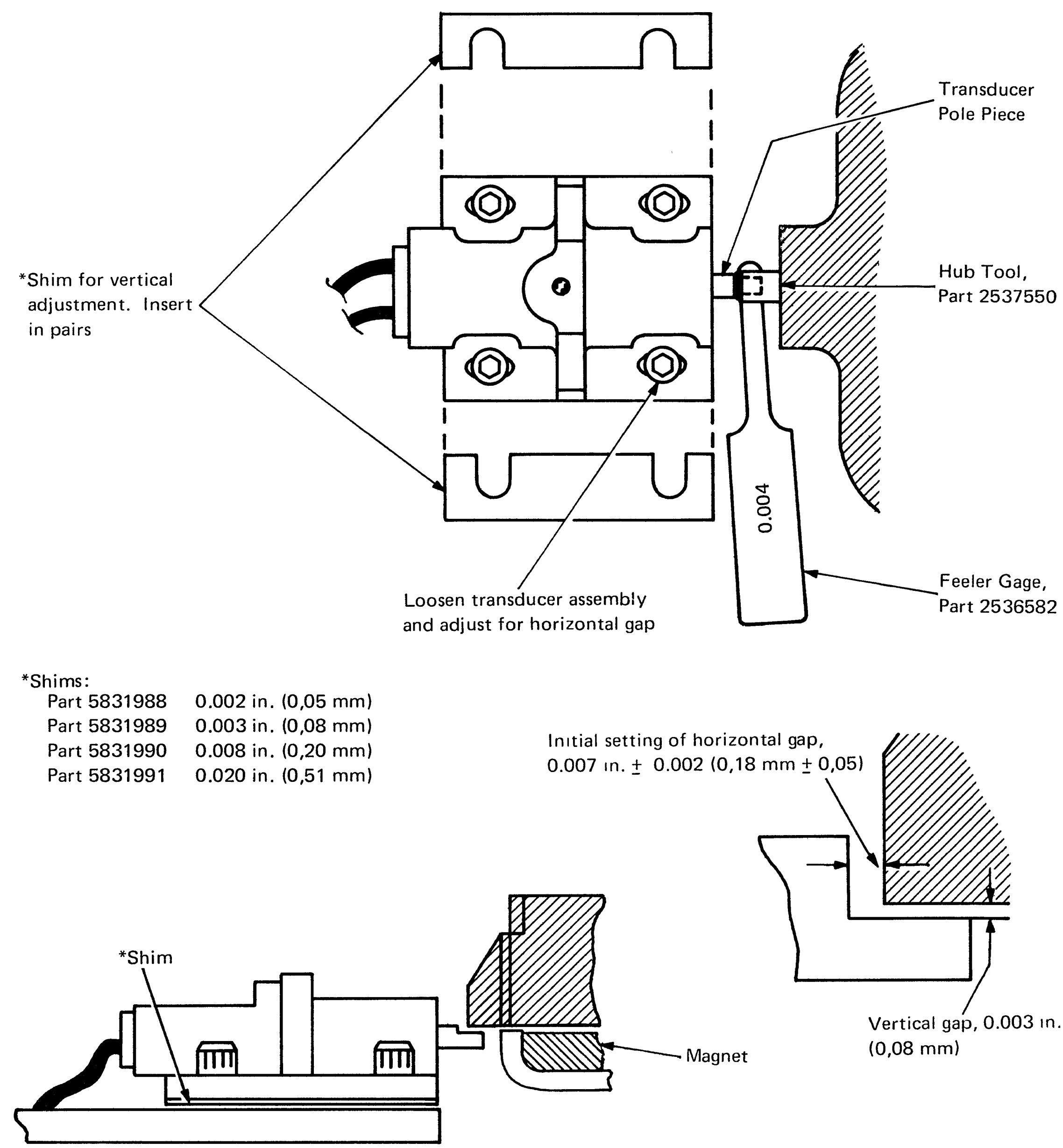
3.5.2.1 Vertical and Horizontal Checks and Adjustments

1. Turn off power.
2. Open the cartridge clamp arms and remove the disk cartridge.

CAUTIONS

a. In the following steps, do not drop metal particles on to the fixed disk surface.
b. Use only the nonmagnetic feeler gages provided in the customer installation tool kit for these adjustments. For part numbers, see 2.3.3.2.

3. Place the hub tool, part 2537550, on the spindle, with the projecting tip clear of the transducer pole piece. Lower the handle and firmly locate the tool.
4. Rotate the hub tool until its tip overlaps the transducer pole piece.
   Note: Make sure that the tip of the tool does not hit the pole piece.
5. Using the 0.003 in. feeler gage, part 2536581, check that the vertical gap between the tip of the hub tool and the pole piece is not less than 0.003 in. (0,08 mm). Make this check at least twice, with the hub tool in different positions.
6. Check that the horizontal gap between the pole piece and the tip of the hub tool is 0.007 in. ± 0.002 (0,18 mm ± 0,05). Adjust by slackening the transducer mounting screws, moving the transducer, and tightening the screws to 4 lb/in. (4,6 kg/cm) torque using torque wrench (part 2597969) and adapter (part 2597971).
7. Remove the hub tool.
8. Carry out the circumferential check (see 3.5.2.2).



[08553]

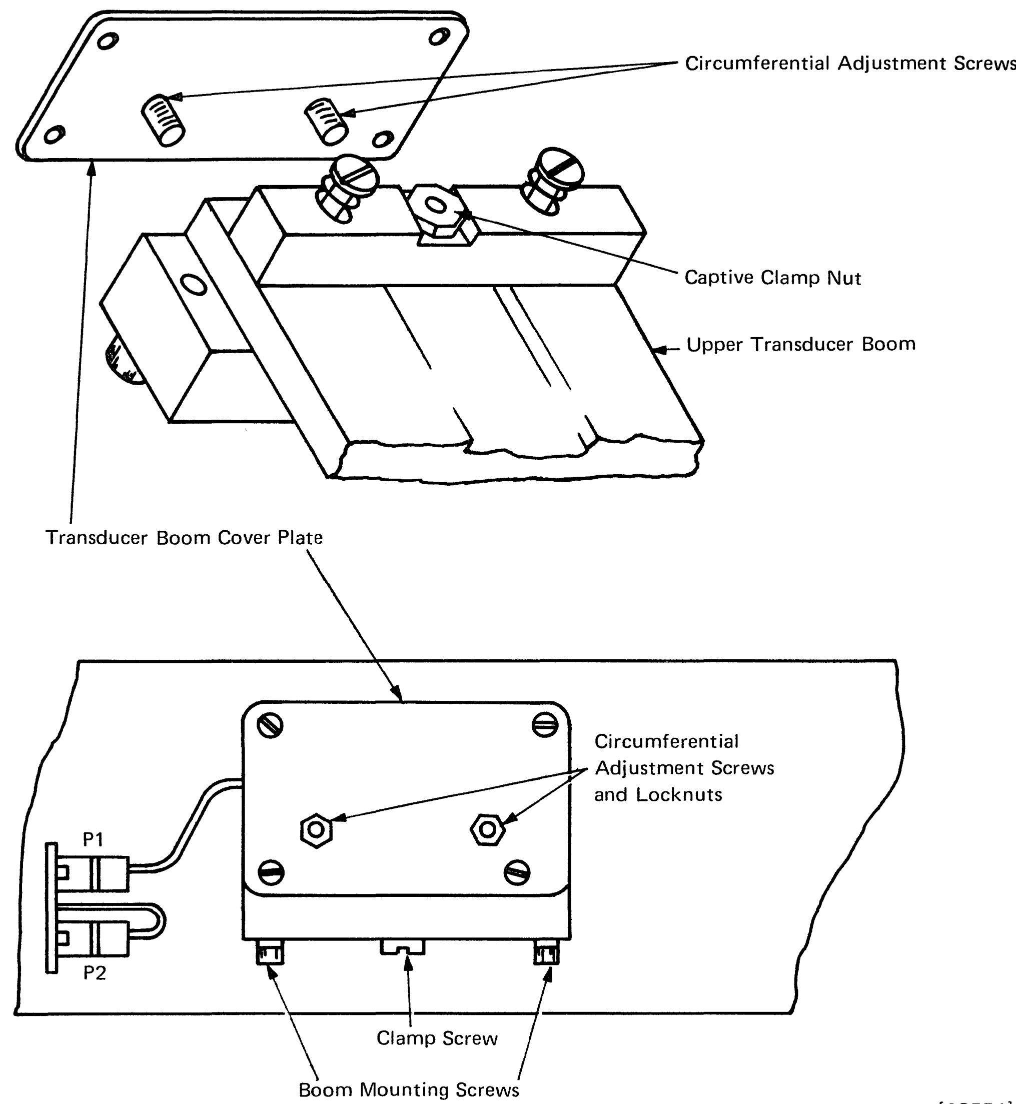
3.5.2 Upper Index Transducer (continued)

3.5.2.2 Circumferential Check and Adjustment

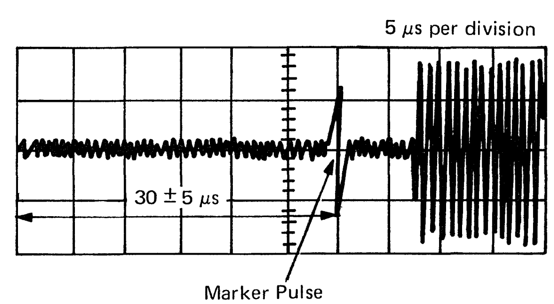
1. Insert the CE cartridge, part 2537301 (see item 2.3.3.3 in Chapter 2).
2. Start the 5444 and load to track 000.
3. Set the CE mode-select switch to 1 TRK and the forward/reverse switch to FORWARD. Go to track 005.
4. Set the CE mode-select switch to HD0 or HD1.
5. Set the Tektronix 453 oscilloscope (using X1 probe) as follows:

A SWEEP MODE	to	NORM TRIG	
LEVEL	to	0 (A TRIGGERING)	
SLOPE	to	+ (A TRIGGERING)	
COUPLING	to	AC (A TRIGGERING)	
SOURCE	to	EXT (A TRIGGERING)	
MODE	to	ADD	
TRIGGER	to	NORM	
CH1 VOLTS/DIV	to	CAL 50mV	
CH2 VOLTS/DIV	to	CAL 50mV (INVERT)	
CH1 and CH2 INPUT	to	AC	
A TIME/DIV	to	50μs	
CH1 probe	to	pin Y-W1 K6J12	ALD page FS260
CH2 probe	to	pin Y-W1 K6J10	
EXT TRIG INPUT probe	to	pin Y-W1 A6D06 (ALD page FS340).	

6. Loosen the locknuts of the circumferential adjustment screws.
7. The oscilloscope display should resemble that shown; the marker pulse, which precedes a train of pulses by 10 μs, should occur 30 μs ± 5 from the start of the trace. To adjust the marker pulse, back off one circumferential adjustment screw and tighten the other screw so that the boom is pivoted about the clamp screw. (If the right-hand screw is backed off and the left-hand screw is tightened, the marker pulse is moved towards the start of the trace, that is, the delay time is shortened.)
8. Ensure that the marker pulse occurs at exactly 30 μs, with the circumferential adjustment screws backed off.
   Note: This timing may change as the adjusting screws are backed off.



[08554]



[08555]

9. Open Y logic gate, to locate the screwdriver on to the head of the clamp screws.
10. Loosen the clamp screw one-half turn and retighten.
    Note: If the clamp screw is removed or replaced, lightly lubricate the screw shank with IBM no. 6 oil.
11. Check that the marker pulse still occurs within 25 to 35 μs. If it does not, repeat the adjustment from step 8.
12. Lock the circumferential adjustment screws in the backed-off position.
    Note: The horizontal gap between the pole piece and the hub tool tip may now measure 0.007 in. ± 0.005 (0,18 mm ± 0,13) due to pivoting of the transducer boom (see 3.5.2.1, step 6).
13. Close Y gate.

3.5.2.3 Transducer Removal and Replacement

An upper index transducer replacement kit is supplied as part 2598087, and consists of a transducer and shims. Remove the transducer as follows:

1. Take out the disk cartridge.
2. Remove the fixed disk shield. Place a lint-free tissue, part 2162567, between the underside of the boom and surface of the fixed disk.
3. Remove the four screws that secure the transducer boom cover plate, and take off the plate. Unplug connector P1.
4. Remove the four socket screws that hold the transducer assembly, and lift off the assembly. Take care not to lose the shims beneath. Remove tissue.

Install the transducer and shims in the reverse order to removal. Check the adjustments (see 3.5.2.1 and 3.5.2.2).

3.5.2.4 Boom Assembly Removal and Replacement

1. Carry out steps 1, 2, and 3 of item 3.5.2.3.
2. Remove both boom mounting screws, taking care not to allow the boom to fall onto the disk. Withdraw the boom assembly.
3. Install the boom assembly in reverse order to removal.
4. Check the adjustments (see 3.5.2.1 and 3.5.2.2).

3.5.3 Lower Index Transducer

CAUTION
In the following procedures, do *not* overtighten the transducer setscrew; tighten until it just grips the transducer, then turn one-quarter turn to secure, and lock with locknut.

3.5.3.1 Not Used

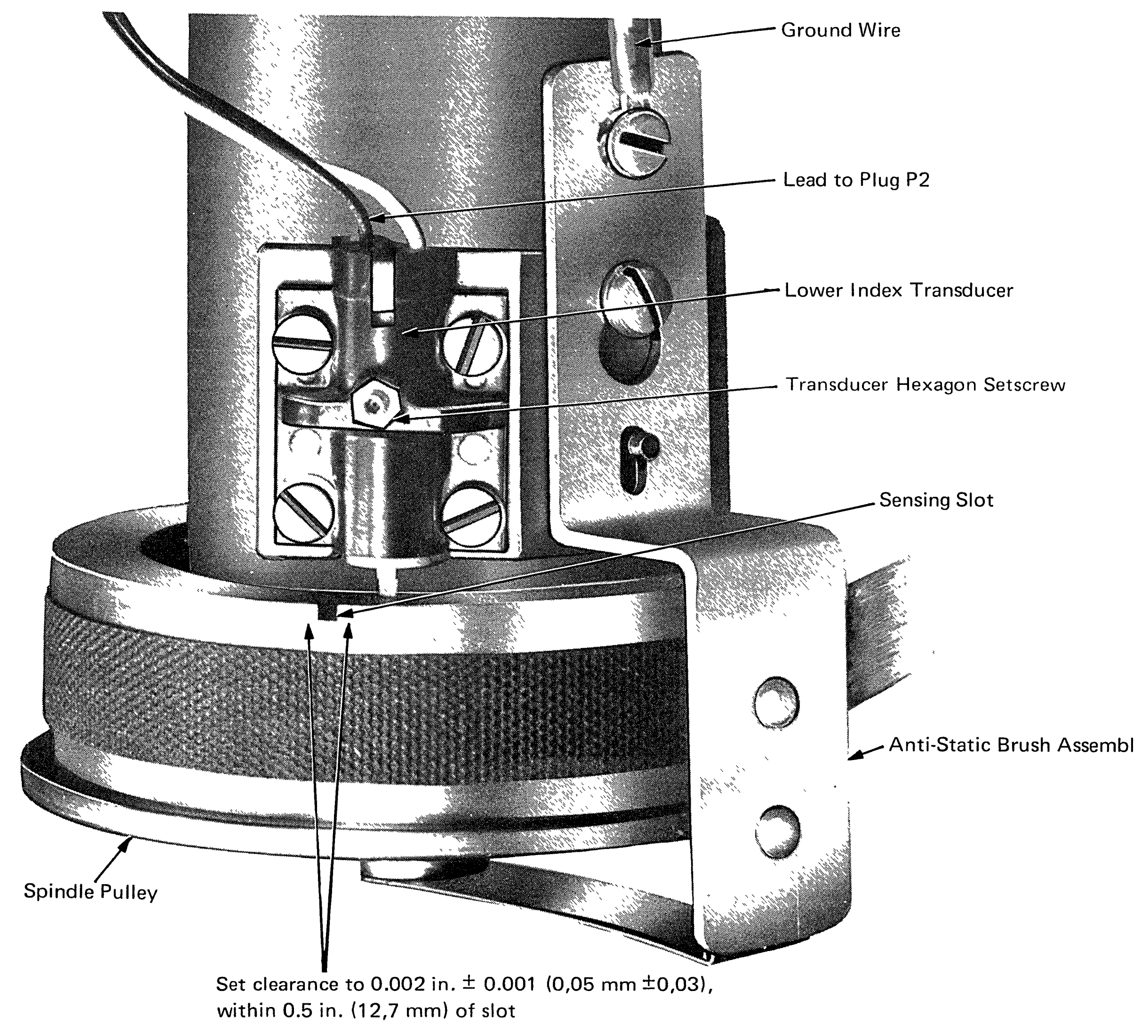
3.5.3.2 Removal

Note: Before starting removal, give the customer an opportunity to save any data that is stored on the fixed disk. After the transducer is replaced, disk initialization is carried out, which may destroy his data. If the lower index transducer fault condition prevents data retrieval, another attempt can be made after transducer replacement (3.5.3.3, step 5).
Remove the transducer as follows:

1. Open Y logic gate.
2. Without disturbing the transducer housing, release the hexagon setscrew that holds the transducer.
3. Withdraw the transducer from its housing. Unplug connector P2 and withdraw the leads. Cut the leads back to the cable loom at both ends.

3.5.3.3 Replacement

1. Insert the transducer into the housing. Route and tape the leads alongside the cable loom. Plug in connector P2.
2. Adjust the transducer (see 3.5.1.2).
3. Using the long hexagon screw and locknut, secure the transducer without overtightening. Lock the screw.
4. Close Y logic gate.
5. Before re-initializing the fixed disk, give the customer an opportunity to save any data that is on the disk.
6. Re-initialize the fixed disk by running the disk initialization program *five* times without errors or alternate track assignment.



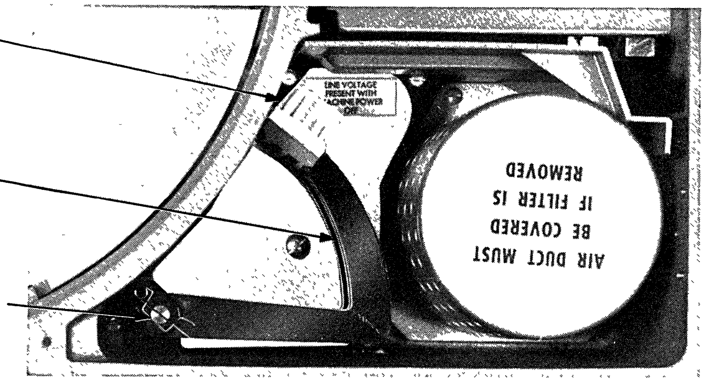
[08556A]

3.6 Disk Cleaning Brushes

- Two pairs of cleaning brushes, driven by a motor, sweep dust particles from the disk recording surfaces before the heads are loaded onto the disks.
- The brush sweep cycle forms part of the machine start-up sequence and takes approximately one minute to complete. The brush motor is switched on or off by the brush cycle-complete microswitch which, together with the brush mid-cycle microswitch, is actuated by the cam.
- The 'ready' line is not activated until the brushes return to the parked position, off the disks.
- Different link and cam mechanisms are used on 50-Hz and 60-Hz machines.

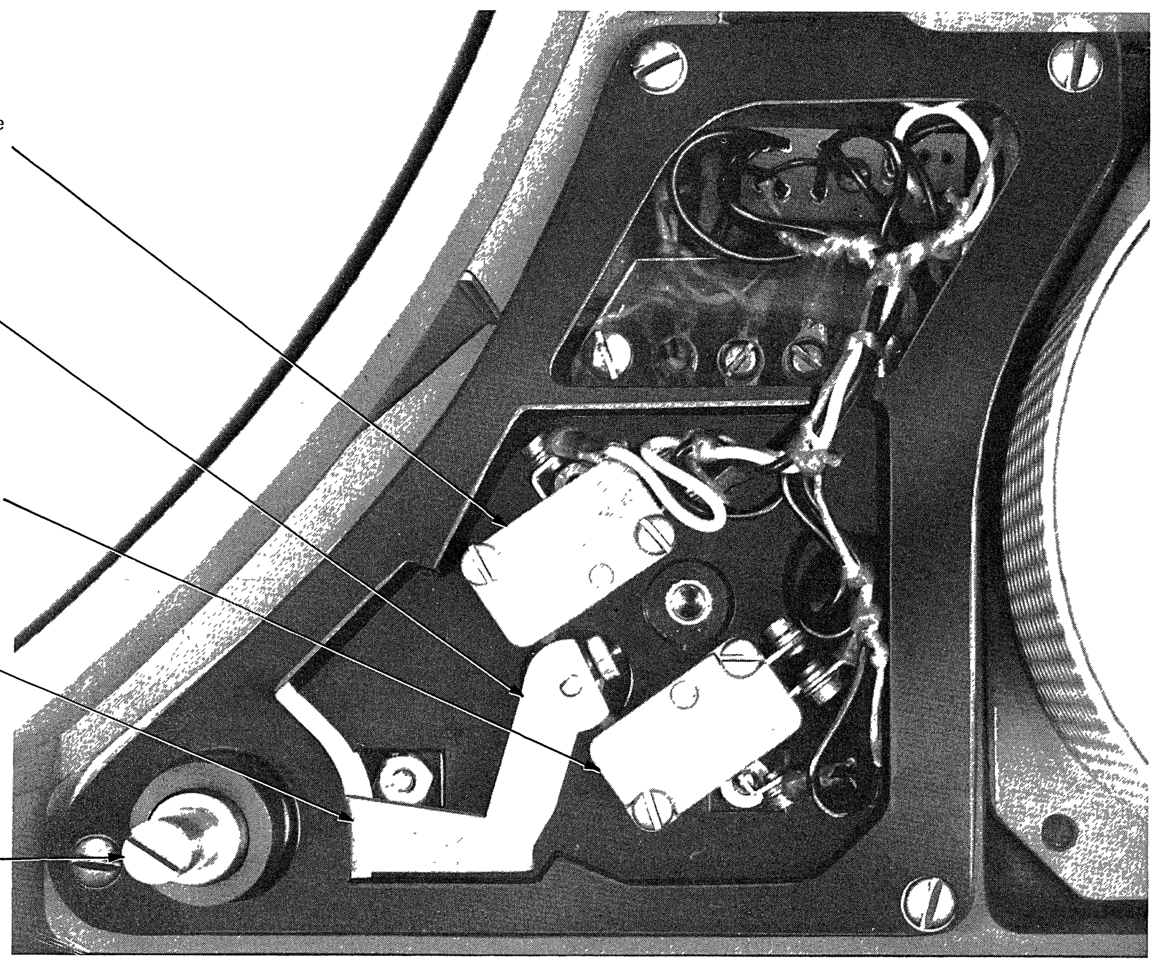
Brush Motor–Description

- The brush motor is a synchronous motor. Different brush motors are used for 50-Hz and 60-Hz power supplies (see item 3.12.2 in "3.12 Power Supplies").



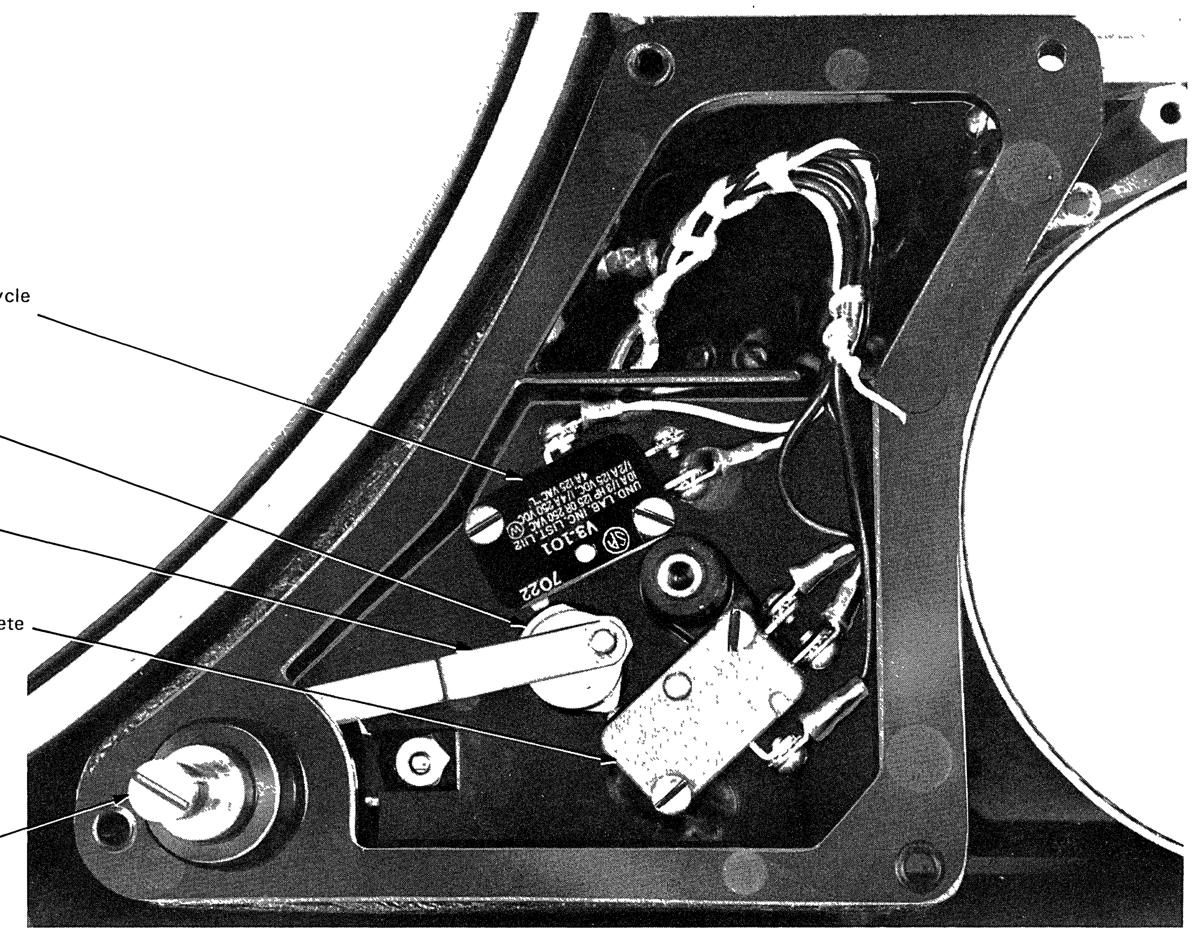
Brushes Retracted

[08558]



50-Hz Machines

[08557]



60-Hz Machines

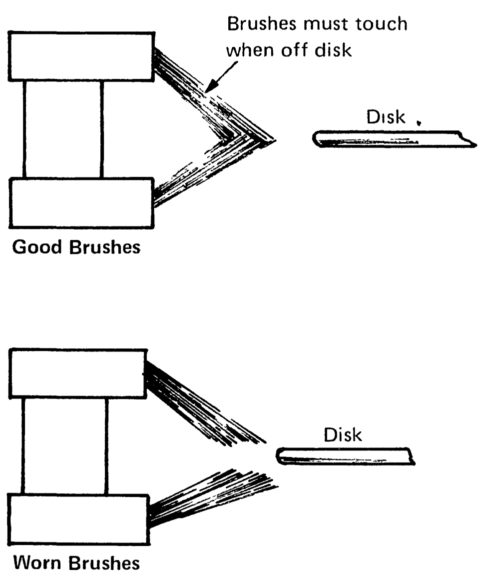
[08559]

3.6.1 Brush Arm

Notes:
1. To check that the brush arm is in the fully retracted position, view the assembly through the small window in the top cover.
2. The spring clip securing the brush arm must be removed before attempting to manually retract the brushes; otherwise the brush assembly can be permanently damaged.

3.6.1.1 Check

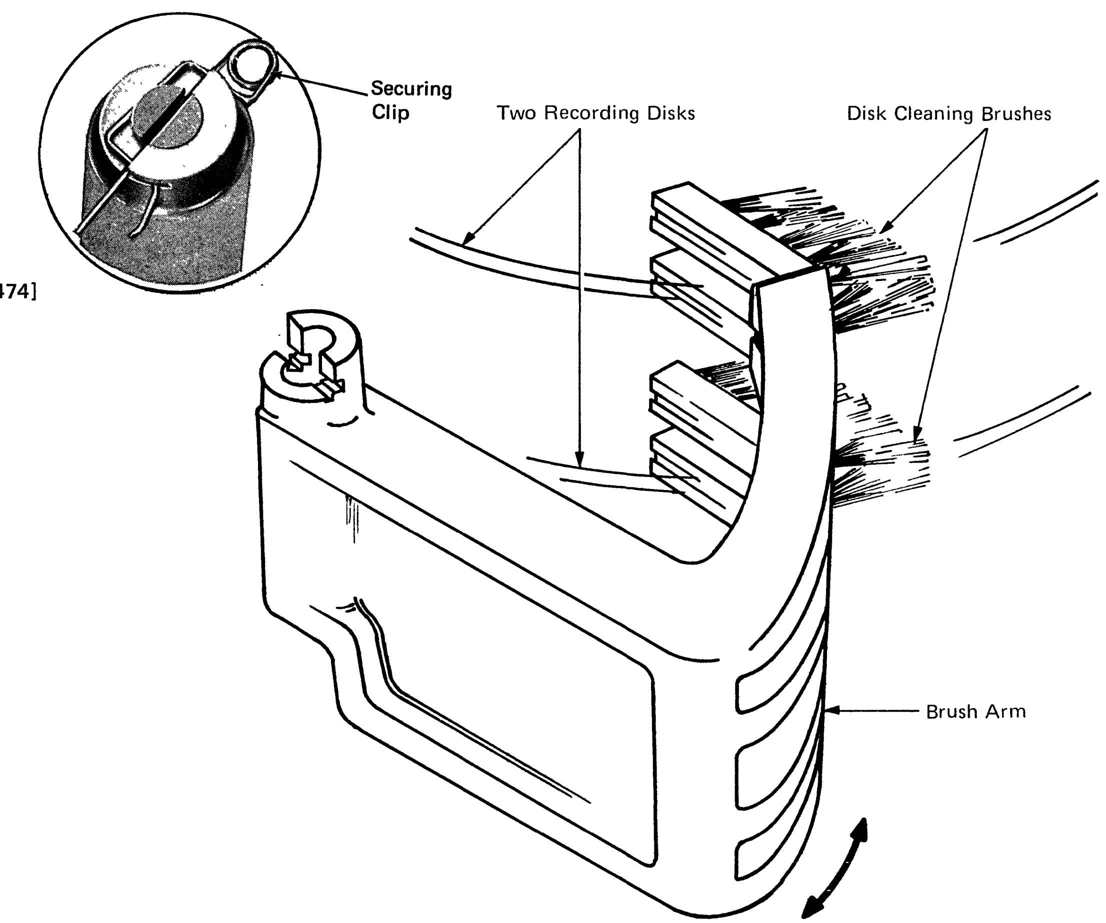
Check that brushes are not worn, that is, they are deflected as they pass over the disk. If worn, change them (see 3.6.1.2).



[08560]

3.6.1.2 Removal and Replacement

Change the brushes during preventive maintenance if they are worn, as follows:
1. Turn off power and remove the top cover.
2. Take off the clip from the brush arm support and lift off the brush arm. Take care not to damage the clip.
3. Unclip the brushes from the end of the brush arm and slide on new brushes.
4. Mount the brush arm and secure with the clip.
5. Refit the top cover.



[07474]

[08561]

3.6.2 Brush Mid-Cycle Switch and Brush Cycle-Complete Switch

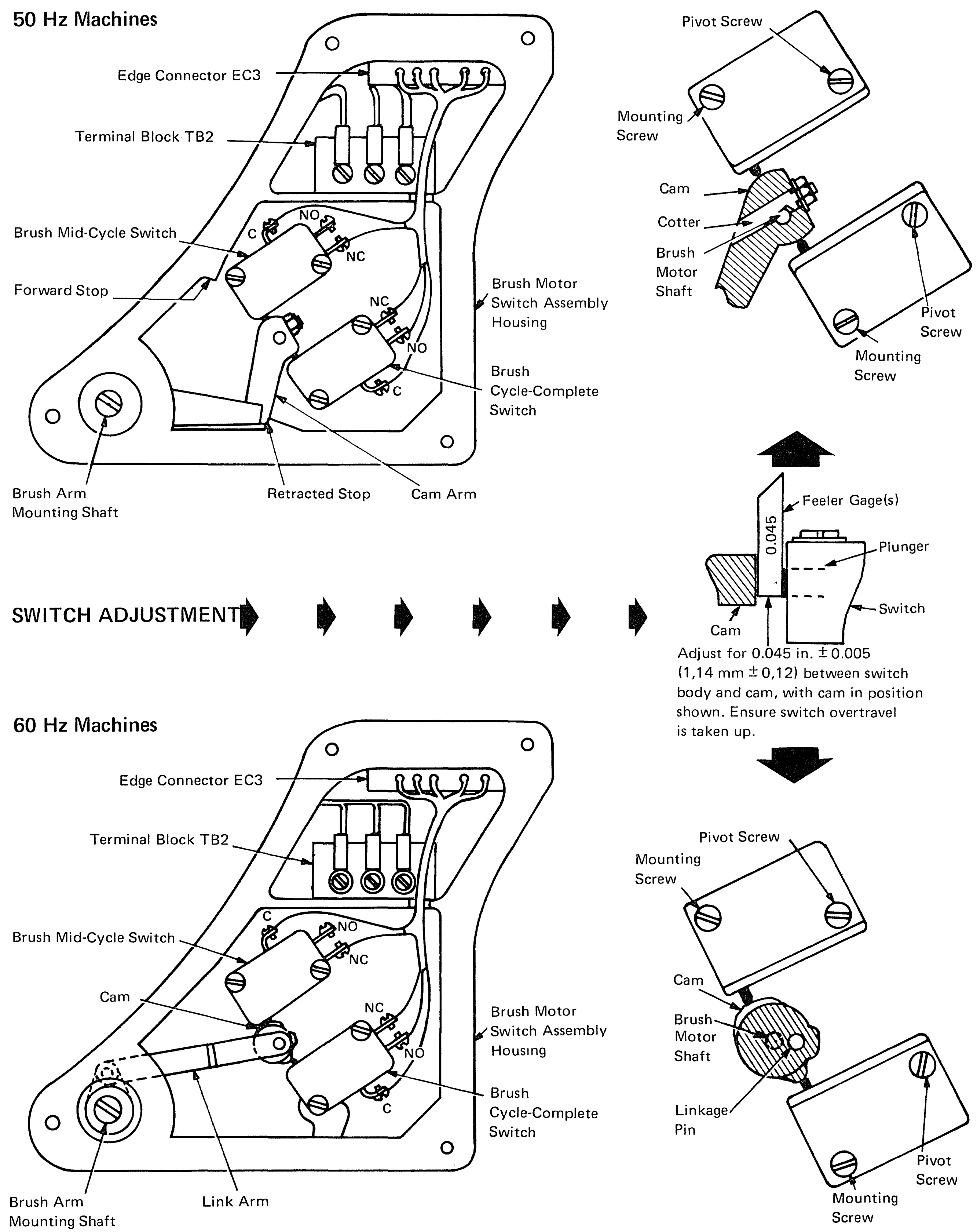
CAUTION
The brush mechanism must not be held back to shorten the brush cycle.

3.6.2.1 Adjustment

1. Turn off power and remove the top cover.
2. Remove the air filter (see 3.1.1.2).
3. Unclip and take off the brush arm (see 3.6.1.2). Do not damage the clip. Remove the brush motor cover plate.
4. With the cam in the brush-retracted position, slacken off the pivot and mounting screws, and adjust the switches (the nuts below the screws are captive).
5. Check the order in which the switches operate.
   Note: At the *start* of the brush cycle, the cycle-complete switch must transfer before the mid-cycle switch. At the *end* of the brush cycle, the mid-cycle switch must transfer before the cycle-complete switch.
   Vary the setting gaps within the tolerances allowed to obtain these conditions.
6. Refit the following items:
   a. Brush motor cover plate.
   b. Brush arm.
   c. Air filter (see 3.1.1.3).
   d. Top cover.

3.6.2.2 Removal and Replacement

1. Turn off power and remove the following items:
   a. Top cover.
   b. Brush motor cover plate.
2. Note the wiring to the switch and then disconnect.
3. Unscrew the switch mounting and pivot screws (the nuts below the screws are captive). Remove the switch.
4. Install the new switch in reverse sequence to removal. Check the adjustment (see 3.6.2.1).



[08562A]

3.6.3 Brush Motor-Servicing

3.6.3.1 Removal

1. Turn off power and remove the top cover.
2. Remove the air filter (see 3.1.1.2). Block the air duct and brush entry with lint-free tissue (for part number, see 2.3.3.2 in Chapter 2).
3. Unclip and take off the brush arm (see 3.6.1.2). Do not damage the clip.
4. Remove the brush motor cover plate.
5. Disconnect the motor leads at terminal block TB2 and the switch connections at edge connector EC3.
6. Take out the four screws at the corners of the molded housing and lift out the housing assembly.
7. Loosen the cam from the motor shaft by:
   a. On 50-Hz machines, slackening the cotter nut and tapping the cotter to release the grip on the shaft.
   b. On 60-Hz machines, slackening the socket screw in the cam body.
8. Unscrew the motor mounting screws and take out the motor. Do not lose the cam or other loose parts.

3.6.3.2 Replacement

CAUTION
The 60-Hz motor shaft must only be rotated electrically, to avoid damage to the gear train.

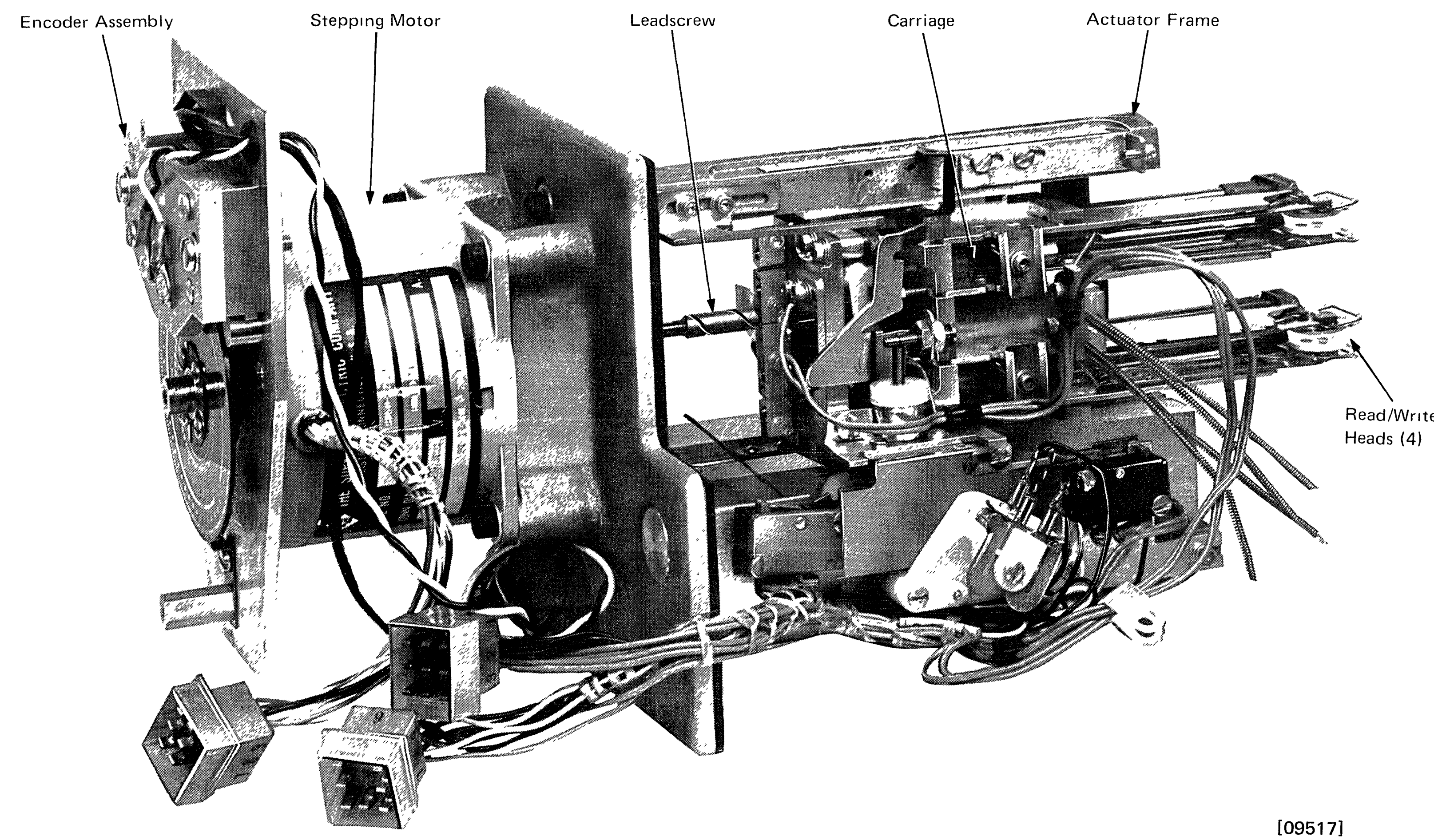
Note: When chaining a motor, make sure that the new motor is of the correct frequency for the power supply.

1. a. For 50-Hz machines, insert the cam cotter, turning the motor shaft so that its flat side engages the cotter. Fit and tighten the nut. Assemble the cam arm peg into the link. Fit the motor and secure with its screws.
   b. For 60-Hz machines, fit the motor and secure with its screws. Fit the cam onto the motor shaft with the setscrew engaging flat on the shaft. Take care that the end of the cam clears the housing face, and that the cam operating surfaces are vertically aligned to the microswitch buttons.
2. Check adjustments of the brush mid-cycle and cycle-complete switches (see 3.6.2.1).
3. Re-install the assembly, and the items taken off in 3.6.3.1 without trapping the wires (see ALD pages ZZ200, ZA200, and ZA220, with wiring details). Ensure that tissues are removed from the air duct and the brush entry port before fitting the air filter.

3.7 Actuator and Encoder Assemblies

Actuator – Description

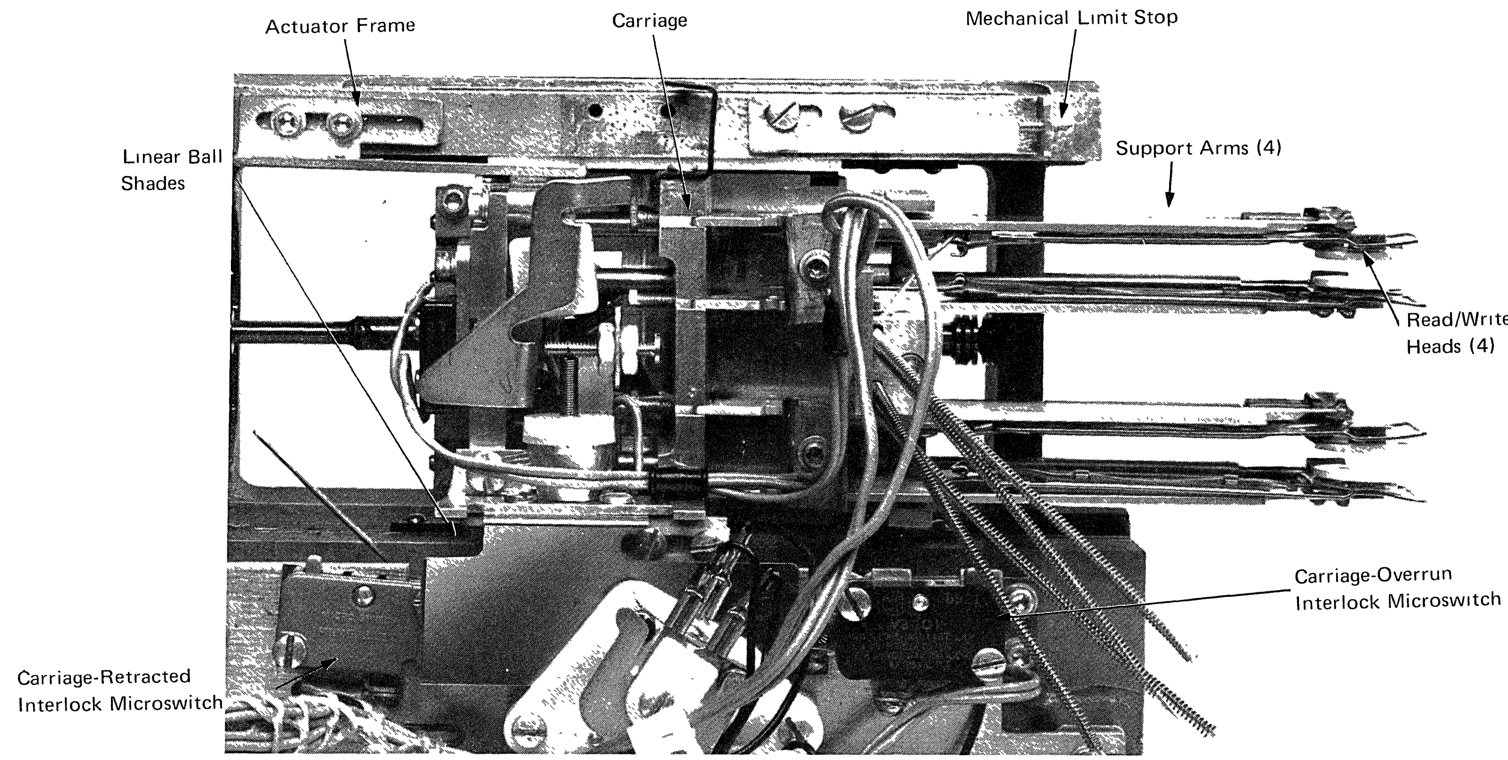
- The actuator accurately positions the four read/write heads at the track address that is defined by the using system. This positioning is carried out within a specified time, the external control signals being provided by the using system.
- The read/write heads are attached to a carriage that moves backwards and forwards within the actuator frame. Carriage movement is made by an access mechanism that consists of a follower wheel integral with the carriage and a precision leadscrew.
- The leadscrew is coupled to the shaft of a reversible stepping motor. A steady current in the motor windings holds the leadscrew and carriage stationary. When drive pulses are applied to the motor windings (in the correct order), the leadscrew rotates, moving the read/write heads across the disks.



[09517]

Carriage

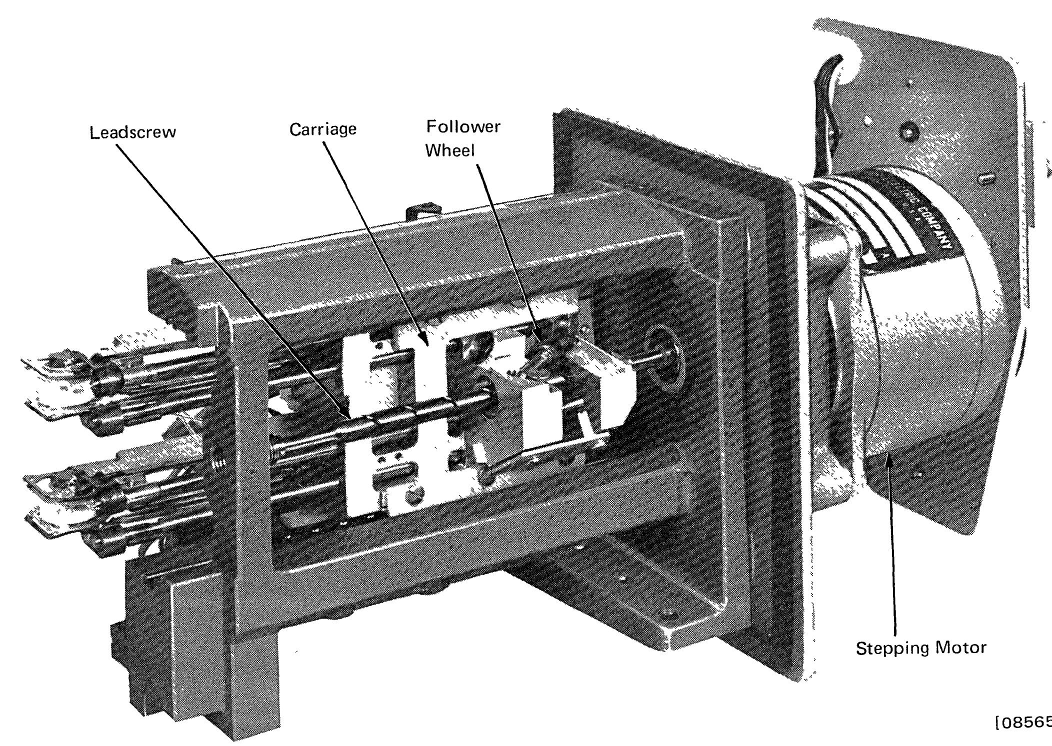
- The carriage is mounted within the actuator frame and runs on linear ball slides.
- Read/write heads on support arms are fitted into slots in the carriage. When the carriage moves along the actuator frame, the read/write heads move across the disk surfaces.
- Inner and outer limit switches (carriage overrun interlock and carriage retracted interlock, respectively) restrict carriage movement. A mechanical limit stop is fitted beyond the inner limit switch to prevent damage to the read/write heads, in case this switch fails to stop the carriage.
- The head load mechanism is attached to the carriage to maintain the read/write heads in a loaded condition when they are moved across the disks.
- During maintenance, when the 5444 is switched off, the carriage can be moved by hand by turning the stepping motor shaft at the encoder assembly. *Do not turn the encoder disk. Do not attempt to move the carriage by pushing on it.*



[09518]

Access Mechanism

- Carriage movement is obtained from a rotating leadscrew that drives a follower wheel mounted in the carriage. The carriage moves forwards or backwards, depending on the direction of rotation of the leadscrew.
- The leadscrew is coupled to the shaft of a stepping motor that can be driven in either direction, or held in one position.
- The leadscrew has a pitch of 0.5 in. (12,7 mm). The carriage moves 0.5 in. (50 tracks), therefore, for each revolution of the stepping motor shaft.



[08565]

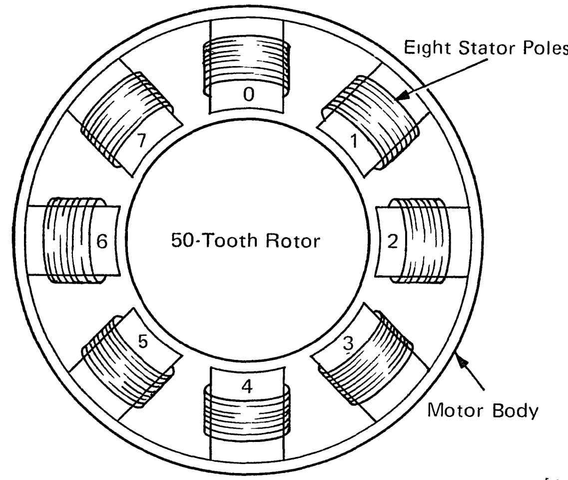
Stepping Motor-Description

- The stepping motor can be driven in either direction, or held at one position. The drive pulses controlling the motor are derived from a shaft 'position feedback' signal that is obtained from an encoder disk mounted on the motor shaft.
- The motor is a 200-step-per-revolution motor. For a carriage movement of one track, therefore, the motor moves through four steps. (The carriage moves 50 tracks for each revolution of the motor shaft.)
- The motor has eight stator poles and a permanent magnet rotor, magnetized axially.
- The motor has four windings, labeled N, S, E, and W (these winding labels have no significance magnetically). The windings are wound on the poles as follows:

Poles 0, 2, 4, and 6: Have N and S windings, wound in opposition

Poles 1, 3, 5, and 7: Have E and W windings, wound in opposition

[08566]



[08568]

- When the stator windings are energized, the poles are magnetized as follows:

Winding Energized	Magnetic State of Stator Pole (Magnetic North or South) 0	1	2	3	4	5	6	7
Winding N	N		S		N		S	
Winding S	S		N		S		N	
Winding E		N		S		N		S
Winding W		S		N		S		N

[08567]

- The motor is used in two-phase mode, that is, two windings are always energized at any one time. The possible configurations are as follows:

1. N and E windings energized (Detent [rest] position)
2. N and W windings energized
3. S and W windings energized
4. S and E windings energized

[08569]

- The rotor moves one step when any one of a pair of windings changes its magnetic state. That is,

$$\left.\begin{array}{l} NE \rightarrow NW \\ NW \rightarrow SW \\ SW \rightarrow SE \\ SE \rightarrow NE \end{array}\right\} = 1 \text{ step}$$

- The rotor moves one tooth pitch (1/50 revolution) when four such changes of magnetization (steps) occur in the same direction as follows:

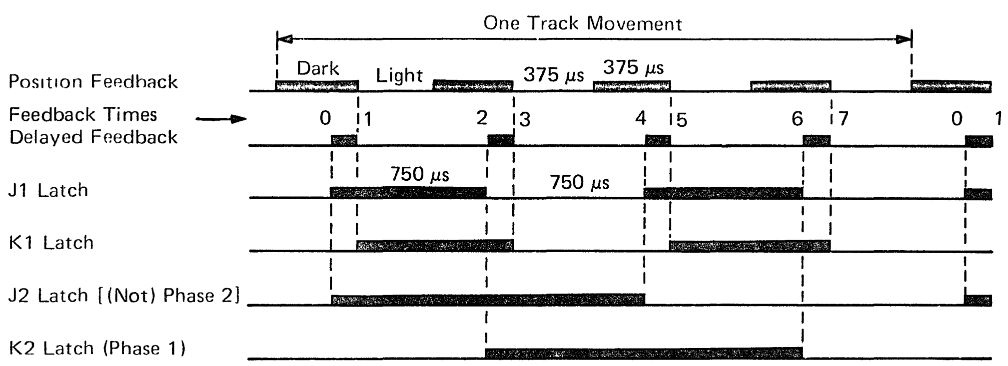
	N E (Detent) →	NW →	SW →	SE →	N E (Detent)
No. of Steps		1	2	3	4

[08570]

Thus, with a 50-tooth rotor, the motor makes one revolution for 200 steps.

Stepping Motor-Operation

- Drive signals controlling the motor are derived from an encoder disk that is attached to the motor shaft. A 'position feedback' signal is obtained from a photocell that views a lamp through the outer band of windows on the encoder disk.
- The timing signals (when the motor is running) are as shown:



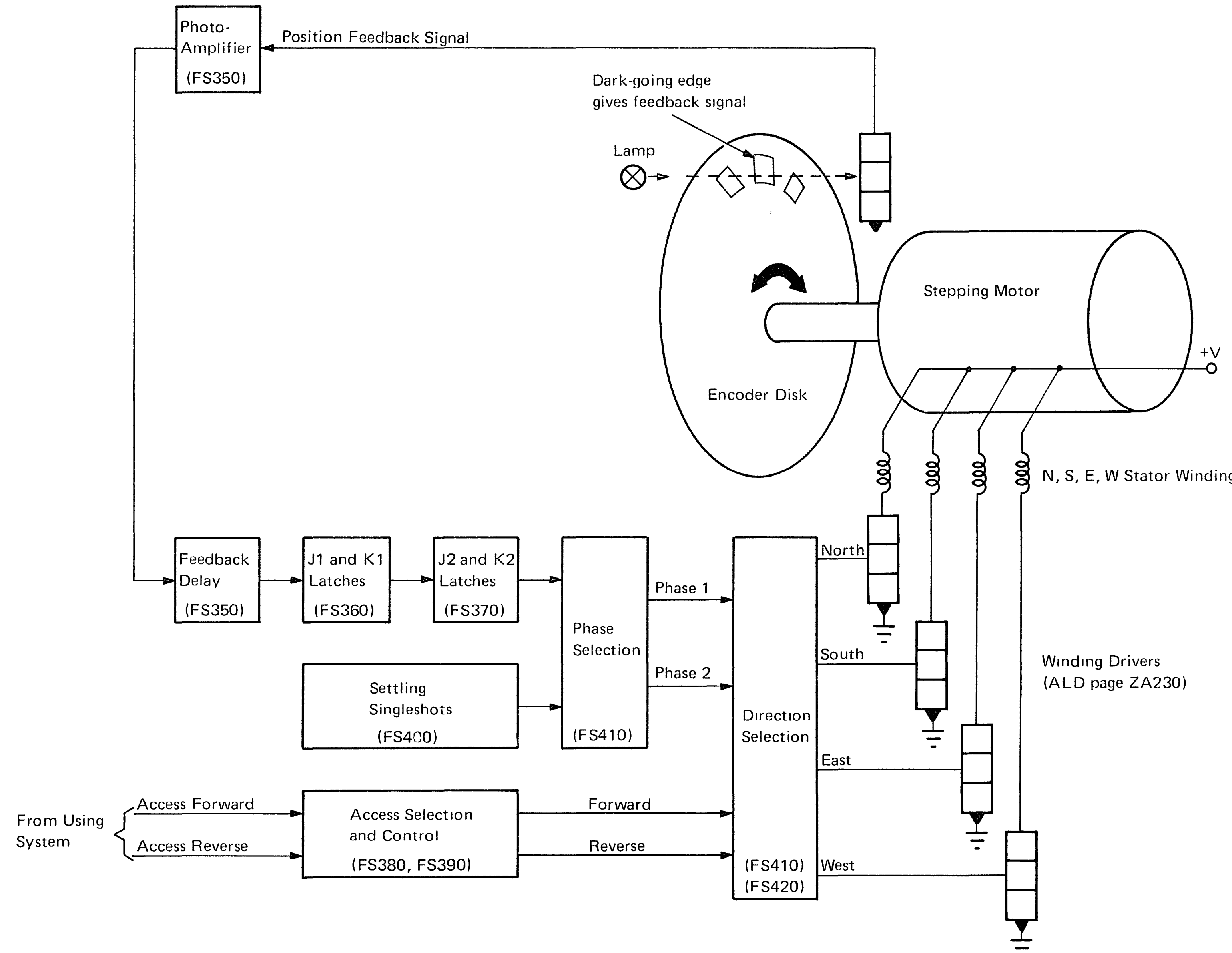
[08571]

- The stator windings are energized (when the motor is running) as follows:

Winding	Carriage moves FORWARDS (energized by)	Carriage moves BACKWARDS (energized by)
N	Phase 1	Phase 2
S	(Not) Phase 1	(Not) Phase 2
E	Phase 2	Phase 1
W	(Not) Phase 2	(Not) Phase 1

[08572]

- During start and stop sequences of the stopping motor, stator winding energizations and timing signals are not as detailed here. For instance, during a stop sequence, the output of three singleshots ('SS A multi', 'SS A single', 'SS B') is used to obtain the best rotor settling time.



[08573]

Encoder Assembly

• The encoder assembly contains an encoder disk that is mounted on the stepping motor shaft, a lamp/photocell assembly that contains three lamp/photocell pairs, and a track position indicator.

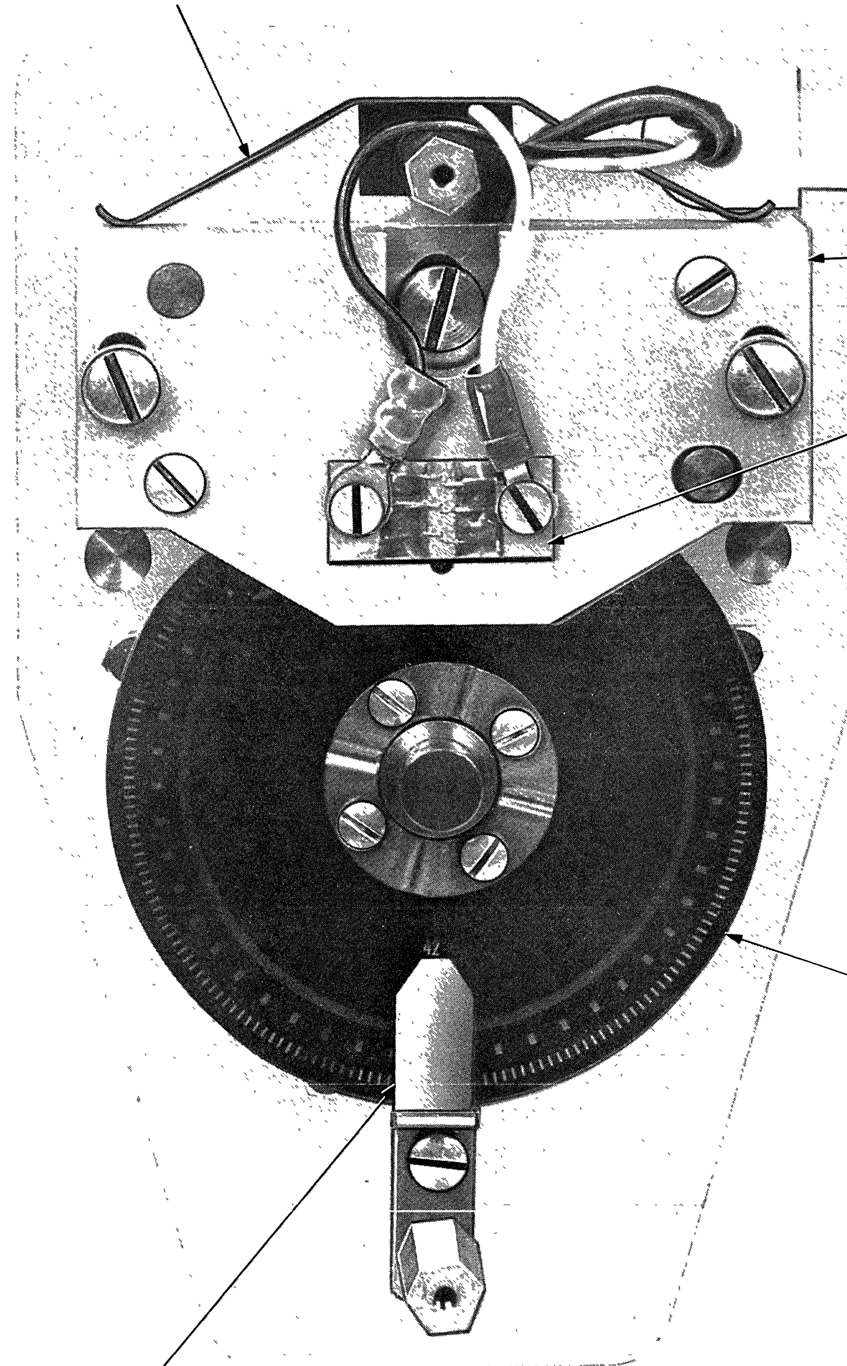
• The encoder disk is made of clear plastic with an opaque coating. The coating is etched away in three concentric bands of windows to allow light to pass from a lamp on one side of the disk, through the etched window, to a photocell on the other side. Each band of windows has a separate lamp/photocell pair.

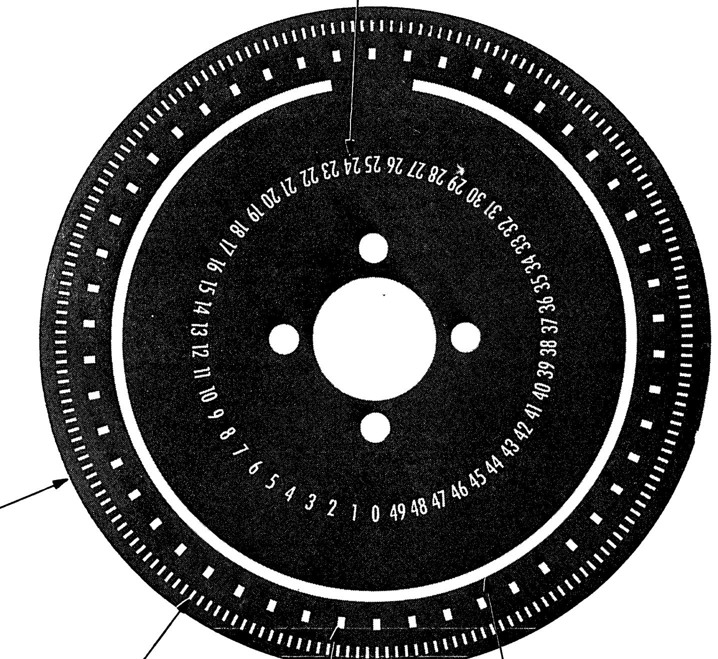
• *Inner Band:* The fine home photocell is blanked off once per revolution of the encoder disk, that is, every 50 tracks. The 'fine home' signal is activated in the region of tracks 000, 050, 100, 150, and 200. In conjunction with 'coarse home' from the carriage photocell, 'fine home' indicates when the carriage has reached track 000. The signal is also used in the CE 50-track mode.

• *Center Band:* Fifty equally spaced windows in this band cause the on-track photocell to be illuminated whenever the read/write heads are near to a data track. The photocell output is gated with 'feedback' to give 'on track'. 'On track' activates the 'track crossing' line to indicate, to the using system, when each track is crossed during an access operation.

• *Outer Band:* The windows in this band give the 'position feedback' signal that is used to time the switching of the stepping motor stator magnetization. The feedback photocell is illuminated 200 times per revolution of the disk (four times per track crossing). When the carriage is stationary on a track, the feedback cell is illuminated.

• A track position indicator is used in conjunction with a ring of numbers on the disk (00 to 49) to indicate read/write head track position. A coarse indicator on the carriage indicates track position to the nearest ten tracks.





[08574]

Access Operations

- Standard-speed access operations are used by the 5444 Models 1, 2, and 3.
- Access operations are controlled by the 'access forward' and 'access reverse' lines from the using system.
- If an access error occurs, a recalibration operation may be used to reset the read/write heads to track 000.
- Access operations cannot begin unless 'ready' is activated, that is, until the following conditions are satisfied:

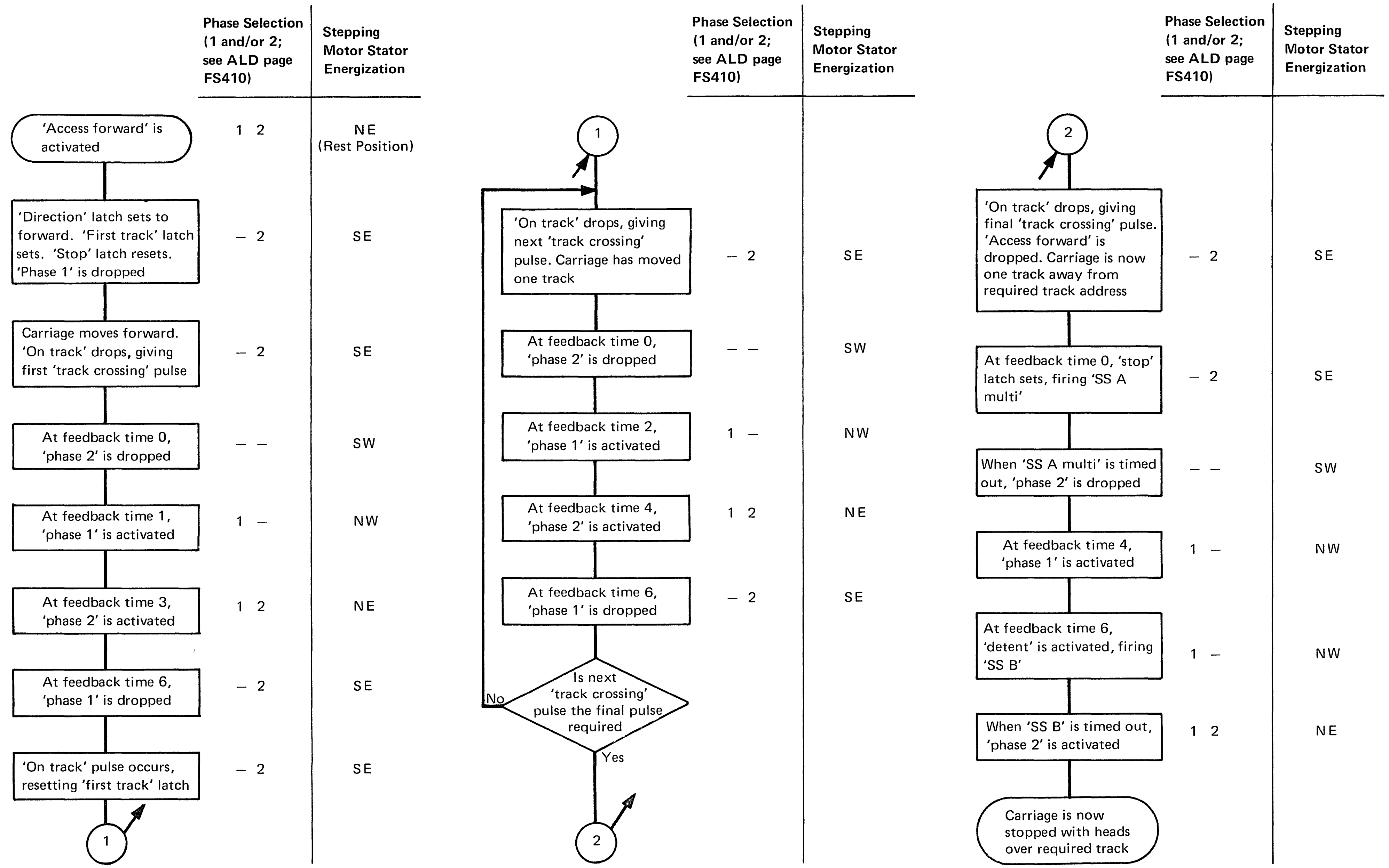
1. The disks are running at full speed.
2. The read/write heads are loaded over the disks.
3. No unsafe latch is set.
4. The mode-select switch on the CE control panel is set to ON LINE.

Access Forward Operation

- The flowchart shows a multiple-track operation.
- For each track crossed, the 5444 sends, to the using system, a 'track crossing' pulse on the track crossing line.
- As the carriage starts to move, the 'track crossing' pulse rises when the read/write heads move off-track. This edge of 'track crossing' is counted as the first track crossing pulse. This early track-crossing indication is provided because the carriage takes one track (in time) to stop from its normal running speed. The counter in the using system is kept one track ahead of the carriage during the access operation, to ensure that the access command is dropped one track early.

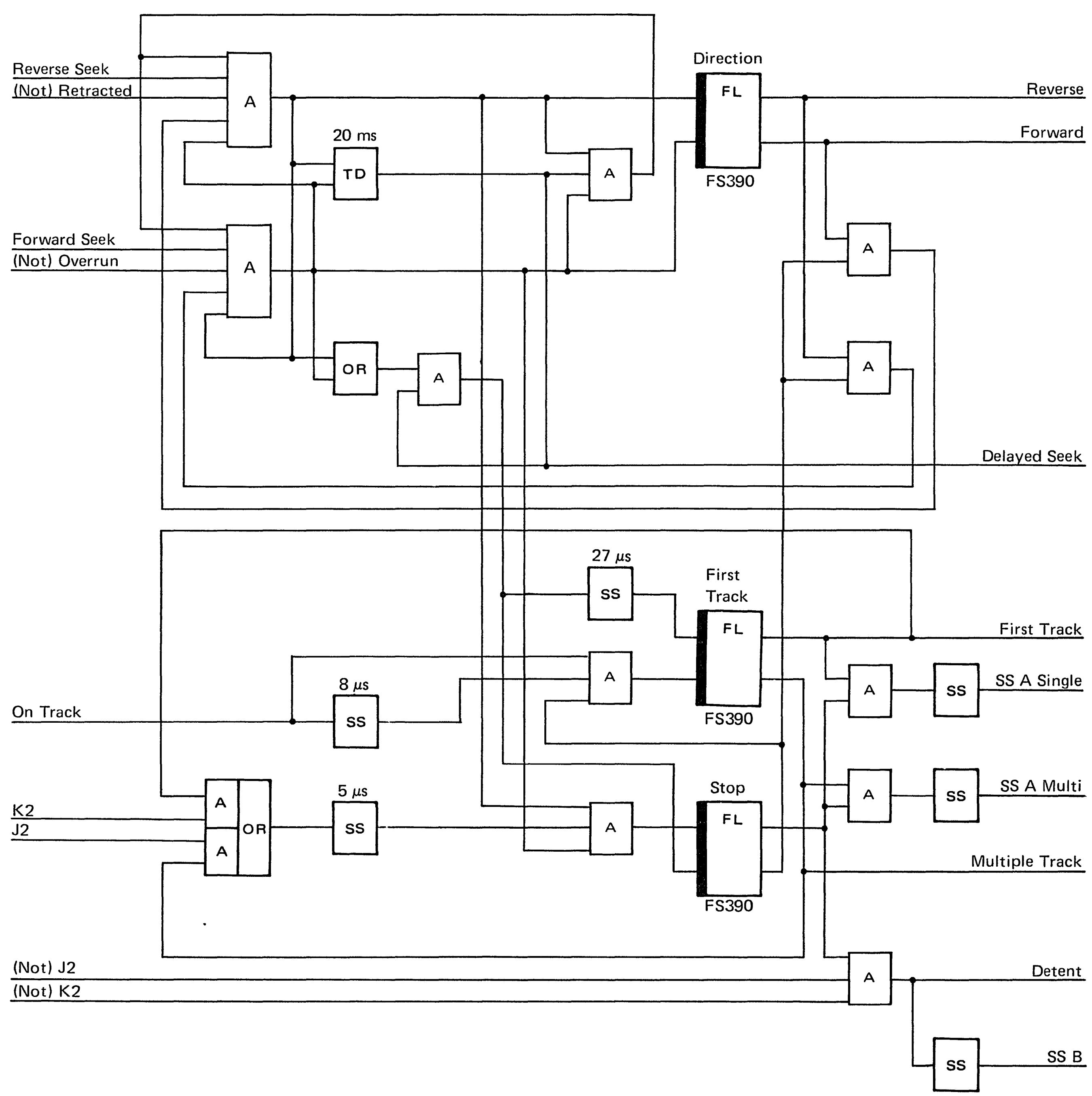
Access Reverse Operation

- The access reverse operation is similar to the access forward operation.
- If an attempt is made to reverse the carriage beyond track 000, the operation is terminated at track 000 (see "Recalibration to Track 000" in this section).

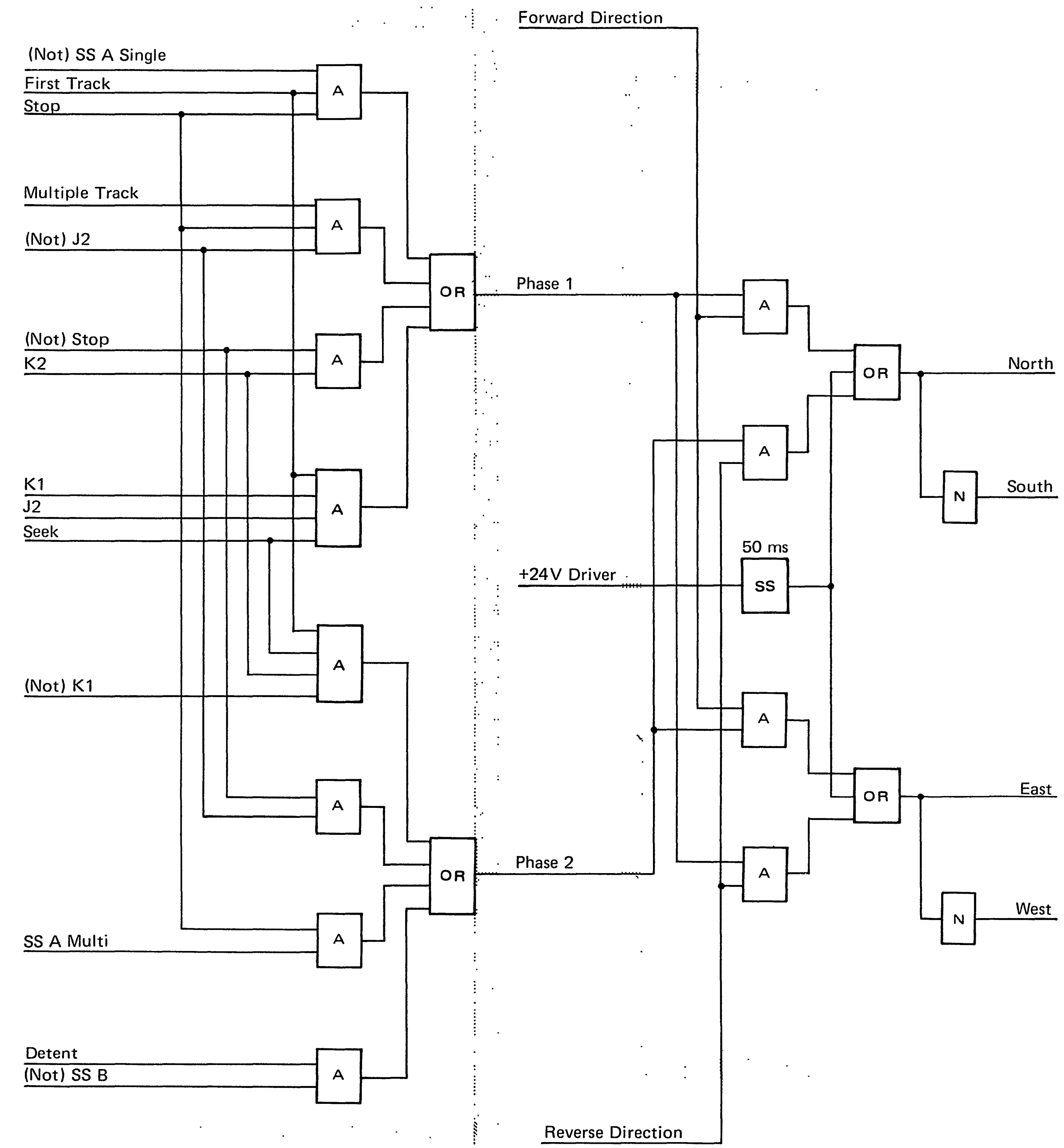


[08575]

Logic Used in Standard-Speed Access Operations



Access Control Logic (ALD page FS390)

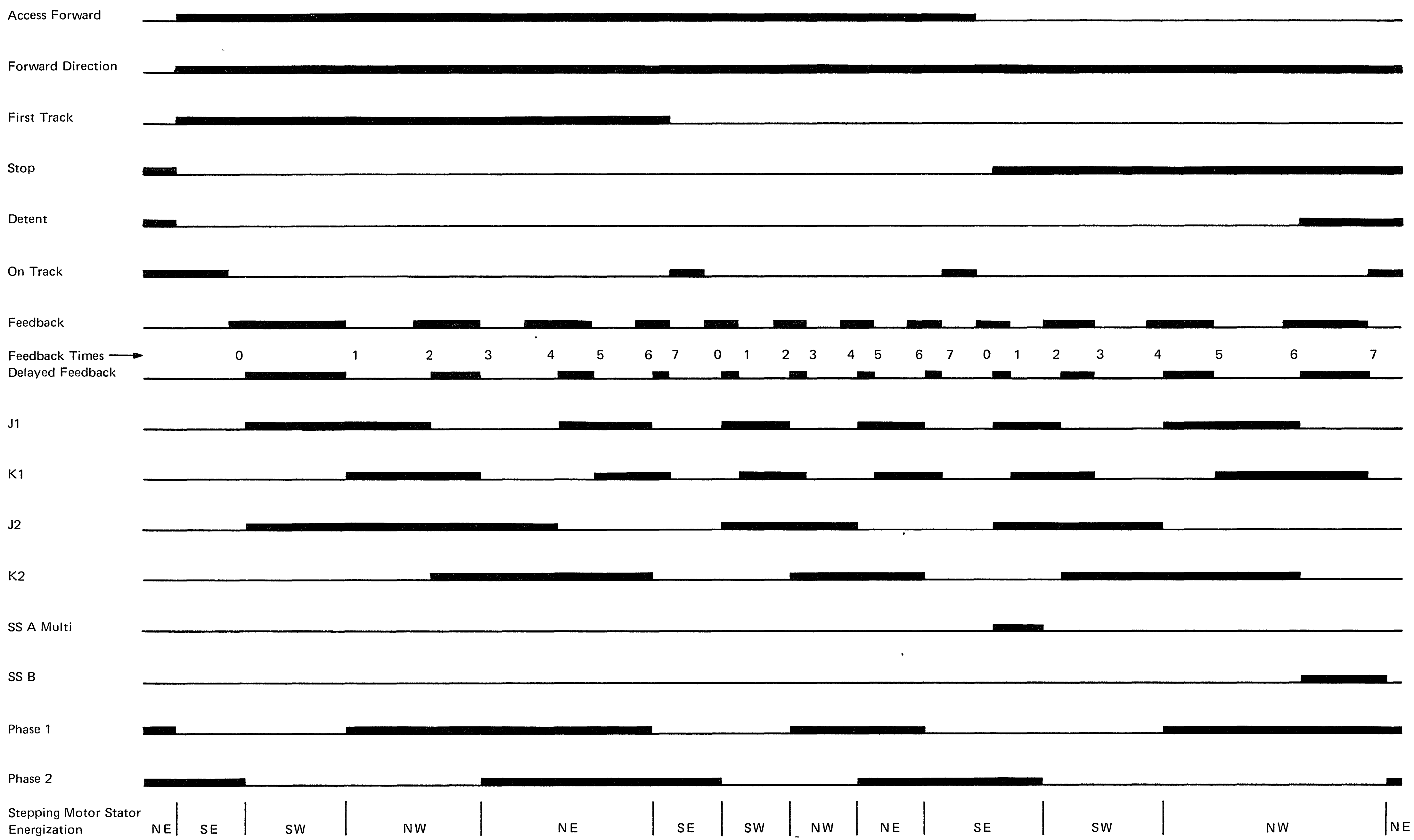


Stepping Motor Control Logic (ALD page FS410)

[08576]

Timing Signals for Standard-Speed Access Forward Operation

- The chart describes a 3-track movement.



[08577A]

High-Speed Access Operations

- High-speed access operations are used by the 5444 Models A01, A02, and A03.
- Access operations are controlled by the 'access forward', 'access reverse' and 'high speed' lines from the using system.
- If an access error occurs, a recalibration operation may be used to reset the read/write heads to track 000.
- Access operations cannot begin unless 'ready' is activated, that is, until the following conditions are satisfied:

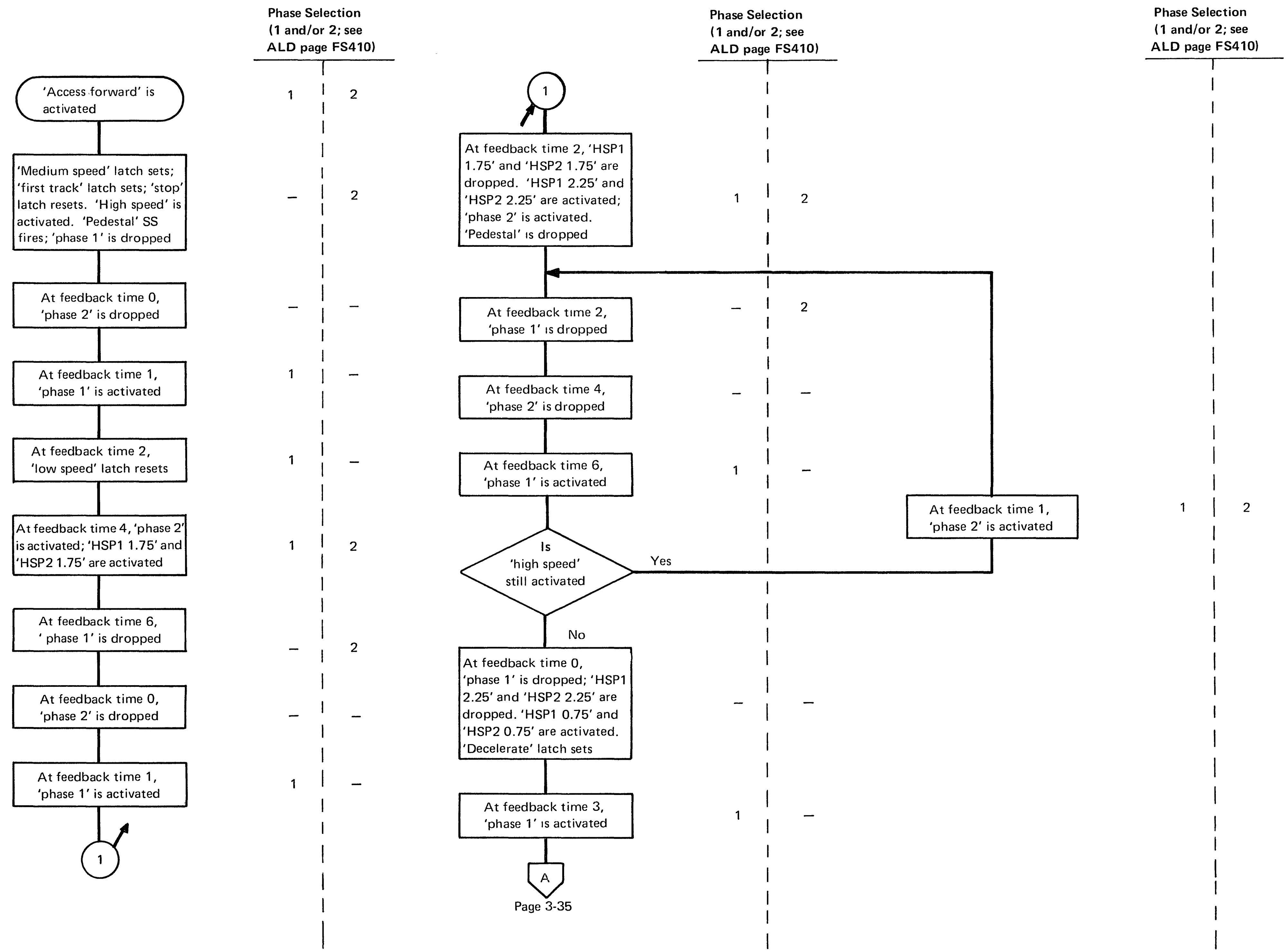
1. The disks are running at full speed.
2. The read/write heads are loaded over the disks.
3. No unsafe latch is set.
4. The mode-select switch on the CE control panel is set to ON LINE.

Access Forward Operation

- The flowchart shows a multiple-track operation.
- Access forward operations of more than three tracks are performed at high speed (except for operations starting above track 170).
- During high-speed access operations, the carriage accelerates continuously while 'high speed' is activated. 'High speed' is dropped a specified number of tracks (determined by the using system) before the required track address is reached, to slow the carriage to the standard speed, prior to stopping with the read/write heads over the required track.

Access Reverse Operation

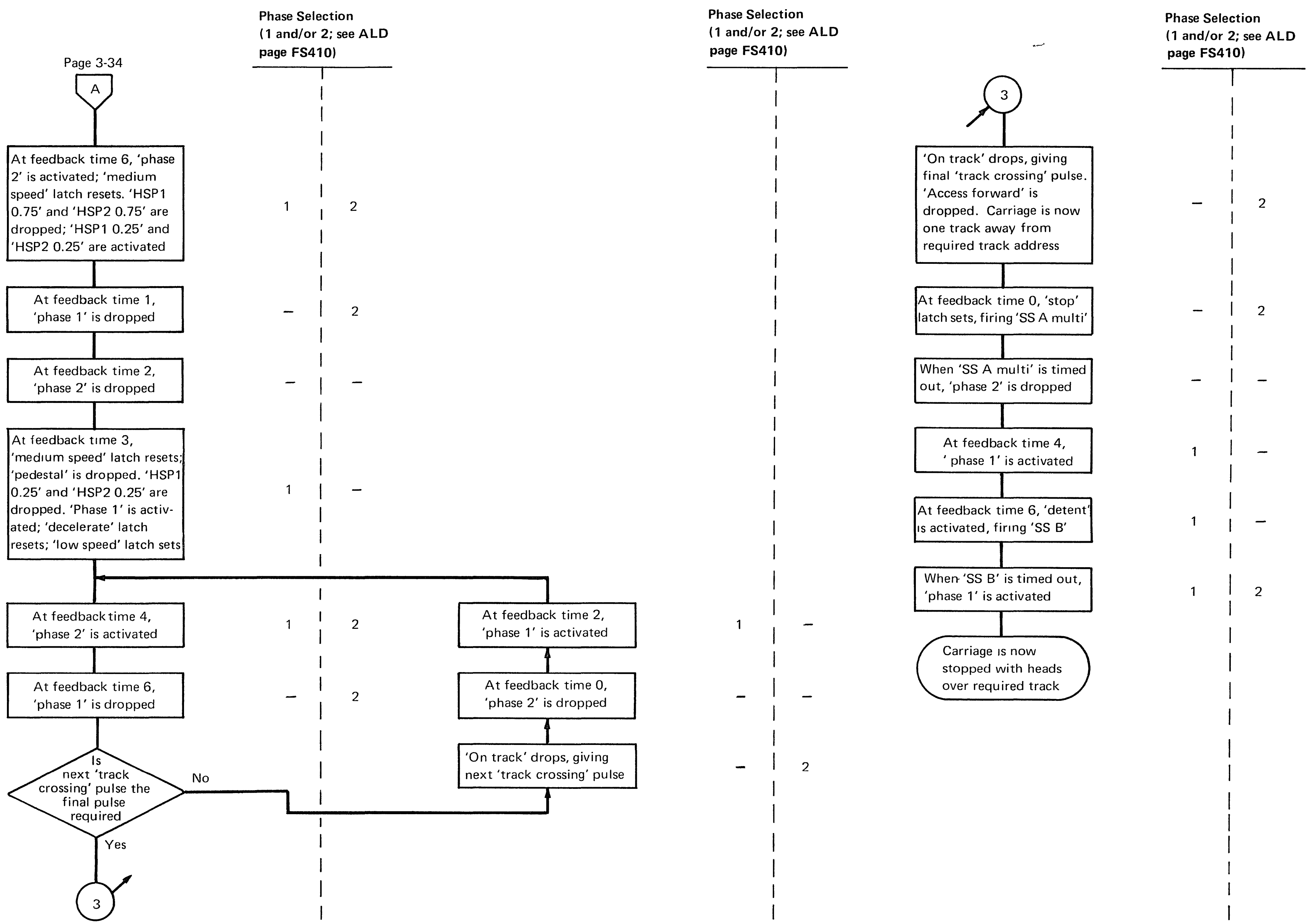
- Access reverse operations at high speed are similar to the access forward operations at high speed.
- If an attempt is made to reverse the carriage beyond track 000, the operation is terminated at track 000 (see "Recalibration to Track 000" in this section).



[09519]

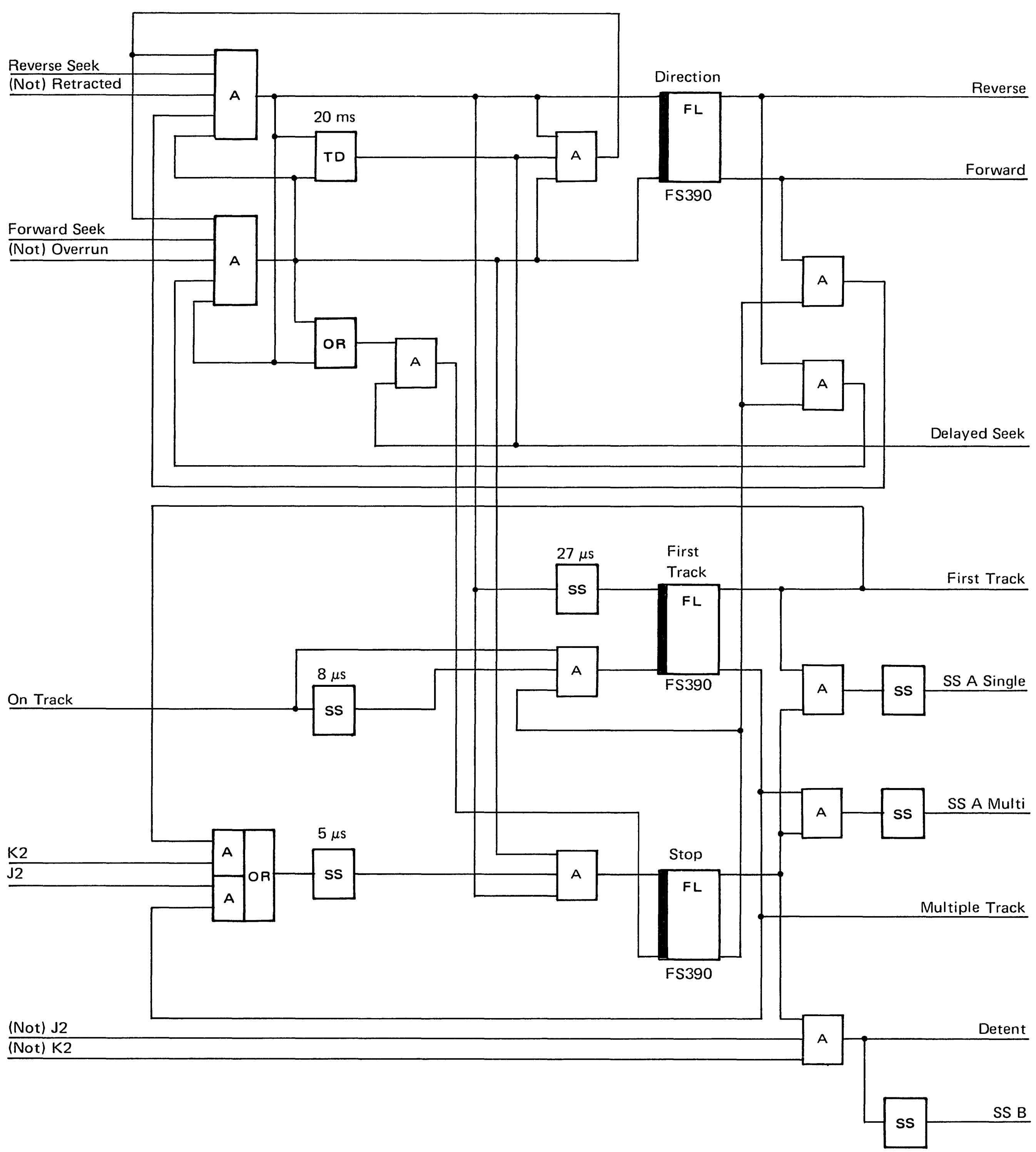
High-Speed Access Forward Operation

(Flowchart continued)

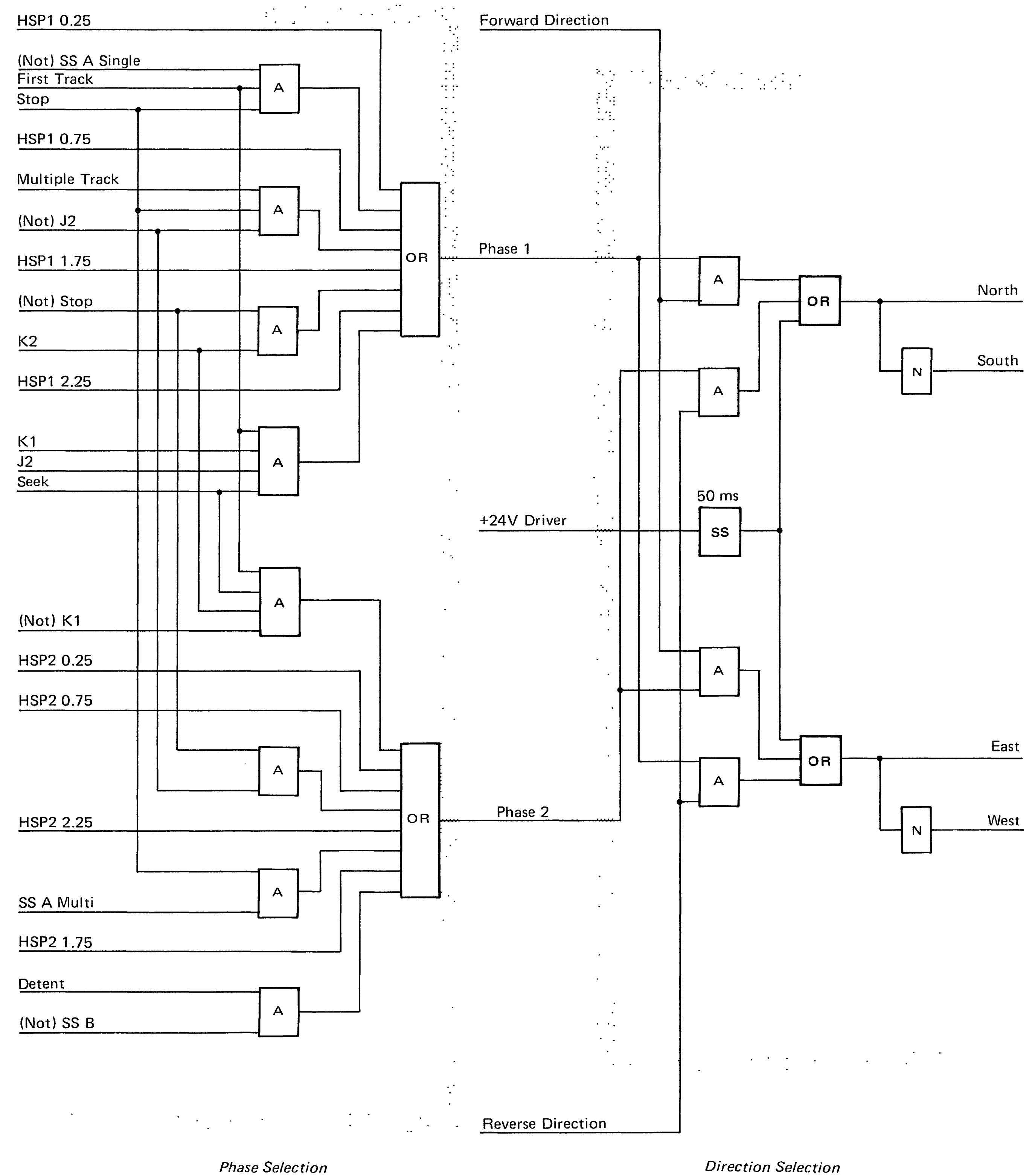


[09520]

Logic Used in High-Speed Access Operations



Access Control Logic (ALD page FS390)

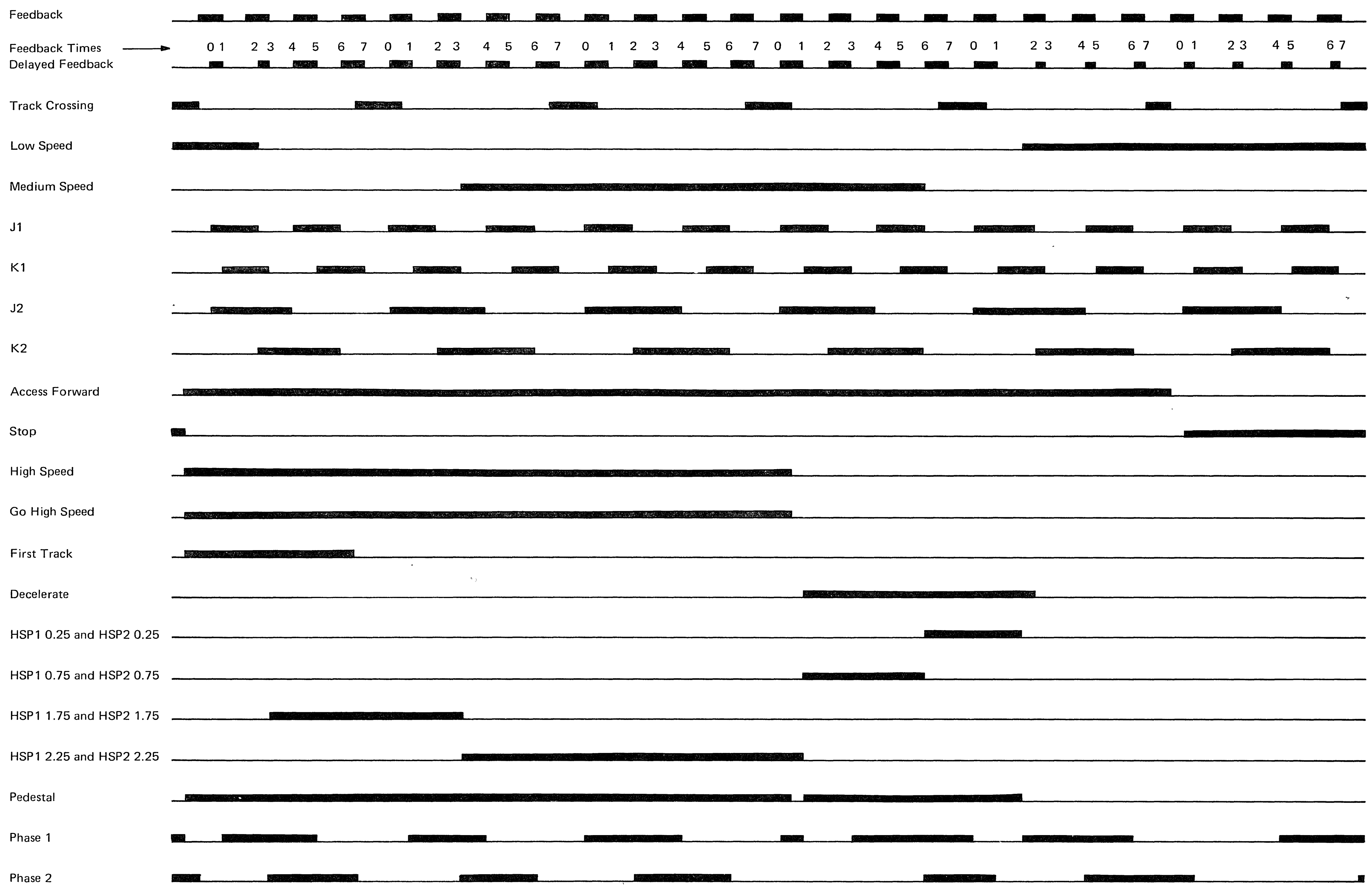


Stepping Motor Control Logic (ALD page FS410)

[09521]

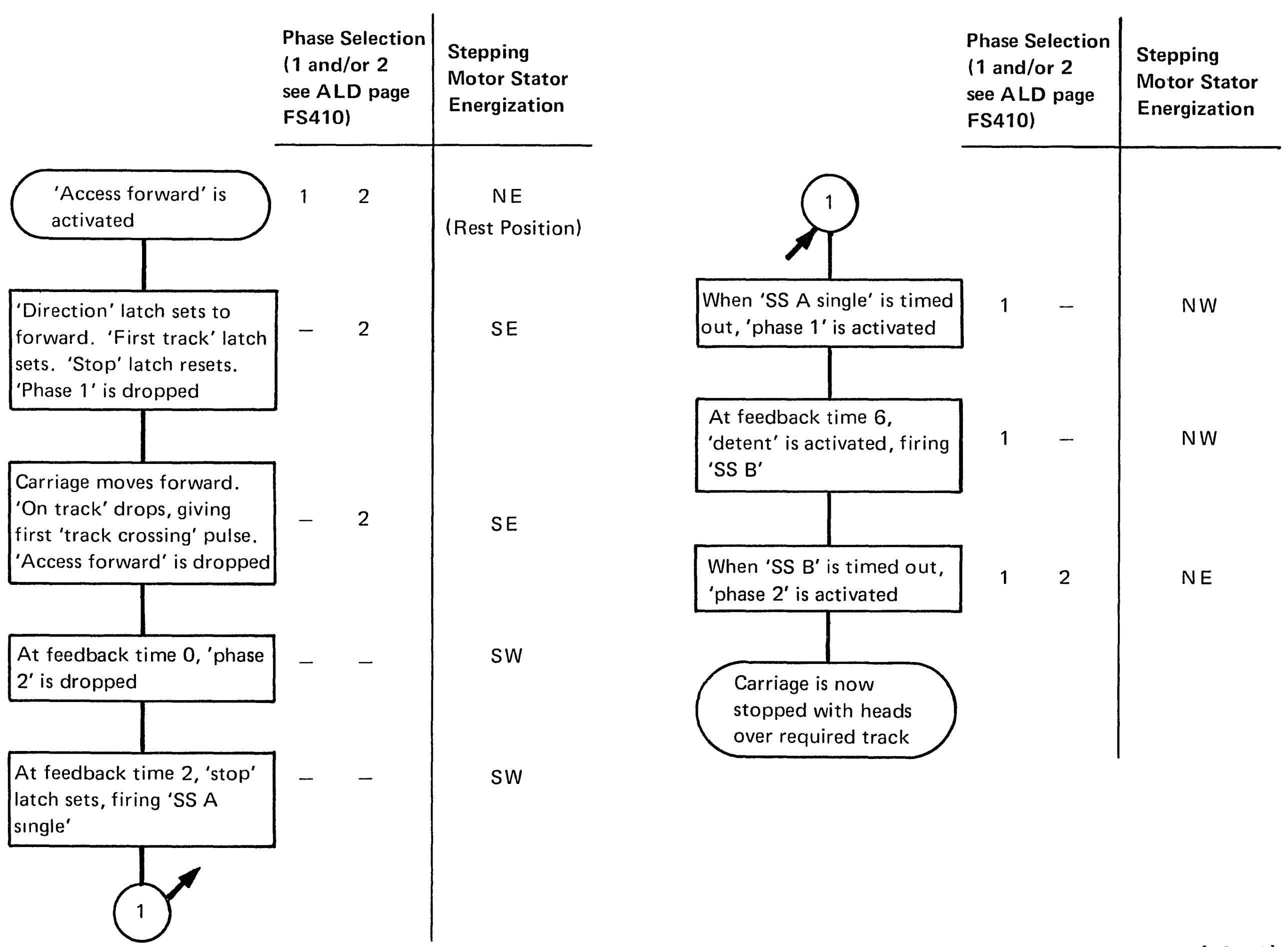
Timing Signals for High-Speed Access Forward Operation

- The chart describes a 6-track movement.

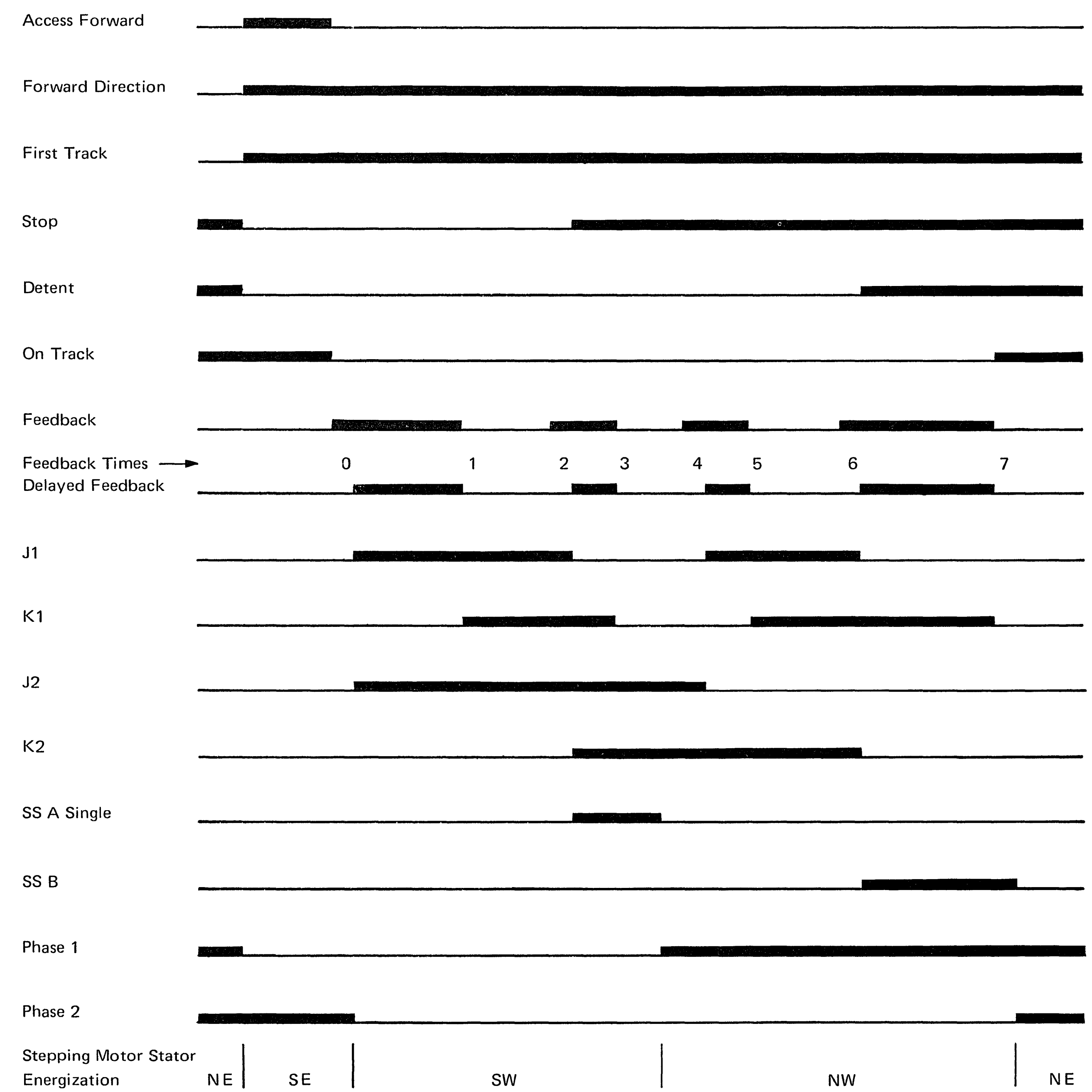


Single-Track Accessing

- For a single-track access operation, the access command is dropped almost as soon as carriage movement takes place, on detection of the first positive edge on 'track crossing'.
- These charts show the operation and timing for a single-track access forward operation.



[08578]



[08579]

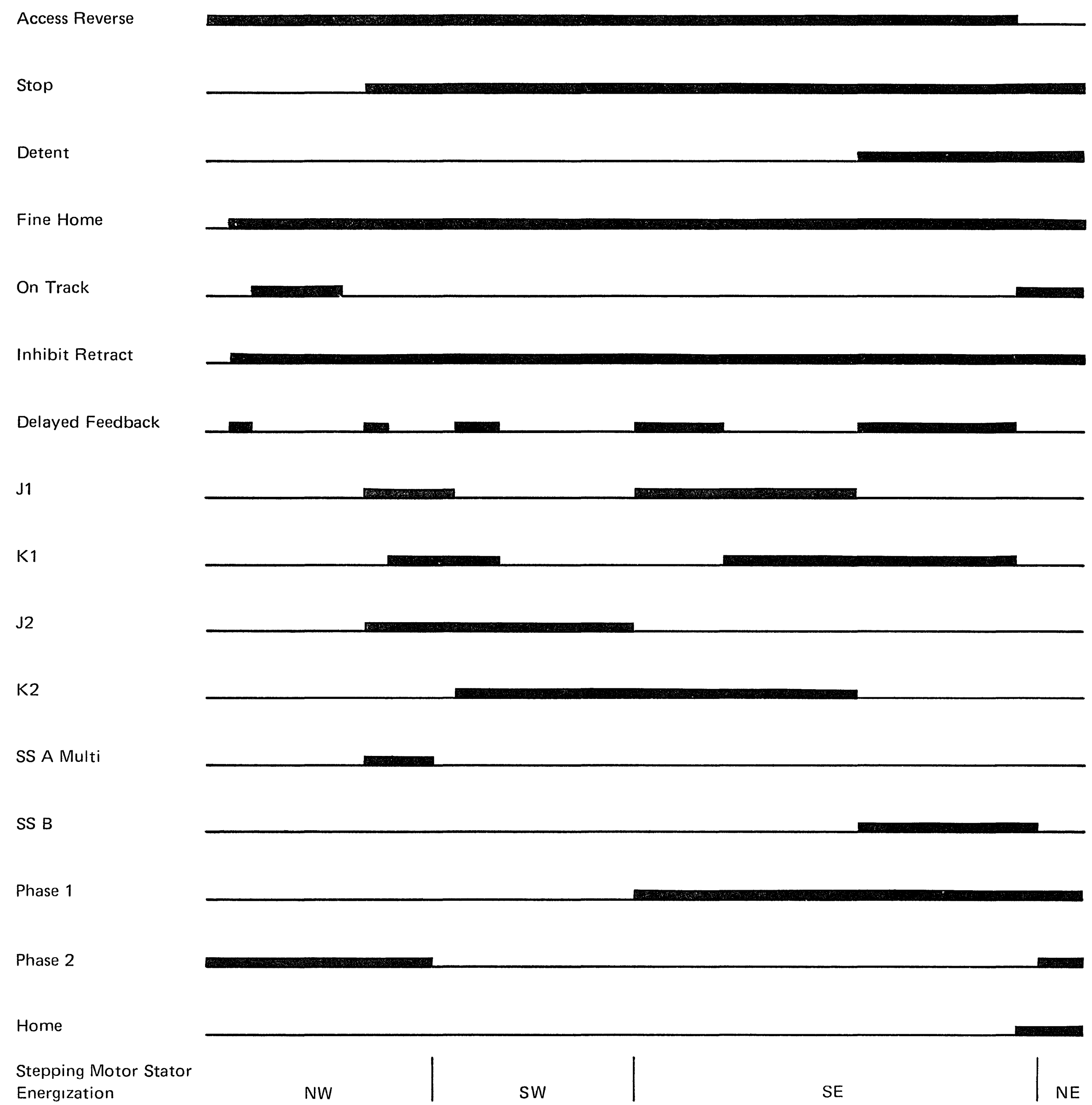
Recalibration to Track 000

- The using system needs to know the cylinder address of the read/write heads at all times. The correct cylinder address, however, could be lost because of one of the following reasons:
1. Wrong track address (heads stop on the wrong track).
2. Carriage overrun (heads move as far as the carriage overrun interlocks).
3. Misregistration (heads stop between tracks).

- If the cylinder address is lost, because of 1 or 2 above, the using system starts a recalibration operation to return the read/write heads to track 000; the 5444 contains the logic circuits used for the recalibration.

- A failure that causes misregistration probably prevents recalibration by dropping 'ready'. In these circumstances, it may be possible to recalibrate by stopping and starting the 5444, provided fuse F1 in the dc box has not blown.

- The recalibration operation is similar to an access reverse operation, except that 'access reverse' is not dropped at the end of the track 001 crossing pulse. The 'inhibit retract' latch is set by 'fine home' to inhibit 'reverse seek' at the correct time. 'Access reverse' is dropped when 'home' is activated.



[08580]

3.7.1 Actuator-Servicing

Carriage or leadscrew parts are not field replaceable units; if they are defective, change the complete actuator assembly. The stepping motor and encoder assembly are field replaceable units.

Handle and store all parts of the actuator assembly with extreme care. In particular, keep the leadscrew, follower wheels, and linear ball slides free from damage or contamination.

3.7.1.1 Removal

If data on the fixed disk is to be retained, recover the data (if possible) before removal of the actuator. If data has to be recovered after actuator replacement, attempt recovery using the error recovery procedure (see item 2.2.2 in Chapter 2).

A T-handled wrench, part 460947, is supplied as a special tool to facilitate actuator fixing screw removal where the enclosure makes entry to the base of the machine difficult. This tool is held at the IBM branch office.

Remove the actuator assembly as follows:

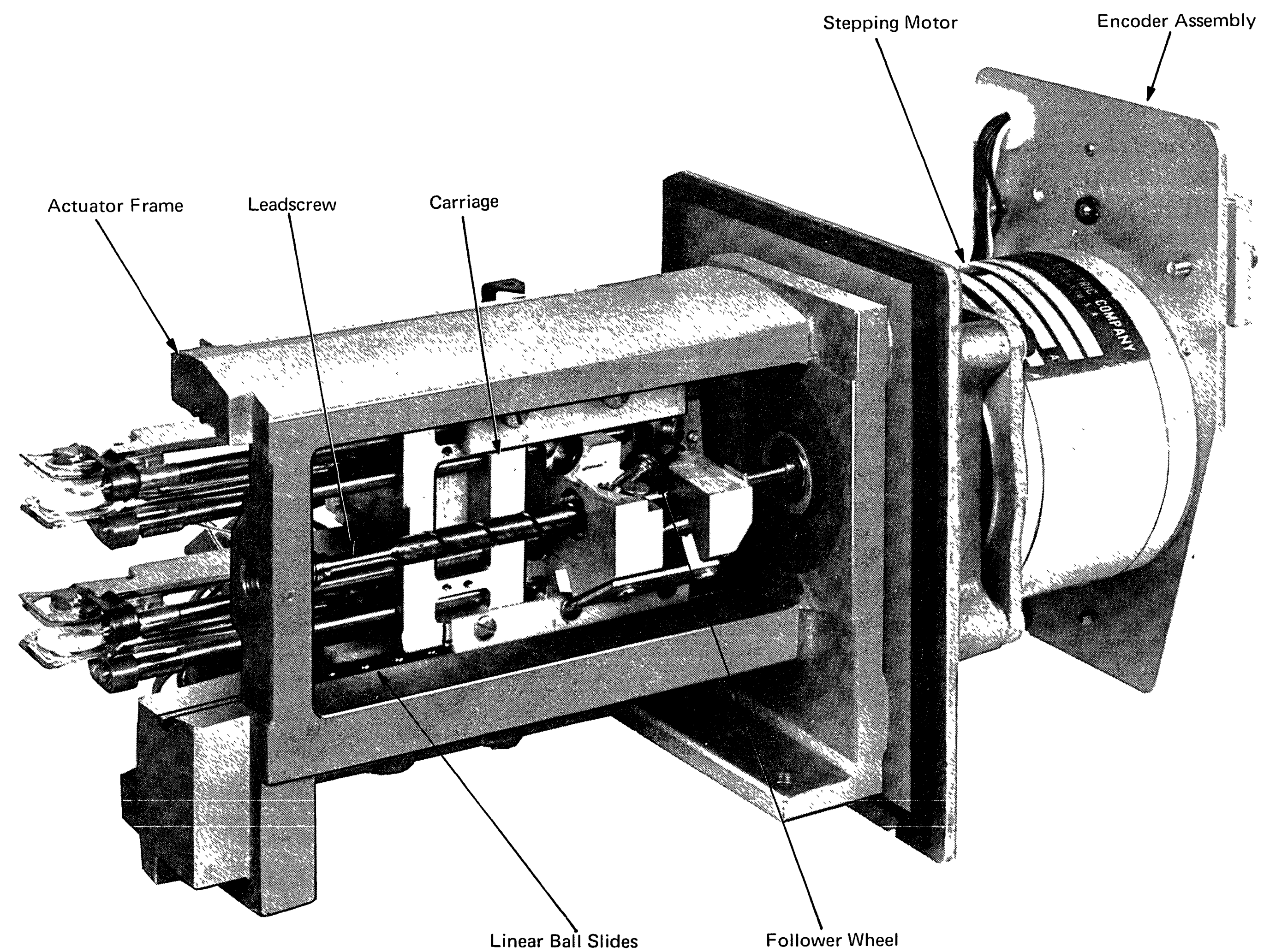
1. Remove the drive belt (see 3.2.2.3). This allows one idler to retract, giving access to the actuator fixing screws.
2. Remove the shield between the filter and the actuator assembly.
3. Disconnect the plugs from sockets J3 and J4 on the dc box, and J5, J6 and cable clamps inside the base casting.
4. Remove the motor/encoder assembly from the actuator (see 3.7.3.2).
5. Ensure that the carriage is fully retracted. Remove the read/write heads (see 3.8.2.4).
6. Remove the drive motor fixing screws so that the drive motor can be moved to one side.
7. Remove the three actuator fixing screws and slightly lift the assembly to clear the locating dowel from the base casting.
8. Carefully withdraw the actuator assembly, moving the drive motor to one side to allow easy withdrawal.
9. Protect the assembly by storing it in a dustproof bag while it is out of the machine.

3.7.1.2 Replacement

1. Check that the read/write head assemblies are removed.
2. Refit the stepping motor/encoder unit (see 3.7.3.3).
3. Ensure that the carriage is in the fully retracted position.
4. Make sure that the mating surfaces of the actuator and base castings are clean.
5. Insert the actuator assembly into the casting and locate it on the dowel.
6. Refit and tighten the three actuator fixing screws.
7. Connect the plugs to sockets J5 and J6.
8. Refit the drive motor screws and tighten. Do not fit the drive belt at this stage.

CAUTION
During the following alignment procedure, ensure that wiring in the area of the microswitches and carriage photocells does not foul the carriage flag when the carriage is accessed over full range of travel.

9. Carry out the alignment procedure (see 3.7.1.4).



[08581]

3.7.1 Actuator – Servicing (continued)

3.7.1.3 Actuator Alignment Check

Note: If the data on the fixed disk is to be retained, try to recover the data before adjusting the actuator. (See error recovery procedures, item 2.2.2 in Chapter 2.)

1. Remove the disk cartridge.
2. Remove read/write head 00 (see 3.8.2.4).
3. Ensure that the carriage is fully retracted.
4. Perform steps 6, 7, and 8 of item 3.7.1.4.
5. Check that the gap between the face of the actuator alignment tool and the boss of the hub tool is 0.002 in. ± 0.001 (0,05 mm ± 0,03). If the gap is other than 0.002 in. ± 0.001, continue at step 4 of section 3.7.1.4.

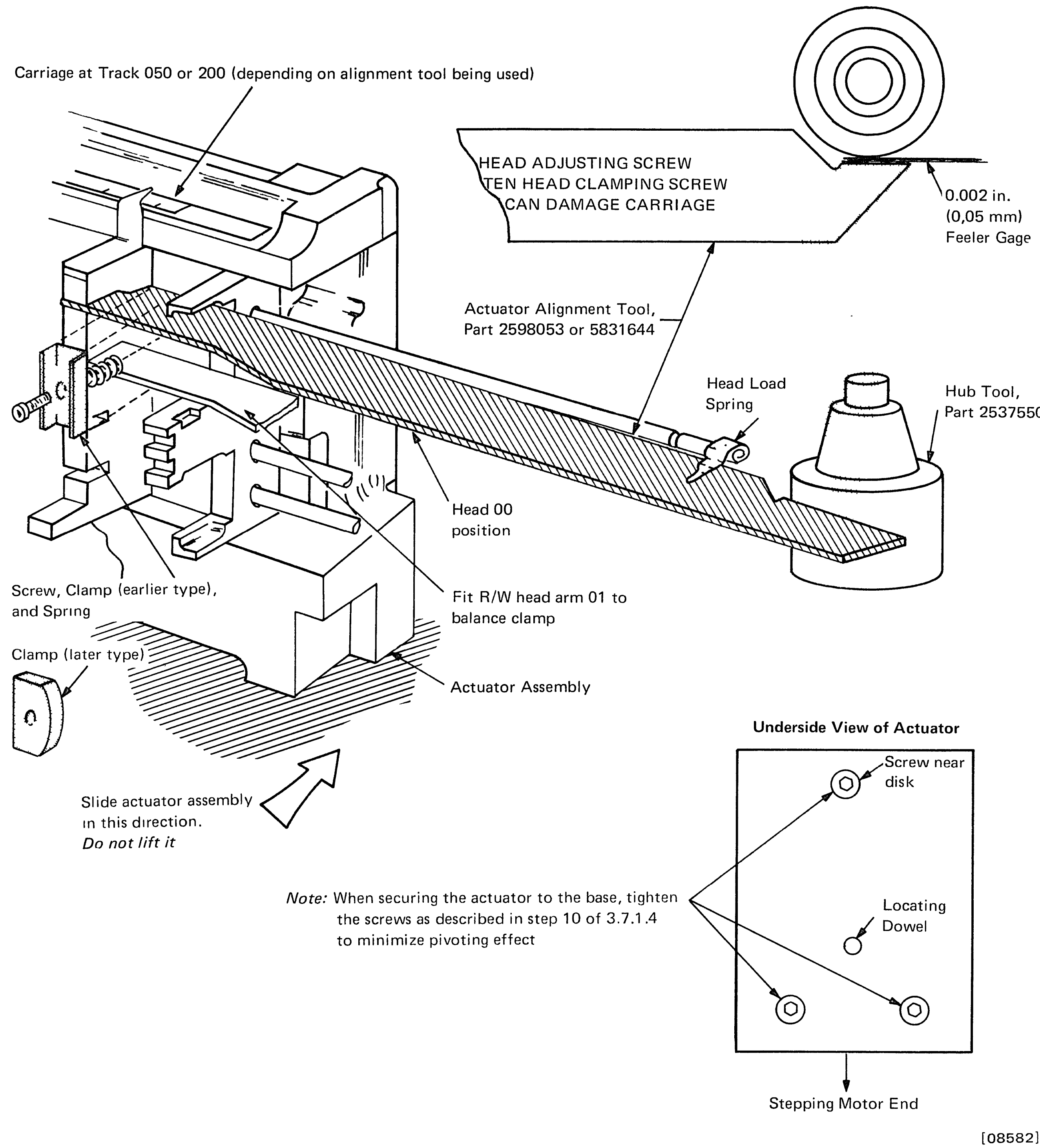
3.7.1.4 Actuator Alignment after Replacement

The actuator assembly must be aligned so that the carriage moves in a true radial line to the disk. A hub tool, part 2537550, and two actuator alignment tools, parts 2598053 and 5831644, are available at IBM branch offices for aligning the actuator assemblies. Part 2598053 can be used on all 5444 models with the carriage situated at track 050, whereas part 5831644 can be used on all models with the carriage at track 200.

1. Remove the disk cartridge.
2. Remove read/write head 00 (see 3.8.2.4).
3. Perform steps 6, 7, and 8, then check the gap between the face of the actuator alignment tool and the boss of the hub tool. If the gap is 0.002 in. ± 0.001 (0,05 mm ± 0,03), continue at step 11; if this gap is not obtained, continue at step 4.
4. Ensure that carriage is fully retracted, then remove heads 02 and 03 (see 3.8.2.4).
5. Ensure that the actuator assembly is seated firmly on the base but is free to pivot on the dowel.

CAUTION
In the next step, avoid damaging the head load spring on the top of the tool.

6. Back off the top head adjusting screw. Fit the actuator alignment tool in the top (00) position and register the tool snugly on the locating faces. Keep the head arm in position 01 to balance the clamp. Fit the clamp and finger tighten the clamp screw.
7. Place the hub tool, part 2537550, on the drive spindle.



8. Position the carriage.
   a. Move the carriage to track 050 (if using tool, part 2598053) by rotating the leadscrew coupling; *or*
   b. Move the carriage to track 200 (if using tool, part 5831644) by rotating the leadscrew coupling.

CAUTION
From this point, the fixed disk is at risk. If the actuator assembly is allowed to lift off the base, the head springs will damage the fixed disk.

9. Adjust the actuator assembly sideways with a 0.002 in. (0,05 mm) feeler gage between the face of the actuator alignment tool and the boss of the hub tool. The gap should be 0.002 in. ± 0.001 (0,05 mm ± 0,03).
10. Tighten the actuator fixing screws. (The tightening sequence of the fixing screws is important. As the fixing screws are tightened, the actuator assembly tends to pivot about the locating dowel.)
    a. Fingertighten all three screws.
    b. Further tighten the single screw nearest the disk and observe which way the 0.002 in. gap moves.
    c. Select one of the two screws near the stepping motor end and tighten it so that the gap moves in the opposite direction.
    d. Alternately tighten these two screws until the gap remains constant at 0.002 in.
    e. Tighten the third screw and check the gap.
11. Retract the carriage to track 000 by turning the leadscrew coupling.
12. Remove tools and refit the drive belt (see 3.2.2).
13. Refit the read/write heads (see 3.8.2.5).
    Note: If the replacement actuator is being fitted to a 5444 Model 3 or A03, carry out item 3.7.2.
14. Adjust the motor/encoder (see 3.7.3.1).
15. Check the upper transducer setting and adjust if necessary (see 3.5.1.1).
16. If data on the fixed disk is still to be retained, refer to the error recovery procedure in item 2.2.2 of Chapter 2.
17. Initialize the fixed disk.
18. Write the customer's data on the fixed disk, if required.

3.7.2 Replacement Actuator Assembly – R/W Heads

If a replacement actuator assembly is being fitted to a 5444 Models 3 or A03 (removable disk only), read/write head arm assemblies are fitted in the upper two positions (00 and 01) only. Fit positions 02 and 03, therefore, with blank arms to hold off the head springs, as follows:

1. Retract the carriage by rotating the stepping motor shaft.
2. Fit arm B (downwards facing head, part 2536625) to position 02. Fit arm B (upwards facing head, part 2536626) to position 03.
   Note: Locate the head load springs on the raised portion of the blank arms.
3. Check that the head load spring adjustments are still correct (see 3.9.9).

3.7.3 Stepping Motor - Servicing

3.7.3.1 Adjustment

1. Ensure that the carriage is in the fully retracted position.
2. Fit the CE cartridge (see 2.3.3.3 under "2.3 Maintenance Facilities" in Chapter 2).
3. Slacken the clamp screw of the stepping motor half-coupling shown.
4. Start the 5444.
5. Position and hold the carriage manually so that the carriage retracted microswitch is transferred until a brush cycle starts.
6. When the brushes are on the return half of the cycle, move the carriage to track 100 by turning the leadscrew coupling. When the brush cycle is completed, switch the CE mode-select switch to 50 TRKS.
7. Move the stepping motor through one (or more) 50-track moves. This action ensures that the stepping motor indicates track 000 on the encoder disk.
8. Move the stepping motor forward through 23 single-track moves. The motor is now stopped at track 073 and the pointer on the encoder disk indicates track 23.
9. With the oscilloscope connected as shown in item 3.8.2.3 under "3.8 Head/Arm Assembly", move the carriage manually to track 073, using the oscilloscope trace to monitor the head position.
10. Tighten the clamp screw of the stepping motor coupling, using torque wrench, part 2598187, and adapter, part 2597971, at the same time retaining the stepping motor and carriage at track 073. Ensure that the coupling rotates clear of the casting. *Note:* The coupling spring must be on the coupling when tightening the clamp screw and the pressure pads must be in contact.
11. Move the carriage backwards and forwards several times, using the switches on the CE panel.
12. Access to track 073, and check the head positions.
    Notes:
    a. If the oscilloscope trace shows the heads to be on or near track 073, carry out the procedure described in item 3.8.2.3 for final alignment of the top two heads (00 and 01).
    b. If a stepping motor/encoder replacement only has been carried out, and the R/W heads have not been disturbed, it should not be necessary to align each individual head. Adjust the stepping motor coupling to position the top head (00) correctly over track 073 of the CE disk. Check the position of head 01 to ensure that all heads are in their correct positions; if head 01 is not aligned and cannot be aligned satisfactorily together with head 00 (by adjusting the stepping motor coupling), align heads 00 and 01 as described in item 3.8.2.3.
    c. If the heads are not near track 073, repeat the alignment procedure from step 7.
13. Adjust the motor speed (see 3.7.8.1).
14. On Models A01, A02, and A03, carry out the low-speed sense adjustment (see 3.7.8.2).
15. Adjust the singleshots (see 3.7.8.3 and 3.7.8.4).
16. Check the carriage interlock switches (see item 3.10.2.1 under "3.10 Auxiliary Electronics").

3.7.3.2 Removal (Motors with Coupling Spring Type A)

Note: If data on the fixed disk is to be retained, transfer the data (if possible) to a "scratch" disk.

1. Remove all power from the machine.
2. Remove all plugs from sockets J3 and J4 of the dc box.
3. Rotate the stepping motor manually by the encoder shaft to approximately track 073. *Do not touch the encoder disk.*
4. Slacken the clamp socket screw on the stepping motor half-coupling at the stepping motor end of the shaft.
   Note: Do not remove the other half of the coupling; it is not necessary to remove the coupling spring A.

CAUTION
In the next step, do not slacken the two screws holding the motor mounting casting to the actuator casting; these are aligned and set in the factory.

5. Remove the four motor fixing screws.

CAUTION
In the next step, take care not to damage the bronze bush that aligns the stepping motor shaft to the leadscrew.

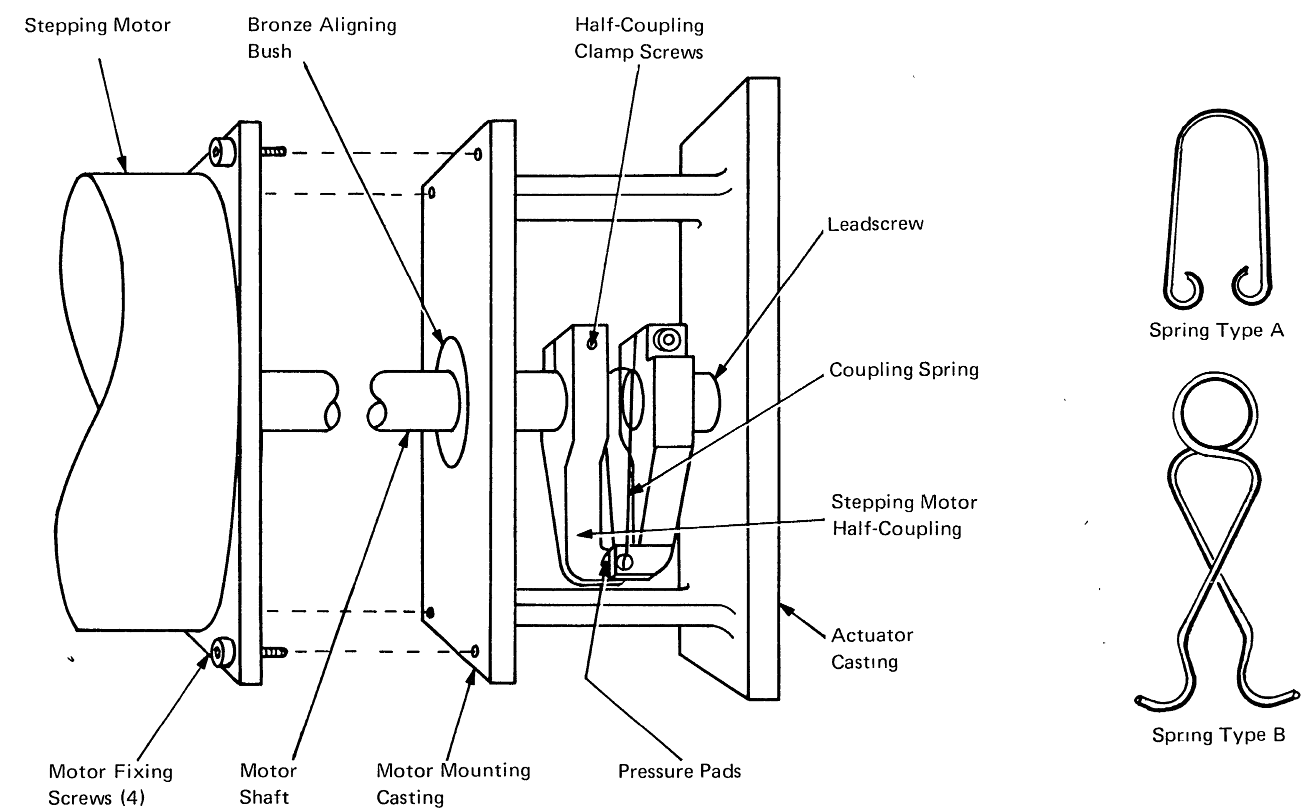
6. Withdraw the stepping motor/encoder assembly from the casting, leaving the motor half of the coupling attached to the other half by the spring.

3.7.3.3 Replacement (Motors with Coupling Spring Type A)

1. Lubricate the bore of the bronze bush in the motor mounting casting with a thin film of Molykote 'G' Rapid grease (IBM part 5144304) to prevent the shaft from seizing.

CAUTION
In the next step, take care not to damage the bronze bush.

2. Insert the stepping motor into the casting.
3. Refit the four socket head screws and tighten them. Turn the stepping motor manually to ensure that it is free to rotate.
4. Do not tighten the coupling clamp screw at this stage.
5. Connect the plugs to sockets J3 and J4 of the dc box.
6. Adjust the stepping motor (see 3.7.3.1).



[08583A]

3.7.3. Stepping Motor – Servicing (continued)

3.7.3.4 Removal (Motors with Coupling Spring Type B)

Note: If data on the fixed disk is to be retained, transfer the data (if possible) to a "scratch" disk.

1. Switch off all power to the 5444.
2. Remove the plugs from sockets J3 and J4 of the dc box.
3. Rotate the encoder shaft until the couplings are vertical and the pressure pads uppermost.
4. Remove the coupling spring B as follows:
   a. Pass the coupling spring mounting tool, part 5144438, up from underneath the couplings and hook one lug of the tool under one end of the spring (see **A**).
   b. While preventing the couplings from turning (see **B**), hook the other lug under the other end of the spring. It is necessary to open the spring to achieve this.
   c. Remove the spring by carefully withdrawing the spring and tool downwards. The free ends of the spring must pass between the couplings.
   d. Remove the spring from the tool.
5. Remove the pressure pad.
6. Rotate the stepping motor manually by the encoder shaft to approximately track 073. *Do not touch the encoder disk.*
7. Slacken the clamp socket screw on the coupling of the stepping motor shaft only.

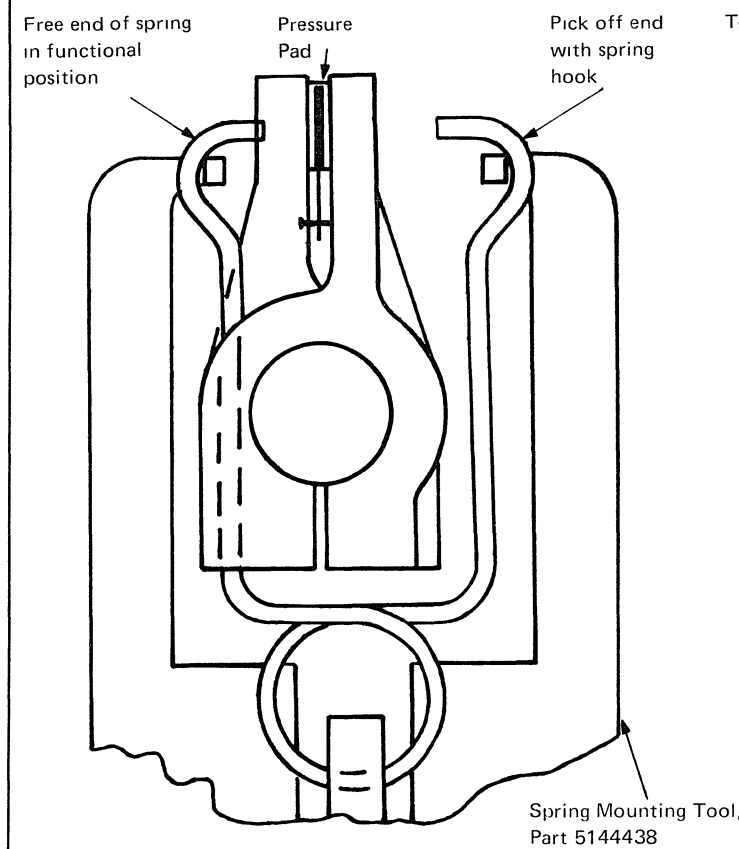
CAUTION
In the next step do not slacken the two screws holding the motor mounting casting to the actuator casting; these parts are factory aligned.

8. Remove the four motor fixing screws.

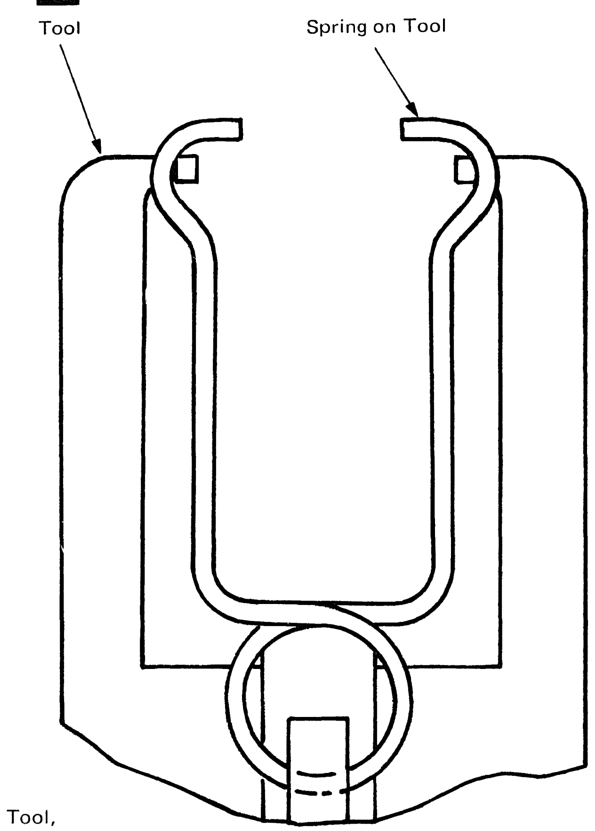
CAUTION
In the next step, take care not to damage the bronze bush that aligns the stepping motor shaft to the leadscrew.

9. Withdraw the stepping motor from the casting, removing the coupling from the stepping motor shaft at the same time.

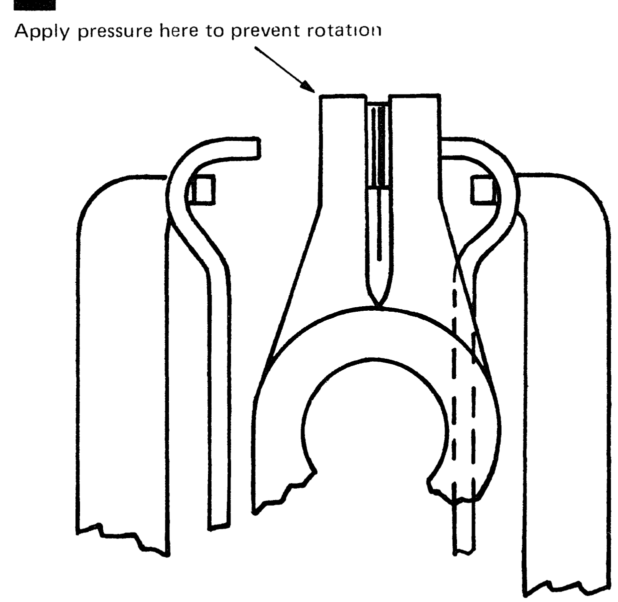
A



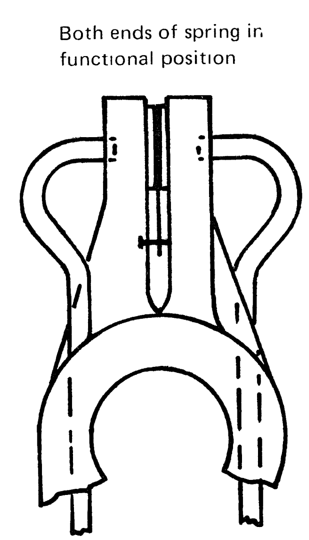
C



B



D



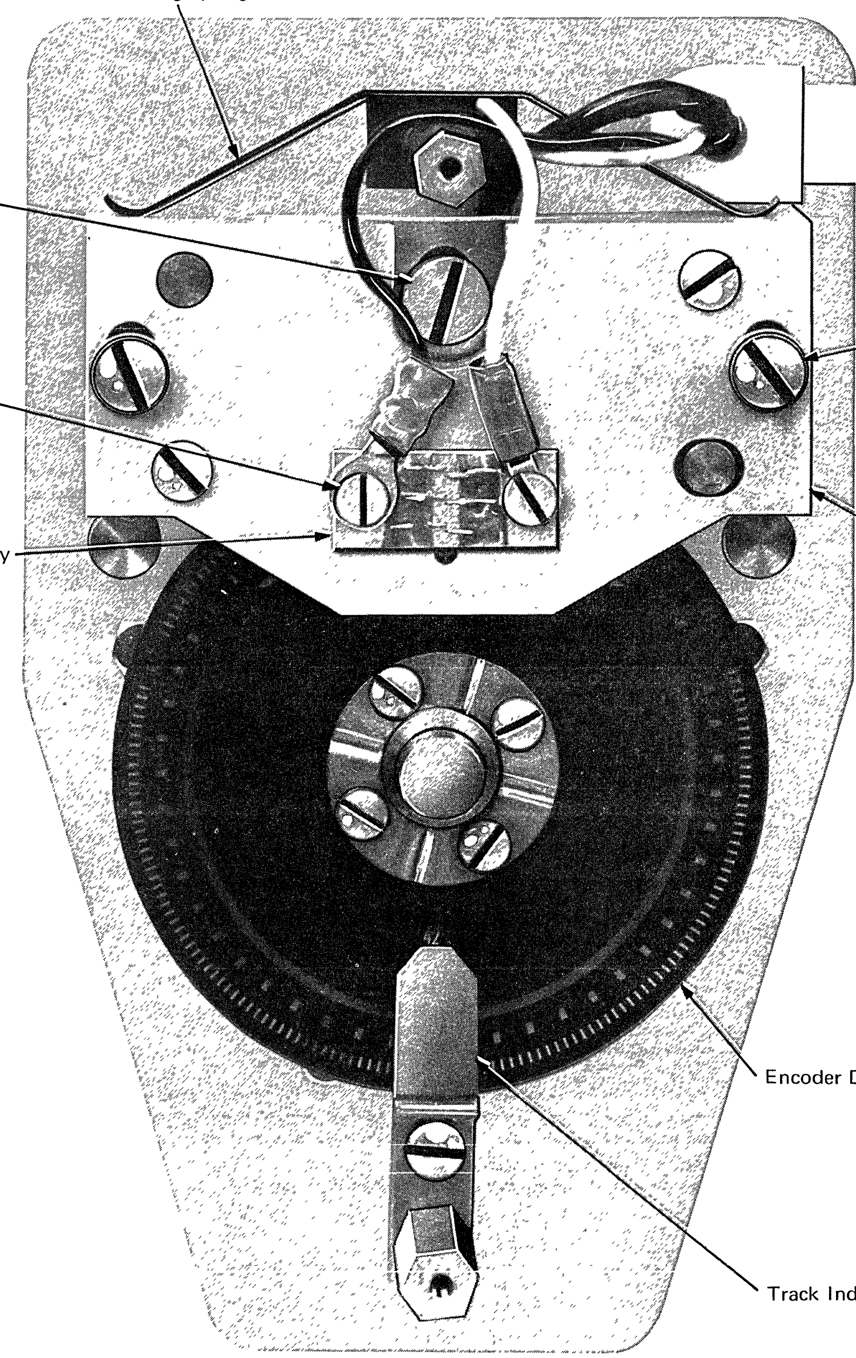
3.7.3.5 Replacement (Motors with Coupling Spring Type B)

1. Lubricate the bore of a bronze bush in the motor mounting casting with a thin film of Molykote 'G' Rapid grease (IBM part 5144304) to prevent the shaft from seizing.

CAUTION
In the next step, take care not to damage the bronze bush.

2. Insert the stepping motor into the casting and assemble the coupling onto the shaft as it passes through the casting.
3. Refit the four socket head screws and tighten them. Turn the stepping motor shaft manually to ensure that it is free to rotate.
4. Do not tighten the coupling clamping screw at this stage.
5. Assemble the pressure pad to the couplings.
6. Rotate the couplings until they are vertical and the pressure pads are uppermost.
7. Assemble the coupling spring as follows:
   a. Assemble the spring on the spring mounting tool, part 5144438, as shown in **C** .
   b. Pass the spring and tool up from underneath the couplings and position one free end of the spring in its functional position as shown in **A** . The free end of the spring must pass *between* the couplings to achieve this.
   c. With the spring in this position, pick the free end off the tool with a spring hook and position it as shown in **D** .
   d. Disengage the tool and withdraw it downwards.
   e. Ensure the spring is positioned correctly, that is, in line with and between the two couplings.
8. Connect the plugs to sockets J3 and J4 of the dc box.
9. Adjust the stepping motor (see 3.7.3.1).

3.7.4 Encoder Detector Board Assembly



[08585]

If a photocell fails, change the complete encoder detector board assembly, including the cable.

3.7.4.1 Removal

1. Disconnect plug J4 from the dc box. Remove the relevant cable terminations from the plug.
2. Remove the encoder assembly cover.
3. Remove the cable clip from the rear of the encoder assembly.
4. Remove the cable and grommet from the support plate.
5. Disconnect the cable from the lamp plate and remove the lamp assembly.
6. Unscrew the cover support post and remove the retaining spring.
7. Remove the horizontal adjustment screw and securing clip.

CAUTION
In the next step, take great care not to damage the emulsion-coated surface of the encoder disk.

8. Remove the fixing screws of the lamp/cell assembly and lift off the assembly.
9. Remove the detector board assembly.

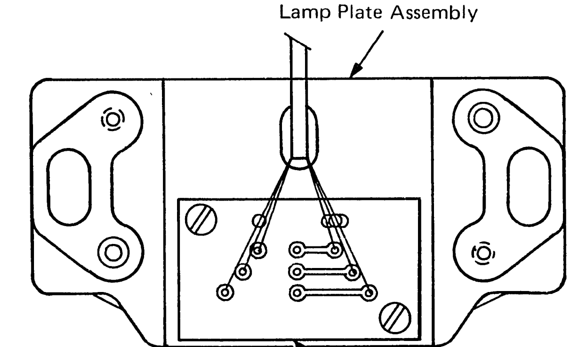
3.7.4.2 Replacement

CAUTION
When cleaning the encoder disk in step 1, take great care not to damage the emulsion-coated side. If isopropyl alcohol is not available, *use only dry lint-free tissue.* Take care also not to disengage the carriage from the leadscrew when rotating the motor shaft.

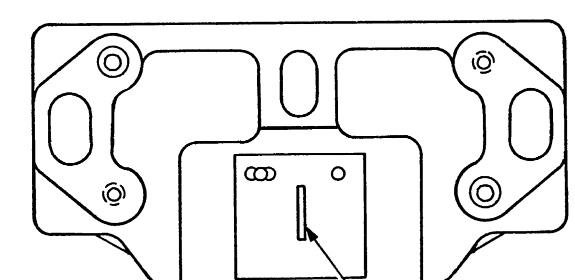
1. Remove the lamp plate from the detector board and clean all parts with isopropyl alcohol, applied with a lint-free tissue (see item 2.3.3 in Chapter 2 for part numbers). Pay particular attention to the aperture slit, which must be clean and unobstructed.
2. Refit the lamp plate.
3. Assemble the detector board assembly to the photocell plate.

CAUTION
In the next step, take care not to damage the emulsion-coated surface of the encoder disk.

4. Slide the lamp/cell assembly over the encoder disk and refit the fixing screws.
5. Refit the horizontal adjustment screw.
6. Assemble the retaining spring and cover support post. Ensure that the lamp/cell assembly is in contact with both support pins.
7. Refit the lamp assembly and reconnect the voltage cable. (Orientation of the lamp assembly and cable is not important.)
8. Slide the cable and grommet into the support plate. *Note:* Ensure that the cable is clear of the retaining spring and does not interfere with the free movement of the lamp/cell assembly.
9. Refit the cable terminations to plug J4.
10. Refit the cable clip.
11. Reconnect plug J4 to the socket on the dc box.
12. Adjust the speed symmetry (see 3.7.6.4).
13. Adjust the motor speed (see 3.7.8.1).
14. Adjust the singleshots (see 3.7.8.3 and 3.7.8.4).



Rear View of Lamp/Cell Assembly



Front View of Lamp/Cell Assembly (Lamp Plate Removed)

[08584]

3.7.5 Encoder Lamp Assembly

If an encoder lamp fails, change the complete assembly.

3.7.5.1 Removal

Remove the nylon screws and lift off the encoder lamp assembly.

3.7.5.2 Replacement

1. Fit the encoder lamp assembly and reconnect the voltage cable.
2. Refit the nylon screws and tighten them.
3. Adjust the speed symmetry (see 3.7.6.4).
4. Adjust the motor speed (see 3.7.8.1).
5. Adjust the singleshots (see 3.7.8.3 and 3.7.8.4).

3.7.6 Encoder Assembly Service Checks and Adjustments

Note: Use a Tektronix 453 oscilloscope for the following adjustments.

3.7.6.1 Lamp Assembly

Ensure that all three lamps are lit. If not, check the connections. If the lamps are still not lit, change the lamp assembly.

3.7.6.2 Photoamplifier Card

The photoamplifier card is located at Y-W1 B6.

1. Stop the 5444, but leave system power on.
2. Remove fuse F1 and plug P4.
3. Place a CE probe on the following output pins of card B6 in turn, and note the levels:
   '– Fine home' pin B13 should show down level;
   '+ Track crossing' pin J07 should show up level;
   '– Advance jk latches' pin J04 should show down level.
4. Add the following jumpers to apply –4V to inputs of the photoamplifiers:
   B6 B06 to B6 G09;
   C6 B06 to B6 J13;
   D6 B06 to B6 B09.
5. Place a CE probe on the output pins shown in step 3. The output levels should be reversed.
6. If any one of these outputs does not reverse, change the photoamplifier card and carry out these adjustments:
   a. Motor speed adjustment (see 3.7.8.1).
   b. Adjustments detailed in 3.7.8.3 and 3.7.8.4.
7. Remove the jumpers. Refit plug P4 and fuse F1.

3.7.6.3 Cell Assembly

Note: Check the photoamplifier card (see 3.7.6.2) before performing this operation.

1. Stop the 5444, but leave system power on.
2. Remove fuse F1.
3. Set the CE meter on dc 10V range. Connect the negative terminal by-gate frame and the positive terminal to the following pins on B6 card, in turn:
   'Fine home' B6 B12;
   'On track' B6 G11;
   'Feed back' B6 B10.
4. Rotate the motor shaft slowly by hand. Meter readings should vary between 0V and +4V for each pin probed, thus indicating that the photocells are switching.
5. Test each photocell in turn. If any photocell does not switch, check that the –4V dc supply is at the emitters of the photocells (plug P4, pins 2, 4, and 6). Note that the fine-home photocell only switches once per revolution of the encoder disk. If any photocell still does not switch, change the photocell board.
6. Refit fuse F1.

3.7.6.4 Speed Symmetry Adjustment

Adjustment of the lamp/cell assembly relative to the encoder disk ensures that the speed of the stepping motor (and, therefore, the access speed) is the same in both forward and reverse directions for seek operations. The adjustment is carried out by observing the time interval between the fall of 'fine home' at the start of one fine home in a forward seek operation, and overlaying this by the same time interval in a reverse seek operation. The two time intervals are equalized by positioning the lamp/cell assembly.

Note: Wipe clean the encoder disk with a lint-free tissue before attempting any adjustment because dirt on the disk could introduce extra pulses and upset the motor running. Clean the encoder disk also after any checking or adjustment. If the cell mounting block has been removed, ensure that the slit is clean and unobstructed.

If checking only is required, carry out steps 9 through 11.

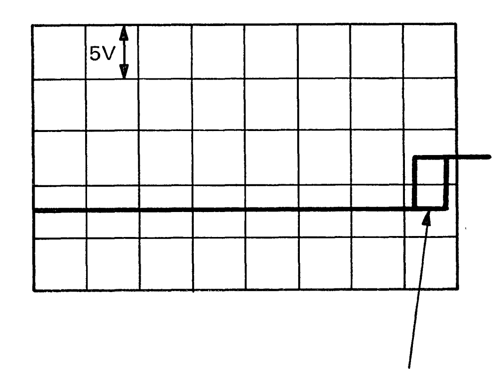
1. Remove all power to the 5444.
2. Attach jumper Y-W1 D6G13 to ground to inhibit '+ run'.
3. Power up the 5444 but do not start it.
4. Display 'feedback photocell output' (pin Y-W1 B6B09). Set the oscilloscope as follows:

CH1 VOLTS/DIV	to	2 volts/div
MODE	to	CHAN 1
TRIGGER	to	NORM
INPUT	to	DC
A SWEEP MODE	to	AUTO TRIG
SLOPE	to	– (negative)
COUPLING	to	DC
SOURCE	to	INT
MAG	to	OFF
A AND B TIME/DIV AND DELAY TIME	to	10 ms UNCAL

5. Remove the encoder assembly cover and slacken the lamp-cell assembly fixing screws. Leave the screws fingertight.
6. Adjust the horizontal adjusting screw on the lamp/cell assembly for the most negative level of the trace.
7. Reset the oscilloscope to CH1 VOLTS/DIV to 1 volt/div.
8. Repeat step 6.
9. Carefully tighten the fixing screws, alternating between the two to avoid altering the setting.
10. Set the CE mode-select switch on the CE panel to 50 TRKS and remove the jumper Y-W1 D6G13.
11. Start the 5444 and ensure that the carriage is at track 000 and that the brush cycle is complete. Set up 50-track repetitive accesses by jumpering Y-W1 F6G02 to ground.
12. Place a X1 probe on Y-W1 B6B12 ('+ fine home'). Set the oscilloscope as follows:
    CH1 VOLTS/DIV to 5 volts/div;
    A SWEEP MODE to NORM.
    Adjust 'A' variable so that the positive-going edges occur near the end of the sweep. When the triggering is correctly adjusted, the scope should trigger for both forward and reverse movements. If adjustment is required, the positive-going edges appear at two different positions, indicating that the seek is faster in one direction.
13. Slacken off the lamp/cell assembly fixing screws. Leave the screws fingertight.

CAUTION
In the next step, turn the horizontal adjusting screws little by little because fuse F1 will blow if the screw is turned to the full extent in either direction. If the fuse blows, repeat the adjustment procedure from step 1.

14. Adjust the horizontal adjusting screw on the lamp/cell assembly small amounts at a time so that the two edges come together. A fine adjustment can be obtained using the X10 magnification on the oscilloscope. Note that there is a lot of backlash in the adjusting screw.
15. Tighten the fixing screws carefully, alternating between the two to avoid upsetting the setting. Refit the encoder assembly cover.
    Note: Recheck after tightening. Repeat from step 13 if necessary.



[08586]

3.7.7 CE Tachometer Assembly

The CE tachometer assembly is used when the motor control system adjustments (see 3.7.8) are being made. The parts required are as follows:

Tachometer (1), part 450976.
Tachometer Coupling Assembly (1), part 2538084.
Capacitor Assembly (1), part 2600559.
Tachometer Bracket Assembly (1), part 2538137.
Tachometer Mounting Screws (3), part 438538.

Note: When assembling the tachometer to the encoder shaft assembly, ensure that the coupling is screwed up tightly.

3.7.8 Motor Control System Adjustments

Use a Tektronix 453 oscilloscope and the CE tachometer assembly for the motor control system adjustments. These adjustments must be performed as follows:

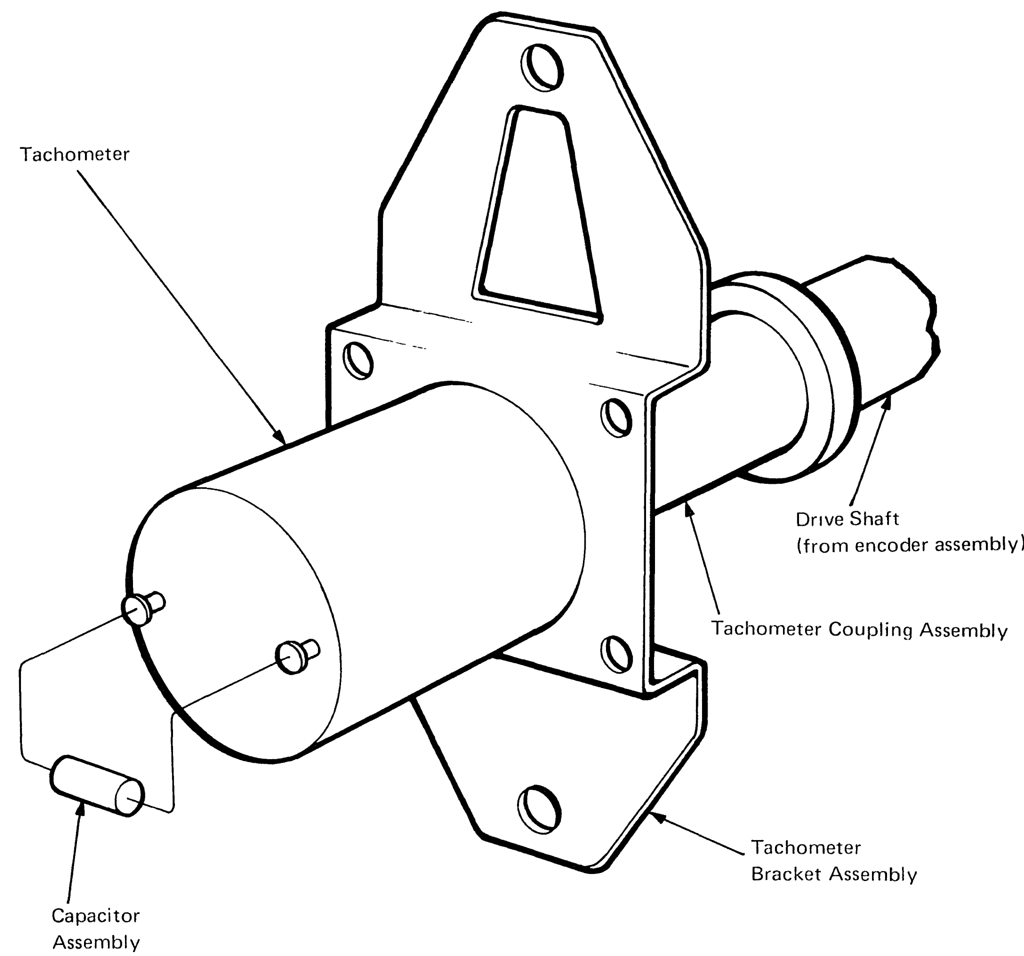
For Models 1, 2, and 3: perform adjustments 3.7.8.1, 3.7.8.3, and 3.7.8.4 in sequence.

For Models A01, A02, and A03: perform adjustments 3.7.8.1, 3.7.8.2, 3.7.8.3, and 3.7.8.4 in sequence.

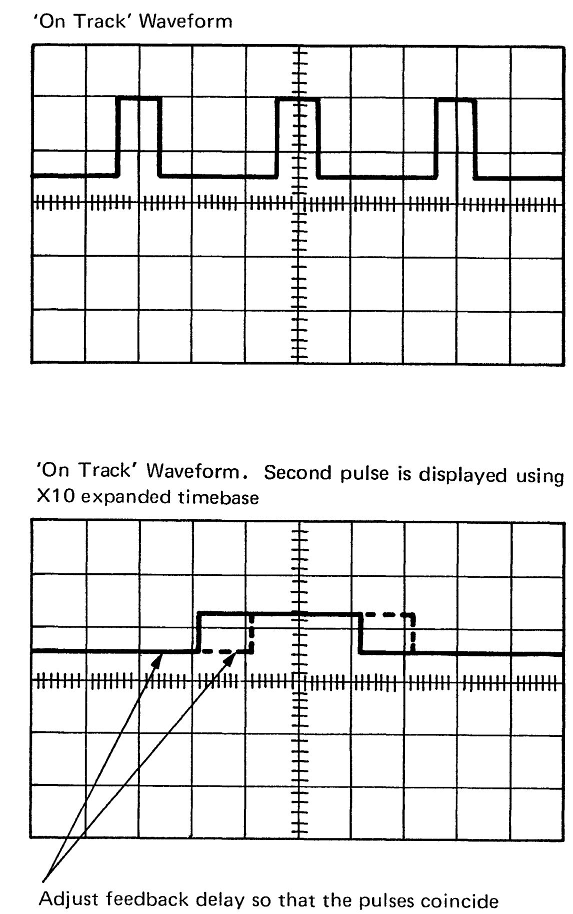
3.7.8.1 Motor Speed Adjustment

Note: The reason for this speed adjustment is to ensure that the motor runs at a constant speed equal to that speed reached after the first track of an access operation. The adjustment is carried out by observing the time interval between the fall of 'fine home' near track 001 and the 'on track' pulse at track 003, and equalizing this time interval to the corresponding time interval as the carriage passes track 053 during an access from track 0 to track 100.

1. Start the 5444 and allow the brush cycle to complete.
2. Move the mode-select switch on the CE panel to 50 TRKS.
3. Set up alternating moves between tracks 000 and 100 by jumpering Y-W1 B6G12 to B6D13 and Y-W1 F6G02 to ground.
4. Add the following jumpers:
   B6B02 to B6B13; and
   B6D04 to C6D09
   so that an AND gate (FS260) forms a signal to trigger the oscilloscope.



[08587A]



[08588]

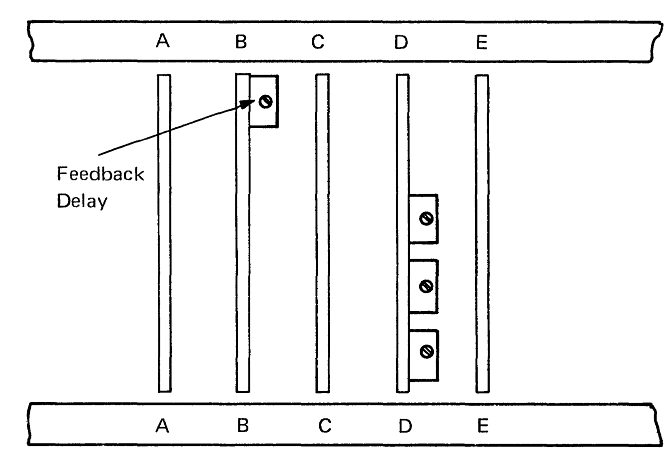
5. Set the oscilloscope as follows:

CH1 VOLTS/DIV	to	5 volts/div
MODE	to	CH1
TRIG	to	NORM
INPUT	to	DC
A SWEEP MODE	to	NORM
SLOPE	to	– (negative)
COUPLING	to	DC
SOURCE	to	EXT
MAG	to	OFF
A AND B TIME/DIV AND DELAY TIME	to	1 ms/DIV

6. Display 'on track' (pin Y-W1 B6J06) on CHAN 1 using the X1 probe and connect EXT TRIG input to Y-W1 B6B03. When triggering is correct, two traces are seen in rapid succession (double sweep) for each forward movement from track 000, as shown on first waveform.

CAUTION
If fuse F1 blows during adjustment, use the following procedure:

a. Remove all power to the 5444.
b. Remove fuse F1. Unplug plug P4 (lamps and photocell cables). Remove the four jumpers on Y-W1 gate.
c. Attach jumper Y-W1 A6J12 to B6B10.
d. Power up and start the 5444.
e. Display 'advance' latches (pin Y-W1 B6J10) on 2 volts/div. Trigger the oscilloscope with the negative edge of 'index pulse' (pin Y-W1 M6B13) and set the timebase to 50 μs/div.
f. Adjust the feedback delay potentiometer on card B6 until a negative-going pulse is displayed with its leading edge at four divisions from the start of the



Potentiometer Position on Y Gate (Card side)

[08589]

3.7.8 Motor Control System Adjustments (continued)

trigger. Readjust the timebase to 20 μs/div. Adjust the feedback delay potentiometer so that the leading edge of the pulse is 10 divisions from the start of the trigger.

g. Remove jumper. Stop the 5444 and remove power from it. Replug plug P4 and refit the fuse.

h. Return to step 1.

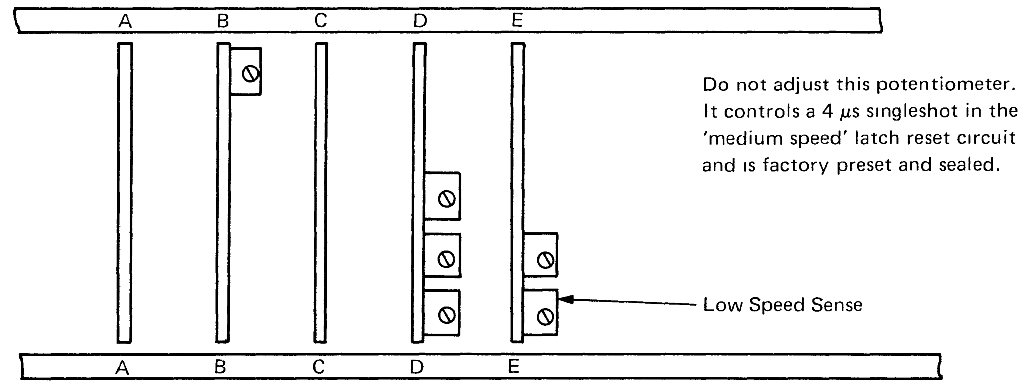
Note: If the double sweep ceases, check that the carriage is still moving between tracks 000 and 100. If it is not, remove the jumpers (step 3) and access to track 000, then refit the jumpers to start again. If the carriage does not retract by use of the CE mode-select switch, ground pin C6B13, make one forward access, then retract to track 000. Remove the jumper from C6B13.

7. Expand the timebase, using the X10 knob, and adjust the horizontal position control to display the second pulse as shown in second waveform.
8. Observe the timings of the pairs of pulses; they should occur at identical times, within one small division on the oscilloscope. If they do not occur thus, adjust the feedback delay (step 9).

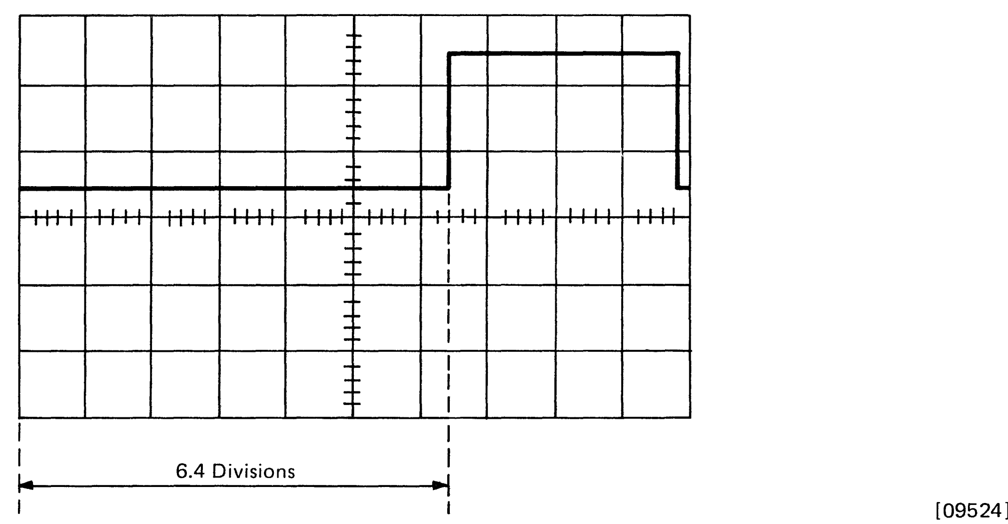
Note: Pulses appear within about 150 ms of each other, with one pair every 640 to 720 ms.

9. If the first pulse appears to the left of the second pulse (motor speed is too slow), turn the feedback delay potentiometer counterclockwise. Adjust the horizontal position control on the oscilloscope to keep the pulses on the screen as the motor speed increases. When the two pulses coincide, the adjustment is correct.

   If the first pulse appears to the right of the second pulse (motor speed is too fast), turn the potentiometer clockwise.
10. Perform the multitrack stop adjustment (see 3.7.8.3).



Potentiometer Positions on Y Gate (Card side)



3.7.8.2 Low Speed Sense Adjustment

The low speed sense adjustment is only required on high speed machines (Models A01, A02, and A03). It is performed to ensure that the machine runs at low speed at the correct time. If the low speed sense potentiometer is incorrectly adjusted, it may cause the heads to stop between, or over, the wrong tracks.

Note: Item 3.7.8.1 must be performed before this item.

1. Ensure that the 5444 is switched on and that the start-up cycle is completed.
2. Using the jumpers applied in section 3.7.8.1, steps 3 and 4, set the carriage alternating between tracks 000 and 100.
3. Reset the oscilloscope as follows:

A TIME/DIV	to	50 μs	A TRIGGERING
SOURCE	to	INT	
SLOPE	to	– (negative)	

4. Display 'low speed detect' pulses from Y-W1 E6J12.

   Adjust A TIME/DIV so that the average period occupies 10 divisions.
5. Adjust the low speed sense potentiometer to set the down level duration to 6.4 divisions, as shown.

   Note: If the potentiometer adjustment is inaccurate, the pulses may not be seen. In this case, set A SWEEP MODE to AUTO TRIG, then adjust the potentiometer until the pulses are seen. Proceed with the adjustment from step 3.
6. Remove the jumpers, then perform the adjustment given in item 3.7.8.3.

3.7.8 Motor Control System Adjustments (continued)

3.7.8.3 Multitrack Stop Adjustment

Adjustment of 'singleshot A multi' and 'singleshot B' ensures that the stepping motor and actuator come to a smooth controlled stop at the end of a multitrack seek. The motion of the actuator is monitored by scoping the voltage generated by the CE tachometer part 450976, attached to the end of the stepping motor shaft.

Note: For Models 1, 2, and 3: item 3.7.8.1 must be performed prior to this section. For Models A01, A02, and A03: items 3.7.8.1 and 3.7.8.2 must be performed prior to this section.

1. Stop the 5444 but leave system power on.
2. Remove the encoder assembly cover and attach the CE tachometer assembly (see 3.7.7).
   Note: Primary power noise is picked up on tachometer output if the drive motor is running during this operation.
3. Connect the following jumpers:
   Y-W1 A6G09 to ground
   Y-W1 A6D12 to ground
   Y-W1 C6J07 to ground
   } Allows carriage to be accessed without heads loading.
4. Switch the CE mode-select switch to 50 TRKS, then move the read/write heads to track 050. Using the forward/reverse switch, retract the read/write heads to track 000.
   Note: If a check only is required, perform steps 10 through 13, then proceed to step 18.
5. Connect a jumper from Y-W1 F6G02 to ground to set the carriage alternating between tracks 000 and 050.
6. Set up the oscilloscope as follows, using a X10 probe connected to CH1:

A SWEEP MODE	to	NORM TRIG
LEVEL	to	0 (A TRIGGERING)
SLOPE	to	+ (A TRIGGERING)
COUPLING	to	DC (A TRIGGERING)
SOURCE	to	INT (A TRIGGERING)
MODE	to	CH1
TRIGGER	to	CH1 ONLY
CH1 VOLTS/DIV	to	CAL, 0.2V
INPUT	to	DC (CH1)
A TIME/DIV	to	CAL, 0.1 ms

7. Display '+singleshot A multi' by connecting the CH1 probe to Y-W1 D6B04. Adjust 'singleshot A multi' to set the duration of the positive pulse to 500 μs.
8. Reset the oscilloscope as follows:

SLOPE	to	– (A TRIGGERING)
A TIME/DIV	to	CAL, 0.2 ms

9. Display '–singleshot B' by connecting the CH1 probe to Y-W1 D6G09. Adjust 'singleshot B' to set the duration of the negative pulse to 1400 μs.
10. Reset the oscilloscope as follows, using X10 probes:

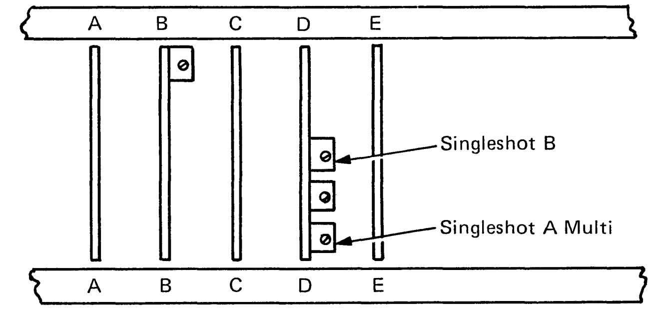
A SWEEP MODE	to	NORM TRIG
LEVEL	to	0 } (A TRIGGERING and B TRIGGERING)
SLOPE	to	+
COUPLING	to	DC
SOURCE	to	INT
MODE	to	CH2
TRIGGER	to	CH1 ONLY
CH1 VOLTS/DIV	to	CAL, 0.2V
CH2 VOLTS/DIV	to	CAL, 5 mV
INPUT	to	GROUND (CH1 and CH2)
A TIME/DIV	to	CAL, 5 ms

11. Set the CH2 trace to the centerline on the oscilloscope screen.
12. Reset the oscilloscope as follows:

INPUT	to	DC (CH1 and CH2)

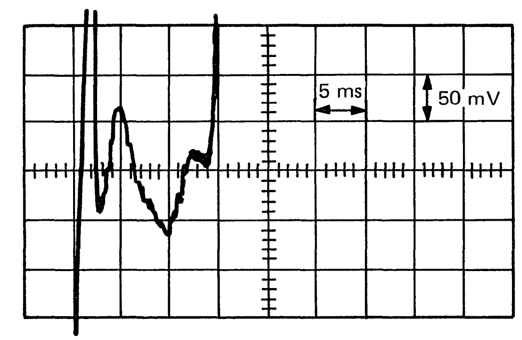
CAUTION
In the next step, radial force on the tachometer can change the waveform.

13. Connect the CH2 probe and ground lead across the tachometer, and the CH1 probe to Y-W1 G7D12. The oscilloscope waveform should be similar to that shown. If the oscilloscope waveform is inverted, reverse the probe connections to the tachometer.
14. Adjust 'singleshot A multi' so that the positive peak occurring at 10 ms from the start of the waveform lies on the centerline of the screen.
    Note: This positive peak may be hidden if the potentiometers are considerably out of adjustment. In this case, set the waveform to lie on the centerline of the screen at a point 10 ms from the start of the waveform.
15. Adjust 'singleshot B' to obtain minimum amplitude after 12 ms from the start of the waveform.
16. Repeat steps 14 and 15 until no further improvement is obtained.
17. Disconnect the jumper between Y-W1 F6G02 and ground.
18. Using the forward/reverse switch on the CE panel, move the carriage alternately forwards and backwards. Check the complete waveform to ensure that the potentiometers are adjusted correctly. On each reverse movement, check that there are no peaks greater than ± 50 mV occurring after 15 ms from the start of the waveform.
19. If the waveform is outside the tolerance limits, connect a jumper from Y-W1 F6G02 to ground, and repeat the adjustment from step 14.
20. Perform the single-track stop adjustment (see 3.7.8.4).



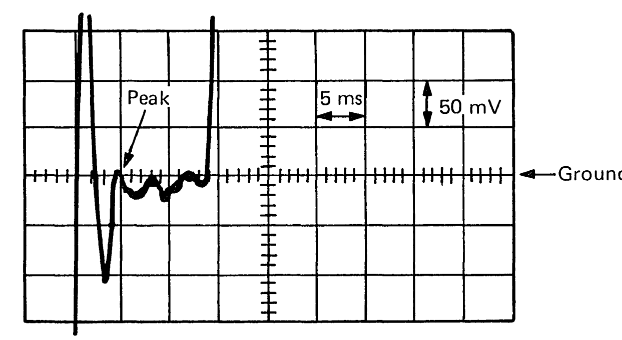
Potentiometer Positions on Y Gate (Card side)

[08590]



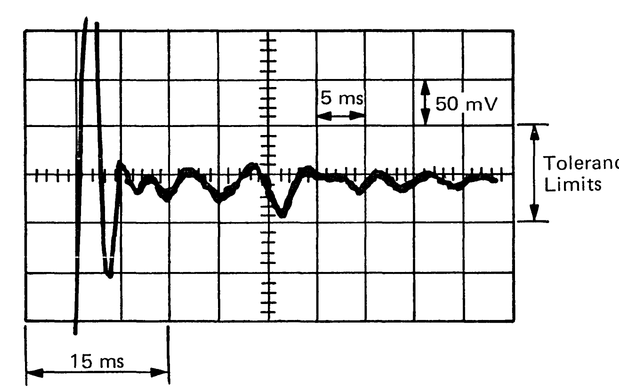
Tachometer Waveform before Adjustment

[08591]



Tachometer Waveform after Adjustment of 'Singleshot A Multi' (See step 14)

[08592]



Tachometer Waveform after Adjustment of 'Singleshot A' and 'Singleshot B' (See step 18)

[08593]

3.7.8 Motor Control System Adjustments (continued)

3.7.8.4 Single-Track Stop Adjustment

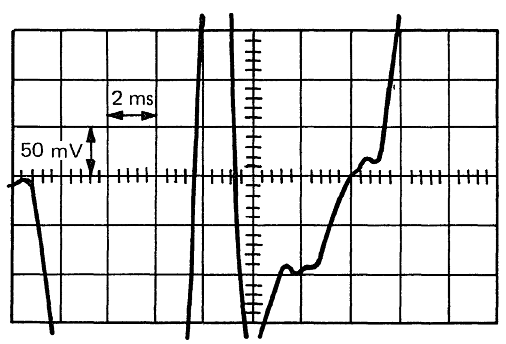
Note: Item 3.7.8.3 must be performed before this item.

1. Using the switches on the CE panel, move the carriage to track 000.
2. Set the mode-select switch on the CE panel to 1 TRK.

   Note: If a check only is required, proceed to step 7.
3. Connect a jumper from pin Y-W1 F6G02 to ground to set the carriage alternating between tracks 000 and 001.
4. Reset the oscilloscope as follows:

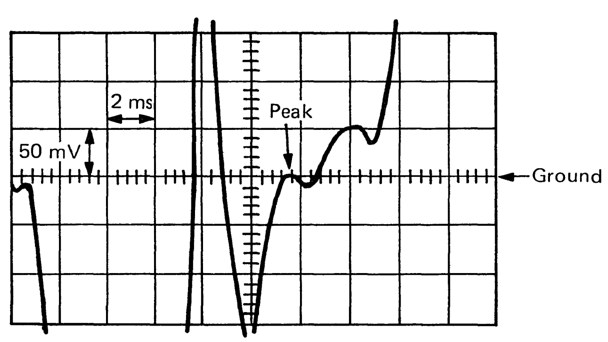
   A TIME/DIV to CAL, 2 ms

   The oscilloscope waveform should be similar to that shown.



[08594]

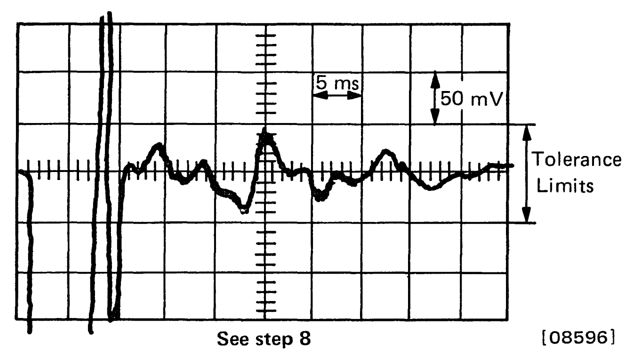
5. Adjust 'singleshot A single' to reduce the peaks to a minimum.



[08595]

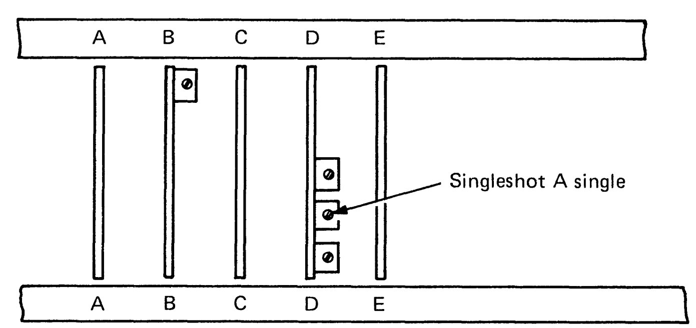
6. Disconnect the jumper between Y-W1 F6G02 and ground.
7. Reset the oscilloscope as follows:

   A TIME/DIV to CAL, 5 ms
8. Using the forward/reverse switch on the CE panel, move the carriage alternately forwards and backwards. Check the complete waveform to ensure that the potentiometer is adjusted correctly. On each reverse movement, check that there are no peaks greater than ±50 mV occurring after 15 ms from the start of the waveform.



[08596]

9. If the waveform is outside the tolerance limits, repeat the adjustment from step 3.
10. Remove all jumper and oscilloscope probe leads and the tachometer assembly.
11. Refit the encoder assembly cover.
12. Switch the CE mode-select switch to ON LINE.



Potentiometer Positions on Y Gate (Card side)

[08597]

3.7.9 Forward and Reverse Crash Stops

If the carriage travels beyond its limit switches, the follower wheel disengages from the leadscrew. When the carriage moves forwards, it is possible for the lowest R/W head (03) to be damaged by hitting the disk hub assembly; to prevent this occurrence, a mechanical limit stop is fitted. The following items describe the checks and adjustments that are needed to ensure safe operation.

3.7.9.1 Forward Crash Stop Adjustment

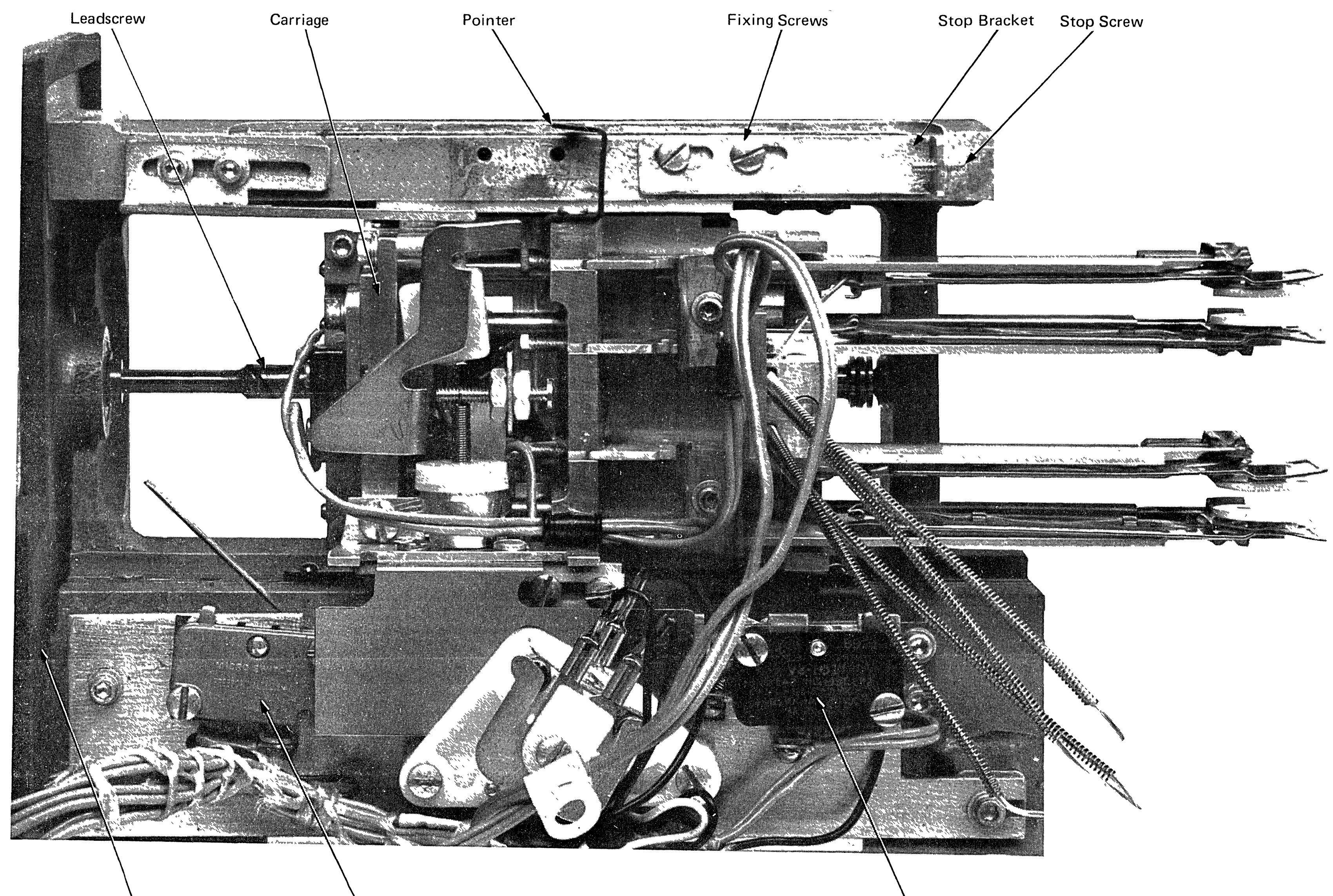
1. Remove power from the 5444, then remove the top cover.
2. Undo the hexagon-headed stop screw one half-turn from the fully tight position.
3. Slacken the two fixing screws of the stop bracket so that the bracket is free to slide.
4. Move the carriage gently forwards as far as it will go. (The carriage will disengage from the leadscrew.)
5. With the stop screw touching the carriage pointer, tighten the two fixing screws.
6. Tighten the stop screw. The carriage pointer now reaches the stop screw approximately 0.012 in. (0,30 mm) before R/W head 03 touches the disk hub.
7. Re-engage the carriage (see 3.7.9.2).

3.7.9.2 Carriage Re-Engagement

1. Remove power from the 5444.
2. Remove the top cover.

CAUTION
In the next step, do not use excessive force to push the carriage towards the threaded part of the leadscrew, otherwise the carriage may be forced onto the raised part of the leadscrew without engaging the threadform, thereby separating the thrust bearing from the end of the leadscrew. If this happens, carefully push the thrust bearing back into place. If the thrust bearing becomes completely detached, the actuator assembly must be changed.

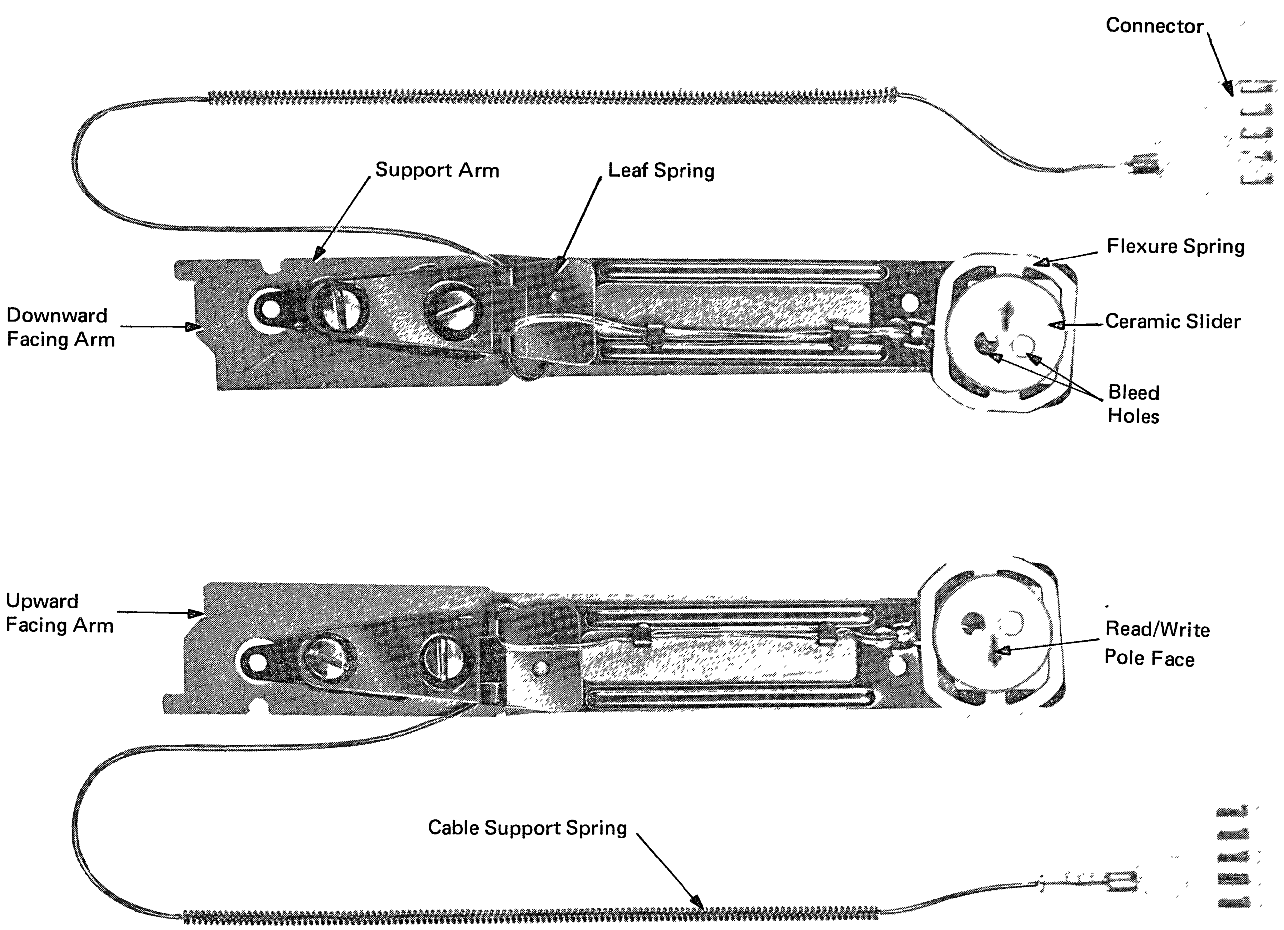
3. Push the carriage firmly towards the threaded part of the leadscrew; at the same time, rotate the stepping motor shaft in the following directions until the follower wheel engages the leadscrew:
   a. Clockwise, if the carriage is off the leadscrew at the forward crash stop.
   b. Counterclockwise, if the carriage is off the leadscrew at the reverse crash stop.
4. Release the carriage and continue to rotate the stepping motor shaft until the carriage is at track –100.
5. Investigate the reason for the crash stop condition.
6. Refit the top cover.



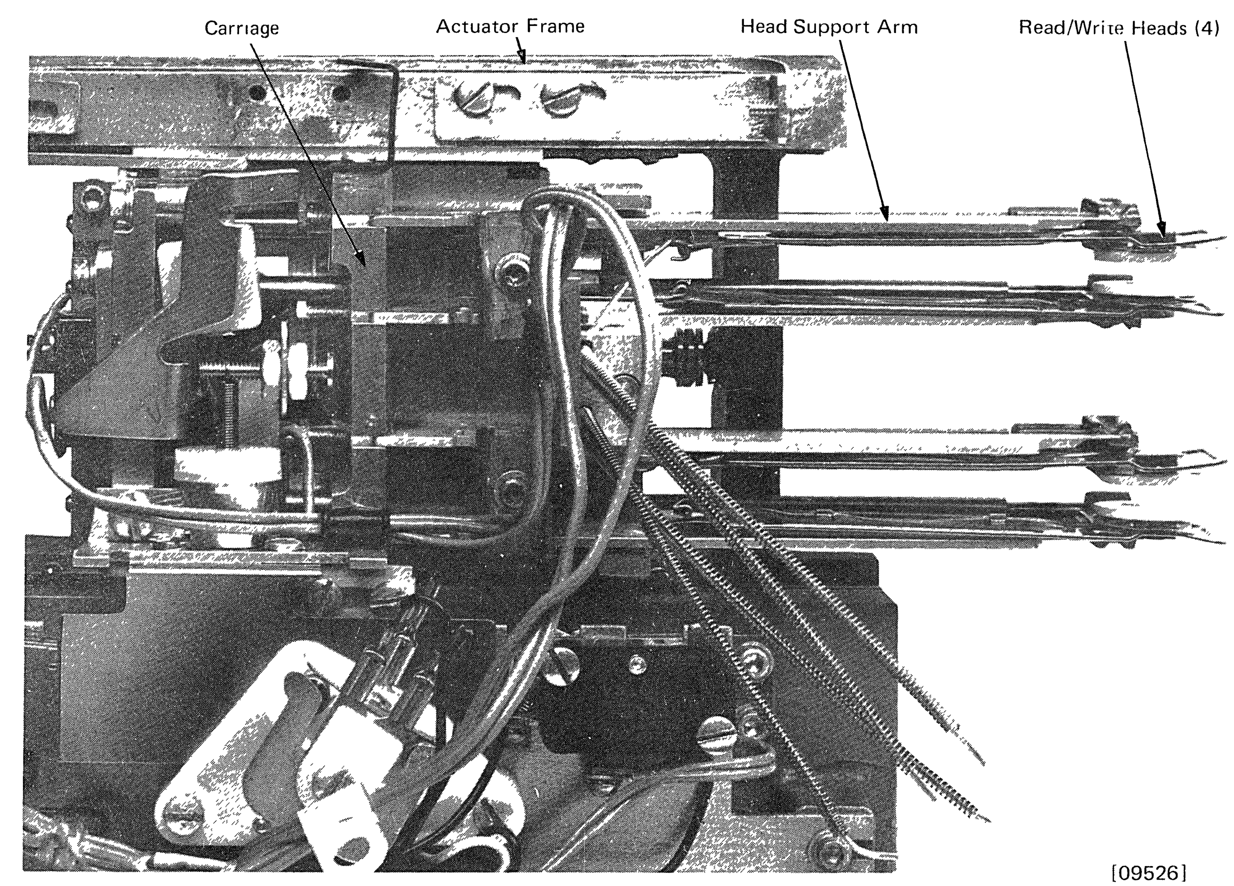
[09525]

3.8 Head/Arm Assembly

- The head/arm assemblies each consist of a read/write head, a support arm, and the connecting cable and plug.
- The support arms fit into slots in the carriage, which moves within the actuator frame and carries the heads over the disks. The head/arm assembly is adjusted in this slot to position the head exactly over the center of a particular track.



[07483]



[09526]

Read/Write Head

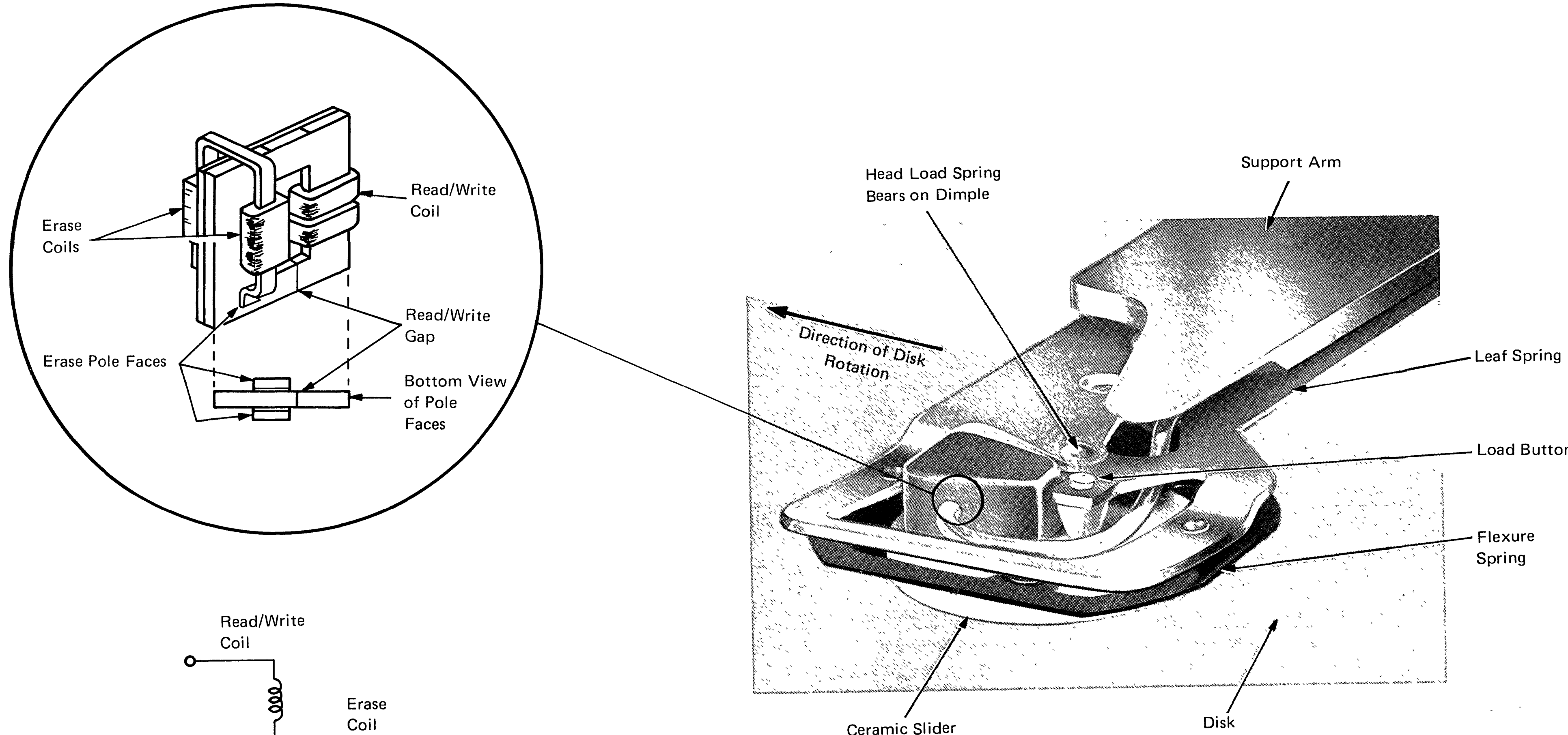
- The read/write head contains a read/write coil that is wound on a single core and an erase coil that is wound on a yoke.
- The erase coil follows the read/write coil and trims the edges of the written data tracks. The erase coil is always energized during a write operation.

Flying the Heads

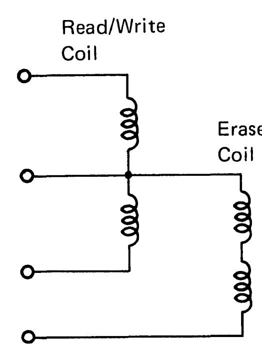
- A ceramic slider floats above the surface of the rotating disk on a thin film of air.
- This film of air acts as a lubricant between the slider and the rotating disk surface. While the air film is maintained, no wear or abrasion can occur. The spinning disk forces air between the disk and the slider, lifting the head against a head load force; at this point, the head is "flying". Two bleed holes in the slider partially relieve the pressure beneath it.
- A head load spring provides the force that holds the read/write head above the disk surface. The head load spring bears on the dimple of a leaf spring, which transfers the head loading through a load button to the ceramic slider.
- The head loading just balances the upward force from the air film, thus allowing the slider to fly. The flying height is 80 microinches at the innermost track and 99 microinches at the outermost track.

Write Current Level

- The write current is increased for tracks 000 through 099 (approximately) to compensate for the increased flying height at the outer tracks. (See "Write Circuits" in Section 3.11.)



[08601A]



Head Circuit

3.8.1 Cleaning R/W Heads

For the methods of cleaning R/W heads, see item 2.4.4 under "2.4 Preventive Maintenance" in Chapter 2.

3.8.2 Checks, Adjustments, and Removals

3.8.2.1 Height Check

1. Turn off power.
2. Remove the top cover.
3. Check that the carriage is fully retracted and the heads are unloaded.
4. Remove the disk cartridge.
5. Place the head clearance gage, part 5831638, on machined pad at the disk side of the cable clamp pillar. The jaws of the tool should be behind the heads.
6. Carefully move the carriage and check that the heads clear the jaws of the tool. If a head does not clear the jaws, change the head arm (see 3.8.2.4 and 3.8.2.5) and recheck. If the new head does not clear the jaws, check the adjustment of the head-load spring shaft (see 3.9.9).
7. Remove the tool, then refit the disk cartridge and top cover.

3.8.2.2 Head Damage

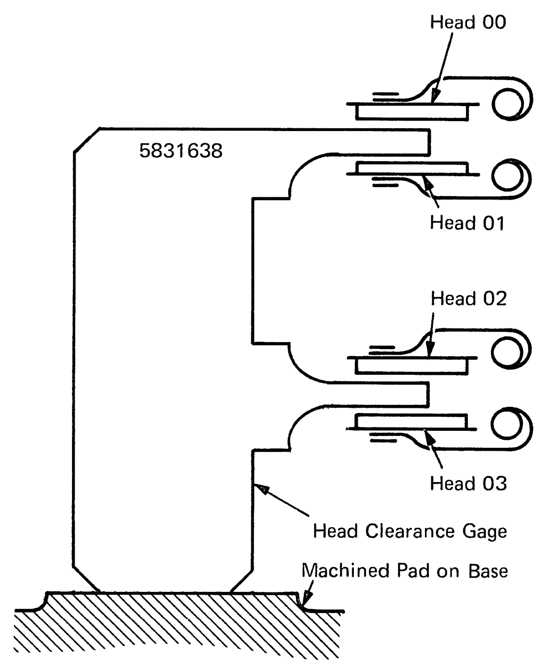
The routine inspection for damage to R/W heads is described in item 2.4.4 under "2.4 Preventive Maintenance" in Chapter 2.

A faulty head can give read/write errors or can cause damage to a disk; typical symptoms of faulty heads are:

1. A rapid accumulation of oxide on a particular head.
2. Regularly spaced radial, circular, or spiral scratches on the disk surface.
3. Tinkling noises, caused by the head bouncing on the disk.

In all cases, change the faulty head (see 3.8.2.4 and 3.8.2.5).

On replacement, align the new head (see 3.8.2.3) and clean the disk (see 3.3.2.2 or 3.3.3.2).



As the heads move forward they must clear the gage

[08602]

3.8.2 Checks, Adjustments, and Removals (continued)

3.8.2.3 Head Alignment

Alignment of Heads 00 and 01: The two upper R/W heads need to be aligned so that they can accept any disk cartridge. The two lower R/W heads keep a constant relationship with the fixed disk.

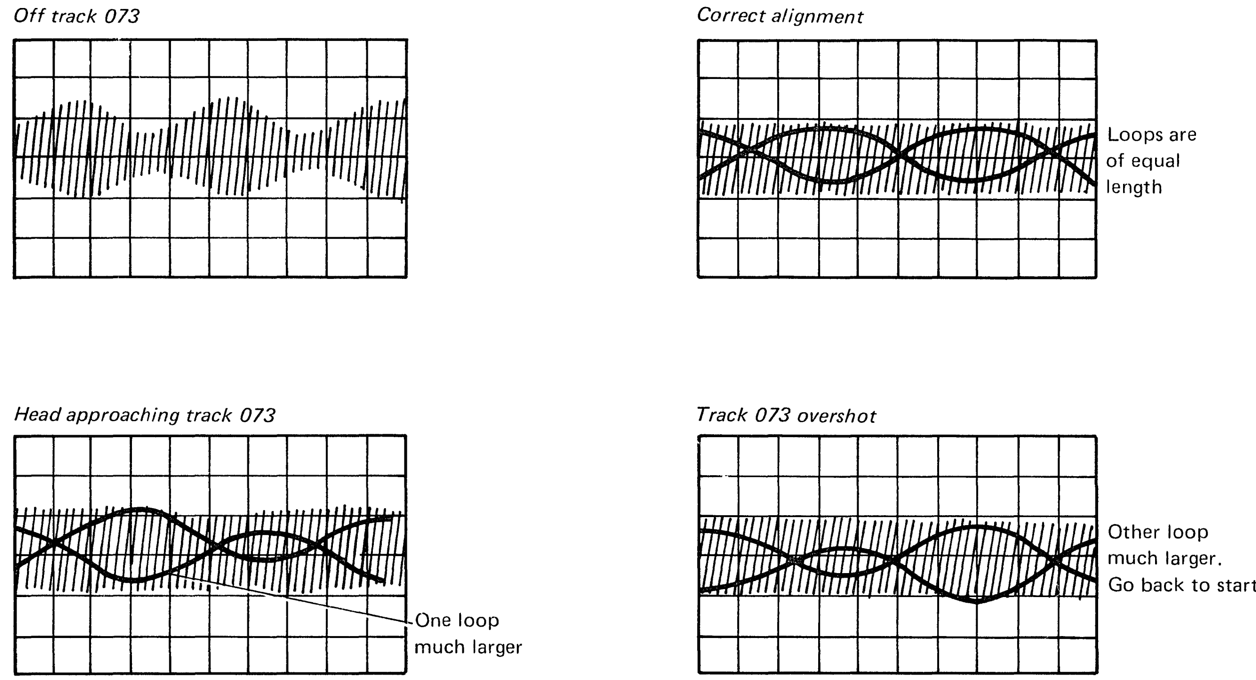
1. Turn off power.
2. Remove the disk cartridge.
3. Install the CE cartridge, part 2537301 (see item 2.3.3.3 under "2.3 Maintenance Facilities" in Chapter 2).
4. Turn on power.
5. Remove the top cover and observe that the R/W heads are loaded to track 000.
6. Operate the switches on the CE panel to move heads to track 073 (see item 2.3.1 under "2.3 Maintenance Facilities" in Chapter 2).
7. Set the CE mode-select switch to HD0.
8. Set the Tektronix 453 oscilloscope (using X1 probes) as follows:

Connect CH1 probe	to	Channel 1
Connect CH2 probe	to	Channel 2
A SWEEP MODE	to	NORM TRIG
LEVEL	to	0 (A TRIGGERING)
COUPLING	to	AC (A TRIGGERING)
SOURCE	to	EXT (A TRIGGERING)
TRIGGER	to	NORM (A TRIGGERING)
MODE	to	ADD
CH1 VOLT/DIV	to	50 mV
CH2 VOLT/DIV	to	50 mV (INVERT)
INPUT	to	AC (CH1 and CH2)
A TIME/DIV	to	CAL 5 ms

Note: Before commencing alignment, run the CE cartridge for 15 minutes to allow it to reach the temperature of the 5444.

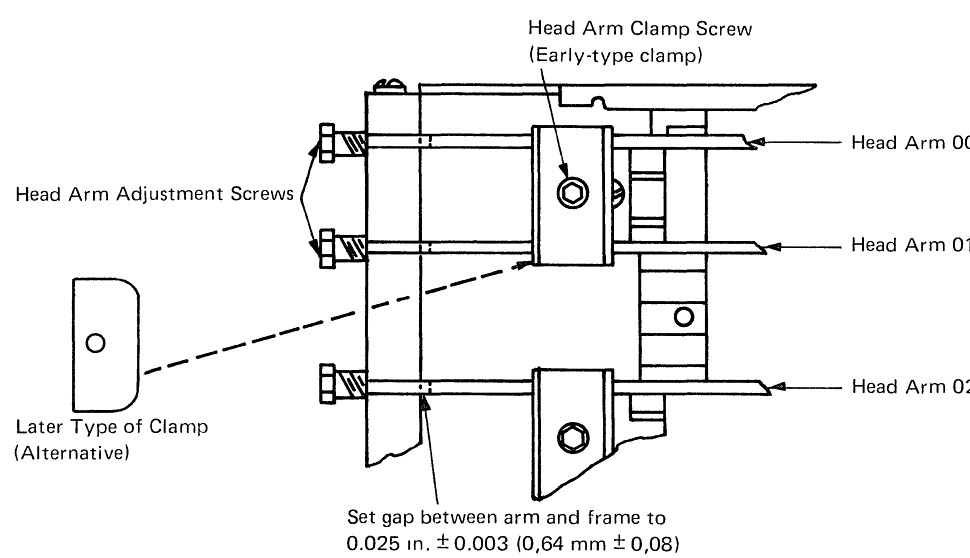
Prior to any adjustment, check the oscilloscope trace, against the display shown, for correct head alignment. Use the horizontal sweep control to position the two loops across eight divisions. If the loops are not equal within 0.15 division, carry out the head alignment as follows:

9. Slacken the clamp screw of the upper head arms. Turn back, *by one-quarter of a turn,* the adjustment screws of the two upper head arms.



Oscilloscope Displays (5 ms/division)

[08603]



[08604A]

10. Push R/W heads 00 and 01 back to the adjustment screws and tighten the clamp screw to 4 lb in. (4,6 kg cm) with torque wrench, part 2597969, and 6-flute adapter, part 2597971.
11. Screw in on the adjustment screw of head arm 00; as the R/W head approaches track 073, the oscilloscope display loops appear.
    Continue to screw in carefully until the loops are similar in size, 3.8 to 4.2 divisions in length. Use the horizontal sweep control to place the two loops across eight divisions.
    Note: The head arm adjustment screw only pushes the arm forward. If track 073 is overshot, return to step 9.
12. Set the CE mode-select switch to HD1. Screw in on the adjustment screw of head arm 01 and set the equal length loops as in step 11.
    Note: When checking head 01, if track 073 is overshot and the head arm clamp is loosened, recheck head 00 to ensure that its setting has not changed.
13. Remove the CE cartridge.
14. Carry out the forward crash stop adjustment (see 3.7.9.1) unless the alignment of heads 02 and 03 is to be performed immediately.

Alignment of Heads 02 and 03: If the heads are being replaced on an existing fixed disk, refer to the error recovery procedure in item 2.2.2 (Chapter 2).

After fixed disk replacement align heads 02 and 03 as follows:

1. Slacken the clamp screw of the lower head arms. *Fully* turn back the adjustment screws of the two lower head arms.
2. Insert a 0.025 in. (0,64 mm) feeler gage between the rear of the arms and the carriage casting then tighten the clamp screw to 4 lb in. (4,6 kg cm) with torque wrench, part 2597969, and 6-flute adapter, part 2597971.
3. After tightening, turn forward the head arm adjustment screws to just touch the head arms. Check that the gap is still 0.025 in. ± 0.003 (0,64 mm ± 0,08).
4. Carry out the forward crash stop adjustment (see 3.7.9.1).
5. Refit the top cover.

3.8.2 Checks, Adjustments, and Removals (continued)

3.8.2.4 Removal

If R/W heads 02 and 03 are to be removed and the data on the fixed disk to be retained, transfer the data to a disk cartridge before head removal. Refer to item 2.2.2 in Chapter 2.

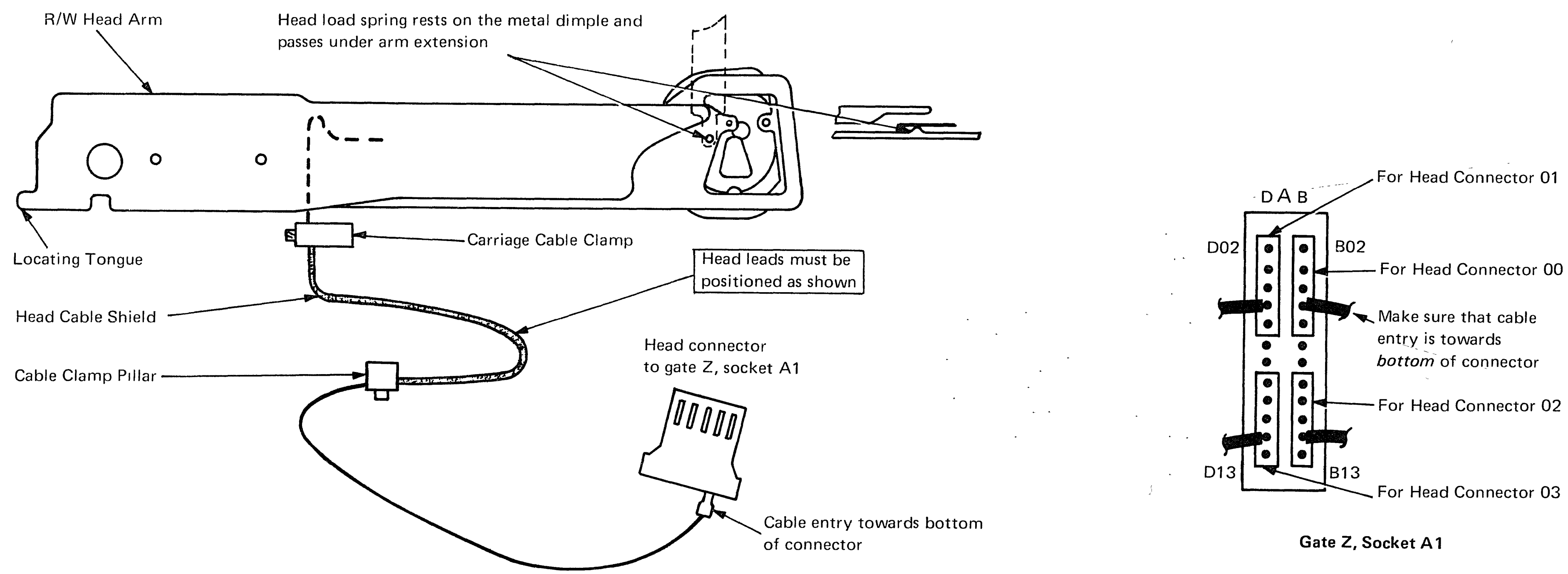
CAUTION
In the following steps, do not touch the face of the R/W head. Do not touch the disk with the head arm.

1. Turn off power and ensure that the carriage is fully retracted.
2. Remove the disk cartridge and the top cover.
3. Remove the clamp and unplug the head connector at gate Z.
4. Release the head cable shield from the clamp pillar and from the carriage cable clamp.
5. Take off the appropriate head arm clamp.
6. Take out the head sideways from the carriage, holding by the head support arm.

3.8.2.5 Replacement

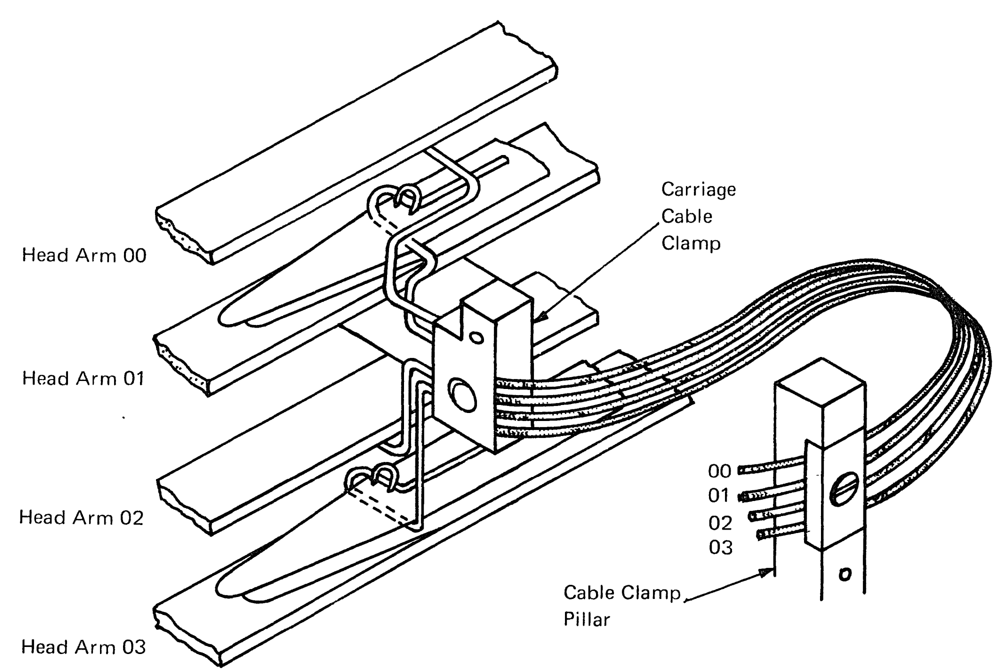
CAUTION
In the following steps, do not touch the face of the R/W head. Do not touch the disk with the head arm.

1. Route the cable in the new R/W head arm as shown. Open the leaf spring not more than 0.2 in. (5 mm) to insert cable. *The separation between the leaf spring and the head support arm must not exceed 0.2 in.*
2. Slide the head support arm into the carriage from the side. Insert the locating tongue of the arm in a slot near the head arm adjustment screw.
   Note: Make sure that the head-load springs are correctly located on the metal dimple and pass under the arm extension.
   CAUTION
   In the next step, it is essential that the head leads are positioned exactly as shown, to prevent them breaking.
3. Loosely fit the head arm clamp. Secure the ends of the head cable shield in the carriage clamp and the clamp pillar.
4. Plug the head connector into socket A1 of gate Z, then check that the head cables do not touch the disk at any carriage position. Refit the head plug clamp at gate Z.
5. Carry out the height check and alignment procedures (see 3.8.2.1 and 3.8.2.3).
6. Install the disk cartridge and refit the top cover.



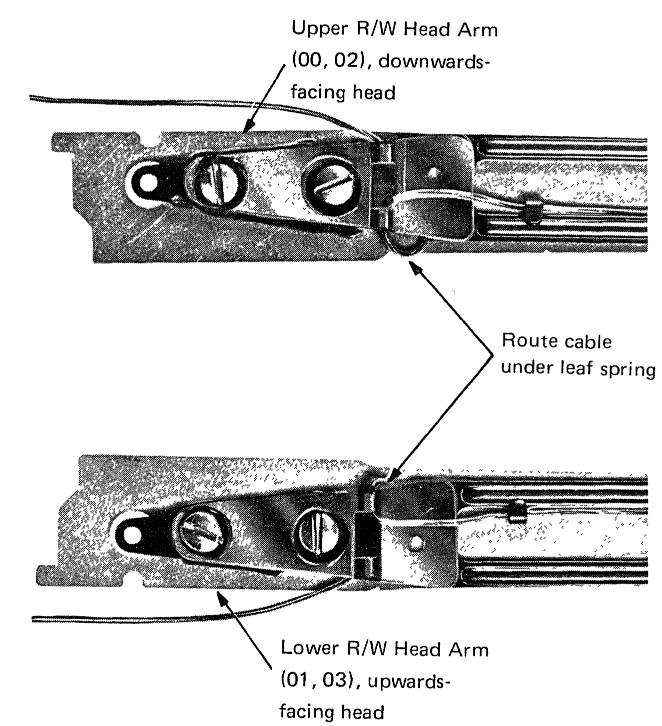
Gate Z, Socket A1

[08605A]



Cable Runs to R/W Head Arms

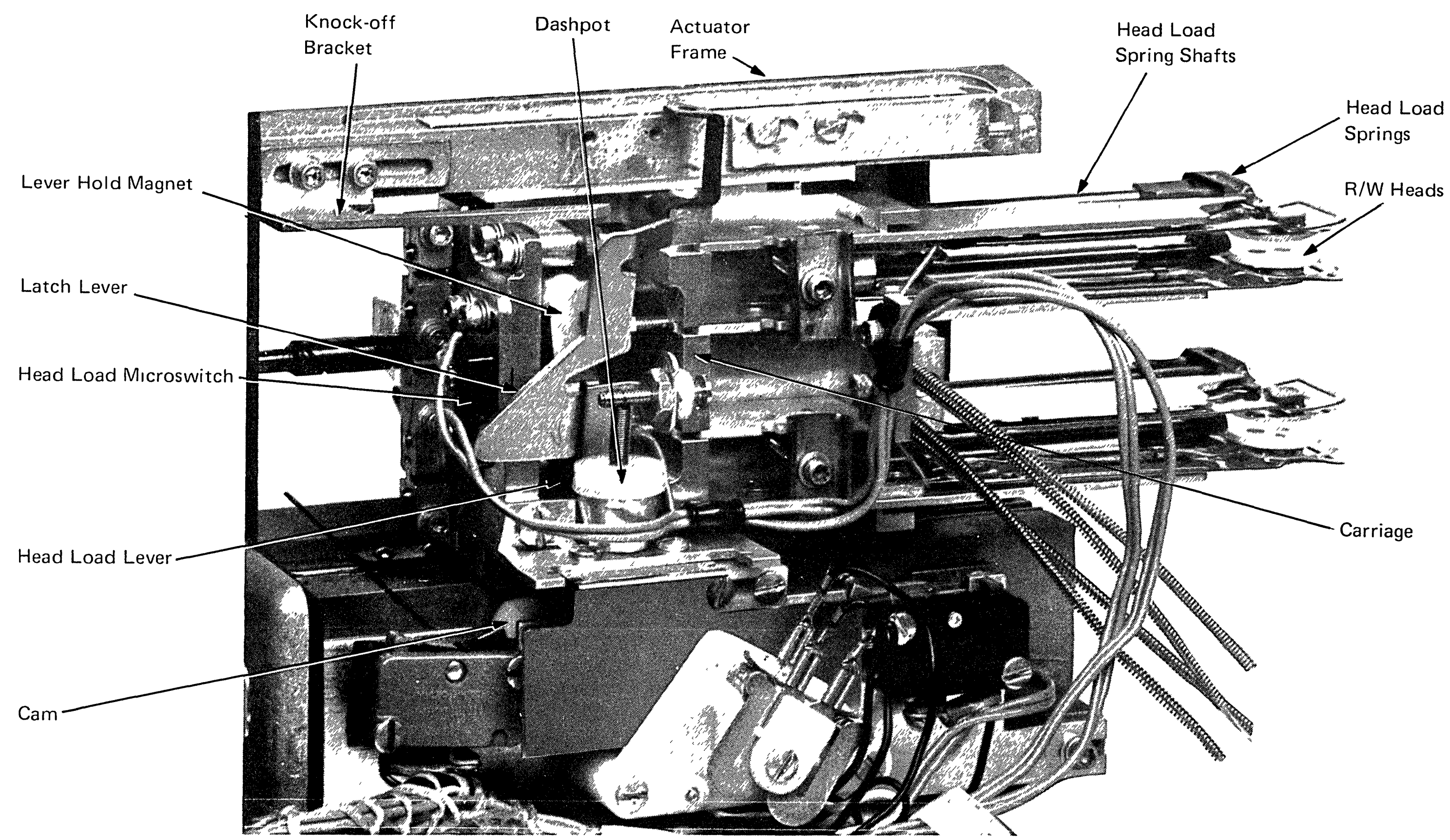
[08606]



[08607]

3.9 Head Load Mechanism

- The R/W heads are held close to the disks by head load springs that are attached to four head load spring shafts. The shafts are linked together so that all heads are loaded simultaneously.
- A head load lever is attached to head load spring shaft 03. When the heads are loaded, a load arm bearing (attached to the head load lever) rides up a cam, lifting the head load lever to turn shaft 03. All four shafts turn together; shafts 00 and 02 turn to move their head load springs downwards, shafts 01 and 03 turn to move their head load springs upwards.
- The head load lever is held "loaded" by a latch lever that is retained by a lever hold magnet. When the magnet is de-energized, the latch lever drops and releases the head load lever, and the heads are unloaded.
- The head load mechanism is mounted on the carriage to maintain the head-loaded condition while the carriage is moving.



[09527]

Knock-Off Bracket – Description

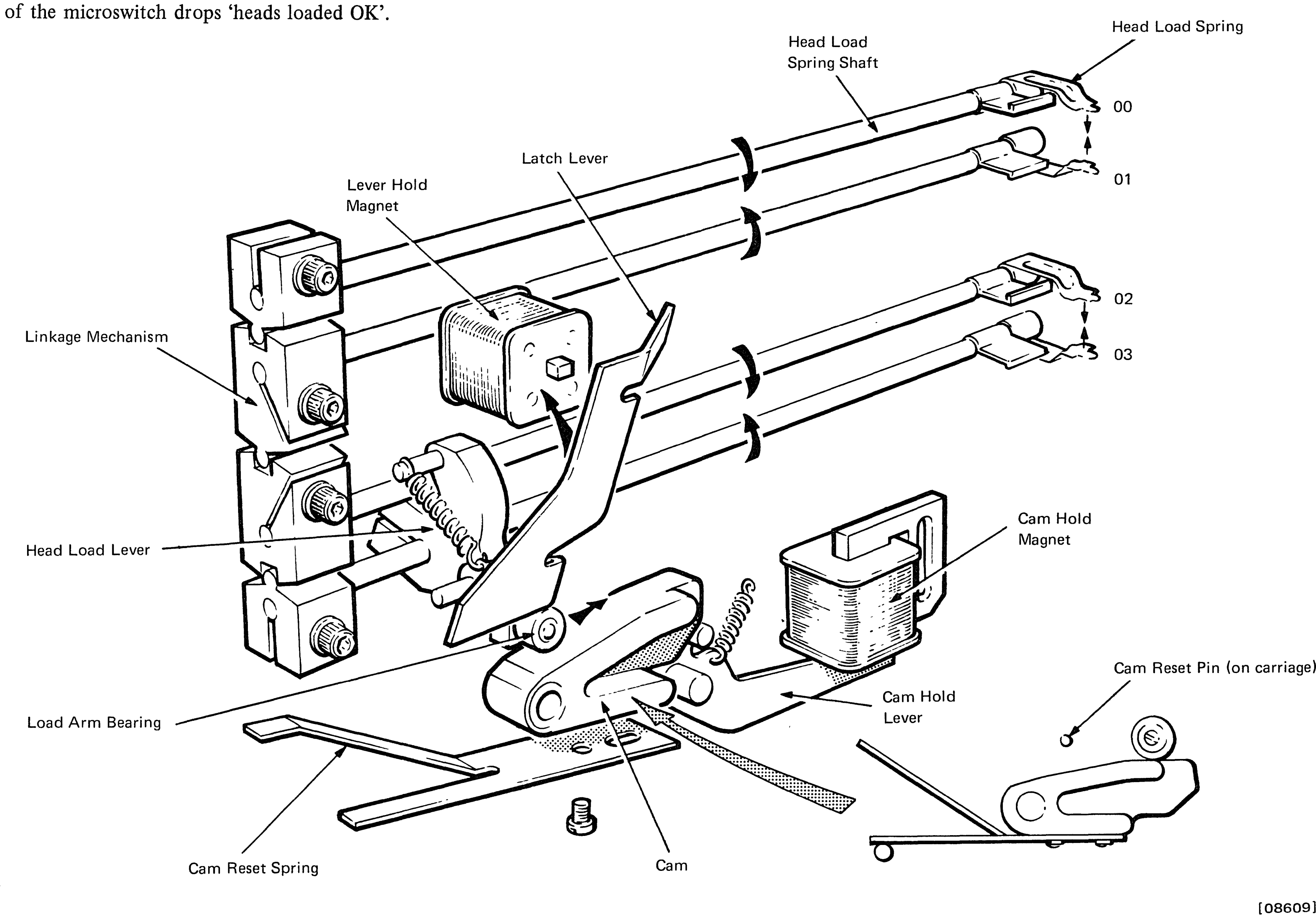
- A knock-off bracket is fitted to prevent the heads being withdrawn from the disks in a loaded or semi-loaded condition.
- If the heads are retracted behind track 000 with the latch lever still raised (thus holding up the head load lever), the knock-off bracket hits the latch lever, forcing the lever away from the lever hold magnet. The head load lever then drops to unload the heads.

Loading the Heads

- When the 5444 is not in use, the R/W heads are retracted from the disks, unloaded.
- The heads are loaded during the start-up sequence when the disks have reached their normal running speed, the brush sweep over the disks is completed, and the heads are over the disks.
- When the carriage is fully retracted, the cam reset pin, by pushing on the raised portion of the cam reset spring, raises the cam to its operating position. The cam hold lever is free to rise under the influence of its spring to make contact with the cam hold magnet.
- When '+24V file start' is activated during a start-up sequence, the cam hold magnet is energized, holding up the cam hold lever; the cam is now prevented from falling even when the cam reset spring is released. When the disk-cleaning brushes start to move, 'brush midcycle' causes the lever hold magnet to be energized in preparation for the expected movement of the latch lever.
- Near the end of the brush cycle, 'brush midcycle' drops, initiating forward carriage movement. At approximately track 000, the load arm bearing comes into contact with the cam. Further forward carriage movement causes the bearing to rise up the cam, thereby raising the head load lever and turning head load spring shaft 03. When the bearing reaches the top of the cam (at approximately track 080), the heads are fully loaded.
- As the bearing moves up the cam, a pin on the head load lever rides up a ramp on the latch lever, allowing the spring-loaded latch lever to move into contact with the lever hold magnet. The magnet (already energized) retains the latch lever, allowing the latch lever to support the head load lever in the head-loaded position. The latch lever also operates the head load microswitch, giving the logic signal 'heads loaded OK'.
- The carriage continues moving forward to track 100 and is then recalibrated to track 000, with the heads loaded (see "Recalibration to Track 000" in "3.7 Actuator and Encoder Assemblies"). Meanwhile, the brush cycle continues. When 'brush cycle complete' is dropped, the cam hold magnet is de-energized and the lower part of the cam reset spring (bearing on a pin in the actuator housing) forces the cam to drop. The cam hold lever is pushed down against its spring, and finally locked in the down position.

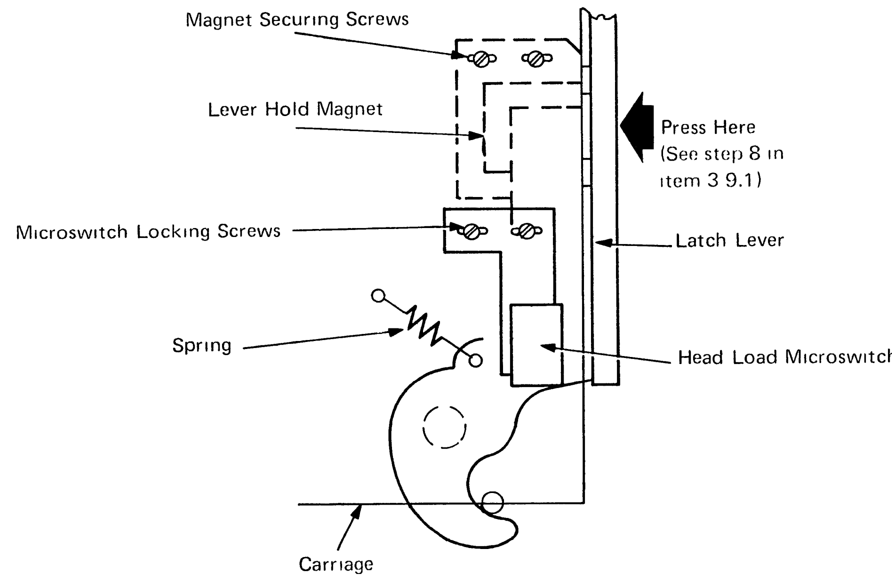
Unloading the Heads

- The heads unload automatically if the disk speed falls below 64% of maximum, or if a data-unsafe condition exists.
- When the lever hold magnet is de-energized, the latch lever is released, and the head load lever falls, turning shaft 03 to unload the heads.
- As the head load lever falls, its pin moves down the ramp on the latch lever, causing the lever to move away from the lever hold magnet and head load microswitch. Operation of the microswitch drops 'heads loaded OK'.

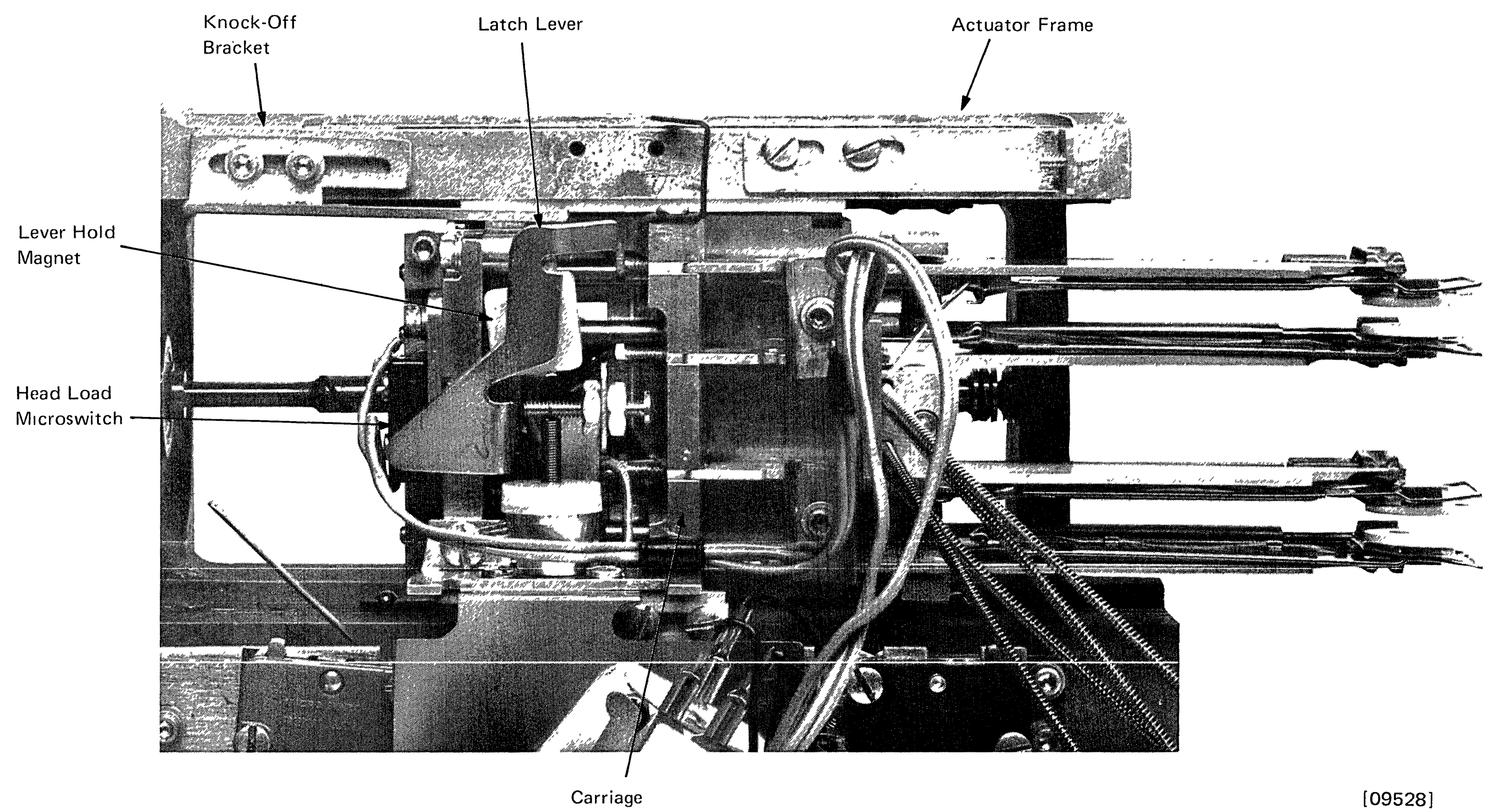


3.9.1 Mechanism Adjustment

1. Remove all power from the 5444. Disconnect the stepping motor plug P3.
2. Check that the cam hold magnet is against the cam hold lever and that the two poles of the magnet are in contact with the lever.
3. Connect a jumper from pin Y-W1 F6B07 to ground.
4. Turn on power and start the 5444.
   Note: The brush motor will now cycle continuously, enabling the cam hold magnet to be energized.
5. Move the carriage manually to track 100 by turning the stepping motor shaft counterclockwise.
6. Loosen the two securing screws on the lever hold magnet and move the magnet away from the latch lever.
7. Hold the latch lever in its present position.
   Note: Hold the latch lever firmly but do not overcome the resistance of the R/W heads, otherwise this will overload the heads and push them onto the disks.
8. Press the lever hold magnet against the latch lever, ensuring that the two poles of the magnet are in contact with the lever. Lock the securing screws.
9. Remove the jumper from Y-W1 F6B07.
10. Switch off the 5444. Reconnect plug P3, then restart the 5444.
11. Move the carriage to track 200, using the CE mode-select switch on the CE panel set to 50 TRKS.
12. Slacken off the head load microswitch locking screws.
13. Adjust the microswitch so that it is in the "operated" condition and all overtravel is taken up. Tighten the locking screws.
    Notes:
    a. Take care not to release the latch lever from the lever hold magnet, but do not hold the lever manually in position when carrying out this adjustment.
    b. For a visual indication of when the switch is operated, connect a CE probe to pin Y-W1 C6G03. When the switch is operated, the probe indicates 'line up'.
14. Refit the top cover.



End View from Stepping-Motor End of Actuator [08610A]



[09528]

3.9.2 Knock-Off Bracket - Adjustment

Note: Whenever the latch lever is removed, the knock-off bracket requires adjusting.

1. Switch on the 5444.
2. Move the carriage to track 000, then connect a jumper from pin Y-W1 C6D02 to ground (to permit carriage movement behind track 000).
3. Set the CE mode-select switch to 1 TRK.

CAUTION
In the next step, do *not* move the carriage past track –008; if the heads unload, remove the jumper and restart at step 1.

4. Access the carriage forward one track to reset the 'inhibit retract' latch.
5. Adjust the knock-off bracket to operate the latch lever between tracks –005 to –007.
6. Move the carriage forward to track 000.
7. Remove the jumper.

3.9.3 Latch Lever

3.9.3.1 Removal

1. Unhook the latch lever spring and remove the circlip from the lever pivot.
2. Withdraw the latch lever from the pivot.

3.9.3.2 Replacement

1. Smear the pivot lightly with IBM no. 20 grease.
2. Assemble the latch lever to the pivot and refit the circlip.
3. Hook the spring on to the spring post.
4. Adjust the knock-off bracket (see 3.9.2).

3.9.4 Lever Hold Magnet

3.9.4.1 Removal

1. Remove all power from the 5444.
2. Move the carriage forward manually to approximately track 200 by turning the stepping motor shaft counter-clockwise.
3. Remove the magnet connections from actuator plug P6.
4. Remove the screws holding the magnet.

3.9.4.2 Replacement

1. Place the magnet in position and secure it with the screws.
2. Remake the magnet connections to plug P6.
3. Tape the wires to the cable assembly.
4. Adjust the head load mechanism (see 3.9.1).

3.9.5 Head Load Microswitch

3.9.5.1 Adjustment

1. Remove all power from the 5444. Disconnect the stepping motor plug P3.
2. Turn on power and start the 5444.
3. Remove the top cover.
4. During the brush cycle return stroke, move the carriage manually to track 200 by turning the stepping motor shaft counter-clockwise.
5. Slacken the head load microswitch locking screws. The adjusting plate is now free to move.
6. Adjust the microswitch so that it is in the "operated" condition and all overtravel is taken up. Tighten the locking screws. Reconnect motor plug P3.

Notes:

a. Take care not to release the latch lever from the lever hold magnet, but do not hold the lever manually in position.

b. For an indication of when the microswitch is made, connect the CE probe to pin Y-W1 C6G03. When the switch is made, the probe indicates 'line up'.

7. Refit the top cover.

3.9.5.2 Removal

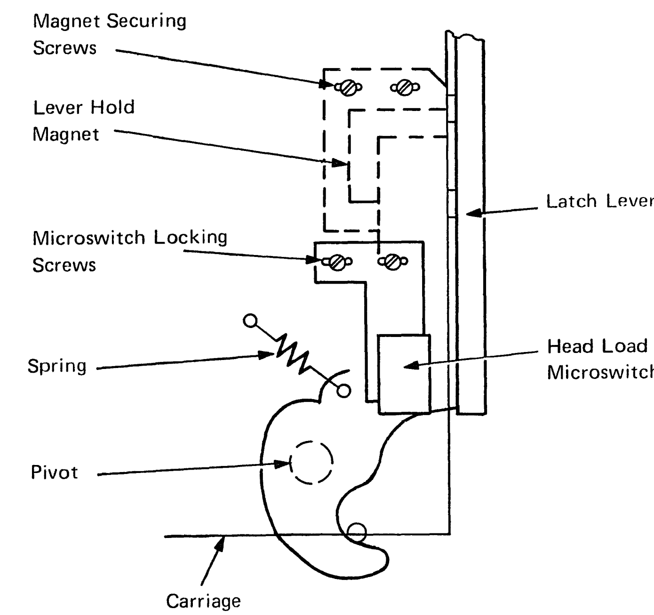
1. Remove all power from the 5444.
2. Move the carriage forward manually to approximately track 200 by turning the stepping motor shaft counter-clockwise.
3. Remove the locking screws and lift out the microswitch assembly.
4. Remove the screws and separate the microswitch from the backplate.

3.9.5.3 Replacement

1. Assemble the microswitch to the backplate.
2. Place the microswitch assembly in position and secure with the locking screws.

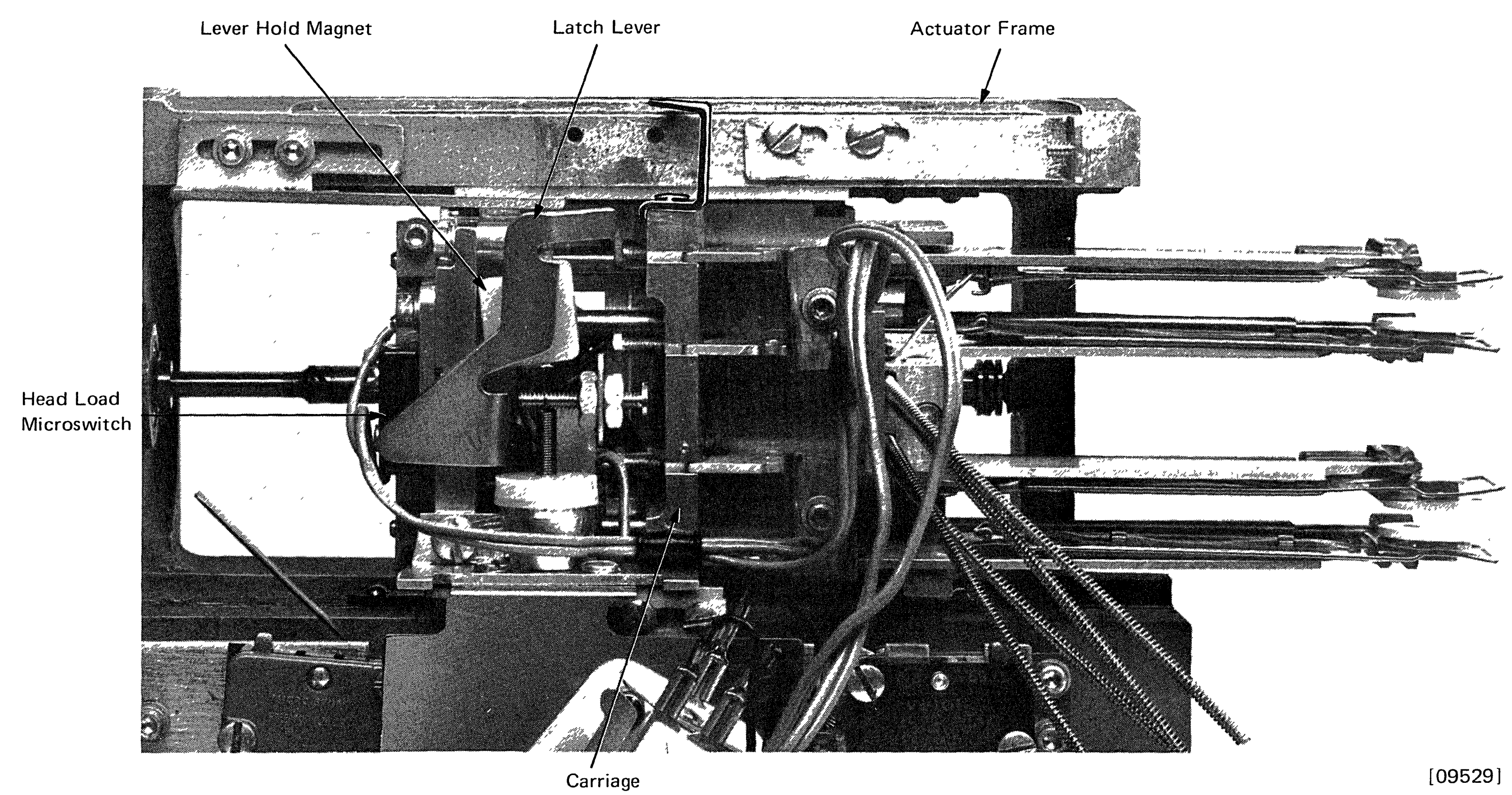
CAUTION
In the next step, ensure that cables are clear of moving parts when the carriage is moved over the full range of travel.

3. Fully retract the carriage by manually turning the stepping motor shaft clockwise.



End View from Stepping-Motor End of Actuator

[08612]



[09529]

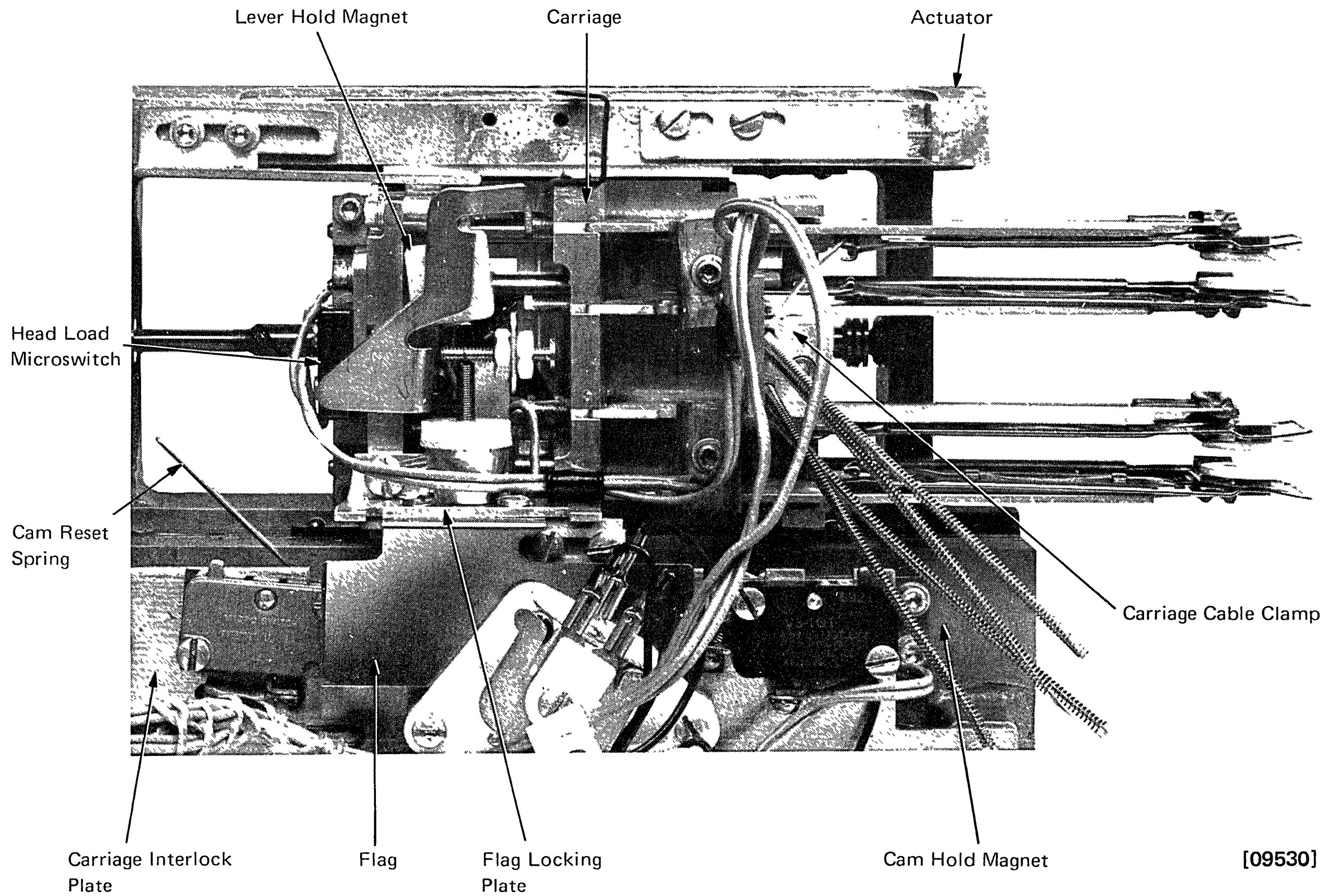
3.9.6 Cam and Cam Reset Spring

3.9.6.1 Removal

1. Release the leads of the R/W heads, lever hold magnet and head load microswitch from the carriage cable clamp. Remove the clamp.
2. Remove the two screws and lift off the flag, flag locking plate, and plastic mounting-piece.
3. Loosen the three screws and move the carriage interlock plate assembly to one side. *Do not* remove cable connections.
4. Remove the circlip from the cam pivot and withdraw the cam from the pivot.
5. Remove the two screws and disassemble the cam and cam reset spring.

3.9.6.2 Replacement

1. Assemble the cam and cam reset spring.
2. Lightly smear the cam pivot with IBM no. 20 grease.
3. Assemble the cam to the pivot and refit the circlip.
4. Refit the carriage interlock plate assembly and secure with the screws.
5. Adjust the interlock switch (see item 3.10.2.1 under "3.10 Auxiliary Electronics").
6. Refit the flag, flag locking plate, and plastic mounting piece.
7. Adjust the flag (see item 3.10.5.1 under "3.10 Auxiliary Electronics").
8. Refit the carriage cable clamp.
9. Reposition and clamp the leads of the R/W heads, lever hold magnet, and head load microswitch to the carriage cable clamp.
10. Adjust the head load mechanism (see 3.9.1).

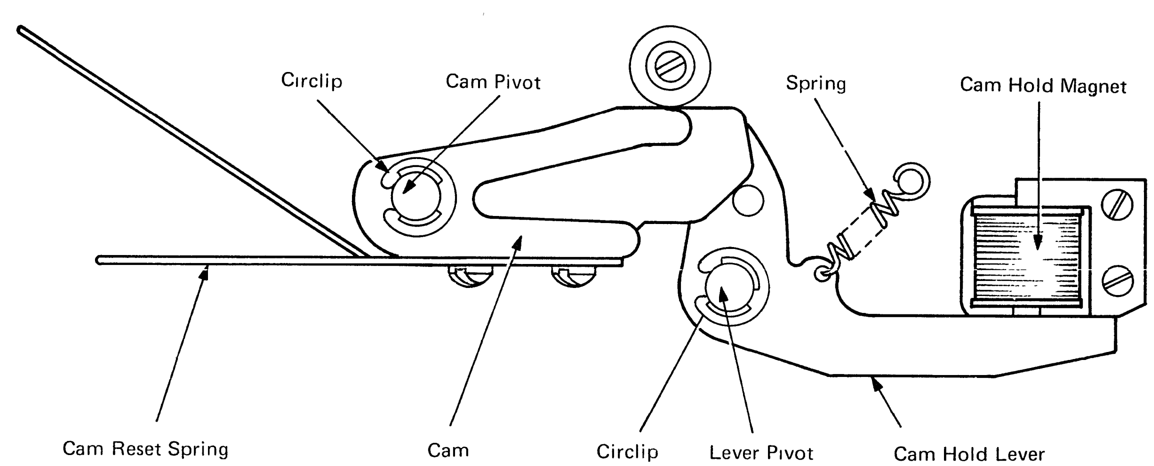


[09530]

3.9.7 Cam Hold Lever

3.9.7.1 Removal

1. Release the leads of the R/W heads, lever hold magnet and head load microswitch from the carriage cable clamp. Remove the clamp.
2. Remove the two screws and lift off the flag, flag locking plate, and plastic mounting piece.
3. Loosen the three screws and move the carriage interlock plate assembly to one side. *Do not* remove cable connections.
4. Unhook the spring from its post and remove the circlip from the lever pivot.
5. Withdraw the cam hold lever from the pivot.



[08615]

3.9.7.2 Replacement

1. Lightly smear the lever pivot with IBM no. 20 grease.
2. Assemble the cam hold lever to its pivot and refit the circlip.
3. Hook the spring on to the spring post.
4. Refit the carriage interlock plate assembly and secure with screws.
5. Adjust the interlock switches (see 3.10.2.1 under "3.10 Auxiliary Electronics").
6. Refit the flag and flag locking plate. Tighten the locking screws.
7. Adjust the flag (see 3.10.5.1 under "3.10 Auxiliary Electronics").
8. Refit the carriage cable clamp.
9. Reposition and clamp the leads of the R/W heads, lever hold magnet and head load microswitch to the carriage cable clamp.

3.9.8 Cam Hold Magnet

3.9.8.1 Adjustment

1. Adjust the cam hold magnet against the cam hold lever, ensuring that *both* poles of the magnet are in contact with the lever.
2. Tighten the locking screws.

3.9.8.2 Removal

1. Remove all power supplies from the 5444.
2. Remove the magnet connections from plug P6.
3. Remove magnet locking screws and withdraw the cam hold magnet.

3.9.8.3 Replacement

1. Place the spacer plate and cam hold magnet in position and secure with the locking screws.
2. Remake the magnet connections to plug P6.
3. Tape the wires to cable assembly.
4. Adjust the magnet as in item 3.9.8.1.

3.9.9 Head Load Spring Shafts

3.9.9.1 Check and Adjustment in Machine, Using Gage Part 2600555

To *check* the head load spring shaft, carry out steps 1 through 20 *only*. Do *not* loosen the clamp screws.

Note: If data has to be retained, all attempts should be made to transfer the data to a "scratch" disk cartridge.

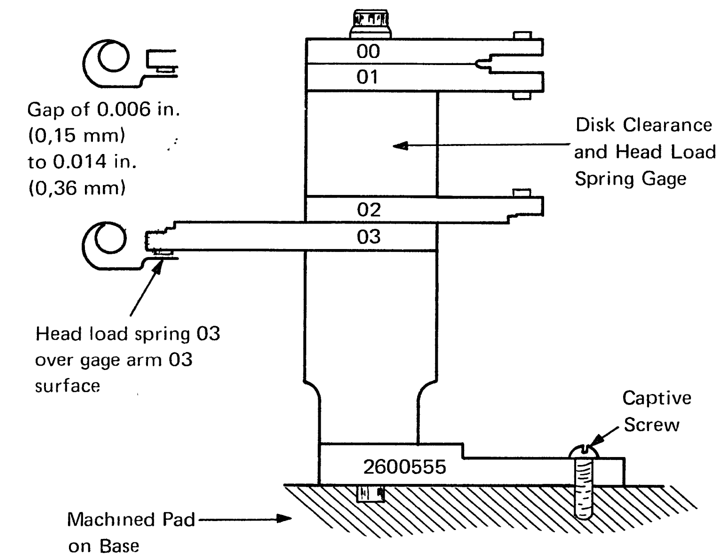
1. Remove all power from the 5444. Remove the top cover.
2. With the carriage fully retracted, remove the head arm assemblies (see item 3.8.2.4).
3. Remove the head load microswitch assembly (see item 3.9.5.2).
4. Remove the cable clamp pillar.
5. Locate the disk clearance and head load spring gage (part 2600555) on the machined pad, securing the gage with the captive screw.
6. Remove the transparent transistor cover.
7. Set up the links in the order 03–02–01 and 00. (03 shaft carries the head load lever.)
8. Loosen the head load lever clamp screw. With the head load lever in the unloaded position, touching the carriage surface and centrally positioned in the recess of the carriage casting, the head load spring 03 should clear the gage 03 surface by 0.006 in. (0,15 mm) to 0.014 in. (0,36 mm). Ensure that the shaft shoulder is bearing on the bush. Tighten the head load arm clamp screw. The head load spring should be just clear of the gage 03 surface as shown. Tighten the clamp screw to 8 lb/in. (9,2 kg/cm) with the torque wrench, part 2598187, and adapter, part 2597971.

CAUTION
In the next step, ensure that the head load springs are clear of the fixed disk as the carriage is moved.

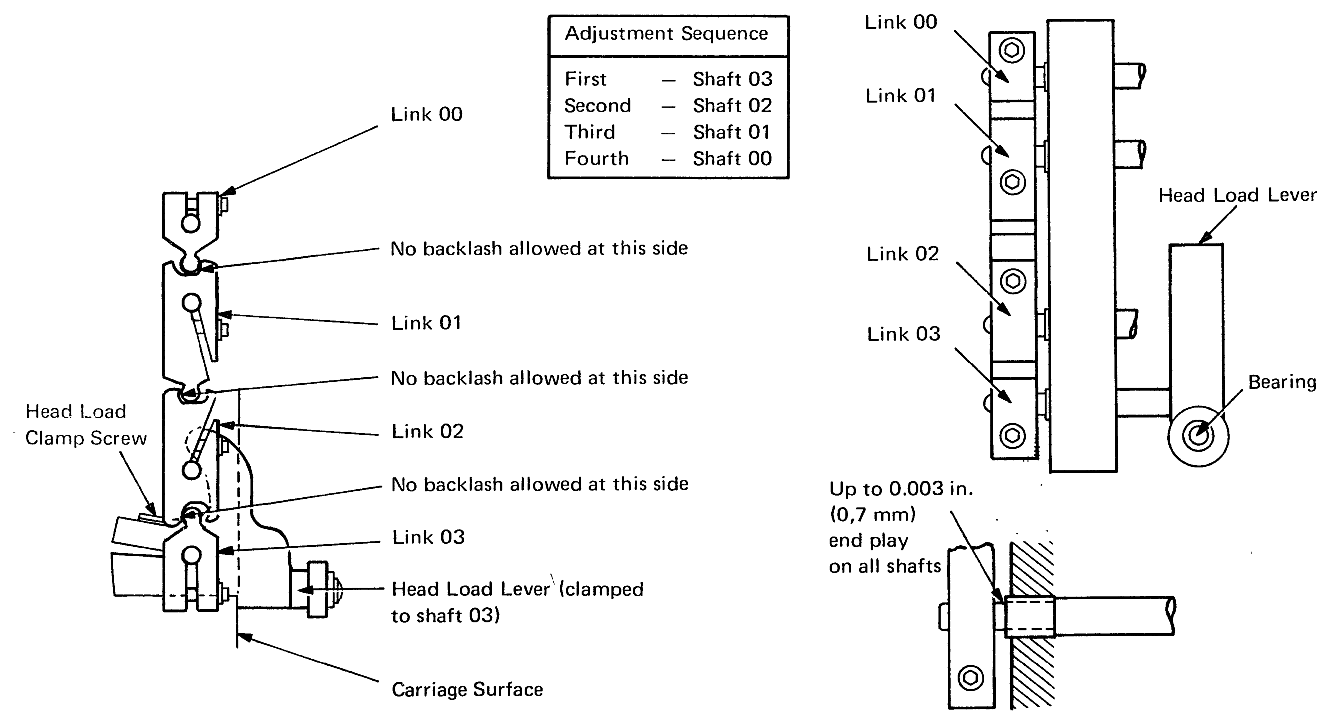
9. With the head load lever touching the carriage casting, move the carriage to track 100.
10. Still keeping the condition in step 8, loosen the socket screw of link 03, set link 03 vertical, and tighten the screw to 8 lb/in. torque. Ensure that the end play of the shaft does not exceed 0.003 in. (0,076 mm).
11. Move the gage arm 03 back and proceed with shaft 02. Loosen link 02 socket screw, retract the carriage to approximately track –070. Set head load spring 02 to 0.006 in. to 0.014 in. above the gage 02 surface. Adjust the link to touch the slot of link 03 as shown. Tighten the link 02 socket screw, move the carriage to track 100, and retighten the socket screw to 8 lb/in. torque.
Note: Adjust *all* head load springs even if blank arms are fitted in the lower positions.
12. Retract the carriage to approximately track –070, and check that the head load spring 02 clears the gage 02 surface by 0.006 in. to 0.014 in. as shown.
13. Move gage arm 02 back and proceed with shaft 01. Loosen link 01 socket screw; set the head load spring 01 to 0.006 in. to 0.014 in. above the gage 01 surface. Adjust the link to touch the slot of the link 02 as shown. Tighten the link socket screw, move the carriage to track 100 and retighten the socket screw to 8 lb/in. torque.
14. Retract the carriage to approximately track –070. Check that the head load spring 01 is 0.006 in. to 0.014 in. above the gage 01 surface as shown.
15. Move gage arm 01 back and proceed with adjustment of shaft 00, as previously shown. Make sure the link touches link 01 on the correct side.
16. Refit the head load microswitch assembly and adjust as detailed in item 3.9.5.1.
17. Refit the head arm assemblies and adjust as detailed in items 3.8.2.3 and 3.8.2.5.

CAUTION
Ensure that wiring in the area of microswitches and carriage photocells does not foul the carriage flag when the carriage is moved over the full range of travel.

18. Refit the transistor cover.
19. Ensure that the knock-off bracket setting is correct as detailed in item 3.9.2.1.
20. If data is still to be recovered from the fixed disk, refer to "2.2 Error Recovery Procedures" in Chapter 2.
21. Initialize the fixed disk.
22. Write the customer's data on to the fixed disk, if required.



[08509A]



Carriage – End View from Stepping Motor End (Latch lever removed)

Carriage – Side View

[08616A]

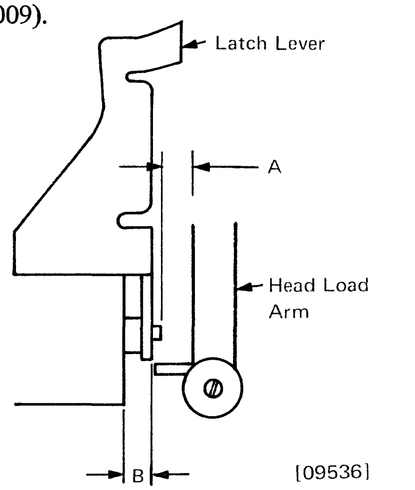
3.9.9 Head Load Spring Shafts (continued)

3.9.9.2 Check and Adjustment in Machine, Using Gage Part 5144375

To check the head load shaft springs, carry out steps 1 through 6 and 17 through 23.

Note: If data has to be retained all attempts should be made to transfer the data to a "scratch" disk cartridge.

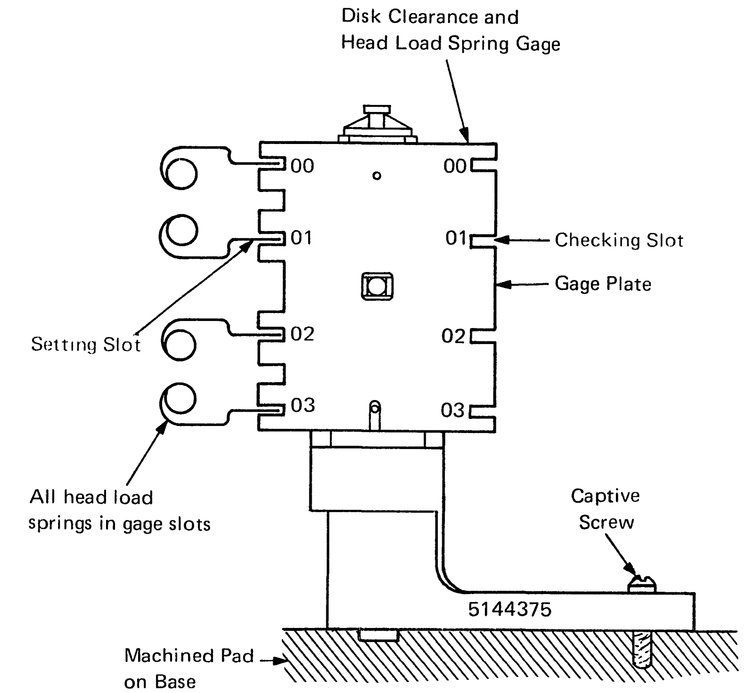
1. Remove all power from the 5444. Remove the top cover.
2. With the carriage fully retracted, remove the head arm assemblies (see 3.8.2.4).
3. Remove the head load microswitch assembly (see 3.9.5.2).
4. Remove the cable clamp pillar.
5. Locate the disk clearance and head load spring gage (part 5144375) on the machined pad and secure with captive screw.
6. Remove the transparent transistor cover.
7. Set the links in the order 03–02–01 and 00. (03 shaft carries the head load lever.)
8. By turning the encoder shaft, move the carriage forward until it is possible to insert the torque wrench (part 2598187) and adapter (part 2597971) into the socket heads of the link clamp screws. Ensure that it is possible at the same time to cover the head load springs with the gage plate of part 5144375.
9. Loosen the clamp screws of all four links and of the head load lever.
10. Feed the setting slots of the gage over the four head load springs.
11. With the head load lever resting against the side of the carriage frame and positioned so that distance A is approximately 0.010 in. (0,25 mm) wider than distance B, tighten the lever clamp screw using torque wrench (part 2598187) and adapter (part 2538009).



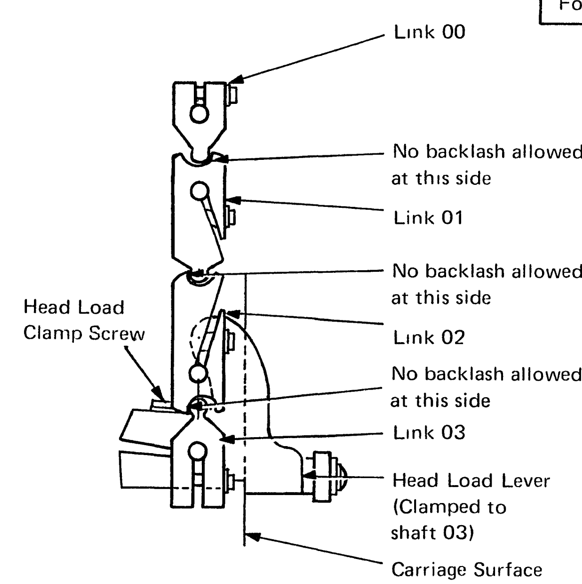
12. With the head load springs still located by the gage plate, set link 03 vertical and tighten the link clamp screw to 8 lb/in. (9,2 kg/cm) with the torque wrench. Check that end play of the shaft does not exceed 0.003 in. (0,076 mm).
13. Adjust link 02 to touch link 03 and lightly tighten the clamp screw. Check the end play of the shaft. Tighten the screw to 8 lb/in., using the torque wrench.
14. Repeat step 13 for link 01. Ensure that link 01 touches link 02 in the correct place as shown.
15. Repeat step 13 for link 00. Ensure that link 00 touches link 01 in the correct place as shown.
16. Disengage the springs from the gage by retracting the carriage.
17. Remove the gage plate and reassemble it to the pillar so that the checking slots are presented to the head load springs.
18. Feed the springs into the checking slots of the gage by moving the carriage forwards. When making this check, link 00 must be supported so that it touches link 01, as shown, the head load lever must rest against the carriage casting, and the springs must pass through the checking slots. If the springs are distorted or do not pass through the checking slots, repeat from step 7, followed by a further check.
19. Refit the head load microswitch assembly and adjust as detailed in item 3.9.5.1.
20. Refit the head arm assemblies and adjust as detailed in items 3.8.2.3 and 3.8.2.5.

CAUTION
Ensure that wiring in the area of microswitches and carriage photocells does not foul the carriage flag when carriage is moved over the full range of travel.

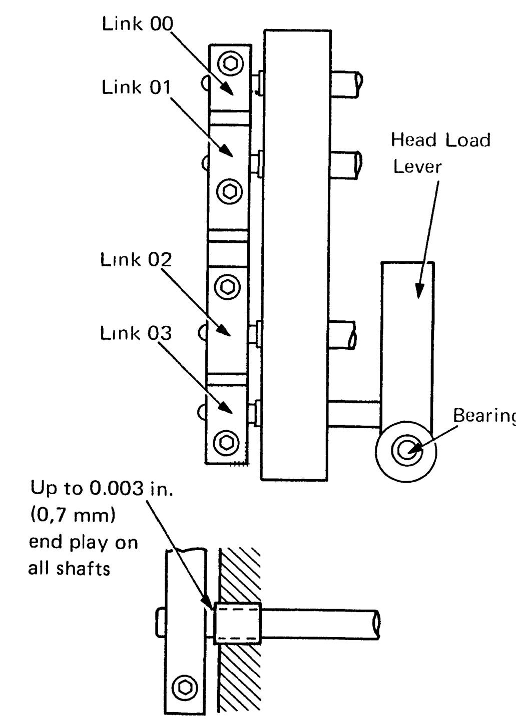
21. Refit the transistor cover.
22. Ensure that the knock-off bracket setting is correct as detailed in item 3.9.2.1.
23. If data is still to be recovered from the fixed disk, refer to "2.2 Error Recovery Procedures" in Chapter 2.
24. Initialize the fixed disk.
25. Write the customer's data on to the fixed disk, if required.



Adjustment Sequence	
First	– Shaft 03
Second	– Shaft 02
Third	– Shaft 01
Fourth	– Shaft 00



Carriage – End View from Stepping Motor End (Latch lever removed)



Carriage – Side View

[08617A]

3.9.9 Head Load Spring Shafts (continued)

3.9.9.3 Adjustment Out of Machine, Using Base Plate Part 5144386

Note: Use the following section when carrying out adjustments to the head load spring shafts, if the actuator has been removed from the 5444.

1. Assemble the actuator to the base plate (part 5144386), using the three socket screws from the 5444.
2. If using disk clearance and head load spring gage (part 2600555), carry out steps 3 through 16 of item 3.9.9.1.
3. If using disk clearance and head load spring gage (part 5144375), carry out steps 3 through 19 of item 3.9.9.2.
4. Refit the actuator as detailed in item 3.7.1.2.

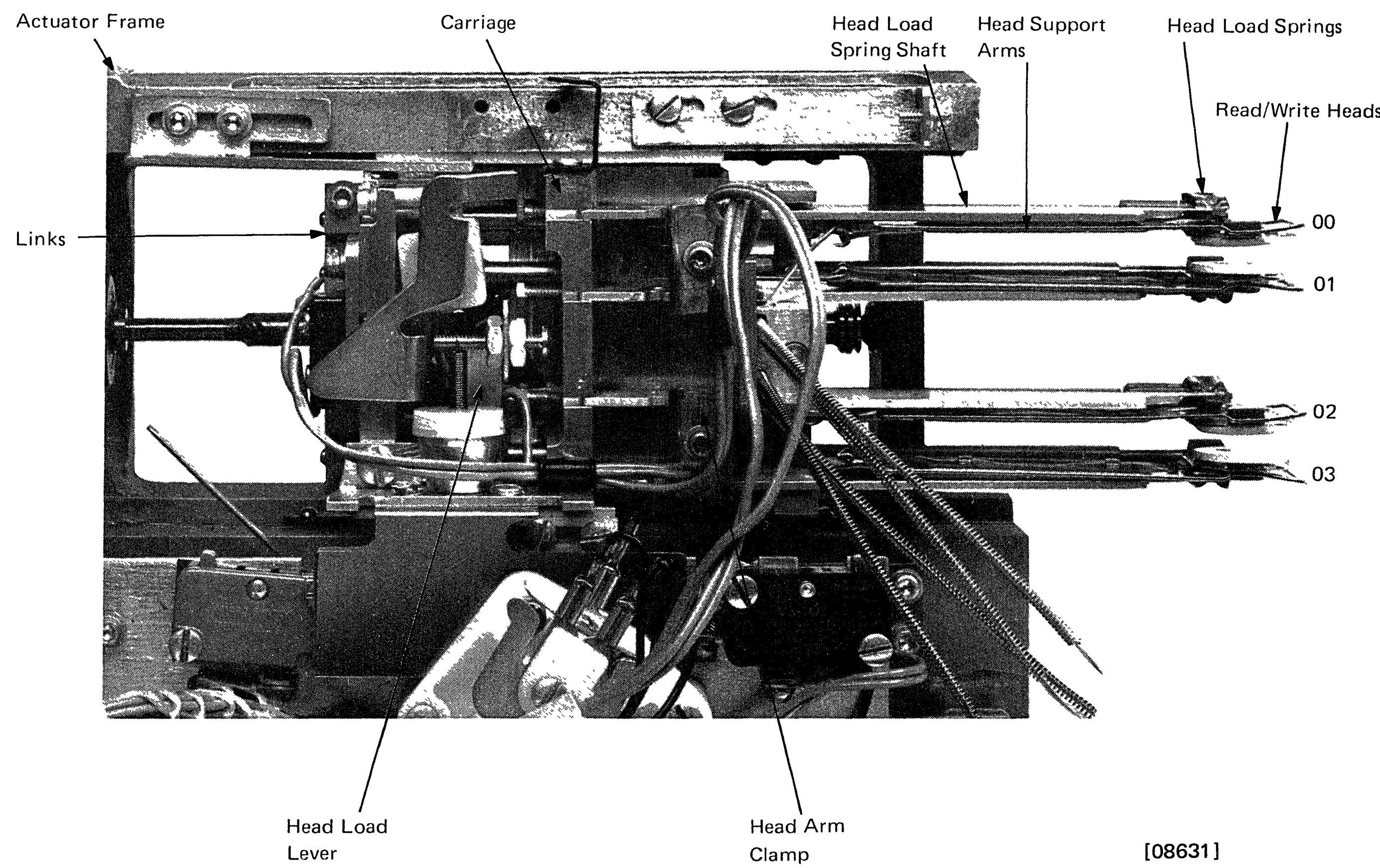
3.9.9.4 Removal

1. Before removing the head load spring shafts, remove the following components:
   a. To take out shaft 00 or 01, remove the disk cartridge and the R/W head/arms 00 and 01 (see item 3.8.2.4 under "3.8 Head/Arm Assembly").
   b. To take out shaft 02 and 03, remove the actuator (see item 3.7.1.1 under "3.7 Actuator and Encoder Assemblies") to prevent damage to the fixed disk. In addition, for shaft 03, remove all head support arms; for shaft 02, remove head support arms 02 and 03.
2. Loosen the link clamp screws and take off the links. (Note the shaft to which each link belongs.) Shaft 03 carries the head load lever; loosen the lever clamp screw to remove the lever.
3. Holding the carriage steady, pull out the shafts towards the center of the disks.

3.9.9.5 Replacement

Note: Shaft 03 carries the head load lever.

1. Smear a thin film of IBM no. 20 grease on the bearing ends of the shafts.
2. Insert the shafts until their shoulders bear on the bushes.
3. When the shafts are fully home, wipe away excess grease with a lint-free tissue.
4. Fit the links and adjust the assemblies (see 3.9.9.1, 3.9.9.2, or 3.9.9.3). During the adjustment, the R/W head support arms are refitted.
   Note: On all models, check the head load springs with the head load spring gage, even if blank arms are fitted in the lower positions.



[08631]

3.9.10 Dashpot

Note: The dashpot is not fitted on some early machines served by IBM World Trade Corporation.

3.9.10.1 Removal

CAUTION
Do not remove the plastic cap from the dashpot because the dashpot is a sealed unit.

Note: Observe the cable routing before removing any parts.

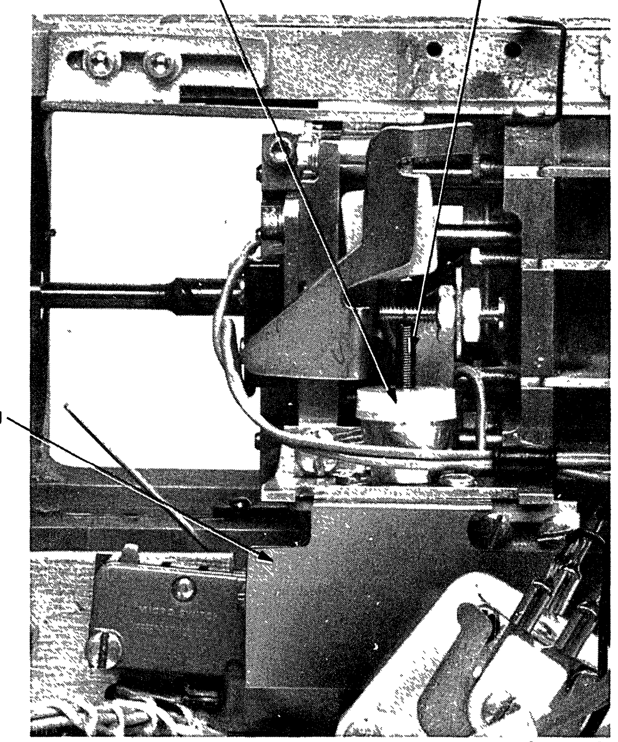
1. Withdraw the 5444 to the rear service position.
2. Remove the top cover from the 5444.
3. Remove the head leads from the cable clamp pillar.
4. Remove the head load microswitch cable and latch lever solenoid cables from the cable clamp pillar.
5. Remove the cable clamp pillar.
6. Remove the encoder shield.

CAUTION
In the next step, do not touch the face of the encoder plate, and do not damage the head leads.

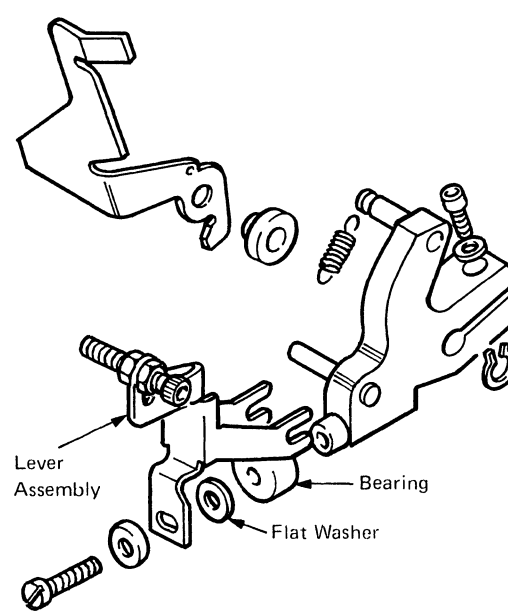
7. Move the carriage to track 000 by manually rotating the encoder plate, touching it on its outer edge only.
8. Disconnect the piston extension spring by slackening the two locknuts on the lever assembly and unscrewing the screw from the spring loop. Do not remove the screw and locknuts from the lever.
9. Remove the flag, striker bracket, cable clamp, dashpot assembly and, if fitted, the nut plate.
10. If the lever assembly is to be changed, remove the screw and washers that fix the lever and bearing to the arm assembly, and withdraw the lever.
    Note: It is not necessary to remove the bearing for lever replacement.

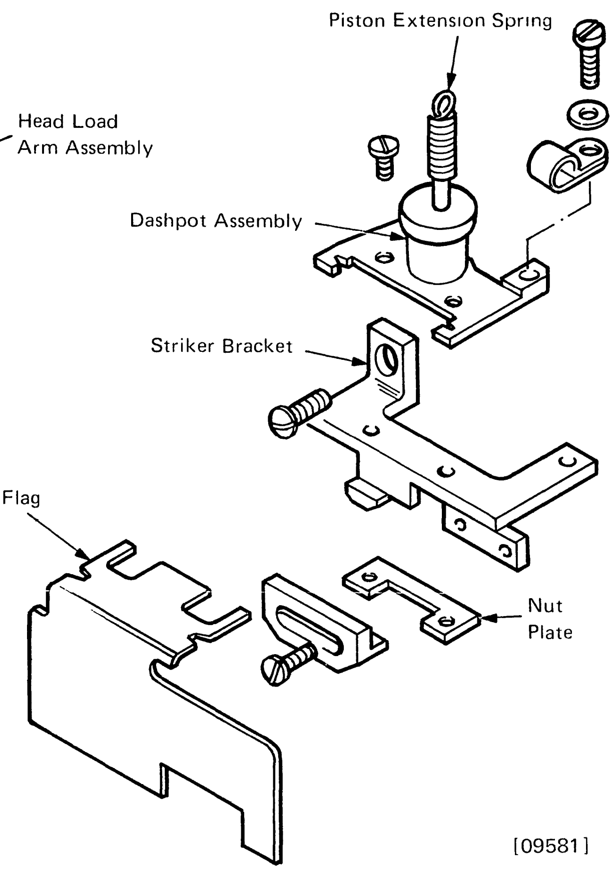
3.9.10.2 Replacement

1. If the lever is not being changed, go to step 2. Otherwise, assemble the lever (between the two washers) to the head load arm, ensuring that the flat washer is adjacent to the bearing. Tighten the screw.
2. Remove and discard the patch that covers the air bleed hole in the dashpot cap. With the open side of the piston extension spring loop facing the flag adjustment-slot side, check the distance from the bottom of the spring on the piston to the top of the cap on the dashpot assembly. Make a note of this dimension as X inches.
3. Assemble the striker bracket and the dashpot with the two flag clamping screws, and the nut plate if previously fitted. Lightly tighten these screws to hold the parts together during assembly to the carriage (step 4).
4. Attach the striker and dashpot assembly to the carriage; fit the cable clamp and washer. Locate the cable clamp and route the head load microswitch cable and latch lever solenoid cable. The solenoid cable must clear the lever when the lever is in the loaded position.



[09532]





[09581]

5. Check that the open side of the piston extension spring loop faces the adjustment slot side of the flag, then screw the screw of the lever assembly into the loop until approximately three screw threads project through the loop. Ensure that the spring is vertical when viewed from the side of the 5444 by adjusting the locknuts on the screws at each side of the vertical member of the lever.
6. Position the spring screw in the vertical slot of the lever so that the distance from the bottom of the spring to the top of the cap on the dashpot is X in. *plus* 0.025 in. ± 0.01 (0,64 mm ± 0,25); set this dimension at the same position relative to the open side of the spring loop where dimension X was checked in step 2. Fully tighten the screw.

CAUTION
In the next step, take care not to damage the head leads.

7. Manually position the carriage in the fully retracted position by carefully rotating the encoder plate by its outer edge.
8. Slacken the screws that attach the striker bracket and the dashpot assembly to the carriage.
9. Assemble the flag to the striker bracket and lightly tighten the flag clamping screws.
   Note: The dashpot assembly clamps the flag.
10. Lightly tighten the screws that were loosened in step 8.
11. Refit the cable clamp pillar. See item 3.8.2 for pillar positioning.
12. Refit the head load microswitch cable and latch lever solenoid cable on the cable clamp pillar.
13. Refit the head leads on the cable clamp pillar (see item 3.8.2).
14. Fully tighten the two screws referred to in step 10.
15. Adjust the flag (see item 3.10.5.1). If the nut plate is not fitted, take care not to overtighten the flag clamping screws to avoid stripping the threads in plastic striker brackets.
16. Recheck the carriage retracted microswitch and carriage overrun microswitch settings (see item 3.10.2).
17. Refit the encoder shield.
18. Refit the top cover.
19. Return the 5444 to the operating position and check that it operates.

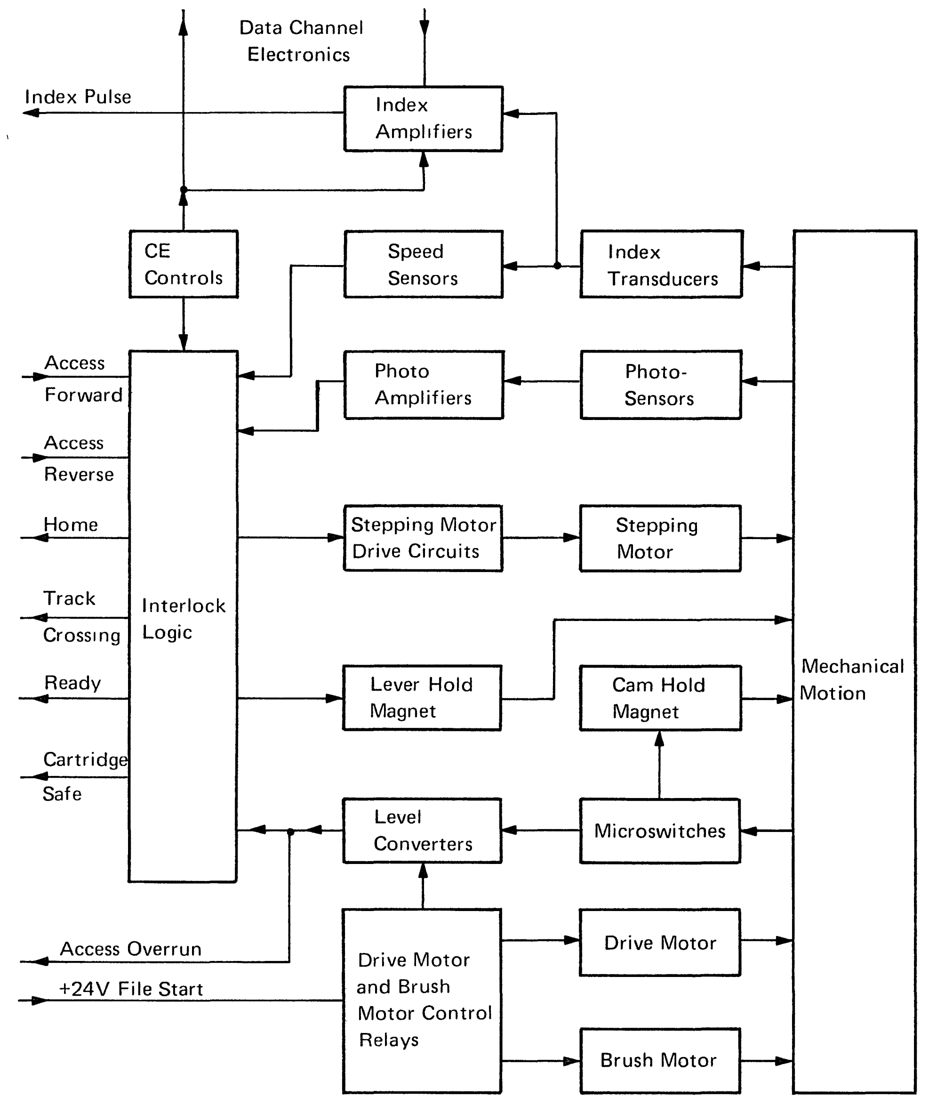
3.10 Auxiliary Electronics

- The auxiliary electronics form the interface between the using system and the 5444, and include all the electronics on the machine other than data channel electronics.
- The auxiliary electronics use SLD-100 logic, contained on seven SLT cards:
  Six cards (seven for Models A01, A02, and A03) on a 2 X 13 SLT board, mounted in Y gate.
  One card (stepping motor driver), mounted in X gate (in the dc box).

Electronic Interlocks

- The electronic interlocks, which interface between the 5444 and the controlling signals from the using system, control the magnets, relays, and motors on the 5444, and process the signals from microswitches and transducers, in the following manner:

1. Condition the start/stop sequencing.
2. Use command signals from the using system.
3. Protect the circuits against damage by operator error.
4. Limit any damage that is caused by machine failure.
5. Provide machine status information to the using system.
6. Provide CE test facilities.



Block Diagram of Auxiliary Electronics

[08619]

	Row 1	Row 2
B	Cable Socket	Cable Socket
A	Stepping Motor Drivers	

X Gate Card Layout (View from card side)

	Row 6		Row 7	
N	Using System Cable	Using System Cable	Control and Driver Signal Cable	
M	(Unused)	Using System Cable	Regulated Signal Cable	
L	Preamplifier Cable		(Unused)	
K				Three cards for data channel electronics
J				
H				
G	Manufacturing Test Socket		Access Control	Six cards (seven in Models A01, A02, and A03) for auxiliary electronics
F	Voltage Regulator			
E	High Speed Logic (Used on Models A01, A02, and A03 only)			
D	Stepping Motor Logic			
C	Interlocks			
B	Photo Amplifiers			
A	Speed Sensors			

Note: This board is located physically with the row-6 card positions at the top, as shown in "Locations" in Chapter 1

Y Gate Card Layout (View from card side)

[08620]

Microswitch Interlocks

- Three interlock switches have associated level converters that produce the required logic levels:
1. Brush cycle-complete interlock.
2. Carriage retracted interlock.
3. Cartridge interlock.

- Three more interlock switches require only a resistor to interface with the logic:
1. Carriage overrun interlock.
2. Brush mid-cycle interlock.
3. Head load interlock.

- *Cartridge Interlocks:* Two interlock switches connected in series with '+24V file start' to prevent machine start-up when the cartridge and cartridge bottom cover are not in position on top of the machine. The interlock switches are operated by the two cartridge clamp arms. *Note:* Later models may be fitted with only one cartridge interlock switch.

- *Brush Mid-Cycle Interlock:* Provides a logic switching level 'brush mid-cycle interlock' for use in the machine start-up sequence. The interlock switch is operated by a cam attached to the brush motor spindle.

- *Brush Cycle-Complete Interlock:* Indicates completion of brush cleaning cycle and raises 'brush cycle complete' for use in the machine start-up sequence. The interlock switch is operated by a cam attached to the brush motor spindle.

- *Head Load Interlock:* Indicates that the heads are loaded and, after level conversion, provides the logic line 'heads loaded OK'. The interlock is mounted on the carriage and is operated by the latch lever.

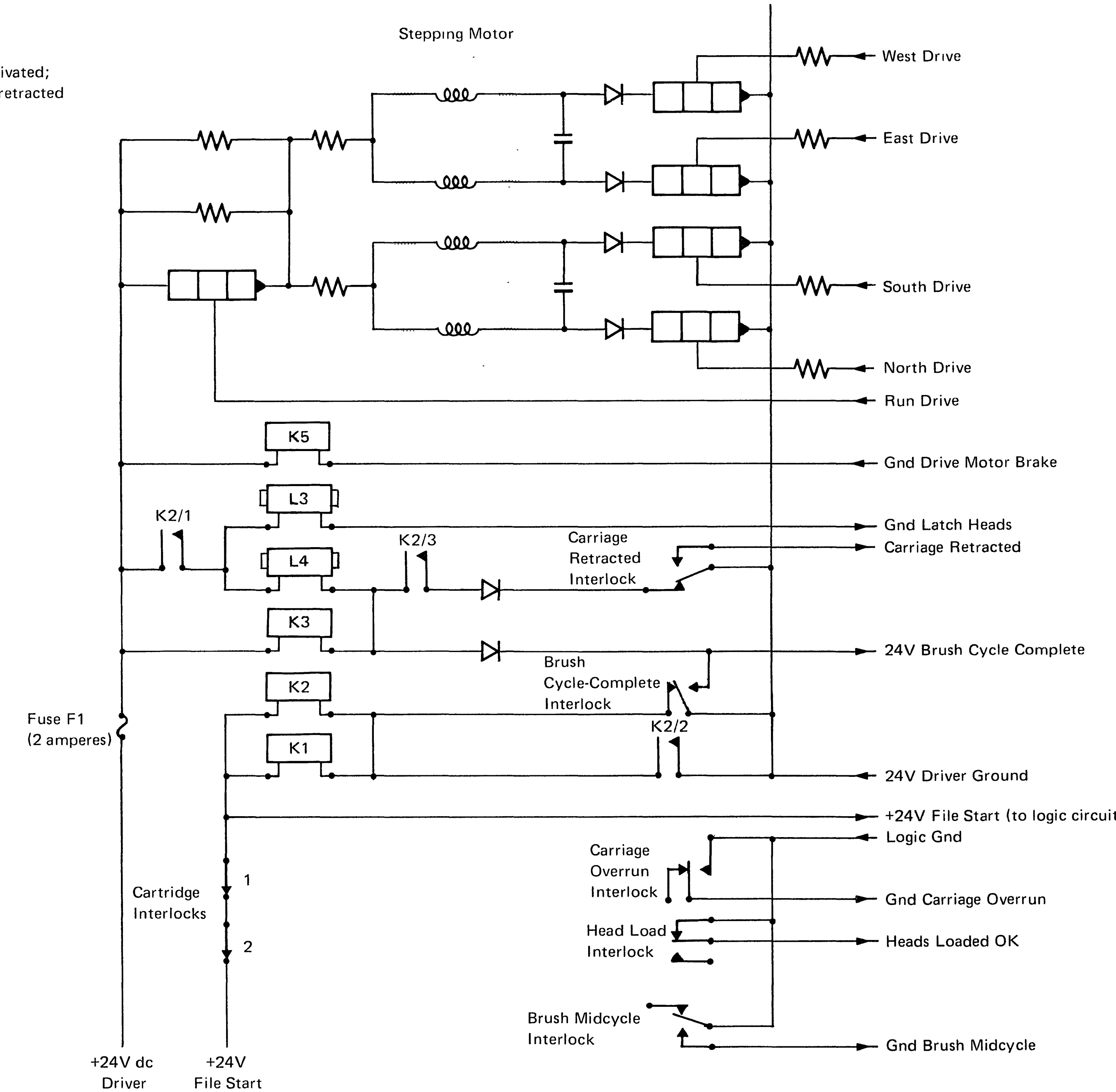
- *Carriage Overrun Interlock:* Prevents carriage travel past the inner limit and, after level conversion, raises the logic line 'access overrun'. The interlock is mounted on the actuator frame.

- *Carriage Retracted Interlock:* Stops the carriage at the retracted position and, after level conversion, raises the logic line 'carriage retracted'. The interlock is mounted on the actuator frame.

Cartridge is in position;
'+24V file start' is de-activated;
brushes and carriage are retracted

Legend

K1 Drive Motor Relay
K2 DC Control Relay
K3 Brush Motor Relay
K5 Drive Motor Brake Relay
L3 Lever Hold Magnet
L4 Cam Hold Magnet



[08621]

Carriage Photocell Assembly

• The carriage photocell assembly, mounted on the actuator frame, consists of two lamp/photocell pairs. Light that passes between each lamp and photocell is interrupted by two flags attached to the carriage, the coarse home flag and the add write current flag.

• Photocell 1 is darkened by the coarse home flag from approximately tracks −011 through +025, to give 'coarse home'. The photocell is darkened by the add write current flag from approximately track 095 to the carriage overrun position beyond track 202, to drop 'add write current' (thus dropping the additional write current needed at the outer tracks). Photocell 1 is illuminated between tracks 025 through 095 to give 'carriage pc 1 lit'.

• Photocell 2 is darkened by the flags from near the carriage retracted position up to track 170, to give '(not) carriage pc 2 lit'. (Photocell 2 is illuminated at the carriage retracted position.) 'Carriage pc 2 lit' is used with 'carriage pc 1 lit' as a backup signal to 'carriage retracted', in the cartridge safe logic.

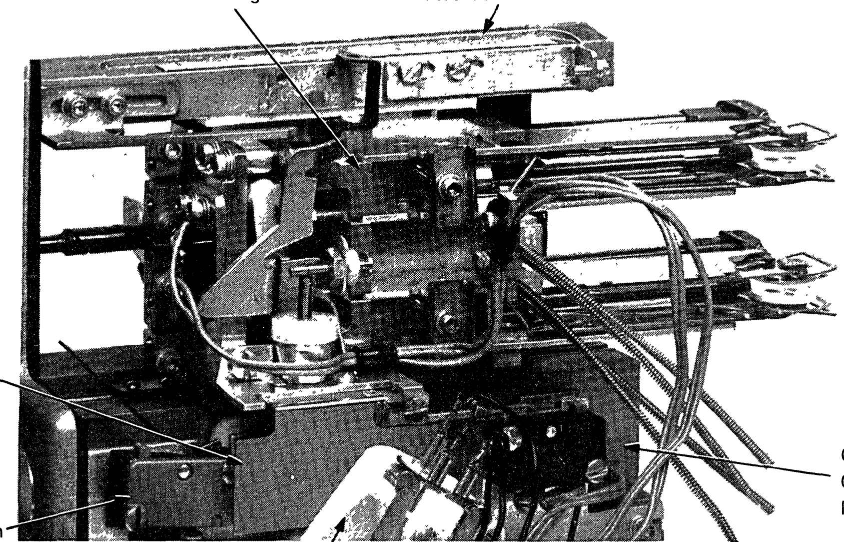
Circuit Description

Index Amplifiers

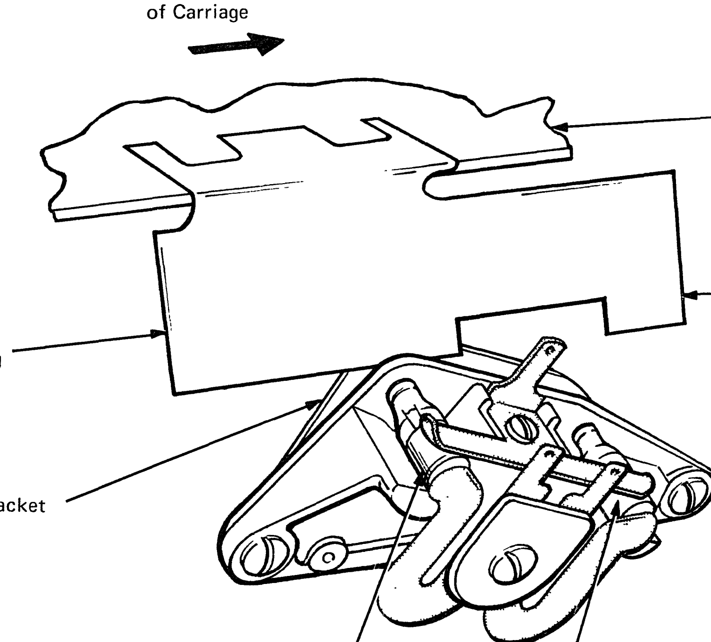
• An index amplifier circuit is provided for each of the two index transducers. Index amplifier 1 is used with the upper index transducer; index amplifier 2 is used with the lower index transducer. The appropriate amplifier is selected by the condition of 'disk select upper'.

• The index amplifiers detect the output signals from the upper or lower index transducers and convert the signals to SLD-100 logic levels.

• To indicate the start of each recording track on the disk, an index marker pulse is obtained on the 'index pulse' line for each revolution of the disk selected.



[09533]



[08623]

Speed Sensors (Speed Sensors Card)

• The speed sensors card contains two circuits that monitor the disk speed: speed zero detector, and 80% speed detector.

• The speed zero detector amplifier uses the output from the lower index transducer to control the 'speed zero' line. When the disk speed falls to a safe level, the 'speed zero' line raises the 'cartridge safe' line.

• The 80% speed detector circuit uses the output from the upper index transducer, through index amplifier 1, to control the 'speed OK' line. During a start-up sequence, the circuit detects when the disk speed is 80% of maximum (1200 rpm) and raises 'speed OK' line. The line is dropped if the disk speed falls below 64% of maximum (960 rpm).

Photo-Amplifiers (Photo-Amplifiers Card)

• Five photo-amplifier circuits convert the output from five photocells to SLD-100 logic levels:
1. On track photocell – to give 'on track' and 'track crossing'.
2. Fine home photocell – to give 'fine home'.
3. Feedback photocell – to give 'feedback' signal.
4. Carriage photocell 1 – to give 'carriage pc 1 lit'.
5. Carriage photocell 2 – to give 'carriage pc 2 lit'.

Drivers

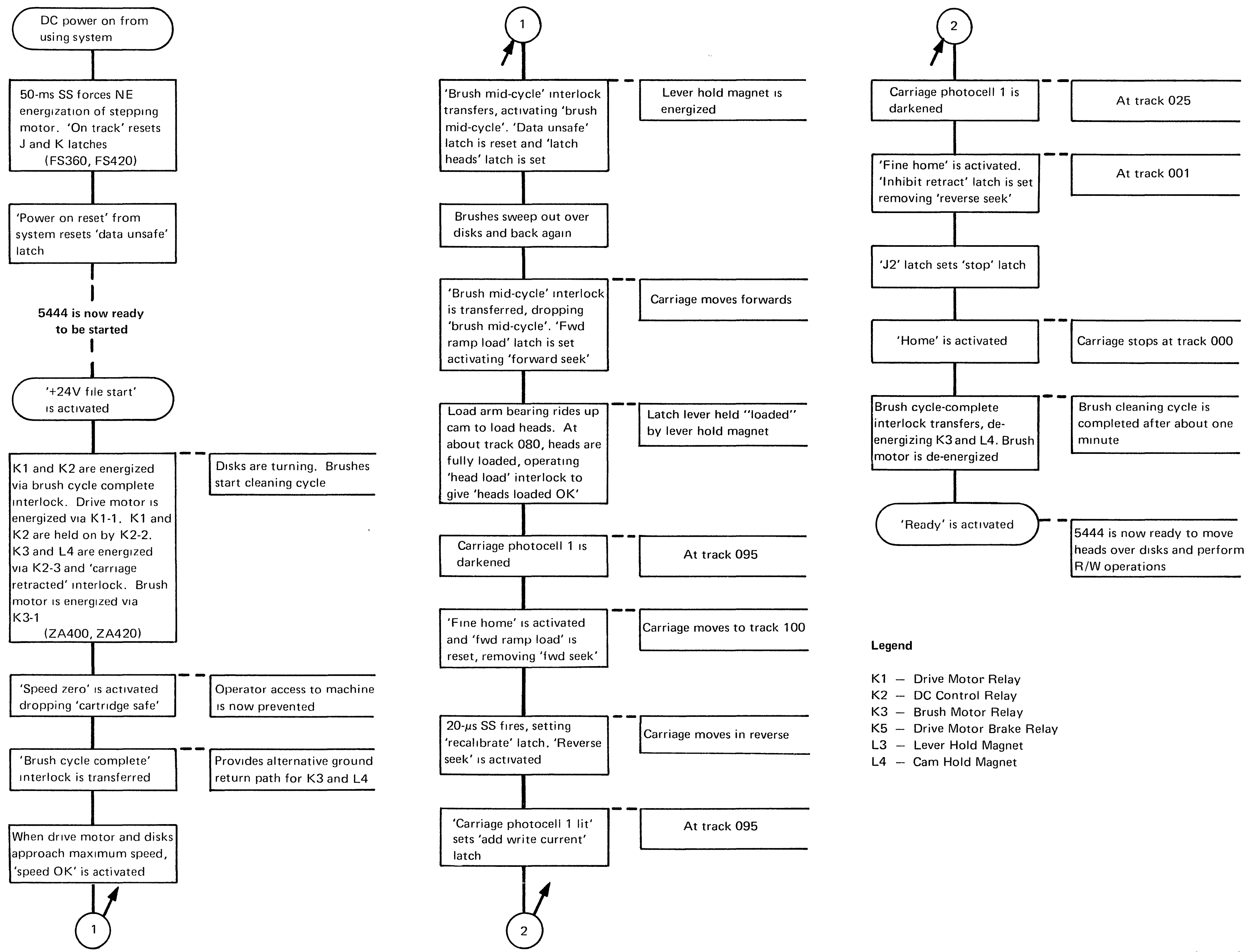
• Seven driver circuits are used:
1. One run driver, to turn on the +24V dc driver supply to the stepping motor when this is rotating.
2. Four winding drivers, providing north, south, east, and west drive signals to the stepping motor.
3. Two magnet drivers to drive the lever hold magnet and the drive motor brake relay (K5).

Start-Up Sequence

- The initial machine conditions are:

1. Using systems supplying ac and dc power to the machine.
2. Disk cleaning brushes parked.
3. Carriage retracted.
4. Mode-select switch on CE panel set to ON LINE.
5. Cartridge in position.

- The sequence is initiated when '+24V file start' is activated.
- The purpose of the sequence is to allow time for the disk cleaning cycle to be completed, the electronics to stabilize, and the disk enclosure temperature to stabilize.
- The sequence takes about one minute to complete.
- When complete, the sequence activates the 'ready' line, and the machine can perform operations under control of the using system.

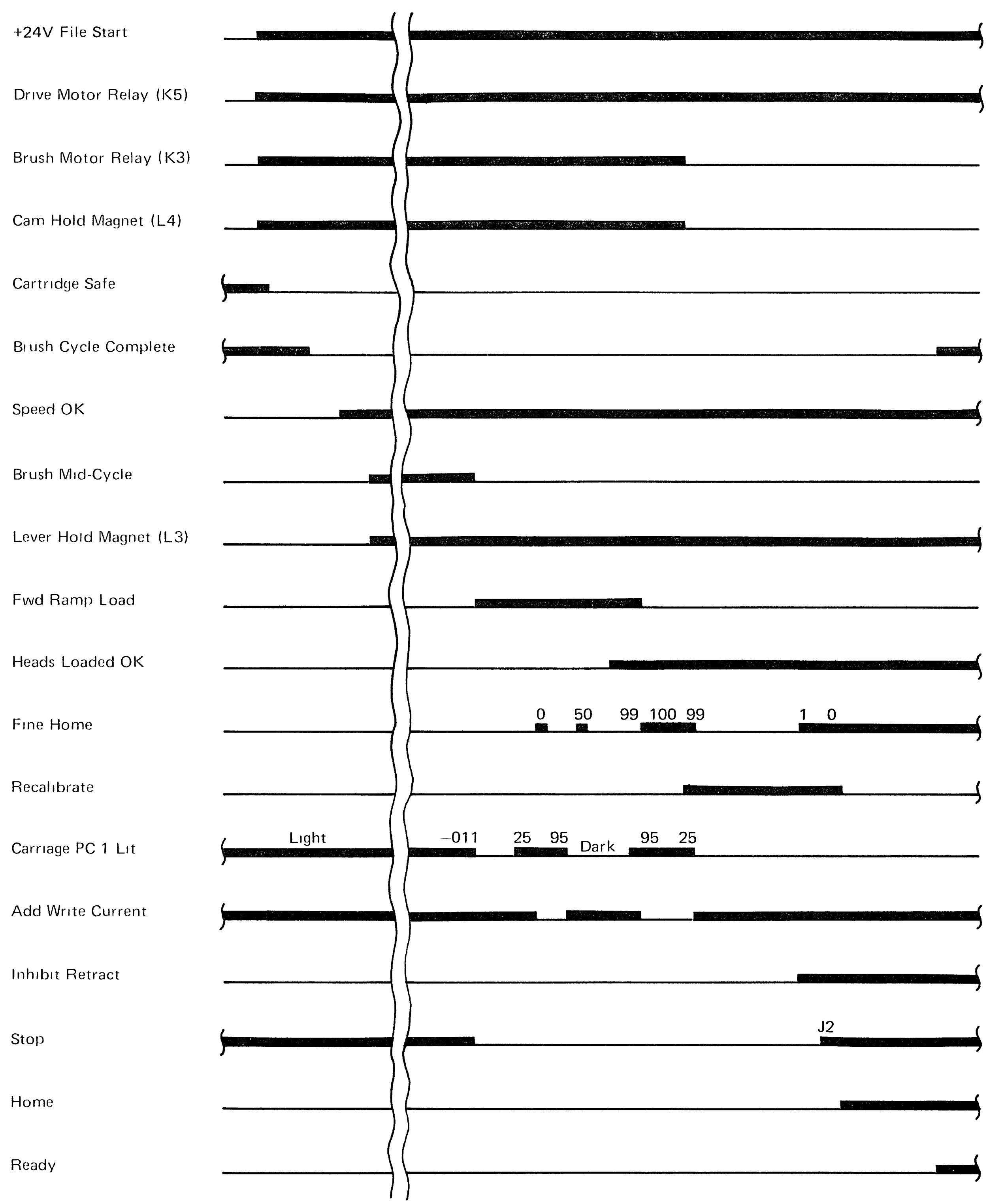


Legend

K1 – Drive Motor Relay
K2 – DC Control Relay
K3 – Brush Motor Relay
K5 – Drive Motor Brake Relay
L3 – Lever Hold Magnet
L4 – Cam Hold Magnet

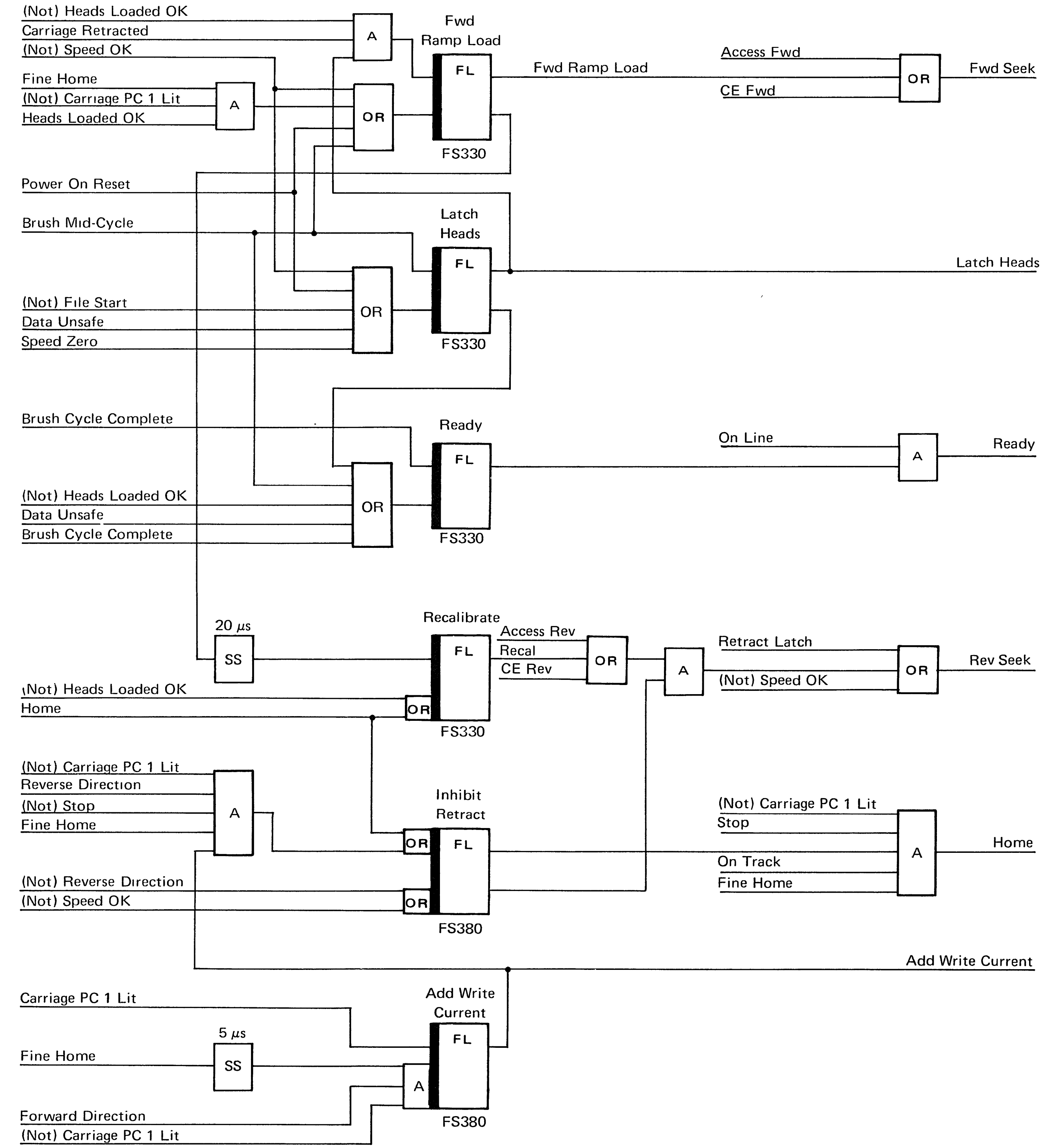
[08624]

Start-Up Sequence (continued)



Start-Up Sequence Timing

[08625]

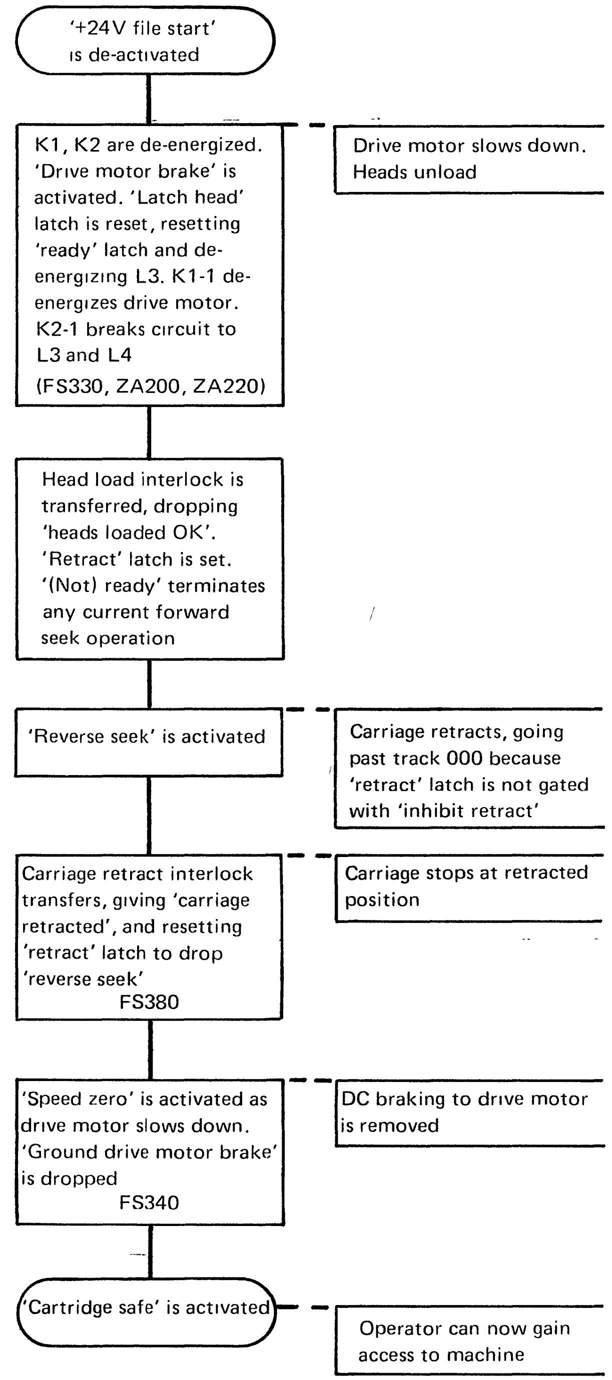


Logic Used in Start-Up Sequence

[08626]

Stop Sequence

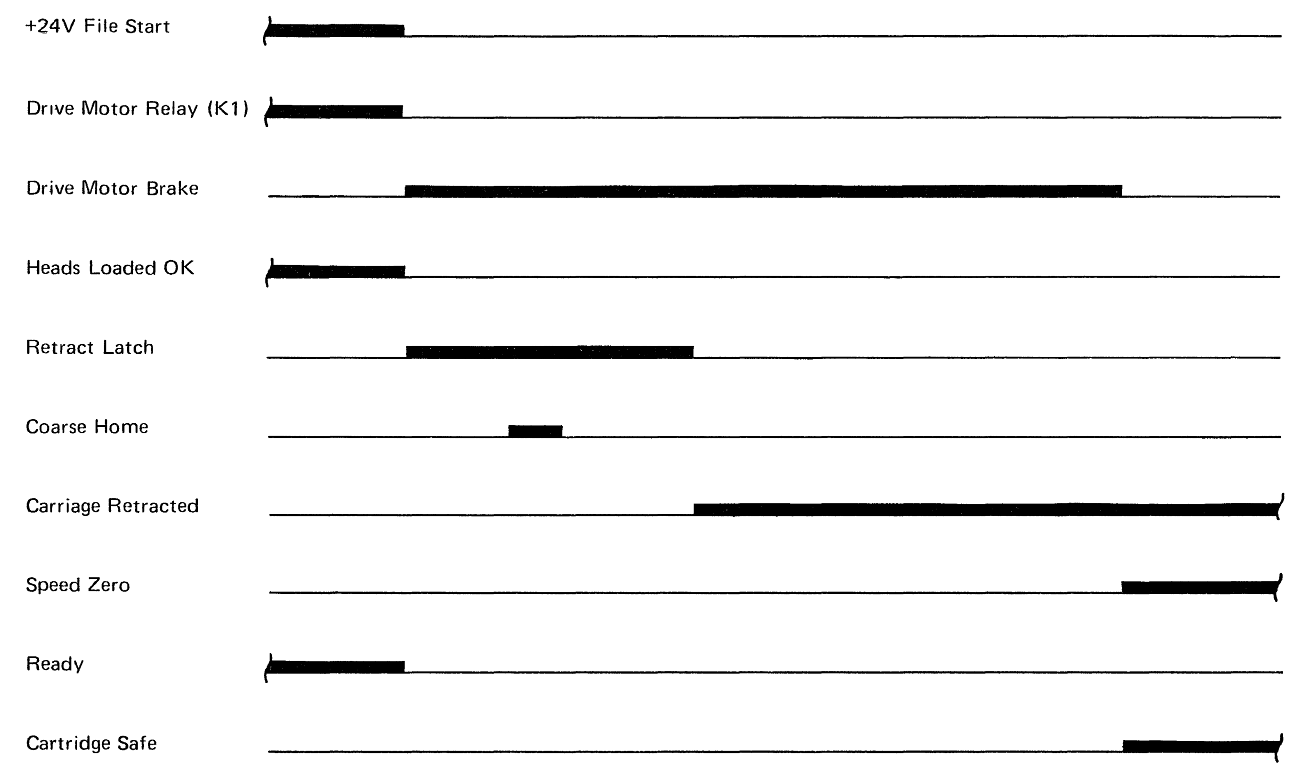
- The stop sequence is initiated when '+24V file start' drops.
- DC braking reduces the machine stop sequence time to approximately 30 seconds.
- When the machine stop sequence is complete, the heads mechanically unload, the carriage retracts, and the disks stop. (The heads must be retracted off the disks to prevent damage while removing or installing a cartridge.) 'Cartridge safe' is activated, allowing customer access to the machine to remove the disk cartridge.
- When '+24V file start' drops, all other ac and dc power supplies remain on at the machine. Note that ac power is still present at the ac box. If '+24V file start' drops within one minute of being activated (that is, during a machine start-up sequence), the start-up sequence must complete before 'cartridge safe' is activated; this allows the disk brushes to park.



Legend

K1 – Drive Motor Relay
K2 – DC Control Relay
K3 – Brush Motor Relay
K5 – Drive Motor Brake Relay
L3 – Lever Hold Magnet
L4 – Cam Hold Magnet

[08627]



Stop Sequence Timing

[08628]

3.10.1 Fault Finding

CAUTION
Turn off power before removing or replacing SLT cards.

The method of fault finding is based on the MAP package that is contained in the using system. The basic method of fault correction in the 5444 is by card replacement.

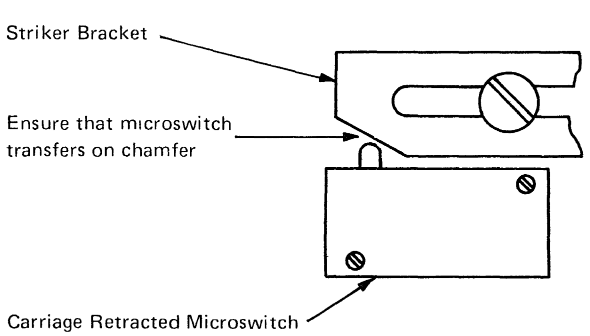
3.10.2 Carriage Retracted Microswitch and Carriage Overrun Microswitch

CAUTION
When replacing and adjusting the following components, ensure that the moving parts do not interfere with the cables as the carriage is moved between the two microswitches.

3.10.2.1 Adjustment

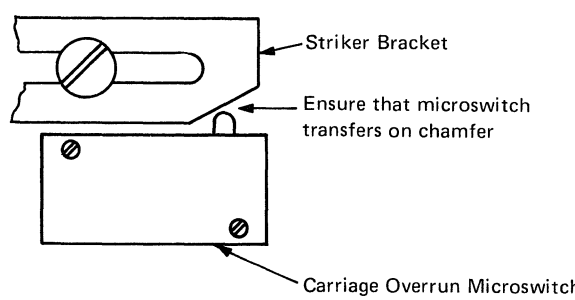
Adjust the carriage retracted microswitch as follows:

1. Loosen the two securing screws of the microswitch.
2. Switch off the 5444, but keep system power on.
3. Remove the fuse (in dc box) and flag (see 3.10.5.2).
4. Turn the stepping motor shaft by hand. Set the microswitch to transfer at track −118 ± ½. The encoder disk should indicate track 32 ± ½.
   Note: For a visual indication of when the microswitch is made, connect a probe to pin Y-W1 F6D10. When the switch is made, the probe shows 'line down'.
5. Tighten the microswitch securing screws.
6. Refit the fuse and the flag (see 3.10.5.2).



Adjust the carriage overrun microswitch as follows:

1. Loosen the two securing screws of the microswitch.
2. Start the 5444.
3. Using the CE switches, set the carriage overrun microswitch to transfer at track 204 ± ½. The encoder disk should indicate track 4 ± ½. Fine adjustment can be made by adjusting the striker bracket.
   Notes:
   a. On a 5444 Model 1, the carriage overrun microswitch is reversed. Set the interlock to transfer at track 104 ± ½. The encoder disk should indicate track 4 ± ½.
   b. For a visual indication of when the microswitch is made, connect a probe to pin Y-W1 C6B13. When the switch is made, the probe shows 'line down'.
4. Tighten the microswitch securing screws.
5. Switch the CE mode-select switch to ON LINE.



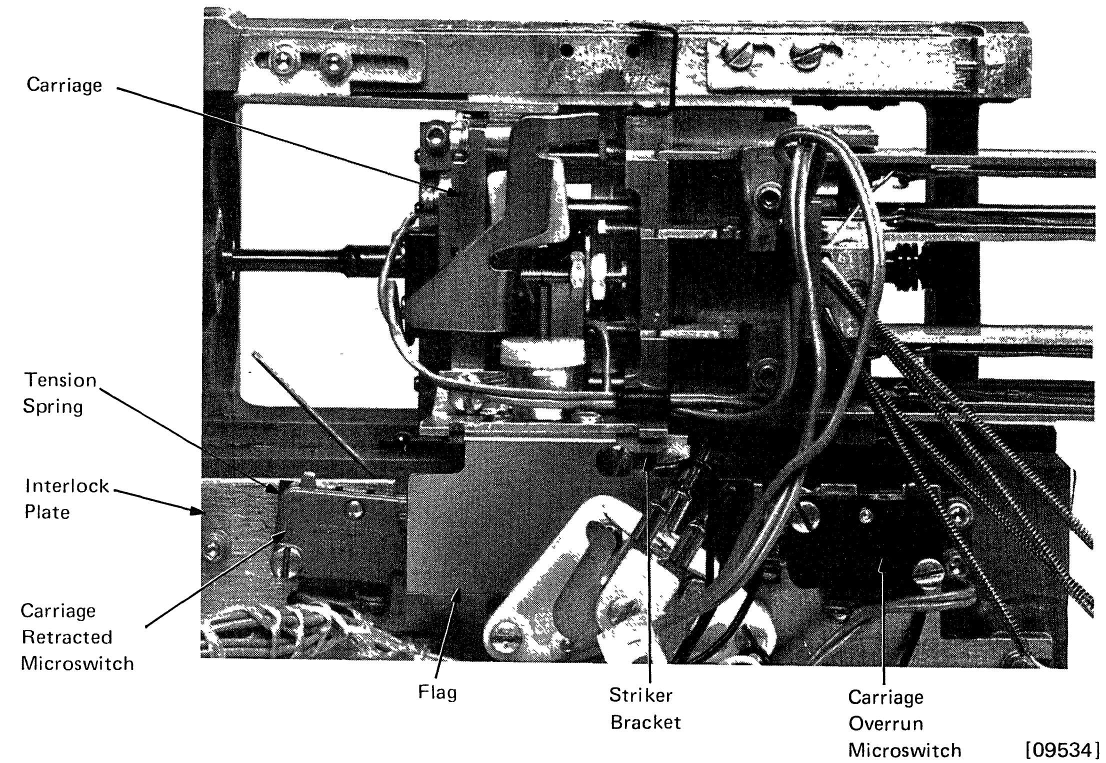
[08629]

3.10.2.2 Removal

1. Loosen the upper securing screw and remove the lower screw.
   Note: By not removing the top screw, the nut plate and tension spring are retained in place.
2. Lift off the microswitch assembly.
3. Note the position of leads for replacement, then disconnect wiring from the microswitch.

3.10.2.3 Replacement

1. Reconnect wiring to the microswitch.
2. Lower the microswitch onto the interlock plate and position the lower screw, through the assembly, into the nut plate.
3. Ensure that the tension spring is located between the microswitch and the interlock plate.
4. Tighten both screws.



[09534]

3.10.3 Striker Bracket

3.10.3.1 Removal

1. Remove the flag (see 3.10.5.2).
2. Remove the two striker bracket securing screws and the bracket.

3.10.3.2 Replacement

1. Position the striker bracket on the carriage and secure by the two screws.
2. Refit and adjust the flag (see 3.10.5.2 and 3.10.5.1).
3. Check the setting of the carriage retracted and overrun microswitches. Adjust if necessary (see 3.10.2.1).

3.10.4 Carriage Photocell Assembly

CAUTION
When replacing and adjusting the following components, ensure that the moving parts do not interfere with the cables when the carriage is moved between the two microswitches.

3.10.4.1 Lamps – Removal and Replacement

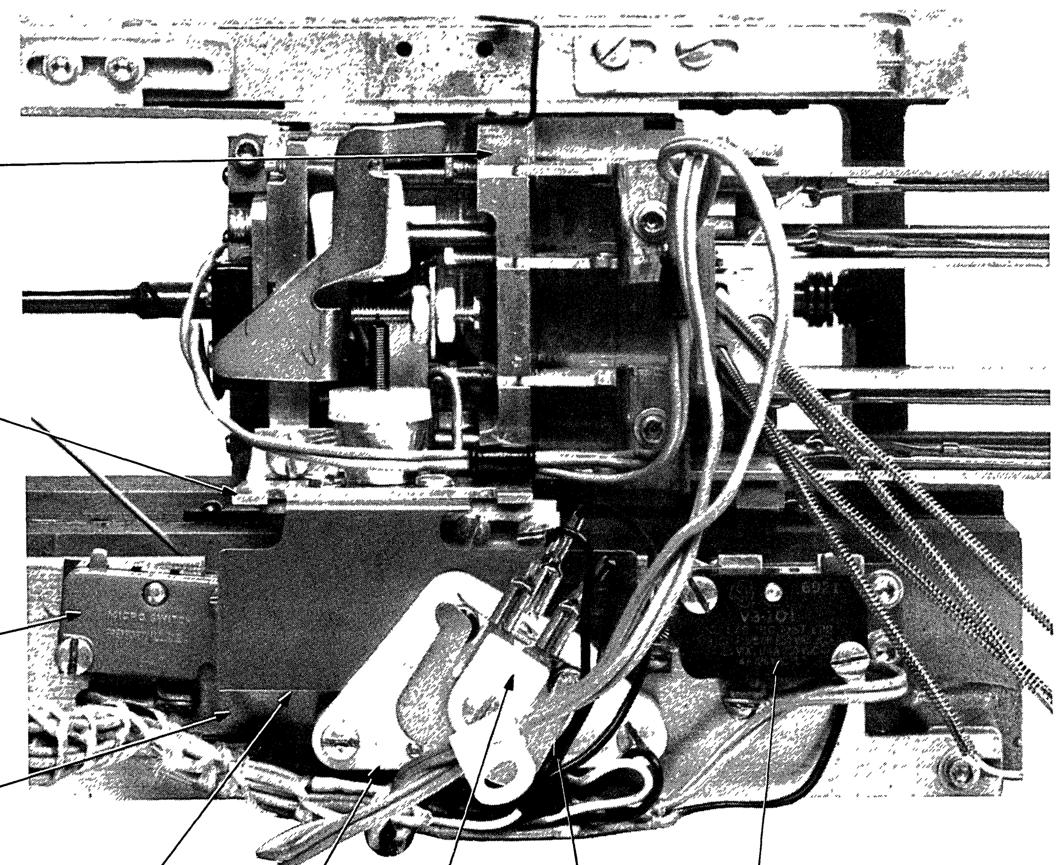
1. Unclip the lamp from the lamp holder.
2. To fit the lamp, clip it into the lamp holder. Make sure that the filament end of the lamp fits into the counter-sink on the lamp holder.

3.10.4.2 Lamp Holder – Removal and Replacement

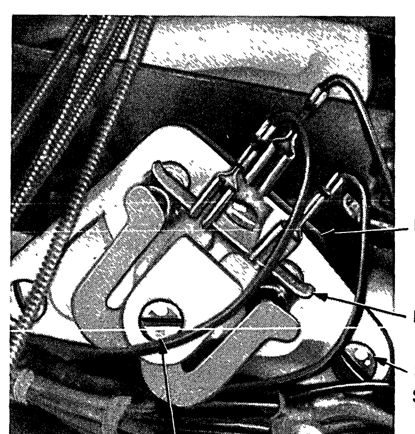
1. Note the position of leads for replacement, then disconnect the three lamp terminal connections.
2. Remove the flag (see 3.10.5.2).
3. Remove the two lamp holder retaining screws.
4. Remove the two retaining screws of the printed-circuit board, pull the board away from the lamp holder and remove the holder.
   Note: The printed-circuit board is still connected to the cable form.
5. To fit, position the new printed-circuit board on the locating dowels on the lamp holder and secure by the two screws.
6. Attach the lamp holder to the interlock plate by the two screws.
7. Re-connect the three lamp terminal connections.
8. Refit and adjust the flag (see 3.10.5.2 and 3.10.5.1).

3.10.4.3 Lamp Locator – Removal and Replacement

1. Note the position of leads for replacement, then disconnect the three lamp terminal connections.
2. Remove the lamp locator securing screw.
3. Remove the locator from between the dowels.
4. To fit, position the lamp locator between the dowels.
5. Replace and tighten the securing screw.
6. Reconnect the lamp terminal connections.



[09535]



[08632]

3.10.4.4 Lamp Retainer – Removal and Replacement

1. Remove the retainer clamp screw.
2. Remove the lamp retainer.
3. To replace, position the lamp retainer between the locating surfaces, position the retainer clamp, and tighten the securing screw.

3.10.4.5 Printed Circuit Board and Photocells – Removal and Replacement

1. Remove the lamp holder (see 3.10.4.2).
2. Note the lead positions for replacement, then unsolder the four photocell leads and remove the printed-circuit board.
3. To replace, solder the four photocell leads to the new printed-circuit board.
4. Fit the new board.
5. Refit the lamp holder (see 3.10.4.2).

3.10.5 Flag

3.10.5.1 Adjustment

1. Loosen the two flag retaining screws and position the flag so that it runs midway between the photocells on the photocell board and the lamp holder.
   Note: The flag should not touch the photocells or the lamp holder when the carriage is moved over its complete range.
2. Adjust the flag.
   a. 5444 Models 1 and A01.
      i. Use the CE switches on the CE panel to stop the carriage at track 092.
      ii. Connect a probe to Y-W1 B6G05. Adjust the flag until '+ carriage pc 1 lit' changes from active (up) to inactive (down).
      iii. Tighten the two flag retaining screws.
      iv. Use a CE probe to monitor '+ carriage pc 1 lit' at B6G05 (ALD page FS350). With the carriage at track 088, the line should be active (up); at track 096, the line should be inactive (down). Re-adjust if necessary.
   b. 5444 Models 2, 3, A02, and A03.
      i. Use the CE switches on the CE panel to stop the carriage at track 170.
      ii. Connect a probe to Y-W1 C6G07. Adjust the flag until '+ carriage pc 2 lit' changes from active (up) to inactive (down).
      iii. Tighten the two flag retaining screws.
      iv. Use a CE probe to monitor '+ carriage pc 2 lit' at Y-W1 C6G07 (ALD page FS350). With the carriage at track 171, the line should be active (up); at track 169, the line should be inactive (down). Re-adjust if necessary.

3.10.5.2 Removal and Replacement

1. Remove two screws and lift off the flag locking plate and flag.
2. Position the new flag and flag locking plate and secure with the two screws.

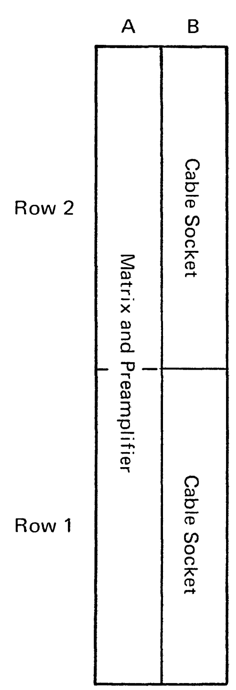
3.11 Data Channel Electronics

• The data channel contains safety circuits to ensure that read and write operations take place only when it is safe for them to do so.

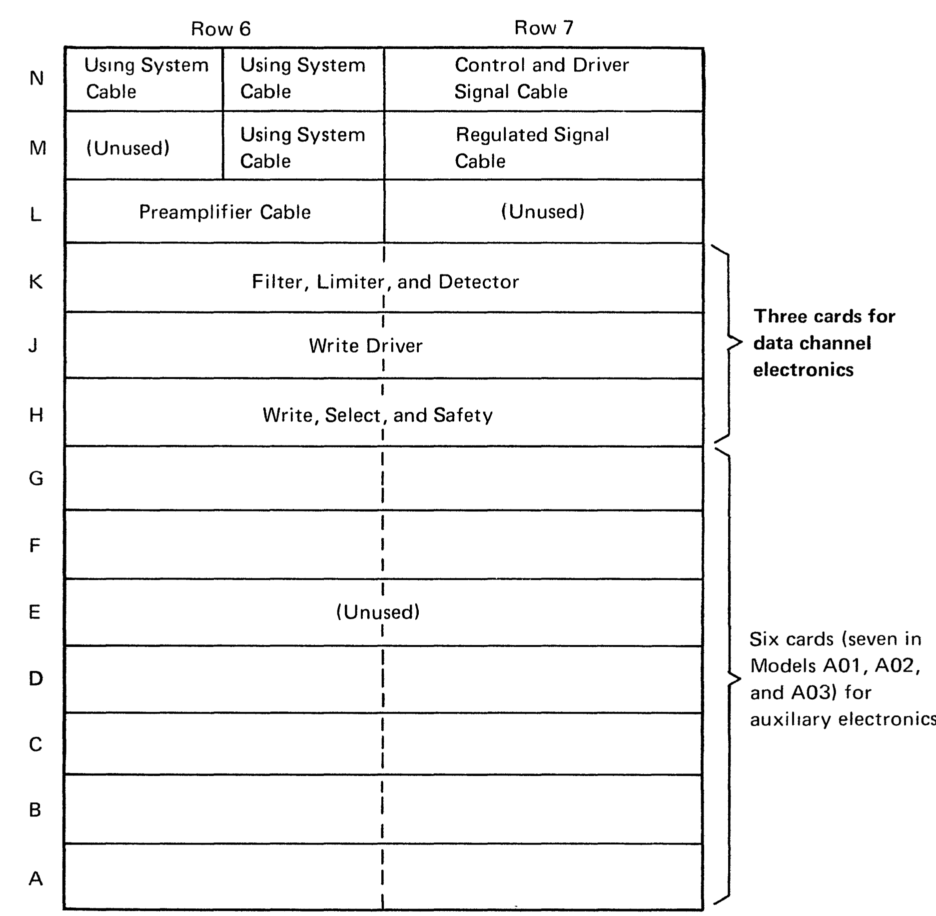
• The data channel also contains the circuits that enable the read/write heads to write information onto the recording disks, or to read information from the disks. Separate head select circuits are used for read and write operations.

• The data channel circuits are contained in four SLT cards, three of which are mounted in a 2 X 13 SLT board on Y gate. The fourth card (matrix and preamplifier) is mounted on Z gate in the preamplifier enclosure.

• The preamplifier enclosure is placed close to the read/write heads to keep the head leads short, thus minimizing pickup.



Z Gate Card Layout
(View from card side)



Note: This board is located physically with the row-6 card positions at the top, as shown in "Locations" in Chapter 1

Y Gate Card Layout (View from card side)

[08633]

Safety Circuits

• The 5444 contains safety circuits to protect data recorded on the disk. The safety circuits are located on the write select and safety card (see ALD page FS230).

• The circuits detect unsafe conditions in the write circuits (see "Write Circuits" in this section). Four outputs from the write circuits ('write current on', 'erase current on', 'no write transitions', and 'multi-head output') are compared with 'write select', 'erase select', 'read select', and 'access in motion' to determine whether an unsafe condition exists. If an unsafe condition does exist, one of three latches is set, activating 'data unsafe'; the heads mechanically unload and 'ready' drops, inhibiting all further read or write operations.

• The three latches, together with the conditions that set the latches, are as follows:

Select Unsafe Latch:

1. 'Read select' activated, together with either 'write select' or 'erase select'.
2. 'Access in motion' activated, together with either 'write select' or 'erase select'.

Erase Unsafe Latch:

1. 'Write select' activated, with 'erase current on' dropped.
2. 'Write select' dropped, with 'erase current on' activated.

Write Unsafe Latch:

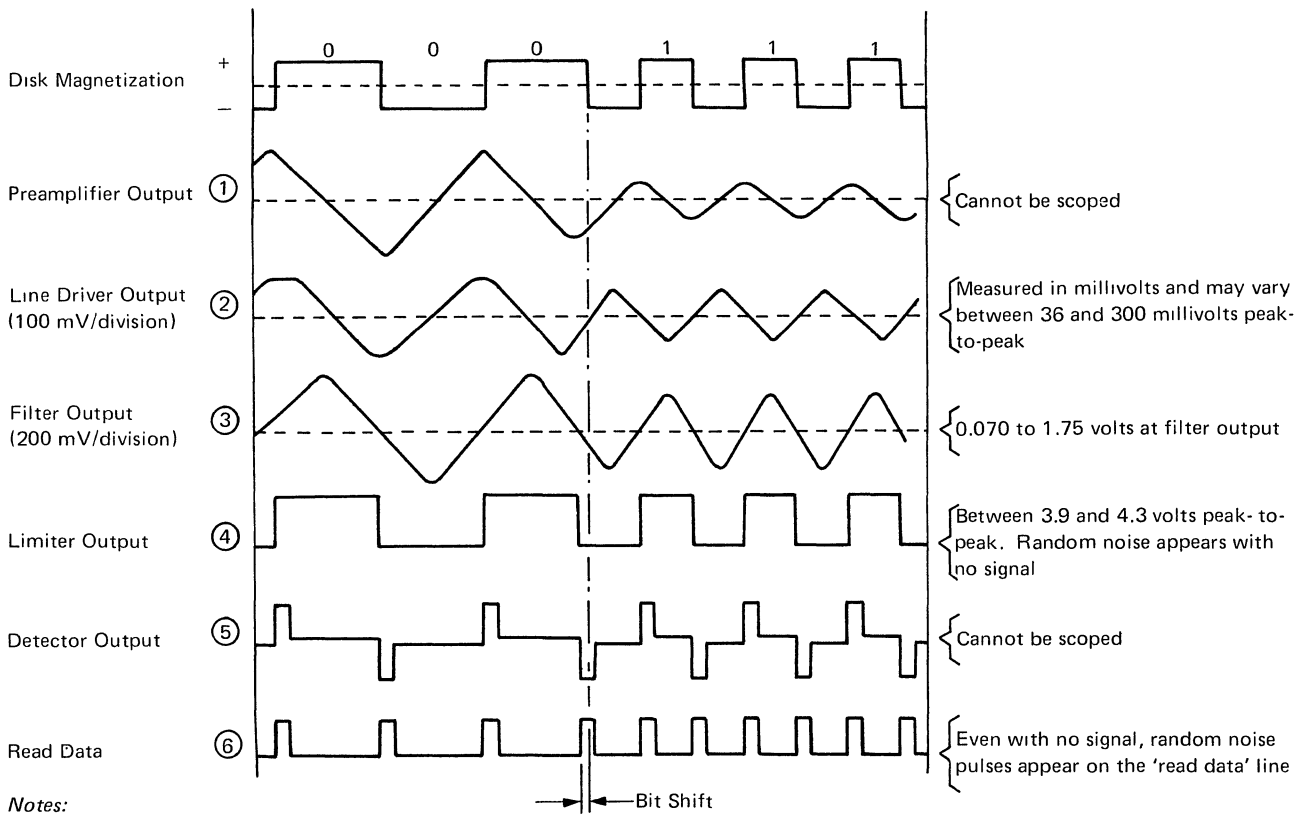
1. 'Write select' activated, with 'no write transitions' activated.
2. 'Write select' dropped, with 'write current on' activated.
3. 'Write select' activated, with 'multi head output' activated.

• The latches can only be reset on machine start up, the line 'brush midcycle interlock' raising 'data unsafe reset'. If the unsafe condition is removed, read/write operations can resume.

• When the using system powers up, the latches are reset by 'power on reset' raising 'data unsafe reset'.

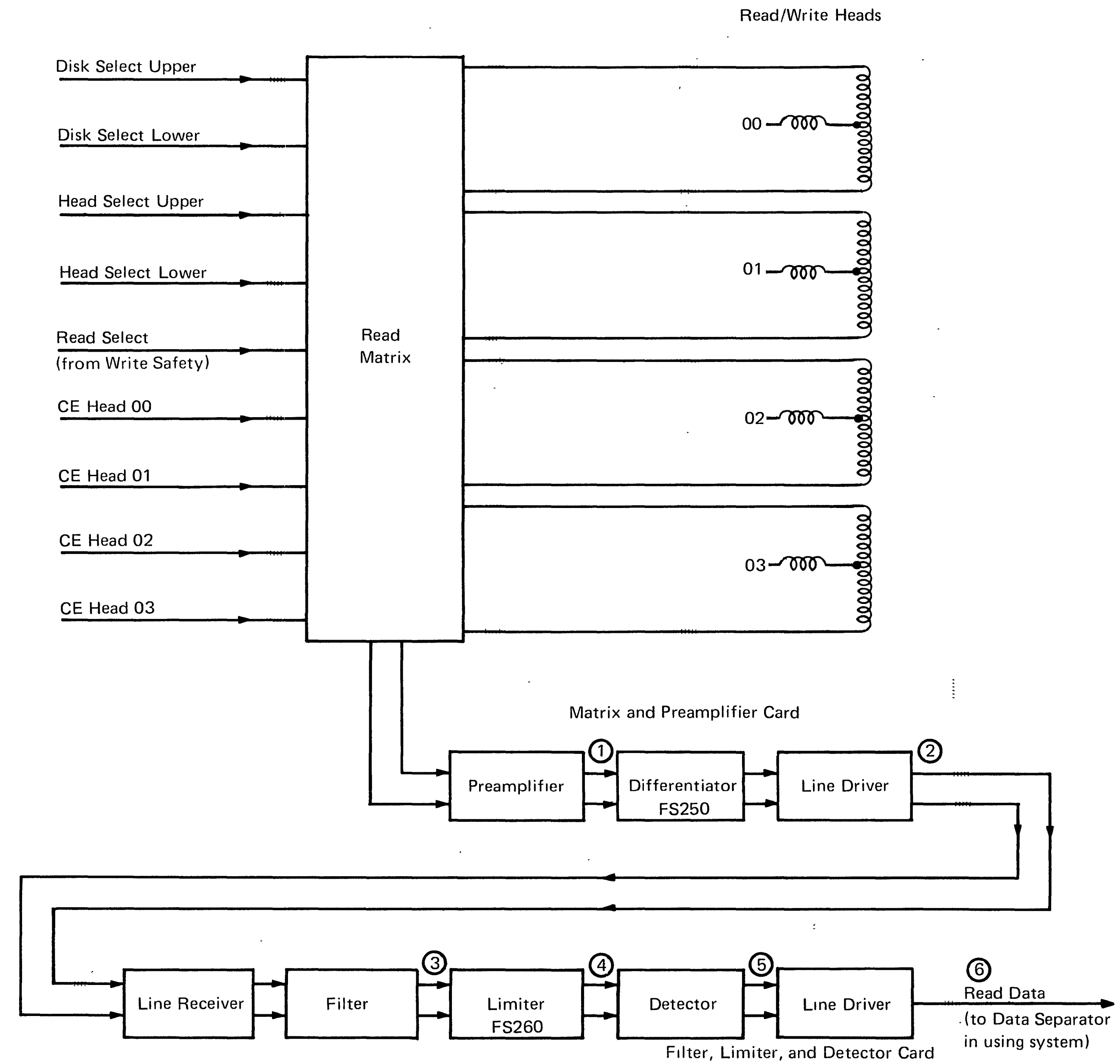
Read Circuits

- The read circuits consist of head select circuits, preamplifier, filter, limiter and detector circuits.
- The read circuits produce a train of pulses that represent the magnetic patterns recorded on the disk surface. The bit-cell period is nominally 629.5 ns. Individual bit-cell periods can vary by ±22% because of the interaction between adjacent magnetic patterns that are recorded on the disk surface. Variation may occur in the relationship between the data and clock pulses due to this interaction. This effect is called "bit shift" and is kept to a minimum.
- During a read operation, the center taps of all the read/write heads are left floating. Head selection is achieved by taking the center tap of the read/write coil load resistor to 0V dc. The center taps of the non-selected heads are at +5V dc.



Notes:
1. Circled numbers refer to the read circuits in the adjacent diagram
2. Voltage amplitude values are differential

Read Circuit Waveforms [08634]

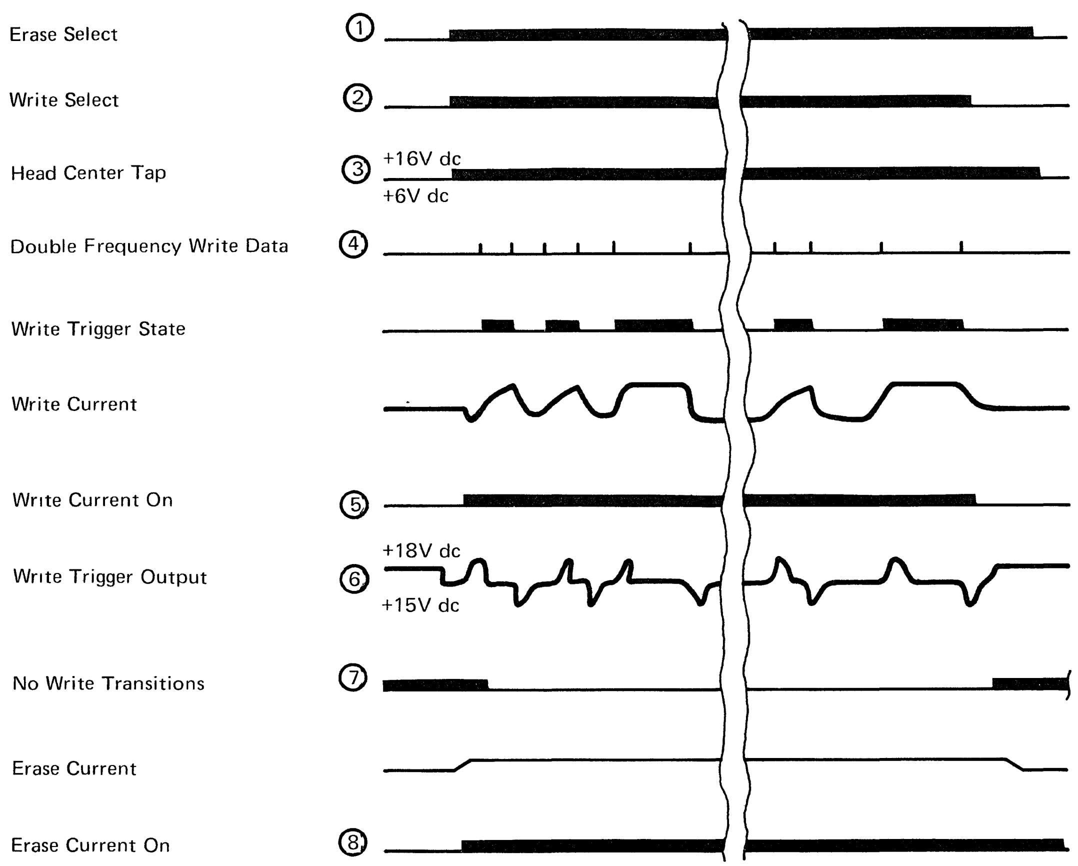


Note: Circled numbers refer to read circuit waveforms in the adjacent diagram

Read Circuits [08635]

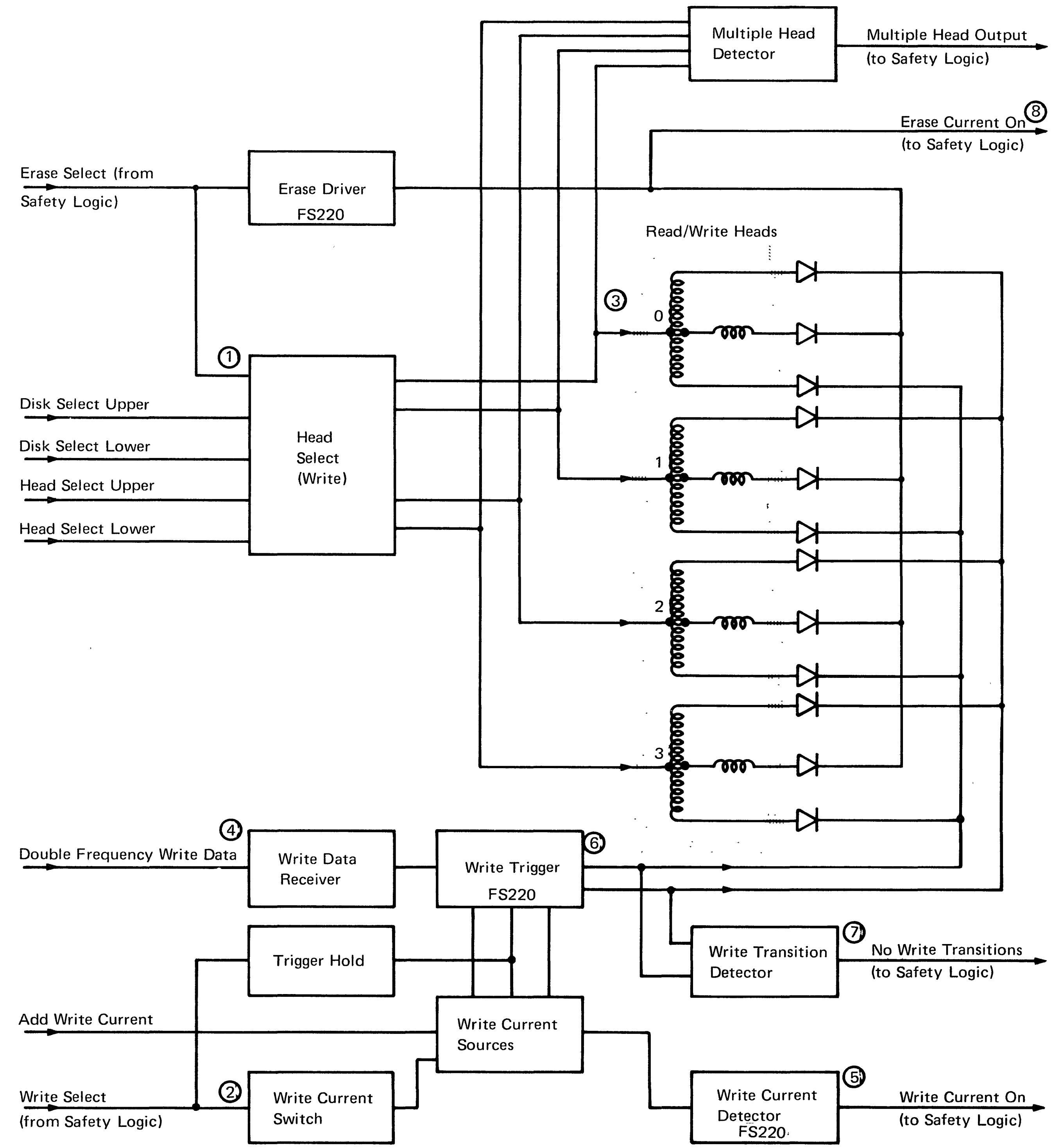
Write Circuits

- The write circuits consist of head select circuits, and write and erase drivers.
- The write current is turned on when 'write select' is activated and is switched between the two halves of the read/write coil by the write trigger, which switches every time a clock or data bit is received on the 'double frequency write data' line. The write current is 35 mA (nominal) for tracks 000 to +099, and 30 mA (nominal) for tracks 100 to 203. This current level is controlled by the 'add write current' line.
- Head selection for a write operation is achieved by switching the center tap of the selected read/write coil to +16V dc. The center taps of the read/write coils in the three nonselected heads are left floating.



Note: Circled numbers refer to the write circuits in the adjacent diagram

Write Circuit Waveforms [08636]



Note: Circled numbers refer to the write circuit waveforms in the adjacent diagram

Write Circuits [08637]

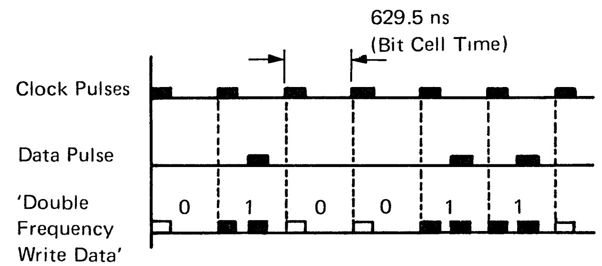
Read/ Write Operations

- Read/write operations are controlled by the using system.
- During a write operation, a data bit is recorded on the disk surface when the current in the head coils is reversed.
- During a read operation, a bit is sensed when there is a flux reversal on the disk surface.

Double Frequency Recording

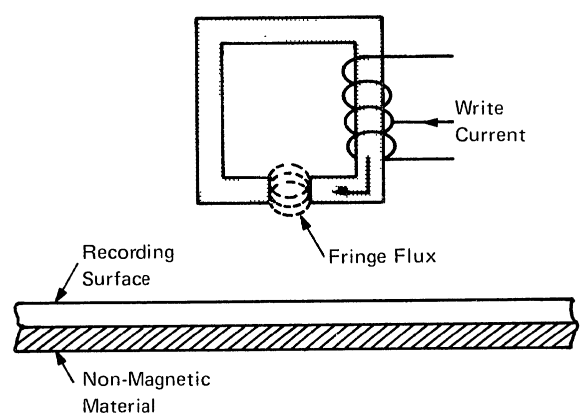
- The 5444 uses the double-frequency horizontal non-return to zero (NRZ) recording method.
- The using system clock frequency produces a train of pulses for the basic bit-cell timing cycle. Data pulses alternate with clock pulses from the using system to produce a write signal on the 'double frequency write data' line.
- The write signal presents either a zero-bit condition or a one-bit condition for each bit-cell time generated by the clock. A zero bit-cell (clock pulses only) produces a single flux change on the disk surface; a one bit-cell (data pulse located between two clock pulses) produces a double flux change on the disk surface.

- The recording device used is a read/write head (see "Read/Write Head" under "3.8 Head/Arm Assembly" in this chapter). When current flows, the flux that is induced in the pole piece fringes at the gap. As the magnetic recording surface passes, the fringe flux horizontally magnetizes the surface.



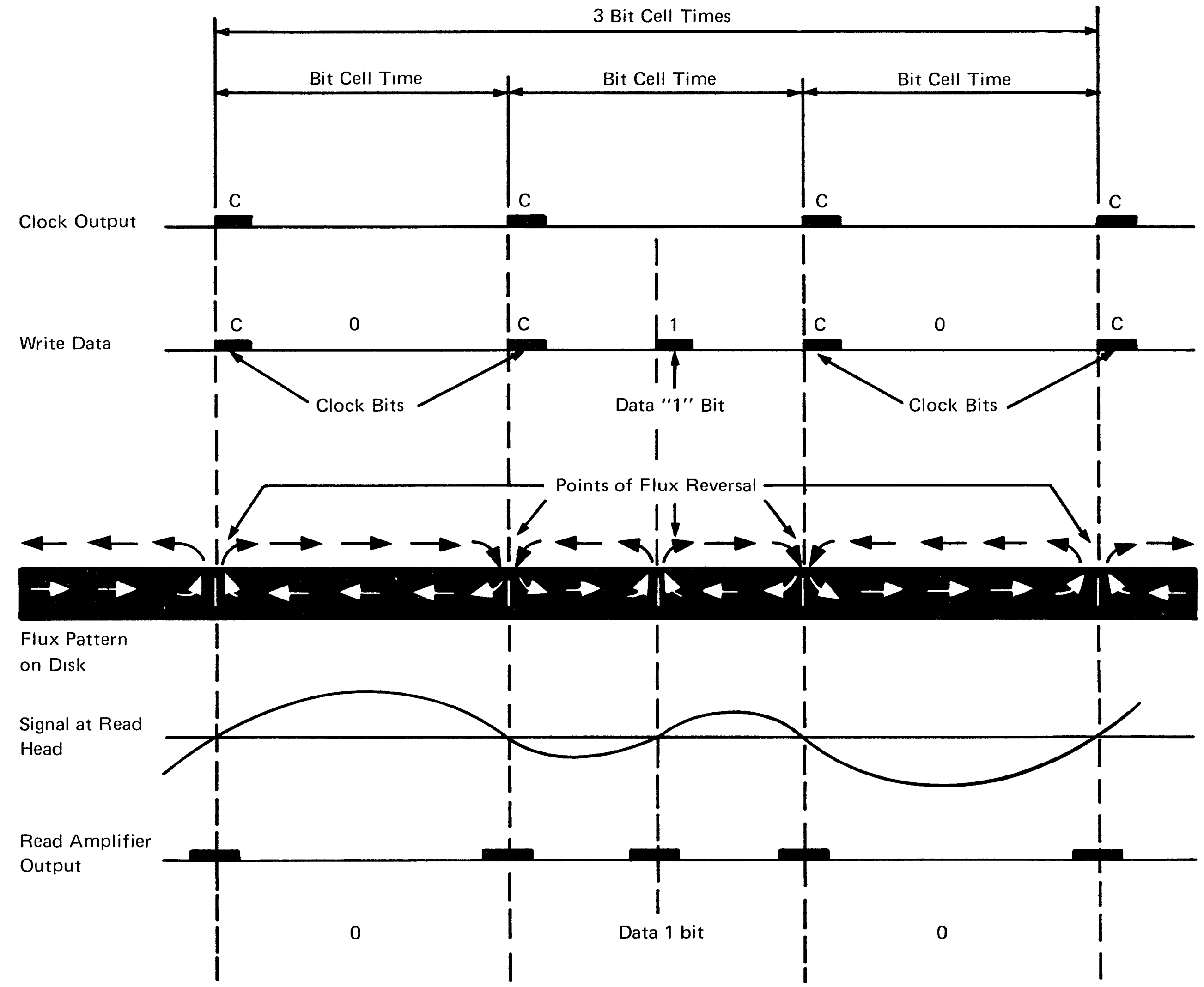
Derivation of Composite Write Signal

[08638]



Basic Read/Write Head

[08639]



Double Frequency Recording—Flux and Pulse Relationship

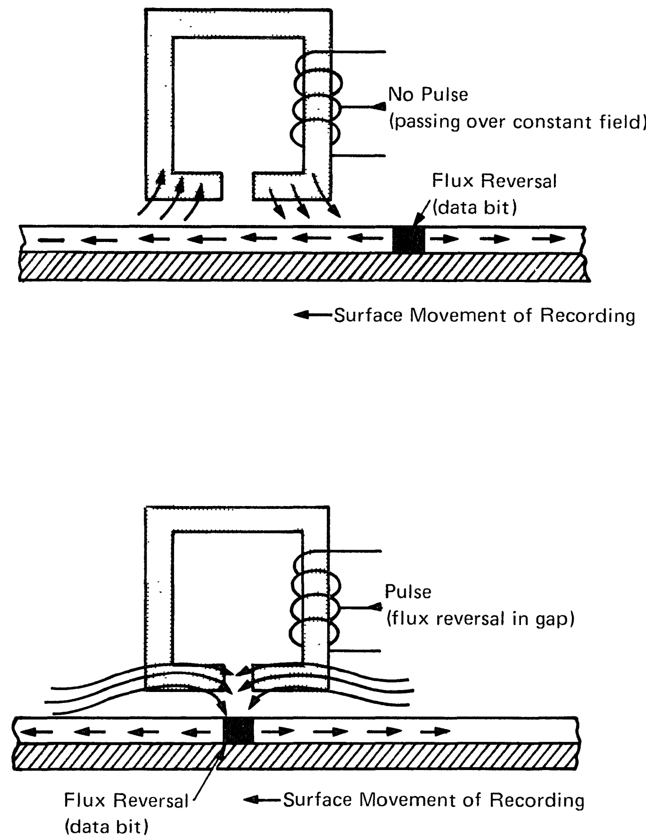
[08640]

Read / Write Operations (continued)

Read Operation

- The required read/write head is defined by the head select and disk select lines.
- Read circuits are then activated by 'read select'.
- During a read operation, with the recording surface magnetized in one horizontal direction, constant flux flows and the coil registers no output voltage. However, when a recorded bit (180 degrees horizontal flux reversal) passes the gap, the flux flowing through the ring and coil also reverses and produces a voltage output pulse.
- The read circuits are activated for as long as 'read select' remains up. Read signals, read off the selected disk by the read/write head, are amplified and shaped in the read circuits.
- The raw data output from the read circuits is fed via the 'read data' line to the using system where a data separator separates the raw data into data bits and clock bits.

Note: The 5444 may also be used for read operations when off-line, and controlled from the CE control panel. The appropriate read/write head is selected by one of four CE head select lines. 'Read select' is not required.



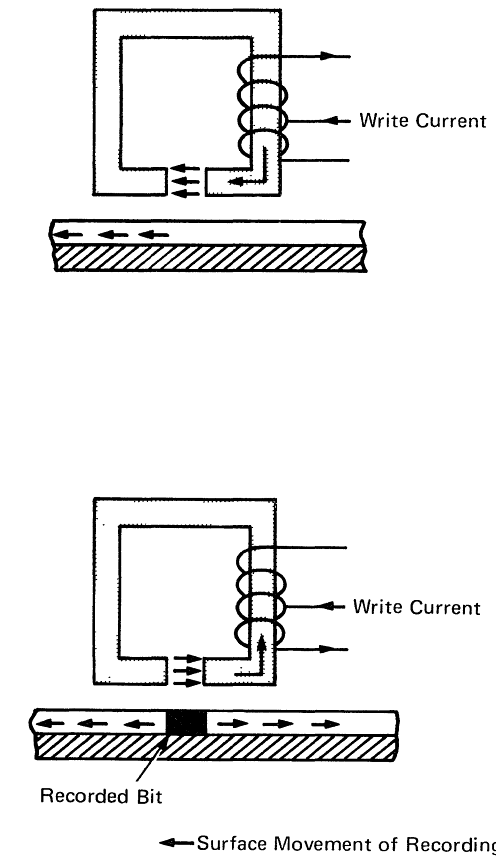
Horizontal Reading

[08641]

Write Operation

- The required read/write head is defined by the head select and disk select lines.
- Write and erase circuits are then activated by 'write select' and 'erase select'.
- Data to be recorded enters the 5444 on the 'double frequency write data' line.
- During a write operation, a data bit is recorded by reversing the direction of the current in the coil, which reverses the flux direction in the pole piece and reverses the fringe flux in the gap. At the instant that the flux in the pole piece gap reverses, the direction of magnetization changes on the disk surface. Each reversal between clock pulses represents a recorded data bit.
- Write operations end when the flow of clock and data bits ceases. 'Write select' then drops, turning off the write current in the read/write coil. 'Erase select' drops 25 μs after 'write select', ensuring that the newly written track is 'side' erased to the end of the data.

Note: The write operation is inhibited when the 5444 is controlled from the CE control panel.



Horizontal Recording

[08642]

3.12 Power Supplies

Power Requirements

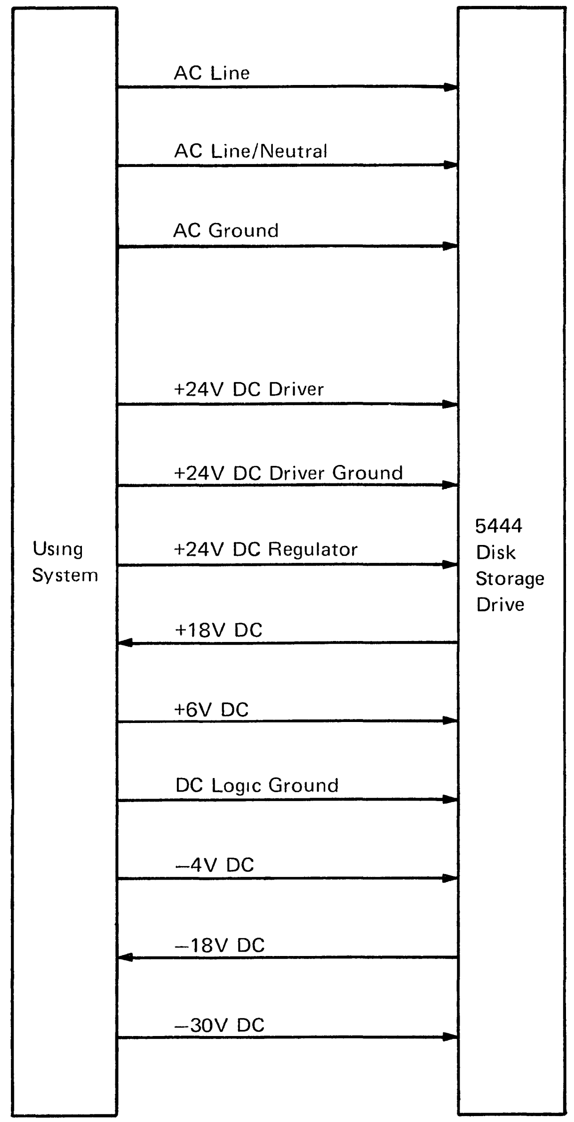
- All power supplies are obtained from the using system.
- The 5444 can be operated from 50-Hz or 60-Hz power supplies.
- The 5444 has separate ac and dc logic grounds.

AC Power

- The ac power requirements are as follows:
220/235V ac ± 10%, 50 ± 0.5 Hz, single phase,
or
208/230V ac ± 10%, 60 Hz ± 0.5 Hz, single phase.
Surge current (starting): 3.5A rms maximum.
Average current: 1A rms maximum.
- AC ground is connected as a separate line to the using system; the ac box is connected to ac ground and is insulated from the machine base. The drive motor and brush motor are also ac grounded. AC ground points must not be allowed to contact the 5444 base casting (dc logic ground) or else read/write errors could occur.

DC Power

- The following dc power supplies are required:
+24V dc ± 10%, 'file start' line, maximum current 0.2A.
+24V dc ± 10%, driver supply, maximum current 6.0A.
+24V dc ± 10%, regulator supply, maximum current 0.65A.
+24V dc ± 8%, maximum current 1.0A.
–4V dc ± 8%, maximum current 1.3A.
–30V dc + 6.1V, –5.1V, maximum current 0.35A.
- Two lines are required for the +24V dc input: a +24V regulator line, and a +24V driver line. The regulator line is used to supply the +18V dc voltage regulator. The driver line supplies all other +24V dc requirements, including relays, magnets, magnet drivers, and the stepping motor.



Input Power Lines

[08643]

- Two dc ground lines are used. The ground line for the +24V regulator, +6V, –4V, and –30V supplies (logic ground) is connected to the machine base. A separate ground line is used for the +24V driver supply. Both dc ground lines are connected to the using system as separate lines.

Power Sequencing

Power-On Sequence

- The +6V dc, and –4V dc supplies must be switched on at least 5 ms before the +24V dc supply is applied.

Power-Off Sequence

- The +24V dc supply must have decayed to at least 2.5V dc before the +6V dc, and –4V dc supplies are switched off.

18V DC Voltage Regulators – Description

- Two voltage regulators are used to generate +18V dc and –18V dc supplies. The +18V dc supply is generated from the '+24V dc' regulator line, and the –18V dc supply from the '–30V dc' line. The two 18-volt supplies are connected across the machine interface for use by the using system.
- Both series voltage regulators are on a card mounted at Y-W1 F6. The series regulating power transistors are mounted on heat sinks on Y gate and on the base casting.
- The regulated supplies obtained are:
+18V dc ± 3%, maximum current 600 mA.
–18V dc ± 3%, maximum current 300 mA.

AC Box

- The ac box contains:

1. The input terminal block (TB1) for the ac input supply from the using system.
2. Two line filters.
3. Three relays: K1 (drive motor relay), K3 (brush motor relay), K5 (drive motor brake relay).
4. The drive motor capacitor.
5. One brake resistor (60-Hz machines only).

- The ac box is electrically isolated from the base and is connected to ac ground at the ac box ground bus (the base is connected to logic ground). The ac supply is distributed from the ac box to the drive motor and the brush motor.

DC Box

- The DC box contains:

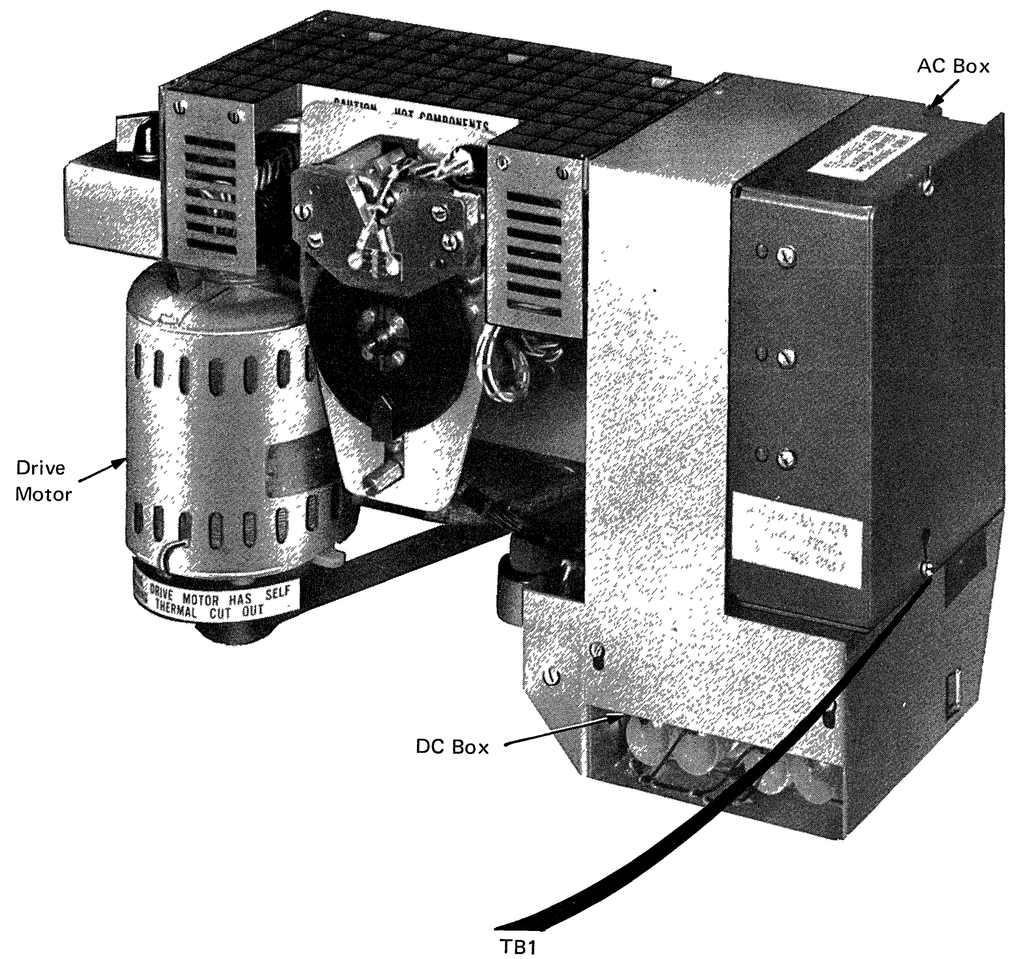
1. Terminal block (TB3) for the dc supply from the using system.
2. Relay K2 (dc control relay).
3. One SLT card (2 wide X 2 high) containing stepping motor drive circuits and the lever hold magnet driver.
4. Four diodes (in series with the stepping motor drive transistors).
5. Two capacitors (in the stepping motor drive circuit).
6. Two sockets: J3 (stepping motor leads), J4 (to encoder assembly).
7. One fuse (fuse F1) (2-ampere on Models 1, 2, and 3 and 3-ampere on Models A01, A02, and A03) to protect the stepping motor in the event of a drive circuit failure.
8. One smoothing capacitor for +24V dc driver supply.

- The dc box is connected electrically to the base (logic ground). The stepping motor drive circuits in the dc box are wired directly to the output transistors that are mounted on the base casting as a heat sink.

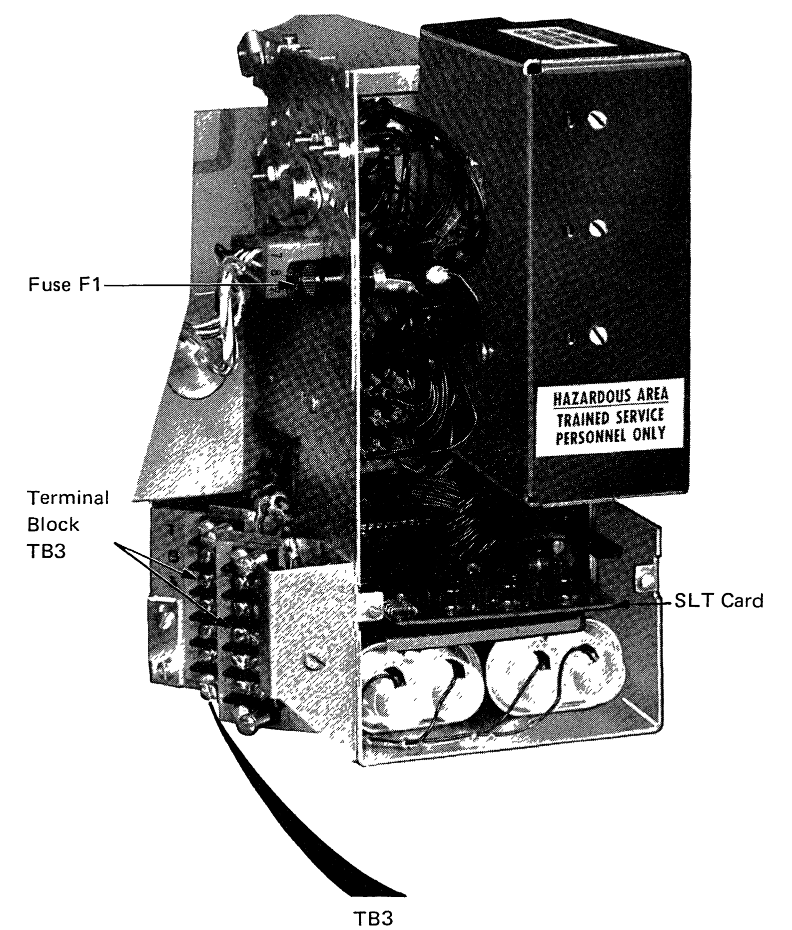
Protective Devices

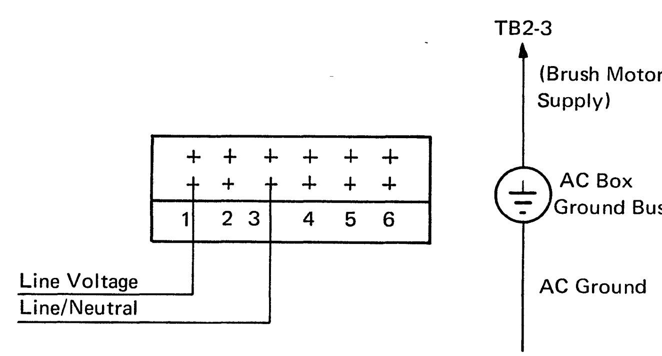
- The +24V dc regulator supply is protected by fuse F1 (2 amperes) in the dc box.
- A thermal cutout operates when the drive motor overheats and automatically resets when the motor cools down.

Rear View of 5444



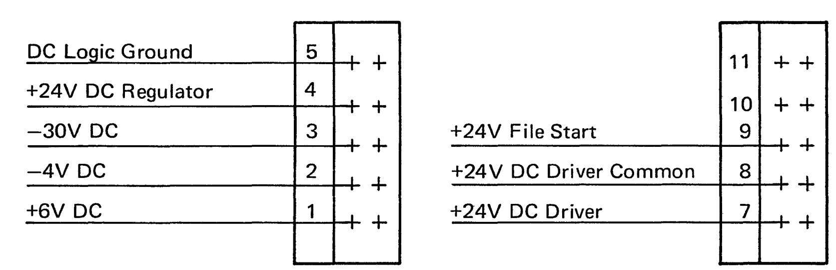
DC Box Cover Removed





AC Connections at AC Box (ZA200)

[08645]



DC Connections at DC Box (ZA200)

[08644]

DANGER
Power to the 5444 may not be automatically disconnected when the enclosure has been opened and the cartridge removed. Unless the complete system is powered down, some terminal blocks remain live.

3.12.1 18V DC Voltage Regulators

Two 18V regulated supplies, positive and negative, are produced by a voltage regulator card sharing level converters.

Supplies:
+18V dc, 600 milliamperes maximum (transistor Q1).
−18V dc, 300 milliamperes maximum (transistor Q2).

Metering Points:
+18V: Y-W1 N6D04.
Ground: Any D08.
−18V: Y-W1 N6D10.

Checking:
No servicing or adjustment is possible on the 18V regulator other than checking that +24V and −30V inputs are present. The output should be 18V ± 0.5V. If a regulator card appears defective, change the card; if the fault persists, check the transistors Q1 (+18V) and Q2 (−18V), which are mounted on the machine front casting.

3.12.2 Change of Power Supply – Components

When the power supply frequency or voltage is changed, change the components listed below.

Power Supply Changed	Component to be Changed
Frequency and voltage	1. Brush motor assembly (see 3.6.3) 2. Drive motor and drive motor pulley (see 3.2.1) 3. AC box
Voltage only	Drive motor (see 3.2.1)

[08646]

3.12.3 Separated AC and DC Grounds

CAUTION
The majority of the machine is connected to dc ground; the using system enclosure is usually connected to ac ground. It is essential that the machine is electrically isolated from its system enclosure at all times.

Two separate grounds exist on the 5444:
1. DC logic ground, which is common to the logic supplies at TB 3-5, and is connected to the machine base.
2. AC ground, which is common to the exterior frame of the enclosing system, and is connected to the drive motor, the brush motor, and the ac box.

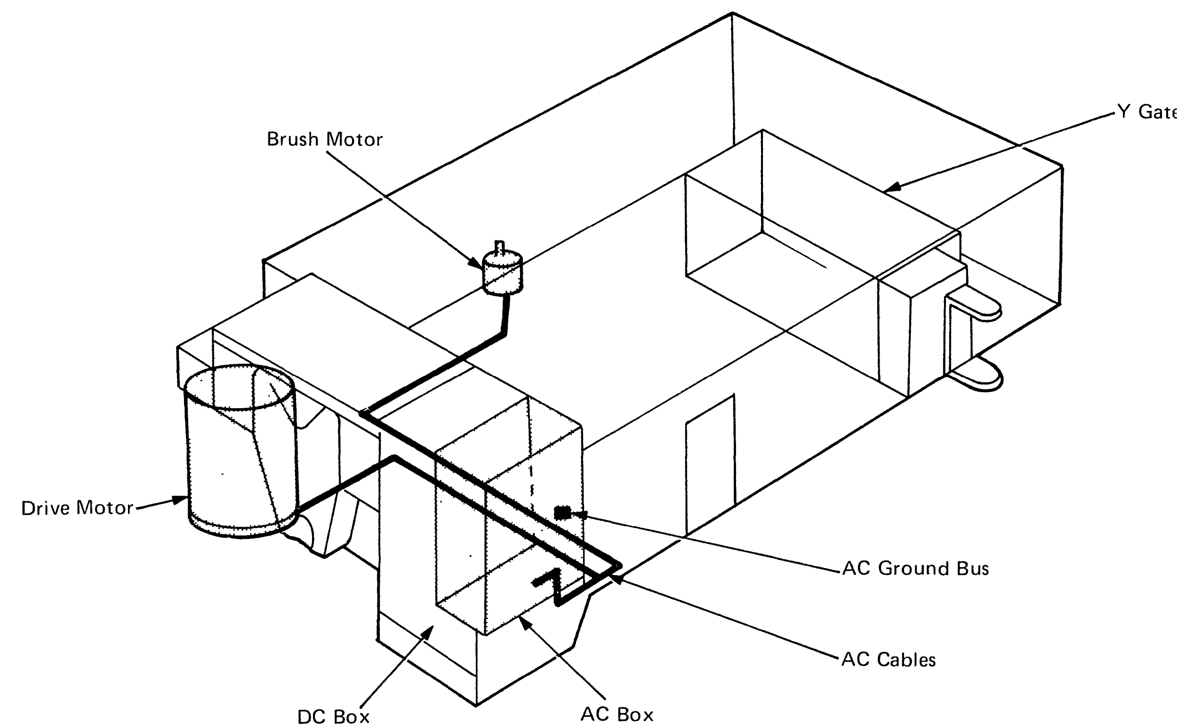
The two grounds must not come into contact with each other or else read/write errors can occur.

3.12.3.1 Leakage Check between Grounds

1. Switch off power at the using system.
2. Disconnect the ac cable between the 5444 and the system.
3. Check that the dc resistance between TB 3-5 and the ac box is greater than 500 kiloohms.
4. Reconnect the ac cable between the 5444 and the system.
5. Turn on power supplies.

3.12.3.2 Drive Belt

The drive belt that connects the drive motor to the drive spindle is a conducting belt. Do not replace it with a non-conducting belt.



Shaded Areas: Connected to AC ground
Other Areas: Connected to DC logic ground

[08647]

Appendixes and Index

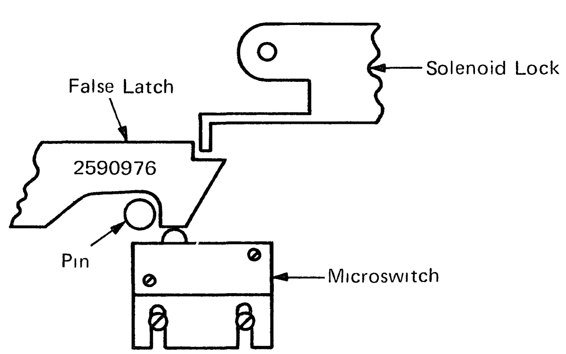
Appendix A. Access to 5444 in IBM System/3 Model 10

Drawer Lock Bypass Procedure

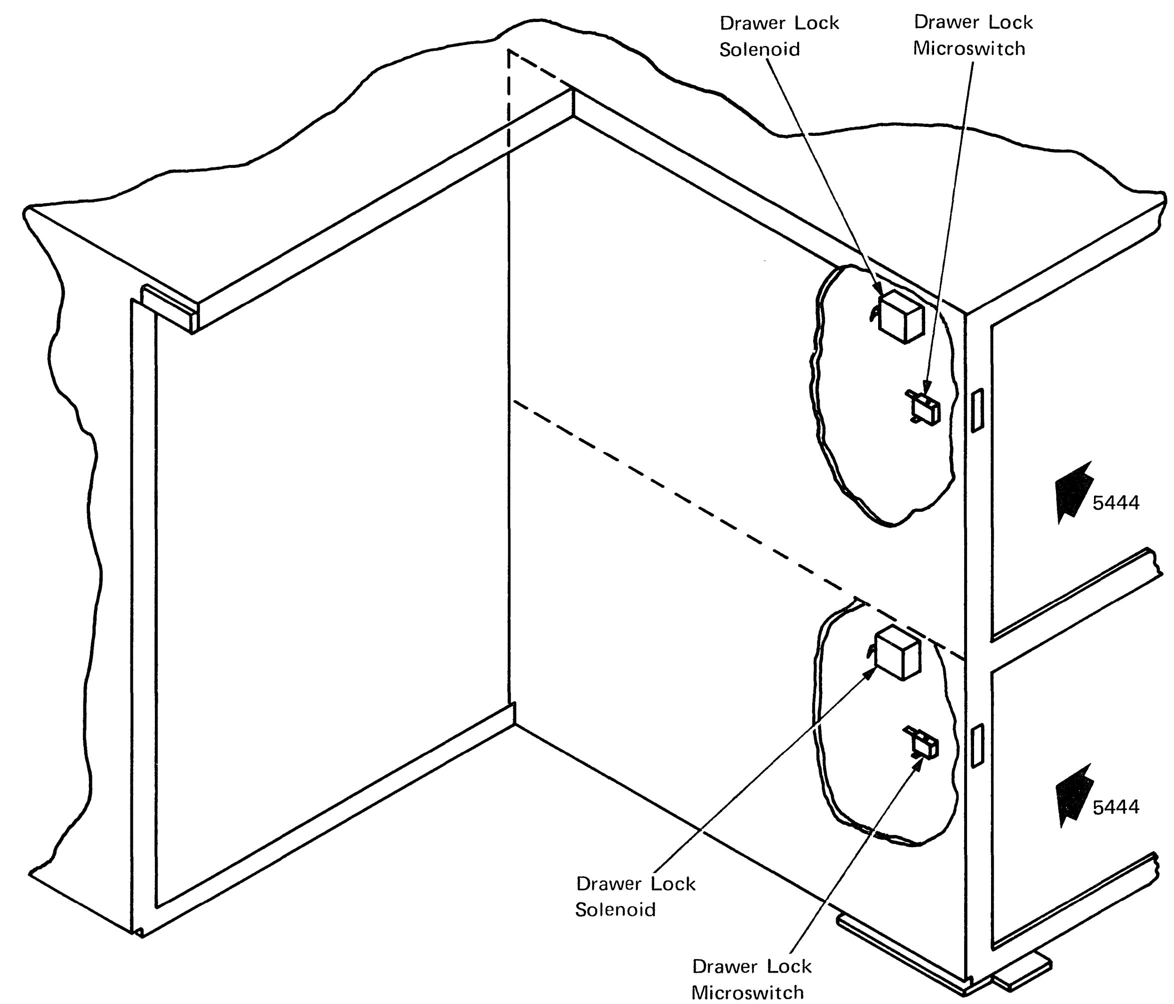
The drawer lock must be bypassed so that the 5444 can be operated with the drawer open. The drawer lock components are part of the using system, *not* part of the 5444.

CAUTION
If the disk cartridge is to be removed, be sure that the head cleaning brushes in the read/write heads are fully retracted.

1. Insert a small tool, approximately ½ in. (13 mm), into the lock access hole located on the left side of the enclosure. Use a prying motion to lift the lock while unlatching the drawer.
2. To power up the 5444 with the drawer open, activate the drawer lock microswitch by inserting the false latch, part 2590976.



[08648]



Front View of IBM System/3 Disk Enclosure

[08649]

Appendix B. Reference Information

Abbreviations

A	ampere
AC,ac	alternating current
ALD	automated logic diagram
C	common
CE	customer engineer
cm	centimeter
DC,dc	direct current
EC	edge connector
EMF	electromotive force
ERP	error recovery procedures
FBM	field bill of material
FCU	file control unit
fwd	forward(s)
g	gramme
gnd	ground
hd	(read/write) head
HDI	head-to-disk interference
hp	horsepower
Hz	hertz
in.	inch
kg	kilogramme
lb	pound
mA	milliampere
MAP	maintenance analysis procedure
mm	millimeter
ms	millisecond
mV	millivolt
NC	normally closed
NO	normally open
NRZ	non-return to zero
ns	nanosecond
pc	photocell
PM	preventive maintenance
preamp	preamplifier
rd	read
rev	reverse
rms	root mean square
rpm	revolutions per minute
R/W	read/write
SLD	solid logic (dense)
SLT	solid logic technology
SS	singleshot
TAP	timing analysis program
TB	terminal block
TD	time delay
TRK	track
TM	theory-maintenance manual
V	volt
μs	microsecond
(>30100)	machines with serial numbers above 30100

Glossary

Beat Frequency: The frequency that is produced by the intermodulation of two frequencies.

Circumferential Adjustment: The adjustment of the upper index transducer to ensure that the index pulse from the transducer is in an identical position relative to the read/write heads when the disk cartridge is transferred between 5444s.

Data Rate: The nominal rate at which data can be transmitted from a 5444.

Direct Access Storage: The type of storage where information may be stored or retrieved directly without prior sequential search.

Microinch: One millionth of an inch (1×10^{-6} inch)

Micron: One millionth part of a meter (1×10^{-6} meter) Equivalent to 39.4 microinches.

Period: The time between consecutive pulses.

Reluctance: The ratio that the magnetomotive force acting around a magnetic circuit bears to the flux that produces this force.

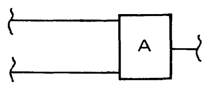
Runout: The total up-and-down vertical movement at the disk edge during one revolution.

SLD-100: A specification for voltages that are used in solid logic dense construction.

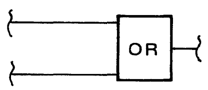
Tracking Adjustment: An adjustment to ensure that the read/write heads move in a true radial line across the disk surfaces.

Symbols Legend

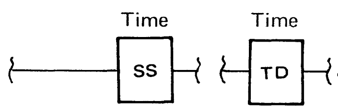
Logic Diagrams



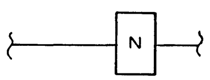
AND
The output is active only when all inputs are active



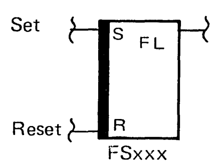
OR
The output is active if one or more inputs are active



Singleshot, Time Delay



Inverter (Negator)
Inverts the level of the input

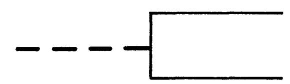


Flip Latch
A set (S) input sets the FL and activates the output; a reset (R) input resets the FL and deactivates the output. The FL retains its state (set or reset) between the application of active inputs. The set input overrides the reset input; therefore, the application of coincident set and reset inputs activate the output. One output line is shown, but multiple output lines may be used. An ALD page reference (FSxxx) is given below the block

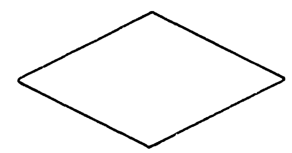
Flowcharts

Terminal
Indicates the beginning or end of an event

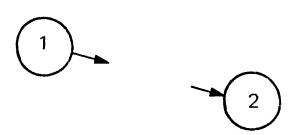
Process
Indicates a major function or event



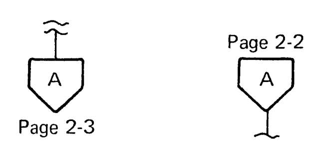
Annotation
Gives a descriptive comment or explanatory note



Decision
Indicates a point in a flowchart where a logical decision is necessary



On-Page Connector
Indicates the connection between two points on the same diagram. The arrow leaving one symbol points to the symbol with the same number



Off-Page Connector
Indicates the connection between two points that are located on separate pages

[08652]

Inches to Millimeters Conversion Table

Inches	Millimeters
0.001	0,025
0.002	0,051
0.003	0,076
0.004	0,102
0.005	0,127
0.006	0,152
0.007	0,178
0.008	0,203
0.009	0,229
0.010	0,254
0.020	0,508
0.030	0,762
0.040	1,016
0.050	1,270

Inches	Millimeters
0.060	1,524
0.070	1,778
0.080	2,032
0.090	2,286
0.100	2,540
0.200	5,080
0.300	7,620
0.400	10,160
0.500	12,700
0.600	15,240
0.700	17,780
0.800	20,320
0.900	22,860
1.000	25,400

[08650]

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Note: Where more than one page reference is given, the major reference is first.

d

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