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Single Disk Storage

(Serial Numbers 00001 through 39999)

PREFACE

The scope of this manual is limited to the Single Disk Storage (disk drive unit only) which is used in the IBM 2310, Model A1, A2 and A3 of the IBM 1800 Data Acquisition and Control System. The disk drive is also used as a part of the storage system in the IBM 1130 Computing System.

Content in this manual was reviewed for accuracy on December 15, 1965. Users of this manual are cautioned that machine specifications are subject to change at any time and without prior notice by IBM. System diagrams (logics) at the engineering change level for a specific machine are included in each machine shipment.

This information consists of maintenance instructions which enable the CE to rapidly diagnose equipment malfunctions in the machine and to perform corrective maintenance to keep the equipment in a state of readiness for the customer. The CE must have completed prior IBM training for this equipment, and must be familiar with practical applications of the maintenance concept and techniques derived from training.

Alternate procedures are provided in the back of this manual for machines with serial numbers 00001 through 00050. These procedures are designated by a footnote in other sections of the manual.

This manual is divided into seven chapters.

Chapter 1 contains instructions and procedures for diagnosing and isolating equipment malfunctions by the use of service aids and functional checkout procedures.

Chapter 2 describes switches and controls used by the CE to accomplish checkout and maintenance operations.

Chapter 3 contains instructions for performing scheduled maintenance and includes a tabulated schedule for accomplishing periodic maintenance operations.

Chapter 4 provides instructions for service checks, adjustments, and removal and replacement of components.

Chapter 5 provides a listing of power requirements and power sequencing.

Chapter 6 contains information which enables the CE to locate components, major assemblies, meters, gages, etc., which are described by the instructions contained in the manual.

Chapter 7 consists of alternate procedures for use with machines having serial numbers 00001 through 00050.

The companion publication, IBM Field Engineering Theory of Operation (Manual of Instruction), Single Disk Storage (Serial Numbers 00001 through 39999) (Form 227-3669-0) provides information for the theory of operation, and may be used as a reference to augment information contained within this manual.

Maintenance of power supply and attachment circuits for the IBM 2310 is described in IBM Field Engineering Maintenance Manual, 1800 Data Acquisition and Control System (Form 227-5956-1).

This manual (Form 226-3668-0) is a complete revision of and supersedes Form 227-5984-1 which described maintenance of the IBM 2310 Disk Storage .

Copies of this and other IBM publications can be obtained through IBM Branch Offices.
A form has been provided at the back of this publication for readers' comments.
If the form has been detached, comments may be directed to :
IBM, Product Publications Department, San Jose, Calif. 95114

CONTENTS

SAFETY

Personal safety cannot be overemphasized. To ensure your own safety, make it an every day practice to follow safety precautions at all times. Become familiar with and use safety practices outlined in IBM cards, Forms 124-0002 and MO4-8401, issued to all Customer Engineers.

AC Power

The start and stop switches do not apply and remove ac power to the machine, but simply energize and de-energize the spindle drive motor. Caution must be exercised when servicing the machine since objects can contact 110/220-volt connections despite the safety shields and covers provided.

Isopropyl Alcohol

Use only IBM approved 91% Isopropyl Alcohol (part 2155966) for cleaning read/write heads. Other types of alcohol may cause damage and/or contamination due to impurities. The 91% isopropyl alcohol solution is a flammable liquid; therefore, keep only the quantity needed for impending use in the customer's office.

Keep the plastic bottle containing isopropyl alcohol in the sealed metal container except when in use.

When shipping 91% isopropyl alcohol, comply with the appropriate regulations (noted on the container) for shipment of flammable liquids.

WARNINGS

There are many ways in which the machine can be damaged by improper operation or improper servicing techniques. These are described in the text under the appropriate servicing procedure. The most significant of these are listed below.

Disk Cartridge Handling

Cleanliness must be maintained while handling the disk cartridge. The cartridge door which receives the read/write heads must never be unlatched and opened when the cartridge is out of the machine except when using the disk cartridge cleaning fixture to clean the disk. Also, the air valve located on the bottom surface of the cartridge must never be opened. Serious damage to disk surfaces could result if foreign particles are introduced inside the cartridge.

Never disassemble a disk cartridge. The disk cartridge assembly is a permanently encased unit which cannot be disassembled without damage.

Never stack a disk cartridge, subject it to top loading, or store it on a protruding object. Handling practices of this nature could deform the diaphragm which centers the disk within the cartridge housing. Damage to the diaphragm renders the cartridge unusable and could cause damage to read/write heads.

Disk Cartridge Insertion into Machine

DC power must always be on before insertion of the cartridge. The machine is interlocked so that when dc power is on, and ac power is turned off, the carriage returns to home position. If the cartridge is inserted without first turning on dc power, the carriage could be in some position other than home, and the cartridge could strike the heads. The machine contains interlocking switches which prevent this condition from occurring unless the Customer Engineer violates or overrides the safety function of these switches.

CE Restricted Tracks on Disk Cartridge

Do not write on the CE disk cartridge at tracks 90 through 110. This band contains prerecorded test tracks 95, 100, and 105, which will be destroyed. Any other tracks may be used for test purposes.

Read/Write Heads

Avoid touching the gliding surface of read/write heads. Acids from the skin can etch and ruin the head.

Do not load heads manually when a cartridge is out of the machine, when disk is stopped, or when blower system is not operating. If it becomes necessary to load heads under these static conditions, a folded IBM card should be inserted between the heads to protect gliding surfaces from possible damage. Read/write heads must be cleaned immediately whenever this is done.

Machine Operation

Head loading precautions must be observed when operating the machine. Proper operation of the machine provides ac and dc power to energize the blower system and home the carriage. The cartridge is then inserted, and the receiver handle is raised to lower the cartridge onto the spindle. Power is applied to the disk drive motor and the spindle will come up to speed.

If power is applied to the disk drive motor without a cartridge present, the cartridge in place switch can be manually operated to energize the motor to load heads; however, a folded IBM card should be inserted between the heads for protection.

DC Power

The +3 vdc, -3 vdc, and +6 vdc power must be applied to, and removed from, the machine at the same time to prevent damage to internal circuits of the machine. The +48-vdc power must never be applied without all other dc voltages being present.

Tachometer Cable Removal

Turn off dc power before removing the tachometer cable. If this is not done, accessing may be uncontrolled with resulting damage to the access mechanism.

1.1 DIAGNOSTIC TECHNIQUES

WARNING: Voltage is present on both sides of most circuit cards. Metal caps of transistors are often a part of the circuit. Avoid pulling or replacing cards with the d-c power on, since a resultant short circuit could damage transistors or other components in the circuit.

WARNING: A potential of +48 volts is present for head pick, cartridge lock, access amplifier, and voltage regulator circuits. A potential of +36 volts is present for write circuits. Exercise care when probing near SLT cards containing these circuits to avoid possible shorts which could result in extensive damage.

Intermittent problems can sometimes be aggravated by vibration. Tapping the edge of cards with the plastic handle of a screwdriver in the area suspected should be sufficient. Use caution because excessive vibrations can cause a short circuit in adjacent card components.

Conditions will arise where it is desirable to jumper in signals or voltages to specific inputs or outputs to check certain functions. Care should be taken to ensure that logic blocks are not overloaded during these checks, as erroneous indications will result. More important, avoid the use of high voltages which can damage or destroy the transistors. For the majority of logic block cases, a properly placed ground will create the effect desired. All other cases must be treated individually based on knowledge of the circuits involved.

When the electronic gate is opened to check the positioning of SLT cards, care should be taken to properly replace the SLT card support before closing the gate. This support serves to rigidly brace the outer edges of the cards with the gate housing to minimize card vibration. The support normally interferes with the bottom of the electronic gate to provide a preload on ends of the SLT cards.

1.2 FUNCTIONAL CHECK

The functional check provides for operating the equipment without using signal control circuits of the central processing unit (CPU). This check verifies that the drive actuator, carriage access motion, head selection, and start/stop equipment functions will perform as required.

The CE control panel contains switches which become active only when the CE interlock (CPU) signal cable is disconnected at row A of the electronic gate. When this cable is disconnected from system control circuits, the machine is automatically placed in a read select mode to prevent inadvertent erasure of recorded data, and to allow the CE to examine the read circuit and recorded data. The functional check is to be accomplished as follows:

NOTE: No CE check is provided on the machine for writing information.

1. Remove CE interlock (CPU) signal cable from socket in row A of the electronic gate.
2. Ensure ac and dc power is available to machine.
3. Install CE cartridge.
4. Energize drive motor.
5. Using CE switches, access carriage and select each head to determine that machine operates satisfactorily.

1.3 READ MALFUNCTIONS

1.3.1 Read Circuit Troubleshooting (Figure 1-1)

All read/write safety circuits in the machine are coupled with the write lock latch, which becomes set and produces a write select error signal when incompatibility exists at gated outputs from read/write lines. Always check the write driver SLT card when neither read nor write operations function.

When the write-lock latch becomes set, file ready condition is removed from the machine, and the carriage will access to home position (track 000) and stop while the disk will continue to rotate.

It will be necessary to turn off power to the drive motor to reduce disk speed to 30 RPM to reset the latch — then power up the machine to attain a file ready status.

WARNING: Do not put scope probes, leads, or jumpers of any kind on lines coming directly from read/write heads. The heads can be damaged and/or data destroyed by the presence of voltages at these points.

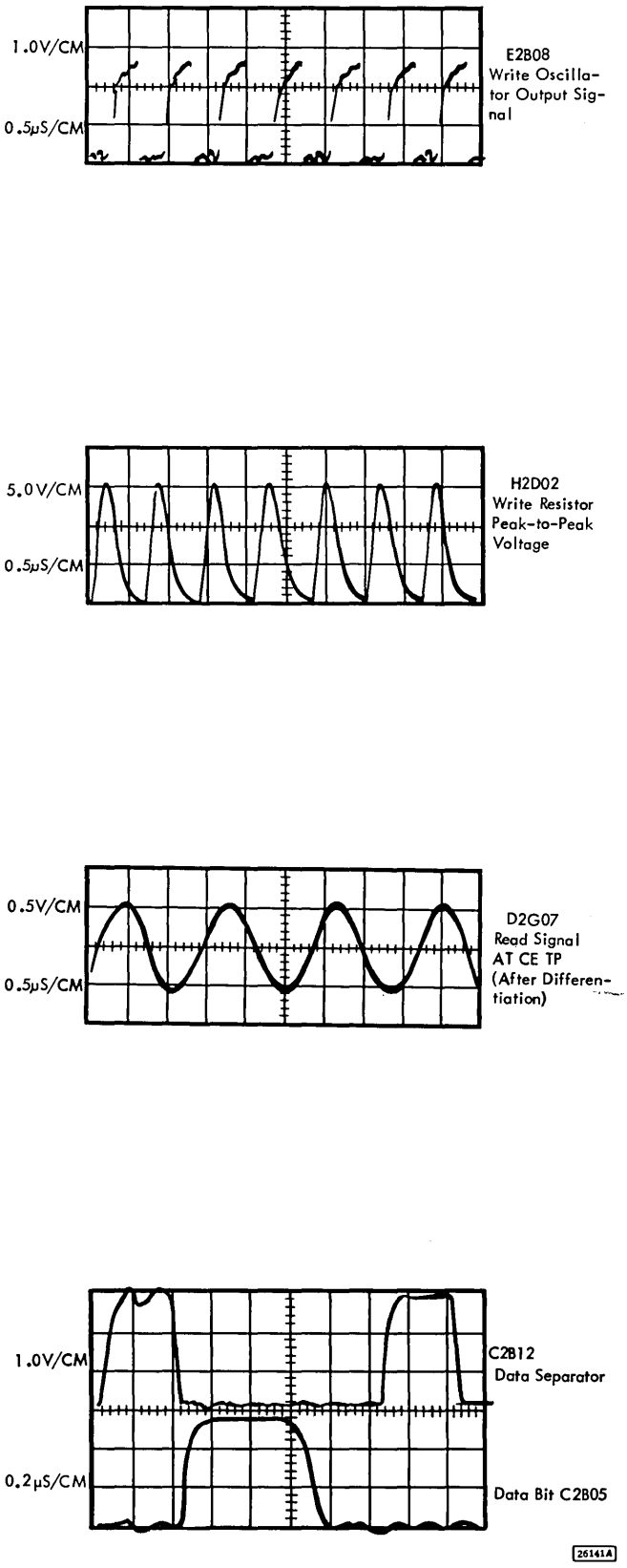

Figure 1-1. Oscilloscope Display of Read/Write Circuits

The read circuits consist of read/write heads, the preamplifier/write driver SLT card, read amplifier SLT card, and data separator SLT card. All cards are located in the electronic gate.

The preamplifier circuit provides a differential signal input to the read amplifier of 360 KC (all zero pattern) and 720 KC (all one's pattern). The output from the read amplifier is single ended, and provides double frequency data to the data separator SLT card. The read gate is the only gate required by the read amplifier.

A CE test point is located on the read amplifier for CE use. Input to the amplifier differentiator circuit is measured at TP D2 G07. Output of the detector circuit is measured at pin location D2 B03.

The voltage at TP D2 G07 should be 1.5 v minimum to 3.15 v maximum. This voltage will vary with respect to the track being read. A higher voltage will prevail at the outside track than at the inside track because of the difference in disk surface speed relative to the read/write head.

The following analysis is to be used to troubleshoot read circuits: Oscilloscope display patterns for read/write circuits are shown in Figure 1-1.

Both Heads Fail to Read - Probable Causes:

1. Heads not loaded. Check visually.
2. Carriage at incorrect cylinder to read disk. Check visually.
3. DC voltage supplies not at a correct level. This is an unsafe condition. Check interlock SLT card. In a read select mode, the write lock latch should be set.

NOTE: Voltages should be checked at the SLT board.

4. Head not selected, or both heads selected. Check head select line (+3 v level for head zero and ground level for head one).
5. Data separator circuit has improper output. Check for read clock output signal on C2 B03 and read data output signal on C2 D05.
6. Read amplifier has no output. Check for output signal at detector circuit on read amplifier SLT card at location D2 B03.
7. Read amplifier has no input. Check for presence of input signal at amplifier differential circuit on read amplifier SLT card at CE test point TP D2 G07.

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

Machine Reads but Generates Read Errors — Probable Causes:

1. Machine fails to read on a particular head:
   a. Head select transistor for this head is inoperative. Check write driver SLT card for malfunction of head select transistors.
   b. Line noise present in read signal. Check that head-arm assembly is electrically isolated from frame ground.
   c. Open head diode(s). Replace preamplifier/write driver card.
   d. Disk speed detection output fluctuates. Check for sector time of 5 ms between pulses. Possible that speed detector is defective.
   e. Data separator circuit defective — does not provide read clock signal output at C2B03 and/or read data output signal at C2D05. Check data separator adjustment of 600 nsec single shot which gates between clock pulses to permit data pulses to pass.
   f. Head shoe dc resistance relative to base plate should be 5 ohms or less.
   g. Intermittent short between coils, or between coils and ground of read/write head.
   h. Heads improperly aligned to read track.
2. Machine makes frequent read errors on a particular head.
   a. Disk speed detector output signal fluctuates. Check for defective speed detector.
   b. Weak read signal at head. Check for improper loading of head against disk surface. Check for defective head. Check for improper force on head-load spring.
   c. Head shoe dc resistance relative to base plate should be 5 ohms or less.
   d. Bad head. Check for presence of read amplifier output at pin location D2B03.
   e. Intermittent open in head diodes. Replace preamplifier/write driver SLT card.
   f. Intermittent head select. Check write driver SLT card for malfunction of head select circuit.
   g. Head is out of alignment. Check alignment of read/write head with CE track 100.

1.4 WRITE MALFUNCTIONS

1.4.1 Write Circuit Troubleshooting (Figure 1-1)

NOTE: An apparent failure to write can be caused by a write select error condition when the write lock latch becomes set because of a read/write circuit malfunction. Check for a latched condition in the read/write safety circuit before investigating the write driver SLT card or read/write head for trouble. Refer to section 1.3.1 which lists machin status conditions caused by setting of this latch.

Information to be written is supplied to the machine via the write data line. The writing process is unde complete control of the system control circuits. Th machine is conditioned to write when the write gate line and write clock gate line are at ground level.

The write circuits consist of read/write heads, preamplifier/write driver SLT card, write select safety SLT card, and 1.44 mc oscillator and trigger SLT card. All cards are located in the electronic gate.

The write amplifier furnishes the write driver with three lines: write gate, write data, and a 1.44 mc oscillator signal line. The nominal dc voltage o the write signal at the heads is +26 volts.

The following analysis is to be used to troubleshoot write circuits:

Both Heads Fail to Write — Probable Causes:

1. Heads not loaded. Check visually.
2. Write gate is not at the correct level to allow write data to enter the machine. The write gate line should be at ground level for write and erase circuits to be turned on.
3. Write resistor voltage to read/write head is insufficient. Peak-to-peak voltage across the write resistor should be 15 volts.

Machine Generates Write Errors — Probable Cause

1. Intermittent write driver or write amplifier.
2. Output of write amplifier on write data lines is incorrect.
3. Write resistor voltage into the head is insufficient. Peak-to-peak voltage across the write resistor should be 15 volts.

1.5 ACCESS MALFUNCTIONS

1.5.1 Access Circuit Malfunction Troubleshooting

The access circuits contain the access amplifier SL card, access logic SLT card, tachometer assembly, and detent mechanism. These circuits and components effect control of detent operation, duration of drive current, and dynamic braking of carriage motion.

Whenever malfunction is suspected in accessing circuits, the following four adjustments are to

be accomplished according to procedures of Chapter 4:

1. A deadband adjustment is accomplished to minimize carriage oscillations when the carriage is decelerated to arrive at a new track location.
2. A 10 milli-inch and 20 milli-inch integrator set adjustment is made to calibrate the trip level for decelerating and stopping carriage motion within limits for a single step increment. A separate adjustment is made for each stepping mode.
3. A 10 ms single shot adjustment provides for timing of the detent to correctly seat in the rack after the carriage has been accessed to a new track location.
4. A dynamic balance adjustment is made to obtain smooth detent operation for both directions of carriage travel between track 000 and track 200.

Some of these adjustments are inter-related, and it will be necessary to perform a complete adjustment whenever a single adjustment is disturbed, or, whenever a new SLT card is substituted in the access circuits during troubleshooting. Oscilloscope display patterns for access circuits are shown in Figure 1-2.

1.5.2 Detent Assembly and Rack Troubleshooting

No adjustment of the detent assembly is made other than initially locating the assembly against the rack and establishing a clearance of 0.006 (±0.001) inch between the clapper and pole piece while the electromagnet is energized. The CE cartridge can be used to check odd-even detent operation by comparison of the signal on track 100 with the signal on track 105 to determine that spacing between tracks is within acceptable limits. A check of detent operation is made as follows:

1. With the CE Cartridge installed, allow 15 minutes for temperature of the cartridge to stabilize with temperature of the machine.
2. Use the CE switches to access the carriage to CE track 100 and verify that heads are aligned properly with this test track. The even detent will be engaged at this track location.
3. Access the carriage to CE track 105 and verify that heads are still aligned properly with the test track. The odd detent will be engaged at this track location.

NOTE: It may be necessary and is permissable to apply a slight pressure against the front or rear of the carriage to check head alignment at this track location.

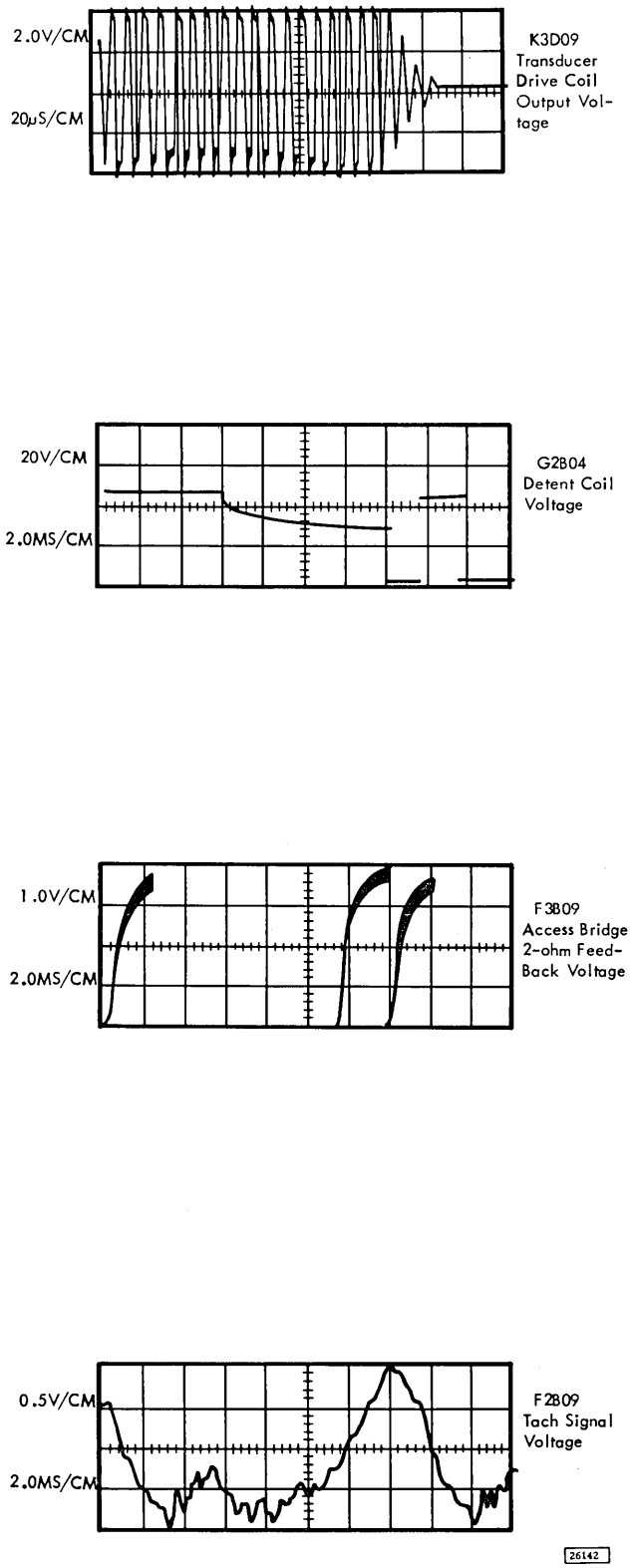

Figure 1-2. Oscilloscope Display of Access Circuits

4. Verify that the same head alignment signal pattern is displayed at both track locations (100 and 105). A discrepancy in signal patterns denotes that the spacing between detents is not within allowable limits.

1.6 BASE PLATE COMPONENT MALFUNCTIONS

1.6.1 Troubleshooting Base Plate Components

The following procedure is to be used to check components of the base plate.

1. Remove cover by removing two retaining screws located on cartridge-guide posts and lift cover from the machine.
2. Check sector transducer signal lines for good connections. Check to determine that slots in sector ring and transducer are free from build up of foreign obstructions.
3. Check for 0 to 5-ohm resistance when measured between the dc gate ground and the base plate.
4. Check spindle and drive belt for proper tension.
5. Check detent mechanism to determine that even detent is fully engaged at home position (track 000) and that odd detent is not engaged but is evenly aligned with crest of detent rack.
6. Check detent rack for cleanliness.
7. Check head-load mechanism for non-binding movement.
8. Check read/write head flexure springs for tightness, and check head-load spring for proper contact with heads while heads are loaded manually on an IBM card.

1.7 SERVICE AIDS

Service aids provide for diagnosing malfunctions which interface with CPU programming. CEM references for a sympton index were not available as of December 15, 1965. A blank sympton index chart (Figure 1-3) may be used by the reader to list CEM references until the manual is updated.

1.7.1 Track Addressing

Since the machine does not provide any carriage position information to the using system except in the home position, hardware or programming errors in carriage positioning or head selection are not directly detectable. Therefore, it is imperative that the using system record address information on the disk either as part of the data field or in a separate address field along with each data record. This address must provide verification of the position of the selected information.

Problem	Cause	C. E. M. Reference

26143

Figure 1-3. Symptom Index of Service Aids

1.7.2 Disk Formatting Procedure

Disk defects on new or used 2315 Disk Cartridges can effect data recording, causing loss of useable tracks, because of the high density recording of the disk cartridge. Using systems should therefore program storage capacities based on 200 data track allowing three spare tracks to ensure that the state capacities are maintained for the life of the cartrid Whenever a 2315 Disk Cartridge is used, a custom utility program employing the following procedure used to locate the defects, flag the tracks in error, and identify the alternate track locations. The pro cedure to be used is as follows

1. Starting with head 0, track 000, the pattern 11100101 must be written and verified by a rea operation.
2. Then the pattern 00010011 must be written and verified again.
3. If successful, the formatting procedure should be continued. However, if an error repeats it self ten times on either pattern, the track

must be flagged and an alternate track address written.

4. To ensure that the alternate track is alright for use, it should be formatted immediately before continuing with the subsequent disk cartridge tracks. Use spare tracks in locations 200-202 for alternate tracks.

1.7.3 Error Retry Procedure

The IBM programming systems supporting the single disk storage provide for a ten-retry procedure to be utilized on any failure of access or write. A fifty retry procedure must be used for read errors. In addition, an automatic track flagging procedure must be established in the file programs if errors occur during a write operation. In order to protect against machine read/write malfunctions as opposed to its defects, this formatting procedure should first skip to the alternate track to record this data. If errors occur at this new alternate track, the procedure should stop and request attention of the C. E. If, however, the recording at the alternate track occurs without error, the old track should be flagged, the alternate address recorded and the program should continue.

1.7.4 Homing the Carriage

When initializing the carriage to the home position from an unknown location, the carriage must be decremented in single track steps. By testing for home after each step, the program can determine when Track 000 has been reached. This can be accomplished by providing an access command to move the carriage 203 tracks, or more in a reverse direction so that carriage will access to home and stop. This will present an access home communication signal to the using system.

1.7.5 Errors and Data Retrieval

A sporadic increase in random errors can sometimes be corrected by cleaning the heads and disk cartridge using the scheduled maintenance procedure. A solid error during a customer program, caused by failure to read a record from the file properly, need not mean the loss of that data to the customer. If the trouble is pinpointed in the head disk area:

1. Thoroughly clean the heads using the scheduled maintenance procedure. Clean the disk using the branch office cleaning fixture and then try to read the data.
2. If the data cannot be read, examine the disk surface at the point in question for a comet trail and an imbedded particle. An attempt can be made to dislodge the particle by "scrubbing" the spot with lint-free tissue and a cleaning tool. Do not use any other method as serious disk damage can result.
3. Temporary replacement of the head may be tried, but make certain that the new head will not be damaged
4. If all else fails, it may be possible to read the affected area on a scope trace as a final resort to recover the data.

2.1 LEADING PARTICULARS

Maintenance features of the single disk storage include switches and controls which permit checking and monitoring operating characteristics of the machine in a read select mode during maintenance.

A CE disk cartridge is used for radial alignment of read/write heads, and circumferential adjustment of the sector transducer.

Special tools are available at the branch-office level to properly service the machine and its components. A special disk cartridge cleaning fixture is used to clean read/write surfaces of the disk. A disk run out fixture is used to measure vertical deflection of disk surfaces.

2.2 CE DISK CARTRIDGE

The CE Disk Cartridge (part 2200001) can be identified by its red access door. (Customer disk cartridges are white all over.) The CE disk cartridge has three pre-recorded tracks on each side of the disk. These tracks are used for head-alignment tracking adjustment (track 100) and sector index timing adjustments (track 095). The third track, which checks detent spacing (track 105), is provided for troubleshooting the detent assembly and rack alignment. Care must be taken not to damage the pre-recordings contained on these tracks. Allowance is made for protection of CE tracks by avoiding the use of tracks 90 through 110. Any other tracks may be used by the CE for read/write maintenance applications.

The alignment of read/write heads is accomplished by using CE Track 100 which consists of two tracks. One of the tracks is written outboard from track 100, and the other is written inboard from track 100 so that eccentricity is built into the track. The two tracks are written with a clock pattern of all zeros at a frequency of 720 KC. Read/write heads are adjusted to read equal amplitudes of the two eccentric tracks (Section 4.17.1).

The index timing is adjusted by the use of CE track 095. A burst of bits and a reference timing pulse is recorded on this track. The sector transducer is positioned radially about the spindle so that a time delay of 30 (±5) μsec exists between the reference burst for an all-bits pattern and presentation of the index timing pulse.

2.3 CE CONTROL PANEL

A CE control panel located on back of the equipment (Figure 2-1) is provided to permit limited operation of the machine independent of the using system, except for power input. The CE switches located on the panel are normally inoperative and become active only when the CE interlock (CPU) signal cable between the using system and the disk storage drive is disconnected from row A of the electronic gate.

Disconnecting this cable places the machine in a read select mode. The CE can examine the read circuit and recorded data without the possibility of erasing recorded information.

2.4 CE SWITCHES

Four CE switches are provided on the CE panel; head select switch, step mode switch, direction switch, and step control switch. No CE control is provided on the machine for writing information.

2.4.1 Head Select Switch

The head select switch controls the selection of hea so that the CE may examine read signals originatin from either head. This switch determines which of the two heads is in use, and is particularly useful when aligning heads to a CE cartridge. The switch has two positions, labeled 0 and 1, which correspo with the upper and lower read/write head.

2.4.2 Step Mode Switch

The step mode switch controls the actuator steppin mode by determining the distance to be traversed b the carriage for each step of the actuator. The switch has two positions, labeled 10 MIL and 20 M which correspond with the distance to be displaced by the carriage (10 or 20 milli-inches) each time the step control switch is actuated.

2.4.3 Direction Switch

The direction switch controls the direction of carriage motion by causing the carriage to move in a forward or reverse direction while it is being actu ated. The switch has two positions labeled IN and OUT. The in position causes the carriage to move forward toward the center of the data disk when th

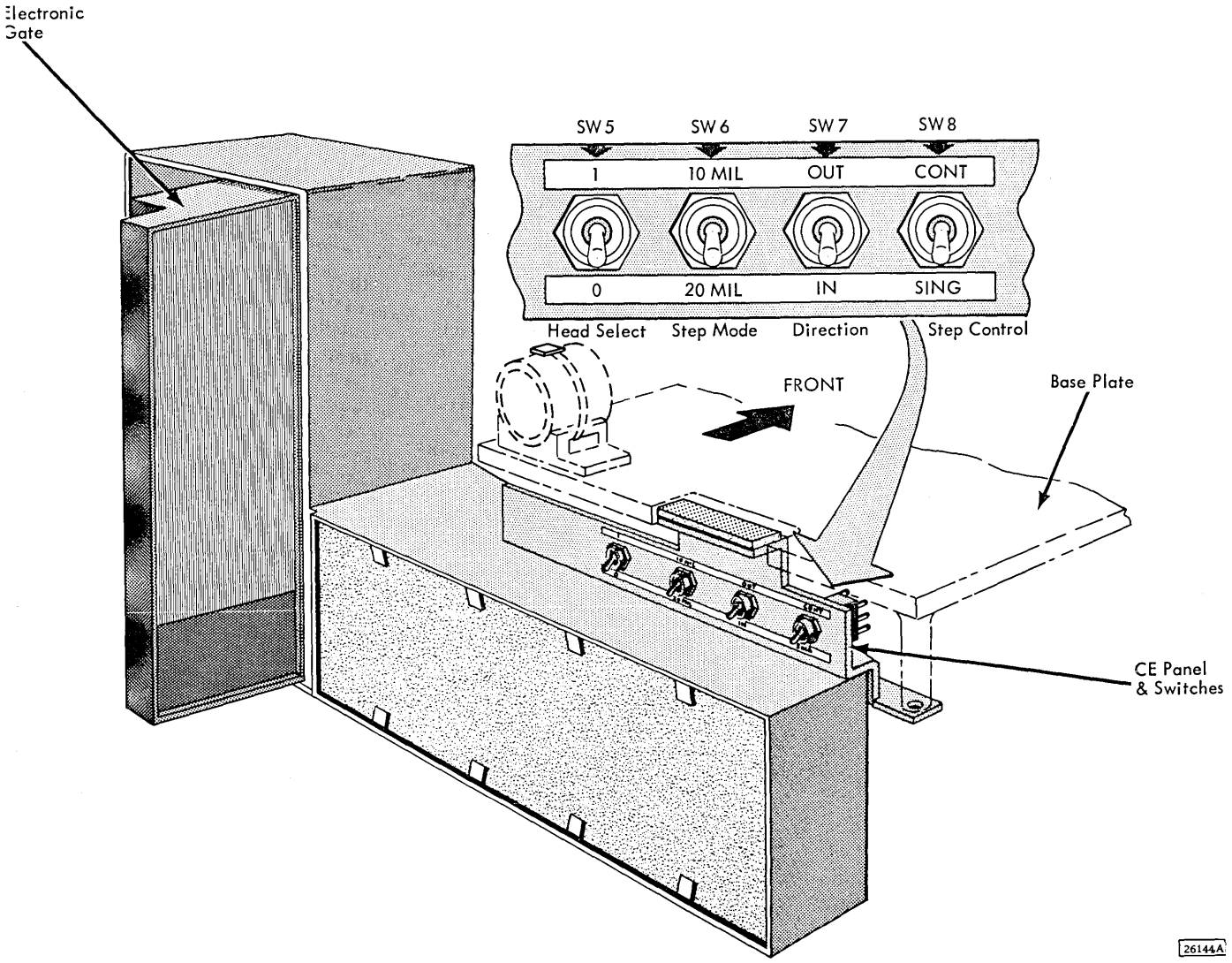

Figure 2-1. CE Panel and Switches

step control switch is actuated. The out position causes the carriage to move, in reverse, away from center of the data disk each time the step control switch is actuated.

2.4.4 Step Control Switch

The step control switch initiates carriage motion by providing an access drive pulse to access circuits to effect movement of the carriage. This switch has three positions; continuous step, single step, and neutral. Labeling on the switch, CONT and SING, correspond with the continuous or single stepping movement.

When the switch is positioned for a continuous step movement, the actuator is caused to step continuously at a 15 ms rate in a forward or reverse direction as determined by the position of the direction switch. The actuator steps in increments of 10 or 20 milli-inch steps as determined by the position of the step mode switch. The actuator continues this stepping cycle until the carriage strikes the mechanical limits of travel where the detent continues to operate without carriage motion, or until the step control switch is removed from the continuous step position.

When the switch is positioned for a single step movement, the actuator will move one step each time the switch is operated. The switch is spring loaded so that it will return to the neutral position when released. The direction of carriage travel, and 10 or 20 milli-inch step increment is determined by the respective positions of the direction and step mode switches.

2.5 TOOLS AND TEST EQUIPMENT

2.5.1 Standard Tools

To properly service the equipment, the CE requires the following tools

Small CE Tool Kit . . . . . (part 451558)
Standard SLT Tools
CE Oscilloscope, Type 561S
with Indicator Unit . . . . . (part 451647)

The following oscilloscope attachments are required:

Plug-in Dual Trace . . . . . (part 451648)
Plug-in Time Base . . . . . (part 451651)

2.5.2 Special Tools and Supplies*

The following special tools are required to service the equipment and are available in the shipping group for systems which use the disk storage drive.

Feeler Gage, non-magnetic
(0.005 inch) . . . . . .(part 2200007)
Feeler Gage, non-magnetic
(0.007 inch) . . . . . .(part 2200057)
Lint Free Tissue . . . . . .(part 2162567)
SLT Board Jumper Wires . . . . . (part 353796)
Alcohol, 91% Isopropyl,
Pint Container . . . . . .(part 2155966)
Head Alignment Oscilloscope
Adapter . . . . . .(part 2200052)

2.5.3 Branch Office Tools

The following is a list of tools and supplies which are normally located in the Branch Office. These tools can be obtained when needed:

CE Disk Cartridge . . . . . (part 2200001)
Cleaning Paddles . . . . . (part 2108474)

Disk Cleaning Fixture (part 2200008)

The disk cartridge cleaning fixture provides for cleaning the disk while it is encased within the cartridge. The operator unlatches the cartridge door and inserts the cartridge into the fixture so that cleaning pads span the data surfaces as disk is positioned on the spindle. The spindle can be rotated manually while cleaning solution is applied to the disk data surfaces. This fixture is used for unscheduled maintenance.

Disk Run Out Gage (part 2200050)*

The disk run out gate (Figure 2-2) enables the CE to determine the extent of warpage present in a disk by measuring the amount of vertical deflection present at the outer edge of the disk while it is rotated. This gage is mounted on the base plate, adjacent to the head-arm assemblies, so that the disk can be manually rotated between the gap established by adjustable lips of the gage. A knurled adjusting screw on the gage permits adjusting the gap size to determine runout. Procedures for using the gage are describe in Chapter 4.

*Alternate procedures are contained in Chapter 7 for machines with serial numbers 00001 through 00050.

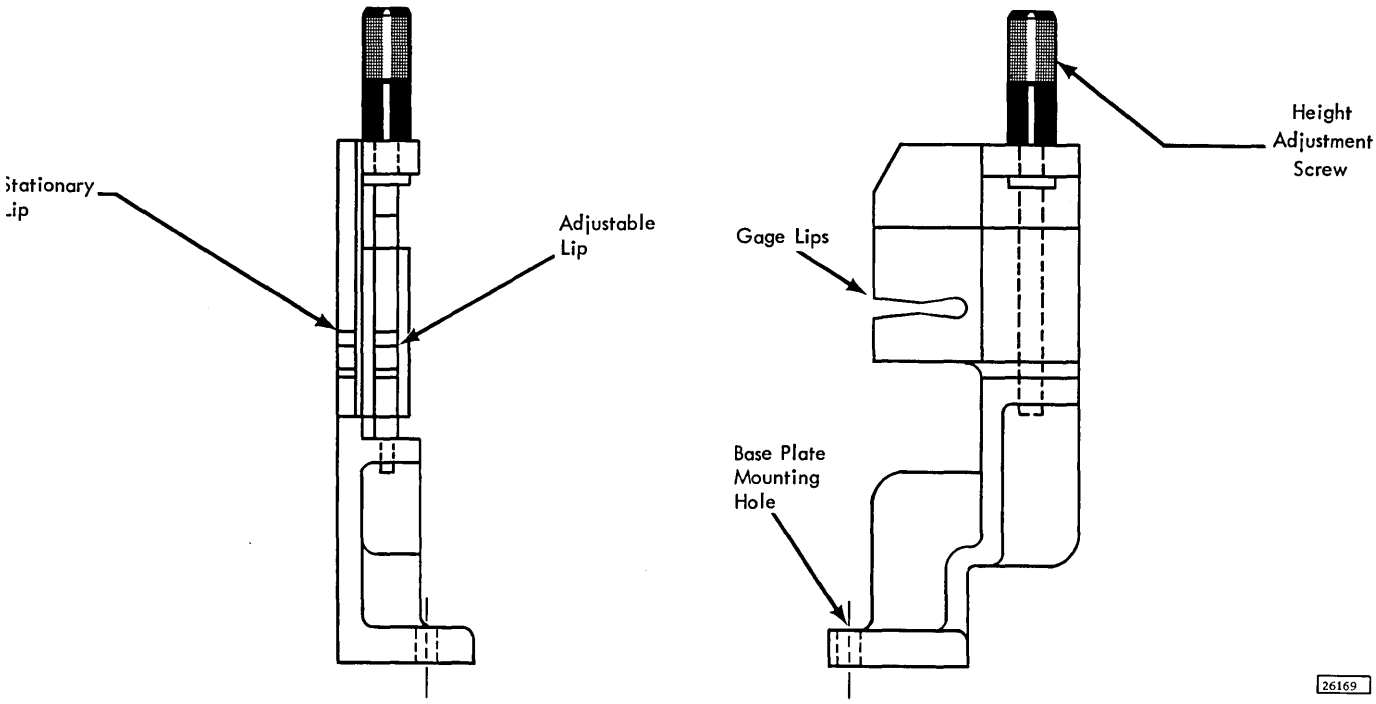

Figure 2-2. Disk Run Out Gage

3.1 APPROACH TO SCHEDULED PREVENTIVE MAINTENANCE

The prime objective of any maintenance capability is to provide maximum machine availability to the customer. Every preventive maintenance operation should assist in realizing this objective. Unless a preventive maintenance operation cuts machine downtime, it is unnecessary.

3.1.1 Visual Inspection

Visual inspection is the first step to every preventive maintenance operation. Always look for corrosion, dirt, wear, cracks, binds, and loose connections in wiring and on hardware. Alertness in noticing these items may minimize machine downtime later.

3.1.2 Electronic Circuits

Diagnostic programs and pulse checking are the two basic tools used in preventive maintenance of electronic circuits. All of these are effective in locating potential and intermittent troubles. These items are also excellent troubleshooting tools.

3.1.3 Mechanical Units

The three basic preventive maintenance steps performed on every mechanical or electro-mechanical machine are clean, lubricate, and inspect. Remember, do not do more than recommended preventive maintenance on equipment that is operating satisfactorily.

3.1.4 Cleanliness

Cleanliness cannot be overemphasized in maintaining the single disk storage machine.

When the heads are "flying" a clearance of approximately 125 to 150 microinches exists between the heads and the surfaces of the disk. Very small particles of dust can accumulate and become trapped between the heads and the disk. The accumulated dust can cause the disk surface to become scored, and this condition can result in an unusable track or in head damage.

Do not allow oil to accumulate anywhere on the machine. Oil accumulates dust and dirt. Do not operate the machine with the top cover removed unless analysis cannot be performed in any other manner. If the machine must run with the cover off, replace customer's cartridge with a CE cartridge to avoid dam age to customer data.

3.2 SCHEDULED MAINTENANCE PROCEDURES

Details of scheduled maintenance operations are listed in Figure 3-1. During normal scheduled maintenance, perform only those operations listed on the chart for that particular maintenance period. The scheduled maintenance period is established by the time interval of machine use by the customer. Details on adjustments and service checks are found in the Operation column of Figure 3-1. Observe all safety practices.

3.2.1 Cleaning Read/Write Heads

1. Wrap a lint-free wiper (part 2162567) around a paddle and dampen with 91% isopropyl alcohol (part 2155966).

   NOTE: Paddle is made by folding an IBM card four to five times lengthwise.

2. Use a second paddle to support the back of a read/write head, and thoroughly wipe the face of each read/write head with the lint-free wiper dampened with alcohol. Use a dental mirror to inspect the head surface. Be very careful that all dirt is cleaned off. Any extraneous material which is not cleaned off will damage the disks. Finally, wipe head with dry wiper.

WARNING: Do not touch the face of the read/write head with fingers. Acids emitted from skin can etch and ruin a head. Do not leave any residue on face of the read/write head. Do not blow on heads. Moisture will rust and contaminate the heads.

3.2.2 Lubrication of Machine

Scheduled lubrication requirements for the machine are described in Figures 3-1 and 3-2. Specified lubricants are to be applied according to instructions contained in these charts.

CODE U	CODE R	LOCATION OPERATION	*FREQ	OPERATION
3		Read/Write Heads	4	Clean; Inspect: Clean and inspect read/write heads for scratches and build up of oxide. See Section 3.3.2. Inspect head leads for damage.
		Carriage rail		Clean; Lubricate: Clean carriage rail with lint-free tissue and 91% Isopropyl alcohol. Apply a thin film of IBM #6 oil. Remove excess with lint-free tissue.
		Preload Bearing		Clean: Clean outer race of the Preload Bearing by holding a dry lint-free tissue against it while moving the carriage back and forth.
		Detent Rack		Clean; Lubricate: Clean detent rack with IBM Brush (P/N 1018992). Apply film of ***Molykote "G" (P/N 357830) in three equally-spaced places on the rack. Access the carriage from track 000 to 199 and back three or four times. Wipe excess oil from detent rack.
		Spindle Assembly (Magnetic Chuck)		Clean: Clean each pole piece of the Magnetic Chuck with lint-free tissue dampened with 91% Isopropyl Alcohol.
		Air Filter Electronics Duct		Replace Filter. Disconnect head plug leads from heads and loosen binding head screw on top of electronics gate. Swing gate door downward and remove air filter from left side of gate.
5		Head Load Cam	12	Lubricate: Apply a light film of IBM #22 grease on wear points of Head Load Cam surface.
		Head Load Spring Support Pivots		Lubricate: Apply one drop of IBM ±9 oil at four points of Head Load Spring Support Pivots.
		Spindle Center Cone		Lubricate: Apply a light film of IBM #22 grease on cone surface. Wipe off any excess grease.
		Drive Magnet and Voice Coil Motor Flux Gap		Inspect; Clean if necessary: Remove actuator motor (Drive Magnet) and inspect for contamination; especially for metal particles. If cleaning is necessary, place a piece of masking tape on a paddle with adhesive side exposed, and wipe each side of flux gap.
		Base Plate Casting and Covers		Clean the voice coil with dry lint-free tissue. Inspect; Clean: Inspect for cleanliness and loose parts. Clean as necessary.
		Air Filter Plenum Chamber		Test; Replace if necessary: Test plenum chamber air flow as outlined in Section 4.3.1. Replace air filter if necessary.
		Drive Belt Tension		Check; Adjust Loosen three motor mounting screws and allow the belt tension spring to position the motor to obtain the required belt tension. Tighten the screws progressively to prevent changing the position of the plate.
		**Drive Motor		Lubricate: Apply IBM #6 oil to fill oil cups on each end of motor shaft.
		Read/write heads		Check: Check read/write head alignment using CE disk Cartridge track 100 according to procedures of Section 4.17.1
		Sector Pulse Timing		Check: Check sector pulse timing using CE disk Cartridge track 095 according to procedures of Section 4.20.1

* The preventive maintenance Frequency is determined by machine usage rates computed at 176 hrs-per-month on a single shift basis

** Lubrication is to be accomplished on 50-cycle, 208/220-volt motors only.

***Trade mark of The Alpha-Molykote Corporation.

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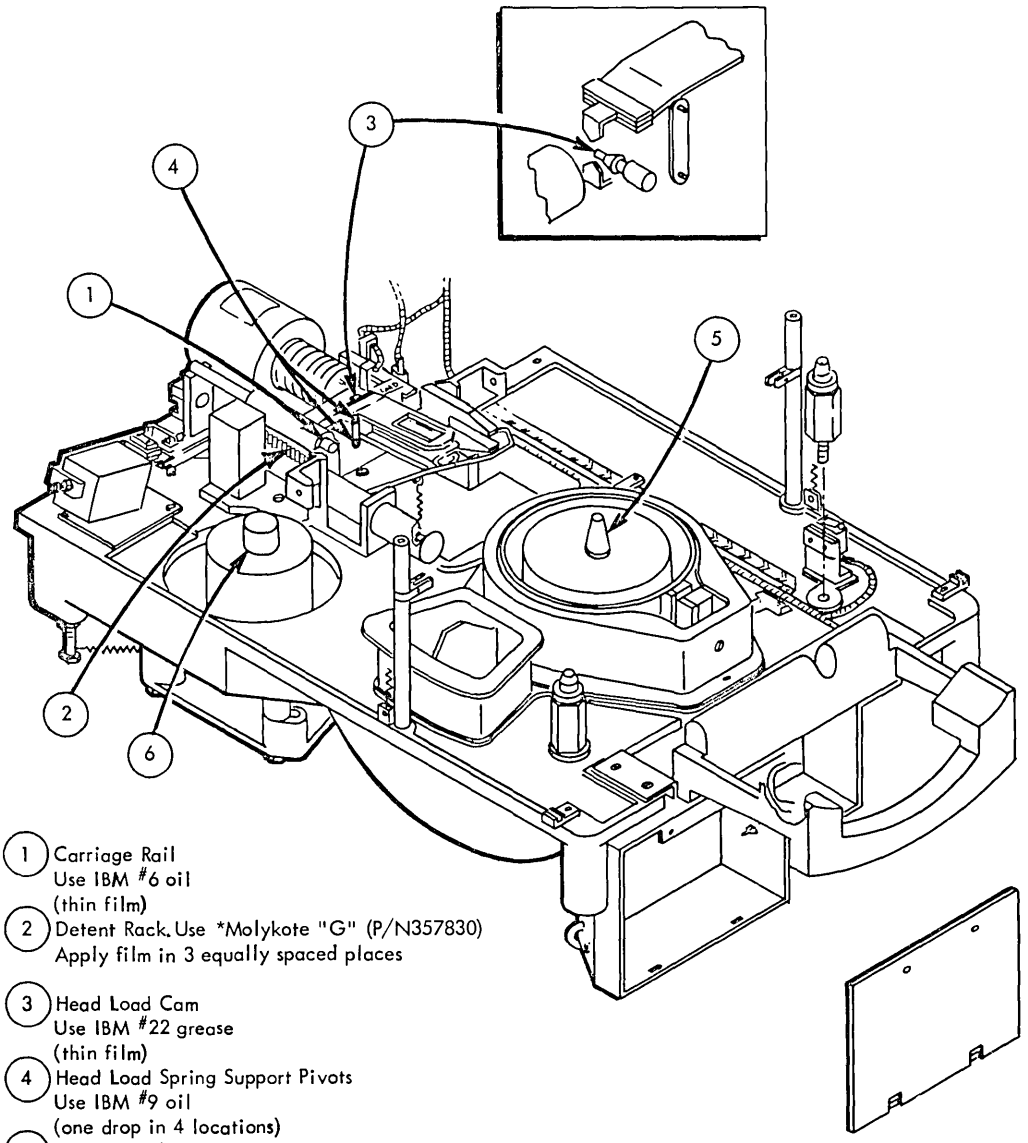
Figure 3-1. Preventive Maintenance Schedule



(1) Carriage Rail
Use IBM #6 oil
(thin film)

(2) Detent Rack. Use *Molykote "G" (P/N357830)
Apply film in 3 equally spaced places

(3) Head Load Cam
Use IBM #22 grease
(thin film)

(4) Head Load Spring Support Pivots
Use IBM #9 oil
(one drop in 4 locations)

(5) Spindle Center Cone
Use IBM #22 grease
(thin film)

(6) 50 CPS Drive Motor
Fill cups on each end of shaft with IBM #6 oil
(Applicable for 50 cps, 220 volt drive motors only)

*Trademark of The Alpha-Molykote Corporation

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Figure 3-2. Machine Lubrication Points

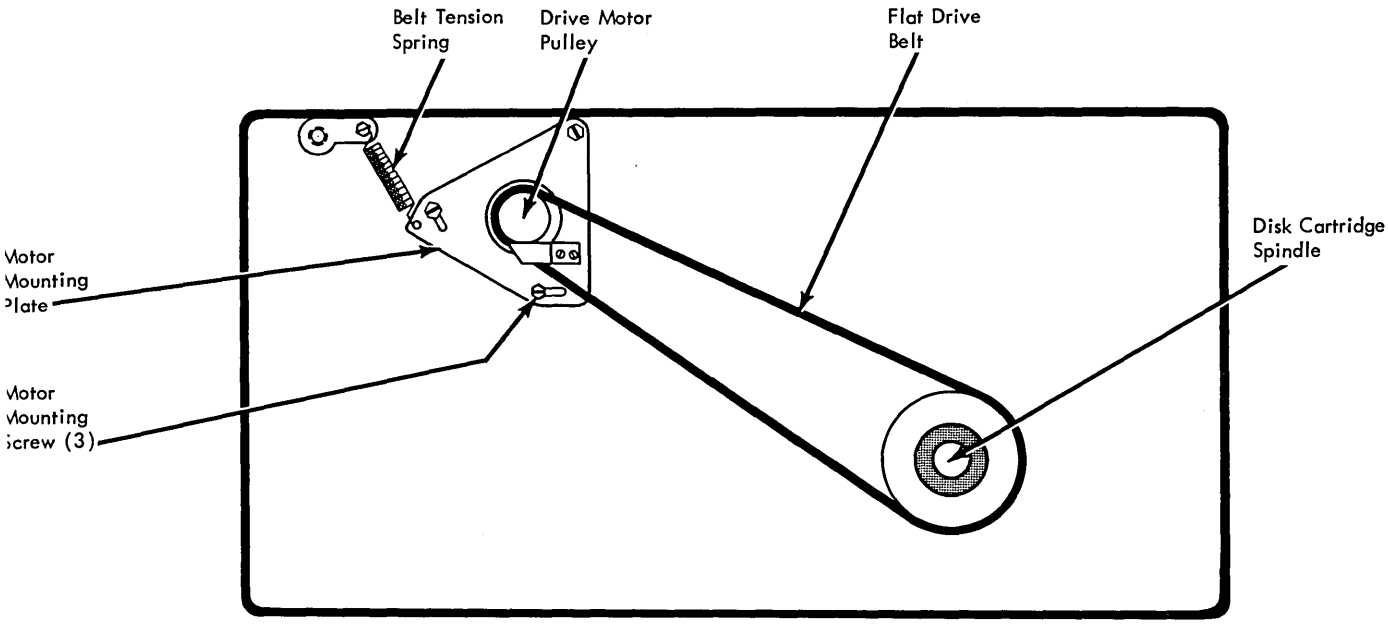


Figure 3-3. Drive Belt Adjustment

3.2.3 Drive Belt Tension Adjustment

Adjust drive belt tension according to instructions contained in Figure 3-1. The location of adjusting screws is contained in Figure 3-3.

3.3 HEAD AND DISK CARTRIDGE SCRATCH DESCRIPTION

3.3.1 Particle Damage to Disk

Head and disk damage can be caused by a small particle of foreign matter being deposited onto the surface of a disk. The gliding shoe of the head "flies" on an air bearing of 125 to 150 microinches while the disk is rotating.

When a particle is carried into the gap between the head and disk, it may be embedded into the surface of the disk. The damage which results from this and subsequent passes of the head over the embedded particle depends on the material and size of the particle.

Harder materials, such as aluminum oxide, may embed in the disk surface. A comet-trail scratch on the disk will mark the path of some particles.

3.3.2 Particle Damage to Head (Figure 3-4)

A large, hard particle embedded in the disk surface may cut a groove in the face of the shoe on the read/write head. The disk data tracks are 0.010 inch apart and a head being addressed to different tracks in the area of the embedded particle will soon be etched with a succession of 0.010 inch grooves or scratches across its face. Eventually, this particle could be dislodged or be pounded below the flight height (of this head) but not necessarily below that of a head on another machine.

When the surface of a head contacts a particle, a burr may be formed on the head, or the particle may be partially embedded in the head epoxy. If this protrusion on the gliding shoe is greater than the flight height, it will scratch the disk surface.

3.3.3 Non-Particle Damage

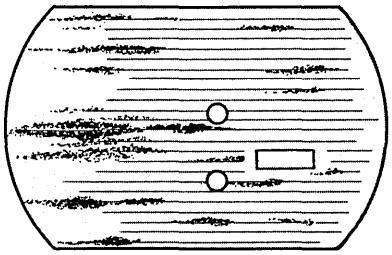
Damage to both head and disk surfaces can occur as a result of head-to-disk interference. This can be generally covered by considering that imperfections, on the surface of either head or disk, or any imperfection in shoe curvature that will interfere with proper head "flight", will result in interference.

Typical examples of surface imperfection would be fingerprints or other stains on the surface of a head or disk, residue resulting from misuse of isopropyl alcohol, lint, and dust from a contaminated atmosphere.

Presence of fingerprints, films, or stains on a head or disk surface means a deposit of oils and salts which, in most cases, will cause deposits to build up to a height greater than the flight height of the head. This condition can result in head-to-disk interference.

A continuous accumulation of foreign material on the head surfaces may result in generating read/

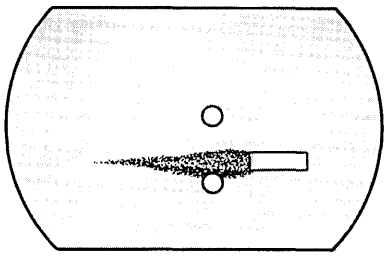
ROTATION



A

Scratch and oxide build-up due to scratches. Replace drawer.

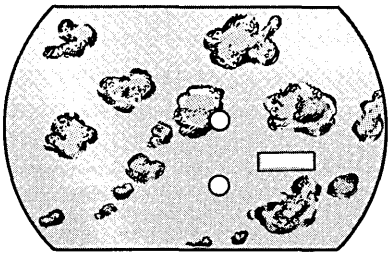
ROTATION



B

Oxide has accumulated in the pole tip area. Replace drawer.

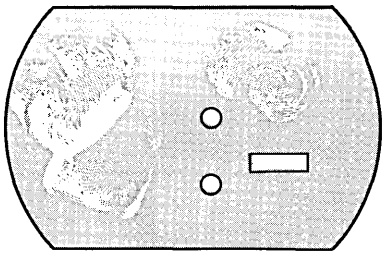
ROTATION



C

Alcohol Residue. Clean gliding surface with 91% isopropyl alcohol. However never allow alcohol to dry in small pools such that residue areas are formed. Remove alcohol, using lint-free tissue and a gentle wiping motion.

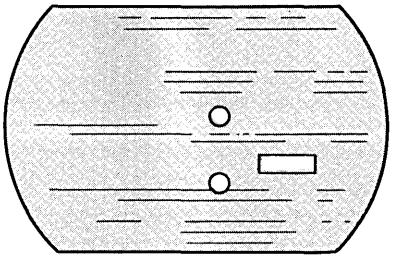
ROTATION



D

Finger prints and other oil like stains. These form an excellent means by which oxide may be transferred to the gliding surface. Complete removal of this contaminate is mandatory prior to resuming file operation.

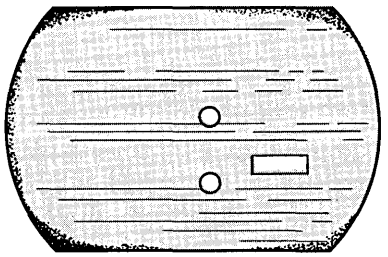
ROTATION



E

Slight scratches without oxide build-up. Drawer may be used.

ROTATION



F

Slight oxide build-up. Clean with 91% isopropyl alcohol. Drawer may be used.

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Figure 3-4. Inspection of Read/Write Heads

vrite errors if scheduled maintenance activity is
ıot followed.

3.3.4 Disk Cartridge and Read/Write Head Damage

Scratches on Disk Surfaces

Some types of scratches on disk surfaces are practically harmless while other types can result in damage to equipment. One type of harmful scratch is a typical comet trail where the head of the comet is an embedded particle protruding out of the surface.

Some types of scratches indicate other problems. Scratches which are regularly spaced 0.010 inch apart indicate a head had been used on that surface with a protrusion on its shoe face, or an embedded particle in the head pole epoxy.

A Series of Scratches or Grooves Across Head (Figure 3-4)

If a head has a series of 0.010 inch spaced grooves across the face of the shoe, it has been flown on a disk surface with an embedded particle which may or may not still be present. The presence of these grooves does not necessarily mean a ruined head. Heads become scratched during normal use but a damaged head will not read data properly, or it will fly with an audible tinging.

Oxide Deposit on Heads

The distinctive color of the reddish brown oxide makes it fairly easy to detect. Its presence may mean that oxide is being scraped off a disk surface by head to disk interference. Heads should be cleaned using preventive maintenance procedures.

Audible Tinging from Head and Disk Interference

An audible tinging or scratching sound is an indication of head to disk interference. This can be an initial symptom and may not continue if the particle is dislodged or is smashed flat.

Examine the heads and disk surface for scratches and comet trails. The approximate radial position of the embedded particle can be determined by noting the track positions of the carriage where the tingling occurred. The head, cartridge, and spindle area should be thoroughly cleaned using scheduled maintenance procedures.

4.0 INDEX OF SERVICE CHECKS, ADJUSTMENTS AND REMOVALS

Component	Service Checks	Cleaning	Adjustment	Removal/ Replacement
Actuator Assembly	Figure 3-1	Figure 3-1	Section 4.5.2	Section 4.5.1, 7.5.1
Blower Assembly				Section 4.4.1, 7.4.1
Blower Motor				Section 4.4.4, 7.4.2
Blower Scroll				Section 4.4.3
Blower Wheel				Section 4.4.2
Carriage Preload Bearing				Section 4.14.1
Carriage Rail	Figure 3-1	Figure 3-1		Section 4.13.1, 7.13.1
Carriage Subassembly				Section 4.15.1, 7.14.1
Cartridge Assembly	Section 4.2.1, 4.2.2			
Cartridge in Place Switch			Section 4.18.3	
Cartridge Receiver			Section 4.18.2, 7.16.2	Section 4.18.1, 7.16.1
Crash Stop, Front			Section 4.10.1	
Crash Stop, Rear			Section 4.10.2, 7.10.1	
Data Separator			Section 4.21.1	
Detent Assembly			Section 4.7.2, 7.7.2	Section 4.7.1, 7.7.1
Detent Rack	Figure 3-1		Section 4.7.4, 7.7.4	Section 4.7.3, 7.7.3
Disk Runout	Section 4.2.3			
Drive Belt	Figure 3-1		Section 3.2.3	Section 4.1.1
Drive Coil				Section 4.6.2
Drive Magnet		Figure 3-1	Section 7.6.2	Section 4.6.1, 7.6.1

NOTE: Mechanical differences for adjustment, removal, and replacement are described in Chapter 7 which provides alternate procedures for machines with serial numbers 00001 through 00050.

Component	Service Checks	Cleaning	Adjustment	Removal/ Replacement
Drive Motor				Section 4.1.2
Head Arm Assembly			Section 4.17.1, 7.15.1	Section 4.17.2
Head Load Assembly	Figure 3-1		Section 4.8.2, 7.8.2	
Head Load Spring Assembly	Figure 3-1		Section 7.9.1	Section 4.9.1
Head Load Solenoid				Section 4.8.1, 7.8.1
Heads Loaded Switch			Section 4.8.3	Section 4.8.3
Home Switch			Section 4.11.2, 7.11.2	Section 4.11.1, 7.11.1
Interlock Handle			Section 4.19.1	Section 4.19.1
Plenum Air Filter	Figure 3-1 Section 4.3.1			Section 4.3.2, 7.3.2
Plenum Cover				Section 4.3.2, 7.3.1
Read/Write Heads	Figure 3-1 Section 4.16.1	Figure 3-1 Section 3.2.1	Section 4.17.1, 7.15.1	Section 4.17.2
Sector Transducer			Section 4.20.1, 7.17.1	Section 4.20.2
Spindle Assembly	Figure 3-1			Section 4.1.3
Tachometer Assembly				Section 4.12.3, 7.12.3
Tachometer Extension Rod			Section 4.12.2, 7.12.2	Section 4.12.1, 7.12.1

.1 DRIVE MOTOR AND DRIVE BELT

.1.1 Drive Belt Removal and Replacement

. Loosen three hex-head mounting screws securing motor mounting plate to base plate.
. Push drive motor mounting plate horizontally until drive belt slips off the pulleys.
. Replace drive belt by reversing Steps 1 and 2.
. Adjust the drive belt tension by following procedures of Section 3.2.3.

.1.2 Drive Motor Removal and Replacement

. Disconnect leads from terminal strip in ac power box.
2. Remove drive belt. See Section 4.1.1.
3. Remove four socket-head screws securing drive motor to motor mounting plate and remove drive motor.
4. Replace drive motor by reversing steps 1, 2, and 3. Adjust drive belt tension, Section 3.2.3.

4.1.3 Spindle Assembly Removal and Replacement

1. Remove drive belt. See Section 4.1.1.
2. Remove three socket-head mounting screws securing spindle housing to base plate (Figure 4-1). Access to mounting screws is provided through two holes (180° apart) located in bottom of outer pole piece of magnetic chuck assembly.
3. Lift the spindle vertically out of its locating bore.

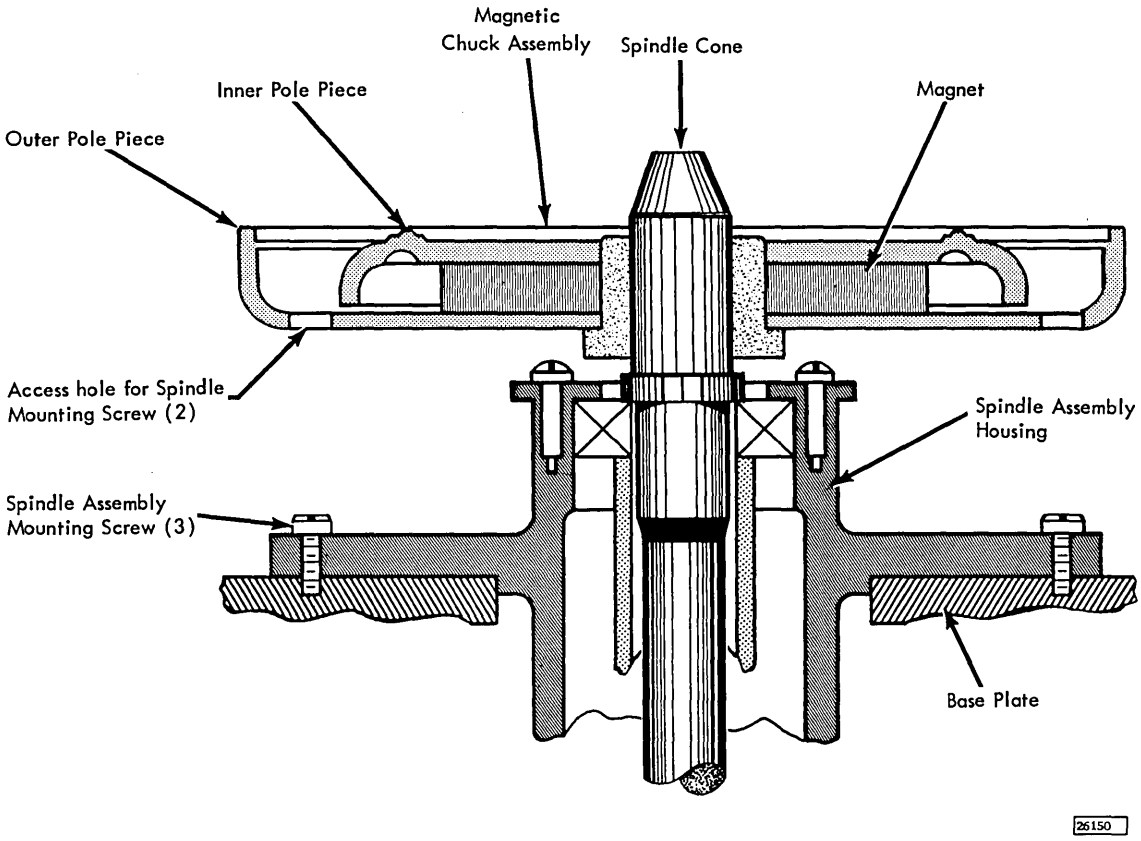


Figure 4-1. Magnetic Chuck and Spindle Assembly

WARNING: A close fit exists between the spindle housing and base plate. Do not pry the spindle off the base-plate since the accurate location of the spindle can be destroyed if this is done.

4. Replace spindle assembly by reversing Steps 1, 2, and 3.

WARNING: Tighten the three mounting screws evenly or spindle alignment will be destroyed.

5. Adjust head-arm assemblies by alignment with track 100 on CE disk cartridge. See Section 4.17.1.

4.2 CARTRIDGE ASSEMBLY

4.2.1 Cartridge Service Check

Scratches on heads and/or disk data surface are related as described in Section 3.3. The following symptoms should be investigated to determine the cause of read/write problems:

1. Check for scratches on disk surfaces. See Section 3.3.4 and Figure 3-4.
2. Check for a series of scratches or grooves across head. See Section 3.3.4 and Figure 3-4.
3. Check for oxide deposited on heads. See Section 3.3.4 and Figure 3-4.
4. Check for audible tinging resulting from head and disk interference. See Section 3.3.4.

4.2.2 Visual Inspection

Examine the disk surfaces for scratches and comet trails. The approximate radial position of the embedded particle can be determined by noting the track positions of the carriage where the tinging occurred. The head and the shroud area should be thoroughly cleaned using scheduled maintenance procedures. Also, the disk should be cleaned using the branch office disk cleaning fixture. (Cleaning of the disk is accomplished for remedial purposes, and is not scheduled as preventive maintenance.) Exercise care to prevent introducing foreign particles into the cartridge while inspecting the disk surfaces.

4.2.3 Disk Height and Run Out Check

The disk height and run out check is performed to determine if the amount of warpage in a disk exceeds allowable limits. The disk run out gage (part 2200050) is used to accomplish this check. This gage (Figure 2-2) is mounted on the base plate adjacent to the head arm assemblies, so that the disk can be manually rotated between the gap established by adjustable lips of the gage. A knurled adjusting screw on the gage permits adjusting the gap size to determine runout. Procedure for accomplishing a check for runout is as follows

1. Remove power from the machine.
2. Remove cartridge from machine.
3. Remove top cover.
4. Remove the disk guide (Figure 6-1).
5. Remove the air deflector.
6. Remove the door opener along with its mounting bracket.

WARNING: Avoid dropping screws or spacers into the plenum through the cored hole in the casting. Loose items in this area can damage the machine.

7. Position the disk run out gage on the base plate, in the space previously occupied by the disk guide. Use the tapped hole closest to the spindle for mounting the gage.
8. Insert cartridge partially into the receiver. After pushing the cartridge two-thirds of the way, open the door manually and continue inserting the cartridge carefully while observing that the disk slides properly between the two read/write heads and in the mouth of the gage.
9. After the cartridge is pushed to the foremost position and touches the two cartridge stops, lower the cartridge door upon the upper side of the gage-base, and carefully lower the cartridge by operating the handle.

WARNING: Avoid scratching the disk while revolving disk through gage. Any scratching of the disk will cause damage. Be particularly careful in the procedure that follows.

10. Turn the spindle pulley slowly by hand. Listen carefully to determine that disk does not touch on the gage lip. If any contact noise is heard, readjust the disk run out gage by turning the adjusting screw. The disk is in proper height and its runout is within permissible limits if the spindle can be turned one revolution without disk surface touching gage lips.
11. After the checking procedure is completed, carefully remove the cartridge, then the disk runout gage. Replace the door opener bracket and air deflector first, then the disk guide, and the top cover last.

4.2.4 Disk Cartridge Replacement Conditions

Replacement of a disk cartridge is necessary when any of these conditions exist

1. The cartridge has been damaged mechanically.
2. A surface of the disk is scratched or gouged and is causing read/write errors.
3. An embedded particle or surface contamination is present on a disk surface and the particle cannot be dislodged by cleaning.

4.3 PLENUM AIR FILTER

4.3.1 Plenum Filter Air Flow Test

1. Prepare a test gage as follows:
   a. Fold an IBM card at column 40 and again at columns 20 and 60 so that card is four layers thick.
   b. Tear off and discard one layer.
   c. Use transparent tape to secure edges so that card will remain flat in folded position.
2. Verify that blower is operating and disk cartridge is removed.
3. Place test gage over that half of the air valve duct which is nearest the disk cartridge receiver handle. If test gage remains in this position, the plenum filter is clogged and must be replaced. If it blows off or will not remain where placed, the air flow is sufficient and the plenum filter does not require replacement.

4.3.2 Plenum Air Filter Removal and Replacement*

WARNING: When replacing plenum air filter, make certain that the foam rubber seal is between the air filter and baseplate. If this seal is not in place, leaks can result which will allow foreign particles to be blown into the cartridge. Also clean the plenum cover and cartridge air duct with lint-free tissue dampened with 91% isopropyl alcohol.

1. Remove plenum cover by removing single mounting nut which also secures the filter.

*Alternate procedures are contained in Chapter 7 for machines with serial numbers 00001 through 00050.

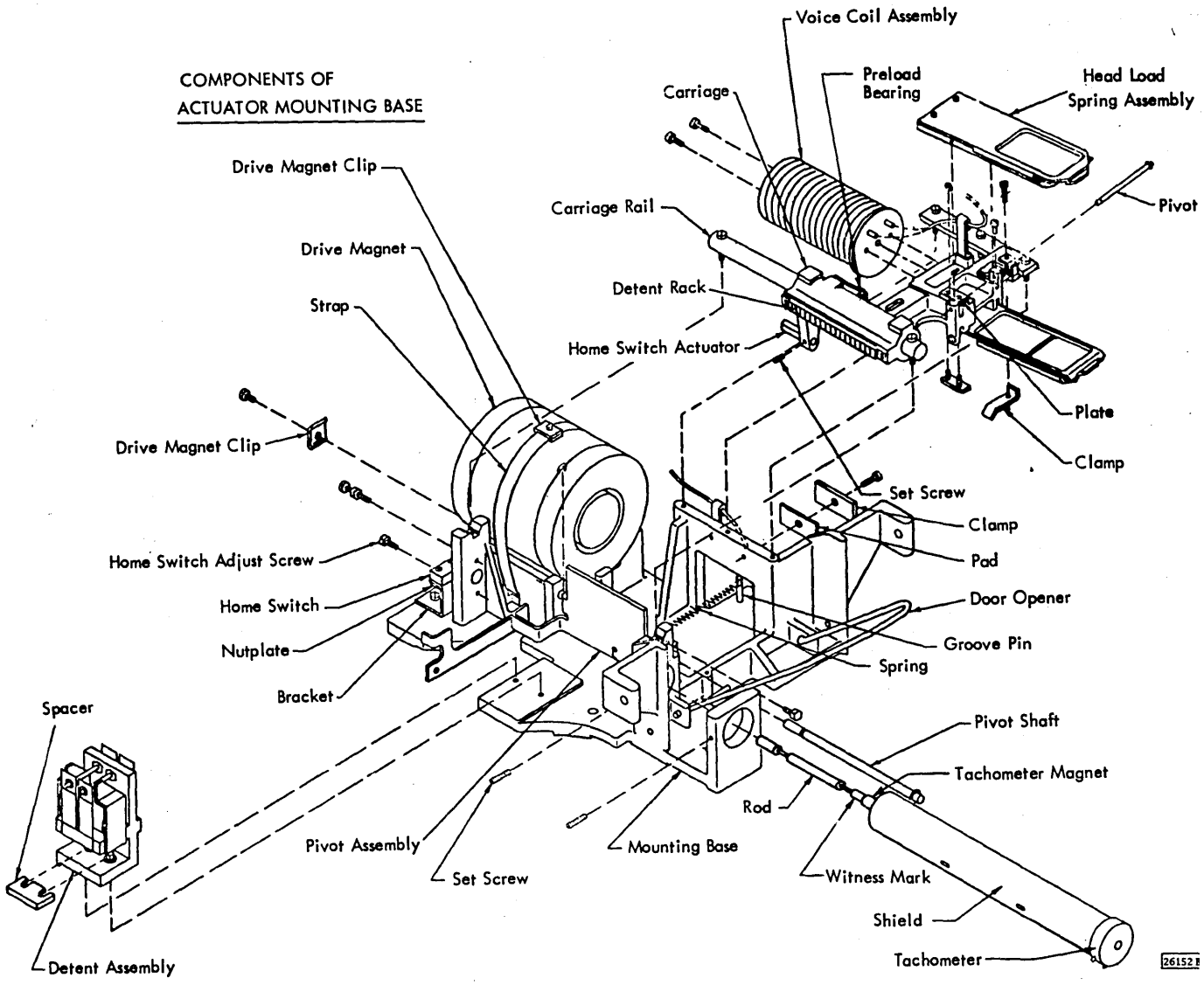


Figure 4-2. Actuator Assembly, Exploded View

7. Disconnect voice-coil leads. Tag each lead for identification. (Improper connection of these leads will demagnetize the drive magnet.) Disconnect ground wire from carriage.
8. Remove pivot pin and spacer from head-load solenoid plunger.
9. Disconnect the spring attached to the cartridge door opener and remove the air baffled mounted between actuator and shroud. Remove the disk guide located adjacent to the actuator assembly
10. Remove the five slotted hex-head mounting screv which secure the actuator assembly to the base
11. Lift carriage drive assembly off the two dowel pins in carriage mounting base along with the tachometer assembly which is attached to the actuator assembly.

WARNING: Ensure that all leads are connected to their original terminals. Equipment will be damaged if incorrect leads are connected to terminals during replacement of the actuator. Uncontrolled carriage motion results from a reversal of leads for the tachometer. The drive magnet becomes demagnetized, requiring replacement for the unit when leads are reversed for the voice coil.

12. Replace the actuator assembly by reversing steps 2 through 11.
13. Check head load assembly adjustment and readjust if necessary. (See section 4.5.2.)
14. Check access adjustment and readjust if necessary. (See section 4.4.2.)
15. Check head alignment adjustment with CE track 100 and readjust if necessary. (See section 4.6.3.) Verify that equal amplitudes exist for the envelopes developed by the track signal.

4.4.2 Access Adjustments

4.4.2.1 Systems Without Access Diagnostic Programs

The CE control panel is used to operate the machine while adjusting access control circuits. The following four adjustments are required to maintain carriage positioning accuracy:

1. Amplifier balance adjustment.
2. Dead band adjustment.
3. Tachometer dynamic balance adjustment.
4. Coarse and fine timing adjustment.

NOTE: The location of potentiometers involved in access adjustments is shown in Figure 4-3. Some of the adjustments are inter-related; therefore, all four adjustments must be checked whenever a new SLT card is installed for the access amplifier or access logic circuits. These adjustments must also be checked whenever components of the actuator assembly are replaced. If a new access amplifier card is used, the 100-ohm, 20-mil step potentiometer may be initially adjusted for 4.0 volts, measured at pin F2B2 and the 2k-ohm, 10-mil step potentiometer may be adjusted for 5.0 volts using the same pin.

WARNING: Use alignment screwdriver (part 460811) to avoid shorting adjacent contacts while adjusting potentiometers on the access amplifier and access logic SLT cards.

1. Perform an amplifier balance adjustment of the tachometer output voltage as follows:
   a. Verify that dc power is removed from the machine and remove the cover. Disconnect the CPU signal cable at A2 or A3 of the electronic gate so that CE switches are made active.
   b. Ensure that CE cartridge is installed and power up the machine.
   c. Use a multimeter to measure the tachometer amplifier output voltage between pins F2B12 and F2D11. Adjust the 2k-ohm balance potentiometer (Figure 4-3) located on the access amplifier card to obtain a zero (balanced) voltage condition across these pins.
   d. Measure the voltage from F2B12 or F2D11 to ground under the same balanced conditions of step c above. This voltage should be within +0.65 vdc maximum and -0.85 vdc minimum.
2. Perform a dead band adjustment of the access amplifier as follows:
   a. Use a multimeter to monitor the negative wiper voltage of the 100-ohm dead band potentiometer at pin F2D13.
   b. Adjust the 100-ohm dead band potentiometer to obtain the least negative voltage across pin F2D13 without causing the actuator to oscillate while the carriage is in a static condition.
      (1) Turn the dead band potentiometer in (clockwise) until the actuator begins to oscillate. This oscillation may be detected by an audible whine caused by frequency generated by the voice coil.

          NOTE: If the system oscillates, proceed with substep (2) below. If the system does not oscillate, turn the potentiometer inward until an audible click is heard, then back off one-half turn and proceed with the tachometer dynamic balance adjustment of step 3.

          WARNING: Do not allow oscillations to continue for an extended period of time because this can result in damage to equipment.

      (2) Back out the potentiometer (counterclockwise) until oscillations cease. This is the least negative voltage obtainable.
3. Perform the tachometer dynamic balance adjustment as follows:

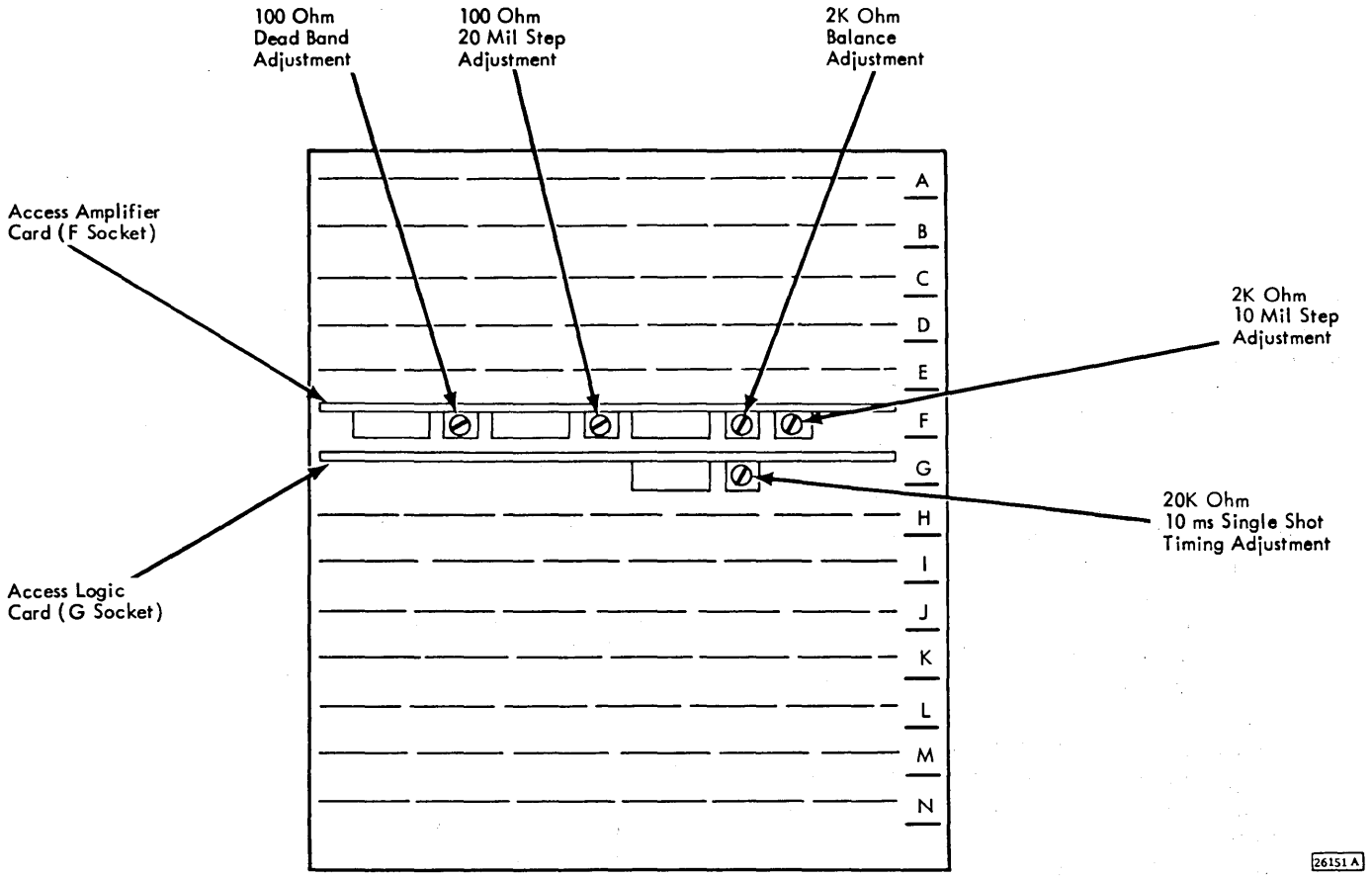


Figure 4-3. Access Adjustment, Potentiometer Locations

a. Connect the multimeter between ground and pin F2B02.

b. Use the CE switches to continuously access the machine in a 10-mil stepping mode. Simultaneously, adjust the 2k-ohm, 10 mil step potentiometer until a minimum voltage is obtained at the point where detent motion changes from smooth to erratic operation.

NOTE: Erratic detent operation can be detected easiest by observing the detent clapper operation. When operating smoothly, the detent motion is so fast that it appears to be stationary. Erratic motion causes the clapper to deviate from a steady vibration of perfect adjustment to random skipping of the detent rack grooves.

c. Adjust the 2k-ohm balance potentiometer until smooth operation is regained. Continue to decrease the voltage at the 10-mil 10-mil step potentiometer while adjusting the tachometer balance potentiometer until the balance adjustment no longer improves detent operation.

d. Use the multimeter to measure the voltage at pins F2B12 and F2D11 with respect to ground. The voltage at each pin must be within the range of +0.65 volts maximum and -0.85 volts minimum.

4. Perform a coarse timing adjustment for the access ready signal line as follows:

a. Use a multimeter to measure the voltage at pin F2B02. Select the 20 milli-inch stepping mode, and adjust the 100-ohm, 20-mil step potentiometer (located behind card retainer) to obtain +3.9 volts at pin F2B02.

b. Apply access drive pulses to the access circuitry and monitor the access ready signal line by scoping on pin G2D04, using a time base of 5ms/cm. The line drops from +L to -L (+3v to -3v) about 5 milliseconds after the access drive pulse is applied.

c. Adjust the 20k-ohm, 10-ms, single shot potentiometer to obtain a duration of 10 ± 0.5 ms for the -L level of the access ready signal.

5. Perform a 20 milli-inch step adjustment as follows:

NOTE: When stepping the carriage in the CE mode, the direction of step must be continuously controlled manually by the CE. Otherwise, the carriage would strike either front or rear crash stops. The direction of travel is controlled by the direction switch located on the CE panel.

a. Step the carriage forward and backward in the 20 milli-inch mode. Avoid hitting the crash stops and observe the operation of the detent clapper.
b. Adjust the 100-ohm, 20-mil step potentiometer until the detent operation is so smooth that the detent clapper appears stationary.
c. Increase the voltage at pin F2B02 with respect to ground until the detent clapper motion just becomes erratic. Record this voltage value as the high voltage limit.
d. Decrease the voltage at pin F2B02 until the detent clapper motion is smooth and then again just becomes erratic. Record this voltage value as the low voltage limit.
e. Adjust the 100-ohm, 20-mil step potentiometer so that the voltage at pin F2B02 is within the limit established by the following computation:

$$\text{Voltage Adjustment} = \frac{2\,V_{High} + V_{Low}}{3}$$

6. Perform a 10 milli-inch step adjustment as follows:
   a. Select the 10 milli-inch stepping mode, and adjust the 2k-ohm, 10-mil step potentiometer to obtain +5v at pin F2B02 with respect to ground.
   b. Step the carriage forward and backward in the 10 milli-inch mode. Avoid hitting the crash stops and observe the operation of the detent clapper.
   c. Adjust the 2k-ohm, 10-mil step potentiometer until the detent action is so smooth that the detent clapper appears stationary.
   d. Repeat step 5c through 5d by using the 10-mil step potentiometer to obtain high and low voltage limits for detent action. Repeat step 5e for final adjustment of the 10-mil step potentiometer.
7. Perform a fine timing adjustment of the access ready signal line as follows:
   a. Step the carriage forward and backward in the 20 milli-inch step mode. Avoid hitting the crash stops.
   b. Adjust the 20k-ohm, 10-ms, single-shot timing potentiometer so that the time (including jitter) between the negative-going leading edge of the access drive pulse (pin G3B03), and trailing edge of the access ready signal (pin G2D04) is 14.5 (+0.0, -1.5) milliseconds.
8. Disconnect test equipment after completing the access circuit adjustments.

4.4.2.2 Systems With Access Diagnostic Programs

System diagnostic programs for accessing the Single Disk Storage enable on-line accessing adjustment. This on-line adjustment procedure includes the following four adjustments:

1. Amplifier balance
2. Dead band
3. 10 and 20 mil step
4. Access time

The location of the potentiometers used in these adjustments is shown in Figure 4-3.

The adjustments are interdependent; therefore, all four adjustment areas must be checked whenever any of the following SLT cards are replaced:

1. Access amplifier
2. Access logic
3. Power transistor
4. Power resistor

The adjustments should also be checked when components in the actuator assembly are replaced.

Access Adjustment Programs: For on-line access adjustment, a program is available which accesses the carriage, in either 10-mil or 20-mil mode, between cylinders 002 and 200. The program checks for proper access operation by reading the cylinder address word at cylinders 002 and 200; therefore, the procedure requires that the disk cartridge to be used must have the correct sector-zero address recorded at cylinders 002 and 200. When an access error is detected, the program halts. Subsequent restarting of the program re-zeros the access and continues with normal program-controlled accessing.

The access adjustment programs for the 1130 and 1800 systems are:

1130 system - PID 030A

1800 system - PID 08C9 (CE utility programs)

Adjustment Summary: A summary of the adjustment procedure is shown in the simplified flow chart in Figure 4-3A.

The purpose of the 10-mil and 20-mil step adjustment is to set a voltage which causes the voice coil motor to switch from acceleration to deceleration at the correct time for a 10 or 20 milli-inch access. Assuming that necessary mechanical adjustments have been made (such as detent, tachometer, and preload bearing), the carriage performance for a given step mode is affected by the balance potentiometer and the corresponding step potentiometer. However, in most cases it is not necessary to move the balance potentiometer from its static adjustment of zero volts. Therefore, it is necessary only to find the optimum setting of the step potentiometer.

20-Mil Step Adjustment: If the 20-mil mode is selected and the performance of the machine is recorded for all possible combinations of balance and 20-mil step settings, the result is the plot shown in Figure 4-3B. Note that there is a definite region of error-free access operation.

The following description shows how the plot in Figure 4-3B is generated. The procedure itself is included in the flow chart in Figure 4-3D.

> Note: When making the following adjustments, the potentiometers involved should be turned slowly to eliminate inaccuracy and time-consuming retries.

Find the initial balance point by adjusting the balance pot from (1) to (2). Initialize the 20-mil pot by moving from (2) to (3) along the balance line. Determine the 20-mil range of operation by moving from (3) to (4) with the 20-mil pot. This movement causes an error. Determine the working edge of the operating range by returning the 20-mil pot from (4) to (5). Record this value of 20-mil voltage as the upper limit of 20-mil operation. Find the low limit of 20-mil operation by moving from (5) to (6), then back to (7). Set final 20-mil adjustment (8) at 2/3 of the difference between points (7) and (5).

10-Mil Step Adjustment: To find the 10-mil final setting, repeat the preceding (20-mil) procedure (except for the initial balance point) using the 10-mil step pot.

Dynamic Balance Adjustment: In some cases the initial balance setting does not provide an adequate 10-mil or 20-mil operating range. Figure 4-3C shows that a balance voltage of zero does not always produce the best operating range. The dynamic balance adjustment is used to obtain the optimum balance line and therefore produces the best 10/20 mil range. Figure 4-3C shows the steps used to accomplish the dynamic balance adjustment.

The following description shows how the plot in Figure 4-3C is generated. The procedure itself is included in the flow chart in Figure 4-3D.

> Note: When making the following adjustment, the potentiometers involved should be turned slowly to eliminate inaccuracy and time-consuming retries.

The starting point (1) for the dynamic balance adjustment is within the operating range on the initi balance line. Using the 10-mil pot, move from (1) to (2) which is outside the error-free region. Then return to point (3) with the 10-mil pot. Determine the balance range by moving the balance pot from (3) to (4). This movement causes an access error. To define the working edge of the balance range, us the balance pot to move from (4) to (5). This balan voltage is the positive limit. Find negative balance limit by moving from (5) to (6) and back to (7) using the balance pot. Set the final balance adjustment halfway between the positive and negative balance limits with the balance potentiometer.

Scoping Procedures: Scope probes with X1 attenuat are recommended for all adjustments. Either of th following two methods can be used to achieve the differential scope connection called for in the balan adjustment:

1. Use a differential plug-in unit on the scope.
2. Use a dual-input preamp unit. Turn one polari switch to NORMAL and the other polarity switc to INVERTED. Then turn the mode switch to ADDED ALGEBRAICALLY. Where a polarity sign is noted with the pin number, such as F2B12 (-), connect the probe from the inverte scope input to the negative SLT pin, and the probe from the non-inverted scope input to the positive SLT pin.

Complete Access Adjustment: The 20-mil step, 10 mil step, and dynamic balance adjustments, previously described, are part of the complete adjustr procedure which is presented in flow chart form in Figure 4-3D.

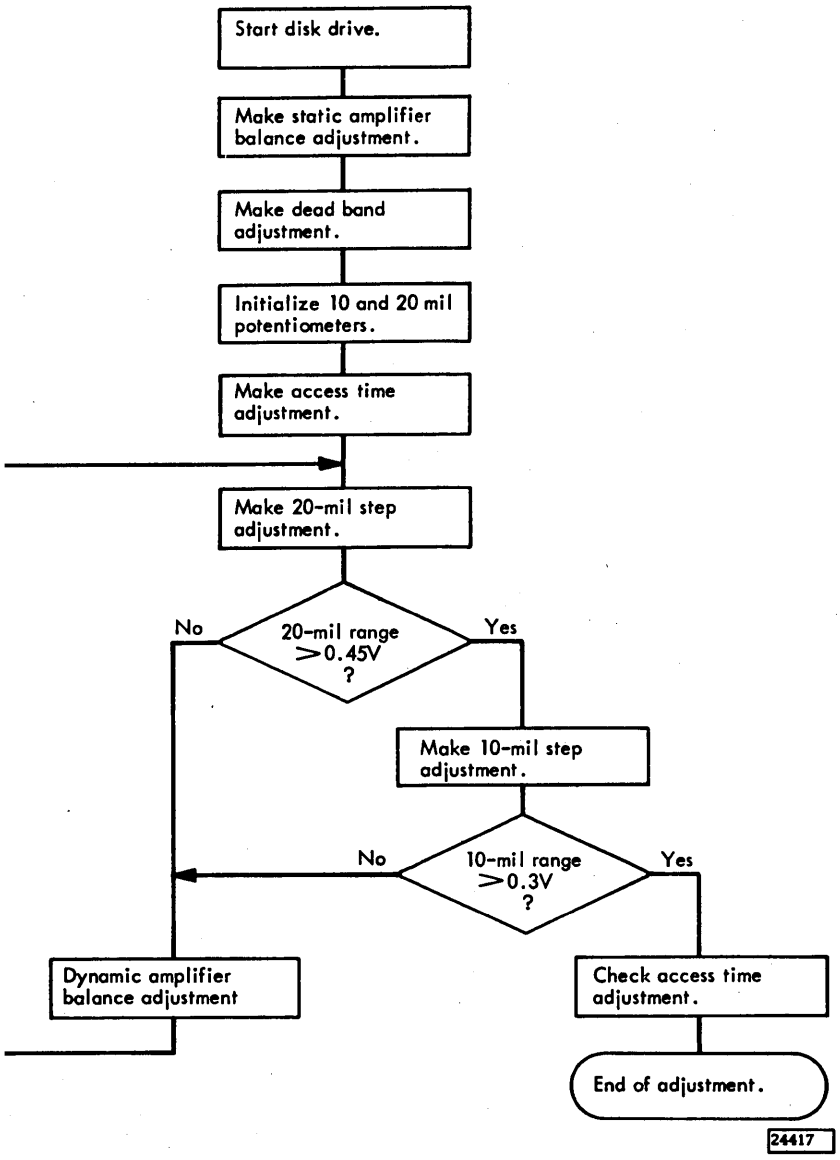
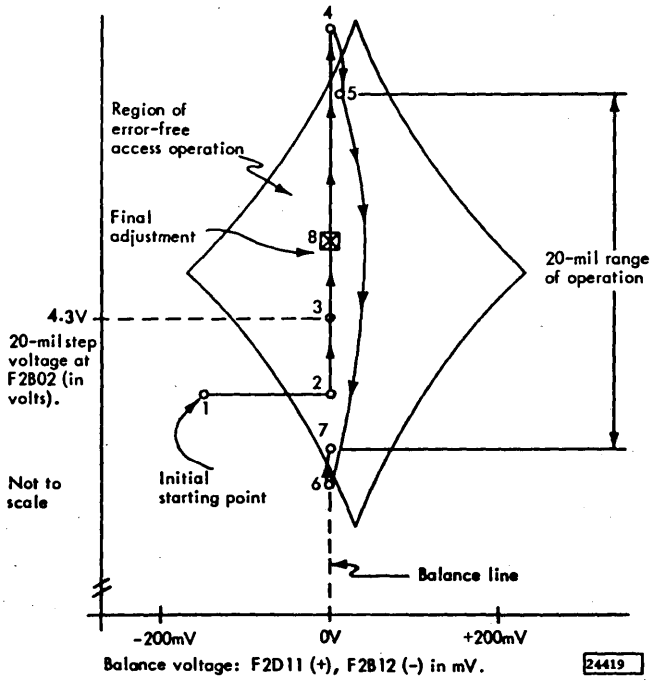
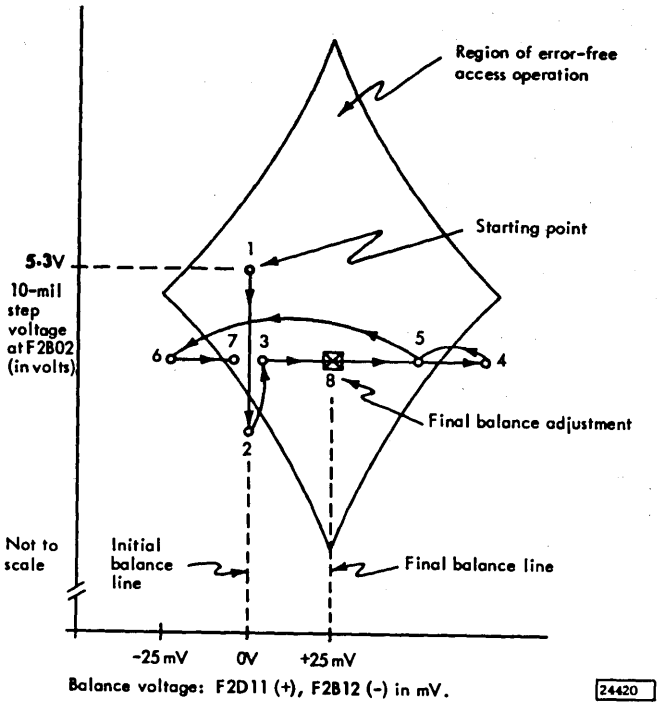


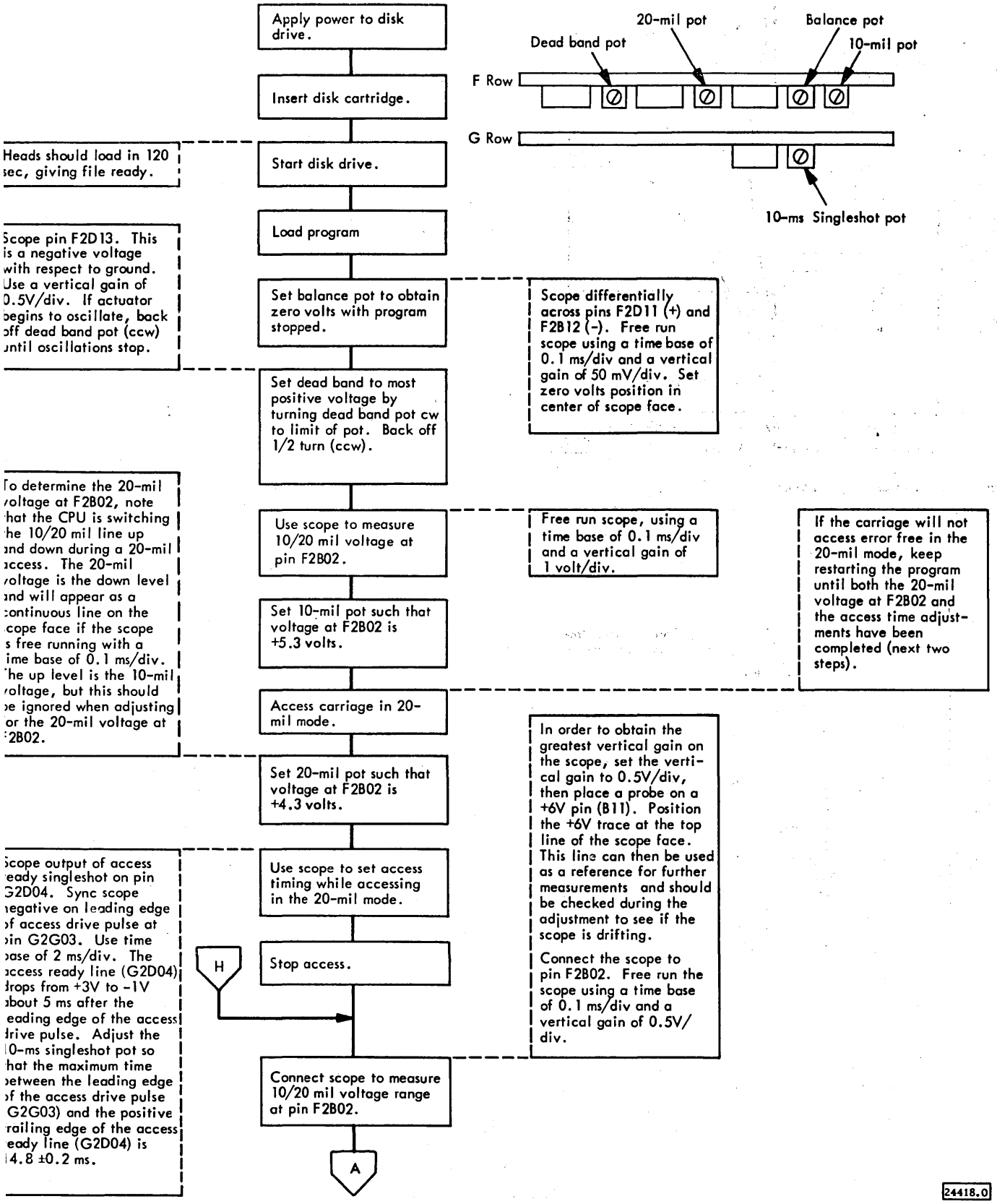
Fig. 4-3A. Access Adjustment Summary



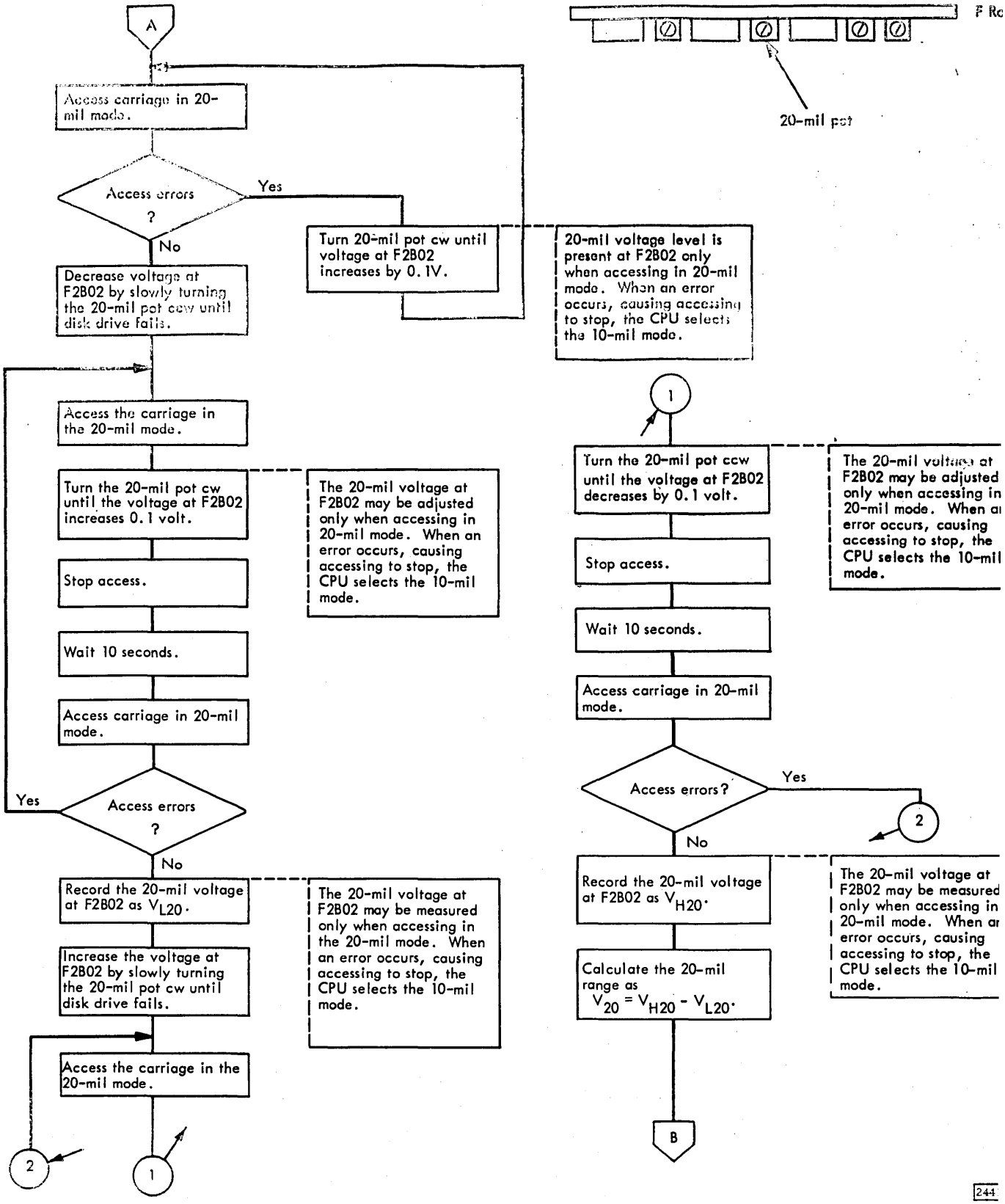
● Fig. 4-3B. 20-mil Range of Operation



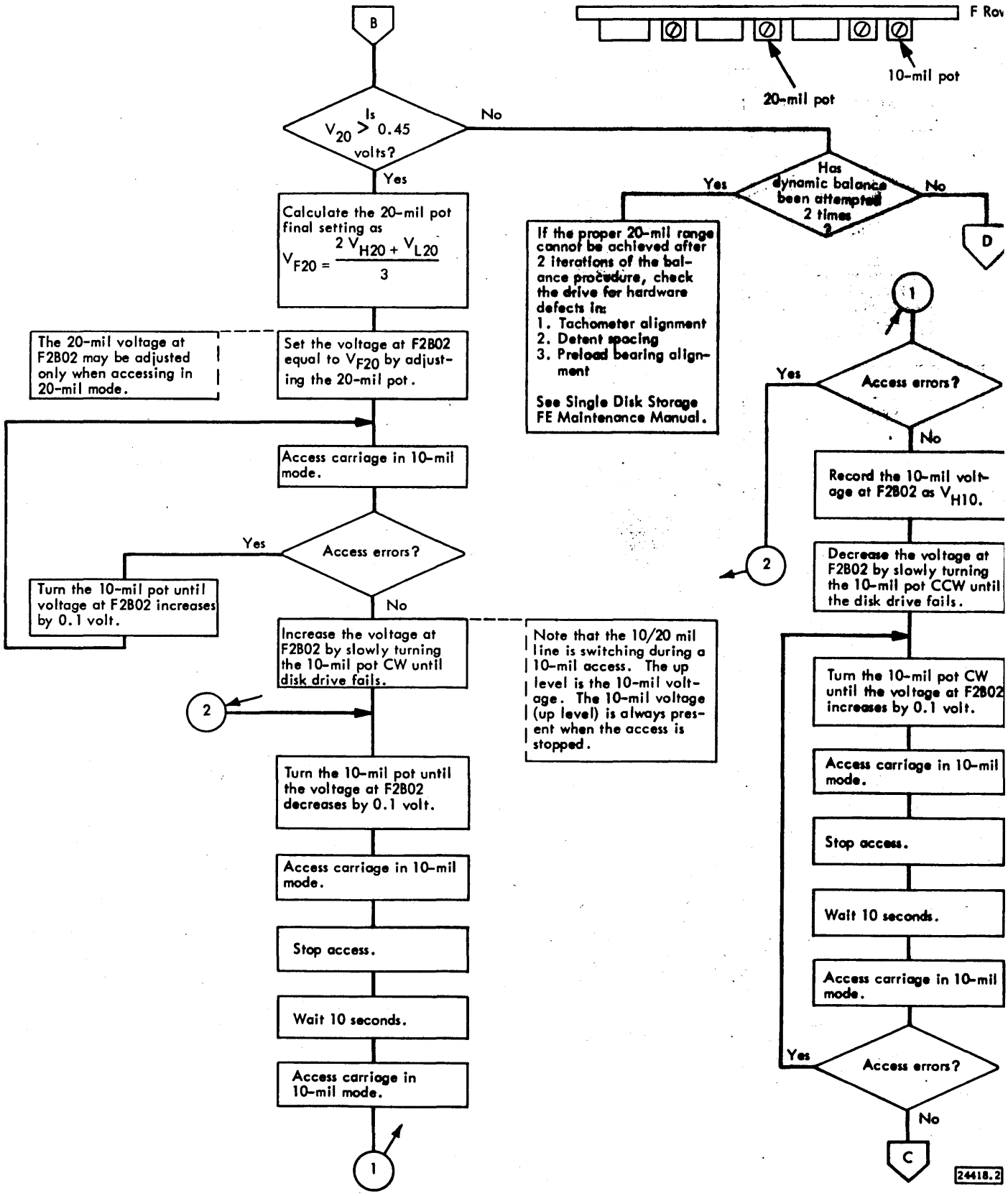
● Fig. 4-3C. Dynamic Balance Adjustment



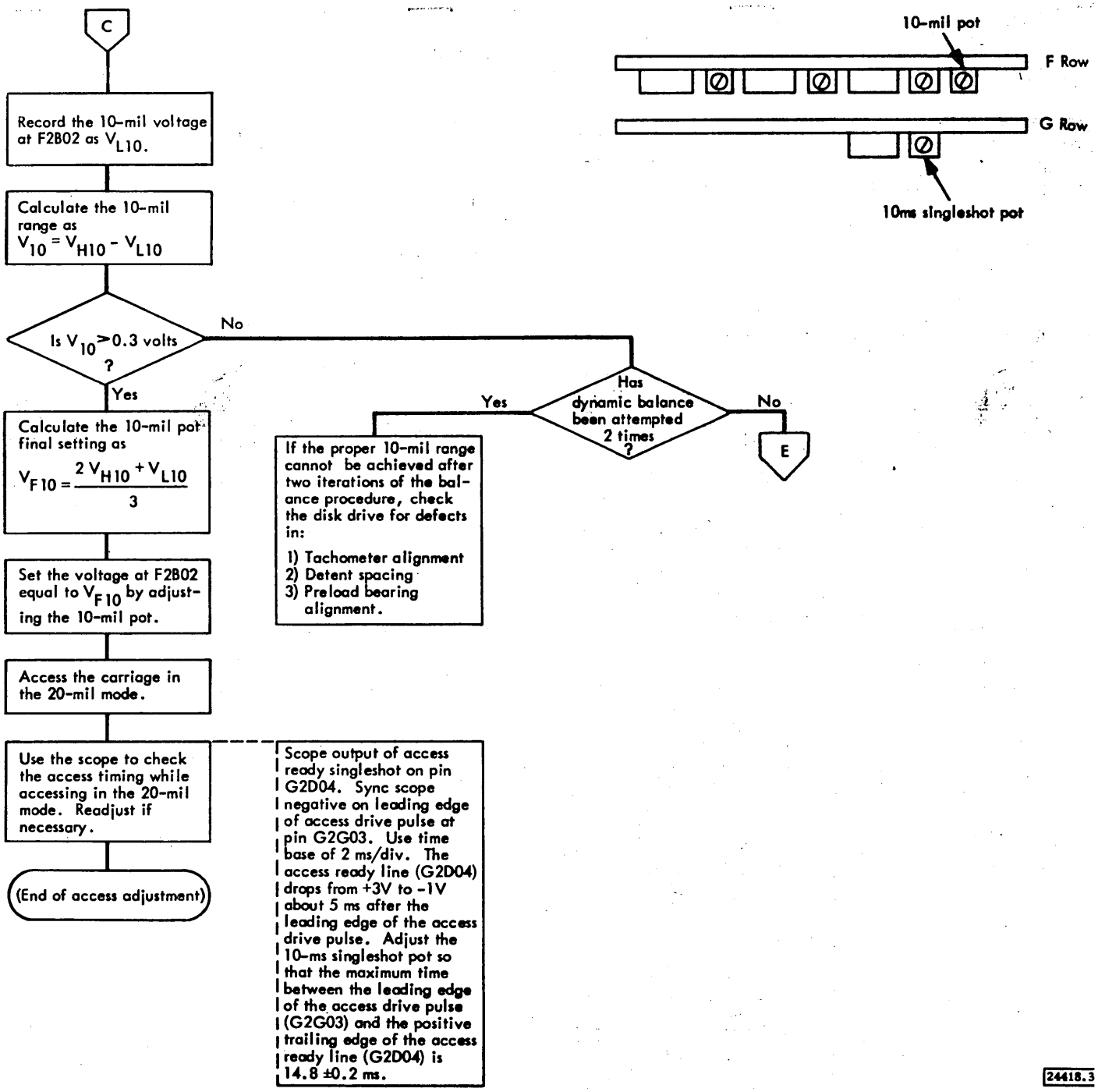
ig. 4-3D. Access Adjustment (Part 1)



● Fig. 4-3E. Access Adjustment (Part 2)



● Fig. 4-3F. Access Adjustment (Part 3)



● Fig. 4-3G. Access Adjustment (Part 4)

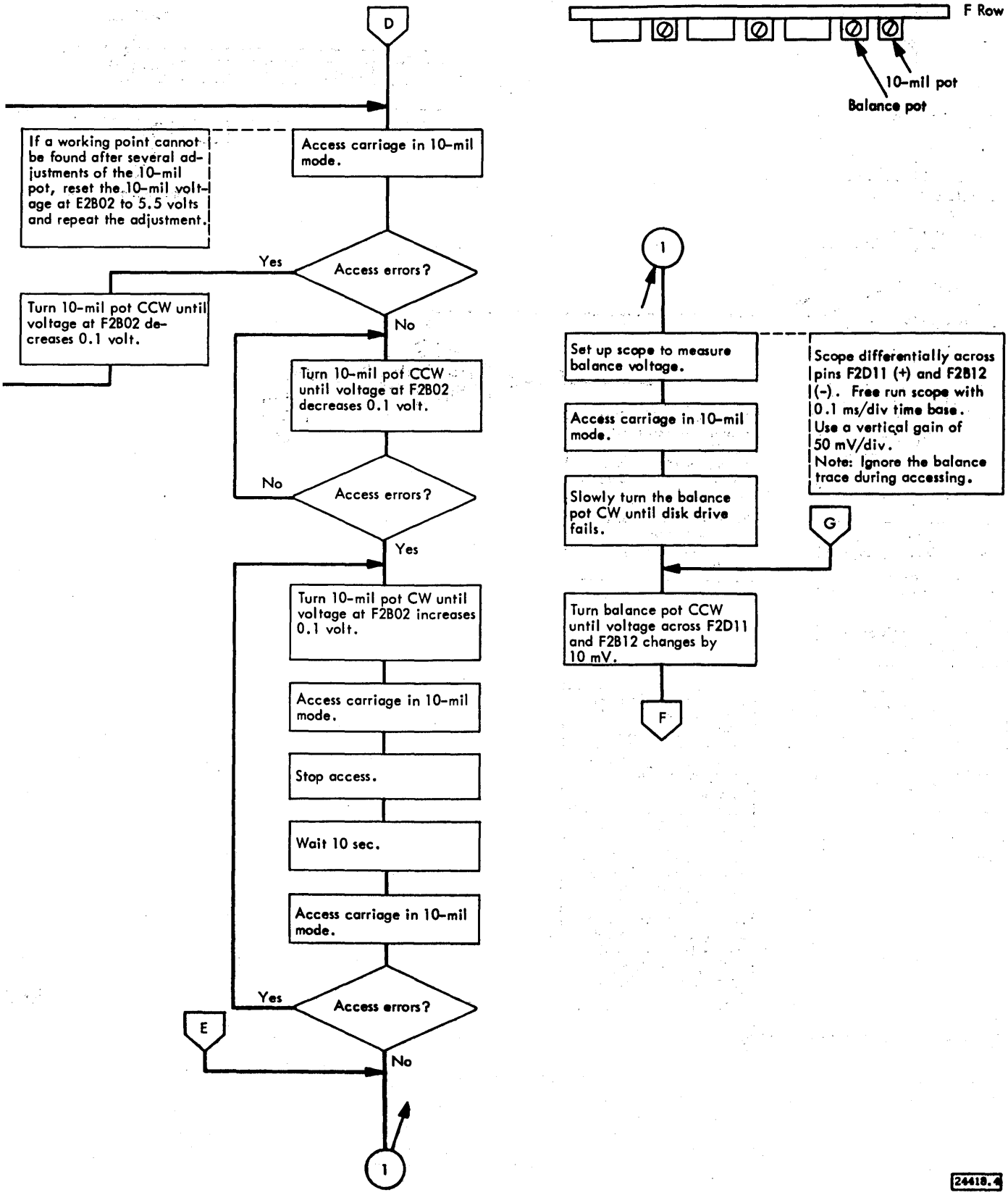
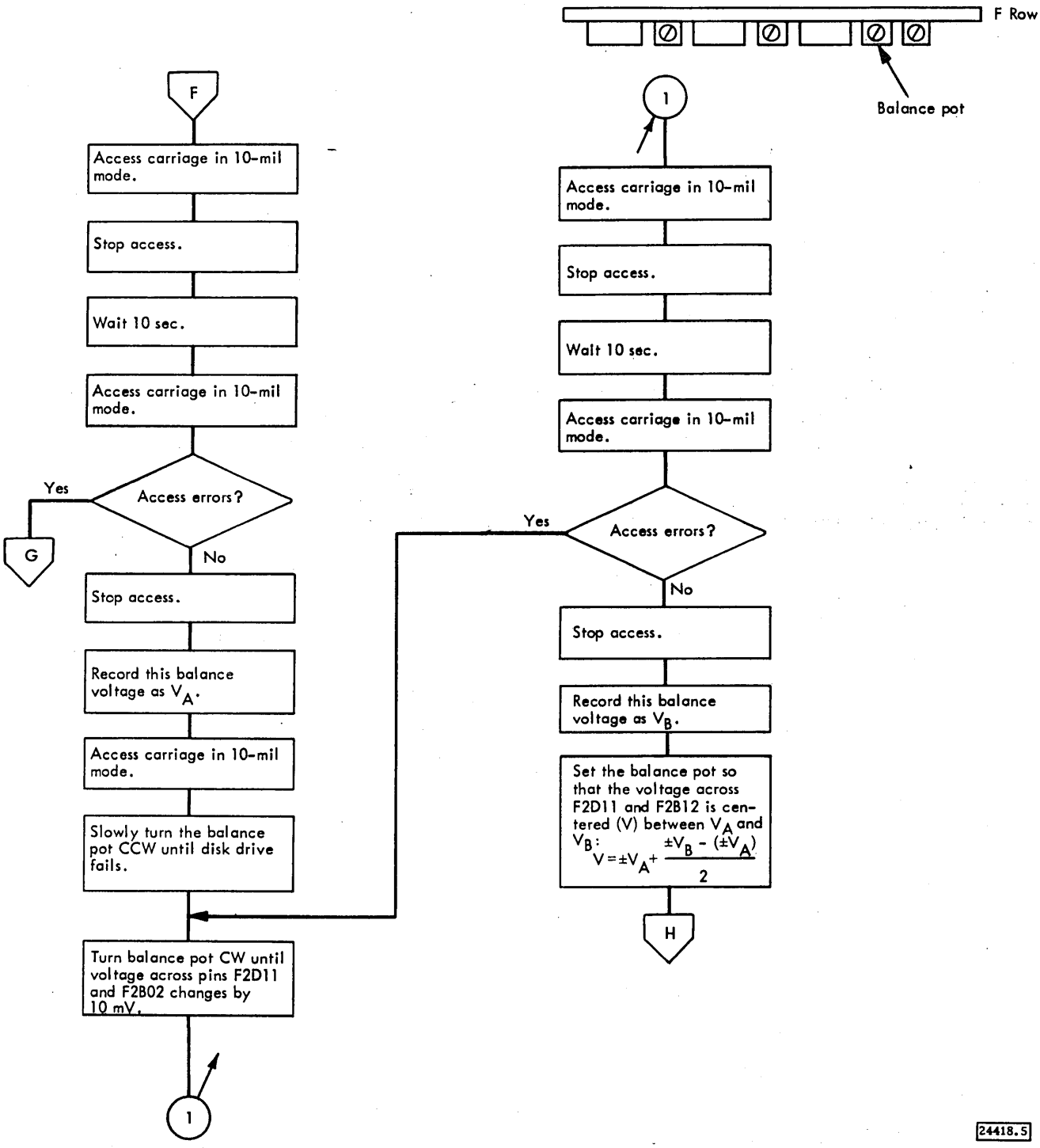


Fig. 4-3H. Access Adjustment (Part 5)



● Fig. 4-3J. Access Adjustment (Part 6)

4.4.3 Drive Magnet and Voice Coil

4.4.3.1 Drive Magnet Removal and Replacement (Figure 4-2)*

1. Turn off all power to the machine.
2. Push the carriage forward as far as it will extend. Loosen screw on top of magnet which secures the strap clamp to magnet.
3. Loosen screw in back of magnet and rotate clip which secures magnet to cradle of actuator bracket out of the way.
4. Slide magnet horizontally back from bracket cradle. Use extreme caution to avoid scraping magnet against voice coil.
5. Replace drive magnet by reversing steps 1 through 4. Ensure that magnet contacts front stop on actuator bracket before securing the installation with mounting screws.

*Alternate procedures are contained in Chapter 7 for machines with serial numbers 00001 through 00050

4.4.3.2 Voice Coil Removal and Replacement (Figure 4-2)

1. Turn off all ac and dc power.
2. Remove drive magnet. (Refer to section 4.4.3.1.
3. Unsolder voice coil leads and tag each lead to facilitate identification. (Improper connection of these leads will demagnetize the drive magnet.)
4. Remove two non-magnetic mounting screws located inside the voice coil.
5. Slide coil horizontally, away from carriage, off dowel pin.

WARNING: Ensure voice-coil leads are connected to their original terminals. The drive magnet becomes demagnetized, requiring a replacement for the unit if these leads are reversed.

to achieve final track position accuracy. When this condition prevails, the detenting action is very smooth.

NOTE: Non-smooth detenting action can be determined by direct observation of the detent clapper. When operating properly, the detent clapper will move so smoothly and quickly that it will appear to be stationary.

b. Readjust the 2K-ohm, 10-mil integrator set potentiometer by rotating it in one direction until the detent clapper does not appear to be stationary, but displays erratic motions. Measure the dc voltage at pin F2B02 and record this high voltage limit. Next, turn the potentiometer in the opposite direction until the detent clapper motion is first smooth, and then once again erratic. Once more, measure the voltage at pin F2B02 and record this low voltage limit.
c. Make a final adjustment of the potentiometer to ensure that the voltage at pin F2B02 is 65% of the difference between the extremes of voltage limits producing erratic motion with the most positive value taken as 100%. When determining the extremes, the carriage should be allowed to travel in both the forward and reverse directions. The actuator is now properly adjusted for 10 milli-inch steps.

Tachometer Dynamic Balance Adjustment

1. Step the actuator continuously in the 10 milli-inch step mode and adjust the 2K-ohm, tachometer balance potentiometer until detent action is no longer smooth.
2. Stop the actuator and measure the balance voltage from pin F2B12 to pin F2D11. Record this value.
3. Step the actuator once more, and turn the 2K-ohm, tachometer balance potentiometer in the other direction until the detent action first becomes smooth, and again becomes erratic.
4. Stop the actuator and again measure the balance voltage from pin F2B12 to F2D11. Record the value.
5. Compute the average value of the balance voltage and adjust the 2K-ohm tachometer balance potentiometer until this voltage value appears across the designated pins.
6. Recheck the 20 milli-inch integrator trip level setting by performing a fine adjustment for the 100-ohm, 20-mil integrator set potentiometer contained in steps 3a, 3b, and 3c. Omit the initial voltage setting contained in steps 1 and 2.
7. Recheck the 10 milli-inch integrator trip level setting by performing a fine adjustment for the 2K-ohm, 10-mil integrator set potentiometer described in steps 3a, 3b, and 3c. Omit the initial voltage setting described in steps 1 and 2.

Fine Timing Adjustment of Access Ready
(10 MS Single Shot)

1. Apply access drive pulses to the machine by using the CE step control switch to step the carriage forward and backward in the 20 milli-inch step mode.
2. Adjust the 20K-ohm, timing cycle potentiometer (Figure 4-3) to provide a time (including jitter) of 14.5 (+0.0, -1.5) milliseconds between the negative-going leading edge of the access drive pulse at pin G3B03 and the positive-going trailing edge of the access ready signal at pin G2D04.

4.6 DRIVE MAGNET AND COIL

4.6.1 Drive Magnet Removal and Replacement (Figure 4-2)*

1. Turn off all power to the machine.
2. Push the carriage forward as far as it will extend
3. Remove screw and clip from top of the magnet which secures the strap clamp to magnet.
4. Remove the screw and clip from back of the magnet which secures magnet to cradle of actuator bracket.
5. Slide magnet horizontally back from bracket cradle.
6. Replace drive magnet by reversing steps 1 through 5. Ensure that magnet contacts front stop on actuator bracket before securing the installation with mounting screws.

4.6.2 Drive Coil Removal and Replacement

1. Turn off all ac and dc power.
2. Remove drive magnet. (Refer to section 4.6.1.)
3. Unsolder voice coil leads and note terminal from which each lead is removed.
4. Remove three binding head mounting screws located inside the voice coil.
5. Slide coil horizontally, away from carriage, off dowel pin.

*Alternate procedures are contained in Chapter 7 for machines with serial number 00001 through 00050.

CAUTION: Ensure that correct leads are matched to terminals on the voice coil after replacement. Reversal of these leads would cause uncontrolled carriage motion resulting in damage to equipment.

6. Replace drive coil by reversing steps 2 through 4. Replace drive magnet. (See section 4.6.1.)

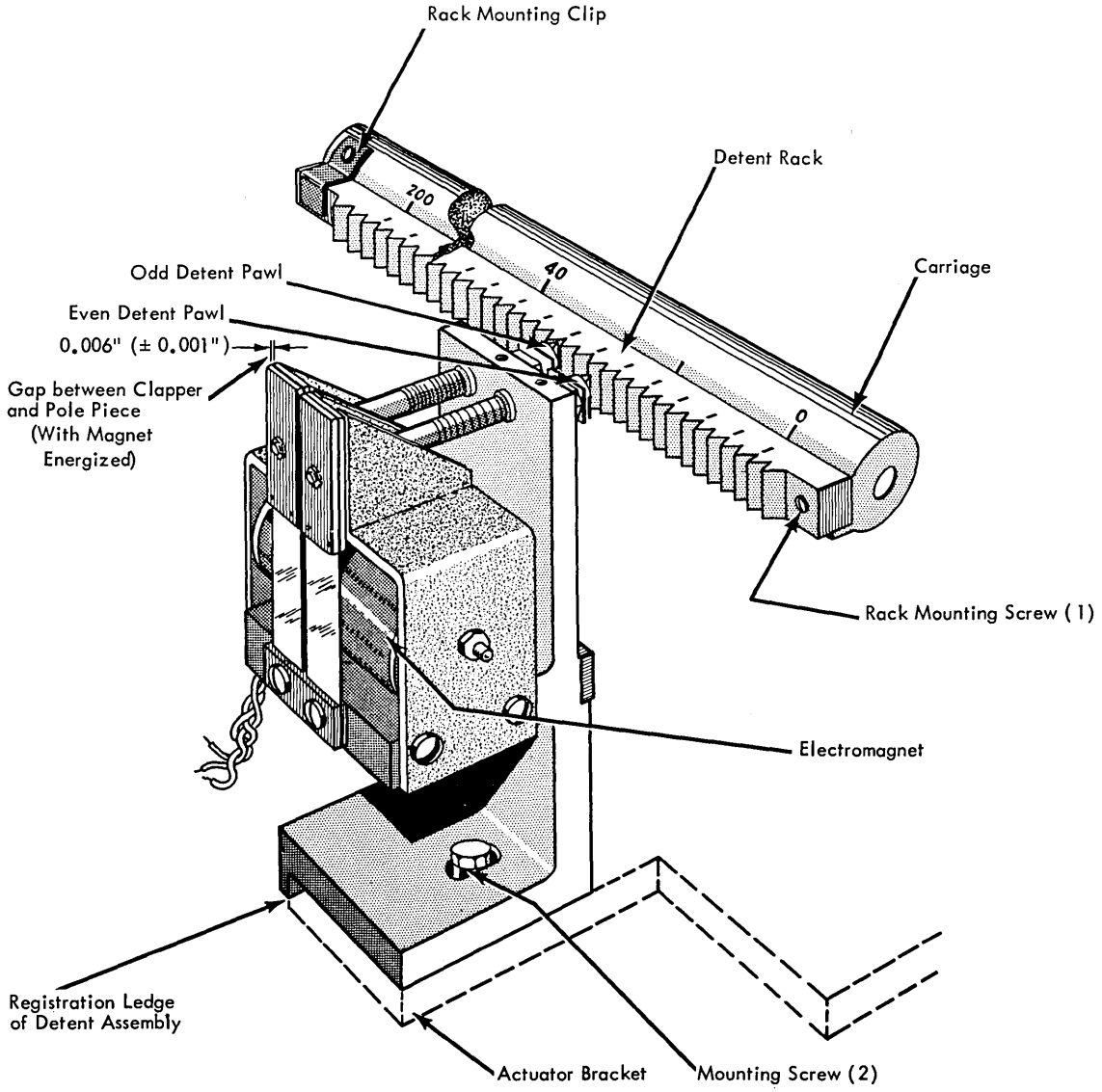
4.7 DETENT ASSEMBLY AND DETENT RACK

4.7.1 Detent Assembly Removal and Replacement

1. Disconnect detent coil leads from terminal strip. Mark the pin location of each lead prior to removal to facilitate identification.
2. Remove two hex-head mounting screws securing detent assembly to carriage mounting base.
3. Remove detent assembly by lifting it away from carriage assembly.
4. Replace detent assembly by reversing steps 1, 2, and 3. Insert mounting screws, but do not tighten at this time. Adjust detent assembly. (Refer to section 4.7.2.)

4.7.2 Detent Assembly Adjustment (Figure 4-4)

WARNING: The only CE adjustment required is the fixed pawl-to-rack alignment which is established by controlling the air gap between clapper and pole piece of the energized detent. Do not, under any



igure 4-4. Detent Assembly, Adjustment Clearance

Alternate procedures are contained in Chapter 7 for machines with serial numbers 00001 through 00050.

circumstances, loosen screws holding the springs, electromagnet, or pawls and pole pieces.

1. Energize one of the detents.
2. Push registration ledge of detent assembly against the corresponding edge of carriage mounting base (Figure 4-4).
3. Insert a 0.006-inch, non-magnetic shim in the gap between clapper and pole piece and slide detent assembly along registration ledge until energized detent pawl engages the rack.
4. Ensure that the 0.006-inch gap between clapper and pole piece is maintained while positioning the assembly to engage the rack. The shim should have a sliding-fit in the gap.
5. Repeat this procedure for the other detent by energizing its electro-magnet and maintaining the 0.006-inch gap between clapper and pole piece with pawl engaged in rack.
6. Tighten mounting screws to secure the detent assembly. Check the air-gap dimension between clapper and pole pieces of both detents to ensure that a 0.006 (±0.001) inch clearance is maintained.
7. Insert CE disk cartridge, and remove CPU signal cable from processor so that CE switches can be used to control accessing.

WARNING: The CE disk cartridge must be inserted before continuing with the procedure.

8. Set the CE step mode switch to 10 milli-inch steps. Using the CE step control switch, move carriage one track (0.010 inch). The other detent pawl should now be engaged with the rack.
9. Move carriage slightly to check for good contact between pawl and rack engagement.
10. Set the CE step mode switch to 20 milli-inch steps, and repeat steps 8 and 9 to check operation of the other detent.
11. Turn off all power to the machine.
12. Replace CPU signal cable on processor.

NOTE: The read/write head must be adjusted with a CE cartridge installed after each adjustment of the detent assembly has been accomplished. (Refer to section 4.17.1)

4.7.3 Detent Rack Removal and Replacement*

Removal

1. Remove detent assembly. (Refer to section 4.7.1.)
2. Remove the single binding-head mounting screw and clip that secure detent rack (Figure 4-5) to the carriage.
3. Lift detent rack to remove from carriage.

*Alternate procedures are contained in Chapter 7 for machines with serial numbers 00001 through 00050.

Replacement

1. Place detent rack in position shown in Figure 4-5. Position rack so that calibrated mark for track 100 on carriage is aligned with corresponding mark on rack. Press downward on rack to ensure contact between registration surfaces on detent rack and registration ledge on carriage (refer to section 4.7.4 for detail of adjustment).
2. Install single binding-head mounting screw and clip to secure the installation.
3. Replace detent assembly. (Refer to section 4.7.1.)
4. Check detent adjustment by observing clapper spacing and detent alignment with the rack. (Refer to Section 4.7.2.)
5. Realign read/write heads. (Refer to section 4.17.1.
6. Adjust crash stops. (Refer to sections 4.10.1 and 4.10.2.)
7. Adjust home switch. (Refer to section 4.11.2.)

4.7.4 Detent Rack Adjustment

NOTE: Adjustment of the detent rack is accomplished during replacement only. The rack should never be loosened or readjusted after it is initially installed on the carriage.

When a detent rack is replaced (section 4.7.3), the calibrated mark for track 100 on the carriage is aligned with the corresponding mark on the rack.

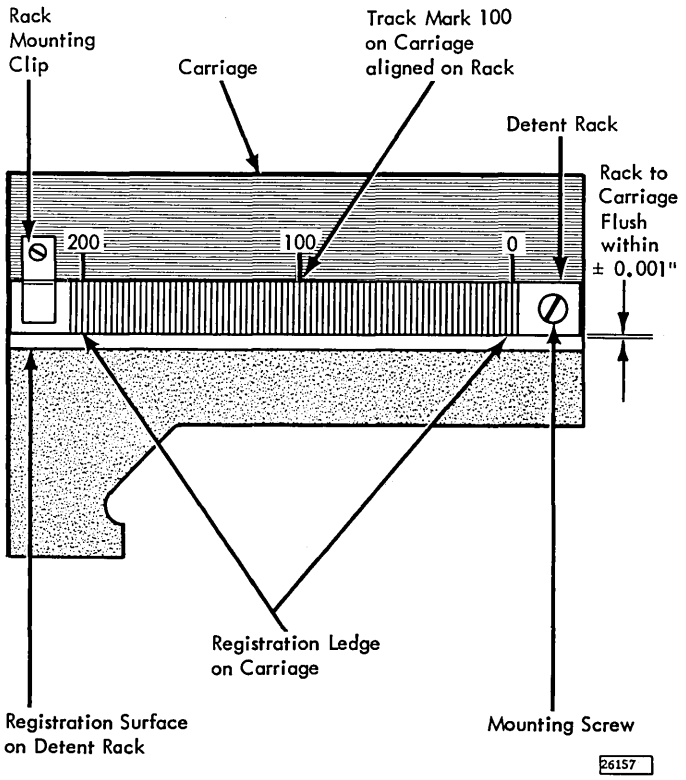


Figure 4-5. Detect Rack Removal and Replacement

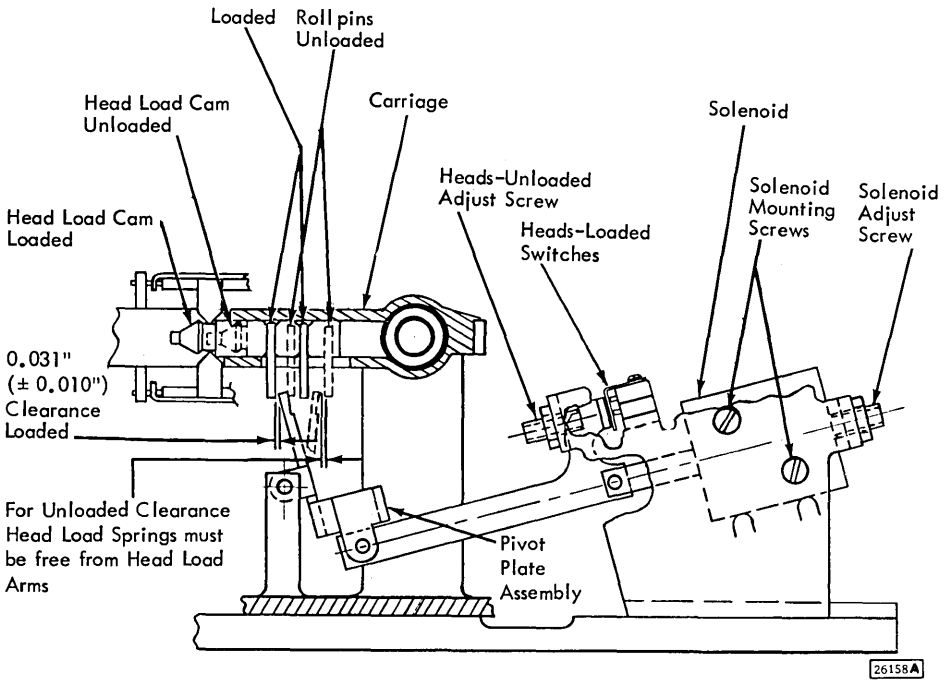


Figure 4-6. Head Load Assembly Adjustment

The top registration surfaces of detent rack must be pressed to establish a contact flush with the registration ledge of carriage. The mounting screw and clip must be tightened to secure the detent rack alignment.

4.8 HEAD LOAD ASSEMBLY

4.8.1 Head Load Solenoid Removal and Replacement

1. Turn off all ac and dc power to machine.
2. Remove solenoid leads from terminal strip TB4 (pins 7 and 8).
3. Remove pivot pin from solenoid plunger.
4. Remove two binding head screws securing solenoid to mounting bracket.
5. Slide solenoid horizontally away from bracket to effect removal.
6. Replace the head load solenoid by reversing steps 1 through 5. Readjust head load assembly (section 4.8.2).

4.8.2 Head Load Assembly Adjustment (Figure 4-6)*

WARNING: Do not load heads when disk is not rotating in machine. When cartridge is out of machine, insert an IBM card between heads prior to loading. Failure to comply will result in damage to heads and/or disk.

1. Remove CPU signal cable from plug connection on machine.
2. Install a CE cartridge in machine.
3. Power up the machine and check for loading of heads.

NOTE: Read/write heads should load after a 90-second delay. If heads fail to load, use the following procedure to accomplish head loading:

   a. Observe that solenoid plunger has bottomed out.
   b. Shut off power to machine.
   c. Loosen the two binding head screws that secure the head load solenoid to the mounting bracket.
   d. Use the solenoid adjust screw (0.031-inch per turn) to move the solenoid forward or backwards in the bracket. If solenoid plunger has bottomed out, move the solenoid backwards approximately 0.031 inch. If solenoid has not bottomed out, move solenoid forward approximately 0.031 inch.
   e. Tighten the two mounting screws to secure the adjustment.
4. Use masking tape to hold the heads loaded switches in the transferred position. Loosen the switch mounting screws and slide the switches backwards toward the solenoid as far as possible.

*Alternate procedures are contained in Chapter 7 for machines with serial numbers 00001 through 00050.

WARNING: If heads loaded switches are not held in transferred position, 48 vdc will be applied to solenoid coil resulting in damage to equipment.

5. With the carriage detented at track 000, loosen the two solenoid mounting screws and the solenoid adjusting screw. Slide the solenoid backward until the pivot plate contacts the head-loading roll pin in the head load cam. Continue to slide the solenoid back until the cam moves all the way into the cam followers. Tighten the solenoid mounting screws and position the solenoid adjusting screw against the back of the solenoid.
6. Back off the solenoid adjusting screw one turn, and tighten the lock nut. Loosen the solenoid mounting screws and slide the solenoid backward so that it will bear lightly against the adjusting screw.
7. Check clearange between the pivot plate and head loading roll pin. This clearance should be within 0.031 (±0.010) inch. Tighten the solenoid mounting screws after this clearance has been obtained.
8. Adjust heads loaded switches using the following procedure.
   a. Slide switches toward head load contact point against the head load actuator link and remove the masking tape.
   b. Place a 0.005 inch shim between both switch buttons and link. Move switch until it bottoms out.
   c. Tighten mounting screws to secure switches in this position.

CAUTION: Touch the head loaded solenoid coil to inspect for overheating. The solenoid coil is warm to the touch during normal operation when 24 vdc is applied. A defective heads loaded switch adjustment will cause 48 vdc to be applied to the coil resulting in excessive heating. If the coil is too hot to grasp and hold, the heads loaded switch is not in proper adjustment.

9. Adjust the heads loaded switch if solenoid coil is excessively hot. (Refer to procedures of section 4.8.3.)
10. Remove power from the machine.
11. Adjust the heads-unloaded adjust screw so that when heads are unloaded the head load springs do not contact the head load arms. Tighten the locknut to secure this adjustment.

NOTE: Failure of the linear ball bearings or head load cam requires replacement of the carriage assembly.

4.8.3 Heads Loaded Switch, Removal, Replacement, and Adjustment

1. Remove all ac and dc power from the machine.
2. Unsolder leads at heads loaded switch (Figure 4-6) and note terminal from which each lead is removed.
3. Remove two binding head screws from nut plate located underneath the switch.
4. Remove bracket and heads loaded switches.
5. Replace heads loaded switches by reversing steps 2, 3, and 4. The switches should be positioned as near as possible to the solenoid.
6. Power up machine and load heads. As soon as heads are loaded, transfer switches with a 0.005-inch shim. Slide switches and shim toward head load actuator link until both switches bottom out.
7. Tighten mounting screws.

4.9 HEAD LOAD SPRING ASSEMBLY*

4.9.1 Head Load Spring Assembly Removal and Replacement*

1. Remove the split retainer ring from one side of head load spring assembly pivot pin.
2. Remove pivot pin.
3. Remove spring assembly.

NOTE: The head load spring assembly is replaced as a complete unit and is not to be disassembled.

4. Replace the head load spring assembly by reversing steps 1 through 3.

4.10 CRASH STOPS

4.10.1 Front Crash Stop Adjustment

Use appropriate switches on the CE panel to operate carriage in a forward direction to detent on track 202 against front crash stop (near spindle).

Adjust screw on right end of front crash stop and tighten locknut so that a 0.006 (±0.003) inch clearance exists between front crash stop and carriage.

Operate carriage first in reverse direction, and then forward, to check that the 0.006 (±0.003) inch clearance adjustment is maintained at the front crash stop when carriage is detented on track 202.

*Alternate procedures are contained in Chapter 7 for machines with serial numbers 00001 through 0050.

4.10.2 Rear Crash Stop Adjustment*

Use appropriate switches on the CE panel to operate carriage in a reverse direction to detent on track 000 against rear crash stop (near drive magnet).

Adjust screw on left end of rear crash stop and tighten locknut so that a 0.003 (±0.001) inch clearance exists between rear crash stop and carriage.

Operate carriage, first in forward direction and then reverse, to check that the 0.003 (±0.001) inch clearance adjustment is maintained at the rear crash stop when carriage is detented on track 000.

4.11 HOME SWITCH*

4.11.1 Home Switch Removal and Replacement (Figure 4-2)

1. Remove all ac and dc power from machine.
2. Remove leads from home switch terminals.
3. Remove two binding head screws securing switch to mounting bracket.
4. Replace home switch by reversing steps 2 and 3 and adjust switch according to section 4.11.2.

4.11.2 Home Switch Adjustment

1. Use appropriate switches on the CE panel to operate carriage in a reverse direction to detent on track 001.
2. Place a 0.007-inch feeler gage between the carriage actuator and home switch pushbutton, and adjust the home switch adjusting screw until the switch just transfers.
3. Check this adjustment with a 0.005-inch feeler gage to determine that home switch will not transfer.

4.12 TACHOMETER AND TACHOMETER EXTENSION ROD

4.12.1 Tachometer Extension Rod Removal and Replacement (Figure 4-2)*

The tachometer extension rod can be removed from the tachometer core by unscrewing the rod from the core assembly. Use extreme care when removing the extension rod because the core can be broken or scarred. Remove the rod as follows:

1. Unscrew and remove the home switch actuator which serves as a lock screw to retain the rod in the carriage bracket.
2. Remove the set screw which secures the rod in the carriage bracket.
3. Detach the rod by unscrewing it from the carriage bracket, and slide the rod away from the home switch and out of the tachometer coil and housing assembly.
4. Replace tachometer extension rod by reversing steps 1, 2, and 3.

4.12.2 Tachometer Extension Rod Adjustment*

The tachometer extension rod is to be adjusted visually by positioning the tachometer so that the groove on the rod is flush with the end of the carriage end of the tachometer when the carriage is detented at track 000. Perform the adjustment as follows:

NOTE: Do not disconnect the rod from carriage to make this adjustment.

1. Detent carriage to track 000.
2. Loosen the two set screws which secure the tachometer and shield to the carriage mounting base.
3. Slide the tachometer or the shield along the rod until the groove in the rod is flush with the end of the tachometer.
4. Tighten the two set screws to secure the adjustment.
5. Check the carriage for friction to ensure that binding does not prevail as a result of making the tachometer extension rod adjustment.

4.12.3 Tachometer Assembly Removal and Replacement (Figure 4-2)*

1. Remove disk cartridge from machine.
2. Remove cartridge receiver, shroud, and spindle from base plate.
3. Unsolder tachometer cable leads from terminals on tachometer, and mark each lead to facilitate identification.
4. Remove the tachometer extension rod. (See section 4.12.1.)

WARNING: Caution must be exercised in handling the tachometer core and extension rod. These assemblies can be damaged if dropped.

5. Remove the two set screws in the carriage mounting base which secure the tachometer shield.

*Alternate procedures are contained in Chapter 7 for machines with serial numbers 00001 through 00050.

6. Slide tachometer shield out of carriage mounting base and tachometer bracket.
7. Slide tachometer coil and housing assembly out of tachometer shield.

WARNING: Slide coil and housing assembly out the end of tachometer shield nearest the spindle. Do not bend tachometer electrical leads back and forth since they can break within the coil and housing assembly.

8. Replace the tachometer assembly by reversing steps 2 through 7, and adjust according to section 3.12.2.

4.13 CARRIAGE RAIL

4.13.1 Carriage Rail Removal and Replacement (Figure 4-2)*

1. Turn off all ac and dc power to the machine and remove top baseplate cover.
2. Remove two retaining screws, one each, located at front and rear of rail. (These screws retain the rail in V-grooves of the carriage mounting base.)
3. Insert 0.100-inch feeler gage shim between the carriage preload spring and carriage. Remove preload force on the rail, and slide the rail out of the carriage mounting base being careful to avoid misalignment.

WARNING: Misalignment in this step could damage the carriage bearings.

4. Replace carriage rail by reversing steps 2 and 3.

4.14 CARRIAGE PRELOAD BEARING ASSEMBLY

4.14.1 Carriage Preload Bearing Assembly Removal and Replacement

1. Remove all ac and dc power to the machine.
2. Remove drive magnet. (Refer to Section 4.6.1.)
3. Remove drive coil. (Refer to Section 4.6.2.)
4. Remove two binding head mounting screws which secure preload bearing spring to carriage and remove bearing assembly.

NOTE: When replacing bearing assembly in step 4, ensure that edge of preload bearing is fully engaged with registration surfaces before tightening the mounting screws.

5. Replace carriage preload bearing assembly by reversing steps 2 through 4.

4.15 CARRIAGE SUBASSEMBLY

4.15.1 Carriage Subassembly Removal and Replacement*

1. Remove all ac and dc power to machine.
2. Remove Drive Magnet. (Section 4.6.1.)
3. Loosen binding head screw securing head plug clamp to release head plug. Disconnect head plugs from head cables.
4. Remove tachometer extension rod from carriage (See section 4.12.1).
5. Unsolder voice coil leads and note terminal from which each lead is removed.
6. Remove three binding head screws which secure carriage outrigger slide to carriage. Remove slide.
7. Remove carriage rail. (See section 4.13.1.)
8. Lift carriage assembly away from carriage mounting base.

WARNING: Be careful to ensure that read/write heads do not strike anything during removal.

9. Replace carriage subassembly by reversing steps 2 through 7.
10. Adjust tachometer extension rod according to section 4.12.2.
11. Adjust head-arm assemblies according to section 4.17.1.
12. Perform the following adjustments if a new carriage subassembly has been installed:
    a. Check detent adjustment and readjust if necessary according to section 4.7.2.
    b. Adjust front and rear crash stops according to section 4.10.
    c. Adjust home switch according to section 4.11.2.

4.16 READ/WRITE HEADS

4.16.1 Read/Write Head Service Check

The service check for read/write heads is a part of the preventive maintenance schedule described in

*Alternate procedures are contained in Chapter 7 for machines with serial numbers 00001 through 00050.

Figure 3-1. Refer to Section 3.3 for a description of of the causes of read/write head damage.

4.16.2 Read/Write Head Replacement

The inspected read/write head need not be replaced unless it is capable of damaging disk surfaces or causing errors.

Disk damage by a head can usually be detected by the following diagnosis:

1. Persistent oxide collection on the suspected head after cleaning.
2. Helical scratches and 0.010 inch spaced radial scratches on the disk surface.
3. Audible tinging noises.

If any of the above symptoms occur, the suspected head should be replaced.

NOTE: Clean the disk using the disk cleaning fixture and look at the disk surface to be certain no "comet trails" with embedded particles are present to damage the new head. (See Section 3.3.1.)

After head replacement and proper disk cleaning, the new head should be checked for audible tinging after the new head is loaded and is addressed onto the disk cartridge.

4.16.3 Read/Write Head to Base Plate Resistance Check

The resistance from read/write head to baseplate should be checked in the event of read errors which cannot be traced to any other source.

Follow this procedure:

1. With cartridge out of the machine, load head on a loading pad (IBM card).
2. Check electrical resistance from read/write head to carriage. This resistance should not exceed 5 ohms. If this resistance exceeds 5 ohms, replace read/write head-arm assembly and/or head load spring assembly.
3. Check resistance from carriage to baseplate. If this resistance exceeds 5 ohms, check the ground lead in the drive coil cable, which grounds carriage to baseplate, for breakage or loose connections.

4.17 HEAD-ARM ASSEMBLY

4.17.1 Head-Arm Assembly Adjustment*

Both sides of the CE cartridge contain accurately recorded master tracks at track position 100. The width of this track (0.005 inch) is the same as a data track after tunnel erasure. The track is written with a clock pattern of all zeros at a frequency of 720 kc. The track is read by the tunnel erasure element of the read/write head for purposes of adjustment and both heads must be adjusted to obtain equal amplitudes for the envelopes developed by the signal.

NOTE: The head alignment oscilloscope adapter (part 2200052) is used to connect the erase winding into the preamplifier of the read circuit. Output for scoping is from pin D2G07. Location of head clamping screws and adjustment screws is shown in Figure 4-7. Oscilloscope signal-pattern displays are shown in Figure 4-8. Remove the CPU signal cable and use CE switches to access the carriage.

The CE track is written with a slight eccentricity so that it will sweep slightly below one leg of the tunnel erase pole tip during one-half revolution of the disk, and then slightly above the other leg of the pole tip during the other one-half revolution. With proper adjustment of the heads, the signal will appear on the scope as shown in View B, Figure 4-8, with two nulls in 40 ms and beginning with a signal equal to the amplitude of the first complete envelope.

If a slight misalignment exists, the track will sweep more under one leg than the other, and the envelopes generated will be at different amplitudes as shown in View A, Figure 4-8, with only one envelope in 40 ms beginning with a null.

If a bad misalignment exists (for example: 0.004 inch), one leg only will see the track, and a large signal, of more or less constant amplitude, will appear on the scope.

If misalignment is total (for example: 0.100 inch) only noise will appear on the scope.

Procedures for adjustment of head-arm assembly are to be accomplished as follows:

*Alternate procedures are contained in Chapter 7 for machines with serial numbers 00001 through 00050.

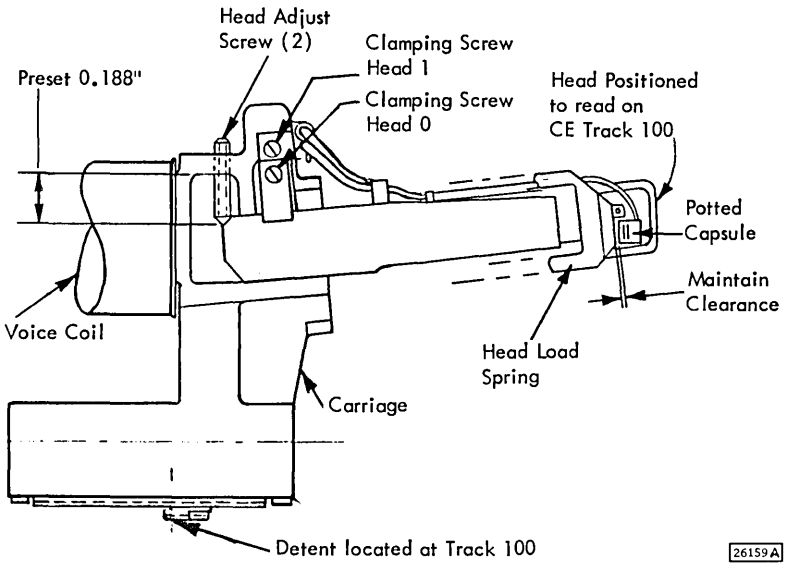


Figure 4-7. Head-Arm Assembly Adjustment

1. Loosen head clamping screw.
2. Back off the head adjusting screws and push each head-arm assembly back toward the voice coil until the head load spring just clears the potted capsule on the head. A dental mirror is required to observe the lower head.
3. Tighten head clamping screws.
4. Install the CE cartridge and apply power to the machine to load heads. Use the CE switches to access the carriage to track 100, and ensure that the even detent is energized at this track location.
5. Allow the machine and cartridge to operate continuously for 15 minutes to ensure that temperature stabilization has taken place before adjusting heads.
6. Use direct probe and scope from pin D2G07. Set time base to display 5 ms/cm (One revolution of the disk is 40 ms). Synchronize the oscilloscope on negative reference pulse, pin K2B04.
7. Insert the head alignment oscilloscope adapter (part 2200052) between the head cable plug and socket for Head 1. Select Head 1 with the CE head select switch.
8. Slowly advance the head adjusting screw while observing the scope pattern. The scope will first show noise only, then the pattern of View A, Figure 4-8 will appear. When the head is properly aligned, the pattern of View B, Figure 4-8 will be present and the lobes will be equal in amplitude. If head is advanced beyond track 100, the scope picture of View C, Figure 4-8 will be seen on the display.

NOTE: If the head is moved forward too much toward the spindle, it will be necessary to shut down the machine, remove the CE cartridge, push the arm backwards toward the voice coil as described in step 2, and then repeat step 8. When the head-arm assembly is correctly positioned, the lip of the head load spring will bear on the dimple of the arm assembly spring. The head load spring will not be in contact with the potted capsule which encases the read/write coils. It will be necessary to shift the detent rack slightly if correct adjustment cannot be made using step 7.

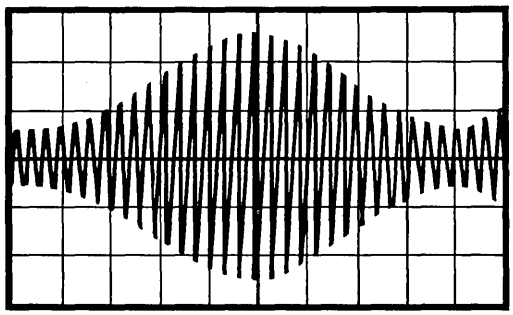
9. Tighten head clamping screw to secure adjustment.
10. Back off the head adjusting screw one-half turn when adjustment has been completed. Observe the scope display pattern to ensure that the head alignment is not affected.
11. Repeat steps 1 through 10 for aligning head 0.

NOTE: If the detent rack was moved to accomplish the adjustment of head-arm assemblies, it will be necessary to readjust the crash stops (section 4.10), home switch (section 4.11.2), and tachometer extension rod (section 4.12.2).

4.17.2 Head-Arm Assembly Removal and Replacement

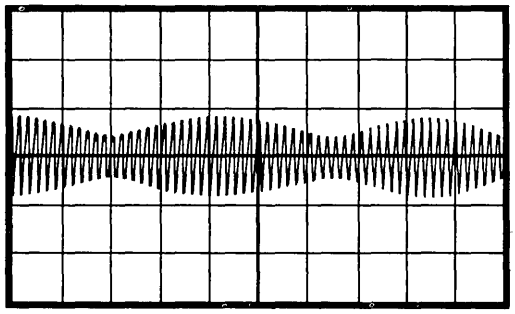
1. Loosen binding head screw in head plug clamp sufficiently to remove head plug. Remove head plug from cable leading to electronic gate.

5 MS/Div



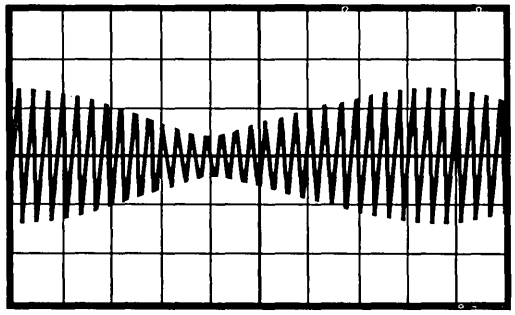
A Approximate wave shape when head approaches master track 100

5 MS/Div



B Wave shape when head is properly adjusted on master track 100

5 MS/Div



C Approximate wave shape when head is positioned beyond master track 100

26126A

Figure 4-8. Signal Patterns for Head Alignment Adjustment

2. Remove head leads from head-lead clip located near plastic outrigger slide on carriage.
3. Loosen head clamp but do not remove head at this time.

WARNING: Caution must be exercised when handling head-arm assemblies to prevent damage from rough handling or contamination from contact with solid surfaces.

4. Place fingers on the arm only. Do not grasp the flex-gimble springs or head assembly. Slide head horizontally toward spindle until head can be lifted out.
5. Replace head by reversing steps 1 through 4. Readjust head arm assembly with CE cartridge at track 100 according to section 4.17.1.

4.18 CARTRIDGE RECEIVER*

4.18.1 Cartridge Receiver Removal and Replacement

1. Remove all ac and dc power from the machine.
2. With receiver handle in the raised position, remove tension spring attached to the receiver and handle interlock assembly.
3. Unhook and slip the cartridge load springs from cartridge load rods.
4. Position cartridge receiver handle down.
5. Remove the two socket-head shoulder screws at receiver pivots.

WARNING: Exercise care in lifting the cartridge receiver from machine to avoid striking the detent assembly and disrupting the detent adjustment.

6. Lift the cartridge receiver from machine.
7. Replace the cartridge receiver by reversing steps 2 through 6.
8. Adjust the cartridge receiver according to procedures described in section 4.18.2.

4.18.2 Cartridge Receiver Adjustment (Figure 4-9)*

1. Loosen both socket-head shoulder screws located on the pivots of the cartridge receiver so that receiver is free to move slightly from side to side. Ensure that shoulder of screw does not come out of receiver pivot hole.
2. Insert cartridge into receiver and lower handle so that cartridge is positioned on rest pins.
3. Tighten the two shoulder screws until they just contact surfaces of the receiver. At the same time ensure that an equal space exists between front of receiver and cartridge guide. This will secure the adjustment. (See Figure 4-9.)

4.18.3 Cartridge in Place Switch Adjustment

NOTE: The cartridge in place switch cannot be adjusted. However, its function may be checked by

*Alternate procedures are contained in Chapter 7 for machines with serial numbers 00001 through 00050.

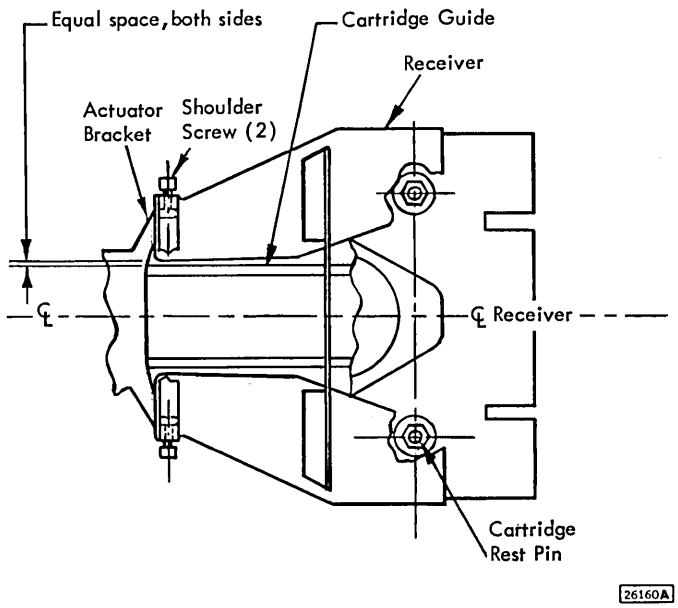


Figure 4-9. Cartridge Receiver Adjustment

standing in front of machine while using the following procedure: (A quick check of the switch operation can be accomplished by step 4.)

1. Insert cartridge in receiver and observe the action of the cartridge in place switch as the receiver handle is raised.
2. Verify that switch transfers when cartridge is fully seated on its rest pins. Ensure that the cartridge is not touching the switch lever anywhere except on its operating end.
3. Use five IBM cards as shims between the shoulder of the closest rest pin and the bottom of the cartridge. Verify that the switch transfers before cartridge is fully seated on the rest pin.
4. With the cartridge receiver handle locked in place by the interlock latch to secure the cartridge in place, move the handle end of the cartridge up and down with moderate force to see if the transferred condition of the switch is affected. The switch must remain transferred.

4.19 INTERLOCKS

4.19.1 Handle and Interlock Adjustment

NOTE: The cartridge must be inserted, and the handle must be raised and locked prior to adjustment of the interlock.

Handle Stop Screw Adjustment (Figure 4-10, View A)

The handle stop screw must be adjusted with the cartridge in place so that a 0.020 (±0.010) inch clearance exists between handle pads and top of cartridge. Adjustment of the handle stop screw is accomplished as follows:

NOTE: Two types of cartridges are used with the single disk storage. One type has a metal access door. The other type is all plastic. Adjust the handle stop screw using either type of cartridge. However, each cartridge type uses a different location point for clearance.

1. Remove the two stationary side guide posts so that the receiver can be raised to the maximum height while accomplishing adjustment.
2. Remove tension spring attached to cartridge receiver and interlock assembly.
3. Lower handle and loosen stop screw lock nut.
4. Raise handle and check for a 0.020 (±0.010) inch clearance between the handle pads and top of cartridge. Access to stop screw can be reached by lowering handle and inserting a screwdriver in the handle riser slots of the receiver.

NOTE: The reference point for measuring the 0.020 (±0.010) inch clearance is different for each of the two cartridges used with the machine. Step 4 is valid only for all-plastic cartridges. For cartridges with metal access doors, the clearance must be measured from the lower edge of the handle (instead of the lug) and the top of the cartridge surface. See Figure 4-10, View A.

5. Tighten stop-screw lock nut finger tight to retain stop-screw adjustment after the 0.020 (±0.010) inch clearance has been obtained. Final tightening of this screw to secure the stop-screw adjustment is accomplished after completing the latch screw clearance adjustment.

Latch Screw Clearance Adjustment (Figure 4-10, View B)

NOTE: The disk cartridge and receiver must be removed to adjust the latch screw clearance. Refer to procedures in section 4.18.1 for removal of receiver

1. Remove the receiver, lower the handle, and loosen the latch screw lock nut.
2. Raise handle against stop screw.

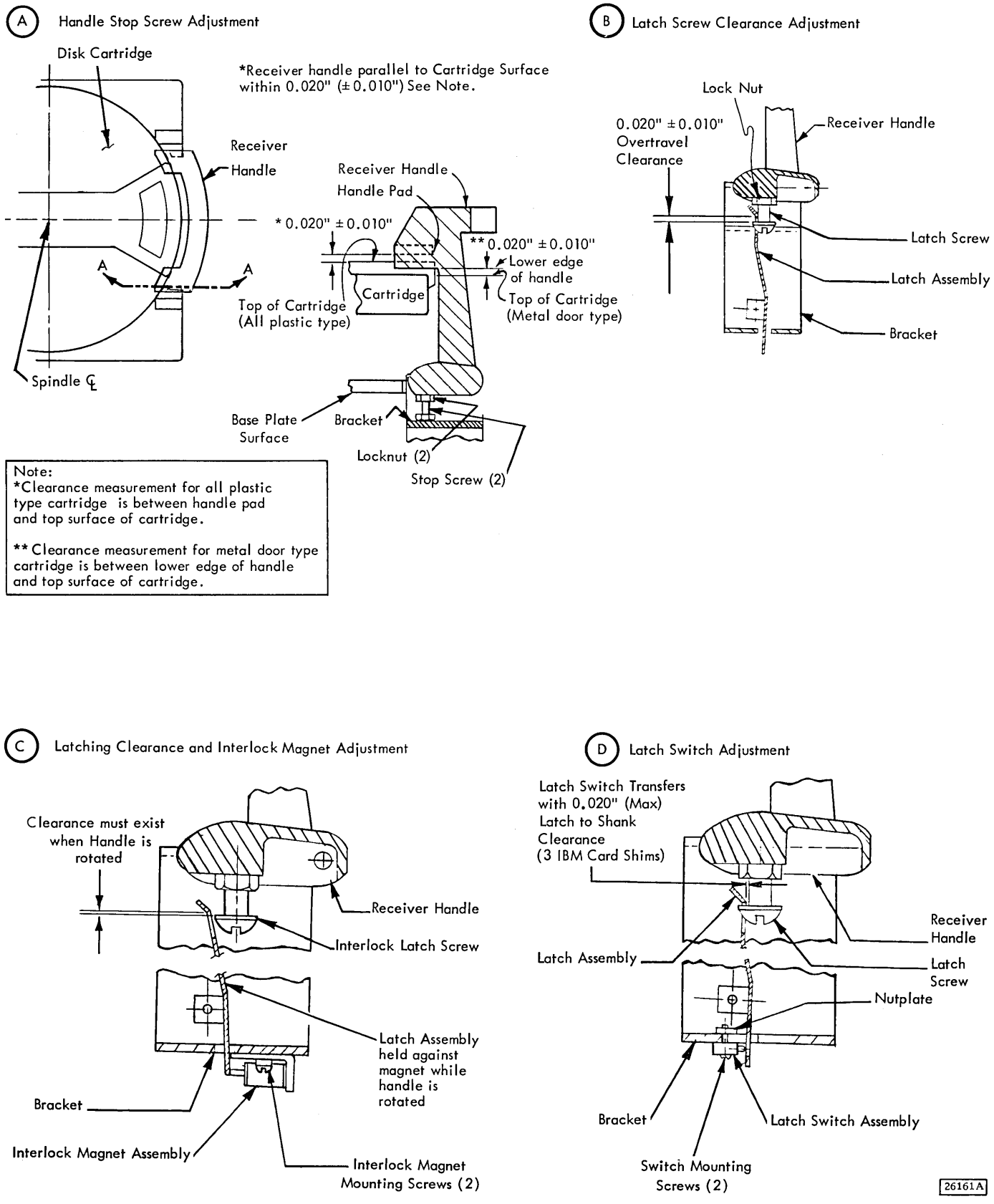


Figure 4-10. Handle and Interlock Adjustment

3. Adjust the interlock latch screw so that head of screw will seat in square-hole of the latch. Verify that a 0.020 ±0.010 inch overtravel latching clearance exists between underside of the latch screw head and the upper edge of notch on the latch. (See Figure 4-10, View B.)
4. Tighten lock nut on latch screw after making adjustment.
5. Tighten lock nut on the handle stop screw to secure stop-screw adjustment.

Latching Clearance and Interlock Magnet Adjustment (Figure 4-10, View C)

1. Loosen the two mounting screws which secure the interlock magnet to its bracket. Loosen screws sufficiently so that the magnet assembly can be manually positioned, but maintains its position if not disturbed.
2. Raise receiver handle against the handle stop screw.
3. Hold latch against the magnet, and rotate the handle so that when magnet is moved, the latch just clears the head of the latch screw. (See Figure 4-10, View C.)
4. Tighten the two mounting screws to secure the interlock magnet adjustment.

Latch Switch Adjustment (Figure 4-10, View D)

1. Raise receiver handle to the latched position.

NOTE: The shoulder of the red switch button is flush with brown collar of the switch body to denote that switch is in transferred position when the latch is fully engaged.

2. Place two IBM card shims between latch surface and magnet. Determine that switch still transfers.

NOTE: The switch should transfer with the latch located 0.020 inch (max.) from shank of latch screw. Transfer of the switch may be checked electrically at the switch terminals, or by listening for the audible click which occurs when switch transfers.

3. Loosen switch screws slightly (so that switch can be repositioned) and operate the latch so that switch will open. Verify that the latch is still engaged with the latch screw by at least half the thickness of the latch, at the time switch opens.
4. Tighten latch switch screws securely to prevent subsequent slippage after this adjustment has been accomplished.
5. Check that the light latch spring succeeds in transferring the switch and then pulling the latch into contact with the shank of the latch screw when a minimum of 5 grams force is applied.

NOTE: Hold assembly in the normal vertical orienta tion while accomplishing this check. Otherwise, gravity on the latch will destroy the measurement. When the latch rotates away from the latch screw, th switch should transfer while latch is still engaged with the head of latch screw by at least 50% of the latch sheet-metal thickness.

6. Replace the receiver assembly and the two side guides after the handle interlock adjustments have been completed.

4.20 SECTOR TRANSDUCER*

4.20.1 Sector Transducer Index Timing Adjustment (Figure 4-11)

Index timing on the machine is adjusted to a commor reference point on the CE cartridge to align the machine at the same starting point for reading or writing at the beginning of a sector field.

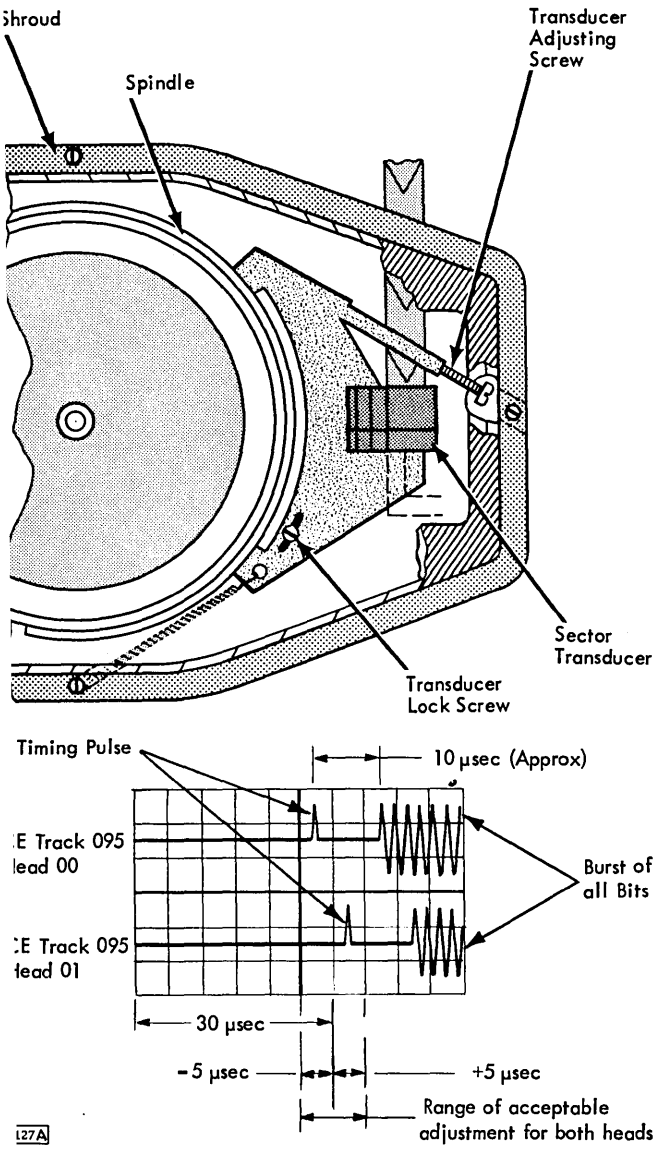
Eight equally spaced sector pulses are generate during each revolution of the disk. These pulses are 160 μs ± 25% wide and occur at 5-ms time intervals. These pulses also establish the beginning of a sector field.

A single reference pulse is generated during each revolution of the disk. This pulse is 160μs ±25 wide and occurs at a 40-ms time interval. This pul is used to provide a reference point for index timing adjustment.

Track 095 of the CE cartridge produces the reference signal which is used to align the sector transducer. Adjustment is accomplished as follows

1. Remove CPU signal cable from machine. Loos transducer lock screw enough so that transduce can be positioned by the adjusting screw, but is still locked sufficiently to overcome the force exerted by the tension spring.
2. Install CE Cartridge.

*Alternate procedures are contained in Chapter 7 for machines with serial numbers 00001 through 00050.



gure 4-11. Sector Transducer Index Timing Adjustment

3. Power up the machine so that heads will load.
4. Using CE panel, access carriage to track 095.
5. Using a CE oscilloscope, read track 095 by scoping pin D2B07. Synchronize the negative reference on pin K2B04.
6. Observe the time delay from reference pulse to the peak of the timing pulse on track 095. The delay from the leading edge of the reference pulse to the timing pulse should be 30 (±5)µs.

NOTE: The timing pulse precedes the burst of all bits pattern by 10 µs. If a weak signal is developed, the transducer amplifier gain must be adjusted as described in the succeeding paragraph.

7. Determine the magnitude and direction (+ or -) of the correction to be made in pulse timing so that a time delay of 30 (±5) µs will prevail for both read/write heads. Use the CE head select switch to check both read/write heads.
8. Use the transducer adjusting screw to position the transducer to increase or decrease the time delay. Turn the screw clockwise to increase the time delay and counterclockwise to decrease the time delay. One turn of the adjusting screw provides a change in time delay of 78 µs. Observe the scope pattern (Figure 4-11) while making this adjustment.

NOTE: Some jitter will be experienced in making this adjustment. The mean timing-pulse position is to be used as a reference setting. It may be necessary to readjust gain in the transducer amplifier as described below if the timing signal is unstable.

9. Power down the machine, remove the CE cartridge and tighten the transducer lock screw to secure the adjustment.
10. Repeat steps 1 through 7 to check the adjustment and readjust according to step 8 if required.

Transducer Amplifier Gain Adjustment

Adjust gain in the transducer amplifier whenever oscillation signals are unstable, weak, and do not agree with the display pattern shown in View B, Figure 4-12. An unstable amplifier signal prevents correct adjustment of index timing. Adjust transducer amplifier gain as follows:

1. Synchronize main sweep of oscilloscope with the reference pulse.
2. Display the oscillation waveform on pin K2J09 on the delayed sweep.
3. Set the oscilloscope for displaying the first oscillation occurring after the reference pulse (5 v c/m, 100 µs/cm).
4. Adjust the amplifier gain potentiometer located on the transducer SLT card until the display pattern shown in View B, Figure 4-12 is obtained.

Excessive Gain. The amplifier gain is adjusted too high as shown in View A. The picture appears very unstable at the beginning of oscillation. It is necessary to decrease gain by rotating the potentiometer cw until the display pattern shown in View B is obtained.

Correct Adjustment. The amplifier gain is adjusted correctly in View B. The picture is stable and the

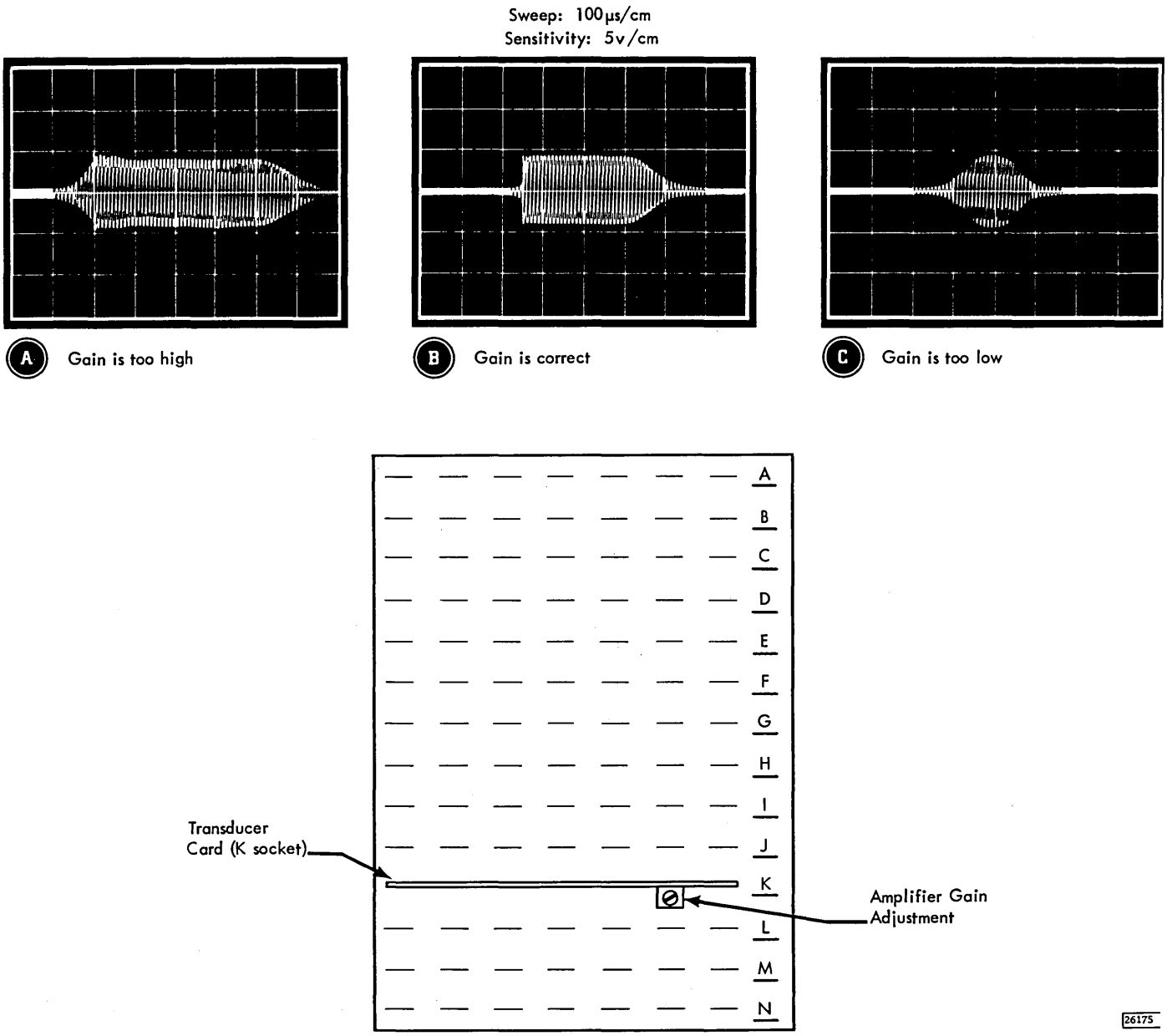


Figure 4-12. Sector Detector Amplifier Gain Adjustment

oscillation amplitude increases sharply. This is the required pattern display.

Insufficient Gain: The amplifier gain is adjusted too low as shown in View C. Increase the gain by rotating the potentiometer CCW.

4.20.2 Sector Transducer Removal and Replacement

1. Remove all ac and dc power from machine.
2. Remove cartridge.
3. Back off adjusting screws two or three turns.
4. Remove two binding head screws securing cable clamp to transducer bracket.
5. Remove transducer cable from transducer.
6. Remove single binding head screw securing transducer bracket to baseplate.
7. Lift transducer vertically to remove from baseplate.
8. Replace sector transducer by reversing steps 4 through 7.
9. Insert CE cartridge and check index timing adjustment according to section 4.20.1.

4.21 DATA SEPARATOR (MDM XA021)

4.21.1 Data Separator Adjustment (Figure 4-12)

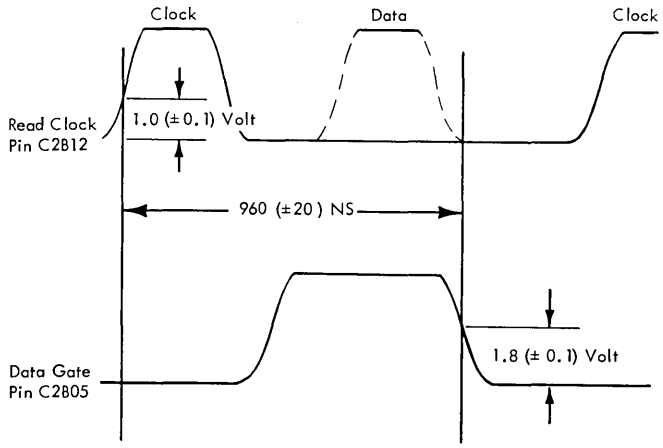
The data separator circuit is adjusted to allow for various circuit tolerances to place an electronic gate signal in time coincidence with data bits. A gate signal is formed in the logic circuits of the data separator card to separate read clock and read data information from the composite double frequency signal. A 5K-ohm potentiometer in the variable 600 nanosecond single-shot circuit is adjusted to achieve this purpose.

The process of adjustment involves displaying separate oscilloscope traces for the output of the 600-nanosecond single-shot gate signal and the clock signal.

This adjustment can be made on-line or off-line; in either case clock pulses must be on the disk cartridge. The data may appear between clock pulses as shown in Figure 4-12.

Adjustment is accomplished in the following manner:

1. Set up the oscilloscope
   a. Adjust time base for 200 nanoseconds/cm.
   b. Adjust vertical gain for 1.0 v/cm.
   c. Provide external synchronization from read check signal at C2 B03.
2. Connect one scope probe at C2 B12 to observe clock pulse and the other probe at C2 B05 to observe the 600-nanosecond window.
3. On-line the processor must be in a read loop. In off-line (CPU signal cable disconnected) use SLT jumper between pins D2 D05 and D2 D08. Both conditions allow output of the read amplifier.
4. Adjust the 5K-ohm potentiometer on the data separator card so that the trailing edge of the data gate pulse is 960 (±20) nanoseconds from the leading edge of the read clock pulse as shown in Figure 4-13.



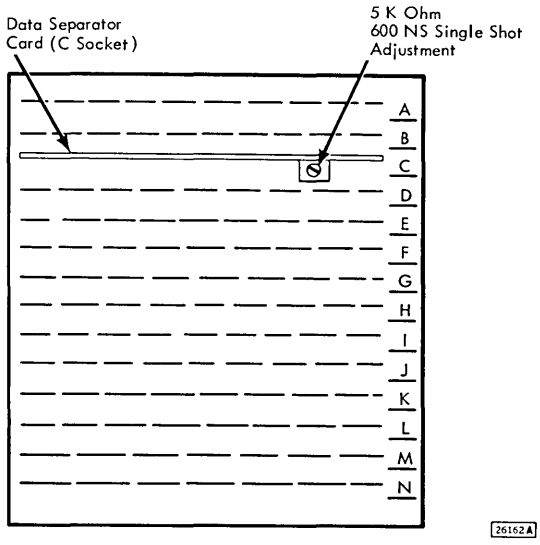


Figure 4-13. Data Separator Adjustment

5.1 POWER REQUIREMENTS

All power required by individual single disk storage machines is obtained from system circuits (Figure 5-1).

Those machines which are installed within a stand alone enclosure (I/O unit) are connected to power supply circuits which are an integral part of the I/O unit. Although internal power supply circuits may vary for different system applications, the input power requirements for each machine are the same. Details of power supply attachment circuits for a given system application are covered in the manual of instruction for the respective system.

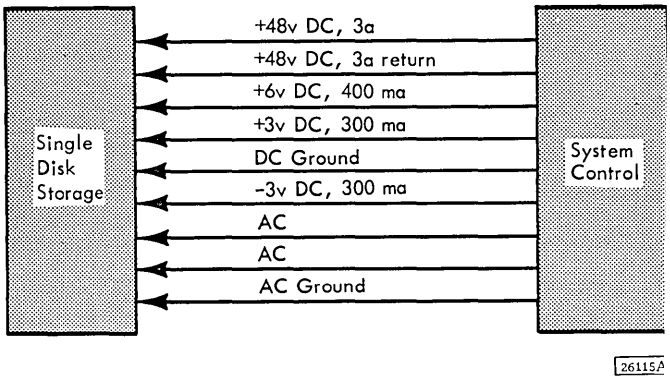


Figure 5-1. Power Lines Interface

5.1.1 AC Input Supply Power

Three versions of the single disk storage contain the following type of primary ac power inputs (Figure 5-2). Internal circuits of the AC box located on the front of the machine receive ac input power and distribute it to machine components.

5.1.2 DC Input Supply Power

DC input power requirements for the machine are listed in Figure 5-3. DC power is received by the machine at TB1 located on the base plate at the rear of the machine from where it is distributed to machine components.

5.2 POWER SEQUENCING

5.2.1 Power On Sequence

All dc voltages must be at the specified levels before ac power is applied to the drive motor. Blower power must be applied when dc is on.

5.2.2 Power Off Sequence

AC power to spindle drive motor is removed before removing dc power to machine.

5.3 POWER LINE INTERFACE

5.3.1 Input Power Lines to Single Disk Storage

Input power lines to the machine are shown in Figure 5-1.

Machine Version	Use	Voltage (ac)	Tolerance	Phase	Frequency (CPS)	Current
Type I	Blower Disk Drive	115 115	±10% ±10%	Single Single	60 ± 1/2 60 ± 1/2	3 Amp, Start/1 Amp, Run 14 Amp, Start/1.5 Amp, Run
Type II	Blower Disk Drive	208/230 208/230	±10% ±10%	Single Single	60 ± 1/2 60 ± 1/2	2 Amp, Start/0.5 Amp, Run 7.5 Amp, Start/0.8 Amp, Run
Type III	Blower Disk Drive	208/220 208/220	±10% ±10%	Single Single	50 ± 1/2 50 ± 1/2	2 Amp, Start/0.5 Amp, Run 7.5 Amp, Start/0.8 Amp, Run
NOTE: A switch located on the rear of the machine is attached to two terminals and is used to control the disk drive motor by opening and closing a 48-vdc interlock line. The blower should be on whenever dc power is applied to the machine.						

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Figure 5-2. Primary AC Power Inputs

Use	Voltage (dc)	Tolerance	Current
Signal Lines	-3V	± 4%	0.3 Amp
Signal Lines	+3V	± 4%	0.3 Amp
Control Circuits	+6V	± 4%	0.4 Amp
Control and Interlock Circuits	+48V	± 8%	3.0 Amp

NOTE: To prevent damage to internal circuits of the machine, the +3 vdc, -3 vdc, and +6 vdc power must be applied to and removed from the machine at the same time. The +48 vdc power must never be applied without all other dc voltages being present.

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Figure 5-3. DC Power Inputs

6.1 GENERAL

This chapter consists of general arrangement illustrations of the single disk storage which show equipment locations within the machine. These illustrations support procedures described in other chapters of the manual and serve as an aid to the CE for accomplishing maintenance operations.

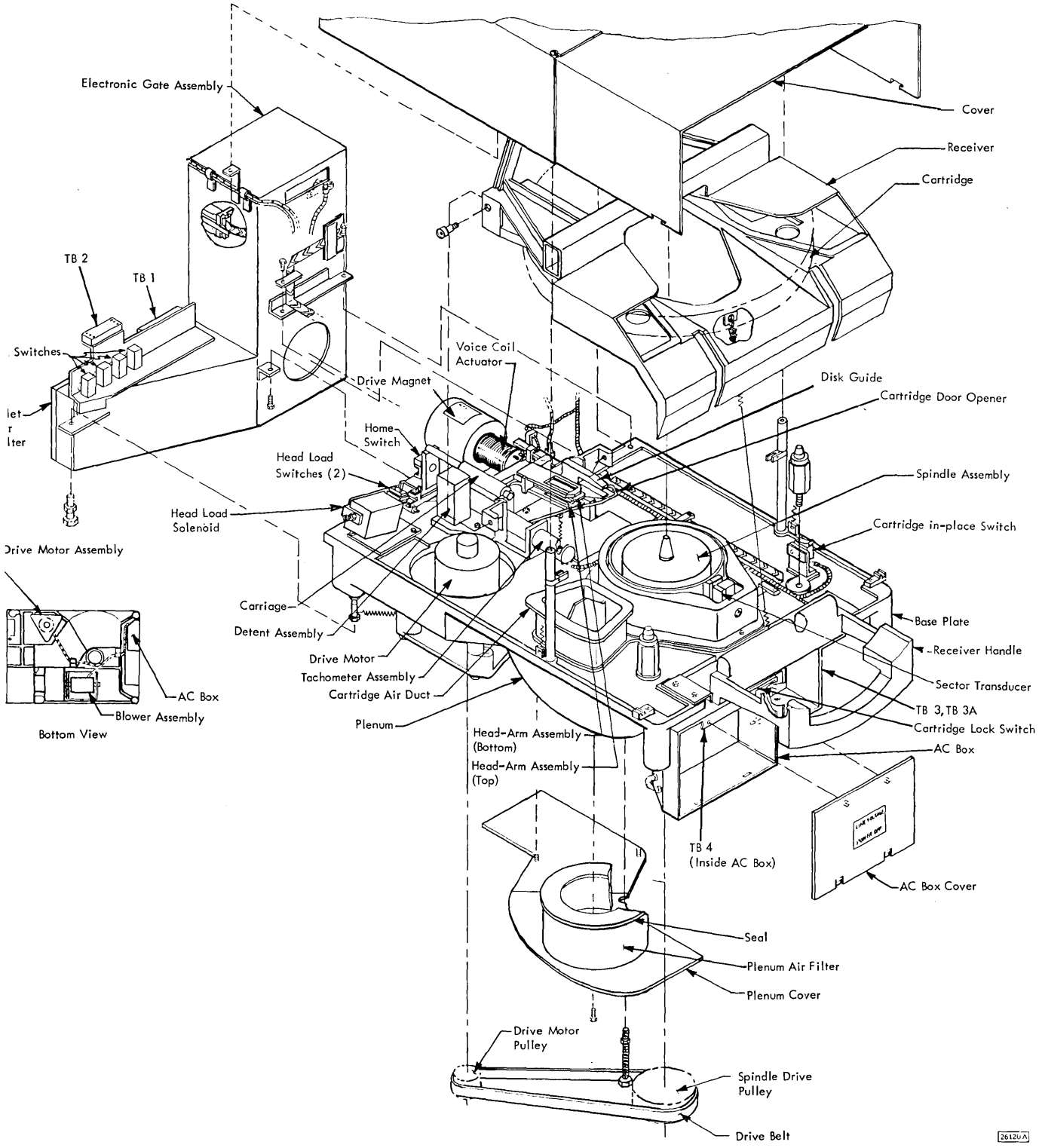


Figure 6-1. Disk Storage Drive Arrangement of Components

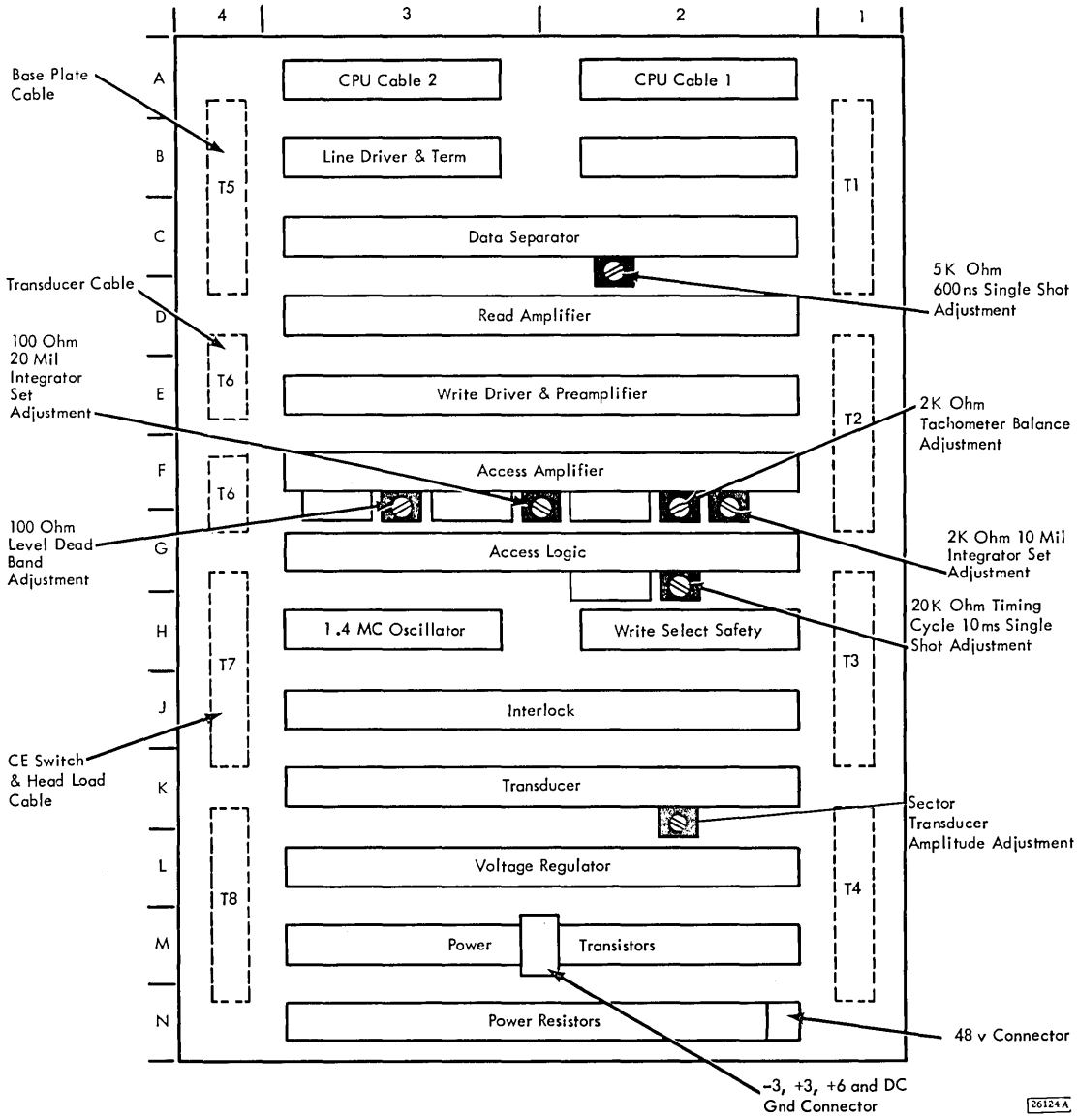
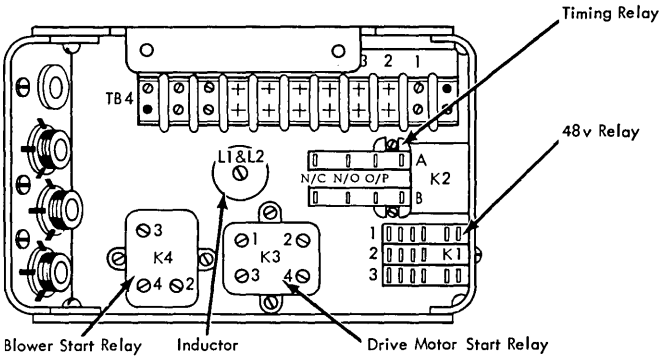


Figure 6-2. Arrangement of SLT Cards in Electronic Gate

A Configuration for machines with serial numbers 00101 and upward.



B Configuration for machines with serial numbers 00001 through 00050.

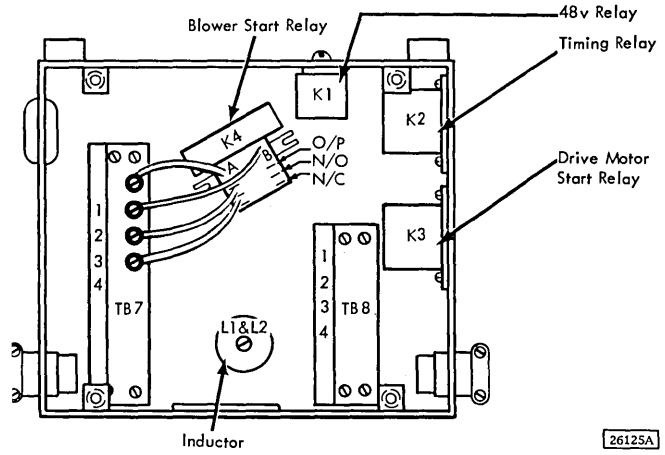


Figure 6-3. AC Box, Location of Components

7.1 PURPOSE OF CHAPTER

This chapter provides alternate instructions which are used to maintain single disk storage machines containing serial numbers 00001 through 00050. This chapter is supported by baseline information located in other chapters of the manual which contain an asterisk and footnote for stipulating machine differences applicable to the alternate procedures described in this chapter.

7.2 ALTERNATE MAINTENANCE FEATURES

7.2.1 Identification of Machines

Two designs of the single disk storage are in the field. Although both machines are the same functionally, separate maintenance instructions are required for various mechanical assemblies.

Machines can be identified by high order and low order serial numbers stamped on the edge of the base plate, below the drive magnet. Machines with low order serial numbers, 00001 through 00050, are maintained according to instructions described in this chapter. Machines with high order serial numbers, 10101 through 39999 are maintained according to instructions described in other chapters.

7.2.2 Special Tools

The following are special tools which are a part of the shipping group for machines containing serial numbers 00001 through 00050:

Feeler Gage, non-magnetic (0.002 inch) (part 2200006)
Feeler Gage, non magnetic (0.005 inch) (part 2200007)
Head Alignment Oscilloscope Adapter (part 2200052)
Disk Run Out Gage (part 2200002)

The disk run out gage (Figure 7-1) enables the CE to determine the extent of warpage in a disk by

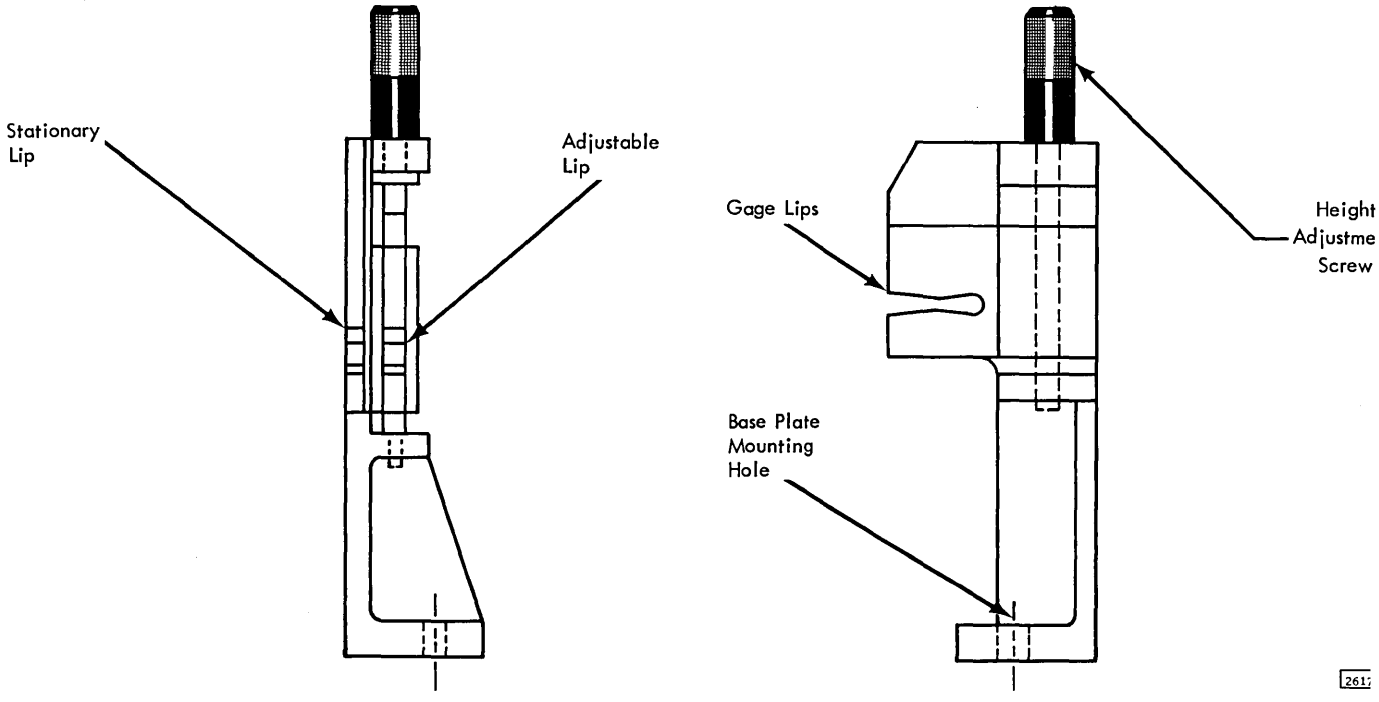


Figure 7-1. Disk Run Out Gage

measuring the amount of vertical deflection at the outer edge of the disk.

The disk run out gage, used for machines with serial numbers 00001 through 00050, has a different shape and part number than the gage specified in Chapter 2, although its attachment to the base plate and its use are identical.

This gage is mounted on the base plate adjacent to the head arm assemblies, so that the disk can be manually rotated between the gap on adjustable lips of the gage. A knurled adjusting screw on the gage permits adjusting the gap to determine runout. Procedures for using the gage are described in Section 4.2.3.

7.2.3 Branch Office Tools

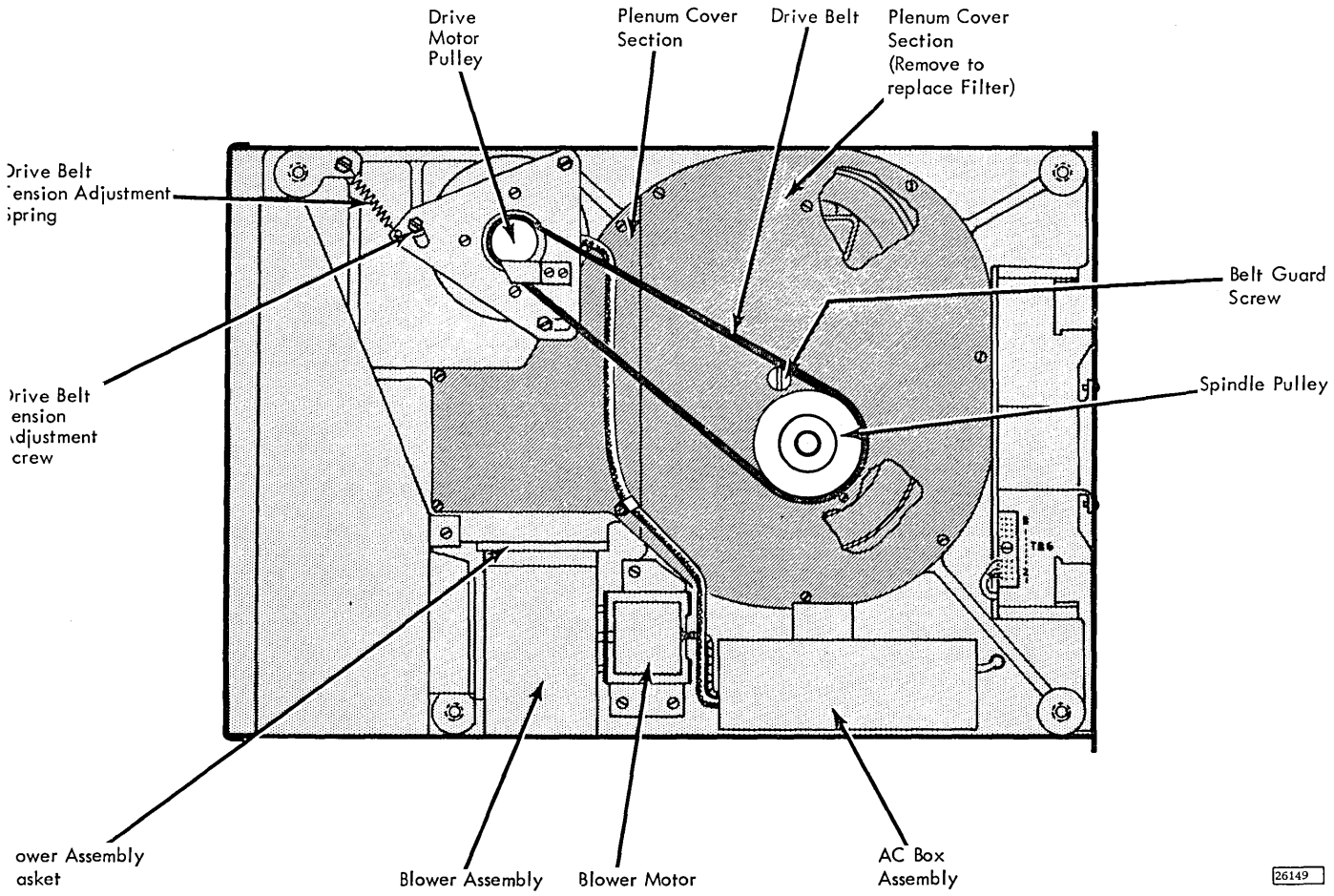
Branch office tools are the same as those described in Chapter 2.

7.3 PLENUM COVER AND FILTER

7.3.1 Plenum Cover Removal and Replacement

The complete plenum cover is composed of two sections, one of which can be removed. The removable section can be identified as that section through which the spindle pulley protrudes.

1. Remove drive belt. (Refer to Section 4.1.1)
2. Remove eight mounting screws (Figure 7-2) securing plenum cover to baseplate. One of these screws secure the belt guard to plenum cover.
3. The plenum cover can now be lowered from baseplate of the machine.
4. Replace plenum cover by reversing Steps 1 and 2.



igure 7-2. Single Disk Storage, Bottom View of Machine

7.3.2 Plenum Air Filter Removal and Replacement

1. Remove drive belt. See Section 4.1.1.
2. Remove plenum cover. See Section 7.3.1.
3. The air filter can be lowered.
4. Replace air filter by reversing steps 1, 2, and 3.

WARNING: When replacing plenum air filter, make certain that the foam-rubber seal is between the air filter and base plate. If this seal is not in its proper position, leaks can result which will allow foreign particles to be blown into the cartridge. Also, clean the plenum cover and cartridge air duct with lint-free tissue dampened with 91% Isopropyl Alcohol to remove accumulated particles.

7.4 BLOWER ASSEMBLY

7.4.1 Blower Assembly Removal and Replacement (Figure 7-2)

1. Turn off all ac and dc power to machine.
2. Disconnect blower motor leads from terminal strip located in ac box.
3. Remove three binding-head mounting screws securing blower motor mounting bracket to baseplate.
4. The blower may now be lowered from the base-plate.
5. Replace blower assembly by reversing steps 1, 2, 3, and 4.

NOTE: There is a gasket between the inlet to blower assembly and electronics gate. Be sure this gasket is properly positioned to prevent excessive openings in this area.

7.4.2 Blower Motor Removal and Replacement

Same as Section 4.4.4, except motor installation does not contain clamps at the end rings.

7.5 ACTUATOR ASSEMBLY

7.5.1 Actuator Assembly Removal and Replacement

The entire carriage and mount of the actuator assembly may be removed as a unit as follows:

1. Shut off all power to the machine and remove cartridge.
2. Disconnect read/write head cables from receptacles and remove the clamp which secures the cable receptacles.
3. Unsolder home switch leads and mark each lead with a different colored grease pencil to facilitate identification.
4. Remove tachometer leads and drive coil leads from terminal strip and note terminal from whic each lead is removed.
5. Remove retaining ring from pivot pin in head-load solenoid plunger and slide pivot pin out of plunger.
6. Disconnect the spring attached to the cartridge door opener and remove the air baffle mounted between actuator and shroud. Remove the disk guide located adjacent to the actuator assembly.
7. Remove tachometer bracket mounting screws to unfasten tachometer assembly from actuator assembly.
8. Remove the five socket head mounting screws which secure the actuator assembly to the base-plate.
9. Lift carriage drive assembly off the two dowel pins in carriage mounting base, and the single dowel pin on tachometer mounting bracket.

CAUTION: Ensure that correct leads are matched for terminals of the tachometer assembly and voic coil after replacing the actuator. Reversal of thes leads would cause uncontrolled carriage motion resulting in damage to equipment.

10. Replace actuator assembly by reversing steps 2 through 10. Check head load adjustment and readjust if necessary. (See Section 7.8.2.)

7.6 DRIVE MAGNET

7.6.1 Drive Magnet Removal and Replacement

1. Turn off all power to the machine.
2. Push the carriage forward as far as it will extend.
3. Remove the three binding-head mounting screws

NOTE: Access can be gained to the screws nearest the electronics gate by opening gate and removing filter from gate.

WARNING: Do not force the magnet to slide out of the mounting bracket since damage to drive coil, mounting base, and magnet mounting spacers would result. With a moderate force, the magnet will slid

smoothly out of the mounting bracket. Do not drop or hammer on the magnet since this could destroy the epoxy joints binding the face plates to the permanent magnet. When the magnet is out of the machine, place masking tape over the flux gap to prevent particle accumulation. When replacing the magnet, be certain that mounting spacers are seated in their respective counterbore recesses.

4. Slide magnet horizontally away from carriage.
5. Replace drive magnet by reversing steps 2 and 3. If a new magnet is installed, perform the drive magnet adjustment described in Section 7.6.2.

7.6.2 Drive Magnet Adjustment

Adjustment of the drive magnet (Figure 7-3) is to be accomplished whenever a new drive magnet is installed. This adjustment prevents binding which could cause distortion of the base and result in misalignment of the carriage.

The threaded sleeve located outboard on the actuator mounting bracket must be positioned to provide a 0.0005-inch clearance with the drive magnet spacer which is located inboard on the mounting bracket.

1. Remove the mounting screw, and loosen the locknut which secures the sleeve against the spacer.
2. Use a feeler gage to obtain the 0.0005-inch clearance between the spacer and sleeve.
3. Tighten the locknut after the 0.0005-inch clearance is obtained and replace the mounting screw.

7.7 DETENT ASSEMBLY AND DETENT RACK

7.7.1 Detent Assembly Removal and Replacement

1. Disconnect detent coil leads from terminal strip. Mark the pin location of each lead prior to removal to facilitate identification.
2. Remove three socket-head mounting screws securing detent assembly to carriage mounting base.
3. Remove detent assembly by lifting it from carriage assembly.
4. Replace detent assembly by reversing steps 1, 2, and 3. Insert mounting screws, but do not tighten at this time. Adjust detent assembly. (Refer to section 7.7.2.)

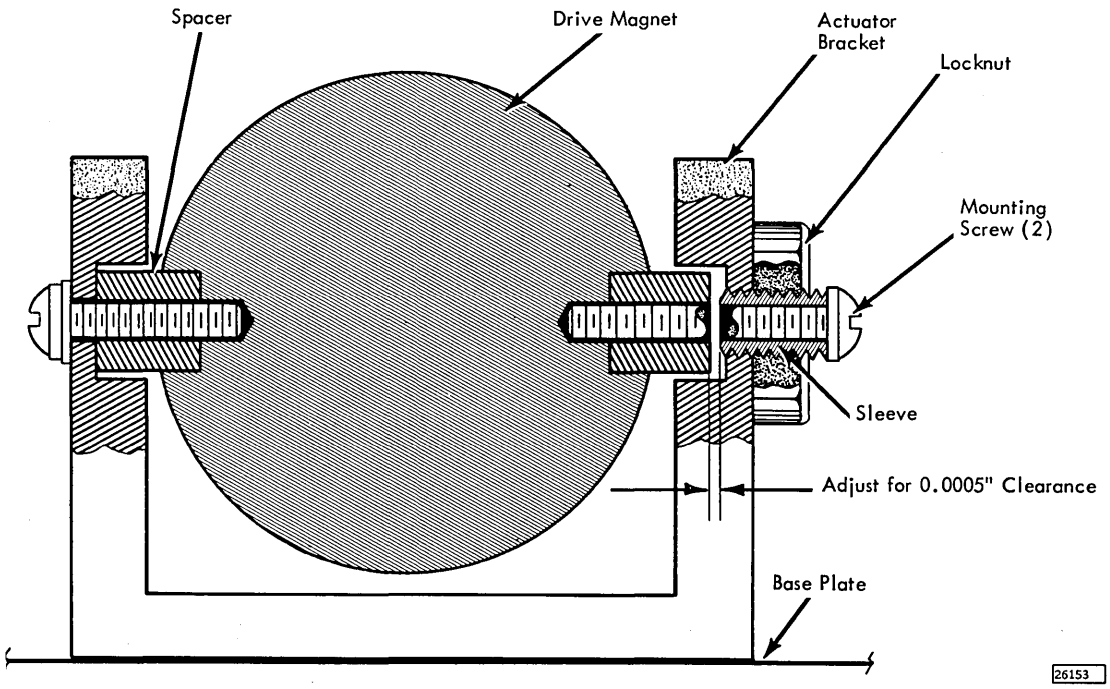


Figure 7-3. Drive Magnet Adjustment

7.7.2 Detent Assembly Adjustment (Figure 7-4)

WARNING: The only two CE adjustments required for the detent assembly are the pawl-to-rack alignment and the electromagnet air-gap alignment spacing. Do not, under any circumstances, loosen bolts holding the springs, spring post, spring mount, or electro-magnet.

1. Turn off all power to the machine.
2. Loosen three socket-head cap screws securing detent assembly to actuator assembly. Loosen screws until detent assembly will slide, without rocking, toward and away from detent rack.
3. Push registration ledge of detent assembly against the corresponding edge of carriage mounting base (Figure 7-4). Slide detent assembly along this edge until a gap of 0.007 (±0.003) inch is formed between either the odd or even pawl and a detent crown tooth of the detent rack. (If necessary, move carriage to align a crown tooth of detent rack with a pawl). Tighten the three socket head mounting screws to secure this adjustment.
4. Check adjustment made in step 3. Repeat step 3 if necessary.
5. Remove CPU signal cable from processor so that CE switches can be used to control accessing.
6. Turn on power to machine and insert CE disk cartridge.

WARNING: The CE disk cartridge must be inserted before continuing with the procedure.

7. Upon completion of step 6, one detent coil is energized. Give carriage a slight push to ensure full engagement between rack and detent pawl.
8. Loosen # 0-80 nut (Figure 7-3) on the energized detent coil using a 3/16-inch end wrench.

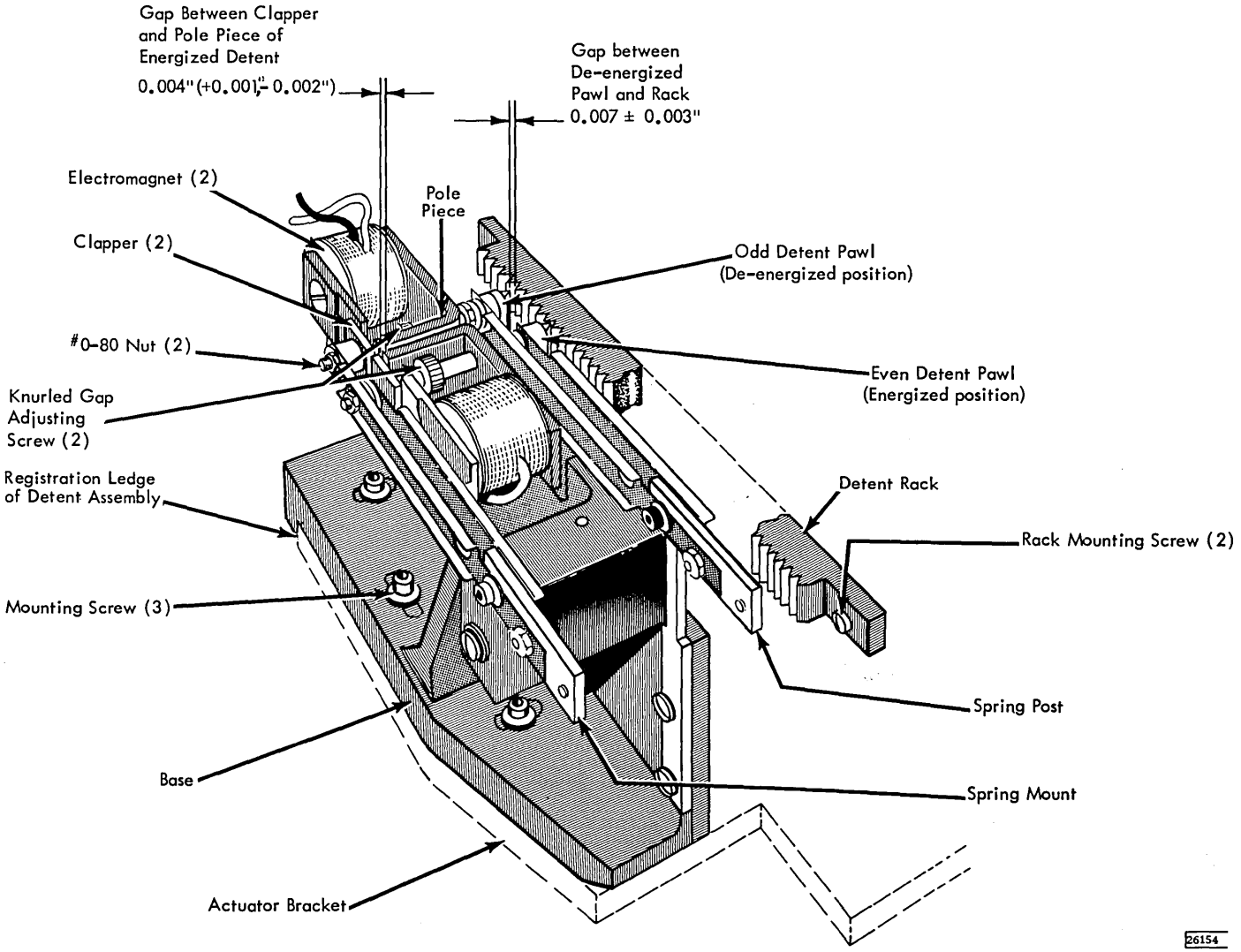


Figure 7-4. Detent Assembly, Adjustment Clearance

9. Use a fine blade screwdriver to turn the knurled (serrated) portion of the gap-adjuster nut (Figure 7-4) until an air gap between the clapper and pole pieces is within 0.004 (+0.001, -0.002) inch width. Use non-magnetic shims to check this air gap measurement. Do not apply excessive force on the adjustment because too much force will cause deflection of the spring supported clappers resulting in an uneven gap. When the proper gap is achieved, tighten the #0-80 nut by applying 15 to 20 inch-oz of torque.

NOTE: The required 15 to 20 inch-oz of torque can be applied by loading the free end of the end wrench with 170 to 225 grams, using a gram gage. The 170 to 225 gram load must be applied at a right angle to the shaft of the end wrench.

10. Set the CE step mode switch to 10 mulli-inch steps. Using the CE step control switch, move carriage one track (0.010-inch). The other detent pawl should now be engaged with the rack.
11. Move carriage slightly to check for good contact between pawl and rack engagement.
12. Repeat steps 8 and 9 for the second detent.
13. Turn off all power to the machine.
14. Replace CPU signal cable on processor.

NOTE: The read/write head must be adjusted with a CE cartridge installed after each adjustment of the detent assembly has been accomplished.

15. Adjust read/write head. (See Section 7.15.1.)

7.7.3 Detent Rack Removal and Replacement

Removal

1. Remove detent assembly. (Refer to section 7.7.1).
2. Remove two binding-head mounting screws that secure detent rack (Figure 7-5) to the carriage.
3. Lower detent rack to remove from carriage.

Replacement

1. Place detent rack in position shown in Figure 7-5. Press upward on rack to ensure contact between registration surfaces on detent rack and registration ledge on carriage. (Refer to section 7.7.4 for details of adjustment.)
2. Install two binding-head mounting screws to secure the installation.
3. Check detent adjustment by observing clapper spacing and detent alignment with the rack.
4. Realign read/write head. (Refer to section 7.15.1.)
5. Adjust crash stops (Refer to section 4.10.1 and 4.10.2.)
6. Adjust home switch (Refer to section 7.11.2).
7. Replace detent assembly (Refer to section 7.7.1).

7.7.4 Detent Rack Adjustment

NOTE: The detent rack (Figure 7-5) is adjusted during replacement and should never be loosened or readjusted after it is initially installed on the carriage.

When a detent rack is replaced (section 7.7.3), its right end (as viewed from the direction of the detent assembly) should be flush (±0.001-inch) with the right end of carriage. The top registration surfaces of detent rack must be pressed to establish a flush contact with the registration ledge of carriage. The two mounting screws must be tightened to secure the detent rack alignment.

7.8 HEAD LOAD ASSEMBLY

7.8.1 Head Load Solenoid Removal and Replacement

1. Turn off all ac and dc power to machine.
2. Remove solenoid leads from terminal strip TB4 (pins 7 and 8).

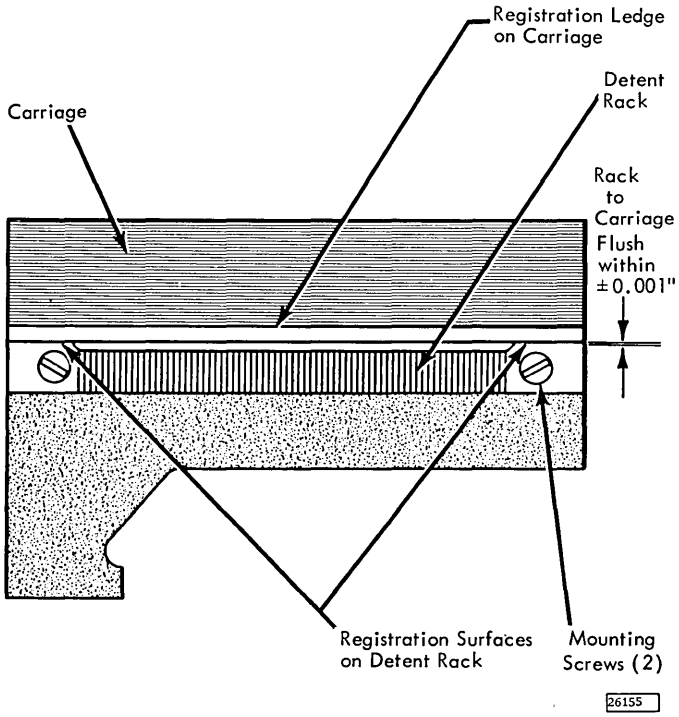


Figure 7-5. Detent Rack, Removal and Replacement

3. Remove pivot pin from solenoid plunger.
4. Remove two binding head screws securing solenoid to mounting bracket.
5. Slide solenoid horizontally from bracket to effect removal.
6. Replace the head load solenoid by reversing steps 1 through 5. Readjust head load assembly (section 7.8.2).

7.8.2 Head Load Assembly Adjustment (Figure 7-6)

WARNING: Do not load heads when disk is not rotating in machine. When cartridge is out of machine, insert an IBM card between heads prior to loading. Failure to comply will result in damage to heads and/or disk.

1. Remove CPU signal cable from plug connection on machine.
2. Install a CE cartridge in machine.
3. Power up the machine and check for loading of heads.

NOTE: Read/write heads should load after a 90-second delay. If heads fail to load, use the following procedure to load heads:

a. Observe that solenoid plunger has bottomed out.
b. Shut off power to machine.
c. Loosen the two binding head screws that secure the head load solenoid to the mounting bracket.
d. Use the solenoid adjust screw (0.031-inch per turn) to move the solenoid forward or backwards in the bracket. If solenoid plunger has bottomed out, move the solenoid backwards approximately 0.031-inch. If solenoid has not bottomed out, move solenoid forward approximately 0.031-inch.
e. Tighten the two mounting screws to secure the adjustment.

4. Use masking tape to hold the heads loaded switches in the transferred position. Loosen the switch mounting screws and slide the switches backwards toward the solenoid as far as possible.

WARNING: If the heads loaded switches are not held in transferred position, 48 vdc will be applied to solenoid coil resulting in damage to equipment.

5. With the carriage detented at track 000, loosen the two solenoid mounting screws and the solenoid adjusting screw. Slide the solenoid backward until the pivot plate contacts the head-loading roll pin in the head load cam. Continue to slide the solenoid back until the cam moves all the way into the cam followers. Tighten the solenoid

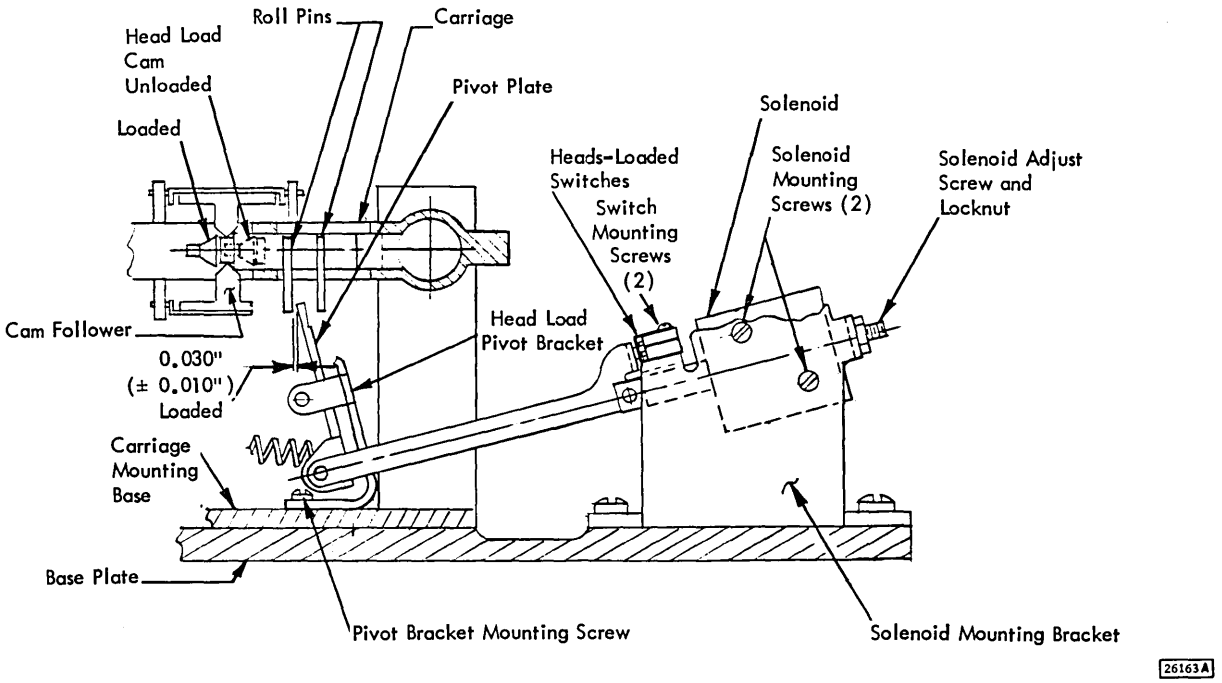


Figure 7-6. Head Load Assembly Adjustment

mounting screws and position the solenoid adjusting screw against the back of the solenoid.

6. Back off the solenoid adjusting screw one turn, and tighten the lock nut. Loosen the solenoid mounting screws and slide the solenoid backward so that it will bear lightly against the adjusting screw.
7. Check clearance between the pivot plate and loading roll pin. This clearance should be within 0.030 (±0.010) inch. Tighten the solenoid mounting screws after this clearance has been obtained.
8. Access the carriage to track 199. Use a dental mirror to check for a minimum clearance of 0.010 inch between the pivot plate and the head loading roll pin while the carriage is positioned at track 199. This check determines parallelism between the carriage rail and pivot plate.
9. Shut down the machine and manually move the carriage between the forward and rear crash stops. There should be a minimum clearance of 0.010 inch between the pivot plate and the head unloading roll pin for all carriage positions.
10. If conditions of parallelism between the pivot plate and roll pins in steps 8 and 9 are not apparent, it will be necessary to adjust the pivot bracket to obtain the required clearances. This is accomplished by first loosening the forward mounting screw of the pivot bracket, then loosening the rear mounting screw 1/8-turn each, and tapping the forward end of the bracket in the proper direction to obtain parallelism.

NOTE: It may be necessary, in some instances, to move the rear end of the pivot bracket also, to obtain the 0.010 inch clearance for parallelism.

11. Repeat steps 5 through 9 to ensure that other adjustments have not been altered.
12. Adjust heads loaded switches using the following procedure.
    a. Slide both switches toward head load contact point against the head load actuator link and remove the masking tape.
    b. Place a 0.005 inch shim between switch buttons and link. Move switches until buttons bottom out.
    c. Tighten mounting screws to secure switches in this position.

CAUTION: Touch the head loaded solenoid coil to inspect for overheating. The solenoid coil is warm to the touch during normal operation when 24 vdc is applied. A defective heads loaded switch adjustment will cause 48 vdc to be applied to the coil resulting in excessive heating. If the coil is too hot to grasp and hold, the heads loaded switch is not in proper adjustment.

13. Adjust the heads loaded switches if solenoid coil is excessively hot (refer to procedures of section 7.8.3).
14. Power down the machine.

7.9 HEAD LOAD SPRING ASSEMBLY

NOTE: Removal and replacement of the head load spring assembly is the same as that described in Chapter 4. Do not replace the counterbalance spring assembly whenever a new head load spring assembly is installed.

7.9.1 Head Load Spring Assembly Counterbalance Spring Adjustment

NOTE: The head load counterbalance spring is not installed on all machines, and this spring is not to be replaced whenever a new head load spring is installed on machines. The following procedures apply to machines which still incorporate the head load counterbalance spring.

Adjust the counterbalance spring as follows:

1. With heads unloaded, position the counterbalance spring perpendicular to the side of the head load spring support.
2. Check the force required to lift the spring support off of the head. This force is measured at the tab on the spring which contacts the head. If this force is not 4 (±1) grams at the top head, and 9 (±1) grams at the bottom head, form the associated counter balance spring at the bend nearest the mounting screw to deliver the required force.
3. Repeat step 2 to ensure that the required force is maintained.

7.10 CRASH STOPS

NOTE: Adjustment of front crash stop is the same as described in Section 4.10.1.

7.10.1 Rear Crash Stop Adjustment

Use appropriate switches on the CE panel to operate carriage in a reverse direction to detent on track 000 against rear crash stop (near drive magnet).

NOTE: It may be necessary to move the home switch out of the way to accomplish the rear crash stop adjustment.

Adjust screw on left end of rear crash stop and tighten locknut so that a 0.003, (±0.001) inch clearance exists between rear crash stop and carriage.

Operate carriage, first in forward direction and then reverse, to check that the 0.003, (±0.001) inch clearance adjustment is maintained at the rear crash stop when carriage is detented on track 000.

NOTE: If the home switch was repositioned to accomplish adjustment of the rear crash stop, it must be readjusted as described in Section 7.11.2.

7.11 HOME SWITCH

7.11.1 Home Switch Removal and Replacement

1. Remove all ac and dc power from machine.
2. Remove leads from home switch terminals.
3. Remove two binding head screws securing home switch mounting bracket to actuator bracket.
4. Remove binding head screws securing switch to mounting bracket.
5. Replace home switch by reversing steps 2 through 4 and adjust switch according to Section 7.11.2.

7.11.2 Home Switch Adjustment

1. Use appropriate switches on the CE panel to operate carriage in a reverse direction to detent on track 001.
2. Place a 0.007-inch feeler gage between the carriage and home switch pushbutton and adjust the home switch adjusting screw until the switch just transfers.
3. Check this adjustment with a 0.005-inch feeler gage to determine that home switch will not transfer.

7.12 TACHOMETER AND TACHOMETER EXTENSION ROD

7.12.1 Tachometer Extension Rod Removal

1. Remove outboard adjusting nut which secures rod to carriage arm.
2. Loosen inboard adjusting nut sufficiently to free rod from carriage arm.
3. Slide extension rod away from home switch and out of the tachometer coil and housing assembly.

WARNING: Take care to avoid bending the rod or scoring the core as rod is extracted from shield.

4. Replace tachometer extension rod by reversing steps 1, 2, and 3.

7.12.2 Tachometer Extension Rod Adjustment

The tachometer extension rod (Figure 7-7) is adjusted so that when the carriage is dented in track 000, the shoulder of the rod protrudes 0.137 (±0.010) inch from the carriage end of the tachometer. This adjustment is performed as follows:

WARNING: Use extreme care to avoid bending the tachometer extension rod while making this adjustment.

1. Detent carriage to track 000.
2. Loosen the two locking nuts where rod attaches to arm extending downward from carriage. As a point of reference, advance the inboard nut. This will push the extension rod further into the tachometer. Continue this process until the extension rod shoulder is flush with the end of the tachometer.

NOTE: This distance can be judged within 0.010-inch by eye (See Figure 7-7).

3. Back off the inboard nut by 5-1/2 turns from the reference position obtained in step 2. Since the nut advances 0.025-inch per revolution, the total movement will be 0.137 inches.
4. Hold the inboard nut firmly to prevent rotation, and tighten the outboard nut. In accomplishing this step, apply Sealant (Part 2111360) to secure the adjustment from vibration. If the assembly is equipped with an outboard lockwasher, omit the use of sealant to secure the adjustments.
5. Check the carriage for friction to ensure that binding does not prevail as a result of making the tachometer extension rod adjustment.

7.12.3 Tachometer Assembly Removal and Replacement

1. Remove disk cartridge from machine.
2. Remove cartridge receiver, shroud, and spindle from baseplate.

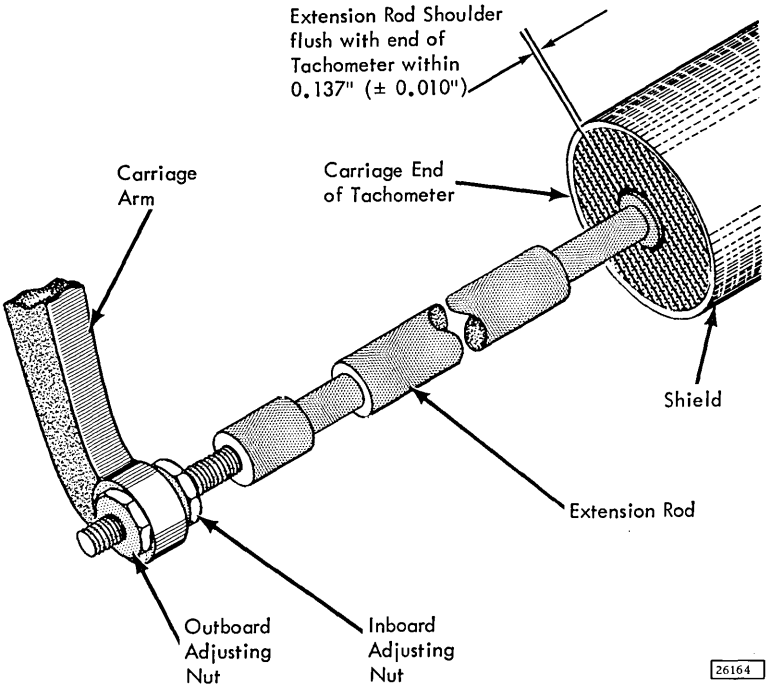


Figure 7-7. Tachometer Extension Rod Adjustment

3. Unsolder tachometer leads from terminal strip on tachometer bracket. Mark each lead to facilitate identification.
4. Remove tachometer extension rod according to section 7.12.1.

WARNING: Caution must be exercised in handling tachometer core and extension rod. The extension rod can be bent, and the core broken if dropped.

5. Remove two set screws (one located in carriage mounting base and one located in tachometer bracket) which secure the tachometer shield.
6. Slide tachometer shield out of carriage mounting base and tachometer bracket.
7. Slide tachometer coil and housing assembly out of tachometer shield.

WARNING: Slide coil and housing assembly out the end of tachometer shield nearest the spindle. Do not bend tachometer electrical leads back and forth since they can break within the coil and housing assembly.

8. Replace the tachometer assembly by reversing steps 2 through 7 and adjust according to section 7.12.2.

7.13 CARRIAGE RAIL

7.13.1 Carriage Rail Removal and Replacement

1. Turn off all ac and dc power to the machine and remove top baseplate cover.
2. Loosen two set screws, which eliminate side-play of rail, sufficiently to allow the rail free movement.
3. Insert 0.100-inch feeler gage shim between the carriage preload spring and carriage. Remove preload force on the rail, and slide the rail out of the carriage mounting base being careful to avoid misalignment.

WARNING: Misalignment in this step could damage the carriage bearings.

4. Replace carriage rail by reversing steps 2 and 3.

NOTE: After carriage rail has been replaced, test carriage rail for movement in the direction of carriage motion. If any movement is apparent, tighten set screws located in the rail supports until movement disappears.

7.14 CARRIAGE SUBASSEMBLY

7.14.1 Carriage Subassembly Removal and Replacement

1. Remove all ac and dc power to machine.
2. Remove drive magnet (section 7.6.1).
3. Loosen binding head screw securing head plug clamp to release head plug. Disconnect head plugs from head cables.
4. Remove tachometer extension rod from carriage (section 7.12.2).
5. Unsolder voice coil leads and note terminal from which each lead is removed.
6. Remove two binding head screws securing carriage outrigger slide to carriage. Remove slide.
7. Remove carriage rail (section 7.13.1).
8. Lift carriage assembly from carriage mounting base.

WARNING: Caution must be exercised to ensure that read/write heads do not strike anything during removal.

9. Replace carriage subassembly by reversing steps 2 through 7.

WARNING: When replacing the plastic outrigger slide, be certain that the slide does not touch, and is parallel to, the vertical surface of its guide in the carriage mounting base.

10. Adjust tachometer extension rod according to section 7.12.1.
11. Adjust head-arm assemblies according to section 7.15.1.
12. Perform the following adjustments if a new carriage subassembly has been installed:
    a. Check detent adjustment and readjust if necessary according to section 7.7.2.
    b. Adjust front and rear crash stops according to section 4.10.
    c. Adjust home switch according to section 4.11.2.

7.15 HEAD-ARM ASSEMBLY

7.15.1 Head-Arm Assembly Adjustment

NOTE: The requirements for aligning read/write heads by using track 100 of the CE cartridge to obtain the oscilloscope display patterns (Figure 4-8, Section 4.17.1) are identical for machines with serial numbers 00001 through 00050.

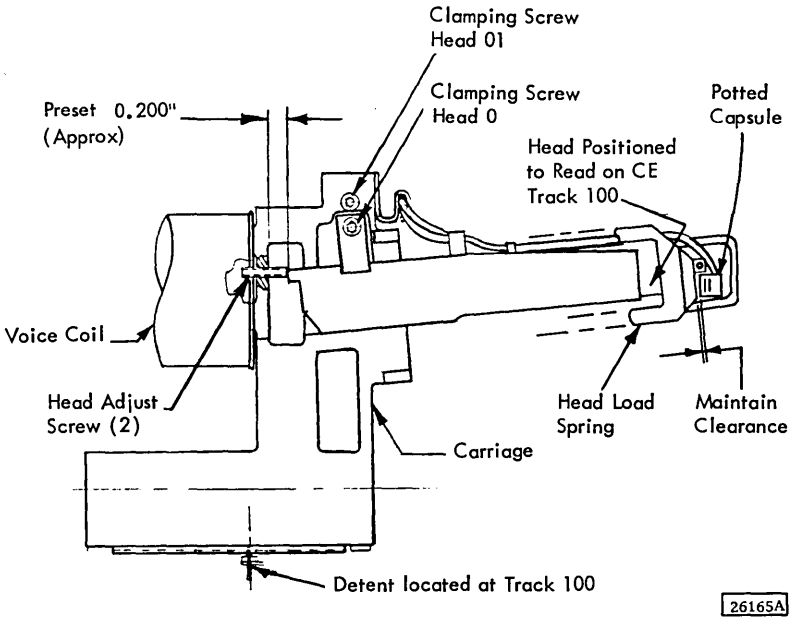


Figure 7-8. Head Arm Assembly Adjustment

However, the location of the head adjustment screw, which is accessible from inside the voice coil (Figure 7-8) requires that the drive magnet be removed to gain access to this screw.

Procedures for adjustment of the head-arm assembly are as follows:

1. Loosen head clamping screw and remove drive magnet from the actuator according to procedures in section 7.6.1 to gain access to the head adjusting screws.
2. Back off the head adjusting screws and push each head-arm assembly back toward the voice coil until the head load spring just clears the potted capsule on the head. A dental mirror is required to observe the lower head.
3. Tighten head clamping screws.
4. Install the CE cartridge and apply power to the machine to load heads. Manually move the carriage to track 100 and detent by energizing the even detent coil.

NOTE: Operate the CE STEP MODE switch to energize the even detent coil. Ensure that carriage is still positioned at CE track 100 when detent engages rack.

5. Allow the machine and cartridge to operate continuously for 15 minutes to ensure that temperature stabilization has taken place before adjusting heads.
6. Use direct probe and scope from pin D2G07. Set time base to display 5 ms/cm (one revolution of the disk is 40 ms). Synchronize the oscilloscope on negative reference pulse pin K2B04.
7. Insert the head alignment oscilloscope adapter (part 2200052) between the head cable plug and socket for head 1. (See Figure 7-9.) Select head 1 with the CE head select switch.
8. Slowly advance the head adjusting screw while observing the scope pattern. The scope will first show noise only, then the pattern of View A, Figure 4-8 will appear. When the head is properly aligned, the pattern of View B, Figure 4-8 will be present and the lobes will be equal in amplitude. If head is advanced beyond track 100, the scope picture of View C, Figure 4-8 will be seen on the display.

NOTE: If the head is moved forward too much toward the spindle, it will be necessary to shut down the machine, remove the CE cartridge, and push the arm backwards toward the voice coil as described in step 2, then repeat step 8. When the head-arm assembly is correctly positioned, the lip of the head load spring will bear on the dimple of the arm assembly spring. The head load spring will not be in contact with the potted capsule which encases the read/write coils. It will be necessary to shift the detent rack slightly if correct adjustment cannot be made using step 8.

9. Tighten head clamping screw to secure the adjustment.

10. Back off the head adjusting screw one-half turn when adjustment has been completed. Observe the scope display pattern to ensure that the head alignment is not affected.
11. Repeat steps 2 through 10 for head 1.

NOTE: If the detent rack was moved to accomplish adjustment of the head-arm assemblies, it will be necessary to readjust the crash stops (section 4.10), home switch (section 7.11), and tachometer extension rod (section 7.12.2). When installing the drive magnet mounting screw, torque will affect head alignment. Observe signal to maintain alignment.

12. Replace drive magnet on the actuator (section 7.6.1) and connect head cables, plugs, and sockets.

7.16 CARTRIDGE RECEIVER

7.16.1 Cartridge Receiver Removal and Replacement (Figure 7-10)

1. Remove all ac and dc power from the machine.
2. Remove tension spring that attaches to cartridge receiver and interlock handle assembly.
3. Remove both cartridge receiver support-pivot brackets from baseplate.

WARNING: Exercise care in lifting the cartridge receiver from machine to avoid striking the detent assembly and disrupting the detent adjustment.

4. Lift cartridge receiver from machine.
5. Replace the cartridge receiver by reversing steps 2 through 4.
6. Check the cartridge receiver adjustments described in section 7.16.2. Readjust only if absolutely necessary.

7.16.2 Cartridge Receiver Adjustment

NOTE: The cartridge receiver adjustment must be completed prior to attempting an adjustment of the

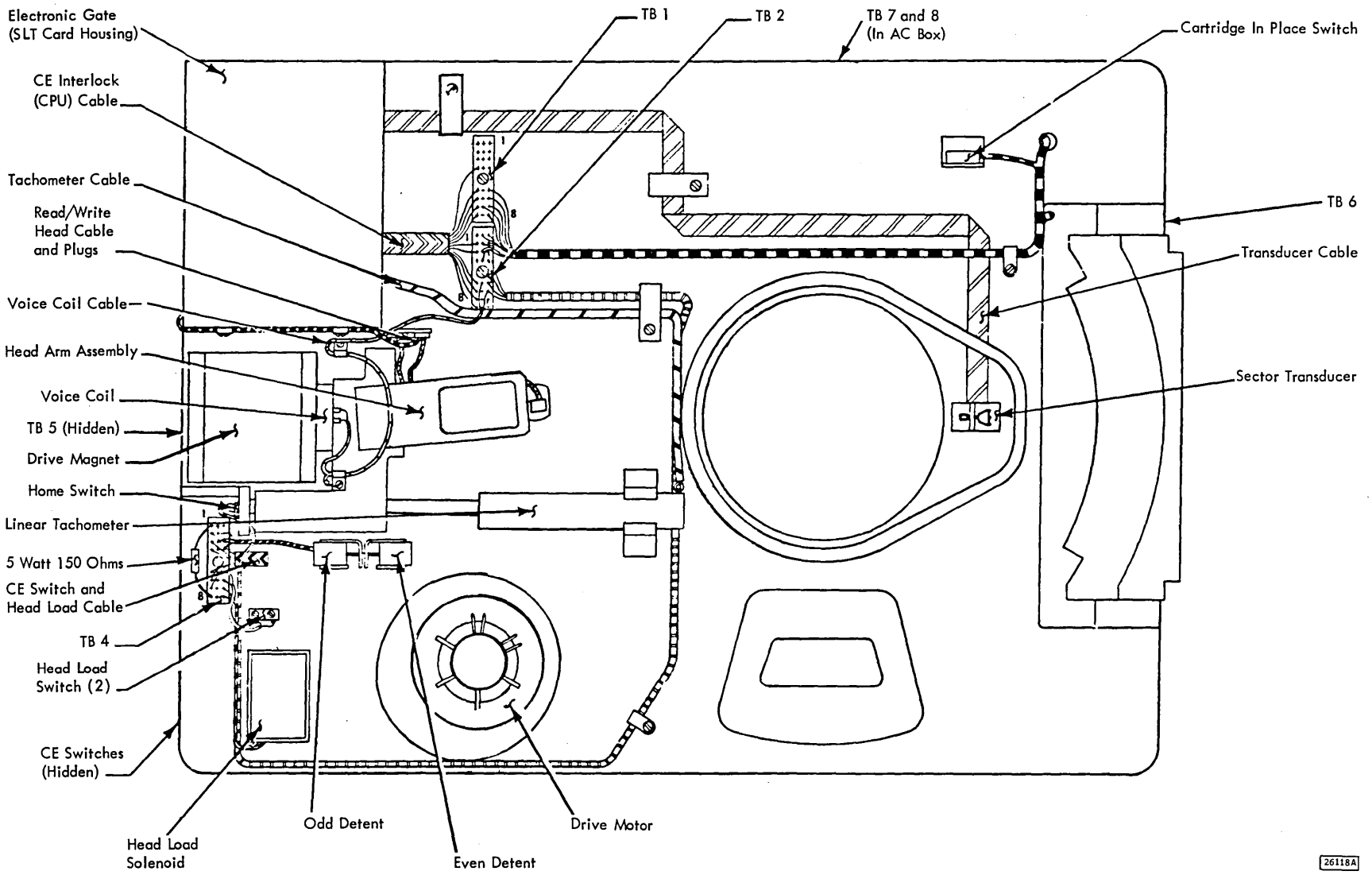


Figure 7-9. Single Disk Storage, Top View

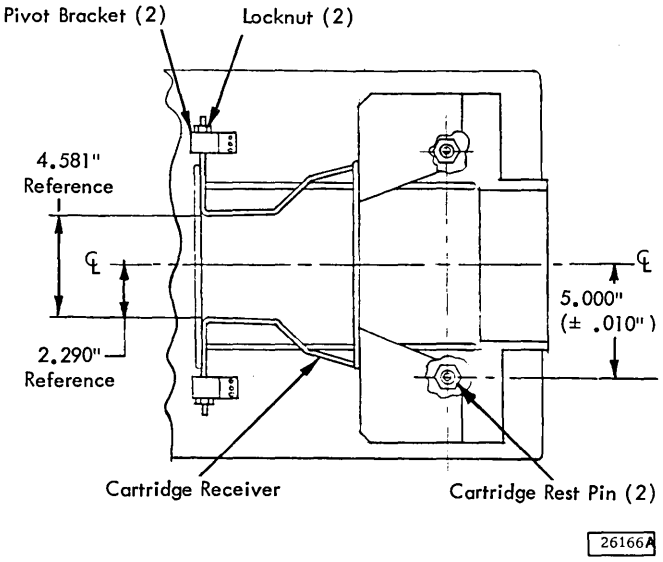


Figure 7-10. Cartridge Receiver Adjustment

cartridge interlocks. Any cartridge serves as a gage for adjusting the side-to-side position of the cartridge receiver. After this adjustment is made, it should not be changed unless trouble is suspected. Adjustment is to be accomplished as follows:

1. Loosen both self locking nuts located on the pivots of the cartridge receiver so that receiver is free to move slightly in a sidewise direction (Figure 7-10).
2. Install a cartridge and check for clearance on each side. If there is a gap between the front of the top rails of the receiver and the matching raised portion of the front top of the cartridge (near the door), take up this clearance equally on both sides using IBM cards as shims.
3. Shake the front of the cartridge receiver sideways until it assumes its preferred position.
4. With the front of the cartridge receiver located in its preferred position, tighten the two self locking nuts until they just contact surfaces of the cartridge receiver pivot brackets. This will secure the adjustment.

NOTE: With this adjustment established, the cartridge receiver and receiver pivot brackets should always be removed and replaced as an assembly without disturbing the adjustment of the self locking nuts.

7.17 SECTOR TRANSDUCER

7.17.1 Sector Transducer Index Timing Adjustment (Figure 7-11, 4-12)

1. Remove CPU signal cable from machine.
2. Install CE Cartridge.
3. Power up machine so that heads will load.
4. Using CE panel, access carriage to track 095.
5. Using CE oscilloscope, read track 095 by scoping pin D3B07. Synchronize the negative reference on pin K2B04.
6. Observe the time delay from reference pulse to the peak of the timing pulse on track 095. The delay from the leading edge of the reference pulse to the timing pulse should be 30 (±5)μs.

NOTE: The timing pulse precedes the burst of the all bits pattern by 10μs. If a weak signal is developed, gain in the transducer amplifier must be adjusted as described in section 4.20.1.

7. Determine the magnitude and direction (+ or -) of the correction to be made in pulse timing so that a time delay of 30 (±5)μs will prevail for both read/write heads. Use the CE head select switch to check both read/write heads.
8. Power down machine and remove CE cartridge.
9. With the cartridge handle in the open position, loosen the transducer lock screw (Figure 7-11).
10. Use the transducer adjusting screw (Figure 7-11) to position the transducer to increase or decrease the time delay. Turn the screw clockwise to increase the time delay and counterclockwise to decrease the time delay. One turn of the adjusting screw provides a change in time delay of 78 μs.

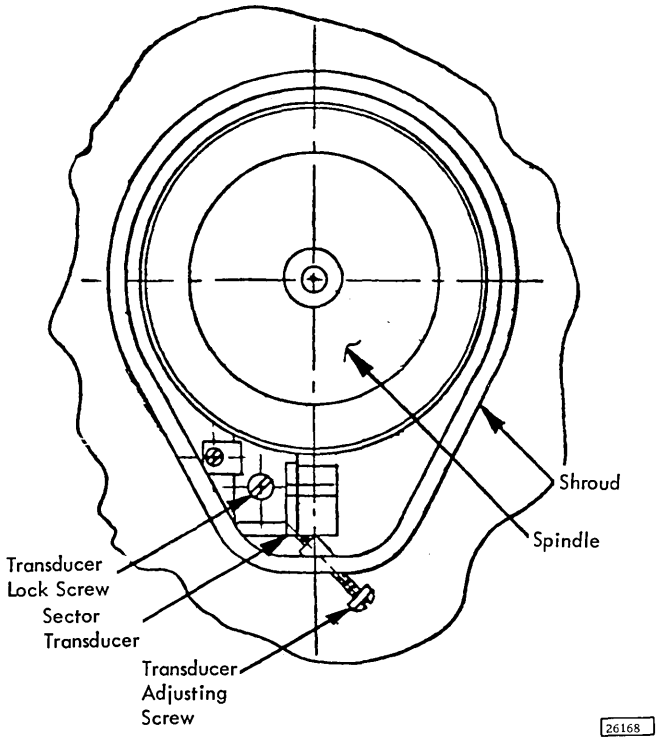


Figure 7-11. Index Timing Adjustment

11. Install the CE cartridge, power up machine and observe the scope pattern (Figure 4-11) to verify that timing adjustment is within limit of 30 (±5)μs.

NOTE: Some jitter will be experienced in making this adjustment. The mean timing pulse position is to be used as a reference setting. It may be necessary to readjust gain in the transducer amplifier as described in section 4.20.1 if the timing signal is too unstable.

12. Power down the machine, remove the CE cartridge and tighten the transducer lock screw to secure the adjustment.
13. Repeat steps 1 through 7 to check the adjustment and readjust according to steps 8 through 10 if required.

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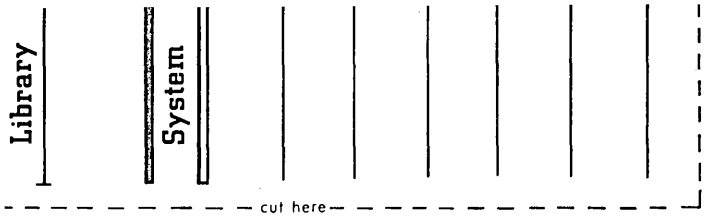

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