# CONTROL DATA® 853
## DISK STORAGE DRIVE

A01-A11
B01-B11

MAINTENANCE

CONTROL DATA CORPORATION

CUSTOMER ENGINEERING MANUAL

# CONTROL DATA® 853
## DISK STORAGE DRIVE

A01-A11
B01-B11

## MAINTENANCE

CONTROL DATA CORPORATION

CUSTOMER ENGINEERING MANUAL

40823100
September 1966

# RECORD of REVISIONS

| REVISION | NOTES |
|---|---|
| A | Manual released. Final edition complete through Product Designation 853, Mod A and B. This |
| (2-15-68) | edition obsoletes all previous editions. |
| B | Engineering Change Order PM2940 incorporating the following: FCO PM0662/ECO PM0662 affecting |
| (6-28-68) | pages A-1, A-14, A-15. ECO PM2298 affecting page 6-5. FCO PM2572 affecting pages 6-37, 6-39 |
| | ECO PM2847 affecting pages 6-18, 6-19, 6-20. Technical Changes affecting pages v, 1-3, 2-2, 2-4, |
| | 5-1, 5-4, 5-6, 6-13, 6-16, 6-17, 6-21, 6-23, 6-28, 6-33, 6-35, 6-39, 6-40, 6-41, 6-42, 6-43, |
| | 6-44, 6-45, 6-46, 6-47, 6-48, 6-53, 6-57, 6-64, 7-9. Editorial Changes affecting pages iii, v, vi, |
| | 1-4, 214, 5-10, 6-1, 6-6, 6-14, 6-15, 6-16, 6-17, 6-28, 6-36, 6-42, 6-43, 6-46, 6-47, 6-48, 6-64, |
| C | Engineering Change Order PM3062 incorporating the following: Technical Changes affecting pages |
| (7-18-68) | 7-1, 7-3, through 7-7. Editorial Changes affecting pages iv, v, vi, 7-2, 7-8 through 7-12. |
| D | Manual revised; includes Engineering Change Order PM4058, FCO/ECO PM1987, 1987A, FCO |
| (2-15-69) | PM2819, ECO PM 2086, FCO/ECO PM2209, FCO/ECO PM2242, ECO PM2328, ECO PM2387, |
| | FCO/ECO PM2468, ECO PM2470, ECO PM2628, FCO/ECO PM2819, ECO PM2937. This |
| | edition obsoletes all previous editions. |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

FORM CA230 REV. 1-67

Address comments concerning this manual to:

Control Data Corporation
Technical Publications Department
4201 North Lexington Avenue
St. Paul, Minnesota 55112

or use Comment Sheet in the back of this manual.

Pub.No. 40823100
© 1969
by Control Data Corporation
Printed in United States of America

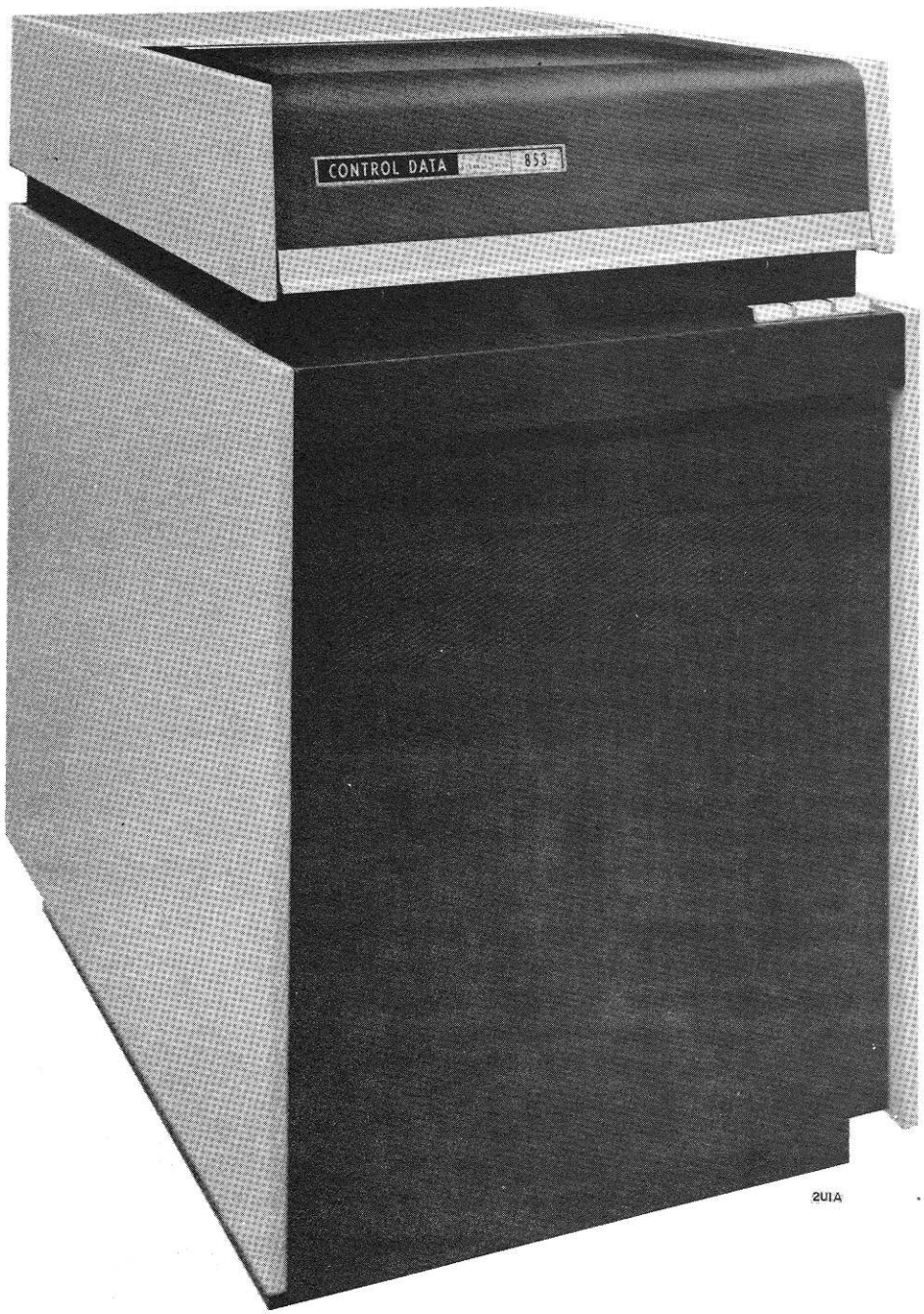
CONTENTS

FIGURES

TABLES

# SECTION 1

# OPERATION




853 DISK STORAGE DRIVE

# INTRODUCTION

The CONTROL DATA® 853 Disk Storage Drive is a high-speed, random access, input/output device to be used with a central processor. The performance characteristics of the unit make it suitable for use with all Control Data computers and most other data processing systems.

# SCOPE

This manual is a technical guide for customer engineers and other technical personnel who are directly involved with maintaining the disk storage drive. The manual is divided into seven parts: Introduction, Operation, Functional Description, Diagnostic Maintenance Routines, Preventive Maintenance, Maintenance Procedures, and Special Maintenance Information.

# DESCRIPTION

The 853 Disk Storage Drive stores information on a disk pack arranged as magnetized bits or spots. Disk packs may be readily interchanged between disk storage drives of the same type and addressing scheme. Disk packs also allow unlimited shelf storage of files of input data as well as random access to the data. Although permanent, the data on a disk pack may be erased and replaced by new information.

The 853 may be used with computers in an on-line capacity, or with external equipment in an off-line processing system. Transfer of data and the exchange of control information from computers or off-line equipment to the disk storage drive is through a separate external control unit. The control unit provides the timing information necessary to buffer and control the flow of information in to and out of the disk storage drive.

## ASSOCIATED PUBLICATIONS

Manuals of the customer engineering series which are to be used in conjunction with this maintenance manual are:

- 853 (Mod: A01-A09, B01-B09) Disk Storage Drive Diagrams and Wire List, Pub. No. 40825600
- 853 (Mod A10 - A11, B10 - B11) Diagrams and Wire List, Pub. No. 41240900.

  The diagrams section contains the logic and electrical schematics of the major disk storage drive assemblies. The wire list section describes conductor origin and destination, color coding, length, and size. The circuit descriptions, located in the diagrams section, contain explanations of logic and electrical schematics.
- 853 Disk Storage Drive Parts List, Pub. No. 40826300.

  The parts list contains part numbers, identification views, and identification information.
- Printed Circuit Manual: 1604 Series Cards, Pub No. 60040800.

  The electrical schematics, component layout diagrams, and the operational description of the logic cards used in Control Data peripheral equipment are found in this manual.

Refer to the current Literature Catalog for the publication number and latest revision for each of the manuals listed above.

## CONFIGURATION BY EQUIPMENT MOD LEVEL

### MOD A

The 853 Mod A is designed to operate with a 60-hertz power source.

### MOD B

Thc 853 Mod B is designed to operate with 50-hertz power sources.

## SPECIAL TOOLS

| Tool | Control Data Part Number |
|---|---|
| CE Disk Pack | 84357500 |
| Disk Pack Runout Gage | 84357600 |
| Plastic Feeler Gage (0.001 in.) | 12205637 |
| Plastic Feeler Gage (0.002 in.) | 12205636 |
| Plastic Feeler Gage (0.003 in.) | 12205635 |
| Plastic Feeler Gage (0.005 in.) | 12205633 |
| Tachometer | 84362900 |
| Track Pulse Adjusting Tool | 84353100 |
| Extraction Tool | 12210915 |
| Push-Pull Gage | 12210797 |
| Speed Detector (Type JAF) | 50042805 |
| Oscilloscope, dual-trace, Tektronix 545 with Type CA preamplifier (or equivalent) | |

## EQUIPMENT SPECIFICATIONS

### PHYSICAL

| | |
|---|---|
| Height | 41 in. |
| Width | 24 in. |
| Depth | 36 in. |
| Weight | 480 lb |
| Environment | |
| Operating | 60°F to 90°F at 10% to 80% relative humidity (20°F per hour maximum gradient) |
| Non-operating | -30°F to 150°F at 5% to 98% relative humidity |
| Heat Dissipation | 3000 BTU per hour |

### ELECTRICAL

Power source

| | Volts | Hertz | Phase (wye) |
|---|---|---|---|
| Mod A | 208 | 60 | 3 |
| Mod B | 208 | 50 | 3 |

Maximum current: 3 amp per phase

| | |
|---|---|
| Input/Output Connectors | Four connectors (two each for cables A & B) at rear of logic chassis. Pin assignments according to Table 1-1. Cable connections according to Figure 7-3. |

## EQUIPMENT CHARACTERISTICS

| | |
|---|---|
| DISKS | |
| Number of Disks | 6 disks |
| Usable Disk Surfaces | 10 surfaces |
| Tracks per Disk Surface | 100 tracks |
| Speed | 2400 + 48 rpm |
| Diameter | 14 in. |
| Coating | Magnetic oxide |
| HEADS | |
| Number | 10 heads |
| Read/Write width | 0.010 in. |
| Erase Width | 0.018 in. |
| Track Spacing | 0.020 in. |
| OPERATOR CONTROLS | START switch/indicator<br>FAULT switch/indicator<br>Unit Number indicator |
| ADDRESSING | Optional |
| CAPACITY/DATA FORMAT | |
| Bits per | |
| Sector | 1536 |
| Disk surface | 245, 760 |
| Total Capacity | 24, 576, 000 bits |
| Bits per | |
| Byte | 12 |
| Bytes per Sector | 128 |
| Sectors per Track | 16 |
| Tracks per Cylinder | 10 |
| Cylinders per Disk Pack | 100 |
| RECORDING | |
| Mode | Double frequency |
| Density | |
| Outer Track | 765 bpi |

| | |
|---|---|
| Inner Track | 1105 bpi |
| Bit Rate | 1.25 MHz |
| Data Transfer Rate | 208,333 characters/second |
| PROCESSING SPEED | |
| 99-Track Access Time (max) | 135 ms |
| 1-Track Access Time (max) | 24 ms |

TABLE 1-1. INPUT/OUTPUT CONNECTOR PIN ASSIGNMENTS

| CABLE A INTERFACE (J100-J101) | | CABLE B INTERFACE (J102-J103) | |
|---|---|---|---|
| Pin | Function | Pin | Function |
| A1&2 | Address and Control Line Bit 0 | A1&2 | Unit Select 0 |
| A3&4 | Address and Control Line Bit 1 | A3&4 | Unit Select 1 |
| A5&6 | Address and Control Line Bit 2 | A5&6 | Unit Select 2 |
| A7&8 | Address and Control Line Bit 3 | A7&8 | Unit Select 3 |
| A9&10 | Address and Control Line Bit 4 | A9&10 | Unit Select 4 |
| B1&2 | Address and Control Line Bit 5 | B1&2 | Unit Select 5 |
| B3&4 | Address and Control Line Bit 6 | B3&4 | Unit Select 6 |
| B5&6 | Address and Control Line Bit 7 | B5&6 | Unit Select 7 |
| B7&8 | Spare | B7&8 | Spare |
| B9&10 | Spare | B9&10 | Spare |
| C1&2 | Spare | C1&2 | Spare |
| C3&4 | Spare | C3&4 | Spare |
| C5&6 | Cylinder Select | C5&6 | Unit Selected 0 |
| C7&8 | Head Select | C7&8 | Unit Selected 1 |
| C9&10 | Difference Select | C9&10 | Unit Selected 2 |
| D1&2 | Control Select | D1&2 | Unit Selected 3 |
| D3&4 | Read Cylinder Select | D3&4 | Unit Selected 4 |
| D5&6 | Sector Select | D5&6 | Unit Selected 5 |
| D7&8 | End of Cylinder | D7&8 | Unit Selected 6 |
| D9&10 | Spare | D9&10 | Unit Selected 7 |
| E1&2 | Write Data | E1&2 | Spare |
| E3&4 | Read Data | E3&4 | Clear Compare Enable |
| E5&6 | Spare | E5&6 | Spare |

TABLE 1-1. INPUT/OUTPUT CONNECTOR PIN ASSIGNMENTS (Cont'd)

| CABLE A INTERFACE (J100-J101) | | CABLE B INTERFACE (J102-J103) | |
|---|---|---|---|
| Pin | Function | Pin | Function |
| E7&8 | Selected On Sector | E7&8 | Spare |
| E9&10 | On Cylinder | E9&10 | Disk Pack Unsafe |
| F1&2 | Seek Error or On Sector | F1&2 | Spare |
| F3&4 | Sector Mark | F3&4 | Selected |
| F5&6 | Index | F5&6 | Spare |
| F7&8 | Seek Error | F7&8 | Selected Unit Ready |
| F9&10 | Termination Power | F9&10 | Termination Power |

# SECTION 2

# OPERATION

# GENERAL OPERATING INSTRUCTIONS

Section 2 provides the operator with general operating instructions for the disk storage drive and a functional description of the controls and indicators of the unit.

## APPLICATION OF POWER

The power distribution circuit contains three interlock switches. The front and top rear covers must be closed and a disk pack installed before power can be applied to the spindle drive motor.

1. Make certain that the disk storage drive power cord is connected to the correct external ac power source (check the unit identification plate for voltage and frequency requirements).
2. To gain access to the power supply control panel, grasp the top edge of the cabinet rear panel and pull outward.

**CAUTION**

If the disk storage drive is connected to the controller in series with other units, do not turn the power supply MAIN POWER circuit breaker ON or OFF while one of the other units is reading or writing. This may cause errors to the disk storage drive or to the controller. Refer to Section 7 and Appendix A of this manual for additional information on the Power On sequence.

3. Set the power supply MAIN POWER circuit breaker to ON. The adjacent neon phase and +20Y indicators light to verify the application of external ac power.
4. Set the remaining power supply circuit breakers to ON. The related indicators light to verify the presence of each voltage. Both the +20V and -20V breakers must be on and sequence power on before the +20V and -20V indicators will light.
5. Install the cabinet rear panel. Install a disk pack.

CAUTION

Maximum operational stability is achieved after the unit has reached thermal stability. The warmup time (spindle rotating) is approximately 45 minutes if the ac power has been removed for longer than 4 hours. It is recommended that the power supply remain energized (MAIN POWER circuit breaker ON) or that the warmup period be allowed prior to a Read/Write operation.

6. Press the START switch to apply power to the spindle drive motor and start the First Seek operation. The Unit Number indicator lights when the read/write heads are loaded. When the carriage stops at Track 00, the unit is ready to receive a Read, a Write or a Seek command from the controller.

## DISK PACK INSTALLATION AND REMOVAL

### Installation

Prior to installing a disk pack, set the power supply MAIN POWER circuit breaker to ON (applies spindle brake). Do not press the START switch/indicator. Make certain that the disk pack to be installed has been cleaned according to the Preventive Maintenance schedule, Section 5.

1. Lift the disk pack by the plastic cannister handle.
2. Unscrew the bottom dust cover from the disk pack using the knob in the center of the cover. Set the cover aside.
3. Raise the front cover on the disk storage drive (Figure 2-1).

CAUTION

In the following step, avoid abusive contact between the disk pack and the spindle assembly. Avoid touching either the spindle assembly or the mating surface of the disk pack, corrosion may result.

4. Place the disk pack onto the spindle.
5. Twist the dust cover handle clockwise to lock the disk pack in place.
6. Lift the cannister clear of the disk pack and set it aside.
7. Close the front cover immediately to prevent the entry of dust and the contamination of the disk surfaces.

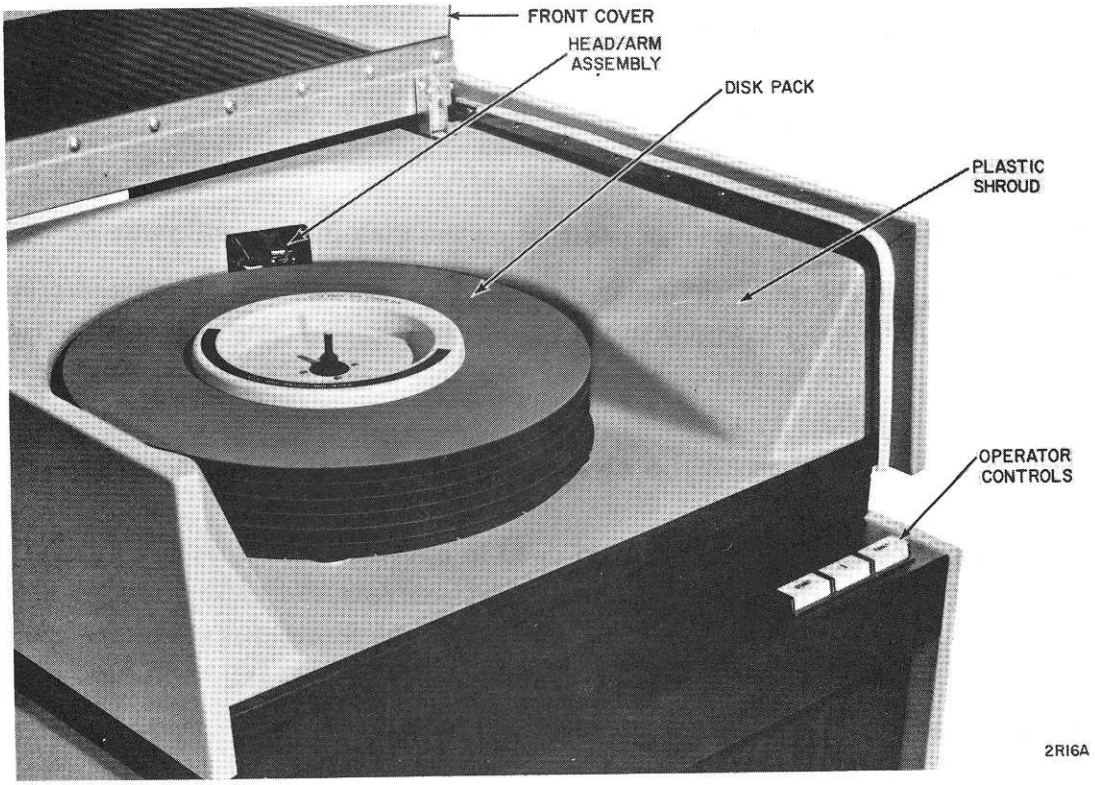



Figure 2-1. Disk Pack Load and Unload Mechanics

Removal

Before removing the disk pack, make certain that the disk pack has stopped rotating. The power supply MAIN POWER circuit breaker should remain ON to apply the spindle brake.

1. Raise the front cover on the disk storage drive.
2. Place the plastic cannister over the mounted disk pack so that the post protruding from the center of the disk pack is received into the cannister handle.
3. Twist the cannister handle counterclockwise until the disk pack is free of the spindle.

CAUTION

In the following step, avoid abusive contact between the disk pack and the spindle assembly.

4. Lift the cannister and the disk pack clear of the spindle.
5. Close the front cover over the shrouded area.
6. Place the bottom dust cover in position on the disk pack and tighten it.
7. If operations (requiring further use of the disk storage drive) are complete, set the power supply MAIN POWER circuit breaker to OFF.

## CONTROLS AND INDICATORS

Manual controls and indicators (Figure 2-2) used in operating the disk storage drive are mounted in front of the front cover. Additional controls and indicators (used by authorized maintenance personnel only) are located on the logic chassis maintenance panel (Figure 2-3) and the power supply control panel (Figure 2-4). Table 2-1 contains a brief functional description of these controls and indicators.

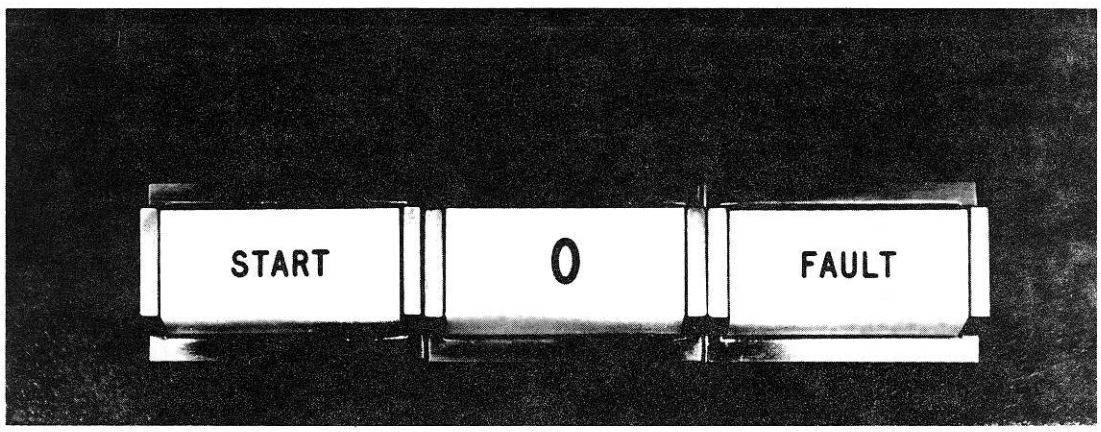



Figure 2-2. Operator Panel

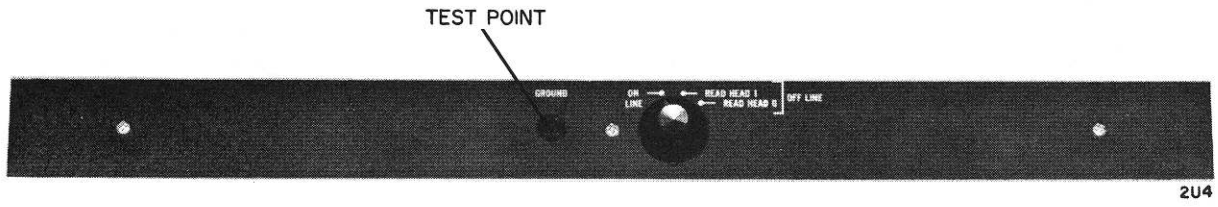



Figure 2-3. Logic Chassis Maintenance Panel

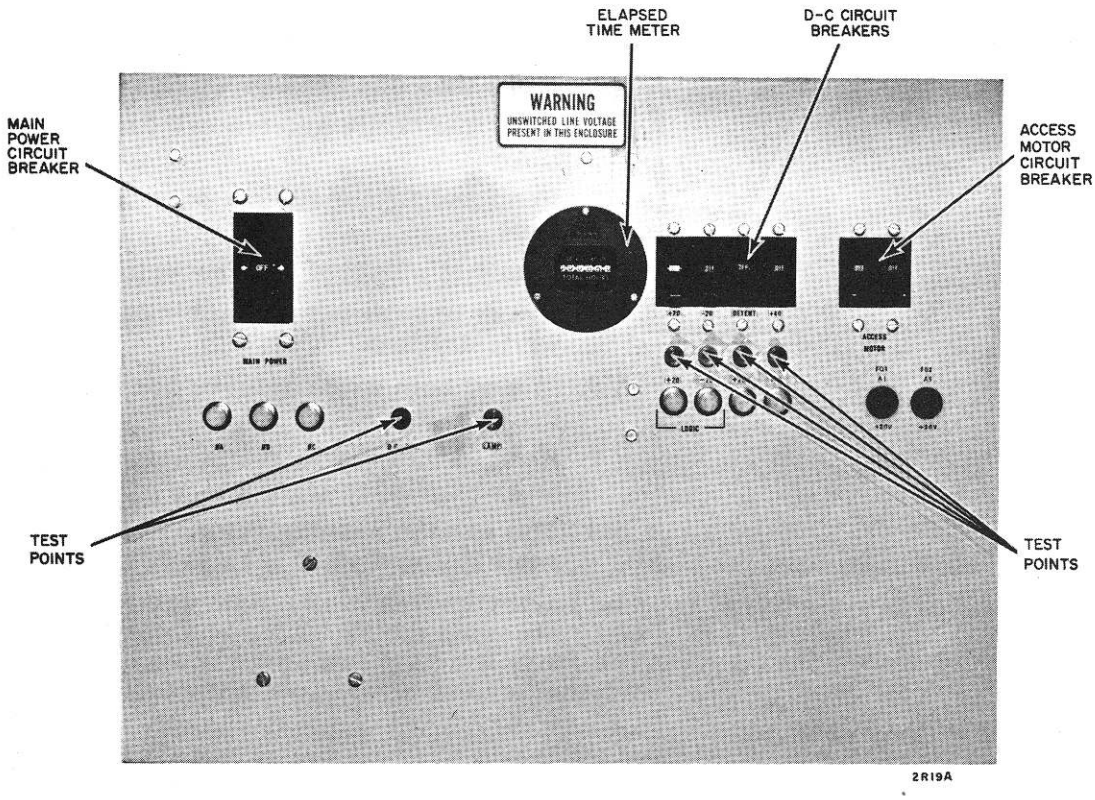



Figure 2-4. Power Supply Control Panel

TABLE 2-1. CONTROLS AND INDICATORS

| CONTROL OR INDICATOR | FUNCTION |
|---|---|
| Operator Panel | |
| START switch/indicator | Energizes (when pressed to light) the spindle drive motor to begin a First Seek sequence if the disk pack is in place, the front cover is closed, spindle lock pawl is disengaged, and the sequence relay is energized by the control unit. |
| Unit Number indicator | The number assigned to the disk storage drive unit when several units are used in the same system. The indicator lights when the disk drive heads are loaded.<br>All disk storage drives leave the factory as unit 0. Refer to Part 7 for procedures to change a unit number. |
| FAULT switch/indicator | Lights when the following fault conditions exist:<br>1. More than one head is selected.<br>2. Read and Write selects exist at the same time.<br>3. Read and Erase selects exist at the same time.<br>4. Erase is selected with no write driver.<br>5. Erase is selected in combination with both write drivers.<br>6. One or both write drivers are on with no erase driver.<br>7. Read, write, or erase is selected without an On-Cylinder signal.<br>8. The voltage sensing card indicates improper +20V and -20V levels.<br>The Fault flip-flop in the logic section is cleared by pressing the FAULT switch/indicator. The Fault flip-flop remains cleared until the original source of the problem reappears. |
| Power Supply Control Panel | |
| MAIN POWER circuit breaker | Controls the ac voltage to the disk storage drive unit. |
| CONVENIENCE OUTLET circuit breaker (applicable to Serial No. 1927 and below only) | Controls the ac voltage to the convenience outlet. |
| ±20 vdc circuit breakers | Control the application of these voltages to the logic section. |

TABLE 2-1. CONTROLS AND INDICATORS (Cont'd)

| CONTROL OR INDICATOR | FUNCTION |
|---|---|
| +40 vdc circuit breaker | Controls the application of this voltage to the write supply.<br><br>NOTE<br><br>Indicators provided with each of the preceding circuit breakers (except CONVENIENCE OUTLET) are lighted when corresponding voltage is present. Test points provide aids to test the various voltage levels. |
| DETENT circuit breaker | Controls the +20X vdc to the detent solenoid coil magnet. |
| ACCESS MOTOR circuit breaker | Controls the +20X vdc to the access motor. |
| Elapsed time meter | The elapsed time meter indicates the spindle drive motor operating time (pack rotating). |
| F01/5 amp/+20V fuse (applicable to units Serial No. 3981 and above only) | Protects the +20Y vdc line to the head and cam latch solenoids and the brake solenoid. |
| F02/1 amp/+20V fuse (applicable to units Serial No. 3981 and above only) | Protects the +20X vdc line to the sector solenoid. |
| Logic Chassis Maintenance Panel | |
| OFF LINE/ON LINE switch | Transfers the control of the disk storage drive unit from the controller to the unit itself and vice-versa. When the switch is in one of the two OFF LINE positions, a Read operation may be performed from either head 0 or head 1 as selected. |
| Actuator Assembly | |
| Track indicator dial | Part of the detent gear (Figure 3-12); it indicates the track number at which the carriage is detented. The dial is read at the pointer tip (located above pawl). |

# SECTION 3

# FUNCTIONAL DESCRIPTION

## GENERAL

Functional description is divided into five parts. The first part considers the disk storage drive in terms of the general functions it performs and the signals (Figure 3-1 and Table 3-1) exchanged with the controller. (For a detailed description of the logical functions of the unit, refer to the Diagrams and Wire List manual.) The second part relates the major assemblies of the unit to the previously discussed functions. The last three parts (unit cooling, the disk pack, and cylinder concept) cover subjects which are not functional entities, but aid in understanding overall operation.

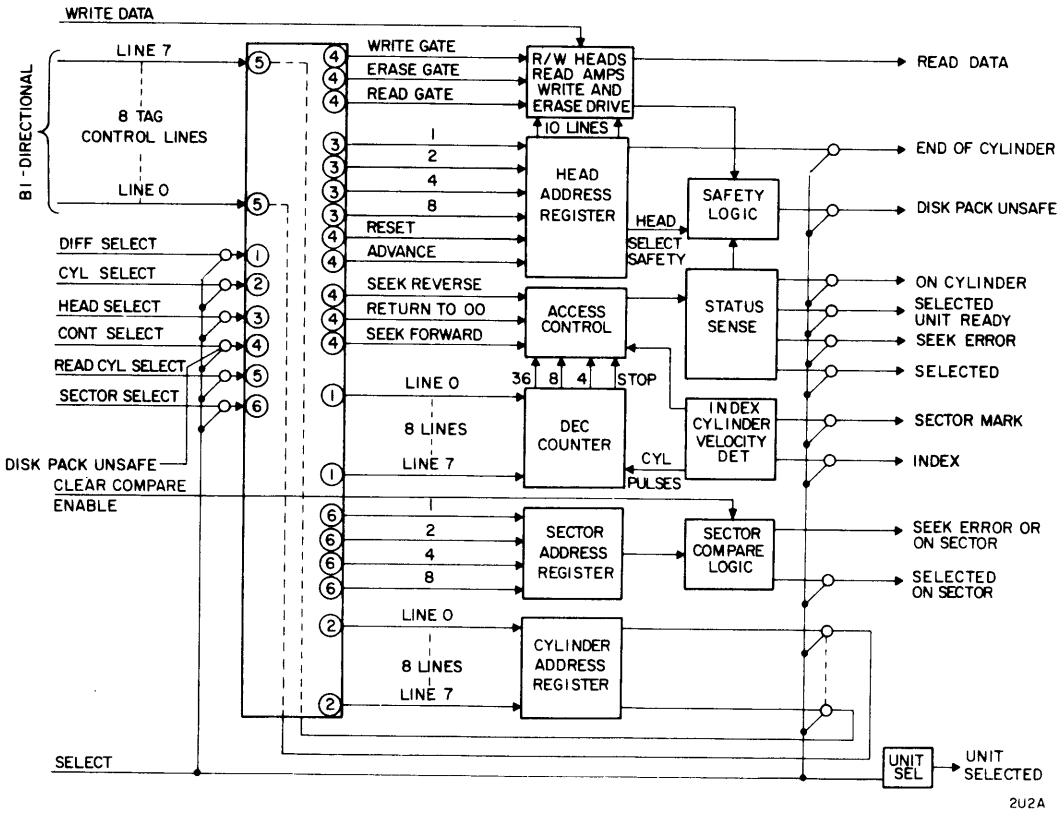



Figure 3-1. General Block Diagram

## FUNCTIONS

### FIRST SEEK AND UNIT SELECT

The First Seek function includes those preliminary operations the disk storage drive must perform before it can effectively respond to a Read, a Write, or a Seek command from the controller.

In preparation for the First Seek, the controller provides a sequence voltage to the disk storage drive power supply. This signal causes the power supply to perform a Power On sequence (refer to Appendix A for a detailed description). After the disk pack is up to speed, the carriage (mounting point of the read/write heads) is driven forward into the disk pack until the read/write heads are loaded (latched in the read/write position over the disk surfaces). As soon as the heads are loaded, carriage motion is reversed and the read/write heads are positioned over cylinder zero of the disk pack and the spring-loaded detent pawl engages the detent gear. An On Cylinder signal is sent to the controller 15 ms later. The disk storage drive is now ready to perform a Read, a Write, or a Seek (Direct or Return to Zero) operation.

TABLE 3-1. INPUT/OUTPUT LINES

| SIGNAL | FUNCTION | | |
|---|---|---|---|
| Bidirectional lines | Information carried by the bidirectional lines is coupled by six select (enable) signals. The influencing enable signal must be known before information on a bidirectional line can be interpreted. The six enable signals are defined under Input Lines (below). The information coupled by each enable signal is as follows: | | |
| Address and Control | | | |
| Address/ Control Bus | Read Cylinder Select, Difference Select, or Cylinder Select | Head Select | Control Select |
| Bit 0 | 1 | 1 | Write Gate - A "1" input on this line enables the write drivers. |
| Bit 1 | 2 | 2 | Read Gate - A "1" input on this line enables the digital read data line. |
| Bit 2 | 4 | 4 | Seek Forward - A "1" input on this line initiates forward carriage movement. |

TABLE 3-1. INPUT/OUTPUT LINES (Cont'd)

| Address/ Control Bus | Read Cylinder Select, Difference Select, or Cylinder Select | Head Select | Control Select |
|---|---|---|---|
| Bit 3 | 8 | 8 | Reset (Hd Reg) - A "1" input on this line sets the Head Address register to zero. |
| Bit 4 | 16 | Not Used | Erase Gate - A "1" input on this line enables the erase driver to pass current through the head erase coil. |
| Bit 5 | 32 | Not Used | Seek Rev. - A "1" input on this line initiates reverse carriage movement. |
| Bit 6 | 64 | Not Used | Return to 00 - A "1" input on this line initiates carriage movement to cylinder 00. |
| Bit 7 | Not Used | Not Used | (Hd Reg) Advance - A "1" input on this line increments the Head Address register so that the next head in order can be selected. |

| Input Lines | |
|---|---|
| Read Cylinder Select | A "1" input on this line enables the address and control lines transmitter of the selected disk storage drive. Information transmitted to the controller through these lines is the current cylinder address. |
| Difference Select | A "1" input on this line indicates that the address and control lines contain the difference address from the controller. This address is the difference between the controller's current cylinder request and the disk storage drive's present cylinder location. |
| Cylinder Select | A "1" input on this line indicates that the address and control lines contain the controller's current cylinder request. |
| Sector Select | A "1" input on this line enables the address and control lines to couple the sector information to the disk storage drive. |
| Head Select | A "1" input on this line indicates that the address and control lines contain the head select information. |
| Control Select | A "1" input on this line indicates that the address and control lines contain control information. |
| Write Data | Carries information to be written from the controller to disk storage drive. |

TABLE 3-1. INPUT/OUTPUT LINES (Cont'd)

| SIGNAL | FUNCTION |
|---|---|
| Clear Compare Enable | Allows programmer (operating through controller) to clear the compare enable interrupt. |
| Unit Select (0 through 7) | Determines which disk storage drive is selected. |
| Output Lines | |
| Read Data | Carries digital information read from the disks to the controller. |
| On Cylinder | Indicates that the positioning mechanism has stopped and the read/write heads have reached the addressed cylinder. |
| Sector Mark | Carries sector reference marks from the selected disk pack to the controller. |
| End of Cylinder | A "1" output is provided when the Head Address register goes from 9 to 10 as it is incremented (by Head Advance signal) in a multitrack operation requiring the use of sequential head addressing. |
| Seek Errors | A "1" output indicates that the selected disk storage drive unit was unable to complete a Seek operation to the point of returning an On Cylinder signal to the controller. A Return to Zero Seek command (send to the unit indicating a seek error) clears the Seek Error condition, returns the heads to cylinder 00, and enables an On Cylinder signal to be sent to the controller. |
| Unit Selected | Eight lines used to check that no more than one disk storage drive is selected at any one time. |
| Selected | A "1" output indicates that the respective disk storage drive unit has been selected. |
| Selected Unit Ready | A "1" output indicates that the selected disk storage drive unit is available. Unavailable conditions occur when:<br>1. Heads not loaded and motor not up to speed.<br>2. A disk pack not loaded on the disk drive unit.<br>3. ON LINE/OFF LINE switch in OFF LINE position. |
| Index | Provides a track reference mark from the selected disk storage drive unit to the controller. All other track reference marks are measured from this point. |
| Disk Pack Unsafe | A "1" output indicates that the selected disk storage drive unit has one or more fault conditions. These conditions include:<br>1. More than one head selected<br>2. Both read and write gates up at same time<br>3. Erase and no write driver on |

TABLE 3-1. INTPUT/OUTPUT LINES (Cont'd)

| SIGNAL | FUNCTION |
|---|---|
| | 4. Erase and both write drivers on<br>5. One or both write drivers on and no erase driver on<br>6. Read, write, or erase gate on and not on cylinder<br>7. Both read and erase gates up at same time |
| Selected On Sector | A 1-ms pulse indicates that the disk storage drive unit is in position and the recording heads are one sector away from the addressed sector. |
| Seek Error or On Sector | A 4-$\mu$sec "1" pulse output indicates that the disk storage drive has completed a seek (on sector). A static "1" output indicates a seek error. |

DIRECT (FORWARD/REVERSE) SEEK

The Direct Seek function involves those operations that must be performed to move the read/write heads from their current cylinder to the cylinder specified by the controller.

To start a Direct Seek, a Read Cylinder Select is applied to the selected disk storage drive. This signal enables the control line transmitters in the Cylinder Address register and causes the disk storage drive to transmit the current cylinder address to the controller. The controller then determines the number of cylinders that must be traversed to reach the desired cylinder. For example, if the heads are presently at cylinder 10 and the desired cylinder is 31, the difference address is 21.

The difference address is coupled to the disk storage drive by the Difference Select signal which allows the difference address to be registered in the Decrement counter. Once the difference address is in the Decrement counter, the Cylinder Select signal is applied to the disk storage drive. This signal causes the transfer of the controller's current cylinder address into the disk storage drive Cylinder Address register. If the latency overlap function is in use, refer to that paragraph for additional events occurring at this time.

The Control Select signal is now applied. This signal couples the Forward or Reverse (as applicable) command and the seek is initiated under control of the Access Control circuit. At this point the controller may (assuming it has the capability) elect to

proceed to the next unit and command a Read, a Write, or a Seek operation while the previous unit performs the assigned seek, or it may wait for the completion of the seek by this unit. In either case the seek continues in the same manner.

Assume that the number of cylinders (or tracks, refer to Cylinder Concept paragraph) to go is greater than 36. Then the access motor driving the carriage accelerates toward maximum velocity. As the carriage is moved to reposition the heads, track pulses are supplied to the Decrement counter from a track photocell (part of Index Cylinder Velocity Detector). Each track pulse decreases the Decrement counter content by one. A speed photocell (also part of Index Cylinder Velocity Detector) provides pulses representative of the rate (in ips) at which the read/write heads are approaching the desired cylinder. When the counter content is less than 36, the carriage is dynamically braked to a speed of 15 ips. The motor now drives at 15 ips until the number of tracks to go is less than eight. The carriage is then dynamically braked to a speed of 6 ips and continues at this speed until four tracks remain. At this point, the carriage is braked to approximately 2 ips. This speed is maintained until the desired cylinder is reached.

When the selected track is reached, the spring-loaded detent pawl engages the detent gear, positioning the heads precisely over the selected track. An On Cylinder signal is supplied to the controller 15 ms after the carriage stops. If the latency overlap function is in use, refer to that paragraph for additional events occurring at this point. This signal indicates that the disk storage drive is ready to perform a Read or Write operation.

## RETURN TO ZERO SEEK

The Return to Zero Seek function allows a controller to reestablish the location of the read/write heads if for some reason the location is in doubt or if an illegal seek length caused a Seek Error signal to occur.

When a Return to Zero Seek is selected, the Decrement counter and the Cylinder Address register are set to zero and the carriage is driven toward Track zero at 6 ips. When light is sensed by the home cell (photocell that senses when heads are outside of recordable area of disk surfaces), the access motor drive current is reversed and the carriage is driven forward until Track zero is reached. The detent pawl is dropped.

and 15 ms later the On Cylinder signal is supplied to the controller. The disk storage drive is now ready to perform a Seek, a Read, or a Write operation.

## LATENCY OVERLAP

NOTE

The Latency Overlap function can be used only with a controller having that capability.

The Latency Overlap function (performed by the Sector Address register and the Sector Compare logic) allows a sector to be accessed prior to going on line to the central processor. The first event of this function occurs after the selected address is set into the Cylinder Address register. At this point the controller's Sector Select signal gates the desired sector address into the Sector Address register. The Seek operation is then performed. When the On Cylinder signal occurs, the Sector Compare logic is enabled. This logic compares the contents of the sector counter (counts pulses from sector/presector photocell) and the Sector Address register. When the contents of the two agree, a 4-$\mu$sec On Sector pulse is sent to the controller indicating that the disk storage drive is ready to perform a Read or a Write operation.

## READ/WRITE/ERASE

The On Cylinder (or On Sector if Latency Overlap is in use) signal indicates to the controller that the disk storage drive has completed the Seek operation and is waiting for further instruction.

The Write operation starts when the Control Select signal enables the Read Gate signal (enabling the Read Drive circuit). At this point the Head Select signal may enable the head select lines into the Head Address register (the occurrence of this event is optional at this time since the head may have been selected, in the same manner, before seek motion started). As each record is reached, the address is read and compared, by the controller, with the address of the desired record. When comparison indicates that the address just read was the address of the desired record, the Read Gate signal is dropped and Control Select enables the Write Gate (enabling the Write Drive circuit).

Data from the controller is then written on the selected record. Erase current is applied to the erase head during the Write operation to ensure a clear writing surface.

A Read operation is performed in much the same manner as a Write operation. The difference being that the Write Gate signal is never enabled (Read Gate stays on constantly).

## ASSEMBLIES

### POWER SUPPLY

The disk storage drive has a self-contained power supply (Figure 3-2) located behind the rear panel of the machine. The various dc voltages developed by the power supply are used by all major assemblies of the disk storage drive except the spindle drive motor.

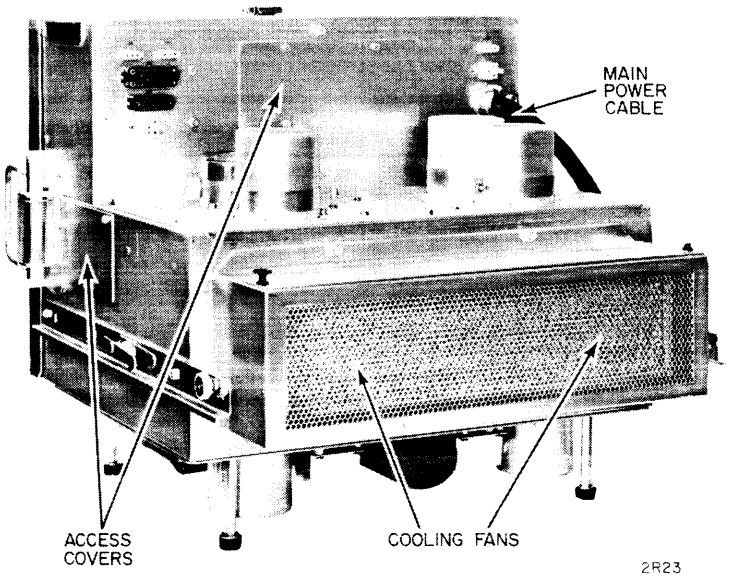



Figure 3-2. Power Supply

Basic on/off power control is accomplished at the power supply control panel. Power distribution is performed by a series of relays in the power supply. The supply mounts on slide rollers that allow extension of the assembly from the interior of the disk storage drive. The power supply front panel is hinged and latched to allow access to the interior wiring and components.

Refer to Appendix A of this manual for descriptive, maintenance, and troubleshooting information for the power supply.

## LOGIC CHASSIS

Logic cards for the disk storage drive are mounted on a single forced-air-cooled chassis (Figure 3-3). This assembly is located behind the front panel of the machine. All units manufactured since Serial No. 231, use a five-row chassis to mount the logic cards. Units with Serial No. 230 and below use a four-row chassis. The chassis is hinged and latched and equipped with a removable plate to allow access to the wiring.

The logic chassis contains circuit cards to control printed circuit motor velocity, head positioning, head loading, head selecting, seek overlap, and data channeling. The logic chassis maintenance panel (located along top edge of chassis) contains the switch that controls the on line/off line status of the unit. The off line positions of this switch are used only during maintenance situations.

Figure 3-4 is a rear view of the logic chassis showing the connector panel at which the system interface connections are made.

Refer to the related Diagrams and Wire List Manual (see Section 1 of this manual) for a detailed description of the function performed by the logic.

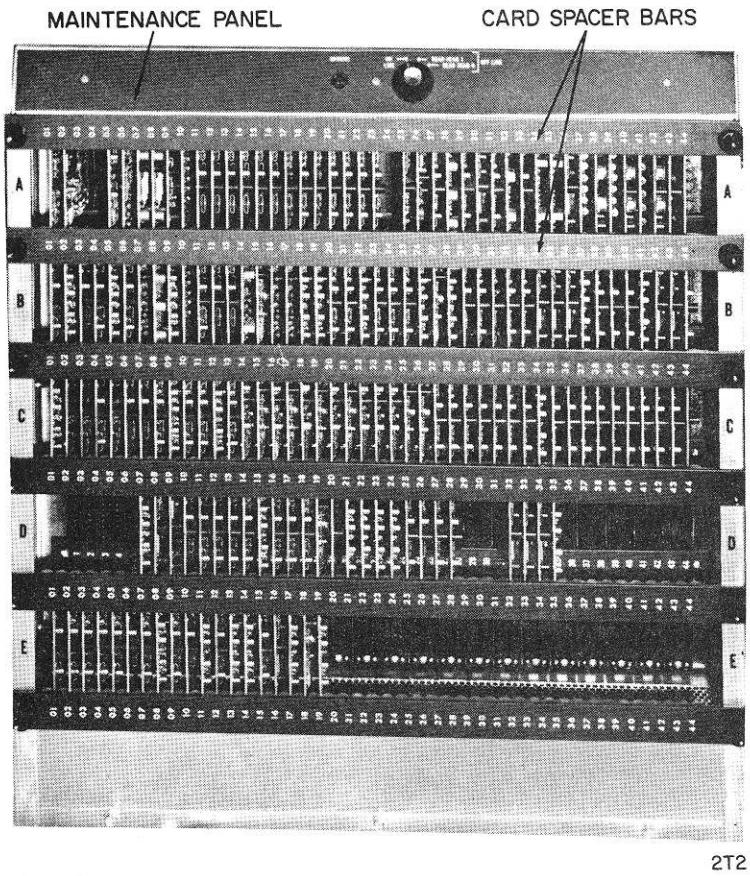



Figure 3-3. Logic Chassis- Front View

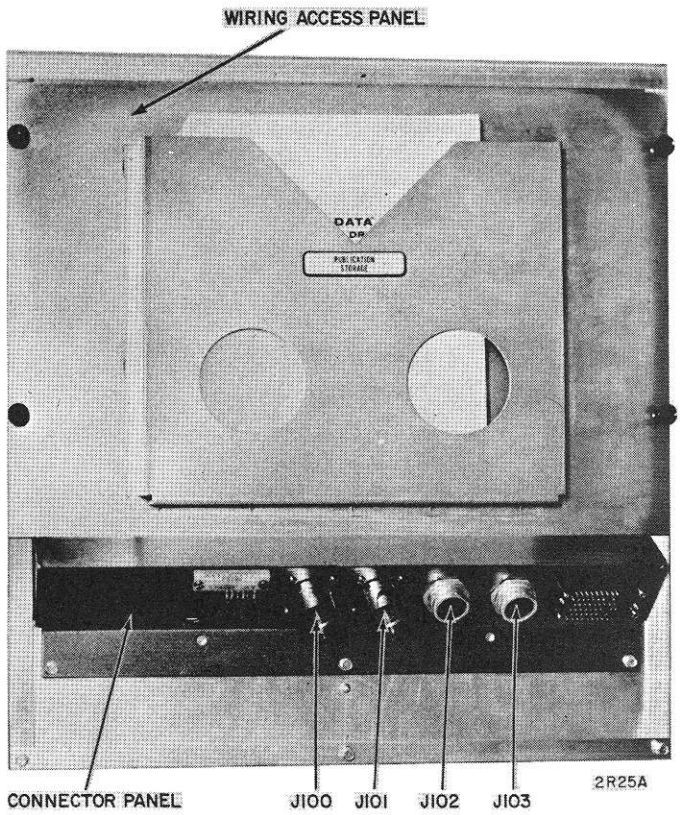



Figure 3-4. Logic Chassis - Rear View

## READ/WRITE LOGIC CHASSIS

The read/write logic chassis is mounted on the main deck adjacent to the actuator. The logic cards of this chassis are involved in all Read and Write operations. Access to the cards is gained by raising the top rear cover of the disk storage drive.

Refer to the related Diagrams and Wire List Manual for a detailed description of the functions performed by this logic.

## SPINDLE AND BRAKE

The spindle and brake assembly is the physical interface between the disk storage drive and the disk pack. The conical surface of the spindle cone (Figure 3-5) mates directly with the cone-shaped opening in the center of the disk pack.

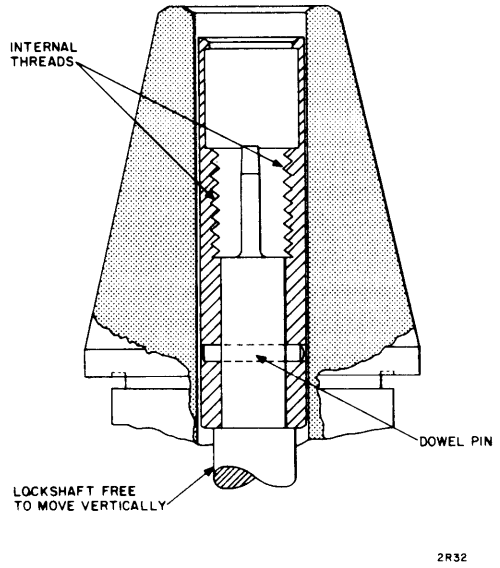



Figure 3-5. Spindle Cone

Starting in the spindle cone and running through the center of the spindle and brake assembly is the vertically-free-floating lockshaft (Figure 3-6). The upper end of the lockshaft contains internal threads (Figure 3-5) that engage the external threads of a stud projecting from the disk pack. When the disk pack cannister cover handle is rotated clockwise, the spring-loaded lockshaft is pulled upward and the disk pack is pulled down. As a result, the conical surfaces of the disk pack and the spindle cone are engaged by a force of approximately 200 pounds. When the disk pack is fully engaged, a release mechanism in the cannister handle frees the cannister from the disk pack.

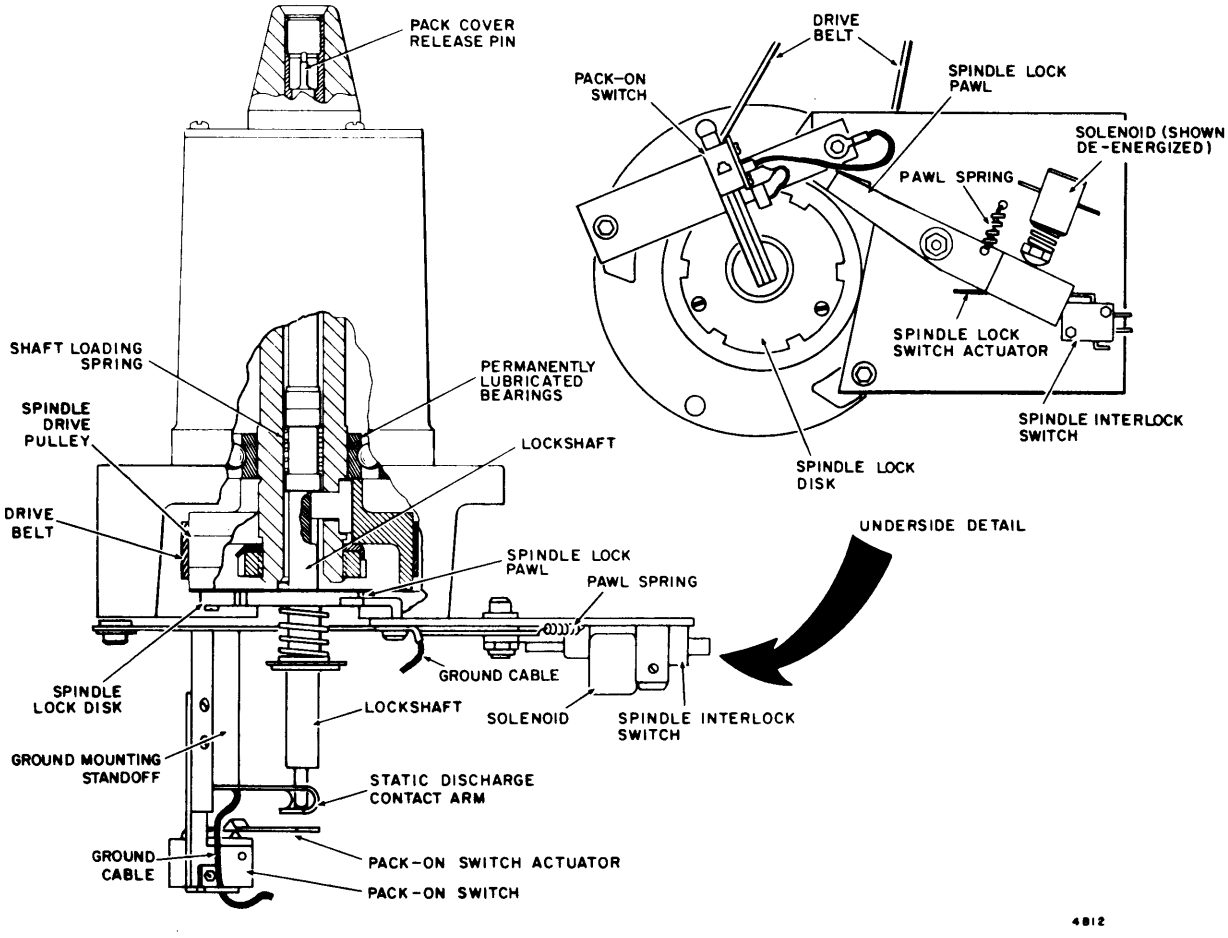



Figure 3-6. Spindle and Brake Assembly

The spindle drive pulley secures to the lockshaft. A flat belt links the spindle drive motor and the pulley.

The brake assembly (consisting of the spindle lock assembly and the spindle lock disk) mounts at the lower end of the spindle (Figure 3-6). The brake holds the spindle stationary to facilitate loading and unloading a disk pack. The spindle lock assembly (consisting of a pawl, a spring, a solenoid, and a switch) is the mechanism that engages the lock disk. The spring-loaded pawl engages the disk whenever the power supply MAIN POWER and DC INPUT POWER circuit breakers are ON and the disk pack rotation is below a predetermined rpm (except during Power On sequence, refer to Appendix A). When the solenoid de-energizes, the spring-loaded plunger (on solenoid) pivots the pawl tip clear of the lock disk. The switch monitors the position of the pawl.

The Pack-On switch and a static discharge contact are also mounted on the spindle base. The static discharge contact mounts on a spring arm so that it is always in contact with the tip of the lockshaft. The Pack-On switch contacts are closed only when a disk pack is installed. The contacts are opened or closed by the vertical position of the lockshaft.

## SPINDLE DRIVE MOTOR

The spindle drive motor drives the disk pack. The motor is an induction-type, 1/3-hp, unit. The motor is mounted on the lower surface of the main deck. Thermal and electrical isolators are used when mounting the motor. These isolators allow separation of the signal ground from the ac motor ground, preventing ground loops, and reducing heat transfer to the main deck.

The motor drives the pulley on the spindle and brake assembly via a flat, smooth-surfaced belt. The motor brings the disk pack up to normal operating speed in approximately 4 seconds.

The temperature of the motor is monitored by a thermal protection switch. To restore operation after an over temperature condition, the red 1/4-inch button on the lower end of the motor must be manually reset (pressed).

## SECTOR SENSOR

The sector sensor originates pulses (in combination with the disk pack) used by the power supply to sequence power application and by the controller when reading or writing data on the disk pack.

The sensor consists of two photocells (sector and presector, each containing a lamp and a phototransistor), the sector solenoid, and a base block. The base block mounts on the main deck and the photocells are pivot mounted on the base block. The pivoting of the photocell is controlled by the sector solenoid and a spring. When power is applied to the spindle drive motor (refer to Power On Sequence, Appendix A), the solenoid is energized and pivots the sector sensor so that the notched edge of the sector disk (part of disk pack, Figure 3-7) comes between the lamps and phototransistors of the photocells. When the solenoid is de-energized (spindle drive motor power removed and disk pack speed below predetermined rpm), the spring pulse the photocells from the edge of the disk pack. With the sensor retracted, a disk pack may be installed or removed from the spindle without danger of damage.

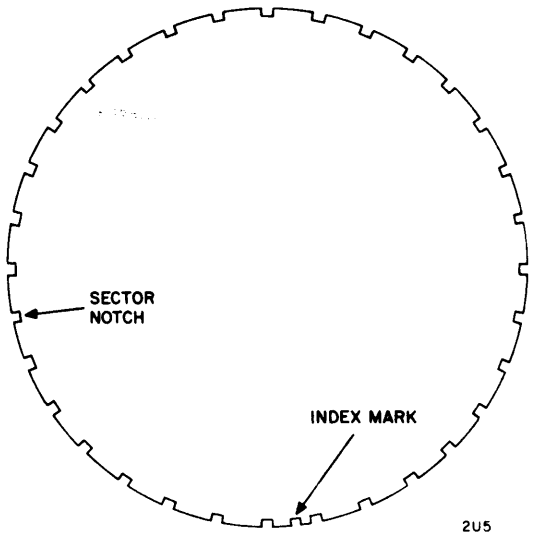



Figure 3-7. Sector Disk

The sector and presector photocells generate separate output pulses each time a notch on the sector disk passes. The repetition rate of these pulses is logically decoded to determine the speed of the disk pack. Further, the output pulses of both photocells indicate the starting point of various organizational segments of the disk pack. The sector pulse indicates the start of a sector of data, while the simultaneous occurrence of a sector and a presector pulse indicates the start of a cylinder of data. The starting point for a cylinder is called index. The Index pulse occurs because the distance between the index mark notch (Figure 3-7) and the nearest sector notch is identical to the distance between the sector and presector photocells. This is the only point in a revolution of the disk pack at which simultaneous output pulses can occur.

## ACTUATOR

The actuator assembly (Figure 3-8) loads (to the read/write position) and unloads (to prevent impact with the disk surfaces) the read/write heads, drives the heads to the correct data track at speeds proportional to the distance to be traveled, and accurately positions and holds the head over the track as data is read or written.

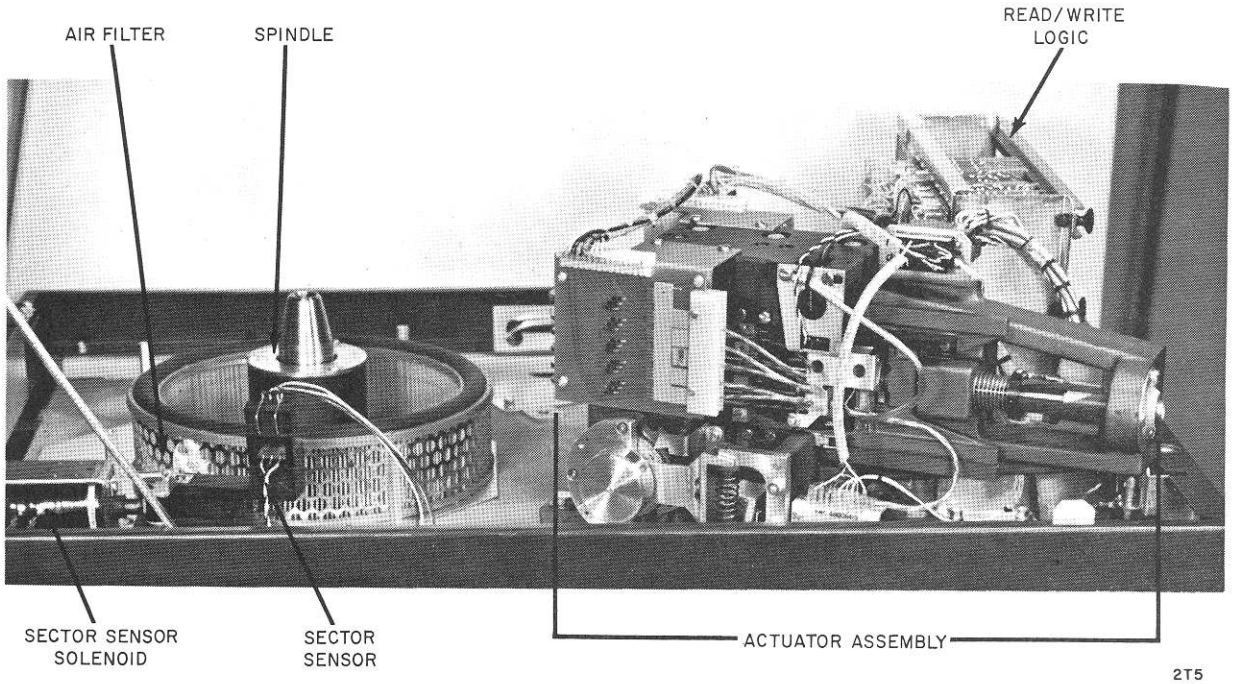



Figure 3-8. Actuator Assembly

The actuator consists of three subassemblies: the carriage, the carriage mount, and the carriage drive and positioning mechanism.

## Carriage Subassembly

The carriage subassembly (Figure 3-9) is the mounting point and the accessing mechanism for the read/write heads.

The carriage consists of a casting on which are mounted ten head/arm assemblies, two guide plates, two clamp strips, five torsion arms, five torsion arm loading gears, the heads-loaded latch assembly, and the carriage rack gear.

Carriage motion is derived via the carriage rack gear which is driven by the carriage drive and positioning subassembly. Total travel of the carriage is 3.3 inches, of which 1.3 inches are required to bring the carriage from the fully retracted position outward until the heads are over Track 00 of the disk pack.

Each read/write head is mounted on a supporting arm to form a head/arm assembly, (Figure 3-10). The ten head/arm assemblies are secured to the carriage (using the guide plates and the clamping strips) in two adjacent vertical stacks (five heads per stack).

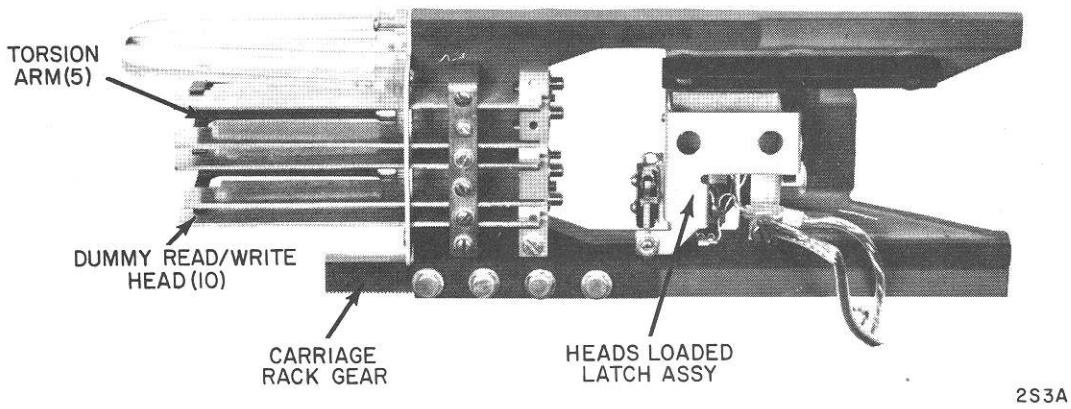



Figure 3-9. Carriage Subassembly

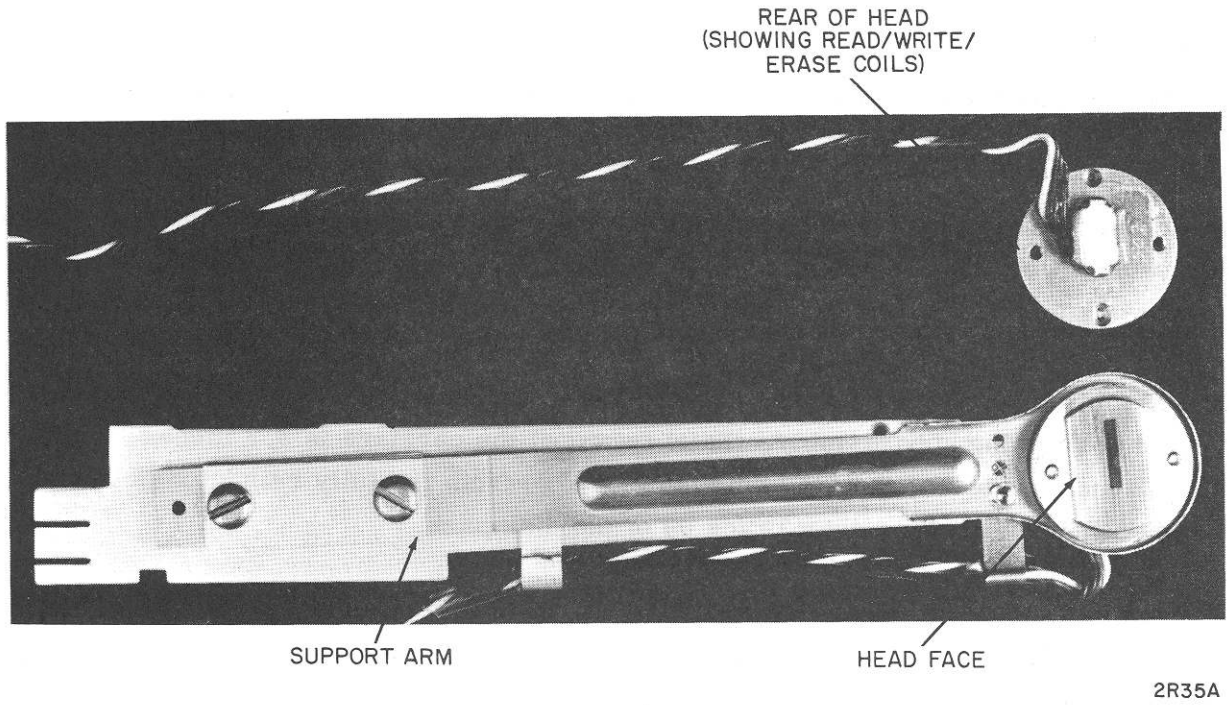



Figure 3-10. Head/Arm Assembly

The torsion arms, torsion arm loading gears, and the heads-loaded latch assembly are used during head loading and unloading operations. A torsion arm is secured to the center of each torsion arm loading gear. The five gears are mounted in-line vertically (between the two rows of heads) and are driven by the center gear. When the gears turn, the attached torsion arms rotate and each tip of the T-shaped torsion arms applies a vertical (either up or down) force to the back side of one head/arm assembly. This vertical force drives the head face toward the related disk surface. The spinning disk surface creates a cushion of air between itself and the adjacent head face. An equilibrium is established between the two forces such that the head flies at approximately 120 microinches from the disk surface. Loading heads involves a number of components that are not part of the carriage subassembly. For a detailed description of the operation, refer to the Head Loading paragraph.

The heads-loaded latch assembly holds the heads in the loaded position until power is removed from the spindle drive motor or the speed of the disk pack drops below a predetermined rpm.

## Carriage Mount Subassembly

The carriage mount (Figure 3-11) is the mounting point for the carriage and the carriage drive and positioning subassemblies. It consists of a casting, bearings, a cam mechanism and torsion rod, and the home photocell assembly (home cell).

The cam mechanism and torsion rod are used during read/write head loading and unloading operations. These operations involve additional components that are not part of the carriage mount. Refer to the Head Loading paragraph for a detailed description of the operation.

The home cell consists of a lamp and a phototransistor mounted on a bracket which is secured to the carriage mount. When the lamp excites the phototransistor, the latter produces a signal. Mounted on the movable carriage subassembly is the home cell mask.

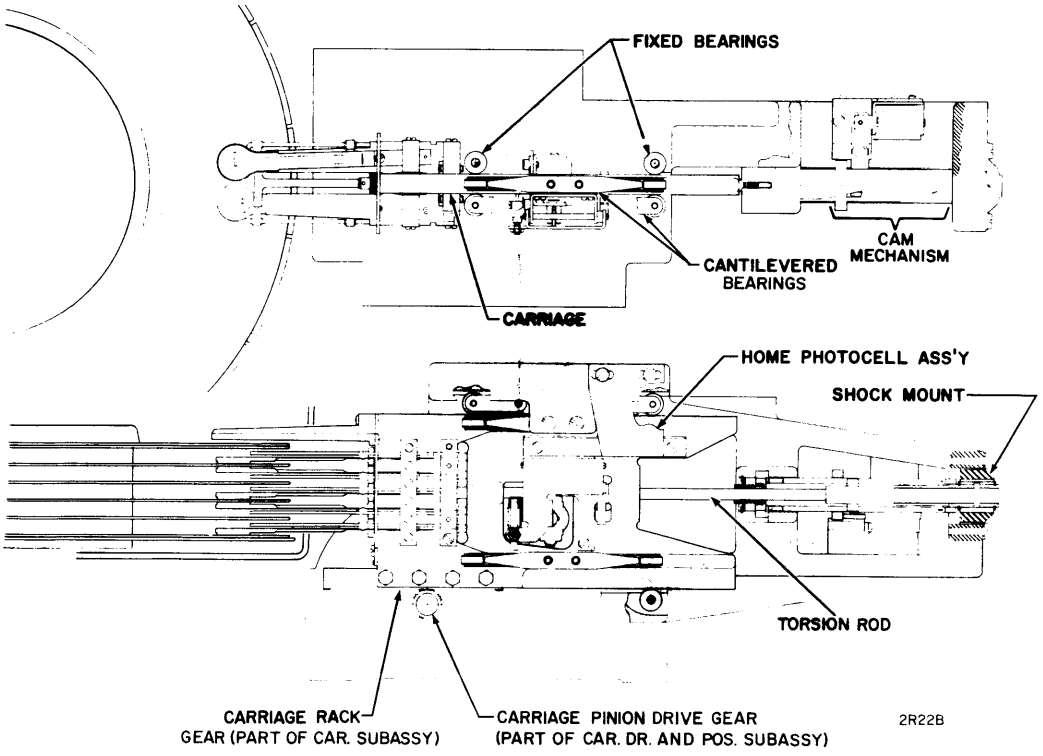



Figure 3-11. Elements of Carriage Mount Subassembly

The mask separates the lamp from the phototransistor when the read/write heads are positioned anywhere between (and including) the first and last cylinders of data on the disk pack. Whenever the heads are positioned outside of the data track area, the lamp activates the phototransistor which sends a signal to the logic chassis. The logical response to the occurrence of a home cell signal depends on the operation being performed at the time.

The carriage mount casting is accurately positioned on the main deck by a dowel pin and is secured to the deck by four machine bolts. The carriage mount casting, in effect, surrounds the carriage subassembly with bearing surfaces. The carriage subassembly is supported from below by a fixed bearing (and the carriage pinion drive gear which engages the carriage rack gear). The carriage is held down on the bearing (and the gear) by cantilevered bearings at the top of the carriage. The carriage subassembly is also supported horizontally by three cantilevered bearings which are opposed by fixed bearings. As a result, the only freedom the carriage has is in two lateral directions (forward and reverse), so that the carriage may be extended toward the disk pack or retracted from it.

Carriage Drive and Positioning Subassembly

The carriage drive and positioning subassembly (Figure 3-12) provides the mobility required by the carriage. The subassembly also keeps itself in check by providing velocity and position signals to the logic chassis. The logic decodes these signals and returns signals which cause the carriage to be driven to the desired track or cylinder at speeds that are proportional to the distance that must be traveled. When the read/write heads are positioned over the desired track, the subassembly locks itself in place while the Read or Write operation takes place.

A Move command comes from the controller. The command specifies the number of tracks to be moved (entered into the Decrement counter on logic chassis) and the direction of the move (relative to the disk storage drive's current position). When a Move command is received from the controller, current is supplied to the detent solenoid. Activating the solenoid causes the spring-loaded pawl to be pulled out of the detent gear. The assembly is now free to move.

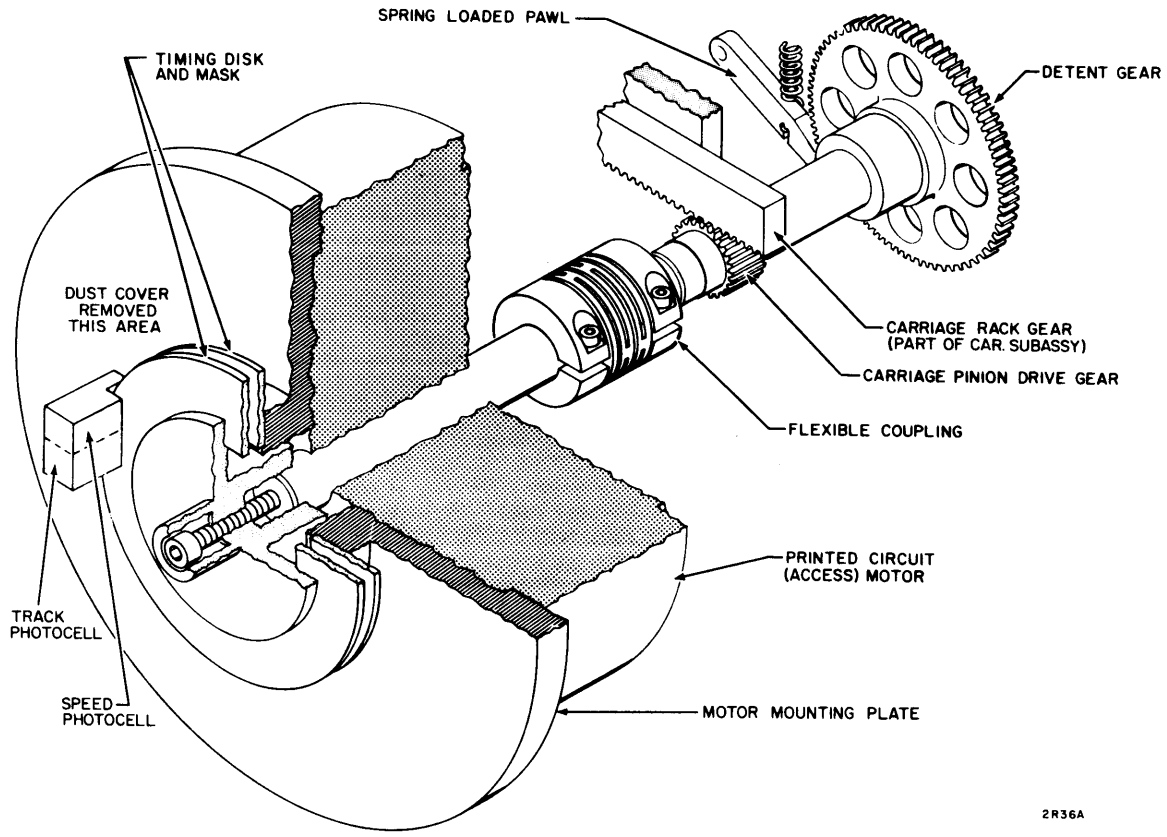



Figure 3-12. Carriage Drive and Positioning Mechanism

The Move command is applied to the printed circuit motor in the form of current. The polarity of the current determines the motor's direction of rotation. The amplitude and drive time of the applied current depends on the number of cylinders of data over which the carriage must be moved. When the cylinders to go is greater than 36, maximum drive current is applied to the motor and no velocity limits are imposed.

As the motor is driven, the carriage pinion rotates imparting forward or reverse movement to the carriage rack gear (Figure 3-13). As the carriage assembly moves, a corresponding rotational movement is imparted to the detent gear and the glass timing disk. A pair of photocells sense the slots etched on the timing disk as they pass.

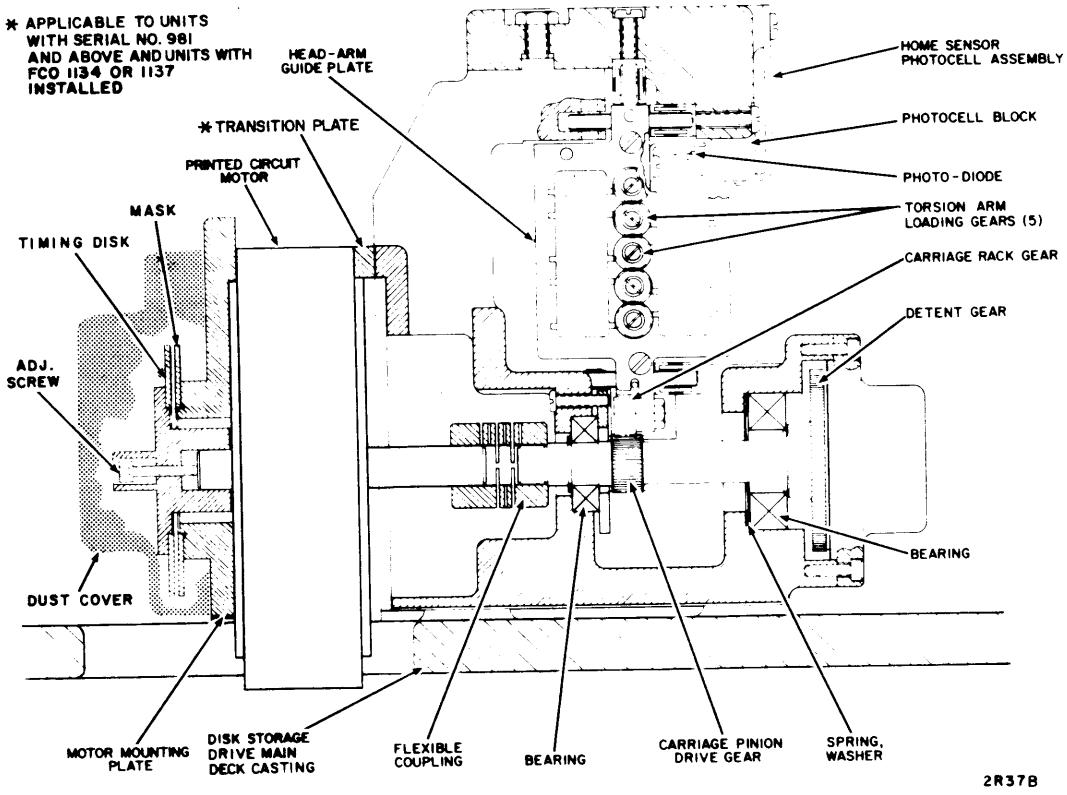



Figure 3-13. Actuator Cutaway - Front View

This glass disk is photoetched with three concentric rings of transparent slots (Figure 3-14). The outer ring contains 1020 slots, the middle ring contains 203 slots, and the inner ring contains 100 slots. Only the outer and inner ring of slots are used by the disk storage drive. The inner ring (100 slots) represents the data cylinder locations on the disk pack. Each slot corresponds to a gear tooth on the detent gear. The blank position provides an area used for reversing carriage motion. As the space between each slot (track) is crossed, the photocell light contacts the phototransistor and produces an output pulse to the logic chassis. Each output pulse decreases the content of the Decrement counter by one.

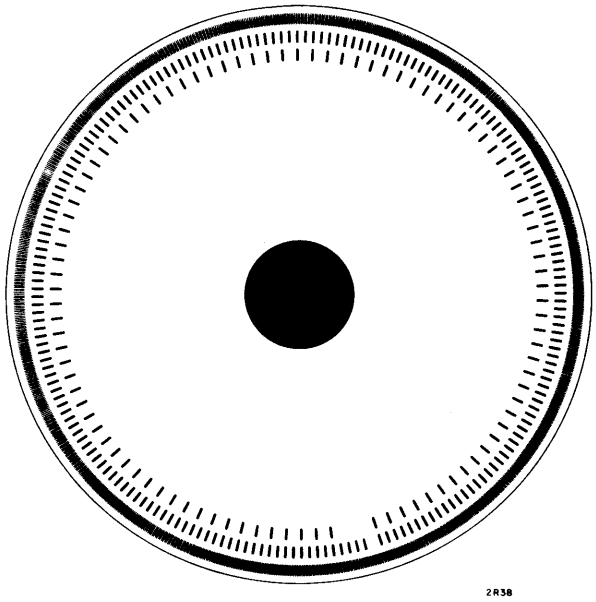



Figure 3-14. Timing Disk

The outer ring (1020 slots) provides pulses that are used for speed control of the printed circuit motor. The output pulses of this ring are supplied to the logic where the time between the pulses is measured to determine the speed of the motor (and hence the carriage). The greater number of slots is required for speed sensing to maintain stability at lower speeds.

When a maximum carriage movement of 100 cylinders is required, full current is applied to the motor, accelerating the carriage at a maximum rate. The carriage continues to accelerate until the Decrement counter indicates less than 36 cylinders to go. At this time the carriage velocity is approximately 35 ips.

Once the carriage has less than 36 cylinders to go, the current applied to the motor is reversed, dynamically braking the motion of the carriage to 15 ips. When the speed is reduced to 15 ips, the motor is servoed (current is applied to the motor in pulses so that the average current sustains the carriage at the selected speed). The servoing of the printed circuit motor continues until the Decrement counter indicates less than eight cylinders remaining to the selected cylinder. At this point the carriage is again

dynamically braked. When the carriage has been slowed to 6 ips, the printed circuit motor is servoed until the Decrement counter indicates less than four cylinders remaining to the desired cylinder. The carriage is again dynamically braked, reducing the forward speed of the carriage to 2 ips. The carriage continues to be moved forward at 2 ips until the selected cylinder is reached.

When the trailing edge of the next to last track pulse is sensed, the Stop command is initiated within the logic. This command is not completed until the leading edge of the last track pulse is detected. The trailing edge of the last track pulse causes the logic to produce a Detent command. The Detent command drops the current to the detent solenoid. The detent pawl is spring-loaded so that when the solenoid is de-energized, the spring pulls the pawl to the detent gear. When the pawl engages the gear, it holds the carriage securely on the selected cylinder.

When the Detent command occurs and the pawl begins to drop, a delay is initiated. During this delay time, the gear continues to rotate so that the falling pawl is approximately one-third of the way over the selected gear tooth when the delay is timed out. The end of the delay causes a 2-ms high-current Dynamic Braking pulse to be applied to the motor. This pulse completely stops the motor (and the carriage) so that the pawl tip engages the gear very near to the center of the selected slot. A settling time of 15 ms (beginning at the Detent command) is allowed for all vibration to be damped before an On Cylinder signal is sent to the controller. This signal indicates that the disk storage drive is ready for a Read or Write operation.

### Head Loading

Head loading amounts to applying spring pressure to the back of the read/write head so the aerodynamically shaped head face approaches the related disk surface. When the cushion of air that exists on the surface of the spinning disk is encountered, it resists the further approach by the head. Spring pressure is designed to just equal the opposing cushion pressure (function of disk pack rpm) at a height of approximately 120 microinches. As a result the head flies. However, if the spring pressure exceeds the cushion pressure (as would happen if the disk pack lost enough speed), the heads will stop flying and contact the disk surface. This could cause damage to the head as well as the disk surface.

The read/write heads must be loaded to the disk surfaces before exchanging data with the controller. The heads must be released from this position (unloaded) and driven clear of the disk pack when power is removed to the unit or the disk pack velocity falls below a predetermined rpm. The actuator components involved in these operations are identified on Figure 3-15.

When the unit is initially energized, the carriage subassembly is in the retracted position (heads clear of the disk pack edge) and the heads are unloaded. However, as the power to the unit is sequenced up, the disk pack speed is brought up to 2400 rpm. When the pack is up to 1900 rpm, a 12-second delay is allowed for the pack to purge the air in the shroud area. This action assists in maintaining clean disk surfaces and reduces the possibility of disk scoring.

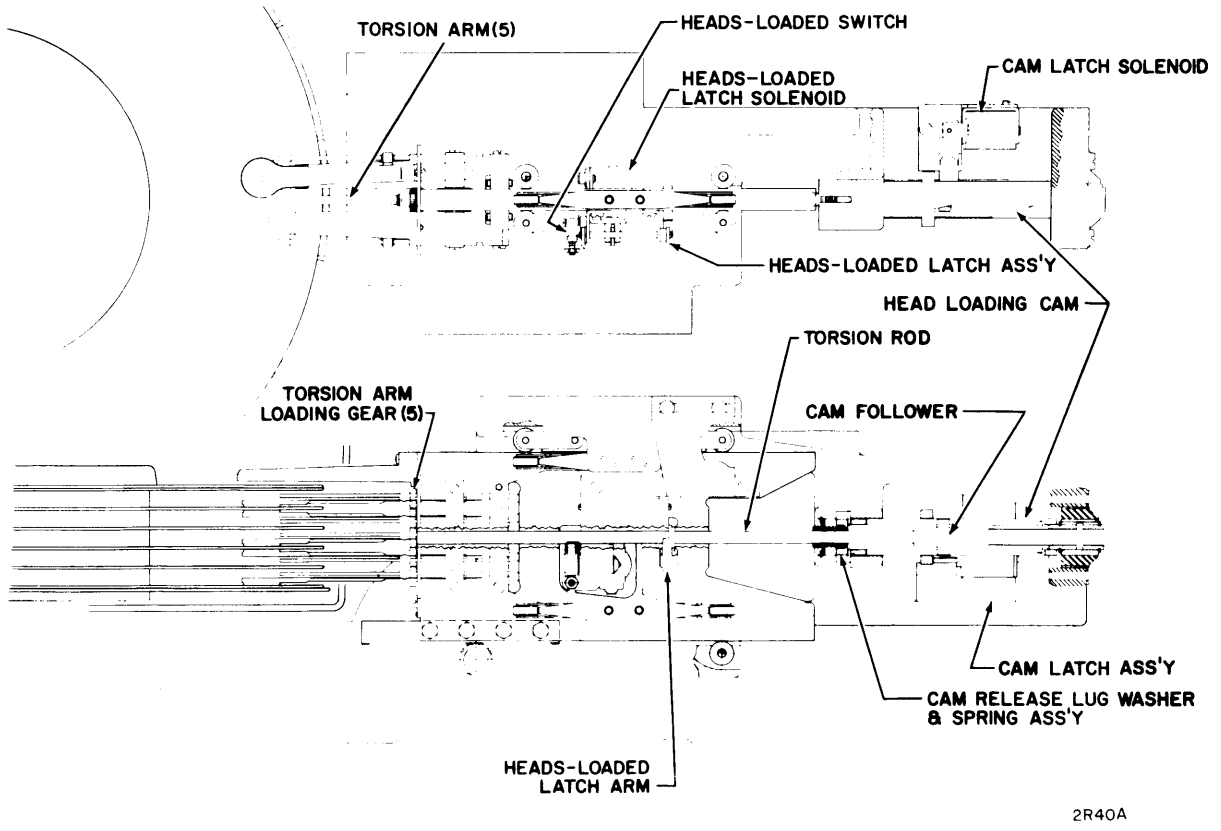



Figure 3-15. Head Loading Components

Once the 2400-rpm speed is reached and the pack has purged the surrounding air, the machine automatically proceeds to load the heads by performing a First Seek operation. First the spring-loaded pawl is pulled out of the detent gear by energizing the detent solenoid. When the pawl tip is out of the gear, the printed circuit motor starts driving the carriage toward the spindle at 6 ips.

With the heads unloaded, the torsion rod holds the cam follower at such an angle that the head loading cam is aligned with two notches in the carriage mount subassembly. The head loading cam is forced into these notches by the cam latch solenoid when the carriage starts moving forward.

With the head loading cam held (to stop rotation) by the notches, the cam follower is forced to ride the cam sides and rotates the torsion rod 60 degrees. Rotation occurs as the carriage is moved forward.

The 60-degree rotation imparted to the torsion rod by the cam follower turns the middle torsion arm loading gear. The five gears are meshed and mounted vertically so that as the middle gear rotates all the gears rotate (Figure 3-16).

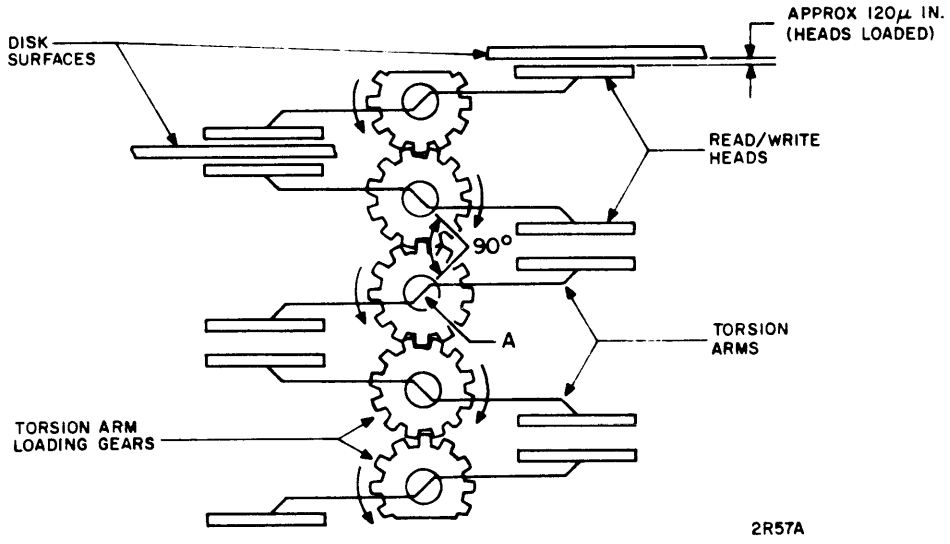



Figure 3-16. Head Loading Mechanism

A torsion arm mounted in the center of each gear is connected between each pair of heads. By rotating each arm, one head is forced down toward a disk surface while the other head is forced upward toward a disk surface. Rotating the five gears and torsion arms (each accommodating two heads) results in the loading of all 10 heads. At the end of the 60-degree rotation, the heads are loaded and the heads-loaded latch arm engages a catch in the heads-loaded latch assembly. The catch is enabled by the latch solenoid when the pack is up to speed.

When the heads have been loaded, the heads-loaded switch closes and the head loading cam is disengaged by de-energizing the cam latch solenoid. The heads remain loaded as long as the heads-loaded latch solenoid is energized. If power to the machine is lost or the disk pack speed is not properly maintained, the solenoid is de-energized. This releases the latch arm and removes torsion arm pressure to the back side of the heads causing the heads to move (vertically) away from the disk surfaces. An air damper device cushions the release of the heads.

When the heads are loaded, the First Seek operation generates a Reverse Motion command. This causes the carriage to be driven in the reverse direction at 2 ips. The carriage is retracted until a home cell signal is sensed at which time a Forward Motion command occurs, causing the carriage to be driven forward at 2 ips to cylinder 00 where the spring-loaded pawl is dropped.

## CABINET COOLING

Filtered air is distributed throughout the disk storage drive to clean and cool the various components (Figure 3-17).

The logic chassis is cooled by filtered air from two fans. The front panel of the unit allows air to enter between the lower portion of the panel and the main frame. Mounted over this opening is the logic chassis air intake through which air is drawn, filtered, and then forced upward between the cards of the logic chassis. The warm air is exhausted through openings in the top of the logic chassis and channeled out of the disk storage drive between the top of the front panel and the main frame and the grill in the front panel.

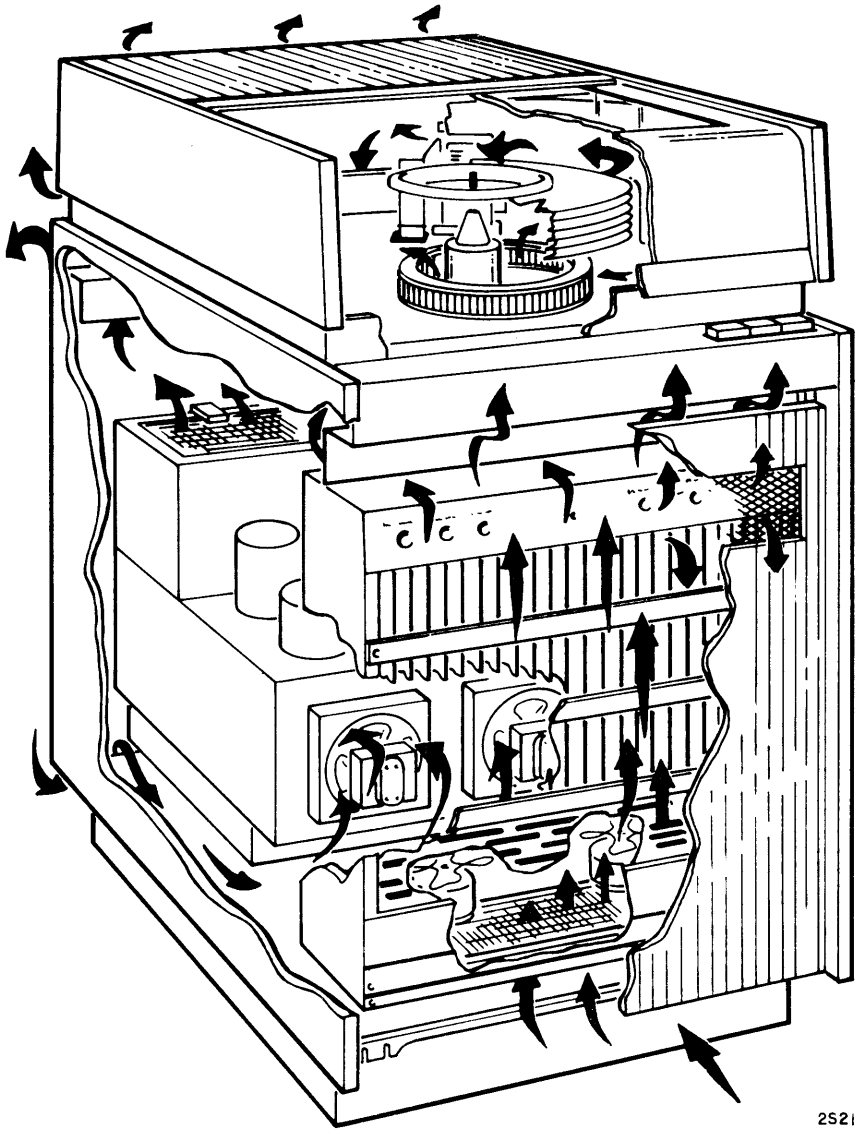



Figure 3-17. Cabinet Cooling

The power supply is also cooled by filtered air from two fans. Air enters between the lower portion of the rear panel and the main frame. This air is drawn by the fans along the bottom and to the rear of the power supply. The air is then forced through the power supply, exhausted through a grill in the top of the power supply, and channeled out (via a metal deflector) through the openings between the top of the rear panel and the main casting and the rear panel grill.

The spinning disk pack acts as an air pump, drawing air through the filter at the base of the disk pack on the main deck and through the nylon mesh filter in the base of the disk pack. This air is channeled up through the hub of the disk pack and dispersed outward between the disks. Consequently, all air in and around the disk pack surfaces is filtered air. This prevents head and disk surface damage due to foreign particle accumulation. Whenever the disk pack is set in motion, a 12-second purge time (starting when disk pack is up to 80 percent of maximum speed) is allowed to clean the disk surfaces before the heads are loaded. The filtered air blown across the disk surfaces is forced through the shroud opening for the head/arm assembly. The air is exhausted through an opening between the lower edge of the top rear cover and the main frame and through slotted holes at the back of the top rear cover.

## DISK PACK ASSEMBLY

The disk pack is the recording medium for the disk storage drive. The disk pack consists of six 14-inch, magnetic-oxide coated disks that are center mounted on a vertical shaft. Eight recording surfaces are gained by using both surfaces of the four interior disks. Only the inner (relative to original four) surfaces of the top and bottom disk are used; yielding a total of 10 recording surfaces. The outer surface of the top recording disk is covered by a seventh disk which provides stability and protection only. A larger disk at the bottom of the assembly, with notches around the circumference, divides the disk pack into organizational pieces called sectors.

When in use, the disk pack mounts on and is driven by the spindle of the disk storage drive. Each disk pack has a two-piece dust cover (plastic cannister with bottom). The handle of the plastic cannister contains a mechanism to release or lock (depending on direction of rotation) the disk pack on the spindle during removal or installation.

When the disk pack is not installed, both dust covers should be in place. After the disk pack is installed, the front cover of the disk storage drive should be kept closed.

## CYLINDER CONCEPT

The 10 recording surfaces of a disk pack are numbered 00 through 09 from top to bottom. Ten read/write heads are mounted on the carriage assembly in two adjacent

vertical stacks (5 heads per stack). Each head is oriented so as to service one disk surface. Each head is identified by the number assigned to the disk surface it services. By moving the carriage assembly, the actuator can position the 10 heads (as a group) at 100 discrete positions (tracks) on the disk surfaces. These 100 tracks are numbered 00 through 99 from the outer edge of the disk pack toward the spindle. Assume now that the disk pack is rotating and that the actuator is detented so that the heads are positioned over Track 50 of the disk surfaces. Then a cylinder (Figure 3-18) is defined as the total data available to all heads during one revolution of the disk pack. In this example there would be 49 additional cylinders of data available if the heads were moved one track at a time toward the spindle (forward), and 50 additional cylinders if the heads were moved in the reverse direction from their present position.

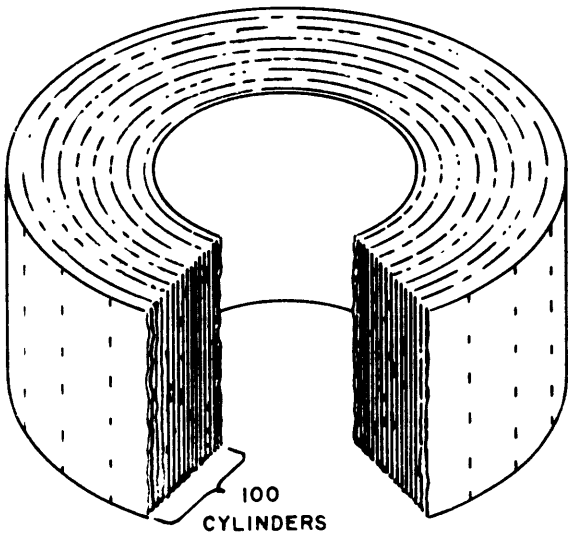



Figure 3-18. Cylinder Concept

# SECTION 4

# DIAGNOSTIC MAINTENANCE ROUTINES

# DIAGNOSTIC MAINTENANCE ROUTINES

Refer to the appropriate System Maintenance Monitor or Diagnostic Maintenance Routines Reference Manual.

# SECTION 5

# PREVENTIVE MAINTENANCE

## INTRODUCTION

The performance of the disk storage drive (Figure 5-1) depends on a carefully planned and executed program of preventive maintenance, proper corrective maintenance when required, and recording of all information pertinent to the maintenance and operation of the unit. This program, if followed, will ensure optimum performance and maximum equipment up-time.

This section contains the procedures for scheduled preventive maintenance on an hours-used basis except for the read/write heads and the disk pack (see Caution). It is essential that scheduled preventive maintenance be performed at the specified intervals even though the unit is operating satisfactorily. Scheduled preventive maintenance procedures should not be performed other than at the intervals indicated. The elapsed time meter (Figure 5-2) should be used to check these intervals. Kepp an accurate log of all pertinent maintenance and operation information.

**CAUTION**

Be especially attentive to the following paragraphs relating to contamination of the heads and disk surfaces. Failure to observe the cleaning procedures outlined could cause serious scoring of the heads and recording surfaces through buildup of foreign particles on these areas.

## HEADS

Clean heads once a week, and any time an oxide accumulation is noted or read errors begin to occur. Dust and dirt present on the disks or the read/write heads can damage both the heads and the disks. When pressurization of the pack and actuator is positive, the air is kept clean and any loose dust is evacuated. Dust does not accumulate under these conditions. However, when the disk storage drive is off or a disk pack is in storage, dust and dirt tend to accumulate on the heads and the recording surfaces and possibly cause scoring of the heads.

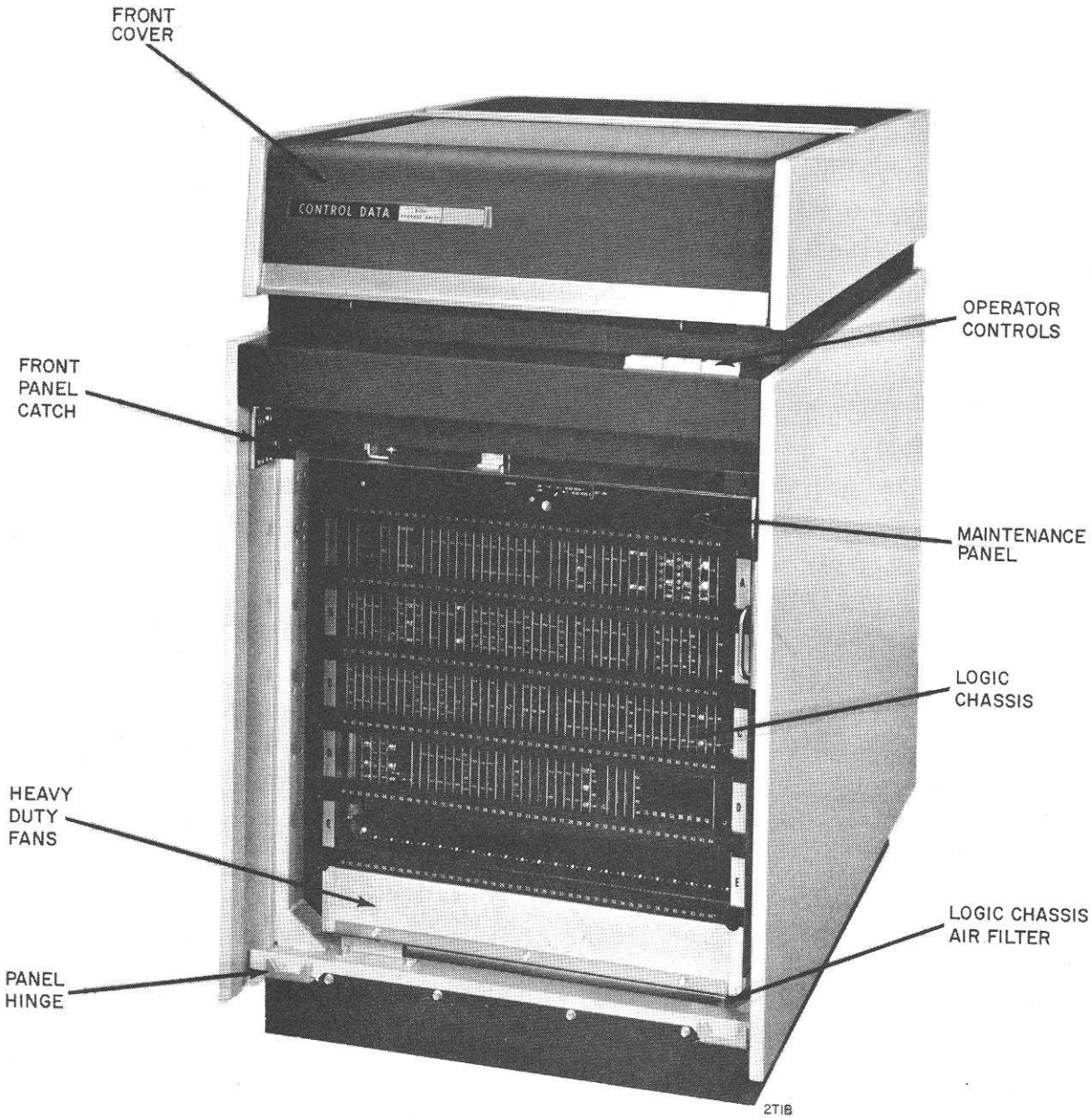



Figure 5-1. Disk Storage Drive - Front View

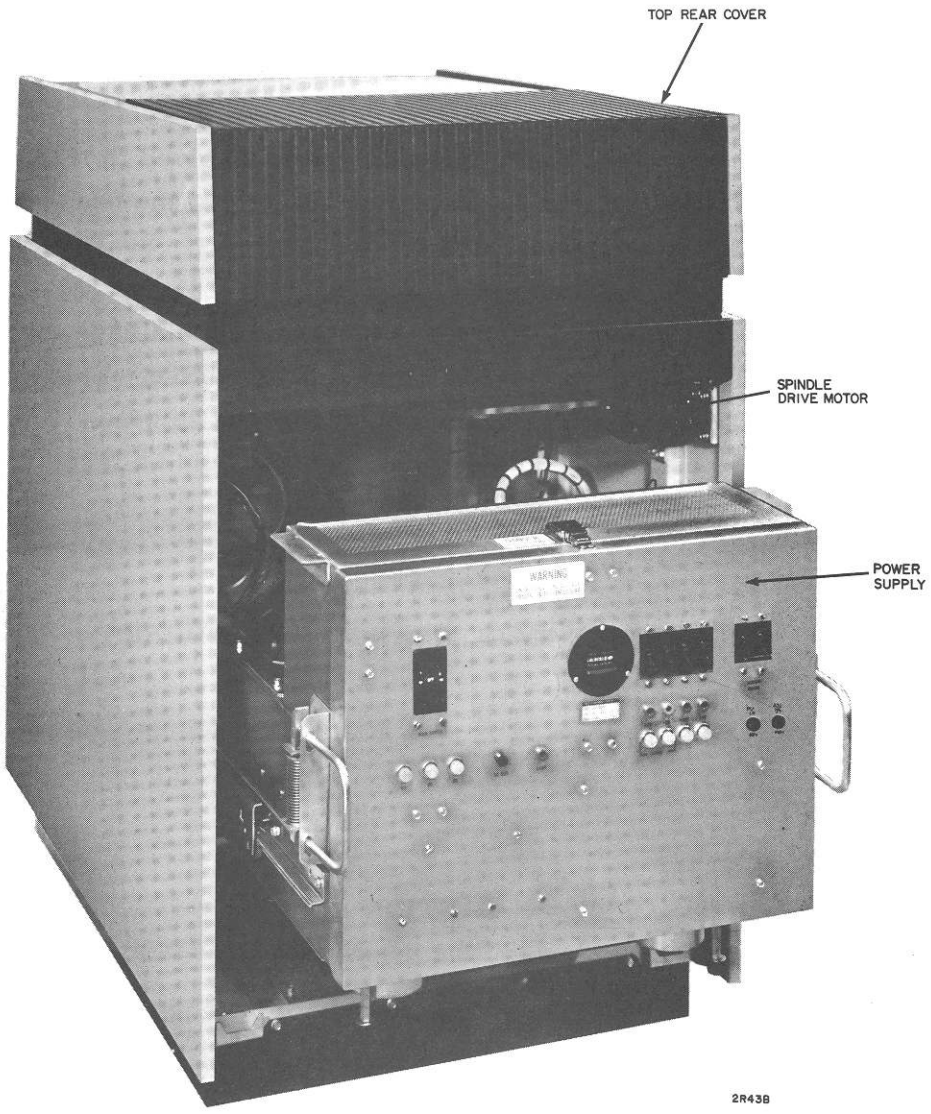



Figure 5-2. Disk Storage Drive - Rear View

DISK PACKS

Clean disk pack at the following intervals:

- New disk pack - clean before using.
- Disk pack used less than once a week - clean before each use.
- Disk pack used more than once a week - clean once a week.

In operating in other than a clean room environment or involved in frequent Start/Stop operatings, clean once daily. Clean the pack immediately if the heads show an oxide buildup or a specific disk pack causes read errors.

The disk pack should not remain on unpowered units and should have the bottom cover secured immediately upon removal from the disk storage drive. This cover should remain secured until the disk pack is again mounted on the spindle. Both top and bottom covers should be cleaned periodically and care should be taken so that they do not become a source of contamination.

## PREVENTIVE MAINTENANCE PROCEDURES

### 500 HOUR

Inspect Heads for Scratches

CAUTION

Use care not to damage the heads with the dental mirror.

1. Using a dental mirror, inspect the head for scratches.
2. If the head has a series of grooves across the shoe face, the head has been flown across a disk surface which contains an imbedded particle. Clean the suspected disk pack.

NOTE

The presence of the grooves does not necessarily mean an unusable head. Further examination is necessary. When the surface of a head contacts a particle it is possible for a burr to be formed on the head or for a particle to be partially imbedded in the ferrite. If this protrusion is greater than the flight height it will scratch the disk. Refer to Head Replacement Criteria.

3. Using dry lint-free gauze on a plastic spatula, carefully check a scratched head for protrusions by drawing the gauze across the head.

4. Check the functioning of the head with trial Read and Write operations.

Inspect Heads for Oxide Buildup

CAUTION

Use care not to damage the heads with the dental mirror.

1. Using a dental mirror, inspect the head for oxide. The reddish brown oxide buildup is readily discernible on the head.

2. Proceed with the head cleaning described below, if required.

Clean Read/Write Heads

CAUTION

Do not touch or breathe on heads; skin acids etch head surfaces and moisture causes dust to accumulate and rust to form. Wipe heads carefully; residue or dirt scores heads and disks when unit is returned to operation. Data is lost in scored areas.

1. Wrap a piece of lint-free gauze around a plastic spatula and dampen with 9-percent isopropyl alcohol.

2. Support the back of the read/write head with a second spatula.

3. Thoroughly wipe the face of each read/write head with the isopropyl alcohol dampened gauze.

CAUTION

Use care not to damage the heads with the dental mirror.

4. Inspect the head surface with a dental mirror, to be sure that the surface is free of dirt and scratches. Repeat cleaning if necessary.
5. Wipe the head with a clean, dry, lint-free gauze.

## Head Replacement Criteria

Heads of the disk storage drive have been designed such that they should not have to be replaced if given proper preventive maintenance and care. If a head requires replacement, refer to Part 6 of this manual. Heads can be deemed defective and in need of replacement if any of the following conditions exist:

1. Consistent oxide buildup on the head, indicating repeated head/disk impact.
2. Concentric scratches on the disk surface. Inspect head for imbedded particle.
3. An audible ping indicating that the head is hitting the disk surface.

## Clean Disk Pack

1. Mount the disk pack to be cleaned on a de-energized disk storage drive spindle.
2. Wrap a clean lint-free piece of gauze around a plastic spatula and dampen (do not soak) with 91-percent isopropyl alcohol.
3. Insert the gauze wrapped spatula between the disks and manually rotate the disk pack. Apply downward pressure to clean the lower disk surfaces, then apply upward pressure to clean the upper disk surfaces.
4. Withdraw the gauze wrapped spatula while the disk pack is still rotating.
5. Wrap a piece of dry lint-free gauze around a plastic spatula and repeat step 3.
6. Dampen another piece of gauze with 91-percent isopropyl alcohol and wipe the exposed outer surface of the disk pack.
7. Remove the disk pack from the spindle.
8. Clean the disk pack spindle mounting area and the disk pack bottom cover thoroughly with a 91-percent isopropyl alcohol dampened gauze.

9. Inspect the nylon gauze filter in the bottom of the disk pack. If the filter is dirty or discolored, remove the O-ring securing the filter. Install a new filter (Control Data 45546500) and secure it with the original O-ring.
10. Replace the disk pack in the container and store until required for use.

Disk Pack Visual Inspection

1. Set the disk storage drive power supply MAIN POWER circuit breaker to OFF.
2. Open the front cover and inspect the disk pack.
3. Inspect each disk surface for scratches.
4. Comet-like scratches indicate that a particle has been caught and dragged between the head and the disk surface. The particle is usually imbedded in the disk. Proceed with disk pack cleaning. If the particle cannot be dislodged the disk pack must be replaced.
5. Scratches that are concentric and have spirals connecting them indicate that the head contains an imbedded particle, a burr on the shoe face, or an improperly mounted head. Check the head related to that disk surface.

Disk Pack Replacement Criteria

The disk pack has been designed to last the lifetime of the equipment. Replacement of the disk pack is required only if excessive runout (see Disk Pack Runout Check, Part 7) is encountered, or physical damage to the pack results in the loss of recording ability. This physical damage includes:

1. Damage to the disk pack resulting in a broken disk. If a disk is bent, refer to the Disk Pack Runout Check, Section 7.
2. Gouged or scored disk surface causing the loss of stored data.
3. Imbedded particles in a disk surface that cannot be removed by cleaning and are causing damage to the heads.

Clean Shroud

1. Open front cover and remove disk pack.
2. Dampen a piece of gauze with 91-percent isopropyl alcohol.

3. Wipe shroud and the spindle carefully. Remove all dirt and smudges.
4. Inspect for any metal or dust particles remaining on, around, or near shroud.
5. Remove these loose particles, using the sticky surface of adhesive or masking tape.

Clear Air Intake Filters

1. Remove the air filters from bottom of the logic chassis (Figure 5-3) and at the rear of the power supply (Figure 5-4).
2. Agitate the filter in mild household detergent solution. Rinse the filter in the reverse direction using a low-pressure nozzle.
3. Shake any excess water from the filter and allow a reasonable drying time before proceeding.
4. Spray the filter thoroughly with Filter Coat (Research Products Corp) to restore filtration ability.

Lubricate Rack, Pinion Gear, and Cam

Saturate the oil wick assembly on the carriage rack gear (Figure 3-11) with oil (Texaco All-Purpose EP Lubricant, Control Data 95020400). Do not add oil to the extent that it runs out of the wick assembly. Add 1 drop of oil to the pinion. Add 1 drop of oil to the upper and lower forward-sloping surfaces of the cam.

Lubricate Cam Release Lug Washer

Using the customer engineering syringe (or equivalent) carefully lubricate the two cams on the cam follower side of the cam release lug washer (Figure 3-15) with 1 drop of oil (Texaco All-Purpose EP Lubricant, Control Data 95020400).

Lubricate Detent Gear

Carefully clean the detent gear (Figure 3-12) using a lint-free cloth. Apply a thin coating of oil (Texaco All-Purpose EP Lubricant, Control Data 95020400). Wipe off any excess.

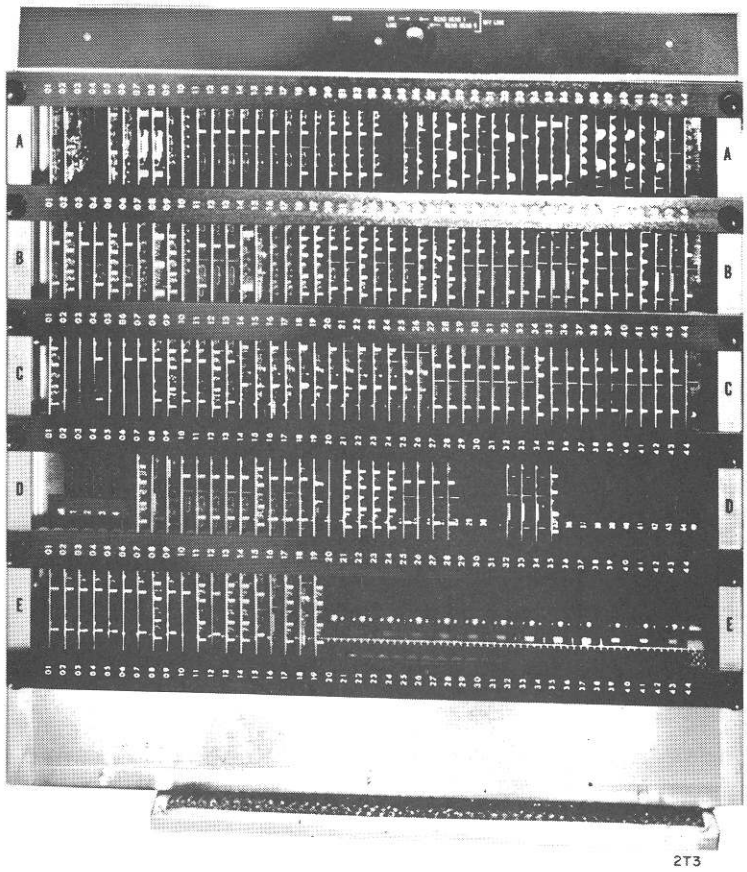



Figure 5-3. Air Filter at Bottom of Logic Chassis

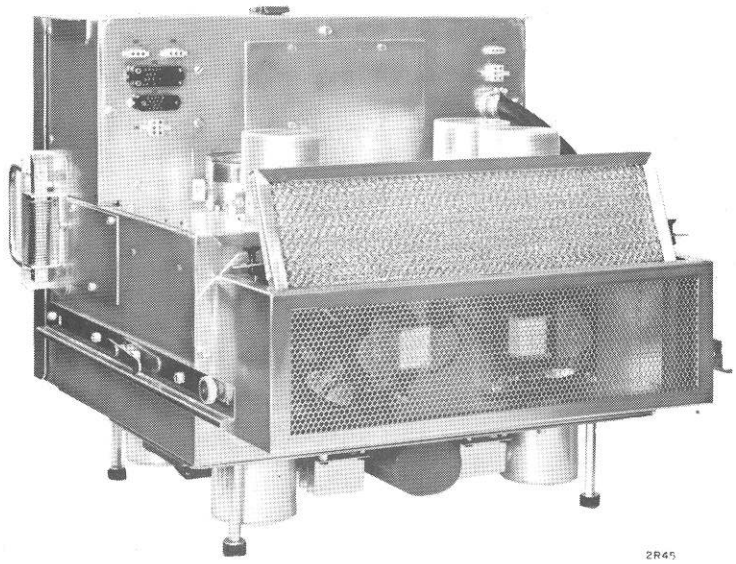



Figure 5-4. Air Filter at Rear of Power Supply

1000 HOUR

Lubricate Carriage Rollerways

Carefully clean the carriage rollerways using a lint-free cloth. Apply a thin coating of oil (Texaco All-Purpose EP Lubricant, Control Data 95020400).

Lubricate Torsion Arm Loading Gears

Clean the gears carefully using a lint-free cloth. Apply 1 drop of oil (Texaco All-Purpose EP Lubricant, Control Data 95020400) to each gear.

2000 HOUR

Lubricate Disk Pack Locking Screw and Spindle Lockshaft

Wipe the disk pack locking screw (in disk pack) and the spindle lockshaft (in the spindle) using a lint-free cloth to remove contaminated lubricant. Repeat procedure with clean cloth until the surfaces are clean. Apply a light coat of oil (Texaco All-Purpose EP Lubricant, Control Data 95020400) to the clean surfaces.

Clean Base of Machine and Covers

1. Dampen a lint-free cloth with 91-percent isopropyl alcohol.
2. Carefully wipe the sides and base to remove dirt and dust accumulations. Use a new cloth as often as necessary.
3. Stains or heavy dirt accumulation may be removed using soap and water.

Replace Disk Pack Air Filter

1. Remove the disk pack.
2. Raise and latch the top rear cover.
3. Remove the four Phillips screws holding the inner shroud to the main casting standoffs. Carefully remove the shroud.
4. Remove the disk pack filter.
5. Visually center the replacement filter (Control Data 45467300 on units Serial No. 499 and below; 45482300 on units Serial No. 5000 and above).

6. Place the shroud over the filter, press the shroud into place, and tighten the four Phillips head screws.

7. Make certain that the shroud allows clearance for the carriage and the sector/presector photocell assembly.

8. Lower the top rear cover.

## Check Disk Storage Drive Leveling

Check the inclination of the disk storage drive unit by placing a level on the top of each of the supporting sides. If the inclination is more than 3 degrees, the symmetry of the forward and reverse carriage move times may be lost. Level the machine, as required by adjusting the four screw-type feet.

# SECTION 6

# MAINTENANCE PROCEDURES

## GENERAL

The maintenance procedures for the disk storage drive are provided in the form of replacement and adjustment procedures. It is recommended that maintenance personnel read the entire procedure prior to performing the replacement or adjustment. In order to apply spindle drive motor power when the unit is disconnected from the controller, a jumper wire must be installed between pins 2 and 3 of J08 (located on exterior surface of power supply opposite the circuit breakers).

Refer to Section 1 for a listing of special tools required during the performance of maintenance procedures.

### CAUTION

During some of the procedures of this section, it is necessary to operate the disk storage drive (disk pack installed) with the top covers open. Operating in this configuration for a period in excess of 2 hours may damage the read/write heads and disk pack. Operating in this configuration for a period in excess of 1 hour necessitates cleaning the heads and disk pack according to Section 5.

## REPLACEMENT

### SPINDLE LOCK OR DRIVE BELT REPLACEMENT ( Figure 6-1)

1. Press (to extinguish) the START switch. Disconnect the line voltage power cord.
2. Open and latch the disk drive top rear cover and remove the front panel. Swing the logic chassis out.
3. Proceed to step 4 for spindle lock replacement or to step 5 for drive belt replacement.

4. Replace the spindle lock disk according to step a. Replace any other spindle lock part according to steps b, c, and d.

   a. To replace the spindle lock disk, remove the two socket head screws securing the switch mounting bracket to the base of the spindle assembly. Carefully lower the assembly clear of the spindle. Remove the three screws and washers securing the spindle lock disk to the bottom of the pulley. Install the replacement disk with the original three screws and washers. Install the switch mounting bracket with two socket head screws. Use two washers between the bracket and the spindle casting leg at the right-hand end of bracket; use one washer between the left-hand screw and the bracket. Secure the loose end of the ground cable with the screw in the right-hand end of the bracket. Proceed to step 6.

   b. To replace the spindle lock solenoid, the pawl, or the spindle lock switch, tag and then disconnect the four electrical connections to the spindle lock assembly. Remove the two socket head screws that secure the assembly to the base of the spindle. Slide the assembly clear of the spindle. Replace the faulty component according to the original installation.

   c. Tighten the screw/nut pivot through the pawl until all play is removed, but make certain that the pawl is free to pivot. Check that the acorn nut is completely threaded on to the armature of the solenoid, and that the armature spring is in place. Hook the extension spring between the pawl and the grooved pin. Loosen the screws securing the solenoid. Place a 14/64 $\pm$ 1/64-inch shim or feeler gauge between the pawl and the mounting plate as shown on Figure 6-1. With the solenoid armature fully retracted and the acorn nut against the pawl, tighten the solenoid mounting screws. Remove the shim or feeler gauge and check that the pawl/plate gap is correct.

   d. Install the spindle lock assembly on the base of the spindle. At the mounting point, used in common by the spindle lock assembly and the switch mounting bracket, the spindle lock assembly faces against the spindle casting. Restore the four electrical connections to the lock assembly. Proceed to step 6.

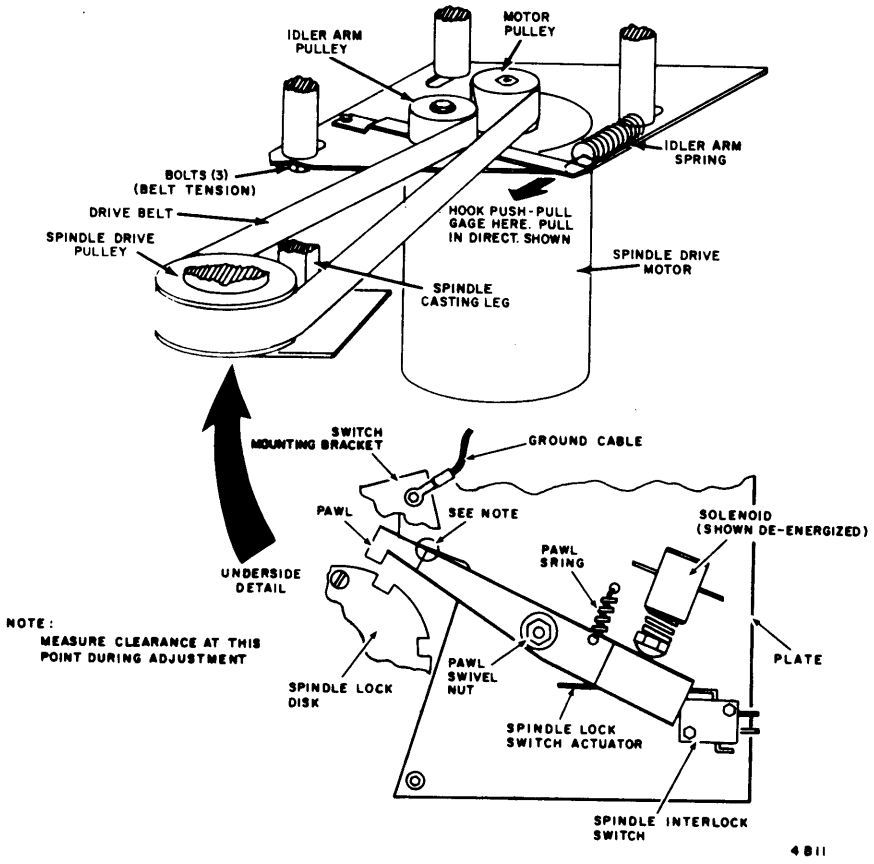



Figure 6-1. Lock and Belt Adjustment

5. Replace the drive belt as follows:

   a. Disconnect the spring to the drive belt idler arm. Lift the belt clear of the motor pulley.

   b. Remove the two socket head screws securing the switch mounting bracket to the base of the spindle assembly. Carefully lower the assembly clear of the spindle.

   c. Thread the belt between the pawl tip and the spindle lock disk. Allow the belt to fall free of the spindle assembly.

d. Place a loop of the replacement drive belt around the spindle drive pulley so that when the belt is extended toward the motor pulley, it passes on both sides of the spindle casting leg between the spindle drive pulley and the motor pulley. Place the drive belt over the motor drive pulley. Make certain that the belt is not twisted and that the smooth surface of the belt faces against the pulleys. Connect the spring to the idler arm.

e. Assemble the switch mounting bracket to the base of the spindle with two socket head screws. Use two washers between the bracket and the casting leg at the right hand end of the bracket; use one washer between the left-hand screw and the bracket. Secure the loose end of the ground cable with the screw in the right-hand end of the bracket.

f. Using a push-pull gauge (12210797) check that the idler arm just pulls away from the drive belt with a pull force (applied perpendicular to the arm length axis) of $1.0 \pm 0.25$ pound. Loosen the three bolts securing the drive motor assembly to the bottom of the main deck, and reposition the drive motor assembly to meet the requirement.

6. Connect the unit power cords. Set the power supply MAIN POWER circuit breaker to ON. Place a disk pack on the spindle and tighten it in place. Set the MAIN POWER circuit breaker to OFF and disconnect the power cords.

7. Using a feeler gauge, check that the gap between the static discharge contact arm and the Pack-On switch actuator meets the requirement of Figure 6-2. Loosen the two screws securing the microswitch bracket to the switch mounting bracket and slide the bracket vertically to attain the correct dimension. Tighten the screws. Make certain that the static discharge contact is aligned to the lockshaft according to Figure 6-2. The contacts will be damaged during operation if not properly aligned.

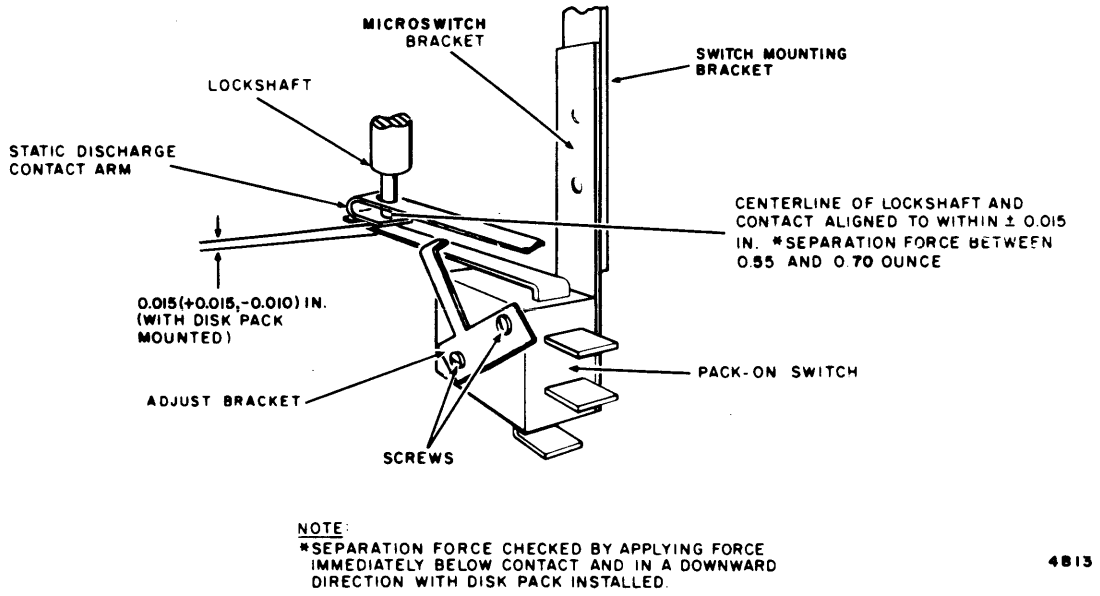



Figure 6-2. Pack-On Switch Adjustment

## PACK-ON SWITCH OR STATIC DISCHARGE CONTACT REPLACEMENT

1. Press (to extinguish) the START switch. Disconnect the line voltage power cords.
2. Remove the disk drive front panel and swing the logic chassis out.
3. Note or tag all electrical connections to the Pack-On switch and the static discharge terminals. Detach each connection.
4. Remove the two screws and four washers holding the microswitch bracket to the switch mounting bracket.
5. Proceed to step 6 for Pack-On switch replacement or step 7 for static discharge contact replacement.
6. Replace the Pack-On switch as follows:
   a. Remove the two screws, three washers, and the nut securing the adjust bracket, the ground cable, and the faulty switch to the microswitch bracket.

b. Apply 2 drops of Loctite, Grade C, to the screw threads. Loosely assemble the adjust bracket, the ground cable, and the replacement switch to the microswitch bracket.

c. Position the adjust bracket to keep the downward travel of the switch actuation arm (before switching) to an absolute minimum. Make certain, however, that this position allows switching to occur again when the switch actuation arm moves upward. Then tighten the screws.

d. Proceed to step 8.

7. Replace the static discharge contact as follows:

   a. Remove the screw and shims (if used) securing the static discharge contact arm to the bottom of the ground mounting standoff.

   b. Install the replacement static discharge contact arm (use all shims present on the faulty contact arm). Make certain that the contact and the lockshaft center lines are aligned, and that the contact arm and the lockshaft are not in contact. Tighten the screw to secure the contact arm.

8. Loosely assemble the microswitch bracket to the switch mounting bracket with two screws and four washers.

9. Restore the electrical connections at the Pack-On switch and the static discharge contact terminals.

10. Connect the unit power cords. Set the power supply MAIN POWER circuit breaker to ON. Place a disk pack on the spindle and tighten it in place. Set the MAIN POWER circuit breaker to OFF and disconnect the power cords.

11. Using a feeler gauge, check that the gap between the static discharge contact arm and the Pack-On switch actuator meets the requirement of Figure 6-2. Slide the microswitch bracket vertically to attain the correct dimension. Tighten the screws.

12. Use a push-pull gauge(12210797) to check that the force required to separate the contacts is as shown on Figure 6-2. If the separation force exceeds the maximum allowable, add shims as required between the ground mounting standoff and the contact arm (shim part numbers are available in Illustrated Parts List).

## HOME CELL PHOTOTRANSISTOR OR LAMP REPLACEMENT

1. Press (to extinguish) the START switch. Disconnect the line voltage power cord.
2. Open and latch the disk drive top rear cover.
3. Proceed to step 4 for phototransistor replacement or step 5 for lamp replacement.
4. Replace home cell phototransistor as follows:
   a. Note or tag the two leadwires connected to the home cell phototransistor plate and disconnect them.
   b. Remove the two screws securing the home cell mounting bracket to the carriage and separate the two assemblies.
   c. Remove the two screws holding the phototransistor plate to the photocell block.

   NOTE

   Throughout subsequent reassembly procedures, apply 2 drops of Loctite, Grade C, to all screw threads unless otherwise specified.

   d. Install the replacement phototransistor plate using two screws.
   e. Secure the home cell mounting bracket to the carriage with two screws. Keep the dimension between the phototransistor plate and the mask to a minimum. Make certain that the ground lead terminal is secured by the right (viewed from screw head side) screw.
   f. Restore leadwire connections to home cell according to step a.
   g. Proceed to step 6.
5. Replace home cell lamp as follows:
   a. Remove the two screws securing the home cell mounting bracket to the carriage and separate the two assemblies.
   b. Remove the lamp from the mounting block.
   c. Disconnect the J230-P230 connection at the top rear of the carriage.

d. Note the lamp pin positions in J230. Using an extraction tool (12210915), remove the lamp pins from J230. Remove the related leadwires from the cable bundle.

e. Crimp contact pins on each leadwire of the replacement lamp.

f. Dress the leads of the replacement lamp into the cable bundle. Press the contact pin of the lamp leadwires into J230.

g. Connect P230 to J230.

h. Applicable only to units with Serial No. 1927 and below without FCO 1751. Insert the lamp into the mounting block and secure with the retaining spring.

i. Applicable only to units Serial No. 1927 and below with FCO 1751 installed, and to all units Serial No. 1928 and above. Carefully insert the lamp into the spring clip.

j. Secure the home cell mounting bracket to the carriage with two screws. Keep the dimension between the phototransistor plate and the mask to a minimum. Make certain that the ground lead terminal is secured by the right hand (as viewed from screw-head side) screw.

6. Perform the Home Cell Mechanical and Switching Level Adjustment procedures.

## SECTOR/PRESECTOR PHOTOTRANSISTOR OR LAMP REPLACEMENT

1. Press (to extinguish) the START switch. Disconnect the line voltage power cord.
2. Open and latch the disk drive top rear cover.
3. Proceed to step 4 for phototransistor replacement or step 5 for lamp replacement.
4. Replace the sector and presector phototransistors as follows:
   a. Note or tag the three leadwires connected to the phototransistor plate and disconnect them.
   b. Remove the two screws securing the phototransistor plate to the bracket.

c. Apply 2 drops of Loctite, Grade C, to the screw threads and install the replacement phototransistor plate.

d. Restore the leadwire connections to the phototransistor plate according to step a.

e. Proceed to step 6.

5. Replace the sector or presector lamp as follows:

a. Separate the two-wire connectors to the faulty lamp. Using an extraction tool (12210915), remove both pins from the connector wired to the lamp.

b. Remove the lamp from the mounting block.

c. Crimp contact pins on each leadwire of the replacement lamp.

d. Press the black leadwire pin into position 1 of the connector. Press the yellow leadwire pin into position 2 of the connector.

e. Connect the two-wire connectors.

f. Applicable only to units with Serial No. 1927 and below without FCO 1750 installed. Insert the lamp into the mounting block and secure with the retaining spring.

g. Applicable only to units Serial No. 1927 and below with FCO 1750 installed, and to all units Serial No. 1928 and above. Carefully insert the lamp into the spring clip.

6. Perform the Sector/Presector Photocell Switching Level Adjustment procedure.

7. Perform the Sector/Presector Block Tangential and Radial Adjustment procedure.

## TRACK/SPEED PHOTOTRANSISTOR OR LAMP REPLACEMENT

1. Press (to extinguish) the START switch. Disconnect the line voltage power cord.

2. Open and latch the disk drive top rear cover.

3. Remove the two screws holding the timing disk dust cover in place.

4. Proceed to step 5 for phototransistor replacement or step 6 for lamp replacement.

5. Replace the track and speed phototransistors as follows:

   a. Note or tag the three leadwires connected to the phototransistor plate and disconnect them.

   b. Remove the two screws holding the photocell assembly to the motor mounting plate.

   c. Remove the two screws securing the phototransistor plate to photocell mounting bracket.

   d. Apply 2 drops of Loctite, Grade C, to the screw threads and install the replacement phototransistor plate.

   e. Restore the leadwire connections to the phototransistor plate according to step a.

   f. Proceed to step 7.

6. Replace track or speed lamps as follows:

   a. Remove the lamp from the mounting block.

   b. Disconnect the J230-P230 connection at the top rear of the carriage.

   c. Note the position of the lamp pins in J230. Using an extraction tool (12210915), remove the pins of the applicable lamp from J230. Remove the leadwires from the cable bundle.

   d. Crimp contact pins on each leadwire of the replacement lamp.

   e. Dress the leads of the replacement lamp into the cable bundle. Press the pins into connector J230.

   f. Connect P230 to J230.

   g. Applicable only to units Serial No. 1927 and below without FCO 1751 installed. Insert the lamp into the mounting block and secure with the retaining spring.

   h. Applicable only to units Serial No. 1927 and below with FCO 1741 installed, and to all units Serial No. 1928 and above. Carefully insert the lamp into the spring clip.

7. Perform the Track/Speed Photocell Mechanical and Switching Level Adjustment procedures.

8. Perform the Timing Disk Rotational Adjustment procedure.

9. Perform the Actuator Dynamic Tests and Adjustments procedure.

## TIMING DISK REPLACEMENT

1. Press (to extinguish) the START switch. Disconnect the line voltage power cord.

2. Open and latch the disk drive top rear cover.

3. Remove the two screws holding the timing dust cover in place.

4. Note the positioning of the track and speed photocell and remove the two screws securing it to the motor mounting plate.

5. Manually disengage the detent pawl and move the carriage forward until the screw securing the timing disk hub to the motor shaft is visible in the slotted opening of the motor mounting plate. Loosen the screw with a long shaft Allen wrench.

6. Note the position of the blank area (or interruption) in the timing disk marks. Remove the timing disk and hub.

7. Install the replacement timing disk and hub aligning the blank area in the disk marks according to step 6.

CAUTION

The timing disk markings are photo emulsion. Use extreme care and plastic feeler gauges when setting the gap.

8. Using the adjustment screw in the center of the hub, establish a gap of $0.005 \pm 0.002$ inch between the timing disk and the mask. Disengage the detent pawl and check the runout and wobble of the timing disk through one revolution. The timing disk should hold the gap dimension and must not contack the mask. Tighten, slightly, the screw securing the hub to the shaft. Recheck the gap dimension.

9. Apply 2 drops of Loctite, Grade C, to the screw threads and assemble the photocell assembly to the motor mounting plate according to the orientation of step 4.

10. Perform the Track/Speed Photocell Mechanical and Switching Level Adjustment procedure.
11. Perform the Timing Disk Rotational Adjustment procedure.
12. Perform the Actuator Dynamic Tests and Adjustments procedure.
13. Apply 2 drops of Loctite, Grade C, to the threads and install the timing disk dust cover.

## FLEXIBLE COUPLING OR ACCESS MOTOR REPLACEMENT

1. Press (to extinguish) the START switch. Disconnect the line voltage power cord.
2. Open and latch the disk drive top rear cover.
3. Remove the two screws holding the timing disk dust cover in place.
4. Remove the four screws and washers holding the plastic shroud and set the shroud aside.
5. Note the positioning of the track and speed photocell and remove the two screws securing it to the motor mounting plate.
6. Manually disengage the detent pawl and move the carriage forward until the screw securing the timing disk hub to the motor shaft is visible in the slotted opening of the motor mounting plate. Loosen the screw with a long shaft Allen wrench.
7. Note the position of the blank area (or interruption) in the timing disk marks. Remove the timing disk and hub.
8. Disconnect each of the read/write head cable plugs from the head diode boards. Stow each plug so that it will not interfere with carriage motion. Remove the two screws securing the head diode board mounting bracket to the top of the actuator. Set the boards and bracket carefully aside.
9. Applicable to units Serial No. 480 and below only: remove the four bolts securing the actuator assembly to the disk storage drive main deck.
10. Manually disengage the detent pawl and position the carriage until the screws securing the flexible coupling to the motor shaft are visible (as viewed from behind the carriage and between the actuator casting and access motor).

11. Proceed to step 12 for flexible coupling replacement or step 13 for access motor replacement.

12. Replace a flexible coupling as follows:

    a. Remove the two screws at each end of the flexible coupling with a long shaft Allen wrench.

    b. While supporting the access motor, remove the three screws securing the motor and the motor mounting plate to the transition plate (units Serial No. 981 and above or other units with FCO 1134 installed) or the actuator casting.

    c. Carefully separate the motor shaft from the flexible coupling. Use care not to strain or damage the motor leadwires. If the disk storage drive has a Serial No. of 480 or lower, the actuator must be tipped until the motor clears the disk drive main deck in order to separate the shaft and coupling.

    d. Slide the faulty flexible coupling from the shaft.

NOTE

When reassembling, apply 2 drops of Loctite, Grade C, to the threads of all screws or bolts, unless otherwise instructed.

    e. Apply a light bead of Loctite retaining compound to both ends and the first 1/16-inch of inner surface of the flexible coupling. Loosely install the four screws in the coupling.

    f. Slide the flexible coupling on the detent gear shaft as far as it will go and tighten evenly, the two screws at the end of the shaft.

13. Replace access motor as follows:

NOTE

Field repair of the access motor is not recommended. Return faulty motor to the factory for repair.

    a. Remove the two screws at the access motor end of the flexible coupling with a long shaft Allen wrench.

b. While supporting the access motor, remove the three screws securing the motor and the motor mounting plate to the transition plate (units Serial No. 981 and above or other units with FCO 1134 installed) or the actuator casting.

c. Carefully separate the motor shaft from the flexible coupling. Use care not to strain or damage the motor leadwires. If the disk storage drive has a Serial No. of 480 or lower, the actuator must be tipped until the motor clears the disk drive main deck in order to separate the shaft and coupling.

d. Disconnect the J230-P230 connection at the top rear of the carriage.

e. Note the motor leadwire pin positions in J230. Using an extraction tool (12210915), remove the motor leadwire pins from J230. Remove the leadwires from the cable bundle.

f. Applicable to units Serial No. 480 and below: use a file to enlarge the motor opening in the main deck to allow clearance for the replacement motor.

g. Dress the leadwires of the replacement motor into the cable bundle. Press the contact pins into J230.

NOTE

When reassembling, apply 2 drops of Loctite, Grade C, to the threads of all screws and bolts unless otherwise instructed.

h. Apply a light bead of Loctite retaining compound to the first 1/16-inch of the outer surface of the motor shaft and the inner surface of the flexible coupling.

i. Reconnect the J230-P230 connection.

CAUTION

In the following step, avoid abusive contact between the motor shaft and the flexible coupling.

14. Install the motor and motor mounting plate on the transition plate (units Serial No. 981 and above or other units with FCO 1134 installed) or on the actuator casting with three evenly tightened screws. The motor leadwires must be pointing toward the rear of the actuator.

15. Tighten, evenly, the two screws at the motor end of the flexible coupling.

16. Applicable to units Serial No. 480 and below: secure the actuator assembly to the disk drive main deck with four bolts.

17. Install the timing disk and hub aligning the blank area in the disk marks according to step 7.

CAUTION

The timing disk markings are photo emulsion. Use extreme care and plastic feeler gauges when setting the gap.

18. Using the adjustment screw in the center of the hub, establish a gap of between 0.005 $\pm$ 0.002 inch between the timing disk and the mask. Disengage the detent pawl and check the wobble of the timing disk through one revolution. The timing disk should hold the gap dimension and must not contact the mask. Tighten, slightly, the screw securing the hub to the shaft. Recheck the gap dimension.

19. Assemble the photocell assembly to the motor mounting plate according to the orientation of step 5.

20. Manually disengage the detent pawl. Using a push-pull gage (12210797), check that the force required to move the carriage from Track 00 to Track 99 and back, does not exceed 32 ounces.

21. Secure the head diode board mounting bracket to the top of the actuator with two screws. Connect each of the read/write head cable plugs to the applicable connector on the head diode boards. Make the connections so that no two cables cross (top read/write head plug connected to top head diode board connector, etc.).

22. Perform the Track/Speed Photocell Mechanical and Switching Level Adjustment procedure.

23. Perform the Timing Disk Rotational Adjustment procedure.

24. Perform the Actuator Dynamic Tests and Adjustments procedure.

25. If the bolts securing the actuator to the main deck were loosened, perform the Head/Arm Adjustment procedure.

26. If the bolts securing the actuator to the main deck were loosened, perform the Actuator Adjustment procedure.

27. Install the timing disk dust cover with two screws.

28. Install the plastic shroud with four screws and washers. Make certain that both the carriage and sector/presector block fit properly through the openings in the shroud. Pull the shroud toward the front of the unit to ensure that it protects the heads when the carriage is in the retracted position.

## DETENT PAWL REPLACEMENT

1. Press (to extinguish) the START switch. Disconnect the line voltage power cord.

2. Open and latch the disk drive top rear cover.

3. Referring to Figure 6-3, remove the two socket head screws securing the yoke locating plate to the actuator casting. Disconnect the pawl retraction spring.

4. Remove the three socket head screws securing the yoke mount to the actuator casting. The yoke mount is now held to the actuator casting by two spring pins and may resiste separation. Grasp the hub of the yoke mount and carefully separate it from the actuator casting and the yoke hub.

5. Pull the two spring pins from either the yoke mount or the actuator casting.

NOTE

During reassembly, apply 2 drops of Loctite, Grade C, to the threads of all screws and bolts unless otherwise instructed.

6. Remove the retaining ring that holds the pawl on the shaft. Install the replacement pawl on the shaft and secure with the retaining ring. Connect the pawl retraction spring.

7. Carefully tape the two spring pins into (partially) the yoke mount. Align the spring pins with the receiving holes in the actuator casting and secure the yoke amount to the actuator casting with three screws.

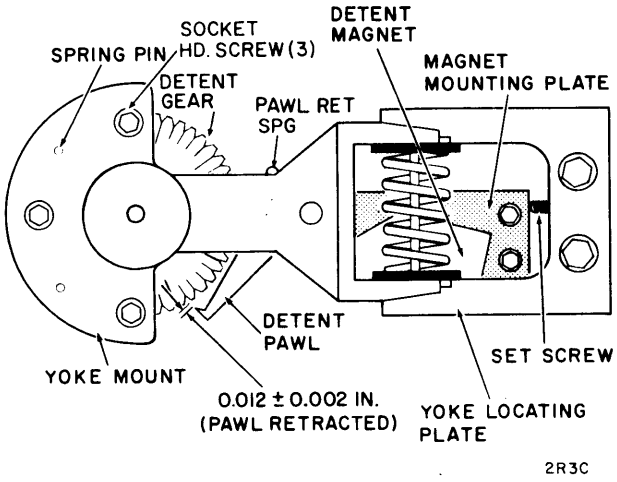



Figure 6-3. Detent Pawl Adjustment

8. Assemble the yoke locating plate to the actuator casting with two screws.

9. Manually pull the detent pawl from the detent gear and check the gap (use feeler gauge) between the tip of the pawl and the top of the adjacent detent gear teeth. The dimension should be 0.012 $\pm$ 0.002 inch (Figure 6-3), and at the same time the pawl block must be mated squarely and flush with the detent magnet pole faces. If the dimension is incorrect, loosen the two screws through the magnet mounting plate and adjust the setscrew against the rear edge of the mounting plate to gain the correct dimension. If the pawl block and detent magnet surfaces do not match, reposition the detent magnet. Tighten the two screws.

10. Perform the Head/Arm Adjustment procedure.

11. Perform the Actuator Dynamic Tests and Adjustments procedure.

## DETENT MAGNET REPLACEMENT

1. Press (to extinguish) the START switch. Disconnect the line voltage power cord.

2. Open and latch the disk drive top rear cover.

3. Referring to Figure 6-3, remove the two socket head screws securing the yoke locating plate to the actuator casting.

4. Remove the two socket head screws holding the magnet mounting plate to the actuator casting.

5. Raise the yoke locating plate and slide the magnetic actuator assembly clear.

6. Remove the two screws and plate holding the detent magnet to the mounting plate.

7. Unsolder the two leadwires connected to the detent magnet terminals and resolder them to the terminals of the replacement unit.

NOTE

During reassembly, apply 2 drops of Loctite, Grade C, to the threads of all screws and bolts, unless otherwise instructed.

8. Assemble the detent magnet to the mounting plate with two screws and a plate.

9. Apply a thin coat of Loctite retaining compound to the surface of the mounting plate that contacts the actuator casting.

10. Raise the yoke locating plate and secure the magnetic actuator assembly to the actuator with two socket head screws.

11. Secure the yoke locating plate to the actuator with two socket head screws.

12. Manually pull the detent pawl from the detent gear and check the gap (use feeler gauge) between the tip of the pawl and the top of the adjacent detent gear teeth. The dimension should be $0.012 \pm 0.002$ inch (Figure 6-3) and at the same time the pawl block must be mated squarely and flush with the detent magnet pole faces. If the dimension is incorrect, loosen the two screws through the magnet mounting plate and adjust the setscrew against the rear edge of the mounting plate to gain the correct dimension. If the pawl block and detent magnet surfaces do not match, reposition the detent magnet. Tighten the two screws.

13. Perform the Actuator Dynamic Tests and Adjustments procedure.

## HEAD LATCH SOLENOID OR MICROSWITCH REPLACEMENT

1. Press (to extinguish) the START switch. Disconnect the line voltage power cord.
2. Open and latch the disk drive top rear cover.
3. Remove the three screws holding the solenoid mounting bracket to the carriage and carefully pull the assembly clear of the carriage.
4. Proceed to step 5 for head latch solenoid replacement or step 6 for microswitch replacement.
5. Replace a head latch solenoid as follows:
   a. Remove the two screws and washers that hold the solenoid to the bracket.
   b. Note or tage the two leadwire connections to the solenoid and disconnect each.
   c. Connect the leadwires to the replacement solenoid according to step b.
   d. Apply 2 drops of Loctite, Grade C, to the screws and secure (use washers) the solenoid to the bracket.
   e. Proceed to step 7.
6. Replace the microswitch as follows:
   a. Rotate the assembly so that the microswitch is up and level.
   b. Carefully remove the two screws and washers that secure the microswitch and actuating mechanism to the bracket.
   c. Carefully lift the microswitch off the bracket and immediately place the replacement unit in place. Apply 2 drops of Loctite, Grade C, to the threads and secure (use washers) the switch to the bracket.
   d. Transfer the leadwire connections from the faulty microswitch to the new unit.
7. Apply 2 drops of Loctite, Grade C, to the threads and install the mounting bracket on the carriage with three screws. Make certain that the cable clamp is secured by the lower mounting screw.
8. Perform the Head Latch Solenoid and Switch Adjustment procedure.

## CAM LATCH SOLENOID REPLACEMENT

1. Press (to extinguish) the START switch. Disconnect the line voltage power cord.
2. Open and latch the disk drive top rear cover.
3. Remove the three screws and washer securing the cam latch solenoid bracket to the carriage.
4. Note or tag the two leadwire connections to the solenoid and disconnect each.
5. Remove the two screws securing the solenoid to the bracket.
6. Apply 2 drops of Loctite, Grade C, to the screws and install the replacement solenoid on the bracket.
7. Connect the leadwires to the replacement solenoid according to step 4.
8. Apply 2 drops of Loctite, Grade C, to the screws and secure (use washers) the bracket to the carriage.
9. Perform the Cam Latch Solenoid Adjustment procedure.

## HEAD/ARM REPLACEMENT

1. Press (to extinguish) the START switch. Disconnect the line voltage power cord.
2. Open and latch the disk drive top rear cover.
3. Determine the faulty head. Refer to Figure 6-4 for physical location of the head. Remove the two screws that hold the head diode board bracket.
4. Disconnect the connector plug for the faulty head at the head diode board.
5. Loosen the wrenching nuts immediately above and below the faulty head/arm (Figure 6-4).

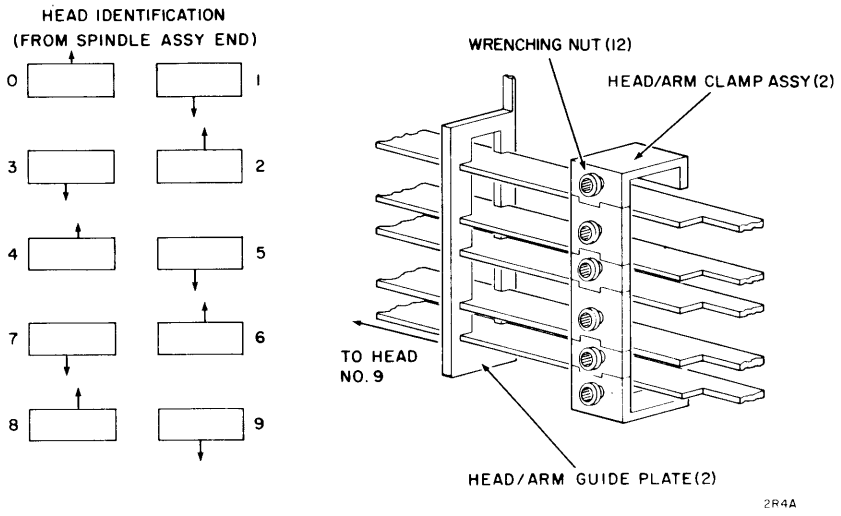



Figure 6-4. Head/Arm Assembly Adjustment

CAUTION

When performing the following step, do not touch the faces of the heads. Skin acids can etch and damage the faces. Also avoid any contact between the head/arm assembly being removed and any adjacent head/arm assembly.

6. Push the head/arm assembly toward the spindle assembly. Grasp the support arm and carefully pull it clear of the head/arm guide plate. Guide the head connector plug until it is clear of the carriage.

7. Carefully thread the connector plug for the replacement head/arm through the head/arm guide plate and clamp. Align the leading end of the head/arm with the slot in the guide plate. Slide the assembly toward the rear of the carriage until alignment is approximately the same as the adjacent head/arm assemblies. Connect the head connector plug. Tighten the adjacent wrenching nuts.

NOTE

If the disk drive is not connected to the controller, a jumper wire must be connected between pins 2 and 3 of connector J08 (power supply exterior surface opposite circuit breakers).

8. Connect the unit power cord. Set the MAIN POWER circuit breaker to ON. Install a disk pack.

9. Manually pull the detent and move the heads slowly into the pack. Make certain that no part of the carriage (cable, cable clamp, torsion arm, or head) contacts the disk. Prior to latching, the replacement head should approach the disk with the outside and rear edges leading. Return the carriage to the retracted stop.

10. Set the ACCESS MOTOR circuit breaker to OFF. Pull upward on the top rear cover interlock switch (behind the carriage). Press (to light) START switch.

11. Repeat the checks of step 9.

12. Perform the Head/Arm Adjustment procedure.

13. Perform the Actuator Adjustment procedure.

## TORSION ARM/SHAFT REPLACEMENT

1. Open and latch the top rear cover.

2. Set the power supply MAIN POWER circuit breaker to OFF.

3. Remove the four screws and washers holding the plastic shroud. Remove the shroud and set it aside.

4. Note the connection scheme, and disconnect the 10 read/write head connector plugs from the head diode board.

5. Remove the two screws securing the head diode boards support arm to the actuator. Set the assembly back on the actuator.

6. Remove the 12 wrenching nuts (Figure 6-4) from the head/arm clamp.

CAUTION

Do not touch the face of the heads. Skin acids can etch and damage faces.

7. Push one of the head/arm assemblies toward the spindle assembly. Grasp the support arm and carefully pull it clear of the head/arm guide plate. Guide the head connector plug until it is clear of the carriage. Repeat this step for the nine remaining heads.

8. If the center torsion arm is to be replaced, go to step 9. If one of the other four torsion arms is to be replaced, go to step 10.

9. Replace the center torsion arm assembly as follows:

   a. Disengage the detent pawl and move the carriage to the fully retracted position (against the stop). Note the carriage track location for later use.

   b. Free the Delrin block by removing the screw immediately behind the Delrin block setscrew. Slide the Delrin block clear of the top of the carriage.

> NOTE
>
> Further disassembly and reassembly will be greatly aided by referring to the exploded view for the carriage assembly in the Parts List.

   c. Remove the three screws securing the heads loaded latch assembly to the carriage. Remove the two screws from the cam retaining collar.

   d. Disengage the detent pawl and move the carriage to the fully extended stop. Remove the screw securing the ground strap to the carriage.

   e. Locate the box-like part of the actuator casting that surrounds the forward end of the head loading cam. Remove the retaining ring (0.831-inch OD) from the forward face of the box.

   f. Raise the forward end of the carriage and carefully separate the carriage assembly from the carriage mount.

   g. Remove the torsion arm assemblies (except the center torsion arm) from the carriage by releasing the retaining ring at the end of the torsion arm shaft.

   h. Note the orientation of the cam follower (pinned on end of torsion shaft) for use during reassembly. Use a punch to remove the 3/32-inch diameter roll pin that secures the cam follower to the torsion shaft.

   i. Note the orientation of the heads loaded latch arm (pinned to approximate center of torsion shaft) for used during reassembly. Use a punch to remove the 3/32-inch diameter roll pin that secures the latch arm to the torsion shaft.

j. Slide the center torsion arm (and torsion shaft) out of the carriage.

k. Slide the replacement center torsion arm (and torsion shaft) into the carriage. Stop sliding the torsion shaft when the end of the shaft is just visible in the second opening of the carriage casting.

l. Seat the unloading damper piston in the damping cylinder (mounted on side of carriage). Place the heads loaded latch arm (oriented according to step i) and the thrust bearing over the end of the shaft and slide the torsion shaft through the remainder of the carriage.

m. Pin the heads loaded latch arm to the torsion shaft with the roll pin (3/32 x 1/2 inch).

n. Slide on in the following order: the retaining ring (0. 831 inch OD), the spring retaining washer (small OD first), the spring (smaller of two available), and the lug-cam washer (lug-end first) on the end of the torsion shaft.

o. Slide the head loading cam (notched end first) on the end of the torsion shaft until the shaft end is just visible in the opening cut in the side of the cam. Place the cam follower (lug end to the rear) in the cam opening and slide the torsion shaft through the center of the cam follower. Pin the cam follower to the end of the torsion shaft with the roll pin (3/32 x 3/8 inch).

p. Carefully slide the carriage assembly into the carriage mount. As the head loading cam exits the rear of the box-like part of the actuator casting, place the spring and then the cam retaining collar over the head loading cam. Make certain that the cam retaining collar stays forward of the cam latch arm and slide the carriage all the way to the retracted position in the carriage mount.

q. Secure the cam retaining collar to the head loading cam with two screws. Threads for the screw ends are provided in the cam.

r. Seat the lug-cam washer, the spring and the spring retaining washer in the box-like part of the actuator casting. Install the retaining ring (0. 831 inch OD) to hold the parts in the actuator.

s. Disengage the detent pawl and move the carriage to the fully retracted position. Make certain that the lugs on the cam follower are pointing up and down and are located at the extreme rear of the slotted opening in the head loading cam. The center torsion spring (see Point A on Figure 3-16) should be aligned to 45-degrees from vertical running from upper-right to lower-left.

CAUTION

The 90-degree relationship in the next step (shown on Figure 3-16) must be closely adhered to. The disk pack and/or the read/write heads may be damaged by incorrect assembly.

t. Place a washer over the shaft end of each torsion arm assembly and carefully install the assemblies on the carriage. The assemblies with the full set of gear teeth go immediately above and below the center torsion arm. The assemblies with the partial set of gear teeth are the top and bottom assemblies in the stack and the flat spot on the gear should be up on the top assembly and down on the bottom assembly. As the torsion arms are installed, mesh the gears so that a 90-degree angle is formed between adjacent faces of the torsion springs (Figure 3-16). Secure the torsion arm assemblies to the carriage with retaining rings (0.145 inch ID).

u. Install the heads loaded latch assembly on the carriage with three screws. Secure the loose end of the ground strap with the home cell mask screw.

v. Disengage the detent pawl and move the carriage to the fully retracted position. Separate the carriage rack gear from the pinion gear by pressing downward on the rear of the carriage. Rotate the pinion gear until the carriage track location is the same as it was in step a. Allow the gears to mesh and check that the track location did not change.

w. Install the Delrin block with one screw. Perform the Carriage Limit Stop Adjustment procedure.

x. Adjust the home cell mechanically according to the Home Cell Mechanical and Switching Level Adjustment procedure.

y. Proceed to step 11.

10. Replace a torsion arm assembly (other than the center assembly) as follows:

    a. Disengage the detent pawl and move the carriage to the fully extended position.

    b. Remove the retaining ring that secures the faulty torsion arm to the carriage. Pull the assembly clear of the carriage.

    c. Slide the washer (from old assembly) onto the shaft end of the replacement torsion arm assembly.

CAUTION

The 90-degree relationship in the next step (shown on Figure 3-16) must be closely adhered to. The disk pack and read/write heads may be damaged by incorrect assembly.

    d. As the replacement assembly is installed, mesh the gears so that a 90-degree angle (Figure 3-16) is formed between the adjacent faces of the torsion springs. Secure the new assembly to the carriage with the original retaining ring.

CAUTION

Do not touch the face of the heads. Skin acids can etch and damage faces.

11. Referring to Figure 6-4, thread the connector plug for a head/arm assembly through the head/arm guide plate and clamp. Slide the head/arm into the slots in the guide plate and back to the head/arm locating block. Repeat this procedure for each of the nine remaining head/arm assemblies. Install the 12 wrenching nuts at the head/arm clamp.

12. Restore the head connector plug connections according to step 4.

13. Perform steps 8 through 13 of the Head/Arm Replacement procedure.

14. Install the shroud with four screws and washers. Make certain both the carriage and the sector/presector block fit properly through the openings in the shroud. Pull the shroud toward the front of the unit to ensure that it protects the heads when the carriage is in the retracted position.

# ADJUSTMENT

## SPINDLE LOCK ADJUSTMENT

1. Set the power supply MAIN POWER circuit breaker to OFF. Disconnect the line voltage power cord.
2. Remove the front panel and swing out the logic chassis.
3. Referring to Figure 6-1, use a feeler gauge to check for a gap of 14/64 $\pm$ 1/64 inch between the pawl and the plate (circled on figure). If this requirement is not met, remove the spindle lock assembly from the base of the spindle and adjust it according to step 4c of the Spindle Lock or Drive Belt Replacement procedure.
4. Press the armature of the spindle lock solenoid into the body of the solenoid and hold it there. Grasp the pawl and check that it rotates freely. The ends of the pawl should not be free to move vertically. Carefully allow the solenoid armature to extend.
5. Close the logic chassis and install the front panel.

## PACK-ON SWITCH ADJUSTMENT

1. Set the power supply MAIN POWER circuit breaker to ON. Open the disk drive front cover, mount a disk pack on the spindle assembly, and tighten it in place.
2. Set the MAIN POWER circuit breaker to OFF.
3. Remove the front panel and swing out the logic chassis.
4. Using a feeler gauge, check that the gap between the static discharge contact arm and the Pack-On switch actuator meets the requirements of Figure 6-2. Loosen the two screws securing the microswitch bracket to the switch mounting bracket and slide the lower bracket vertically until the dimension is correct. Tighten the screws. Make certain that the static discharge contact is aligned to the lockshaft according to Figure 6-2. The contacts will be damaged during operation if not properly aligned.

5. Refer to Figure 6-2 and use a push-pull gauge (12210797) to check that the force required to separate the contacts is as shown.

6. Close the logic chassis and install the front panel.

## DRIVE BELT TENSION ADJUSTMENT

1. Press (to extinguish) the START switch.

2. Remove the front panel and swing out the logic chassis.

3. Using a push-pull gauge (12210797), check that the idler arm just pulls away from the drive belt when a pull force of 1.0 $\pm$ 0.25 pounds is applied perpendicular to the length-axis of the arm (Figure 6-1).

4. If the requirement is not met, loosen the three bolts securing the drive motor assembly to the disk drive and reposition the drive motor assembly to meet the requirement. Apply 2 drops of Loctite, Grade C, to the bolt threads and tighten.

## HEAD/ARM ADJUSTMENT

The head/arm assemblies must be adjusted to place each of the read/write heads on the same radial position with reference to the center of the disk pack. Radial positioning is accomplished by physically moving the heads into or out of the disk pack.

NOTE

The room temperature should be maintained at $72^{\circ} \pm 60^{\circ}$F during the entire adjustment procedure.

1. Open and latch the top rear cover of the disk drive.

2. Remove the disk drive front panel. Remove the diode card at X04 (read/write logic chassis). Remove JAG speed detector card at A25 and install a speed detector (50042805) at the same location.

3. Connect the oscilloscope external trigger to test point C of I028 Index pulse (C27) and set the External Sync switch to negative. Ground the oscilloscope at the maintenance panel GROUND jack.

NOTE

To read any head other than head 0 or head 1, the selected head cable plug connection must be exchanged with either head 0 or head 1 at the head diode card. Connect heads 3, 4, 7, and 8 (Figure 6-4) at the head 0 head diode card connector. All other heads are exchanged with head 1.

4. Exchange the head plug connection of the desired head with either head 0 or head 1.

5. Set the maintenance panel Function Selector switch to the OFF LINE READ 0 or READ 1 position (as required by the exchange in step 4).

6. Connect 1X oscilloscope probes (to read differentially) to test points A and B of the EUC card at X03 (on read/write logic chassis).

7. Set the oscilloscope sweep frequency to 2 ms/cm.

8. Remove the disk drive rear panel and slide the power supply out about 1 foot. Connect a jumper wire between pins 2 and 3 of connector J08 (located on upper rear surface of power supply).

9. Set the power supply circuit breakers to ON. Mount the CE disk pack (84357500) on the spindle and tighten in place. Pull the post of the interlock switch (behind carriage) upward.

10. Press (to light) the START switch. Record the time of power application.

11. After the heads load and the carriage stops, set the power supply ACCESS MOTOR and DETENT circuit breakers to OFF.

12. Manually pull the detent pawl, move the carriage to Track 35, and allow the detent pawl to engage the detent gear. Remove the two screws securing the head select diode cards bracket to the actuator. Carefully position the boards such that they will not be shorted out by the chassis.

13. A 45 minute warm-up period with the top rear cover down and the heads loaded, followed by a 15-minute period with the top cover raised must precede the following adjustment procedures.

14. Adjust the oscilloscope for a stable pattern. The pattern should be similar to Figure 6-4, part C.

15. If beat frequency envelopes are not observed, pull the detent pawl and manually move the carriage back and forth across the tracks adjacent to Track 35. As the heads are moving, the following linear progression should be observed on the oscilloscope.

    a. An erased area with no signal.

    b. An all "1's" pattern.

    c. A pattern of beat frequency envelopes (Track 35).

    d. An all "1's" pattern.

    e. An erased area with no signal.

16. Determine which way the head/arm must be moved to appear as shown on Figure 6-5, part C. Detent the carriage at Track 35.

NOTE

Do not contact or otherwise disturb an adjacent head/arm during the following adjustments.

17. Loosen the two wrenching nuts above and below the affected head/arm clamp (Figure 6-4). If the head/arm is located before Track 35 proceed to step 18. If the head/arm is located beyond Track 35, carefully slide the head/arm away from the spindle.

18. Slowly move the head/arm assembly toward the spindle assembly. Stop when the beat frequency envelopes begin to form.

19. Set the oscilloscope to display one complete revolution of the disk (2 ms/cm). The beat frequency display will now be seen as a bright pattern or envelope of nulls within the all "1's" frequency pattern (Figure 6-5, part D or E).

20. Slowly adjust the head/arm assembly toward the spindle. The envelope of nulls will come to an absolute null at one point, and then will develop into a pair of absolute nulls, with lobes of greater amplitude between. The head/arm is properly aligned over Track 35 when the maximum amplitude of the two envelopes is equal to within 20 percent (Figure 6-5, part F). Tighten the two adjacent wrenching nuts at the head/arm clamp. Repeat this procedure (from step 14) for any adjacent heads.

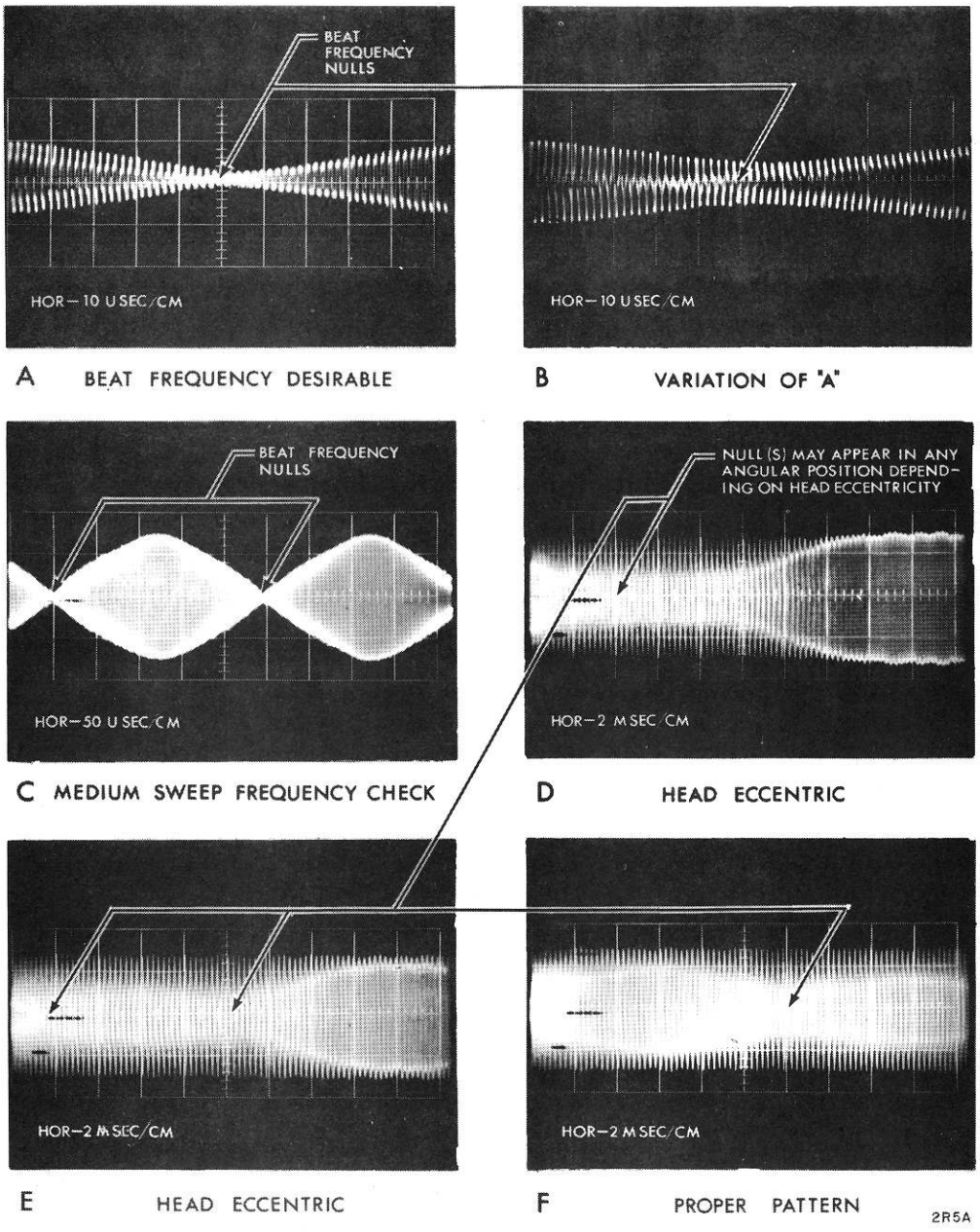



Figure 6-5. Head/Arm Adjustment

21. Apply 2 drops of Loctite, Grade C, to the screw threads and secure the head diode cards bracket to the actuator with two screws.

22. Set the ACCESS MOTOR and DETENT circuit breakers to ON. Perform three First Seek operations (by pressing the START switch 6 times at 30-second intervals).

23. Recheck the Track 35 beat frequency envelope trace on the oscilloscope. If the difference between the maximum amplitude of the two envelopes exceeds 66 percent, repeat the adjustment procedure from step 16.

24. Press (to extinguish) the START switch. Remove the CE disk pack from the spindle.

25. Install the diode card at X04 on the read/write logic chassis. Remove the speed detector at A25 and install the JAG speed detector card at the same location.

26. Remove the jumper installed in step 8.

27. Restore the head plug connections to the original configuration.

## ACTUATOR ADJUSTMENT

1. Open and latch the top rear cover of the disk drive.

2. Remove the disk drive front panel. Remove the diode card at X04 (read/write logic chassis). Remove the JAG speed detector card at A25 and install a speed detector (50042805) at the same location.

3. Connect the oscilloscope external trigger to test point C of I028 Index pulse (C27) and set the External Sync switch to negative. Ground the oscilloscope at the maintenance panel GROUND jack.

4. Connect 1X oscilloscope probes (to read differentially) to test points A and B of the EUC card at X03 (on read/write logic chassis).

5. Set the oscilloscope sweep frequency to 5 $\mu$sec/cm.

6. Remove the disk drive rear panel and slide the power supply out about 1 foot. Connect a jumper wire between pins 2 and 3 of the connector J08 (located on upper rear surface of power supply).

7. Set the power supply circuit breakers to ON. Mount the CE disk pack (84357500) on the spindle and tighten in place. Pull the post of the interlock switch (behind carriage) upward.

8. Press (to light) the START switch. After the heads load and the carriage stops, set the power supply ACCESS MOTOR and DETENT circuit breakers to OFF.

9. Manually pull the detent pawl, move the carriage to Track 00, and allow the detent pawl to engage the detent gear.

10. Set the maintenance panel ON LINE/OFF LINE switch to the OFF LINE READ 0 position.

11. Record the oscilloscope period (as well as head and track) between the Index pulse and the peak of the first Data pulse (Figure 6-6).

12. Set the maintenance panel ON LINE/OFF LINE switch to the OFF LINE READ 1 position and repeat the observation of step 11.

NOTE

To read any head other than head 0 or head 1, the selected head cable plug must be exchanged with either head 0 or head 1 at the head diode card. Connect heads 3, 4, 7, and 8 (Figure 6-4) at the head 0 head diode card connector. All other heads are exchanged with head 1. In either case, the maintenance panel ON LINE/OFF LINE switch must be positioned to reflect the exchange.

13. Repeat the observation of step 11 for each of the eight remaining heads.

14. Manually pull the detent pawl, move the carriage to Track 99, and allow the detent pawl to engage the detent gear.

15. Repeat steps 10 through 13.

16. The total spread for the 10 recorded periods at Track 00 must not exceed 8 $\mu$sec. If this requirement is not met, replace the applicable head/arm assembly.

17. The difference in timing at Track 00 and Track 99 for any one head must not exceed 4 $\mu$sec. If this requirement is met, proceed to step 19.

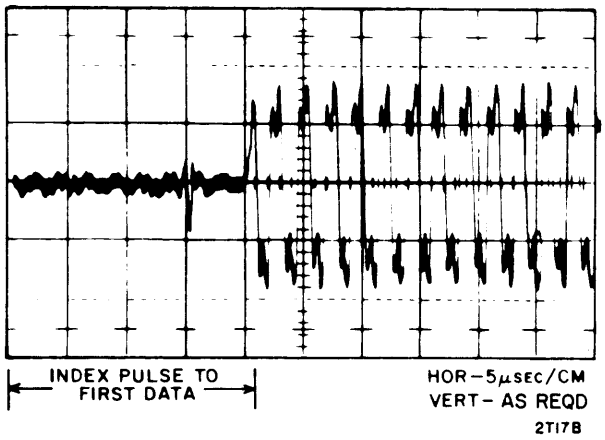



Figure 6-6. Index to Data Period

18. If the requirement of step 17 is not met, loosen the four bolts holding the actuator assembly to the main deck. Pivot the actuator assembly to bring the Track 00 and Track 99 periods to within 4 μsec of each other. Tighten the bolts.

19. Recheck the alignment of each head to Track 35 according to the Head/Arm Adjustment procedure. Make adjustment as required.

20. The midpoint in the spread of the 10 recorded periods at Track 00 must be approximately 20 μsec. If this requirement is met, proceed to step 21. If the requirement is not met, perform steps 20 and 21 of the Sector/Presector Block Tangential and Radial Adjustment procedure.

21. Press (to extinguish) the START switch. Remove the CE disk pack from the spindle.

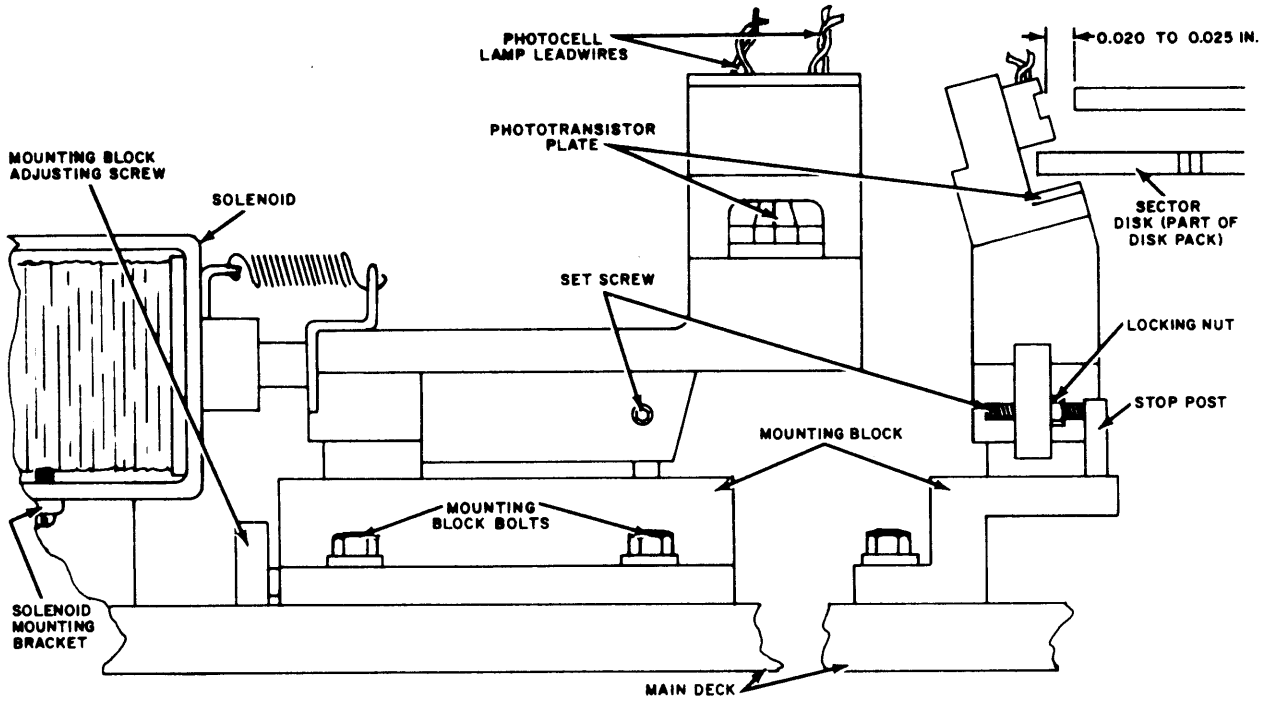
22. Remove the jumper wire installed in step 6.

23. Restore the head plug connections to the original configuration.

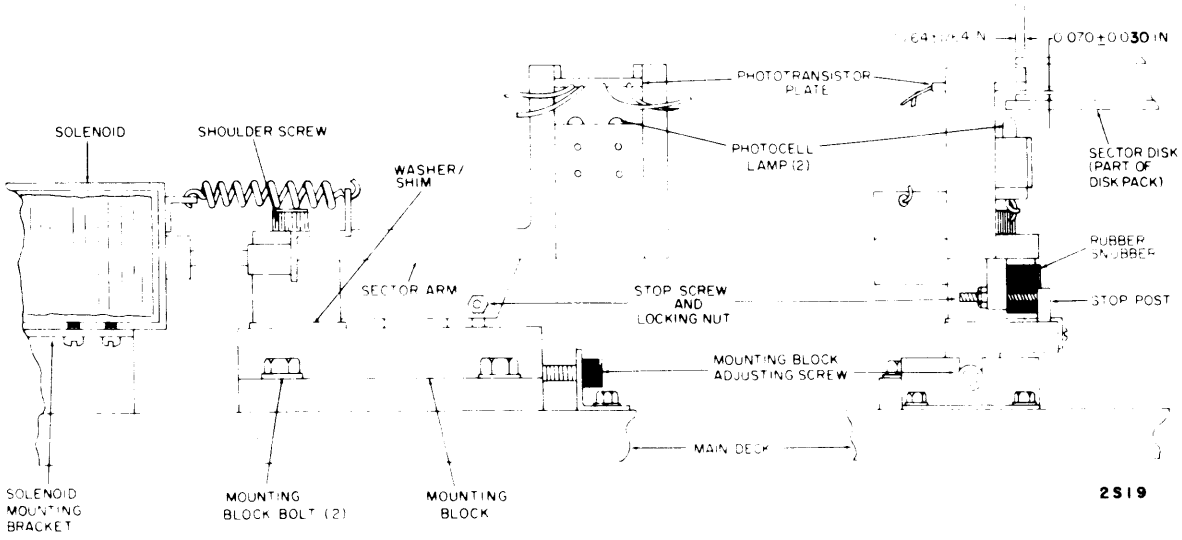
24. Install the diode card at X04 on the read/write logic chassis. Remove the speed detector at A25 and install the JAG speed detector card at the same location.

## SECTOR/PRESECTOR BLOCK TANGENTIAL AND RADIAL ADJUSTMENT

1. Open and latch the top rear cover of the disk drive.
2. Remove the disk drive front panel. Remove the diode card at X04 (read/write logic chassis). Remove the JAG speed detector card at A25 and install a speed detector (50042805) at the same location.
3. Remove the disk drive rear panel and slide the power supply out about 1 foot. Connect a jumper wire between pins 2 and 3 connector J08 (located upper rear surface of power supply).
4. Set the power supply circuit breakers to ON. Mount the CE disk pack (84357500) on the spindle and tighten in place. Pull the post of the interlock switch (behind carriage) upward.
5. If the disk storage drive to be adjusted has a Serial No. of 3980 or below and does not have FCO 2209 installed, perform the adjustment procedure of step 6. All other units should be adjusted according to step 7.
6. Adjust the sector/presector photocell as follows:
   a. Move the sector/presector photocell toward the disk pack until the stop post is encountered.
   b. Using a feeler gauge, check the gap between the disk (immediately above sector disk) edge and the photocell, applicable part of Figure 6-7. The gap should be between 0.020 and 0.025 inch.
   c. If the requirement is not met, loosen the setscrew locking nut.
   d. Adjust the setscrew against the stop post until the gap is correct.
   e. Tighten the setscrew locking nut.
   f. Proceed to step 8.
7. Adjust the sector/presector photocell as follows:
   a. Move the sector arm toward the disk pack until the stop post is encountered.
   b. Using a plastic feeler gauge, check the $0.070 \pm 0.030$ inch clearance, applicable part of Figure 6-7.




APPLICABLE TO SERIAL NO 3980 AND BELOW
NOT HAVING FCO **2209** INSTALLED




APPLICABLE TO SERIAL NO 3981 AND ABOVE AND UNITS
WITH FCO **2209** INSTALLED

Figure 6-7. Sector/Presector Radial Adjustment

c. If the requirement is not met, remove the shoulder screw (Figure 6-7) and add shims (P/N according to Illustrated Parts List) between the top of the mounting block and the washer.

d. Secure the sector arm with the shoulder screw.

e. Move the sector arm toward the disk pack until the stop post is encountered.

f. Using a 6-inch scale, check the 10/64 $\pm$ 1/64 inch clearance, applicable part of Figure 6-7.

g. If the requirement is not met, loosen the stop screw locking nut.

h. Adjust the stop screw against the stop post until the clearance is correct.

i. Tighten the locking nut.

8. Move the sector/presector photocell toward the disk pack until the stop post is encountered (Figure 6-7). At this position the solenoid armature should be bottomed out. If this requirement is not met, loosen the screws in the solenoid mounting bracket.

9. Press (to light) the START switch. Ground the oscilloscope at the maintenance panel GROUND jack.

10. Connect the oscilloscope probe to the yellow (presector) leadwire terminal of the sector/presector phototransistor plate.

11. The photocell analog output trace should go to 0 vdc (ground) between each pulse.

12. Repeat steps 10 and 11 for the sector photocell. Connect the oscilloscope probe to the white leadwire terminal.

13. Connect the oscilloscope external trigger to test point C of I028 Index pulse (C27) and set the External Sync switch to negative.

14. Connect the 1X oscilloscope probes (to read differentially) to test points A and B of the EUC card at X03 (on read/write logic chassis).

15. Set the oscilloscope sweep frequency to 5 $\mu$sec/cm.

16. Set the power supply ACCESS MOTOR and DETENT circuit breaker to OFF.

17. Manually pull the detent pawl, move the carriage to Track 00, and allow the detent pawl to engage the detent gear.

18. Set the maintenance panel ON LINE/OFF LINE switch to the OFF LINE READ 0 position.

19. Record the oscilloscope period between the Index pulse and the peak of the first Data pulse (Figure 6-6).

NOTE

To read any head other than head 0 or head 1, the selected head cable plug must be exchanged with either head 0 or head 1 at the head diode card. Connect heads 3, 4, 7, and 8 (Figure 6-4) at the head 0 head diode card connector. All other heads are exchanged with head 1. In either case, the maintenance panel ON LINE/OFF LINE switch must be positioned to reflect the exchange.

20. Repeat step 19 for the remaining heads.

21. The midpoint in the spread of the 10 recorded periods at Track 00 must be approximately 20 $\mu$sec. If this requirement is met, proceed to step 24.

22. If the requirement is not met, determine the difference between the actual midpoint and 20 and whether the actual midpoint must be increased or decreased.

23. Select one of the heads. Loosen the two bolts securing the sector/presector photocell mounting block to the disk drive main deck (Figure 6-7). (Applicable to units Serial No. 3980 and below: Turn the mounting block adjusting screw, under solenoid arm, clockwise to increase or counterclockwise to decrease the period). (Applicable to units Serial No. 3981 and above: Turn the mounting block adjusting screw, under solenoid arm, clockwise to decrease or counterclockwise to increase the period). Stop adjusting when the period of the selected head has been changed by the amount and in the direction determined in step 22. Tighten the mounting block bolts and recheck the adjustment.

24. Press (to extinguish) the START switch. Remove the CE disk pack from the spindle.

25. Install the diode card at X04 on the read/write logic chassis. Remove the speed detector at A25 and install the JAG speed detector card at the same location.

26. Remove the jumper installed in step 3.

## HOME CELL MECHANICAL AND SWITCHING LEVEL ADJUSTMENT

NOTE

Photocell faults are sometimes caused by improper lamp current. Check lamp power according to Power Level Adjustment procedure, step 3c. If a voltage adjustment is made, step 7 and 8 of the Track/Speed Photocell Mechanical and Switching Level Adjustment must be performed.

1. Open and latch the top rear cover.

NOTE

If the disk drive is disconnected from the controller a jumper wire must be connected between pins 2 and 3 of connector J08 (located on power supply exterior surface opposite the circuit breakers).

2. Connect the disk drive power cord. Set the power supply circuit breakers to ON.
3. Install a disk pack pull upward on the rear cover interlock switch. Press (to light) the START switch.
4. Remove the front panel and connect the ground of an oscilloscope to the maintenance panel GROUND jack.
5. Set the power supply ACCESS MOTOR and DETENT circuit breakers to OFF.
6. Proceed to step 7 for home cell mechanical adjustment or step 8 for home cell switching level adjustment.
7. Adjust the home cell mechanically as follows:
   a. Connect the oscilloscope probe to the left leadwire terminal of the home cell phototransistor plate.
   b. Disengage the detent pawl and move the carriage to a position that results in maximum light on the home cell phototransistor. The oscilloscope should indicate a minimum of +17 vdc. If the requirement is not met, twist the photocell lamp until the requirement is met. On units with Serial No. 1927 and below (without FCO 1754), apply 1 drop of Eastman 910 adhesive to the lamp base when the adjustment is completed.

NOTE

The photocell output is approximately -1 vdc when dark.

c. Manually pull the detent pawl and position the carriage at Track 00. The oscilloscope should indicate an output of 0 ± 1 vdc. Position the carriage at Track -01. The output should be a minimum of +10 vdc.

d. If the above requirement is met, go to step g. If the requirement is not met and the unit has a two-piece home cell mask, go to step e. If the requirement is not met and the unit has a one-piece home cell mask, go to step f.

e. Position the carriage at Track 00 and loosen the two screws securing the notched mask (nearest the spindle) to the carriage. Position the mask (hold a clearance of approximately 1/16-inch between the mask and the mask of the phototransistor plate) until an output of 0 ± 1 vdc is attained. Tighten the screws securing the mask. Position the carriage at Track -01. The output should be a minimum of +10 vdc. If this requirement is not met, replace the lamp and/or phototransistor.

f. Position the carriage at Track 00 and loosen the screws securing the photocell to the mounting bracket. Position the photocell until 0 ± 1 vdc is attained and the dimension between the phototransistor mask and the main mask is approximately 1/16-inch. Tighten the bracket screws.

g. Position the carriage at Track 99. The oscilloscope should indicate an output of 0 ± 1 vdc. Position the carriage at Track 100. The output should be a minimum of +10 vdc. If the requirement is met, go to step k.

h. If the requirement is not met and the unit has a two-piece home cell mask, go to step i. If the requirement is not met and the unit has a one piece home cell mask, go to step j.

i. Position the carriage at Track 99. Loosen the two screws securing the unnotched mask (farthest from spindle) to the carriage. Position the mask (hold a clearance of approximately 1/16-inch between the mask and the mask of the phototransistor plate) until an output of 0 ± 1 vdc is attained. Tighten the screws securing the mask. Position the carriage at Track 100. The output should be a minimum of +10 vdc. If this requirement is not met, replace the lamp and/or phototransistor.

j. Position the carriage at Track 99. Loosen the screws holding the photocell to the mounting bracket. Position the photocell until 0 ± 0.1 vdc is attained. Keep the dimension between the main mask and the phototransistor mask to approximately 1/16-inch and tighten the bracket screws. Make certain that the required outputs are still present at Tracks 100 and -01.

k. Disconnect the oscilloscope and go to step 9.

8. Adjust the home cell switching level as follows:

a. Connect the oscilloscope probe to the left leadwire terminal of the home cell phototransistor plate.

b. Manually pull the detent pawl and move the carriage back and forth between Track 10 and Track -02.

c. The photocell output should change from 0 vdc (ground) when dark to a minimum of +17 vdc when lighted by the lamp. Note the maximum amplitude.

d. Connect the oscilloscope probe and the external trigger to logic chassis test point A34A (ONA card).

e. Manually disengage the detent pawl and position the carriage at Track -01 and then Track 100. At each of these tracks the oscilloscope should indicate that the home cell is lighted. Note both of the voltage readings.

f. Repeat step b and adjust the upper potentiometer on the ONA card until the oscilloscope indicates that switching occurs at three-fourths of the average peak amplitude (±1.5 vdc) observed at Track -01 or 100 whichever had the lower voltage reading in step e. The maximum switch point of the ONA card is approximately +13 vdc.

g. Disconnect the oscilloscope.

9. Remove the jumper wire at J08 (if used).

## SECTOR/PRESECTOR PHOTOCELL SWITCHING LEVEL ADJUSTMENT

NOTE

Photocell faults are sometimes caused by improper lamp current. Check lamp power according to Power Level Adjustment procedure, step 3c. If a voltage adjustment is made, steps 7 and 8 of the Track/Speed Photocell Mechanical and Switching Level Adjustment must be performed.

1. Open and latch the top rear cover.

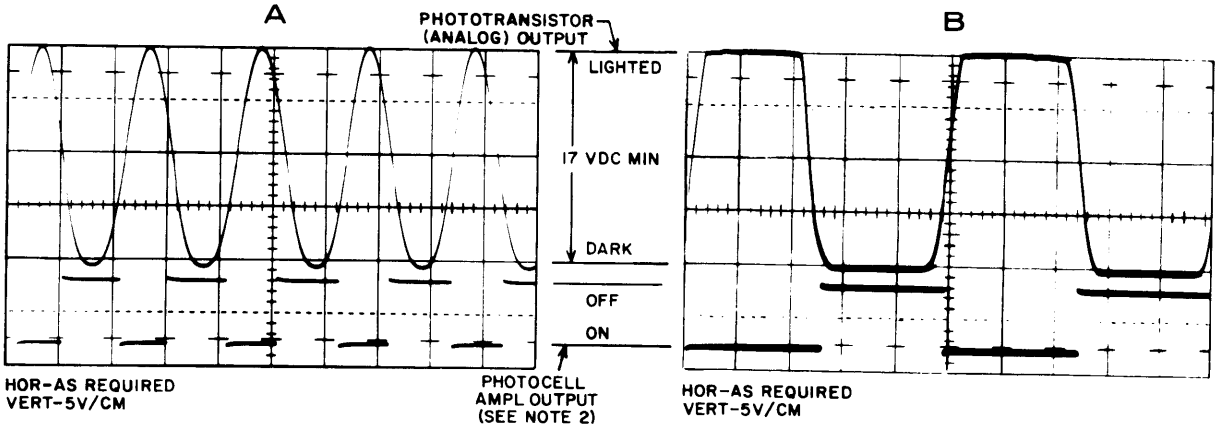
NOTE

If the disk drive is disconnected from the controller a jumper wire must be connected between pins 2 and 3 of connector J08 (located on power supply exterior surface opposite the circuit breakers).

2. Connect the disk drive power cord. Set the power supply circuit breakers to ON.
3. Install a disk pack. Pull upward on the rear cover interlock switch. Press (to light) the START switch.
4. Remove the front panel and connect the ground of an oscilloscope to the maintenance GROUND jack.
5. Connect the channel A oscilloscope probe to the yellow (presector) leadwire terminal of the sector/presector phototransistor plate. Connect the channel B probe and the external trigger to the logic chassis test point B14A (ONA card).
6. Set the oscilloscope External Sync switch to negative.
7. Make sensitivity settings and analog (upper) trace comparisons according to Figure 6-8.
8. If the analog output trace amplitude is below +17 vdc, change the lamp filament alignment (above oscilloscope probe) until the requirement is met. On units Serial No. 1927 and below (without FCO 17500), apply 1 drop of Eastman 910 adhesive to the lamp base.

9. Observe the lower trace. The photocell amplifier switching should occur at +10 ± 2.5 vdc. If this requirement is not met, adjust the upper potentiometer on the B14 ONA card until the oscilloscope trace meets the requirement.

10. Repeat steps 5 through 9 for the sector photocell. Connect the oscilloscope to the white leadwire terminal and test point B14C in step 5 and adjust the lower potentiometer on the B14 ONA card in step 9.




1. ANALOG (UPPER) TRACES ARE TYPICAL. TRACE B IS SATURATED OUTPUT. BOTH TRACES ARE NORMAL.
2. TRACE A AMPLIFIER SWITCHING AT +10± 2.5 VDC.

2R59A

Figure 6-8. Photocell/Amplifier Outputs

11. Connect the oscilloscope external trigger to test point C of I028 (C27) and set the External Sync switch to negative.

12. Connect the oscilloscope probes to B14A (presector) and B14C (sector).

13. The oscilloscope traces should meet the requirements of Figure 6-9.

14. Perform the Sector/Presector Block Tangential and Radial Adjustment procedure.

15. Remove the jumper wire at J08 (if used).

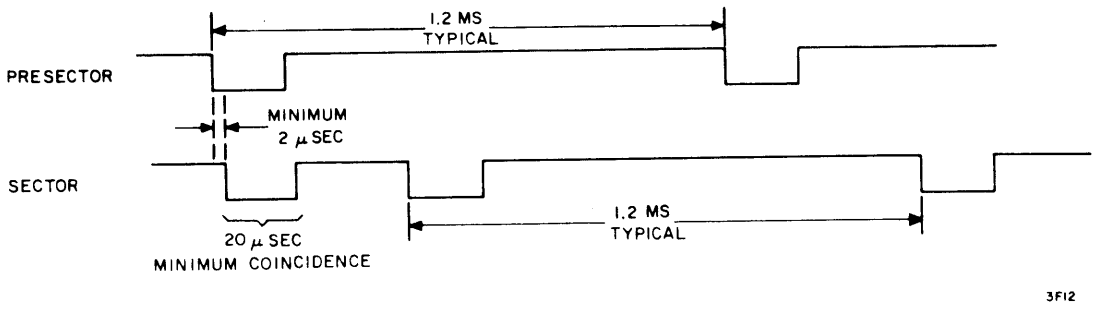



Figure 6-9. Sector/Presector Pulse Timing

## TRACK/SPEED PHOTOCELL MECHANICAL AND SWITCHING LEVEL ADJUSTMENT

NOTE

Photocell fualts are sometimes caused by improper lamp current. Check lamp power according to the Power Level Adjustment procedure, step 3c. If a voltage adjustment is made, steps 7 and 8 of the Track/Speed Photocell Mechanical and Switching Level Adjustment must be performed.

1. Open and latch the top rear cover.

NOTE

If the disk drive is disconnected from the controller a jumper wire must be connected between pins 2 and 3 of connector J08 (located on power supply exterior surface opposite the circuit breakers).

2. Connect the disk power card. Set the power supply circuit breakers to ON.

3. Install a disk pack. Pull upward on the rear cover interlock switch. Press (to light) the START switch.

4. Remove the front panel and connect the ground of an oscilloscope to the maintenance panel GROUND jack.

5. Set the power supply ACCESS MOTOR and DETENT circuit breakers to OFF. Remove the two screws securing the timing disk dust cover to the detent motor mounting plate.

6. Proceed to step 7 for the photocell mechanical adjustment or step 8 for the photocell switching level adjustment.

7. Adjust the photocell mechanically as follows:

   a. Connect the oscilloscope probe to the yellow (track) leadwire terminal of the track/speed phototransistor plate.

   b. Manually pull the detent pawl and move the carriage back and forth.

   c. The photocell output trace should be an excursion between 0 vdc (ground) and a minimum of +17 vdc (Figure 6-8). Release the detent pawl. If a minimum of +17 vdc is not attained, correct according to one of the following:

      - Twist the photocell lamp in the block to change the filament alignment.
      - Loosen the two screws securing the photocell to the motor mounting plate. Reposition the photocell radially for a maximum amplitude. Make certain that the photocell is sensing the correct row of slots on the timing disk. Tighten the photocell mounting screws.
      - Refer to the Power Level Adjustment procedure, step 3c, and increase the lamp voltage (do not exceed 3.4 vdc).
      - Replace the lamp and/or the phototransistor.
      - On units with Serial No. 1927 and below (without FCO 1751), apply 1 drop of Eastman 910 adhesive to the lamp base if the lamp was repositioned or replaced.

   d. If the screws in the photocell were loosened in step c, perform the Timing Disk Rotational Adjustment and the Actuator Dynamic Tests and Adjustments procedure.

   e. Connect the oscilloscope probe to the white speed leadwire terminal of the track/speed phototransistor plate. Repeat steps b and c.

   f. Command the disk storage drive to perform a 99-track repeat seek.

g. Make oscilloscope settings and trace comparisons according to Figure 6-10. The photocell output amplitude may decrease during maximum acceleration, but must be an excursion between 0(+4, -1) vdc and a minimum of +16 vdc in this area.

h. Proceed to step 9.

8. Adjust the photocell switching levels as follows:

a. Connect the channel A oscilloscope probe to the yellow (track) leadwire terminal of the track/speed phototransistor plate. Connect the channel B probe and the external trigger to the logic chassis test point A34C (ONA card).

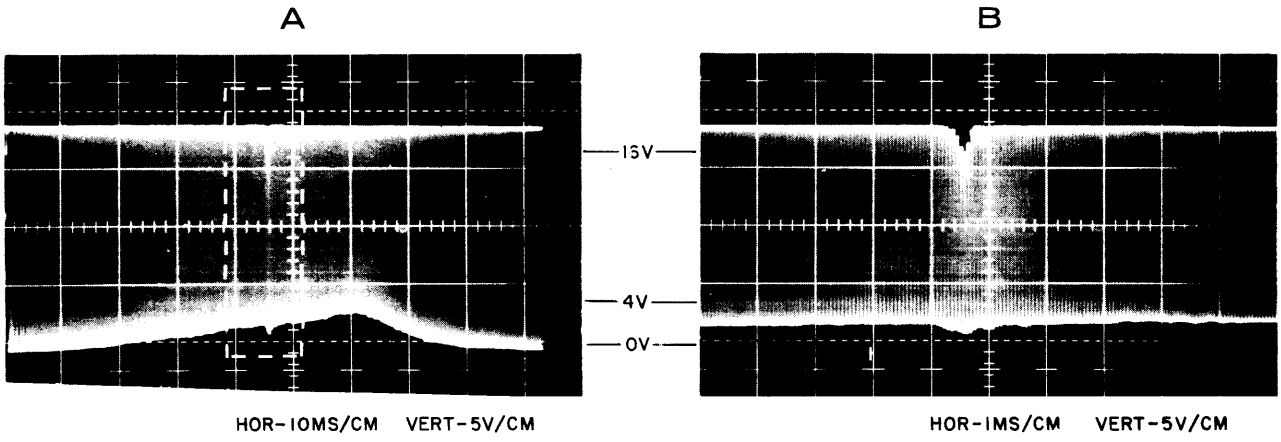



Figure 6-10. Speed Photocell Output

b. Make sensitivity settings according to Figure 6-8. Manually pull the detent pawl and move the carriage back and forth while observing the oscilloscope.

c. The oscilloscope should indicate that the amplifier is switching at $+10 \pm 2.5$ vdc.

d. If this requirement is not met, adjust the lower potentiometer on the A34 ONA card until the track meets the requirement.

e. Repeat steps a through d for the speed photocell. Connect the oscilloscope to the white leadwire terminal of the track/speed phototransistor plate and to test point A35A in step a. In step c the amplifier should switch at +10 (+2.5, -1.5) vdc and if it does not, adjust the upper potentiometer on the A35 ONA card.

9. Disconnect the oscilloscope.

10. Remove the jumper wire at J08 (if used).

11. Install the timing disk dust cover.

## TIMING DISK ROTATIONAL ADJUSTMENT

1. Open and latch the top rear cover.

NOTE

If the disk drive is disconnected from the controller, a jumper wire must be connected between pins 2 and 3 of connector J08 (located on power supply exterior surface opposite the circuit breakers).

2. Connect the disk drive power cord. Set the power supply circuit breakers to ON.

3. Install a disk pack. Pull upward on the rear cover interlock switch. Press (to light) the START switch.

4. Remove the front panel and connect the ground of an oscilloscope to the maintenance panel GROUND jack.

5. Set the power supply ACCESS MOTOR and DETENT circuit breakers to OFF.

6. Remove the two screws securing the timing disk dust cover to the detent motor mounting plate.

CAUTION

The timing disk markings are photo emulsion. Use plastic feeler gauges with extreme care when setting the gap.

7. Manually disengage the detent pawl and move the carriage forward until the screw securing the timing disk hub to the motor shaft is visible in the slotted opening of the motor mounting plate. Loosen the screw (with a long-shaft Allen wrench) just enough so that the disk will turn with some effort. Using the adjustment screw in the center of the hub, establish a gap of 0.005 $\pm$ 0.002 inch between the timing disk and the mask.

8. Disengage the detent pawl and position the carriage at Track -01.

9. Connect the oscilloscope probe to the yellow (track) leadwire terminal of the track/speed phototransistor plate.

10. Rotate the timing disk so that the blank area (interruption in marks) is under the photocell and extending clockwise from that position. The oscilloscope trace should reflect a steady-state voltage level of 0 vdc.

11. Disengage the detent pawl and move the carriage back from the disk pack. The oscilloscope should indicate a steady-state 0 vdc (ground) between Tracks -01 and -02 and between Tracks -02 and 99.

12. Disengage the detent pawl and move the carriage forward until the screw securing the timing disk hub to the motor shaft is visible in the slotted opening of the motor mounting plate. Use the track pulse adjusting tool (84353100) to set the pawl squarely on top of the nearest detent gear tooth (Figure 6-11).

13. Slowly rotate the timing disks to place the nearest disk mark under the photocell lamp. Stop rotation when the oscilloscope trace reaches the maximum amplitude.

14. Check the gap between the timing disk and the adjacent glass mask is 0.005 $\pm$0.002 inch. Make adjustments using the socket head screw in the end of the hub. If gap adjustment is required, rotational adjustment must be rechecked. Disengage the detent pawl and check the wobble of the timing disk to one revolution. The timing disk should hold the gap and must not contact the mask. Tighten the screw securing the hub to the motor shaft and recheck both adjustments.

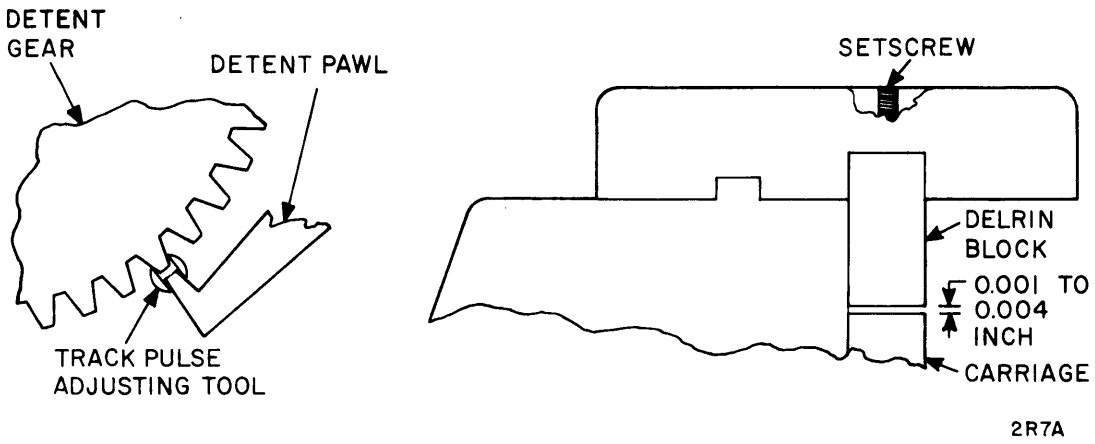



Figure 6-11. Carriage Limit Stop Adjustment

15. Disengage the detent pawl and move the carriage toward the spindle assembly. Observe the oscilloscope and the detent gear pointer to make certain that no track pulses occur between Tracks 99 and -02 and between Tracks -02 and -01. Check that the first track pulse does occur between Tracks -01 and 00.
16. Perform the Carriage Limit Stop Adjustment procedure.
17. Disconnect the oscilloscope and the jumper wire at J08 (if used).
18. Install the timing disk dust cover.

## CARRIAGE LIMIT STOP ADJUSTMENT

1. Open and latch the top rear cover.
2. Set the power supply MAIN POWER circuit breaker to OFF.
3. Disengage the detent pawl and move the carriage out to the forward stop. The track indicator pointer should be pointing at Track 00 mark on the detent gear. If this requirement is met, proceed to step 7.
4. If the requirement of step 3 is not met, remove the screws securing the head diode boards bracket. Under the bracket (and above the Delrin block, Figure 6-11) is a setscrew. Free the Delrin block by removing the screw immediately to the rear of this setscrew. Pull the Delrin block clear of the top edge of the carriage.

5. With the carriage against the forward stop, disengage the detent pawl and lift the front of the carriage slightly. Manually turn the detent gear until the track indicator pointer is pointing at the Track 00 mark.

6. Lower the front end of the carriage, slide the Delrin block in place, and secure with one screw.

7. Disengage the detent pawl and position the carriage at approximately Track 50. Using a feeler gauge, check that the gap dimension between the bottom of the Delrin block and the top of the carriage (Figure 6-11) is between 0.001 and 0.004 inch.

8. If the requirement is not met, remove the head diode boards bracket (if not already removed). Adjust the setscrew (located above Delrin block) to attain the correct dimension.

9. Disengage the detent pawl and check that the established dimension is maintained as the carriage is positioned at various tracks. Secure the head diode boards bracket to the top of the actuator.

10. Disengage the detent pawl and extend the carriage until the cam follower just contacts the cam lug washer. (Applicable to units Serial No. 4999 and below: The carriage stop bumper should be just contacting the end of the carriage rack gear and should be horizontal). (Applicable to units Serial No. 5000 and above: The carriage stop bumper should be just contacting the carriage mount below the home photocell assembly and should be horizontal).

11. If the requirement in step 10 is not met, loosen the locking nut and adjust the stop. Tighten the locking nut.

## HEAD LATCH SOLENOID AND MICROSWITCH ADJUSTMENT

1. Open and latch the top rear cover.

NOTE

If the disk drive is disconnected from the controller, a jumper wire must be connected between pins 2 and 3 of connector J08 (located on power supply exterior surface opposite the circuit breakers).

2. Connect the disk drive power cord. Set all power supply circuit breakers, except ACCESS MOTOR and DETENT, to ON.

3. Install a disk pack. Pull upward on the rear cover interlock switch. Turn the microswitch actuation adjust (Figure 6-12) counterclockwise until it is completely clear of the microswitch actuating arm.

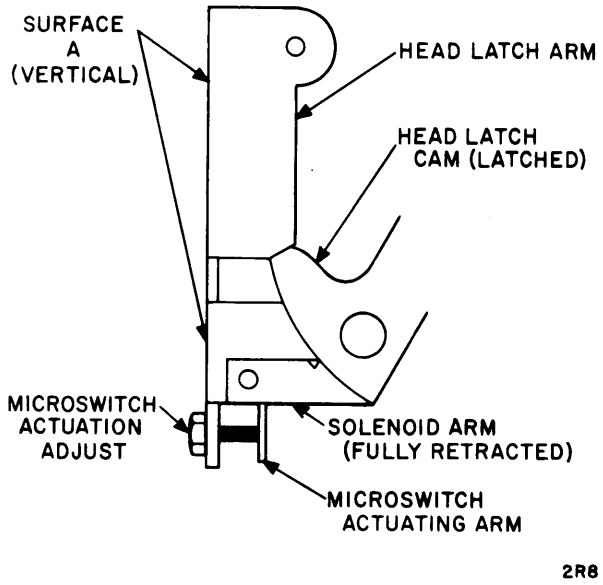



Figure 6-12. Head Latch Solenoid Adjustment

4. Press (to light) the START switch. The Unit Number indicator should not be lighted.

5. With the detent pawl disengaged from the detent gear, manually push the carriage forward while observing the head latch cam and arm. Stop moving the carriage as soon as the cam and arm become latched.

6. The disk drive Unit Number indicator should not be lighted. Adjust the microswitch actuation adjust until the Unit Number indicator lights, then turn the actuation adjust an additional three-quarter turn. Tighten the adjust setscrew locking nut.

7. When the heads are latched, surface A (Figure 6-12) of the head latch arm must be vertical and the solenoid armature should be fully retracted. If this requirement is not met, loosen the two screws securing the solenoid to the bracket and reposition.

8. Remove the jumper wire at connector J08 (if used).

## CAM LATCH SOLENOID ADJUSTMENT

1. Open and latch the disk drive top rear cover.

2. Manually disengage the detent pawl and move the carriage seven tracks forward.

3. Push the cam latch solenoid (Figure 6-13) to the fully energized position.

4. The solenoid actuator arm must fully engage the cam latch collar.

5. If the requirement of step 4 is not met, loosen the three screws securing the solenoid mounting bracket to the actuator and reposition the entire assembly as required.

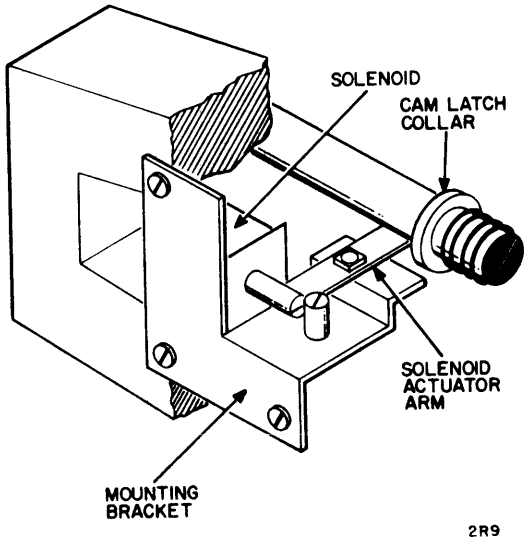



Figure 6-13. Cam Latch Solenoid Adjustment

## COVER INTERLOCK SWITCHES ADJUSTMENT

1. Set the power supply MAIN POWER circuit breaker to OFF. Open and latch the top rear cover.

2. Adjust the top rear cover interlock switch as follows:

   a. Connect an ohmmeter across the leadwire terminals of the rear cover interlock switch, S306 (located below and at rear of actuator).

   b. Push the switch post down (to simulate top rear cover closed). The ohmmeter should indicate zero ohm.

   c. Allow the switch post to spring upward. The ohmmeter should indicate infinity. Disconnect the ohmmeter.

   d. Lower the top rear cover while listening for the switch to close.

   e. If the switch does not actuate when the cover is closed, loosen the screws in the switch mounting bracket and move the assembly upward. Repeat step d.

3. Adjust the front cover interlock switch as follows:

   a. Connect an ohmmeter across the leadwire terminals of the front cover interlock switch, S304 (located on interior surface on actuator side of top rear cover).

   b. Open and close the front cover while observing the ohmmeter indication.

   c. The ohmmeter should indicate zero ohm when the cover is closed and infinity when the cover is open. The switch should operate when a gap of $1.0 \pm 0.5$ inch exists between the front edge of the cover and the frame.

   d. If the switch does not operate as required, loosen the two screws securing the switch and reposition it vertically.

## ACTUATOR DYNAMIC TESTS AND ADJUSTMENTS

NOTE

In the following procedures, it is necessary to command the disk drive to perform various seek lengths. These commands may be derived via a disk storage drive exerciser or suitable software and the computer. Unit must meet the requirements of Detent Pawl Replacement procedure and Delay Tests and Adjustments procedure before performing the following:

1. Open and latch the top rear cover of the disk drive.

2. Connect the disk drive power cord. Set the power supply circuit breakers to ON.

3. Remove the front panel and connect the ground of an oscilloscope to the maintenance panel GROUND jack.

4. Install a disk pack. Pull upward on the rear cover interlock switch (behind carriage). Press (to light) the START switch.

5. Remove the two screws securing the timing disk dust cover to the access motor mounting plate. Attach a tachometer (84362900) to the timing disk hub.

CAUTION

A tachometer must be used when performing the following adjustments.

6. Connect the oscilloscope external trigger to test point C of I218 Any Seek (C36). Connect the tachometer leadwires to one channel of the oscilloscope preamplifier (polarity not significant). Connect a probe from the other channel to the track pulse amplifier output at location A34D. Set the External Sync switch to negative.

NOTE

If, during steps 7 and 8, the carriage starts walking (jumping tracks in the reverse direction), roughly adjust the potentiometer shaft on Y330 at logic chassis location D34 until the walking stops.

7. Command the disk storage drive to perform a 3-track repeat seek (three tracks forward and three tracks reverse, continuously) centering on Track 50.

8. Set the oscilloscope vertical to 0.2 v/cm and the horizontal to 5 ms/cm. Compare the oscilloscope trace to Figure 6-14, part A.

NOTE

Some interaction may occur between the adjustments made in steps a and b. Performing these steps alternately should allow all requirements to be met.

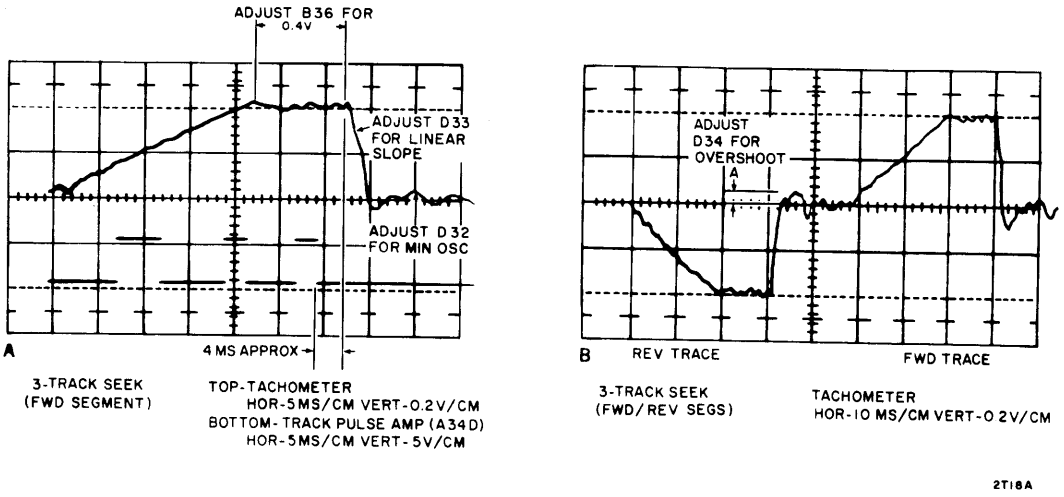



Figure 6-14. Tachometer Output (3-Track Seek)

a. The plateau amplitude should be approximately 0.4 vdc and the width should be between 10 and 15 ms. Adjust the amplitude with the potentiometer on Y307 at location B36 (counterclockwise adjustment increases the amplitude).

b. Adjust the stop delay to end the plateau 4 ms after the end of the last track pulse and for a linear fall time slope. Use the potentiometer shaft on Y331 at location D33.

c. Adjust the stop and settle-out period for minimum oscillation. Use the potentiometer shaft on Y332 at location D32.

9. Disconnect the oscilloscope connection to A34D. Set the oscilloscope horizontal to 10 ms/cm. Compare the oscilloscope trace with Figure 6-14, part B. Adjust the potentiometer shaft on Y330 at location D34 so that a slight overshoot at A occurs.

10. Command the disk storage drive to perform an eight-track repeat seek centering at Track 50. Make oscilloscope setting and a trace comparison according to Figure 6-15. If required, adjust the potentiometer shaft on Y306 at location B35 for two-track pulses during the 6 ips plateau.

11. Command the disk storage drive to perform a 99-track repeat seek. Connect the oscilloscope external trigger to test point C of the Detent FF (C38). Set the External Sync switch to positive. Make oscilloscope settings and a trace comparison according to Figure 6-16. The upper plateau width should be 15 ± 5 ms and should have an amplitude of between 2.0 and 3.5 vdc. The 6 ips plateau width should be 6 ± 2 ms. Adjust the width of the 6 ips plateau with the potentiometer shaft on Y305 at location B34.

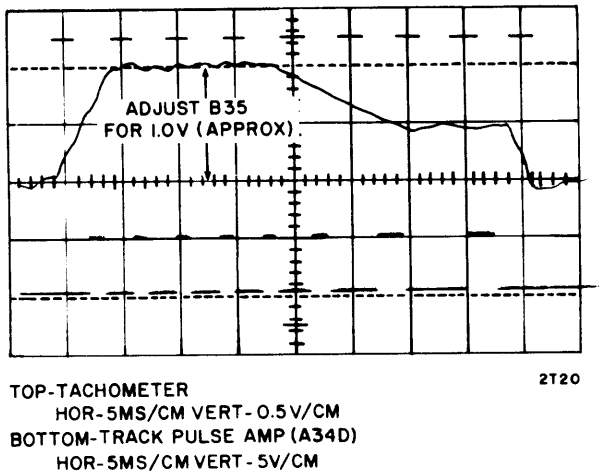



Figure 6-15. Tachometer Output (8-Track Forward Seek)

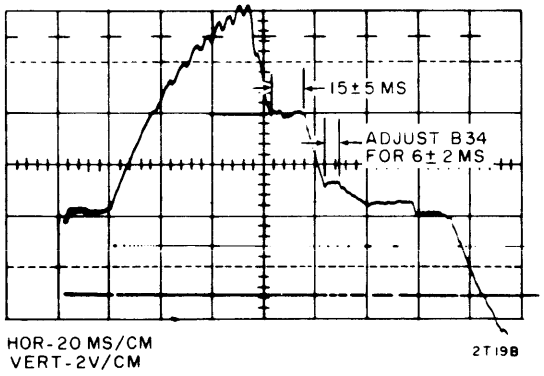



Figure 6-16. Tachometer Output (99-Track Forward Seek)

12. Connect the oscilloscope probe to test point C of the Detent FF (C38). Set the External Sync switch to negative. As the 99-track repeat seek cycles, make oscilloscope settings and a trace comparison according to Figure 6-17. Time A (carriage access time for a 99-track seek) should not exceed 150 ms.

13. Disconnect the oscilloscope. Install the timing disk dust cover.

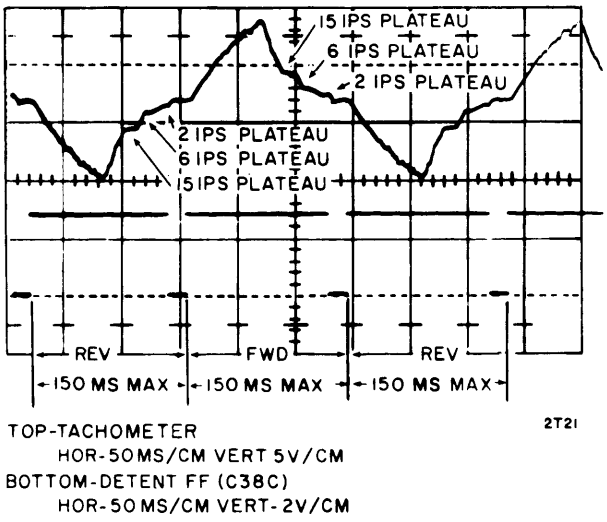



Figure 6-17. Tachometer Output (99-Track Repeat Seek)

## READ OPERATION TEST AND ADJUSTMENT

1. Open and latch the top rear cover of the disk storage drive.

NOTE

The following procedure requires that data be written on a disk pack. The Write operation may be done via a disk storage drive exerciser or the central processor. Timing measurements of the recorded data require that the oscilloscope be triggered from an external source that is synchronous with the data being displayed. Oscilloscope synchronizing with the Index pulse or internally on the signal results in signal instability that may make measurements unreliable. If a disk storage drive exerciser is used, a suitable sync point is available at exerciser test point D, location A04. Amplitude measurements can be made with the oscilloscope triggered by index test point C, logic chassis location C27.

2. Remove the disk storage drive rear panel. Set the power supply circuit breakers to ON. Mount a disk pack (not a CE disk pack) on the spindle and tighten in place. Pull the post of the interlock switch (behind carriage) upward.

3. Press (to light) the START switch.

4. Test and adjust the ATB card adjustment as follows:

   a. Write a pattern of all "1's" with each head at Track 99.

   b. Ground an oscilloscope at the maintenance panel GROUND jack. Connect the external trigger according to the above note. Connect the oscilloscope differentially to test points A and B of the EUC card at X03 (read/write logic chassis).

   c. Select any head and read Track 99. Make oscilloscope settings according to Figure 6-21, part C.

   d. Turn the potentiometer shaft on the ATB card at X06 (read/write logic chassis) until the amplitude of the trace is maximum, then turn the shaft three turns counterclockwise. The amplitude of the signal (Figure 6-21, part C) will be a minimum of 1.5 volts, although amplitudes of slightly less are acceptable if no readback problems exist.

5. Rest and adjust the EWC card adjustment as follows:

   a. Write a pattern of all "1's" with each head at Track 99.

   b. Ground an oscilloscope at the maintenance panel GROUND jack. Connect the external trigger according to the above note. Connect the oscilloscope probe to test point C of L402 (A01).

   c. Select any head and read Track 99. Make oscilloscope settings and a trace comparison according to Figure 6-18.

   d. The pulses should be 200 $\pm$ 50 nsec wide and should occur every 400 nsec. Adjust the pulse symmetry with the potentiometer shaft at A02, if required.

   e. Select several heads. There should be no measurable difference in the symmetry of the traces for any of the heads.

6. Test the read/write head peak shift as follows:

   a. Write a pattern of alternate "1's" and "0's" with each head at Track 99.

   b. Ground an oscilloscope at the maintenance panel GROUND jack. Connect

the external trigger according to the above note. Connect the oscilloscope to test point C of L402 (A01).

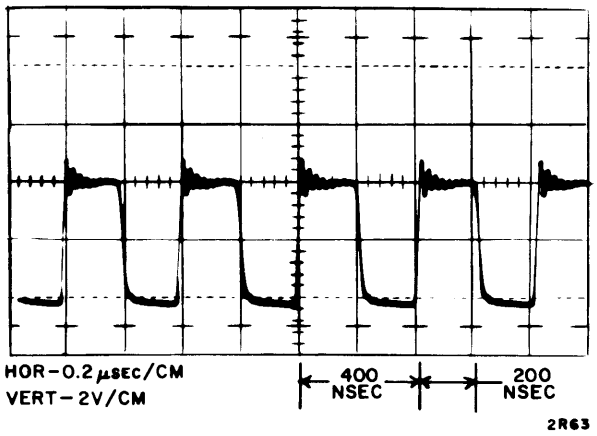



Figure 6-18. Pulse Shaper Trace

c. Select any head and read Track 99. Make oscilloscope settings and a trace comparison according to Figure 6-19, parts A or B. The trace should meet the requirements of Figure 6-18, part B.

d. Repeat step c for the remaining read/write heads.

e. If the requirements of Figure 6-18 are not met, replace the applicable head/arm assembly and/or the related torsion arm assembly.

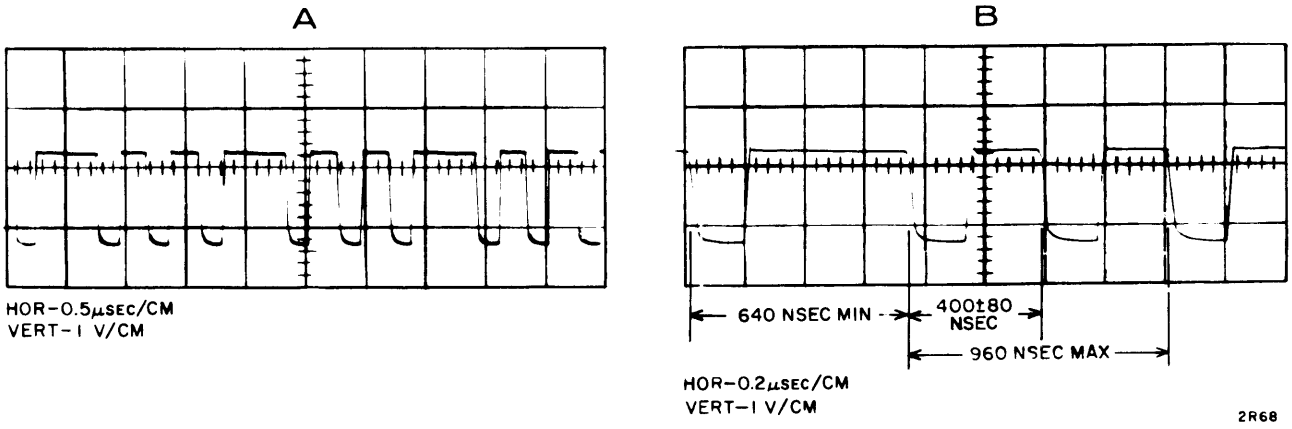



Figure 6-19. Read/Write Peak Shift

7. Test the read/write head amplitude as follows:

   a. Ground an oscilloscope at the maintenance panel GROUND jack. Connect the external trigger according to the above note. Connect the oscilloscope differentially to test points A and B of the EUC card at X03 (read/write logic chassis).

   b. Refer to Figure 6-20 and 6-21. Write the pattern of "1's" or "0's" on the specified track with all heads. Read the data from each head and compare it with the applicable figure. The figures depict typical amplitudes that will be encountered. A pattern of all "1's" at Track 99 (Figure 6-21, parts A and C) should result in a minimum amplitude of approximately 1.5 volts, although amplitudes of slightly less are acceptable if no readback problems have been encountered.

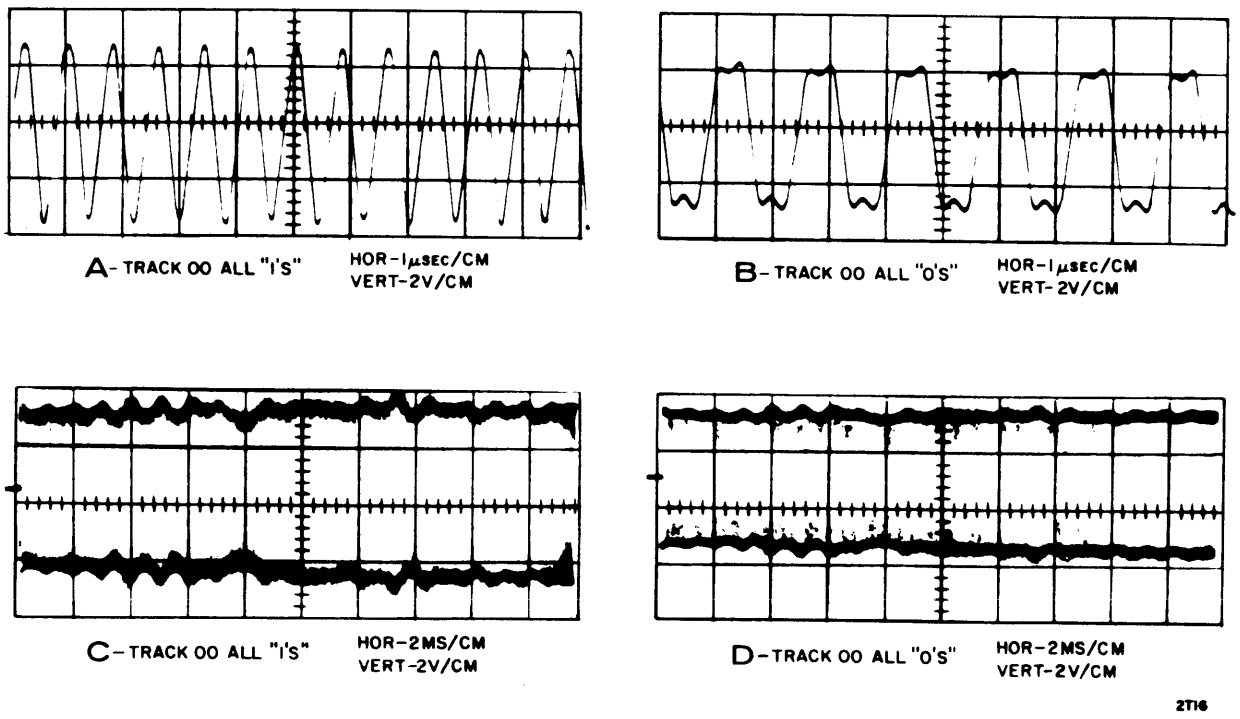



Figure 6-20. Read/Write Amplitude (Track 00)

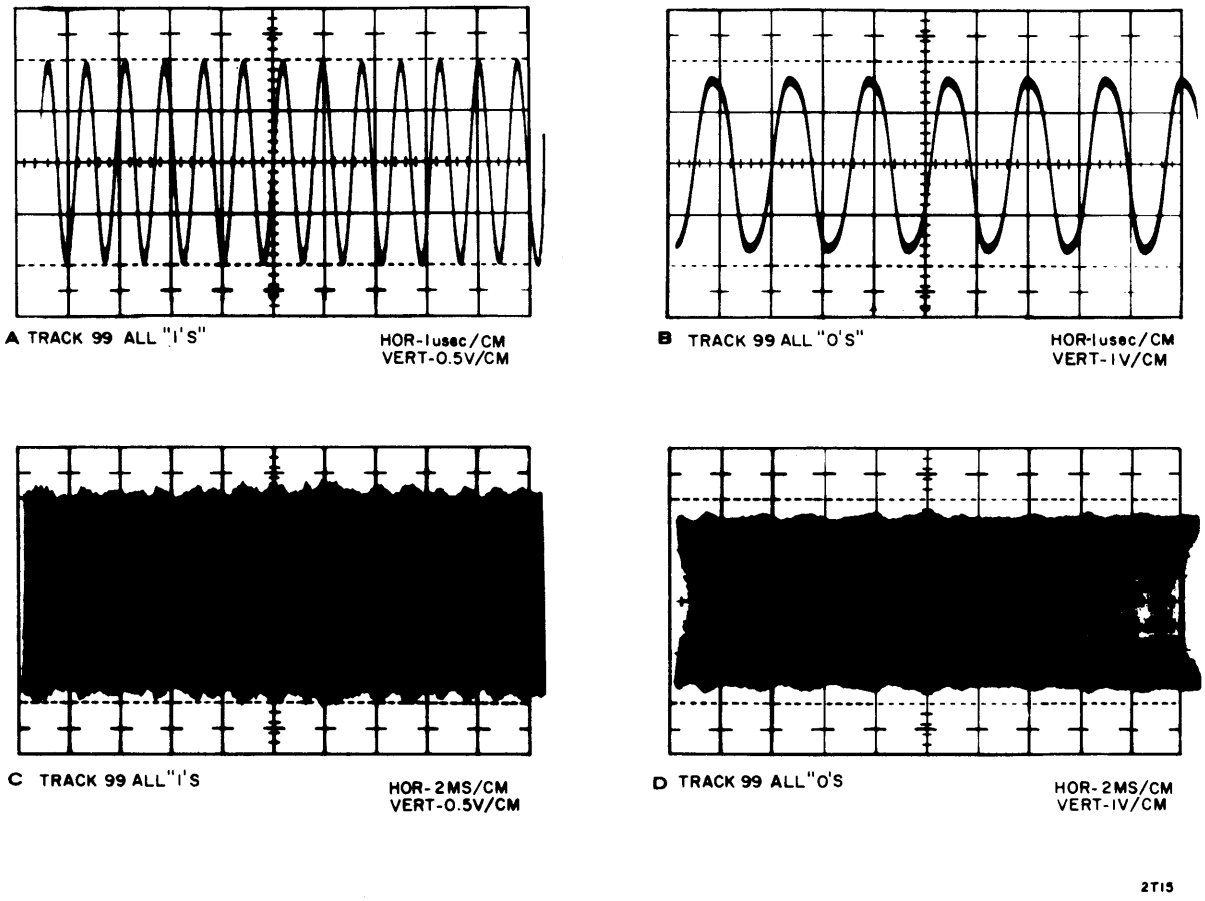



Figure 6-21. Read/Write Amplitude (Track 99)

## DELAY TESTS AND ADJUSTMENTS

The procedures of this paragraph cover the following delays: Y203 and Y221 (On Cylinder), Y312, Y313, and Y407 (Head Select).

NOTE

In the following procedures, it is necessary to command the disk storage drive to perform Seek operations. These commands may be derived via a disk storage drive exerciser or the central processor.

1. Remove the disk storage drive rear panel and set the power supply circuit breakers to ON.
2. Install a disk pack. Press (to light) the START switch.
3. Remove the disk storage drive front panel. Ground an oscilloscope at the maintenance panel GROUND jack.
4. Adjust delays Y203 and Y221 as follows:
   a. Connect the oscilloscope external trigger and channel A probe to test point C of I220 (B28). Set the External Sync switch to positive.
   b. Connect the channel B probe to test point A of Y203 (A30).
   c. Command the disk storage drive to perform a one-track repeat Seek operation.
   d. Make oscilloscope settings and trace comparisons according to Figure 6-22, part A. Adjust the potentiometer shaft on Y203 until its output pulse is delayed by 15 ms with respect to the "0" output of I220.
   e. Connect the oscilloscope external trigger and channel A probe to test point A of Y203 (A30).
   f. Connect the channel B probe to test point A of Y221 (A36).

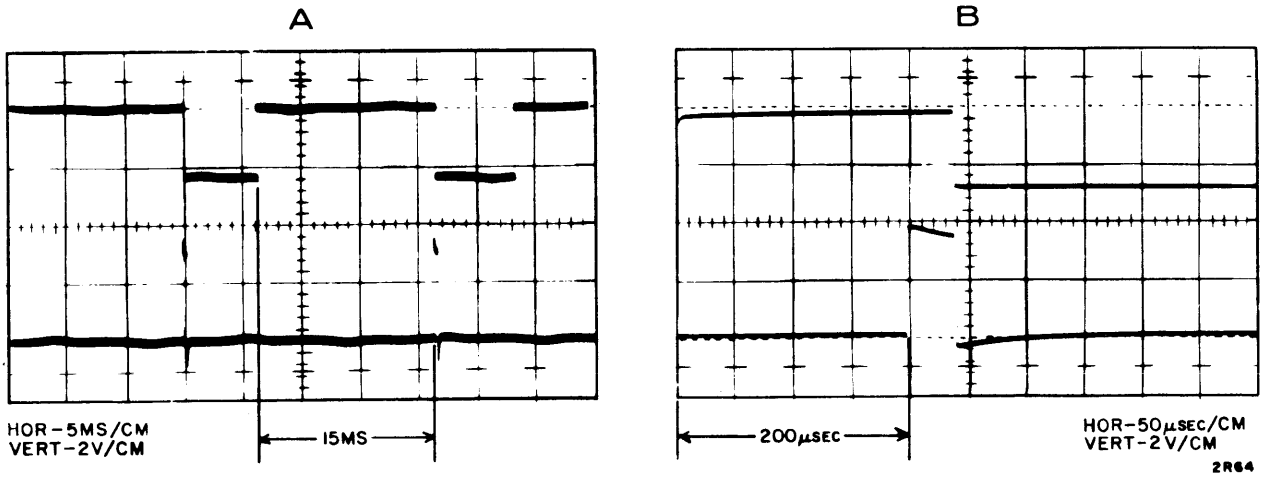



Figure 6-22. On Cylinder Delay Timing

g. Make oscilloscope settings and trace comparisons according to Figure 6-22, part B. Adjust the potentiometer shaft on Y221 until its output pulse is delayed by 200 $\mu$sec with respect to the "0" output of Y203.

h. Stop the Seek operation.

5. Adjust delay Y312 as follows:

a. Connect the oscilloscope external trigger and channel A probe to test point C of K213 Detent FF (C38). Set the External Sync switch to positive.

b. Connect the channel B probe to test point C of Y312 (B42).

c. Set the oscilloscope horizontal sensitivity to 0.5 ms/cm. Command the disk storage drive to perform a one-track repeat seek.

d. Observe the delay time of Y312. Slowly turn the potentiometer shaft counterclockwise. Note the duration of the delay when the detent fails to pick.

e. Turn the shaft a few turns clockwise and restart the disk storage drive. Continue to turn the shaft clockwise until the delay time is 0.5 ms greater than the delay noted in step d, or equal to 4 ms.

f. If the final delay time (step e) is not the same as the initial delay time (step d), perform the Actuator Dynamic Tests and Adjustments procedure.

6. Adjust delay Y313 as follows:

a. Connect the oscilloscope external trigger and channel A probe to test point C of Y312 (B42). Set the External Sync switch to positive.

b. Connect the channel B probe to test point C of Y313 (B43).

c. Set the oscilloscope horizontal sensitivity to 1 ms/cm. Command the disk storage drive to perform a one-track repeat seek.

d. Adjust the potentiometer shaft on Y313 until its output pulse is delayed 5 ms with respect to Y312.

7. Adjust delay Y407 as follows:

NOTE

During the following procedure, it is necessary that a Control Select signal be received by the disk storage drive once each revolution of the disk pack. If an exerciser is being used, this requirement is met automatically. If the central processor is controlling the unit, suitable software must cause this occurrence.

a. Connect the oscilloscope external trigger and channel A probe to test point D of I459 (D21).

b. Connect the channel B probe to test point C of Y407 (D09).

c. Make oscilloscope settings and trace comparisons according to Figure 6-23. As the one-track repeat seek cycles, adjust the potentiometer shaft of Y407 until its output pulse is delayed by 10 $\mu$sec with respect to the "0" output of I459.

8. Disconnect the oscilloscope.

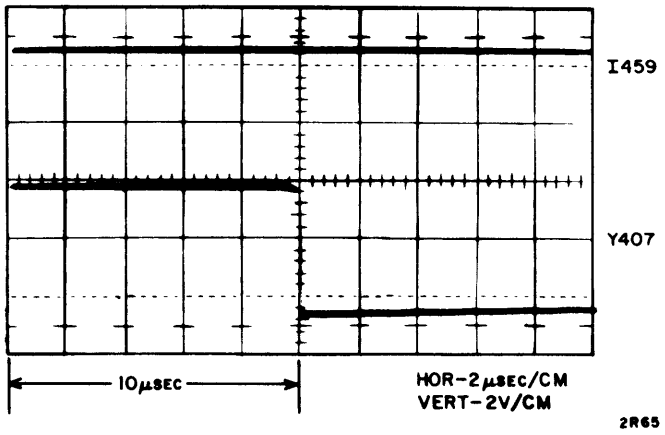



Figure 6-23. Head Select Timing

## POWER LEVEL ADJUSTMENT

1. With the disk drive power cord connected to a suitable source, open the rear panel and slide the power supply out about 1 foot.

NOTE

If the disk drive is disconnected from the controller, a jumper wire must be connected between pins 2 and 3 of connector J08 (located on upper rear surface of power supply).

2. Set the power supply MAIN POWER, +20, and -20 circuit breakers to ON.

3. Using a multimeter make voltage checks and adjustments as follows:

WARNING

Dangerous voltages are present inside the power supply. When making power supply adjustments, do not contact interior components other than those to be adjusted.

a. Open and latch the top rear cover of the disk drive and pull the post of the interlock switch (behind carriage) upward. Measure +20 (+1, -0) vdc at read/write logic chassis locations X16-15 and -14 (ground). Unlatch power supply panel and adjust rheostat R03 (Figure A-6) if required.

b. Open and latch the top rear cover of the disk drive and pull the post of the interlock switch (behind carriage) upward. Measure -20 (+1, -0) vdc at read/write logic chassis locations X16-13 and -14 (ground). Unlatch power supply panel and adjust rheostat R04 (Figure A-6) if required.

CAUTION

The following adjustment is made at the factory to give optimum output and should not be readjusted unless all photocell outputs are rechecked. If a voltage adjustment is made, steps 7 and 8 of the Track/Speed Photocell Mechanical and Switching Level Adjustment must be performed.

c. Measure -3.2 $\pm$ 0.2 vdc at power supply LAMP and DC GRD jacks. Unlatch power supply panel and adjust rheostat R12 (Figure A-6) if required.

4. Disconnect the jumper wire at J08 if used.

# SECTION 7

# SPECIAL MAINTENANCE INFORMATION

# INSTALLATION REQUIREMENTS AND PROCEDURES

Section 7 contains information required at the time of initial installation and setup.

The installation of the disk storage drive equipment requires only that allowance be made for the physical space requirements of the machine. These requirements are the height, width, depth, and weight of the machine plus 3 additional feet in front of and to the rear of the machine. This additional space is needed to allow for proper maintenance of the machine.

The information provided on Figure 7-1 and in Installation Requirements outlines miscellaneous data pertaining to operational requirements and environmental conditions.

For an initial installation, the packing material should be removed and the disk storage drive carefully taken from the container. Inspect for shipping damage. All claims for damage should be filed promptly with the transportation company involved. If claims are filed for shipping damage, save the original packing case and materials.

## INITIAL CHECKOUT PROCEDURE

The following procedures and visual inspections should be performed at the site immediately following installation and before the disk storage drive is placed in operation. If the equipment does not respond as outlined, corrective procedures must be performed.

1. Open and latch the disk storage drive top rear cover. Inspect the actuator assembly and read/write heads for shipping damage.
2. Remove the tape from the top rear cover interlock switch.
3. Remove the four rubber shipping blocks located at the corners between the main deck and frame.

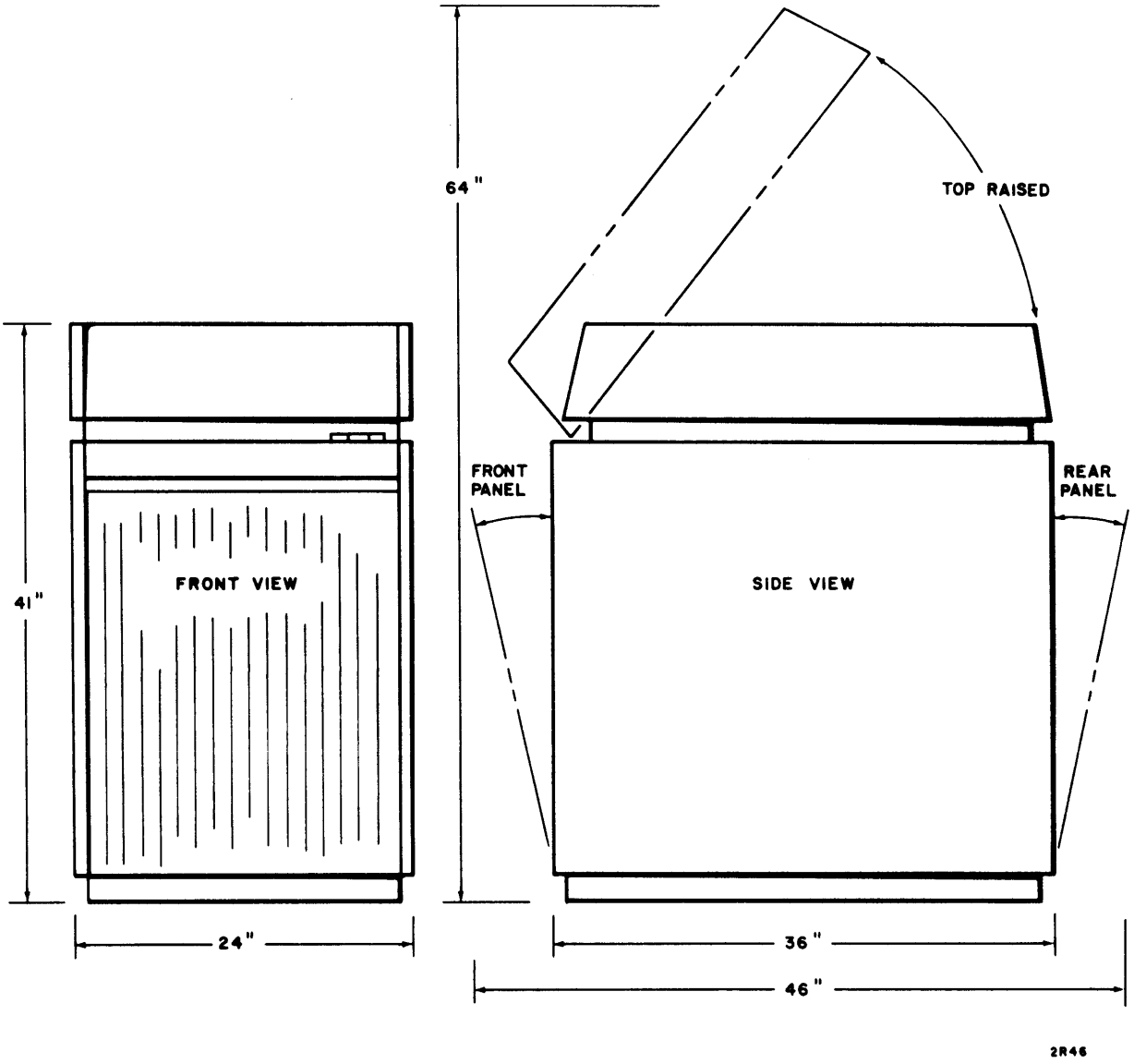



Figure 7-1. Outline Dimensions

4. Remove the tape holding the sector sensor assembly against its opening in the shroud. The sector sensor arm should pivot freely.

CAUTION

Any disturbance to the read/write heads in the following step could require a replacement or readjustment of one or more heads.

5. Remove the tape covering the shroud opening for the read/write heads. Inspect for any apparent head damage.

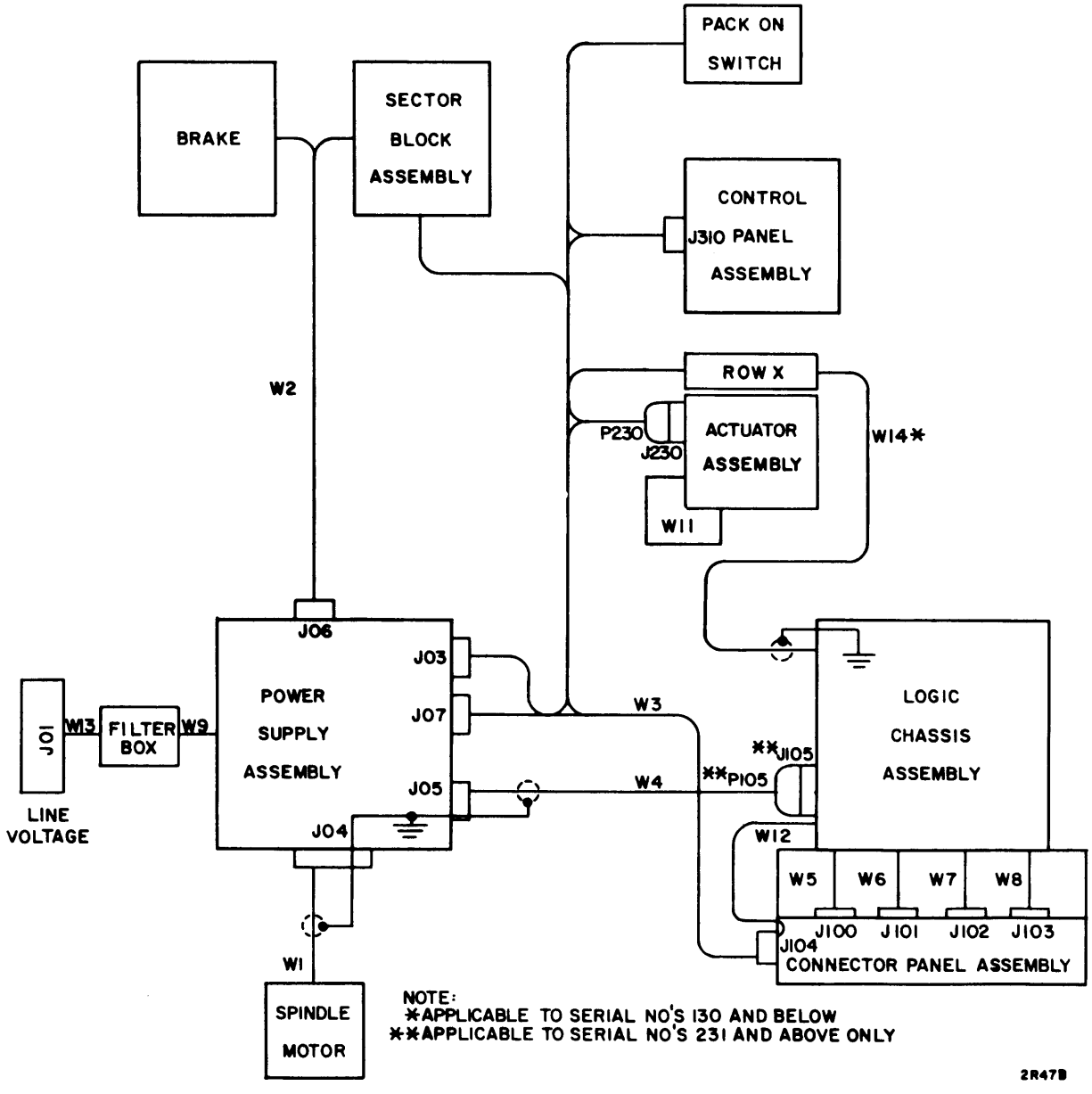



Figure 7-2. Intracabling of Disk Storage Drive

6. Remove the carriage tie down cord and the attached red identification tag. Do not attempt to move the carriage at this time.

7. Remove the disk storage drive front panel.

8. Open and close the logic chassis assembly. If binding or drag occurs, adjust the upper and lower pivot brackets.

9. Check that all logic cards are firmly seated in their connectors.

10. Remove the disk storage drive rear panel.

11. Slide the power supply in and out of the unit. Replace any nylon rollers which do not move freely.

12. Inspect the intracabling connections of the unit (Figure 7-2).

13. Inspect the ground lead running from the home cell assembly to the carriage. Make certain that it is clear of all components and will not interfere with carriage movement.

CAUTION

The timing disk markings are a photo emulsion. In the following step, use extreme care to prevent scraping or scratching the disks.

14. Remove the timing disk dust cover. Carefully inspect the glass timing disk, the adjacent glass mask, and the photocell mount assembly. The timing disk should rotate freely as the carriage is moved and should not contact either the glass mask or the photocell mount assembly. Check that there are no scratches in the inner and outer rings of slots. If the disks require cleaning, use only a dry lint-free piece of gauze to clean the emulsion. Do not use alcohol and do not rub the emulsion side of the disks. If the timing disk is scratched, perform the Timing Disk Replacement procedure.

15. Open the power supply front panel. Inspect power transistor plug-ins Q01 through Q07. Check that the banana plugs are not loose on their heat sinks and the plug-ins are properly seated.

16. Remove the protective cover on the bottom of the power supply. Inspect the rectifier plug-ins CR01 and CR02. Check that the banana plugs are not loose on their heat sinks and the plug-ins are properly seated.

17. Connect the input/output cables (refer to the System Cabling paragraph). Check for proper intercabling between all disk storage drives and the controller. Terminators must be plugged into the signal-out connectors of the last unit in a daisy chain. Ensure that terminator power is provided to all units.

18. Close the disk storage drive top rear cover, raise the front cover, remove and discard plastic spindle cover.

19. Grasp and turn the spindle. The spindle should rotate with little resistance. Wipe the spindle surface clear using alcohol-dampened gauze.

20. Using a vacuum cleaner, clean the area inside the air filter located beneath the shroud.

21. Clean all read/write heads according to the procedure in Section 5.

22. Set all power supply circuit breakers to OFF. Ensure that the carriage assembly is in the fully retracted position.

23. Connect the disk storage drive input power cable to the external ac power source (check unit identification plate for required voltage and frequency).

24. Enable the controller power on. The disk storage drive phase indicator lamps on the power supply will not light.

25. Set the power supply MAIN POWER circuit breaker (CB01) to ON. The adjacent neon phase and +20Y indicators light verifying the application of external ac power. The cooling blowers in the power supply and logic chassis should start.

26. Set the following power supply circuit breakers to ON:

    a. +20 vdc (CB03)

    b. -20 vdc (CB02)

    c. DETENT (CB04)

    d. +40 vdc (CB05)

    The related indicators light to verify the presence of each voltage.

27. Check the following power supply voltages:

    a. Perform the Power Level Adjustment procedure (±20 vdc and LAMP).

b. +20Y test point (approximately 24 vdc).

c. +40 vdc test point (40 ± 4 vdc).

28. Check all five phototransistor lamps (track, speed, home, sector, and pre-sector). They should be lighted and approximately equal in intensity.

NOTE

In the following step, it is not necessary to have a disk pack mounted to perform the procedures.

29. Check the photocell amplifier adjustments as follows:

a. Perform the Home Cell Mechanical and Switching Level Adjustment procedure.

b. Perform the Track/Speed Photocell Mechanical and Switching Level Adjustment procedure.

CAUTION

Do not install a disk pack on the unit when the top rear cover interlock switch is locked in the upward position.

30. Install and clear a disk pack as outlined in Section 5.

31. Set the power supply ACCESS MOTOR circuit breaker (CB07) to ON.

NOTE

In the following step, the disk pack must rotate counter-clockwise. If the rotation is clockwise, the facility wiring of the receptacle is incorrect. Reverse the connection of any two phase leadwires of that receptacle.

32. With the disk storage drive top rear cover and front cover closed, press (to light) the START switch on the operator control panel.

a. START indicator lights.

b. Disk pack is brought up to speed.

c. Actuator performs a First Seek operation, detenting at cylinder 00.

33. Unload the disk storage drive by pressing the START switch on the operator control panel. Remove the disk pack.

CAUTION

A 45 minute warmup period with the top rear cover down and the heads loaded, followed by a 15-minute period with the top cover raised must precede the following adjustment procedures.

34. Perform the Head/Arm Adjustment procedure.

35. Perform the Actuator Adjustment procedure.

36. Perform the Sector/Presector Block Tangential and Radial Adjustment procedure.

37. Install a test disk pack. Begin on-line testing, preferably using diagnostic programs.

## INSTALLATION REQUIREMENTS

### Physical

| | |
|---|---|
| Height | 41 in. |
| Width | 24 in. |
| Depth | 36 in. |
| Weight, supported by four adjustable feet (approximate) | 480 lb |

### Electrical

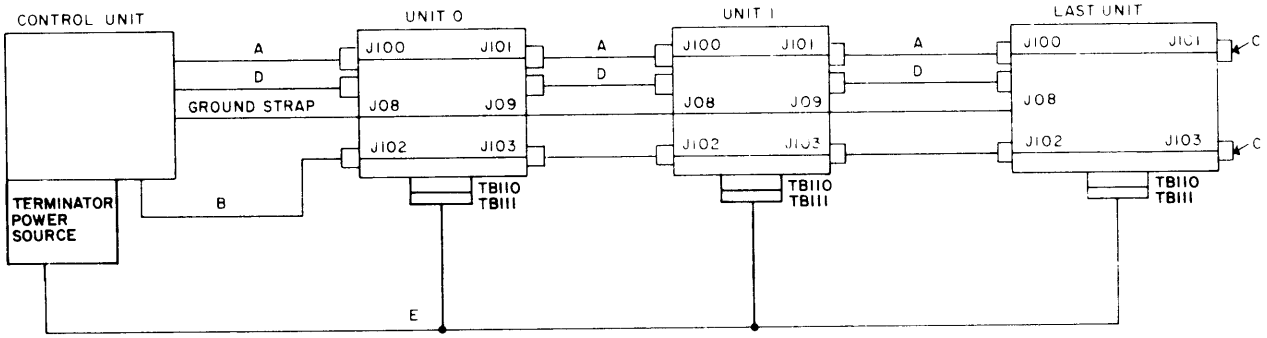
| | |
|---|---|
| Power source | 208 volts ± 10%, 60 (Mod A) 50 (Mod B) Hz, 3-phase, wye source, 3 amp/phase. |
| Line current | |
| Running | 3 amp/phase |
| Starting | 12 amp/phase |
| Input power circuit | 20 amp |

### Environmental

| | |
|---|---|
| Temperature | $60^{\circ}$ to $90^{\circ}$F (Computer room environment) |
| Relative humidity | 10% to 80% |
| Cabinet cooling | Room air |

## SYSTEM CABLING

The disk storage drive units are designed such that eight units may be connected to each controller. The cabling required to accomplish this intercabling is shown in Figure 7-3. The cabling arrangement shown is called "daisy chaining". Data, in this method of cabling, is coupled from the active disk drive unit (in a Read operation), through the intervening disk storage drives to the controller (the reverse is true for a Write operation). Consequently, data read from disk drive number 3 is coupled through the connector panels of disk drive units numbers 2, 1, and 0, in that succession, prior to reaching the controller.




A - DATA AND CONTROL CABLE

B - UNIT SELECT, UNIT SELECTED, 853, SELECTED, SELECTED UNIT READY AND PACK UNSAFE

C - LINE TERMINATOR

D - SEQUENCE PICK AND HOLD

E - TERMINATOR POWER

2U6

Figure 7-3. System Intercabling Diagram (Daisy Chain)

### CAUTION

Do not turn the power supply MAIN POWER circuit breaker of an inactive disk storage drive on or off while another storage drive is reading or writing. This may produce errors to the controller or to the disk storage drive recording surface.

To allow information coupling, all machines must be plugged into the primary power source and the MAIN POWER circuit breaker of each unit must be set to ON. If any one of the machines is not plugged in or the MAIN POWER circuit breaker is OFF, subsequent machines cannot be cycled up or used (Figure 7-4).

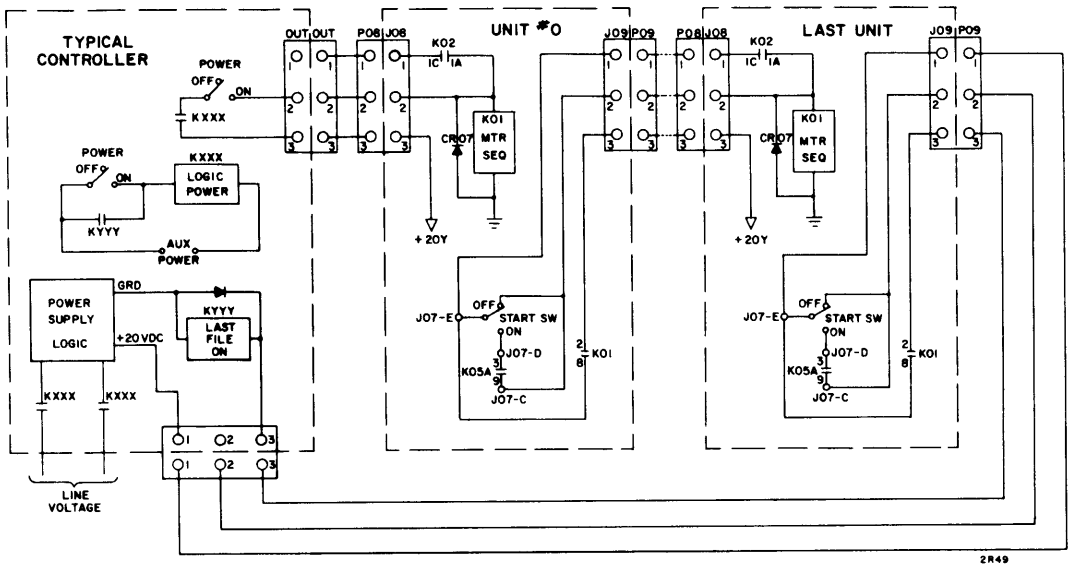



Figure 7-4. System Power-On Sequencing Circuit

## DISK DRIVE UNIT NUMBER CHANGING

The unit number designator may be changed according to the following instructions.

1. Press (to extinguish) the START switch. Disconnect the line voltage power cord.
2. Remove the disk drive front panel and swing out the logic chassis. Remove the wiring access panel.

NOTE

Each location and pin number in Table 7-1 represents two wires of the same color code. These wires must remain together as a pair during the following procedures.

3. Disconnect the leadwires at C24-1 and exchange them with the leadwires at the location (Table 7-1) listed for the desired unit number.
4. Repeat step 3 for the leadwires at C24-2, C25-11, and C25-12.

5. Install the wiring access panel, swing the logic chassis into place, and close the front panel.

6. Change the plastic switch lens on the control panel to agree with the selected unit number.

TABLE 7-1. UNIT NUMBER CHANGING

| LINE FUNCTION | LINE LOCATION | UNIT NUMBER LOCATION | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Unit Select | C24-1<br>C24-2 | D31-5<br>D31-6 | D29-1<br>D29-2 | D29-3<br>D29-4 | D29-5<br>D29-6 | D29-7<br>D29-8 | D29-9<br>D29-10 | D29-11<br>D29-12 | D30-1<br>D30-2 |
| Unit Selected | C25-11<br>C25-12 | D31-7<br>D31-8 | D30-3<br>D30-4 | D30-5<br>D30-6 | D30-7<br>D30-8 | D30-9<br>D30-10 | D30-11<br>D30-12 | D31-1<br>D31-2 | D31-4<br>D31-4 |

## DISK PACK RUNOUT CHECK

This procedure will determine whether a bent disk pack may remain in use. If the disk pack fails to meet the requirements of the procedure, it should be returned to the manufacturer for reconditioning.

1. Open and latch the disk drive top rear cover.

2. Remove the four screws and washers securing the plastic shroud. Set the shroud aside.

3. Install the disk pack to be checked on the spindle.

4. Place the disk pack runout gage (84357600) on the disk drive base plate (Figure 7-5).

5. Turn the bezel of the dial indicator to indicate zero. Orient the dial indicator so that the plastic tip is not only contacting the disk surface but is deflected for an indication of approximately 0.020 inch. Tighten the dial indicator in this position. Turn the bezel to zero the dial indicator.

6. Manually and slowly rotate the disk pack one full revolution while carefully observing the dial indicator. The sum of the deviations (to either side of zero) should not exceed 0.012 inch.

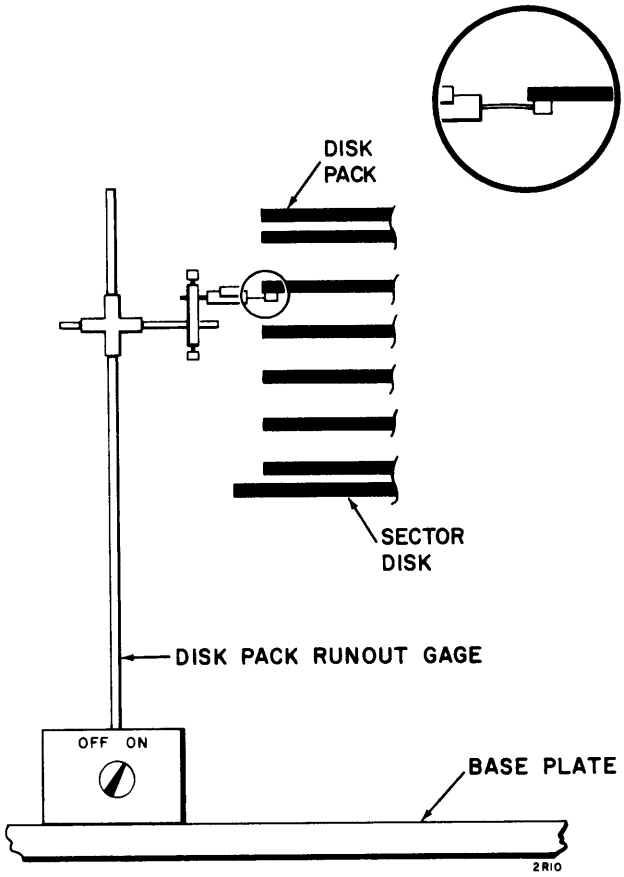



Figure 7-5. Disk Pack Runout Gage

7. If a total deflection of 0.012 inch is encountered in step 6, recheck the indication. The total deflection must occur in a disk circumference of 4 inches or more.

8. Repeat steps 5 through 7 for the eight remaining disk surfaces.

9. Remove the disk pack and the disk pack runout gage.

10. Install the shroud with four screws and washers. Make certain both the carriage and the sector/presector block fit properly through the openings in the shroud. Pull the shroud toward the front of the unit to ensure that it protects the heads when the carriage is in the retracted position.

# APPENDIX A

# POWER SUPPLY

## INTRODUCTION

The disk storage drive power supply requires a three-phase, four-wire, 208 vac, 60/50 cycle input. The power supply provides adjustable ±20 vdc, and fixed +24 vdc, +20X vdc, +20Y vdc, +40 vdc as output voltages. The power supply is manufactured by Control Data Corporation. The following parts provide information for proper operation and maintenance of the power supply.

## SPECIFICATIONS

The following specifications apply to the disk storage drive power supply.

### PHYSICAL

| | |
|---|---|
| Height | 18-3/4 in. |
| Width | 21-5/8 in. |
| Depth | 22-1/2 in. |
| Weight | 135 lb. |

### ELECTRICAL

| | |
|---|---|
| Input voltage | 208-volts, 60-cycle (50-cycle Mod B), 3-phase, wye at 3 amps per phase |
| Output voltage | +20 volts ± 5% (adjustable) at 2 amp max |
| | -20 volts ± 5% (adjustable) at 7 amp max |
| | +20Y volts +20%, -10% at 6 amps max |
| | +20X volts +20%, -10% at 6 amps max average |
| | +24 volts ±15% at 100 ma |
| | +40 volts ± 10% at 0.5 amp max |
| Overload Protection | Main power: 5-amp CB |
| | Convenience outlet (applicable to Serial No. 1927 and below only): 10-amp CB |
| +20 vdc | 2-amp CB |
| -20 vdc | 7-amp CB |
| Detent | 5-amp CB |
| +40 vdc | 1/2-amp CB |
| Access motor | 7-amp CB |
| +20 Y | 5-Amp Fuse |
| Sector Solenoid | 1-Amp Fuse |

# INSTALLATION

## MOUNTING

**WARNING**

**Do not disconnect or connect the power supply cables while the main power cable is connected to a power source.**

The power supply is a drawer-type unit that mounts on self-lubricating slide-borne rollers. A mechanical stop prevents the power supply from being over extended, and latch assemblies hold the drawer in the closed position. Electrical connections are accomplished through easily removable connectors.

## CONNECTING EXTERNAL EQUIPMENT

**WARNING**

**Make certain that the power supply is not connected to any power source, and that all capacitors have been discharged, before making any external connections.**

External test equipment connections to the power supply are made to test points on the front panel of the unit (located behind the lower rear panel). The terminals are color coded and labeled for easy reference.

Troubleshooting of the individual portions of the power supply requires that the front panel be lowered. If the power supply must be opened, observe the above warning.

## COOLING

Two axial vane fans provide forced air cooling with filtered ambient room air.

## INITIAL ADJUSTMENT

Initial adjustment of the power supply should not be required since adjustments and tests are completed on each unit prior to shipment. If an adjustment check is desired

or becomes necessary, resistors R03 and R04 may be varied to produce a constant +20 volt and -20 volt output level, respectively (refer to Part 6). Test points on the power supply front panel are used to check the adjusted output level.

## THEORY OF OPERATION

### GENERAL

The power supply (Figure A-1 and A-2) is completely solid state to provide low dissipation and high reliability to the operating system. The power supply provides an adjustable ±20 volts dc to the logic chassis, +24 and +20X volts dc to the access motor and detent solenoid, and +40 volts dc to the Write circuitry.

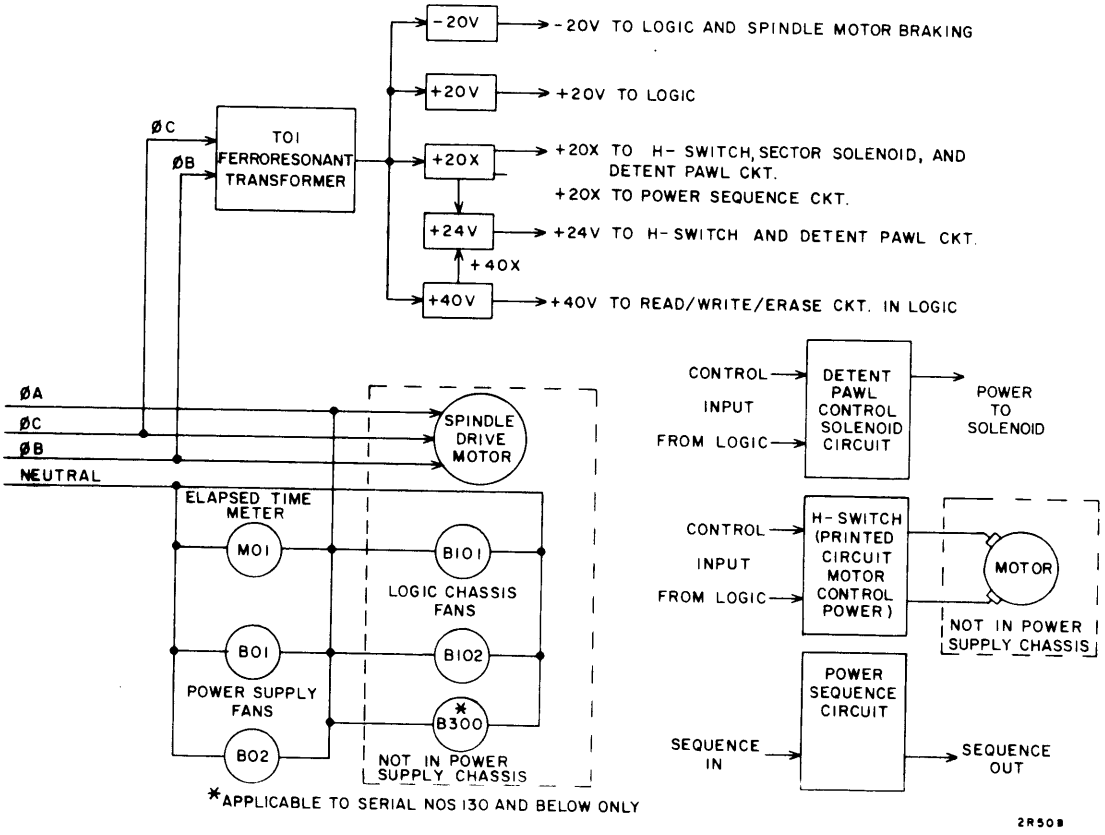



Figure A-1. Power Supply - General Block Diagram

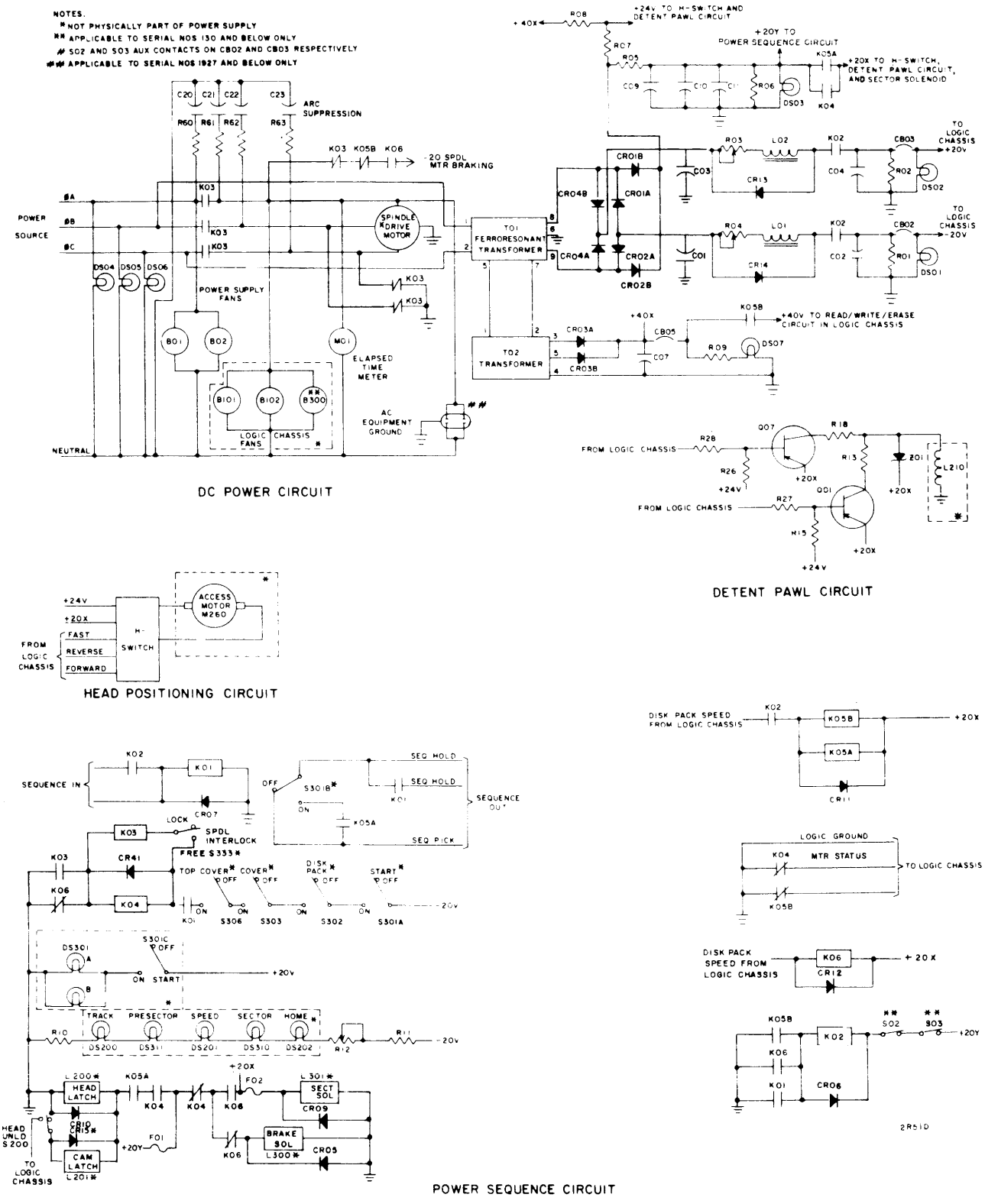



Figure A-2. Power Supply Simplified Schematic

These voltages are sequenced and coupled to the related circuit in such a way as to prevent improper head loading, track accessing, or disk movement.

The 208-volt input power is applied through the closed contacts of the MAIN POWER circuit breaker to the primary windings of transformer T01, to the line voltage indicators, and to the fan motors.

The line voltage indicators, DS04, DS05, and DS06, are connected between the three-phase input wires and the neutral wire, to provide an indication of the power applied.

Phase A of the primary power, is applied to the two blower motors in the logic chassis and to the two fan motors in the power supply.

Power (phase B and phase C) applied to the primary of transformer T01, is coupled to the secondary. Transformer T01 is a ferroresonant transformer. Consequently, the transformer secondary voltage tends to remain constant, regardless of the voltage variation of the applied signal or the load applied to the secondary. The voltage developed across the secondary of T01 is coupled from pins 7 and 5 to the primary of transformer T02, and from pins 8 and 9 to rectifier diodes CR01, CR02, and CR04.

The +20 vdc developed at diodes CR01B and CR02B is also applied to the junction of resistors R07 and R05. Resistors R08 and R07 form a voltage divider. With +40 vdc applied to resistor R08, the junction of resistors R08 and R07 is driven to approximately +24 vdc. This voltage is applied to the H switch and the detent circuit for transistor bias. The +20 vdc at the junction of R07 and R05 is applied to filter capacitors C09, C10, and C11. Resistor R06 is a bleeder to discharge the capacitors once the unit has been turned off. Indicator DS03 provides an indication that the +20Y and +20X voltages are available.

Transistors Q01 and Q07 are used to pull the spring loaded pawl out of the detent gear. Transistor Q07 provides an initial high current pulse for 2 ms, which is needed to pull the detent pawl. Transistor Q01 is also gated on at the same time and is left on until the Detent command is received. The current through Q01 flows through the 10 ohm resistor (R13) to provide approximately 2 amperes holding current to the solenoid. Once the Detent command is reached, power is removed from the base of Q01, allowing the spring-loaded pawl to be pulled into and engage the detent gear. Approximately 2 ms are required, after Q01 is gated off, to engage the gear.

## PRINTED CIRCUIT MOTOR MOTION CONTROL

The printed circuit motor, which moves the carriage drive and positioning mechanism, is controlled by a 5-transistor switching circuit (refer to Diagrams and Wire List Manual, Section 1) in the power supply. By controlling the transistor selection and the amount of current through these transistors, the motor is driven fast or slow in the reverse or forward direction. Transistors Q03 and Q06 are switched on for a forward operation, causing the printed circuit motor to drive the carriage forward. Transistors Q04 and Q05 are switched on for a reverse operation, connecting the switching circuit in such a manner as to allow motor current flow in the reverse direction.

The five transistors (Q02 through Q06) are normally gated off by the +24 vdc applied through resistors to each base. Emitter voltage, applied to the PNP transistors, is supplied by the +20X voltage source. The base bias voltage is greater than the applied emitter voltage, to assure that the transistors are cut off when not selected. When a Move command is applied, the base resistors complete a voltage divider resulting in a forward biased transistor.

Resistors R29 and R31 prevent overdrive of transistors Q03 and Q05 respectively. This allows the amplifier card inputs to the switching circuit, to drive both switching transistors (Q05 and Q04 or Q03 and Q06) in parallel, even though the emitter reference voltages are different. The values of R29 and R31 are selected to provide equal drive to the parallel switching transistors.

The magnitude of current in the printed circuit drive motor is determined by the power supply voltage and the total effective series resistance in the circuit. The voltage supplied to the switching transistors is fixed, but the total circuit resistance during the high current drive, excluding the saturation resistance of the switching transistors, is approximately 2.5 ohms. After the current is reduced, the total circuit resistance is approximately 7.5 ohms.

The use of series resistor R17 during slow speeds prevents excessive current and motor torque when not needed. Slow speeds are maintained by servoing and not current limiting. Circuit breaker CB07 prevents sustained high level currents from damaging the printed circuit motor.

Assume that a Forward move command of greater than 36 tracks is received; ground is applied through pins P and S of power supply jack J03 to bias on the respective transistors. The Fast command or ground level applied to J03-P turns on Q02. The ground level applied through J03-S forward biases Q06 and Q03. Electron flow is through parallel resistors R32, R33, and R34, through forward biased transistor Q06 to one side of the printed circuit motor. From the motor, electron flow is through resistor R20, forward biased Q03, and forward biased Q02 to +20X vdc. With electron flow through Q03 and Q06, the motor is driven forward. Transistor Q02 shunts resistor R17, resulting in maximum current flow through the motor and consequently maximum motor acceleration. When the Decrement counter indicates less than 36 tracks remaining, and if the carriage velocity is greater than 15 inches per second, the following occurs:

1. Q03 and Q06 are switched off and Q04 and Q05 are switched on (Q02 remains on). The reverse current through the motor causes the motor to slow the carriage down.
2. When the carriage speed has slowed to 15 inches per second in the forward direction Q02, Q04, and Q05 are turned off.
3. From this time until the Decrement counter indicates less than 8 tracks remaining, current pulses through the H switch are used to sustain 15 inches per second carriage speed.
4. With 7 tracks remaining, Q02, Q04, and Q05 turn on (Q03 and Q06 turn off), and again the motor is used as a brake, slowing the carriage to 6 inches per second.
5. At 6 inches per second, Q02, Q04, and Q05 turn off and current pulses (through R17, Q03, the motor, and Q06) sustain a carriage velocity of 6 inches per second.
6. With 3 tracks remaining, Q04 and Q05 turn on and Q03 and Q06 turn off (Q02 remains off), and slow the carriage to 2 inches per second.
7. At 2 inches per second, Q04 and Q05 turn off and current pulses (through R17, Q03, the motor, and Q06) sustain a carriage velocity of 2 inches per second.

When the selected track is reached, the spring loaded pawl is dropped.

## POWER ON SEQUENCE

Sequencing of the power within the power supply is accomplished by six relays. This sequencing is necessary to prevent damage to the heads and/or disks, and to assure proper control of the actuator mechanism by the logic.

Motor sequence relay K01 is energized when the unit receives a Sequence In from either the control unit or the previous storage drive on the line. Sequencing of the storage drives is necessary to prevent loading of the primary power source.

If this disk drive unit START switch is not lighted (S301 OFF), the Sequence Out Level is applied to the next storage drive.

Assume that a Power On command is received from the control unit and the START switch (S301) is lighted. The +20Y vdc is applied through connector J08 to complete the path and energize relay K01. When relay K01 is energized, contacts 1 and 7 close to energize relay K02. When K02 is energized, contacts 3A and 3C close to supply +20 vdc to the logic chassis, and contacts 4C and 4A close to supply -20 vdc to the logic chassis. Relay K02 contacts 2A and 2C also close allowing power to be applied to relays K05A and K05B when the spindle motor is up to speed.

Relay K01 also completes the path through contacts 3 and 9 to energize relay K04 (assuming the disk pack is on, both top covers are closed, and the START switch is lighted). Contacts 2 and 5 of K04 open and remove +20Y volts to the brake solenoid. This causes the pawl to free the spindle and close the spindle interlock switch, S333. Relay K03 energized when the switch closes. Relay K03 contacts 2A/2C, 3A/3C, and 4A/4C close to apply power to the spindle motor. Relay K04 contacts 1 and 4 open to apply an output signal indicating that the motor is on. Contacts 2 and 8 of K04 close so that power sill be applied to the head latch and cam latch solenoids when the disk pack is up to speed. Contacts 3 and 9 of K04 close to provide +20X vdc to the sector solenoid and relay K06. When the disk pack speed reached 50 rpm, the logic completes a circuit and energizes K06.

When the disk pack ip up to 70 percent of the rated speed, the logic completes a circuit to energize relays K05A and K05B, through J03-X. When these relays energize, the following events occur:

1. +40 vdc is applied to the Write circuit.

2. Contacts 1 and 4 of K05B are open and a signal is applied to the logic indicating that the pack is up to speed. This signal is applied to a 12-second delay card which allows time for the air to be purged from the disk pack area before loading the heads.

3. Contacts 2 and 8 of K05A close to apply power to the head latch. Once the heads are loaded, the solenoid armature holds the heads loaded.

4. Holding current is supplied to hold relay K02 energized.

## POWER OFF SEQUENCE

Power in the disk storage drive can be cycled off in any of three ways; from the START switch on the disk storage drive operator control panel, by opening either top cover, or from the control unit. It is assumed that the purpose for this Power Off sequence is to change packs. The sequence is initiated when START switch S301 is pressed, which opens the contacts of S301A and breaks the circuit holding relays K03 and K04 energized. The following events occur:

1. K03 contacts 2A/2C, 3A/3C, and 4A/4C open and remove power to the spindle motor (rotation begins to slow).

2. K03 contacts 2C/2B, 3C/3B, and 4C/4B close (partially completes circuit that will later dynamically brake the spindle motor).

3. K04 contacts 1 and 4 close and signal logic that the spindle motor is off.

4. K04 contacts 2 and 5 close (partially completes circuit that will energize the brake solenoid when spindle motor rpm is less than 50).

5. K04 contacts 2 and 8 open to remove power to the head and cam latch solenoids (heads unload and carriage starts retracting).

When the logic senses that the spindle rpm is below 70 percent of the rated speed, it de-energizes relays K05A and K05B. This causes the following events:

1. K05B contacts 3 and 6 close and apply -20 vdc to the windings of the spindle drive motor. This causes a magnetic field to form. The field opposes further rotation and the motor speed slows rapidly (dynamic braking).

2. K05B contacts 2 and 8 open to remove +40 vdc to the Write circuit.

3. K05A contacts 2 and 8 perform a backup service by further disabling the head and cam latch solenoids to ensure safe unloading of the heads.

When the logic senses that the spindle rpm is below 50 rpm, it de-energizes relay K06. This causes the following events:

1. K06 contacts 2 and 8 remove the -20 volt spindle motor braking power.
2. K06 contacts 1 and 7 also remove the +20X voltage to the sector solenoid and the access motor H switch (prevents further movement of the carriage.
3. K06 contacts 1 and 4 close to energize the brake solenoid so that the pawl on the spindle lock assembly engages spindle lock disk to hole the spindle stationary.

## MAINTENANCE

### GENERAL

**WARNING**

**High voltages are located within this power supply. Do not make any connections within the power supply while the main power cable is connected.**

Mounted in a roller drawer, and employing a hinged front panel, the power supply components are all easily accessible with no special tools or connections.

### REPLACEMENT PARTS

Replacement parts are shown on Figure A-3 through A-7 and are listed in Table A-1.

Refer to the Parts List Manual (Section 1) for a detailed description of all parts in the power supply.

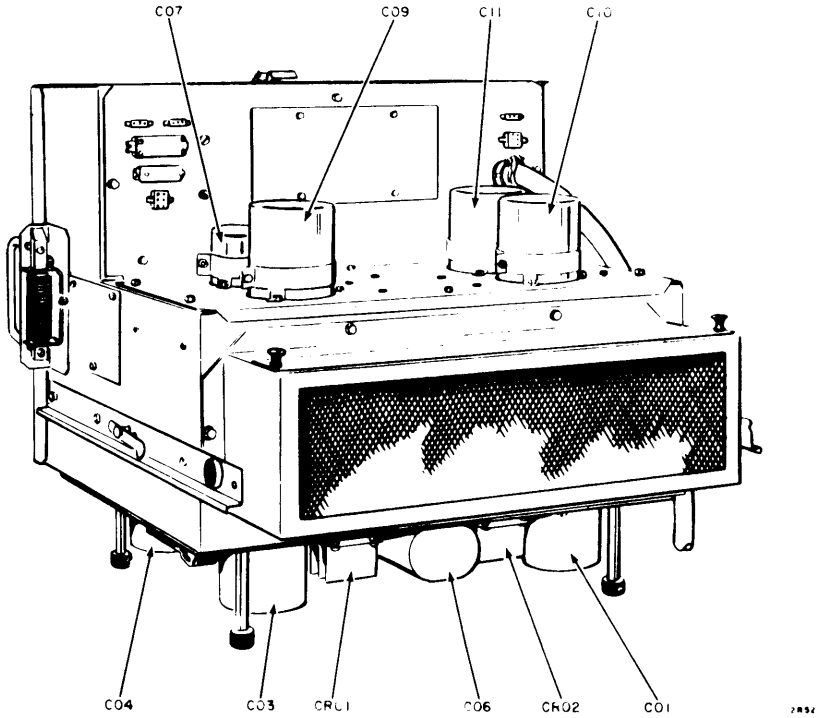



Figure A-3. Power Supply- External Rear View

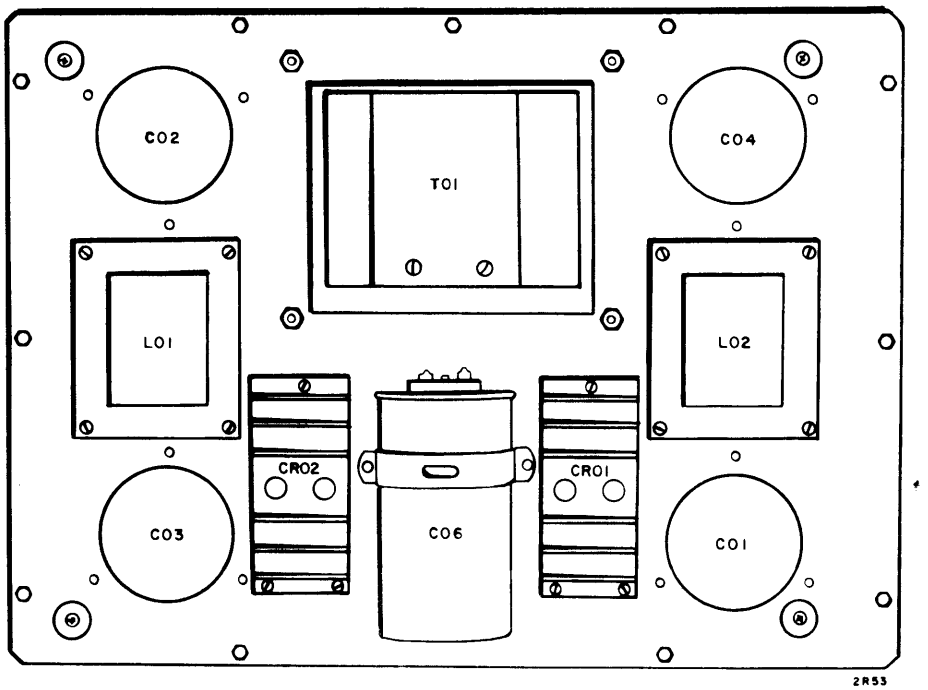



Figure A-4. Power Supply - Bottom External View

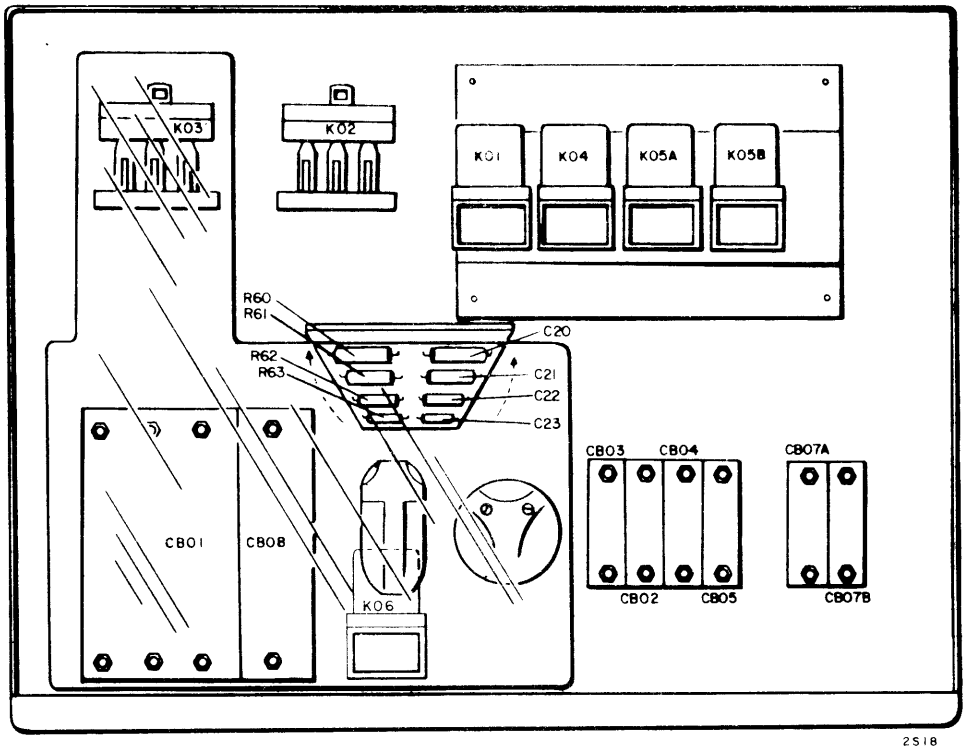



Figure A-5. Power Supply - Rear Front Panel

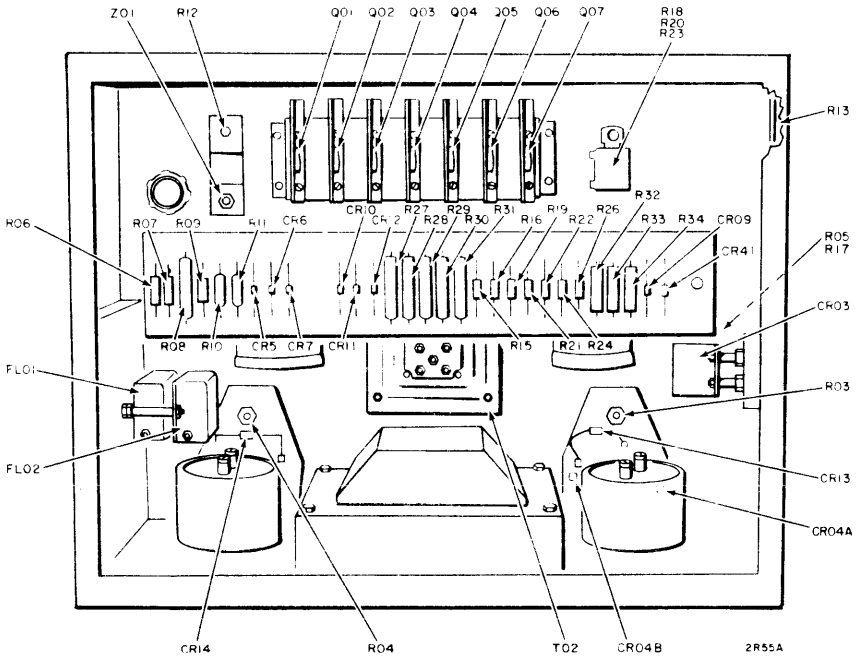



Figure A-6. Power Supply Chassis

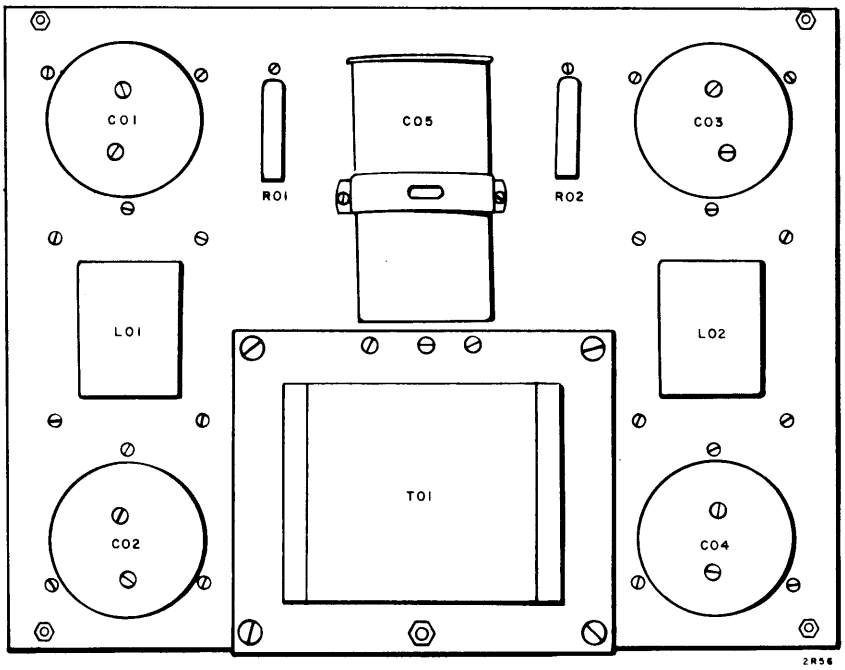



Figure A-7. Power Supply, Internal Bottom View

TABLE A-1. PARTS LIST

| Reference Designation | Qty | Control Data Corp. P/N | Manufacturer and Part Number | Description |
|---|---|---|---|---|
| B01, B02 | 2 | 94275500 | | Axial vane fan, 50/60 cycle, 115 vac |
| C01, C02, C03, C04, C09, C10, C11 | 7 | 92632002 | P. R. Mallory 20-90077 | Capacitor, 50,000 μf, 25 volts |
| C05, C06 | 2 | 92639007 | Sprague Electric 3S1683 | Capacitor, 20 μf, 370 volts ac |
| C07 | 1 | 92632037 | Sprague Electric 36D153G050CC6B | Capacitor, 15,000 μf, 50 volts |
| C20, C21, C22, C23 | 4 | 92496245 | Sprague Electric 155P22496 | Capacitor, 0.22μf 600 volts |
| CB01 | 1 | 94268500 | Heinemann Electric 33635Y5 | Circuit breaker, 3P, 5 amp, 250 volts ac |

TABLE A-1. PARTS LIST (Cont'd)

| Reference Designation | Qty | Control Data Corp. P/N | Manufacturer and Part Number | Description |
|---|---|---|---|---|
| CB01 | 1 | 94268500 | Heinemann Electric 33635Y5 | Circuit breaker, 3P, 5 amp, 250 volts ac |
| CB02 | 1 | 92696047 | Wood Electric 128-207-101 | Circuit breaker, 1P, 7 amp, 50 volts |
| CB03 | 1 | 92696041 | Heinemann Electric AM-12-HK-2 | Circuit breaker, 1P, 2 amp, 50 volts |
| CB04 | 1 | 92696039 | Heinemann Electric AM-12-AK-5 | Circuit breaker, 1P, 5 amp, 50 volts |
| CB05 | 1 | 92696037 | Heinemann Electric AM-12-HK-0.5 | Circuit breaker, 1P, 1/2 amp, 50 volts |
| CB07 | 1 | 94268308 | Heinemann Electric AM-33-10-HK-7 | Circuit breaker, 2P, 7 amp, 50 volts |
| CB08 (Applicable to Serial No. 1927 and below only) | 1 | 94268400 | Heinemann Electric 1163SY-10 | Circuit breaker, 1P, 10 amp, 250 volts ac |
| CR01, CR02 | 2 | 46266700 | | Rectifier diode assembly, dual |
| CR03A, CR03B CR03A, CR04B | 4 | 94065010 | Westinghouse 367C | Rectifier diode, silicon |
| CR05 thru CR07, CR09 thru CR12 CR41 | 8 | 93935000 | Semtech, SC1 | Rectifier diode, silicon |
| CR13, CR14 | 2 | 45595600 | | Rectifier diode, silicon |
| DS01, DS02 DS03, DS07 | 4 | 94039102 | Amp,Inc 380672 | Lamp, 24 volts |
| DS04, DS05, DS06 | 3 | 94039103 | Amp,Inc 380627 | Lamp, 125 watts |
| FL01, FL02 | 2 | 92641001 | Cornell-Dubilier Elect, NF-1A364 | Line filter |
| F01 (Applicable to units Serial No. 3981 and above only) | 1 | 93418133 | Bussman Mfg Type AGC 5A | Fuse, fast-blow, 5 amp, 32v |
| F02 (Applicable to units Serial No. 3981 and above only) | 1 | 92412003 | Bussman Mfg Type MDL 1A | Fuse, slow-blow, 1 amp, 250v |

TABLE A-1. PARTS LIST (Cont'd)

| Reference Designation | Qty | Control Data Corp. P/N | Manufacturer and Part Number | Description |
|---|---|---|---|---|
| K01, K04, K06 K05A, K05B | 5 | 94268600 | Guardian Elect. 1225-3PDT | Relay, 3 PDT |
| K02, K03 | 2 | 92643005 | Potter and Brumfield PMT-17D-20 | Relay, 4 PDT |
| M01 (Mod A) | 1 | 93671002 | | Meter, 60-hertz |
| M01 (Mod B) | 1 | 93671001 | | Meter, 50-hertz |
| Q01 through Q07 | 7 | 50220700 | Motorola SP2142 | Transistor, PNP |
| R01, R02 | 2 | 92758017 | Ohmite 2-H-48-F | Resistor, 50 ohm, 20 watt |
| R03 | 1 | 93720324 | Ohmite 0143 | Rheostat, 6 ohm, 25 watt |
| R04 | 1 | 93296302 | Ohmite K-Z-M02-7.07 | Rheostat, 2 ohm, 100 watt |
| R06 | 1 | 92512991 | Memcor Val-10-100 | Resistor, 100 ohm, 10 watt |
| R07, R10, R11 | 3 | 92512987 | Dale RS-5 | Resistor, 10 ohm, 5 watt, 1% |
| R08 | 1 | 92512989 | Memcor Val-10-50 | Resistor, 50 ohm, 10 watt |
| R09 | 1 | 92512935 | Ohmite AB type HB | Resistor, 680 ohm, 2 watt |
| R12 | 1 | 93700308 | Ohmite 0108 | Rheostat, 25 ohm, 12-1/2 watt |
| R13, R17 | 2 | 94237001 | Ohmite 3-1/2-TE-53-18B-F-S-10 | Resistor, power 10 ohm, 55 watt |
| R15, R16, R19, R21, R22, R24, R26 | 7 | 92512399 | Ohmite AB Type GB | Resistor, 1.2K ohm, 1 watt |
| R18, R20, R23 | 3 | 94237000 | Ohmite 1-1/4-TE-53-18B-F-S-1 | Resistor, power, 1 ohm, 30 watt |
| R27, R28, R29, R30, R31 | 5 | 92512985 | Memcor Val-10-35 | Resistor, 35 ohm, 10 watt |
| R32, R33, R34 | 3 | 92825001 | International Resistance PW-7 | Resistor, 0.1 ohm, 7.5 watt, 1% |
| R60, R61, R62, R63 | 4 | 92512434 | Ohmite AB Type HB | Resistor, 100 ohm, 2 watts |
| T01 (Mod A) | 1 | 93914000 | | Transformer, power, 11 ampere, 60-hertz |

TABLE A-1. PARTS LIST (Cont'd)

| Reference Designation | Qty | Control Data Corp. P/N | Manufacturer and Part Number | Description |
|---|---|---|---|---|
| T01 (Mod B) | 1 | 93920000 | | Transformer, power, 11 ampere, 50-hertz |
| T02 | 1 | 94222800 | | Transformer, power, 1 ampere |
| Z01 | 1 | 93409005 | JEDEC IN2993 | Zener Diode, 43 volt, 10 watt, 20% |

## INITIAL TROUBLESHOOTING PROCEDURE

**WARNING**

**The power supply is capable of producing voltages that are dangerous. Whenever measurements are being made on internal components, be sure that the measuring equipment case has a common ground with the power supply. Whenever test equipment leads are attached or removed, the power supply should be turned off.**

Check the output voltage and ripple at the front panel test points. Check the line voltage applied to the power supply. Visually inspect the power supply for burned or damaged parts, foreign matter, and loose leads.

## TROUBLESHOOTING TABLE

The troubleshooting table (Table A-2) lists the symptom, probable cause, and remedy. To properly check the power supply and associated circuits, match the observed sympton with the symptom on the chart, then complete the analysis and correction.

TABLE A-2. TROUBLESHOOTING TABLE

CAUTION

Before making continuity measurements, remove all input power.

| SYMPTON | PROBABLE CAUSE | REMEDY |
|---|---|---|
| 1. Phase indicator lamps do not illuminate | a. No input power | Check to assure that the main power cable is connected. |
| | b. MAIN POWER circuit breaker defective | With the main power cable disconnected, check the continuity of the circuit breaker. |
| | c. Defective wiring | Check the continuity of the neutral and phase wiring from input connector J01 to output connector J04. |
| | d. Lamps defective | Check, by replacement, the continuity of the lamps. |
| 2. Phase lamps illuminate, but fans do not operate | a. Defective wiring | Check continuity of fans (the wiring between the phase A input and TB05-1, and the wiring between the neutral input and TB05-2). |
| 3. Phase lamps illuminate, power supply fans operate, but logic chassis fans do not operate. | a. Defective wiring | Check the continuity between the phase A wiring input and pin 1 of J05. Check the wiring between the neutral input wiring and pin 3 of J05. Make the necessary corrections. |
| 4. No voltage at +20 test point | a. Loss of input voltage | Check voltage at pins 8 and 9 of ferroresonant transformer T01. |
| | b. Rectifier diode defective | Check continuity of rectifier diodes CR04A and CR04B. |
| | c. Capacitor C03 shorted | Check C03, using a multimeter set to the Rx1 meg scale. |
| | d. Resistor R03 defective | Check resistance of the resistor. |
| | e. Choke L01 open | Check continuity of the choke. |
| | f. Contacts 3C and 3A of K02 are pitted | Check continuity of the relay contacts. Replace K02 if necessary. |

TABLE A-2. TROUBLESHOOTING TABLE (Cont'd)

| SYMPTON | PROBABLE CAUSE | REMEDY |
|---|---|---|
| | g. Capacitor C04 shorted | Check C04, using a multimeter set to the Rx1 meg scale. |
| 5. Improper voltage at +20 test point | a. R03 needs adjustment | Adjust R03 for the proper output. |
| | b. Leaky or open output filter | Check C04 using a multimeter set to the Rx1 meg scale. |
| | c. Capacitor C03 open or leaky | Check C03 using a multimeter set to the Rx1 meg scale. |
| | d. CR13 shorted | Check reverse resistance of CR13 on the Rx100 scale. |
| | e. Improper front-to-back ratio on rectifier diodes CR04A and CR04B | Check and replace if defective. |
| | f. Bleeder resistor R02 open | Check resistance and replace if necessary. |
| 6. Excessive ripple at +20 test point | a. Leaky or open output filter | Check C04 using a multimeter set to the Rx1 meg scale. |
| | b. Shorted turns of choke | Check and replace L02 if defective. |
| | c. Improper front-to-back ratio on rectifier diodes CR04A and CR04B | Check and replace if defective. |
| 7. No voltage at -20 test point | a. Loss of input voltage | Check voltage at pins 8 and 9 of ferroresonant transformer T01. |
| | b. Rectifier diode defective | Check continuity of rectifier diodes CR01A and CR02A. |
| | c. Capacitor C01 shorted | Check C01 using a multimeter set to the Rx1 meg scale. |
| | d. Resistor R04 defective | Check resistance of resistor. |
| | e. Choke L01 open | Check continuity of choke. |
| | f. Contacts 4C and 4A of K02 are pitted | Check continuity of the relay contacts and replace K02 if necessary. |

TABLE A-2. TROUBLESHOOTING TABLE (Cont'd)

| SYMPTON | PROBABLE CAUSE | REMEDY |
|---|---|---|
| | g. Capacitor C02 is shorted | Check C02 using a multimeter set to the Rx1 meg scale. |
| 8. Improper voltage at -20 test point | a. R04 needs adjustment | Adjust R04 for the proper output. |
| | b. Leaky or open output filter | Check C02 using a multimeter set to the Rx1 meg scale. |
| | c. Capacitor C01 open or leaky | Check C01 using a multimeter set to the Rx1 meg scale. |
| | d. Diode CR14 is shorted | Check reverse resistance of CR14 on the Rx100 scale. |
| | e. Improper front-to-back ratio on rectifier diodes CR01A and CR02A | Check and replace if defective. |
| | f. Bleeder resistor R01 open | Check the resistance and replace if necessary. |
| 9. Excessive ripple at -20 test point | a. Leaky or open output filter | Check C02 using a multimeter set to the Rx1 meg scale. |
| | b. Shorted turns of filter choke | Check and replace L01 if defective. |
| | c. Improper front-to-back ratio on rectifier diodes CR01A and CR02A | Check and replace if defective. |
| 10. No voltage at +20 test point | a. Capacitor C09, C10, or C11 shorted | Check the capacitors using a multimeter set to the Rx1 meg scale. |
| | b. Resistor R05 open | Check continuity and replace if necessary. |
| | c. Bad lead or broken solder connection. | Check continuity, isolate, and repair the defective lead. |
| | d. Contacts 1 and 7 of K05A are not making electrical contact | Check continuity of the relay contacts. Replace K05A if defective. |
| 11. Improper voltage at +20Y test point | a. Leaky or open capacitor | Check the capacitors using a multimeter set to the Rx1 meg scale. |

TABLE A-2. TROUBLESHOOTING TABLE (Cont'd)

| SYMPTON | PROBABLE CAUSE | REMEDY |
|---|---|---|
| | b. Resistor R05 aged beyond the tolerance limits | Check the resistance and replace if necessary. |
| | c. Resistor R06 is open | Check and replace if defective. |
| 12. Excessive ripple at +20V test point | a. Leaky or open capacitor | Check the capacitors using a multimeter set to the Rx1 meg scale. |
| | b. Improper front-to-back ratio on rectifier diodes CR01B and CR02B | Check and replace if defective. |
| 13. No voltage at +40 test point | a. No input power | Check the continuity from pins 5 and 7 of T01 to pins 1 and 2 of T02 respectively. |
| | b. Transformer T02 is defective | Check the voltage developed across pins 3 and 5 of T02. Replace the transformer if defective. |
| | c. Capacitor C07 is shorted | Check the capacitor using a multimeter set to the Rx1 meg scale. |
| | d. Contacts of CB05 are not making contact | Check continuity and replace if necessary. |
| | e. Contacts 2 and 8 of K05B are not making electrical contact | Check and replace K05 if defective |
| | f. Rectifier CR03A or B is shorted | Check the reverse resistance of the diodes using a multimeter set to the Rx1 meg scale. |
| 14. Improper voltage at +40 test point | a. Transformer is shorted or open | Check continuity and replace if necessary. |
| | b. Rectifier CR03A or B is defective | Check the forward and reverse resistance using a multimeter set to the Rx1 meg scale. |
| | c. Capacitor C07 is leaky | Check and replace if necessary. |
| | d. Resistor R09 is defective | Check continuity and resistance of the resistor. |

TABLE A-2. TROUBLESHOOTING TABLE (Cont'd)

| SYMPTON | PROBABLE CAUSE | REMEDY |
|---|---|---|
| | e. Bad lead or broken solder connection | Check continuity, isolate, and repair the defective lead. |
| 15. Excessive ripple at +40 test point | a. Leaky or open capacitor | Check C07 and replace if defective. |
| | b. Rectifier CR03A or B is defective | Check the forward and reverse resistance using a multimeter set to the Rx1 meg scale. |
| 16. No automatic First Seek | a. H switch circuit defective | With the disk drive in the on condition and the START switch ON, check the base bias of the forward transistors and check the applied supply voltages. Repair the defect. |
| | b. Bad lead or solder connection | Check continuity, isolate, and repair the defective lead. |
| | c. Detent pawl not pulled | Check Q07 associated circuit. Replace if found to be defective. |
| | d. Detent pawl pulled, then dropped, prior to loading heads. | Check transistor Q01 and associated circuit. Replace defective part. |
| | e. Bad lead or broken solder connection | Check continuity, isolate and repair the defective lead. |
| 17. Heads are loaded but no reverse drive | a. Reverse drive transistors Q05 or Q04 are defective | Check transistors and replace if defective. |
| | b. Bad lead or solder connection | Check continuity of H switch reverse drive section, isolate and repair the defect. |
| 18. Brake solenoid not operating | a. Shunt diode is shorted. | Check reverse resistance of CR05 using a multimeter set to Rx100 scale. |
| | b. Relay contacts not completing circuit or defective lead or solder connection | Check continuity, isolate, and repair defect. |
| | c. Pawl binding | Check adjustment according to Section 6. |

TABLE A-2. TROUBLESHOOTING TABLE (Cont'd)

| SYMPTON | PROBABLE CAUSE | REMEDY |
|---|---|---|
| 19. Sequence power is not completed to successive units | a. Bad lead or broken solder connection or defective relay | Check continuity of circuit, isolate, and repair defective lead or replace defective relay. |

# COMMENT SHEET

MANUAL TITLE CONTROL DATA 853 DISK STORAGE DRIVE

Customer Engineering Manual

PUBLICATION NO. 40823100 REVISION _____

**FROM:** NAME: _____

BUSINESS ADDRESS: _____

## COMMENTS:

This form is not intended to be used as an order blank. Your evaluation of this manual will be welcomed by Control Data Corporation. Any errors, suggested additions or deletions, or general comments may be made below. Please include page number references and fill in publication revision level as shown by the last entry on the Record of Revision page at the front of the manual. Customer engineers are urged to use the TAR.

CUT ALONG LINE

FORM CA231 REV. 1-67

NO POSTAGE STAMP NECESSARY IF MAILED IN U. S. A.

FOLD ON DOTTED LINES AND STAPLE

STAPLE

STAPLE

FOLD

FOLD

FIRST CLASS
PERMIT NO. 8241

MINNEAPOLIS, MINN

**BUSINESS REPLY MAIL**
NO POSTAGE STAMP NECESSARY IF MAILED IN U.S.A.

POSTAGE WILL BE PAID BY

**CONTROL DATA CORPORATION**

**8100 34TH AVENUE SOUTH**

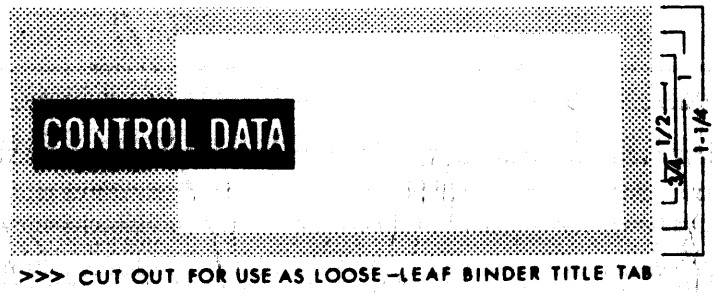
**MINNEAPOLIS, MINNESOTA 55440**

**ATTN: TECHNICAL PUBLICATIONS DEPT.**
**PLANT TWO**

CUT ALONG LINE

FOLD

FOLD




>>> CUT OUT FOR USE AS LOOSE-LEAF BINDER TITLE TAB

CONTROL DATA

8100 34th AVE. SO., MINNEAPOLIS, MINN. 55440

LITHO IN U.S.A.