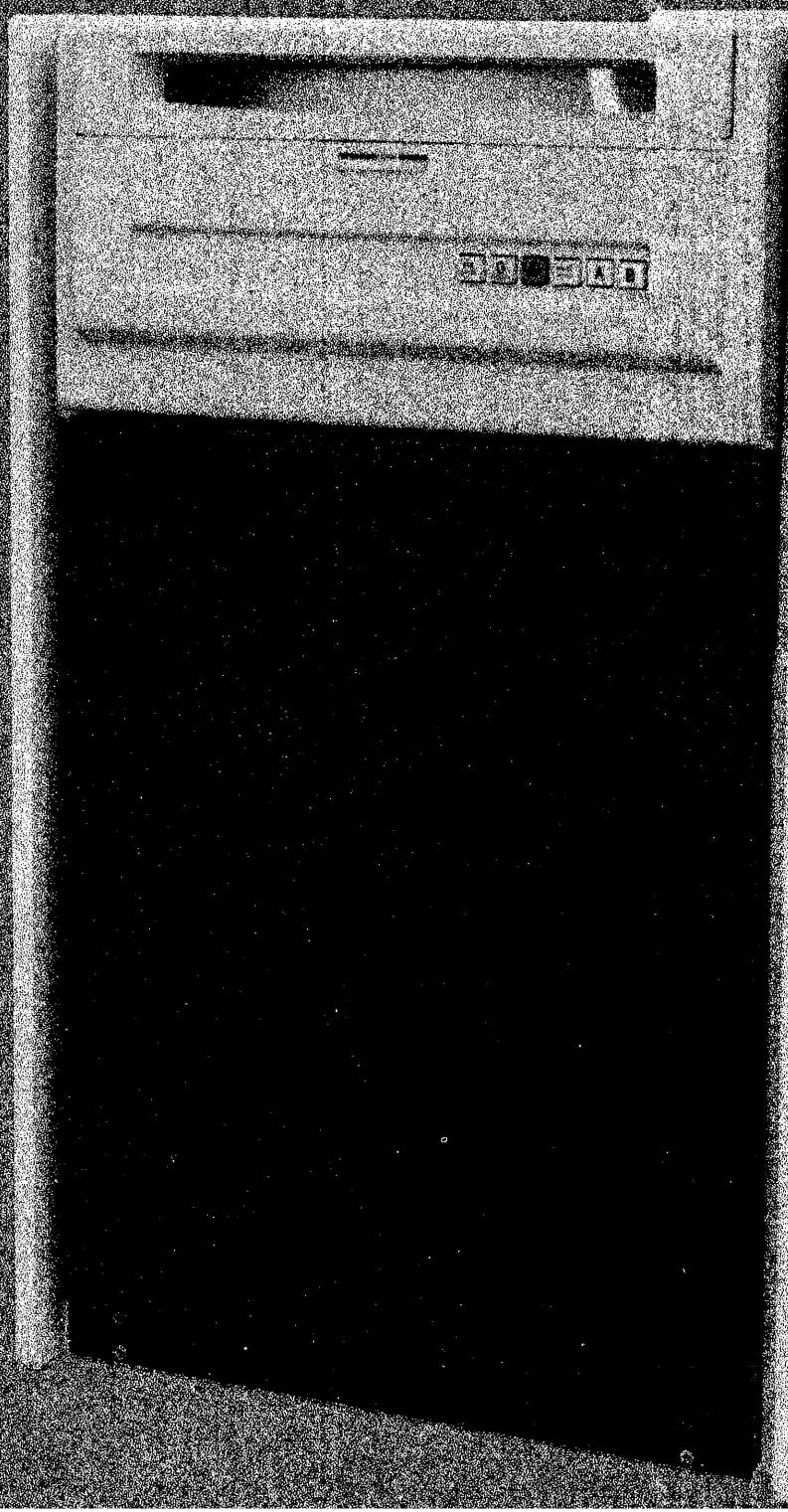


# RKO6/RKO7 Disk Drive Service Manual



digital

# **RK06/RK07 Disk Drive Service Manual**

1st Editon, January 1979

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## PREFACE

The *RK06/RK07 Disk Drive Service Manual* is intended as an aid for maintaining an RK06 or RK07 disk drive. Chapter 1 describes the maintenance philosophy and lists the necessary tools and available diagnostics. It also includes a description of the RK06/07 Field Test Box and several different views of the drive. Preventive maintenance procedures are also outlined here. Chapter 2 contains the removal and replacement procedures for all the drive field replaceable units (FRUs). Chapter 3 details the procedures for performing any necessary checks, adjustments, or alignments that may be necessary on an RK06 or an RK07. The appendices contain information on the User Defined Test (UDT) diagnostic and its use with the Bad Sector File, the procedure for hand-toggling in the bootstrap procedure, and the installation and field acceptance procedures for the drive.

There is a list of supplemental documentation relative to the RK06 or RK07 drive in Chapter 1.



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# CHAPTER 1

## MAINTAINABILITY

### 1.1 MAINTENANCE PHILOSOPHY

The RK06/RK07 Disk Drive maintenance philosophy consists essentially of taking full advantage of the software and hardware tools available to troubleshoot down to the defective field replaceable unit (FRU). Replacement of the defective FRU is the primary maintenance strategy whenever possible. Should this become impractical, sufficient diagnostics and maintenance aids will be provided to continue troubleshooting to the component level.

### 1.2 RELATED DOCUMENTATION

The documents listed below contain information necessary for a complete understanding of the function, installation, operation, programming, and maintenance of the RK611 Controller and the RK06 and RK07 Disk Drives Information on the PDP-11 processors and Unibus is provided in the *PDP-11 Peripherals Handbook*.

Title	Number
RK06/RK07 Disk Drive User's Manual	EK-RK067-UG-001
RK06/RK07 Disk Drive Technical Description	EK-RK067-TD-001
RK06 IPB Manual	EK-RK06-IP-001
RK611 Controller Technical Manual	EK-RK611-TM-002
RK06/07 FTB Operating and Service Manual	EK-RK67F-0P-001
RK07 IPB Manual	EK-RK07-IP-001

### 1.3 TOOLS AND EQUIPMENT

Maintenance of the RK06 and RK07 Disk Drive units requires that Field Service personnel possess the following special tools peculiar to the maintenance of these drives.

Part No.	Part
RK06/07-TA	Field Test Box (115 Vac; 50 or 60 Hz)
RK06/07-TB	Field Test Box (230 Vac, 50 or 60 Hz)
RK06K-AC	RK06 Alignment Cartridge
RK07K-AC	RK07 Alignment Cartridge
93-06058	Wrench
93-06240	Glass Alignment Tool (New)
93-06076	Head Installation/Removal Tool
93-06087	Head Alignment Tool
93-06122-01	Shim 0.003 inch
93-06122-02	Shim 0.00015 inch
93-06123-01	Shim 0.020 inch
93-06123-02	Shim 0.015 inch
93-06171	Head Separation Tool

Part No.	Part
93-06154	Pulley Plunger Gauge
29-19633	Mirror
29-20065	Magnifier
29-20906	Torque Wrench
29-21487	Head Torque Wrench
29-21832	Hex Ball Driver Set
29-22526	Screwdriver, 14.5-inch Phillips
93-06056	Carriage Roll Alignment Tool

#### 1.4 DIAGNOSTIC TESTING

The diagnostic tests that are used during installation of the RK06 or RK07 Disk Subsystem may be used anytime to demonstrate system performance or to help pinpoint problem areas. Table 1-1 lists the diagnostics available and Appendix C (Paragraph 3.2) provides a brief summary of the function that each performs.

**Table 1-1 Diagnostic Programs Used in RK611/RK06 and RK611/RK07 Disk Subsystem Field Acceptance Tests**

MAINDEC-11-DZR6A	RK611 Diskless Controller Diagnostic, Part I (no drive required)
MAINDEC-11-DZR6B	RK611 Diskless Controller Diagnostic, Part II (no drive required)
MAINDEC-11-DZR6C	RK611 Diskless Controller Diagnostic, Part III (no drive required)
MAINDEC-11-DZR6D	RK611 Diskless Controller Diagnostic, Part IV (no drive required)
MAINDEC-11-DZR6E	RK611 Diskless Controller Diagnostic, Part V (no drive required)
MAINDEC-11-DZR6G	Unibus RK06-RK07 Dual Port Drive Diagnostic
MAINDEC-11-DZR6H	Unibus RK06-RK07 Drive Diagnostic, Part I
MAINDEC-11-DZR6I	Unibus RK06-RK07 Drive Diagnostic, Part II
MAINDEC-11-DZR6J	Unibus RK06-RK07 Drive Diagnostic, Part III
MAINDEC-11-DZR6K	RK611 Functional Controller Diagnostic
MAINDEC-11-DZR6L	RK06K-RK07K Cartridge Formatter
MAINDEC-11-DZR6M	RK611/RK06 – RK611/RK07 Subsystem Verification, Part I
MAINDEC-11-DZR6N	RK611/RK06 – RK611/RK07 Subsystem Verification, Part II
MAINDEC-11-DZR6P	RK611/RK06–RK611/RK07 Performance Exerciser
MAINDEC-11-DZR6Q	RK06 – RK07 Drive Compatibility
MAINDEC-11-DZR6R	RK611/RK06 – RK611/RK07 User Defined Test

## **1.5 RK06/07 FIELD TEST BOX**

### **1.5.1 General**

The RK06/07 Field Test Box (RK06/07-TA, TB) is a self-contained, system independent, suitcase tester capable of complete RK06 or RK07 operation directly through the drive's interface hardware and is necessary to perform RK06 or RK07 head alignment. The section of the tester used in head alignment is functionally independent from the section of the tester that communicates with a drive through the interface (interface section). Therefore, head alignment may be performed with the drive interface under either diagnostic control or under control of the interface section of the tester.

To fully utilize the capabilities of the interface section of the tester, a knowledge of the drive interface is mandatory. The tester panel is designed to be a visual reminder of the interface to anyone who has read the interface specification and should become self-explanatory after a short period of use (Figure 1-1).

### **1.5.2 Basic Loop Operation**

A basic loop operation is defined, for an RK06 drive, by putting all applicable front panel switches in their *underlined* position, and, for an RK07, by putting the cylinder address switches to their *dotted* positions and the remaining applicable switches in their underlined positions. Operation in this mode puts an RK06 or an RK07 through the most complex exercises the tester is capable of generating.

Since much of the usefulness of the tester lies in the flexibility with which the basic loop may be modified, the basic loop description will be followed by a front panel switch description defining each switch's function and detailing how each switch modifies the basic loop operation.

The operation of the interface section of the tester centers around a repetitive loop in which the tester sends the drive a message, receives messages A0 and B0 from the drive, checks for a Drive-to Controller parity error or a Drive Fault, and then a Drive Ready. These steps happen repetitively until a message from the drive indicates that the command has been executed, signified by the assertion of Drive Ready. This assertion is delayed by the tester (the time is variable by the operator) and then the write process starts.

As a sector comes under the selected head, the tester starts writing at a high frequency (232.5 ns/flux reversal) on all even-numbered sectors, and at a low frequency (465 ns/flux reversal) on all odd-numbered sectors (in either format). Data is always written from the end of one sector pulse to the middle of the next sector pulse. The high frequency is the same frequency as an all 0 or all 1 data pattern. The low frequency is the same as the frequency of the data pattern 1010101010. Writing and reading are automatically inhibited on cylinder 410 (on an RK06K cartridge) or on cylinder 815 (on an RK07K cartridge) to avoid destruction of important bad track information prerecorded on each pack.

Reading starts next on sector 0 and continues for a whole revolution (in either format). Any data error is stored and halts operation after the whole revolution is completed. (Again, cylinder 410 (RK06) or 815 (RK07) to preserve bad track information.) If no errors are found, the tester increments its address (head first, then cylinder) and sends out its new address starting the whole cycle over again.

In "basic loop" operating mode, cylinders are addressed in an alternating (ALT) mode. This means that the cylinder address sent out by the tester alternates between the address in the switch register (SWR) and the address in an incrementing register in the tester. For example, if the SWR content is 5, the order of the cylinders addressed would be 5, 0, 5, 1, 5, 2, 5, 3, . . . 5, 410, 5, 0, 5, 1, . . . etc.

### **1.5.3 Switch Description**

The following switch descriptions detail the function of each front panel control and describe how the "basic loop" operation can be varied by the operator. Where applicable, potential uses for these deviations from "basic loop" operation will be mentioned.

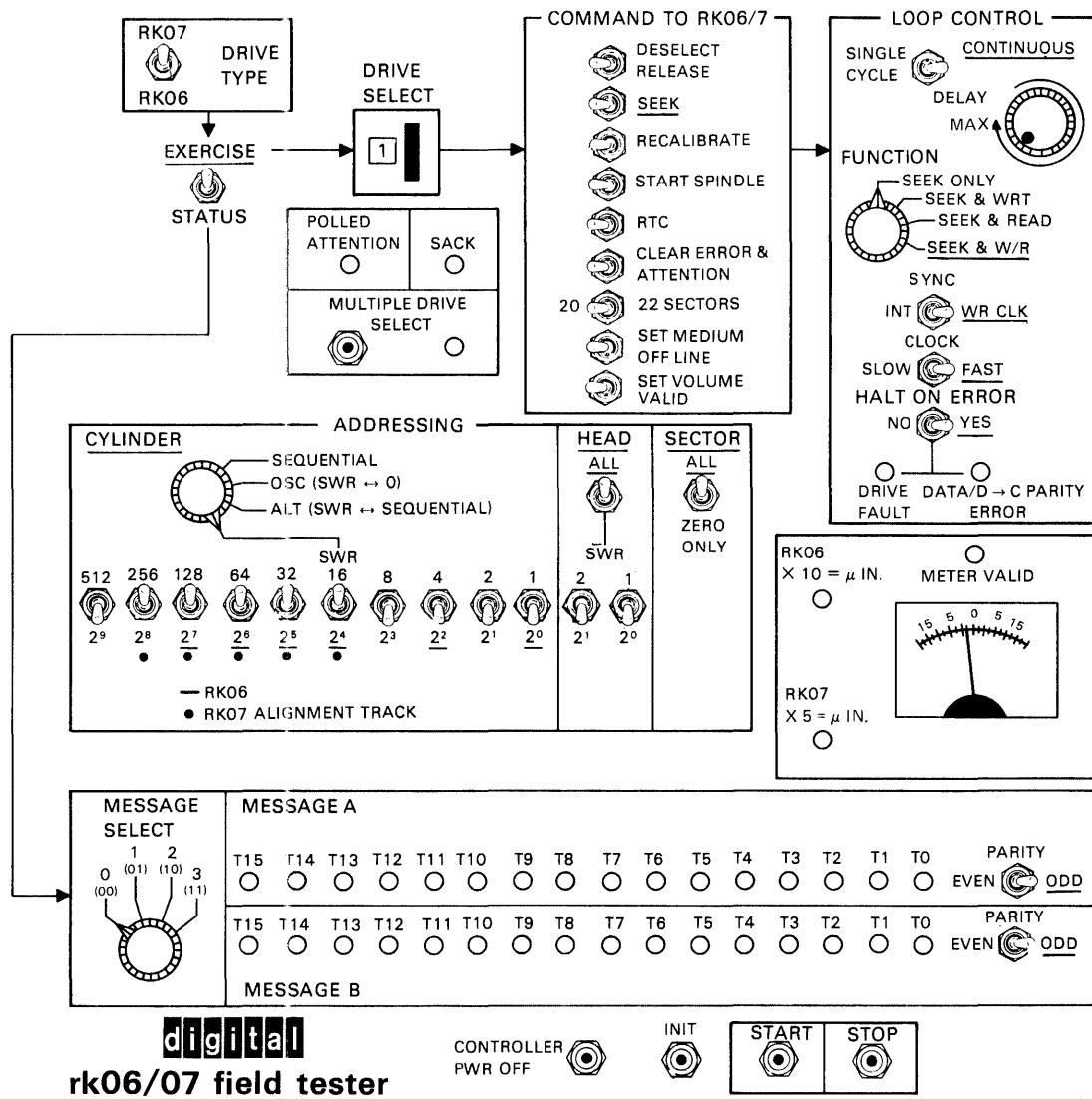


Figure 1-1 Field Test Box

## **EXERCISE-STATUS**

In STATUS mode, the tester formulates a message requesting the message set in the MESSAGE SELECT switch, transmits the message once, receives the requested message, displays it in the MESSAGE A and MESSAGE B LEDs, and halts.

Potential uses are, if the tester halts on a Drive Fault error, Status mode can be selected, and START pushed to display any one of four messages in the message LEDs to find the specific error condition generating Drive Fault.

## **DRIVE SELECT**

The DRIVE SELECT switch is used to select the drive number to which messages will be sent. The switch also determines what drive number will be sent on the  $2^0$ ,  $2^1$ , and  $2^2$  polled address interface lines.

The POLLED ATTENTION LED indicates the condition of the POLLED ATTENTION interface line. If the drive whose address is in the DRIVE SELECT switch has attention set, the LED should be on.

### **NOTE**

**The LED will appear to be on all of the time. In reality, however, the  $2^0$  polled address line sent out to the drive is automatically inverted for a very short amount of time to properly toggle the drive logic and facilitate scoping in the drive, i.e., although the POLLED ATTENTION LED in the tester appears fully on, it is actually being run at a very high duty cycle.**

The SACK LED displays the condition of the select acknowledge line transmitted by the drive. It should be on after the drive number set in the DRIVE SELECT switch is sent out to the drive, if, and only if, the DRIVE SELECT button matches the number in the DRIVE SELECT switch and if the DESELECT/RELEASE bit is negated.

The MULTIPLE DRIVE SELECT LED displays the state of the multiple drive select line transmitted by the drive. The LED light should light when the MULTIPLE DRIVE SELECT button is pushed. Pushing the button causes the tester to assert the index-sector line. The drive under test should detect multiple drive select and assert the multiple drive select line after sensing index and sector assertions other than its own.

All switches in the COMMAND TO RK06/07 block (top middle of panel) set the message bits that the tester sends to the drive in Message A, T3 (DESELECT/RELEASE) through T11 (SET VOLUME VALID). These bits are exactly as described in the drive interface specification.

All switches in the LOOP CONTROL block (upper right of panel) allow modification of the "basic loop" mode of system operation.

If the top switch is removed from the Continuous mode and put into the Single Cycle mode, a command is formulated, messages are continuously transmitted and received until Drive Ready is asserted, writing and reading are done, errors are checked, and a new command is formulated in the tester but is not sent. In this Single Cycle mode, the new message is sent only when the start button is activated. That is, repetitive operations must be manually initiated by repetitive activation of the START switch.

Typical uses for the Single Cycle modification of “basic loop” operation are:

1. To write only one track of the disk and have the writing stop in an orderly manner at a track boundary. Pushing STOP would stop writing instantly, potentially making an error in the current sector.
2. If positioning problems were present causing the drive to shut itself down, it would be useful to manually initiate seeks at a very low rate while scoping the problem.

The DELAY knob is a continuously adjustable time delay control that delays tester recognition of Drive Ready from approximately 100  $\mu$ s to approximately 0.7 seconds. This offers a continuous adjustable time delay between completion of a Seek and initiation of a Write/Read.

Typical uses for the adjustable time delay could be:

1. If settling of the servo was taking longer than is proper, waiting before writing could make data errors cease, thereby giving a clue to the problem source.
2. If a problem exists which causes the drive to cease operation for its own safety, a long time between seeks would give more time for scoping before the drive stopped itself.
3. Any unwanted resonances could be excited by varying (tuning) the time between seeks.

The FUNCTION switch is self-explanatory. “Basic loop” operation involves positioning, writing, and then reading. The modifications to the “basic loop” offered by this switch involve SEEK ONLY, SEEK & WRITE, or SEEK & READ. The positions are useful when working on positioning problems not involving reading or writing, or when working on data problems to separate write problems from read problems.

**SYNC** – In “basic loop” operating mode, the “system” clock source is Interface Write Clock, always generated by the drive from its disk pack. Write Clock is so imperative to proper read/write operation of a drive, with either a controller or tester, that difficult to detect problems with Write Clock can cause very random data errors. To help isolate this type of problem, the SYNC switch can be put in its INT position. This causes the tester to use an internal oscillator as “system” clock and ignore Interface Write Clock. In summary, if random data errors are occurring, and switching to SYNC INTernal stops the errors, Write Clock should be suspected.

**CLOCK** – Main Clock on the interface clocks status and command information between the tester and the drive. In Fast mode, Control Clock happens at standard subsystem speed  $\approx$ 465 ns/cycle); in SLO mode, Control Clock happens at  $(465 \times 64) \approx 29.8 \mu$ s/cycle. Slow speed makes scoping much easier and is useful in detecting speed problems.

The HALT ON ERROR switch is self-explanatory. The DRIVE FAULT LED is lit (in Exercise mode only) whenever the Interface Drive Fault bit is asserted by the drive. Simply put, this LED indicates errors detected by the drive. The other LED indicates any errors detected by the tester. These may be of two types:

1. Data error. (If Function includes a Read).
2. A drive to tester – (D)rive →(C)ontroller – parity error.

#### NOTE

To aid in debugging intermittent problems, the error LEDs will light when errors exist independent of the setting of the HALT ON ERROR switch.

The Addressing block provides many addressing variations from the “basic loop” operation addressing scheme already described.

Successive Cylinder addresses may be:

1. SEQUENTIAL - 0, 1, 2, . . . 410, 0, 1, . . . (on an RK06)  
0, 1, 2, . . . , 814, 0, 1, . . . , (on an RK07), or
2. OSCillating - SWR, 0, SWR 1, . . . SWR, 410, . . . SWR, 0, . . . , (on an RK06)  
SWR, 0, SWR, 2, . . . SWR, 815, . . . SWR, 0, . . . , (on an RK07), or
3. just SWR.

#### NOTE

In just SWR mode, successive messages call for the same cylinder (contained in the switch register) and allow repetitive writing and reading with no physical seeking.

Successive Head (track) addresses may be:

1. ALL - 0, 1, 2, 0, 1, 2 . . . ,
2. SWR - Only the head address set in the switch register.

#### SECTOR

Sectors to be written and read may be ALL sectors (20 in 20-sector mode or 22 in 22-sector mode) or sector ZERO ONLY LEDs under the cylinder and head switch registers always display the last cylinder and head addresses sent to the drive.

The MESSAGE A and MESSAGE B PARITY switches (bottom right of panel) cause the tester to transmit wrong EVEN parity to the drive independently on A and B to ensure the drive can detect these errors independently.

The CONTROLLER POWER OFF button tells the drive through the interface line of similar name that the controller (or tester) has lost power. It is used to verify that the drive will properly sense this line in case a real power loss occurs on the computer system. This interface line is also connected to +5 in the tester so the drive will behave properly if any true lack of tester power disables the interface.

The INIT button generates an assertion on the Initialize interface line.

The START and STOP switches start and stop the tester. Operation is not guaranteed if switches are changed without stopping the tester first. STOP clears the whole tester and all addressing, etc., will start at an initialized state when START is released after being pushed. Should the tester halt on error, status may be checked by selecting STATUS and repeatedly pushing START without pushing STOP and the tester formulated message will not change. In Single Cycle mode, repetitive STARTs act like continues and will increment the tester while a STOP will initialize the tester.

#### 1.5.4 Sample Switch Exercises

**1.5.4.1 Pack Acknowledge** – This command is used to set the volume valid flip-flop in a selected drive which indicates that the subsystem has acknowledged the medium. This is accomplished by setting the volume valid bit in Message A (T11).

Switch	Position
EXERCISE/STATUS	EXERCISE
DRIVE SELECT	DESIRED DRIVE #
COMMAND TO RK06/07	SET VOLUME VALID
SINGLE CYCLE/CONTINUOUS	SINGLE CYCLE
FUNCTION	SEEK ONLY
SYNC	N/A
CLOCK	FAST
HALT ON ERROR	YES
ADDRESSING (cylinders)	N/A
ADDRESS switches: (RK06 – underlined positions)	N/A
(RK07 – dotted positions)	N/A
(HEAD)	N/A
(HEAD address switches)	N/A
(SECTOR)	N/A
PARITY (both switches)	ODD
Press the INIT and START switches.	
At this point, the volume valid bit should be set in the selected drive.	

**1.5.4.2 Seek\*** – This command directs the selected drive to relocate the heads over a new cylinder.

Switch	Position
EXERCISE/STATUS	EXERCISE
DRIVE SELECT	DESIRED DRIVE #
COMMAND TO RK06/07	SEEK
SINGLE CYCLE/CONTINUOUS	OPTIONAL
FUNCTION	SEEK ONLY
SYNC	WR CLK
CLOCK	FAST
HALT ON ERROR	OPTIONAL
ADDRESSING (cylinders)	OPTIONAL
ADDRESS switches: (RK06 – underlined positions)	OPTIONAL
(RK07 – dotted positions)	OPTIONAL
(HEAD)	OPTIONAL
(HEAD address switches)	OPTIONAL
(SECTOR)	N/A
PARITY (both switches)	ODD
Press the INIT and START switches.	

---

\*Volume valid must be set prior to this operation.

**1.5.4.3 Seek and Write/Read\*** – This command directs the selected drive to relocate the heads over a new cylinder, write the selected sector(s), read the selected sector(s), and compare the results.

Switch	Position
EXERCISE/STATUS	EXERCISE
DRIVE SELECT	DESIRED DRIVE #
COMMAND TO RK06/07	SEEK 22 SECTORS
SINGLE CYCLE/CONTINUOUS	OPTIONAL
FUNCTION	SEEK AND W/R
SYNC	WR CLK
CLOCK	FAST
HALT ON ERROR	OPTIONAL
ADDRESSING (cylinders)	OPTIONAL
ADDRESS switches: (RK06 – underlined positions)	OPTIONAL
(RK07 – dotted positions)	OPTIONAL
(HEAD)	OPTIONAL
(HEAD address switches)	OPTIONAL
(SECTOR)	OPTIONAL
PARITY (both switches)	ODD

Press the INIT and START switches.

## 1.6 DRIVE ORIENTATION

In this section, the major assemblies of the RK06 and RK07 Disk Drives are called out through a series of illustrations (Figures 1-2 through 1-9) as an aid for persons not thoroughly familiar with all the important areas of the drives.

### NOTE

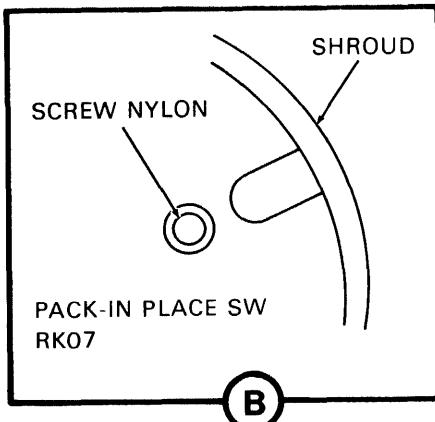
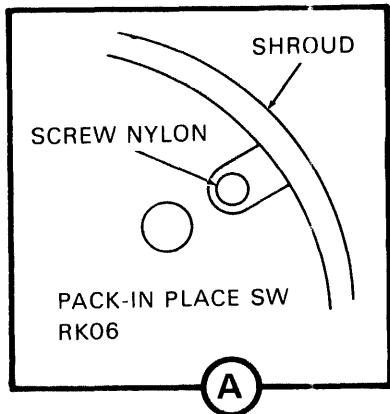
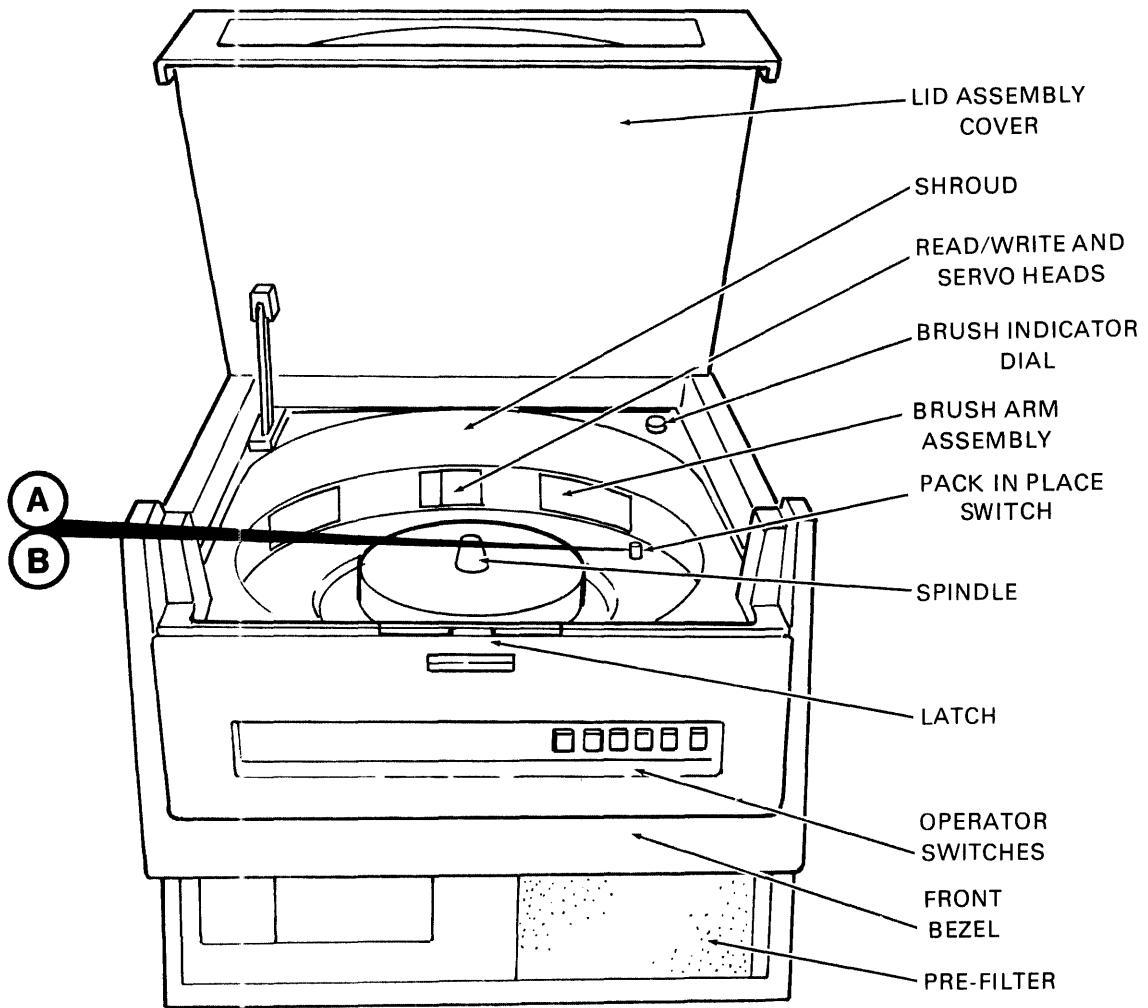
Drives referred to as “early model” machines are those drives with a serial number below 12614 (RK06) or 53380 (RK07). They can also be identified by the transition board behind the magnet assembly. On “late model” machines, drive serial numbers 12614 and up (RK06) or 53380 and up (RK07), there is no transition board behind the magnet assembly.

## 1.7 OPERATOR CONTROLS AND INDICATORS

The operator control panel is located on the front of the RK06 or RK07 drive (Figure 1-10). The control panel consists of the following switches and indicators.

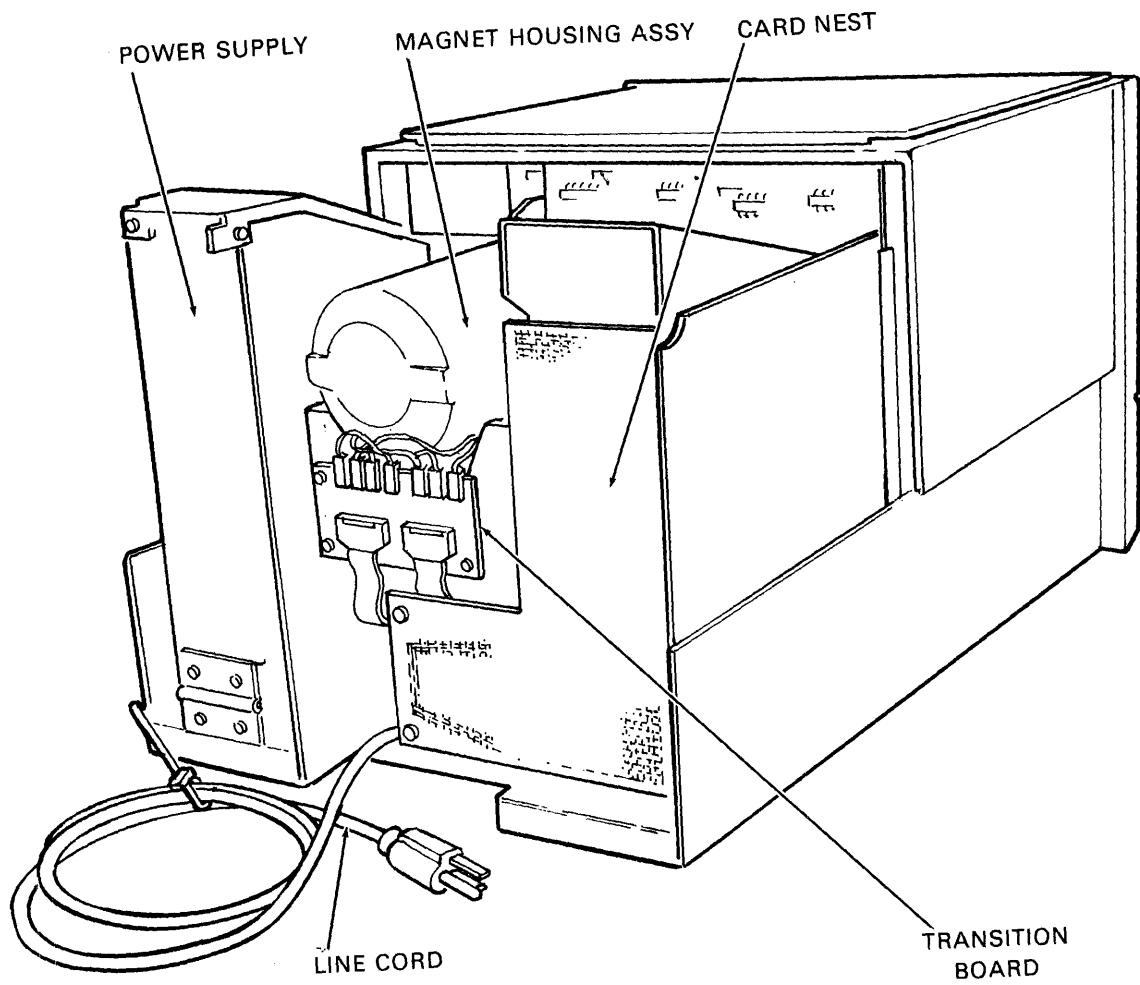
### 1.7.1 RUN/STOP Switch

When pressed, this push/push alternating action switch energizes the spindle motor. When released, it de-energizes the spindle motor if the heads are not loaded. If the heads are loaded, it causes the head to unload and the spindle motor to de-energize in sequence. Since this switch has a mechanical memory, a power interrupt followed by power restoration will, if the switch is in its pressed position, cause the drive to automatically cycle up when power is restored.



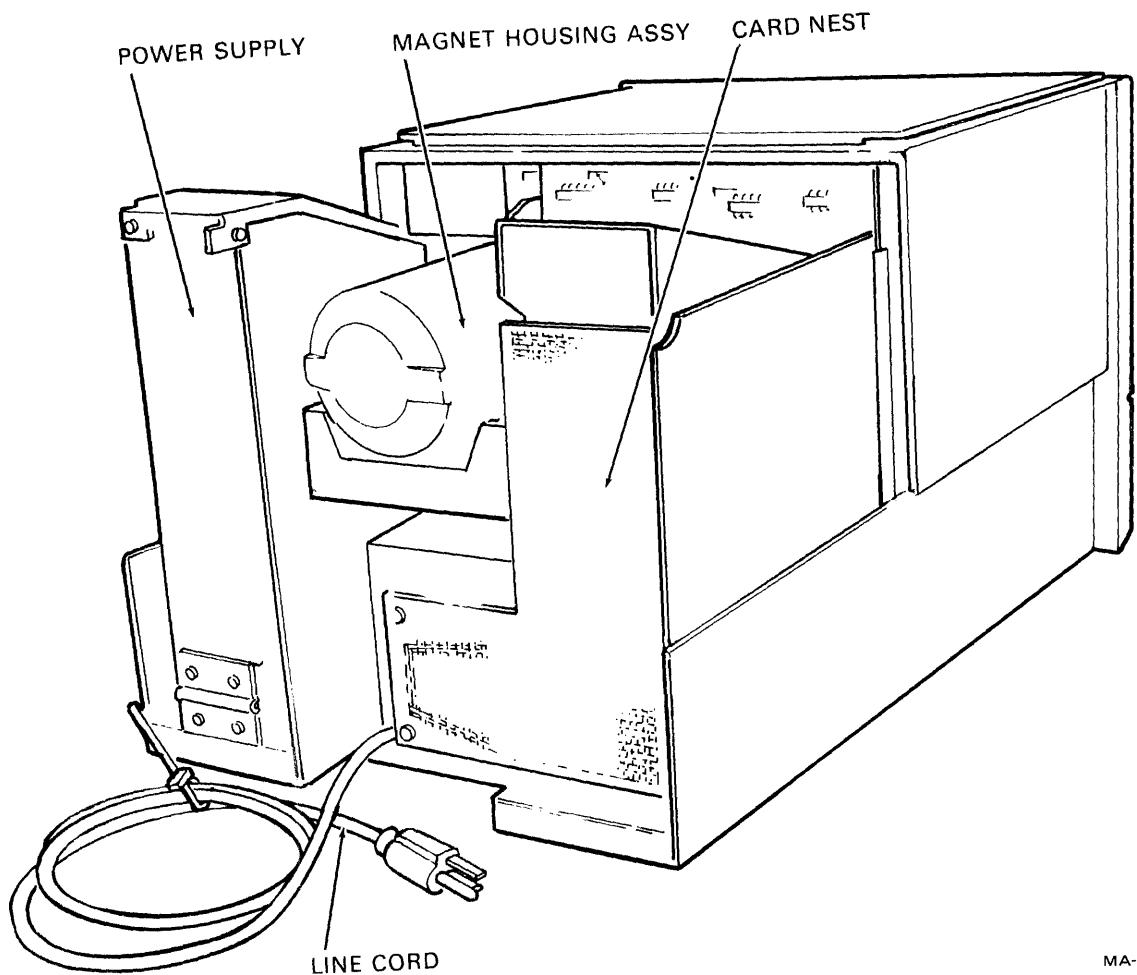
MA-2129

Figure 1-2 RK06/RK07 Drive Front View



MA-2141

Figure 1-3 RK06/RK07 Drive Rear View (Early Model)



MA-2142

Figure 1-4 RK06/RK07 Drive Rear View (Late Model)

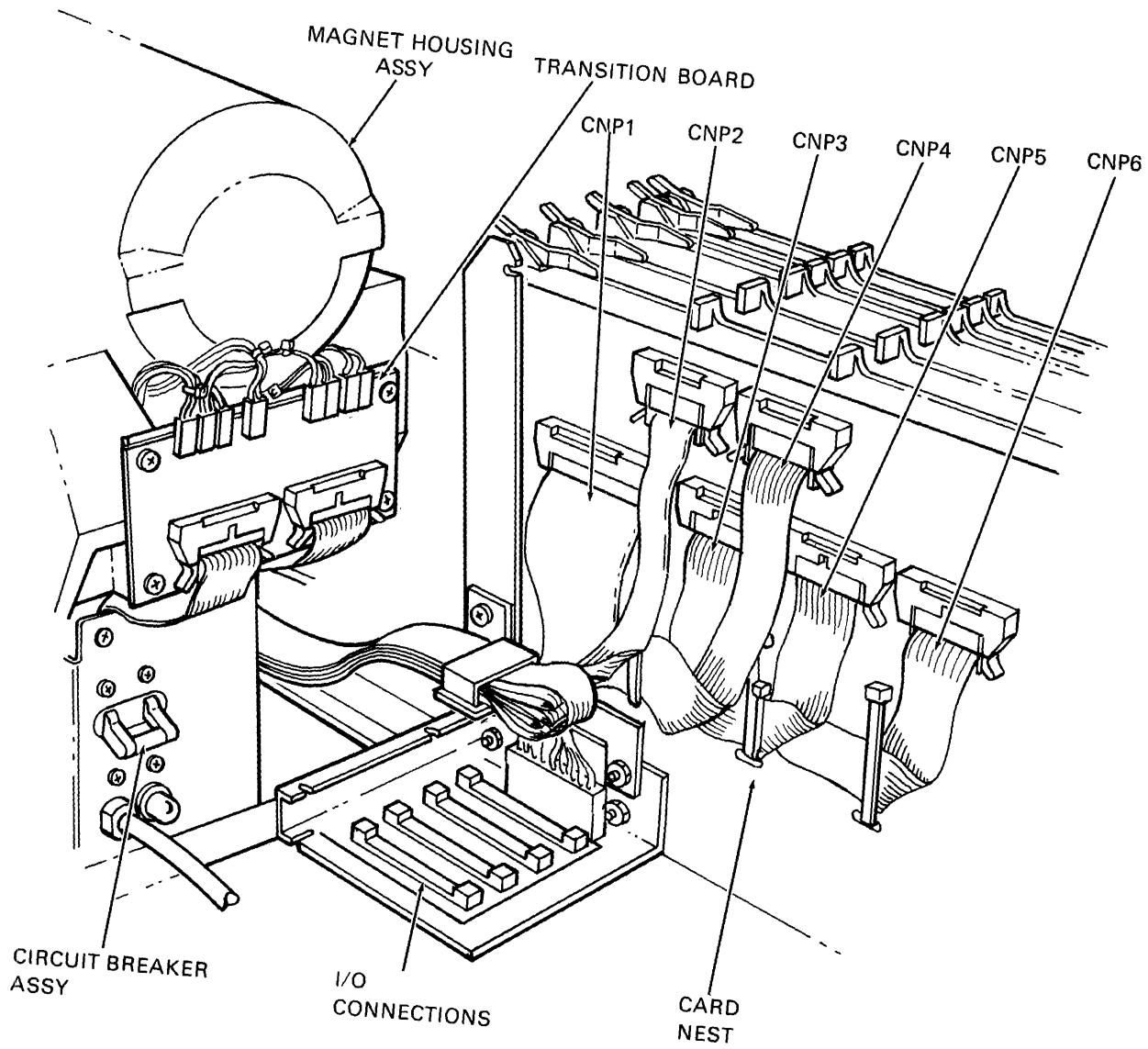


Figure 1-5 Card Nest (Early Model)

MA-2119

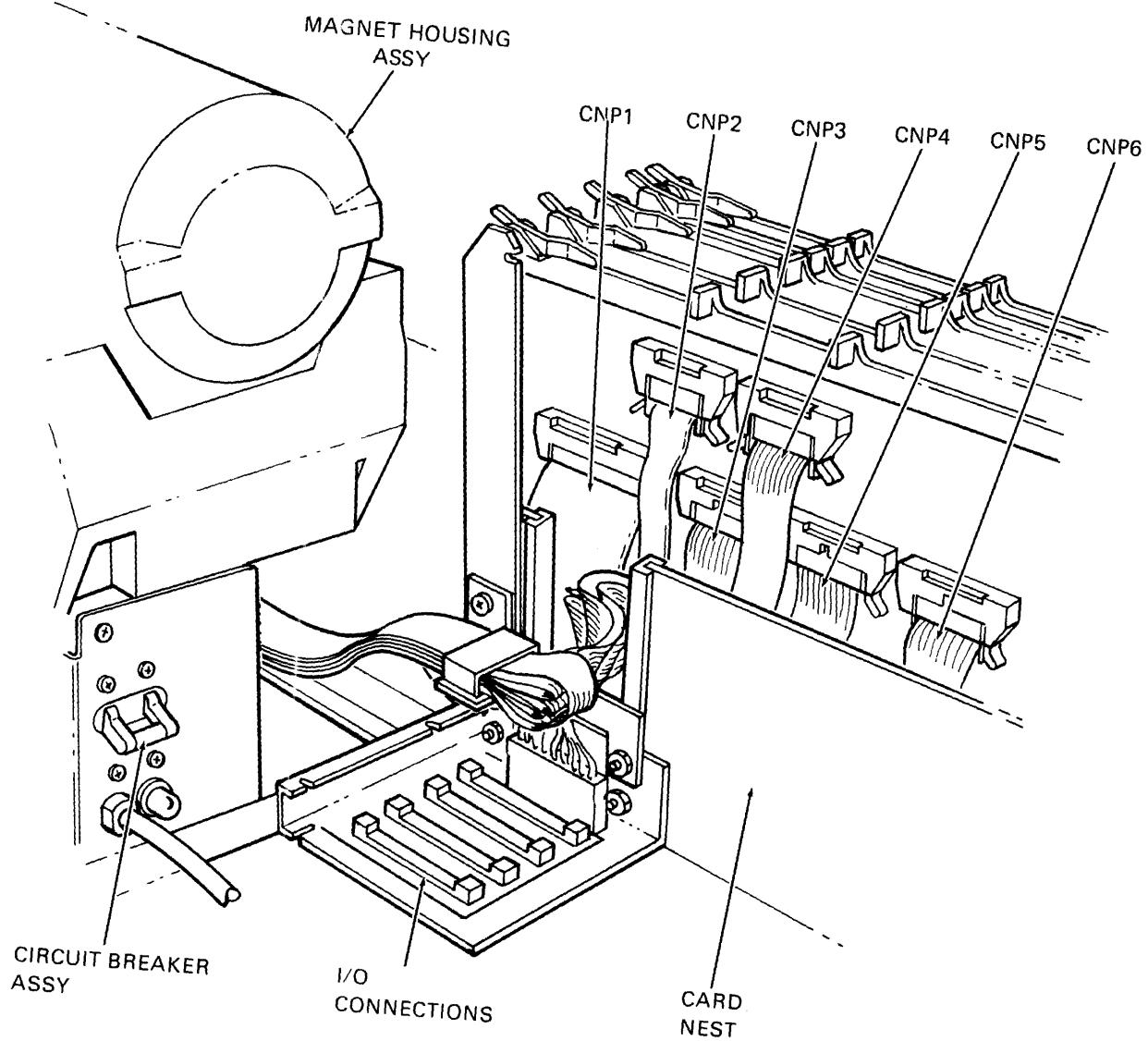
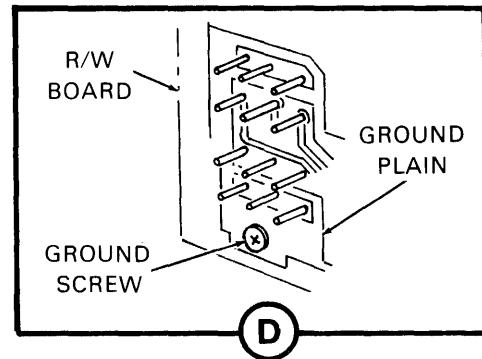
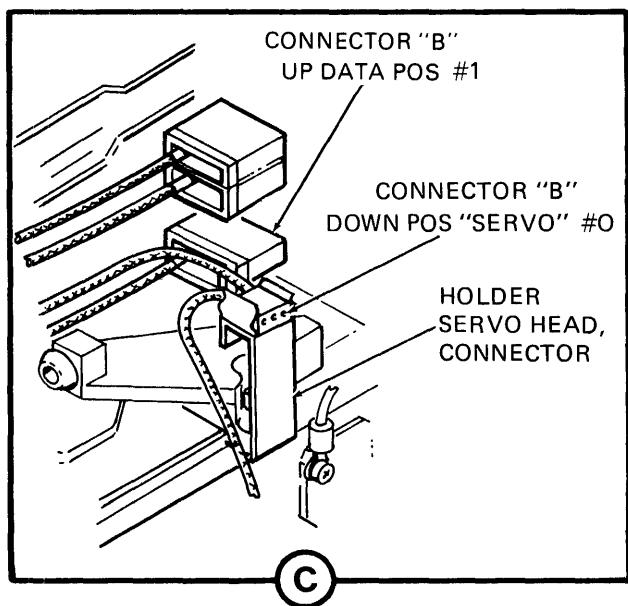
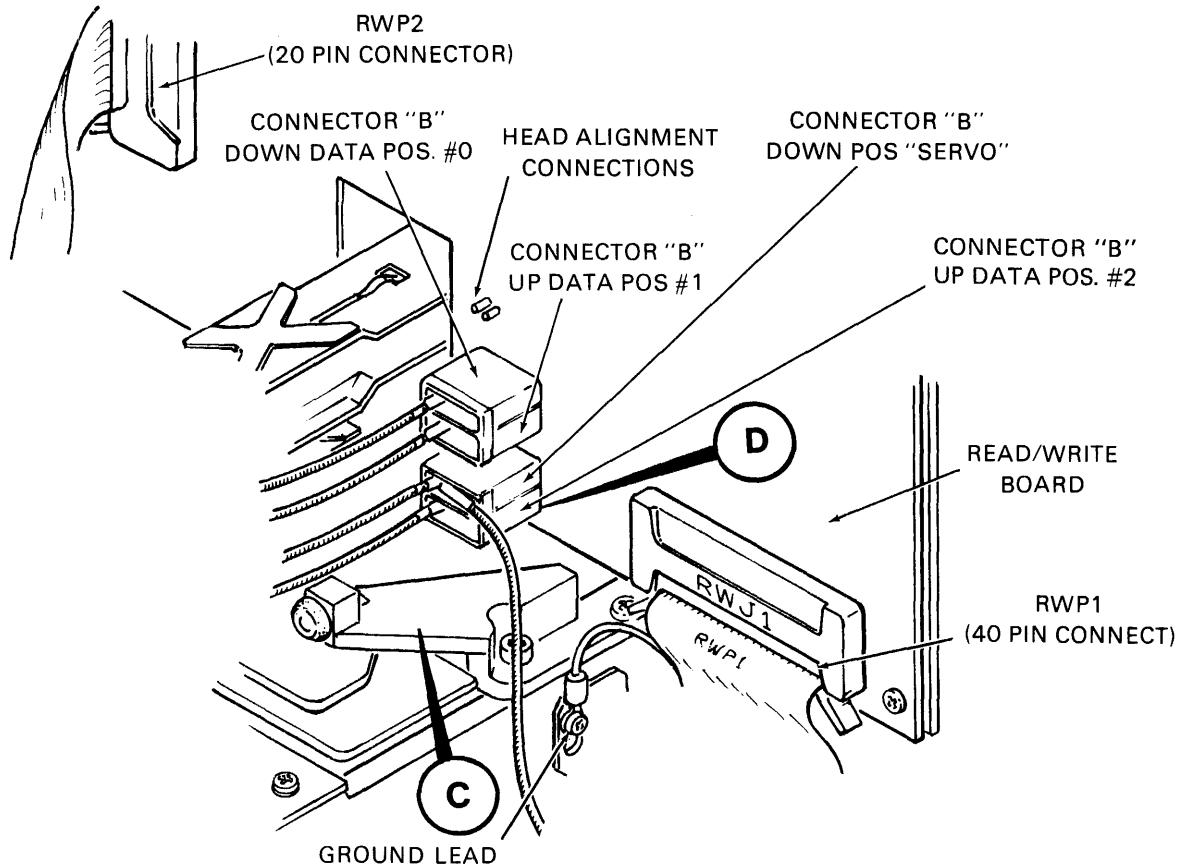


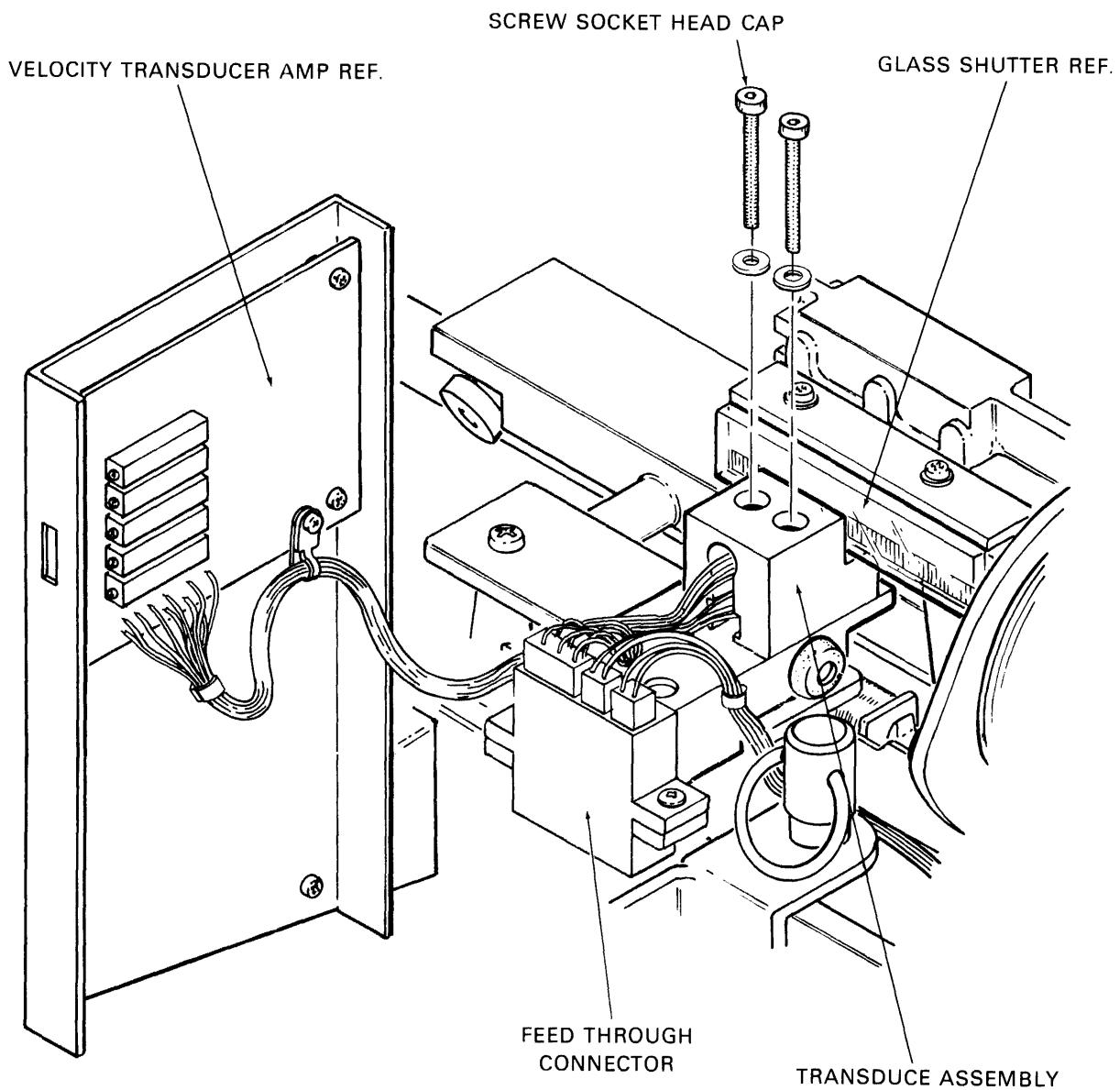
Figure 1-6 Card Nest (Late Model)

MA-2118



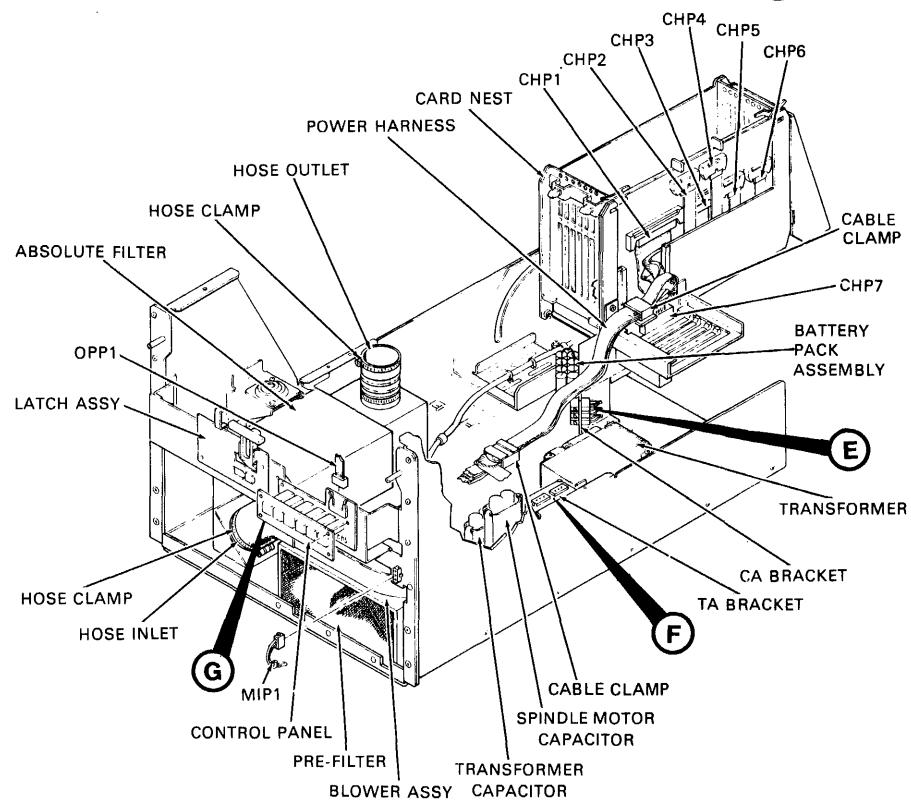
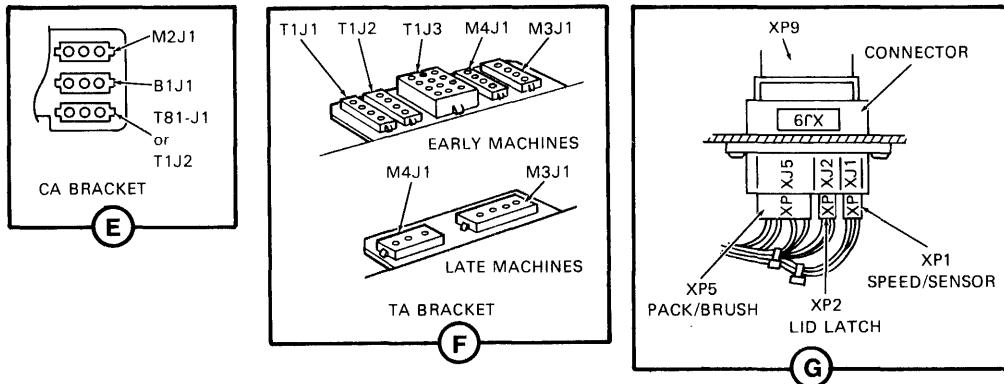
MA-2106

Figure 1-7 Read/Write Board Area



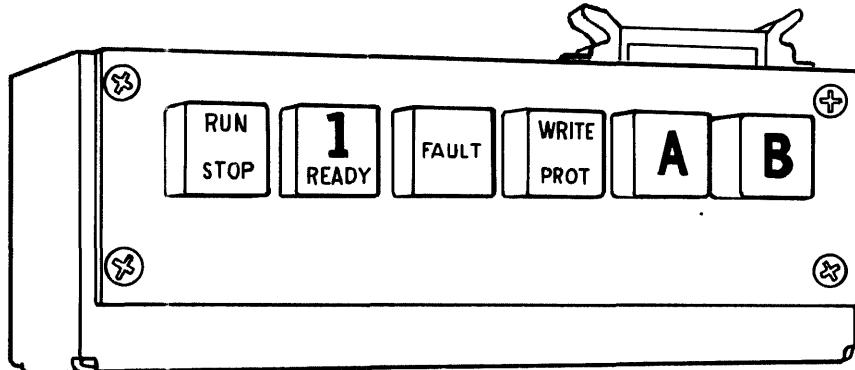
MA-2136

Figure 1-8 Velocity Transducer Assembly



MA-2148

Figure 1-9 Chassis Assembly



MA-2110

Figure 1-10 Operator Control Panel

The Start Spindle command from the controller is not enabled unless (1) the RUN/STOP switch is in the pressed state and the drive has been cycled down due to a Set Medium Off line command, or if any of the errors leading to head unload occur. In the second of these situations, the heads will not reload unless the error condition has been cleared.

The load indicator of the RUN/STOP switch illuminates whenever (1) the spindle is less than 1 rps, (2) heads are home, (3) brushes are home, and (4) the spindle motor is not energized.

#### 1.7.2 UNIT SELECT Switch

The UNIT SELECT switch is a cam-operated switch that is actuated by inserting a numbered cammed button into it. The contacts are binary encoded such that the drive logic will recognize the drive address code corresponding to the unit select number. The numbered indicator is lit indicating "ready" condition, whenever the heads are loaded and detented on a cylinder or detented in an off position.

#### 1.7.3 FAULT Indicator

This indicator is lit whenever the following fault or error conditions develop in the drive:

1. Selection of more than one drive.
2. Positioner, when detented, has moved too far from its original position (e.g., due to the drive being inadvertently jarred).
3. Parity error in a control transmission from controller to drive.
4. Any read/write unsafe condition in the drive (see bit T14 of this message for an explanation of the read/write unsafe conditions).
5. A write lock error condition, i.e., the receipt of a Write Gate signal when the drive is write locked.
6. Low ac voltage in the drive.
7. A seek incomplete condition.
8. A non-executable function (NXF) from the receipt of a write gate or seek command with volume valid reset.

Fault is reset when all of the components are reset.

#### **1.7.4 WRITE PROTECT Switch**

This push/push alternating action switch, when pressed, sets the drive in Write Protect mode only when write gate is not asserted in the drive. If Write Gate is asserted at the time that the switch is pressed, Write Protect will be inhibited until Write Gate is negated. Additionally, the Write Protect indicator will not be lit until Write Protect is truly enabled. Removal of Write Protect will occur immediately upon the release of the switch.

#### **1.7.5 Access "A" Enable Switch**

This alternating action push/push switch, when pressed, enables communication to and from the drive via the "A" set of I/O info connectors under the following conditions:

1. If the drive is single access only, the interface and timing module must be located in the appropriate module slot for that set of connectors. When this is the case, the access "A" enable switch enables (when pressed) or inhibits (when released) communication to/from the drive. For single access, the indicator on this switch indicates when the drive is selected.
2. If the drive includes the dual access option, this switch enables/inhibits communication via the "A" set of I/O connectors. When both access "A" and access "B" switches are pressed, arbitration logic selects the appropriate access to the drive. For dual access drives, the indicators on the "A" and "B" switches indicate which drive I/O is in use.

#### **1.7.6 Access "B" Enable Switch**

This switch is functionally identical to the access "A" enable switch except that this switch enables or inhibits communication via the "B" set of I/O connectors.

#### **1.7.7 Dual Access Option**

If the drive includes the dual-access option, the access enable switches enable (when pressed) and inhibit (when released) communication via that access. When both access switches are pressed, arbitration logic in the drive selects the appropriate access. In dual-access drives, the access in use at any time is indicated by an illuminated condition for the indicator of the associated access switch.

### **1.8 MAINTENANCE CONTROLS AND INDICATORS**

In the performance of maintenance procedures, it is essential that Field Service personnel know the location of the various controls and indicators to be used for servicing. Figures 1-11 and 1-12 show the locations of the two main maintenance switches in the logic card nest assembly that will be used most frequently. They are the SERVO SAFETY switch and the SERVO RELEASE switch.

#### **1.8.1 SERVO RELEASE Switch (SW1)**

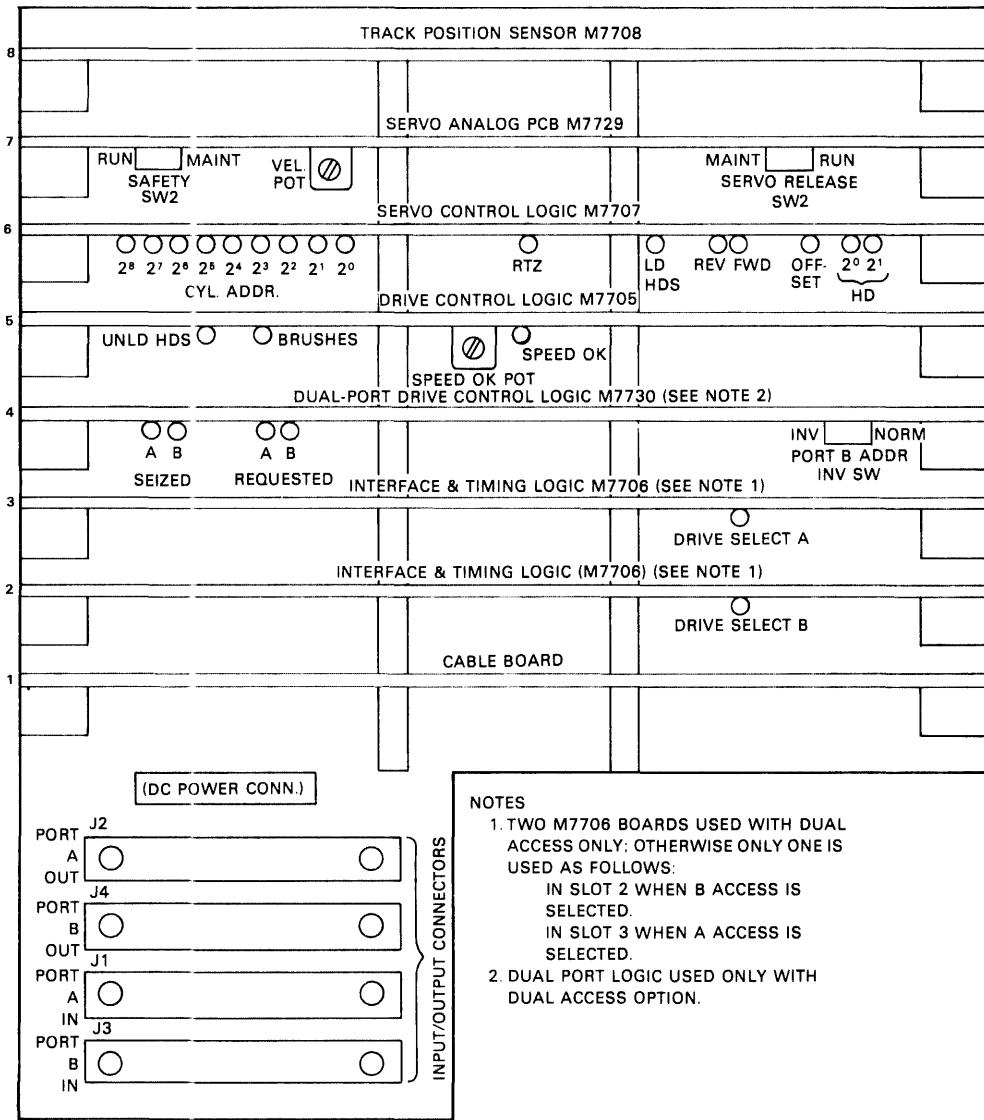
This switch is set to the MAINT position when it is desired to move the carriage by hand while observing signal outputs, or under any condition where carriage motion could harm service personnel or the drive. This switch disables the Servo Unsafe circuit.

#### **1.8.2 SERVO SAFETY Switch (SW2)**

This switch is set to the MAINT position when performing head adjustments or other service operations, where inadvertent carriage motion could harm personnel or damage the drive. This switch will both disable the Servo Unsafe circuit and write protect the drive. If a write command is received while this switch is still in the MAINT position, a Write Lock error will occur.

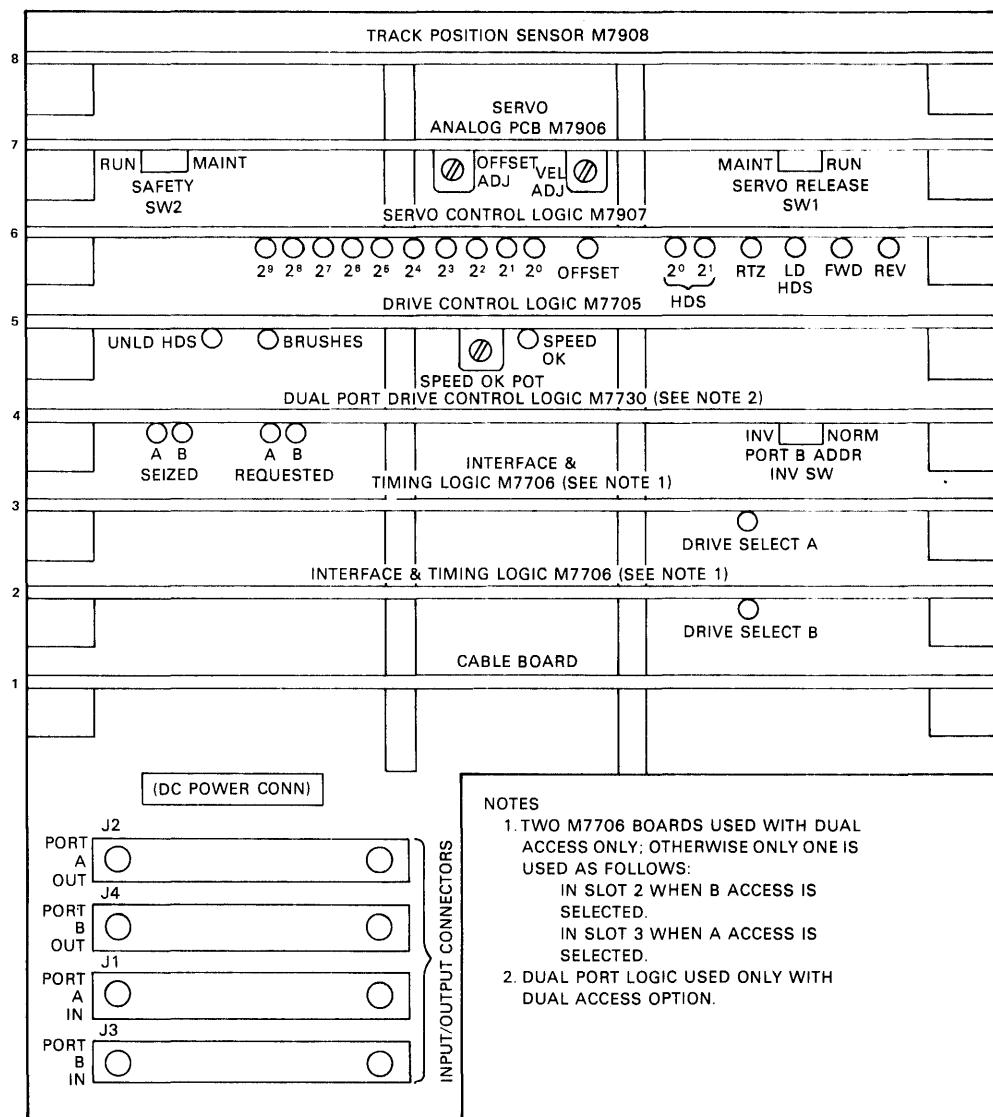
### **1.9 PREVENTIVE MAINTENANCE**

The preventive maintenance procedures necessary to maintain the RK06 or RK07 Disk Drive will depend on the environmental conditions and use of the drive, but the following tasks should be performed quarterly for the average system.



CP-2456

Figure 1-11 RK06 Maintenance Controls and Indicators



MA-0923

Figure 1-12 RK07 Maintenance Controls and Indicators

**Inspect Quarterly**

Read/write and servo heads	Check for foreign substances or scratches on the heads.
Spindle ground	Check to see if the ground appears to be worn down where it contacts the spindle.
Brushes	Check to see if the bristles are worn down.
Cabling and wiring harnesses	Ensure that all connections are still good.
Lamps	Check to see if lamps are burned out.
For FCO requirements	Ensure that machine is up-to-date.
Cartridge chamber	Check for dust or other foreign matter in the chamber.
Error log (if supported by system software)	See if system problems may be related to the drive.

**Clean Quarterly**

Read/write and servo heads  
Spindle core  
Carriage guide rod  
Cartridge chamber  
Drive exterior

**Replace Quarterly**

Pre-filter (in front of the blower assembly; Paragraph 2.2.4)  
Brushes (as needed; Paragraph 2.5.7)  
Lamps (as needed; Paragraph 2.2.2)  
Spindle ground (as needed; Paragraph 2.2.7)

**Perform Quarterly**

Head Alignment Check (Paragraph 3.4)  
Diagnostic performance tests (Appendix C, Paragraph (3.2.2)  
System exercise, RK611 modules (Appendix C, Paragraph (3.2.1)  
Any other adjustments or checks if the error log or diagnostics indicate a problem.

These tasks should be performed annually (in addition to the quarterly checks) for the typical system:

Replace absolute filter (Paragraph 2.3.3)  
Check voltage levels (Paragraph 3.14)  
Check transducer preamp adjustments (Paragraph 3.9)  
Align heads (Paragraph 3.4)  
Perform drive selection checks (Appendix C, Paragraph (3.2)  
Check velocity adjustment (Paragraph (3.10)

## CHAPTER 2

### SUBSYSTEM REMOVAL AND REPLACEMENT

#### **2.1 INTRODUCTION**

Chapter 2 is divided into five sections, one for each major area of the RK06/RK07 Disk Drive:

- Front Bezel area (2.2)
- Front Bezel and Rear Cover area (2.3)
- Rear Cover area (2.4)
- Lid Assembly area (2.5)
- Baseplate Assembly area (2.5).

Each of these sections is accompanied by a flow diagram that indicates, for a given subassembly, which other assemblies must be removed first and which do not have to be removed. All of these flow diagrams are combined in a single overall diagram in Figure 2-1 as a convenience to the reader. These flows should be utilized to perform removal and replacement procedures in a minimum amount of time.

#### NOTE

Drives referred to as "early model" machines are those drives with a serial number below 12614 (RK06) or 53380 (RK07). They can also be identified by the transition board behind the magnet assembly. On "late model" machines, drive serial numbers 12614 and up (RK06), or 53380 and up (RK07), there is no transition board behind the magnet assembly.

#### **2.2 FRONT BEZEL AREA**

See Figure 2-2 for the front bezel area removal and replacement procedures block diagram.

##### **2.2.1 Front Bezel**

###### **Removal Procedure**

1. Open the lid assembly cover.
2. Remove the two Phillips flat head screws holding the bezel to the front frame (Figure 2-3).
3. Pull the bezel straight out from the front frame.

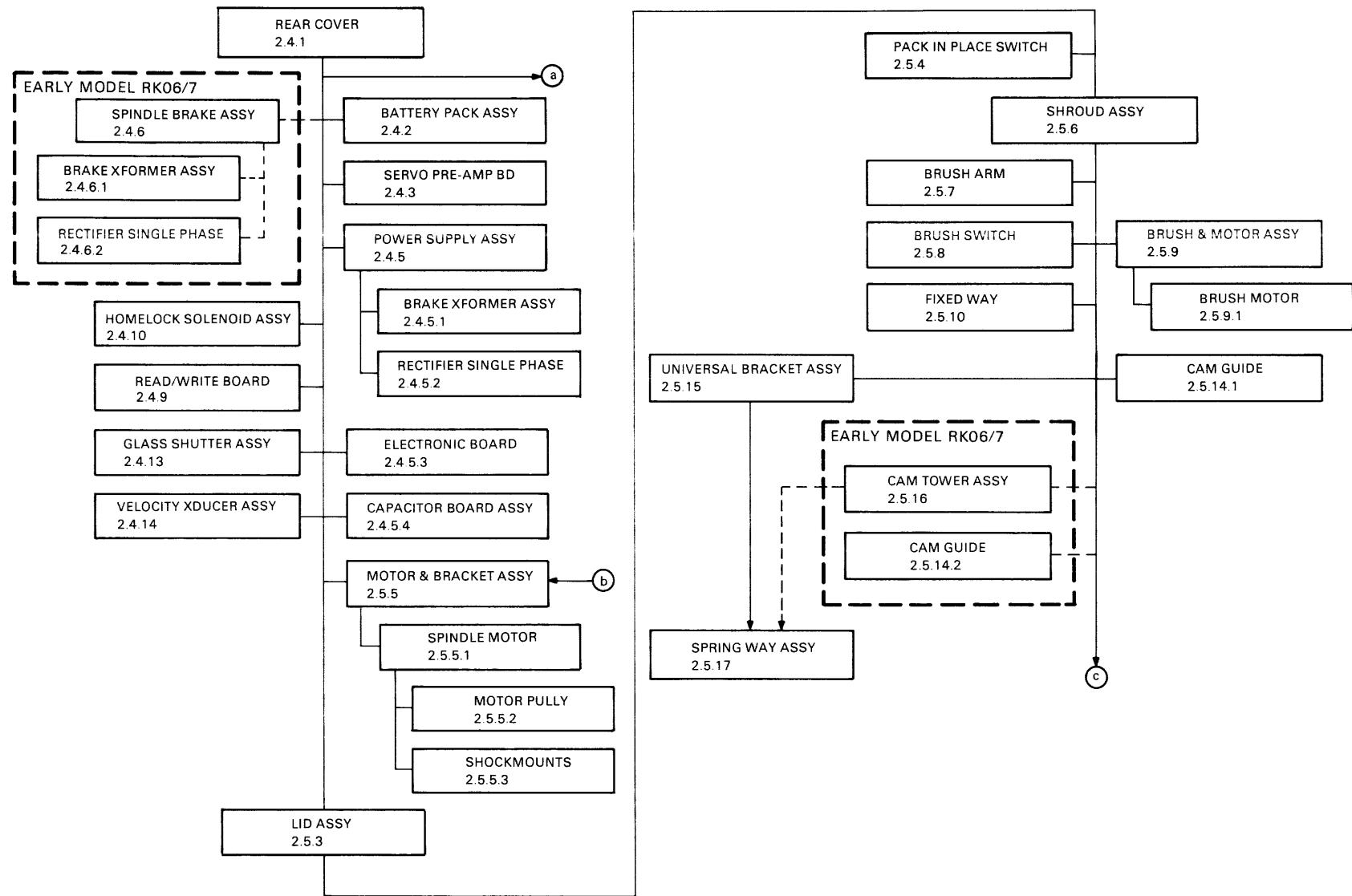


Figure 2-1 Removal and Replacement Procedures Block Diagram (1 of 2)

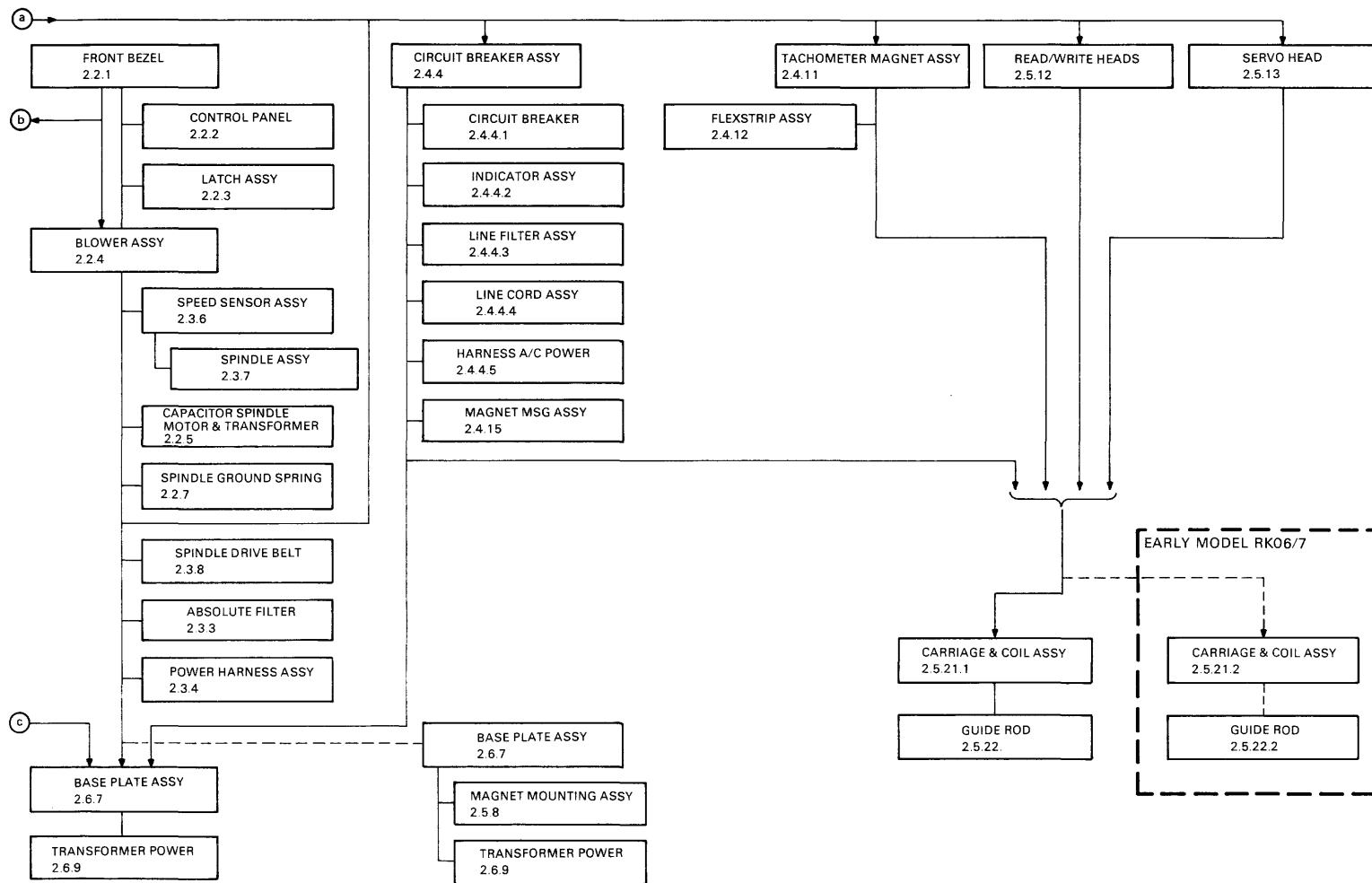
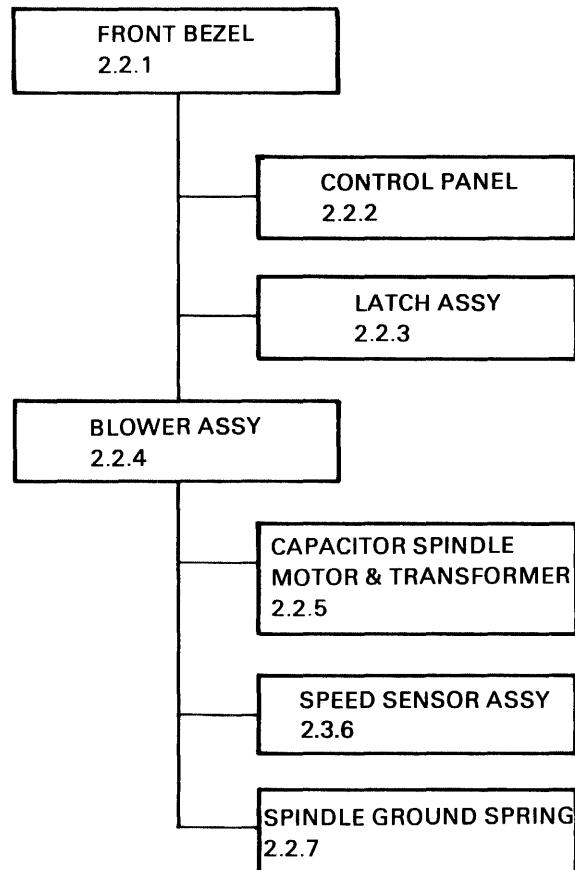


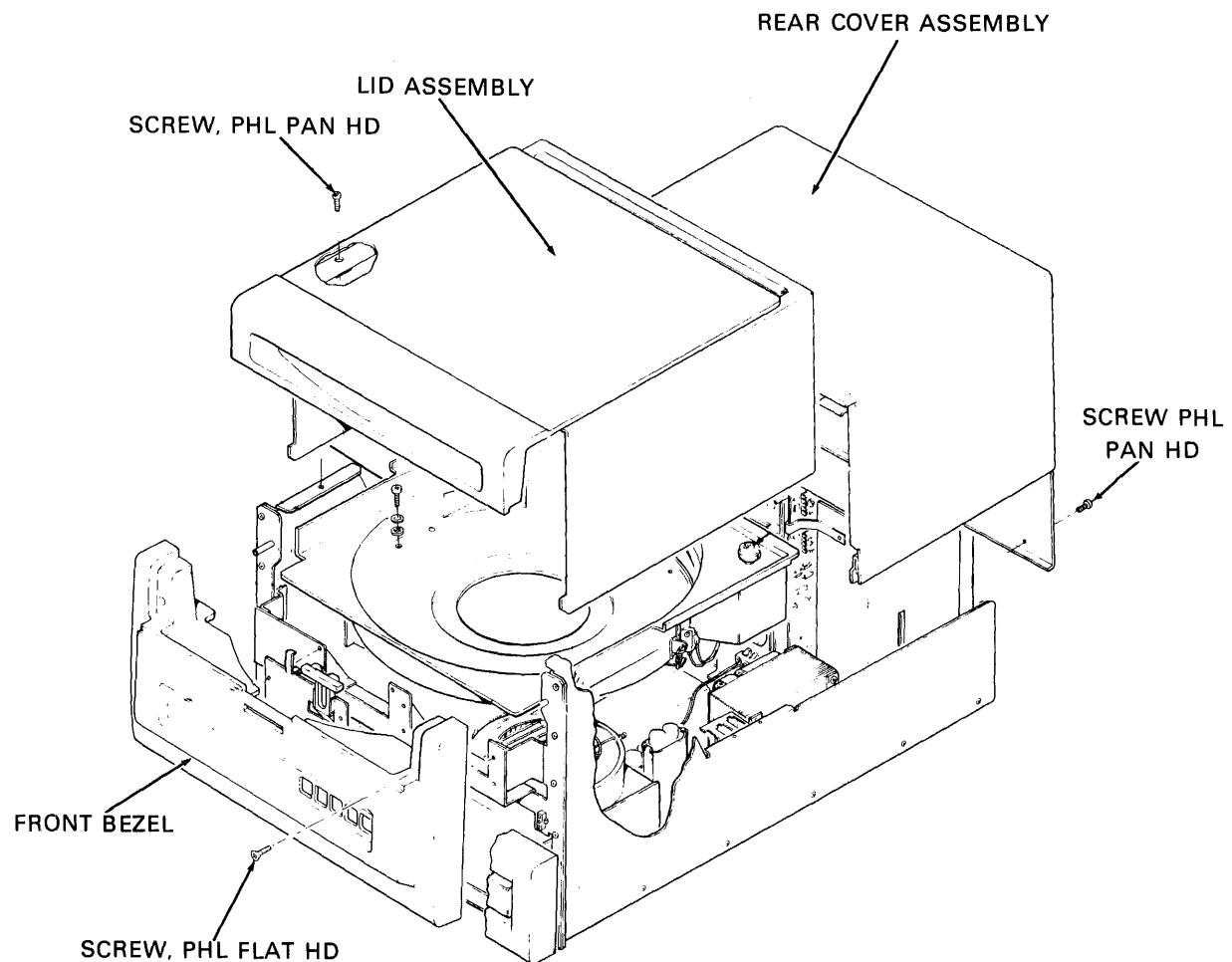
Figure 2-1 Removal and Replacement Procedures Block Diagram (2 of 2)

**FRONT BEZEL AREA**  
**2.2**



MA-2114

Figure 2-2 Front Bezel Area Removal and Replacement Procedures Block Diagram



MA-2120

Figure 2-3 Bezel Lid and Cover

### **Replacement Procedure**

1. Insert the bezel guide pins into the holes in the front frame; push bezel into place.
2. Install the two Phillips flat head screws.

#### **NOTE**

If this machine has a plastic bezel, do not overtighten the screws. This causes the bezel to bend, making it difficult or impossible to do the latch adjustment. Tighten the screws until the front bezel is just touching the drive; then turn the screw one-half to one more turn.

3. Close the lid assembly cover.

### **2.2.2 Control Panel Assembly**

#### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.2.1).
2. Disconnect flat cable connector CPP1 from CPJ1 on top of the switch panel (Figure 2-4).
3. Remove the four Phillips pan head screws holding the control panel to the front frame.
4. Pull the control panel forward and lift up and out of the front frame.

#### **Replacement Procedure**

1. Replace the control panel circuit board behind the front frame and lower into position.
2. Install the four Phillips flat head screws.
3. Connect flat cable connector CPP1 to CPJ1 on top of the switch panel.
4. Replace the front bezel (Paragraph 2.2.1).

### **2.2.3 Latch Assembly**

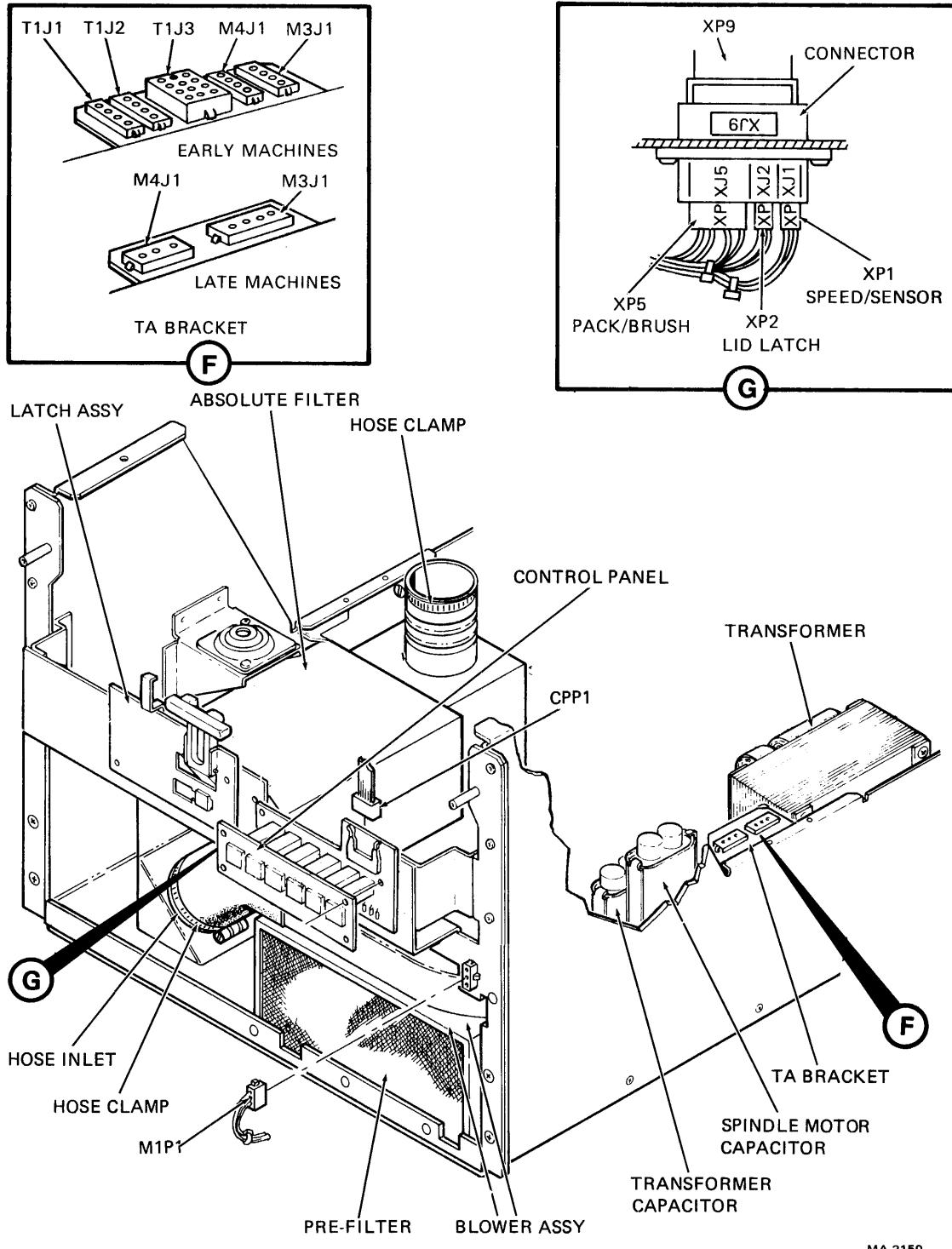
#### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.2.1).
2. Remove the rear cover (Paragraph 2.3.2).

#### **NOTE**

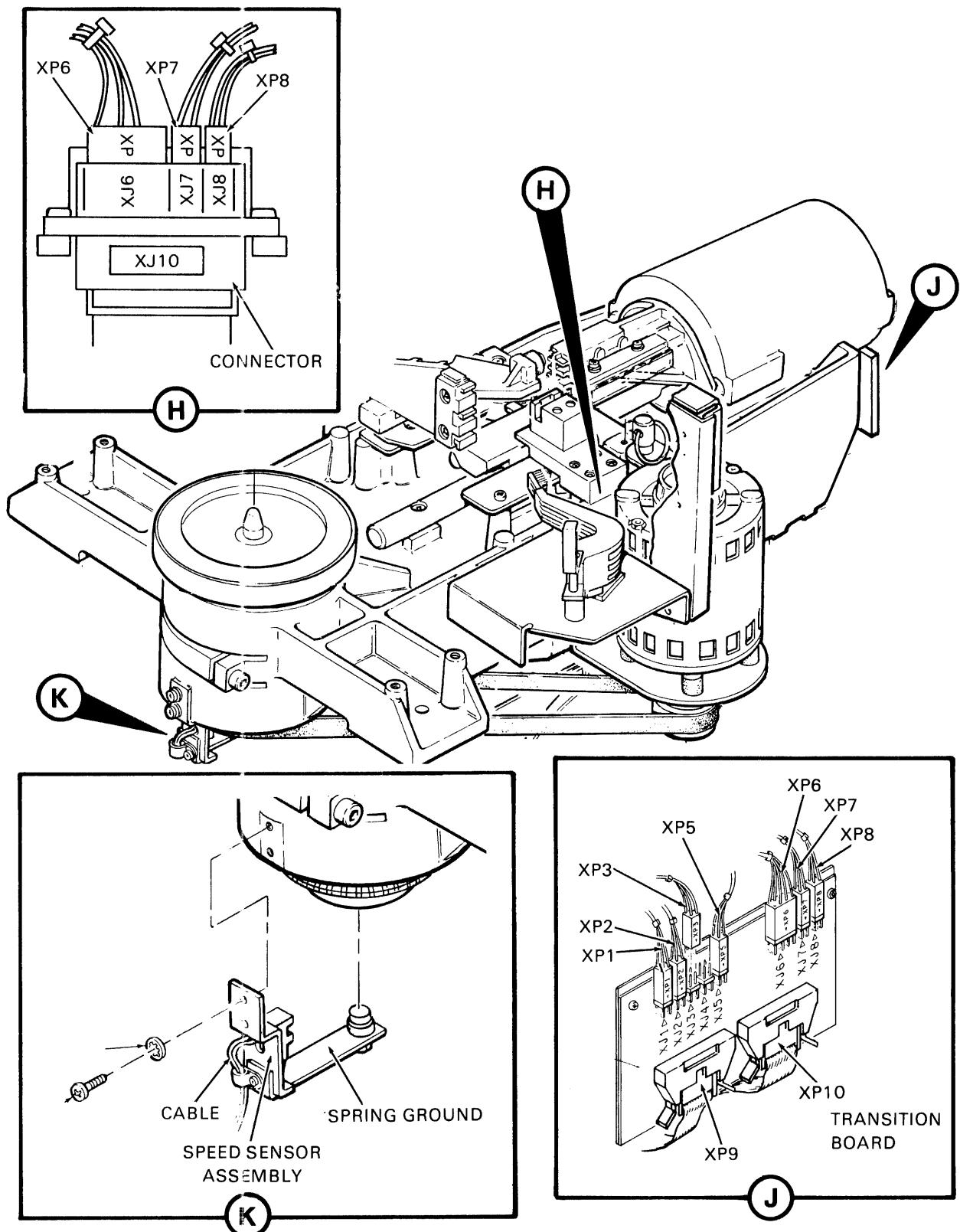
On early model machines, the latch assembly cable is routed along the base plate to the transition board and is held in place with stick-on cable clamps. To gain access to the cable connector and cable clamps the rear cover must be removed.

3. Remove the cable clamp and disconnect the latch assembly cable connector XP2 from XJ2 on the feed-through connector or the XJ2 connector on the transition board (Figures 2-4 and 2-5).
4. Remove the four Phillips pan head screws holding the latch assembly to the front frame.
5. Remove the latch assembly from the machine.



MA-2150

Figure 2-4 Chassis Assembly (Front)

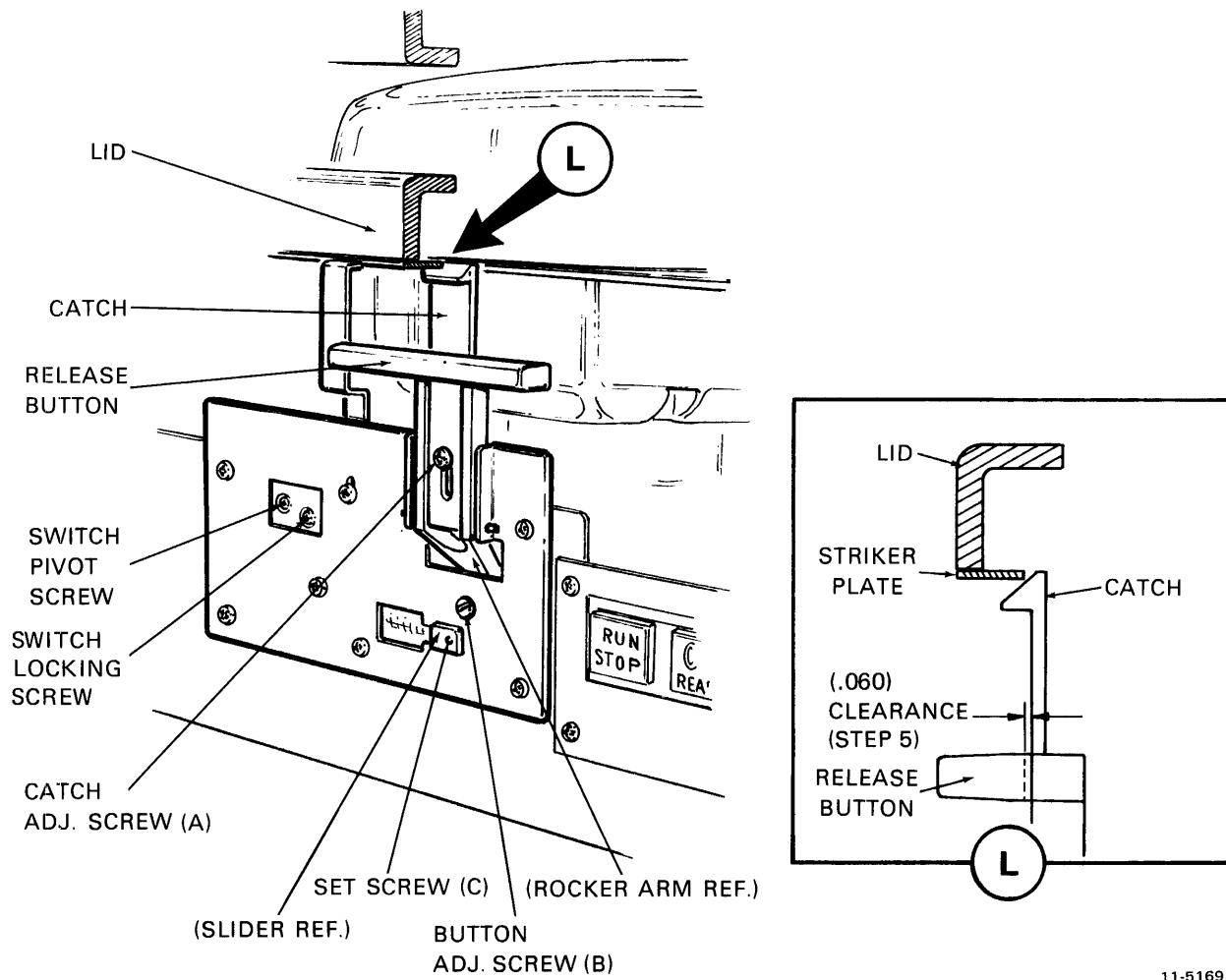


MA-2121

Figure 2-5 Base Plate Assembly

## Replacement Procedure

1. Position the latch assembly on the front frame and secure with four Phillips pan head screws.
2. Connect latch assembly cable connector XP2 to XJ2 on the feed-through connector and assemble the cable clamp or XJ2 on the transition board.
3. Open the lid assembly cover. (If power is OFF, insert a screwdriver blade into the slot beneath the latch and push to release the latch.)
4. Bring the lid assembly cover down until the striker plate rests on the top of the catch (Figure 2-6). Adjust catchscrew "A" until the edge of the striker plate touches the uppermost of the catch ramp. Close the lid assembly cover to make sure it is latched properly (for example, edge of striker plate is engaged under catch).



11-5169

Figure 2-6 Latch Assembly

5. With the lid assembly cover up, turn button adjusting screw "B" until there is approximately 0.060 inch clearance between the back of the button and the catch.
6. Tighten set screw "C" in the slider until it touches the rocker arm, then back off one full turn.
7. As a check for the above adjustments, perform the following test. With power OFF and the lid assembly cover up, press the latch release button. If the adjustments are correct, the 0.060 inch clearance behind the button should decrease by about one-half.
8. The latch assembly switch can be checked for proper adjustment by performing the following steps:
  - a. With power ON and the lid assembly cover closed, hold the slider all the way to the left. Press the RUN/STOP button. If the adjustments are correct, the spindle motor will not start. If the motor does start, the latch switch is down too far and must be moved up. Next, let the slider move back to the right; the motor should start.
  - b. Also, check the latch switch adjustment by applying upward pressure on the lid assembly cover. If the switch breaks, the carriage and coil assembly will move back into the magnet housing and the latch switch will have to be readjusted.
9. To adjust the latch switch, perform the following steps:
  - a. With the lid assembly cover closed and power ON, slightly loosen the switch pivot and locking screws. Then move the switch up.
  - b. Press the RUN/STOP button.
  - c. Move the slider approximately 1/8 inch from the right edge of the slot and hold it there with one hand.
  - d. While holding the slider, use the other hand to move the switch down until the spindle motor starts turning. Tighten both the pivot and locking screws.
  - e. Go back to step 8 and perform the latch switch adjustments checks.
10. Replace the rear cover, if it was removed.
11. Replace the front bezel (Paragraph 2.2.1).

## 2.2.4 Blower Assembly

### Removal Procedure

1. Remove the front bezel (Paragraph 2.2.1).
2. Remove the hose from the blower outlet (Figure 2-4).
3. Disconnect blower assembly cable connector M1P1 from M1J1 on the front frame.
4. Remove the two Phillips pan head screws holding the blower assembly to the front frame.
5. Remove the blower assembly from the chassis.

### **Replacement Procedure**

1. Slide the blower assembly into the chassis making sure that the tab on the blower assembly locks into the guide on the chassis floor.
2. Install the two Phillips pan head screws.
3. Connect the hose to the blower assembly outlet.
4. Connect blower assembly cable connector M1P1 to M1J1 on the front frame.
5. Replace the front bezel (Paragraph 2.2.1).

#### **2.2.5 Capacitor, Spindle Motor and Transformer**

##### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.2.1).
2. Remove the blower assembly (Paragraph 2.2.4).
3. Remove the two insulating caps and disconnect the two quick-connect terminals on the capacitor (Figure 2-4).
4. Remove the front hold-down bracket by removing the Phillips pan head screw. Tip the top of the capacitor toward the rear and pull the capacitor out from under the rear hold-down bracket. Do not remove the rear hold-down bracket.

##### **Replacement Procedure**

1. Insert the top of the capacitor under the rear hold-down bracket and push the bottom of the capacitor into place.
2. Install the front hold-down bracket and secure with the Phillips pan head screw.
3. Place the two insulating caps on the capacitor leads and connect the quick-connect terminals, with the black wire to the rear.
4. Replace the blower assembly (Paragraph 2.2.4).
5. Replace the front bezel (Paragraph 2.2.1).

#### **2.2.6 Speed Sensor Assembly**

##### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.2.1).
2. Remove the rear cover (Paragraph 2.3.2).

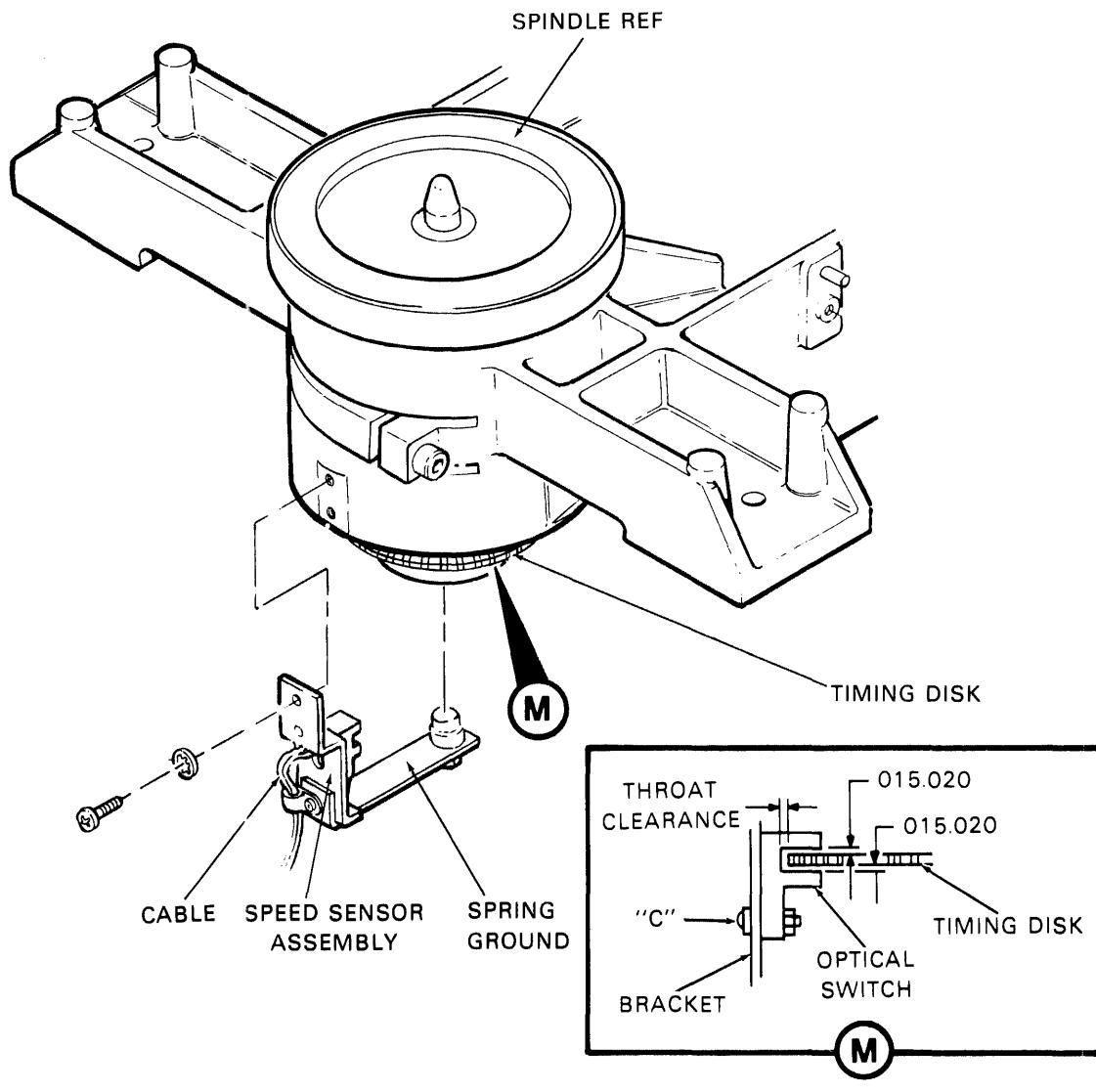
##### **NOTE**

**On early model machines the speed sensor assembly cable is routed along the base plate to the transition board and held in place with stick-on cable clamps. To gain access to the cable connector and cable clamps, the rear cover must be removed.**

3. Remove the blower assembly (Paragraph 2.2.4).
4. Remove the cable clamp and disconnect speed sensor assembly cable connector XP1 from XJ1 on the feed-through connector or XJ1 on the transition board (Figure 2-4).
5. Remove the two Phillips pan head screws holding the speed sensor to the base plate and remove from machine.

#### **Replacement Procedure**

1. Loosen the speed sensor holding screw on the new speed sensor assembly (Figure 2-7).



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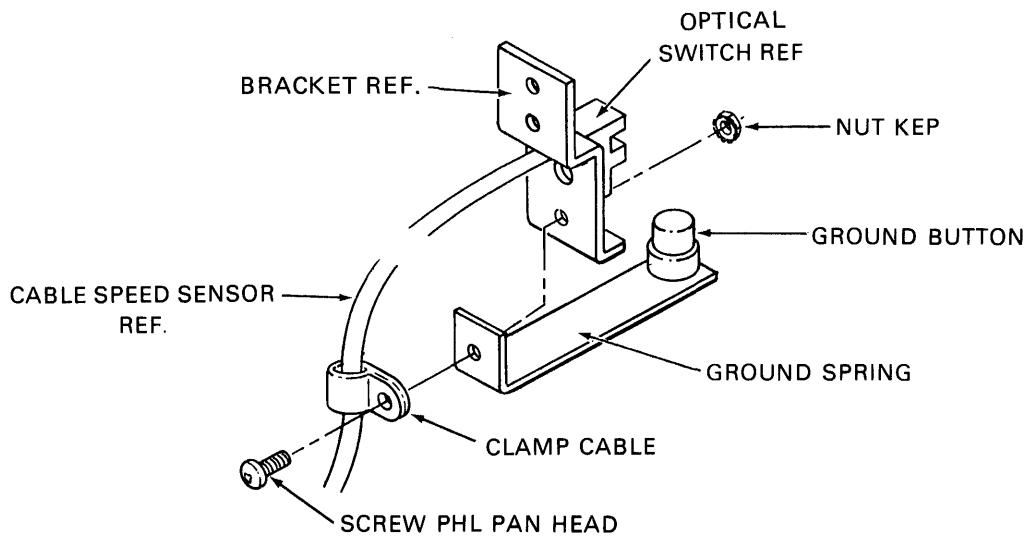
Figure 2-7 Speed Sensor Adjustment

2. Position the speed sensor assembly on the base plate and secure with two Phillips pan head screws; place the cable clamp on the pack and the brush switch cable under the top screw.
3. Connect speed sensor assembly cable connector XP1 to XJ1 on the feed-through connector and assemble cable clamp or XJ1 on the transition board (Figure 2-4).
4. Loosen adjusting screw "C" (Figure 2-7).
5. Place a 0.015 inch shim between the optical switch and the timing disk and tighten the adjusting screw. Check both sides of the timing disk for the 0.015/0.020 inch clearance.
6. Check the throat clearance by rotating the spindle; ensure that there is no interference.
7. Replace the blower assembly (Paragraph 2.2.4).
8. Replace the rear cover, if it was removed (Paragraph 2.3.2).
9. Replace the front bezel (Paragraph 2.2.1).

### **2.2.7 Spindle Ground Spring**

#### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.2.1).
2. Remove the blower assembly (Paragraph 2.2.4).
3. Remove the bottom Phillips pan head screw and kep nut from the speed sensor bracket and remove the ground spring (Figure 2-8).
4. Remove the ground button from the ground spring by removing the kep nut on the ground button.



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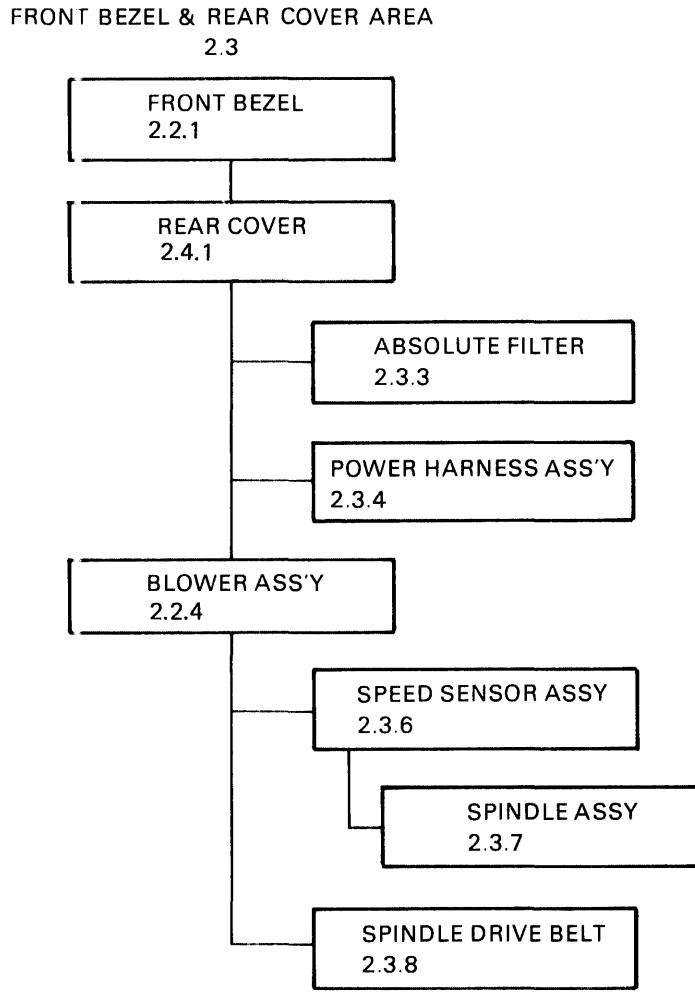
**Figure 2-8 Spindle Ground Spring**

## Replacement Procedure

1. Assemble the ground button to the new ground spring and secure with the kep nut.
2. Install the ground spring to the speed sensor bracket with 2 Phillips pan head screws and kep nuts.
3. Center the ground button on the spindle ground and check for proper tension, as described in Paragraph 2.2.6.
4. Replace the blower assembly (Paragraph 2.2.4).
5. Replace the front bezel (Paragraph 2.2.1).

### 2.3 FRONT BEZEL AND REAR COVER AREA

See Figure 2-9 for the front bezel and rear cover area removal and replacement procedures block diagram.



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Figure 2-9 Front Bezel and Rear Cover Area Removal and Replacement Procedures Block Diagram

### **2.3.1 Front Bezel**

#### **Removal Procedure**

1. Open the lid assembly cover.
2. Remove the two Phillips flat head screws holding the bezel to the front frame (Figure 2-3).
3. Pull the bezel straight out from the front frame.

#### **Replacement Procedure**

1. Insert the bezel guide pins into the holes in the front frame and push the bezel into place.
2. Install the two Phillips flat head screws.

#### **NOTE**

If this machine has a plastic bezel, do not overtighten the screws. This causes the bezel to bend, making it difficult or impossible to do the latch adjustment. Tighten the screws until the front bezel is just touching the drive; then turn the screw one-half to one more turn.

3. Close the lid assembly cover.

### **2.3.2 Rear Cover**

#### **Removal Procedure**

1. Remove the two Phillips pan head screws holding the rear cover in place (Figure 2-3).
2. Pull the rear cover back approximately two inches and lift up and out of machine.

#### **Replacement Procedure**

1. Position the rear cover, making sure the slides engage the chassis and push forward to engage the locking tabs with the lid assembly (Figure 2-3).
2. Install the two Phillips pan head screws.

### **2.3.3 Absolute Filter**

#### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.3.1).
2. Remove the rear cover (Paragraph 2.3.2).
3. Remove the hose from the blower outlet (Figure 2-4).
4. Swing the card nest down (open).

5. Loosen the lower hose clamp on the absolute filter and lift the flexible hose off the filter outlet.
6. Remove the absolute filter from the front of the machine.
7. Loosen the front hose clamp and remove the hose from the filter.

#### **Replacement Procedure**

1. Place the front hose over the absolute filter inlet but do not tighten the hose clamp (Figure 2-4).
2. Slide the absolute filter into the machine until it contacts the filter stop.
3. Slip the hose over the blower outlet and tighten the clamp on the filter inlet.
4. Place the rear flexible hose over the absolute filter outlet and tighten hose clamp.
5. Swing the card nest up (closed).
6. Replace the rear cover (Paragraph 2.3.2).
7. Replace the front bezel (Paragraph 2.3.1).

#### **2.3.4 Power Harness Assembly**

##### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.3.1).
2. Remove the rear cover (Paragraph 2.3.2).
3. Swing the card nest down (open).
4. Remove the single Phillips pan head screw and the kep nut holding the cable bracket to the card nest (Figure 2-14).
5. Lift the connector board M9016, and disconnect the following flat cable connectors: CNP1, CNP2, CNP3, CNP4, CNP5, and CNP6.
6. Disconnect the electronic board to card nest cable connector CNP7 and lift the cable bracket from the card nest.
7. Remove the Phillips pan head screw holding the cable clamp to the chassis floor and remove the cable clamp.
8. Disconnect the two flat cable connectors RWP1 and RWP2 from the read/write board.
9. Disconnect the two flat cable connectors XP9 and XP10 from the feed-through connectors on the transition board (Figure 2-5).
10. Disconnect the single flat cable connector OPP1 from the control panel assembly.

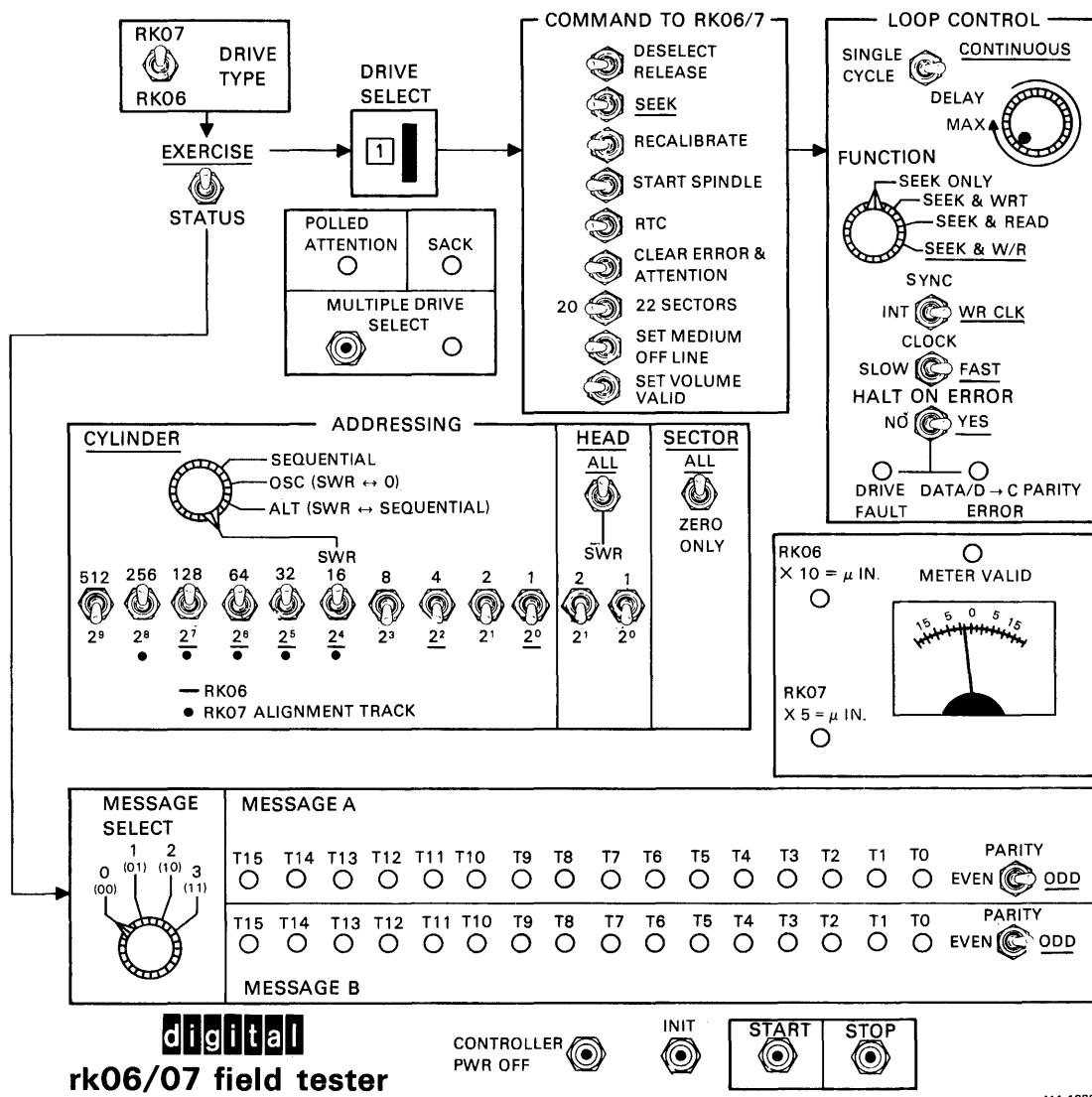


Figure 2-10 RK06/RK07 Field Test Box

11. Swing down (open) the plenum on the power supply assembly and disconnect the three cable connectors A1P1, A1P2, and A1P3 from the electronics board (Figure 2-11).
12. Remove the two Phillips pan head screws holding the power harness assembly cable clamps to the chassis.
13. Disconnect the three connectors on the CA bracket M2P1, B1P1, and TB1-P1. (On late model machines the connector TB1-P1 in this position is T1P2.)
14. Remove the power harness assembly connectors M2J1, B1J1 and TB1-J1 from the CA bracket. (On late model machines the connector TB1-J1 in this position is T1J2.)
15. Remove the power harness assembly from the machine.

### **Replacement Procedure**

1. Place the power harness assembly into the machine and route the cables to their proper positions (Figure 2-14).
2. Connect the following flat cable connectors to the connector board M9016: CNP1, CNP2, CNP3, CNP4, CNP5, and CNP6.
3. Position the cable bracket on the card nest and secure with a single Phillips pan head screw; tighten the kep nut.
4. Connect the electronic board to card nest cable connector CNP7 and by hand form the cable around the cable bracket so it will not rub the baseplate when the card nest is closed or opened.
5. Position the power harness assembly on the chassis floor and assemble the cable clamp to the chassis with a Phillips pan head screw.
6. Connect the two flat cable connectors XP9 and XP10 to the feed-through connectors or the transition board.
7. Connect the two flat cable connectors RWP1 and RWP2 to the read/write board.
8. Connect the single flat cable connector OPP1 to the control panel assembly.
9. Swing down (open) the plenum on the power supply assembly and connect the three cable connectors to the electronic board (Figure 2-11).
10. Position the power harness assembly cable clamps on the chassis floor and secure with two Phillips pan head screws.
11. Assemble the three power harness assembly cable connectors M2J1, B1J1 and TB1-J1 to the CA bracket. (On late model machines TB1-J1 in this position is T1J2) (Figure 2-14).
12. Connect cable connectors M2P1, B1P1, and TB1-P1 to the CA bracket. (On late model machines TB1-P1 in this position is T1P2).
13. Lift the power harness assembly cables between the card nest and cable clamp on the chassis floor to form a smooth arc and close the card nest.

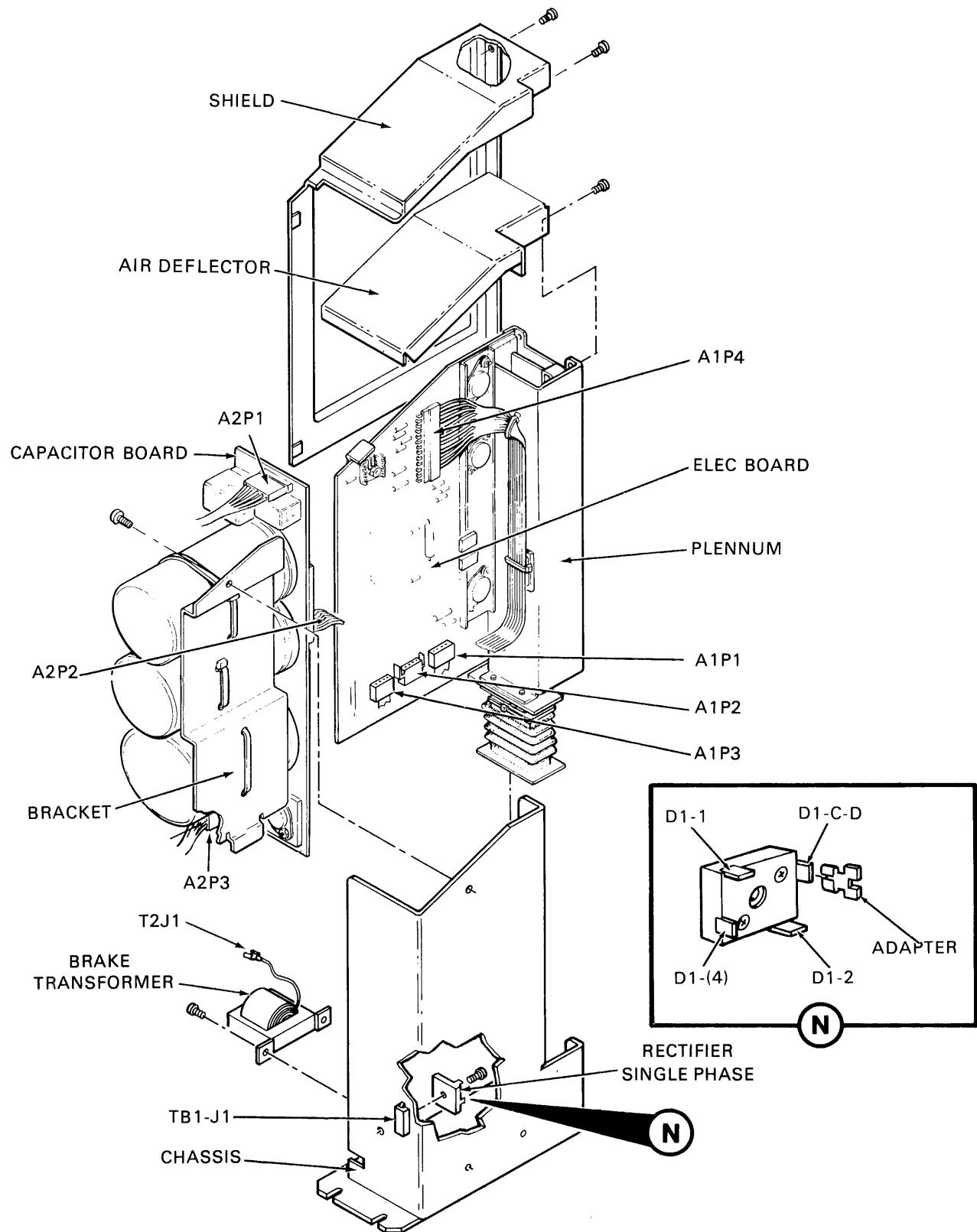


Figure 2-11 Power Supply

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14. Replace the rear cover (Paragraph 2.3.2).
15. Replace the front bezel (Paragraph 2.3.1).

#### NOTES

1. On early model machines the power harness assembly is secured to the card nest with a single cable clamp. When replacing with a new power harness assembly, discard this clamp and use the cable bracket attached to the new power harness assembly.
2. Individual cable assemblies in the power harness assembly may be replaced by removing cable clamps and cable ties. Remove the cable assembly to be replaced and replace with a new cable assembly. Position and replace cable clamps and cable ties.

### 2.3.5 Blower Assembly

#### Removal Procedure

1. Remove the front bezel (Paragraph 2.3.1).
2. Remove the hose from the blower outlet (Figure 2-4).
3. Disconnect the blower assembly cable connector M1P1 from M1J1 on the front frame.
4. Remove the two Phillips pan head screws holding the blower assembly to the front frame.
5. Remove the blower assembly from the chassis.

#### Replacement Procedure

1. Slide the blower assembly into the chassis making sure that the tab on the blower assembly locks into the guide on the chassis floor (Figure 2-4).
2. Install the two Phillips pan head screws.
3. Connect the hose to the blower assembly outlet.
4. Connect the blower assembly cable connector M1P1 to M1J1 on the front frame.
5. Replace the front bezel (Paragraph 2.3.1).

### 2.3.6 Speed Sensor Assembly

#### Removal Procedure

1. Remove the front bezel (Paragraph 2.3.1).

2. Remove the rear cover (Paragraph 2.3.2).

**NOTE**

**On early model machines the speed sensor assembly cable is routed along the baseplate to the transition board and is held in place with stickon cable clamps. To gain access to cable connector and cable clamps, the rear cover must be removed.**

3. Remove the blower assembly (Paragraph 2.3.5).
4. Remove the cable clamp and disconnect the speed sensor assembly cable connector XP1 from XJ1 on the feed-through connector or XJ1 on the transition board (Figure 2-4).
5. Remove the two Phillips pan head screws holding the speed sensor to the baseplate and remove from machine.

**Replacement Procedure**

1. Loosen the speed sensor holding screw on the new speed sensor assembly (adjusting screws "C") (Figure 2-7).
2. Place the speed sensor assembly into position on the baseplate and secure with two Phillips pan head screws, with the cable clamp on the pack and brush switch cable under the top screw.
3. Connect the speed sensor assembly cable connector XP1 to XJ1 on the feed-through connector and assemble cable clamp or XJ1 on the transition board.
4. Loosen the adjusting screw "C."
5. Place a 0.015 inch shim between the optical switch and the timing disk and tighten the adjusting screw. Check both sides of the timing disk for the 0.015/0.020 clearance.
6. Check the throat clearance by rotating the spindle, making sure that there is no interference.
7. Replace the blower assembly (Paragraph 2.3.5).
8. Replace the rear cover, if it was removed (Paragraph 2.3.2).
9. Replace the front bezel (Paragraph 2.3.1).

**2.3.7 Spindle Assembly**

**Removal Procedure**

1. Remove the front bezel (Paragraph 2.3.1).
2. Remove the rear cover (Paragraph 2.3.2).
3. Remove the blower assembly (Paragraph 2.3.5).
4. Remove the speed sensor assembly (Paragraph 2.3.6).

- Remove the drive belt from the spindle pulley by pressing on the motor to release the belt tension, and slip the belt from the spindle pulley (Figure 2-12).

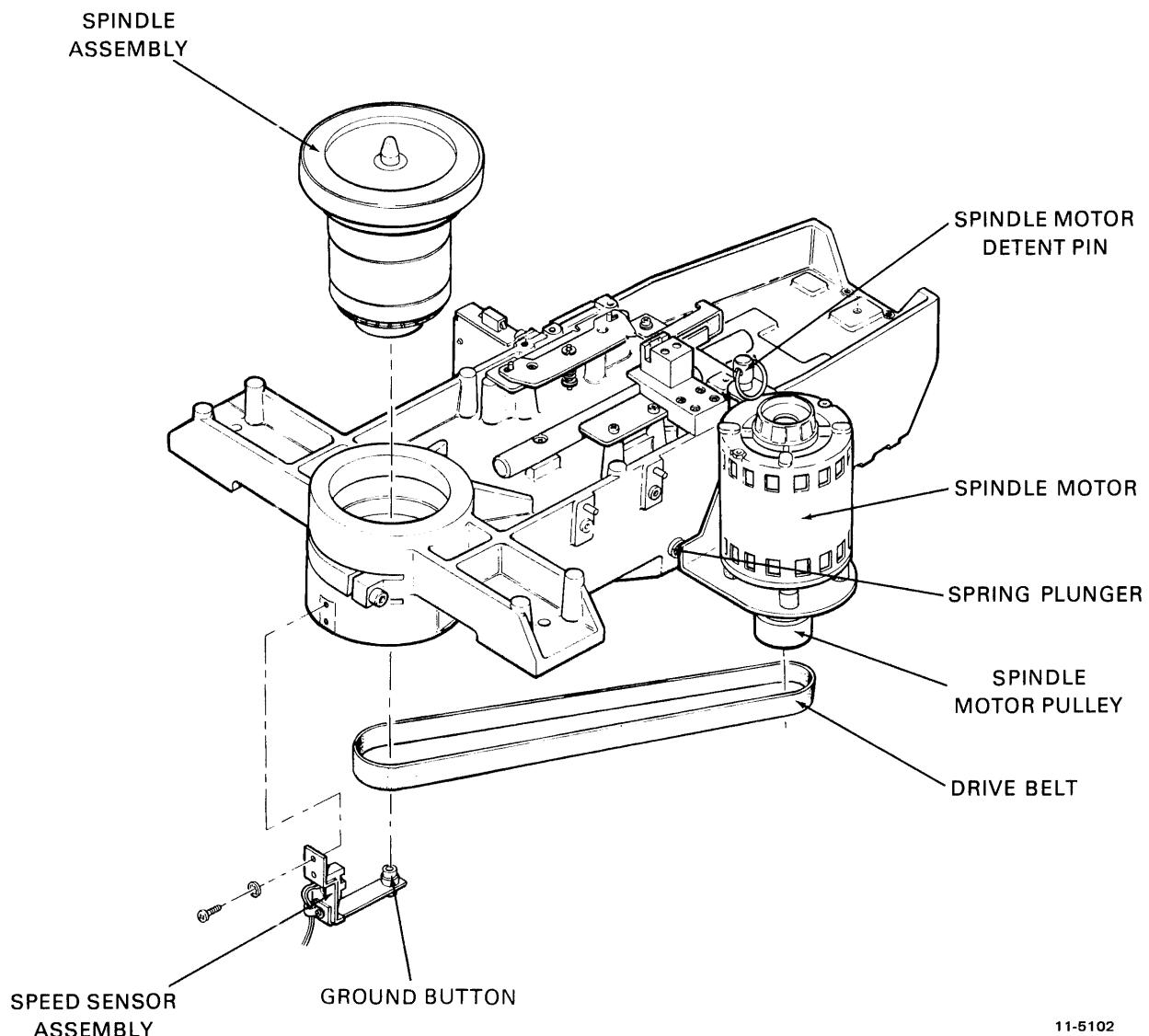


Figure 2-12 Spindle Drive

- Loosen the socket head cap screw securing the spindle to the baseplate.
- Open the lid assembly cover.
- Carefully lift the spindle straight up from the drive with a slight twisting motion.

**CAUTION**

The spindle assembly is a precision fit to the baseplate bore and can be damaged if not handled gently.

### **Replacement Procedure**

1. Inspect the spindle housing and the bore in the baseplate for burrs or other obstructions which might prevent proper clamping. Burrs can be removed with the edge of a six inch scale (Figure 2-12).
2. Hold the spindle collar with both hands and gently lower the spindle into the bore of the baseplate.
3. Remove the socket head cap screw and apply Locktite 290 to the threads. Replace and tighten in the following sequence.
  - a. Torque the screw to 20 inch-pounds.
  - b. Tap the baseplate to seat the spindle in the bore center.
  - c. Torque the screw to 100 inch-pounds.
  - d. Release the torque to 20 inch-pounds.
  - e. Torque to 60 inch-pounds.

**NOTE**

**If the sequence is broken, repeat steps a, b, and e.**

4. While pressing on the motor to release the belt tension, slip the belt over the spindle pulley.
5. Turn the spindle by hand and ensure that the belt rides in the middle of the pulley. If it does not, adjust the motor pulley up or down until it does.
6. Replace the speed sensor assembly (Paragraph 2.3.6).
7. Replace the blower assembly (Paragraph 2.3.5).
8. Replace the rear cover (Paragraph 2.3.2).
9. Replace the front bezel (Paragraph 2.3.1).

### **2.3.8 Spindle Drive Belt**

#### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.3.1).
2. Remove the rear cover (Paragraph 2.3.2).
3. Remove the blower assembly (Paragraph 2.3.5)
- \*4. Remove the lid assembly (Paragraph 2.5.3).
5. While pressing on the motor to release the belt tension, slip the belt off the spindle pulley (Figure 2-12).
6. Pull down lightly on the ground spring and slip the belt between the ground button and the spindle ground.
7. Remove the belt from the spindle motor pulley and out of the machine.

## **Replacement Procedure**

1. Slide the belt over the spindle motor pulley with the shiny surface against the pulley surface.
2. Pull down lightly on the ground spring and slip the belt between the ground button and the spindle ground.
3. While pressing on the motor to release the belt tension, slip the belt over the spindle pulley.
4. Turn the spindle by hand and ensure that the belt rides in the middle of the pulley, if it does not, adjust the motor pulley up or down.
5. Use the spring plunger gauge (DIGITAL 9306154-00) to set the spring plunger compression. If a spring plunger gauge is not available, set the spring plunger compression to about 50 percent or approximately 0.1000 inch. All checks are done when the belt is in place.
6. Adjust the spring plunger as follows:
  - a. While pressing on the motor to release the belt tension slip the belt off the spindle pulley.
  - b. Loosen the locking nut.
  - c. Turn the spring plunger CCW to increase the tension.
  - d. Turn the spring plunger CW to decrease the tension.
  - e. Tighten the locking nut making sure the spring plunger does not move.
7. Slide the belt over the spindle motor pulley with the shiny surface against the pulley surface.
8. While pressing on the motor to release the belt tension, slip the belt over the spindle pulley.
9. Check the spring plunger compression with the spring plunger gauge (DIGITAL 9306154-00).
10. Replace the blower assembly (Paragraph 2.3.5).
- \*11. Replace the lid assembly (Paragraph 2.5.3).
12. Replace the rear cover (Paragraph 2.3.2).
13. Replace the front bezel (Paragraph 2.3.1).

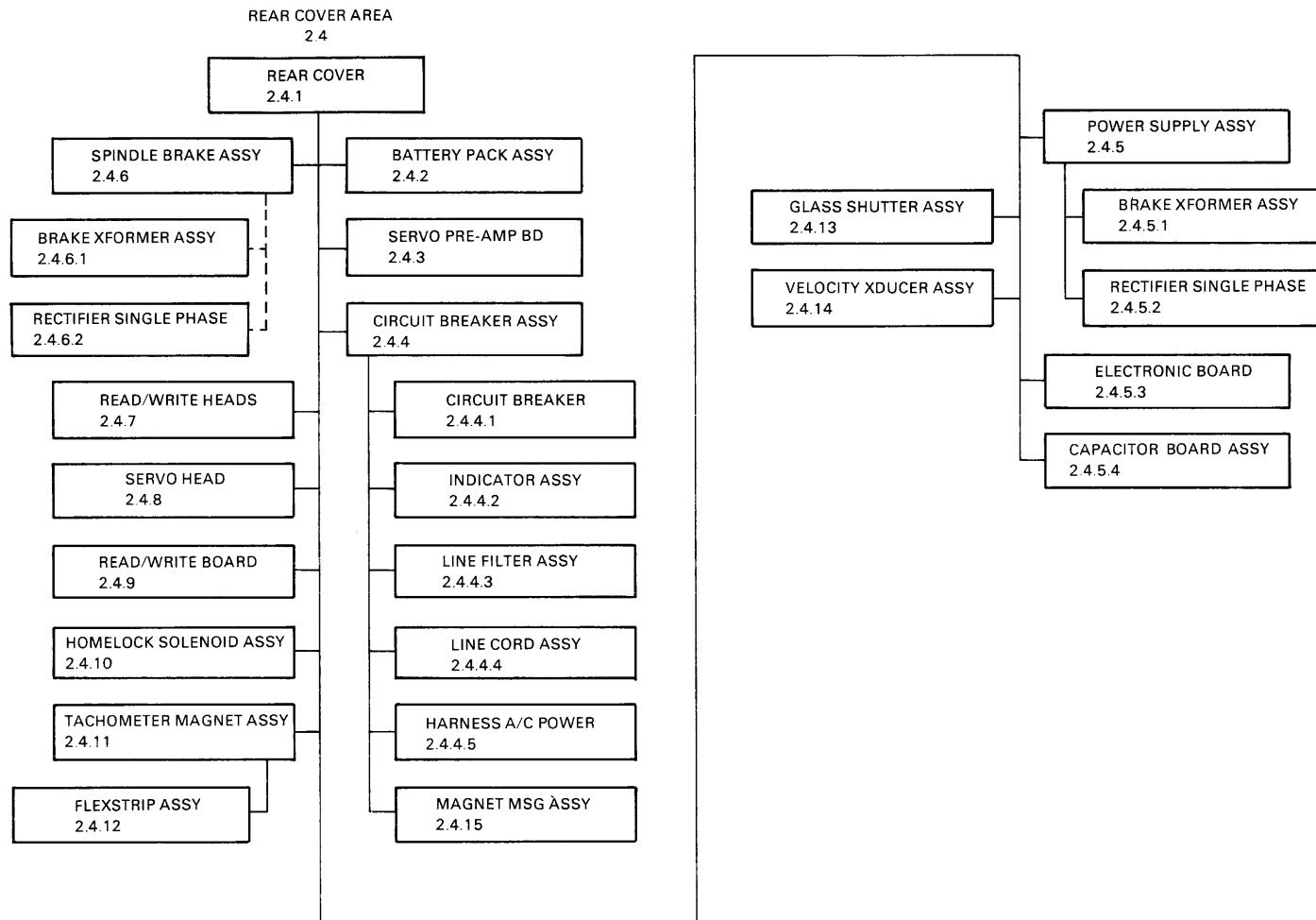
## **2.4 REAR COVER AREA**

### **NOTE**

**See Figure 2-13 for the rear cover area removal and replacement procedures block diagram.**

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\* On late model machines the spring plunger has been replaced with a spring that does not require adjustment. The lid assembly does not have to be removed to allow access to the spring plunger and steps 5, 6, and 9 of the replacement procedure does not have to be performed.



NOTE:

--- EARLY MODEL  
MACHINES ONLY

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Figure 2-13 Rear Cover Area Removal and Replacement Procedures Block Diagram

### **2.4.1 Rear Cover**

#### **Removal Procedure**

1. Remove the two Phillips pan head screws holding the rear cover in place (Figure 2-3).
2. Pull the rear cover back approximately two inches; lift up and out.

#### **Replacement Procedure**

1. Place the rear cover into position, making sure the slides engage the chassis and push forward to engage the locking tabs with the lid assembly (Figure 2-3).
2. Install the two Phillips pan head screws.

### **2.4.2 Battery Pack Assembly**

#### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.4.1).
2. Swing the card nest down (open).
3. Disconnect the battery pack assembly cable connector B1P1 from B1J1 on the CA bracket (Figure 2-14).
4. Remove the two Phillips pan head screws holding the battery pack assembly to the chassis and lift the battery pack assembly from the machine. See note below.

**NOTE**

**On late model machines the battery pack assembly is mounted near the CA bracket with a snap-in clamp and does not require mounting screws.**

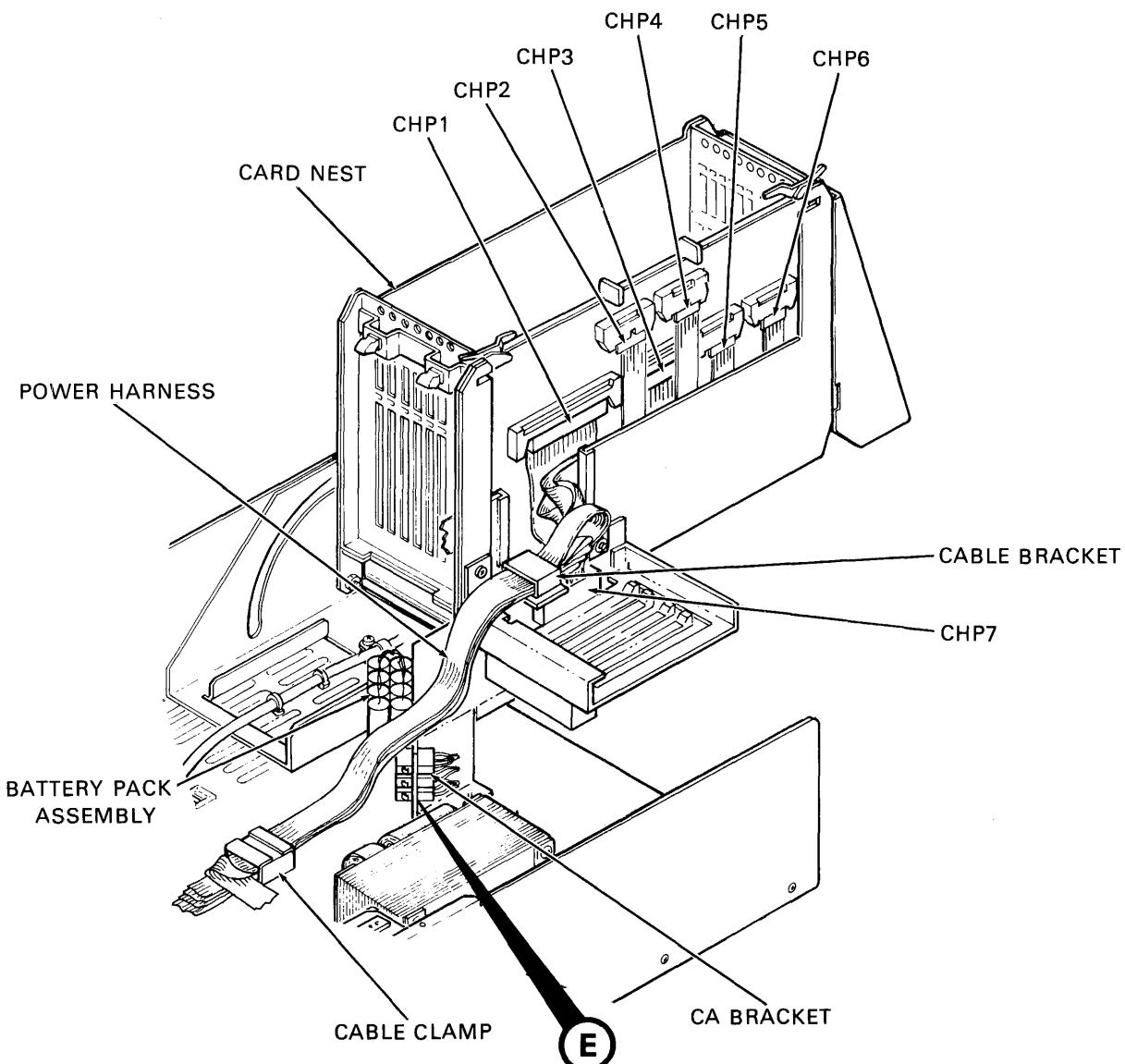
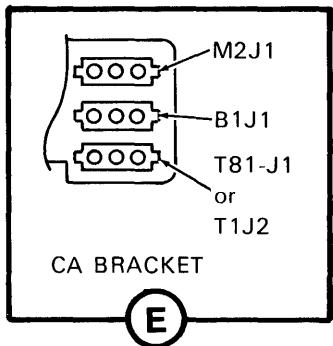
#### **Replacement Procedure**

1. Install the new battery pack assembly in the chassis with two Phillips pan head screws (Figure 2-14).

**NOTE**

**On late model machines the battery pack assembly is mounted near the CA bracket with a snap-in clamp and does not require mounting screws.**

2. Connect the battery pack assembly cable connector B1P1 to B1J1 on the CA bracket.
3. Swing the card nest up (closed).
4. Replace the rear cover (Paragraph 2.4.1).



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Figure 2-14 Chassis Assembly (Rear)

### 2.4.3 Servo Pre-Amp Board

#### Removal Procedure

1. Remove the rear cover (Paragraph 2.4.1).
2. Disconnect the servo head connector (Figure 2-15).

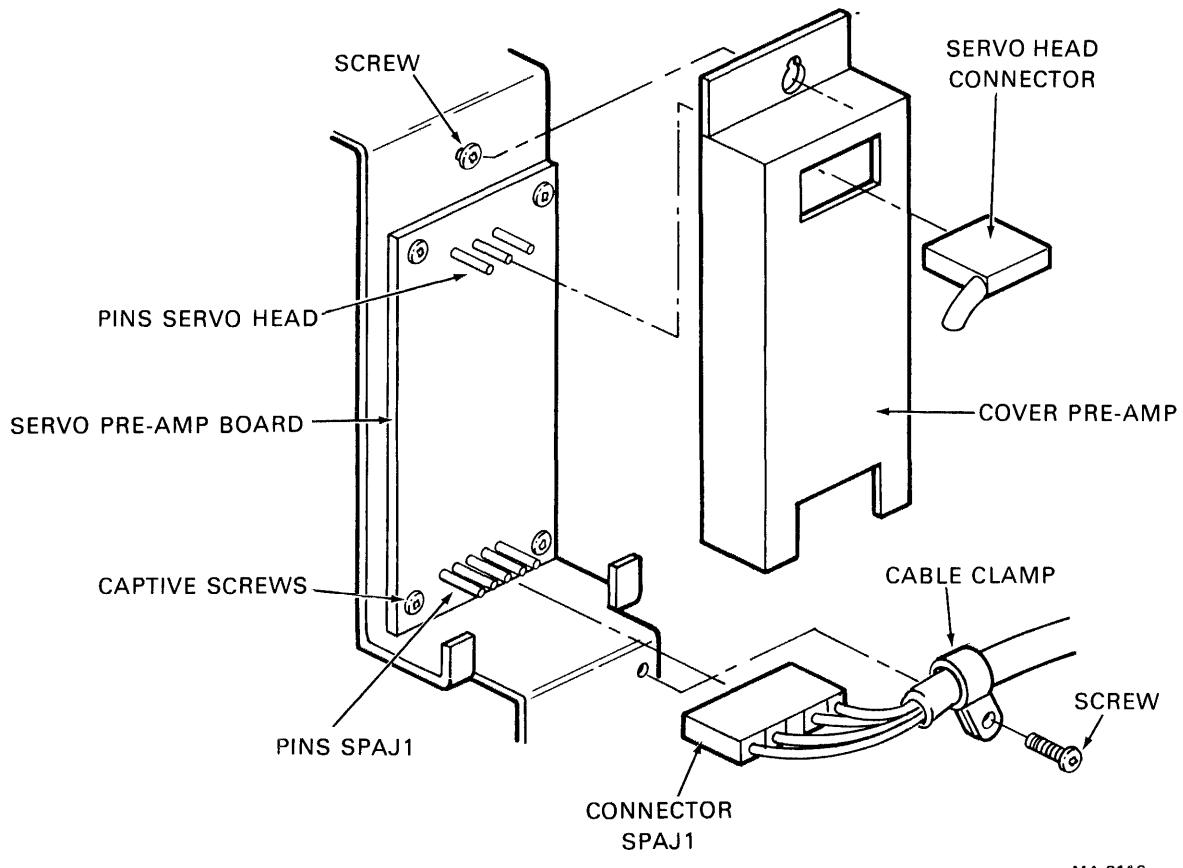


Figure 2-15 Servo Pre-Amp Assembly

3. Remove the cable clamp and disconnect the cable connector SPAJ1.
4. Remove the servo pre-amp cover by loosening the single Phillips pan head screw and lift the cover off. Early model machines have a squeeze-release fastener.
5. Loosen the four captive Phillips pan head\* screws and remove the pre-amp board.

#### Replacement Procedure

1. Replace the servo pre-amp board and tighten the four Phillips pan head captive screws (Figure 2-15).

2. Replace the servo pre-amp cover and tighten the single Vhillips pan head screw. Early model machines have a squeeze-release fastener.
3. Connect the cable connector SPAJ1 to the servo pre-amp board and install the cable clamp.
4. Connect the servo head connector.
5. Replace the rear cover (Paragraph 2.4.1).

#### **2.4.4 Circuit Breaker Assembly**

##### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.4.1).
2. Disconnect the ac line cord from the wall receptacle.
3. Swing the card nest down (open).
4. Disconnect the power transformer cable connector T1P1 from T1J1 (Figure 2-16).

**NOTE**

**On early model machines this does not have to be performed.**

5. Disconnect the two flat cable connectors XP9 and XP10 from the transition board.

**NOTE**

**On late model machines this does not have to be performed.**

6. Remove the two Phillips pan head screws holding the circuit breaker assembly to the rear chassis mount and remove from machine.
7. Disconnect line cord ground leads from the chassis ground stud.
8. Disconnect the ac distribution cable connector CBP1 from CBJ1.

##### **Replacement Procedure**

1. Connect the ac distribution cable connector CBP1 to CBJ1 (Figure 2-16).
2. Connect the line cord ground leads to the chassis ground stud.
3. Slide the circuit breaker assembly into the rear chassis mount and secure with two Phillips pan head screws.
4. Connect the power transformer cable connector T1P1 to T1J1.

**NOTE**

**On early model machines this does not have to be performed.**

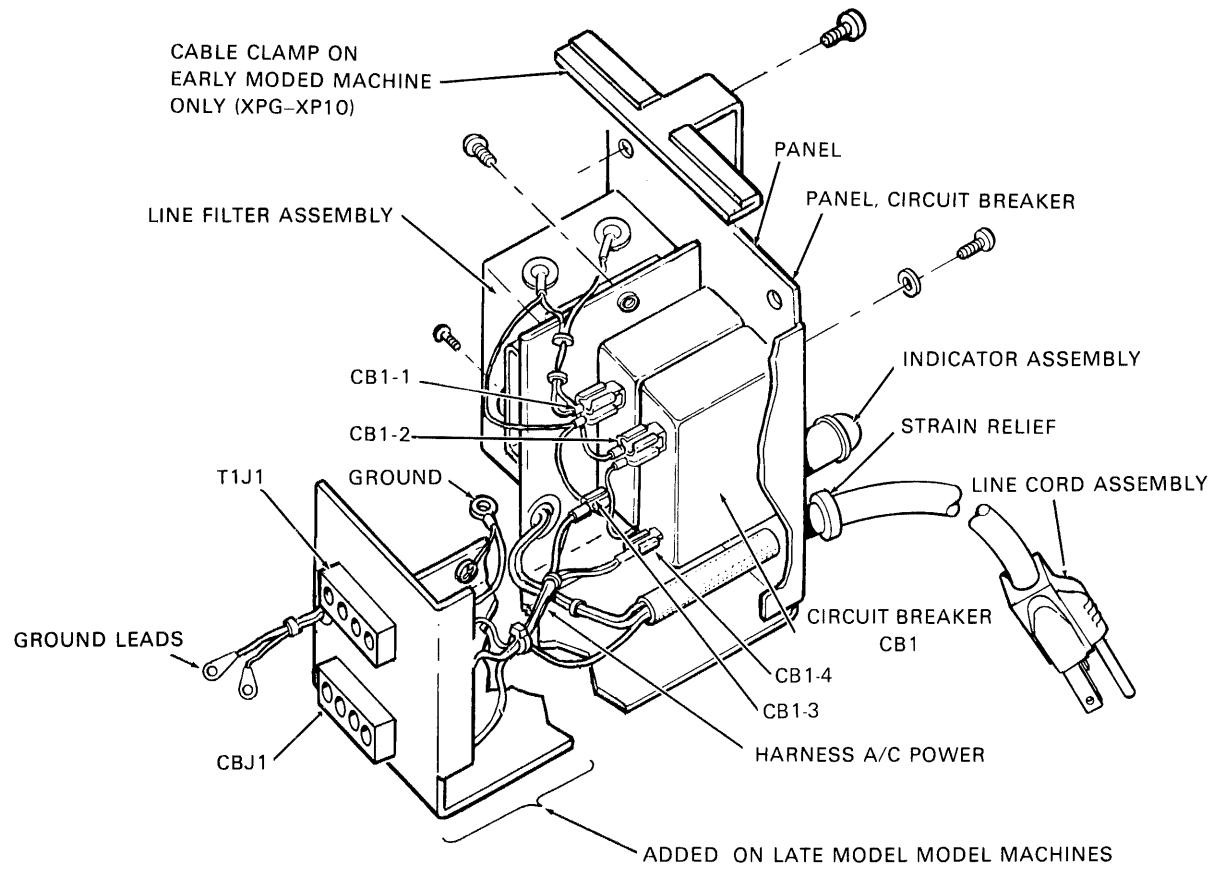


Figure 2-16 Circuit Breaker Assembly

5. Connect the two flat cable connectors XP9 and XP10 to the transition board.

**NOTE**

**On late model machines this does not have to be performed.**

6. Swing the card nest up (closed).
7. Connect the ac line cord to the wall receptacle.
8. Replace the rear cover (Paragraph 2.4.1).

#### **2.4.4.1 Circuit Breaker**

##### **Removal Procedure**

1. Disconnect the two quick-connect terminals CB1-3 and CB1-4 from the circuit breaker (Figure 2-16).
2. Disconnect the two quick-connect terminals CB1-1 and CB1-2 from the circuit breaker.
3. Remove the four Phillips pan head screws holding the circuit breaker to the panel and remove the circuit breaker.

##### **Replacement Procedure**

1. Place the circuit breaker into position on the panel and secure with the four Phillips pan head screws (Figure 2-16).
2. Connect the two quick-connect terminals from the ac power harness to CB1-3 (white lead) and CB1-4 (red lead) on the circuit breaker.
3. Connect the two quick-connect terminals from the line filter to CB1-1 (blue lead) and CB1-2 (brown lead) on the circuit breaker.

#### **2.4.4.2 Indicator Assembly**

##### **Removal Procedure**

1. Disconnect the quick-connect terminals from the line filter piggyback quick-connect terminals CB1-1 and CB1-2 on the circuit breaker (Figure 2-16).
2. Push the indicator assembly out of the panel.

##### **Replacement Procedure**

1. Feed the leads of the indicator assembly through the panel and push the body into place (Figure 2-16).
2. Connect the quick-connect terminals of the indicator assembly to the line filter piggyback quick-connect terminals CB1-1 and CB1-2 on the circuit breaker.

#### **2.4.4.3 Line Filter Assembly**

##### **Removal Procedure**

1. Disconnect the indicator assembly quick-connect terminals from the two piggyback quick-connect terminals of the line filter on CB1-1 and CB1-2 on the circuit breaker (Figure 2-16).
2. Disconnect the two quick-connect piggyback terminals CB1-1 and CB1-2 on the circuit breaker.
3. Disconnect the line cord assembly quick-connect terminal black or brown lead from the line filter terminal LF1-1.

**NOTE**

**On early model machines the line cord leads are soldered to the line filter terminals. Replace with quick-connect terminals.**

4. Disconnect the line cord assembly quick-connect terminal white or blue lead from the line filter terminal LF1-2.

**NOTE**

**On early model machines the line cord leads are soldered to the line filter terminals. Replace with quick-connect terminals.**

5. Disconnect the line cord assembly green/yellow ground lead from the line filter terminal LF1-3.

**NOTE**

**On early model machines the line cord green lead is soldered to the line filter terminal. Replace with a ring tongue terminal.**

6. Remove the two Phillips pan head screws holding the line filter to the panel and remove the line filter.

##### **Replacement Procedure**

1. Position the line filter on the panel and secure with two Phillips pan head screws (Figure 2-16).

**NOTE**

**On early model machines when replacing the line filter with No. 7013855-00, use special mounting plate no. 7418430-00.**

2. Connect the line cord assembly quick-connect terminal black or brown lead to the line filter terminal LF1-1.

**NOTE**

**On early model machines the line cord leads are soldered to the line filter terminals. Replace with quick-connect terminals.**

3. Connect the line cord assembly quick-connect terminal white or blue lead to the line filter terminal LF1-2.

**NOTE**

**On early model machines the line cord leads are soldered to the line filter terminals. Replace with quick-connect terminals.**

4. Connect the line cord assembly green/yellow lead ring tongue to the panel with a Phillips pan head screw.

**NOTE**

**On early model machines the line cord green lead is soldered to the line filter terminal. Replace with a ring tongue terminal.**

5. Connect the two quick-connect piggyback terminals of the line filter load side, black or brown, to CB1-1 and white or blue to CB1-2 on the circuit breaker.
6. Connect the two quick-connect terminals of the indicator assembly to the two quick-connect piggyback terminals CB1-1 and CB1-2 on the circuit breaker.

#### **2.4.4.4 Line Cord Assembly**

##### **Removal Procedure**

1. Disconnect the line cord assembly two quick-connect terminals from the line filter terminals LF1-1 and LF1-2 (Figure 2-16).
2. Disconnect the line cord assembly green ground lead from under the Phillips pan head screw on the panel.
3. Remove the line cord assembly from the panel.

##### **Replacement Procedure**

1. Feed the line cord assembly leads through the panel and attach the green/yellow ground lead to the panel with a Phillips pan head screw (Figure 2-16).
2. Feed the white or blue and black or brown leads through the grommet in the side of the panel.
3. Connect the line cord assembly white or blue lead quick-connect terminal to the LF1-2 terminal of the line filter.
4. Connect the line cord assembly black or brown lead quick-connect terminal to the LF1-1 terminal of the line filter.

**NOTE**

**If the line filters in this machine have line cord assembly leads soldered to line filter terminals, replace the line filter assembly.**

#### **2.4.4.5 AC Power Harness**

##### **Removal Procedure**

1. Disconnect the harness ac power quick-connect terminals from the circuit breaker terminals CB1-3 and CB1-4 (Figure 2-16).

##### **Replacement Procedure**

1. Connect the harness ac power quick-connect terminals to the circuit breaker terminals, white to CB1-3 and red to CB1-4 (Figure 2-16).

#### **2.4.5 Power Supply Assembly**

##### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.4.1).
2. Disconnect the ac distribution harness connector TB1-P1 from TB1-J1, located at the rear of the power supply chassis (Figure 2-11).

**NOTE**

**On early model machines there is no connector TB1-P1 located at the rear of the power supply.**

3. Swing the power supply plenum down (open).
4. Disconnect the power harness cable connectors A1P1, A1P2, and A1P3 from the electronic board.
5. Disconnect the cable connector A2P3 from A2J3, located at the lower end of the capacitor board, and remove from the power supply.
6. Disconnect the cable connector A2P1 from A2J1, located on the top of the capacitor board, and remove from the power supply.

**NOTE**

**On late model machines this connector A2P1 does not have to be removed.**

7. Loosen the four Phillips pan head screws holding the power supply chassis to the chassis, slide back and out of the machine.

##### **Replacement Procedure**

1. Place the power supply into position on the chassis; slide under the four Phillips pan head screws; and tighten the screws (Figure 2-11).
2. Route and connect the cable connector A2P1 to A2J1 located on the top of the capacitor board.

**NOTE**

**On late model machines this connector A2P1 does not have to be removed.**

3. Route and connect the cable connector A2P3 to A2J3 located at the lower end of the capacitor board.
4. Connect the power harness cable connectors A1P1, A1P2, and A1P3 to the electronic board.
5. Connect the ac distribution harness connector TB1-P1 to TB1-J1 located at the rear of the power supply.

**NOTE**

**On early model machines there is no connector TB1-P1 located at the rear of the power supply.**

6. Swing the power supply plenum up (closed).
7. Replace the rear cover (Paragraph 2.4.1).

#### **2.4.5.1 Brake Transformer Assembly**

##### **Removal Procedure**

1. Swing the plenum down (open).
2. Disconnect the two green quick-connect terminal leads from the rectifier terminals D1-1 and D1-2 (Figure 2-11).
3. Disconnect the blue quick-connect terminal lead from the rectifier terminal D1- (+).
4. Disconnect the white quick-connect terminal lead from the rectifier terminal D1 (-) on the double male adapter.
5. Disconnect the white/black and white/red quick-connect terminal lead from the rectifier terminal D1 (-) on the double male adapter.
6. Disconnect the black and red lead cable connector BCP1 from BCJ1.
7. Remove the two Phillips pan head screws holding the brake transformer assembly to the power supply chassis and remove the transformer assembly.

##### **Replacement Procedure**

1. Position the brake transformer assembly into the power supply chassis and secure with two Phillips pan head screws (Figure 2-11).
2. Connect the black and red lead cable connector BCP1 to BCJ1.
3. Connect the white/black and white/red quick-connect terminal lead to the rectifier terminal D1- (-) on the double male adapter.
4. Connect the white quick-connect terminal lead to the rectifier terminal D1- (-) on the double male adapter.
5. Connect the blue quick-connect terminal lead to the rectifier terminal D1- (+).
6. Connect the two green quick-connect terminal leads to the rectifier terminal D1-1 and D1-2.
7. Swing the plenum up (closed).

#### **2.4.5.2 Rectifier Single Phase**

##### **Removal Procedure**

1. Swing the plenum down (open).
2. Disconnect the two green quick-connect terminal leads from the rectifier terminals D1-1 and D1-2 (Figure 2-11).
3. Disconnect the blue quick-connect terminal lead from the rectifier terminal D1- (+).
4. Disconnect the double male adapter from the rectifier terminal D1- (-).
5. Remove the single Phillips pan head screw holding the rectifier to the power supply chassis and remove the rectifier.

##### **Replacement Procedure**

1. Apply heat sink compound to the mounting surface of the rectifier (Figure 2-11).
2. Position the rectifier into the power supply chassis and secure with a single Phillips pan head screw.
3. Connect the double male adapter to the rectifier terminal D1- (-).
4. Connect the blue quick-connect terminal lead to the rectifier terminal D1- (+).
5. Connect the two green quick-connect terminal leads to the rectifier terminals D1-1 and D1-2.
6. Swing the plenum up (closed).

#### **2.4.5.3 Electronic Board**

##### **Removal Procedure**

##### **NOTE**

**The power supply does not have to be removed from the machine to remove the electronic board.**

1. Remove the two Phillips pan head screws holding the power supply shield or air deflector to the plenum and remove (Figure 2-11).
2. Swing the plenum down (open).
3. Disconnect the power harness connectors A1P1, A1P2, and A1P3 from the electronic board.
4. Disconnect the electronic board to capacitor board cable connector A1P4 from A1J4 located on the electronic board.
5. Remove the three Phillips pan head screws holding the electronic board to the plenum.
6. Slide the electronic board out of the plenum.

### **Replacement Procedure**

1. Slide the new electronic board into the plenum (Figure 2-11).
2. Secure the electronic board to the plenum with three Phillips pan head screws.
3. Connect the electronic board to capacitor board cable connector A1P4 to A1J4 located on the electronic board.
4. Connect the power harness connectors A1P1, A1P2, and A1P3 to the electronic board.
5. Position the power supply shield or air deflector on the plenum and secure with two Phillips pan head screws.
6. Swing the plenum up (closed).

#### **2.4.5.4 Capacitor Board Assembly**

##### **Removal Procedure**

**NOTE**

**The power supply does not have to be removed from the machine to remove the capacitor board assembly.**

1. Swing the plenum down (open).
2. Disconnect the cable connector A2P1 from A2J1 located on the top of the capacitor board (Figure 2-11).
3. Disconnect the cable connector A2P3 from A2J3 located at the lower end of the capacitor board.
4. Disconnect the electronic board to capacitor board cable connector A2P2 from A2J2 located on the capacitor board and cut the cable tie.
5. Remove the single Phillips pan head screw holding the capacitor board bracket to the power supply chassis.
6. Lift the capacitor board assembly out of the power supply.

##### **Replacement Procedure**

1. Position the capacitor board assembly in the power supply chassis and secure with a single Phillips pan head screw. Make sure the A2P1 cable is behind the bracket (Figure 2-11).
2. Connect the cable connector A2P1 to A2J1 located on the top of the capacitor board.
3. Connect the cable connector A2P3 to A2J3 located at the lower end of the capacitor board.
4. Connect the electronic board to capacitor board cable connector A2P2 to A2J2 located on the capacitor board and secure with two cable ties.
5. Swing the plenum up (closed).

## **2.4.6 Spindle Brake Assembly**

### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.4.1).
2. Swing the card nest down (open).
3. Remove the two kep nuts holding the spindle brake assembly to the chassis floor (Figure 2-17).
4. Remove the green ground lead ring tongue from the ground stud.
5. Disconnect the cable connector BCP1 from BCJ1 located on the spindle brake assembly box.
6. Lift the spindle brake assembly off the ground studs and out of the machine.

### **Replacement Procedure**

1. Place the spindle brake assembly over the two ground studs on the chassis floor (Figure 2-17).
2. Place the green ground lead ring tongue over the ground stud and secure the spindle brake assembly in place with the two kep nuts.
3. Connect the cable connector BCP1 to BCJ1 on the spindle brake assembly box.
4. Swing the card nest up (closed).
5. Replace the rear cover (Paragraph 2.4.1).

## **2.4.6.1 Brake Transformer Assembly**

### **Removal Procedure**

1. Disconnect the two green quick-connect terminal leads from the rectifier terminals D1-1 and D1-2 (Figure 2-17).
2. Disconnect the single white/black and white/red quick-connect terminal lead from the double male adapter on the rectifier terminal D1- (-).
3. Disconnect the white quick-connect terminal lead from the double male adapter on the rectifier terminal D1- (-).
4. Disconnect the blue quick-connect terminal lead from the rectifier terminal D1- (+).
5. Remove the connector BCJ1 from the spindle brake assembly box.
6. Remove the two Phillips pan head screws and kep nuts holding the transformer assembly to the box.
7. Lift the transformer assembly out of the box.

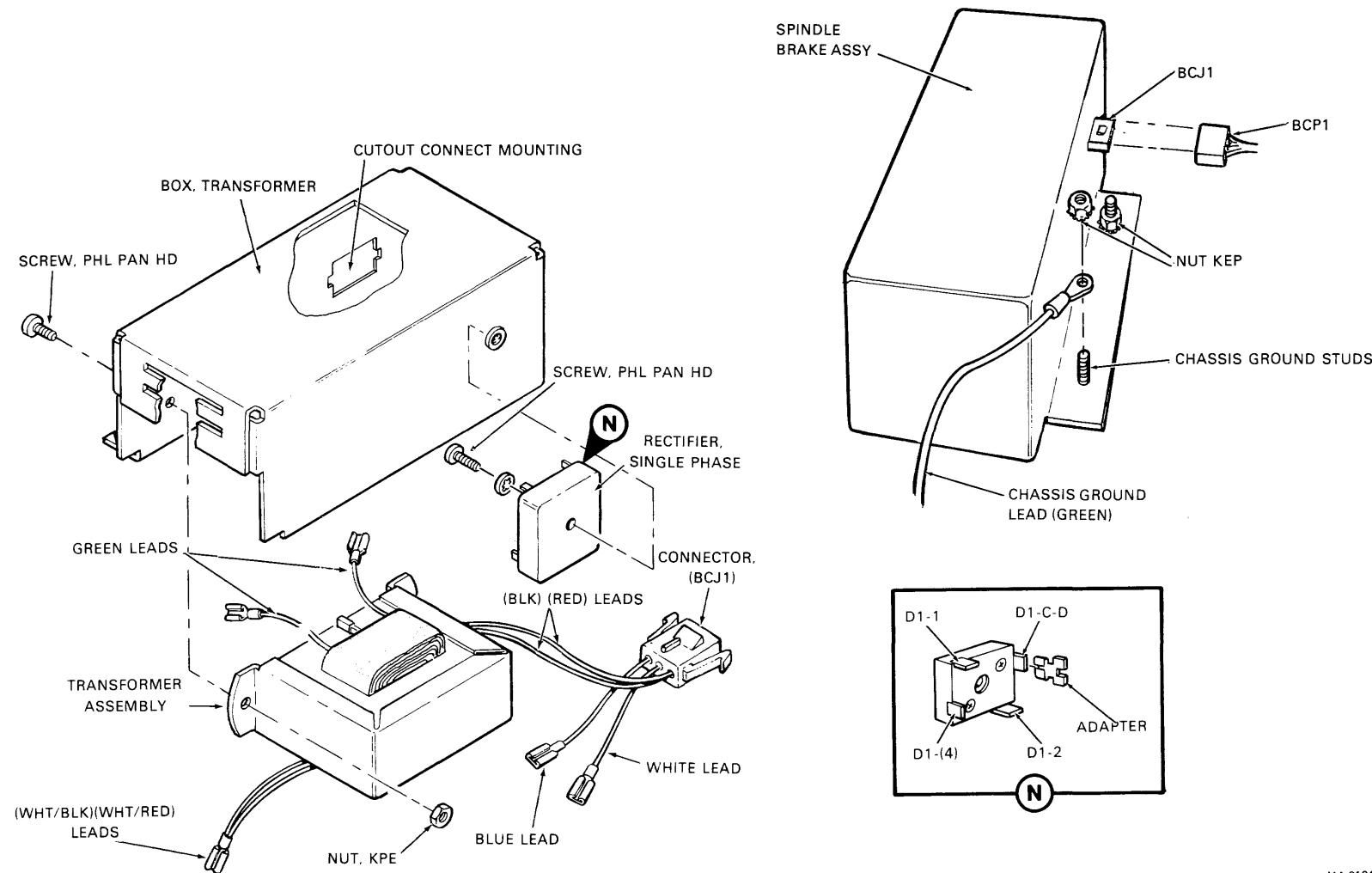


Figure 2-17 Spindle Break Assembly

### **Replacement Procedure**

1. Place the brake transformer into the spindle brake assembly box and secure with two philips pan head screws and kep nuts (Figure 2-17).
2. Insert the connector BCJ1 into the box.
3. Connect the two green quick-connect terminal leads to the rectifier terminals D1-1 and D1-2.
4. Connect the white/black and white/red quick-connect terminal lead to one terminal of the double male adapter on the rectifier terminal D1- (-).
5. Connect the white quick-connect terminal lead to the other terminal of the double male adapter on the rectifier terminal D1- (-).
6. Connect the blue quick-connect terminal lead to the rectifier terminal D1- (+).

#### **2.4.6.2 Rectifier Single Phase**

##### **Removal Procedure**

1. Disconnect the two green quick-connect terminal leads from the rectifier terminals D1-1 and D1-2 (Figure 2-17).
2. Disconnect the blue quick-connect terminal from the rectifier terminal D1- (+).
3. Disconnect the double male adapter from the rectifier terminal D1- (-).
4. Remove the connector BCJ1 from the spindle brake assembly box.
5. Insert a screwdriver through the connector cutout in the box and remove the Phillips pan head screw holding the rectifier to the box; remove the rectifier.

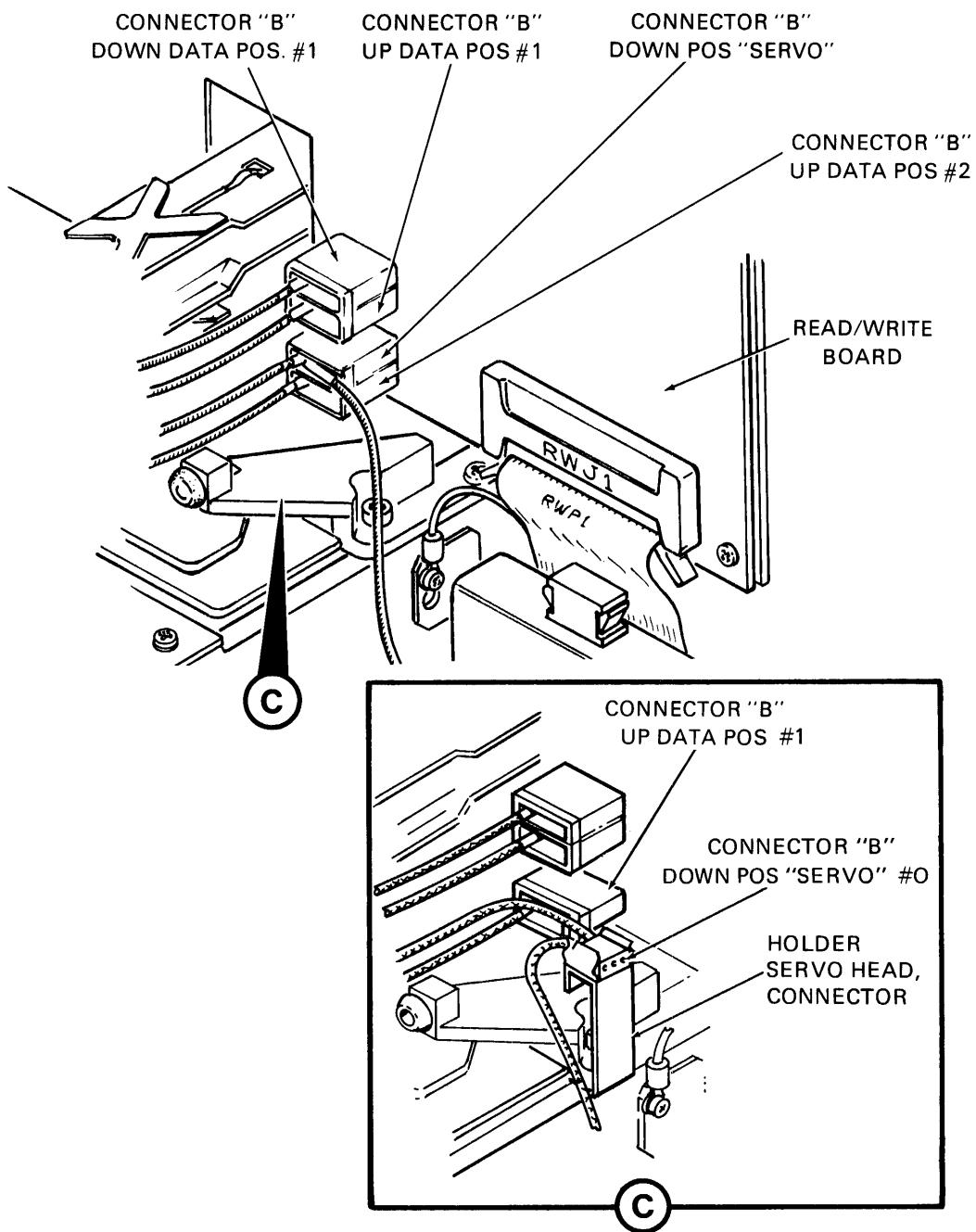
##### **Replacement Procedure**

1. Apply heat sink compound to the mounting surface of the rectifier.
2. Position the rectifier into the box and secure with a Phillips pan head screw (Figure 2-17).
3. Connect the two green quick-connect terminal leads to the rectifier terminals D1-1 and D1-2.
4. Connect the white/black and white/red quick-connect terminal lead to one terminal of the double male adapter on the rectifier terminal D1- (-).
5. Connect the white quick-connect terminal lead to the other terminal of the double male adapter on the rectifier terminal D1- (-).
6. Connect the blue quick-connect terminal lead to the rectifier terminal D1- (+).

## 2.4.7 Read/Write Heads

### Removal Procedure

1. Remove the rear cover (Paragraph 2.4.1).
2. Disconnect the read/write head connectors from the read/write board (Figure 2-18).



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Figure 2-18 Read/Write Head Connectors

3. Install the head insertion and removal tool on the head.
4. Loosen the captive socket head cap screw holding the head to the carriage and remove the read/write head.
5. Repeat steps 3 and 4 as required.

**CAUTION**

**When installing the head insertion and removal tool,  
make sure the carriage does not tip beyond the point  
where the heads fall out of the cam guide.**

#### **Replacement Procedure**

1. Place the new read/write head into the insertion and removal tool and carefully install the read/write head into position (Figures 2-19 and 2-20).
2. Torque the captive socket head cap screw to five inch-pounds.
3. Remove the head insertion and removal tool.
4. Connect the read/write head connector to the read/write board.
5. Perform the head alignment procedure (Paragraph 3.4).

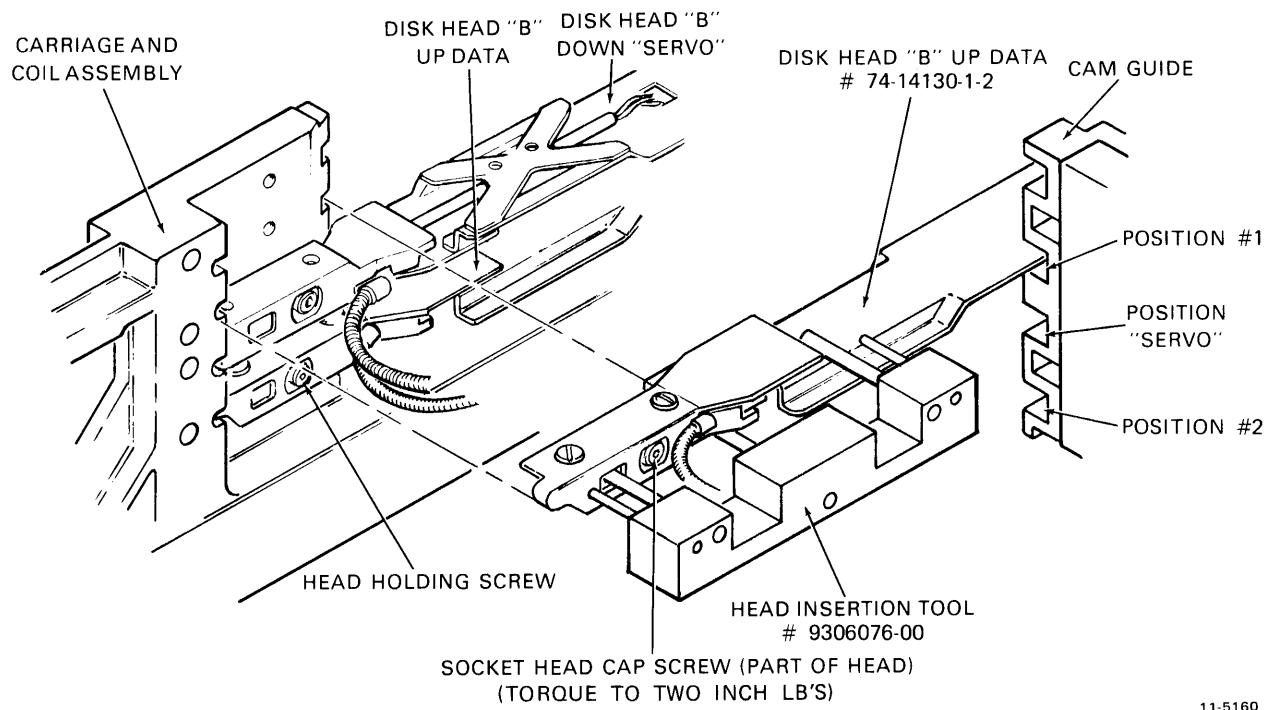
#### **2.4.8 Servo Head**

##### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.4.1).
2. Disconnect the servo head connector from the read/write board or from the servo head connector holder (Figure 2-21).
3. Disconnect the servo head connector from the servo pre-amp board.
4. Install the head insertion and removal tool on the servo head.
5. Loosen the captive socket head cap screw holding the servo head to the carriage and carefully remove the servo head.

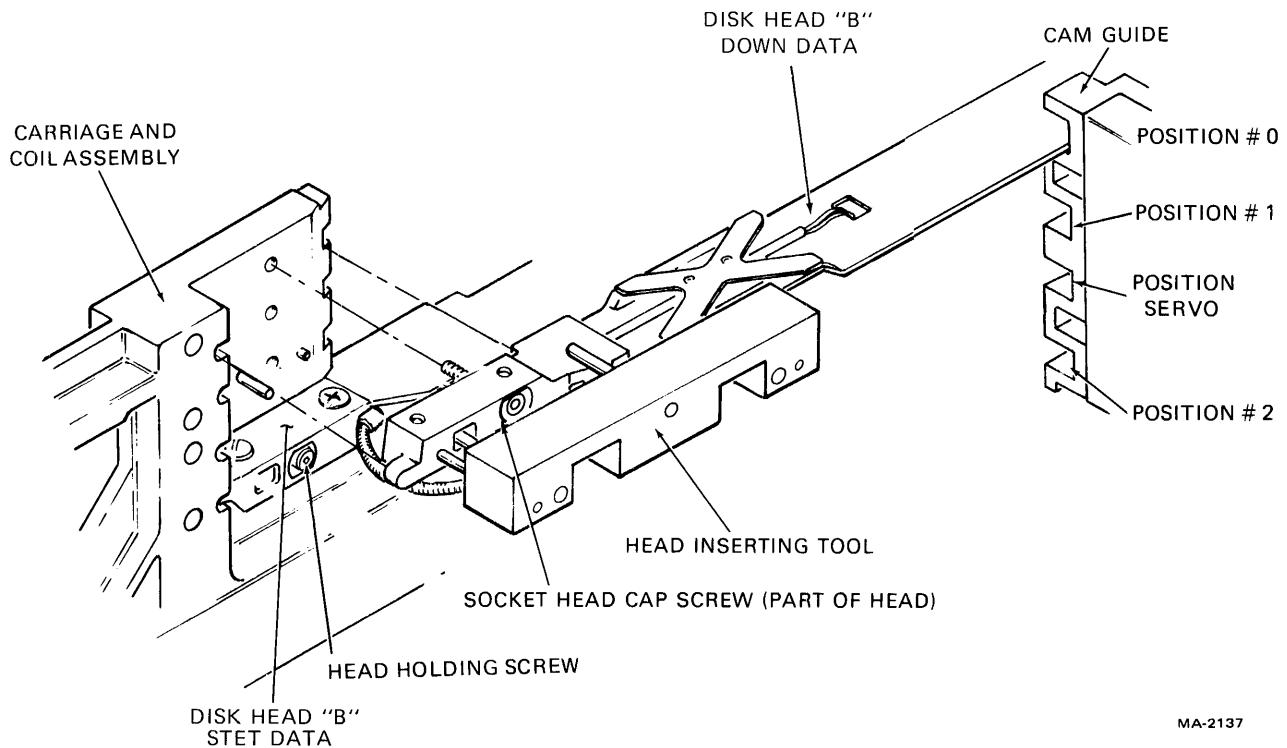
**CAUTION**

**When installing the head insertion and removal tool,  
make sure the carriage does not tip beyond the point  
where the heads will fall out of the cam guide.**



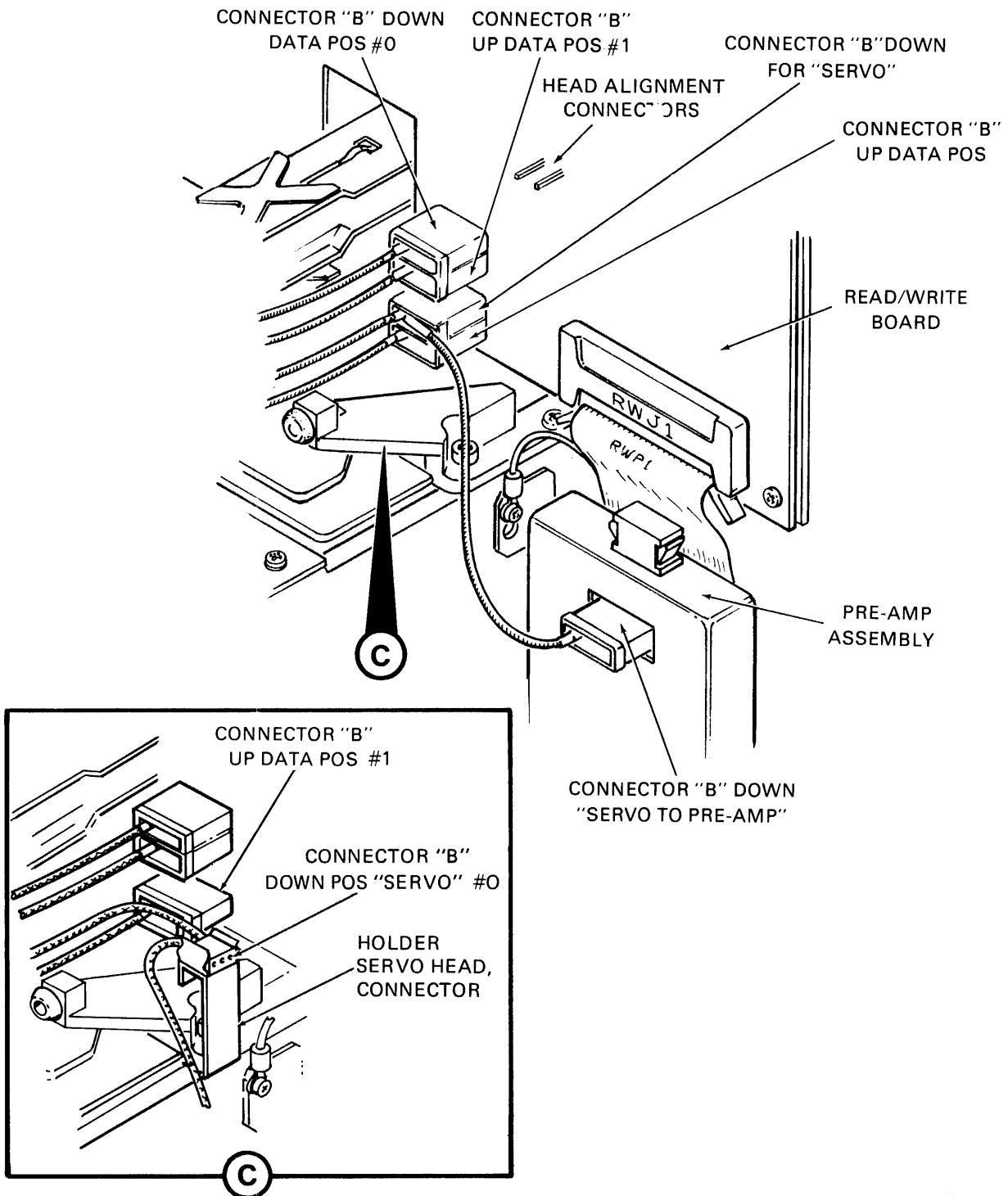
11-5160

Figure 2-19 Insertion Tool Position Up Data Heads



MA-2137

Figure 2-20 Insertion Tool Position Down Data Heads

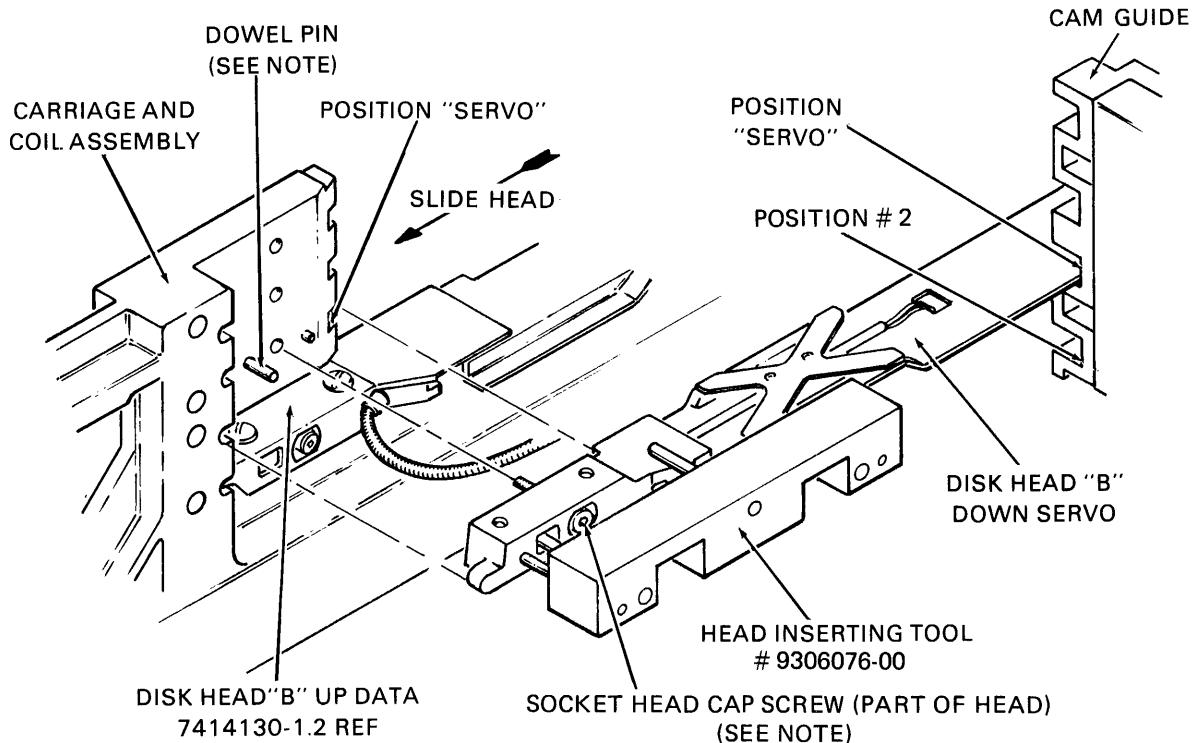


MA-2126

Figure 2-21 Servo Head Position

## Replacement Procedure

1. Place the new servo head into the insertion and removal tool with the dowel pin located all the way to the rear of the slot in the head (Figure 2-22).



**NOTE:**

AFTER INSERTING HEAD INTO SERVO POSITION OF CARRIAGE  
AND COIL ASSEMBLY AND CAM GUIDE, SLIDE HEAD BACK  
AGAINST DOWEL PIN AND TORQUE TO FIVE INCH LB's.

11-5159

Figure 2-22 Insertion Tool Position Servo (Down) Head

2. Install the servo head into the carriage servo position, sliding the servo head all the way back against the dowel pin in the carriage, toward the coil.
3. Torque the captive socket head cap screw to five inch-pounds and remove the head insertion and removal tool.
4. Connect the servo head connector to the read/write board or connector holder (middle connector) on the cable.
5. Connect the servo head connector to the servo pre-amp board. (End connector on the cable.)
6. Perform the head alignment procedures (Paragraph 3.4).

**NOTE**

If at any time the servo head is moved or replaced,  
head alignment procedures must be performed.

#### **2.4.9 Read/Write Board**

##### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.4.1).
2. Disconnect the two flat cable connectors RWP1 and RWP2 on the read/write board (Figure 2-23).
3. Disconnect the read/write and servo head connectors from the read/write board.
4. Loosen the six Phillips pan head captive screws holding the read/write board to the mounting bracket and remove the read/write board.

##### **Replacement Procedure**

1. Position the read/write board and secure the six Phillips pan head captive screws. Make sure the insulator is in place and the ground screw is making a good contact with the ground plain (Figure 2-23).
2. Connect the two flat cable connectors RWP1 and RWP2 to the read/write board.
3. Connect the read/write and servo head connectors to the read/write board.
4. Replace the rear cover (Paragraph 2.4.1).

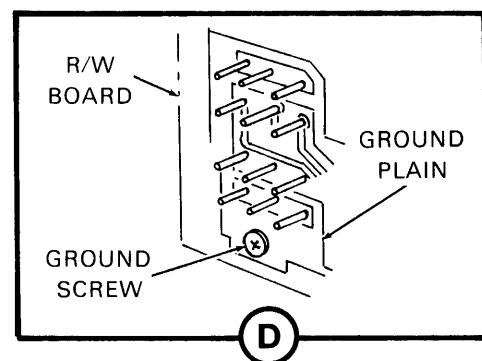
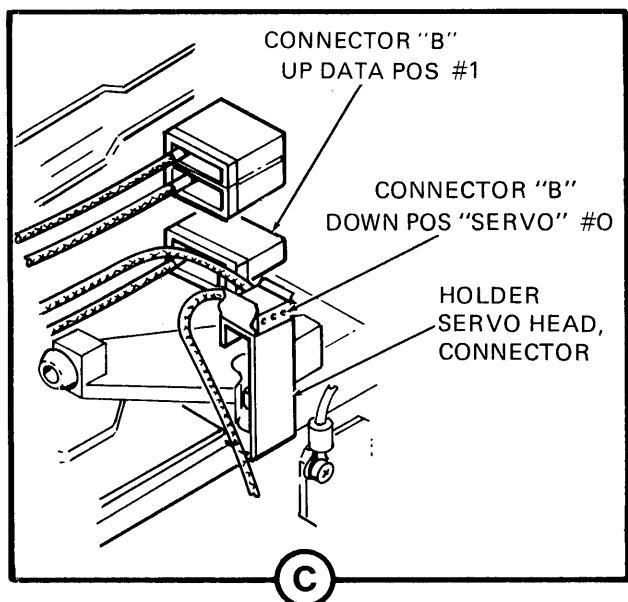
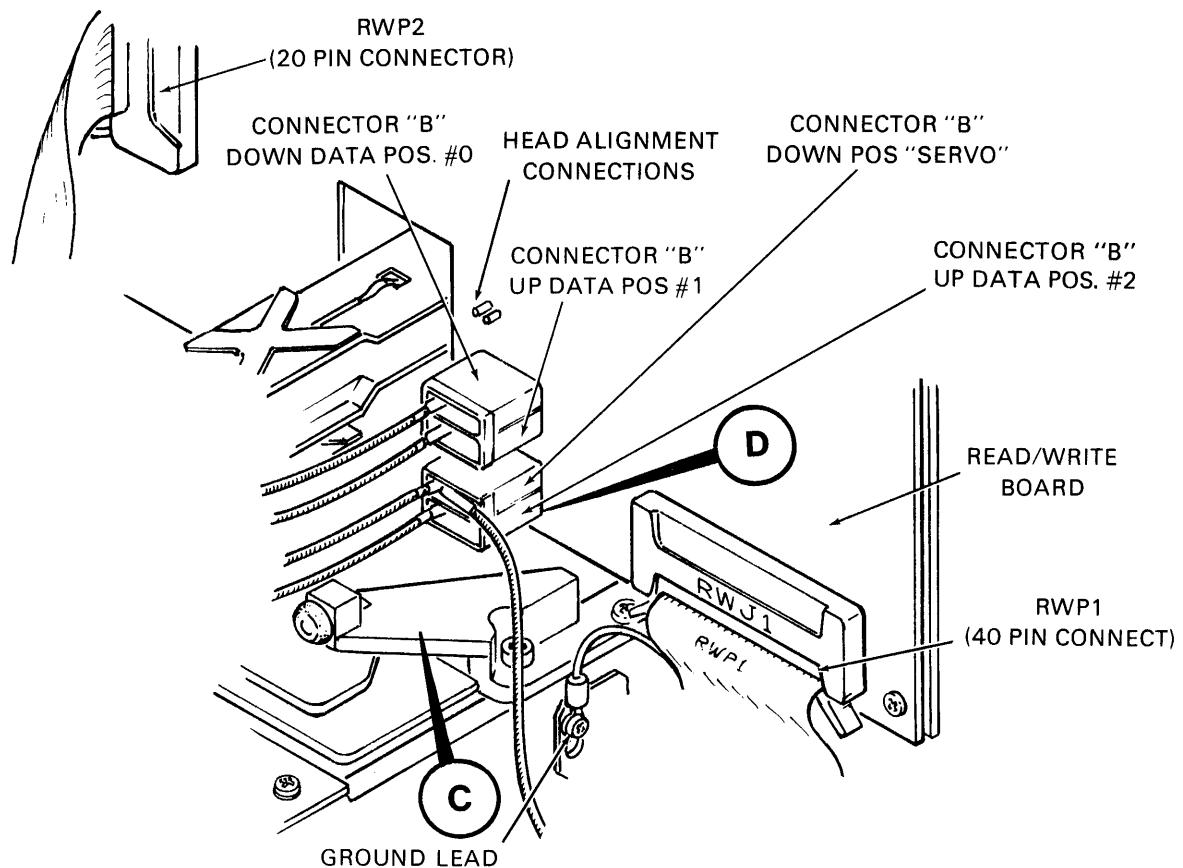
#### **2.4.10 Home Lock Solenoid Assembly**

##### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.4.1).
2. Some early machines have the home lock solenoid ground wire mounted under one of the tachometer magnet assembly mounting screws. If this applies to this machine, remove the ground wire now (Figure 2-26).
3. Place an elastic band around the carriage and magnet housing to prevent the carriage from moving forward once the home lock solenoid assembly has been removed.
4. Disconnect the home lock cable connector XP7 from XJ7 located on the feed-through connector or on the transition board (Figure 2-5).
5. Disconnect the single green lead connector E1P1 from E1J1 or M2S1-2 on the home lock solenoid assembly switch from the battery pack assembly (Figure 2-24).
6. Remove the two Phillips pan head screws holding the home lock solenoid assembly to the baseplate.
7. Release the latch detent on the home lock solenoid assembly and slide the assembly toward the magnet housing assembly and out of the machine.

##### **CAUTION**

**When removing the mounting screws, do not scratch  
the glass shutter.**



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Figure 2-23 Read/Write Board Area

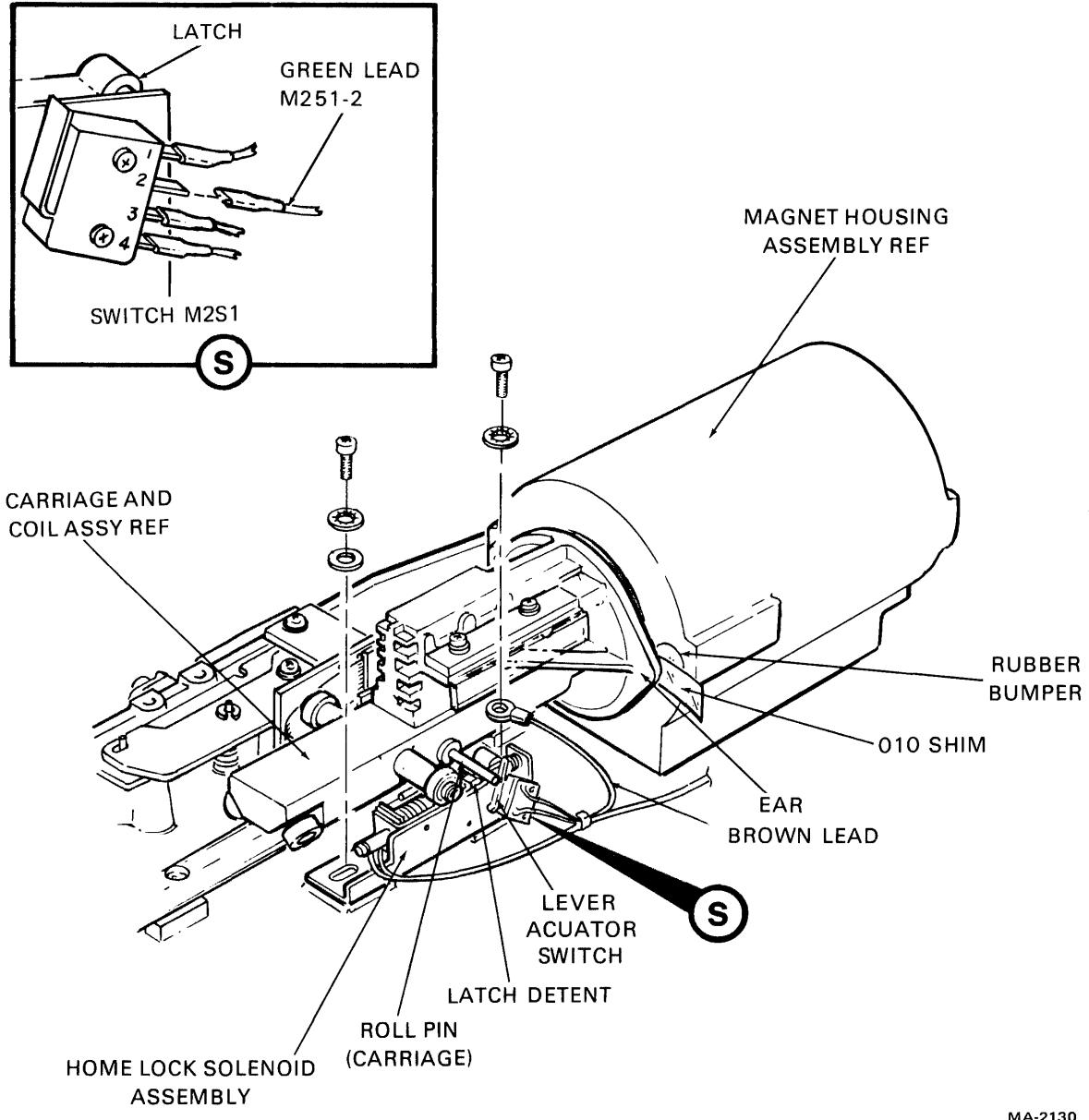
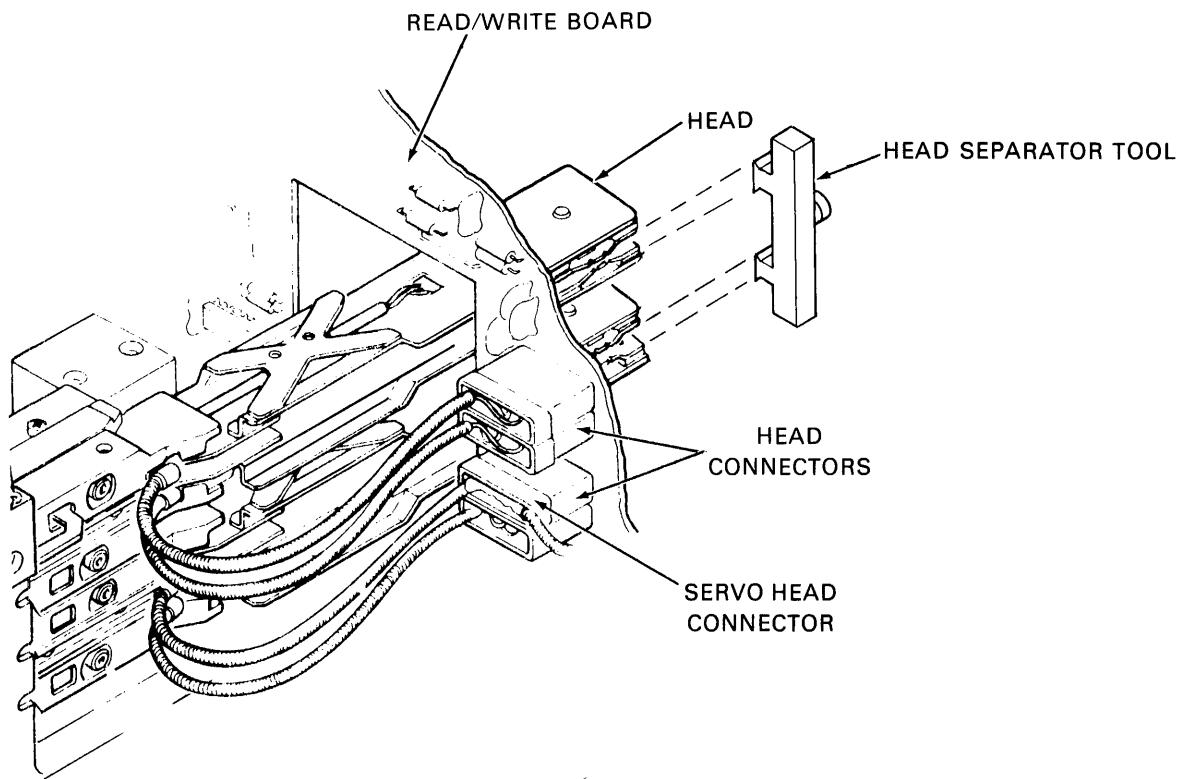


Figure 2-24 Homelock Assembly



MA-2123

Figure 2-25 Head Separator Tool

### Replacement Procedure

1. Slide the home lock solenoid assembly into position and secure with two Phillips pan head screws making sure that the ground wire is under the front screw (Figure 2-24).
2. Some early machines have the home lock solenoid assembly ground wire under one of the tachometer magnet assembly mounting screws. If this applies to this machine, replace the ground wire now.
3. Connect the home lock solenoid assembly cable connector XP7 to XJ7 located on the feed-through connector or on the transition board (Figure 2-5).
4. Connect the single green lead E1P1 to E1J1 or M2S1-2 on the home lock solenoid assembly from the battery pack assembly (Figure 2-24).
5. Remove the elastic band around the carriage and magnet housing assembly.
6. Loosen the two Phillips pan head screws holding the home lock solenoid assembly to the baseplate.
7. Move the carriage and coil assembly, with the roll pin engaged in the detent latch of the home lock solenoid assembly, and place a 0.010 inch shim between the rubber bumper and the carriage to achieve the 0.010 inch clearance between the rubber bumper and the carriage.

8. Tighten the two Phillips pan head screws, remove the shim, and:
  - a. Check to see that the home lock switch is activated.
  - b. Place a cartridge into the machine and power up, to make sure that the solenoid will release the latch and load heads.
9. Replace the rear cover (Paragraph 2.4.1).

#### **2.4.11 Tachometer Magnet Assembly**

##### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.4.1).
2. Swing the card nest down (open).
3. Disconnect the single green lead connector E1P1 from E1J1 or M2S1-2 on the home lock solenoid assembly switch from the battery pack assembly (Figure 2-24).
4. Push the carriage assembly toward the spindle approximately one inch and install the head separator tool (DIGITAL 9306171-00) (Figure 2-25).
5. Remove the two Phillips pan head screws holding the tachometer magnet assembly to the baseplate. Some early machines have the home lock solenoid assembly ground wire under one of the screws (Figure 2-26).

##### **Replacement Procedure**

1. Place the tachometer magnet assembly into position on the baseplate and secure with two Phillips pan head screws. On some early machines the home lock solenoid assembly ground wire is under one of the screws; replace it at this time (Figure 2-26).
2. Loosen the two Phillips pan head screws holding the tachometer magnet assembly to the baseplate, with the magnet inside the bobbin. Adjust the tachometer magnet assembly in or out until there is an equal amount of clearance on either side of the magnet. Move the carriage assembly the length of the magnet to make sure the clearance is equal, and tighten the two Phillips pan head screws.
3. Loosen the two Phillips pan head screws holding the flexstrip assembly to the carriage, move the board up or down to center the bobbin on the tachometer magnet assembly, and tighten the two Phillips pan head screws.
4. Move the carriage to home position and remove the head separator tool (Figure 2-25).
5. Connect the single green lead connector E1P $\pm$  to E1J1 or M2S1-2 to the home lock solenoid assembly switch from the battery pack assembly (Figure 2-24).
6. Swing the card nest up (closed).
7. Replace the rear cover (Paragraph 2.4.1).

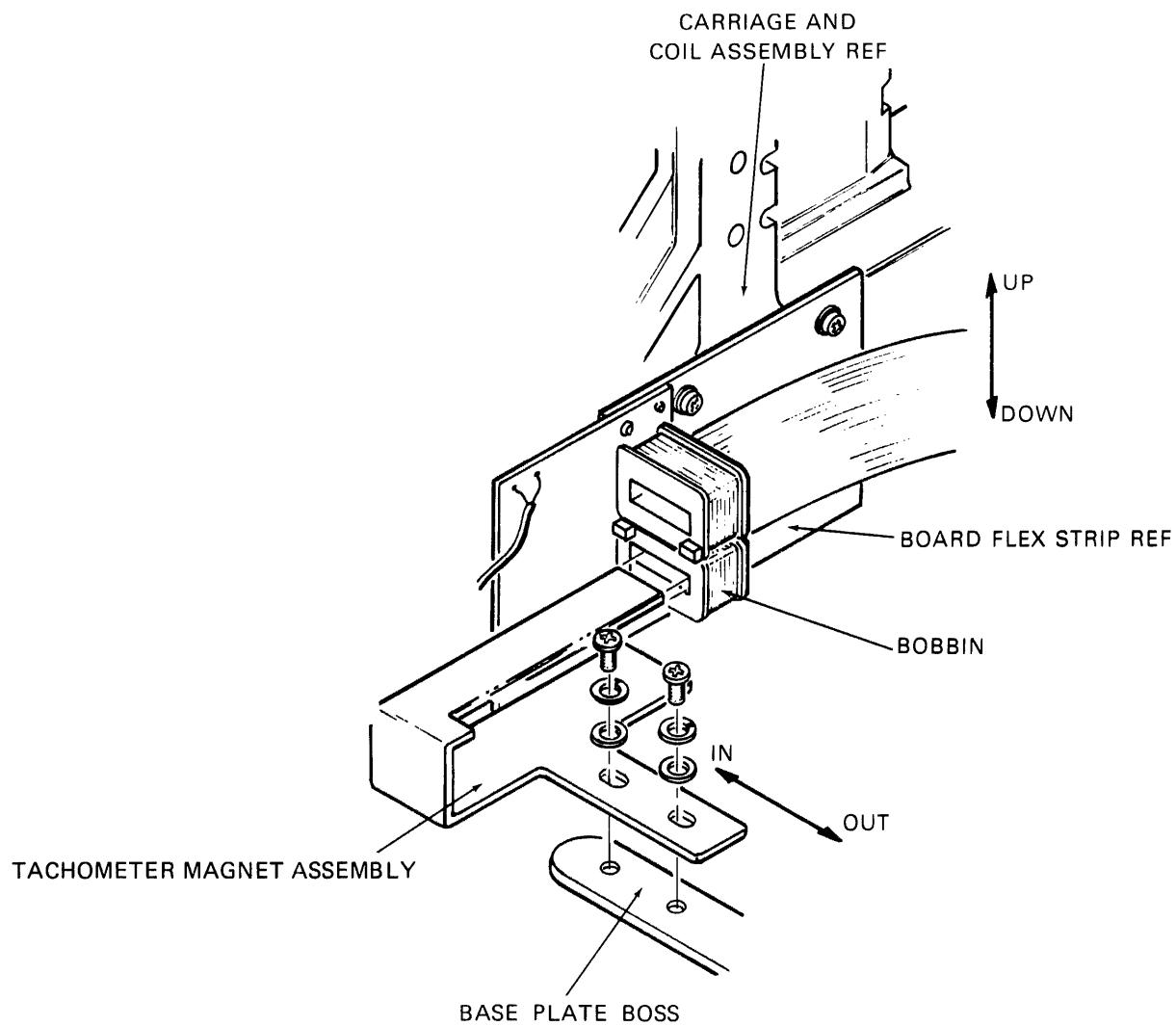
## **2.4.12 Flexstrip Assembly**

### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.4.1).
2. Remove the tachometer magnet assembly (Paragraph 2.4.11).
3. Disconnect the liner motor power cable connector M2P1 from M2J1 on the CA bracket (Figure 2-14).
4. Disconnect the linear motor signal cable connector XP8 from XJ8 on the feed-through connector or the transition board (Figure 2-5).
5. Disconnect the single green lead connector E1P1 from E1J1 or M2S1-2 on the home lock solenoid assembly switch from the battery pack assembly (Figure 2-24).
6. Push the carriage assembly toward the spindle approximately one inch and install the head separator tool (DIGITAL 9306171-00) (Figure 2-25).
7. Unsolder the two coil leads from the flexstrip assembly and mark one of the leads so that the polarity will be correct on reinstallation (Figure 2-27).
8. Remove the two Phillips pan head screws holding the flexstrip assembly to the carriage and coil assembly.
9. Remove the two Phillips pan head screws holding the cable to the baseplate and bring the cable to the same side as the flexstrip.
10. Remove the two Phillips pan head screws holding the flexstrip bracket to the baseplate and remove the flexstrip assembly.

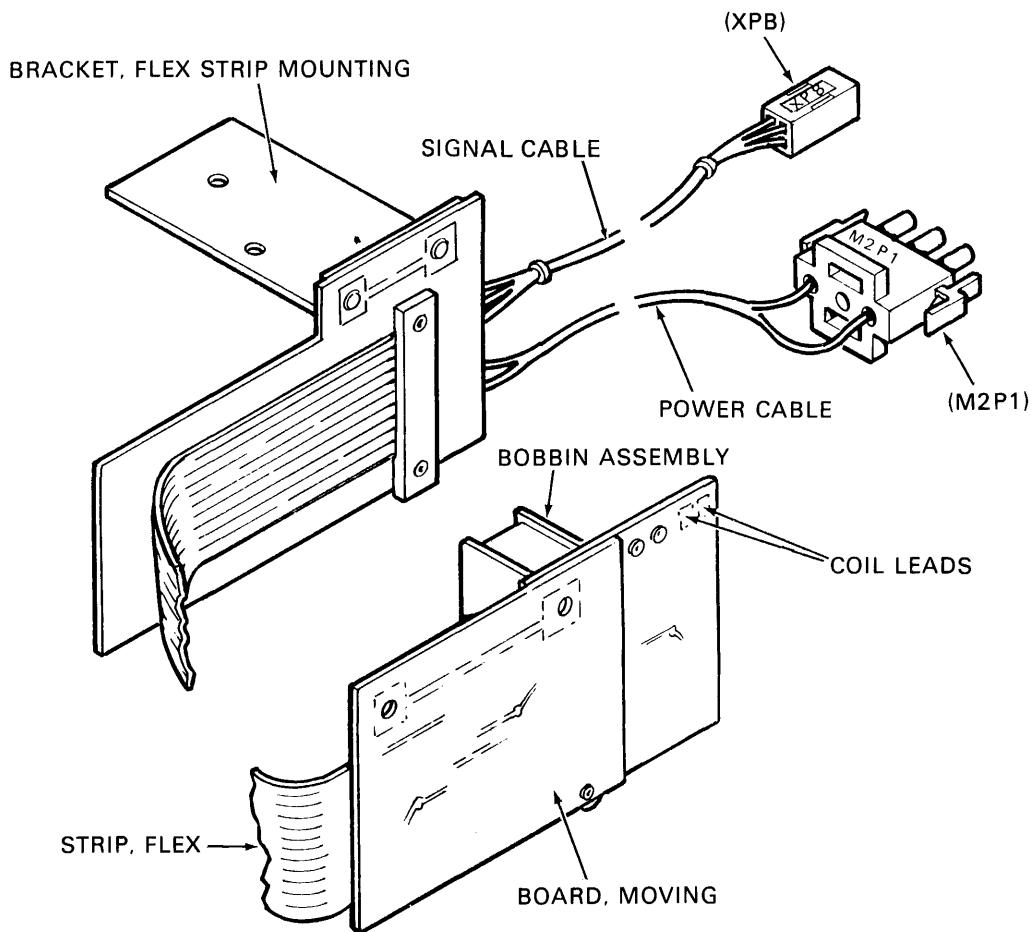
### **Replacement Procedure**

1. Position the flexstrip assembly in the baseplate and mount the bracket to the baseplate with two Phillips pan head screws. (Figure 2-27).
2. Mount the flexstrip assembly to the carriage with two Phillips pan head screws.
3. Solder the two coil leads to the flexstrip, making sure that the polarity is the same as the original assembly.
4. Route and connect the linear motor power cable connector M2P1 to M2J1 on the CA bracket (Figure 2-14).
5. Route and connect the linear motor signal cable connector XP8 to XJ8 on the feed-through connector or the transition board (Figure 2-5).
6. Check for a possible short in the coil. The forward terminal closest to the spindle should measure approximately 4 ohms to ground. The rear terminal is connected to ground.
7. Replace the tachometer magnet assembly (Paragraph 2.4.11).



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Figure 2-26 Tachometer Magnet Assembly



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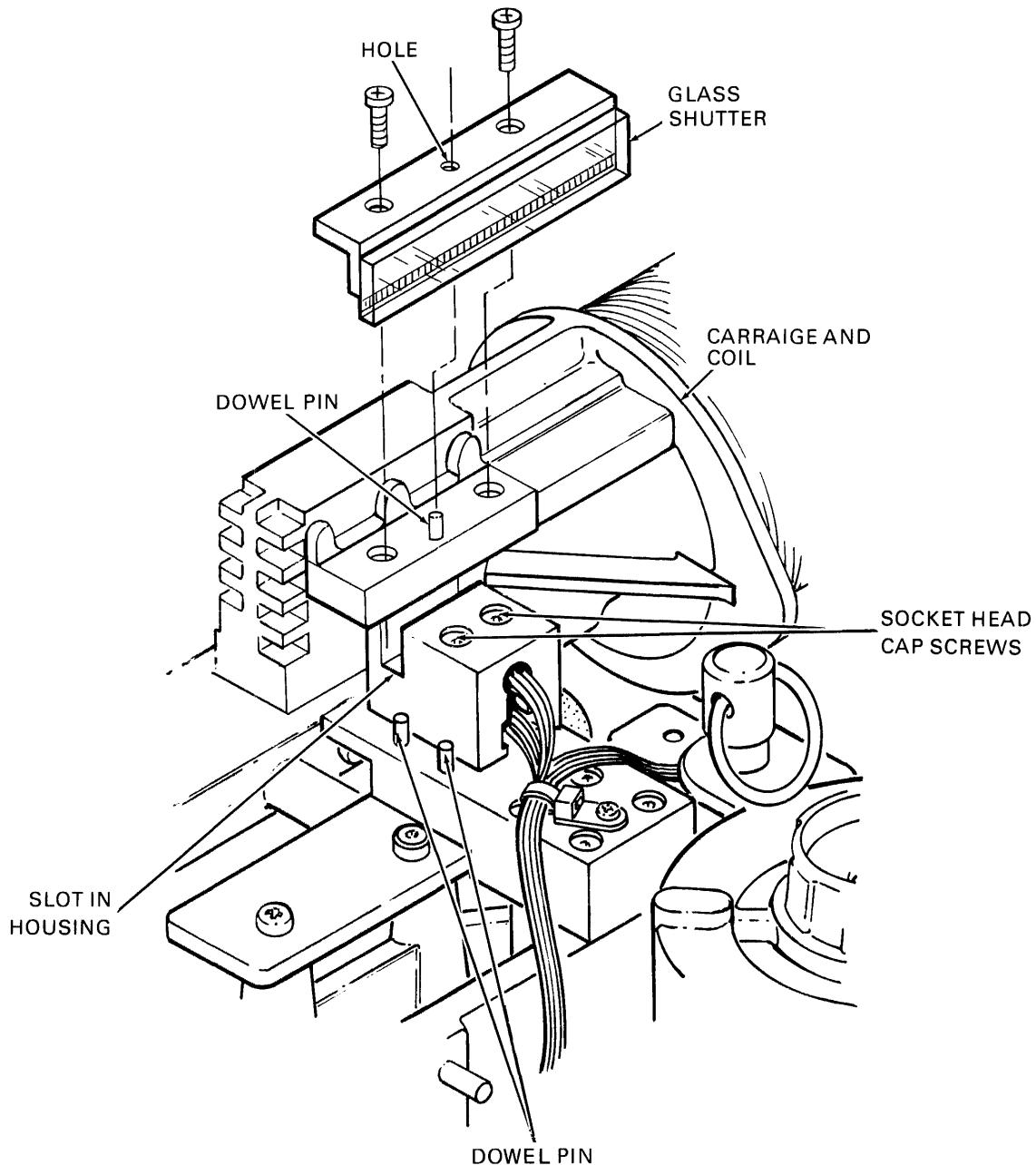
Figure 2-27 Flexstrip Assembly

8. Loosen the two Phillips pan head screws holding the tachometer magnet assembly to the baseplate. With the magnet inside the bobbin, adjust the tachometer magnet assembly in or out until there is equal amount of clearance on either side of the magnet. Move the carriage assembly the length of the magnet to make sure the clearance is equal, and tighten the two pan head screws (Figure 2-26).
9. Loosen the two Phillips pan head screws holding the flexstrip assembly to the carriage, move the board up or down to center the bobbin on the tachometer magnet assembly, and tighten the two Phillips pan head screws (Figure 2-27).
10. Move the carriage to home position and remove the head separator tool (Figure 2-25).
11. Connect the single green lead connector E1P1 to E1J1 or M2S1-2 on the home lock solenoid assembly switch from the battery pack assembly (Figure 2-24).
12. Swing the card nest up (closed).
13. Replace the rear cover (Paragraph 2.4.1).

## 2.4.13 Glass Shutter Assembly

### Removal Procedure

1. Remove the rear cover (Paragraph 2.4.1).
2. Remove the two Phillips pan head screws holding the glass shutter assembly to the carriage and coil assembly (Figure 2-28).
3. Lift the glass shutter assembly from the carriage and coil assembly.



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Figure 2-28 Glass Shutter Assembly

## **Replacement Procedure**

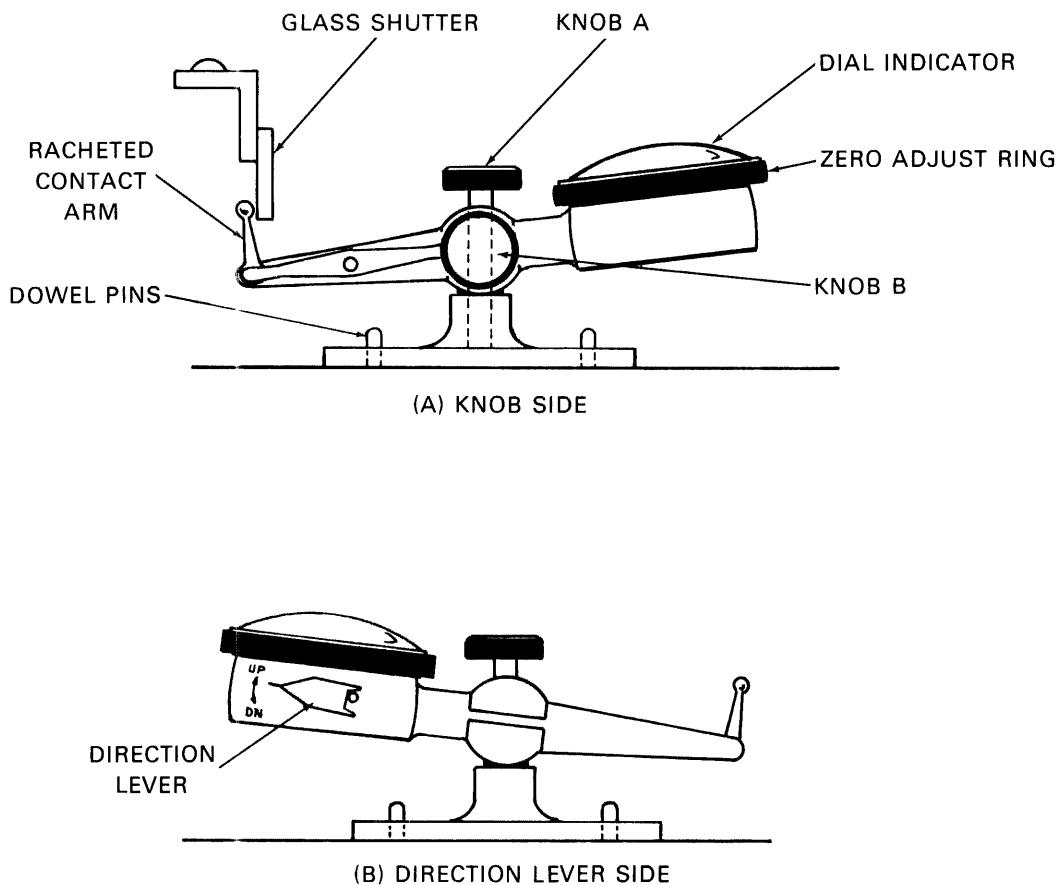
1. Remove the two Allen head screws holding the transducer to the baseplate and set the transducer aside (Figure 2-28).
2. Place the shutter assembly over the guide pin in the carriage and coil assembly (Figure 2-28).
3. Install the two Phillips head holding screws but do not tighten them.
4. Perform the glass shutter alignment.
  - a. Disconnect the single green lead connector E1P1 from E1J1 or M2S1-2 on the home lock solenoid assembly switch from the battery pack assembly (Figure 2-24).
  - b. Remove the transducer block.
  - c. With the head separator tool in place, push the carriage assembly toward the spindle (Figure 2-25).
  - d. The following steps will vary depending on which glass shutter alignment fixture is used. If the older fixture is used, begin at step e. If the new fixture (No. 93-06240) is used, begin at Step j.

### **NOTE**

**If both fixtures are available, it is recommended that the newer one be used. Do not use the old fixture unless the newer fixture is unavailable.**

- e. Assemble the glass shutter alignment fixture onto the transducer mounting block, locating the slot in the fixture around the two dowel pins (Figure 2-28). Assemble the screw clamp as shown. Loosen the two screws holding the shutter.
- f. Move the carriage and coil assembly so that the dowel pin on the glass is in line with the contact of the dial indicator.
- g. Set the dial indicator to zero by moving the fixture in or out and clamp in place.
- h. Move the carriage and coil assembly so that the contact of the dial indicator is at one end of the glass shutter. Move the glass shutter in or out until a zero reading is obtained and tighten the screw lightly.
- i. Move the carriage and coil assembly back and forth, checking the dial indicator movement. The total indicator reading should not vary more than 0.001 inch. Adjust the shutter until the proper reading is obtained and tighten both screws. Recheck the alignment after tightening the screws. Proceed to step q.
- j. Assemble the glass shutter alignment fixture (No. 93-06240) onto the transducer mounting block, locating the holes in the fixture around the two dowel pins (Figure 2-29). Tighten down screw knob A to lock the fixture in place. Loosen the two screws holding the glass shutter.

- k. Move the carriage and coil assembly back away from the spindle area to allow the contact arm of the dial indicator to be positioned behind the inside surface of the glass shutter as shown (Figure 2-29). The contact arm pivots in a ratchet to allow for adjustments.
- l. Move the carriage and coil assembly so that the dowel pin on the glass is in line with the contact arm of the dial indicator.
- m. The direction lever on the side of the dial gauge must be set in the upward position to allow the gauge to read when contact is made with the glass (Figure 2-29).



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Figure 2-29a Glass Shutter Alignment Fixtures

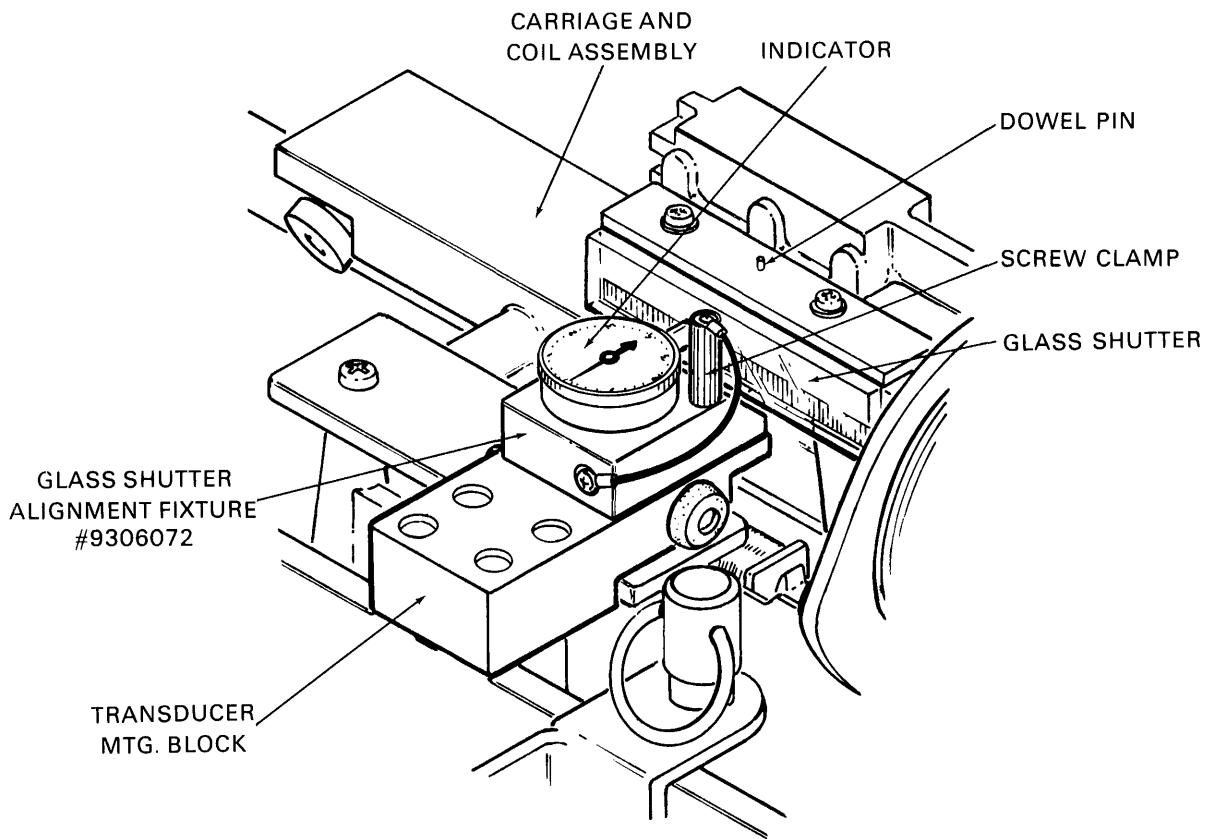


Figure 2-29b Glass Shutter Alignment Fixtures - Early Version

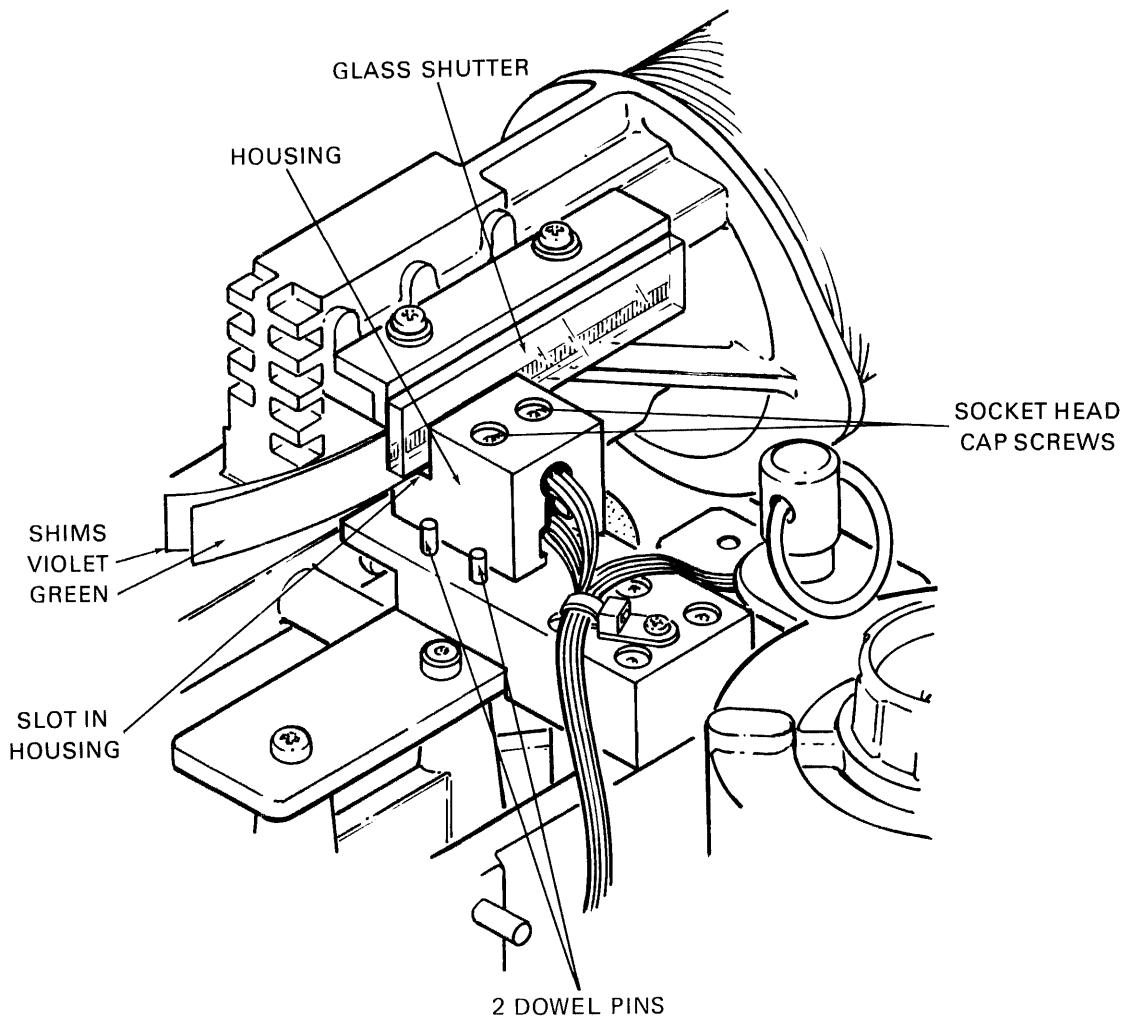
- n. Loosen knob B and pivot the indicator arm slightly until the glass shutter touches the dial contact arm and the dial pointer is at 0.015. Tighten knob B with the indicator in this position.
  - o. Twist the zero adjust ring until the zero on the gauge sits directly under the dial pointer.
  - p. Move the carriage and coil assembly back and forth, checking the dial indicator movement. The total indicator reading should not vary more than 0.001 inch. Adjust the shutter until the proper reading is obtained and tighten both screws. Recheck the alignment after tightening both screws.
  - q. Remove the alignment fixture.
5. Perform the velocity transducer assembly replacement procedure (Paragraph 2.4.14).

## 2.4.14 Velocity Transducer Assembly, Two Dowel Version

**NOTE**  
Single dowel version of velocity transducers assembly  
is located in Appendix D.

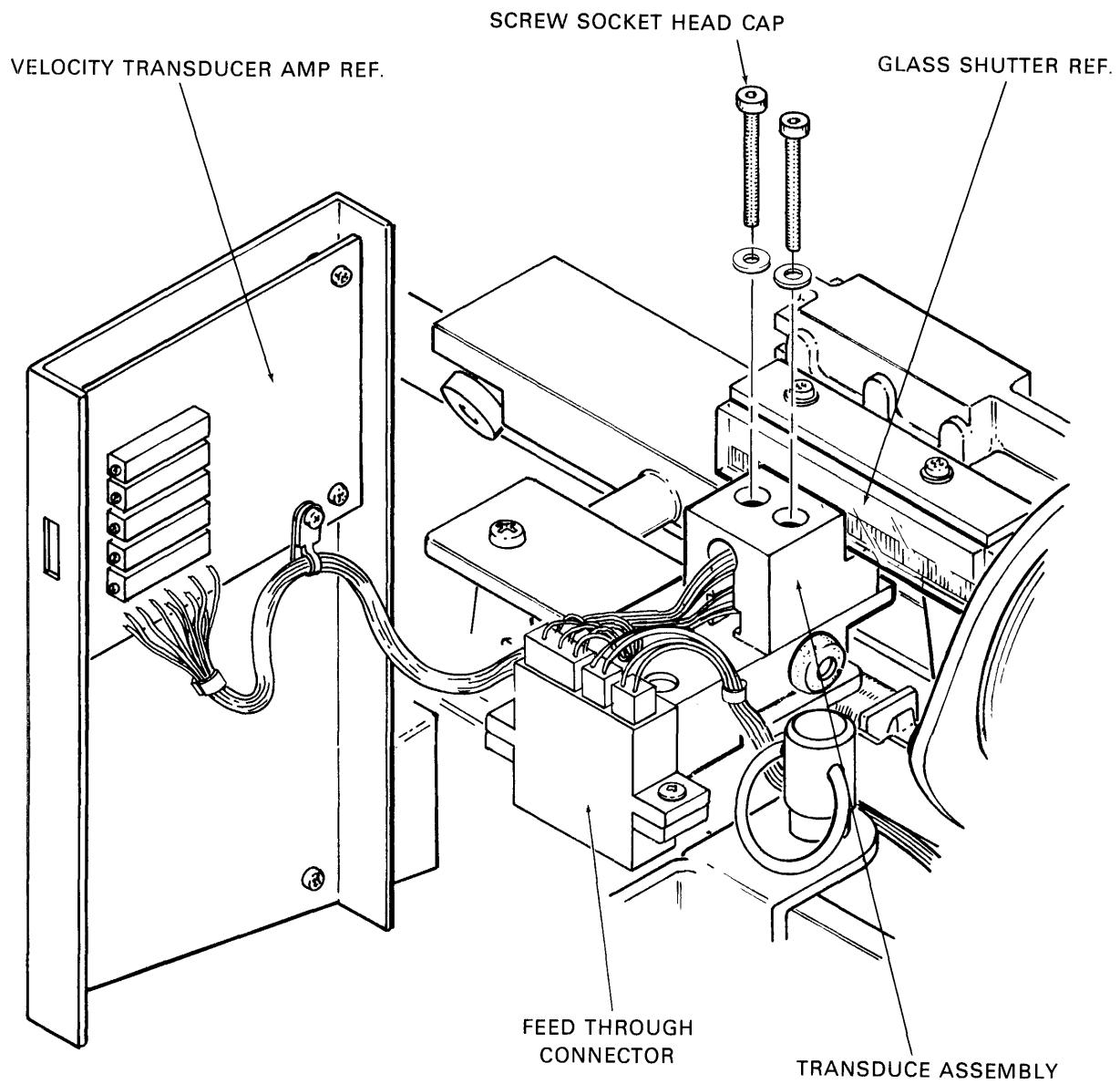
### Removal Procedure

1. Remove the rear cover (Paragraph 2.4.1).
2. Disconnect the pre-amp signal cable connector XP6 from XJ6 on the feed-through connector or the transition board (Figure 2-5).
3. Remove the two socket head cap screws holding the transducer housing to the transducer mounting block on the baseplate (Figure 2-31).



11-5111

Figure 2-30 Transducer Block Alignment (Two Dowels)



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Figure 2-31 Velocity Transducer Assembly

4. Remove the cover from the transducer pre-amp.
5. Loosen the four Phillips pan head captive screws on the pre-amp board and remove the transducer assembly.

**CAUTION**

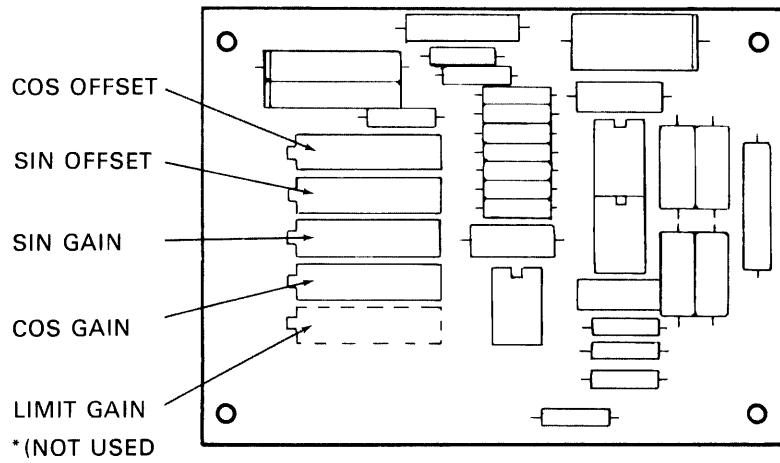
**Pre-amp leads are solid wire and are easily broken;  
handle this unit gently.**

## Replacement Procedure

1. Assemble the pre-amp board to the bracket and secure with the four Phillips pan head captive screws on the pre-amp board (Figure 2-31).
2. Set the transducer housing against the two dowel pins on the transducer mounting block and install the two socket head cap screws; tighten lightly.
3. Connect the pre-amp signal cable connector XP6 to XJ6 on the feed-through connector or the transition board (Figure 2-5).
4. Disconnect the single green lead connector E1P1 from E1J1 or M2S1-2 on the home lock solenoid assembly switch from the battery pack assembly (Figure 2-24).
5. Push the carriage assembly toward the spindle approximately one inch and install the head separator tool (DIGITAL 9306171-00) (Figure 2-25).
6. Loosen the two socket head cap screws holding the transducer housing to the transducer mounting bock.
7. Use the purple shim and green shim together to form a 0.0045 inch shim. Place the shim into the slot of the housing, green side toward the glass shutter. While holding the housing against the two dowel pins, push the carriage assembly toward the spindle and adjust the housing until there is a slight drag on the shim when the glass shutter is moved. Tighten the two socket head cap screws. Ensure that the housing is resting against the two dowel pins (Figure 2-30).

**CAUTION**  
**Do not damage or smudge the glass shutter when  
making this adjustment.**

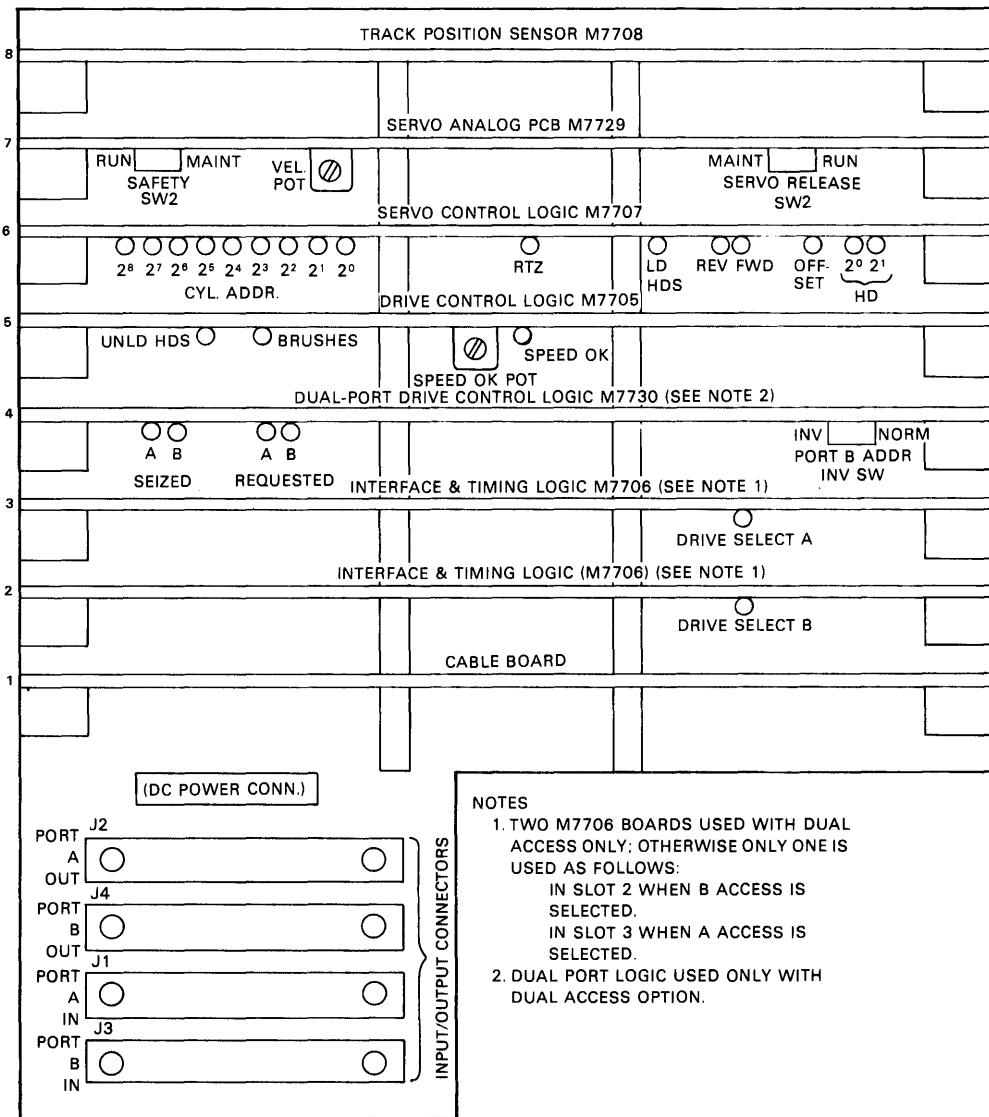
8. Move the carriage to the home position and remove the head separator tool (Figure 2-25).
9. Connect the single green lead connector E1P1 to E1J1 or M2S1-2 on the home lock solenoid assembly from the battery pack assembly (Figure 2-24).



\* REPLACEMENT BOARDS  
WILL HAVE THIS POT.

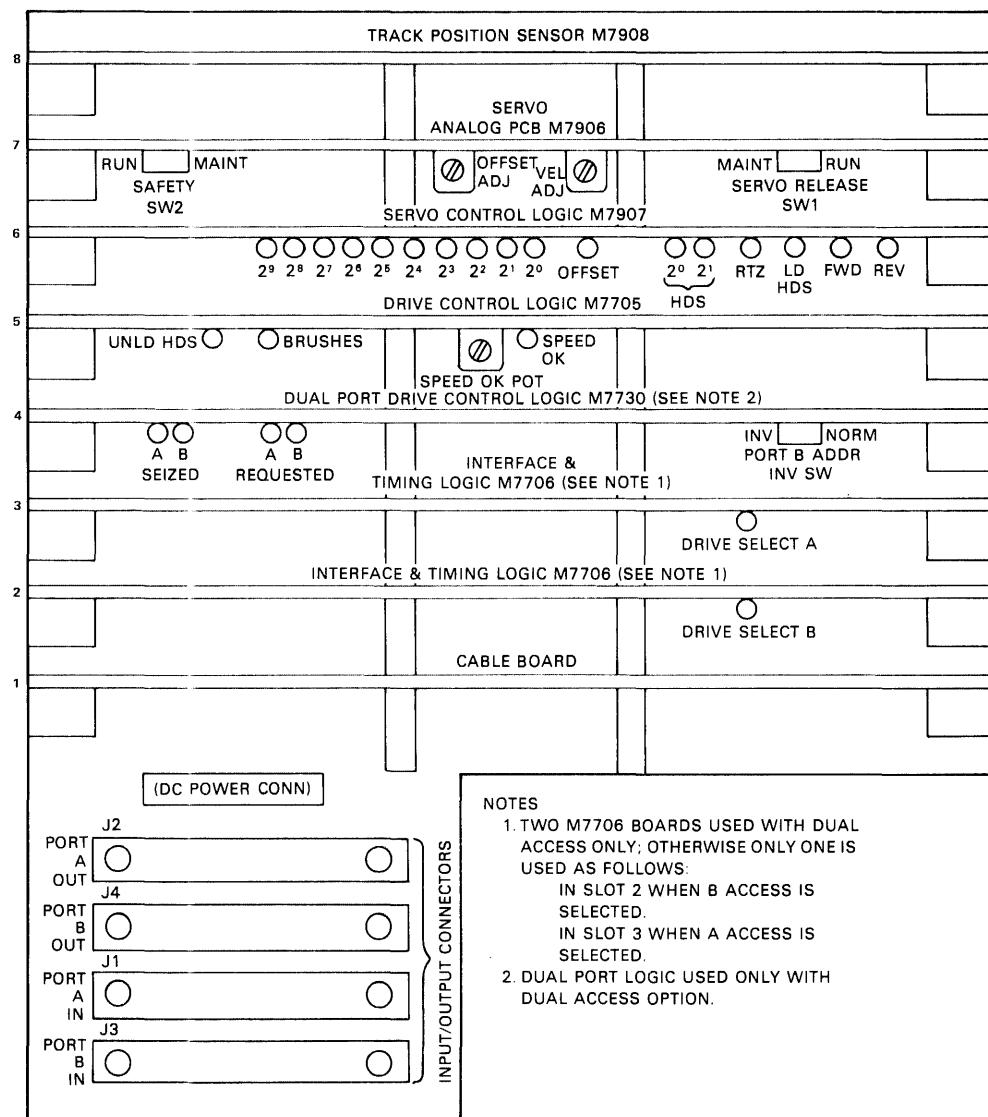
MA-2138

Figure 2-32 Transducer Pre-Amp Adjustments



CP-2466

Figure 2-33 RK06 Maintenance Controls and Indicators



MA-0923

Figure 2-34 RK07 Maintenance Controls and Indicators

10. Remove the transducer pre-amp cover.
11. SIN and COS adjustments:  
Before proceeding, make sure that the following have been done:
  - a. SERVO disable switch S1 (on the RK06 M7729 module or the RK07 M7906 module) is in the MAINT position (Figures 2-33 and 2-34).
  - b. SAFETY switch S2 (on the RK06 M7729 module or the RK07 M7906 module) is in the MAINT position.
  - c. HOME LOCK (pin D7K2 of RK06 M7729 module or RK07 M7906 module) is jumped to ground (D7T1).
12. Mount a scratch pack on the drive and press START. Wait for the drive to come up to speed and home lock to disengage.
13. Connect the oscilloscope to pin A7J1 of the RK06 M7729 module or RK07 M7906 module (SIN signal).
14. Manually load the heads; then move the carriage back and forth by hand while watching the oscilloscope.
15. Adjust the SIN GAIN (SG) potentiometer on the transducer pre-amp board for a peak-to-peak SIN signal of 18 V.
16. Use the SIN OFFSET potentiometer to make the SIN signal symmetrical, i.e., the positive half cycle measures +9 V; the negative half cycle measures -9 V.
17. Connect the oscilloscope to pin A7E1 and adjust the COSINE signal to the same values as the SIN signal.
18. If COS-signals peak-to-peak value was adjusted, repeat steps 15 through 17 again. This will insure correct peak-to-peak value of SIN and COS.
19. Use the COS offset potentiometer to make the COS-signal symmetrical, i.e.,  $\pm 9$  V from ground.
20. Move the carriage to the home position and block the transducer light path with several pieces of paper.

**CAUTION**

**Because the fixed glass in the transducer housing is easily scratched, metal or other hard material must not be used against the transducer.**

21. Measure the amplitude of the -COSINE signal (pin A7E1 of the RK06 M7729 module or RK07 M7906 module). It should measure  $-10.0 \pm 0.4$  with the light path blocked. If it does not, continue with step a; if it does, proceed to step 21.
  - a. Short pin A7B1 of the RK06 M7729 module or RK07 M7906 module to ground (A7T1).
  - b. If the -COSINE signal is now correct, the problem is with the pre-amp board or cabling.

- c. If the -COSINE signal is still wrong, the problem is with the RK06 M7729 module or RK07 M7906 module.
  - d. Correct the problem before proceeding.
22. Remove the paper from the transducer light path; then move the carriage back and forth and note the amplitude of the negative peaks of the COSINE signal. They should be slightly less negative than the dc level measured with the light path blocked. The amount that it is less negative is a measure of the amount of light that leaks past the fixed and moving glass. If the difference is greater than 1.5 V, the glass parts are not properly aligned and must be corrected. Repeat the transducer housing alignment procedure step 6 of this procedure. Reduce the clearance from 0.0045 to 0.003 inch using a green shim only. If a mechanical adjustment is made, all electrical adjustments must be repeated starting at step 11 of this procedure.

Repeat this test for the SIN signal (pin A7J1 of the RK06 M7729 module or RK07 M7906 module).

**NOTE**  
**The following COARSE LIMIT and FINE LIMIT**  
**adjustments cannot be made on an RK07. If the drive**  
**being serviced is an RK07, skip to step 24.**

23. Coarse Limit Adjustment:

Move the carriage back and forth across the limit and adjust the limit gain potentiometer until the amplitude of the negative-going triangle at pin C7M2 of the RK06 M7729 module measures -0.5 V.

24. Fine Limit Adjustment:

- a. Manually unload the heads, remove the jumper on the home lock signal, and turn the drive off.
- b. Enable the servo via the SERVO DISABLE switch.
- c. Start the drive and after the regular load heads sequence, install a jumper from pin D7A1 on the RK06 M7729 module to ground (pin D7T1). The AGC level is now stored in the counter (E39 and E46) and the jumper will prevent any changes to the count as long as the carriage is not allowed to go back and close the home lock switch.
- d. Set the SERVO DISABLE switch to the MAINT position and move the carriage back and forth over the outer limit.
- e. Place Channel 1 on signal LIMIT-H (Pin C701 on RK06 M7729 module).
- f. Place Channel 2 on signal -COS (Pin A7E1, RK06 M7729 module).
- g. Trigger on Channel 1 positive.
- h. Adjust the COS- signal to  $-7 \text{ V} \pm 1.5 \text{ V}$  at the rising edge of LIMIT-HV signal.
- i. Check the amplitude of the limit triangle at pin C7M2 of the RK06 M7729 module. It should measure  $0.5 \pm 0.1 \text{ Vdc}$ .

25. Check the tachometer ripple at pin B7D1 of the RK06 M7729 module or RK07 M7906 module. The ripple should be less than 1.5 V peak-to-peak at the maximum velocity.
26. Replace the transducer pre-amp cover.
27. Swing the card nest down (open).
28. Attach the field tester and power up the drive and field tester (Figure 2-35).
29. Perform a continuous 411 track seek (on a RK06) or a continuous 815 track seek (on a RK07).
30. Trigger the oscilloscope internal positive on CHAN 1.
31. Set sweep speed to 10 ms/cm.
32. Set the velocity potentiometer (R131) on the RK06 M7729 module or RK07 M7906 module so that the maximum duration of PIP-H is  $71 \pm 1$  ms.
33. To verify adjustment, run diagnostic DZR6M and ensure that the seek time is less than 75 ms.
34. Swing the card nest up (closed).
35. Replace the rear cover (Paragraph 2.4.1).

#### **2.4.15 Magnet Housing Assembly (Late Model Machines Only)**

##### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.4.1).
2. Remove the circuit breaker assembly (Paragraph 2.4.4).
3. Disconnect the single green lead connector E1P1 from E1J1 or M2S1-2 on the home lock solenoid assembly switch from the battery pack assembly (Figure 2-24).
4. Push the carriage and coil assembly toward the spindle approximately one inch and install the head separator tool (DIGITAL 9306171-00) (Figure 2-25).
5. Remove the three socket head cap screws from the underside of the baseplate that are holding the magnet housing assembly in place. It is necessary to use a ratchet wrench and short extension to remove the screws. The right front screw is accessible through an access hole in the top of the rear chassis mount (Figure 2-36).
6. Move the carriage and coil assembly toward the spindle and remove the magnet housing assembly to the rear and out of machine.

##### **Replacement Procedure**

1. With the carriage and coil assembly forward, toward the spindle, position the magnet housing on the baseplate (Figure 2-36).

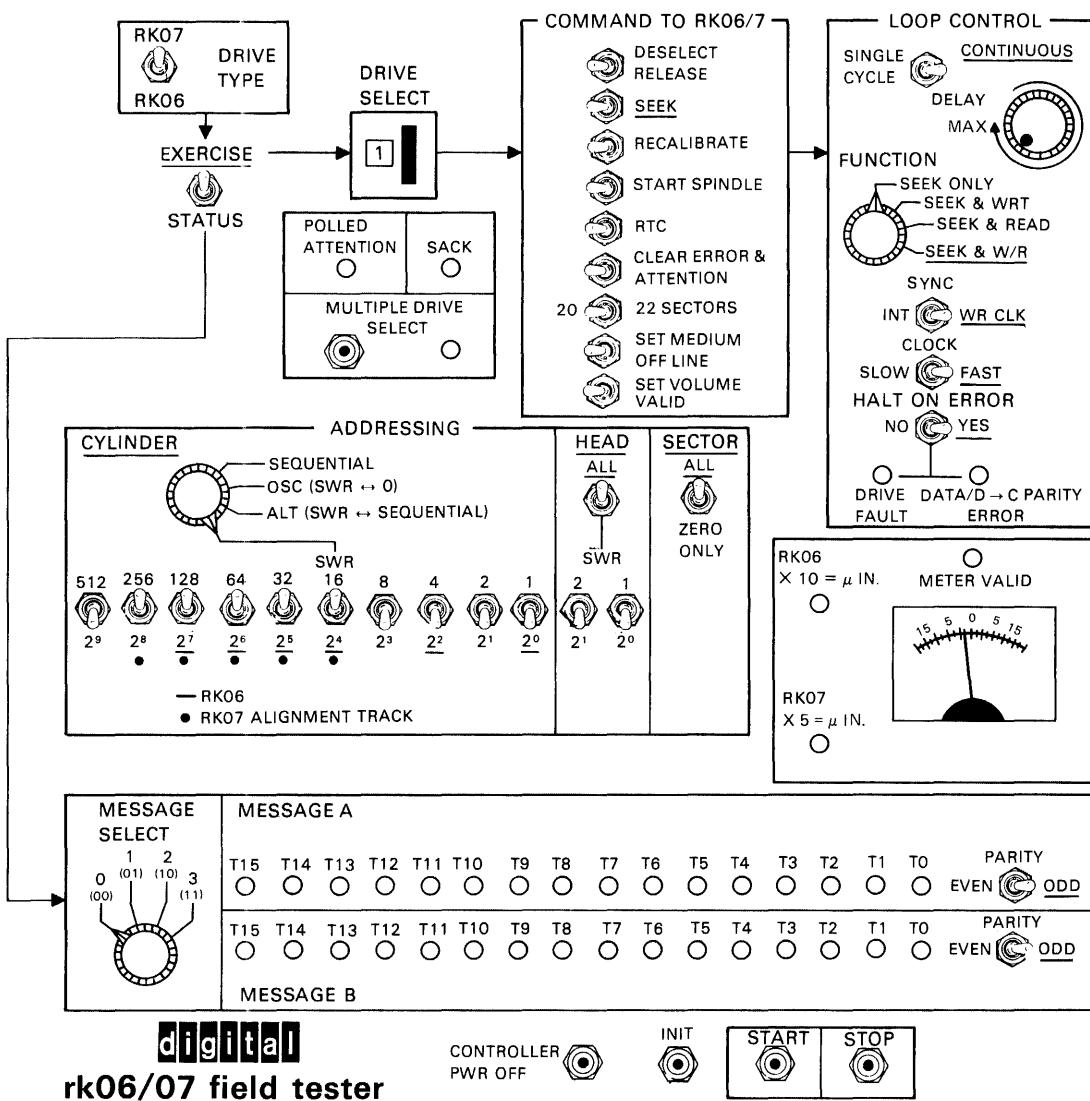
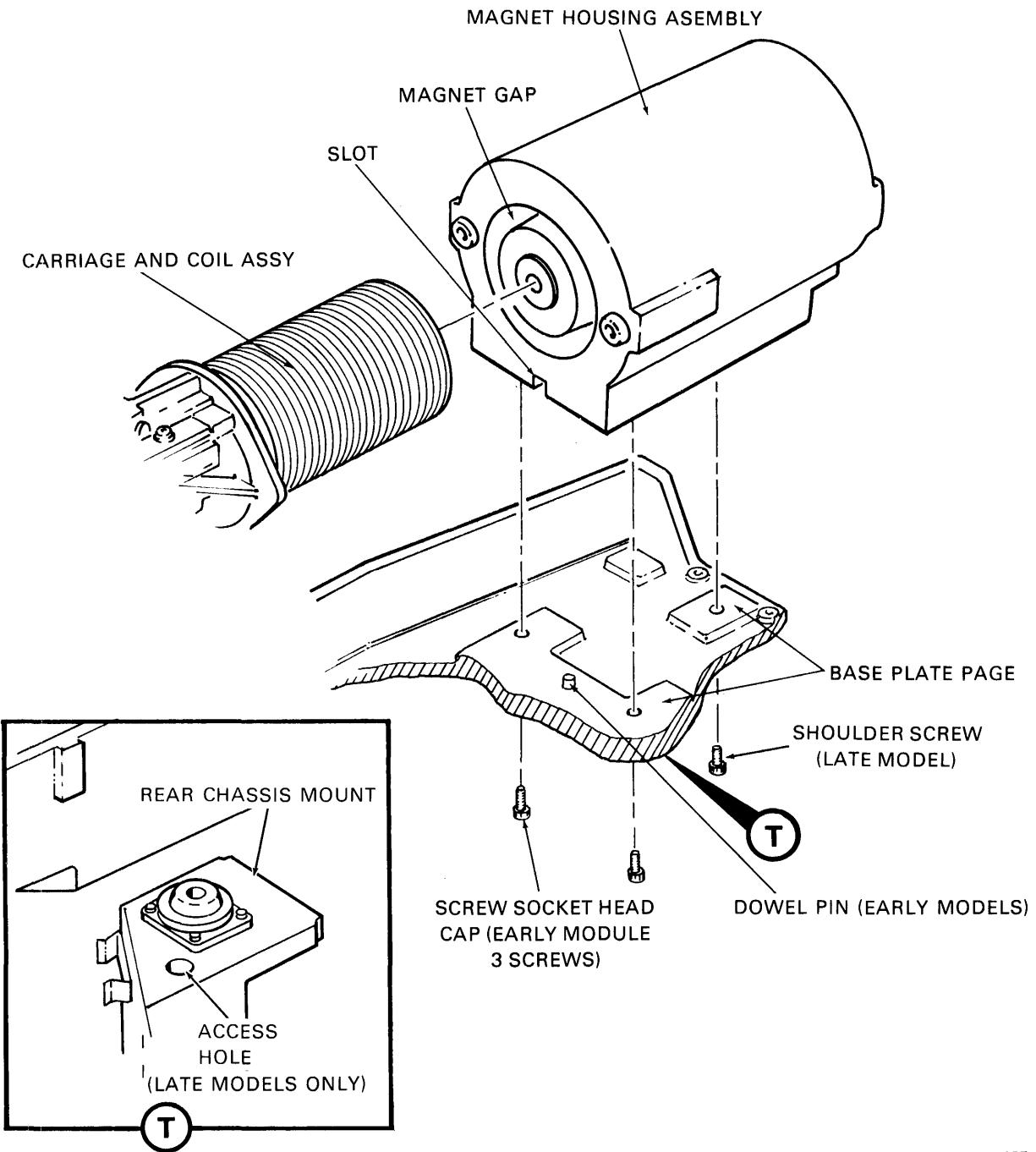


Figure 2-35 RK06/RK07 Field Test Box



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Figure 2-36 Magnet Housing Assembly

2. Insert the three socket head cap screws from the underside of the baseplate; do not tighten. It is necessary to use a ratchet wrench and a short extension to assemble the screws. The right front screw is accessible through an access hole in the top of the rear chassis mount.
3. Move the carriage and coil assembly back so that the coil enters the gap in the magnet housing assembly. Adjust the rear of the magnet housing assembly, left or right, until the gap is equal on both sides of the coil. Tighten the screws.
4. Move the carriage and coil assembly to the home position and remove the head separator tool (Figure 2-25).
5. Connect the single green lead connector E1P1 to E1J1 or M2S1-2 on the home lock solenoid assembly switch from the battery pack assembly (Figure 2-24).
6. Replace the circuit breaker assembly (Paragraph 2.4.4).
7. Replace the rear cover (Paragraph 2.4.1).

## **2.5 LID ASSEMBLY AREA**

**NOTE**

**Refer to Figure 2-37 for the lid assembly area removal and replacement procedures block diagram.**

### **2.5.1 Front Bezel**

#### **Removal Procedure**

1. Open the lid assembly cover.
2. Remove the two Phillips flat head screws holding the bezel to the front frame (Figure 2-3).
3. Pull the bezel straight out from the front frame.

#### **Replacement Procedure**

1. Insert the bezel guide pins into the holes in the front frame and push bezel into place.
2. Install the two Phillips flat head screws.

**NOTE**

**If this machine has a plastic bezel, do not overtighten the screws. Doing so will cause the bezel to bend, making it difficult or impossible to perform the latch adjustment. Tighten the screws until the front bezel is just touching the drive, and then turn the screw one-half to one more turn.**

3. Close the lid assembly cover.

### **2.5.2 Rear Cover**

#### **Removal Procedure**

1. Remove the two Phillips pan head screws holding the rear cover in place (Figure 2-3).
2. Pull the rear cover back approximately two inches and lift up and out of machine.

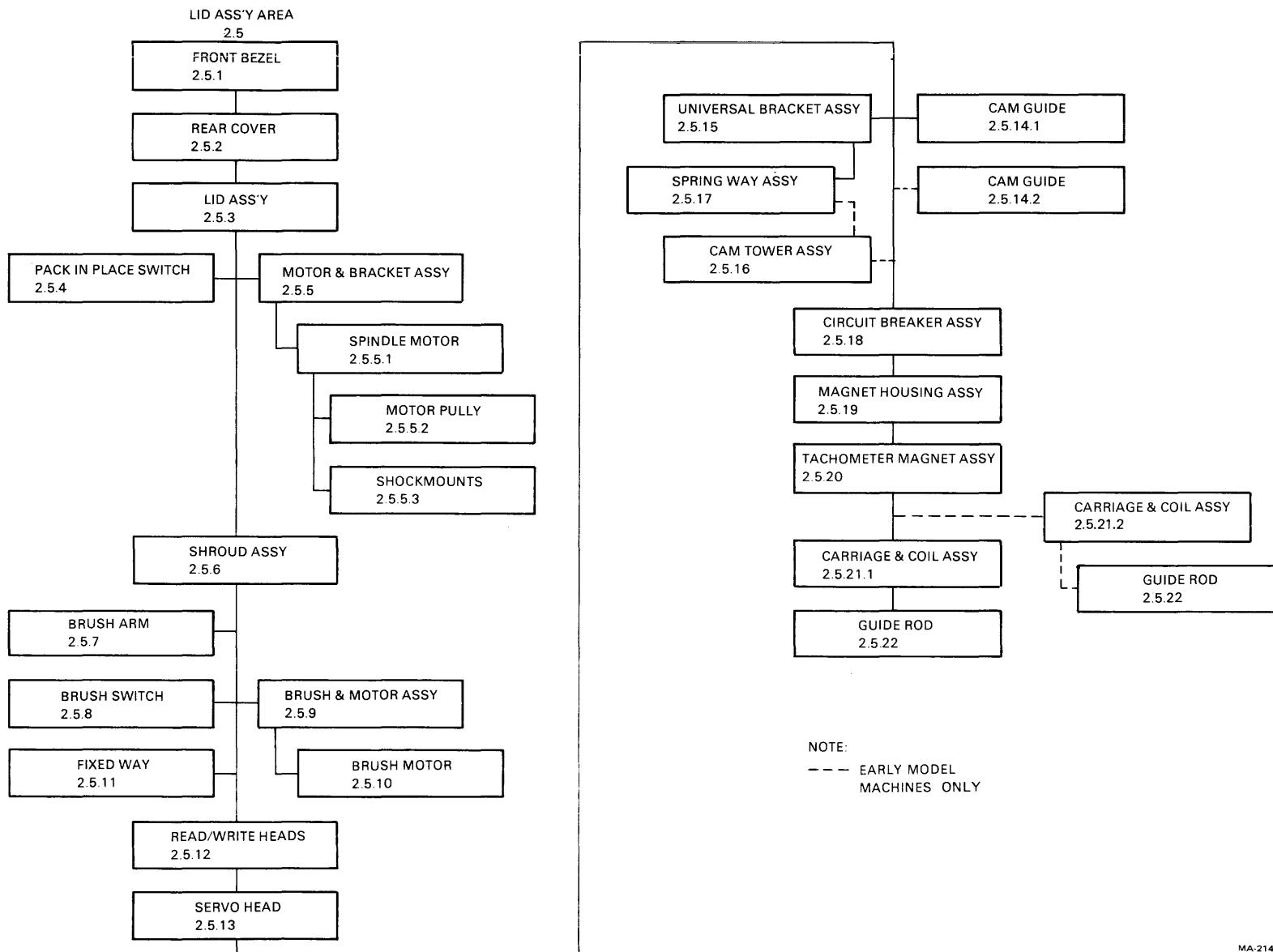


Figure 2-37 Lid Assembly Area Removal and Replacement Procedures Block Diagram

### **Replacement Procedure**

1. Place the rear cover into position making sure the slides engage the chassis and push forward to engage the locking tabs with the lid assembly (Figure 2-3).
2. Install the two Phillips pan head screws.

### **2.5.3 Lid Assembly**

#### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.5.2).
2. Open the lid assembly cover and remove the two Phillips pan head screws holding the lid assembly in place (Figure 2-3).
3. Slide the lid assembly to the rear and lift up and out of machine.

#### **Replacement Procedure**

1. With the lid assembly cover open, place the lid assembly over the chassis and lower into place; slide the lid assembly forward to engage the two tabs into slots located in the front of the chassis (Figure 2-3).
2. Insert the two Phillips pan head screws and secure, making sure the lid assembly is all the way forward.

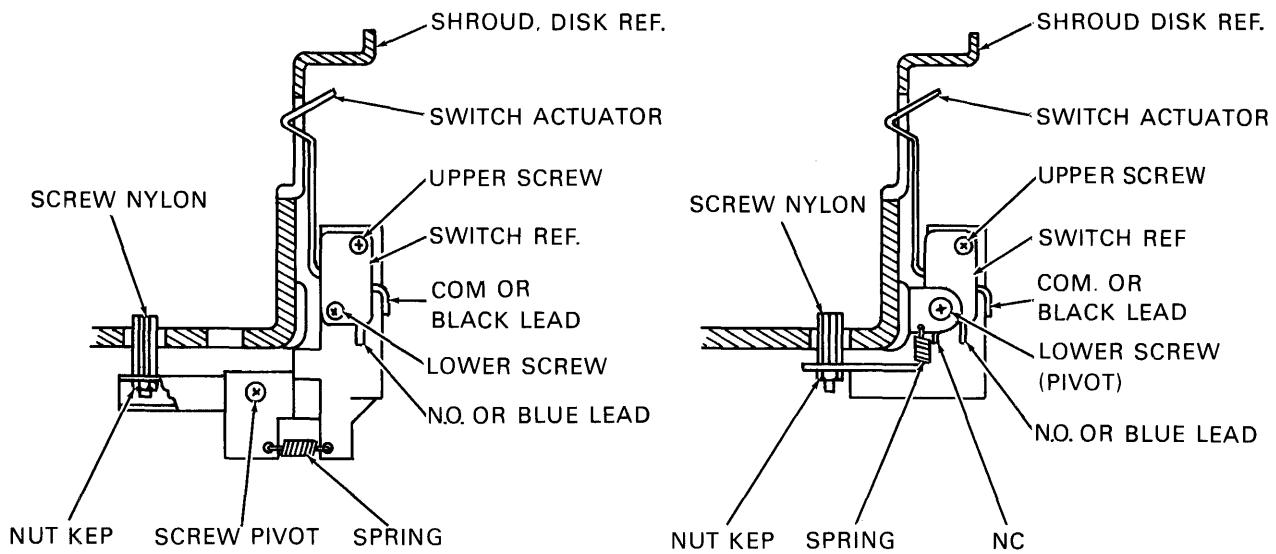
### **2.5.4 Pack-In-Place Switch**

#### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.5.1).
2. Remove the rear cover (Paragraph 2.5.2).
3. Remove the lid assembly (Paragraph 2.5.3).
4. Remove the two quick-connect terminal leads from the switch located at the right side of the shroud assembly (Figure 2-38).
5. Remove the upper Phillips pan head screw holding the switch to the switch bracket.
6. Remove the lower Phillips pan head screw holding the switch to the switch bracket. On RK06 machines this screw is also the pivot screw, and when removed the switch bracket will hang free on the return spring.
7. Remove the switch from the machine.

#### **Replacement Procedure**

1. Place the switch into position on the switch bracket and install the upper Phillips pan head screw; position the lower hole in the switch over the hole in the switch bracket (Figure 2-38).
2. RK07 Only: Install the lower Phillips pan head screw.



RK07 PACK-IN PLACE SWITCH

RK06 PACK-IN PLACE SWITCH

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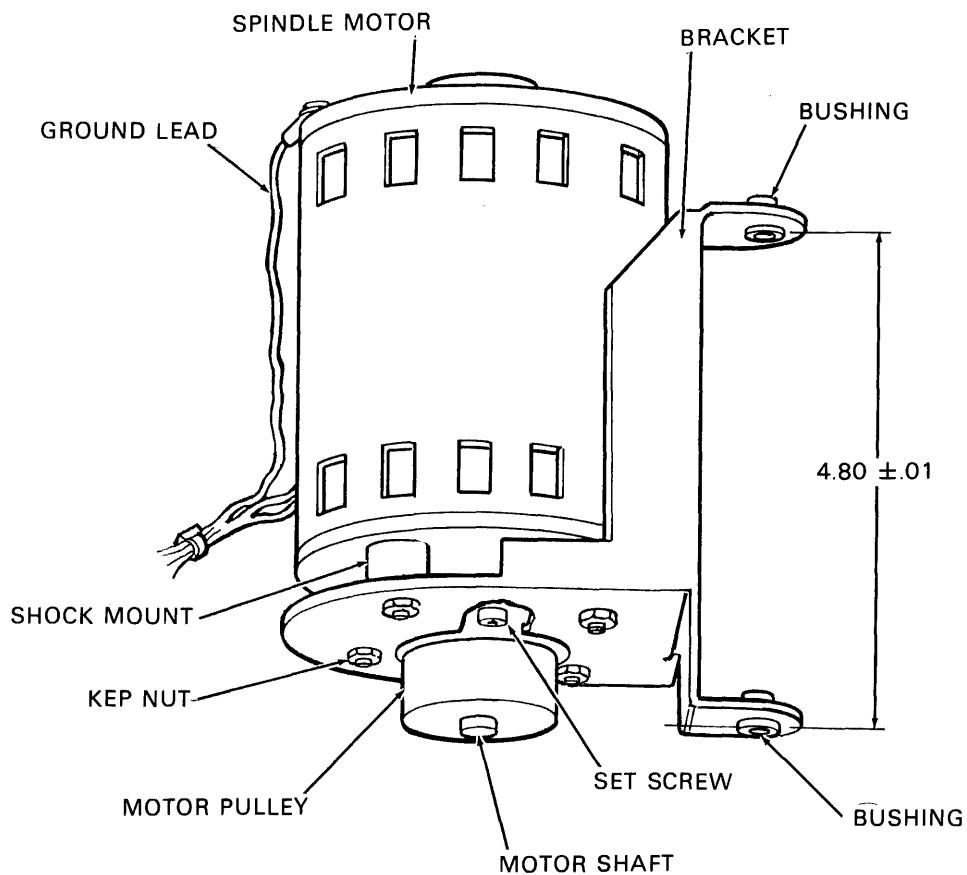
Figure 2-38 Pack-In Place Switch

3. RK06 Only: Position the switch bracket into the pivot bracket and install the lower Phillips pan head screw. Adjust the screw until the switch bracket pivots freely without binding.
4. Connect the quick-connect terminal leads to the switch terminals, black to COM and blue to NO.
5. Loosen the locking kep nut in the adjusting screw and turn the adjusting screw CW (looking from the top of drive) several turns.
6. Place a continuity tester between the switch COM and NO terminals.
7. Place a cartridge and cover into the drive; while holding them away from the switch location, turn the adjusting screw CCW (looking from the top of drive) until the switch makes.
8. Remove the cartridge and cover; mark the position of the adjusting screw and make one full turn CCW (looking from the top of drive) and lock in this position with the kep nut.
9. The following requirements will be met:
  - a. With the cartridge in place and moving, the cartridge in its allowable travel, the switch does not make.
  - b. With the cartridge and cover in place, the switch makes and does not break when the cartridge and cover together are moved in their allowable travel.
10. Replace the lid assembly (Paragraph 2.5.3).
11. Replace the rear cover (Paragraph 2.5.2).
12. Replace the front bezel (Paragraph 2.5.1).

## 2.5.5 Motor and Bracket Assembly

### Removal Procedure

1. Remove the front bezel (Paragraph 2.5.1).
2. Remove the rear cover (Paragraph 2.5.2).
3. Remove the lid assembly (Paragraph 2.5.3).
4. Remove the drive belt from the spindle pulley by pressing on the motor to release the belt tension; slip the belt from the spindle pulley (Figure 2-12).
5. Disconnect the spindle motor connector M3P1 from M3J1 on the TA bracket (Figure 2-4).
6. Remove the shoulder screw or the detent pin holding the motor and bracket assembly to the baseplate (Figure 2-12).
7. Remove the motor and bracket assembly from the baseplate (Figure 2-39). Late model machines have a spring between the motor bracket and the baseplate. Do not lose the spring.



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Figure 2-39 Motor and Bracket Assembly

## **Replacement Procedure**

1. Assemble the motor and bracket assembly to the baseplate and insert the shoulder screw or detent pin (Figure 2-39).
2. On late model machines there is a spring between the motor bracket and the baseplate. If this is the case, place it into position at this time.
3. Place the drive belt over the motor pulley.
4. While pressing on the spindle motor to release the belt tension, slip the belt over the spindle pulley (Figure 2-12).
5. Turn the spindle by hand and make sure the belt rides in the middle of the pulley. If it does not, adjust the motor pulley up or down.
6. Connect the spindle motor connector M3P1 to M3J1 on the TA bracket (Figure 2-4).
7. On early model machines there is a spring plunger in place of a spring to apply the belt tension. The spring does not require adjustment but if the spring plunger is present it should be adjusted per belt tension adjustment procedures in Paragraph 3.3.
8. Replace the lid assembly (Paragraph 2.5.3).
9. Replace the rear cover (Paragraph 2.5.2).
10. Replace the front bezel (Paragraph 2.5.1).

### **2.5.5.1 Spindle Motor**

#### **Removal Procedure**

1. Remove the four kep nuts holding the motor to the bracket and lift the motor from the bracket (Figure 2-39).
2. Remove the four shock mounts from the motor.
3. Loosen the pulley setscrew and remove the pulley from the motor shaft.

#### **Replacement Procedure**

1. Install the four shock mounts to the new motor (Figure 2-39).
2. Place the motor on the bracket with the motor leads in the proper location.
3. Secure the motor to the bracket with four kep nuts.
4. Slip the motor pulley over the motor shaft, position to the  $4.8 \pm 0.01$  dimension, and tighten the setscrew.

### **2.5.5.2 Motor Pulley**

#### **Removal Procedure**

1. Mark the motor pulley location on the motor shaft, loosen the pulley setscrew, and slide the pulley from the motor shaft (Figure 2-39).

#### **Replacement Procedure**

1. Assemble the new motor pulley to the motor shaft, aligning to the mark on the motor shaft, and tighten the setscrew (Figure 2-39).

### **2.5.5.3 Shock Mounts**

#### **Removal Procedure**

1. Remove the four kep nuts holding the motor to the bracket and lift the motor from the bracket (Figure 2—39).
2. Remove the four shock mounts from the motor.

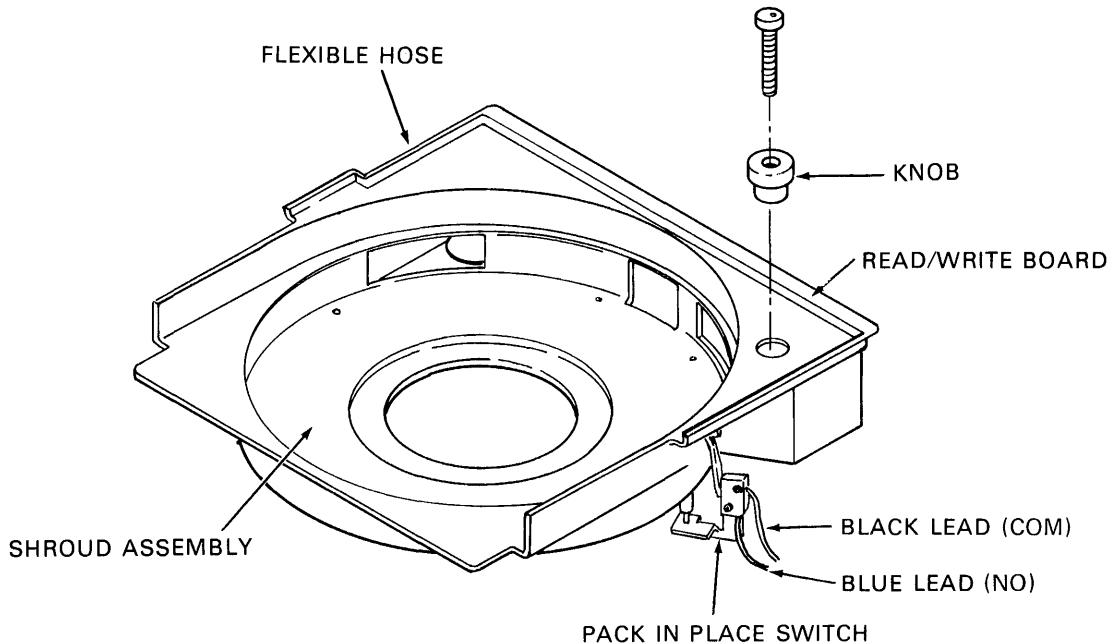
#### **Replacement Procedure**

1. Install the four new shock mounts to the motor (Figure 2-39).
2. Place the motor on the bracket with the motor leads in the proper position.
3. Secure the motor to the bracket with the four kep nuts.

### **2.5.6 Shroud Assembly**

#### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.5.1).
2. Remove the rear cover (Paragraph 2.5.2).
3. Remove the lid assembly (Paragraph 2.5.3).
4. Remove the socket head cap screw holding the brush indicator knob in place and remove the knob (Figure 2-40).
5. Remove the two quick-connect terminal leads from the pack-in-place switch terminals.
6. Loosen the top hose clamp holding the flexible hose to the shroud inlet and remove the flexible hose from the shroud inlet.



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Figure 2-40 Shroud Assembly

- \*7. Remove the read/write board ground lead ring tongue from under the top servo pre-amp assembly mounting screw.
- \*8. Disconnect the two flat cable connectors RWP1 and RWP2 from the read/write board (Figure 2-23).
- \*9. Disconnect the read/write and servo head cable connectors from the read/write board.
- 10. Remove the six Phillips pan head screws holding the shroud assembly to the baseplate.
- 11. Remove the shroud assembly.

#### Replacement Procedure

- 1. Place the shroud assembly into position on the baseplate (Figure 2-40).
  - 2. Secure the shroud assembly to the baseplate with six Phillips pan head screws.
  - \*3. Connect the read/write and servo head cable connectors to the read/write board (Figure 2-23).
  - \*4. Connect the two flat cable connectors RWP1 and RWP2 to the read/write board.
  - \*5. Connect the read/write board ground lead ring tongue under the top mounting screw of the servo pre-amp assembly.
- \* On late model machines the read/write board is mounted to a universal bracket assembly, making it possible to remove the shroud assembly without disconnecting cable or grounds located on the read/write board.

6. Place the flexible hose on the shroud inlet and tighten the hose clamp.
7. Connect the quick-connect terminal leads to the pack-in-place switch terminals, black to COM and blue to N.C.
8. Place the socket head cap screw into the brush indicator knob and insert through the hole in the shroud. Position the arrow on the knob to indicate the position of the brushes and tighten the screw.
9. Replace the lid assembly (Paragraph 2.5.3).
10. Replace the rear cover (Paragraph 2.5.2).
11. Replace the front bezel (Paragraph 2.5.1).

### **2.5.7 Brush Arm**

#### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.5.2).
2. Remove the lid assembly (Paragraph 2.5.3).
3. Remove the shroud assembly (Paragraph 2.5.6).
4. Loosen the set screw at the base of the brush arm and lift off the motor shaft (Figure 2-41).

#### **Replacement Procedure**

1. Place the brush arm on the motor shaft, slide down against the spacer or nylon washer, and tighten the set screw (5 to 6 inch-pounds torque). Ensure that the dowel pin on the arm is positioned between the two dowel pins on the base (Figure 2-41).
2. With the brush arm resting against the outer dowel pin, there must be no continuity between the COM and NO terminals of the switch.
3. If switch adjustments are required, loosen the pivot and adjusting screws, adjust the switch as required, and tighten both screws.
4. Replace the shroud assembly (Paragraph 2.5.6).
5. Replace the lid assembly (Paragraph 2.5.3).
6. Replace the rear cover (Paragraph 2.5.2).

### **2.5.8 Brush Switch**

#### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.5.2).
2. Remove the lid assembly (Paragraph 2.5.3).
3. Remove the shroud assembly (Paragraph 2.5.6).
4. Swing the brush arm all the way toward the spindle.
5. Disconnect the three quick-connect terminal leads from the switch terminals (Figure 2-41).
6. Remove the two Phillips pan head screws holding the switch to the adjusting plate and remove the switch.

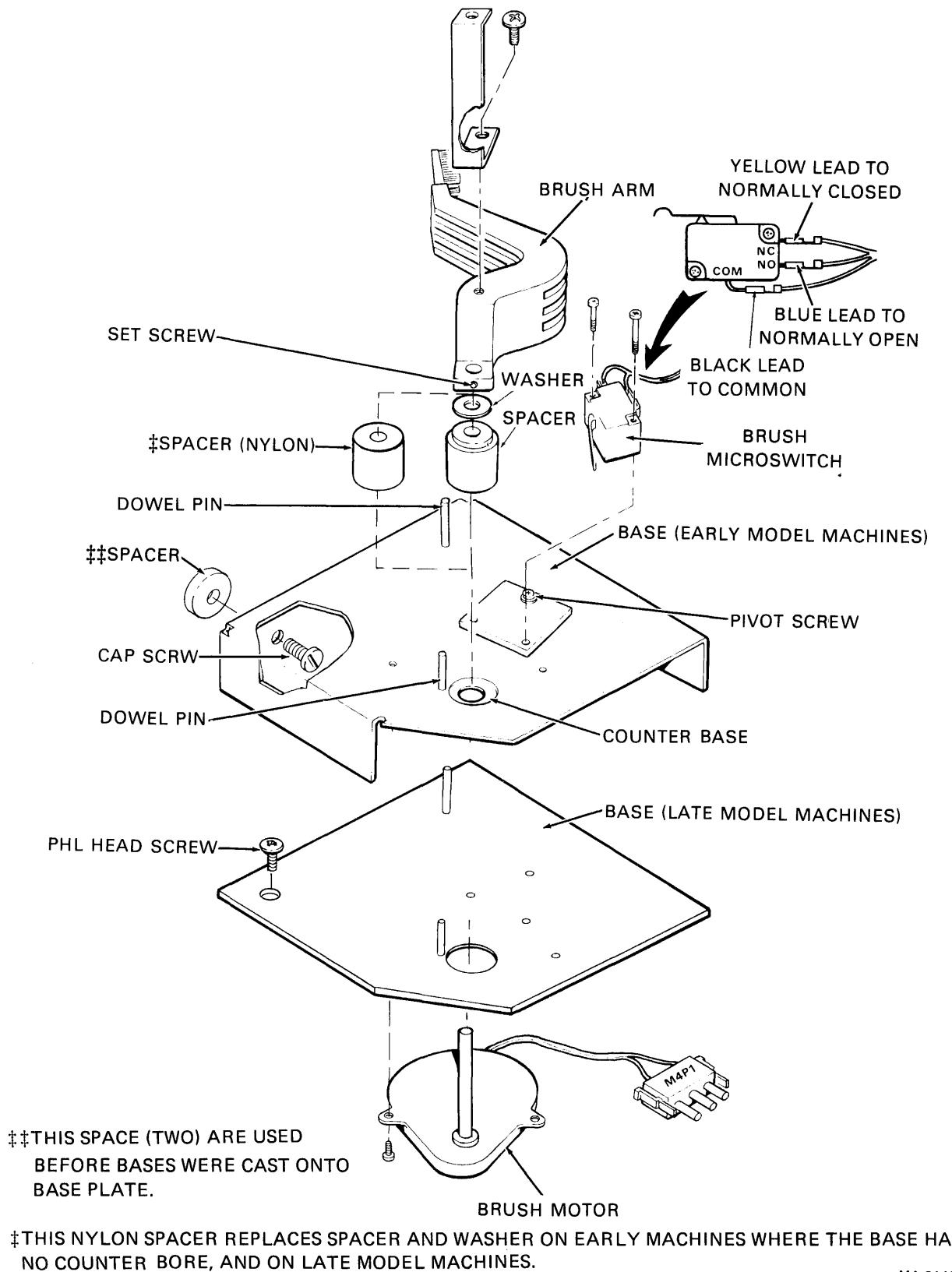


Figure 2-41 Brush and Motor Assembly

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## **Replacement Procedure**

1. Position the switch on the adjusting plate and secure with two Phillips pan head screws (Figure 2-41).
2. Connect the three quick-connect terminal leads to the switch terminals, black lead to COM, blue lead to NO and the yellow lead to NC.
3. With the brush arm resting against the outer dowel pin, there must be no continuity between the COM and NC terminals of the switch.
4. If switch adjustments are required, loosen the pivot and adjusting screws, adjust as required, and tighten both screws.
5. Replace the shroud assembly (Paragraph 2.5.6).
6. Replace the lid assembly (Paaragraph 2.5.3).
7. Replace the rear cover (Paragraph 2.5.2).

## **2.5.9 Brush and Motor Assembly**

### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.5.2).
2. Remove the lid assembly (Paragraph 2.5.3).
3. Remove the shroud assembly (Paragraph 2.5.6).
4. Disconnect the brush and motor assembly cable connector M4P1 from M4J1 on the TA bracket (Figure 2-41).
5. Disconnect the three quick-connect terminal leads from the switch terminals.
6. Late model machines:
  - a. Remove the Phillips pan head screw holding the pack and brush switch cable clamp to the brush base.
  - b. Remove the three Phillips pan head screws holding the brush and motor assembly to the universal bracket assembly; remove the brush and motor assembly.
7. Early model machines:
  - a. Remove the velocity transducer pre-amp cover.
  - b. Loosen the four Phillips pan head captive screws holding then the velocity transducer board to the mounting bracket; remove the board.
  - c. Remove the two socket head cap screws holding the brush and motor assembly to the baseplate; slide the brush base off the two locating pins and out of machine.

## **Replacement Procedure**

1. Late model machines:
  - a. Position the brush and motor assembly on the universal bracket assembly and secure with three Phillips pan head screws (Figure 2-41).
  - b. Connect the pack and brush switch cable quick-connect terminal leads to the switch terminals, black lead to COM, blue lead to NO and yellow lead to NC.
  - c. Position the pack and brush switch cable clamp and secure with a single Phillips pan head screw.
2. Early model machines:
  - a. Position the brush and motor assembly base over the two dowel locating pins on the baseplate. If spacers were used, ensure that they are in place; secure with two socket head cap screws (Figure 2-41).
  - b. Connect the brush and motor assembly cable quick-connect terminal leads to the switch, black lead to COM, blue lead to NO and yellow lead to NC.
  - c. Position the velocity transducer pre-amp board on the mounting bracket and secure with four Phillips pan head captive screws.
  - d. Replace the velocity transducer pre-amp cover.
3. Connect the brush and motor assembly cable connector M4P1 to M4J1 on the TA bracket.
4. Replace the shroud assembly (Paragraph 2.5.6).
5. Replace the lid assembly (Paragraph 2.5.3).
6. Replace the rear cover (Paragraph 2.5.2).

### **2.5.10 Brush Motor**

#### **Removal Procedure**

1. Loosen the set screw at the base of the brush arm and lift the arm off the motor shaft (Figure 2-41).
2. Remove the nylon or aluminum spacer and nylon washer.
3. Turn the brush and motor assembly over and remove the two Phillips pan head screws holding the motor to the base; then remove the motor.

#### **Replacement Procedure**

1. Position the brush motor on the underside of the base and secure with two Phillips pan head screws (Figure 2-41).
2. Place the nylon or aluminum spacer and nylon washer over the motor shaft and seat on the base.

3. Place the brush arm on the motor shaft, slide down against the spacer or nylon washer, and tighten the set screw (5 or 6 inch-pound torque). Ensure that the dowel pin on the arm is positioned between the two dowel pins on the base.
4. With the brush arm resting against the outer dowel pin, there must be no continuity between the COM and NC terminals of the switch.
5. If switch adjustments are required, loosen the pivot and adjusting screws, adjust the switch as required, and tighten both screws (Paragraph 3.12).

### **2.5.11 Fixed Way**

#### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.5.1).
2. Remove the rear cover (Paragraph 2.5.2).
3. Remove the lid assembly (Paragraph 2.5.3).
4. Remove the shroud assembly (Paragraph 2.5.6).
5. Remove the socket head cap screw and Phillips pan head screws holding the fixed way to the baseplate (Figure 2-42).
6. Slide the fixed way toward the spindle and out of machine.

#### **Replacement Procedure**

1. Slide the fixed way into the machine from the spindle end and secure with socket head cap and Phillips pan head screws (Figure 2-42).
2. Replace the shroud assembly (Paragraph 2.5.6).
3. Replace the lid assembly (Paragraph 2.5.3).
4. Replace the rear cover (Paragraph 2.5.2).
5. Replace the front bezel (Paragraph 2.5.1).

### **2.5.12 Read/Write Heads**

#### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.5.2).
2. Disconnect the read/write head connectors from the read/write board (Figure 2-18).
3. Install the head insertion and removal tool on the head (Figures 2-19 and 2-20).
4. Loosen the captive socket head cap screw holding the head to the carriage and remove the read/write head.

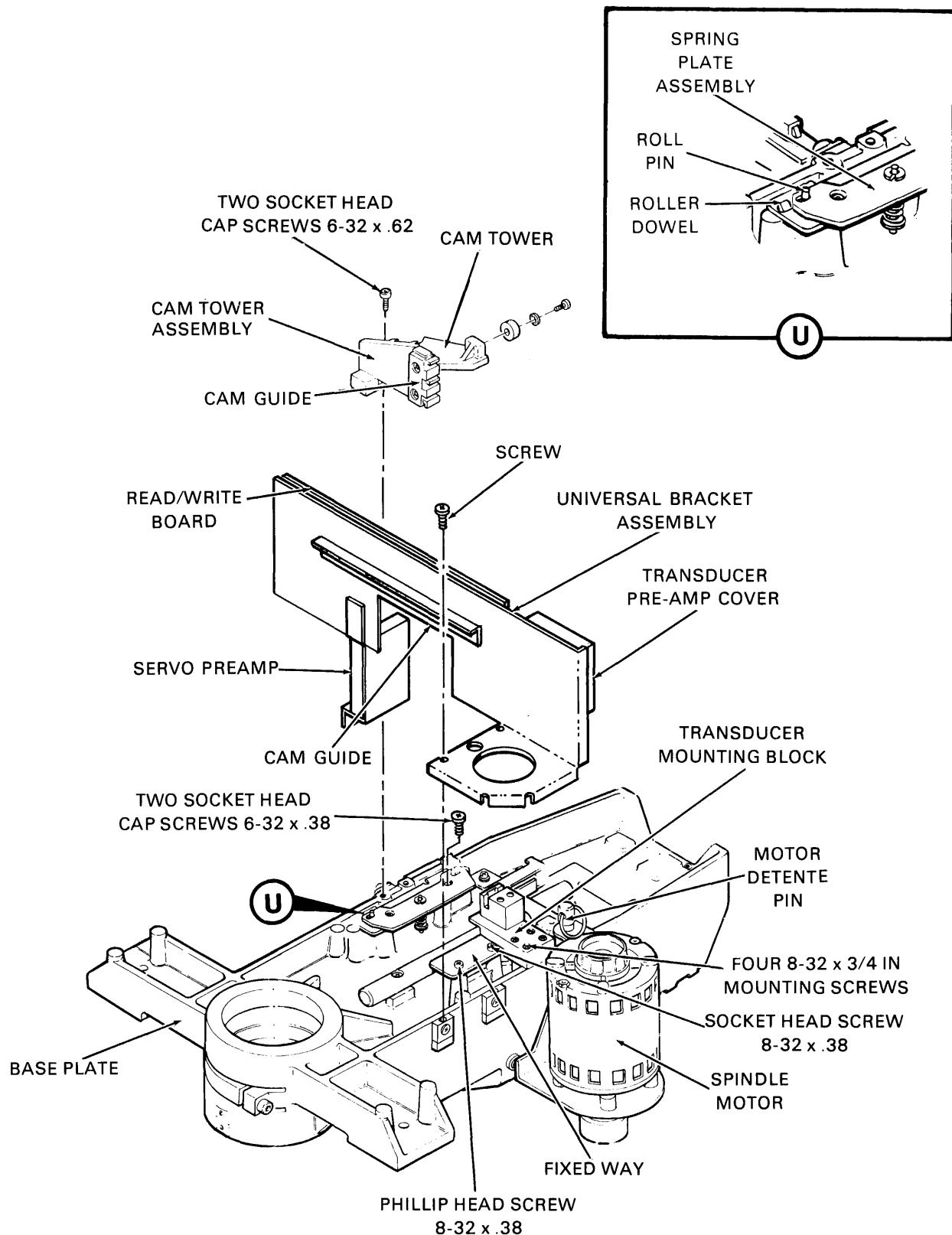


Figure 2-42 Spring Plate Assembly

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5. Repeat steps 3 and 4 as required.

**CAUTION**

**When installing the head insertion and removal tool,  
the carriage does not tip beyond the point where the  
heads fall out of the cam guide.**

#### **Replacement Procedure**

1. Place the new read/write head into the insertion and removal tool and carefully install the read/write head into position (Figures 2-19 and 2-20).
2. Torque the captive socket head cap screw to 5 inch-pounds.
3. Remove the head insertion and removal tool.
4. Connect the read/write head connector to the read/write board.
5. Perform the head alignment procedure in Paragraph 3.4.

#### **2.5.13 Servo Head**

##### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.5.2).
2. Disconnect the servo head connector from the read/write board or from the servo head connector holder (Figure 2-18).
3. Disconnect the servo head connector from the servo pre-amp board.
4. Install the head insertion and removal tool on the servo head (Figure 2-22).
5. Loosen the captive socket head cap screw holding the servo head to the carriage and carefully remove the servo head.

**CAUTION**

**When installing the head insertion and removal tool,  
ensure that the carriage does not tip beyond the point  
where the heads will fall out of the cam guide.**

##### **Replacement Procedure**

1. Place the new servo head into the insertion and removal tool with the dowel pin located all the way to the rear of the slot in the head (Figure 2-22).
2. Install the servo head into the carriage servo position, sliding the servo head all the way back against the dowel pin in the carriage, toward the coil.
3. Torque the captive socket head cap screw to 5 inch-pounds, and reuse the head insertion and removal tool.
4. Connect the servo head connector to the read/write board or connector holder, middle connector, on the cable.

5. Connect the servo head connector to the servo pre-amp board, end connector on the cable.
6. Perform the head alignment procedures in Paragraph 3.4.

**NOTE**

If at any time the servo head is moved or replaced,  
head alignment procedures must be performed.

## **2.5.14 Cam Guide**

### **2.5.14.1 (Late Model Machines Only)**

#### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.5.1).
2. Remove the rear cover (Paragraph 2.5.2).
3. Remove the lid assembly (Paragraph 2.5.3).
4. Remove the shroud assembly (Paragraph 2.5.6).
5. Remove the two Phillips pan head screws holding the cam guide to the universal bracket assembly, and remove the cam guide (Figure 2-42).

#### **Replacement Procedure**

1. Position the cam guide on the universal bracket assembly and insert the two Phillips pan head screws, but do not tighten (Figure 2-42).
2. Using the locating gauge to position the cam guide on the universal bracket assembly, tighten the two Phillips pan head screws.
3. Replace the shroud assembly (Paragraph 2.5.6).
4. Replace the lid assembly (Paragraph 2.5.3).
5. Replace the rear cover Paragraph 2.5.2).
6. Replace the front bezel (Paragraph 2.5.1).

### **2.5.14.2 (Early Model Machines Only)**

#### **Removal Procedure**

1. Open the lid assembly cover.
2. Remove the two Phillips pan head screws holding the cam guide to the cam tower and remove the cam guide (Figure 2-42).

#### **Replacement Procedure**

1. Position the cam guide over the dowel pin on the cam tower assembly and secure in place with two Phillips pan head screws (Figure 2-42).
2. Close the lid assembly cover.

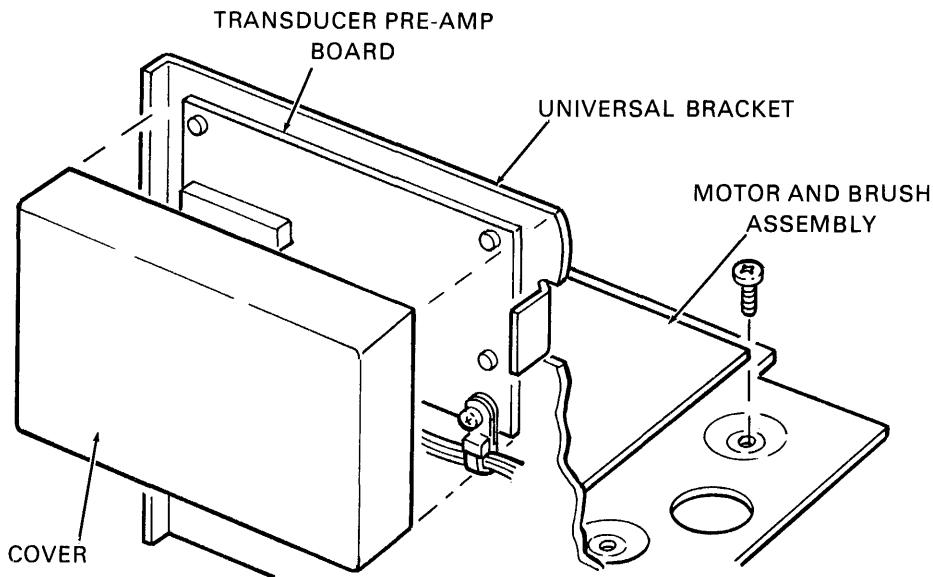
## **2.5.15 Universal Bracket Assembly (Late Model Machines Only)**

### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.5.1).
2. Remove the rear cover (Paragraph 2.5.2.).
3. Remove the lid assembly (Paragraph 2.5.3).
4. Remove the shroud assembly (Paragraph 2.5.6).
5. Remove the read/write heads (Paragraph 2.5.12).
6. Remove the servo head (Paragraph 2.5.13).
7. Disconnect the two flat cable connectors RWP1 and RWP2 from the read/write board (Figure 2-23).
8. Remove the cable clamp and disconnect the SPAJ1 connector from the servo pre-amp board (Figure 2-15).
9. Remove the velocity transducer pre-amp cover (Figure 2-43).
10. Loosen the four Phillips pan head captive screws holding the velocity transducer pre-amp board to its mounting and place the pre-amp board aside.
11. Disconnect the brush motor cable connector M4P1 from M4J1 on the TA bracket.
12. Disconnect the single green lead M2S1-2 on the home lock switch from the battery pack assembly (Figure 2-24).
13. Push the carriage and coil assembly toward the spindle approximately 1 inch and install the head separator tool (DIGITAL 9306171-00) (Figure 2-25).
14. Remove the four Phillips pan head screws holding the universal bracket assembly to the baseplate (Figure 2-43).
15. Remove the universal bracket assembly from the baseplate.

### **Replacement Procedure**

1. Position the universal bracket assembly on the baseplate (Figure 2-43).
2. Secure the universal bracket assembly to the baseplate with four Phillips pan head screws.
3. While holding the carriage and coil assembly against the outer limit stops, adjust the universal bracket assembly forward or back until both limit stops contact the carriage at the same time; then secure the universal bracket in this position.
4. Move the carriage and coil assembly to home position and remove the head separator tool (Figure 2-25).



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Figure 2-43 Velocity Transducer Pre-Amp Board

5. Connect the single green lead M2S1-2 to the home lock switch from the battery pack assembly (Figure 2-24).
6. Position the velocity transducer pre-amp board on its mounting and secure with the four Phillips pan head captive screws (Figure 2-43).
7. Replace the velocity transducer pre-amp cover.
8. Connect the brush motor cable connector M4P1 to M4J1 on the TA bracket.
9. Connect the connector SPAJ1 to the servo pre-amp board and replace the cable clamp (Figure 2-15).
10. Replace the servo head (Paragraph 2.5.13).
11. Replace the read/write heads (Paragraph 2.5.12).
12. Replace the shroud assembly (Paragraph 2.5.6).
13. Replace the lid assembly (Paragraph 2.5.3).
14. Replace the rear cover (Paragraph 2.5.2).
15. Replace the front bezel (Paragraph 2.5.1).

## **2.5.16 Cam Tower Assembly (Early Model Machines Only)**

### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.5.1).
2. Remove the rear cover (Paragraph 2.5.2).
3. Remove the lid assembly (Paragraph 2.5.3).
4. Remove the shroud assembly (Paragraph 2.5.6).
5. Disconnect the single green lead E1P1 from E1J1 from the battery pack assembly (Figure 2-14).
6. Push the carriage and coil assembly toward the spindle approximately 1 inch and install the head separator tool (DIGITAL 9306171-00) (Figure 2-25).
7. Remove the two socket head cap screws holding the cam tower assembly to the baseplate; remove the assembly (Figure 2-42).

### **Replacement Procedure**

1. Locate the cam tower assembly on the baseplate, against the spring plate assembly, and install the two socket head cap screws (Figure 2-42).
2. Move the carriage and coil assembly to home position and remove the head separator tool (Figure 2-25).
3. Connect the single green lead E1P1 to E1J1 from the battery pack assembly (Figure 2-14).
4. Replace the shroud assembly (Paragraph 2.5.6).
5. Replace the lid assembly (Paragraph 2.5.3).
6. Replace the rear cover (Paragraph 2.5.2).
7. Replace the front bezel (Paragraph 2.5.1).

## **2.5.17 Spring Way Assembly**

### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.5.1).
2. Remove the rear cover (Paragraph 2.5.2).
3. Remove the lid assembly (Paragraph 2.5.3).
4. Remove the shroud assembly (Paragraph 2.5.6).
5. Remove the universal bracket assembly (Paragraph 2.5.15).

- \*6. Remove the cam tower assembly (Paragraph 2.5.16).
7. Remove the two socket head caps screws holding the spring way to the baseplate (Figure 2-40).
8. Lift the spring way assembly and remove the two roller dowels from the baseplate.

#### **Replacement Procedure**

1. Place the two roller dowels alongside the two roll pins in the baseplate; place the spring way over the roll pins and roller dowels (Figure 2-42).
2. Secure the spring way assembly to the baseplate with two socket head cap screws.
3. Replace the universal bracket assembly (Paragraph 2.5.15).
- \*4. Replace the cam tower assembly (Paragraph 2.5.16).
5. Replace the shroud assembly (Paragraph 2.5.6).
6. Replace the lid assembly (Paragraph 2.5.3).
7. Replace the rear cover (Paragraph 2.5.2).
8. Replace the front bezel (Paragraph 2.5.1).

---

\* On late model machines the cam tower assembly has been replaced by the universal bracket assembly. Remove either assembly as required.

#### **2.5.18 Circuit Breaker Assembly**

##### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.5.2).
2. Disconnect the ac line cord from the wall receptacle.
3. Swing the card nest down (open).
- \*4. Disconnect line cord ground leads from the chassis ground stud (Figure 2-16).
- †5. Disconnect the power transformer cable connector T1P1 from T1J1.
- \*6. Disconnect the ac distribution cable connector CBP1 from CBJ1.
- ‡7. Disconnect the two flat cable connectors XP9 and XP10 from the transition board.
8. Remove the two Phillips pan head screws holding the circuit breaker assembly to the rear chassis mount; then remove from machine.

---

\* On early model machines this can only be done after the circuit breaker assembly has been removed.

† On early model machines this does not have to be performed.

‡ On late model machines this does not have to be performed.

### **Replacement Procedure**

1. Slide the circuit breaker assembly into the rear chassis mount and secure with two Phillips pan head screws (Figure 2-16).
- ‡2. Connect the two flat cable connectors XP9 and XP10 to the transition board.
- \*3. Connect the ac distribution cable connector CBP1 to CBJ1.
- †4. Connect the power transformer cable connector T1P1 to T1J1.
- \*5. Connect the line cord ground leads to the chassis ground stud.
6. Swing the card nest up (closed).
7. Connect the ac line cord to the wall receptacle.
8. Replace the rear cover (Paragraph 2.5.2).

### **2.5.19 Magnet Housing Assembly (Late Model Machines Only)**

#### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.5.2).
2. Remove the circuit breaker assembly (Paragraph 2.5.18).
3. Disconnect the single green lead connector E1P1 from E1J1 or M2S1-2 on the home lock solenoid assembly switch from the battery pack assembly (Figure 2-24).
4. Push the carriage and coil assembly toward the spindle approximately 1 inch and install the head separator tool (DIGITAL 9306171-00) (Figure 2-25).
5. Remove the three socket head cap screws from the underside of the baseplate that hold the magnet housing assembly in place. It is necessary to use a ratchet wrench and short extension to remove the screws. The right front screw is accessible through an access hole in the top of the rear chassis mount.
6. Move the carriage and coil assembly toward the spindle and remove the magnet housing assembly to the rear and out of machine.

#### **Replacement Procedure**

1. With the carriage and coil assembly forward toward the spindle, position the magnet housing on the baseplate (Figure 2-24).
2. Insert the three socket head cap screws from the underside of the baseplate; do not tighten. It is necessary to use a ratchet wrench and a short extension to assemble the screws. The right front screw is accessible through an access hole in the top of the rear chassis mount.

\* On early model machines this can only be done after the circuit breaker assembly has been removed.

† On early model machines this does not have to be performed.

‡ On late model machines this does not have to be performed.

3. Move the carriage and coil assembly back so the coil enters the gap in the magnet housing assembly. Adjust the rear of the magnet housing assembly left or right until the gap is equal on both sides of the coil. Then tighten the screws.
4. Move the carriage and coil assembly to the home position and remove the head separator tool (Figure 2-25).
5. Connect the single green lead connector E1P1 to E1J1 or M2S1-2 on the home lock solenoid assembly switch from the battery pack assembly (Figure 2-24).
6. Replace the circuit breaker assembly (Paragraph 2.5.18).
7. Replace the rear cover (Paragraph 2.5.2).

## **2.5.20 Tachometer Magnet Assembly**

### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.5.2).
2. Swing the card nest down (open).
3. Disconnect the single green lead connector E1P1 from E1J1 or M2S1-2 on the home lock solenoid assembly switch from the battery pack assembly (Figure 2-24).
4. Push the carriage assembly toward the spindle approximately 1 inch and install the head separator tool (DIGITAL 9306171-00) (Figure 2-25).
5. Remove the two Phillips pan head screws holding the tachometer magnet assembly to the baseplate. Some early machines have the home lock solenoid assembly ground wire under one of the screws (Figure 2-26).

### **Replacement Procedure**

1. Place the tachometer magnet assembly into position on the baseplate and secure with two Phillips pan head screws. On some early machines the home lock solenoid assembly ground wire is under one of the screws; replace it at this time (Figure 2-26).
2. Loosen the two Phillips pan head screws holding the tachometer magnet assembly to the baseplate. With the magnet inside the bobbin, adjust the tachometer magnet assembly in or out until there is an equal amount of clearance on either side of the magnet. Move the carriage assembly the length of the magnet to ensure that the clearance is equal, and tighten the two Phillips pan head screws.
3. Loosen the two Phillips pan head screws holding the flexstrip assembly to the carriage, move the board up or down to center the bobbin on the tachometer magnet assembly, and tighten the two pan head screws.
4. Move the carriage to the home position and remove the head separator tool (Figure 2-25).
5. Connect the single green lead connector E1P1 to E1J1 or M2S1-2 to the home lock solenoid assembly switch from the battery pack assembly (Figure 2-24).
6. Swing the card nest up (closed).
7. Replace the rear cover (Paragraph 2.5.2).

## **2.5.21 Carriage and Coil Assembly**

### **2.5.21.1 (Late Model Machines Only)**

#### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.5.2).
2. Remove the lid assembly (Paragraph 2.5.3).
3. Remove the shroud assembly (Paragraph 2.5.6).
4. Remove the read/write heads (Paragraph 2.5.12).
5. Remove the servo head (Paragraph 2.5.13).
6. Remove the circuit breaker assembly (Paragraph 2.5.18).
7. Remove the magnet housing assembly (Paragraph 2.5.19).
8. Remove the tachometer magnet assembly (Paragraph 2.5.20).
9. Remove the glass shutter assembly (Paragraph 2.4.13).
10. Disconnect the flexstrip power cable connector M2P1 from M2J1 on the CA bracket (Figure 2-14).
11. Disconnect the flexstrip signal cable connector XP8 from XJ8 on the feed-through connector.
12. Disconnect the single green quick-connect terminal lead M2S1-2 on the home lock switch from the battery pack assembly (Figure 2-24).
13. Remove the two Phillips pan head screws holding the flexstrip power and signal cable to the baseplate and move to the flexstrip side of the baseplate (Figure 2-44).
14. Remove the two Phillips pan head screws holding the flexstrip bracket to the baseplate.
15. While supporting the flexstrip, remove the carriage and coil assembly to the rear and out of machine.

#### **Replacement Procedure**

1. While supporting the flexstrip, replace the carriage and coil assembly by lifting the spring way up to allow the carriage bearings to enter the ways (Figure 2-44).
2. Position the flexstrip bracket on the baseplate and secure with two Phillips pan head screws.
3. Route the power and signal cable along the baseplate and secure the cable clamps with two Phillips pan head screws.

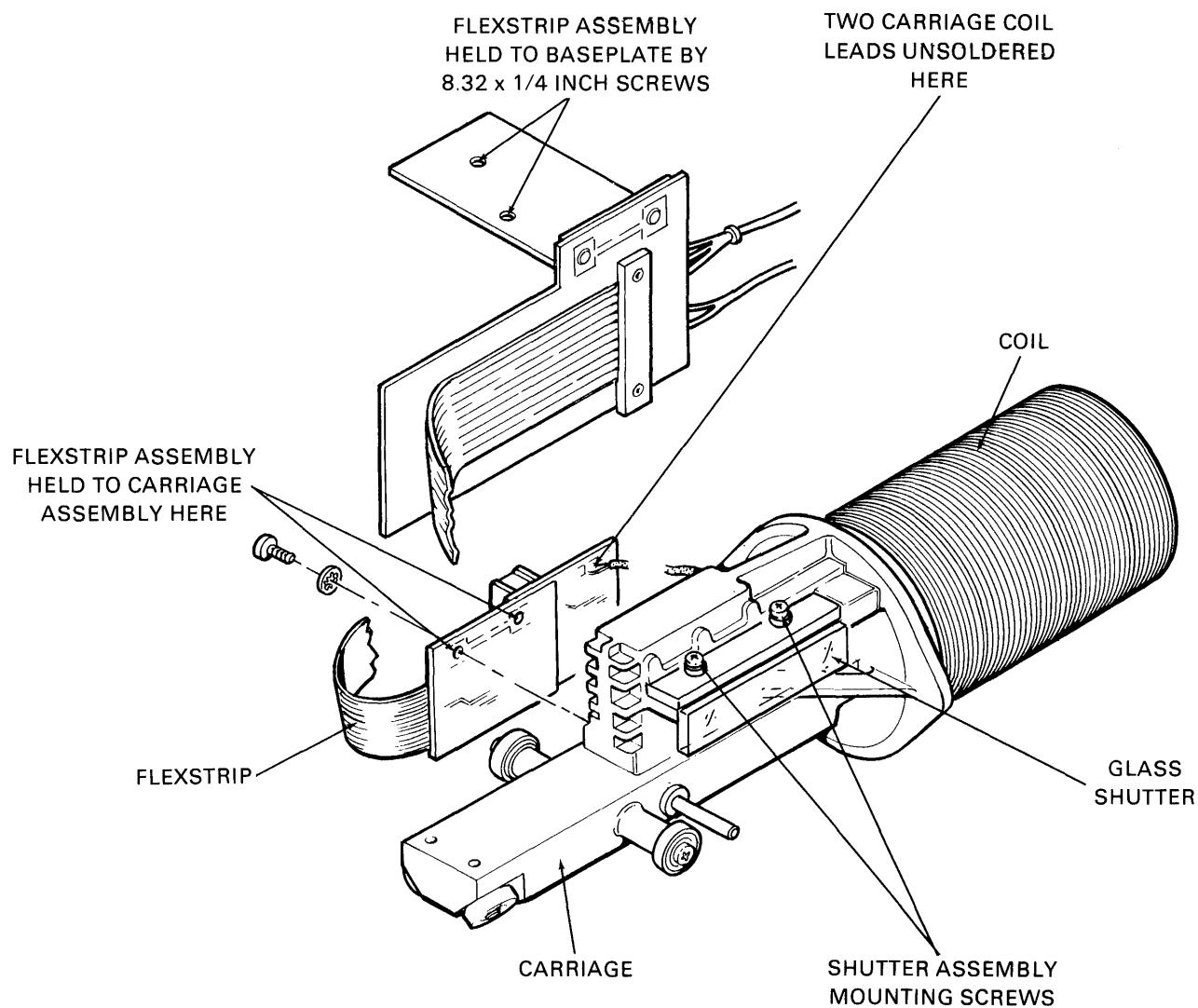


Figure 2-44 Carriage and Coil Assembly

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4. Connect the flexstrip signal cable connector XP8 to XJ8 on the feed-through connector (Figure 2-14).
5. Connect the flexstrip power cable connector M2P1 to M2J1 on the CA bracket.
6. Replace the magnet housing assembly (Paragraph 2.5.19).
7. Proceed to replacement procedures in Paragraph 2.5.21.2, step 8.

## **2.5.21.2 (Early Model Machines Only)**

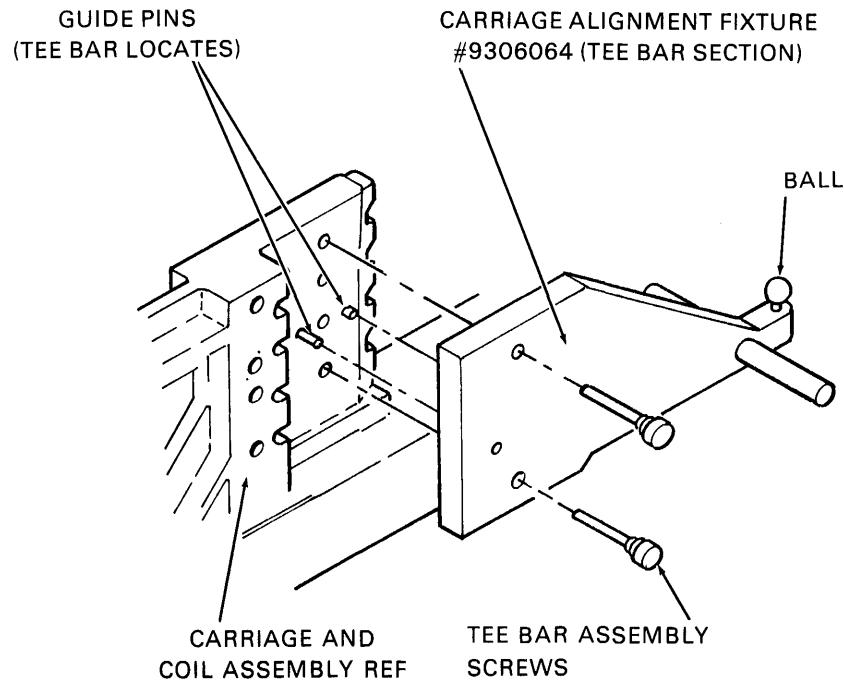
### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.5.2).
2. Remove the lid assembly (Paragraph 2.5.3).
3. Remove the shroud assembly (Paragraph 2.5.6).
4. Remove the read/write heads (Paragraph 2.5.12).
5. Remove the servo head (Paragraph 2.5.13).
6. Remove the glass shutter assembly (Paragraph 2.4.13).
7. Remove the fixed way (Paragraph 2.5.11).
8. Remove the cam tower assembly (Paragraph 2.5.16).
9. Remove the spring way assembly (Paragraph 2.5.17).
10. Remove the socket head cap screws holding the velocity transducer mounting block to the baseplate (Figure 2-30).
11. Remove the velocity transducer mounting block and set aside.
12. Disconnect the flexstrip power cable connector M2P1 from M2J1 on the CA bracket (Figure 2-14).
13. Disconnect the flexstrip signal cable connector XP8 from XJ8 on the transition board.
14. Remove the two Phillips pan head screws holding the flexstrip bracket to the baseplate (Figure 2-44).
15. While supporting the flexstrip, move the carriage toward the spindle and out of the machine.

### **Replacement Procedure**

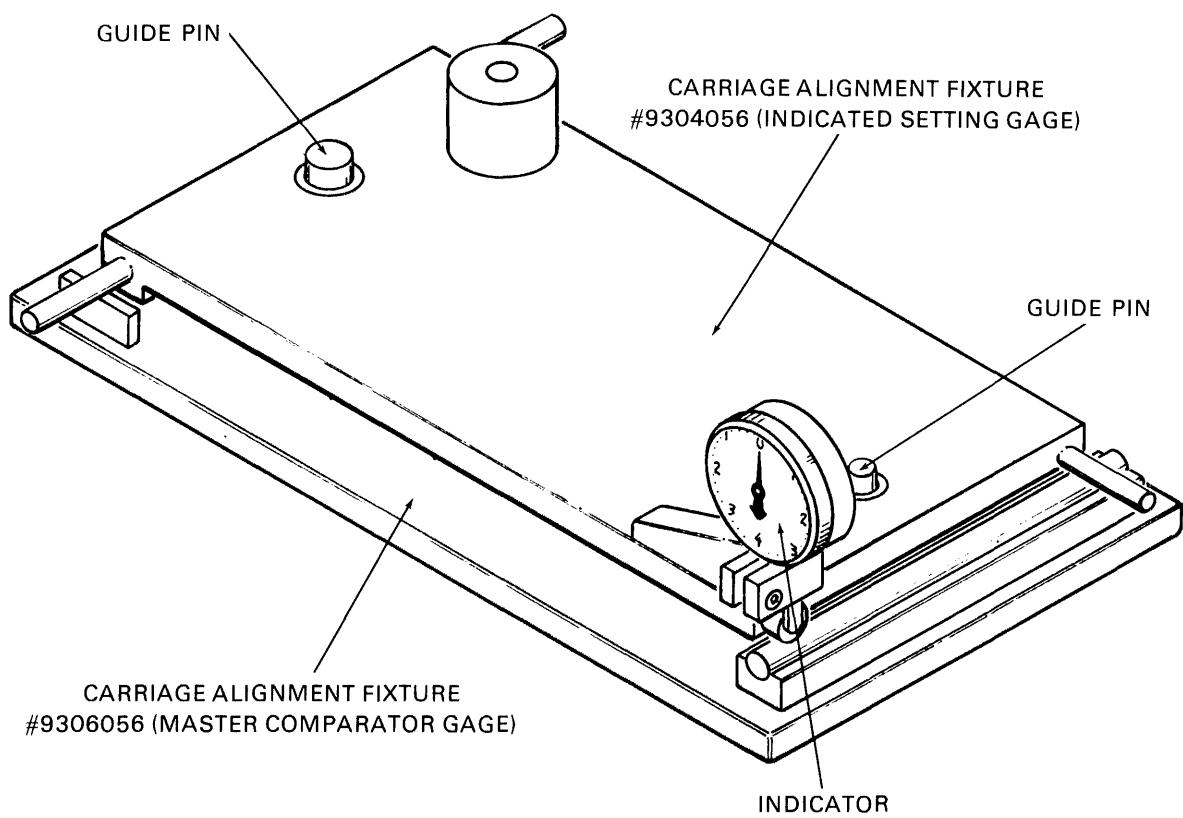
1. While supporting the flexstrip, place the carriage on the guide rod and move into the magnet housing assembly (Figure 2-44).
2. Position the flexstrip bracket on the baseplate and secure with two Phillips pan head screws.
3. Connect the flexstrip signal cable connector XP8 to XJ8 on the transition board (Figure 2-14).
4. Connect the flexstrip power cable connector M2P1 to M2J1 on the CA bracket.

5. Replace the spring way assembly (Paragraph 2.5.17).
6. Replace the cam tower assembly (Paragraph 2.5.16).
7. Replace the fixed way (Paragraph 2.5.11).
8. Move the carriage and coil assembly out beyond the cam tower or universal bracket assembly.
9. Assemble the tee bar section of the alignment fixture (DIGITAL 9306056-00) to the carriage (Figure 2-45).
10. With the indicator comparator gauge resting on the master setting gauge, set the indicator dial to zero. Note the number of turns of the indicator needle when the indicator comparator gauge is removed from the master setting gauge (Figure 2-46).
11. Place the indicator comparator gauge over the spindle cone, resting the dowels on the outer ring of the spindle. While holding the indicator end up, move the carriage forward toward the spindle to engage the ball on the tee bar. Note the number of turns of the indicator needle (Figure 2-47).



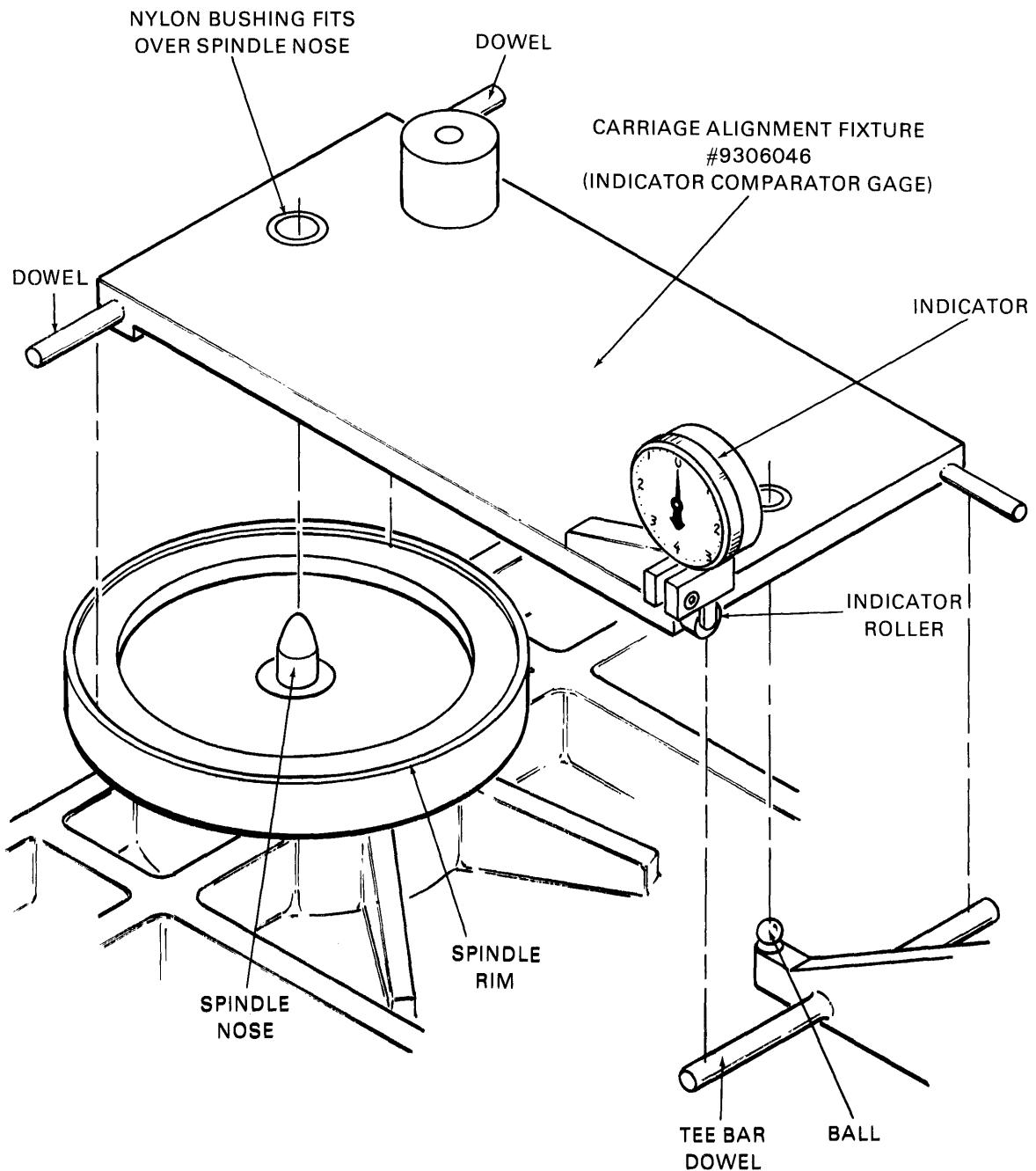
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Figure 2-45 Tee Bar Assembly



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Figure 2-46 Carriage Alignment Fixture



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Figure 2-47 Indicator Comparator Gauge

12. Loosen the screw holding the eccentric bearing to the carriage and retighten lightly. Insert the eccentric wrench (DIGITAL 9306058-00) and move the eccentric bearing until a zero reading is obtained on the indicator; then tighten the screw (tolerance  $\pm .001$  of zero). (The number of turns of the needle must equal the number of turns in step 10).
13. Lift the gauge off the ball on the tee bar and move the carriage and coil assembly back and forth several times. Replace the gauge on the tee bar and check the reading; readjust as required.
14. Remove the comparator indicator gauge off the ball on the tee bar and the spindle cone. Place it on the master gauge.
15. Remove the tee bar from the carriage and coil assembly.
16. Move the carriage and coil assembly to the home position.
17. Perform the glass shutter alignment.
  - a. Disconnect the single green lead connector E1P1 from E1J1 or M2S1 on the home lock solenoid assembly switch from the battery pack assembly.
  - b. Remove the transducer block.
  - c. With the head separator tool in place, push the carriage assembly toward the spindle (Figure 2-25).
  - d. The following steps will vary depending on which glass shutter alignment fixture is used. If the older fixture is used, begin at step e. If the new fixture (No. 93-06240) is used, begin at step j.

**NOTE**

**If both fixtures are available, it is recommended that  
the newer one be used. Do not use the old fixture  
unless the newer fixture is unavailable.**

- e. Assemble the glass shutter alignment fixture onto the transducer mounting block, locating the slot in the fixture around the two dowel pins (Figure 2-29). Assemble the screw clamp as shown. Loosen the two screws holding the shutter.
- f. Move the carriage and coil assembly so that the dowel pin on the glass is in line with the contact of the dial indicator.
- g. Set the dial indicator to zero by moving the fixture in or out and clamp in place.
- h. Move the carriage and coil assembly so that the contact of the dial indicator is at one end of the glass shutter. Move the glass shutter in or out until a zero reading is obtained and tighten the screw lightly.
- i. Move the carriage and coil assembly back and forth, checking the dial indicator movement. The total indicator reading should not vary more than 0.001 inch. Adjust the shutter until the proper reading is obtained and tighten both screws. Recheck the alignment after tightening the screws. Proceed to step q.

- j. Assemble the glass shutter alignment fixture (No. 93-06240) onto the transducer mounting block, locating the holes in the fixture around the two dowel pins (Figure 2-29). Tighten down screw knob A to lock the fixture in place. Loosen the two screws holding the glass shutter.
  - k. Move the carriage and coil assembly back away from the spindle area to allow the contact arm of the dial indicator to be positioned behind the inside surface of the glass shutter as shown (Figure 2-29). The contact arm pivots in a ratchet to allow for adjustments.
  - l. Move the carriage and coil assembly so that the dowel pin on the glass is in line with the contact arm of the dial indicator.
  - m. The direction lever on the side of the dial gauge must be set in the upward position to allow the gauge to read when contact is made with the glass (Figure 2-29).
  - n. Loosen knob B and pivot the indicator arm slightly until the glass shutter touches the dial contact arm and the dial pointer is at 0.015. Tighten knob B with the indicator in this position.
  - o. Twist the zero adjust ring until the zero on the gauge sits directly under the dial pointer.
  - p. Move the carriage and coil assembly back and forth, checking the dial indicator movement. The total indicator reading should not vary more than 0.001 inch. Adjust the shutter until the proper reading is obtained and tighten both screws. Recheck the alignment after tightening both screws.
  - q. Remove the alignment fixture.
18. Replace the transducer housing to the transducer mounting block and assemble the two socket head cap screws, but do not tighten.
19. Use both the purple and green shims to form a 0.0045 inch shim. Place the shim into the slot of the housing, green side toward the glass shutter. While holding the housing against the two dowel pins, push the carriage assembly toward the spindle and adjust the housing until there is a slight drag on the shim when the glass shutter is moved. Tighten the two socket head cap screws. Recheck that the housing is resting against the two dowel pins (Figure 2-30).

#### **CAUTION**

**Do not damage or smudge the glass shutter when  
making this adjustment.**

- 20. Move the carriage to the home position and move the head separator tool.
- 21. Connect the single green lead connector E1P1 to E1J1 or M2S1-2 to the homelock solenoid assembly switch from the battery pack assembly (Figure 2-24).
- 22. Replace the shroud assembly (Paragraph 2.5.6).
- 23. Place the servo head into the insertion tool (DIGITAL 9306171-00) with the dowel pin all the way to the rear of the slot in the head (Figure 2-22).

24. Install the servo head into the carriage servo position, sliding the servo head all the way back against the dowel pin in the carriage, toward the coil.
25. Torque the captive socket head cap screw to 5 inch-pounds and remove the head insertion and removal tool.
26. Connect the servo head connector to the read/write board or connector holder, middle connector on the cable (Figure 2-21).
27. Connect the servo head connector to the servo pre-amp board, end connector on the cable.
28. Replace the read/write heads 0, 1, and 2, as follows:
  - a. Place the read/write head into the insertion and removal tool, and carefully install the read/write head into its proper positions (Figures 2-19 and 2-20).
  - b. Torque the captive socket head cap screw to 5 inch-pounds.
  - c. Remove the head insertion and removal tool.
  - d. Connect the read/write head connector to the read/write board (Figure 2-21).
29. Replace the lid assembly (Paragraph 2.5.3).
30. Replace the tachometer magnet assembly (if required) (Paragraph 2.5.20).
31. Replace the circuit breaker assembly (if required) (Paragraph 2.5.18).
32. Perform the head alignment procedure (Paragraph 3.4).
33. Replace the rear cover (Paragraph 2.5.2).

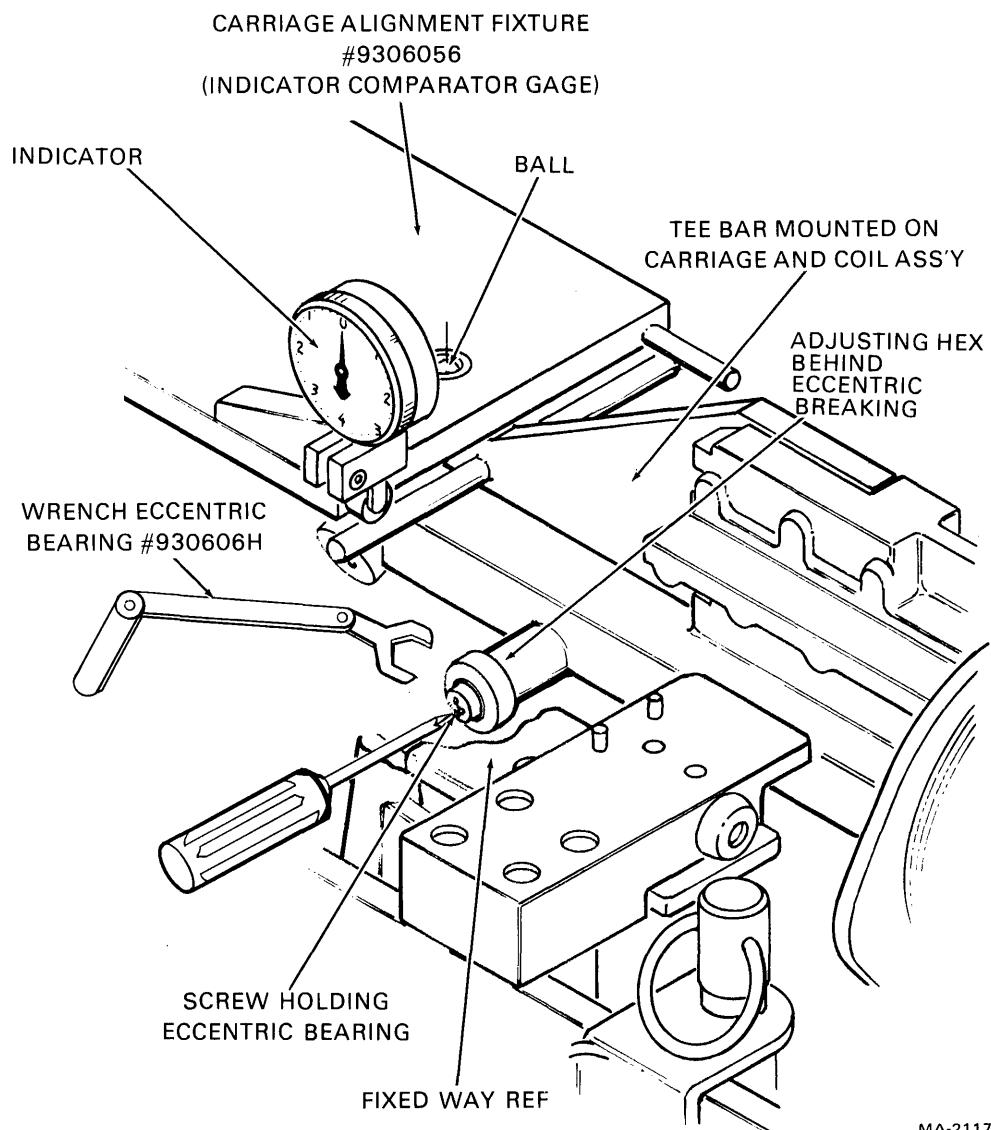
## **2.5.22 Guide Rod**

### **Removal Procedure**

1. Remove the carriage and coil assembly (Paragraph 2.5.21).
2. Remove the two socket head cap screws holding the guide rod to the baseplate and lift the guide rod out of machine (Figure 2-49).

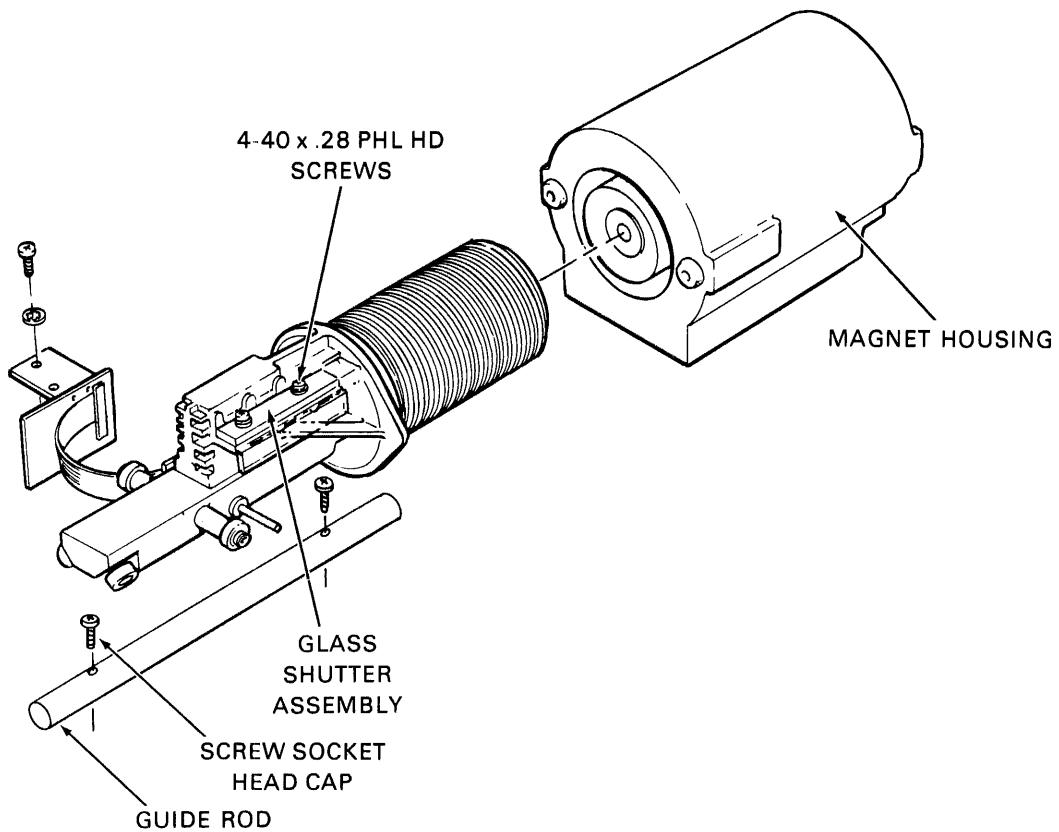
### **Replacement Procedure**

1. Replace the guide rod with the counterbores facing up, and the shortest distance to the holes toward the spindle (Figure 2-49).
2. Replace the two socket head cap screws and torque the screw nearest the spindle to 1/2 inch-pounds and the other screw to 13/15 inch pounds.
3. Replace the carriage and coil assembly (Paragraph 2.5.21).



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Figure 2-48 Eccentric Bearing Adjustment



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Figure 2-49 Guide Rod

## 2.6 BASEPLATE ASSEMBLY AREA

### NOTE

See Figure 2-50 for the baseplate assembly area removal and replacement procedures block diagram.

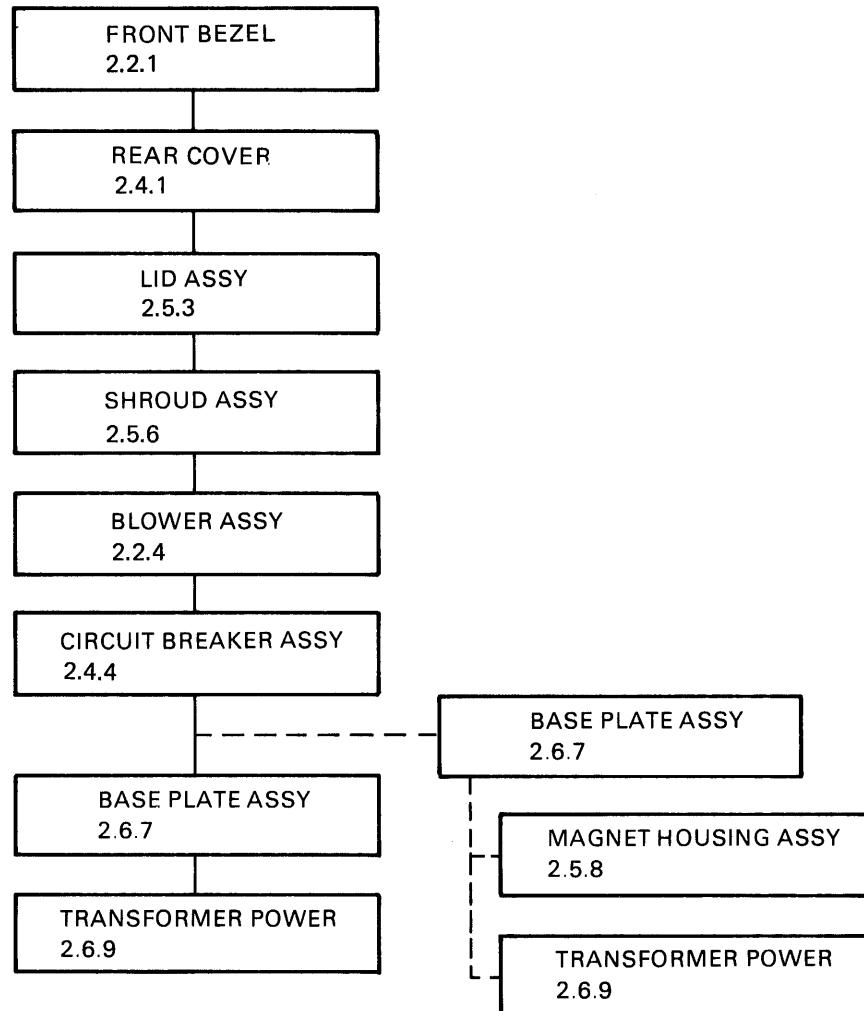
### 2.6.1 Front Bezel

#### Removal Procedure

1. Open the lid assembly cover.
2. Remove the two Phillips flat head screws holding the bezel to the front frame (Figure 2-3).
3. Pull the bezel straight out from the front frame.

**BASEPLATE ASSEMBLY REMOVAL**

2.5



NOTE:

--- EARLY MODEL MACHINES ONLY

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Figure 2-50 Baseplate Assembly Area Removal and Replacement Procedures Block Diagram

### **Replacement Procedure**

1. Insert the bezel guide pins into the holes in the front frame and push the bezel into place.
  2. Install the two Phillips flat head screws.
- NOTE**
- If this machine has a plastic bezel, do not overtighten the screws. Doing so will cause the bezel to bend, making it difficult or impossible to do the latch adjustment. Tighten the screws until the front bezel is just touching the drive, and then turn the screw one-half to one more turn.
3. Close the lid assembly cover.

### **2.6.2 Rear Cover**

#### **Removal Procedure**

1. Remove the two Phillips pan head screws holding the rear cover in place.
2. Pull the rear cover back approximately two inches and lift up and out of machine.

#### **Replacement Procedure**

1. Place the rear cover into position; ensure that the slides engage the chassis and push forward to engage the locking tabs with the lid assembly.
2. Install the two Phillips pan head screws.

### **2.6.3 Lid Assembly**

#### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.6.2).
2. Open the lid assembly cover and remove the two Phillips pan head screws holding the lid assembly in place.
3. Slide the lid assembly to the rear and lift up and out of machine.

#### **Replacement Procedure**

1. With the lid assembly cover open, place the lid assembly over the chassis and lower into place; slide the lid assembly forward to engage the two tabs into slots located in the front of the chassis.
2. Insert the two Phillips pan head screws and secure; ensure that the lid assembly is all the way forward.

## **2.6.4 Shroud Assembly**

### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.6.1).
2. Remove the rear cover (Paragraph 2.6.2).
3. Remove the lid assembly (Paragraph 2.6.3).
4. Remove the socket head cap screw holding the brush indicator knob in place and remove the knob (Figure 2-40).
5. Remove the two quick-connect terminal leads from the pack-in place switch terminals.
6. Loosen the top hose clamp holding the flexible hose to the shroud inlet and remove the flexible hose from the shroud inlet.

#### **NOTE**

**On late model machines the read/write board is mounted to a universal bracket assembly making it possible to remove the shroud assembly without disconnecting cable or grounds located on the read/write board.**

7. Remove the read/write board ground lead ring tongue from under the top servo pre-amp assembly mounting screw.
8. Disconnect the two flat cable connectors RWP1 and RWP2 from the read/write board (Figure 2-23).
9. Disconnect the read/write and servo head cable connectors from the read/write board.
10. Remove the six Phillips pan head screws holding the shroud assembly to the baseplate (Figure 2-40).
11. Remove the shroud assembly.

### **Replacement Procedure**

1. Place the shroud assembly into position on the baseplate (Figure 2-40).
2. Secure the shroud assembly to the baseplate with six Phillips pan head screws.

#### **NOTE**

**On late model machines the read/write board is mounted to a universal bracket assembly making it possible to remove the shroud assembly without disconnecting cable or grounds located on the read/write board.**

3. Connect the read/write and servo head cable connectors to the read/write board (Figure 2-23).

4. Connect the two flat cable connectors RWP1 and RWP2 to the read/write board.
5. Connect the read/write board ground lead ring tongue under the top mounting screw of the servo pre-amp assembly.
6. Place the flexible hose on the shroud inlet and tighten the hose clamp (Figure 2-40).
7. Connect the quick-connect terminal leads to the pack-in-place switch terminals, black to COM and blue to NO.
8. Place the socket head cap screw into the brush indicator knob and place through the hole in the shroud. Position the arrow on the knob to indicate the position of the brushes and tighten the screw.
9. Replace the lid assembly (Paragraph 2.6.3).
10. Replace the rear cover (Paragraph 2.6.2).
11. Replace the front bezel (Paragraph 2.6.1).

### **2.6.5 Blower Assembly**

#### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.6.1).
2. Remove the hose from the blower outlet (Figure 2-4).
3. Disconnect the blower assembly cable connector M1P1 from M1J1 on the front frame.
4. Remove the two Phillips pan head screws holding the blower assembly to the front frame.
5. Remove the blower assembly from the chassis.

#### **Replacement Procedure**

1. Slide the blower assembly into the chassis; ensure that the tab on the blower assembly locks into the guide on the chassis floor (Figure 2-4).
2. Install the two Phillips pan head screws.
3. Connect the hose to the blower assembly outlet.
4. Connect the blower assembly cable connector M1P1 to M1J1 on the front frame.
5. Replace the front bezel (Paragraph 2.6.1).

### **2.6.6 Circuit Breaker Assembly**

#### **Removal Procedure**

1. Remove the rear cover (Paragraph 2.6.2).

2. Disconnect the ac line cord from the wall receptacle.
3. Swing the card nest down (open).
4. Disconnect line cord ground leads from the chassis ground stud (Figure 2-16).

**NOTE**

**On early model machines this can only be done after  
the circuit breaker assembly has been removed.**

5. Disconnect the power transformer cable connector T1P1 from T1J1.

**NOTE**

**On early model machines this does not have to be  
performed.**

6. Disconnect the ac distribution cable connector CBP1 from CBJ1.

**NOTE**

**On early model machines this can only be done after  
the circuit breaker assembly has been removed.**

7. Disconnect the two flat cable connectors XP9 and XP10 from the transition board.

**NOTE**

**On late model machines this does not have to be per-  
formed.**

8. Remove the two Phillips pan head screws holding the circuit breaker assembly to the rear chassis mount and remove from machine.

#### **Replacement Procedure**

1. Slide the circuit breaker assembly into the rear chassis mount and secure with two Phillips pan head screws (Figure 2-16).
2. Connect the two flat cable connectors XP9 and XP10 to the transition board.

**NOTE**

**On late model machines this does not have to be per-  
formed.**

3. Connect the ac distribution cable connector CBP1 to CBJ1.

**NOTE**

**On early model machines this can only be done after  
the circuit breaker assembly has been removed.**

4. Connect the power transformer cable connector T1P1 to T1J1.

**NOTE**

**On early model machines this does not have to be  
performed.**

5. Connect the line cord ground leads to the chassis ground stud.

**NOTE**

**On early model machines this can only be done after  
the circuit breaker assembly has been removed.**

6. Swing the card nest up (closed).
7. Connect the ac line cord to the wall receptacle.
8. Replace the rear cover (Paragraph 2.6.2).

## **2.6.7 Baseplate Assembly**

### **2.6.7.1 (Late Model Machines Only)**

#### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.6.1).
2. Remove the rear cover (Paragraph 2.6.2).
3. Remove the lid assembly (Paragraph 2.6.3).
4. Remove the shroud assembly (Paragraph 2.6.4).
5. Remove the blower assembly (Paragraph 2.6.5).
6. Remove the circuit breaker assembly (Paragraph 2.6.6).
7. Disconnect the two flat cable connectors RWP1 and RWP2 from the read/write board (Figure 2-23).
8. Disconnect the single flat cable connector XP10 from XJ10 on the feed-through connector (Figure 2-5).
9. Disconnect the brush and motor assembly cable connector M4P1 from M4J1 on the TA bracket (Figure 2-4).
10. Disconnect the motor and bracket assembly cable connector M3P1 from M3J1 on the TA bracket.
11. Disconnect the flexstrip power cable connector M2P1 from M2J1 on the CA bracket (Figure 2-14).
12. Disconnect the speed sensor assembly cable connector XP1 from XJ1 on the feed-through connector.
13. Disconnect the SPAJ1 cable connector on the servo pre-amp assembly and remove the cable clamp.
14. Remove the two bolts and kep nuts holding the baseplate to the front shockmounts (Figure 2-5).

15. Remove the single bolt holding the baseplate to the front shockmounts (Figure 2-5).
16. Lift the baseplate out of the chassis (requires two people).

#### **Replacement Procedure**

1. Lift the baseplate assembly into the chassis and position the mounting holes over the shockmounts (Figure 2-5).
2. Install the rear mounting bolt through the shockmount to the baseplate. Do not tighten.
3. Install the two front mounting bolts through the baseplate and shockmounts and install the two kep nuts.
4. Torque the 3 mounting bolts to 45 inch-pounds.
5. Attach connector SPAJ1 to the servo pre-amp board and install cable clamp (Figure 2-10).
6. Connect the speed sensor assembly cable connector XP1 to XJ1 on the feed-through connector.
7. Connect the motor and bracket assembly cable connector M3P1 to M3J1 on the TA bracket.
8. Connect the brush and motor assembly cable connector M4P1 to M4J1 on the TA bracket.
9. Connect the flexstrip power cable connector M2P1 to M2J1 on the CA bracket.
10. Connect the single flat cable connector XP10 to XJ10 on the feed-through connector (Figure 2-5).
11. Attach the two flat cable connectors RWP1 and RWP2 to the read/write board (Figure 2-23).
12. Replace the circuit breaker assembly (Paragraph 2.6.6).
13. Replace the blower assembly (Paragraph 2.6.5).
14. Replace the shroud assembly (Paragraph 2.6.4).
15. Replace the lid assembly (Paragraph 2.6.3).
16. Replace the rear cover (Paragraph 2.6.2).
17. Replace the front bezel (Paragraph 2.6.1).

#### **2.6.7.2 (Early Model Machines Only)**

#### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.6.1).
2. Remove the rear cover (Paragraph 2.6.2).

3. Remove the lid assembly (Paragraph 2.6.3).
4. Remove the shroud assembly (Paragraph 2.6.4).
5. Remove the blower assembly (Paragraph 2.6.5).
6. Remove the circuit breaker assembly (Paragraph 2.6.6).
7. Disconnect the single green lead connector E1P1 from E1J1, located at the left rear of the baseplate, from the battery pack assembly (Figure 2-10).
8. Disconnect the flexstrip power cable connector M2P1 from M2J1 on the CA bracket.
9. Disconnect the brush and motor assembly cable connector M4P1 from M4J1 on the TA bracket.
10. Disconnect the motor and bracket assembly cable connector M3P1 from M3J1 on the TA bracket.
11. Disconnect the latch assembly cable connector XP2 from XJ2 on the transition board (Figure 2-5).
12. Disconnect the servo head connector from the servo pre-amp board and remove the servo pre-amp assembly from the baseplate (Figure 2-23).
13. Remove the two bolts and kep nuts holding the baseplate to the front shockmounts (Figure 2-5).
14. Remove the single bolt holding the baseplate to the rear shockmount.
15. Lift the baseplate assembly out of the chassis (requires two people).

#### **Replacement Procedure**

1. Lift the baseplate assembly into the chassis and position the mounting holes over the shockmounts (Figure 2-5).
2. Install the rear mounting bolt through the shockmount to the baseplate. Do not tighten.
3. Install the two front mounting bolts through the baseplate and install the two kep nuts.
4. Torque the 3 mounting bolts to 45 inch-pounds.
5. Assemble the servo pre-amp assembly to the baseplate and connect the servo head connector to the servo pre-amp board (Figure 2-23).
6. Connect the latch assembly cable connector XP2 to XJ2 on the transition board (Figure 2-5).
7. Connect the flexstrip power cable connector M2P1 to M2J1 on the CA bracket (Figure 2-14).

8. Connect the motor and bracket assembly cable connector M4P1 to M4J1 on the TA bracket.
9. Connect the brush and motor assembly cable connector M3P1 to M3J1 on the TA bracket.
10. Connect the single green lead connector E1P1 to E1J1, located at the left rear of the baseplate, from the battery pack assembly.
11. Replace the circuit breaker assembly (Paragraph 2.6.6).
12. Replace the blower assembly (Paragraph 2.6.5).
13. Replace the shroud assembly (Paragraph 2.6.4).
14. Replace the lid assembly (Paragraph 2.6.3).
15. Replace the rear cover (Paragraph 2.6.2).
16. Replace the front bezel (Paragraph 2.6.1).

## **2.6.8 Magnet Housing Assembly (Early Model Machines Only)**

### **Removal Procedure**

1. Remove the baseplate assembly (Paragraph 2.6.7.2).
2. Push the carriage and coil assembly toward the spindle approximately 1 inch and install the head separator tool (DIGITAL 9306171-00) (Figure 2-25).
3. Remove the four Phillips pan head screws holding the transition board to the transition board bracket; then remove the board. There is no need to disconnect any cable connectors (Figure 2-5).
4. Remove the transition board insulator.
5. Remove the three socket head cap screws from under the baseplate that are holding the magnet housing in place (Figure 2-36).
6. Move the carriage and coil assembly forward (toward the spindle) and remove the magnet housing assembly to the rear and out of machine.

### **Replacement Procedure**

1. With the carriage and coil assembly forward (toward the spindle) position the magnet housing on the baseplate (Figure 2-36).
2. Insert the three socket head cap screws from under the baseplate. Do not tighten.
3. Move the carriage and coil assembly back so that the coil enters the gap in the magnet housing assembly. Adjust the rear of the magnet housing assembly left or right until the gap is equal on both sides of the coil. Tighten the screws.

4. Move the carriage and coil assembly to the home position and remove the head separator tool.
5. Replace the transition board insulator and transition board and secure with four Phillips pan head screws (Figure 2-5).
6. Replace the baseplate assembly (Paragraph 2.6.7.2).

## **2.6.9 Power Transformer**

### **Removal Procedure**

1. Remove the front bezel (Paragraph 2.6.1).
2. Remove the rear cover (Paragraph 2.6.2).
3. Remove the lid assembly (Paragraph 2.6.3).
4. Remove the shroud assembly (Paragraph 2.6.4).
5. Remove the blower assembly (Paragraph 2.6.5).
6. Remove the circuit breaker assembly (Paragraph 2.6.6).
7. Remove the baseplate assembly (Paragraph 2.6.7).
8. Disconnect connector T1P2 from T1J2 on the CA bracket or T1P2 from T1J2 on the TA bracket (Figure 2-14).
9. Disconnect connector T1P1 from T1J1 on the TA bracket. (With the circuit breaker assembly removed, T1P1 is already removed on late model machines.)
10. Disconnect connector A2P3 from A2J3 inside the power supply (on late model machines) and T1P3 from T1J3 on the TA bracket (on early model machines).
11. Disconnect the two quick-connect terminals from the transformer capacitor (Figure 2-4).
12. Remove the four Phillips pan head screws holding the transformer to the chassis; then remove the transformer.

## **Replacement Procedure**

1. Position the power transformer into the chassis and secure with four Phillips pan head screws (Figure 2-4).
2. Connect the two quick-connect terminals to the transformer capacitor.
3. Attach connector A2P3 to A2J3 inside the power supply or T1P3 to T1J3 on the TA bracket.
4. Attach connector T1P1 to T1J1 on the TA bracket. (When the circuit breaker assembly is replaced on late model machines this connector will be attached).
5. Attach connector T1P2 to T1J2 on the CA bracket or T1P2 to T1J2 on the TA bracket.
6. Replace the baseplate assembly (Paragraph 2.6.7).
7. Replace the blower assembly (Paragraph 2.6.5).
8. Replace the shroud assembly (Paragraph 2.6.4).
9. Replace the lid assembly (Paragraph 2.6.3).
10. Replace the rear cover (Paragraph 2.6.2).
11. Replace the front bezel (Paragraph 2.6.1).



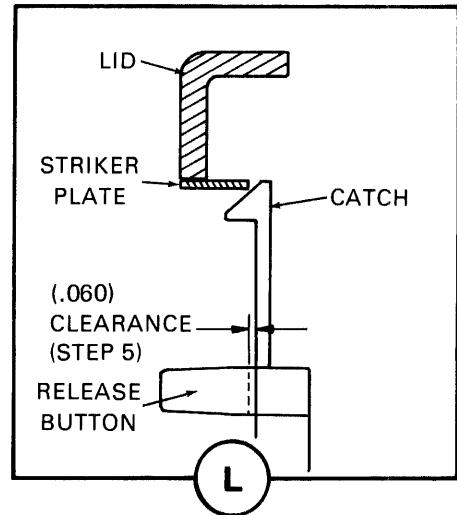
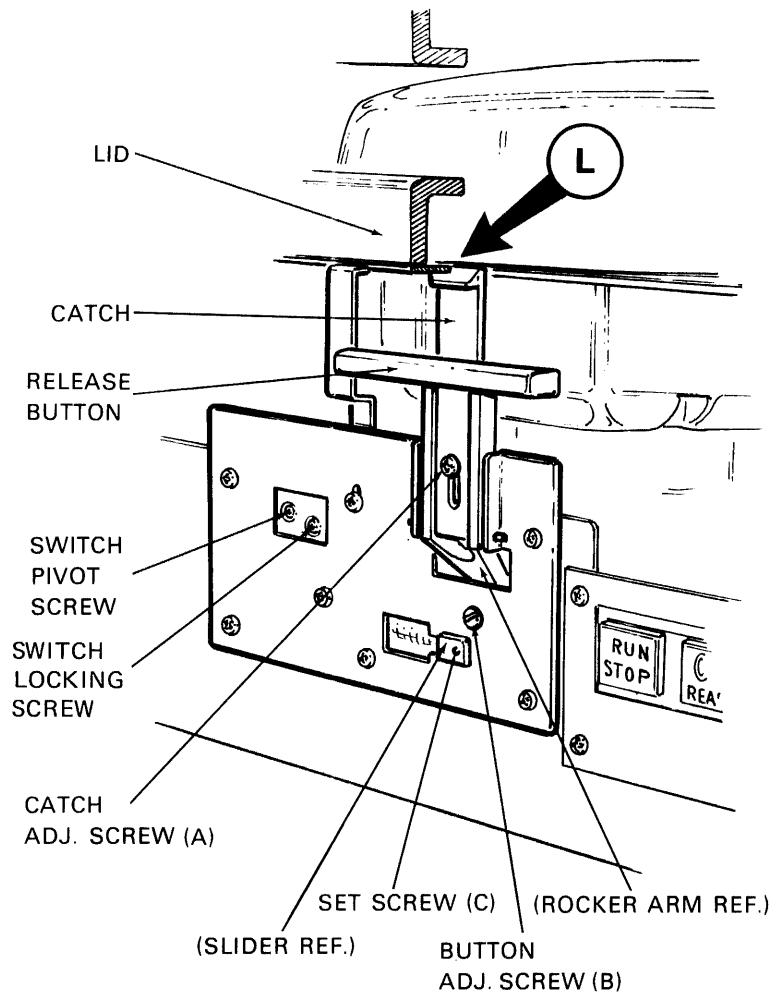
## CHAPTER 3

### ADJUSTMENT PROCEDURES

#### 3.1 LATCH ASSEMBLY ADJUSTMENT

##### Procedure

1. Open the lid assembly cover. (If the power is OFF, insert a screwdriver blade into the slot beneath the latch and push to release the latch.)
2. Remove the front bezel (Paragraph 2.2.1). (If not already removed.)
3. Bring the lid assembly cover down until the striker plate rests on the top of the catch. Adjust the catch screw (A) until the edge of the striker plate touches the uppermost part of the catch ramp. Close the lid assembly cover to make sure it is latched properly. (EXAMPLE: Edge of striker plate is engaged under catch.) (Figure 3-1).
4. With the lid assembly cover up, turn the button adjusting screw (B) until there is approximately .060 inch clearance between the back of the button and the catch.
5. Tighten the set screw (C) in the slider until it touches the rocker arm, then back off one full turn.
6. As a check for the above adjustments, perform the following test. With the power OFF and the lid assembly cover up, press the latch release button. If the adjustments are correct, the .060 inch clearance behind the button should decrease by about one half.
7. The latch assembly switch can be checked for proper adjustment by performing the following steps:
  - a. With the power ON and the lid assembly cover closed, hold the slider all the way to the left. Press the RUN/STOP button. If the adjustments are correct, the spindle motor will not start. If the motor does start, then the latch switch is down too far and must be moved up. Next, let the slider move back to the right; the motor should start up.
  - b. Also, check latch switch adjustment by applying some upward pressure on the lid assembly cover. If the switch breaks, the carriage and coil assembly will move back into the magnet housing and the latch switch will have to be readjusted.
8. To adjust the latch switch, perform the following steps.
  - a. With the lid assembly cover closed and the power ON, loosen the switch pivot and locking screws slightly. Then move the switch up.
  - b. Press the RUN/STOP button.



11-5169

Figure 3-1 Latch Assembly

- c. Move the slider approximately 1/8 inch from the right edge of the slot and hold it there with one hand.
  - d. While holding the slider, use the other hand to move the switch down until the spindle motor starts turning. Tighten both the pivot and locking screws.
  - e. Go back to step 8 and perform the latch switch adjustment checks.
9. Replace the front bezel (Paragraph 2.2.1).

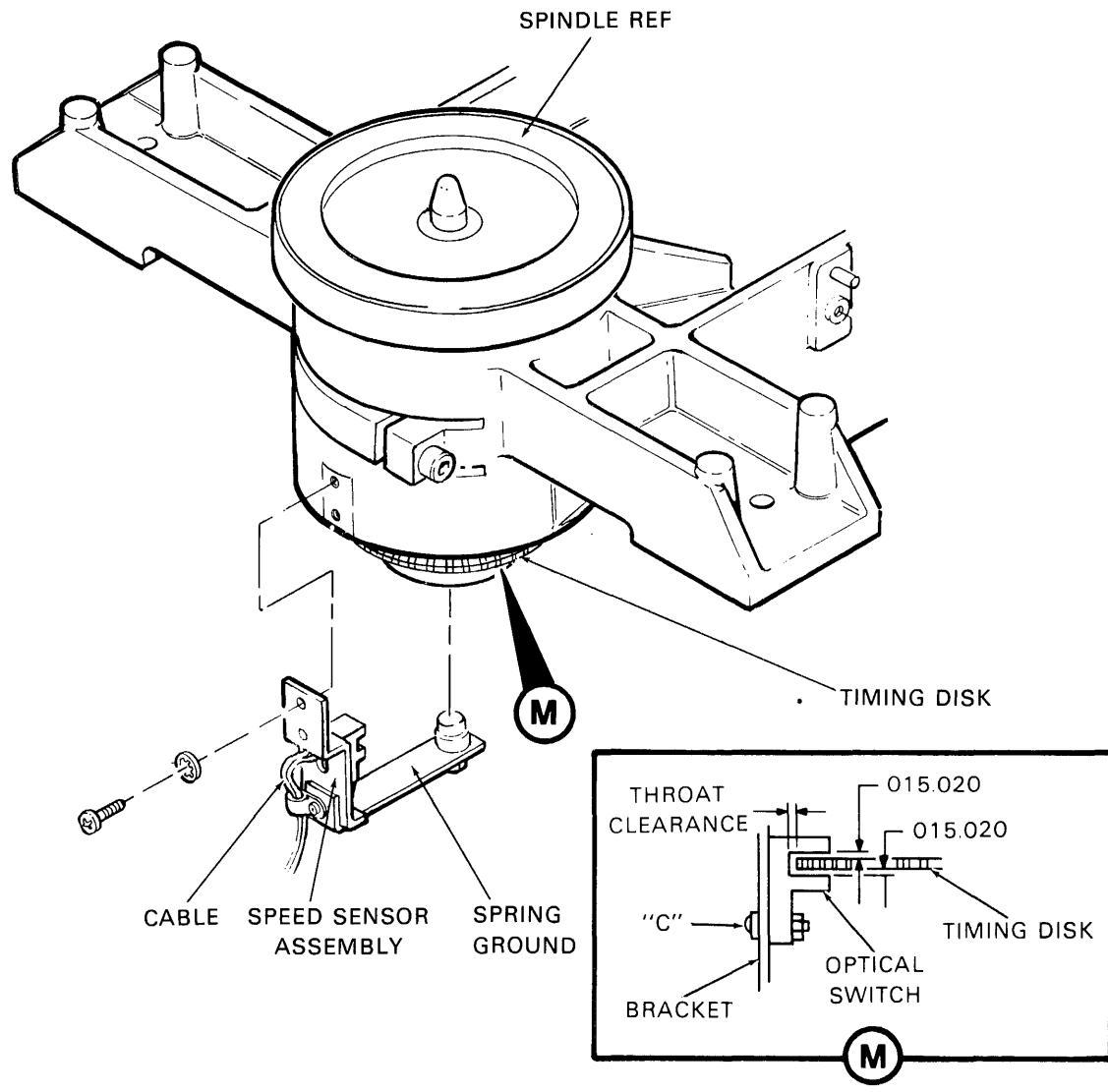
#### CAUTION

If this machine has a plastic bezel, do not overtighten the screws. Tighten the screws until the bezel just touches the machine, and then give the screws an additional 1/2 to a full turn more.

### 3.2 SPEED SENSOR ASSEMBLY ADJUSTMENTS

#### Procedure

1. Open the lid assembly cover.
2. Remove the front bezel (Paragraph 2.2.1).
3. Remove the blower assembly (Paragraph 2.2.4).
4. Loosen the adjusting screw "C" (Figure 3-2).



MA-2124

Figure 3-2 Speed Sensor Adjustment

5. Place a .015 inch shim between the optical switch and the timing disk and tighten the adjusting screw. Check both sides of the timing disk for the .015/.020 inch clearance.
6. Check the throat clearance by rotating the spindle, making sure that there is no interference.
7. Replace the blower assembly (Paragraph 2.2.4).
8. Replace the front bezel (Paragraph 2.2.1).

### 3.3 BELT TENSION ADJUSTMENT

#### Procedure

1. Remove the front bezel (Paragraph 2.6.1).
2. Remove the rear cover (Paragraph 2.6.2).
3. Remove the lid assembly (Paragraph 2.6.3).
4. Remove the blower assembly (Paragraph 2.6.5).
5. Use the spring plunger gauge (DIGITAL 9306154-00) to set the spring plunger compression. If a spring plunger gauge is not available, set the spring plunger compression to about 50 percent or approximately 0.100 inch. All checks are done when the belt is in place (Figure 3-3).

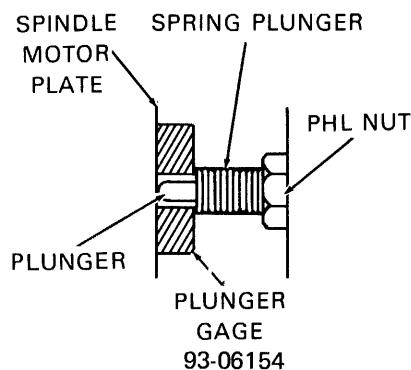


Figure 3-3 Spring Plunger Adjustment

#### 6. Adjust the spring plunger as follows:

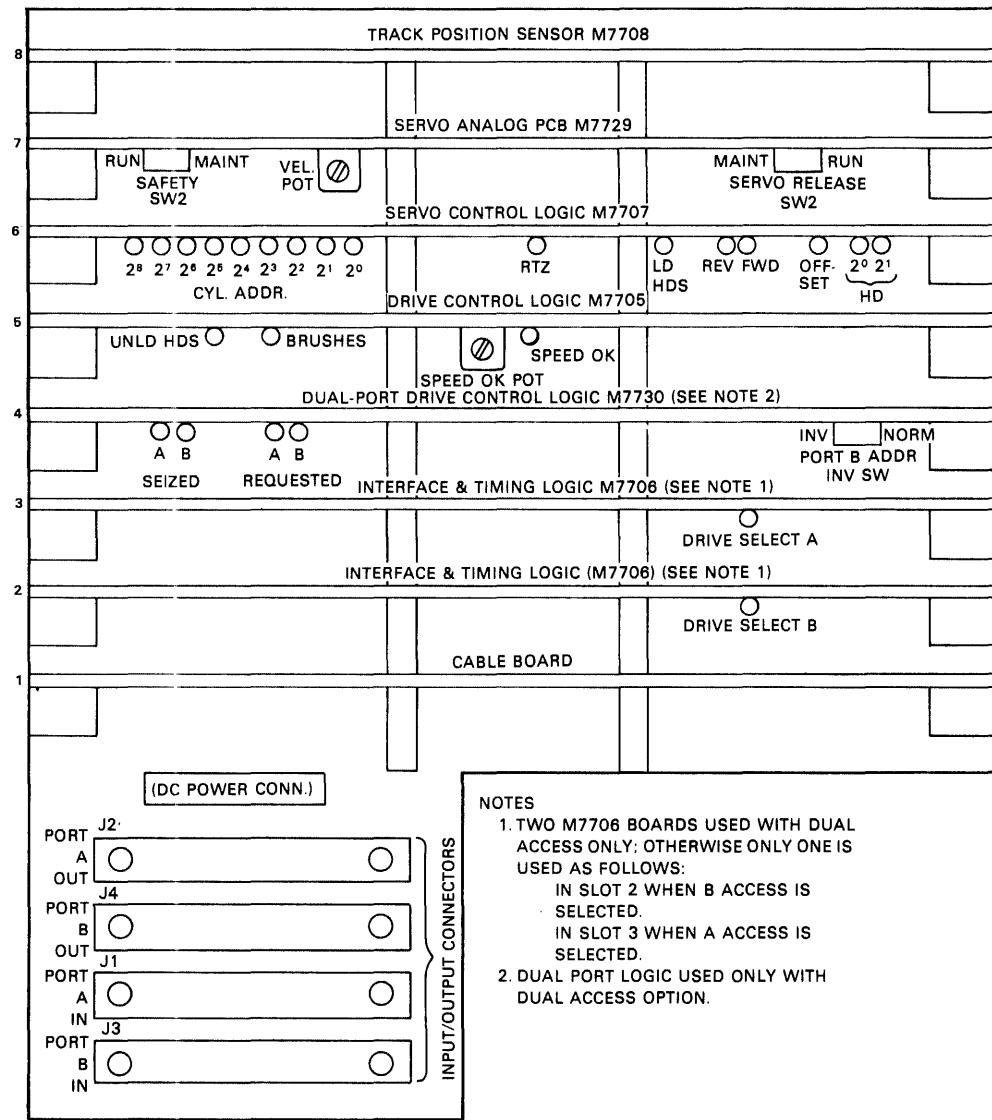
- a. While pressing on the motor to release the belt tension, slip the belt off the spindle pulley.
- b. Loosen the locking nut.
- c. Turn the spring plunger CCW to INCREASE the tension.

- d. Turn the spring plunger CW to DECREASE the tension.
- e. Tighten the locking nut making sure the spring plunger does not move.
- 7. Slide the belt over the spindle motor pulley with the shiny surface against the pulley surface.
- 8. While pressing on the motor to release the belt tension, slip the belt over the spindle pulley.
- 9. Check the spring plunger compression with the spring plunger gauge (DIGITAL 9306154-00).
- 10. Replace the blower assembly (Paragraph 2.6.5).
- 11. Replace the lid assembly (Paragraph 2.6.3).
- 12. Replace the rear cover (Paragraph 2.6.2).
- 13. Replace the front bezel (Paragraph 2.6.1).

### **3.4 HEAD ALIGNMENT CHECKS AND CARTRIDGE CARE**

Several principles exist that should be understood before attempting any alignment procedures. Hopefully, a familiarity with these principles will discourage any short cuts leading to possible damage or improper alignment.

- 1. Whenever head alignment exceeds  $\pm 200$  microinches (on an RK06) or  $\pm 125$  microinches (on an RK07) maximum, the heads should be realigned to within  $\pm 50$  microinches.
- 2. Power must be applied to the drive for two hours prior to performing any head alignment procedures.
- 3. The cartridge should be mounted and spinning for a minimum of one half-hour prior to beginning head alignment.
- 4. Head alignment techniques assume that the drive being aligned is a properly working device. If the device is not working properly, do not attempt alignment.
- 5. To protect the alignment pack, Write Protect should always be set when the alignment pack is in the machine.
- 6. The SAFETY SWITCH on RK06 module M7729 or RK07 module M7906 near the D end forces Write Lock and disables the servo Unsafe circuit. It is important to remove this special maintenance switch from its maintenance mode to re-enable the servo Unsafe circuit (Figures 3-4 and 3-5).
- 7. Linear force applied to the carriage during adjustments may cause the heads to unload and do damage if the SAFETY SWITCH is not set to the MAINT position.
- 8. Lateral forces on the carriage can cause the heads to tilt and possibly crash, therefore, all procedures requiring the application of a lateral force to the carriage must be performed with the heads unloaded.
- 9. Positioner parts and fixtures are precision parts and must be handled carefully. The use of torque wrenches, set to specified levels, is mandatory to guarantee that tolerances will hold and thus prevent damaged parts.



CP-2456

Figure 3-4 RK06 Maintenance Controls and Indicators

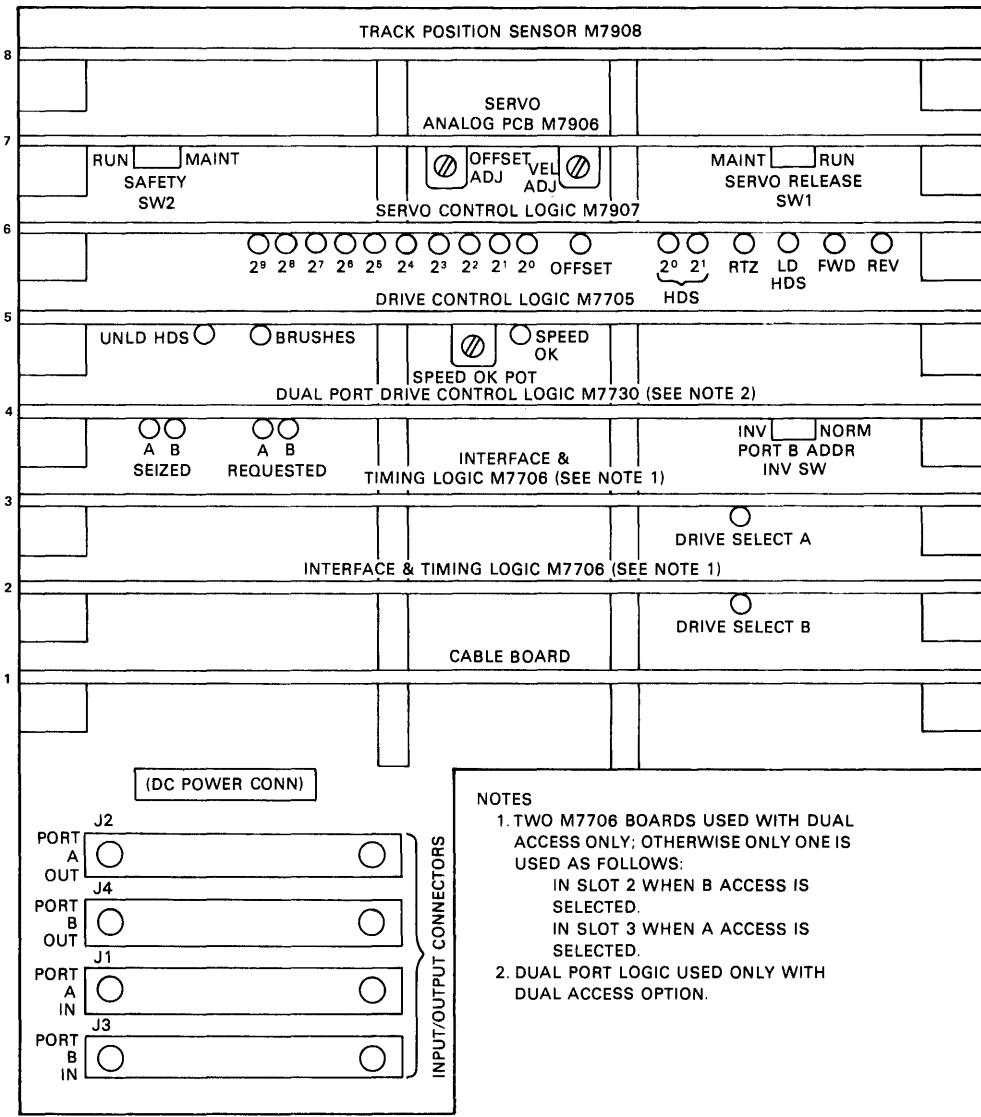


Figure 3-5 RK07 Maintenance Controls and Indicators

10. When transporting cartridges by auto, always keep the cartridge in the passenger compartment and never in the trunk.
11. Always transport cartridges in their carrying case.

### **3.4.1 Head Alignment Using Program Control**

To perform head alignment checks under program control:

1. Remove the rear cover (Paragraph 2.5.2).
2. Check that the power is removed from the drive and the field test box.
3. Connect the head alignment cable from the field test box to the drive read/write board (Figure 3-6).
4. Apply power to the drive and field test box.
5. Load MAINDEC-11-DZR6N and start at address 224.

As per program instructions, install an RK06K-AC or an RK07K-AC alignment cartridge and write lock the drive.

#### **NOTE**

**Prior to beginning head alignment procedures, power should be applied to the drive for two hours, and the cartridge should be mounted and spinning for at least one-half hour.**

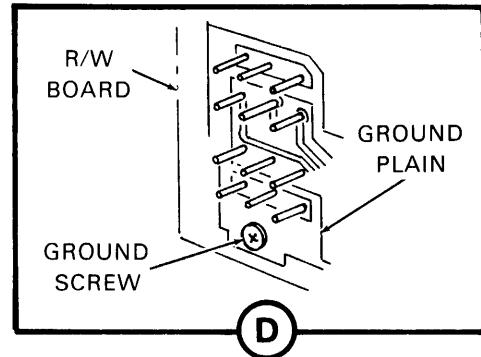
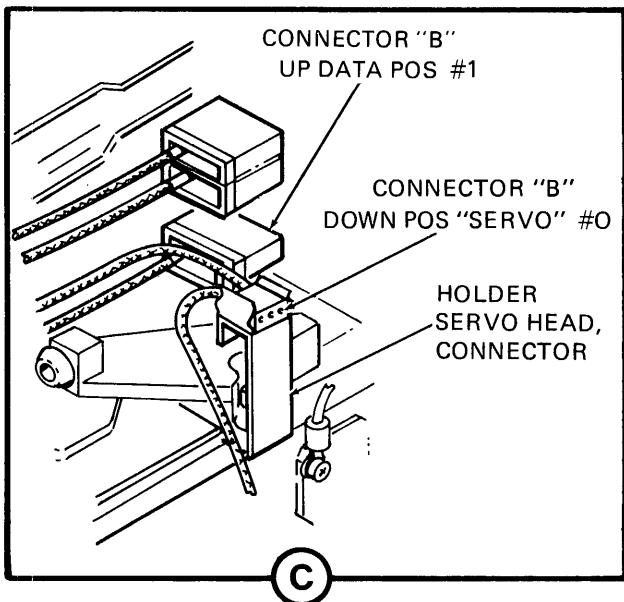
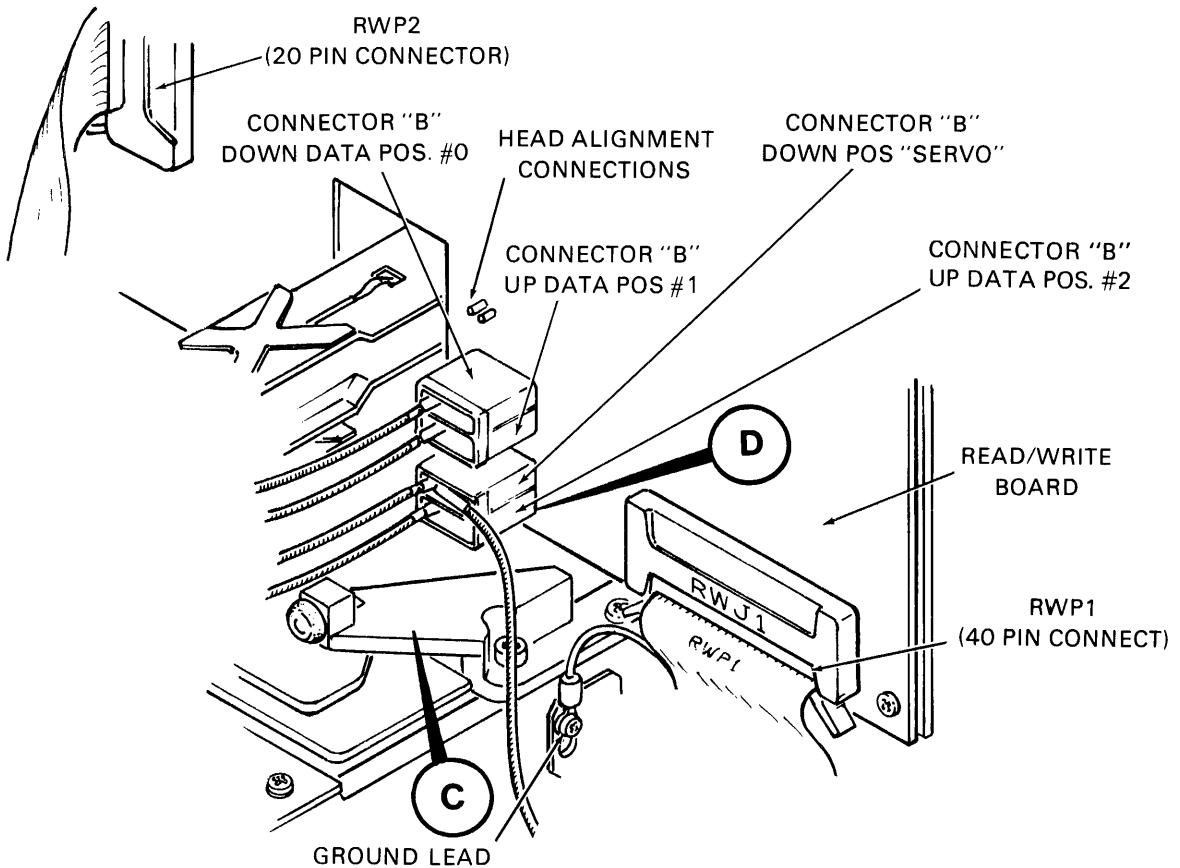
To write lock the drive, set the safety switch, S2, on the RK06 M7729 board or the RK07 M7906 board to the MAINT position. This action will also prevent the heads from unloading if a servo unsafe condition occurs (Figures 3-4 and 3-5).

6. Respond to program questions 1 through 5 as illustrated in the following sample printout.
7. Mount the head alignment fixture on the appropriate head (Figure 3-7).

#### **CAUTION**

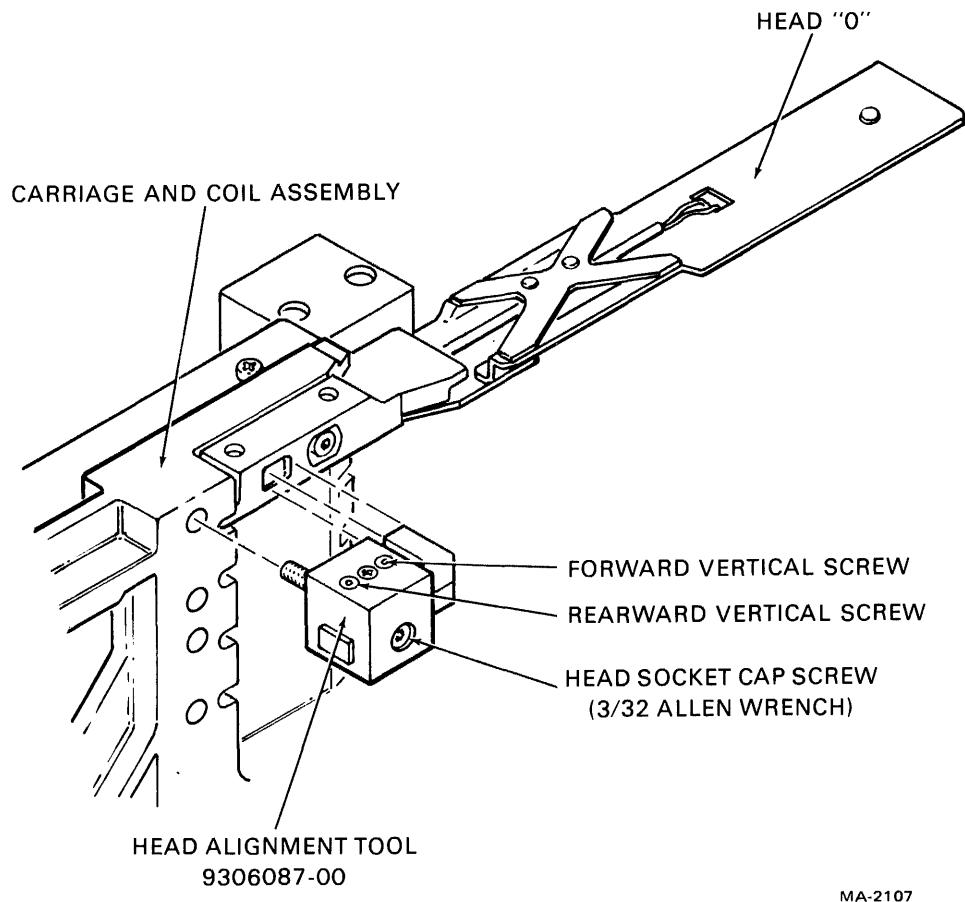
**Make sure that the carriage does not tip beyond the point where the heads will fall out of the cam guide.**

8. Torque the head alignment fixture mounting screw to five inch-pounds. Loosen the head mounting screw and then torque it to two inch-pounds. Turn both vertical screws of the head alignment fixture fully CCW (Figure 3-7).
9. Load the heads by typing the letter "R".



MA-2106

Figure 3-6 Servo Head and Board Area



MA-2107

Figure 3-7 Head Alignment Tool

10. Set the torque wrench to five inch-pounds and tighten the forward vertical screw to move the head forward, or the rear screw to move the head toward the rear. Since these screws cause opposite actions, the screw not in use must be turned fully CCW. Adjust until:

- a. The red LED on the meter is ON (STEADY STATE).
- b. The meter on the field test box reads  $0 \pm 50$  microinches.

**NOTE**

If the needle deflects to the right of zero, move the head forward; if to the left of zero, move toward the rear.

11. Unload the heads by typing the same head number again. Tighten the head to five inch-pounds.
12. Reload the heads by typing the letter "R".
13. Check that the conditions of step 10 (a) and (b) are met.

14. Unload the heads by typing the next head number.
15. Remove the head alignment fixture and mount it on the next head.
16. Repeat the procedure of steps 8 through 15 for each data head.
17. When all heads have been aligned, restart the program under its "EXERCISER" mode and exercise the drive for two minutes. Recheck the alignment of all heads.
18. Remove the alignment cartridge and the field test box; clear the Write Lock condition.
19. Replace the rear cover (Paragraph 2.5.2).

### **3.4.2 Head Alignment Using the Field Test Box**

1. Remove power from the drive and from the field test box.
2. Connect the head alignment cable from the field test box to the drive read/write board (Figure 3-8).
3. Attach the appropriate drive interface cable to the field test box.
4. Apply power to the drive and to the field test box.
5. Install an RK06K-AC or an RK07K-AC alignment cartridge and write lock the drive.

**NOTE**

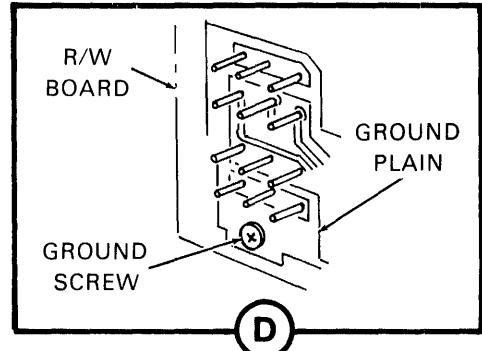
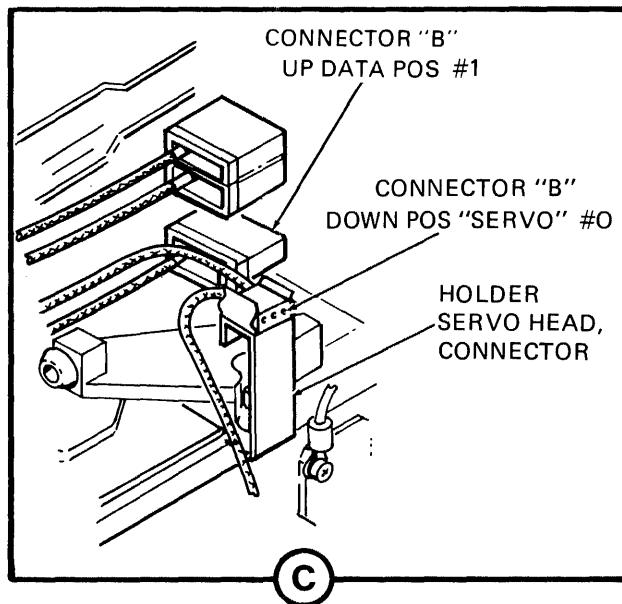
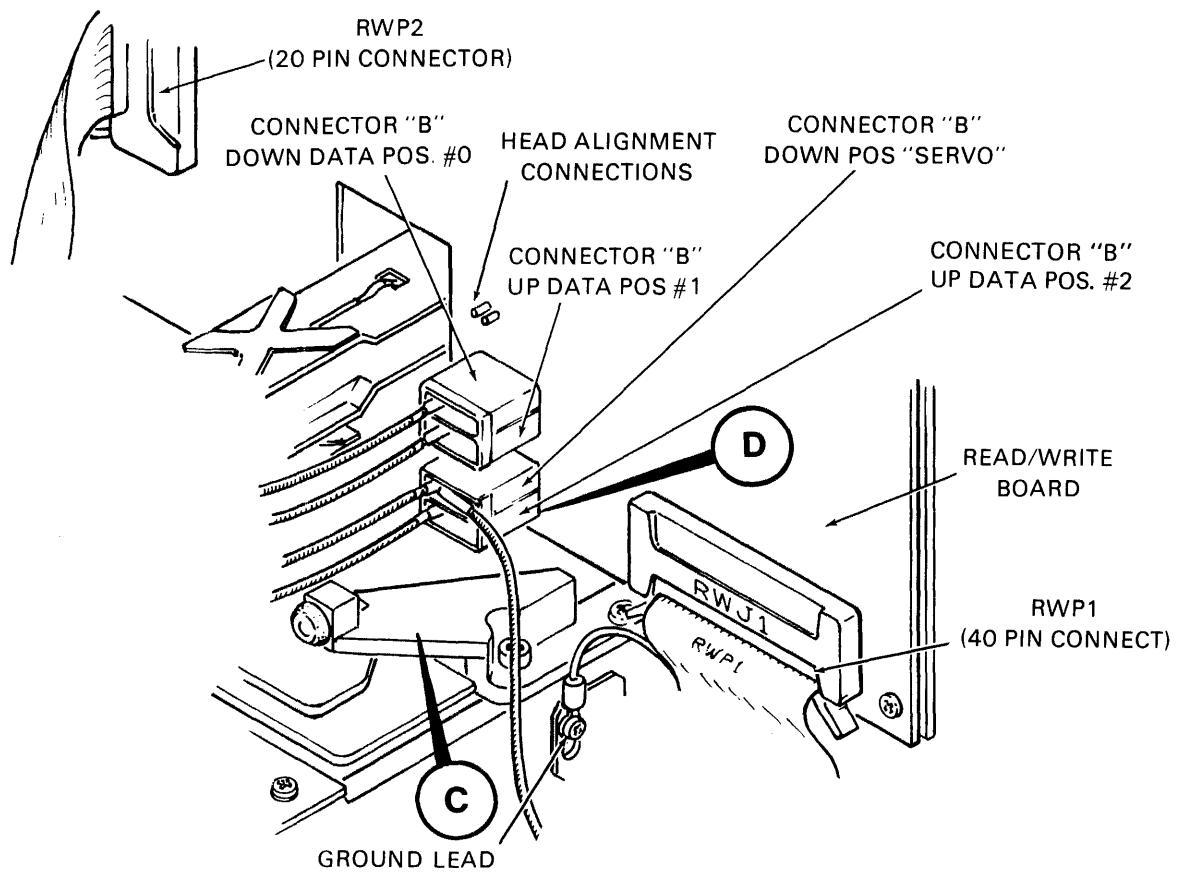
**Prior to beginning head alignment procedures, power should be applied to the drive for two hours, and the cartridge should be mounted and spinning for at least one-half hour.**

6. To write lock the drive, set the safety switch (S2) on the m7729 board to the MAINT position. This action will also prevent the heads from unloading if a servo unsafe condition occurs.
7. Mount the head alignment fixture on the appropriate head (Figure 3-7).

**CAUTION**

**Make sure that the carriage does not tip beyond the point where the heads fall out of the cam guide.**

8. Torque the head alignment fixture mounting screws to five inch-pounds. Loosen the head mounting screw and then tighten it to two inch-pounds. Turn both vertical screws of the head alignment fixture fully CCW.
9. Select the desired head and load to the actual cylinder address that corresponds to the underlined (for RK06 alignment) or dotted (for RK07 alignment) cylinder address switches on the field tester. Refer to the switch settings that follow (Figure 3-9).



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Figure 3-8 Servo Head and Board Area

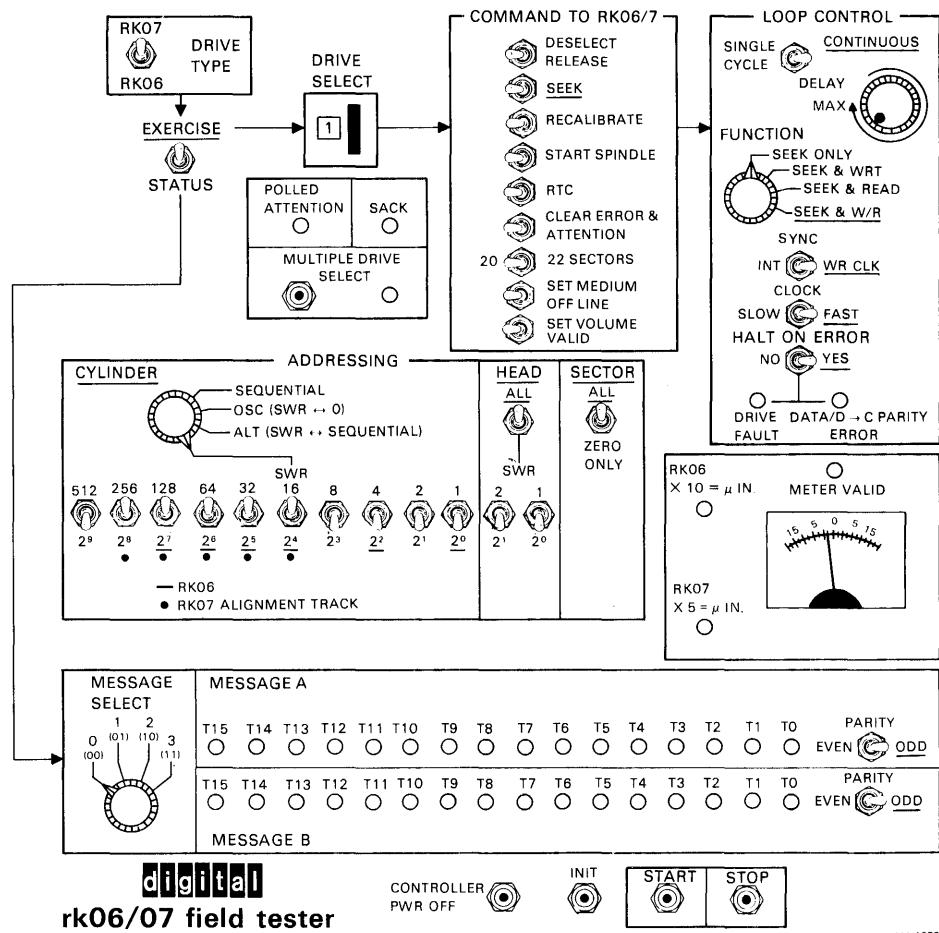


Figure 3-9 RK06/RK07 Field Test Box

<b>Switch</b>	<b>Position</b>
EXERCISE/STATUS	EXERCISE
DRIVE SELECT	DESIRED DRIVE#
COMMAND TO RK06/07 (All switches off except these four)	SEEK
	22 SECTOR
	CLEAR ERROR & ATTENTION
	SET VOLUME VALID
SINGLE CYCLE/CONTINUOUS	SINGLE CYCLE
FUNCTION	SEEK ONLY
SYNC	INT
CLOCK	FAST
HALT ON ERROR	NO
ADDRESSING (CYLINDERS)	& SWR
ADDRESS SWITCHES: <u>UNDERLINED POSITIONS</u>	245 (RK06)
<u>DOTTED POSITIONS</u>	496 (RK07)
(HEAD)	SWR
(HEAD ADDRESS SWITCHES)	DESIRED HEAD#
(SECTOR)	ALL
PARITY (BOTH SWITCHES)	ODD

Press the INIT and START switches.

10. Set the torque wrench to five inch-pounds and tighten the forward vertical screw to move the head forward, or the rear one to move the head toward the rear. Since these screws oppose each other, the screw not in use must be fully CCW. Adjust until:
  - a. The red LED on the meter is ON (STEADY STATE).
  - b. The meter on the field test box reads  $0 \pm 50$  microinches.

**NOTE**

If the needle deflects to the right of zero, move the head forward; if to the left of zero, move toward the rear.

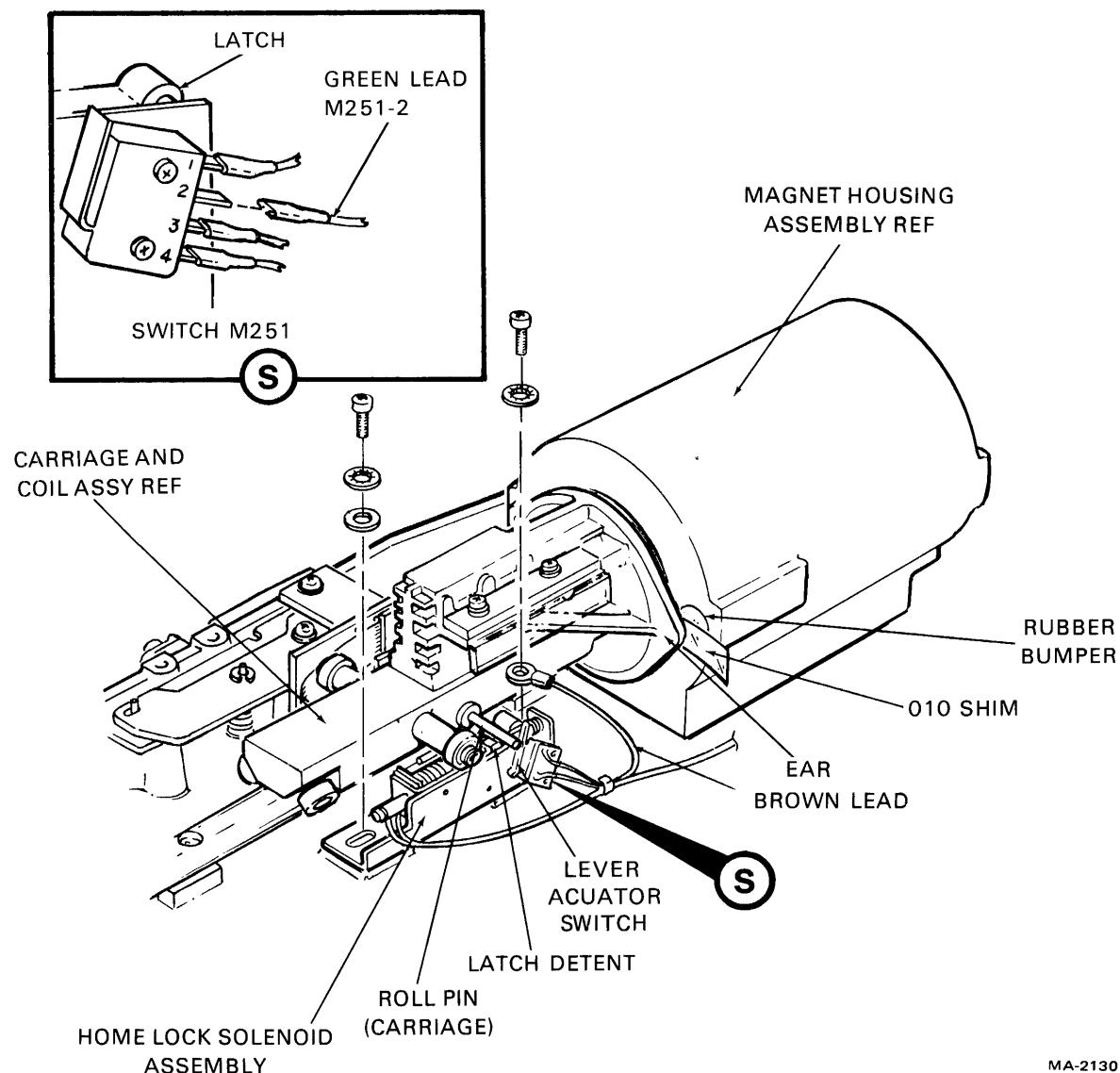
11. Unload the heads.
12. Tighten the heads to five inch-pounds.

13. Load the heads and check that the condition of step 10 (a) and (b) are still met.
14. Unload the heads; remove the head alignment fixture and mount it on the next head.
15. Load the heads and repeat the procedures of steps 8 through 14 until all the data heads are aligned.
16. Replace the rear cover (Paragraph 2.5.2).

### 3.5 HOME LOCK SOLENOID ASSEMBLY ADJUSTMENTS

#### Procedure

1. Remove the rear cover (Paragraph 2.4.1).
2. Loosen the two Phillips pan head screws holding the home lock solenoid assembly to the base plate (Figure 3-10).



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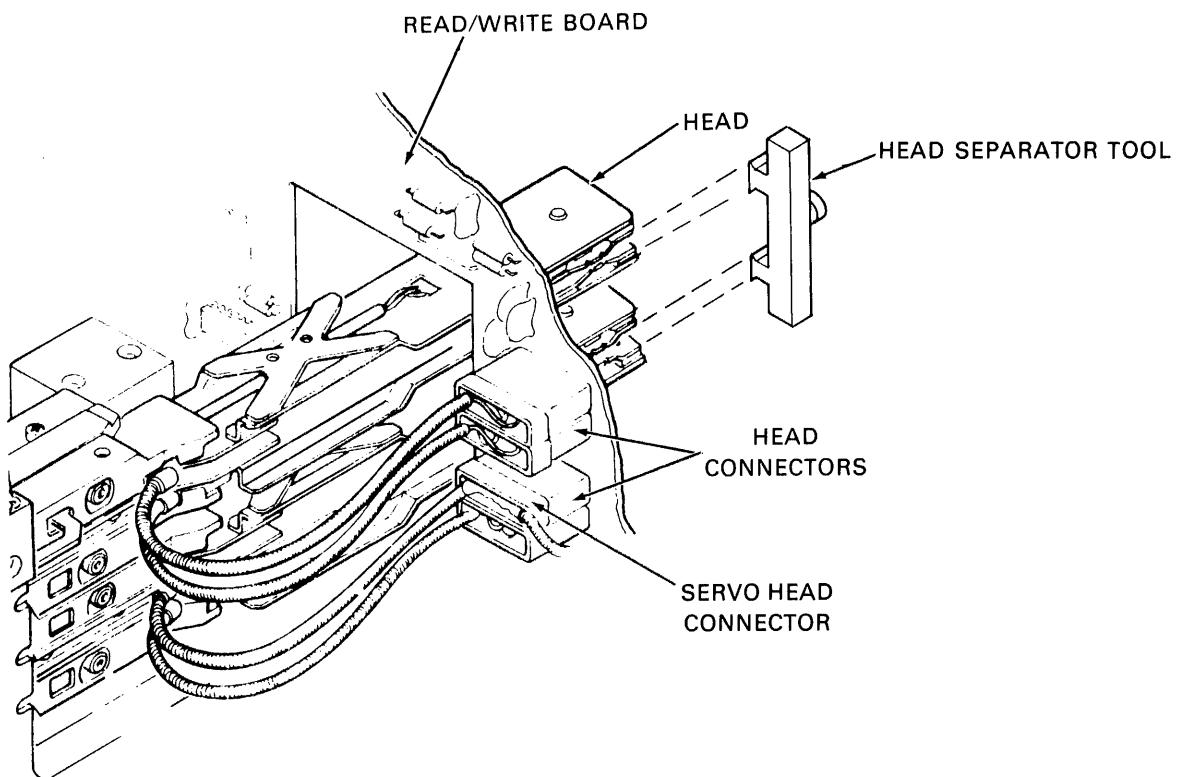
Figure 3-10 Homelock Assembly

3. Move the carriage and coil assembly, with the roll pin engaged in the detent latch of the home lock solenoid assembly and place a .010 inch shim between the rubber bumper and the carriage to achieve the .010 inch clearance between the rubber bumper and the carriage.
4. Tighten the two Phillips pan head screws, remove the shim and check to see that;
  - a. The home lock switch is activated.
  - b. Place a cartridge into the machine and power up, to make sure that the solenoid will release the latch and load heads.
5. Replace the rear cover (Paragraph 2.4.1).

### 3.6 TACHOMETER MAGNET ASSEMBLY ADJUSTMENTS

#### Procedure

1. Remove the rear cover (Paragraph 2.4.1).
2. Swing the card nest down (open).
3. Disconnect the single green lead connector E1P1 from E1J1 or M2S1-2 on the home lock solenoid assembly switch from the battery pack assembly (Figure 3-10).
4. Push the carriage assembly toward the spindle approximately one inch and install the head separator tool (DIGITAL 9306171-00) (Figure 3-11).



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Figure 3-11 Head Separator Tool

5. Loosen the two Phillips pan head screws holding the tachometer magnet assembly to the base plate, with the magnet inside the bobbin, adjust the tachometer magnet assembly in or out until there is equal amount of clearance on either side of the magnet, move the carriage assembly the length of the magnet to make sure the clearance is equal, and tighten the two Phillips pan head screws (Figure 3-12).

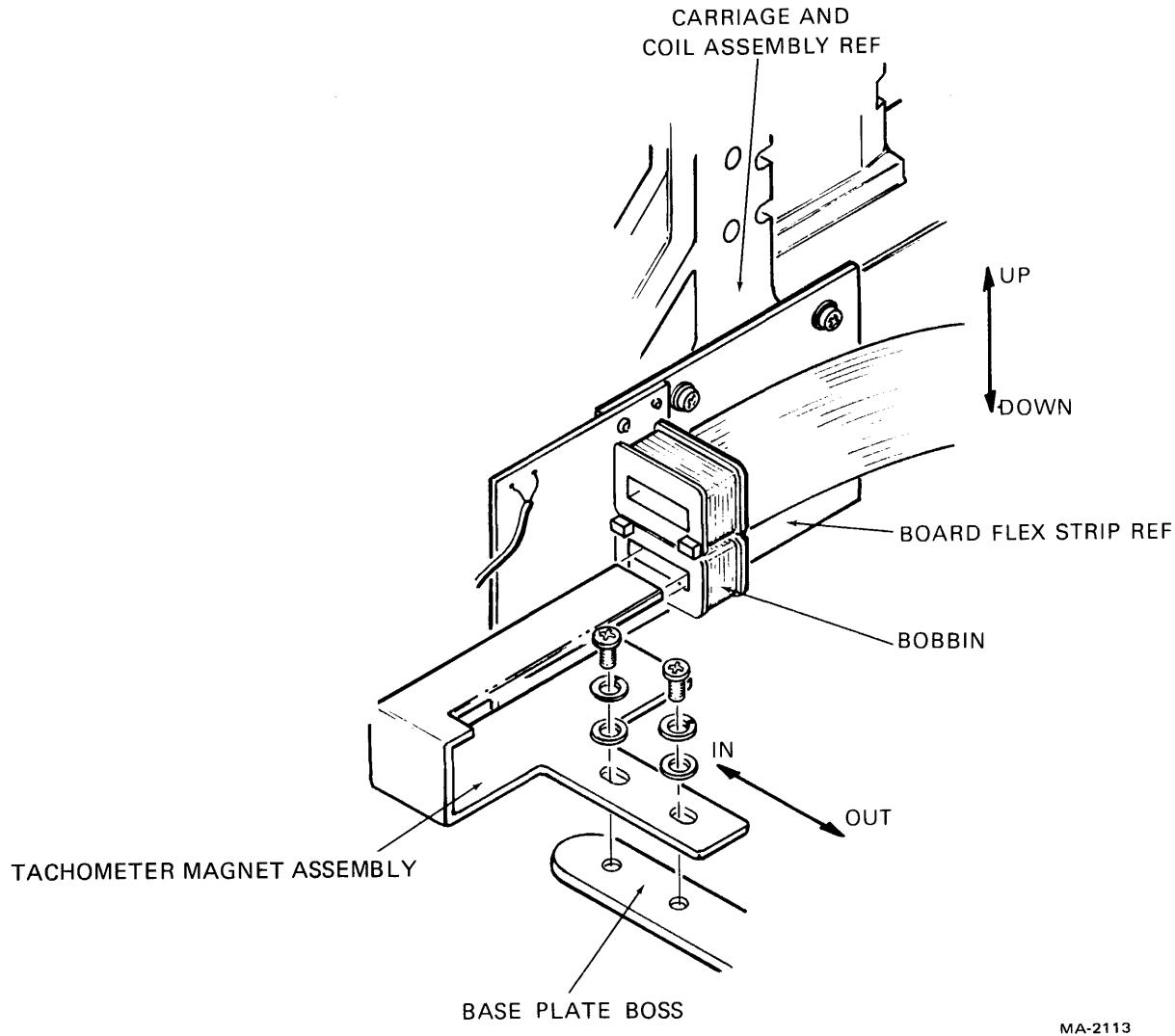
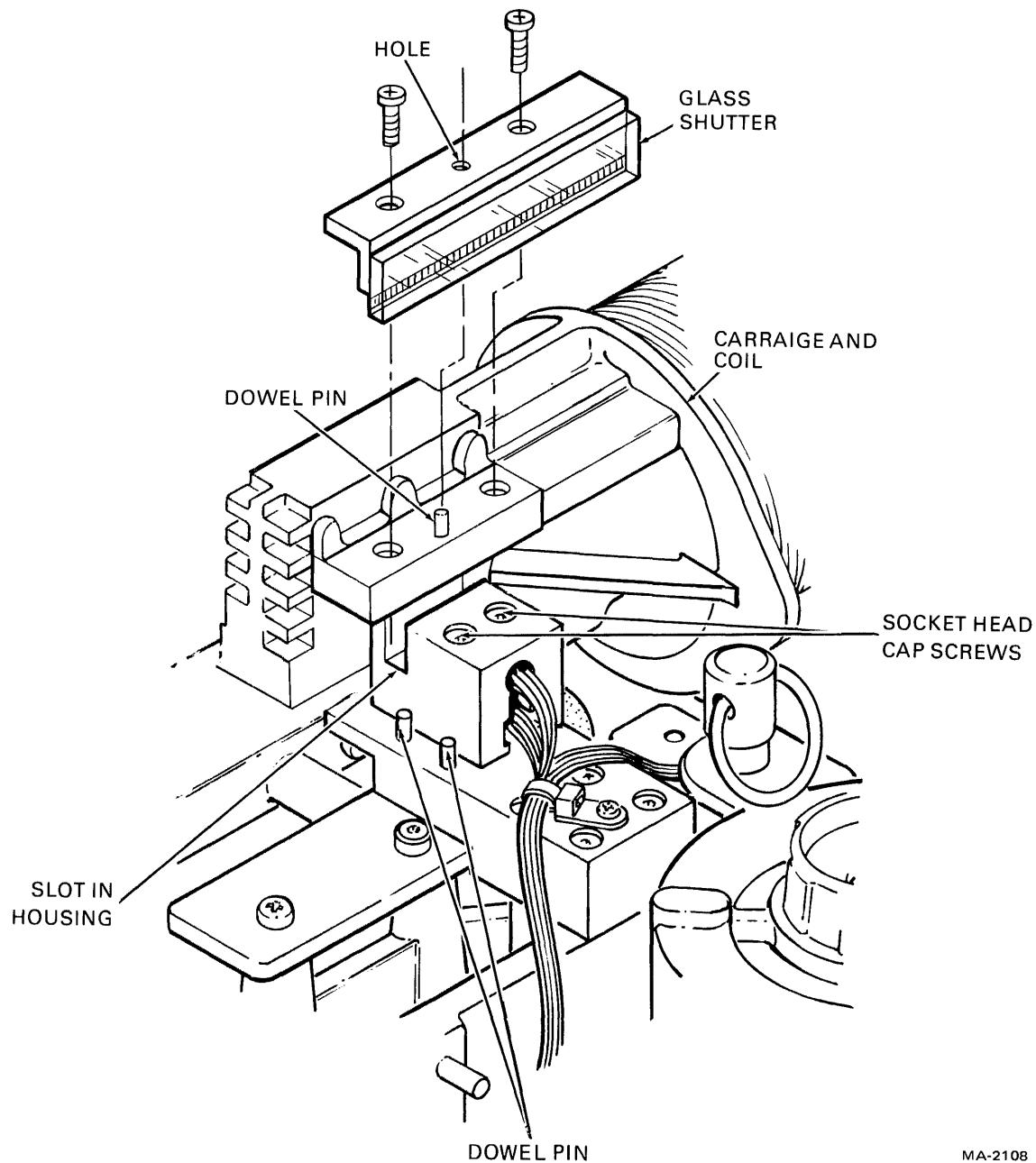


Figure 3-12 Tachometer Magnet Assembly

6. Loosen the two Phillips pan head screws holding the flexstrip assembly to the carriage, move the board up or down to center the bobbin on the tachometer magnet assembly and tighten the two Phillips pan head screws.
7. Move the carriage to home position and remove the head separator tool (Figure 3-10).
8. Connect the single green lead connector E1P1 to E1J1 or M2S1-2 to the home lock solenoid assembly switch from the battery pack assembly (Figure 3-10).



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Figure 3-13 Glass Shutter Assembly

9. Swing up the card nest (closed).
10. Replace the rear cover (Paragraph 2.4.1).

### **3.7 GLASS SHUTTER ASSEMBLY ALIGNMENT**

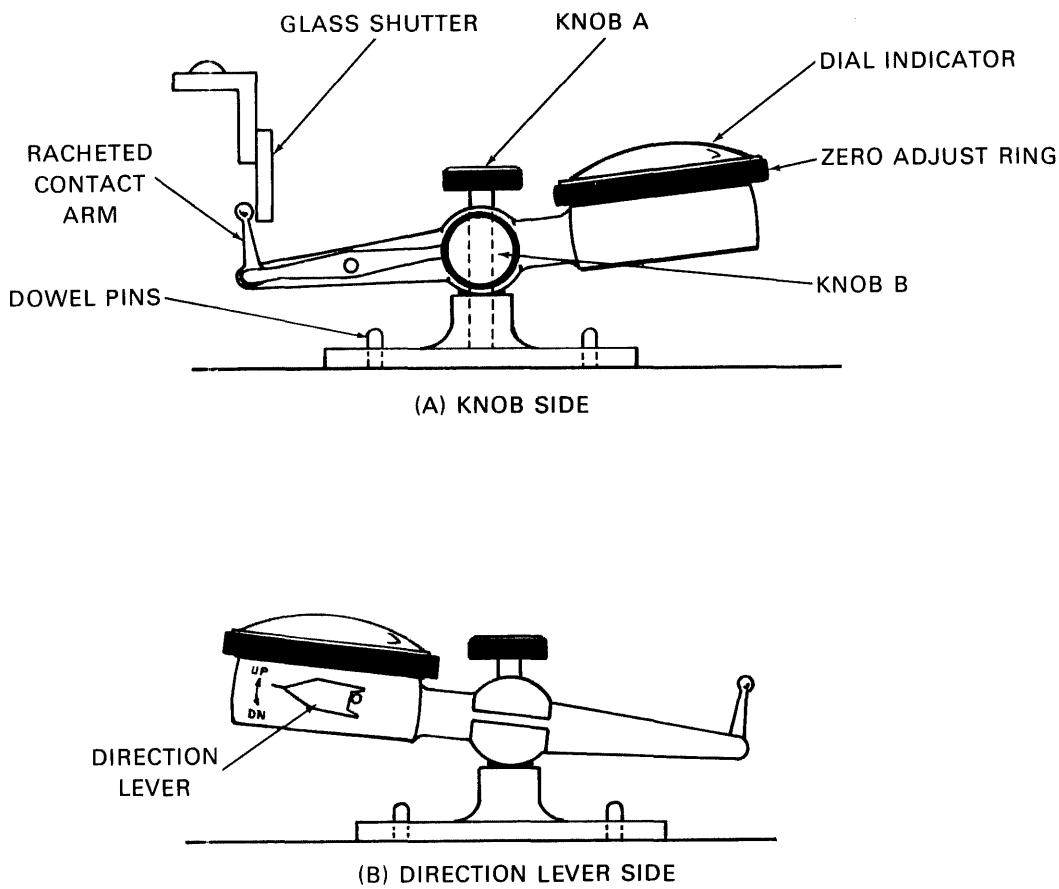
1. Disconnect the single green lead connector E1P1 from E1J1 or M2S1 on the home lock solenoid assembly switch from the battery pack assembly (Figure 3-10).
2. Remove the transducer block (Figure 3-13).
3. With the head separator tool in place, push the carriage assembly toward the spindle (Figure 3-11).
4. The following steps will vary depending on which glass shutter alignment fixture is used. If the older fixture is used, begin at step e. If the new fixture (No. 93-06240) is used, begin at step 10.

**NOTE**

**If both fixtures are available, it is recommended that the newer one be used. Do not use the old fixture unless the newer fixture is unavailable.**

5. Assemble the glass shutter alignment fixture onto the transducer mounting block, locating the slot in the fixture around the two dowel pins (Figure 3-14). Assemble the screw clamp as shown. Loosen the two screws holding the shutter.
6. Move the carriage and coil assembly so that the dowel pin on the glass is in line with the contact of the dial indicator.
7. Set the dial indicator to zero by moving the fixture in or out and clamp in place.
8. Move the carriage and coil assembly so that the contact of the dial indicator is at one end of the glass shutter. Move the glass shutter in or out until a zero reading is obtained and tighten the screw lightly.
9. Move the carriage and coil assembly back and forth, checking the dial indicator movement. The total indicator reading should not vary more than 0.001 inch. Adjust the shutter until the proper reading is obtained and tighten both screws. Recheck the alignment after tightening the screws. Proceed to step 17.

10. Assemble the glass shutter alignment fixture (No. 93-06240) onto the transducer mounting block, locating the holes in the fixture around the two dowel pins (Figure 3-14). Tighten down screw knob A to lock the fixture in place. Loosen the two screws holding the glass shutter.
11. Move the carriage and coil assembly back away from the spindle area to allow the contact arm of the dial indicator to be positioned behind the inside surface of the glass shutter as shown (Figure 3-14). The contact arm pivots in a ratchet to allow for adjustments.



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Figure 3-14 Glass Shutter Alignment Fixtures

12. Move the carriage and coil assembly so that the dowel pin on the glass is in line with the contact arm of the dial indicator.
13. The direction lever on the side of the dial gauge must be set in the upwards position to allow the gauge to read when contact is made with the glass (Figure 3-14).
14. Loosen knob B and pivot the indicator arm slightly until the glass shutter touches the dial contact arm and the dial pointer is at 0.015. Tighten knob B with the indicator in this position.
15. Twist the zero adjust ring until the zero on the gauge sits directly under the dial pointer.
16. Move the carriage and coil assembly back and forth, checking the dial indicator movement. The total indicator reading should not vary more than 0.001 inch. Adjust the shutter until the proper reading is obtained and tighten both screws. Recheck the alignment after tightening both screws.
17. Remove the alignment fixture.

### **3.8 TRANSDUCER HOUSING ALIGNMENT (TWO DOWEL VERSION)**

**NOTE**

**Single dowel version of velocity transducer assembly  
is located in Appendix D.**

**Procedure**

1. Remove the rear cover (Paragraph 2.4.1).
2. Disconnect the single green lead connector E1P1 from E1J1 or M2S1-2 on the home lock solenoid assembly switch from the battery pack assembly (Figure 3-10).
3. Push the carriage assembly toward the spindle approximately one inch and install the head separator tool (DIGITAL 9306171-00) (Figure 3-11).
4. Loosen the two socket head cap screws holding the transducer housing to the transducer mounting block (Figure 3-13).
5. Use the purple shim and green shim together to form a .0045 inch shim. Place the shim into the slot of the housing, green side toward the glass shutter. While holding the housing against the two dowel pins, push the carriage assembly toward the spindle and adjust the housing until there is a slight drag on the shim when the glass shutter is moved. Tighten the two socket head cap screws. Recheck that the housing is resting against the two dowel pins.

**CAUTION**

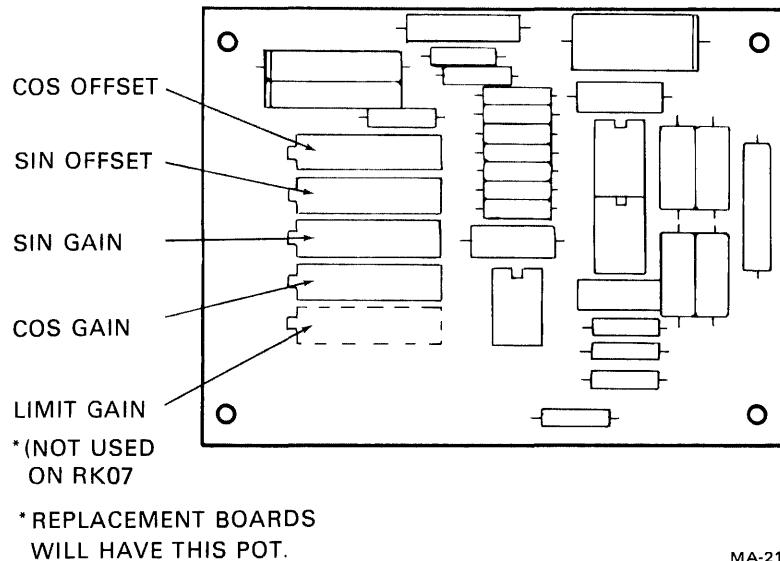
**Be careful not to damage or smudge the glass shutter  
when making this adjustment.**

6. Move the carriage to home position and remove the head separator tool.
7. Connect the single green lead connector E1P1 to E1J1 or M2S1-2 to the home lock solenoid assembly switch from the battery pack assembly.
8. Perform the transducer pre-amp adjustments in Paragraph 3.9.

### 3.9 TRANSDUCER PRE-AMP ADJUSTMENTS

#### Procedure

1. Remove the rear cover (Paragraph 2.4.1).
2. Remove the transducer pre-amp cover.
3. SIN and COS Adjustment  
Before proceeding, make sure that the following have been done:
  - a. SERVO disable switch S1 (on the RK06 M7729 module or the RK07 M7906 module) is in the MAINT position (Figure 2-33 and 2-34).
  - b. SAFETY switch S2 (on the RK06 M7729 module or the RK07 M7906 module) is in the MAINT position.
  - c. HOME LOCK (pin D7K2 of RK06 M7729 module or RK07 M7906 module) is jumped to ground (D7T1).
4. Mount a scratch pack on the drive and press START. Wait for the drive to come up to speed and home lock to disengage.
5. Connect the oscilloscope to pin A7J1 of the RK06 M7729 module or RK07 M7906 module (SIN signal).
6. Manually load the heads, then move the carriage back and forth by hand while watching the oscilloscope.
7. Adjust the SIN GAIN (SG) potentiometer on the transducer pre-amp board for a peak to peak SIN signal of 18V (Figure 3-15).



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Figure 3-15 Transducer Pre-Amp Adjustment

8. Use the SIN OFFSET potentiometer to make the SIN signal symmetrical i.e., the positive half cycle measures +9V; the negative half cycle measures -9V.
9. Connect the oscilloscope to pin A7E1 and adjust the COSINE signal to the same values as the SIN signal.
10. If the COS- signals peak-to-peak value was adjusted, repeat steps 7 through 9 again. This will insure correct peak-to-peak value of SIN and COS-.
11. Use the COS offset potentiometer to make the COS- signal symmetrical, i.e.,  $\pm 9$  V from ground.
12. Move the carriage to home position and block the transducer light path with several pieces of paper.

**CAUTION**

**Because the fixed glass in the transducer housing is easily scratched, metal or any other hard material must not be used against the transducer.**

13. Measure the amplitude of the -COSINE signal (pin A7E1 of the RK06 M7729 module or RK07 M7906 module). It should measure  $-10. \pm 0.4$  with the light path blocked. If it does not, continue with step a; if it does, proceed to step 13.
  - a. Short pin A7B1 of the RK06 M7729 module or RK07 M7906 module to ground (A7T1).
  - b. If the -COSINE signal is now correct, the problem is with the pre-amp board or cabling.
  - c. If the -COSINE signal is still wrong, the problem is with the RK06 M7729 module or RK07 M7906 module.
  - d. Correct the problem before proceeding.
14. Remove the paper from the transducer light path, then move the carriage back and forth and note the amplitude of the negative peaks of the COSINE signal. They should be slightly less negative than the dc level measured with the light path blocked. The amount that it is less negative is a measure of the amount of light that leaks past the fixed and moving glass. If the deference is greater than 1.5V, the glass parts are not properly aligned and must be corrected. Repeat the transducer housing alignment procedure step 6 of this procedure. Reduce the clearance from .0045 to .003 inch using a green shim only. If a mechanical adjustment is made, all electrical adjustments must be repeated starting at step 11 of this procedure.

Repeat this test for the SIN signal (pin A7J1 of the RK06 M7729 module or RK07 M7906 module).

**NOTE**

**The following COARSE LIMIT and FINE LIMIT adjustments does not apply on an RK07. If the drive being serviced is an RK07, skip to step 17.**

15. Coarse Limit Adjustment  
Move the carriage back and forth across the limit and adjust the limit gain potentiometer until the amplitude of the negative going triangle at pin C7M2 of the RK06 M7729 module measures -0.5V.
16. Fine Limit Adjustment:
  - a. Manually unload the heads, remove the jumper on the home lock signal, and turn the drive off.
  - b. Enable the servo via the SERVO DISABLE switch.
  - c. Start the drive and after the regular load heads sequence, install a jumper from pin D7A1 on the RK06 M7729 module to ground (pin D7T1). The AGC level is now stored in the counter (E39 and E46) and the jumper will prevent any changes to the count as long as the carriage is not allowed to go back and close the home lock switch.
  - d. Set the SERVO DISABLE switch to the MAINT position and move the carriage back and forth over the outer limit to get the LIMIT-H triggering signal.
  - e. Place Channel 1 on signal LIMIT-H (Pin C7D1 on RK06 M7729 module).
  - f. Place Channel 2 on signal -COS (Pin A7E1, RK06 M7729 module).
  - g. Trigger on Channel 1 positive.
  - h. Adjust the COS- signal to  $-7 \text{ V} \pm 1.5 \text{ V}$  at the rising edge of LIMIT-H signal.
  - i. Check the amplitude of the limit triangle at pin C7M2 of the RK06 M7729 module. It should measure  $0.5 \pm 0.1 \text{ Vdc}$ .
17. Check the tachometer ripple at pin B7D1 of the RK06 M7729 module or RK07 M7906 module. The ripple should be less than 1.5V peak-to-peak at the maximum velocity.
18. Replace the transducer pre-amp cover.
19. Perform the velocity adjustments in Paragraph 3.10.

### **3.10 VELOCITY ADJUSTMENT**

#### **Procedure**

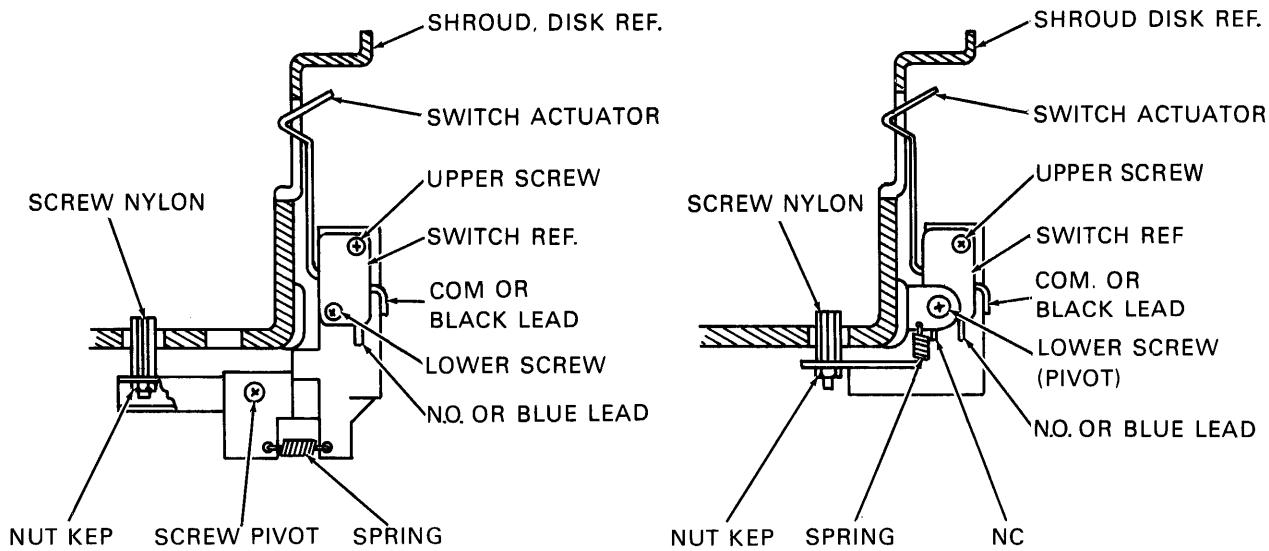
1. Remove the rear cover (Paragraph 2.4.1).
2. Swing the card nest down (open).
3. Attach the field tester and power up the drive and field tester.
4. Perform a continuous 411 track seek (on a RK06) or a continuous 815 track seek (on a RK07) (Figure 3-9).
5. Trigger the oscilloscope internal positive on CHAN 1.
6. Set sweep speed to 10 ms/cm.

7. Set the vertical sensitivity to 2V cm and connect the oscilloscope CHAN 1 probe to signal DC2PIP H (M7705, pin C5P1).
8. Adjust the velocity potentiometer (R131 on the RK06 M7729 module or the RK07 M7906 module so that the maximum duration of PIP H is  $71 \pm 1$  ms.
9. To verify adjustment, run diagnostic DZR6M and insure the seek time is less than 75 ms.
10. Swing the card nest up (closed).
11. Replace the rear cover (Paragraph 2.4.1).

### 3.11 PACK-IN PLACE SWITCH ADJUSTMENT

#### Procedure

1. Remove the front bezel (Paragraph 2.5.1).
2. Remove the rear cover (Paragraph 2.5.2).
3. Remove the lid assembly (Paragraph 2.5.3).
4. Loosen the locking kep nut on the adjusting screw and turn the adjusting screw CW, (looking from the top of drive) several turns (Figure 3-16).



RK07 PACK-IN PLACE SWITCH

RK06 PACK-IN PLACE SWITCH

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Figure 3-16 Pack-In Place Switch

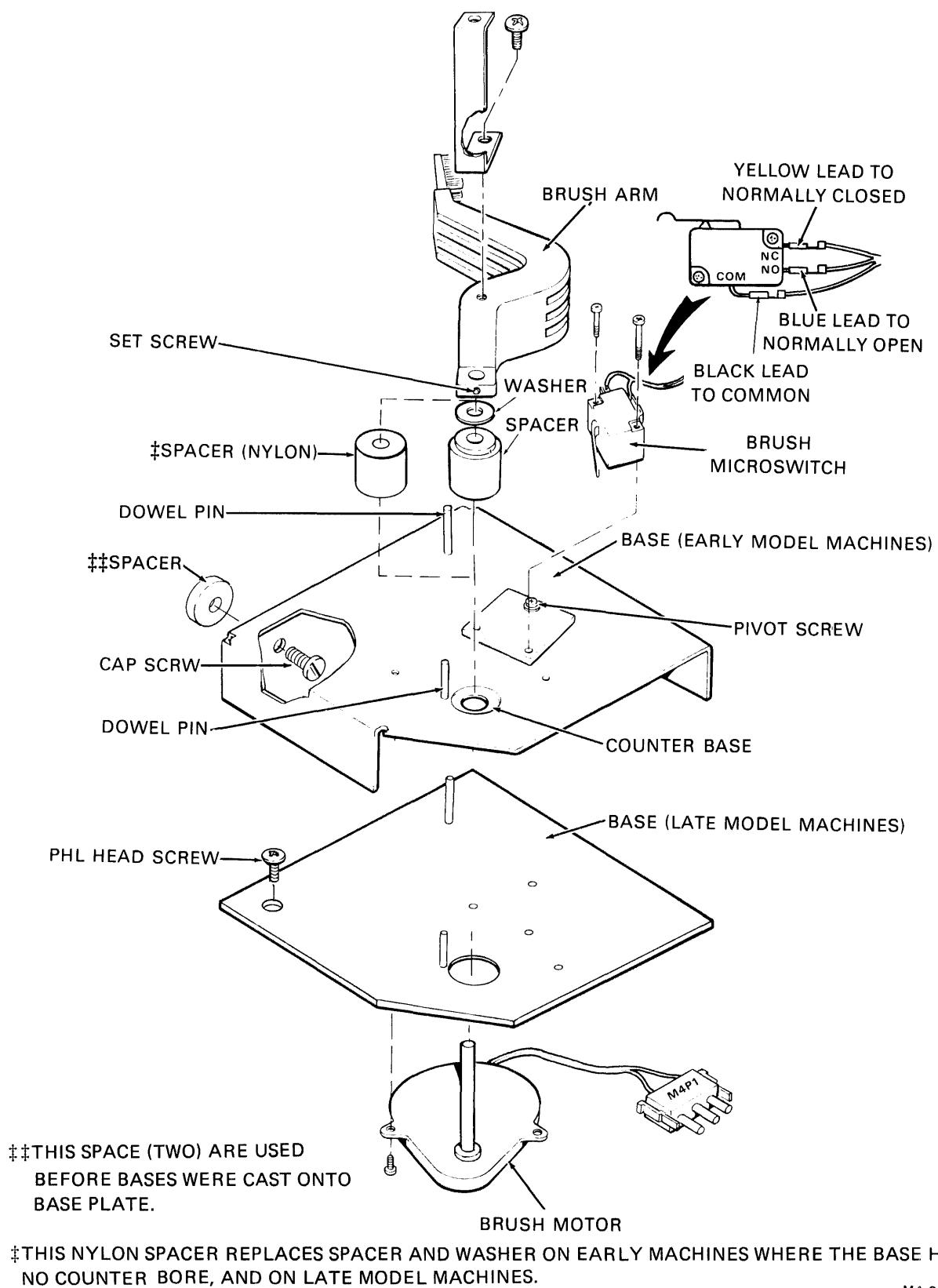


Figure 3-17 Brush and Motor Assembly

5. Place a continuity tester between the switch com. and number terminals.
6. Place a cartridge and cover into the drive, while holding them away from the switch location, turn the adjusting screw CCW (looking from the top of drive) until the switch makes.
7. Remove the cartridge and cover, mark the position of the adjusting screw and make one full turn CCW (looking from the top of drive) and lock in this position with the kep nut.
8. The following requirements shall be met:
  - a. With the cartridge in place and moving the cartridge in its allowable travel, the switch does not make.
  - b. With the cartridge and cover in place the switch makes and does not break when the cartridge and cover together are moved in their allowable travel.
9. Replace the lid assembly (Paragraph 2.5.3).
10. Replace the rear cover (Paragraph 2.5.2).
11. Replace the front bezel (Paragraph 2.5.1).

### **3.12 CARRIAGE ROLL ALIGNMENT**

#### **Procedure**

1. Remove the rear cover (Paragraph 2.5.2).
2. Remove the lid assembly (Paragraph 2.5.3).
3. Remove the shroud assembly (Paragraph 2.5.6).
4. Remove the read/write heads (Paragraph 2.5.12).
5. Remove the servo head (Paragraph 2.5.13).
6. Disconnect the single green lead connector E1P1 from E1J1 or M2S1-2 on the home lock solenoid switch from the battery pack assembly (Figure 3-10).
7. Move the carriage and coil assembly out beyond the cam tower or universal bracket assembly.
8. Assemble the tee bar section of the alignment fixture (DIGITAL 9306056-00) to the carriage (Figure 3-18).
9. With the indicator comparator gauge resting on the master setting gauge set the indicator dial to zero. Note the number of turns of the indicator needle when the indicator comparator gauge is removed from the master setting gauge (Figure 3-19).
10. Place the indicator comparator gauge over the spindle cone, resting the dowels on the outer ring of the spindle. While holding the indicator end up, move the carriage forward toward the spindle to engage the ball on the tee bar. Note the number of turns of the indicator needle (Figure 3-20).

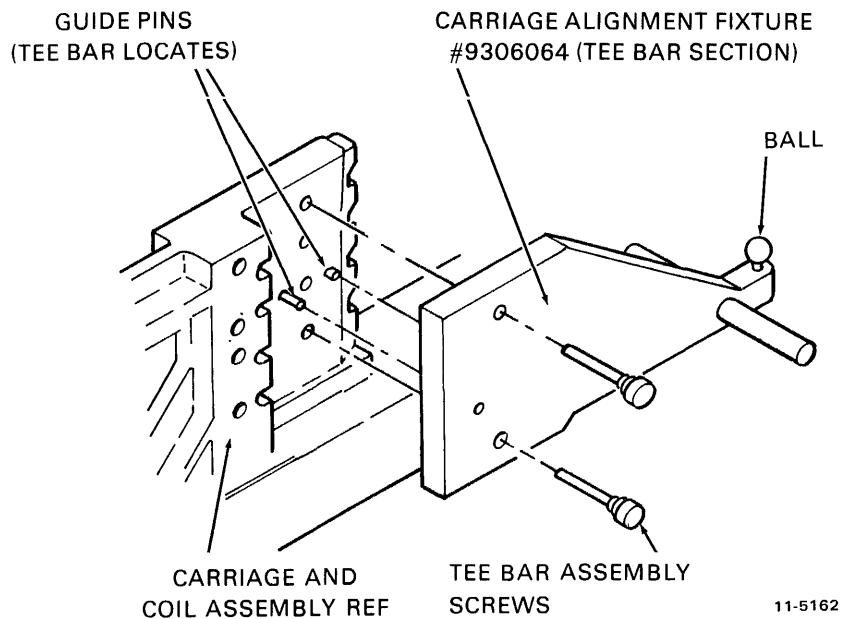


Figure 3-18 Tee Bar Assembly

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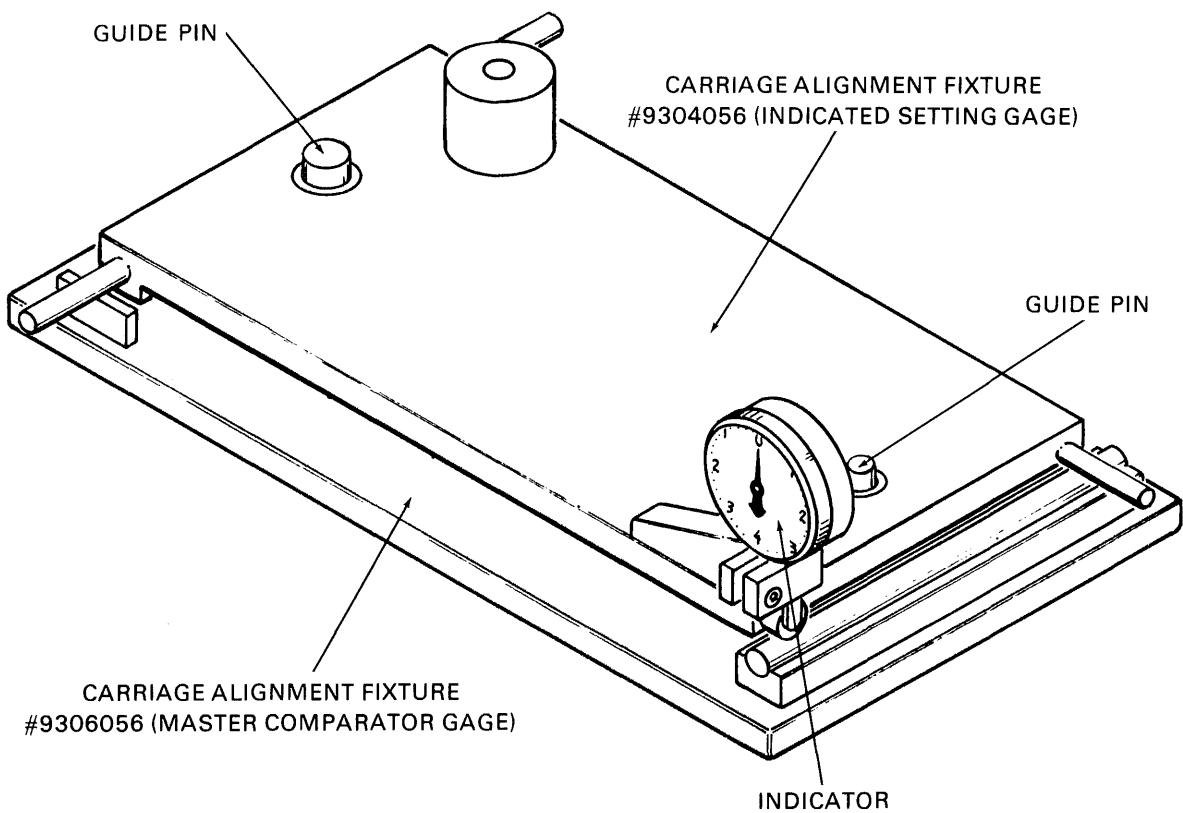
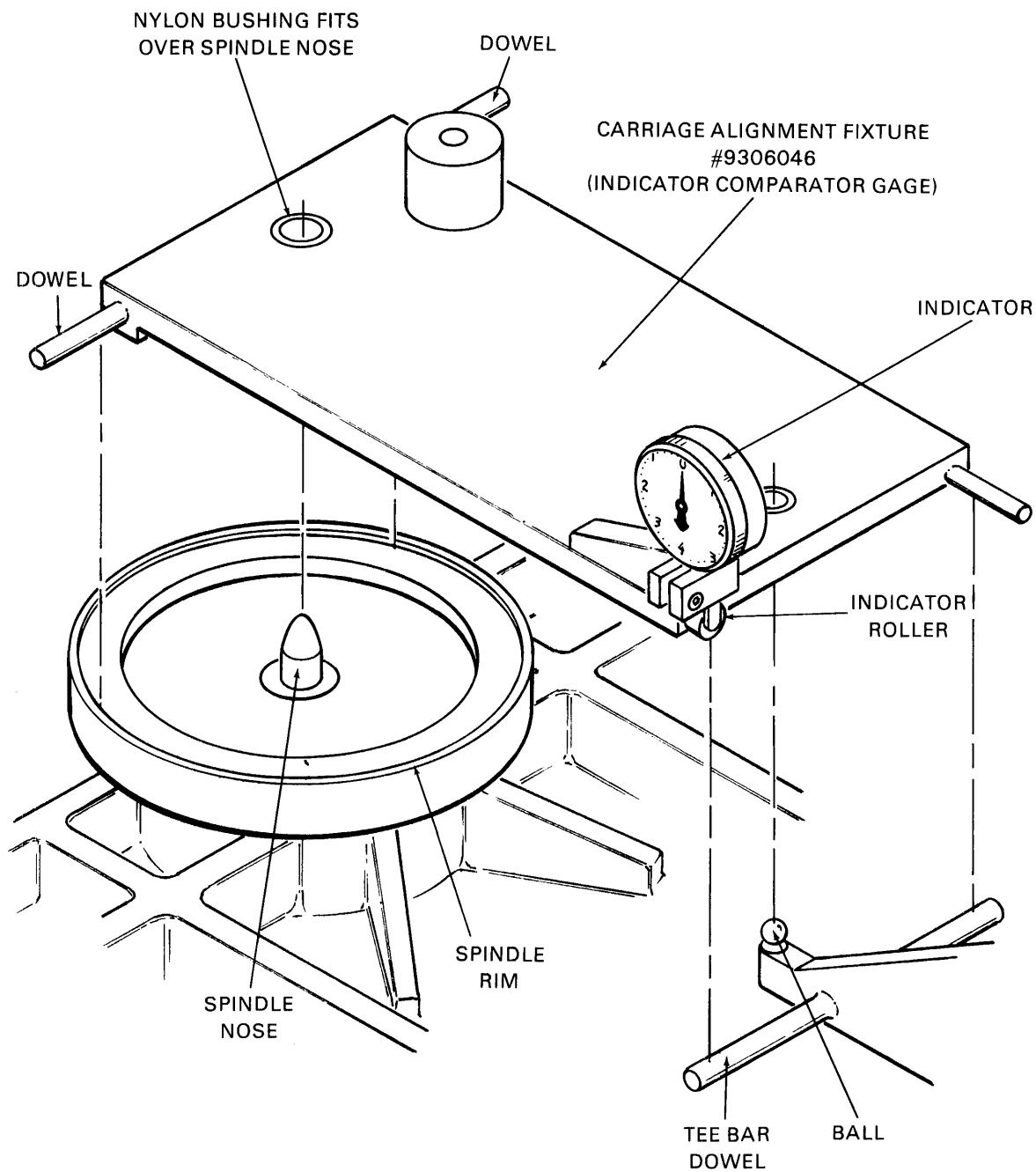


Figure 3-19 Carriage Alignment Fixture

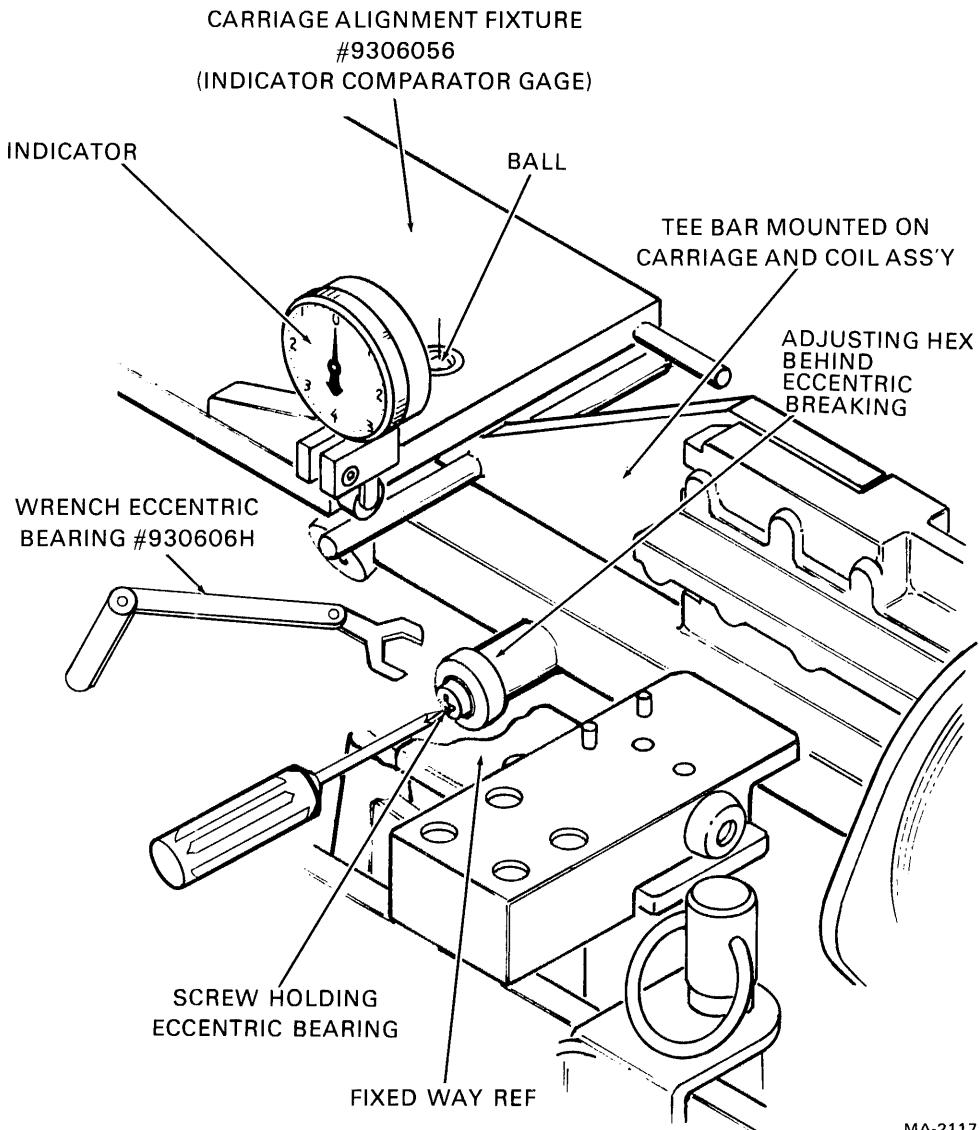
11-5164



11-5163

Figure 3-20 Indicator Comparator Guide

11. Loosen the screw holding the eccentric bearing to the carriage and retighten lightly, insert the eccentric wrench (DIGITAL 9306058-00) and move the eccentric bearing until a zero reading is obtained on the indicator and tighten the screw. (Tolerance  $\pm .001$  of zero) the number of turns of the needle must equal the number of turns in step 10 (Figure 3-21).



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Figure 3-21 Eccentric Bearing Adjustment

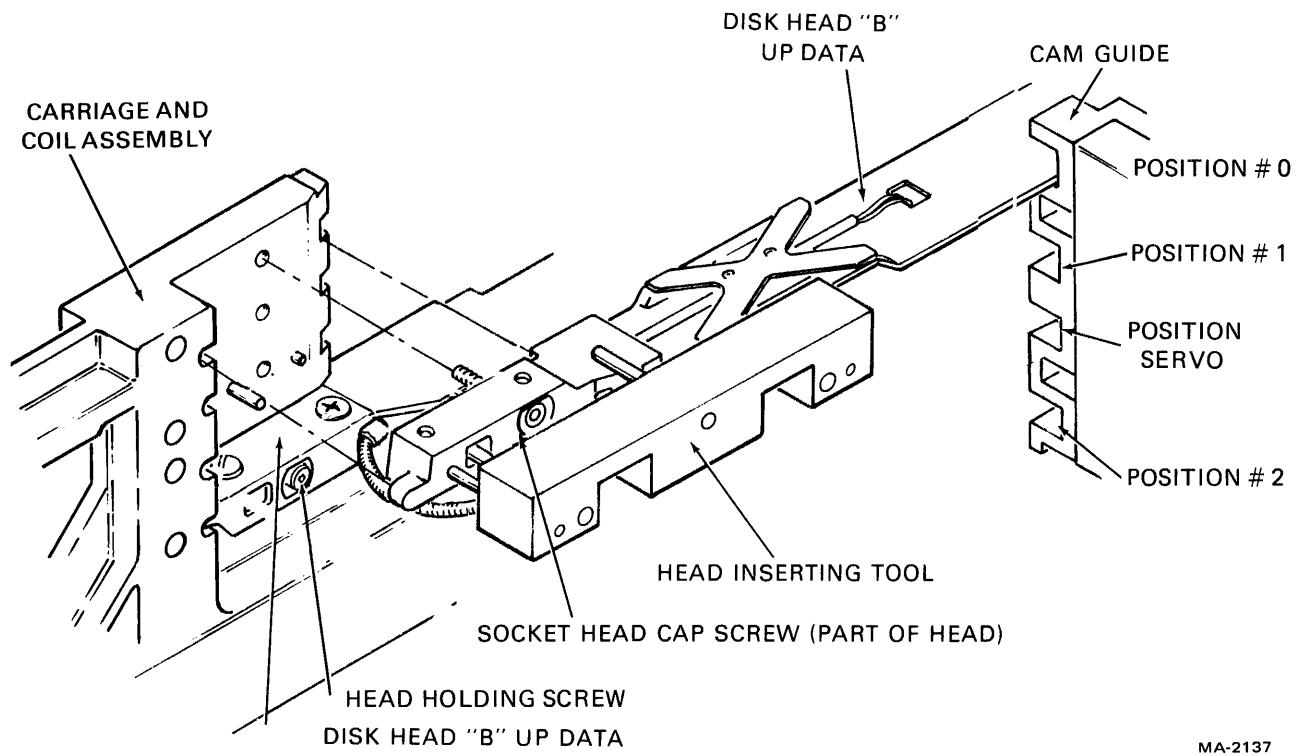
12. Lift the gauge off the ball on the tee bar and move the carriage and coil assembly back and forth several times, replace the gauge on the tee bar ball and check the reading, readjust as required.
13. Remove the comparator indicator gauge off the ball on the tee bar and the spindle cone. Place it on the master gauge.
14. Remove the tee bar from the carriage and coil assembly.

15. Move the carriage and coil assembly to home position.
16. Replace the shroud assembly (Paragraph 2.5.6).
17. Place the servo head into the insertion and removal tool (DIGITAL 9306076-00) with the dowel pin located all the way to the rear of the slot in the head (Figure 3-23).
18. Install the servo head into the carriage servo position, sliding the servo head all the way back against the dowel pin in the carriage, toward the coil.
19. Torque the captive socket head cap screw to five inch-pounds and remove the head insertion and removal tool.
20. Connect the servo head connector the read/write board or connector holder, middle connector on the cable.
21. Connect the servo head connector to the servo pre-amp board, end connector on the cable.
22. Replace the read/write heads 0, 1, and 2, as follows:
  - a. Place the read/write head into the insertion and removal tool, and carefully install the read/write/head into its proper position (Figure 3-22).
  - b. Torque the captive socket head cap screw to five inch-pounds.
  - c. Remove the head insertion and removal tool.
  - d. Connect the read/write head connector to the read/write board.
23. Replace the lid assembly (Paragraph 2.5.3).
24. Perform the glass shutter alignment procedure in Paragraph 3.7.
25. Perform the head alignment procedure in Paragraph 3.4.

### **3.13 POWER SUPPLY $\pm$ 5 VOLTS**

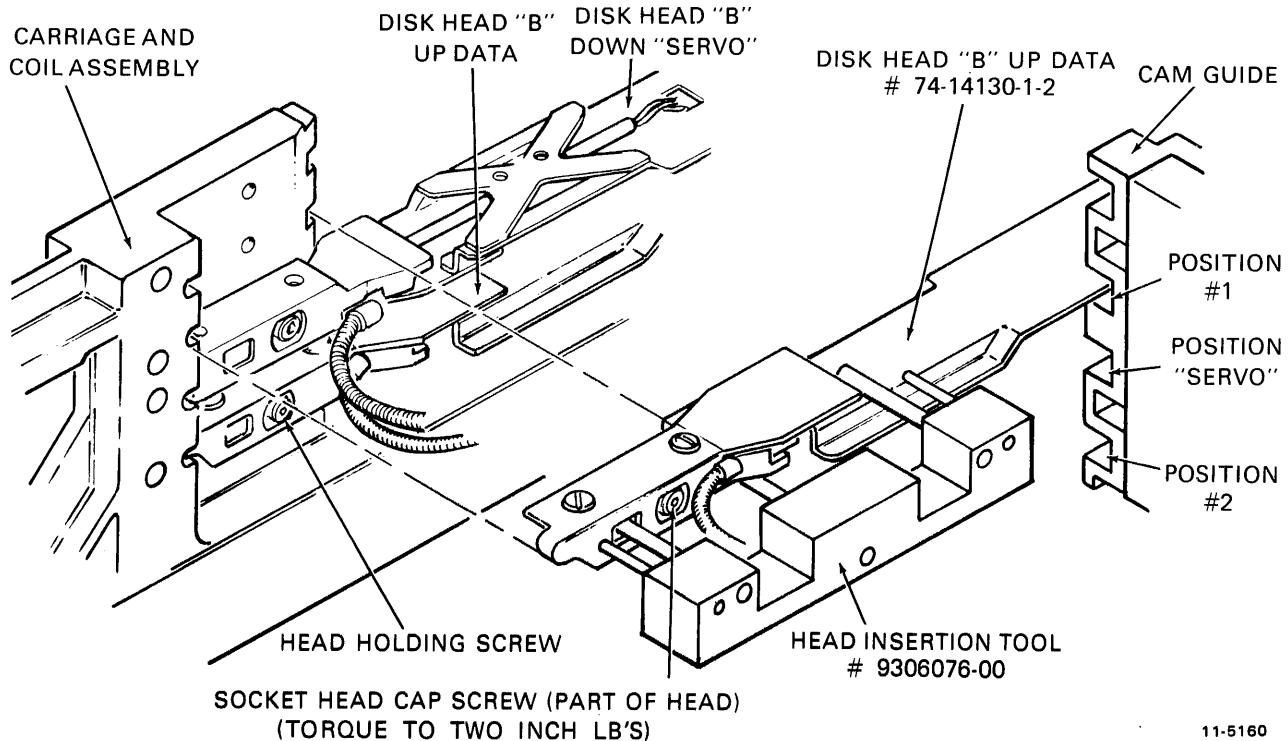
#### **Procedure**

1. Remove the rear cover (Paragraph 2.5.2).
2. Swing the electronic board on the power supply down.
3. Monitor  $+5V \pm 0.15V$  on any A2 on the card nest backplane. Monitor  $-5V \pm 0.15V$  on D1R2 of the card nest backplane.
4. Adjust as required (Figure 3-24).
5. Swing up the electronic board on the power supply.
6. Replace the rear cover (Paragraph 2.5.2).



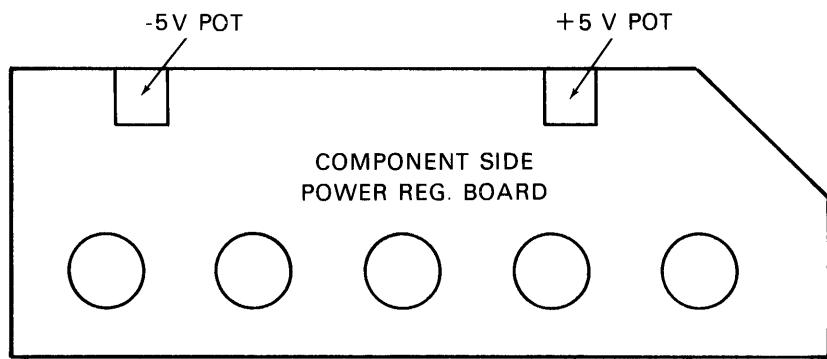
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Figure 3-22 Insertion Tool Position Up Data Heads



11-5160

Figure 3-23 Insertion Tool Position Down Data Heads



11-5134

Figure 3-24 Power Supply Adjustments

### 3.14 VCO ADJUSTMENT

1. Make sure that port A and port B are disabled on all drives attached to RK611.
2. Place Channel 1 on signal DR6 control clock H (E4J1 on M7904 module).
3. Adjust potentiometer R72 on the M7904 module for a pulse period of 465  $\mu$ sec.



## **APPENDIX A**

# **BAD SECTOR FILE**

The bad sector file is a list of the bad sectors in the RK06K or RK07K cartridge, and is constructed during formatting at the time of manufacture. Any sector found with a weak or bad spot is flagged in the header, and is recorded on the highest track and cylinder on the cartridge (cylinder 410, track 2 for an RK06K and cylinder 814, track 2 for an RK07K). This track is always written in 22 sector, 16-bit word format.

Figure A-1 shows the format and utilization of the bad sector file (within one sector). Word 0 contains the disk cartridge serial number. Words 1 and 2 are filled with zeros, as a reserve for possible future expansion of the cartridge serial number. Word 3 indicates whether the cartridge is an alignment cartridge or a data cartridge. If Word 3 has any ones, the cartridge is an alignment cartridge, and if word 3 is all zeros, the cartridge is a data cartridge.

Figure A-2 shows the format of the first bad sector address, located in Words 4 and 5. The first word contains the cylinder address, and the second word contains the track and sector addresses, in octal, as shown.

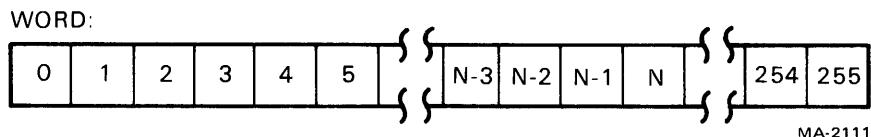


Figure A-1 Bad Sector File Format

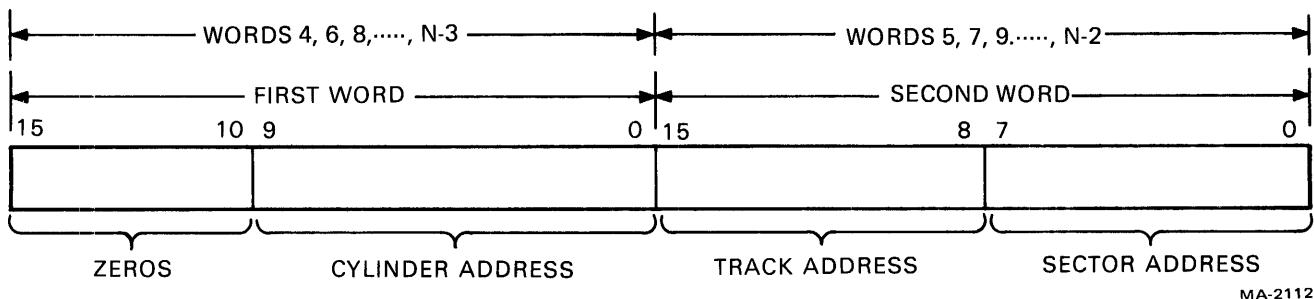


Figure A-2 Bad Sector Address Format

The last bad sector address is located in words N-3 and N-2 of Figure A-1. The two sectors after these, N-1 and N, are both filled with ones, indicating the end of the bad sector file.

The track reserved for storing the bad sector file is written in 22 sector format, although only 20 of the sectors are used. These sectors are employed as follows:

- Sectors 0, 2, 4, 6, and 8 contain bad sector addresses, in 22 sector format, and are recorded during manufacturing.
- Sectors 10, 12, 14, 16, and 18 contain bad sector addresses, in 22 sector format, and are recorded by software during normal span of cartridge life.
- Sectors 1, 3, 5, 7, and 9 contain bad sector addresses, in 20 sector format and are recorded during manufacturing.
- Sectors 11, 13, 15, 17, and 19 contain bad sector addresses, in 20 sector format, and are recorded by software during normal span of cartridge life.

#### NOTE

**All the subsequent sectors under each division contain redundant copies of the first sector to ensure the information is still available in the event of a read error.**

If the diagnostics cannot read the bad sector file, they will not execute any of their tests. The most common reason for the diagnostics not being able to read this file is that the heads are misaligned. The formatter diagnostic, MAINDEC-11-DZR6L must also be able to read the bad sector file. If it will not run, the heads must be realigned. (See Chapter 5 for this procedure.) The formatter should be run as soon as the heads have been aligned.

If the formatter will not run, even after the lead alignment, the bad sector file must be reconstructed by using the User Defined Test (UDT) diagnostic, MAINDEC-11-DZR6R.

After the UDT is loaded, this program should be run to clean up the bad sector file:

```
* SF, CC      <CR>
* SF, DC, dev #    <CR>
* SF, PA, dev #    <CR>
* SF, WH, dev #, 632, 2, 0, 102    <CR>
* DP, X, pack serial number    <CR>
000xyz, (pack serial number – if less than six digits, the leading zeros are necessary)

000000<CR>
000000<CR>
000000<CR>
177777<CR>
177777<CR> <CR>

* SF, WD, dev #, 632, 2, 0, 12000, x    <CR>
* CO      <CR>
* COMPILE OK
* RU      <CR>
```

(The UDT will give this response when the program has been compiled)

\* (This asterisk will appear after a successful run of this program.)

Refer to the UDT listing for detailed information on the individual parameters in this program.



## APPENDIX B TOGGLE BOOTSTRAP

In case of a ROM boot failure, the routines below can be used to boot in an RK06 or RK07 bootable medium. The drive select must be the "0" plug.

	<b>RK06</b>	<b>RK07</b>	<b>RK06</b>	<b>RK07</b>
LA	10000	10000		
DEP	012737	012737	MOV #3,@ #RKCS1	MOV #2003,@ #RKCS1
	000003	002003		
	177440	177440		
	132737	132737	BITB #200, @ #RKCS1	BITB #200,@ #RKCS1
	000200	000200		
	177440	177440		
	001774	001774	BNE \$ - 3	BNE \$-3
	012737	012737	MOV #21, @ #RKCS1	MOV #2021, @ #RKCS1
	000021	002021		
	777440	777440		
	000001	000001	WAIT	WAIT
LA	10000	10000		
<b>START</b>	wait one second			
LA	000000	000000		
<b>START</b>				

## APPENDIX C

### SUBSYSTEM INSTALLATION AND CHECKOUT

#### C.1 SITE CONSIDERATIONS AND PREPARATIONS

##### C.1.1 ENVIRONMENTAL CONSIDERATIONS

**C.1.1.1 General** – The RK611/RK06 or RK611/RK07 Disk subsystem is designed to operate in a light industry or a business environment.

**C.1.1.2 Temperature** – The operating temperature range of either Disk Subsystem is from 10° C to 40° C (50° F to 104° F); maximum gradient is 30° F per hour. The nonoperating temperature range is from -40° C to 66° C (-40° F to 151° F). The disk cartridge operating temperature range is from 15.6° C to 48.9° C (60° F to 120° F).

**C.1.1.3 Relative Humidity** – Humidity control is important in a data storage system as static electricity can cause errors in any CPU with memory. Either disk subsystem is designed to operate efficiently within a relative humidity range of 10 to 90 percent, with a maximum wet bulb temperature of 28° C (82° F) and a minimum dewpoint of 2° C (36° F). The non-operating relative humidity range is from 10 percent to 95 percent, with a maximum wet bulb temperature of 46° C (115° F). The relative humidity range for the disk cartridge is 8 to 90 percent, with a maximum wet bulb temperature of 28° C (82° F).

**C.1.1.4 Heat Dissipation** – Heat dissipation of the RK06 or RK07 is 1500 Btu/hr nominal and 1700 Btu/hr maximum. By adding this figure to the total heat dissipation for the other system components, and then adjusting the result to compensate for such factors as the number of personnel, heat radiation from adjoining areas, sun exposure through windows, system efficiency, etc., the approximate cooling requirements for the system can be determined. It is advisable to allow a safety margin of at least 25 percent above maximum estimated requirements.

**C.1.1.5 Acoustics** – Most computer sites require at least some degree of acoustic treatment; however, the RK06 or RK07 Disk Subsystem will not contribute unduly to the overall acoustic problem. Acoustic materials should neither produce nor harbor dust.

**C.1.1.6 Altitude** – Computer system operation at high altitudes can result in heat dissipation problems. The maximum altitude specified for the RK06 or RK07 is 2440 m (8000 ft). However, maximum allowable operating temperatures are reduced by a factor of 1.8° C/1000 m (1° F/1000 ft) for operation at high-altitude sites. Thus, the maximum allowable operating temperature at 2440 m (8000 ft), for example, would be reduced to 28° C (82° F).

**C.1.1.7 Radiated Emissions** – The effects of radiated emissions can be reduced by:

1. Grounding window screens and other large metal surfaces
2. Shielding interconnection cables with grounded shields
3. Providing additional grounding to the system cabinets
4. In extreme radiation environments, providing a grounded cage for the system.

**C.1.1.8 Vibration/Mechanical Shock/Attitude** – The RK06 or RK07 is designed to operate within specifications in a moderately controlled environment, such as an office or computer facility, during the following sine vibration test, applied once in each of three orthogonal axes (sweep rate = 1 octave/min):

50–60 Hz 0.002 inch double-amplitude (DA) displacement

50–5000 Hz 0.25 G pk

500–50 Hz 0.25 G pk

50–5 Hz 0.002 inch DA

It is also designed to operate while a half sine shock pulse of 3 G pk and  $10 \pm 3$  ms duration is applied once in either direction of three orthogonal axes (3 pulses total).

Performance of the RK06 or RK07 will not be affected by an attitude where the maximum pitch and maximum roll do not exceed  $\pm 5$  percent.

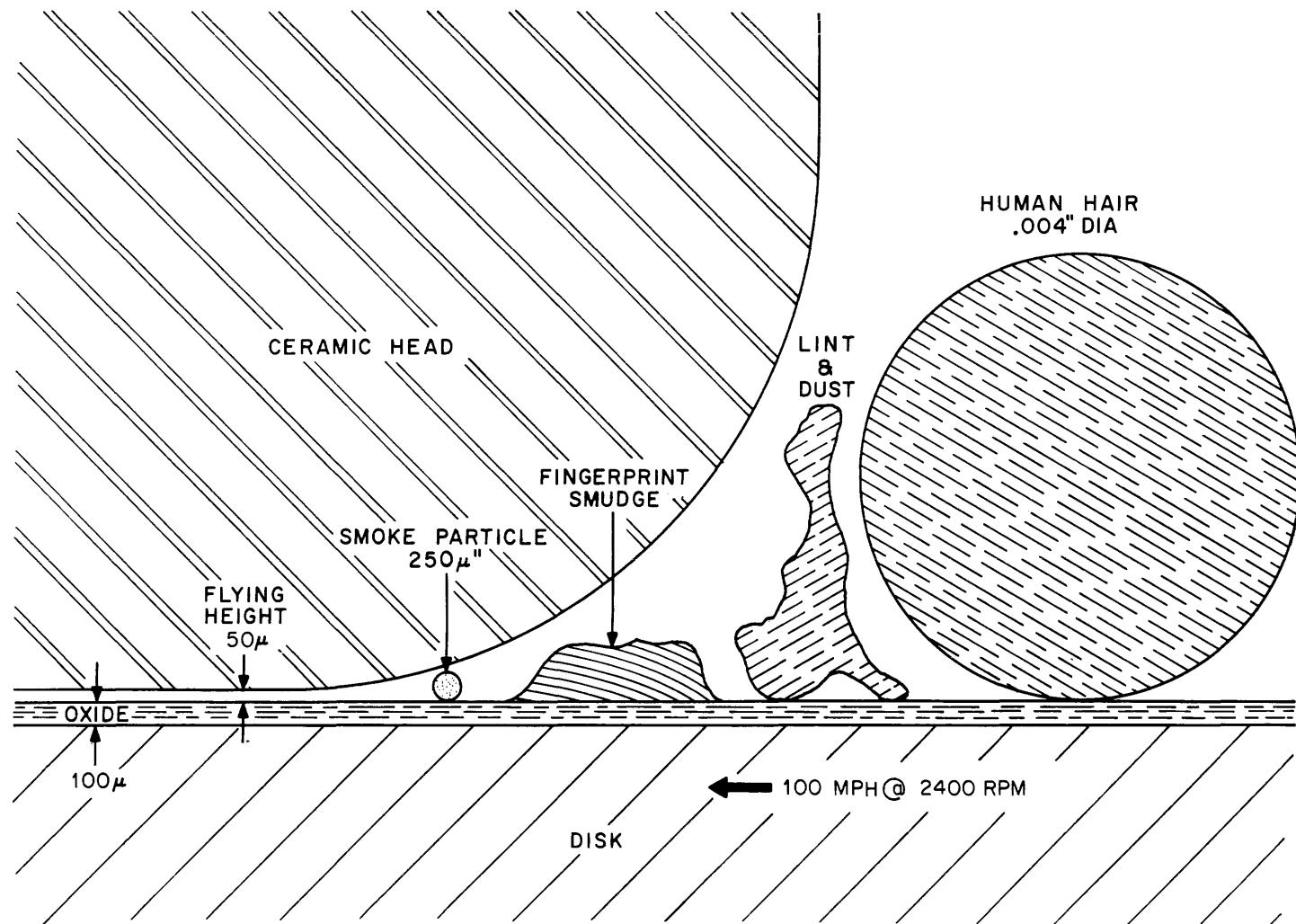
**C.1.1.9 Cleanliness** – Although cleanliness is important in all facets of a computer system, it is particularly crucial in the case of a device such as the RK06 or RK07 Disk Subsystem. Disk cartridges are not sealed units, while loading, and are extremely vulnerable to dirt. Even such minute obstructions as smoke particles, fingerprint smudges, or dust specks can cause head crashes and catastrophic destruction of heads and/or disk surfaces, as shown in Figure C-1.

The RK06 or RK07 is capable of operating in an ambient atmosphere containing not more than one million particles of 0.5 micron or larger per cubic foot of air.

During site preparation, there are a number of steps that may be taken to enhance subsequent cleanliness:

1. Seal all windows in the vicinity of the Disk Subsystem.
2. If partitions are to be installed, consider floor-to-ceiling walls which minimize the flow of dust.
3. If painting is to be done in advance of installation, select paint for walls, ceilings, and floors that will not tend to flake or powder excessively. (Waterbound distemper is generally unsatisfactory in this respect.)
4. Check that the flow of air from the air-conditioning system will tend to carry lint, etc., away from the Disk Subsystem location. Provide filtration to inhibit dust and other particulants.
5. Select acoustical material that will neither produce nor harbor dust.
6. Avoid glass fiber tiles that could produce abrasive particles and floor coverings that tend to crack or crumble.
7. Provide closed cabinets for disk storage.

C-3



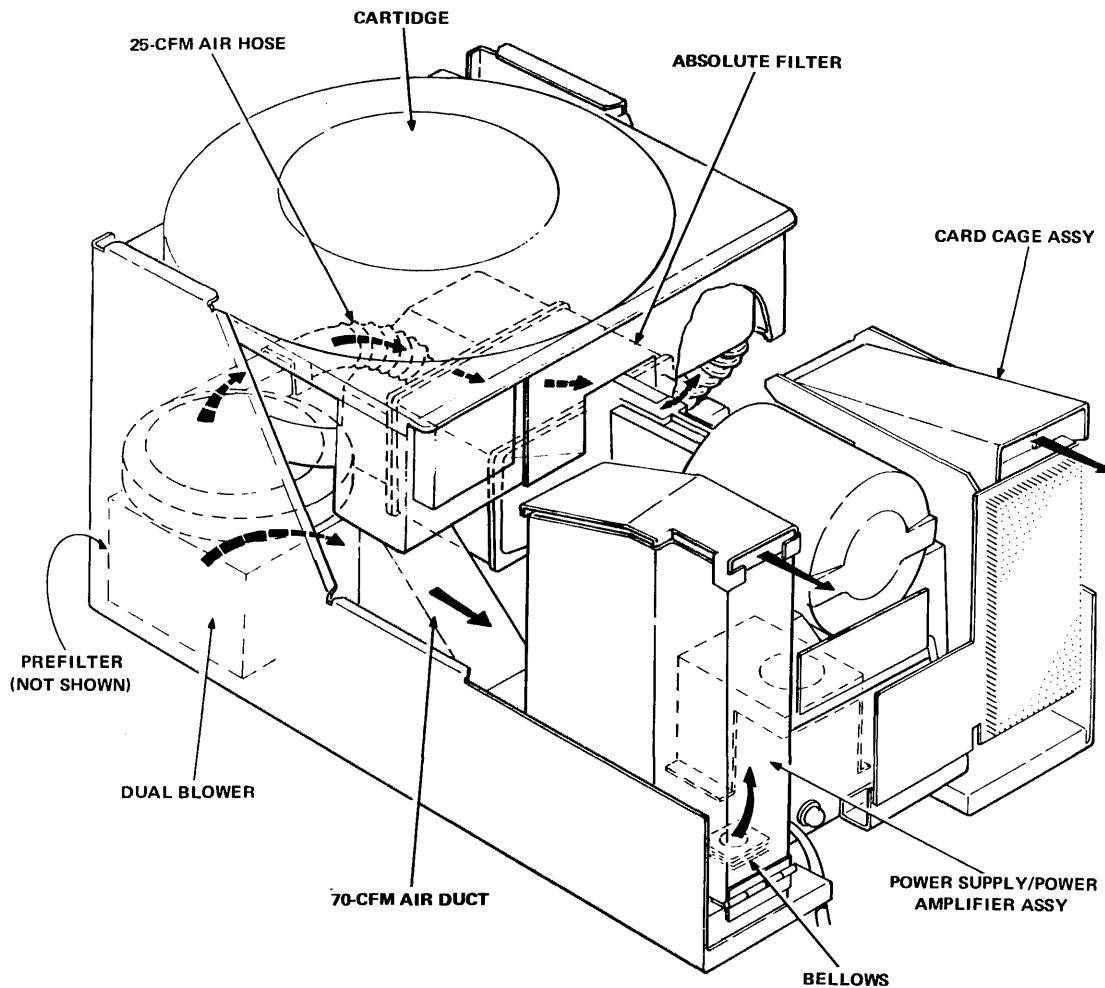
11-4978

Figure C-1 Relationship of Disk-Head, Disk, and Contaminants

8. Clean and vacuum subfloor areas and air-conditioning systems just prior to installation.
9. Place impregnated mats at each entrance to reduce the amount of dust tracked in from other areas.

The disk drive air circulation system (Figure C-2) is designed to supply clean air for:

1. Disk temperature control.
2. Cleaning of the shroud area by low pressure (3/4 inch of water) at 70 cfm of air.
3. Card cage cooling.
4. Power supply/power amplifier assembly cooling.



11-4982

**Figure C-2 RK06/RK07 Disk Drive Air Supply and Distribution Subsystem**

To ensure that exhausted air moves freely, floor air-conditioning outlets should not be placed at the rear of the drive.

## C.1.2 Site Preparation

**C.1.2.1 Space** – Provision should be made for service clearances of 916 mm (36 inches) at the front and rear of the RK06 or RK07 disk drive. Space should also be made available in the system environment for storage of disk cartridges, each of which has a diameter of approximately 355 mm (14 inches) and a height of approximately 101 mm (4 inches). No more than five cartridges should be placed in a single stack.

**C.1.2.2 Cabling** – Each RK06 and RK07 Disk Drive is equipped with a molded line power cord with a length of 2.7 m (9 ft).

**C.1.2.3 Power Requirements** – Both  $60 \pm 0.5$  Hz and  $50 \pm 0.5$  Hz drives operate from 90–128 Vac or 180–264 Vac power sources at a power factor greater than 0.80. While operating at 60 Hz, the RK06 input power is 450 W nominal and 500 W maximum. While operating at 50 Hz, the input power is 500 W nominal and 550 W maximum. While operating at 60 Hz, the input power of the RK07 is 500 W nominal and 550 W maximum, or 550 W nominal and 600 W maximum while operating at 50 Hz.

Receptacles that will accept the 90–128 Vac plugs are designated variously as: DEC (12-05351), NEMA (5-15R), Hubbell (5000-M9), and General Electric (4050-ITA). Receptacles that will accept the 180–264 Vac plugs are designated variously as: DEC (12-11204), NEMA (6-15R), Hubbell (5662ST), and General Electric (4092-ITA). Appropriate circuit breakers are also necessary.

Digital Equipment Corporation must be notified of available input power well in advance of shipment, so that the proper drive may be shipped.

**C.1.2.4 Floor Loading** – The weight of the RK06 or RK07 (148 kg/325 lb) alone is not sufficient to place unusual stress on most office building or industrial plant floors. However, the added weight should be considered in relation to the weight of the existing computer system and possible future expansion.

**C.1.2.5 Installation Constraints** – The route the equipment will travel from the receiving area to the installation site should be studied in advance to ensure problem-free delivery. Among the factors to be considered are the height and location of loading doors; the size, capacity, and availability of elevators; the number and size of aisles and doors en route; and any restrictions, such as bends or obstructions, in the hallways. Any constraints should be reported to Digital Equipment Corporation as soon as possible so that the requirements of the individual installation site may be considered when the unit is packed for shipment.

**C.1.2.6 Fire and Safety Precautions** – The RK06 and RK07 Disk Drives present no unusual or additional fire or safety hazards to an existing computer system. Wiring should be carefully checked, however, to ensure that the capacity is adequate for the added load and for any contemplated expansion. The 60 Hz version of the RK06 or RK07 is UL-listed and CSA-certified. The 50 Hz version complies with IEC 435 standards.

## C.2 INSTALLATION

This chapter includes the procedures required for unpacking and installing the RK611/RK06 or RK611/RK07 Disk subsystem. Installation will only be performed by qualified DIGITAL personnel. If the equipment is installed by personnel not so qualified, the equipment will lose its CSA rating.

The drive is designed for installation as a free-standing device.

### C.2.1 Unpacking and Inspection

When packaged for shipment, the RK06 or RK07 in its H969 cabinet weighs approximately 148 kg (325 lb). Although excessively heavy and bulky for single-person handling, the package does not require the use of a forklift or similar equipment for moving or lifting. Table C-1 lists the special tools and test equipment required for the RK611/RK06 or RK611/RK07 Disk subsystem installation.

#### CAUTION

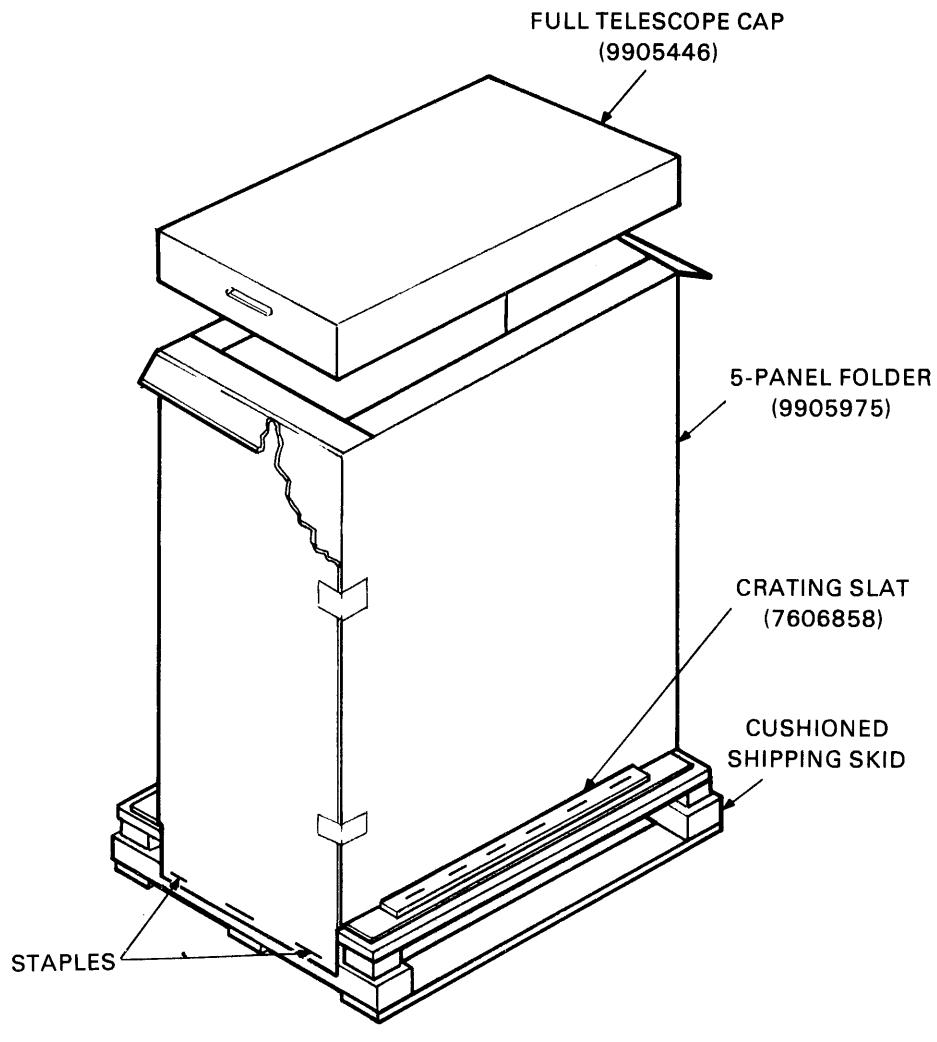
**When moving or lifting the RK06 or RK07, always grasp the frame structure. Do NOT hold any part of the top or side covers.**

**Table C-1 Special Tools and Test Equipment for RK611/RK06 or RK611/RK07 Disk Subsystem Installation**

Part No.	Part
RK6/7-TA	Field Test Box (115 Vac, 50 or 60 Hz)
RK6/7-TB	Field Test Box (230 Vac, 50 or 60 Hz)
RK06K-AC	Alignment cartridge (RK06)
RK07K-AC	Alignment cartridge (RK07)
93-06058	Wrench
93-06240	Glass alignment tool
93-06076	Head installation/removal tool
93-06087	Head alignment tool
93-06122-01	Shim, 0.003 inch
93-06122-02	Shim, 0.00015 inch
93-06123-01	Shim, 0.020 inch
93-06123-02	Shim, 0.015 inch
93-06171	Head separation tool
29-19633	Mirror
29-20065	Magnifier
29-20906	Torque wrench
29-21487	Head torque wrench
29-21832	Hex ball driver set
29-22526	Screwdriver, 14.5-inch, Phillips
93-06056	Carriage roll alignment tool

The procedure for unpacking the disk drive is as follows:

1. When delivered, the RK06 or RK07 is mounted on a shipping skid and covered by a cardboard carton (Figure      ). First, remove the two plastic straps that hold the carton secure to the skid.
2. Remove the lid from the top of the cardboard carton.
3. Remove the staples that fasten the three wooden slats to the bottom flanges of the cardboard-overlay carton. Also remove the staples from that portion of the carton that extends to the bottom of the skid.



11-4979

Figure C-3 RK06/RK07 Shipping Package Configuration

4. Visually inspect the cabinet for outward signs of shipping damage. Retain the original packing materials and receipts in case any claims are filed for shipping damage. All damage claims should be promptly filed with the transportation company involved. DIGITAL should be notified immediately of any such claims.
5. Remove the rear and front covers; visually inspect for shipping damage.
6. Inspect for loose cable connectors, terminal points, and subassemblies.
7. Inspect the logic backplane in both (X and Y) axes for bent pins.
8. Pull rearward on the logic assembly and power supply assembly. Both assemblies will open 90 degrees for access to components. Ensure that all logic modules are in proper locations (refer to Figures C-4 and C-5).

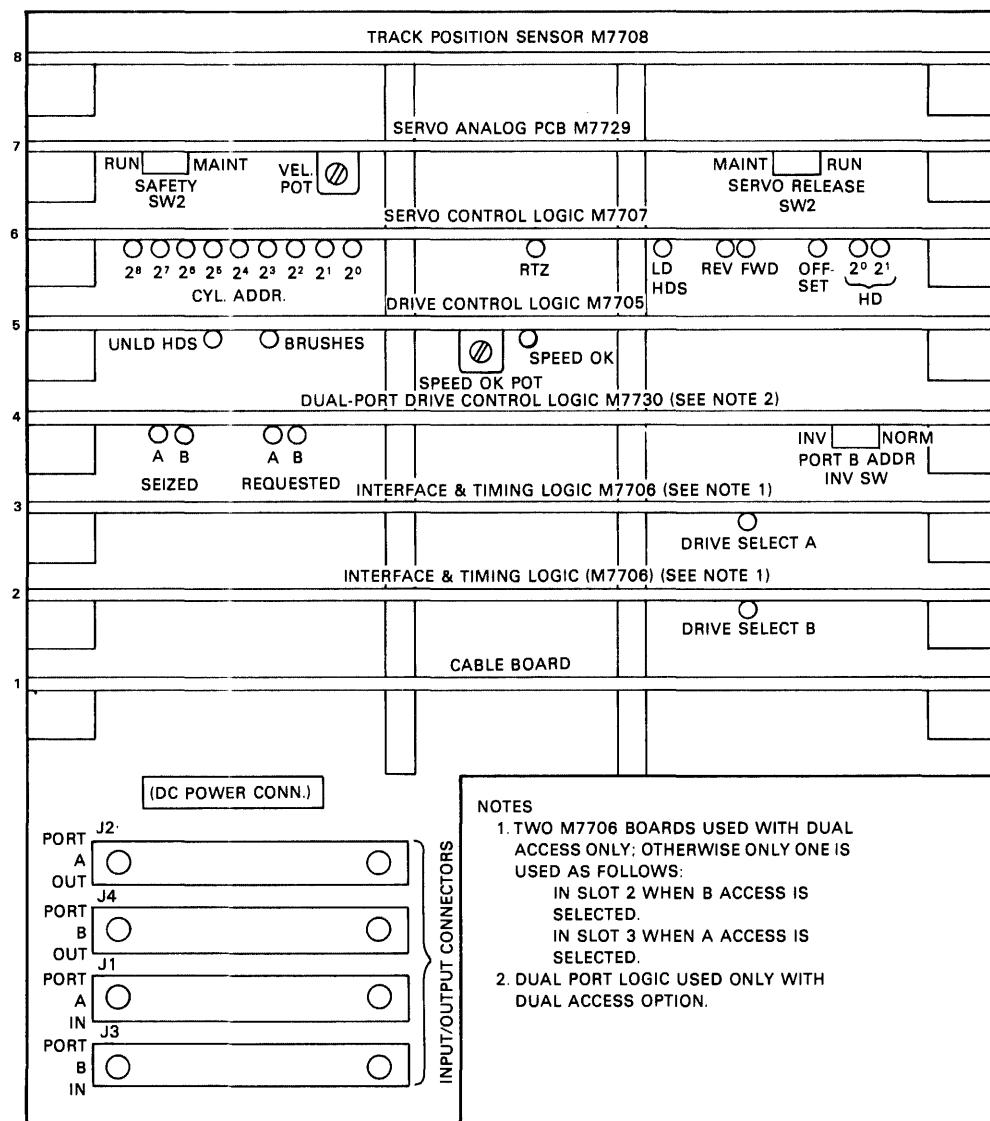
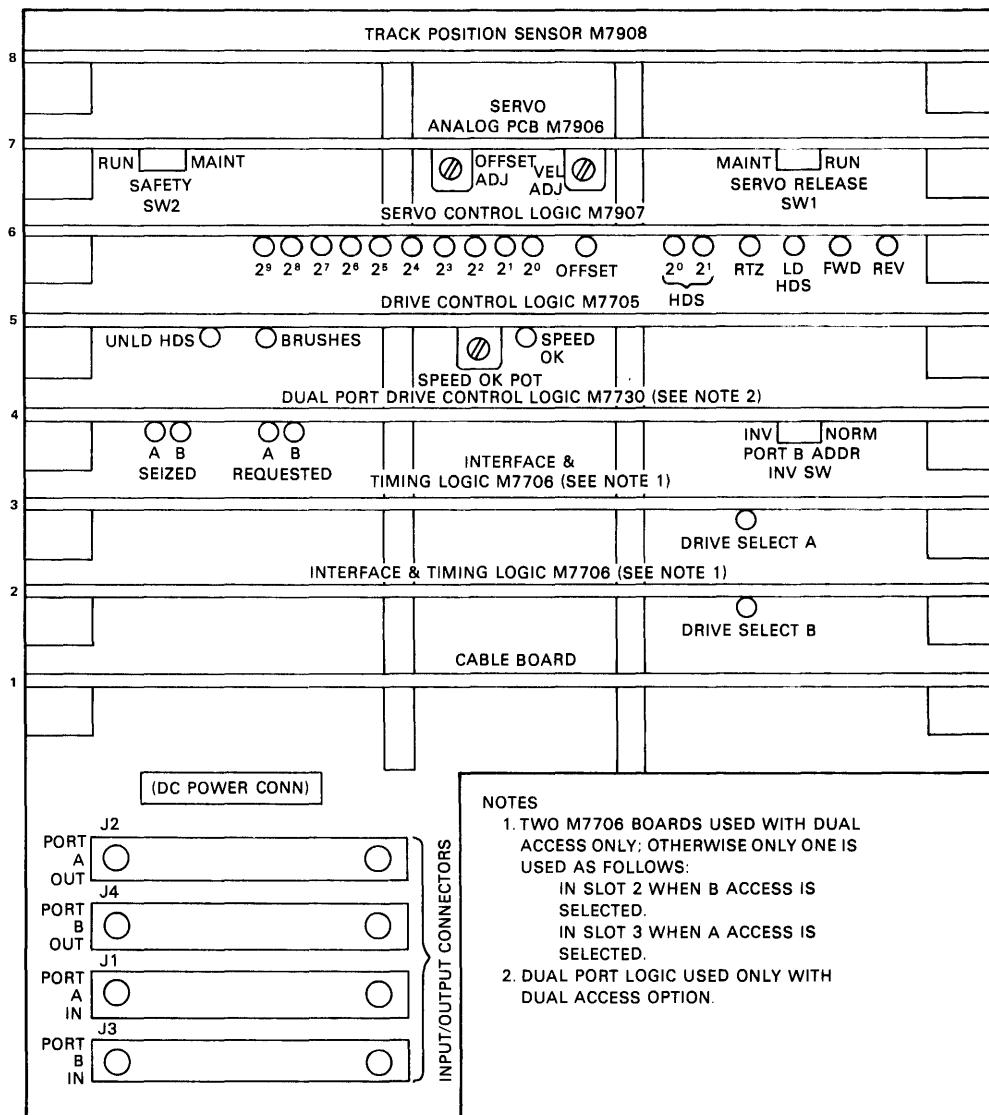


Figure C-4 RK06 Disk Drive Logic Module Locations



MA-0923

Figure C-5 RK07 Disk Drive Logic Module Locations

9. Check the cable connectors and modules in the logic assembly (card nest) to ensure tightness.
10. Check the power supply assembly for loose cables, connectors, and connection of air distribution system bellows (Figure C-2) and proper installation of the motor release pin.
11. Inspect the absolute filter area for proper attachment of hoses. Clean the foam prefilter if necessary.
12. Check the head cam area to ensure that the head arms are engaged properly on the head cam.
13. If any problems are encountered during execution of the above procedures, refer to the *RK06/RK07 Disk Subsystem Service Manual* for corrective procedures.
14. Close the hinged power supply and card nest assemblies and replace all access covers.
15. Remove both bolts securing the cabinet to the shipping skid.
16. Remove the skid blocks and position the cabinet leveling feet so that the cabinet rests on its casters.
17. Remove the cabinet from the shipping skid, using a ramp or other suitable device. At this point there are no other shipping restraints for the drive.

**CAUTION**  
**Use care in moving the drive/cabinet.**

### C.2.2 Safety Precautions

When performing the installation procedures in Paragraph C.2.3, observe the following precautions to avoid injury to personnel or damage to the equipment.

1. Keep fingers and hands out of the area between the cartridge and the carriage while drive power is ON.
2. Always remove ac power cables when it is necessary to work inside the drive.

**CAUTION**  
**Always remove wristwatch before servicing the drive**  
**(linear-motor electromagnetic fields are destructive**  
**to watches).**

3. Use only nonmagnetic tools near the recording area of the disk cartridge. Use care when working in the linear-motor area with ferrous materials. Keep read/write heads away from the electromagnetic area.
4. Avoid touching or blowing breath on read/write heads. Skin acids can etch and ruin heads; breath can cause condensation deposits that disfigure the gliding surface.
5. Never move the carriage assembly forward manually without a spinning disk in place or the head-separator tool installed.
6. Never remove or change modules without shutting down all internal drive power.

### C.2.3 Installation Procedure

The procedures for installing the RK611 Controller and the RK06 or RK07 Disk Drive are covered in the following paragraphs.

#### C.2.3.1 RK611 Controller – To install the RK611 Controller in a PDP-11 expander box:

1. Remove the RK611 from its shipping container.
2. Install the RK611 backplane into the designated expander box and secure with the screws provided in the accessories bag. Install power harnesses (2), using expander box instructions.

#### NOTE

If the M7901 module of the RK611 is higher than ETCH.E, skip step 3. Also, for all RK06 only installations, skip step 3.

3. If the subsystem contains any RK07 Disk Drives, verify that the RK611 Controller has been modified to operate with RK07 Drives as well as with RK06 Drives. To make this verification, ensure that the following changes have been made to the M7901 module:
  - a. On Side 2, the etch at pin E11-11 has been cut.
  - b. On Side 2, the etch at pin E12-5 has been cut.
  - c. On Side 1, a wire has been added, connecting E11-10 to E11-11.
  - d. On Side 1, a wire has been added, connecting E12-5 to E17-2.

If these changes have not been made, then make them.

4. Set the switch configuration for the desired Unibus address and interrupt vector into the M7900 module. Use Table C-2 as a guide when making these settings.

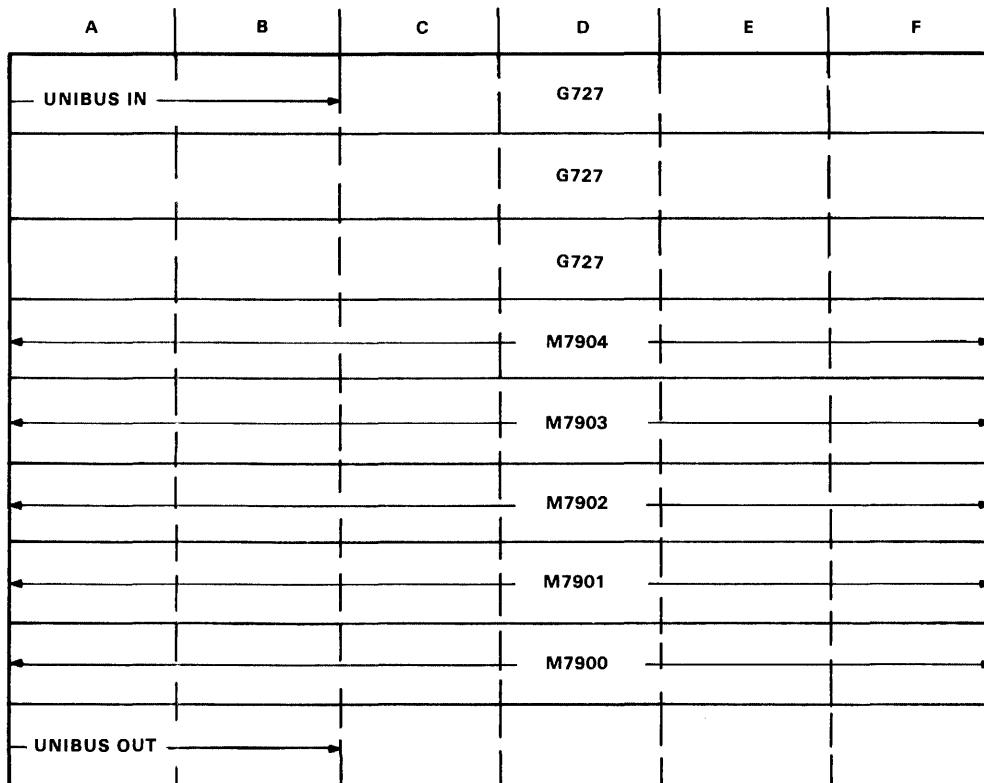
**Table C-2 RK611 Control Switch Configurations  
for Desired Unibus Address and Interrupt Vector**

Switch Section	Unibus Bit	Switch Section	Unibus Bit
S1-1	A12	S2-1	NA
S1-2	A11	S2-2	D08
S1-3	A10	S2-3**	D07
S1-4	A09	S2-4	D06
S1-5	A08	S2-5	D05
S1-6*	A07	S2-6	D04
S1-7*	A06	S2-7**	D03
S1-8	A05	S2-8	D02

\*For the standard address of 777440, these switches should be in the ON position; all others should be in the OFF position. Note that this address overlaps the Look-Ahead Register in the RC11 Disk Subsystem.

\*\*For the standard vector of 210, these switches should be in the OFF position; all others should be ON. Note that this vector overlaps the interrupt vector in the RC11 Disk Subsystem.

5. If the controller is to be connected to a PDP-11/40 system, remove the M7234 from the processor. Remove W5 on the M7234 and replace the module in the backplane. This jumper must be removed to successfully run the RK06 or RK07 diagnostics.
6. Insert the modules into the RK611 backplane using Figure C-6 as a guide.



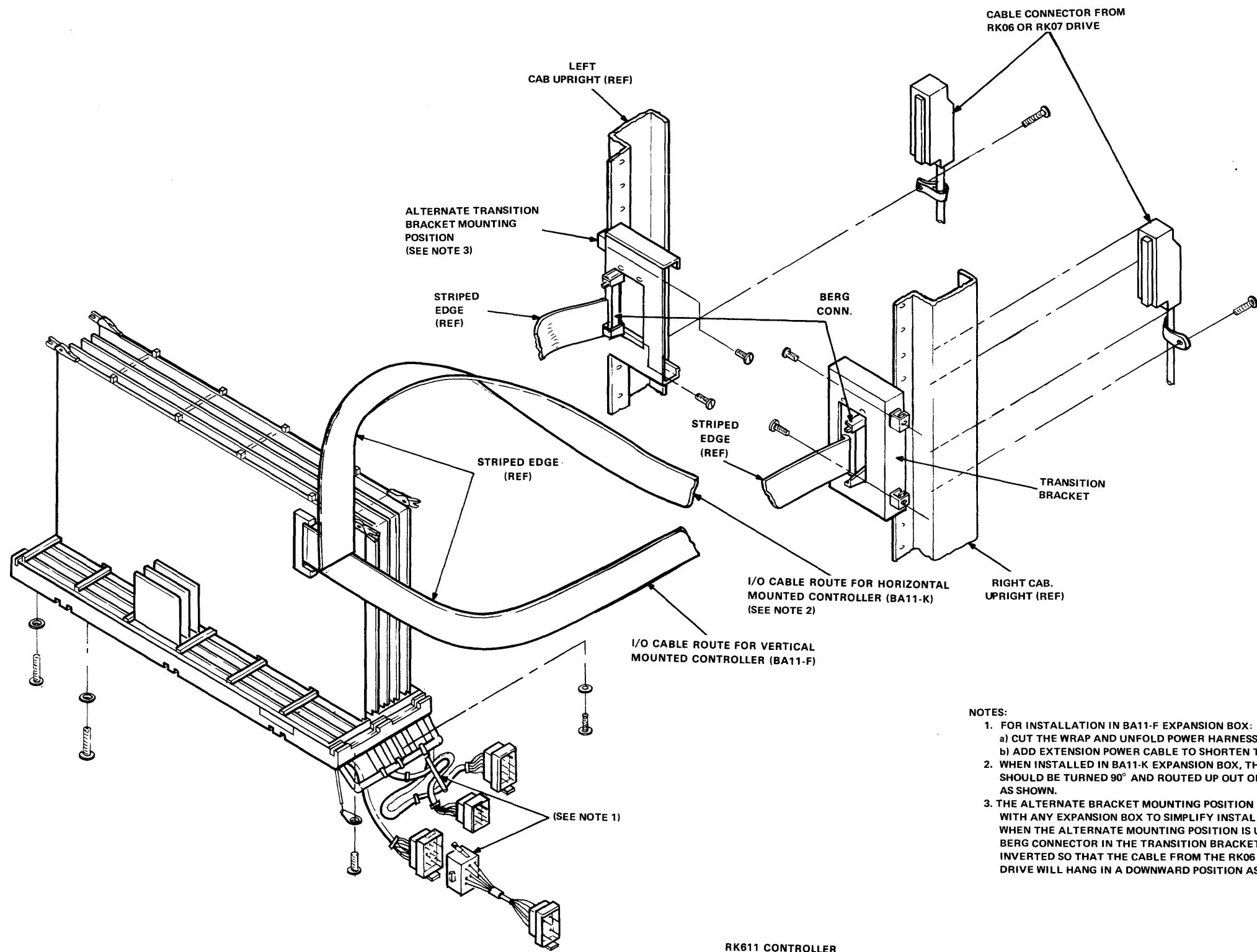
11-4981

Figure C-6 RK611 Controller Backplane (from Module Side)

7. Attach the transition connector assembly (PN-70-12415-0-0) to the cabinet containing the RK611 using the nuts and bolts provided.
8. Connect the flat cable (PN-BC06R-06) from the M7904 module to the Berg connector side of the transition connector. Refer to Figure C-7 for placement of the striped edge of the cable.
9. If the RK06 or RK07 subsystem is to be dual ported, repeat this procedure for the second controller.

**NOTE**

**Check for a different address and vector on the second controller.**



NOTES:

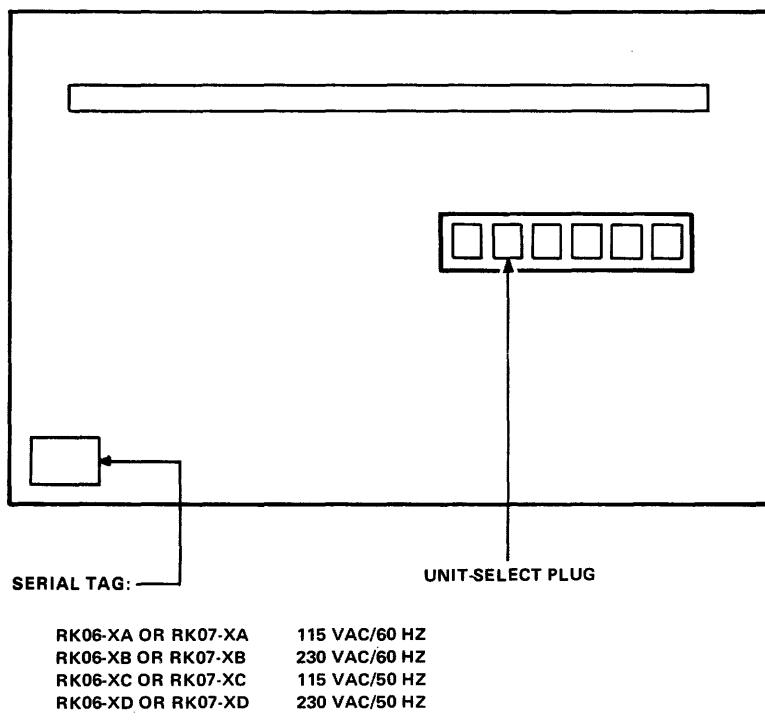
1. FOR INSTALLATION IN BA11-F EXPANSION BOX:
  - a) CUT THE WRAP AND UNFOLD POWER HARNESS.
  - b) ADD EXTENSION POWER CABLE TO SHORTEN THE HARNESS.
2. WHEN INSTALLED IN BA11-K EXPANSION BOX, THE I/O CABLE SHOULD BE TURNED 90° AND ROUTED UP OUT OF THE BOX AS SHOWN.
3. THE ALTERNATE BRACKET MOUNTING POSITION MAY BE USED WITH ANY EXPANSION BOX TO SIMPLIFY INSTALLATION. WHEN THE ALTERNATE MOUNTING POSITION IS USED, THE BERG CONNECTOR IN THE TRANSITION BRACKET MUST BE INVERTED SO THAT THE CABLE FROM THE RK06 OR RK07 DRIVE WILL HANG IN A DOWNWARD POSITION AS SHOWN.

11-4984

Figure C-7 RK611 I/O Connector Details

**C.2.3.2 RK06 or RK07 Disk Drive – To install the disk drive:**

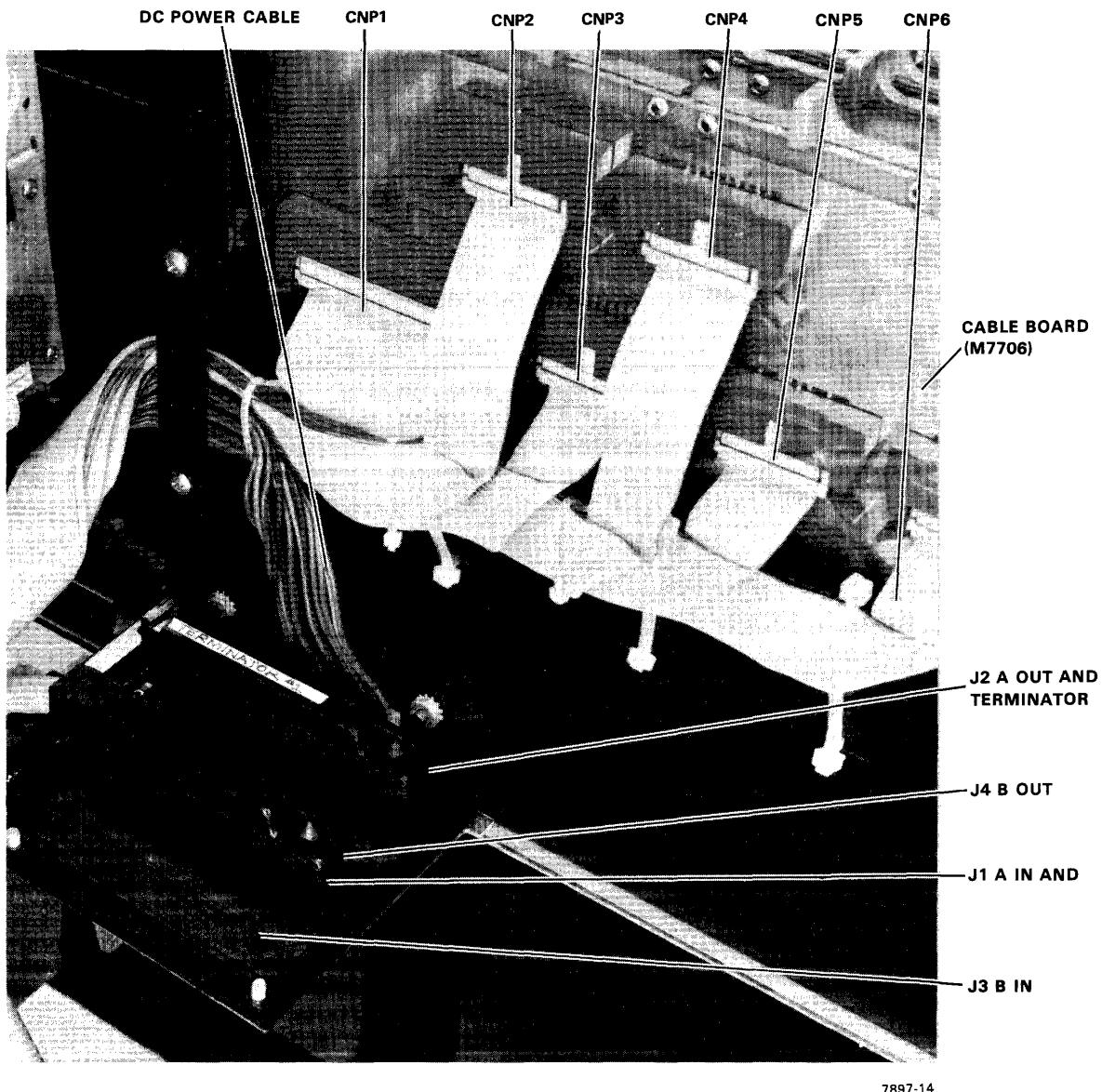
1. Roll the drive cabinet to its designated location. Level the cabinet by lowering the four leveling feet attached to the cabinet until all weight is removed from the casters.
2. Remove the front and rear access covers from the drive.
3. Verify that the model number listed on the serial tag (Figure C-8) corresponds to the site power requirements. Refer to the voltage ranges given in Figure C-8, and if a discrepancy exists, correct it before continuing with the installation.
4. Connect a ground wire (PN-7212827-25) from the ground stud on the H969 cabinet to the ground stud on the cabinet containing the RK611 Controller (Figures C-10 and C-11).
5. Lower the card nest assembly to its horizontal (service) position and install a drive bus cable (PN-70-12292-xx) between the transition connector (PN-70-12415-0-0) of the controller cabinet and I/O connector J1 (A-IN) of the RK06 or RK07 (Figure C-9 and Table C-3). The standard drive cable length from controller to drive is 7.62 m (25 ft). However, optional cable lengths can be used if the total drive bus does not exceed 30.48 m (100 ft). (See Table 4-3 for part numbers.)



**Figure C-8 Serial Tag Location and Model Identifications  
(Tag Visible with Front Cover Removed)**

**Table C-3 Drive Bus Cables**

Part No.	Length
70-12292-8	2.44 m (8 ft)
70-12292-12	3.66 m (12 ft)
70-12292-25	7.62 m (25 ft)
70-12292-40	12.19 m (40 ft)



**Figure C-9 RK06/RK07 I/O Connector Details**

CABLE CHART			
FROM	TO	REMARKS	
CONNECTION	WITH	CONNECTION	WITH
CONTROLLER	--	J1A IN	DRIVE
CONTROLLER	--	J3B IN	DRIVE
J2A OUT	DRIVE	NEXT DRIVE	DRIVE
J4B OUT	DRIVE	NEXT DRIVE	DRIVE
		OR TERMINATED (SEE NOTE)	

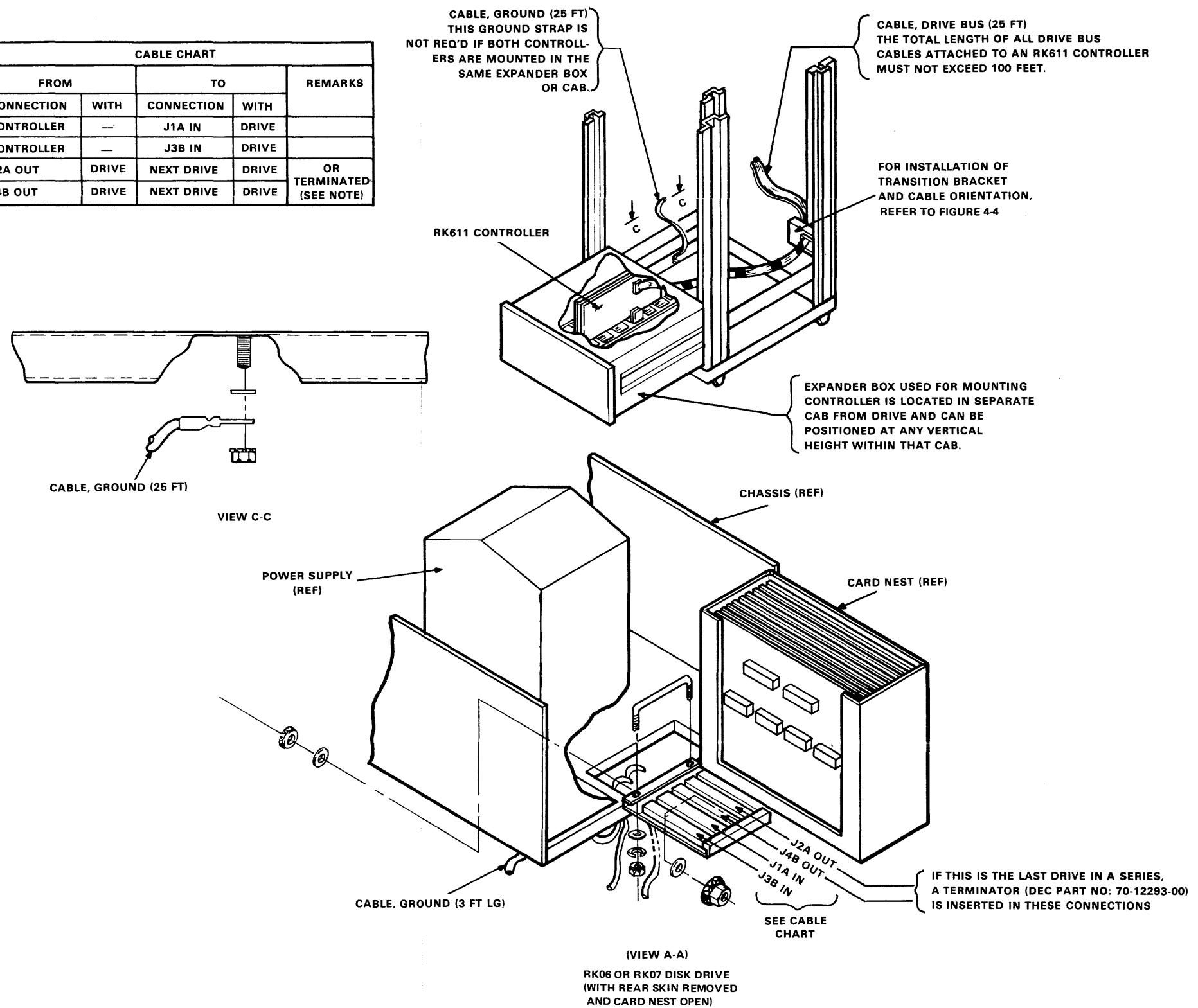
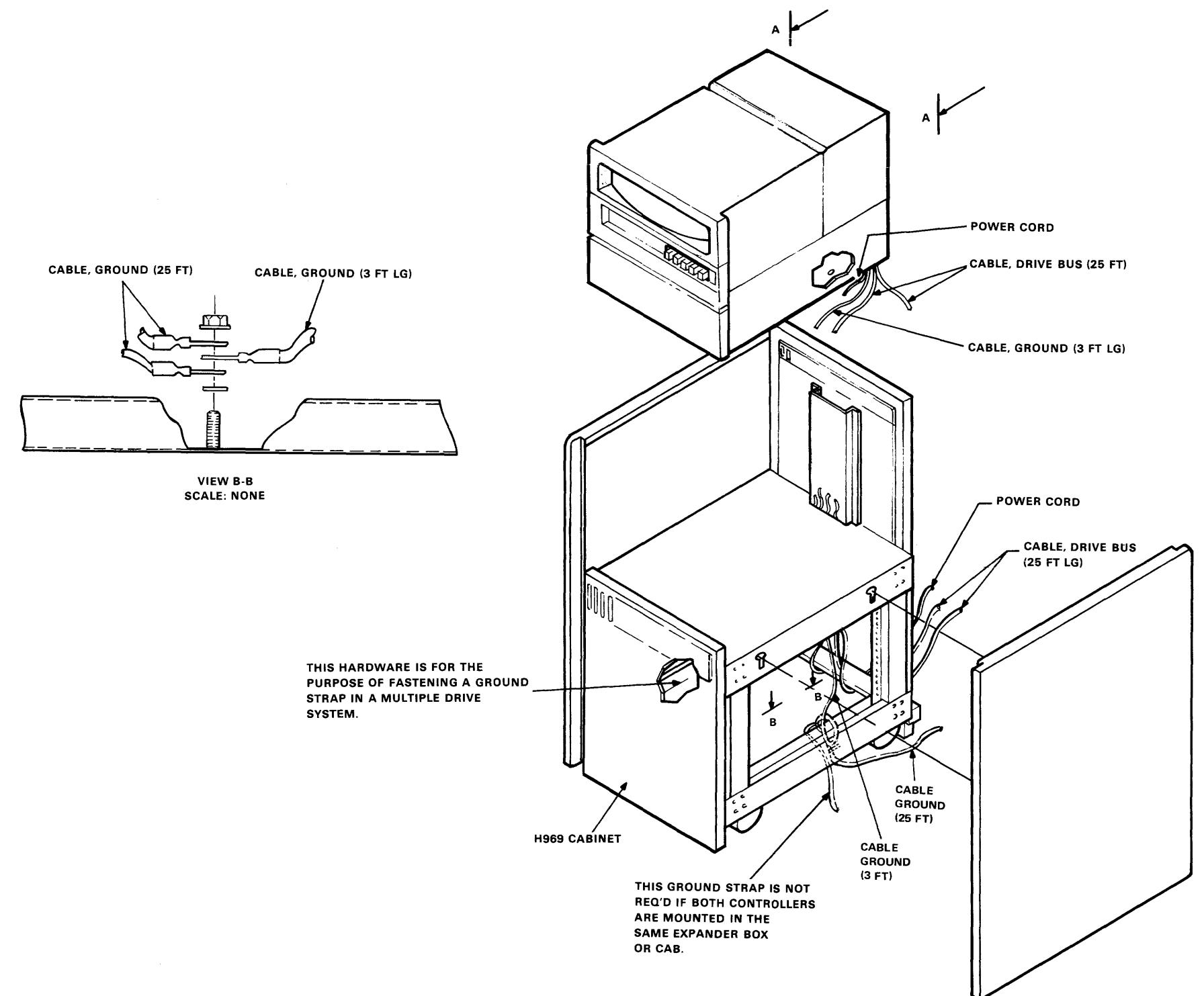


Figure C-10 Dual-Access Disk Subsystem H969 Cabinet



11-4983

Figure C-11 Dual-Acccess Disk Subsystem  
H969 Cabinet

6. On some drives, there are two rows of 12 zero ohm resistors on the M9016 module. They represent the last three digits of the drive serial number and must be clipped to give the BCD representation of these three digits. If they have not already been clipped, remove the top resistor of a pair to represent zero, or remove the bottom resistor for a one, for each of the 12-bit locations. Also, there is a pair of zero ohm resistors, representing the drive type, placed to the left of the serial number resistors. If neither has been removed, clip the top one if the drive is an RK06 or the bottom if the drive is an RK07.

If the M9016 module does not have these resistors, the serial number must be wired to the back plane. To do this:

- a. Set up a table similar to this:

**Table C-4 Sample Table for Backplane Wiring**

	A				B				C				
Row 1	800	400	200	100	80	40	20	10	8	4	2	1	
Row 2	A	A	A	A	A	B	A	B	B	B	A	A	Backplane
0	1	1	1	1	1	1	1	1	1	1	1	1	Pin
6	4	4	4	4	4	4	4	4	4	4	4	4	Assignments
R	P	R	S	S	M	T	D	C	A	V	V	2	
2	1	1	2	1	2	2	1	1	1	1	1	2	

- b. For a serial number ABC, enter the BCD equivalent of digit A in Row 1, Column A; enter the BCD equivalent of digit B in Row 1, Column B; enter the BCD equivalent of digit C in Row 1, Column C.
  - c. Enter the complement of Row 1 in Row 2.
  - d. For every “1” in Row 1, wire the appropriate backplane pin (below Row 1 and Row 2) to pin D6H1 (+3 V). For every “1” in Row 2, wire the appropriate pin to A6T1 (ground).
  - e. If the drive is an RK06, wire 01V1 to A1T1 (ground). If the drive is an RK07, wire 01V1 to D6H1 (+3 V).

7. If the installation is multidrive, proceed to step 8; otherwise, proceed to step 10.

8. Connect drive bus cable (PN-70-12292-xx) from J2 (A OUT) of the previous drive to J1 (A IN) of the next drive. Repeat for each additional drive. The standard length between drives is 2.44 m (8 ft); however, optional length cables are available. Total drive bus length must not exceed 30.48 m (100 ft).

9. Daisy chain each drive, using a ground wire (PN-7212827-8) between the ground studs in the drive cabinets.

10. For the last drive, connect a drive bus terminator (PN-70-12293-0-0) to I/O J2 (Figure C-9).

**NOTE**

For the dual-controller cabling configuration (Figure C-9), the installation of the drive bus cable should follow the above sequence. The drive connectors used are J3 (B IN) and J4 (B OUT). A second drive bus terminator (PN-70-12293-0-0) must be connected to J4 (B OUT) of the last drive. The second controller may be mounted in the same expander box as the first or in another cabinet altogether. If the same box is used, a second transition connector is mounted in the cabinet to accommodate the second drive bus cable.

11. Ensure that circuit breaker CB1 is OFF. Connect the power cable to a power outlet whose voltage and frequency meet the requirements of the drive model (Figure C-8).
12. Insert the proper drive-select plug into the unit select jack of the operator control panel (Figure C-8). Table C-5 lists the part numbers for each of the eight drives in the daisy chain configuration.

**Table C-5 Unit-Select Plugs for RK06/RK07 Disk Drives**

Plug No.	Part Number
0	12-12691-0
1	12-12691-1
2	12-12691-2
3	12-12691-3
4	12-12691-4
5	12-12691-5
6	12-12691-6
7	12-12691-7

#### **C.2.4 Installation Checks And Adjustments**

To verify performance and adjust the disk subsystem:

1. Check controller power supply voltage.
2. Check drive power supply voltage.
3. Check head load/unload.
4. Check head alignment.
5. Check response to abnormal conditions.

The required actions are detailed in Paragraphs C.2.4.1 through C.2.4.5.

**C.2.4.1 Controller Power Supply Voltage Checks** – To perform the required voltage checks on the controller power supply, set controller power to ON and make measurements at the following points:

Test Point	Voltage
A04 A2	+5 Vdc $\pm$ 0.25 V
A04 B2	-15 Vdc $\pm$ 0.75 V
A04 C2	GND
A04 D2	+15 Vdc $\pm$ 0.75

If any voltage is out of tolerance, refer to the appropriate expander box manual for adjustment and/or repair procedures.

**C.2.4.2 Disk Drive Power Supply Voltage Checks** – To perform the required voltage checks on the disk drive power supply:

1. Ensure that the power cable is connected to a power outlet of the proper voltage and frequency rating.
2. Ensure that the RUN/STOP switch is in the STOP position.
3. Set circuit breaker CB1 to the ON position. The air system should start operating and the lid-lock solenoid will energize to enable the lid.
4. Check the five output voltages at the logic backplane:

Backplane Location	Voltage
B08A2	+5 Vdc $\pm$ 3%
D01E2	+25 Vdc $\pm$ 10%
C08D2	+15 Vdc $\pm$ 5%
C08B2	-15 Vdc $\pm$ 5%
A08R2	-5 Vdc $\pm$ 3%

If any voltage is not within tolerance, refer to the *RK06/RK07 Disk Subsystem Service Manual* for adjustment and/or repair procedures.

**C.2.4.3 Head Load/Unload Checks** – The following head load/unload checks are performed during the POWER ON sequence to ensure that operational status can be attained:

1. With power ON, install a scratch cartridge into the drive.
2. Depress the appropriate access select switch, either A or B.
3. Press the RUN/STOP switch. After approximately one second, the spindle will begin to rotate and the RUN/STOP light will extinguish.

**NOTE**

Power must be applied to the controller (or to the Field Test box, if used) during performance of the load/unload checks.

4. When the disk reaches nominal speed (after approximately 30 to 60 seconds), the heads will load onto the disk surfaces and begin a slow movement toward the inner limit. After reaching this limit, they then return to cylinder zero. When head motion has stopped, the READY light on the operator control panel should be lit. The FAULT light should not be lit.
5. Press the RUN/STOP switch again. The READY light should extinguish and the heads move to their fully retracted position. When the drive has stopped, the RUN/STOP indicator will light. The drive motor should stop in approximately 20 seconds after the RUN/STOP switch is released.

**C.2.4.4 Head Alignment Checks and Cartridge Care** – Several principles should be understood before attempting any alignment procedures. A familiarity with these principles will hopefully discourage any “shortcuts” leading to possible damage or improper alignment.

1. Whenever head alignment exceeds  $\pm$  200 microinches maximum, the heads should be realigned to within  $\pm$  50 microinches.
2. Power must be applied to the drive for two hours prior to performing any head alignment procedures.
3. The cartridge should be mounted and spinning for a minimum of one-half hour prior to beginning head alignment.
4. Head alignment techniques assume that the drive being aligned is a properly working device. If the device is not working properly, do not attempt alignment.
5. To protect the alignment pack, Write Protect should always be set when the alignment pack is in the machine.
6. The SAFETY SWITCH on RK06 module M7729 or RK07 module M7906 (near the D end) forces Write Lock and disables the Servo Unsafe circuit. It is important to remove this special maintenance switch from its maintenance mode to re-enable the Servo Unsafe circuit.
7. Linear forces applied to the carriage during adjustments may cause the heads to unload and cause damage if the SAFETY SWITCH is not set to the MAINT position.
8. Lateral force on a carriage can cause the heads to tilt and possibly crash. Therefore, all procedures requiring the application of a lateral force to the carriage must be performed with the heads unloaded.
9. Positioner parts and fixtures are precision parts and must be handled carefully. The use of torque wrenches set to specified levels is mandatory to guarantee that tolerances will hold and thus prevent damaged parts.
10. When transporting cartridges by auto, always keep the cartridges in the passenger compartment – never in the trunk.
11. Always transport cartridges in their carrying case.

**Head Alignment Using Program Control** – To perform head alignment checks under program control:

1. Remove the rear cover from the RK06 or the RK07.
2. Ensure that power is removed from the RK06 or RK07 and the Field Test Box.
3. Connect the head alignment cable from the Field Test Box to the RK06 or RK07 Read/Write board (Figure C-12 and Figure C-13).
4. Apply power to the RK06 or RK07 and the Field Test Box.
5. Load MAINDEC-11-DZR6N and start at address 224.

Per program instructions, install an RK06K-AC or RK07K-AC alignment cartridge, depending on the type of drive, and WRITE LOCK the drive.

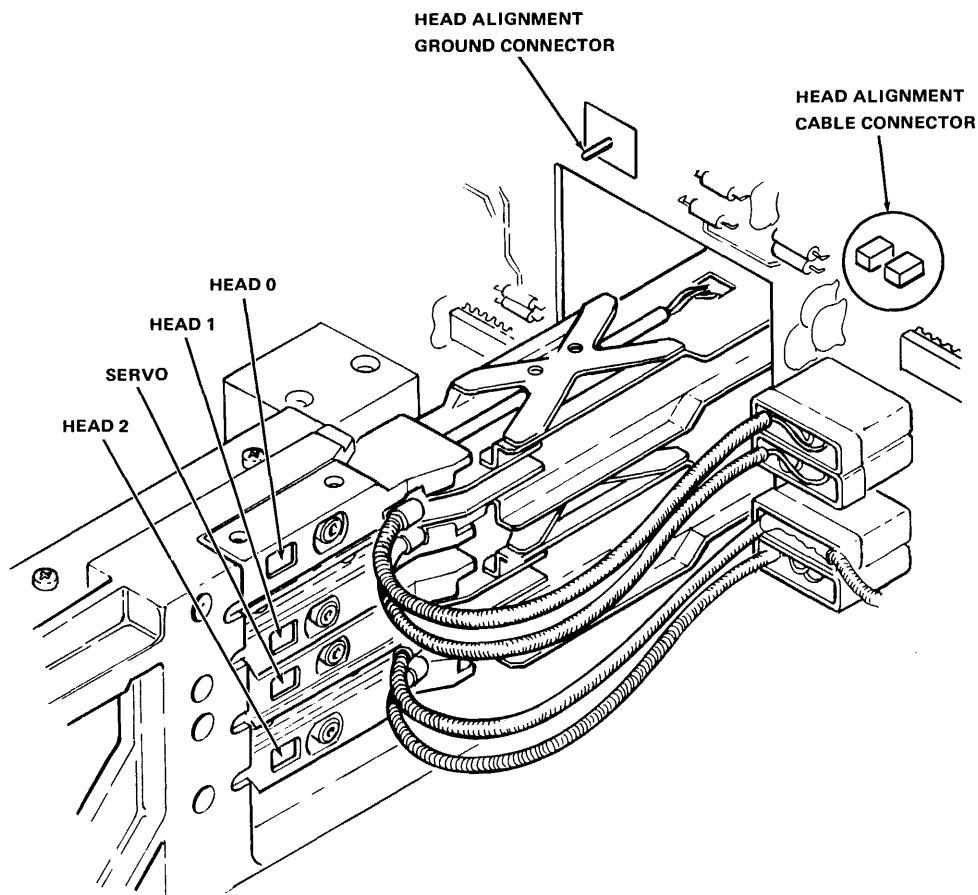


Figure C-12 RK06 Head Assembly Area

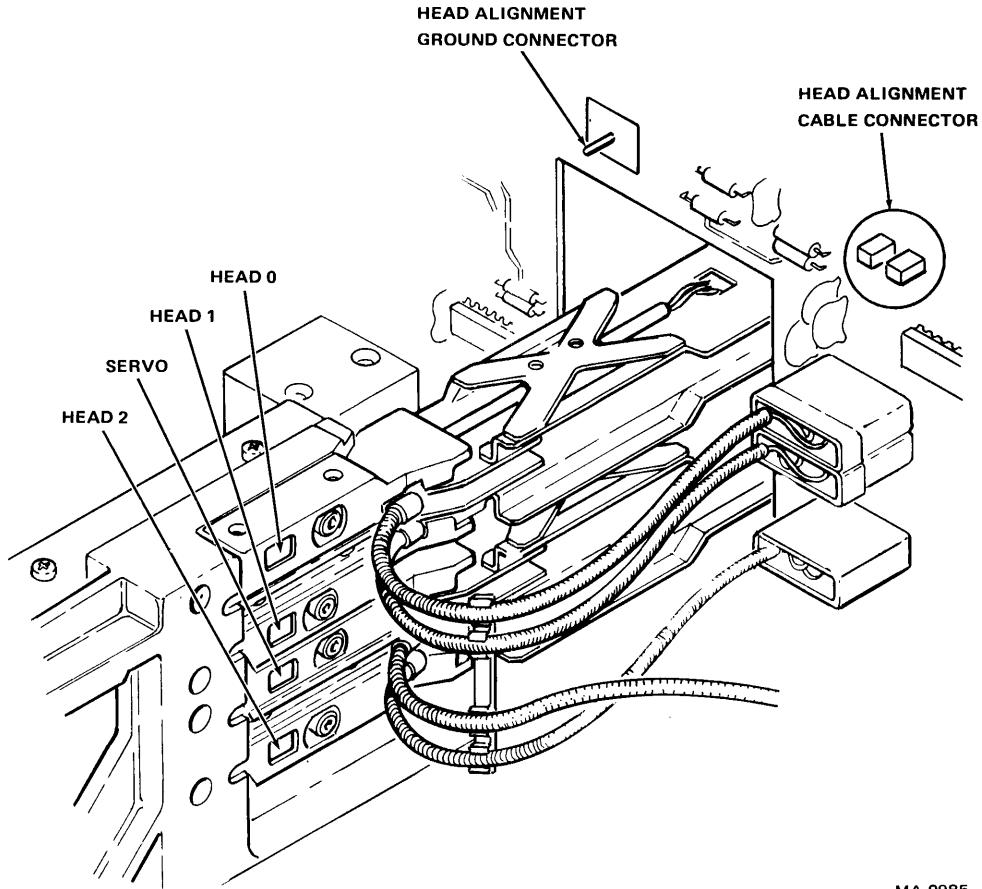


Figure C-13 RK07 Head Assembly Area

#### NOTE

Prior to begining head alignment procedures, power should be applied to the drive for two hours; the cartridge should be mounted and spinning for at least one-half hour.

To WRITE LOCK the drive, set the SAFETY SWITCH (S2) on the RK06 M7729 board or the RK07 M7906 board to the MAINT position. This action will also prevent the heads from unloading if a Servo Unsafe condition occurs.

6. Respond to program questions 1 through 5 as illustrated in the sample printout in Paragraph 4.4.4.2.
7. Mount the head alignment fixture on the appropriate head (Figures C-12 and C-13).

#### CAUTION

Make sure that the carriage does not tip beyond the point where the heads will fall out of the cam tower.

8. Torque the head alignment fixture mounting screw to 5 inch/lb. Loosen the head mounting screw and then torque it to 2 inch/lb. Turn both vertical screws of the head alignment fixture fully CCW.
9. Load the heads by typing the letter R.
10. Set the torque wrench to 5 inch/lb. Tighten the forward vertical screw to move the head forward or the rear screw to move the head toward the rear. Since these screws cause opposite actions, the screw not in use must be turned fully CCW. Adjust until:
  - a. The red LED on the meter is ON (steady state).
  - b. The meter on the Field Test box reads  $0 \pm 50$  microinches.

**NOTE**

If the needle deflects to the right of zero, move the head toward spindle; if to the left of zero, move away from spindle.

11. Unload the heads by typing the same head number again. Tighten the head to 5 inch/lb.
12. Reload the heads by typing the letter R.
13. Check that the conditions of steps 10a and 10b are met.
14. Unload the heads by typing the next head number.
15. Remove the head alignment fixture and mount it on the next head.
16. Repeat steps 8 through 15 for each data head.
17. When all heads have been aligned, restart the program under its Exerciser mode and exercise the drive for two minutes. Recheck the alignment of all heads.
18. Remove the alignment cartridge and the Field Test Box; clear the WRITE LOCK condition.
19. Replace the rear cover removed in step 1.

#### **Sample Printout**

#### **INSERT K**

#### **Head Alignment Using the Field Text Box**

1. Remove the rear cover from the RK06 or RK07.
2. Remove power from the RK06 or RK07 and from the Field Test Box.
3. Connect the head alignment cable from the Field Test Box to the RK06 or RK07 read/write board.
4. Attach the appropriate drive interface cable to the Field Test Box.
5. Apply power to the RK06 or RK07 and to the Field Test Box.

6. Install an RK06K or RK07K alignment cartridge, depending on the drive, and WRITE LOCK the drive.

**NOTE**

Prior to beginning head alignment procedures, power should be applied to the drive for two hours; the cartridge should be mounted and spinning for at least one-half hour.

To WRITE LOCK the drive, set the SAFETY SWITCH (S2) on the RK06 M7729 board or the RK07 M7906 board to the MAINT position. This action will also prevent the heads from unloading if a Servo Unsafe condition occurs.

7. Mount the head alignment fixture on the appropriate head (Figures C-12 and C-13).

**CAUTION**

Make sure that the carriage does not tip beyond the point where the heads will fall out of the cam tower.

8. Torque the head alignment fixture mounting screw to 5 inch/lb. Loosen the head mounting screw and then tighten it to 2 inch/lb. Turn both vertical screws of the head alignment fixture fully CCW.
9. Select the desired head and load to the actual cylinder address that corresponds to the underlined (for an RK06 alignment) or dotted (for an RK07 alignment) cylinder address switches on the Field Tester. Refer to the switch settings that follow.

<b>Switch</b>	<b>Position</b>
EXERCISE/STATUS	EXERCISE
DRIVE SELECT	Desired Drive#
COMMAND TO RK06 switches	SEEK 22 SECTORS CLEAR ERROR & ATTENTION SET VOLUME VALID
SINGLE CYCLE/CONTINUOUS	SINGLE CYCLE
FUNCTION	SEEK ONLY
SYNC	INT
CLOCK	FAST
HALT ON ERROR	NO
ADDRESSING (CYLINDER) (UNDERLINED SWITCHES) (DOTTED SWITCHES) (HEAD) (HEAD ADDRESS SWITCHES) (SECTOR)	SWR <u>245</u> <sub>10</sub> (for RK06) <u>496</u> <sub>10</sub> (for RK07) SWR DESIRED HEAD# ALL

Switch	Position
PARITY (both switches)	ODD
Depress the INIT and START switches.	
To change heads, simply change the head address switch setting and depress the START switch.	
10. Set the torque wrench to 5 inch/lb. Tighten the forward vertical screw to move the head forward or the rear one to move the head to the rear. Since these screws oppose each other, the screw not in use must be fully CCW. Adjust until:	
a. The red LED on the meter is ON (steady state). b. The meter on the Field Test Box reads $0 \pm 50$ microinches.	
<b>NOTE</b>	
If the needle deflects to the right of zero, move the head toward spindle; if to the left of zero, move away from spindle.	
11. Unload the heads.	
12. Tighten the head to 5 inch/lb.	
13. Load the heads and check that the conditions of steps 10a and b are still met.	
14. Unload the heads; remove the head alignment fixture and mount it on the next head.	
15. Load the heads and repeat the procedures of steps 8 through 15 until all data heads are aligned.	

**C.2.4.5 Response to Abnormal Conditions** – The following procedures are for handling abnormal conditions encountered during a system installation.

**Clearing an Unsafe Condition** – Clearing of an unsafe condition can be accomplished by releasing the RUN/STOP switch on the front panel. Press the RUN/STOP switch again. If the fault no longer exists, the FAULT light will go off. When the READY light is on, the drive is ready for further operations.

**Removing a Cartridge When Drive Power is Lost** – If power to the driver is lost and it is necessary to remove the disk cartridge, use the following procedure:

1. Insert a small, flat-blade screwdriver into the opening above the door latch.
2. While pushing on the screwdriver, lift the pack loading door.
3. Ensure that the brush drive knob is turned fully clockwise.
4. Ensure that the head loading arms are fully retracted.
5. Remove the disk cartridge in the usual manner.

**Detecting Head-to-Disk Interference** – The read/write heads actually fly over the disk surface at an altitude of approximately 50 millionths of an inch. When for any reason the read/write heads touch the disk surface (a condition referred to as “head crash”), damage to either heads or disk surface is possible. If there is an audible ticking sound after the heads load or if the heads show an oxide buildup on the gliding surface when inspected, a head crash has probably occurred. The following procedure should be followed for recovery from a head crash:

1. Clean the oxide buildup from the head, using a head cleaning kit.
2. Reinspect the head, using an inspection mirror. If any scratches or oxide are visible, the head must be replaced. Refer to the *RK06/RK07 Disk Subsystem Service Manual* for the appropriate procedure.
3. If a head shows no visible scratches or oxides, install a scratch pack and load the heads onto the pack as in the head load/unload checks.
4. When the drive is ready, cycle the drive down by setting the RUN/STOP switch and re-inspect the heads in question. If any oxide buildup is present, a catastrophic condition exists. Refer to the *RK06/RK07 Disk Subsystem Service Manual* for corrective procedures.

#### CAUTION

Never use a cartridge involved in a head crash until it has been inspected and found usable; i.e., there are no visible marks on the platter surfaces. Catastrophic crashes can be propagated from drive-to-drive under such conditions.

Never use an alignment cartridge in a drive that has experienced a head crash. Always use a scratch cartridge for testing.

#### C.2.5 Power Conversion

The RK611/RK06 or RK611/RK07 Disk Subsystem is configured during manufacture to be either a 50-Hz or 60-Hz unit. Although it is possible to change the frequency characteristics of the drive in the field, this requires such parts substitution as the power supply transformer and spindle motor pulley, plus a belt change.

Changing of voltage range (120 Vac to 240 Vac or vice versa) merely requires a circuit breaker change (CB1 at the rear of the drive).

#### C.2.6 Dual Access Drive Installation

Site preparation and environmental considerations for the RK06 or RK07 dual access disk drive are the same as those for the single access drives and are discussed in Paragraph C.1 of this manual. The adjustment and installation procedures for the RK06 or RK07 dual access drive are also identical with those of the single access drive, except for the added cables for dual access. Refer to the single access installation procedures described earlier in this chapter. Figure C-14 is a dual access cable diagram.

### C.2.7 Dual Access Acceptance Procedure

**C.2.7.1 Dual Access Diagnostic** – The Dual Access diagnostic (DZR6GA.X) must be run first to establish that a port can seize and release the drive. To accomplish this, perform the following procedures:

1. On each drive to be tested, the dual access test switch located on module M7730 must be placed in the invert position for the duration of this test. Refer to Figure C-4 or C-5 for the location of this switch. When in the invert position, this switch grounds bit 0 of the port B unit select lines and causes each drive to appear as two separate units to the RK611. The unit select switch will define the address of port A. Port B address will respond to the address of A + 1. Since each drive will appear as two units to the RK611, a maximum of four drives can be tested by this program at one time.
2. Use only even numbered UNIT SELECT SWITCHes on the drive operator panel. Any other drives on the system which have an address in conflict with any of the test addresses must be deselected (both ports switched off). The even numbered UNIT SELECT SWITCH on any drive can be removed and inserted into the current drive under test.
3. For this test, the RK611 is daisy chained to both ports of the RK06 or RK07. Refer to Figure C-15 for the cable diagram.
4. Run the Dual Access diagnostic (DZR6G.X) to test dual access seizure and release.
5. After running the Dual Access diagnostics, return the dual port invert switch on module M7730 to its normal position. Return any UNIT SELECT SWITCHes borrowed for this test to their former drives.
6. Recable the RK06 or RK07 Drives for normal operation, as shown in Figure C-14.

**C.2.7.2 RK611, RK06, and RK07 Diagnostics** – With the drives cabled for normal operation, run all RK611, RK06, and RK07 diagnostics through *both* ports.

**C.2.7.3 RK06 and RK07 Performance Exerciser** – To run the RK06 and RK07 Performance Exerciser (DZR6P.X), all disks must first be written with a predetermined data pattern through one of the systems. This is accomplished by starting the Performance Exerciser at address 200. The exerciser will automatically write all disks on the drive bus and begin testing data transfers immediately, without operator intervention. While the first system is undergoing testing, the second system can be entered into the performance tests by starting the exerciser at address 240. This will skip over the disk write portion of the test and allow the operator to manually begin the performance tests on the second system. Both systems will then be undergoing performance testing simultaneously.

## C.3 FIELD ACCEPTANCE TEST PROCEDURE

Field acceptance testing is intended to demonstrate performance of the RK06 or RK07 Disk Drive and/or the RK611 Controller to the customer prior to his acceptance of the equipment.

### C.3.1 Error Definitions/Rates

The RK611 has five registers that display the various error conditions that can exist in the Disk subsystem. Table C-6 lists the various error indications and gives an explanation of their significance. Errors are broken down into five categories:

- |              |                  |
|--------------|------------------|
| 1. Control   | 4. Hard errors   |
| 2. Cartridge | . 5. Soft errors |
| 3. Seek      |                  |

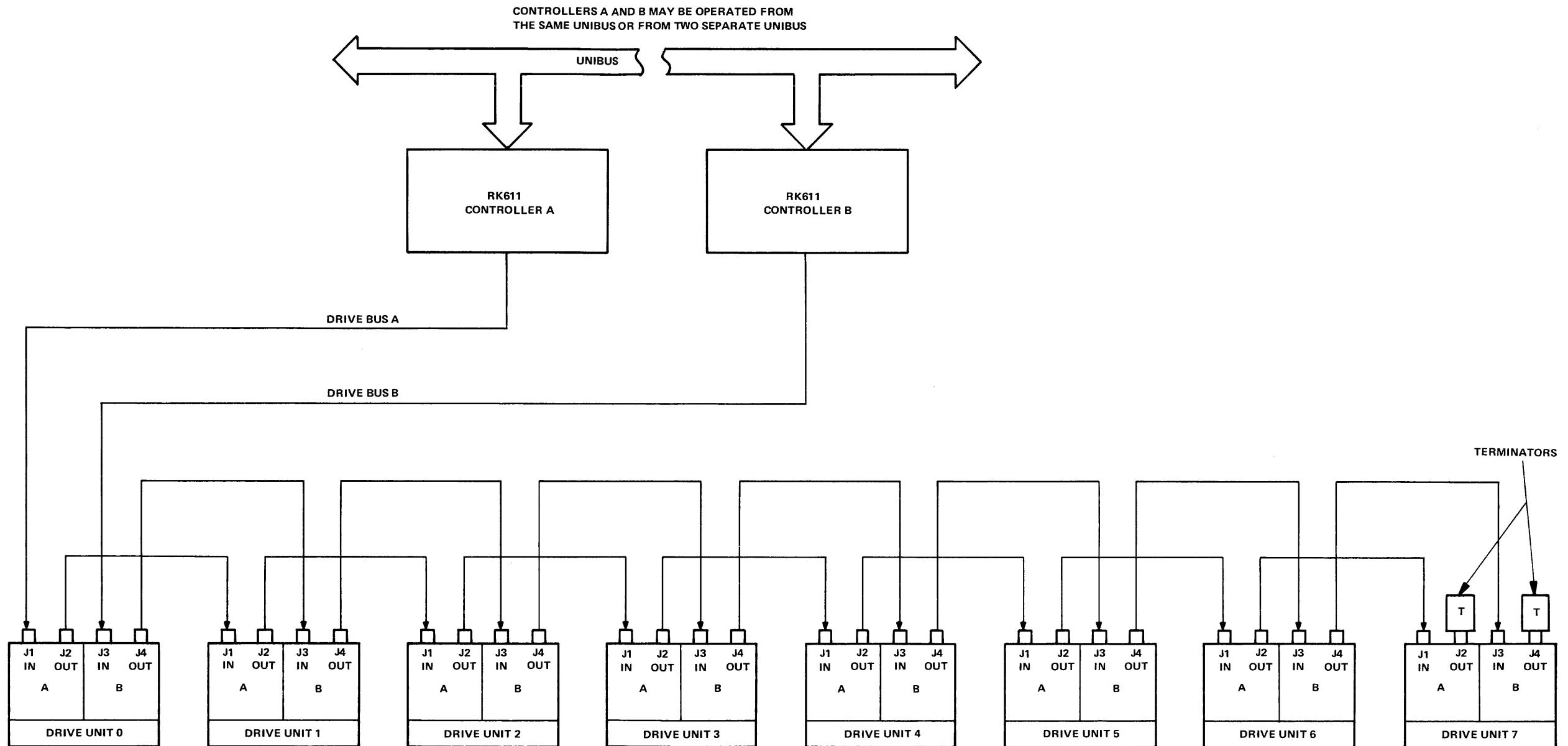
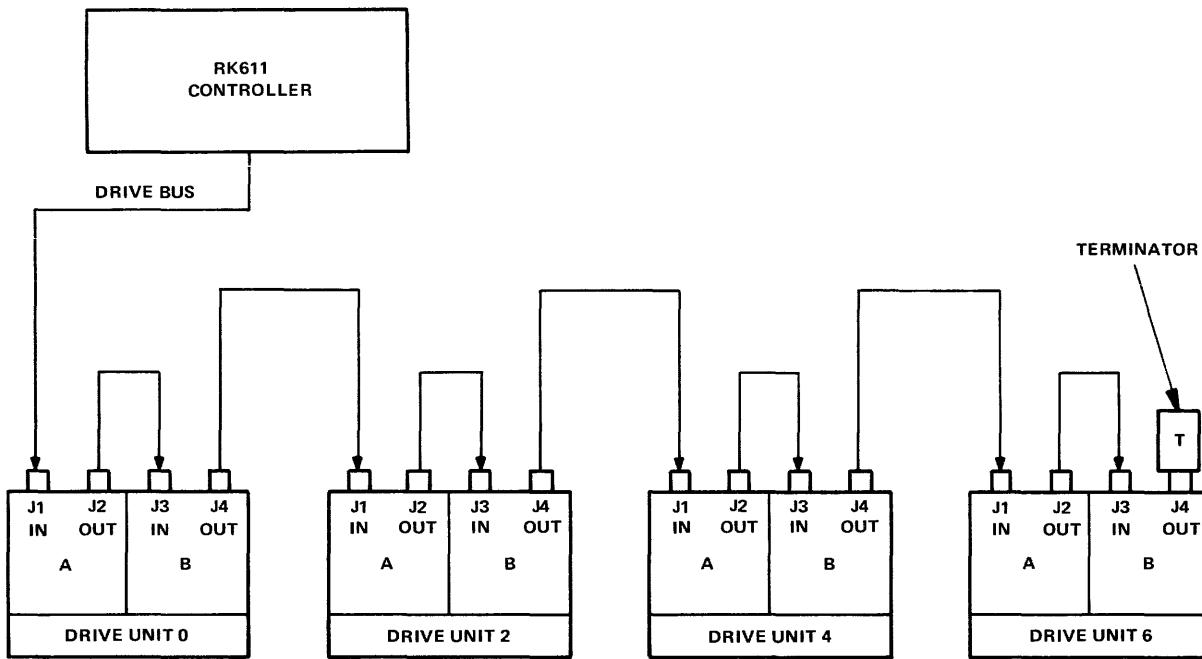


Figure C-14 RK611/RK06 or  
RK611/RK07 Dual Access Cable Diagram



**NOTES:**

1. On each drive the dual port test switch located on module M7730 must be placed to the invert position for the duration of this test.
2. Only even numbered unit select switches should be used on the drive operator's panel.

11-5509

Figure C-15 RK611/RK06 or RK611/RK07 Cable Diagram for Testing Dual Access

**Table C-6 RK611/RK06 and RK611/RK07 Disk Subsystem Diagnostic Errors**

Error	Indicator Bit	Condition	Error Type
Programming Error (PGE)	RKCS2 bit 10	Register written (except CCLR, SCLR) with GO set.	Control
Illegal Function (ILF)	RKER bit 0	Illegal command in low-order 5 bits of RKCS1.	Control
Format Error (FPER)	RKER bit 4 or 5	Format or drive type error.	Control
Cylinder Overflow (COE)	RKER bit 9	Cylinder address exceeded.	Control
Invalid Disk Address (IDAE)	RKER bit 10	Invalid cylinder or track address detected.	Control
Unit Field Error (UFE)	RKCS2 bit 8	Drive selection problem.	Control

**Table C-6 RK611/RK06 and RK611/RK07 Disk Subsystem Diagnostic Errors (Cont)**

Error	Indicator Bit	Condition	Error Type
Unibus Parity Error (UPE)	RKCS2 bit 13	Error in 16-bit data word from main memory.	Control
Nonexistent Drive (NED)	RKCS2 bit 12	Drive response problem.	Control
Drive Available Interrupt (DAINT)	RKDS bit 0	Drive is not available (dual-access only).	Control
Drive Error (DRERR)	Message BO:T (FAULT)	Any 1 of 21 drive error conditions.	Control
Bad Sector Error (BSERR)	RKER bit 7	Data transfer attempt to/from bad sector.	Cartridge
Header VRC Error (HVRC)	RKER bit 8	Header check, indicates bad header information.	Hard/Soft
Operation Incomplete (OPI)	RKER bit 13	Desired header cannot be found.	Seek
DTC Parity Error (DTC PAR)	RKCS1 bit 13	Parity error in message from drive.	Control
Write Check Error (WCE)	RKCS2 bit 14	Write check, indicates data from disk did not match data from memory.	Hard/Soft
Nonexistent Memory (NEM)	RKCS2 bit 11	No SSYN within 10 $\mu$ s of MSYN assertion.	Control
Data Late Error (DLTERR)	RKCS2 bit 15	Data late to/from silo.	Control
Drive Timing Error (DTE)	RKER bit 12	Write clock loss during write; data loss during read.	Control
Data Check (DCK)	RKER bit 15	Data error detected by ECC.	Soft
Multiple Drive Select (MDS)	RKCS2 bit 9	More than one drive simultaneously selected.	Control
Error Correction Hard (ECH)	RKER bit 6	Data error uncorrectable using ECC.	Hard
Controller Time-Out (CTO)	RKCS1 bit 11	Command possibly not executed.	Control
Seek Incomplete (SKI)	RXER Bit 1	Seek operation did not complete.	Seek

These classifications aid in the identification of the various errors encountered in acceptance testing only.

**C.3.1.1 Control Errors** – A control error indicates an operational aberration in the execution of command and control functions. Any control error detected by a diagnostic program during acceptance testing indicates a hardware malfunction that must be corrected before testing can continue.

**C.3.1.2 Hard Errors** – Any failure to read data correctly after a complete recovery sequence<sup>1</sup> with ECC enabled constitutes an irrecoverable, i.e., “hard” error. Errors that are not ECC-correctable include: (1) bursts greater than 11 bits in length and, (2) isolated dropped bits that are separated by more than 11 bits within a sector. The allowable error rate for hard errors is one error per  $10^{12}$  bits read.

**C.3.1.3 Soft Errors** – A soft error is defined as any read error that is correctable by ECC and/or a complete recovery sequence. The allowable error rate for soft errors is one error per  $10^9$  bits read.

**C.3.1.4 Cartridge Errors** – A cartridge error caused by imperfections in the recording surface is regarded as cartridge-attributable or media-dependent. If the imperfection is less than 11 bits long, it is ECC-correctable and will appear as a soft error. If longer than 11 bits, it will appear as a hard error. On a given cartridge, attributable errors will always appear at the same cylinder, sector, and track addresses. The definitions of hard and soft errors (see C.3.1.2 and C.3.1.3) apply only to randomly distributed errors and do not take into account errors that are cartridge-attributable. Imperfections in the cartridge surface may be found by mapping the cartridge by means of the formatter program.

**C.3.1.5 Seek Errors** – Any positioning operation that terminates with seek incomplete, or with the positioner in an incorrect location, constitutes a seek error. The allowable error rate for seek errors is one error per  $10^6$  seek operations.

<sup>1</sup>A complete recovery sequence consists of 28 retries, 16 of which are at the nominal head position and 2 each at offsets of  $\pm 400$ ,  $\pm 800$ , and  $\pm 1200$  microinches (for the RK06) or  $\pm 200$ ,  $\pm 400$  and  $\pm 600$  microinches (for the RK07), respectively.

### **C.3.2 Diagnostic Testing**

When all installation procedures have been completed, the tests detailed in the following subsections should be performed. Table C-7 briefly describes the diagnostic programs used in field acceptance testing of the RK611/RK06 or RK611/RK07 Disk subsystem. The total time required to run these tests (except DZR6Q<sup>2</sup>) in the absence of failures is 2.5 hours per drive.

#### **C.3.2.1 RK611 Controller**

**General** – In diagnostic testing, the RK611 is tested first. All five of the diskless controller diagnostics (Table C-7, DZR6A-DZR6E) and the RK611 functional controller diagnostic (DZR6K in the Table) must run for two error-free passes before the remainder of the acceptance program can be carried out. Any failure detected by any of the diagnostics must be corrected, and all programs must be rerun before proceeding.

#### **Procedure**

##### **NOTE**

**In the following steps, repair or replace the failing module; rerun the program that detected the failure; then return to step 1.**

1. Load diagnostic DZR6A; run two passes with no errors.
2. Load DZR6B; run two passes with no errors.
3. Load DZR6C; run two passes with no errors.
4. Load DZR6D; run two passes with no errors.
5. Load DZR6E; run two passes with no errors.
6. Load DZR6K; run two passes with no errors.

**NOTE**

**Any failures occurring during program DZR6K may not necessarily be limited to the RK611 Controller. Thus, it should only be run on a known good drive.**

**CAUTION**

**Diagnostic program DZR6K modifies headers on certain tracks. Failure to halt the program, either during the "End of Pass" printout or by typing CTRL C may leave the pack formatted incorrectly and cause inaccurate error reporting in subsequent testing. If the formatting is left modified, the RK06K/RK07K Cartridge Formatter Program (DZR6L) must be run (using Mode 1) before any further testing can be performed.**

At this point in the testing, the RK611 is functionally checked out. The only RK611 test not performed at this time is the Data Reliability Test.

<sup>2</sup>The run time of this diagnostic depends on the number of drives being tested.

### **C.3.2.2 RK06 or RK07 Disk Drive**

**General** – This section of the diagnostic procedure covers the testing of the RK06 or RK07 Drive. With a high degree of confidence, any failures detected in these tests can be attributed to the Drive only. All programs listed below must run through the specified number of error-free passes before performing the remainder of the program. Any failure detected by any of the diagnostics in this section must be corrected and all programs rerun before proceeding.

#### **Procedure**

**NOTE**

**In the following steps, repair or replace any failing component; rerun the program that detected the failure to verify the correction; then return to step 1.**

1. Load diagnostic DZR6H; run two passes with no errors.
2. Load DZR6I; run two passes with no errors.
3. Load DZR6J; run one pass with no errors.

4. Load DZR6M; run one pass with no parameters out of the specified limits (printed by the diagnostic).
5. Load DZR6N; run two passes with no errors.
6. Load DZR6G; run two passes with no errors.

**C.3.2.3 Cartridge Interchangeability Test** – This test requires the use of at least two drives. If there is only one drive on the system being tested, it will be necessary to use another system containing an RK06 or RK07 to complete this test.

Load and run diagnostic DZR6Q. If any drive fails this test, make any necessary adjustments and rerun the program.

#### **Data Reliability Testing**

**General** – Data reliability testing consists of running diagnostic DZR6P to exercise the entire RK611/RK06 or RK611/RK07 Disk subsystem for at least one hour. At the end of this period, the statistics for each drive must be analyzed to determine whether or not the subsystem is to be accepted.

In analyzing the statistics for each drive, no control, seek, or hard errors are allowed during the testing. Refer to Paragraph C.3.1 for error definitions. The occurrence of any of these errors is sufficient to reject a drive. If it is determined that an error is due to the cartridge, it is sufficient to reformat the cartridge, making sure that the failing sector is flagged bad. The Data Reliability Test may then be rerun.

If the excessive errors are caused by the drive, required corrective action must be performed and the acceptance restarted with the RK06 or RK07 diagnostic (Paragraph C.3.2.2). If the errors are caused by the controller, the acceptance must be restarted with the RK611 diagnostic testing (Paragraph C.3.2.1) after the corrective action has been taken.

**Procedure** – Load and start diagnostic DZR6P. Write the cartridge on all drives on the subsystem. After one hour of running, obtain the statistics for all drives. If the total number for all drives of “WORDS READ\*65K” is less than 967, allow the subsystem to run for an additional 15 minutes and again obtain the statistics. Repeat until the total “WORDS READ\*65K” is greater than 967. If the total number of SOFT DATA ERRORS is zero or one, accept the subsystem. If it is three or more, the failing component (drive or controller) must be fixed. If there were two SOFT DATA ERRORS, continue running the subsystem for an additional hour. At this point, obtain statistics and continue running until the total “WORDS READ\*65K” is greater than 1934. If the total SOFT DATA ERRORS is still two, accept the subsystem. If the total is three or more, the failing component (drive or controller) must be fixed and acceptance restarted.

**Table C-7 Diagnostic Programs used in RK611/RK06 or RK611/RK07 Disk Subsystem Field Acceptance Tests**

<b>Program</b>	<b>Function</b>
MAINDEC-11-DZR6A RK611 Diskless Controller Diagnostic Part 1	Reads and writes every RK611 register.  Tests the interrupt mechanism.  Tests the SILO loading logic. (Note: No drive is required for the execution of this program.)

**Table C-7 Diagnostic Programs Used in RK611/RK06 or RK611 or RK611/RK07  
Disk Subsystem Field Acceptance Tests (Cont)**

Program	Function
<b>MAINDEC-11-DZR6B</b> RK611 Diskless Controller Diagnostic, Part 2	Tests the loading of drive bus messages by executing Class A commands. Some Part 1 tests execute commands that are partially maintenance mode and partially at normal speed in order to "fool" the controller and force errors (no drive is required).
<b>MAINDEC-11-DZR6C</b> RK611 Diskless Controller Diagnostic Part 3	<p>Tests the loading of the drive bus message shift register for Class B commands.</p> <p>Tests index and sector pulse detection.</p> <p>Tests SILO and NPR transfers from memory in 16- and 18-bit mode.</p> <p>Tests nonexistent memory and Unibus parity error detection.</p> <p>Tests Read and Write MFM loopback.</p> <p>Tests Class B instruction errors (no drive is required).</p>
<b>MAINDEC-11-DZR6D</b> RK611 Diskless Controller Diagnostic Part 4	<p>Tests loading of drive bus message shift registers for Class C commands.</p> <p>Tests header generation for search operations.</p> <p>Tests write data NPR transfers to SILO.</p> <p>Tests header recognition.</p> <p>Tests cylinder, track, and sector increment after successful header search.</p> <p>Tests detection of all header-type errors.</p> <p>Tests ECC generation and writing.</p> <p>Tests partial sector write (zero fill).</p> <p>Tests 18-bit format ECC generation and data write (no drive is required).</p>

**Table C-7 Diagnostic Programs Used in RK611/RK06 or RK611/RK07 Disk Subsystem Field Acceptance Tests (Cont)**

Program	Function
<b>MAINDEC-11-DZR6E</b> RK611 Diskless Controller Diagnostic Part 5	Tests multisector data transfers.  Tests midtransfer seeks.  Tests cylinder overflow checking.  Tests NPR transfers to memory.  Tests ECC error detection and correction in 16-and 18-bit modes.  Tests write check in both 16- and 18-bit modes and forces.
<b>MAINDEC-11-DZR6G</b> Unibus RK06-RK07 Dual Port Drive Diagnostic (available Q4, FY78)	Tests write check errors (no drive is required). Ensures that port request, port seize, and timeout function correctly.  Ensures that the release function operates correctly.  Ensures that the timer inhibiting logic operates correctly.  Ensures that data transfers function correctly through both parts.
<b>MAINDEC-11-DZR6H</b> Unibus RK06-RK07 Drive Diagnostic Part 1	Ensures that the drive can perform all static and cycle-up tests.  Ensures that the drive can write and read headers in both 20- and 22-sector formats.  Ensures that the disk can perform seek operations by doing several seek patterns.  Checks error-detection logic by software error forcing.
<b>MAINDEC-11-DZR6I</b> Unibus RK06-RK07 Drive Diagnostic, Part 2	Ensures that the disk is capable of performing read and write data operations in both 20- and 22-sector formats.  Performs worst case patterns, spiral writing and reading, and all offset operations.  Reports unloading and loading times.

**Table C-7 Diagnostic Programs Used in RK611/RK06 or RK611/RK07 Disk Subsystem Field Acceptance Tests (Cont)**

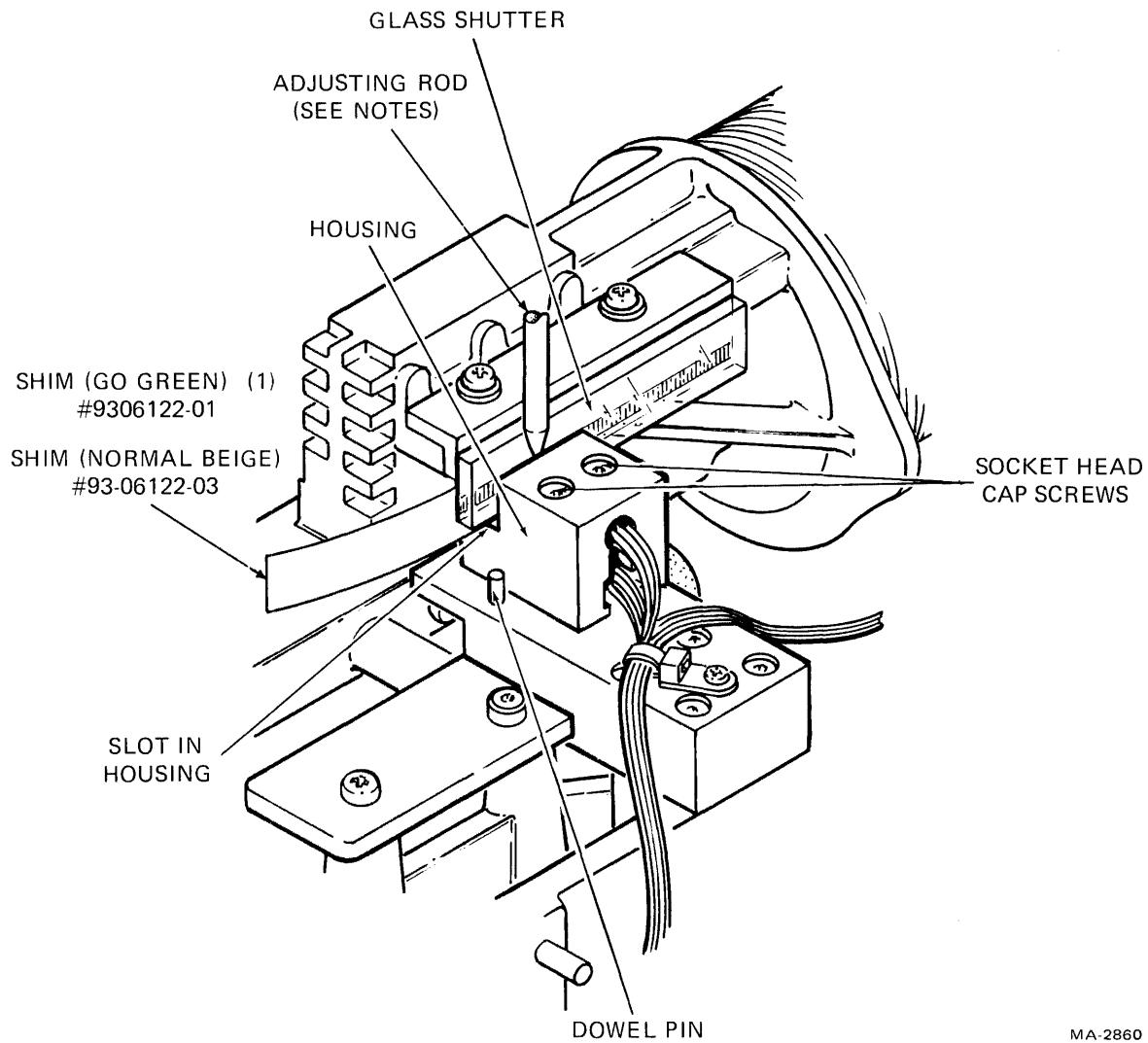
Program	Function
MAINDEC-11-DZR6J Unibus RK06-RK07 Drive Diagnostic, Part 3	<p>Ensures that the disk is capable of performing all operator intervention functions properly.</p> <p>Checks error-detection logic by manual and by software forcing of errors.</p>
MAINDEC-11-DZR6K RK611 Functional Controller Diagnostic	<p>Tests those areas in the controller that cannot be tested in a diskless environment.</p> <p>Tests those areas of the drive that cannot be tested until controller operation in a diagnostic or maintenance mode has been tested.</p>
MAINDEC-11-DZR6L RK06K-RK07K Cartridge Formatter	<p>Writes and verifies header and data information on an RK06K or RK07K disk pack at all possible disk pack addresses.</p> <p>Uses the Bad Sector File to: (1) report the serial number or the cartridge being formatted, (2) determine whether the cartridge is an alignment cartridge, and abort the program if it is, and (3) identify the sectors that are to be marked "bad."</p>
MAINDEC-11-DZR6M RK611/RK06-RK611/RK07 Subsystem Verification, Part 1	<p>Provides a functional shakedown of the entire subsystem, including the Unibus interface and access to main memory.</p> <p>Employs worstcase situations involving mechanical positioning, disk addressing, and data transfer.</p> <p>Measures drive operational timing.</p> <p>Provides numerous options that may be specified by the user.</p> <p>Reports errors as they occur.</p>
MAINDEC-11-DZR6N RK611/RK06-RK611/RK07 Subsystem Verification, Part 2	<p>Continues functional shakedown provided by Part 1.</p> <p>Employs worstcase situations involving head offsetting, memory addressing and data transfer, Unibus cycle contention, and multiple-drive operations.</p> <p>Provides RK06 or RK07 head-alignment aid.</p> <p>Provides numerous options that may be specified by the user.</p>

**Table C-7 Diagnostic Programs Used in RK611/RK06 or RK611/RK07  
Disk Subsystem Field Acceptance Tests (Cont)**

Program	Function
<b>MAINDEC-11-DZR6P</b> RK611/RK06-RK611/RK07 Performance Exerciser	<p>Exercises in a random overlapped routine from one to eight RK06 or RK07 Drives connected to a common Unibus controller in a dedicated stand-alone mode.</p> <p>Generates read, write, and write/write check commands.</p> <p>Reports system errors upon occurrence.</p> <p>Maintains performance statistics on each drive.</p>
<b>MAINDEC-11-DZR6Q</b> RK06-RK07 Drive Compatibility	<p>Verifies the capability of each drive to write data that can be successfully read by all other drives of the same type and to completely overwrite data written by all other drives.</p> <p>Detects: (1) head misalignment, (2) positioner lateral misalignment, (3) spindle/cartridge interface runout, (4) improper levels of write current, and (5) incorrect addressing of read/write heads.</p> <p>Prints summary of compatibility test results for each drive.</p> <p>Reports unexpected errors as they occur.</p>
<b>MAINDEC-11-DZR6R</b> RK611/RK06-RK611/RK07 User Defined Test	<p>Provides a capability for entering, editing, saving, recalling, and executing test programs designed by the user.</p> <p>Provides an interactive command set for use in entering, storing, retrieving, editing, and executing tests.</p>

**APPENDIX D**  
**TRANSDUCER HOUSING**  
**ASSEMBLY**  
**SINGLE DOWEL VERSION**

1. Line up dowel pin in shutter assembly with center of transducer block. Slide green .003 shim (9306122-01) between glass shutter and inside surface of slot in housing as shown. While holding housing against dowel pin in transducer block, push housing away from shutter by inserting adjusting rod between shutter and housing. Green shim should drag between shutter and housing. Torque housing screws to 4-6 inch-lbs.
2. Check clearance by inserting beige .004 shim (9306122-03) between glass shutter and inside surface of slot in housing as shown. Beige shim should not slip between shutter and housing. If beige shim slides between shutter and housing, readjust as specified in step above.



MA-2860

NOTES:

1. ADJUSTING ROD PIVOTS TRANSDUCER  
PARALLEL WITH GLASS SHUTTER.
2. ADJUSTING ROD CAN BE  $\frac{1}{4}$  TAPERED DOWEL OR  
PENCIL. IF PENCIL IS USED CARE SHOULD BE  
TAKEN TO AVOID BREAKING PENCIL TIP.

Figure D-1 Transducer Block Alignment (One Dowel)

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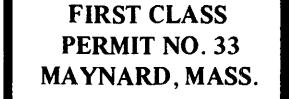
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