IBM

Field Engineering Maintenance Manual

Restricted Distribution

This manual is intended for internal use only and may not be used by other than IBM personnel without IBM's written permission.

2311 Disk Storage Drive Models 1, 11, and 12

IBM Form 59831-5
US Form Y26-5923-5

IBM

Field Engineering Maintenance Manual

Restricted Distribution

2311 Disk Storage Drive Models 1, 11, and 12

PREFACE

This manual consists of maintenance instructions to assist the reader in diagnosing equipment malfunctions in the IBM 2311 Disk Storage Drive, Models 1, 11, and 12. Information is also provided for performing corrective and preventive maintenance to keep the machine at its optimum performance level.

It is assumed that the reader has completed training on and understands the IBM 2841 and/or IBM System/360 Model 20 SCU feature, and the IBM 2311.

The FE Theory of Operation, IBM 2311, Form Y26-5897, provides information on the theory of operation of the 2311. Other related manuals are:

Illustrated Parts Catalog, IBM 2311, Form 127-0792.
FE Theory of Operation, SLT Packaging, Tools, Wiring Changes, Form Y22-2800.
FE Theory of Operation, SLT Power Supplies, Form 223-2799.
FE Maintenance Manual, IBM 2841 Stage 2, Form Y26-3688.
FE Maintenance Manual, IBM System/360 Model 20, Form Y26-5942.

The abbreviation SCU in this text refers to either the IBM 2841 Storage Control or the IBM System/360 Model 20 storage control feature.

Sixth Edition

This edition (Form Y26-5923-5) is a major revision of the former edition (Form Y26-5923-4).

Specifications contained herein are subject to change from time to time. Any such change will be reported in subsequent revisions or Field Engineering Supplements.

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

Copies of this and other IBM publications can be obtained through IBM Branch Offices.

A form is provided at the back of this publication for your comments.

This manual was prepared by the IBM Systems Development Division, Product Publications, Dept. 455, Bldg. 014, San Jose, California 95114.

CAR	cylinder address register
Hz	hertz (cycles per second)
I	current
kbs	kilobits per second
MHz	megahertz
ms	milliseconds
mv	millivolts
ns	nanoseconds
pf	picofarad
p-p	peak-to-peak
SCU	(See Preface)
SLT	solid logic technology
μsec	microsecond(s)
vac	volts alternating current
VOM	volt-ohm meter

Personal safety cannot be overemphasized. To ensure your own safety, make it an everyday practice to follow safety precautions at all times. Become familiar with and use the safety practices outlined in IBM Safety Card (Form 229-1264-1).

Access Mechanism

Danger
The access mechanism may move without warning, causing accidental injury. Take these precautions:
1. If motor is running, keep fingers out of area between the carriage and the carriage housing.
2. If hands must be placed between carriage and carriage housing, turn the machine off or disable the CE cover switch.

High Voltages

High voltage lines and connections exist in many areas within the machine. Such voltages are found on transformers, terminals, convenience outlets, and the like. Contactor relays utilize high voltages at their points. Check these contactor relays with the power on only if absolutely necessary and with extreme caution.

Potential difference within the power sequence box is -36 vdc to 208 vac (380 vac on 50 Hz machines). Potential difference within the electronic gates is -36 vdc to +36 vdc. Blowers in electronic gates and the brush actuator motor are powered by 208 vac (220 vac on 50 Hz).

Power Supplies

When a DC failure is sensed, a power-off sequence is initiated, but 24 vac is still present at various points on the sequence panel and 208 vac is available at the convenience outlet. Do not depend on the DC off feature as safety protection.

The power supplies should be serviced with care. Remove line cord from power receptacle and wait at least 15 seconds after power is turned off before attempting any repair or adjustment within any power supply.

Isopropyl Alcohol

The 91% isopropyl alcohol used to clean 2311 read/write heads is a flammable liquid; therefore, keep only the quantity needed for impending use in the customer' office. Keep the glass bottle containing the isopropyl alcohol in the sealed metal container except when in use (a plastic bottle will be furnished in the future).

When shipping 91% isopropyl alcohol, comply with the appropriate regulations for shipment of flammable liquids.

Caution
There are many ways in which the 2311 Disk Storage Drive can be damaged by improper operating or servicing techniques. These are described in the text under the appropriate servicing procedure. The most significant of these are listed below.

Read/Write Heads

Avoid touching the gliding surface of read/write heads. Acids from the skin can etch and ruin the head. Do not load heads manually against stopped or rotating disks.

Hydraulic Sump Oil Deflector

To avoid soiled clothing, keep the plastic shield (inside the sump) in place when running the machine with sump cover off.

Disk Pack

Never disassemble a disk pack.

Disk Pack Cleanliness

Serious damage to disk surfaces will result from servicing procedures which introduce foreign particles in the area under the covers of the 2311.

CE Disk Pack

Do not write on the CE disk pack on cylinders 02, 03, 04, 71, 72, 73, 74, 75, 200, 201, or 202 because prerecorded test tracks will be destroyed. (See paragraph 2.1.) Any other cylinder may be used.

Sector Disk

The sector slots cut into the edge of the sector disk are sharp. Avoid contact with the disk pack particularly when running with the shroud off.

SECTION 1. REFERENCE DATA

No applicable information available.

SECTION 2. DIAGNOSTIC TECHNIQUES

1.1 READ CIRCUIT TROUBLESHOOTING

Refer to Figure 1-1 for read circuit troubleshooting.

1.2 SEEK ERRORS

See Figure 1-2 for seek error troubleshooting.

1.3 TROUBLESHOOTING OF DROP OF READY CONDITION

See Figure 1-3 for troubleshooting of conditions causing drop of ready condition.

1.4 WRITE CIRCUIT TROUBLESHOOTING

Two cards are used in the write process: write amplifier and write driver. The write amplifier is located in the SLT gate. The write driver card incorporates the following circuits:

1. Line receiver for write data
2. Write trigger
3. Level setter
4. Erase driver
5. Write current source
6. Write and erase current sense circuits for safety functions.

The write amplifier furnishes the write driver with three lines: write current and write data (two differential lines). The nominal dc voltage of these lines during a write is +24 vdc. The write data signals move approximately 2.5v about the dc level.

The peak-to-peak write current into the head (differential) is about 70 ma with a rise or fall time (10% to 90%) of less than 200 ns.

All Heads in 2311 Fail to Write – Probable Cause

1. Heads not loaded. Check visually.
2. Write gate is not at the correct level to allow write data to enter the file.
3. Output of write amplifier on write data lines is incorrect (K2 J03 and K2 G04). The correct nominal voltage of the write data lines during a write condition is +24 vdc. Write data signals move approximately 2.5v about the dc level.
4. Write current into the head is insufficient. The correct write current should be about 70 ma peak to peak with a rise time (10% to 90%) of less than 200 ns.

File Makes Write Errors – Probable Causes

1. Intermittent write driver or write amplifier. Indicated by pinched read signal.

Read Signal

10301

2. Output of write amplifier on write data lines is incorrect (K2 J04 and K2 G04). The correct nominal voltage of these lines during a write condition is +24 vdc. The write data signals move approximately 2.5 volts about the dc level.
3. Write current into the head is insufficient. The correct write current should be 70 ma p-p with a rise time (10% to 90%) of less than 200 ns.

1.5 HEAD SELECT CIRCUIT TROUBLESHOOTING

The head selected level is ground, and the deselect level is +36v. The rise time of the head deselect (between 0 to 10 v) is about 10 μsec. If the deselect time (0 to +10 v) exceeds 13 μsec a select lock condition may occur indicating that two heads are selected momentarily. A bad head select transistor is the cause of the problem.

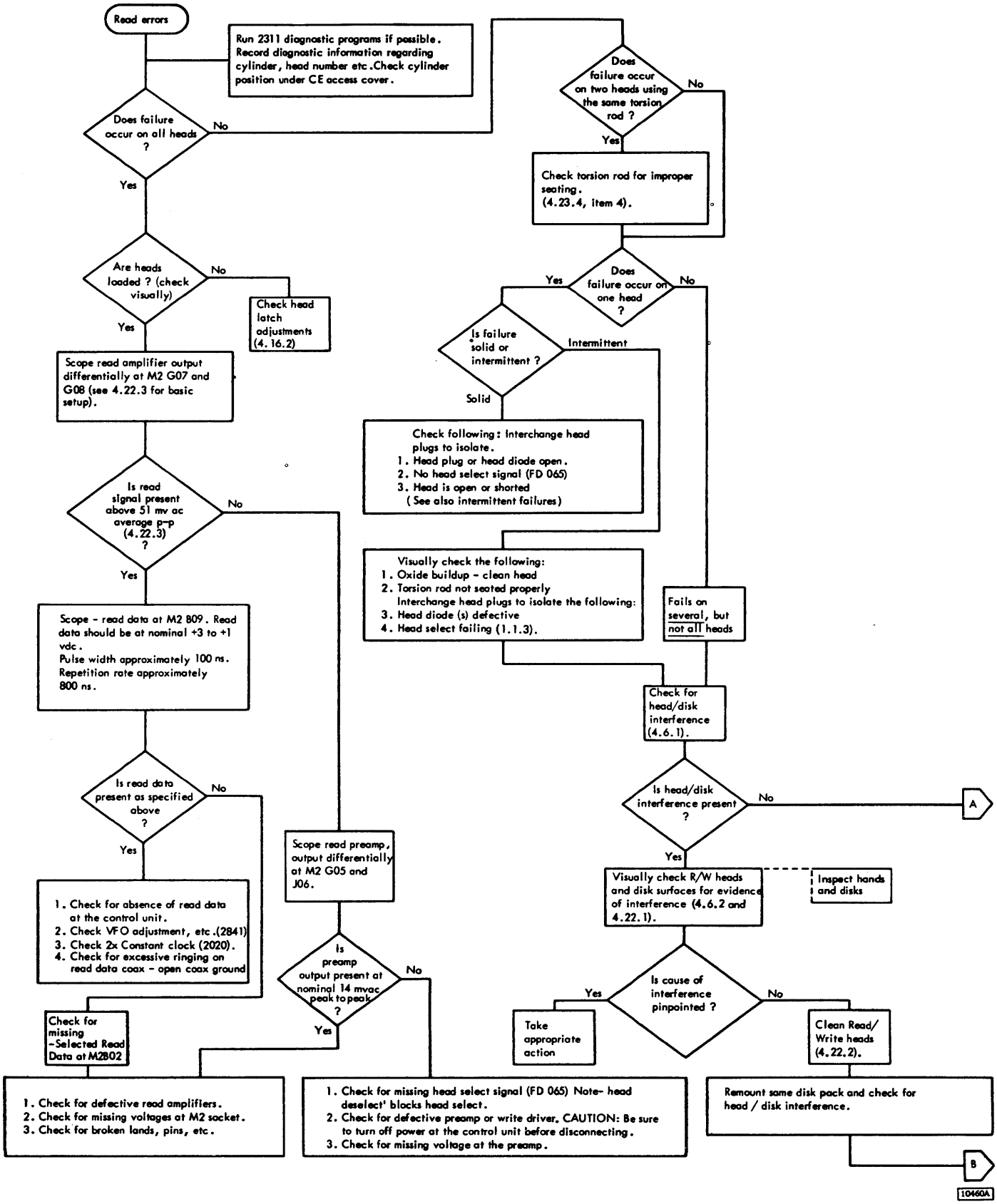


Figure 1-1a. Read Error Diagnostic Procedure, Part 1

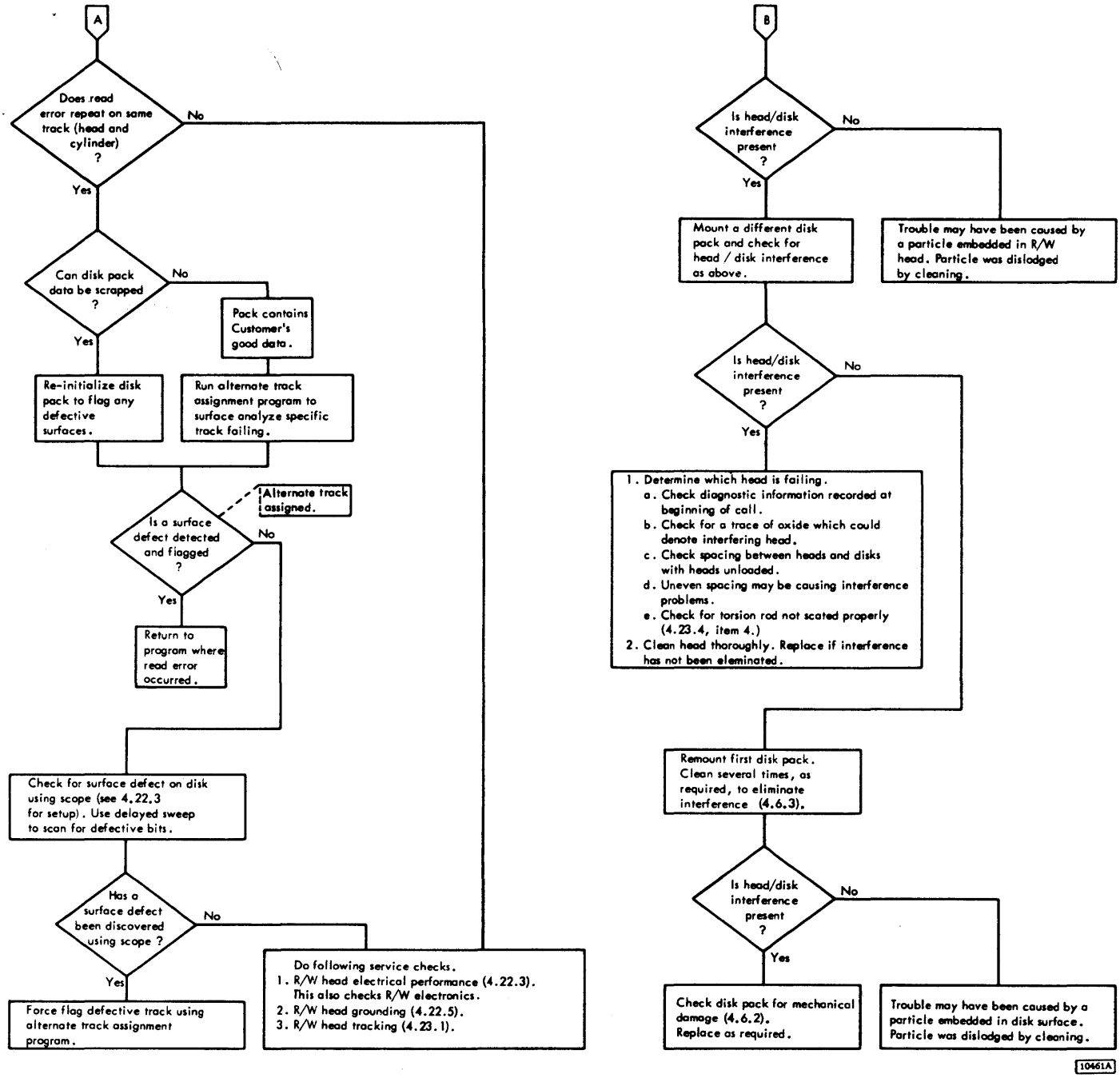


Figure 1-1b. Read Error Diagnostic Procedure, Part 2

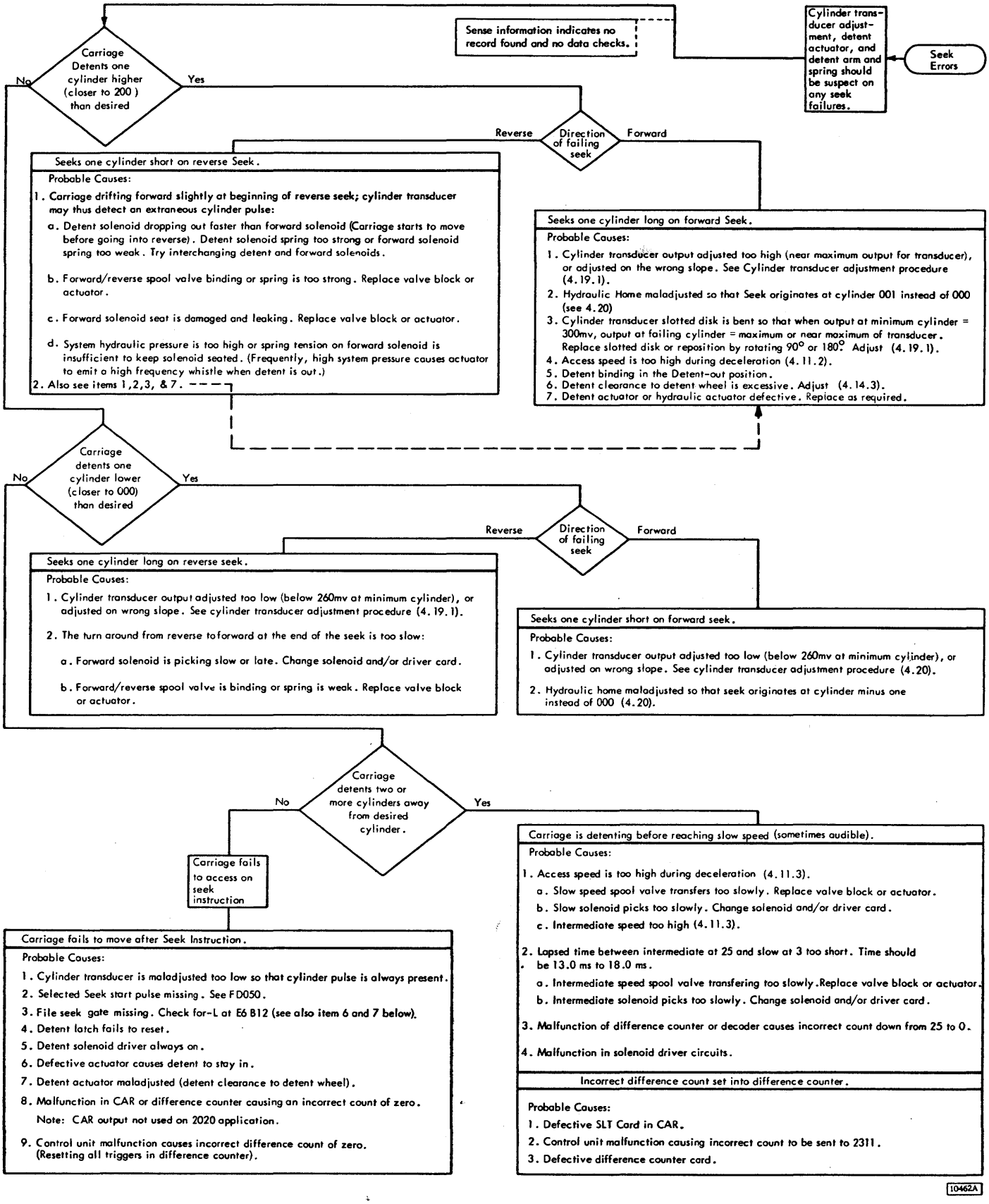


Figure 1-2. Seek Error Diagnostic Procedure

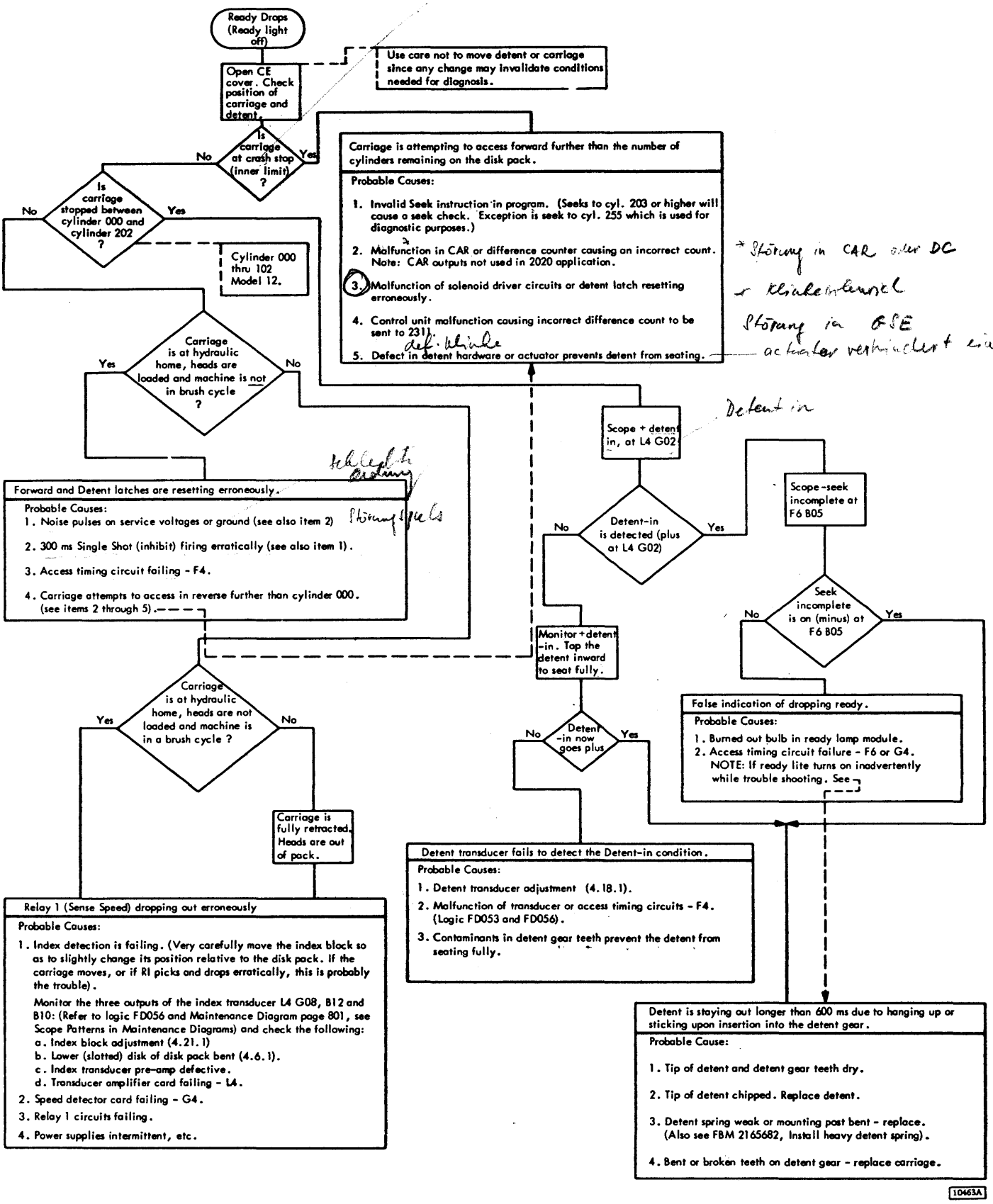


Figure 1-3. Drop of Ready Diagnostic Procedure

File Cannot Select Any Heads – Probable Causes

1. Control tag line is intermittent. If control is intermittent, the file may also have accessing problems.
2. Head select line does not reach proper level. Replace line receiver card at L6 (FD021).
3. Safety card is bad. A select lock condition is indicated and head selection is blocked. Replace card at C4.
4. Head address register card is bad. Check outputs of head address register for head to be selected. Replace card at G2.
5. Head select 0-9 and safety card bad. Check outputs. Replace card at J2.

File Cannot Select Some Head(s)

1. Head address register card is bad. Check outputs of head address register for head to be selected. Replace card at G2.
2. Head select 0-9 and safety card bad. Check output for the correct select level. Replace card at J2.

1.6 SELECT LOCK TROUBLESHOOTING (Figures 1-4, 1-5)

Select Lock – Condition and Purpose

1. AC unsafe condition. Loss of +36v power supply and/or line voltage.

   Note 1: Select lock lamp will not light if +36v or 6v is lost.

   Note 2: Refer to Appendix A, Special Circuits, for detailed description and voltage levels.

2. DC unsafe condition. An over-voltage or under-voltage of +6, ±3, or -36 vdc supplies.

   Note: Refer to Appendix A, Special Circuits, for detailed description and voltage levels.

3. Read/write unsafe conditions:
   a. Not seek ready, read gate, write gate, erase gate.
   b. Not seek ready, read gate, write gate, not erase gate.
   c. Not seek ready, read gate, not write gate, erase gate.
   d. Not seek ready, not read gate, write gate, erase gate.
   e. Not seek ready, not read gate, not write gate, erase gate.
   f. Seek ready, read gate, write gate, erase gate.
   g. Seek ready, read gate, write gate, no erase gate.
   h. Seek ready, read gate, not write gate, erase gate.
4. Heads unsafe conditions:
   a. Head select register – improper address
   b. Head select 0-9 and safety – shorted diodes and transistors.
   c. Read/write coil grounded at shoe.
   d. Not seek ready when head is selected.
   e. Heads deselecting too slowly when advancing heads. (The time must be less than 13 μsec from the head deselect signal to a voltage of 10v.)
5. Write unsafe conditions
   a. Not write gate but write current sense
   b. Write gate but no ac write current

      Note: Refer to Appendix A, Special Circuits, for detailed description and voltage levels.

   c. Write gate but no erase current
   d. Erase current but no erase gate

1.7 TROUBLESHOOTING COMPONENTS ON BASE PLATE

To inspect components under the top cover, follow this procedure:

1. Remove cover
2. Check cover on switch position and connections for contact.
3. Check slip-on contacts on the terminal block at the rear of the hydraulic actuator for good connection.
4. Check head extended switches A and B for opens and shorts. (Use a VOM.)
5. Check read pre-amp slip-on contacts and head plugs for good connections.
6. Check index transducer paddle connector for good connection with transducer contact pins.
7. Check for 0 to 10 ohms resistance when measured between the dc gate ground and the base plate.
8. Check brush motor switch for n/o position. If necessary, the brush motor linkage may be

Mode	Problem	Cause	Solution
Read Only (Seek ready)	R/W Unsafe Write Unsafe	Write gate is up intermittently or continuously.	Check the cards at K6, C4, E6, K2
Read Only (Seek ready)	R/W Unsafe	Erase gate is up intermittently or continuously.	Check the cards at K6, C4, K2, G4, K4, G2, G6. Write Driver or Read Preamp.
Seeking (Not seek ready)	R/W Unsafe	Read gate and/or erase gate came up during seek.	Check cards at K6, C4, K2, G4, K4, G2, G6. Write Driver or Read Preamp and M2.
Seeking (Not seek ready)	R/W Unsafe Write Unsafe	Write gate came up during seek.	Check the cards at K6, C4, E6, K2.
Read Only Green lamp goes out (not seek ready)	Heads Unsafe	Seek ready was lost during the time a head was selected. *	Check the cards at H6, F4, E6, J2, G4, C4.
Write Only (Seek ready)	R/W Unsafe	Read gate came up and/or erase gate was lost.	Check cards at K6, C4, K2, G4, K4, G2, G6. Write Driver or Read Preamp and M2.
Write Only Green lamp goes out (not seek ready)	R/W Unsafe Heads Unsafe	Not seek ready when a head is selected. Not seek ready during write.	Check these cards for seek ready: H6, F4, E6, J2, G4, C4, G2.
Seeking (Not seek ready)	Heads Unsafe	Heads selected during not seek ready. *	Check deselection time of head select 0-9 output transistors.
Read Only (Seek ready)	Heads Unsafe	Multiple head selection*	Check cards at G2, J2, C4.
Read Only Advance Heads (Seek ready)	Heads Unsafe	Multiple head selection*	Check deselection time of head select 0-9 output transistors.
Write Only (Seek ready)	Heads Unsafe	Multiple head selection*	Check cards at G2, J2, C4.
Write Only Advance Heads (Seek ready)	Heads Unsafe	Multiple head selection*	Check head deselection time of head select 0-9 output transistors.
Read Only (Seek ready)	Write Unsafe	Erase current but not erase gate, or write current sense but not write gate	Check card at K2
Write Only (Seek ready)	Write Unsafe	No erase current, or no ac write current	Check card at K2, Check output from read preamplifier for signal (see Appendix A).

*This cause may be checked by using the CE Control Unit.

10476A

Figure 1-4. Select Lock Troubleshooting

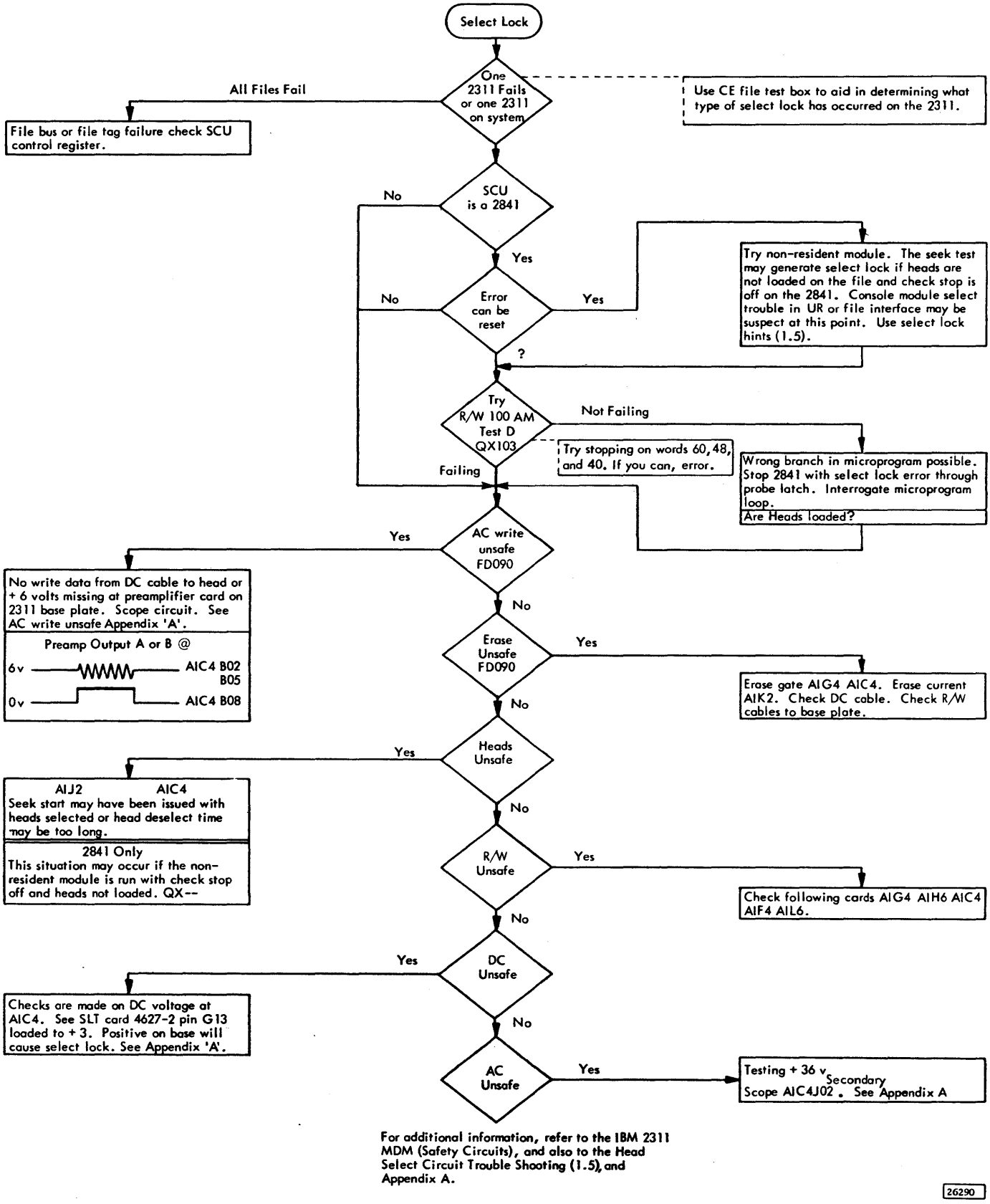


Figure 1-5. Select Lock Flowchart

moved by hand to set switch in the above position.

9. Check suppression network for good connection to usage meter.
10. Check operators panel lamp resistors (2-watt) for good connection.
11. Check cylinder transducer for a firm attachment to its pivot plate.
12. Check cylinder transducer pivot plate for a firm attachment to the base plate.
13. Check detent transducer for a firm attachment to its pivot plate.
14. Check detent transducer pivot plate for a firm attachment to the base plate.
15. Check detent wheel teeth for cleanliness.
16. Check detent spring for position.
17. Check write driver slip-on contacts and head plugs for good connection.
18. Check head loading mechanism for non-binding movement.
19. Check head assembly clamps for tightness.
20. Check torsion rods for proper location on heads.
21. Visually check index block for clearance when moved to and from the disk pack.
22. Install cover.

1.8 MISCELLANEOUS SERVICE TIPS

1. Plugging in SLT cards without the plastic guide installed on the card allows the card to be misaligned far enough to short out pins or components. To prevent component damage, always install the plastic guide before plugging in the card.
2. Top covers on the 2311 are not interchangeable once the sector block retracting mechanism is properly adjusted. When removing several top covers simultaneously be sure that the proper cover is returned to each 2311 (Figure 4-25).
3. Do not ground the +L outputs of the 2311 transducer amplifiers as this procedure may cause catastrophic damage to SLT card components.

SECTION 3. SYMPTOM INDEX

Field Engineering generates and distributes the Symptom Index. Insert the index following this page.

SECTION 4. SERVICE AIDS

Field Engineering generates and distributes Service Aids. Insert these Service Aids following the Symptom Index.

CHAPTER 2. CONSOLE AND MAINTENANCE FEATURES

SECTION 1. BASIC UNIT

2.1 CE DISK PACK

A CE disk pack with a yellow top must be used on the 2311. The CE disk pack has four prerecorded cylinders. Cylinders 03 and 201 have bursts of pulses (Figure 2-1), positioned so that the beginning of the burst on each track has a known timing relation with respect to the index pulse. Figure 2-1 shows which tracks are read by the A heads and which tracks are read by the B heads. The tracks read by the B heads are offset from the tracks read by the A heads, but they still start at a specified time after the index pulse. Cylinders 03 and 201 are used in making the head arm assembly alignment check (4.23.2) and the index transducer assembly circumferential adjustment (4.23.3).

Cylinders 72 and 74 consist of eccentric cylinders written 0.008 inches outboard from cylinder 72 and 0.008 inches inboard from cylinder 73. Since fringing of the cylinders into cylinders 71, 72, 73, 74 and 75 takes place, records should never be written on cylinders 71, 72, 73, 74, or 75. The inner of the two cylinders is written at 1,120 kilobits per second (kbs), the outer at 1,112 kbs. These two cylinders are used to make tracking adjustments on the read/write head arm assemblies (Sec. 4.23.1).

> Caution
> Do not write data on cylinders 02, 03, 04, 71, 72, 73, 74, 75, 200, 201, or 202. To do so will destroy prerecorded tests.

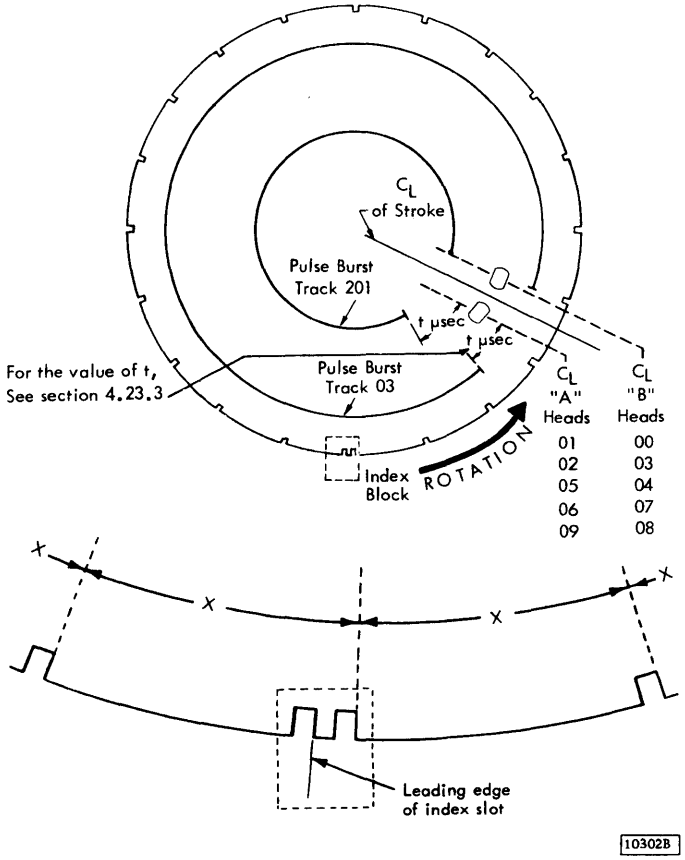


Figure 2-1. Head/Arm Assembly Alignment Tracks

2.2 CE CONTROLS

AC Line Switch (on Sequence Panel)

When the switch is in the off position (down), ac power cannot be applied to the drive motor, brush motor, gate fan, and +36v power supply.

CE Top Cover Switch (Between Frame and Top Cover)

With the top cover assembly removed (1.8 item 2), the file remains off-line unless the switch actuator is manually pulled up. With the top cover assembly installed, the top cover switch remains closed and allows the file to be on-line.

2.3 SPECIAL TOOLS FOR USE WITH THE 2311

2.3.1 Tools for Each Installation

	Domestic Part No.	WTC Part No.
Head adjusting bristol	2108626	2108626
Alcohol, 91% (pint)	2200200	2200200
Lint-free tissues	2162567	2162567
Disk- and head-cleaning paddle (2)	2108474	2108474
CE disk pack (yellow top)	2200018	2200018

2.3.2 Branch Office Tools

	Domestic Part No.	WTC Part No.
Carriage replacement arm	2108634	2108634
Carriage replacement ring	2108633	2108633
Plastic tape	2121873	596763
Tektronix 561 Oscilloscope or equivalent		
Pliers (retaining clip)	460966	460966
CE disk pack runout gage	2108627	2108627
Screwdriver, insert (WTC only)		4261079
Syringe	450640	4261085
Hydraulic actuator oil, quart	2164584	2164584
Seal inserting tool	2108916	2108916
CE head alignment adapter	2108913	2108913
CE file test box	2200012	2200012
Shielded sync lead or direct probe (2)	4261093	4261093

SECTION 2. FEATURES

Model 1: This is the basic 2311 used with the IBM 2841 Storage Control Unit. With EC 411227 (model 11 and 12 compatibility) installed, a model 1 may be converted to a model 11 or model 12.

Model 11: Basic operation is the same as the model 1. The model 11 may be used only on the IBM System/360 Model 20 with the storage control feature. The model 11 provides sector pulse circuitry used by the System/360 Model 20 storage control feature.

Model 12: Basic Operation is the same as the model 1. The model 12 may be used only on the IBM System/360 Model 20 with the storage control feature. The model 12 has the same sector pulse circuitry as the model 11. Additionally, it has a new cylinder slotted disk, which limits the access to the outer 103 cylinders under control of the IBM System/360 Model 20 storage control feature.

SECTION 1. BASIC UNIT

3.1 APPROACH TO PREVENTIVE MAINTENANCE

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

Visual inspection is the first step in every scheduled maintenance operation. Always look for corrosion, dirt, wear, binds, oil leaks and loose connections. Alertness in noticing these items may save machine downtime later.

3.2 PREVENTIVE MAINTENANCE PROCEDURES

Details of preventive maintenance operations are listed in Figure 3-1. During normal preventive maintenance, perform only those operations listed on the chart for that preventive maintenance period. Details on adjustments and service checks are found on the pages listed in the chart. Observe all safety procedures.

3.2.1 Electronic Circuits

Diagnostic programs are a basic tool provided for preventive maintenance of electronic circuits. They can be effective in locating potential and intermittent troubles. Time spent in becoming proficient in the use of the diagnostics results in reduced troubleshooting time.

3.2.2 Mechanical Units

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

3.3 CLEANLINESS

Cleanliness cannot be overemphasized in maintaining the IBM 2311 Disk Storage Drive.

1. Do not allow oil to accumulate anywhere on the machine. Oil accumulates dust and dirt.
2. Do not run the machine with the top covers open unless analysis cannot be performed in any other manner. If the machine must be run with covers off, replace the customer's disk pack with the CE disk pack to avoid harming customer data.

New disk packs should not be cleaned prior to customer use. Dick packs should be cleaned only if:

1. Read/write heads show an oxide buildup.
2. A specific pack causes read errors.

Clean read/write heads and shroud according to the schedule in Figure 3-1. See 4.6.1 and 4.22.1 for a description of the causes of head and disk damage.

SECTION 2. FEATURES

There are no additional maintenance requirements for models 11 and 12.

CODE U	CODE R	LOCATION OPERATION	FREQ. MONTHS	LUBRICATE/CLEAN	OBSERVE
1		Read-Write Heads and Shroud	3	Clean Read-Write Heads. Clean shroud as required (4.22.2 and 4.7.2).	Inspect for oil leaks. Look for oil on belt, in pump pulley and in oil reservoir bottle. If large quantity of oil has leaked, check oil level. Fill actuator with clean oil only (4.9 item 3).
		Air Intake Filter		Replace filter.	
		Actuator Drive Rod Seal, All O Ring Seals, Pump Tubing Connections			
2		Read-Write Heads			Inspect for scratches and oxide build-up (4.22.1).
		Racks and Pinions	6	Lubricate with IBM #6. Remove and replace any dirty felt wipers. Saturate felt with IBM #6. Remove excess oil with Kimwipes, using light pressure on felt. Wipe excess oil from rails and racks with Kimwipes. Repeat if excess oil appears dirty.	
		Carriage Roller Ways, Detent Gear and Head Load Latch (Latch Surface)		Lubricate with IBM #20. Apply a thin coat of grease. Wipe off excess grease. Be sure no grease is on the slotted disk or in the slots.	
3		Disk Pack Locking Screw and Disk Pack Locking Shaft		Lubricate with IBM #20. Clean; add light coat of grease to threads and the insert inside of cover handle.	
		Head Loading Linkage Pivots		Lubricate with IBM #6. One drop - 11 points.	
		Head Loading Cam Follower Pivots and Detent Arm Pivot	12	Lubricate with IBM #9. One drop each point.	
		Base and Covers		Clean base and covers	Inspect for cleanliness, loose parts, adjustments of interlock switches and cover latches. Check for base plate grounding (4.26).
		Disk Pack Cover		Clean disk pack cover (4.6.3).	
		Disk Pack Brushes			Inspect brushes for wear (4.8.1).
		Air Filters - Shroud and Disk Pack		Replace filters	
		Read-Write Heads			Check tracking adjustment and ground. (4.23.1 and 4.22.5).

10276B

Figure 3-1. Preventive Maintenance Schedule

SECTION 1. BASIC UNIT

4.1 DRIVE MOTOR AND PULLEY

4.1.1 Drive Pulley Service Check

The side of the drive pulley nearest the motor mounting plate should be approximately 11/32" from the plate (Figure 4-1).

4.1.2 Drive Pulley Adjustment

1. Loosen drive pulley clamp (split block).

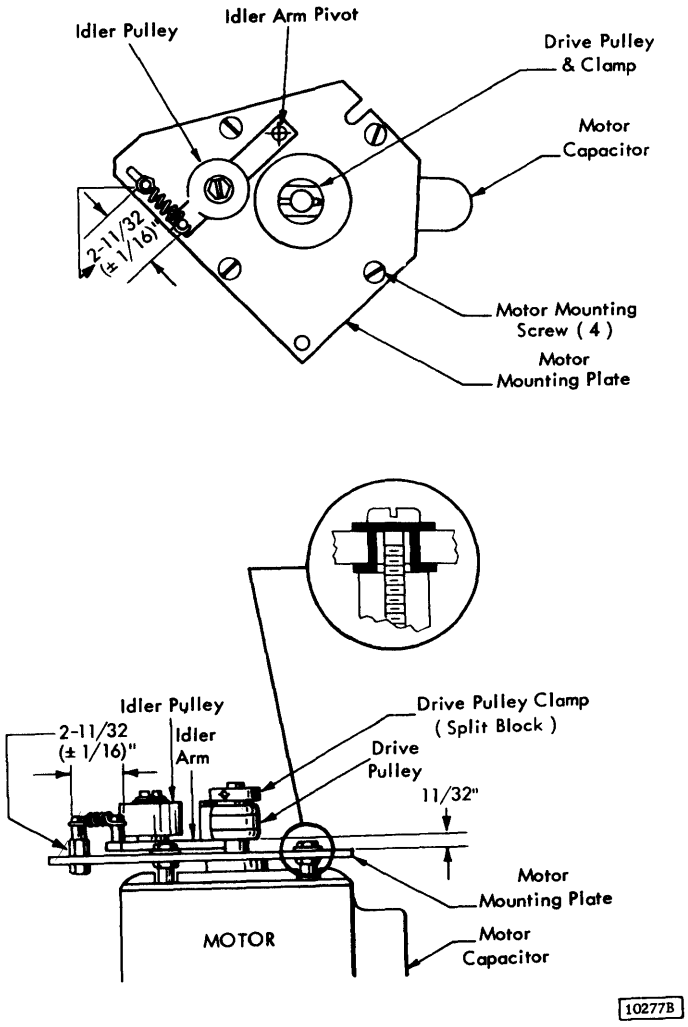


Figure 4-1. Drive Motor & Pulley

2. Position pulley so side of drive pulley nearest motor mounting plate is 11/32" from the plate (Figure 4-1).
3. Tighten clamp.

4.1.3 Drive Motor Removal and Replacement

1. Turn off main power.
2. Remove drive belt from motor pulley.
3. Remove cover from sequence box.
4. Disconnect motor leads at terminal and at the frame ground.
5. Loosen the bolt holding the slotted portion of the motor mounting plate to the base plate about three turns. Remove the remaining two bolts and standoffs from the base plate. The motor drive assembly may now be removed by sliding the assembly clear of the loosened bolt.
6. Remove the four screws, insulating washers, and insulating bushings holding the motor to its mounting plate.
7. Replace the drive motor by reversing steps 1-6.

Note: Check that the motor plate is insulated from the motor before mounting the assembly to the base plate.

8. Check for base plate grounding (4.26).

Note: The motor mounting plate is grounded to the base plate through the three mounting bolts.

4.2 DRIVE BELT AND IDLER PULLEY

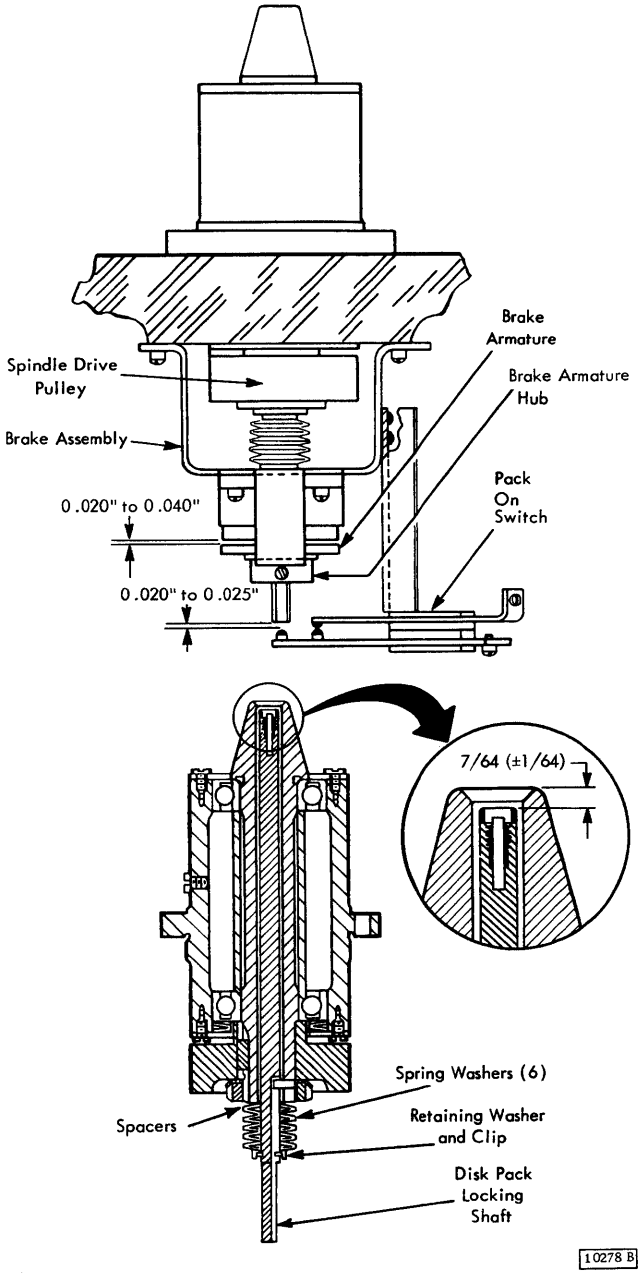
4.2.1 Drive Belt Adjustment

With the drive belt installed, adjust the drive belt tension spring by positioning the adjustable spring post to 2-11/32 (±1/16)" from the idler arm spring post. Measure from the outside of the adjustable spring post to the outside of the idler arm spring post (Figure 4-1). This positioning gives proper belt tension.

4.2.2 Drive Belt Removal and Replacement

Magnetic Brake Assembly (Figure 4-2a)

1. Remove the brake armature hub. Remove the two screws holding the brake assembly to the base casting and remove the brake assembly and brake armature (Figure 4-2a).



● Figure 4-2a. Disk Pack Spindle Assembly (Magnetic Brake)

2. Slide the belt off of the hydraulic pump pulley and the disk pack pulley. The belt may now be removed by working it around and over the drive and idler pulleys.
3. Replace belt, threading as shown in Figure 4-3. When replacing the belt, make certain that the side marked "outside" is away from the drive (motor) pulley.
4. Install the brake assembly and brake armature, then install and adjust the brake armature hub, the brake spline stop, and position the brake assembly (4.4).
5. Check pack-on-switch adjustment (4.5).

Mechanical Brake Assembly (Figure 4-2b)

1. Slide the belt off of the hydraulic pump pulley and the disk pack pulley. The belt may now be removed by working it around and over the drive and idler pulleys.
2. Replace belt, threading as shown in Figure 4-3. When replacing the belt, make certain that the side marked "outside" is away from the drive (motor) pulley.

4.3 DISK PACK SPINDLE

If trouble is experienced with the spindle assembly other than the inner shaft (disk pack locking shaft), replace the entire unit. If the spindle is replaced, check the following adjustments:

Spindle brake assembly (4.4)
Pack-on switch (4.5)
Tracking and carriage alignment (4.23.1 and 4.23.2)

4.3.1 Disk Pack Locking Shaft Removal and Replacement

Follow this procedure:

1. Remove the pack-on switch and the brake armature hub. Remove the two screws holding the brake assembly to the base casting and remove the brake assembly and brake armature.
2. Remove the retaining clip below the spring washers (Figure 4-2a). The spring washers and spacers will fall off, and the shaft may be removed from the top.
3. Replace by inserting the shaft from the top.
4. Install the spring washers and spacers as shown in Figure 4-2a. Obtain the adjustment shown in the insert by adding or removing spacers (P/N 2154419).
5. Install the retaining washer.
6. Install the retaining clip.
7. Install the brake armature hub. Adjust as described in 4.4.
8. Install the pack-on switch and adjust as described in 4.5.

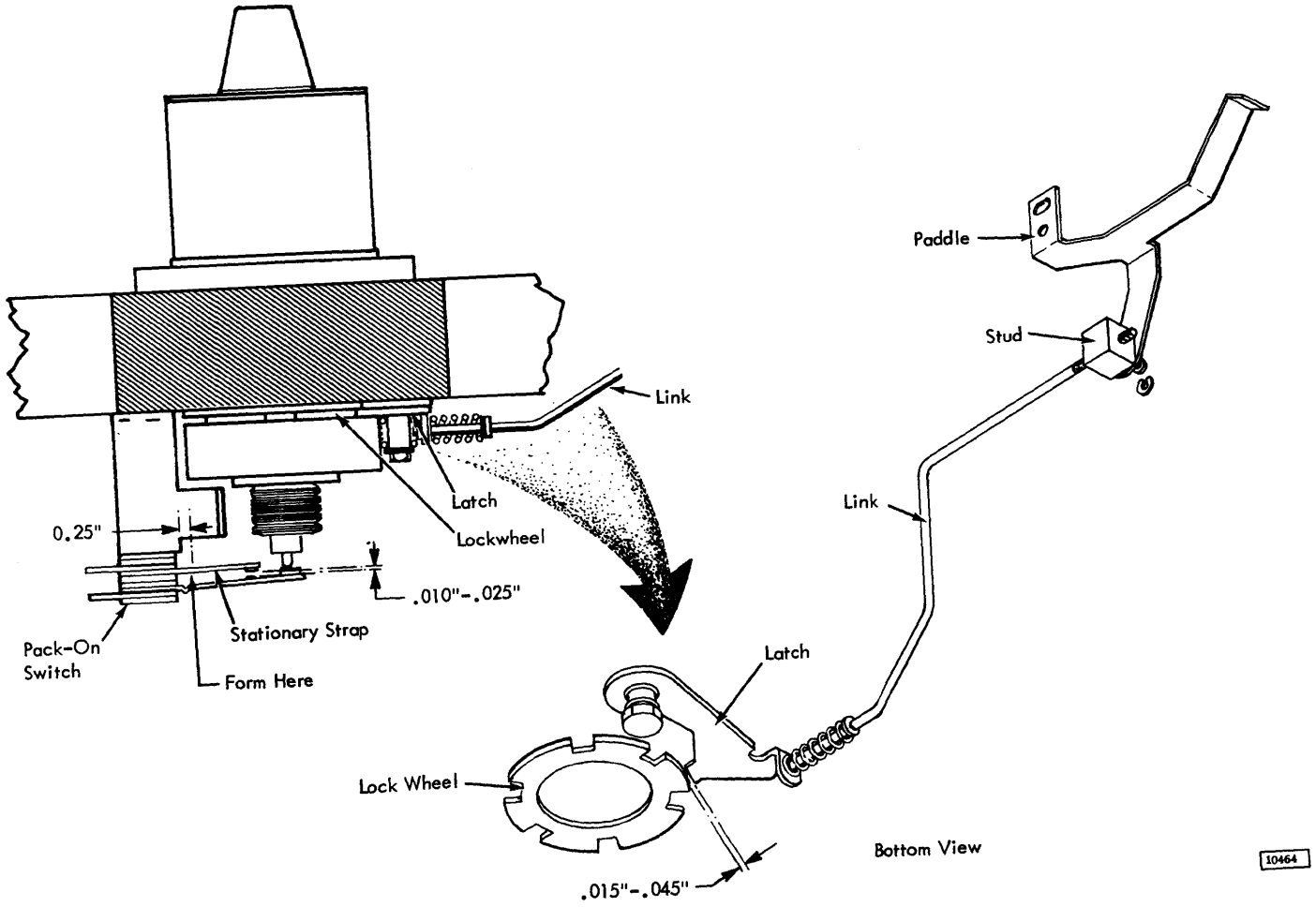


Figure 4-2b. Disk Pack Spindle Assembly (Mechanical Brake)

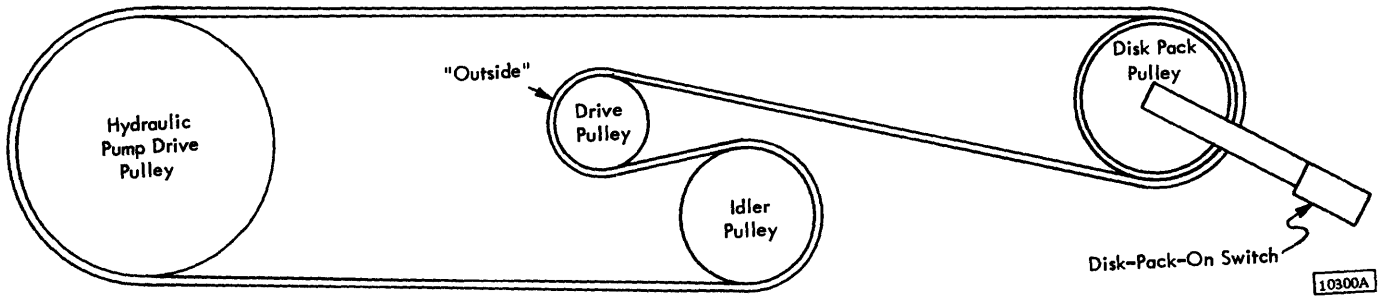


Figure 4-3. Drive Belt Threading (Bottom View)

4.4 SPINDLE BRAKE ASSEMBLY ADJUSTMENT

Magnetic Brake Assembly

1. Mount a disk pack on the spindle. Hold the drive pulley manually to prevent rotation of the spindle. Be certain that the lock shaft has bottomed on the flange of the lock screw.
2. With the brake armature against the support shelf on the hub, adjust the brake hub so there is 0.020" - 0.040" clearance between the brake armature and the brake face (Figure 4-2a). Lock the brake hub to the lock shaft.
3. Loosen the two screws holding the brake assembly to the base casting and adjust the brake position so that it is concentric with the brake armature on the hub. Tighten the two screws.

Mechanical Brake Assembly

1. Remove clip holding stud to paddle (Figure 4-2b) and disconnect stud from paddle.
2. Turn stud on threaded end of link to obtain 0.015" to 0.045" between latch and lock wheel (Figure 4-2b) with the top cover closed.

4.5 PACK-ON-SWITCH ADJUSTMENT

Magnetic Brake Assembly

1. With the disk pack removed, position the switch so the longer of the two contact leaves is supporting the lock shaft. The lock shaft must be supported so that there is no clearance between the disk springs.
2. With a disk pack mounted on the spindle and the lock shaft bottomed against the flange of the disk pack lock screw, check for a clearance of 0.020" to 0.025" between the bottom of the lock shaft and the nylon bearing on the lower contact leaf (Figure 4-2a).

Mechanical Brake Assembly

With no pack on the spindle, form the pack-on-switch stationary strap at the point indicated (Figure 4-2b) for 0.010" to 0.025" gap.

4.6 DISK PACK

4.6.1 Disk Initialization

Thirty spare tracks have been provided for alternate assignment in case of errors (defects) on any of the normal tracks.

OS/360 Independent Utilities, 360S-UT-507 (DASDI), or BPS/360 Initialize Disk, 360P-UT-069, will test and assign alternate tracks as required for all model 1 machines. 1316 disk packs to be used on 2311 models 11 and 12 should be initialized by IBM System/360 Model 20 DPS program 360W-UT-183. Disk packs initialized by System/360 OS or DOS programs must be re-initialized for use on the System/360 Model 20.

In addition, all new packs are being surface-analyzed at the factory and all defective tracks listed on a track-flagging log. The defective tracks listed on the track-flagging log should be flagged prior to running customer jobs to ensure optimum performance.

4.6.2 Disk Pack Service Check

Caution

When installing disk packs with top cover off, hold index block assembly away from pack.

4.6.2.1 Scratches on Disk Surfaces

Fine scratches on the oxide coating are usually harmless; however, severe scratches or gouges are likely to cause read errors. It is important to identify and eliminate the source of scratches to prevent further damage to heads and disk packs.

4.6.2.2 Particle Damage to Disks

The heads "fly" approximately 125 microinches from the surface of the disk. Any particles of foreign material allowed to accumulate on the heads and disks will probably be smashed between the heads and disk. Such foreign material may interfere with proper head flight, causing head-to-disk contact.

Hard materials (such as ordinary dust) are quite brittle and may break up, leaving the main body of the particle embedded in the disk surface with smaller particles strewn in an arc ("comet tail") around the disk. A particle may become embedded in the head-pole epoxy and, upon accessing, cut a spiral groove in the disk surface. Spiral scratches accompanied by a 0.010" spaced circular scratches indicate that a head with a protrusion on its shoe face, or an embedded particle, has been used on that surface.

Particle interference typically produces an audible tinging sound and leaves an oxide deposit on the affected head. When particle damage is found, check all 2311s which may have used this pack recently; examine the head(s) corresponding to the damaged surface (see 4.22.1 and 4.22.2).

4.6.2.3 Non-Particle Damage

Damage to both head and disk surface can occur as a result of head to disk interference. Any imperfection on the surface of head or disk which prevents

proper head "flight" may result in damage. Typical surface imperfections are fingerprints or other stains on the surface of a head or disk (do not blow on heads or disks), residue from misuse of isopropyl alcohol, lint, material from a contaminated atmosphere, etc. Fingerprints, stains, etc. on a head or disk surface mean oils and salts which, in most cases, will build salt deposits and films to a height greater than the flight height of the head, resulting in head-to-disk interference. An accumulation of oxide on head surfaces will result if maintenance activity is relaxed and may cause a rash of read errors.

4.6.2.4 Check for Head-Disk Interference

1. Remove the top cover. Place the file in off-line status (CE cover switch off).
2. With the disks turning and heads loaded, manually pull out the detent and listen closely while slowly moving the carriage back and forth between inner and outer crash stops. Pay particular attention as the carriage passes the cylinder(s) where errors occur. Any head-disk interference produces an audible tinging sound as described in 4.6.2.2 and 4.22.1.

4.6.2.5 Mechanical Damage

Use the following procedure to determine whether a disk pack has been damaged by dropping or other mishandling. Do not complete the checking procedure if any of the standards listed below are not met. (See Disk Pack Replacement, 4.6.2.6.)

1. Using extreme care, visually inspect the disk surfaces. There should be no raised areas of coating or foreign material. Scratches on the disk surface may be expected, but they are damaging to the pack only if they cause read or write errors.
2. Remove the top covers and the shroud from a 2311 and install the disk pack on the spindle. Place the runout gage, without the pointer assembly, on the base plate as shown in Figure 4-4A. This gage checks the amount of wobble in the disk. With power off, rotate the disk pack by hand. The disks should not touch the upper or lower edges of the notches in the gage. Also, the sector disk should not touch the index transducer block. This procedure tests for head accessing clearance, not for runout.
3. Install the pointer as shown in Figure 4-4B. Hold the gage at an angle so that the wire pointer clears the air duct. Be sure the tip of the plastic guide is riding smoothly on the disk surface. The pointer indicates the amount of runout (up and down movement) of the disk. The distance between adjacent lines, as indicated by the pointer, corresponds to 0.004" of disk run-out.

   Slowly turn the disk pack by hand and carefully watch the pointer movement. A maximum of 0.012", or three indicated divisions, is allowed. Turn the pointer over to read bottom of top disk. If any disk approaches the full 0.012" runout, the maximum and minimum reading must be indicated over a disk circumference of 4.0" or greater. If a reading approaching 0.012" occurs in less than 4.0", the pack is defective. This criterion ensures that no sharp kinks exist in the disk.
4. If the disk pack does not meet any one or more of the preceding checks, do not proceed further. Do not load heads on the pack. If the pack passes the above tests, continue.
5. Clean the read/write heads and then install the shroud and disk pack. Start the machine and load the heads. Listen carefully to see if there is any audible head-to-disk contact.
6. For a final checkout of the disk pack, run the disk surface analysis program.

4.6.2.6 Disk Pack Replacement

Replacement of a disk pack is necessary under either of these circumstances:

1. An embedded particle or surface contamination is present in a disk surface which cannot be dislodged by cleaning and scrubbing (4.6.3) and is scratching heads, causing an audible tinging; or
2. The pack has sustained mechanical damage rendering it unsuitable for further use. (See Mechanical Damage, 4.6.2.5).

If all the preceding checks are made and no difficulties are encountered, the disk pack may be considered to be satisfactory for continued use. If the disk pack fails to meet any of the standards described above, return it to the plant for reconditioning.

The procedure for returning the disk pack for repair varies with the purchased/non-purchased/maintenance agreement status of the faulty pack. Consult the IBM Sales office for the proper procedure.

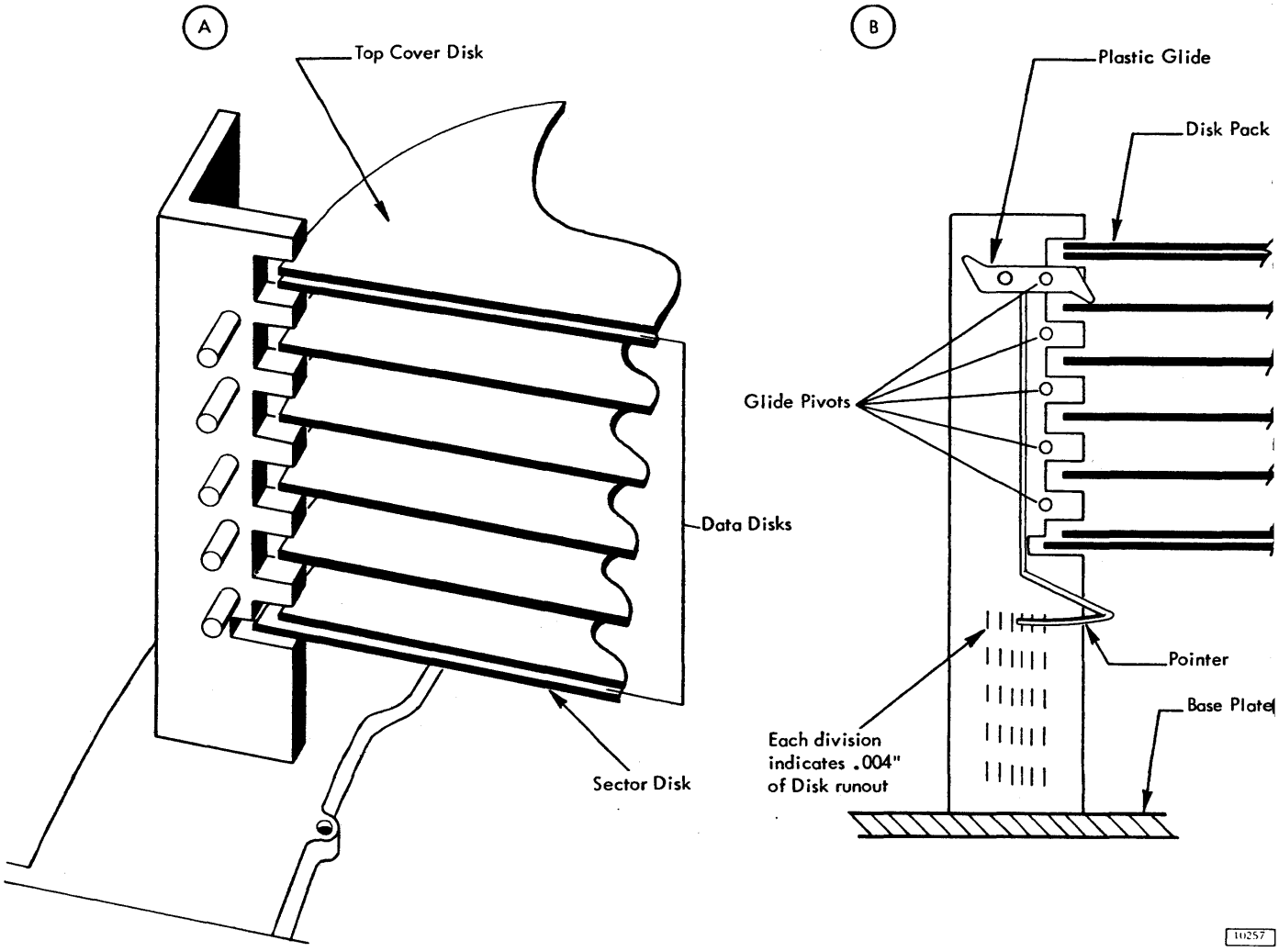


Figure 4-4. Runout Gage

4.6.3 Disk Pack Cleaning

Note: Disk packs should be cleaned only when particle damage or oxide buildup is suspected (4.6.2.2 and 4.6.2.3).

1. Install the disk pack to be cleaned on the machine spindle. (Use the spindle as a pivot for rotating the disk pack.)
2. Deactivate the spindle brake by:
   a. On machines with magnetic brakes, turn off ac disconnect switch.
   b. On machines with mechanical brakes, remove the entire top cover.
3. Wrap a lintfree tissue (P/N 2162567) around a disk-pack cleaning paddle (P/N 2108474) and dampen (do not soak) with 91% isopropyl alcohol (P/N 2155966). (WTC uses cleaning kit, P/N 4061685.)
4. Insert the paddle between the disks and manually rotate the disk pack while exerting pressure on the disk surface in which the particle is embedded.
5. With the pack rotating, slowly withdraw the paddle.
6. Using the same method but with a dry lintfree tissue, repeat the procedure.

4.6.4 Disk Pack Cover Cleaning

Dampen a clean lintfree tissue with 91% isopropyl alcohol and clean the entire disk pack cover, removing dirt and smudges.

4.6.5 Installation of Cover with Pack Off Machine

1. With cover upside down, place pack in cover.
2. Using small screwdriver, depress plunger in center of disk pack screw.

   Caution
   Do not use a pencil. Broken lead will jam the plunger.

3. Hold disk pack screw flange with small screwdriver and rotate disk pack handle until the three pins enter the holes in the flange and the plunger pops up. If the plunger does not pop up, the cover is not fastened to the pack.

   Note: Before lifting pack by handle, pull pack and handle to be certain cover is firmly attached.

   Caution
   Do not disassemble a disk pack.

4.6.6 Disk Pack Storage

Always store disk packs at the same temperature as the using unit. A cold disk pack (one recently shipped in, etc.) should be allowed to come to using system temperature before being used. If this precaution is not taken, read failures can result.

4.7 SHROUD

4.7.1 Shroud Service Check

Check carefully for metal particles in the shroud area or in the air filter and air plenum area. Very small particles are particularly dangerous. The airflow within the shroud is directed to flush most foreign matter forward and out of the shroud area. However, particles left in the shroud can get into the pack because of the rush of air caused when the pack cover is removed.

Normally, the particles which cause the most damage are generated within the 2311 rather than brought in from the outside. If particles are detected, the heads, disks and shroud area should be cleaned.

Particle generation occurs with wear. Any two surfaces which rub, bump, or scuff produce particles. Particle generation can be controlled by:

1. Proper adjustment of top cover, CE, and customer access covers and latches.
2. Proper adjustment of index block mechanism and shroud to prevent rubbing against the edges of the sector block port.
3. Adjustment of shroud to prevent rubbing by upper carriage roller.
4. Careful handling of disk pack while installing it in a machine.
5. Proper operation of disk pack brush mechanism and head load delay until end of brush cycle.
6. Proper operation of pack lock screw and handle insert.
7. Proper fit of pack cover and proper clearance between handle well and dish on top of pack.
8. Proper runout of sector disk so that it does not rub on index block or air deflectors in shroud.

4.7.2 Shroud Cleaning Procedure

Clean the shroud by dampening a lint-free tissue very lightly with alcohol and wiping the shroud to remove all dirt and smudges. Thoroughly wipe surface of spindle. After cleaning the shroud with alcohol, take a wad of adhesive tape and pick up any particles that were not picked up with the tissue. Remove all particles from the air plenum area by use of the adhesive tape. Watch closely to be sure that all metal particles are removed.

4.7.3 Shroud Adjustments

1. Adjust the shroud so that both access opening and sector block opening allow free movement of the mechanisms. Butt the shroud against the carriage and then move away to maintain a 0.010" minimum clearance between the shroud assembly and carriage housing.
2. Check for about 0.040" clearance between deflector on shroud at access port and bottom of lower head load pad. Form the shroud if required.
3. Check for 5/16 (±1/32)" clearance between the top disk and the leading edge of the disk pack guides. Adjust the shroud if required.

4.8 DISK PACK BRUSH MECHANISM

4.8.1 Disk Pack Brush Service Check

Check for brush wear. If a brush is worn so that it is not compressed when it enters the disk pack, it should be replaced (Figure 4-5).

Figure 4-5. Disk Pack Brush Condition

4.8.2 Brush Drive Adjustment

1. Manually turn the brush motor crank until the crank and the connecting link are in line (Figure 4-6). The brush motor has a friction drive which allows the crank to be turned for adjustment.
2. Line up the curved edge of the brush holder parallel to the shroud by loosening the two motor mounting screws and moving the motor mount toward the front or rear. The brush pivot arm must be detented to the shaft when this and the following adjustments are made.
3. When the brush holder and the drive mechanism are in the fully retracted position, adjust the position of the microswitch so that the switch plunger is moved 1/32" beyond the point where the switch makes (audible click).

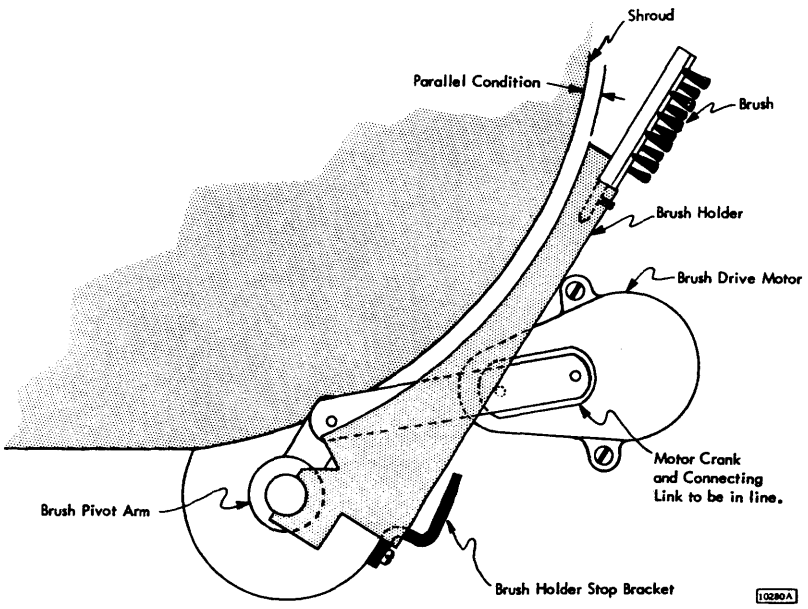


Figure 4-6. Brush Drive Assembly

4.8.3 Disk Pack Brush Removal and Replacement

1. Loosen the setscrew which secures the brush in the holder and remove the worn brush.
2. Insert a new brush (the flat on the brush must be aligned with the key on the holder) and tighten the setscrew.

4.9 HYDRAULIC OIL REMOVAL

1. Remove the sump cover.
   a. Remove the disk pack.
   b. Read the caution below.

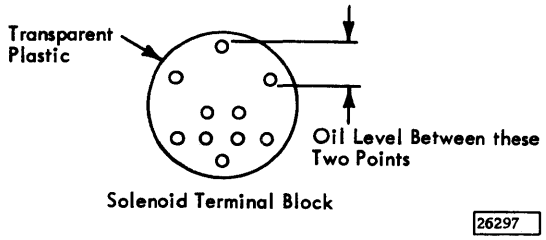
   Caution
   Do not allow the heads to load during carriage manual accessing (4.15).

   c. Manually access the carriage to cylinder 202 (Section 4.15).
   d. Remove the sump cover retaining screws and the sump cover.

   Caution
   The shield inside the hydraulic sump is used to deflect oil streams in case the sump cover is off and machine power is turned on. To avoid soiled clothing, keep the shield in place.

2. Withdraw the oil from the sump using the syringe (P/N 450640 or WTC P/N 4261085) or similar device.
3. Always replace with new oil (P/N 2164584). Beware of contaminants. Oil level should be 1/4" to 3/8" below top of sump. Newer-level 2311 actuators have a clear plastic terminal block. Maintain the oil level between the top two rows of pins, as viewed through the solenoid terminal block.

Caution
Strict adherence to item 3 is necessary to prevent machine damage.



4.10 HYDRAULIC PUMP AND DRIVE SHAFT REMOVAL AND REPLACEMENT

1. Remove oil from the system (4.9).
2. Remove the oil line between the pump and the valve block and between the pump and the sump.
3. Remove the two screws holding the pump to the base casting.
4. Lift the pump clear of the hydraulic pump drive shaft and housing.
5. To remove the hydraulic pump drive shaft and housing, remove the plastic spacer, and the retainer ring and drop the housing down through the base casting. Replace by reversing steps 1 through 5. Use plastic tape (P/N 2121873 or WTC P/N 596763) on the male hydraulic pipe fittings. Remove all old tape.
6. Replace the hydraulic oil with new oil (4.9.3).

4.11 HYDRAULIC ACTUATOR ASSEMBLY

4.11.1 Hydraulic Actuator Service Check

Check for oil leakage around the:

1. Rear cylinder cap.
2. Carriage drive piston rod seal.
3. Valve stops (slotted screws) in the valve block.
4. Sump cover.
5. Oil lines attached to the actuator assembly.
6. Detent actuator.

4.11.2 Accessing Deceleration (Intermediate Speed Check and Adjustment)

Service Check

Note: Use the following procedure only when seeking failures occur (Figure 1-2). In addition, before performing the check and/or adjustment, verify that the subject machine has the high speed actuator. The high speed actuator valve block has the number 2181145 or 2181185 stamped on it. If the valve block does not have one of the preceding numbers stamped on it, FBM 2165673 must be installed to bring the actuator's functional level up to present production standards. The following procedure applies only to the high speed actuator.

1. Preheat the machine with the disk pack turning for a minimum of 55 minutes to allow the hydraulic system to reach operating temperature.
   (The 55-minute warmup is essential for a precision check or adjustment. Customer operation requires that the actuator operate properly throughout a broad temperature range. This capability is best achieved by using the correct procedure which guarantees the maximum performance built into the actuator.)
2. Do repetitive seeks between cylinders 010 and 085, using one of the following methods:
   a. Use CE test box.
   b. If the 2311 is attached to a IBM 2841 Storage Control Unit, use diagnostic F613 special seek loop (refer to F610 description, page 2).
   c. If the 2311 is attached to an IBM System/360 Model 20, use routine 7, section 0, of diagnostic 2305.
3. Sync the scope negative on the 'slow at 3' signal (G6D10) and probe '-stop' (H6J02). Display the elapsed time between 'slow at 3' and 'stop' for both forward and reverse accessing.
4. Observe the 'stop' signal while accesssing continuously (Figure 4-7). Note that the stop time varies with the direction of access. It also varies from one access to the next. This variation is normal. Typically, the stop signals tend to fall into two discrete groups (one for forward and one for reverse accesses).
   With the machine seeking, watch the stop pulses for several minutes. Look for the earliest stop occurring in either forward or reverse direction (Figure 4-7). The earliest stop pulse should occur between 7ms and 9ms after the 'slow at 3' signal.
5. If the stop pulses are checked when the machine has been running considerably longer than one hour, or when the machine is doing random seeks, it is normal for the stop time to vary outside the

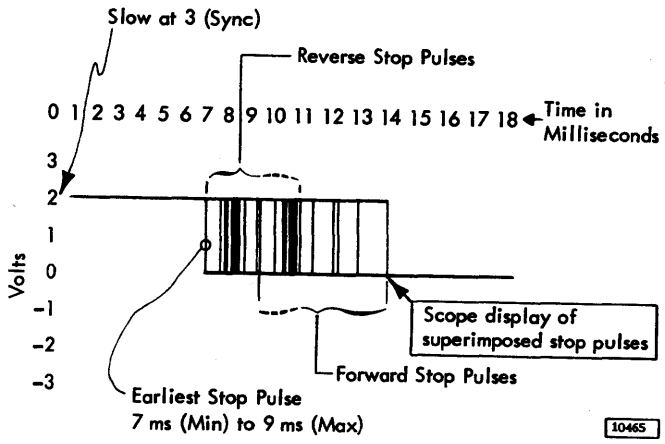


Figure 4-7. Accessing Deceleration Check

above limits. However the stop time should never occur before 5.5 ms since this early occurrence may cause the carriage to detent one tooth early.

Adjustment

1. Loosen the intermediate speed adjusting screw locknut (Figure 4-10). Remove sealant if present.
2. Adjust the screw so that the earliest stop pulse (See Service Check) occurs between 7 and 9 ms after the 'slow at 3' signal comes on.

   Note: A very small movement of the intermediate speed adjusting screw causes a significant change in the stop time.

   As the adjustment is being made, note that relatively few stop pulses occur between 6 and 7 ms. This is normal due to low velocity during the 6 to 7 ms interval.

4.11.3 Hydraulic Actuator Assembly Removal and Replacement

1. Remove the hydraulic oil (4.9).
2. Disconnect the oil lines from the actuator assembly.
3. Remove the wires to the solenoids at the rear cylinder cap.
4. Remove the carriage coupler plate holding the piston to the carriage. Be sure that the head load cam is unlatched before removing the coupler plate (4.15).
5. Remove the screw holding the actuator assembly to the carriage assembly frame.
6. Remove the screws holding actuator assembly to the base. The actuator assembly is now free to be moved.
7. Replace by reversing steps 1 through 6. (Refer to 4.9.3, Oil Replacement.) Remove all old tape from pipe fittings. Use plastic tape (P/N 2121873 or WTC P/N 596763) on male hydraulic pipe fittings.
8. Bleed air from the hydraulic system as follows:
   a. Disconnect the detent solenoid by removing the wire from terminal #4 of actuator. This disconnection prevents detenting at high speed.
   b. Turn on machine and wait for heads to load.
   c. Connect one end of a jumper wire to G4 B09 on the SLT gate. Touching the other end of the jumper on DC ground causes the carriage to restore. Alternately make and break this connection so that the carriage restores and extends at least ten times. This procedure forces air out of the actuator.
   d. Remove the jumper wire and turn the machine off.
   e. Reconnect the detent solenoid wire and turn machine on.
   f. Bleed air from the detent oil line by loosening the joint at the detent actuator assembly until oil leaks from the joint. Retighten the fitting.
9. Check the following items after replacing the actuator:
   a. Access deceleration check and adjustment (4.11.2).
   b. Hydraulic home adjustment (4.20).
   c. (Head) tracking adjustment (4.23.1).

4.12 O-RING AND SEAL REPLACEMENT

4.12.1 Rear Cylinder Cap O-Ring

1. Carefully remove the rear cylinder cap, using rags to catch the hydraulic fluid (about two tablespoons full). Remove the defective O-ring from the cap (Figure 4-10).
2. Lubricate the new O-ring and the surface of the cylinder cap thoroughly with hydraulic oil. Carefully stretch the O-ring over the cap and slip it into place in the groove. Make sure the O-ring is properly seated in the groove without twists or kinks.
3. Lubricate the O-ring and screw the cap on.

4.12.2 Valve Block O-Rings

If any of the O-rings on or attached to the valve block leak hydraulic fluid, they must be replaced with new ones (Figure 4-8). The hydraulic oil must be removed before replacing any valve block O-rings (4.9). Discard the oil. When installing new O-rings, check them with extreme care to determine that they have not been twisted or kinked, and that they have not been scratched or otherwise damaged. Always lubricate them with hydraulic oil before installing, and be certain that they are seated properly. Replace hydraulic oil with new oil (4.9.3).

4.12.3 Carriage Drive Piston Rod Seal

1. Remove the oil from the sump (4.9).
2. Disconnect the carriage from the drive piston rod by manually accessing the carriage out until the carriage coupler plate is accessible. Be sure that the head load cam is unlatched to avoid R/W head damage (4.15).
3. Remove the coupler plate by removing the three attaching screws.
4. Push the piston rod in the retract direction as far as it will go, leaving the carriage out in its accessed position.
5. Pry the seal out with a small screwdriver. Be careful to not scratch the housing seal cavity or the drive rod. Force the screwdriver through the rubber of the seal and pry against the metal insert (Figure 4-9).
6. Lubricate the new seal outer diameter with hydraulic fluid and place it on the drive rod with the lip turned toward the hydraulic unit. Using the seal inserting tool (P/N 2108916) over the drive rod, drive the seal into its cavity.
7. Reconnect the carriage to the drive piston rod by moving the piston rod out to the carriage and replacing the coupler plate and the three screws.
8. Fill the sump with fresh hydraulic fluid (4.9.3) and replace the sump cover.
9. Replace the disk pack.
10. Check the carriage home position and adjust as needed (4.20).

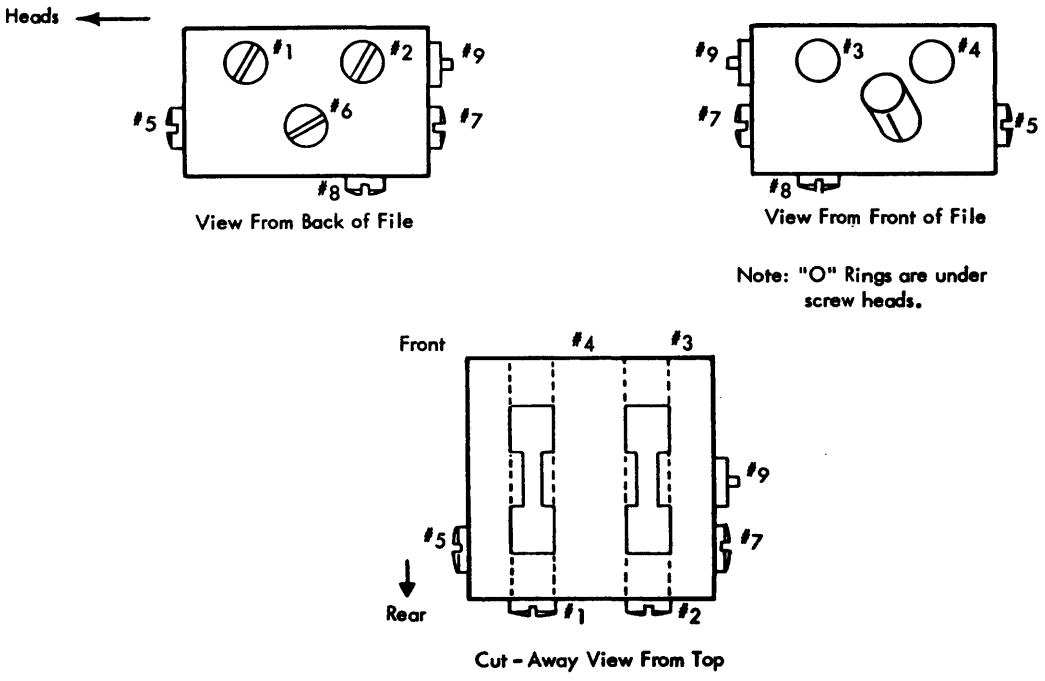


Figure 4-8. Valve Block

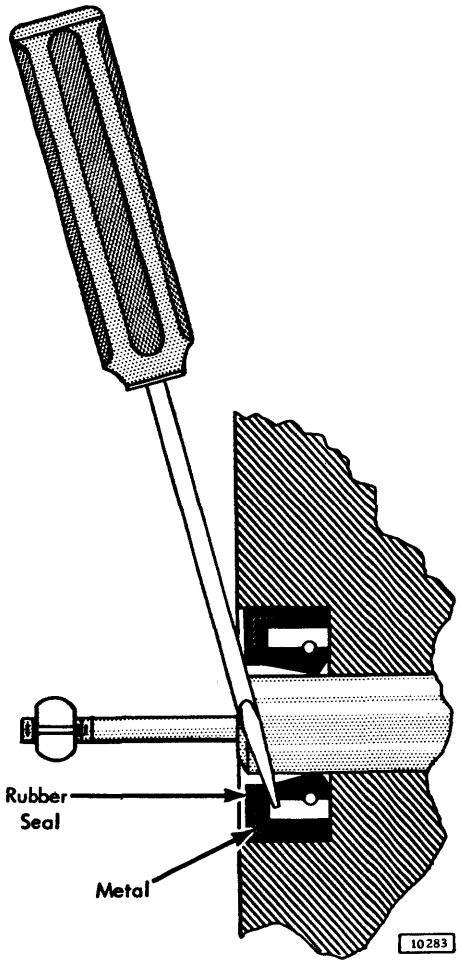


Figure 4-9. Drive Shaft Seal Removal

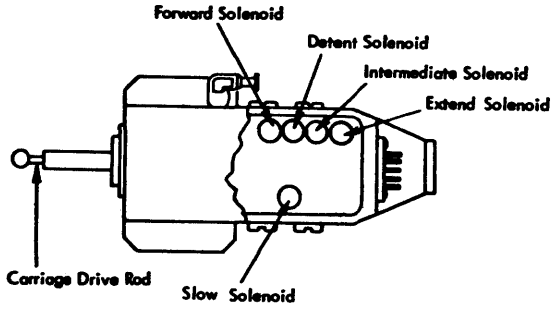
4.12.4 Extend Piston Cup Seal

1. Remove the hydraulic oil (4.9).
2. Remove the rear cylinder cap.
3. Remove the extend piston. Use a spring hook, catching and pulling the piston at its exposed small diameter.
4. Replace the cup seal on the extend piston and lubricate it with hydraulic fluid.
5. Carefully push the extend piston forward past the cross hole at the end of the housing threads. Replace the O-ring on the rear cylinder cap and reinstall the rear cap. See rear cylinder cap O-ring replacement procedure (4.12.1).
6. Fill the sump with fresh hydraulic fluid and replace the sump cover (4.9.3).
7. Replace the disk pack.
8. Check the carriage position and adjust as needed.

4.13 SOLENOID REMOVAL AND REPLACEMENT

To remove a solenoid (Figure 4-10), it is not necessary to replace or drain the hydraulic fluid.

1. Disconnect the solenoid taper pins from the solenoid connector inside the oil reservoir.
2. Using a close-fitting screwdriver to prevent burring the slot, remove the solenoid from the actuator casting (WTC only: use screwdriver; insert P/N 4261079).
3. Install the solenoid plunger in the solenoid and place the assembly into its hole in the casting. Tighten the solenoid only enough to be sure it has seated securely. Because the solenoid does not hold any moving parts in place, a tight seal need not be made when seating the solenoid.



Note: A change in distance between carriage and piston is reflected in a change in relation of detent arm and detent gear. A change of .005" here results in a change of approximately .015" detent arm to detent gear dimension.

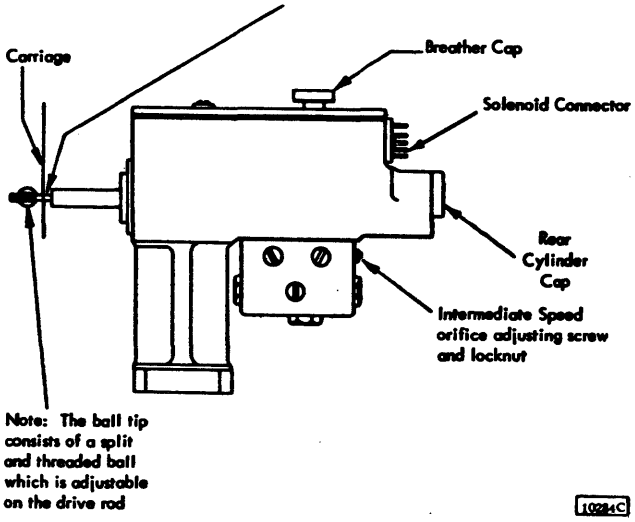


Figure 4-10. Hydraulic Actuator Assembly

Caution

Too much torque on the screwdriver may damage the solenoid by rotating the slotted plate within the outside shell, breaking the internal wires.

Stripped solenoids can be removed by gripping the top edge of the solenoid tightly with "duck bill" pliers to hold the case to the end cap. Then, use a screwdriver to turn the solenoid out in the normal way.

4. Reinstall the taper pins on the connector and replace the sump cover.

Caution

The shield inside the hydraulic sump is used to deflect oil streams in case the sump cover is off and machine power is turned on. To avoid soiled clothing, keep the shield in place.

4.14 DETENT ACTUATOR

4.14.1 Detent Actuator Service Check

Check for oil leakage.

4.14.2 Detent Actuator Assembly Removal

1. Remove the detent arm actuating spring and the detent arm.
2. Back off the oil line fitting at the detent actuator end.
3. Remove the two screws holding the actuator housing to the base. The entire housing may now be removed.

4.14.3 Detent Actuator Assembly Replacement

1. Replace by reversing steps 1 through 3 of the removal procedure.
2. Disconnect the wire from pin 1 of the solenoid connector on the outside of the oil reservoir.
3. Check that the detent clears the detent gear teeth by 0.001" to 0.003" when the detent is out, file running, and detent solenoid deenergized. Adjust by slightly loosening the two block mounting screws and rotating the block about the detent point using a 7/16" wrench (Figure 4-11).
4. After the adjustment is complete, loosen the fitting holding the tube to the detent actuator. After bleeding the air from the tube, tighten the fitting. Remove sump cover and check that the oil level is 1/4" to 1/8" below top of sump, or between the top two rows of pins on the clear plastic actuator terminal block. Clean all the oil from the cylinder position slotted disk and from the base plate. Check for oil leaks.
5. Adjust detent transducer (4.18.1).
6. Adjust cylinder position transducer (4.19.1).
7. Adjust read/write head tracking (4.23.1).
8. Recheck for oil leaks.

4.14.4 Detent Diaphragm Removal and Replacement

1. Remove the detent spring. Do not remove the actuator housing.
2. Remove the oil line.
3. Remove the four screws holding the detent tubing housing to the detent actuator housing.
4. Remove the old diaphragm and discard it.
5. Remove the detent plunger and lubricate it with IBM #20 grease and reinstall it in its housing.
6. Lubricate the diaphragm with a light coat of IBM #20. Place the diaphragm in its cavity with the higher bead of the diaphragm (marked with a raised dot) facing outward away from the detent plunger (Figure 4-12). Be certain that it fits smoothly and is complete inserted into the cavity.
7. Carefully place the tubing housing in place and replace the four screws.
8. Replace the oil line.
9. After assembly is complete, start the motor and loosen the fitting holding the tube to the detent actuator. After bleeding air from the tube, tighten the fitting.

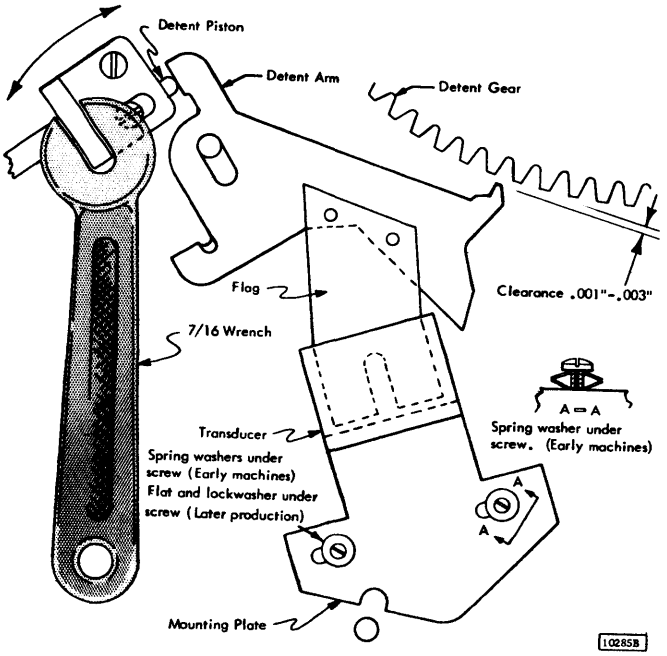


Figure 4-11. Detent Mechanism

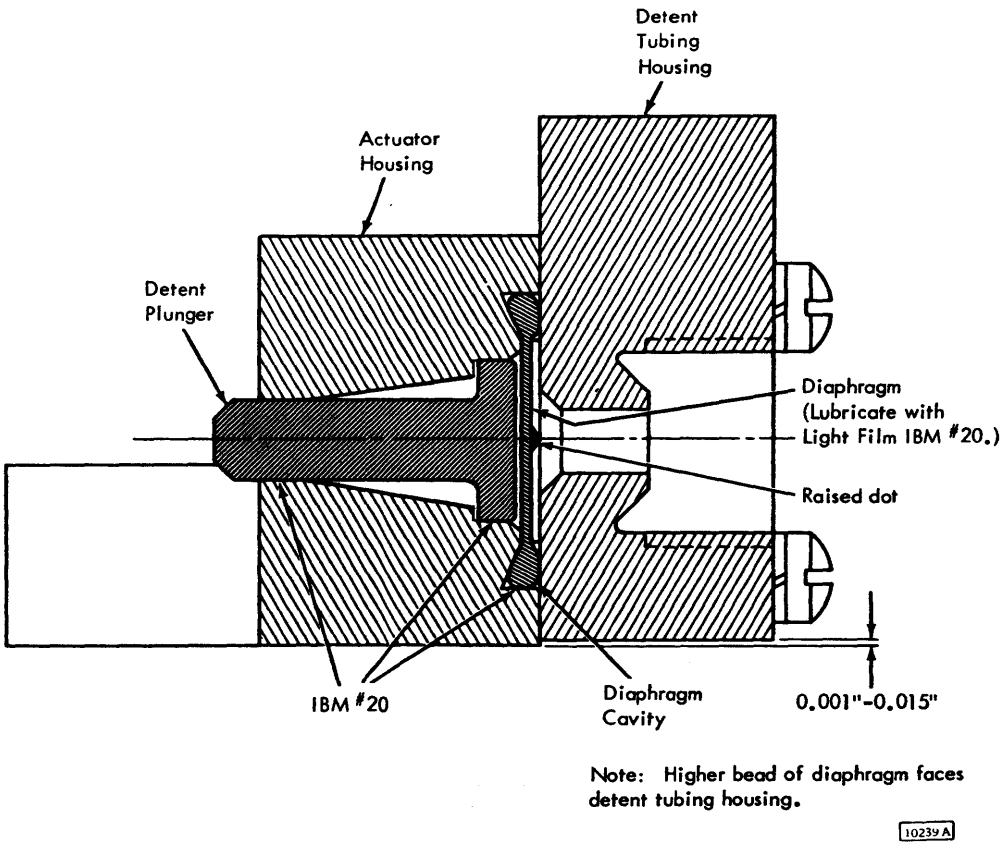


Figure 4-12. Detent Actuator Assembly

Checks

1. Remove the sump cover after reassembly and check that the oil level is 1/4" to 3/8" below top of sump.
2. Clean all the oil from the track position slotted disk and from the base plate.
3. Check for oil leaks.

4.15 CARRIAGE MANUAL ACCESSING

Caution
Never allow the heads to load with pack on unless the pack is up to speed.

To prevent head load during manual accessing operations, unlatch the head loading cam. Use a small screwdriver to reach in through the hole in the lower pressure rail assembly to unlatch the cam (Figure 4-13). A click will be heard when the cam unlatches, and the back end of the cam will rise away from the heads extended switch.

The carriage may now be moved manually from cylinder to cylinder or from home to cylinder repeatedly without loading the heads. The detent arm may be held away from the detent gear with the finger or with a screwdriver (Figure 4-11).

Caution
Do not pry with screwdriver between piston and detent arm.

The head loading cam is automatically relatched by returning the carriage to the retracted position. The heads will then be loaded on the disks on the next access stroke.

Some adjustments require that the heads be in a loaded condition. This can be done in the following manner.

1. Remove disk pack, if on.
2. Place strips of accounting machine card stock between opposing heads, and between top and bottom heads and the head load pads. The card stock will prevent damage to the gliding surface of the heads.

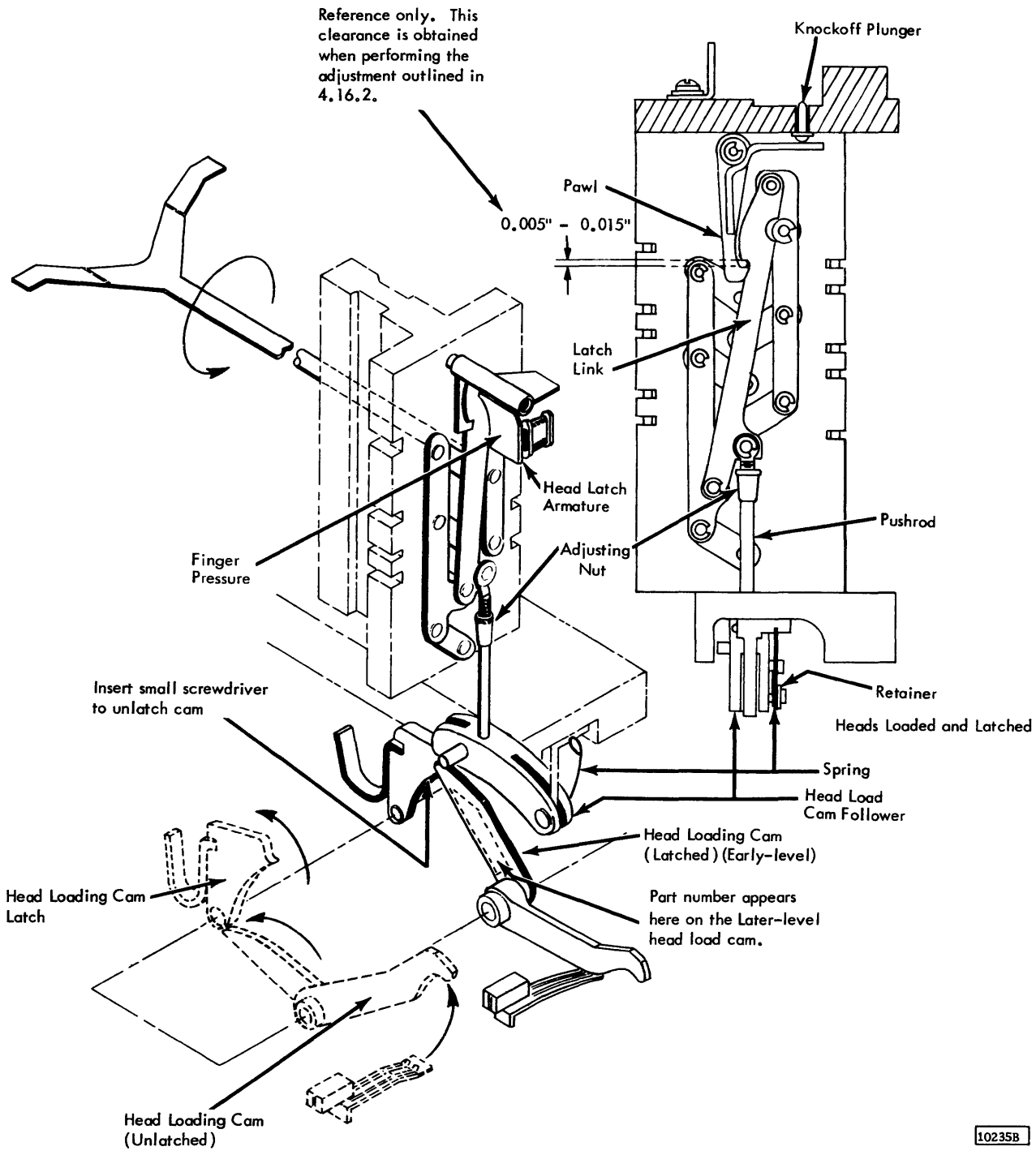


Figure 4-13. Carriage Manual Accessing

3. Do not trip off (unlatch) the head loading cam.
4. Pull the detent arm away from the detent gear using a finger or a screwdriver (Figure 4-11). Do not pry between piston and detent arm.
5. The carriage can now be moved from cylinder to cylinder. Head loading takes place at about cylinder 145 (depending on the style of the head load cam), and the heads stay loaded until the carriage is retracted to between minus cylinder 7 and minus cylinder 12 (4.16.3).

4.16 HEAD LOADING MECHANISM

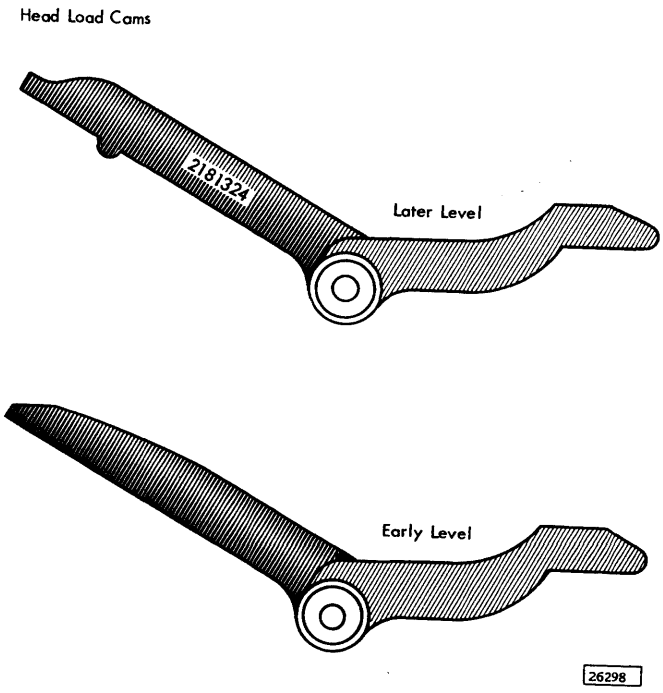
4.16.1 Head Loading Mechanism Service Check

1. The heads must unload when the holding current is removed from the head latch magnet. Check this requirement with the disk pack running and the heads previously loaded in the normal manner. To check, open the connector on the head cable terminal assembly. The heads should unload. If they fail to unload, stone the latch point to remove burrs which may cause failure to unlatch.
2. With the heads loaded and the head latch magnet energized, the magnet armature must not be knocked off mechanically in the area from hydraulic home to the forward positive stop position, but must be knocked off when the carriage has moved approximately 1/8" back of hydraulic home position. To check for no knock-off between home and the maximum accessible cylinder (cylinder 202 for models 1 and 11 and cylinder 102 on model 12), program repetitive seek operations between cylinder 000 and the maximum accessible cylinder. (Use CE file test box.) If the 2311 is attached to a System/360 Model 20, use diagnostic MFT 2311 I/O Short.

4.16.2 Head Latch Magnet Assembly Adjustment

There are different head load cams in use, each requiring different adjustment procedures. Early-level head load cam adjustments are described in 4.16.2.1. Later-level head load cam adjustments are described in 4.16.2.2. Compare the head load cam on the machine with the head load cams in the drawing to determine the level of the cam and the correct adjustment procedure.

All but about the first 150 later-level head load cams have the part number (2181324) stamped on the side of the cam. Machines with serial number 26259



(WTC Europe, 73-15565; WTC Canada, 91-02521 except 91-02541 and 91-02546) and above have the later-level head load cam.

The early-level head load cam part number is 2154331. In conjunction with this part, the head load cam follower assembly (P/N 2154255) and head load latch push rod (P/N 2162749) are used. These three parts form a group and must be used together.

Later-level head load cam (P/N 2181324), head load cam follower assembly (P/N 2181329), and head load latch push rod (P/N 2218636) form the other group.

Parts cannot be exchanged from one group to the other. If the machine has the early-level cam, only the early-level follower and push rod may be used. The same is true of the later-level cam, follower, and push rod.

If necessary because of the lack of a particular part, the machine may be converted from one group to the other group by exchanging all three parts. However, it is sometimes difficult to get the spring (P/N 2154212) and retainer ring (P/N 1073418) installed on the back side of the cam follower. This fact should be taken into consideration before deciding to convert (Figure 4-13). FBM 2166076 is available to convert the machine from the early-level group to the later-level group (head load cam, follower, and push rod).

4.16.2.1 Head Load Cam, Early Level

1. Place strips of accounting machine card stock between opposing heads and between top and bottom heads and head load pads to prevent damage to the gliding surface of the heads while performing the following adjustments.
2. Energize the magnet with 36 vdc by removing the wire from the magnet at the sequence panel end and jumper to ±36 vdc. With the magnet holding screws loosened, both pole pieces should be sealed against the armature.
3. With the carriage in the cylinder 193 position and the head load cam in latched position, locate the magnet assembly so that the latch fully enters the notch in the link (Figure 4-14c). Tighten the screws and check that armature is tight against both pole pieces.
4. With the head load cam latched as shown in Figure 4-13, apply finger pressure to the head latch armature and slowly move the carriage forward from cylinder 000. When the pawl drops into the latch, it will be felt by the finger that is applying pressure to the head latch armature. This drop must occur between cylinder positions 173 and 177. Adjust the head load push rod up or down, as required to have the pawl drop into the latch between cylinder positions 173 and 177.
5. When proper adjustment has been attained, snug down the locknut against the adjusting nut. Remove the push rod from the carriage and tighten the locknut securely. Replace the push rod and reinstall the retaining ring. Check for complete engagement of the retaining ring.
6. Verify that the pawl still drops into the latch between cylinder positions 173 and 177. If not, repeat steps 4, 5, and 6.

4.16.2.2 Head Load Cam, Later Level

1. Place strips of accounting machine card stock between opposing heads and between the top and bottom heads and head load pads to prevent damage to the gliding surface of the heads while performing the following adjustments.
2. Energize the magnet with 36 vdc by removing the wire from the magnet at the sequence panel end and jumper to ±36 vdc. With the magnet holding screws loosened, both pole pieces should be sealed against the armature.
3. With the carriage in cylinder position 165 and the head load cam in latched position, locate the magnet assembly so that the latch fully enters the notch in the link (Figure 4-14c). Tighten screws and check that armature is tight against both pole pieces.
4. With the head load cam latched as shown in Figure 4-13, apply finger pressure to the head latch armature and slowly move the carriage forward (toward the spindle) from cylinder 000. When the pawl drops into the latch, it will be felt by the finger that is applying pressure to the head latch armature. This drop must occur between cylinder positions 140 and 145. Adjust the head load push rod up or down, as required to have the pawl drop into the latch between cylinder positions 140 and 145.
5. When proper adjustment has been attained, snug down the locknut against the adjusting nut. Remove the push rod from the carriage and tighten the locknut securely. Replace the push rod and reinstall the retaining ring. Check for complete engagement of the retaining ring.
6. Verify that the pawl still drops into the latch between cylinder positions 140 and 145. If not, repeat steps 4, 5, and 6.

4.16.3 Head Unload Knockoff Adjustment

1. With the linkage in the unloaded condition and with the pawl held against the latch link (Figure 4-14b), check that the knockoff plunger contacts the roller arm in the range of carriage travel between minus cylinder 7 and minus cylinder 12.
2. Adjust by forming the upper leg of the armature or by shifting the position of the roller arm (elongated holes). If the roller arm position is changed, check the 0.005"-0.015" clearance shown on Figure 4-14a.

4.16.4 Head Load Microswitch Adjustment

Both switches should transfer to the n/o (heads extended) position when the head load latch is tripped.

1. Push the switch down as far as the holes in the bracket permits and tighten the screws.
2. Rotate the switches and switch actuators clockwise (as seen from the hydraulic actuator side) as far as possible and tighten the screws holding the switches (Figure 4-15a).
3. Check that both switches transfer from the n/o (heads extended) to the n/c side within 0.01" to 0.07" dimension between the actuator leaf spring and the switch actuator arm. This dimension must be checked with the head load cam latched and the carriage at approximately home position. Lift the switch actuator arm to its maximum height using the end of a small screwdriver. Slowly allow it to move toward the leaf spring.

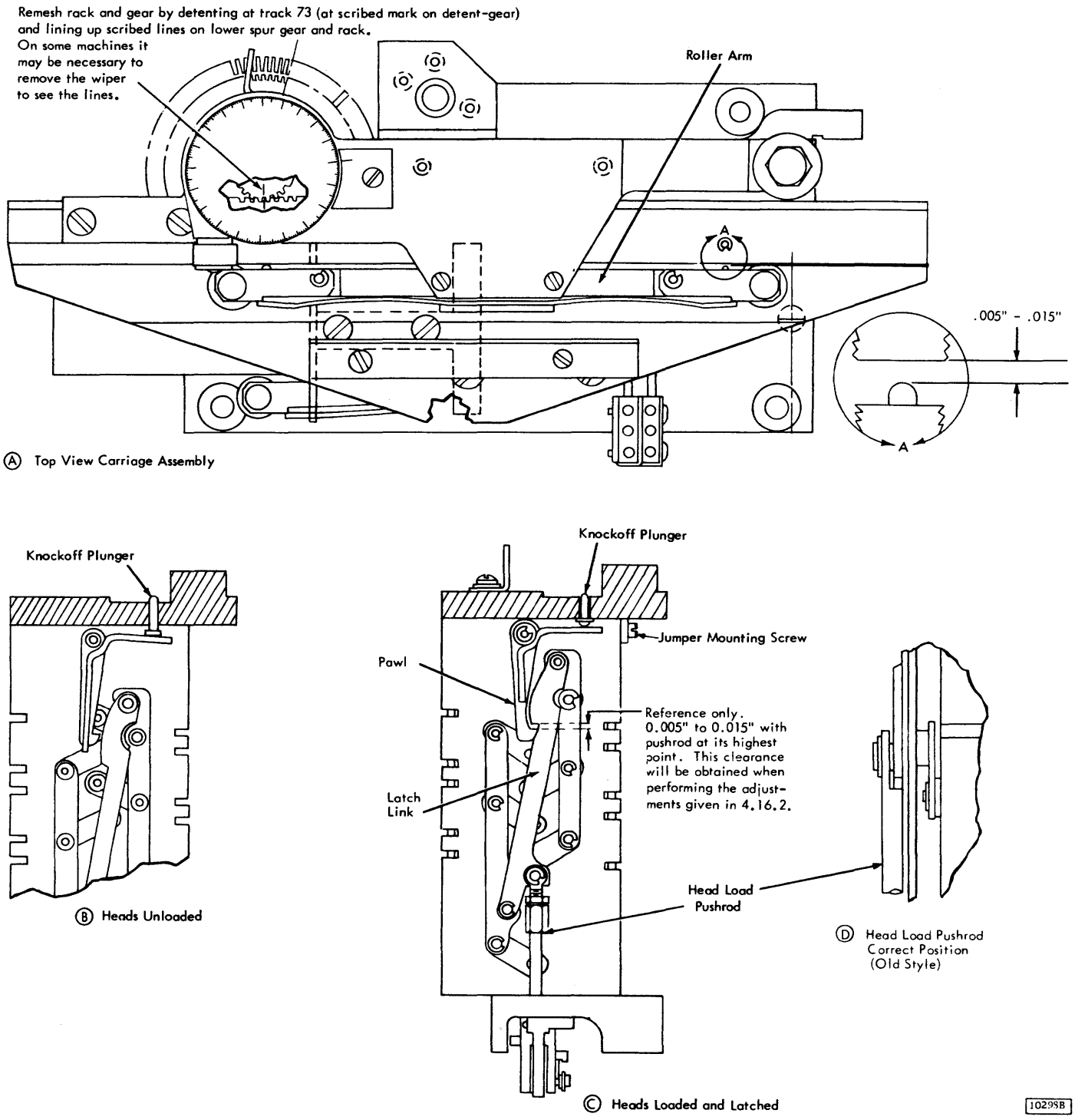


Figure 4-14. Head Loading Mechanism Adjustments

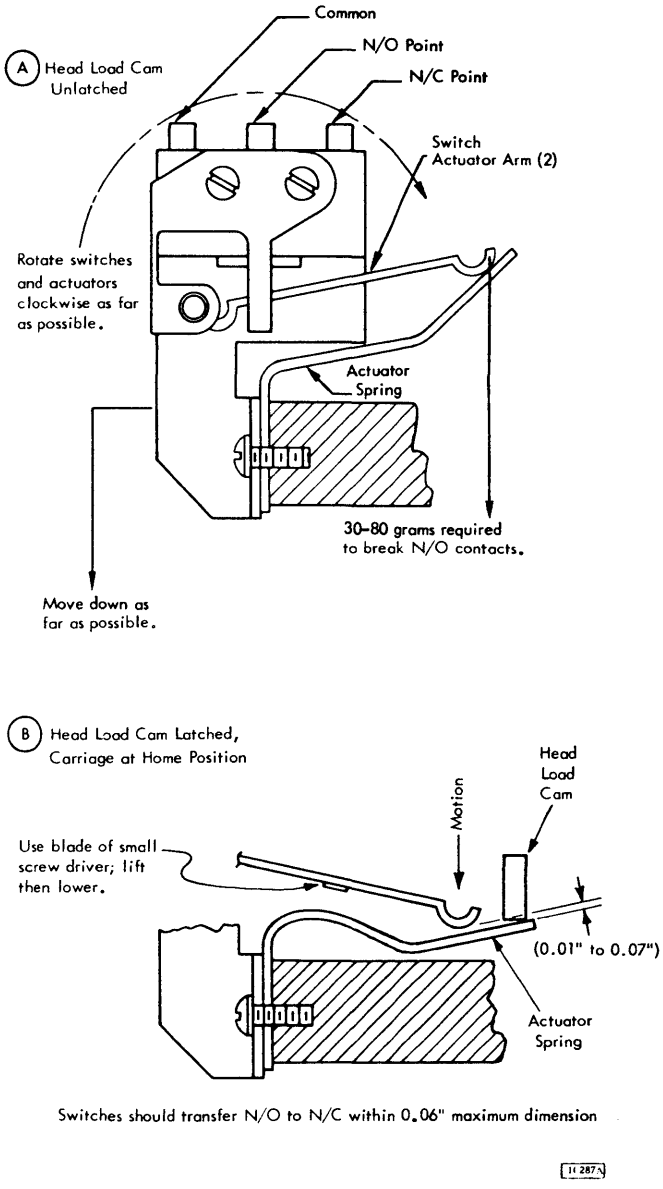


Figure 4-15. Heads Extended Switch Adjustments

The audible click indicates switch transfer. Adjust by forming the two switch actuator arms individually to obtain the transfer from normally open to normally closed within the 0.06" movement of the switch actuator arm shown in Figure 4-15b.

4. Check that a force of 30-80 grams is required to break the n/o contacts (Figure 4-15a).

4.16.5 Head Loading Mechanism Removal and Replacement

The knockoff plunger can be removed and replaced by removing the head latch magnet armature.

On very early machines, if the head loading pushrod is removed, replace it with the flat side toward the E-ring. If the pushrod is installed backwards, the mechanism will bind (Figure 4-14d).

4.17 CARRIAGE AND CARRIAGE HOUSING

4.17.1 Carriage and Carriage Housing Removal and Replacement

If troubles are experienced with the carriage and carriage housing, such as chipped rack tooth, broken detent gear tooth, etc., the entire carriage and carriage housing must be replaced.

1. Remove the disk pack.
2. Unplug and remove the head arm assemblies and all cables attached to the housing.

   Caution
   Do not touch the faces of the read/write heads.

3. Remove the coupler plate holding the drive piston to the carriage.
4. Move the track pulse and detent transducer assemblies and the cylinder wheel guards away from the carriage housing.
5. Remove the detent actuator and detent arm to clear the housing.
6. Loosen the hydraulic actuator from the base plate.
7. With all units clear of the carriage housing, remove the screws holding the housing to the base and lift the housing off the base. There is one pin holding the housing to the base.
8. Place new carriage in position and align the carriage as described in 4.17.2.

4.17.2 Carriage Assembly Adjustment

The carriage assembly must be positioned on the base so that the stroke is on a radial line with the disk drive spindle. The carriage field replacement tools are used to attain this condition. The carriage

is pinned at the rear (next to the hydraulic actuator unit). The front end may be moved from side to side to adjust the stroke alignment. The adjustment is not made unless the carriage is removed and replaced (4.17.1). Align the new carriage as follows:

1. Remove head assembly 02 or 05 (4.23.4).
2. Install carriage field replacement arm (P/N 2108634) in place of head assembly and tighten in place.
3. Install carriage field replacement ring (P/N 2108633) on spindle.
4. Trip head loading latch so heads will not load and, with detent held out, extend carriage. The carriage field replacement arm should just touch the ring or be not more than 0.004" from it.
5. Tighten securely the four screws mounting the carriage assembly to the base plate.
6. Reposition and bolt the hydraulic actuator to the base plate and the carriage assembly.
7. Replace the remaining components by reversing the removal procedure. Check adjustment step 4 again. Replace head assembly.
8. Make the following checks and adjustments in sequence.
   a. Detent clearance with gear. (See Detent Actuator Replacement, (4.14.3).
   b. Detent Transducer Adjustment (4.18.1).
   c. Cylinder Transducer Adjustment (4.19.1).
   d. Hydraulic Home Adjustment (4-20).
   e. Read/write head alignment to master cylinder 73 (Tracking Adjustment, 4.23.1).
   f. Carriage Alignment Check (4.23.2).

4.17.3 Cylinder Slotted Disk (Wheel) Removal/Replacement

1. Remove top cover and disk top cover shroud.
2. Remove detent arm extension spring and swing detent arm assembly away from detent gear.
3. Remove detent transducer from baseplate and swing it away on its cable.
4. Remove both halves of slotted disk cover.
5. Remove cylinder transducer from baseplate and swing it away on its cable.
6. Manually extend carriage to crash stop.

Caution

Trip head load latch when extending beyond cylinder 0 to prevent loading heads against each other (4.15).

7. Remove slotted disk by removing single nut holding it to the detent and track position shaft. Use 11/16" wrench P/N 2244061 or equivalent (Figure 4-16).

Danger

Be aware of the roll pin located under the detent and track position shaft. Exercise caution to avoid cutting fingers or hand.

8. Return carriage to retracted position.
9. Install new slotted disk, P/N 2180464 (P/N 2181257, model 12) on detent and track position shaft (scribed line facing up). Install nut P/N 2157344 (Figure 4-16) with counterbored side up, but do not tighten down at this time.

Note: On the IBM 2311, Models 1 and 11, the position of the scribed line is unimportant. Steps 10-13 apply only to the model 12. For models 1 and 11, tighten the nut on the detent and track position shaft, and ignore steps 10-13.

10. Manually extend carriage, observing above caution, until scribed mark on detent gear is visible.
11. Line up scribe mark on slotted disk with scribe mark on detent gear.
12. Without disturbing the position of the slotted disk in relation to the detent gear, retract carriage all the way, tighten nut on detent-and-track-position shaft.
13. Re-extend carriage until scribed marks are visible and check that they still line up.
14. Retract carriage all the way and fasten cylinder transducer in place. Tighten screws snug but loose enough to allow transducer to be adjusted later.
15. Replace slotted disk covers.
16. Replace detent transducer. Leave screws loose enough to allow transducer to be adjusted later.
17. Swing detent arm assembly into detent gear and replace detent arm extension spring.
18. Replace disk top cover shroud.
19. Adjust detent transducer (4.18) and cylinder transducer (4.19).
20. Replace top cover, and run appropriate file diagnostic tests.

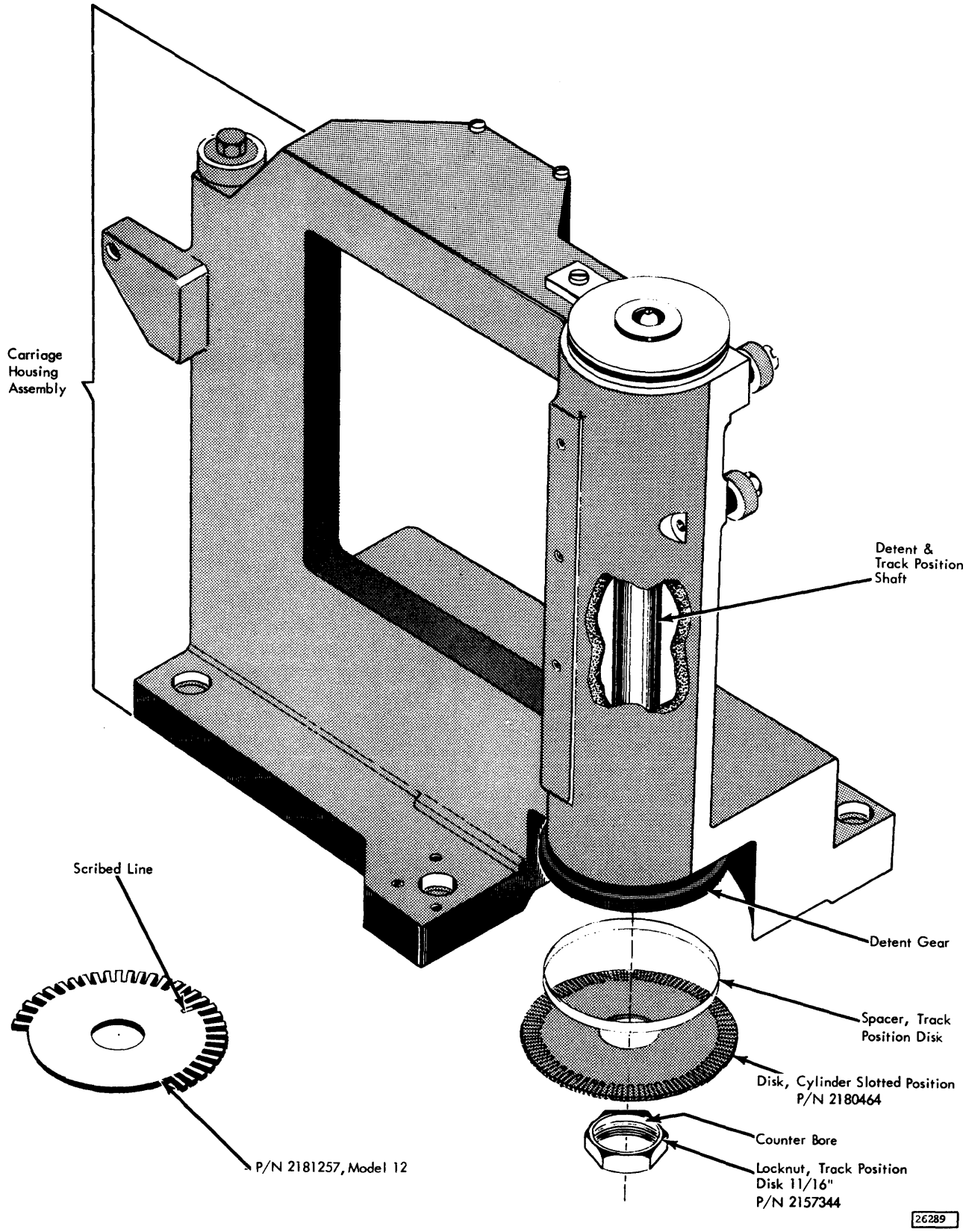


Figure 4-16. Carriage Housing Assembly

4.18 DETENT TRANSDUCER

Two types of mounting hardware are used. One type uses two conical washers under each mounting screw. The screws are tightened at the factory until they make contact with the washer and then are tightened another 1/2 turn. Do not loosen these screws when making adjustments.

A second type of mounting hardware uses two conical washers under the right mounting screw (viewed from the front of the machine) and a flat-washer-lockwasher combination under the left mounting screw. Loosen the screw with this flatwasher-lockwasher combination only when making adjustments.

Screws with conical washers are held in place with a light adhesive. Use care in the event the screws must be removed.

4.18.1 Detent Transducer Adjustment

1. Check the compensation of the scope probe to ensure that its calibration is accurate.
2. Scope L4J12 (detent adjustment test point).
3. Detent arm in detent wheel.

   Note: The detent transducer adjustment is affected by the setting of the +6 volt supply as well as by temperature changes. Before adjusting, make sure the +6 supply equals 6.0 (±0.25) volts and that the room temperature is between 60° and 90° F.

4. Loosen the left hand mounting plate screw if it has a flatwasher and lockwasher. Using a screwdriver tip between the adjustment slot and the pin in the base plate, rotate the transducer pivot plate towards the cylinder transducer as far as possible. Now rotate the pivot plate away from the cylinder transducer until the signal level at L4J12 increases to +2.2v ± 0.3v.
5. To check the adjustment, tighten left-hand mounting screw if it was loosened. Move the detent slightly away from the detent wheel. The signal level should decrease. However, if the signal level increases, the adjustment is incorrect. The incorrect adjustment occurred because the detent pivot plate has been rotated too far from the cylinder transducer block. Readjust, beginning with step 2.
6. To check for excessive wear of the detent gear, and to verify the previous adjustment, do a repetitive one-cylinder seek, from 000 to the maximum addressable cylinder (cylinder 202 on models 1 and 11, and cylinder 102 on the model 12). This operation can be done in one of three ways:
   a. On-line: run diagnostic program F611 if the 2311 is attached to an IBM 2841 Storage Control. If the 2311 is attached to an IBM System/360 Model 20, use diagnostic 2305, routine 6.
   b. Use the CE file test box (P/N 2200012). If the Model 12 is incremented past cylinder 102 using the CE file test box, the drive will hang up at approximately cylinder 110-112.
   c. Manually position and detent the carriage at each cylinder. (See Cautions 4.15.)
7. While scoping L4J12, look for a detent position that exhibits a large variation from the normal adjustment range of 1.9V to 2.5V. This variation, indicating a worn detent gear, could be as high as 3.0V to 3.5V. If a worn detent gear is discovered, the wear may be tolerated if the machine is not malfunctioning and the detent transducer can be adjusted to bring the worn detent gear position within specifications (2.5V) without causing the normal detent gear position to go below the low limit of the adjustment (1.9V). If the preceding conditions cannot be met, and a worn detent gear is causing trouble, the entire carriage assembly must be replaced.

   Note: Occurrences of this type can be minimized by proper lubrication of the detent gear, paying special attention to those areas (cylinders) where accessing is extremely frequent. Refer to the "Preventive Maintenance Schedule" (Figure 3-1) for frequency of lubrication and lubrication procedure.

4.18.2 Detent Transducer Removal and Replacement

1. Remove old block being careful to retain all shims. Be careful when removing screws with conical washers since they are held in place with a light adhesive.
2. Install new block using all shims. Tighten mounting screws with conical washers until screw head makes contact, then tighten another 1/2 turn. Install screws with flat washers.
3. In rare cases, the flag may rub on one of the surfaces in the transducer block slot. Add or remove shims to provide clearance.
4. Adjust detent transducer (4.18.1).

4.19 CYLINDER POSITION TRANSDUCER

Two types of mounting hardware are used. One type uses two conical washers under each mounting screw. The screws are tightened at the factory until they make contact with the washer and then are tightened

another 1/2 turn. Do not loosen these screws when making adjustments.

A second type of mounting hardware uses two conical washers under the right mounting screw (viewed from the front of the machine) and a flatwasher-lockwasher combination under the left mounting screw. Loosen the screw with this flatwasher-lockwasher combination only when making adjustments.

Note: Screws with conical washers are held in place with a light adhesive. Use care in the event the screws must be removed.

4.19.1 Cylinder Transducer Adjustment

1. Check the scope calibration and probe compensation. Monitor the peak-to-peak voltage at test point L4J13 while performing the following steps.
2. With the start/stop switch off, manually position and detent the carriage at approximately cylinder 000.

Note: The cylinder transducer adjustment is affected by the setting of the +6 volt supply as well as by temperature changes. Before adjusting, make sure the +6 supply equals 6.0 (±0.25) volts and that the room temperature is between 60° and 90° F.

3. Allow the scope trace to free-run. Loosen the left-hand mounting plate screw if it has a flat and lockwasher. Rotate the transducer pivot plate away from the detent transducer as far as possible. (Use a screwdriver to pry between the slot in the pivot plate and the rolled pin in the base plate, shown in Figure 4-17.) Next, rotate the pivot plate toward the detent transducer until the signal drops to a minimum and begins to increase. Continue to rotate until the signal amplitude equals approximately 300 mv peak to peak.
4. Do a repetitive one-cylinder seek, incrementing from 000 to the maximum addressable cylinder (cylinder 202 on models 1 and 11, and cylinder 102 on the model 12). This operation can be done in one of three ways:

   a. On line: run diagnostic program F611 if the 2311 is attached to an IBM 2841 Storage Control. If the 2311 is attached to an IBM System/360 Model 20, use diagnostic 2305, routine 6.
   b. Use CE file test box (P/N 2200012).

   Note: If the model 12 is incremented past cylinder 102 using the CE file test box, the drive will hang up at approximately cylinder 110-112.

   c. Manually position and detent the carriage at each cylinder. (See Cautions 4.15.)
5. Sync the scope external plus at L4G02 (+detent in) and note the peak-to-peak voltage at L4J13 while detented at each cylinder (seeking per step 4). Note the cylinder with the largest as well as that with the smallest peak-to-peak voltage. Position and detent the carriage at the cylinder with the smallest peak-to-peak voltage. It is important that the cylinder with the smallest output be used. Record the number of the cylinder with the smallest p-p voltage on the decal provided.

   Note: On newer machines, the number of the smallest-output cylinder is recorded on the decal (P/N 2244025) by the plant.

6. Move the pivot plate towards the detent transducer until the voltage equals 300 mv (±40 mv). Tighten left-hand mounting screw if it was loosened in step 3. The carriage must be detented at the "minimum" cylinder per step 5.
7. Check that the transducer is sensing the proper edge of the slot in the cylinder disk as follows: The signal should decrease slightly when hand pressure is applied to the carriage in a forward direction. If the signal increases, the transducer has been rotated too far toward the detent transducer. This condition can be corrected by repeating the adjustment starting with step 2.

   Another check that must be performed at this point is to verify that the transducer has been adjusted to the cylinder with the lowest output. To do this check, pull the detent arm out of the detent gear, and move the carriage to the two adjacent cylinders lower than the adjustment cylinder and verify that these two cylinder outputs are higher in output than the adjustment cylinder. Then move the carriage to the two adjacent cylinders higher than the adjustment cylinder and verify that these two cylinder outputs are also higher in output than the adjustment cylinder. If each of the four cylinder outputs (two above and two below) are not greater in amplitude than the adjustment cylinder, re-do the adjustments, starting with step 2.
8. Refer to the cylinder which had the largest peak-to-peak voltage while detented (in step 5). Check that the transducer output at this "maximum" cylinder is less than the peak value (maximum undetented) for that transducer. The cylinder transducer should never be at maximum output when the carriage is detented. If it is, either a bent slotted disk or a bent or broken tooth on the detent wheel is indicated (4.17.1 and 4.17.3).

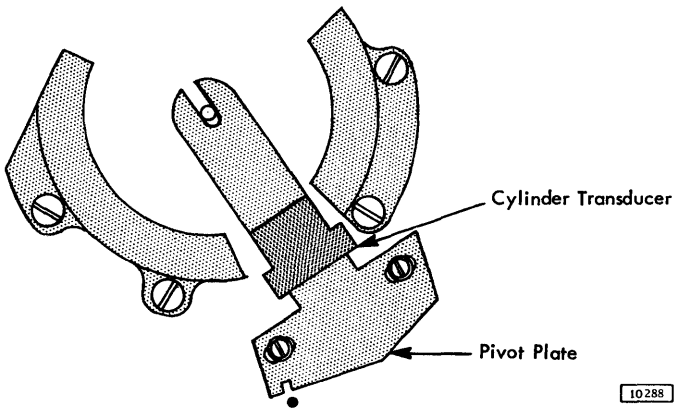


Figure 4-17. Cylinder Transducer

4.19.2 Cylinder Position Transducer Block Replacement

1. Remove old block, being careful to retain all shims.
2. Install new block using all shims.

3. In rare instances, the slotted disk may rub one or the other surface in the transducer block slot. If this condition occurs, add or remove shims as necessary. Also, check for bent slotted disk. Replace if necessary (4.17.3). Tighten each mounting screw until head makes contact with conical washer. Then tighten an additional 1/2 turn. If left mounting screw uses a flatwasher, tighten screw.
4. Adjust cylinder transducer (4.19.1).

4.20 HYDRAULIC HOME ADJUSTMENT

1. Turn the drive motor off.
2. Disable the forward solenoid by removing the wire from terminal #1 at the back of the hydraulic actuator.

3. Turn on the start/stop switch. When the disk pack gets up to speed, the carriage will move forward slowly and stop at hydraulic home (approximately 1 and 1/3 cylinders behind cylinder 000).
4. If the carriage stops at about minus 1-1/3 cylinders, go to step 8. If the carriage is not at minus 1-1/3 cylinders, proceed to step 5.
5. Turn off the start/stop switch and manually access the carriage to about cylinder 200.

Caution
Follow the instructions given under Carriage Manual Accessing (4-15) to prevent head damage during manual positioning of carriage.

Loosen the carriage drive rod clamping plate slightly, so that the carriage drive piston and rod can be rotated within the ball tip, but not enough so the ball tip can move laterally (Figure 4-10).

6. Restore the carriage to the fully retracted position. Turn on the start/stop switch and allow the carriage to extend.
7. Rotate and drive rod so that the cylinder position indicator wheel and pointer show cylinder minus 1-1/3. Tighten the clamping plate.
8. At this point, the cylinder position transducer must be in proper adjustment. If it is not known to be correct, do the adjustment procedure at this time (4.19.1).

Note: Reconnect the forward solenoid in order to seek.

9. With the cylinder transducer in correct adjustment, and the carriage extended to hydraulic home (approximately minus 1-1/3 cylinders), check that the cylinder transducer output at L4J13 is within 20% of its peak output. (The peak occurs between minus 1 and minus 1-2/3 cylinders.) Manually move the carriage very slightly to determine this. If necessary, loosen the drive rod clamping plate and rotate the drive rod slightly to establish this relationship.
10. If carriage drive rod adjustment is changed, read/write head tracking must be checked (4.23.1).

4.21 INDEX TRANSDUCER RADIAL ADJUSTMENT

1. With shroud removed, motor turned off, and with CE disk pack stationary on the spindle, back off the microswitch actuator screw and rotate the CE pack until the clearance between the data disk (surfaces 7 and 8) and the stepped face of the index transducer is at a minimum (Figure 4-18b). At this minimum point, adjust the index block stop screw until the clearance is 0.045" (±0.003").
2. With the index transducer assembly against the stop, turn in the microswitch actuating screw until the switch makes an audible click. Give the screw 1/2 to 3/4 turn more and lock in place.

4.22 READ/WRITE HEADS

4.22.1 Read/Write Head Service Check (Mechanical)

Refer to 4.6.2 for a detailed description of the causes of read/write head damage. Check the read/write heads and disk surfaces for the following conditions:

4.22.1.1 A Series of Scratches or Grooves Across Head

A series of 0.010" spaced grooves across the face of the shoe indicates that the head was used on a disk surface with an embedded particle which may or may not still be present. The presence of these grooves does not necessarily mean a ruined head.

4.22.1.2 Deposit on Heads

The distinctive color of the reddish brown oxide makes it fairly easy to detect. Oxide presence means that oxide is being scraped off a disk surface by head-to-disk interference. Make observations for other symptoms which could pinpoint the specific cause. In any case, clean heads, using preventive maintenance procedures (4.22.2).

4.22.1.3 Audible Tinging from Head-to-Disk Interference

An audible tinging could mean head-to-disk interference, usually in the form of an embedded particle in the disk (4.6.2).

4.22.2 Read/Write Head Cleaning

1. Wrap a lint-free wiper around a paddle and dampen with 91% isopropyl alcohol.
2. Support the back of the read/write head and thoroughly wipe the face of each read/write head with the lint-free wiper dampened with the alcohol. Use the dental mirror to inspect the head surface. Be very sure that all dirt is

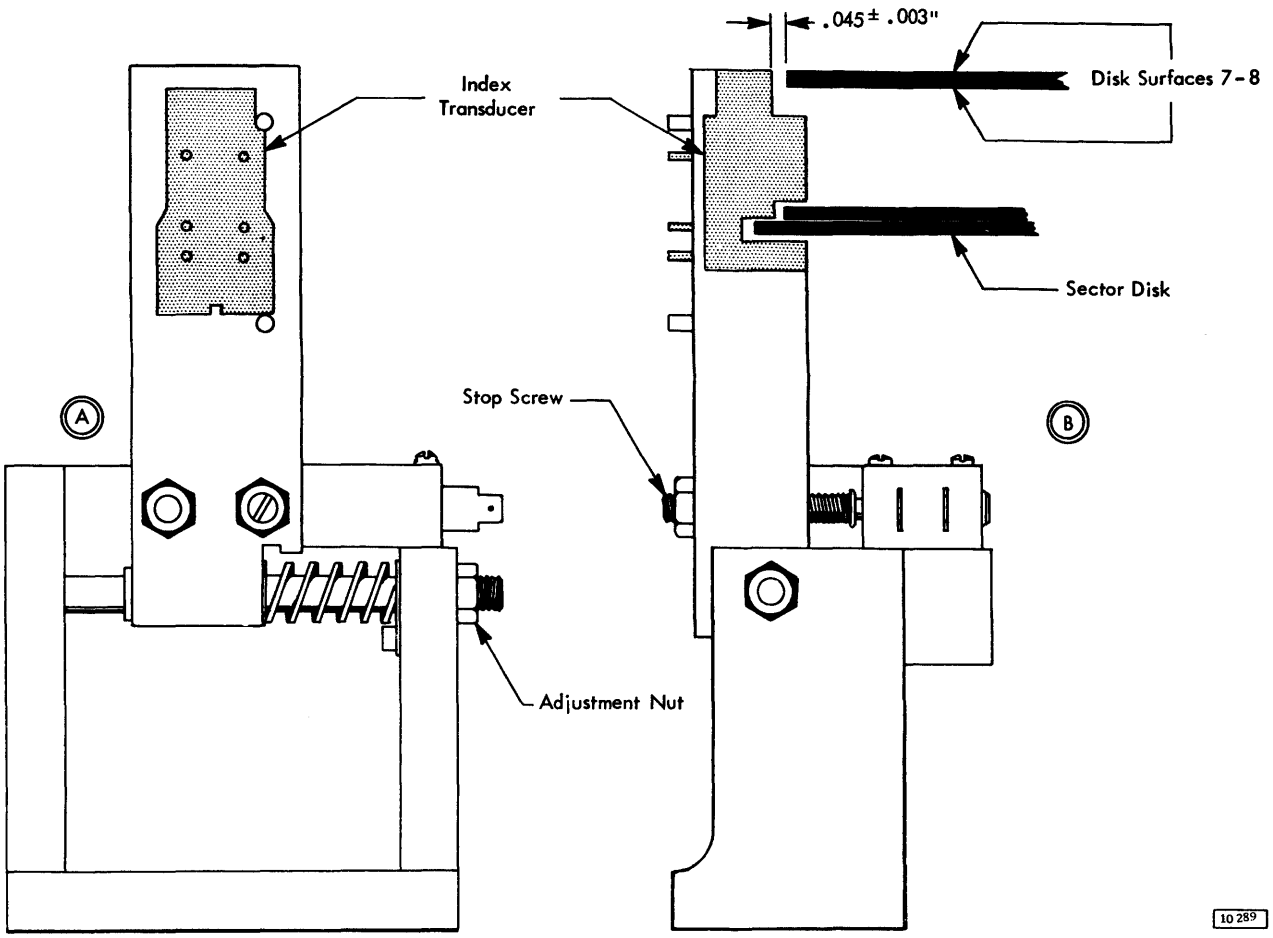


Figure 4-18. Index Assembly

cleaned off. Any extraneous material can build up up dirt and oxide and damage the disks. Finally, wipe head with dry wiper.

Caution

Do not touch the face of the read/write head with your fingers. Acids from the skin can etch and ruin a read/write head.

Do not leave any residue or lint on the face of the read/write head.

Do not blow on heads or disks. Moisture will rust and contaminate the heads.

4.22.3 Read/Write Head Check (Electrical)

Use the following procedure only when data handling failures are experienced. (Also, see 1.1.)

4.22.3.1 Data Collection for the Read/Write Head Check

1. Test equipment required:
   a. Scope and pre-amp with differential input: minimum bandwidth 15 MHz, sensitivity 50 mv/cm. (For example: Tektronix 453, 535, or 555 with CA plug-in unit.)
   b. Shielded direct probes with capacitance of 95 pf or less. (For example: Tektronix P6028 1X 95pf. 1 megohm.)
2. Install CE pack. Turn on 2311 and allow it to become ready.
3. Write 1s on cylinder 199, all tracks (use cylinder 099 on 1/2 capacity model 12). If the 2311 is attached to an IBM 2841 Storage Control, use the non-resident module to write 1s from index to index.

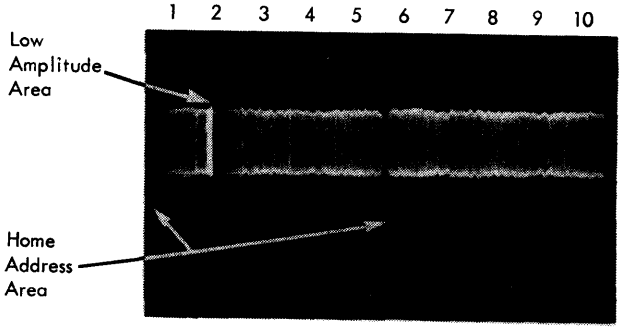
If the 2311 is attached to an IBM System/360 Model 20, use diagnostic MFT 2311 I/O Short to write 1s from index to index.

4. Install CE file test box with 2311 turned off. Turn on 2311 and allow it to become ready. (If the CE file test box is not available, proceed using alternate method listed in following steps.)
5. Set up scope:
   a. Calibrate scope on 50 mv/div. scale.
   b. Sync external on index, delaying sweep (sync minus, at L4B10, -index).
   c. Set time base to 5 ms/div.
   d. Set time base of delayed sweep to 50 μsec/div.
   e. Set vertical sensitivity to 50 mv/div.
   f. Set mode to algebraic add, ac input, with one channel inverted (differential input).
   g. Probe M2G07 and G08 on the 2311 SLT gate.
6. Seek to cylinder 199 (099, Model 12), using CE file test box. (Alternate method: remove top cover, disable cover interlock switch to take 2311 off line, manually pull out the detent and position the carriage at cylinder 199. (See Cautions 4.15.) Seat the detent fully to avoid getting a select lock in the next step.
7. Select head 0, using CE file test box. (Alternate method: install a jumper from the head select AND circuit output, J2 G09, to any D08 pin. (See FD065.) The scope display should now show the read envelope for about 2 revolutions, of track 0, cylinder 199 (099, model 12).
8. Prepare a chart (Figure 4-19) for recording read/write head outputs. This chart will be used later.

Head Number	Average "All Ones" Amplitude of 'Area A'					
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
Date of Check	Installation					

10468A

Figure 4-19. Read/Write Head Check Summary



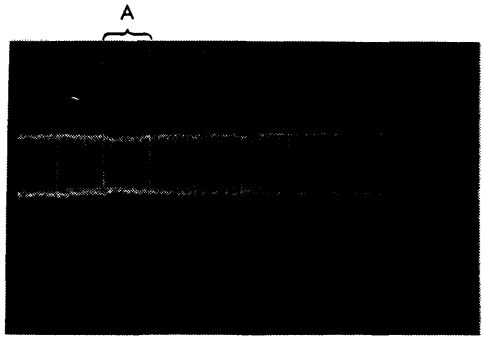
Example: Read envelope showing all 1s amplitude at cylinder 199. Delaying sweep has been positioned over low amplitude area. Scope set-up: 5 ms and 50 mv/div. Delaying sweep 50 μs/div. 26291A

● Figure 4-20. Read Envelope

9. The scope picture should agree approximately with Figure 4-20. Turn the delayed sweep time delay knob until the bright area is positioned over the lowest amplitude area of the trace. Turn on delayed sweep. The scope trace should now approximate Figure 4-21.

   The area labeled 'A' is the lowest amplitude area in Figure 4-21. Area A is a 50-μsec group of read data and clock pulses. It is the average of area A that is to be placed in the table. Using Figure 4-21 as an example, the highest amplitude excursion in area A is approximately 70 mv. The lowest amplitude excursion in the 50-μsec group is approximately 55 mv. Thus the average of this area is approximately 62 mv. Enter this figure in the table.

   It cannot be stressed enough that only the average for area A is desired. One or two smaller excursions can generally be regarded as a disk defect and are not to be regarded as a R/W head problem.



Example: Read envelope of Figure 4-20 with delayed sweep on. This shows the bright area of Figure 4-20 blown up to a scale of 50 μs and 50 mv/div. 26292A

● Figure 4-21. Read Envelope, Expanded

10. Select the next sequential read/write head (step 7) and repeat step 9 for all heads.

4.22.3.2 Read/Write Head Check Chart Analysis

Note: Head output specifications apply after installation of EC 411265. Before installation of EC 411265, head output of all 1s should be 76 mv minimum peak-to-peak.

1. Refer to the table (Figure 4-19) of area A average head outputs obtained from 4.22.3.1, item 8.
2. On all heads, the minimum average head output (as obtained for the table) of an all 1s pattern, on the innermost accessible track, must be at least 51 mv.
3. If one or two heads are below the 51 mv minimum and all others are well above the 51 mv minimum, replace the low-output heads.
4. If three or more heads are below the 51 mv minimum, check the following before replacing any heads:
   a. Read amplifier card at M2 defective. Exchange card to isolate trouble.
   b. Preamplifier defective (located above base plate on rear of actuator). Temporarily remove head select jumper if used. Drop power at SCU and swap preamp card. Turn on power, seek to cylinder 199 (099, model 12), replace head select jumper, and continue.
   c. Scope setup does not meet the requirements established in 4.22.3.1, items 1 and 5.
5. If items 4a and 4b have been eliminated, replace only those low output heads actually causing read errors in customer operation. This should be an extremely rare case.
6. Recheck any replacement head starting in 4.22.3.1 item 2.

Note: If data checks are being experienced, the read data observed at the read amplitude test points M2G07 and M2G08 should be checked. Use the scope setup given in 4.22.3.1, item 5, except for time base, and verify that the following specifications are being met:

a. Clock to data must be 470 ns or less.
b. Clock to clock must be 680 ns or more.

To achieve specifications (a) and (b) preceding, it is necessary that the input and write data to the file from the SCU conform to the following specifications:

a. Single-frequency bit spacing (writing 0s) 800 ns ±10 ns.
b. Double-frequency bit spacing (writing 1s) 400 ns ±10 ns.

4.22.4 When to Replace Read/Write Head

Replace read/write heads for any of the following reasons:

1. The head has collected significantly more oxide than the other heads in the machine (4.22.1.2).
2. Audible tinging occurs on more than one disk pack (4.6.2.2 and 4.22.1.3). A particle is embedded on the face of the head, and it cannot be dislodged by cleaning (4.22.2).
3. Read/write head check shows a low all 1s output (4.22.3).
4. Head is causing read errors even though above items check OK.

4.22.5 Read/Write Head to Base Plate Resistance Check (Figure 4-22)

The ground connection to the read/write head should be checked every 52 weeks, or whenever one of the following occur:

1. Any read/write trouble, whether trouble is located or not.
2. A torsion rod is removed.
3. Removal of any part of the read/write head to base plate resistance path, such as head-arm assembly, torsion spring, torsion rod operating linkages, head latch magnet latch assembly, or wiring to carriage casting.

Follow this procedure:

1. With power off and disk pack off, extend carriage to cylinder 73. Do not trip head load cam latch so that heads partially load.
2. Insert an IBM card between each read/write head so that none of the heads make contact with each other.
3. Continue extending the carriage to track 185 or just before the head load cam latch is tripped.
4. Check the electrical resistance from each read/write head shoe to the base plate. The resistance should not exceed 10 ohms.
5. If the resistance is greater than 10 ohms, check the following elements of the circuit to locate and correct the poor connection:
   a. Head to torsion spring (look for oxidation of the leaf spring at point of contact to the read/write head).

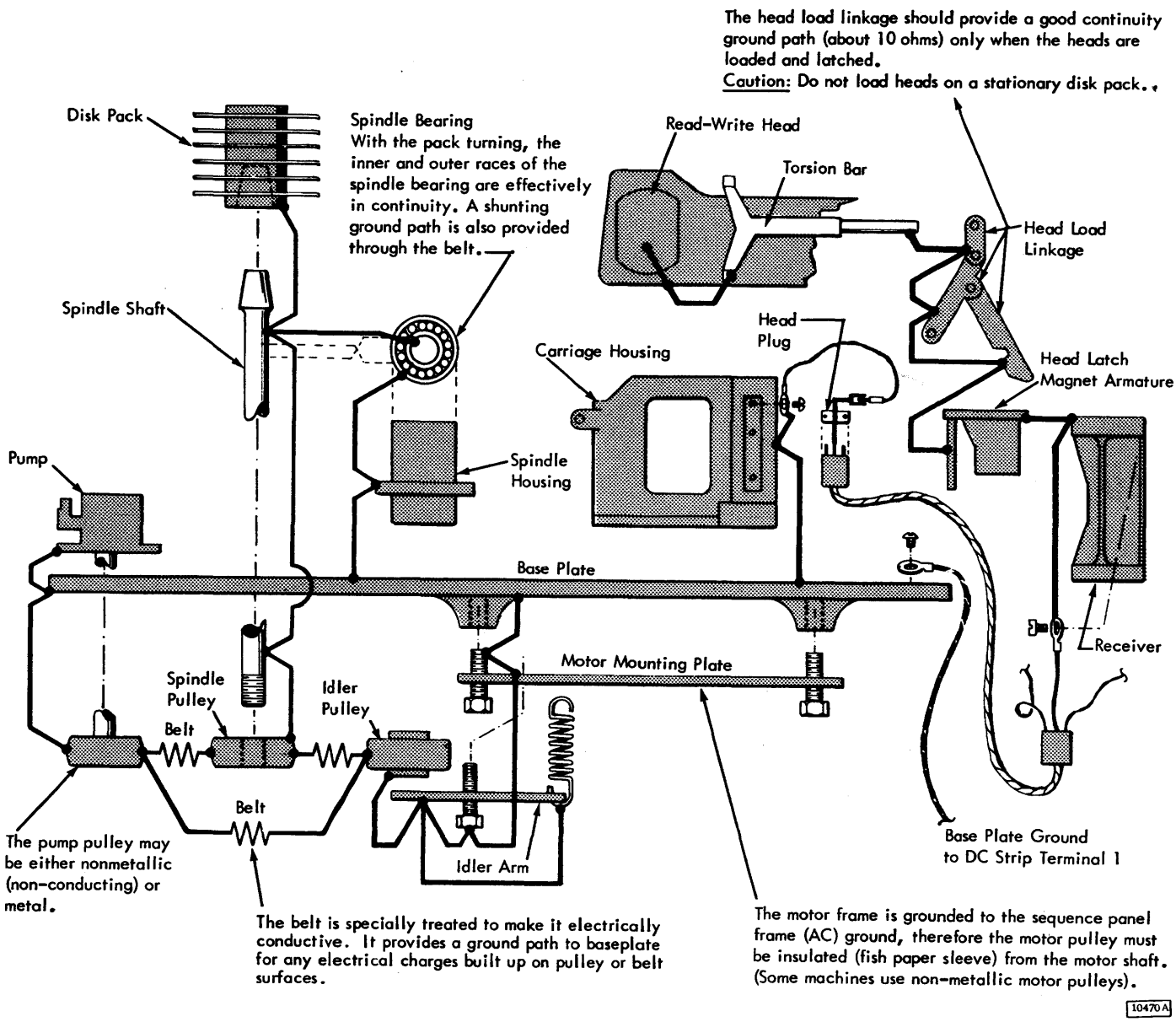


Figure 4-22. Baseplate Grounding System

b. Torsion spring to head load link.
c. Head load latch link to pawl.
d. Pawl to jumper mounting screw to carriage housing.
e. Rear coupler jumper mounting screw to carriage housing (through head latch solenoid cable).

4.23 HEAD/ARM ASSEMBLY

4.23.1 Tracking Adjustment

The tracking adjustment aligns each read/write head to the optimum position to read master cylinder 73 of the CE disk pack. Cylinder 73 of the CE disk pack thus acts as a master gage to which all 2311 machines are aligned. Thus, a record written on the disk pack at one 2311 can be read with proper tracking on any other 2311. The master alignment track is written at the factory to close tolerances. The master cylinder is actually two eccentric cylinders written at different frequencies, on approximately cylinders 72 and 74. The eccentricity is intended to minimize adjustment error introduced by spindle eccentricity.

A CE disk pack with a yellow top must be used on the 2311.

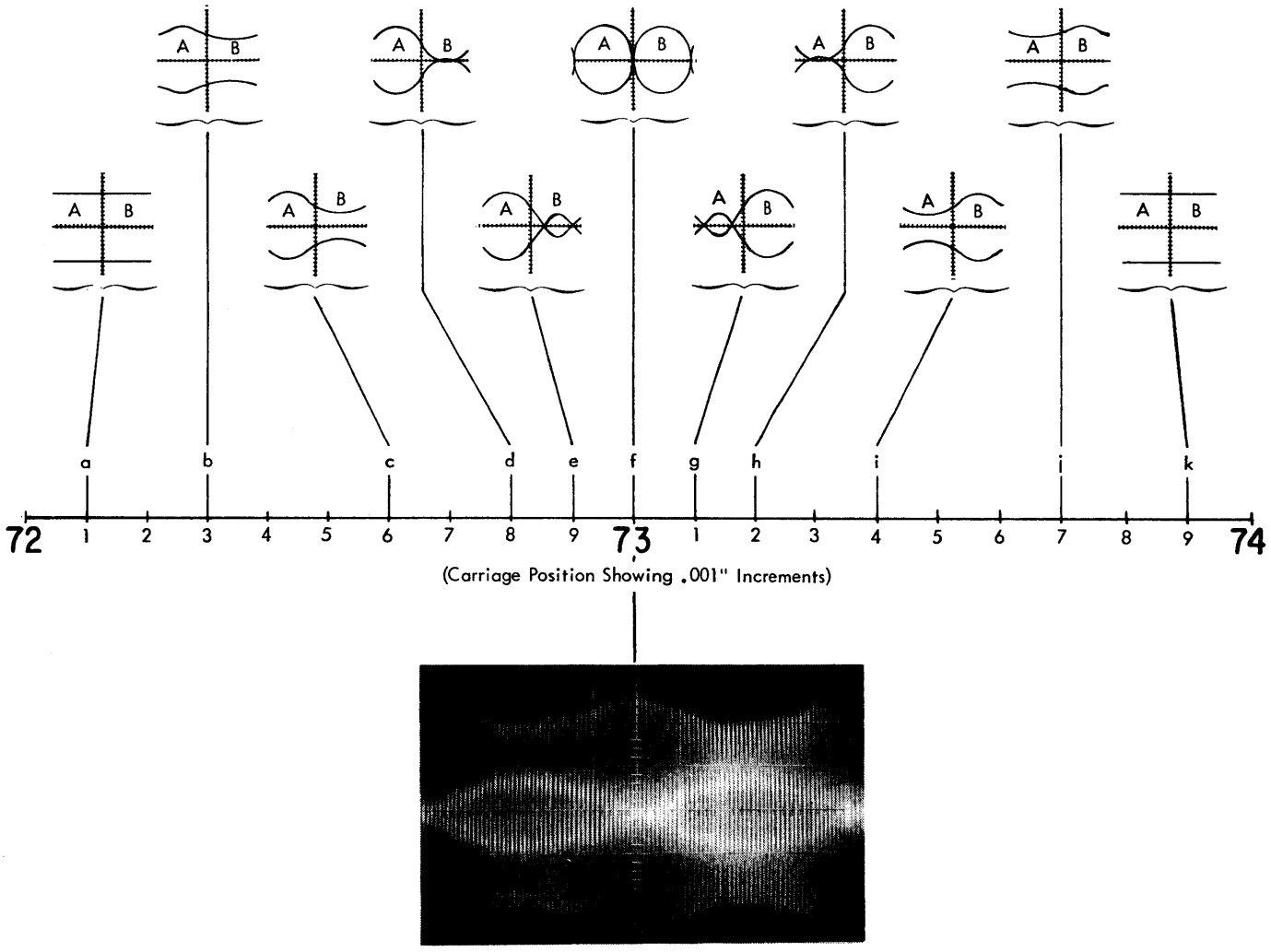
Note: On the 2311, the tunnel erase pole tips define the cylinder location. Therefore, the tracking adjustment is made while reading with the erase head. This is done by plugging the head into an adapter plug (P/N 2108913).

Caution

Do not write on the CE disk pack on cylinders 02, 03, 04, 71, 72, 73, 74, 75, 200, 201, 202.

Before the tracking adjustment is made, the 2311 and the CE disk pack must be in thermal equilibrium. This is done by operating the 2311 with a rotating CE disk pack for 1 hour and 15 minutes with the upper covers on. Then remove the upper covers and allow the 2311 and the CE pack to operate for an additional 20 minutes. At this time the 2311 is in thermal equilibrium and the heads can be adjusted.

Note: If head tracking is checked when the 2311 or disk pack is not in thermal equilibrium, the amplitude of the two lobes (item 7) may differ by as much as 4 to 1 (Figure 4-23). This ratio is equivalent to approximately 0.001" off the center of track 73. A



Note: Small letters "a" through "k" indicate scope displays of read envelope under varying conditions of head tracking between cylinders 72 and 74. Compare the relative amplitudes of lobes A and B. Correct adjustment is shown at "f". Displays "d"-"h" show these approximate proportions; d = 1/0, e = 4/1, f = 1/1, g = 1/4, and h = 0/1.

10291A

Figure 4-23. Beat Frequency Envelope Proportions

lobe amplitude ratio of 4 to 1 (tracking error) normally does not cause read problems. If the ratio of lobe amplitude exceeds 4 to 1 when the 2311 or disk pack is not in thermal equilibrium, proceed with warmup. When thermal equilibrium is reached, perform head tracking adjustments.

1. Install the CE file test box (P/N 2200012) on the 2311. (This step may be omitted if CE file test box is not available.)
2. Install CE disk pack (yellow top only). Turn on the start/stop switch and allow the disk drive to reach thermal equilibrium.
3. Do a seek to cylinder 073 as follows:
   a. Use CE file test box or
   b. Manually position and detent the carriage with the disks rotating and the heads loaded. (See Cautions, 4.15.)

   Caution
   Do not pry with screwdriver between piston and detent arm.

4. Sync the scope external minus at L4 B10 (-L index), set vertical amplifier to 5 mv/cm, and differentially probe M2 G07 and M2 G08 using shielded direct-probe leads. Set the time base to approximately 3 ms/division. (This setting will display slightly more than one revolution of the disk.)
5. Loosen and then snug down all head/arm assembly clamps on the A-side.

   Note: Overtightening clamp screws can deform the clamps, causing extreme difficulty in making the tracking adjustment. Tighten screws holding large clamping plates until plate starts to visibly deflect. Tighten screws holding small clamping plates to a comparable torque (deflection will not be visible).

6. Select head 1.
   a. Install CE head plug adapter in head 1 receptacle; then plug head 1 into the adapter.
   b. Select head 1, using CE file test box, or manually select head 1 by attaching a jumper wire between pin J2 G04 and any D08 pin (Refer to logic FD065 for appropriate head select AND circuit).
7. a. Determine the present position of the head relative to cylinder 073.
   b. Back out the arm backstop screw 1/4 to 1 full turn (approximately 1/3 turn = 0.010" = 1 cylinder), as required to position the head approximately at cylinder 072.

   Caution
   If the arm is moved too far, the torsion bar may slip off the dimple on the back side of the head shoe. This may cause the head to crash.

   c. Move the arm back against the backstop screw.

   Note: The actual adjustment process moves the head toward the spindle. The following may be observed in sequence as the head approaches and passes cylinder 073:
   a. An erased area-no signal (approximately cylinder 071).
   b. An all-bits pattern (approximately cylinder 072).
   c. A repetitive pattern of beat frequency envelopes - see Figure 4-23 (cylinder 073).
   d. An all-bit pattern (approximately cylinder 074).
   e. An erased area-no signal (approximately cylinder 075).

8. a. Slowly turn the backstop screw inward until a pattern of beat frequency envelopes begins to form. As the screw is advanced, the envelope of nulls will come to an absolute null with lobes of greater amplitude between (Figure 4-23). Adjust the backstop screw until the two lobes are equal in amplitude.
   b. Tighten the top head/arm assembly clamp.

   Note: If the clamps are overtightened, the arm may shift out of alignment. Check the adjustment by applying hand pressure to the carriage, first in the forward direction, then in reverse (the detent is still fully seated). Observe that even very slight displacement of the carriage causes a change in the amplitudes of the lobes. Determine that the two lobes are nearly equal in amplitude, with the smaller being at least 90% of the larger. If they are not, loosen the arm clamping screws slightly and repeat steps 7 and 8.

9. a. Plug head 2 into the adapter (still located in head receptacle 1).
   b. Align head 2; then tighten the second lower clamp. At this point, both head/arm assembly 1 clamps are tight, and the upper clamp only is tight on head/arm assembly 2.

10. After head 2 is aligned, recheck the alignment of head 1. If head 1 is still in alignment, proceed.
11. a. Plug head 5 into the adapter.
    b. Align head 5; then tighten head 5 upper clamp (the third clamp from the top).
    c. Recheck the alignment of head 2. If head 2 is still in alignment, proceed.
12. a. Plug head 6 into the adapter.
    b. Align head 6, then tighten head 6 upper clamp (fourth from the top).
    c. Recheck head 5 alignment. If it is still in alignment, proceed.
13. a. Plug head 9 into the adapter.
    b. Align head 9; then tighten head 9 upper and lower clamps.
    c. Recheck the alignment of head 6. If it is still in alignment, all A-side heads are aligned and all A-side head/arm assembly clamps are tight.
14. Select head 3:
    a. Install CE head plug adapter in head 3 receptacle; then plug head 3 into the adapter.
    b. Select head 3 using the CE file test box or manually select head 3 by jumpering pin J2 B10 to any D08 pin.
15. a. Loosen, then snug down, all B-side head/arm assembly clamps.
    b. Repeat steps 6 through 13 for all B-side heads using head receptacle 3.

    Note: Some head/arm assembly clamps hold two assemblies. When a single head/arm assembly is replaced, check alignment of adjacent heads.

4.23.2 Carriage Alignment Check

1. Install the CE file test box on the 2311. (This step may be omitted if CE box is not available.)
2. Install the CE disk pack (yellow trim shield). Turn on the start/stop switch and allow heads to load.
3. Do a seek to cylinder 003 as follows:
    a. Use the CE file test box or
    b. Manually position and detent the carriage with the disks rotating and the heads loaded.

    Caution
    Do not pry with screwdriver between piston and detent arm.

4. Sync the scope external minus at L4 B10 (-index) and probe M2 G07 and M2 G08 differentially.
5. Select head 0 (or head 9).
    a. Install CE head plug adapter in head 0 receptacle, then plug head 0 into the adapter.
    b. Select head 0 using CE file test box or manually select head 0 by attaching a jumper wire between pin J2 G09 and any D08 pin. (Refer to FD065 for appropriate head select AND circuit.)
6. Record the time between index and the data burst at cylinder 03 (approximately 48 μsec).
7. Seek to cylinder 201 (step 3), and record the time between index and the data burst.
8. Repeat steps 5 through 7 using head 9 instead of head 0.
9. The carriage stroke is properly aligned if the time recorded for head 0 cylinder 003 is within 4 μsec of the time recorded for head 0 cylinder 201. The same requirement must be met on head 9. If the time difference on either head exceeds 4 μsec, repeat alignment procedure (4.17.2).

4.23.3 Index Transducer Circumferential Adjustment and Head Seating Check

The index transducer is adjusted circumferentially while observing the pulse burst on cylinder 003 of the CE disk pack, monitoring all read/write heads.

1. Install the CE file test box on the 2311. (This step may be omitted if the CE file test box is not available.)
2. Install the CE disk pack (yellow trim shield). Turn on the start/stop switch and allow the heads to load.
3. Seek the cylinder 003 as follows:
    a. Use CE file test box or
    b. Manually position and detent the carriage with the disks rotating and the heads loaded (see Cautions, 4.15).

    Caution
    Do not pry with the screwdriver between piston and detent arm.

4. Select head 0 as follows:
    a. Use CE file test box or
    b. Manually select the desired head by grounding the output pin of the appropriate head select circuit, for example: Head 0, J2 G09 (refer to FD065).
5. Sync the scope external minus at L4 B10 (-index) and probe M2 G07 and M2 G08 differentially. Set the time base to 5 μsec/div.
6. Record the time between the index pulse and the data burst for head 0.
7. Select each of the remaining heads 1-9 in turn (step 4) and record the time between index and the data burst for heads 1-9.

8. The head/arm assemblies are properly seated if the range of times recorded for all heads does not exceed 8 μsec. Any head falling outside of this range should be reseated and/or replaced.

   Caution
   Remove head select jumper before turning power off or on to prevent accidentally erasing the CE disk pack.

9. Select and monitor each of the two heads whose times (step 8) were found to be at the extremes of the range. Position the index transducer circumferentially by turning the nut on the end of the pivot shaft (Figure 4-17) until the peak of the first pulse in the data burst on each of these two heads appears 16 to 24 μsec after the leading edge of the index pulse. The times on all heads should now fall within this range.

4.23.4 Head/Arm Assembly Removal and Replacement (Figure 4-24)

Caution
Do not touch the faces of the read/write heads. Acids from the skin can etch and ruin the faces.

1. With the disk pack removed, loosen the two screws that clamp the head/arm assembly.
2. Unplug connector associated with read/write head to be removed.
3. Pull read/write head/arm assembly straight out, being careful not to damage the torsion bars.
4. Install new read/write head/arm assembly, pushing it back against the adjustable stop screw. This procedure aligns the head very closely to the correct radial cylinder position. Be sure that torsion rod slides between stiffener and leaf spring and that the torsion spring is resting on the dimple on the arm assembly.
5. Align the read/write heads to cylinder 73 (4.23.1) and make the alignment check (4.23.2); adjust as needed.

4.24 TORSION ROD REPLACEMENT AND ADJUSTMENT

Caution
Use care in removing the torsion rod to avoid scratching the read/write head surface. Never attempt to form a torsion rod.

Lubricate the new rod with IBM #20 (Figure 4-25). With the head arm assembly removed, use a plier P/N 460966 (Branch Office tool) to adjust the retaining clips (Figure 4-25).

4.25 COVER AND SWITCH ADJUSTMENTS

4.25.1 Cover Adjustments

1. Place the top cover assembly with covers closed in a vertical position on a flat surface. Loosen the screws mounting the hinges to the cover. With the back edge of the cover and the top cover assembly resting on the flat surface, both covers are aligned front to rear.
2. Align the left side of the left cover with the left side of the top cover assembly and tighten screws.
3. Align the right side of the right cover with the top cover assembly and tighten screws.
4. Check that the stay braces do not rub the sides of their openings during the closing of the cover. A clearance of approximately 3/32" should exist on both sides of the stay braces.

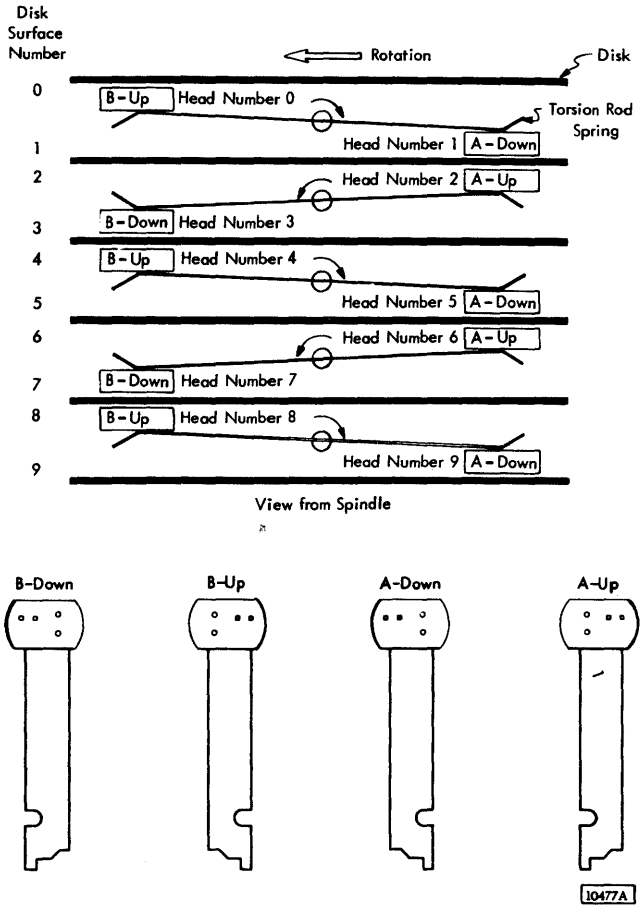


Figure 4-24. Read/Write Head Identification

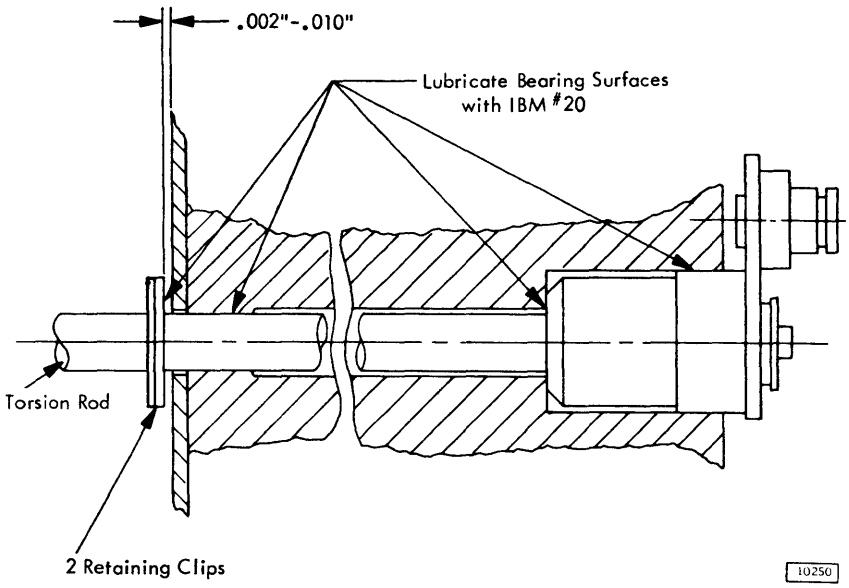


Figure 4-25. Torsion Rod Adjustment

4.25.2 Index Block Retract Mechanism Adjustment

1. With the right cover closed and the left cover open, adjust the paddle (Figure 4-26) to obtain 0.031" minimum clearance between the paddle and the retract roller.
2. With the right cover closed, set dimension B so that when the right cover is opened Point A is flush with or behind the inside radius of the shroud.

4.25.3 CE Switch Adjustment

With the covers on the machine, open the left hinged cover, loosen the switch actuator (on the cover) and insert a 0.030" thickness gage between the actuator and the switch plunger. Push downward on the actuator until the switch plunger is bottomed. Lock the actuator in place and remove the thickness gage. This adjustment assures that the switch makes with an overtravel of 0.030 to 0.060".

4.26 BASE PLATE GROUND SERVICE CHECK

A check for lack of continuity between base plate and frame ground or base plate and dc ground can be made by either of two methods (Figure 4-22):

1. With power off, disconnect ground lead on top of baseplate at A side head cable connector and check for a minimum of 2 megohms between baseplate and machine frame or baseplate and dc ground. Reconnect ground lead.
2. With power off at the control unit, disconnect all interconnecting cables at the 2311. Check for a minimum of 2 megohms between base plate and machine frame.

SECTION 2. FEATURES

The differences in adjustments on the 2311 model 11 and 12 are noted along with the basic adjustments.

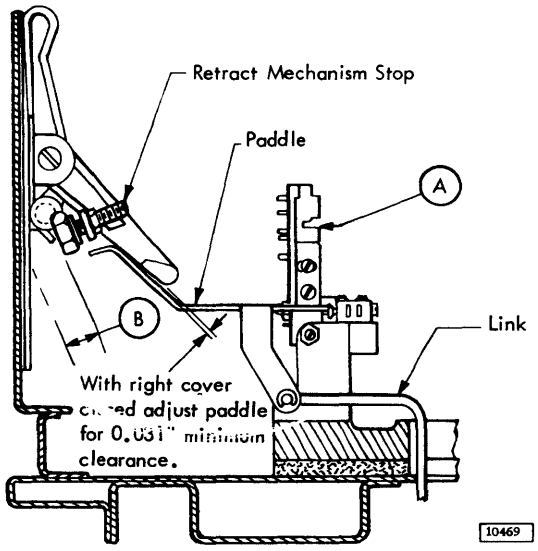


Figure 4-26. Sector Block Retract Mechanism Adjustment

SECTION 1. BASIC UNIT

5.1 POWER REQUIREMENTS

AC Input Supply Voltages

Voltage	Tolerance	Phase	Freq. Hz
*208	±10%	Single	60 ±1/2
*230	±10%	Single	60 ±1/2
*195Δ	±10%		50 ±1/2
*220Δ	±10%		50 ±1/2
*235Δ	±10%		50 ±1/2
*220/238Y	±10%		50 ±1/2

*One voltage only is required to drive the motor on the file. The 50 Hz machines can be operated on Δ or Y Systems. See installation procedure.

DC Input Supply Voltages (from SCU)

Voltage	Tolerance
-36	±4.0%
+6	±4.0%
+3	±4.0%
-3	±4.0%

DC Internal Supply Voltages

Voltage	Tolerance
+36	±8%

NOTE: The DC voltage tolerances include regulation and ripple and are measured at the voltage bus assembly of each 2311 gate.

5.2 FUSING

Types and ratings of fuses are listed on the fuse chart located in the systems diagrams accompanying each machine (FD117.)

5.3 POWER SEQUENCING

5.3.1 Power Up

Before ac or controlled ground is applied to the file, the CPU must be in "Halt" and dc must be within rated tolerance.

5.3.2 Power Down

Controlled ground must be dropped before AC and DC are removed from the file.

SECTION 2. FEATURES

Model 11 and model 12 require minor changes to to the power supply as noted on ALD pages FD111 (2 sheets), and FD115.

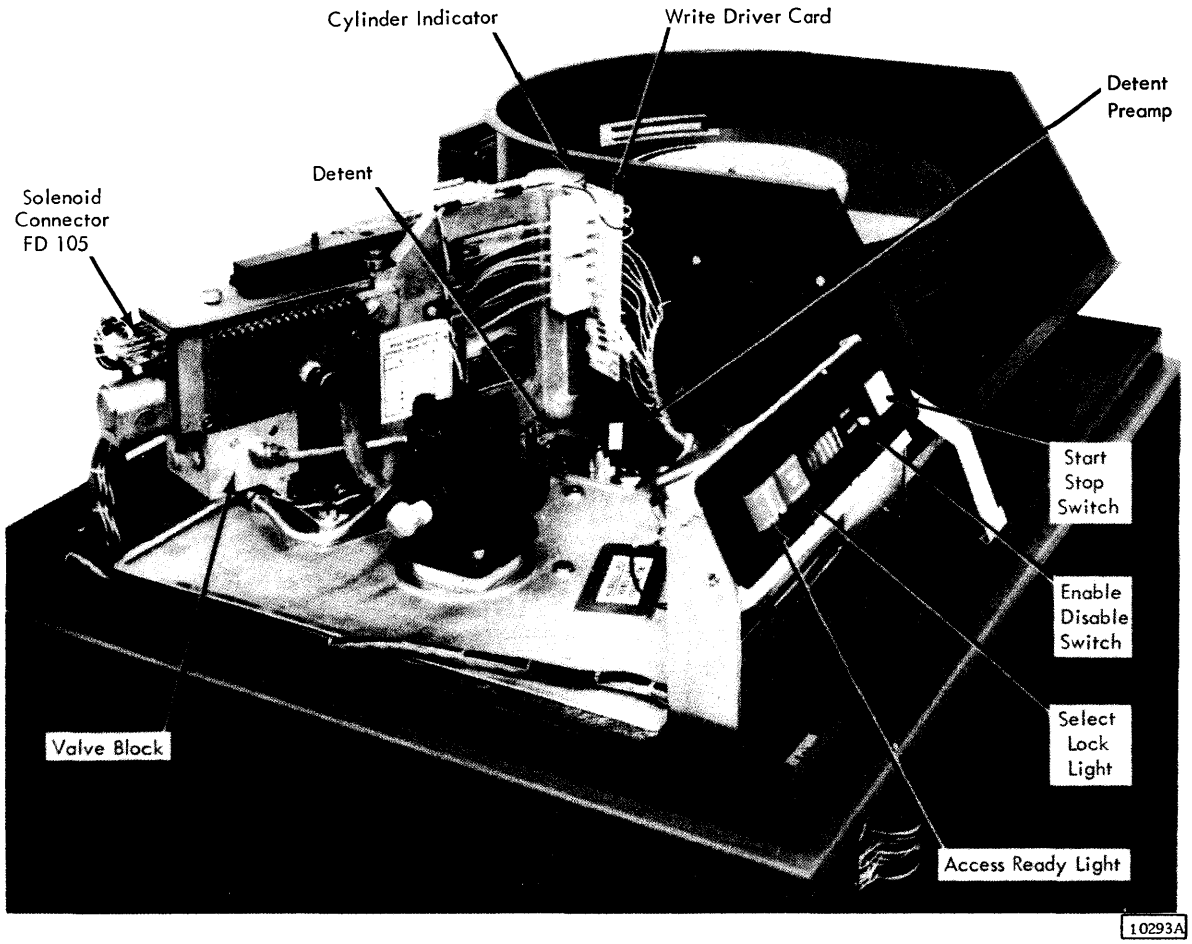


Figure 6-1. Hydraulic Mechanism, Front View

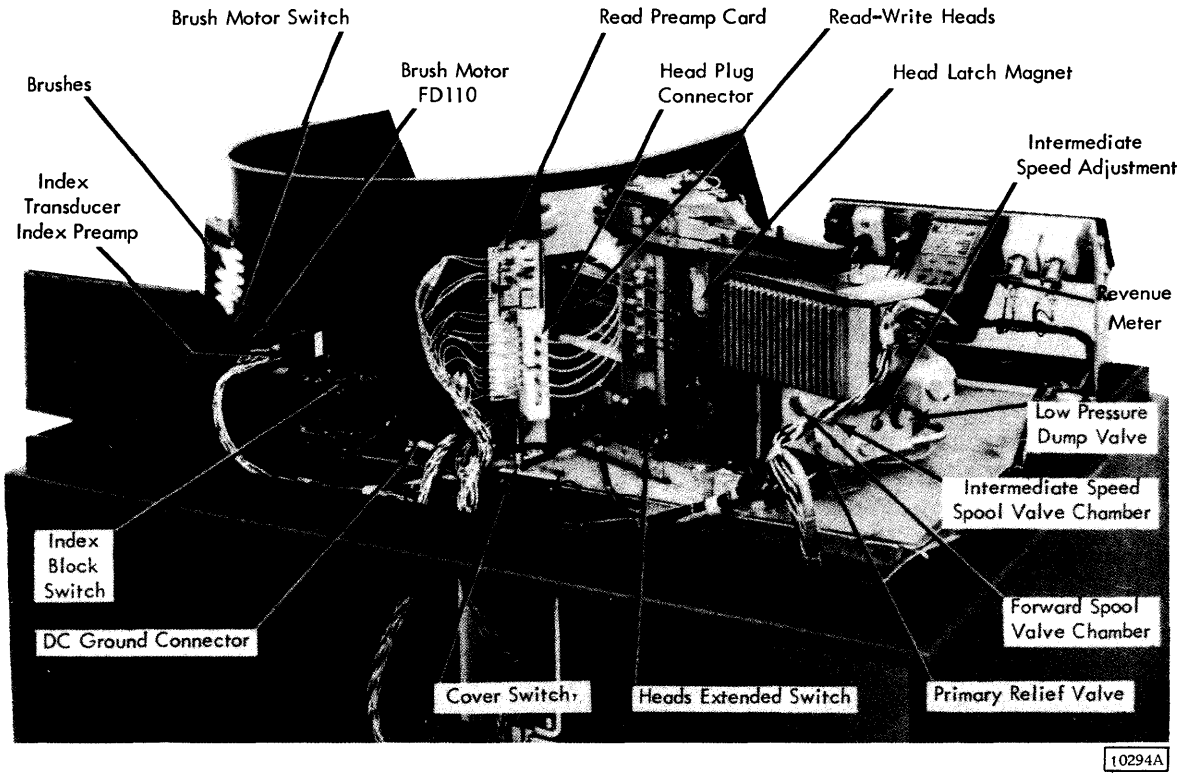
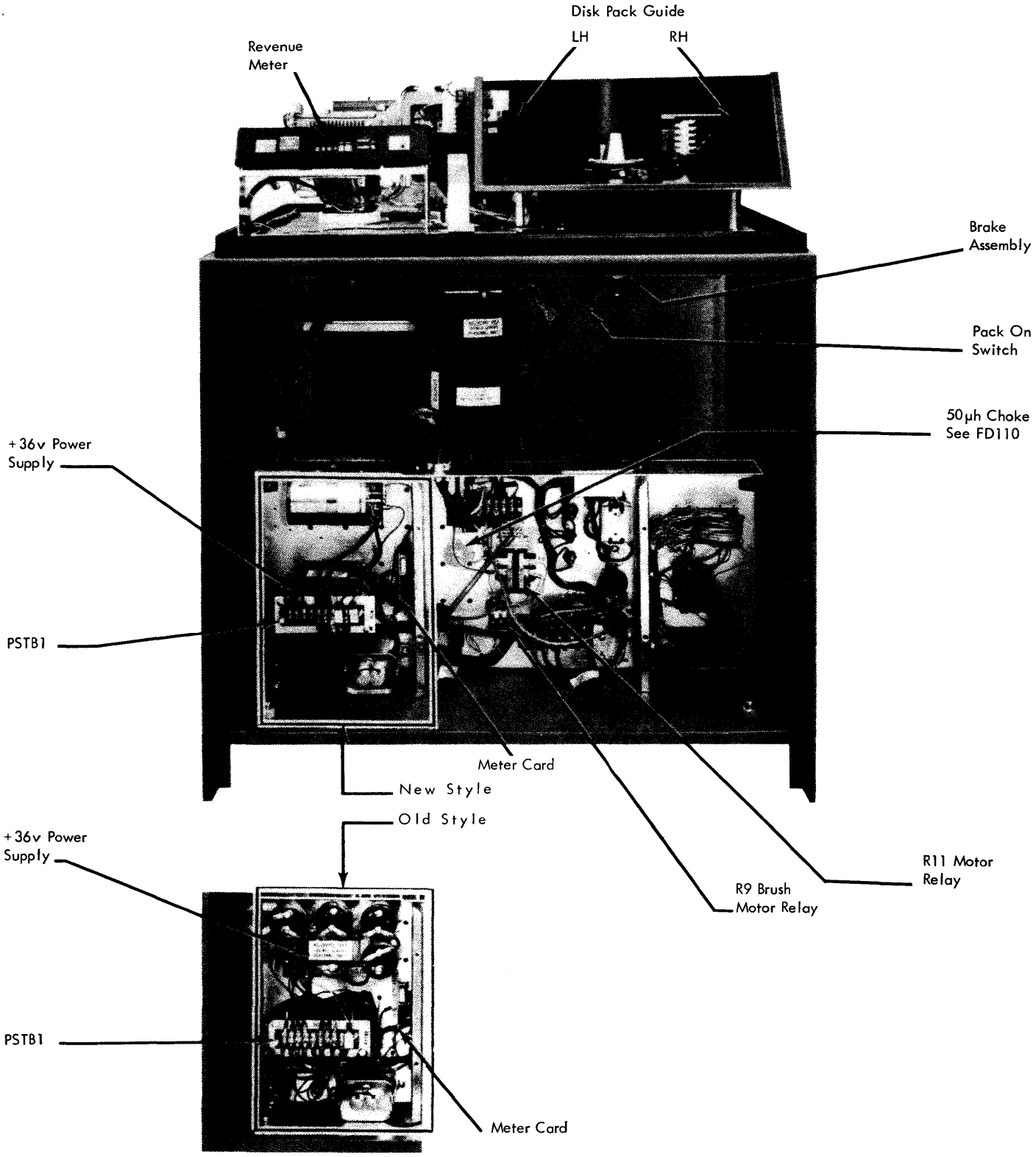


Figure 6-2. Hydraulic Mechanism, Rear View


Disk Pack Guide
LH
RH
Revenue Meter
Brake Assembly
Pack On Switch
50µh Choke See FD110
+36v Power Supply
PSTB1
Meter Card
New Style
Old Style
+36v Power Supply
R11 Motor Relay
R9 Brush Motor Relay
PSTB1
Meter Card

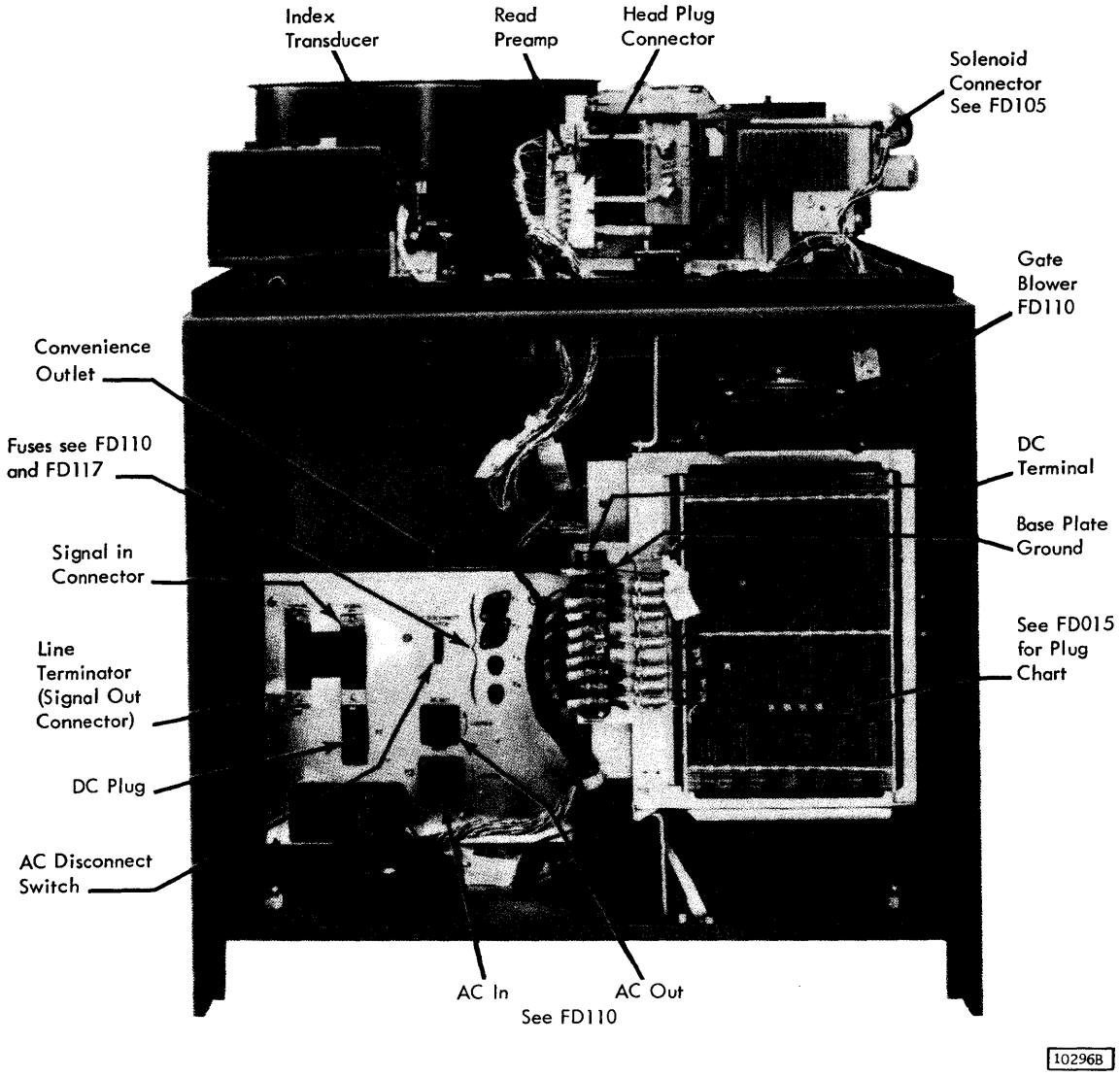


Figure 6-4. Rear View of 2311

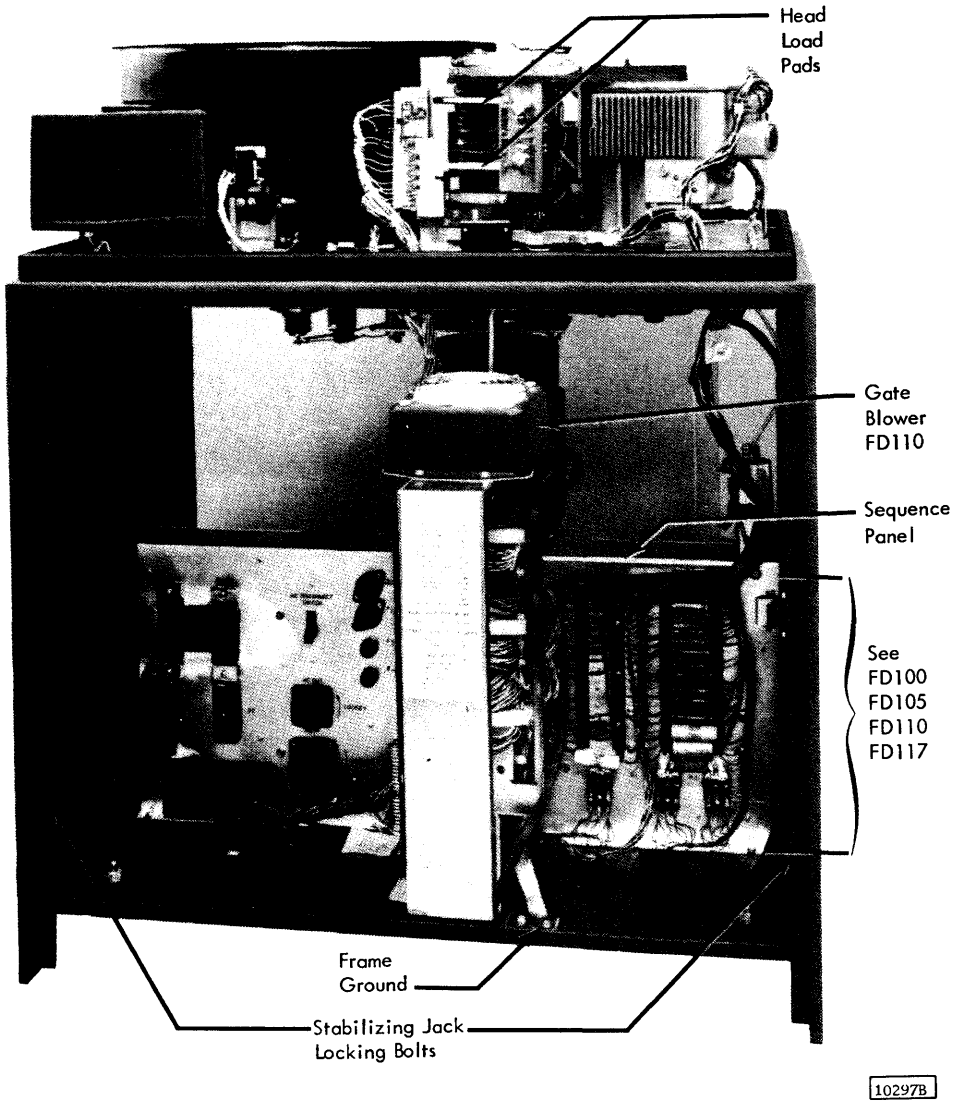


Figure 6-5. Rear View of 2311, SLT Gate Open

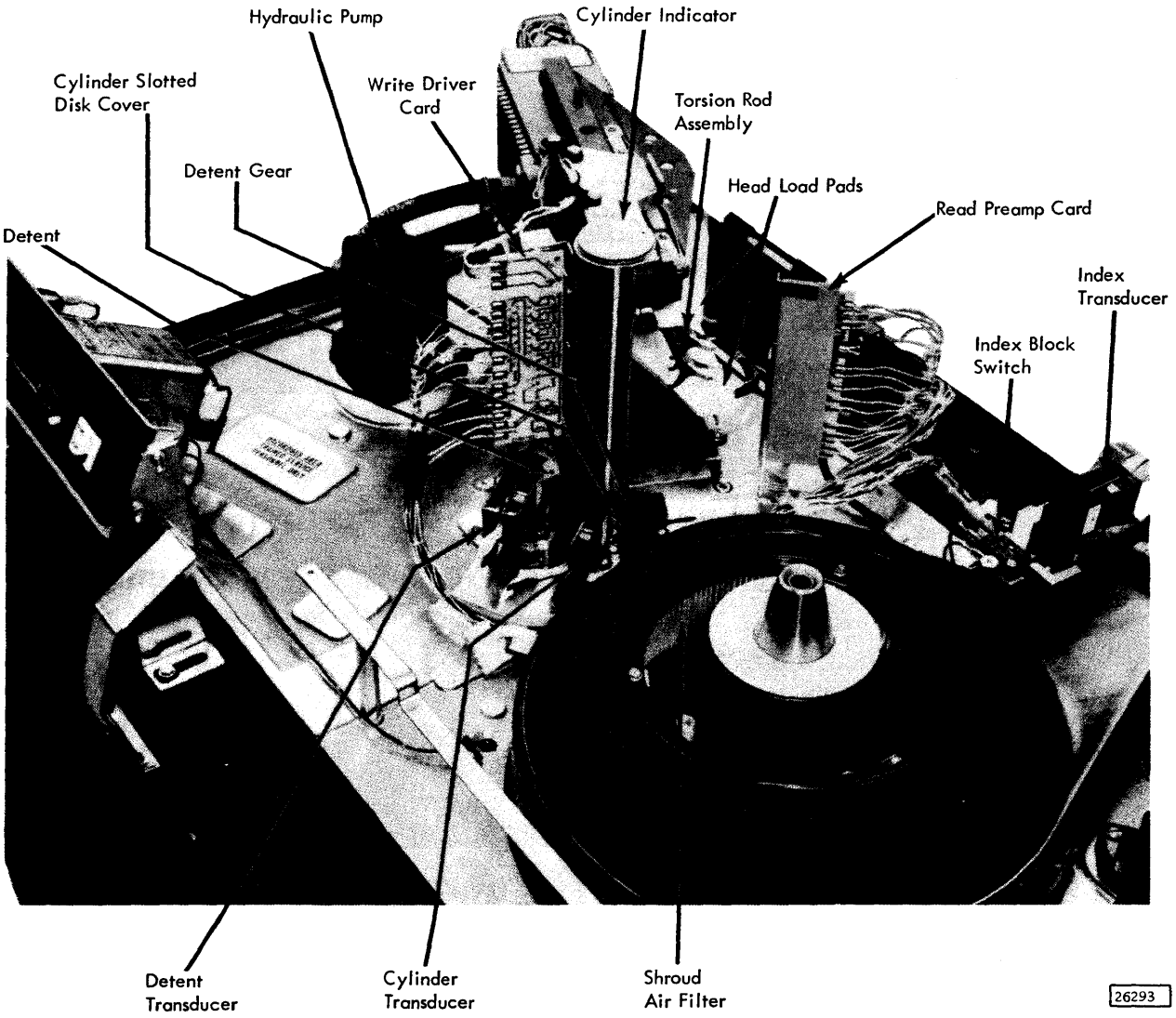


Figure 6-6. Top View of 2311, R/W Heads and Shroud Removed

SPECIAL CIRCUITS

Information on the following special circuits is found in this Appendix: read preamplifier and write driver circuits, ten sector generator, ac unsafe, dc unsafe, and ac write I unsafe.

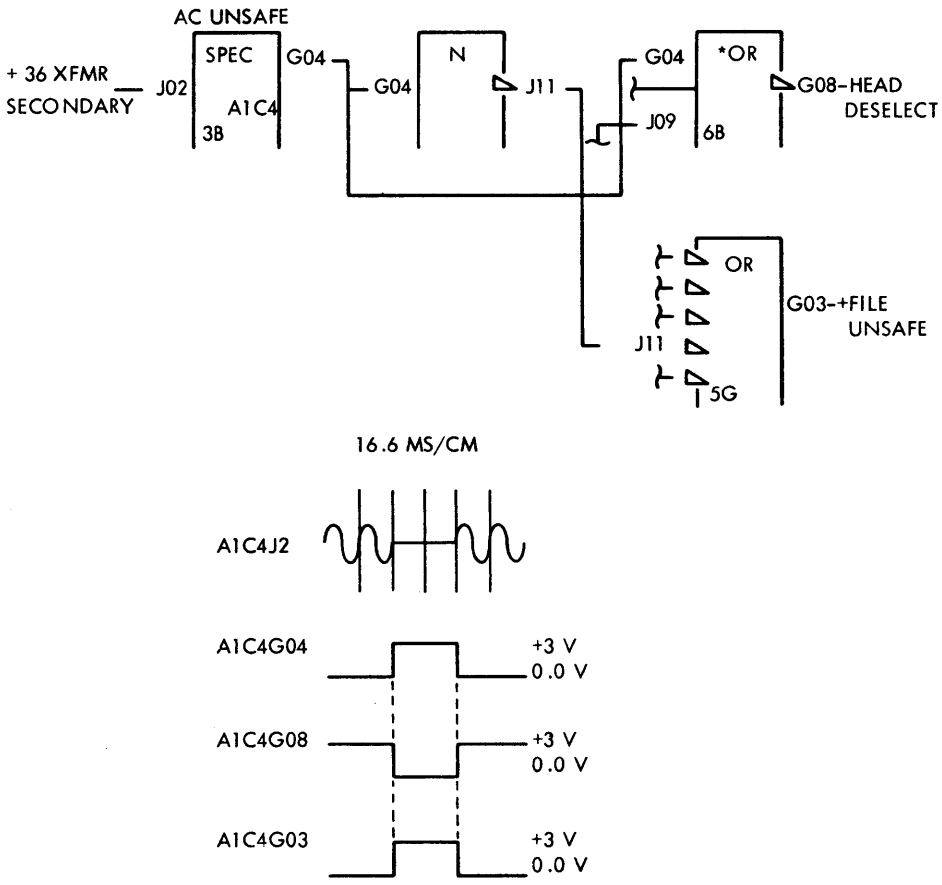
For additional information on the following circuits, refer to the maintenance diagram listed.

Transducer circuits	Diagram 502
Read circuits	Diagram 506
Write circuits	Diagram 507
Safety circuits	Diagram 508
X-Y recordings:	
Transducers	Diagram 801
Read Amplifier	Diagram 802
Write Amplifier	Diagram 803

The 2311 read preamplifier circuit diagram (P/N 2181223) and write driver circuit diagram (P/N 2181068) are located in the 2311 MDMs. The 2311 MDMs are in Volume 7 of the 2841 system manuals. The 2311 MDMs on the System/360 Model 20 are located with the system diagrams. The volume is labeled 2311 MDM.

The ten-sector generator used on the model 11 and 12 provides ten 'selected sector' pulses to the SCU (FD057). The inputs to the ten-sector generator are the 20 'sector pulses' and 'index'. The first 'selected sector' pulse appears in conjunction with the second 'sector pulse' after index, and with every even 'sector pulse' after index, and with every even 'sector pulse' thereafter.

AC UNSAFE (FD090)

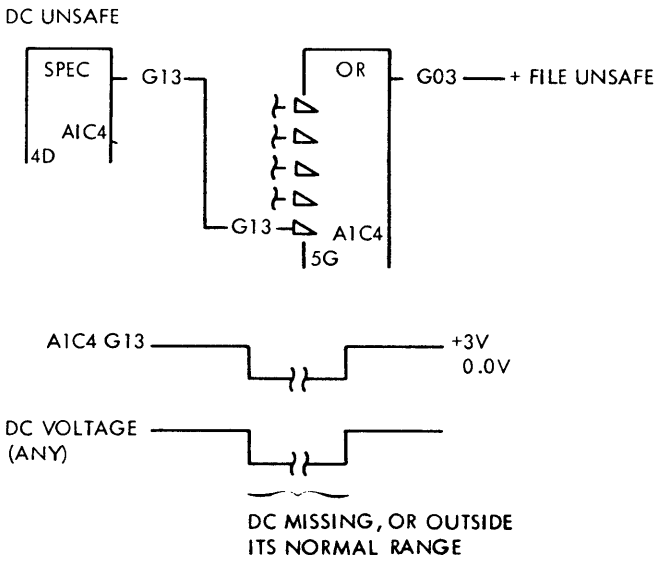


Momentary lack of ac at the 2311, while the 2311 is not being used, is not detected by the SCU. Momentary lack of ac while the 2311 is in use may or may not be detected because 'file unsafe' is only tested at specific times by the SCU. If the momentary lack of ac occurs during the actual reading of a track, it causes data checks. If the lack of ac occurs during writing, the 'ac write unsafe gate' circuit will be conditioned and cause the 'write unsafe gate' to latch back. During the period of time that 'file unsafe' is active, the 'select lock' lamp is on.

26294

Figure A-1. AC Unsafe Circuit.

DC UNSAFE (FD 090)

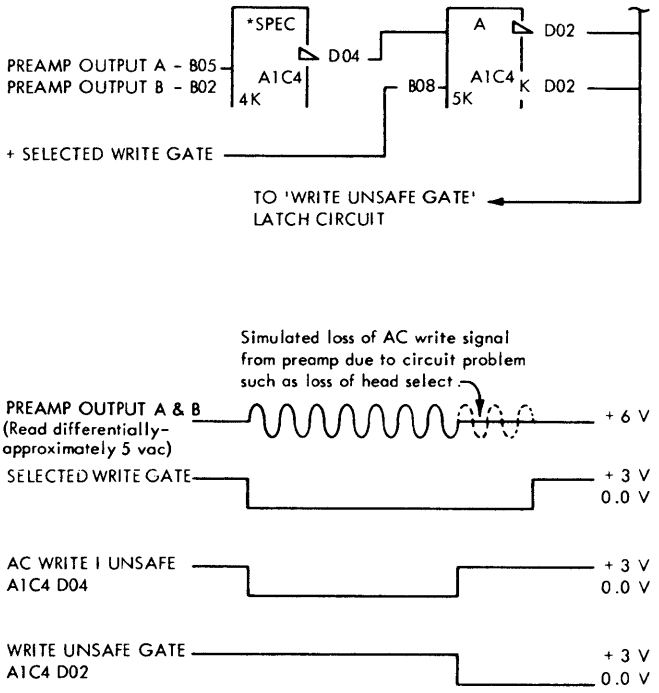


All DC in the 2311 is sampled by the DC unsafe circuit. If any DC voltage exceeds its specified range, the circuit is activated. This circuit does not latch back. As soon as the DC voltage activating the circuit returns to normal, the 'file unsafe' line returns to normal, and the select lock light goes out.

26295

Figure A-2. DC Unsafe Circuit

AC WRITE CURRENT UNSAFE



The ac write I unsafe circuit is basically an echo check circuit utilizing the read preamp (not gated at this point) to drive a special circuit. The write circuits cause a large ac signal at the write frequency to appear at the output of the read preamp. This ac signal, 5-6 vac at a plus 6v level, causes the output pin D04 (4K-FD090) to go to a 0.0v (<0.3v) level. In the wave forms shown above, the loss of this ac signal is simulated, causing the output pin D04 to go plus before 'selected write gate' falls. Pin D04 going plus while 'selected write gate' is still plus allows the output pin D02 to go minus setting 'AC write unsafe gate'. 'AC write unsafe gate' is a latch-back circuit preventing further operation until the select lock is reset.

26296

Figure A-3. AC Write Current Unsafe

APPENDIX B. WORLD TRADE

World Trade differences are described in the appropriate sections.

INDEX

FE System Maintenance Library

System

cut here

IBM Form 59831-5
Y26-5923-5

IBM 2911

IBM Form 59831-5
US Form Y26-5923-5

Printed in Germany

IBM
International Business Machines Corporation
Field Engineering Division
112 East Post Road, White Plains, N.Y. 10601