

IBM

Field Engineering

Maintenance Manual

1301 Disk Storage

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Field Engineering Maintenance Manual

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1301

Disk Storage

This manual is a major revision updating the previous edition, Form 227-5581-4 to Form 227-5581-5. Previous editions of this manual are made obsolete by this revision.

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SAFETY

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

Use caution when working around moving parts of the machine. Parts of the body or clothing near the machine can cause accidents if the machine starts unexpectedly. These accidents can be prevented.

Potential difference within the power contactor gate is -48 vdc to 208 vac. Potential difference within electronic gates, printed cards, and display back panel is -48 vdc to +36 vdc. Do not remove or replace circuit cards when dc power is on.

Do not short out or bypass safety features. One such item is the access cover door safety switch. Do not allow the access to run with this door open by manually energizing this cover safety switch. Also note that, although the actuator is electronically interlocked with this door open, if for any reason the solenoid dc power goes off the actuator will attempt to move under hydraulic pressure.

Access Mechanism

Because of the random and sometimes unpredictable motion of the access mechanism, it should be serviced with caution. Shields and guards have been provided and can only be of assistance when firmly in place.

Care should be taken to remove access assembly according to outlined procedures. Two men must be available to handle this unit as it weighs approximately 60 pounds and the mounting screws are accessible only from the rear of the supporting strut.

Power Supplies

When a dc failure is sensed, a dc off sequence is initiated, but power remains on at the gate blowers, convenience outlets, and disk drive motor. Do not depend on this feature as safety protection.

Always use fuse pullers to remove or insert fuses. Replace plastic protective covers over fuses immediately after replacing fuse.

The power supplies are heavy and should be removed 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 only isopropyl alcohol that is to be used for cleaning 1301 Read/Write heads and disks is 91%

isopropyl alcohol, P/N 2155966. (Five plastic bottles packed in a reuseable container). Alcohol is a flammable liquid. Keep only the quantity needed for impending use in the customer's office.

Keep the bottle containing the isopropyl alcohol in the sealed metal container except when in use. Replace the bottle in the container and reseal the lid whenever it is stored between usages.

Comply with appropriate regulations for flammable liquids when shipping 91% isopropyl alcohol.

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.

Power On States

Before the file is brought up to running condition from the power sequence panel, it may exist in one of several states of power on. In all cases, the following assumptions are made:

1. The file is plugged into the wall.
2. The wall plug is at the specified potential.
3. An external source of 24 vac is applied to the file (Emergency Off Power).

Mainline (70 amp C. B.) switch is off.

1. 208-230 volts ac is present at:
 - a. input and output of mainline filter.
 - b. input to the mainline switch.
2. 24 volts ac is present at the coil of K-1.

Mainline switch and CB-2 (30 amp C. B.) on.

1. 208-230 vac is present at:
 - a. input and output of mainline filter.
 - b. input and output of mainline switch.
 - c. input and output of CB-2 and K-1.
 - d. input to K-2, K-3, K-4, T1.
2. 110 vac is present at:
 - a. convenience outlet.
 - b. TB204, TB203, T1.
3. 24 vac is present at:
 - a. coil of K-1.
 - b. TB204, T1.
 - c. power sequence panel.

When working in these areas, remove the input power cord or turn off ac power at customer's wall switch.

INSTALLATION INSTRUCTIONS

1. Remove packing material as specified in unpacking instructions. Do not install drawers.
2. Inspect machine for shipping damage especially in the power contactor box, hydraulic power supply, and SMS gates.
3. Check input voltage. The 1301 is factory wired for 208 vac input. If 230 vac Operation is desired, complete the following:
 - a. Remove cable wire from Bulk transformer terminal 4 and install on terminal 5.
 - b. Remove cable wire from service transformer (T1) terminal 2 and connect to terminal 3.
 - c. Remove cable wire from TB300-4 and connect to TB300-5.

WARNING: Applying power to machine with loose or damaged connections in these areas can cause damage to the machine and its surrounding area.

4. Before securing electronic frame to mechanical frame, connect all power cables from mechanical frame to electronic frame. Level electronic frame with mechanical frame. Verify that frame-grounding washers are secured between frames.
5. It is necessary to rearrange some of the components in the I/O area depending upon whether the file is the last one (or only one) of a series of files or if it is not the last one.
 - a. Last File, or only one (Figure 4-4) - The End-of-Line Terminators (TCK-370334) should be placed in C02, C03, C04, and C05.
 - b. Not Last File (Figure 4-4) - The End-of-Line Terminators should be placed in B05.
6. Swing out the receiver (see Receiver Swing Out, Section 2).
7. Clean the disks (refer to Disk Cleaning, Section 2).
8. As the drawers are installed (see Drawer Replacement, Section 2), inspect the drawer

- and clean the heads. These units are adjusted at the plant to be interchangeable with each other. (Once the file has been in operation, it is recommended that the drawers be maintained in their respective locations.)
9. Swing receiver into the array (see Receiver Swing In, Section 2). Check for binds in loading mechanism (see Figure 2-21).
 10. Manually load and unload heads to ensure correct alignment. Do not let the heads unload rapidly because this will cause the heads to pivot out of alignment.

WARNING: Never load or unload the heads when they are out of the array.

11. Push access fully into disk array against inner limit stop.
12. Check that the carriage way wipers are not dry and that the way is not dirty.
13. Replace access cover.
14. Before applying power, check that the voltage at outlet agrees with that shown on the nameplate.
15. Set sequence control switches to Local-Manual control then start disk drive motor and check disk rotation as indicated by arrow on filter frame. Turn on electronic dc, gate blowers, solenoid dc, and hydraulic power supply.

WARNING: Do not load the heads.

16. Reinspect drawer profiles.
17. Allow the disk array to run (purge) for 1-1/2 hours before loading the heads.
18. Load heads for 30 minutes.
19. Unload heads and turn machine off. Check run-down time of disk array and compare it to the run-down time recorded on the decal in the power sequence gate. Run-down time at installation should not be less than 60% of that recorded on the decal.
20. After the disks have come to a complete stop, remove the access cover and again inspect and clean heads and disks.

21. Manually load and unload heads to ensure correct alignment.
22. Replace access cover.
23. Purge system for 15 minutes before loading heads.
24. Reinspect the heads and disks again at the end of the first, second, and third weeks of operation. After that time, refer to the scheduled Maintenance Routine Chart in Section 1 for correct inspection frequency.

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APPROACH TO SCHEDULED MAINTENANCE

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

Absolute cleanliness is essential to proper operation and maintenance of this machine. A vacuum cleaner should be used to ensure cleanliness of machine components and surrounding areas.

Visual Inspection

Visual inspection is the first step in every scheduled maintenance operation. Always look for corrosion, dirt, wear, cracks, binds, burned contacts, and loose connections and hardware. Alertness in noticing these items may save machine downtime at a later date.

SCHEDULED MAINTENANCE PROCEDURES

Specific items of scheduled maintenance are scheduled on punched cards processed in the Central Processing Unit for the branch office. Details of scheduled maintenance operations are listed in the Scheduled Maintenance Routine Chart. During normal scheduled maintenance, perform only those operations listed on the chart for that scheduled maintenance period.

Details on adjustments, service checks, and removal and replacement are given in the pages listed in the index column of the chart (Figure 1-1). Observe all safety practices.

Solid-State Circuits

Diagnostic programs and marginal checking are the basic tools used in scheduled maintenance of

solid-state circuits. These items are excellent troubleshooting tools and are effective in locating potential and intermittent troubles. When using them for scheduled maintenance, use them only as directed on the scheduled maintenance chart. Diagnostic programs for the 1301 are available through the system to which the 1301 is attached.

Do not adjust pulses unless the condition of the machine warrants it.

Mechanical Units

Three basic scheduled maintenance steps that are performed on every machine are cleaning, lubrication, and inspection. Remember, do not do more than recommended scheduled maintenance on equipment that is operating satisfactorily, unless abnormal conditions are noted (Figure 1-1).

ELECTRONIC SCHEDULED MAINTENANCE ROUTINE

Access Time Adjustment and Check

NOTE: To accurately adjust or check access time, the motion oscillator must be in the fast state (oil temperature normal).

Adjust Single Shot

Actuator must be in rezero position to use this adjustment.

1. Adjust the single shot card (DHE-) output at 6C04P for a 3.3-millisecond (ms) minus pulse. Jumper 6F17C to 6C04L to provide an input signal to the single shot for this adjustment.
2. Remove jumper after adjustment of single shot.

CODE	UNIT	FREQ. MONTHS	LUBRICATE/CLEAN	OBSERVE	PAGE
9	Actuator	2	Do not use any solvent on any actuator moving parts. Wipe actuator way clean with a clean lint-free tissue, dampened with IBM #6. Leave a light film of oil on ways. Saturate wipers with IBM #6 oil. Wipe off any excess oil from felt wiper housing.	After oiling and cleaning actuator way, check gib adjustment. Check wipers for wear - replace if worn, or if excessively blackened. Check that aluminum wiper holders do not touch housing ways (Figure 1-2). Check output shaft seal for leaks. If output shaft seal leaks excessively, replace the output shaft seal.	2.34
1	Head Load Linkage with 4-bar linkage	4	Oil head load linkage with IBM #6. Oil sparingly. These links are not high speed and are seldom operated. Lubricate rack Assy. and gear rack block Assy. sparingly with IBM #6.	Check if force required to unload gear rack assembly as outlined on page 2.17 exceeds 15 lbs.	2.17
1	Head Load Linkage with Integrated Head Load		Oil head load sparingly with IBM #6. Lubricate main link pivot sparingly with IBM #6. With the head load mechanism in the head load position, sparingly apply Molykote (P/N 357830) to the piston shaft.		2.23 2.24
1	Data & Clock Head & Arm Assembly. Steel pivots		Remove any accumulated dirt from arm assembly. If required, clean heads with lint-free tissues, isopropyl alcohol, and head cleaning paddle. Absolute cleanliness is essential.	Check all heads for smooth surface finish. Check head for freedom in cone pivots - pitch and roll 50 grams maximum. Pitch 10 grams and roll 3 grams minimum. Use gram gage P/N 2108473.	2.26 2.31
1	Data and Clock Head and Arm Assembly with Delrin Pivots.		Remove accumulated dirt from arm assembly. If required, clean heads with lint-free tissues, isopropyl alcohol, and head cleaning paddle. Absolute cleanliness is essential.	With the heads unloaded at the outer CE track and the disks stopped, manually load the heads and then release slowly to the unloaded position. (Do not allow the heads to unload rapidly as this may cause the heads to pivot out of alignment). Turn on the Disk Drive Motor. With the heads unloaded, check that the heads remain parallel to the disk surface. If the heads assume an angle in either the pitch or roll plane the disks must be stopped and step 1 repeated.	2.23 2.29
0	Blowers & Filters		Lubricate the three blower bearings with IBM #6.	Check SMS gate filters. If dirty, replace. Check power supply blower filter.	2.54
9	Hydraulic Power Supply	6	Change hydraulic oil. Add oil to bring level to center of sight gauge. <u>Clean dirt from cooling coils.</u> Drain drip pan and wipe clean.	Replace mechanical paper filter and rear paper filter (formerly magnetic filter). Replace inner steel mechanical filter after every fourth mechanical paper filter change. Check system pressure 550 ± 10 PSI. Check oil temperature 120° ± 3° F. Check cooling system pressure 50 ± 10 PSI. Check accumulator precharge on Power Supply P/N 2164574 Figure 4-10.	2.45
9	Base			Check line cards for safe condition and grounding. Check run-down time and compare it with run-down time recorded on decal on power sequence gate door. Replace motor if run-down time is less than 60% of original run-down time.	2.51
9	Compressed Air System		Open shut-off valve on air-pipe air line to drain any accumulated moisture from the tank	Check that system pressure is between 58 and 60 PSI. Check must be made when heads are loaded. Compressor should turn "ON" no more than once every 2 hours. If frequency increases, check air system for leaks. Compressor should pump up system from 0 - 30 PSI within 45 seconds.	2.54

Figure 1-1a. Scheduled Maintenance Routine Chart for Single Shift Basis (176 Hours)

15470.1

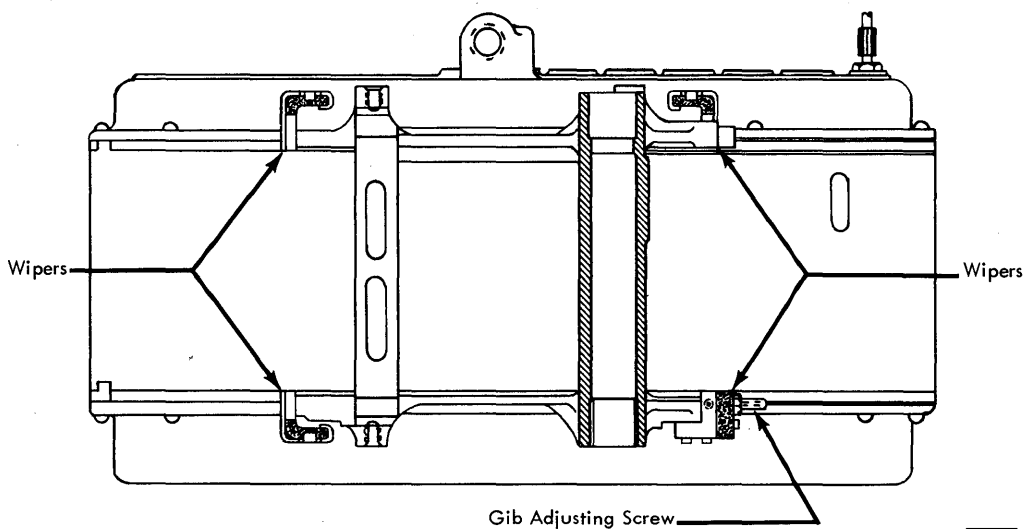
CODE	UNIT	FREQ. MONTHS	LUBRICATE/CLEAN	OBSERVE	PAGE
0	Disk Array Filter			The disk array filter will normally last 3 years on single shift operation. However, adverse environmental conditions can cause it to become heavily clogged. Replace this filter if it has over 1/4" of dirt accumulation or at the end of 3 years. Mark installation date on new filter.	2.2
8	Electronic Circuits			Perform Electronic Routine.	2.51
8	B-Gate Single Shots in Models 11, 12, 21, 22.			Check that single shots are within tolerance.	2.53

15470.2

Figure 1-1b. Scheduled Maintenance Routine Chart for Single Shift Basis (176 Hours)

Adjusting Oscillator:

1. Set up a program loop to servo 100 tracks and back.
2. Scope the 33 count trigger at 6C17B and sync on + glob got-to-go at 6B21D. Adjust oscillator at 6C06 so that 6C17B goes plus at 140 ms (± 2 ms).
3. Scope access ready at 6A16C. Readjust oscillator to obtain 180 ms (+0 ms -2 ms) from + glob got-to-go to access ready.
4. Set up a program loop to servo 8 tracks and back.
5. Sync on + got-to-go at 6B25H and scope access ready at 6A16C to verify 50 ms (+0 -2 ms) from got-to-go to access ready.
6. If greater than 50 ms, reduce oscillator until 50 ms (+0 -2 ms) is obtained.
7. Set up program loop to servo 100 tracks and back.
8. Sync + glob got-to-go 6B21D. Scope access ready at 6A16C. Adjust single shot (6C04) to get 180 ms (+0 -1%). (Do not adjust the single shot pulse shorter than 2.0 ms or longer than 5.0 ms.) To check ss timing; with 100 loop servo running, sync minus on 6C04K and scope output of 6C04P, minus pulse must not be less than 2 ms nor longer than 5 ms.



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Figure 1-2. Carriage Wiper Locations

9. Sync on + glob got-to-go at 6B21D and again scope the 33 count trigger at 6C17B to verify that the time from glob got-to-go to the turn off of the 33 count trigger is 140 ms (+2, -2 ms).
10. Scope the 17 count trigger to verify that the time from glob got-to-go to the turn off of the 17 count trigger is 115 (+0, -10 ms).

Service Check. After proper adjustment, the motion oscillator settings will normally be:

Fast range: 4.125 ms \pm .100 ms
 Slow range: 6.1 ms to 6.8 ms

When the oscillator is set to the fast range value, the slow oscillator time should fall between the limits shown.

Detent Safety Check - B7.A5.03.1

Detent safety is an indication that the access has slowed enough to allow the detent to be inserted safely.

1. Adjust the detent safety integrator (TED-01A5E12) for maximum down (-s) level at

01A5E12F while performing an access of 50 cylinders.

2. Set address 50 in the access register. Set and reset the register and observe 01A5E12F with an oscilloscope. If the signal looks like Figure 1-3, the integrator pulse is too narrow and should be increased until the minus level is at a maximum.

Index Check B7.A5.03.1

Check the time from leading edge of early index (01A5E07B) to leading edge of late index (01A5E07C). The time should be 475 \pm 15 microseconds. If this time cannot be met by adjusting the late index circumferentially, then check motor speed for possible bearing trouble.



Figure 1-3. Short Stroke

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DISK ARRAY

WARNING: If any of the disk array shields are removed, the disks must be cleaned and the disk array must be purged after the shields are re-installed. If the access cover or the access cover door is removed, only purging is necessary. Never run the disk array with shields removed. Never leave the covers off the disk array except when necessary for servicing. The access cover door in the access cover may be opened any time the actuator is not in motion without stopping the array, but care should be taken to keep out dirt and dust.

Purging

Purging is the process of removing airborne foreign particles from the disk array chamber. These foreign particles are removed by running the array with the heads unloaded, thereby replacing the air in the pressurized chamber with filtered air for a prescribed interval of time. The benefit of purging may not be readily apparent, since there is no immediate measurable effect. However, failure to adhere to the process will invite damage to the disk surfaces. Purging is mandatory.

The purging process will not remove large particles. Therefore, it is essential to maintain extreme cleanliness when the pressurized chamber or its auxiliary areas are exposed to outside environments during servicing.

Purging is performed by placing the file in a "Local-Manual" mode and manually starting the disk drive motor only. After allowing the disk array chamber to be purged for the prescribed interval, manual sequencing operation may be resumed and the control switches restored to "Remote-Auto."

As a broad guide, purging durations are listed in Table 2-1 without defining environment. Continued good judgment should be exercised in establishing a sound purging time for each and every occasion.

DISK ARRAY FILTER

Removal

1. Remove AC and DC file power.
2. Remove the canopy over the disk array after it has been vacuumed to remove accumulated dust.
3. Remove filter by loosening the thumb screws and rotating the filter retaining hooks.

Table 2-1. Purging Time

Service Activity Performed	Purging Time (minutes)	
	Good Environment	Poor Environment
Access Cover Door Removed (with Disk Array stationary)	10	15
Access Cover Removed	15	30
Any Disk Array Shield Removed	30	60
Disk Replaced	45	90
Filter Replaced	45	90
Shaftmotor Replaced	45	90

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4. Lift filter off the filter holder surface, being careful not to allow any loose dirt to drop into the array.
5. Vacuum the machine area under the filter, being careful to vacuum all corners where particles may accumulate.

Replacement

1. Remove the replacement filter from the box and plastic bag in which it is shipped. Handle with care so filter will not be damaged in any way.
2. Check filter by holding it next to a strong light and looking through filter. If any tears or pin holes of light are seen, the filter must be replaced.
3. Place the filter in position with the gasket resting on the filter holder. Check that the filter seats all around the holder surface, then tighten the filter retaining hooks by hand as tightly as possible.
4. Run the array with the actuator at rezero and the heads unloaded for 45 minutes to purge the system and the new filter. Remove the filter after the array has stopped, revacuum as before and re-assemble the filter to the machine.

WARNING: Do not run the array if the filter is not securely in place, as head and disk damage can result.

5. Remove actuator cover and clean disks by using the disk cleaning paddle covered with lint-free tissue. If dirt adheres to

- the disk surface, isopropyl alcohol must be used on the tissue (see Disk Cleaning).
6. Vacuum all areas and surfaces exposed by the actuator cover removal. Replace the actuator cover.
 7. Purge array for 15 minutes before loading heads.

DISK ARRAY SHIELDS

Plastic Shields - Front and Rear (Figure 2-1)

Removal

1. Remove AC and DC power.
2. Vacuum false floor and all surfaces surrounding the shields.

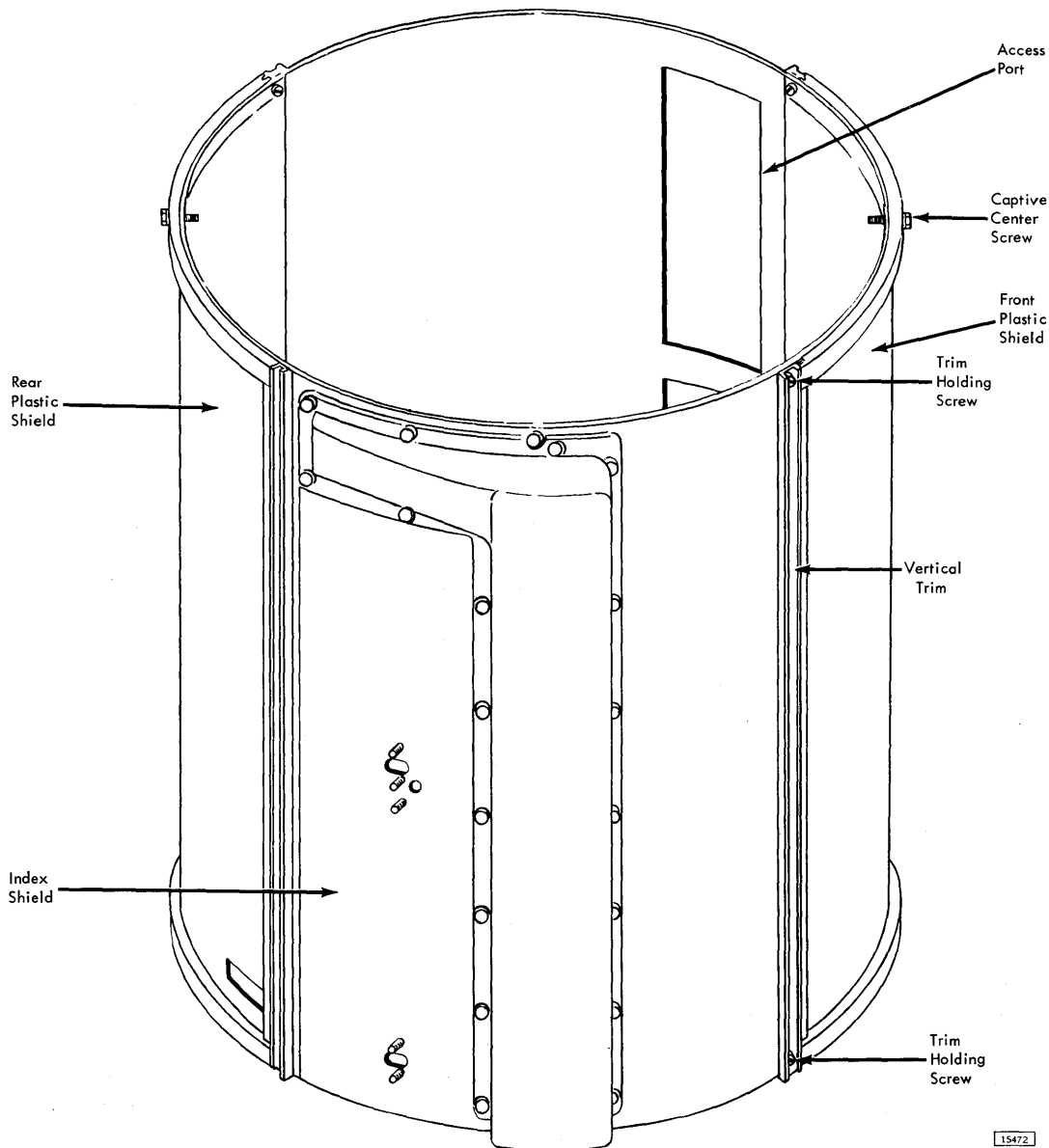


Figure 2-1. Disk Array Shields

3. Do not remove disk array shields until disks are completely stopped.
4. Remove access cover (see Access Cover).
5. Remove vertical trim (Figure 2-1).
6. Loosen the captive center screws and remove the shield.
7. Use a vacuum cleaner to remove any foreign particles from the surfaces and rubber seals exposed by the shield removal. Do not vacuum the disks.

Replacement (Figure 2-1)

1. Clean the plastic shield with isopropyl alcohol and lint-free tissue.
2. Secure the shield loosely with the captive center screw.
3. Install the left vertical trim (nearest the index shield) as far as possible toward the plastic shield and tighten trim holding screws.
4. Tighten the center captive screw.
5. Install access cover (see Access Cover).
6. Install and adjust the right vertical trim so that it retains the access cover securely but allows the access cover to be removed without loosening the trim holding screws. Tighten the trim holding screws.
7. Purge the array for 30 minutes.

Index Shield (Figure 2-1)

Removal

1. Remove AC and DC power.
2. Vacuum false floor and all surfaces around the shield.
3. Remove the two rearmost screws from the top and bottom of the front support casting and rotate casting 90° away from the disk array.
4. Remove vertical trim from each side of index shield.
5. Remove shield holding screws and shield. Do not remove the blue air duct from shield.
6. Use a vacuum cleaner to remove any foreign particles from the surfaces and rubber seals exposed by the shield removal. Do not vacuum the disks.

Replacement

WARNING: Back off transducers one revolution before installing index shield. This is to allow for any difference in compression of the rubber gasket around the disk array when the shield is replaced.

1. Replace index shield and secure with shield holding screws.
2. Place vertical trim as close as possible to plastic shield and secure in place.
3. Adjust transducers (see Index Heads).
4. Purge array for 30 minutes.

Access Port Shield (Figure 2-1)

Removal

1. Remove AC and DC power.
2. Vacuum false floor and all surfaces around the shield.
3. Swing out all receivers (see Receiver Swing Out Procedure).
4. Remove vertical trim from each side of shield.
5. Remove shield holding screws.
6. Lift shield approximately 1/4" and remove from rear of machine.
7. Vacuum all surfaces exposed by shield removal. Do not vacuum disks.

Replacement

1. Replace access port shield and secure with shield holding screws.
2. Install and adjust the vertical trim so that it retains the access cover securely but allows the access cover to be removed without loosening the trim holding screws. Tighten the trim holding screws.
3. Swing in receiver (see Receiver Swing In Procedure).
4. Purge array for 30 minutes.

INDEX HEADS

Service Check

The +S output pulse of the index amplifiers (TEB-01A5E07B and 01A5E07C) should be a minimum of 25 microseconds (Figure 2-2) and a maximum of 65 microseconds. Width adjustment is accomplished by moving the index transducer. Counter-clockwise rotation of the index transducer decreases the index pulse width as well as the amplitude. A minimum negative shift of 1.3 volts is required at the input to index amplifier. Clockwise rotation of the index transducer increases the index pulse width and amplitude (Figure 2-3).

WARNING: Clockwise rotation of the index transducer must be done slowly and carefully as there is a possibility of the index slug contacting the pole tip.

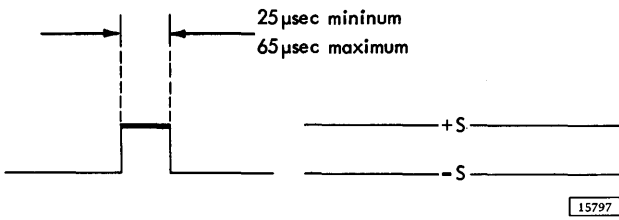


Figure 2-2. Correct Index Pulse

Check the respective index amplifier input for a minimum shift of 1.3 v. If less than 1.3 v, adjust the transducer air gap (Figure 2-3).

The time between the positive leading edges of the outputs at the early and late index amplifiers should be 475 microseconds plus or minus 15 microseconds (Figure 2-4).

Adjustment

WARNING: Adjust transducer inward slowly, as contact with disk pole tip can cause serious damage.

Loosen jam nut on transducer prior to making adjustment. Adjust the gap between transducer pole tip and disk pole tip by rotating transducer until the required voltage output is obtained (Figure 2-2). Gap should be $.015' \pm .005''$. Lock transducer with jam nut. Adjustment of one fourth turn is approximately $0.015''$.

Replacement

1. Mount the index-head assembly to the index shield so that both transducer pole tips are in horizontal alignment with the index pole tip on the format disk within $.020''$. Tighten nut to retain the index-head assembly.
2. Locate register plate relative to the bottom surface of the index-head assembly and tighten nut.

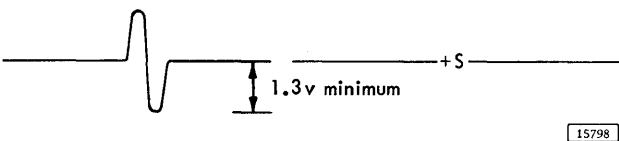


Figure 2-3. Index Amplifier Input

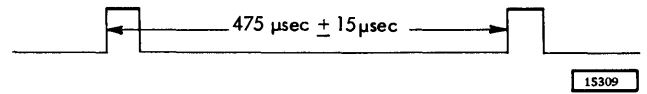


Figure 2-4. Early to Late Index Timing

DISKS

Cleaning

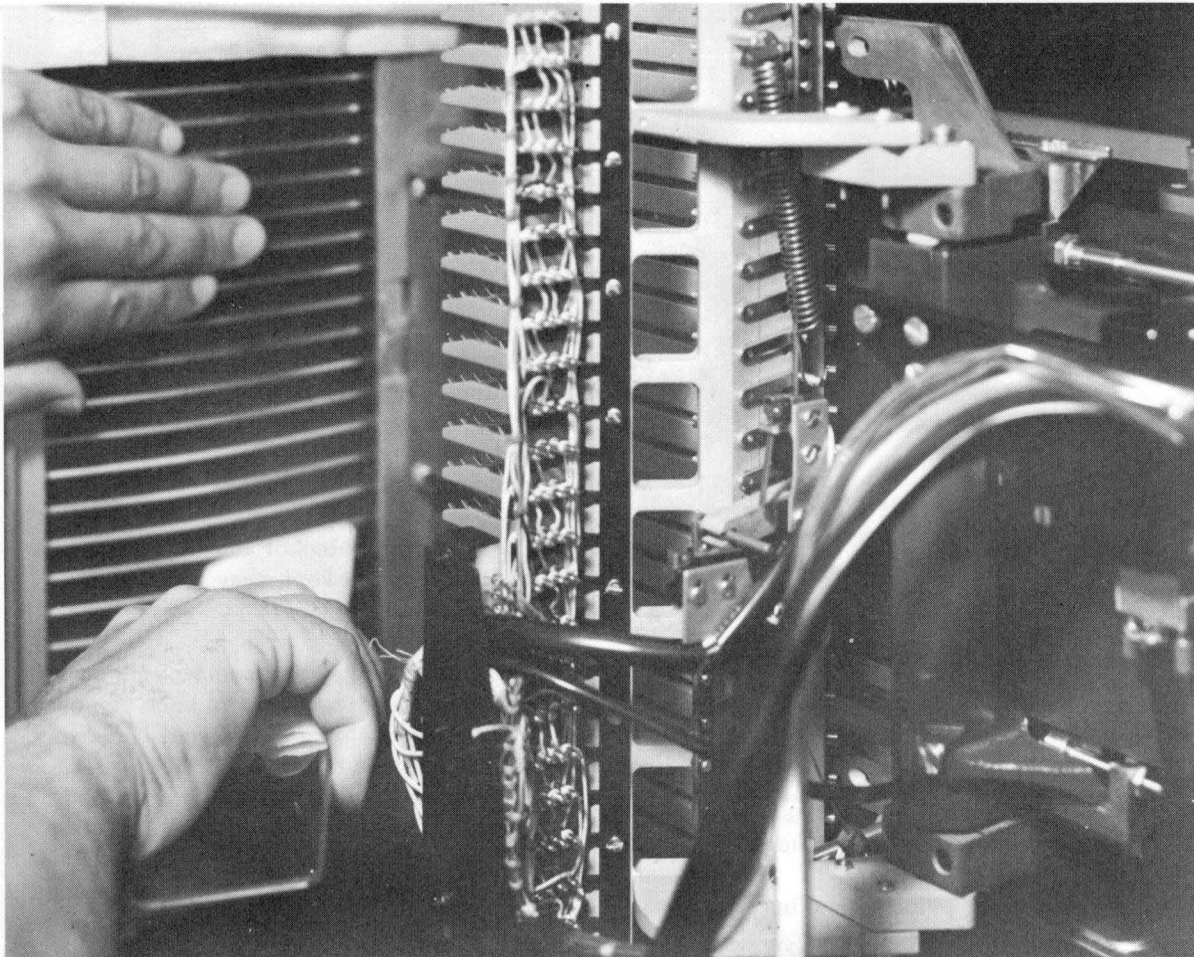
Any time a disk array shield is removed, the disks must be cleaned. This cleaning is very important and must be done carefully as outlined below. Cleaning can be done through the access entry port of the disk array shield. Use only 91 percent isopropyl alcohol for cleaning disks and heads.

CAUTION: Isopropyl alcohol and its vapors are flammable and must be kept away from open flames or lighted cigarettes.

1. Swing out receiver and secure with swing-out brace. If drawers have been removed, it is not necessary to swing out receiver; just return it to the outer limit stop.
2. Wrap the disk cleaning paddle with an approved lint-free tissue dampened, not soaked, with isopropyl alcohol. A tissue that is soaked in alcohol can dissolve part of the dirt that is being removed and re-deposit the dirt on the surface of the disk. However, a completely dry tissue should not be used either.
3. Place paddle between disks and rotate the disk array manually (Figure 2-5). If the surfaces of the disks are wet after cleaning, too much alcohol was used on the tissue, and the disks should be cleaned again properly.
4. Clean the disks until the contamination is removed. If the first tissue comes out dirty, reclean the disk. Use clean tissues for each surface of the disk.

When it is necessary to clean individual disks that are not in the file, place the disks on a flat cushioned surface (for example, a desk or table padded with several layers of lint-free tissue) to prevent scratching the recording surfaces of the disk.

1. Wipe the top surface of the disk with a tissue dampened with isopropyl alcohol. The surface of the disk should dry shortly after the tissue is removed. Use fresh tissues



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Figure 2-5. Cleaning Disks

when the original tissue becomes dirty and for each new disk surface that is cleaned.

2. Turn the disk over and clean the bottom side.
3. Replace any disk that does not clean well or has deep scratches.

Removal

WARNING: Handle all disks with nylon gloves to prevent fingerprints on the disks.

1. Obtain disk replacement kit (P/N 2108433) from Emergency Parts Center (E.P.C.)
2. Remove AC and DC file power.
3. Remove glass doors from both sides of the machine.

4. Swing out receiver and remove drawers, place in plastic bags in which they were received, and place in slots in shipping cartons.
5. Remove canopy grill and disk array filter.
6. Remove the two rearmost screws from the top and bottom of the front support casting and rotate casting 90° clockwise, away from the disk array (Figure 2-7).
7. Remove all shields that house the disk array.
8. Mount the disk scribing and aligning fixture assembly (Figure 2-6) to rear support casting and tighten the two screws 140 ±10 in. lb. torque.

WARNING: Do not loosen these screws until disks have been installed and realigned.

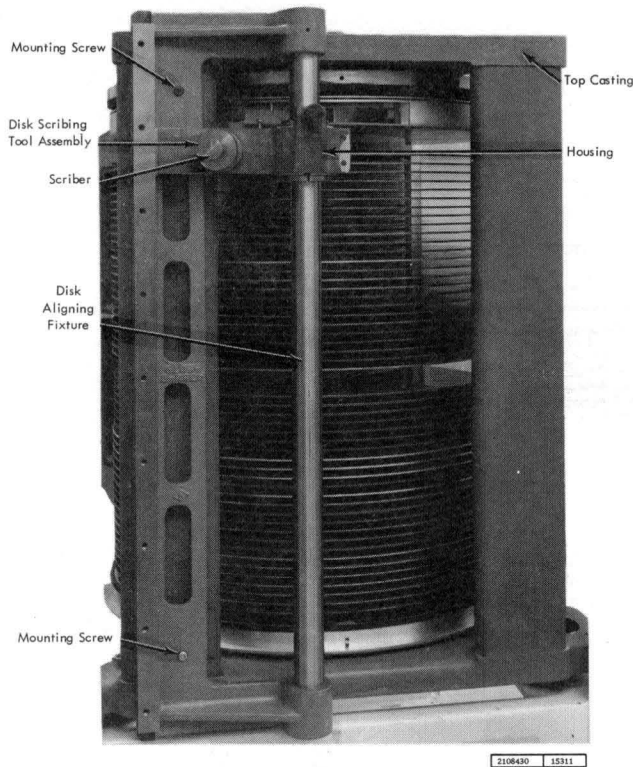


Figure 2-6. Disk Scribing and Aligning Fixture

9. Remove locking bolt (Figure 2-7). During this removal process, the locking bolt will exert a lifting force on the bottom of the screw retaining plate. This lifting force will raise the screw retaining plate and the shaft support stationary shaft. Do not remove locking bolt or shaft support from top casting. If just restacking disk, raise it so that its underside is flush with bottom of top casting. Use aluminum spacer block from disk alignment kit to prevent its falling and damaging disk surface. If replacing shaftmotor, remove entirely.
10. Lock shaftmotor with shaftmotor clamp to keep disks from rotating during disk scribing operation (Figure 2-8).

NOTE: If the disks have been previously scribed, these scribe marks may be used for realignment, and rescribing is unnecessary; however, verify that all disks are scribed and properly aligned before using any previous marks.

If the previously scribed marks are not to be used, mark them out with a narrow (1/8" to 1/4") ink strip. (A wider strip could be confused with the error free area.)

11. Insert the disk scribing tool assembly into housing (Figure 2-6). Rotate scriber until point is just short of making contact with edge of disk (Figure 2-9). Move scribing tool up and down over the full length of the disk edge, while slowly rotating scriber, until disk is scribed. Back out scriber while moving from one disk to another. Remove scriber.
12. Remove the six screws (Item A, Figure 2-10) which fasten the impeller housing assembly to the top casting.
13. Remove four screws (Item B, Figure 2-10) which fasten top bowl assembly to top casting. Remove top bowl through front of the machine (Figure 2-11).
14. Remove four screws (Item C, Figure 2-10) which fasten impeller to top clamping ring. The impeller housing cover, impeller housing, and impeller can be removed through the front of the machine as an assembly (Figure 2-11).
15. Remove the six disk clamping ring screws (Item D, Figure 2-10) and the clamping ring.
16. Separate each spacer ring from each disk before taking them off the shaft motor, if they are taken off together the ring blocks and spring will tend to scratch the shaft motor. As the spacer and disks are removed from the shaftmotor, they should be stacked on a firm table or bench, one on top of the other in a reverse stack. Mark disks in the uncoated area where the disk part number (P/N) is stamped. Start numbering spacers and disks with #1. Lint-free tissues should be placed on top of the table before stacking.

Replacement

NOTE: Use a vacuum cleaner (approved IBM style) during disassembly and reassembly to remove chips and dirt generated by removal and replacement of screws. Before restacking disks, vacuum disk-array chamber thoroughly and search out all corners and crevices to remove any accumulated dust, dirt, and chips.

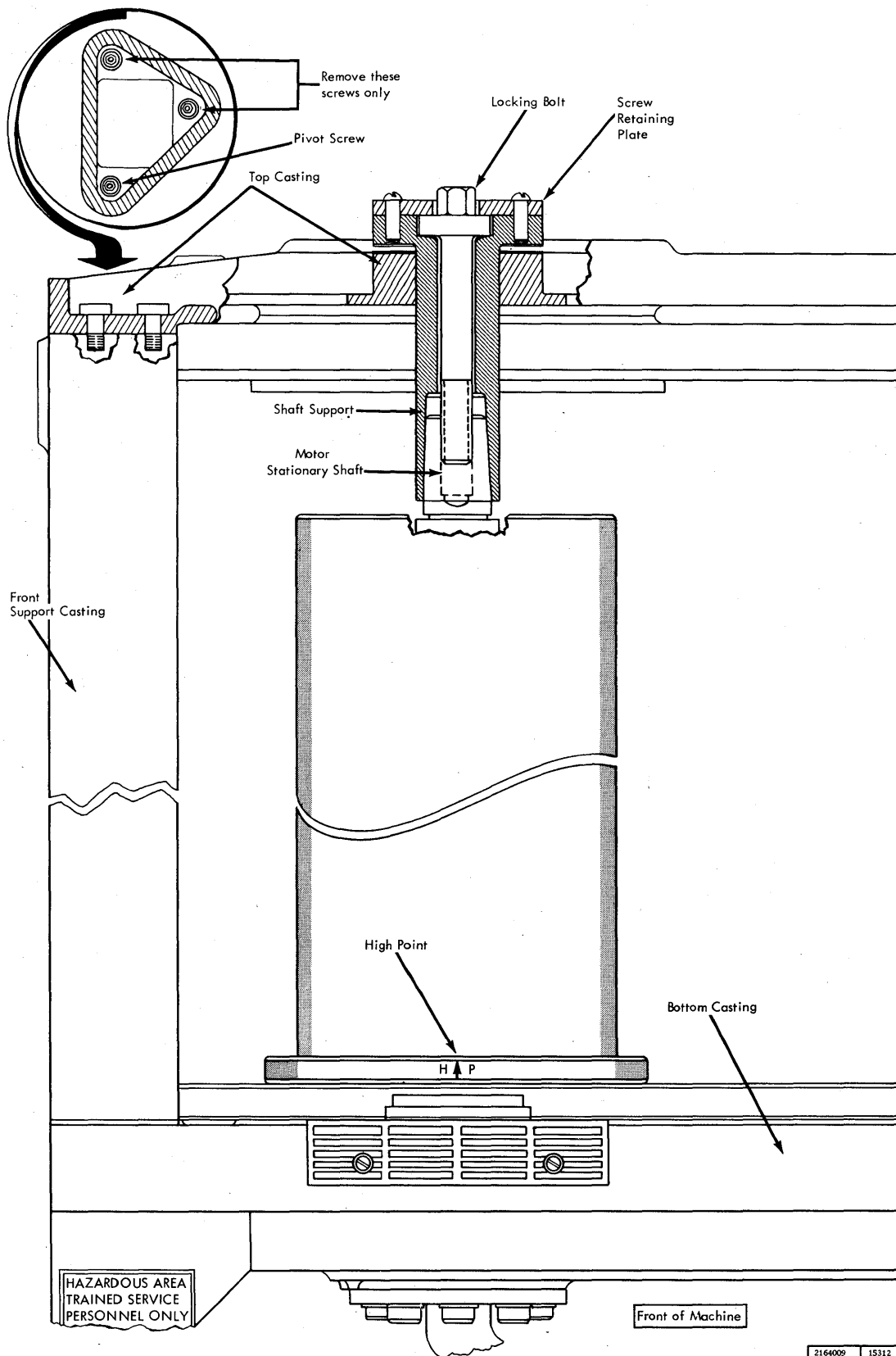


Figure 2-7. Shaft Motor

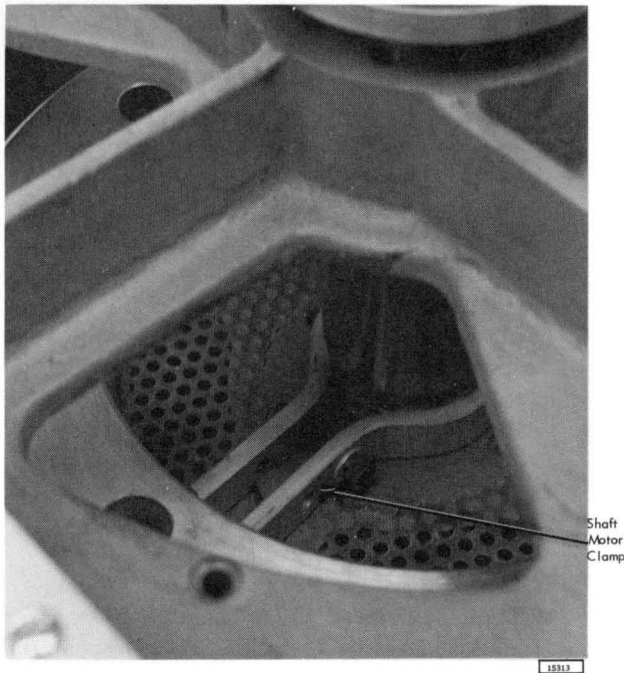


Figure 2-8. Shaft Motor Clamp

WARNING: Precautions should be taken to prevent dropping any metal chips or dirt into the top of the shaftmotor or disk array during assembly.

1. If the spacer above the clock disk was removed, install it with its scribed mark aligned within .5" of the shaftmotor high point (H/P). All other spacers are self-aligning and must be installed highest-numbered spacer first. Check each spacer spring for damage and replace if necessary.
2. Install first disk (highest-numbered) with P/N facing upward. The leading edge of the error free sector (dimple on edge of disk) must be aligned within .5" of the shaftmotor high point (H/P).

WARNING: When stacking disks, try to align the scribe mark before settling the disk on the spacer ring. If the disks are rotated after they are put on the ring, there is a possibility that the aligning blocks can shave the inner disk edge.

3. Install microscope into disk aligning fixture in scriber mounting. Align the scribe mark with the center of the cross-hair by positioning the disk. Then the microscope should be rotated to appear as shown in Figure 2-12.

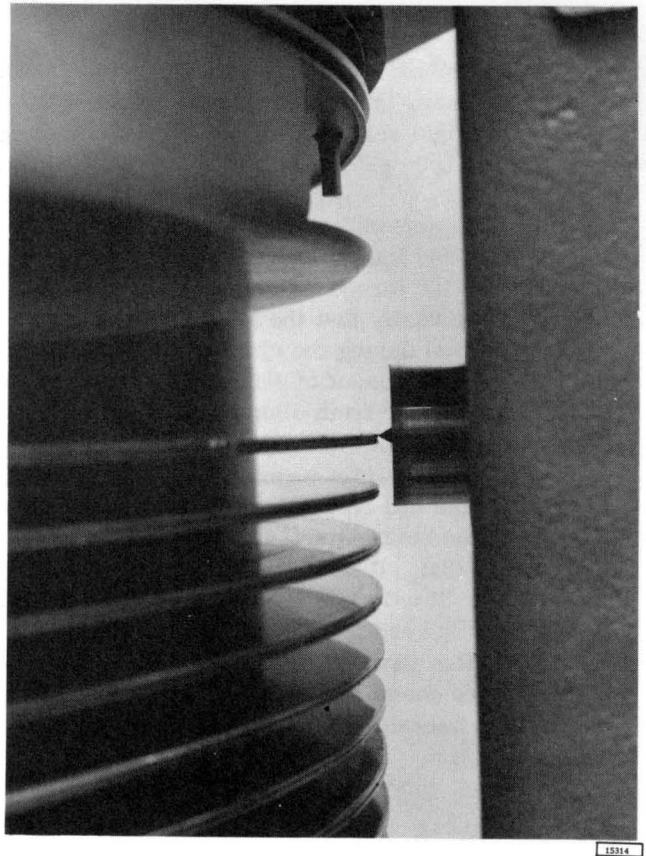


Figure 2-9. Disk Scribing

4. Install balance of disks and spacers in numerical sequence. Wipe each disk with isopropyl alcohol and lint-free tissue. Replace any scratched disks. Align each disk as it is installed.

NOTE T-1301: If the sector disk is replaced, align the index scribe mark on sector disk within .010" of the pole tip on format disk (Figure 2-13). If a format disk has been replaced, align the leading edge of the pole tip on the format disk in the top module to the leading edge of the pole tip on the format disk in the lower module within .062", measured as viewed in the microscope.

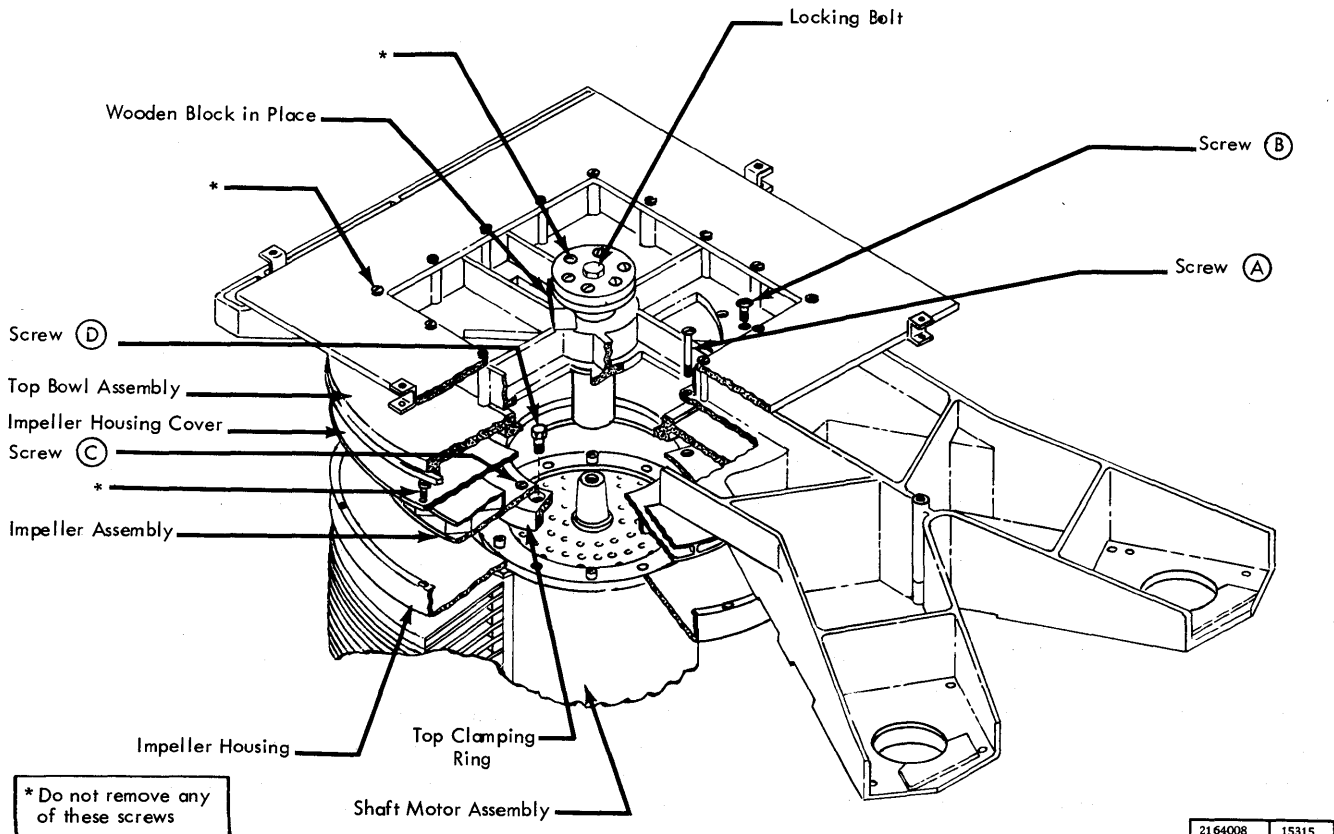
NOTE: Due to the thickness of the rubber gasket on the spacer assembly on the two module file, it is possible that only 49 disks can be installed the first time. It is necessary to install the top spacer assembly and the top clamping ring to compress the array. When locating the mounting holes of the ring to the shaftmotor, try not to rotate it, for it will tend to move the top spacers and disks also. Use the three long clamping ring screws to secure the disk clamping

ring to the shaftmotor. Two men should tighten down opposite each other, turning the same amount of turns. Then check the final set of the torque on the clamping ring screws for $230 \pm 10''$ lb.

5. Remove screws, clamping ring, and top spacer and install last disk and reclamp to $230 \pm 10''$ torque. Recheck two or three disks to verify that the scribe marks have not moved during the clamping operation.
6. Check disk runout of every fifth disk with dial indicator from disk-aligning kit. Measure runout at $3/16'' \pm 1/16''$ from the edge of disk while turning the array manually through a full revolution. Measure runout from the bottom surface of the disk (Figure 2-13a). Runout should not exceed $.020''$. If a disk is found that exceeds a total indicator reading of $.020''$, it may be an indication that one of the lower disks or spacers does not lay flat, possibly due to a chip between the surfaces. If such a disk

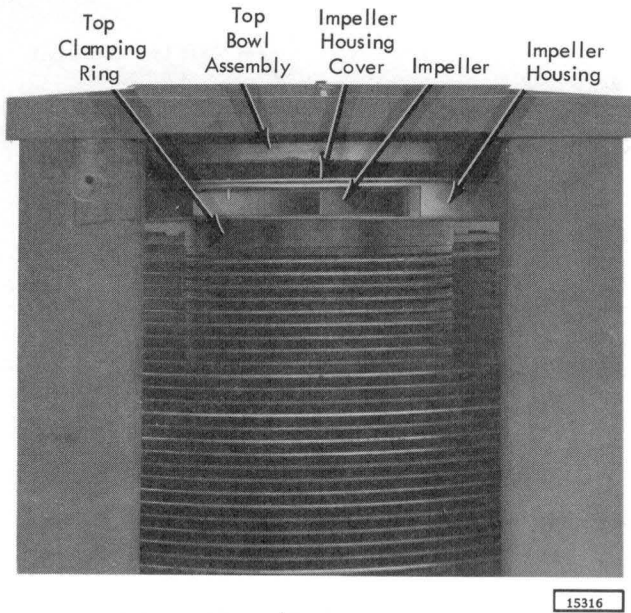
is found, disks beneath it should be checked to determine the disk at which runout becomes excessive. The disks must then be unstacked to locate the problem. If only one disk has excessive runout, then the disk runout log should be checked to verify if the disk initially had much runout. If it did not, then the disks must be unstacked to locate the problem.

7. Remove the disk aligning tool from the rear support casting, place in shipping crate, and return to E. P. C. (Emergency Parts Center).
8. After installing disk array shields, slowly rotate the disks array by hand to ensure that the index slugs do not contact the index transducer pole tips. If there is contact, back off the transducer.
9. Clean the disks. Refer to Disk Cleaning. Mount the drawer assemblies to the receiver (refer to Drawer Installation). Swing in the receiver (refer to Swing In Procedure) and mount the access cover.



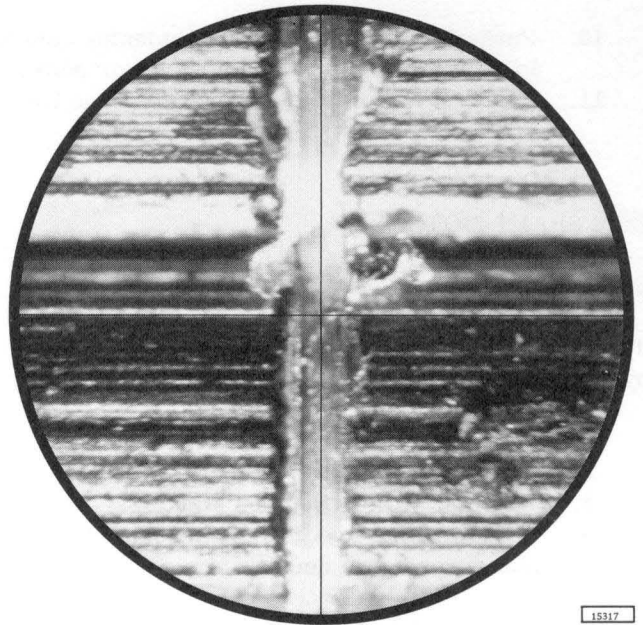
2164008 15315

Figure 2-10. Disk Array Disassembly



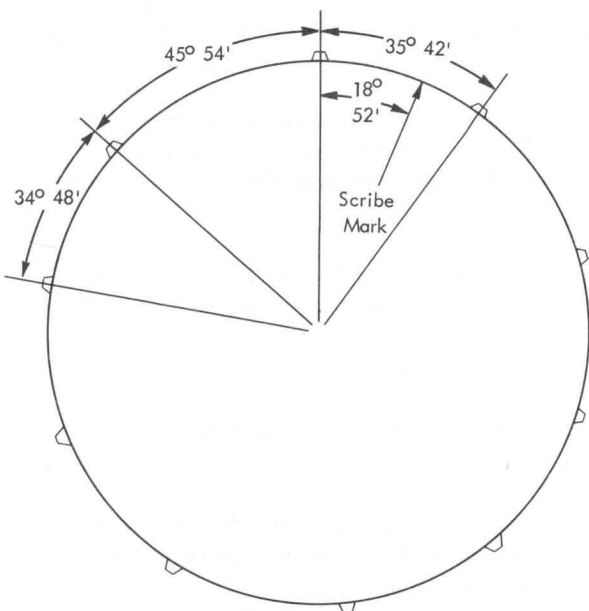
15316

Figure 2-11. Disk Array Assembled



15317

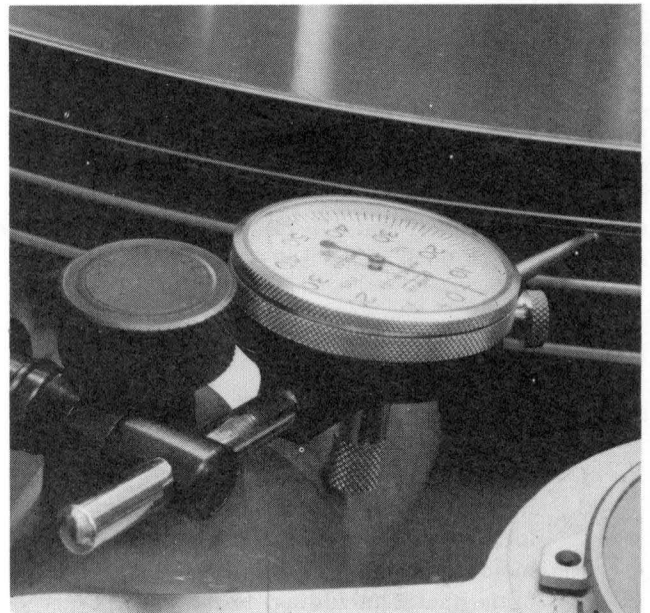
Figure 2-12. Magnified Scribed Line on Disk



P/N 2122923

15474

Figure 2-13. Sector Disk (T 1301)



15318

Figure 2-13a. Dial Indicator Mounting

10. Purge the file for at least 45 minutes before loading the heads on the disks under power.
11. Perform complete read/rewrite of the file to align formats, addresses, and data.

DISK SHAFT MOTOR

Service Check

The start of a shaft motor failure may be indicated by:

1. Noisy bearings.
2. Timing problems in the machine.
3. Overloads do not stay closed.
4. Thermal switch opens on starting.
5. Rundown time less than 60 percent of that recorded on decal.

NOTE: To accurately check rundown time, the disk drive motor must have been on for a minimum of 1.5 hours. The receiver must be in rezero position.

Removal

Order the shaft motor by part number (see Parts Catalog). The shaft motor hoist and the disk-aligning kit will be automatically sent with the motor.

Disk Drive Thermal Overload Switches

Service Hint

A "spare" Thermal Overload switch is installed on the disk drive motor. Should the switch become defective, the spare switch can be installed by interchanging the leads X2 and X1 located in the contactor cabinet (Figure 2-14). The switch appears on page B7.C1.05.0 of the 1301 system diagrams.

RECEIVER ASSEMBLY

Swing-Out Procedure (Figures 2-15 and 2-16)

1. Remove all power to machine.
2. Release the nylon dowel in the lower left-hand corner of the inner glass-door moulding by moving the dowel retaining slide (under moulding) to the right.
3. Remove access cover.
4. Move carriage to outer limit stop.

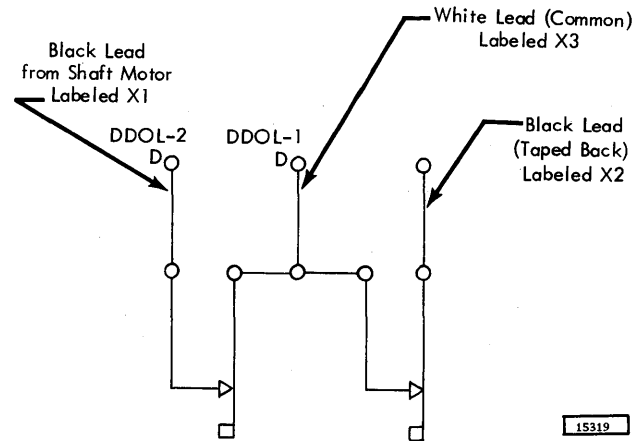


Figure 2-14. Additional Disk-Drive-Motor Thermal

5. Retract carriage locking pins. Apply a slight inboard pressure on the receiver to aid retraction. Do not press on arms or stiffeners.
6. Pull rail linkage release rod. Move rail linkage so that it clears roller on rack assembly.

NOTE: Applies to files with 4-bar linkage.

7. Swing receiver out carefully. Make sure gimbals clear the disk array shields and glass doors.
8. Engage swing-out brace with lower end of diamond pin.

WARNING: Any time receiver is swung out, drawers and heads are in an extremely vulnerable position. Do not leave the receiver unattended while in this position.

9. Cover access-entry port with a lint-free tissue, or plastic covers (part No. 2108742).

Swing-in Procedure (Figures 2-15, 2-16, and 2-17)

WARNING: Never load heads when they are out of the disk array.

1. Check to ensure that the proper relationship exists between the heads and the torsion bar assembly.
2. Swing in receiver and align heads.
 - a. Remove swing-out brace.

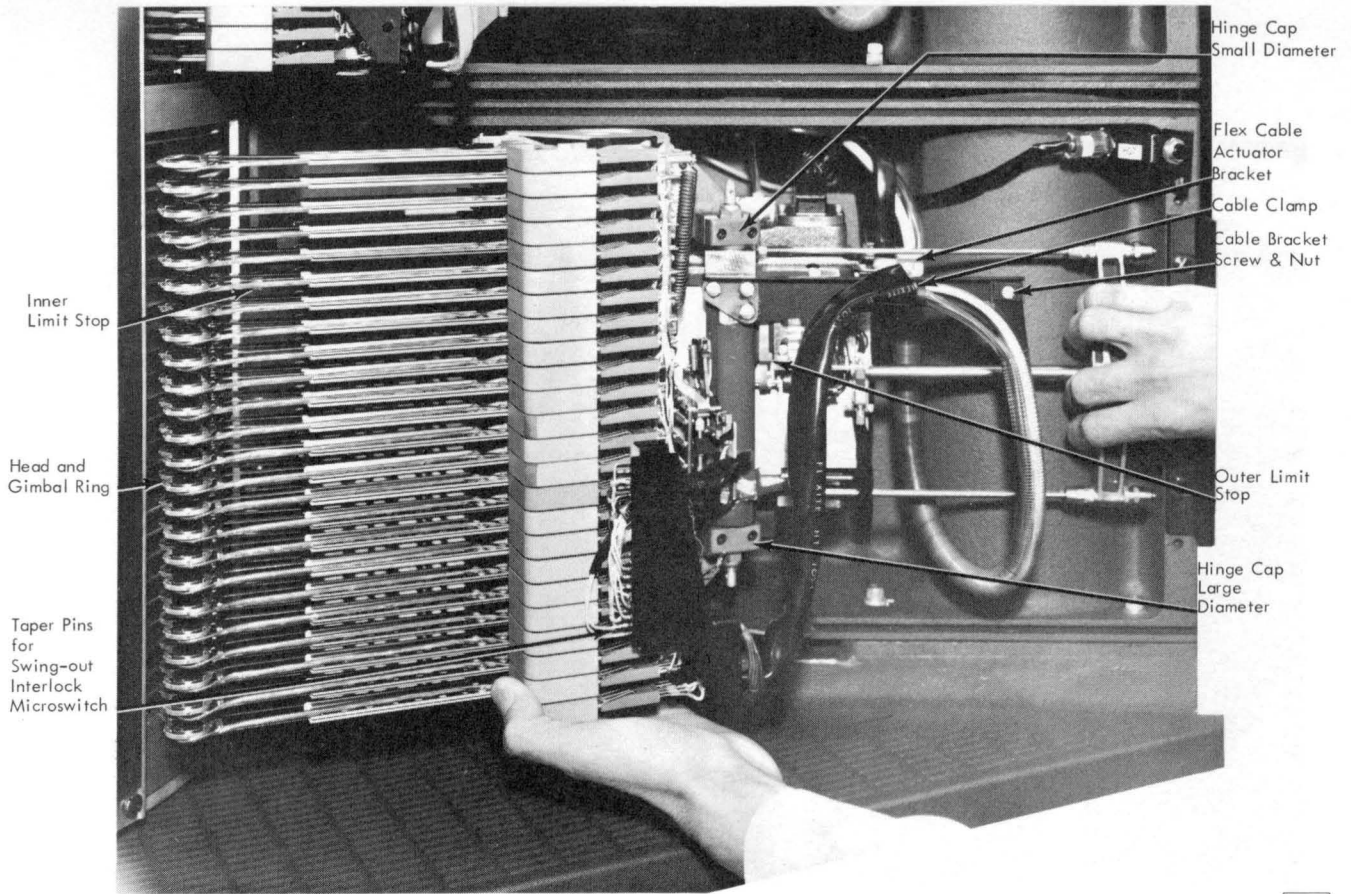


Figure 2-15. Receiver Swing-Out Procedure

- b. Move carriage to outer limit stop.
- c. Swing receiver in carefully. Make sure that carriage is against outer limit stop.

NOTE: For 4-bar linkage equipped files, channel should straddle the rack roller.

- d. Press on receiver to seat locking pins. Do not put any pressure on arms and stiffeners.
- e. Pull rail linkage release rod. Move rail linkage flush to actuator mounting plate. Retract rail linkage release rod and press firmly. Verify that rail linkage is locked securely against actuator mounting plate.

NOTE: Applies to files with 4-bar linkage.

- f. Manually rotate main drive link to load and align heads with disk surfaces. Unload the heads.
3. Check head unload and microswitch contact.

NOTE: See adjustments under Receiver as an Assembly.

4. Check electrical contact of swing-out interlock microswitch (see Swing-Out-Interlock Microswitch Adjustment). Check electrical contact of rail linkage interlock microswitch (see Rail Linkage Interlock Microswitch Adjustment).
5. Check drawer assembly profile.
 - a. Move carriage to outer limit stop position and check clearance between each head-pair profile and the disk surfaces when the heads are unloaded. The distance between head and disk should be a minimum of .030" on top side of drawer profile and .040" on the bottom side (Figure 2-17). Profile should be checked throughout a complete disk revolution by rotating the disks manually. This same procedure should be followed with the carriage positioned against the inner limit stop. To adjust the receiver relative to the disks, add or subtract shims from shim spacers next to the small diameter hinge arm (Figure 2-18).
 - b. Move carriage to inner limit stop. Sight along disk spacers as carriage moves in

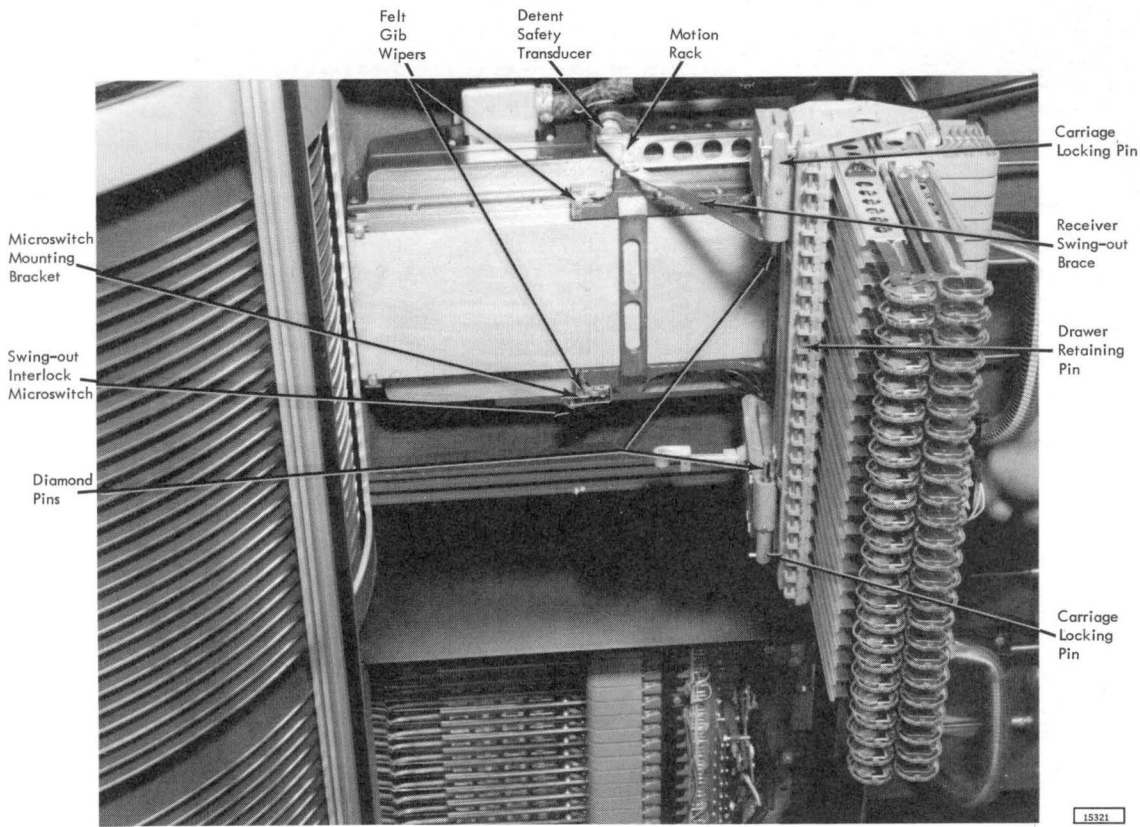


Figure 2-16. Receiver in Servicing Position

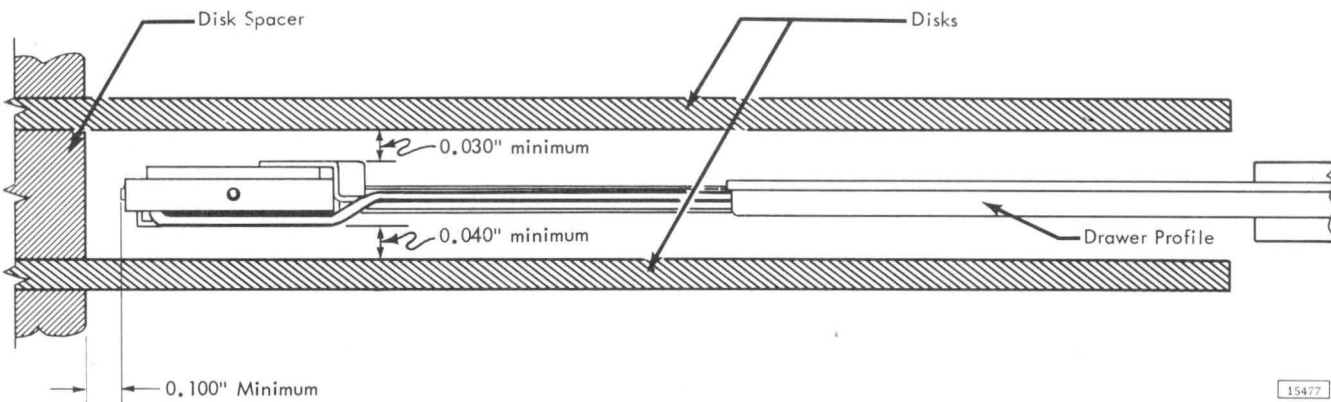


Figure 2-17. Drawer Assembly Profile

so closing gap between gimbal rings and disk spacers is visible. Pitch pivot screw on gimbal ring should have a visible clearance from spacer when carriage is against properly adjusted inner limit stops.

- c. Load heads by picking R-125. (Tie R-125-A coil to ground.)

WARNING: Do not rotate disk array or move carriage while heads are loaded.

- 6. Check head load and microswitch contact.

NOTE: See adjustments under Receiver as an Assembly.

RECEIVER AS AN ASSEMBLY

Removal (Figures 2-15, 2-16, 2-18, and 2-19)

1. Swing out receiver (see Receiver-Swing-Out Procedure).
2. Remove drawer retaining pin and drawer assemblies.
3. Loosen but do not remove the screws and nuts that secure adapter to buttress (top and bottom buttress) (Figure 2-19).
4. Remove screws that retain adapter on hinge arm (top and bottom hinge arm) assembly (Figure 2-19).
5. Loosen but do not remove large-diameter hinge cap.
6. Loosen but do not remove hinge shaft nuts.
7. Disconnect two taper pins for swing-out interlock microswitch (Unsolder leads on later model files). Extreme care must be taken to prevent solder from contaminating actuator ways, disks, heads or other parts in this area.
8. Disconnect the integrated head load air line at the strut by removing the knurled nut and the air supply line (red) from the connector assembly mounted on the strut. Next remove the clamp holding the connector assembly to the strut.
9. Remove data and format cable paddles from their corresponding electronics panel. Disconnect interlock switch cable at its connector, H04 (behind strut).
10. Remove flex-cable actuator bracket.
11. Draw cable assembly through casting port.
12. Remove cable-bracket nut and cable clamp.
13. Remove both hinge caps. Remove receiver. This step requires two people.

Replacement (Figures 2-15, 2-16, 2-17, 2-18, and 2-19)

1. Move carriage to outer limit stop.
2. Position receiver hinge arms on shaft assembly. Ensure correct position of washers, felt shields, and spacer during assembly. This step requires two people.
3. Loosely assemble hinge caps to arms.
4. Swing in receiver and press to seat locking pins.
5. Install cable bracket nut and cable clamp.
6. Tighten hinge assembly:
 - a. With shaft assembly against retained bearings, tighten hinge cap screws

while maintaining an even gap on each side of cap.

- b. Loosen each cap screw by turning it approximately 30°. This allows shaft to move within caps during following step.
- c. Torque nuts to 50 ± 10" lb. Place a set screw wrench in one of the holes provided in ends of the shaft or use a wrench on the opposing nut to keep shaft from turning.
- d. Tighten cap screws.
- e. Replace the two screws that retain adapter on hinge arm assembly. Tighten screws and nuts that secure adapter to buttress (top and bottom buttress assemblies) (Figure 2-19).
7. Feed cables through casting port.
8. Clamp the integrated head load air line connector assembly to the strut and connect air supply line (red) to the connector assembly using the knurled nut.
9. Mount flex-cable actuator bracket.
10. Check that the receiver and cable bracket are electrically isolated from carriage.
11. Connect swing-out interlock microswitch taper pins, (solder leads on later model files). Extreme care must be taken to prevent solder from contaminating actuator ways, disks, heads or other parts in this area.
12. Swing out receiver and engage swing out brace.
13. Install drawer assemblies and drawer retaining pin.
14. Swing in receiver (see Receiver Swing-In Procedure).

Service Check

Head Unload Check (With 4-bar linkage, Figure 2-22).

Proper unloading of the heads can occur only when the force required at the rack to rotate the gear from its over-center position does not exceed the unloading force which is supplied by the rail linkage. The force required to unload the heads may be determined as follows:

1. Remove access cover.
2. Check gear and rack adjustment and rack freedom. Cable must be between scribed marks on gear when heads are loaded via air cylinder and rail linkage (see Gear and Rack Adjustment.)
3. Move carriage to outer limit stop. Pull rail

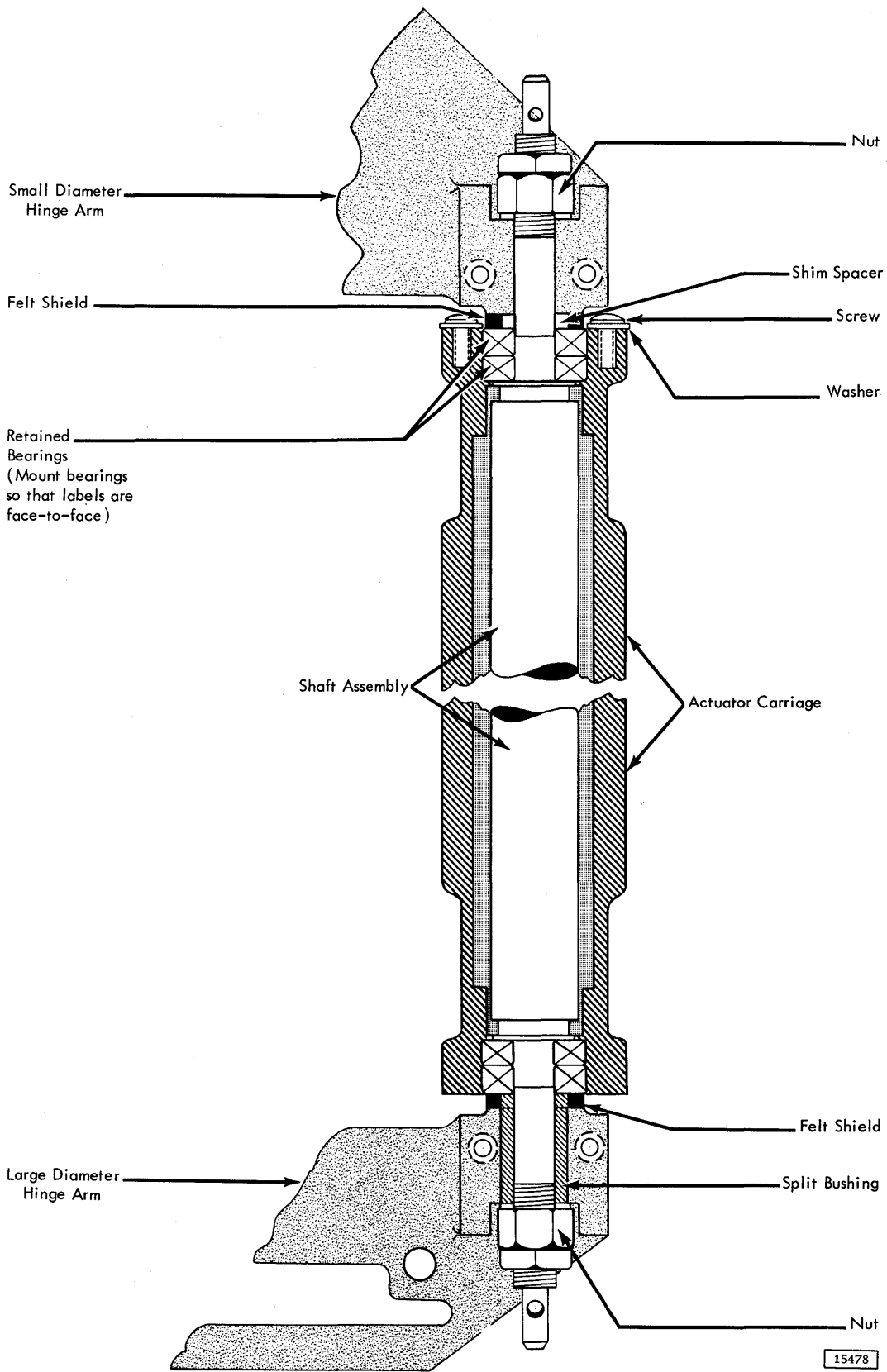


Figure 2-18. Hinge Shaft Assembly

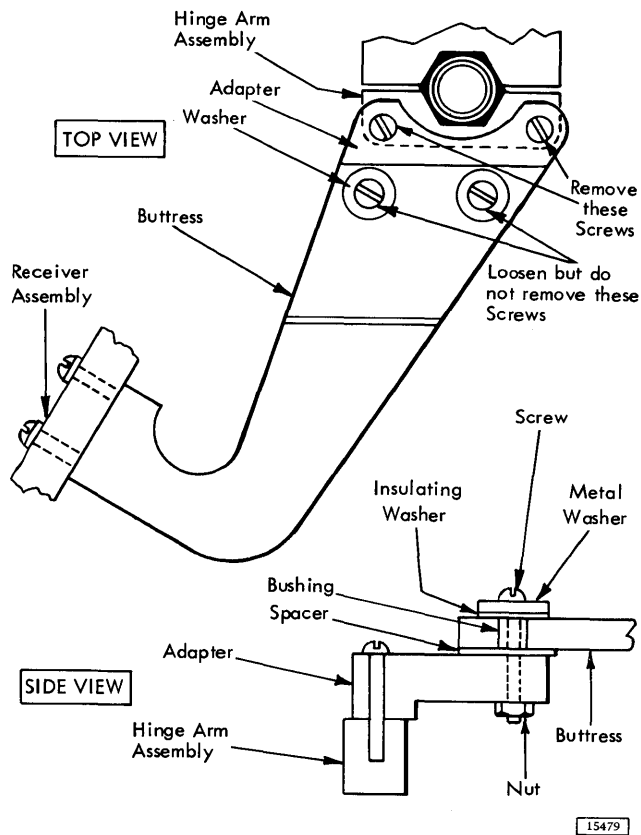


Figure 2-19. Buttress and Adapter Assembly

linkage release rod, move rail linkage so that it clears roller on rack assembly, manually rotate main drive link to load heads, and return rail linkage to its locked position.

4. Place force gage (P/N 2108578) on end of rack assembly protruding from brass rack guide (Figure 2-22).

WARNING: Do not rotate disk array or move carriage while heads are loaded.

5. Push directly along axis of rack and increase applied force gradually until heads unload. Note force required to unload heads. This force should not exceed 15 pounds. If the force exceeds 15 pounds check for points of excessive friction or interference.
6. Manually load and unload heads to insure correct alignment.
7. Replace rack assembly roller in rail linkage and lock linkage securely in place against actuator mounting plate.

8. Check electrical contact of rail linkage interlock switch.
9. Actuate air cylinder to verify that head load mechanism operates correctly.

Adjustment (With 4-bar linkage)

Head Unload. Proper position of unloaded heads requires a .090" distance between the stop screw and main drive link when the main drive link is in a horizontal plane (Figure 2-20). Proper adjustment can be attained in the following manner:

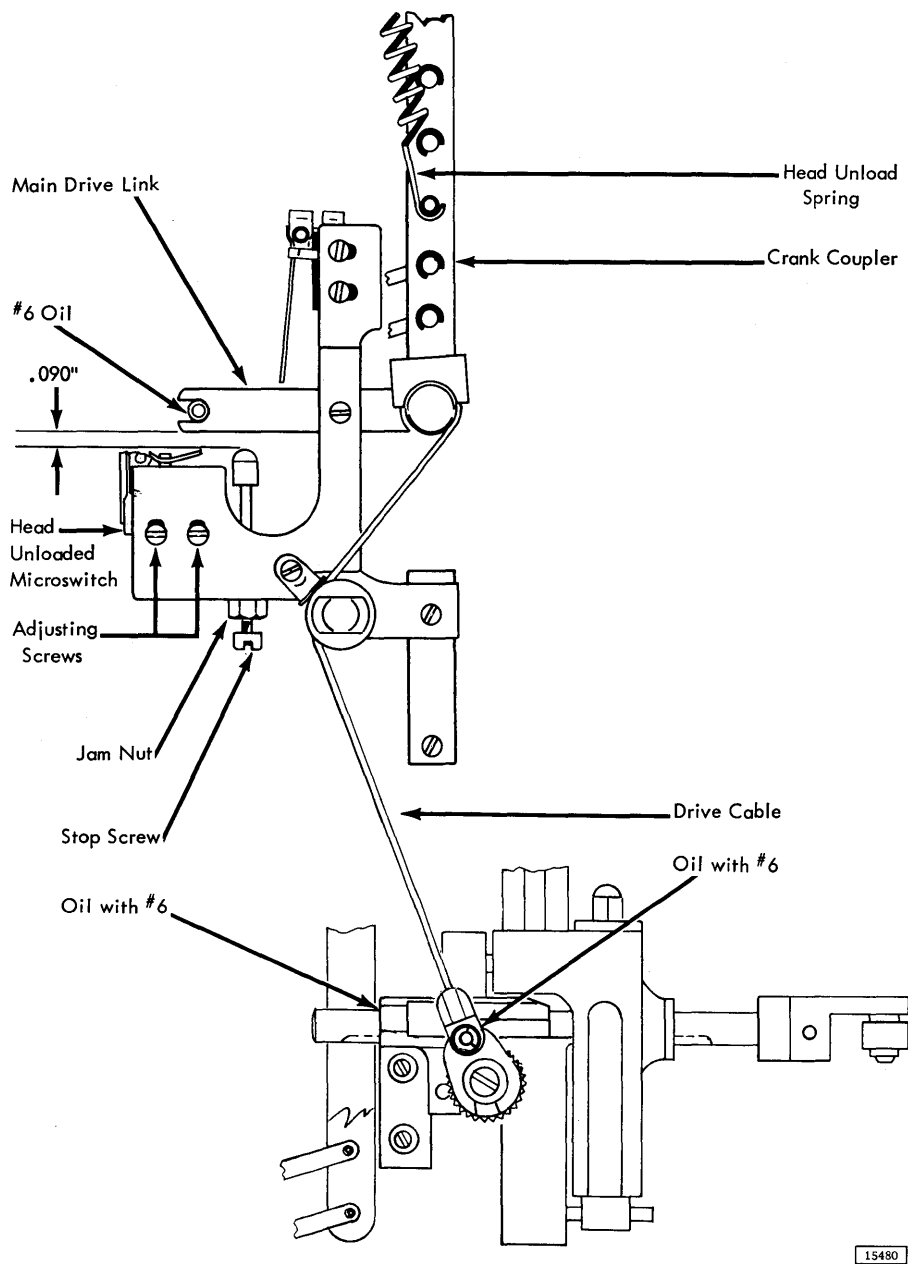
1. Loosen jam nut.
2. Adjust stop screw. The specified distance can be obtained by positioning the link horizontally with the stop screw using either of the following methods and then by turning the screw counterclockwise three turns.
 - a. Adjust the stop screw until the ends of the main drive link are equal distances from the top of the receiver.
 - b. Place the end of a scale rule against the actuator face as you would a carpenter's square and align link to the edge of the rule.
3. Tighten jam nut.
4. Adjust head unloaded microswitch so that the switch just makes with a .020" gage between the stop and main drive link.

Head Load. The head load adjustment is done in three steps. These steps must be done in order.

1. Gear and Rack. Proper over-center relationship of gear and rack exists when there is no gap at rack and cable is within scribed lines on gear surface (Figure 2-21). (Use a 6" scale as a square placed against the gear surface to determine if the cable lies between the scribed lines.) These scribed lines indicate the required .018" to .096" over-center perpendicular distance from pin to a line passing through the gear center and tangent to the outside diameter of roller.

Proper adjustment can be obtained in the following manner:

 - a. Unload heads and release head unload spring.
 - b. Loosen cable keeper screw and move keeper away from roller.
 - c. Disengage cable from roller.
 - d. Loosen gear mounting screw sufficiently



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Figure 2-20. Head Unload Adjustment

to allow gear to be disengaged from rack. Check rack freedom in guides. Rotate gear to obtain proper relationship of gear and rack. (One tooth rotation is equivalent to .078" at the pin.)

- e. Tighten gear screw and recheck over-center position.
- f. Engage cable in roller, reset cable keeper, and engage head unload spring.

2. Cable (Figures 2-21 and 2-22). Proper cable length can be determined only when gear and rack relationship is in proper adjustment.

With heads unloaded, check the clearance between the pair of cranks opposite the 1/8" square marked on the receiver (or any other pair if no mark is present) for a clearance equal to the large end of the head-load gage (section 5).

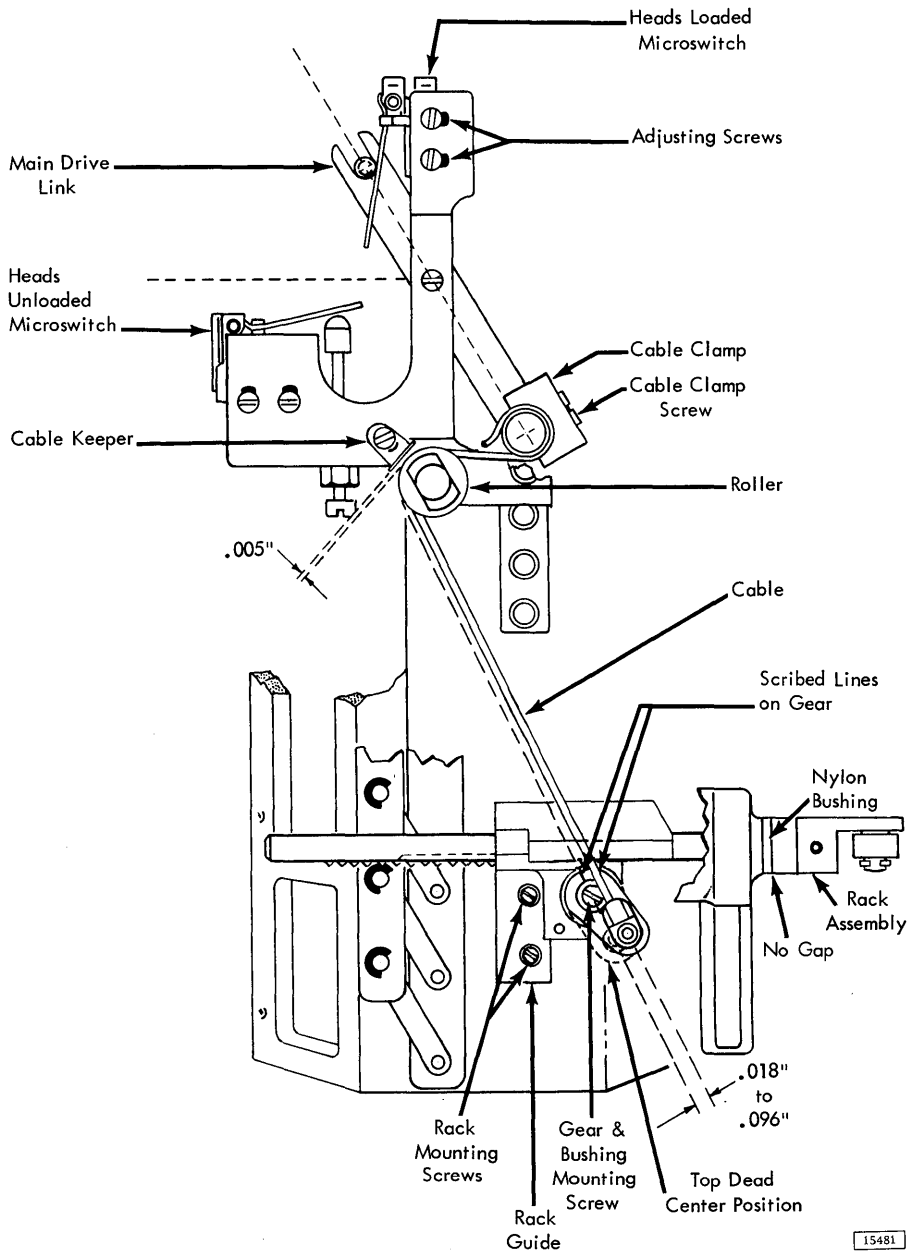


Figure 2-21. Gear and Rock and Cable Adjustment

With the heads loaded and no gap at the rack, this same pair of cranks should have a clearance (.110") equal to the small end of the head-load gage (Figure 2-22). If .110" is exceeded, the cable is too long. A minimum clearance must also exist between cranks and main-drive-link pivot. If interference is noted, cable is too short (Figure 2-22).

WARNING: Do not rotate disk array or move carriage while heads are loaded.

- Proper adjustment can be attained in the following manner:
- a. Unload heads and remove head unload spring.
 - b. Loosen cable clamp screw about one turn.

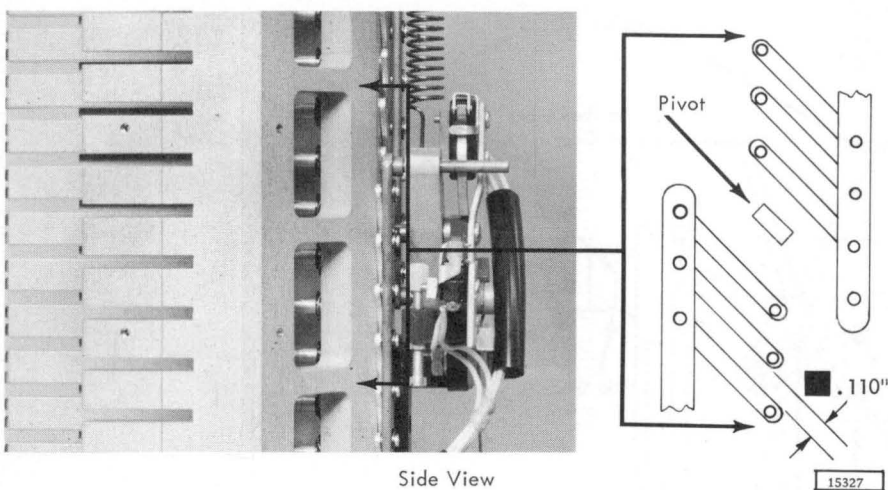
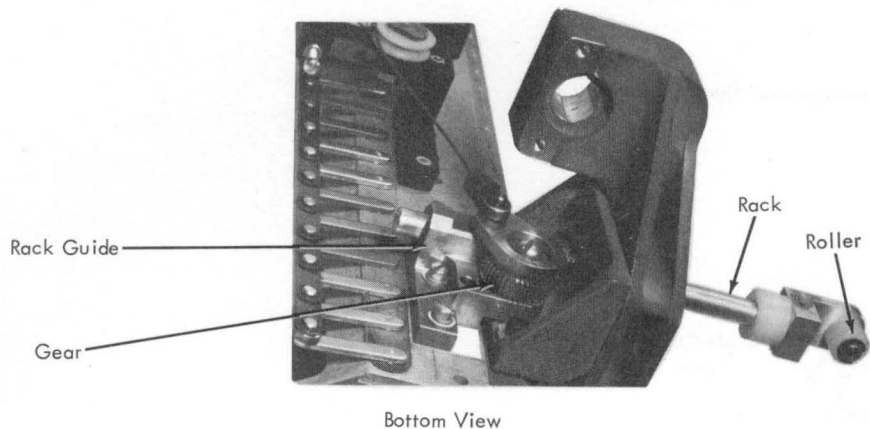


Figure 2-22. Receiver

- c. Adjust cable as required.
- d. Tighten screw.
- e. Load heads and recheck.
- f. Adjust head-loaded microswitch so that it makes when heads are loaded.
- g. Engage head unload spring.
3. Air Cylinder Nose (Figures 2-23, and 2-24) Proper air cylinder nose positions can be established only when gear and rack relationship is in proper adjustment. With heads loaded, two conditions must be met in order (Figure 2-21):
 - a. The gear must pass top dead center with no gap at the rack. (Cable between scribed lines on gear.)
 - b. There must be a minimum of .005" clearance between rack roller and rail,

with no gap at rack. If the rack roller and rail are in contact with gap at rack, manually move rack assembly to close gap, then check for the specified minimum clearance.

If clearance is less than .005" rotate nose clockwise in 180° intervals until the proper clearance is obtained. Recheck steps 1 and 2.

ADJUSTMENT (INTEGRATED HEAD LOAD) (Figures 2-22a and 2-22b)

Head Unload. With assembly in the heads unloaded condition adjust the heads unloaded switch to just make with a .001" shim between the air cylinder

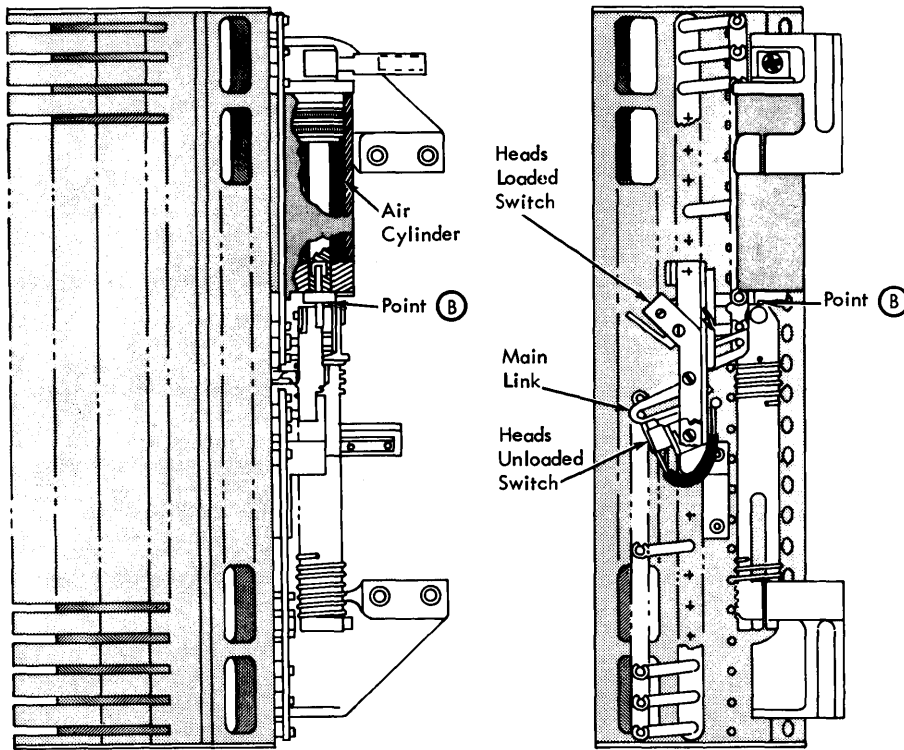


Figure 2-22a. Receiver Assembly

piston head and the main link roller (Point B), Figure 2-22a) and not make with a .005" shim at Point B.

Head Load. With the disks not rotating and the compressed air system supplying 58-60 PSIG to the head load cylinder, adjust head load switch so that it is just made.

WARNING: Do not rotate disk array or move carriage while heads are loaded.

DRAWER ASSEMBLY

Drawer As An Assembly

NOTE: Format drawers are not interchangeable with data drawers. Format drawers are not interchangeable between "A" suffix and "B" suffix machines. "B" suffix format drawers have diodes installed and "A" suffix format drawers do not.

Adjustment

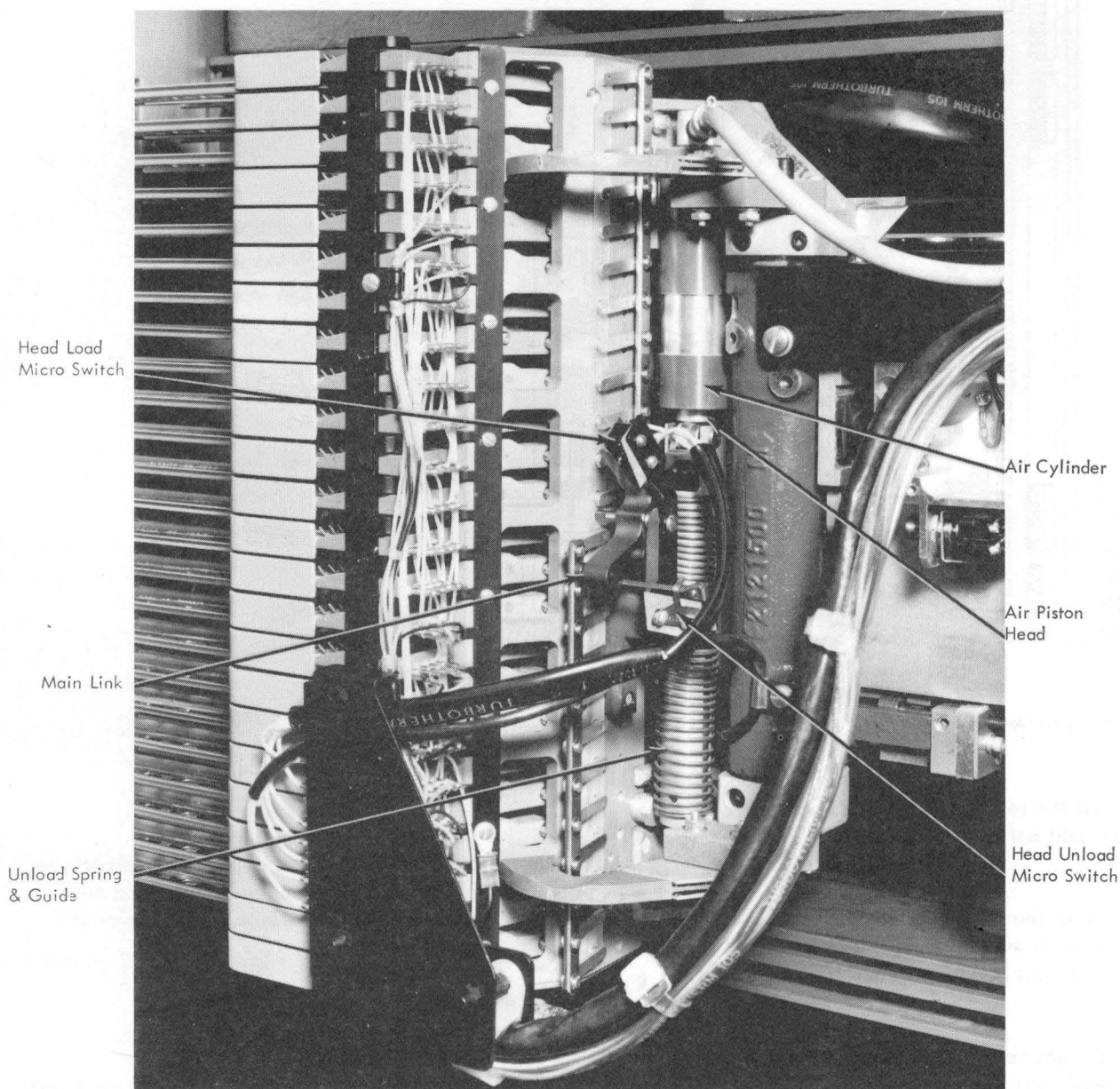
The magnetic elements in the drawer assembly are precisely located during manufacturing, and adjustment is not necessary or possible on latest model drawer assemblies.

Removal

1. Swing out receiver.
2. Remove drawer retaining pin (Figure 2-16).
3. Loosen drawer retaining screw.
4. Remove drawer by applying a clamping force with index fingers and pushing on adjacent drawers with thumbs (Figure 2-26). Drawer assemblies must be handled with care. Never handle assembly by stiffeners, arms, or diode boards.

Replacement

1. Check proper engagement of torsion-spring fingers with arms (Figure 2-25).



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Figure 2-22b. Integrated Head Load Receiver Assembly

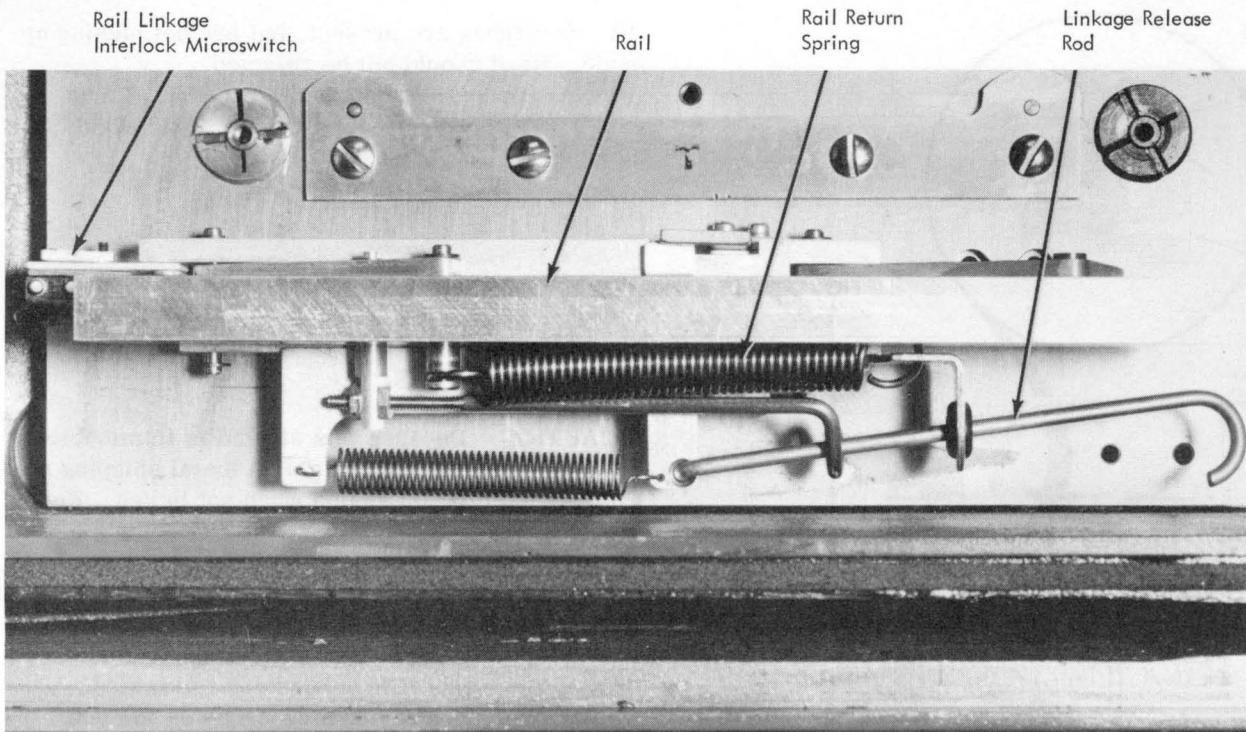
2. Check Bowed E-Ring and E-Ring for proper engagement.
3. Check that cable is not restricting gimbal action.
4. Insert drawer (Figure 2-27).
5. Seat drawer firmly with retaining screw.
6. Insert retaining pin through holes in drawers until E-Ring rests against top drawer.
7. Swing in receiver (see Receiver Swing-In Procedure).

Head

WARNING: Electrical arcing between the head and disk can occur if a voltage of about 25 v is applied between the isolated receiver and frame ground.

This amount of voltage will cause damage under the following conditions:

1. Assuming AC and DC grounds are isolated, arcing may occur if a DC voltage is shorted to frame ground. The power supply fuse



15483

Figure 2-23. 4-Bar Linkage

will not blow and damage may result if the head-disk spacing is less than nominal for the voltages under 25 v and at a nominal spacing for higher voltages. It is very easy to short a DC voltage to frame ground during servicing, e.g. (a) a gate may be opened against a metal object such as a metal stool or an oscilloscope cart. The back panel wiring can then be shorted to frame. (b) Scope leads left dangling, etc., can also cause trouble.

2. If AC and DC grounds are tied together at some point in the system, arcing will not occur if a DC voltage is shorted to the receiver or to the frame. However, there exists the possibility of wiring errors or a loose or broken ground wire at the receiver, in which case a DC voltage on the receiver may cause damage.
3. 24-v AC is present throughout the machine. A short between one side of the 24-v line and DC ground would apply 24 volts directly across the receiver and the frame.

NOTE: Remove all drawer assemblies in the receiver if a megger is used to check isolation.

Inspection and Routine Cleaning of the Read or Write Head

Inspection and routine cleaning of heads can normally be made without removing the drawers from the receiver. However, if in doubt concerning the condition of a head, it should be removed from the receiver for inspection.

Visual Inspection

The following is the criteria for rejecting heads. Particular emphasis should be given to areas in which:

- a. Oxide has accumulated due to scratches and/or projections.
- b. Oxide has accumulated without scratches.
- c. Heads contain scratches, but oxide has not accumulated.

Paragraphs (A) through (F) below refer to Figure 2-24a.

(A) Scratches and Oxide Build-Up. The degree to which a head is scratched is not necessarily the criteria for rejection. The amount and relative

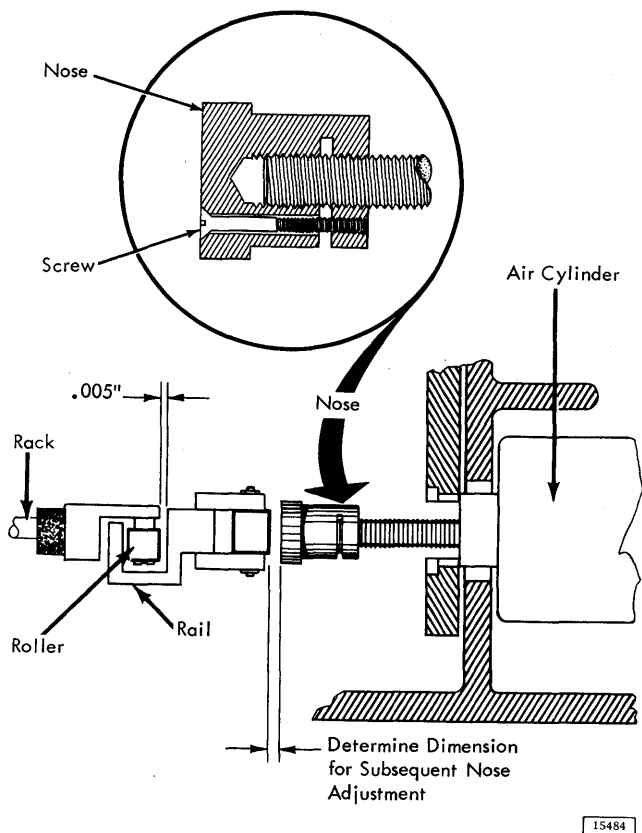


Figure 2-24. Air Cylinder Nose Adjustment

position of oxide build-up is much more significant. Scratches with oxide, are cause for rejection of the head. It may be necessary to remove the oxide to determine if a scratch has caused the build-up. Use lint-free tissue and 91 percent isopropyl alcohol per periodic maintenance instructions for cleaning.

(B) Oxide Build-Up Without Scratches. Foreign material of any type must be removed from the gliding surface before file operation is resumed. Provided no scratches occur in the oxide areas, this head may be cleaned per periodic maintenance instructions and reused.

If oxide has accumulated in the pole tip areas (in Figure B ,) the head should be rejected.

(C) Scratches are permissible on the gliding surface provided that no oxide is present.

(D) The radius around the entire perimeter of the shoe may pick up oxide during normal operation, and although the oxide should be removed, it is no cause for concern.

Inadequate cleaning and/or operation in a contaminated atmosphere results in an unsatisfactory condition. Contaminant removal is again essential prior to resuming file operation.

(E) Scratches are present, but are not picking up oxide. Head should not be rejected.

(F) A slight oxide build-up is present. Clean with 91 percent isopropyl alcohol. Head should not be rejected.

Cleaning

WARNING: Only isopropyl alcohol P/N 2155966 should be used for disk and head cleaning. This cannot be purchased locally and should be ordered from Mechanicsburg.

CAUTION: Because this alcohol is flammable, it must be stored in a one gallon metal shipping container with the lid sealed when not in use. Keep only a minimum quantity in the customer's office.

Inspection of all heads can be easily made without removing them from the receiver. If a drawer must be removed for cleaning, refer to Drawer Removal. Clean heads as follows:

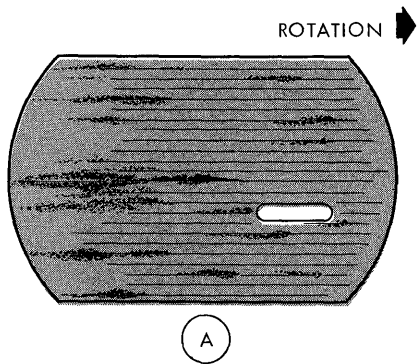
Place a piece of cleaning tissue on the test plate (P/N 2108024). Position the drawer so that both heads rest on the test plate with one head face down on the cleaning tissue to prevent scratching the gliding surface. Wrap a piece of cleaning tissue (P/N 2108036) around the head cleaning paddle (P/N 2108474). Moisten the cleaning tissue with alcohol (P/N 2155966) and remove any foreign material on the shoe face which is facing upward, using as little pressure as possible. Repeat for other shoe face.

CAUTION: No water marks from the alcohol or fingerprints should be on the gliding surface after cleaning.

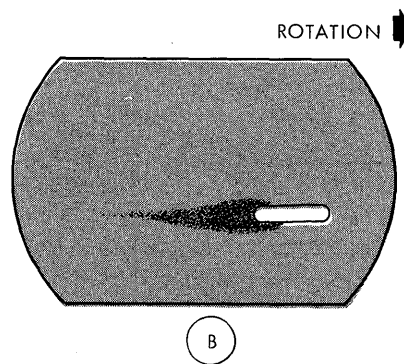
Service Check (For Steel Pivots)

Gimbal Torque Measurement. Pitch and roll torque measurements are made with a gram gage, P/N 2108473 or P/N 2108617 (Figures 2-28 and 2-29). With a head surface in a horizontal plane, the face of the gage must be in a vertical plane with the arm parallel to the head surface. Gimbal torque measurements must be made with drawers out of the receiver if the torque approaches the limits specified. A head that does not meet the minimum torque specification, as shown in Figure 2-30, must be replaced. Figure 2-30 indicates the areas where the gage arm must be applied.

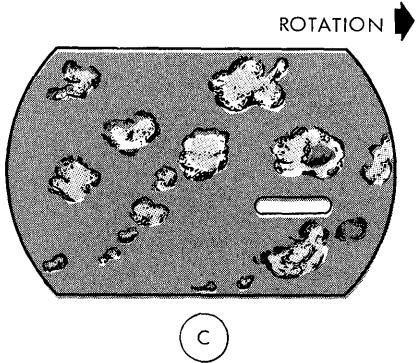
Readings must be taken on both sides of the head about the axis concerned and the average



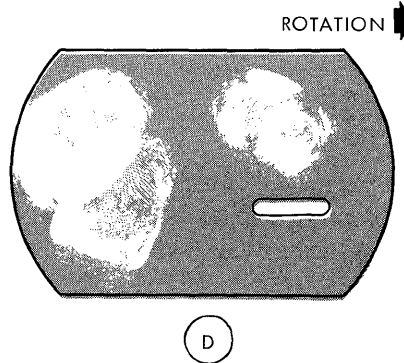
Scratch and oxide build-up due to scratches.
Replace drawer.



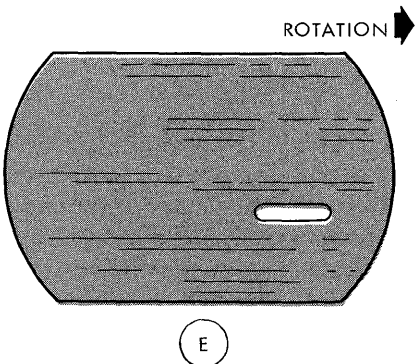
Oxide has accumulated in the pole tip area.
Replace drawer.



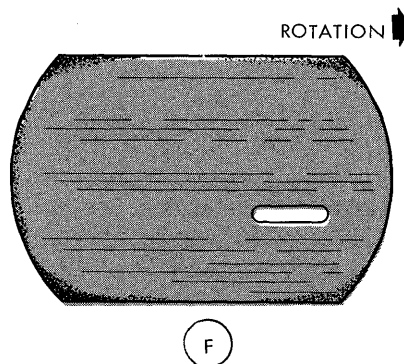
Alcohol Residue. Clean gliding surface with 91% isopropyl alcohol. However never allow alcohol to dry in small pools such that residue areas are formed. Remove alcohol, using lint-free tissue and a gentle wiping motion.



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



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



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

15329

Figure 2-24a. Head Imperfections

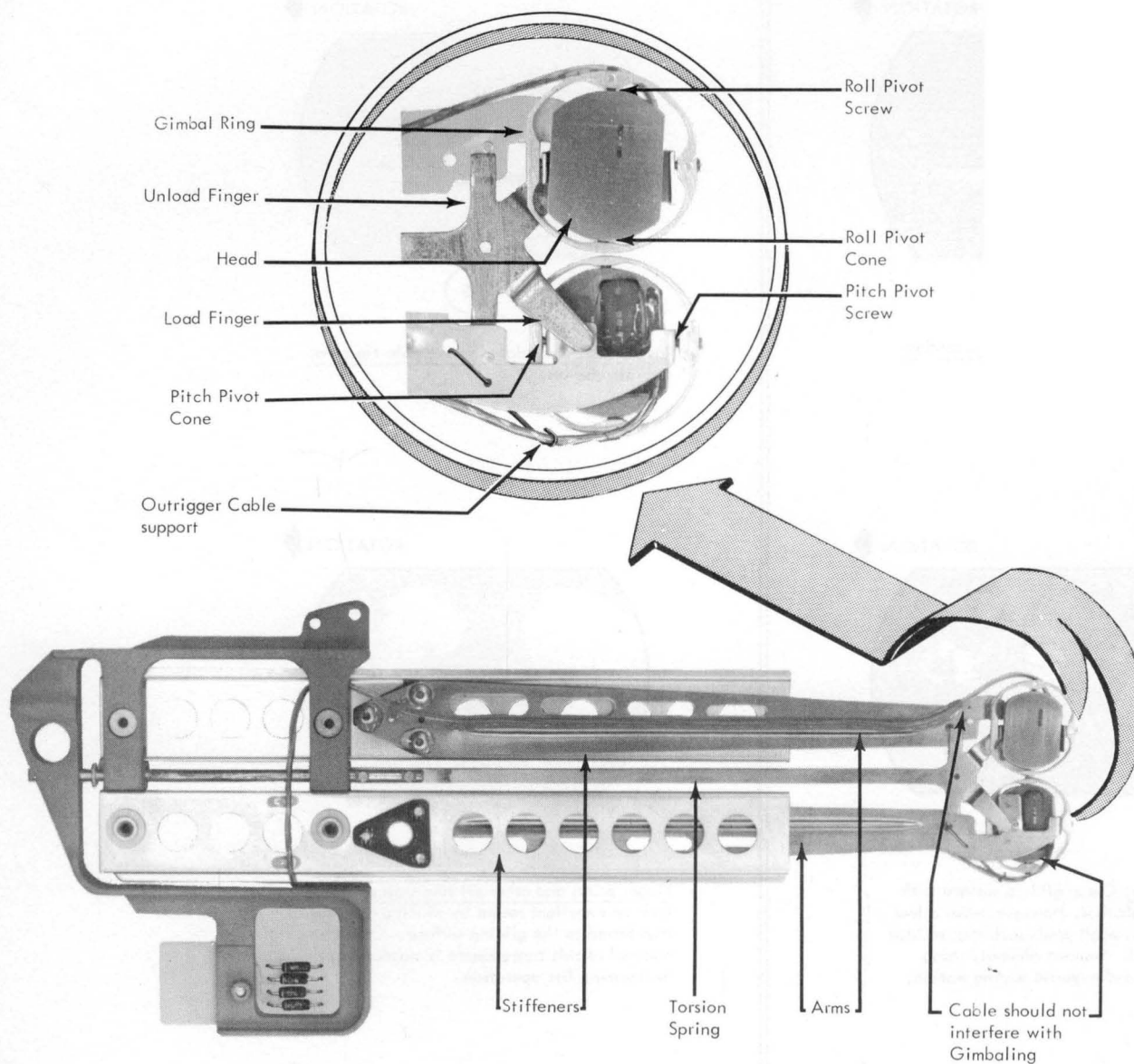


Figure 2-25. Drawer Assembly

computed. The desired reading occurs at the instant head motion is detected. If the average pitch or roll reading exceeds 50 grams, the pivots must be cleaned as follows:

Flush the pivot points with alcohol, P/N 2155966.

NOTE: Do not lubricate to reduce torque. Exercise the gimbal ring pivots for about 10 seconds by placing a piece of cleaning tissue on the face of the head and with the index finger gently move the tissue around

the periphery of the head face. Apply sufficient pressure so that all four pivots move in their cone hole. If this fails to reduce excessive torque, repeat the above procedure. The torque should again be measured and if it is still too high the drawer should be replaced.

NOTE: To measure torques above 30 grams utilize the X2 multiplier on the torque gage arm and multiply the gage reading by 2.

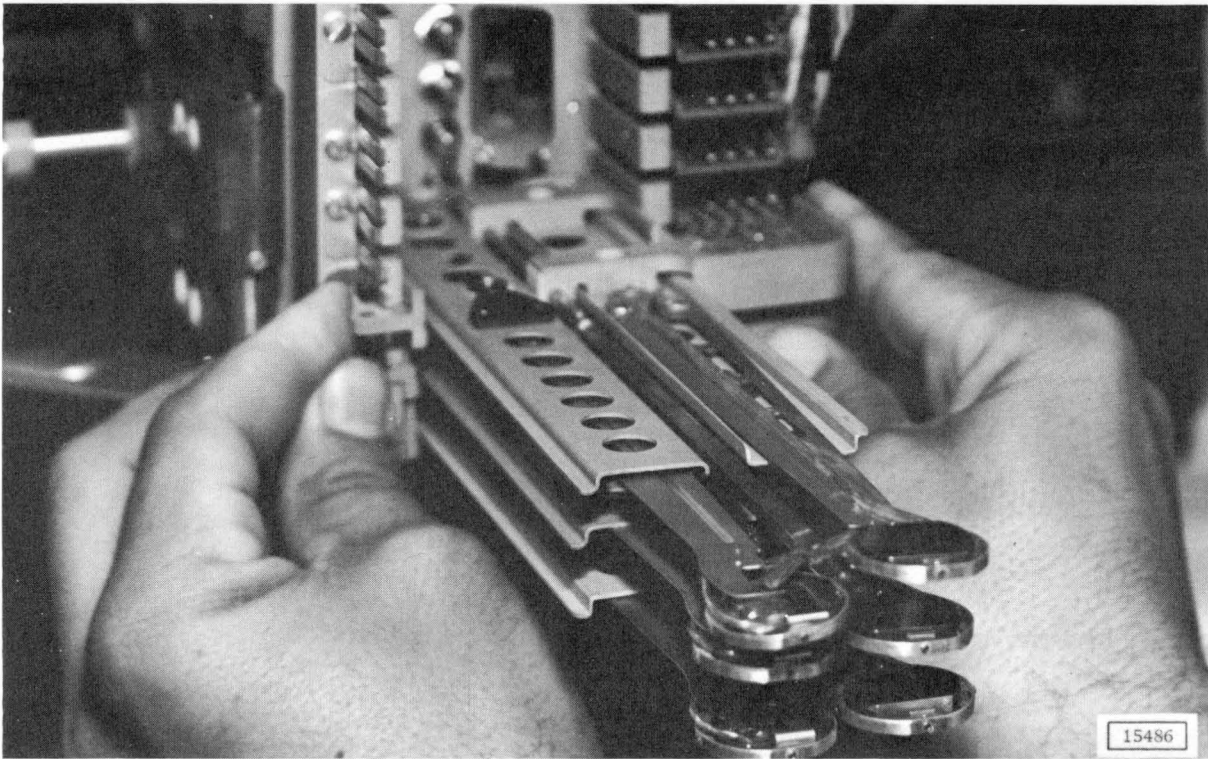


Figure 2-26. Drawer Removal

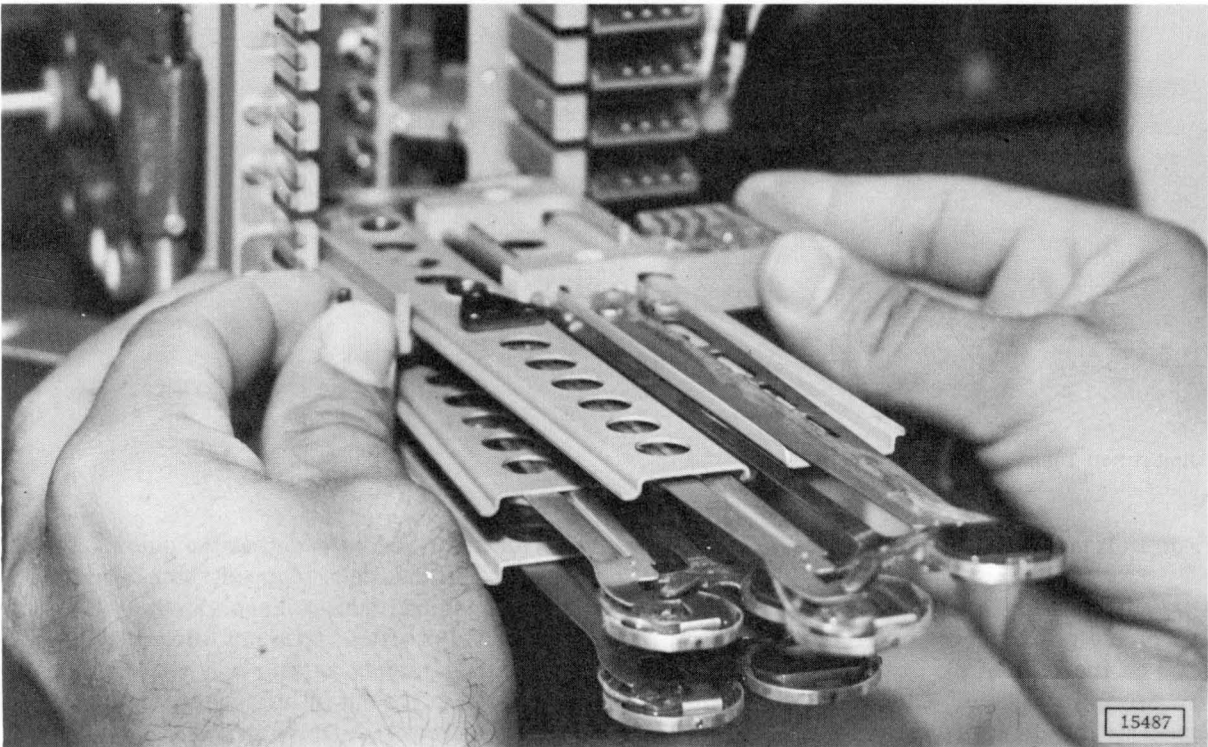
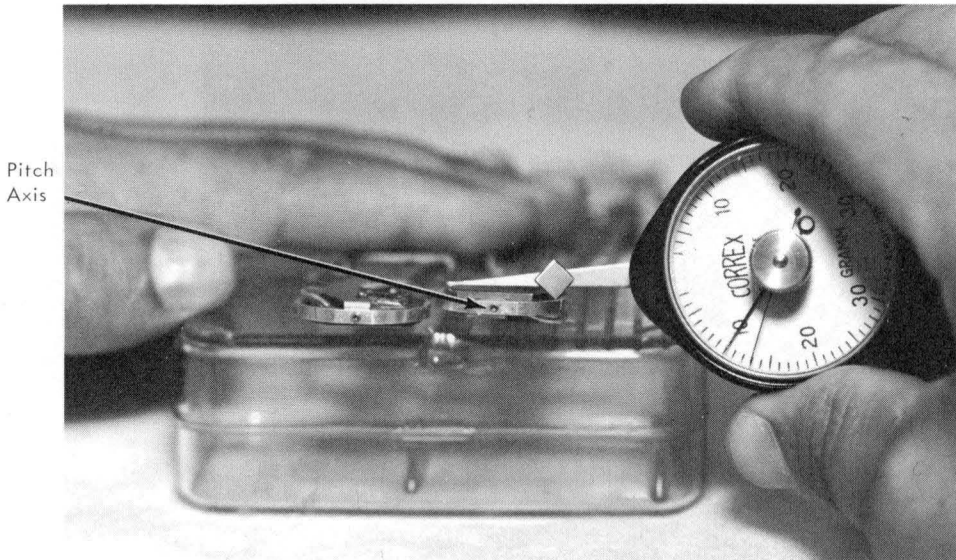
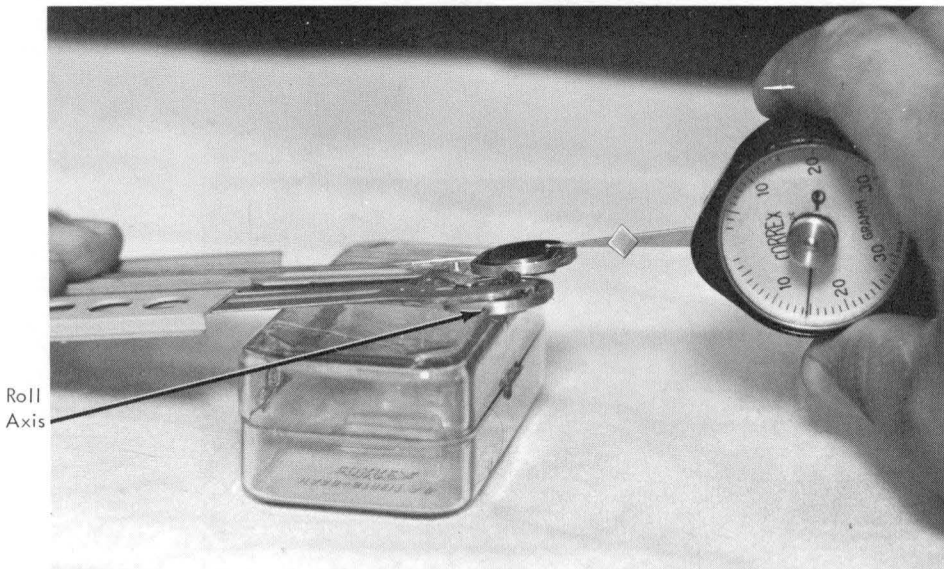


Figure 2-27. Drawer Insertion



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Figure 2-28. Head Gimbal Pitch Torque Measurement



15489

Figure 2-29. Head Gimbal Roll Torque Measurement

Service Check (For Delrin Pivots)

NOTE: Drawers equipped with Delrin pivots are identified by a red circle (.125" in diameter, Figure 2-29a) stamped on the rear of the drawer assembly adjacent to the torsion rod hole. Clock head assemblies equipped with Delrin pivots have the red circle stamped on the top side of the arm.

1. With the heads unloaded at the outer CE track and the disks stopped, manually load the heads and then release slowly to the unloaded position. (Do not allow the heads to unload rapidly as this may cause the heads to pivot out of alignment).
2. Turn on the Disk Drive motor. With the heads unloaded, check that the heads

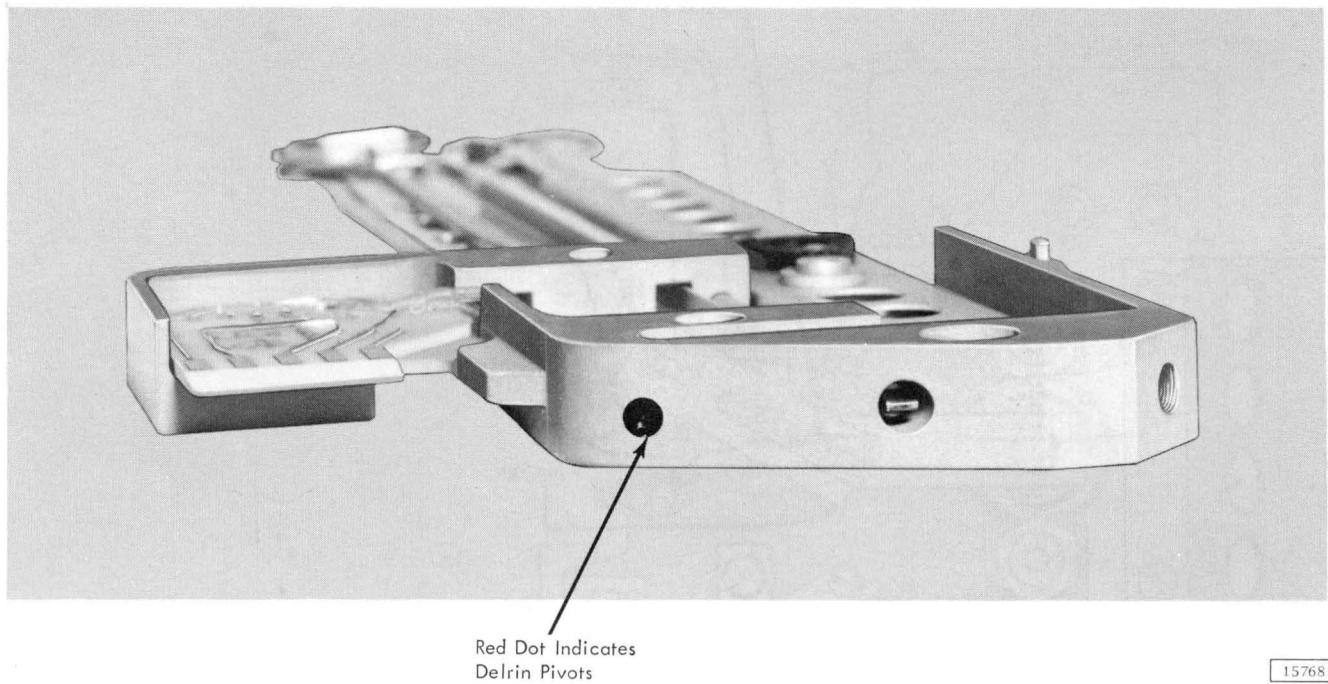


Figure 2-29a. Delrin Pivot Equipped Drawer

remain parallel to the disk surface. If the heads assume an angle in either the pitch or roll plane the disks must be stopped and step 1 repeated.

3. If the heads still assume an angle the drawer must be replaced as outlined in the section on Drawer As An Assembly.

SWING-OUT INTERLOCK MICROSWITCH

Adjustment

Adjust mounting bracket so microswitch is made by the drawer retaining pin when access is closed and locking pins are seated (Figure 2-16).

CLOCK HEAD

WARNING: Do not check continuity of the clock head while the head is loaded. If continuity of the clock head is checked with the head loaded, the clock track can be erased. The potential of a VOM is sufficient to erase the clock track.

The DC resistance of the clock head should measure approximately 4 ohms.

Two groups of three clock tracks each are recorded at intervals marked on the clock indexing plate (Figure 2-31).

The 625 kc clock tracks have 20,920 cycles. The 555.6 kc clock tracks have 18,618 cycles.

Each clock track must match the other tracks, cycle for cycle, except at the trailing edge of index time.

A gap or nonsymmetry may occur at the trailing edge of index time if the crossover point does not represent a phase shift greater than 36°.

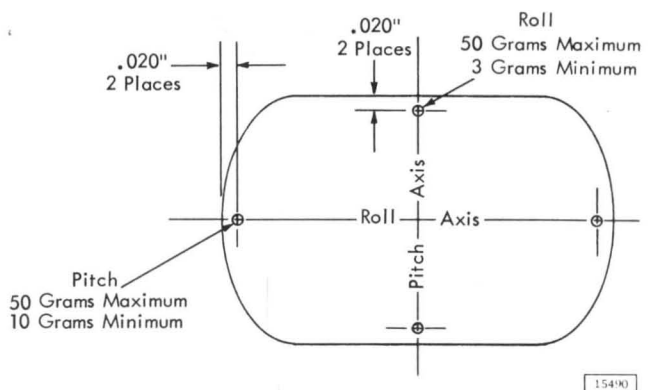


Figure 2-30. Gimbal Torque

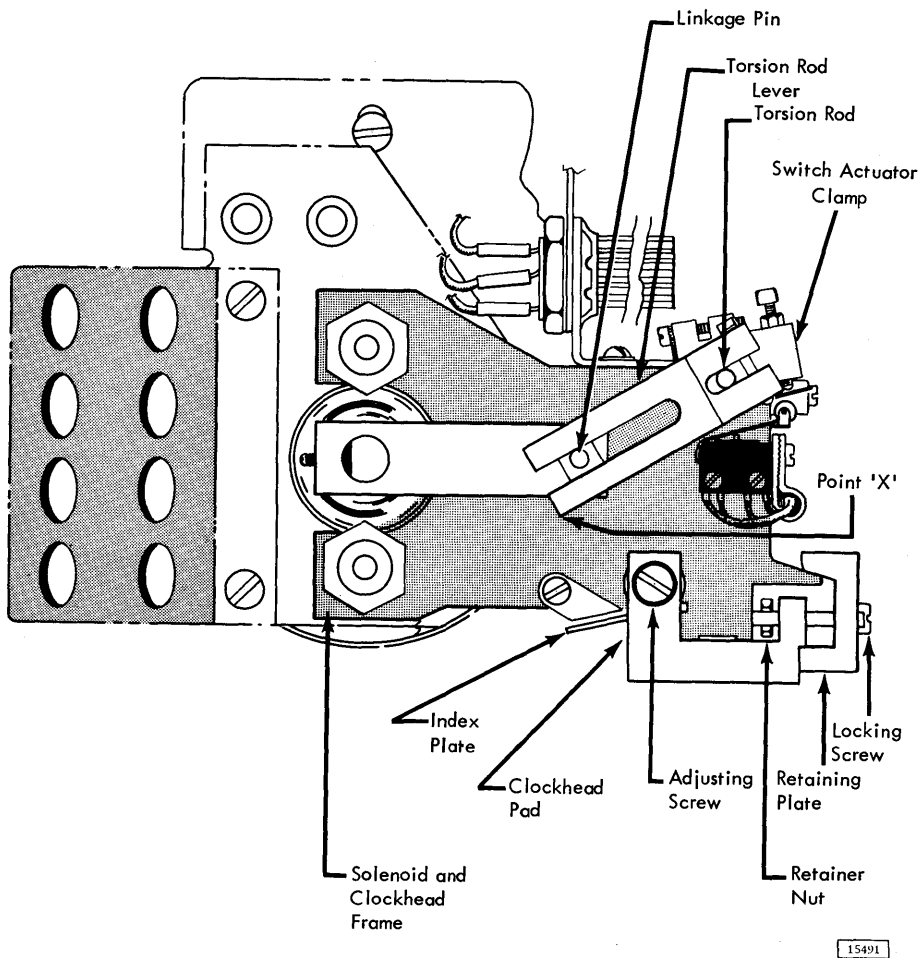


Figure 2-31. Clock Head Assembly

Service Check

The amplitude of the clock-head signal should average 2.0 to 2.5 volts peak-to-peak minimum for any ten-cycle period. This should be measured at the output of the second linear amplifier with a CA preamplifier added algebraically.

Clock Head as an Assembly (Figure 2-31)

Adjustment

1. Attach oscilloscope as in the service check.
2. Loosen locking screw.
3. Turn adjusting screw in or out to obtain maximum signal.

NOTE: IBM #6 may be used on the rails to facilitate moving head assembly.

Removal

1. Detach cable at plugs G01 and G02. Allow disks to stop rotating.
2. Adjust clock head as far forward as possible and remove rear mounting screw.
3. Back off clock head to its rearmost position and remove front mounting screw.
4. Lift clock-head assembly off locating pins, being careful not to damage disk. A folded IBM card can be placed over the clock disk with the lower flap between the disk and the clock head to protect disk.

Replacement

1. Check plastic shim for damage and replace if necessary. Clean mounting pad of chips and dirt before replacing shim.

2. Replace clock head assembly by slipping over locating pins. By means of the adjusting screw (Figure 2-32), adjust clock head as far in as possible and install rear mounting screw. Check for head to disk interference. Back off clock head to extreme out position and install front mounting screw.
3. With an ohmmeter, check the resistance between the clock-head support and the machine frame. This should exceed 2 megohms.
4. Attach cable at plugs G01 and G02.
5. Perform Clock-Head Service Check. Adjust if necessary.

3. Remove three mounting screws.
4. Lift arm assembly from locating pins and at the same time move the head down and toward the electronic frame to free the arm from the torsion spring.

Replacement

1. Engage arm into the torsion spring and into the locating pins.
2. Secure with three mounting screws and attach ground lead.
3. Connect cables G01 and G02.
4. Check torsion spring for proper engagement.
5. Check head loading and unloading.

NOTE: The clock-head assembly is pre-adjusted at the plant and should require no further attention, but failing to obtain the required signal, the following adjustment can be made.

With solenoid energized and head loaded, the torsion rod lever (Figure 2-31) should be clamped on the torsion rod in such a position that 260 ± 10 grams are required at point 'x' to lift it off the linkage pin (switch should not be actuated during this time). Adjust switch actuator clamp to close switch.

Clock-Head Arm Assembly (Figure 2-33)

Removal

1. Disconnect cable assembly to G01 and G02.
2. Disconnect jack leads.

CLOCK HEAD (Models 11, 12, 21, 22)

Three 625 kc clock tracks are recorded at the intervals marked on the clock indexing plate (Figure 2-33a). Each of the clock tracks contain 20,920 cycles less the 20 missing cycles representing the sector marks. Each clock track must match the other tracks, cycle for cycle, except at the trailing edge of index time. A gap or nonsymmetry may occur at this point if the crossover point does not represent a phase shift greater than 36 degrees.

The 1301 Model 11, 12, 21, 22 clock head may be adjusted radially for maximum signal in the same manner as the standard clock head. In addition, a circumferential adjustment of the head must be made to time the relation between the sector pulse and the record. The clock head-arm assembly pivots about a point (Figure 2-33b) to move the head in an arc and

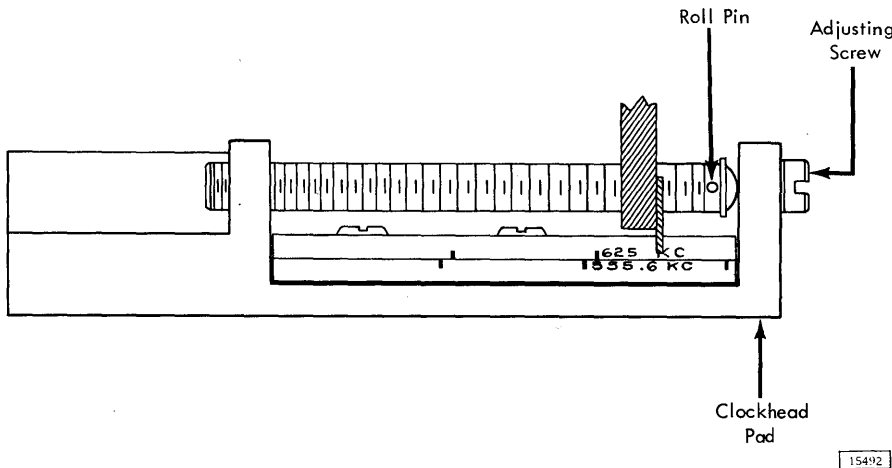


Figure 2-32. Clock-Head Adjustment

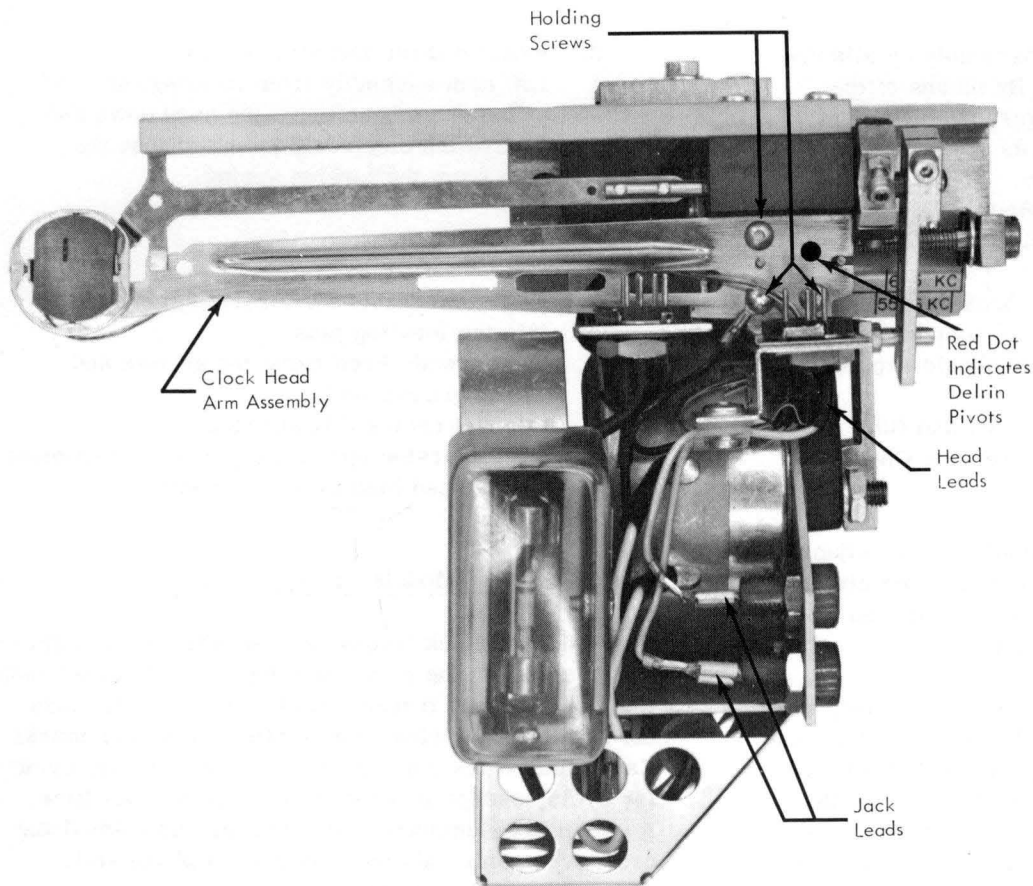


Figure 2-33. Clock Head-Arm Assembly

thus change the time relationship between the sector pulse and the data on the disks. Note that because of the arc through which the head is adjusted, the position of the head changes relative to the clock track. Thus, the radial adjustment must be checked if the sector pulse timing adjustment is made.

NOTE: The clock head-arm assembly is not removable from the clock head as in the basic 1301. Replace the entire clock head assembly if required.

WARNING: Do not check continuity of the clock head while the head is loaded. If continuity of the clock head is checked with the head loaded, the clock track can be erased. The potential of a VOM is sufficient to erase the clock track.

The d-c resistance of the clock head should measure approximately 4 ohms.

Service Check

The amplitude of the clock-head signal should be a minimum of 2.0 v peak-to-peak for any ten-cycle period. Measure this at the output of the second linear amplifier with a CA preamplifier added algebraically.

The rise of the 9.6 μ sec sector pulse single shot should line up with the leading edge of the pre-address AGC within $\pm 5 \mu$ sec.

Radial Adjustment

1. Attach oscilloscope as in the service check.
2. Loosen locking screw (Figure 2-33c).
3. Turn adjusting screw in or out to obtain maximum signal.

NOTE: IBM #6 may be used on the rails to facilitate moving head assembly.

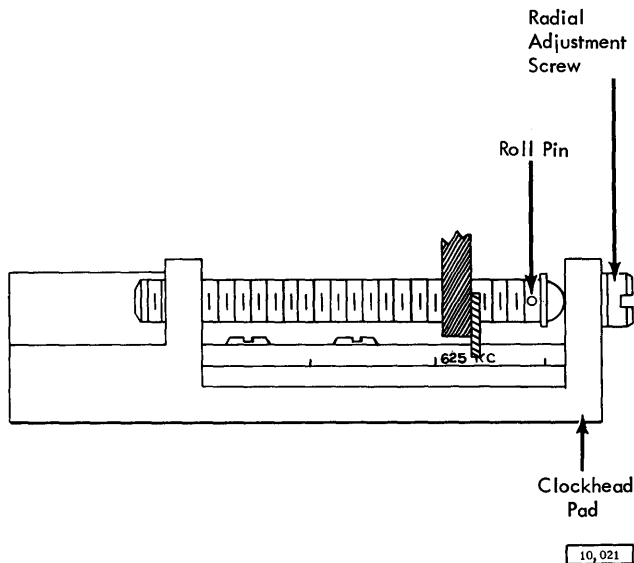


Figure 2-33a. Clock Head Radial Adjustment

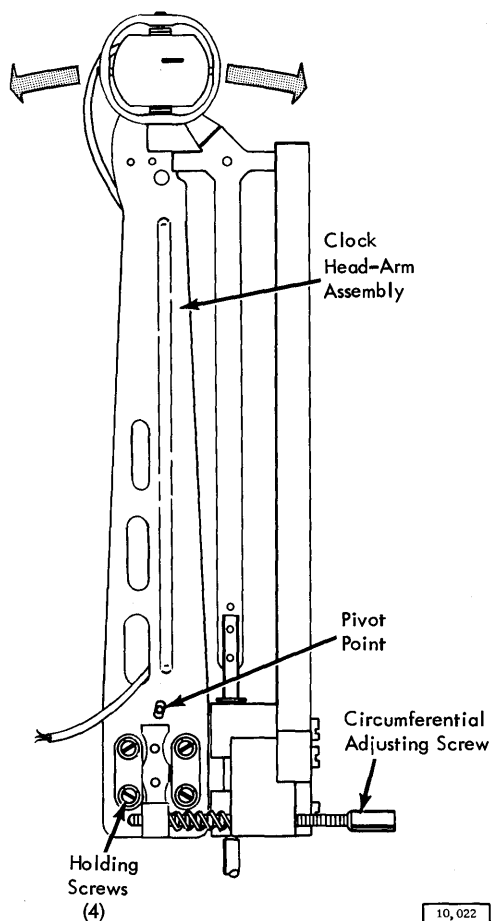


Figure 2-33b. Models 11, 12, 21, 22 Clock Head-Arm Circumferential Adjustment

Circumferential Adjustment

It should normally not be necessary to make the circumferential adjustment except when replacing the clock head assembly. The radial adjustment is made first, then the circumferential. The radial adjustment should then be rechecked.

1. Connect oscilloscope to observe the $9.6 \mu\text{sec}$ sector pulse (01B2 C03P) and the beginning of the pre-address AGC on any track (Raw Read Data at 01B1 D24B).
2. Turn the circumferential adjusting screw (Figure 2-33c) until the pre-address AGC lines up with the rise of the sector pulse. Do not loosen the screws holding the arm assembly to the clock head. Spring washers hold the arm in place. Approximately one turn of the adjusting screw is required to take up thread clearance.

WARNING: Do not turn the adjusting screw more than three turns in either direction from the center location. Damage to clock head parts will result.

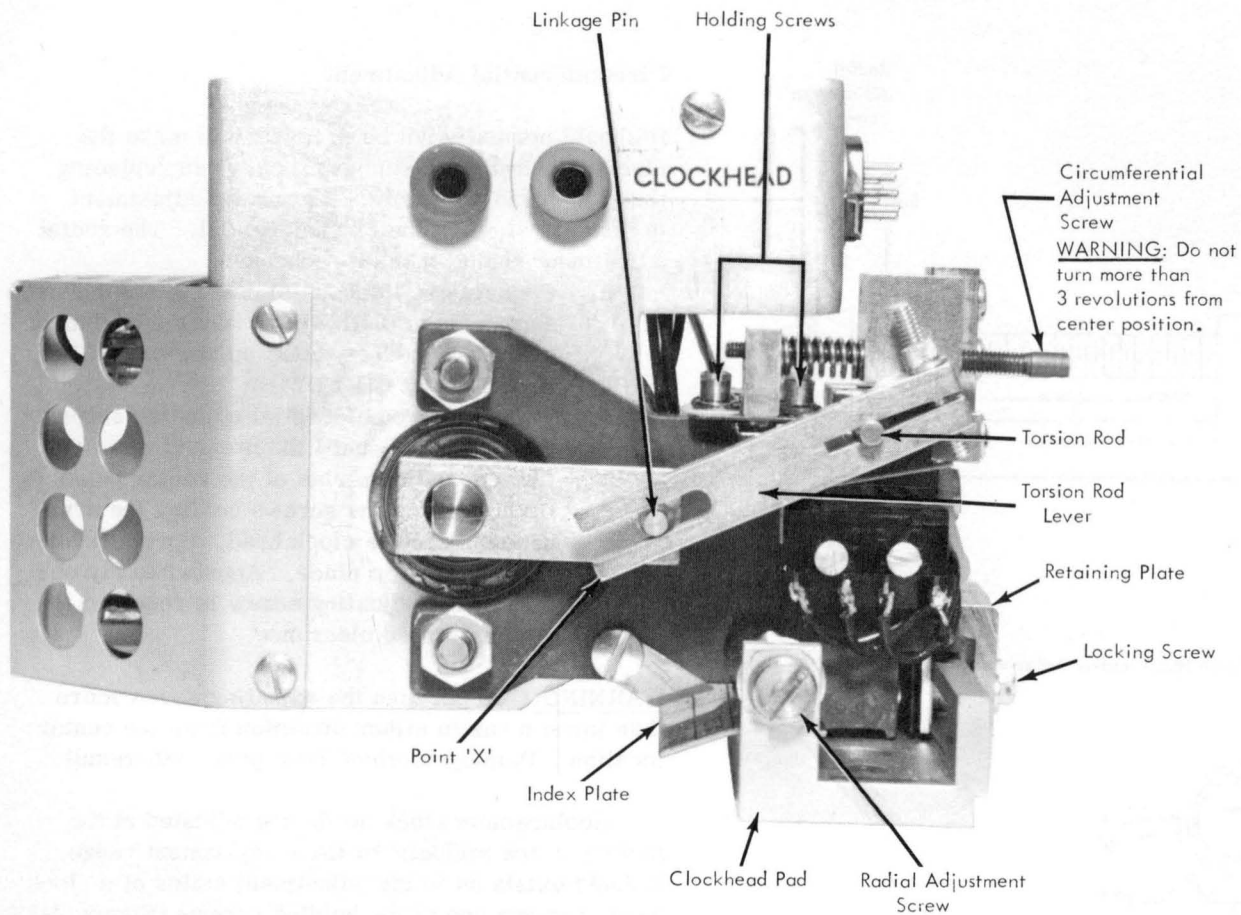
Replacement clock heads are adjusted at the factory at the midpoint of their adjustment range. If doubt exists as to the adjustment status of a clock head, remove one of the holding screws (Figure 2-33b) and check the threaded hole position relative to the hole in the head arm. The threaded hole will be in the middle of the hole in the arm at the midpoint of the adjustment range.

Removal

1. Detach cable at plugs G01 and G02. Allow disks to stop rotating.
2. Adjust clock head as far forward as possible and remove rear mounting screw.
3. Back off clock head to its rearmost position and remove front mounting screw.
4. Lift clock-head assembly off locating pins, being careful not to damage disk. A folded IBM card can be placed over the clock disk with the lower flap between the disk and the clock head to protect the disk.

Replacement

1. Check plastic shim for damage and replace if necessary. Clean mounting pad of chips and dirt before replacing shim.
2. Replace clock head assembly by slipping over locating pins. By means of the adjusting screw (Figure 2-33a), adjust clock head



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Figure 2-33c. Clock Head Assembly

as far in as possible and install rear mounting screw. Check for head-to-disk interference. Back off clock head to extreme out position and install front mounting screw.

3. With an ohmmeter, check the resistance between the clock-head support and the machine frame. This should exceed 2 megohms.
4. Attach cable at plugs G01 and G02.
5. Perform Clock-Head Service Check. Adjust if necessary.

NOTE: The clock-head assembly is preadjusted at the plant and should require no further attention. If the required signal cannot be obtained, the following adjustment can be made.

With solenoid energized and head loaded, the torsion rod lever (Figure 2-33c) should be clamped on the torsion rod in such a position that 260 ± 10 grams are required at point "x" to lift it off of the linkage pin (switch should not be actuated during

this time). Adjust the switch actuator clamp to close the switch.

HYDRAULIC ACTUATOR

CAUTION: Any time maintenance is to be performed around an actuator with power on, the access mechanism must be set INOP and the safety circuits which hold the actuator output shaft detented (while the access cover door is removed) must be checked at least once for correct operation before proceeding.

WARNING: With hydraulic power supply P/N 2164574 (Figure 4-10), the hand valve on the bottom of the manifold must be open except when pressure readings are being taken.

This Safety check is accomplished as follows:

1. Set the desired access inop.
2. From the CE panel, reset rezero.

3. Set in an address of 200 cylinders.
4. Check rezero operation by setting rezero. Check that the detent holds about 1 second while address clears, and is followed by a slow return of carriage to outer limit stop.
5. Reset rezero and set in an address of 20 cylinders.
6. Remove access cover. This should cause rezero to come on. The cylinder address should clear, and the detent should hold.
For the first second after removal of the cover, the detent will be held, even if the switch is bumped. After that, when the switch is bumped or depressed, the carriage will return toward the outer limits at rezero force, but only while the switch is closed. When it is released, the detent will drive in and hold.
7. With cover off, try to reset rezero from CE panel. Try to set a new address. Both should be impossible. Check an address of over 200 cylinders in the same manner. (Dropping of the piston adders will cause slight movement of the carriage.)
8. After safety check is made, set access to the desired location and proceed.

CAUTION: Although the actuator is electronically interlocked when the access-cover door is open, the actuator may attempt to move under hydraulic pressure if solenoid DC power goes off for any reason.

Service Check

The following technique is to be employed if a stuck hydraulic valve is diagnosed in the actuator.

NOTE: This applies to files with hydraulic power supply. P/N 2121874 (Figure 4-9) only.

1. Shift selector valve on hydraulic power supply to circulate: leave at this position for 10 minutes.
2. Shift selector to H/P.
3. Turn off hydraulic pump.
4. Manually pick and hold R64 (file ready) relay in power sequence gate.
5. Set access inop.
6. Pick solenoid of stuck valve from CE panel several times.
7. Remove manual hold of R64.
8. Turn on hydraulic pump.

9. Pick solenoid of stuck valve from CE panel several times.
10. If valve transfers now, pick rezero solenoid and leave in this position for 15 minutes. If valve does not transfer, repeat steps 3 through 9. Steps 3 through 9 should be repeated several times before replacing actuator.
11. Drop rezero solenoid.
12. Shift selector valve on hydraulic power supply to circulate: leave at this position for 10 minutes.
13. Shift selector valve to H/P.
14. From CE panel, select solenoids to move carriage to all track positions before returning to normal operation.

Actual internal repairs and adjustments are not allowed. If actuator proves to be defective, it is to be replaced.

Removal (Figure 2-34)

1. Remove receiver assembly including electrical cables. All power should be off and disks stopped (see Receiver Removal).
2. Disconnect the following three electrical connectors to actuator:
 - a. One on actuator lid.
 - b. One for motion transducer.
 - c. One to limit stop plate and switch assembly.
3. Disconnect bleed line from actuator lid and install cap (P/N 2121687) on nipple.

WARNING: Do not start hydraulic power supply with bleed line disconnected.

4. Unlock and back off radial positioning screw.
5. Disconnect pair of hydraulic lines located at back of actuator housing by loosening retaining screw between lines. Catch oil drippings with absorbent cloth or paper. Wrap quick-disconnect with lint free tissue.
6. Remove actuator by removing four actuator mounting screws. This step requires two people. With actuator resting on horizontal positioning key, unit must be held against mounting plate, while screws are being removed. Be certain that two men lift actuator off positioning key. The actuator weighs about 60 pounds.
7. Push carriage fully forward.

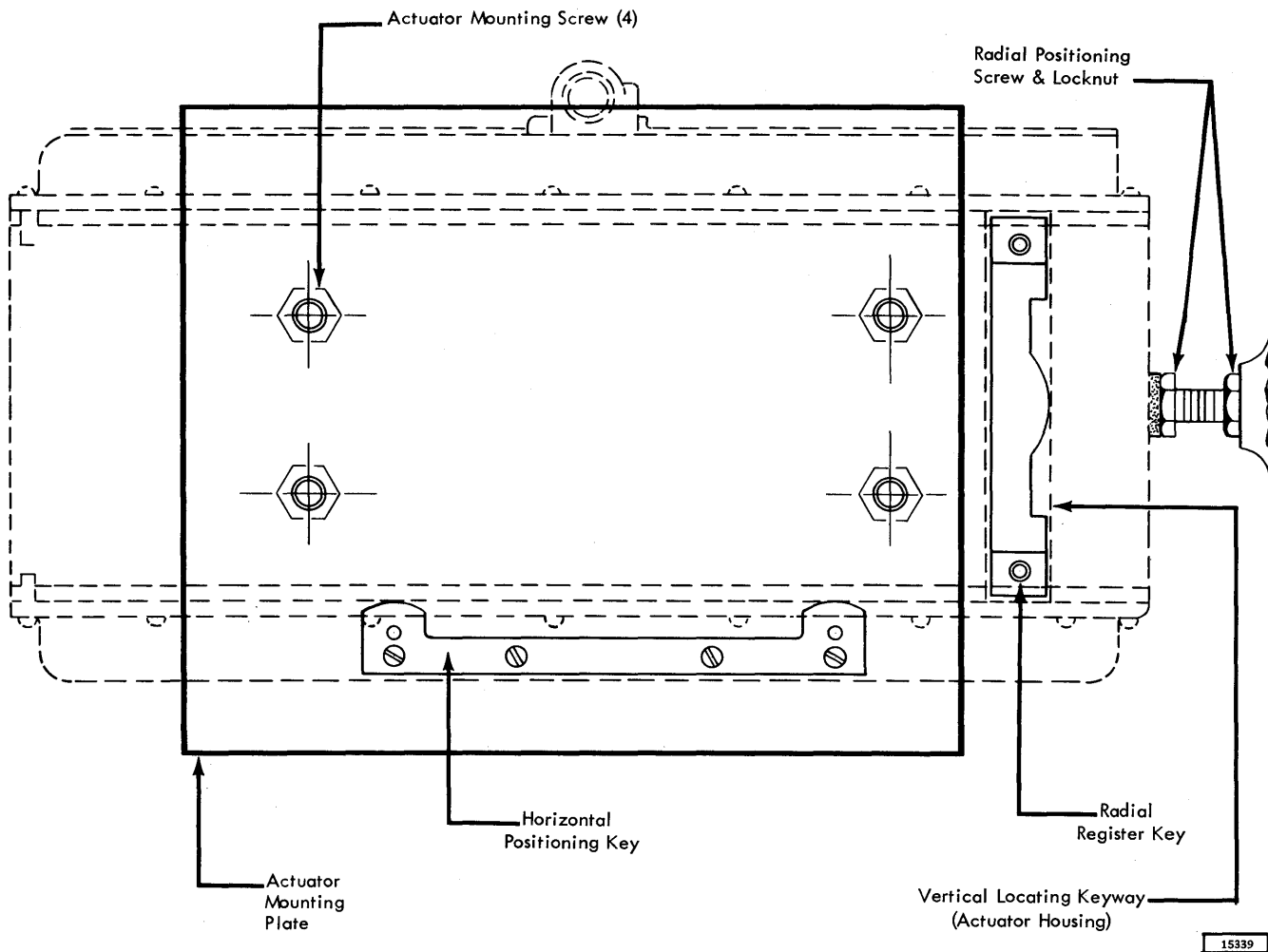


Figure 2-34. Radial and Horizontal Positioning Keys

Replacement

NOTE: Replacement actuators and associated hardware are to be ordered as follows: For 1301 and T1301, order bill of material 2155982. For 353, order bill of material 2164555.

1. Clean actuator mounting surfaces.
2. Make sure that actuator fittings are clean. Do not remove protective caps of new actuator until ready for connection to hydraulic lines.
3. Mount actuator on mounting plate. Make sure that actuator is resting on horizontal positioning key, and that vertical locating keyway is straddling radial register key.
4. Insert and finger tighten four mounting screws.
5. Torque radial positioning screw and lock

with lock nut. Because of the arm leverage of the actuator-torque-wrench adapter (P/N 2108436), the actuator-torque wrench (P/N 2108435) must be set for 12" lb. This setting gives the desired screw torque of 25 ±2 inch pounds.

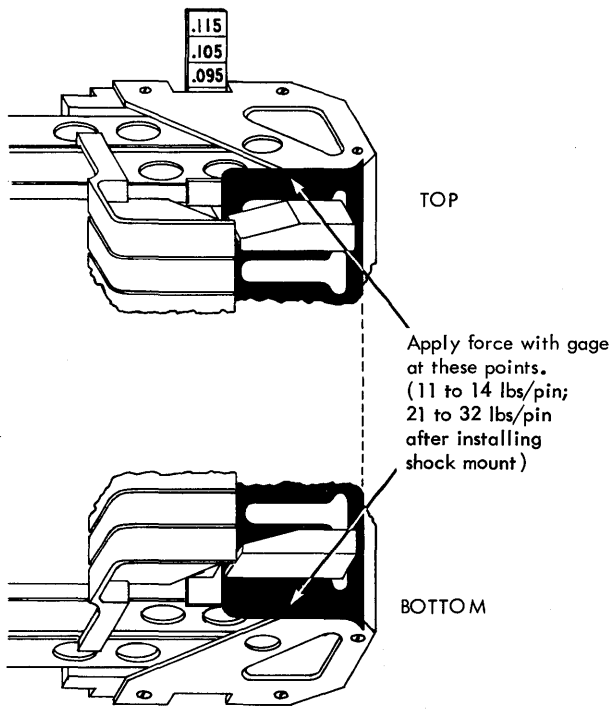
WARNING: The actuator housing can be damaged in the area where the housing is positioned against the radial locating key if excessive torque is applied to the radial positioning screw. To eliminate the possibility of damaging the actuator housing, the radial positioning screw should be torqued to a setting of 12" lb at the wrench dial. When using the torque wrench and adapter, exercise caution to assure that the wrench is used in the direction which snaps to indicate proper torque (wrench is solid in opposite direction).

6. Torque four actuator mounting screws to 75 ±10 inch pounds.
7. Remove caps from new actuator.
8. Connect two hydraulic lines, one bleed line and three electrical connectors.
9. Replace Receiver Assembly (see Receiver Replacement).
10. After the receiver is installed to the new actuator, check the force required to easily engage the diamond pins in their carriage position (Figure 2-35). If the required force is not within the 11 to 14 lb range, add or subtract shims as shown in Figure 2-36.

WARNING: When making the diamond pin force checks, the pin opposite the one being checked must be engaged.

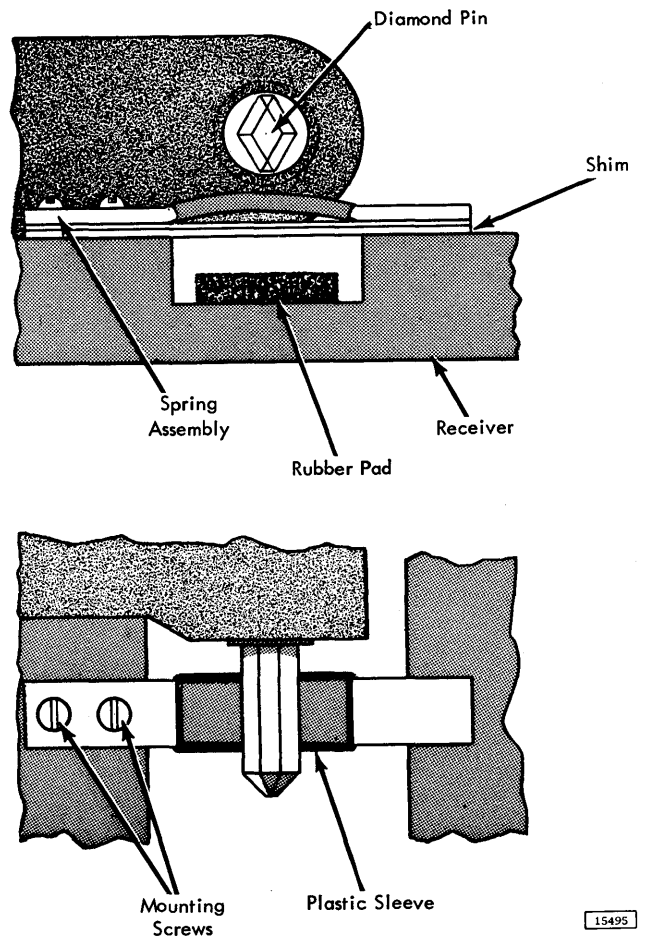
11. Install a new shock mount when the actuator has been replaced:
 - a. With receiver locked to carriage, measure the distance between receiver and carriage with gage P/N 2108576 as shown in Figure 2-35.
 - b. Note the number which appears on the gage just above the receiver (.095" as shown in Figure 2-35). This should indicate the shock mount to be used.

- .085" thick P/N 2155709
 - .095" thick P/N 2155710
 - .105" thick P/N 2155711
 - .115" thick P/N 2155712
 - .125" thick P/N 2155901
- c. Swing out the receiver and clean the surface of the receiver indicated in Figure 2-37 with isopropyl alcohol.
 - d. Remove the protective covering from the appropriate shock mount assembly and press it firmly in position (Figure 2-37).
 - e. Swing receiver in, and with a force gage, measure the force required to freely disengage each diamond pin (Figure 2-35). This force should be a minimum of 21 pounds at each pin but if it exceeds 32 pounds, use the next lower thickness shock mount.
 - f. Reinsert drawers and retaining pin, tighten drawer retaining screws, and follow Receiver Swing-In Procedure.



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Figure 2-35. Force Measurement



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Figure 2-36. Diamond Pin Springs

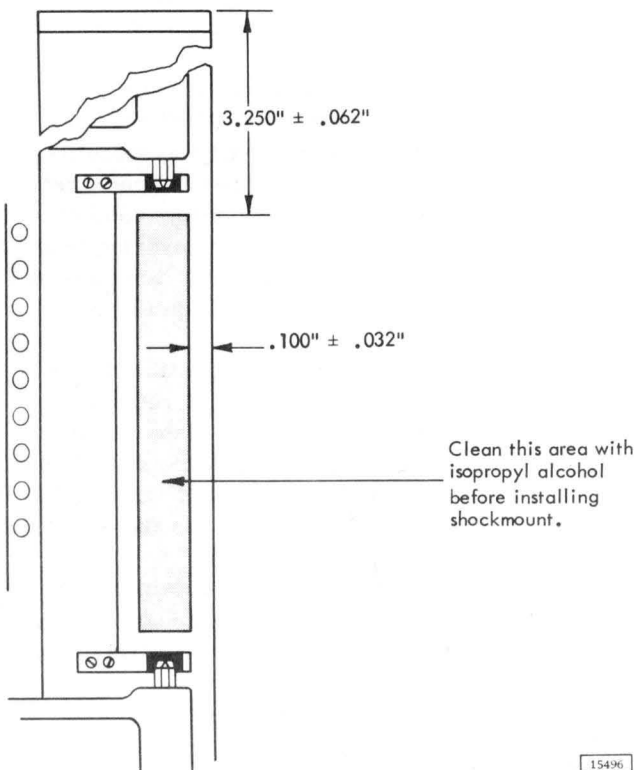


Figure 2-37. Shock Mount Installation

12. Check carriage gib adjustment, yoke inner limit stops, and inner and outer limit switch adjustments (see Limit Switches).
13. Measure the resistance of the primary of the detent detector coil as specified in the note on system diagrams page B7.A5.02.0. Add or remove jumper as required.

ACTUATOR CARRIAGE

The carriage gib and the actuator housing ways are a matched set, lapped for maximum sliding surface contact with minimum friction. Gib adjustment is provided only to compensate for wear. This adjustment should not normally be required at each scheduled maintenance period.

Carriage Gib (Figure 2-38)

Service Check

The carriage gib adjustment can be accurately checked and corrections made only when machine is at operating temperature and disks are rotating at maximum speed.

1. Properly lubricate ways with a light film of IBM #6 oil.

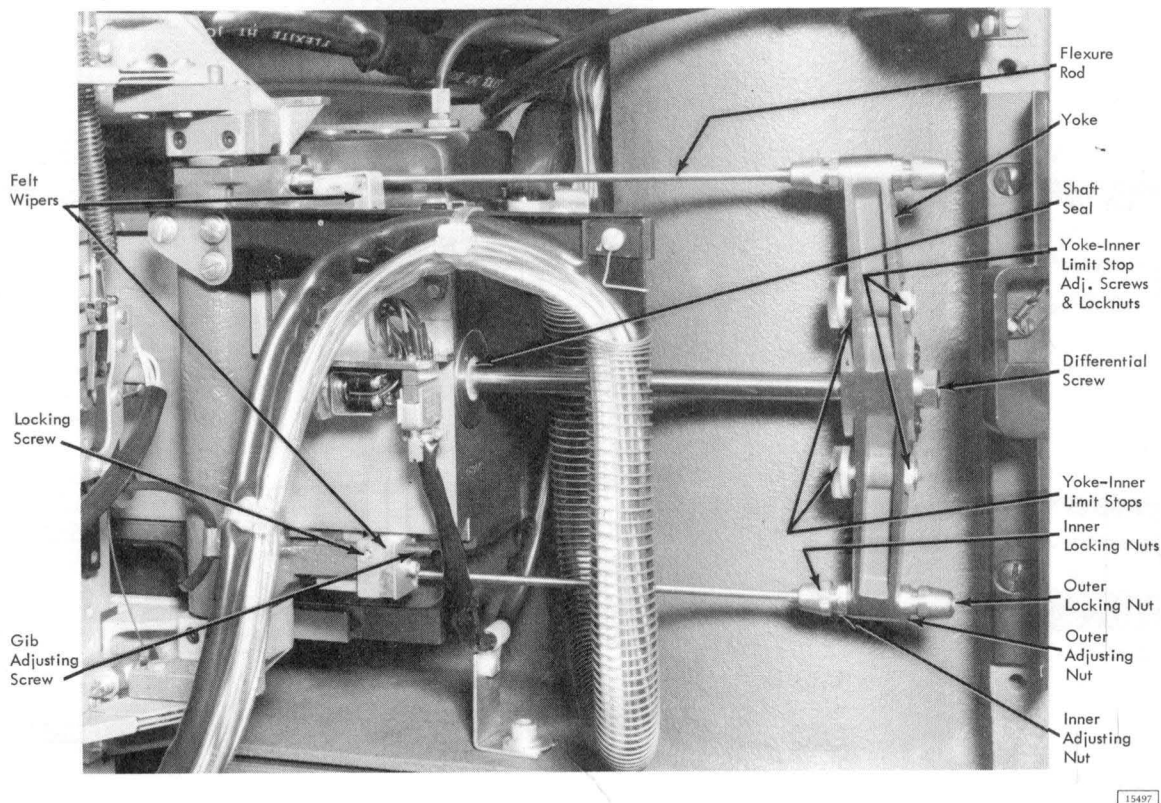


Figure 2-38. Carriage Components

2. Load the heads.
3. Disengage yoke assembly from both flexure rods by removing outer flexure rod locking nuts and adjusting nuts. Do not disturb setting of inner flexure rod locking nuts and adjusting nuts.
4. Check the gib for a 3 lb \pm 1 lb moving drag of the carriage. Check this moving drag at 4" to 8" per second velocity with the actuator housing at operating temperature after accessing on the fast oscillator for at least one hour.
5. Move carriage assembly slowly and smoothly between inner and outer limit stops. No binds of any nature must exist. Static (break-away) friction of from 6 to 8 lb is considered normal.

Adjustment

1. Perform carriage gib service check.
2. Free locking nut for adjusting screw.
3. Turn adjusting screw until conditions 5 and 6 of service check are satisfied. A clockwise movement of the adjusting screw tightens gib and counterclockwise motion loosens gib.
4. Secure locking screw for gib adjusting screw.
5. Attach yoke to flexure rods and replace outer flexure rod adjusting and locking nuts.

Yoke Assembly (Figure 2-39)

The yoke assembly is connected to the actuator output shaft through the use of a differential screw. The differential screw facilitates accurate positioning of

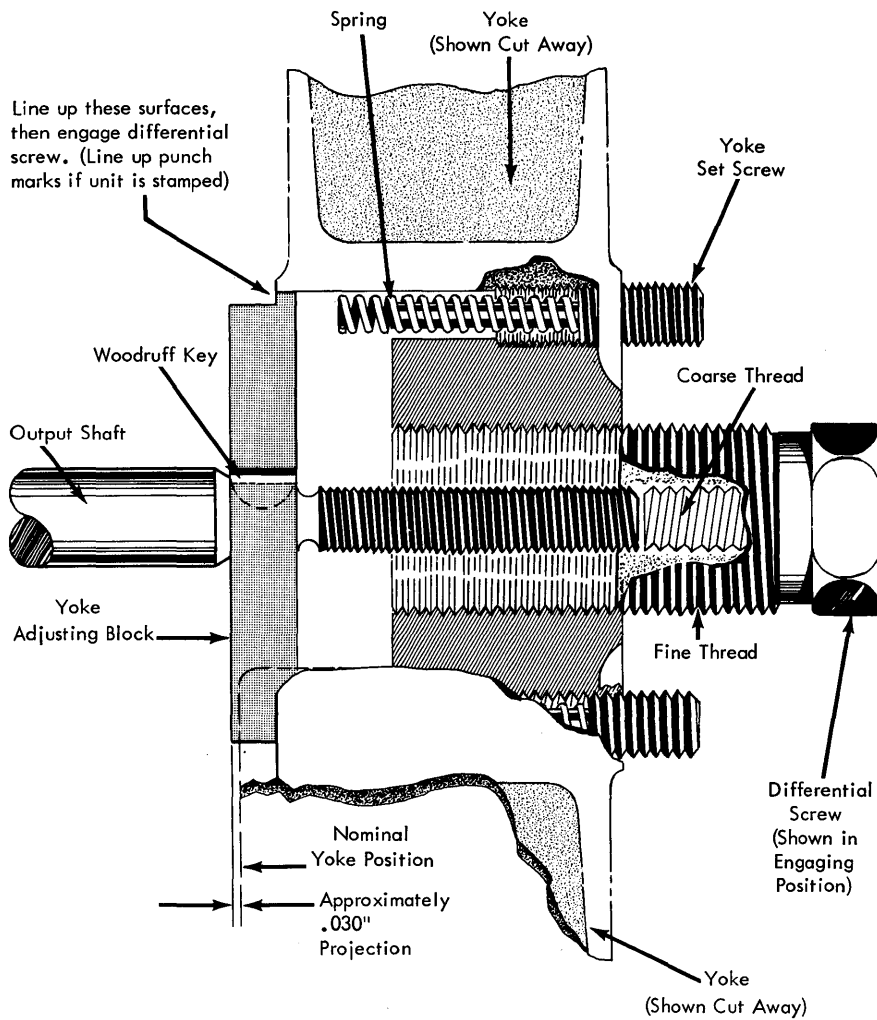


Figure 2-39. Yoke Adjustment

read/write head with respect to previously written information. Thread backlash is taken up by spring-loaded set screws. It is important that the yoke adjusting block projects equal amounts at top and bottom.

Adjustment

1. Alternately loosen yoke set-screws until differential screw is free to turn.
2. Monitor the differential read data at pins "A" and "C" of "TEL" card 5B07 and turn differential screw until maximum head signal amplitude is obtained.
3. Lock differential screw in position by alternately "snugging up" both set screws, and torque to 10 ± 2 inch pounds.

Removal (Figure 2-40)

1. While power is still on, position heads at cylinder 0 and:
 - a. Measure and record space between actuator outer limit stop and carriage limit stop. This should be $.076'' (+.002, -.001'')$.
 - b. Measure and record signal amplitude at head 20.
2. Turn power off and proceed:
 - a. Remove actuator shield.
 - b. Remove yoke set screws.
 - c. Remove differential screw.
 - d. Remove yoke by sliding output shaft into actuator housing.
 - e. Remove yoke adjusting block from output shaft.

Replacement (Figure 2-39)

1. Install yoke adjusting block on output shaft.
2. Align two punch marks (or on some models machined edge) on yoke adjusting block with yoke inner face and carefully engage differential screw. This is to obtain proper relationship for coarse and fine thread engagement.
3. Install set screws and springs with sufficient thread engagement to produce a preloading effect.
4. Continue turning differential screw until yoke adjustment block projects approximately $.030''$ from yoke.
5. Use yoke set screws to maintain an even projection and torque to 10 ± 2 inch pounds.
6. Push carriage in against inner limit stop and start file.

7. Detent output shaft at cylinder zero and measure space between actuator outer limit stop and carriage limit stop. Check value against that obtained in step 1a of the removal procedure. Compare signal amplitude from head 20 against that obtained in step 1b of the removal procedure. Obtain agreement by adjusting differential screw (see Yoke Assembly Adjustment).

Carriage Flexure Rods (Figure 2-38)

Motion is transmitted to the carriage from the actuator through its output shaft and the yoke assembly. The carriage is attached to the yoke by means of two flexure rods. It is important that the force presented by the output shaft be evenly distributed between the two flexure rods.

Service Check

1. Check for evenness of projection of yoke adjusting block from inner face of yoke assembly. (See Yoke Assembly Replacement procedure.)

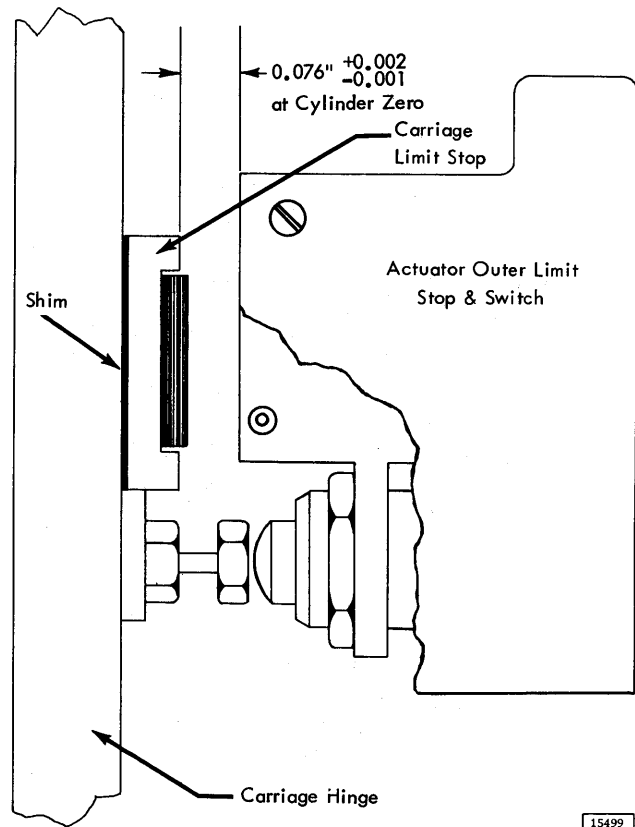


Figure 2-40. Carriage Outer Limit Stop Adjustment

2. Loosen the outer flexure-rod locking and adjusting nuts. Do not disturb the setting of inner flexure rod locking and adjusting nuts.
3. Move the carriage slowly back and forth with respect to yoke assembly. The top and bottom inner face of yoke must contact top and bottom inner flexure-rod adjusting nuts simultaneously.

Adjustment

1. Position heads at cylinder zero.
2. Loosen outer and inner flexure rod locking and adjusting nuts.
3. Place a .076" shim between carriage limit stop and actuator outer limit stop (see Figure 2-40).
4. Rotate inner flexure rod adjusting nuts until they meet inside face (top and bottom) of yoke assembly simultaneously.
5. "Snug up" outer flexure rod adjusting and locknuts. Care must be taken to avoid putting a torsional strain on actuator output shaft.
6. Without disturbing setting of inner flexure rod adjusting nuts, tighten their respective locking nuts.
7. Monitor head 20 output on an oscilloscope and by means of differential screw, position carriage for maximum signal amplitude at cylinder zero (see Yoke Assembly Adjustment).

Yoke Inner Limit Stops (Figure 2-41)

Two adjustable plastic pads are provided on yoke assembly. These, together with the plastic pads on the inner limit stops, provide a cushioning effect if the carriage overtravels.

Adjustment

1. Swing out receiver assembly and secure receiver by swing-out brace (see Receiver Assembly Swing-out Procedure).
2. Place a .098" shim between carriage and inner limit stop (metal-to-metal). See Figure 2-41.
3. Loosen locknuts on yoke inner limit stops. Adjust for a .001" to .005" (metal-to-plastic) clearance between yoke inner

limit stops and actuator housing. Tighten locknuts.

4. Swing in receiver assembly (see Receiver Assembly Swing-in Procedure).

LIMIT SWITCHES (FIGURE 2-42)

The inner and outer limit switches indicate extremities of carriage travel (inner CE cylinder and rezero position). They are located on the actuator limit stop and switch plate assembly. They can be checked and adjusted only after the carriage gib, yoke assembly, and flexure rods are in correct adjustment.

Inner Limit Switch

Service Check

The inner limit switch must be made when the carriage is at cylinder 254 and not made when the carriage is at cylinder 253. Check switch operation by alternately setting in the two addresses from the CE panel and observing the CE cylinder indicator.

Adjustment

1. Remove switch cover.
2. Loosen inner limit switch holding screw, and position switch assembly, by means of the eccentric adjusting screw, until the switch is made at cylinder 254 and not made at cylinder 253.
3. Tighten holding screw.
4. Replace switch cover.

Outer Limit Switch

Service Check

This switch must be operated when the carriage is in the rezero position and not operated when it is in cylinder zero position.

1. Alternately set rezero and reset the access register from the CE panel and observe that the CE cylinder indicator comes on only when the actuator is in the rezero position.
2. Set cylinder 249 into the access register switches and alternately set and reset the access register. There should be no CE cylinder indication. A CE cylinder

indication at this time indicates an incorrectly adjusted switch or excessive over-travel of the carriage.

Adjustment (Figure 2-42)

The outer limit switch is set by means of the adjusting screw on the carriage outer limit stop:

1. Reset the access register (Detent at cylinder zero).
2. Loosen locknut on carriage outer limit switch adjusting screw.
3. Place .024" feeler gage between adjusting screw and switch.
4. Rotate adjusting screw until switch just operates. This can be determined by observing the CE cylinder indicator.
5. Remove .024" feeler gage and place .015" feeler gage between adjusting screw and switch.
6. Tighten locknut on adjusting screw and recheck switch with feeler gages.
7. Repeat Service Check.

ACTUATOR OUTPUT SHAFT SEAL

Removal

WARNING: Cleanliness must be maintained during all steps so that actuators will not be contaminated.

1. Detent the output shaft at cylinder zero. Measure and record the space between the actuator outer limit stop and the carriage limit stop (Figure 2-40).
2. Scope pin A and C of the TEL card at 5/3B07 differentially and record the amplitude.
3. Turn off power to the machine.
4. Remove the yoke, differential adjusting screw, and yoke adjusting block (see Yoke Removal).
5. Place several lint free tissues under the output shaft seal area to soak up the oil that will flow when the seal is removed.
6. Remove wiper seal cap including rubber support ring and felt wiper. Use tool P/N 2121394.

NOTE: Before proceeding, be familiar with the replacement procedure and have parts available for immediate installation.

7. Remove seal assembly (Use tool P/N 2121395 and 2121394). Hold tissues under seal during removal.

Replacement

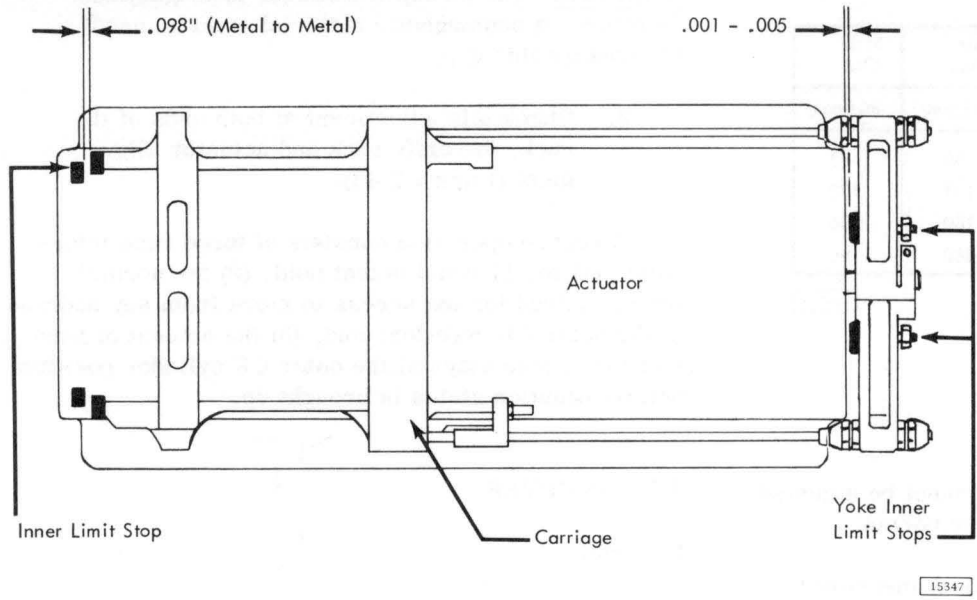
WARNING: To insure cleanliness and prevent contamination, the replacement parts must be left in their packages until they are needed.

1. Slide the seal assembly over the output shaft taking care not to damage the seal lip. Use back side of tool (P/N 2121394) to push the seal into the actuator housing. Care must be taken to prevent damage to the O-ring.
2. Install rubber support ring and wiper seal cap with felt wiper. Screw cap into actuator housing until cap is firmly sealed. (Use tool P/N 2121394.)
3. Assemble yoke assembly (See yoke replacement procedure).
4. Start file.
5. Start hydraulic power supply and allow the actuator to rest in the rezero position for 5 minutes.
6. Detent in track zero.
7. With the differential adjusting screw locking set screws tightened only enough to apply their spring load, adjust the yoke differential screw to give the exact amplitude and distance as measured and recorded in step 1 and 2 of the removal procedure.
8. Lock the differential adjusting screw into position by tightening the locking screws evenly. Care must be taken to prevent binding the carriage or output shaft. Torque the lock to 10 ± 2 inch pounds.
9. Use care to be sure that the heads are not positioned one full track off. A read operation will allow verification of the address. If the heads are positioned one track off, a no record found indication should occur.

ACCESS TIME

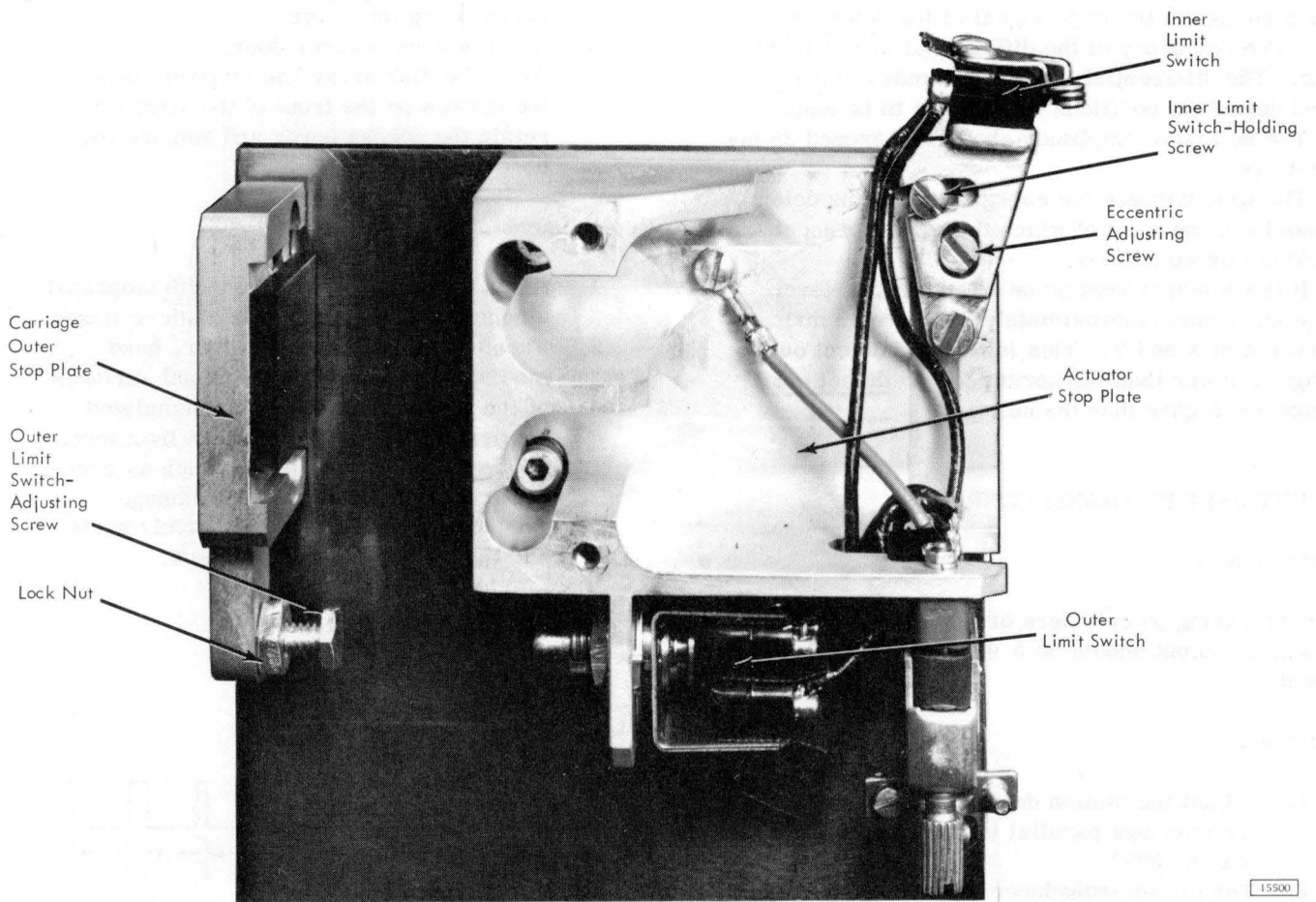
Service Check

The maximum access times (Table 2-2) are for any single operation. These are the times required for the access to become ready after the cylinder portion of the Access Register has changed.



15347

Figure 2-41. Yoke Inner Limit Stop Adjustment



15500

Figure 2-42. Limit Switch Adjustment

Table 2-2. Access Times

Type of Movement	Cylinder Movement of:	Fast Osc.	Slow Osc.
		ms (max)	ms (max)
Piston Adder	Less than 10	50	82
Small Glob	Less than 50	111	170
Large Glob	Less than 250	180	286
Inner CE Cyl	254	180	286

15771

DETENT DETECTOR

Service Check

The detent detector in the actuator cannot be adjusted or replaced, but it can be checked for normal operation.

The minimum differential signal as measured at X and Y of the secondary winding (Figure 2-44) is 70 millivolts. This minimum should be measured after a change in the logic signal of the detent in line. The frequency of the differential signal is 20-25 kc. The differential signal amplitudes at detent in and detent out positions do not have to be equal.

The null point amplitude should not exceed 35 mv peak-to-peak.

The time between the energization of the detent solenoid and the point at which the null is present should not exceed 15 ms.

If the detent is resting on a land, a low-level detent out signal (approximately 30 mv to 65 mv) is present at X and Y. This low-level "detent out" voltage is lower than the normal 70 mv detent out voltage and higher than the null point.

DETENT SAFETY TRANSDUCER

Service Check

When accessing 50 cylinders or more, the motion transducer output should be 0.9 v to 1.6 v peak-to-peak.

Adjustment

1. Adjust the motion detector rack located on the carriage parallel to the carriage way within .003".
2. The pickup transducer mounted on the top lid of the actuator is adjusted to have an air gap to the rack of .007" ± .003". Check this adjustment with an IBM card.

WARNING: The pickup transducer is magnetized, therefore, a nonmagnetic material must be used to measure this gap.

3. Check this adjustment at both ends of the rack, to verify rack and actuator alignment (Figure 2-43).

A rezero operation consists of three time intervals: (1) the 17 count detent hold; (2) the normal time required for the access to move from any address to the outer CE cylinder; and, (3) the amount of time that the access stays at the outer CE cylinder position before attention status is brought up.

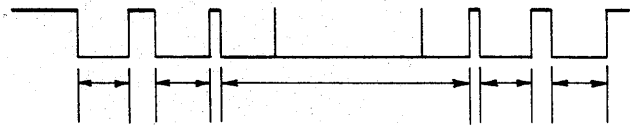
ACCESS COVER

Removal

1. Remove input power.
2. Vacuum the false floor and all surfaces surrounding the cover.
3. Remove access cover door.
4. After the disk array has stopped, loosen the screws on the front of the strut which retain the access cover and remove the cover.

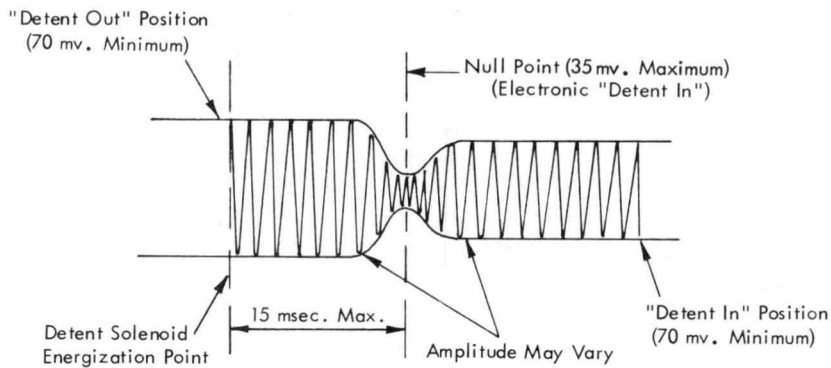
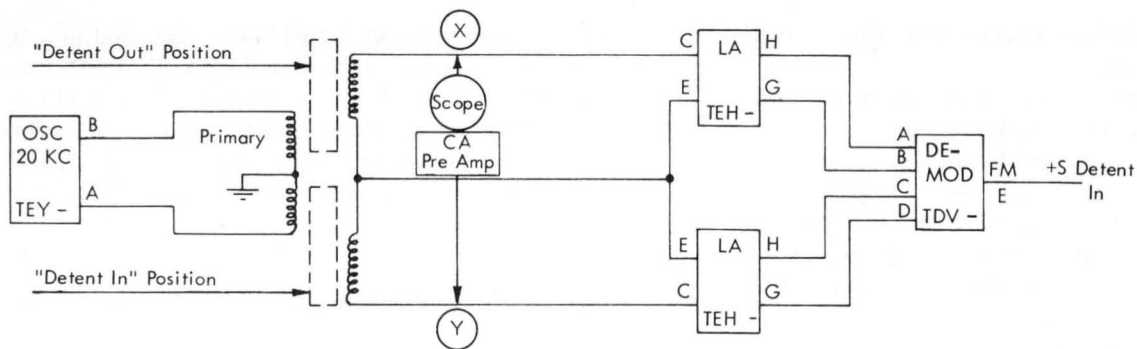
Replacement

1. Clean cover and cover door with isopropyl alcohol and a lint-free soft cloth or tissue.
2. Vacuum the actuator, receiver, head loading mechanism, and internal surfaces of the strut to remove any accumulated particles. Be careful to use a light touch on the more delicate parts, such as arm stiffeners, in order to avoid damage.
3. Replace the cover so that it firmly seats and tighten the retaining screws.



15501

Figure 2-43. Motion Integrator



15351

Figure 2-44. Detent Detector

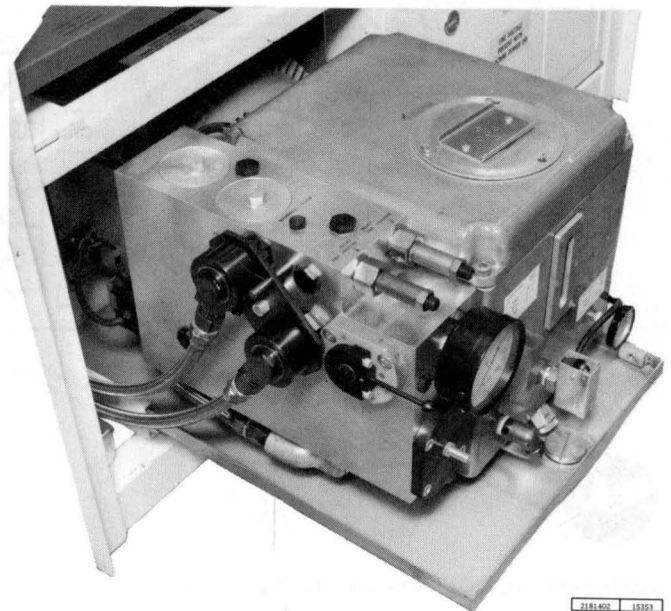
HYDRAULIC POWER SUPPLY (Figures 2-45, 4-9 and 4-10)

WARNING: During normal operation and any time the file is left unattended, the Sequence Control switch must be left in the AUTO position. In the MANUAL position, low oil pressure sensing on power supply P/N 2121874 does not shut off the pump. Thus, if the machine is unattended and a hydraulic leak develops, the hydraulic power supply can continue to run, pumping oil out of the hydraulic system.

HYDRAULIC POWER SUPPLY AS AN ASSEMBLY

Removal and Replacement

1. Disengage rear threaded stud.
2. Slide unit out of machine to servicing position (Figure 2-45).
3. Remove electrical connections.
4. Remove actuator air bleed lines and wrap ends in lint-free tissue.



2181400 15353

Figure 2-45. Hydraulic Power Supply in Servicing Position

5. Remove hydraulic connections after cleaning adjacent area.
6. Slide unit onto receiving platform of crate.
7. Put new unit in machine.
8. Attach electrical and hydraulic connections and actuator air bleed lines. Figure 2-46 shows contactor box connections. Encircled numbers indicate numbered tags on cable. Refer to Figure 2-47 for hydraulic quick disconnect installation
9. Check reservoir oil level.
10. Check that the direction of rotation of fan is counterclockwise when viewed over the top of the power supply.

NOTE: If power supply #2164574 is installed in a file previously equipped with power supply #2121874, the file must first be modified according to the field bill shipped with the new power supply. It is also necessary to install a field bill when power supply 2121874 is installed in a file previously equipped with power supply 2164574.

OIL LEVEL (For Power Supply P/N 2121874, Figure 4-9)

Service Check

Check the oil level. Add oil when level hits ADD line. The quantity of oil needed to raise the level from ADD

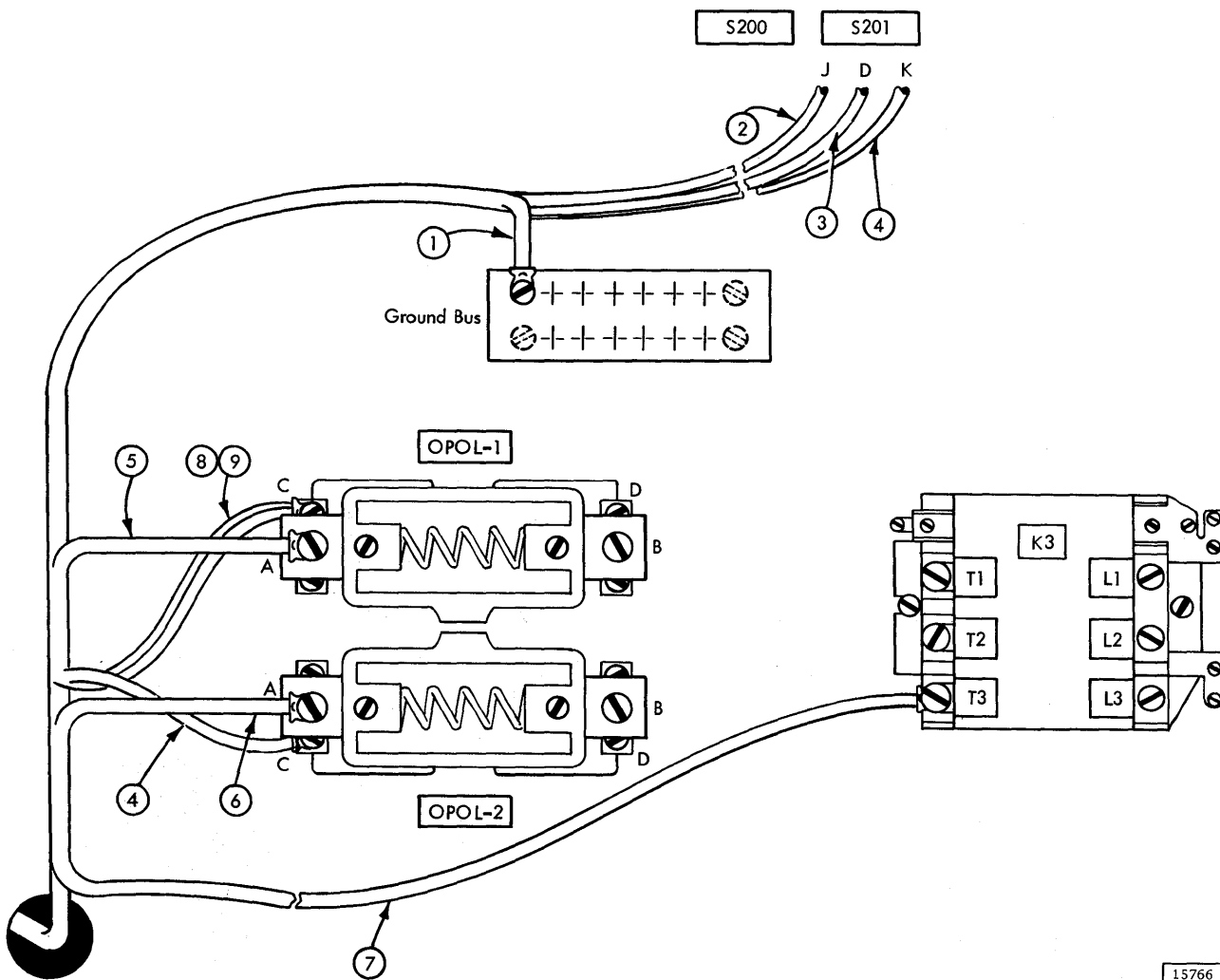


Figure 2-46. Hydraulic Power Supply Contactor Box Connections

to FULL is one gallon. Use only IBM P/N 2115252 (one gallon) or IBM P/N 2164584 (one quart), of pre-filtered oil in a disposable container. Destroy container after initial use.

OIL LEVEL (For Power Supply P/N 2164574, Figure 4-10)

Service Check

Check the oil level. Add oil only when level reaches bottom of sight glass. Use only IBM P/N 2115252 (one gallon) or IBM P/N 2164584 (one quart), of pre-filtered oil in disposable containers. Destroy container after initial use.

OIL LEVEL SWITCH (For Power Supply P/N 2164574, Figure 4-10)

Service Check

This switch is normally closed when the oil level is correct. The switch is not adjustable.

SYSTEM PRESSURE RELIEF VALVE

Oil must be at normal operating temperature before any checks or adjustments are made.

Service Check

Place all actuators INOP. Check the system pressure (550 psi \pm 10 psi). Adjust if necessary.

With the selector valve on Power Supply P/N 2121874 in position SP, the system pressure will be registered on the pressure gauge. With the hand valve on the bottom of the manifold on Power Supply P/N 2164584 closed, the system pressure will be registered on the pressure gauge.

Adjustment

1. Unlock lock nut.
2. Adjust pressure by turning adjusting screw:
 - a. Clockwise rotation will increase pressure.
 - b. Counterclockwise rotation will decrease pressure.
3. Lock in place.
4. Return selector valve to HP (Home Position on Power Supply P/N 2121874). Open hand valve on Power Supply P/N 2164574.

Removal and Replacement

1. Turn off hydraulic power supply.
2. Put selector valve in circulate position (on Power Supply P/N 2121874). Open hand valve on bottom of manifold (on Power Supply P/N 2164574).
3. Remove system pressure relief valve. Approximately 1 cup of oil will drain from this port. Be sure that small O-ring is removed from the bottom of the cavity.
4. Replace with new valve.
5. Adjust system pressure.

COOLING SYSTEM PRESSURE

Service Check

1. Set all actuator(s) INOP.
2. Check cooling system pressure for 50 psi \pm 5 psi.
3. Pressure is read on pressure gage with selector valve at the CS position (on Power Supply P/N 2121874). With power supply P/N 2164574, pressure is read on pressure gage on left of manifold.

Adjustment

1. Put selector valve in CS position (on Power Supply P/N 2121874 only).
2. Use low pressure relief valve.
3. Unlock locknut.
4. Adjust pressure to 50 psi \pm 5 psi by turning adjusting screw:
 - a. Clockwise rotation will increase pressure.
 - b. Counterclockwise rotation will decrease pressure.
5. Lock in place.
6. Return selector valve to HP (on Power Supply P/N 2121874 only).

Removal and Replacement

1. Turn off hydraulic power supply.
2. Put selector valve in circulate position (on Power Supply P/N 2121874 only).
3. Remove low pressure relief valve. Approximately 1 cup of oil will drain from this port. Be sure that small O-ring is removed from the bottom of the cavity.
4. Replace with new valve.
5. Adjust new valve.

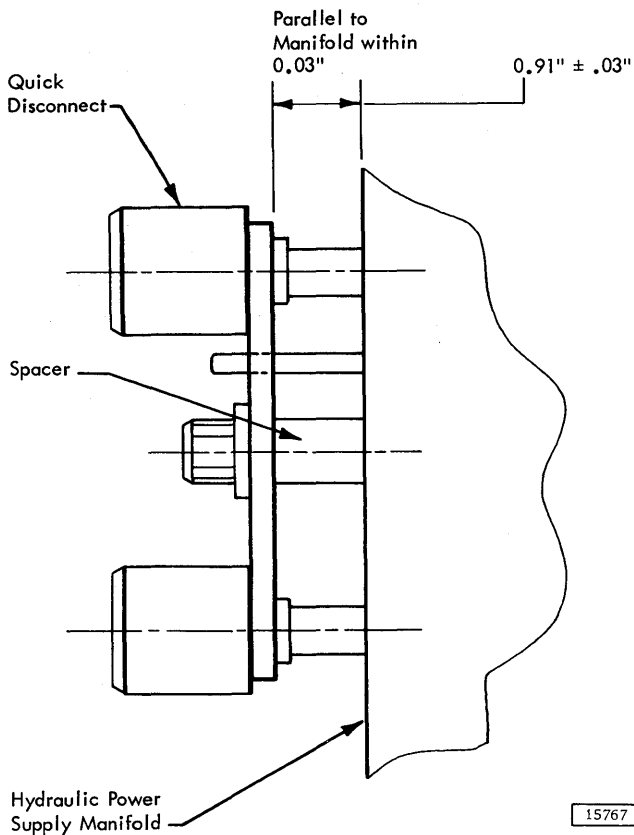


Figure 2-47. Hydraulic Quick Disconnect

ACCUMULATOR (On Power Supply P/N 2164574, Figure 4-10)

Service Check

This check is to determine the nitrogen precharge of the hydraulic accumulator.

1. Place all actuators INOP.
2. Close hand valve on bottom of manifold and verify that system pressure is 550 psi.
3. Shut hydraulic power supply off by depressing Oil Pump Off button on power sequence control panel and quickly get in position to observe hydraulic power supply system pressure gage.
4. The system pressure will decrease slowly at first, then drop off rapidly. The point at which the pressure commences to drop rapidly is the precharge pressure.
5. If the precharge pressure is below 375 psi, replace the accumulator.

OIL TEMPERATURE

Service Check

1. Check the oil temperature indicated on the temperature gage. The oil temperature for a single module, single access machine should be $124^{\circ} \pm 1^{\circ}\text{F}$. Oil temperature on all other machines should be $120^{\circ} \pm 3^{\circ}\text{F}$.
2. Before making any adjustment, check cleanliness of heat exchanger core. Remove lint collected on core and recheck temperature after 5 minutes.

Adjustment

Place all actuators INOP for 5 minutes before adjusting.

1. Check the cooling system pressure as this has a slight effect on temperature.
2. Adjust the screw on the thermal valve. Clockwise rotation will increase temperature, counterclockwise rotation will decrease temperature.

NOTE: Allow 20 minutes after each adjustment for stabilization of temperature.

UNLOADING VALVE (On Power Supply P/N 2121874, Figure 4-9)

Service Check

This check cannot be made accurately with greater than 5 psi drop across the mechanical filter.

1. Place all actuators INOP.
2. Set selector valve to System Pressure (SP).
3. Unlock system pressure relief valve.
4. Slowly unscrew this adjusting screw while watching the pressure gage. The pressure will drop uniformly, hesitate, then continue to drop uniformly again.
5. The pressure at which the gage hesitates should be 500 psi ± 10 psi. This hesitation indicates that the unloading valve is closing and causing more flow over the relief valve.

Adjustment

1. Unlock the unloading-valve adjusting screw.
2. Turn adjusting screw clockwise to increase the pressure at hesitation as described in

- the service check. Counterclockwise rotation will decrease the pressure at hesitation.
3. Lock adjusting screw in place. Recheck service check.
 4. Readjust system pressure relief valve to 550 psi \pm 10 psi and lock in place.
 5. Return selector valve to HP (Home Position).

PRESSURE SWITCH (On Power Supply P/N 2121874, Figure 4-9)

Service Check

This switch is normally open with no hydraulic pressure present. It is set to close at 500 psi \pm 25 psi system pressure.

1. Set power-sequence control to LOCAL-MANUAL; pressure normal light should be on.
2. Set hydraulic selector valve to CIR (circulate); pressure normal light should go out.
3. Return selector valve to HP (Home Position) and power-sequence control to REMOTE-AUTO.

Adjustment

1. Turn power sequence control to Local-Manual.
2. Turn switch adjusting screw clockwise until pressure-normal light on power-sequence panel goes out.
3. Reduce system pressure to 500 psi \pm 25 psi.
4. Turn switch adjusting screw counterclockwise until pressure-normal light comes on.
5. Set system pressure at 500 psi \pm 10 psi.
6. Return power sequence control to Remote-Auto.

OIL FILTERS (Figure 2-48)

The filters must be changed as outlined in the Scheduled Maintenance Routine Chart (Figure 1-1).

Paper Filter Removal and Replacement

1. Power down machine and slide power supply out of machine to extended position.
2. Move the selector valve to the circulate position on power supply P/N 2121874 (Figure 4-9) or verify that the hand valve on the bottom of the manifold is open on power supply P/N 2164574 (Figure 4-10).

3. Remove the rear (paper) filter cap.
4. Remove old paper filter from adapter in filter cavity.
5. Remove paper filter from package. Hold by end flange at closed end and check for presence of O-ring in open end.
6. With adapter firmly seated in the bottom of the filter cavity, insert the open end of the paper filter into the cavity and over the adapter until bottomed. The filter should be in a vertical centered position in the cavity.
7. Install the filter cap in the filter port. Rotate the cap slowly to prevent damage to the O-ring. Rotate the cap until it just bottoms. Do not torque beyond this position.
8. Proceed to step 3 of Combination Steel and Paper Filter Removal and Replacement.

Combination Steel and Paper Filter Removal and Replacement

1. Power down machine and slide power supply out of machine to extended position.
2. Move the selector valve to the circulate position on power supply P/N 2121874 (Figure 4-9) or verify that the hand valve on the bottom of the manifold is open on power supply P/N 2164574 (Figure 4-10).
3. Remove the front (combination paper and steel) filter cap.
4. Remove old paper filter from cap. Remove steel filter also if it is to be replaced at this time. If steel filter is not being replaced go to step 7.
5. If steel filter is being replaced, remove filter from package, hold by flange at closed end and check for presence of O-ring on the outer diameter of the neck.
6. Assemble the new steel filter to the cap by inserting it into the cap boss. Bottom the filter to the shoulder.
7. Remove the wrapping from the new paper filter using care to hold at bottom end cap. Be sure that there is an O-ring in the inner diameter of the filter neck.
8. Assemble the new paper filter to the cap by slipping the filter over the steel filter and cap boss. Push the filter to the bottom of the boss.
9. Install the filter-cap assembly in the filter port of the manifold. Rotate the cap slowly to prevent damage to the O-ring. Rotate the cap until it just bottoms. Do not torque beyond this position.

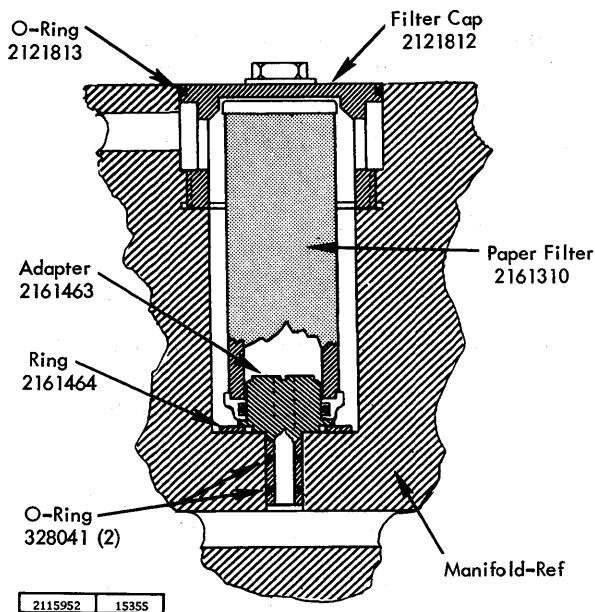


Figure 2-48a. Paper Filter

10. Move the selector valve to the HP position on power supply P/N 2121874 (Figure 4-9). Leave hand valve on the bottom of the manifold open on power supply P/N 2164574 (Figure 4-10).
11. Slide the hydraulic power supply back and lock in place.

HYDRAULIC OIL CHANGE

Change the hydraulic oil every six months. Use the following procedure for draining and filling the hydraulic power supply.

1. Turn off all power to the file and position the glass door to allow access to the hydraulic power supply.

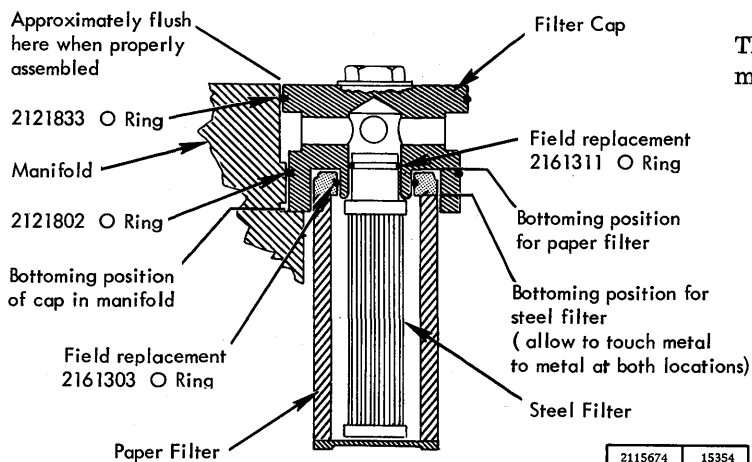


Figure 2-48b. Combination Paper and Steel Filter

2. Unlatch the hydraulic power supply locking device and slide the power supply out of the file approximately 12 inches.
3. Place several tissues or rags under the drip tray.
4. Place the notched plastic container under the drip tray with the notch directly under the drain plug. Remove the drip tray drain plug.
5. Loosen the hydraulic power supply drain plug in the sump casting and proceed to drain the oil in approximately one gallon increments. (Use oil drain container P/N 2108743). Tighten the hydraulic power supply drain at each increment to minimize oil dripping to floor.
6. After the oil has been drained, lock the drain plug in the sump casting and replace the drain plug in the drip tray.
7. Wipe all dust and dirt from the top lid of the hydraulic power supply and filter caps with lint free tissues.
8. Remove filter caps and paper filters. Remove the refill cover from top lid of sump.
9. Replace new paper filters and install filter caps.
10. Add four gallons and two quarts of new oil to the sump and replace refill cover on sump lid. Wipe top of oil cans clean before opening.
11. Wipe oil drippings from power supply, drip tray and floor.
12. Slide power supply back into file and lock unit in place.

THERMAL SWITCHES

Over Temperature Protection

Adjustment

This microswitch is set to open at 130°F. Adjustments are not normally necessary.

Oil Temperature Thermal

Service Check

This switch is located on the actuator hydraulic disconnect. This switch is set to close at 105°F and is not adjustable.

POWER SEQUENCE CONTROL

Service Check

The proper starting sequence of file components under AUTOMATIC LOCAL and AUTOMATIC REMOTE operation, after a "heads unloaded" and "Air Pressure Normal" indication is:

1. Cycle start
2. Disk drive and electronic gate blowers
3. Electronic DC; and start next file (remote only)
4. Solenoid DC
5. Oil pump
6. Head load
7. Head load check
8. File ready

An access is set INOP if:

1. The access is not retracted at head load time or,
2. The heads are not loaded at head load check time, or
3. The access cover door is open or off.

POWER SUPPLIES

48 v Supply (Relay and Actuator)

The 48 volt supply must be between 44.6 volts and 50.4 volts. If these values cannot be met and input voltage and input taps are correct, change transformer output taps to obtain desired voltage. Refer to system diagrams for correct taps.

CAUTION: Turn off main-line switch (CB1) in connector panel prior to changing transformer taps.

DC Supplies

The DC power supplies (-48 not included) must regulate within $\pm 2\%$ of rated voltage, but are adjustable from +4% to -1%. Measure the voltages at the power supplies. If these values cannot be met and input voltage and input taps are correct, change transformer output taps to obtain desired voltage. Refer to system diagrams for correct taps.

The location of components within the power supplies are shown in the circuit diagrams. These diagrams should be used to find the part number and description of the suspected component. With the part number available, the physical location of the component can be easily located in the parts catalog.

New DC power supplies are available for replacement purposes. The new power supplies are completely interchangeable with the old supplies except for cable length. Therefore, field bill of material No. 2115360 must be obtained when ordering the new supplies. This B/M will include the additional length of cable, fittings and instructions.

Over-voltage sensing and regulator cards are required with the new power supplies and must be ordered separately.

The following (Table 2-3) is a listing of the old and new power supplies and associated cards:

Table 2-3. DC Power Supplies

DC Power Supplies		New Cards	
Old No.	New No.	Over Voltage Sensing	Regulator
207204	473400	370575	370612
207225	473390	370576	370610
208267	472240	370577	370609
207201	473450	370575	370612
208258	473380	370576	370610
207282	473550	370578	370608

Voltage Change

To change the voltage from 208 v to 230 v:

1. Move cable wire from bulk transformer terminal 4 to terminal 5.
2. Move cable wire from service transformer (T1) terminal 2 to terminal 3.
3. Move cable wire from TB300-4 to TB300-5.

ELECTRONIC COMPONENTS

READ CIRCUITS

WARNING: Do not put scope probes, leads or jumpers of any kind on the lines coming directly from the data or format heads. The heads can be damaged and/or data destroyed by possible potential differences.

The peak-to-peak signal at pins A and F of the second linear amplifier should be 6.0 to 6.50 volts. This applies to customer and CE cylinders. Wave forms showing input and output signals for circuit cards are in logic diagrams manuals.

The drop in peak-to-peak signal amplitude from a minimum (single) bit pattern to a maximum (all) bit pattern should be no greater than 25%.

The pulse width of the output of the single shot shall be .5 microsecond pulse or minus 10%.

Read Amplifier Calibration

Three potentiometers are used in the read amplifier and bit detector to facilitate setting the regulated signal output and the bit detection threshold.

Throughout the following description only the data amplifier (in the B row) points are mentioned, but the format amplifier (in the A row) has a one-to-one relationship for the points concerned. The calibration procedure for both amplifiers is identical (use a 1-to-1 probe or a X10 compensated probe with a wide band (2 megacycle or greater) preamplifier such as a CA or D). Sync on index (01A5E07B). Use an expanded scale of about 50 microseconds/cm and find an all bit pattern such as an AGC burst. Cylinders around 125 should be used as the amplitude difference between single bit and all bit patterns will be slight.

1. Set the machine in a continuous read condition on one head and one track. This can be done by setting the desired access INOP and turning on head select at CE Panel.
2. Balance the DC levels (no signal in) at pins H and G or test point 1 and test point 2 of the Overdriven and Limiter Amplifier (TEN-) at 01A5B17 within .1 volt by means of the potentiometer on card.
3. Adjust the voltage on pins A and F of the second linear amplifier (TEH-) at 01A5B12 to 6 to 6.50 volts peak-to-peak (measured differentially) by means of the potentiometer on 01A5B09. If this voltage cannot be obtained, the variable gain amplifier (TEV-), the AGC detector (TEQ-), and the two subsequent linear amplifiers (TEH-) should be checked (Figure 2-49).
4. Observe pin A of the OR-AND (ANW-) at 01A5B18 and, by means of the potentiometer on this card, adjust the clipping level to 50% (Figure 2-50).

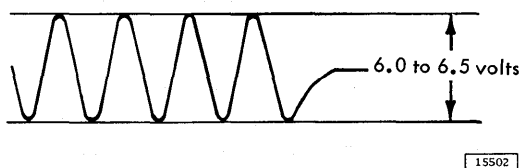


Figure 2-49. Voltage Output of Second Linear Amplifier

It is very important that the base line reference used for measuring the clipping level be after the recovery time as shown. Any overshoot is to be disregarded in the measurement of the 50% level.

NOTE: This ratio (2-1) is easily accomplished by maintaining E_2 (Figure 2-50) at a constant vertical deflection of one cm (by means of the oscilloscope variable voltage control) and adjusting the potentiometer on the OR-AND (ANW-1) to obtain a vertical oscilloscope deflection of two cm for E_1 .

Read Amplifier Noise Rejection

If the read amplifier does not reasonably reject conducted line noise, the following conditions should be verified on each access:

1. The receiver assembly is electrically isolated from frame ground and is to be connected to the J pin of the read Preamplifier card (TEL-).
2. The shield of the format head cable is returned to the J pin of the format Preamplifier card (TEL-).

Disk Surface Requirements

A maximum of 5 defects per data disk surface are permitted during manufacturing, including the flag surfaces but not including the CE cylinders.

The disk area in which the first address after index is written must be error-free. This is the marked 2 inch error free area.

There will be no more than 5 defects in any given cylinder location, including the flag surfaces, but not including the CE cylinders, when the 1301 leaves the plant.

The format disk must be defect free.

The following procedure for making a complete surface check is performed at the plant before the machine is shipped. The same procedure can be

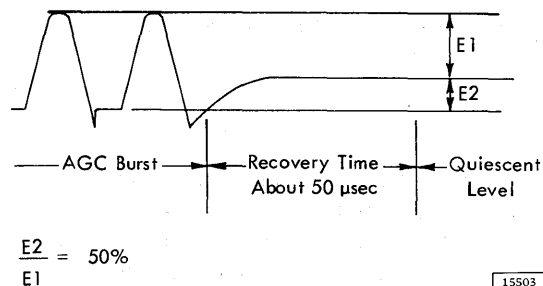


Figure 2-50. Read Amplifier Clipping Level

used to verify or diagnose defective surfaces in the field.

1. Record the format track for single record operation.
2. Record a minimum bit pattern on all disk surfaces at all track locations.
3. With the clipping level of the data and format read amplifier set at 40%, read all surfaces and log all defective tracks.
4. Record a maximum bit pattern on all disk surfaces.
5. With the clipping level of the data and format read amplifier set at 60%, read all surfaces and log all defective tracks.
6. Relocate the access to the Track 00 position.
7. With the read amplifier clipping level set to 50%, all data surfaces not designated as defective, and the alternate surfaces to be used in lieu of the defective tracks, must be read without error when written with any 8-bit character combination.

A disk defect log is in the system diagrams of each machine.

MODELS 11, 12, 21, 22 SINGLE SHOT AND GAP SENSOR ADJUSTMENTS

Check the following single shot timings from the point at which the SS output falls to the -1.0 v level to the time the output rises to the -1.0 v level.

Head Set SS (B7. B2. 08)

1. Set B-gate CE panel switches to Test and Mod 0 Select.
2. Set up scope for 1 $\mu\text{sec}/\text{cm}$, 5 v/cm, internal trigger-negative and place scope probe on 01B2 A07P.
3. Push Head Select/Seek pushbutton.
4. Adjust SS at 01B2 A07 for a $5.5 \pm 1.0 \mu\text{sec}$ -S pulse.

Sector Pulse Generator SS (B7. B2. 10)

1. Set B-gate CE panel switches to Test and Mod 0 Select.
2. Verify that clock A and clock B sine waves are present at 01B2 B15A and 01B2 B15F, respectively.
3. Set up scope for 0.1 $\mu\text{sec}/\text{cm}$, main sweep normal and sync internal negative.
4. Adjust the pot on 01B2 C15 for $525 \pm 25 \text{ ns}$ -S output at 01B2 C15C.

5. Adjust the pot on 01B2 C14 for $525 \pm 25 \text{ ns}$ -S output at 01B2 C14C.
6. Change scope setup to time base of 1.0 μsec cm.
7. Adjust the pot on 01B2 C03 for $9.6 \pm 0.2 \mu\text{sec}$ output at 01B2 C03C.

Test Gap Gate SS (B7. B1. 13)

1. Set B-gate CE panel switches to Test and Mod 0 Select.
2. Set up scope to sync on +S Late Index at 01B1 D23F. Use a delayed sweep and verify -S Sector Pulses at 01B1 A20L.
3. Place the scope probe on 01B1 A20P and adjust the pot on A20 for a $16 \pm 0.5 \mu\text{sec}$ -S output for each sector pulse.

Test End IA or End Record SS (B7. B1. 13)

1. Set B-gate CE panel switches to Test, Mod 0 Select and Read Test.
2. Set up scope to sync on +S Late Index at 01B1 D23F. Use a delayed sweep and observe the -S Test Gap Gate pulse at 01B1 B20G.
3. Move the scope probe to 01B1 A19P and adjust the pot on A19 for a $1.0 \pm 0.1 \mu\text{sec}$ -S output.

Safety Holdover SS (B7. B2. 07)

1. Set 1301 CE panel switches to Inoperative, Rezero on Module 0.
2. Set B-gate CE panel switches to Test and Mod 0 Select.
3. Remove 01B2 A13 and tape pin G.
4. Jumper Late Index at 01B2 A12H to the holdover SS input at 01B2 A15Q.
5. Sync on Late Index and scope the SS output at 01B2 A15C. Each 50 μsec +S Late Index pulse will release the holdover SS.
6. Adjust pot on A15 for a -S level at 01B2 A15B starting 5.0 +1.0, -0.0 μsec after Late Index.
7. Remove jumper and tape.

Read Data Gap Sense SS (B7. B2. 06)

1. Use an existing data track with 5-bit (or more) gaps or write a special track on the CE cylinder to give 5-bit gaps. The special track may be written by being in test status, Write Bits switch on, Access Inop, Head Selected, A-gate, Write Gate on and CE cylinder located.

2. Sync on +S Late Index at 01B1 D23F and use a delayed sweep to display a 5-bit gap.
3. Verify that read data exists at 01B2 A22C and algebraically add gap sensor input at 01B2 A22C and gap sensor output at 01B2 A22H.
4. Adjust the pot on A22 until a +S pulse starts 4.8 +1.0, -0.0 μ sec after the end of Raw Read Data.

Write Data SS (B7. B2. 06)

1. Set B-gate CE panel switches to Test and Mod 0 select.
2. Turn on Write Bits switch. Phase 2 pulses to 01B2 A20K trigger the single shot.
3. Scope the SS output at A20P and adjust the pot on A20 for a 0.6 \pm 0.020 μ sec -S output.

GATE VENTILATING SYSTEM

The ventilating system for the SMS gates consists of a motor, a blower assembly, and a set of filters. A complete description of these blowers and their maintenance is contained in Form 223-6900, Standard Modular System.

COMPRESSED AIR SYSTEM

Service Check (Figure 2-51)

Pressure on air pressure gage should be 58-60 psi. Air pressure should remain constant without the air compressor running. Loss of pressure is indicated by frequent starting and stopping of the air compressor. The compressor should start no more often than every 30 minutes.

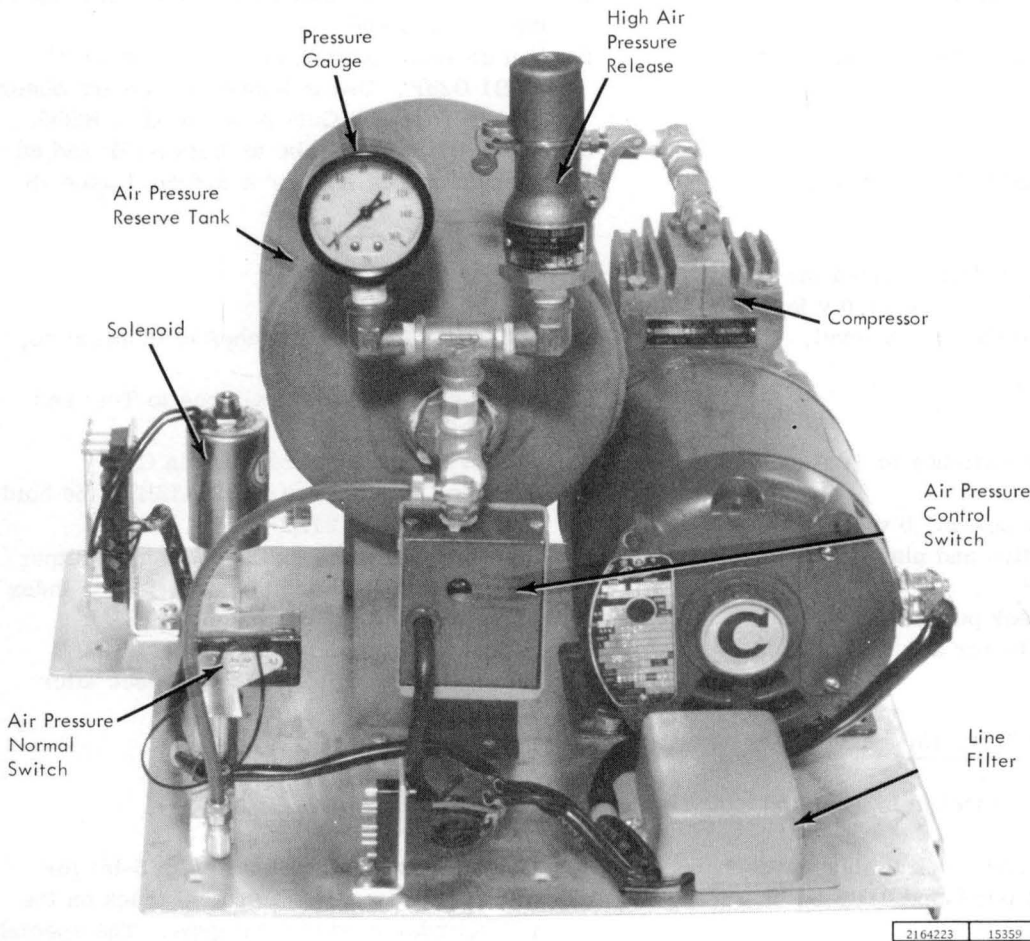


Figure 2-51. Compressed Air Supply

Adjustment

Air Pressure Normal Switch (On Files Equipped with 4-Bar Linkage). Set this switch to close and turn on the Air-Pressure-Normal light on the Power Sequence Panel when the air pressure reaches 26 to 28 psi (Figure 2-52).

Air Pressure Normal Switch (On Files Equipped with Integrated Head Load). Set this switch to close

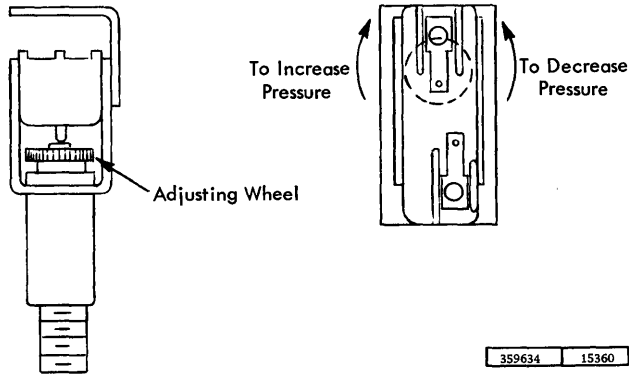


Figure 2-52. Air Pressure Normal Switch

and turn on the Air-Pressure-Normal light on the Power Sequence Panel when the air pressure reaches 45 to 47 psi (Figure 2-52).

Air Pressure Control Switch. Set this switch to maintain 58 to 60 psi as indicated on the air pressure gage. The adjusting wheel (Figure 2-53) can be turned with the tip of a screwdriver.

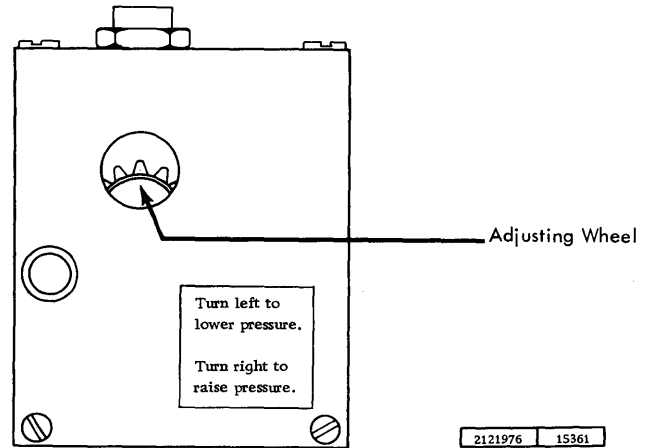


Figure 2-53. Air Pressure Control Switch

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TROUBLESHOOTING HINTS

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

Solenoid Drive No. 2 (TDR-) must never have -48 v on it alone. If this card is removed from the gate there is a possibility of having this condition. Solenoid dc and Electronic dc must be turned off prior to removing this card.

Intermittent problems can sometimes be aggravated by vibration. Tapping the edge of the cards with the plastic end of a screw driver in the area suspected should be sufficient. Caution is required since too violent vibrations can cause adjacent card components to short.

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

Special circuit card diagrams are shown in the system diagrams. Also shown are input and output waveforms for most of these cards.

Most S levels may be clamped to ground without damage to the circuit card (DFK- and AEK-cards are the exceptions to this rule).

READ MALFUNCTIONS

WARNING: Do not put scope probes, leads, or jumpers of any kind on the lines coming directly from the data or format heads. The heads can be damaged and/or data destroyed by possible potential differences.

1. Failure of the read amplifier to reject line noise can be caused if the receiver is not electrically isolated from frame ground (minimum of one megohm resistance). The receiver should be connected to pin J of the read Preamplifier card (TEL-). The shield of the format head cable should be connected to pin J of the format Preamplifier card (TEL-).
2. Read failures can be caused by a non-calibrated read amplifier or a too long or too short single shot pulse. The single shot pulse width should be 0.5 microseconds \pm 10%.
3. The average peak-to-peak read signal at the preamplifier for any 300 microsecond period should be not less than 15 millivolts or more than 70 millivolts. Signals beyond this range can cause read failures.
4. Read failures can be caused by heads not being fully loaded. This condition causes all heads of a module to have decreased

output. In this case the heads loaded microswitch would also have to be in incorrect adjustment.

8. Examples of proper read amplifier signals are shown on Figure 3-1. Improper signals are shown on Figure 3-2. Signal polarity is dependent on the probe connections and the recorded signal.

WRITE FAILURES

An apparent failure to write can be caused by a write safety circuit malfunction. Check for proper write safety conditions before investigating a write driver or write head for trouble.

A +S level on pin A of the Write Driver Safety (TDU-) card indicates that one or more Write Drivers (TEF-) are conducting.

A Not Write gate condition or write gate and more than one Write Driver selected will cause output pin B of the Multiple X Select (TDT-) card to be a +S. A -S at pin B indicates write gate and only one write driver selected. The Voltage Safety (TEA-) card prevents any Y selection from being made when the loss of any voltage except +6 volts occurs.

ACCESS MALFUNCTIONS

1. There is no blown fuse indication on the 1301. Failure to go to the correct cylinder can be caused by a blown fuse.
2. Access failure can be caused by the access door being partially open or failure of the interlock.
3. Failure of the motion oscillator to switch to slow speed can cause the access to be set inop when the hydraulic oil is cold.
4. Excessive access time can be caused by failure of the oscillator to switch to high speed.
5. Extraneous rezeros can be caused by:
 - a. Improper hydraulic power supply temperature regulation.
 - b. Improper accumulator valve cut-in on overlapped seeks.
 - c. Clogged actuator bleeder lines to sump.
 - d. Motion timings.
 - e. Improper clearance of the motion rack to its transducer resulting in erroneous detent safety conditions at detent time.
 - f. Gib out of adjustment or dirty carriage ways and wiper pads.
 - g. Loose or improper yoke and tie bar adjustments.
 - h. Improper hydraulic power supply pressure or clogged filters.

READ/WRITE FAILURES

1. The voltage safety card protects both read and write circuits. Check this card when neither read nor write operations function.
2. Failure of the clock read circuit will cause read and write failures. Check that the clock line driver (01A1F04, TEJ-) is gating and passing clock signals properly.
3. Incorrect adjustment or loosening of the carriage yoke assembly can cause read or write failures.
4. The input voltage must remain within plus or minus 10%. This tolerance includes any variable combination of steady state and/or short duration transients.
5. Defective diodes in the Read/Write head selection circuits can be detected by observing the base line of read signals at the input to the preamplifier. Base lines which differ more than ± 20 millivolts from ground indicate a defective diode in the head selection matrix.
6. The selection of multiple X circuits is detected as an error, however, the selection of multiple Y circuits is not. Problems in this area cause simultaneous selection of heads and are difficult to diagnose.
7. Loose taper pins in the receiver block assembly can cause intermittent Read/Write errors when they loosen slightly and become vibration sensitive.

SERVICE CHECKS

ATTENTION STATUS

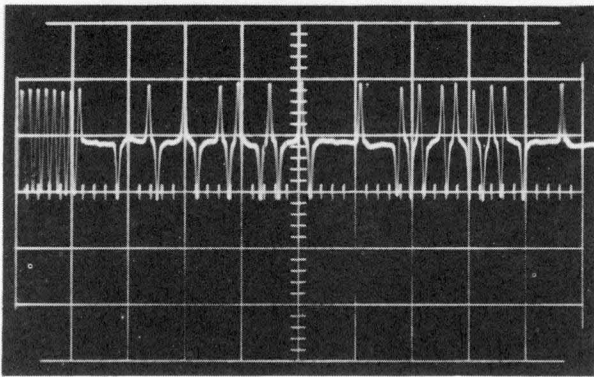
Attention status is raised and driven to the system when any of the following conditions occur:

1. Access becomes Ready.
2. End Rezero comes up.
3. 60 count comes up.

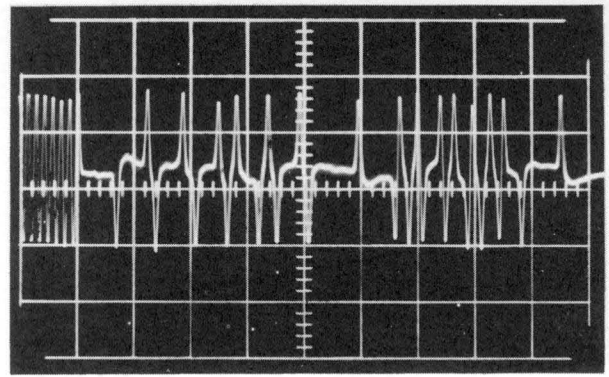
REZERO

Rezero can be caused by:

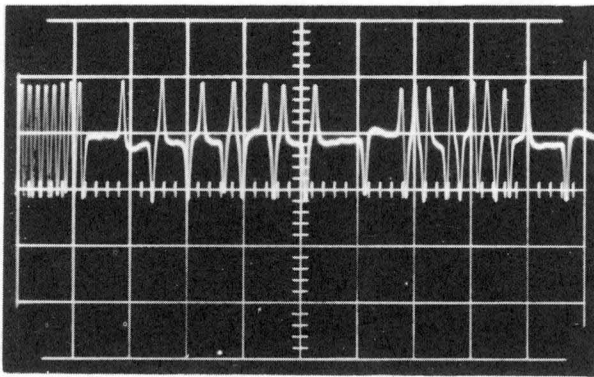
1. CE Rezero
2. Power sequence Rezero



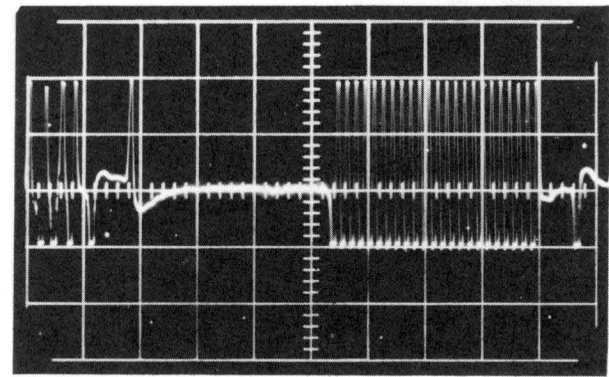
① Input to Preamp
 AGC and Record Address
 Vertical: 20 mv/cm
 Horizontal: 20 μ s/cm
 Preamp: D



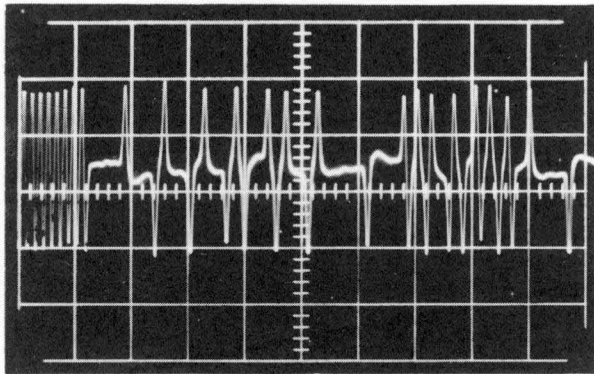
④ Output of Second Linear Amplifier to CLPA
 AGC and Record Address
 Vertical: 2 v/cm
 Horizontal: 20 μ s/cm
 Preamp: CA (A channel inverted)
 added algebraically



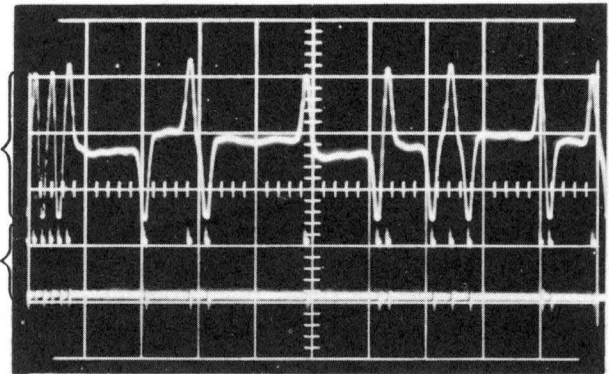
② Output of First Linear Amplifier
 AGC and Record Address
 Vertical: 200 mv/cm
 Horizontal: 20 μ s/cm
 Preamp: D



⑤ Test Point (Pin A) of OR-AND
 Clipping level set at 50%
 Vertical: Set for 3 cm
 Horizontal: 20 μ s/cm
 Preamp: D



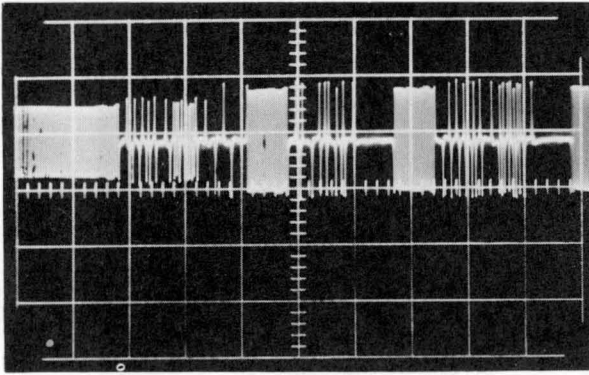
③ Output of Second Linear Amplifier to CLPA
 AGC and Record Address
 Vertical: 2 v/cm
 Horizontal: 20 μ s/cm
 Preamp: D



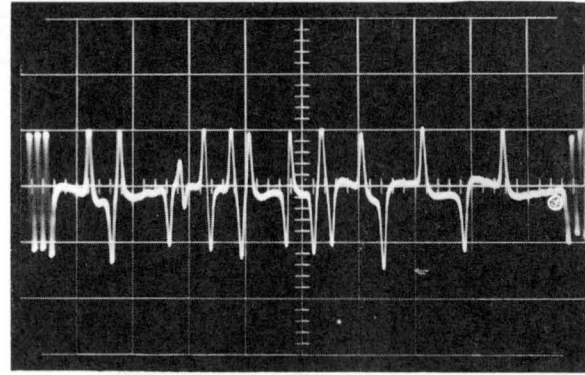
⑥ A Input to OR-AND (B18F) B Output of Convert Card
 AGC and Record Address AGC and Record Address
 Vertical: 2 v/cm Vertical: .5 v/cm
 Horizontal: 10 μ s/cm Horizontal: 10 μ s/cm
 Preamp: CA Preamp: CA

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Figure 3-1. Read Amplifier Signals



⑦ Input to Preamp (Improper Signal)
 AGC-HA1-AGC-HA2-AGC-RA-AGC
 (First AGC and HA1 Recorded .005"
 off track)
 Vertical: 20 mv/cm
 Horizontal: 100 us/cm
 Preamp: D



⑧ Input to Preamp (Improper Signal)
 AGC and Record Address
 (Fifth and sixth pulses after AGC are
 extraneous)
 Vertical: 10 mv/cm
 Horizontal: 10 us/cm
 Preamp: D

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Figure 3-2. Read Amplifier Signals (Improper)

3. Arrival failure
4. Invalid address (all globs)
5. Hitting the inner limit switch when not addressed to cylinder 254
6. Opening access cover door

Rezero coming on will:

1. Set the Access Register to 0000.
2. Pull detent (except if access cover door open).
3. Energize Rezero valve.
4. Return to outer CE cylinder (except if access cover door open).
5. Re-calibrate the oil.
6. After the actuator has returned to the outer CE cylinder, the oil is recalibrated for the required length of time, then attention status is raised.

Rezero Reset

To reset rezero when off-line, push CE reset. This will turn off Rezero and cause access to detent at cylinder 00. When on-line, a seek instruction will set the detent at 00.

ACCESS COVER SAFE SWITCH

When the access cover door (B7. A6. 15. 1) is opened or removed, this switch will open and cause:

1. The access to be set INOP.
2. The Access Register Cylinder Address set pulse to be blocked (from system).
3. Rezero to be held on.
4. Access Register to be held reset.
5. The detent to be held in.

CAUTION: If solenoid dc is dropped for any reason the actuator may attempt to move under hydraulic pressure.

DC VOLTAGES

1. The 48 v relay supply must be a minimum of 44.6 v and a maximum of 50.4 v.
2. The DC SMS supply voltages must be within $\pm 2\%$ rated output voltage at the laminar bus on the gates.
3. The machine should perform all normal functions with the + 12-volt marginal voltages varied between + 9 volts and + 15 volts.

PULSE WIDTH OF SINGLE SHOTS

WARNING: Adjustment of single shots should only be made while actuator is stationary and under CE control.

T301 Single Shots

Squelch Single Shot

The pulse width of the output of the single shot should be $375 \mu\text{sec} \pm 10\%$.

Record Ready Single Shot

The pulse width of the output of the single shot should be $180 \mu\text{sec} \pm 10\%$.

Record Ready Sample Single Shots

The pulse width of the output of the single shots should be $1 \mu\text{sec} \pm 10\%$.

Write Gate Single Shot

The pulse width of the output of the single shot should be $375 \mu\text{sec} \pm 10\%$.

1301 Model 11, 12, 21, 22 Single Shots

Check the following single shot timings from the point at which the signal falls to -0.1 v to the time the signal rises to -1.0 v . See section on Servicing Procedures.

Head Set Single Shot	$5.5 \pm 1.0 \mu\text{sec}$
Test Gap Gate Single Shot	$16 \pm 0.5 \mu\text{sec}$
Test End IA or End Record SS	$1.0 \pm 0.1 \mu\text{sec}$
Safety Holdover Single Shot	$5.0 +1.0, -0.0 \mu\text{sec}$
Read Data Gap Sensor SS	$4.8 +1.0, -0.0 \mu\text{sec}$
	after end of raw read data.
Write Data Single Shot	$0.6 \pm 0.2 \mu\text{sec}$
Sector Pulse Single Shot	$9.6 \pm 0.2 \mu\text{sec}$
Single Shots in sector pulse circuit (B7, B2, 10)	$0.525 \pm 0.025 \mu\text{sec}$
Read Data Single Shot	$0.600 \pm 0.020 \mu\text{sec}$

STANDARD MODULAR SYSTEM MAINTENANCE

All normal maintenance of standard modular system components is found in form 223-6900, Standard Modular System. Included in this form are:

- Wrapped Wire Connections
- Crimped Connections

Soldered Connections
Wiring Rules
SMS Service Tools
SMS Card Maintenance
Measurements
Ventilating Systems

CE SERVICE AIDS

Many service aids are incorporated into the IBM 1301 Disk Storage. These aids allow the CE to observe or duplicate machine functions.

CE TEST CONTROL PANEL (FIGURE 3-3)

The CE test control panel is located in panel A1 (A2 on T1301). From this panel, the CE can monitor most file functions. However, the respective access must first be set inop and the access cover must be on before most of the switches on this panel are effective.

Head Select

The on-off toggle switch in the upper right corner turns head select on or off. This switch must be turned off before Inop can be reset because "CE head select" holds "access inop."

Cylinder Select Lights

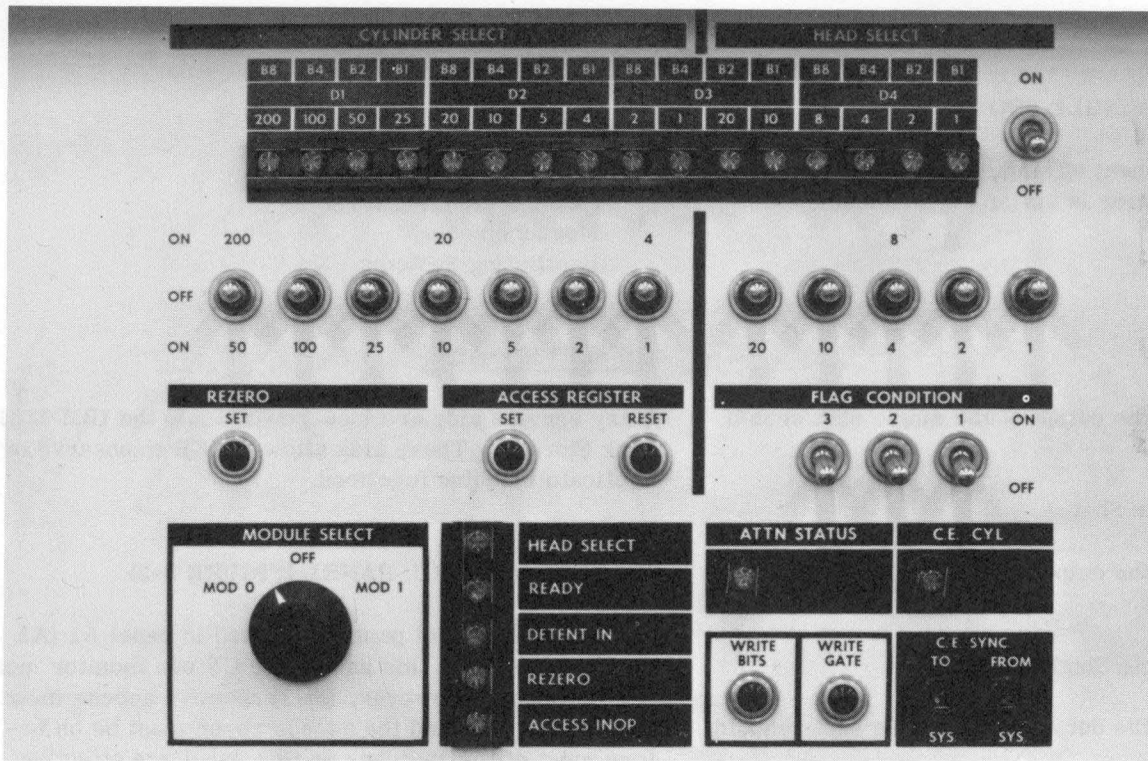
Ten cylinder select lights indicate the contents of the access register and are driven by the outputs of the access register. Above each light is the binary and cylinder equivalent number represented by the light.

Head-Select Lights

Six head-select lights indicate the head to be selected. These indicators are driven from the access register. Above each light is the binary and decimal equivalent number represented by the light.

Cylinder and Head-Select Switches

These twelve switches can be used to select any cylinder-head address including the inner CE cylinder which is located at cylinder position 254. Certain combinations are considered improper addresses. For example, track 200 and 50, track 20 and 10, track 4 and 1, and head 8 and 4. These combinations are interlocked by the switches. However, there are other improper address combinations that can be



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Figure 3-3. CE Test Control Panel

selected by the switches. For example, track 200 and 100, track 5, 4, and 2, and head 8 and 2.

Access Register Set-Reset

The address selected by the cylinder and head select switches is set into the access register by depression of the set button. Additional access register latches can be set without a reset. However, none can be turned off without a total reset. The access register is reset by depression of the reset button. This button also resets rezero.

Resetting the access register puts the actuator at cylinder 0 and selects head 00.

Rezero Set Switch

Two functions are performed by this switch: rezero, and locate CE outer cylinder. This position is not detented, and as long as the actuator is in rezero, the actuator can be moved manually with a small amount of force. Rezero can be reset by depression of the access register reset switch.

Flag Condition Select Switches

These three switches allow the CE to set the three flag latches which allow selection of any of the six alternate (flag) surfaces.

CE Cylinder Arrival Light

This light indicates that the CE inner or outer cylinder has been located.

Attention Status Light

This light indicates that the access has ended a seek operation. If the access is not inop, a signal is sent to the FCU that indicates an end of seek.

Module Select Switch

This switch selects the module to be monitored or operated from the CE panel. Selection of a module also selects the access for that module.

Condition Indicator Lights

Head select, access ready, detent in, rezero, and access inop are the conditions indicated by lights.

Write Bits - Write Gate Switches

Depression of the write gate button raises the write gate if the access is located at the CE inner or CE outer cylinder. Depression of the write bits button allows raw format data (read from the CE format) to be

put on the write data line. This data will then write on the selected head within the CE cylinder.

CE Sync Hubs

These hubs are serviced by convenience wires between the FCU and the 1301. The line from the FCU is terminated in the 1301. The line to the FCU is driven from the 1301.

HYDRAULIC MANUAL SELECTOR VALVE

NOTE: Selector valve is present only on power supply P/N 2121874.

The hydraulic selector valve is used to check cooler system (CS), upstream (USP), and system pressures (SP). The selector valve can also be used to circulate (CIR) oil through the system. The selector valve should be in HP (home position) when the system is being used.

CE TEST CONTROL PANEL B-GATE, MODELS 11, 12, 21, 22

These controls (Figure 3-4) provide the CE with the ability to seek to any cylinder and to read with any head. Writing cannot be performed from the B-gate CE panel. The controls cannot be used for accessing

or for head selection until the following conditions are met:

1. Access cover door is closed.
2. B-gate Module Select switch is set to the module that contains the desired access.
3. B-gate Test/Operate switch is in test position.

Setting the Address Buffer Register

Before seeking to a cylinder or selecting a head, the desired address must be set in the address buffer register. This is accomplished by placing the address buffer register switches on the CE panel in the desired bit configuration and then pressing the Set switch for the appropriate digit. Once the address buffer register is set, the address is displayed in the CE panel lights and the desired access or read operation can be performed. CE tracks and diagnostic tracks may be addressed as follows:

Outer CE Cylinder (Rezero). Modify any address for the desired access so that the digit 7 position of the address buffer register contains an @ (8 and 4 bits).

Diagnostic Cylinder 252. Modify any cylinder 0 address for a particular access so that it contains a # (8, 2, 1 bits) in the digit 7 position.

Diagnostic Cylinder 253. Modify any cylinder 1 address for a particular access so that it contains a # (8, 2, 1 bits) in the digit 7 position.

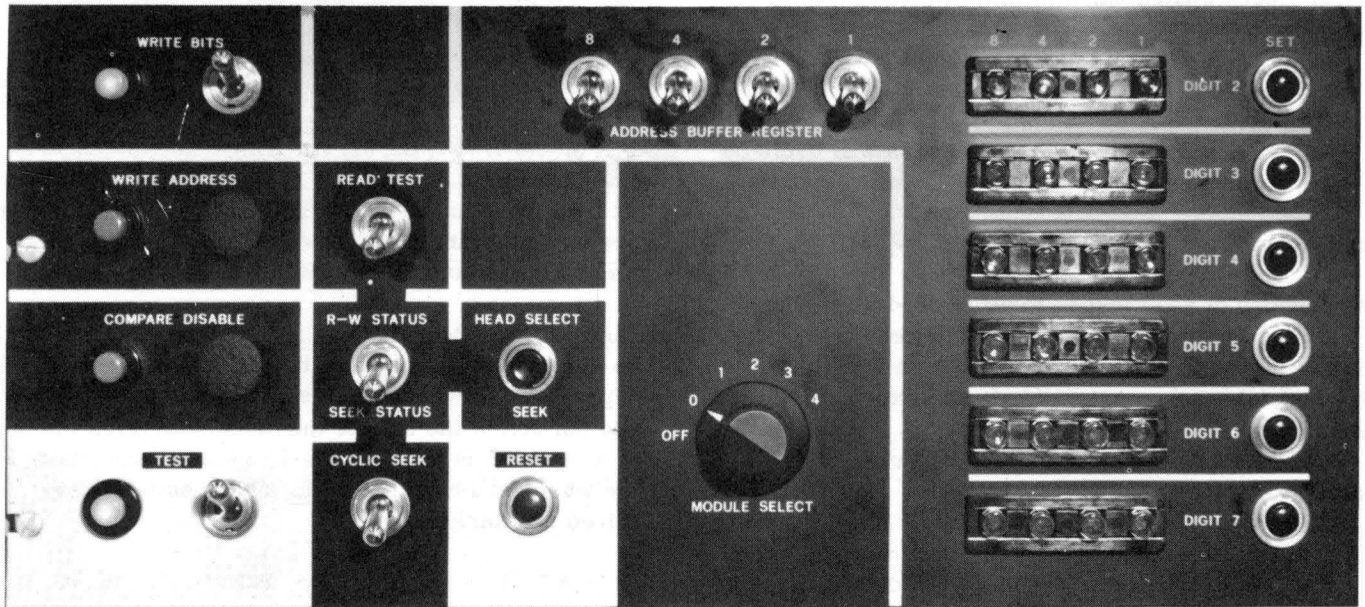


Figure 3-4. B-Gate CE Panel

10,024

Inner CE Cylinder. Modify any cylinder 4 address for a particular access so that it contains a # (8, 2, 1 bits) in the digit 7 position.

Functional Operations

Seek

1. Test switch on.
2. Seek status on.
3. Select module.
4. Set desired legal address in address buffer register.
5. Press seek pushbutton. Access will seek to address specified in the A-gate address register.

Head Select

1. Test switch on.
2. Read-Write status on.
3. Select module.
4. Set desired legal address in address buffer register.
5. Press Head Select pushbutton. Head selected by 1301 (observe A-gate CE panel indicator lights) will correspond to translated address set in address buffer register.

Cyclic Seek

1. Test switch on.
2. Seek switch on.
3. Select module.
4. Reset, then set desired legal address in address buffer register.
5. Cyclic Seek switch on.
6. Press Seek pushbutton. Access will cycle between cylinder 0 and the cylinder specified.

Read Test

The purpose of read test is to allow off-line testing of the phase selection circuitry. The read test operation requires a special track of data on the file. This special track consists of all bits except at sector pulse time.

Follow this procedure to write the read test track:

1. Turn on B-gate Test and Write Bus switches. Select module.
2. Place both accesses IN OP, locate CE track, turn on A-gate CE panel Head Select switch and select head.
3. Press A-gate CE Write Gate pushbutton.

Follow this procedures to use the read test track:

1. Select the cylinder and head for the read test track.
2. Turn on B-gate Test, Read-Write Status and Read Test switches.
3. Set up scope to sync on Late Index with external trigger and delayed sweep.

The following areas of the phase selection circuitry may be observed.

Phase Pulses (B7. B2. 01. 1). The 400 ns phase pulses occur sequentially in order over a 1.6 μ sec period and then repeat.

Allow Phase Select Latch (B7. B2. 02. 1). The Allow Phase Sel latch sets with the first simulated S1 bit following Test Gap Gate. The latch causes the first phase selection and allows subsequent phase selections by the Select New Phase latch through the entire record.

Select New Phase Latch (B7. B2. 02. 1). Starting with the second character (8 bits past the read test track gap), the Select New Phase latch should be set once every 8 bits and should reset before the second bit of any 8 bit group is received. The first bit of each group simulates the S1 bit and phase selection occurs because this bit is allowed (if the Select New Phase latch is set) to flip the Comp Phase trigger.

Comp Phase Trigger (B7. B2. 02. 1). The Comp Phase trigger flips once every eight bits as a result of a simulated S1 and Select New Phase latch set. The square wave Comp Phase trigger outputs are out of phase relative to each other.

Sel A or Sel B (B7. B2. 02. 1). These are the square wave outputs (12.8 μ sec on, 12.8 μ sec off) which result from the Comp Phase trigger outputs. The square wave outputs start when the Allow Phase Sel latch sets and continue until the latch resets.

Phase 1A, 2A, 3A, 4A; 1B, 2B, 3B, 4B (B7. B2. 01. 1). The numeric portion of the title of the block describes the phase pulse which originated the pulse. The alphabetic portion of the title of the block describes whether Sel A or Sel B is Off. Phase 1A occurs each phase 1 time when Sel Phase A is Off. Other outputs are derived similarly.

Select A Odd, A Even, B Odd, B Even (B7. B2. 03. 1). These latches alternately set and reset until a new phase is to be selected. At the time Sel A occurs, the Select A Odd and Select A Even latches will freeze

in the positions held at that moment (one for four combinations). The combination will hold until the next phase selection (8 bits later) which will utilize B Odd, B Even. The combination held will allow only one of the 4 phase pulses to set the Sel Phase latch (B7. B2. 05. 1).

Phase Selection AB Latches (B7. B2. 03. 1).

1. Select A Odd sets each phase 1A time and resets each phase 3A time.
2. Select A Even sets each phase 2A time and resets each phase 4A time.
3. Select B Odd sets each phase 1B time and resets each phase 3B time.
4. Select B Even sets each phase 2B time and resets each phase 4B time.

Selected Phase 1A, 2A, 3A, 4A; 1B, 2B, 3B, 4B (B7. B2. 04. 1). Some of the selected phases will be used almost 50 percent of the time, other selected phases will almost never be used. The selected phase used depends on the simulated S1. Each selected phase is used 8 times.

Sel Phase Latch (B7. B2. 05. 1). The Sel Phase latch is set by the selected phase. The output of the latch drives a tapped delay line. One of the delay line outputs resets the Sel Phase latch.

Approximate Delay Line Timings (B7. B2. 05. 1). Delay line pulses are the result of a simulated S1 data bit selecting a phase that sets the Sel Phase latch which drives the delay line. The same S1 bit is delayed by another delay path (B7. B2. 06. 1) and temporarily stored in the Data A latch. Once the proper phase has been selected, the tapped delay line is used:

1. To gate data out of the Data A latch and send it to the FCU.
2. To send a clock pulse to the FCU with a time condition relative to the data bit.
3. To reset the Data A latch.
4. To reset the Sel Phase latch.

The following delay line timings are based on the use of the +S output of the OR circuit (B7. B2. 04, 01B2 C18C) which sets the Sel Phase latch as a scope sync and timing reference point.

<u>Name</u>	<u>Timing</u>
+S Reference point	0-700 ns
-S Sel Phase Latch Set	60-580 ns
+S Sel Phase Set	100-800 ns

<u>Name</u>	<u>Timing</u>
-S Clock Pulse	200-900 ns
-S Reset Data A latch	440-800 ns
-S Sel Phase Delayed 200 ns	580-1260 ns

Data A Latch (B7. B2. 06. 1). The reference point for the Data A latch is the same as for the delay line above.

<u>Name</u>	<u>Timing</u>
+S Reference point	0-700 ns
-S Data A latch set pulse	500 ns before reference point* and 500-600 ns wide
Output sampled	200-560 ns

Write Bits Switch

1. Test switch on.
2. Access Inop.
3. CE cylinder and head selected.
4. Write Bits switch on.

MARGINAL VOLTAGE CHECK JACK

Marginal voltage checks of the logic circuitry are made by placing the portable marginal voltage supply plug into the jack receptacle. The +12 marginal voltage can then be raised to +15 volt or lowered to +9 volts.

POWER SEQUENCE CONTROLS

The power sequence control panel (Figure 3-5) provides the facilities for starting and stopping the file during normal operations and ensures proper operation of file components. The sequence control may be either automatic or manual. The manual control of power sequence has been provided for CE manual start or component check. The automatic control of power sequence is under control of a 4-minute timing device. Normally, initiation of start on the first 1301 is under system control. Subsequent files, in remote control, are started on receipt of a timed pulse during the sequencing of a preceding 1301. When the 1301 is ready for normal operation, a "Power sequence complete" signal is sent from file to file. When this line is completed by the last file,

* The leading edge of the set pulse may vary to about 100 ns before the reference point.



Figure 3-5. Power Sequence Control Panel

15506

the line indicates to the FCU that the file sequence is complete for all files in remote control.

Indicator lights are provided as servicing aids for the Customer Engineer. They indicate both normal and malfunction conditions as long as the main-line 70-amp breaker is closed.

Power Sequence Panel

All power sequence functions are controlled by and monitored at this panel. The red lights indicate unsatisfactory conditions. The white lights indicate satisfactory conditions. Normal sequence is indicated by the small arrow heads next to the lights.

Auto Control Switch

This switch selects the originating point of the start or stop sequence signal. A remote signal originates at the system. A local signal originates with the start or stop switch on the 1301 power sequence panel.

Sequence Control Switch

Auto or manual sequence is selected by this switch. Auto sequence puts all functions under control of the sequence timer. Manual sequence allows the CE to select the time and sequence for most functions.

Damage to the heads or disks can result if the heads are loaded before the disks are at operating speed. To prevent this damage, the head load

circuit is always directed through the timer 180 second contact. The disks and the timer, therefore, must run for 180 seconds before the heads can be loaded. In a stop sequence, the heads must be unloaded before the disk array is stopped.

System Function Lights

Remote start and remote stop from the FCU to the 1301, and start next file from the 1301 to the next file are indicated by these lights.

Access Inop Lights

If any access is put inop, manually or automatically, the associated inop relay picks, turning on the respective inop light.

Access Inop Switches

Manual operation of any of these switches causes an inop relay to be picked or tripped. Accesses that have been set inop by any method can be reset only by tripping the inop relays with these switches.

Auto Start Stop Controls

Auto local start and auto local stop are initiated with the start or stop switches. The start lock up light comes on with the pick of R10 during an auto start sequence. The timer light is tied in parallel with the timer motor and is on whenever there is power to the

timer motor. The cycle start light comes on with the pick of R111 at 15 seconds after the start of an auto power sequence start. During a manual sequence start, the cycle start light does not come on until the disk drive auxiliary (R32) picks. The stop lock up light comes on when R47 picks during any stop sequence.

Disk Drive

The disk drive on and off switches are for manual control of the disk drive motor. The disk drive can be manually started only if the heads are unloaded and the timer is at the beginning of a cycle. The disk drive light is in parallel with the disk drive contactor (K2). If a disk-drive-motor-overload switch or overtemperature switch opens, R39 picks and turns on the motor overload light. A disk drive overload or overtemperature condition causes a stop sequence to occur.

Electronic Dc

The electronic dc on and off switches are for manual control of the electronic dc power. If electronic dc is applied and all access swingout interlocks are closed (access in operating position), R44 picks to turn on the electronic dc present light. An overtemperature condition in an electronic gate causes R48 to drop. R48 picks R36 which turns on the electronic air temperature light.

Solenoid Dc

The solenoid dc on and off switches are for manual control of the solenoid dc power. The solenoid dc present light is turned on when R8 is picked by K301. Solenoid dc can come on only when electronic dc is present. Loss of electronic dc results in dropping solenoid dc. This protects the solenoid driver cards from damage caused by having 48 volts without proper biasing voltages.

Oil Pump, Power Supply 2121874

The oil pump on and off switches are for manual control of the hydraulic power supply motor. A pressure switch in the hydraulic system picks R7 when operating pressure has been reached. R7 turns on the pressure normal light. Opening an overload in the oil pump drops R2 which in turn picks R40 which turns on the motor overload light. When the temperature of the oil exceeds 130°, R49 drops to pick R38 which turns on the high oil temperature light.

Oil Pump, Power Supply 2164574

The pressure switch is replaced by an oil level switch. If the oil level is low, this switch opens

causing R102 to drop which in turn drops File Ready and turns off oil pump power.

Head Load

The head load switch is for manual loading of the heads. The switch is effective only after the timer has run 180 seconds. This time must be allowed to build pressure in the array and remove particles of dirt. The head unload switch is for manual unloading of the heads. In any stop sequence, the heads must be unloaded before the disk array can be stopped.

Before the heads can be loaded, at least one access must be retracted and air pressure must be normal. The accesses retracted lights is picked by R4. R4 is picked by all the access retracted switches or inop relay points in series. The air pressure normal switch closes to pick R46 which turns on the pressure normal light. The head load light is turned on by R125. R125 also picks the clock head solenoid and the head load air solenoid control (K202). The heads unloaded light is turned on by the pick of R43. R43 will pick only if all the heads, including the clock head, are unloaded. The head load check switch is for manual control of the head check operation. Depression of this switch in manual control will pick the head load check relay (R45). This relay, in series with the head loaded switches on each access and the clock head, will pick R5 if all heads, including the clock head are loaded. R5 turns on the heads loaded light.

File Ready

The file ready light is turned on by the file ready relay (R64) if all of the following conditions are present.

1. Not stop sequence delay
2. Heads loaded
3. Electronic dc present
4. Oil pressure normal (with power supply 2121874) or oil level normal (with power supply 2164574).
5. Solenoid dc present
6. Solenoid power supply control

Manual Reset

Depression of the manual reset switch is the only way the following conditions can be reset.

1. Disk drive overload
2. Electronic air overtemperature
3. Oil overtemperature
4. Oil pump overload
5. Dc failure indication
6. Air pressure normal (after disk drive on).

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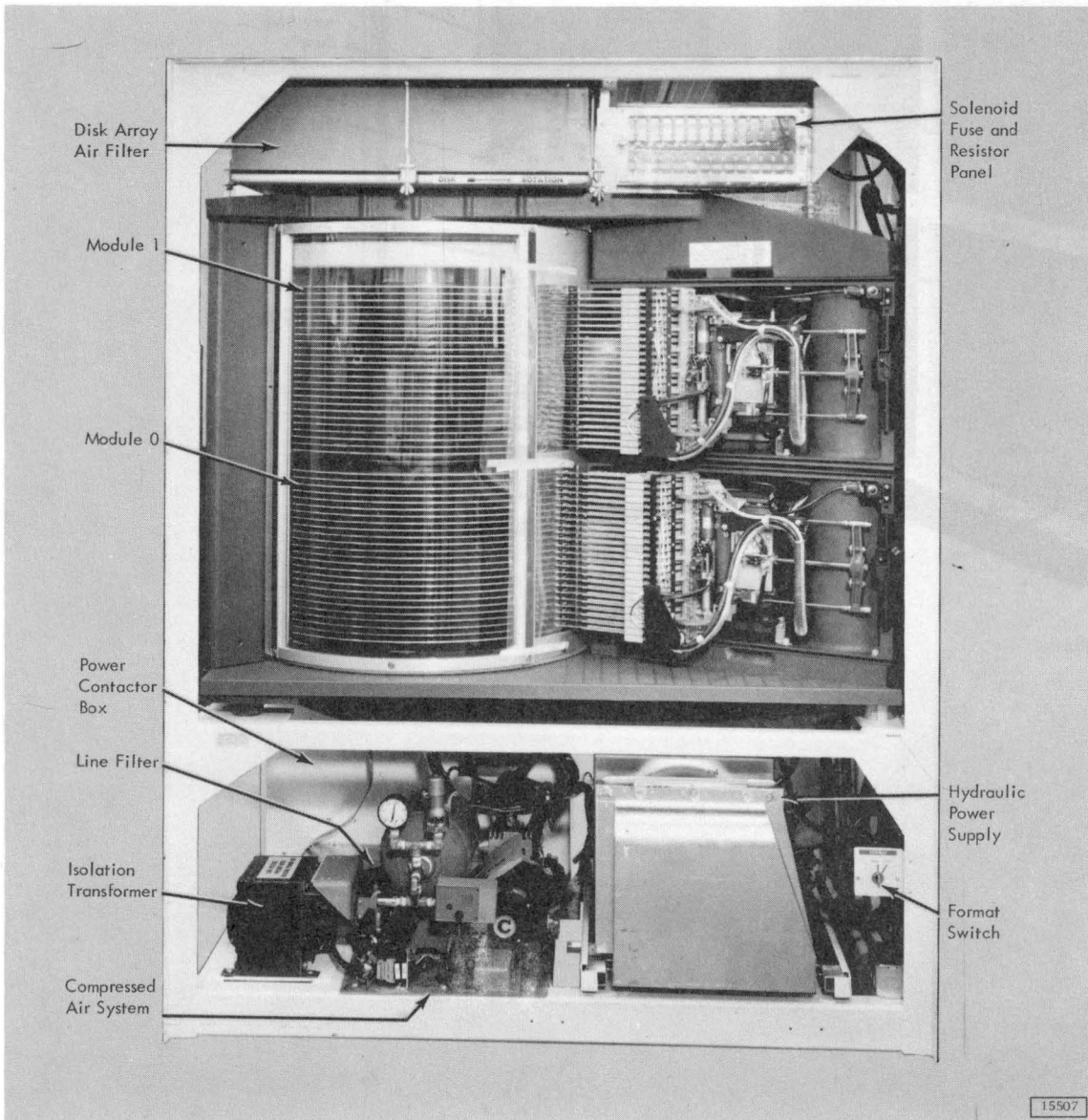


Figure 4-1. Mechanical Frame

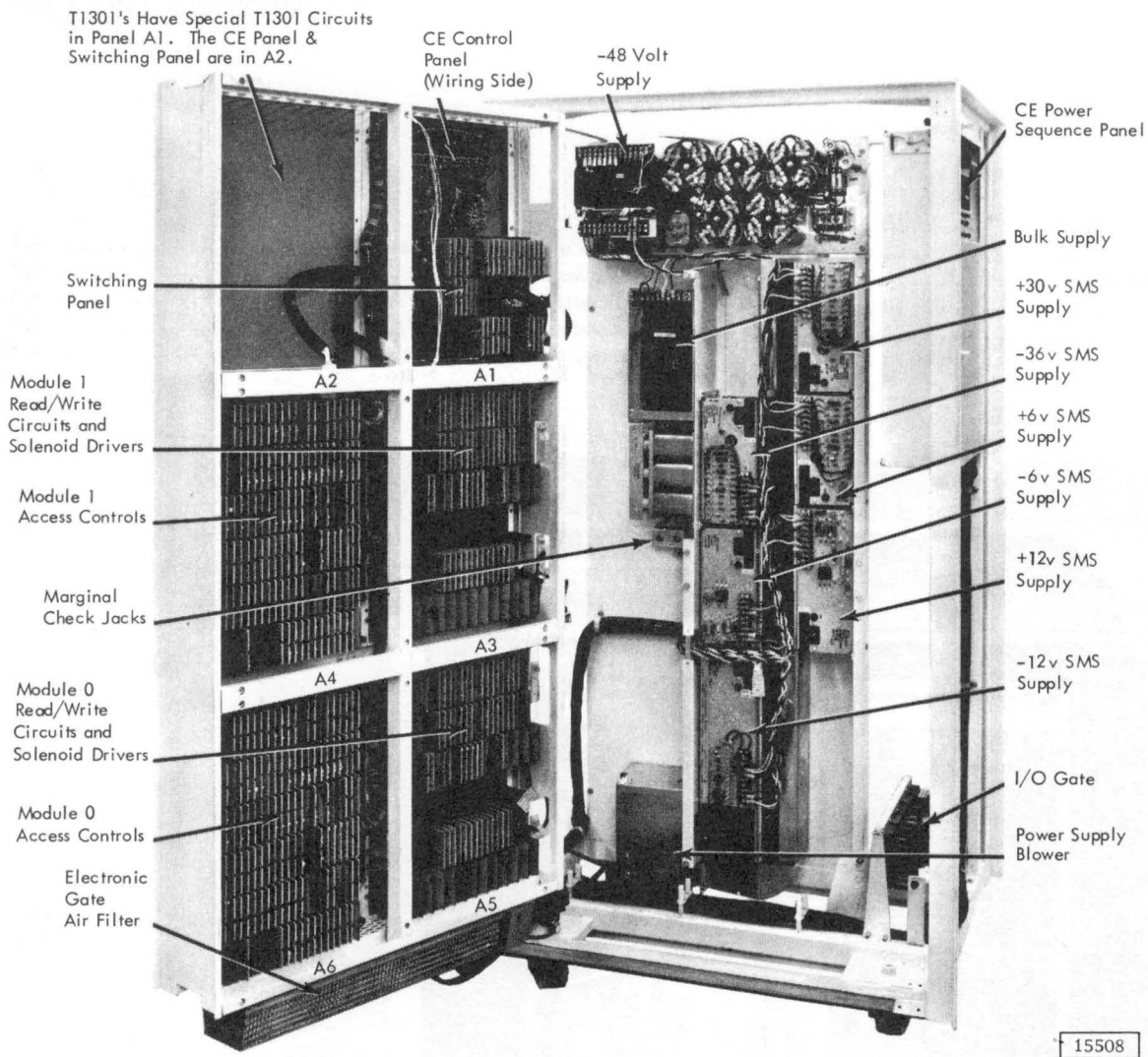


Figure 4-2. Electronic Frame

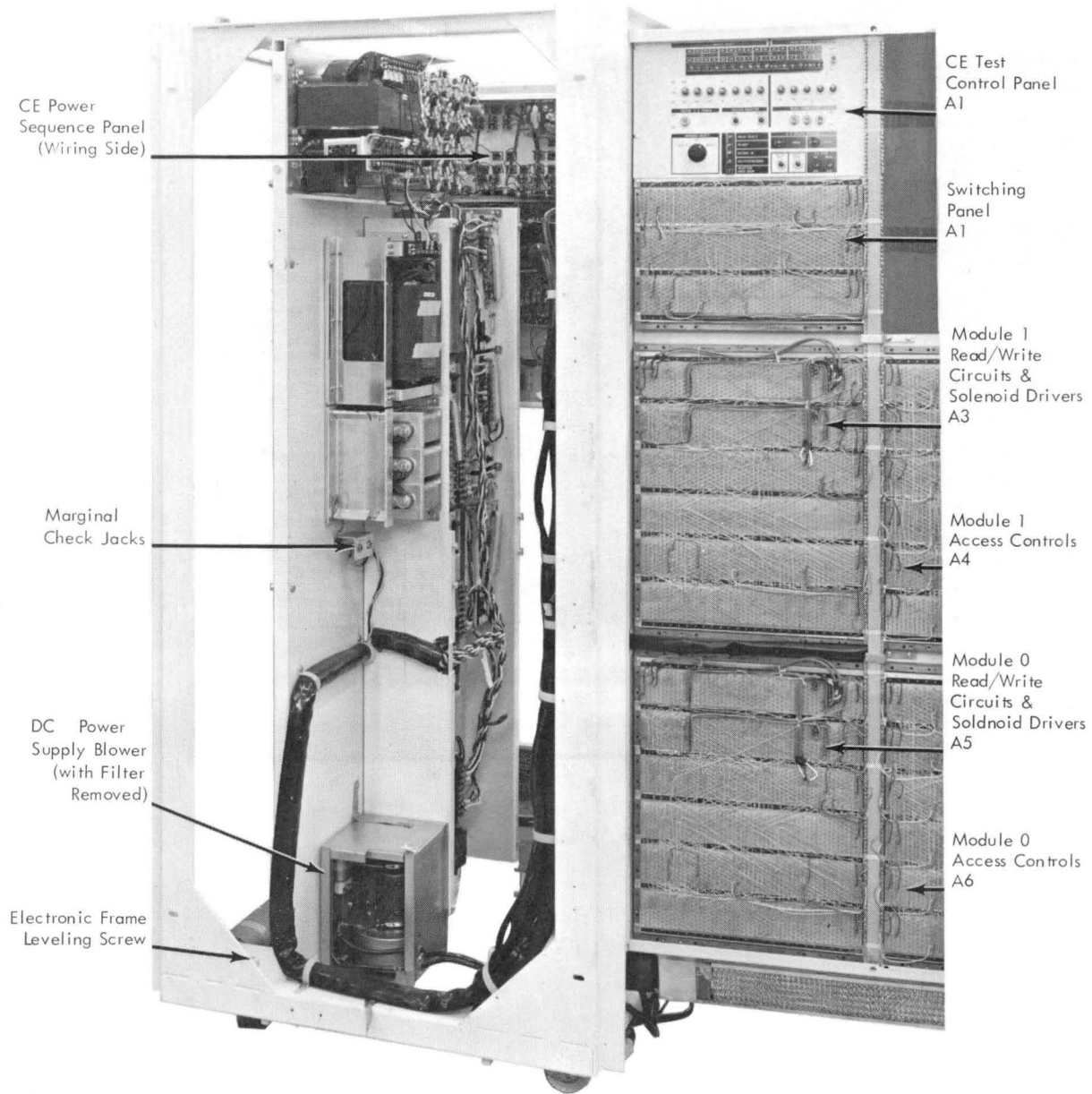
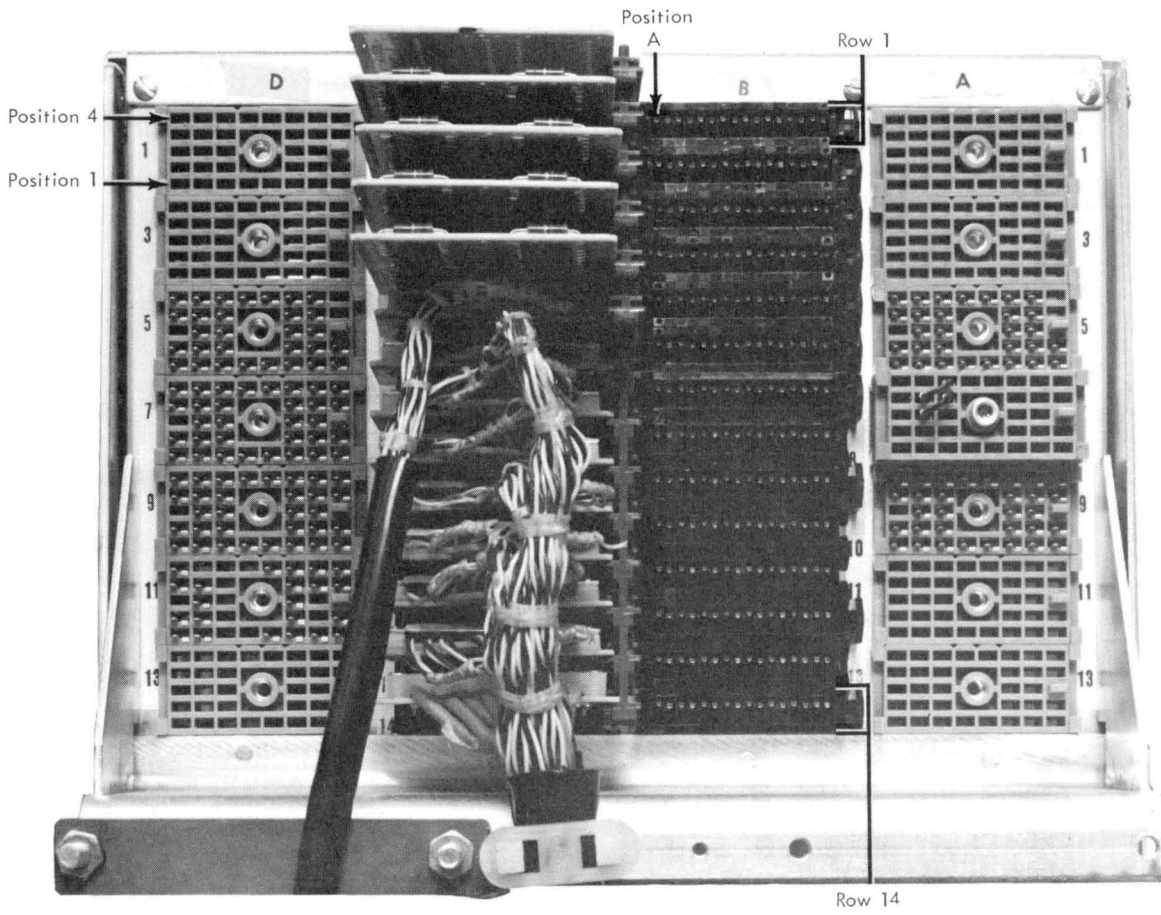
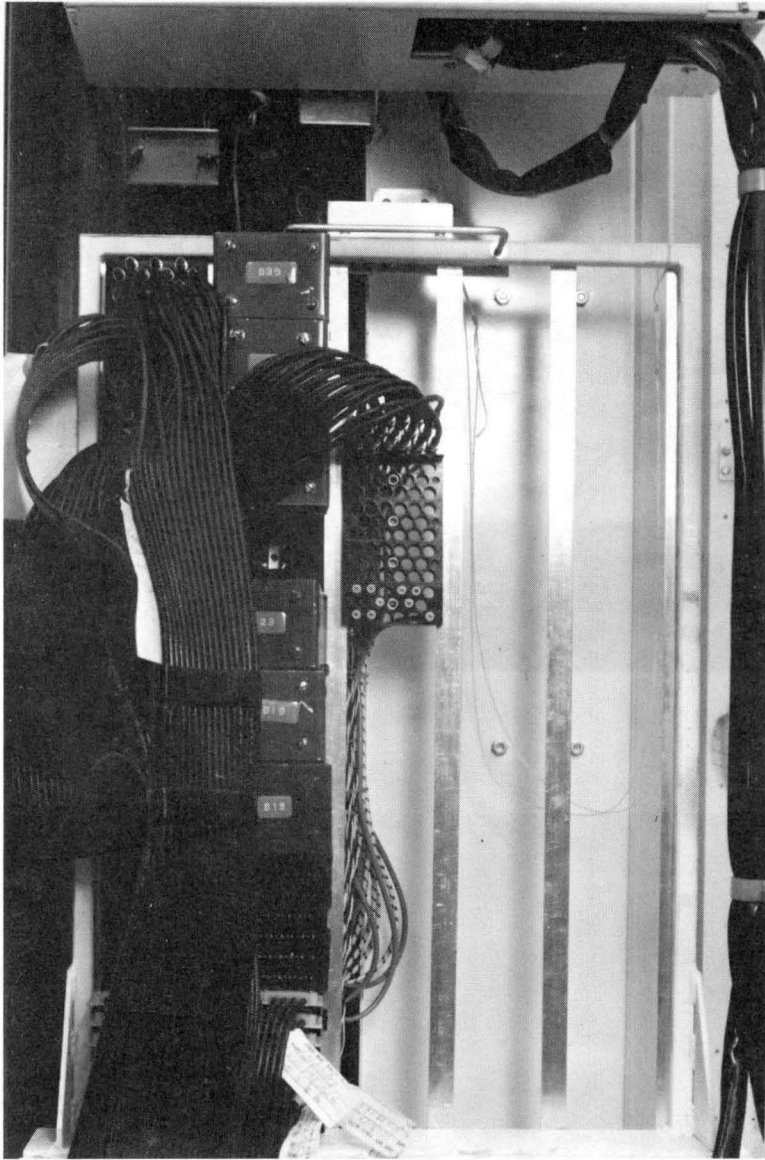


Figure 4-3. Electronic Frame - Left End



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Figure 4-4. I/O Gate



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Figure 4-5. I/O Gate - T 1301

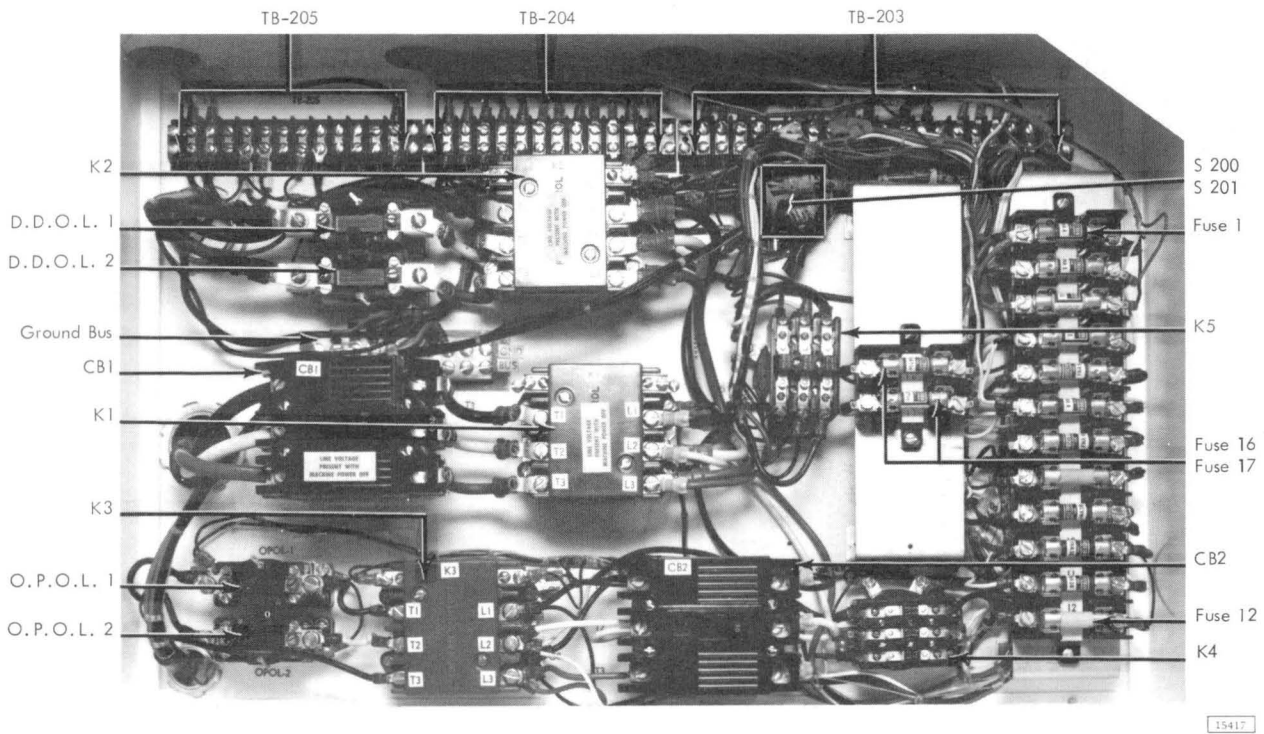


Figure 4-6. Power Contactor Box

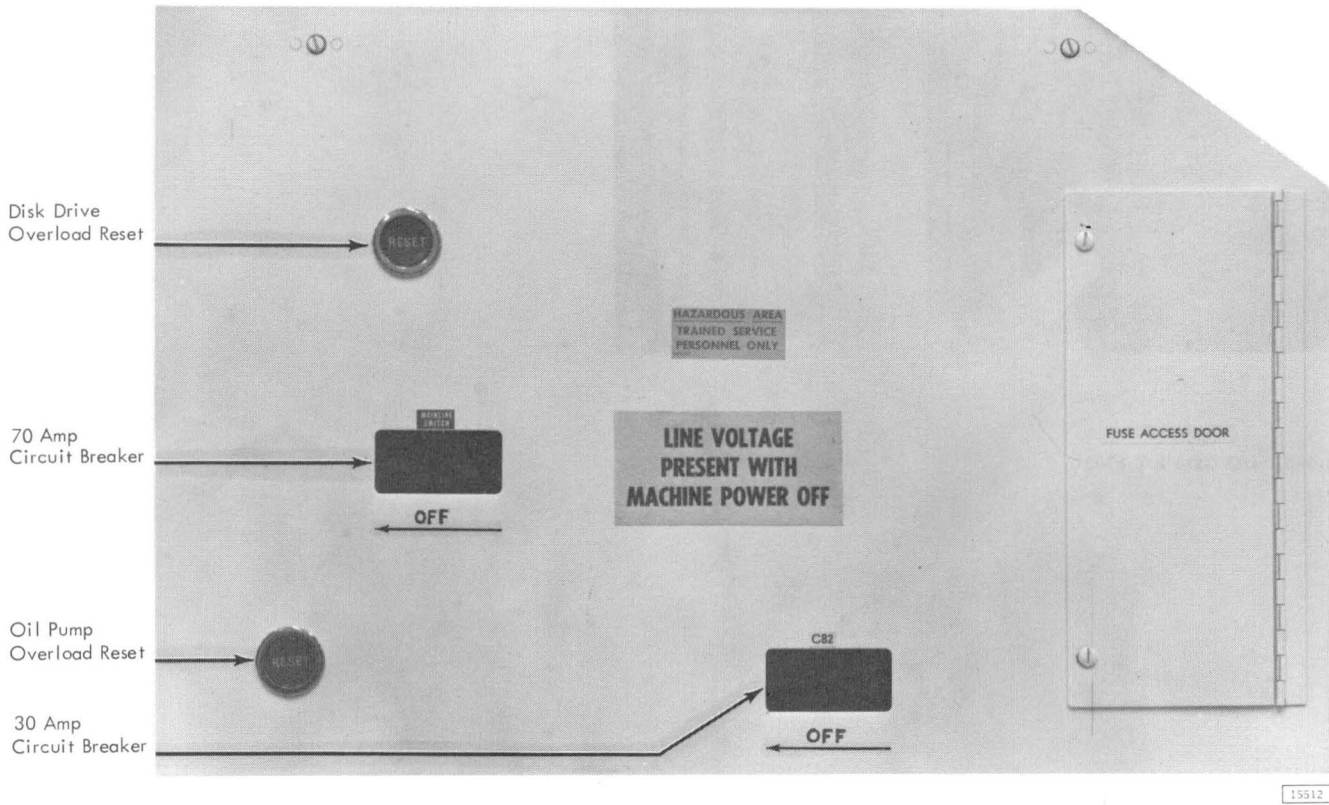
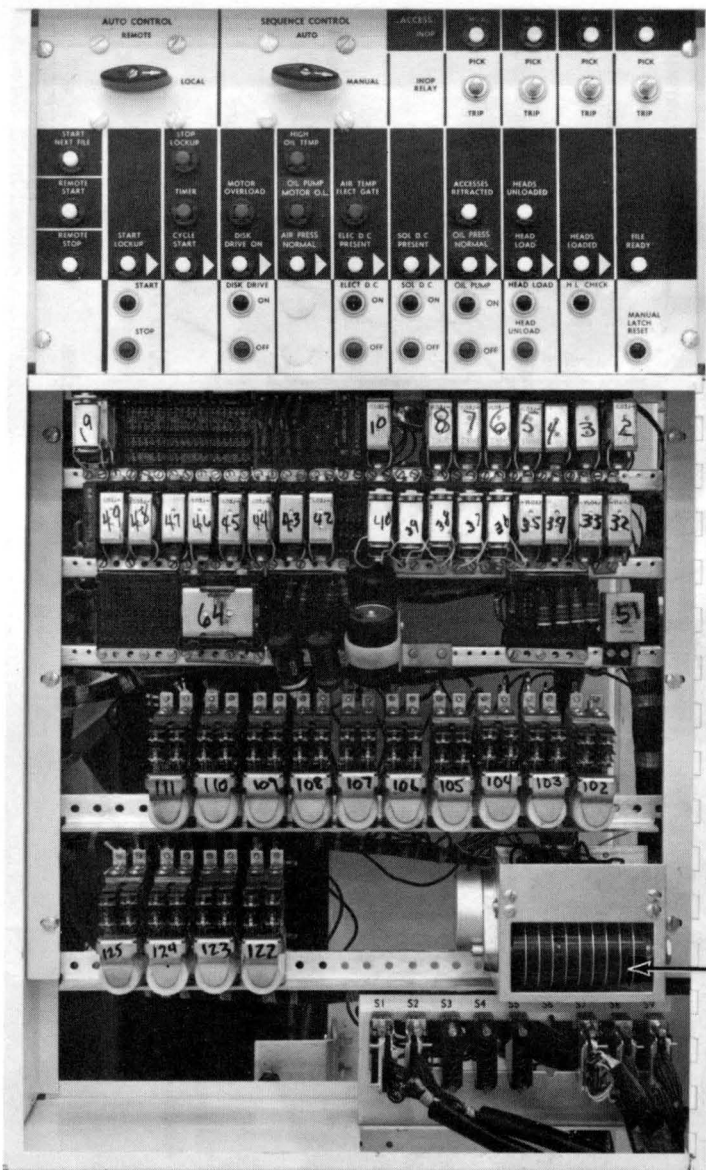


Figure 4-7. Power Contactor Box - Covered



CE Power Sequence Panel

Timer

15513

Figure 4-8. Power Sequence Gate

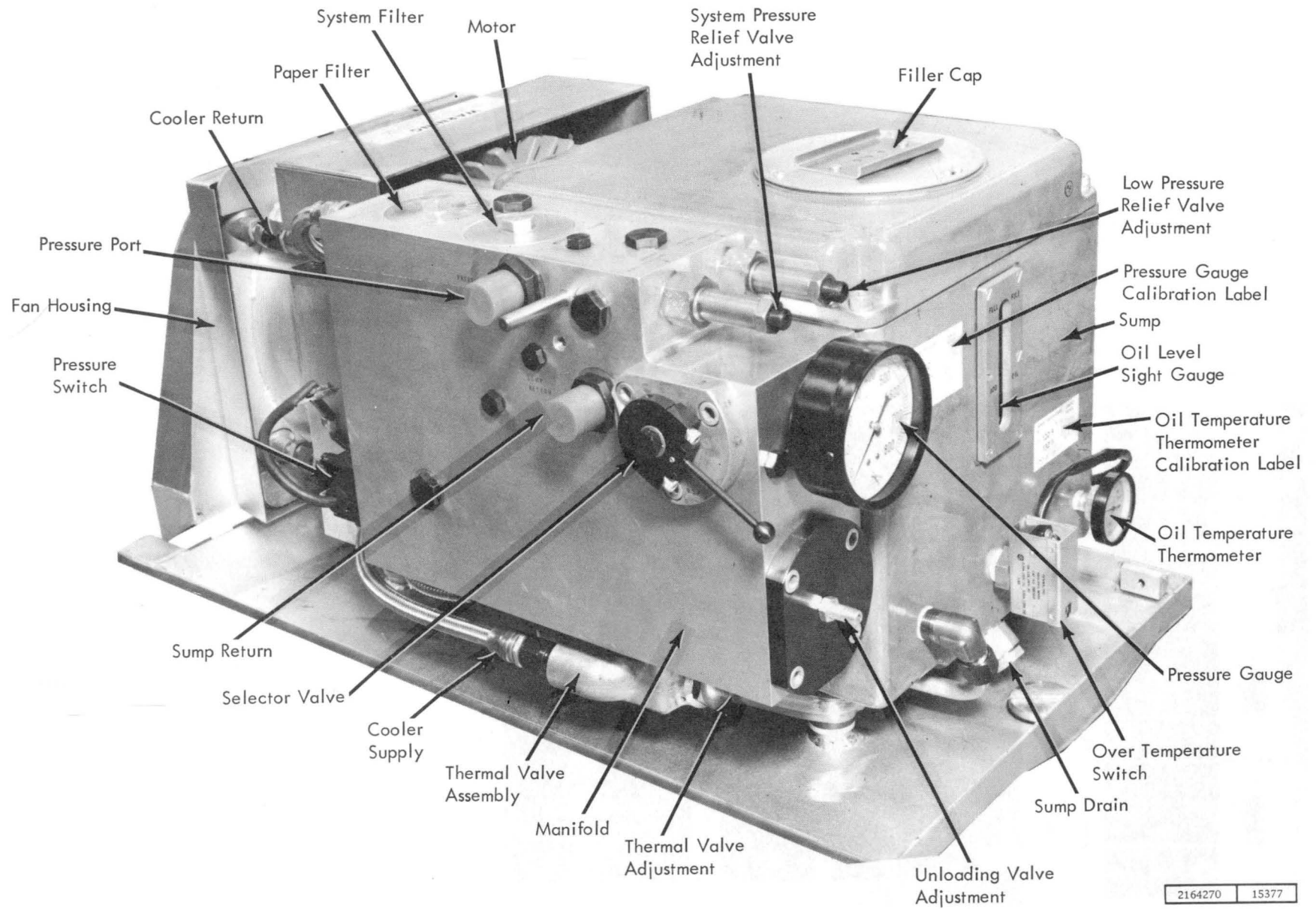


Figure 4-9. Hydraulic Power Supply P/N 2121874

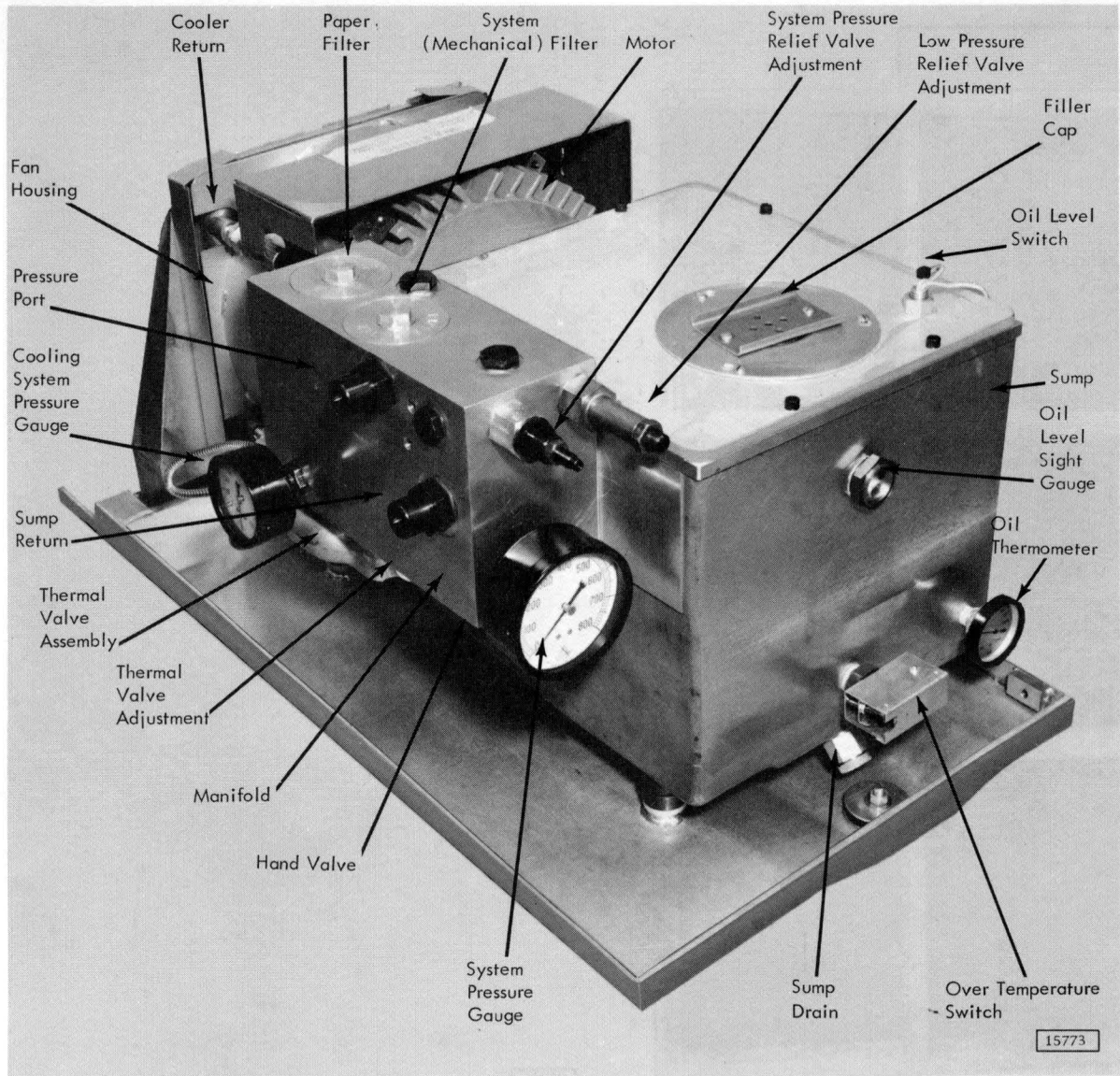


Figure 4-10. Hydraulic Power Supply P/N 2164574

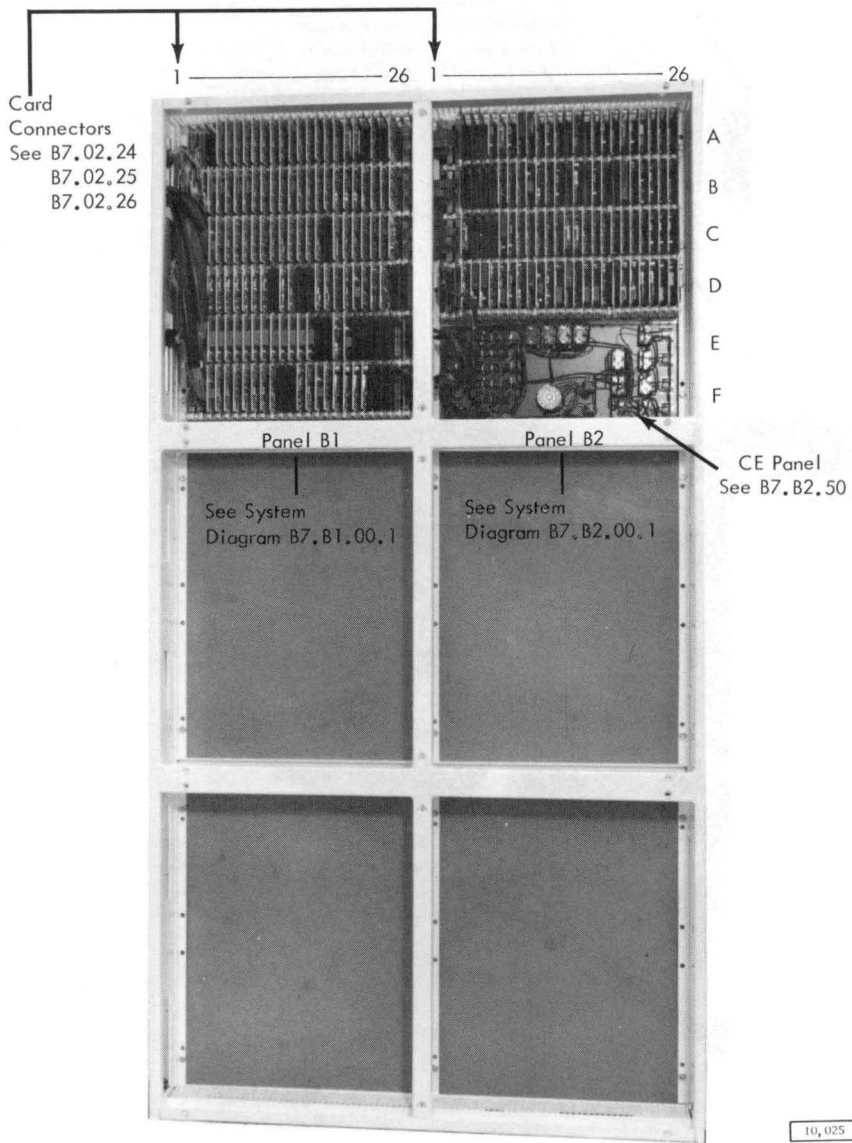


Figure 4-11. B-Gate, Models 11, 12, 21, 22

SECTION 5 SPECIAL TOOLS AND SUPPLIES

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SHIPPING GROUP

This is a list of special tools and supplies that are sent with the machine from the plant. They should be kept with the machine.

Customer Engineering Reference Manual	Form 227-5581
Parts Catalog 1301	Form 127-0767-2
T1301	Form 127-0767-1
Disk Cleaning Paddle	P/N 2108010
Lint Free Tissue	P/N 2123106
Wrench - Hex Key	P/N 2108467
Alcohol	P/N 2155966
Cleaning Tissue	P/N 2162567
Force Gage	P/N 460870
Brace Assembly, Swing Out	P/N 2155780
Binder - CE Manual	Form 229-2048
Extr - Tool Diamond Pin	P/N 2108733
Container Oil Drain	P/N 2108743
Pan Oil Drip	P/N 2164576
Tool Kit (P/N2108609 includes the following)	P/N 2108609
Extraction Tool	P/N 2108398
Paddle - Head Cleaning	P/N 2108474
Wrench - Hex Key 7/64	P/N 2108490
Output Shaft Seal Tool	P/N 2108394
Output Shaft Seal Puller	P/N 2108395
Key Format Switch	P/N 2122347
Plate Test	P/N 2108024

TOOLS AVAILABLE WITH SYSTEM

The following is a list of tools available for systems which use the 1301 Disk Storage Unit.

Tektronix 535 Oscilloscope and Accessories	P/N 460257
Tektronix Pre-Amp 53/54 CA	P/N 460999
Direct Coaxial Scope Probe (X1)	P/N 460852

OFFICE TOOLS AND SUPPLIES

The following is a list of tools and supplies normally located in the branch office. They can be obtained when needed.

Meter, Simpson P/N 450497
Force Gage P/N 2108578
Prefiltered Hydraulic Oil (in one gallon container) . . P/N 2115252
Vacuum Cleaner -- Hoover Model 86
10" Adjustable Wrench P/N 450177
Carriage Spacing Tool P/N 2108576
Wrapped Wire Pistol Tool P/N 461012
Torque Wrench and Accessory Kit P/N 2108470
(for shaft motor or actuator replacement)
Kit (P/N 2108470) includes the following:
 Wrench - 5 to 150 In/Lbs Torque P/N 2108435
 Adapter - Actuator Torque P/N 2108436
 Socket .500" P/N 2108464
 Socket - Universal P/N 2108466
 Socket - .375" P/N 2108478
 Roll - Torque Kit Tool P/N 2108481
 Socket - .125" Hex P/N 2108486
 Socket Adapter 3/8 to 1/4 Sq Drive P/N 2108746
 Socket .078 Hex Bit P/N 2108747
Lint Free Tissue P/N 2123106
Burndy Extractor Tool Rx 20-10 P/N 461043
Solder Iron Tip-SMS Pin Removal P/N 451111
Replacement Plunger P/N 451113
Marginal Check Power Supply P/N 210860
Wrapping Bit, Wire Size #24 P/N 461235
Sleeve, Wire Size #24 P/N 461015
Hand Crimping Tool P/N 450898
Wire Stripper P/N 450694
Wire Gage P/N 461076
#24 Gage Solid Tinned -- Copper Wire P/N 216226

TOOLS FOR SMS SERVICING

The following is a list of tools and supplies that are not shipped with the machine, but are recommended for each installation.

Hand Un-wrap Tool P/N 451573
Card Extender -- Cable Isolation Tool P/N 451075
SMS Card Contact Lubricant P/N 451053
SMS Card Insertion -- Extraction Tool P/N 451030

TOOLS IN EMERGENCY PARTS CENTERS

The following is a list of tools available in all Emergency Parts Centers. They can be obtained when needed.

Disk Aligning Kit P/N 2108433

This kit contains special disk replacement tools. This kit does not contain replacement disks. Included in this kit is a special flashlight. However, due to the decay factor inherent in dry cell batteries they are not shipped with the light. Obtain two type AA pen light batteries locally.

Hoist for Shaft Motor Kit B/M 2108247

When replacing a shaft motor, the Hoist for Shaft Motor Kit (B/M 2108247), Disk Alignment Kit (B/M 2108433) and Shaft Motor and Instructions (B/M 2115248) must be ordered from the E. P. C. Special tools required for motor replacement will be shipped with the shaft motor.

Hydraulic Power Supply Replacement Kits P/N 2121874 (Figure 4-9) and P/N 2164574 (Figure 4-10)

These kits contain a complete hydraulic power supply, including fluid with the equipment necessary to

remove the used unit and install the new unit. The container for this unit serves the dual purpose of a shipping crate and a dolly platform to assist in the removal of the used unit and installation of the new unit.

APPLICABLE CUSTOMER ENGINEERING MANUALS

This is a list of CE manuals that contain information that is of value in servicing the IBM 1301 Disk Storage.

Customer Engineering Manuals of Instruction:

Tektronix Oscilloscopes	*Form 223-6725
Transistor Component Circuits	Form 223-6889
Transistor Theory Illustrated	Form 223-6794
Transistor Theory and Application	Form 223-6783
IBM 1301 Disk Storage	*Form 227-5582

Customer Engineering Reference Manuals:

Standard Modular System	*Form 223-6900
Analysis Guide and Service Index 1301, 7631	*Form 229-3136

*Recommended for each installation.

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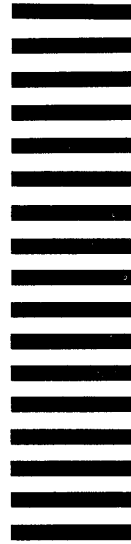
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