John S Likes

IBM Field Engineering
Maintenance Manual

2302 Disk Storage

227-5864-3

IBM Field Engineering Maintenance Manual

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2302 Disk Storage

PREFACE

This manual contains instructions to enable a rapid diagnosis to be made of equipment malfunctions in the IBM 2302 Disk Storage for accomplishing corrective maintenance to keep the equipment ready for use by the customer.

These instructions assume that maintenance personnel have been trained on the operation and application of this machine.

The companion publications, IBM Field Engineering Manual of Instruction, 2302 Disk Storage, Models 1 and 2 (Form 227-5863-2), and Field Engineering Manual of Instruction, 2302 Disk Storage, Models 3 and 4 (Form 227-5995-0) provide information for the theory of operation, and may be used as a reference to augment information contained within this manual.

This manual is divided into six sections which contain the following data:

Section 1 contains instructions and procedures for troubleshooting the equipment to diagnose and isolate malfunctions by the use of service aids and functional checkout procedures.

Section 2 describes maintenance features of the equipment and includes switches and controls which are used to accomplish checkout and maintenance operations.

Section 3 contains instructions for preventive maintenance and includes a tabulated schedule for accomplishing periodic maintenance operations.

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

Section 5 provides instructions for power requirements and procedures for adjustment of power supplies.

Section 6 contains information which locates components, major assemblies, meters, gages, etc., which are described in the procedures contained in the manual.

This manual (Form 227-5864-3) is a complete revision of and replaces Form 227-5864-2.

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CONTENTS

Personal safety cannot be overemphasized. To ensure personal 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 safety cards (Forms 124-0002 and M04-8401) 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 box is -48vdc to 208 vac. Potential difference within the electronic gates, printed cards, and display back panel is from -48vdc to +36vdc. Do not remove or replace circuit cards when dc power is on.

The access cover door safety interlock switch must be bypassed for some servicing procedures (an example would be recovery of data using the tool drawer). Use extreme caution when this is done because the actuator can move if dc power is dropped.

Wear safety glasses when performing any task that could possibly result in parts, lubricants, cleaning solvents, or any other material coming in contact with the eyes.

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 secured in place.

Care should be taken to remove the access assembly according to procedures given in this manual. 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.

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.

POWER SUPPLIES

When a dc power failure is sensed, a dc power 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 must 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 91% Isopropyl Alcohol solution used to clean 2302 Read/Write heads is a flammable liquid. Therefore, keep only the quantity needed for impending use in the customer's office.

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

Comply with appropriate regulations on container when handling 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 24vac is applied to the file (Emergency Off Power).

Mainline (70-amp C.B.) switch OFF

1. 208-230 vac is present at:
   a. Input and output of mainline filter.
   b. Input to the mainline switch.
2. 24 vac 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, and T1.
2. 110 vac is present at:
   a. Convenience outlet.
   b. TB204, TB203, and T1.
3. 24 vac is present at:
   a. Coil of K-1.
   b. TB 204, and 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.

GROUND CONNECTIONS

Convenience outlets for Customer Engineers are provided on all machines. Convenience outlets for customer requirements may be provided as desired; however, the following grounding requirements should be noted.

Machine grounding is required. Four-wire grounded power cords are provided. The fourth wire is for grounding and must not carry current from any source except the radio interference filter.

It is important to the safety of personnel that if any machine of a group is grounded, all other equipment of the group must be grounded. Grounded machines must not be placed so that it is possible for a person to touch both a grounded machine and any ungrounded metal equipment. Grounded machines do not present a hazard in themselves; the real hazard is from contact between grounded and ungrounded equipment.

NOTE: The word CAUTION is used in this manual to indicate procedures that require extra precautions to ensure personal safety.

SERVICING

Any +S signal level may be grounded during trouble analysis unless that level is at the output of an emitter follower (DE card). If a DE output is tied to +S, the +S will be transmitted to the DE input line and represent a damaging short on the transistor driving the DE.

Use caution when installing or removing plastic covers over terminal blocks. The cover mounting springs can become easily bent and could touch a terminal resulting in a short between terminal and frame. Avoid operating the file for prolonged periods of time with the SMS card covers removed.

RECEIVER

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

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

DISK ARRAY

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 reinstalled. If the access cover or the access-cover door is removed, Warm-Up Stabilization is necessary (see Section 4.1).

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.

Do not run the array if the disk-array filter is not securely in place. Head and disk damage may result from accumulation of particles.

Always handle the disks with nylon gloves to prevent contamination by fingerprints on the disks.

READ/WRITE HEADS

Never load the heads when they are out of the disk array, as this will result in damage to heads.

Use only 91% Isopropyl Alcohol (P/N 2155966) to clean heads and disks.

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

HYDRAULIC ACTUATOR

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 1-2 inch lbs at the wrench dial, when using the torque wrench and adapter. Exercise caution to ensure that the wrench is used in the direction which snaps to indicate proper torque (wrench is solid in opposite direction).

INDEX TRANSDUCERS

Adjust the index transducers carefully, as there is a possibility of the index slug contacting the transducer pole tip and breaking off the slug.

INOP SWITCH

Data can be destroyed if this switch is operated when the system is not halted.

HEAD ARCING

To avoid head-to-disk arcing, the following precautions must be observed:

1. Do not remove receiver cables with heads loaded.
2. Do not turn power on unless ac and dc grounds are connected together (in the systems).

NOTE: The word WARNING is used in this manual to indicate procedures that require extra precautions to prevent machine damage and/or malfunctions.

POWER DOWN PROCEDURE

Power down of a single disk storage machine must be accomplished in a local manual mode if other machines are still being operated in the system. This procedure will eliminate noise in the system and avoid probable loss of customer data.

1.1 DIAGNOSTIC TECHNIQUES

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

WARNING: Solenoid Drive No. 2 (TDR-) must never have -48v on it alone. If this card is removed from the gate, there is a possibility of this condition existing. 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 handle of a screwdriver in the area suspected should be sufficient. Use caution because excessive vibrations can cause a short circuit in adjacent card components.

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

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).

1.2 READ MALFUNCTIONS

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

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 assembly must be electrically dc isolated from frame ground by at least 5,000,000 ohms and is to be connected to the pin J of the read filter card (EUV- at 5A08).

The shields of the format head cable must be connected to pin J of the format pre-amplifier card (TXT- at 5C08). The access end of the shields must be tied together and connected to the format drawer shield.

2. Data Read failures can be caused by a defective data read amplifier.
   a. The pulse width of the output (Pin E) of detector (EUK- at A5B10) must be 165 nanoseconds ±15% measured from 10% up on leading edge to 10% down on trailing edge.
   b. The peak-to-peak signal at input to the pre-amplifier (SLT) for any data configuration should not be less than 1.0 millivolts. This applies to customer cylinders only.
   c. The amplitude ratio of 1F (clock bits only) to 2F (clock and data bits) should not exceed 3 to 1.
3. Examples of proper read amplifier signals are shown in Section 1.7. Signal polarity is dependent upon probe connections and the recorded signal.
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.
5. Format read failures can be caused by a defective format read amplifier.
   a. The peak-to-peak signal at the input to the Pre-Amplifier (TXT-) for any data configuration must be between 7 millivolts, and 50 millivolts. This applies to customer cylinders (single access file only).

b. The DC levels (no signal) at pins H and G, or TP1 and TP2 of the Overdriven and Limiter Amplifier (TEN-), must be within 0.1 volt of each other. Use the potentiometer on this card for adjustment.
c. The output of the second Linear Amplifier (TEH-) following the variable Gain Amplifier (TEV-) must be 6.25 volts ±0.25 volt with signal peak-to-peak. Use potentiometer located on Variable Gain Amplifier for this adjustment.
d. Set the clipping level to 50% by observing pin A of the OR-AND. Use potentiometer of the OR-AND card for making this adjustment.

1.3 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 (Section 1.6.8).

1.4 READ/WRITE FAILURES

1. The voltage safety card (SSAF) protects both read and write circuits. Check this card when neither read nor write operations function (See System Diagram 01.15.05.1).
2. Failure of clock read circuit may cause excessive bit shift to be stored on format which could cause data errors.
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. The selection of multiple write X circuits is detected as an error, however, the selection of multiple read X and multiple Y circuits is not. Problems in this area cause simultaneous selection of heads and are difficult to diagnose.

1.5 ACCESS MALFUNCTIONS

1. There is no blown fuse indication on the 2302. 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 timing circuit malfunction.
   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 causing the carriage to bind.
   h. Improper hydraulic power supply pressure or clogged filters.

   NOTE: Clogged filters can also cause overheat problems in the hydraulic power supply.

6. Use the following technique if a stuck hydraulic valve is diagnosed in the actuator.
   a. Pick and drop solenoid of stuck valve from CE panel as rapidly as possible 50 to 100 times.
   b. If Step a frees the valve, select solenoids from CE panel to move carriage to all track positions before returning the 2302 to normal operation.
   c. If Step a fails to free the valve, replace actuator.

   NOTE: Internal repairs and adjustments on the actuator are not allowed. If the actuator proves to be defective, it must be replaced.

1.6 SERVICE CHECKS

1.6.1 Attention Status

Attention status in the 2302 Mod 1 and 2 is reset by the leading edge of the Module Select and Access-Select signal if an End-Of-Seek signal is present.

Attention Status in the 2302 Mod 3 and 4 is reset by the leading edge of Machine Reset ANDed with the Module and Access Select signal.

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 (56 count, outer limit stop, rezero).
3. 60 count comes up.

1.6.2 Rezero

1.6.2.1 Conditions Which Cause Rezero

1. CE Rezero.
2. Power sequence Rezero.
3. Arrival failure.
4. Invalid address (all globs).
5. Hitting the inner limit switch when not addressed to cylinder 250.
6. 250 count, Access Ready, and not Inner Limit Switch
7. Opening access cover door.

1.6.2.2 Machine Status Established by Rezero Condition

1. Set the Access Register to 0000.
2. Pull detent after initial drive (except when access cover door is open).
3. Energize Rezero valve.
4. Return to outer CE cylinder at Rezero force (except when access cover door is 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.

1.6.2.3 Rezero Reset

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

1.6.3 Access Cover Safe Switch

When the access cover door (01.06.15.1) is opened or removed, this switch will open and cause the following machine status conditions:

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.

1.6.4 DC Voltages

1. The 48v relay supply must be a minimum of 42.6v and a maximum of 50.4v.
2. The dc SMS supply voltages must be within ±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 +12 volts.

1.6.5 Pulse Width of Single Shots

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

1.6.6 Access Inop

Access inop can be caused by:

1. Access cover door open or off.
2. System set-access-inop signal. (2302, Models 1 and 2 only).
3. 60 count comes up.
4. Access not retracted at head-load time of start sequence.
5. Heads not loaded at head-load check time of start sequence.

1.6.7 Power Sequence Control

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, Solenoid dc, and start next file (remote only).
4. Oil pump.
5. Head load M0.
6. Head load check M0 and head load M1.
7. File ready and head load check M1.

An access is set INOP during the starting sequence if:

1. The access is not retracted at head load time.
2. The heads are not loaded at head load check time.

1.6.8 Read and Write Safety Circuits

1.6.8.1 Read Safety

1. Pin D of 01A1F14 on System Diagram 01.01.04.1 should be -C when neither Write Gate nor Erase Gate is enabled, and no

Write Driver or Erase Driver output transistor is conducting.

2. Read Safety should fall within 16 microseconds after the rise of Write and Erase Gate. (Both must be present before timing begins).
3. Read Safety and Write Safety should only be on together, following a write operation, between the time from the fall of Write Gate and the fall of Erase Gate. This is an error condition at any other time.
4. The controlling system should monitor Read and Write Safety Lines to assure each is in their proper condition prior to any file operation.

1.6.8.2 Write Safety

1. Pin E of 01A1F01 on System Diagram 01.04.01.1 should be -C when either Write Gate or Erase Gate is enabled, or when any one Write driver or Erase driver output transistor is conducting.
2. Write safety should rise within 10 microseconds after the rise of either Write Gate or Erase Gate.

1.6.9 Bit Cell Time

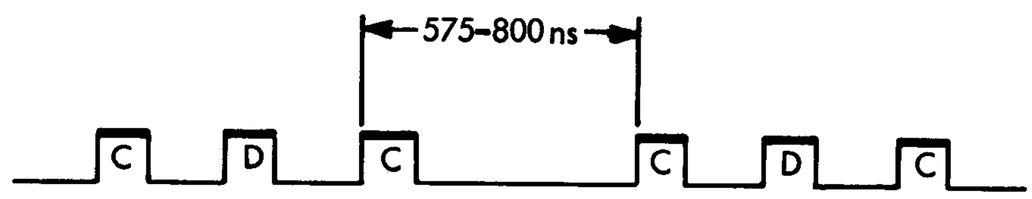
Bit Cell time is defined as 800 nanoseconds plus or minus motor speed variations measured from clock bit to clock bit with data bits evenly spaced between clock bits. There will be magnetic bit shift due to magnetic displacement. There are five basic bit patterns which have different bit shift specifications. They are shown in Figure 1-1.

1.6.10 Format Track

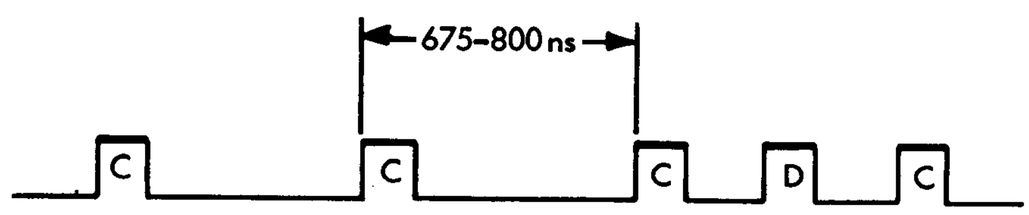
A format track is written which consists of a series of combinations of all bits and no bits. These combinations consist of a specific number of all bits and no bits. These bits are written approximately 1.6 microseconds apart and only vary with motor speed. The format track is written with respect to the clock track.

This format is written on the file format for all four actuators with the layout shown in Figure 1-2 for 2302 Mods 1 and 2, and Figure 1-3 for 2302 Mods 3 and 4.

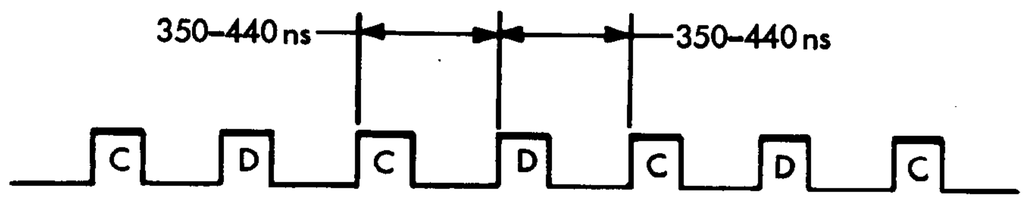
1. An isolated zero bit (no data bit)



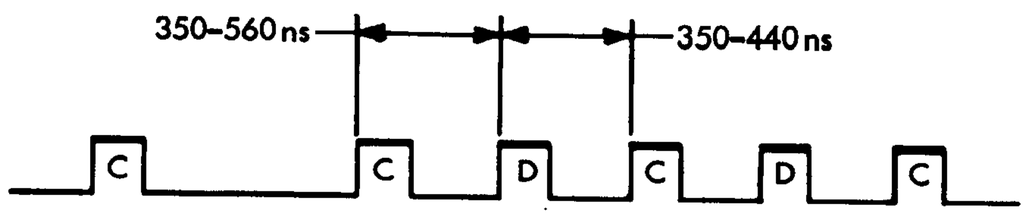
2. The last bit of a chain of zero bits



3. Data bits in a chain of data bits



4. A data bit preceded by a zero bit



5. A data bit preceded by a data bit and followed by a zero bit

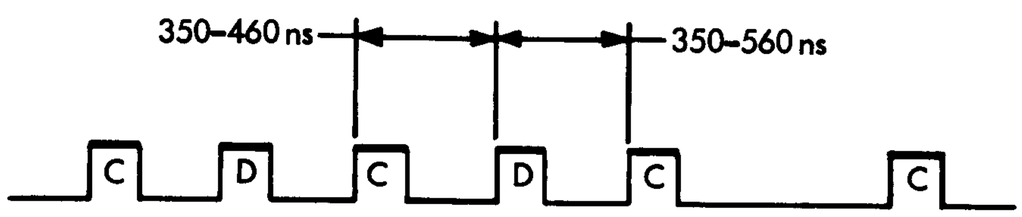


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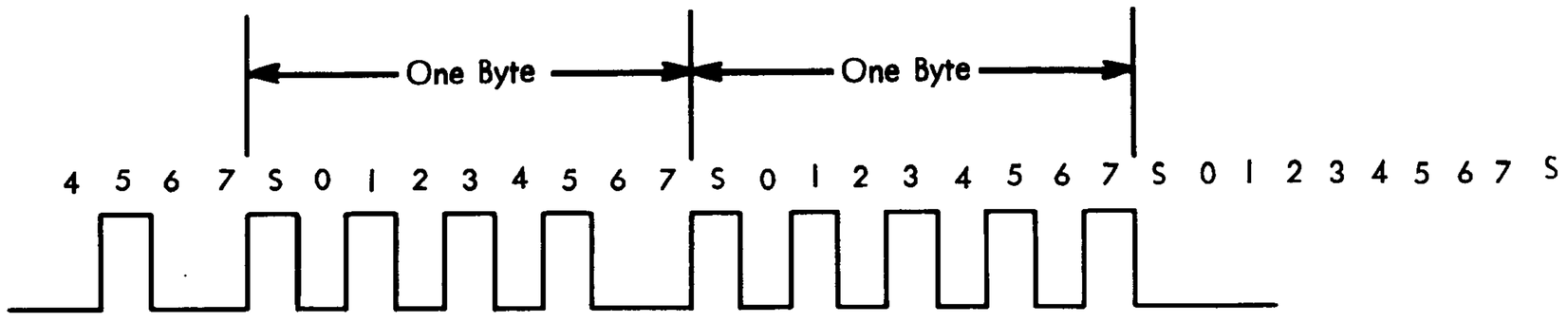
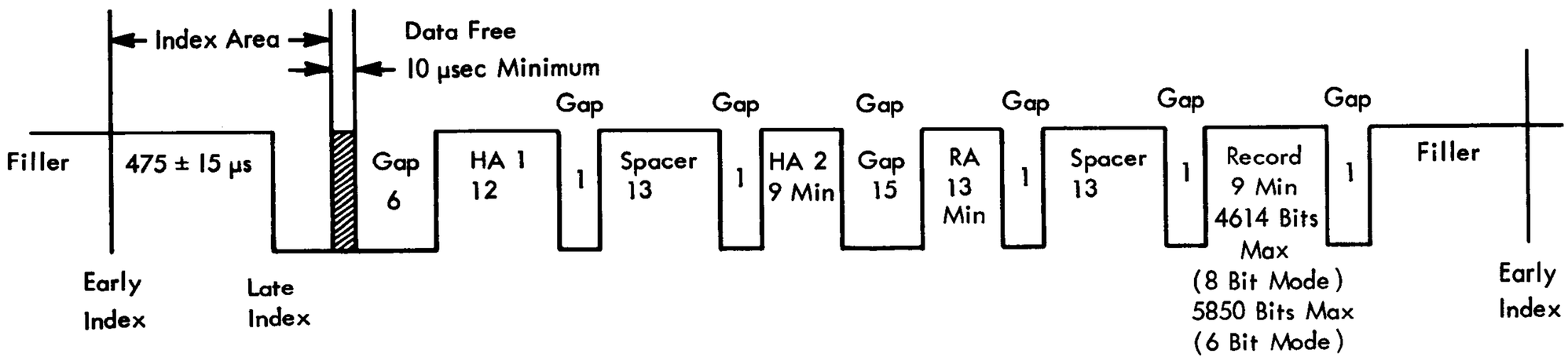
Figure 1-1. Basic Bit Patterns

1.6.11 Write Data

1. Pulse Width — 100 to 140 nanoseconds. Measured from 10% up to 10% down.
2. Pulse rise time — 15 nanoseconds (max.)
3. Pulse fall time — 35 nanoseconds (max.)
4. There shall be no more than ±10 nanoseconds bit shift from any bit to any adjacent bit.



Character Bit Pattern



Note: All area numbers not labeled are 7631 FCU characters.

Figure 1-2. Track Format Configuration (2302 Mods 1 and 2)

1.7 READ/WRITE CIRCUIT DESCRIPTION (Figure 1-4)

1.7.1 Complementary Emitter Follower

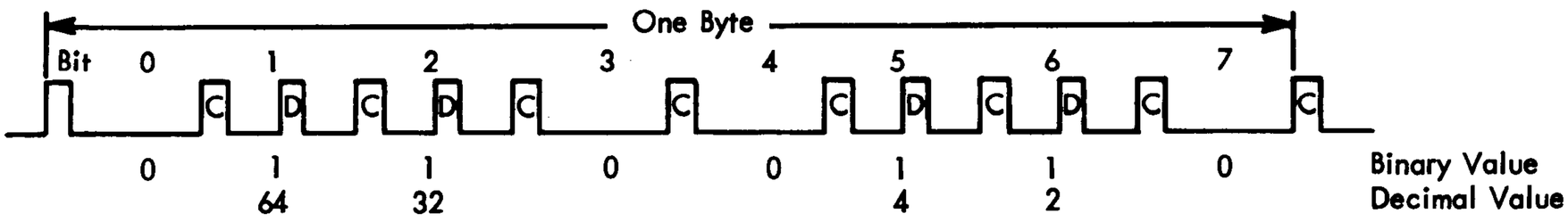
The complementary emitter follower circuit (Figure 1-5) provides the necessary low impedance and proper voltage levels required to drive the write driver.

The input pins A and B accept the Y-level output of the Write trigger. For a typical operation, the output voltage at pins D and C is either -21 volts or -24 volts. If pin A is at a -Y level, the output at pin D is -31 volts and pin B will be at +Y level causing output at pin C to be -24 volts.

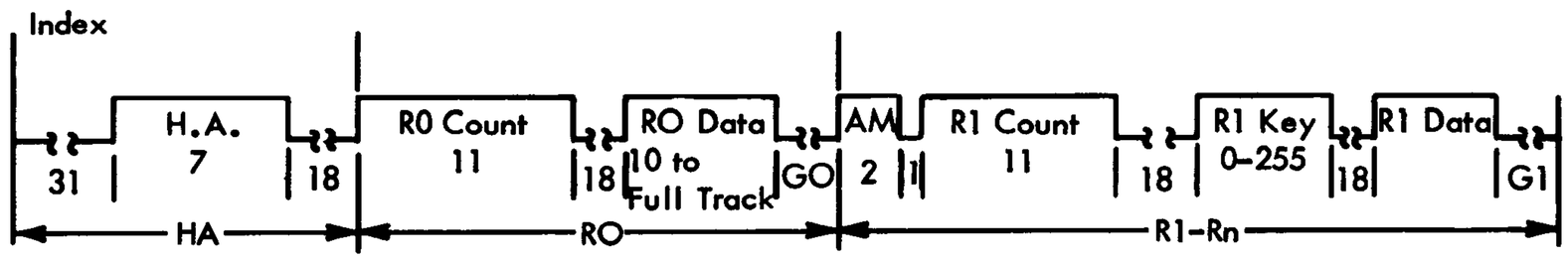
1.7.2 Write Driver

The write driver circuit (Figure 1-6) provides current pulses to the write element. Gating and safety provisions are also included.

Write data from the complementary emitter follower stage are applied to pins D and N in opposite phases. In write operation, the write gate at pin C is at -Y level. When either pin D or pin N is at -21v, write current is available to the write element of the head through its associated drive pin (A or G). Likewise, a voltage level of -24v at either pin D or pin N blocks the current flow from its associated pin (A or G) to the write element. If a not write condition exists, the write gate at pin C is 0v. The write



Character Bit Pattern



G0 = 27, if R0 Data = 8
G0 = 27 +0.049 (R0 Data), if R0 data >8
G1 = 27 +0.049 (KL+ DL)
Gn = 0 if data is written up to index.

Note: All numbers are shown in 8 Bit Bytes
Track format is controlled by 2841 SCU and System Program

26067A

Figure 1-3. Track Format Configuration (2302 Mods 3 and 4)

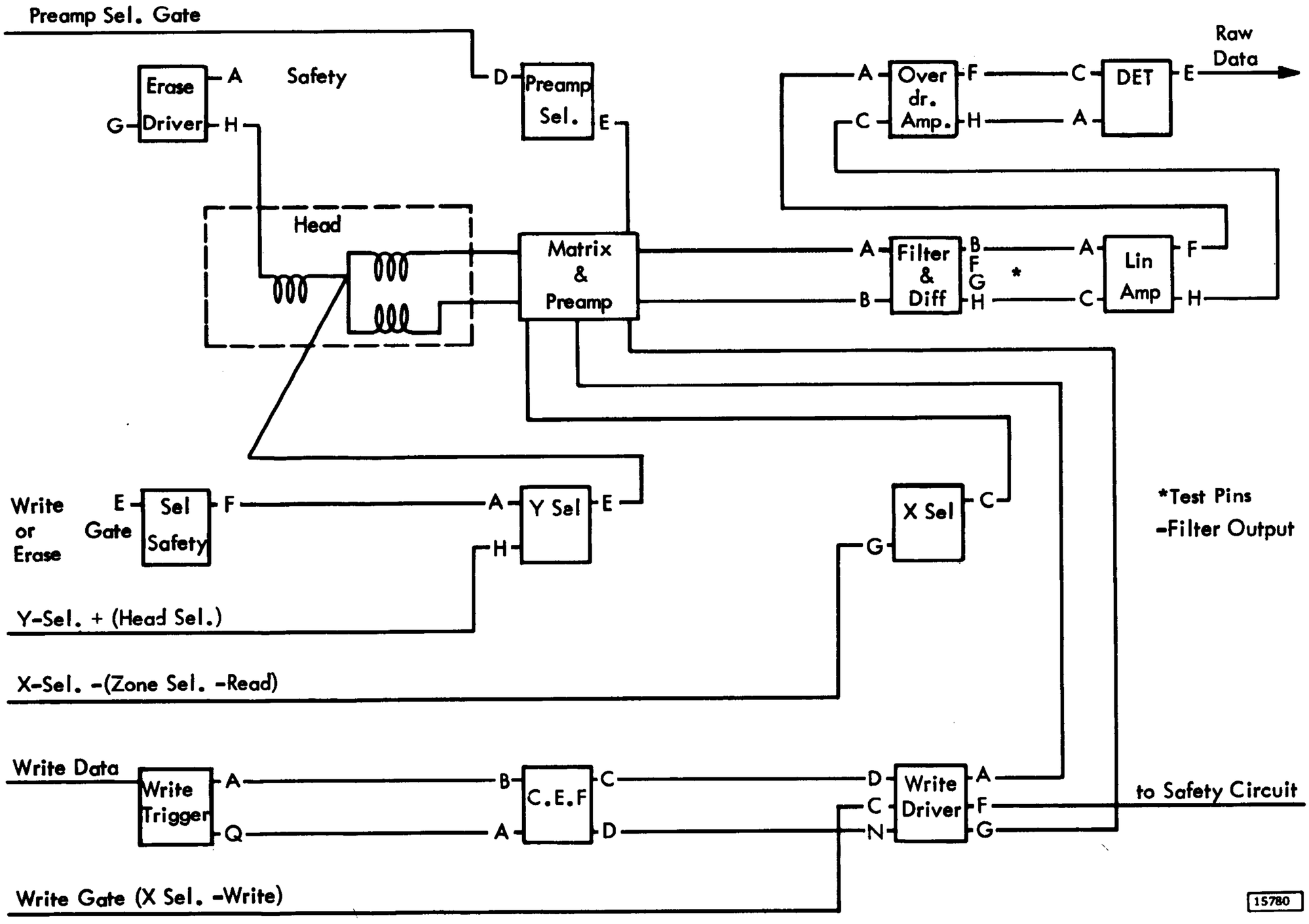
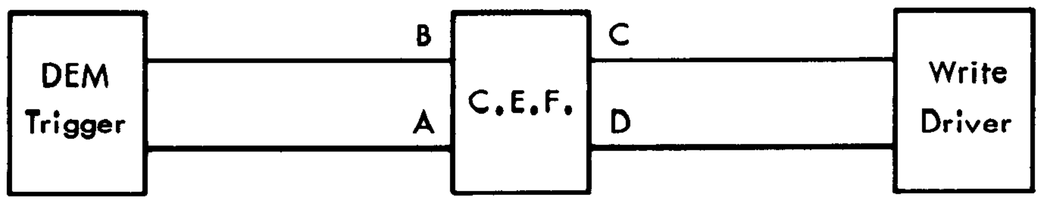
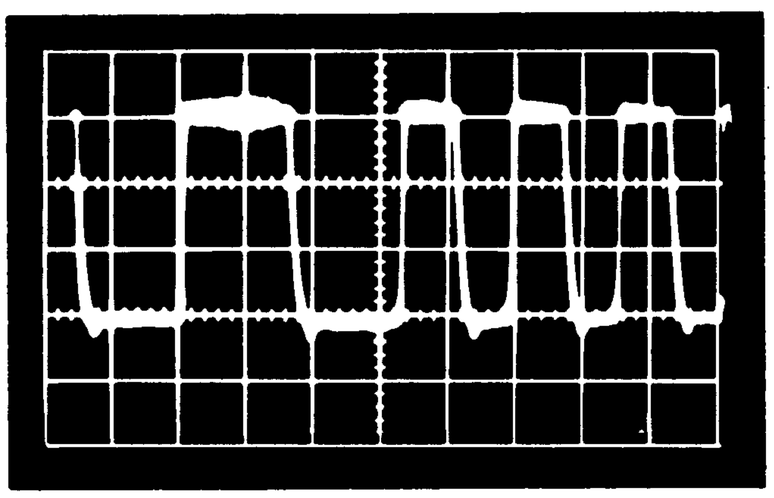


Figure 1-4. 2302 Read/Write Circuits



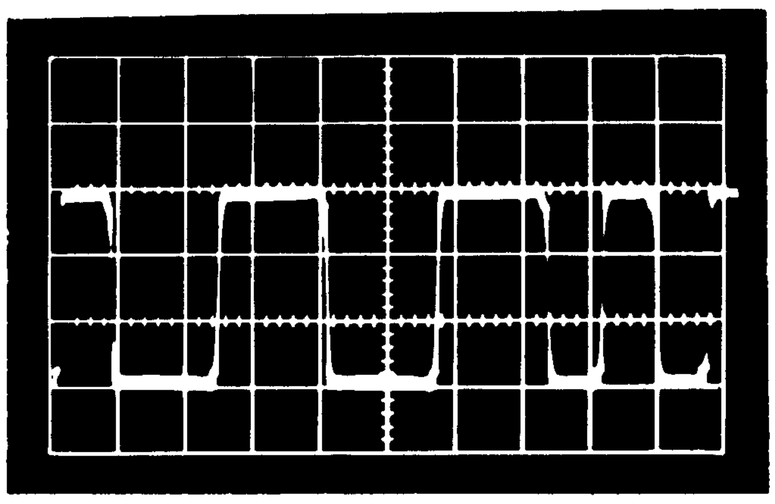
Block Diagram



CEF Input

(Pins A and B)

Sensitivity: 2 v/cm
Sweep: 0.5 μsec./cm



C.E.F. Output

(Pins D and C)

Sensitivity: 1 v/cm
Sweep: 0.5 μsec./cm

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Figure 1-5. Complementary Emitter Follower Circuits

current can be increased by connecting pin B to -36v supply. The output at pin F is used for multiple write driver selection safety check; the level is at -24v while writing.

1.7.3 Erase Driver

The erase driver circuit (Figure 1-7) provides the driving power required when the head is selected for erase operation.

The gate input to Pin G is a standard S level. When the input at Pin G is at -S level, current is allowed to flow from the center tap of the magnetic head (+12v) to the erase coil through Pin H of the erase driver. The erase current has a relatively long rise and fall time (5 μ sec.) to prevent transient currents from erasing information on the adjacent channels. The output transistor at Pin A is Off when the erase current is On for multiple safety check.

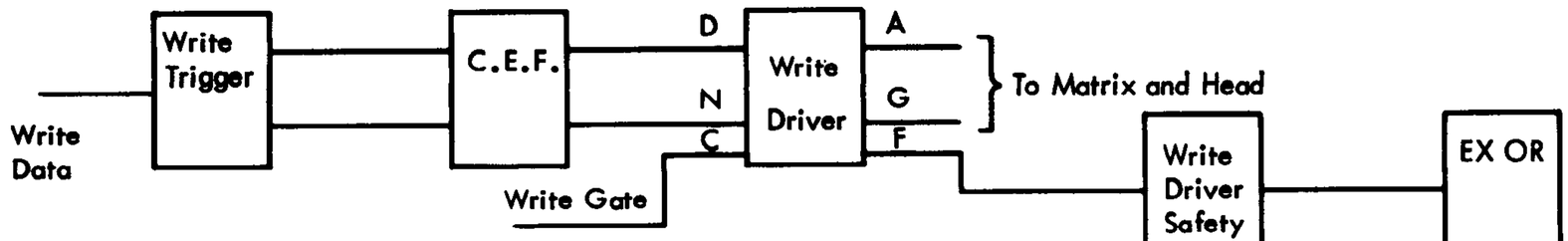
1.7.4 Pre-Amplifier

The pre-amplifier circuit (Figure 1-8) is a differential amplifier, consisting of an emitter follower stage, an amplifying stage, and an output stage which is capable of driving a 93-ohm coaxial cable. The circuit provides a high input impedance and rejects common mode signal to a high degree and amplifies the head signal from 100 KC to 2.5 MC with a gain of approximately 3. The pre-amp can be deselected by changing the voltage level at Pin G7 from -12v to 0v.

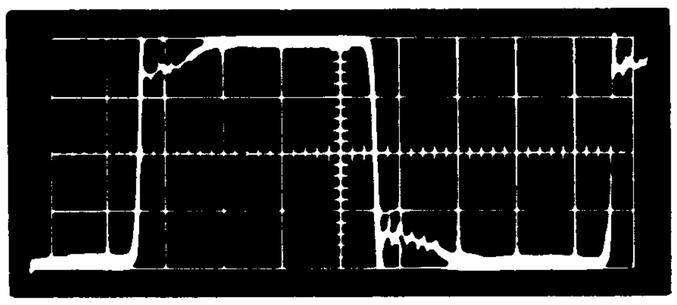
The pre-amp is used in conjunction with 2302 matrix and filter differentiator.

1.7.5 Filter-Differentiator

The filter-differentiator circuit (Figure 1-9) consists of a current source driving a low pass Butterworth filter, an emitter follower stage, and a differentiating stage.



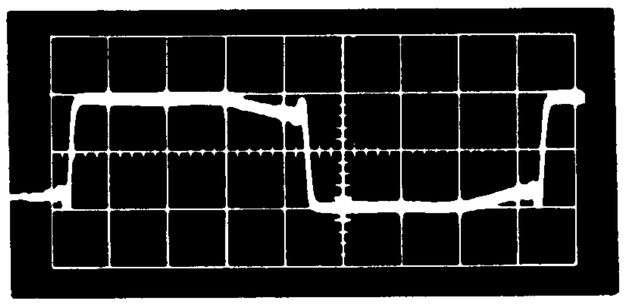
Block Diagram



Write Current

(Pin A & G differential
Pin B connects to -36V)

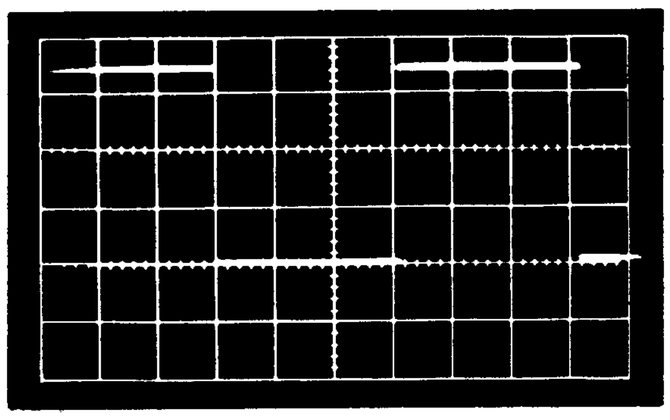
Sensitivity: 50 ma/cm
Sweep: 200 ns/cm



Write Current

(Pin A & G differential
Pin B open)

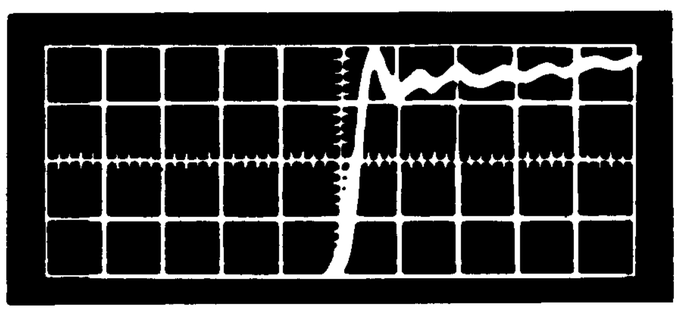
Sensitivity: 20 ma/cm.
Sweep: 200 ns/cm



-24 V

Voltage at Pin F

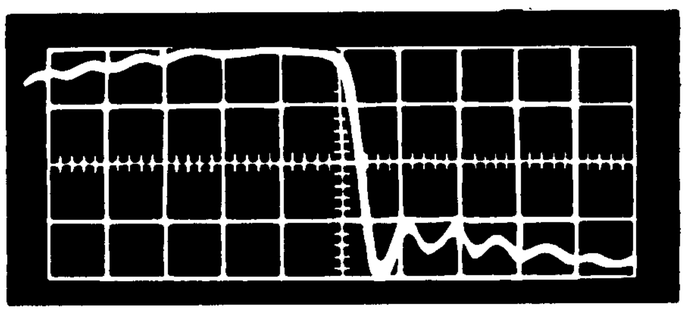
Sensitivity: 10 v/cm
Sweep: 10 ms/cm



Current Rise Time

(Pin A & G differential
Pin B open)

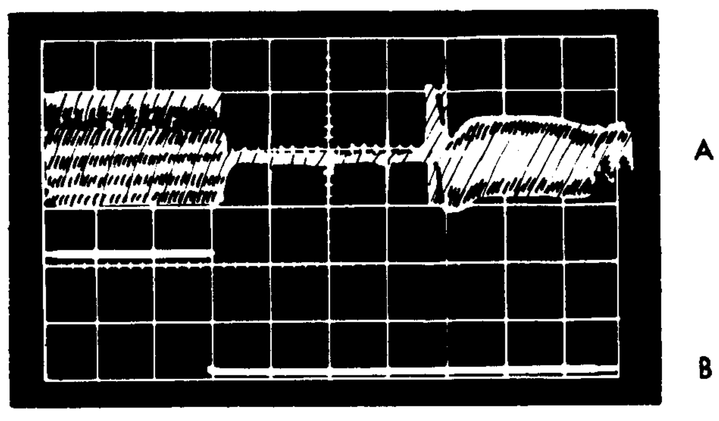
Sensitivity: 20 ma/cm
Sweep: 50 ns/cm



Current Fall Time

(Pin A & G differential
Pin B open)

Sensitivity: 20 ma/cm
Sweep: 50 ns/cm



A

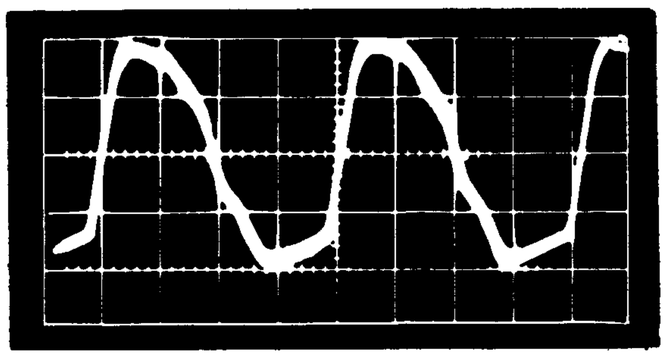
B

Write to Read Recovery

(A) Preamp Output

(B) Write Gate

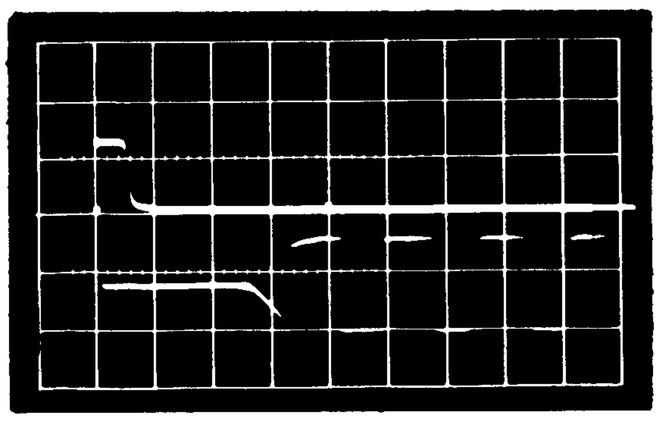
Sweep: 20 μsec./cm



Write Driver Output

(Pin A or G)

Sensitivity: 10 v/cm
Sweep: 200 ns/cm



Turn on Delay

(A) Write Gate (PINC) Sensitivity: 5 v/cm

(B) Write Current Pin A & G Sensitivity: 50 ma/cm

Sweep: (synchronized) 1 μsec./cm

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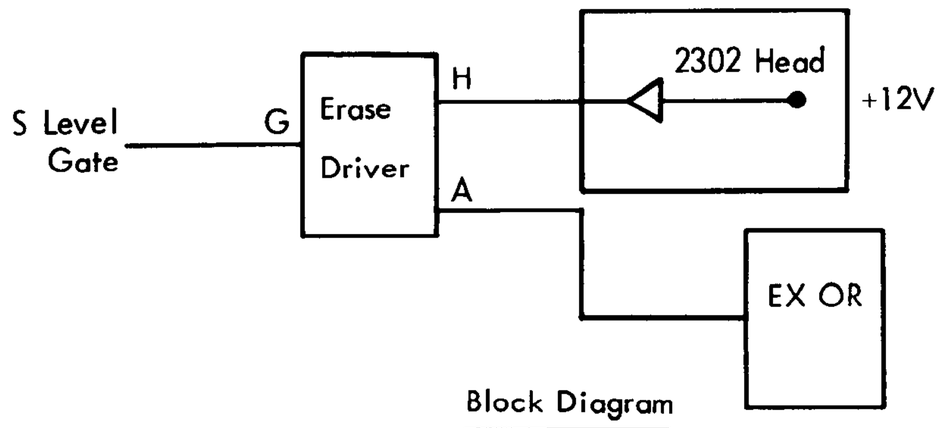
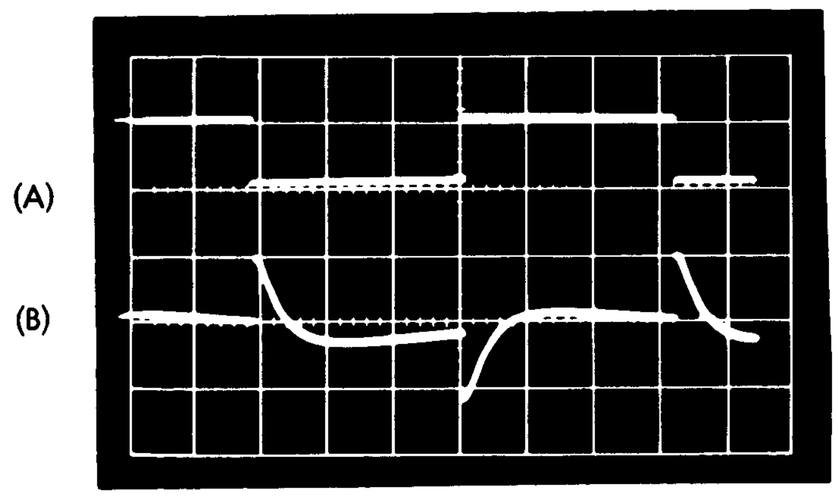
Figure 1-6. Write Driver Circuits



Block Diagram

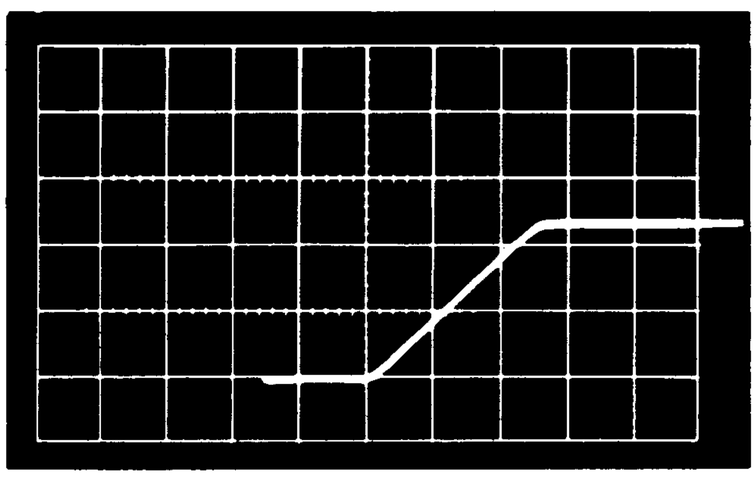


(A) Input Gate (Pin G)

Sensitivity: 5 v/cm
Sweep: 10 μsec./cm

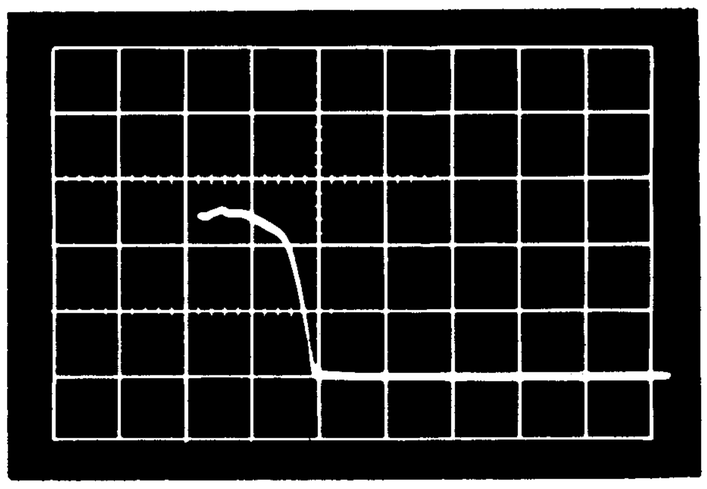
(B) Erase Current (Pin H)

Sensitivity: 50 ma/cm
Sweep: 10 μsec./cm



(A) Rise Time

Sensitivity: 20 ma/cm
Sweep: 2 μsec./cm

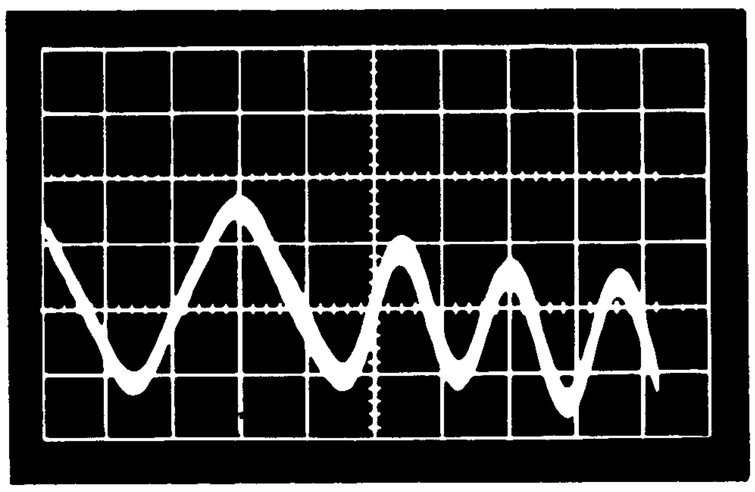


(B) Fall Time

Sensitivity: 20 ma/cm
Sweep: 2 μsec./cm

26049

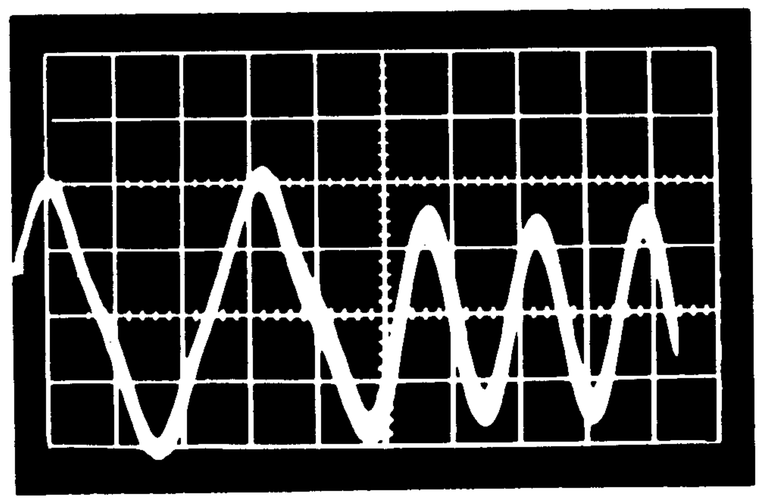
Figure 1-7. Erase Driver Circuits



Input Voltage Wave Form

(Pins G2 & B13)

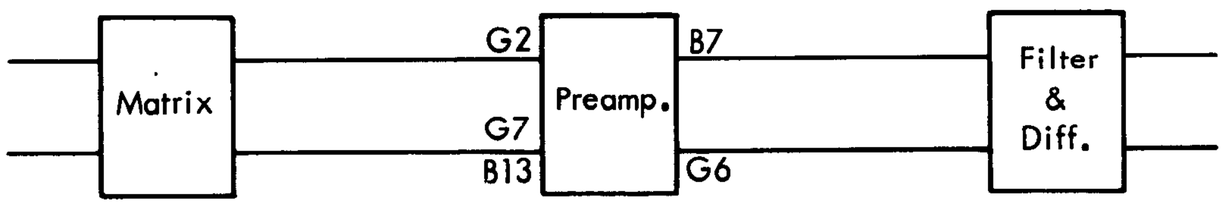
Sensitivity: 5 mv/cm
Sweep: 0.5 μsec./cm



Output Voltage Wave Form

(Pins B7 & G6)

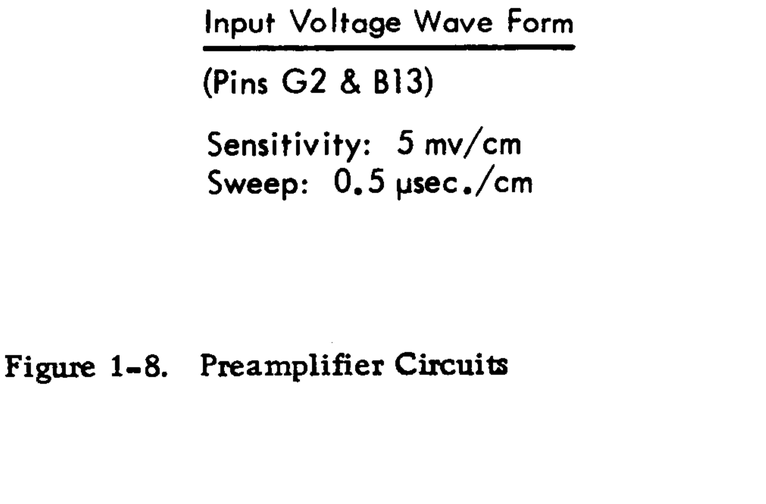
Sensitivity: 10 mv/cm
Sweep: 0.5 μsec./cm



Block Diagram

26050

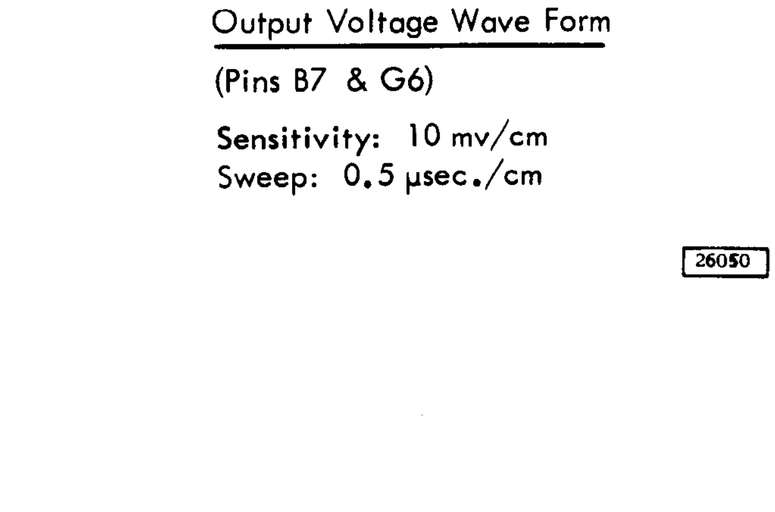
Figure 1-8. Preamplifier Circuits



Filter Output

(Pins F & G)

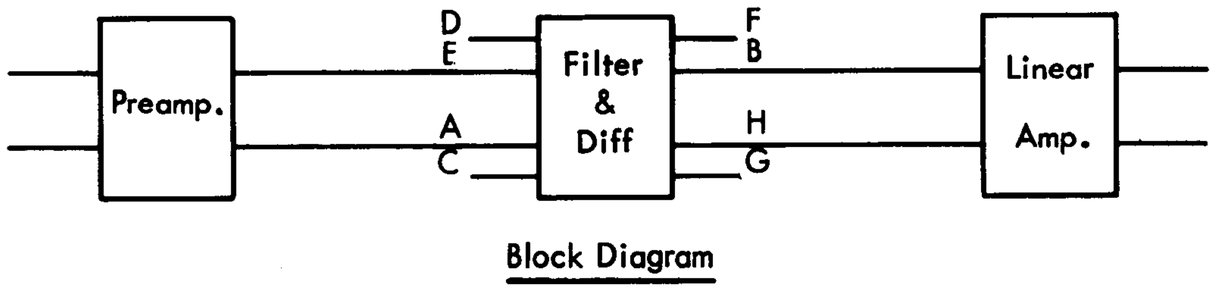
Sensitivity: 50 mv/cm
Sweep: 0.5 μsec./cm



Differentiator Output

(Pins B & H)

Sensitivity: 100 mv/cm
Sweep: 0.5 μsec./cm



Block Diagram

26051

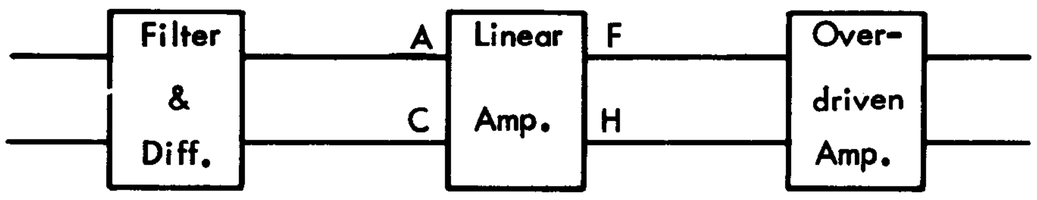
Figure 1-9. Filter Differentiator Circuits

The differential input signal is applied either at pins D and C or pins A and E, depending on which pre-amplifier in the 2302 is selected. A three section low pass Butterworth filter represents the load for the first stage which has a gain of approximately 5.5. The bandwidth of the filter is 2 MC and it rolls off at 18 db/octave after that. The emitter follower's stage isolates the filter from the differentiator whose impedance is frequency dependent. The differentiation of the read signal is performed by the last stage which has a gain of 2 at 1f and a gain of 4 at 2f. The differentiated signal is ac coupled to the output at Pins B and H.

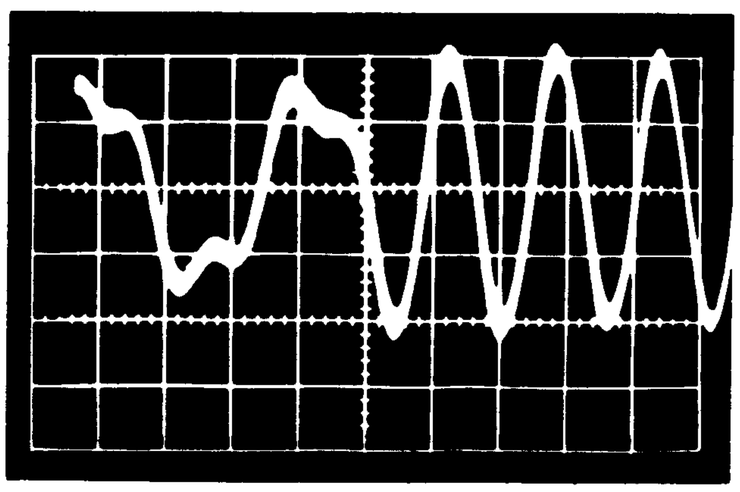
1.7.6 Linear Amplifier

The linear amplifier circuit (Figure 1-10) is a two stage direct coupled differential amplifier with an emitter follower as an output stage. This circuit amplifies the input signals with a flat frequency response of 100 KC to 2 MC. The gain of this amplifier is approximately 18.

Output signals from the differentiators are applied at Pins A and C of the first amplifier stage which has a gain of approximately 3. The gain of the second stage is approximately 6. The amplified signal is then applied to the emitter follower and from there ac coupled to the output Pins F and H.



Block Diagram



Linear Amplifier Output

(Pins F & H)

Sensitivity: 2 v/cm
Sweep: 0.5 μsec./cm

26052

Figure 1-10. Linear Amplifier Circuits

1.7.7 Overdriven Amplifier

The overdriven amplifier circuit (Figure 1-11) is a high-gain differential amplifier which overdrives the head signal without introducing any appreciable time shift.

The input signal to the three-stage differential amplifier is through Pins A and C. The biasing voltage for the first stage is a -15v zener supply from the linear amplifier and is applied through Pins A and C. Pin L is also connected to the -15v zener supply to get the proper bias for the third stage. Large coupling capacitors between stages provide a long time constant and therefore keep the DC level constant when the signal is overdriven. The gain of these three stages is approximately 80. The minimum head signal which will cause the overdriven amplifier to give a constant output amplitude is approximately 1 mv at 2f (double) frequency.

1.7.8 Detector

The Detector circuit (Figure 1-12) limits and differentiates the input signal. The generated pulse is then shaped and ORed at the output.

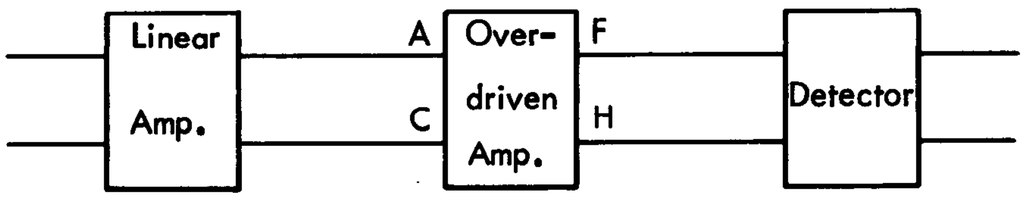
The output signal from the overdriven amplifier is fed into Pins A and C. A positive pulse at either pin is used to switch the current alternately between the two input transistors in the first stage. The limited signal from the first stage is then fed into the second stage where each transition is differentiated. The generated positive pulses are clipped to ground. The negative voltage pulse generated then turns on the transistor on the output stage for the duration of the pulse. The output at Pin E represents the raw data. The leading edge of each pulse corresponds to a peak in the head signal. The output is a standard +Y level.

1.7.9 Line Driver

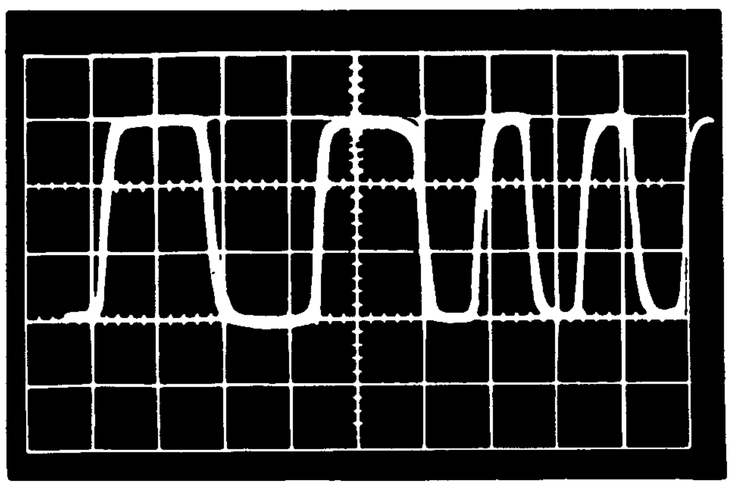
The line driver circuit (Figure 1-13) provides drive power for a 93-ohm coaxial cable.

The input to Pin A of the line driver for 2302 Mod 1 and 2 is a standard Y level. The output at Pin B is connected to a 93-ohm transmission line. A current of 10 ma is available at Pin B to drive a -C level line in a coaxial cable when the input gate is at +Y level.

The input to Pin G of the line driver for 2302 Mods 3 and 4, is a standard Y level. The output at Pin A is connected to a 93-ohm transmission line. Pin A will drive a +L level line in a coaxial cable when the input gate is at +Y level.



Block Diagram



Overdriven Amplifier Output
(Pins F & H)

Sensitivity: 10 v/cm
Sweep: 0.5 μsec./cm

26053

Figure 1-11. Overdriven Amplifier Circuits

1.7.10 Line Terminator

The line terminator circuit (Figure 1-14) provides a load for the line driver and supplies an in phase Y line output respective to the line driver input.

Pin A is a direct connection through the transmission line to the collector of the output transistor of the line driver. When the output transistor of the line driver is On, current flows through the transmission line to the input of the line terminator; the output at Pin B (2302 Mod 1 and 2) or Pin P (2302 Mod 3 and 4) will be at 0 volts. If the output transistor of the line driver is Off, no current flows in the transmission line. Subsequently, the output at Pin B of the line terminator is clamped to -6 volts. The input line is -C for 2302 Mod 1 and 2, and -L for 2302 Mod 3 and 4.

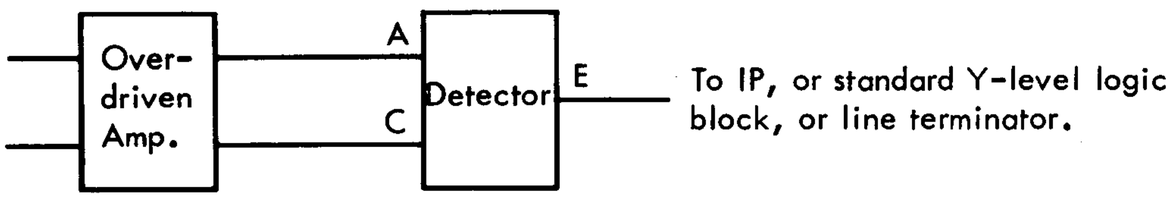
1.7.11 Selection Matrix

The selection matrix circuit (Figure 1-15) provides gating for the read-write head during a read or a write operation.

During a write cycle, X-select Pin B 10 is at +30v, thus back biasing the diodes connecting to the read amplifiers. There is write current from the write-driver into Pins B4 and B12 and out at Pins B7 and B9 to the read-write coil of the head. During a read cycle, X-select is at -12v, forward biasing the diodes connecting to the read amplifiers and the read-write coil of the head; and no current is available from the write driver.

1.7.12 Selection Safety

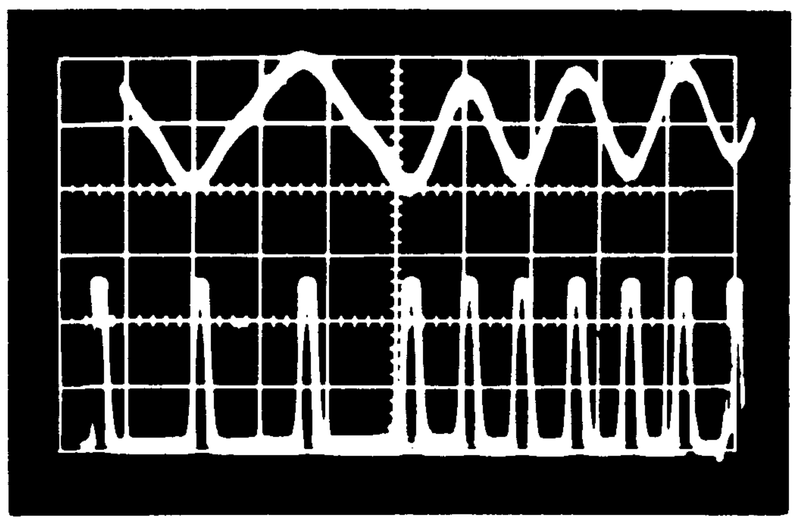
The selection safety circuit (Figure 1-16) prevents the loss of recorded information if the -12v or +12v supplies should fail. It also provides +12 volts through Y-select to the read-write coil when writing and 0 volts when reading.



Block Diagram

(A)

(B)



(A) Preamp. Output
(Pins B7 and G6)

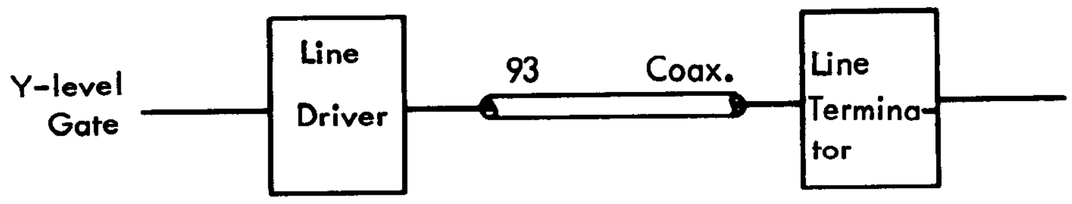
Sensitivity: 20 mv/cm
Sweep: 0.5 μsec./cm

(B) Detector Output (Pin E)

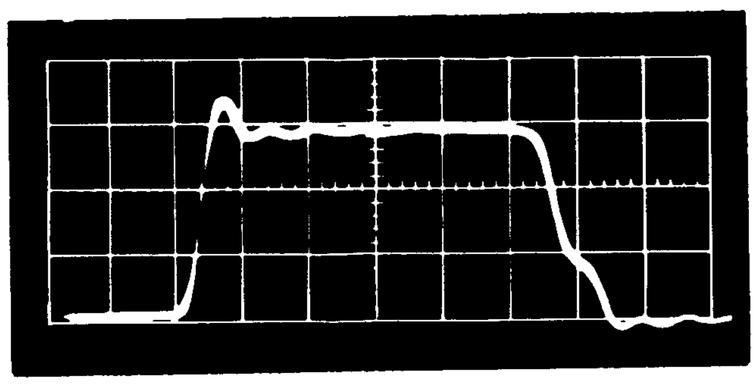
Sensitivity: 2.5 v/cm
Sweep: 0.5 μsec./cm

26054

Figure 1-12. Detector Circuits



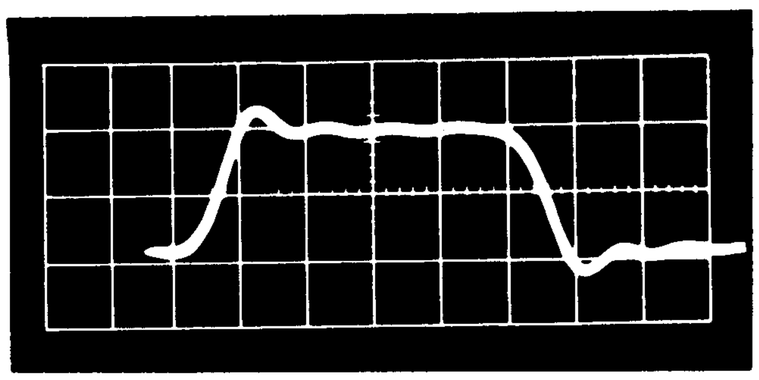
Block Diagram



Input to Line Driver

(Pin A)

Sensitivity: 2 v/cm
Sweep: 20 ns/cm



Current Output

(Pin B)

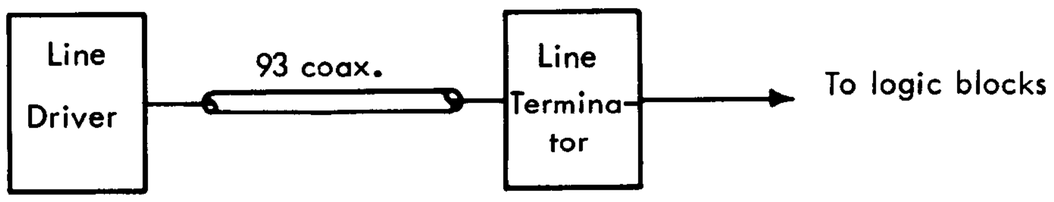
Sensitivity: 5 ma/cm
Sweep: 20 ns/cm

Neg 2302 (Mod 1 and 2)

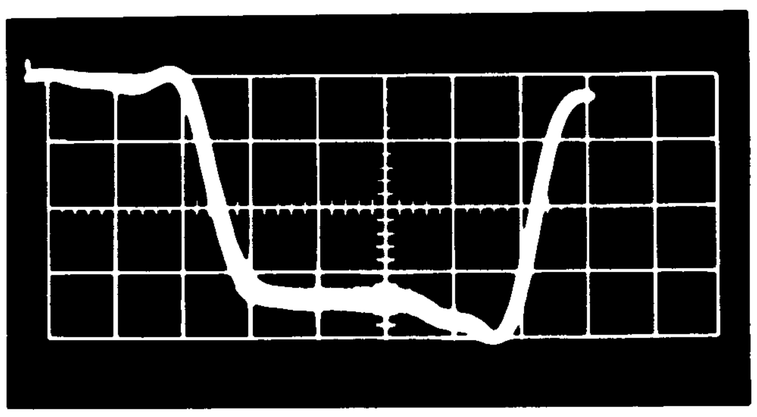
Pos 2302 (Mod 3 and 4)

26055

Figure 1-13. Line Driver Circuits



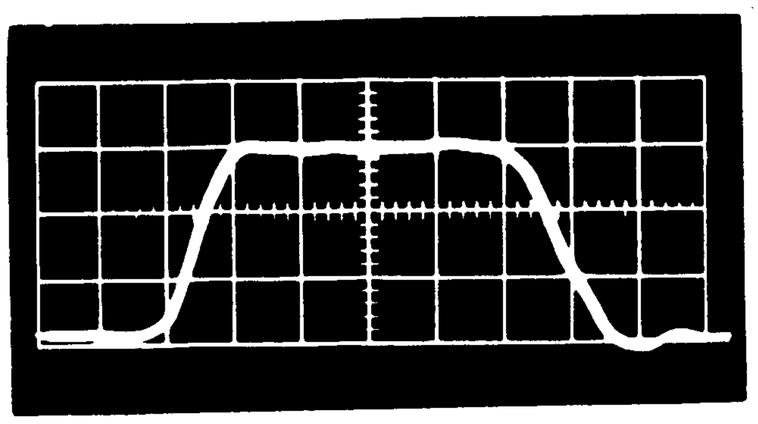
Block Diagram



Current Input

(Pin A)

Sensitivity: 2 ma/cm
Sweep: 20 ns/cm



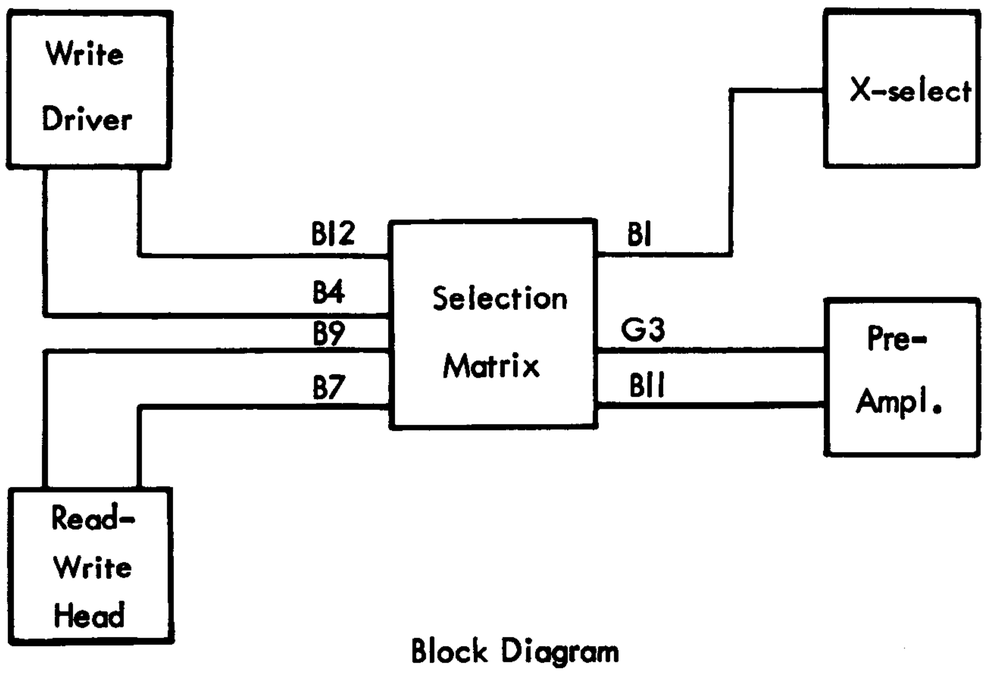
Voltage Output

(Pin B)

Sensitivity: 2 v/cm
Sweep: 20 ns/cm

26056

Figure 1-14. Line Terminator Circuits



Block Diagram

26057

Figure 1-15. Selection Matrix Circuits

The input to Pin E is driven by an unloaded Y level logic. An up level (0v) at Pin E brings forth +12 volts at Pin F to the Y-Select. If the Y-Select is properly gated, the -12 volts appears at the center tap of the read-write head. Likewise, a down level input at Pin E results in 0 at the head. Provisions have been made that if the -12v or +12v supplies should fail, no current is available at Pin F which subsequently is directed to the head.

1.7.13 Y-Select

The read/write Y-select circuit (Figure 1-17) selects a Y line in the selection matrix and provides gate voltages to the selected head when in the read or write mode.

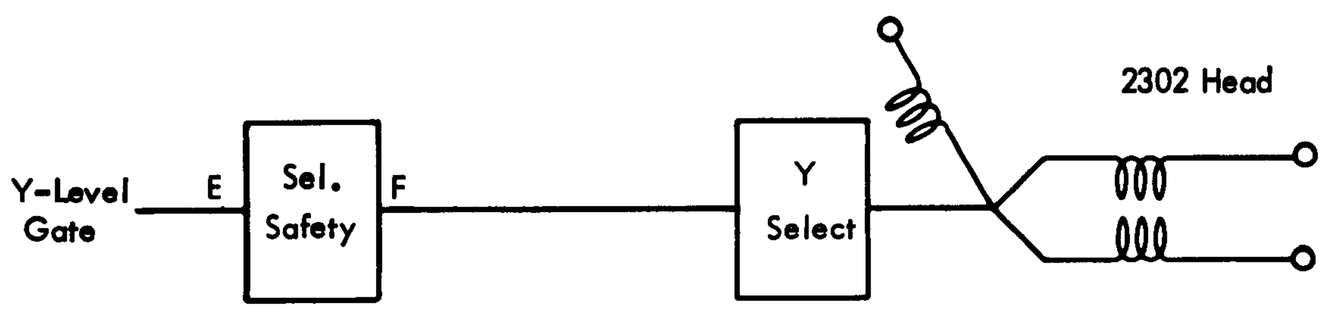
Pin H operates on an S level input. When Pin H is driven to a +S level, the output at Pin E is determined by the voltage level at Pin A which is the output of the selection safety card.

When the write mode is selected, Pin E is +12 volts, gating the write driver and erase driver to the On condition. When the read mode is selected, Pin E is 0 volt, gating the write and erase drivers to the off condition, but, allowing the selected head to read. When the input to Pin H is at a -S level, Pin E is -36 volts which gates off the head in that particular Y line of the selection matrix.

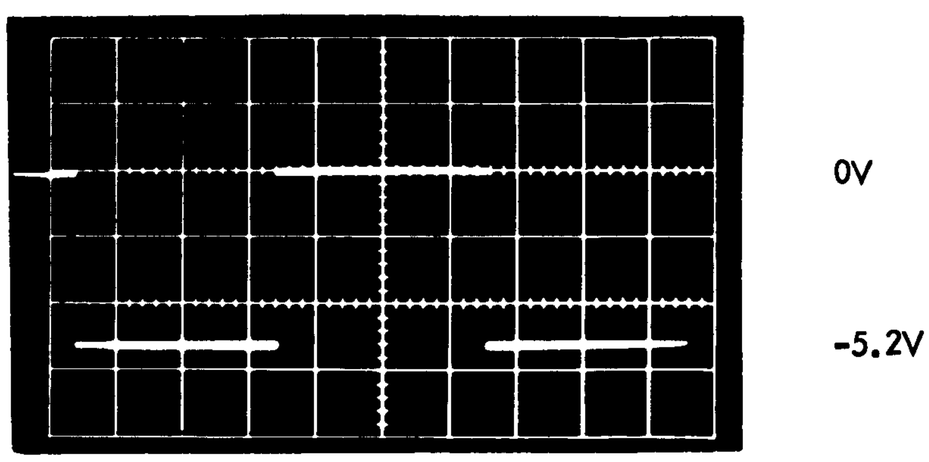
1.7.14 X-Select

The X select circuit (Figure 1-18) provides a gate to connect a selected head electrically to read amplifiers.

There are four X-select zones in the matrix. The input to the X select is an S level gate. When either one of the input Pins G, E, H, or F is at -S level, there will be a corresponding output at Pin C, B, D, or A of -12v which forward bias as the diodes in the selection matrix. When one X-select zone is

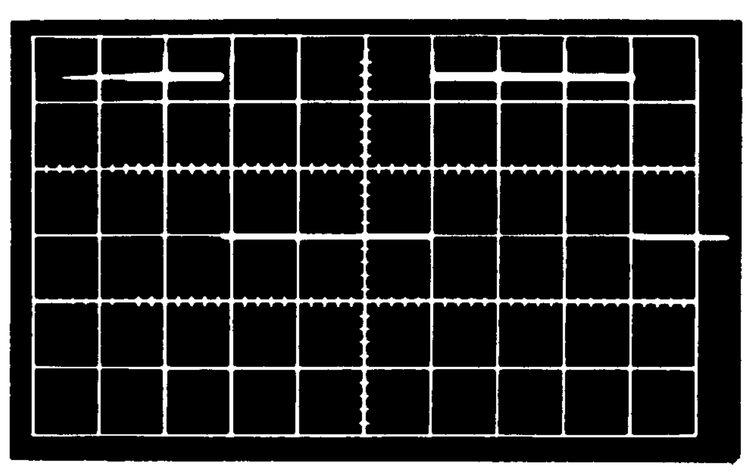


Block Diagram



Input Gate (Pin E)

Sensitivity: 2 v/cm
Sweep: 10 msec./cm

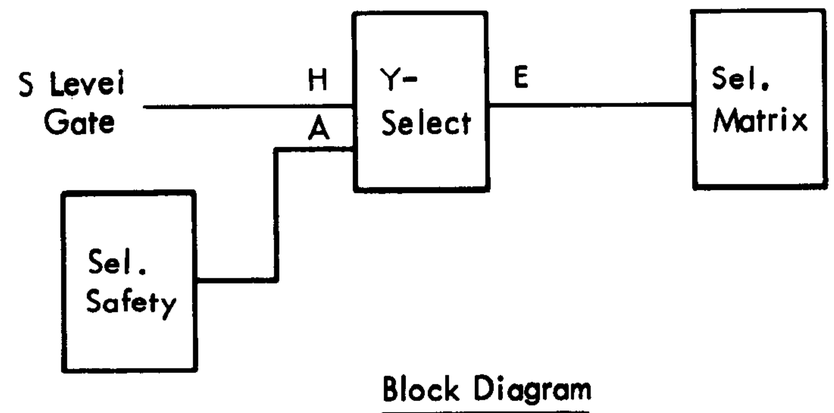


Output (Pin F)

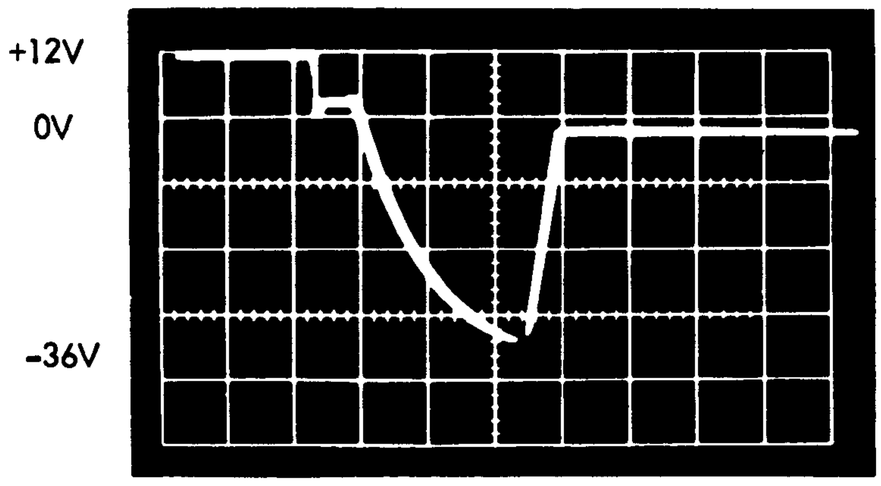
Sensitivity: 5 v/cm
Sweep: 10 msec./cm

26058

Figure 1-16. Selection Safety Circuits



Block Diagram



Y-Select Output

Sensitivity: 10 v/cm
Sweep: 20 µsec./cm

26059

Figure 1-17. Y Select Circuits

selected, the input gate to the other three zones is at an up level and results in an output of +30v which is the Not-Selected level for the matrix.

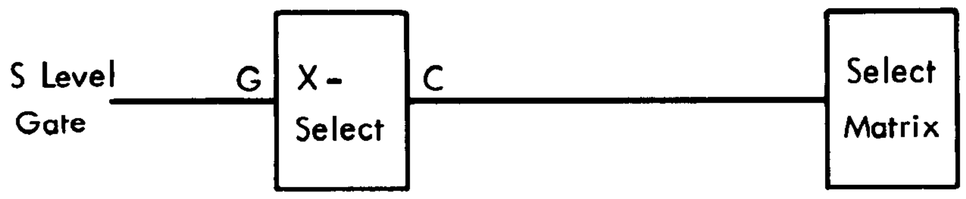
1.7.15 Pre-Amp Select

The pre-amp select circuit (Figure 1-19) gates the preamplifiers with module zero or module one, whichever is selected.

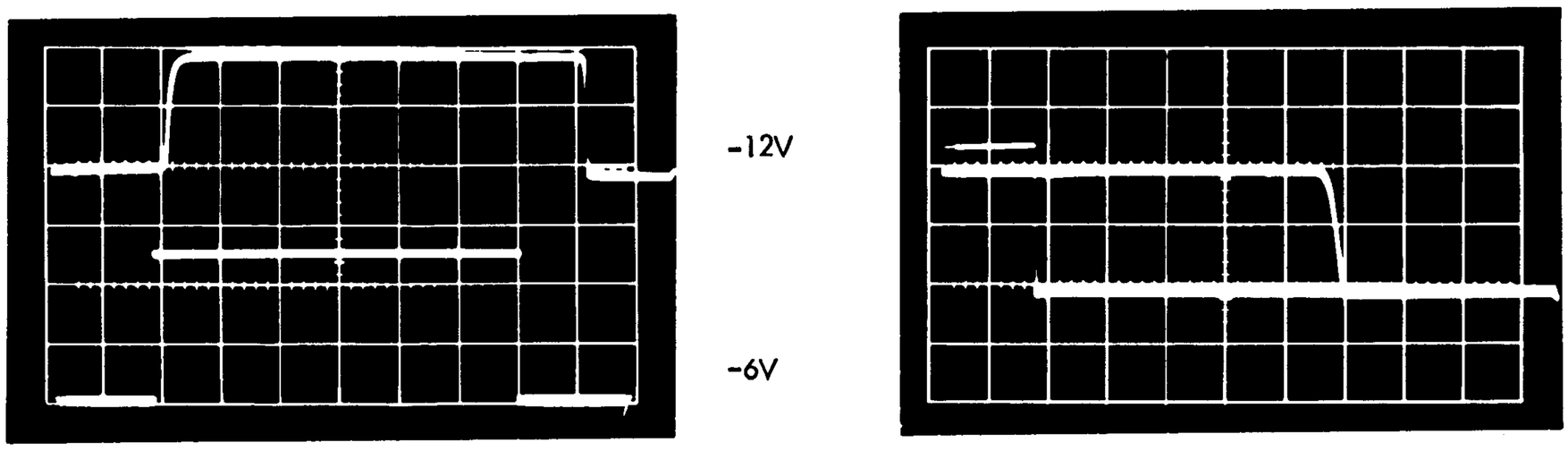
The input to Pin D is driven by a loaded S level logic card. When Pin D goes to a -S level, the output at Pin E is -12 volts. During a non-select condition, the output is at 0v.

1.7.16 Recovery Time

Diagrams of Recovery Time for Write to Read, Head Switching, and combined Write to Read (with Head Switching) are contained in Figures 1-20, 1-21, and 1-22 respectively.



Block Diagram



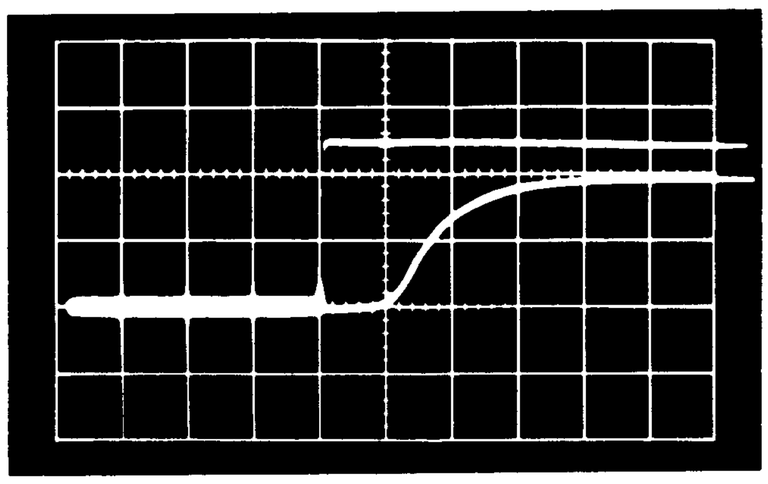
(A) X-Select Output

(Pin C)

Sensitivity: 20 v/cm
Sweep: 10 μsec./cm

(B) Input Gate (Pin G)

Sensitivity: 2.5 v/cm
Sweep: 10 μsec./cm



Turn off Delay

(Pins G and C)

Sensitivity: 2.5 v/cm (top curve)
20 v/cm (bottom curve)
Sweep: 1 μsec./cm

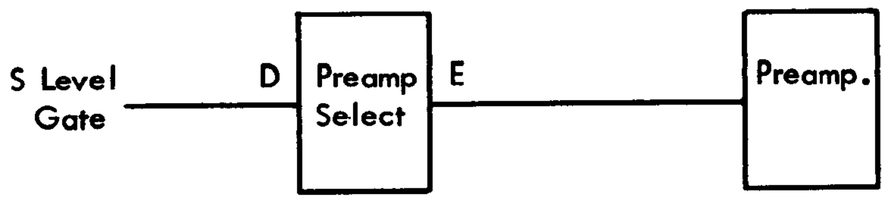
Turn on Delay

(Pins G and C)

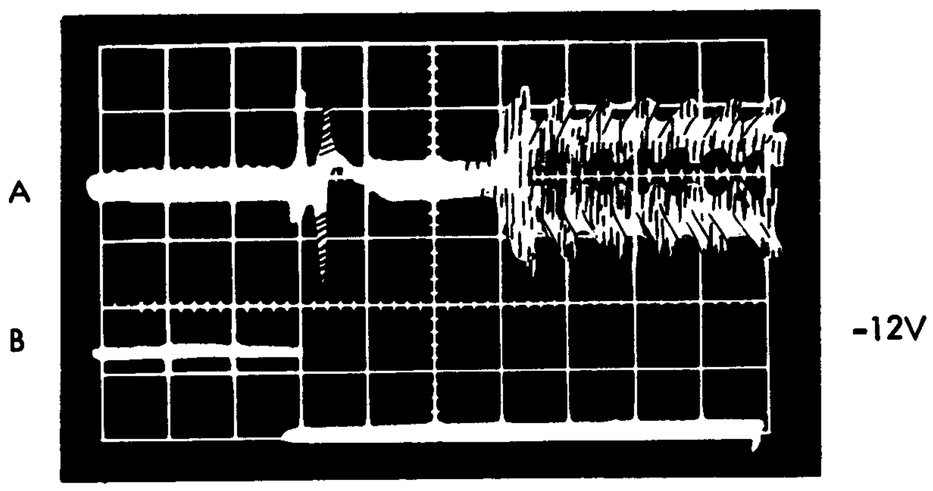
Sensitivity: Top Curve
20 v/cm
Bottom Curve
2.5 v/cm
Sweep: 2 μsec./cm

26060

Figure 1-18. X Select Circuits



Block Diagram



Preamplifier Select

(A) Linear Amplifier Out

Sensitivity: 1 volt/cm
Sweep: 20 µsec./cm

(B) Preamp. Select Gate (Pin A)

Sensitivity: 10 volt/cm
Sweep: 20 µsec./cm

Figure 1-19. Preamplifier Select Circuits

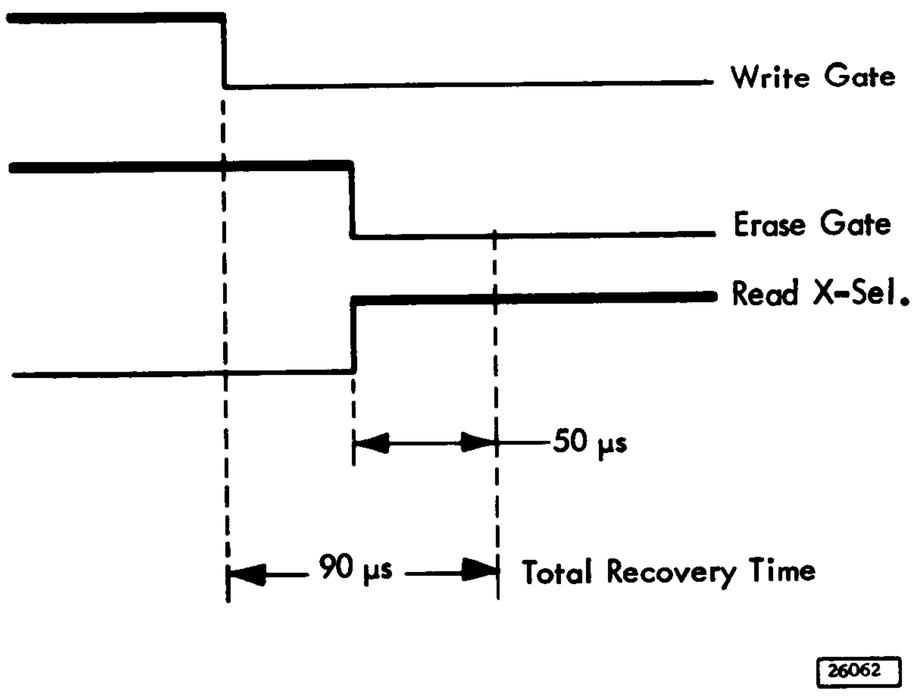


Figure 1-20. Write to Read Recovery Time

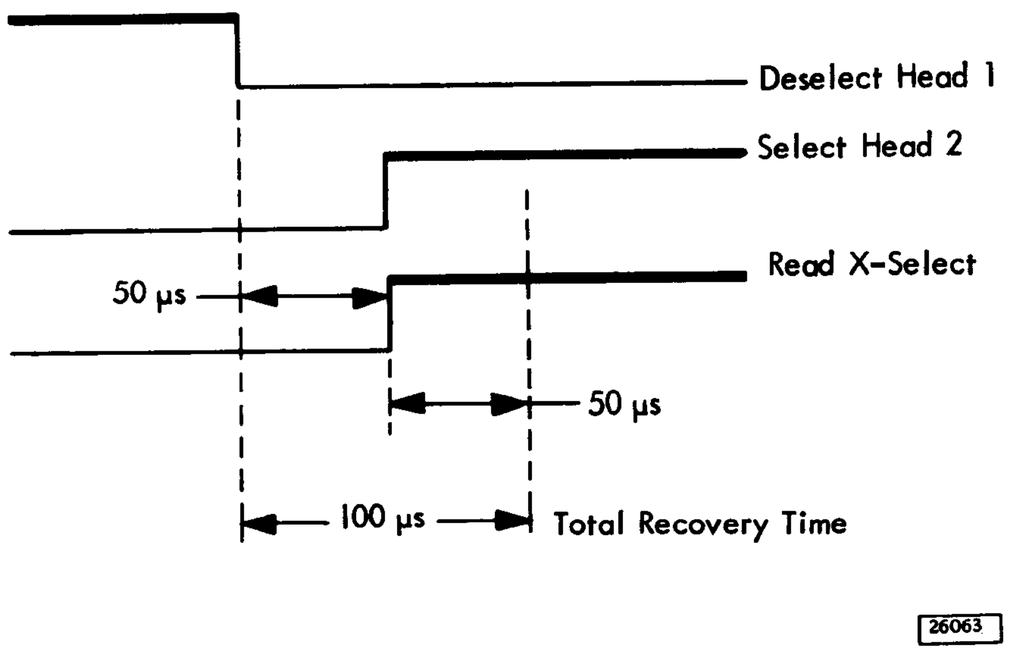


Figure 1-21. Head Switching Recovery Time

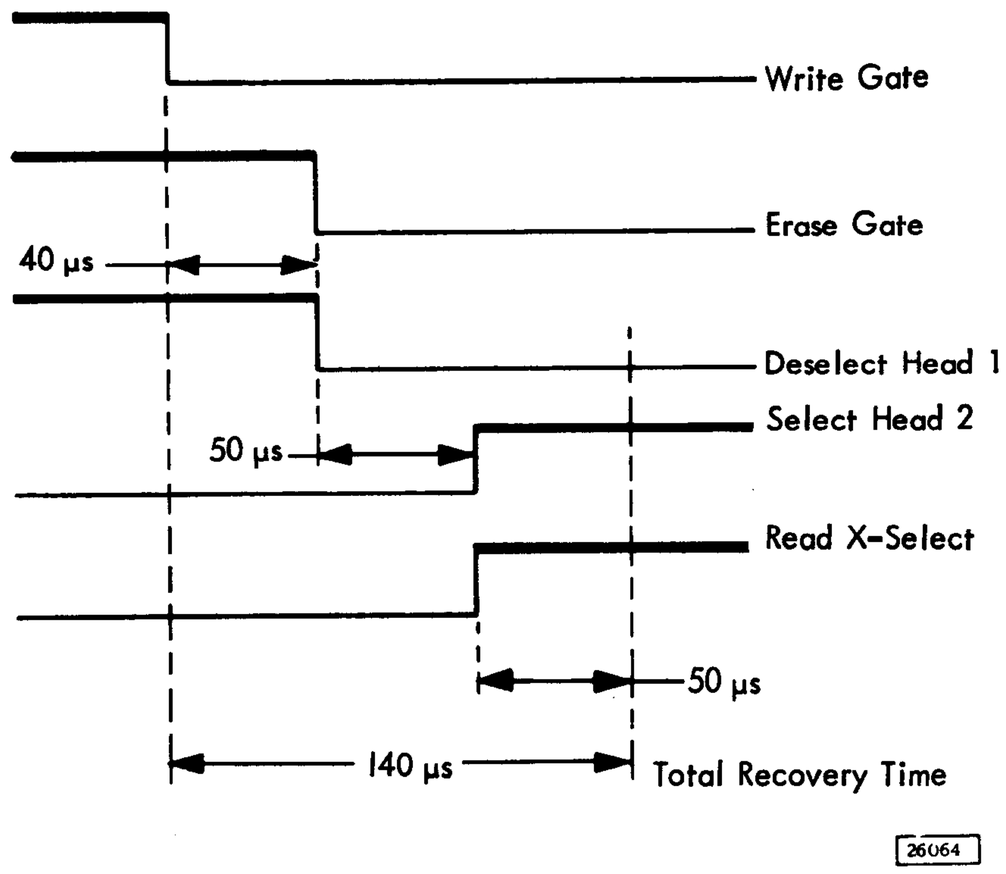


Figure 1-22. Write to Read Recovery Time (With Head Switching)

2.0 GENERAL INFORMATION

The IBM 2302 Disk Storage is available in four models:
IBM 2302 Model 1 - 1 Disk Module, 2 Accesses
IBM 2302 Model 2 - 2 Disk Modules, 4 Accesses
IBM 2302 Model 3 - 1 Disk Module, 2 Accesses
IBM 2302 Model 4 - 2 Disk Modules, 4 Accesses

The 2302 Model 1 and 2302 Model 2 are controlled by the IBM 7631 File Control Unit. The 2302 Model 3 and 2302 Model 4 are controlled by the IBM 2841 Storage Control Unit.

2.1 UNIQUE FEATURES

All models of the 2302 Disk Storage contain common features and are maintained in the same manner except for the following machine differences which are peculiar to 2302 Models 3 and 4:

2.1.1 Format

There is no format track on 2302 Models 3 and 4. The format is controlled by the programmer through the 2841 Storage Control unit and is recorded on the data tracks themselves.

2.1.2 Head Selection

All 46 data recording surfaces (normal and flag) on 2302 Models 3 and 4 are directly addressable by the programmer through the 2841 Storage Control unit. Therefore, the 2841 must decode the programmers head selection address (00 to 45) into the specific head address (normal or flag) and raise the proper access register or flag condition lines to the 2302.

2.1.3 Timing

2.1.3.1 Clock

A prerecorded clock track is not incorporated into 2302 Models 3 and 4, therefore a clock head is not used. Date is written by a crystal oscillator located in the 2841 Storage Control unit. The oscillator frequency is 2.5 mc ±0.3%. Since 2f (double frequency) recording is used, the nominal data rate is 1.25 mc. Read data is separated in the 2841 Storage Control unit variable frequency oscillator (VFO) similar to that used in the 7631 File Control Unit.

2.1.3.2 Index

The early and late index transducers are not incorporated into 2302 Models 3 and 4. A single index transducer is used instead. The pulse from this index transducer is ANDed with the module selected and is then driven to the system to identify the beginning of a track.

2.1.4 Access Motion

The access register address decoder (E gate) is not required for 2302 Models 3 and 4. The address from 2841 Storage Control unit is set directly into the access register.

2.1.5 Other Differences

All power from the 2841 Storage Control unit is provided by a 9-pin power cable. No power lines are included in the multiplex cables. All models of the 2302 require 1 Simplex and 3 Multiplex signal cables from their respective control units.

The process time (meter control) line is removed from the Simplex cable and included in a multiplex cable in the 2302 Models 3 and 4.

Several of the signal lines are carried over different wires in the 2302 Models 3 and 4; however, these signal lines are still contained in the simplex or multiplex cables as in the 2302 Models 1 and 2.

Many service aids common to all machine models are incorporated into the IBM 2302 Disk Storage. These aids allow the CE to observe or duplicate machine functions while performing maintenance operations.

2.2 CE TEST CONTROL PANEL (Figure 2-1)

The CE test control panels are located in panels A1 and B1. The CE can monitor most file functions from these panels; however, the respective access must first be set Inop and the access cover must be installed before most of the switches on this panel are effective.

2.2.1 Head Select

This on-off toggle switch located in the upper-right corner turns Head Select on or off. This switch must be turned Off to make other CE switches active. Both accesses on the same side of the 2302 must be Inop in order to turn on head select.

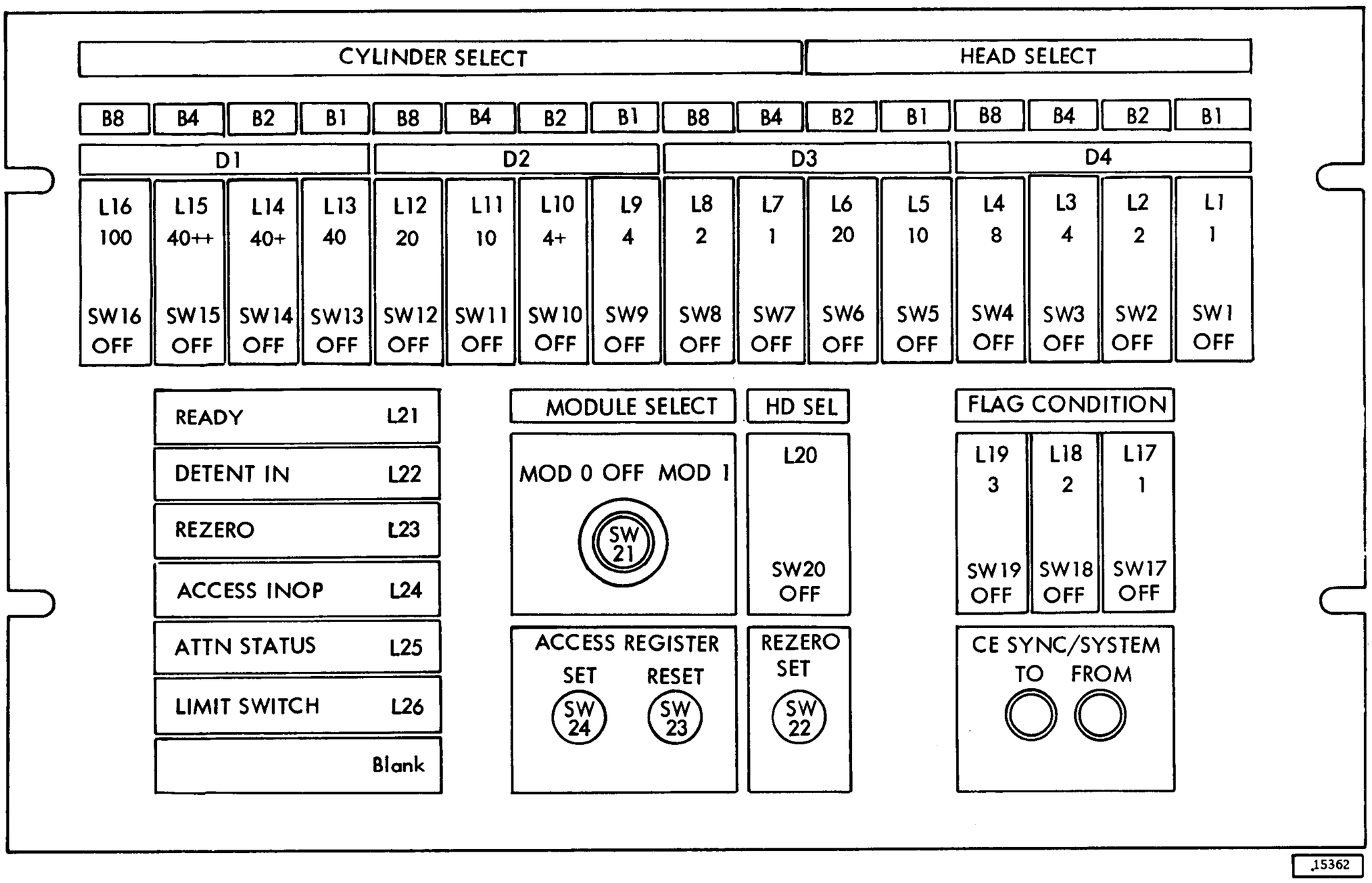


Figure 2-1. CE Test Control Panel

2.2.2 Cylinder Select Lights

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

2.2.3 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.

2.2.4 Flag Lights

These three lights indicate the status of the Flag latches (F1, F2, and F3).

2.2.5 Cylinder and Head Select Switches

These switches can be used to select any cylinder-head address, including the inner CE cylinder which is located at cylinder position 250 (100, 40", 40', 40, 20, and 10).

2.2.6 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 push button. Additional access register latches can be set without a reset. However, no access register latch can be turned off without a total reset. The access register is reset by depression of the Reset push button. This push button also resets Rezero if access is at outer limit switch.

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

2.2.7 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.

2.2.8 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.

2.2.9 Limit Switch Light

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

2.2.10 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 control unit that indicates an end of seek.

2.2.11 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.

2.2.12 Condition Indicator Lights

Head Select, Access Ready, Detent In, Rezero, and Access Inop are the conditions indicated by lights.

2.2.13 CE Sync Hubs

These hubs are serviced by convenience wires between the control unit and the 2302. The line to the control unit is driven from the 2302.

2.3 CE REMOTE CONTROL BOX

The CE Remote Control box is shown in Figure 2-2. Machine connections are contained in Figure 2-3.

2.3.1 Write Bits - Write Gate Switches

Depression of the Write Gate switch raises the write gate if the access is located at the CE inner cylinder. Depression of the Write Bits switch allows one mega-cycle oscillator data to be put on the write data line. This data will then write on the selected head within the inner CE cylinder.

2.3.2 Seek Repeat Switch

The Seek Repeat switch causes the selected, access to ocillate between the address set on the remote control box and the address set on C.E. panel.

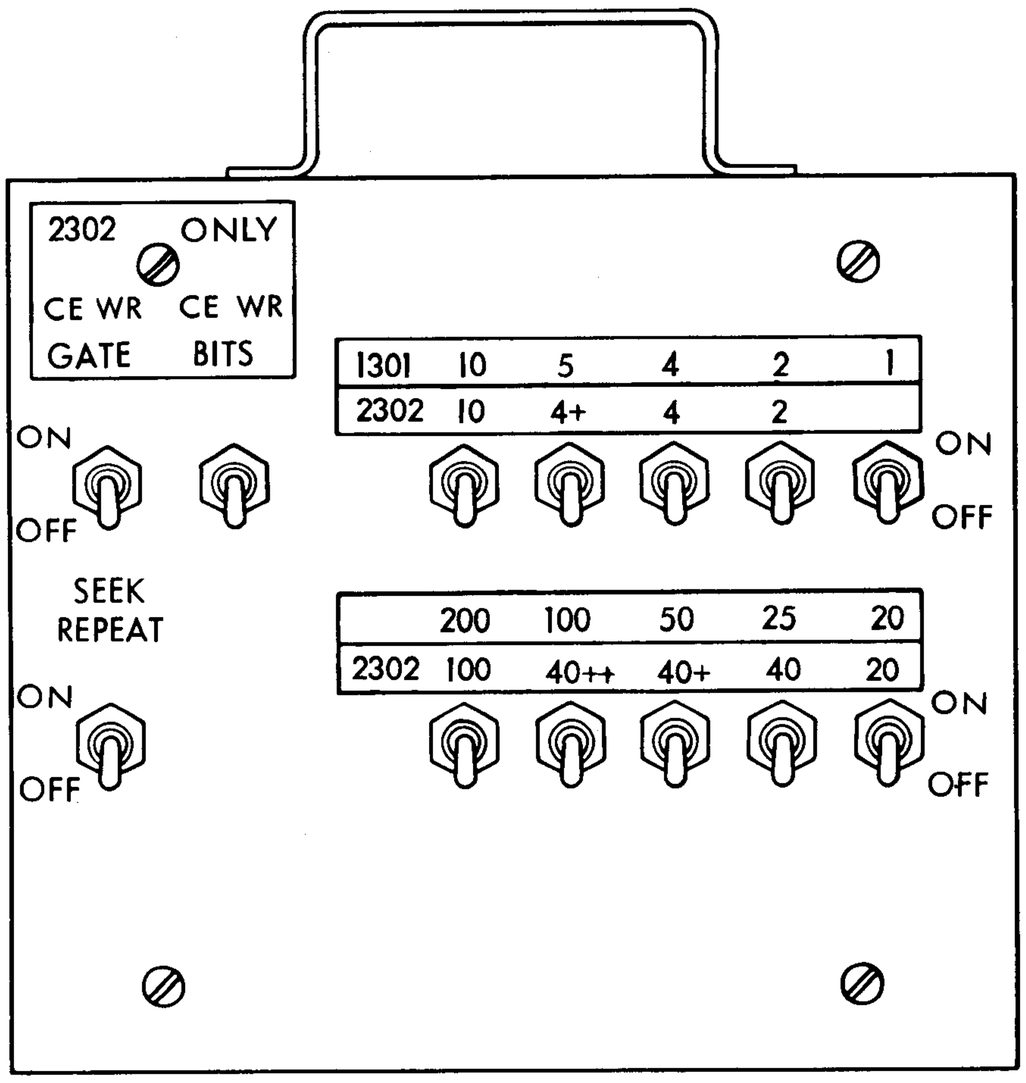


Figure 2-2. CE Remote Control Box

2.3.3 Single Shot Settings

The two single shots in the remote control box should be adjusted as follows:

a. DHE - at G1A01 to 18 milliseconds ±5%.
b. DHE - at G1A02 to 2 microseconds ±5%.

2.4 MARGINAL VOLTAGE CHECK JACK

Marginal voltage checks of the electronic circuitry are made by placing the portable marginal voltage supply (Figure 2-4) plug into the jack receptacle. The +12 marginal voltage can be lowered to +9 volts. Raising the marginal voltage above +12 volts is not recommended.

Access	Plug Locations	Write Driver Box Cable
M0A0	A6F02 and A6F03	C3A10B
M0A1	B6F02 and B6F03	D3A10B
M1A0	A4F02 and A4F03	C2A10B
M1A1	B4F02 and B4F03	D2A10B

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Figure 2-3. CE Remote Control Box Connection

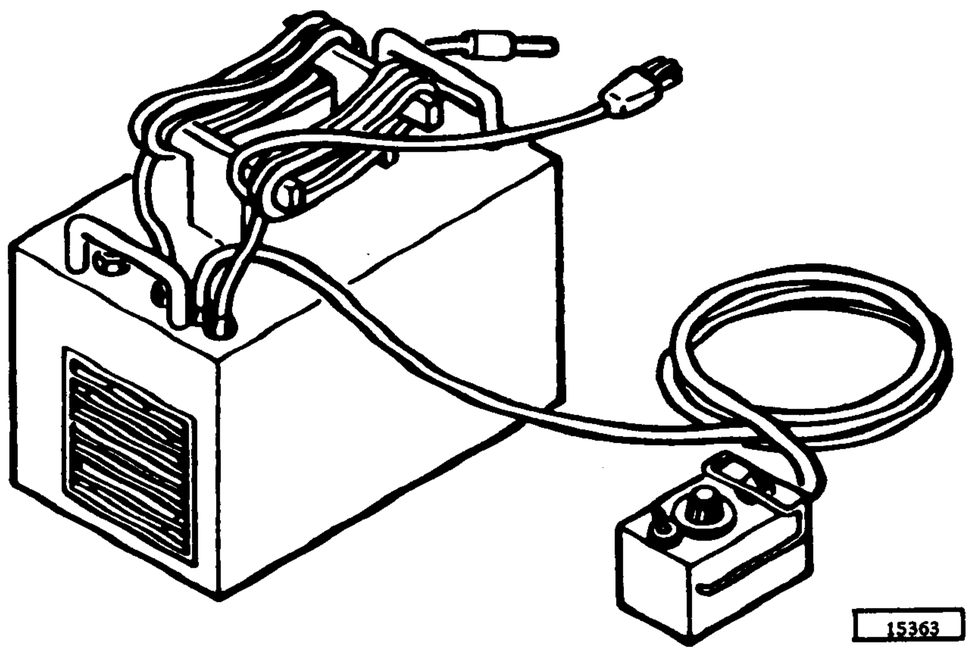

Figure 2-4. Marginal Check Unit

2.5 POWER SEQUENCE CONTROLS

The Power Sequence Control Panel (Figure 2-5) 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. Nomally, initiation of start on the first 2302 is under system control Subsequent files, in remote control, are started on receipt of a timed pulse during the sequencing of a preceding 2302.

Indicator lights are provided as servicing aids for the Customer Engineer. They indicate both normal and malfunctioning conditons as long as the mainline 70-amp breaker is closed.

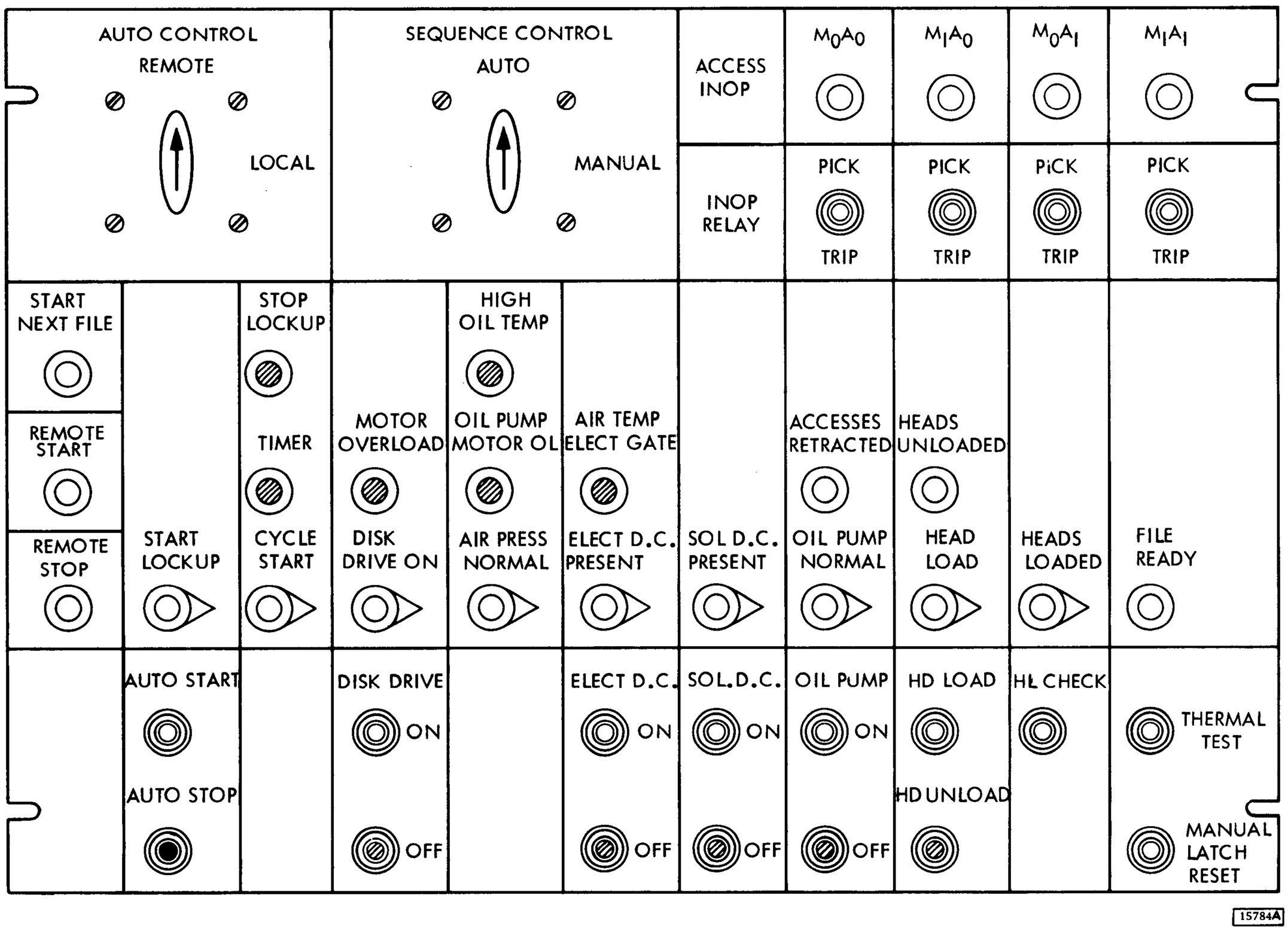

Figure 2-5. Power Sequence Control Panel

2.5.1 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 arrowheads next to the lights.

2.5.1.1 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 2302 power sequence panel.

2.5.1.2 Remote Local Switch

The Remote Local switch changes the control of power sequencing from the file control unit to the sequence gate. In Local operation, power sequencing may be performed from the 2302 sequence gate in either the Auto or Manual mode. In Remote Operation, power sequencing may be performed from the file control unit. This switch must be in Remote position for data transfer to file control unit.

CAUTION: If dc power is Off, it will come On when the machine is switched from Local to Remote.

2.5.1.3 Auto-Manual 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.

2.5.1.4 Thermal Test Switch

If, for any reason, the File Power is turned off, then on within a short period of time, the thermal test switch will bypass the 30-minute warm-up timer to bring up File Ready, providing the Thermal switch is made also.

2.5.1.5 System Function Lights

Remote Start and Remote Stop from the control unit to the 2302, and start next file from the 2302 to the next file are indicated by these lights.

2.5.1.6 Access Inop Lights

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

2.5.1.7 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. If all accesses are set Inop then relay 64 will drop, causing the loss of File Ready.

2.5.1.8 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 parallels the timer motor. This light is on whenever power goes to the timer motor. The cycle start light comes on with the pick of R111 within 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.

2.5.1.9 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 parallels the disk drive contactor (K2). If a disk-drive-motor-overload switch or over-temperature switch opens, R39 picks and turns on the motor overload light. A disk drive overload or overtemperature condition causes a stop sequence to occur.

2.5.1.10 Electronic DC

The electronic dc On and Off switches are for manual control of the electronic dc power. If electronic dc

is applied R44 picks to turn on the electronic dc present light. An over-temperature condition in an electronic gate causes R48 to drop. R48 picks R36 which turns on the electronic air temperature light.

2.5.1.11 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.

2.5.1.12 Oil Pump

The oil pump on and off switches are for manual control of the hydraulic power supply motor. An oil level switch in the hydraulic system picks R7 when the oil pump is turned on through relay 102. R7 turns on the oil pump light. Opening an overload in the oil pump drops R2 which in turn picks R40 which turns on the motor overload light. When the tmeperature of the oil exceeds 130°, R49 drops to pick R38 which turns on the high oil temperature light.

2.5.1.13 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 (above 50 psi). The accesses retracted light 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.

2.5.1.14 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 pump normal
5. Solenoid DC present.
6. Solenoid power supply control.
7. Strut temperature normal. (See Section 1.3).
8. 30 minute warm-up timer has completed its cycle.
9. All accesses are not Inop.

2.5.1.15 Manual Latch 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).

2.6 CE LATCH AND LIGHT

The CE Latch and Light is an electronic latch with an indicator attached. The latch has a 4-way (plus) ANDed input and 1 reset (minus) LINE. Any inputs not used may be left floating. The indicator is attached to the On side of the latch. (See System Diagrams 01.06.02.1)

2.7 OPERATOR CONTROLS

2.7.1 Format Write Switch

This switch is located on the front right-hand vertical strut of the mechanical frame. It must be set to Write before the format track can be rewritten. The switch must be Off in order to operate both accesses.

2.7.2 Ready Light

The Ready Light indicates only that the file strut is up to operating temperature and the 30-minute warm-up timer has completed its cycle. These are two of the conditions listed under File Ready that must be met before the File Ready signal is sent by the file to the control unit. (This light does not indicate the File Ready condition received by the control unit.)

2.8 SPECIAL TOOLS AND SUPPLIES

2.8.1 Shipping Group

This is a list of special tools and supplies that are shipped with each machine from the plant. These tools should be kept with the machine. Shipping Group No. B/M 2164004 is applicable for 2302 Model 1 and 2. Shipping Group No. B/M 2194104 is applicable for 2302 Mod 3 and 4.

Parts Catalog	Form 127 - 0785
CE Maintenance Manual	Form 227 - 5864
System Diagram Manual (2302 Mod 1 and 2)	P/N 2176716
System Diagram Manual (2302 Mod 3 and 4)	P/N 2194200
Frame Joining Screw	10303
Lock Washer	9092
Nut Cable Clamp	11598
Nut Frame Joining	25793
Screw Plate	28413
Screw - Plate Cond Strap	32042
Washer (16)	45690
Lockwasher Gnd Strap	56079
Lockwasher	56121
Screw (15)	91611
Washer Frame Joining	161351
Lockwasher Frame Joining	257983
Force Guage 6.5 lb.	460870
Binder CE Manual	222836
Paddle Disk Cleaning	2108010
Syringe-Wiper Lubricating	2108790
Wrench Allen	2108467
Container Oil Drain	2108743
Tool Kit	2108775
Bracket Kickstrip Corner	2121110
Bracket Kickstrip Corner	2121111
Plate	2163872
Clamp Cable	2122374
Clamp Cable	2123024
Wiper Disk	2123106
Washer Frame Ground	2123127
Shipping ASM - Alcohol	2155966
Brace ASM	2192836
Drawer ASM Front Tool	2164250
Drawer ASM Rear Tool	2164251
Pan Oil Drip	2164576
Kickstrip Plain	2181501
Kickstrip ASM -Entry	2122373
Kickstrip ASM	2181563
Plate ASM	2192852
Kickstrip ASM-Entry	2123123
Kickstrip	2121112
Plate-Blank Off	2164034
Reticle Scope	2178397
Gage, Crash Stop	2108962
Gage, Crash Stop (U Shape)	2108791
Wiper	216567

2.8.2 Tools Available with System

The following is a list of tools available for systems which use the 2302 Disk Storage Unit.

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

2.8.3 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
Prefiltered Hydraulic Oil (in one gallon container)	2115252
Vacuum Cleaner--Hoover Model 86	
10" Adjustable Wrench	450177
Wrapped Wire Pistol Tool	461012
Torque Wrench and Accessory Kit (for shaft Motor or actuator replacement)	2108470
Wrench - 5 to 150 lb inches Torque	2108435
Adapter - Actuator Torque	2108436
Socket 0.500"	2108464
Socket - Universal	2108466
Socket - 0.375"	2108478
Roll - Torque Kit Tool	2108481
Socket = 0.125" Hex	2108486
Lint Free Tissue	2123106
Burndy Extractor Tool Rx 20-10	261043
Solder Iron Tip-SMS Pin Removal	451111
Replacement Plunger	451113
Marginal Check Power Supply	210860
Wrapping Bit, Wire Size #24	461235
Sleeve, Wire Size #24	461015
Hand Crimping Tool	450898
Wire Stripper	450694
Wire Gage	461076
#24 Gage Solid Tinned--Copper Wire	216226
Output Shaft Seal Tool	2121394
Output Shaft Seal Puller	2121395
Data Recovery Mechanism Tool	2108793
Box ASM, Remote CE	2108788

2.8.4 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

2.8.5 Tools in Emergency Parts Centers

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

2.8.5.1 Disk Aligning Kit P/N 2108433

This kit contains special disk replacement tools, but does not contain replacement disks.

The kit includes a special flashlight. Dry-cell batteries are not shipped with the light because they might decay. Obtain two type AA pen-light batteries locally.

2.8.5.2 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.

2.8.5.3 Hydraulic Power Supply Replacement Kit

This kit contains a complete hydraulic power supply, including fluid and the equipment necessary to remove the used unit and install the new unit. The container for this unit serves both as a shipping crate and as a dolly platform to assist in the removal of the used unit and installation of the new unit.

2.8.5.4 Clock Writer

The clock write box is available to rewrite the clock on 2302 (Mod 1 and 2) machines if the clock disk is replaced with a new disk, or, if the clock tracks become misaligned due to disk restacking.

2.8.5.5 Marginal Check Unit (P/N 210860)

The marginal check (MC) unit is a special self contained power supply with a variable output voltage. When plugged into the Marginal Check Unit (Figure 2-4), this unit is placed in series with the +12v supply and permits the Customer Engineer to change the +12v a maximum of -3 volts.

WARNING: The Marginal Check Unit power supply may be damaged if the MC voltage is not at zero (or OFF) when the jack plug is inserted or removed.

2.9 APPLICABLE FIELD ENGINEERING MANUALS

The following listing consists of FE manuals that contain information that is of value in servicing the IBM 2302 Disk Storage.

MANUAL NAME	TYPE	FORM NUMBER
IBM 2302 Disk Storage (Mod 1 and 2)	FEMI	227-5863
IBM 2302 Disk Storage (Mod 3 and 4)	FEMI	227-5995
IBM 2302 Disk Storage	FEMM	227-5864
IBM 2302 Disk Storage	PC	127-0785
Standard Modular System	FEIMM	223-6900
Tektronix Oscilloscopes	FEMI	223-6725
Transistor Component Circuits	FEMI	223-6889
Transistor Theory Illustrated	FEMI	223-6794
Transistor Theory and Application	FEMI	223-6783
60 Cycle SMS Power Supplies	FEMI	225-6478
IBM 7631 File Control	PC	123-0463
IBM 7631 File Control	FEIMM	223-2766
IBM 2841 Storage Control	FEMM	227-5925
IBM 2841 Storage Control	FEMI	227-5901
IBM 2841 Storage Control	PC	127-0793

FEMI = Field Engineering Manual of Instruction

FEMM = Field Engineering Maintenance Manual (Formerly Reference Manual)

FEIMM = Field Engineering Instruction - Maintenance Manual

FEISD = Field Engineering Instructional System Diagrams

PC = Parts Catalog

FEILD = Field Engineering Intermediate Level Diagrams

FES = Field Engineering Supplement

SECTION 3 PREVENTIVE MAINTENANCE

3.1 APPROACH TO PREVENTIVE MAINTENANCE

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

3.1.1 Visual Inspection

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

3.2 SCHEDULED MAINTENANCE PROCEDURES

Specific items of preventive maintenance are scheduled on punched cards processed in the Central Processing Unit for the branch office. Details of preventive maintenance operations are listed in the Scheduled Maintenance Routine Chart (Figure 3-1). During normal preventive 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 Sections listed in the index column of the chart (Figure 3-1). Observe all safety practices.

3.2.1 Solid-State Circuits

Diagnostic programs and marginal checking are the basic tools used to accomplish preventive 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 2302 are available through the system to which the 2302 is attached.

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

3.2.2 Mechanical Units

Three basic scheduled maintenance steps that are performed on mechanical units are cleaning, lubrication, and inspection. Remember, do not do more than recommended scheduled maintenance on equipment that is operating satisfactorily. Figures 3-2, 3-3, and 3-4 are lubrication charts for the 2302 mechanical components.

3.3 ELECTRONIC SCHEDULED MAINTENANCE ROUTINE

3.3.1 Access Time

3.3.1.1 Adjustment

NOTE: All card and signal locations are given for MOAO. These card and signal locations can be converted to any other access by changing the first two characters (A6) to the following:

M1A0 - A4
M0A1 - B6
M1A1 - B4

To accurately adjust or check access time, the motion oscillator must be in the fast state (oil temperature at thermal switch = 105°F. ±3°F. There must be a minimum of 6.5 ms from Seek Complete to the next seek if a loop program is used. This delay is necessary because of the single shot of A6C04P which fires at Access Ready and will unblock the motion oscillator.

1. Adjust the single shot card (DHE-) output at A6C04P for a 4.0 millisecond (ms) minus pulse:
   a. Set rezero.
   b. Jumper A6F17C to A6C04L to provide an input signal to the single shot for this adjustment. The L pin on the card at A6C04L is an additional input that is not used: therefore, it is not shown in the system diagrams.
   c. Remove jumper after adjustment of single shot.
2. Adjust oscillator at A6C06 to produce an access time for a short seek (1, 2, 4, Piston) of 50 ms (+0 ms -1 ms):

Item No.	Unit Code	Unit or Routine	* Freq. Mo.	Lubricate - Clean	Observe	Hrs. Mod 1,3	Hrs. Mod 2,4
1	9	Actuator	2	Oil with eye dropper and IBM #6 Oil if required. See "Observe" column.	Check rear felt (Figure 3-2). If wet when eye dropper is pushed against it, do not oil. If dry, fill syringe to approximately 1.0"; add this amount of oil to each rear felt. Do not add oil to the front felt wipers.	0.05	0.1
2	9	Actuator	4	Do not use any solvent on any actuator moving parts. Wipe actuator ways with a clean lint-free tissue dampened with IBM #6. Leave a light film of oil on ways. Oil rear felt as directed at two-month period. Wipe any excess oil from felt wiper housings and from actuator housing. Check oil absorption pads. If saturated, squeeze out excess oil or replace pad. Add several drops of oil to output shaft seal to prevent rusting of output shaft.	Check output shaft seals for leaks. Seal should be moist with oil to lubricate shaft, but should not be saturated enough to indicate leakage. If seal is leaking replace actuator according to Section 4.11.4.	0.5	1.0
3	9	Air Compressor System	6	*Open valve on bottom of air tank to drain any accumulated moisture.	Check with heads loaded that system pressure is between 64 and 66 psi. Compressor whould turn on no more than once every two hours. If frequency increases, check air system for leaks. Compressor should pump up system from 0 to 30 psi within 45 seconds.	0	0
4	9	Hydraulic Power Supply		Change both paper filters. Change oil. Check cooling coils for dirt and clean if required. Drain drip pan and wipe clean.	*Check system pressure 550 ± 10 psi. Also check accumulator. See Section 4.19.8	0.5	0.5
5	1	Clock Head and Mechanism			Inspect and clean using instructions for data head and arm. (Accomplish with item 6).	0	0
6	1	Data Head and Arm Assemblies		Remove any accumulated dirt from arm assembly. If required, clean heads with lint-free tissues and IBM Isopropyl Alcohol, using head cleaning paddle. Absolute cleanliness is essential.	Check all heads for smooth surface finish per FE Maintenance Manual Instructions. Check visually for relative alignment of heads and arms. Visually check receiver cables, clamps, braces, connectors, etc. for any looseness or fraying.	1.4	1.7
7	0	Blowers and Filters	8	*Lubricate the three blower bearing felts in each gate with IBM #6 Oil. Gate filters can be vacuumed clean rather than washed, however, washing is preferred and should be done when possible.	*Check SMS gate filters. If dirty, clean by flushing with hot water and shake dry. Check power supply blower filter and replace if required.	0	0

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

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Figure 3-1. Scheduled Maintenance (Part 1 of 2)

Item No.	Unit Code	Unit or Routine	Freq. Mo.	Lubricate – Clean	Observe	Hrs. Mod 1,3	Hrs. Mod 2,4
8	0	Disk Array Filter	12	When filter is replaced clean thoroughly and purge as described in Section 4.1.1.	The disk array filter will normally last three years. However, adverse environmental conditions can cause it to become clogged. Replace if it has over 1/4" dirt accumulation, or at the end of three years. Mark installation date on new filter.	1.08/3	1.08/3
9	9	Shaft Motor			Check line cords for safe condition and grounding. Check disk 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. Always make this check at a time when you or the customer would be shutting down the disk array.	0	0
10	9	Actuator		Replace felt wipers and oil absorption pads. Lubricate new felts (front and rear wipers) with IBM #6 Oil after installation. Lubricate rear felts only at two-month periods. Clean ways as directed at four-month periods.	Check that aluminum wiper holders do not touch housing ways. Oil front felts only when newly installed. At all other times oil rear felts only. Since new felts can increase drag, excersize actuator with Seek Repeat box for a short period of time after file ready.		
11	1	Head Load Mechanisms		*Oil head load linkages with IBM #6 Oil. Oil sparingly. These links are not high speed and are seldom operated. If any of the head load time requirements are not met, the piston cylinder assembly should be checked for adequate lubrication and the mechanism checked for freedom of motion. When handling and assembling the assembly, extreme care must be exercised to keep it absolutely clean. Lubricate cylinder assembly as shown in Figure 3-3.	With working pressure at 64 - 66 psi, the total load time between the break of the heads unloaded switch and the make of the heads loaded switch must not exceed 120 ms. (Both head load mechanisms in a module are loaded simultaneously.) Total unload time between the break of the heads loaded switch and the make of the heads unloaded switch must not exceed 105ms.		
				*Do during warm up after head-actuator P.M.	*Do during warm up after head-actuator P.M.		
12	9	Hydraulic Power Supply	24		Change hydraulic oil. Replace inner steel filter and return replaced filter to San Jose. (Accomplish with Item 8)	0	0

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

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Figure 3-1. Scheduled Maintenance (Part 2 of 2)

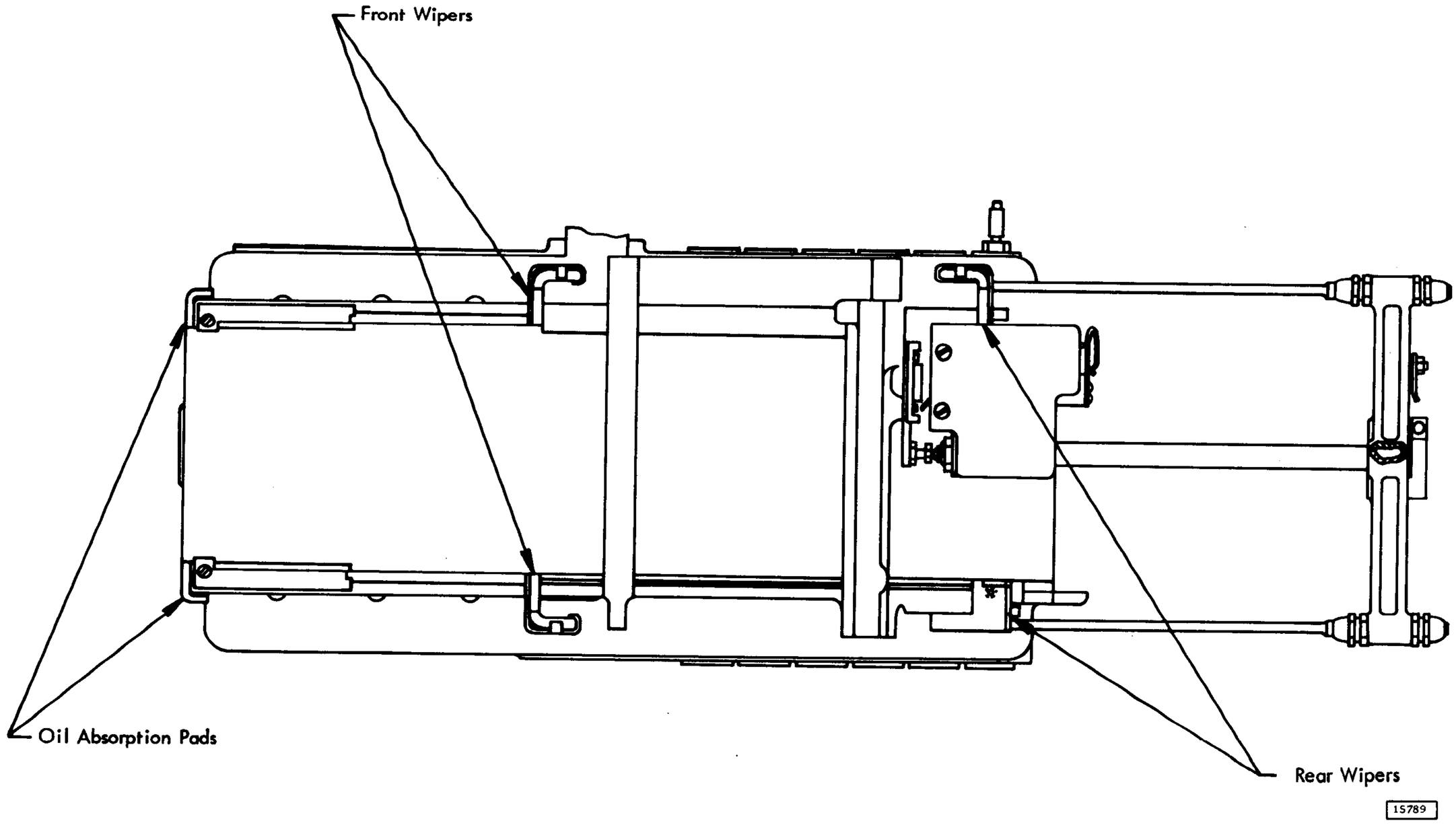


Figure 3-2. Carriage Wiper Location

a. Set up a program loop (or Remote CE Box) to move the actuator 8 tracks and back.
b. Sync on the +S Got-To-Go signal at A6B25H and scope the access-ready signal at A6A16C.
c. Adjust oscillator at A6C06 until 50 ms (+0 ms -1 ms) is obtained from the Got-To-Go signal to the access-ready signal.

3. Check access time for the large piston (10 piston) for 120 ms (+0 ms -3 ms). Since the oscillator has been adjusted in Step 2, this time should be correct.
   a. Set up a program loop (or use CE Remote Control Box) to pick and drop the 10 piston only.
   b. Sync on the +S Got-To-Go signal at A6B25H.
   c. Scope the access-ready signal at A6A16C.
4. Check the access time of a long seek (40', 40", 100) for 180 ms (+0 ms -2 ms) as follows:
   a. Set up program loop (or use CE Remote Control Box) to move the actuator 100 tracks and back.
   b. Sync on +S Got-To-Go signal at A6B21D.
   c. Scope the access-ready signal at A6A16C.
   d. Adjust single shot (A6C04) to get 180 ms (+0 ms -2 ms). Do not adjust the single shot pulse shorter than 2.0 ms or longer than 6.0 ms. To check single shot timing with 100 loop servo running, sync minus on A6C04K and scope output of A6C04P. The minus output pulse must not be shorter than 2 ms or longer than 6 ms.
5. Check the access time for the small globs (20 - 40) for 120 ms (+0 ms -2 ms).
   a. Set up a program loop (or use CE Remote Control Box) to pick and drop the 20 and 40 globs.
   b. Sync on +S Got-To-Go signal at A6B21D.
   c. Scope the access-ready signal at A6A16C.
   d. This time should be within the allowable tolerances. If it is not, the adjustment of the single shot in Step 4 may have to be compromised to satisfy both small and large glob seeks. However, do not adjust the single shot shorter than 2 ms or longer than 6 ms.

3.3.1.2 Service Check

When the oscillator is set within the fast range the slow frequency should fall between the limits shown.

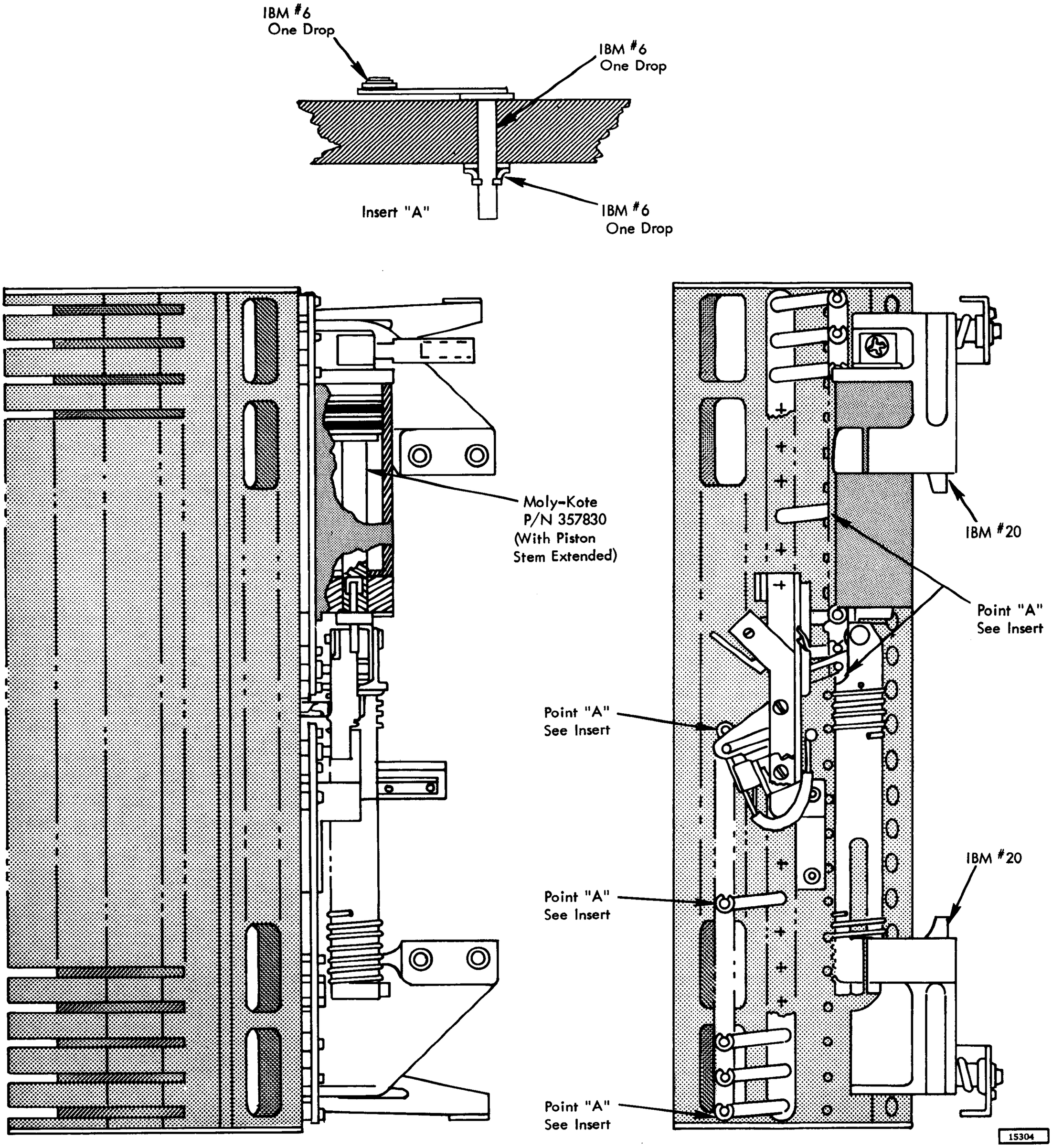
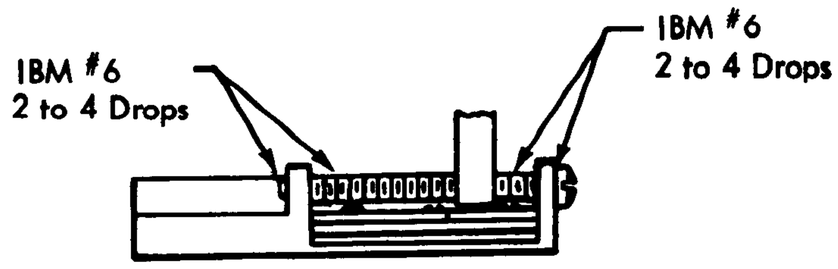


Figure 3-3. Receiver Lubrication Chart



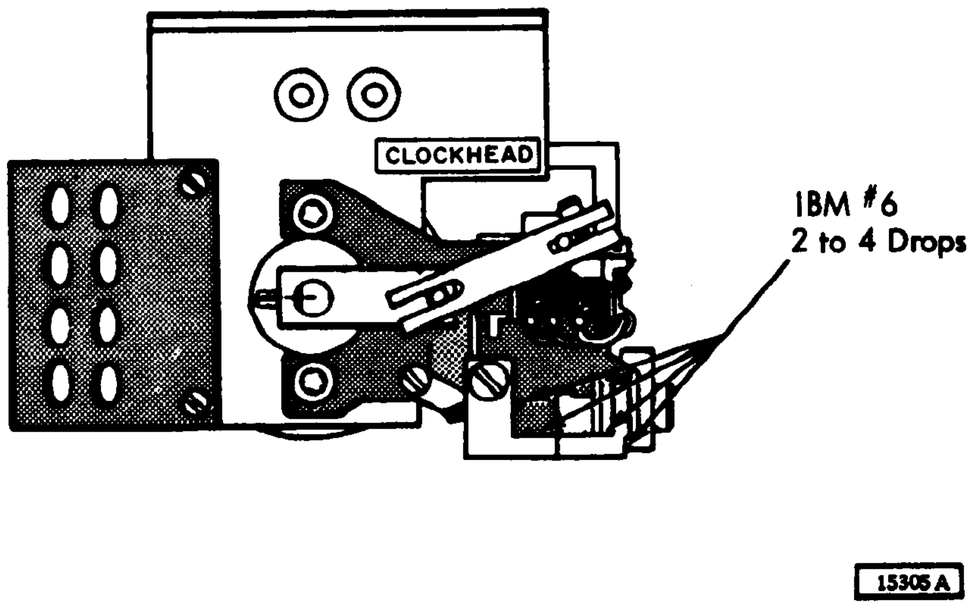


Figure 3-4. Clock Head Lubrication Chart

3.3.2 Detent Safety Check

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

1. Check the air gap between the center pole of the transducer and the steel rack. It should be 0.007 inch ±0.003 inch (this should be measured with a non-metallic material). The difference in the size of the gap at each end of the steel rack should not exceed 0.003 inch.
2. Set address 100 into the register. Set and reset the register. The output of the transducer should be within 0.9 volt minimum and 1.6 volts maximum.
3. Check the motion integrator (TED-at 01A5E 12). It should be adjusted to give maximum down level time (as observed at Pin F) while performing an access of 250 cylinders. This is to be measured during B-C portion of the motion cycle (See Figure 3-5).

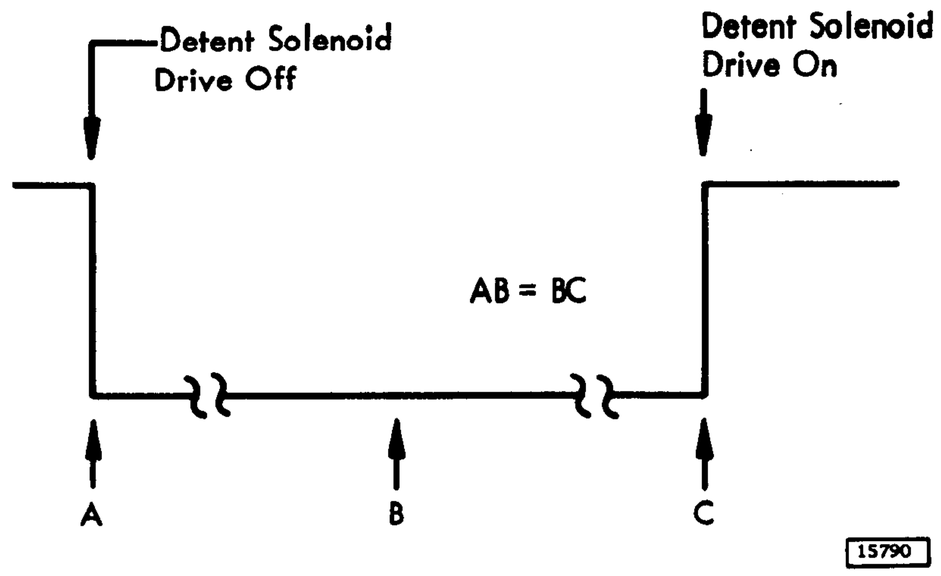


Figure 3-5. Detent Safety Check

3.3.3 Index Check -- 01.05.03.1 (2302 Mods 1 and 2)

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

3.4 ALTERNATE SURFACE LOG (2302 Mod 1 and 2)

An Alternate Surface Log (Figure 3-6) is available to the CE to document the assignment of data to alternate disk surfaces. The Alternate Surface Log is contained in System Diagrams 01.90.01.0 thru 01.90.40.0, for documenting defective and alternate surfaces. A separate page is provided for each of the logical modules within a 2302 (A0 M0, A0 M1, A1 M0, and A1 M1). This log, with a listing of defective tracks on alternate surfaces is provided by the manufacturer with each machine.

All tracks originally found during manufacture should be recorded, although the CE may not encounter an error on a specific track. The manufacturing list is a compilation of the full disk surface, both on track and off track. Flagging of all tracks specified ensures maximum reliability to the customer.

3.4.1 Recording Entries on Log (General Cases)

The prescribed method for recording Defective and Alternate (Flag Head) disk surfaces on the Alternate Surface Log is shown in Figure 3-6.

Space is provided on each log sheet for listing up to 60 cylinders per logical module, and for listing the six alternate surfaces available to each cylinder.

Whenever a track is determined to be defective, the cylinder number, head number, and logical track

Cylinder Number	Head	Track Address	Flag Head	Cylinder Number	Head	Track Address	Flag Head
2	10	0090	1	137	23	5503	1
	17	0097	2				
12 ① ②	2	0482	1	178 ②	33	7153	1
	A6		6		12	7132	2
	28	0508	3				
18 ③	21	0741	1	201	13	8005	
	33	0753	3				
	A2		2				
24 ①	A4		4				
②	34	0994	1				
39	29	1589	1				

Note: Circled items ①, ②, and ③ denote recording applications for special cases.

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Figure 3-6. Alternate Surface Log

address (Cyl x 40 + Hd) should be recorded as shown. The Alternate Surface (Flag Head) chosen by the CE for each such surface should also be recorded as shown in Figure 3-6.

3.4.2 Recording Entries on Log (Special Cases)

An example of documented entries for Special Cases is shown with encircled numberals on the Alternate Surface Log (Figure 3-6). The significance of each special-case entry is as follows:

1. Indicates the recording of a defective Alternate surface.
2. Shows the recording of an additional surface by the CE after initial installation of the machine.
3. Shows the changing of a flag on a surface because the original CE Alternate surface was found to be defective. The original defective surface is reflagged and the original alternate surface, now defective, is recorded on the log.

3.5 ALTERNATE SURFACE LOG (2302 Mod 3 and 4)

Since the customer flags defective tracks on 2302 Mod 3 and 4, no tracks have been flagged by manufacturing. However, a list of Defective tracks and an Alternate Track Log is provided with the System Diagrams. This information may be used (if desired) to flag and document those defects which are located by the factory.

4.0 GENERAL INFORMATION

The access area can be serviced with power On, but off line from the system provided only one access door is off at any one time, and all accesses but the one being serviced are at 000 position. If an access door is removed for any reason, a specific warm up period is required if the room ambient temperature is below 70° F.

The receiver assembly should not be swung out of the disk array until all power has been removed from the file. However, once power has been removed, and the disk array has started to coast down, it is permissable to swing out the receiver before waiting for the disk array to come to a complete stop. When the file is serviced in this manner, and power is restored, a warm up period to set the thermal and timer will be necessary to bring "File Ready" up.

A switch is provided which will bypass the warm up timer and permit operation of the file. However, it does not bypass the thermal switch and File Ready will not be up unless the file is at the proper temperature. This switch should be used only for servicing. At no time should it be used to effectively reduce normal warm up time by consistently bypassing the timer control.

Door removed 0-5 minutes equals 20 minutes warm up.

Door removed 5 minutes or more equals 30 minutes warm up.

These warm up periods should be monitored by the person servicing the File. They must be adhered to in order to safeguard file data.

4.1 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 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 without stopping the array at any time that the actuator is not in motion, but care should be taken to keep out dirt and dust.

4.1.1 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 for a prescribed interval of time, thereby replacing the air in the pressurized chamber with filtered air. Purging has no immediate measurable effect. However, failure to adhere to the process will invite damage to the disk surfaces. Therefore 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 mode.

Purging, where possible, can be done concurrent with file warm up time.

4.2 DISK ARRAY FILTER

4.2.1 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.
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.

4.2.2 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 to ensure that filter seats all around the holder surface, then tighten the filter retaining hooks by hand as tightly as possible.
4. To purge the system and the new filter, run the array for 45 minutes with the actuator at rezero and the heads unloaded. After the array has stopped, remove the filter, re-vacuum as before, and reassemble 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 the front plastic array shield(see section 4.3.1) 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. Replace the disk array shield. (See Disk Array Shield Replacement, Section 4.3.1.)

4.3 DISK ARRAY SHIELDS

4.3.1 Plastic Shields (Front and Rear)

4.3.1.1 Removal

1. Remove ac and dc power.
2. Vacuum false floor and all surfaces surrounding plastic shields (Figure 4-1).
3. Do not remove disk array shields until disks have completely stopped.
4. Remove access cover (see Access Cover).
5. Remove vertical trim (Figure 4-1).
6. Loosen screw in rear plastic shield block (Figure 4-27). Slide clockhead seal assembly away from plastic shield.
7. Loosen the captive center screws and remove shield.
8. 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.

4.3.1.2 Replacement

1. Clean the plastic shield (Figure 4-1) 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. 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. Also make certain that the vertical trim at the cover side is positioned as far as possible away from the access port to allow clearance for swing out of the head assemblies. Tighten the trim holding screws.
7. Replace clockhead seal (Section 4.9.4) after installation of rear plastic shield.
8. Install sliding port door. Inspect Clearance between inner edge of door and drawer assemblies. Clearance should be a minimum of 1/8-inch and a maximum of 3/16-inch. Bend stop on access shield if necessary to obtain this clearance.
9. Purge array for 30 minutes.

4.3.2 Index shield (Figure 4-1)

4.3.2.1 Removal

1. Remove ac and dc power.
2. Vacuum false floor and all surfaces around the shield.
3. Remove two screws located at extremerear from the top and bottom of front support casting and rotate casting 90^{O} away from disk array.
4. Remove vertical trim from each side of index shield.
5. Remove shield holding screws and shield. Do not remove 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.

4.3.2.2 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 Section 4.4.2.)
4. Purge array for 30 minutes.

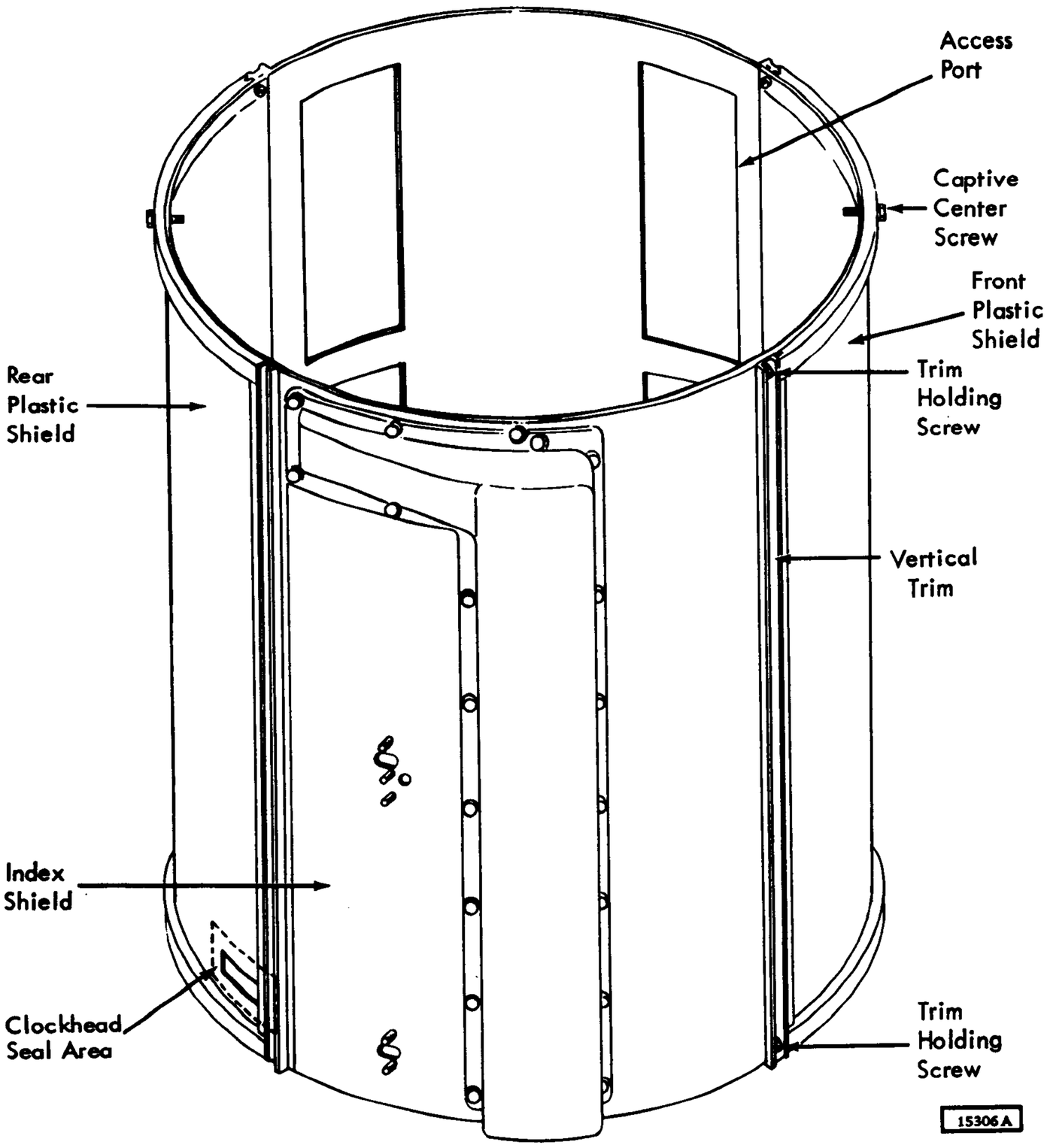

Figure 4-1. Disk Array Shields

4.3.3 Access Port Shield (Figure 4-1)

4.3.3.1 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 nylon door guides in from front.
5. Remove vertical trim from each side of shield.
6. Move clockhead seal backwards. (See Section 4.3.1.1, Step 6).
7. Remove rear plastic shield.
8. Remove shield holding screws.
9. Lift shield approximately 1/4-inch and remove from rear of machine.
10. Vacuum all surfaces exposed by shield removal. Do not vacuum disks.

4.3.3.2 Replacement

1. Replace access port shield and secure with mounting screws. Replace rear access shield and secure with mounting screws.
3. Install and adjust front nylon door guides for proper fit at the front access covers.
4. Install and adjust front and rear vertical trims so that sliding port doors fit without binding and read/write heads clear the trim on swing-in. Tighten the trim retaining screws after these conditions are satisfied.
5. Swing in receiver (see Receiver Swing In Procedure, Section 4.7.2).
6. Purge array for 30 minutes.

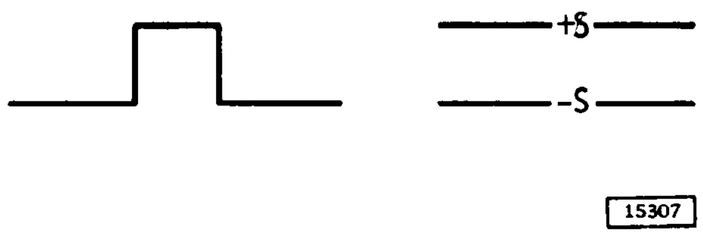

Figure 4-2. Correct Index Pulse

4.4 INDEX HEADS

4.4.1 Service Checks

1. The +S output pulse of the Index Amplifiers (TEB-01A5E07B and 01A5E07C) should be a minimum of 25 microseconds (Figure 4-2) and a maximum of 65 microseconds as measured at the -6 volt level.

   If either output resembles the pattern of Figure 4-3, check the respective index amplifier input for a minimum shift of 1.3 volts. If less than 1.3 volts, adjust the transducer air gap. If more than 1.3 volts, check amplifier for possible failure.
2. 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 4-4). If this timing is not within these limits, the shaft motor may have failed.

4.4.2 Adjustment

Index-signal amplitude and width are adjusted simultaneously by moving the index transducer.

WARNING: Clockwise rotation of the index transducer must be done slowly and carefully since the machine may be seriously damaged if the index slug contacts the transducer pole tip. The gap between transducer pole tip and index slug should be 0.015 ±0.005-inch.

1. Loosen jam nut on transducer.
2. Adjust the gap between transducer pole tip and disk pole tip by rotating transducer until the required signal output is obtained (Figure 4-2). Adjustment of one-fourth turn moves the transducer approximately 0.015-inch in or out.
   a. Counter-clockwise rotation of the index transducer decreases the index pulse width as well as the amplitude. A minimum amplitude of 1.3 volts must be maintained.
   b. Clockwise rotation of the index transducer increases the index pulse width and amplitude. A minimum gap of 0.010 inch must be maintained.
3. Lock transducer with jam nut.

WARNING: When tightening jam nut, make certain that transducer does not rotate inward. Do not push on shield while adjusting or locking transducer.

4.4.3 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 0.020-inch. Tighten nut to retain the index-head assembly.
2. Align register plate against the bottom surface of the index-head assembly and tighten nut.
3. Adjust index transducer according to section 4.4.2.

4.5 DISKS

4.5.1 Cleaning

Whenever a disk array shield is removed, the disks must be cleaned. This cleaning is very important and it must be done carefully as outlined below. Cleaning must be accomplished throught the access entry port. Use only 91% Isopropyl Alcohol(P/N2155 966 for cleaning disks and heads.

WARNING: Do not energize disk drive motor to clean disks.

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

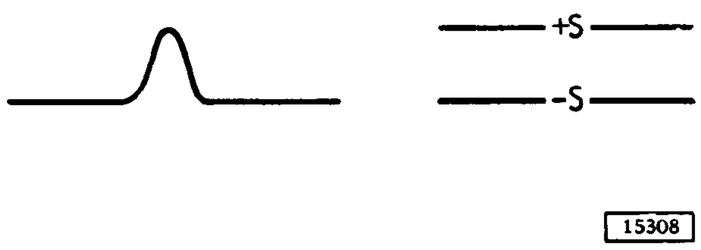

Figure 4-3. Incorrect Index Pulse

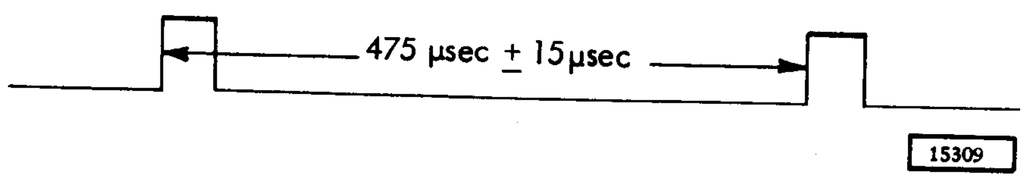

Figure 4-4. Early to Late Index Timing

1. Turn off main line switch (CBI) located in contactor panel prior to cleaning disks.
2. Swing out receiver and secure with swingout brace. If drawers have been removed, it is not necessary to swing out receiver; just return it to the outer limit stop.
3. Wrap the Disk Cleaning Paddle (P/N2108010) with an approved lint-free tissue dampened, not soaked, with Isopropyl Alcohol.

   NOTE: A tissue that is soaked in alocohol 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. Do not permit paddle to strike spacers and rings while cleaning disks.
4. Place paddle between disks and rotate the disk array manually (Figure 4-5). If the surfaces of the disk are wet after cleaning, too much alcohol was used on the tissue, and the disks should be cleaned again properly.
5. Clean the disks until 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.

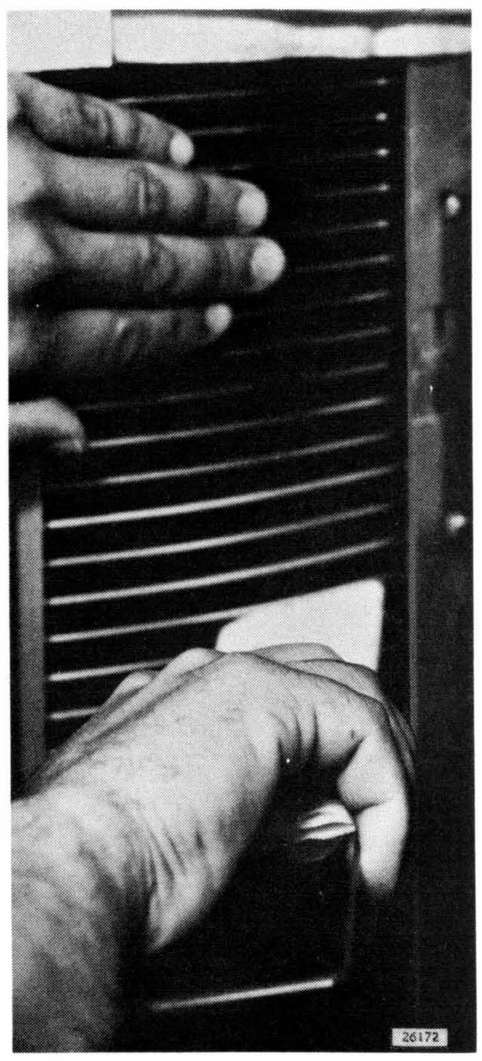

Figure 4-5. Cleaning Disks

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 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.

4.5.2 Removal

WARNING: Handle all disks with nylon gloves to prevent contamination by fingerprints.

1. Obtain Disk Replacement Kit (P/N 2108433) and Clock Writer (B/M 2108620) from Emergency Parts Center (E. P. C.).
2. Read data from all disks if possible. Store this data so it can be rewritten after disks are replaced.

NOTE: There is no guarantee that data can be recovered from the file after restacking disks. In the event that data cannot be read out prior to restacking, due to some catastrophic failure, a Disk Scribing and Aligning Tool Assembly is included with the disk replacement kit. With the use of the Scribing and Aligning Procedure described therein, it may be possible to recover some of the data which is of value to the customer. If data recovery is not to be attempted, the following steps may be eliminated from the restack procedure: Removal - Steps 9, 11, and 12; Replacement - Step 3.

3. Remove ac and dc file power.
4. Remove glass doors from both sides of the machine.
5. Swing out receiver and remove drawers, place in plastic bags in which they were received, and place in slots in shipping cartons.
6. Remove canopy grill and disk array filter (See Section 4.2)
7. 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 4-6). Do not bend, or tear strut alignment shims. The arrangement of stacked disks is shown in Figure 4-7.
8. Remove all shields that house the disk array (See Section 4.3).
9. Mount the Disk Scribing And Aligning Fixture assembly (Figure 4-8) to rear support casting and tighten the two screws 140 ±10 lb inches torque.

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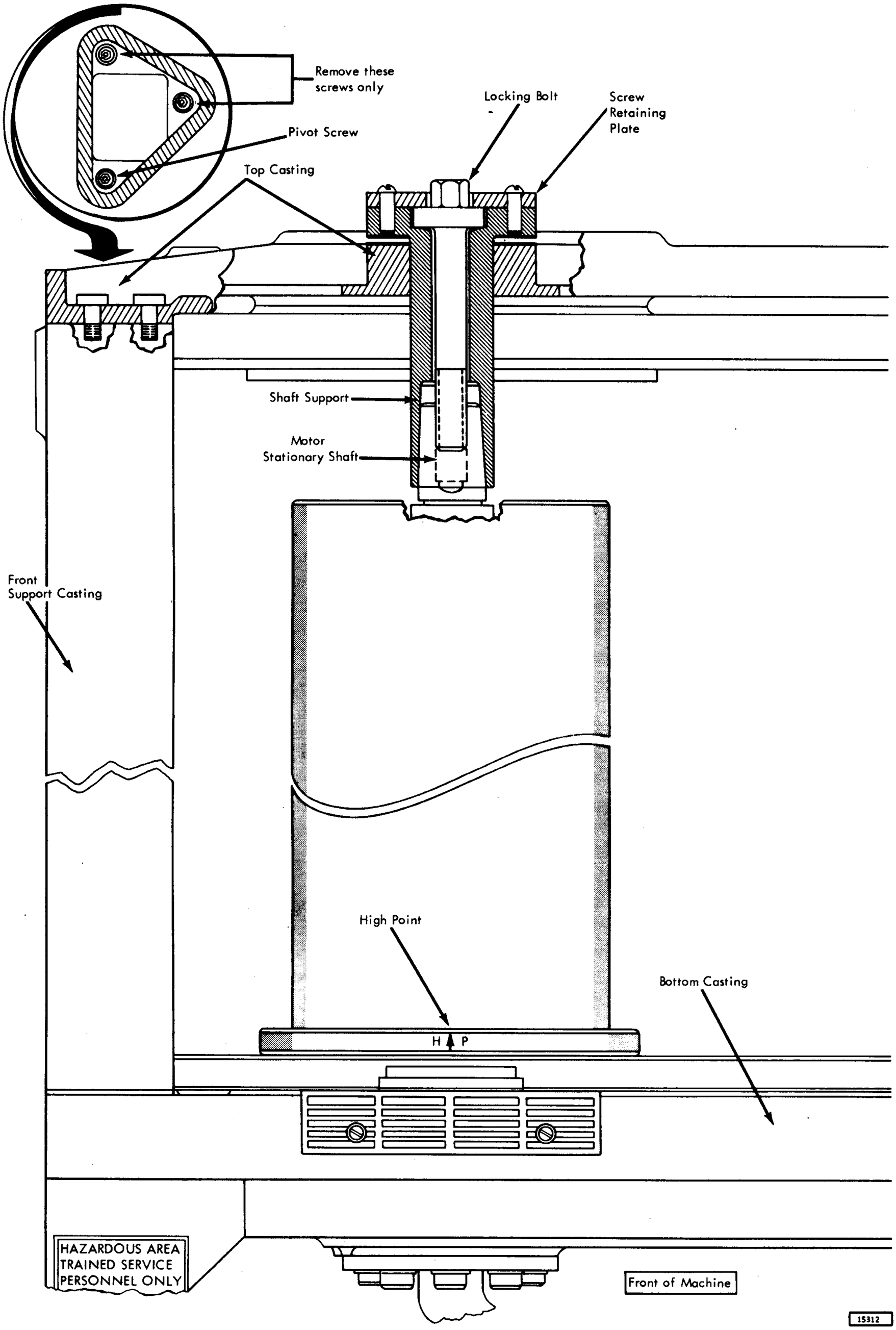

Figure 4-6. Shaft Motor

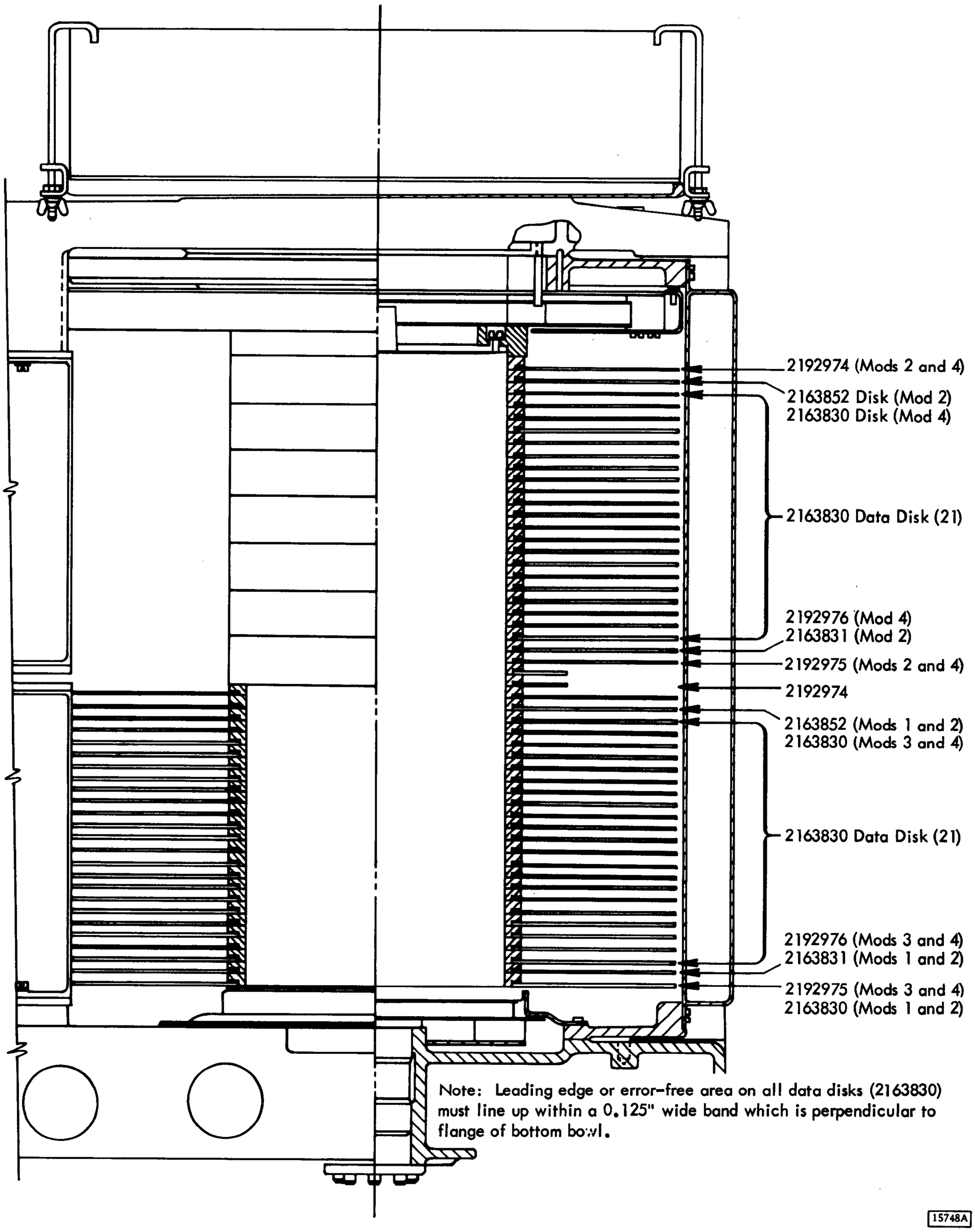

Figure 4-7. Disk Stacking

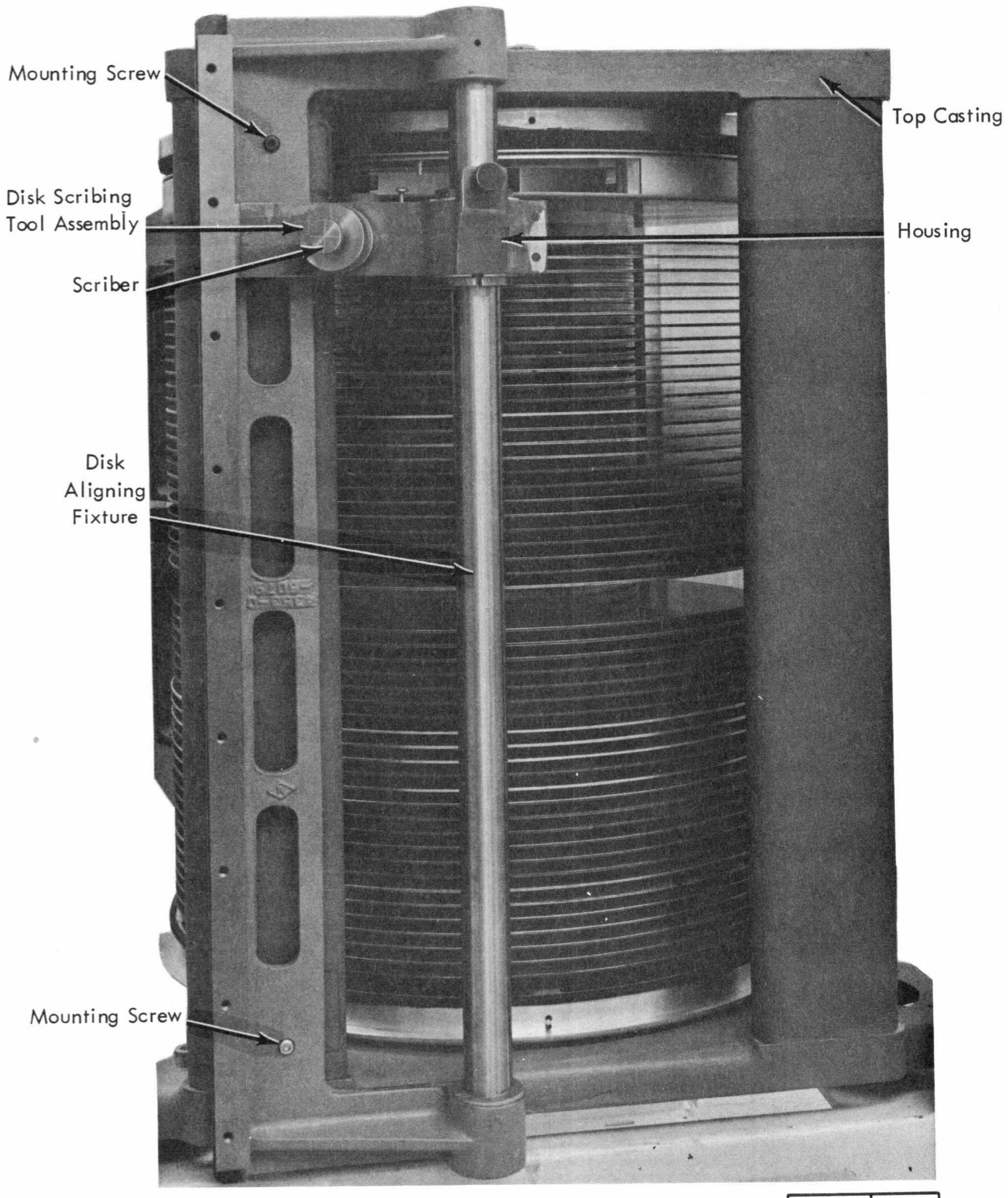

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Figure 4-8. Disk Scribing and Aligning Fixture

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

10. Remove locking bolt (Figure 4-6). 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 shaft motor, remove entirely.

11. Lock shaft motor with shaft motor clamp to keep disks from rotating during disk scribing operation (Figure 4-9).

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

Figure 4-9. Shaft Motor Clamp

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

12. Insert the disk scribing tool assembly into housing (Figure 3-8). Rotate scriber until point is just short of making contact with edge of disk (Figure 4-10). 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.
13. Remove the six screws (Item A, Figure 4-11) which fasten the impeller housing assembly to the top casting.
14. Remove four screws (Item B, Figure 4-11) which fasten top bowl assembly to top casting. Remove top bowl through front of the machine (Figure 4-12).
15. Remove four screws (Item C, Figure 4-11) 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 4-12).
16. Remove the six disk clamping ring screws (Item D, Figure 4-11) and the clamping ring.
17. 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 shaft motor, 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/U) is stamped. Start numbering spacers and disks with No. 1. Lint-free tissues should be placed on top of the table before stacking.

4.5.3 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.

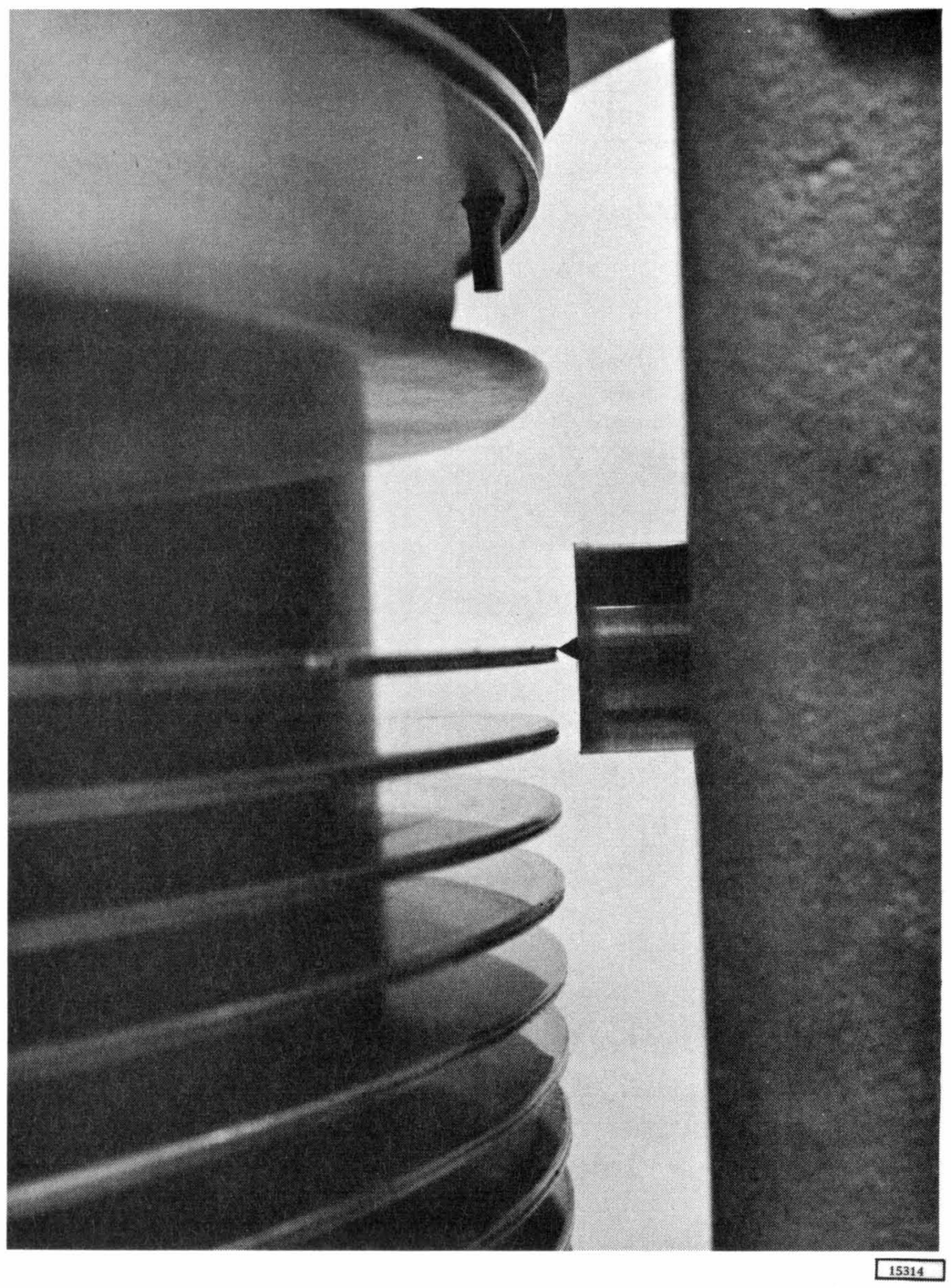

Figure 4-10. Disk Scribing

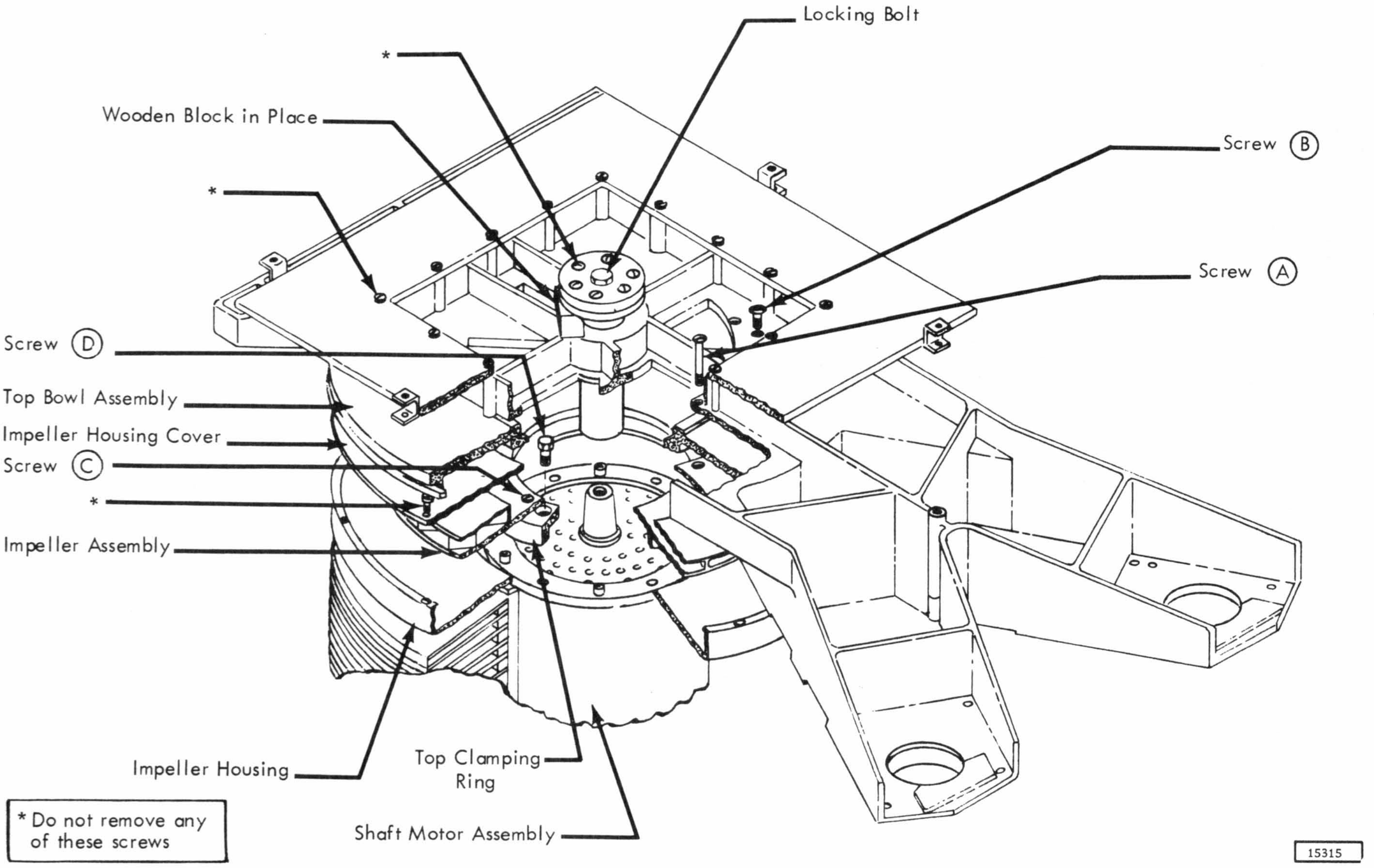

Figure 4-11. Disk Array Disassembly

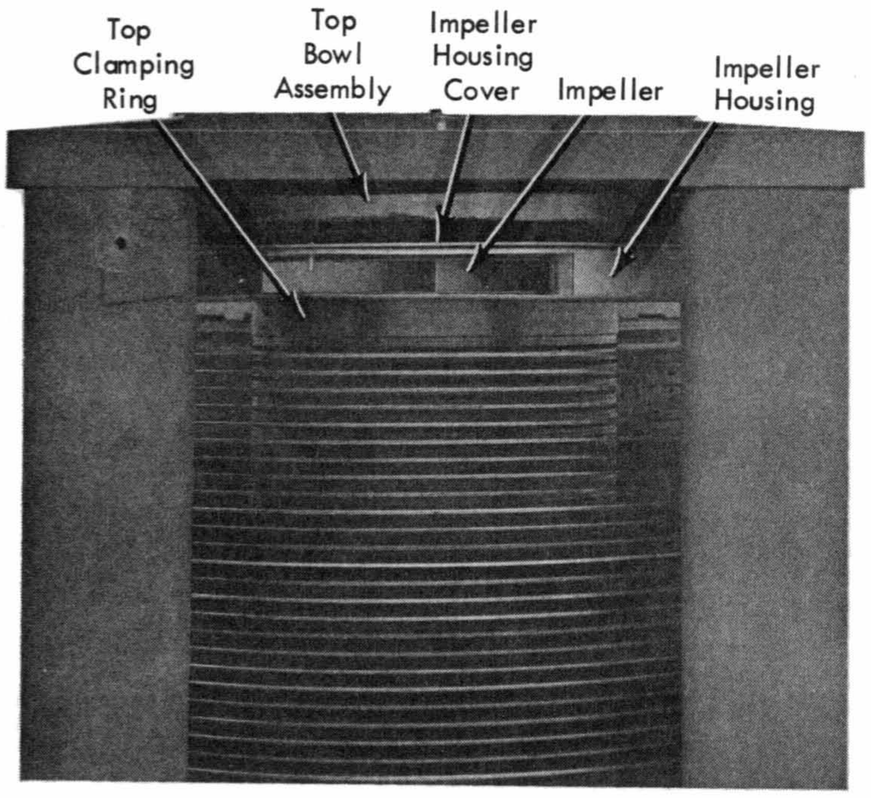

Figure 4-12 Disk Array Assembled

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

1. Install highest-numbered spacer first. All other spacers are self-aligning. 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 0.5-inch of the shaft-motor high point (H/P) (Figure 4-6 and 4-7).

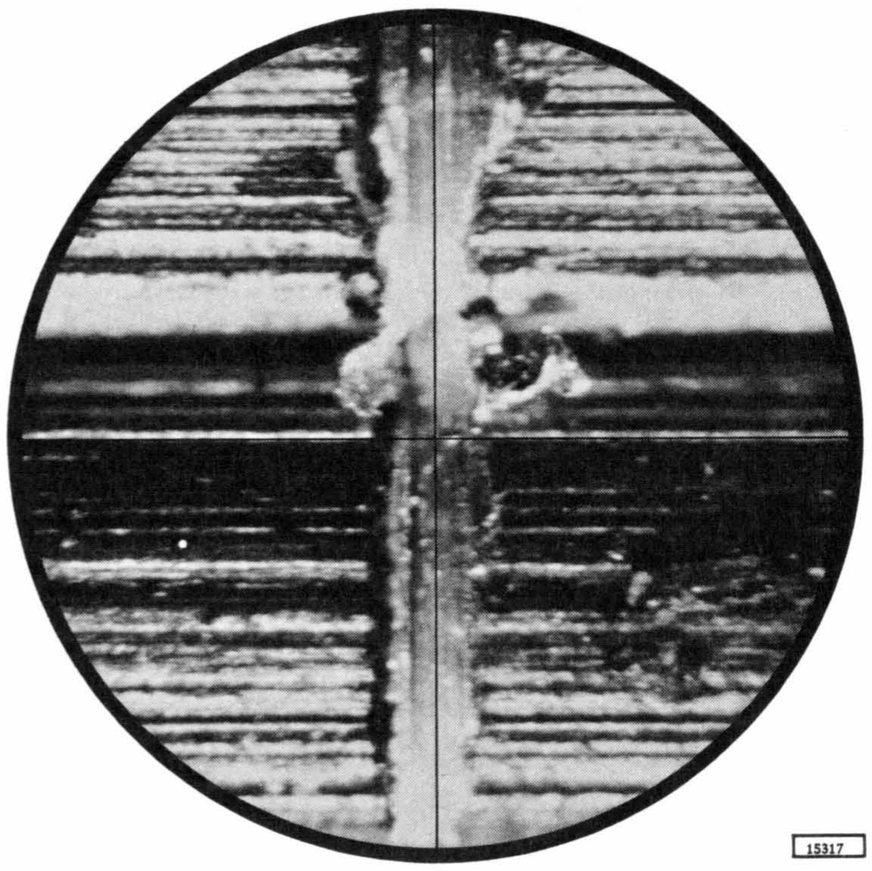

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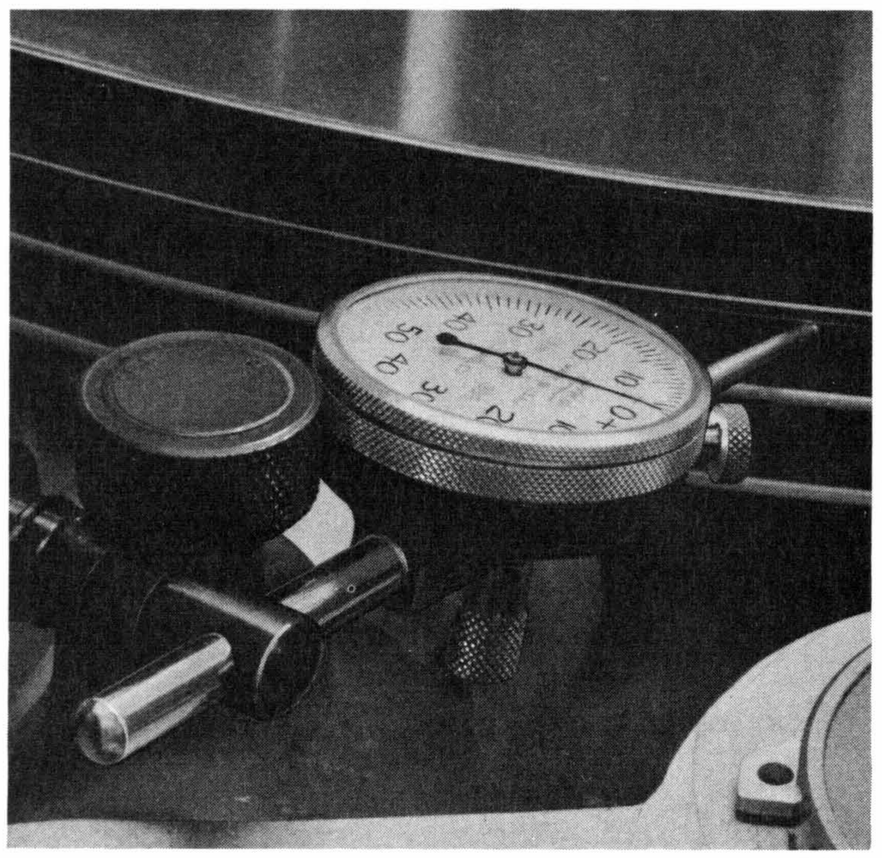
Figure 4-13. Magnified Scribed Line on Disk

WARNING: When stacking disks, try to align the scribe before settling the disk on the spacer ring. If the disks are rotated after they are put on the ring, aligning blocks may shave the inner disk edge.

3. Install microscope disk aligning fixture in scriber mounting. Align the scribe mark with the center of the crosshair by positioning the disk. Then, the microscope should be rotated to appear as shown in Figure 4-13.
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. If replacement disks are required, line up leading edge (in direction of disk rotation) of error free sector (black stripe on edge of disk) with error free sector of existing disks. The leading edges should line up vertically within 0.125 inch wide band. See Figure 4-7 for disk locations, data, format, and order of stacking.

NOTE: Due to the thickness of the rubber gasket on the spacer assembly on the two module file, it may be possible to install only 49 disks 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 shaft motor, try not to rotate it, because rotation 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 shaft motor. Two men should stand opposite each other to tighten down, each making the same number of turns. Then check the final set of torque on the clamping ring screws for 230 ±10 lb inches.

5. Remove screws, clamping ring, and top spacer and install last disk and reclamp to 230 ±10 lb inches torque. Recheck two or three disks to verify that the scribe marks have not moved during the clamping operation.
6. Check disk runout on every fifth disk with Dial Indicator from disk-aligning kit. Measure runout at 3/16-inch ±1/16-inch from the edge of disk while turning the array manually through a full revolution. Measure runout from the bottom surface of the disk (Figure 4-14). Runout should not exceed 0.020-inch. If a disk exceeds a total indicator reading of 0.020-inch one of the lower disks or spacers may not be flat, possibly because a chip lies between the surfaces. If such a disk is found, disks beneath it should be checked to determine at which disk runout becomes excessive. The disks must then be unstacked to locate the excessive runout. If only one disk has excessive runout, then the disk runout log should be checked to see if the disk had much runout initially. If it did not, then the disks must be unstacked to locate the problem.



15318

Figure 4-14. Dial Indicator Mounting

7. Remove the disk aligning tool from the rear support casting, place in shipping crate, and return to Emergency Parts Center (EPC). Replace support casting, shims, and screws.
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 to obtain clearance.
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.
10. Purge the file for at least 45 minutes before loading the heads on the disks under power.

NOTE: If data recovery is to be attempted, it should be accomplished prior to proceeding with Step 11.

11. Perform complete rewrite of all disks in the array.
12. Perform a surface analysis diagnostic check and flag defective tracks as follows:
    a. Using Gauge P/N 2108962, set outer limit (crash stop) adjustment to 0.0735 inch. (Refer to Section 4.12.4.)

    ▌CAUTION: Use only Yoke Adjustment (Differential) Screw for adjustment.

    b. Run surface analysis diagnostic once for each bit pattern.
    c. Record all tracks found to be defective on these two runs.
    d. Using gauge P/N 2108962, set crash stop adjustment to 0.0785 inch. (Refer to Section 4.12.4.)

    ▌CAUTION: Use only Yoke Adjustment (Differential) Screw for adjustment.

    e. Run surface analysis diagnostic once for each bit pattern.
    f. Record all tracks found to be defective on these two runs.
    g. Using Gauge P/N 2108962, set crash stop adjustment to 0.076 inch. (Refer to Section 4.12.4.)

    ▌CAUTION: Use only Yoke Adjustment (Differential) Screw for adjustment.

    h. Run Surface Analysis diagnostic once for each bit pattern.
    i. Flag all tracks found to be defective at these three crash stop settings.
    j. After disk replacement, compare the original bad track log with the bad tracks found while running the surface analysis diagnostics. The diagnostic may show a pattern of defective tracks that will reveal the location of defective tracks not pinpointed by the test. It should be noted that after a disk restack, all disks may not shift the same amount or in the same direction. Consequently, each surface must be dealt with individually. For example, if only three of four original bad tracks were found after disk replacement, the fourth could be flagged by comparing the original bad track log with the new data found on surface analysis. If the three bad tracks found were exactly one track in, or one track out, or at the original address, the fourth track should then be flagged by examining the pattern of defective tracks. Flag all tracks found to be defective at this setting. This completes the Surface Analysis check. Update the Alternate Surface Log by recording all defective tracks.

4.6 DISK SHAFT MOTOR

4.6.1 Service Check

The following conditions may indicate the start of a shaft motor failure:

a. Noisy bearings.
b. Timing problems in the machine.
c. Overloads do not stay closed.
d. Thermal switch opens on starting.
e. Rundown time less than 60 percent of that recorded on Decal P/N 2123138 located on cover of power sequence gate.

4.6.2 Removal

Remove the disk shaft motor by following the instructions contained in the Shaft Motor-and-Hoist Kit (Section 2.8.5.2), which is supplied whenever a spare disk shaft motor is ordered.

4.6.3 Replacement

1. Order the disk shaft motor by part number (See Parts Catalog). The Shaft Motor-and-Hoist Kit and the Disk-Aligning Kit will be sent with the motor automatically. The Shaft Motor-and-Hoist Kit includes instructions for removing and replacing the shaft motor. Replace the disk shaft motor according to these instructions.
2. Rewrite all disks in the array after shaft motor replacement.
3. Perform a surface analysis diagnostic and flag defective tracks according to the procedure in Section 4.5.3, Step 11.

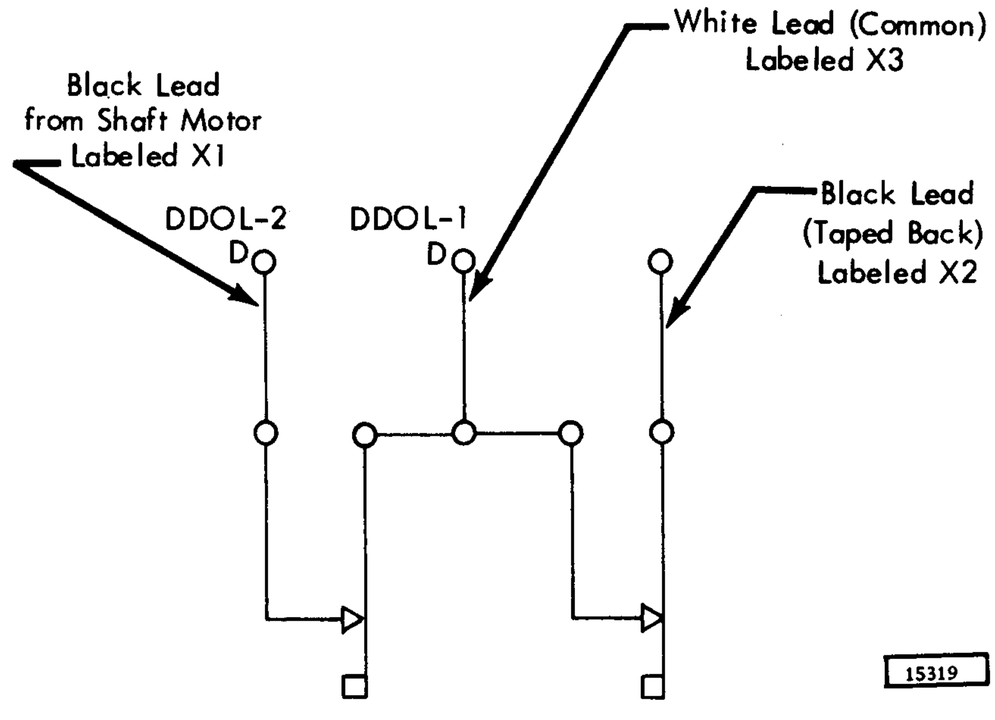


Figure 4-15. Additional Disk-Drive-Motor Thermal

4.6.4 Disk Drive Thermal Overload Switches

Service Hint

A spare Thermal Overload switch is installed on the disk drive motor. Should the switch in use become defective, the spare switch can be installed by interchanging the leads X2 and X1 located in the contactor cabinet (Figure 4-15). The switch appears in 2302 System Diagrams on page 01.50.12.0. If both switches are defective, disconnect and tie back leads from both switches and jumper across the terminals where X3 and X1 or X2 was attached. Adequate protection is still provided in the power sequence gate.

4.7 RECEIVER ASSEMBLY

4.7.1 Swing-Out Procedure, Disk Array Stopped (Figures 4-16 and 4-17)

1. Remove power to machine.
2. Remove glass doors.
3. Remove access cover and sliding door.
4. Move carriage to outer limit stop. For the rear actuator, it will be necessary to remove the dummy rear crash stop.
5. Loosen the two set screws at rear of carriage swing out shaft housing. Loosen the outermost screw on the swing out shaft cap. Disconnect receiver cable from end of bridge assembly.
6. Depress carriage locking levers. Apply a slight inboard pressure on the receiver to aid in unlocking. Do not press on arms or stiffeners.
7. Swing receiver out carefully. Ensure that flex rings clear the disk array shields.
8. To retain the receiver at a fixed location, attach Swing Out Brace, P/N 2192836.

WARNING: Any time the receiver is swung out, drawers and heads can be easily damaged. Do not leave the receiver unattended while it is in this position.

9. Cover access-entry port with long door.

4.7.2 Swing-In Procedure, Disk Array Stopped

1. Swing receiver in far enough to allow installation of actuator shield. Install shield.
2. Remove long door.
3. Ensure carriage is against outer stop and swing receiver in carefully.
4. Press on receiver to lock wedges. Do not put any pressure on drawer stiffeners. Apply slight pressure on levers in direction of spring force.

NOTE: Levers are approximately horizontal when locking pins are seated. Ensure that pins are seated before opening file.

5. Observe profile of drawers between disks. All drawers must be equally spaced between disks when the access is fully into the disk array against the inner limit stop (See Figure 4-18). If any drawer appears to be badly misaligned, replace drawer.
6. Tighten the outer screw on the swing out shaft cap.
7. Tighten the two carriage swing out shaft set screws. Connect receiver cable to bridge assembly.

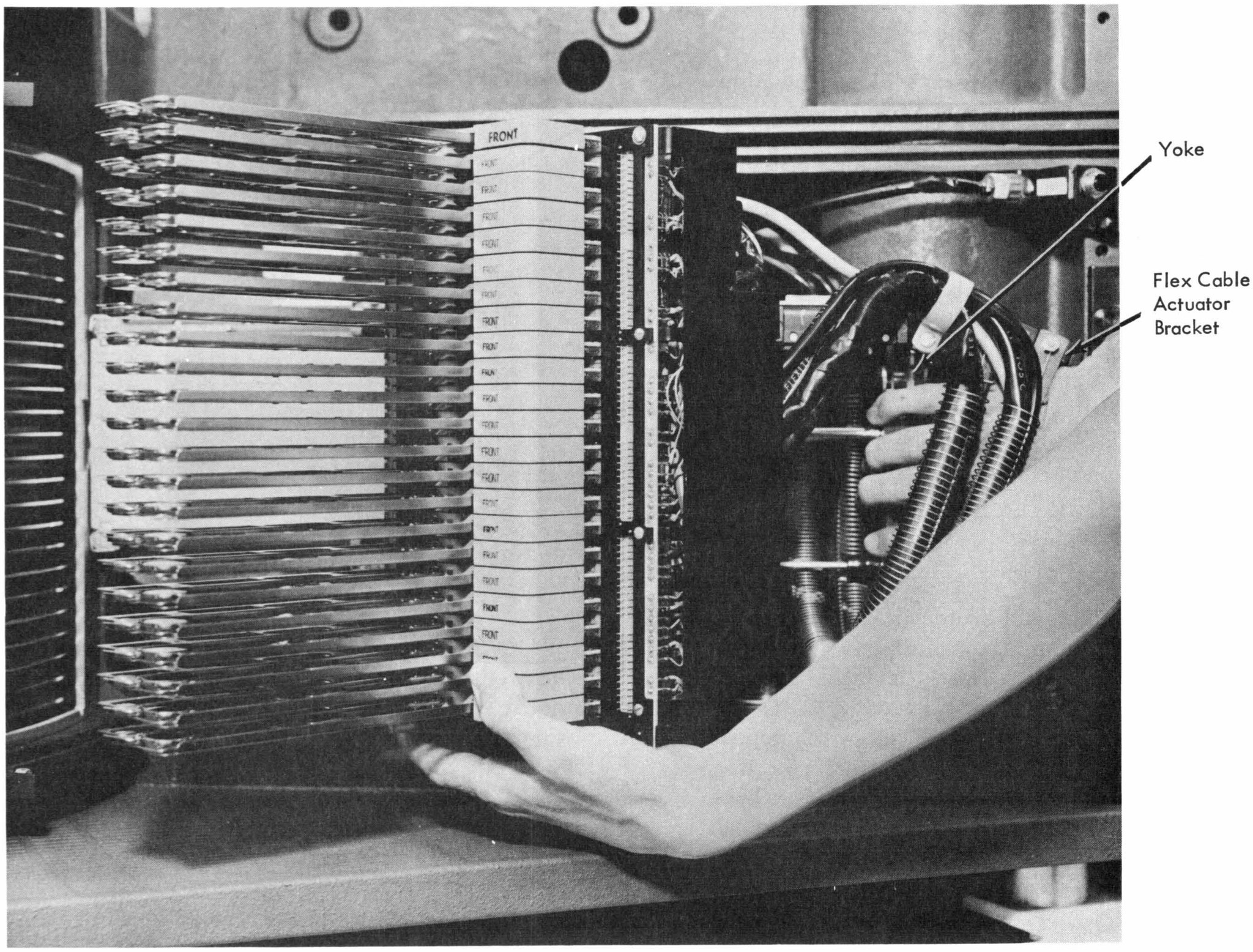


Figure 4-16. Receiver Swing-Out Procedure

8. If rear actuator, install dummy outer limit stop.
9. Install actuator shield door and sliding door. Inspect clearance between sliding door and drawer assemblies. This should be 1/8-inch minimum to 3/16-inch maximum. Adjust stops on access shield if required. If necessary, bend stops to obtain the required clearance.
10. Turn on File dc power and hydraulic power supply.
11. After 30 minutes, of purging and warm up, the file can be brought on line.

4.7.3 Swing Out Procedure, Disk Array Coasting Down

1. Remove power to machine.
2. Remove glass doors.
3. Remove the short door on actuator shield next to disk array port.
4. Remove the actuator shield door.
5. Move carriage to outer limit stop. For the rear actuator, it will be necessary to remove the dummy rear crash stop.
6. Loosen the two set screws located at rear of the carriage swing out shaft housing. Loosen the outermost screw on the swing-out shaft cap. Disconnect receiver cable from end of bridge assembly.
7. Depress carriage locking levers. Apply a slight inboard pressure on the receiver to aid in unlocking. Do not press on drawer stiffeners.
8. Swing receiver out carefully. Ensure that flex rings clear the disk array shield.
9. Cover the access entry port with long door.

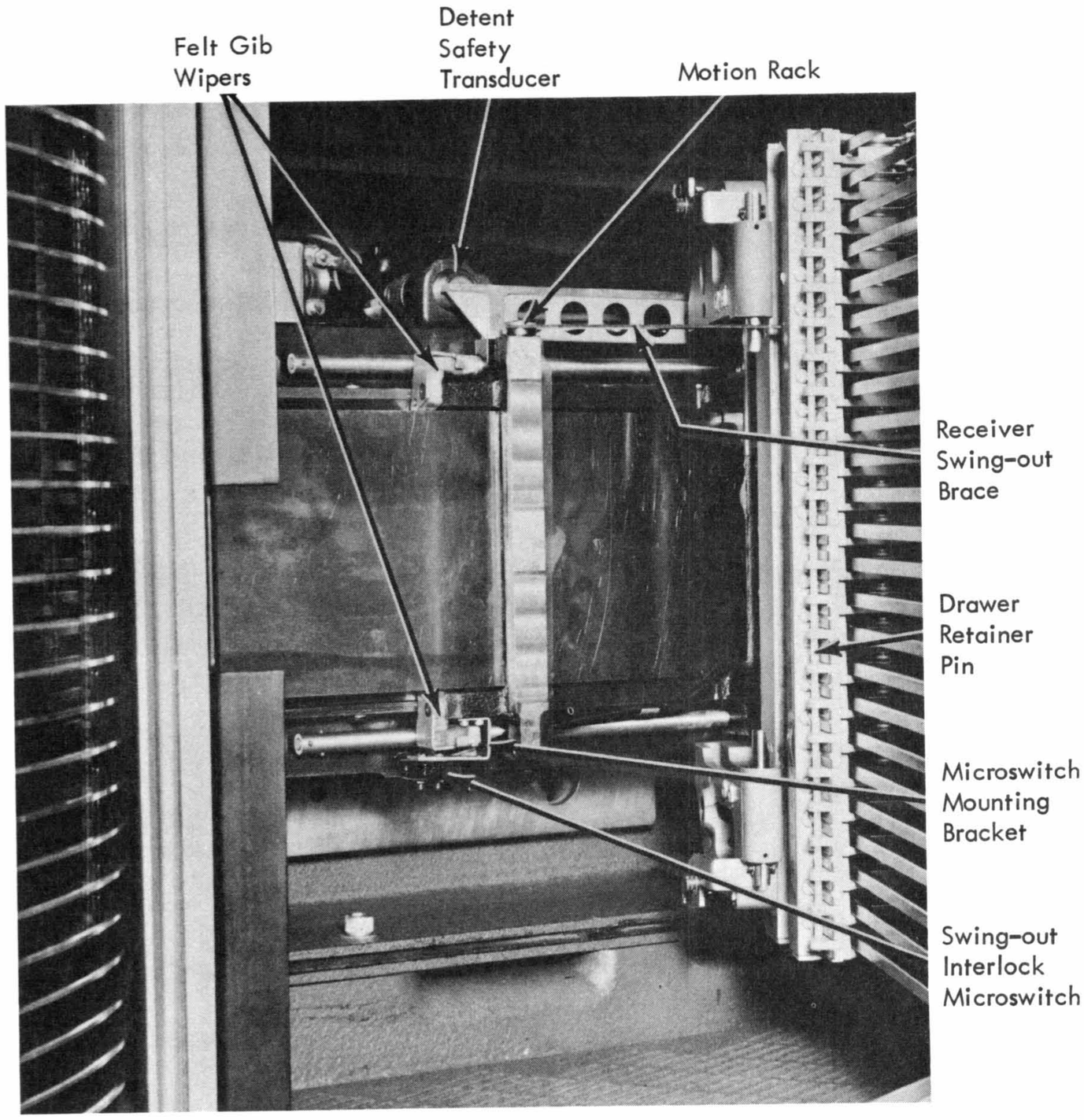


Figure 4-17. Receiver in Servicing Position

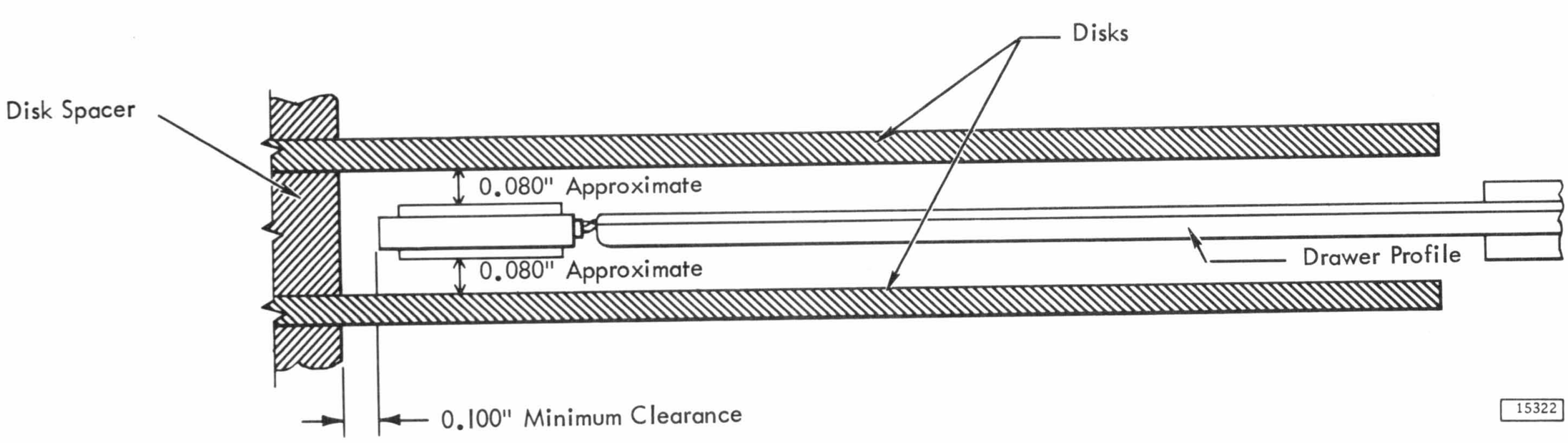


Figure 4-18. Driver Assembly Profile

10. Remove the actuator shield. Retain the receiver in place using the Swing Out Brace P/N 2164240.

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

4.7.4 Removal (Figures 4-16, 4-17, 4-19, and 4-20)

NOTE: When a receiver is removed and reinstalled, or a new receiver substituted, it is necessary to read out the data and rewrite with the new assembly. If possible, the reading out of all the data serviced by that access should be done prior to disassembly in order to eliminate the necessity of readjusting the yoke and/or using the tool drawers.

1. Read data from all the disks serviced by this receiver. Store this data so it can be rewritten after the receiver is replaced.
2. Swing out Receiver (see Receiver Swing out Procedure Section 4.7.3).
3. Remove the drawer retaining pin and the drawer assemblies (Section 4.8.2).
4. Tighten the swing out shaft cap screws and the two set screws on the carriage.
5. Loosen the hinge shaft nut a few turns.
6. Remove the air hose from the head load air cylinder.
7. Disconnect the connector from the swing out interlock microswitch, head load switch, and head unload switch.
8. Remove the head load and unload microswitch assembly.
9. Remove the receiver printed circuit board assembly by removing the mounting screws.
10. Remove both hinge caps and the receiver. This step requires two people.

4.7.5 Replacement

1. Move the carriage to outer limit stop.
2. Check to verify that the swing out shaft cap screw and the two carriage set screws are tight.
3. Position receiver hinge arms on shaft assembly. Ensure correct position of shim spacer and split bushing during assembly.
4. Assemble hinge caps to arms and tighten as follows:
   a. Tighten hinge cap screws while maintaining an even gap on each side of the cap.
   b. Loosen each cap screw by turning approximately 30°. This allows shaft to move with caps during following step.
   c. Torque nut to 30 ±5 lb inches.
   d. Tighten cap screws.
5. Loosen the swing out shaft cap screw and the two carriage set screws.
6. Assemble the receiver printed circuit board assembly.
7. Assemble head load and unload microswitch and plug connector.
8. Connect air hose to the head load assembly.
9. Swing out receiver and engage swing out brace.
10. Install drawer assemblies and drawer retaining pin (Section 4.8.3). Exercise care to prevent damage or contamination of heads (Figure 4-21) while handling drawer assemblies.

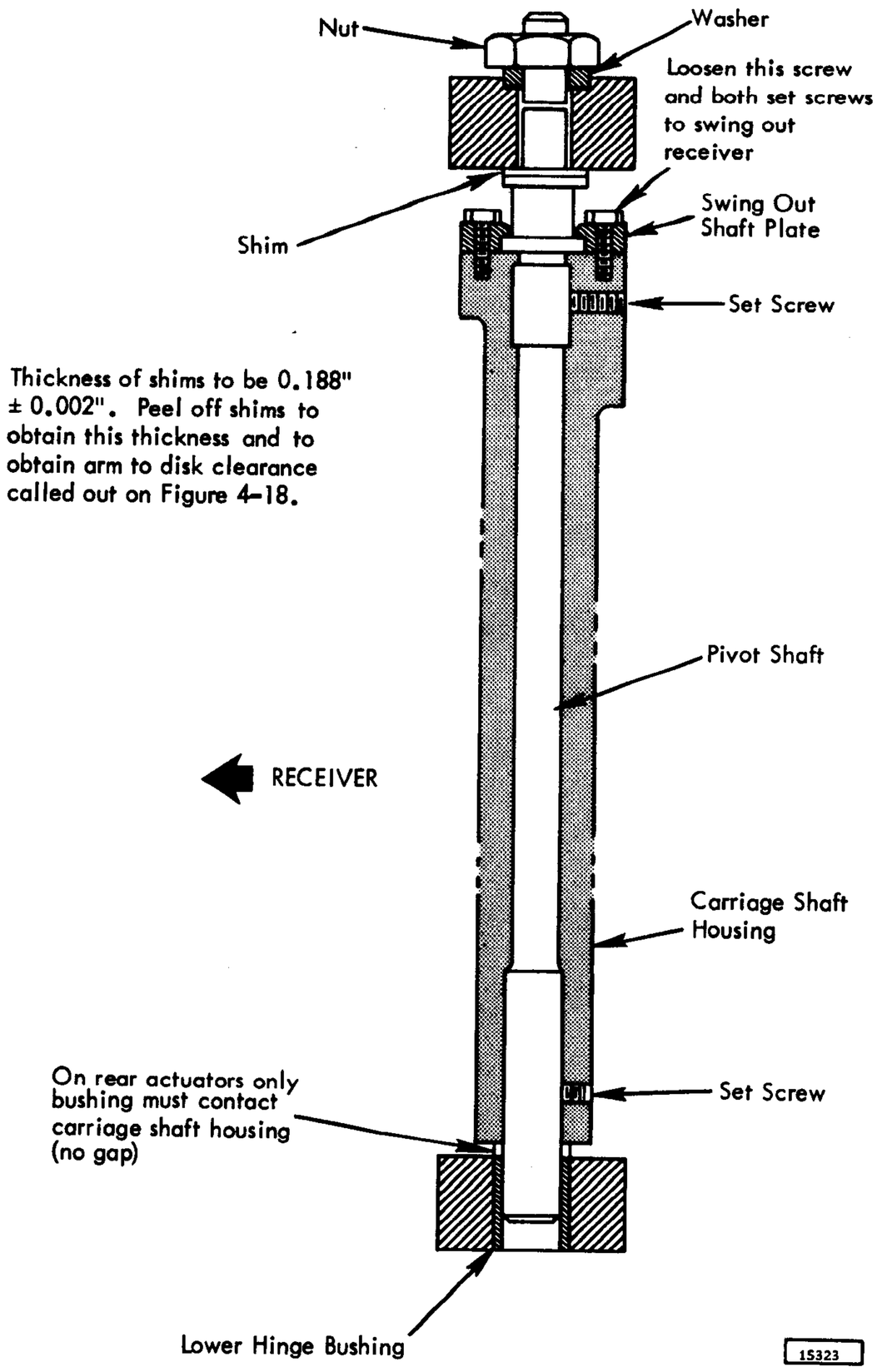


Figure 4-19. Pivot Shaft Assembly

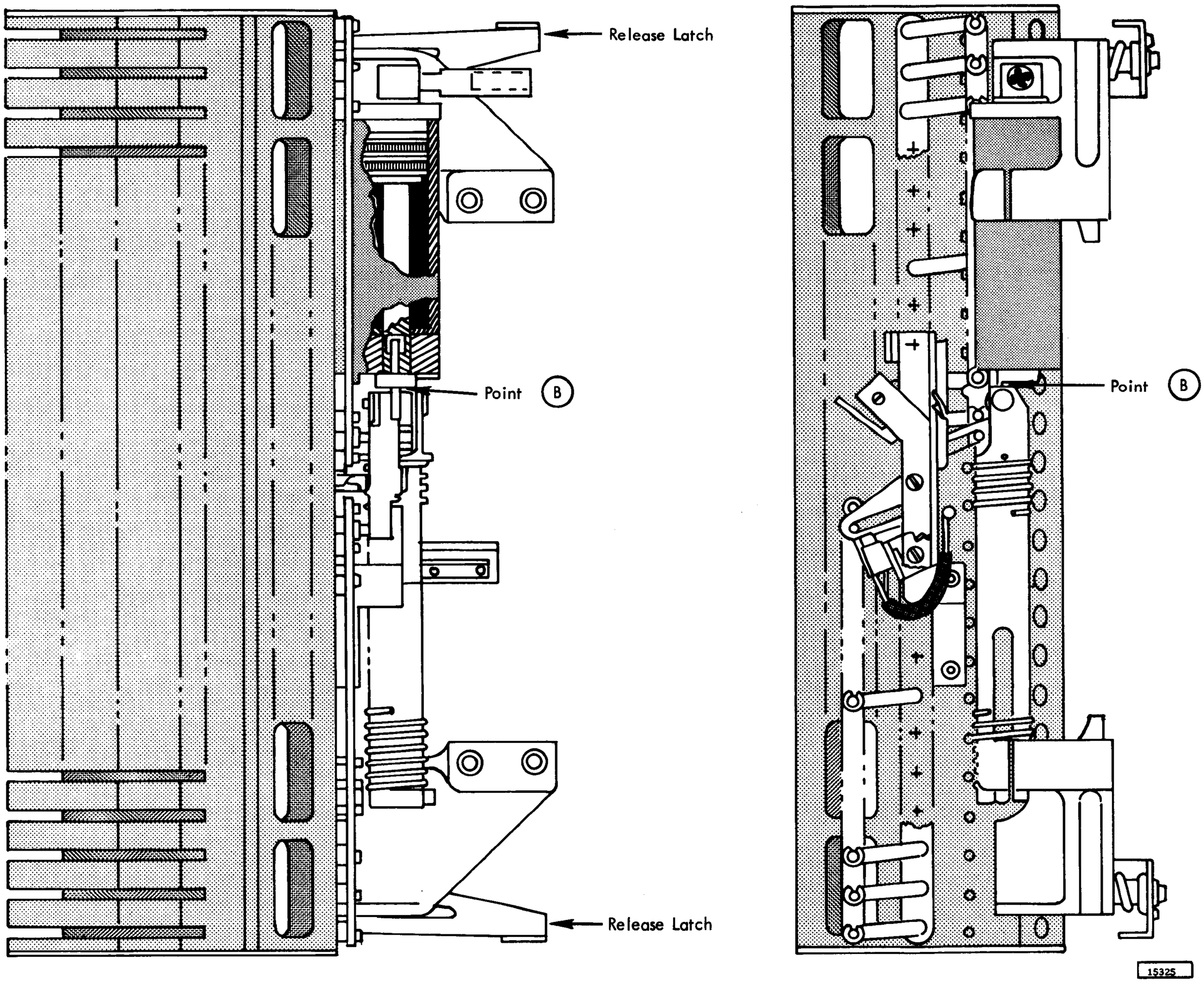


Figure 4-20. Head Load-Head Unload Adjustments

11. Check receiver and drawers for proper position and straightness.
12. Swing in receiver (see Receiver Swing In procedure Section 4.7.2).
13. Perform a complete rewrite of all disks serviced by this receiver.

4.7.6 Adjustment

4.7.6.1 Head Load

Heads Unloaded Switch. With assembly in the heads unloaded condition, the heads unloaded switch should be adjusted to just make with a 0.001-inch shim between the air-cylinder piston and the main-link roller (Point B) and not made with a 0.005-inch shim at Point B (Figure 4-20).

Heads Loaded Switch. With 65 psi applied to air cylinder, adjust head load switch so that it is just made.

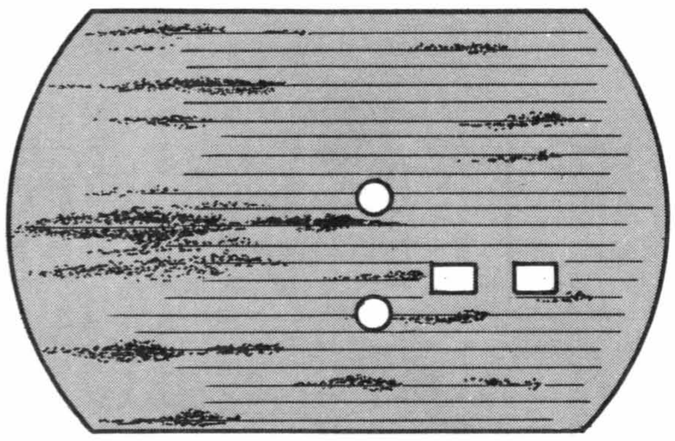
4.8 DRAWER ASSEMBLY (Figure 4-22)

NOTE: Format drawer assemblies are not interchangeable with data drawers. Drawers from the front accesses are not interchangeable with drawers from the rear accesses.

4.8.1 Adjustment

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

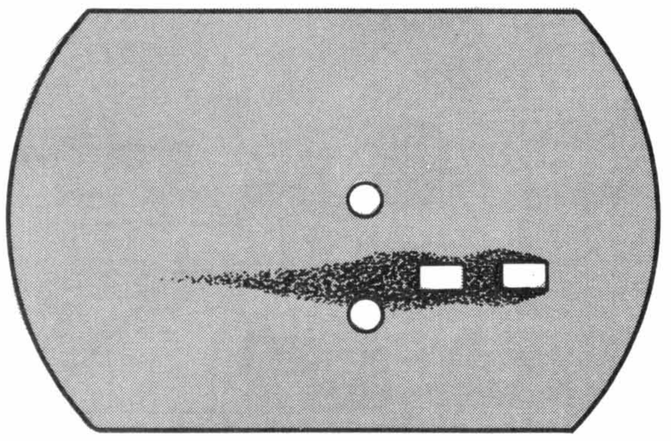
ROTATION



A

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

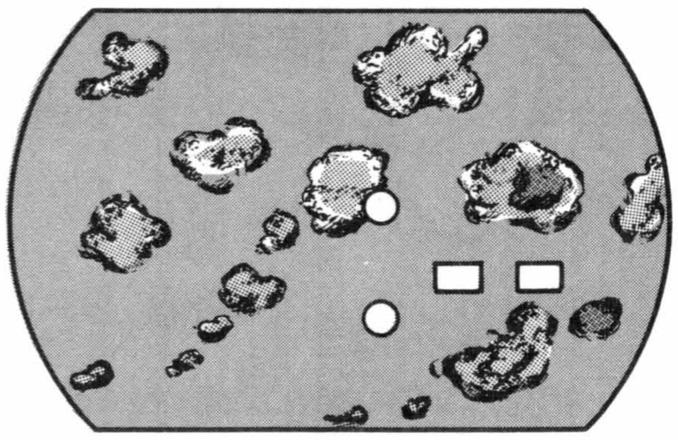
ROTATION



B

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

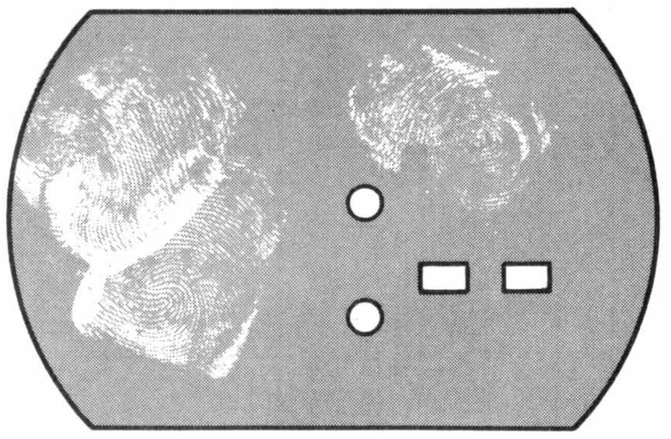
ROTATION



C

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

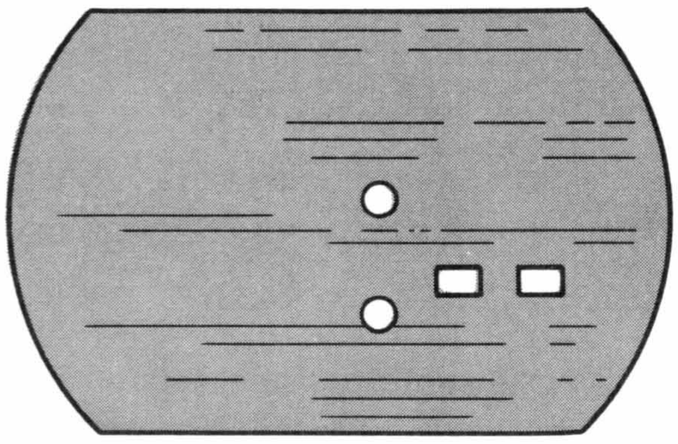
ROTATION



D

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

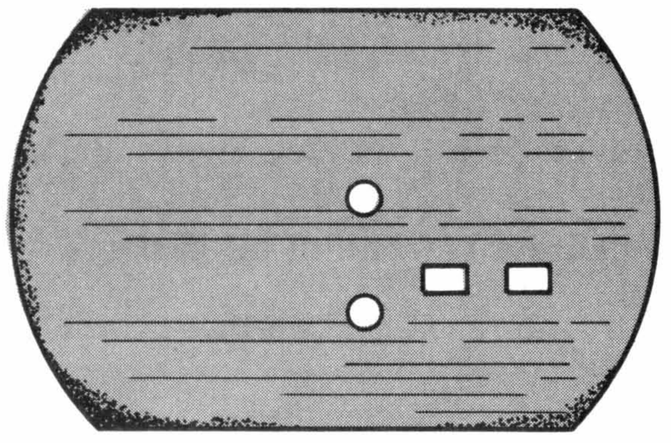
ROTATION



E

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

ROTATION



F

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

15329A

Figure 4-21. Head Inspection

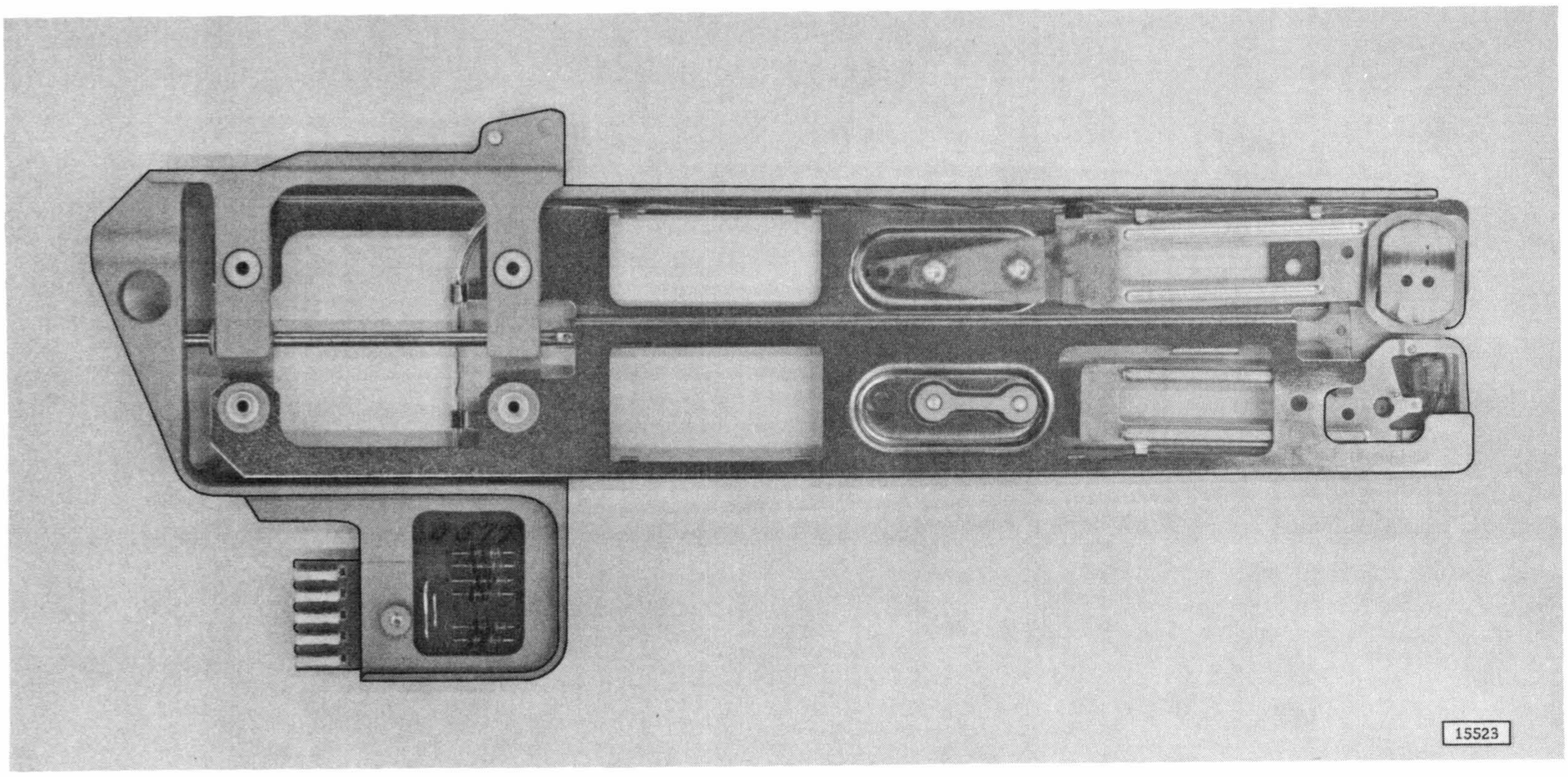


Figure 4-22. Drawer Assembly

4.8.2 Removal

1. Read data from both disks serviced by this drawer. Store data so it can be rewritten after drawer is replaced.
2. Swing out receiver (see Section 4.7.3).
3. Remove drawer retaining rod. (Figure 4-17).
4. Loosen drawer retaining screw in rear of receiver.
5. Remove drawer assembly by applying a clamping force with index fingers and pushing on adjacent drawers with thumbs (Figure 4-23). Drawer assembly must be handled with care. Never handle assembly by stiffeners or arms. Avoid damage to or contamination of heads while handling drawer assemblies.

4.8.3 Replacement

1. Check drawer to see if it is for the correct side (front and rear).
2. Check for proper position of torsion rod (Figure 4-22).
3. Insert drawer (Figure 4-24).
4. Seat drawer firmly by tightening the retaining screw.
5. Insert retaining pin through holes in drawers until cotter pin rests against top drawer.
6. Swing-in receiver (see Receiver Swing-in Procedure Section 4.7.2).
7. Rewrite both disk surfaces serviced by replaced drawer. If the data was not read out before removal of the drawer (Step 1 of Removal procedure), attempt to recover the data with the new drawer, or if necessary, use a Tool Drawer (P/N 2164250 or P/N 2164251). After recovering data, however, it must always be rewritten with the new drawer.
8. Perform a surface analysis diagnostic check and flag defective tracks as follows:
   a. After a new drawer is installed, and before the customer data is reloaded, run the surface analysis diagnostic on those two surfaces only.
   b. Flag all tracks found to be defective on this run.
   c. After drawer assembly replacement, compare the original bad track log with the bad tracks found while running the Surface Analysis diagnostics. The diagnostic may show a pattern of defective tracks that will reveal the location of defective tracks not pinpointed by the test. It should be noted that after a disk restack, all disks may not shift the same amount or in the same direction. Consequently, each surface must be dealt with individually. For example, if only three of four original bad tracks were found after replacement of drawer assembly, the fourth could be flagged by comparing the original bad track log with the new data found on Surface Analysis. If the three bad tracks found were

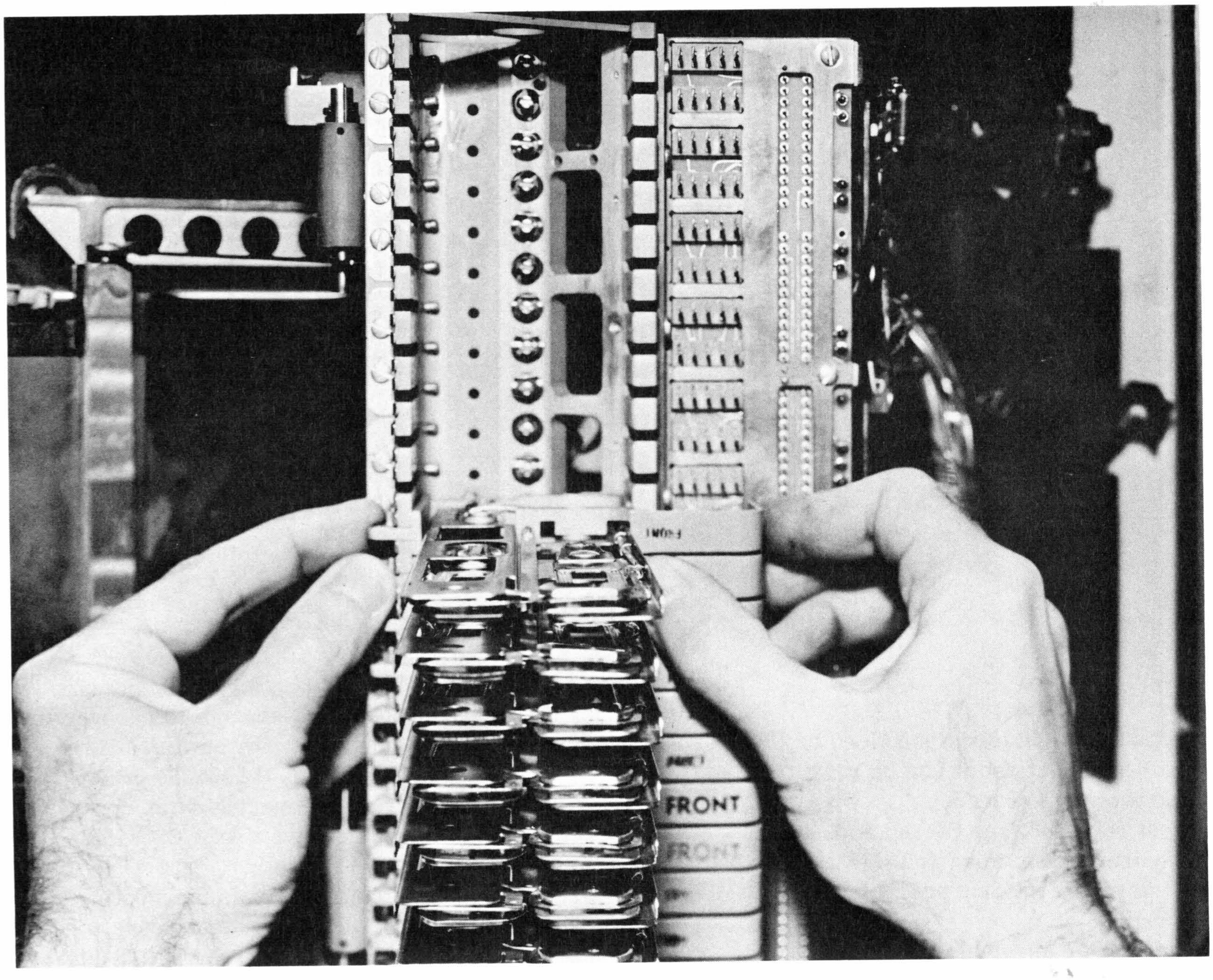


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Figure 4-23. Drawer Removal

exactly one track in, or one track out, or at the original address, the fourth track should then be flagged by examining the pattern of defective tracks.

d. Update Alternate Surface Log by recording all defective tracks.

NOTE: The adjusting screw on the tool drawer moves both heads, so, it may be necessary to readjust the drawer for each disk surface. See Section on head signals for method of peaking on signal.

4.8.4 Head

WARNING: Electrical arcing between the head and disk can occur if a voltage of about 25v 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 will not blow and damage may result if the head-disk spacing is less than normal for the voltages under 25v and at normal spacing for higher voltages. It is very easy to short a dc voltage to frame ground during servicing. For example:

(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, or

(b) Scope leads left dangling can also cause trouble by creating shorts.

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. A potential of 24v ac is present throughout the machine. A short between one side of the 24v line and dc ground would apply 24 volts directly across the receiver and the frame.

NOTE: All drawer assemblies in the receiver must be removed if a high-resistance, low-voltage ohmmeter (megger) is used to isolate malfunctions.

4.8.4.1 Visual Inspection (Figure 4-21)

Heads can normally be inspected and cleaned without removing drawers from the receiver. However, if the condition of a head is questionable, remove the head from the receiver for inspection (see Drawer Removal Section 4.8.2).

Look particularly for the following conditions to determine the status of a read/write head.

1. Oxide accumulation due to scratches and/or projections.
2. Oxide accumulation without scratches.
3. Scratches without oxide accumulation.

Scratches and Oxide Build-up. (A, Figure 4-21). The amount and relative position of oxide build-up

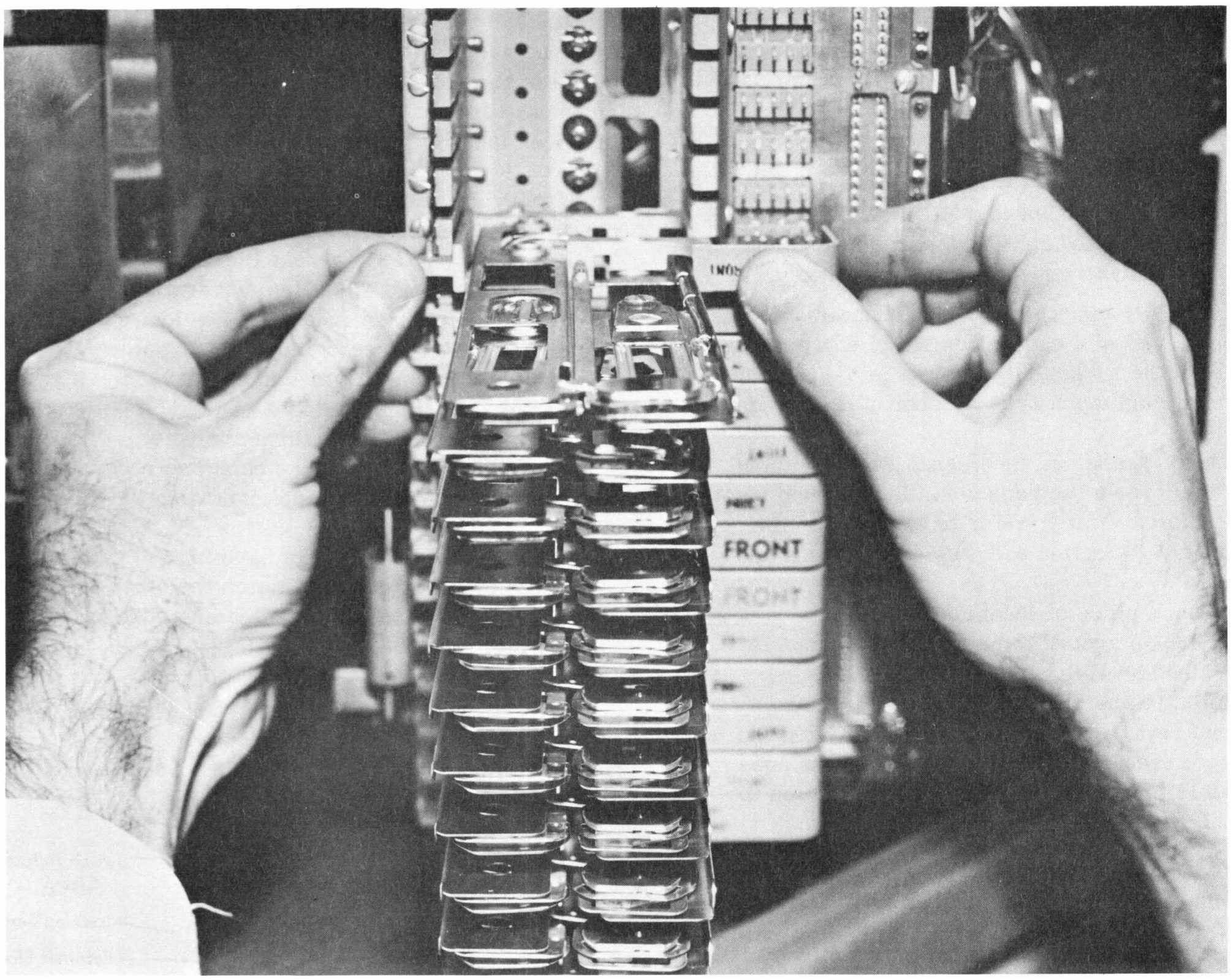

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Figure 4-24. Drawer Insertion

on a head is much more significant as a criterion for rejection of a head than the degree to which a head is scratched. Oxide build-up due to scratches causes rejection of the head. It may be necessary to remove the oxide to determine if a scratch has caused the build-up (see Head Cleaning).

Oxide Build-Up Without Scratches. Provided no scratches occur in the oxide areas, the head may be cleaned and reused.

If oxide has accumulated in the pole tip areas (B, Figure 4-21), the head should be replaced.

The radius around the entire perimeter of the shoe may pick up oxide during normal operation (F, Figure 4-21). Although the oxide should be removed, it is no cause for concern.

Remove foreign material of any type from the gliding surface before resuming file operation, as inadequate cleaning and/or operation in a contaminated atmosphere results in an unsatisfactory condition (C, D Figure 4-21).

Scratches without Oxide Build-Up. (E, Figure 4-21). Scratches are permissible on the gliding surface provided that no oxide is present.

4.8.4.2 Cleaning

WARNING: Use 91% Isopropyl Alcohol, P/N 2155966 for disk and head cleaning. This cannot be purchased locally. It should be ordered from IBM Supply.

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 of alcohol in the customer's office.

Normally, heads can be cleaned easily without removing them from the receiver. If a drawer must be removed for cleaning, refer to procedures for Drawer Removal (Section 4.8.2). Clean heads as follows:

1. Wrap a piece of cleaning tissue (P/N 2108036) around the head cleaning paddle (P/N 2108474).
2. Moisten the cleaning tissue with alcohol and remove any foreign material from the shoe face. Use as little pressure as possible to prevent permanent deformation to the drawer assembly while cleaning.

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

4.8.5 Swing-Out Interlock Microswitch

Adjustment

Adjust mounting bracket so microswitch is made by the drawer retaining pin when receiver is closed and locking pins are seated (Figure 4-17).

WARNING: Do not over adjust bracket. Abnormal pressure is required to engage receiver locking pins if this bracket is over adjusted.

4.9 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.

4.9.1 Service Check

The amplitude of the clock-head signal should average 0.5 to 1.50 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. If an adjustable potentiometer has been installed on the clock amplifier, adjust for 3.0 to 6.0 volts peak-to-peak.

This voltage may be measured in the 7631 at input to phase detector, pins D and E of B1 H04 and B1 J05 (Refer to 7631 System Digrams 01.40.19.1).

Also verify that 2302 line driver output at A1 D09 is not overdriving. A smooth sinusoidal wave form appears for the correct voltage setting.

If the 2302 line driver output is overdriving, readjust the potentiometer to decrease voltage so that a smooth sinusoidal wave form appears.

Six (640 kc) clock tracks each are recorded at intervals marked on the clock indexing plate (Figure 4-25).

The 640 kc clock tracks have 21,510 cycles.

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

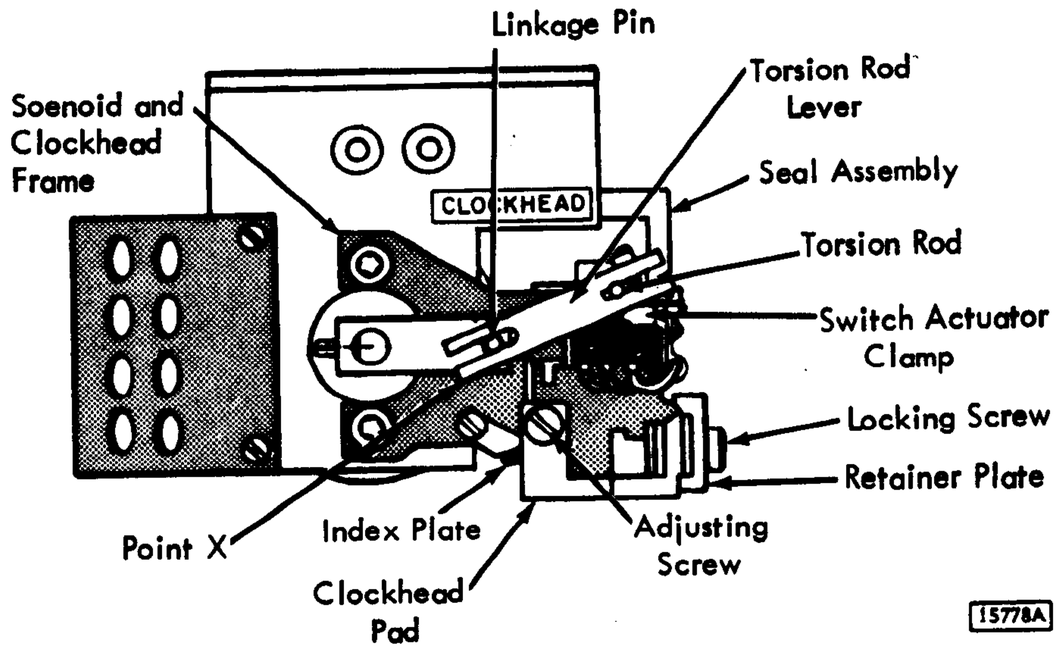


Figure 4-25. Clock Head Assembly

The last pulse of all clock tracks must close at the leading edge of early index within plus or minus 36^{o} of an in-phase condition with the first pulse.

4.9.2 Adjustment

1. Attach oscilloscope as in the service check (Section 4.9.1).
2. Loosen locking screw (Figure 4-25).
3. Turn Adjusting screw in or out to obtain maximum signal.

NOTE: IBM #6 oil may be used on the rails to facilitate moving head assembly. Use syringe P/N 21087-90 to apply two to four drops of oil. See Clock-Head lubrication chart (Figure 3-4).

4.9.3 Removal

1. Turn off all power.
2. Detach cable at plugs G01 and G02. Allow disks to stop rotating
3. Remove seal assembly (Figure 4-27).
4. Adjust clock head as far forward as possible and remove rear mounting screw.
5. Back off clock head to its rearmost position and remove fron mounting screw.
6. 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.

4.9.4 Replacement

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

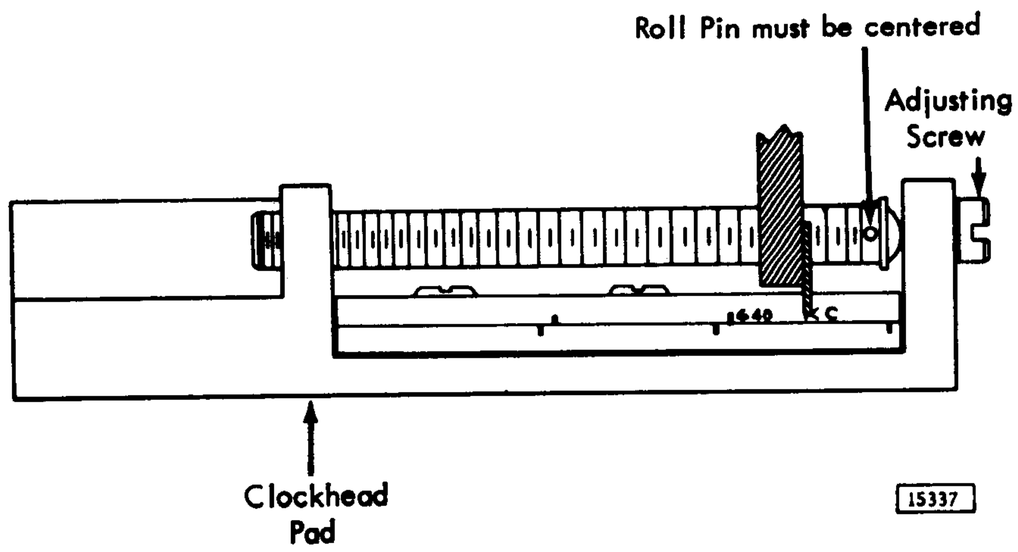


Figure 4-26. Clock Head Adjustment

2. Replace clock head assembly by slipping over locating pins. By means of the adjusting screw (Figure 4-26), adjust clock head as far in as possible and install rear mounting screw. Check for proper head-to-disk clearance(0.050±0.020-inch). Back off clock head to extreme out position and install front mounting screw.
3. With an ohmmeter, check resistance between clock-head support and machine frame. Resistance must not be less than 2 megohms.
4. Mount shield assembly retaining plate and block on dummy bar as shown in Figure 4-27. After full contact is made with shield, slide retaining plate forward approximately 1/16-inch and lock in place.
5. Manually load and unload clockhead several times to make certain its operation is not restricted.

NOTE: It may be necessary to loosen bottom and vertical trim in order to clear the dummy arm bar when mounting the retaining plate.

6. Attach cable at plugs G01 and G02.
7. Perform Clock-Head Service Check (Section 4.9.1). Adjust if necessary.

NOTE: The clock-head loading mechanism 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 should be clamped on the torsion rod in such a position that 260±10 grams are required at point "x" (Figure 4-25) to lift the torsion rod off the linkage pin(switch should not be actuated during this time). Adjust switch actuator clamp to close switch when head is properly loaded.

4.10 CLOCK-HEAD ARM ASSEMBLY (Fifure 4-27)

4.10 Removal

1. Remove seal assembly
2. Disconnect cable assembly to G0l and G02.
3. Disconnect jack leads.
4. Remove three mounting screws.

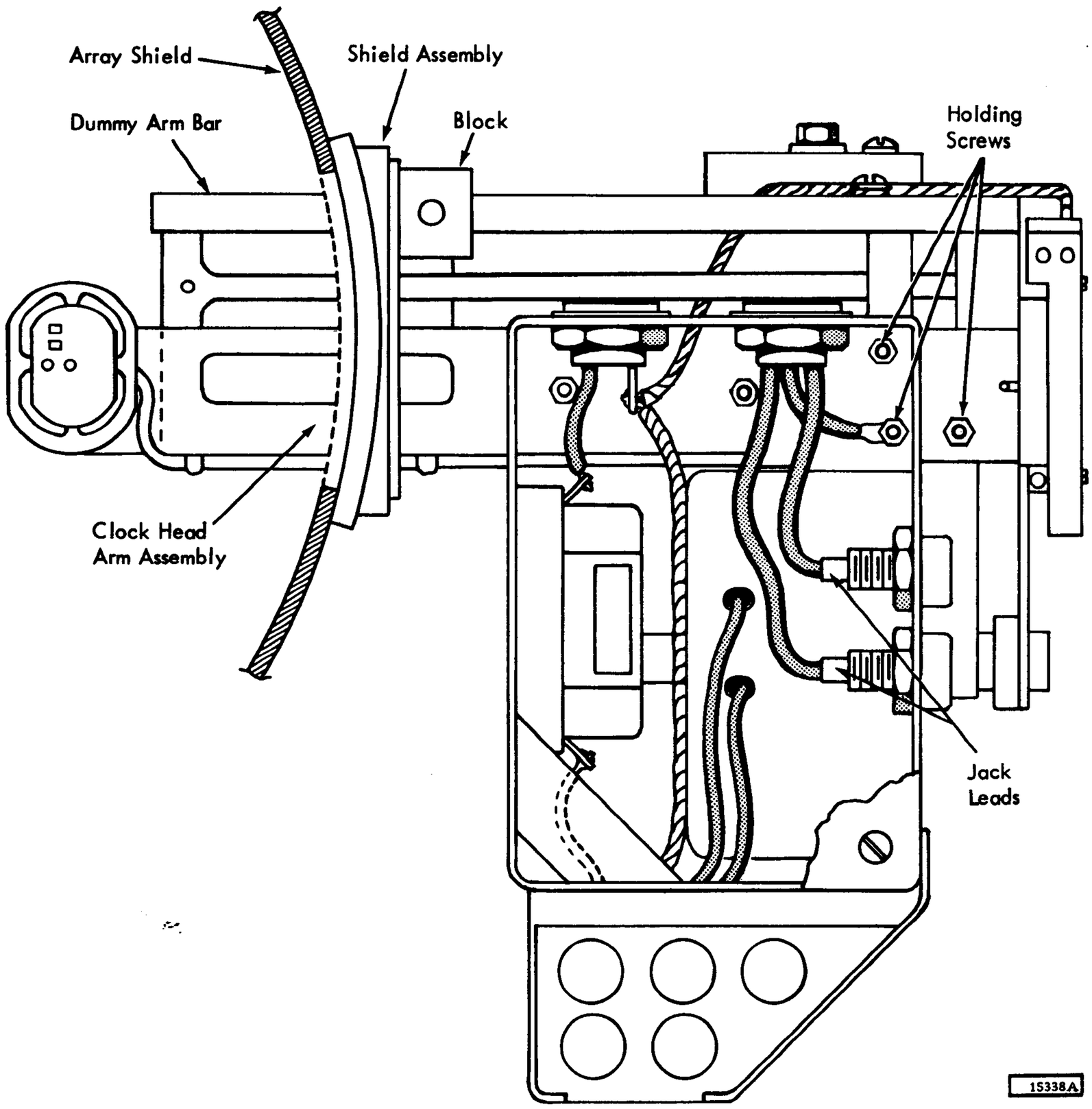


Figure 4-27. Clock Head-Arm Assembly

5. Lift arm assembly from locating pins. At the same time, move the head down and toward the electronic frame to free arm from the torsion spring.

4.10.2 Replacement

1. Engage arm with torsion spring and locating pins.
2. Attach ground lead and secure mounting screws by applying a torque of 4 to 6-inch lbs.
3. Connect cables G01 and G02.
4. Check torsion spring for proper engagement.
5. Check head loading and unloading.
6. Mount shield assembly (Figure 4-27) according to procedures in section 4.3.4.

4.11 HYDRAULIC ACTUATOR

NOTE: After data has been written on discs, any adjustment of the actuator yoke screw requires that all tracks covered by that actuator be read out before adjustments are made and then subsequently rewritten. Nothing should be touched on an actuator other than the yoke adjustment screw which is used for peaking an actuator on data whenever an actuator is being replaced. Should a track defect require that a head be peaked on data, use the Data Recovery Mechanism Tool, P/N 2108793. This tool will allow the peaking to be accomplished without changing the set position of the yoke adjustment (differential) screw.

Actuator replacement also requires readout and rewrite. If readout cannot be made because of a defective actuator, use replacement actuator to readout by peaking on track signals with oscilloscope and yoke adjustment (differential) screw. Because of the critical requirements for readout and rewrite of data, the above-mentioned adjustments should not be made unless warranted by some indication of trouble.

4.11.1 Safety Check

CAUTION: Any time that maintenance is to be performed around an actuator with power on, the access mechanism must be set Inop and 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.

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.

4.11.2 Service Checks (See NOTE under 4.11 HYDRAULIC ACTUATOR)

4.11.2.1 Gib Adjustment

1. Stabilize oil temperature in actuator by random accessing actuator on fast oscillator for half hour (minimum) (or use remote CE box in Seek Repeat mode).
2. Set one address in switches on CE panel; set second address in Remote CE box prior to gib adjustment (see Section 4.12.1).
3. Clean ways and wipe with IBM #6 oil so that a very light film of oil is present. Ensure that moving drag of carriage is within 3 (±1) lbs at 4 to 8 inches-per-second velocity when the flexure rods are disconnected, disks are rotating, and heads are loaded.

4.11.3 Removal (Figure 4-28)

1. If possible, read the data from all the disks serviced by the actuator to be removed. Store this data so it can be rewritten after the actuator is replaced.
2. Remove receiver assembly including electrical cables. All power should be off and disks stopped (see Receiver Removal).
3. Disconnect the following four electrical connectors to actuator:
   a. One on actuator lid.
   b. One for motion transducer.
   c. One to limit stop plate and switch assembly.
   d. One to head load, head unload, and swing-out interlock switches and remove wires from pins P, M, and R.
4. 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.

5. Unlock and back off radial positioning screw.

WARNING: Always check hydraulic power supply for pressure. Ensure that gage indicates zero when valve is closed. Observing these conditions will ensure that system accumulator is completely discharged.

6. 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.

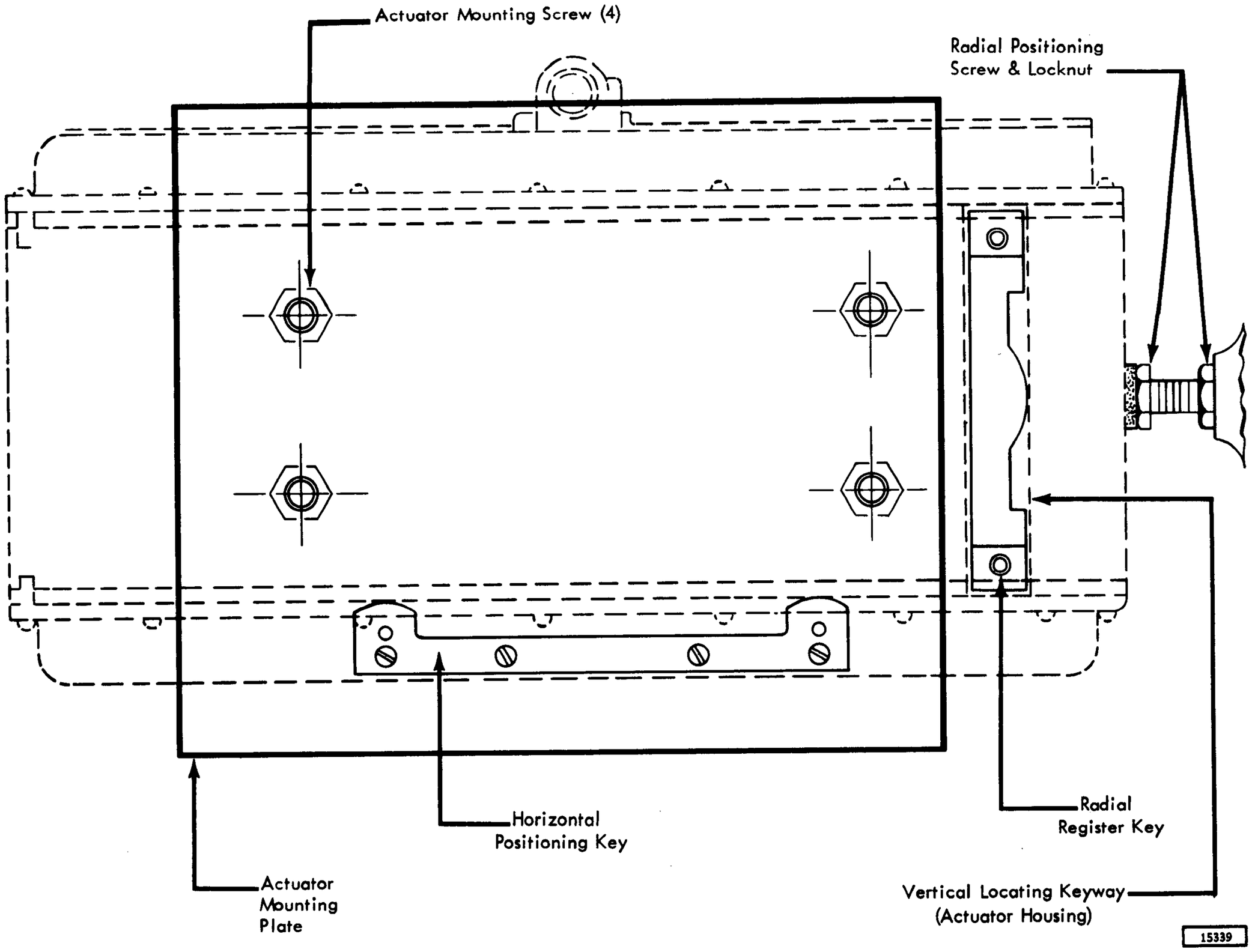


Figure 4-28. Radial and Horizontal Positioning Keys

7. 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 weight about 60 pounds.
8. Push carriage fully forward.
9. Remove swing-out interlock switch, cable, and clamps.

4.11.4 Replacement

1. Clean actuator mounting surfaces
2. Ensure actuator fittings are clean.

NOTE: Do not remove protective caps of new actuator until ready for connection to hydraulic lines. The radial positioning screw should be withdrawn partly into strut (Figure 4-28).

3. Mount actuator on mounting plate. (This step requires two people.) Make sure that actuator is resting on horizontal positioning key, and that vertical locating key way is straddling radial register key.
4. Insert and tighten four mounting screws, just enough to hold actuator snugly to plate, but, still allowing the positioning screw to move the actuator firmly against the vertical key.
5. Torque radial positioning screw to 25±2 lb inches and secure with lock nut. Because of the extensive arm leverage of the Actuator-Torque-Wrench Adapter, P/N2108436, the Actuator-Torque Wrench, P/N2108435 must be set for 12 lb inches.

WARNING: The actuator housing can be damaged 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 inches at the wrench dial, when using the torque wrench and adapter. Exercise caution to ensure that wrench is used in the direction which snaps to indicate proper torque (wrench is solid in opposite direction).

6. Torque the four actuator mounting screws to 75 ±5 lb-inches.
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. Check carriage gib adjustment (see Section 4. 12. 1).
11. Detent new actuator at track 000 and monitor the Read signal of Head No. 20. Use the Yoke Differential screw to peak the signal (verify that signal originates from track 0).
12. Adjust carriage yoke outer limit stop for 0. 076-inch dimension (see Section 4. 12. 2).
13. Adjust carriage yoke inner limit stop within 0. 015 inch to 0. 020 inch dimension (see Section 4. 12. 3).
14. Adjust carriage yoke inner and outer limit switches (see Sections 4. 13. 1 and 4. 13. 2).
15. Perform readout of file data if this has not been accomplished previously. See track flagging procedure, step 16 below, before rewriting file.
16. Perform a surface analysis diagnostic check and flag defective tracks as follows:
    a. Detent new actuator at track 000.
    b. Select head 19 and observe Read data at 5A08F and G. Peak on the unerased portion of data about six characters after early index by using differential screw on the yoke assembly.
    c. Readjust outer limit (crash) stop to 0. 076 inches (see Section 4. 12. 4).
    d. Flag all tracks listed in the bad track log.
    e. Run Surface Analysis diagnostic on this access once for each pattern.
    f. Flag all tracks found to be defective on this run.
    g. After an actuator replacement, compare the original bad track log with the bad tracks found while running the surface analysis diagnostics. The diagnostic may show a pattern of defective tracks that will reveal the location of defective tracks not pinpointed by the test. It should be noted that after a disk restack, all disks may not shift the same amount or in the same direction. Consequently, each surface must be dealt with individually. For example, if only three of four original bad tracks were found after an actuator replacement, the fourth could be flagged by comparing the original bad track log with the new data found on surface analysis. If the three bad tracks found were exactly one track in, or one track out, or at the original address, the fourth track should then be flagged examining the pattern of defective tracks.
    h. Update Alternate Surface Log by recording all defective tracks.

4. 12 ACTUATOR CARRIAGE

4. 12. 1 Carriage Gib (Figure 4-29)

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.

4. 12. 1. 1 Adjustment

This adjustment should be made only when a problem arises that indicates that the drag may be incorrect.

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 clean and lubricate ways with a light film of IBM #6 oil.
2. Load the heads.
3. Disengage yoke assembly from both flexure rods by removing outer flexure rod locking nuts.

WARNING: When removing and replacing outer flex-rod nuts, holding at end of flex rod so that flex rod does not twist while nuts are being rotated. Do Not disturb setting of inner flex rod nuts. (See Note Section 4. 11 and Figure 4-30.)

4. Check the gib for a 3 ±1 lb moving drag of the carriage. Check this moving drag at a 4 to 5 inch-per-second velocity with the actuator housing at operating temperature after accessing on the fast oscillator for at least one-half hour.

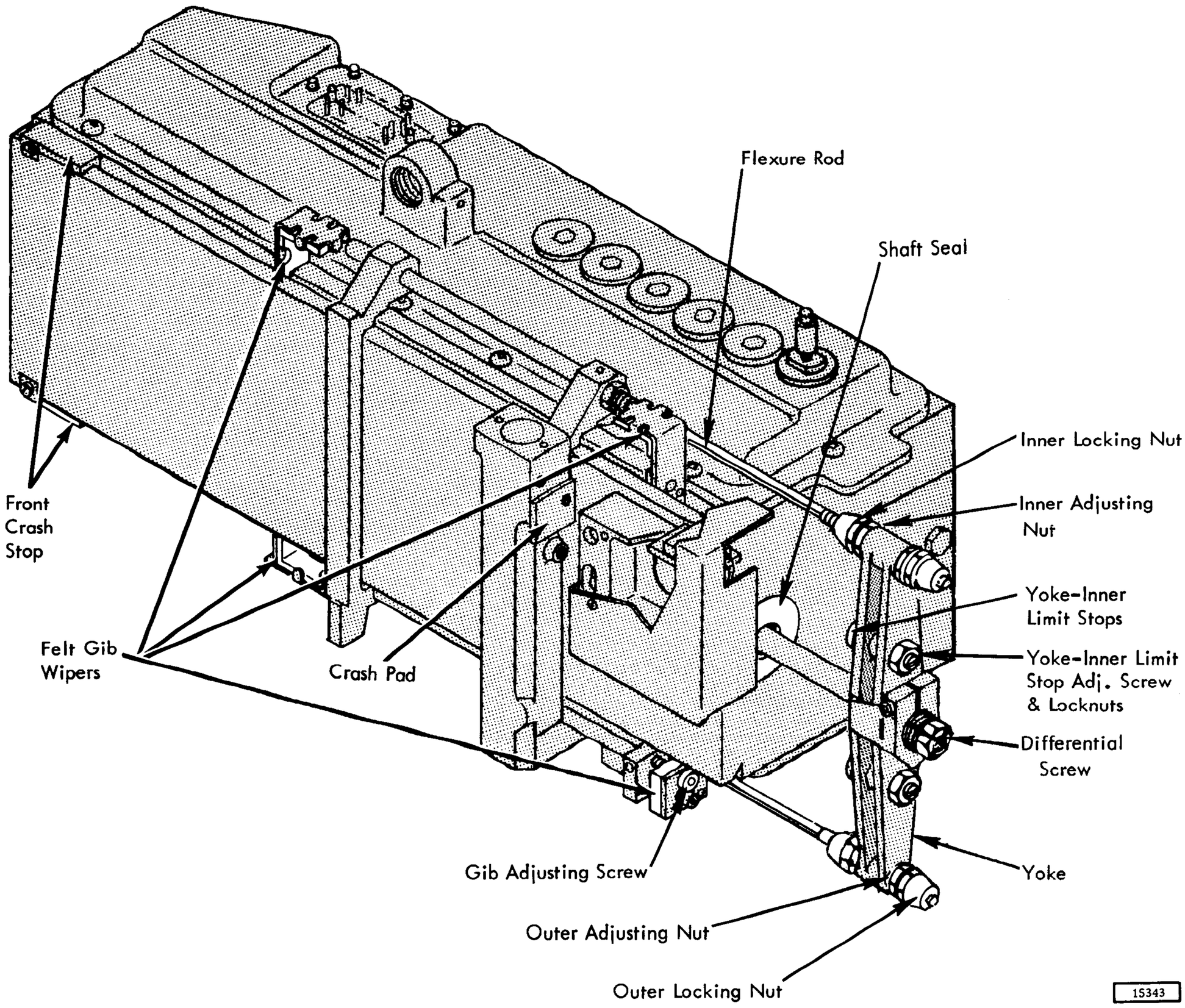


Figure 4-29. Carriage Components

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 lbs. is considered normal.
6. If the conditions in step 5 or step 6 exist, go directly to step 10. If these conditions do not exist, proceed with step 7.
7. Free locking nut for adjusting screw.
8. Turn adjusting screw until conditions in step 4 and step 5 are satisfied. A clockwise movement of the adjusting screw tightens gib and counterclockwise motion loosens gib.
9. Secure locknut for adjusting screw.
10. Attach yoke to flexure rods and replace outer flexure rod adjusting and locking nuts.

4.12.2 Yoke Assembly (Figure 4-30)

The yoke assembly is connected to the actuator output shaft by a yoke differential screw. The differential screw facilitates accurate positioning of the read/write head in relationship to data tracks containing previously written information. It is important that the yoke adjusting block projects equal amounts at top and bottom. (See Note under Section 4.11, Hydraulic Actuator.)

4.12.2.1 Adjustment

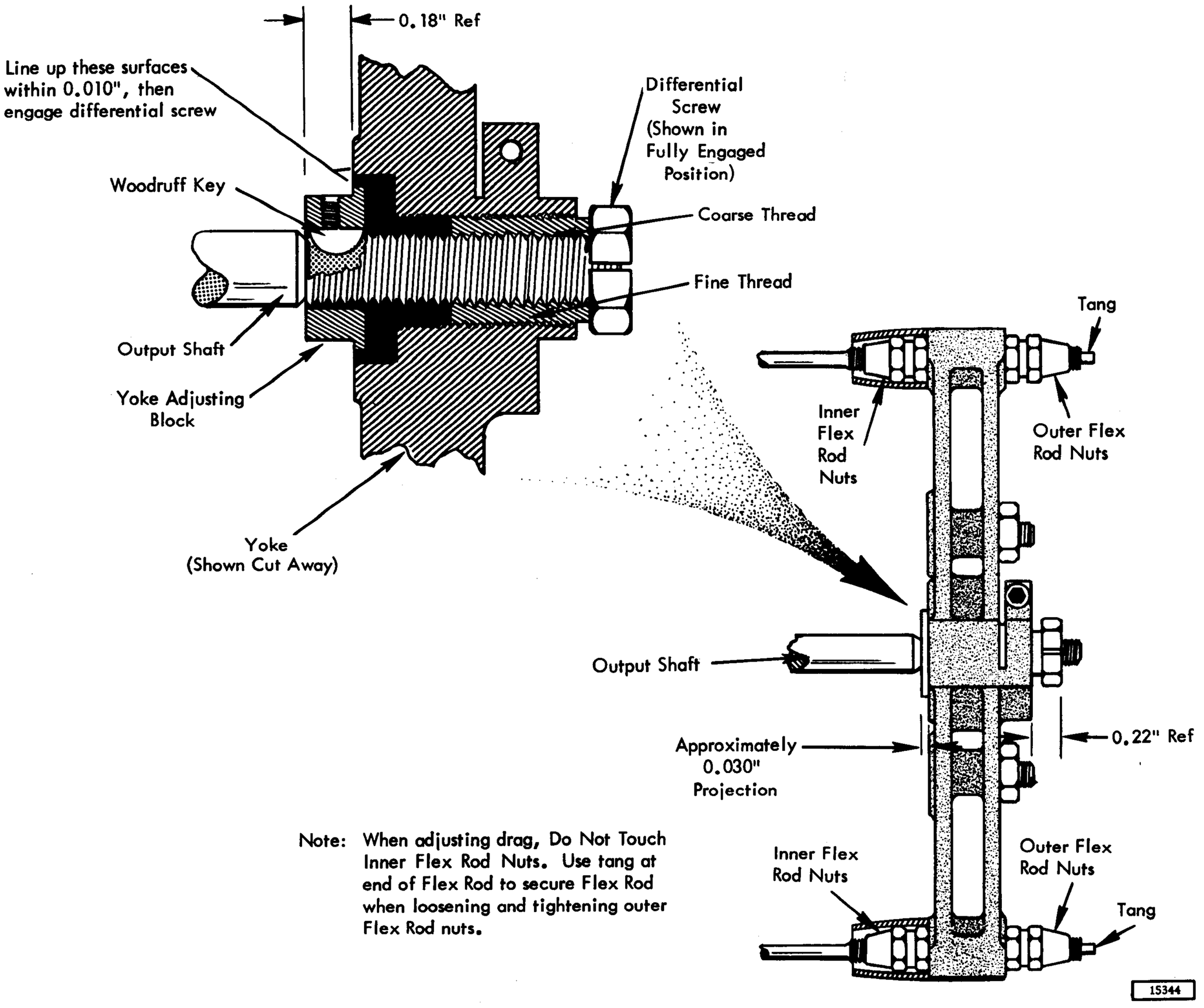
Adjustment of the yoke assembly is normally required whenever a defective actuator or drawer assembly has been replaced with a new assembly. Read out and

rewrite all data whenever a yoke assembly is replaced. (See Procedure for Surface Analysis and Flagging of Defective Tracks when actuator or drawer assembly is replaced.)

1. Use Gage P/N 2108962 and adjust the yoke differential screw to obtain a 0.076-inch dimension at outer limit stop. Loosen locking screw just enough to permit yoke differential screw to turn freely. Do not exceed the 0.076-inch dimension when making this adjustment.
2. Secure this adjustment by relocking the yoke differential screw.

4.12.2.2 Removal (Figure 4-31)

1. If possible, while power is still on, read out data. If this is not possible, position head at cylinder 0 and use Gage P/N 2108962 to check (or adjust) space between actuator outer limit stop and carriage limit stop to 0.076 inch.
2. Remove electrical power to machine.
3. Remove actuator shield door.
4. Remove nuts holding yoke to flexure rods.
5. Loosen yoke locking screw.
6. Remove yoke differential screw.



Note: When adjusting drag, Do Not Touch Inner Flex Rod Nuts. Use tang at end of Flex Rod to secure Flex Rod when loosening and tightening outer Flex Rod nuts.

Figure 4-30. Yoke Adjustment

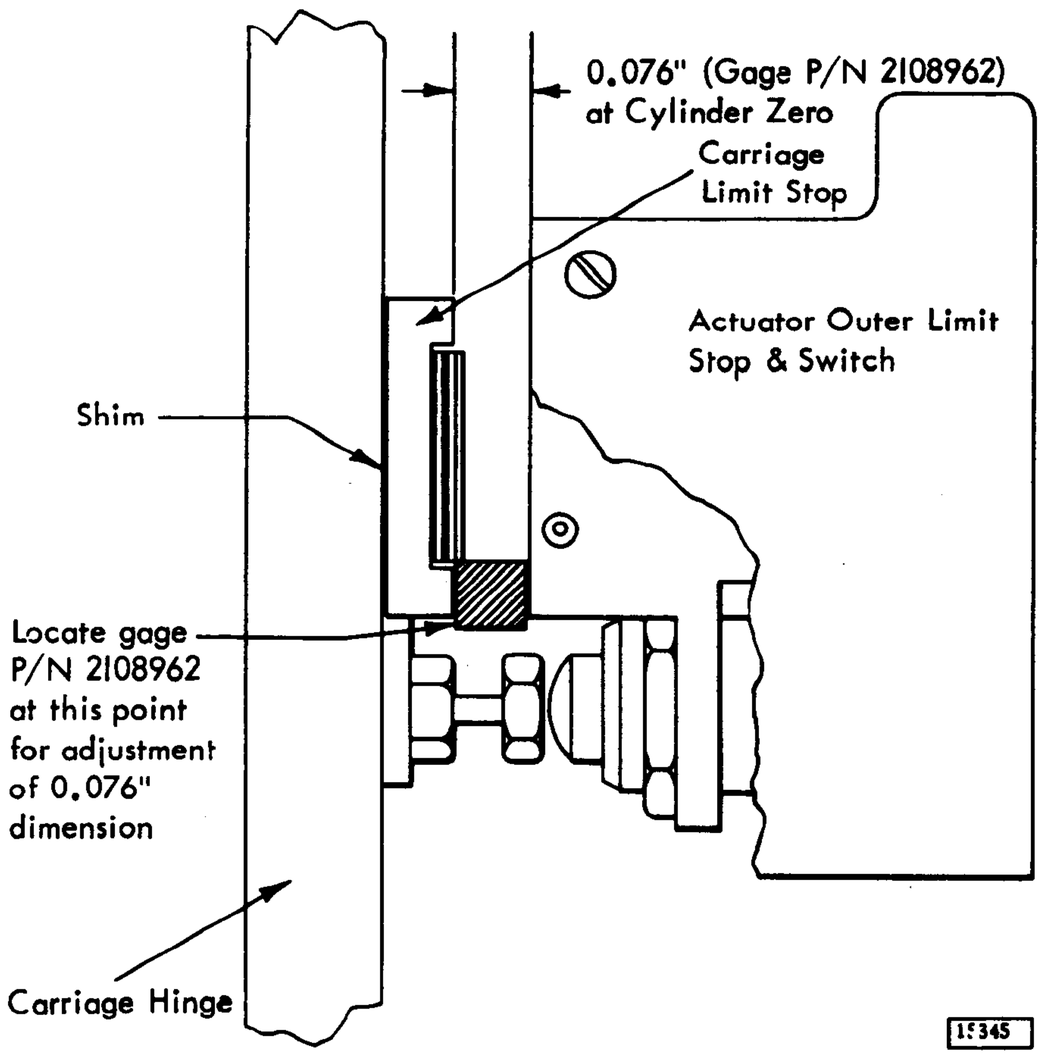


Figure 4-31. Carriage Outer Limit Stop and Switch Adjustment

7. Remove yoke and adjusting block from output shaft.

4.12.2.3 Replacement (Figure 4-30)

1. Install yoke adjusting block on output shaft.
2. Align machined edge on yoke adjusting block with yoke inner face and engage yoke differential screw carefully to allow proper coarse and fine thread engagement.
3. Turn yoke differential screw until yoke adjusting block projects approximately 0.030 inch from yoke.
4. Tighten yoke locking screw.
5. Attach yoke to flexure rods.
6. Push carriage in against inner limit stop and start file.
7. If data was read out, detent output shaft at cylinder 0, and adjust 0.076-inch outer-limit-stop dimension with yoke adjusting screw and Gage P/N 2108962.

NOTE: Do not exceed the 0.076-inch dimension when making this adjustment.

8. If data was read out before yoke was removed, rewrite all surfaces serviced by this actuator. If data was not readout, monitor the output of head 20 on an oscilloscope and by using the yoke differential screw. Position carriage for maximum signal amplitude at cylinder zero (see Yoke Assembly Adjustment). Read out module after setting 0.076-inch dimension and rewrite data.

4.12.3 Yoke Inner Limit Stops (Figure 4-32)

Two adjustable plastic pads are provided on yoke assembly. These pads (sometimes designated as crash stops) provide a cushioning effect if the carriage overtravels.

4.12.3.1 Adjustment

Rear Actuator. Adjust rear actuator as follows:

a. Detent rear actuator at track 250.
b. Adjust crash-pad stop adjusting screws to obtain a 0.015 to 0.020-inch (metal to plastic) clearance between actuator housing and crash-pad stops on yoke.
c. Tighten lock nuts.

Front Actuator. Front actuator adjustment is to be accomplished as follows:

a. Detent front actuator at track 250.
b. Position inner limit crash-pad stops to obtain a 0.015 to 0.020-inch clearance between the actuator housing and crash-pad stops on yoke.
c. Tighten lock nuts.

NOTE: Any yoke adjustments will require readjusting of the yoke limit stops.

4.12.4 Outer Limit Stops

Service Hint

The outer limit stop, in addition to providing a mounting for the outer and inner limit switches, establishes the basic actuator reference for head-to-disk relationship through the 0.076-inch gap (Figure 4-31). The 0.076-inch dimension is set with Gage P/N 2108962 at the time of final assembly, and the disk surface analysis is made with this gage setting. If this dimensional relationship should be altered by moving the yoke adjustment (differential) screw, or the flexure rod setting, the relationship may be re-established by resetting the 0.076-inch dimension. This can be accomplished with the yoke adjustment screw provided the outer limit stop has not been moved.

If the adjustment has been altered, and the outer limit stop has also been moved, the disk surface analysis will probably require a rerun to flag defective

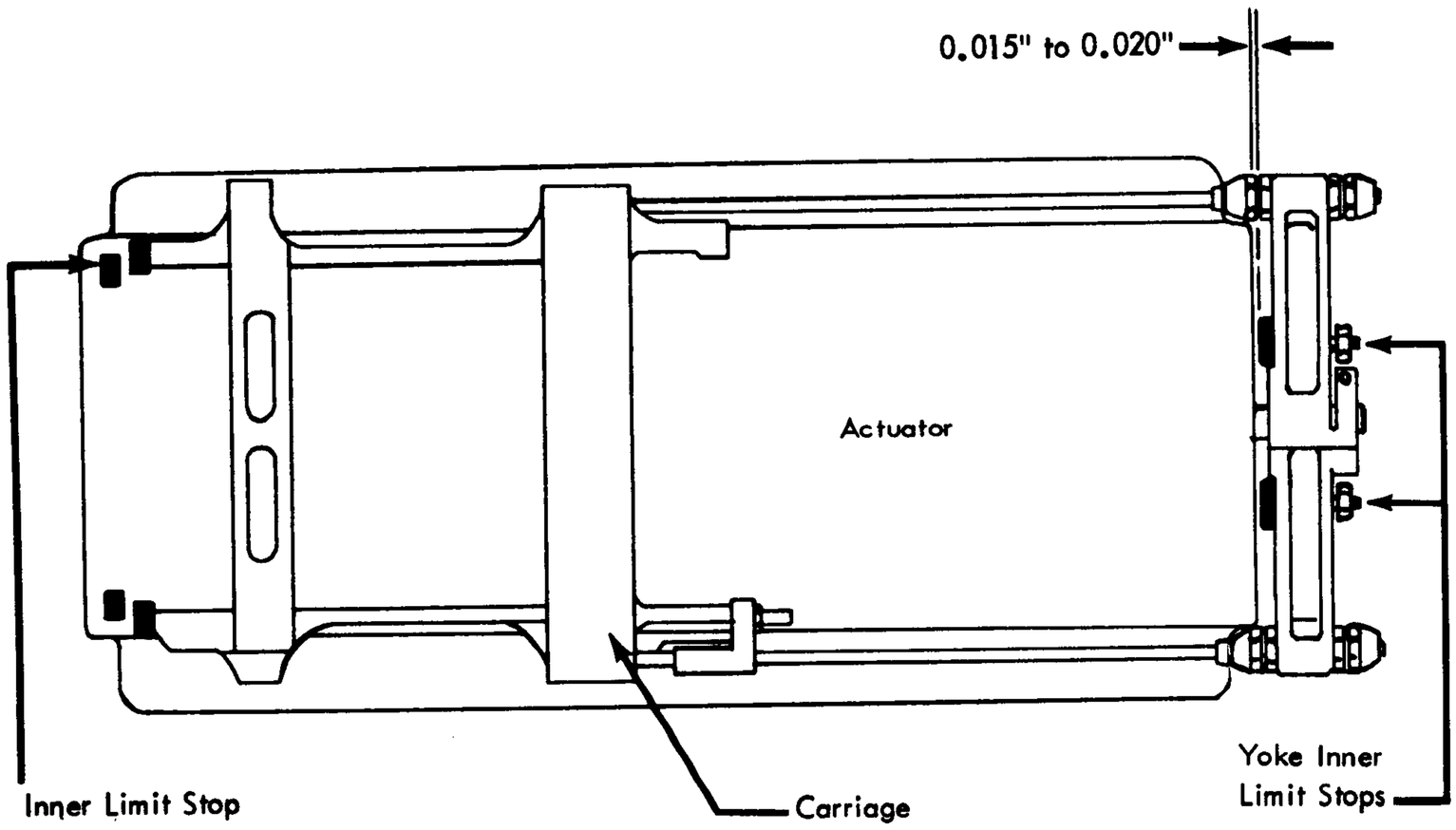


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Figure 4-32. Yoke Inner Limit Stop Adjustment

tracks. For this reason, the outer limit stop should not be removed from the actuator.

Should the outer or inner limit switches require replacement, the switch must be disassembled from the outer limit stop without disturbing the stop, and must be replaced as a switch assembly. (The spare replacement assembly will include both a switch and an outer limit stop. The switch must be disassembled and the outer limit stop should be returned to IBM Salvage at San Jose, California.)

If the outer limit stop should become loosened, or removed from its installed position for any reason, the required stop position may be relocated as follows:

Adjustment (0.076-Inch Gap)

1. Detent actuator at track 000 (as noted in Service Hint above, this can only be accomplished if the yoke adjustment screw and flexure rod adjustments have not been moved).
2. Place U-shaped Gage P/N 2108791 between outer limit stop and carriage limit stop. While pressing lightly against gage with outer limit stop, fasten outer limit stop just tight enough to hold. Now insert Gage P/N 2108962 in the position shown in Figure 4-31.
3. Tap outer limit stop so that gage just slides freely and then secure outer limit stop firmly in place.
4. After replacing an actuator, first peak on the unerased portion of the data track while detented at track 000, with Head No. 20. Use the yoke adjustment screw to obtain the peak condition, then lock the screw and proceed with the adjustment procedure as described in Steps 1 through 3 above.

4.13 LIMIT SWITCHES

The inner and outer limit switches (Figure 4-33) 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.

4.13.1 Inner Limit Switch

4.13.1.1 Service Check

The inner limit switch must be made when the carriage is at cylinder 250 and not made when the carriage is at cylinder 249. Check switch operation by alternately setting in the two addresses from the CE panel and observing the CE cylinder indicator.

4.13.1.2 Adjustment

1. Disable rezero circuitry by removing SMS Card at 4/6A21.
2. Remove the Access cover door. Hold the cover switch by hand. Do not tape the cover switch so it is inoperative.

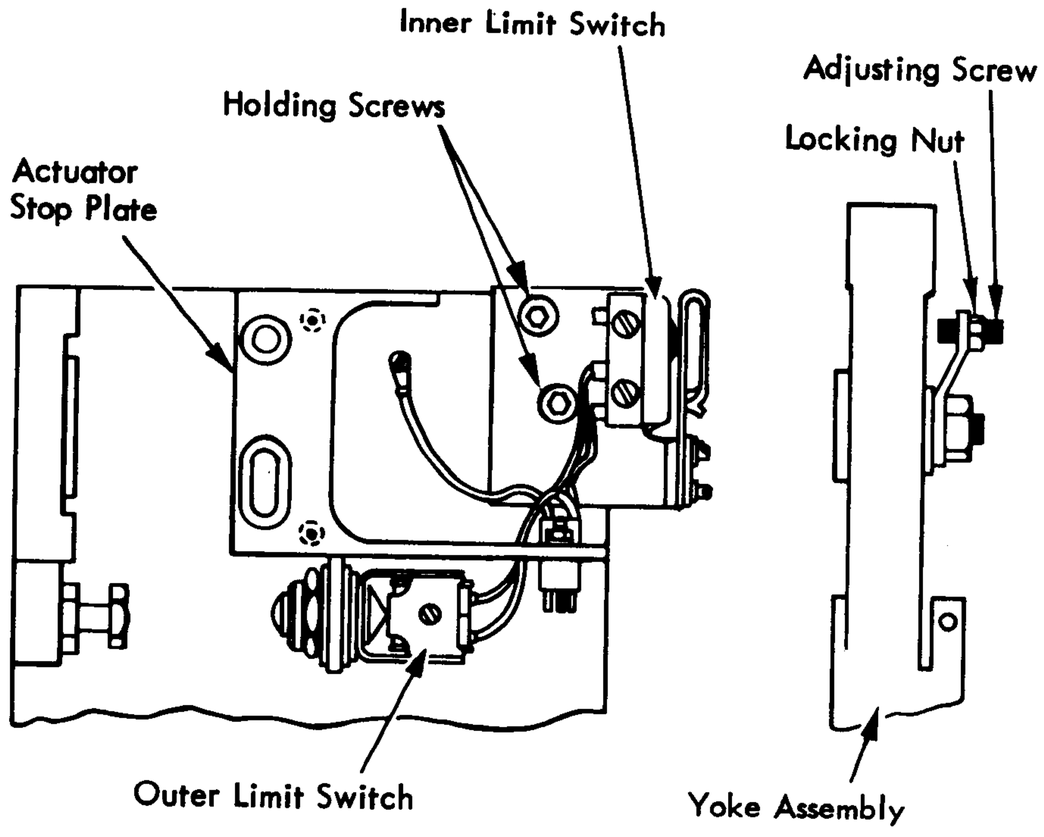


Figure 4-33. Limit Switch Adjustment

3. Seek to cylinder 249.
4. Insert a 0.008-inch shim between the end of the adjusting screw and armature of the Inner Limit Switch. The Limit Switch light on the CE Panel should be On.
5. Insert a 0.005-inch shim in place of the 0.008-inch shim. The Limit Switchlight should not be on.
6. The conditions of both Items 4 and 5 must be satisfied. Failure of either test indicates need for adjustment. If the need for adjustment is indicated, proceed as follows:
7. Release the cover switch. Loosen the lock nut on the adjusting screw. Adjust as indicated in results of test of Items 4 and 5. Tighten lock nut.
8. Recheck Items 4 and 5. Hold cover switch by hand and seek to cylinder 249.
9. When Items 4 and 5 are both satisfied, replace access cover door.
10. Seek to Cylinder 250. The Limit Switch light should be On. Reset to Cylinder 000 then 250 several times. Check that the Limit Switch light comes On each time.
11. Seek to Cylinder 249. The Limit Switch light should not be On. Reset to 000 then 249 several times. The Limit Switch light should never come On.
12. Replace SMS Card at 4/6A21 (which was removed in step 1).
13. Remove Access Cover door, hold cover switch by hand. Seek to Cylinder 249.
14. Manually operate the Inner Limit Switch momentarily. The access should rezero. Replace access cover door.
15. Remove the fuse from any glob, 10 through 100. Seek to Cylinder 250. The access should Rezero when the Set button is released.
16. Replace fuse removed in Item 15. Seek repeatedly to Cylinder 250. The access should not Rezero.
17. Seek repeatedly to Cylinder 249. The access should not rezero.

4.13.2 Outer Limit Switch

4.13.2.1 Service Check

This switch must be operated when carriage is in the rezero position. It must not be 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 limit switch 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 limit switch indication. A limit switch indication at this time indicates an incorrectly adjusted switch or excessive overtravel of the carriage.

4.13.2.2 Adjustment (Figure 4-33)

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 0.024-inch 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 the 0.024-inch Feeler Gage and place a 0.015-inch feeler gage between adjusting screw and switch. Switch should close with a 0.024-inch gap but not close with the 0.015-inch gap.
6. Tighten locknut on adjusting screw and recheck switch with feeler gages.
7. Repeat Service Check.

4.14 DETENT SAFETY TRANSDUCER

4.14.1 Service Check

When accessing 100 cylinders or more, the motion transducer output should be 0.9 volt to 1.6 volts peak-to-peak.

4.14.2 Adjustment

1. Adjust the motion detector rack located on the carriage parallel to the carriage way within 0.002-inch.
2. The pickup transducer mounted on the top lid of the actuator is adjusted to have a voltage output of 0.9 volt to 1.6 volts peak-to-peak and an air gap to the rack of not less than 0.004-inch.

WARNING: The pickup transducer is magnetized, therefore, a nonmagnetic material (an IBM card for example) must be used to measure this gap.

3. Check this adjustment at both ends of the rack, to verify rack and actuator alignment (Figure 4-34).

4.15 DETENT DETECTOR

4.15.1 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 4-35) is 90 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 20-30 kc. The differential signal amplitudes at detent in and detent out positions do not have to be equal.

The time between the energization of the detent solenoid and the point at which the null is present should not exceed 14.5 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.

4.16 ACCESS TIME

4.16.1 Service Check

The maximum access times for any single operation are shown in Figure 4-36. These are the times

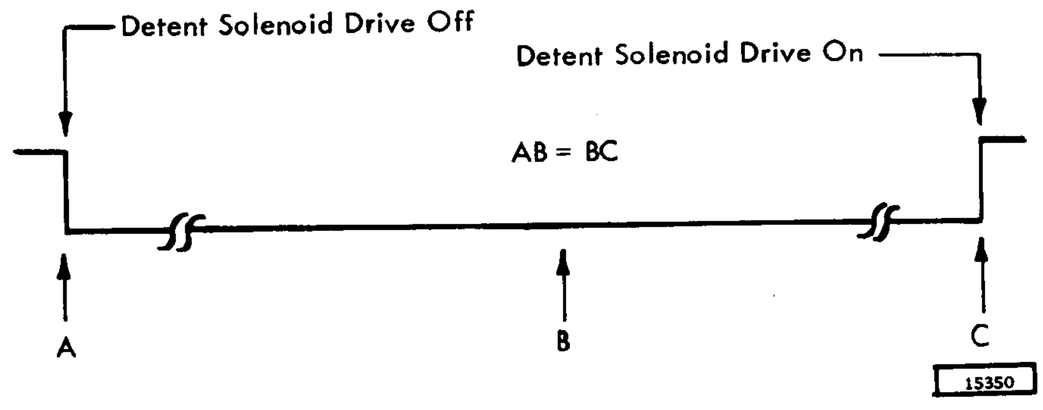
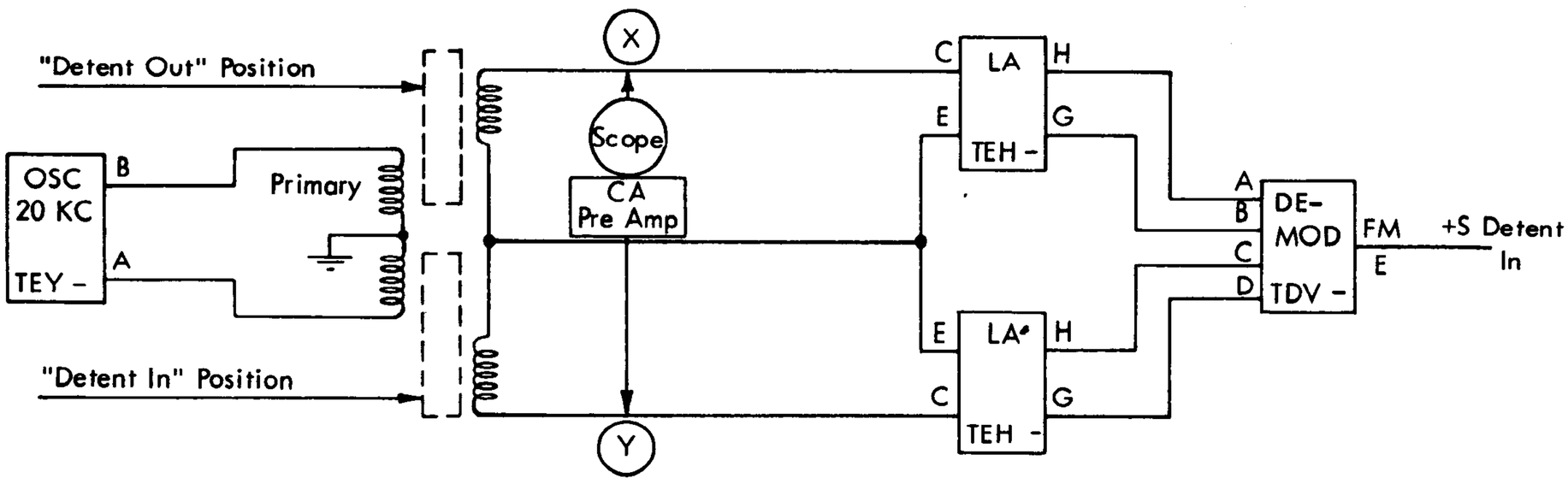


Figure 4-34. Motion Integrator



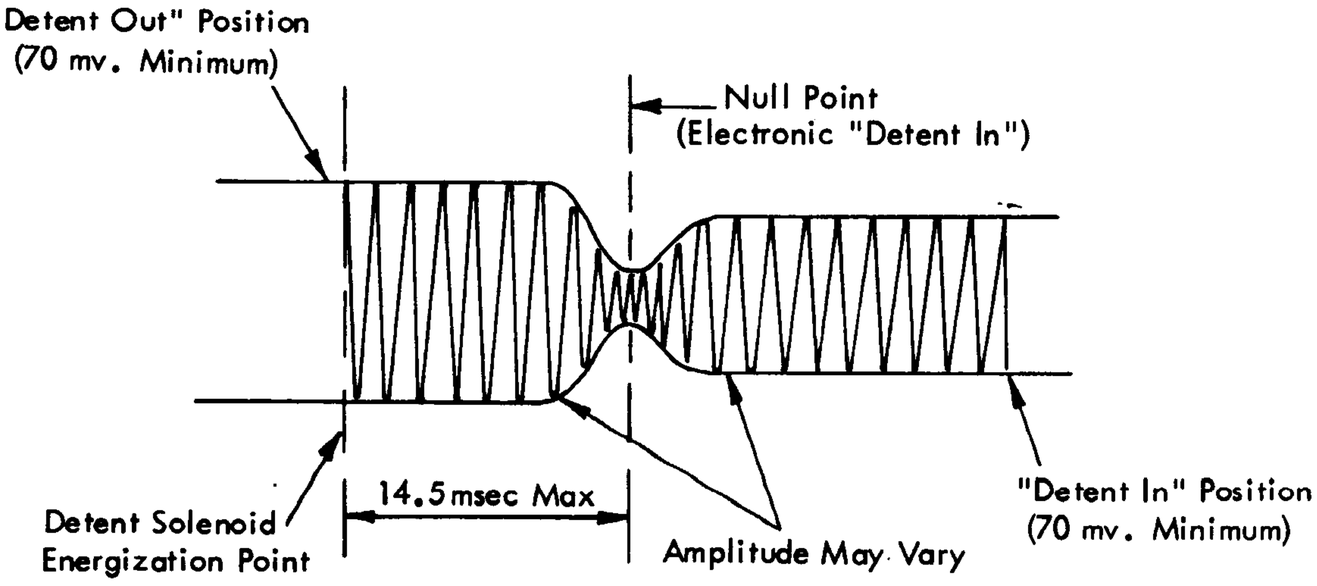


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Figure 4-35. Detent Detector

	Piston Interchange						Glob Interchange					
	Small Piston 1, 2, 4, 4'			Large Piston 10			Small Glob 20, 40			Large Glob 40', 40", 100		
	No. of Counts	Min. Time	Max. Time	No. of Counts	Min. Time	Max. Time	No. of Counts	Min. Time	Max. Time	No. of Counts	Min. Time	Max. Time
Motion Time	11 1/2	49.00	49.91	27 1/2	117.18	119.35						
Detent Drive							15 1/2	66.05	67.27	27 1/2	117.18	119.35
Detent In and Reset SS								16.50	15.00		16.50	15.00
Detent Delay							8 1/2	36.22	36.89	10 1/2	44.74	45.57
Time to Ready		49.00	49.91		117.18	119.18		118.77	119.16		178.42	179.92
Total Time Allowable	50 + 0 -1			120 + 0 - 3			120 + 0 - 2			180 2 + 0 - 2		

Notes:
1. Single shot must be between 2.0 milliseconds and 6.0 milliseconds.
2. Minimum times are based on a motion oscillator adjusted to 4.261 milliseconds per count.
3. Maximum times are based on a motion oscillator adjusted to 4.340 milliseconds per count.
4. All times are in milliseconds (ms).

15788

Figure 4-36. Access Times

required for the access to become ready after the cylinder portion of the Access Register has changed.

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

4.17 ACCESS COVER

4.17.1 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.

4.17.2 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 with roller engaged in positioning bar and tighten the retaining screws.

4.18 ACTUATOR OUTPUT SHAFT SEAL

4.18.1 Removal

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

1. Read out all data from file covered by actuator which is to be serviced.
2. Detent the output shaft at cylinder zero. Check and set the 0.076-inch gap between actuator outer limit stop and the carriage limit stop if required. (See Figure 4-31).
3. Turn off Power to the machine.
4. Remove the yoke, differential adjusting screw, and yoke adjusting block (see yoke removal).

WARNING: Do not alter position of inner flex-rod nuts. This would destroy the alignment of yoke assembly and read/write heads.

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.

4.18.2 Replacement

WARNING: To ensure 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 of tool pin 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, adjust to dimension recorded in step 2 of removal.
8. Lock the differential adjusting screw into position by tightening the locking screw.
9. After normal warmup time with file ready On, rewrite all tracks of serviced actuator.

4.19 HYDRAULIC POWER SUPPLY

4.19.1 Removal and Replacement (Complete Unit)

1. Remove front and back locking screws.

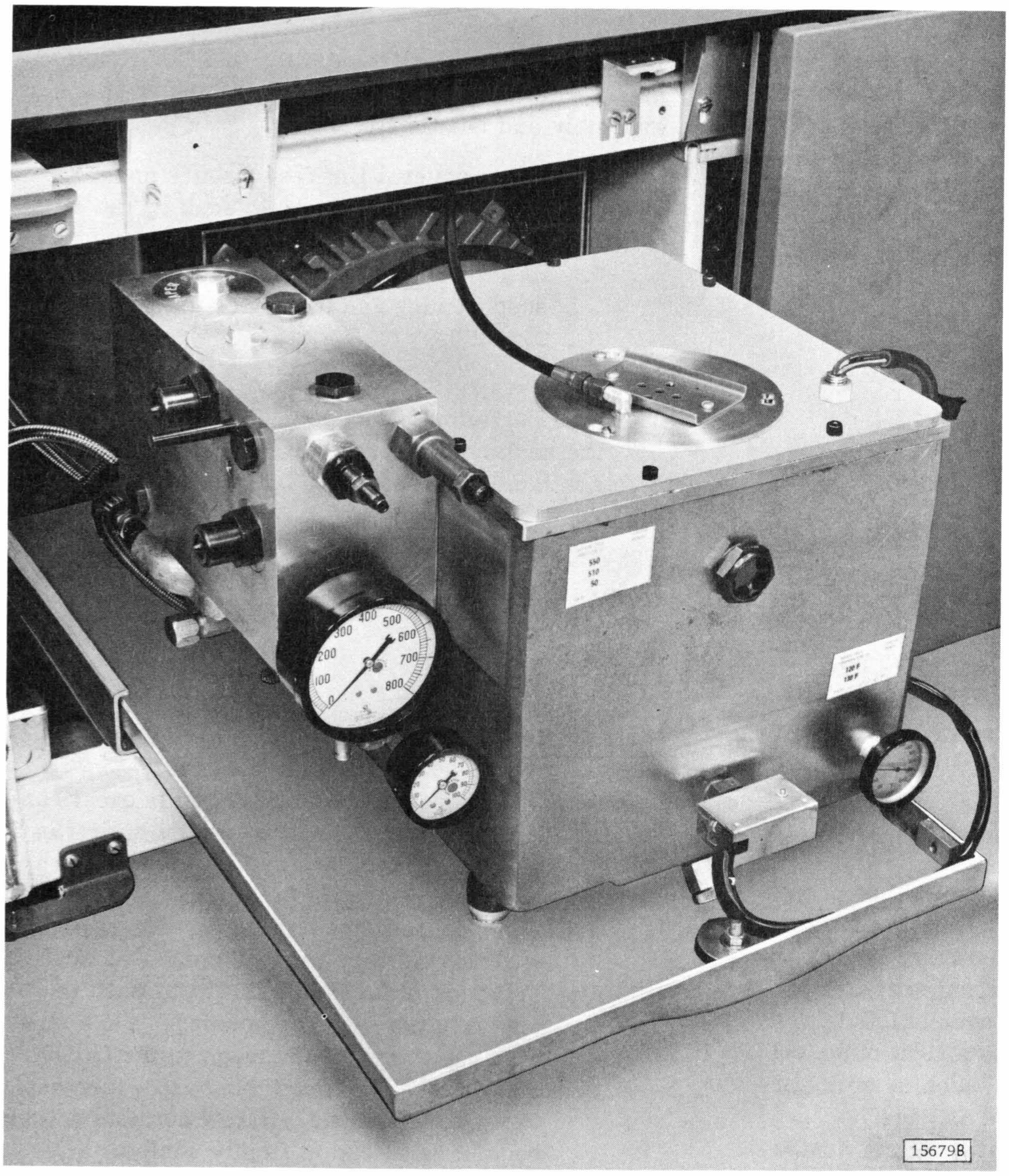


Figure 4-37. Hydraulic Power Supply in Servicing Position

NOTE: The spring locking pin must be depressed by hand when positioning supply with respect to air duct at front of machine. Spring lock pin must also be depressed when removing the supply from the file.

2. Slide unit out rear of machine to servicing position (Figure 4-37).
3. Remove electrical connections.
4. Remove actuator air bleed lines and wrap ends in lint-free tissue.

WARNING: Check hydraulic power supply for zero pressure prior to breaking connections. Ensure that system pressure gage indicates zero to show that system accumulator is completely discharged when pressure valve is closed.

5. Clean adjacent areas of hydraulic lines connections to avoid contamination and disconnect hydraulic lines.
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.
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.
11. Secure power supply in place (with screws removed in step 1). Position power supply so that cooler frame meets the air duct fastened on frame below cooler. Gasket material around cooler frame must be compressed by door when door is closed.

4.19.2 Service Check

Check the oil level. Oil level shall be maintained to sight indicator when unit is operating. Add oil only when level does not appear in sight gage. Une only IBM oil, P/N 2115252 which is pre-filtered oil in a disposable container. Dispose of container and any excess oil aft er filling supply.

NOTE: Do not overfill hydraulic power supply. An open surface of oil in sump reduces back pressure sensed by the actuator.

4.19.3 System Pressure Relief Valve

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

4.19.3.1 Service Check

Close valve under manifold at large gage so that system pressure shows on gage. Place all actuators In op. Check the system pressure indication for 550 ± 5 psi. Adjust if necessary. Open valve after checking or adjusting pressure so that pressure gage is off. This protects gage from vibration and allows an orifice discharge for the system accumulator.

4.19.3.2 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.

4.19.3.3 Removal and Replacement

1. Turn off hydraulic power supply.
2. Remove system pressure relief valve. Approximately 1 cup of oil will drain from this port.
3. Replace with new valve.
4. Adjust system pressure.

4.19.4 Cooling System Pressure

4.19.4.1 Service Check

1. Set all actuators INOP.
2. Check cooling system pressure for 50 ±5 psi.
3. Cooling system pressure is indicated on the small low pressure gage located in front of manifold.

4.19.4.2 Adjustment

CAUTION: Do not exceed 100 psi pressure, as read on the pressure gage, while making adjustments, otherwise, damage to the exchanger could result.

1. Close thermal valve by screwing in plug.
2. Use low pressure relief valve.
3. unlock locknut.
4. Adjust pressure to 50± 5 psi by turning adjusting screw:
   a. Clockwise rotation will increase pressure.
   b. Counterclockwise rotation will decrease pressure.
5. Lock in place.

4.19.4.3 Removal and Replacement (Low Pressure Relief Valve)

1. Turn off hydraulic power supply.
2. Remove low pressure relief valve. Approximately 1 cup of oil will drain from this port. Verify that the O-ring at the end of valve is removed with the old valve.
3. Replace with new valve. Verify that the O-ring at end of valve is removed with the old valve.
4. Adjust new valve.

4.19.5 Oil Temperature

4.19.5.1

1. Check the oil temperature indicated on the temperature gage. The stabilized oil temperature must be 120°F (+3° - 0°F) when unit is operating at operating pressure.
2. Before making any adjustment, check cleanliness of heat exchanger core. Remove lint collected on core and recheck temperature after 5 minutes.
3. Do not clean heat exchanger with hydraulic power supply on in order to avoid loose line from being blown into the file area.

4.19.5.2 Adjustment (Thermal Valve)

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. Generally a 1/4 turn equals 5° F.

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

4.19.6 Hydraulic Power Supply Filters

Replace both paper filters every six months. Replace the steel part of the mechanical filter every nine months.

4.19.6.1 Mechanical (System) Filter

Removal and Replacement. The Mechanical (System) Filter is to be replaced as follows:

1. Shut down machine power using the normal sequence and remove all power plugs from wall.
2. Roll out hydraulic power supply to mechanical stop.
3. Carefully remove mechanical filter Cap by unscrewing from port in manifold. The paper filter and the steel filter should come out with the filter cap.
4. Remove paper filter from cap.
   a. If a new paper filter is to be installed, scrap paper filter locally.
   b. If only a new steel filter is to be installed, save used paper filter for reuse.
5. If a new steel filter is to be installed, assemble as follows:
   a. Remove old steel filter from cap.
   b. Remove the wrapping from the new steel filter, (P/N 2161309), using care to handle or hold at bottom end cap. Be sure that there is an O-ring on the outer diameter of the neck. Figure 4-38 shows field replacement O-ring.
   c. Attach the new steel filter to the cap by inserting it into the cap boss. Bottom the filter to the shoulder as shown in Figure 4-38.
   d. Drain oil from sump and fill with fresh oil.
6. Remove the wrapping from the new paper filter, (P/N 2161310), using care to handle or hold at bottom end cap. Be sure that there is an O-ring in the inner diameter of the filter neck. Figure 4-38 shows field replacement O-Ring.
7. Assemble the new paper filter or the used paper filter (See Step 5b) to the new cap by slipping the filter over the assembled steel filter and by fitting over the cap boss. Push the filter to the bottom of the boss as shown in Figure 4-38.

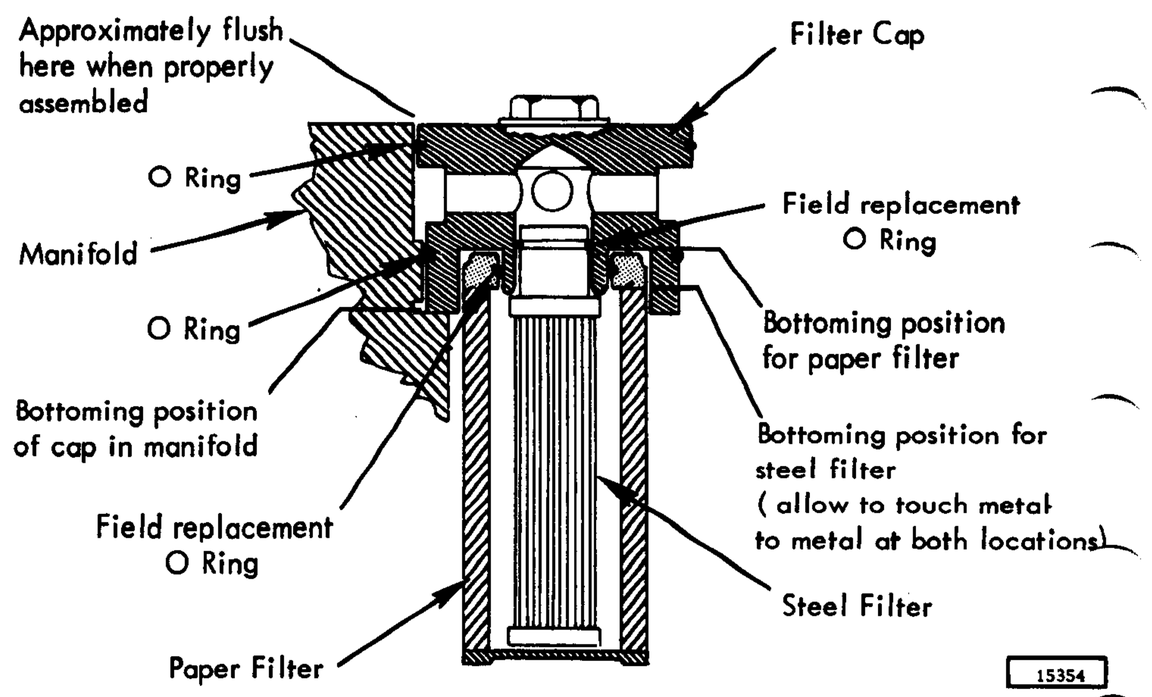


Figure 4-38. Mechanical Filter Assembly

8. Install filter cap assembly in the filter port of hydraulic power supply manifold. When the upper cap O-Ring enters the manifold port, rotate cap slowly to prevent shearing or cutting the O-Ring. Continue rotating cap until it just bottoms. Do not torque beyond this bottom position in which the top edge of the cap is approximately flush with the surface of the manifold. If the cap does not seat properly, remove and check the filters to be sure they are bottomed in the cap boss (Figure 4-38).
9. If the paper filter was replaced proceed directly to Section 4.19.6.2 Step 1.
10. If only the steel filter was replaced proceed directly to Section 4.19.6.2 Step 6.

4.19.6.2 Paper Filter

Removal and Replacement (Figure 4-39). The paper filter is to be replaced as follows:

NOTE: Replace this filter at the same time the paper element of the system filter is replaced.

1. Remove the Paper Filter Cap.
2. Remove the Paper Filter. Scrap filter locally. Do not attempt to remove the adapter or centering ring. However if they come out with the filter, replace them in this manner:
   a. Place Centering Ring at bottom of exposed filter cavity in Manifold.
   b. With the smallest diameter cylinder of the adapter facing downward, place

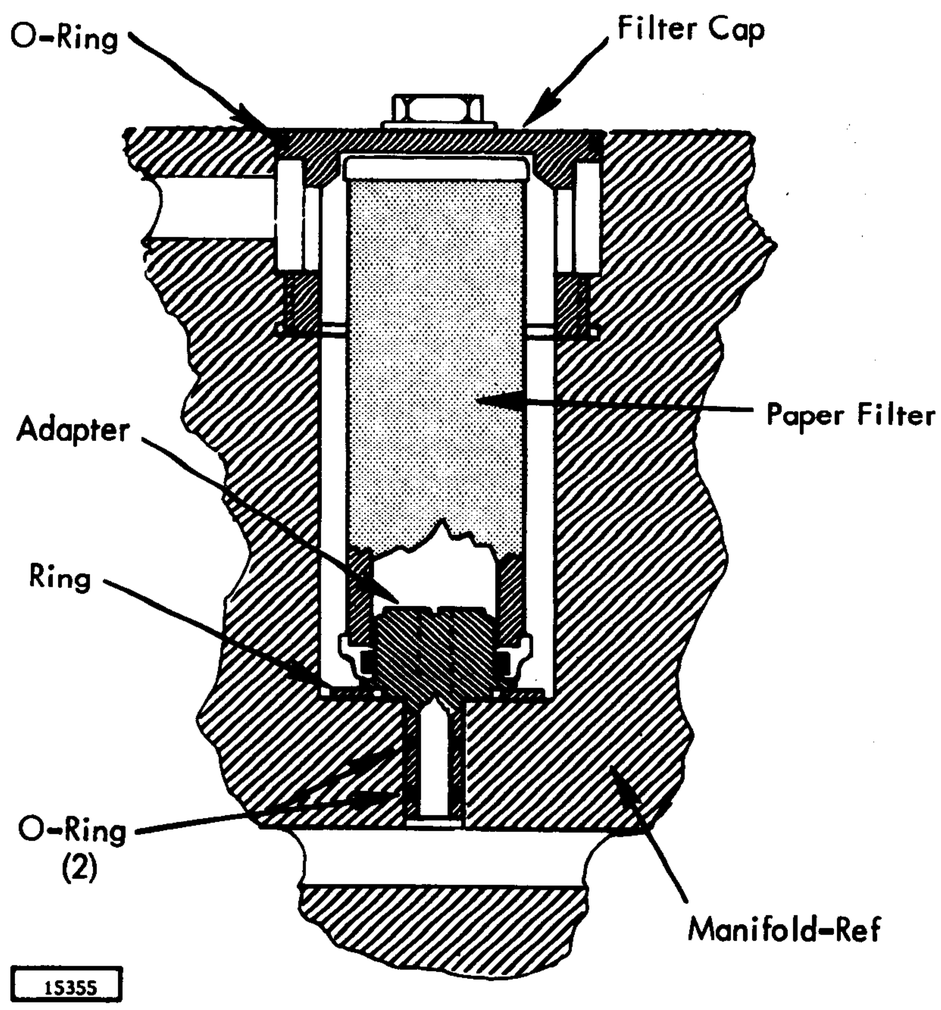


Figure 4-39. Paper Filter Assembly

adapter in filter bore and allow to fit into inner diameter of ring. Push the adapter into 1/2 diameter drilled hole at bottom of Filter Cavity. Rotate adapter using proper screwdriver on top slot so that the adapter will center itself in the ring. Do not burr edges of slot. Be sure that the adapter bottoms on the ring and bottom of the bore. See Figure 4-39 for proper fit.

3. Remove Paper Filter from package. Hold by end flange at closed end. Check for the presence of O-ring in open end. The O-ring replacement P/N is 2161303.
4. Insert the open end of the Paper Filter into the filter Cavity and over the adapter until bottomed on adapter. (The O-ring will fit and act as a seal on the adapter). The filter should be in a vertical centered position in the cavity.
5. Screw Cap into filter Cavity until it just bottoms. Do not tighten further. The top edge of the cap will be approximately flush with the top surface of the Manifold. If the cap does not seat properly, remove the cap and check for proper position of the filter. See Figure 4-39.
6. Wipe excess oil from Manifold.
7. Replace the Power Plugs into wall and start the Hydraulic Power Supply.
8. Watch oil temperature and allow it to rise to normal operating temperature. The temperature should stabilize. Look for oil leakage around both Filter Caps. If leakage is evident, turn off Power Supply and check condition of O-ring on the leaking Filter Cap. Re-assemble cap and turn on Power Supply.
9. Slide the Power Supply back to Machine and lock in place.
10. Close metal door.
11. Machine is now ready for operation.

4.19.7 Thermal Switches

4.19.7.1 Adjustment (Over Temperature Protection Thermal Switch)

This microswitch is set to open at 125°(+3°, -0°F) with unit at operating pressure. Adjustments are not normally necessary.

4.19.7.2 Service Check (Oil Temperature Thermal Switch)

This switch is located on the sump line fitting of the hose sub manifold. This switch is set to close at 105° F. and is not adjustable.

4.19.8 Hydraulic Accumulator

4.19.8.1 Service Check

The hydraulic accumulator is precharged to 450 ± 10 psi. The accumulator charge may be checked by observing the System Pressure gage when the hydraulic power supply is turned off.

NOTE: The gage valve below the manifold should be closed so that gage indicates 550 psi before hydraulic power supply is turned off.

When hydraulic power supply is turned off, pressure will initially drop slowly and then decay quickly. The pressure value indicated at the point where pressure starts to drop off quickly is the pressure charge present in accumulator. This accumulator pressure should be 375 psi minimum. If this value is not obtained replace the accumulator.

4.20 COMPRESSED AIR SYSTEM

4.20.1 Service Check (Figure 4-40)

Pressure on air pressure gage should be 64 to 66 psi. Air pressure should remain constant without the air

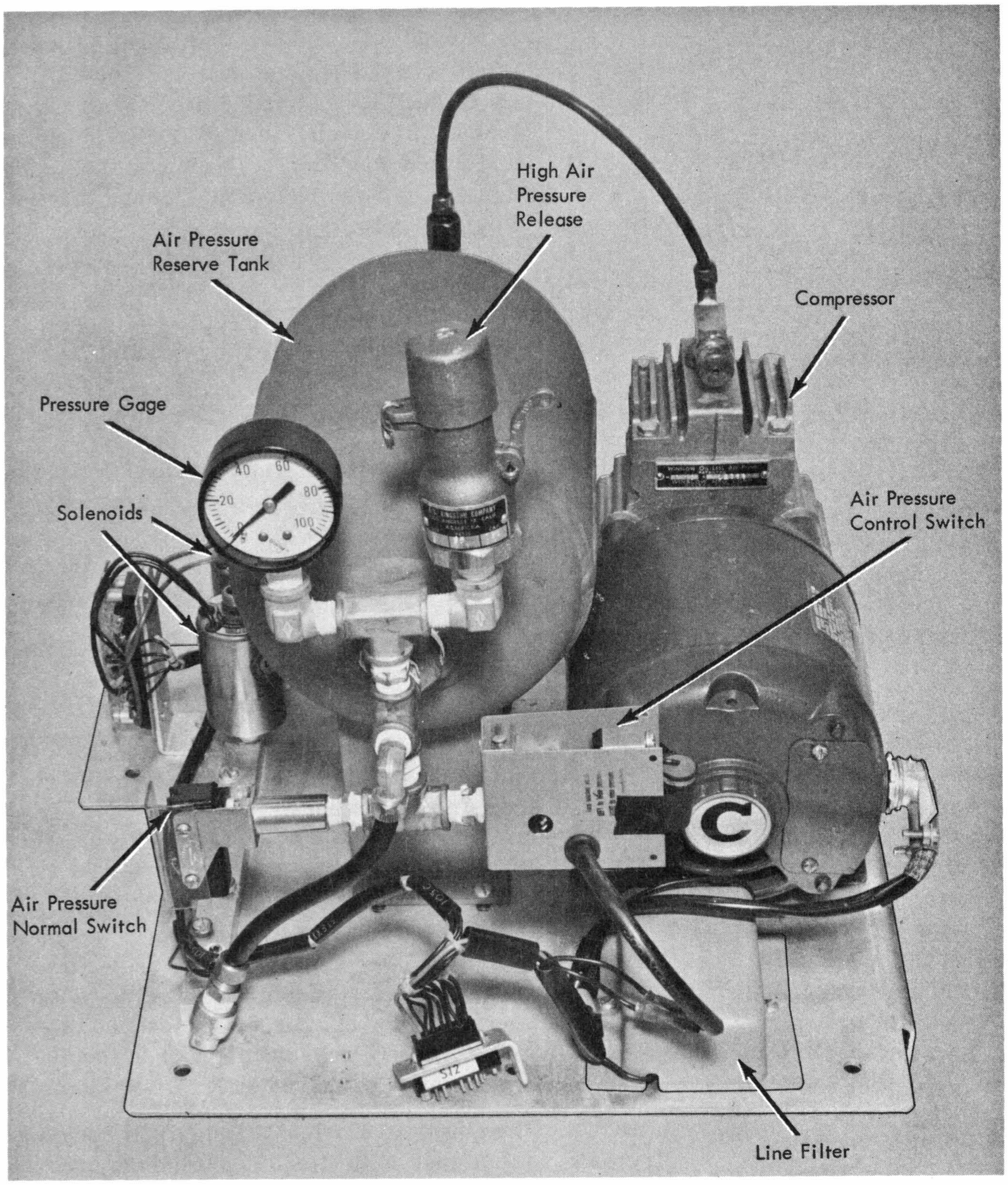


Figure 4-40. Compressed Air Supply

compressor running. Loss of pressure is indicated by frequent starting and stopping of the air compressor. The compressor should start no more often than once every two hours when heads are loaded.

4.20.2 Adjustment

Air Pressure Normal Switch

Set this switch to close and turn on the Air-Pressure-Normal light on the Power Sequence Panel when the air pressure reaches 50 to 52 psi (Figure 3-41).

Air Pressure Control Switch

Set this switch to maintain 64 to 66 psi as indicated on the air pressure gage. The adjusting wheel (Figure 3-42) can be turned with the tip of a screwdriver.

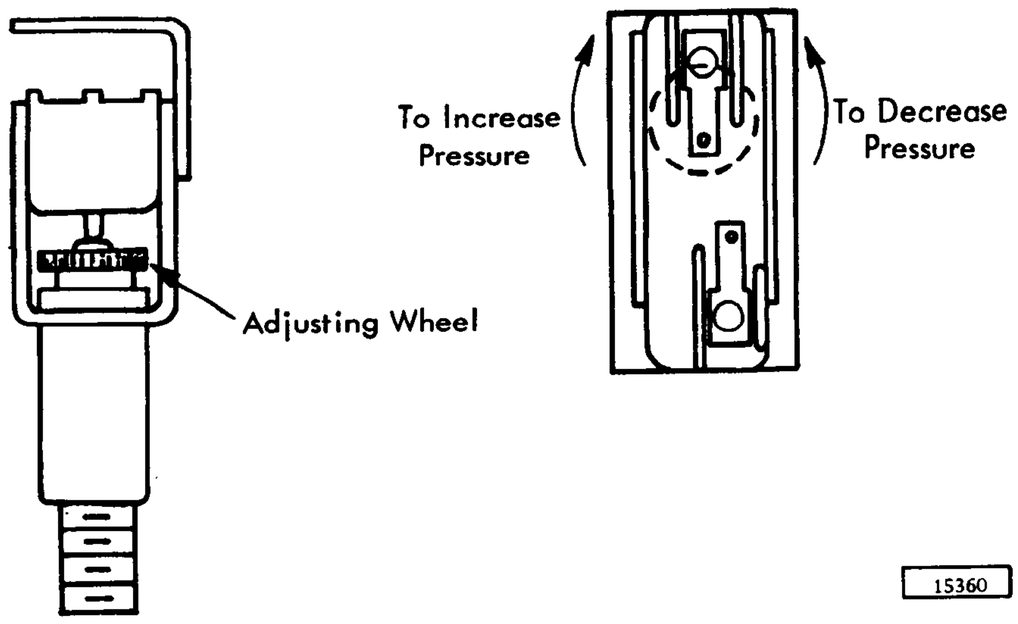


Figure 4-41. Air Pressure Normal Switch

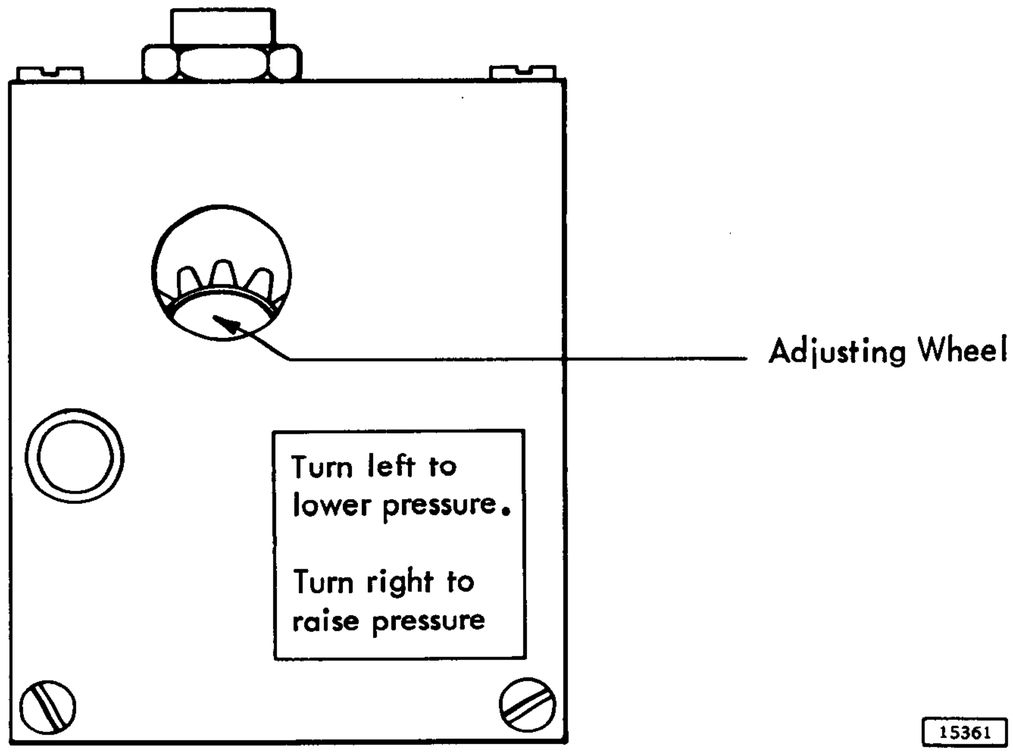


Figure 4-42. Air Pressure Control Switch

5.1 POWER REQUIREMENTS

5.1.1 Input Supply Voltages

The 2302 Disk Storage unit requires a 208/230-volt, 3-phase, 60-cycle input power source. The line-to-line voltage tolerances must be maintained within ±10% of the rated RMS voltage when the file is in operation. This tolerance includes any variable combination of steady state and/or transitions of greater than 0.5 seconds.

Bonding and grounding shall be such that the electrical resistance between the metallic frame or shell of any electrical chassis and the file frame, or components thereof, does not exceed 1.0 ohm when measured with an ohmmeter whose open circuit voltage does not exceed 1.5 dc.

The emergency off contactor shall be operable and shall break all incoming power to the machine including the 24vac and 110vac convenience circuits when the contactor is de-energized.

5.1.2 Input Voltage Change

To change the Input Voltage from 208v to 230v:

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.

5.2 POWER SUPPLIES

5.2.1 48v Supply (Relay and Actuator)

The 48-volt supply must be between 42.6 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 contactor panel prior to changing transformer taps.

5.2.2 DC Supplies

The dc power supplies (-48 not included) must regulate within ±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.

All machine operations must function normally when the voltages on the electronic panels are:

1. Within ±4% of the rated voltage or
2. At the supply limits whichever occurs first
3. When the +12 marginal supply is varied from +9 to +12v.

New dc power supplies are available for replacement purposes. However, over-voltage sensing and regulator cards are required with the new power supplies and must be ordered separately (Figure 5-1).

5.3 ELECTRONIC COMPONENTS

5.3.1 Read Circuits

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

1. The pulse width of the output (Pin E) of detector (EUK- at A5B10) must be 165 NANO seconds plus or minus 15% measured from the 10% up on leading edge to 10% down on trailing edge (System Diagrams page 01.05.06.1).
2. The peak-to-peak signal at the input to the pre-amplifier (SLT) for any data configuration should not be less than 1.0 millivolts. This applies to customer cylinders only.
3. The Amplitude ratio of single frequency bit recording (clock bits only) to double frequency bit recording (clock and data bits) should not exceed 3 to 1.

5.3.1.1 Format Read Amplifier Calbration

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

Use a 1-to-1 probe or a X10 compensated probe with a wide band (2 megacycle or greater) preampflifier such as a CA or D. Sync or 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 01A5B14 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 01A5C13 to 6 to 6.50 volts peak-to-peak (measured differentially) by means of the potentiometer on 01A5C10. If this voltage cannot be obtained, the Variable Gain Amplifier (TEV-), the AGC Detector (TEQ-), the two subsequent Linear Amplifiers (TEH-) should be checked (Figure 5-2).
4. Observe pin A or the OR -AND (ANW-) at 01A5B13 and, by means of the potentiometer on this card, adjust the clipping level to 50% (Figure 5-3).

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.

DC Power Supplies	New Cards	
New No.	Over Voltage Sensing	Regulator
473400	370575	370612
473390	370576	370610
472240	370577	374597
473450	370575	370612
473380	370576	370610
473550	370578	370608

15356

Figure 5-1. DC Power Supply SMS Cards

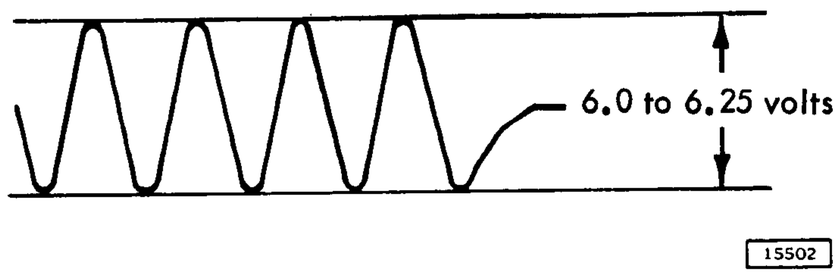


Figure 5-2. Voltage Output of Second Linear Amplifier

NOTE: This ratio (2-1) is easily accomplished by maintaining E2 (Figure 5-3) 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-) to obtain a vertical oscilloscope deflection of two cm for E1.

5.3.1.2 Read Amplifier Noise Rejection

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

1. The receiver assembly is electrically isolated from frame ground by at least 5,000,000 ohms and is to be connected to Pin J of the Read Pre-amplifier card (TXD-).
2. The shields of the format head cable are connected to Pin J of the Format Pre-amplifier card (TXT). The access ends of the shields are tied together and connected to the format drawer shield.
3. Remove all cables to receiver and check for an ac to dc short. Resistance between isolated receiver and frame ground should be greater than 2 megohms.

5.4 STANDARD MODULAR SYSTEM MAINTENANCE

All normal maintenance procedures for standard modular system (SMS) components are found in the Field Engineering Instruction-Maintenance Manual, Standard Modular System (Form 223-6900). Included in this form is information regarding:

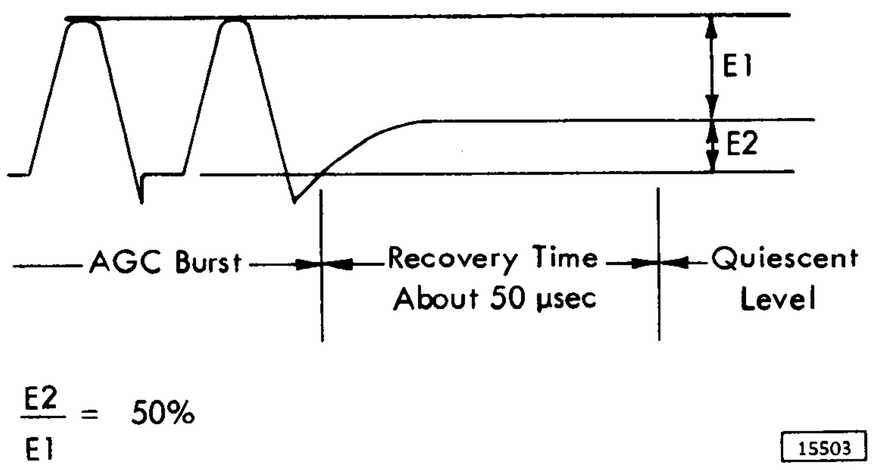


Figure 5-3. Format Read Amplifier Clipping Level

Wrapped Wire Connections
Crimped Connections
Soldered Connections
Wiring Change Procedures
SMS Service Tools

SMS Card Maintenance
Measurements
Ventilating Systems
SMS Components
SMS Service Techniques

6.1 GENERAL

This section consists of reference illustrations which will enable the CE to locate components, major assemblies, power supplies, meters, gages, and test panels which are involved in maintaining the equipment.

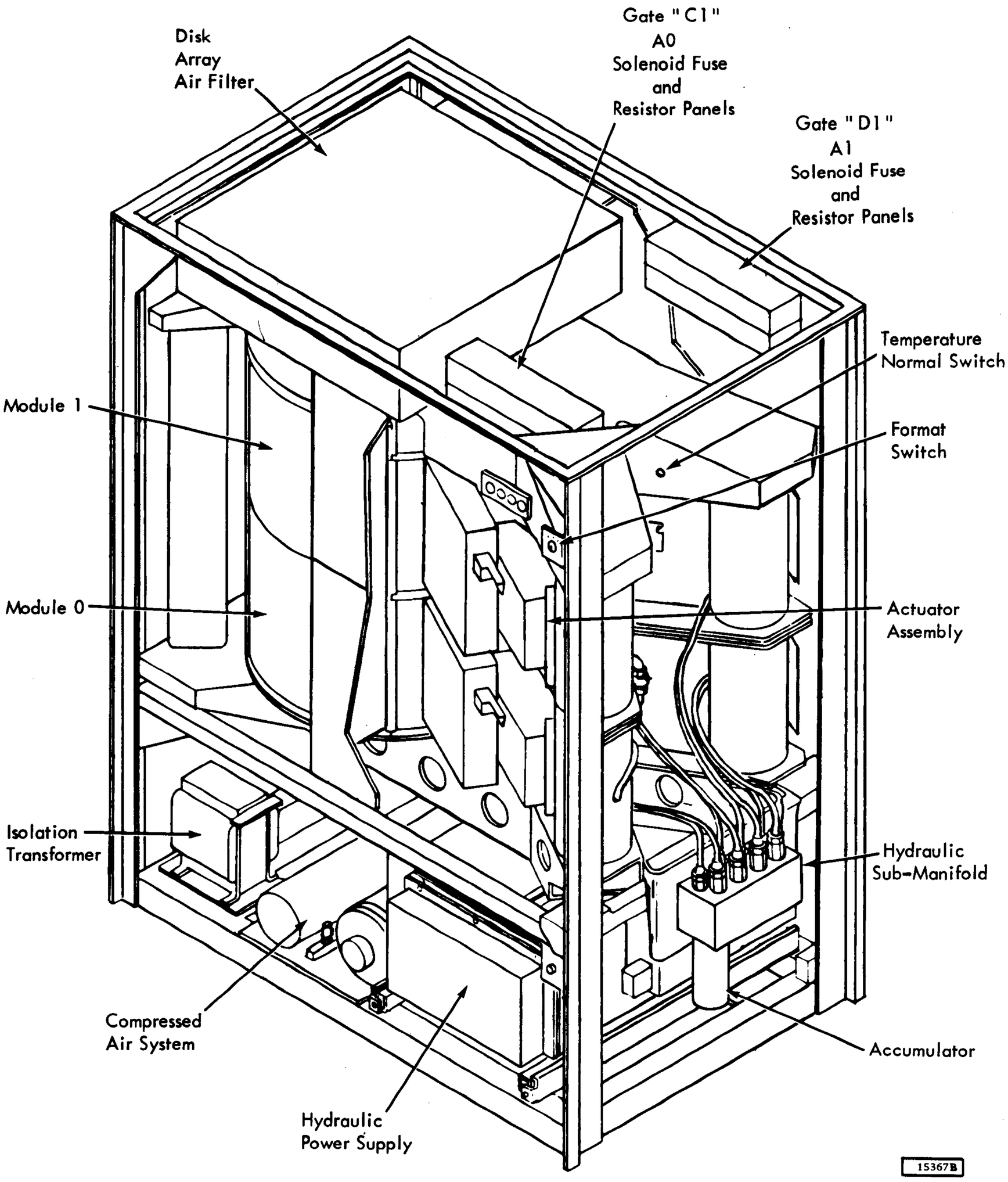


Figure 6-1. Mechanical Frame

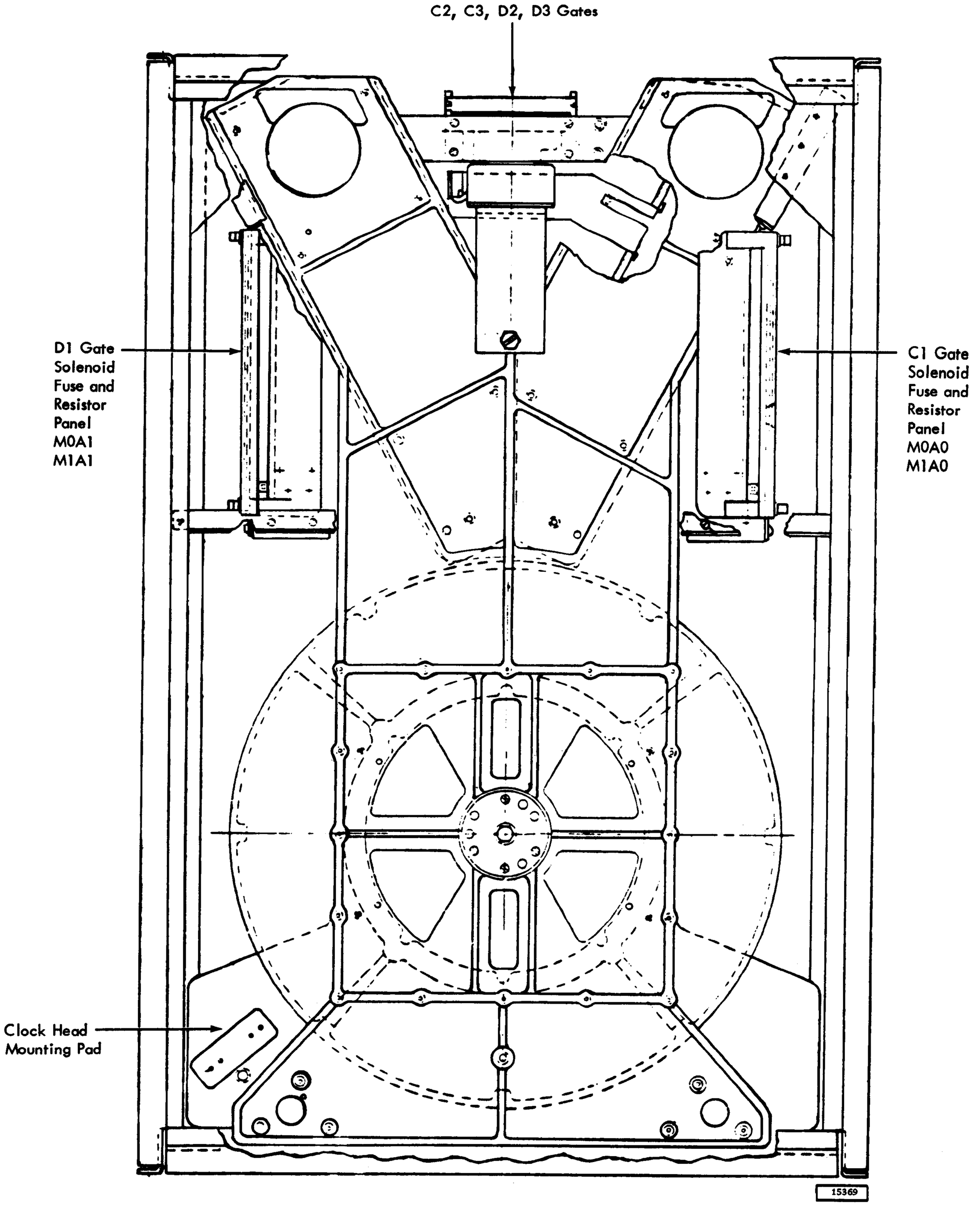


Figure 6-2. Mechanical Frame, Top View

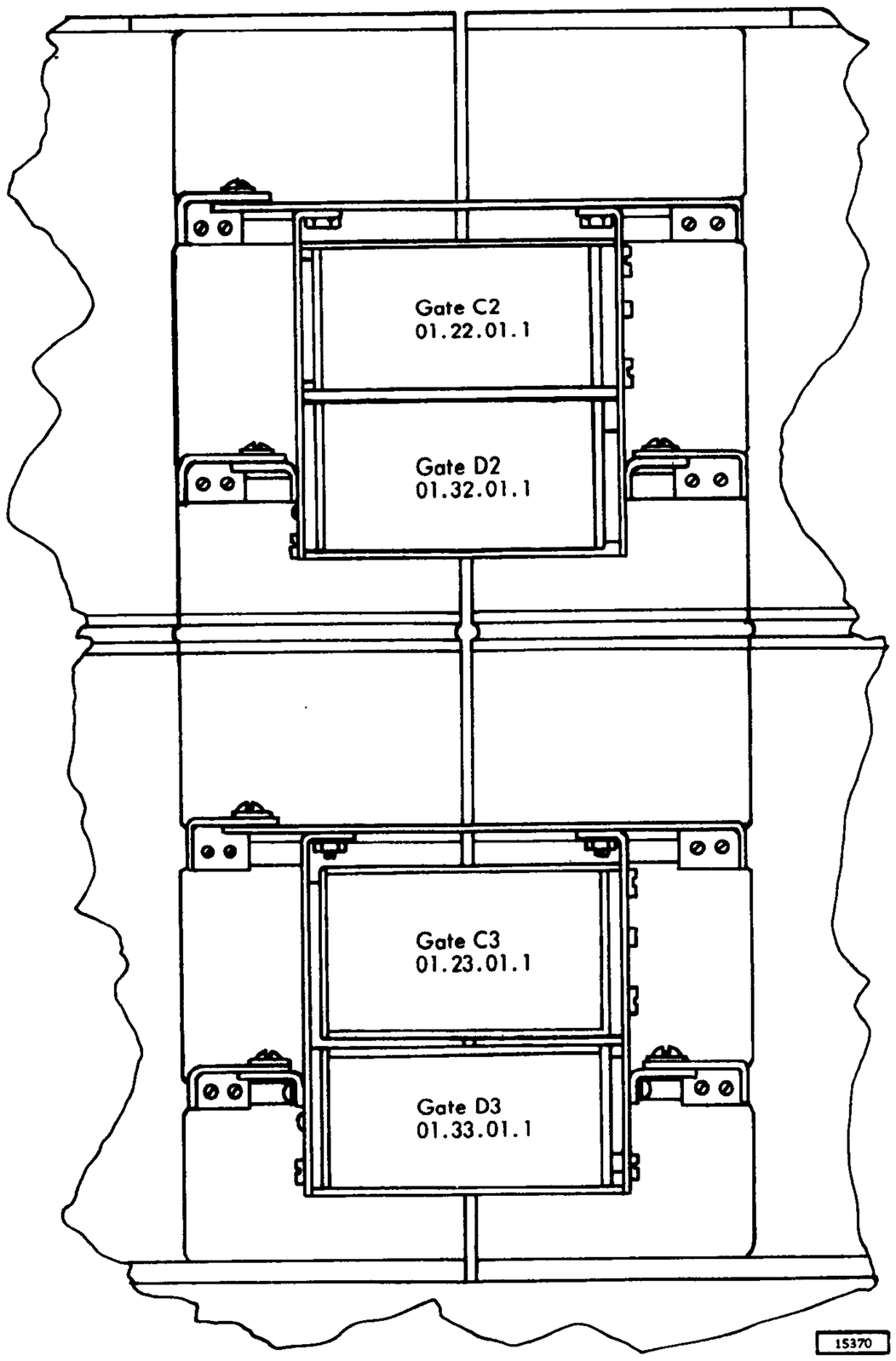


Figure 6-3. C and D Gates

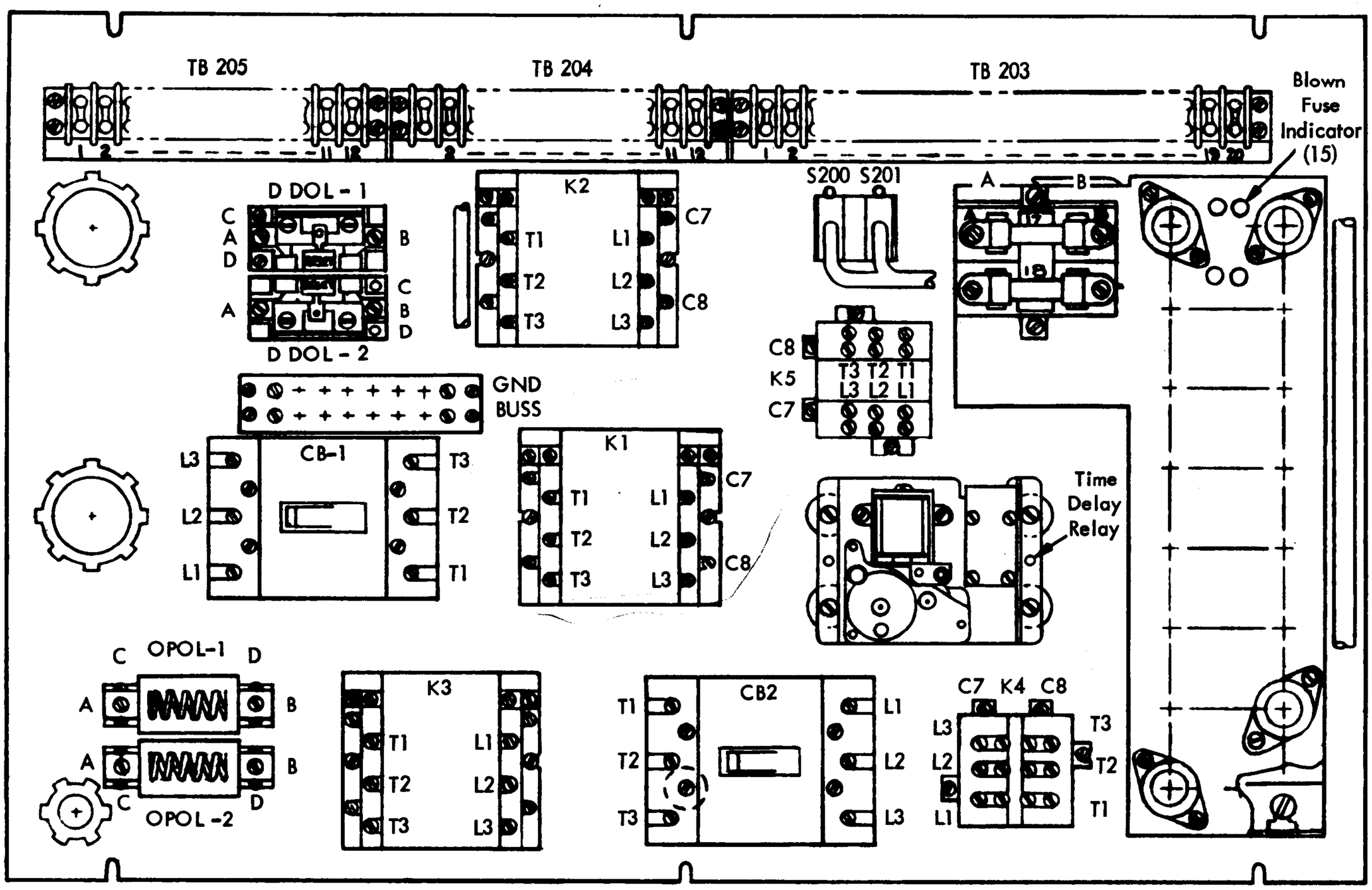


Figure 6-4. Power Contactor Box, Uncovered

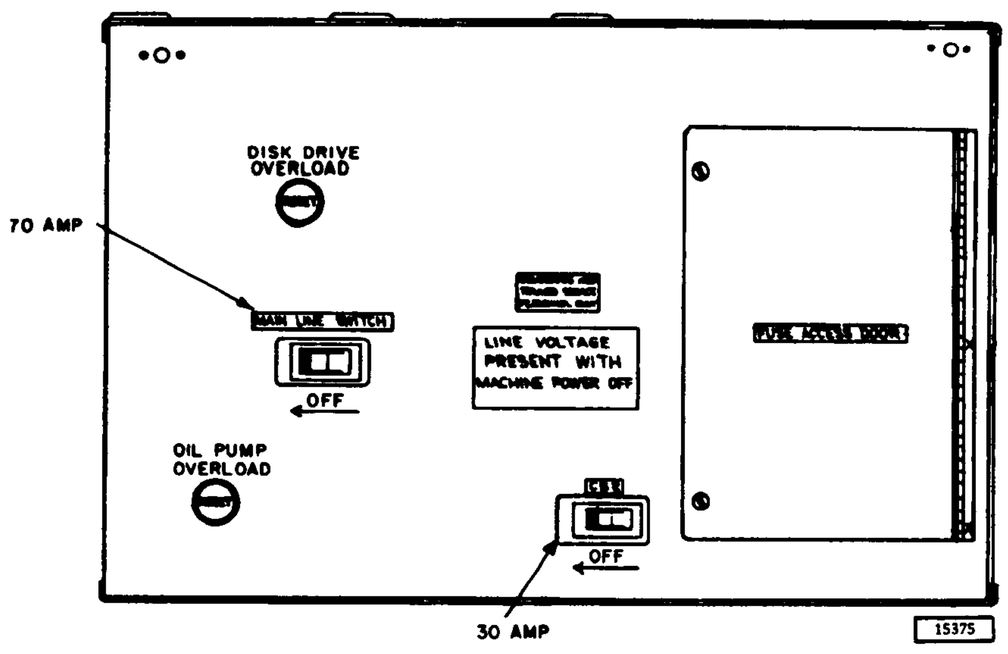


Figure 6-5. Power Contactor Box, Covered

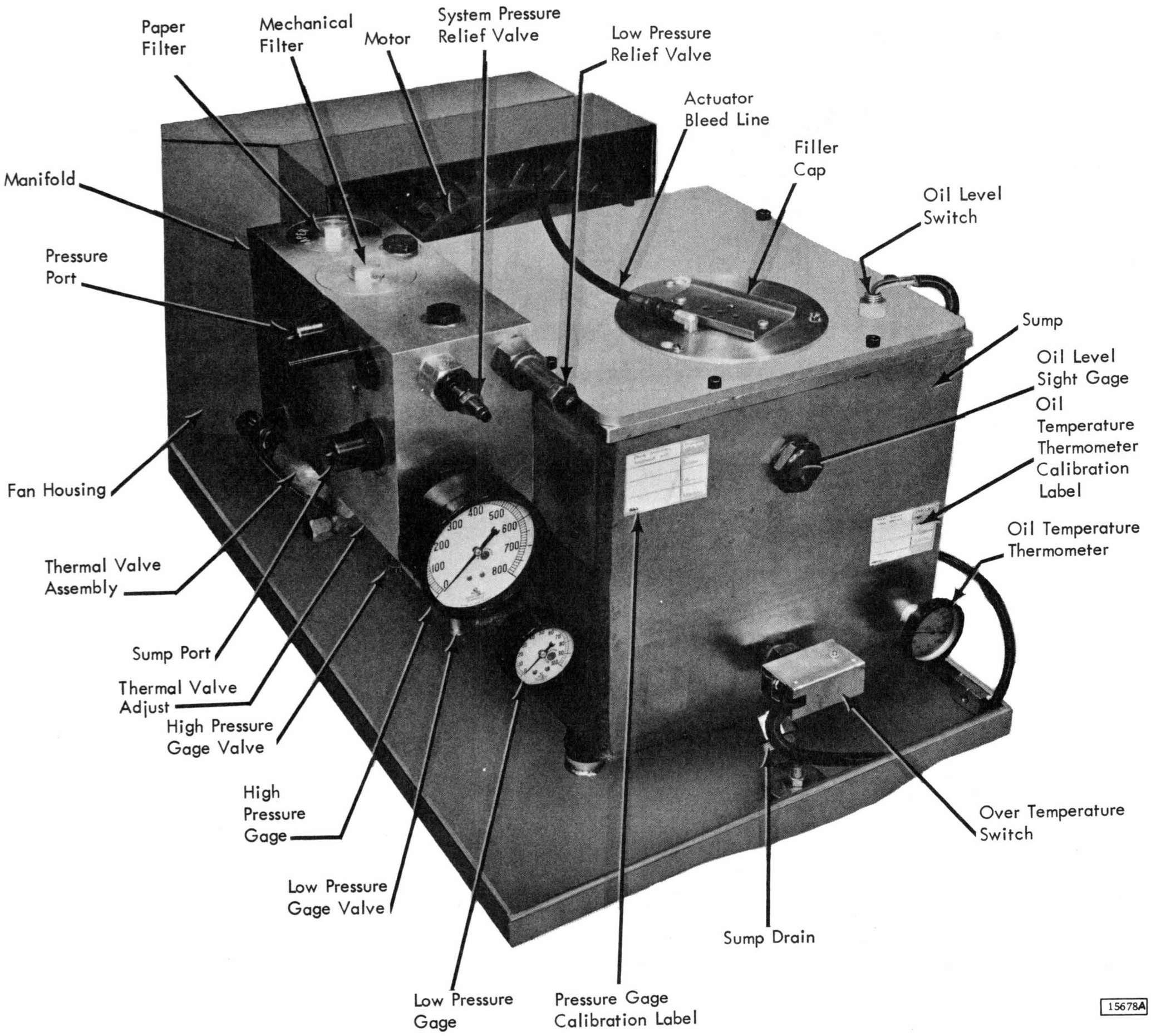


Figure 6-6. Hydraulic Power Supply

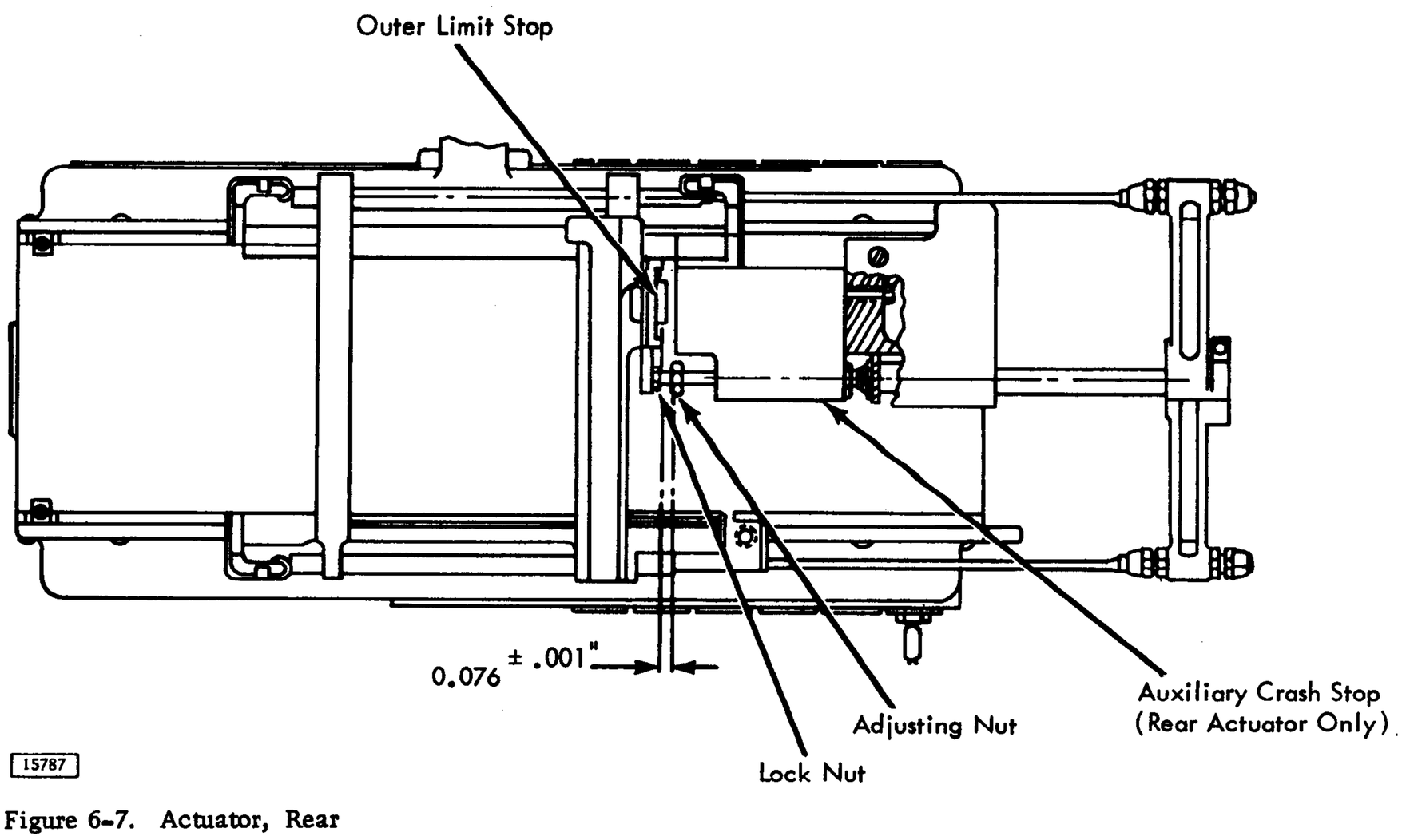


Figure 6-7. Actuator, Rear

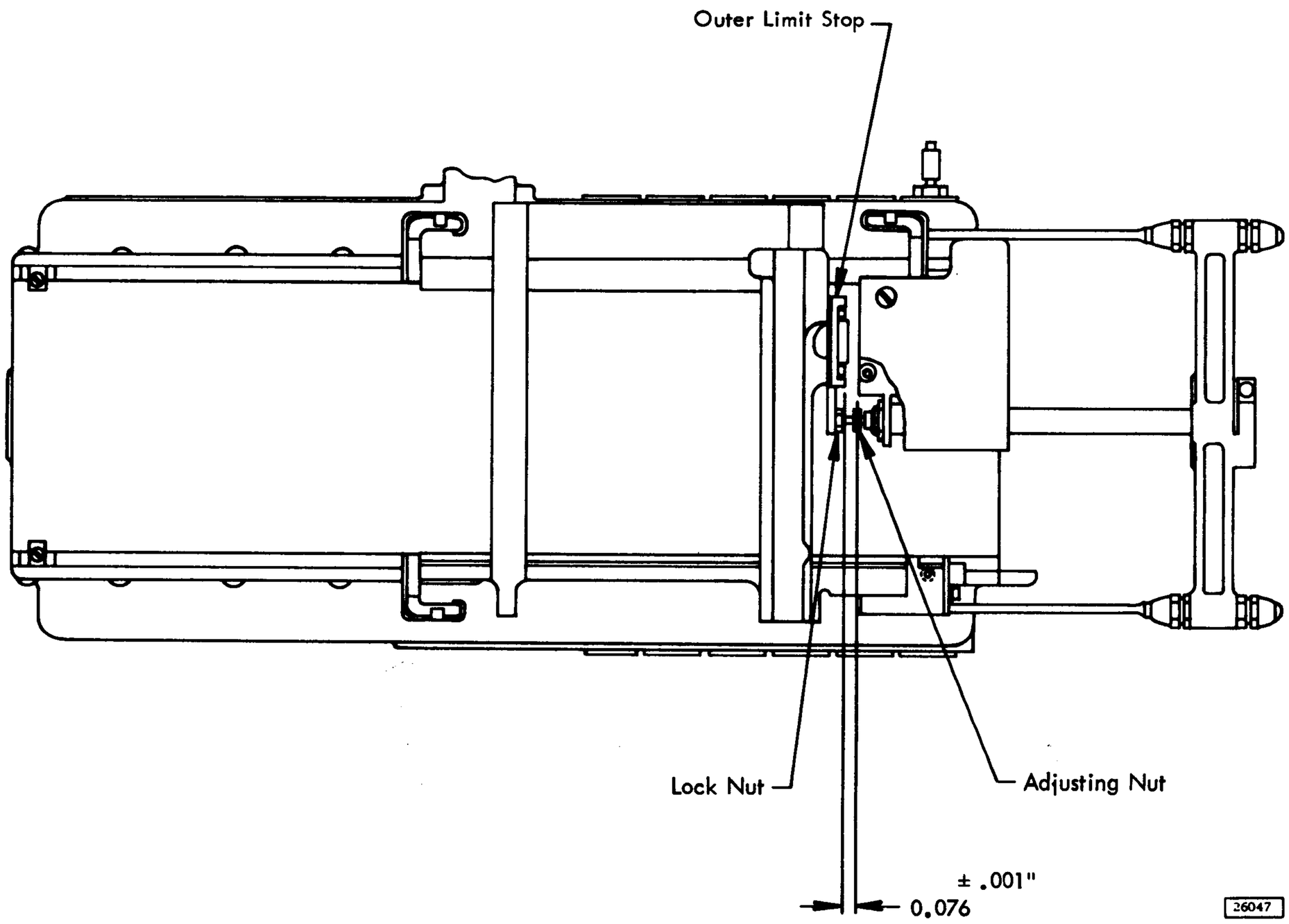


Figure 6-8. Actuator, Front

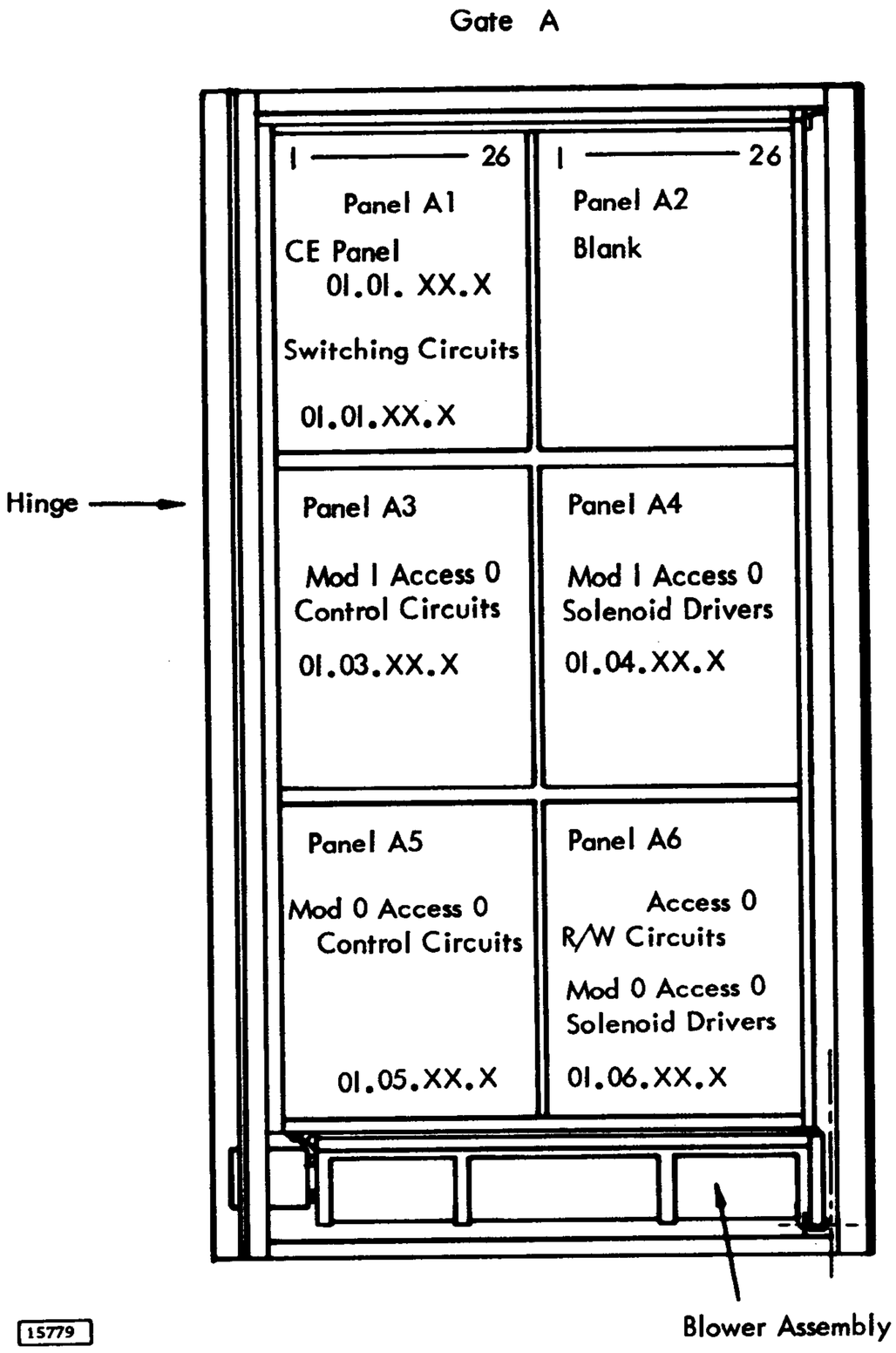


Figure 6-9. Electronic Frame, Front

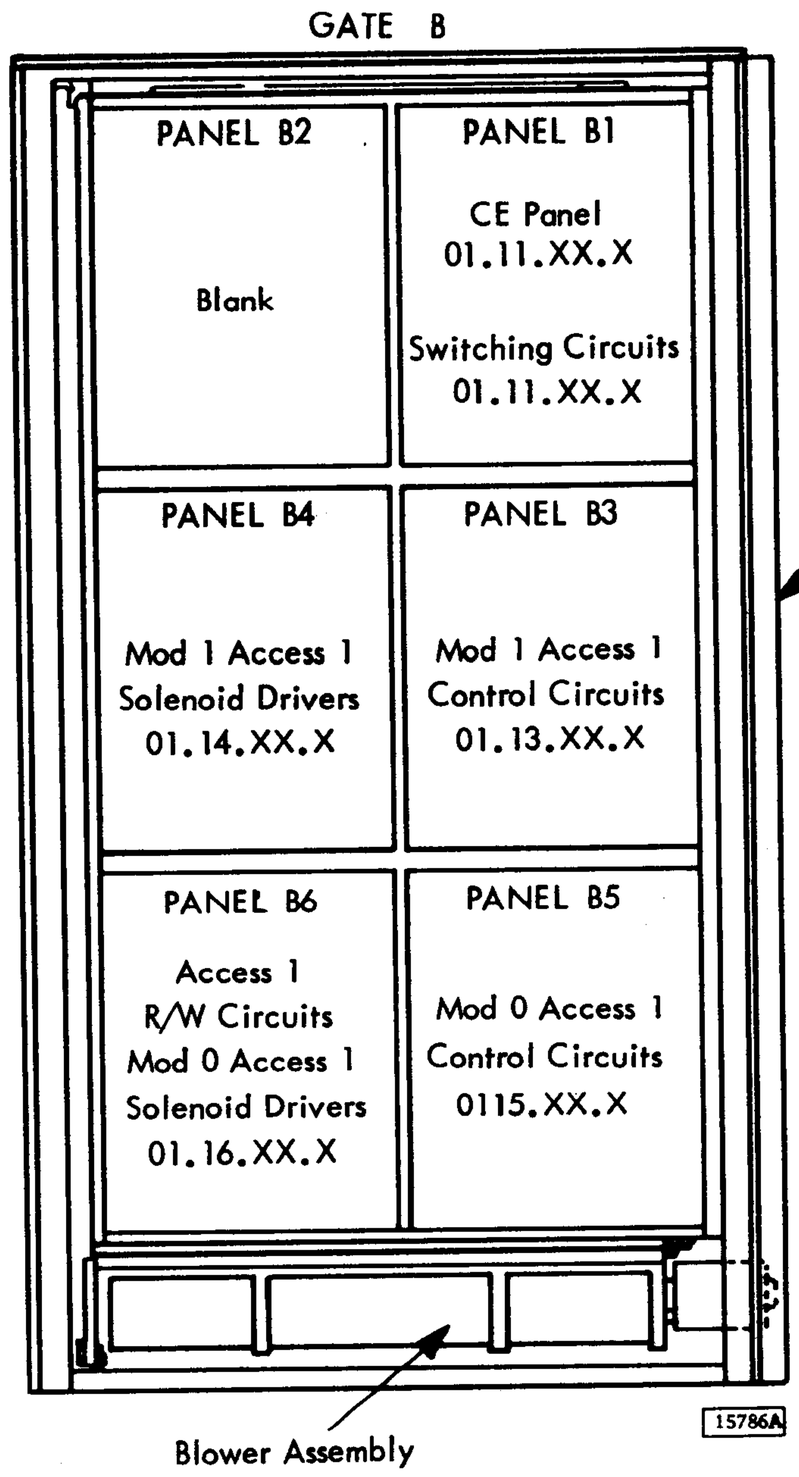


Figure 6-10. Electronic Frame, Rear

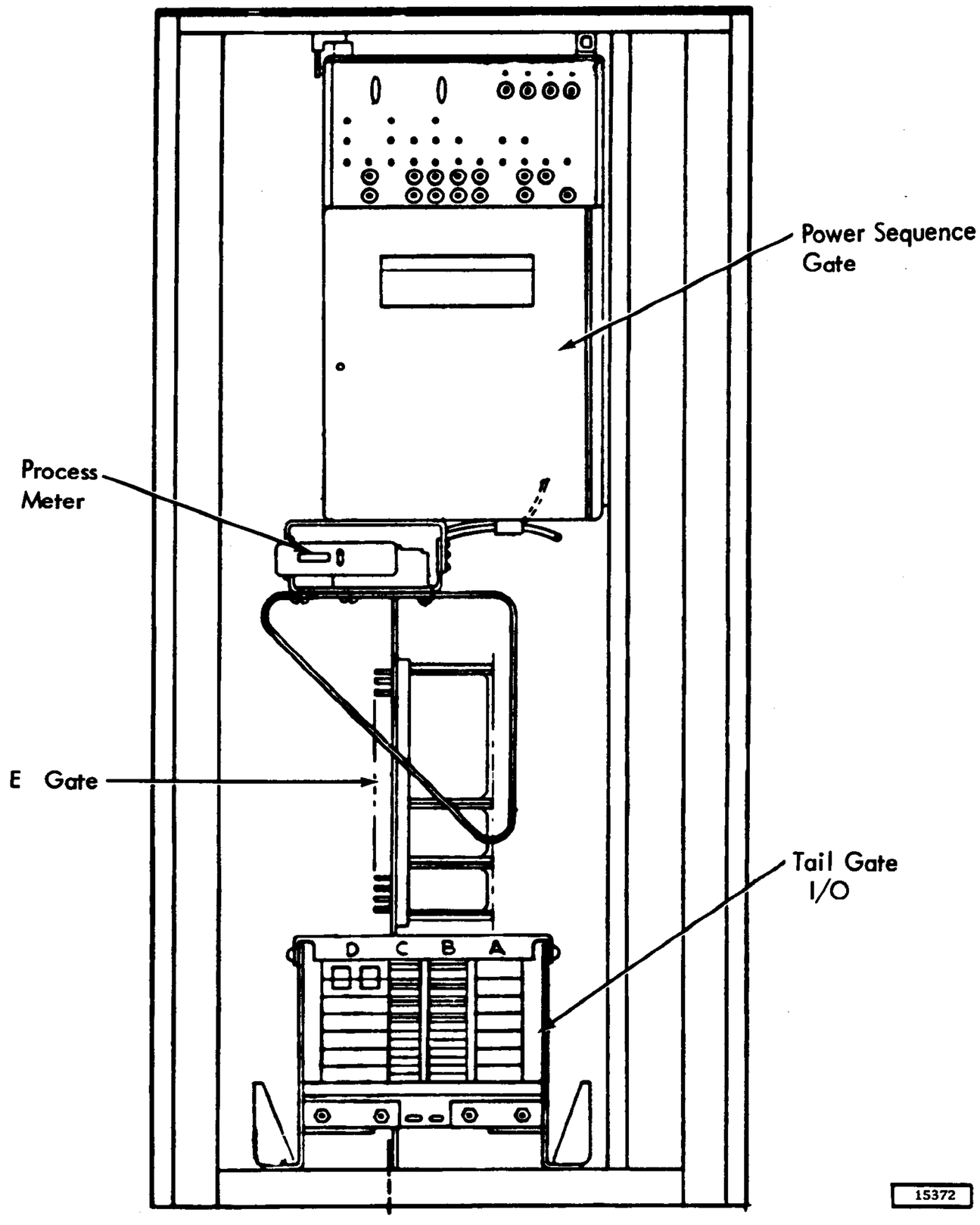
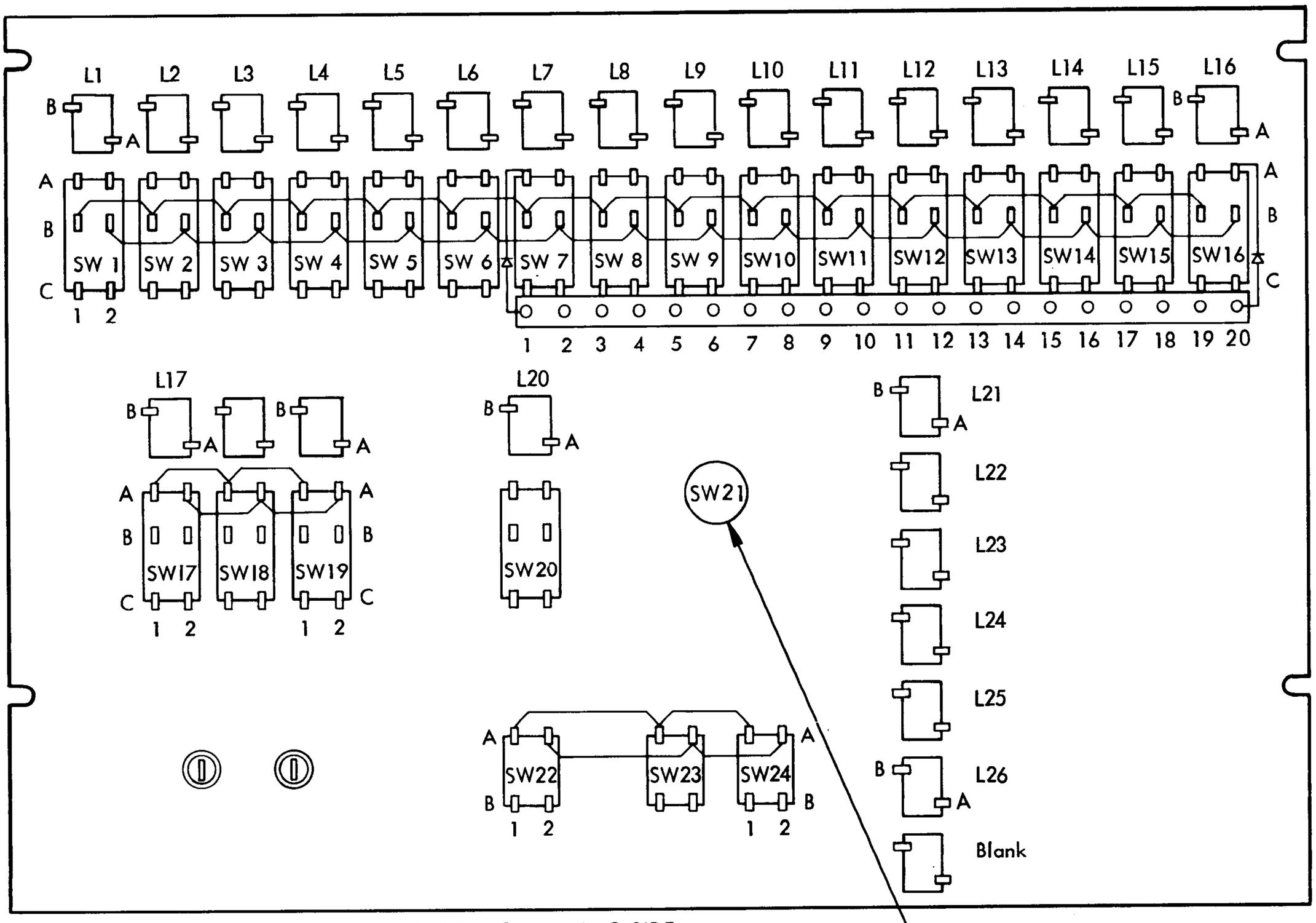
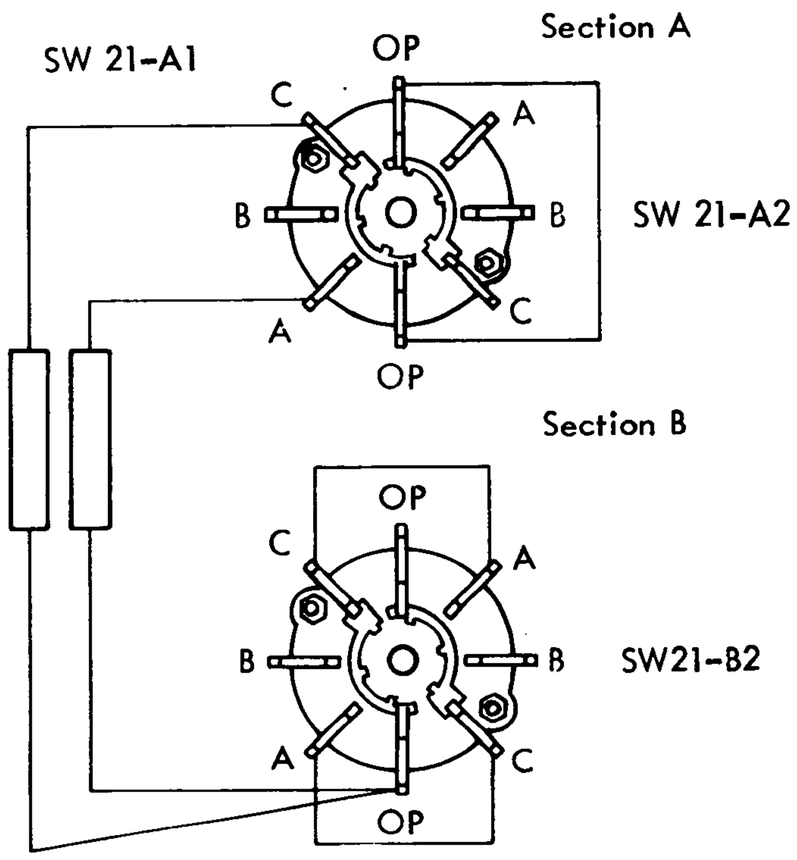
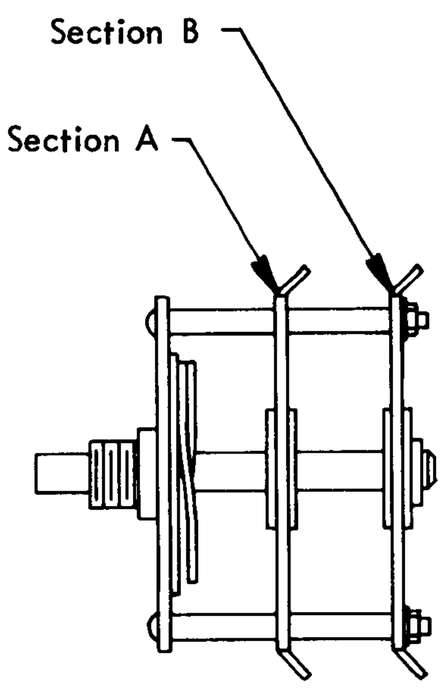


Figure 6-11. Electronic Frame, Right End



CHASSIS VIEWED FROM WIRING SIDE

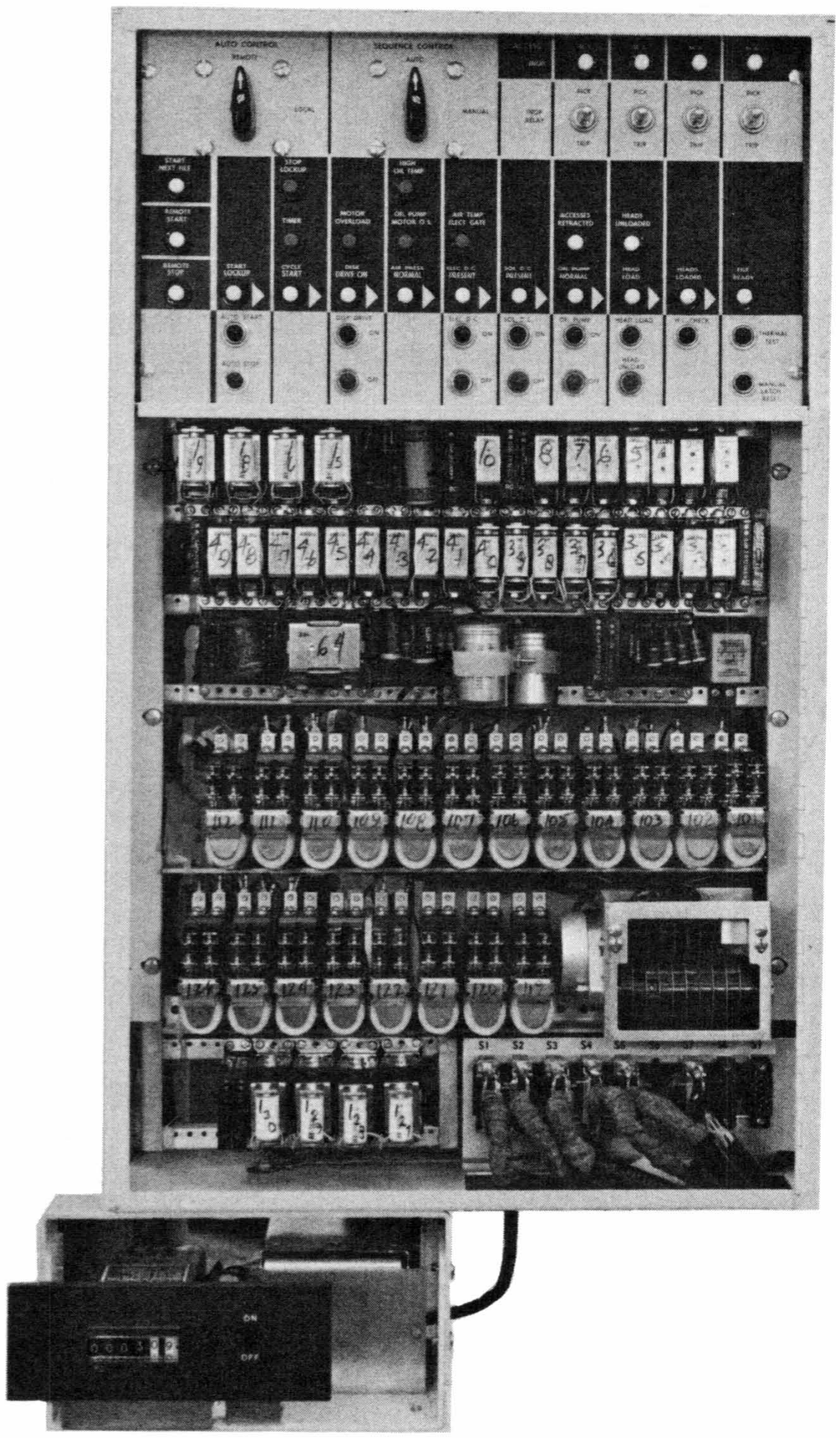




Note: Locating tab of switch must be mounted toward bottom of CE panel.

15782

Figure 6-12. CE Panel Component Numbering



15753

Figure 6-13. Power Sequence Gate

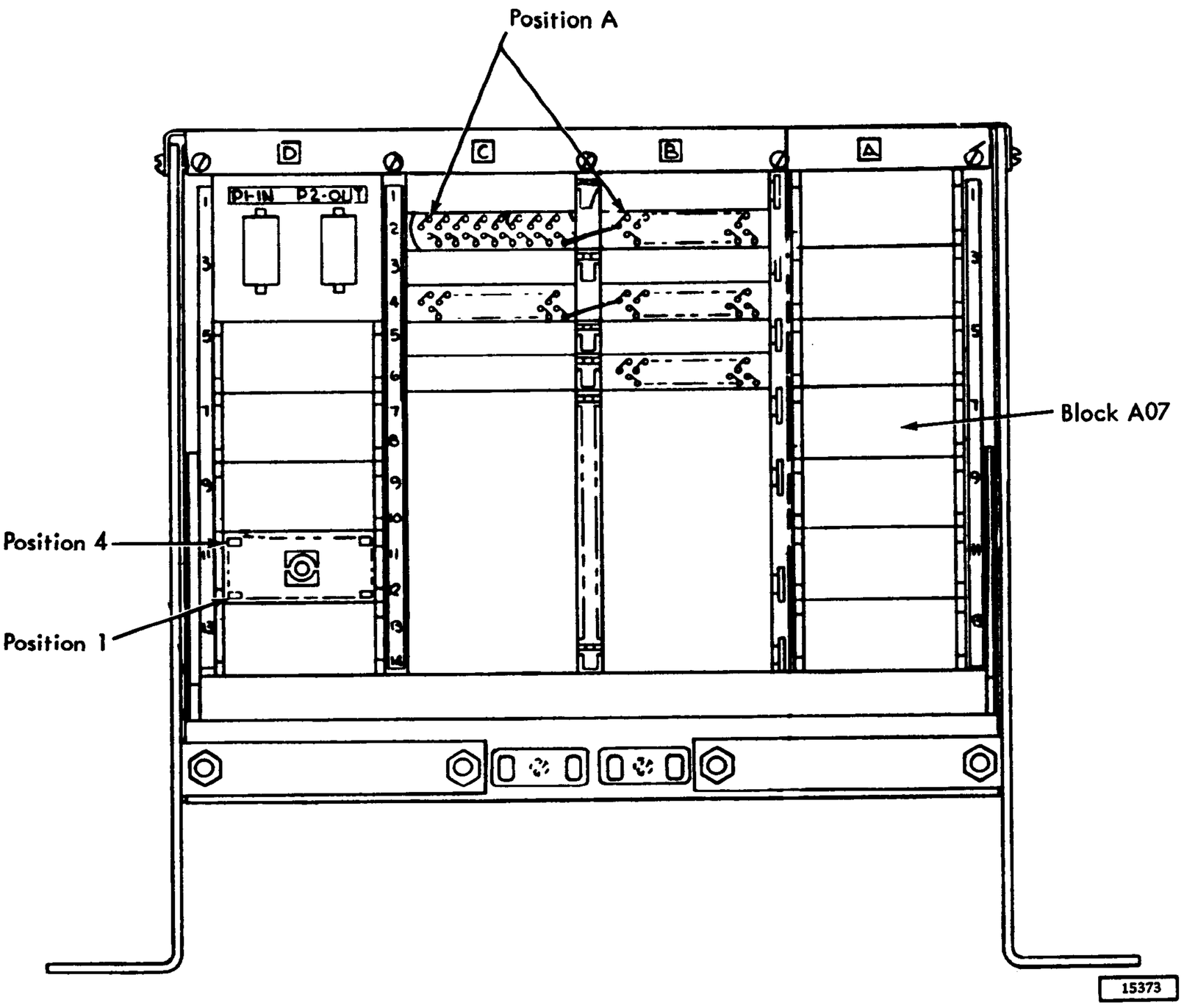


Figure 6-14. I/O Gate

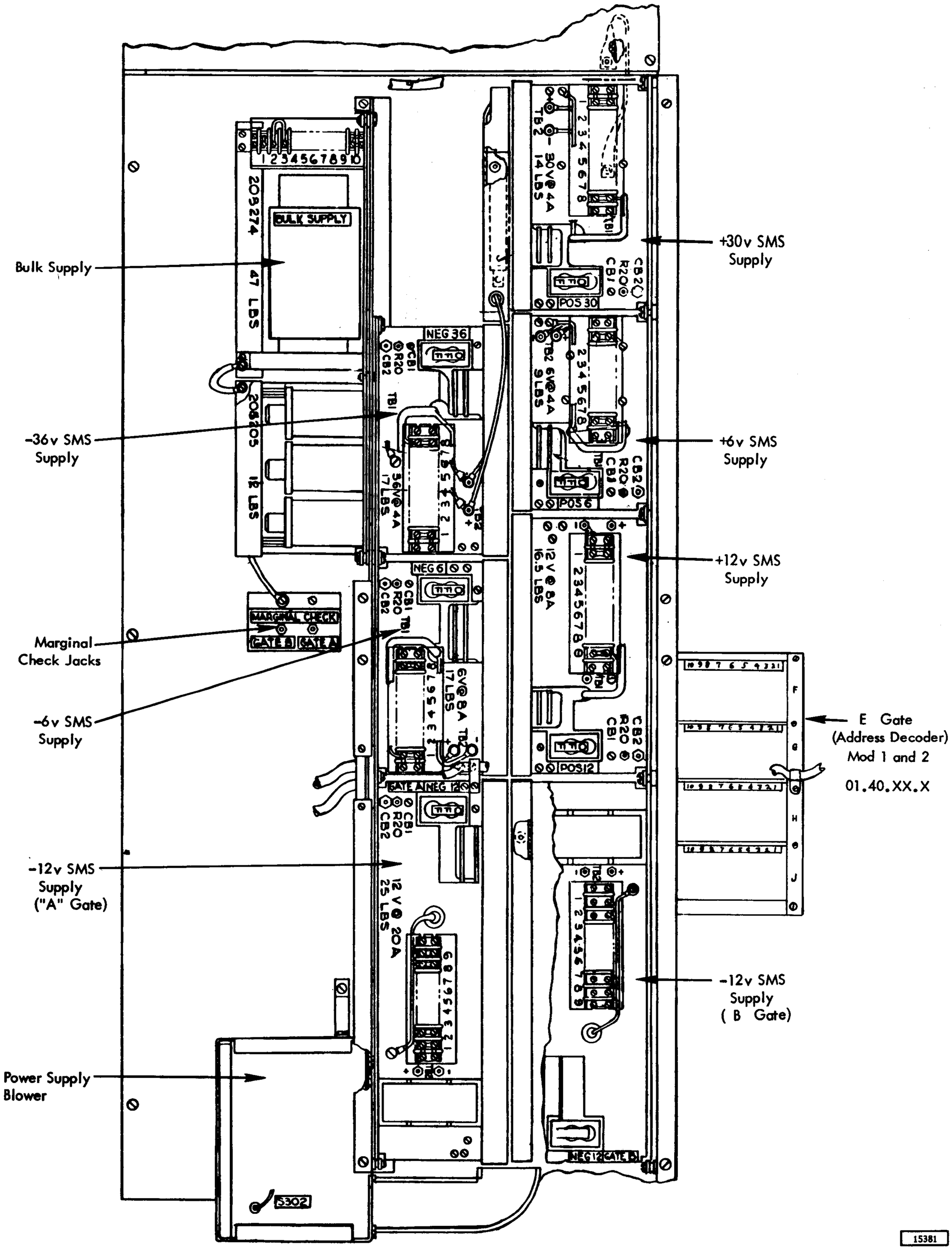


Figure 6-15. DC SMS Power Supplies

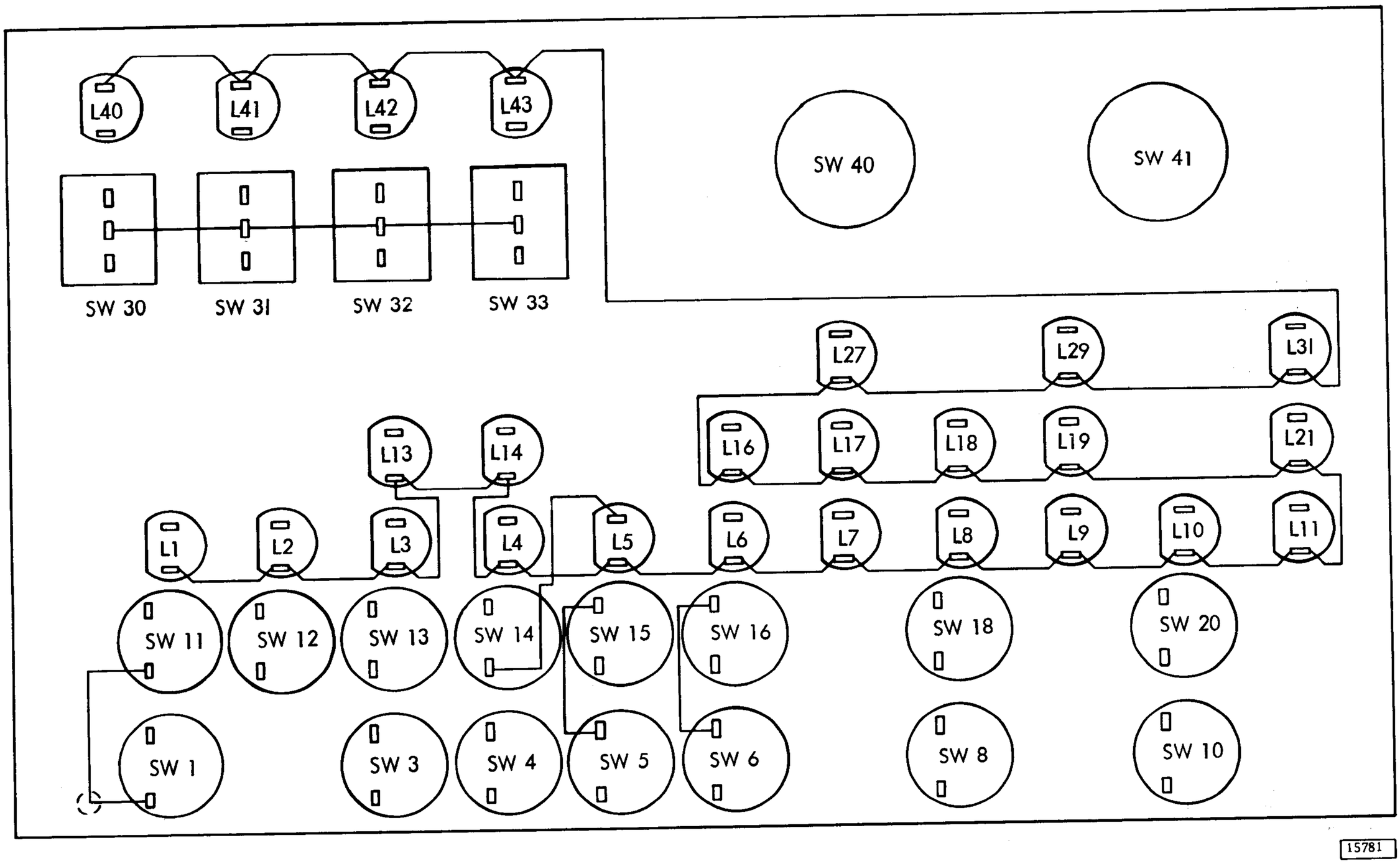
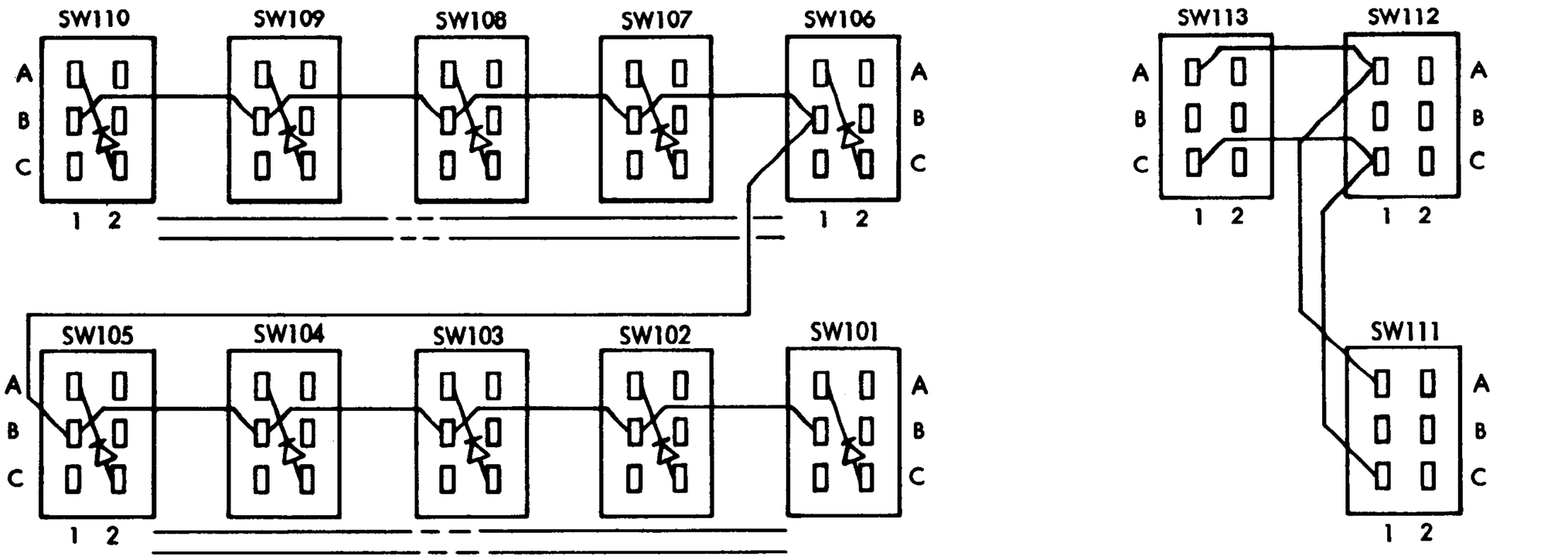


Figure 6-16. Power Sequence Panel, Component Numbering



Voltage Bus Part No. 212822		
Pin Row	Position	
	From	To
J	1	16
M	1	6
M	8	11
N	1	11
P	6	7

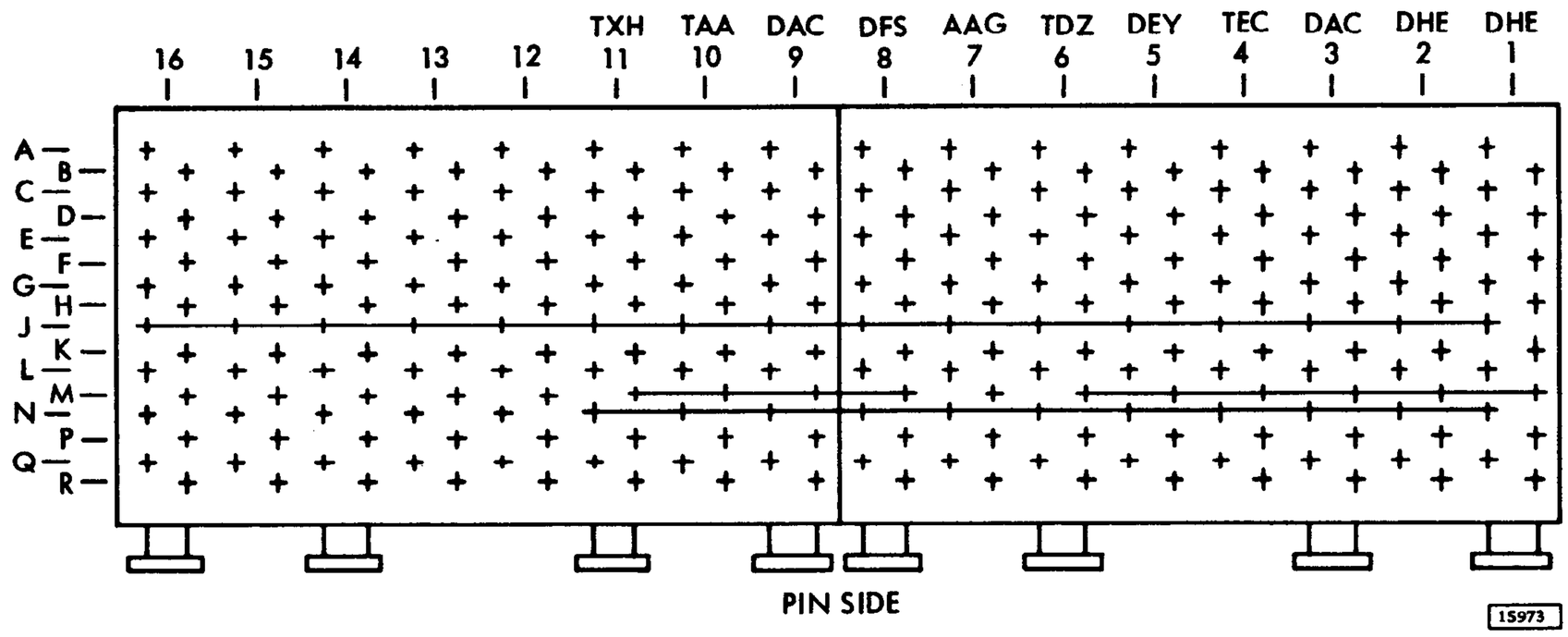


Figure 6-17. Remote CE Box, Component Numbering

INDEX

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