IBM® Customer Engineering

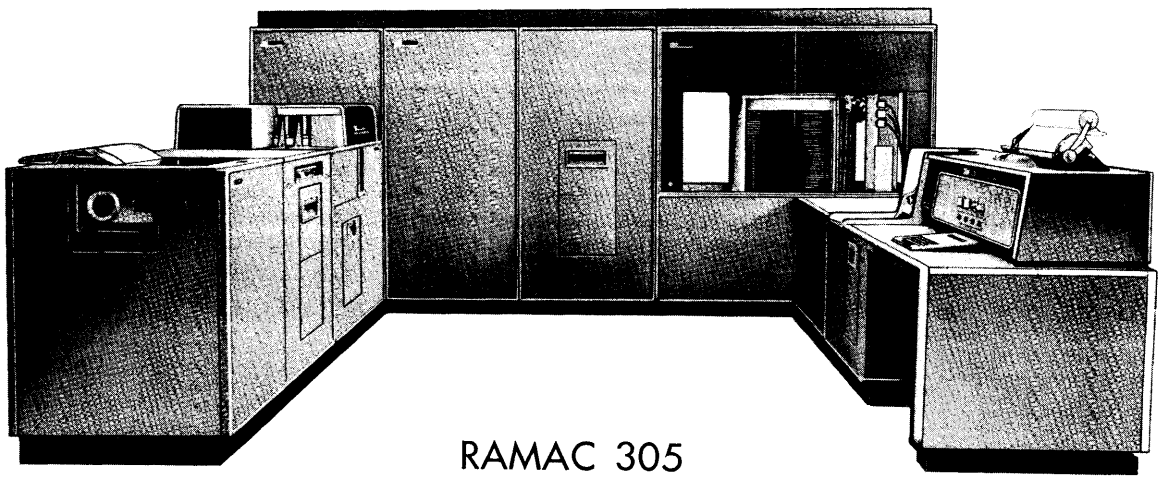
Reference Manual

IBM RAMAC® 305

Minor revision

This edition, Form 227-3533-1, is a minor revision of the preceding edition but does not obsolete Form 227- 3533-0.

CONTENTS



RAMAC 305

Section 1. General

The purpose of this reference manual is to serve as a guide for proper preventive maintenance and adjustment procedures for the IBM RAMAC® 305. The information contained herein is based on current engineering specifications.

Proper planning and use of preventive maintenance will reduce emergency breakdowns and will help keep the machine in such a condition that the Customer Engineer can schedule his work and time efficiently. Preventive maintenance consists of four phases: cleaning, inspecting, marginal testing, and lubrication. The frequency at which any or all of these phases should be done will depend a great deal upon machine usage and the conditions in the customer's office. Too much inspection should be guarded against in the same manner as too little. The recommended frequency of preventive maintenance as outlined in this manual, based upon a usage rate of 173 hours system operating time per month, should serve as a guide for machines operating under normal conditions.

Safety and Appearance

It is recommended that thoughtful consideration be given safe working practices. Hazards can be virtually eliminated when personnel understand and recognize the features of the equipment that may on occasion present an unsafe condition. Do not expose the customer or yourself to unnecessary hazards when running the machine uncovered. Check to make sure all guards are in place and installed properly. Wear safety glasses. Normal good housekeeping practices keep the machine looking neat and clean, and improve the appearance of the customer's installation.

Covers

Covers are manufactured of thick gage metal and are large and heavy. Take care when removing for servicing. Place in a safe, stable position with sharp edges inaccessible. Guard against covers being bumped accidentally and falling or dropping unexpectedly.

File Units

Due to the random and sometimes unpredictable motion of the access mechanism, it should be handled with caution whenever the clutch drive motor is turning. Shields and guards have been provided which can only be of assistance when firmly in place. Before turning the clutch mechanism by hand, make sure that the motor will not be turned on unexpectedly by another person.

Care should be taken in attempting to use the tilt back mechanism of the 350 or when it is necessary to remove the access assembly. Two men should be available to restrain this unit and prevent injury to the Customer Engineer.

Particular care should be taken when working in the area of the access mechanism. The possibility of bumping your head is very great.

Power Supply

When a DC fuse opens due to overload, a DC off sequence is initiated, but power remains on at the blowers, tube heaters, convenience outlets, and drive motors. **Do not depend on this feature as safety protection.** Always employ an insulated tool to remove or insert fuses. Replace plastic protective covers over fuses as soon as possible. The power supply drawers are also heavy and should not be removed without assistance.

Filament Voltage

The lines and terminals carrying heater voltage (6.3 volts AC) are to be regarded with respect, due to the large current capacity of the circuits. A metal wrist watch band or a ring shorting this voltage is capable of causing severe burns. Exploding molten metal from a screwdriver or other tool in contact with the 6.3 volt lines can cause eye or facial injuries.

High Voltages

High voltage lines and connections exist in many areas within the machine. It is expected to find such voltages

on transformers, terminals, tubes and the like. Recognize also that a number of wire contact relays utilize high voltages at their points. Changing relays or tubes with the power on is therefore to be done only if absolutely necessary and with caution.

CAUTION: With all power off, 230v AC is still available on 380 start switch, emergency off, remote air compressor sequence box, at input terminals, 340 meters, etc. When working in these areas, pull line cord or turn off AC at customer's wall switch.

Process Unit Drum

If, for any reason, the magnetic drum assembly is to be removed from the machine, make arrangements for assistance because this unit is heavy and quite awkward to handle alone. Care should be taken to insure that the drum is not running when specific adjustments are being checked. There are counter balance holes drilled into the face of the drum assembly and they serve as a built-in decal. If the drum is running, these holes will not be visible. Care should be taken to insure that the plastic cover is over the drum when working in the drum area with power on.

370 Printer

On the 370, particular attention should be paid to the somewhat random motion of the print carriage. When working on the 370 in this area it is possible to be struck on the head by the returning print carriage assembly unless extreme care is observed. Particular attention should also be given to the rotating shafts throughout the 370, particularly in the area of the print and hammer carriage sections.

On both 370 and 380, interlocks should never be deactivated unnecessarily.

305 Process Unit

Mercury relays should never be disassembled. Defective mercury relays should be returned to the factory. Due to the internal pressure of the relay point enclosure, the possibility of flying glass particles is especially dangerous.

Caution should be exercised when working with the 305 relay gate open, as the possibility of bumping your head is very great.

380 Console

The return of the typewriter carriage can be dangerous. Use caution when working in this area.

Artificial Respiration

Following certain accidents involving electrical shock or gas asphyxiation, a person's breathing stops. The life saving method that should be immediately applied is known as the "Back Pressure-Arm Lift Method" of artificial respiration. Instructions on the proper use use of this method follow.

1. *Position of Victim and Operator* (Figure 1). The victim should be placed on his stomach, with his elbows bent and his hands placed (one upon the other) under his head. His head should be turned slightly to one side, with his cheek on his hands.

The operator kneels on either the right knee, the left knee, or both knees. If both knees, he should kneel facing the victim, one knee on either side and just above the head of the victim. If on one knee, the knee should be close to the victim's forearm and the foot near the elbow of his other arm. The hands should be flat on the victim's back so that the heels of the hands lie just below a line running between the armpits, with the tips of the thumbs just touching and the fingers spread downward and outward.

Figure 1. Position of Victim and Operator

2. *Compression Phase* (Figure 2). The operator rocks forward until his arms are approximately vertical, allowing the weight of the upper part of his body to exert slow, steady, even pressure downward upon his hands, keeping elbows straight. This forces the air out of the lungs. The amount of effort exerted upon the back should be governed by the size of the patient.

Figure 2. Compression Phase

3. *Position of Expansion Phase* (Figure 3). In releasing the pressure, the operator should avoid a final thrust upon the victim's back. Then rock back slowly, placing the hands upon the victim's arms just above the elbows.

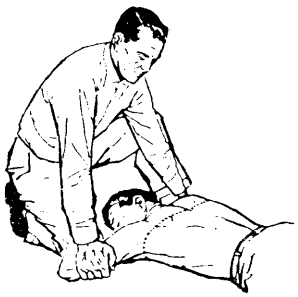


Figure 3. Position of Expansion Phase

4. *Expansion Phase* (Figure 4). Keeping the elbows straight, the operator continues rocking backwards slowly, drawing the victim's arms toward him and lifting until he feels the resistance of the victim's shoulders. He now drops the patient's arms gently to the ground. This completes a full cycle. The arm lift expands the chest by pulling on the chest muscles, arching the back, and relieving the weight on the chest.

The cycle should be repeated 12 times per minute at a steady rate. The compression and expansion phase should occupy about equal time, the release period being of minimum duration.

Time is most important; seconds count. Begin at once. Do not delay resuscitation to loosen clothes, warm the victim, apply stimulants, etc. These are secondary to the main purpose of reviving him.

When help is available, the clothing should be loosened around neck, chest and waist. Make sure that the victim's tongue is forward; clean his mouth, remove all foreign matter. Check for loose dentures.

Carry on artificial respiration at the rate of 12 complete cycles per minute. When the victim begins to breathe naturally, adjust and synchronize your rhythm with his. Treat the patient for shock.

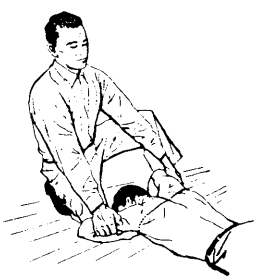


Figure 4. Expansion Phase

Installation Procedures

The installation procedures are now being shipped in a separate package with each machine (Form 227-3527). If additional copies are needed, write to the Customer Engineering Department at San Jose.

If a machine is field transferred to another office, it is the responsibility of the shipping office to have the installation procedures shipped with the machine. If they were not kept with the machine, order a set before the machine is transferred.

Preparation for Shipment

Prior to packing for shipment, the following B/M's should be ordered from San Jose, California. Instructions, packing materials, etc., will be provided.

MACHINE TYPE	PADDED VAN OR AIR FREIGHT	COMMON CARRIER
305	B/M 7350004	B/M 7350003
Remote Air Compressor	7350082	7350082
305 Storage Cabinet	7350025	7350024
323	7350007	7350006
340	7350010	7350009
350	7350013	7350012
370	7350019	7350018
380	7350022	7350021

NOTE: It is required that all cables leaving the file and the remote air compressor be disconnected at one end, tagged, and rolled up into the file or remote air compressor.

Machine Specifications

NOTE: The following material is for your information only. Any problems of location, air conditioning or power *must* be referred to District Physical Planning.

Power Requirements

340 POWER SUPPLY REQUIREMENTS

Includes all RAMAC circuits except file power, compressor, and access motors. Average full load current per phase at:

208 volts 3∅, 34.5 amps.

230 volts 3∅, 31.5 amps.

NOTE: Phase sequence to be 3-2-1 at power input terminals L_1, L_2, and L_3, respectively.

Customer's fuse size: 3-60 amp.

350 File Power Requirements

(Gear Drive)

1½ HP file motor: 2.9 amps @ 208 volts.

½ HP compressor motor: 4.1 amps @ 208 volts.

⅓ HP access motor.

Average full load current per phase at:

208 volts 3∅, 9.9 amps.

230 volts 3∅, 10.3 amps.

Customer's fuse size: 3-30 amps.

350 File Motor Starting Characteristics

230 volts 3∅ starting current: 27 amps.
full speed current: 3.4 amps.

208 volts 3∅ starting current: 24 amps.
full speed current: 2.9 amps.

350 File Power Requirements

(Motor Drive)

2 HP file motor: 3.7 amps @ 208 volts.

¾ HP compressor motor: 3.7 amps @ 208 volts.

½ HP compressor blower motor: 2.0 amps @ 208 volts.

⅓ HP access motor.

Average full load per phase at:

208 volts 3∅, 13.5 amps.

230 volts 3∅, 14.0 amps.

Customer's fuse size: 3-30 amps.

Note: The above figures are approximate.

Source Power

Voltage: Source voltage may have a total variation of ±10% of the rated voltage, including transient and steady state.

Frequency: The line frequency must be 60 cycles per second, ±½ cycle per second.

Weights

Unit	*Total*	*L-End*	*R-End*
305 Processing Unit	1,945	1,075	870
323 Card Punch	760	385	375
340 Power Supply	1,810	905	905
350 Disk Storage Unit	2,140	878	1,262
370 Printer	985	370	615
380 Console	1,015	595	420
Remote Air Compressor	600	300	300
SYSTEM TOTAL	9,255 lbs.		

Unit Dimensions

Assembled, With Covers

Unit	*Length*	*Depth*	*Height*
305 Processing Unit	65″	32″	73″
323 Card Punch	44″	32″	51″
340 Power Supply	32″	32″	73″
350 Disk Storage Unit	65″	32″	73″
370 Printer	57″	32″	42″
380 Console	62″	32″	47″
Remote Air Compressor	39″	32″	29″

Without Covers

Unit	*Length*	*Depth*	*Height*
305 Processing Unit	60″	29″	68″
323 Card Punch	38″	23″	49″
340 Power Supply	29″	29″	68″
350 Disk Storage Unit	60″	29″	68″
370 Printer	54″	29″	41″
380 Console	60″	29″	42″ W/O typewriter 47″ W typewriter
Remote Air Compressor	39″	32″	29″

Environmental Requirements

Temperature

For system operational periods, the air temperature entering the RAMAC 305 system must be between 50° and 90° F. During non-operational periods when power is OFF, the room temperature must be maintained between 50° and 110° F. However, the air temperature must be brought within the range of 50° and 90° F before the system is started. Air cooling will be required in those installations where the air, as it enters the system, exceeds 90° F.

Humidity

The relative humidity of the air in the installation area must not exceed 80%. This limit should not be exceeded during operational or non-operational periods.

Air Filtration

Normal filtration of the area, for dust control, can be met with filters that have an efficiency rating of 20% by the National Bureau of Standards Discoloration Test method.

Special air filtration is necessary in only those installations which will be subject to corrosive gases, salt air, or unusual dirt or dust conditions.

Note: The preceding material is for your information only. Any problems of location, air conditioning, or power *must* be referred to District Physical Planning.

Special Tools and Supplies

Shipping Group

This list contains special tools and supplies which will be sent with the machine from the factory. These tools will be kept at the installation.

Item	*Part Number*
Air line service assembly	2108006
Control panels and test deck	2108074
Wired 305 control panel	2108060
Wired 380 control panel	2108061
Punched card test deck	2108069

Item	*Part Number*
Wired 370 control panel	2108066
Wired 323 control panel	2102499
Diagnostic Function Test Manual	2108062
File Test Deck	2108226
Disk cleaning paddle	2108010
Drum head extensions (2)	2108043
Fuse puller	73478
Gage, brass feeler .001 (5)	2108142
Gage feeler	2108056
Head cleaning kit	2108311
Adaptor, gram gage	2108075
Bottle for 4 oz. Isopropyl Alcohol. Purchase alcohol locally Specify 70% or better	2108055
Box, plastic kit	2108312
Brush	2108025
Cloth tool carrier	2108313
Drill, No. 56	450037
and/or	2108018
Dropper	2108021
Nipple cover, arm air inlet	2108023
Plastic tube tool	2108305
Plate, test .125" nominal	2108024
Tissue, cleaning	2108036
Tweezer	2108014
Wire probe holder	2108316
Manuals	
System Diagrams Vol. I	2104808
System Diagrams Vol. II	2104808
System Diagrams Vol. III	2104808
Component Circuits Manual	2104962
Customer Engineering Reference Manual	227-3533-0
Typewriter Reference Manual	22-6652
Remote cycling box	2100937
Single shot adjusting tool	2108031
Spacer, magnetic drum head track	2108042
Test lead, black	2108050
Test lead, red	2108049
Test lock key	2102067

Office Tools

The following tools will normally be located in the branch office and can be obtained when needed.

Item	*Part Number*
Disk replacement tool kit	2108058
Adaptor, hex socket	2108040
Bolt, pull down (3)	2108041
Clamp, disk positioning	2108314
Crutch tip	2108051
Disk position indicator	2108004
Gage block, clamping	2108002
Holder, rotating shaft	2108052
Nut, 3/8" (3)	22349
Puller assembly, disk array	2108008
Tool assembly, disk install	2108027
Washer, 3/8" (3)	45740
Wrench, spider locknut	2108001
Wrench, tee handle with 5/16" hex	2108000
Wrench, torque	2108039
Emitter gage kit (C.E.M. #2043)	454337
Meter, Simpson	450497
Meter, 904 Weston (or equivalent; requires iron vane meter with low range voltage scale)	460880
Wrench, 10 inch adjustable	450177

Tools in Each 305 Installation

This list contains the tools and supplies which are not shipped with the machine and should be ordered for each installation.

Item	*Part Number*
Dynamic timer power pack assembly	454105
Probe, additional attenuator scope	450857
Probe, direct coaxial scope	460852
Remote start key	454304
Scope clip assembly, black	2108156
Scope clip assembly, red	2108157
Scope dual input switch	450934
Scope, 310 Tektronix and accessories	450841
Adaptor, B.N.C. to U.H.F.	450837
Probe, attenuator	450857
Test lead, 10′ black	450840
Test lead, 10′ red	450839
Binding post adaptor	
Filter	
Instruction Manual	
Viewing hood	

Section 2. 305 Process Unit

Marginal Voltage Tests

Preventive Maintenance

The 305 Process Unit funtion test should be run at periodic intervals. The machine should perform properly under the prescribed marginal voltage conditions. Correct any malfunction indicated by a function test failure.

Limited Marginal Voltage Checks

Run the diagnostic function test at least once for each DC voltage at the levels listed below:

+140v at +147v
+140v at +133v
−250v at −235v
−250v at −265v

Extended Marginal Voltage Checks

Run the diagnostic function test at least once for each DC voltage at the levels listed as follows:

+70v at +75v
+70v at +65v
−60v at −54v
−60v at −66v
+48v at +53v
+48v at +43v
+270v at +285v
+270v at +255v

Single Shots (Adjustable)

Adjustment

NOTE: A chart in Section 12 shows the factory settings of the machine. This chart includes the setting of the clock track gap, file oscillator gap, process and disk phase A, B, and C.

Process Unit Clock Phases

ϕA pluggable unit 1Y2 (1.01.01) (Figure 5)

1. If drum clock track has already been written, proceed with step 6.
2. If clock track is not yet written, it will be necessary to drive the single shots with the drum clock oscillator.
3. Check the drum clock oscillator frequency and adjust if necessary (See "Clock Track").
4. Disconnect drum clock amplifier from single shots by removing 1Zd end of connector between edge connector 1Zd and 4Ky or 5Mx (3.10.30).
5. Connect drum clock oscillator to single shot drive. 1Zc (1.01.00) to 1Zd (3.10.30).
6. Set scope triggering mode to external plus and trigger with the rise of ϕC at 1Xc (1.01.01).
7. Observe ϕA at 1Xa (1.01.01) and adjust 1Y2 (1.01.01) for a pulse length of 2.25 μs (+.25, −0) at the zero volt level (See Figure 5). The pulse length is adjusted by inserting the single shot adjusting tool (#2108031) through the base of the adjustable inductance tank unit (CU302) and turning clockwise to increase the pulse length and counterclockwise to decrease.
8. Restore all temporary edge connector connections to normal.

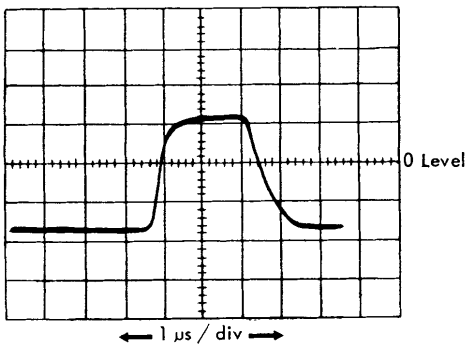


Figure 5. Process Unit Clock ϕA (1Xa) 2.25 +.25, −0 μs

ϕB pluggable unit 1W2 (1.01.01) (See Figure 6):

1. Set the scope triggering mode to EXTERNAL PLUS and trigger with the rise of ϕA, 1Xa, (1.01.01).

2. Observe ϕB pulses at 1Xb (1.01.01) (See Figure 6).

3. Adjust 1Wq for a ϕB pulse length of 3.5 μs (+.25, −0) at the zero volt level. Use ϕA procedure, step 7.

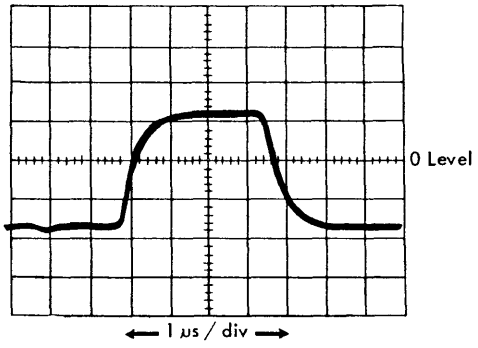


Figure 6. Process Unit Clock ϕB (1Xb) 3.5 +.25, −0 μs

ϕC pluggable unit 1S2 (1.01.01) (See Figure 7):

1. Set the scope trigger mode to EXTERNAL PLUS and trigger with the rise of ϕB at 1Xb (1.01.01).

2. Observe ϕC pulses at 1Xc (1.01.01) (See Figure 7).

3. Adjust 1S2 for a ϕC pulse length of 3.0 μs (+.25, −0) at the zero volt level. Use ϕA procedure, step 7.

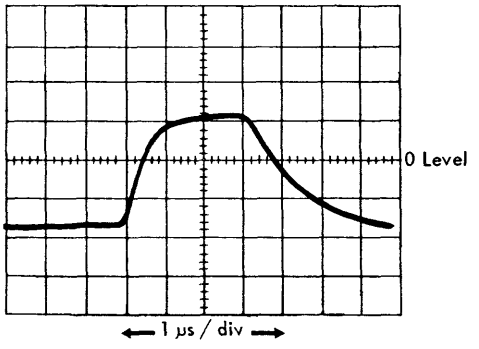


Figure 7. Process Unit Clock ϕC (1Xc) 3.0 +.25, −0 μs

DISK CLOCK PHASES

The disk ϕA, B, and C pulses should be adjusted in sequence. Disk ϕA must be adjusted first.

Disk ϕA pluggable unit 2T8 (3.01.02):

1. If the machine is in condition to read and write on the file, program it to continuously read from the file and proceed with step 5 to adjust the disk phases.

2. If the machine is not in condition to read and write on the file, the write oscillator must be connected to drive the phase circuits.

3. Remove 2C7 and 2F8 (3.01.01).

4. Tweak trigger 2E7 (3.01.01) ON (pin 10 high) (See Section 8 for triggers).

5. Set the scope triggering mode to EXTERNAL PLUS and trigger with the rise of disk ϕC at 3Zd (3.01.02).

6. Observe disk ϕA pulses at 3Zb (3.01.02) (See Figure 8).

7. Adjust 2T8 (3.01.02) for a pulse length of 2.25 ±.25 μs at the zero volt level. Use Process Unit, ϕA procedure, step 7 (Figure 8).

8. Replace the pluggable units that may have been removed in step 3.

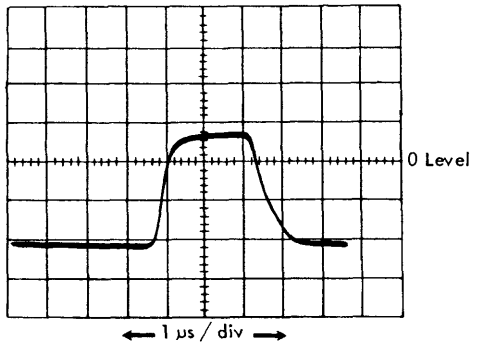


Figure 8. Disk Clock ϕA (2U6-3) 2.25 ± .25 μs

Disk ϕB and ϕC (2W6 and 2V8, 3.01.02):

1. Obtain a phase drive. See disk ϕA, steps 1 and 2.

2. Set scope triggering mode to EXTERNAL PLUS and trigger with the rise of disk ϕA, 3Zd (3.01.02).

3. Observe disk ϕB pulses at 3Zc (3.01.02).

4. Adjust 2W6 (3.01.02) for a disk ϕB pulse length of 2.25 ±.25 μs at the zero volt level (See Figure 9). Use process unit clock, ϕA adjustment procedure, step 7.

5. Trigger scope with the rise of disk ϕB at 3Zc (3.01.02) and observe disk ϕC pulses at 3Zd (3.01.02).

6. Adjust 2V8 (3.01.02) for a disk ϕC pulse length of 3 ±.25 μs at the zero volt level (See Figure 10).

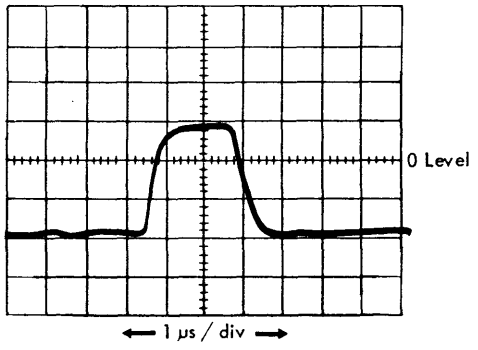


Figure 9. Disk Clock ϕB (3Zc) 2.25 ± .25 μs

7. Trigger the scope with the rise of disk ϕA, 3Zb (3.01.02) and alternately observe disk ϕB (3Zc) and disk ϕC (3Zd). The phase pulses should not overlap at a point more positive than −20 volts.

8. Replace the pluggable units if previously removed from 2C7 and 2F8 (3.01.01).

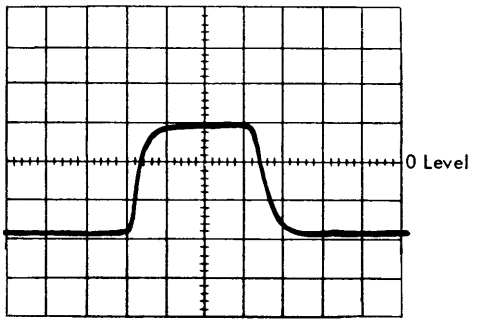


Figure 10. ϕC (3Zd) 3.0 ±.25 μs

DISK CYCLE GATE READ DELAY (FIGURE 12)

1. Program the machine to read a record from the file repetitively.

2. Observe the disk cycle gate read delay signal at 2R1 pin 10 (3.01.05). Sync on INTERNAL PLUS.

3. Adjust 2R2 (3.01.05) for a 4.0 ±.25 μs pulse width at the 50% voltage level. Use the process unit clock ϕA procedure, step 7.

CORE BUFFER READ GATE AND WRITE GATE (4.10.00)

These gates should be 3 to 3.5 μs at the zero volt level. Program the machine for any track to track transfer.

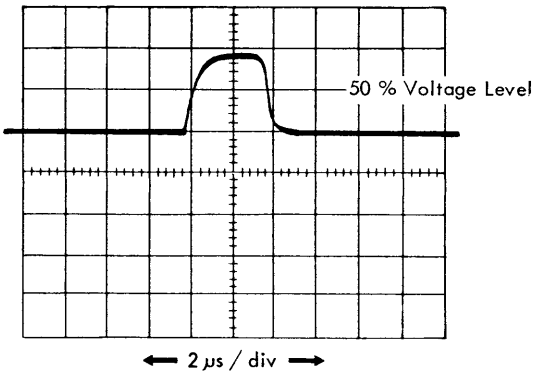


Figure 12. Disk Cycle Gate Read Delay (2R1-10) 4.0 ±.25 μs

1. Sync the scope with core bit R (4H6-7) and observe the read gate at 4L5-3. Adjust 4J5 if necessary.

2. Sync the scope with core start (4H6-9) and observe the write gate at 4L5-10. Adjust 4K6 if necessary.

Single Shots (Non-Adjustable)

(Figures 11 and 13)

All single shots (non-adjustable) are to be checked for their tolerance at 50% amplitude level. If they are not within tolerance replace the unit.

To observe the above pulses use the following procedures.

CAUTION: Always test these pulses with the remote cycling box plugged in and test lock ON.

1. Disk Read Delay: Sync on R cycle record start (2W2a, pin 6) while performing a file read operation.

2. Control Level Gate: Sync on 2C6 pin 6 while performing a file write operation.

(2V2-3.01.05) (2C6-3.01.01) (2S4-3.01.05) (2U1-3.01.07)

Type of File or System	Disk Read Delay	Control Level Gate	Disk Write Delay	Disk Write Turn Off	Gap
Gear Driven	180 ± 27 μs	--------	300 ± 45 μs	180 ± 27 μs	500 ± 50 μs
Shaft Motor File See logic pages above for correct timing.	180 ± 27 μs	--------	300 ± 45 μs	180 ± 27 μs	600 ± 50 μs
Shaft Motor File See Logic pages above for correct timing.	360 ± 40 μs	200 ± 20 μs	400 ± 40 μs	180 ± 27 μs	1200 ± 100 μs
Dual File-One Gear Drive & one shaft motor drive.	180 ± 27 μs	-------- (Adjust gap to the fastest file-Gear Drive)	300 ± 45 μs	180 ± 27 μs	500 ± 50 μs
Dual file both shaft motor drive	(Adjust according to machine level (See shaft motor adjustment above.)				
Dual Processing	360 ± 40 μs	200 ± 20 μs	400 ± 40 μs	180 ± 27 μs	1200 ± 100 μs
Dual Access	360 ± 40 μs	200 ± 20 μs	400 ± 40 μs	180 ± 27 μs	1200 ± 100 μs

Figure 11. File Gates and Oscillator Timings

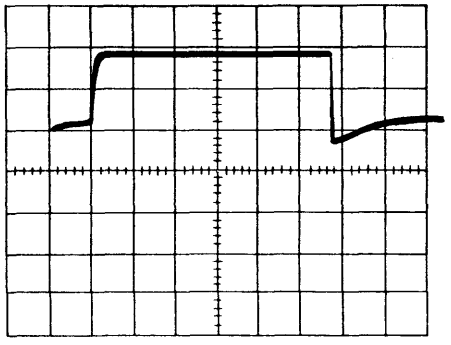


Figure 13. Disk Write Delay (2S4-3) 300 ±45 μs

3. Disk Write Delay: Sync on 2S4 pin 6 while performing a file write operation (Figure 13).

4. Disk Write Turn-Off: Sync on 2U1 pin 6 while performing a file write operation.

OTHER NON-ADJUSTABLE SINGLE SHOTS

Should be ± 15% of the value listed in "System Diagrams." Replace unit if not within tolerance at 50% amplitude level.

File Speed Interlock Single Shot (3.01.08)

(Figure 14)

NOTE: This will be on later machines.

Adjust the duration of the IN307 at 4Y2 as follows:

1. After the file has been running at least one hour, check the voltage to the file motor. Record it.

2. Run the file RPM test deck (PN 2108183) with the 305 DFT control panel. Follow the typed out instructions.

3. The file must be running at or above one of the following speeds.

	Nominal Voltage	
	208v	220v
Drawer file—single access	1240 RPM	1245 RPM
Gate file—single access	1191 RPM	1192 RPM
Gate file—dual access	1171 RPM	1174 RPM

4. Using the curve in Figure 14, determine the value "t" for the voltage recorded in Item 1.

5. Set up the system to constantly repeat X99R-99000b writing on a CE track.

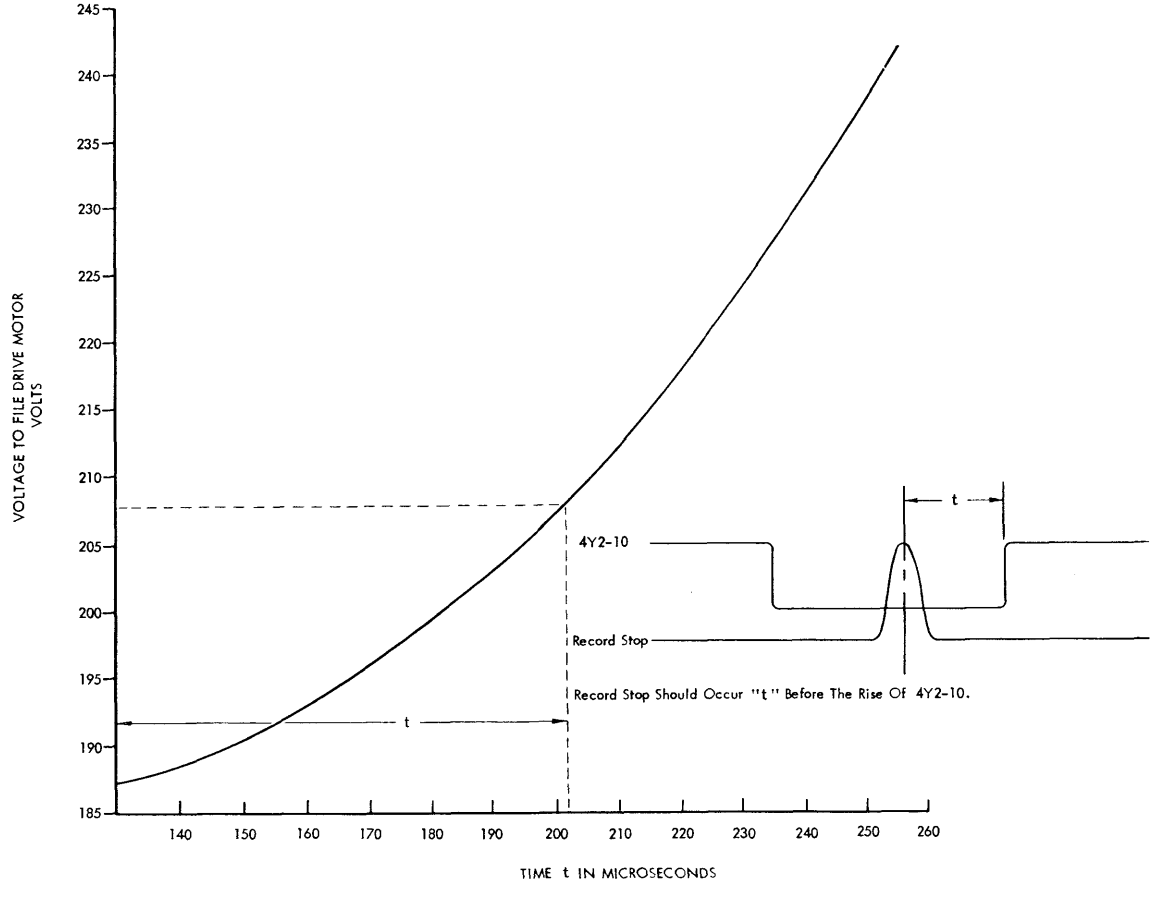


Figure 14. File Speed Interlock

6. Sync the scope on W cycle, core 98, and store check (1Aa on 3.01.05).

7. Observe the single shot output at 4Y2-10 (3.01-.08) and record stop at 4Yd (3.01.08). The record stop pulse should occur while 4Y2-10 is low.

8. Adjust the one meg pot between 4Z1-9 and 4Y2-6 (3.01.08) so that the center of the record stop pulse will occur "t" time ahead of the rise of 4Y2-10. Use the "t" value determined in Item 4 (See Figure 14).

To test that the file speed interlock circuits are operating correctly:

1. Set up the system to repeat the program X99-R99000b with test lock ON. Start the program.

2. Set the file control switch to LOCAL.

3. Depress the file desk drive motor stop button.

4. The neon at 4Z1 and the file check light should glow within 30 seconds.

Mercury Relays

The mercury relays used in the RAMAC are not to be adjusted. Replace if they do not operate within the tolerances prescribed on the "Systems Diagrams" timing charts.

CAUTION: Do not open the metal cover of a mercury relay. The glass envelope contains mercury and is sealed under pressure. Exercise great care in the disposition of defective relays. Defective MR relays shall be disposed of in accordance with local safety regulations.

TESTING PROCEDURE

1. Program the machine so mercury relay to be tested will be used (see chart, Figure 15).

Relay	Contact	Machine Program	MR Pick or Drop Pulse		Points	Scope Sync Point	
			Make	Break	Make or Break	Make	Break
MR-1 2.09.01	N/C	A99B99001 P exit to repeat *	3M2-3 2.09.01	3M2-10 2.09.01	10-1b 2.09.10	3M4b-7 P cycle 2.09.01	3G5-7 D cycle 2.09.01
MR-2 2.09.01	N/C	Same as for MR-1	3N2-5 2.09.01	3N2-10 2.09.01	10-2b 2.09.10	3F3-5 R cycle 2.09.03	3M4-10 P cycle F4 2.09.01
	N/O	Same as for MR-1	3N2-10 2.09.01	3N2-3 2.09.01	10-2c 2.09.10	3M4-10 P cycle F4 2.09.01	3F3-5 R cycle 2.09.03
MR-3 2.09.01	N/C	A99-99001 P exit to repeat *	3M3-3 2.09.01	3M3-10 2.09.01	10-3b 2.09.10	1 FW W cycle 1.03.06	1 Gc I cycle 1.03.04
MR-4 2.09.03	N/O	A04J99051 P exit to repeat *	3F2-10 2.09.03	3F2-3 2.09.03	10-4c 2.09.10	3N4-6 R cycle 2.09.01	3G5-5 D cycle 2.09.03
MR-5 2.09.03	N/C	Same as for MR-4	3H2-10 2.09.03	3H2-3 2.09.03	10-5b 2.09.10	3J3-7 2ndDcycle 2.09.03	3N4-6 R cycle 2.09.01
MR-6 2.09.03	N/O	Same as for MR-4	3G5-3 2.09.03	3G5-3 2.09.03	10-6c 2.09.11	3G1-6 P cycle end 2.09.03	3G5-5 D cycle 2.09.03
MR-7 2.09.02	N/O	A99B99001 P exit to repeat *	3J1-6 2.09.02	3J1-6 2.09.02	10-7c 2.09.11	3J4-7 D cycle 2.09.02	3N3-7 P cycle end 2.09.01
MR-8 2.09.02	N/O	Same as for MR-7	3G2-10 2.09.02	3G2-3 2.09.02	10-8c 2.09.11	1 Dc Wcycle end 1.03.06	3J4-6 D cycle 2.09.02
MR-9	N/O	A99B99001 P exit, not plugged, Machine cycling DDP *	3K2-10 2.09.02	3K2-3 2.09.02	10-9c 2.09.11	3F3-8 P cycle 2.09.02	3G3-8 2nd D cycle 2.09.02
MR-10 2.09.02	N/O	Same as for MR-9	3L2-10 2.09.02	3L2-3 2.09.02	10-10c 2.09.11	3K3-6 2ndD cycle 2.09.02	3J1-6 P cycle 2.09.02
	N/C	Same as for MR-9 Pick R1048 and R1090 in Console	3L2-3 2.09.02	3L2-10 2.09.02	10-10d 2.09.11	3J1-6 P cycle 2.09.02	3K3-6 2nd D cycle 2.09.02
MR-11 2.09.02	N/C	A99B990012 P exit to repeat *	3L3-3 2.09.02	3L3-10 2.09.02	10-11b 2.09.11	3N4-8 W cycle 2.09.01	1Gc I cycle 1.03.04

* By writing these Instructions in Prog. Step 10 and using the DFT Board, The Program will be set up to Repeat.

Figure 15. Mercury Relay Timing and Sync Points

2. Trigger the scope with proper signal and set sweep time to desired setting.

3. Observe and record wave shape and time of pulse used to pick or drop relay.

4. Move input probe and repeat step 3 for make or break of mercury relay points (2.09.10 or 2.09.11).

5. Compare the time difference between 3 and 4 and the established tolerances on the timing chart (0.09.03, 0.09.08).

6. Replace if necessary.

Filament Transformers

Adjustment

Two Main Transformers

Check filament voltage of pluggable units supplied by the transformer in question with the Iron Vane AC Meter (Weston #904, part #460880) capable of measuring RMS values of non-sinusoidal voltages.

1. Measure the voltage between pins 1 and 2 of a centrally located pluggable unit in the upper and lower halves of each panel served by the transformer. Main filament transformer #1 serves panels 4, 5, 7, and 8. Main filament transformer #2 serves panels 1, 2, 3, and 6. All filament voltages must be 6.3 ±.3 volts.

2. All voltage readings of panels served by the same transformer should be within ±0.1 volts.

3. If all voltage readings of all panels served by the same transformer indicate the same discrepancy, and are not within the 6.3 ±0.3 volt limit, proceed as follows:

a. Never move the primary leads on tap 1 (common connection) of the filament transformers.

b. Move the primary leads one tap higher to decrease or lower to increase the secondary voltage by 2½%.

c. Do not separate the tapped leads on #1 main transformer, when moving them, if the secondary voltage on the special transformer is correct. (The special transformer connecting wire is size #16 and the #1 main transformer connecting wire is size #14.) Always check secondary voltage of special transformer after adjusting #1 main transformer (See "Special Transformers" and Figure 16).

Special Transformers

1. Adjust #1 main transformer first.

2. Check voltage across pins 7 and 8 of 2L4, 2U10, 2U11, 4R5, 4R3, and 7M6. (These units are served by the special filament transformer.) CAUTION: The cathodes of these units are connected to −250 volts DC level. The secondary winding of the special filament transformer is ungrounded and biased to a −170 volt DC level. This is necessary to avoid exceeding the allowable heater to cathode potential of these units.

3. Move size #16 wire (smaller of the two) primary lead on #1 main transformer one tap higher to increase, or lower to decrease, the secondary voltage on the special transformer 2½%. Do not move the leads on #1 tap of main transformer (See Figure 16).

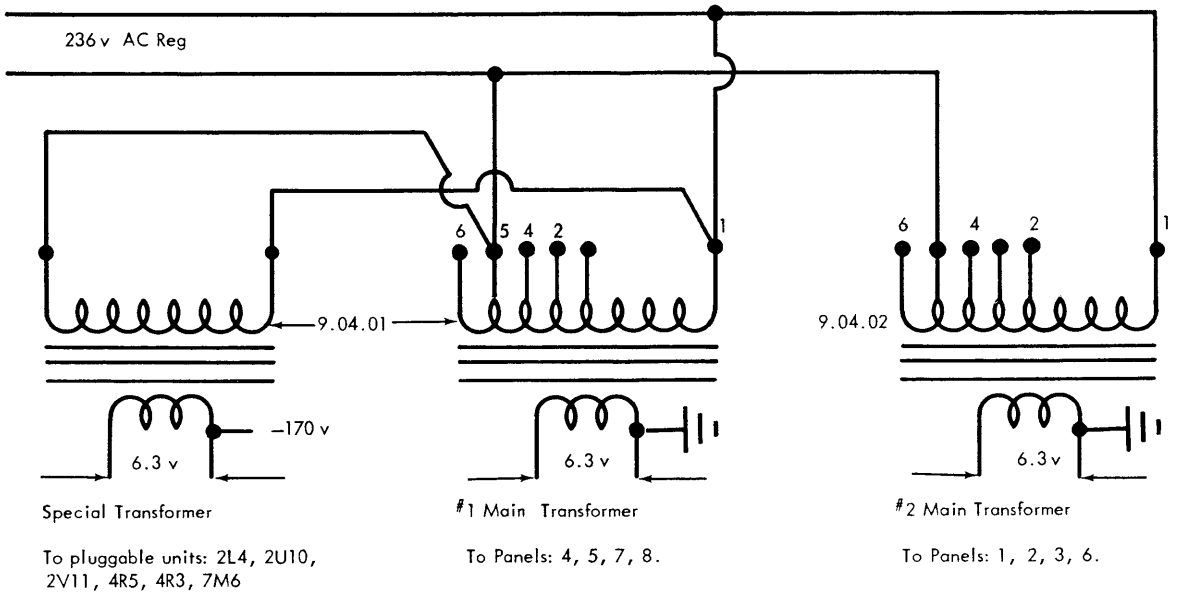


Figure 16. Filament Transformers

Clock Track

Process Drum Clock Oscillator (Figure 17)

1. The drum clock oscillator frequency determines the gap length of the clock track. This frequency should be approximately 83 kilocycles.

2. Set the scope to internal triggering mode and observe the signal at 1J4 pin 3 (1.01.00). A cycle should be 12 μs long (See Figure 17).

3. Adjust by inserting the single shot adjusting tool (#2108031) through the base of 1J1 (1.01.00) and turn clockwise to decrease the frequency or counter-clockwise to increase the frequency. A ¼ turn will cause approximately 60 μs change in the gap length of the clock track (with a CU 303).

Write Clock Track (Figures 18 and 19)

NOTE: Check "System Records" (Section 12) and check the duration of the old clock track gap. If the new gap is written to agree, it may not be necessary to readjust the PP and accumulator read heads.

To write the clock track, it is necessary to connect the oscillator output to the clock head. Since there is no circuitry to the clock head write coil, the K1 cable is substituted on the clock head during the erase and write procedure. The following procedure makes the necessary circuit changes and outlines the proper procedure to write a new clock:

1. Turn off DC at sync box.

2. If the clock writing P.U.'s (1J1, 1J2, 1J3, 1J4, 1J5, and 1K1 on 1.01.00) have been removed from the machine, the following P.U.'s can be substituted if it becomes necessary to write the clock.

For			Use:		
	1J2	(CV302)		1H5	(1.02.09)
	1J3	(IN306)		1T11	(1.02.02)
	1J4	(CF301)		1W11	(1.02.01)
					(1.02.06)
	1J6, 1J5	(TR307)		1U11	(1.02.01)
	1K1	(DF303)		1V11	(1.02.01)

NOTE: For the oscillator 1J1, (CU 303, CU 306, CU 306a, or 306b) a P.U. from available stock should be used.

3. Isolate the clock track amplifier by disconnecting the wire between 1Zd (3.10.30) and 5Ky or 5Mx (3.10.30) at 1Zd.

4. Install the following temporary jumpers (See Figure 18):

   a. 1Ha (1.01.17) to 1Hc (1.01.02). This connects the trailing edge of CL to the clock error trigger.

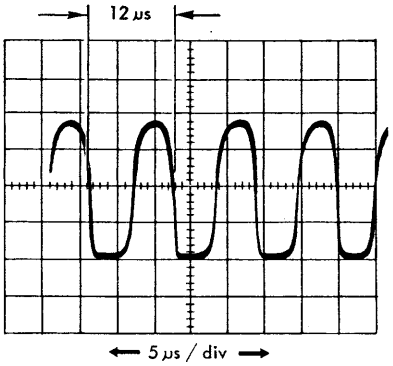


Figure 17. Process Drum Clock Oscillator (1J4-3)

   b. 1Zc (1.01.00) to 1Zd (3.10.30). This connects clock oscillator output (83Kc) to the phase generating circuits.

   c. 1Ja (1.01.00) to 1Jd (1.01.06). This connects ϕA clock write pulses to character and field ring control.

   d. 5Qy (1.01.00) to 5Qz (3.10.20). Clock write pulses to K1 write current drivers

   e. 5Zw (0.01.42) to 5Tz (7.22.04). +140 volts to K1 circuitry to erase clock track when DC is applied.

   f. Remove clock track drum head cable connector.

   g. Move cable from the K1 head to the clock track drum head.

   h. Remove the unit at 1G1.

NOTE: Put plastic cover back on drum to keep wind turbulence down.

5. Apply DC. This will erase the clock track.

6. Check ϕA width.

   a. Width of clock track pulses are determined by the width of ϕA at the time the clock track is written.

   b. Adjust as necessary using process unit clock ϕA adjustments.

7. Manually reset the machine.

8. Turn off DC at sync box (wait 30 seconds).

9. Replace the unit at 1G1.

10. Remove the jumper between 5Zw and 5Tz. This removes erase voltage.

11. Apply DC (Wait 30 seconds).

12. Depress program start key. The character and field rings should run through one drum cycle sequence and stop. The clock track should be written.

13. Turn off DC and then remove the temporary jumpers and replace the connection between 1Zd and 5Ky or 5Mx.

14. Move cables back to the proper drum heads.

15. Check the clock track gap (See Figure 19).

   a. Apply DC.

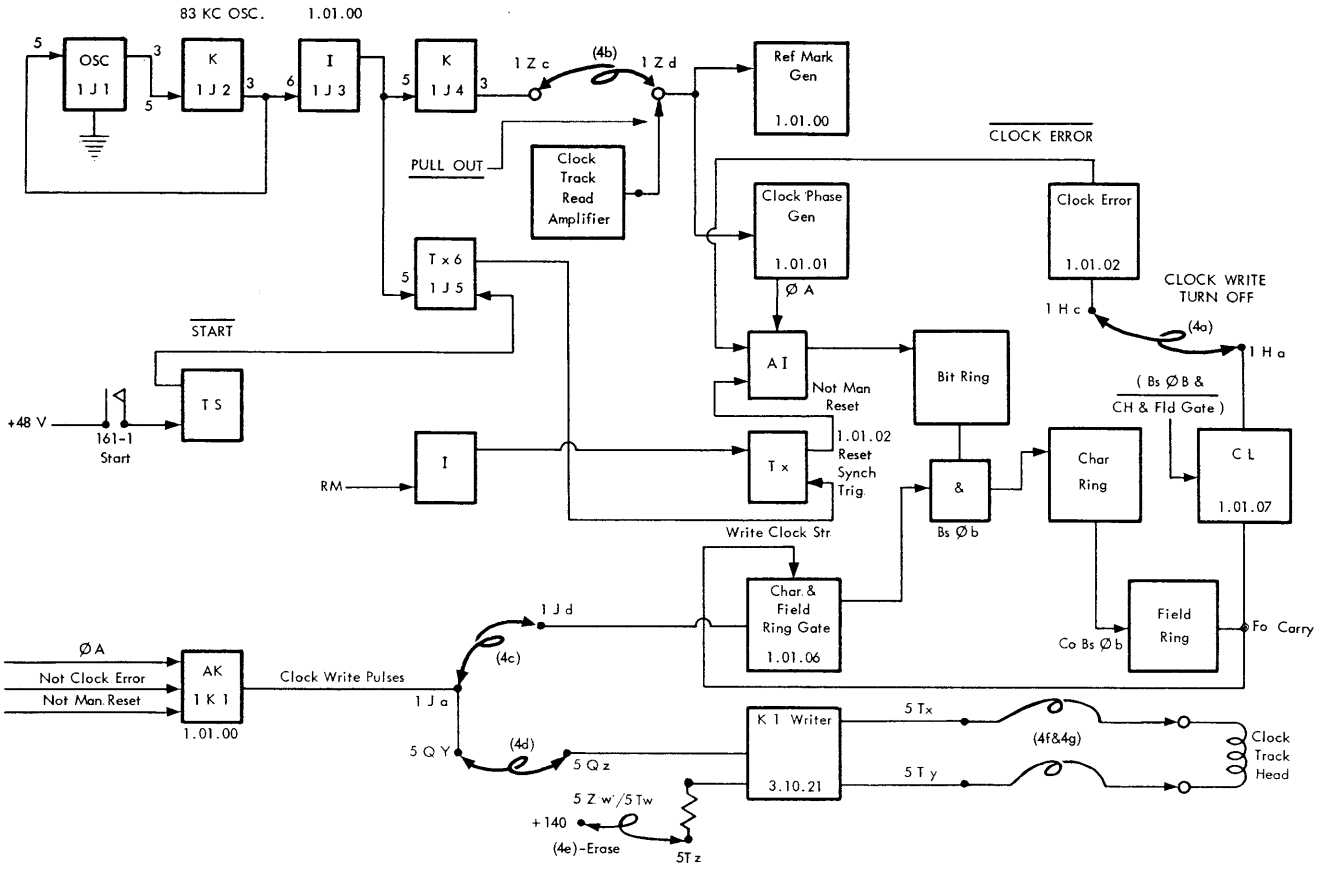


Figure 18. Temporary Wiring and Logic for Writing Clock Track

b. Trigger scope with the rise of C00.
c. Set sweep at 50 μs/division.
d. Observe clock read amplifier output at 1Zd (3.10.30).
e. The gap should be 210 $\pm$20 μs long (See Figure 19).

NOTE: If the frequency is extremely low, there may not be a gap present. It will be necessary to rewrite the clock track at an increased frequency.

16. If the gap is not 210 $\pm$20 μs long, change the oscillator frequency following the procedure under "Clock Track" or see service hint below and rewrite the clock track. Repeat until the clock gap tolerances have been achieved.

Service Hint: If the gap is present, but is not the correct length, the following procedure will help set the oscillator to nearly the correct setting.

a. Determine the number of microseconds change needed.
b. Connect a 330 micro-microfarad (Part #2102298) capacitor, or similar size, between 1Hw (1.01.09) and 1J1 pin 8 (1.01.00). This will squash the oscillator frequency during field 9 of every drum cycle.
c. Connect scope to 1J4 pin 3.
d. Sync on character 00 and display 2 drum revolutions (2 millisec/division) to verify the squashing action.
e. Reset scope time to 10 microseconds/division.
f. Adjust the oscillator at 1J1 and move the oscillations the desired number of microseconds. Moving the oscillations to the left increases the gap, to the right decreases the gap.

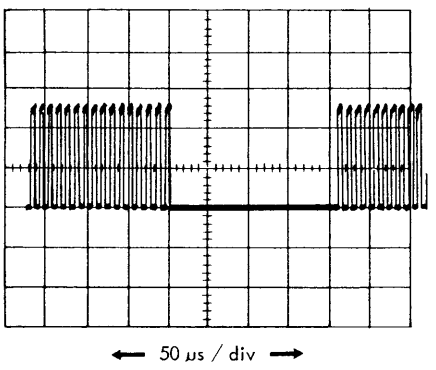


Figure 19. Clock Track Gap (1Zd) 210 $\pm$20 μs

g. Rewrite the clock track with the new oscillator frequency.

17. After writing a new clock track, it will be necessary to recheck the adjustment of the accumulator and partial product heads (See "Drum Head Adjustments").

18. Replace P.U.'s in original places.

19. The P.U.'s used for substitution (step 2) are mainly from the inquiry circuits. A manual inquiry should be made to insure that all P.U.'s were replaced in the proper locations.

20. Measure the clock track head output at Pin 7 of 5M11 (3.10.30). It should be 2.6 to 4.0 volts. With this input, a properly adjusted clock read amplifier will give an output of 90 volts minimum at pin 10 of 5M10 (3.10.30).

File Clock Oscillators

ADJUSTMENT

This adjustment sets the frequency of the write oscillator for the correct gap between records. It sets the second oscillator to the same frequency. (See Figure 13 for the correct gap time.)

NOTE: These oscillators are initially adjusted in the factory and should not need further adjustment. Any frequency change made after the system has been used by the customer might affect reading the data previously recorded on the disks.

WRITE OSCILLATOR ADJUSTMENT (FIGURES 11, 20 AND 21 OR 22).

NOTE: In dual file operation, where a gear driven and shaft motor file are used, the gap should be set to the faster (gear driven) file.

1. Turn on CE Test Lock.
2. Clear Q.
3. Alter Q.
   a. Write a "G" in character 01 of Q track; space over all other characters.

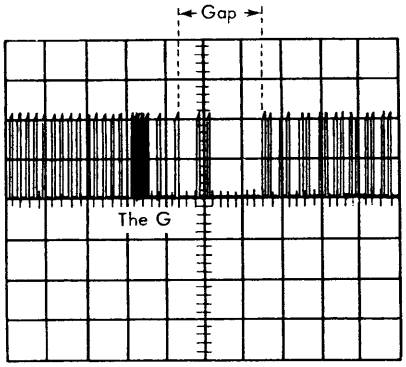


Figure 20. Write Oscillator Adjustment

4. Write this on track A.

5. Program machine: In program step 000, write A99R99000b. 0 flag wired back to repeat same program.

6. Plug in CE test box and turn the parity switch to NO.

7. Execute program loop.

8. Machine will cycle IRWRWDPIRWRWDP, etc.

9. AND Core Char. 0
   Core F8 From CE Sync Box
   W Cycle
   Not Store Check (1Aa-3.01.05)

NOTE: This gives you a sync start toward the end of the 2nd cycle. Core 80 is used as a starting point in case the file write oscillator is too slow, in which case, you would never get to core position 96-97-98-etc.

10. Connect input to scope at 2Fz (3.01.01).

11. Time per division: 1 millisecond.

12. If you can see the "G" (bright spot), change core switches to core character 97 and proceed with step 13 (Figure 20). If not, increase the oscillator frequency by inserting the single shot adjusting tool into the base of the pluggable unit at 2D6 (clockwise decreases oscillator frequency) until the "G" appears, then proceed with step 13.

13. Set time per division to 100 μs per division.

14. Set true gap by adjusting oscillator frequency at 2D6 (See Figures 11 and 21 or 22 for correct gap setting).

15. The 2nd oscillator must be readjusted.

SECOND OSCILLATOR ADJUSTMENT (2E6 and 2F6b, 3.01.01)

1. Program machine to continue to read the CE track record that was previously written. (Check to insure that the file active relay R219 on 8.10.04 is picked.)

2. Trigger scope with sync box core 00 pulse, set sweep time to 10 μs/division, and observe negative OR 2G7 pin 5 output (3.01.01).

3. Adjust oscillator tank circuit 2E6 (3.01.01) for minimum distortion at point where oscillators switch (Figure 23).

4. If difficulty is encountered using the above three step method, an alternate four step method which will set the second oscillator to very nearly the correct frequency is provided below:

   a. Remove DF302 at 2D7 (This allows both oscillators to oscillate).

   b. Using two 10:1 attenuator probes:
      (1) Place vertical input on pin 5 of 2D6.

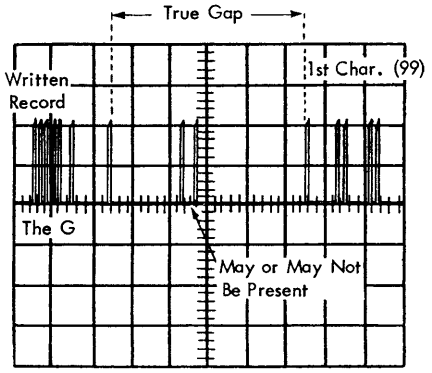


Figure 21. File Gap (No AGC Pulses)

(2) Place horizontal input on pin 5 of 2E6.

(3) Set scope in horizontal input position; adjust vertical and horizontal gain controls for adequate display.

c. Adjust oscillator at 2E6 through an elipse to a 45° line (null). On either side of the null, if the oscillators are wide apart, multiple Lissajous patterns will be observed.

d. Both oscillators are now adjusted to the same frequency and further adjustment may not be required. Check for distortion as outlined in steps 1, 2, and 3 above.

NOTE: The file clock oscillators on systems with dual access or dual process must be tuned accurately. Therefore, the adjustment method using a Lissajous pattern is recommended for these systems.

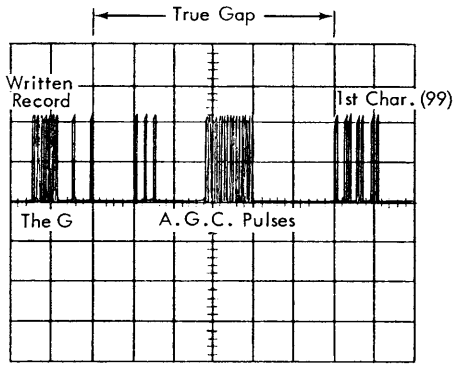


Figure 22. File Gap with AGC Pulses

File Clock Oscillators (Dual Process)

(Figures 13 and 22).

All four oscillators must be set to the same frequency. Set one oscillator to develop a gap of 1200 ±100 microseconds between records. AGC pulses will appear in the middle of the gap. With the first oscillator adjusted, do the following:

1. Remove 2C7 and 2F7 from the system with one oscillator adjusted.
2. Connect 2F6-3 to the vertical scope input. Connect 2F6-10 to the horizontal scope input.
3. Adjust the second oscillator to form a 1 to 1 Lissajous pattern. This makes the frequencies identical.
4. Remove 2C7 from the second system.
5. Move the scope vertical input lead from 2F6-3 of the first system to 2F6-3 on the second system.
6. Replace 2F7 on the first system.
7. Manually flip 2E7 on both systems so their 10 pins are high.
8. Adjust the second system 2D6 to form a similar 1 to 1 Lissajous.
9. Install 2C7 on the first system. Remove 2C7 on the second system.
10. Move the scope vertical input lead from 2F6-3 of the first system and put it on 2F6-10 of the second system.
11. Remove 2F7 from the second system.
12. Adjust 2E6 on the second system for a 1 to 1 Lissajous.
13. Replace 2F7 and 2C7 on the second system.
14. All four oscillators should be at the same frequency.

An alternate method to adjust the oscillators on dual processing is as follows:

1. Adjust master system file ocsillators according to standard oscillator adjustments for a gap of 1200 ±100 μs.
2. Exchange master system 2nd oscillator (2E6) with 2D6 of the slave system.
3. Write on the file with the slave system and check the gap. It should be the same as the gap determined in step #1. A slight adjustment may be necessary to match the gaps.
4. Adjust master system 2nd oscillator at 2E6 (on record written by the master system) as per standard 2nd oscillator adjustment.

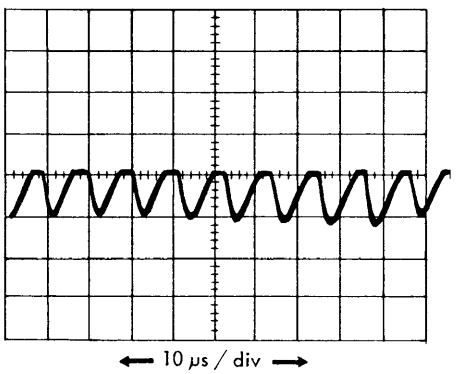


Figure 23. File Clock Oscillators (2G7-5)

5. Adjust slave system 2nd oscillator at 2E6 (on record written by the slave system) as per standard 2nd oscillator adjustment.

6. All oscillators should now be matched and the systems should work using either system to write or read on the file.

Core Plane

Removal (Figure 24)

1. Turn off machine, set DC switch on sync box to OFF.
2. Remove the cover.
3. Disconnect core array connecting cables from panel 4 edge connectors.
4. Remove 4 screws that fasten core array mounting plate brackets to vertical members in 305 Process Unit.
5. Remove core array and place in a convenient location to work on it.
6. Remove 4 plastic plate mounting screws and washers from front of core array.
7. Remove plastic plate.
8. Remove top and bottom connector plug mounting screws for all core planes.
9. Carefully remove top and bottom connectors from all core planes.
10. Remove connector plug mounting screws for right and left connectors of all core planes up to and including the plane that is to be removed.

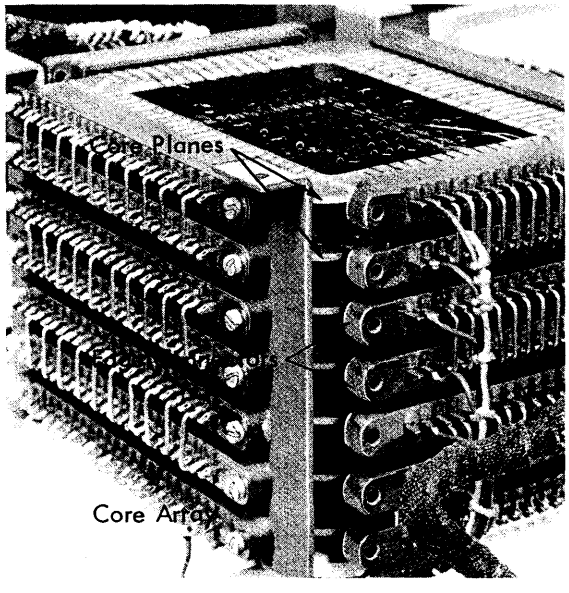


Figure 24. Core Array

11. Use Extreme Caution: Gradually loosen core plane #1 right and left edge connectors and remove them. Remove edge connectors for two planes as an assembly if they are tied together with stiff jumpers.
12. Remove first core plane.
13. Repeat steps 11 and 12 for each succeeding core plane until the desired plane is removed.

Assembly (Figure 24)

1. Install the core planes so the connector contacts will line up properly when the edge connector is installed.
2. The core plane is fragile and must be lined up before the connector assembly can be pressed into position. Considerable pressure must be applied to force the connector into place.
3. Follow the reverse of the removal procedure.
4. Check the machine for proper operation.

Drum Heads

Adjustment

Radial Adjustment

This adjustment applies to all heads (See Figure 25).

1. Do not run drum while making this adjustment.
2. A good drum head should have 27 ±3 ohms resistance between the two outside base pins. If the head is scribed 175 at the base, (K1, K3 and Q) the resistance should be approximately 8 ohms from the center to either outside pin.

Note: Use IBM volt ohmeter, not a Simpson meter, when checking the continuity of heads.

3. Locate and mark high spot on drum.
4. Rotate drum until high spot is directly under head.
5. Place a .001" brass feeler gage (#2108142) between head and drum.

Note: Do not use steel feeler gages for this adjustment.

6. Position the head so its side is flush against the frame aligning shoulder and its pole piece rests against feeler gage blade.
7. Tighten the two head mounting screws alternately with even pressure. Test the tension on the feeler gage blade as the adjustment is being made. (Tightning the screw nearest the drum will tend to clamp the blade; and tightening the outer screw will tend to loosen the blade.) The final adjustment should be:

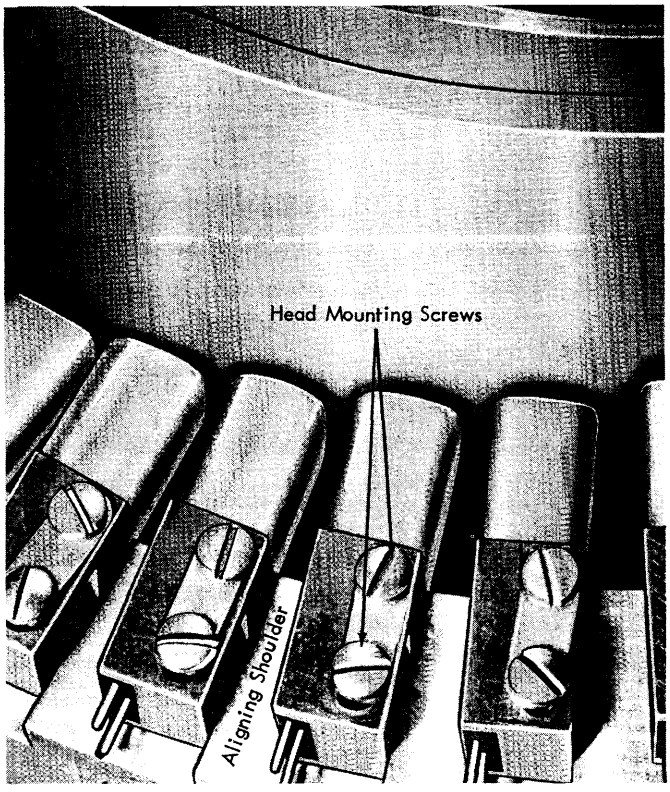


Figure 25. Drum Head Adjustments

a. Both screws tight.

b. Brass feeler gage blade should require light pull to remove (at highest point on drum), but should not be bound tight.

c. Drum should rotate freely with feeler gage removed.

8. Place .001″ brass feeler gage blade between head and drum and manually rotate drum. Check for a minimum head to drum clearance of 0.001″. Readjust head if necessary.

NOTE: The normal clearance is .001″. This can be altered slightly to have the head signal meet the electrical specs. The head should NOT touch the drum, nor have a gap greater than .0015″.

9. The damped waveform voltage of a drum head that is in proper radial position will normally be 1.4 to 1.9 volts peak to peak. Using a scope, observe the signal of a selected head at the edge connector pin of drumhead cable. USE EXTREME CAUTION to avoid ground when observing head signal as head coils burn out very easily. (Most drum heads have one side, or the center tap of their coil, connected to +140 volts or +270 volts).

NOTE: K1, K3 and Q output (175 turns) should be .8 to 1.4 volts peak to peak.

CAUTION: To avoid overheating the thermal overload switch (and possibly the motor windings), the drum should not be stopped and started more than 3 times in 15 minutes.

ACCUMULATOR READ HEAD (PERIPHERAL ADJUSTMENT, (FIGURES 26 AND 27).

(See note at the end of this procedure for machines with an adjustable write head.)

1. Turn off machine power at wall switches, tag them open, and check head radial adjustment.

2. Be sure that the head is against its shoulder and that all the axial slack has been removed from the peripheral adjusting mechanism.

3. Apply power and set up the machine as follows:

a. Turn the test lock ON. Read M to clear accumulator track.

b. Depress the read key then the space bar, this will clear Q track.

c. Depress the alter key and space over to character 99.

d. Depress the 5 key—the typewriter should carriage return. Write L. This places a 5 in character 99 of L track which should be read during character early time.

4. Sync on Reference Mark (20 μ/div) and observe the ϕC pulses at 1Xc. The display should appear as Figure 26a. The first ϕC seen is bit XϕC of character early. The third ϕC is the bit 1ϕC of character early, etc.

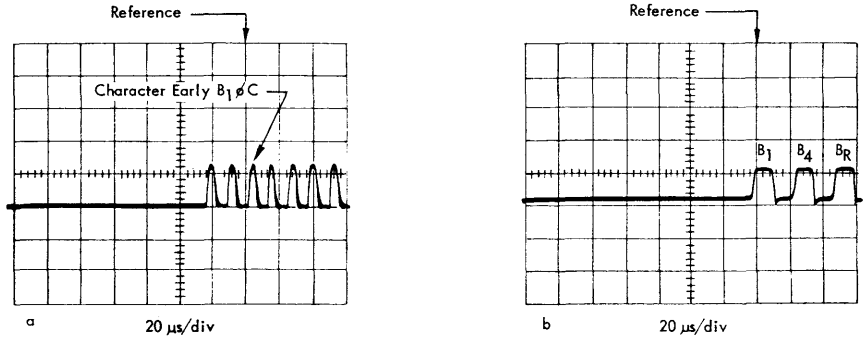


Figure 26. a. ϕC (1Xc); b. Accumulator Read Data (5Nx)

5. Observe accumulator (L) read data at 5Nx on 3.10.42. Note the position of the leading edge of the bit 1 and bit 4 on the accumulator read data (See Figure 26b).

6. If no data appears, the head is more than one character off. The data can be seen by changing the time/division setting to 50 μs/division.

7. The leading edge of bit 1 should come up 4½ ±1 μs before the leading edge of the 3rd ϕc at 0 volt level. Adjust the accumulator read head if not within this tolerance (Step 8).

NOTE: The 5 is used to distinguish the bit 1 from bit R's which are written on the accumulator track. On drum replacements or head replacements it is possible to be a character time or more out of adjustment. The use of this procedure which uses the 5 and the positive identification of character early (Step 4) prevents this condition from occurring.

8. If the accumulator head is out of time, turn off drum motor and adjust as follows:

a. Determine the direction and number of μs the head should be moved. The ratio of thousands of an inch to μs is .00258"/μs. A .005" feeler gage is equal to approximately 2 μs. Moving the accumulator read head closer to the accumulator write head will shift the bit 1 pulse to the left with respect to the ϕC pulses.

b. To move the head counterclockwise:

(1) Loosen adjusting bar clamping screw.

(2) Insert appropriate feeler gage (as determined by step 2) between the bar and the adjusting shoulder.

(3) Slide adjusting bar against feeler gage and tighten the adjusting bar clamping screw. Remove the feeler gage.

(4) Loosen two clamping screws and rotate the assembly until the bar is touching the shoulder on the mounting ring. Tighten the clamping screws.

(5) Check for proper head to drum clearance.

c. To move the head clockwise:

(1) Loosen the adjusting bar clamping screw and push the bar against the mounting ring shoulder, tighten the clamping screw.

(2) Loosen the two clamping screws.

(3) Insert feeler gage as determined by step a between bar and shoulder.

(4) Tighten the two clamping screws.

(5) Check for proper head to drum clearance.

NOTE: On earlier production machines the adjusting bar was not used. On machines with a knurled nut, one turn of the nut results in approximately 10 μs of movement. If neither the knurled nut nor adjusting bar is present, the clamping screws can be loosened and the head moved manually the desired direction and amount.

9. Start drum motor and check timing.

CAUTION: To avoid overheating the thermal overload switch (and possibly the motor windings), the drum motor should not be stopped and started more than 3 times in 15 minutes.

NOTE: Older machines may have the accumulator write head as the adjustable head. If so follow the same procedure, but any time you move the head you have to rewrite the 5 back on the accumulator track (Step 3). The direction of adjustment in step 8 is also reversed.

PARTIAL PRODUCT READ HEAD

1. Turn off machine power at the wall switches, tag them open, and check the head radial adjustment.

2. Set up the system as follows after turning the system on:

a. Write the program A00N99010*b* in program 000 (The P flag of zero will repeat step 000).

b. Place the DFT board in the 305.

c. Write a "5" in each character 9 position of V track.

d. Clear Q track. Write a "1" in character 00 of Q track. Write this "1" on track A.

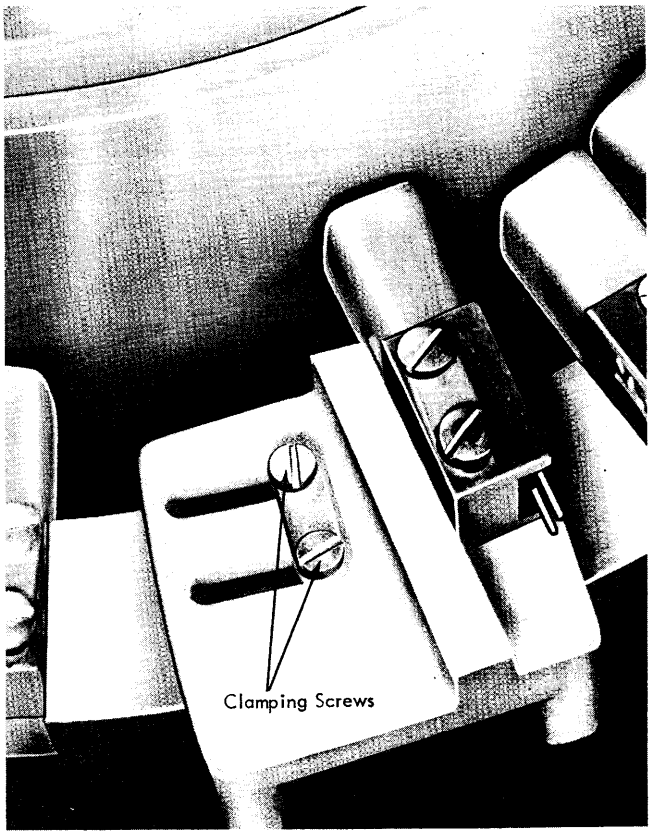


Figure 27. Partial Product or Accumlator Adjustable Head

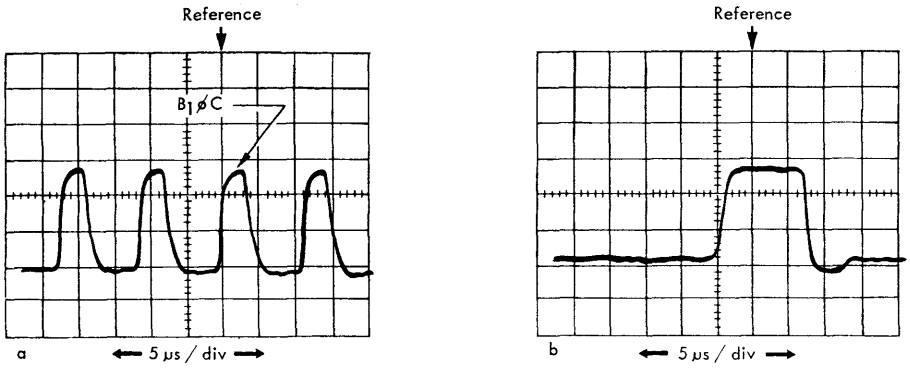


Figure 28. a. ϕC (1Xc) ; b. Partial Product Head Bit 1 (5Ny) 4 ± .5μs Ahead of Reference

e. Clear Q track. Write a "5" in character 09 of Q track.

NOTE: If the console is used to read a track, step 2e must be repeated.

f. Start machine in program step 000.

NOTE: The machine is now executing a multiply instruction multiplying 5 times 1. The 5 will write on PP track during character 18 time and must be available at character 09 time as PP read data. The following steps will verify or accomplish this.

3. Set up scope to sync on character 09 of W cycle.

4. Probe Q read data at 5Ly on 3.10.41. Identify the bit 1, bit 4, and bit R.

5. Probe the PP read data at 5Ny on 3.10.43. Identify the bit 1, bit 4, and bit R.

6. Compare the bit 1 from Q track with the bit 1 from PP track. They should be within 2 μs of each other. This is a check to insure that the PP track is approximately in adjustment. The PP read head should be adjusted as per step 8 until the above condition exists.

7. For the final adjustment the leading edge of the PP bit 1 must be 4 ±½ μs ahead of bit 1 ϕC. ϕC may be seen at 1Xc. After any adjustment, the correct ϕC can be determined by checking Q read data (the 5 in character 09) and selecting the ϕC which coincides with the bit 1.

8. If any adjustments are necessary:

a. Stop the drum motor.

CAUTION: To avoid overheating the thermal overload switch (and possibly the motor windings), the drum motor should not be stopped and started more than 3 times in 15 minutes.

b. Move the read head further from the write head to move the bit 1 pulse to the right with respect to ϕC, or closer to the write head to move the bit pulse to the left with respect to ϕC.

c. Follow basic adjustment procedure outlined in step 8 of "Accumulator Read Head Adjustment".

Read Amplifiers

ADJUSTMENT

Process drums on current production machines and drums used for field replacement will have a table (Figure 29) fixed to the drum cover. Individual characteristics of the drum surface may cause a variation in signal levels from one drum to the next. This chart is filled out at the factory and the check mark indicates what the signal range was when the drum was tested at the factory. For example: A check at D under "Matrix" indicates that all matrix head signals fell in the range of 1700 to 2200 millivolts. These values are measured directly from the head, i.e., pin 99 of the current drivers, with head selected.

MATRIX READ-AMPLIFIER ADJUSTMENT

1. Write N's in all character positions of all matrix tracks.

2. Place machine in single cycle and test read one of the matrix tracks.

3. Sync on character 99 and display one drum revolution (1 millisecond/division).

4. Check the input signal at pin 9 of the AM 316 (3.10.11). Checking the signal at this point will permit checking of all matrix heads without moving the scope probe, but the signal level will be approximately 500 millivolts lower than the actual head outputs.

5. Repeat steps, 2, 3, 4 for all matrix heads and determine the maximum and minimum signal level. All signals should fall between the range determined by the chart (minus approximately 500 millivolts). If there is no chart fixed to the drum, signals measured here should fall between 900 and 1400 millivolts. Do not proceed to step 6 until these inputs are correct.

6. Determine the minimum output peak to peak voltage at pin 3 or pin 10 of the AM 315. This should

be 70 ±5 volts peak to peak in the case of the matrix track with the lowest output (.9 volts at pin 9 of AM 316).

7. If the output is below 65 volts at any character position of the matrix tracks, the resistor at pin 10 of the AM 314 should be decreased until a minimum peak to peak value of 70 ±5 volts is obtained. Each resistor step as listed on the "System Diagrams" (3.10.11) will change the output by approximately 6 volts. As an example: if the resistor in the amplifier is 2.7K and the output is 57 volts, then a 1.8K resistor will increase the output to approximately 63 volts, while a 1.2K will give an output of 69 volts. If the matrix amplifier is suspected, the output of every matrix track should be checked. If all tracks are in the low range, the resistor should be decreased so that the track with the minimum output is increased to 70 ±5 volts peak to peak. If, however, only one matrix track is low, the gain should not be changed as the trouble is not in the AM 314 or AM 315. Example: if all the outputs fall in a range from 55 to 75 volts, the gain should be increased. If, however, one track is 55 and the rest of the tracks attain a minimum output of 70 ±5 volts, the amplifier is adjusted properly and the trouble lies in improper signal input to amplifier.

8. If the output voltage is too high, the resistor on pin 10 of the AM 314 should be increased.

NOTE: It may be timesaving to place a 5K pot temporarily in place of the gain resistor and use this to determine the size needed.

9. The maximum signal from the matrix tracks at pin 3 or 10 of the AM 315 should not exceed 90 volts.

SPECIAL READ AMPLIFIERS (K1-K2-K3-Q-PP-Acc)

NOTE: K1 and K3 have 175 turn heads (175 scribed on bottom of head), and both have a lower output than the other heads on the drum. On future machines, Q track will have a 175 turn head.

1. Write N's on every character position of the track being adjusted. Program ones (1) continuously on the PP track being adjusted.

2. Determine the maximum and minimum signal level at pin 7 of the AM 314 in question.

3. This signal should be 1.4 to 1.9 volts peak to peak or as indicated by the chart. (Check K2 at the head.) 175 turn heads should be .8 to 1.4, or as indicated by the chart.

4. Change the resistor at pin 10 of the AM 314 in question so that the weakest signal at pin 3 of the AM 315 is 70 ±5 volts. Maximum signal should not exceed 90 volts. Accumulator head maximum signal is 80 volts.

CLOCK AMPLIFIER

1. The input to the clock amplifier is taken across the entire head so that the input at pin 7 of 5M11 should be 2.6 to 4 volts peak to peak. It is not recommended that any gain adjustments be made on this amplifier; however, the output should be at least 90 volts peak to peak, at pin 10 of 5M10 (3.10.30).

PREVENTIVE MAINTENANCE

Determine the weakest signal on the weakest track available from the matrix at 5W11 pin 3 or 10 (3.10.00). The minimum signal should be 70 ±5 volts peak to peak. If the weakest signal does not fall in

THIS DRUM SER#
READ AMP OUTPUT ALL TRACKS 65V→90V*
DATA ON THIS DRUM ASSEMBLY IN MILLIVOLTS

RANGE TYPE	MAX SIG	MAX NOISE	MIN SIG	MATRIX	Q	PP	*ACCM 65 → 80	S	T	K_1	K_2	K_3
A	2500	500	2000									
B	2400	450	1900									
C	2300	450	1800									
D	2200	400	1700	✓								
E	2000	400	1600									
F	1900	350	1500									
G	1800	300	1400									
H	1600	300	1300									
J	1500	250	1200									
K	1400	250	1000									
L	1250	200	900									
M	1100	200	800									
N	1000	150	700									
P	850	150	600									

Figure 29. Drum Table

this range, make the read amplifier adjustment for the matrix. Before making this adjustment, check to see that the minimum head signal (at pin 9 of AM 316) does not fall below .9 volts peak to peak or in the range indicated by the chart on the process drum.

Process Drum Assembly Replacement

Removal

1. Remove all power from the system.
2. Remove the plastic cover over the drum.
3. Remove the plate on the motor and remove the 2 leads supplying power to the motor.
4. Remove the head connectors and the grounding strap.
5. Remove the front mounting bolts and tilt the unit.
6. Support the drum and remove the rear mounting bolts.

Caution: This unit is heavy and will require 2 men to remove.

7. Remove the process drum.

Replacement

1. Reverse the removal procedure.
2. Adjust belt tension. See "Drum Motor Adjustments."
3. Check head to drum clearance using the brass feeler gage .001" (PN 2108142). Do not use steel feeler gages as they may ruin the clock track.
4. Future replacement drums will have a prewritten clock track. If no clock track exists, write a clock track following the procedure outlined under "Write Clock Track".
5. Measure the clock track head output at pin 7 of 5M11 (3.10.30). It should be 2.5 to 4.0 volts. With this input, a properly adjusted clock read amplifier will give an output of 70-100 volts at pin 10 of 5M10 (3.10.30).
6. Adjust read amplifiers as per "Read Amplifier Adjustment".
7. Adjust the accumulator and partial product read heads according to the procedure outlined under "Accumulator Read Head, Peripheral Adjustment and Partial Product Read Head, Peripheral Adjustment".
8. Machines prior to 305-10280 may require rearrangement of the head cables in the vicinity of the G, H, accumulator read and partial product read head. The PP read head leads will have to be reversed at the edge connector if all bits but the desired bits are read out.
9. Check the system for proper operation using the DFT on multiply repeat and at the +140 and −250 margins. Particularly emphasize track to track transfer and arithmetic tests.

Drum Motor

Removal

1. Turn machine off and pull the main line switches.
2. Lower the 305 control panel.
3. Open inspection cover at back of motor and remove motor utility leads.
4. Remove belt cover.
5. Loosen motor mounting bolts and remove belt.
6. Remove motor mounting bolts.
7. Remove motor.

Assembly

1. Follow reverse of removal procedure. Leave motor mounting screws slightly loose.
2. Adjust belt tension.
3. Rotate drum manually and check for belt smoothness.
4. Install belt cover.
5. Turn power on.
6. Check for proper operation.

Adjustment

Belt Tension (Figure 30)

1. Leave motor mounting bolts slightly loose.
2. Rotate motor about its pivot mounting bolt (all others are in slotted holes) until belt is properly adjusted (See Figure 30).
   a. Squeeze belt together midway between the pulleys.
   b. Position the assembly for 7/16 ±1/16" belt deflection on one side with 500 grams applied at the midpoint of the belt. Tighten mounting screws.
3. Rotate drum manually and check for smooth belt operation.

Note: It may be necessary to shim the motor so the motor shaft and drum shaft run parallel. This will prevent the belt from creeping off the pulley.

Preventive Maintenance

1. Drum motor bearings are permanently lubricated.

2. Check for wear or cracks on belt. Check belt tension.

3. Brush off excess dirt and adjust tension each time belt cover is removed.

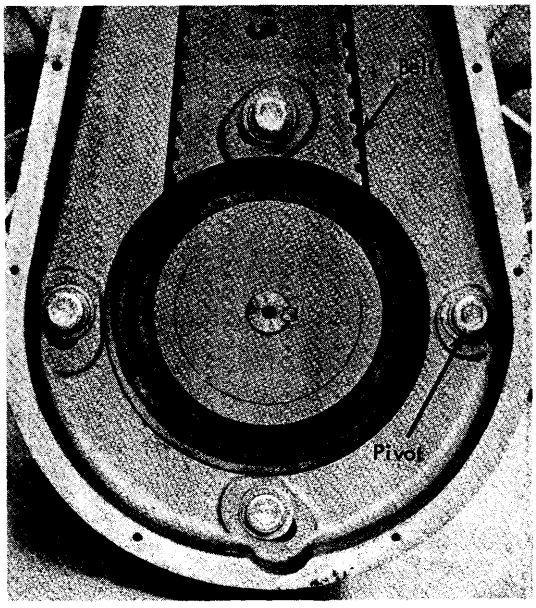


Figure 30. Drum Belt Tension Adjustment

Upper Gate Blower Motor

Removal

1. Remove process unit power at wall switches and tag them open.
2. Disconnect blower motor utility cord at terminal block in process unit (inside metal cover below filament transformers).
3. Remove upper gate panel cover (4 bolts and 6 screws).
4. Remove fan housing mounting screws (7 on each).
5. Remove (4) motor mounting bolts.
6. Remove motor and fans as an assembly.

Assembly

1. Follow reverse of removal procedure.
2. Check blower for proper direction of rotation (See Figure 31).

Preventive Maintenance

1. Motor bearings are permanently lubricated.
2. Check for loose screws in fan housing.
3. Check that blowers rotate freely.

Lower Gate Blower Motor

Removal

1. Remove process unit power at wall switches and tag them open.
2. Remove filter clamping bracket and remove vertical and horizontal filters.
3. Disconnect blower motor utility cord at terminal box in process unit.
4. Remove fan housing mounting screws (located on pluggable unit side of bottom panel).
5. Remove motor mounting bolts.
6. Remove motor and fans as an assembly.

Assembly

1. Follow reverse of removal procedure.
2. Install new filters if necessary.
3. Check blower for proper direction of rotation (See Figure 31).

Preventive Maintenance

1. Motor bearings are permanently lubricated.
2. Check that blowers rotate freely.
3. Replace air filters when they become dirty.

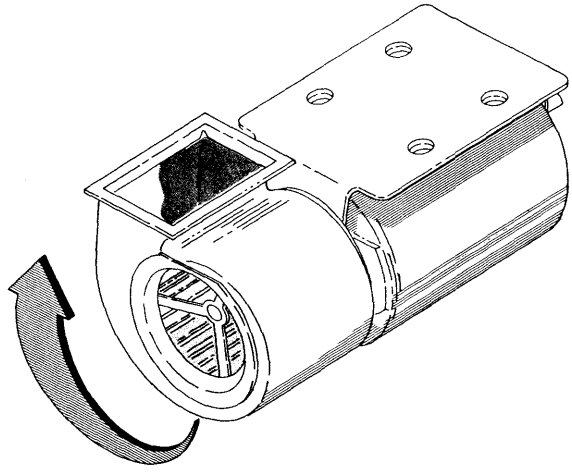


Figure 31. Blower Motor

Error Detection Circuits

These checks insure that the error detection circuits are functioning properly.

Preventive Maintenance

Check the error detection circuits at the +140 and −250 volt marginal and normal levels.

PARITY CHECK LOADING

1. Servo to any track, turn on the CE test lock.

NOTE: Leave test lock ON for this entire operation.

2. Load the following program instructions on track 0. (Programs of this nature and others can be loaded on CE tracks or punched in cards to facilitate test routines.)

Program Step 000	Q9939900	NOTE: P flag is wired to print, punch, and program advance.
Program Step 001	—9939900	
Program Step 002	—99S9900	
Program Step 003	A99B9900A	
Program Step 004	A99R9900	

3. Read "J" (this puts 100 parity characters on Q track). Alter Q using the space bar and the dup. key, spacing over all characters except one in field 0.

R CYCLE PARITY

1. Program set to step 000.

2. Depress program start. This should produce an R cycle parity error.

W CYCLE PARITY

1. Check reset.

2. Program set to step 001.

3. Depress program start. This should produce a W cycle parity error.

I CYCLE PARITY

1. Check reset.

NOTE: Instruction track 3 now has a parity character in field 0.

2. Program set to 030.

3. Depress program start. This should produce an I cycle parity error.

PRINT AND PUNCH ERROR

1. Depress check reset.

2. Program set to step 002.

3. Depress program start (this will produce a W cycle parity error. There is now an invalid character on S track).

4. Check reset.

5. Program set to step 003.

6. The punch and printer ready light should be ON.

NOTE: If you are unable to obtain punch or printer ready, check that the interlocks on the control panels are wired ON. DFT interlocks are wired through communications.

7. The P flag should be wired to print, punch, and program advance.

8. Both machines should give parity error indications.

NOTE: On machines with the optional output track (T), modify this step to utilize T instead of S.

FILE CHECK

1. Remove the 305 control panel.

2. Program set to step 04.

3. Depress program start; this should produce a file check light.

NOTE: If file check light does not come on, check to see that tracks A and R do not agree. If they are the same, no file check will occur. They should be different.

FILE SPEED INTERLOCK

Note: Turn test lock ON.

1. Set up the system to repeat the program X99R-99000b, then start the program.

2. Set the file control switch to LOCAL.

3. Depress the file disk drive motor stop button.

4. The neon at 4Z1 and the file check light should glow within 30 seconds.

5. The SS at 4Yz should be checked for correct timing if the conditions outlined in step 4 are not satisfied (Refer to File Speed Interlock Single Shot Adjustment).

READ CHECK

1. Double punch a card in one column with a 12 and an 11 punch. When fed into the 380, this card should produce a read check.

2. Machines with K3 will accept double punched cards. To test read check, place K switch in TEST and run in cards. First card should give read check.

Write and Check Conversion Circuits

PREVENTIVE MAINTENANCE

Check the output of the 160 CF 312 units in the write conversion and check conversion circuits. With a scope, observe the output up level for each of eighty write conversion units at 7S4-7 (7.21.05) and for each of eighty check conversion units at 7T8-7 (7.23.05). This check is made with the +140 volts supply lowered to +133 volts. The +133v is applied to each of the edge connectors connected to the write and check brush cables on panel 7. The output is observed at the above mentioned points for an up level which should be above ground.

NOTE: A quick method for checking conversion up levels is to jumper from 7AX (+140v) to any write or check brush edge connector. With no cards in the feed and the brush assembly latched in, probe the output of 7S4 for the write conversion or 7T8 for the check conversion. Scope should be set up to display 100 characters.

Section 3. 323 Punch

This section provides preventive maintenance recommendations, lubrication specifications, and adjustment procedures for the 323 Punch Unit of the IBM RAMAC 305 system.

The lubricants specified are important. Do not over lubricate. Wipe all excess oil and grease from the machine parts. The appearance of this machine is important in maintaining the customer's satisfaction.

Magazine

The 323 Punch in current production includes a card aligning punch feed which improves punching registration. The card aligning feed differs from previous feeds as follows (Figure 32):

1. Feed knife blocks are guided by skewed feed knife guides.
2. The rear magazine side plate is non-adjustable.
3. Card guide blocks are used to keep cards level in the magazine.
4. The magazine guide posts have been relieved at the front bottom to provide clearance for the feed knives.

Cards being fed are held against the fixed rear magazine side plate by the lateral movement of the feed knives. This assures that each card will enter the feed in alignment. Vertical registration and horizontal punching registration are controlled by the positioning of the punch magnet unit.

Adjustment

Magazine Guide Posts (Figure 32)

1. Place several inches of joggled cards in the hopper.
2. Check for a definite drag on 2 cards and no drag on 1 card (.010"-.015" clearance) between the 9 edge of the cards and the guide posts.
3. Adjust by adding or removing shims between the guide posts and feed bed casting.

Magazine Guide Plate (Figure 32)

1. The rear guide plate is fixed at the factory and requires no adjustment.
2. The front guide plate adjustment is checked by placing a card against the rear guide plate and securing clearance between the cards and the front guide plate. The clearance should be for one card to "go" and two "not to go". The front guide plate should be parallel to the column-one edge of the cards.
3. Check punching registration and adjust punch magnet unit if necessary.

Feed Knife Slide (Figure 32)

1. Latch the punch clutch.
2. Mesh feed knife slide with picker shaft sector to obtain 1-3/32" ±1/32" measurement between leading edge of knife slide and junction point of first feed rolls.

Note: This is provided as a reference dimension only to aid the Customer Engineer to determine the correct feed knife slide location relative to the card picker shaft sectors.

Feed Knife Slide Guides (Figure 32)

Laterally position feed knife slide guides for minimum sideplay between slide and slide guides. The clearance should be uniform and should not cause binds at any point in the entire stroke of the slides. Check along entire stroke.

Feed Knives (Figure 33)

The feed knives currently used are made of carboloy and require no adjustment. These knives are identified by a red sealing compound over the adjusting screws. Replace the knife and block assembly as a unit if an even .004"-.0045" projection measured with a "go no-go" gage is not obtained.

Buckle Feed Timing (Figure 32)

Feed knives set for the buckle feed principle are adjusted to produce the proper buckle in the card, rather than to establish punch brush timing.

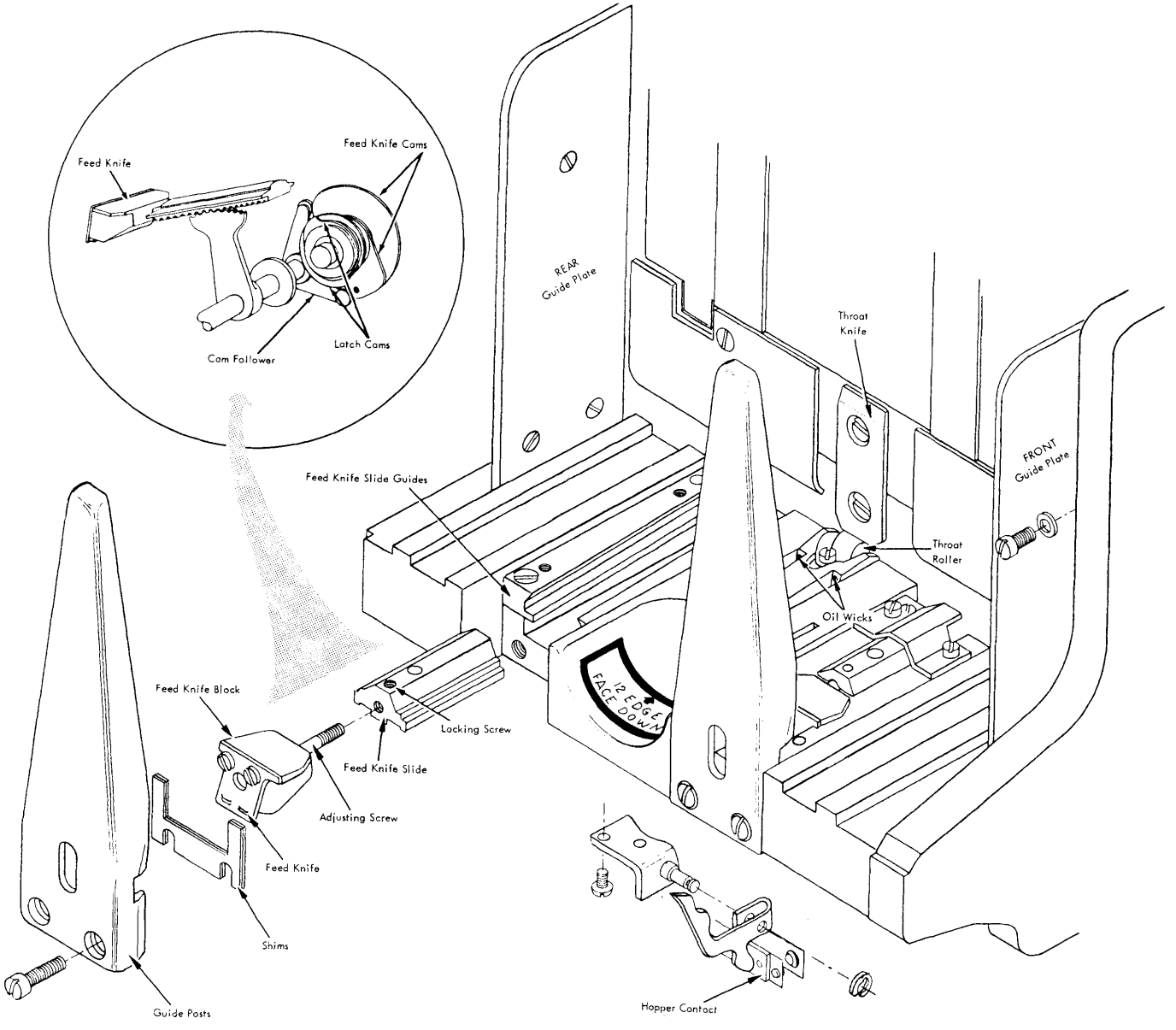


Figure 32. Skewed Feed Card Magazine

The adjustment procedure follows:

1. Loosen the knife block adjusting screw locking set screw.

2. Position the adjusting screw so that the feed knives travel .015" past the point at which the card is stopped by the first set of feed rolls (approximately 2½ teeth before 5). Hopper gage #158333 can be used for making this adjustment.

3. The feed knives must be positioned evenly and parallel to each other to insure the cards feeding squarely into the first feed rolls.

4. The feed knives should travel at least .020" beyond the left edge of the cards in the hopper when the cards are held against the guide posts and the knives are fully retracted.

Buckle Feed Service Hints

The following is a check list to be used as a guide in adjusting the buckle feed for optimum feeding conditions (Refer to CEM #2482).

1. *Card Guide Blocks.* These are necessary to keep warped cards from creasing at the rear magazine plate. Some machines may have been shipped without the card guide blocks, or with the blocks mounted in a reversed direction. The largest portion of the block should be toward the feed rolls. The edges of the blocks are beveled on production machines to prevent interference with punched cards. Removal of the front guide block may improve feeding of warped card stock.

2. *Front and Rear Hopper Guide Posts.* These must have .010" to .015" clearance to the edge of the card. Also, check with ½ hopper of cards to eliminate possible binds above the card line. Guide post shims, part #159868, may cause the feed knife to tilt and partially engage a card. Rework or reposition as a correction.

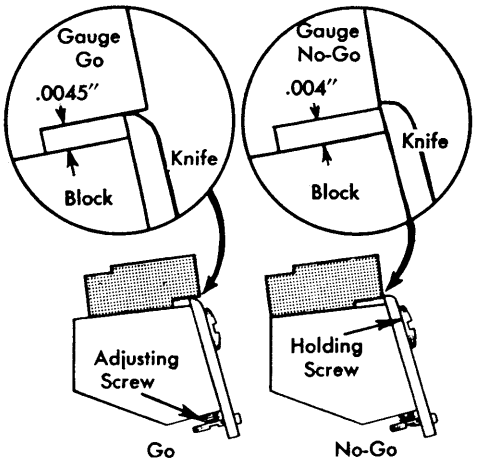


Figure 33. Feed Knife Projection

3. *The Card Buckle.* Adjustment must be set with the buckle gage (see Figure 34). The gage should also be used to check that the feed knives are parallel to the feed rolls. The gage should snap off feed knives with knives at their full forward stroke. As shown in the sketch, the feed knife must contact the card along the full length of the knife.

NOTE: Variations in old style buckle gage thickness may cause variation in the card buckle adjustment (Refer to CEM #2822).

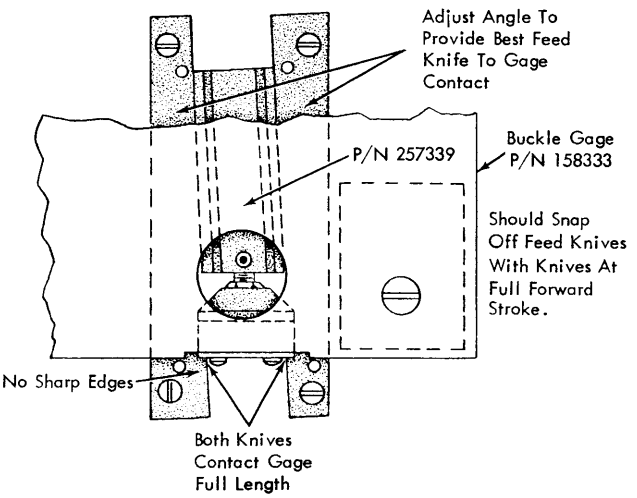


Figure 34. Card Feed Buckle Adjustment

4. *Roller Throat and Knife.* Inspect to see that the roller is centered under knife. Also check for burrs on the knife.

5. *The Roller Throat Assembly.* This assembly should be in line with the opening between the first upper and lower feed roll. The roller throat block may be shimmed if it is found to be low.

6. *Front Magazine Plate.* Adjustment should be set for the standard .005" to .008" adjustment. The plate must be perpendicular to the feed rolls.

7. *Feed Knife Guards.* Inspect for bent or deformed guards. There is a nominal dimension of .025" clearance between the top of the feed knife guard and the card line. The minimum allowable clearance is .007" to the card line. Distorted feed knive guards will raise cards above the roller throat and cause intermittent jamming. (Refer to CEM #2740.)

8. *Feed Knife.* Check for normal adjustment and sharp edges or burrs. If necessary, bevel corners of knife with a power grinding wheel (See CEM #1195). Check knife projection with "go no-go" gage as some sealed carboloy knives may not have sufficient projection. Replace knife holder, part #313824, when knife cannot be reworked locally.

9. *First Upper Feed Roll.* Inspect for even pressure. The center bearing may be adjusted as outlined under the "Feed Roll Section", or by positioning the center bearing on machines not equipped with the eccentric screw. (Refer to CEM #2778, Item 4.)

10. *Picker Knife Pin.* This may be loose or partially sheared. Excessive end play in the picker knife shaft is caused by a loose card picker shaft collar, part #183753.

11. *Card Knife Guides.* This should be checked for minimum clearance to racks, with no binds over entire stroke. Adjust angle within limits of counter bored mounting holes to provide best card-feed knife contact. If adjusting guides does not provide proper contact, replace knife holder rack, part #257339. When both knife holder and rack require replacement, order part #257340, feed knife holder assembly.

12. *Feed Knife Holder.* This must not have over .003" end play on the rack adjusting stud. The holder must be free to swivel. Check with punch feed latched to be sure that knives are not striking the hopper posts.

13. *Loose Magazine Back Plate.* The holding screws will allow the back plate to change position and alter throat knife clearance.

14. *1st and 2nd Lower Feed Roll Pressure Shoe Assembly.* Remove pressure shoe assembly and check shoes for binds and for excessive feed roll end play.

THROAT

1. Roller assembly—position laterally on feed bed casting so vertical center line of roller is aligned with edge of throat knife.

2. Throat knife — position vertically, relative to throat roller, to obtain opening of .0095" to .0105". The .0095" gage should pass through the throat opening freely, the .0105" gage should not enter.

PREVENTIVE MAINTENANCE

MAGAZINE GUIDE POSTS

1. Check for and tighten any loose guide posts.
2. Check for proper guide post to card clearance.

MAGAZINE GUIDE PLATE

1. Check punching registration.
2. Check for and tighten any loose side plates.
3. Check that side plates are parallel to ends of cards and have proper card end clearance.

FEED KNIVES

1. Check for even .004" to .0045" knife projection.
2. Check to see that knives retract at least .020" beyond the leading edge of the hopper guide posts when the knives are fully retracted.
3. Lubricate knife block adjusting screw pivot surfaces with a small amount of IBM #6 oil.

THROAT

1. Clean out accumulation of dirt and dust around roller pivot points.
2. Check roller throat adjustment (.010" opening).
3. Check roller for excessive wear.
4. Lubricate throat roller pivots with IBM #6 oil by placing oil on wicks behind set screws.

Feed Rolls

ADJUSTMENT

FIRST UPPER FEED ROLL CENTER BEARING

1. This bearing prevents bowing of the upper feed roll and insures even tension over the entire roll. It is adjusted by an eccentric screw located behind the throat knife.
2. Remove throat knife and loosen three holding screws.
3. Position pressure bearing centrally between the feed rollers.
4. Adjust eccentric screw so the bearing is just seated on the upper feed roll shaft. Tighten holding screws.
5. Replace and adjust throat knife.

FEED ROLL TENSION

Feed roll tension is not adjustable. It is determined by the four compression springs in the feed roll pressure brackets.

FIRST UPPER CARD GUIDE

Move the guide in its elongated holes for a uniform clearance of .012"-.018" between the guide and the die.

PREVENTIVE MAINTENANCE

1. Check feed roll pressures for eveness of tension over entire feed roll to insure accurate card feeding. In case of weak or broken springs, it is recommended that all springs in that bracket be replaced. Be sure to use correct springs.
2. Lubricate with IBM #9 oil in cups of all lower feed roll pressure brackets.

Contact Roll

Removal

1. Turn off 323 Punch main line switch.
2. Lower the brushes.
3. Remove the two large screws (8/32) that hold the contact-roll bushing plate to the side casting.
4. The contact roll may now be pulled out of the front of the machine.

Assembly

1. Follow the reverse of the removal procedure.
2. Use caution not to damage the common brushes when replacing the roll.
3. Rotate the roll until its tongue or key lines up with the slot in the driving spindle.
4. Position the front bushing so its oil holes line up with the oil lines.

Preventive Maintenance

1. Clean out any accumulation of dust or dirt.
2. Inspect contact roll for burned spots and excessive wear in the area of the common brushes. Try to rotate the contact roll manually to check for broken driving keys. Clean off burned spots and make any necessary repairs.
3. Lubricate bushing oil lines with IBM #9 oil.

Card Lever Contact

Adjustment

1. Contact alignment: Loosen contact pile screws and align contacts.
2. Brass support: Adjust for 1/32" minimum non-operating blade rise from support strap when contact is closed and 1/16" minimum air gap when contact is open.
3. Operating contact blade tension: Should be sufficient to insure that points will open but should not cause the cards to be marked or damaged by the card levers.
4. Card lever contact and switch timing: Refer to "323 System Diagrams" electrical timing chart.

Preventive Maintenance

Worn and maladjusted card lever assemblies cause intermittent and unusual machine troubles. Check the following conditions:

1. Binding card lever assemblies.
2. Worn card levers.
3. Dirty, worn, pitted, or loose contact points.
4. Contact air gap and tension.
5. Contact timing.

Lubricate card lever pivot points with IBM #6 oil and the operating contact strap pad with a thin film of IBM #17 grease.

Punch Brushes

Adjustment

The following adjustments are sequential in nature:

Brush Projection (Figure 35)

1. Check for loose brushes in the block.
2. Position brushes in brush seperators.
3. Check for crossed brush wires at the separators.

Heel Alignment (Figure 36)

Position brush block in adjusting slots, so heels of brushes line up with scribed line on brush separator when the brush tips are forced down to the level of the brush separators.

Note: This adjustment is only a starting point. On machines utilizing buckle feeds, the brushes are moved off the scribed line if necessary, in order to obtain correct punch brush timing.

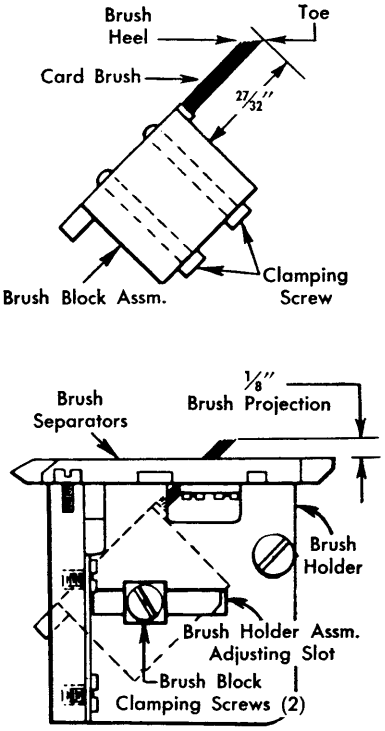


Figure 35. Brush Projection

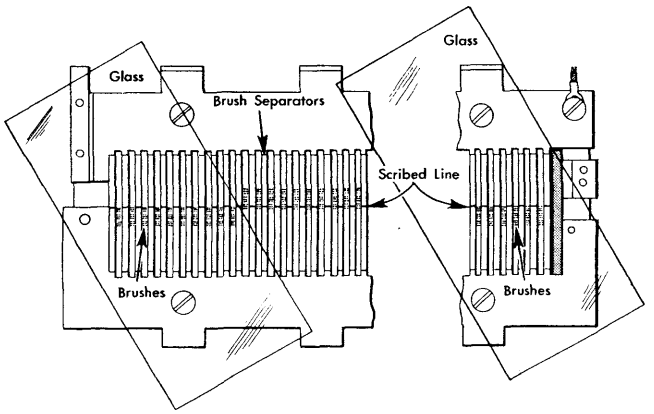


Figure 36. Brush Alignment in Holder

Lateral Brush Alignment

1. Loosen the six brush separator frame mounting screws and shift frame within the limits of the oversized holes so brushes are centrally located between the separators.
2. Align individual brushes with brush bending tool.

Anchor Slide (Brush Tension Adjustment) (Figure 37)

Adjust the front and rear anchor slide adjusting screws to position the brush holder assembly vertically for a uniform .012"-.018" brush separator to contact roll clearance across the entire assembly. Use 082 chute blade feeler gage.

Brush Tracking

1. Hopper must be in correct adjustment before brush tracking is checked.
2. Punch Q's (11-8) in alternate columns of a card and check the punching registration with a card gage.

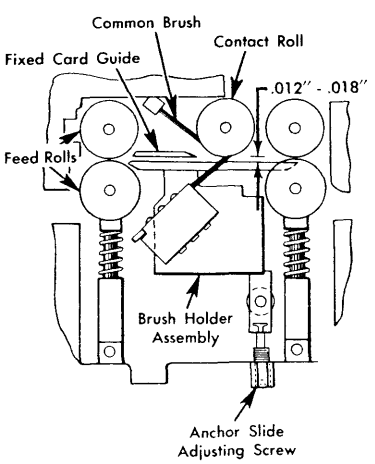


Figure 37. Anchor Slide Adjustment

3. Place pieces of scotch tape over approximately 10 holes at each end of the card. Put the tape on the back of the card in a stack of cards in the hopper and feed it through under power.
4. Observe the brush scratches on the sticky side of the scotch tape that is visible through the holes in the card.
5. If the brushes do not track through the center of the holes, loosen the 3 brush assembly holding screws and shift the assembly so the brushes track properly.
6. Tighten the holding screws and recheck brush tracking.

Brush Timing

1. Move the brush block off the scribed line, if necessary, so the brushes will make ¾ ±¼ tooth before an index line and break 8½ ±½ teeth past an index line (See 0.09.40).
2. Check timing on both ends of the brush block using the dynamic timer.

Preventive Maintenance

1. Brush out all dirt and dust.
2. Inspect brush block for burned or loose brushes, crossed brush strands, short strands, and loose connecting wires.
3. Check brush timing and tracking.
4. Test machine for proper operation.

Punch Stacker

Adjustment

Stacker Roll Timing (Figure 38)

1. Engage the punch clutch and crank the machine to index line 4.
2. Remove idler gear stud spring clip and disengage idler gear from gear train.
3. Position stacker roll in a vertical (high side down) position as shown in Figure 38.
4. Remesh idler gear and replace spring clip.
5. Check stacking operation.

Note: Stacker can be put out of time by a jam.

Stacker Plate to Stacker Roll Clearance (Figure 39)

1. Engage clutch and crank machine to index line 4, to position stacker rolls vertically with respect to the stacker plate (Figure 38).
2. Remove stacker stop switch and depress stacker plate to expose adjusting sleeve locking nut.

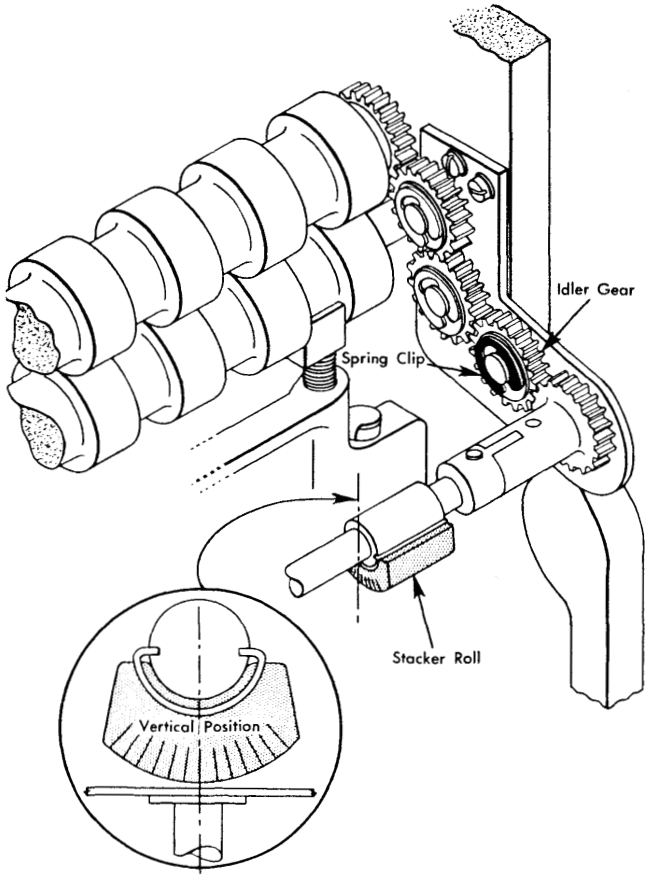


Figure 38. Stacker Timing

3. Remove locking nut and position adjusting sleeve up or down to obtain the specified clearances between the high side of the stacker roll and the stacker plate (.005" above plate and .015" into recess).

Stacker Plate Dampening (Figure 39)

1. Loosen the felt-washer compression nut locknut.
2. Adjust the compression nut to the position where the compression felt washer will brake the stacker plate return speed but still allow it to reach its upper limit rapidly.
3. Tighten locknut and replace stacker stop switch.

Top Pocket Liner

Adjust for good stacking as follows:

1. Loosen two holding screws on right side of stacker pocket.
2. Raise or lower pocket liner to obtain 1/16" to 1/8" vertical stacker plate travel as the stacker rotates. Place approximately 1" of cards in the hopper and feed cards under power to check this operation. Too much stacker plate movement may cause the stack of cards to protrude toward the front of the machine. Too little movement may cause irregular stacking or card jams.

Preventive Maintenance

1. Clean out any accumulation of card chips, dirt, or oil.
2. Inspect gear train idler gear bushings for excessive wear and replace if necessary. Worn bushings can affect timing and result in poor stacking.
3. Turn clip-on stacker rolls periodically to increase their effective life. Worn stacker rolls result in poor stacking. Replace if necessary.
4. Check stacker plate dampening.
5. Check for proper stacking.

Punch Magnet Unit

Removal

1. Turn off the punch main line switch and disconnect the cable shoe connector.
2. Separate the three magnet unit cable connectors (on later machines, 2 connectors).
3. Remove the die.
4. Crank the eccentric shaft to position the punch bail in its uppermost position.

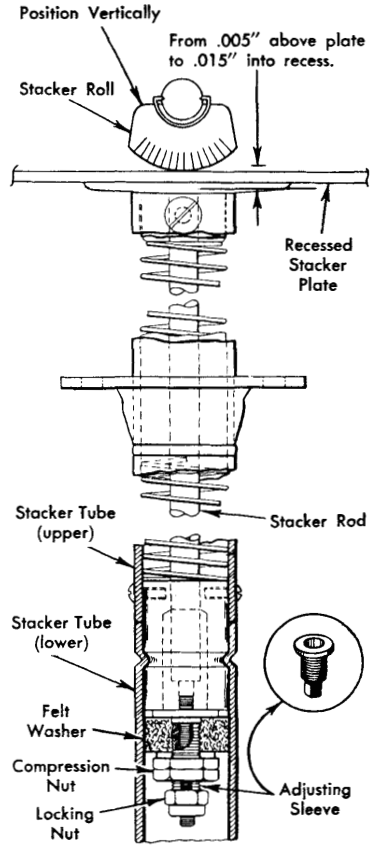


Figure 39. Stacker Plate Adjustment

5. Remove the spring clips, the connecting link pins, and swing the connecting links out of the way.

6. Remove the four screws that fasten the magnet unit to the base casting. The magnet unit should now be free to be removed from the machine.

Assembly

1. Follow the reverse of the removal procedure.

2. Carefully crank the machine through several eccentric shaft revolutions and check for binds.

3. Run the machine under power and check punching registration.

Adjustment (Figure 40)

1. Horizontal registration is fixed by the position of the rear magazine guide plate.

2. Vertical registration is obtained by positioning the punch magnet unit right or left as required relative to the hopper.

a. Check registration. Fill hopper half full of cards, punch several cards, check registration with a card gage, and determine direction the magnet unit must be moved.

b. Loosen the four magnet unit mounting screws and adjust the two aligning screws to position the magnet unit assembly right or left, to obtain correct vertical punching registration. Move the two aligning screws evenly, and only after the mounting screws are loose, to prevent straining the unit and affecting horizontal registration.

c. Be sure the aligning screw heads are positioned against the castings. Tighten the aligning screw locknut and the mounting screws securely. *Do not run the machine.*

d. Check for .003" interposer to punch bail tongue clearance with the punch bail at its upper limit of travel (Figure 40). Adjust the punch bail connecting links to obtain this clearance. Repositioning the magnet unit always affects this clearance.

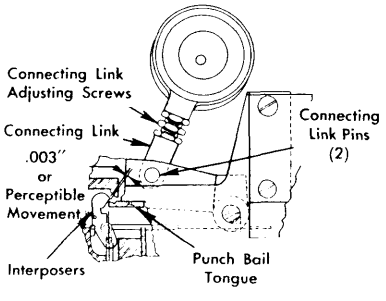


Figure 40. Punch Bail Connecting Link Adjustment

Note: Perfect vertical registration should be obtained in the manner just described when the hopper is half full of cards. Slight variations in vertical registration may result when the hopper is nearly empty or completely filled.

Preventive Maintenance

1. Clean away any accumulation of dust, dirt, and card chips.

2. Check punching registration with a card gage.

3. Lubricate the following units with IBM #6 oil:

a. Felt pad behind punches.

b. Interposers: Oil sparingly. Pull a card, soaked with IBM #6, between gummy or sticky interposers.

c. Punch magnet armature pivots: Lubricate the magnet armatures with IBM #17 grease at the point where the pull wires fasten.

Punch Mechanism

Removal

Punch

1. Turn off the punch main line switch and disconnect the cable shoe.

2. Remove magnet unit from the machine. See "Punch Magnet Unit Removal."

3. Remove the two interposer knock off bar mounting screws and remove the knock off bar.

Caution: Do not crank machine over with the knock off bar removed.

4. Remove the punch bail assembly by loosening the two screws in the magnet-unit side frame, pulling out the pivot rod, and lifting the punch bail from the unit.

5. Hold the die against the bottom of the stripper and position the magnet unit so the die handles rest on top of a working surface. This aligns the holes in the die with the punches and will hold the die in position. Insert card between die and stripper.

6. Apply pressure to the tops of the interposers with a screwdriver handle to drive all the punches through the card to their extreme limit of travel. The card holds the punches in place when the die is removed. Pull up the interposer controlling the punch being replaced.

7. Remove the die.

8. Remove two or three of the punch stop bar mounting screws and loosen the others. (Four screws hold the stop bar in position. The two end screws

are short and the center ones are longer. *Do not interchange them.*) Move the stop bar out of the notch in the punches so the desired punch can be removed.

9. Lift the interposer to withdraw the punch that is to be replaced.

Assembly

Punch

Replacement punches are available in standard and oversize. Oversize punches are identifiable by an electrical pencil mark on one side near the interposer pivot stud and can be used in worn dies or dies that are slightly damaged.

1. Follow the reverse of the removal procedure.

2. Carefully align the punch with the holes in the stripper and work it into position. Do not drive it into position. Stone the punch, if necessary, to make it fit properly.

3. Position the punch stop bar as near as possible to the punches without causing binds and tighten its holding screws securely.

4. Gangpunch several hundred cards, using all 80 punches (not more than 10 of same digit spread evenly across the card), and check for fuzzy holes and proper punching operation. Make any necessary adjustments.

Adjustment

Punch Bail Tongue (Figure 41)

The bail tongue is positioned on the punch bail to provide for proper relationship (clearance and overlap) between the bail tongue and the interposers with the interposers in either the normal or operated positions.

1. To adjust:
   a. Loosen the five bail tongue holding screws.
   b. Position the bail tongue, relative to the punch bails by means of two adjusting screws, to obtain a uniform 2-17/32″ from the left edge of the tongue to the right side of the punch bail pivot shaft.
2. To check this adjustment:
   a. Operate the punch bail to a point where the bail tongue is just below the interposer engagement point.
   b. Check for .005″-.008″ clearance between the punch bail tongue and the interposers. Reposition the bail tongue slightly if necessary.

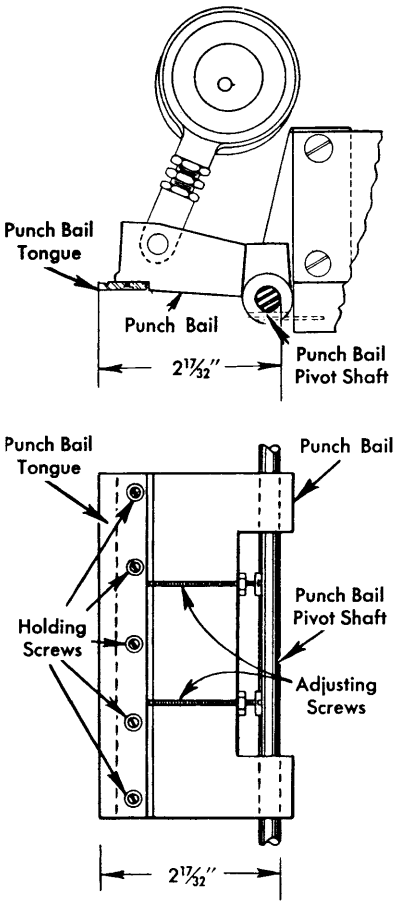


Figure 41. Punch Bail Tongue Adjustment

Note: When correctly positioned, no further adjustment is necessary unless the punch bail or bail tongue is replaced.

Punch Stop Bar (Figure 42)

1. Loosen holding screws and position stop bar within limits of its elongated screw holes, as near to the punches (over entire length of bar) as possible without causing interference to punch movement.
2. Tighten holding screws.

Punch Bail Connecting Links (Figure 40)

The adjustable connecting links provide the means for positioning the stroke of the punch bail tongue to the interposers. The links are adjusted to keep the tongue from binding against the interposers at its upper limit of travel and for minimum punch travel into the die at the lower limit.

1. Remove the front connecting link pin.
2. Crank machine to position punch bail at its uppermost position.
3. Rear connecting link: Loosen locknuts and adjust adjusting screw for .003″ interposer to punch bail tongue clearance. Use a .003″ feeler gage, or check

for perceptible interposer to bail tongue movement of interposers to determine this clearance. In case the clearance varies from one end of the bail tongue to the other, the .003" is to apply to the closest end.

4. Front connecting link: Loosen locknuts and adjust adjusting screw so the front connecting link pin will slide into position in the bail and bail connecting link freely. This assures an even adjustment on both links and eliminates strain on the punch bail.

5. Check adjustment:

a. Engage an interposer at each end of the punch bail and crank the machine until the punch bail is at its lower limit of travel.

b. Press on the top of the engaged interposers and carefully check for additional downward movement of at least .005" (Figure 42). This is to insure that the notch in the punch will not be driven against the punch stop bar.

c. Further check this adjustment after all other die and stripper and vertical punching registration adjustments have been made. Run approximately fifty cards through the machine and punch zeros in all eighty columns. The holes in all positions should be punched cleanly. If not, increase the punch travel slightly. Be sure to check for some punch to stop bar clearance each time until the test is performed successfully (See Figure 42). Punch travel into the die should always be held to a minimum consistant with proper punching results. This insures longer die life and minimizes pulling of card chips.

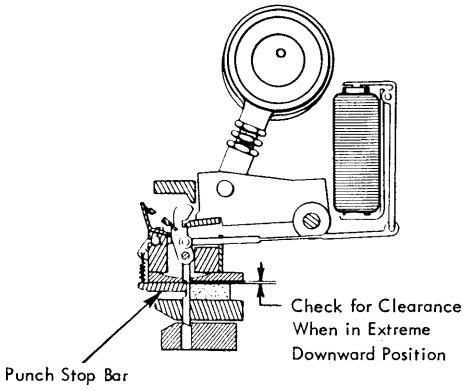


Figure 42. Punch Bail Stop Bar

INTERPOSER PAWL STOP BAR (FIGURE 43)

The interposer pawl stop bar is positioned and pinned at the factory. The fixed horizontal position of this stop bar, relative to a correctly positioned punch bail tongue (2-17/32" adjustment), should provide .005" to .008" interposer to bail tongue clearance.

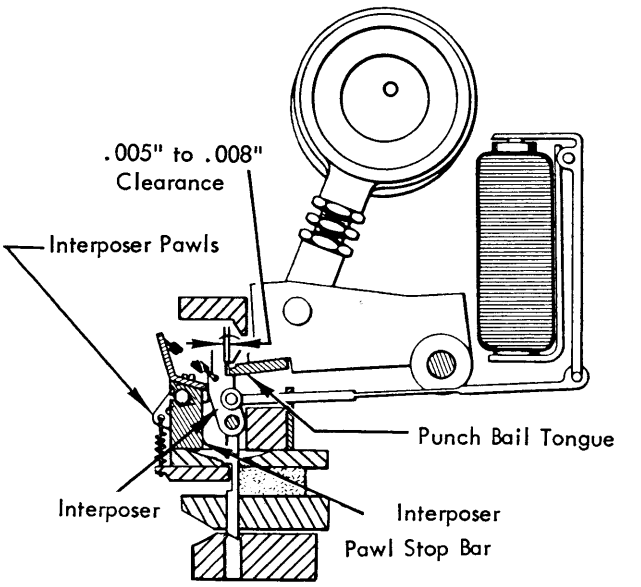


Figure 43. Adjustment Check

1. Check for .005" to .008" pawl to bail tongue clearance when the interposers are engaged with the punch bail tongue and are driven to their extreme downward position by the punch bail.

2. If the .005" to .008" clearance is not present, it may be necessary to reposition the punch bail tongue on the punch bail. See "Punch Bail Tongue Adjustment".

INTERPOSER SPRING BAIL (FIGURE 44)

1. Loosen interposer spring bail holding screws and position bail horizontally on the interposer stop bar so it does not touch the interposers and does not interfere with the .005" to .008" interposer to punch bail tongue clearance.

2. Check the .005" to .008" clearance with the interposers in their normal and extreme downward position.

PUNCH MAGNET ARMATURE

(Interposer latching clearance)

1. The punch magnet armatures should be so adjusted that when they are attracted and sealed to their cores, their respective interposers will move 1/8" from their normal position toward the magnet coils.

2. Check adjustment: The adjustment can be checked with the punch bail tongue in position to engage the interposers but can be checked more accurately with the punch bail removed. Hold the armature attracted and check for 1/8" interposer movement by measuring the distance the operated interposer moved with respect to an adjacent normally positioned interposer.

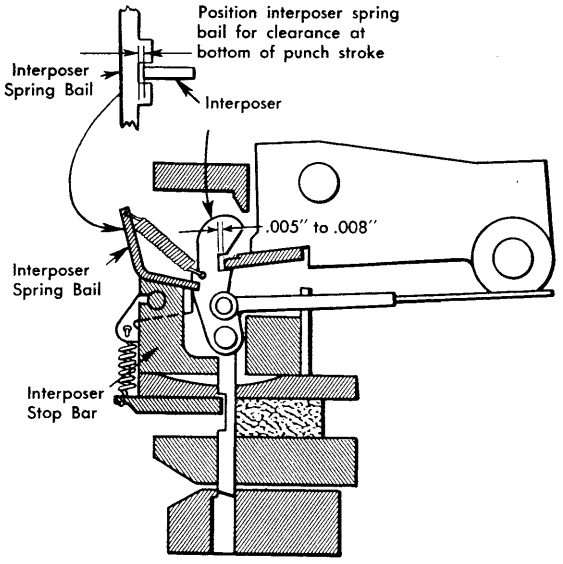


Figure 44. Interposer Spring Bail

3. To adjust: Bend the armature just above the point where the pull wire connects to obtain 1/8" interposer movement when the armature is attracted and sealed to the core. Use two screwdrivers to make the adjustment; one to support the armature, the other to bend it.

4. Interposer alignment: Adjust all armatures so they move freely and line up the interposers evenly in their normal position. Check for .005" to .008" interposer to punch bail tongue clearance with interposer engaged with the bail tongue when it is at its lower limit of travel (See Figure 44).

Preventive Maintenance

Punch Bail Tongue

Check for loose holding screws.

Die and Stripper

Removal

A new die can be installed without replacing both the die and stripper as an assembly. Extra precautions must be taken when performing this operation (See CEM #1664).

1. Turn off the punch main line switch and disconnect the shoe connector.
2. Remove the die.
3. Remove the magnet unit and place it on a suitable working surface.
4. Remove the punch interposer knockoff bar.
5. Remove the punch bail assembly. Replace the pivot bar and tighten the screws to prevent spreading side frames.
6. Remove extreme left pull-rod guide comb.
7. Unhook all magnet pull wires from the interposers. This may be done by moving the interposers toward the magnets, spreading the interposers slightly with a small screwdriver, and lifting the pull rods off the studs.
8. Remove the four screws that hold the punch and stripper assembly to the magnet unit side frame.
9. Remove the punch and stripper assembly.

Assembly

1. Place the stripper assembly in position on the magnet unit for assembling the pull wires and screw in the holding screws loosely. This permits more flexibility of the unit and the stripper when the pull wires are assembled.
2. Assemble the pull wires on the pawls. Move the pawl forward, place the pull wire on the pawl stud, and check for the proper fit.
3. Tighten the screws that hold the stripper assembly to the magnet unit.
4. Replace the guide comb.
5. Check all interposers and pull wires for binds.
6. Check punch magnet armature adjustments.
7. Replace the punch bail.
8. Install the punch magnet unit on the machine and make all necessary adjustments (See adjustments which follow).
9. Install the interposer knockoff bar.
10. Replace the shoe connector and turn on the punch switch. Run in each punch five minutes without punching cards. This can be done by wiring each fifth magnet to each fifth punch brush and shorting relay 4-7 and 4-8 points. Hold the start key down and run the machine five minutes. The first run should condition 10, 15, 20, etc.; the second run should condition punches 4, 9, 14, 19, etc. Continue this until all 80 punches are run in. Running in too many punches at one time may cause the die plate to pull off the heads of the rivets.

Adjustment

Die to Stripper Clearance (Figure 45)

1. Loosen the two left end magnet unit mounting screws and the adjusting screw lock nuts (located next to the mounting screws).
2. With the die latching bars resting on the side frame recesses, raise or lower the magnet unit with the

two adjusting screws to position the stripper stop studs snugly against the die assembly.

3. Tighten the mounting screws and the adjusting screw lock nuts.

4. Check adjustment by removing and replacing the die several times. The die latching bars must have a slight drag as they leave and enter the casting recesses. Check both front and rear latching bars.

Die Assembly Angle Guides (Figure 45)

The die assembly angle guides facilitate removal and insertion of the die.

1. Loosen the angle guide mounting screws and install the die.

2. Move the guides parallel to and toward the side frames for a maximum angle guide to side frame clearance of .005". Tighten the holding screws.

3. Check the adjustment by removing and installing the die several times.

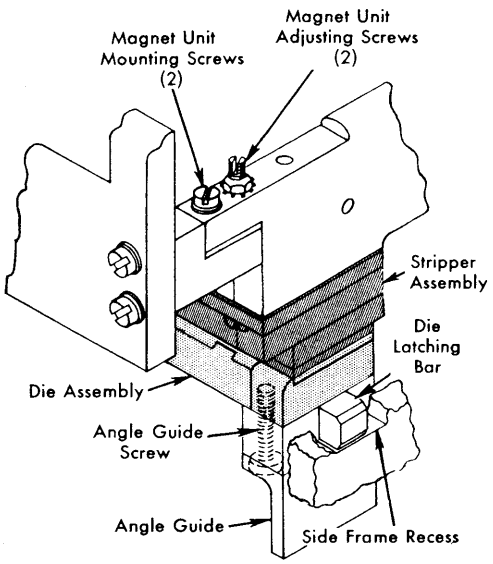


Figure 45. Die Assembly

Motor

Adjustment

Motor Pulley

Adjust motor pulley for punch card feeding speed of 100 −3, +7 cards per minute.

Belt

Position motor horizontally on its slotted base mounting to provide for ¼" to ½" belt deflection when the sides of the belt are pressed together with thumb and forefinger midway between the pulleys.

Preventive Maintenance

1. Lubricate motor bearing oil wells with IBM #9.

2. Check motor pulley to insure that the adjustable section is tight.

3. Check belt for proper tension, cracks, or excessive wear.

Punch Clutch

Adjustment

Latch Time

Long line on index (14.5 or D).

Relative Position of Latch and Pawl Arm (Figure 46)

1. Latch and fully detent clutch pawl arm.

2. Loosen three holding screws and position magnet coil mounting plate so top surface of tail of clutch pawl arm is parallel to latching surface of clutch latch. This relative position of latch to arm is critical to insure latching of punch clutch.

Unlatching Clearance (Figure 47)

Attract clutch latch (armature) and adjust stop screw for .015" to .017" unlatching clearance.

Armature to Core Clearance (Figure 47)

Attract clutch latch and position the magnet yoke, within limits of elongated holes, for .010" to .012" armature to core clearance.

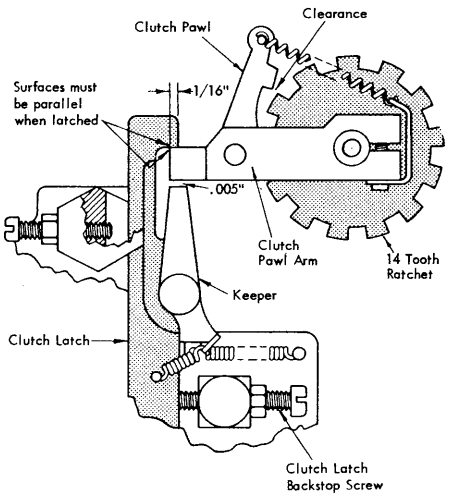


Figure 46. Punch Clutch (Normal)

Latching Overlap (Figure 46)

1. Latch and detent clutch pawl arm.
2. Adjust clutch latch (armature) backstop screw to obtain 1/16" overlap of the latch on the clutch pawl and pawl arm.

Keeper End to Clutch Pawl Arm Clearance

Check for .005" clearance between end of keeper and pawl arm when arm is forced against clutch latch (Figure 46). Stone or peen keeper end, as required, to obtain this clearance.

Clutch Pawl to 14 Tooth Ratchet Clearance

A clearance must exist between the pawl and the ratchet when pawl is latched and detented (Figure 46).

Preventive Maintenance

1. Check all mounting screws to insure that they are tight.
2. Check latching and unlatching clearance and adjust if necessary.
3. Lubricate all bearing and pivot points with a small amount of IBM #9 oil.

Drive Housing

Removal

Drive Housing (Figures 48, 49, 50)

The alternate method of drive housing removal is also included in this section.

1. Turn off main switch and disconnect shoe connector and motor plug.
2. Check and record timing of a critical P cam so it can be used as a reference to facilitate reassembly. Remove (4) mounting screws that hold P cam and P cam drive assemblies.
3. Remove dynamic timer index assembly (2 mounting screws). Check timer relationship to index gear before removing timer.
4. Remove cap from drive housing drain hose and drain oil into suitable container.
5. Remove drive belt.
6. Remove seven screws from drive housing top cover, and remove cover.
7. Remove crank stud and lock washer from drive-pulley shaft.
8. Loosen allen screw in pulley. Remove drive pulley and key from shaft.
9. Remove three punch clutch mounting screws and remove punch clutch.

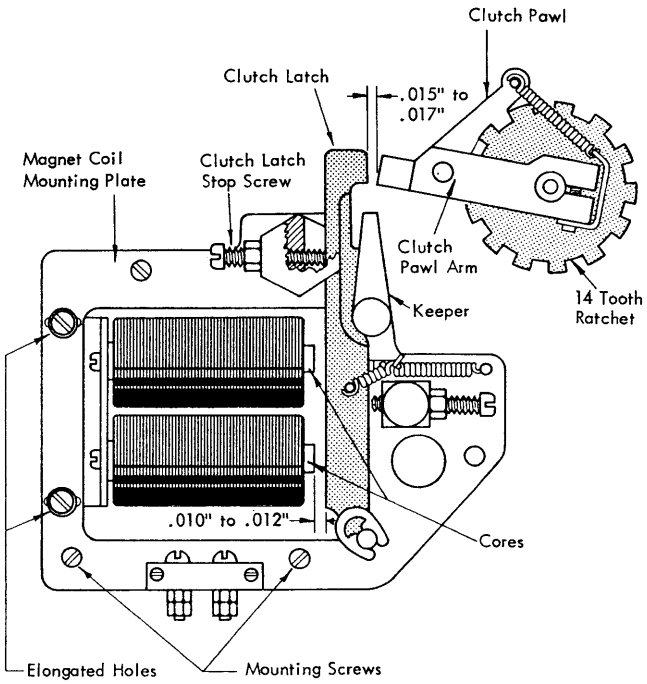


Figure 47. Punch Clutch (Attracted)

Note: There is a spacer on the upper screw between the clutch plate and the casting. The cycle point timings are not stamped on the index gear. There is a 14 tooth punch clutch ratchet, hence D time may be any one of the long timing marks on the index, depending on the tooth of the multi-tooth ratchet that is used. Each one of the short timing marks may be any one of the 14-cycle point timings in the cycle, depending again on which tooth of the multi-tooth ratchet is engaged. To determine the cycle-point timings on the index, trip the punch clutch and crank the machine slowly by hand until the punch clutch pawl engages in a tooth of the multi-tooth ratchet. Observe the long timing mark on the index to which the index pointer is pointing. This long timing mark now becomes D or 14.5 for this particular cycle. The next short timing mark on the index now becomes 12; the next shorter one, 11; etc.

10. Engage the punch clutch pawl in one of the teeth of the multi-tooth ratchet and turn the index to 3 teeth past 14. This should place the small end of all taper pins in position to be driven. Loosen the clutch pawl spring and drive the pins in the index drive gear, the punch clutch pawl, and the P cam drive gear. The punch clutch pawl, index drive gear, and P cam drive gear can now be removed.
11. The index wheel can now be removed. There are 47 needle bearings in the hub of the index wheel. Place a cloth beneath the hub of the gear so the bearings will be caught in the cloth and not lost when the

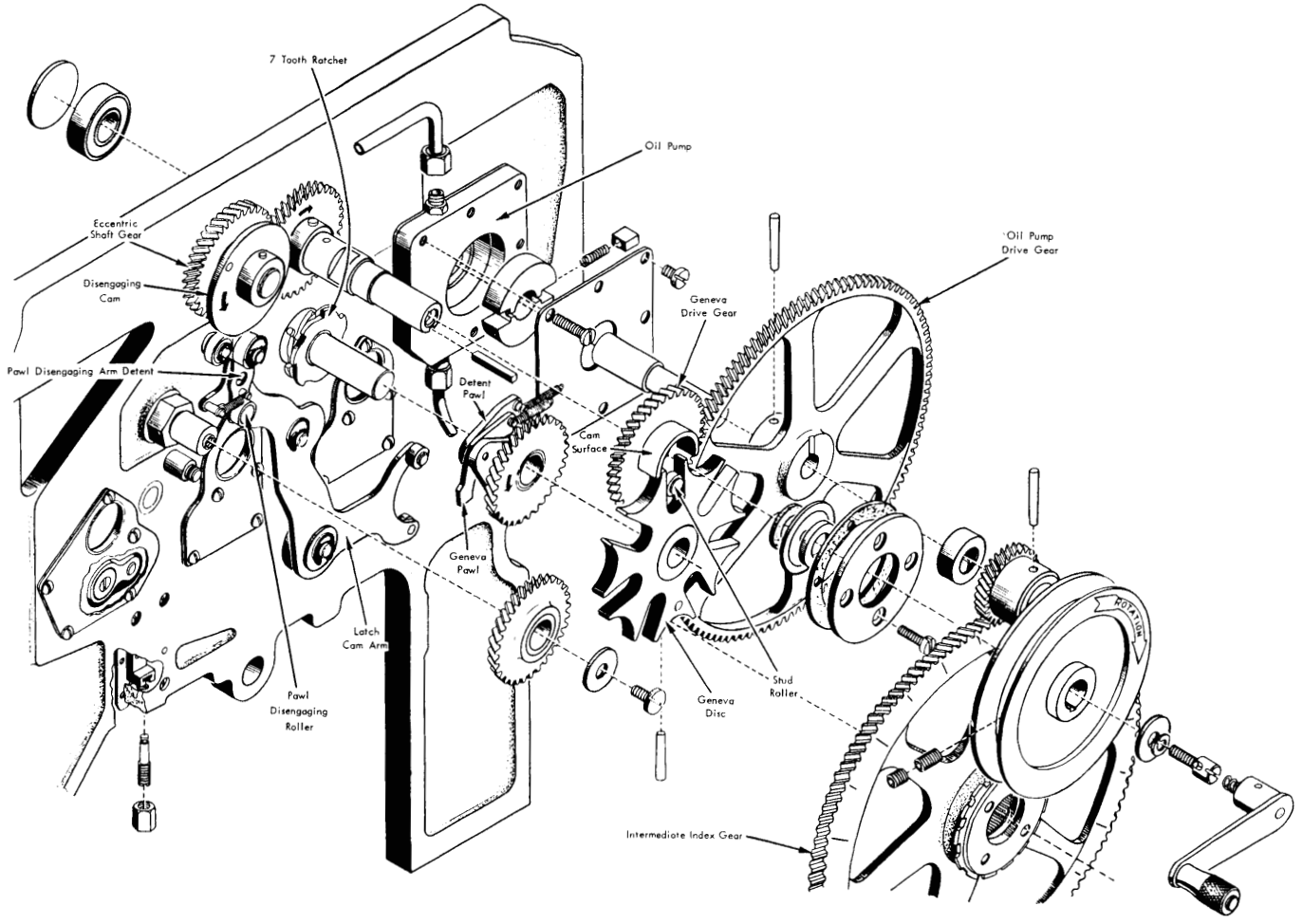


Figure 48. Geneva Mechanism

wheel is removed. An alternate method is to push the bearings toward the drive housing, slide the index wheel far enough off the shaft to expose about ⅜" of the needle bearings, and tie a string or rubber band around them to hold them to the shaft. The index wheel can then be removed.

12. Remove the nine drive housing mounting screws. The drive housing is now free to be pulled off the casting and the shafts. If the housing sticks to the base, do not pry at any point except the top, because a screwdriver inserted along the sides or bottom will cut the fibre gasket that seals the drive housing to the base and cause oil leaks. Work the drive housing off the four shafts carefully to avoid oil leaks and to avoid disturbing the timing relationships. It may not be necessary to remove the geneva mechanism each time the drive housing is removed; hence, valuable reassembly time can be saved.

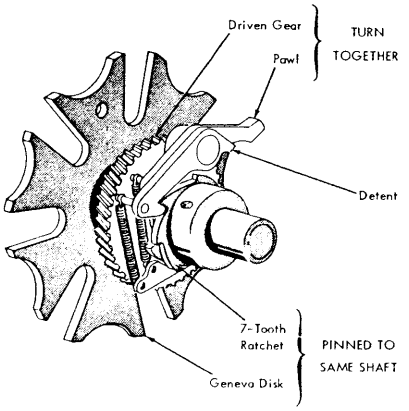


Figure 49. Geneva Assembly

Geneva Mechanism (Figure 50)

1. Turn the geneva mechanism to a point where the geneva clutch pawl will clear the two gears just below the shaft of the geneva disk. The tail of the pawl will just clear the feed roll drive gear (2 holes).

2. Remove the pulley shaft and gear assembly, the geneva disk, and the punch clutch idler gear as an assembly.

3. Correct position for removal and reassembly is approximated in Figure 50.

Assembly

Install Geneva Mechanism

1. In order to get the geneva clutch pawl to clear the two upper feed-roll drive gears, it is necessary to turn the gears so the factory scribed marks do not line up. However, if the following new reference marks are made, these may be lined up to assure that the geneva mechanism is properly timed when it is replaced in the machine.

2. Eccentric shaft gear (41 teeth), pencil or spot mark the sixth tooth space in a counterclockwise direction from the thooth space already marked (A red pencil is recommended).

3. Eccentric shaft drive gear (41 teeth), mark the sixth tooth in a clockwise direction from the presently marked tooth. Geneva drive gear, mark the sixth tooth space in a clockwise direction from the present marked tooth space. The eccentric shaft drive gear and the geneva drive gear are both pinned to the drive pulley shaft.

4. Punch clutch idler gear (110 teeth), mark the sixth tooth in a counterclockwise direction from the present marked tooth.

5. Turn the eccentric shaft and the punch clutch idler shaft until the new marks point toward the drive pulley shaft center.

6. Turn the oil pump key slot so it lines up with the punch clutch idler gear hub key tongue.

7. Engage the geneva pawl in some tooth of the seven tooth ratchet.

8. Place the roller in the first slot of the geneva disk to the right of the pawl pivot.

9. Match the pencil marks, work the three gears forward into position, and position the three shafts into their respective bearings in the side frame. The punch clutch idler gear shaft, being the longest, should enter the hole in the rotor of the pump first. The geneva disk shaft should then enter its bearing and the pulley-shaft bearing should enter its housing in the side frame.

10. After the punch clutch idler gear shaft enters the rotor of the oil pump, raise the shaft to line it up with its bearing in the side frame.

11. If the geneva disk shaft seems to bind just after it enters the bearing, check to see that the geneva clutch gear meshes properly with the two upper feed roll drive gears. It may be necessary to turn either one or both of these gears part of a tooth so they will mesh properly with the geneva clutch gear.

12. Do not hammer these shafts into position. If any of the mechanism does not seat properly, check to see that all gears are properly meshed, all shafts are aligned with their bearings, and that the oil pump rotor is aligned with its drive key.

13. Support the shaft ends and turn the pulley shaft clockwise (the crank can be used) until the factory marks (scribed lines) line up and the following conditions are satisfied:

a. The factory timing marks line up.

b. One half of the geneva disk drive roller is out of (leaving) the geneva disk.

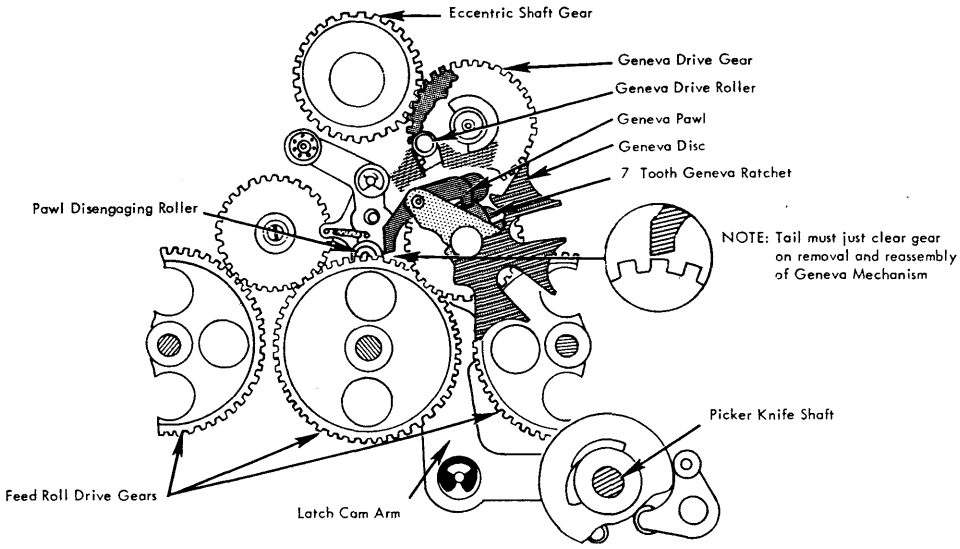


Figure 50. Geneva Removal

c. Tail of geneva driving pawl strikes the pawl disengaging roller. It may take many revolutions of the pulley shaft to satisfy all of these conditions.

NOTE: In order to satisfy all these conditions, it may be necessary to turn the picker knife shaft until the pawl disengaging roller is fully to the right.

INSTALL DRIVE HOUSING

1. Check to see that the conditions of step 13 under "Install Geneva Mechanism" are satisfied.
2. Work the drive housing onto the picker-knife camshaft, the punch clutch idler gear shaft, the geneva disk shaft, and the pulley shaft.
3. Replace the nine screws that hold the casting to the side of the machine.
4. Replace the index wheel.
5. With the conditions of step 1 still set up, turn the index wheel until the scribed line on the drive-housing casting lines up with one tooth past any short timing mark on the index.
6. Replace the index drive gear so the scribed line on the index drive gear meshes with the second tooth past the short timing-mark on the index. The holes in the index drive gear and the shaft should now line up.
7. To check timing: Crank the machine over until the index has made five revolutions. The conditions at 12.1 should be:
   a. Index wheel should be at one tooth past a short timing mark (12.1).
   b. Scribed line on under side of index drive gear should line up with second tooth past a short timing mark on the index wheel.
   c. Factory timing marks on gears inside the drive housing should line up.
   d. One half of the geneva disk drive roller is out of (leaving) slot of the geneva disk.
   e. Tail of geneva driving pawl strikes the pawl disengaging roller.
8. Replace the punch clutch pawl and P cam drive gear.
9. Place the cap on the drive housing oil drain tube and fill it to the proper level with IBM #12 oil. Use the dip stick to determine the amount.
10. Replace punch clutch. Check adjustments.
11. Replace and retime the P cams and the punch dynamic timer.
12. Crank cards through by hand.

NOTE: When geneva clutch is not engaged, the clutch will click when the machine is turned over by hand.

Drive Housing (Alternate Method)

REMOVAL

1. Drain the oil from the drive housing.
2. Remove drive belt, belt guards.
3. Remove drive housing top cover.
4. Crank machine until all factory spot marks line up on the geneva roller gear, oil pump gear, eccentric gear and the eccentric drive gear. At this time, the spot mark on the index drive gear should line up at 2 teeth past an index mark (small mark on the index gear).

5. Carefully back machine up 6 teeth, mark all gears at the 6 tooth position. Red pencil is recommended. Line the gears up at the pencil marks. At this time the geneva mechanism will clear the surrounding gears as drive housing is being removed.

6. Unlatch dog and rotate clockwise until the spring stud is approximately straight up. At this time, the tail of the pawl should be at the 8 o'clock position and the dog seated in one of the 14 teeth. The dynamic timer should read approximately 13.

7. Mark cam unit gear and remove cam unit assembly.

8. Remove dynamic timer.

9. Remove drive housing holding screws.

10. Remove drive housing carefully. Resistance will be encountered about half way; push feed knives forward about ¼ inch, gently work timer gear and remove housing.

Assembly

The assembly procedure is the reverse of the preceeding steps. The following outline will aid in getting the unit back in time.

1. Before replacing the housing, be sure clutch dog is engaged in tooth, and the tail of the dog pointed to 8 o'clock position.

2. Line up pencil marks on the eccentric gear and the eccentric drive gear. Install the drive housing.

3. Maneuver the latch cam arm to allow the cam to get past the cam followers. About half way in, it will be necessary to move feed knives to clear the picker knife cam followers. The slot in the oil pump rotor may be aligned correctly by using the end of a paper clip bent "L shaped" about ⅛" long. To be able to turn the oil pump rotor, lift the drive housing slightly to free the parts.

4. Replace cam unit assembly using the pencil marks.

5. Replace dynamic timer and check cam and machine timings.

Preventive Maintenance

Check the oil level. Fill to the proper level with IBM #12 if necessary.

Dynamic Timer

Assembly

When replacing a neon bulb in the timer, glue it in position to keep the leads from breaking.

Adjustment

1. Latch and fully detent punch clutch pawl and pawl arm.

2. Loosen the locking nut and position the index pointer to 14.5.

3. Tighten the lock nut.

Control Panel

Adjustment (Figure 51)

1. Remove control panel door cover.

2. Remove the two roller block assemblies, one from each side of the stationary panel frame.

3. With the control panel retainer in its closed (contacting) position against the stationary panel frame, adjust the two eccentric studs to obtain a .842" ±.015" (approximately 27/32") clearance between the bottom retaining bar of the control panel retainer and the lower row of stationary control panel contacts. Adjust the eccentric studs evenly.

4. Re-install the roller block assemblies on the permanent panel frame. With the roller blocks in place, hold or block the closing bracket assembly in a position perpendicular to the control panel retainer rails. Adjust the roller blocks up or down with the two adjusting screws to obtain approximately .711" (45/64") distance between the bottom retaining bar and the lower row of permanent panel contacts. Adjust the screws evenly for uniform contact lift across the entire panel.

5. Interlock operation: The centralizing bracket insures horizontal alignment of stationary panel and removable panel contacts. The safety catch prevents the control panel mechanism from closing if the removable panel is not fully seated in the retainer.

   a. Place control panel in the retainer and close the mechanism slowly. There should be approximately 1/16" safety catch to closing bracket clearance as the safety catch passes over the leading edge of the closing bracket.

   b. To Adjust: Loosen bracket holding screw and position bracket for the 1/16" clearance. Tighten the holding screw.

6. Stationary control panel contacts: Adjust in the usual manner using control panel gage, part #450323. The contacts are prestressed; thus, the last bend must be in an upward direction.

Preventive Maintenance

1. Check mechanism bolts and screws to insure they are tight.

2. Check for bent or broken stationary control panel contacts.

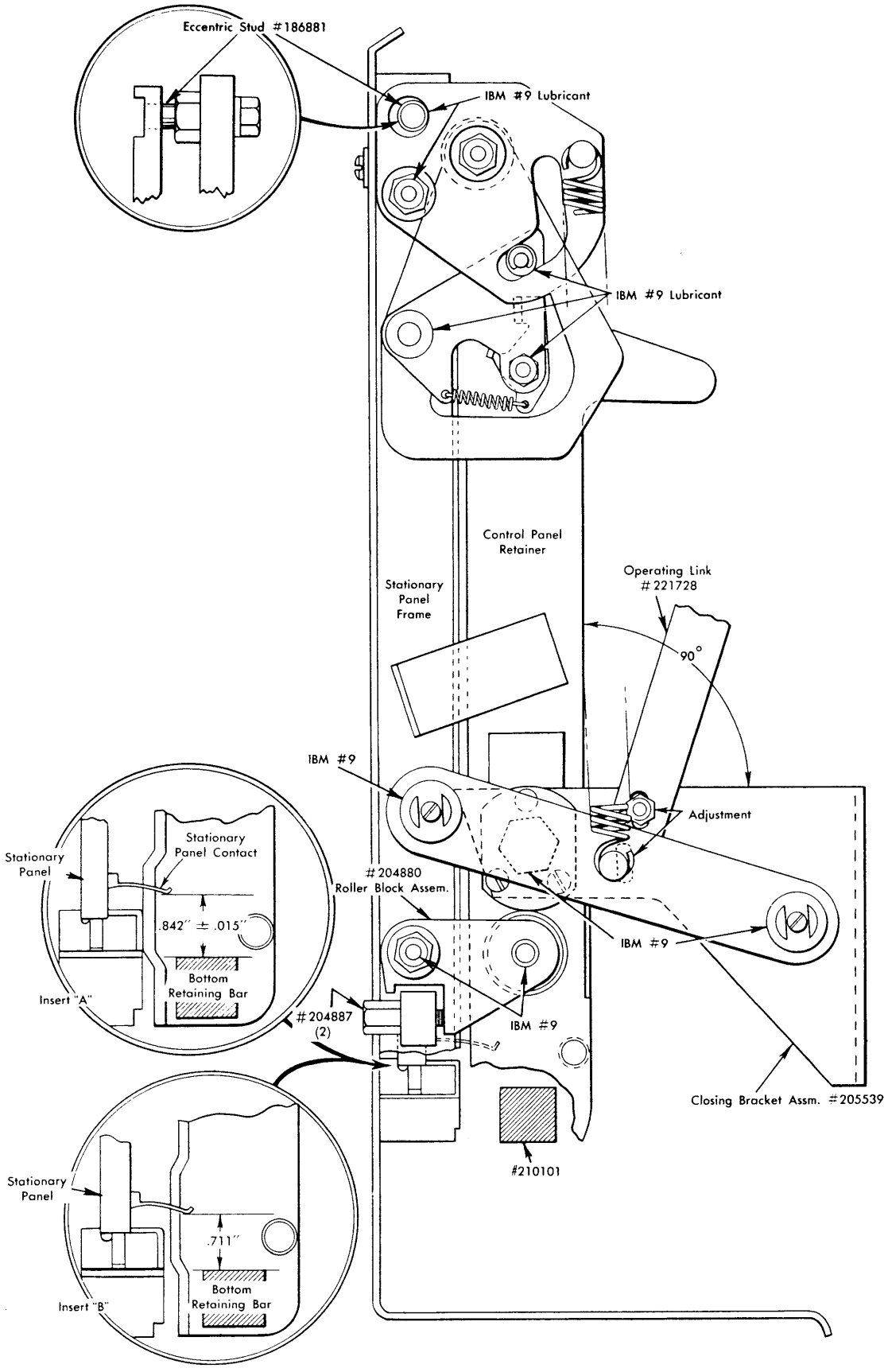


Figure 51. Control Panel Closure Mechanism

3. Check interlock operation. Adjust if necessary.

4. Lubricate control panel pivot points with IBM #9 oil and camming surfaces with a light film of IBM #17 grease (See Figure 51).

Covers

Preventive Maintenance

1. Inspect covers, cover latches, and hinge mechanism for proper operation and loose screws. Make any necessary repairs.

2. Lubricate cover hinges and latch pivots sparingly with IBM #9 oil. Lubricate any latch mechanism sliding surfaces with IBM #17 grease.

Emitter (Figure 52)

Adjustment

1. Concentricity: The emitter assembly must be concentric about the shaft before contact duration and timing is adjusted. (Use emitter gage #454337; refer to CEM #2223.)

2. Rotor assembly alignment: Position the rotor assembly on the shaft so the center of the rotor roller lines up with the push-rod shoes.

3. Contact duration: Loosen the rotor roller eccentric screw lock nut and position the eccentric screw for 10 ±2 teeth duration and tighten the lock nut (See System Diagram 0.09.40).

4. Individual contact: Check each contact with the dynamic timer. Form the support straps with a contact bending tool to achieve proper individual contact duration.

5. Contact air gap: Check to insure that all contacts have a safe working air gap (minimum .006"-.008").

6. Emitter timing: Shift the motor on the shaft to obtain correct emitter timing. Refer to System Diagrams 0.09.40 and 0.09.41 for timing chart.

Preventive Maintenance

1. Clean inside surface of emitter with a cloth moistened with IBM #6 oil. Do not use cleaning solvent. The cleaning process should leave a light film of IBM #6 oil on the rotor roller and push rod shoes.

2. Inspect contacts for wear and timing, Adjust if necessary.

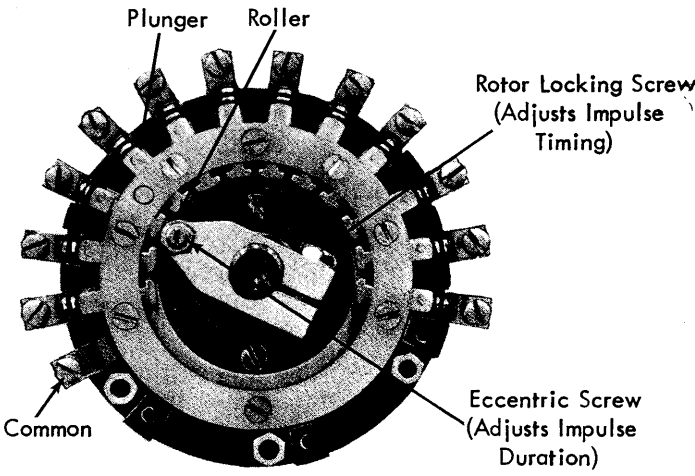


Figure 52. Emitter

P Cams

Adjustment

1. Air gap and contact duration: Set as recommended on the 323 wiring diagram (See "System Diagram 0.09.40").

2. Timing: Slightly loosen the set screws that clamp the cam to the shaft and rotate the cam to achieve the desired timing ("System Diagrams 0.09.40"). Tighten the set screws.

Preventive Maintenance

1. Clean away any accumulation of dust and caked grease.

2. Check for dirty and burned contacts.

3. Clean dirty contacts.

4. Check for proper timing when necessary.

5. Lubricate cam surfaces with a light film of IBM #17 grease.

6. Lubricate the movable contact roller and pivot point with IBM #6 oil.

Offset Stacker

Adjustment

Camshaft Timing (Figure 53)

1. Engage the punch clutch; turn the machine to 6.3 on the index.

2. Loosen the two clamping screws and position the camshaft so the restoring cam extends straight down with the two holes in the cam in vertical alignment. Tighten the clamping screws.

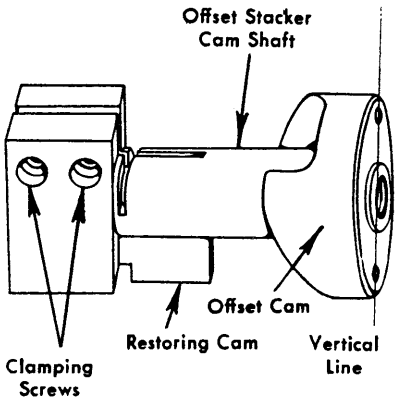


Figure 53. Cam Shaft Timing

CAM FINGER (FIGURES 54 AND 55)

1. With the punch feed clutch engaged, trip the offset-stacker magnet armature; turn the machine manually until both cam fingers, right and left, fall into the low dwells of the offset cam.

2. Continue turning the machine until the midway camming surface of the offset cam operates against the cam fingers, pulling the stacker shaft partially forward in the offsetting action.

3. Manually pull the offset cam forward away from the fingers; now permit the offset cam to move backward toward the cam fingers and note whether both offset cam surfaces touch the right and left cam fingers at the same time. If not, an equalizing adjustment must be made.

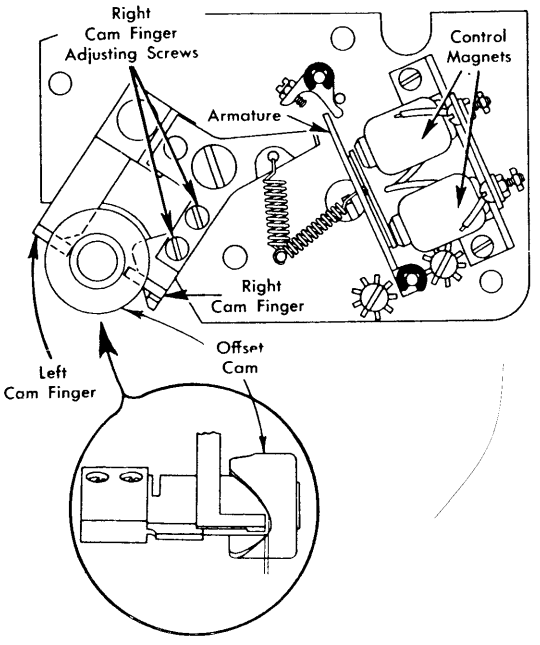


Figure 54. Cam Finger Adjustment

4. To adjust, loosen the right cam finger adjusting screws and position this finger so it will touch the camming surface of the offset cam at the same time as the left cam finger. This adjustment provides for an even or equalized forward pull on the stacker shaft during the offsetting action.

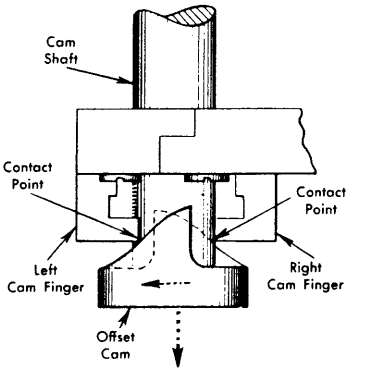


Figure 55. Cam Finger Adjustment

ARMATURE PIVOT AND BACKSTOP (FIGURE 56)

The control-magnet armature pivot and the backstop are combined in one assembly and require simultaneous adjustment.

1. Loosen the holding screws; with the armature held against the backstop, position the backstop laterally to obtain a .020" to .025" latching overlap of the cam finger latch to the armature.

2. Position the armature vertically to provide a .020" to .030" clearance between the periphery of the offset cams and both cam fingers, when fingers are latched on the armature.

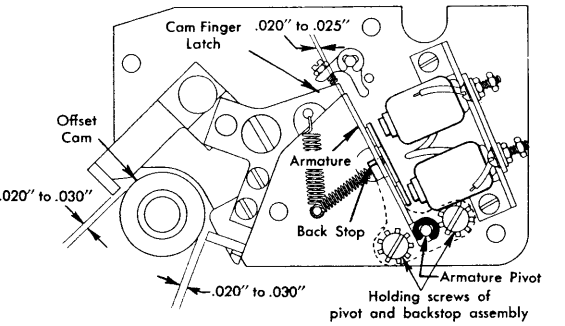


Figure 56. Armature Pivot and Backstop Adjustment

CAM FINGER UNLATCHING CLEARANCE (FIGURE 57)

1. Position the magnet mounting bracket laterally to the armature to obtain an .008" to .010" unlatching clearance between the cam finger latch and the armature, with the armature held against the upper core.

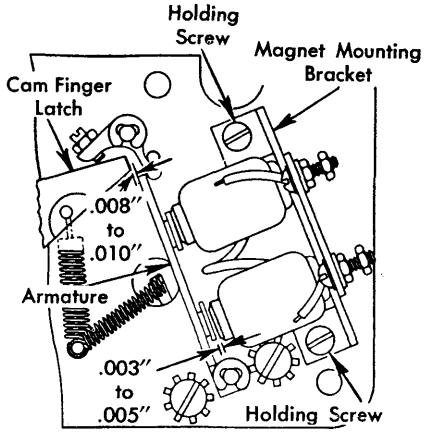


Figure 57. Unlatching Clearance Adjustment

2. At the same time, position the magnet mounting bracket for a .003" to .005" air gap between the armature and lower magnet core.

Armature Knockoff and Cam Finger Relatch Clearance (Figure 58)

1. With the punch feed clutch engaged, turn the machine until the restoring cam is fully positioned on the restoring lobe of the right cam finger. Adjust the armature knockoff screw to provide a .005" to .008" clearance or wink between the armature and the armature backstop. The relatching clearance at this time will be about .045" to .050".

2. Continue to turn the machine until the restoring cam is fully under the left cam finger. At this time the latch arm of the right cam finger should be raised slightly above the armature; this permits the armature to be attracted under a no-load condition.

Positioning Camshaft (Figure 59)

1. With the stacker roll shaft in its normal (not offset) position, engage the punch feed clutch and trip the offset-stacker control magnet armature. Turn the machine until the cam fingers are in the low dwell of the offset cam.

2. Loosen the locking screws and position the camshaft laterally on the stacker shaft to provide 1/32 inch clearance between the low dwell cam surface and the cam fingers. Use care not to turn the cam shaft and destroy the adjustment shown in Figure 53.

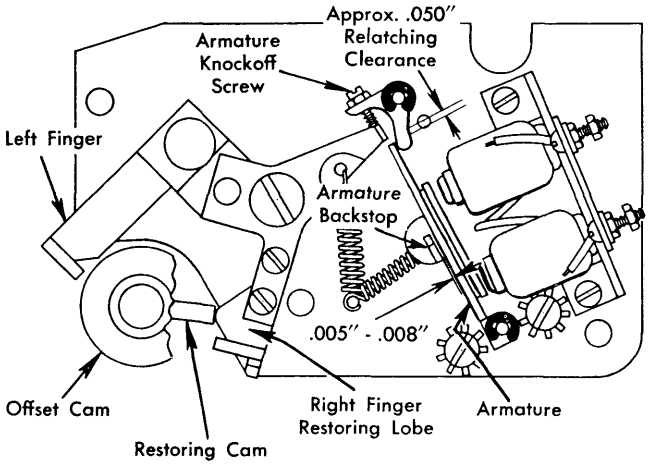


Figure 58. Armature Knockoff Adjustment and Cam Finger Relatching Clearance

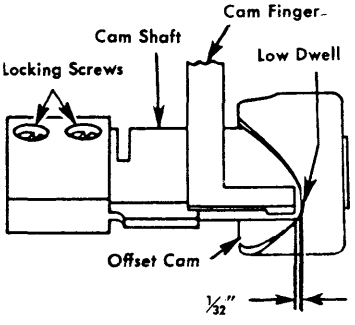


Figure 59. Cam Shaft Positioning

Section 4. 340 Power Supply

Power Specifications

The IBM RAMAC 305 system will operate from either a 208 or a 230 volt, 60 cycle, three phase, four wire service line. For information regarding change from one voltage to the other, see "RAMAC 305 Installation Procedures," Form No. 227-3527.

PERMISSIBLE VARIATIONS

Voltage: Input voltage at the power supply may have a total variation of ±10% of the rated voltage, including transient and steady state.

Frequency: The line frequency must be 60 cycles per second, ±½ cycle per second.

Precautions

Extreme care should be exercised when servicing or inspecting the power supply. Dangerous voltages with high currents are present at various points within the power supply, even when the system is in a power off status. If necessary to make a test instrument connection within the power supply, or to reach into it for any reason, the commercial power input should be disconnected. Since the large capacitors within the power supply retain their charges even after power is removed, care should be taken to be sure that all such capacitors are discharged.

Power Distribution

Power distribution includes all RAMAC 305 circuits except file power, compressor and access motors. Average full load current per phase at:

208 volts 3∅ — 34.5 amps
230 volts 3∅ — 31.5 amps

NOTE: Phase sequence to be 3-2-1 at power input terminals L_1, L_2, and L_3, respectively. The AC sequence light is lit at the correct phase sequence.

The power source must be capable of supplying the full-load running current required by the RAMAC 305. The current peak when starting the system is sequenced to reduce a sudden high current load when the power on key is depressed. The branch circuit to the 340 Power Supply should be rated at least 60 amperes. The circuits must be protected by a circuit breaker or a fused safety switch.

Main Circiut Breaker

Overload protection is provided to the machine by the fully magnetic main circuit breaker. It will instantaneously trip at overload or on line surges. When tripped, the breaker must be reset manually before the machine can be restarted.

Component Location

The 340 Power Supply (gate style) consists basically of 12 drawer assemblies, a meter panel assembly, and a swinging gate assembly with components mounted on either side. To facilitate servicing, terminal block, transformers, switches, contactors, etc., have been stamped with their logic designation. The terminal block connections are also numbered whereever practical. The weights are stamped on each drawer.

NOTE: Machines after 305-10471 have a redesigned 340 (panel style). The main differences between the earlier 340 and the redesigned 340 are pointed out as follows:

1. Main circuit breaker is a thermal magnetic type with a delayed trip on overload or line surges, an instantaneous trip on shorts or when immediate off switch in actuated.

2. Consists basically of seven drawer assemblies, a pin-pivoted meter panel assembly, a hinged relay panel, a circuit breaker panel, a pin-pivoted fuse panel, and a voltage adjust panel.

Voltage Change

Conversion of source voltage (208-230) requires the changing of the wire marked X at main terminal blocks for each DC voltage, each filament regulator, convenience outlet transformer, and control transformer (a total of eight places). In section 9 of the

"System Diagrams" the wires are also marked with an X for reference. See "305 Installation Procedures," Form Number 227-3527, for the correct terminals to change.

Drawers

Removal

Caution: When the drawer is pulled out it may not be grounded. Install a temporary ground jumper when working with power on.

1. Remove all power from system.
2. Disconnect terminal block connections.
3. Remove the ground wire screw in retaining block below drawer and pivot the block so it will not obstruct the lower projection on the drawer.
4. Remove the drawer.

Note: Two men should be available when removing any drawers which weigh in excess of 60 pounds.

Replacement

1. Reverse the removal procedure.

Note: Be sure to reposition the retaining block.

Blower Timer

Adjustment

1. The timer is spring reset when the blower timer drive motor is de-energized. The length of time required to operate the time contacts is controlled by the time dial setting.
2. Loosen dial lock nut and position dial with respect to its index so electronics panel blowers continue to run for 3 minutes after the timer drive motor is energized (machine power off).
   a. Each dial division = 0.5 minutes.
   b. Proper dial setting for 3 minute delay=position #6.

Duo and Thermal Relays

Adjustment

See Relay section of "Customer Engineering Reference Manual," Form 22-5857.

Thermal relays: Set the adjustable thermal contact point air gap so the relay will pick 30 ±10 seconds after the pick impulse is applied. (Repeated pick operations with insufficient thermal point cooling time will cause the delay time to be less.)

Preventive Maintenance

Clean, inspect, and lubricate relays. Use procedure outlined in the "Relay" and "Special Duo Relay" sections of "Customer Engineering Reference Manual" Form 22-5857.

Voltage Check

Preventive Maintenance

1. Compare all voltages mentioned in the following steps, with those listed on the Installation Chart of Section 12.
2. With the machine idle in a power on status, zero the AC and DC meters on the power supply control panel.
3. Check the line voltage and the output voltage of the two regulators. The regulator output voltages should be 236 volts ±3% for a line voltage of 208 volts (±10%) or 230 volts (±10%) in accordance with the primary (208 volts or 230 volts) tap setting on the regulators.
4. Check filament transformer voltages each time power supply voltage checks are made. Follow procedure outlined in the filament transformer adjustments of the "305 Process Unit Section".
5. DC Voltages
   a. Check the DC voltage and adjust the associated Variac controls to bring the voltage reading to the nominal value as shown on the meter calibration chart on the power supply.
   b. Leave the machine in the idle condition and repeat this check for each DC unit.
6. The peak to peak ripple on the +48v DC supply should not exceed 2% at full load. The peak to peak ripple on the other DC voltages should not exceed 1% at full load. Observe AC ripple with scope set to external sync while running the functional test.
7. Function test voltage levels are included in the "305 Process Unit Section".

Access Mechanism

Remove file power before starting removal and adjustment procedures. Do not operate access motor when access is disengaged from disk array.

Access Mechanism as an Assembly

Removal (Figure 60)

1. Visually check and record the arm to disk ratio (disks 0-25-49) (Figure 61) with the arm at track 00 and at track 99. These recordings will be used in the re-assembly procedure. Move arm to home position.
2. Remove false floor.
3. Engage trolley at top of access assembly with trolley rail and adjust nut finger tight.
4. Loosen the four mounting bolts which hold the access mechanism assembly to the disk array.
5. Tighten the large nut on the trolley king pin so as to just lift the access assembly from the disk array.
6. Pull access assembly away from the disk array. It can now be rotated on the trolley king pin for easy servicing.

Caution: Do not bump arm when removing access mechanism.

7. To remove the access assembly from the trolley rail (Drawer Model):
   a. Disconnect air hose at the frame or manifold.
   b. Disconnect motor power line.
   c. Disconnect the 4 connectors at the top of the back plate.
   d. Remove tilt out bar.
   e. Remove access by opening safety latches or rotating trolley block to clear trolley rails.

Caution: This unit is heavy and should be handled with care.

8. To tilt out the access assembly:
   a. Disconnect utility connector to access motor.
   b. Disconnect the 4 connectors at the top of the back plate.
   c. Disconnect air hose at frame or manifold.
   d. Raise the access with the tilt mechanism.
   e. Rotate trolley to clear trolley rails.
   f. Lower access to full movement of tilt mechanism.

Note: Lower access by raising tilt lever. This locks access to tilt bar and lever.

   g. Rotate top of access out and down and rest on floor or other support.

Caution: Do not rest on arm.

Assembly

Reverse the removal procedure and check the arm to disk clearances. This should be the same as before the removal.

Adjustment (Figure 61)

1. Visually check the arm-to-disk clearance with arm in the home position and at track 99. (These are factory set clearances and should not be changed unless replacement of parts warrant.)
   a. Engage the disk detent with air and move the arm to an inner track address, checking for arm to disk clearance.
   b. Rotate the disks by hand.

Caution: Rotate the disk array by the bottom disk only.

   c. Observe runout (Figure 61).
      (1) High point on disk with maximum upward runout +.010" from horizontal for double thickness disks and +.005" for single thickness disks.
      (2) Low point on disk with maximum downward runout —.030"from horizontal for double thickness, or —.035" from horizontal for signle thickness.
      (3) High point to low point should not exceed .030" for double thickness disks or .025" for single thickness.

2. If either of the above checks reveals interference or discrepancies from limits illustrated in Figure 61, look for improper mounting of the access mechanism, a warped arm, disks, or other faulty components.
3. If a new access mechanism is being installed, it may be necessary to add or remove shims to position the mechanism for proper access arm to disk alignment (Figures 60 and 61). Shims can be peeled off in .003" sections if too thick.
   a. With the arm at track 99 position single thickness or 199 double thickness, the ideal adjustment

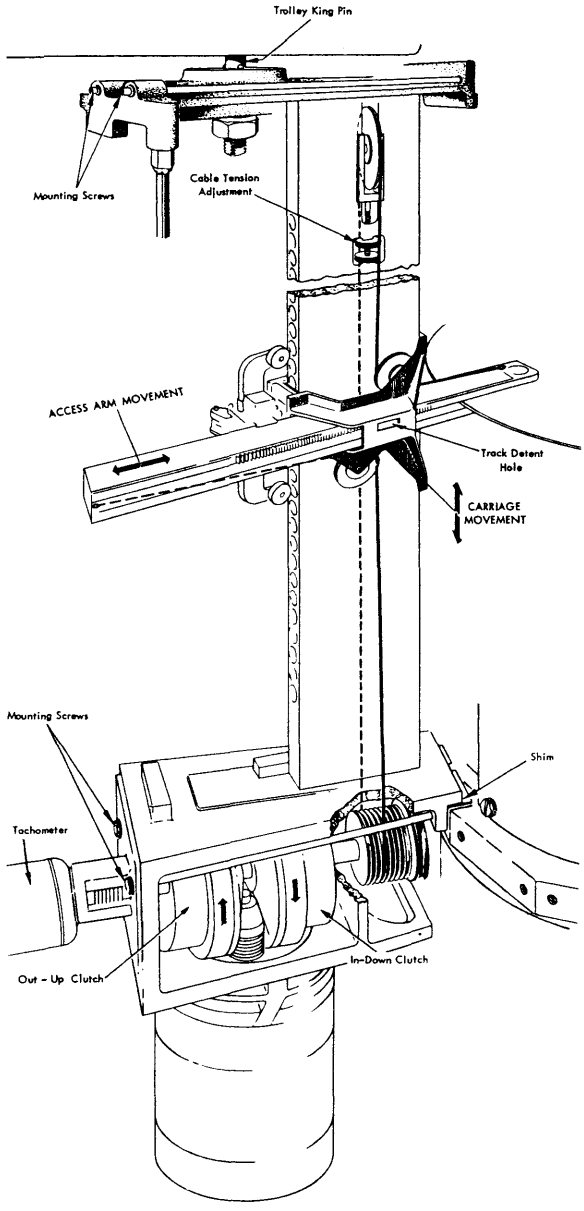


Figure 60. Access Mechanism

for a double thickness disk will be A = B. Ideal adjustment for a single thickness disk will be A = 4 and B = 6.

b. The clearance ratio at the inner track of the disk ideally should be C = 4, and D = 6 for a double thickness disk. It should be C = 5 and D = 5 for a single thickness disk. Wiggle the arm gently to account for freedom of the arm in the carriage.

c. A C/D clearance ratio on either type disk of less than 3/7 will require shimming the access mechanism upward.

d. Dimensions at E and F should be no less than those of C and D.

e. The G/H clearance ratio between the head covers and the disks should be no less than A/B.

Airfoil Assembly (On Machines with Dual Access)

Removal

The access assembly must be removed before the airfoil can be removed.

1. Remove the two bolts that hold the airfoil assembly to the disk array.
2. Use care to avoid damaging the disks. Rotate the airfoils counterclockwise (looking down on the assembly) using the access assembly locating dowell pins as a pivot.
3. Do not lose the shims at the bottom of the airfoil assembly. When the airfoils clear the disks lift the assembly away.

Assembly

Reverse the removal procedure. Check the airfoil to disk clearance on each access.

Adjustment (Figure 62)

Adjust the airfoil assembly before installing the access assembly.

1. With the airfoil assembly installed, rotate the disks by hand, using the bottom disk. Determine the clearance (X) between the highest disk and the airfoil above.
2. Determine the clearance between the lowest disk and the airfoil below (Y).
3. Clearance X should be .010" ±.004" greater than clearance Y. Move the airfoil assembly up or down by increasing or decreasing the thickness of the laminated shim (2109474) between the base casting and the airfoil assembly (See Figure 62).

Way

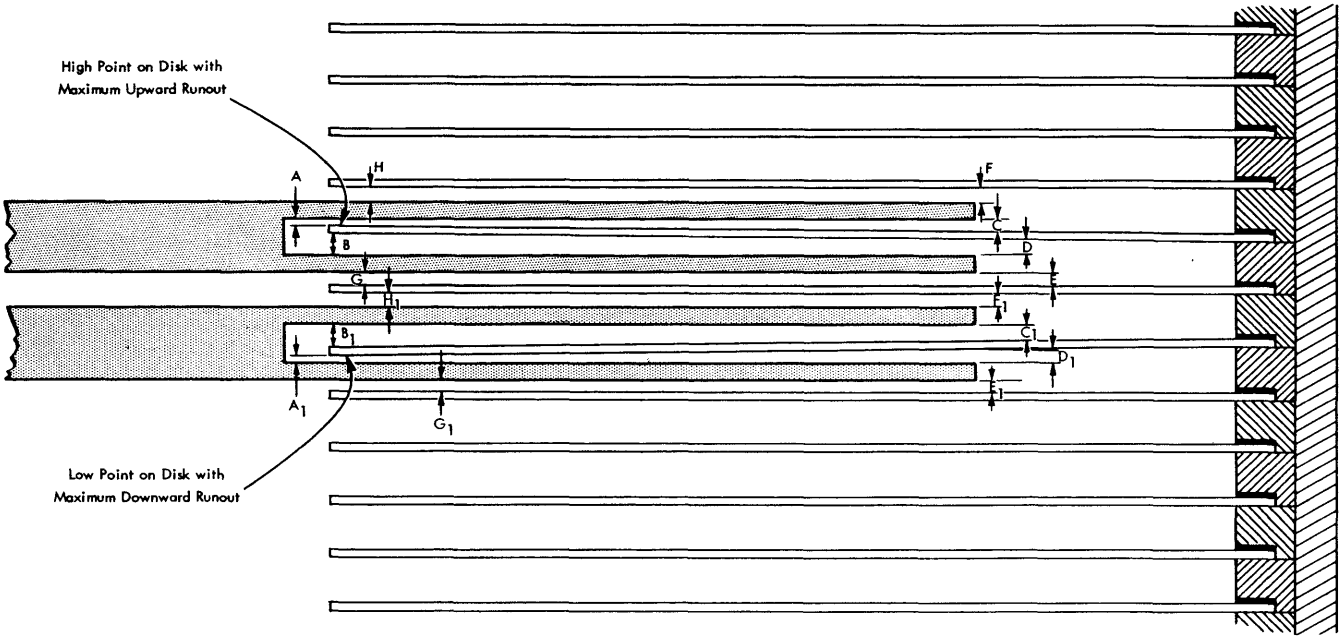
Removal

Replace the entire access mechanism assembly if this part is not usable. See "Removal," "Assembly," and "Adjustments," under Access Mechanism as an Assembly.

Preventive Maintenance

Remove file power.

1. Clean and provide a light film of IBM #6 oil on the detent and "V" surfaces. Care should be taken not to spread oil on the potentiometer strip as this may result in faulty servo operation.



Single Thickness Disk		Double Thickness Disk	
IDEAL CLEARANCES	LIMITS	IDEAL CLEARANCES	LIMITS
A/B = 4/6	A/B & A1/B1 = 3/7	A/B = 5/5	A/B & A1/B1 = 2/8
C/D = 5/5	C/D & C1/D1 = 3/7	C/D = 4/6	C/D & C1/D1 = 3/7
E/F = 5/5	E/F & E1/F1 = 3/7	E/F = 4/6	E/F & E1/F1 = 3/7
G/H = 4/6	G/H & G1/H1 = 3/7	G/H = 5/5	G/H & G1/H1 = 2/8

Figure 61. Arm to Disk Clearance

2. Check for freedom of carriage movement over the entire length of the way. Make the necessary adjustments to eliminate excessive play or binding (See "Carriage Adjustments"). Check access time if this is the only portion of the file on which PM is accomplished at this time.

Access Way Vetrical Alignment

This adjustment is designed to allow alignment of access vertical ways on multiple access files. It should be followed when replacing an access assembly on any file.

NOTE: Before starting this adjustment, be certain that the access is aligned to obtain a maximum signal on the bottom disk. Follow the Access Detent Alignment adjustment to do this. Then:

1. Connect the file robot.
2. Servo to the outside CE track of the top disk.
3. Follow steps 1, 2, 3, 4, 5, and 7 of the Access Detent Alignment adjustment.
4. Measure this top head signal. Turn off track detent switch and manually position arm to obtain peak signal. Note the amplitude difference of signals and direction arm was moved to obtain peak signal.
5. Servo to middle disk, outer CE track.
6. Repeat step 4 at this address.
7. If the arm had to be moved in one direction to obtain the peak signals in items 4 and 6 and they were linear, this indicates the access way is tilted. Follow steps 8, 9, and 10. If the signals were not linear, add the two differences together (top and center) and take an average of the two signals (i.e., If top peak signal difference = +4, center = −1, Arm would have to be moved +2½ in item 10).

NOTE: It is possible to get a very strong signal off of one disk. If this happens, you may have to try several disks to come up with an average.

8. Loosen the 2 screws at the top of the way just enough to allow movement of the way with the adjusting screw.
9. CAUTION: Arm to disk clearance must be maintained during this adjustment. Move the top of the way in or out until the correct signal (determined in item 8) is obtained from the top disk.
10. Tighten the 2 screws at the top of the way to lock this adjustment. Check the scope reading.

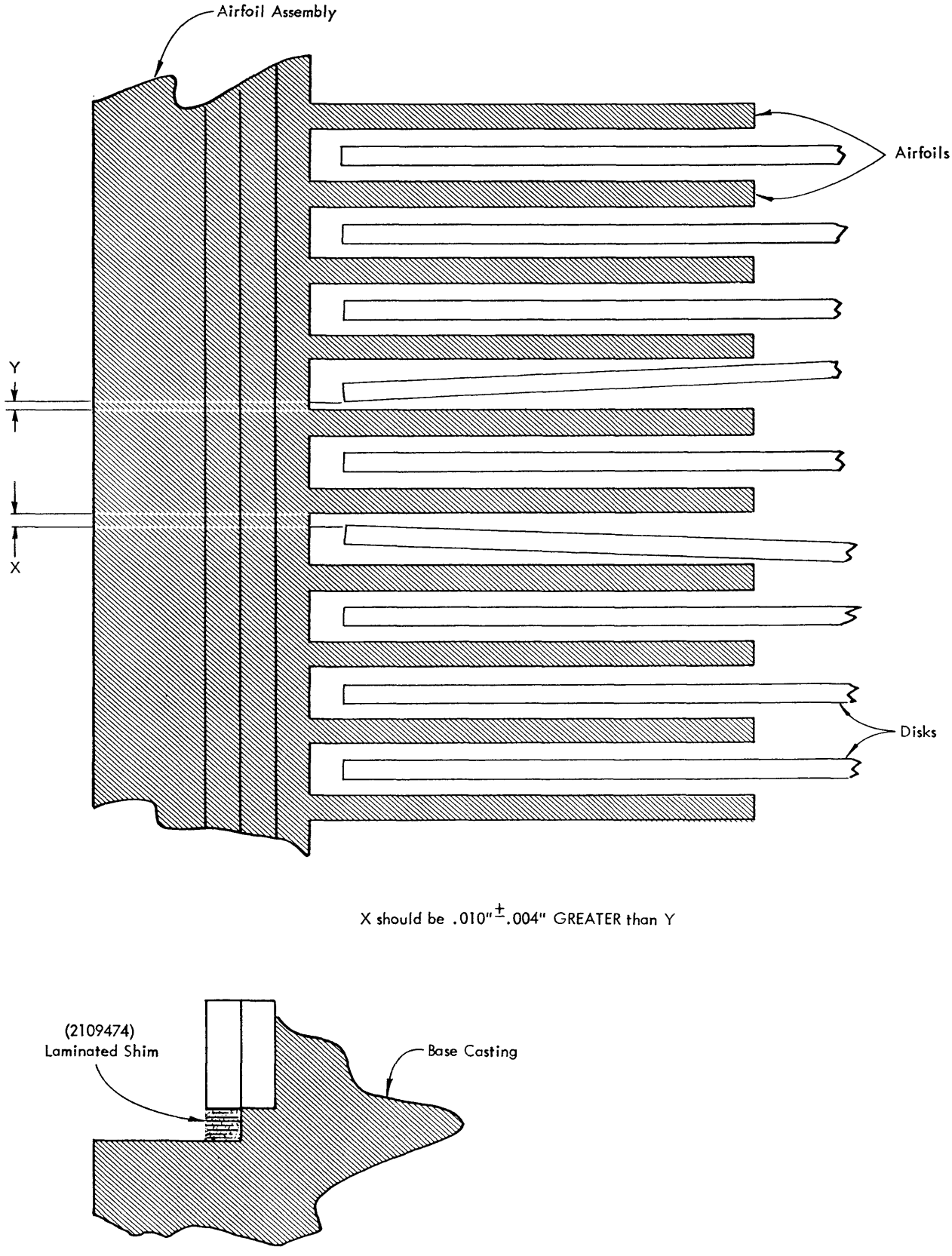


Figure 62. Airfoil Adjustment

Access Drive Cable

Removal

1. Remove AC and DC file power.
2. Move arm to its home position and move carriage near center of way.
3. Fully release the take-up pulley to provide slack in the top cable.
4. Slip top head cover out to expose cable end. (It may be necessary to move the arm toward the disk about ½".) Do not remove head cover completely or the head will pop up and pistons may be lost.
5. Remove cable end from the top arm and slide the head cover back into position to retain the head.
6. Remove bottom cable from rear of arm.
7. Remove cables from carriage pulleys and take-up pulley. (It may be necessary to loosen the eccentric adjusting bolts and re-position the carriage pulleys to provide clearance to remove the cable ends.)
8. Remove the cables from the capstan by unwinding them and removing their anchor pins.

Assembly

1. These are matched cables and both must be replaced if either is bad.
2. Check to insure that carriage is near mid-point on the way.
3. Balance the number of turns of each cable on the capstan and assemble using the reverse of the removal procedure.
4. Attach cable ends to access arm and adjust pulley eccentric adjusting screws (if they were changed in step 7 of removal) for the best vertical cable alignment and parallel alignment of cable to arm. Move arm back and forth to check for pulley to arm screw head clearance. Tighten the lock nuts.

NOTE: The drive cable should never pass under any portion of the head lifter spring.

5. Check lower pulley for clearance to lower overtravel crash stop with carriage at lowest point of travel.
6. Adjust takeup pulley for proper cable tension (See step 3 of "Adjustments").

Adjustment

1. Position carriage pulleys for best possible vertical cable alignment and parallel alignment of cable to arm. Move the arm back and forth to check for pulley to screw head clearance.
2. Check lower pulley for clearance to lower overtravel stop.
3. With the carriage at midpoint on the way, turn the lower adjustment nut finger tight. Check for slack when carriage is at extreme disk position (00 and 49). Tension with carriage at extreme positions should range from 100 to 200 grams for ¼" cable deflection when measured at midpoint of way on the disk pot side. When checking tension, the disk detent should be engaged and the arm should be fully in on the disk.
4. Lock pulley in place with upper adjustment nut.

Preventive Maintenance

Check for proper cable tension when carriage is in the top disk position and also in the bottom disk position (See adjustment step 3).

Access Arm

Removal

1. Remove AC and DC file power.
2. Use care when working in the vicinity of the arm. It is a delicate part and can be bent easily.
3. Remove transparent shield.
4. Visually check arm to disk clearance at disks 00, 25, and 49, tracks 00 and 99. This clearance should be the same after re-assembly. Make sure the disk detent is fully seated.
5. Move carriage to midpoint on the way and move arm to track 99. This will minimize chance of bending the arm when removing the connector plug.
6. Remove two screws that fasten sub-minature connector plug (end of coiled cable) to arm and separate the connector.
7. Remove air line from arm.
8. Move arm to home position and scribe a reference timing mark on the potentiometer gear before disengaging it. (This will facilitate re-assembly.)
9. Loosen track potentiometer anchor and pivot screws and rotate the assembly to disengage gear (See Figure 63).
10. With arm in home position, tape top and bottom cables to way to prevent them from unwrapping on capstan. (Do not put tape on bearing surfaces of way because gum that remains after tape is removed may cause binds.)
11. Fully release takeup pulley to provide slack in top cable.
12. Slide top head cover out to expose cable end. (Loosen tape and move arm toward disk approximately one-half inch if necessary.) Do not remove head cover completely or the head will pop up and pistons may be lost.
13. Remove top cable end from the arm and slide the head cover back into position to retain the head.
14. Remove bottom cable from rear of arm.
15. It may be necessary to loosen both top and bottom eccentrics on pulleys to allow clearance to arm (See Figure 63).

16. Rotate arm crash stop latch 90° (See Figure 63).

17. Pull arm out from carriage. Use caution to prevent cable ends from jamming between the arm and carriage.

18. Install special arm holder assembly (part #2102078) on arm before working on it (See Figure 65).

Assembly

1. Remove special arm holder assembly.

2. Carefully push arm into carriage until forward edge of fail-safe strip registers against disk detent interlock. Depress disk detent piston and move arm forward so that the interlock can register against the side of fail-safe strip. Use caution to keep cable ends from jamming arm. If difficulty is encountered in sliding arm into guides, it may be necessary to back off arm roller or arm guide shoe or both. Do not force arm into guides. (See "Carriage Adjustments" for arm roller and guide shoe adjustment.)

3. Rotate arm crash stop into interference position.

4. Pull arm back to home position. Access arm crash stop latch should depress .000" to .005" before allowing interlock to be pushed into arm lock position. Adjust if necessary (See "Carriage Adjustments").

5. Attach cable ends and rotate carriage pulleys into arm for best possible vertical cable alignment and parallel alignment of cable to arm. Move the arm back and forth to check for pulley to arm screw head clearance. Tighten lock nuts.

Note: The drive cable should never pass under any portion of the head lifter spring.

6. Remove tape from cables and clean off any sticky gum that may adhere to the bearing surfaces of the way.

7. Adjust take-up pulley for proper cable tension. Be sure that cable ends are fastened properly.

8. Align home reference timing marks and engage the potentiometer gear. Fasten the assembly so there will be about .002" backlash (slight wink) between the

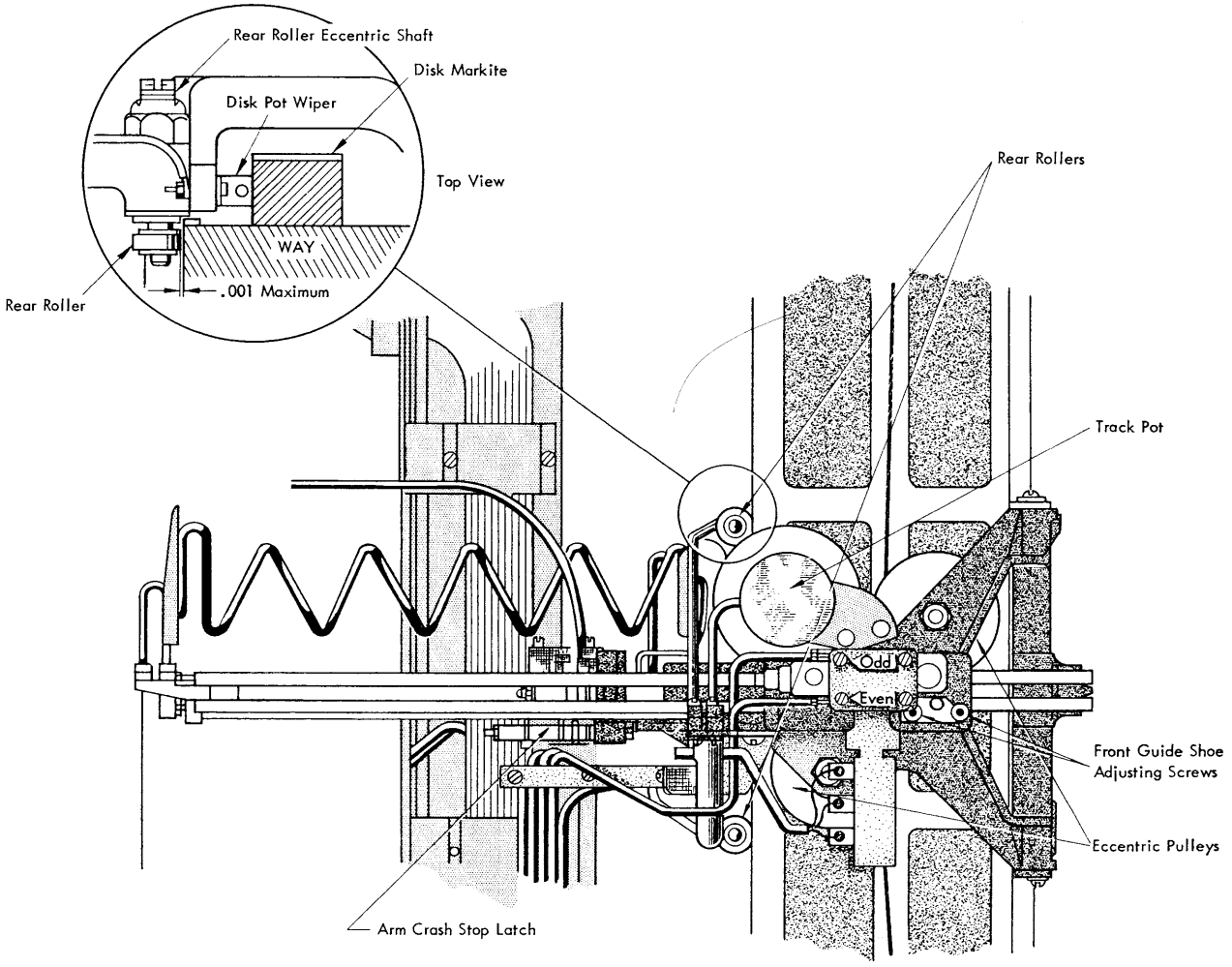


Figure 63. Access Arm and Carriage Assembly (side view)

gear and the rack. Move the arm through the entire stroke and check for any gear to rack interference or more than .002" backlash. Tighten holding screws and re-check.

9. Move the arm to track position 99. Connect the sub-minature connector and tighten its holding screws.

CAUTION: Do not over tighten; connector breakage may result.

Connect air lines.

10. Check access mechanism adjustments.

11. Replace transparent shield.

ADJUSTMENT

1. Check arm for freedom of motion and interlock action. Adjust arm roller, guide shoe, and interlock if necessary (See "Carriage Adjustments").

2. Check cable tension (See "Cable Adjustments").

3. Use the following procedure to visually check arm-to-disk clearance:

a. Move arm from home position to track 99 at disks 00 and 49 and check for arm to disk clearance. It should be the same as before the arm was removed. If proper clearance does not exist, check assembly procedure for possible errors and correct them.

b. Connect robot to file electronics of access that is to be checked (See "Access Mechanism Electronics").

c. Set the file up for local operation.

d. Apply AC and DC file power.

e. Start disk drive motor and then the air compressor motor but leave access motor off.

f. Depress safety reset button on file test station to pick bias and logic safety. (On later machines, switch safety reset-adjust switch to SAFETY RESET momentarily.)

g. Set robot switches.

Switch	*Setting*
Address A	00990
Address B	49990
Start hold	START HOLD
Manual start button	Depress momentarily to change address

h. Depress manual start button and manually rotate clutch disk to servo arm to address A. Check for arm to disk clearance.

i. Depress manual start button and manually rotate clutch disk to servo arm to address B. Check for proper operation. The clearances should be the same as before the arm was removed. If proper clearance does not exist, follow the arm to the disk clearance adjustment. Do not start access motor until all interference has been eliminated.

PREVENTIVE MAINTENANCE

1. Clean and provide a light film of IBM #6 oil on outside sliding surfaces.

NOTE: Do not get oil on heads.

2. Roller bearing to arm clearance, .001" maximum (See Figure 64).

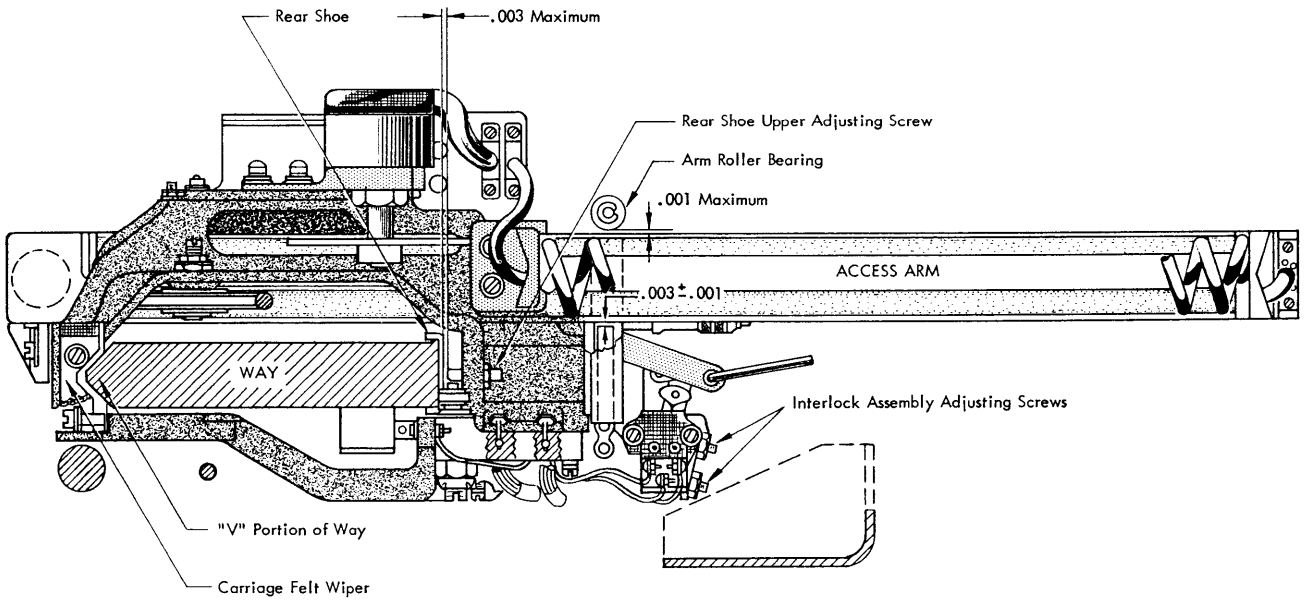


Figure 64. Access Arm and Carriage Assembly (top view)

3. Arm to sliding surface of front guide shoe clearance, .003" maximum.

4. Arm should move freely when operated by hand.

5. Air heads (See Figure 65).

Clean and inspect the air heads using the head cleaning kit (part #2108311) and the following procedure:

CAUTION I: Do not use lubricants on head.

CAUTION II: Remove head spring when installing and removing head plug. Plug must lie flat in arm.

CAUTION III: Adjust plug and pigtail in arm for freedom of head in socket.

CAUTION IV: Pruge auxiliary air line (#2108006) prior to cleaning heads.

NOTE: This procedure can be followed either by removing the access mechanism as an assembly, or by tilting the access mechanism out utilizing the tilt out bar. Service one head at a time.

a. Remove (or tilt out) access mechanism (See "Removal—Access Mechanism").

b. Move arm forward so that heads become accessible. Place head holder (#2102078) over arm to prevent damage to arm while servicing heads.

c. Remove air hose from coupling at carriage bracket.

d. Remove head cover. Care should be taken to prevent heads from "popping up" which could result in losing piston pins.

NOTE: When removing head cover, the head should be depressed sufficiently to assure that the piston pins will clear the recess in the head cover.

e. Remove piston pins.

NOTE: Single thickness disk heads have .012" longer piston pins than double thickness disks and must be flush with top of bushings.

f. Flex head spring to remove from gimbals and allow head to be supported by air tubing and pigtail.

g. Replace head tubing if damage or excessive bowing is noted. If it becomes necessary to remove and replace the plastic tubing, the following procedure should be used:

(1) Remove head spring and head plug from arm.

WARNING: Do not try to pull or push tubing off the nipple as nipple might loosen in the head.

(2) To remove the head tubing, cut through the old tubing behind the shoulder of the nipple. Be careful not to score the shoulder of the nipple. The tubing may now be removed using plastic tube tool (2108305). The tubing remaining on the shank can be split lengthwise and removed.

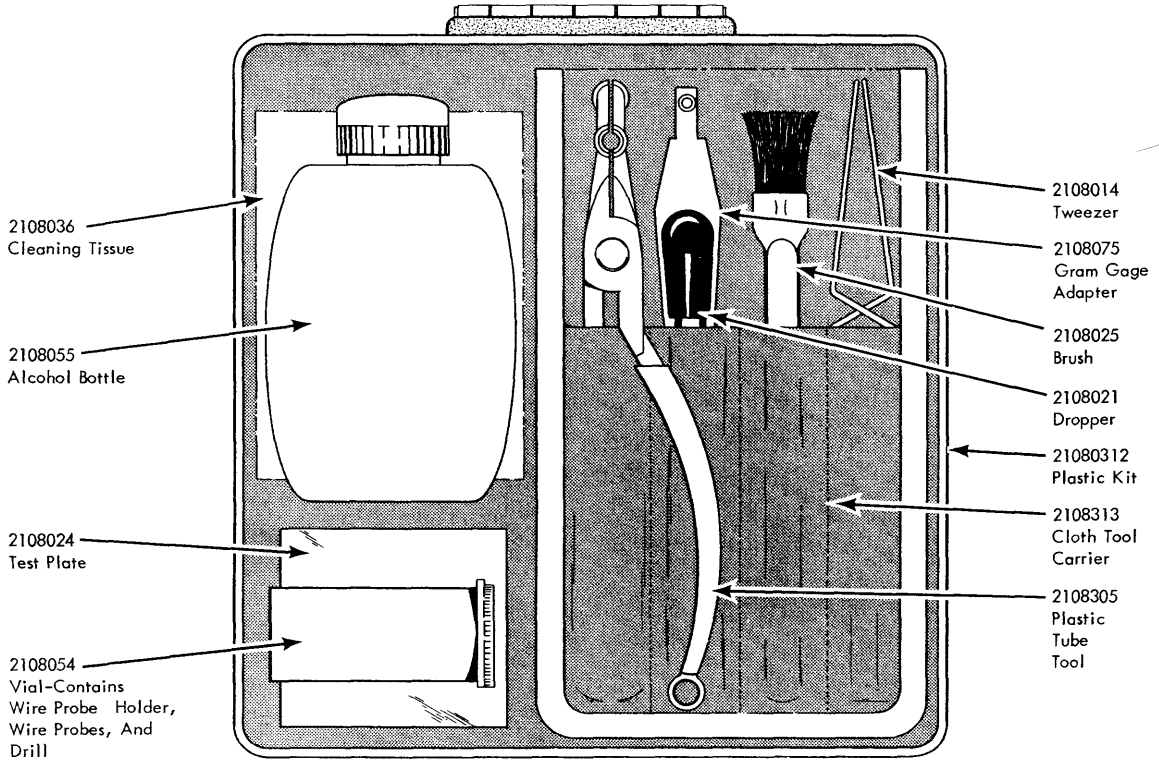


Figure 65. Head Cleaning Kit

NOTE: With tubing removed, replace the head springs temporarily and adjust as follows: The head-lifter springs should rest evenly on the arm at the four points labeled "A" (Figure 66). This is to prevent a rocking action when air is applied or removed. Adjust by forming head lifter springs at points labeled "B" (Figure 66). However, spring replacement is recommended if possible.

(3) An IBM or other mechanical pencil may be used to prestretch the inside diameter of the tubing before installing onto the nipples. Warming the tubing in the hand facilitates installation.

(4) If the plastic tubing has a permanent curl, the tube should be installed on the arm nipple so that it curves away from straddling disk and in a plane vertical to the disks. Use only the plastic tube tool (#210835) provided in the head cleaning kit to install and adjust tubing.

(5) Install the air head in the other end of the tubing so that in its free position, the gimbal pin axis is parallel to the horizontal plane of the arm.

(6) Replace head plug and spring in arm. Do not put spring into gimbal pins.

CAUTION: Ends of the head spring must be fully seated in holes in arm. Failure to accomplish this enables spring to raise and damage disks. Records can be lost if this happens.

h. Brush off heads.

i. Clean air orifice holes with .005" piano wire. Stone end of wire slightly round. The piano wire should project 1/8" from the holding vise. Turn in one direction only while cleaning.

j. Clean .0465" air escape hole by inserting #56 twist drill.

CAUTION: Do not use drill to clean piston holes.

k. Using the small eyedropper, clean piston holes by flushing with solvent (isopropyl alcohol, when initial supply is depleted, purchase locally specifying 70% or better by volume). Blow out excess solvent with compressed air through air connection at carriage.

l. Wash each pin with a drop or two of solvent and wipe the pins clean using the tissues (part #2108036) supplied in kit. Using the tweezers, insert piston pins in the air heads and check for freedom of action. Do not apply any additional closing force on tweezers. Damage to nylatron piston pins can easily result. Absolute cleanliness is necessary.

m. Place special plastic test cover (part #2108015) on top of head to retain piston pins.

n. Test cleanliness of orifice holes by supplying 50 PSI pressure through air inlet at carriage and holding a .003" feeler gage over each hole to see the exhaust of air deflect the feeler gage.

o. Brush and clean head sockets and head covers.

p. Using gram gage (part #450459) and the gram gage adapter (part #2108032), check for proper tension of the head lifter springs. Total tension of both head springs should be 25 grams (+10, −0) equally distributed between both springs when depressed to the midpoint of the spring groove. Each spring should be between 12.5 to 17.5 grams with the difference between pairs of not greater than 2 grams. Adjustment can be made if necessary by forming spring 1½" from the end.

q. Install head springs in gimbal pins. Replace head cover.

NOTE: Check to see that the head spring on the upper head is installed so that the upper drive cable is above and passes completely over the spring. The drive cable should never pass under any portion of the head spring.

r. Check the heads for freedom of action. Using gram gage through center hole of head cover perpendicular to the top surface of the head, check the force required to just move the head. This force should equal the total spring tensions of the head being tested. Should the head be restricted in the arm socket, adjust the length of air tubing and/or pigtail and plug in arm for optimum freedom. If it becomes necessary to alter the position of the tubing, the tubing should be pushed (not pulled) to the required position. Use only the plastic tube tool (#2108305) provided in the head cleaning kit to position tubing.

NOTE: You can check head for binds by connecting the auxiliary air line to the arm and operate its valve slowly. To get air to the file, place the file and compressor in local control, turn the access motors off, then depress the access and compressor start keys.

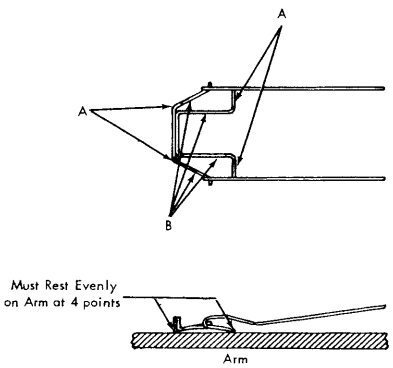


Figure 66. Head Lifter Springs

s. Repeat steps d through r for the second head.
t. Check gimbal action and air bearing when both heads are depressed on the .100" test plate (#2108024) with 50 PSI air pressure.
u. Make sure head cover retaining springs are locked in place.
v. Thoroughly clean access arm with a brush. Remove arm holder (#2102078) and return arm to home position.
w. Replace access mechanism (See "Access Mechanism as an Assembly—Assembly").

Carriage (Figures 63 and 64)

REMOVAL

1. Remove AC and DC file power.
2. Move access away from disk array.
3. Remove transparent shield.
4. Remove access arm.
5. Disconnect airlines from carriage.
6. Remove two screws that fasten elevator cable connector to carriage. Disengage cable connector.
7. Remove carriage back plate. Take care not to damage disk potentiometer wiper.
8. Loosen the locking nuts and back off the two rear shoe adjusting screws.
9. Press the rear shoe against the carriage. Pivot the carriage about the "V" portion of the way and remove it.

ASSEMBLY

1. Press the rear shoe against the carriage and put the "V" part of the carriage on the way. Pivot the carriage on the way until the rear shoe lines up with its bearing surface. Move the rear shoe to engage the way, and the carriage is mounted (The disk markite strip may have to be moved to the side to put the back plate on).
2. Fasten carriage back plate. Take care not to damage disk pot wiper.
3. Adjust rear shoe as near as possible without applying air pressure (See "Rear Shoe Adjustment").
4. Use shims to center the wiper on the potentiometer strip.
5. Connect elevator cable connector and tighten holding screws (See "Elevator Cable Installation").
6. Connect air lines.
7. Install access arm.
8. Turn local-off-remote toggle switch in the starter box, to LOCAL and the manual-automatic toggle switch to MANUAL and apply file power. Start the air compressor but leave the other motors off.
9. Make adjustments.

ADJUSTMENT

1. Rear shoe and rear rollers (Figures 63 and 64).
   a. Apply disk detent air to pull the carriage against the "V" portion of the way (See Figure 64).
   b. Adjust the upper and lower adjusting screws for a .003" maximum clearance between the screws and rear shoe (Figure 64).
   c. Adjust rear roller eccentric shafts for .001" maximum clearance between rollers and way at the tightest point. Lock in place (See Figure 63).
   d. Check freedom of movement of carriage on way over entire length of way.
2. Cable tension: (See "Cable Tension — Adjustment").
3. Arm roller bearing and front guide shoe (Figures 63 and 64).
   a. Fully seat the disk detent and move to home position. (This is necessary to eliminate interlock to arm interference.)
   b. Rotate the roller eccentric stud for a maximum of .001" roller to arm clearance. Tighten lock nut (See Figure 64).
   c. Front Guide Shoe (See Figure 63). Adjust arm guide shoe to .003" maximum clearance between arm and shoe as follows:
      (1) Loosen two nuts on slotted adjustment screw so as to not limit shoe movement during adjustment.
      (2) Adjust each of the two adjusting screws by turning solid against arm and rotate backward 10 to 20 degrees. Arm should be free from any drag, but .003" feeler gage should not enter between arm and shoe. Lock adjustment screws with the adjusting nuts.
      (3) Turn inner nut (on slotted adjusting screw) to bear lightly against plate. Holding nut securely, turn outer nut to lock against it.
      (4) Arm should remain free without drag.

NOTE: On earlier machines, the detent mounting screw may interfere with making this adjustment. A washer can be added or the screw can be shortened to eliminate this condition.

   d. Keep the disk detent fully detented and move the arm through its entire stroke. Check for and remove any binds or excess play.
4. Disk detent interlock (Figure 64).
   a. Arm roller and guide shoe must be properly adjusted.
   b. Apply disk detent air.
   c. Adjust interlock assembly adjusting screw for .003" (±.001") clearance between interlock face and side of arm fail-safe strip at closest point. Tighten lock nuts.

d. Make sure all slack is removed from linkage points.

e. With arm at a track address and the disk detent air removed, vertical freedom of the carraige should not exceed .007" (Visual).

5. Access arm crash stop (Figure 63).

a. Turn the adjusting nut to compress the rubber bumpers 1 to 1.5 turns.

b. Adjust the position of the crash stop latch, so that as the arm returns to the home position, the tab on the underside of the arm strikes the crash stop latch just before (.000"-.005") the interlock slide can enter the cut in the arm. Remove the shims as required.

PREVENTIVE MAINTENANCE

See "Preventive Maintenance" under "Disk Detent," "Track Detent," and "Carriage Felt Wipers." Remove the arm crash stop from the mounting stud and apply a light film of IBM #20 to the portion of the stud on which the stop slides. Readjust after re-assembly as required.

Carriage Felt Wipers

REMOVAL

Remove two screws that fasten wiper bracket and remove the bracket and the felt wiper.

ASSEMBLY

1. Put the felt wiper in position against the way and place wiper bracket on top of it.
2. Fasten wiper down with holding screws.

ADJUSTMENT

Loosen holding screws and move felt so that it contacts the "V" surface on the way. Tighten screws.

PREVENTIVE MAINTENANCE

1. Check for proper wiper to way contact.
2. Wet the felt wipers with IBM #6 oil every month.
3. Replace wipers if surface becomes glazed.

Carriage Overtravel Crash Stops

REMOVAL

Remove mounting bolts and disassemble as desired.

ASSEMBLY

To assemble, reverse the removal procedure.

ADJUSTMENT

Position switch so that an overtravel stop shaft movement of between 1/32" and 1/16" will transfer the switch contacts.

PREVENTIVE MAINTENANCE

Apply a light film of IBM #17 to plungers.

Rear Shoe (Figure 64)

REMOVAL

1. Remove AC and DC file power.
2. Remove carriage from way (See "Carriage Removal").
3. Remove rear shoe.

ASSEMBLY

Assemble using the reverse of the removal procedure.

ADJUSTMENT

1. Make adjustments with access mechanism positioned on the trolley track.
2. Apply disk detent air to pull the carriage against the "V" portion of the way.
3. Adjust the two adjusting screws for a clearance of .003" maximum between the screws and rear shoe (Figure 64).
4. Check freedom of movement of carriage over entire length of way.
5. Make additional adjustment necessitated by carraige removal and assembly procedure (See "Carriage Adjustments").

PREVENTIVE MAINTENANCE

Check freedom of carriage movement over the entire length of the way.

Elevator Cable

REMOVAL

1. Remove file power.
2. Remove upper and lower holding clamps.
3. Remove the connectors at both ends of potted cable.
4. Remove the cable.

ASSEMBLY

1. Install elevator cable (See Figure 67).
2. Assemble connector to back plate. The unpotted portion of the elevator cable should be back of the service cable in order to prevent slack of unpotted wires from snagging the carriage during machine operation.
3. The other end of the elevator cable assembly is connected to the carriage in one of two ways, depending upon the model as follows:

a. Earlier models have elevator cables which can be plugged directly into the carriage at a connector receptacle.

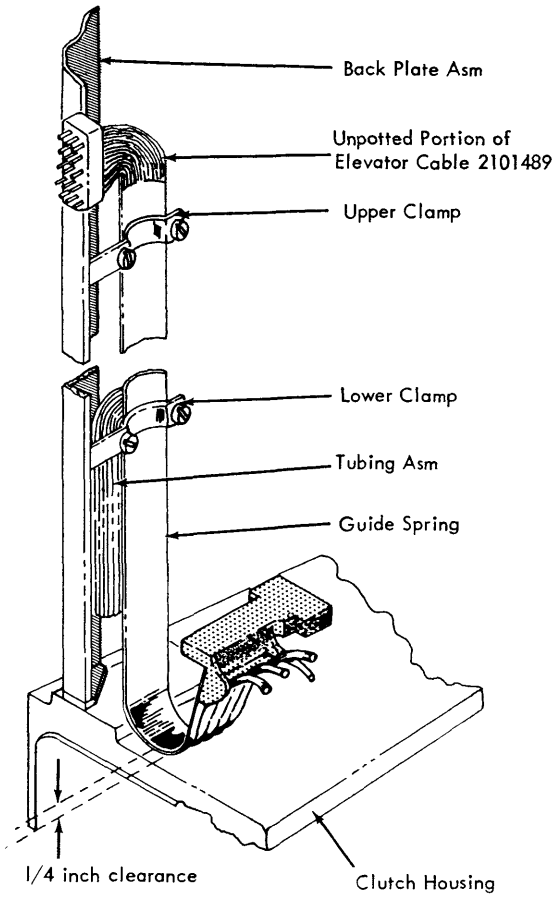


Figure 67. Elevator Cable

b. Later models have elevator cables which are held to the carriage by means of a bracket (which eliminated the connector) and the elevator cable itself terminates with two small connectors which carry the read write circuits and the track address circuits. With models of this construction, care should be exercised to have the bracket, which holds the elevator cable, horizontal and air tubes and cables must not interfere with the operation of the arm and the arm crash stop. Otherwise, alignment procedure is the same as follows:

4. Position the multi air tube assembly (extends down through the opening between the lower clamp and the back plate), the elevator cable, and the guide spring together and lightly secure with the upper and lower clamps so that final positioning can be established.

5. Final positioning of the air tube assembly, elevator cable, and guide spring should be such that:

a. The guide spring is vertical and centered on the elevator cable.

b. Air tube assembly, elevator cable, and guide spring lie one against the other without developing slack when carriage is servoed to disk 00 or disk 49. Check by manually operating arm and carriage.

c. The air tubing is 1/8" to 3/8" from clutch housing when carriage is servoed to disk 49. Check by manually operating arm and carriage.

6. Tighten upper and lower clamps and check for final position and clearance of elevator cable when carriage is detented to disk 00 and moved along the carriage way from disk 00 to disk 49.

Disk Detent Assembly

Removal

1. Remove AC and DC file power.
2. Disconnect the leads from the disk detent switch.
3. Remove detent assembly mounting screws.
4. Remove disk detent.

Assembly

1. Follow reverse of removal procedure.
2. Make adjustments.
3. Lubricate all bearing points.
4. Apply power and check machine for proper operation.

Adjustment

1. Check arm roller bearing and front guide shoe adjustments (See "Access Arm Adjustment").
2. Set up file for local operation.
3. Apply file power and start air compressor. Leave disk drive motor and access motor off.
4. Apply disk detent air to fully detent the carriage. Adjust interlock assembly adjusting screws for a clearance of .003" (±.001") between the fail-safe strip and the interlock with all linkage slack removed. Check at closest point. Tighten adjusting screw lock nuts.
5. Position arm at track address and move carriage up and down to check for vertical motion. It should be .007" or less. The disk detent air should not be applied while making this check.
6. Restore file starter box to normal and check machine for proper operation.

Preventive Maintenance

1. Check for proper detent adjustment.
   a. No slack from linkage pivot points.
   b. Vertical carriage freedom not to exceed .007" when the arm is at a track address and the disk detent air pressure removed.
   c. Clearance between the face of the disk detent interlock and the side of the fail-safe strip is .003" (±.001") when disk detent is engaged by 50 PSI air pressure (Figure 64).
2. Lubricate with one drop of IBM #6 oil in the air inlet.

Disk Detent Switch Assembly (Figure 68)

Removal

1. Remove AC and DC file power.
2. Remove switch mounting screws.
3. Lift switch straight up so actuator will clear drive pin.
4. Disconnect cable from switch by removing screws.

Assembly

1. Follow reverse of removal procedure.
2. Make adjustment.
3. Apply power and check for proper adjustments.

Adjustment

(Caution: To be made with power off)

1. Set drive pin in the approximate middle of its travel.
2. With switch fully against the raised portion of the mounting surface, align switch so that the actuator is centered around the drive pin.
3. Tighten mounting screws.
4. With disk detent fully seated, adjust timing screw so that the contacts are made with 1/64" overtravel (for contact wipe).
5. With disk detent fully retracted, adjust the other timing screw so that the contacts are made with 1/64" overtravel.
6. Operating point must break before make.

Preventive Maintenance

1. Check adjustments and holding ability of adjustment locking nuts.
2. Check machine for proper operation.

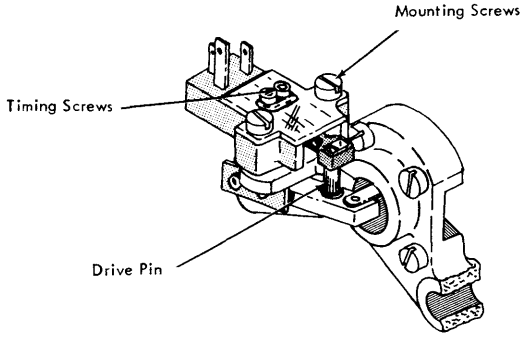


Figure 68. Disk Detent Switch Assembly

Track Detent Assembly (5 million character) (Figure 69)

Removal

1. This unit determines the exact radial position of the heads with respect to the tracks on the disks and must not be removed or adjusted unless absolutely necessary.

Note: PM can be performed without removal of the track detent assembly from the access carriage.

2. Select a disk with minimum runout.
   a. Servo to this disk (note the address used).
   b. Turn test lock on.
   c. Trigger scope with record start and observe read amplifier signal at pin 3 of the first amplifier (8.10.04); record this voltage.
   d. Turn off access motor at convenience outlet.
   e. Tighten the front shoe to lock the access arm in a locked position.
3. Remove file AC and DC power.
4. Separate track pot cable assembly connector.
5. Mark track pot gear and arm to facilitate reassembly.
6. Remove detent air lines.
7. Remove detent assembly adjusting screw.
8. Remove track detent switch or wires.
9. Remove (2) detent assembly mounting screws.
10. Remove track detent assembly and dis-assemble as desired.

Assembly

1. Follow the reverse of the removal procedure.

Note: On re-assembly after you have completed step 3 (i.e., restoring AC and DC file power), seat the odd or even detent, depending on the original address used. Remember the fourth digit of the address denotes the odd or even detent. Have the adjusting screw backed off and the mounting screws loose. Tighten the mounting screws and set the adjusting screw. Readjust the front shoe. Recheck for the voltage noted in step 2c. If any discrepancy exists, make the access detent alignment adjustments.

2. Apply power and check for proper operation.

Access Detent Alignment (5 & 10 Million Character File)

This adjustment is necessary only when an access arm or assembly has been replaced. It serves to align the new access heads to the tracks written by the old heads.

Access zero should always be the first access aligned. Additional accesses should be aligned to data written by access zero. If an assembly has been replaced on access "0" it may be necessary to align it to data written by another access.

1. Turn off DC.
2. Remove the AGC pluggable unit (B5 on 8.10.04 for gate file or E1 for drawer file).
3. Remove the third stage pluggable unit (B4 on 8.10.04 for gate file or E2 for drawer file).

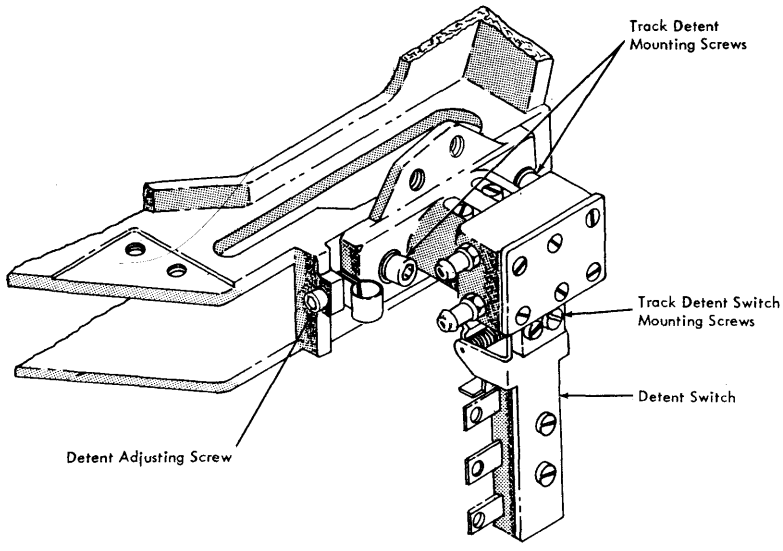


Figure 69. Track Detent Assembly

4. Jumper pin 3 to pin 5, and pin 8 to pin 10 of the third amplifier (8.10.04).

5. Turn DC on.

6. Servo to the outside CE track on the lowest disk.

7. Set the scope to trigger on record start, time/division at 200 microseconds, volts/division at 0-1 volts. Set the vertical position knob so that you monitor only the peaks of the read amplifier clipped monitor point (8.10.04).

8. As you are monitoring this signal, loosen the detent mounting screws. Adjust the track detent adjusting screw until you obtain the largest signal. One vertical division on the scope face is equivalent to 0.001" of access arm movement (See Figures 69 and 72).

9. Tighten the two detent holding screws.

10. Read from the bottom head. Record the output signal. The signal should be about the same. If it is not, readjust the detent adjusting screw for maximum signal from the bottom head.

11. Read from the top head and record the output signal.

12. Adjust the detent adjusting screw for an average of the top and bottom signal.

13. Servo and read from the inside and outside CE tracks on the top, bottom, and middle disks. Check to see that the minimum read signal is not less than 75% of the maximum signal on any track (including modulation). The noise level must not exceed 20% of minimum signal level. If all readings meet these requirements, the access alignment is complete. A quick check of this adjustment would be to compare the read signal strength of information written at a time when the system was known to be functioning correctly (see paragraph 59 page 184), with the read signal strength after the adjustment. The two must be the same. If there is an increase or a decrease in the new read signal, the detent assembly is out of adjustment. See Access Way Vertical Alignment if the signal from top disks are weak. If parity errors occur after the above adjustments, check the head signal directly by using the following procedure.

a. Turn off DC. Pull the wire from R5071-6 O/P. Remove the first amplifier (D4 or F2).

b. Connect the vertical input of the scope to 4W and the ground terminal of the scope to 4Z. Ground the scope to the file frame. Trigger the scope off the record start monitor point.

c. Servo the access to be aligned to the inside CE track on disk 49.

d. Measure the head signal. The following signals are the minimum for a good head:

(1) Outer CE track on 5 million character file—40 millivolts peak to peak.

(2) Outer CE track on 10 million character file —36 millivolts peak to peak.

(3) Inner CE track on 5 million character file—28 millivolts peak to peak.

(4) Inner CE track on 10 million character file —18 millivolts peak to peak.

If the above signals are not obtained the access alignment may still be out, the head may be bad, or the track may have a weak flux pattern.

Preventive Maintenance

1. Check for loose parts (particularly the slotted guide pins) for wear and refer to "Track Detent Assembly—Adjustments" if discrepancies exist.

2. Remove the rear cover of the detent mechanism and place a drop of IBM #6 oil at the top of each U-cup seal.

3. Add one drop of IBM #6 to pistons through hole provided on top of track detent housing. Caution should be exercised when lubricating the track detents, as excess oil will transfer to the arm and then to the disk and cause damage to the disk coating. If the pistons are free and there is some oil on the detent mechanism, postpone lubrication until the next inspection.

In case the detent pistons should stick during normal operation of the file, remove pistons, clean and lubricate as follows:

1. Remove slotted guide pins.
2. Remove piston, U-cup assemblies, and return springs. Caution must be taken not to lose the guide pin lock washer or not to drop it into the mechanism.
3. Clean pistons, piston guide bores, and air cylinder bores and check for wear.
4. Apply light film of oil to pistons and air cylinder bores.
5. Reassemble pistons to their respective bores (piston notched on U-cup end must go back into notched air cylinder).
6. Reassemble slotted guide pins and lock washer to air pistons. Push switch actuator toward carriage so guide pins will be on proper side of actuator and will prevent damage to switch.
7. Reassemble cover and gasket.
8. Remount track detent switch if removed and check adjustment (See "Track Detent Switch").

Track Detent Switch (Figure 70)

REMOVAL

1. Remove AC and DC file power.
2. Remove the two mounting screws holding switch to track detent housing.
3. Remove screws connecting cable to switch.
4. If switch is to be removed for an extended period of time, remove hairpins in order to prevent excessive strain on hairpins.

ASSEMBLY

1. Replace hairpins on switch if removed.
2. Connect cable to switch using the connecting screws.
3. Mount on track detent housing with the two mounting screws (seat switch against its registration surface). Switch actuator paddle to be on carriage side of guide pins for proper operation.
4. Move switch actuator paddle to check for clearance with top of track detent assembly housing.

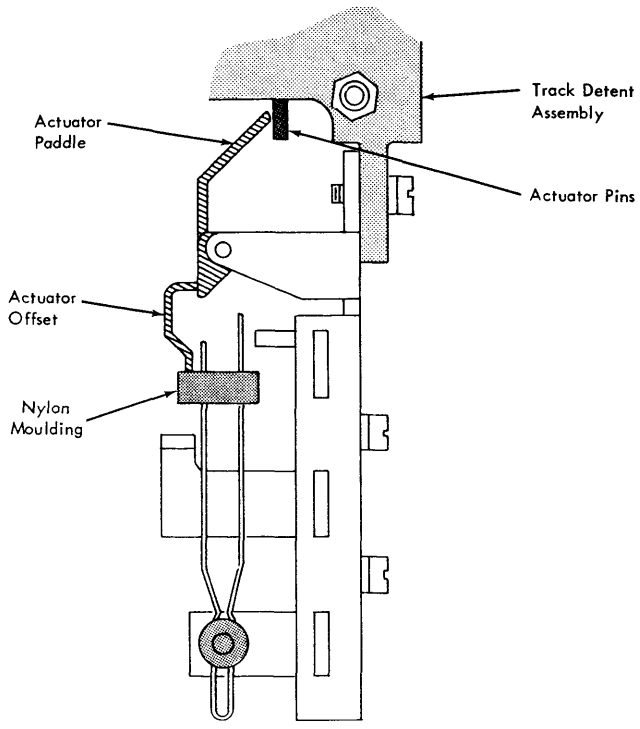


Figure 70. Track Detent Switch Assembly

5. Adjust switch.
6. Apply power and check machine for proper operation.

ADJUSTMENT *(5 Million Character File) (Figures 70 and 71)*

NOTE: In order to make this adjustment, the new style feeler gage set (450745) is required.

1. Turn off DC power.
2. Move switch actuator paddle to check for clearance with detent housing.
3. Actuator paddle to rest evenly against both guide pins with no air on detent. To adjust this, bend the actuator paddle at the split so even contact is made.
4. Place an .018" feeler gage on the face of the arm tooth that one of the detent pistons will seat in. Turn air on and the N/O side of the switch should be open (test with ohmmeter). Turn air off and replace .018" feeler gage with .012" feeler gage; with air on, the N/O side of switch should be made. To make this adjustment, bend actuator at the "offset" near the molding that operates the hairpins.
5. With air off, place a .005" feeler gage across the arm teeth and turn air on. The N/C side of switch is to be open. If it isn't, either the previous steps were not done properly, or the switch isn't within specifications. If the latter is the case, replace the switch.
6. Repeat steps 3 and 4 for the other detent piston. The adjustment should be correct without additional

bending of the goose-neck. If this is not the case, step 2 was not done properly.

Adjustment *(10 Million Character File) (Figures 71 and 72)*

1. Turn off DC power.
2. Move switch actuator paddle to check for clearance with detent housing.
3. Connect an ohm meter across N/O terminal and the O/P terminal.
4. Apply air to any track detent piston and adjust that detent's set screw until the N/O contact is just made. Then turn the set screw ¼ turn clockwise (See Figure 72).
5. Repeat step 4 for each detent.
6. Connect the ohmmeter accross the N/C terminals.
7. Place a .005" feeler gage between the arm teeth and any detent (bottom Figure 71). Apply air. The N/C contact should be open. If it is not open, steps 4 and 5 were not done correctly or the switch is not within specifications. If the latter is the case, replace the switch.
8. Repeat step 7 for each detent.

Preventive Maintenance

1. Check adjustment.
2. Clean electrical contact surfaces.
3. Add one drop of IBM #6 oil to actuator pivot points.
4. Inspect all parts for wear and tightness.

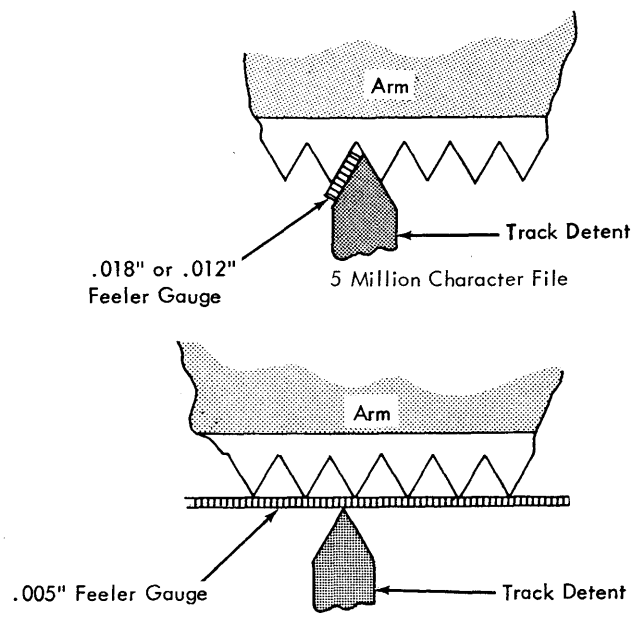


Figure 71. Track Detent Adjustments

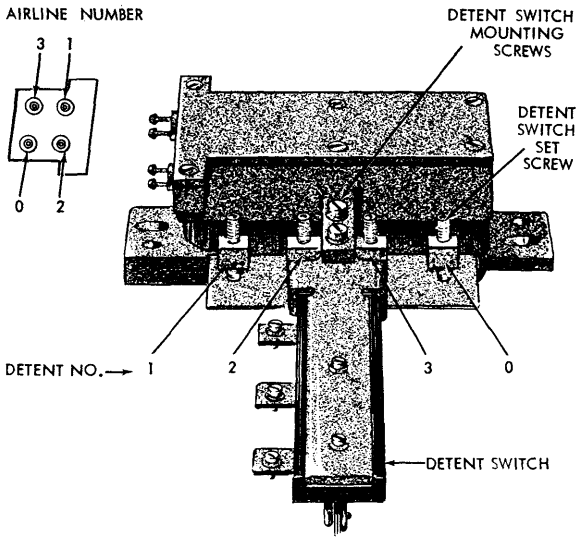


Figure 72. Ten Million Character File Track Detent Assembly

Disk Potentiometer Wiper

Removal

1. Remove power from the system.
2. Turn off the access motor at the convenience outlet.
3. Scribe several places around the markite bar. This will facilitate re-assembly.
4. Remove wiper signal wire and the two mounting screws for the wiper block.
5. Remove four of the five mounting screws that hold the pot to the way.
6. Loosen the remaining screw.
7. Pivot the potentiometer, the wiper block will now drop down.

Assembly

1. Reverse the removal procedure.
2. Make adjustments.

Adjustment

1. Turn off access at convenience outlet.
2. Loosen potentiometer mounting screws.
3. Manually inquire.
4. Turn clutch by hand and servo to the address indicated.
5. Scope disk error signal.
6. Move potentiometer bar up or down until the signal on the scope is zero volts ±.1 volts.
7. Tighten markite.
8. Check several disk locations.
9. Check for proper machine operation.
10. If any difficulty arises in making these adjustments, remake all adjustments under "Access Mechanism Electronics".

Access Motor (Figure 73)

Removal

1. Remove AC and DC file power.
2. Separate access motor utility cable connector.
3. Remove the four bolts that fasten the access mechanism to the pinion housing.
4. Remove access motor and pinion assembly. Be careful to prevent fan blade damage when removing the motor and pinion assembly.
5. Loosen the set screw that fastens the pinion hub to the motor shaft and remove the hub.

Assembly

Assemble using the reverse of the removal procedure.

Adjustment

Position the pinion roller for proper pinion roller to clutch disk tension (See "Pinion Roller Adjustment").

Preventive Maintenance

These are permanently lubricated ball bearings.

Pinion Roller (Figure 73)

Removal

1. Remove AC and DC file power.
2. Separate access motor utility cable connector.
3. Remove four bolts that hold the access motor and pinion housing to the clutch housing.
4. Remove the access motor and pinion assembly.
5. Remove the pinion mounting screw and two washers from pinion shaft.
6. The pinion roller, compression spring, and key are now free to be removed.

Assembly

1. The pinion roller should be free to move axially on the shaft. Remove any binds and lubricate the shaft sparingly with IBM #17. Do not get grease on pinion face.
2. Assemble using the reverse of the removal procedure.
3. Make adjustments.

Adjustment (Figure 73)

1. Check for freedom of axial motion by depressing the pinion roller against the compression spring with a screwdriver or other blunt instrument. Allow the spring to return it. It should operate smoothly and freely.
2. Shim pinion shaft on motor shaft to obtain a pinion roller to retaining washer clearance of 1/32" +1/32", −0". Tighten the mounting screw. Figure 73.

Preventive Maintenance

1. Replace pinion if it becomes cracked, pitted, or shows excessive wear.
2. Pinion roller should be free to move on the shaft. Using a blunt instrument, force the pinion roller against the compression spring.
3. Clearance between the pinion roller and its upper limit retainer should be at least 1/64".
4. Lubricate pinion shaft with thin film of IBM #17. Do not get grease on roller drive surfaces.

Tachometer

Removal

1. Remove AC and DC file power.
2. Remove 2 connecting leads at back of tachometer.
3. Back off double set screws that anchor flexible coupling to tachometer shaft (Two set screws in each tapped hole).
4. Remove 2 bolts that hold tachometer to its mounting bracket.
5. Remove tachometer. Use care not to damage flexible coupling.

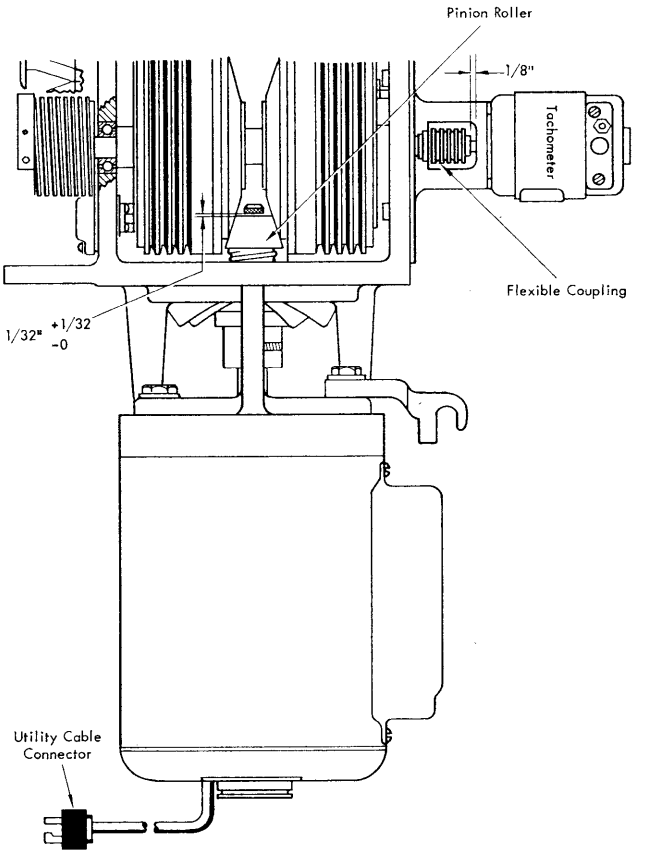


Figure 73. Access Motor

ASSEMBLY

1. Line up flat side of tachometer shaft with set screw in flexible coupling.
2. Install tachometer:
   a. Follow reverse of removal procedure.
   b. Tighten flexible coupling set screw against flat side of tachometer shaft.
   c. Lock set screw.
3. Check operation.

ADJUSTMENT

1. Manually rotate clutch shaft and check for shaft alignment and binds.
2. Check for 1/8" clearance between tachometer and coupling (Figure 73).
3. Apply power and servo to various addresses. Check for proper operation.

PREVENTIVE MAINTENANCE

1. Inspect brushes and replace when necessary.
2. Check set screws on both ends of the coupling for tightness (two in each tapped hole).

Magnetic Clutch

REMOVAL

1. Remove AC and DC file power.
2. Move access assembly out on trolley.
3. Remove access motor and pinion assembly.
4. Tape cable to capstan securely.
5. Lower cable tension pulley to slack off cables.
6. Loosen capstan clamping screws and remove capstan from shaft.
7. Remove tachometer leads and slip ring leads from clutch outboard bearing flange.
8. Loosen locking screw and anchor screw at clutch end of flexible coupling.
9. Remove clutch outboard bearing flange mounting bolts.
10. Remove tachometer and bearing flange assembly.
11. Remove drive clutch assembly.

ASSEMBLY

1. Follow reverse of removal procedure. Be sure the tachometer coupling is secure.
2. Make adjustments.
3. Apply power and check for proper clutch operation.

ADJUSTMENT

1. Check pinion roller adjustment (See "Pinion Roller").
2. Make cable tension adjustment (See "Cable Adjustment").
3. Check arm to disk clearance (See "Access Mechanism Assembly and Adjustment").
4. A tension of 100 +10 grams should exist between the brush and the commutator.
5. Brushes should be well seated on commutator and be riding parallel to each other (sight check).
6. Clutch and shaft assembly should be free to move laterally by hand in the supporting bearings when the pinion drive is disengaged.

PREVENTIVE MAINTENANCE

1. If clutch commutator is pitted or has accumulation of dirt, clean with crocus cloth.
2. Bearings are permanently lubricated.
3. Oil shaft with IBM #6 where it passes through bearings.
4. Check proper brush tension (See "Magnetic Clutch Adjustment").

Disk Array

NOTE: Due to the weight and awkwardness of some of the parts involved, disk and bearing removals and replacements should not be attempted without assistance.

Disk Array Shields

REMOVAL

1. Remove AC and DC file power.
2. Remove screws from top casting.
3. Remove the screws from the bottom casting except for the center metal aligning shield (dowelled) opposite the access mechanism and between access 0 and 2 when applicable. These shields are used as a reference and should not be removed from the bottom casting.
4. Remove all other shields.

ASSEMBLY

Follow the reverse of the removal procedure.

ADJUSTMENT

Check for, and correct, any shield to disk array interference.

PREVENTIVE MAINTENANCE

Clean off any accumulation of dirt and dust with IBM cleaning fluid or perchlorethylene.

Disk

REMOVAL

NOTE: After removing the disks to replace the bottom bearing of a gear drive rotating shaft or a rotating

shaft assembly, and before removing the rotating shaft itself, note as accurately as possible the distance from the base casting to the top side of the rotating shaft flange on which the disks are stacked (i.e., with a steel rule that has a sliding clip or with a pair of inside calipers). After installing the new bearing and rotating shaft the flange must be at its original height above the base casting to +.010" above. If it is not, shims must be added before stacking the disks. (Part #2109664 is .010" thick and #2111634 is .025" thick. This starting point is necessary to obtain arm to disk clearance later on.)

The flange on a shaft motor will always be within a few thousands so it will not have to be measured. Care should be exercised to remove any burrs or chips between shaft motor collar and the base casting.

1. Have the file records on all disks punched into cards if practical. Disks may be removed and replaced without altering information on them if reasonable care is exercised. The customer must be informed of the risk involved in this operation.
   a. Scope signal level of file at pin 3 of the first amplifier, disks 0, 25 and 49.
   b. Record the scope settings, record location and voltage level.
2. Remove AC and DC file power.
3. Move access mechanism out on trolley track. (See "Access Mechanism Assembly Removal").
4. Remove air foils if machine has dual access (See "Air Foil Removal").
5. Remove shield fastening screws from top and bottom of all the shields except the screws at the bottom of the center metal aligning shield (dowelled) opposite the access mechanism and between access 0 and 2 when applicable. These later shields are used as a reference and should not be removed from the bottom casting. Remove all other shields.
6. The left hand edge of the metal shield opposite the access mechanism has been factory set to be perpendicular to the base casting. The disk aligning tool (#2108145) will fit on this shield and the 60° notch in the tool should then be adjacent to the disks. Using this tool check to see that the scribe lines on all the disks are in the center (±.010") of the 60° notch when the tool is slid up and down the aligning shield without rotating the disk array. If not, scribe a new line on all disks using this 60° slot, taking care not to bend disks or leave burrs. Color mark a line at 20° starting at ½" right of existing scribed line. This reference will insure all disks are reassembled right side up and in order.
7. Remove dust cover from top casting and seal assembly.
8. Check record start head gap. Remove top casting and seal assembly (Gear drive file).
   a. Remove spanner lock nut from vertical shaft using long screwdriver as handle and spanner wrench (#2108001).
   b. Cover thread and shaft end with crutch tip (#2108051).
   c. Remove lock washer.
   d. Lift top casting vertically off the shaft.

   On shaft motor files remove the center shaft clamping bolt and spacer, then left the top casting off.
9. Remove the six allen head screws holding the disk clamping ring and lift clamping ring vertically off, taking care not to damage the shaft threads.
10. Remove the top disk spacer. If the spacer should adhere to the disk below it, free it as follows:
    a. Insert the pin which protrudes from the handle of the disk installation tool into the groove located in the outer diameter of the disk spacer.
    b. Lift the toe of the tool until the heel of the handle, pivoting about the pin, bears against the disk and forces the spacer and disk apart.
    c. Use extreme care to prevent scratches on the recording surface and deformation of the disk.
11. Remove the top dummy disk.
    a. Insert the shoe of the disk installation tool between the disk inner diameter and the rotating shaft, adjacent to one of the blocks. The rounded corners of the shoe must be against the disk.
    b. Turn the handle until the toe of the tool bears against the rotating shaft forcing the disk away from the block by compressing the centering spring slightly.
    c. Lift the disk off the block while the tool is holding them apart.
12. Remove the balance of the disks and spacers one at a time until the disk to be replaced is reached.
    a. Use the procedure in steps 9 and 10.
    b. Re-assemble disk and spacers right side up on a table keeping them in order. Do not re-assemble disks and spacers upside down on table.
    c. Never lift a disk without first removing the spacer above it.

Assembly

NOTE: On shaft motor files the high point of the rotating shaft has been marked (HP) and the dummy disk must be installed so that the scribed line is lined up with the high point mark. Also the scribed mark on the first spacer must be lined up with this mark. For a gear drive file, the spacer must be installed as follows:

a. Place the bottom dummy spacer on the bottom dummy disk in such a manner that the centering spring and one locating block that are in the slots in the bottom of the spacer will drop into the hole in the center of the disk.

b. Press radially on the edge of the bottom dummy disk toward the center at a point directly opposite the unseated locating block. Simultaneously, press down on the spacer until the unseated locating block drops down into place.

c. Check to be sure the spacer is properly seated. Use care to prevent overstressing the centering spring and deformation of the dummy disk.

1. Install a disk as follows:

a. Check the centering spring on the spacer to be sure it is installed clockwise from the pin when viewed from the top.

b. Place the disk on top of the spacer in such a manner that the inside diameter will include the centering spring and one locating block. The edge of the inner diameter of the disk should rest on top of the remaining locating block.

c. If a scribed line is present on the outer edge of the disk, rotate the assembly until it is approximately lined up with the center of the 60° slot in the disk aligning tools or the edge of the aligning shield. If no scribed line is present, rotate the disk until the scribed disk number on the clamping surface is approximately adjacent to the centering spring. Check to see that the colored mark is to the right of the scribed mark.

d. Insert the shoe of the disk installation tool into the gap between the disk inner diameter and the rotating shaft adjacent to the unseated locating block. The rounded corners of the shoe must be against the disk.

e. Turn the handle until the toe of the tool bears against the rotating shaft, and draws the disk over by compressing the centering spring slightly. Press the disk down over the block. Use care to prevent over-stressing the centering spring.

f. Press down lightly around the inner diameter to assure that the disk is properly seated. Replace any centering spring which does not seat the disk against the blocks, and the blocks against the rotating shaft. If a scribed line is present on the outer edge of the disk, rotate the disk until it is lined up within .010" to the center of the 60° slot in the disk aligning tool. Scribe line on edge of disk if none is present.

2. Install the spacers as follows:

a. Slip the spacer down the rotating shaft. Rotate the spacer until the slots in the spacer mate with the locating blocks and the centering spring of the spacer below and the spacer drops down into place. (When viewed from above, the centering spring of a spacer will locate 107.5° counterclockwise from the centering spring of the spacer below.)

b. Check to be sure the spacer is properly seated and that the locating blocks are resting properly against the rotating shaft. If a block becomes dislodged from the spacer, be sure to replace the block so the curved portion touches the disk.

3. Replace the remaining existing disks and spacers in the exact same order that they were removed.

a. Use the procedure outlined in steps 1 and 2.

NOTE: If the bottom bearing of a gear driven file or a gear drive rotating shaft has been replaced, check the distance from the base casting to the disk supporting flange of the rotating shaft. If it is too low or too high, shim to height of flange before disassembly (See the note at the beginning of "Disk Removal").

b. Rotate each individual disk, as it is replaced, until disk and spacer are re-orientated approximately as originally, and the scribed line on the edge of the disk is lined up within .010" to the center of the 60° slot in the disk aligning tool. Note the following:

(1) The spacer directly beneath the clamping ring has no locating blocks, pins, or centering spring.

(2) The spacer located between the top dummy disk and disk #00 is .060" thicker than normal spacers.

(3) The spacer located between the bottom dummy disk and disk #49 is .060" thicker than normal spacer. This spacer also has locating blocks, and a centering spring on the bottom to locate the bottom dummy disk.

4. If a number of the top disks and spacers stack up above the rotating shaft and the allen screws for the clamping ring will not reach the rotating shaft, the following procedure is necessary. (Check the apperance of the stack for unevenness. A spacer may be out of the slot or a disk may be cocked.)

On a shaft motor file you may have to insert .008" feeler gage between the rotating shaft and the disk spacers where the spacer springs are located. This will prevent the spacer springs from catching on the rotating shaft at point "X" on Figure 74 when clamping the disks down.

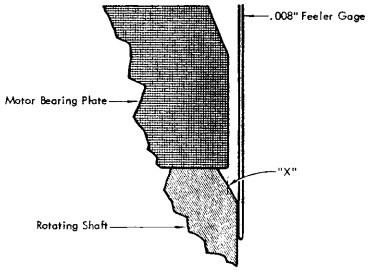


Figure 74. Top Bearing Head Plate

a. Insert three long pull-down screws equally spaced in holes in the top of the rotating shaft.
b. Slip the clamping ring over the screws and place the flat washers and nuts on the screws.
c. Work the spacers and disks carefully down into place by alternately tightening the nuts on the pulldown screws. Guide the spacer blocks and springs into place as they encounter the rotating shaft.
d. It may be expedient, in the event spacer build-up exceeds one or two spacers above the rotating shaft, to place these top spacers in place without the disks, and pull down the lower portion first. Repeat with the top disks in place.
e. Insert the regular clamping screws in the balance of the holes. Remove the pull-down screws and replace with the regular clamping screws.

5. Tighten the clamping screws evenly. Loosen them evenly approximately three turns to free any spacers which may bind.

6. With the torque wrench (#2108039 and socket adaptor (#2108040), retighten the clamping screws evenly to 240 (+0, −50) inch pounds of torque.

7. On shaft motor files replace the top casting, then the spacer and clamp down with the bolt. Skip steps 8 through 11. On gear drive files replace the top casting being careful not to damage the threads on the shaft. Replace lock washer.

8. Tighten the lock nut with the spider lock nut wrench (#2108001) with a long screwdriver as a handle until there is drag perceivable due to tightness in the bearings of the disk array. Rotate (by bottom disk) disks checking air gap between record start heads and magnet. Note the position of the nut, as this indicates a condition of excess bearing preload.

9. Back off the lock nut with the spider lock nut wrench until the nut seems to break free and rotate easily (approximately ¼ turn). Note the position of the nut at this point as this indicates a condition of no bearing preload.

10. From the position of no bearing preload, retighten the lock nut to approximately ¼ of the angular distance between the two conditions determined in steps 8 and 9. The disk array should then rotate freely and smoothly without drag due to bearing preload.

11. Lock the lock nut with the lock washer by bending the appropriate tang into the appropriate slot.

12. Install and fasten disk array shields.

13. Check the air gap between the record heads (5 places) and the magnet. It should be no less than .005". This clearance should be checked any time top casting has been removed and reseated. If the air gap is less than .005", reposition record heads for .005" clearance.

This is accomplished by loosening the two screws holding the head and moving the head either forward or backward. Care should be taken not to damage pole piece of magnet. Tighten screws after proper clearance has been obtained. Contact between side of record head and side of mounting slot in magnetic head ring should be maintained when adjusting head or tightening screws (side of mounting slot angularly positions head).

14. Run disk array for approximately 15 minutes. Turn off motor. On gear drive files loosen knurled screws fastening disk array shields and repeat steps 9 through 12. Tighten knurled screws.

15. Replace dust cover and air foils (dual access).

16. Install and fasten access mechanism.

17. Check arm-to-disk clearance at disk 00, disk 49, the new disk, and the disks above and below the new disk (use the same procedure as in "Access Mechanism").

NOTE: If a new bottom bearing of a gear driven rotating shaft or a rotating shaft itself has been installed, it may be necessary to add or remove shims between the bottom dummy disk and the rotating shaft flange. Shim number 2109664 is .010" thick and number 2111634 is .025" thick.

18. Recheck signal pin 3 of the first amplifier (8.10.04).

19. Check record start head adjustments.

20. Check bearing for temperature after 2 hours. Excessive heat requires loosening of bearing lock nut.

NOTE: The new disk must be loaded by the C.E. The following procedure is suggested: (assume disk 40 was replaced).

1. Load accumulator 0 (zero) with the address of the replaced disk, (i.e.) 0000040000.

2. Write a 1 (one) in character position 00 of X track.

3. Write 100 characters on Y track.

4. Load the following instructions on track 0 (zero): (000) L09J9905bb, (001) Y99R9900bb, (002) X00L-090bb, (003) bbbbbbbb0b.

5. Plug in the Remote Cycling box and flip the Parity switch to No.

6. Reset the machine and program start.

PREVENTIVE MAINTENANCE

Clean the disks by using the disk cleaning paddle (part #2108010) covered with a lint free cloth or absorbent paper such as Kimwipes. Insert paddle between two adjacent disks and turn the array by rotating the bottom disk in the array. Repeat for all disks.

If dirt has adhered to the disk, the paddle covering may be saturated with IBM cleaning fluid or perchlorethylene.

Record Start Head

REMOVAL

1. Remove file power.
2. Remove top casting dust cover.
3. Carefully separate record head electrical connector.
4. Remove mounting screws.
5. Remove record head.

ASSEMBLY

1. Position head on mounting ring for maximum head to record magnet clearance.
2. Tighten mounting screws snug tight.
3. Re-connect the head electrical connector.
4. Adjust for proper head to magnet clearance (See adjustments).
5. Check head to magnet clearance at all the heads. This must be done every time the top casting is removed and replaced.
6. Replace dust cover.

ADJUSTMENT

CAUTION: Do not attempt to adjust spacing with disk array in motion. Do not decrease spacing below .005 inch.

NOTE: Hold magnet assembly toward head when adjusting gap with feeler gage. This will remove any backlash.

The record amplifier consists of a two-stage AC coupled amplifier feeding a cathode follower stage. A separate amplifier is used for the record start and record stop pulse.

No adjustments are required to the record amplifier proper; however, you should check to be sure that the output pulse from the RECORD AMPLIFIER START and STOP hubs fall within the following limits.

1. Amplitude: +14 volt, −25 volt minimum.
2. Fall time from zero volts to −25; 40 microseconds maximum.
3. Pulse width at zero volts: 40 + 15, − 20 μs.
4. Wave shape should not have a double peak.

The values given above can be achieved by moving the record head on the 350 as follows:

Low output: Decrease head to magnet spacing.

Excessive fall time: Decrease head to magnet spacing.

Excessive pulse width: Increase head to magnet spacing.

Record Start Magnet

REMOVAL

1. Remove AC and DC file power.
2. Remove top casting dust cover.
3. Remove top casting.
4. Remove magnet assembly limiting screw.
5. Remove magnet assembly adjusting screw. (Magnet assembly is fastened to adjusting screw.)

ASSEMBLY

1. Follow reverse of removal procedure—leave top casting dust cover off.
2. Manually rotate disk array (by bottom disk) slowly and check for magnet pole piece to record head clearance. Reposition record heads if necessary.
3. Align magnet pole piece and record heads.
4. Adjust record start heads (See "Record Start Head Adjustments").
5. Replace dust cover.
6. Apply file power and check for proper operation.

ADJUSTMENT

1. Rotate self locking adjusting screw to position magnet pole piece in vertical alignment with record head pole pieces.
2. Adjust record heads for proper head to magnet clearance (See "Record Start Head—Adjustment").

Top Bearing

REMOVAL

NOTE: It is not necessary to remove the top bearing to perform routine preventive maintenance. It should be removed only when absolutely necessary.

1. Remove file power.
2. Remove blower and air filter.
3. Remove necessary covers to provide adequate working room.
4. Remove top casting dust cover.
5. Remove screws that fasten disk array shields to top casting.
6. Remove spanner lock nut and spider washer.
7. Remove top casting.
8. Remove cap screws and washers (15) that retain the gear box cover. Do not remove 4 drive assembly mounting bolt nuts. Use caution to prevent gasket damage when breaking the seal on the gear box cover.
9. Remove top casting seal assembly.
10. Remove 2 (180° apart) clamping ring bolts and fasten special puller (#2108008) to the rotating shaft.
11. Elevate the disk array. This will pull the inner race and rollers up above their normal position on the rotating shaft.

12. Lower the disk array until its weight is carried by the bottom bearing. Use caution to insure proper gear mesh during this operation. Replace gear cover bolts and washers. Use a thin film of Permatex #3 (#255880) on all sealing surfaces.

13. Remove the top bearing.

14 The outer race is pressfitted into the rotating shaft and is extremely difficult to remove. If the bearing is to be replaced, the outer race should be carefully inspected under a strong light. Pits, worn areas, breaks or blue discoloration will warrant changing of the rotating shaft. Brown discoloration is ground-in grease and does not indicate trouble. If the outer race is in good condition, the roller assembly and inner race can be replaced utilizing the old outer race. If the outer race is bad, it will be necessary to replace the rotating shaft.

ASSEMBLY

1. Thoroughly flush and clean the top bearing with clean IBM #6 oil. Do not use solvent or cleaner. Pack with IBM #20 grease.

2. Carefully assemble bearing on the stationary shaft. Tap gently on inner race with a brass rod. A thin film of IBM #20 grease on the shaft will facilitate this operation.

3. Replace top bearing seal assembly.

4. Perform steps 8-16 on disk assembly.

5. Install disk array shields.

6. Install top casting dust cover.

ADJUSTMENT

1. Check record start head to record start magnet clearance on all record start heads (See "Record Start Head Adjustment").

2. Tighten spanner nut for proper bearing tightness (step 8-11 of "Disk Assembly").

PREVENTIVE MAINTENANCE

Lubricate with IBM #20 grease by turning cup down ½ turn.

NOTE: Flush with clean IBM #6 oil and repack with IBM #20 grease each time the top bearing is removed. Do not use solvent or cleaner.

Bottom Bearing

REMOVAL

1. Remove top bearing (see "Top Bearing Removal").

2. Remove all disks (see "Disk Removal").

3. Lift the rotating shaft off the stationary shaft. At least two men will be needed to perform this step.

NOTE: Four number 4 wedges may be purchased locally and used to tap lower bearing free.

4. Remove the lower bearing. It may be necessary to acquire an extended bearing puller for this operation.

5. The outer race is pressfitted into the rotating shaft and is extremely difficut to remove. If the bearing is to be replaced, the outer race should be carefully inspected under a strong light. Pits, worn areas, breaks or blue discoloration will warrant changing the rotating shaft. Brown discoloration indicates ground-in grease and does not indicate trouble. If the outer race is in good condition, the roller assembly and inner race can be replaced utilizing the old outer race.

ASSEMBLY

1. Thoroughly flush and clean the bearing with IBM #6 oil. Do not use solvent or cleaner.

2. Seat the bearing by taping gently with a brass rod around the inner race.

3. Inspect the bearing for possible assembly damage.

4. Pack the bearing with IBM #20 grease.

5. Clean the gear cover gasket and mating surface; replace gasket if necessary.

6. Clean any dirt or grit from gear box.

7. Carefully lower the rotating shaft over the fixed shaft. Guide the rotating shaft to keep from scraping flakes from the rotating shaft inner wall.

8. Apply a thin film of Permatex #3 to all sealing surfaces.

9. Lower the rotating shaft until the weight is carried by the bottom bearing. Use care to insure proper gear mesh during this operation.

10. Thoroughly flush and clean the top bearing with IBM #6 oil. Do not use solvent or cleaner. Pack with IBM #20 grease.

11. Carefully reassemble the bearing on the shaft. Gently tap the bearing with a brass rod around the inner race.

12. Install top bearing seal assembly.

13. Replace all disks (see "Disk Replacement").

14. Check file for proper operation.

PREVENTIVE MAINTENANCE

1. After the machine has been running at least two hours at normal temperature with all shields in place, cause the access arm to retract and depress POWER OFF. If the time required for the file to coast to a complete stop is four minutes or less, the motor bearings and top bearings should be checked for excessive tightness. If they seem all right, the bottom bearing should be relubricated.

2. If the bottom bearing requires re-lubrication, the following procedure should be used:

a. Perform steps 1-14 on top bearing removal.

NOTE: At step 11, the bottom bearing will be exposed. Block the gear cover with a 2 × 4 or other suitable

blocking material. Using a long handled brush, clean and flush the bottom bearing with IBM #6 oil and repack with IBM #20 grease.

b. Follow procedure under "Top Bearing – Assembly."

c. Recheck the file rundown time.

Disk Drive Motor (Gear Driven)

Removal

1. Remove AC and DC file power.
2. Reposition air compressor if necessary.
3. Remove bolt locking wire from the mounting bolts.
4. Block the motor up with a scissor jack or suitable blocks.
5. One man should support the motor on the blocks while the other man removes the four bolts that fasten the motor to the array drive mount assembly.
6. Move the blocks aside or lower the jack and remove the motor. The shaft will separate at the flexible coupling. Use caution as the motor is heavy and should have at least two people to handle it.

Assembly

1. Loosen the flexible coupling mounting screws and slide the coupling toward the motor.
2. Block the motor so that it can be elevated into its operating position with a scissor jack or other suitable device.
3. Elevate the motor, align the flexible coupling as nearly as possible, and tighten the mounting bolts.
4. Thread the locking wire through the heads of the mounting bolts and secure it.
5. Adjust the flexible coupling.
6. Connect motor utility cord.
7. Position air compressor if it was moved.
8. Remove all blocks and material and apply file power.

Adjustment

Adjust the flexible coupling (See "Flexible Coupling –Adjustments").

Preventive Maintenance

All bearings in this unit are permanently lubricated.

Flexible Coupling (Gear Driven)

Removal

1. This job involves heavy equipment and requires two people to do it.
2. Remove AC and DC file power.
3. Remove disk drive motor (See "Disk Drive Motor –Removal").
4. Remove flexible coupling.

Assembly

Follow the disk drive motor assembly procedure.

Adjustment

Pry the lower half of the flexible coupling upward until the air gap between the two sections disappears. Then adjust air gap for 1/32" to 1/16". Tighten the set screws in both halves of the coupling.

Preventive Maintenance

1. Inspect rubber insert. Replace if cracked.
2. Gap between the two halves of the coupling should be 1/32" to 1/16" (See "Adjustments").
3. Check set screws for tightness.

Disk Array Drive Assembly (Gear Driven)

Removal

1. This job involves heavy equipment and requires two people to do it.
2. Elevate the disk array as per steps 1-11 under "Top Bearing–Removal."
3. Remove drain plug and drain oil from gear box.
4. Disconnect drive motor utility cord.
5. Block the motor and drive assembly in position with a scissor jack or suitable blocks.
6. Remove the four drive assembly mounting bolt nuts located on the gear box cover.
7. Two men lower the motor and drive assembly and remove it. Use caution as this equipment is heavy and is in an awkward position for handling.
8. The array drive assembly is now free to be dismantled.

Assembly

1. Adjust flexible coupling.
2. Clean oil seal surfaces on bottom of gear box and on drive assembly.
3. Inspect oil seal and replace if necessary.
4. Coat oil sealing surfaces with a light coat of Permatex #3 (part #255880).
5. Elevate the motor and drive assembly into position with a scissor jack or other suitable device.
6. Lower the disk array using extreme caution to insure proper gear mesh.
7. Perform steps 1-6 under "Top Bearing – Assembly."
8. Install the drain plug and fill the gear box to the proper level with clean IBM #6 oil.
9. Connect the drive motor utility cord.
10. Remove all blocks and elevating tools.

11. Manually rotate the disk array by rotating bottom disk and check for binds or gear interference.
12. Apply file power.

ADJUSTMENT

1. Manually rotate the disk array by rotating bottom disk and check for binds or gear interference.
2. Run disk array for approximately 15 minutes. Remove file power, and let the array coast to a stop. Check gear box seals for oil leaks. Specifically check the seal between the drive assembly and gear box. Stop any leaks that may be present.

PREVENTIVE MAINTENANCE

Check gear box oil level at sight gage when disks are not rotating. Add IBM #6 oil if necessary.

Disk Drive Motor (Shaft Motor)

REMOVAL

The shaft motor model 350 File requires replacement of complete shaft motor in case of bearing failure or for other reasons where it might be necessary to replace the file drive. There will be a special hoist located at each parts distribution center and when the shaft motor is ordered from them this hoist should be sent with the motor. Also a set of removal instructions will be shipped with the hoist. Field B/M #2105754.

CAUTION: Extreme care must be exercised when removing the shaft motor as the assembly weighs approximately 300 lbs.

ADJUSTMENT

None.

PREVENTIVE MAINTENANCE

Lubrication of the shaft motor is unnecessary except in cases where the run down time does not meet specifications. If lubrication is required, add one ounce of Shell Cyprina (purchased locally) to upper and lower bearings. Bearing chambers are accessible through two grease plugs in upper and lower bearing heads (180° apart). The grease plugs are accessible through two holes in the top and bottom castings. Grease plugs should be re-installed with Permatex #3 on the threads, wrench tight.

File Starter Box

Contactor

REMOVAL

1. Remove all system power by pulling power plugs.
2. Tag all leads for easy identification before removing them. This will facilitate re-assembly.
3. Disconnect leads.
4. Remove contactor mounting screws and remove contactor.

ASSEMBLY

1. Follow the reverse of the removal procedure.
2. Apply power to the file starter box and check it for proper operation.

ADJUSTMENT

This unit is factory adjusted and the entire assembly should be replaced if it does not function properly.

Relays

These units are factory adjusted and they require no preventive maintenance. The entire relay should be replaced if it does not function properly. Follow the contactor removal and assembly procedures when replacing or removing.

File Sequencing Timer

PREVENTIVE MAINTENANCE

Lubricate with IBM #9 the cam roller pivots of the timer microswitch. Check contacts for freedom of action. Clean the armature and lightly lubricate the hinge pin bearing surface with IBM #17 grease.

NOTE: If a cam needs to be retimed, the timing chart is mounted on the inside of the starter box cover.

Air Compressor (DeVilbiss)

The DeVilbiss type compressor used with the current file consists of these basic components; intake air filter, a compressor and tank safety valve, cooling coils, water separator, water drain assembly, air pressure switch and a blower (See Figures 75, 76, 77, and 78). There may be one or two compressors in a cabinet. Both work the same way.

Air enters the system through an intake air filter. From the filter it passes through the intake valve to each of two cylinders. The air is compressed within the cylinders and exhausted through each of two exhaust valves, through the cooling coils, through the tank check valve, and into the pressure tank. The pressure tank has a pressure gage and a safety valve. The air then goes through the 3 position valve, an inline check valve, cooling coils and to the water separator. The water is separated from the air, collected and drained into an automatic water drain. From the separator the air goes to a manifold, where it controls the unloading valve by means of a pressure switch. When air pressure goes to 80 PSI the pressure switch opens and the unloading valves de-energize which exhausts the compressed air out the muffler into the atmosphere. When pressure is 60 PSI, the valve is closed. From the pressure switch the air passes through

the vent valve to the file. In the file the air goes through another separator which removes the water then through an adjustable regulator where pressure is reduced to a working pressure of 55 to 58 PSI. The air is available to the system as it leaves the regulator.

Functions of Valves, Filters and Regulators

Intake Filter: Filters the air before it enters compressor cylinder.

Intake Valve: Allows air to flow in from the intake air filter during the intake stroke of the piston.

Exhaust Valve: Allows air to be forced into the discharge port when the piston is in its compression stroke.

Check Valve: Allows air to flow only in one direction and conserve supply of air in tank when compressor is unloading (exhausting into atmosphere).

Compressor Safety Valve: Pops open to exhaust the air when air pressure exceeds 100 PSI in the tank. This is a safety device for the compressor if the pressure switch fails.

3 Position Rotary Valve: This valve in the normal position (handle pointed to center of cabinet) allows air to pass from the tank to the separator. With the handle up (vertical) the air passes through a test orifice which is set to allow a fixed amount of air to leak out. With the handle to the right the air is shut off to the separator. Avoid shut off position unless compressor is OFF (via toggle or main switch).

Seperator (Air Filter): Air flows through a chamber designed to force moisture into collection bowl and filter large solid particles from the air.

Automatic Water Drain: Accumulated water from separator flows down into the water drain. A float rises with the water level. It opens a needle valve to allow water to drain out of the drain automatically and to the evaporator pad at the primary cooling coil.

Vent Valve: Electric controlled solenoid valve which will relieve air pressure between the compressor and the file air filter if de-energized. In the energized position the pressurized air from the compressor is available to the file.

Unloading Valve: Electric controlled solenoid valve which will permit compressor to pump at approxi-

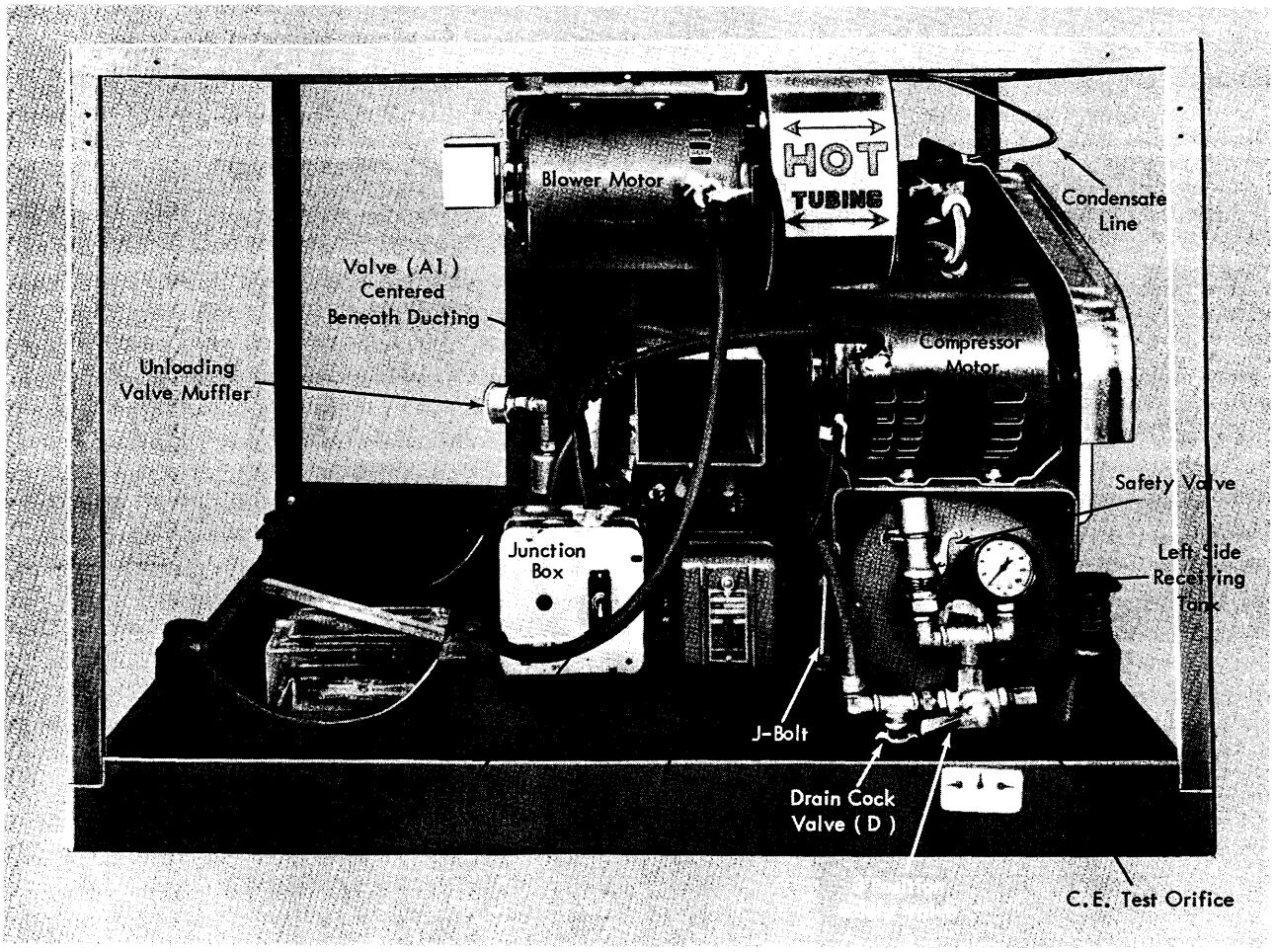


Figure 75. DeVilbiss Air Compressor (rear view)

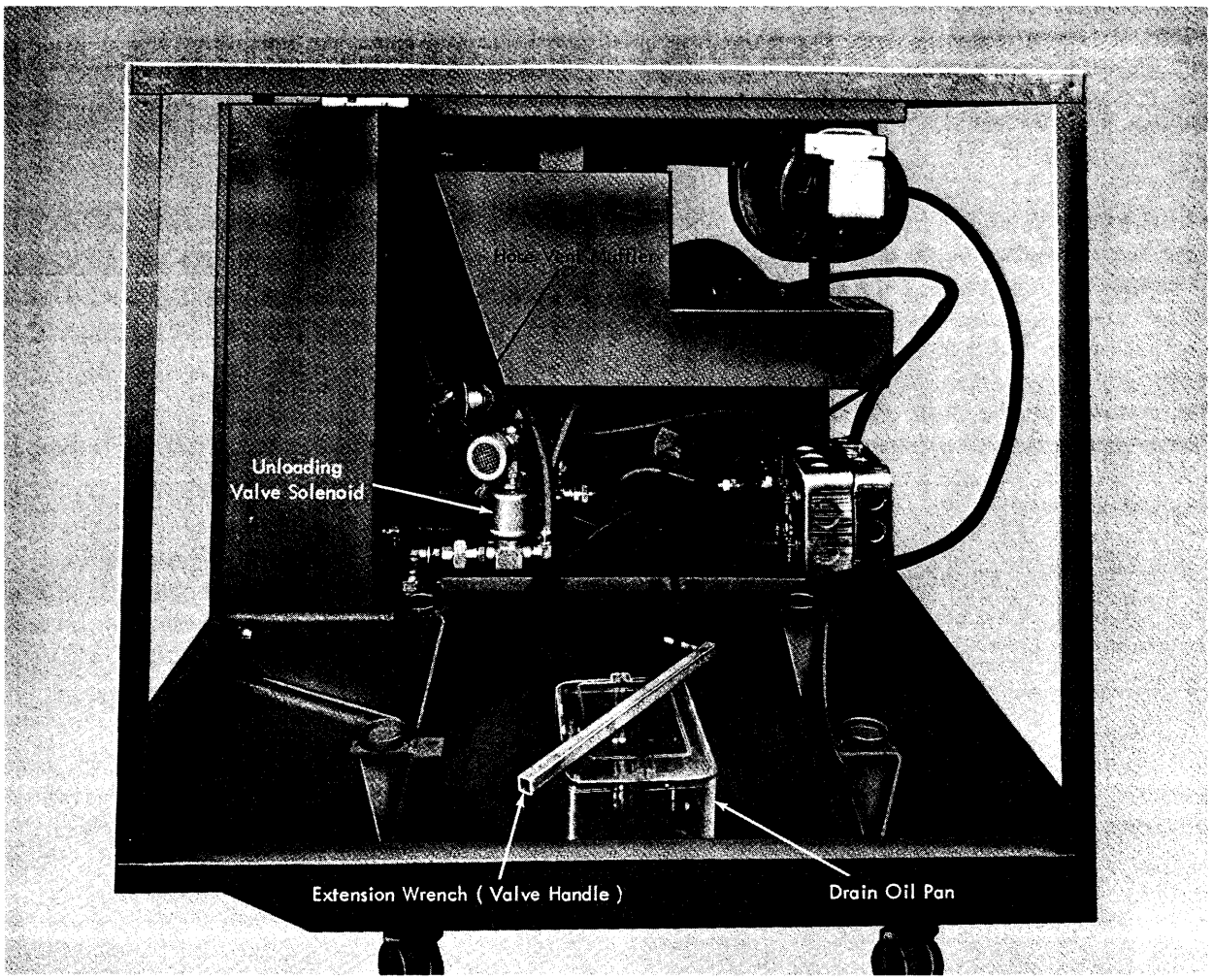


Figure 76. DeVilbiss Air Compressor (right side view)

mately zero pressure into the atmosphere when the pressure in the tank exceeds 80 ±2 PSI.

Pressure Regulator: An adjustable regulator to control air pressure in the File.

Compressor

REMOVAL

1. Shut off power and remove air compressor covers.
2. Open safety valve until pressure reads zero PSI.
3. Disconnect cooling coil at compressor discharge port.
4. Remove belt safety cover and belt.
5. Disconnect drain hose at shut off valve. Tap hose below connection to prevent loosing connector cap nut.
6. Remove 4 mounting screws and lift air compressor out of the top.

CAUTION: This is an awkward position to lift from since the unit is heavy. Two men should lift this unit out.

ASSEMBLY

1. Reverse the removal procedure.
2. Test air compressor.

Capacity Test (Figure 75 and 78)

If the capacity of a compressor is suspected to be too low it may be checked. One compressor may be checked while the other continues to supply the File (s). The procedures below describe a check of compressor No. 1. The valve locations are shown in Figures 75 and 78.

1. Turn 3-way valve handle from filter to orifice position.
2. With the extension wrench provided, shut off valve A-1. The valve is located under the ducting approximately in the middle of the cabinet.
3. Open the safety valve until the tank pressure reaches about 30 PSI.
4. Watch the tank pressure increase. When it remains constant for three minutes, record it.

5. Return the 3-way valve (C1) to the filter position. Gage pressure now increases.

6. After the gage reads 60 PSI and before 80 PSI, open valve A1.

7. Acceptable pressure readings in step 4 vary between 55 and 60 PSI. The reading for a new compressor may be as high as 70 PSI.

8. If the step 4 reading is 50 PSI or less, perform compressor maintenance. Check for leaks. Replace intake exhaust valves, and the intake muffler felt pad. Clean the test orifice. Procedures for completing this compressor maintenance are in this section.

9. After completing step 8 if the pressure is still below 50 PSI, replace the compressor.

10. Record the step 4 readings so you can anticipate compressor maintenance.

Preventive Maintenance

1. Check oil level. This may be done while compressor is running—Remove dip stick at air intake side of crankcase and clean the magnetic plug at the end of the stick. Note oil level indication on dip stick. Add IBM #4 oil if necessary to full mark. Use only Shell Hydraul #33; IBM part number 2127714 (pint can). Quantity necessary to bring oil level from add to full mark is approximately .2 pint. Crankcase capacity to full mark is approximately .6 pint. Record amount added. Never add oil to a level above the full mark.

2. Drain oil. Use available covered plastic pan (#2114417) and extension wrench (#2111849) stored at head of cabinet to collect drain oil. Stop compressor (s). Move cabinet back until cable and hose trough are cleared. Place pan under drain line immediately alongside and at the bottom of the electrical sequence box. Remove pipe cap covering drain line and connector. Open shut off valve at side of crankcase with extension wrench by rotating 90° left or right. Collect oil in pan. After collecting oil, replace pipe cap using Permatex No. 3 (#4500450) on connector threads. Close shut-off valve noting position of

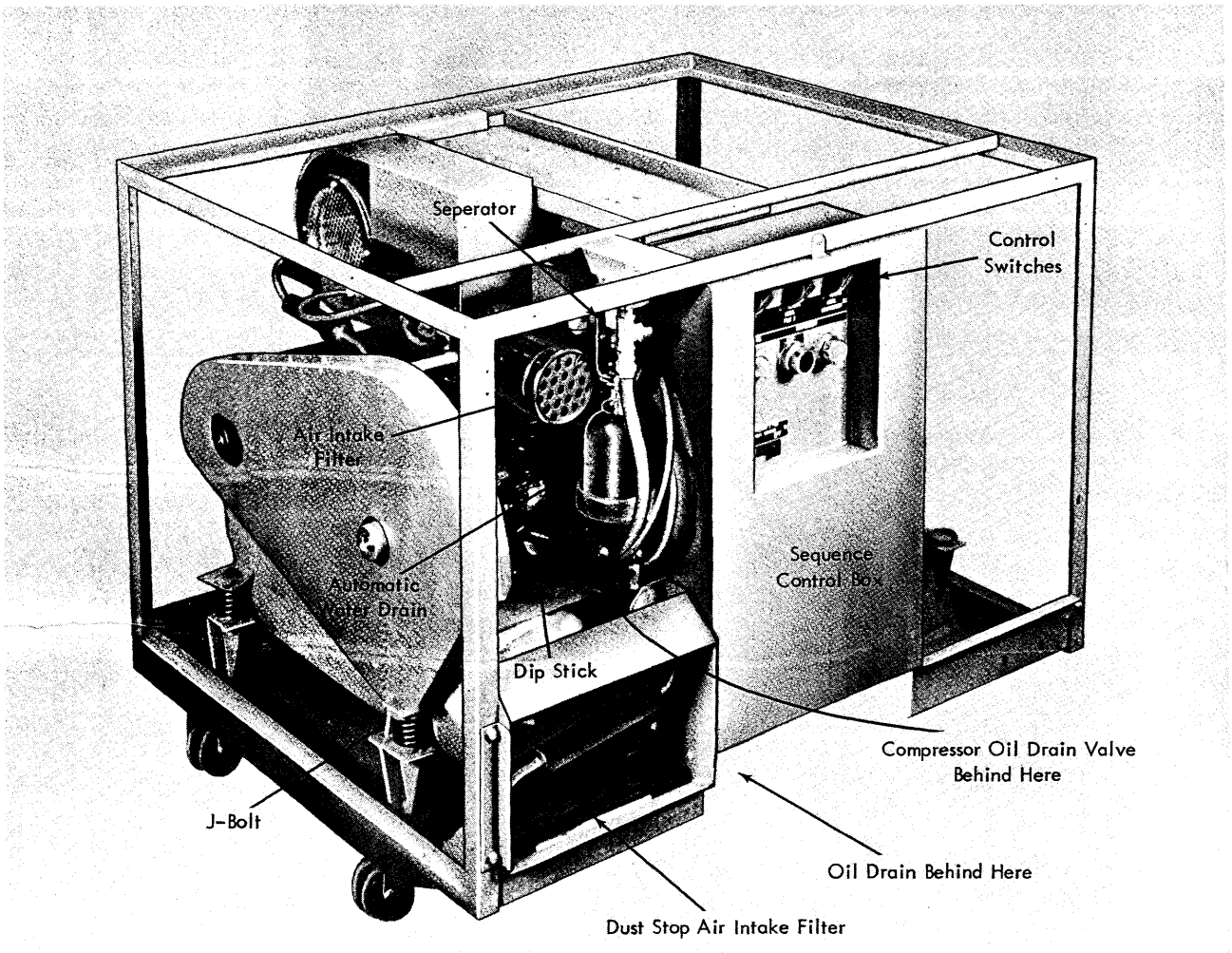


Figure 77. DeVilbiss Air Compressor (front view)

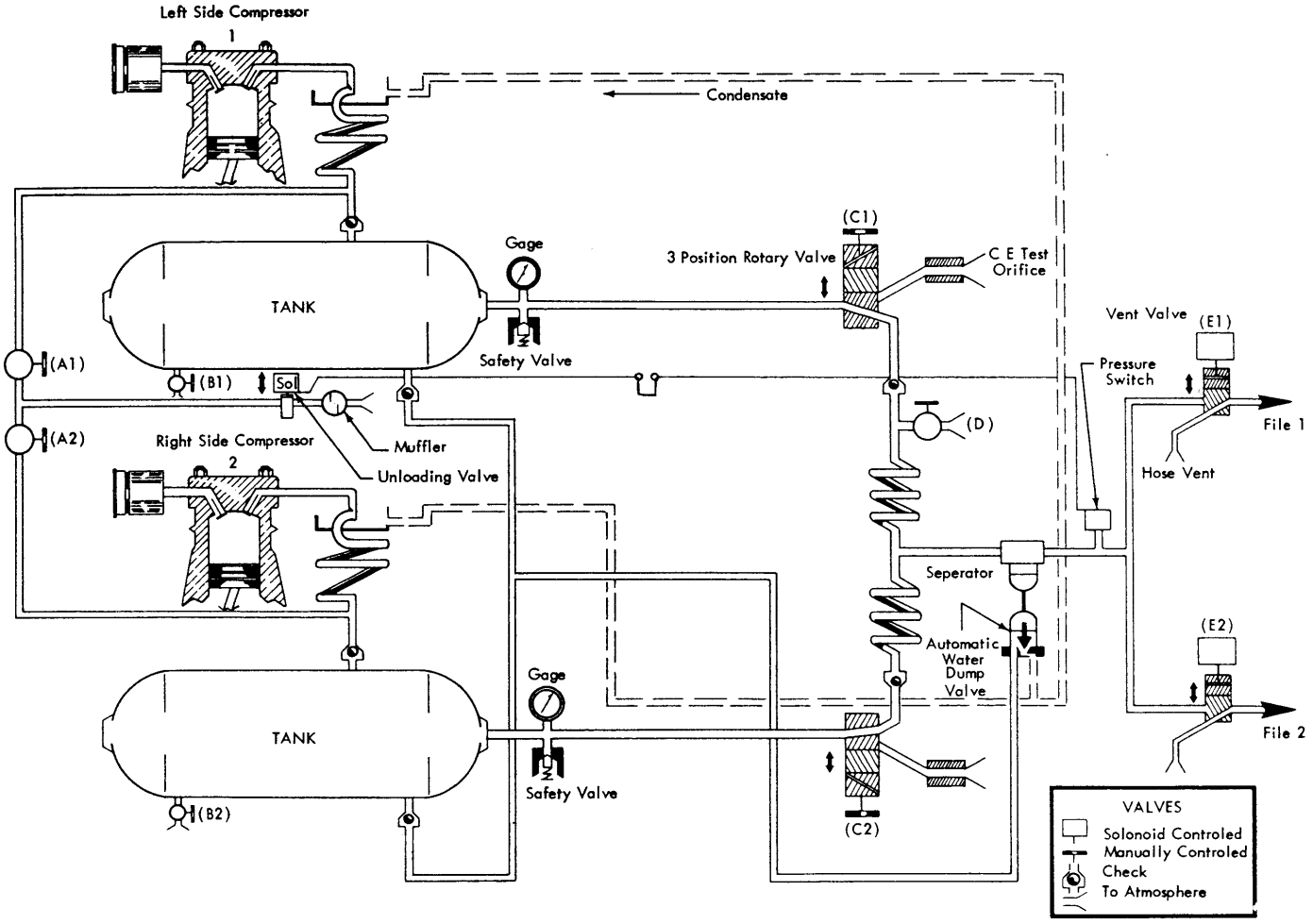


Figure 78. Remote Air Compressor System Schematic (DeVilbiss)

raised indicator line on valve plug stem. Indicator line should be 90° to flow through valve. Fill crankcase with oil to full mark on dip stick. Do not overfill. Dispose of drain oil. Replace pan and wrench in cabinet.

NOTE: Some compressors have a quick disconnect oil drain valve on the inboard side of the crankcase. Insert the plastic oil drain tube into the disconnect.

The latest compressors do not have an oil drain valve. Drain oil by removing the pipe cap covering the drain line.

Compressor Pulley V-Belt

ADJUSTMENT

Tension should be such that normal finger force at the top loop will deflect the belt one (1) inch. Adjust tension by rocking the motor parallel to the pulley belt. If adjustment is necessary, insure alignment of the compressor and motor pulleys is within 1/8 inch.

PREVENTIVE MAINTENANCE

Check condition and tension. Replace if necessary.

Tank

PREVENTIVE MAINTENANCE

Drains automatically through check valve to water drain. However, should be drained manually through valve B1 and/or B2 to drain moisture and emulsified oil collected due to inclination of tank.

Intake Valve Replacement

REMOVAL

1. Unscrew valve cap.
2. Lift out valve spacer.
3. Note the proper valve assembly position within the part.
4. Lift out the valve assembly.
5. Replace the intake valve.

ASSEMBLY

Reverse the removal procedure.

Exhaust Valve Replacement

REMOVAL

1. Unscrew the valve cap.
2. Remove the copper gasket.
3. Unscrew the valve plug.
4. Lift out the spacer.
5. Note the proper valve assembly position within the port.
6. Lift out the valve assembly.
7. Replace the exhaust valve.

ASSEMBLY

1. Replace the copper gasket with a new one.
2. Reverse the removal procedure.

Test Orifice Cleaning

CAUTION: The orifice is soft material. Do not scratch or enlarge the hole.

1. Remove the orifice.
2. Clean from both ends.
3. Replace in its same port.

Compressor and Blower Motors

These motors do not require oiling.

Dust Stop Filters

Clean or replace.

Pressure Switch

ADJUSTMENT

During normal operation, observe pressure range on tank pressure gage. Pressure should be 60 + 4 − 0 PSI to 80 + 3 − 1 PSI. If not, remove nameplate cap, and adjust the 2 spring locknuts. Large spring adjustment determines higher pressure. Tighten to increase and loosen to decrease. The small spring determines the pressure differential. Tighten to increase. Loosen to decrease. Both adjustments affect each other. Adjust each repeatedly and alternately until desired range is met.

PREVENTIVE MAINTENANCE

1. Check contactor surfaces.
2. Look for pits and deterioration.
3. Clean surfaces if necessary.

Safety Valve

Pull lever to clear valve seat.

Motor-Crankcase-Cylinder Head

1. Clean—Remove all dust and dirt.

Compressed Air Filter

PREVENTIVE MAINTENANCE

1. CAUTION: Before disconnecting hoses or tubes:
   a. Stop compressors.
   b. Exhaust air from receiver tanks by holding the safety valve levers down until pressure gages read zero.
   c. Open the drain cock adjacent to the 3 way valve at the left hand tank outlet.
2. Disconnect 1 or 2 hoses "in" and 1 or 2 "out" of filter 1 or 2 conections depend on whether the cabinet houses a single or dual compressor.
3. Connect "in" hoses to "out" connections (Arrow at top of filter points from "In" to "Out"). Leave "in" ports open.
4. Start compressors and permit air to flow from "in" ports into atmosphere. Run for 2 minutes.
5. Shut off compressors. Reconnect hoses as before, using new connector sleeves after each disconnection and connection.

REPLACEMENT OF FILTER ELEMENT

1. CAUTION: Reduce all pressure in the air system by following Item 1 on the preceeding page.
2. Remove filter from mounting bracket.
3. Remove flat head screws from top plate. This disassembles the bowl from the top plate. Remove the bronze element and replace with a new element.
4. Re-assemble.

Compressor Air Intake Filter

PREVENTIVE MAINTENANCE

1. Remove wire retainer clip.
2. Remove 2 metal retainers, metal baffle and felt pad.
3. Clean dust accumulation from items removed and inside of filter housing.
4. Re-assemble in proper order.
5. If necessary replace felt pad.

Solenoid Valve Exhaust Mufflers

No maintenance required.

Compressor Crankcase Breather

Preventive Maintenance

1. Unscrew cap.
2. Remove protective screens (2), plates (2), and felt pads (3).
3. Replace felt pads (3) (Part No. 2114200).
4. Re-assemble in proper order.

Hose Connector Sleeves

Replace after each disconnection.

A rubber hose should overlap a connector nipple 1/4 inch. The brass sleeve taper fits into the connector body. When making a connection, tighten the nut by hand, then use a wrench to rotate the nut about 1½ turns. Always use a new sleeve (#2111943) when making a new connection.

Automatic Water Drain

Assembly

Screw the automatic water drain into the filter bowl by hand.

Caution: Do not use a wrench because you may break the filter bowl inner bosses.

Preventive Maintenance

1. Clean. Caution: See the decal at the rear of the machine. Reduce hose and manifold pressure to zero.
2. Unscrew the ring at the bottom of the float bowl. Lower the bottom of the bowl with the float.
3. Clean the bottom of the float bowl.
4. Remove the float and valve by pulling the 2 cotter pins.
5. Clean the shut off valve.
6. Re-assemble.

Caution: Tighten the bottom of the bowl by hand. Do not use a wrench.

Pressure Switch (Mounted on Frame of File)

Adjustment

The pressure switch contacts are normally open and depend on increasing air pressure to close them and decreasing air pressure to open them. The switch contacts should open when the pressure on the switch is decreased to 45 (+0, −2) psi and should close at 50 psi or more. If the contacts do not open at the proper setting, adjust as follows:

1. The adjusting nut is located within the yoke holding the microswitch plastic housing. The adjusting nut can be turned by hand.
2. Turn the nut clockwise to raise the setting and counterclockwise to lower it.

Note: Adjust pressure regulator to decrease air pressure.

Preventive Maintenance

Check operation of pressure switch.
Adjust if necessary.

Air Pressure Regulator (In File)

Check the air pressure. With no air flowing in the air system and the compressor on the air pressure gage in the file should read 55 psi (+3, −0). Adjust to raise or lower pressure. Lock adjustment screw with jam nut.

Air Leakage

Single Compressor

1. Place file and compressor switches on local.
2. Start compressor. Stop disk and access motors. Allow pressure to build up to 80 ±3 psi. Turn off compressor.
3. Note exact pressure at tank. After 3 minutes, pressure should not decrease more than 3 psi. If it does, check leakage at test orifice, 3 way valve handle, line and tank hose connection, water separator, water drain bowl and line to evaporator (end of tube at felt), aux. control pipe fittings (at center bottom of cabinet) and end of line (quick disconnect under sequence control box). If necessary, remove cooling coil flared connection (small hex) at compressor discharge port, and look for reverse leakage through tank check valve out this coil. If large leak is present here, replace tank check valve.

Dual Compressor Cabinet

Same as single compressor check. Turn off both compressors at 80 psi reading from either tank pressure gage. Maximum allowable pressure drop is 3 psi in 6 min. Inspection for leaks is same as in single cabinet.

Compressor and File

With vent valve open (power on to file with bias and safety relays up) and access solenoids closed, allow pressure at tank (s) to rise at 80 psi. Turn off compressor (s) with toggle switch (es), maximum allowable pressure drop at tank is 8 psi in 3 minutes (single

compressor) and 8 PSI in 6 minutes (dual compressor). This test is permitted after compressor test is sucessfully run. If leakage is excessive, check pressure line and pressure components from the cabinet to the access for leaks.

COMPRESSOR, FILE, AND ACCESS

With vent solenoid, access solenoids open (power to file and access) and access (es) in home position (heads up), build up pressure at the tank (s) to 80 PSI. Turn off compressor (s). Maximum allowable pressure drop at the tank is 8 PSI in 3 minutes for a single compressor and 8 PSI in 6 minutes for a dual compressor. This test will test for leakage in the access and should be run after compressor alone and compressor file test is completed.

Air Compressor (Bell and Gossett type)

The Bell and Gossett type compressor used with the 350 file consists of six basic components; an intake air filter, a compressor, safety valves, cooling coil, air filter and water drain assembly, and a compressed air cleaner (See Figure 81).

Air enters the system through an intake air filter. From the air filter it passes through the intake valve to each of two cylinders. The air is compressed within the cylinders and exhausted through each of two exhaust valves into a pulsation chamber (which is protected by a 90 PSI compressor safety valve). It passes through the compressor check valve which includes an unloading valve that is open until the compressor motor builds up speed. From the check valve it goes into a cooling coil within the compressor frame. From the cooling coil it flows past the system safety valve (65 PSI) and a manually operated blow down valve. The air then enters an air filter where water is centrifugally forced into the bottom of the bowl, collected, and drained into an automatic water drain. From the air filter it passes a relief valve which opens when the air pressure exceeds 55 PSI. From the relief valve, the air is taken through a compressed air cleaner where any contaminants are filtered out. It is available to the system as it exhausts from the compressor air cleaner.

Functions of Valves and Filters

Intake Filter: Filters the air before it enters compressor cylinder.

Intake Valve: Allows air to flow from the intake air filter on the intake stroke of the piston.

Exhaust Valve: Allows air to be forced into the pulsation chamber when the piston is in its compression stroke.

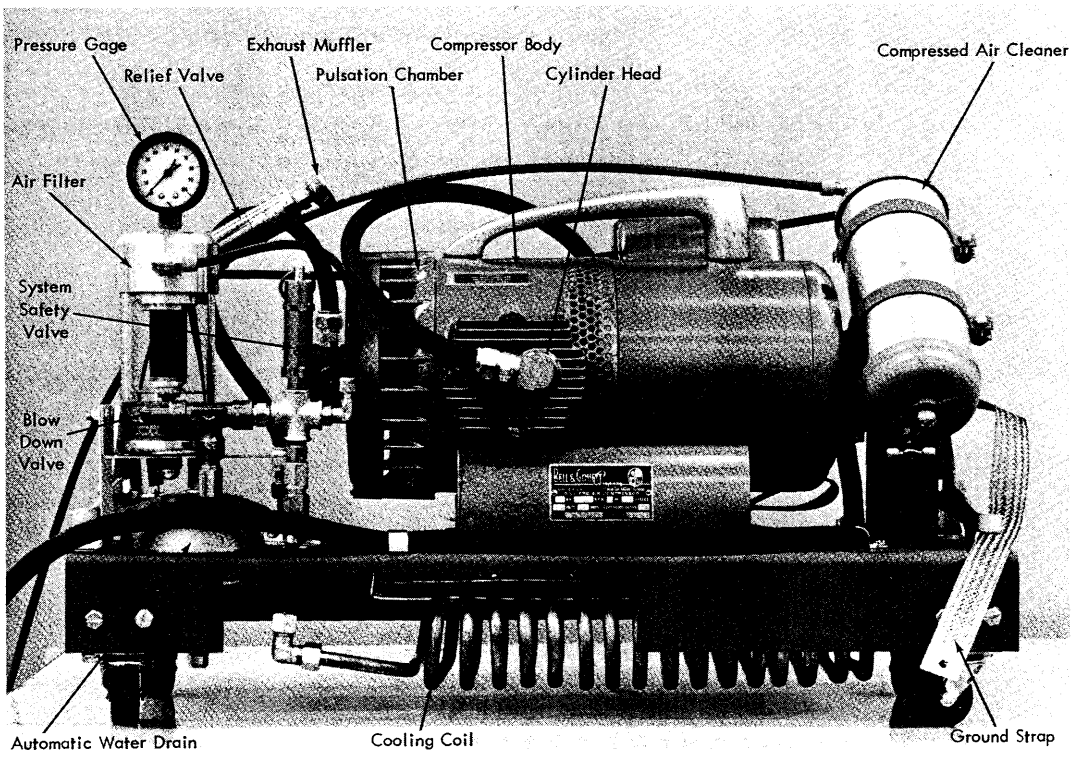


Figure 79. Bell & Gossett Air Compressor (front view)

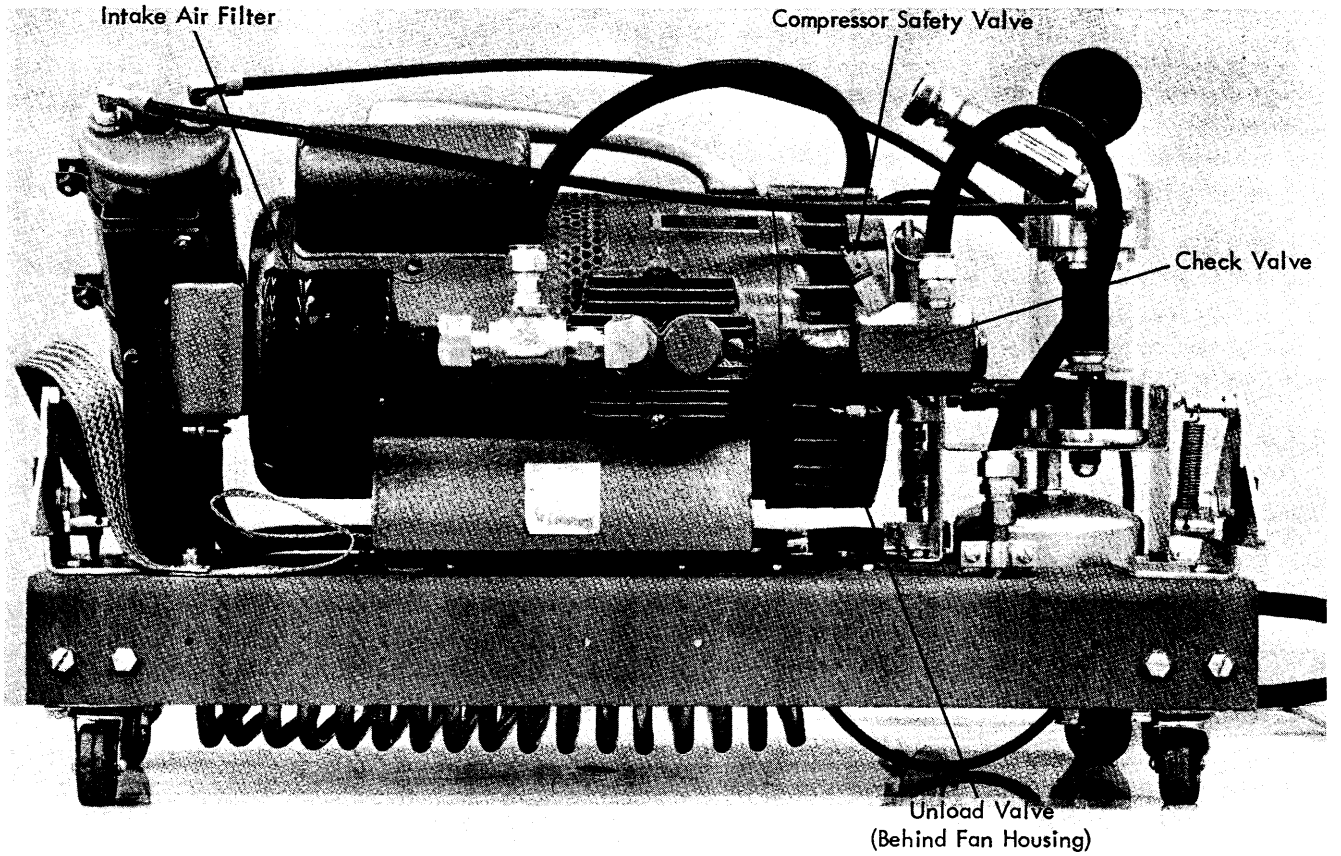


Figure 80. Bell & Gossett Air Compressor (rear view)

Compressor Check Valve: Allows air to flow only from the pulsation chamber to the cooling coil.

Compressor Safety Valve: Pops open to exhaust the air when air pressure exceeds 90 PSI in the pulsation chamber. This is a safety device for the compressor if the check valve sticks closed.

Unloader Valve: Normally open; allows the compressor motor to start with minimum load. Closed by centrifugally operated switch when motor gets up to speed.

System Safety Valve: Normally closed valve. When pressure exceeds 65 PSI, the safety valve exhausts the air from the system and protects the compressed air system piping from pressures above 65 PSI.

Blow Down Valve: A spring loaded, manually operated valve. Push open to exhaust air through a metering orifice into the atmosphere.

Air Filter: Air flows through a chamber designed to force moisture into collection bowl and filter large particles from the air.

Automatic Water Drain: Sump type. Accumulated water from air filter flows down into the water drain. A float rises with the water level and opens a needle valve to allow water to drain out of the drain automatically. Dirt, etc., is accumulated in the sump section of the drain. A plug is provided to remove the foreign matter from the sump periodically.

Relief Valve: Adjustable, pressure operated valve. When the pressure exceeds the value set up by the adjusting procedure, the valve opens and air is blown out of the relief valve through the exhaust muffler. This device acts as a pressure regulator.

Exhaust Muffler: Cuts down the sound of air exhausted from the relief valve.

Compressed Air Cleaner: Removes minute contamination from the compressed air before the air enters the system. This filter thoroughly cleans the air for use in the access.

Compressor Assembly

REMOVAL

1. Remove file power and open file starter gate.
2. Open blow down valve (push button toward system safety valve) until pressure reads zero PSI.
3. Disconnect power plug and air tubing at compressed air cleaner exhaust.
4. Remove ground strap.
5. Lift latch handles.
6. Roll assembly out.

Replacement

1. Open file starter gate.
2. Roll assembly in until the latches fasten into place on rear square tubing.
3. Center laterally within enclosure.
4. Connect ground strap.
5. Connect power plug and air tubing.
6. Place electrical cable within clip on file starter box.
7. Check for proper operation and air pressure.

See Figures 79 and 80 for location of parts in air compressor unit when using these procedures.

Intake Filter

Removal and Disassembly

1. Remove the intake filter from the pipe system by hand.
2. Remove brass retainer wire using a narrow blade screwdriver.
3. Remove the retainer.
4. Remove the felt pad.
5. Remove the next retainer and rubber liner.
6. Remove baffle and perforated pad assembly.

Assembly

Reverse the removal procedure and assemble the unit.

Preventive Maintenance

1. Remove the felt pad as per steps 1 to 3 above and brush off pad with a stiff brush. Further clean by beating the pad against a hard surface.
2. Proceed with removal to step 6 above and clean out the dirt accumulated in the filter body and on the perforated pad assembly.

Compressor Check Valve (Figure 82)

Removal and Disassembly

1. Turn off compressor and open blow down valve until pressure is zero.
2. Remove check valve plug and gasket.
3. Remove spring and valve stem.

Assembly

1. Reverse the removal and disassembly procedure to assemble the unit.
2. Install valve. Be sure the copper gasket is properly seated and tighten with a wrench. Replace the gasket with a new one if necessary.
3. Make a leakage check in insure that the reassembled check valve does not leak.

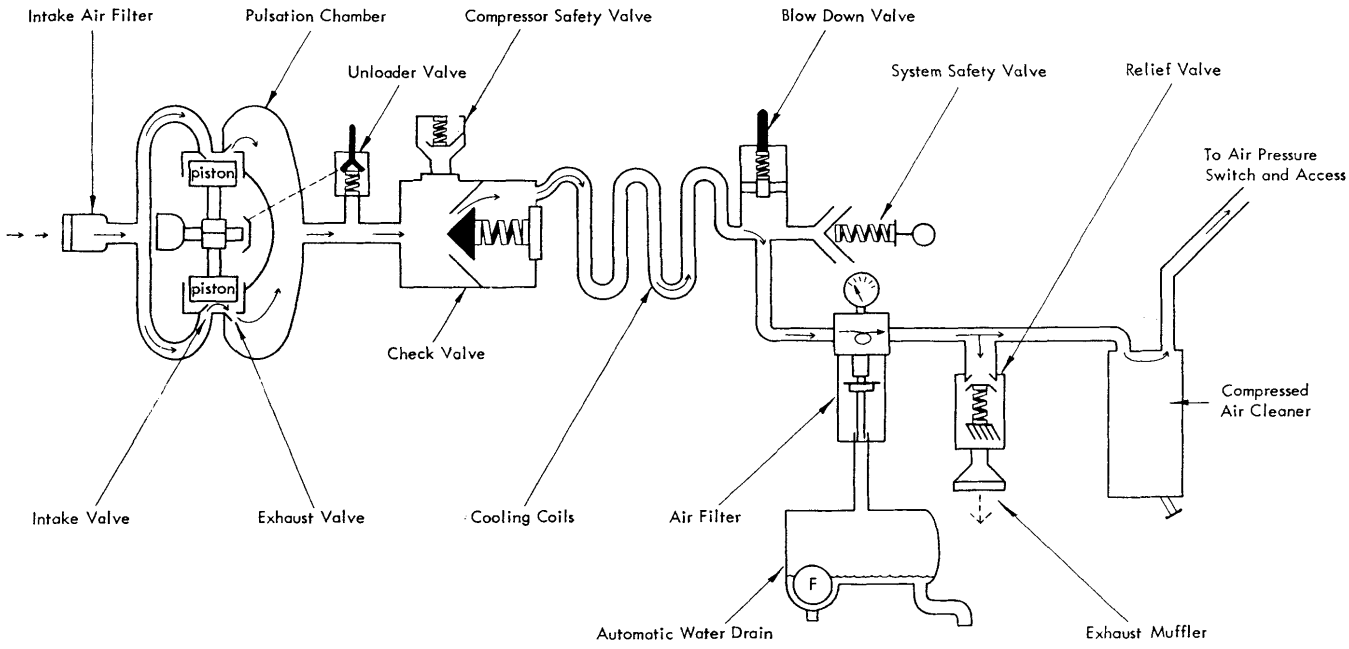


Figure 81. Bell and Gossett Air Compressor Air Flow Schematic

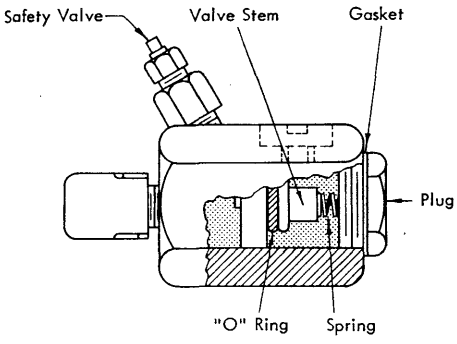


Figure 82. Compressor Check Valve (B and G)

Preventive Maintenance

1. Disassemble unit as per above instructions and clean the valve stem, "O" ring, and internal valve seat with IBM solvent.
2. Check the rubber "O" ring for breakage and replace if necessary.
3. Inspect the spring and replace if corroded.
4. Inspect the valve seat for burrs and foreign matter.
5. Check compressor safety valve by pulling stem to unseat the valve.

Compressor Safety Valve

Removal

1. Unscrew large hex nut from base of check valve.
2. Further disassembly is impractical; replace if defective.

Assembly

Reverse the removal.

Adjustment

No adjustments necessary.

Preventive Maintenance

Pull on valve stem to unseat valve.

System Safety Valve

No adjustments are made on the system safety valve; replace if defective.

Preventive Maintenance

Check the safety valve by pulling on ring to unseat valve. With compressor operating, place hand over relief valve muffler and allow pressure to build up, the system safety valve should exhaust at 62-66 PSI. Replace if defective.

Relief Valve (Figure 83)

Removal and Disassembly

1. Turn off compressor and open blow down valve until pressure is zero.
2. Unscrew the muffler using a 9/16" open end wrench on the muffler bushing. Do not unscrew the muffler from the bushing.
3. Loosen the relief valve assembly by putting a 10" adjustable wrench on the upper hex and another 10" adjustable wrench on the lower hex. Twist the upper hex counterclockwise ¼ turn.
4. Using the wrench on the lower hex only, unscrew and remove the relief valve from the piping assembly.
5. Separate the upper body from the lower body of the relief valve by unscrewing one from the other.
6. Unscrew and remove the threaded adjusting sleeve and large rubber "O" ring, equalizer plate, and valve poppet.

Assembly

1. Reassemble valve poppet within bore of lower body.
2. Replace equalizer plate above poppet making sure that the center flat-surfaced boss is on top (See Figure 83).
3. Replace spring so it seats within the flange of the equalizer plate.
4. Replace threaded adjusting sleeve. This part fits over the top of the spring and screws into the lower body.
5. Replace the upper body by screwing it into the threaded adjusting sleeve. Do not tighten upper body into lower body.
6. Replace valve into piping assembly. Tighten the lower body to the piping assembly.
7. Readjust valve for correct pressure setting.
8. Check for leakage where lower body screws into piping assembly.

Adjustment

Adjust the air pressure to read 55 PSI (+3, −0) at the pressure gage with compressor on and no air flowing through the air system.

1. Unscrew the muffler completely by using a 9/16" open end wrench on the muffler pipe bushing.

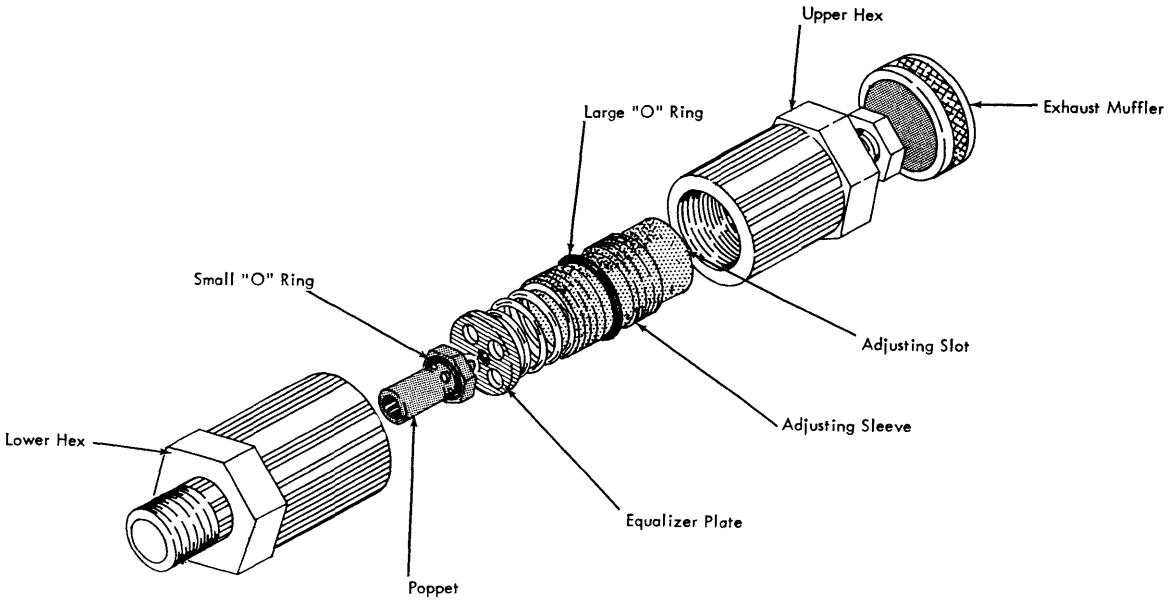


Figure 83. Relief Valve (B and G)

2. Loosen the relief valve assembly about ¼ turn by putting a 10″ adjustable wrench on the upper hex and one on the lower hex and twisting the upper hex.
3. Adjust relief valve as follows:
   Insert a 5/16″ allen wrench or the square shank screwdriver into the adjusting slot; and turn clockwise to increase pressure, counterclockwise to decrease.
4. After air pressure has been adjusted, tighten the relief valve, upper and lower bodies.
5. Replace the muffler.
6. Check the pressure again.

Preventive Maintenance

1. Check the air pressure; adjust as necessary.
2. Remove and disassemble relief valve and clean the four separable parts in step 6 of the removal procedure with IBM solvent.
3. Put three to four drops of IBM #6 oil in the inlet part of the lower body during assembly of the unit.

Exhaust Muffler

Removal and Disassembly

1. Unscrew and remove knurled cap from top of muffler.
2. Remove screen and felt pad.

Assembly

Replace felt pad, screen, and knurled cap.

Preventive Maintenance

Clean the felt pad with compressed air (The compressor may be operated with muffler removed).

Air Line Filter and Automatic Water Drain

Removal and Disassembly

1. Turn off compressor and open blow down valve until pressure is zero. The blow down valve is opened by depressing the brass button on the side of the blow down valve.
2. Disconnect end of air lines connecting to the relief valve piping and filter assembly.
3. Loosen four lock nuts on air filter and automatic water drain bracket plate.
4. Lift complete relief valve piping-filter assembly and pour accumulated water from filter bowl through exhaust side of assembly.
5. Remove drain tubing.
6. Unscrew automatic water drain from bottom of filter plate.
7. Remove ¼″ pipe plug from drain sump and allow water and dirt to flow into the drip pan. Replace pipe plug using Permatex #3 on threads.
8. Unscrew and remove acorn nut which fastens filter to bracket.
9. Disassemble filter base bracket plate and filter plastic bowl. Lift off filter element assembly.
10. Unscrew baffle plate nut, baffle plate, element spacer and filter element. When assembling, tighten baffle by hand and use wrench on baffle nut.

Assembly

Assemble by reversing the removal and disassembly procedure. Take care to properly seat all gaskets and spacers. Replace automatic water drain using Permatex #3 on pipe thread.

Preventive Maintenance

1. Clean the air line filter element as follows:
   a. Turn compressor off and open blow down valve until pressure is zero.
   b. Disconnect both ends of the air line which connects to the safety valve piping assembly and filter piping assembly.
   c. Disconnect end of air line which connects to the intake side of the compressed air cleaner on the compressor assembly and connect that end to the safety valve piping assembly connection.
   d. Start compressor. This provides reverse air forcing dirt out of filter element through the open end of the relief valve piping assembly. Any dirt, etc., will fall into bottom of the bowl.
   e. Clean by this process for two minutes.
   f. Turn off compressor and connect airlines to their normal connections.
2. Check and clean, if necessary, bottom of air line filter and bowl.
   a. Disassemble as per "Removal and Disassembly" procedure.
   b. Step 8 of the "Removal" procedure will expose the top face of base. Clean this face and plastic bowl with a rag taking care not to disturb the rubber gasket seated in grove.
   c. Clean the items mentioned in step 9 with IBM solvent.
   d. Assemble as per "Assembly" procedure.

Compressed Air Cleaner (Figure 84)

Removal and Disassembly

1. Turn off compressor and open blow down valve until pressure is zero.
2. Remove bottom brass acorn nut and spacer.
3. Remove bottom plate. Rotate to free it from threaded stud.
4. Remove "O" ring, washer, spring, second washer, second "O" ring, and lower pressure plate.
5. Remove cotton element; if excessively dirty, replace with a new element.

Assembly

1. Reverse the removal procedure.
2. Make leak test to insure the air cleaner does not leak after reassembly.

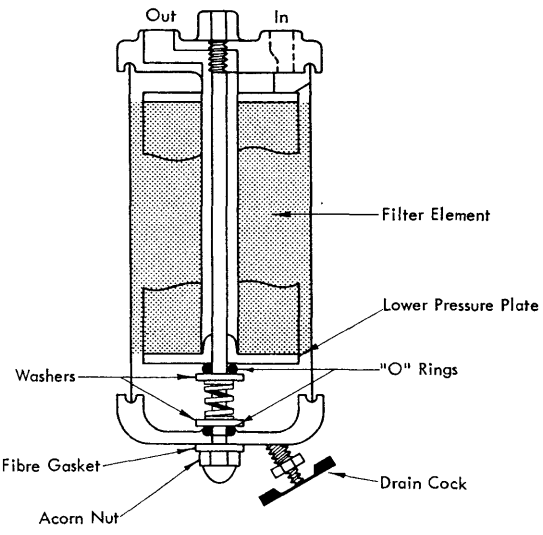


Figure 84. Compressed Air Cleaner (B and G)

3. Purge air system for two minutes by disconnecting tube at access and blowing air into the atmosphere.

Preventive Maintenance

Check compressed air cleaner element and replace if dirty. Follow "Removal" procedure.

Pressure Switch (Mounted on Frame of File)

Adjustment

The pressure switch contacts are normally open and depend on increasing air pressure to close them and decreasing air pressure to open them. The switch contacts should open when the pressure on the switch is decreased to 45 (+0, −2) PSI and should close at 50 PSI or more. If the contacts do not open at the proper setting, adjust as follows:

1. The adjusting nut is located within the yoke holding the microswitch plastic housing. The adjusting nut can be turned by hand.
2. Turn the nut clockwise to raise the setting and counterclockwise to lower it.

NOTE: Open system safety valve slightly by raising stem to decrease air pressure.

Preventive Maintenance

Check operation of procedure switch. Adjust if necessary.

Air Pressure

Check air pressure. With no air flowing in the air system and the compressor on, the air pressure gage

should read 55 PSI (±3, −0) (See "Relief Valve—Adjustment" for adjustment procedure).

Air System Leakage

1. With no air flow into air system (air heads up), turn off the compressor. The pressure will drop 10% rapidly from the running pressure, 55 PSI to 49.5 PSI and hold at approximately 49.5 PSI.

2. The hold pressure should not drop to less than 40 PSI two minutes after the compressor has been turned off.

3. If pressure drops below the values of steps 1 and 2, determine if the leakage is due to reverse pressure through the check valve. This can be done by pinching the rubber hose which comes out of the check valve after the compressor has been turned off. If the leakage persists, proceed as follows:

   a. Tighten all plastic tube connections by hand.

   b. Soap-bubble check each pipe, copper, and rubber tube connection and tighten with a wrench if necessary (To soap-bubble check, work soap and water into a sudsy lather and apply to connections. Air leaks will cause the lather to bubble).

   c. Soap-bubble check automatic drain tube, relief and safety valves, and solenoid connections.

Air Compressor Capacity

With compressor operating and no air flowing through the system (air heads up) open the blow down valve (depress brass button on side of blow down valve). The air will exhaust from a metering orifice on the underside of the blow down valve. With blow down valve still opened, place your other hand over the exhaust muffler to prevent air from escaping. Pressure should read 40 PSI or more. If not, make leakage test of compressor as follows:

1. Soap-bubble check exhaust port plug and bottom plug at underside of compressor body. Slight bubbling is not serious unless noted at a number of places. Seal with Permatex #3, tighten, or replace copper gaskets as necessary.

2. Make capacity check again. If pressure is low again, make leakage check of air system.

3. Make a capacity check again. If pressure is below 45 PSI it will be necessary to change the piston ring, ring springs, exhaust passage gaskets, intake valves, and exhaust valves and gaskets (See "Compressor Overhaul").

4. Make a capacity test again for readings of 40 PSI or more. If the pressure is 40 PSI, or less, change the compressor unloader valve (See "Compressor Overhaul").

Compressor Overhaul

Prior to overhauling the compressor or replacing parts as a result of a low compressor capacity check, the compressor overhaul B/M for Bell and Gossett compressors (B/M 2105420) must be ordered.

305 File Compressor Overhaul B/M for Bell and Gossett Compressors

Part No.	*Name*	*Description*
2192249	Intake valve	(2) Flapper opposite to hex socket
2102250	Exhaust valve	(2) Flapper and hex socket on same side
2111310	Check valve plug gasket	(1) 1/32" thick copper ring
2111309	Unloading valve	(1) Copper tube, brkt., valve asm.
2111306	Check valve "O" ring	(1) Fits on stem, which is enclosed in valve
2111300	Exhaust passage gasket	(2) Fits between cyl. head and compressor body
2111303	Piston ring spring	(2) Fits under piston rings within piston groove. This is a flat spring
2111301	Check valve spring	(1) Fits between stem and outside plug
2111305	Exhaust port gasket	(2) 1/16" thick copper ring. Be sure to seat properly in cyl. head groove.
2111304	Piston ring	(4) Diametrically split, carbon composition
359250	Felt	(1) Intake air filter

CYLINDER UNIT OVERHAUL (FIGURES 85, 86, 87)

REMOVAL AND DISASSEMBLY

1. Remove intake piping system from compressor.

NOTE: Remove large hex nut first and try to free the tubing. If the tubing is tight, it will twist when removed. The same number of twists should be applied before reassembling, so no twists appear when fully assembled.

2. Remove exhaust port plugs and intake port bushings along with the copper gaskets.

3. Using the special valve wrench (#2108045) remove intake valve from cylinder head side.

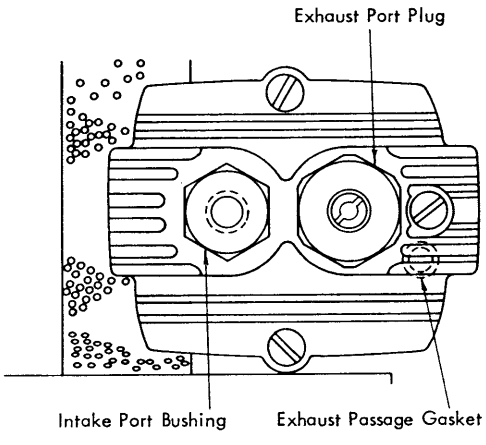


Figure 85. Cylinder Head Assembly (B and G)

4. Remove cylinder head.
   a. Remove three screws from cylinder head.
   b. Pull the cylinder head by hand from compressor body. Head and cylinder are cast together and come out as a unit.
5. Rotate the fan to bring the piston to top dead center.
6. Remove the double rings and spring. The double ring joints should be at 90° ±20° from each other.

NOTE: These rings were manufactured in a complete circle then diametrically broken.

7. Remove exhaust valve using special valve wrench at the cylinder side.
8. Remove old exhaust passage gasket from cutout on exposed surface of compressor body.

ASSEMBLY

Reverse the removal procedure checking for piston freedom of motion with new gaskets and rings. Rotate fan for freedom of action before tightening the three head screws. Make sure all gaskets are properly seated. Tighten plugs and test for leaks and compressor capacity. Do not use Permatex on fittings in the intake piping system.

CHECK VALVE OVERHAUL (FIGURE 82)

Follow "Compressor Check Valve–Preventive Maintenance," and replace "O" ring, safety valve, check valve gasket and check valve spring.

UNLOADER VALVE OVERHAUL (FIGURE 86)

REMOVAL

1. Remove fan guard.
2. Remove fan.
3. Using a puller, remove compressor centrifugal switch assembly.
4. Disconnect unloader valve tubing at check valve body.
5. Back out screw which holds unloader valve and arm assembly to wall of the compressor pulsation chamber.
6. All parts are now removable.

ASSEMBLY

1. Assemble by using the reverse of the removal procedure.
2. When replacing the centrifugal switch assembly, press and tap the assembly into place on the fan extension shaft to a point 1/8" back of the shaft shoulder.
3. Position fan as far back on shaft as possible.
4. Check free rotation of fan between compressor body and guard.
5. Operate centrifugal switch and check for opening and closing of unloader valve. No lubrication is required on the centrifugal switch.
6. Soap-bubble check all valves and connections at compressor and at solenoids. Make a capacity test. The pressure should be at least 45 PSI.
7. Readjust relief valve (See "Relief Valve–Adjustments").

Access Mechanism Electronics

File Robot

There are two styles of file robots. In order to differentiate between the two, they will be referred to as file robot (rotary switch) and file robot (toggle switch). The words in parentheses refer to the method of selecting the file address. Throughout the electronics adjustment procedures, references will be made to the robot. The following section will serve as an introduction to the unit and its switches, lights, jacks, and functions.

NOTE: File robot (toggle switch) is for use with drawer machines only. File robot (rotary switch) is for use with gate machines only.

FILE ROBOT (TOGGLE SWITCH)

Address Switches. Nineteen SPST for each of two addresses. Each switch connects to an address relay coil in the electronic drawer. Binary combination of these switches make possible the selection of any address from 00000 to 49999.

No Null Track. This switch prevents a track null by injecting –60 volts to the input of the last stage of the track null amplifier circuit forcing a no track null condition.

No Null Disk. This switch prevents a disk null by injecting –60 volts to the input of the last stage of the disk null amplifier circuits forcing a no disk null condition.

Compare. This switch is not used at the present time.

Adjust. This switch picks the adjust relay.

Automatic. This switch allows the access arm to servo between two addresses automatically by passing the track located signal from the electronic drawer to the robot.

Start Hold. This switch passes the start hold signal from the robot to the electronic drawer.

Disk Solenoid. This switch prevents the engaging of the disk detent by cutting off the +48 volt supply to the disk detent solenoid.

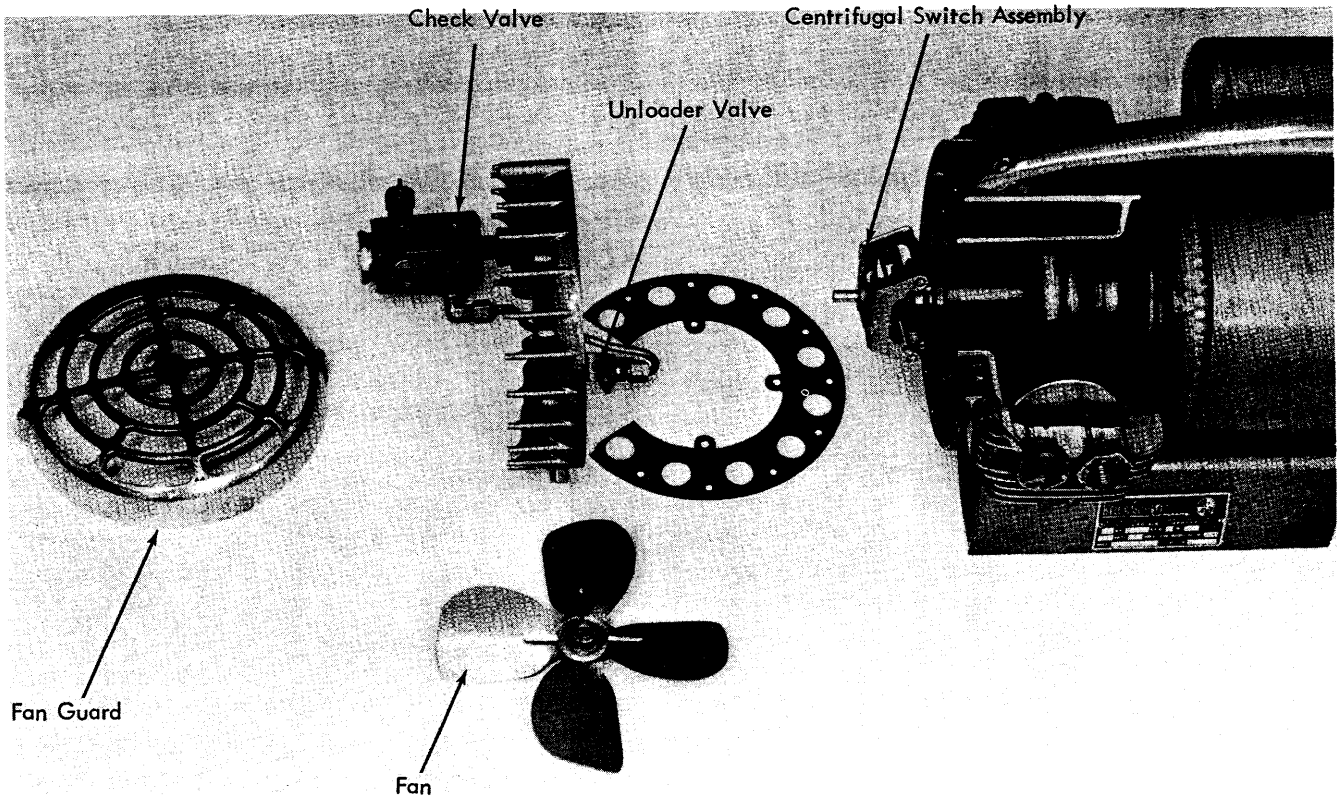


Figure 86. Compressor Overhaul (B and G)

Track Solenoid. This switch prevents the engaging of the track detent by cutting off the +48 volt supply to the track detent solenoid.

Head Solenoid. This switch keeps the air heads up all the time by cutting off the +48 volts input to the air head solenoid.

Manual Start. This is a monmentary contact push button switch (push to make) which initiates generation of the address pick and start hold signals in the robot.

Safety Off. This is a momentary contact push button switch (push to break) which cuts off the +48 volt to the logic safety circuit and drops out the logic safety and bias safety relays.

Start Hold Monitor Point. This is a jack for monitoring the start hold signal from the robot.

Track Located Monitor Point. This is a jack for monitoring the track located signal when it reaches the robot.

"A" and "B" Address Indicators. These are two neons which indicate which of the two addresses is being selected.

Operating Procedure

1. The file robot is connected for servicing the 350 File as follows:
   a. Turn off all DC power.
   b. Place all switches on the robot in the down position.
   c. Connect the H and K connectors on the electronic drawer to the back of the robot.
   d. Turn on DC power.
2. Use of manual switch to servo.

NOTE: The disk drive motor must be operating in all cases where the access mechanism is servoed under power.

   a. Make sure the safety relays in the electronic drawer are picked.
   b. Select an "A"and B"" address by placing the desired address switches up.
   c. Place the solenoid switches up.
   d. Place the start hold switch up.
   e. Depress the manual start switch momentarily. The access arm will go to the address indicated by the address neon.
   f. After the access arm has reached the address, another depression of the manual start switch will cause it to servo to the other selected address.

3. Use of automatic switch for servo.

NOTE: The disk drive motor must be operating in all cases where the access mechanism is servoed under power.

   a. Follow preceding steps 2a through 2d.
   b. Place the automatic switch up.

c. Depress the manual start switch momentarily. The access arm will servo automatically between the addresses selected.

d. To change addresses during an automatic servo, change the address switch settings on the side with the unlit address neon.

e. Stop the automatic servo by switching the automatic switch down.

4. Drop the start relays in the electronic drawer by placing start hold switch down.

5. Pick adjust relay by placing adjust switch in up position.

6. Prevent disk null by placing disk no null switch in up position.

7. Prevent track null by placing track no null switch in up position.

8. Prevent disk detent engagement by placing disk solenoid switch in down position.

9. Prevent track detent engagement by placing track solenoid switch in down position;

10. Prevent lowering the airhead by placing head solenoid switch in down position.

11. Drop safety circuits by depressing safety off switch momentarily.

File Robot (Rotary Switch)

Address Switches. Five rotary switches for each address A and B allow setting up of any disk address 00000-49999.

Solenoid Switches. DISK, TRACK, and HEAD must be ON or in up position in order to obtain a disk detent, track detent, or air applied to the heads.

Start Hold. This switch passes the start hold signal from the robot to the file gate. This switch must be up to servo.

Compare. Not used.

Manual Start—Automatic. A three position toggle switch, center is OFF. Spring returned to OFF when placed in *manual start* position. *Manual start* initiates generation of address pick and start hold signals in the robot. *Automatic* will cause the arm to servo alternately between the "A" and "B" address.

Safety Off. Drops logic and bias safety.

Start Hold (jack plug). Used for monitoring start hold signal from the robot.

Track Located (jack plug). Used for monitoring track located signal from the robot.

"A" and "B" Address Indicating Neons. Indicate which address is being selected.

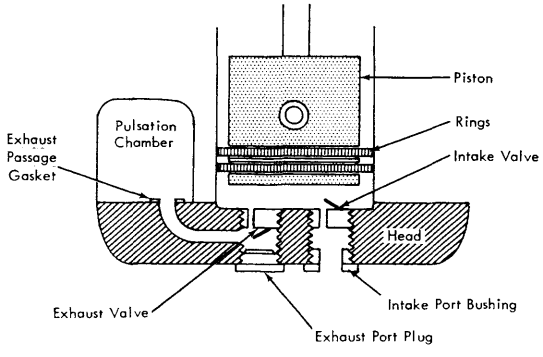


Figure 87. Bell and Gossett Cylinder Head Assembly (cross sectoin)

Operating Procedure

1. The file robot (rotary switch) is connected to the 350 file as rollows:

a. Turn off DC.

b. Place all toggle switches off (manual start: CENTER).

c. Connect H and K connectors to the back of the robot.

d. Turn on DC.

2. Use manual switch for servo.

NOTE: The disk drive motor must be operating whenever the access mechanism is servoed under power.

a. Make sure logic and bias relays are up.

b. Select an "A" and "B" address.

c. Place solenoid switches up.

d. Place start hold up.

e. Deflect manual start up momentarily. The arm should go to the address indicated by the neon.

f. Another deflection of manual start should cause the arm to servo to the alternate address.

3. Use of automatic switch for servo.

Same as 2, except manual start to AUTOMATIC. The arm should servo between the two addresses indicated by the rotary switches.

File Test Station (Gate Machines)

Three switches are mounted on the file test station.

Null Adjust. Three position (center OFF) toggle switch. Up for disk null adjustments. Down for track null adjustments.

No Null. Three position (center OFF) toggle switch. Up prevents a disk null condition. Down prevents track null.

Safety Reset-Adjust. Three position (center OFF) toggle switch. Up (spring returned) picks logic and bias safety relays. Down picks the adjust relay.

Access Mechanism Electronics Adjustments

It is necessary to make the adjustments described in the proper sequence as they affect each other. The correct order is:

1. Voltage Regulator
2. Disk Null

3. Track Null
4. Clutch Amplifier
5. Track Potentiometer
6. Home Potentiometer
7. Disk Potentiometer
8. Access Time Measurement

NOTE: There are two styles of 350 Files; those with electronic drawers and those with electronic gates. Where adjustments are different for the two, they will carry a parenthetical phrase describing which style file they relate to. The adjustments common to both types of files are given first, followed by those applicable to the drawer file, and then those applicable to the gate file.

When adjusting the drawer file electronics, care should be taken to keep the drawer cool. The drawer can be pushed back in occasionally, or a cardboard shipping tube can be placed between the blower housing and the drawer air inlet when the drawer is pulled forward.

VOLTAGE REGULATOR ADJUSTMENTS

1. The voltage regulator output voltages should be checked prior to the adjustment of the track or disk potentiometers, track or disk null, and the clutch amplifiers.

2. Before starting, check to see that all fuses in the file electronics are of correct value. Incorrect fuse ratings can cause parity and file checks.

3. The file DC voltages should be on for at least 15 minutes before making any checks or adjustments.

NOTE: Before proceeding with step 4, check that the 340 voltages are adjusted correctly.

4. The output voltages can be monitored at the hubs of the regulator chassis (8.30.07 drawer, 0.54.05 gate) with a Tektronix 310 oscilloscope. If there is any steady deviation from the rated voltages, they can be adjusted by the potentiometer on the regulator chassis associated with that voltage (8.30.00 drawer, 0.54.04 gate) +215v, P1; +140, P2; −210, P3; −60, P4.

NOTE: 350 Files with EC402257 and all gate files will not have −60 regulated voltages. These files can be identified by the lack of a −60 fuse holder and neon on the face of the voltage regulator chassis.

5. If you are adjusting the access mechanism on a routine preventive maintenance, proceed with the disk null adjustments. If you are having access trouble or if deviations were noted in step 4 above, then proceed with step 6.

6. The objective of this step is to check that the voltage regulator output does not vary more than 1% with an input voltage variation of 10%.

a. Set the +270v on the 340 Power Supply to +297v.

b. Set the −250v on the 340 Power Supply to −230v.

c. Actual allowable variations are to be +1% on the +215, +140, −210 and −60. These small variations are practically unmeasurable with the 310 or the Simpson meter. Practically speaking, no appreciable change in voltage should be noted.

d. Set the +270v on the 340 Power Supply to +243v.

e. Set the −250v on the 340 Power Supply to −270v.

f. Same as c, except −1%.

g. Return voltages to normal.

7. The objective of this step is to see that there is no interaction between the various supplies.

a. Vary the −250 supply first to −225 then to −275 while observing the +140 regulated supply. No change should be noted.

b. Repeat a. while observing the +215 supply. No change should be noted. Return −250 to normal.

c. Vary the +270 supply first to +297 then to +243 while observing the − 60 regulated supply. No change should be noted.

d. Repeat c. while observing the −210 regulated supply. No change should be noted. Return +270 to normal.

e. The voltage regulator bias safety relay R1 (8.30.06 drawer, 8.30.05 gate). should remain energized while these voltages (+270 and −250) are varied ±10%.

NOTE: Gate model machines with E/C 403119 will not have voltage regulator bias safety circuit.

8. If the output voltages are varying, the following procedure can be followed to correct the trouble:

a. +215 v (8.30.01). With the 310 scope measure the voltage drop across V5, (tube type OA2). This voltage should be between +140v and +150v and not varing at all. The slightest change in this voltage dictates replacing the tube.

b. +140v (8.30.02). Check the voltage drop across V11 (tube type OB2). This should be +108v to 114v and not varying. If the voltage drop is varying, the tube should be replaced.

c. −60v (8.30.03 drawer only). Check the voltage across V13 (tube type OA2). This voltage should not be varying. If it is, the tube should be replaced. The voltage drop across the two neons (tube type 6332) should be checked by measuring from ground to both sides of the neon and their connection. (The meter should not be placed across them as this will load them too much.) The voltage drop, figured numerically, should be 100 volts not varying, and should be equally divided between them. If there is any mis-match of voltage, then they should be replaced in pairs

until the voltage drop across them is equal. The neons may flicker slowly in normal operation; check the voltage from RB1-A10 to ground. If this voltage is stable, the neons are good.

d. −210v (8.30.04 drawer, 8.30.03 gate). Check the voltage drop across V15 (tube type OA2). It should be between −140v and −150v and not varying. If it does vary, the tube should be changed. The voltage drop across the two neons (tube type 6332) should be measured from ground to each end of the neon and the connection between them. This voltage drop, figured numerically, should be 100 volts but not lower than 95 volts. The voltage should be divided equally between the two neons. If it is not, they should be changed in pairs.

If it is found necessary to replace one of the voltage reference tubes, OA2 or OB2, the output voltage should be immediately adjusted to the proper value and then checked again after 30 minutes for any necessary readjustments.

e. If none of the above measured voltages is varying, the control tube associated with the troublesome voltage should be replaced. These tubes are:

(1)	+215v (8.30.01)	V 4 (6136)
(2)	+140v (8.30.02)	V10 (6136)
(3)	− 60v (8.30.03 drawer only)	V12 (6136)
(4)	−210v (8.30.04 drawer, 8.30.03 gate)	V 9 (5965)

f. The voltage regulator bias safety circuit (8.30.06 drawer, 8.30.05 gate) should be checked to be certain relay R1 (in the regulator) remains energized when the DC input voltages are varied ±10%. If the relay should de-energize, the bias and logic safety relays will drop out.

NOTE: Gate machines with E/C 403119 will not have voltage regulator bias safety circuit.

NOTE: Before proceeding with "Disk Null Adjustments," read the paragraph preceeding "Voltage Regulator."

NULL SYSTEM ADJUSTMENTS (DRAWER MACHINES)

The null system consists of a disk null circuit and a track null circuit. The null circuits are designed to pick the null relays (track and disk) only when the input to the circuit is within ±.5 volt and to drop the relays when the input is greater than ±.5 volt.

DISK NULL (DRAWER MACHINES)

The objective in making this adjustment is to adjust the null system so that the range of high voltage output is centered around a zero input. This is accomplished by applying AC to the null detector inputs and adjusting for a symmetrical oscilloscope display.

1. Apply power to the system.
2. Press the safety reset-adjust switch to the left to pick the safety relays.
3. Push the safety reset-adjust switch to the right to pick the adjust relay.
4. Connect and set up oscilloscope as follows:
   a. Vertical amplifier AC-DC switch set to AC.
   b. Vertical amplifier input set to 0.2 volts/division or 0.02 volts/division if using the 10X probe.
   c. Connect vertical input of scope to disk null signal monitor point (8.01.04) or M1 pin 3.
   d. Sync scope on LINE PLUS so that the trace is stable.
   e. Set time division to 5 ms.
5. Loosen the disk null potentiometer locknut and adjust the potentiometer until the bottom peaks are equal. There should be six peaks. If there are only three, turn the potentiometer until six equal peaks are obtained (Figure 88).

TRACK NULL (DRAWER MACHINES)

It is necessary to adjust the disk null before the track null adjustments are attempted. The adjustment procedure for the track null system is the same as the one outlined for disk null with the following exceptions:

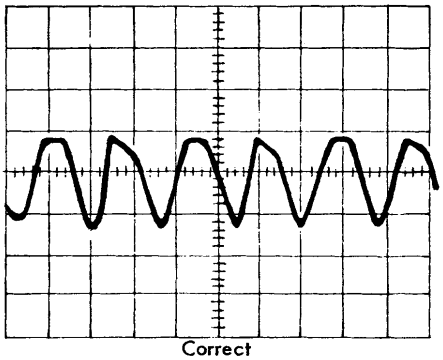
1. Connect the horizontal input to the TRACK NULL signal monitor points.
2. Adjust the track null potentiometer (8.02.04) in the same manner as step 5 preceeding (See Figure 88).

CLUTCH AMPLIFIER ADJUSTMENT (DRAWER MACHINES)

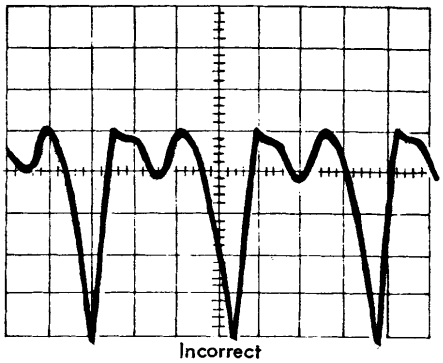
The clutch amplifier consists of a differential amplifier and two parallel amplifiers, one of which is for the out-up clutch and the other for the in-down clutch.

The objective in making this adjustment is to balance the outpost of the differential amplifier and set the correct bais to the paralled clutch current drivers.

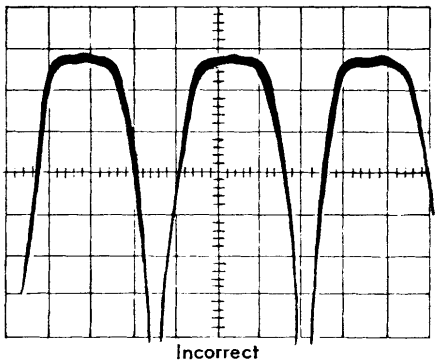
1. Following the "Track Null Adjustment" procedure, connect the robot to the file and pick the adjust relay.
2. Measure the voltages at the clutch amplifier in-down and out-up monitoring points (8.05.01) on the file test station with a scope. Adjust the clutch balance potentiometer (8.05.01) until both voltages are equal.
3. Adjust the clutch bias potentiometer (8.05.01) for − 5 volts at the monitoring point hubs.
4. Drop out the adjust relay by pushing the adjust switch down.



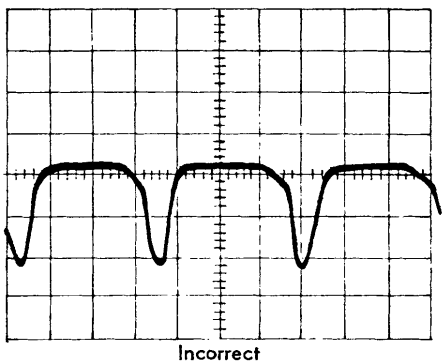
Correct
Vertical Amplifier = .2v/Div.



Incorrect
Ve-tical Amplifier = .2v/Div.



Incorrect
Vertical Amplifier = .2v/Div.



Incorrect
Vertical Amplifier = .2v/Div.

Figure 88. Null Pattern (Time/Division=5 ms)

Track Potentiometer Adjustment (Drawer Machines)

The objective in making this adjustment is to mesh the track potentiometer gear properly with the rack and set the fine adjustment of the potentiometer so the arm will servo to the correct track. This adjustment is accomplished by positioning the track potentiometer to minimize the track wiper error voltage when the track is addressed to and detented at the track address with the largest error signal.

1. Connect the file robot.
2. Place file starter box in manual mode and turn off access at the convenience outlet.
3. Disengage the track potentiometer from the arm by loosening the bracket mounting screws.
4. Loosen the adjusting screw lock nut and turn the adjusting screw (allen head) completely in and then back off two full turns. This sets the potentiometer for maximum fine adjustment in both directions.
5. Move the arm until the even detent (the one nearest to the disks) is opposite the second tooth root counting from the head end of the arm. This is track 00.
6. Pick the logic and bais safety relays.
7. Address the file to track 00 on the disk at which the arm is located.
8. Push the manual start button on the file robot.
9. Push the adjust switch up. The track detent becomes energized and locks the arm in the track 00 location.
10. Connect the oscilloscope between the track error signal monitor point and ground.
11. Rotate the track potentiometer gear until the voltage is as near zero as possible and engage the gear with arm rack. Lock the potentiometer mounting bracket in place by tightening the mounting screws so the gear will not bind and will have a minimum amount of play (approximately .002").
12. Adjust the fine adjustment allen screw until the error voltage measured by the scope is zero (±.1 volts). Adjust the screw by turning inward so that errors due to backlash can be eliminated. Tighten the track potentiometer to the bracket with the hex nut.
13. Record this voltage and reposition the track indicator if necessary.
14. Put the adjust switch down.
15. Set up the address 05 and move the arm manually to this position. If the detent engages in the

wrong track, push the no null track switch down and the adjust switch up and move arm to the proper position.

16. Record the voltage.

17. Repeat steps 15 and 16 for tracks 15, 25, 35-95 (every 10 tracks).

After the potentiometer has been set, a quick method to check every track position is to run the zig zag DFT test with the access motor off, and manually move the arm by rotating the clutch. CAUTION: There is 270 volts on the clutch slip rings. While doing this, scope the track error signal and watch the voltage level when the detent engages.

NOTE: If you replace a track pot, step 17 should be amended to read: "Repeat this procedure (steps 15 and 16) for all tracks:"

18. Compare the voltages recorded for all tracks. The difference between the highest and lowest readings should not be greater than .75 volt. Algebraically add the highest and lowest reading. Address the arm to the highest wiper voltage track position and detent at this track. By turning the fine adjustment screw on the potentiometer assembly, reduce this reading to one-half the algebraic sum of the highest and lowest reading.

19. Set the adjust switch down.

20. Set up several track addresses and manually servo to these positions. In no case should the error signal now exceed ±0.38 volt.

HOME POTENTIOMETER ADJUSTMENT (DRAWER MACHINES)

The objective in making this adjustment is to have the track potentiometer wiper voltage (track error) equal to zero (±.1 volt) when the arm is at the home position (fully retracted).

1. The "Track Potentiometer Adjustment" must be correct before this adjustment is made.

2. Connect the toggle switch style robot to the file.

3. Place file starter box in manual mode and turn off access at the convenience outlet.

4. Address the file to 25000 and manually servo to that address.

5. Address the file to a different disk.

6. Pull the arm out until it stops. The disk detent should disengage and the home relay should pick.

7. Adjust the home position potentiometer for a track error voltage to ground of zero (±.1 volt) measured with an oscilloscope.

8. Set up several disk addresses on the robot and manually rotate the clutch disk to servo to these positions. Check for proper servo operation.

CAUTION: +270 volts on clutch slip ring.

DISK POTENTIOMETER ADJUSTMENT (DRAWER MACHINES)

The objective in making this adjustment is to minimize the disk wiper error voltage when the arm is addressed to and detented at the worst disk. This adjustment is accomplished by positioning the disk potentiometer wiper.

1. Connect the toggle switch style robot to the file.

2. Place file starter box in manual mode and turn off access motor.

3. Set the head solenoid switch down.

4. Pick the logic safety and bias safety relays.

5. Address the file to disk 00 on the file robot.

6. Press manual start on the file robot.

7. Move the carriage to disk 00 by turning one of the clutches by hand. CAUTION: Clutch slip rings have 270 volts on them.

8. Put the adjust switch up. This will create an artificial null and air is applied to clamp the carriage to the way.

9. Loosen the two disk wiper insulating block holding screws and move the wiper block up or down as required in parallel to the potentiometer strip until the error signal monitoring point measured by scope is zero ±.1 volt.

10. Record this voltage.

11. Push the adjust toggle switch down.

12. Address the file to disk 05.

13. Move the carriage to the addressed disk by rotating the clutch by hand. The disk detent should engage at this point. If it engages at the wrong disk, push up the disk no null switch and move the carriage to the correct disk. Push the disk no null switch down and adjust switch up. Measure and record the voltage at this address.

14. Repeat steps 12 and 13 for every fifth disk, i.e., 10, 15, 20, 25, etc.

NOTE: Steps 12 and 13 should be repeated for all disks if you replace the disk potentiometer.

15. Address the carriage to the disk position having the highest wiper voltage. Position the wiper to reduce this voltage to one-half the algebraic sum of the highest and lowest readings.

16. Set up several addresses in the robot and manually rotate the clutch disk to servo the carriage and check for proper disk null operation.

ACCESS TIME MEASUREMENT (DRAWER MACHINES)

The access time is the time elapsed between the pick of the start hold relay and the picking of the arrival relay. This should be 775 ±25 ms and is shortest when the dynamic damping adjustments are correct. If the access time is less than 750 ms, it will be necessary to

increase the dynamic damping. The requirement for dynamic damping is to obtain a fast, smooth servo stroke for both disk and track movements in both directions. The overshoot of the disk or track error signal must be less than .2 volt (See Figure 89).

If considerable adjustment is required in order to obtain access time within the limits below, the mechanical condition of the carriage, latches and tachometer signal should be investigated to insure that you are not compensating for a poor adjustment or worn condition.

1. Connect the robot to the file.
2. Connect a lead from the START HOLD hub on the robot to the external trigger input of the scope.
3. Place the trigger mode to DC and the trigger slope to the EXTERNAL + position.
4. Connect a 10X probe from the vertical input of the scope to the TRACK LOCATED hub on the robot.
5. Set the scope up for 10 volts/division and .2 second/division.
6. Use the robot procedure for automatic servo between address 00999 and 00000.
7. Adjust the trigger so that the scope trace is triggered on the rising slope of the start hold signal (from 0 to 45 volts).
8. Observe the scope for the rising of the track located signal (from 0 to 140 volts).
9. The access time is the time from the start of the scope trace to the rising of the track located signal. The access time must equal 220 ±20ms. Adjust the track dynamic damping potentiometer to obtain this value.
10. Set up the robot for an automatic servo between 00999 and 49999.
11. The access time indicated on the scope must equal 775 ±25 ms. Adjust the disk dynamic damping potentiometer to obtain this value.

Gate Machines

Voltage regulator adjustments should be checked first (See "Voltage Regulator Adjustment").

NULL SYSTEM ADJUSTMENTS (GATE MACHINES)

The null system consists of a disk null and track null circuit. The null circuits are designed to pick the null relays (track and disk) only when the input to the circuit is within ±.5 volt and to drop the relays when the input is greater than ±.5 volt.

DISK NULL (GATE MACHINES)

The objective in making this adjustment is to adjust the null system so that the range of high voltage output is centered around a zero input. This is accomplished by applying AC to the null detector inputs and adjusting for a symmetrical oscilloscope display (See Figure 88).

Preliminary switch settings:
Robot Manual start—center (OFF)
All others down
File Test Station
All in center

1. Apply power to the system.
2. Momentarily push the safety reset-adjust switch up. This should pick the logic and bias safety relays.
3. Push the safety reset-adjust switch to ADJUST.
4. Set the null adjust switch to DISK.
5. Connect and set up the scope as follows:
   a. Vertical amplifier AC-DC switch to AC.
   b. Vertical amplifier input set to 0.2 volts/division or 0.02 volts/division if using the 10X probe.
   c. Connect vertical input of scope to NULL ADJUST monitor point. (PT 20).
   d. Sync scope on LINE PLUS so that trace is stable.
   e. Set time/division to 5 mils.
6. Loosen the disk null potentiometer lock nut and adjust the potentiometer until the bottom peaks are equal. There should be six peaks. If there are only three, turn the potentiometer until six equal peaks are obtained (Figure 88).
7. Push the safety reset-adjust to the center position.

TRACK NULL (GATE MACHINES)

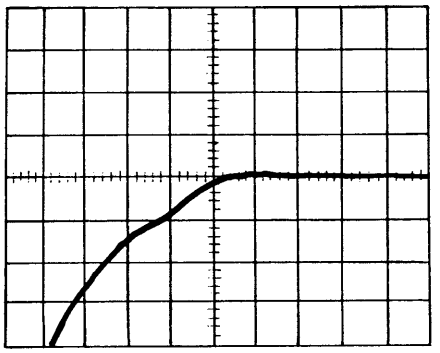
It is necessary to adjust the disk null before the track null adjustments are attempted. The adjustment procedure is the same as the one outlined for disk null with the following exceptions:

1. Vertical input to NULL ADJUST monitor point (PT 20).
2. Null adjust switch to TRACK.
3. Adjust track null potentiometer (8.02.04) in the same manner as step 6 above.

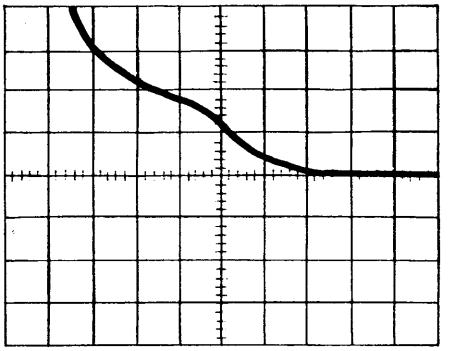
CLUTCH AMPLIFIER ADJUSTMENTS (GATE MACHINES)

The clutch amplifier consists of a differential amplifier and two parallel amplifiers, one of which is for the out-up clutch and the other for the in-down clutch. The objective in making this adjustment is to balance the outputs of the differential amplifier and set the correct bias to the parallel clutch current drivers.

1. Following the "Track Null Adjustment" procedure, pick the adjust relay.
2. Measure the voltages at the clutch amplifier in-down and out-up monitoring points (8.05.01) on the

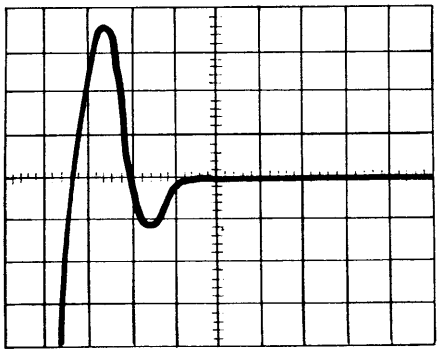


No Overshoot

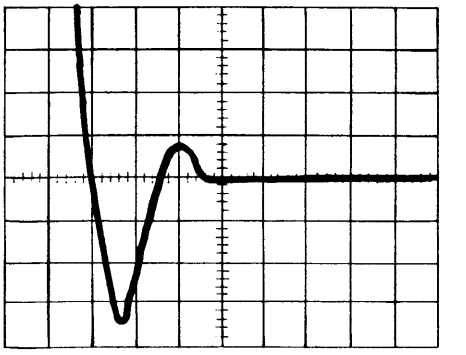


Up or Out Stroke

In or Down Stroke

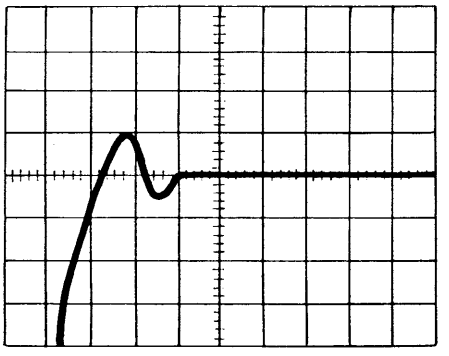


Too Much Overshoot

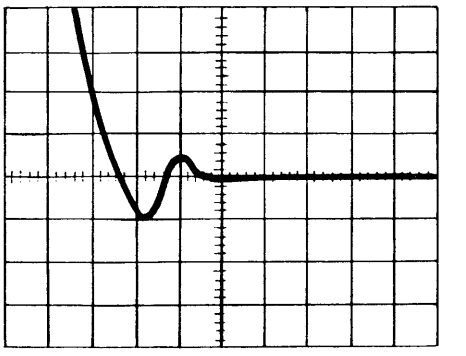


Up or Out Stroke

In or Down Stroke



0.2 Volts Overshoot



Up or Out Stroke

In or Down Stroke

Figure 89. Disk Stroke Damping (Vertical Amplitude ±.2v/div.)

file test station with a scope. Adjust the clutch balance potentiometer (8.05.01) until both voltages are equal.

3. Adjust the clutch bias potentiometer (8.05.01) for – 5 volts at the monitoring point hubs.

NOTE: Machines after 403119 will have a –12 bais. They can be identified on 8.05.01 by the type of amplifiers in parallel; for type CD 308 the bais is –12; for type AM 323 the bais is –5.

4. Drop out the adjust relay.

Track Potentiometer Adjustment (Gate Machines)

The objective in making this adjustment is to mesh the track potentiometer gear properly with the rack and to set the fine adjustment of the potentiometer so the arm will servo to the correct track. This adjustment is accomplished by positioning the track potentiometer to minimize the track error voltage when the track is addressed to and detented in the worst track address.

Preliminary switch settings:
Robot — Start hold–up (ON)
Manual start–center (OFF)
All others–down
File Test Station
All in center (OFF) position

1. Connect the rotary switch robot to the file.
2. Place file starter in manual mode and turn off access motor at convenience outlet.
3. Disengage the track pot from the arm by loosening the bracket mounting screws.
4. Loosen the adjusting screw lock nut and turn the adjusting screw (allen head) completely in and back off two full turns. This sets the pot for maximum fine adjustment in both directions.
5. Move the arm until the even detent (nearest to disks) is opposite the second tooth root counting from the head end of the arm. This is track 00.
6. Momentarily push the safety reset-adjust switch up. This should pick the bias and safety relays.
7. Address the file to track 00 on the disk at which the arm is located.
8. Push the manual start switch up momentarily.
9. Place disk solenoid switch on robot up.
10. Connect the oscilloscope between the track error signal and ground.
11. Rotate the track pot gear until the voltage is as near zero as possible and engage the gear with the arm rack. Lock the pot mounting bracket in place by tightening the mounting screws so the gear will not bind and will have a minimum amount of play (approximately .002").
12. Adjust the fine adjustment allen screw until the error voltage measured by the scope is zero (±.1 volt). Adjust the screw by turning inward so that errors due to backlash can be eliminated. Tighten the track pot to the bracket with the hex nut.
13. Record this voltage and reposition the track indicator if necessary.
14. Set up the address 05 and move the arm to this position by manually operating the clutch. CAUTION: There is 270 volts on the clutch slip rings. If the detent engages the wrong track, push the no null switch to TRACK. Move the arm to the correct position and record the voltage.
15. Repeat step 14 for tracks 15, 25, 35-95 (every 10 tracks).

After the potentiometer has been set a quick method to check every track is to run the zig-zag DFT test with the access motor off, and manually move the arm by rotating the clutch. CAUTION: There is 270 volts on the clutch slip rings. While doing this scope the track error signal and watch the voltage level when the detent engages.

NOTE: If you replace a track pot, step 15 should be amended to read: "Repeat this procedure for all tracks."

16. Compare the voltages recorded for all tracks. The difference between the highest and lowest readings should not be greater than .75 volt. Algebraically add the highest and lowest reading. Address the arm to the highest wiper voltage track position and detent at this track. By turning the fine adjustment screw on the pot assembly, reduce this reading to one-half the algebraic sum of the highest and lowest reading.
17. Set up several track addresses and manually servo to these positions. In no case should the error signal exceed ±0.38 volts.

Home Potentiometer (Gate Machines)

The objective in making this adjustment is to have the track pot wiper (track error) signal equal to zero (±.1 volt) when the arm is in the home position (fully retracted).

Preliminary switch settings:
Robot — Start hold–up (ON)
Disk solenoid–up (ON)
Manual start–center (OFF)
All others–OFF
File Test Station
All switches in center (OFF) position

1. The track pot adjustment must be correct before this adjustment is made.
2. Connect the rotary switch robot to the file.
3. Place file starter box in manual mode and turn off the access motor at the convenience outlet.
4. Address the file to 25000 and manually servo to that address.
5. Address the file to a different disk.
6. Pull the arm out until it stops. The disk detent should disengage and the home relay should pick.
7. Adjust the home position pot for a track error voltage to ground of zero (±.1 volt) measured with an oscilloscope.

8. Set up several disk addresses on the robot and manually rotate the clutch to servo to these positions. Check for proper servo operation. CAUTION: Clutch slip rings have 270 volts DC on them.

DISK POTENTIOMETER ADJUSTMENT (GATE MACHINES)

The objective in making this adjustment is to minimize the disk wiper error voltage when the arm is addressed to and detented at the worst disk address. This adjustment is accompolished by positioning the disk pot wiper.

Preliminary switch settings:

Robot
- Start hold—up (ON)
- Disk solenoid—up (ON)
- Manual start—center (OFF)
- All other switches—down

File Test Station
- All switches—center (OFF)

1. Connect the rotary switch robot to the file.
2. Place file starter box in manual mode and turn off access motor.
3. Safety reset-adjust switch momentarily to SAFETY RESET (the logic and bias safety relays should pick).
4. Address the file to disk 00.
5. Momentarily deflect manual start switch up on the file robot.
6. Move the carriage to disk 00 by turning one of the clutches by hand. CAUTION: Clutch slip rings have 270 volts on them.
7. Set adjust switch to ADJUST. This will create an artificial null and air is applied to clamp the carriage to the way.
8. Loosen the two disk wiper insulating block holding screws and move the wiper block up or down as required in parallel to the potentiometer strip until the error voltage at the disk error signal (as measured by the scope) is zero volts (±.1 volts).
9. Place disk solenoid switch on robot up.
10. Set adjust switch to OFF.
11. Address the file to disk 05.
12. Move the carriage to the addressed disk by rotating the clutch by hand. The disk detent should engage at this point. If it engages at the wrong disk, push the no null switch to DISK and move the carriage to the correct disk. Push no null to CENTER and the safety reset-adjust to ADJUST. Measure and record the voltage at this address.
13. Repeat steps 11 and 12 for every fifth disk, i.e., 5, 10, 15, 20, etc.

NOTE: Steps 11 and 12 should be repeated for all disks if you replace the disk potentiometer.

14. Address the carriage to the disk having the highest wiper voltage. Position the wiper to reduce this voltage to one-half the algebraic sum of the highest and lowest readings.
15. Set up several addresses in the robot and manually rotate the clutch disk to servo the carriage and check for proper disk null operations.

ACCESS TIME MEASUREMENT (GATE MACHINES)

The access time is the time elapsed between the pick of the start hold relay and the picking of the arrival relay. This time should be 775 ±25 ms and is shortest when the dynamic damping adjustments are correct. If the access time is less than 750 ms, it will be necessary to increase the dynamic damping. The requirement for dynamic damping is to obtain a fast, smooth servo stroke for both disk and track movements in both directions. The overshoot of the disk or track error signal must be less than .2 volt (See Figure 89).

If considerable adjustment is required in order to obtain access time within the limits below, the mechanical condition of the carriage, latches and tachometer signal should be investigated to insure that you are not compensating for a poor adjustment or worn condition.

1. Connect the robot to the file.
2. Connect the rotary switch robot to the file. robot to the external trigger input of the scope.
3. Place the trigger mode to DC and the trigger slope to the EXTERNAL + position.
4. Connect a 10X probe from the vertical input of the scope to the TRACK LOCATED hub on the robot.
5. Set the scope up for 10 volts/division and .2 second/division.
6. Set up for automatic servo between address 00999 and 00000.
7. Adjust the trigger so that the scope trace is triggered on the rising slope of the start hold signal (from 0 to 45 volts).
8. Observe the scope for the rising of the track located signal (from 0 to 140 volts).
9. The access time is the time from the start of the scope trace to the rising of the track located signal. The access time must equal 220 ±20 ms. Adjust the track dynamic damping potentiometer to obtain this value.
10. Set up the robot for an automatic servo between 00999 and 49999.
11. The access time indicated on the scope must equal 775 ±25 ms. Adjust the disk dynamic damping potentiometer to obtain this value.

Section 6. 370 Printer

This section provides the removal, assembly, adjustment, and preventive maintenance recommendations for the 370 Printer unit of the RAMAC 305 system. The information contained is based on current engineering specifications. The lubricants specified are important. Do not over-lubricate; wipe off excess oil and grease from the machine parts. Normal good housekeeping practices will insure a presentable machine apperance. The apperance of this system plays an important part in holding the customer's satisfaction.

General Mechanical Timing

(Figure 90)

Adjustment

The dynamic timer, program shaft, and emitter shaft are all driven by the rear motor pulley and timed as follows:

1. Trip the PS clutch magnet in the area of 38 to 39 on the dynamic timer index. Crank the machine manually. The point at which the clutch pawl engages the ratchet should be zero on both dynamic timer and PS indexes. Adjust indexes as necessary.

2. Continue to crank machine to 110 ms. The sector drive gear should start its motion to engage with the sector gear and be fully engaged at 130 ms. At this point, a straight line drawn through the center of both gears should pass between the first and second tooth of the sector gear. The sector gear should be positioned axially for .047"-.060" clearance to the drive gear when the mechanism is in the home position. If any interference occurs between the engaging gears, the sector gear hub should be loosened while the machine is in the home position and the sector gear shifted to improve the meshing action.

3. The setup unit, print carriage, hammer unit, the CRCB's are driven by the front pulley. Adjust the pulley on the motor shaft until the CR index indicates A-10 when the dynamic timer index is at zero.

Note: All CRCB's and print mechanism items should be timed statically to the CR index. It will be desirable, however, to be able to check the timings of the CB's on the dynamic timer under power. Due to the effects of gear play and belt stretch, it will be found that the CR and DT indexes will not agree dynamically even thought they do agree statically. The following procedure will insure that the two indexes agree *dynamically* although they may differ somewhat when the machine is stopped or turned over by hand.

a. Remove the wires from one of the more carefully timed CRCB's and record the timing as read on the CR index.

b. Display this CB on the dynamic timer.

c. Shift the DT index so that the cam timing agrees exactly with the timing recorded in step a.

d. Cam timings can now be accurately checked on the dynamic timer index.

e. Do not rock the mechanism when timing the CB's. Instead, make certain the mechanism is driven in the operating direction to the CB opening or closing point.

Drive Belt Tension

With 650 grams applied, check for approximately ¼" defletion of belts measured at midpoint of belt stretch.

Print Setup Unit

Removal

1. Disconnect the 16-point cable connector at the top of the setup unit.

2. Unhook the print element control tapes from setup tapes. Refer to the section in this manual on control tape removal for procedure. Connect a rubber band from each control tape hook to the machine frame keeping light tension on the tapes and preventing them from slipping off of the pulleys.

Note: Take care not to scratch or kink the tapes against the machine or pulley flanges.

3. Setup tapes can also be kept intact if desired by attaching rubber bands to the tape hooks and positioning the tapes back over the anchor pulley and attaching the rubber bands to the print setup unit (See Figure 92). If the setup tapes are removed for any reason, mark an anchor reference point on the tape

a console read "V" operation and then need not be considered again.

(1) Load V track from the console (0000000033 in each field).

(2) Load a 2 in character 00 of W track.

(3) Load 0000000111 on X track (characters 00-09) (clear X first).

(4) Set up the following two step program loop:

X19L1920b5 Reset add 0000000111
W00N99010b Multiply—0 flag to step 000

c. Execute the program loop one time and read L track. The results should be 000000007710000-00000. An analysis of the error results will often point out specific failures, for example:

Results—
0000000077000000000—Shift gate failure
0000000066l000000000—Accr to Adder failure
0000000011l000000000—Mcand to Adder or PP to Adder failure

d. The multiply gates (5.06.03) can be scoped while syncing on a T_2=N (4Hy) anded with W cycle (4Ty).

The multiply compare line at 6W3 pin 10 (5.06.05) comes up at about Bs ∅ B of character 9 of the field numercially the same as the value of the multiplier digit. This gate can be used as a sync alone or anded with other conditions.

If a multiplier of more than one digit must be used at high speed to produce a failure, any particular step of the multiplication may be seen by anding the proper sync box core position exit with T_2=N and W cycle.

A few facts about the sync box core exits during multiply may be helpful. The units digit of the multiplier is stored in core position 00, tens in 01, etc. The core ring advances to position 01 at about Bx of character early (just after the units multiplier digit has been transferred from the cores to the core character register). The next character early time at the start of the second multiply drum revolution will cause an advance to 02 and so on until all the multiplier digits have been handled. As a result a string of bit 2 pulses starting at CE will come from core sync box position 01 for the units multiplier, 02 for the tens position, etc.

53. Analysis of Division Failures

a. Before going into the divide circuits the machine operation on addition and subtraction should be carefully investigated. Marginal voltage runs should be made if necessary.

b. Load V track manually (0000000003 in every field). Clear Q track and then read V to verify that there is a 3 in the units position of every field.

c. Load W track with 753 (characters 00-02).

d. Set up the following program loop:

W02L1103b5
L09P99020b (0 wired to step 000)

e. Execute the program loop once and read cores. Core buffer should contain 0000000015. Read L track. The results should be 0000000015300000-0002. Any failure to reduce the dividend, develop a quotient, or shift to the left should be evident in the results.

f. If the operation of the quotient counter is in question, it can be checked statically by changing the MN of the instruction to 01. At the end of the divide W cycle the quotient counter neons will still be on for visual checking.

g. The "Manual of Instruction" uses the same program as an illustration, and the duration of pulses and gates can be checked against the sequence chart in the Division section.

h. There is no single cycle divide provision on the machine, but the effect can be duplicated by loading a program track with the programs needed for a divide but with the actual divide step having an MN of 02 rather than the MN called for by the problem. This MN of 02 program should be entered on successive program steps until the total of the 02 MN's equals the number of the MN needed for the problem. With the control selector switch set to SINGLE CYCLE and a program set to the proper point, the program start button can be used to step through a division problem. The L track may be console read at any point (turn the control selector to PROGRAM RUN first) and the division continued from there without interference (unlike single cycle multiply).

Do not use an odd valued MN such as 01, 03, etc. in an attempt to further break down the analysis. Elements of the divide circuitry are directly drum controlled within the odd and even cycles and cannot be stopped by the master stop trigger.

File Techniques

When working on the file extreme care must be taken to have the customer's records undisturbed. Removing the jumper from the FILE INTERLOCK hubs on the 305 control panel whenever possible will help by making

writing impossible from normal operations. Having the test lock switch ON whenever possible while working on the file is another help since only the CE tracks will be scanned by the arm heads.

File troubles will in general stem from four sources: a) Servo troubles, b) wrong readings, c) wrong writing, d) false file checks or missed file checks.

54. Servo Troubles (Figure 177)

Erratic servo operation can be caused by poor magnetic clutch brush contact. Check for proper tension and proper riding on the slip rings.

A quick check on the disk and track damping can be made by observing the action with servos of ten disks and servos of 20 tracks. These servos tend to be the most critical but should still be smooth. Before disk and track damping adjustments are made the electrical clutches must be balanced and any mechanical binds must be removed.

The access motor spindle is designed to slide up and down the keyed motor shaft and is held against the clutches by spring tension. Check this spindle for free up and down sliding motion and keep the mechanism carefully lubricated.

If the access time builds up, be sure to check all mechanical elements as well as electrical. Access time is a good indicator of general mechanical condition as well as electrical.

Failures in the file null detector circuits can be rapidly checked by setting up the file for null adjustments. The input and output signal levels from each stage of the detector circuit are listed in the component circuits description. The listed voltages will be present when the adjust signal is applied to the detector circuit.

A quick method of checking track potentiometer linearity and adjusting the track null follows: Connect a scope direct probe to the TRACK ERROR SIGNAL hub. Set the vertical amplitude to .1 volt/division, DC horizontal sweep to 500 μs/division, and trigger for continuous sweep. Zero the scope with no signal applied. Start the DFT file access test. The error signal for each track will appear on the scope. Observe extreme plus and minus readings to determine linearity. If the readings are greater than .76 volt apart, the track potentiometer should be replaced. If the readings are less than .76 volt, a mid-point adjustment should be made. This can be done by stopping the program, turning off the access motor, adjusting to the proper position, then rerunning the access test.

Servo Oscillations

a. Double detenting (chatter) of the access arm can be caused by a loose fit between the magnetic clutch rotor and the clutch shaft. With the access drive motor turned off and the clutches energized and prevented from rotating, grasp the capstan and note if there is any movement. The spanner lock nut on the clutch shaft should be adjusted to eliminate end play without binding.

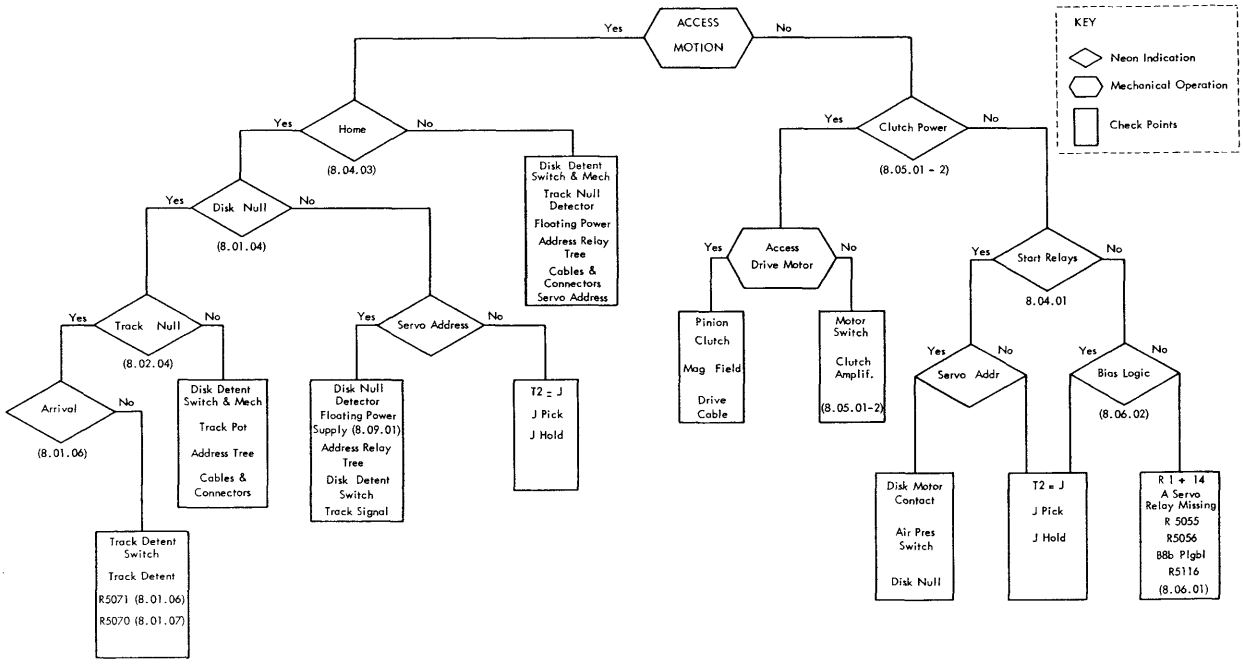


Figure 177. Diagnostic Flow Chart for File Access Failures

b. Under certain conditions, the servo may go to an address, fail to null and remain in a state of oscillation near the address. This condition may cause the clutches to seize, causing severe wear to the drive motor pinion. Several conditions and combinations may cause this problem.
c. The present file servo was designed to run at or below a maximum access time (measured pick of the start 1 relay to pick of the arrival relay on 49999 to 00999) of 800 ms, and preferably at or below 775 ms. If the damping pots are set for a slower maximum access, this oscillation may occur. Other factors entering into the problem are low clutch bias (below 5 volts negative) and low cable tension. Occasionally, an unbalanced cable pair is found which may cause this difficulty in particular access locations. A word of caution: It is best not to go overboard on speed or bias; e.g., at 8 volts negative, a short seek may never reach null or arrival.

55. Wrong Reading

This can be general in nature or localized to a specific spot or area on a disk. Investigation by console reading numerous records should indicate the type of trouble though it should be remembered that even a general malfunction will at times confine its failing to a specific area or condition. Specific spot failures can indicate the need for disk cleaning or possible replacement.

Apparently wrong reading can easily come from improper writing and this possibility should be kept in mind. If the record is known to be written correctly and read failures persist, there are three areas to investigate: a) head to disk clearance and orientation over the track; b) operation of the read amplifier; c) operation of the automatic gain control circuit.

56. Test Routine (Figure 178)

The test routine following will help isolate troubles in these areas: Ground the scope to the file electronics ground bus to reduce ripple pick up. Set the 310 scope vertical gain to .5 volt when using the 10 to 1 probe. The horizontal scale should be set to 1 ms/div and the stability and trigger controls set maximum clockwise (which should produce a free-running sweep). Remove the unit at B5 on 8.10.04 (E1 on drawer files) to kill the AGC operation. Scope at A4 pin 5 (D2 pin 5 on drawer files) while reading a track near 00. A "grass like" pattern of about 45 volts peak to peak should be seen. Servoing to a track near 94 should produce the same general pattern but with about a 25 volt peak to peak amplitude.

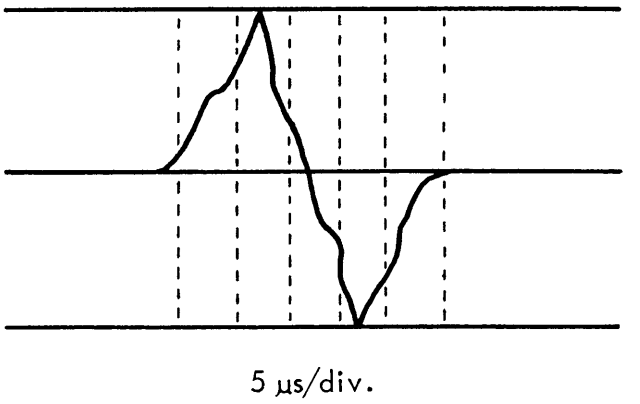


Figure 178. Signal at Pin 5 of A4

Plugging the unit B5 (or E1) back in should reduce this amplitude to about 15 volts peak to peak if the AGC is working properly. This level should not change more than one volt from the outside to the inside tracks. If AGC trouble is suspected, do not overlook the external .1 MFD AGC filtering capacitor between ground and pin 7 of B5 (or E1) nor the .1 MFD plate filter between pin 9 and ground.

A typical normal waveshape for successive bits at pin 5 of A4 (or D2) is about as follows with the horizontal sweep set for 5 μs per division:

Any one bit will give either the mountain or the valley, so there may be a level area in between for some characters.

A defective .1 MFD capacitor in the AGC will put dips and squiggles on this wave.

57. Weak Signals

Weak signals can come from amplifier trouble or from excess clearance between head and disk due to maladjustment of the head springs, sticking pistons, or binds. These adjustments and checks should be carefully made due to their delicacy and importance.

58. Scoping Read Amplifier

When scoping the read amplifier do not probe any nearer the head than C4 on 8.10.04 (F1 on drawer files) unless absolutely unavoidable due to the very real danger of burning out a head coil or erasing a record from a slip of the probe. The output of the amplifier at D4 (or F2) can be safely picked up at pins 3 and 8 of C4 (or F1). The gain of the AM 306 unit at D4 (or F2) is about twelve, and from this fact the actual read head output can be calculated if necessary.

59. Signal Levels Through Read Amplifier (Figure 179)

The pluggable unit locations in parenthesis below are for drawer files. Typical peak to peak signal levels at the inputs (pin 5 or 8 to ground) of the various units follow:

C4 (F1) from .25 ±.05 volts near track 99 to .35 ±.05 volts near track 00 (after subtracting the rather severe AC ripple that is generally picked up at this point).

B4 (E2) about 1 volt ±.1 regardless of the track being read if AGC is working (and after subtracting any AC ripple being picked up).

A4 (D2) about 14 volts ±2.

A5 (D1) about 110 volts ±10.

MP-2 (MP-8) monitor point output should be about 50 volts peak to peak (from −10 to +40 normally).

A worthwhile procedure for reference is to write mixed data on all sectors (top and bottom) of both CE tracks (inner and outer) of some disk least likely to be worked with, such as number 26. This is to be done on installation or when the machine is known to be in excellent condition. As long as these CE records are left undisturbed, a reference signal will be available. Taking peak to peak voltage readings and recording them in a table similar to Figure 179 can provide helpful data for future analysis.

60. Intermittent Read or Write Failure

Intermittent read or write failures can be caused by breaks in the coiled access arm cable or the flat elevator cable. Wiggling and jostling these cables while running the machine in a program repeat T_2 of R condition will provide a convenient check for continuity.

61. Wrong Writing (Figure 180)

Writing troubles will generally show up as file checks, though some marginal conditions can put mildly defective data on the disks that will only show up on a later reading operation. As with reading failures a check should be made to see if the failures appear to be general or are area localized.

The file check circuits do entail reading, and troubles in the reading circuits can thus cause file checks. Reading the signal level and waveshapes from the disk in the failing area and comparing this with an area known to have been correctly written at an earlier time can prove valuable.

62. Head Elements

A few facts about the head elements (8.10.02) may prove helpful.

a. A head with an open erase coil can read perfectly, but will be unable to write.

b. Each of the three coils in each head has a resistance of about 1.5 ohms.

c. Any fuse with a rating less than ¼ amp in FCP 5 will cause trouble by adding excessive resistance in the center leg. Typical ¼ amp fuses measure 3 ohms, ⅛ amp fuses 13 ohms, and 1/100 amp fuses 240 ohms. Any resistance build up in the center leg, from any cause, will produce similar trouble due to incomplete erasing of the old record, weak new writing, and possible head ringing.

d. Excessive head to disk clearance due to air head trouble (wrong spring tension, bends, sticking pistons, etc.) can cause troubles similar to that coming from excessive center leg resistance.

e. A slip of the test probe while in the circuits connected to the heads can erase a record or burn out a head. Staying away from this area when DC is on the machine is strongly advised.

63. Write Amplifier Checking (Figure 181)

Checking the write amplifier can be readily done by connecting the scope across the ¼ amp head fuse FCP #5 (8.10.02). Using the scope set on 10 microseconds /division and .01 volts/division with a 10 to 1 probe, a picture about as follows should be seen while writing:

Date..... Disk #.....

All readings volts peak to peak.

UNIT E1 OUT	Inner CE Track	D2-5 - - - - - - -	D2-8 - - - - - - -	MP8 - - - - - - -
(AGC Killed)	Outer CE Track	D2-5 - - - - - - -	D2-8 - - - - - - -	MP8 - - - - - - -
UNIT E1 IN	Inner CE Track	D2-5 - - - - - - -	D2-8 - - - - - - -	MP8 - - - - - - -
(AGC Active)	Outer CE Track	D2-5 - - - - - - -	D2-8 - - - - - - -	MP8 - - - - - - -

Figure 179. Table of Reference Signals

The write current should be 180 ±20 ma. With a ¼ amp fuse of 3 ohm resistance this will cause a base line deflection of about .54 volts while writing. *Not all ¼ amp fuses have this resistance.* The normal range is 2½ to 5 ohms. Use an ohmmeter to determine the actual value and multiply this number by .18 to determine the deflection called for by your conditions.

Each spike represents a write current transition (or bit). Broad spikes represent switching or trigger trouble. The signal level on either side of any spike should be similar. Variation indicates circuit unbalance. Severe variations may indicate an open circuit or coil for one side of the head. A generally weak signal level indicates bad tubes or components. A much larger signal level indicates too much fuse resistance to ground. Be sure to observe the signal while writing on both the upper and lower sides of a disk to test both heads.

If the foregoing specifications are met but writing troubles persist, mechanical conditions should be checked.

64. False File and Parity Checks

False file checks while writing and false parities when reading can be caused by an overlapping of disk ∅B and disk ∅C (3.01.02). These pulses should overlap at a point no more positive than minus 20 volts. Varying the –230 volt supply within testing limits may aggravate this condition. Replace the tube in the IN 306 at 2T9 (3.01.01) if necessary.

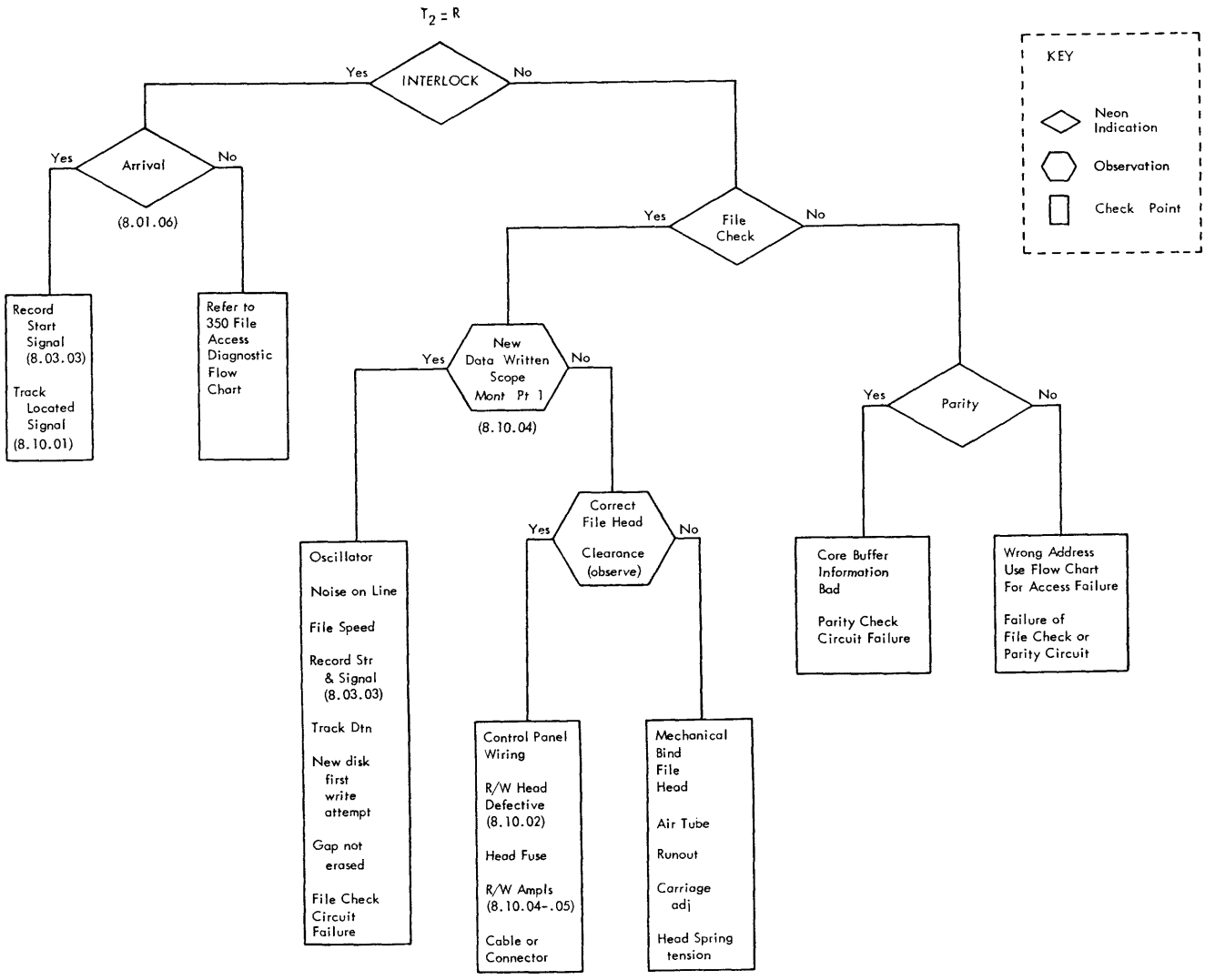


Figure 180. Diagnostic Flow Charts for File Write Failures

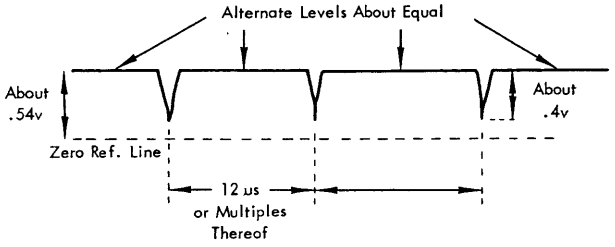


Figure 181. Voltage Drop Across Fuse FCP #5 When Writing

65. File Checks and Reading Troubles

File checks and reading troubles can be caused if a record area preceding the one being used is completely blank (even of R and S bits). (This can happen from injudicious probing of the head circuits.) During the ten milliseconds the blank area is being scanned, the AGC circuit will relax and let the read amplifier gain get so high that noise becomes amplified excessively and the first actual pulse read overloads the amplifier. The solution is to write something on any blank records.

File check may also be caused by file speed interlock operation or by a failure to lower the disk write gate.

66. Sync for Scoping Data to or from the File

Convenient sync pulses for data to or from the file are the CORE ADDRESS TENS and UNITS hubs on the 305 sync panel. However, the following points should be noted about the outputs from these hubs:

a. The CORE UNITS POSITION exit has been internally anded with a bit 2 (2.10.01).

b. On R cycle, the core advances at BR∅C. This enables us to get a C00B2 pulse out about midway through the transfer of C00.

c. On W cycle, the core advance is at BS∅C. Because of this, we step the core ring to 01 before B2 time and thus get no sync pulse 00 exit. Instead, the pulse comes at bit 2 time from hubs 01 (midway during the time core position 00 data is flowing down data from cores line).

In summary, to see any character *in its entirety,* it will be necessary to set the sync box core switches one lower than desired core position on a read cycle and at the desired position for a write cycle. For reasons discussed above, these rules do not work for core position 00. Position 00 may be seen by anding pin 10 of 4G6 with R cycle or W cycle as desired.

Known Machine Trouble Causes

The following information is supplied to assist the Customer Engineer in the analysis of machine failures. The information was compiled from daily logs and other reports from the field. While it is recognized that many other causes can produce similar machine failures, the following items have been known to cause the trouble in many instances.

67. Accumulator Failures

a. Wrong totals—one accumulator:
Defective plus and minus relay or associated ATH (5.05.02-5.05.03).
Defective zero non-zero relay or associated ATH (5.05.05-5.05.06).

b. Wrong totals—all accumulators:
Accumulator fails to reset (5.06.01).
Accumulator head adjustment and signal level (3.10.42).

c. Accumulator circuit improvements:
Accumulator modifications CEM #2669.
Accumulator track circuit improvements CEM #2741.

68. Arithmetic and Compare Failures

a. Intermittent arithmetic and comparing failures:
∅A, ∅B and ∅C duration (set ∅A and ∅B to outer tolerance and ∅C to its inner tolerance).

69. Parity Failures

a. I Cycle parities:
Shorted "P" exit relay point.
Defective program counter trigger (2.01.04-2.01.05-2.01.06).
High resistance distributor used with flag of affected program (fail to reset old instruction).
Instruction track head adjustment and signal level.
Back circuit in control panel.
Overloaded distributors.
(Prior to system 10137) Instruction register.
Reset B/M 2105293 not installed.
See CEM #2706.

b. R Cycle parities:
Wrong/weak write on last instruction using T_1.
Data to cores.

c. W cycle parities:
Data from cores.

d. R and W cycle parities:
Core R/W gate too short.

e. I, R and W cycle parities:
Loose drum head connection.
Drum head clearance.
Ripple on test R/W line (1.02.01).

f. Intermittent:
Loose wires in power supply.
Loose filament connections.
Bad solder joints.

70. Input/Output Tracks

a. Circuit improvements:
9 edge feeding CEM #2654.
S track read loading CEM #2669.
Input/output circuit improvements CEM #2741.

71. Program Sequencing

a. Locked in DDP:
Board wiring at fault, not setting up new instruction.
Control panel hubs open/grounded.
Distributors in series.
No "P" cycle exit pulse (2.05.03).

b. Multiple program steps:
See I cycle parities.

c. AB counter failures (Information shifted):
Use TR 308A in place of TR 308 in AB counters (2.04.04 through 2.04.07).

d. Wrong program step:
(Prior to 10137) instruction register reset not installed B/M 2105293.
See CEM #2706.

72. Clock

a. Clock error lights:
Broken drum belt.

73. Process Drum

a. Noisy:
Excessive belt tension—always check this item first.
Bearing failure.

b. Signal build-up from repetitive writing of the same information:
Thick drum plating.

c. Evidence of heads scraping for part of a revolution:
Blistering of the drum surface due to improper adhesion of drum plating to drum surface.
Bearing failure.

74. Process Unit Shorts

a. Intermittent back panel shorts:
Signal and voltage wires passing too close to socket pins. (Avoid overheating wires while soldering. Softened insulation produces back panel shorts. Use only pencil tip irons for back panel soldering.)

75. Punching

a. Double punching:
Loose punch bail tongue.
CLC out of adjustment.
Emitter out of time (0.09.04-0.09.41).
GT 302 (7.41.01) especially first card or after long ready status.
CF 318 (7.41.01) especially first card or after long ready status.
Improper adjustment of punch clutch not latching up, compare with card ahead and behind error card.

b. Missing cards:
P14 timing too long. Adjust to inner timings (0.09.41).
Punch speed too slow.

c. Dropping punches:
Magnet pull rod adjustment.
Zones—P5 dirty/out of adjustment.
Emitter out of time (0.09.40—0.09.41).
Hopper contact tension.

76. Blowing Fuses

a. Fuse 10, 17, and 24:
Dropping too many selectors from CI hub. Ratings should conform to E/C 402710B (Machines below 10215).

77. Improper Voltage

a. Low/excessive ripple:
Defective resonant capacitor.
Defective filter capacitor.

78. Sequencing

a. DC fails to come up:
Check relays 1, 4, 5, 13, 14, 15, 16, 31, and 32 (K-7 Pick).
Dirty contactors.
Power off depressed too soon after power on.

b. File motor fails to start:
Switches set wrong on file starter box.
Power off depressed while machine is cycling up. Next power on sequence may fail to start

file drive motor or DC may fail to come up. To restart, depress power on, wait one minute, depress power off. Depress power on.

79. Access Interlocks

a. Sluggish accessing/fail to null:
Disk detent switch (8.04.02) dirty/out of adjustment.
R-132/R-165 not picking (8.04.02).
Electronics adjustments out.
Worn pinion.
Cable tension.
Bind in access arm.
No horizontal movement of clutch shaft when pinion is disengaged.
Short or open address relay network.
Loose tachometer coupling.
Low air pressure.
R-214 points burned.
Ripple on −60 or −210. Type 6332 neons in regulated power supply wired in backwards. Cathode red dot should go to RB1-A10 (8.30.03) for −60 and to RB5-A7 (8.30.04) for −210.

b. Chattering/double detention:
Electronics adjustments out.
Track pot not linear (maximum error ±.38V).
Track detent switch out of adjustment (8.01.05).
Warped arm.
Tachometer coupling loose.
Worn pinion.
Drifting track null (adjust with drawer closed).
Q1 or Q2 microphonic (8.02.04-8.01.04).
Loose rotor on magnetic clutch.
Faulty precision resistors in track pot circuit.

c. Access improvements:
Improved disk detent switch CEM #2749.
Improved track detent switch B/M 2105343 CEM #2749.
Improved track detent assembly B/M 2105374 CEM #2749.

80. File Read/Write

a. File checks/parities:
Intermittent open in access arm cable.
Track detent switch (8.01.05) dirty or out of adjustment.
File oscillators out of adjustment.
Poor record start pulse.
PM on head overdue.
Low air pressure (see compressor).
SS timings wrong.
Bouncing clutch brushes.
Bad cable plugs.
Worn air hose/cocked head.
Sticking pistons.
Arrival relay 254 (8.01.05) bouncing burned points.
R218 points burned.

81. Compressor

a. Low air pressure:
Intake and exhaust valves defective.
Defective auto water drain.
Leaking connections.
Safety valve ball seal.

82. Print Quality

a. Poor carbon copies:
Platen positioning.
Binds in hammer arm, control arm, and platen.
Defective plastic pin in spline shaft.
Worn spline shaft.
Timing of hammer and print shaft.
Detent timing (in before 4.5 ms not out before 6.75 ms).
Spring tension should be adjusted toward back lower end of machine—minimum spring tension.
Warped ribbon shield.
Hammer, print stick and carriage adjustments.

83. Setup Check Lights

a. False:
CR 22 and 23 not overlapping (0.09.50-0.09.51).
Dirty setup contacts (7.74.31).
Hairpin contacts loose on pivots.
Emitters dirty/out of time.

b. True:
GT 301/CF 318 units defective, fails on first few lines or after long ready status (8.81.03 through 7.71.06).
Emitters dirty/out of time.
Oil on setup magnet armatures.
Setup pawl springs installed improperly—open end of spring loop must face away from repeat pawls.

84. Relay Failures

a. General:
Relay point contamination (do not handle relays after working on dash pot. Fluid is an excellent insulator).

b. Troublesome relay points:
R111-3 (drops line of print).
R115 (drops line of print).
R38-1 and 4 (Prints one character and drops remainder of line).
R14-2 (ignores print command).
R16 and R5-1 (dropping bits).
R8-11 (drops line of printing).

85. EMITTER

a. Out of time:
Oil level in dashpot.
Line end magnet adjustment.
Spring on dashpot arm weak.
Clamping screw on sector gear hub loose.
b. Burned:
Emitter out of time.
Dangling CP wires.

86. MAIN DRIVE TAPE

a. Breakage:
Poor dashpot operation (carriage return must be smooth without bounce at home. Oil level at least 7/16 above the baffle plate).
Bent or broken ribbon shield.
Weak dashpot operating arm spring.
Binding sector drive gear (gear should be free to move in and out on its shaft).
Sector gear timing (adjust for smooth engagement).
Binds in print and hammer carriage.

87. CRCB

a. Erratic timing:
Bearing shaft wear at the pulley end.
Improper drive belt tension.

88. CARD READER

a. Read checks:
Hopper and feed adjustments.
GT 302/CF 318 units defective (7.25.00) especially on first card or after long ready status.
CB's 21, 23, 24 and 25 dirty/out of adjustment (0.09.32).
Noise on K1.
Loose brushes and connections.
b. Feed checks:
Timing of FCB 4 and 5 (0.09.32).
Card lever timing/adjustment.
Hopper and feed adjustment.
c. Card feed clutch (extra cycles resulting in erroneous transfer of input data):
Clutch pawl–latch overlap, unlatching clearance and armature to core clearance.
Timings of CFCB 12, 14, 30.

89. FUNCTION KEYBOARD

a. Erratic failures:
Warped fishpaper insulator to function key unit.
SCB clutch overthrow and adjustment.

90. SPACING

a. Fails to space:
Space solenoid plunger travel.
Oil on power roll.

Unique RAMAC Waveshapes

This information has been compiled in order to alert CE personnel to waveshapes that exist throughout the machine. These shapes are present when the system is functioning correctly. When persuing intermittent troubles on the system, Customer Engineers have spent time analyzing these waveshapes and attempting to correct them, but they are not the cause of system malfunctions.

The waveshapes shown were actually photographed on a 535 scope, but similar shapes will be seen on a 310 scope. Standard settings of the scope are as follows unless specific variations are mentioned elsewhere in the text:

Sync on–External (DC)
Input AC-DC on DC.
10 X probe.
12 microseconds per division.

91. BIT ELIMINATION

In several areas in the system individual bits are eliminated from data lines. The elimination is not always clean, but this fact does not cause trouble for the line is always clean when the data line is strobed. An example of one of these bit eliminators follows:

When reading from the file, Bs's must be eliminated before the data gets to cores on 3.02.06. 3P4 does this; but because the inverted Bs at pin 6 input to this unit does not always coincide with the disk Bs, a sliver of the Bs is sometimes left at pin 10 (See Figure 182). This sliver will do no harm because it does not coincide with ∅C which strobes the data before it goes to cores at 3P2 on 3.02.06.

An example of this can be seen when reading "ones" from the file. To see this example, set up the system to repeat the program X99R99000b (set up the standard scope settings mentioned earlier). Trigger on W cycle, not store check (3F6-4 on 3.03.01), and core 01.

Figure 182 shows the inputs and output of 3P4. The top waveform shows a Bs followed by a B1 at pin 3. The center waveform shows pin 6, an inverted Bs. The bottom waveform shows the pin 10 output.

Figure 182. Bs Elimination

92. Comparators

Many comparators exist in the system. Because the inputs to these comparators do not always coincide perfectly, their outputs are not perfectly clean. But when necessary their outputs are clean when they are strobed. An example of a typical comparator follows:

The output of the comparator on 3.03.01 is not always a clean low. It usually looks like the second from the bottom waveshape of Figure 183. However the 3 slivers shown are not evidence of an unequal compare for they do not occur at ∅C time. The two slivers on the right of the picture are there because the B1 at 3F7-7 leads the B1 at 3F7-6. The sliver on the left of the figure is all that remains of Bs after it was eliminated on 3.02.06.

To obtain the waveforms shown set up the system to repeat the program X99R99000b. Write B1's in every character of X track. Set up the scope to trigger on W cycle, not store check (3F6-4 on 3.03.01), and core 01.

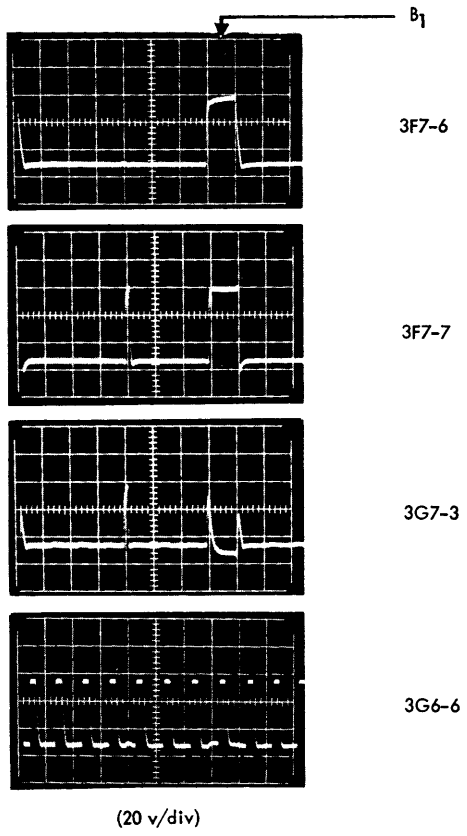


Figure 183. The Comparator

The top waveshape on Figure 183 is the W data input to the comparator (3F7-6 on 3.03.01). The eighth division from the left is B1 time. The second waveshape from the top is the other input to the comparator. The sliver between the fourth and fifth divisions is the small part of Bs that was not eliminated. The third waveshape is the output of the comparator at 3G7-3. However, these slivers do not indicate a compare failure since they do not coincide with ∅C to cores (3G6-6) on Figure 183.

93. Adder Inputs A and B (5.01.01)

Adder input A is a bit input ∅A to ∅A. Adder input B is a bit input ∅B to ∅B. This out of phase input causes the sum line, 6R7-10 on 5.01.01, to go high frequently from ∅A to ∅B of any bit. A high level on this line does not indicate a sum; a sum is indicated when this line is high at ∅C time. This can be seen at the AI 6N9a on 5.01.02. An example of this condition is seen in Figures 184 and 185.

To obtain the waveshapes shown in Figures 184 and 185, the system was set up as follows: The system continuously repeated the programs Y09L0901b5 and Y09L09010b. A "1" was written in C09 of Y track. This caused the system to repeatedly add 1+1. The

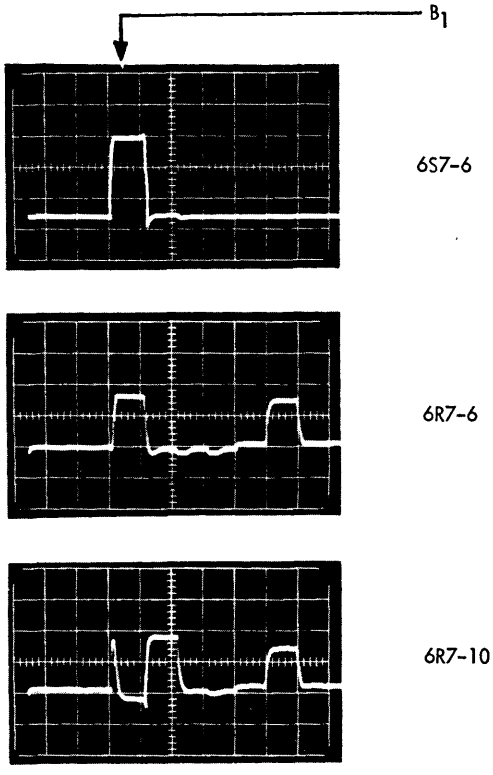


Figure 184. Adder Inputs A and B

programs were on zero track. The standard scope settings mentioned earlier apply.

Triggering started at Program 001 (2B3-3 on 2.01.04), W cycle, and character 09. This set up allowed a look at B1 A and B inputs.

The top waveshape of Figure 184 shows the A input to the adder at 6S7-6 on 5.01.01. The center waveshape shows the B input at 6R7-6. The bottom waveshape shows the sum line 6R7-10 on 5.01.01. The fourth division from the left is B1 time.

The top waveshape of Figure 185 shows ∅C (6N9a-6 on 5.01.02). The center waveshape shows the sum trigger 6N10-3. The bottom waveshape shows the carry trigger 6Q10-3. The fourth division from the left is B1 time.

The sum line was high from B1∅A to B1∅B, but the sum trigger pin 3 did not go high at B1 time because the sum line was not high at ∅C time. (It did go high at B2 time as a result of the carry from B1 to B2). The carry trigger pin 3 did go high at B1∅C time which is as it should be.

94. Access Servo Scoping

When scoping the 350 Gate or Drawer File servo circuits, oscillation may occur in the clutch amplifier circuits. These oscillations are normal, and their presence or absence does not indicate trouble. Figure 186 indicates typical waveforms observed during a dynamic servo from address 00990 to address 49990. Set up the scope and file as follows to obtain these waveforms:

Sync on + External (DC).
Input AC-DC on DC.
Trigger on track not located, 254-6 N/C or 5071-2 N/C on 8.10.01.
10X probe.
100 milliseconds/division.
Robot address A=00990, B=49990.

Notice the oscillations on the tachometer monitor point. The hash seen on the disk error monitor signal may or may not be present.

Many failures which cause the arm to stop or to move sluggishly will cause the clutch amplifier circuit to oscillate. Oscillation will also occur when the nulls are approached while servoing by hand. Figure 187 illustrates a typical oscillation of this nature.

To see this waveform, set up the scope to run free, input AC-DC on AC, 10X probe, and 200 milliseconds/division.

95. Track and Disk Error Signals

If the track or disk error signal is scoped without

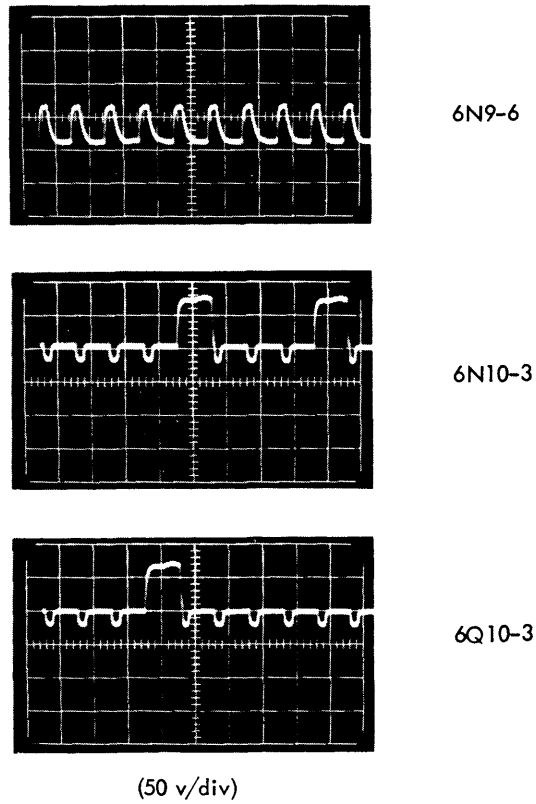
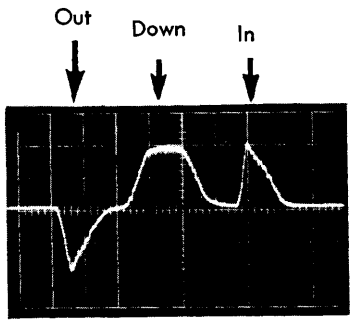
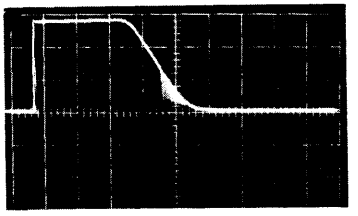


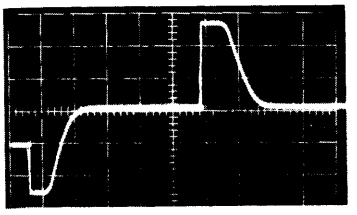
Figure 185. Sum and Carry Triggers



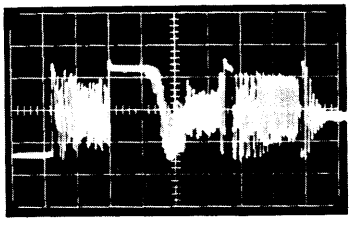
Tach. Monitor
10 volts/division



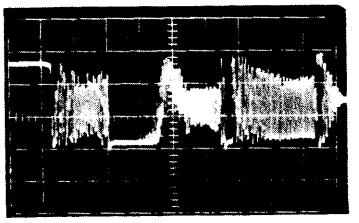
Disk Error Monitor
50 volts/division



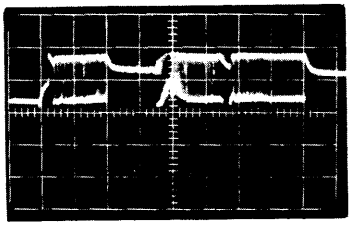
Track Error Monitor
50 volts/division



In and Down
Clutch Amp. Monitor
20 volts/division

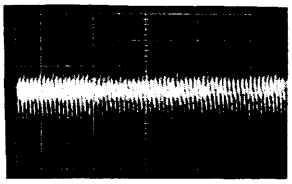


Out and Up
Clutch Amp. Monitor
20 volts/division



AM 323-7
Clutch Pwr Amplifier
8.05.01
200 volts/division

Figure 186. Servo from 00990 to 49990



1.0v/div

Figure 187. Clutch Amplifier Monitor Oscillations

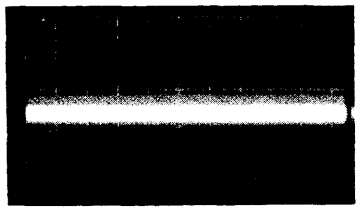
having the robot connected, noise of approximately 0.5 volts may be picked up. This is normal and is a result of crosstalk between file data lines and the error signal lines. Figure 188 shows an example of this condition. The top waveshape shows how this noise will appear when the scope is not "synced" with the data being read from the file.

To prove that the noise is file data, set up the system to repeat the program R99X9900bb. Trigger the scope on R cycle record start. Sync on + External (DC). Input AC-DC on DC. 100 microseconds per division. The lower waveshape of Figure 188 will now be seen on the scope face. The data seen in this figure are AGC pulses in the gap, followed by Bs, Br; a "G"; Bs, Br; Bs, Br, Bs, etc. (The AGC pulses are in gate files only.)

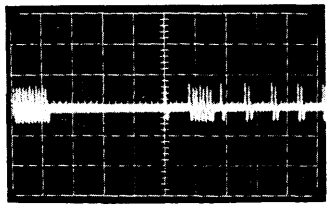
96. File Read Amplifier (8.10.04)

When scoping the read amplifier a severe AC ripple will be encountered on the plate of the first amplifier. The effect of this ripple plus the effect of the AGC will be apparent at pin 3/10 of the second amplifier. These effects are dampened out as you progress through the read amplifier. This can be seen in Figure 189.

To obtain the waveshapes shown, set up the system to repeat the program R99X9900bb. Set up the scope to sync on External – (DC), Input AC-DC on AC, trigger on R cycle record start (2W8-10 on 3.01.04), 5 milliseconds per division. Use a direct probe.



Free Running



Triggered on R Cycle Record Start

0.5 volt/division

Figure 188. Crosstalk on Track and Disk Error Signal

Extraneous noise is evident at the file read head when scoping with a direct probe. Some of this noise can be eliminated by grounding the probe near the probed point. The noise is not transmitted through the first amplifier, however. Figure 190 shows the waveforms developed when using the probe as described above. Data being read is blank, "G", blank, blank.

CAUTION: Due to the very real danger of burning out a head coil with a minor slip of the probe it is not advisable to examine this area in the field. The input to the *second* amplifier can be probed safely and will provide whatever practical information is usually required for field analysis.

To obtain the waveshapes shown in Figure 190, blanks were written in all positions of a record except C98. A "G" was written there. The system was caused to repeat the program R99X9900bb (reading the above record). Triggering for the scope was on record start, AC-DC input on AC, sweep speed set at 200 microseconds per division times 5. The direct probe was used on the top two waveforms; the 10 times probe on the bottom. The signal was set one division above the center graticule so that it would show more clearly.

97. Disk Clock (3.01.01)

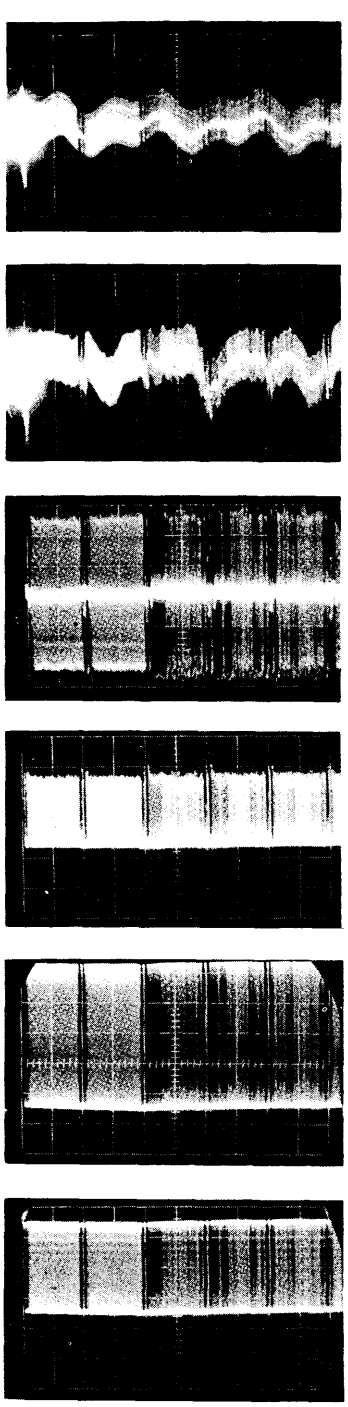
A buildup of oscillator amplitude will occur during a file read operation. It is especially apparent when reading a blank record. Figure 191 shows this condition.

To see the waveform in Figure 191 set the system to repeatedly read a blank record. Trigger the scope on disk cycle gate (3Xa) anded with core 00. Set the time per division at 50 microseconds.

There may be a slight shifting of disk ∅C during a file read operation. A delayed data bit, or slight differences in file clock oscillator speeds, will cause this condition. Disk ∅C is triggered by the fall of the disk clock or the fall of disk ∅B, whichever occurs *LAST*.

98. Record Start/Stop Time Noise

File checks and parities sometimes occur only during the first read or write following a servo. This usually is caused by misadjustment of the track detent switch or faulty detent operation. If you trigger a scope on record start when analyzing this type of trouble, erratic scope operation may result from noise that is on this line. This noise will usually occur when a new record address is used on a servo. Figure 192 shows this noise on the Record start line. Note that the noise is higher in amplitude than the record start pulse.



Drawer File	Gate File	Scope Voltage Setting
F2-3	D4-3	0.2v/div
F1-3	C4-3	0.5v/div
E2-3	B4-3	2.0v/div
D1-3	A5-3	10.0v/div
C1-10	C5-10	10.0v/div
C2-3	C6-3	10.0v/div
Monitor Point	Monitor Point	

Figure 189. File Read Amplifier, 8.10.04

Figure 192 waveforms were obtained by setting the system to repeat the following programs:

A04J9905bb	Address 00994
R99X9900bb	
A09J9905bb	Address 49997
R99J99050b	

99. File Write Amplifier (8.10.05)

The waveforms in Figure 193 were obtained by scoping the file write amplifier during a file write operation. The system was set up to repeat the program A99R99-00bb. A "G" was in C98 of track A. Nothing was written in any other position of track A. The scope was

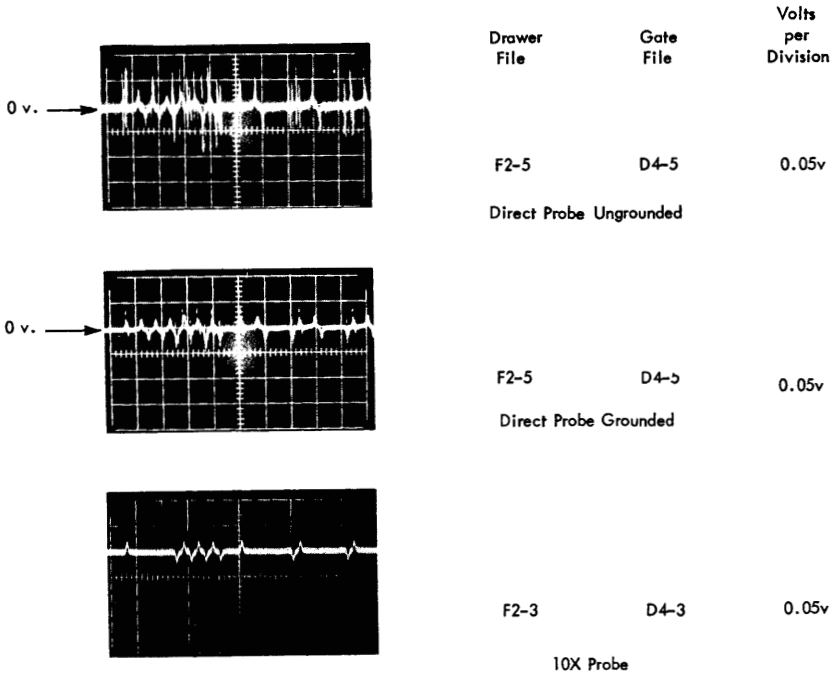


Figure 190. File Read Signals, 8.10.04

synced on External — (DC), Input AC-DC on DC, 10X probe, 24 microseconds per division. The scope was triggered on:

a. Store check (1Bc)

b. Disk cycle gate (2V4-3)

c. Core character 1

d. Core field 0.

Three were "anded" on the CE sync panel. This gives a trigger start at core bit 2 time, just prior to writing the "G" on the File.

The scope picture at D8 pins 3 and 10 will always be the same because the scope lead on the trigger loads the trigger (to flip it on, pin 3 or 10 high, each time). When the scope lead is not on D8, the trigger will flip either side high intermittently. You will notice this intermittent flipping at every point past the trigger.

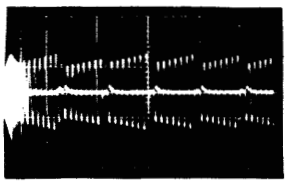


Figure 191. Disk Clock

The bottom 3 waveforms of Figure 193 show the output of the 3 AM units. The form showing normal amplifiication shows the output when writing is normal. The next lower form shows the output when amplification shows the output when writing is normal. The next lower form shows the output when amplification shows the output when writing is normal. The bottom picture shows the plate output when one write coil is open. This was simulated by removing a wire from the edge connector (Hx on drawer files, 7 w on gate files).

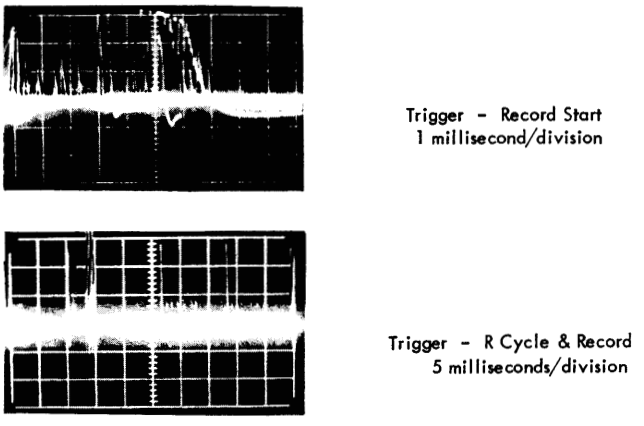


Figure 192. Record Start

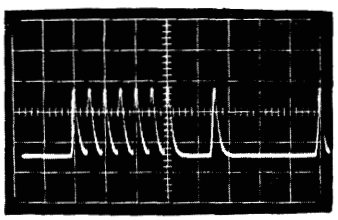
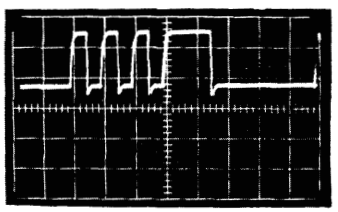
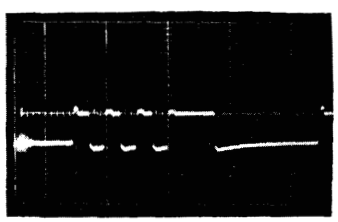
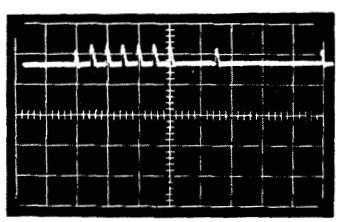
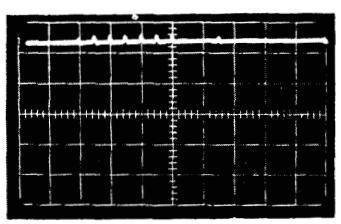
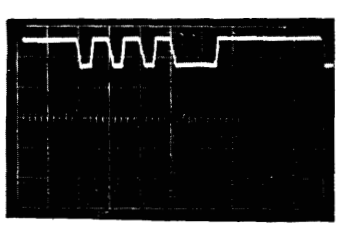
	Drawer File	Gate File	Volts per Division
	L2-7 Monitor Point	Monitor Point	20v
	L1-3	D8-3	50v
	K2-3	B8-3	50v
	C7b-7 Amplification	J2b-7 Normal	100v
	J2b-7 Amplification	C7b-7 Weak	100v
	J2b-7 Open Write Coil	C7b-7	100v

Figure 193. File Write Amplifier, 8.10.05

Section 12. System Records

This section contains system records to help the Customer Engineer assume and maintain the responsibilities of a RAMAC installation. For this purpose, the following records are kept in this section: Installation Chart; CEM Action and Field E/C Activity; Machine Record; E/C Records for the 305, 323, 340, 350, 370, 380, and special feature machines; System Notes; PM Routine Cards for the 305-340, 323, 350, 370, and 380.

When the responsibility for the RAMAC installation is changed from one Customer Engineer to another, all the records should be reviewed by both CE's. In addition, the following items should be discussed:

1. Location of tools. Check inventory against the list in Section 1.
2. Location of any spare parts.
3. Location of "System Diagrams".
4. Optional features, installed or on order.
5. Engineering changes, MES's, and parts which have been ordered.
6. Location of DFT deck and control panels.
7. Location and types of fire extinguishers available.

RAMAC 305

ELECTRICAL CONFORMANCE RECORD

System # _____

Date _____

Signal	Location	Measurement	Specification μ Sec.	Actual Reading μ Sec.	Remarks
Clock Amplifier	1Zd	Gap	210 ± 20		
Process Phase A	1Xa	Duration	$2.25 \begin{smallmatrix}+.25\\-0\end{smallmatrix}$		
Process Phase B	1Xb	Duration	$3.5 \begin{smallmatrix}+.25\\-0\end{smallmatrix}$		
Process Phase C	1Xc	Duration	$3.0 \begin{smallmatrix}+.25\\-0\end{smallmatrix}$		
Disk Read Out Data 1st File	2Fz	Gap	600 ± 50 Without Pulsed AGC 1200 ± 100 With Pulsed AGC		
Disk Read Out Data 2nd File	2Fz	Gap	1200 ± 150		
Disk Phase A	2U6-3	Duration	2.25 ± .25		
Disk Phase B	2U6-10	Duration	2.25 ± .25		
Disk Phase C	2V6-3	Duration	3.0 ± .25		

Figure 194. Factory Chart

INSTALLATION CHART

RECORD the following readings with the machine at its operating point. Fill in each blank when the machine is installed.

Date _____

		Ø1	Ø2	Ø3	
1.	Input Line Voltages	_____	_____	_____	
2.	Reg Out Voltages	_____	_____		
3.	Filament Voltage (See Section 2)	Remarks _____			
4.	DC Voltages	+270	_____	AC Ripple	_____
		+140	_____		_____
		+ 70	_____		_____
		+ 48	_____		_____
		− 60	_____		_____
		−250	_____		_____

5. Depress Power Off
   Run down Time of File _____ Mins. _____ Secs.
   Run down Time of Drum _____ Mins. _____ Secs.
6. Depress Power On
   Total Cycling Up Time _____ Mins. _____ Secs.
7. Compressor Capacity (See Section 5) _____ Lbs.
8. Compressor Air Pressure _____ Lbs.
9. File Regulator (If Present)
   +215 _____
   +140 _____
   − 60 _____
   −210 _____
10. Shipping Braces Stored @ _____
11. Remarks _____

Signature _____

Figure 195. Installation Chart

P.M. ROUTINE

CODE	UNIT or ROUTINE	FREQ.	LUBRICATE - CLEAN	OBSERVE
9	COMPRESSOR	6	Check oil level 350 - Every 500 hours drain crankcase and refill with IBM 2127714 355 - Every 500 hours drain crankcase and refill with IBM 451012.	350 - Every 1000 hours or as required check auto water drain, air filter element, regulator filter. Inspect crankcase plate screws for tightness. Note pressure and adjust. 355 - Every 1000 hours or as required check filter elements in air inlet, discharge bowl and receiver tanks. Drain moisture from receiver tank every 6 weeks.
1	ACCESS MECHANISM		Lubricate pinion shaft with IBM #17. Add drop of IBM #6 to clutch shaft bearings.	Pinion should be free to move vertically on its shaft. With pinion disengaged clutch should have lateral freedom. Check clutch brushes and commutator.
			Clean R/W heads	Clean heads using head cleaning kit. Alter frequency as experience permits. Replace worn air tubing. Check for loose/malformed head retaining springs.
		13	Lubricate access mechanism - IBM #6 on V surface of way, access arm sliding surfaces, carriage felt wipers, disk and track detents.	Check for free movement of carriage and access arm. Note any wear in disk detent linkage. Inspect disk and track detent switches for burned/loose contacts.
6	DISK ARRAY		Gear Drive - Lubricate top bearing with IBM #20 grease cup 1/2 turn. Check oil level - add IBM #6 as required.	Shaft Motor Drive - Every 3 years add 1 oz. of Shell Cyprina grease to upper and lower grease chambers.
			Disks - Clean Surface.	Scheduled PM not required but clean if excessive oxide/dirt accumulation is noted.
8	ELECTRONIC SERVO		Check D.C. voltages, disk and track null systems and clutch balance. Adjust damping for smooth servo and proper access time. Electronic servo adjustments may require inspection if erratic servo or arm chatter is experienced.	
		26	Gate style 350 - Lubricate blower motor bearings.	Check blower motor for proper operation. Replace air filter as necessary.

350/355 GROUP

Figure 210. 350/355 PM Routine