

Maintenance Library

1403

Printer Models N1 and 3  
Maintenance Manual



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## Preface

This manual provides the 1403-trained service representative with information for maintaining and repairing the 1403 Printer Models N1 and 3. Sections included are:

- Reference Data
- Diagnostic Techniques
- Service Hints
- Preventive Maintenance
- Checks, Adjustments, and Removals
- Power Supply
- Print Quality Concepts

The associated Theory of Operation manual is *IBM 1403 Printer Models N1 and 3*, SY24-3518. Refer to the appropriate systems logics for programmed diagnostic routines and tests.

### *Fourth Edition* (December, 1971)

This is a major revision of, and obsoletes, SY24-3395-2. Additions included are: buffer-controlled carriage; train lubricator; new and updated procedures and service aids; Service Hints Nos. 4, 13, 17, 19, 22, 26, 27, 28, 29, 31, 33, 34, 35, 36, 57, 63, and 64; and miscellaneous engineering changes and corrections. Before performing any maintenance or repair operation, read the particular section in its entirety and use the index to locate appropriate service hints and procedures. Changes are continually made to the information herein; any such changes will be reported in subsequent revisions or Technical Newsletters.

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## Safety

Observe the following danger notes in the sections where they occur.

### DANGER (Page 1-36)

Be careful when working on the reservoir unit. The access hole may have sharp edges.

### DANGER (Page 4-4)

Never remove the spring coil bracket screws unless you support the stacker in the fully raised position.

### DANGER (Page 4-7)

When the cover is fully open from the rear on machines having only one lift screw, and this screw is going to be removed, the *SAFETY LOCK* must be installed.

### DANGER (Page 5-1)

Be careful of this voltage.

### DANGER (Page 6-1)

Reverse voltage applied to any of the six condensers located on the resistor panel can cause them to explode. After servicing this area and before power is applied, immediately re-install the perforated steel resistor panel cover.

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## Abbreviations

<u>Abbreviation</u>	<u>Meaning</u>
ac	alternating current
CE	Customer Engineer
dc	direct current
FE	Field Engineering
ICR	impulse check routine
I/O	input/output
max	maximum
MCS	multiple character set
Memo	memorandum
MFT	machine function test
min	minimum
ms	millisecond (.001 second)
mV	millivolts
n/c	normally closed
n/o	normally open
oz	ounce
PCS	preferred character set
PSS	print sub scan
RP	resistor panel
SA	sense amplifier
SMS	standard modular system
STL	selective tape lister
TB	terminal block
UCS	universal character set
$\mu$ s	microsecond (.000001 second)
V	volt

Section 1. Reference Data

Section 2A. Diagnostic Techniques

1.1 INSTALLATION PROCEDURE

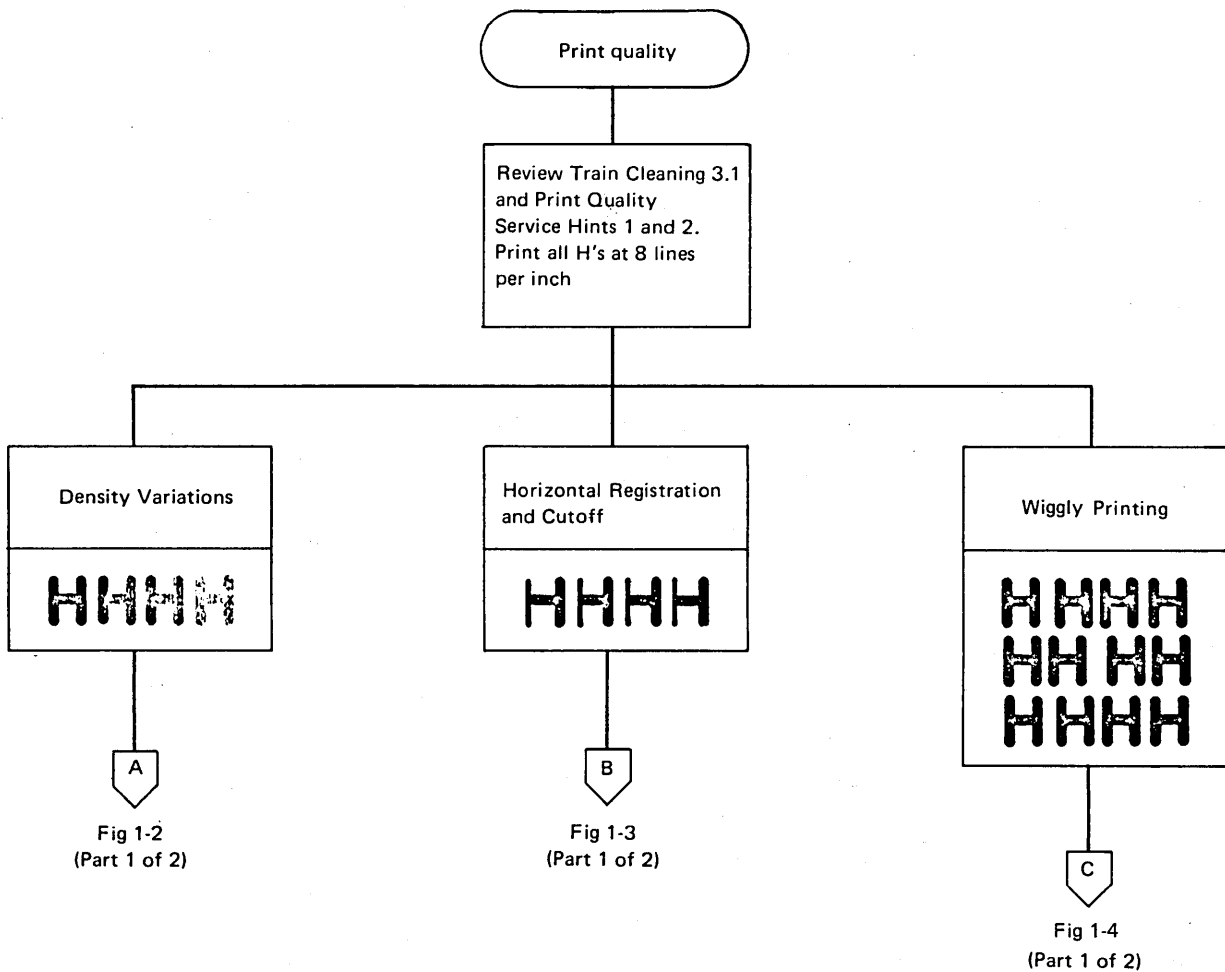
Installation procedures are included in the *Printer Installation Instructions* as part of the shipping group:

- 1403 Model 3 – part 847029
- 1403 Model N1 – part 847070
- 1416 – part 847071.

1.2 TROUBLESHOOTING AIDS

1.2.1 Print Quality – Flow Charts

Print quality flow charts, Figure 1-1 and associated Figures 1-2, 1-3, and 1-4, provide a diagnostic approach to common print quality problems. References to Service Hints (S.H.), unless otherwise specified, refer to those listed under “Print Quality Service Hints.”



**CAUTION**

Before opening top cover from rear, see 4.2.15.

Figure 1-1. Print Quality

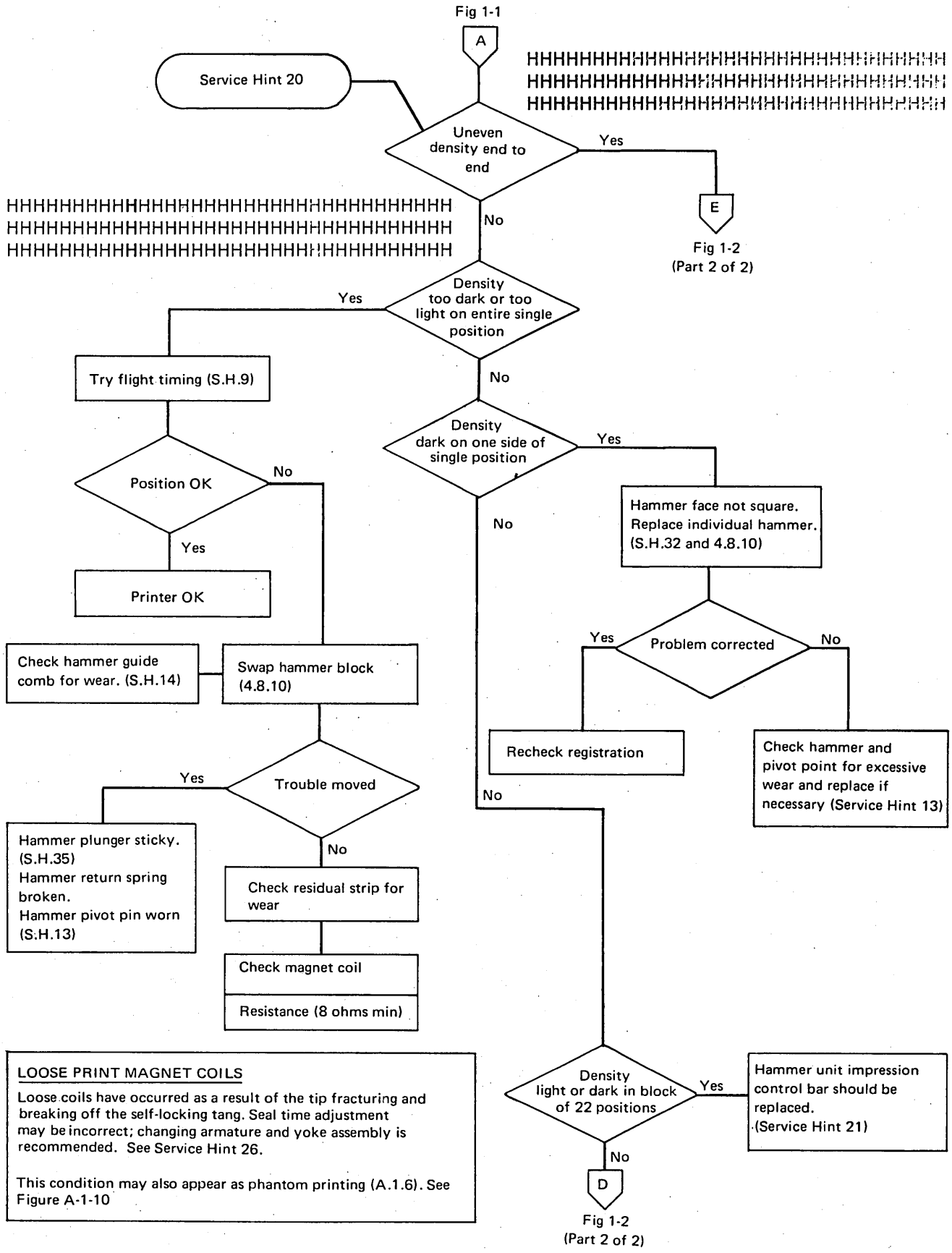


Figure 1-2. Density (Part 1 of 2)





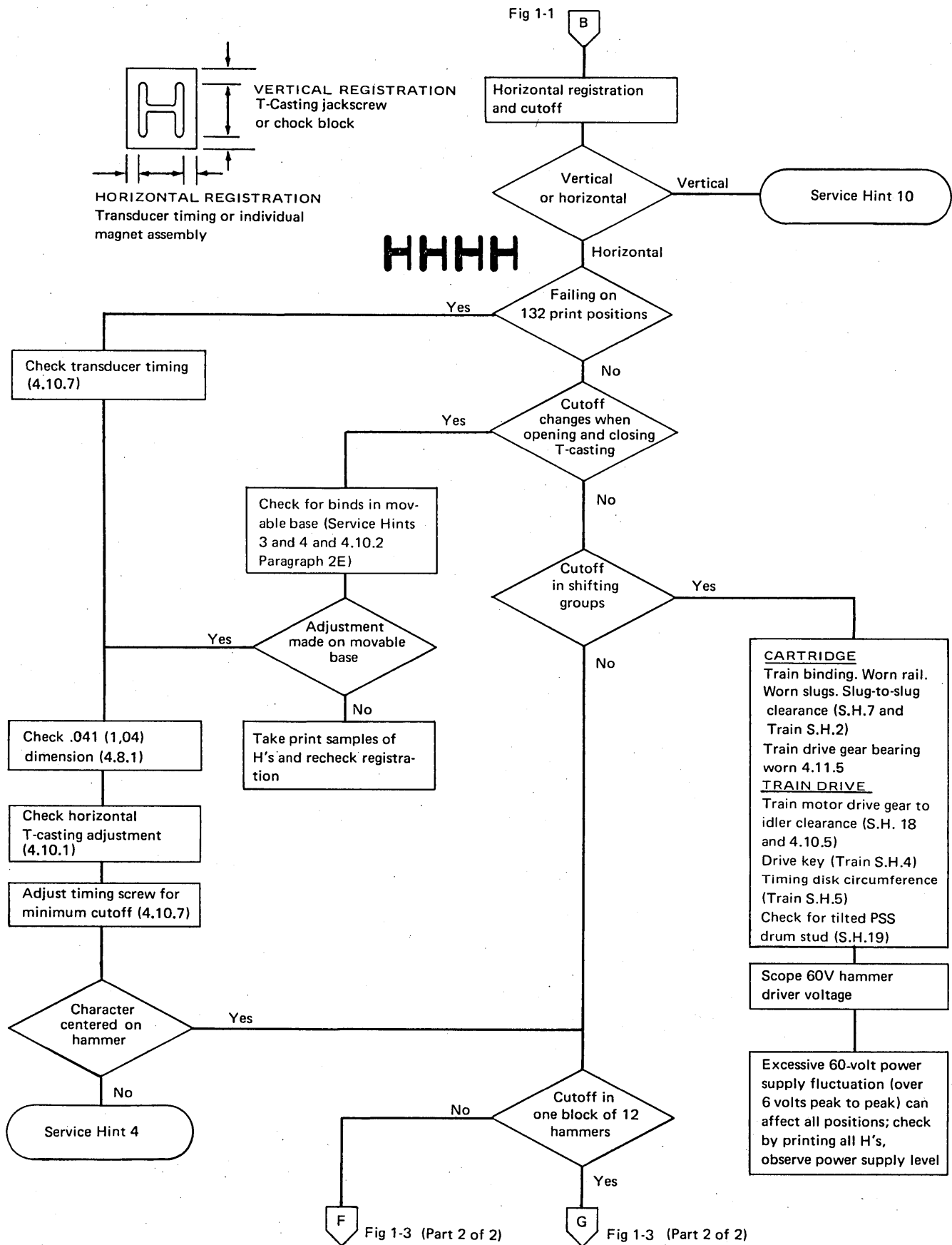


Figure 1-3. Horizontal Registration (Part 1 of 2)

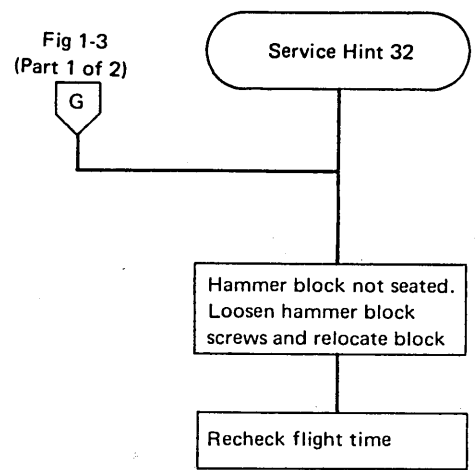
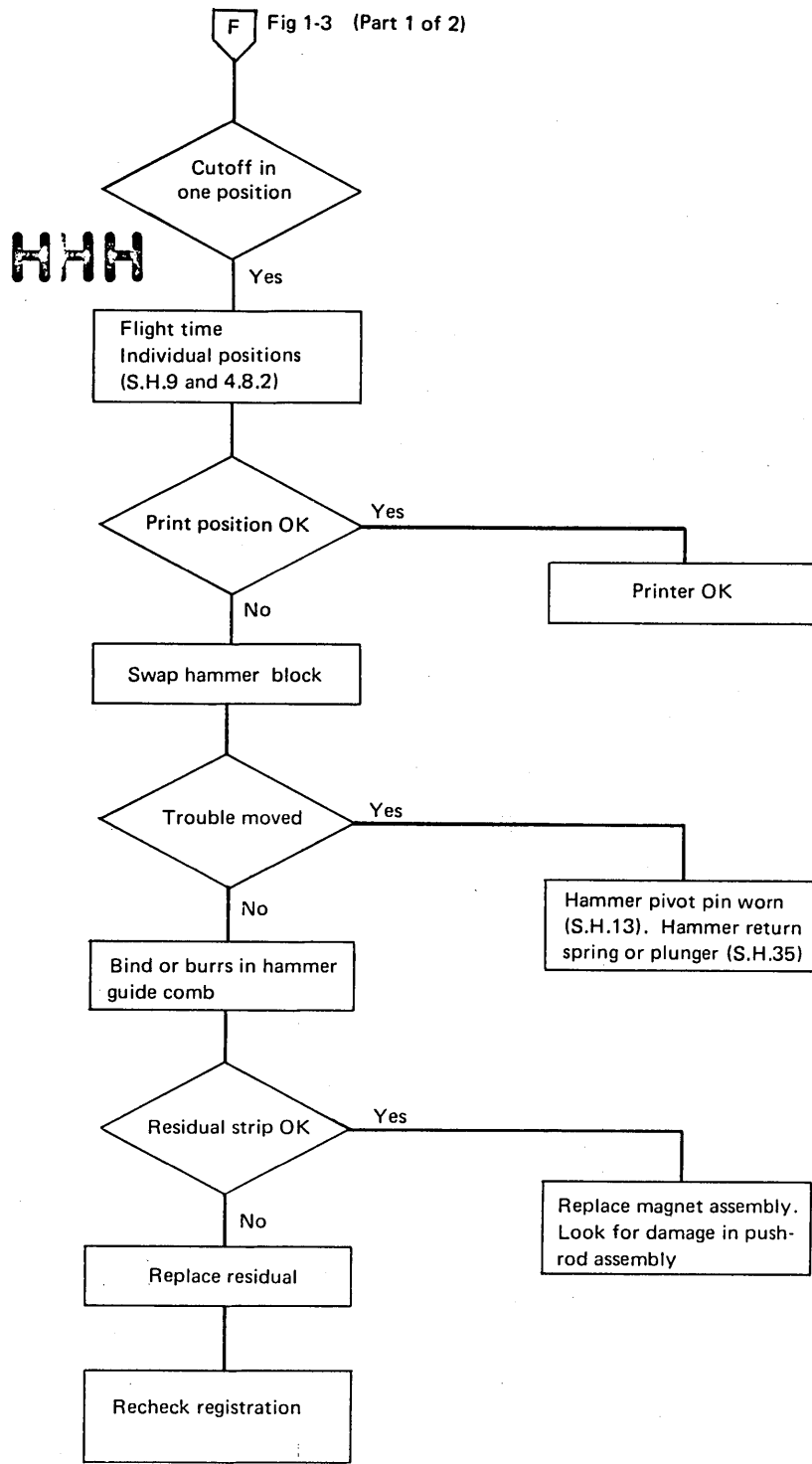


Figure 1-3. Horizontal Registration (Part 2 of 2)



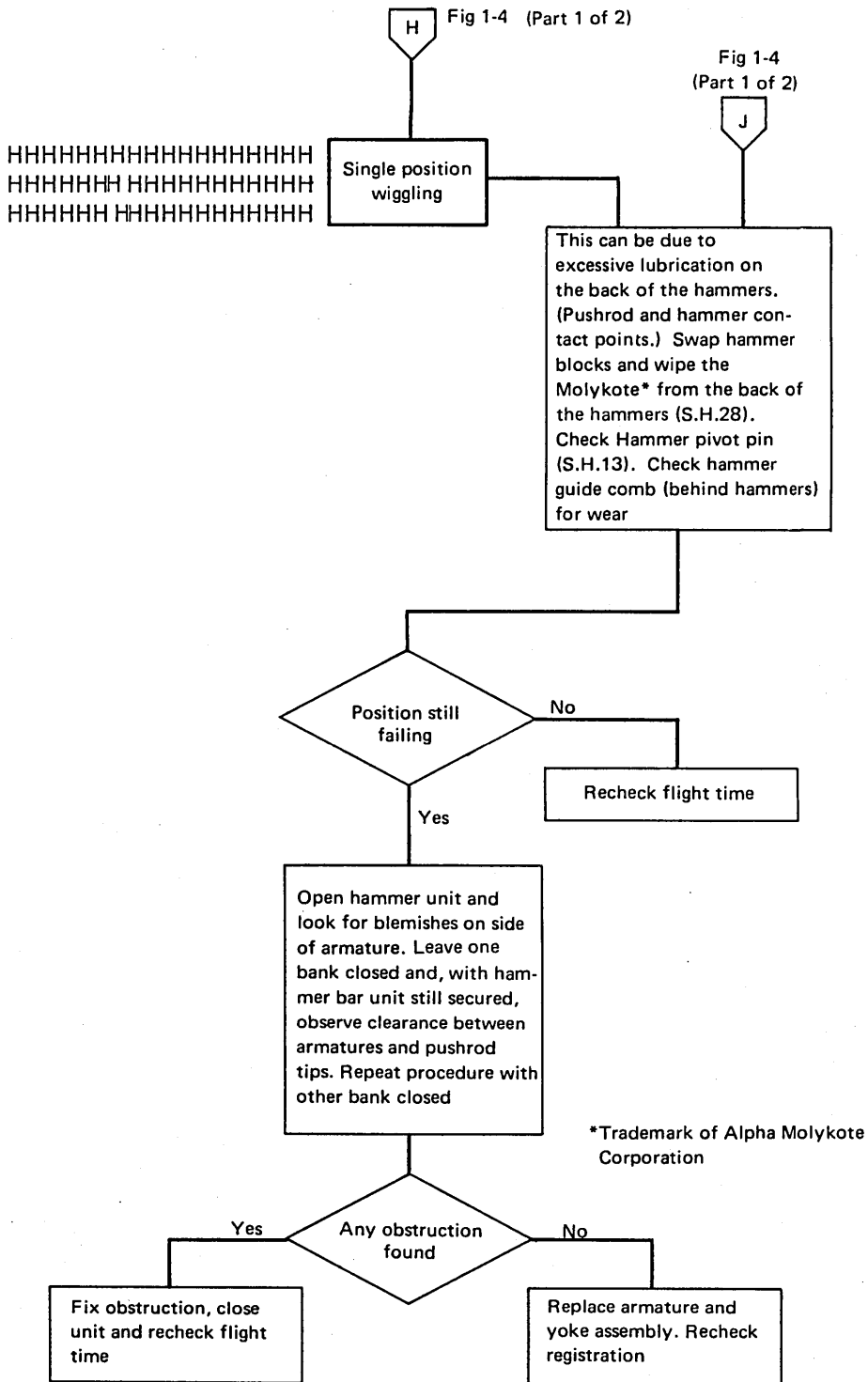


Figure 1-4. Intermittent Wiggly Printing (Part 2 of 2)

### 1.2.2 Print Scan Analysis Tables

Figure 1-5 contains two tables that enable you to determine:

- the character that prints in any particular print position, and
  - the scan on which it prints with the home pulse wired to print start.
1. To determine what character is optioned to print in any print position on scan 1, locate the desired print position in Table B. The character listed beside that print position is optioned to print on scan 1.
  2. To find the scan during which a particular character is optioned to print in any specific print position, first determine from Table B the character that is optioned to print in that position during scan 1.

Then locate that same character in Table A. Starting with this character as 1, count down the column to see what is optioned to print on succeeding scans. If you reach the bottom of the column, go to the top and continue counting until you come to the character in question. The value of the count reached when this character is included is the number of the scan on which the desired character prints. This count is never higher than 48.

*Example:* On what scan is print position 90 optioned to print a 4 with the home pulse tied-down?

First, find print position 90 in Table B. This tells you the character / is optioned to print on scan 1.

Now, find the character / in Table A. Starting with this character, count down the chart (one for each character) until you come to the desired character, 4. Include this character as the last item in your count. The correct count of 40 in this case indicates that the 4 is optioned to print in position 90 on scan 40.

3. Table B is the train break pattern and should not be stored in the storage print area in its entirety.
4. Tables A and B can be used to indicate a good sync point. If you are having trouble printing in a certain position, find that position in Table B. Enter the character that is optioned to print on scan 1 for that position. Count back 3 positions and enter the character that is optioned to print there on scan 1 (same subscan). Sync on the hammer-fire line for that position. This is the hammer-fire pulse just previous to the hammer-fire timing you are interested in observing.

### 1.2.3 Diagnostic Flow Charts

Diagnostic flow charts (Figures 1-6 through 1-12) provide a diagnostic approach to common printer problems; that is, carriage operation failures, ribbon operation failures, cover operation failures, and print or sync check problems.

Table A

Table B

Scan	Character	Bit Structure	Print Position	Character	Sub-Scan	Print Position	Character	Sub-Scan	Print Position	Character	Sub-Scan	Print Position	Character	Sub-Scan	Print Position	Character	Sub-Scan	Print Position	Character	Sub-Scan	Print Position	
1	1	1	1	1	23	U	2	45	P	3	67	1	1	89	@	2	111	L	3			
2	2	2																				
3	3	3	2	2	24	V	3	46	P	1	68	&	2	90	/	3	112	L	1			
4	4	4																				
5	5	5	3	3	25	V	1	47	Q	2	69	.	3	91	/	1	113	M	2			
6	6	6																				
7	7	7	4	3	1	26	W	2	48	R	3	70	.	1	92	S	2	114	N	3		
8	8	8																				
9	9	9	5	4	2	27	X	3	49	R	1	71	□	2	93	T	3	115	N	1		
10	0	10																				
11	#	11	6	5	3	28	X	1	50	-	2	72	1	3	94	T	1	116	O	2		
12	@	12																				
13	/	A 1	7	5	1	29	Y	2	51	\$	3	73	1	1	95	U	2	117	P	3		
14	S	A 2																				
15	T	A 3	8	6	2	30	Z	3	52	\$	1	74	2	2	96	V	3	118	P	1		
16	U	A 4																				
17	V	A 5	9	7	3	31	Z	1	53	*	2	75	3	3	97	V	1	119	Q	2		
18	W	A 6																				
19	X	A 7	10	7	1	32	+	2	54	A	3	76	3	1	98	W	2	120	R	3		
20	Y	A 8																				
21	Z	A 9	11	8	2	33	,	3	55	A	1	77	4	2	99	X	3	121	R	1		
22	+	A 10																				
23	,	A 11	12	9	3	34	,	1	56	B	2	78	5	3	100	X	1	122	-	2		
24	%	A 12																				
25	J	B 1	13	9	1	35	%	2	57	C	3	79	5	1	101	Y	2	123	\$	3		
26	K	B 2																				
27	L	B 3	14	0	2	36	J	3	58	C	1	80	6	2	102	Z	3	124	\$	1		
28	M	B 4																				
29	N	B 5	15	#	3	37	J	1	59	D	2	81	7	3	103	Z	1	125	*	2		
30	O	B 6																				
31	P	B 7	16	#	1	38	K	2	60	E	3	82	7	1	104	+	2	126	A	3		
32	Q	B 8																				
33	R	B 9	17	@	2	39	L	3	61	E	1	83	8	2	105	,	3	127	A	1		
34	-	B10																				
35	\$	B11	18	/	3	40	L	1	62	F	2	84	9	3	106	,	1	128	B	2		
36	*	B12																				
37	A	AB 1	19	/	1	41	M	2	63	G	3	85	9	1	107	%	2	129	C	3		
38	B	AB 2																				
39	C	AB 3	20	S	2	42	N	3	64	G	1	86	0	2	108	J	3	130	C	1		
40	D	AB 4																				
41	E	AB 5	21	T	3	43	N	1	65	H	2	87	#	3	109	J	1	131	D	2		
42	F	AB 6																				
43	G	AB 7	22	T	1	44	O	2	66	I	3	88	#	1	110	K	2	132	E	3		
44	H	AB 8																				
45	I	AB 9																				
46	&	AB10																				
47		AB11																				
48	□	AB12																				

This table shows scan on which a particular character prints in position 1 with Print Start tied to Home Pulse.

Figure 1-5. Characters Printable During Subscans 1, 2, and 3 of Print Scan 1

**SEQUENTIAL ADJUSTMENTS**

1. Space Needle Valve
2. Skip Needle Valve
3. Bypass Needle Valve
4. Single-Space Singleshot
5. Carriage Settling Singleshot
6. Double-Space Singleshot
7. Triple-Space Singleshot
8. E1 Emitter Timing
9. Carriage Brush Timing

**Note:**  
The chart is based on a system having singleshots to control single-, double-, and triple-spacing. If double- and triple-spacing are E1 emitter controlled, the flowchart should be used for reference only. Refer to Chapter 4 for adjustment procedure.

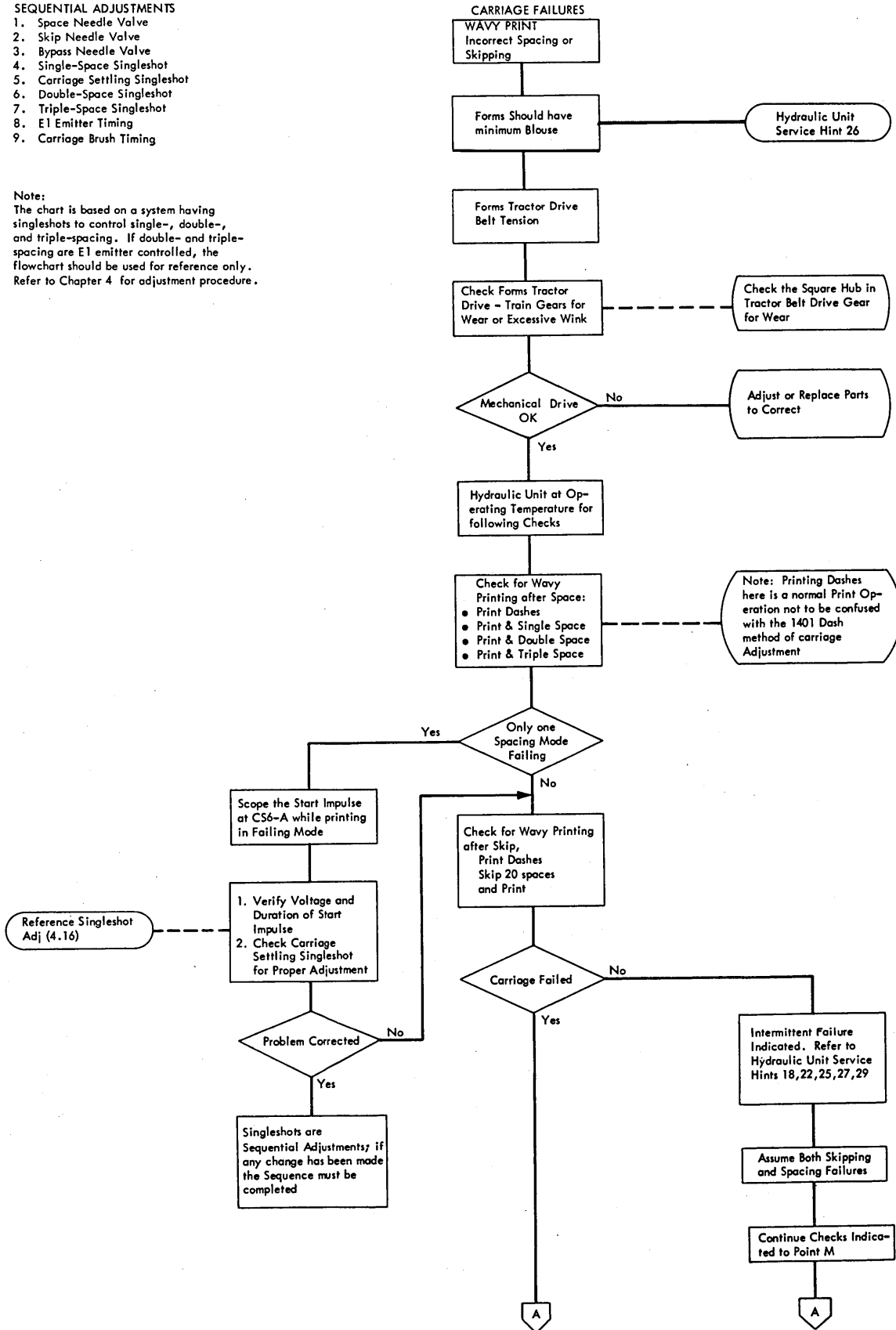


Figure 1-6. Carriage Failures—Wavy Print

SEQUENTIAL ADJUSTMENTS

1. Space Needle Valve
2. Skip Needle Valve
3. Bypass Needle Valve
4. Single-Space Singleshot
5. Carriage Settling Singleshot
6. Double-Space Singleshot
7. Triple-Space Singleshot
8. E1 Emitter Timing
9. Carriage Brush Timing

Not required on buffer-controlled carriages

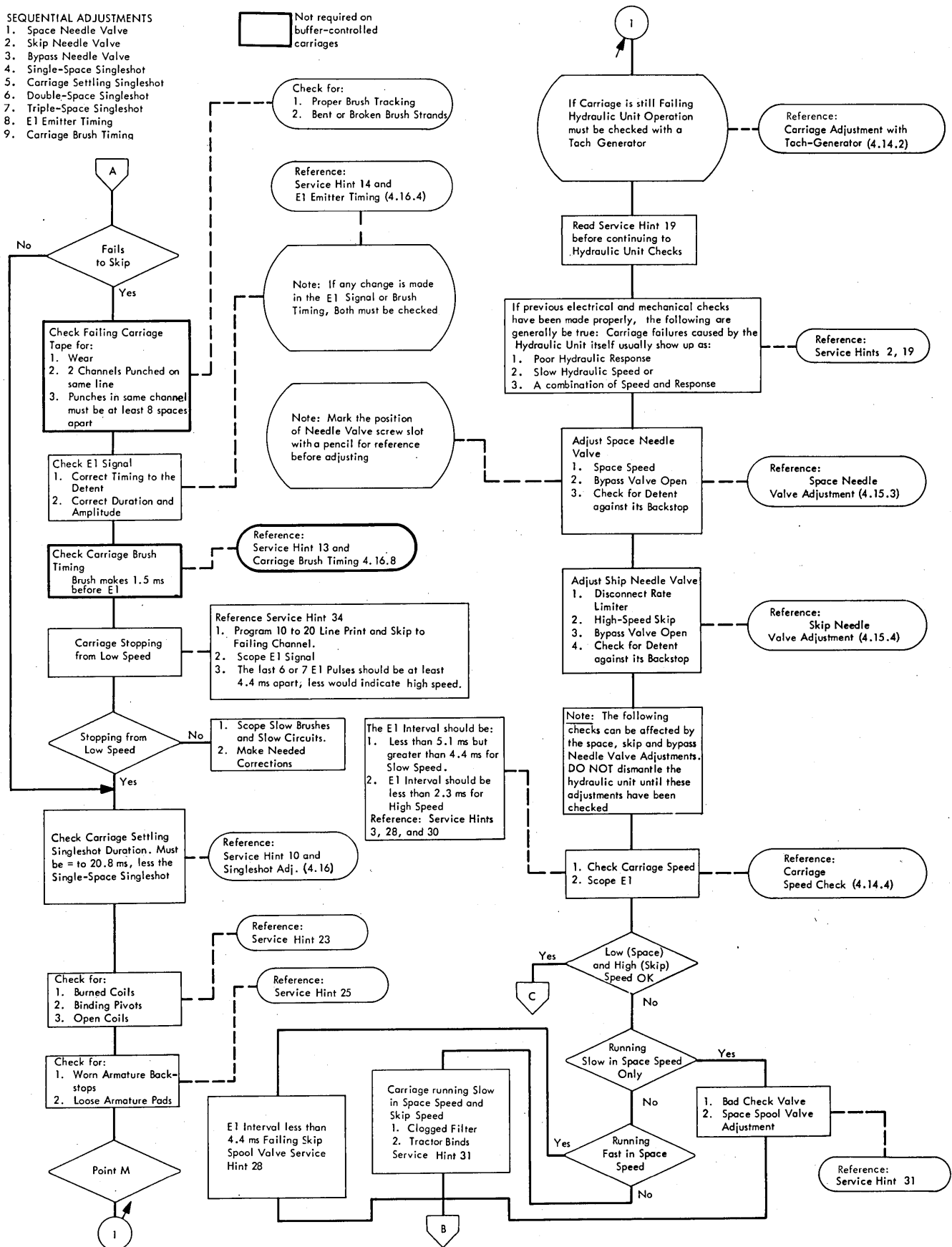


Figure 1-7. Spacing or Skipping Failure (Part 1 of 2)



**SEQUENTIAL ADJUSTMENTS**

1. Space Needle Valve
2. Skip Needle Valve
3. Bypass Needle Valve
4. Single-Space Singleshot
5. Carriage Settling Singleshot
6. Double-Space Singleshot
7. Triple-Space Singleshot
8. E1 Emitter Timing
9. Carriage Brush Timing

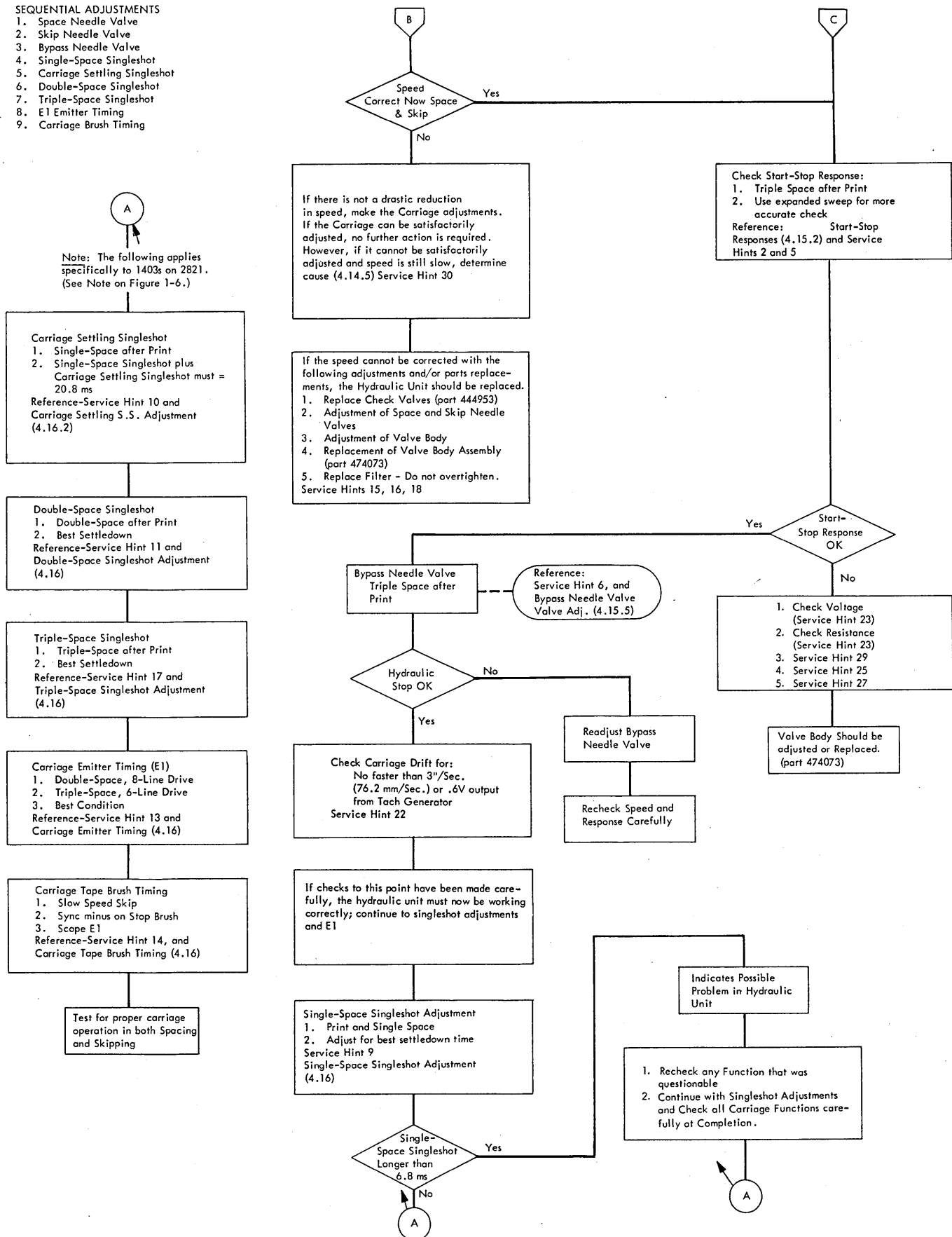


Figure 1-7. Spacing or Skipping Failure (Part 2 of 2)

Ribbon Relay A and B Conditions

	Relay B Not Energized (Ribbon Winding on Upper Spool)	Relay B Energized (Ribbon Winding on Lower Spool)
Relay A Energized (Ribbon to Left, Sense Lever Up, Sense Lever Contact Closed)	Top of Pivot Plate to Front, Circuit through Switch S2 is Opened*	Top of Pivot Plate to Rear, Circuit through switch S1 is Opened*
Relay A Not Energized (Ribbon to Right, Sense Lever Down, Sense Lever Contact Open)	Top of Pivot Plate to Rear, Circuit through Switch S1 is Opened*	Top of Pivot Plate to Front, Circuit through Switch S2 is Opened*

\*Stable position of mechanism when the motor stops

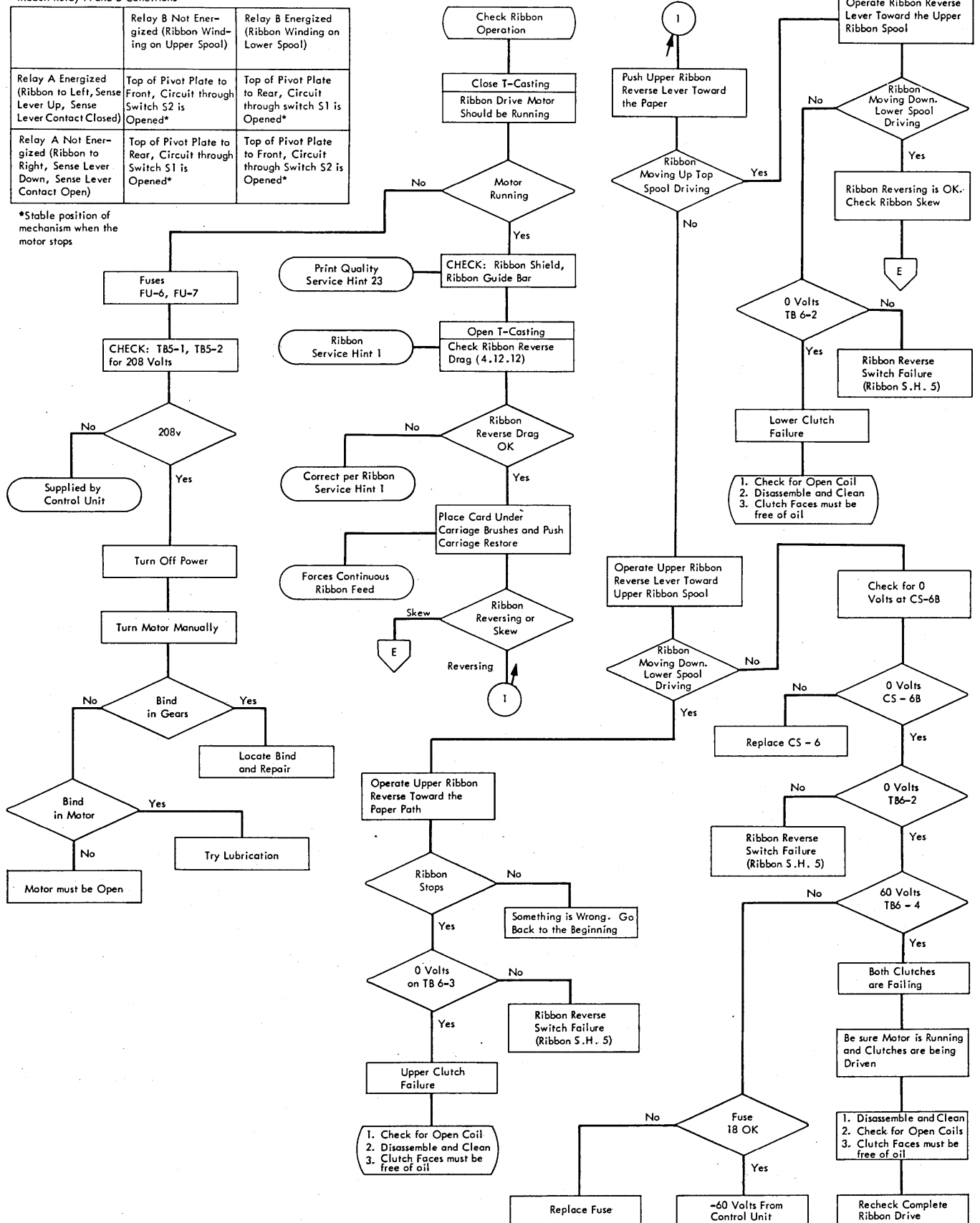
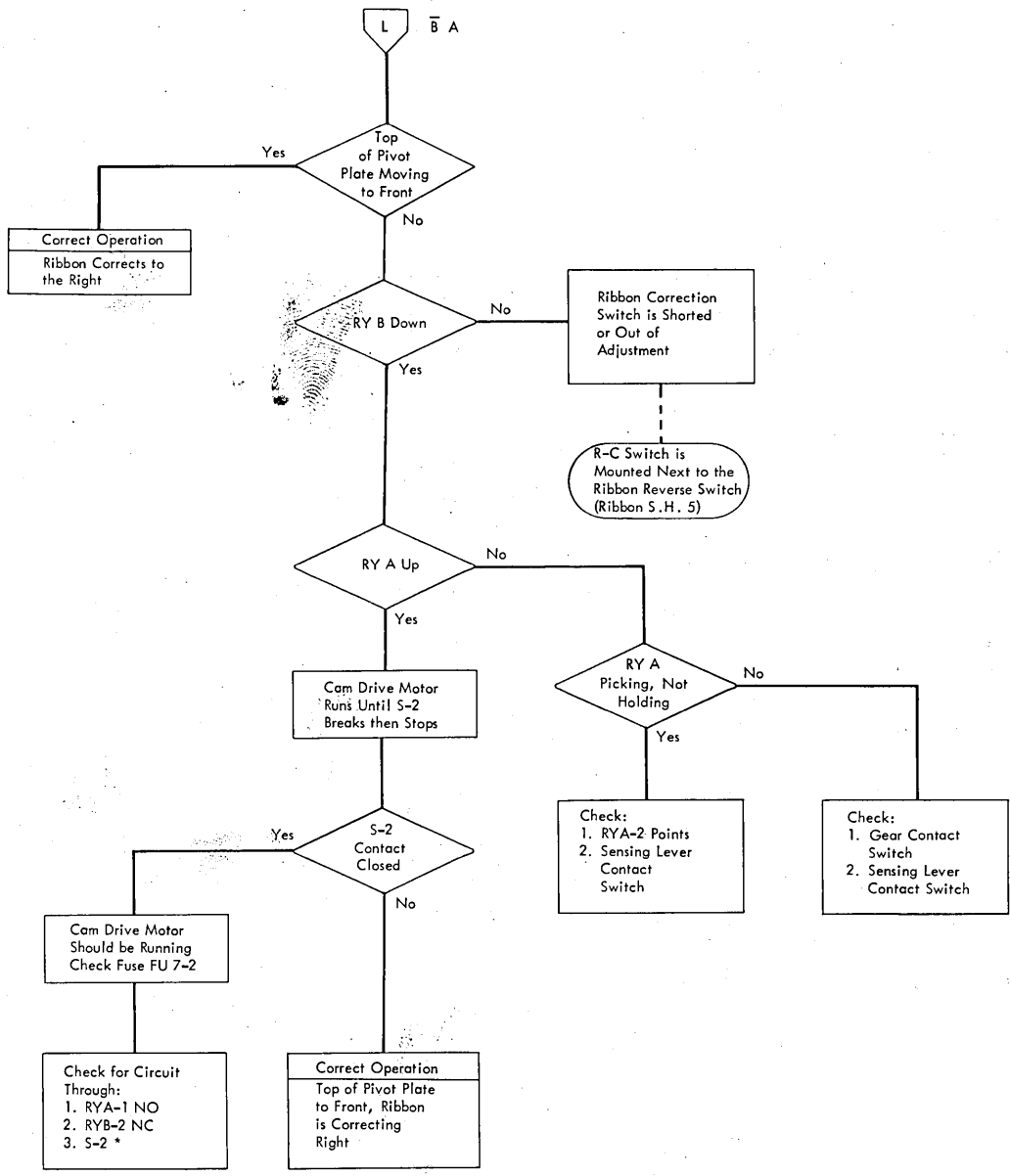


Figure 1-8. Check Ribbon Operation (Part 1 of 3)





\*See Note on H Figure 1-8 Part 2

Figure 1-8. Check Ribbon Operation (Part 3 of 3)

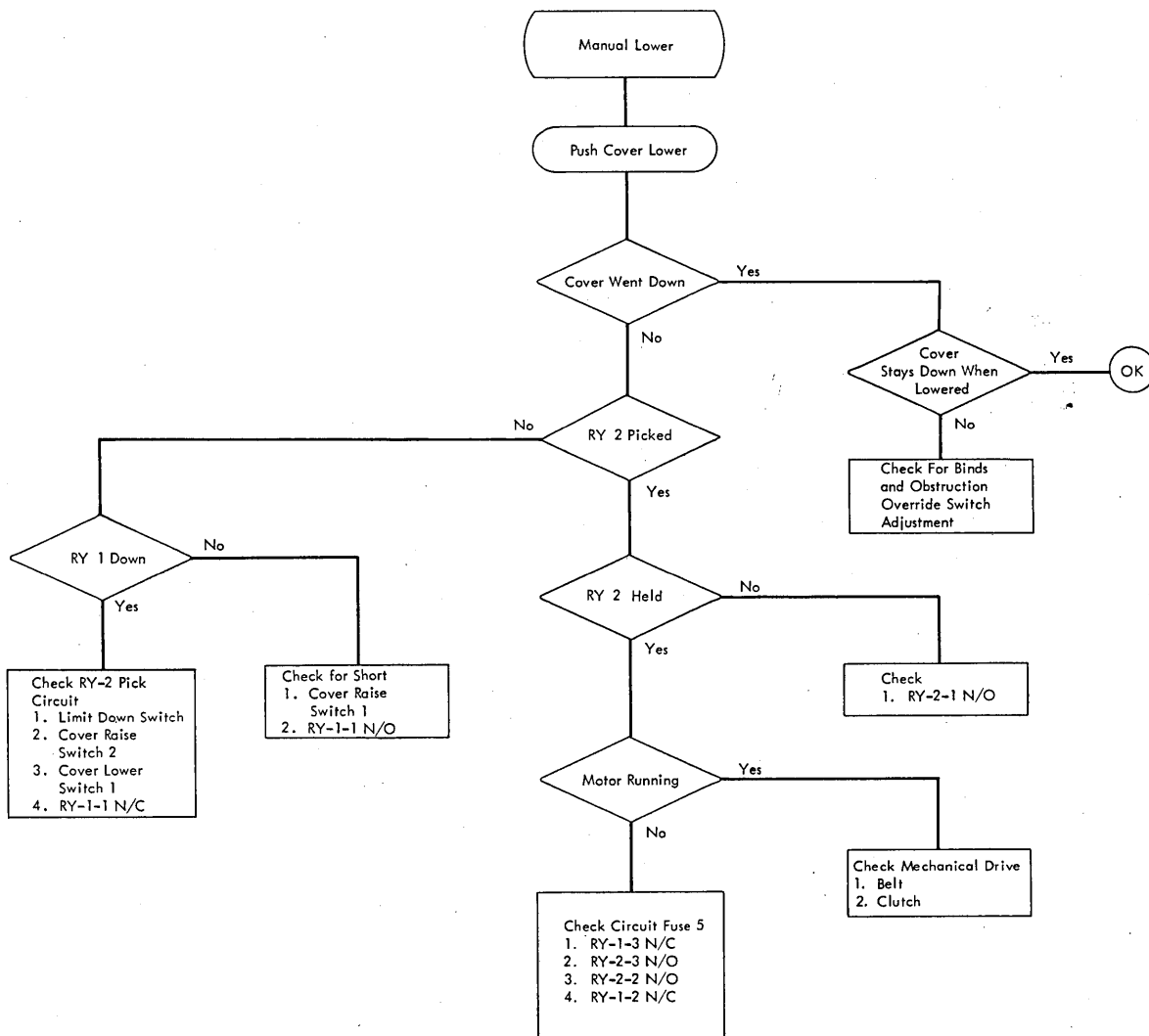


Figure 1-9. Cover (Manual Lower)

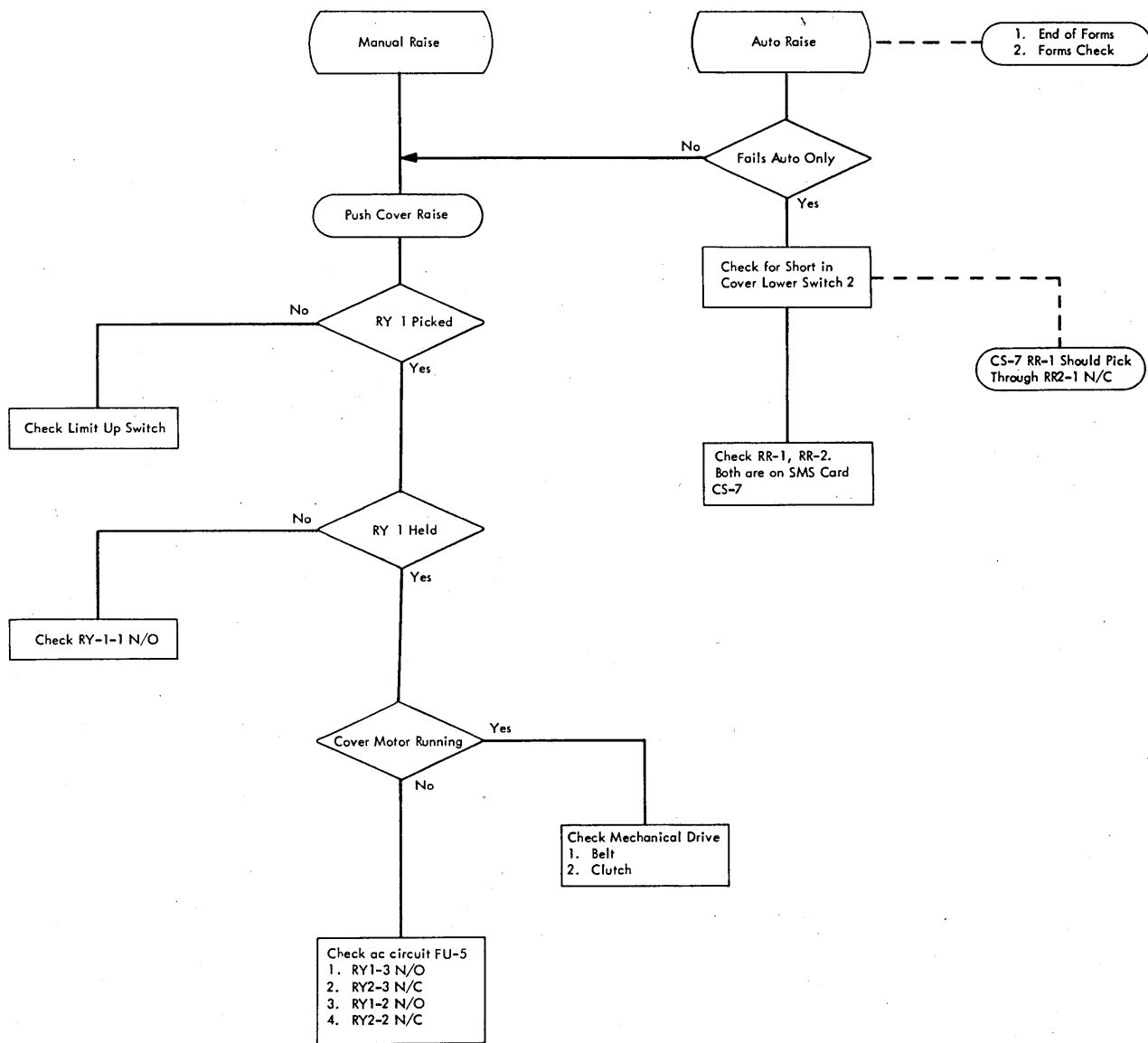


Figure 1-10. Cover (Manual Raise)

Non-UCS: Sync is checked at the Trailing Edge of the Gated PSS Pulse.

UCS: Sync is checked at the Loading Edge of the Gated PSS Pulse.

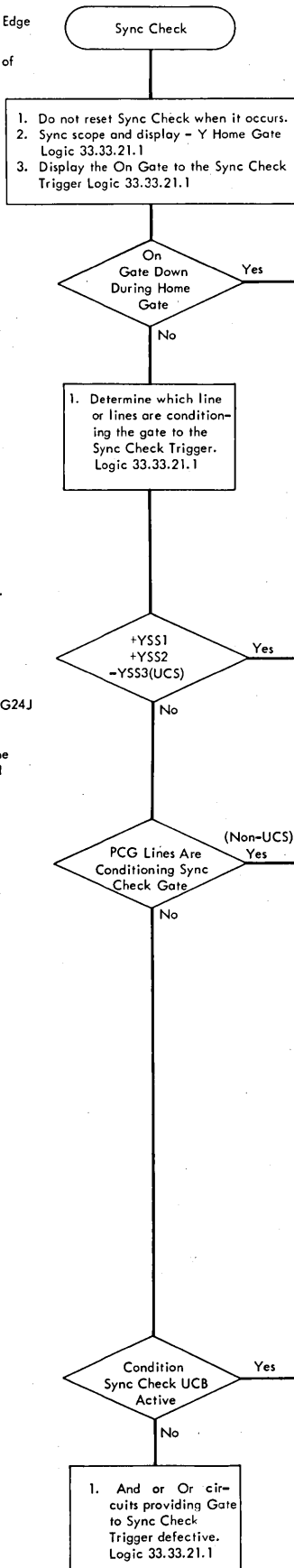
Logic page references are for 2821. For other systems, see system logics.

**Tie Downs:**

To Allow Printing to start at Home Time.  
Non-UCS: Jumper 21A3T28C to 21A3A32H.  
UCS: Jumper 21A2G18D to 21A3A32H.

To Prevent Sync Check from Resetting the Print Ready Latch.  
Non-UCS: Jumper 21A1G24Q to 21A1G24J  
UCS: Jumper 21A1D08L to 21A1D08J.

To Allow the Next PSS Pulse to Reset the Train Ready TR after a Sync Check, and Reset the Print Checks.  
UCS and Non-UCS:  
Jumper 21A3A07D to A 21A3A07N



- If the On Gate is not up during the Home Gate, the Sync Check may have been caused by a false On Gate signal. The most common failures are due to a false or out of time PSS Pulse. Some areas that may cause these erroneous PSS Pulses are:
  - Chain/Train speed low or erratic due to a binding Chain/Train or Chain/Train Drive.
  - Drum Head dirty or out of adjustment.
  - Improper operation of SA 1 or SA 2 in 1403. Replace cards if they are suspected.
  - Poor connections in the Emitter Pulse Lines between the 1403 and 2821. Scope the inputs to the differential amplifier. Logic 33.33.00.1. Both signals should be present and approximately equal in amplitude. The PSS circuitry may work with unbalanced signals, but it will be very sensitive to noise.
  - Static Discharge - Ensure the forms cart is ground on a 1403 Model 3.
  - Noise sensitive Sync Trigger. (Corrected on EC 125655.)
  - UCS - if not dualing, fals UCS Home Gate.

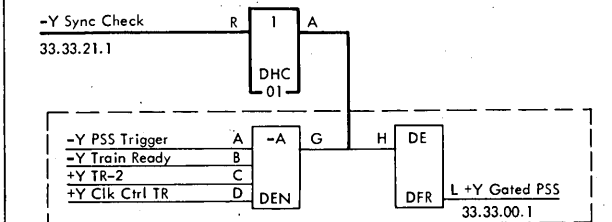
**IMPROVED POWER COVER CONTROL RELAY CIRCUITRY**  
Blowing of Fuse #5 and burning and welding of cover control relays is eliminated by a change to the resistor and capacitor network across RY-2. This change allows the cover motor windings to discharge the collapsing EMF to a near zero level before voltage is again applied.

**SYNC CHECKS CAUSED BY INCORRECT INSTALLATION OF FB/M 5870103, E C 127491 - "CORRECT COVER CONTROL RELAY CIRCUITRY"**  
When performing Step 7.3 of the FB/M Instructions, be sure to remove the correct wire from TS-B-7. The wire removed must be checked for continuity to RY-2-A side. The wire remaining on TS-B-7 should be continuity checked to the Limit Down Switch. Refer to Logic 02.05.1. If the incorrect wire is removed from TS-B-7 and moved to TS-A-7, Sync Checks can occur when the top cover is lowered.

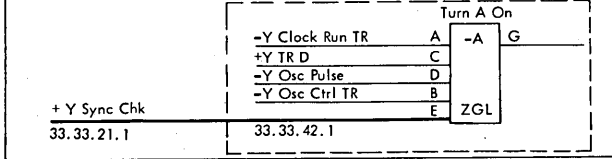
- Check for false or missing gated PSS Pulses.
- Extra Home Gate - If the error has a recurrence rate that allows scoping, the following procedure may be used to detect Extra Home Gates:
  - Sync scope on -Y Home Gate. Logic 33.33.21.1
  - Display -Y Home Gate. Using a variable time base, adjust the horizontal sweep so the next Home Gate is just off the scope screen on the right.
  - It may be necessary to observe two or more Sync Checks to detect an extra Home Gate. It may have occurred during Scope Retrace Time. If an extra Home Gate is observed, see step 1 in Block I above.
- If error rate is such that a scoping procedure cannot be used:
  - An error in advancing the Print Buffer Address Ring may cause a Gate PSS Pulse to be missed.
  - Check adjustment and stability of PSS Singleshot if 1100 lpm Printer is attached. (The Singleshot may be adjusted to improve stability.)

- Ensure PSS Singleshot is correctly timed. (1403 N1, M3) 150 us, can be adjusted to 190 us, to ensure stable operation.
- Reset 2821 - Do a Single Cycle print operation from I/O Tester, observing PCG Stepping.
  - A PCG should advance by +2.
  - Observe correction cycle. PCG should contain a 2 at beginning of SS2.
- Use freeze procedure to determine PCG contents at Sync Check Time.

The following freeze procedure locks up the printer circuitry on a Sync Check. This provides an easy method to determine the UCB Bar or PCG at Sync Check Time. It is necessary to use an unloaded inverter to condition the Gated PSS Pulse Line from the Sync Check. This is accomplished in the following manner.  
Plug a DHC Card, P/N 370372, into an unused SMS socket. Jumper as follows:



The advance to the printer clock is blocked preventing further clock cycles. Adding a jumper according to the following circuit will block the clock advance.



- UCB Bar is out of step. An error in advancing the print buffer address ring may cause advancing errors in the UCB Bar.
- I/O Tester can be used to Single Cycle UCB Bar off-line. Scan Load Single Cycle advances +1. Print Off Line should advance +2. Correction Cycles can be observed. (See I/O Tester - UCB Single Cycle Print)
- Use freeze procedure to determine UCB Bar contents of Sync Check Time.

Figure 1-11. Sync Check

Logic page references are for 2821. For other systems, see system logics.

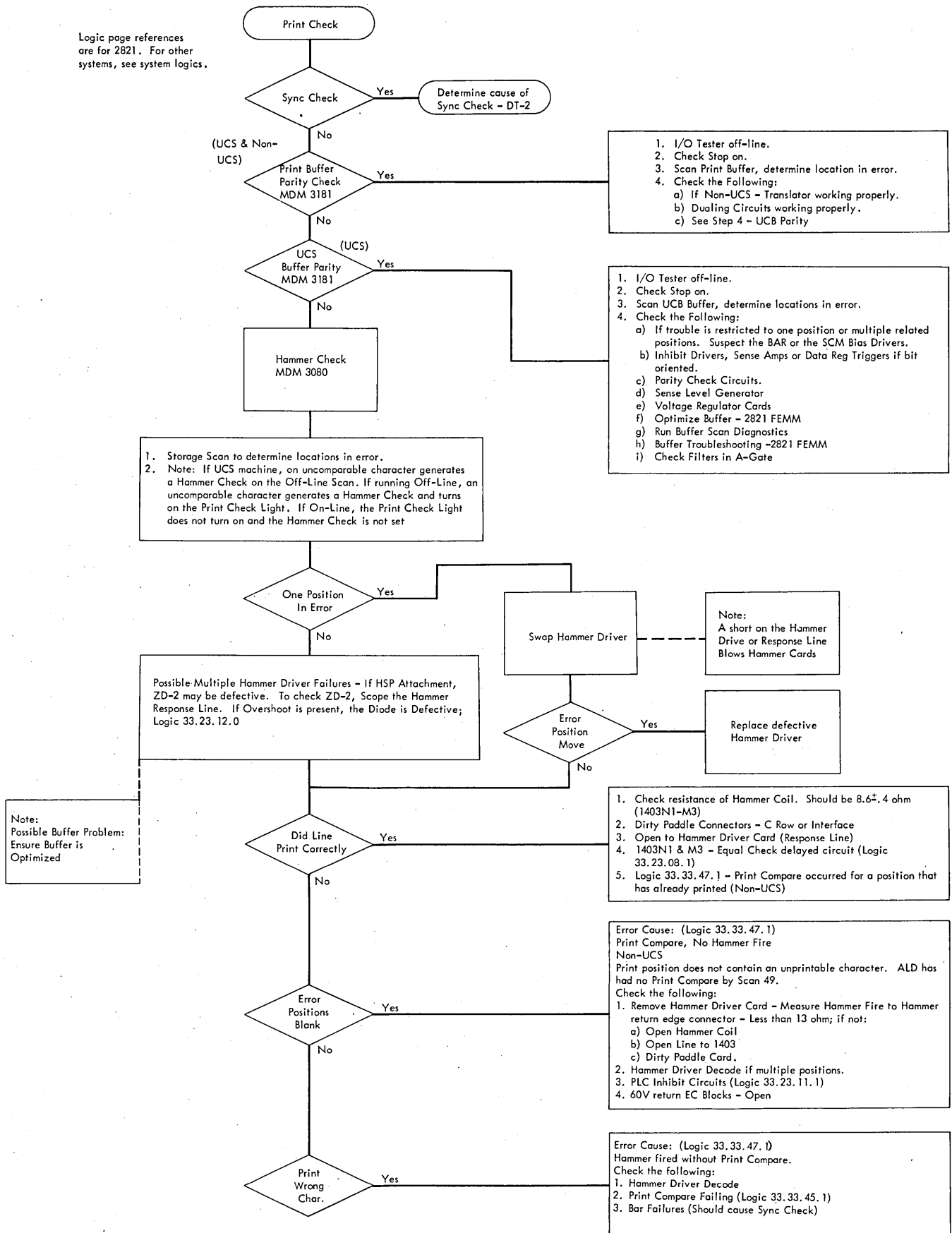


Figure 1-12. Print Check



## Section 2B. Service Hints

### 1.3 PRINT QUALITY

The best overall print quality from a 1403 Models N1 and 3 is obtainable when all the units associated with printing are adjusted to tolerances given in this reference manual.

It is important that adjustments to all these units be performed or checked in the correct sequence. This ensures that proper relationships are established between the hammer unit, paper path, and train cartridge. It also avoids redoing an adjustment once it is properly set.

#### CAUTION

Do not simulate printing with the T-casting open. Hammer breakage can result.

Use the print quality flow charts and service hints to assist you in obtaining good print quality.

The following steps are the recommended sequence in outline form. A 1403 alignment tool (part 452457) must be used to ensure accuracy of adjustment.

1. Align the hammer unit to the paper path (4.8.1).
2. Horizontal T-casting position (align the train to the hammers) (4.10.1).

*Note:* When checking this adjustment, make sure that the .100 in. (2, 5 mm) rod is between the type face and the locating block. Mark the tool at the top surface of the ribbon guide bar to judge correct position of the rod.

3. Impression control bar (see Service Hint 20).
4. Forms compressor adjustment (see Service Hint 24).
5. Check horizontal and vertical print registration.

#### Service Hint 1 – Train Cleaning

The 1416 train cartridge should be cleaned frequently with type cleaning paper (part 451529) and a vacuum cleaner. However, if satisfactory train operation cannot be obtained using this method, do a general cleaning as outlined in Chapter 3.

#### Service Hint 2 – Magnet Assembly Check

1. Preventive Maintenance. The residual strip should be replaced every six months. This is recommended for single-shift operation.

*Note:* For high-usage printers, the residual strip should be replaced with increased frequency. Replace the residual strip whenever the hammer unit is opened; also remove accumulated oil from the pole faces and backstops. (Use paper between these points and pick up armatures manually.)

2. Hammer magnet adjustment. Check the residual strip before performing any hammer magnet adjustment or flight-time adjustment. The reason for a changed flight time may be a worn residual strip. If the residual strip is in a good condition, refer to 4.8 and Service Hint 13.
3. Extreme usage of residual strip. A worn print magnet armature surface may be the reason for the premature wear of the residual strip. A worn armature that shows an impression where it hits against the core may damage the residual strip in less than one day. The armature surface can be damaged if the position prints for a long period of time without the proper residual protection. In case of a damaged armature surface, the armature yoke assembly should be replaced.
4. Slip-out or twisting of residual strip. The reason for a slip-out or twisting of the residual strip is possibly an oily or greasy residual strip or hammer magnet. The residual strip as well as the hammer magnet should be kept free of oil and grease. Never spray oil into the hammer unit, hammer magnets, or hammer blocks.

#### Service Hint 3 – Movable-Base Check

With the cartridge and ribbon removed, examine the movable base for uniform motion of the base when the forms thickness lever is varied. The forms thickness lever is pinned and cannot be adjusted. Nonuniform movement indicates a bind or wear. The hardened washer beneath the holding screw should be free to rotate. A drop of oil may be required to free the washer. Check end rails and transducer cable for a possible source of binds.

Other sources of lost motion of movable base:

1. Lower front portion of train drive motor striking swing pan when forms thickness lever is on .003 in. (0, 1 mm) setting.
2. Ribbon reverse lever mounting plate striking T-casting with forms thickness lever set on .019 in. (0, 5 mm).
3. Dirt on train drive motor support block.
4. Train interlock and UCS (Universal Character Set) interlock switches set too high, causing pressure on bottom of movable base.

Recheck the motion of the base with the cartridge installed. A nonuniform movement will destroy the hammer-to-train parallelism.

*Service Hint 4 – Movable-Base Horizontal Position-Transducer Adjustment*

The lockscrew on the horizontal positioning block (Figure 1-13) must be tight. If proper transducer adjustments cannot be obtained, loosen lock screw and shift the movable base toward the hinge end of the T-casting for maximum adjustment of the transducer adjusting screw. Retighten screw. (This screw does not affect free motion of the movable base.)

*Service Hint 5 – Hammer-Unit-to-Paper-Path Alignment*

Inspect tractor paper guide (Figure 1-14) for warp. Position tractors to line up with hammer unit locating blocks. Check .041 in. (1, 0 mm) dimension on both ends of unit.

*Service Hint 6 – Train-to-Hammer-Unit Position*

With the ribbon removed, close T-casting; observe the latching force on the T-casting latch. A four-to-six

pound force applied at the center of the ball is required to operate the latch. Check for a .100 in. (2, 5 mm) clearance between type slug face and locating block (Figure 1-15). This dimension is critical and must be accurately checked. Misadjustment can cause excessive cutoff on one end or the other. The left side of the hammer unit tends to tighten on the .100 in. (2, 5 mm) dimension due to closing the T-casting too hard. This misadjustment can also cause excessive type slug wear. Do not measure .100 in. (2, 5 mm) between type slug face and hammers.

Set forms thickness lever at .019 in. Insert .100 in. (2, 5 mm) rod end of the tool between a type slug and the hammer-locating block. Decrease forms thickness setting until a light drag on the tool is obtained. The thickness control should be at .011 in. (0, 3 mm). Repeat measurement at the opposite end locating block. Total end-to-end deviation must not exceed .001 in. (0, 03 mm). This adjustment is subject to customer handling of T-casting and should be regularly checked.

*Service Hint 7 – Train Slug Clearance (Slug to Slug)*

The correct slug-to-slug clearance of .001 to .003 in. (0, 03 to 0, 1 mm) must be constantly maintained to ensure proper train operation. Consult Section 4.11. Maintain proper lubrication. Do not overlubricate.

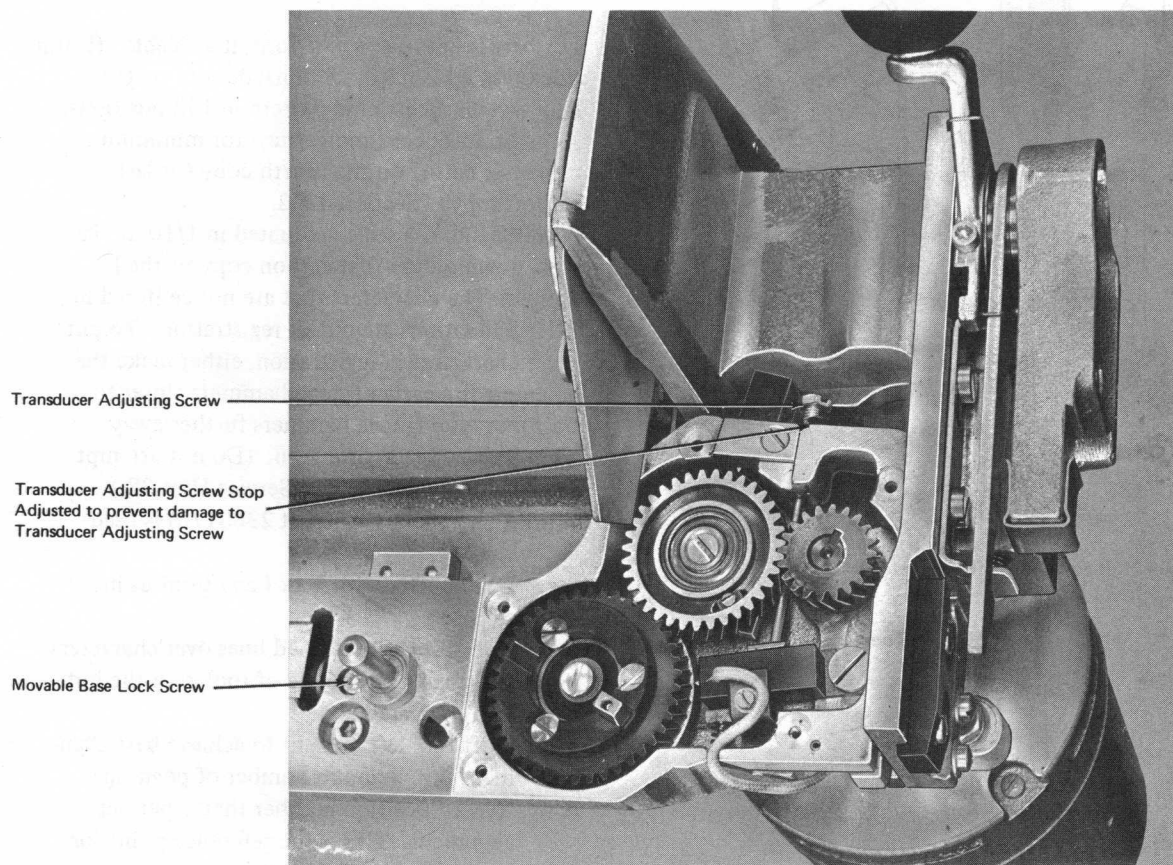


Figure 1-13. Transducer Adjustment

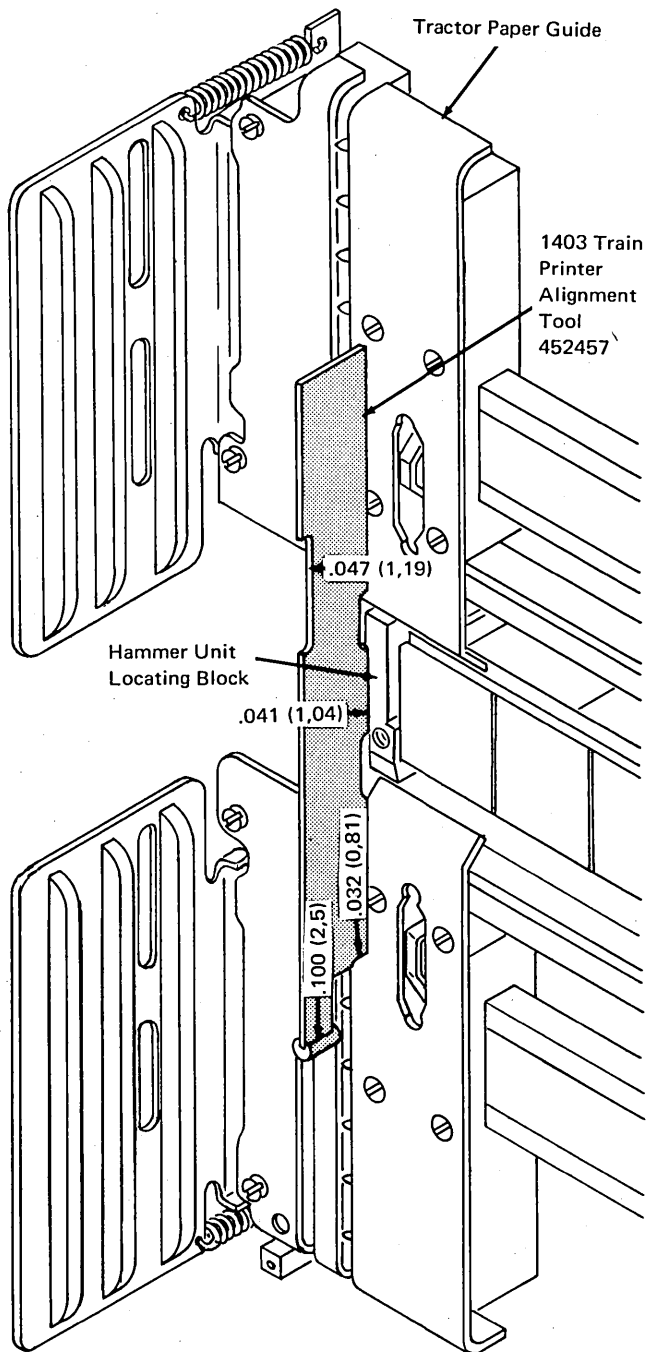


Figure 1-14. Hammer-Unit-to-Paper-Path Alignment

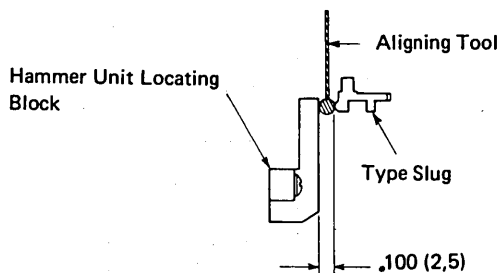


Figure 1-15. Train-to-Hammer-Unit Position

**Service Hint 8 – Horizontal Registration (Transducer Adjustment)**

Use 4-part form paper with the density knob on C and forms thickness lever on .011 in. Print an H-pattern in all 132 positions. If the overall timing indicates a left or right displacement, adjust the transducer timing. If individual positions show misalignment, adjust those positions. See Service Hints 9 and 17.

**Service Hint 9 – Hammer Flight Timing**

Procedure for adjusting flight time:

1. Check for worn parts, such as hammer pivot rods, push rods, guide combs, return plungers, and residuals.
2. Check that all hammer-unit adjustments are correct as specified in:
  - a. Section 4.8.1 – Aligning the Hammer Unit to Paper Path (Hammer-Unit Positioning)
  - b. Section 4.10.1 – Aligning the Train to the Hammers (Horizontal T-Casting Positioning)
  - c. Service Hint 3 – Movable-Base Check.
3. For best results use 4-part form if available. (Form thickness .011 in. (0, 28 mm); density on C.)
4. Run several sheets of H-pattern in 132 positions.
5. Adjust transducer timing screw for minimum character cutoff on the fourth copy (or last carbon copy). Section 4.8.2.
- 6A. With the aid of a scale graduated in 1/10 in., lay scale down on the first carbon copy of the H sample. The characters that are not centered in 1/10 graduations are out of registration. To put these characters in registration, either make the hammers fire earlier (move hammers closer to train), or later (move hammers further away from train). See Figure 1-16. (Do not attempt to adjust for wiggles. See Service Hint 28.)
- 6B. If print alignment tool (part 2360173) is used:
  - a. Load buffer with T or I and print as in step 4.
  - b. Place tool with scribed lines over characters and align bottom line of tool with the bottom of characters.
  - c. Shift tool left or right to achieve best alignment of maximum number of positions.
  - d. Record position number that is perfect alignment. This is the reference point for successive sample printings.
  - e. Adjust as in 6A.

7. Prepare a card for registration to be set (Figure 1-17).
8. Loosen armature and hammer magnet assembly screws one at a time and retighten the screws slightly (Figure 1-18).
9. Insert hammer adjusting tool and move accordingly.
10. Loosen each screw individually and secure tightly.
11. Repeat this procedure until registration is correct.

HHHH - Sample of hammers firing too early

HHHH - Sample of hammers firing too late

Figure 1-16. Hammer Firing Samples

Write down print positions with cutoff on left in this column

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Write down print positions with cutoff on right in this column

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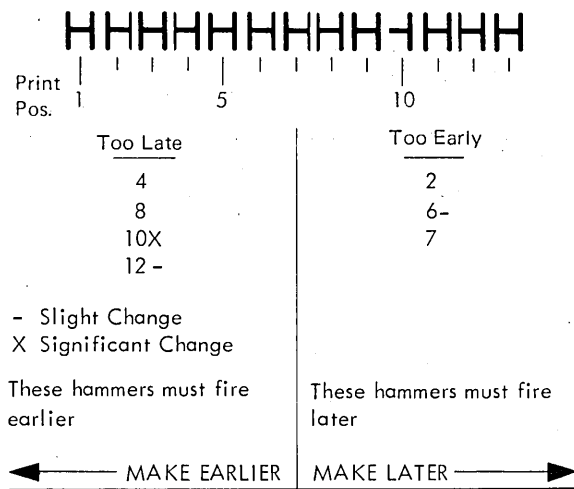


Figure 1-17. Print Position Reference

**Service Hint 10 – Vertical Print Registration (Vertical T-Casting Positioning)**

At both ends of the unit, check that the printed character is located evenly between the upper and lower edges of the hammer faces (Figure 1-19).

Procedure for checking vertical alignment:

1. Use a two-part form and strip off the last copy leaving the last carbon exposed to the hammers.
2. Set up processing to print 132 H's.
3. Remove the ribbon and latch the T-casting.
4. Set the forms thickness lever to .003 in. and the print density to C setting.

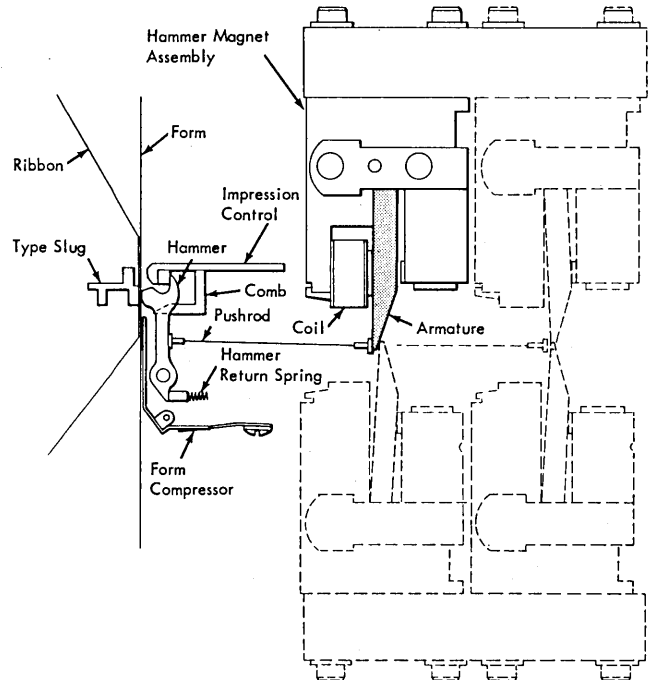


Figure 1-18. Print Position Components

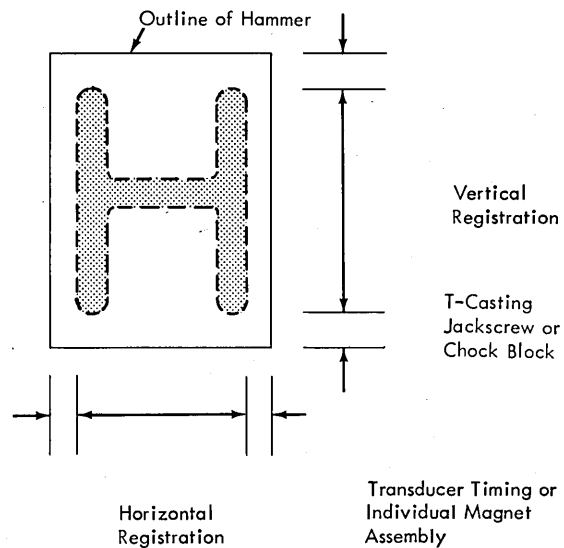


Figure 1-19. Character Registration

5. Print one line of H's and observe the imprint of the characters on the hammers.
6. If the imprint is located evenly between the upper and lower edges of the hammer faces, further adjustment is unnecessary.
7. If an adjustment must be made, refer to Section 4.9.2.1, A through E, and 4.9.2.2, A through C.

Uneven positioning on the right end requires adjustment of the jackscrew. Uneven positioning on the left requires adjustment of the chock block.

If several positions are out of vertical registration (wavy printing) the hydraulic carriage or controls can be at fault. Correct failure as necessary.

**Service Hint 11 – Wavy Printing**

Wavy printing can also be caused by improper tractor and tractor shaft adjustment.

Check the following by using standard customer forms:

- A. Pins should hit feed holes at the top on the top tractor and at the bottom on the bottom tractor to minimize blousing.
- B. Proper belt tension to minimize backlash.
- C. Proper vernier adjustment.

**Service Hint 12 – Vertical Alignment (Shifting Print Lines)**

Slight horizontal movement of the translator can occur while printing because of excessive clearance between the translator lock handle collars, or improper tension on the translator lock lever (Figure 1-20). If this condition is present, horizontal lines of print shift and cause vertical misalignment.

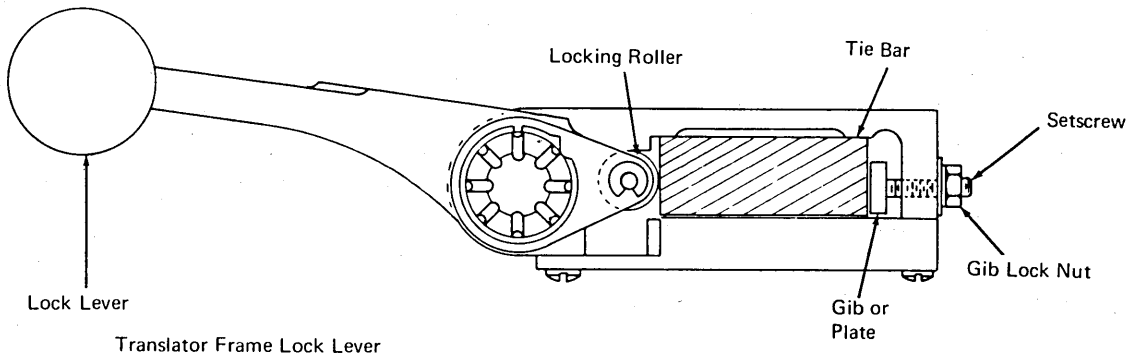
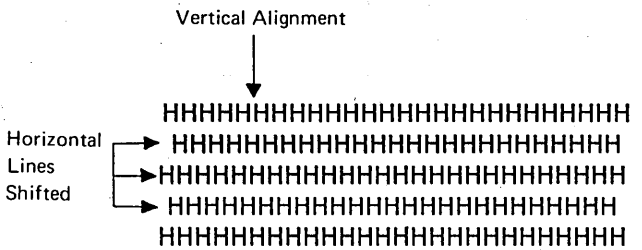
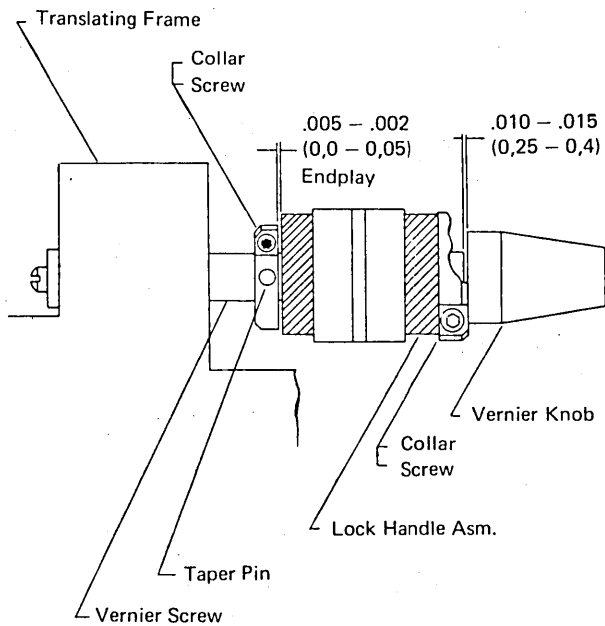


Figure 1-20. Horizontal Movement of Translator Frame

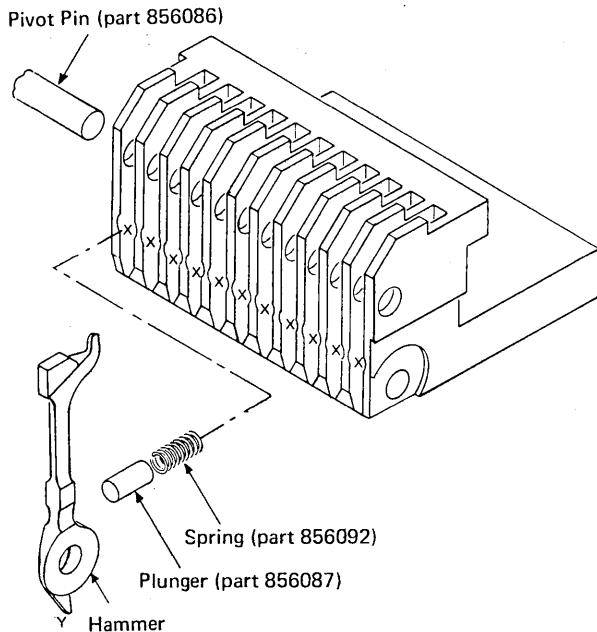


Figure 1-21. Hammer Pivot Pins

**Service Hint 13 – Worn Hammer Pivot Pins**

Wear of pivot pins (Figure 1-21) can affect hammer flight time and registration. Normally, the pin is polished in the areas where the hammers have been pivoting and an edge may be felt with the fingernail. This amount of wear probably would not affect registration. However, because it is not possible to describe the exact amount of wear at which registration is affected, pin replacement is recommended when wear is visible and other causes of registration problems cannot be determined.

**Service Hint 14 – Worn Hammer Guide Combs**

Worn hammer guide combs (Figure 1-22) can cause wiggly printing, flight-time and horizontal registration problems. Remove the hammer block and check the guide comb. Replace the comb (part 839598) as necessary.

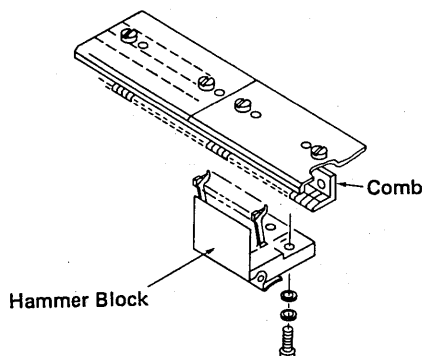


Figure 1-22. Worn Hammer Guide Combs

**1.4 ANALYZING PRINT QUALITY**

**Service Hint 15 – Flight-Time Check**

After each adjustment has been made, print 132 positions of H pattern on a 4-part form. Use density at C and forms thickness lever set on .011 in. (0, 28 mm) to evaluate hammer flight-time problems. The second copy should be used for evaluations. Observe spacing of characters to determine which hammers require flight timing.

**Service Hint 16 – Density Check**

Use density set at E and forms thickness at .011 in. (0, 28 mm) to evaluate overall print density. The fourth copy should be used for this evaluation (see Service Hints 20 and 21).

**Service Hint 17 – Character Cutoff**

If excessive character cutoff exists (decreasing end to end), Figure 1-23, check .041 in. (1, 0 mm) hammer-unit-to-paper path alignment (see Service Hint 5) and .100 in. (0, 25 mm) train-to-hammer-unit adjustment (see Service Hint 6).

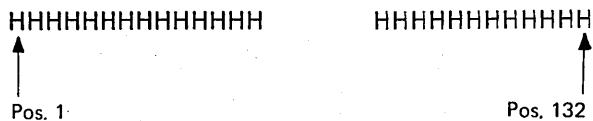


Figure 1-23. Character Cutoff

**Service Hint 18 – Cutoff (Shifting Group)**

Figure 1-24 shows characters shifting (cutoff of a group of print with the cutoff group shifting to other locations). Check gear train wink (Figure 1-25). Inspect for worn drive key, worn slot in the 1416 Train Cartridge drive gear, and worn drive inner circumference. Remove 1416 Train Cartridge, close interlock switch and run. Listen for gear noise.

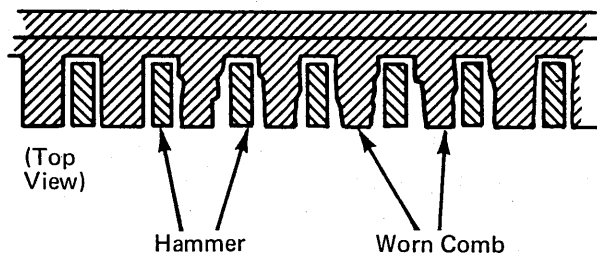




Figure 1-24. Cutoff Printing

**Service Hint 19 – Horizontal Registration**

A tilted PSS drum stud (part 856156) causes train speed variations resulting in horizontal print misregistration. Known causes are: a defective stud, dirt under the stud, or a damaged transducer bracket (part 856167). When printing H's with any 48-character set (AN, HN, etc.), registration variation is in bands repeated every 37 characters. Figure 1-26 shows an exaggerated example of one band. When printing with other than a 48-character train (YN, SN, TN, PN, etc.), erratic registration within a column results as in Figure 1-27. The pattern varies with the character set.

Further indications of a tilted stud are fretting corrosion, (red rust) and excessive wear in the drum gear bore, key, 1416 drive gear outside diameter, and key slot. See Figure 1-28. If this failure exists, replace the following:

- motor pinion gear – part 856134 (60-Hz)  
856277 (50-Hz)
- idler gear – part 856292 (UCS)  
856140 (Non-UCS)

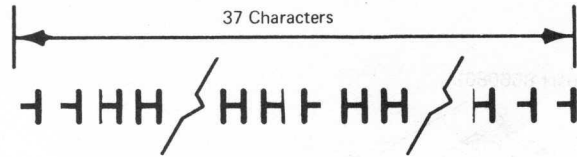


Figure 1-26. Registration Variation (48-Character Sets)



Figure 1-27. Registration Variation (Other than 48-Character Sets)

- PSS drum gear – part 856138
- stud – part 856156
- transducer mounting bracket – part 856167
- drive gears for all 1416s used on the failing machine – part 856194

When installing the drum gear stud, check for burrs in the mounting area and exercise extreme cleanliness.

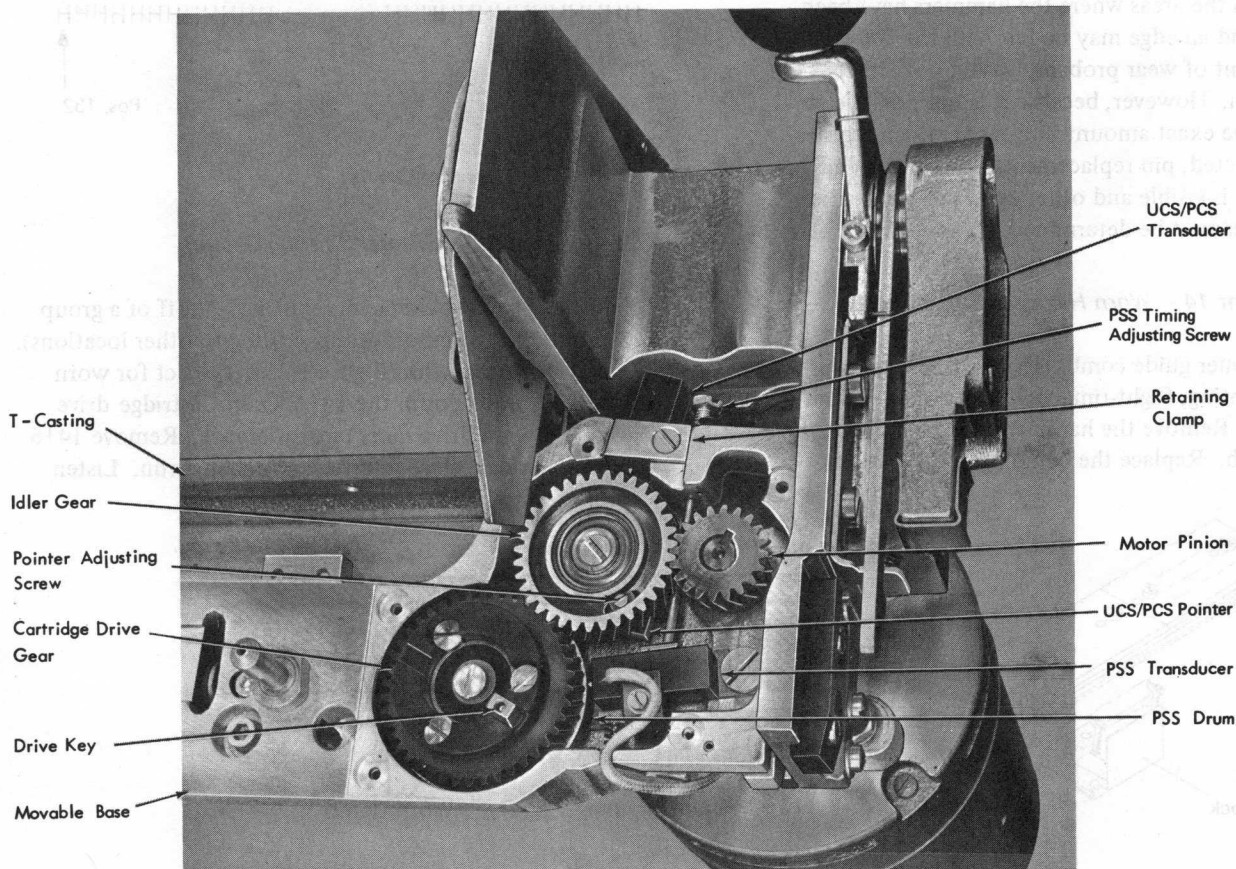


Figure 1-25. Cartridge Drive Gear Train

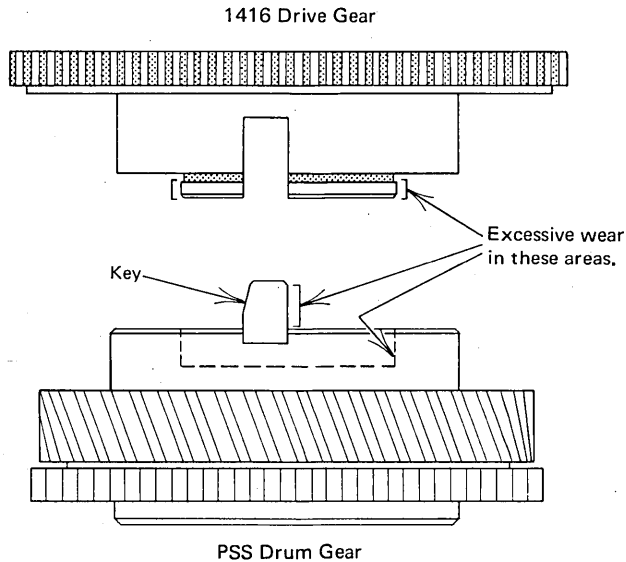


Figure 1-28. Excessive Wear Due to Tilted PSS Drum Stud

**Service Hint 20 – End-to-End Density Variation**

Figure 1-29 represents a sample of uneven end-to-end density. If end-to-end density variation is present, check for .047 in. (1, 2 mm) projection of the impression control bar from the locating blocks on both ends (Figure 1-30) with the density control at A. See 4.8.4 for adjustment procedure. A check to see if this adjustment is correct is to set the density knob to the E setting and while printing 132 positions, to gradually move the density from the E to the A setting. (Make certain there are no binds in the density actuating bar.)



Figure 1-29. Density Variation

*Note:* Uneven density should not be confused with cutoff. When checking for density, check the impression control bar and not the .100 in. (2, 5 mm) train-to-hammer-unit clearance.

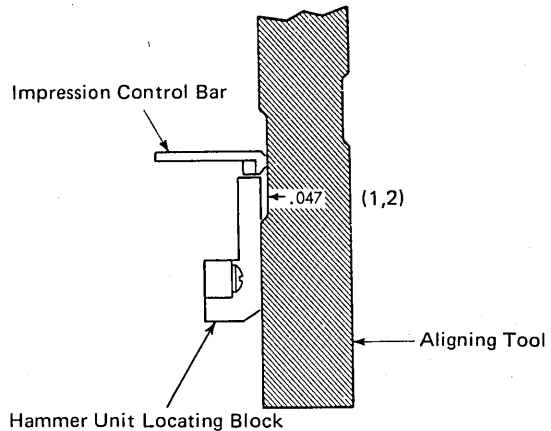


Figure 1-30. Projection of Impression Control Bar

**Service Hint 21 – Density Variation in Groups of 22 Positions**

If density variations occur in groups of 22 (Figure 1-31), check the corresponding impression control pads. If this condition is present when running the machine at proper settings (proper forms thickness and density for paper being used), the hammer unit impression control bar should be changed.

*Note:* If density is incorrectly set to E, this condition will be aggravated.

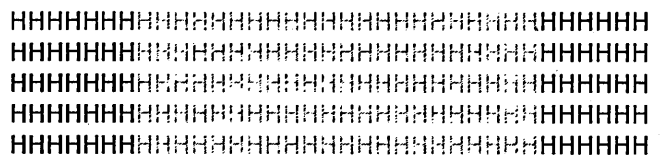


Figure 1-31. Density Variation in Groups of 22 Positions

**Service Hint 22 – Light Printing (Light Areas Not Confined to One Location)**

If light printing occurs as in Figure 1-32, check the forms compressors and ribbon shield. If ribbon shield is suspected, remove shield assembly and rerun test. If trouble disappears, investigate ribbon shield for wear and adjustments. (Check 60V supply.)

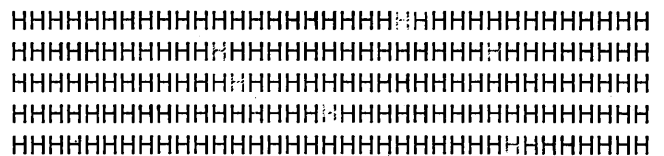


Figure 1-32. Light Printing



**Service Hint 23 – Ribbon Shield and Guide Bar Adjustments**

**Ribbon Shield Assembly**

The collars on the T-frame hinge pin are to be located to establish parallelism within .010 in. (0, 25 mm) between the lower edge of the ribbon guide bar lip and the top edge of the projection on the upper cartridge ribbon guide. The tongue on the left-end ribbon shield assembly casting must enter the slot in the movable base freely.

With the ribbon removed, the inner surface of the ribbon shield is located .005 to .009 in. (0, 13 to 0, 23 mm) from the lower cartridge plate. This is accomplished by adjusting the stop setscrew located in the right-end ribbon shield casting and the socket head screw in the left end of the ribbon shield assembly.

Adjust the ribbon shield so the top surface of the ribbon shield ends are parallel to the top edge of the projection on the upper cartridge ribbon guide within .010 in. (0, 25 mm).

While maintaining the ribbon shield assembly up against its stop screws, position the ribbon guide bar (Figure 1-33) so that the pads on the ends of the guide bar lip are up against the upper cartridge lip within .001 in. (0, 025 mm).

With the forms thickness lever set at .019 in. the double headed screw on the ribbon shield hinge is to be positioned to provide a clearance of .001 to .003 in. (0, 025 to 0, 076 mm) between the inner head and the mating surface of the ribbon shield assembly right-end casting.

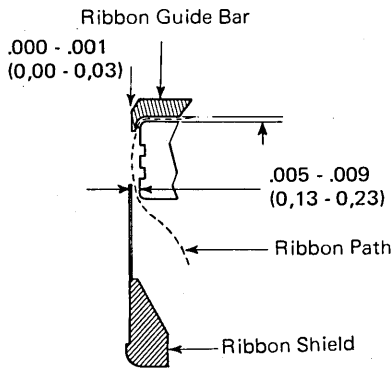


Figure 1-33. Ribbon Guide Bar and Shield

**Service Hint 24 – Forms Compressors**

Compressors must be equal in alignment and tension. Sight down upper edge of compressors. They should be in line with each other. The spring should be to one

side of the compressor. It must not contact the center (adjusting screw tab) of the compressor. If the adjustment is correct, very little movement occurs when an upward pressure is applied on the bottom (spring side) of the compressor plate.

**Forms Compressor Adjustment**

Check all compressors for .032 in. (0, 8 mm) projection from the impression control bar with density at A (Figure 1-34).

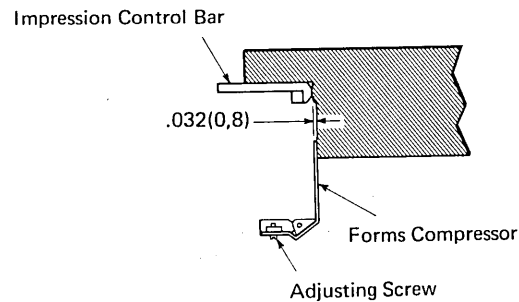


Figure 1-34. Forms-Compressor Adjustment

**Service Hint 25 – Light Printing (One or More End Positions)**

Residual is not being held against the core. (See Figure 1-35.)



Figure 1-35. Light Printing

**Service Hint 26 – Density (Single Position)**

If one position has heavy density on complete character every time (Figure 1-36), seal time (armature to core air-gap) is too great. If one position has light density on complete character, seal time is insufficient. Replace magnet assembly in either case. Check for worn hammer.

**Note:** A broken tip on the back of a hammer also shows an extremely dark position. This can be checked quickly by setting the density to E and running single-part paper. With density on C and form thickness on .011 in. (0, 28 mm), check fourth copy of the 4-part form.

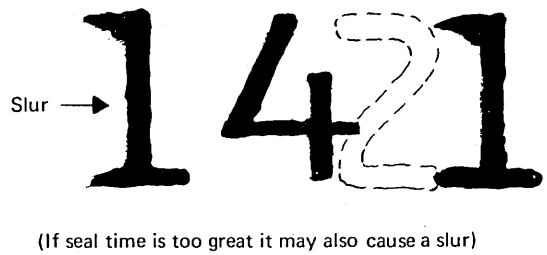
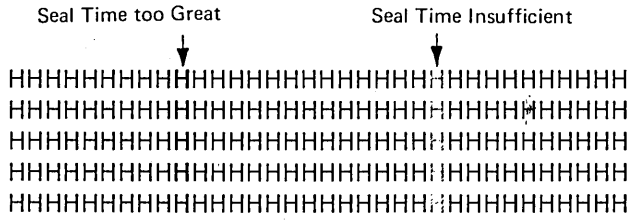


Figure 1-36. Density (Single Position)

**Service Hint 27 – Wiggler**

A wiggler (Figure 1-37) is a print position that drifts from side to side within a printed page. Registration cannot be maintained.



Figure 1-37. Wiggler

**Service Hint 28 – Wiggler (One Position)**

Excessive Molykote\* on hammer back (strike point of pushrod). Remove hammer block and wipe excessive Molykote from hammers. Swap hammer blocks to identify a hammer or print magnet problem. If the position still wiggles, this may also be caused by oil on the armature assembly, or a bad armature and yoke assembly. See also Service Hints 13 and 14.

**Service Hint 29 – Pairs of Wigglers in One or More Locations**

For condition shown in Figure 1-38, check armature-to-armature clearance (evidenced by burnish on tip sides).

\*Trademark of Alpha Molykote Corporation

Minimum clearance is .006 in. (0, 15 mm) with all slack removed (Figure 1-39). Remove hammer bar assembly to check. If necessary, form armature tips only. Do not apply pressure on armature pivots.



Figure 1-38. Pairs of Wigglers

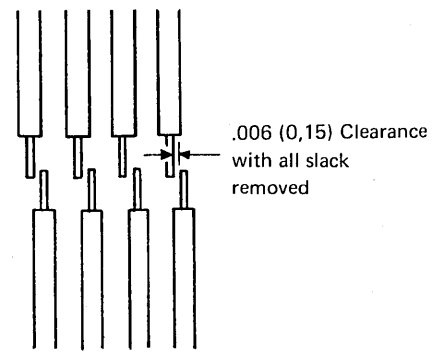


Figure 1-39. Armature Clearance

The hammer blocks can be removed from the front of the machine by rotating the paper-advance knob far enough so that a screwdriver and screw-starter can be used. Oil on armature pole face and/or backstop may also cause wiggles. Remove oil by inserting paper between the pole faces and backstops and manually picking up the armatures.

**Service Hint 30 – Overprinting**

If overprinting is evident (Figure 1-40), try individual flight-time adjustment before proceeding to Service Hints 22 and 26.

If there is an overprint shadow in any position when using a single-part form with the forms thickness lever setting on .003 in. (0, 076 mm) and density on B, the seal time on that particular magnet assembly can be out of adjustment. Inspect the hammer to see if it protrudes farther than adjacent ones. Refer to Service Hint 26.

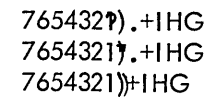


Figure 1-40. Overprinting

**Service Hint 31 – Dark Strokes (Blocks of 12)**

For condition shown in Figure 1-41, check pushrod assembly. A pushrod assembly (Figure 1-42) that is not seated properly usually shows up as a section of 12 hammer positions with dark legs on the left side when printing a pattern of H's. The hammer unit must be removed and the pushrod assembly reset.

If this condition is suspected, remove the corresponding hammer block and see if the pushrod assembly is pressed together.



Figure 1-41. Dark Strokes (Blocks of 12)

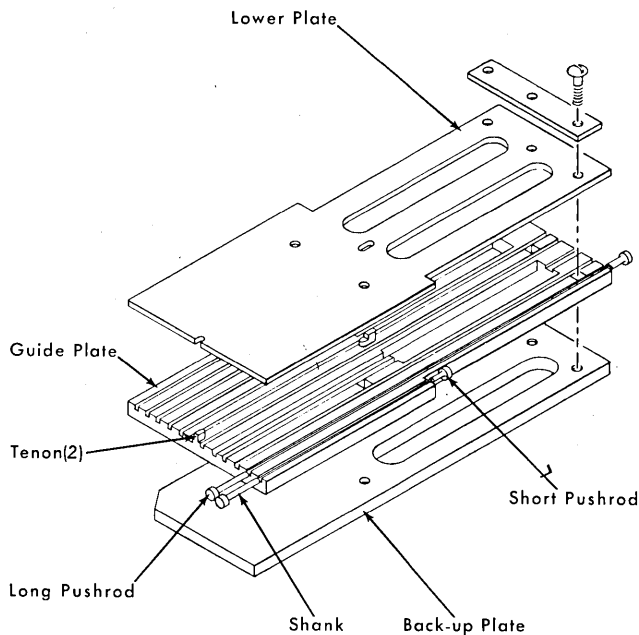


Figure 1-42. Pushrod Assembly

**Service Hint 32 – Dark Strokes (One Position)**

Change the hammer.

**Service Hint 33 – Light or Missing Tops (Blocks of 12)**

A hammer block not pushed back completely shows cutoff on the left leg of the characters. Registration can be set with this condition existing. However, upon careful observation of the printing on single-

part form, slight cutoff can be noticed on the top of the characters (Figure 1-43). The block should be pushed back and registration should be rechecked in these 12 positions.

If cutoff can be seen on the tops of all 132 positions, check .100 in. (2, 5 mm) hammer-unit-to-train-slug clearance, and the proper forms thickness setting for the paper being used.



Figure 1-43. Light or Missing Tops

**Service Hint 34 – Intermittent Missing Characters**

For condition shown in Figure 1-44, remove 12-position hammer block. Take one print cycle. Push the pushrods in one at a time and check for a bind. A bind indicates a sticking armature or bad residual. If there are no binds, inspect hammer block for binding plunger, spring, pivot, bent pushrod, or too much Molykote. If the problem appears after the right-end hammer block or blocks are removed and replaced, the blocks are not replaced all the way to the left. Total tolerance buildup between all blocks is .003 in. (0, 1 mm). A chip or burr between any two blocks could be the cause. If a tight comb bar slot is suspected, check adjacent slots with a feeler gauge (approximately .028 in., 0, 71 mm).

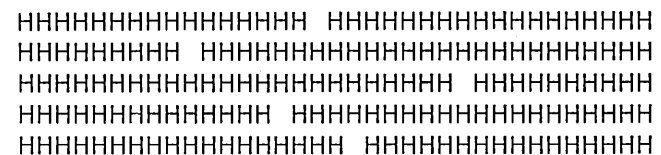


Figure 1-44. Missing Characters

**Service Hint 35 – Sticky Plungers**

For the condition shown in Figure 1-45, swap corresponding hammer blocks to identify the hammer block or armature problem and investigate that position.

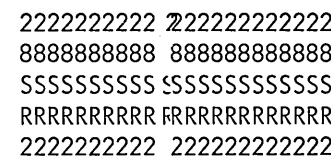
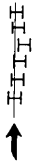


Figure 1-45. Sticky Plungers

**Service Hint 36 – Horizontal Registration (Train Speed)**

1. Worn or maladjusted train drive gears are evident by a 5- or 6-line ripple in the H-pattern when the vertical column of H's is viewed obliquely (Figure 1-46). See also Service Hint 8.



View at Angle

Figure 1-46. Horizontal Registration

2. Drive key is worn.
3. Train binds are caused by slug wear, cam wear, dirt, clearance adjustment, too much or too little oil.
4. Low (or fluctuating) line voltage also affects 60-volt power supply. Variation should be within 10% of 208 or 230 volts nominal on all legs.
5. PSS pulse variation is evident by waviness (runout) of PSS pulse envelope (see Service Hint 1).
  - a. Eccentricity of timing drum.
  - b. Worn timing drum and drive gear bearings.

Either condition causes waviness in the vertical column of the ripple print pattern; if severe enough, it repeatedly cuts off several adjacent positions when printing H's.

6. Light printing on one side of the character can sometimes be confused with cutoff; if the character appears to be properly centered between adjacent print positions, then the hammer face is not square to type face. Check pivot pin for wear, replace hammer.

**1.5 HYDRAULIC UNIT**

**Service Hint 1 – Outline of 1403 Hydraulic-Unit Adjustments and Checks**

Adjustments	Checks
Space & Skip Needle Valves	Detent Arm & Speed
Space & Skip Control Valves	Start-Stop Response
Bypass Needle Valve	Hydraulic Stop

**Preparation:**

1. The hydraulic unit must be warm (approximately 125°F) (1403-N1) and hot to the touch for 1403 Model 3.
2. The start pulse (CS-6-A) (1403-N1) is used as a positive sync for many of the adjustments in this outline.
3. The scope pictures use the stop pulse going negative as a sync.

*Note:* The stop pulse is an inversion of the start pulse.

**Service Hint 2 – Hydraulic-Unit Failures**

Carriage failures caused by the hydraulic unit itself usually show up as:

1. Poor hydraulic response
2. Slow hydraulic speed, or
3. A combination of both speed and response.
4. Exceptions:
  - a. Hydraulic unit does not have correct voltage to the control magnets.
  - b. Mechanical bind in the tractor assemblies interfering with its operation.

**Service Hint 3 – Space Needle Valve**

1. Adjust in low speed to just seat detent against the backstop. (4.15.3)

**Check Low Speed**

1. Low-speed skip (Figure 1-47). (4.14.4)
2. Sync internal minus on E1 pulse.

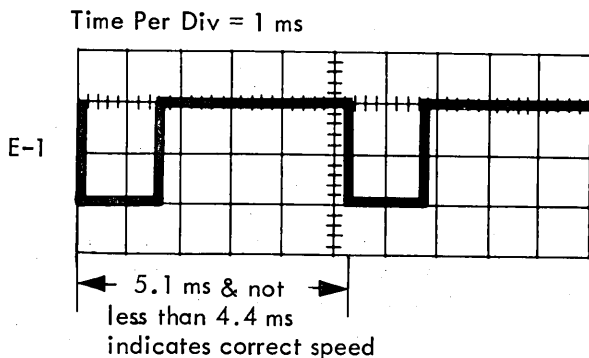


Figure 1-47. Low Speed

**Service Hint 4 – Skip Needle Valve**

1. Adjust in high-speed skip to just seat detent against the backstop. (4.15.4)

**Check High Speed**

1. High-speed skip (Figure 1-48). (4.14.4)
2. Sync internal minus on E1 pulse.

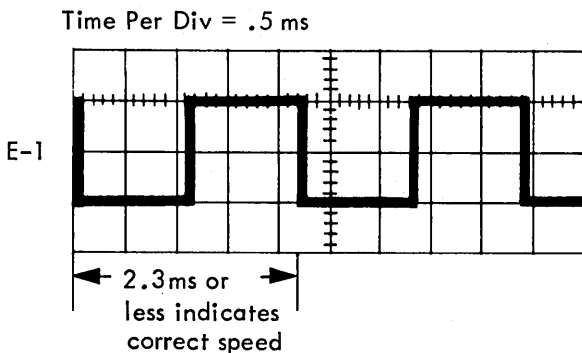


Figure 1-48. High Speed

**Service Hint 5 – Start-Stop Response**

(See 4.15.2.)

1. Check in triple-space after print.
2. A preliminary check of the following adjustments is necessary to make this check.
  - a. Bypass valve
  - b. Triple-space singleshot (14 to 17 ms)
3. Sync pulse on Start pulse.
4. *Observe* (Figure 1-49)
  - a. Tractor shafts start moving within 3 ms and not later than 4 ms.
  - b. Tractor shafts begin stopping within 3 ms and not later than 4 ms.
5. *Remarks*
  - a. 3 to 4 ms are limits and any hydraulic unit that does not respond within this time needs repair.
  - b. Throughout the procedure use the recommended scope setups, especially for displaying the tach generator. Over-amplifying the display detracts from the general pattern that is to be observed.

- c. Start magnet should be 14-17 ms. This is the approximate time for a triple-space (if the hydraulic unit is responding normally), and eliminates the confusion of a changing tach envelope if the carriage is erratically taking more or less spaces.
- d. If the start-stop conditions are satisfied, proceed to check the bypass needle valve.

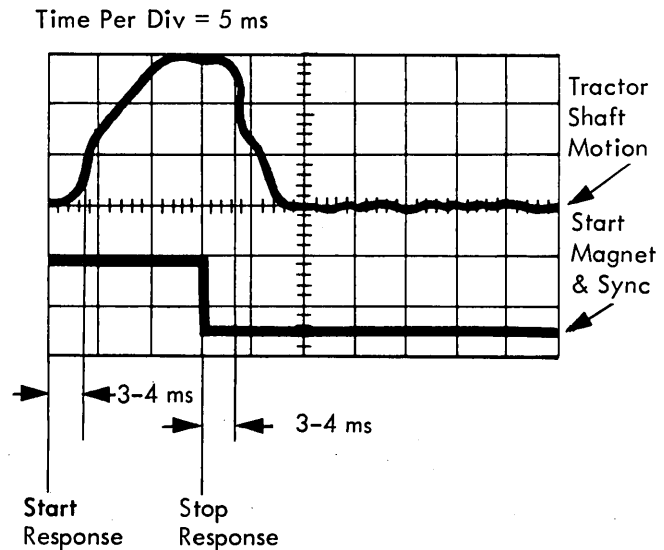


Figure 1-49. Start and Stop Response

**Service Hint 6 – Bypass Needle Valve**

(See 4.15.5.)

1. Triple-space after print.
2. Sync plus on start pulse. (2V/CM) (5MS/CM)
3. Point-A (Figure 1-50) may be above ground level because of carriage drift speed.
4. Point-B should be at ground level when bypass is adjusted correctly.
5. At point C adjust for the best stop in this area.

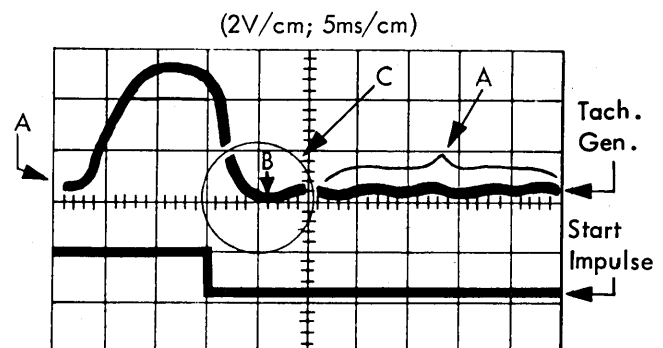
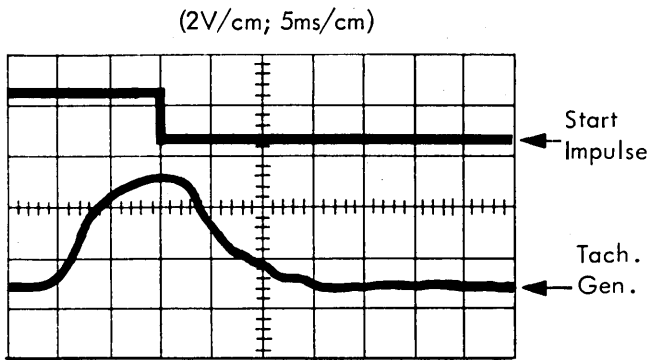


Figure 1-50. Bypass Needle Valve

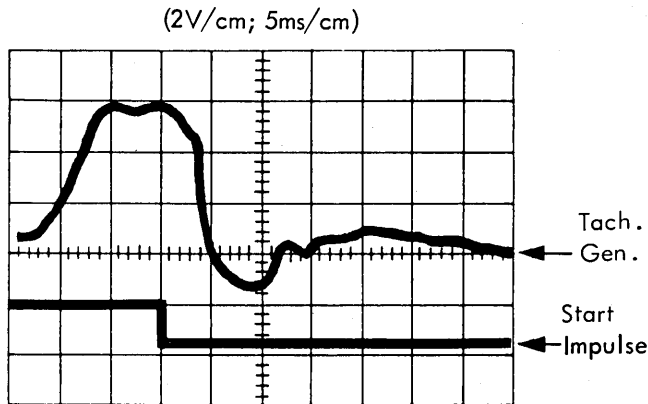
The tach generator displays (Figures 1-51 and 1-52) of *hydraulic stop* and *no hydraulic stop* are very similar in appearance and are not easily discernible. Therefore, to complete the check for hydraulic stop, it is necessary to do the following.

- Mark the position of the needle valve.
- Loosen the locking screw and turn the needle valve in slowly.
- With the detent arm disengaged, overshoot should occur within 1/8 to 1/4 turn.
- Return needle valve to original position and lock. Recheck the waveform because locking can change the adjustment.



Bypass Too Loose - 1/4 Turn

Figure 1-51. Bypass Adjusted too Loosely



Bypass Too Tight - 1/4 Turn

Figure 1-52. Bypass Adjusted too Tightly

**Service Hint 7 – Singleshot Adjustments**

(See 4.16.)

- Singleshots affect the time the detent engages the detent wheel. The detenting action must be checked in both 6- and 8-line drive for all singleshot settings.

Adjustable Signal	Check	Location
Single Space Singleshot	Detent Entry 6 and 8 Line	Control Unit
Carriage Settling Singleshot	Total Interlock Time 20.8 ms	Control Unit
Double Space Singleshot	Detent Entry on 6 & 8 Line	Control Unit
Triple Space Singleshot	Detent Entry on 6 & 8 Line	Control Unit
Carriage Emitter Skip	Compare to 2 & 3 Space SS	1403
Channel Brush	1.5 ms before Emitter	1403

Figure 1-53. Signal Sources

- The signal sources given in Figure 1-53 are for systems having single-, double-, and triple-space singleshots. Other systems use only the single-space singleshot, the carriage emitter controls stopping for all operations except single-space.

**Service Hint 8 – Print and Space Timing Chart**

Figure 1-54 shows the print and single-space timing with scope signals for the carriage operation.

**Service Hint 9 – Single-Space Singleshot**

(See 4.16.1.)

- Adjust in single space after print operation (Figure 1-55).
- Check in 6- and 8-line drive.

**Service Hint 10 – Carriage Settling Singleshot**

(See 4.16.2.)

- Single-space after print.
- Sync on the start impulse.
- Adjust the carriage settling singleshot to time out at 20.8 ms (Figure 1-56). Any variation from 20.8 ms affects print speed.

**Service Hint 11 – Double-Space Singleshot**

(See 4.16.5.)

- Double-space after print.
- Sync on start impulse (Figure 1-57).
- Check in 6- and 8-line drive.

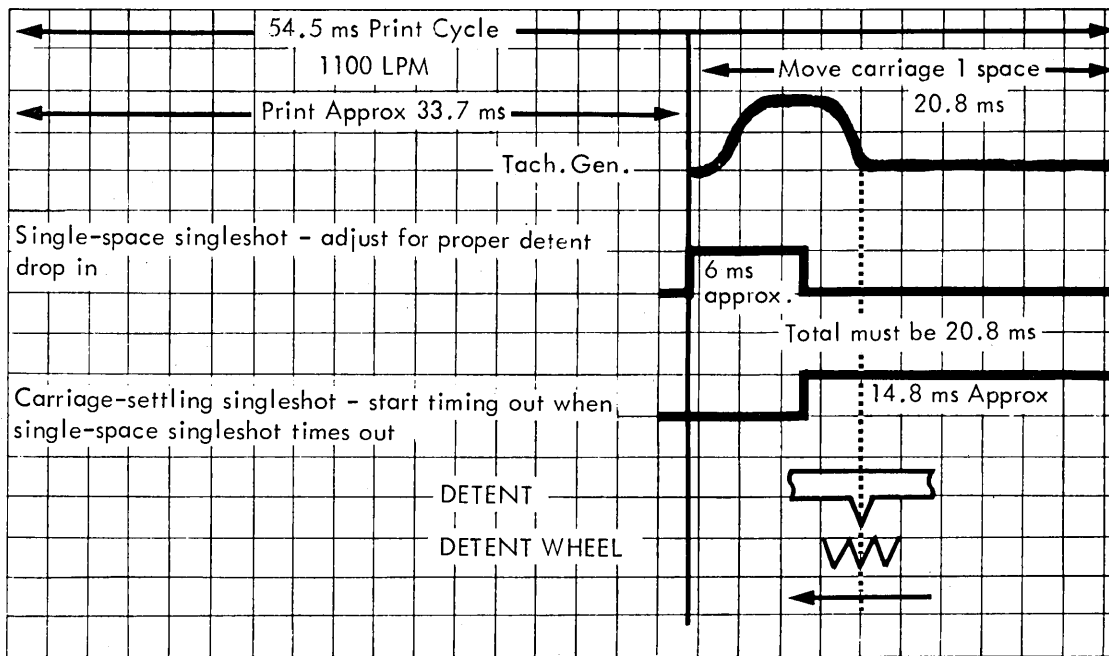


Figure 1-54. Print and Space Timing

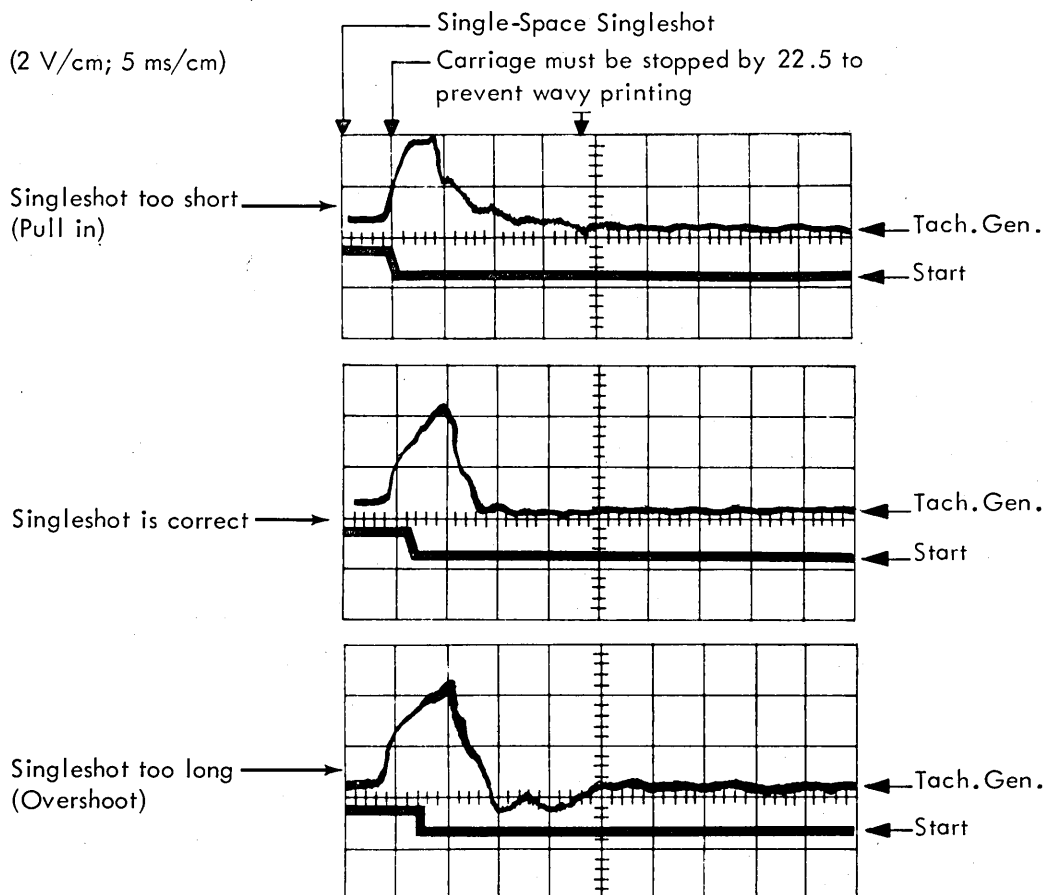


Figure 1-55. Single Space: 6-Lines per Inch

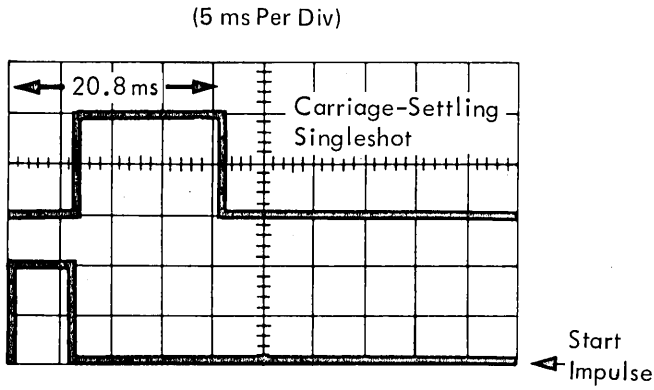
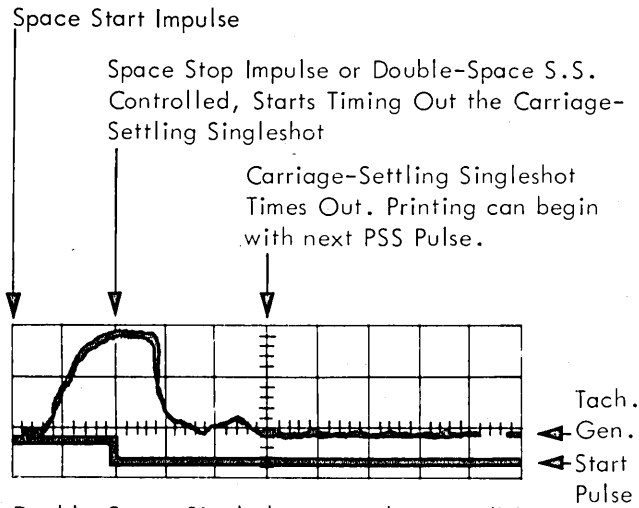
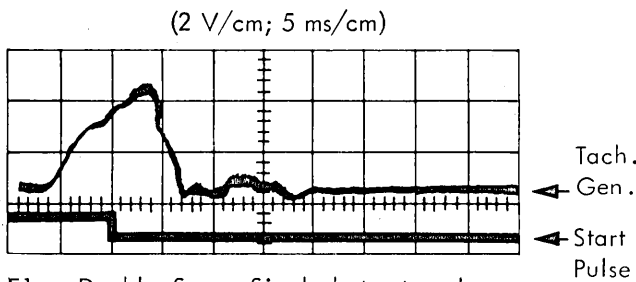


Figure 1-56. Carriage-Settling Singleshot



Double-Space Singleshot set to best condition.

12 Milliseconds from Stop Impulse until Tractor Shaft is settled.



E1 or Double-Space Singleshot set early.

19 Milliseconds from Stop Impulse until Tractor Shaft is settled.

Figure 1-57. Double-Space Singleshot

*Service Hint 12 – Triple-Space Singleshot*

(See 4.16.5.2.)

1. Triple-space after print.
2. Sync on start pulse (Figure 1-58).
3. Check in 6- and 8-line drive.

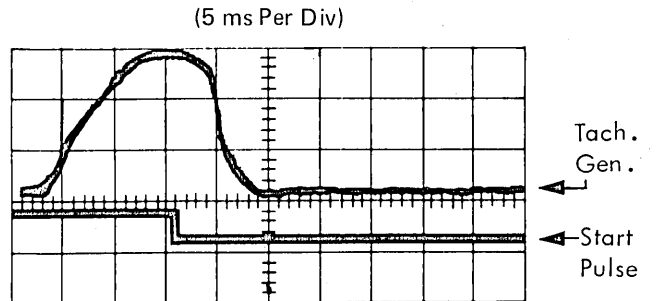


Figure 1-58. Triple-Space Singleshot

*Service Hint 13 – Carriage Emitter Timing*

(See 4.16.5.3.)

1. Magnet E1 emitter output must be correct. Section 4.16.4.
2. Sync on start pulse.
3. Double-space after print – 8-line drive (Figure 1-59).
4. Triple-space after print – 6-line drive (Figure 1-60).
5. Set emitter for best condition of E1 to singleshot time-out triple- and double-space (use expanded sweep)  $T1=T2$ .

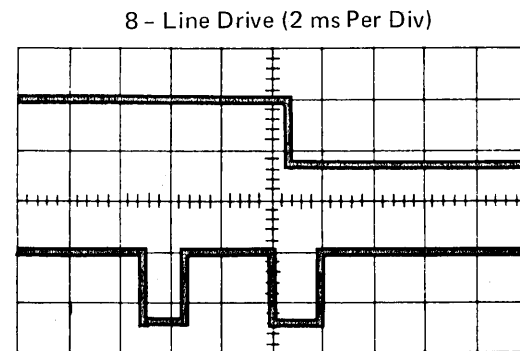


Figure 1-59. Double Space



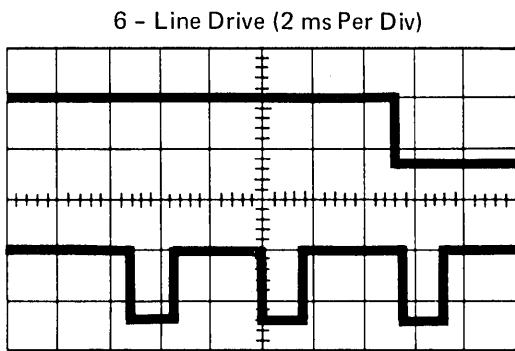


Figure 1-60. Triple Space

**Service Hint 14 – Carriage – Tape Brush Timing**  
(Each of 12 Brushes)

(Not required on buffer-controlled carriages.) (See 4.16.9.)

1. Slow speed skip.
2. Sync minus on carriage stop brush (Figure 1-61).
3. Scope E1 emitter.

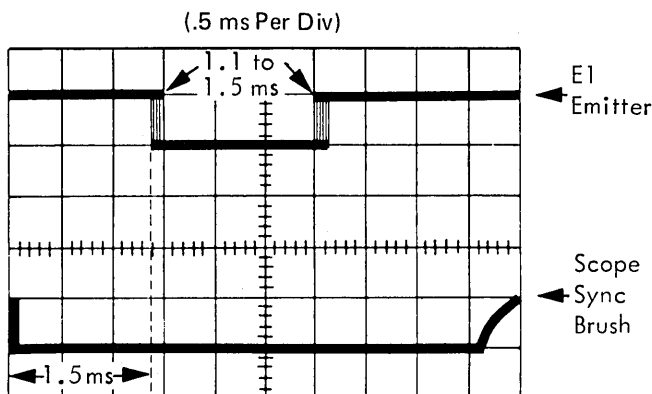


Figure 1-61. Carriage-Tape Brush Timing

**Service Hint 15 – Valve Body Removal**

Refer to 4.13.5 for the standard removal procedure. The following is a quick method for removing the valve body assembly to replace broken valve stems or make valve stem adjustments. This method is also feasible with hydraulic reservoir, part 475102. It saves replacing the gasket. Estimated time for removing the valve block assembly is 25 minutes. The special tool needed is a 3/16 in. allen head tip, part 451913, to be used with the ratchet screwdriver handle.

1. Drain oil out of the hydraulic unit.
2.
  - a. Remove reservoir top cover.
  - b. Remove leads to magnet coil.

3. Remove the two top screws that hold the exhaust baffle. Pivot the baffle gently to attain access to the valve block holding screws.
4. Use a ratchet screwdriver handle with 3/16 in. allen head tip. Remove the two bottom screws and then the two top screws. The block is now free to be removed from the hydraulic unit. A standard 3/16 in. allen wrench can be used to loosen the screws, if the screws are found too tight to start.

**DANGER**

Be careful when working on the reservoir unit. The access hole may have sharp edges.

**Service Hint 16 – Special Tool**

The following is a method to make a 3/16 in. allen head tip to fit the ratchet screwdriver handle when the special tip is not available.

Grind down a 1 in. (25, 4 mm) piece of 1/4 in. (6, 4 mm) allen wrench to fit a 3/16 in. (4, 8 mm) allen head. The shank should be 1/4 in. (6, 4 mm) to the ratchet screwdriver handle. This special tip can be used to remove the four-valve block holding screws.

**Service Hint 17 – Broken Valve Stem**

The first indication of a broken valve stem is continuous spacing with the machine not in operation or program running. If a broken valve stem is suspected, the top cover of the hydraulic unit should not be removed unless the hydraulic drive motor is turned off and valve stems checked. A broken valve stem can cause hydraulic fluid to spurt from the top of the valve assembly. Refer to Service Hint 15 for the removal procedure.

**Service Hint 18 – Valve Stem Locknuts**

The locknuts on the top of the valve stem can be checked without removing the valve block assembly. The valve block assembly must be removed to check the lower valve stem locknuts. Refer to Service Hint 15 for removal.

**Service Hint 19 – Hydraulic Unit Components – Checks and Purpose**

See Figure 1-62.

Check Component	Purpose
Space Needle Valve	Develops enough pressure for hydraulic motor to seat detent arm against backstop; and at same time permits oil flow through the hydraulic unit to drive at space speed.
Skip Needle Valve	Same as space needle valve, except that it drives in skip speed.
Bypass Needle Valve	Permits pressure bleed off from hydraulic motor to assist it in coming to a smooth stop when the space spool valve closes.
Control Valve Body Assembly	Transfers oil from space or skip pumps to hydraulic motor, or exhausts it back to the reservoir.
Check Valve (between space & skip pumps)	Prevents oil flow space pump through skip spool valve in its stopped position when space spool is in its start position.
Check valve (upper, between detent and space pump – mounted vertically)	Stops nipping when the carriage transfers from high to low speed. Defective valve causes the detent arm spring to break. Print alignment is not usually affected.
Oil Filler & Pumps	
Hydraulic pressure system for leaks or restrictions.	

Figure 1-62. Checks and Purpose of Hydraulic Unit Components

*Service Hint 20 – Lower Check Valve*

1. The purpose of the lower check valve is to prevent fluid from the space pump escaping into the skip pump return circuit when the skip stop magnet is energized.
2. A defective lower check valve (mounted horizontally in the hydraulic unit) causes slow carriage operation and poor waveform response when checking the hydraulic unit with a tach generator.

*Service Hint 21 – Upper Check Valve*

1. The upper check valve (mounted vertically in the hydraulic unit) stops nipping when the carriage transfers from high to low speed.
2. A defective upper check valve causes the detent arm spring to break. Print alignment is not usually affected by a faulty upper check valve.

*Note:* The upper and lower check valves are interchangeable. The valves can be interchanged to aid in troubleshooting when trouble is suspected in this area and no other valves are available.

*Service Hint 22 – Carriage Drift Speed*

To check carriage drift:

1. Place single-part forms in the tractors.
2. Use a 6-line drive.
3. Manually disengage the hydraulic unit detent.

Observe these points:

1. The paper should move up through the tractors.
2. Speed
  - a. Not faster than 3 inches (76, 2 mm) per second or .6 volt from the tach generator.
  - b. No low limit. However, the carriage should turn freely if assisted by turning the tractor knob with the detent disengaged.

Corrections:

1. Check bypass valve adjustment.
2. Check control valve body adjustments.
3. Check for binds in the tractor drive.

### Service Hint 23 – Carriage Magnet Coils

Check carriage magnet coils. Burned coils cause insulation to swell, which can interfere with the normal operation of the armature.

1. If slow-speed start coils are burned, check resistor panel (RP) position 36. (1403-N1 ECA 17.)
2. All capacitors should be checked (RP 30, 32, 34, 36) if any burned coils are found.
3. Binding pivots – check for binds with all power to printer off. Power to coils can appear to be a bind.
4. Open coils (one or both on any set of coils). The voltage drop across a pair of coils when energized is as follows.

Both coils good	Approx. 5.0 volts
One coil open	Approx. 10.0 volts
Shorted Capacitor	Approx. 30.0 volts or greater

When coils are de-energized:

Coils good	0 volts
------------	---------

If approximately 5 volts or more are measured, the circuitry should be replaced.

### Service Hint 24 – Carriage Speed

Slow carriage speed. Check rise of emitter pulse to rise of next emitter pulse.

1403	Slow speed	5.1 ms or less
	High speed	2.3 ms or less

If a slow hydraulic unit is indicated, the filter should be checked (4.14.5). (See Service Hint 31.)

### Service Hint 25 – Start-Stop Backstop Screws

Check for wear or peeling of the polyurethane coating. Adjustments must be done under power. Any change to backstop adjustments requires adjustment of the control valves (see 4.15.2.3).

If backstop screws are bad, the armature pad rivets can be loose or the armature cracked. Check carefully.

### Service Hint 26 – Forms Tractor

Tension should be adjusted for minimum slack without binds. Upper tractor pins should touch the top edge of the paper hole, while bottom tractor pins should touch

the bottom edge of the paper hole. No elongation should occur when moving paper manually with the paper advance knob. A slight amount of elongation is permissible under power. Refer to 4.5.2 for belt tension and tractor shaft positioning. Make certain that binds do not exist when turning the advance knob manually in neutral.

### Service Hint 27 – Hydraulic Drive Belt

Hydraulic drive belt should have 1/8 to 5/32 in. (3, 18 to 3, 96 mm) deflection halfway between the drive motor and eject pump. Use force of 1 lb. or 454 grams. Check for broken strands.

### Service Hint 28 – Fast Hydraulic Unit – Space Speed

E1 interval is less than 4.4 ms in space speed.

1. The skip spool valve is transferring along with the space spool valve.

*Check:* Operate the skip armature manually while in space speed. The armature should return to the stop condition.

2. Skip spool valve maladjusted:
  - a. Loose valve stem nuts
  - b. Binding pivot
  - c. Loose armature pads
  - d. Worn back stops
  - e. Control circuitry operating incorrectly (high and slow speed).

### Service Hint 29 – Erratic Start-Stop Conditions

This can be caused by a bent hydraulic unit output shaft, or by an intermittent bind in the tractor assemblies. Check by advancing the carriage manually in 6- and 8-line drive with the hydraulic detent arm *disengaged*.

*Note:* Raise the carriage tape brushes to prevent damage if the unit is turned backward.

### Service Hint 30 – Carriage Speed Check

Before making any adjustments, check the speed of the hydraulic motor to be sure it is not running slowly. A quick check of the printer speed can be made by scoping the output of the E1 emitter. (See Service Hint 24.)

Because the emitter is driven by the hydraulic motor output shaft, it gives a reliable indication of the hydraulic motor speed. The duration of the interval between the corresponding edges of successive emitter pulses should be less than:

1. 5.1 ms at slow speed and
2. 2.3 ms at high speed.

For convenience, these pulses are available at the E1 hub on the CE panel.

Normally, 5.1 ms for space or 2.3 ms for skip is the slowest a hydraulic unit operates. When a hydraulic unit is failing due to speed, there is usually a drastic increase in emitter pulse time (several tenths of a millisecond or more) or even a complete loss of emitter pulses. If there is a drastic reduction in speed, determine the cause (see 4.14.5).

If there is no drastic reduction in speed, make the carriage adjustments. If the carriage can be adjusted satisfactorily, further action is not required; however, if it cannot be adjusted satisfactorily and speed is still slow, determine the cause (see 4.14.5).

The space-and-skip needle valve adjustments affect hydraulic unit speed. Adjust needle valves to provide just enough back pressure to hold the detent against the backstop.

#### *Service Hint 31 – Slow-Running Hydraulic Unit (Space Speed)*

If the hydraulic unit runs slowly at space speed, check for the following possible causes.

1. Severe bind on tractor assemblies. With power off, check by advancing the carriage manually in 6- and 8-line drive with the hydraulic detent arm disengaged.

*Note:* Raise the carriage tape brushes to prevent damage if the unit is turned backward.

2. Clogged filter. Check for foam in the unit or bubbles coming from the exhaust baffle. Exhaust baffle must be on. Overtightening the filter squeezes the filter and causes the unit to run slowly.
3. Leak in the hydraulic pressure system. Bubbles or turbulence coming from any area in the hydraulic unit indicates a leak. This is usually caused by a trapped or missing O-ring. Bubbles coming from the filter indicate that the unit is running backward.

*Note:* In single-speed carriages the stream of fluid issuing from the open skip spool valve port can cause turbulence or a small geyser at the surface of the fluid, depending on the fluid level.

4. Check valve (between space and skip pump lower). An excellent check is to operate the skip armature manually with a minimum of 5 pounds of force to a start position while in a continuous space speed. If the unit now gets up to normal skip speed, the check valve is defective. Replace the complete check valve assembly rather than just replacing the components.  
Both check valves are similar and may be interchanged for checking purposes.
5. Space spool valve not opening enough in a start position. (See 4.15.2.)
6. Detent arm shorting magnet coil leads in hydraulic unit. (See 4.13.)

#### *Service Hint 32 – Single- and Double-Space Chart*

Figure 1-63 shows the carriage operation for single- and double-spacing and the associated waveform of the carriage motion.

#### *Service Hint 33 – Triple-Space Chart*

Figure 1-64 shows the carriage operation for triple-spacing and the associated waveform of the carriage motion.

#### *Service Hint 34 – Skip Chart*

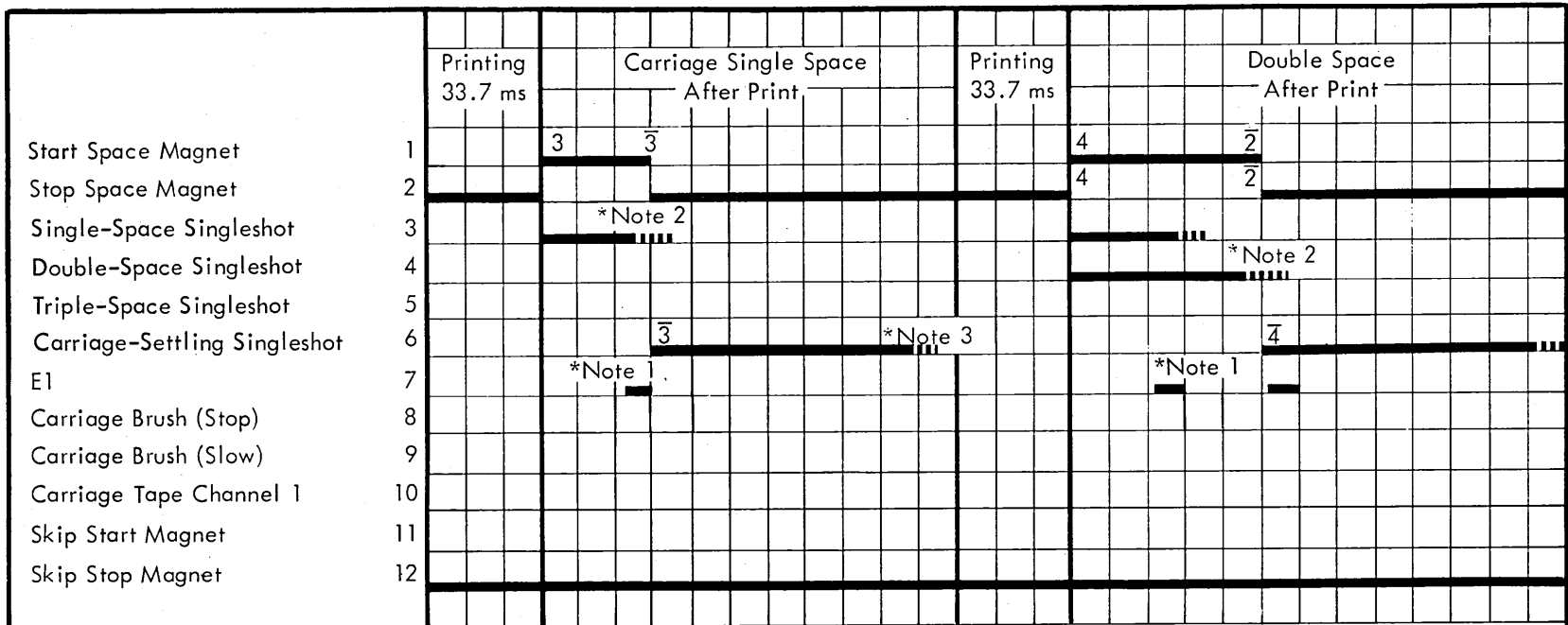
Figure 1-65 shows the carriage operation for skipping and the associated waveform of the carriage motion.

## 1.6 TRAIN AND CARTRIDGE

#### *Service Hint 1 – Cleaning*

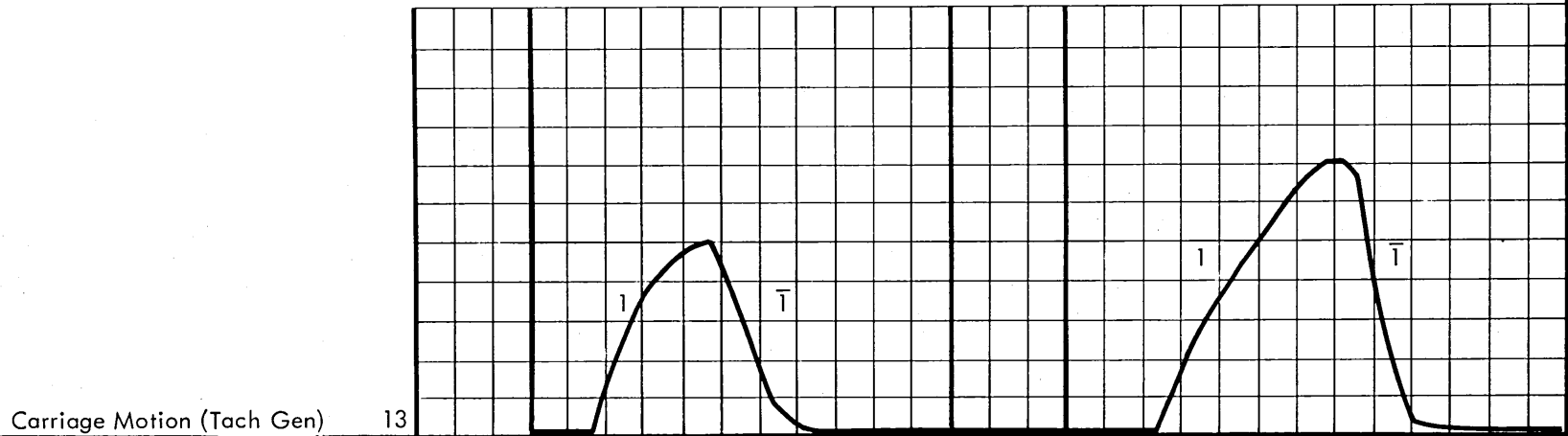
Type-cleaner paper (part 451529) should be run weekly on all trains, followed by a thorough vacuum cleaning of the train and T-casting area. It may be necessary to increase train PM frequency in accounts where print quality is a major concern.

Figure 1-63. Single- and Double-Spacing Chart and Waveforms



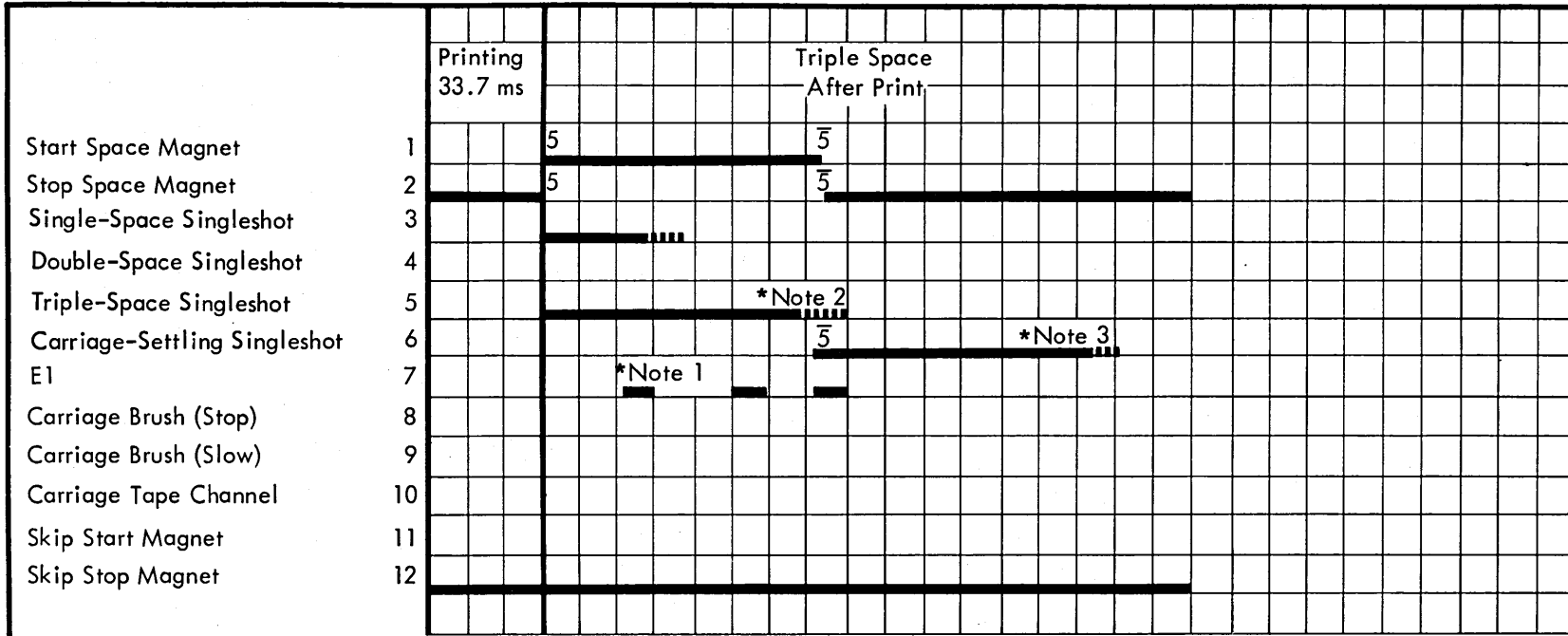
**\*NOTES:**

1. First E1 is not used to control carriage.
2. Single-, double-, and triple-space singleshots are adjusted for best carriage operation.
3. Carriage-settling singleshot adjustment depends on the length on the single-space singleshot.



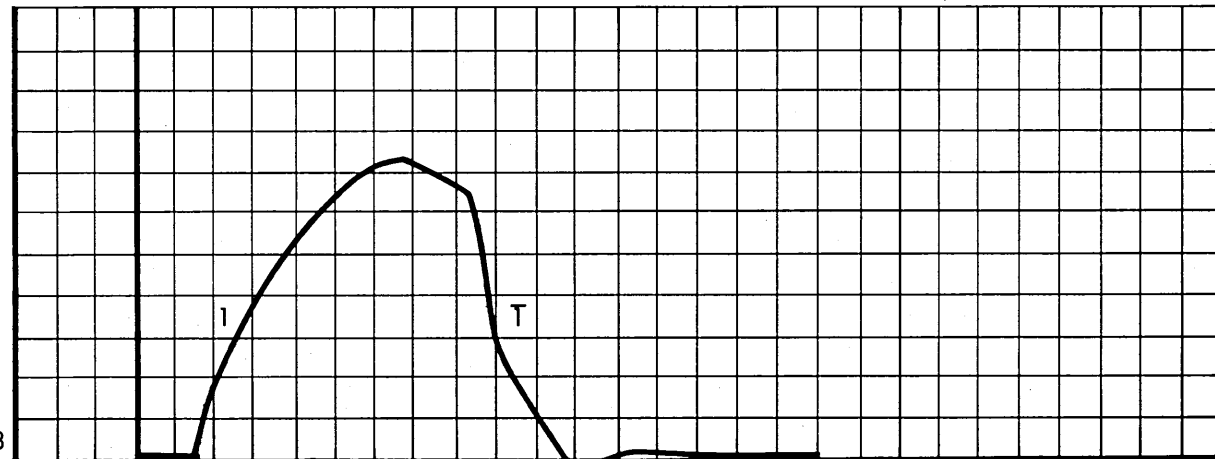
Scale = 2 ms Per Div.

Figure 1-64. Triple-Spacing Chart and Waveform



**\*NOTES:**

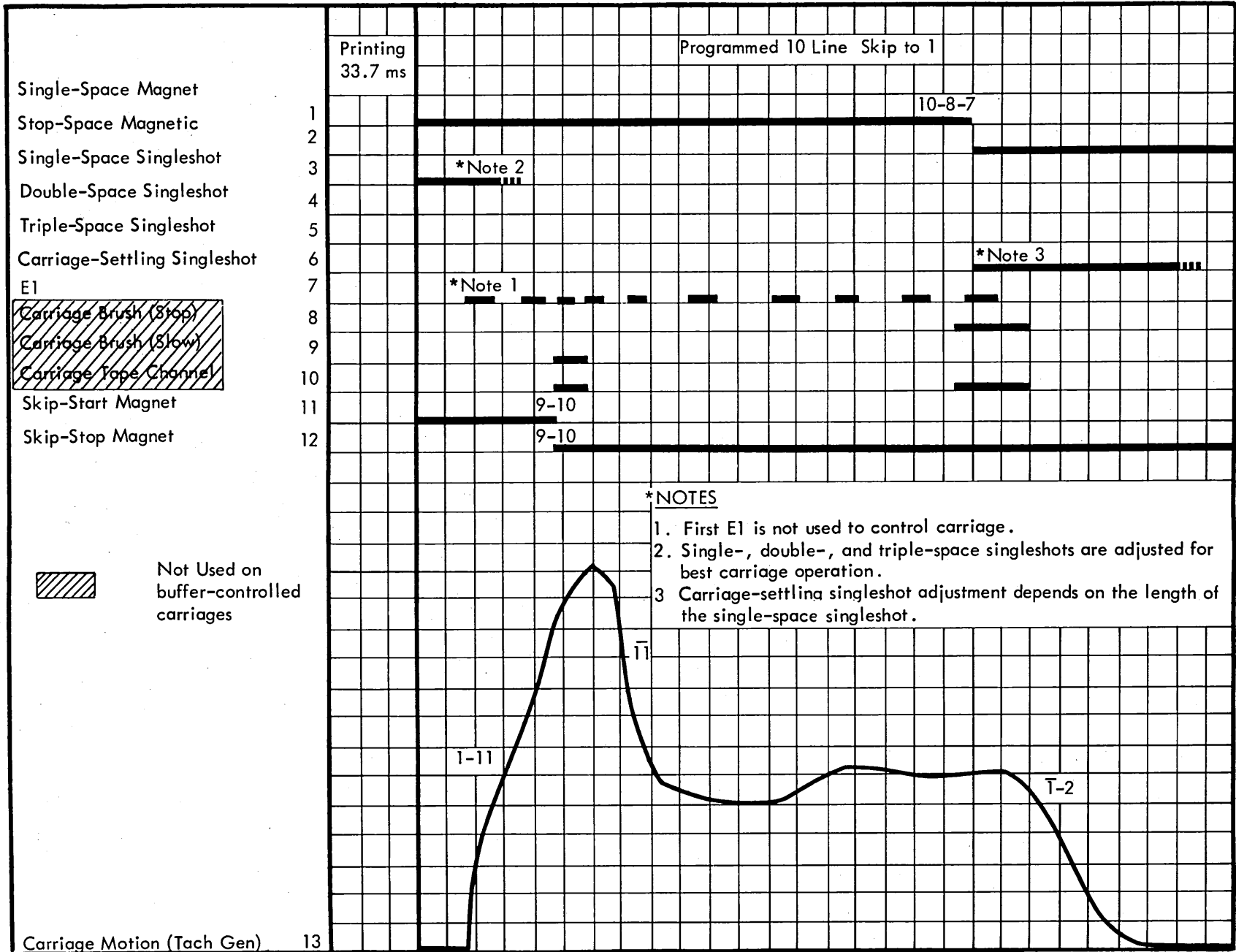
1. First E1 is not used to control carriage.
2. Single-, double-, and triple-space singleshots are adjusted for best carriage operation.
3. Carriage-settling singleshot adjustment depends on the length of the single-space singleshot



Carriage Motion (Tach Gen) 13

Scale = 2 ms Per Div.

Figure 1-65. Skipping Chart and Waveform



Scale = 2 ms Per Div.

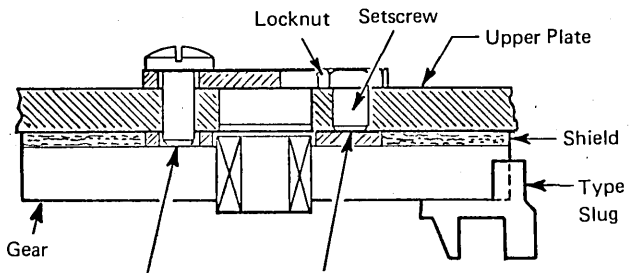
**Service Hint 2 – Slug-To-Slug Clearance**

Slug-to-slug clearance must be checked regularly. It should be checked after the cartridge has been cleaned as outlined in Service Hint 1, and before any additional lubrication is added to the cartridge as outlined in Service Hint 6. This is because oil in a seemingly insignificant film between slugs gives a false slug-to-slug reading. Slug-to-slug clearance is greater on a hot train; therefore, the .001 to .003 in. (0,03 to 0,1 mm) adjustment should be made on a cold train. (See 4.11.1.)

If slug-to-slug clearance is not maintained, rail and slug wear occurs.

**Service Hint 3 – Thrust Plates**

The brass thrust plates (Figure 1-66) must be kept in proper adjustment to prevent excessive motion or binds of the drive or idler gears. The .002 to .003 in. (0,05 to 0,1 mm) clearance between the setscrews and thrust washers is obtained by adjusting the setscrews.



Screw to project into hole to prevent rotation of plate  
 .002 - .003 (0,05 - 0,08) clearance between setscrew and thrust plate with gear against type slugs (2 places)

Figure 1-66. Thrust Plate

**Service Hint 4 – Drive Key**

Lubricate the train drive key (Figure 1-67) with a small amount of Lubriplate\* #70. Inspect the train drive key and the train drive gear keyway for wear. If either part is worn, replace it.

**Service Hint 5 – Drive Gear**

Inspect the timing disk gear inner circumference (Figure 1-67) and the train drive gear outer circumference (where it fits into the timing disk gear inner circumference) for worn areas. If wear is evident, replace the part.

\*Trademark of Lubriplate Div., Fiske Bros. Refining Co.

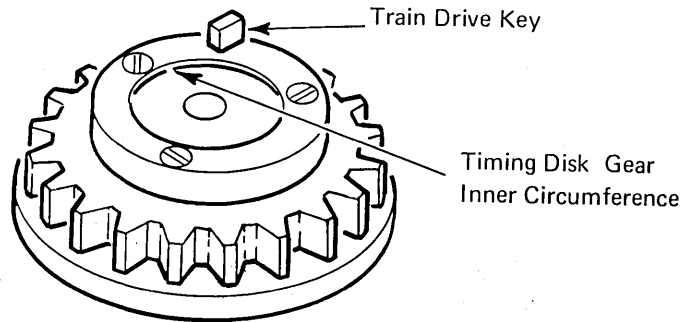


Figure 1-67. Timing Disk and Gear

**Service Hint 6 – Lubrication**

Check that oil is being transferred to the train wick. (Cartridge must have been mounted and the priming pump not operated for eight hours of machine time.)

1. Remove train cartridge.
2. Operate pump handle until oil appears. Oil should not appear until after 4 to 9 pump strokes.
3. Replace the train oil wick (part 856380) if oil appears after 1 or 2 pump strokes. Train wicks are not taking sufficient oil from the supply wick.

**CAUTION**

Use only special oil (part 856381) for train lubricant.

**Service Hint 7 – Oil Pump**

Check the oil level in the reservoir (Figure 1-68) on every PM. If oil level is below the 1/2 level in the oil level gauge, fill with special oil (part 856381). Use a short piece of tubing on the oilcan spout to facilitate filling. Wipe off excess oil.

The pump must be primed after the first filling and if the oil level goes below the oil level gauge, and when the supply tube is disconnected. (See 4.10.8.3.)

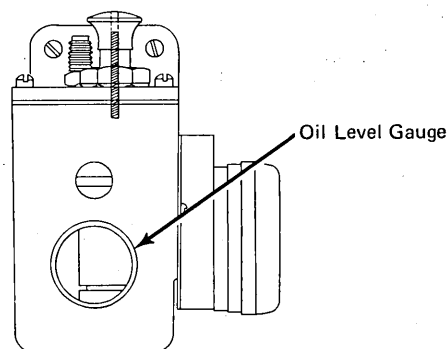


Figure 1-68. Oil Reservoir



### Service Hint 8 – Train Serial Tag

The 1416 Interchangeable Train Cartridge has a machine type number and requires a serial number tag for identification purposes. Care should be taken not to loosen the serial tag with cleaning fluid when cleaning the train. If the 1416 Interchangeable Train Cartridge does not have a serial tag, notify your field manager. He will obtain a tag of the correct color (black for leased, blue for purchased) with the proper serial number stamped on it.

### Service Hint 9 – Train Binding

If a binding condition exists that cannot be alleviated by normal train PM, off-cartridge train cleaning must be performed.

## 1.7 RIBBON UNIT

### Service Hint 1 – Reverse Drag Clutch

1. Upper ribbon reverse drag:
  - a. The ribbon drive plug should rotate freely counterclockwise (as viewed from plug end) with a ratcheting sound.
  - b. When rotated clockwise, there should be an even drag.
  - c. Check for sticking. The force to start the clockwise rotation should not be much greater than the force necessary to continue the rotation.
2. Lower ribbon reverse drag:
  - a. The ribbon drive plug should rotate freely clockwise with a ratcheting sound.
  - b. When the plug is rotated counterclockwise, the drag should be even.
  - c. Check for sticking. The force to start the counterclockwise rotation should not be much greater than the force necessary to continue the rotation.
3. Correction of malfunctions:  
(See 4.12.13.)
  - a. If the ratcheting sound is not heard in the proper direction:
    - Check the ratchet pawl and spring for binds.
    - Check for proper position. The ratchet pawl or friction ring can be installed backward.

- b. Sticking and binding reverse drag: (See 4.12.14.)
  - Disassemble the reverse drag.
  - Remove the friction ring (part 473780).
  - Clean all friction surfaces with cleaning fluid. This clutch must be free of all lubrication to operate correctly.

### Service Hint 2 – Ribbon Curling on Right End

The ribbon indicator bar is drawn too tightly against the train. This causes the ribbon to curl when the bottom spool is driving. This curling can cause the ribbon correction pawl to become inactive and force the ribbon to the left. (See Service Hint 23.)

### Service Hint 3 – Ribbon Sense Finger Failures

A failure to correct ribbon skew can result from an excessive rise of the sense finger lever assembly (part 856307) (Figure 1-69). This condition causes the sense finger to erroneously fall down and fail to correct the ribbon back to the right.

With the sense finger lever on the high dwell, the distance between the bottom of the sense finger and the ribbon path should be  $5/32$  in. (3,96 mm).

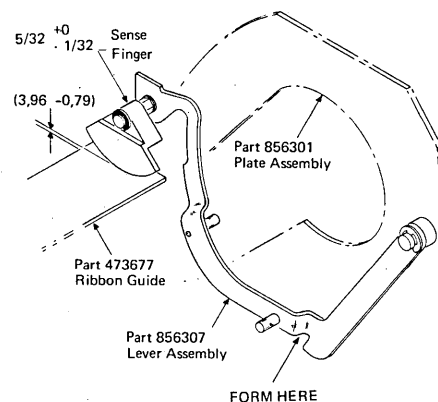


Figure 1-69. Ribbon Sense Finger

### Note:

1. Do not in any way bind the sense finger pivot.
2. Do not in any way try to adjust plate assembly.

### Service Hint 4 – Ribbon Reverse Arm Striking Upper Ribbon Roll

This can make the ribbon reverse arm inactive if the ribbon reverse mounting plate is not adjusted properly.

## Adjustment Procedure

Put forms thickness lever on .019 in. setting. Position the reverse arm mounting plate all the way toward the paper path by loosening the two mounting screws. One of these is used as a pivot screw for the pivot plate.

### *Service Hint 5 – Ribbon Reversing Failure*

Failure of the ribbon to reverse can result if the toggle plate spring (black – part 473795) and the ribbon reverse level spring (cadmium-plated – part 473796) are interchanged. The ribbon reversing switch (operated by the toggle plate) is on the left; the ribbon correction switch is on the right.

## 1.8 COVERS

### *Service Hint 1 – Binds*

If the inside top cover guide (right) catches on the top-right frame seal, form both corners (Figure 1-70) on the top-right frame seals and inside right cover guide so that clearance exists when the cover is raised.

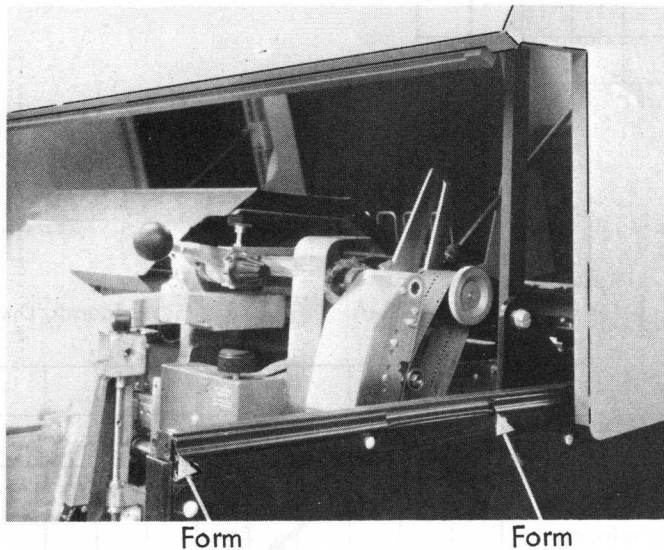


Figure 1-70. Correcting Binding Cover

### *Service Hint 2 – Cover Reversing Before Reaching Bottom*

If this condition exists, chain may need oiling, clutch may need grease, or the cover-lift screw may need adjusting (see 4.2.3).

### *Service Hint 3 – Cover Reaches Bottom and Reverses*

If this condition exists:

1. Obstruction override switch may be set too closely. Readjust switch (4.2.21).

*Note:* If switch is set too closely (or too far down), the cover clamps down and does not reverse if an obstruction is encountered.

2. Floor may be uneven or unsteady and may require additional bracing under the casters.

### *Service Hint 4 – Cover Chatters When Reaching Bottom*

If this condition exists:

1. Limit down switch may not be properly adjusted. Readjust switch (4.2.20).
2. Floor may be uneven or unsteady and may require additional bracing under casters.

## 1.9 DRUM TRANSDUCER

### *Service Hint 1 – Transducer*

1. The amplitude of the transducer output (Figure 1-71) is critical and must be checked correctly. Check for 50 to 150 mV with the scope vertical input to pin B or D of SA-1 and the scope ground to pin J. If 50 to 75 mV are noted, the clearance of the transducer to the drum should be checked. If clearance is .001 in. (0,03 mm) or less, the transducer should be replaced. The output of transducer should be directly proportional to the distance the transducer is from the drum; that is, minimum clearance of .001 in. (0,03 mm) should result in a transducer output somewhere in the upper range (100-150 mV), and a maximum clearance of .002 in. (0,05 mm) should result in a transducer output somewhere in the lower range (50-100 mV).
2. Sufficient sweep time must then be used to display a complete drum revolution, which is approximately 35 ms. The overall envelope of drum pulses should be nearly constant.

In the example shown in Figure 1-72, the runout of the drum is such that all points around the drum do not produce an acceptable minimum level. This drum should be replaced.

The example shown in Figure 1-73 is representative of the scope trace and is fully acceptable. There is no signal dropout below the minimum specification.

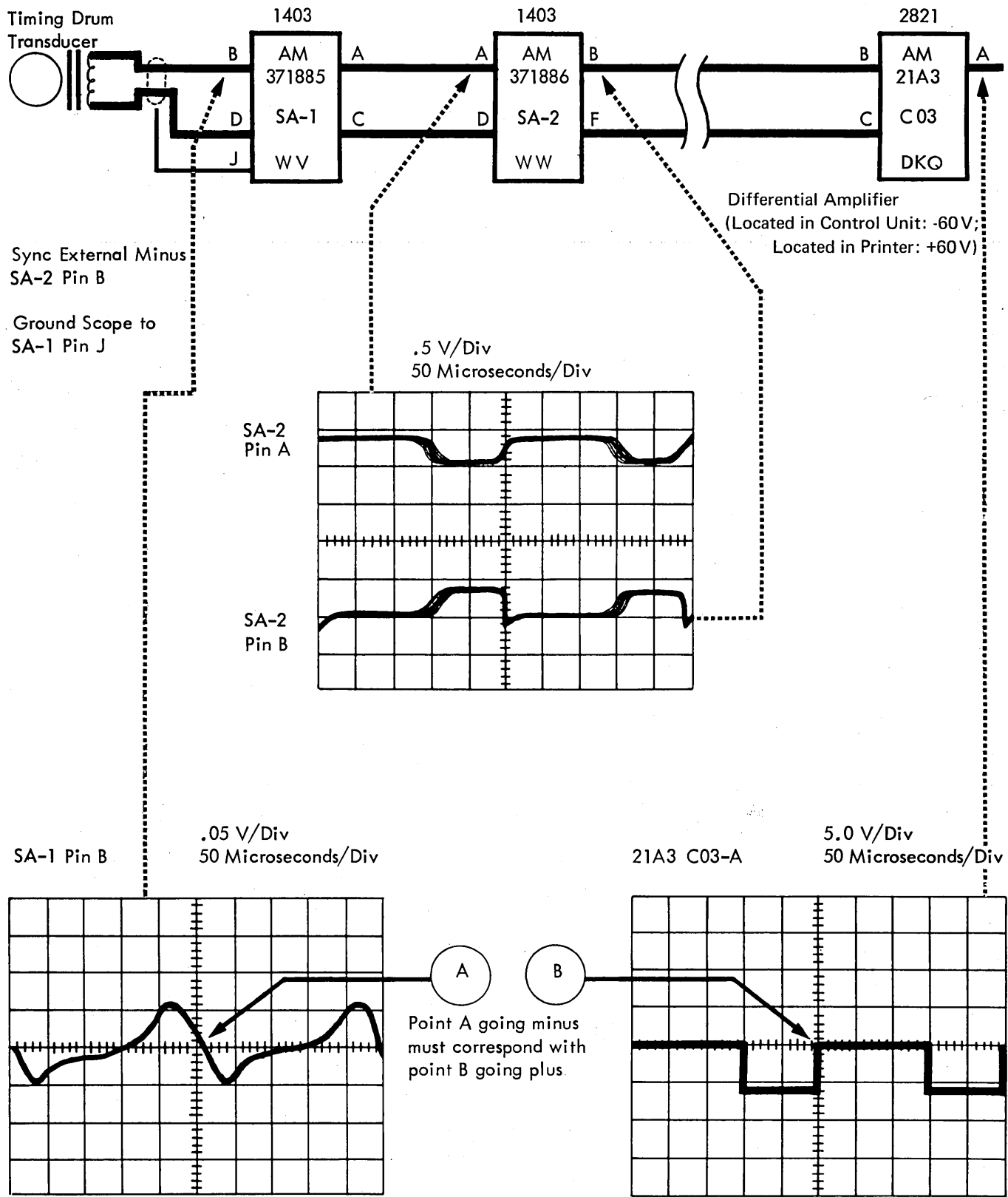


Figure 1-71. Drum Transducer Timing Points

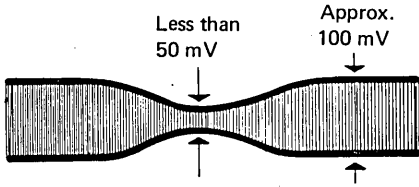


Figure 1-72. Drum Scope Trace (Not Acceptable)

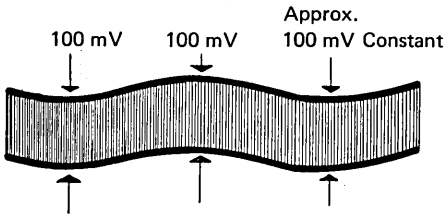


Figure 1-73. Drum Scope Trace (Acceptable)

3. The output of SA-2 (Figure 1-74) is pictured for reference. Set scope vertical on .2V per centimeter. Internal sync may be used.
4. The -6V to the sense amp card sockets should be checked and adjusted if necessary. The -6V adjustment potentiometer is located in the control unit to which the printer is attached.

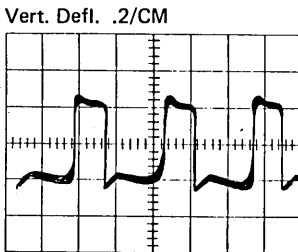


Figure 1-74. SA-2 Pin-B Output

#### Checking for the Correct Level of Transducer Output

*Note:* All checks made with SA-1 and SA-2 cards in sockets. Internal sync may be used.

1. Sync checks can be caused by metal chips in the train drive grease cavity. These chips may pass between the transducer and the drum effectively causing an erroneous PSS pulse. If this condition is found, the cavity must be thoroughly cleaned and new grease used. Use IBM #17 only. When gears are being replaced, check new gears to ensure that no burrs or chips are clinging to the gear teeth.
2. Binding may occur if the train drive motor gear is loose or adjusted such that it rides on the top of the movable base casting. This gear should be positioned to mesh evenly with the train drive idler gear, while maintaining at least .005 in. (0, 1 mm) clearance between the train motor gear and the top of the movable base.

3. The transducer mounting bracket (Figure 1-75) may not fit properly on the gear stud. A burr may be present as shown on illustration (point A) that prevents proper seating of the bracket.

If the transducer bracket does not fit properly for any reason, it must be replaced. Check the new parts for burrs before installation in machine. The bracket must be flat and fit snugly over the gear stud.

4. Motor, idler, and drum gear teeth should be checked for smoothness if sync checks are experienced. An improperly finished gear appears to have wire brush marks across the face of the teeth. The drive motor gear to idler gear clearance must be checked as outlined under 4.10.5.
5. Gear bearings must rotate smoothly (no rough spots) with little or no end play.
6. A static comb is provided (on the 1403-N1 only) just above the stacker tilt-out cover pivot. It should be adjusted for maximum contact with the paper to remove maximum static. Check that mounting screws are tight while still permitting operator adjustment. On 1403-N1 printers, after approximately serial number 33710, the comb is replaced by tinsel. Make certain this tinsel and the tinsel near the feed rolls are installed properly.

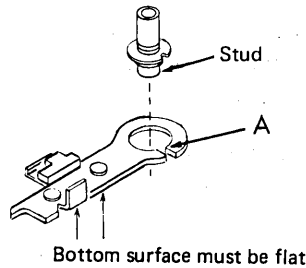


Figure 1-75. Transducer Mounting Bracket

## 1.10 STACKER (IMPROVED)

### 1.10.1 Stacker Improvement Device

The stacker improvement device provides the following changes that improve stacking under certain skipping applications.

1. Reduced stacker feed-roll speed to feed forms onto the stack at a slower rate.
2. Conductive stacker rolls to reduce buildup of static charge from forms passing through the stacker.
3. Static eliminators to remove a greater amount of the static charge from forms entering and leaving the stacker.

If stacking problems occur, install the stacker improvement device. All 1403-N1 printers after approximately serial number 33710 have the improved stacker installed.

### 1.10.2 Improved Stacker Circuit Adjustments

To provide proper forms throughput, the stacking improvement circuit should be adjusted as follows:

1. Install a carriage type with a channel-1 punch every 66 lines (11-inch form).

*Note:* MFT 058 may be used on System/360 Model 20.

2. Remove the forms from the printer and block the forms contacts with a blank card.
3. Engage the carriage clutch in 6-lines-per-inch drive.
4. Set up a print and skip-to-channel-1 loop with blanks in the print area.
5. Start the program and scope the carriage low speed start signal.
6. Adjust the potentiometer on the card such that the time between the rise of one low speed start signal and the rise of the next one is 315 milliseconds. In no case should the setting be less than 315 milliseconds.

When adjusting the hydraulic carriage, continuous high speed can be maintained. See system logics. Reinstall cards or remove jumpers after adjustments are made.

*Note:* The stacking improvement circuit may be installed even though the printer does not have the improved stacker installed.

#### Service Hint 1 – Noise

Excessive noise can be caused by worn feed rolls. Replace rolls as needed.

## 1.11 CARTRIDGE AIR DAMPER

### 1.11.1 Operation

When the gate interlock handle is closed, the air forces the flipper open and the air path is normal.

When the gate interlock handle is opened, the cartridge air damper magnet (Figure 1-76) picks and holds. The armature tip holds the flipper closed until the gate interlock switch is made.

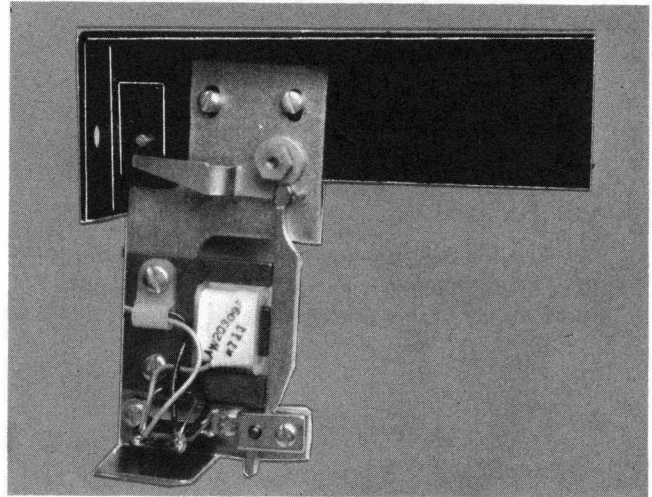


Figure 1-76. Cartridge Air Damper

### 1.11.2 Adjustment

With the gate interlock open, loosen the two upper armature assembly mounting screws and position the assembly for a minimum amount of air flow through the duct. After making this adjustment, close the gate interlock handle and check for normal air flow.

## Chapter 2. Console and Maintenance Features

Except for the occasional changing of a burned-out indicator lamp, the console of the 1403 printer requires no maintenance.

The tools recommended for maintenance and service on 1403 Printer Models N1 and 3 are:

Tool	Tool Number
Hammer Magnet Adjusting Tool	856170
Hammer Unit Alignment Tool	452457
Service Rail Right	474067
Service Rail Left	474068
Tach Generator	450976
Tach Generator Coupling	451290
Tach Generator Cap. (1 mfd)	253826
Hydraulic Motor Output Shaft Aligning Tool	450980
Box End Wrench Hammer Unit Adjustment	856481
Cover Lock Safety Hook	841080
Pocket Comparator	451595
Pocket Comparator Reticle 407-1	451597
Pocket Comparator Reticle 407-E1	451596
Pocket Comparator Reticle 1428	451995
Feeler Gauge Brass .005 in.	2200007
Feeler Gauge Brass .007 in.	2200057
Feeler Gauge Brass .002 in.	2200006
Push-pull Scale-10 pound (Office Tool)	461141
Push-pull Scale-6 pound (Office Tool)	460870
Print Alignment Tool	2360173

## Chapter 3. Preventive Maintenance

The prime objective of preventive maintenance is to provide maximum machine availability to the customer. Unless a preventive maintenance operation reduces machine downtime, it is unnecessary. Figure 3-1 shows the recommended preventive maintenance for single-shift operation. When used by more than one shift daily, increase the maintenance frequency accordingly.

Be alert; visually check for trouble indications any time you service the machine. Look for corrosion, wear, cracks, burned contacts, and loose connections. Watch for filters clogged with dirt.

The three basic steps of preventive maintenance are: cleaning, lubrication, and inspection. Do not do more than the preventive maintenance scheduled on equipment that is operating satisfactorily.

P.M. Routine							
Location Operation	Freq. (Months)	*Freq. (Months)	Lubricate	Clean	Observe		
Train	1/2	1/4		Clean type with vacuum cleaner as required. Clean typeface with IBM Type-Cleaning Paper, Part 451529. For operator cleaning instructions refer to SRL GA24-3073.	Check oil level reservoir sight glass. If less than 1/2, refill with oil (part 856381). Check that oil is available at end of wick in movable base. Check by pressing a white piece of paper against the wick. A light oil film on the paper indicates sufficient lubrication.		
Blowers	1	1			Check blowers for proper operation.		
Ribbon Dr. Mtr.	2	2	Bearing oil cups (2 oil cups) IBM #6 (8 drops each cup)		Not required for WT machines.		
Ribbon Reverse	3	3	Toggle plate pivot IBM #6. Reverse toggle spring anchor IBM #24. Skew roller pivot IBM #6.	Wipe excessive oil and grease from all areas to prevent contaminating ribbon.	Check for wear and correct ribbon reverse and skew operation.		
Ribbon Drive Unit			All gears Lubriplate #70 (light film): all bearings, pivots, and clutch shafts IBM #6. Friction disk interposer stud and ball IBM #6.	Keep friction reverse-drag surfaces oil free. Wipe excessive oil and grease from all surfaces to prevent contamination of ribbon.	Check for wear and binds. Check for correct operation.		
Ribbon Dr. Gear Reduction Housing			Without oil-level hole: 1/8 ounce IBM #6 to cup on top (may have screw instead of cup). With oil-level hole: fill with IBM #6 to oil-level hole. Replace screw.				
Ribbon Correction Device			Light film of Lubriplate #70 on eccentric.	Clean any contamination from the low points on cams.			
Ribbon Shield and Guide Bar			1		Clean		
Train Dr.			3	Light film Lubriplate #70 on drive key.	Clean off old grease first, and check for wear of key.		
Train			1	Fill oil reservoir with special lubricant, part 856381.			Check accumulated slug-to-slug clearance. Free train movement with .001" between butts of two type slugs. Slight binds in train movement with .003" gage. (Check only after cleaning train.)
Forms Cart Mod. 3	3	3			Check for proper grounding. Check grounding strips for foreign material.		
Print Quality			1			Check horizontal and vertical print registration.	
			2			Check hammer unit to paper path alignment.	
						Check forms compressors for proper tension.	
						Check train-to-hammer-unit position.	
			Check hammers and type faces for wear.				

\*Freq. (months): when the application of the printer demands a critical quality of print, use this column for P.M. frequency.

Figure 3-1. Preventive Maintenance Routine (Part 1 of 3)

P M Routine

Location Operation	Freq. (Months)	*Freq. (Months)	Lubricate	Clean	Observe
Cover (N1)	3	3	Use IBM #9 1. <u>Cover lift screws</u> Top anchors casting pivots (4 places). 2. <u>Top cover lever arms</u> Operating pivots--each end. Bell crank pivots--both sides. 3. <u>Counter balance pulley pivots</u> (6 places through holes provided.) 4. <u>Hinges</u> Top cover (at rear of machine) front cover (where attached to top cover). Front Loading door.	Excess oil and dirt.	Check upper left corner of the front forms door for sharp edge. File as necessary to blunt edge.
Carriage Tape	4	4			Replace on buffer-controlled carriage.
Hammer Unit	6	3	No lubrication required.		Check that pushrods are free and straight. Check that armatures, hammers, and form compressors are free to pivot.
Strip Residual		1		Replace as necessary.	Do not allow strip to wear through. Check for loose magnet coils.
Hammer Unit Blower		6	WT blower motor IBM #6	Replace blower air filter as necessary.	
Translator	6	2			Check the translator vernier and lock adjustments.
Hammer					Check the impression control bar adjustment.
T-Casting					Check the adjustments for the movable-base.
Timing Disk		6			Scope disk head output for 50-150 mV (one leg to ground). Adjust head to disk gap to .001" to .002". (Do not go more than .002".)
Train Dr.			Fill train drive gear housing with IBM #17 to just over the bottom of the gears.		Check that grease is lubricating all gears.
Tractor Feed			Light film Lubriplate #70 on tractor drive pulleys, tractor shafts, and operating surface of tractor belt.		Check tractor adjustments as required.
Stacker				Clean as necessary	Check for wear on friction drive roll. Check the tensile condition and position to the paper line.
Carriage Tape Read			Contact roll bearings IBM #6	Clean contact rolls and drive sprocket.	Check tape brushes for bent or broken stands. Check brush tracking and all stop brush timings to E1.

\*Freq. (months): when the application of the printer demands a critical quality of print, use this column for P M frequency.

Figure 3-1. Preventive Maintenance Routine (Part 2 of 3)



P M. Routine

Location Operation	Freq. (Months)	*Freq. (Months)	Lubricate	Clean	Observe
Hydraulic Unit	6	6	Light film of Lubriplate #70 on drive belt.		Check timing belt tension. When leakage is apparent, check for correct hydraulic fluid level (approximately to bottom of coils).
6-8 line drive			Apply light film Lubriplate #70 on active surfaces of all gears, shift fork, camming plate, and detent wheels. Apply IBM #6 on the detent arm pivots and rollers. Lubricate whenever this area is entered on service call.		Check 6-8 line detent retaining collars for loose setscrews.
Frame T-Casting Phenolic Support Chock			Use light film Lubriplate #70 on active surfaces of gears, slides, guides, and levers. Use IBM #6 on bearings, bushings, pivots and T-casting jack-screw pivot.		Check for wear and binds. Check adjustments.
Cover (N1)			Use IBM #20 1. Sprocket teeth and drive chain light film. 2. Safety clutch--with clutch disengaged, lubricate fitting until grease appears at relief holes. Light film in V-notch and surface around V-notch. 3. Obstruction switch operating arm at point of contact with flange on clutch. 4. Cover lift screws, thrust bearings, lubricate fittings. Screws and nuts-light film.	Excess grease/oil and dirt.	Check tension. Check for smooth detenting of clutch assembly.
	Use IBM #9 1. Stacker gate hinges 2. Door and gate latches 3. Obstruction switch operating arm pivot.		Check that obstruction switch is made.		
Ribbon Cover	12				Check for sharp edges. File as necessary to blunt.

\*Freq. (months): when the application of the printer demands a critical quality of print, use this column for P M frequency.

Figure 3-1. Preventive Maintenance Routine (Part 3 of 3)

Apply lubrication only in the quantity necessary to supply the immediate area involved. Wipe off excess. On the 1403, take special care to keep lubricants away from:

Ribbon	Ribbon drive clutches
Paper path	Cover seals
Electrical wiring	Rubber dampers
Ribbon drag brakes	Grommets

### 3.1 TRAIN CLEANING

#### 3.1.1 Off-Cartridge Cleaning

Always remove the train of slugs from the cartridge if the train requires cleaning. Never immerse the complete cartridge into a cleaning fluid. When there is train bind, it is evident that the train needs cleaning.

1. Remove the train from the cartridge (refer to 4.11.3).
2. Wash the type slugs in IBM cleaning fluid (part 450608) or equivalent, using a brush. Place the slugs on a rag or paper towel and allow them to dry.
3. Use a clean rag or paper towel and wipe the plates clean. (If IBM cleaning fluid is used, be sure it does not contaminate the felt pads.) Use a brush to clean out the angular cleaning slots at each end of the base plate.

#### 3.1.2 On-Cartridge Cleaning

Using on-cartridge train cleaning helps maintain print quality and prevents excessive accumulation of ink and ribbon debris. Periodic use of type cleaner reduces the frequency of cartridge disassembly.

Type cleaning paper (part 451529, or equivalent) is available for use in cleaning 1403 print trains. The cleaner comes in a box of twenty perforated 14-7/8 x 11 in. (377, 8 x 279, 4 mm) sheets (Figure 3-2) punched along edges for tractor-pin feeding. Use the cleaner as follows.

1. Remove the ribbon from the machine.
2. Vacuum loose debris from the train:
  - a. Butt the vacuum-hose nozzle against the lip of the cartridge and rotate the train by hand. The narrow vacuum crevice tool is excellent for train cleaning.

#### CAUTION

Do not clean at the cartridge radius where the type slug crevices are open unless a vacuum is used.

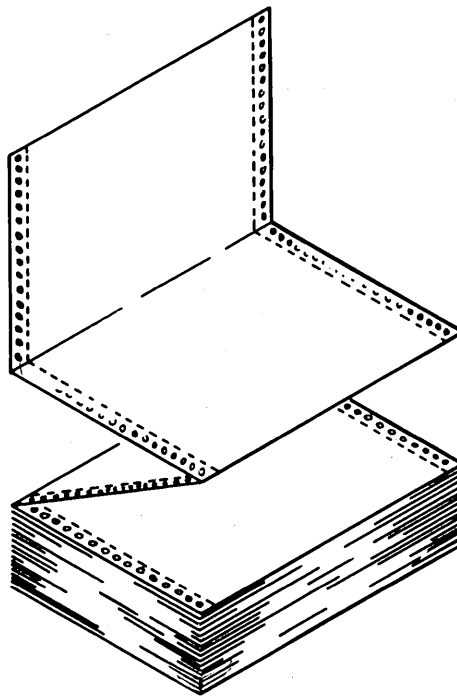


Figure 3-2. Type Cleaning Paper

- b. Check the train for binds caused by dirt accumulation. If necessary, clean the train as described in 3.1.1.
3. Install the type-cleaning paper on the tractors, just like any other form. Be sure the crepe side is facing you.
  4. Position the paper and tractors so the entire print line is between the perforated margins.
  5. Close and lock the print unit.
  6. Set the print-density control knob to C and the form thickness lever to .019 in.
  7. Put the carriage drive in neutral and press check reset. (This turns off the forms check light.)
  8. Leave the top cover open, and with a suitable ripple-print program loaded, press START. The machine starts printing a ripple pattern designed to print every character in every print position many times.
  9. Using the paper advance knob, space the paper manually every five to six lines while printing until the type faces are clean as indicated by a light printed line.
 

More than ten print lines on the same space should be avoided because this tends to shred the crepe surface of the paper. The shreds that flake off may lodge between the type slugs and damage the train.
  10. Remove and discard the dirty cleaning paper. Reinstall the ribbon.

## 3.2 OCR PRINT-QUALITY REQUIREMENTS

When the 1403 printer is used in OCR (optical character recognition) applications, the operator must take certain precautions to ensure acceptable print quality.

These include:

1. Using recommended ribbon/paper weight combinations.
2. Adjusting print density as required.
3. Replacing ribbons as required.
4. Cleaning the type faces.

For details, refer to *IBM 1403 Printer Component Description*, Order No. GA24-3073, "Print-Quality Requirements."

### 3.2.1 Ribbons

For applications in which OCR is used exclusively or extensively, the IBM OCR ribbon (part 414486), or equivalent, is recommended for use on all 1403 N1 and Model 3 printers.

### 3.2.2 Ribbon Life

Ribbon life depends upon the amount of ribbon usage. Because new ribbons contain more ink than used ones, the initial print density (darkness of impression) is heavy. The more the ribbon is used, the less ink it contains and the lighter the print density becomes. Therefore, the print-density control setting must be adjusted accordingly.

In OCR applications, check the print density at the beginning of the job and periodically throughout the run. Adjust the print-density control as required to maintain the best print quality.

When printing becomes so light that further adjustment produces no appreciable improvement, replace the ribbon.

## 3.3 COVERS

### 3.3.1 Cover Drive Motor

The top cover drive motor has sealed bearings. These are lubricated during manufacture and need no further lubrication.

### 3.3.2 Sprocket Teeth and Drive Chains

Lubricate all chain sprockets every six months. Apply a light film of IBM #20 lubricant, or equivalent, to all the teeth on the sprocket wheels and their associated drive chains.

### 3.3.3 Safety Clutch

The safety (cover drive) clutch rotates about a shaft. A grease fitting is provided at the top end of this shaft. With the clutch disengaged (pin out of drive notch), pump IBM #20 lubricant into this fitting until it appears at the relief holes (Figure 3-3). Also apply a light film to the V-notch and the surface of the clutch containing the notch. Do this every six months.

### 3.3.4 Obstruction Switch Operating Arm

The obstruction switch operating rocker arm (refer to Figure 3-4) should be lubricated with a film of #20 lubricant at its point of contact with the flange on the clutch. Also apply IBM #9 at its pivot. Both items should be performed every six months.

### 3.3.5 Cover-Lift Screw Thrust Bearings

The cover-lift (operating) screw(s) passes through a pivotable casting with a grease fitting on the front side. Every six months pump IBM #20 lubricant into these fittings until the lubricant appears at the thrust bearing surfaces (Figure 3-5).

### 3.3.6 Cover-Lift Screws and Nuts

Apply a light film of IBM #20 lubricant to the cover-lift screw threads and nuts every six months (see Figure 3-5).

### 3.3.7 Cover-Lift Screw Top Anchors

Apply a few drops of IBM #9 lubricant every three months to the pivot screws (two places).

### 3.3.8 Cover-Lift Screw Casting Pivots

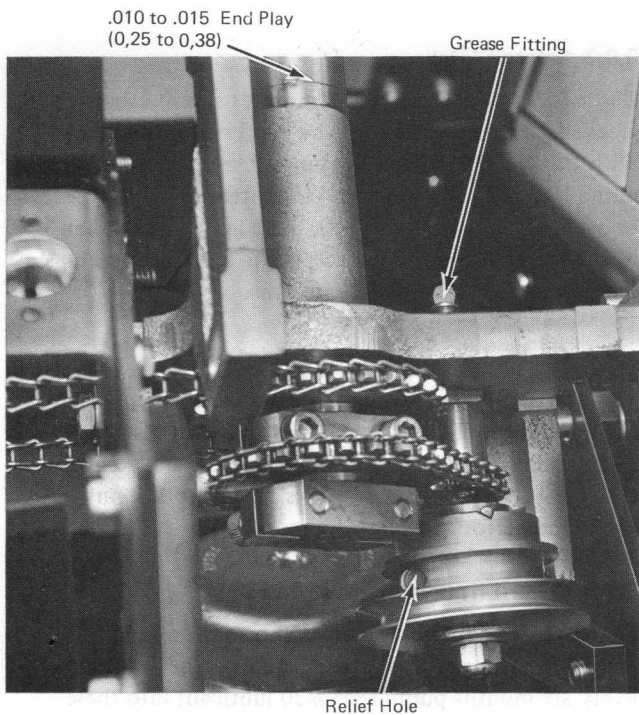
Lubricate both sides of each of the two cover-lift screw casting pivots every three months. Use IBM #9 lubricant.

### 3.3.9 Top Cover Lever Arm Pivots

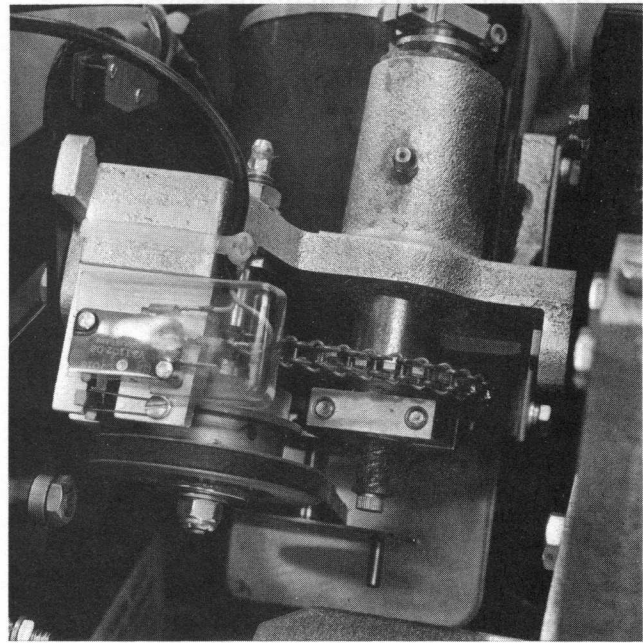
These are the long arms attached to the top cover and counterbalance springs, and pivoted on the heavy bellcranks. Every three months, lubricate the operating pivots at each end of these arms, as well as both sides of the bellcrank pivots, with IBM #9 lubricant. Refer to Figure 3-6. The counterbalance cable passes through one of these pivots. At the same time, lubricate the cable anchor bushings in the lower ends of the bellcranks.

### 3.3.10 Counterbalance Pulley Pivots

Lubricate each of the six counterbalance cable pulley pivots with IBM #9 lubricant (refer to Figure 3-6). Apply the lubricant through the holes provided (both sides, three places) at three-month intervals.



Double-Lift Screw



Single-Lift Screw

Figure 3-3. Safety Clutch Lubrication (Double and Single Lift Screw)

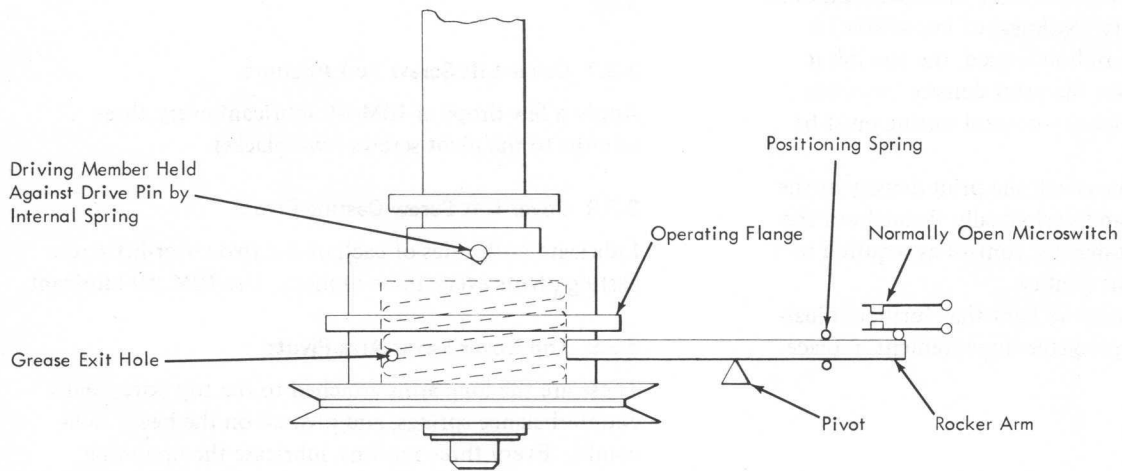


Figure 3-4. Obstruction Switch Operation

**3.3.11 Top Cover Hinges**

These are the two hinges at the rear where the top cover opens from the front. Lubricate every three months with IBM #9 lubricant. Be sure to lubricate both hinges.

**3.3.12 Front Cover Hinges**

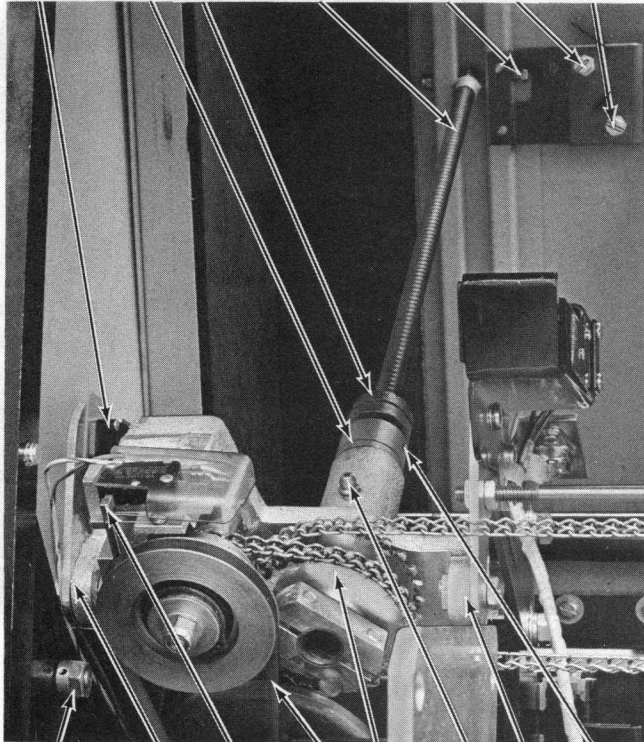
These are the two hinges connecting the top cover to the front cover. The top cover pivots on these hinges when

it opens from the rear. Be sure to lubricate both these hinges every three months with IBM #9 lubricant.

**3.3.13 Front Loading Door Hinge**

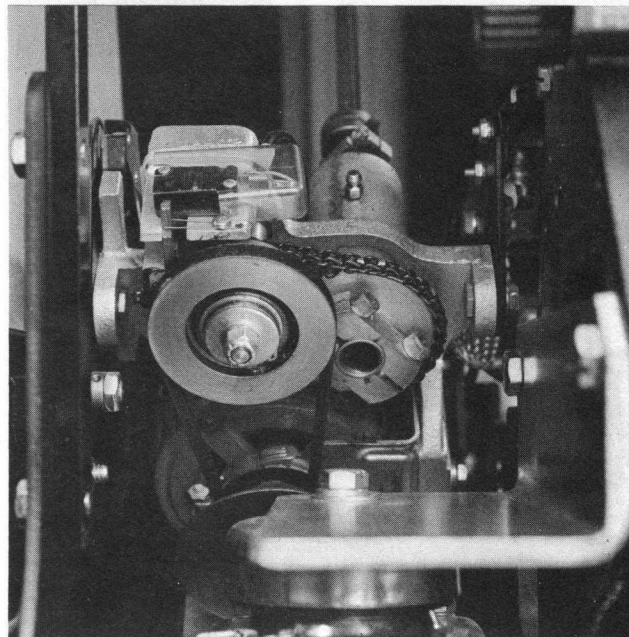
This is the piano hinge on which the transparent access door to the forms-storage area pivots. Lubricate this hinge lightly with IBM #9 lubricant. Wipe off excess lubricant to prevent it from dripping on the floor or getting on the customer's clothing. Do this every three months.

Limit Up Switch    Thrust Bearing Nut    Cover Lift Screw (2)    Top Anchor Pivot Screw (2)    Override Switch Adjusting Screw    Limit-Down Adjusting Switch Screw



Bellcrank Pivot (Both Sides of each Bellcrank)    Casting Pivot (Both Sides)    Obstruction Switch Operating Arm    Drive Belt    Sprocket Wheels (4)    Grease Fitting (2)    Casting Pivot (Both Sides)    Hole for Locking Screw

Double-Lift Screw



Single-Lift Screw

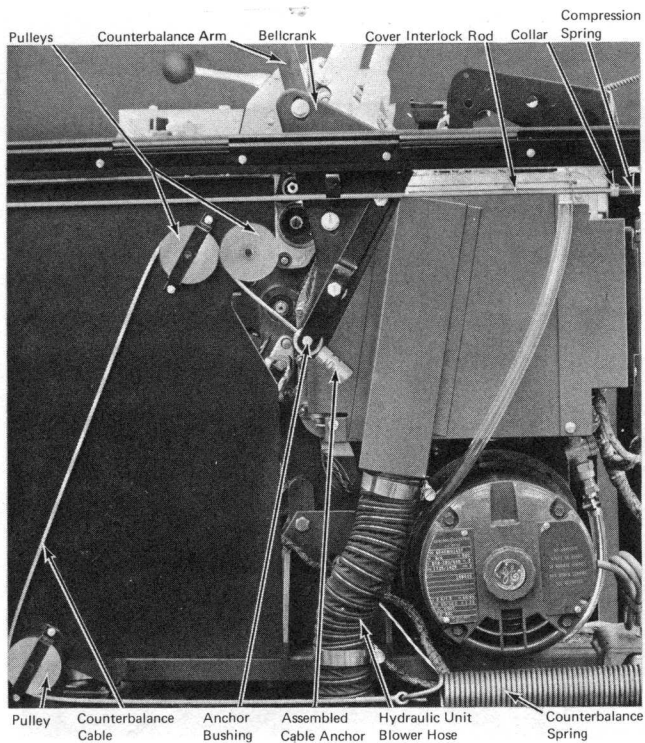
Figure 3-5. Cover Mechanism Lubrication (Double and Single Lift Screw)

### 3.3.14 Stacker Gate Hinges

These are the laminated hidden hinges on which the heavy stacker gate pivots. Lubricate these every six months with IBM #9 lubricant. Make certain to reach all the pivot rods through the laminations. Wipe off excess to maintain machine cleanliness.

### 3.3.15 Door Latches

Every six months, lubricate all door and gate latches (5) with a light application of IBM #9 lubricant.



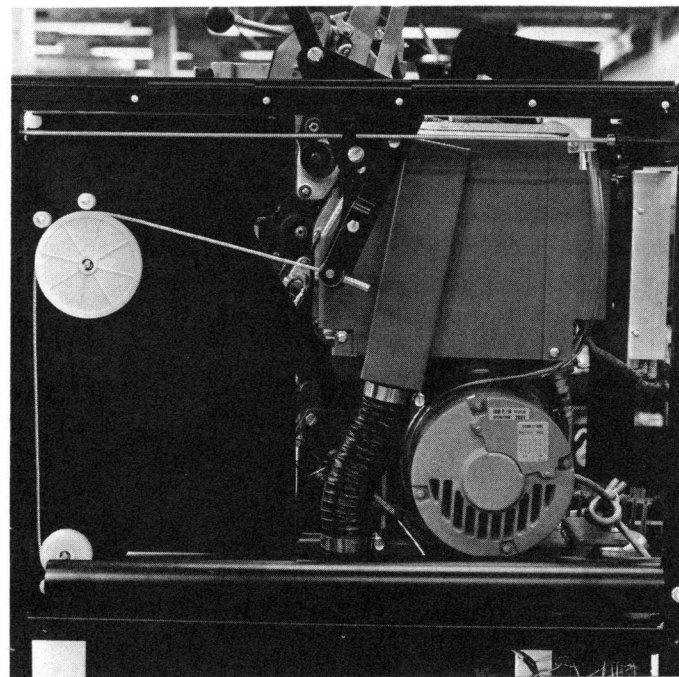
Style A

Figure 3-6. Top-Cover Counterbalance Mechanism Lubrication

### 3.4 SELECTIVE TAPE LISTER (STL) FEATURE MAINTENANCE (MAGNET DRIVEN)

Every six months, clean the paper dust from the tape-advancing mechanisms. Also, check the end-of-forms switches to ensure that they detect an out-of-tape condition. Follow the 1403 printer preventive maintenance routine closely.

If the paper-stacking device special feature is present, lubricate the drive motor rear bearing every 4 months and the gear box every 8 months with IBM #6 lubricant.



Style B

### 3.5 SELECTIVE TAPE LISTER FEATURE MAINTENANCE (CARRIAGE DRIVEN)

Refer to Figure 3-7 for guidance in cleaning, lubrication, and applicable service checks.

### 3.6 UCS/PCS/MCS FEATURES PREVENTIVE MAINTENANCE

Because the UCS/PCS/MCS pointer drive is incorporated into the existing cartridge drive mechanism, additional lubrication is not required for this feature.

Preventive Maintenance				
Unit	Frequency (Weeks)	Clean	Lubricate	Observe
Sense Unit	26	Follower Roll and Ratchet	Lub #70 on Ratchet Teeth	Wire Contacts of Sense Switch Replace if Necessary. Check Adjustment of Sense Switch. Check Adjustment of End-of-Forms Switch
Feed Unit		Magnet Assembly Feed Roll Shaft and Center Bearing Supports Gear Train, Shift Gear and Spline Shift Lever Shaft and Shift Lever Plate (Detent Area)	IBM #6 on Armature Pivots Lub #70 on Shaft at Center Bearing Support, Light Film Lub #70  IBM #20	Check Armature to Yoke Clearance  Check Adjustment of Center Bearing Support
Stacker		Area in and Around Stacker  Idler Roll and Mounting Rod	If Necessary to Replace a Roll or Spring, Lubricate All Bushings with a Light Film of Molykote G Molykote G	Check Feed Rolls for Wear and Broken Pressure Springs

Figure 3-7. STL PM Chart

## 4.1 COVER AND STACKER REMOVAL AND REPLACEMENT

### 4.1.1 Top Cover Removal (Model N1)

Ordinarily the motorized top cover should not have to be removed. Remove only in case of extreme necessity.

1. With the top cover raised from the front, remove the pins attaching the two counterbalance arms to the front cover, while steadying the front cover. (See Figure 3-6.)

#### CAUTION

Hold these arms while removing the pins because there could be some residual tension remaining in the counterbalance springs. (See Figure 3-6.)

2. Remove the pivot anchor screws from the upper ends of the two cover-lift (operating) screws while an assistant holds the cover up.

#### CAUTION

The pivot-anchor screws should be reinserted into the upper ends of the power-lift screws to prevent the power-lift screws from coming apart when they are allowed to drop inside their castings.

3. With the cover in the closed position, remove the four screws from the two rear top-cover hinges (Figure 4-1).
4. Lift off the top cover and front cover as an assembly. Get help in lifting this cover because it is heavy.

### 4.1.2 Top Cover Replacement

To replace the top cover, perform the four steps under 4.1.1 in the reverse order, and make the necessary adjustments indicated under 4.2.1.

### 4.1.3 Stacker Drive Belt and Feed Roll Removal and Replacement

Left and right referenced in this section are as viewed from the back of the machine.

#### 4.1.3.1 Stacker Drive Belt Removal and Replacement

1. Remove Fuse 4 (stacker motor). Printer can continue to be used with the cover raised and letting the forms come out the front of the machine.
2. Remove the cover over the stacker motor (two screws).
3. Remove the two motor mounting screws from the base of the motor.
4. Slide the motor to the left.
5. Remount the motor temporarily with one screw through the left base plate hole into the right screw hole of the motor mount.
6. Work the belt off the motor and stacker shaft pulleys.
7. While holding the new belt in the approximate shape (elliptical) that it assumes when mounted, work it down from the top toward the stacker shaft pulley.
8. With a spring hook through the slot in the belt guard below the stacker shaft pulley, guide the belt to the pulley and roll the belt onto the pulley.
9. Place the belt around the stacker motor pulley.

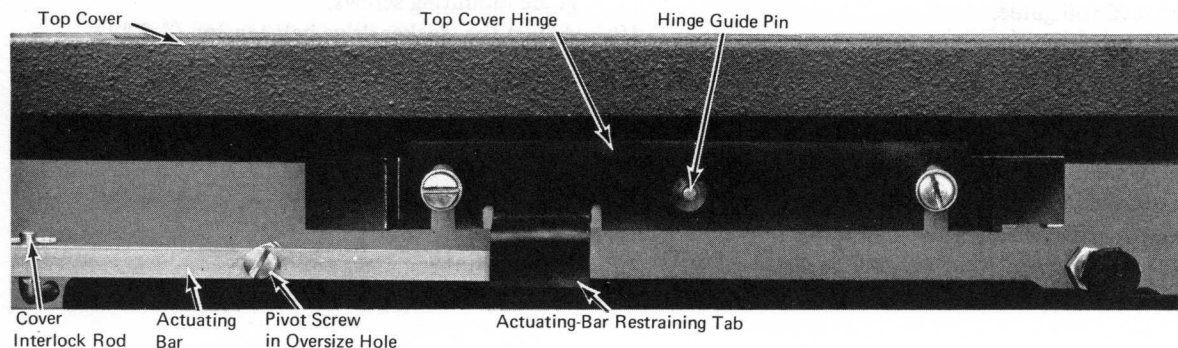


Figure 4-1. Top Cover Hinge



10. Remove the temporary holding screw and remount the stacker motor in proper position.
11. Replace the motor cover.
12. Replace Fuse 4.

#### 4.1.3.2 Stacker Feed Roll Removal and Replacement

##### Removal –

1. Lower the stacker assembly down all the way onto its tubular stop.
2. Open the stacker gate (center rear door).
3. Remove the screw and lockwasher that secures the bottom of the left-hand guide shaft to the stacker gate and remove the guide shaft (Figure 4-2).
4. Remove the screw and lockwasher that secures the bottom of the right-hand guide shaft to the stacker gate.

##### CAUTION

Do not raise the right-hand guide shaft because a spring-loaded friction plunger rests against the lower end of this shaft.

5. With the right-hand guide shaft loose and the left-hand guide shaft removed, shift the stacker all the way to the left. The stacker can now be tilted, or cocked, so the right end is accessible for belt removal.
6. Remove the two screws holding the stacker drive shaft pulley flange and remove the flange. This allows removing and replacing the cog belt without changing the tension adjustment.  
On machines using a V-belt, loosen the screws holding the motor-mounting bracket, and move the bracket down in the slotted holes. These screws are accessible from the back under the mounting bracket (Figure 4-2).
7. Disengage the stacker idler rolls.
8. Remove the feed roll guide.
9. Remove the screw (on left end of the stacker feed roll shaft) that holds the shaft to the bearing.
10. Move the shaft to the right to allow the left end of the shaft to fall below the stacker casting.
11. Loosen the setscrews holding the nylon feed roll bushings to the shaft, and slide the feed roll assembly off the shaft.

##### Replacement –

1. Install the new feed roll assembly on the stacker drive shaft.
2. Reinstall the shaft into the stacker casting and secure with the bearing screw removed in step 3.
3. Replace the stacker belt. Refer to “Removal” step 6.
4. Reinstall the left-hand guide shaft and secure it with the screw and lockwashers.
5. Secure the right-hand guide shaft to the bottom of the stacker as follows.
  - a. Locate the left end of the stacker casting such that the left-hand guide shaft bracket is positioned around the left-hand guide shaft.
  - b. Raise the tubular stop on the right-hand guide shaft and position the bottom of the guide shaft over the hole for its fastening screw.
  - c. While still holding the right-hand guide shaft over its fastening hole, press down with your other hand on the very top of the right-hand guide shaft. If you maintain pressure on the top of the guide shaft, it remains over its mounting hole when you let go of the bottom of the right-hand guide shaft.
  - d. While still pressing down on top of the right-hand guide shaft, go around to the back of the stacker gate and secure the bottom of the guide shaft with the screw and lockwasher.
6. Reinstall the motor drive cover and tighten the retaining screws.
7. Loosely install the feed roll guide. By leaving the guide loose, the position of the feed roll assembly can be adjusted on the shaft.
8. Adjust the feed roll assemblies so that they do not interfere with the guide.
9. Tighten the feed roll bushing setscrews and the guide mounting screws.
10. Adjust the stacker drive belt tension (4.2.11).

#### 4.1.4 Stacker Assembly Removal and Replacement

##### Removing the Stacker Assembly

1. Lower the hinged stacker forms guide out of the way.
2. Pull down the stacker assembly.

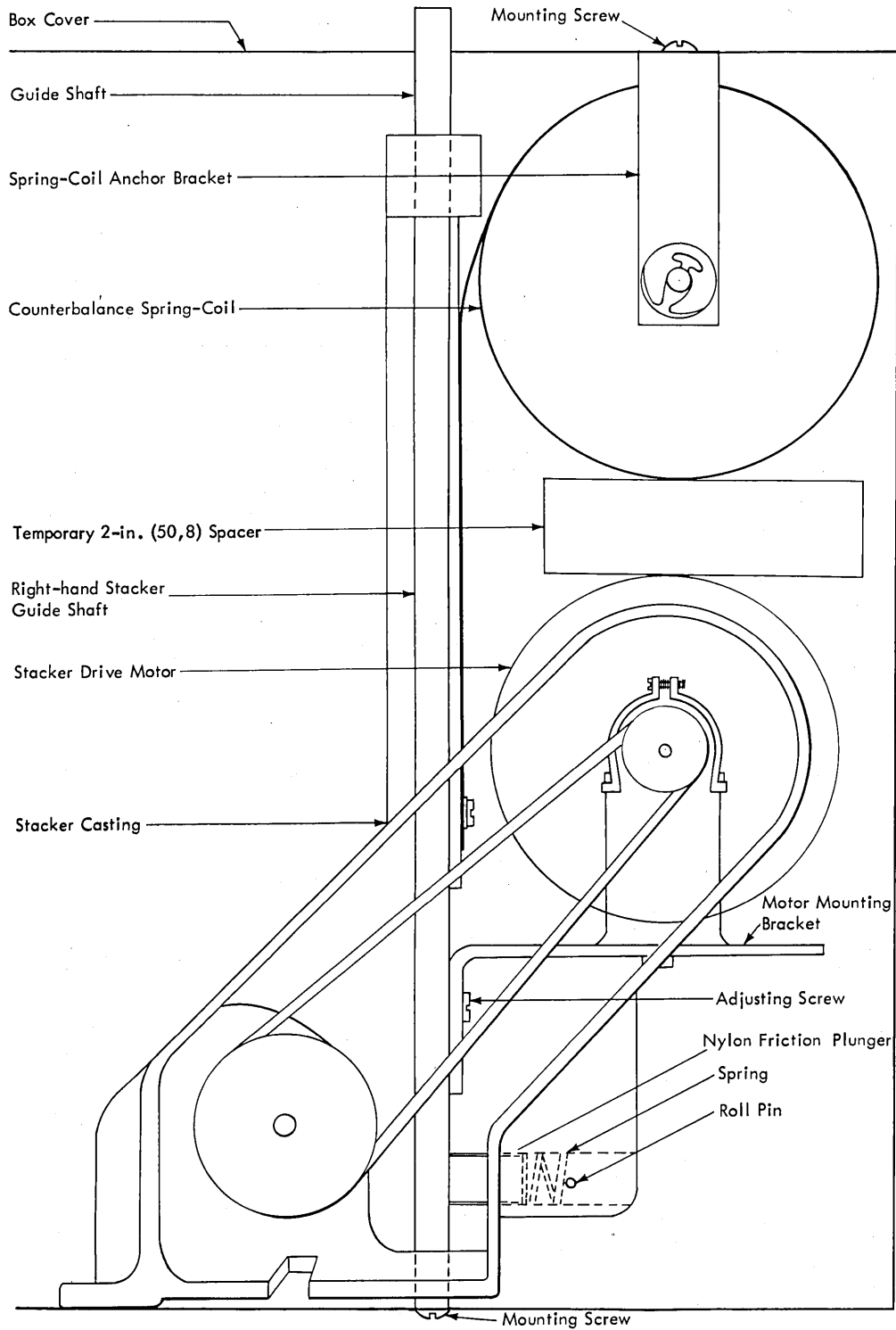


Figure 4-2. Stacker Drive-Belt Replacement

3. Remove the angular cover plate and the two screws that fasten it to the stacker casting.
4. Place a sturdy 2 in. (50, 8 mm) spacer (such as a block of wood, a wrapped deck of cards, or a small box) on top of the drive motor, and raise the stacker. This spacer (Figure 4-2) facilitates removal and replacement of the stacker balance spring assembly by keeping the spring extended (uncoiled) for a convenient distance. It also separates the stacker spring coil from the drive motor and retains this separation when the stacker is removed.
5. Raise the stacker assembly all the way and open the stacker gate. While supporting the weight of the stacker by hand, remove the two screws that anchor the spring-coil bracket to the top of the recess in the stacker gate. Then, lower the stacker all the way while gently supporting its weight.

#### **DANGER**

Never remove the spring coil bracket screws unless you support the stacker in the fully raised position.

6. Disconnect the cable from terminal block 16 on the stacker assembly.
7. Remove the screw and lockwasher from the bottom of the right-hand guide shaft (Figure 4-3). Remove the shaft by pulling it up until it is clear of the machine. At this time, the tubular stacker stop (through which the shaft passes) can fall out. The left-hand shaft does not pass through the stacker casting but is held snugly by a small bracket on the front of the stacker casting. It can be convenient to loosen or remove this bracket at this time. The stacker can now be lifted clear of the machine.

#### With the Stacker Out of the Machine

8. Remove the nylon plunger that acts as a brake on the right-hand guide shaft. To do this, remove the roll pin and compression spring that hold the plunger in place. Put these aside for replacement after the stacker is put back in the machine.

#### Replacing the Stacker Assembly

1. Make certain that the double-angle spring anchor bracket is facing the front of the machine.
2. Put the stacker back in the fully raised position and slide the right-hand guide shaft down through the hole in the stacker gate. Guide this shaft

through both holes in the right end of the stacker casting; and down over the hole in the bottom of the recess in the stacker gate. Make certain it passes through the tubular stop beneath the stacker. Replace the screw and lockwasher in the bottom end of the shaft, and tighten.

3. Fasten the left bracket in place so it holds the casting snugly against the left guide shaft, and tighten the screws. You should now be able to raise and lower the stacker freely by hand, taking care to support its weight.
4. Locate by hand and attach the stacker spring double-angle anchor bracket to the top of the stacker recess. Tighten the screws.
5. Pull the stacker down against its stop. Remove the 2 in. (50, 8 mm) spacer (block of wood, etc.) and reattach the cable to terminal block 16 on the stacker casting.
6. Reinsert the nylon plunger and compression spring in its channel. While holding the spring compressed with a punch, screwdriver, or similar tool, insert the roll pin in its hole until it retains the spring and the holding tool can be withdrawn. The fully seated roll pin should not protrude from either side of the casting.
7. Replace the angular cover plate and holding screws.
8. Raise the hinged forms guide and close the stacker gate.

## 4.2 COVER AND STACKER ADJUSTMENTS

### 4.2.1 Motorized Cover Adjustments

The motorized cover, consisting of a top and front section fastened together by two hinges, is adjusted at the factory. Ordinarily, this cover does not require any further adjustment unless it has been removed in the field. If it has been removed, the following adjustments must be made when the motorized cover is replaced.

#### Cover-Mounting Adjustments

#### Cover Lift-Screw Adjustments

#### Counterbalance Arm Adjustments

Before starting, it is well to identify the stops. The top section of the cover, when closed, rests on the right and left stops which are the rolled top edges of the brackets containing the magnetic rubber seals. (See Figure 4-7.)

The four stops for the front section of the cover consist of the inner surfaces of the two hold-down brackets (see Figures 4-6 and 4-7), and the inner surfaces of two rubber blocks, attached to the front cover below the hold-down brackets.

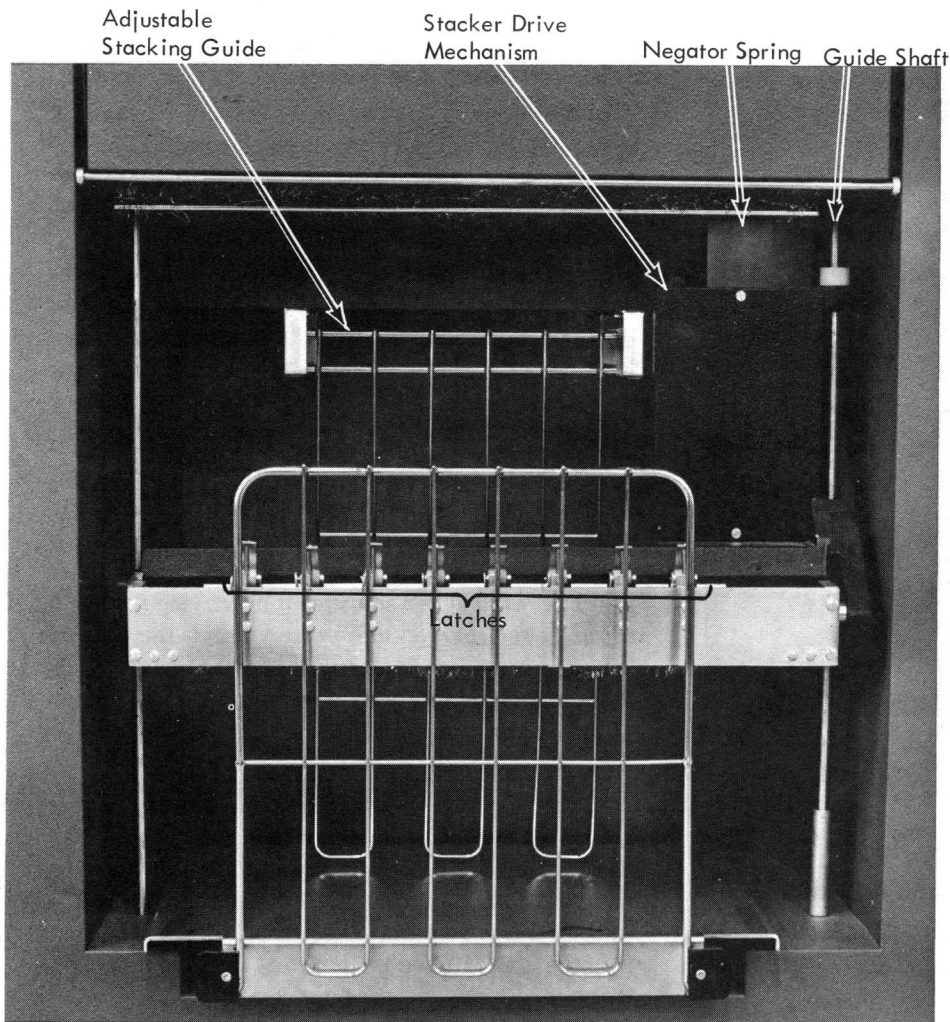


Figure 4-3. Forms Stacker and Guide

#### 4.2.2 Cover-Mounting Adjustments

This adjustment is made with the motorized cover placed on top of the machine. The counterbalance springs are not yet connected and the adjusting screws in the counterbalance arms are loose. This adjustment is necessary only when the motorized cover is replaced.

With the top cover down on its left and right stops, and with both front-cover section upper stops (hold-down brackets) within .020 in. (0, 51 mm) of the vertical frame member and at least one lower (rubber block) against the vertical member, position the top cover. Tape a .020 in. (0, 51 mm) spacer to the vertical frame members at the points of contact with the two upper front cover stops. These spacers will be removed after the adjustments have been made.

The left end of the *top* cover section should be  $.38 \pm .03$  in. (9, 65  $\pm$  0, 76 mm) to the left of the 1/2 in. (12, 7 mm) horizontal frame member.

The left end of the front cover section should be  $.12 \pm .03$  in. (3, 05  $\pm$  0, 76 mm) to the left of the 3/4 in. (19, 0 mm) vertical frame member.

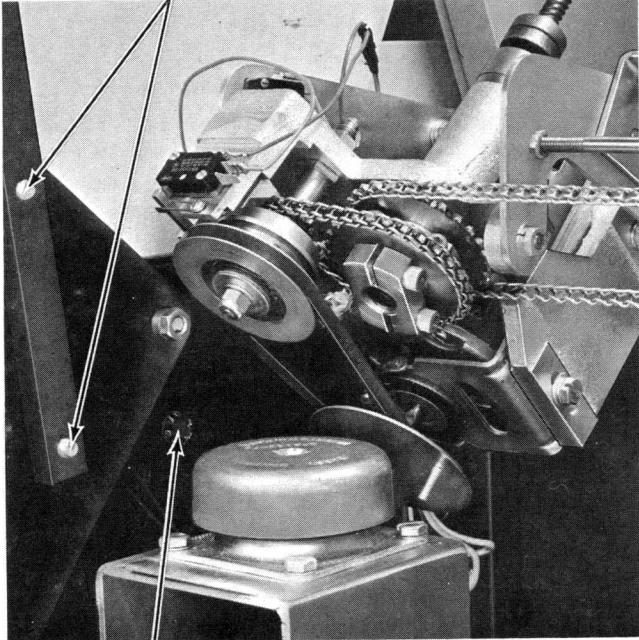
Locate and attach the rear hinges to the rear frame members.

#### 4.2.3 Cover-Lift Screw Adjustments

A top cover having double lift screws may be distorted slightly to bring it into contact with the left and right top stops. This requires adjustment of the left cover-lift screw.

1. Close top cover.
2. Loosen the two sprocket hex screws (see Figure 3-5) between the drive chain and coupling chain.
3. Viewing back of machine (left to right), crank coupling chain until left side of top cover is fully seated.
4. Use the hand crank to assure that the right side of top cover seats properly.
5. Retighten the two hex screws. If you do not have access to the hex screws, raise the top cover simultaneously with the hand crank and the coupling chain.

Counterbalance Arm Adjusting Screws



Removable Plug (On Left Side of Machine Only)

Figure 4-4. Counterbalance Arm Adjustment

#### 4.2.4 Counterbalance (Front Lever) Arm Adjustments

With the top cover hinged to the frame and down against its left and right stops, tighten the counterbalance arm adjusting screws. In making this adjustment, make sure the two lower front cover stops are against the front vertical frame members, and the two upper stops are against the .020 in. (0, 51 mm) spaces taped to the front vertical frame members.

With the cover down, tighten the two right-hand and the left rear counterbalance arm adjusting screws. Remove the access plug (Figure 4-4) and tighten the left rear adjusting screw. After these three screws have been tightened, attach the counterbalance springs and raise the cover. Now tighten the left front adjusting screw and remove the two .020 in. (0, 51 mm) spacers.

#### 4.2.5 Sprocket Adjustments

Position the large sprockets on the cover lift screw to obtain .010 to .015 in. (0, 25 to 0, 38 mm) end play between the top ends of the bronze bushings in the castings and the shoulders on the cover-lift screw sleeves (see Figure 3-5). This adjustment is made by loosening the clamping screws in the sprockets and tightening them when the required clearance is obtained. This provides the necessary thrust bearing operating clearance.

#### 4.2.6 Drive Chain Adjustment

The short drive chain between the left-hand cover lift screw and the lift clutch can be adjusted for proper tension on the newer machines. A force of 1.0 lb. (0, 454 kg) midway between the two sprockets should deflect the chain .09 + .03 in. (2, 29 ± 0, 76 mm).

To obtain this adjustment, loosen the locknut on the end of the clutch shaft (next to the grease fitting) and shift the clutch assembly laterally in the elongated mounting hole in the casting. Then tighten the locknut.

#### 4.2.7 Drive Coupling Chain Adjustment

Adjust the tension\* on the cover drive coupling chain so that a force of 4 to 6 pounds (1, 814 to 2, 722 kg) applied halfway between the sprockets deflects the chain 2 in. (50, 8 mm) inward from the sprocket tangent line. Obtain this adjustment by varying the length of the tie rod (part 833657) that connects the two cover lift-screw mounting brackets. Removing links from the chain may be necessary to prevent excessive separation of the mounting brackets.

#### 4.2.8 Cover Drive Belt Adjustment

A slipping cover drive belt may be burned. Adjust the tension\* of the belt so that the belt is deflected inwardly from the pulley tangent line .380 in. (9, 65 mm) with a force of 2 to 3 pounds (0, 907 to 1, 361 kg) applied at the midpoint between the pulleys. To increase the belt tension:

1. Loosen the two motor mounting screws.
2. Shift the motor.
3. Retighten the two motor mounting screws.

#### 4.2.9 Counterbalance Cable Clamp Adjustment

Adjust the terminal clamp on the upper end of each counterbalance cable. With the top cover raised fully and all slack removed from the cable, adjust the cable clamp (see assembled cable anchor in Figure 3-7) so there is 1 in. (25, 4 mm) between the anchor bushing in the bellcrank and the closest point of clamp (4.2.19).

#### CAUTION

Always raise the cover fully from the front when working on any part of the counterbalance mechanism.

#### 4.2.10 Stacker Gate Adjustment

With the right and left rear doors correctly aligned, center the stacker gate between them. Do this by shifting the stacker gate hinges.

\*Use push-pull (office tool, part 461141).

Adjust the support bracket on the floor of the stacker cavity to support the stacker gate in its correctly adjusted closed position.

#### 4.2.11 Stacker Drive Belt Adjustment

Adjust the tension\* of the stacker drive belt in order to deflect the belt inward from the pulley tangent line .380 in. (9, 65 mm) with a force of 1-1/2 to 2 pounds (0, 681 to 0, 907 kg). Adjust in the same manner used for the cover drive belt (4.2.8).

#### 4.2.12 Front Door Adjustment

The transparent front door to the forms-storage area must seal against the bottom of the motorized top cover when it is down. It should also seal against the vertical side members and the bottom member of the paper storage bin. With the door sealed correctly (Figure 4-5), it should operate freely.

Adjustable brackets attached to the horizontal cover frame members provide for sealing against the bottom of the top cover. These brackets should also be adjusted endwise to close the gaps between them and the center door.

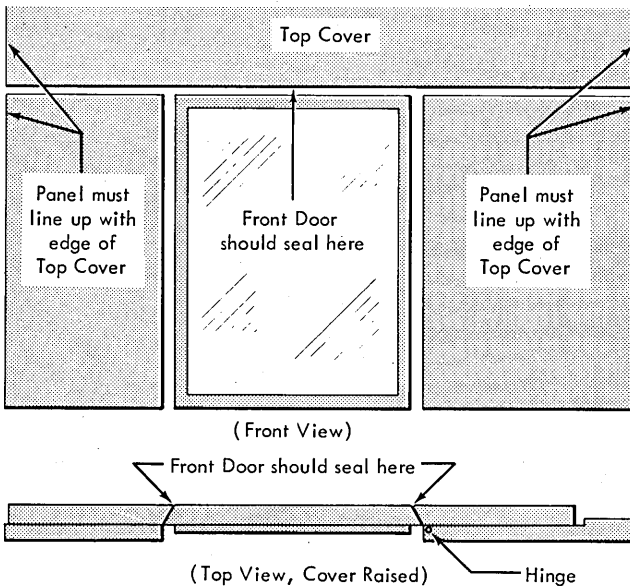


Figure 4-5. Front-Door Adjustment

#### 4.2.13 Paper Chute Adjustment

The removable paper chute guides the forms from the tractor into the stacker. Adjust the paper-chute assembly so that, with its rubber support feet resting on the top of the printer frame, the front edge of the paper guide is vertically in line with the rear paper-guide surfaces of the printer-forms tractors. Adjust the two thumb lock receptacle brackets, if required, to hold the chute in this adjusted position.

\*Use push-pull scale (office tool, part 461141).

#### 4.2.14 Hold-Down Bracket Adjustment

Adjust the right-hand bracket so that, with the top cover closed, the top surface of the bracket is  $.050 \pm .020$  in. ( $1, 27 \pm 0, 51$  mm) below the interlock rod in its forward position (Figure 4-6).

Adjust the left hold-down bracket vertically so that its top surface is  $.050 \pm .020$  in. ( $1, 27 \pm 0, 51$  mm) further below the top hinge than the extended interlock rod is below the stop surface on the top of the frame. This adjustment is not easy to make. Figure 4-7 shows an indirect method of adjustment by measuring the distance between the top surface of the bracket and the undersurface of the top-cover hinge.

#### 4.2.15 Rear Opening of the Top Cover

##### CAUTION

Make certain the cover is fully closed in the front before starting to open the top cover from the rear.

Open both small doors on the rear of the printer located on each side of the stacker gate, leaving the stacker gate closed, and remove the four screws that hold the top cover hinges. These screws must be taken out completely even though the hinges are slotted (see Figure 4-1), so that the actuating bars (which are under spring tension) can force the hinges off their guide pins and push the interlock rod through the front of the frame to engage the hold-down bracket on the front cover (see Figure 4-6). These interlock brackets, with the interlock rods engaged, hold the front cover down while the top section is raised from the rear.

Press the cover raise key on the front of the machine. The cover opens from the back under power of the cover drive motor. The top cover pivots about the hinge that attaches it to the front cover. Note safety decal on motor base.

##### DANGER

When the cover is fully open from the rear on machines having only one lift screw, and this screw is going to be removed, the *SAFETY LOCK* must be installed.

To close the cover, reconnect the lift screw and remove the Safety Lock. Press cover lower key. Position the hinges and replace the mounting screws in the hinges so that the actuating bars are pulled back to release the front cover. This restores the cover to its normal operating position for front opening.

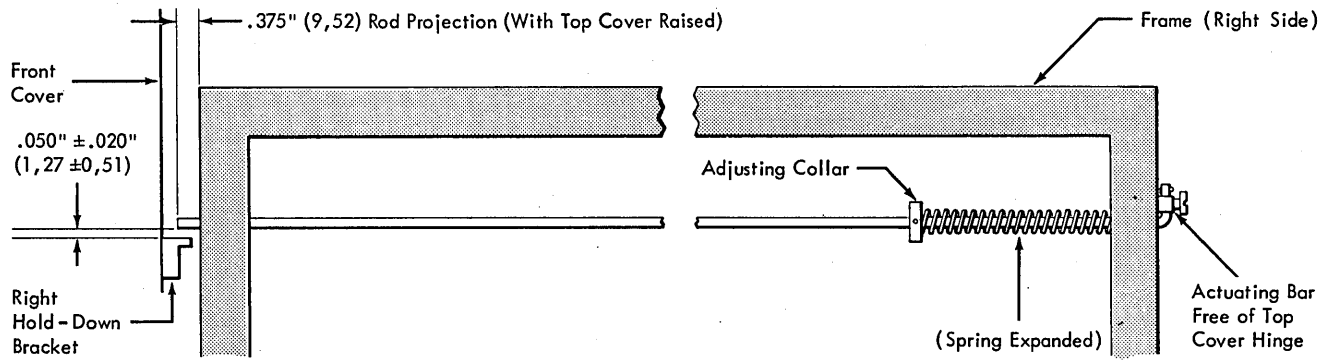


Figure 4-6. Interlock-Rod Adjustment (Unlatched)

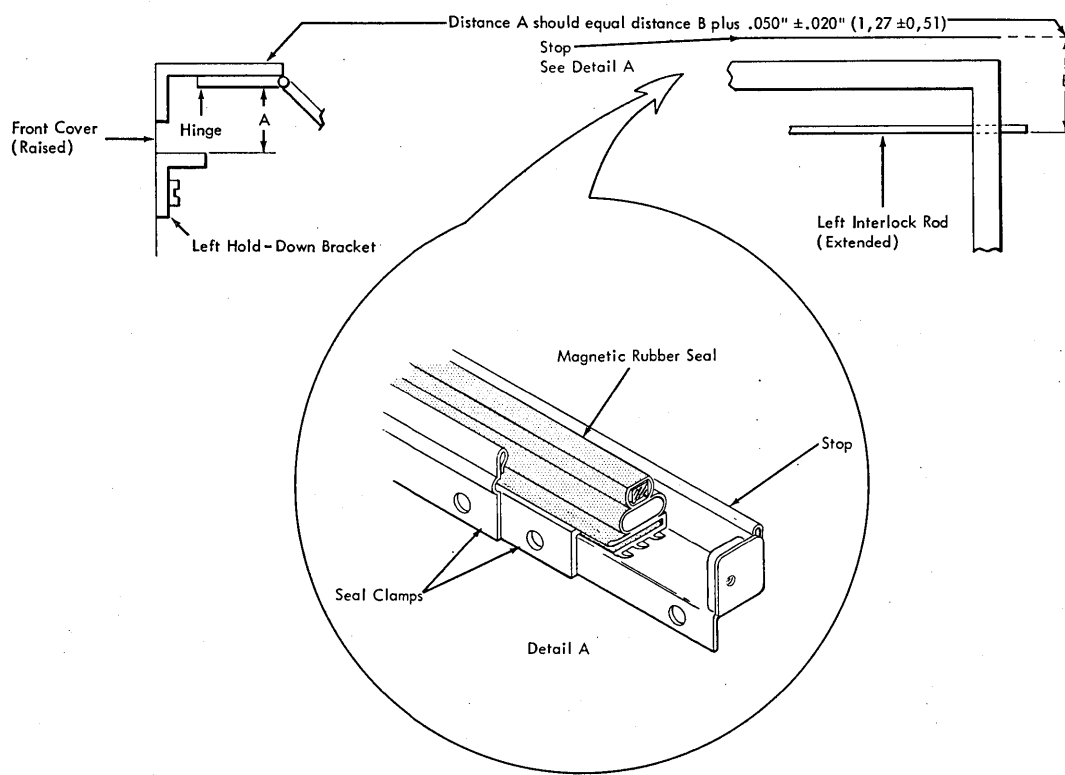


Figure 4-7. Left Hold-Down Bracket Adjustment

#### 4.2.16 Interlock Rod Adjustments

With the rear top-cover hinges (see Figure 4-1) tightened and the cover open from the front:

1. Adjust the collars on the interlock rods (Figure 4-8) to set the length of the compression springs at  $2 \pm .25$  in. ( $50, 8 \pm 6, 4$  mm).
2. Set the rods flush to .060 in. ( $1, 52$  mm) inside the front vertical members of the cover frame. Obtain this setting by adjusting the pivot nut on the screw through the center of each actuating

bar. It may be necessary to adjust the pivot screw to obtain this condition.

3. Maintain this setting and adjust the pivot screw so that the clearance between the actuating bar and the closest point of the screwhead is .045 to .070 in. ( $1, 14$  to  $1, 78$  mm). Then tighten the locknuts.

With the rear hinges released and not touching the correctly adjusted actuating bars, the interlock rods should extend at least .375 in. ( $9, 52$  mm) beyond the front surface of the vertical members of the frame (see Figure 4-6).

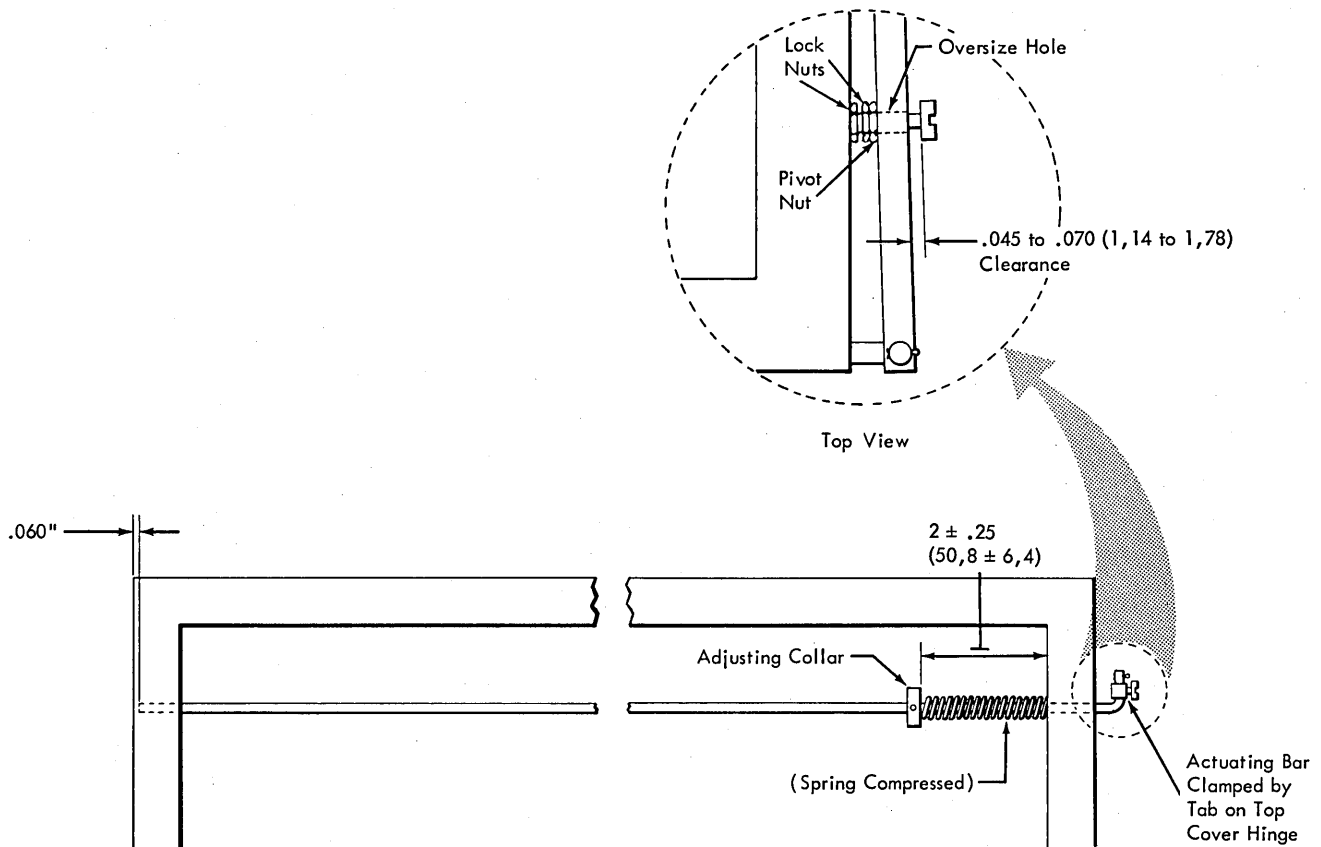


Figure 4-8. Interlock-Rod Adjustment (Latched)

#### 4.2.17 Clutch Trip Adjustment

An opposing force of 30 pounds (13, 608 kg) or less, encountered by the top cover when closing, should cause the safety drive clutch to disengage. This force can be measured with a hand-held spring balance of approximately 8 lb/inch (3, 629 kg/mm) spring rate (necessary to minimize the inertia effects of moving the cover). Measure this force by hooking the scale\* under the bottom of the front cover while holding the scale parallel to the vertical front side of the cover.

#### 4.2.18 Obstruction Switch Adjustments

These adjustments involve the switch, the operating (rocker) arm, and the rocker arm positioning spring.

1. **Switch Adjustment.** With the safety clutch drive pin out of its notch (see Figure 3-5), and the drive pulley and sprocket held against the pivotable casting so as to remove all end play, position the switch against the rocker arm so that the contacts just make.

\*Use push-pull scale (office tool, part 461141).

2. **Rocker Arm Positioning.** With the drive pin bottomed in the notch, locate the hairpin-shaped positioning spring (see Figure 3-4) so that it holds the rocker arm where neither rides on the continuously turning clutch flange nor holds the contact closed. The positioning spring is clamped in place with a screw.

#### 4.2.19 Limit-Up Switch Adjustment

This switch is adjusted so that the cover rises under power, and it stops when it has reached a fully raised position. In this raised position, the back edge of the inner right (vertical) safety shield is approximately parallel to the undersurface of the top cover. Look up inside the cover to see this. Make certain that the switch also operates to stop the cover when it rises from the rear. (See Figure 3-5.) Remember, these adjustments are made to stop the cover under power; therefore, inertia and other dynamic conditions must be taken into account.

One to four revolutions of the pulley and crank assembly (part 833667) should be left after the cover stops as a result of the limit switch. This ensures that the cover does not stop on the safety screw.



#### 4.2.20 Limit-Down Switch Adjustment

##### CAUTION

Overadjustment of the limit-down switch adjusting screw causes breakage of this switch.

This adjustment must be made with the override switch held open. Adjust the limit-down switch so that the top cover fully closes and the switch opens before the safety drive clutch clicks twice. The clicking is made when the notch in the clutch reengages the drive pin after having been cammed away from it as the cover reached its fully closed position.

This adjustment is made by a trial-and-error procedure. With the cover raised, make successive adjustments to the limit-down-switch adjusting screw (see Figure 3-5) until the condition just described is reached. Then tighten the locknut.

#### 4.2.21 Obstruction Override Switch Adjustment

Before making this adjustment, be sure that the limit-down and obstruction switches are properly adjusted.

Adjust the switch operating screw (see Figure 3-5) by trial and error to open the obstruction override switch when the motorized top cover reaches within 1/8 in. (3, 18 mm) of its fully closed position.

This switch makes certain that the cover stays down and does not open because of the resistance encountered as it comes to rest on its stops in a normal closing operation.

In normal closing, the resistance offered by the stopping action causes the safety clutch to disengage or slip. This would ordinarily cause the cover to reverse and go back up. The obstruction override switch must be adjusted to open 1/8 in. (3, 18 mm) before this position is reached.

#### 4.2.22 Miscellaneous Conditions

All covers must fit tightly and not rattle. The printer cavity is provided with rubber noise barriers that must seal tightly.

Machines equipped with the Selective Tape Lister feature (magnet control) have a special removable guide plate containing the tape sensing switches. When this plate is installed, it should cam the forms compressors out of the way. These compressors are used with standard paper forms but not with paper tapes.

On machines equipped with the STL (magnet control) feature, the ribbon runs continuously while in STL mode.

### 4.3 COVER ADJUSTMENT (MODEL 3)

#### 4.3.1 Top-Cover Adjustment (Covers Without Torsion Bars)

Adjust the spanner type nut on the stay arms for correct spring tension. The tension is correct if the cover just closes by its own weight to a point where it aligns with the shelf on the upper left cover assembly. The tension should assure that the top cover remains open in the raised position.

### 4.4 COVER REMOVAL AND REPLACEMENT (MODEL 3)

#### 4.4.1 Top Cover

1. Remove the front cover.
2. Remove the rear cover.
3. Loosen, but do not remove the mounting screws at the rear of the top cover.
4. Tilt the cover down until the left and right stay arms can be unhooked.
5. Unhook the stay arms.
6. Lift the cover and free it from the rear mounting screws.
7. Replace in reverse order.

#### 4.4.2 Top Forms Guide

1. Lift the front cover.
2. Snap the top forms guide out of the front plastic supports.
3. Raise the front end of the guide.
4. Unhook the spring at the rear right.
5. Unhook the rear end of the guide at the right.
6. Slide the guide off the left rear stud.
7. Remove the guide.
8. Replace in reverse order.

#### 4.4.3 Front Cover

1. Raise the cover.
2. Compress the spring on the stay-arm stud and move the stud to the right.
3. Tilt the cover up until the stud clears the stay arm.
4. Remove the retaining clip and slide out the hinge pin.
5. Slide the cover to the right and off the left pivot.
6. Reinstall the cover in reverse order.

#### 4.4.4 Left Front Cover Panel, (Numeric Printers Only)

Pull the bottom of the panel (Figure 4-9) forward until it clears its snap latch, then pull downward until the top of the cover clears the locating pins that go through the holes in the top of the panel.

To replace, slide the cover upward, guiding the locating pins through the holes in the top of the panel. When the panel is up all the way, push the bottom toward the rear of the machine until it snaps into place.

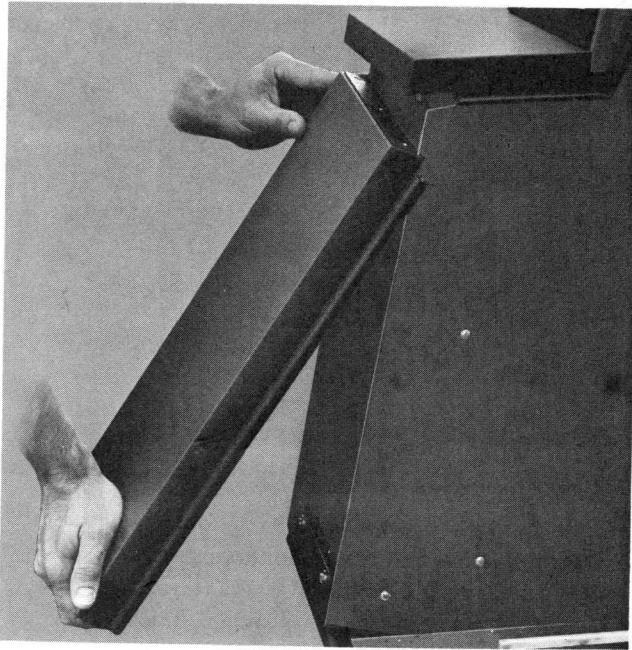


Figure 4-9. Left Front Cover Panel Removal and Replacement

#### 4.4.5 Inner Front Cover

1. Remove the following knobs.
  - a. Manual-clutch and line-selection knob
  - b. Forms-width vernier knob
  - c. Manual-advance knob.
2. Remove the CE indicator panel on the inner front cover.
3. Remove the inner front cover holding screws.
4. Remove the cover.
5. Replace in reverse order.

### 4.5 FORMS-HANDLING EQUIPMENT

#### 4.5.1 Forms-Carts Grounding Adjustment (Model 3)

Adjust the forms-cart guides so that their contact springs press firmly against the sides of both the front and rear carts when they are in position. Some machines have fixed grounding assemblies that do not require adjustment.

#### 4.5.2 Forms-Tractor Adjustment

Adjust the belt tension.

1. Maintain parallelism between the axes of rotation of the drive sprocket and of the movable sprocket (Figure 4-10).
2. Position the movable sprocket stud for a minimum slack at the point of tightest engagement.
  - a. Be sure that belt tension is not excessive.
  - b. Tighten the sprocket stud.

Position the beveled ramps.

1. The point of the ramp must point in the direction opposite to the belt motion.
2. Position the ramp for a clearance of .002 to .007 in. (0, 05 to 0, 18 mm) to the respective sprocket hub.
3. Clamp in position.

Position the tractor paper guides.

1. Align the edge of the paper guide nearest the door pivot plate flush to the pivot plate.
2. Position the underside of the paper guide flush against the edge of the spacer plate.
3. With the conditions in steps 1 and 2 established, secure both the paper guide and the mounting block with their front surfaces flush to the front edge of the spacer plate.
4. Position the lower edge of the adjacent paper guide against the lower edge of the paper guide nearest the door pivot, maintaining the upper edges parallel. Check that the inner edges of the guides are clear of the pins.
5. Fasten the adjacent paper guide to the tractor frame.

#### 4.5.3 Tractor Door Adjustment – Old Style

Position the tractor door for a clearance of .048 to .056 in. (1, 22 to 1, 42 mm) between the door runners and the forms guide plate when the door is closed (Figure 4-11).

1. Loosen the pivot plate.

*Note:* The Loctite\* sealant must be used on the threads of the holding screws if this adjustment is made.

2. Screw the door stop setscrew in below the correct door setting.

\*Trademark of American Sealant Company

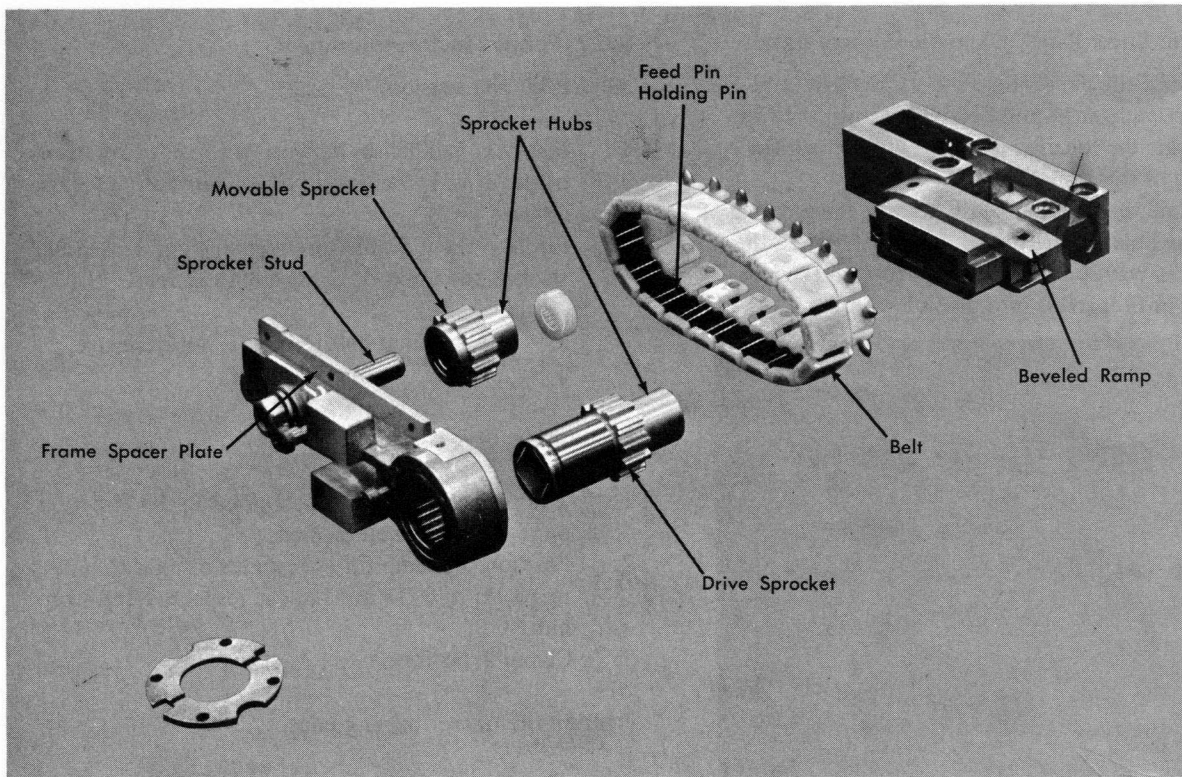


Figure 4-10. Tractor Assembly Components

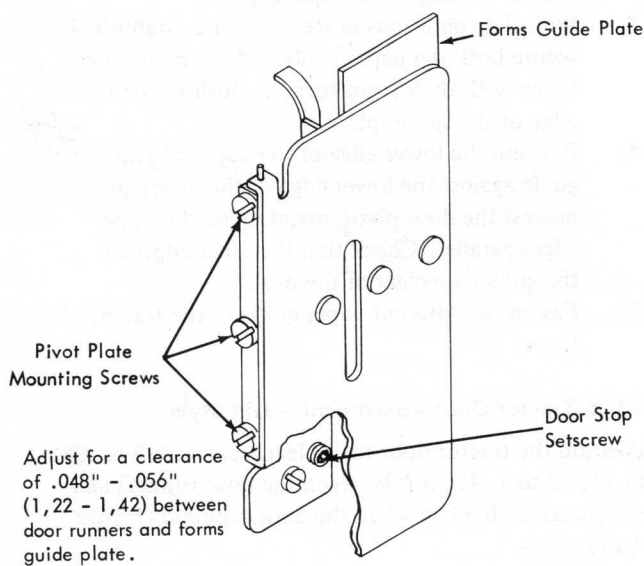


Figure 4-11. Tractor-Door Clearance

3. Temporarily shim the tractor door .048 to .056 in. (1,22 to 1,42 mm) above the forms-guide plate by inserting spacers of suitable thickness between them. Feeler gauges can be used, but seven or eight strips of punch card may be more convenient to use.
4. Force the door against the feeler gauges.
5. Tighten the pivot plate.
6. Set the door stop setscrew to hold the door at the correct clearance.

7. Adjust the slide support plate to limit the tractor door open position. Place a straightedge against the belt-guide step perpendicular to the tractor guide plate as shown in Figure 4-12. Adjust the slide support plate to obtain  $3/32 \pm 1/32$  in. (2,39  $\pm$  0,79 mm) clearance between the door and the straightedge. Be sure to maintain proper belt tension when tightening the plate holding nut.

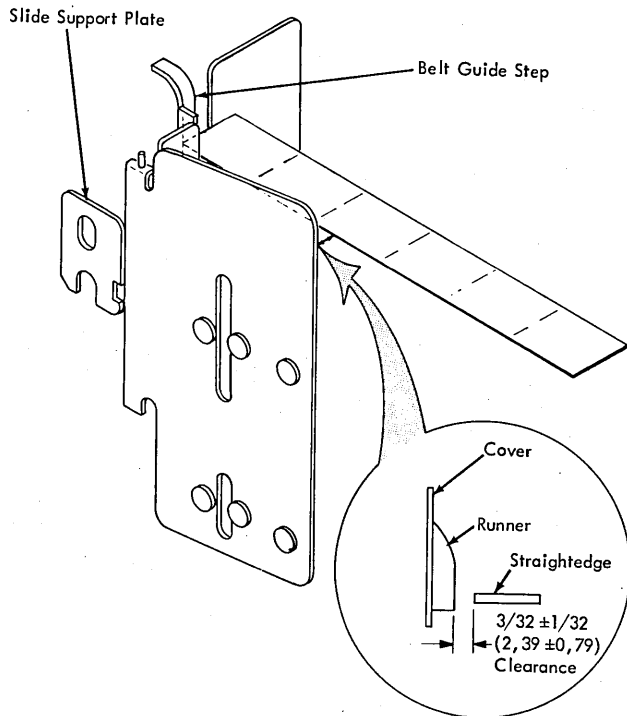


Figure 4-12. Tractor-Door Opening Limit

#### 4.5.4 Forms-Tractor Adjustment – New Design

Machines that have new design forms tractors (Figure 4-13) features:

1. A slotted adjusting plate.
2. An extruded tractor door.
3. A rugged hinge bar that replaces the old pivot plate.

The adjusting plate positively locates the hinge bar and prevents the paper-path clearance from changing once it has been correctly set. The extruded tractor door has a radius on the hinge side that fixes the open position of the door. This radius contacts the hinge bar to automatically stop the door in the open position at the optimum angle. The door stop setscrew has been relocated and now goes through the door instead of into the plate beneath it. This setscrew prevents the heavy spring from warping the door, thus decreasing the paper-path clearance on the spring end. The hinge bar contains two press-fit dowel pins that engage the diagonal slots in the adjusting plate. (Do not disturb these dowel pins because their projection is set so as to be slightly less than the thickness of the adjusting plate.)

The objective in adjusting this new design tractor door and hinge bar is the same as for the old style, namely, to obtain the correct paper-path clearance of .048 to .056 in. (1, 22 to 1, 42 mm) between the forms-guide plate and extruded runners on the door. Usually this is done by adjusting the door stop setscrew. If not, proceed as follows.

1. Disconnect the tractor-door spring.
2. Back off the door stop setscrew a turn or two.
3. Remove the three hinge bar and adjusting-plate mounting screws with their washers.

*Note:* Remove the screws completely even though the hinge bar is slotted. This is to ensure that the tractor door is parallel to the forms-guide plate and not cocked at the hinge side. Manually hold the tractor door, attached hinge bar, and adjusting plate in their closed position.

4. Temporarily shim the tractor door .048 to .056 in. (1, 22 to 1, 42 mm) above the forms-guide plate by inserting spacers of suitable thickness between them. Feeler gauges can be used, but seven or eight strips of punch card may be more convenient to use, and work very well (Figure 4-14).
5. With the adjusting plate still in position on the dowel pins in the hinge bar, hold the tractor door gently closed on the spacers to maintain the .048 to .056 in. (1, 22 to 1, 42 mm) clearance. Now shift the adjusting plate lengthwise until the center mounting screw hole aligns with the center slot in the hinge bar and the center hole in the tractor side plate, and insert the mounting screw and washer.

A projecting tab on the end of the adjusting plate provides a means of shifting the plate to obtain this alignment.

Tighten the center screw and insert and tighten the remaining two screws with their washers.

6. While still holding the tractor door down on the spacers, turn in on the door stop setscrew until it just bottoms on the belt guide; then remove the spacers.
7. Reconnect the tractor door spring. Open the door and let it snap shut under tension of the spring two or three times.
8. Recheck the tractor door clearance and make any final adjustment that may be necessary with the door stop setscrew.

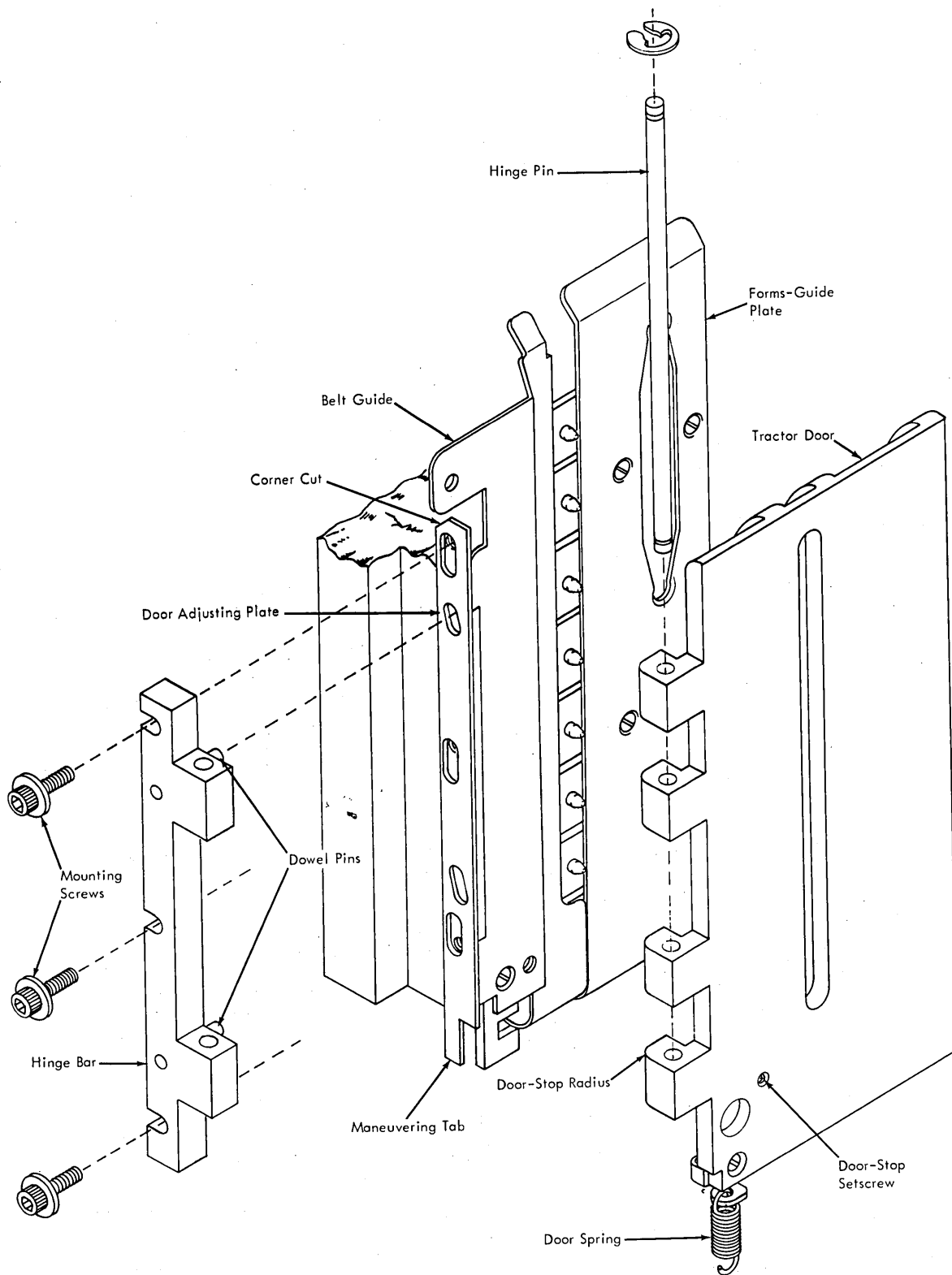


Figure 4-13. New-Design Tractor Door Hinge

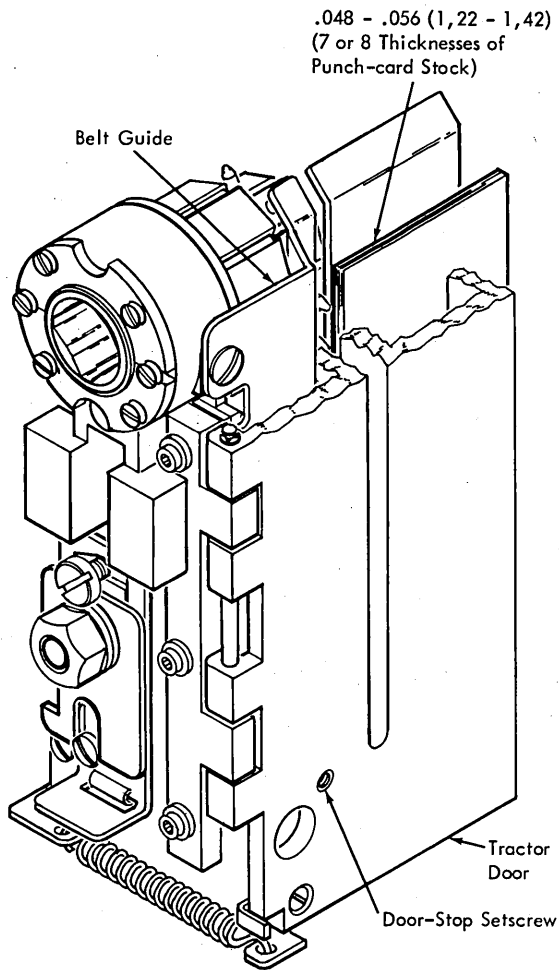


Figure 4-14. New Design Tractor Door Adjustment

#### 4.5.5 Tractor-Mounted Jam-Detection Device Adjustment

Some additional adjustments are applicable to forms tractors that have tractor-mounted jam-detection devices.

1. Adjust the jam-detection setscrew so that the jam-detection switch breaks when the door is opened a total of .095 to .118 in. (2,41 to 3,00 mm) (Figure 4-15).

#### 4.5.6 Upper and Lower Tractor Drive-Shaft Positioning

First, check the forms-width vernier. Prepare to adjust the drive shafts.

1. Position the left forms tractors in the corresponding slots in the tractor mounting bar.
2. Position the right forms tractors in the corresponding holes in the face of the movable slides.
3. Place a form in the forms tractors.

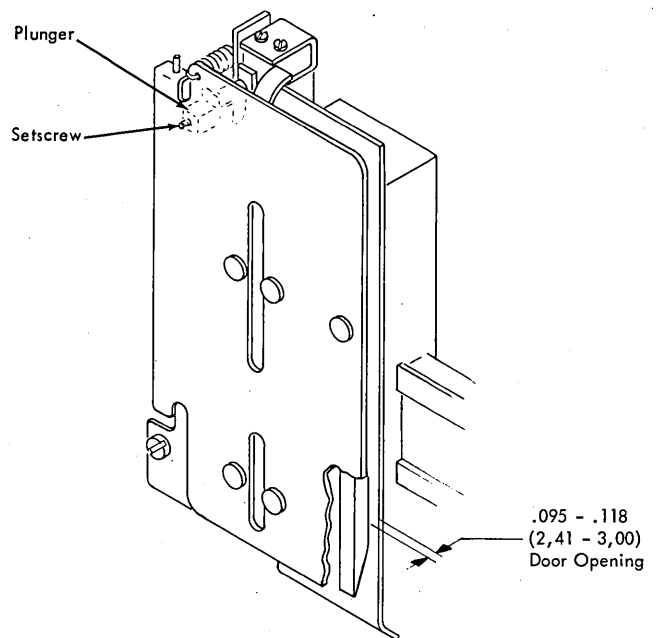


Figure 4-15. Jam-Detection Switch Adjustment

Check the position of the upper tractor drive shaft to the lower tractor drive shaft. The form must fit in the tractors with a minimum of slack in paper. Feed the forms manually and check for no elongation of the pin-feed holes (this may occur under power).

The upper tractor pins should touch the upper edge of the pin-feed holes in the form. The lower tractor pins should touch the lower edge of the pin-feed holes in the form.

If forms are tighter on one side than the other, adjust the left end of the upper mounting bar by means of the eccentric washer. See Figure 4-16.

If necessary, adjust the upper tractor drive shaft in relation to the lower tractor drive shaft.

1. Loosen the upper tractor drive shaft gear.
2. Rotate the shaft manually to remove slack.
3. Clamp the drive gear to the shaft.

#### 4.5.7 Tractor Shafts and Tractor Mounting Bars Removal

This procedure is given for the removal of the upper and lower tractors, the tractor mounting bars, and the drive shafts. If only one set is to be removed, do only as much of each step as will allow the desired set to be removed.

1. Remove the forms.
2. Remove the inner front cover.
3. Remove the upper and lower forms-guide bars.
4. Remove the wires from the form-stop contacts at the terminal block.
5. Shift the T-casting to the left.
6. Remove the gear guard.

Separate the vertical shaft of the forms-width vernier by loosening the setscrews in the vertical coupling of the forms-width vernier. Move the vertical coupling up onto the upper shaft and lock it to the shaft.

Remove the bearing retaining castings. (See Figure 4-16.)

1. Loosen the screws that prevent bearing end shake (at the right).
2. Remove the two bearing-holding screws (at the right) for each bearing retaining casting.
3. Shift the T-casting to the right.
4. Remove the two holding screws (at the left) for each bearing retaining casting (one screw is a dowel).
5. Remove both bearing retaining castings.

Remove the tractor mounting bar and the tractor shaft.

1. Remove the two screws and the slide retainer plate at the left end of one of the tractor mounting bars.
2. Remove the two holding screws at the right end of the same tractor mounting bar.
3. Lift the tractors, the mounting bar, and the shaft out and to the left to clear the T-casting.
4. Remove both bearing retaining castings.

## 4.5.8 Tractor Belt and Individual Feed-Pin Replacement

### 4.5.8.1 Tractor Belt Replacement

1. Remove tractor assembly (see 4.5.7).
2. Remove tractor door and hinge bar.
3. Remove front belt guide, forms guide plate, and rear belt guide.
4. Remove cover switch cable clamps.
5. Separate the frame from the assembly (two screws).
6. Remove belt.
7. Replace in reverse order. Be certain that the belt and sprocket teeth are meshed (see 4.5.2).

### 4.5.8.2 Individual Feed-Pin Removal

1. Open the T-casting.
2. Remove the forms.
3. Open the tractor door.

Remove the tractor paper guides.

1. Remove the tractor paper guide farthest from the hinge of the door.
2. Remove the tractor guide on the other side of the pin feeds.

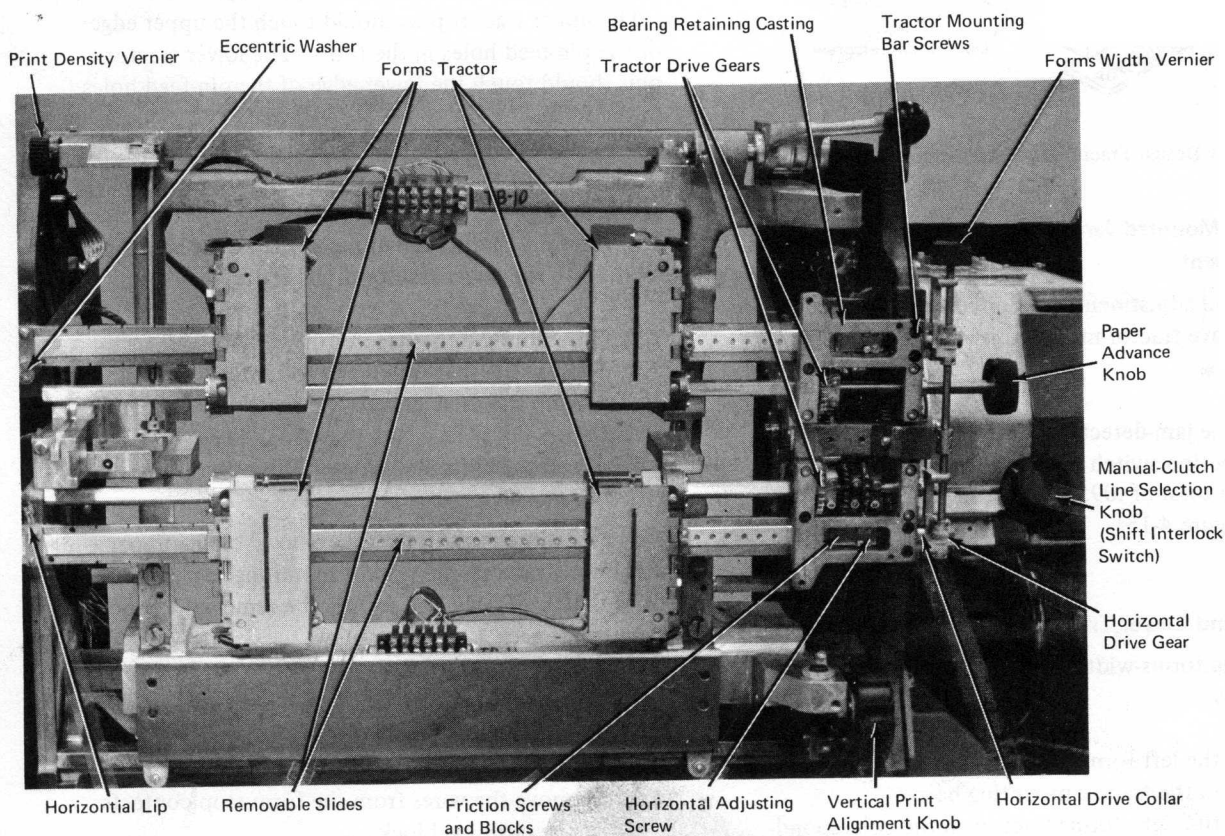


Figure 4-16. Tractors

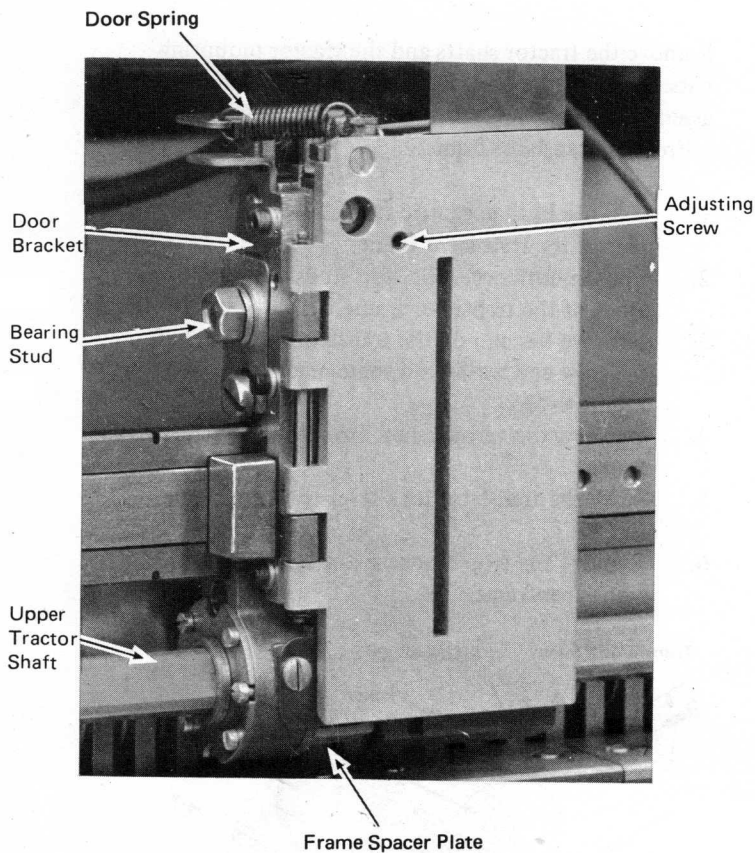


Figure 4-17. Tractor (Upper Left)

Align the feed pin holding pins with the slot in the frame spacer plate (the end nearest the drive shaft, Figure 4-17).

1. Turn the tractor shaft until one holding pin aligns with the slot.
2. Use a similar pin (part 804671) to push the installed pin toward the center of the machine.
3. Repeat step 2 for the second holding pin.

Remove the feed pin by lifting. Insert the new feed pin.

Replace the feed pin holding pins.

1. Insert the second pin.
2. Turn the tractor shaft until the first holding pin hole is aligned with the slot.
3. Insert the first pin.

*Note 1:* If inserting the holding pins in the second holes is difficult, insert the holding pins in the first holes while the feed pin is about the mid-point between the pulleys. Rotate the tractor belt until the holding pins are over the drive pulley. The drive pulley can now assist in aligning the holding pins while they are being driven into the second holes.

*Note 2:* Pins are to be flush or slightly recessed.

Replace the tractor paper guides in reverse order (see 4.5.4).

#### 4.5.9 Tractor Installation

This procedure refers to both upper and lower assembly. Place the tractor shaft and the mounting bar in relative positions on a flat surface.

Install the tractors on the drive shaft.

1. Slide the drive shaft through the square drive hub on the right tractor.
2. Turn the left tractor drive until the pins line up with those on the right tractor and, at the same time, the drive hub lines up with the drive shaft.

*Note:* These pins line up at only one point during one revolution of the drive shaft.

3. Slide the drive shaft through the square drive hub on the left tractor.

Install the tractors on the mounting bar. Slide the mounting bar through right and left tractors.

#### 4.5.10 Tractor-Shaft and Mounting-Bar Replacement

1. Place tractors, mounting bar, and tractor shaft in the machine.
2. Insert the screws in the slide retainer plate and the mounting bar at the left and turn the screws in a few turns.
3. Insert the holding screws at the right end of the mounting bar and turn in until nearly snug. Repeat for the other assembly.

Install the bearing retaining castings.

1. Slide the bearing and bearing retainer ring in position. Some machines do not have the bearing retainer ring.
2. Place the bearing retaining casting in position.
3. Insert the two right holding screws and tighten until almost snug.
4. Insert the two left holding screws and tighten.
5. Snug up the bearing end screws.
6. Tighten the right bearing-retaining casting-holding screws.
7. Tighten the bearing end screws. Repeat this step for the other assembly.



Position the tractor mounting bars.

1. Slide the tractors apart to extreme positions.
2. Position the tractor mounting bars against the lip and eccentric washer on the printer casting at the left.
3. Shift the mounting bars horizontally to position the left tractor pins vertically on the upper mounting bar within .005 in. (0, 13 mm) of the left tractor pins on the lower mounting bar. Use a straightedge laid along the tractor pins for determining vertical alignment.

Connect the vertical shaft of the forms-width vernier.

1. Loosen the setscrews in the vertical coupling and slide into engagement with the upper and lower shaft.
2. Clamp the coupling to both shafts.

Make the following adjustments.

1. Adjust the forms-width vernier.
2. Position the upper and lower tractor drive shafts.

Replace the remaining parts in reverse order.

#### 4.6 TRANSLATOR FRAME

##### 4.6.1 Translator-Frame Positioning

Check that the six guide rollers rest against their respective guiding surfaces. Adjust for .005 in. (0, 13 mm) minimum clearance between the printer casting and:

1. Upper front guide blocks
2. Lower rear guide studs
3. Lower front guide studs.

Check for freedom of movement of the translator frame along the printer casting.

##### 4.6.2 Translator-Frame Removal

1. Remove the forms.
2. Remove the top paper guide.
3. Remove the paper guide at the bottom of the translator frame.
4. Remove the front paper guide (below the translator frame).
5. Remove the ground wire to the translator frame.
6. Lower the translator frame to the lowest position with the vertical print alignment knob.
7. Remove the bumper stop stud:
  - a. From the left end of the translator frame.
  - b. From the right end of the translator frame.

Remove the tractor shafts and the tractor mounting bars. Remove the T-casting. Remove the hammer unit assembly.

Free the translator frame.

1. Remove both eccentric stop studs at the bottom rear of the translator frame.
2. Loosen both eccentric stop studs at the bottom front of the translator frame.
3. Remove the clip on the translator vernier shaft (a screw and washer on some machines). See Figure 4-18.
4. Unscrew the vernier shaft from the translator frame.
5. Move the translator lock lever to the extreme right.
6. Remove the stop blocks at the top front of the translator frame.

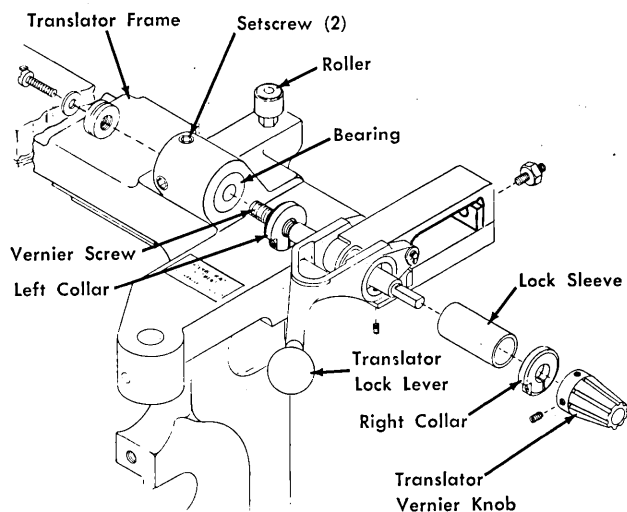


Figure 4-18. Translator Vernier

Remove the translator frame.

1. Lift the translator frame just enough to take the full weight of the frame.
2. Slide the bottom of the frame so that the frame is clear of the printer casting.
3. Tilt the top of the frame to the rear and withdraw the frame from the front of the machine. Reinstall in reverse order.

Perform the following adjustments.

1. Position the translator frame.
2. Position the T-casting front to rear.
3. Position the T-casting vertically.

Replace the remaining parts in reverse order.

## 4.7 MANUAL CONTROLS: ADJUSTMENTS

### 4.7.1 Translator Lock Lever

The lever must operate with a positive locking action when a force\* of 4 to 7 pounds (1, 814 to 3, 175 kg) is applied at the center of the knob and perpendicular to the handle. Adjust as follows (Figure 4-19):

1. Loosen the translating-frame gib locknut.
2. Loosen the frame locking setscrew for gib-to-tie-bar clearance.
3. Lower the lock lever to the fully locked position and recheck for gib-to-tie-bar clearance.
4. Press the locking mechanism to the rear of the machine while holding the locking roller squarely against the tie bar.
5. Turn the frame locking setscrew finger-tight.

*Note:* Make sure the locknut is not against the lock block.

6. Tighten the setscrew 90° to 150°.
7. Tighten the locknut.

### 4.7.2 Translator Vernier Knob

Set the vernier to provide a movement of  $1/2 \pm 1/16$  in. ( $12, 7 \pm 1, 6$  mm).

1. Clamp the translator vernier knob against the shoulder of the vernier screw (see Figure 4-18).
2. Position the right retaining collar against the knob and clamp the collar to the vernier screw.
3. Position the left retaining collar so that a total end play of .0005 to .002 in. (0 to 0, 05 mm) exists between the two collars and the translator lock lever, and clamp the collar to the vernier screw.

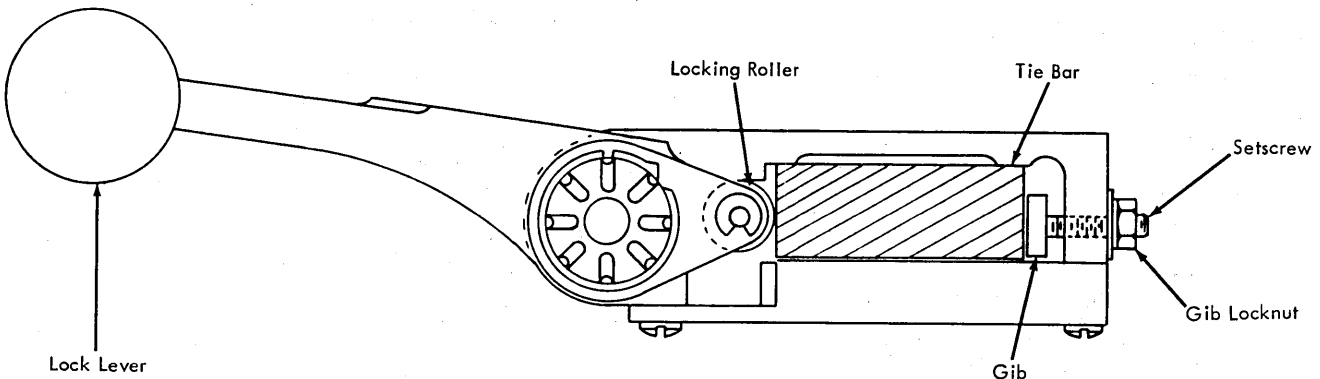


Figure 4-19. Translator Frame Lock Lever

\*Use push-pull scale (office tool, part 461141).

*Note:* On some machines, the left collar is pinned. Adjust this clearance by using the right collar.

4. Tighten the setscrews in the translator frame bearing to provide a slight drag on the vernier screw. Apply Loctite sealant to the setscrew threads if this adjustment is made.

### 4.7.3 Vertical Print-Alignment Knob

1. Position the eccentric shaft (Figure 4-20).
  - a. The slot in the right end should be parallel with the slot in the sector gear hub, within  $1/64$  in. (0, 41 mm).
  - b. Further adjustments may require that this be altered.
2. Position each ball detent barrel to the periphery of the sector gear:
  - a. For clearance throughout full gear rotation.
  - b. For maximum clearance of .008 in. (0, 20 mm).

When installing a new ball detent barrel, insert the new barrel from the sector gear side of the mounting block. This method avoids stripping off too much locking material on initial installation.

3. Lock the translator frame.
4. Check for a bind between the bottom of the vernier screw and the lock sleeve of the translator vernier (see Figure 4-18).
  - a. Raise the translator frame to its uppermost position.
  - b. Turn the translator vernier knob to detect a bind.

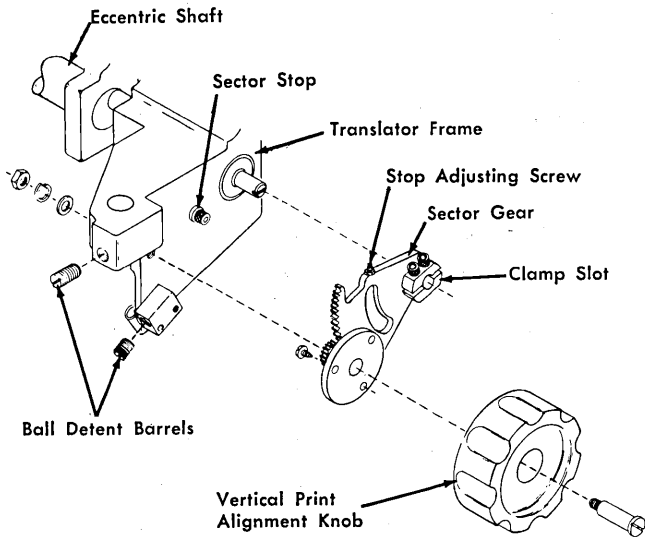


Figure 4-20. Vertical Print Alignment Knob

5. If a bind is not detected, proceed to step 7.
6. Remove the bind between the bottom of the vernier screw and the lock sleeve of the translator vernier.
  - a. Loosen the clamp screws in the sector gear hub.
  - b. Turn the eccentric shaft counterclockwise until the bind is eliminated.
  - c. Tighten the clamp screws.
7. Adjust the sector gear stop screw:
  - a. For a minimum clearance of 1/32 in. (0, 79 mm) between the translator frame and the printer casting.
  - b. For a minimum clearance of 1/32 in. (0, 79 mm) between the lower edge of the sector gear and the printer casting.

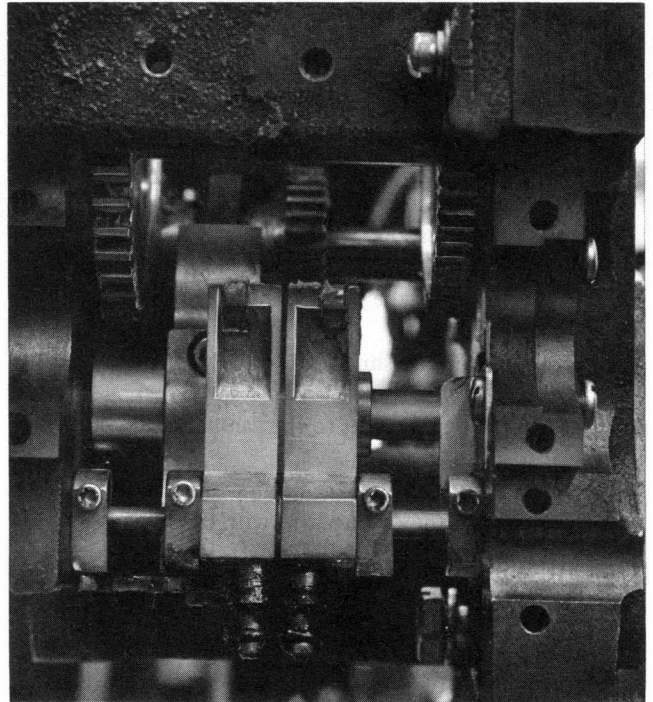
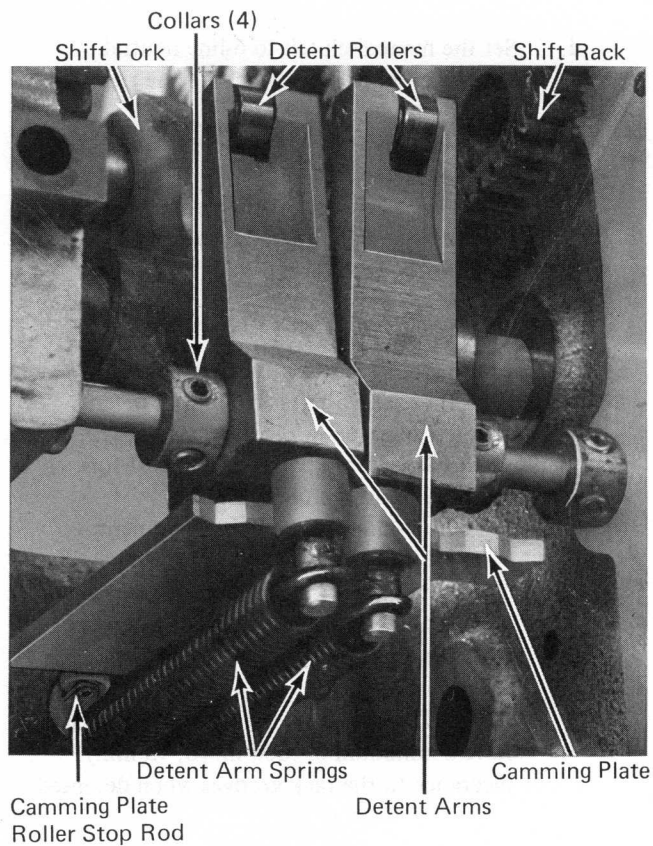
**4.7.4 Forms-Width Vernier**

1. Adjustment procedure:
  - a. Move the translator frame to the left.
  - b. Remove knobs.
  - c. Remove the inner front cover.
  - d. Remove the gear guard.
  - e. Locate the left forms tractors in the corresponding extreme left slots in the tractor mounting bars.
  - f. Locate the right forms tractors in the corresponding extreme right holes in the face of the removable slides.

2. Adjust the left tractor pin feeds horizontally.
  - a. Place a straightedge along the pin feeds to check alignment.
  - b. Shift the tractor mounting bars to align the pin feeds within .005 in. (0, 13 mm). There are two screws in each end of each bar (refer to Figure 4-16).
  - c. Keep the left horizontal surface of the lower mounting bar against the corresponding horizontal lip of the printer casting. The upper mounting bar is positioned up and down by an eccentric washer on current machines. The upper and lower mounting bars must be parallel.
3. Adjust the right tractor pin feeds.
  - a. Orient the horizontal adjusting screws, horizontal drive collar, and gear to align the right pin feeds horizontally within .005 in. (0, 13 mm).
  - b. Place a straightedge along the pin feeds to check alignment.
  - c. Reposition (if necessary) the horizontal adjusting screws in relation to the collars and gears to obtain adjustment.
  - d. Position the collars and gears for a maximum end play of .002 in. (0, 05 mm).
4. Operate the forms-width vernier with light finger force. Adjust the friction screws and blocks as required.
5. After this adjustment has been made, adjust the vertical position of the right ends of the upper and lower tractor mounting bars for free movement of tractor assemblies.

**4.7.5 Manual Clutch and Line-Selection Knob**

1. Preliminary procedure:
  - a. Move the translator frame to the left.
  - b. Remove knobs.
  - c. Remove the front inner cover.
  - d. Remove the gear guard.
2. Check the adjustment of the manual clutch and the line-selection knob assembly (Figure 4-21).
  - a. Check for clearance:
    - (1) For a minimum end play of the detent arms on the shaft.



#### Setscrew-Type Collar

Figure 4-21. Manual Clutch and Line-Selection Assembly  
(Lower Tractor Shaft Removed)

- (2) For a minimum of .025 in. (0,64 mm) between the detent roller and the detent wheel when the detent is inoperative
- (3) Between the tines of the shift fork and the shift-gear hub.
- b. Check for alignment of the:
  - (1) Detent arms to the slots in the camming plate.
  - (2) Detent wheels to the detent arms.
- c. Check for correct operation to make certain that:
  - (1) The clutch shifts from 6-line neutral to 6-line drive and from 8-line neutral to 8-line drive.
  - (2) The detent arm spring causes correct operation of the detent arms and wheels. A force of 4-1/2 to 6-1/2 pounds (2,04 to 2,95 kg) should be on the detent arm. Use push-pull scale (office tool, part 461141).
  - (3) The detent arm roller seats fully in the detent wheel when the detent is operative.

#### Split-Type Collar

- d. On machines having the split-type collars (Figure 4-21), the collars must be positioned with the screws to the front of the machine as shown in Figure 4-21. The retainer plate is inserted in the slot of the right-hand collar to prevent the shaft from rotating.
 

*Note:* Collars in any other position can cause interference with the 6-8 line shift fork.
3. If the conditions in step 2 are met, no further adjustment is necessary. Proceed to step 11. If not:
  - a. Unhook the detent arm springs.
  - b. Loosen both detent wheels.
  - c. Slide the right detent wheel to the right.
  - d. Loosen the detent arm collars.
  - e. Slide the detent arms to the left.
  - f. Loosen the camming plate on the shift fork so that the plate is just free to slide.
  - g. Loosen the setscrew that holds the camming-plate roller stop rod.
  - h. Wedge some paper between the shift-fork tines and the hub of the shift gear to center the tines around the shift-gear hub.

4. Position the shift fork on the shift rack for gear mesh and clearance.
  - a. Detent the shift rack in 6-line drive at the right.
  - b. Position the shift fork on the shift rack so that the shift gear meshes with the 6-line driving and driven gears and has clearance to the casting.
  - c. Rotate the shift fork around the shift rack to center the shift fork around the shift-gear nub.
  - d. Clamp the shift fork to the shift rack.
5. Align the detent arms to the camming plate.
  - a. Set the shift gear to 6-line drive position.
  - b. Align the detent arms with the left two slots in the camming plate.
  - c. Tighten the collars to hold the detent arms in position.
6. Adjust for a clearance between the detent wheels and the detent arms of .025 in. (0, 64 mm) with the manual clutch in either 6- or 8-line drive.
  - a. Turn the 6- and 8-line gear idler to a position where it does not move when the shift gear is shifted from the 6-line drive to the 8-line drive, or vice versa.
  - b. Set the shift gear to the 8-line neutral position.
  - c. Slide the right detent wheel opposite the right detent arm.
  - d. Use a rubber band to hold the right arm against the detent.
  - e. Adjust the camming-plate roller stop rod to provide a .025 in. (0, 64 mm) clearance between the detent arm and the teeth of the right detent wheel.
  - f. Tighten the setscrew to hold the camming-plate roller stop rod.
  - g. Rehook the springs on the detent arms.
  - h. Clamp the camming plate to the shift fork.
7. Align the detent wheels to the detent arms.
  - a. Set the manual clutch to 8-line neutral.
  - b. Align the left detent wheel to the left detent arm.
  - c. Clamp the left detent wheel to the tractor shaft.
  - d. Set the manual clutch to 6-line neutral.
  - e. Align the right detent wheel to the right detent arm.
  - f. Clamp the right detent wheel to the tractor shaft.
  - g. Check the operation of the manual clutch for four manually operated spaces.
  - h. Readjust as necessary.
8. Set the spring tension\* to provide 4-1/2 to 6-1/2 pounds (2, 04 to 2, 95 kg) force on the detent arm when it is engaged in the detent wheel.
9. Remove the paper from between the shift-fork tines and the shift-gear hub.
10. Make the clutch-interlock switch adjustment.
  - a. The switch must transfer before the plunger completely clears all of the four grooves of the shift rack.

*Note:* The switch operating plunger must have a minimum of .005 in. (0, 13 mm) clearance to the rack grooves when detented.
- b. Position the switch to obtain this adjustment.
11. Replace the remaining parts in reverse order.

#### 4.7.6 Print Density Control

Make this adjustment only after the hammer unit has been properly located in the printer.

1. Loosen the setscrews in the cam at the bottom of the vertical shaft.
2. Set control knob to A.
3. Position the impression control adjusting cam so that it just makes contact with the impression control actuating bar (Figure 4-22) when the bar is against its stop (actuating bar all the way to the left).
4. At this time, locate the cam vertically so the shaft has .005 to .010 in. (0, 13 to 0, 25 mm) end play.
5. Tighten the cam setscrews.

#### 4.7.7 Forms Thickness Lever

This lever is pinned to its shaft and no adjustment is provided.

\*Use push-pull scale (office tool, part 461141).

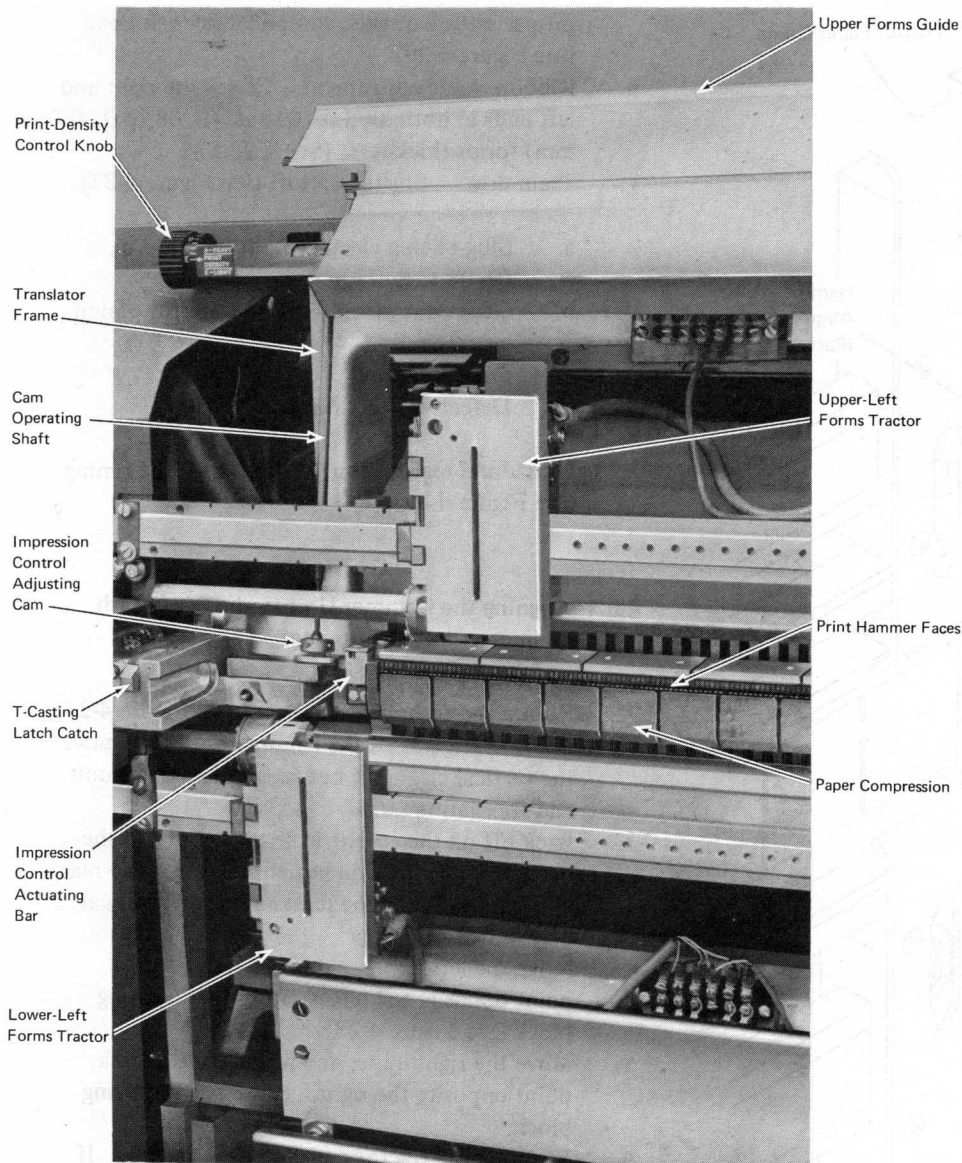


Figure 4-22. Print Density Control Mechanism

#### 4.8 HAMMER UNIT

The best overall print quality from the 1403 printer is obtainable when all the units associated with printing are adjusted to the tolerances given in this manual.

Making adjustments and checks to all these units in the correct sequence is necessary. This ensures that proper relationships are established between the hammer unit, paper path and the train cartridge. It also eliminates redoing an adjustment after it has been set properly.

The following steps are the recommended sequence of adjustments. The detail of each adjustment is given in the following text. A 1403 alignment tool (part

452457) must be used to ensure the accuracy of each adjustment.

1. Alignment of the hammer unit to the paper path .041 in. (1, 04 mm) (Figure 4-23).
2. Movable base – check for binds. Watch for uneven motion of the train cartridge when the position of the forms thickness lever is changed (see 4.10.2).
3. Train-to-hammer-unit locating block adjustment .100 in. (2, 5 mm). Slight drag on the alignment tool (part 452457) with the forms thickness lever setting of .011 in. using the same M-slug on both ends (see Figure 4-35).

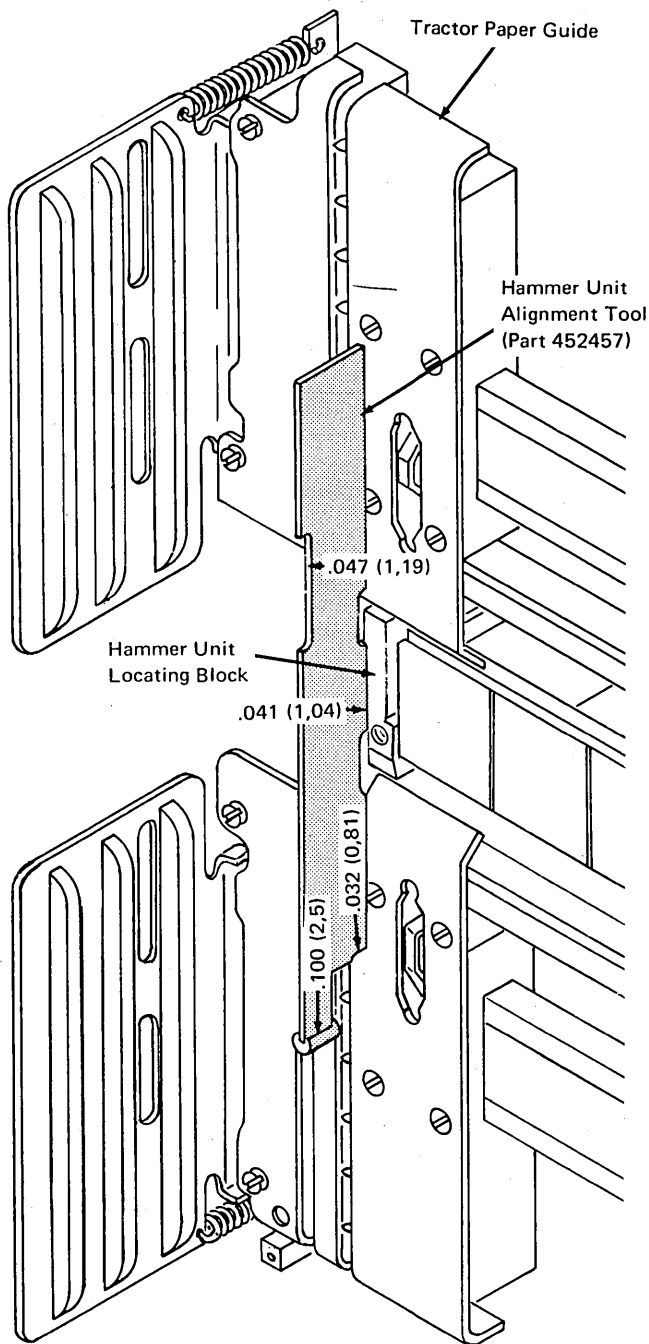


Figure 4-23. Hammer Unit to Paper Path Alignment

4. Hammer unit impression control bar adjustment .047 in. (1, 19 mm). Set the print density knob on A and obtain the proper setting from the hammer unit locating blocks to the front edge of the impression control bar on both ends (see Figure 4-27).
5. Forms compressor adjustment .032 in. (0, 81 mm). With the density knob set on A, check for the

proper setting of each compressor control pad (see Figure 4-29).

6. Ribbon shield adjustments. Check the right and left ends at both .003 to .019 in. (0, 08 to 0, 48 mm) forms thickness. (See 4.12.5.)
7. Train drive – Shifting cutoff (see Figure 4-37).
  - a. Slug-to-slug clearance .001 to .003 in. (0, 03 to 0, 08 mm)
  - b. Gear wear (drum, idler and motor pinion gears)
  - c. Drive key wear
  - d. Defective PSS drum.
8. Horizontal registration. Individual flight timing (see Figure 4-40).

#### 4.8.1 Aligning the Hammer Unit to the Paper Path (Hammer-Unit Positioning)

1. Open the T-casting.
2. Rotate the eccentric screw (refer to Figure 4-24), one on each side of the hammer unit, to remove the vertical clearance between the hammer unit and translating frame.
3. Back off on the eccentric screw slightly so the hammer unit can slide horizontally front to rear with no binds and the least amount of vertical play.
4. Move the left upper and lower tractors to a point opposite the left hammer-unit locating block (see Figure 4-23).
5. Move the right upper and lower tractors to a point opposite the right hammer-unit locating block.
6. Examine the tractor paper guides carefully. If they are bent or deformed and are not flat against the tractor casting, remove and straighten them. Inducing a slight bow in the guides (top and bottom are toward the rear) may be helpful so that when they are remounted, they are flat.
7. With the tractor doors open, place the hammer unit alignment tool (part 452457) vertically against the tractor paper guide plates (Figure 4-23). The projection in the center part of the tool is .041 in. (1, 04 mm).
8. Check for correct clearance between the forms path and the hammer-unit locating blocks at both sets of tractors. Use light pressure to take up the clearance between the tractor and the tractor mounting bar without causing any deflection. The contact between the tool and the locating blocks must be light.

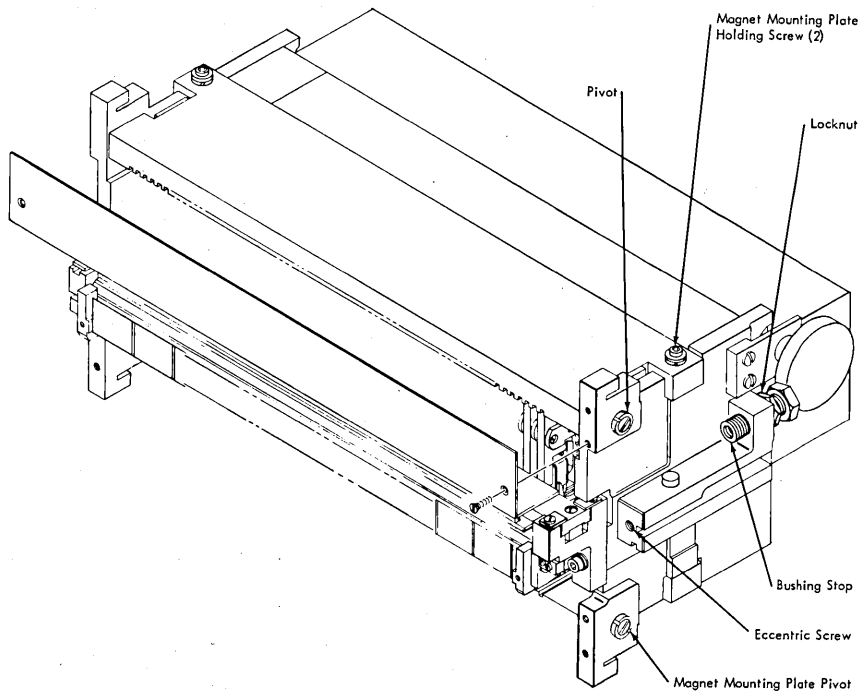


Figure 4-24. Hammer Unit Assembly

9. Adjust the hammer-unit bushing stops (Figure 4-23 and 4-24) to bring the locating blocks into visible contact with the center portion of the tool.
  - a. Loosen the two allen head hammer-unit assembly mounting screws.
  - b. Loosen the two bushing-stop locknuts. Wrench (part 856481) is available for this nut.
  - c. Turn the bushing stops as much as necessary in the desired direction.
  - d. Tighten the bushing-stop locknuts and the mounting screws and recheck the adjustment at both sets of tractors.
  - e. Recheck train-to-hammer adjustment (.100 in.; 2, 54 mm).

#### 4.8.2 Individual Hammer Flight-Time Adjustment

Adjust individual hammers, only after determining that the overall timing is correct. See 4.10.7.

On the Model 3:

1. Open the top cover and remove the forms guide.
2. Open the rear door, and slide the rear forms stacker down out of the way.
3. Remove the inside rear baffle cover.

On Model N1:

1. Open the top cover from the rear.
2. Remove the top forms guide from the rear.
3. Open the stacker gate for access to the hammer unit.

On Models 3 and N1:

1. Remove the upper or lower hammer unit cover to expose the appropriate hammer magnet assembly mounting screws (Figure 4-25).
2. Loosen both mounting screws until the magnet assembly moves with a firm drag when the adjusting tool (part 856170) is rotated.
3. Using either method 1 or method 2 as outlined in 4.10.7, step 7, operate the printer and adjust the magnet assembly until the printed character is centered either on the hammer outline or on the hammer itself. Or, if the two adjacent positions have the correct flight time, center the character between them.
4. Stop the printer and loosen the front magnet assembly mounting screw until the washer and screw head are free to slide. Then tighten the screw securely.
5. In like manner, loosen and tighten the rear screw.
6. Recheck timing and readjust the magnet assembly, if necessary, starting with step 5.
7. If difficulty is experienced in obtaining this adjustment, replace the magnet assembly (Figure 4-26). Check for binds in the armature hammer, or pushrod. Replacement of one or more of these parts may be necessary. Reassemble the parts in reverse order.



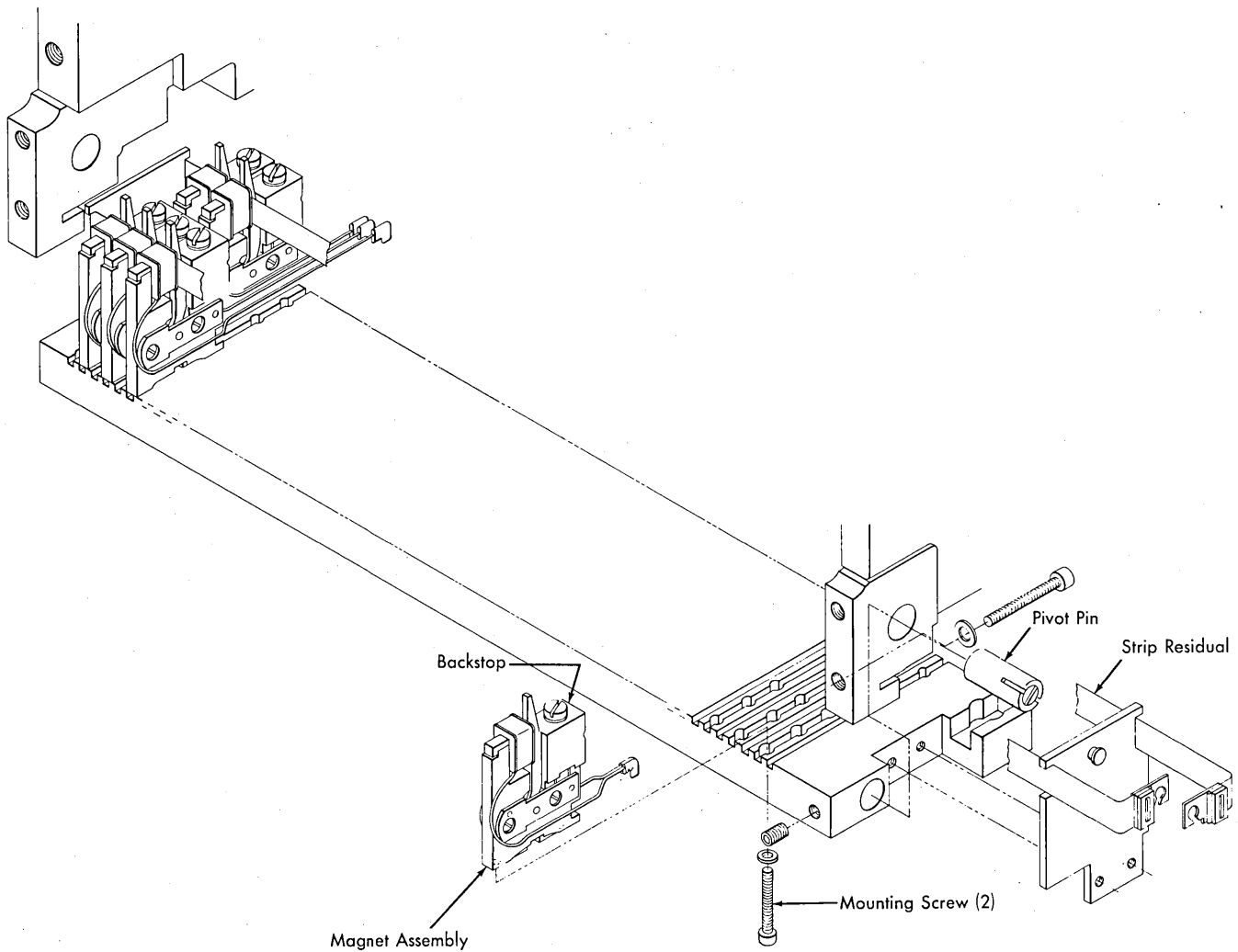


Figure 4-25. Magnet Assembly Mounting Plate (Lower)

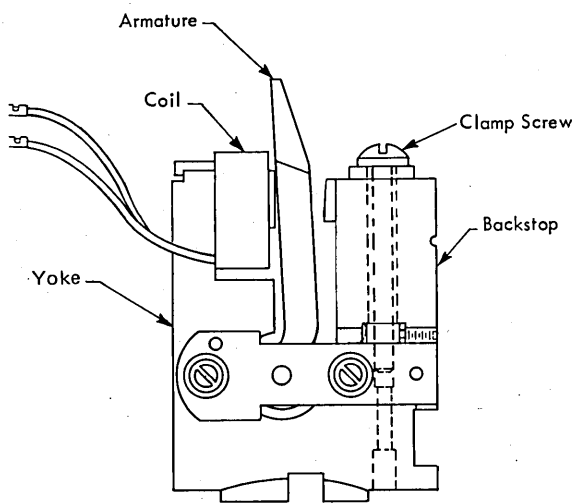


Figure 4-26. Hammer Magnet Assembly

#### 4.8.3 Impression Control Bar Adjustment

This adjustment may be done in or out of the machine.

1. Set the density control to A, if adjusting in the machine. (The density control returns to the A-setting automatically when the hammer unit is removed.)
2. Check, and adjust, if necessary, the .047 in. (1, 19 mm) location of the impression control bar. Use tool (part 452457) and measure between the front edge of the impression control bar and the front edge of the hammer-unit locating block (Figure 4-27). Adjust the position of the impression control wedges (Figure 4-28) to get the .047 in. (1, 19 mm) dimension. Check both ends. Loosen the wedge holding screw and insert a screwdriver into the wedge slot to move the wedge. Tighten the holding screw.

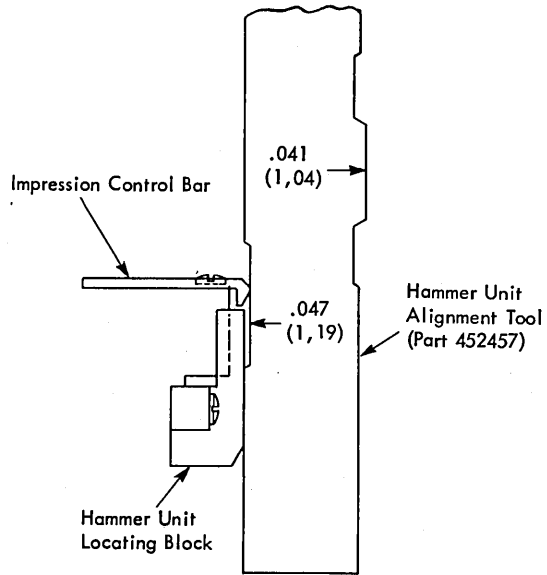


Figure 4-27. Impression Control Bar Positioning

#### 4.8.4 Forms Compressor Adjustment

Set print density lever at A. Raise the translating frame as high as possible, if adjusting in the machine. Adjust the setscrew in the bottom of the forms compressor to bring its front edge .032 in. (0,81 mm) from the front edge of the impression control bar in a horizontal direction. Use tool 452457. Lay the cutout end on the impression control bar with the .032 in. (0,81 mm) edge adjacent to the compressor (Figure 4-29). Make the adjustment while applying finger pressure in a vertical direction to the bottom of the compressor to remove clearances in the pivot pin area.

For machines with the Selective Tape Lister feature, the compressors should cam out of the forms path when the center paper-guide assembly is installed.

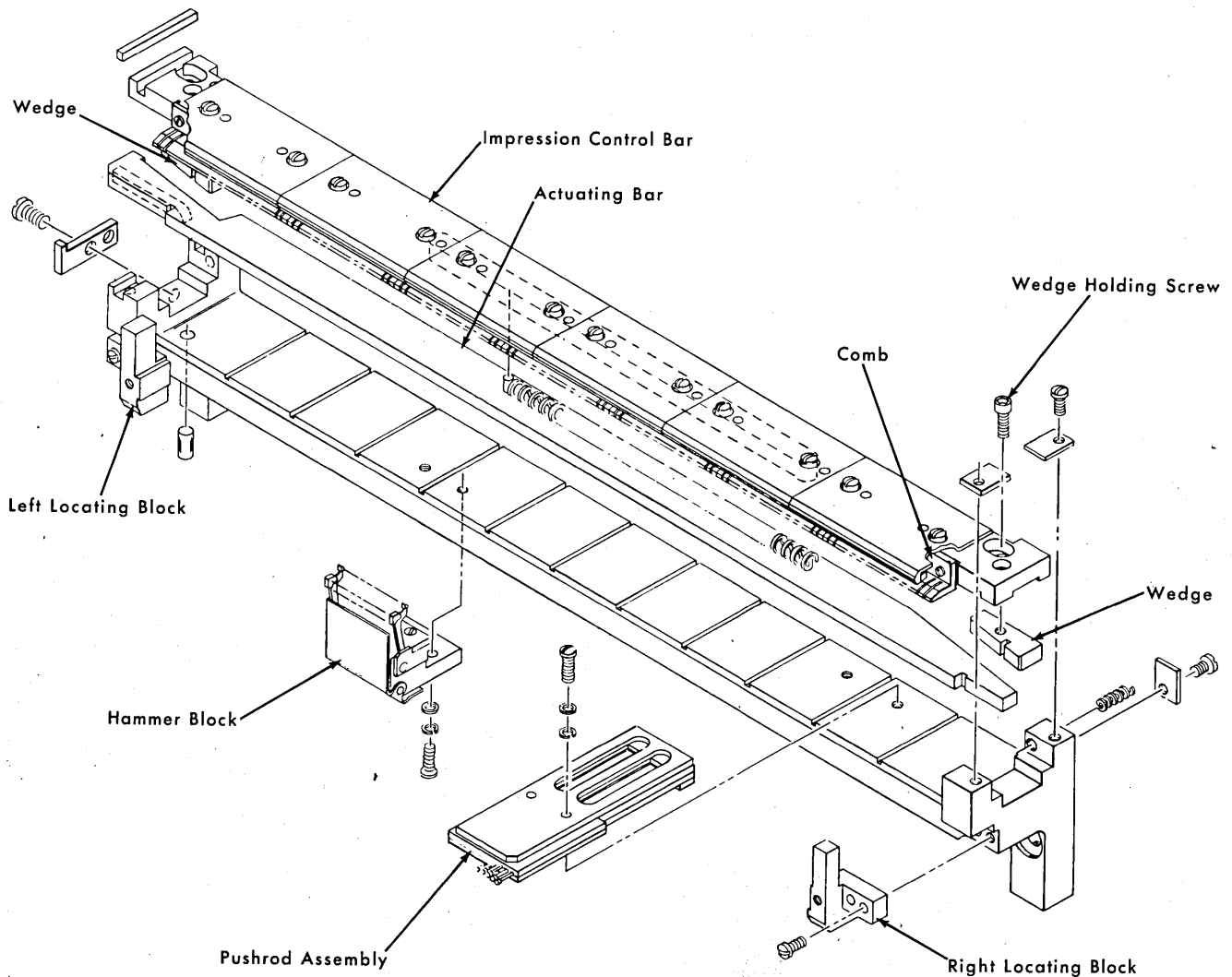


Figure 4-28. Hammer Mounting Bar Assembly

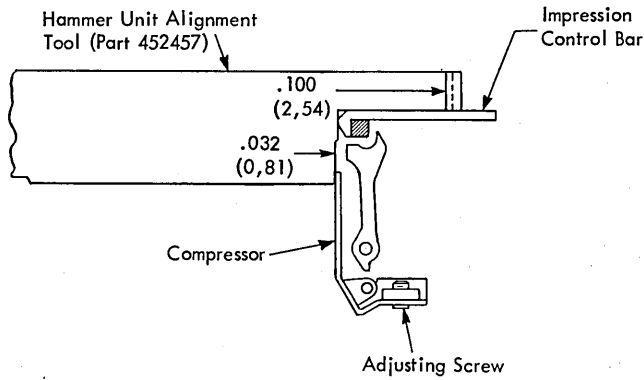


Figure 4-29. Forms-Compressor Adjustment

#### 4.8.5 Forms Compressor Removal and Replacement

To remove:

1. Perform steps 1 through 11 of the 4.8.6.
2. Rotate the unit so the screws on the bottom of the hammer mounting blocks are accessible.
3. Remove the two screws (Figure 4-28) from the mounting block for the hammer to be removed.
4. Slide the mounting block forward out of its position. If necessary, loosen the adjacent blocks so the block in question can be removed.
5. Loosen the spring screw and pivot the spring sideways.
6. Push the compressor pivot pin (see Figure 4-30) out of the hammer mounting block and remove compressor.

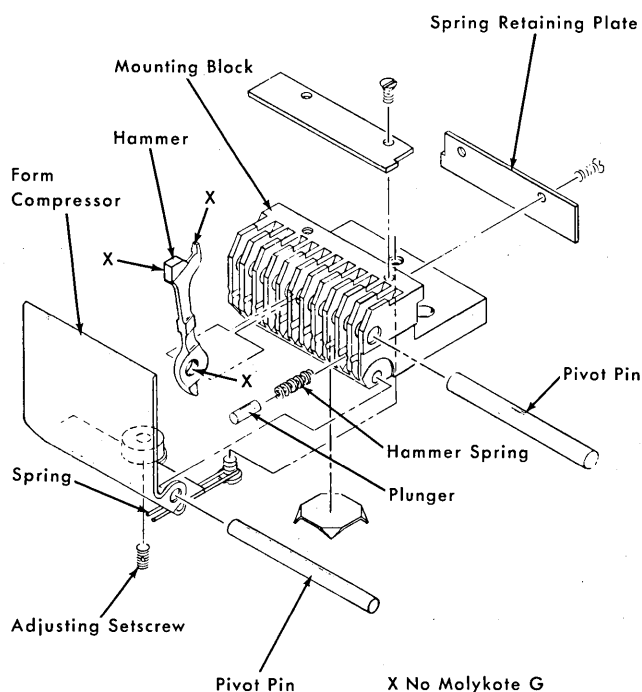


Figure 4-30. Hammer Mounting-Block Assembly

To replace:

1. Hold the compressor in position and insert the pivot pin. The end of the pin must be flush with the side of the block.
2. Reposition the end of the spring on the bottom of the compressor and tighten the screw. The end of the spring must bear on the straight portion of the compressor adjacent to the radius.
3. Replace the hammer and work the hammer pivot pin into place. Replace the form compressor and its pivot pin.
4. Make certain the sides of the removed hammer block and those loosened are clean.
5. Replace the hammer block and any that were loosened or removed originally. All clearance must be removed between the locating pin on the left end of the mounting bar and the first hammer block. There must be no clearance between any of the 11 hammer blocks. The blocks must be mounted up against the front of the mounting bar.

#### 4.8.6 Hammer-Unit Removal and Replacement

With the front cover open, the eccentric screws (see Figure 4-24) that position the hammer unit from being tilted upward, must be loosened to prevent damage to either or both the hammer unit and translator frame. This eliminates binds when the hammer unit is moved on to the service rails.

1. Remove forms.
2. Push tractors aside to avoid catching the compressor on them.
3. Remove the top forms guide.
4. On Model 3:
  - a. Open rear door and slide the rear forms stacker down out of the way.
  - b. Remove the inside rear baffle, held by two screws in the lower left and right corners.
  - c. Remove the rear door and cover assembly.

→ On Model N1:

- a. Close the top cover to the front and open it from the rear.
  - b. Remove the top forms guide.
  - c. Swing open the stacker gate for access to the rear of the hammer unit.
5. Remove the air hose from the hammer unit.
  6. Install the service rails.
  7. Remove hammer-unit holding screws.

8. Slide hammer unit out on the service rails.
9. Remove the upper and lower hammer-unit covers.

This is as far as the hammer unit needs to be removed for the majority of service calls. If complete removal is necessary, proceed with the following steps.

10. Disconnect the hammer unit from the printer.

- a. Remove the cable clamps.
- b. Separate the quick-disconnect electrical connections.
- c. Remove the cables.

11. Remove the hammer unit from the service mounts.

- a. Tilt the hammer unit up (hammers-up).
- b. Remove the clips on the service-mount hand screws.
- c. Remove the hand screws.
- d. Place your forearms with the palms up under the hammer unit.
- e. Lift the hammer unit carefully with both arms until it is free of the service mounts.
- f. Tilt the unit toward you so it cannot fall.
- g. Withdraw the unit clear of the machine.
- h. Place the unit on a flat surface.

*do not do for Lab 70*

12. To replace, install the hammer unit carefully in reverse order.

**CAUTION**

Do not let the unit drop. Make certain the magnet leads do not bind or interfere with the magnet armatures when the covers are installed. On Model N1, be sure the hammer cables are between the air hose and the side frame (cables toward the front of machines from the air hose) or cables may interfere with the stacker box on the rear gate. Make certain external cable clamps are reinstalled to the hammer unit to prevent interference of the cable with the stacker box and the top cover drive chain.

13. Tighten the eccentric screws to set adjustment pins before the hammer-unit holding screws are tightened to ensure that the unit sets level in the translator frame.

**4.8.7 Residual Strip Removal and Replacement**

The train printers use only two residual strips, both having the same part number. Figure 4-25 shows how both ends of each strip are attached to their respective anchor studs. Each strip runs the length of the magnet unit and loops back, hooking on the anchor stud from which it started.

*Note:* If either strip requires replacement, *always* replace *both* strips.

To remove or replace the residual strips, slide the hammer unit out on the service mounts and rotate it until the strips are accessible. Then simply unhook the tabs at each end of the residual strips from their anchor studs, and withdraw the strips.

Before installing new strips, make certain the yokes and armature surfaces are clean. Slide the strips between the rows of armatures and the rows of magnet yokes, using cards as guides if necessary. Then snap the hooked openings in the anchor tabs over their respective anchor studs.

Be careful not to stretch the strips any more than necessary when replacing them.

**4.8.8 Individual Hammer Magnet Removal and Replacement**

To remove:

1. Perform steps 1 through 9 of 4.8.6.
2. Remove the appropriate magnet-mounting plate screws, and pivot the plate.
3. Loosen the end screws and pivot the SMS receptacle bracket 90°.
4. Remove the magnet coil slip connectors from their terminals.
5. Remove two screws holding the assembly to the plate (see Figure 4-25).
6. Remove the magnet assembly.

To replace:

1. Install the magnet assembly with its holding screws snug, but not tight.
2. Center the magnet assembly on the plate with the hammer magnet adjustment tool (part 856170).
3. Route the magnet leads around the assembly as shown in Figure 4-25.
4. Connect the leads to the proper terminals.
5. Close up the hammer unit by following step 12 of 4.8.6.
6. Run the printer and check the printing. Adjust as required. See 4.8.2.

#### 4.8.9 Individual Hammer-Magnet Coil Replacement

If the hammer magnet coil is open or needs replacement, the complete assembly should be replaced. It is not recommended to replace any individual part on this magnet assembly because of preset adjustments.

#### 4.8.10 Individual Hammer Removal and Replacement

The hammer blocks can be removed from the front of the printer without removing the unit. Rotate the tractor shafts and raise the translator frame to allow clearance. Remove the two mounting screws from the hammer block and slide the block out the front of the unit.

To remove a hammer:

1. Perform steps 1 through 9 of 4.8.6.
2. Rotate the unit so the screws on the bottom of the hammer mounting blocks are accessible.
3. Remove the two screws (see Figure 4-28) from the mounting block for the hammer to be removed.
4. Slide the mounting block forward out of its position. If necessary, loosen the adjacent blocks so the block in question may be removed.
5. Remove the hammer spring retaining plate (see Figure 4-30) on the rear of the block. Be careful to retain all springs and plungers.
6. Push the hammer pivot pin out, and remove the hammers to the point where the desired hammer can be removed.
7. Remove the form compressor and its pivot pin. Using this pivot pin as a follower rod, push in the hammer pivot pin until the hammer to be replaced can be removed.

To replace the hammer:

1. Apply a very light film of Molykote G\* (part 357830) to the following surfaces only:  
  
Contact point of spring plungers  
Both sides of hammer in guide comb area  
Contact point of pushrod  
Both sides of hammer in pivot area.
2. If the plunger is replaced, coat it with a light film of Molykote G.
3. Keep the pivot hole, print face, and impression control surface free of Molykote G (see Figure 4-30).

4. Replace the hammer and adjoining hammers one at a time, while moving the pivot pin back to its original position (flush with the edges of the block).
5. Replace the plungers and springs, then the spring retaining plate. Make sure there is free operation of the hammer, plungers and springs.
6. Replace the hammer and work the hammer pivot pin into place. Replace the form compressor and its pivot pin.
7. Make certain the sides of the removed hammer block and those loosened are clean.
8. Replace the hammer block and any there were loosened or removed originally. All clearance must be removed between the locating pin on the left end of the mounting bar and the first hammer block. There must be no clearance between any of the 11 hammer blocks. The blocks must be mounted up against the front of the mounting bar.
9. Both left and right hammer-unit locating blocks must be located tightly against their adjacent hammer mounting blocks.
10. Replace the hammer unit (see 4.8.6).

#### 4.8.11 Pushrod Removal and Replacement

Keep pushrods in their original slots; do not interchange them.

1. Move the hammer unit onto the service rails (see 4.8.6).
2. Remove the upper and lower hammer-unit front dust covers.
3. Pivot the top magnet-assembly mounting plate to expose the hammer mounting bar assembly.
4. Remove the complete hammer mounting bar assembly from the hammer unit. Care should be used when removing the assembly not to bend the pushrods.
5. Remove the mounting screws from the top of the appropriate pushrod assembly (Figure 4-31) and slide the assembly out the rear in a straight line. Be careful to avoid losing pushrods out of their slots, and avoid damaging the locating tenons on the bottom of the guides.
6. Remove the three screws at the rear of the assembly with the steel backup plate down. Separate the plates carefully to get at the desired pushrod. Keep pushrods not being changed in their original slots. Any change may affect print registration.

\*Trademark of Alpha Molykote Corporation

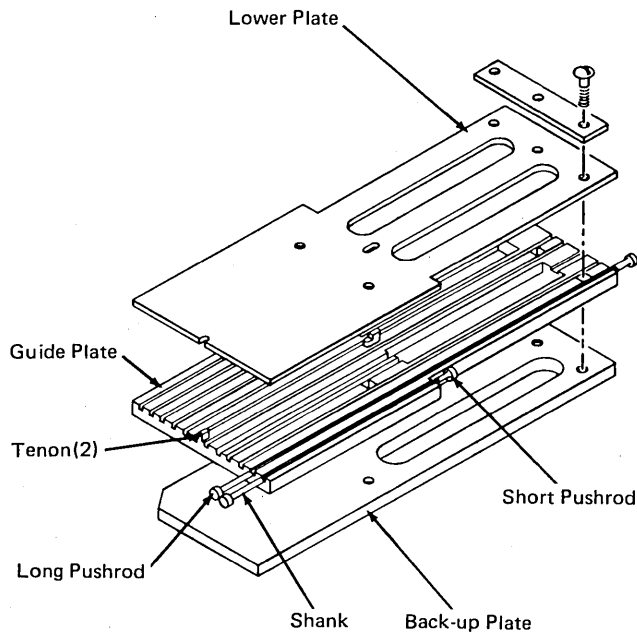


Figure 4-31. Pushrod Assembly (Inverted)

To replace the pushrods:

1. A very light film of Molykote G (part 357830) should be applied to the pushrod, guide, and cover. Do not leave more than a very light film on these parts.
2. Place the pushrod in position and put the guides and backup plate together, making sure all holes line up. Make certain to install the backup plate with its cut corner oriented as shown in Figure 4-31. This places the close tolerance flat side against the pushrod guide plate.
3. Replace the screws that hold the backup plate to the guides. Be sure the pushrods are in place, then tighten the screws.
4. Place the assembly on the mounting bar with the tenons in the locating slot. The tail of the rear tenon must be against the bar.
5. Check that all pushrods are in position.

#### CAUTION

When installed on the mounting bar, the shanks of the pushrod ends must be outside the guides at both ends of the guides. Now insert the mounting screws and tighten securely.

6. Replace the mounting bar in the hammer unit. Make sure all pushrods operate freely.

7. Pivot the magnet mounting plates closed, and secure them.
8. Replace the hammer unit by performing step 12 of 4.8.6.
9. Run the printer tests, check print registration, and adjust if necessary. See 4.8.2.

## 4.9 T-CASTING LATCH

### 4.9.1 T-Casting Latch Adjustment

Remove the interlock-switch cover. Check the adjustment of the T-casting latch (Figure 4-32).

1. Open the T-casting.
  - a. Operate the interlock detent and move the lock lever to the latched position (the handle resting against the stop stud).
  - b. Make certain the high side of the eccentric is toward the front and provides positive locking action; high side  $8^{\circ} \pm 1^{\circ}$  above the horizontal.
  - c. Make sure the interlock switch just makes when the latch handle is  $1/32$  to  $1/16$  in. ( $0,79$  to  $1,6$  mm) from the latch-handle stop stud.
2. Close the T-casting.
3. Make sure a 2 to 6 pound ( $0,907$  to  $2,722$  kg) force\* (applied at the center of the ball) is required to operate the latch.

When these conditions are met, no further adjustment is necessary. Replace the interlock-switch cover.

Position the eccentric shaft.

1. Open the T-casting.
2. Move the T-casting lock lever to the latched position (the handle resting against the stop stud).
3. Loosen the clamp screw in the handle.
4. Position the high side of the eccentric toward the front.
5. Further position the high side of the eccentric above the horizontal so the latch just provides a positive locking action:  $8^{\circ} (\pm 1^{\circ})$  above the horizontal.
6. Clamp the handle to the eccentric shaft.

\*Use push-pull scale (office tool, part 461141).

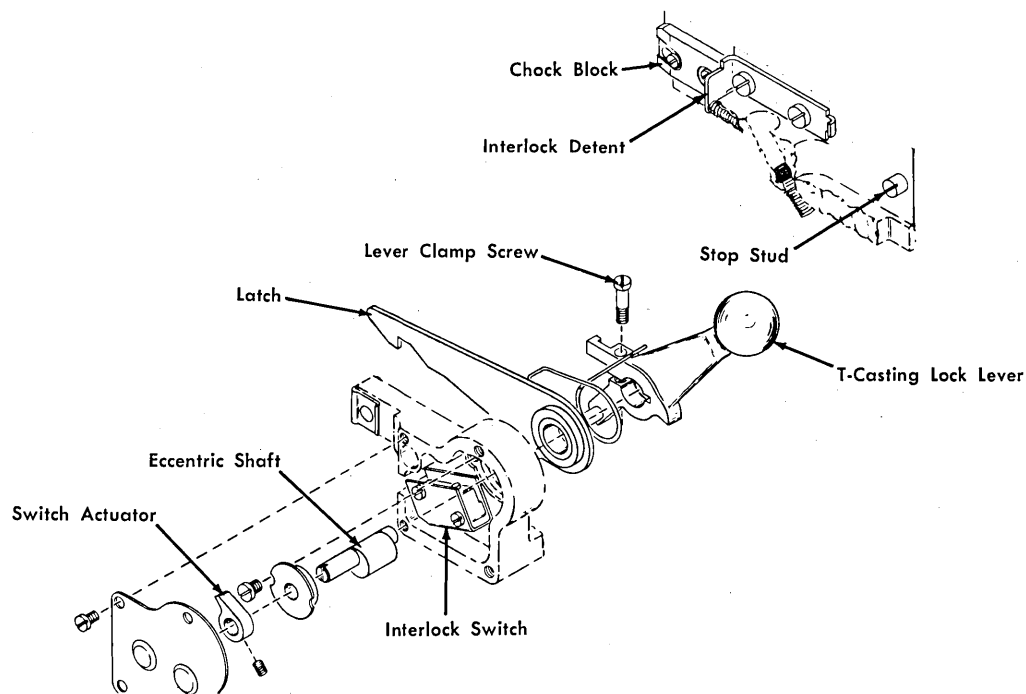


Figure 4-32. T-Casting Latch

Adjust the interlock switch. (*Note: Grinding the fluted wrench can facilitate adjustment.*)

1. Position the latch handle 1/16 in. (1,60 mm) from the latch-handle stop stud in latching position.
2. Position the interlock-switch actuator on the eccentric shaft so that the interlock switch just makes.
3. Lock the actuator to the shaft.

Position the T-casting-latch catch (Figure 4-33).

1. Loosen the T-casting-latch catch holding screws.
2. Latch the T-casting closed.
3. Turn the T-casting-latch catch adjusting screw (socket head) to draw the T-casting against the latch bumper screw (hex head).

Adjust the latching force.

1. Turn in on the T-casting-latch catch adjusting screw 1/16 in. (1,6 mm) turn.
2. Tighten the holding screws.
3. Latch the T-casting and observe the latching force.

4. If the latching force is not correct, loosen the latch-catch holding screws and readjust the adjusting screw as necessary.
5. Tighten the holding screws.
6. Replace the interlock-switch cover.

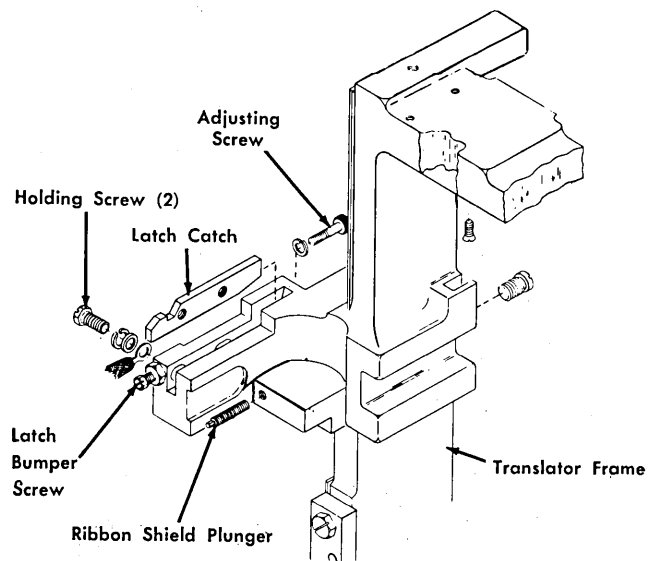


Figure 4-33. T-Casting Latch Catch

#### 4.9.2 Vertical T-Casting Positioning

This adjustment depends on the correct location, front to rear, of the hammer unit and the correct adjustment of the type cartridge and movable base on the T-casting.

Prepare to position the T-casting vertically.

1. Use a two-part form and strip off the last copy, leaving the last carbon exposed to the hammers.
2. Set up the processing unit to print one line of alternate W's and M's.
3. Latch the T-casting closed.
4. Set the print-density control to C.
5. Set the forms thickness control lever at .003 in.

Check the vertical positioning of the T-casting.

1. Print one line of alternate W's and M's.
2. Open the T-casting.
3. Remove the forms.
4. Observe the imprint of the characters on the hammers.
5. If the imprint is located evenly between the upper and lower edges of the hammer faces, no further adjustment is necessary. Replace the ribbon.

Adjust the vertical position of the T-casting.

1. Position the right end of the T-casting.
  - a. Loosen the hinge-pin bushing setscrew in the upper arm of the translator frame.
  - b. Loosen the lower jackscrew locknut on the lower right arm of the translator frame (Figure 4-34).
  - c. Turn the upper jackscrew locknut to obtain the vertical adjustment.
  - d. Tighten the lower jackscrew locknut.
  - e. Force the hinge-pin bushing down and tighten the setscrew.
2. Position the left end of the T-casting.
  - a. Loosen the chock block (see Figure 4-32) on the T-casting to obtain the vertical adjustment.
  - b. Slide the chock block on the T-casting to obtain the vertical adjustment.
  - c. Clamp the chock block to the T-casting.
3. Position the ribbon shield and the print-line indicator. See Service Hint 23.
4. Recheck the vertical position.

#### 4.9.3 T-Casting Removal

Prepare for removal.

1. Remove the ribbon.
2. Remove the ribbon drive unit.
3. Remove the train cartridge.
4. Remove the wires to the T-casting.
5. Remove the front cover.
6. Remove the right cover.
7. Remove the inner front cover.

Remove the movable base (or remove the read head). Free the hinge pin (Figure 4-34).

1. Open the T-casting.
2. Remove the ribbon shield and print-line indicator from the hinge.
3. Remove the screw that is screwed into the hinge pin through the horizontal hole in the upper arm of the T-casting.
4. From the rear side of the T-casting, drive pins from the:
  - a. Upper eccentric bearing
  - b. Lower eccentric bearing
5. Loosen the collars on the hinge pin.
6. Close and lock the T-casting carefully.
7. Loosen the setscrew in the upper hinge-pin bushing.
8. Loosen the setscrew that locks the lower eccentric bearing.

Remove the T-casting.

1. Remove the hinge pin and catch the parts as they are freed by the hinge pin.
2. Unlock the T-casting while supporting the weight of the casting.
3. Slide the T-casting out toward the front to clear the translator frame.

#### 4.9.4 T-Casting Replacement

Prepare to reinstall the T-casting.

1. Ensure that the hinge pin will slide through all parts.
2. Slide the hinge pin through the upper bearing hole in the T-casting.
3. Thread the upper eccentric bearing on the hinge pin.
4. Thread the lower eccentric bearing on the hinge pin.
5. Slide the hinge pin into the lower bearing hole in the T-casting.



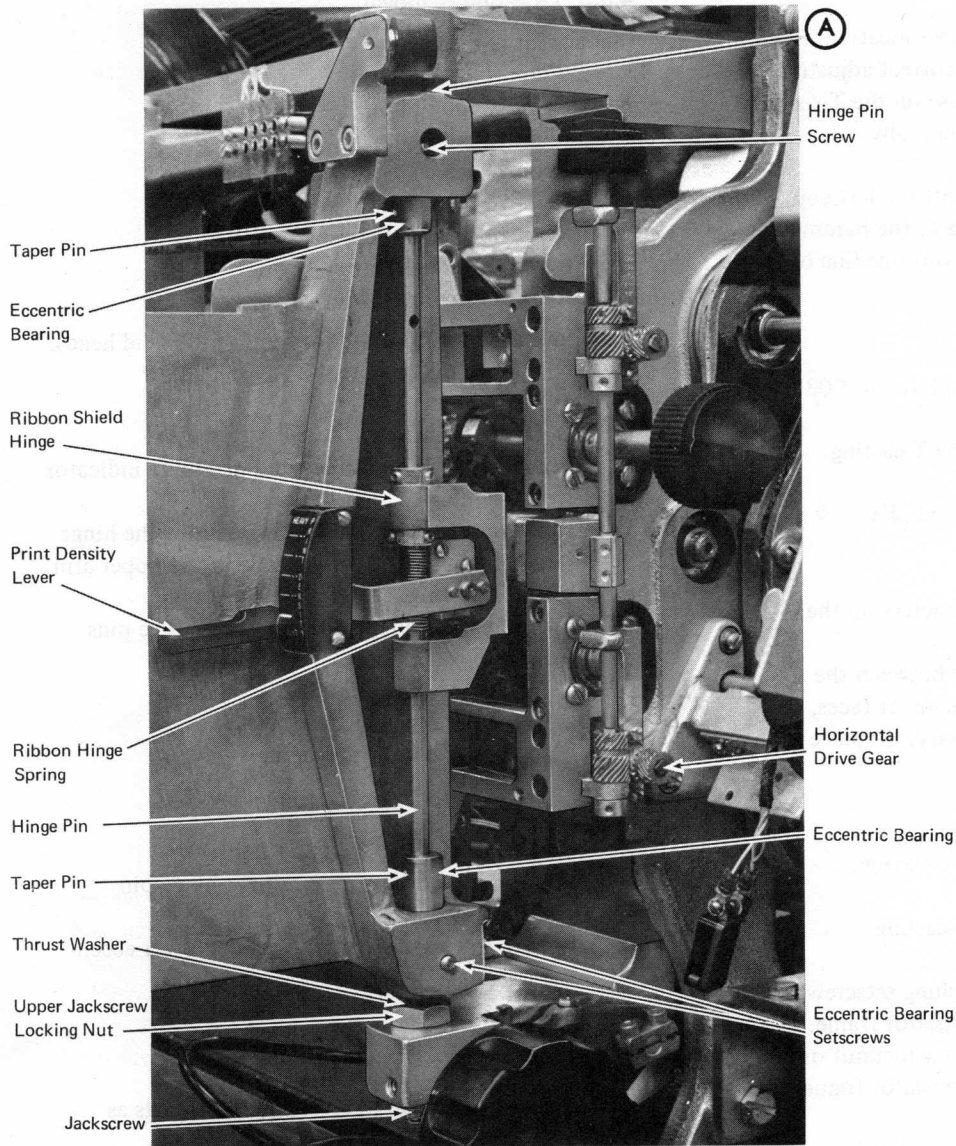


Figure 4-34. T-Casting (Hinge-Pin End)

Locate the eccentric bearings in the T-casting to enable, in a later step after the T-casting has been installed, the pinning of bearings to the hinge pin.

1. Locate the lower eccentric bearing rotationally.
  - a. Rotate the bearing around the hinge pin so that the high side of the eccentric is to the right.
  - b. Further rotate the bearing so that the high side of the eccentric rotates  $45^{\circ}$  toward the rear.
  - c. Work the eccentric into the lower bearing hole.
2. Locate the upper eccentric bearing rotationally.
  - a. Rotate the upper bearing around the hinge pin until it lines up with the upper bearing hole.
  - b. Work the bearing into the upper hole.
  - c. Insert the taper pin (finger-tight) into the bearing and the hinge pin.
- d. Insert the taper pin (finger-tight) into the bearing and the hinge pin.

3. Position the bearings vertically.
  - a. Slide the hinge pin and bearings vertically until the horizontal screw hole in the hinge pin is at the same level as the center of the horizontal hole in the upper arm of the T-casting.
  - b. Insert the setscrew and lock the lower eccentric bearing to the lower arm of the T-casting.
  - c. Remove the taper pins.
  - d. Withdraw the hinge pin.

Prepare the translator frame for the T-casting replacement.

1. Place the bushing in the upper arm of the translator frame and lock the bushing as high as possible in the arm.
2. Place the thrust washer over the jackscrew in the lower arm of the translator frame, align the hole centers, and tape the washer to the jackscrew. See 4.9.4.1.

Set the T-casting into position.

1. Gather all loose parts that fasten to the hinge pin (including the hinge pin) and set them on the printer to be close at hand when needed.
2. Lift the T-casting into position on the translator frame, keeping the right end high so the thrust washer is not dislodged.
3. Actuate the T-casting lock lever until the latch just engages the latch catch.

Install the hinge pin.

1. Slide the hinge pin through the bushing in the upper arm of the translator frame.
2. Slide the hinge pin through the upper eccentric bearing in the upper arm of the T-casting.
3. Thread the hinge pin through the loose parts in correct order and in correct relation to the T-casting.
4. Slide the hinge pin into the lower eccentric bearing.
5. Slide the hinge pin through the thrust washer into the jackscrew.

Fasten the eccentric bearings to the hinge pin.

1. Align the lower pin hole in the hinge pin to the pin hole in the lower bearing.
2. Insert the taper pin into the holes just aligned.

3. Align the pin hole in the upper eccentric bearing to the upper pin hole in the hinge pin.
4. Insert the taper pin into the holes just aligned.
5. Drive in both taper pins.

Position the hinge pin.

1. Turn the hinge pin until the high side of the eccentrics are to the right.
2. Insert the screw through the hole in the upper arm of the T-casting, and screw through the hinge pin.
3. Free the bushing in the upper arm of the translator frame, and force the bushing against the T-casting.

Perform these adjustments:

1. Position the T-casting front to rear.
2. Position the T-casting vertically.
3. Adjust the ribbon-shield assembly.

Replace the remaining parts in reverse order.

#### 4.9.4.1 Jackscrew Replacement

This procedure requires two men working together.

1. Close and latch the T-casting.
2. Using feeler gauges, measure and record the clearance between the upper leg of the T-casting and the translator frame (A in Figure 4-34). This measurement is required for adjustment of the T-casting later on in step 7.
3. Remove the lower locknut and spacer from the jackscrew.
4. Prepare the new jackscrew for installation.

*Note:* On some models, the jackscrews have an internal split nylon bushing and use an external spacer. Assemble the spacer and the locknut on the lower end of the jackscrew. Put only the locknut on the lower end of the jackscrew.

5. With IBM #6 oil, lubricate the lower end of the hinge pin where it passes through the jackscrew.
6. While one man holds the right end of the T-casting,
  - a. Remove the old jackscrew.
  - b. Install the new jackscrew. This may require moving the T-casting around horizontally and vertically until the holes line up and the hinge pin drops into the close fitting jackscrew.

## CAUTION

Be sure the top of the jackscrew is forcing the thrust washer against either the bottom of the lower leg of the T-casting, or the bottom of the lower-eccentric hinge pin bearing (if the bearing is protruding below the bottom surface of the T-casting lower leg).

7. Adjust the jackscrew to obtain the clearance recorded in step 2.
  - a. Adjust the jackscrew upper locknut until the clearance is about .010 in. (0, 25 mm) more than the original recorded measurement. (This takes care of changes in clearance that occur as you tighten the locknuts.)
  - b. Snug-up the lower locknut; do not tighten at this time.
  - c. Tighten the upper locknut.
  - d. Tighten the lower locknut.
  - e. Recheck the clearance. If it is not the same as the original clearance noted in step 2, loosen the lower locknut and repeat the adjustment procedure. Raise or lower the jackscrew until the original clearance is obtained after the locknuts are fully tightened.
8. Check the cartridge to hammer-unit clearance and readjust if necessary. See 4.10.1.
9. Run the print tests to check for print quality. See 4.9.2.

## 4.10 T-CASTING

### 4.10.1 Aligning the Train to the Hammers (Horizontal T-Casting Positioning)

Before the adjustment is made, the hammer unit must be located correctly front to rear (see 4.8.1). Also, the cartridge and movable base must be adjusted correctly on the T-casting (see 4.10.2).

1. Check for any foreign material between the strike plate and the T-casting.
2. Remove the ribbon, and set the forms thickness lever on .019 in.
3. Insert the .100 in. (2, 5 mm) rod end of the tool (part 452457) at the left end of the cartridge between the hammer locating block (see Figure 4-28) and a type slug with wide characters (Figure 4-35).

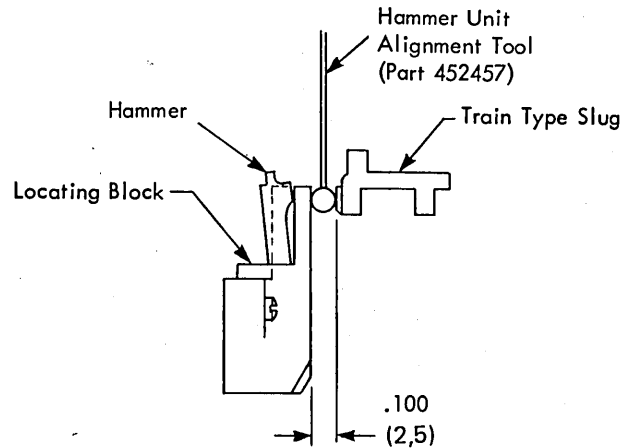


Figure 4-35. Train to Hammer Unit Positioning

4. Decrease the forms thickness setting until a light drag on the tool is obtained. If the clearance is correct, the thickness control should be at .011 in. setting.
5. Using the same type slug, repeat steps 3 and 4 at the right end.
6. If the clearance is incorrect on the right end of the T-casting, perform step 7. If the clearance is incorrect on the left end of the T-casting, perform step 8.

## CAUTION

The setscrew in the top arm of T-casting at the hinge pin position holds the upper bushing in place. This setscrew should not be tightened excessively because it can damage the bushing.

7. To adjust the right end of the T-casting, loosen the setscrew on the inside lower end of the T-casting hinge pin. Close the T-casting and loosen the other locking setscrew, which is accessible with the T-casting closed. Rotate the T-casting hinge pin until a light drag on the tool is obtained at .011 in. thickness. Lock the hinge pin with the setscrew.
8. Adjust the left end of the T-casting by loosening the locknut and positioning the adjustable stop stud until a light drag on the tool is obtained at .011 in. thickness.

Following steps 7 and 8, the .100 in. (2, 54 mm) dimension between the hammer blocks and the train should be rechecked at both ends of the cartridge.

9. The T-casting latch may require adjusting for sufficient tension of the casting on the stop stud to maintain the T-casting latched. (See 4.9.1.) Loosen the two holding screws at the side of the latch, and adjust the allen head screw from the rear of the printer.
10. Tighten the T-casting hinge pin locking screw on the inside of the T-casting.
11. Make a final check with the tool at both ends for proper setting. Readjust if necessary.

#### 4.10.2 Movable-Base Adjustments (Cartridge Removed)

1. Adjust the clearance of the eccentric shaft bearing blocks to the front shoulders of the recesses in the T-casting as follows.
  - a. Set the forms thickness lever to .019 in.
  - b. Loosen the mounting screws (under the T-casting) for the eccentric shaft bearing block.
  - c. Position the block against the front recess in the T-casting with a maximum clearance of .001 in. (0, 03 mm).
  - d. Tighten the mounting screws.
2. Adjust the movable base to the T-casting for a maximum clearance of .001 in. (0, 03 mm) as follows.
  - a. Tighten the two front gibs that hold the movable base to the T-casting (screws under T-casting).
  - b. Loosen the two locknuts on the two screws that hold the rear edge of the movable base down.
  - c. Tighten these nuts enough to remove the clearance between the screw threads and threads in the T-casting.
  - d. Hold the nuts with a wrench and adjust each screw to obtain the .001 in. (0, 03 mm) maximum clearance between the movable base and the T-casting. Make sure the movable base slides freely in the horizontal plane. Repeat the adjustment procedure if necessary.
  - e. Shifting the movable base laterally affects the transducer timing. If the base is moved, the hammer-to-type alignment relationship is changed. This requires corresponding adjustment of the transducer. Moving the base from left to right requires the transducer to be rotated counterclockwise about

the disk. This retards the timing of the pulses. Moving the base from right to left, requires the pulse timing to be advanced. This is done by rotating the transducer in a clockwise direction about the disk.

#### 4.10.3 Movable-Base Removal

1. Remove the train cartridge.
2. Disconnect the train motor leads from the terminal block.
3. Remove the gear cover from the movable base.
4. Remove the gear and key from the train motor shaft.
5. Remove the train motor from the movable base.
6. Remove the transducer (with its lead attached) and place it out of the way in a safe place.
7. Remove the two movable-base front gibs (Figure 4-36).
8. Remove the two screws, washers and locknuts that hold the rear edge of the movable base to the T-casting.

*Note:* The two washers are hardened and must not be replaced with soft ones.

9. Lift the base carefully off the eccentric bearing blocks.
10. Move the base carefully to the right until the motor mounting feet contact the side of the T-casting.
11. Raise the base clear of the T-casting.
12. Reassemble in reverse order and make the proper adjustments on the movable base.

#### 4.10.4 Movable-Base Eccentric-Shaft Removal

1. Remove the movable base. (See 4.10.3.)
2. Free the movable-base eccentric shaft.
3. Support the right end of the eccentric shaft and drive out the taper pin (the small end is up) in the forms thickness control lever.
4. Remove the lever assembly from the shaft.
5. Remove the friction clamp from the right end of the shaft.

The friction clamp provides the necessary friction to hold the forms thickness lever in position .003 in. to .019 in. without binding. The shaft must move in the friction clamp for operator setting of the lever.

The movable base must slide freely in a horizontal plane along the T-casting with a maximum vertical movement of .001 in. (0, 03 mm). Also, the movable base must slide freely with the left end support block assembly in contact with it (no clearance).

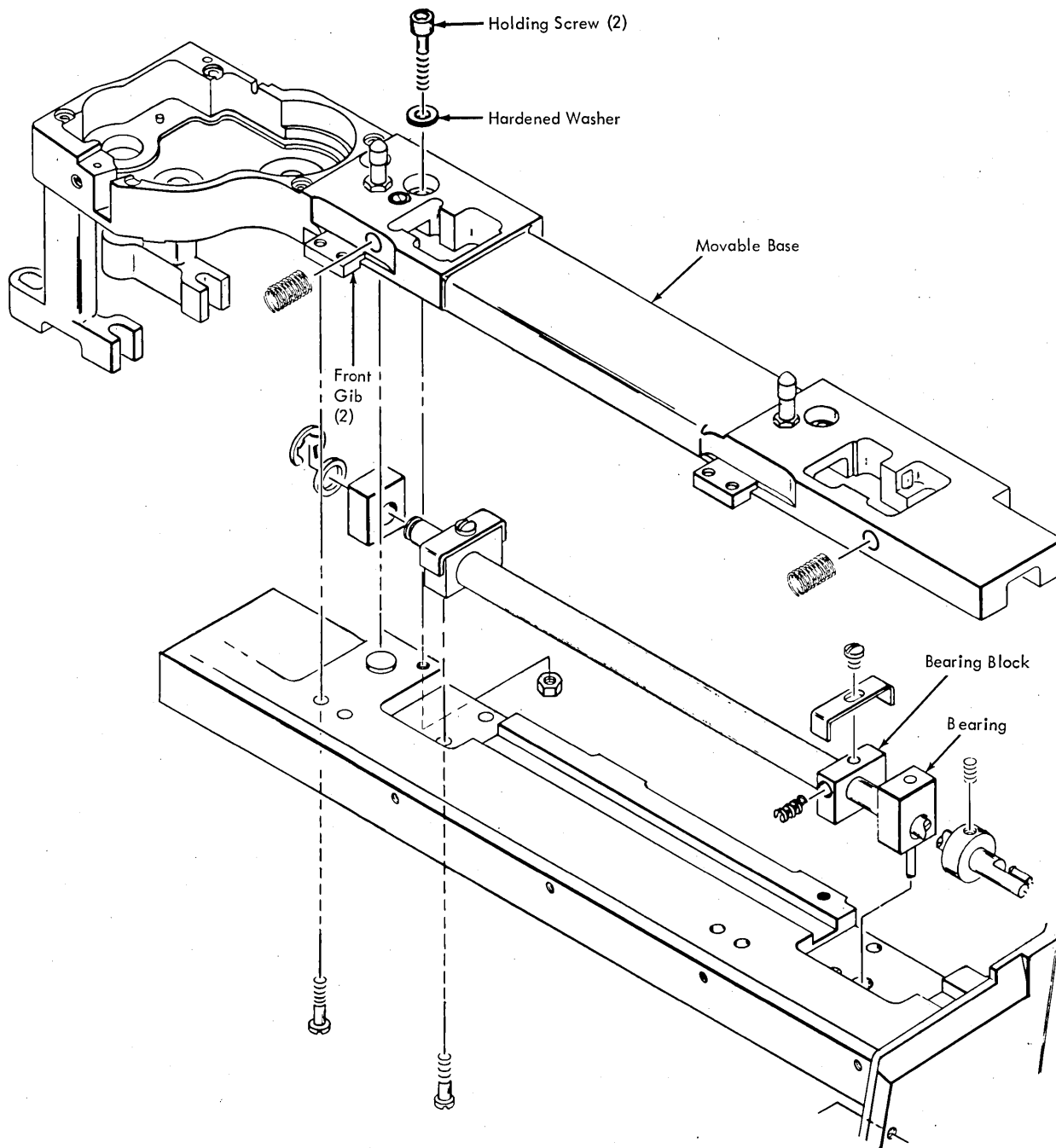


Figure 4-36. Movable Base

Because this adjustment is made before mounting the train drive motor, the warping effect of the motor on the T-casting must be simulated. Suspend the motor or an equivalent weight of 11.5 lbs. (5,221 kg) from the usual motor position to produce approximately the same amount of distortion in the T-casting. The movable base must slide freely as described with the weight attached. Each end of the movable base must slide freely in unison within .0005 in. If this condition is not met, remove the weight and repeat the adjustments.

6. Loosen the screws in the collar (Figure 4-36) that hold the right bearing, and slide the collar to the right.
7. Remove the screws underneath that hold the left and the right bearing blocks to the T-casting.
8. Remove the eccentric shaft.
  - a. Lift the left end of the eccentric shaft so that it clears the T-casting.
  - b. Withdraw the shaft to the left, sliding the shaft carefully through the right bearing and bearing block.

## CAUTION

The right bearing holds the oil line and the wick that oils the type train.

Replace the movable base eccentric shaft in reverse order and adjust the movable base during assembly. (See 4.10.2.)

### 4.10.5 Train Motor Drive-Gear Adjustment

1. Remove the train cartridge.
2. Remove the drive-gear cover plate.
3. Loosen the four motor-mounting screws.
4. Turn the idler gear to obtain the tightest mesh with the motor drive gear (Figure 4-37).
5. Move the motor to obtain a wink of .001 to .003 in. (0,03 to 0,08 mm) between the two gears at the point of tightest engagement.
6. Tighten the motor-mounting screws and recheck the adjustment. The wink must be present with no stress on the motor shaft.

### 4.10.6 Train Drive Motor Removal and Replacement

To remove the train drive motor, the gear on the motor shaft must first be removed. This gear is keyed to the shaft, and both the gear and the key are bound to it with a single setscrew (Figure 4-38). This screw, in the hub of the gear, is hidden from view by the gear teeth.

1. Remove swing pan and correction device cover.
2. Remove the type train cartridge.
3. Remove the gear-train cover plate.
4. Loosen the setscrew holding the gear and key to the motor shaft.
5. Remove the four motor-mounting screws while supporting the motor so it does not drop out.
6. Gently lower the motor vertically, withdrawing its shaft from the gear and key which remain in the gear housing.

To replace the motor, first remove the drive gear and key from the gear housing.

1. Replace the motor shaft through the hole in the casting.
2. While supporting the motor by hand, replace the four motor-mounting screws, but do not tighten them.
3. Install the key in the keyway in the motor shaft and slip the gear over the shaft and key.
4. Snug up the four motor-mounting screws.
5. Position the drive motor gear to mesh evenly with the train drive idler gear, while maintaining at least .005 in. (0,13 mm) clearance between the train motor gear and the top of the movable base. A .005 in. feeler gauge may be used. Tighten setscrew.

6. Adjust gear clearance as described in 4.10.5.
7. Replace gear-train cover plate and type train cartridge.

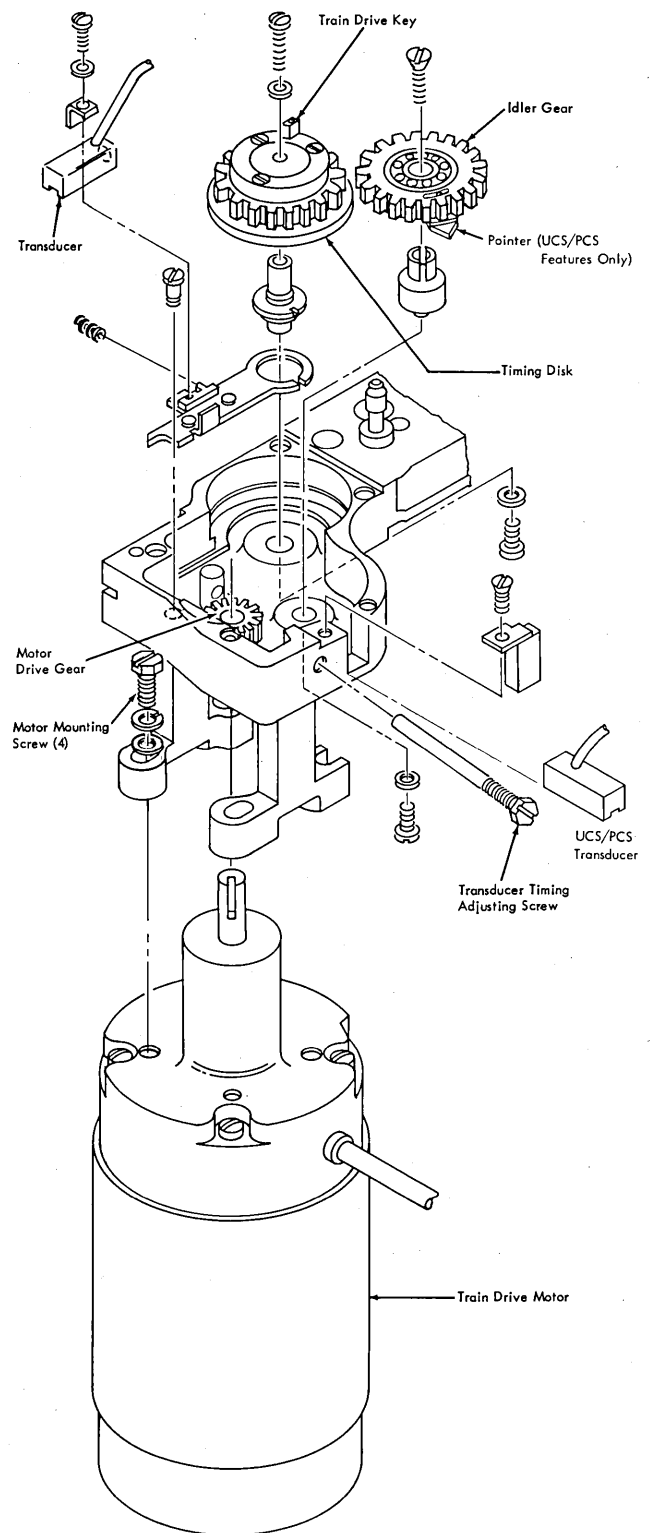


Figure 4-37. Train Drive and Timing Disk.

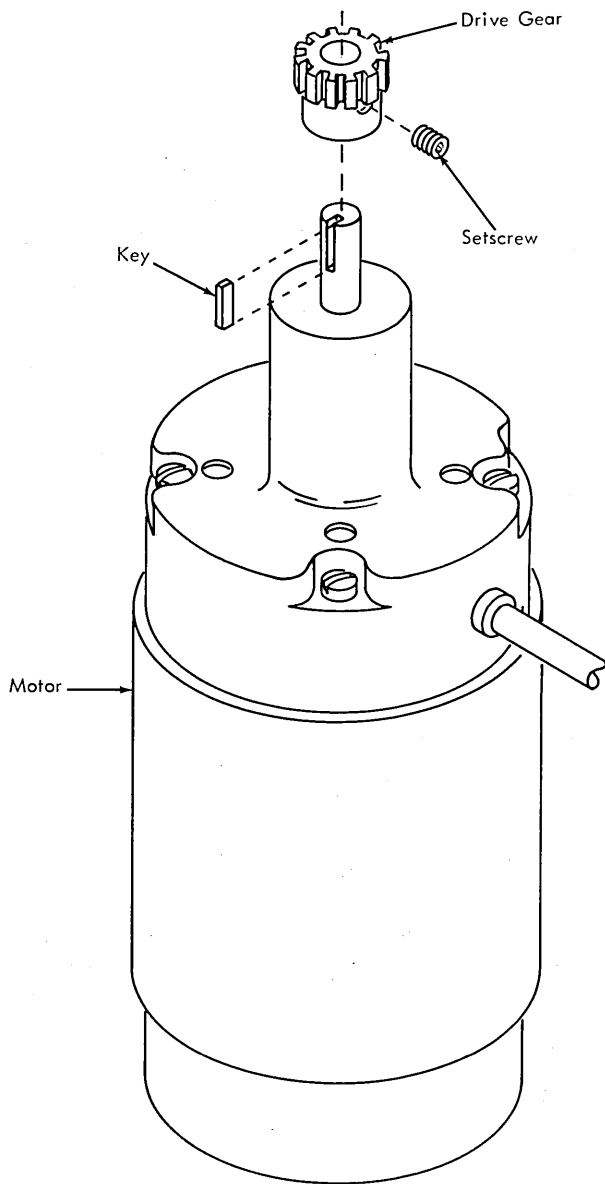


Figure 4-38. Train Drive Motor

#### 4.10.7 Timing-Disk Transducer Adjustments

If UCS feature is installed, use UCS adjustments (4.17).

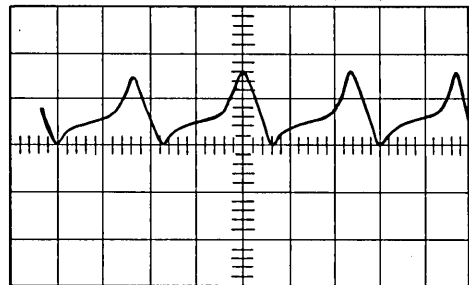
1. Remove the ribbon and cartridge.
  2. Remove the transducer and gear cover.
- Note:* Do not scratch timing disk when checking clearance.
3. Loosen the transducer-holding screw, and position the transducer (see Figure 4-37) so the minimum clearance between the transducer and the closest portion on the disk is .001 to .002 in.

(0,03 to 0,05 mm). Check for the closest portion by rotating the disk. Do not adjust while the disk is turning under power. A greater air gap may cause home-pulse resolution problems even though the output is adequate.

4. Operate the printer and check the output of the transducer with the disk rotating (1714 rpm). The voltage output should be between 50 and 150 millivolts measured at SA-1, pin B or D to dc ground (pin J). Measured across the transducer (across B and D), the output should be between 100 and 300 millivolts.

Normally, the transducer output wave shape as seen at pin B of SA-1 is like Figure 4-39.

Waveform as seen at Pin B of SA-1, using a direct probe.



Vertical - 50 millivolts/division  
Horizontal - 100 microseconds/division

Figure 4-39. Transducer Output Waveform

However, the transducer leads at pins B and D of SA-1 may be interchanged to obtain a rise time of .5 microsecond or less, at the output of the differential amplifier in the control unit.

5. If the condition in step 4 is met, proceed to step 7.
6. If the condition in step 4 is not met, do one or more of the following:
  - a. Recheck the disk-to-transducer clearance, step 3. Move the transducer closer to .001 in. (0,03 mm) clearance if the output is slightly low.
  - b. Check for loose wire connections.
  - c. Replace the transducer and repeat the adjustments.
7. After the transducer air gap and output are properly adjusted, check the overall print timing by one of the following methods.

#### 4.10.7.1 Method 1

- a. Place four-part paper in the printer.
- b. Load all H's, W's, or M's into storage for printing.
- c. Program for print and branch.
- d. Select 8 lines-per-inch carriage mode, and set the print density control knob at C.
- e. Set the forms thickness lever at .012 in. assuming the four-part paper is .012 in. (0, 30 mm) thick. If a micrometer is available, determine the exact thickness of the form, and set the forms thickness lever to that setting.
- f. Run the printer and print 10 to 20 lines.
- g. Examine the fourth copy. The outline of each hammer and the relative position of each printed character to the hammer can thus be examined and evaluated (Figure 4-40).
- h. Rotate the transducer timing adjusting screw (see Figure 4-37), and recheck the printing until the maximum number of printed characters are centered on the hammer impression marks.  
Do not remove transducer-timing stop screw.

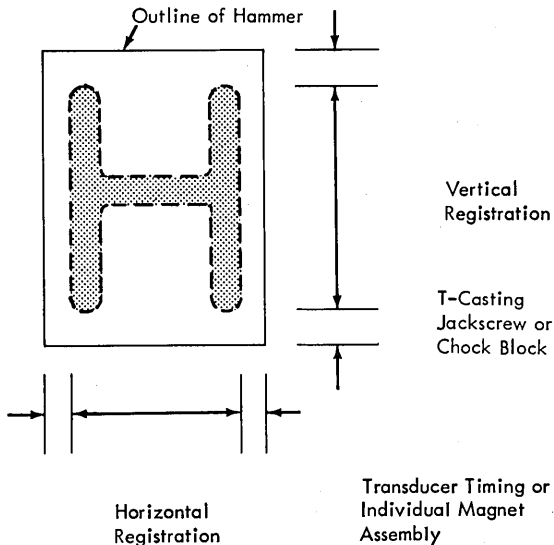


Figure 4-40. Print Registration

#### 4.10.7.2 Method 2

- a. Use a two-part form and strip off the last copy, leaving the last carbon exposed to the hammers.

- b. Load all H's, W's, or M's into storage for printing.
- c. Remove the ribbon.
- d. Latch the T-casting closed.
- e. Set the forms thickness control lever at .004 in.
- f. Set the print density control knob at C.
- g. Print one line.
- h. Open the T-casting.
- i. Remove the forms, and observe the imprint of the characters on the face of the hammers. The relative position of each printed character to the hammer can thus be examined and evaluated.
- j. If a majority of the characters are centered on the face of the hammers, the transducer adjustment is proper. If this is not the case, adjust the transducer with the timing adjusting screw (see Figure 4-37) and repeat the printing check until it is.  
Do not remove transducer-timing stop screw.
- k. Use extreme care when wiping the carbon off the hammer faces. Keep lint and other foreign material from getting between the hammers.

8. Whether method 1 or method 2 is used, adjust individual hammer positions for centering by use of the hammer-magnet adjusting tool (part 856170). See 4.8.2.

If necessary, additional timing adjustment can be obtained by shifting the movable base. Refer to paragraph 2e in 4.10.2.

#### 4.10.8 Train Lubricator

The train oil pump with reservoir (Figure 4-41) is located near the hinge on the lower right side of the T-casting. The factory-adjusted pump delivers .013 to .027 cc per stroke every half hour the train runs. A check valve prevents oil from running back into the reservoir. See Train Service Hints 6 and 7.

Lubricators that give incorrect delivery should be replaced. (Do not disassemble pump; rebuilt and recalibrated at factory *only*.) Normal delivery rate lowers the oil level in the oil level gauge 1/4 inch (6, 4 mm) for each 300 hours of train running time. (Figure 4-41 shows maximum and minimum rates.) Too much lubrication may result in oil on the ribbon and/or forms during long idle periods; too little lubrication can result in train failure. A brown stain on the cartridge rails indicates overheating due to inadequate lubrication.



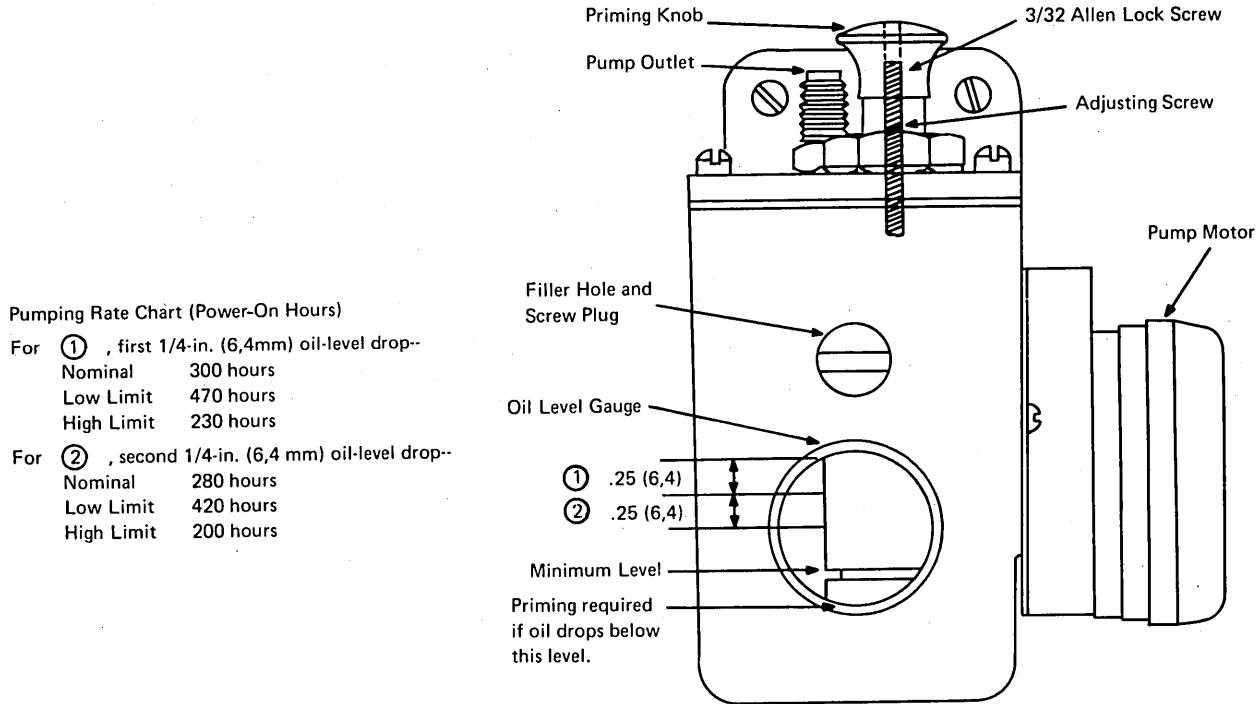


Figure 4-41. Train Lubricator and Pumping Rates

#### 4.10.8.1 Train Lubricator Removal and Replacement

To remove:

1. Turn off power to printer.
2. Remove train cartridge.
3. Disconnect supply tube from pump outlet. Wrap cloth around end of tube to catch oil draining from disconnected tube.
4. Disconnect electrical leads to pump motor.
5. Remove the two screws and lock holding the lubricator bracket to the frame.

To replace:

1. Fasten the lubricator to the frame with the two mounting screws and external-toothed lockwashers (required for grounding).
2. Connect the electrical leads for the pump motor.
3. Attach the supply tube to the pump outlet.
4. Fill the oil reservoir. (See 4.10.8.2.)
5. Prime the pump. (See 4.10.8.3.)

#### 4.10.8.2 Filling

1. Unscrew and remove the screw plug from the filler hole.

2. Fill the oil reservoir just to the top of the oil level gauge. Use *only* special oil (part 856381). A short piece of tubing on the oilcan spout facilitates filling.
3. Wipe off excess oil.
4. Replace screw plug (3/8 x 24 x 3/8; part 2121648).
5. For checking pump delivery rate against train usage, record the oil level, date, and CPU or control unit meter reading (to estimate power-on hours of the train).

#### 4.10.8.3 Priming

Priming is required after initially filling the oil reservoir, if the oil level goes below the level of the oil level gauge, or when the supply tube is disconnected at the pump outlet.

To prime:

1. Remove the train cartridge from the printer.
2. Lift the spring-loaded priming knob slowly and allow it to return.
3. Repeat step 2 until oil appears at the end of the supply wick on the movable base. (See Train Service Hint 6.)
4. Wipe off excess oil.
5. Replace the train cartridge.

#### 4.10.8.4 Adjustment

Field adjustment of the lubricator is not recommended because of the length of time required to check the output and the danger of causing train failure due to inadequate lubrication. If the lubricator is adjusted, heed the following cautions.

- Check the delivery rate before decreasing lubricator output (Figure 4-41).
- Never set the pump delivery below the minimum rate.
- Pump output stops before the adjusting screw reaches a positive stop. Operating the priming knob still delivers oil.
- Do not turn adjusting screw more than 1/2 turn at a time to decrease output. Check delivery before decreasing further.
- Whenever delivery is decreased, check train for overheating (brown residue on the rails after 72 hours of train running time). If overheating occurs, replace the pump.

If adjustment is necessary: (Loosening mounting screws or removing lubricator may be necessary for access to the adjusting screws.)

1. With an allen wrench, remove the locking screw from the center of the priming knob.
2. With a slender screwdriver, turn the adjusting screw (beneath the locking screw) clockwise to decrease the delivery rate or counterclockwise to increase the delivery rate. (One full turn changes the output .01 cc.)
3. Replace and tighten the locking screw.
4. For checking pump delivery rate against train usage, record the date, meter reading, and oil level.
5. Check train condition within 72 hours of train running time.

#### 4.10.9 Electromagnetic Acoustical Dampener Adjustment (Model 3)

On Model 3 only:

1. Locate the swing pan  $3/16 \pm 1/32$  in. ( $4,78 \pm 0,79$  mm) from the fixed paper guide on the paper dampener assembly (Figure 4-42) when the T-casting is latched closed.

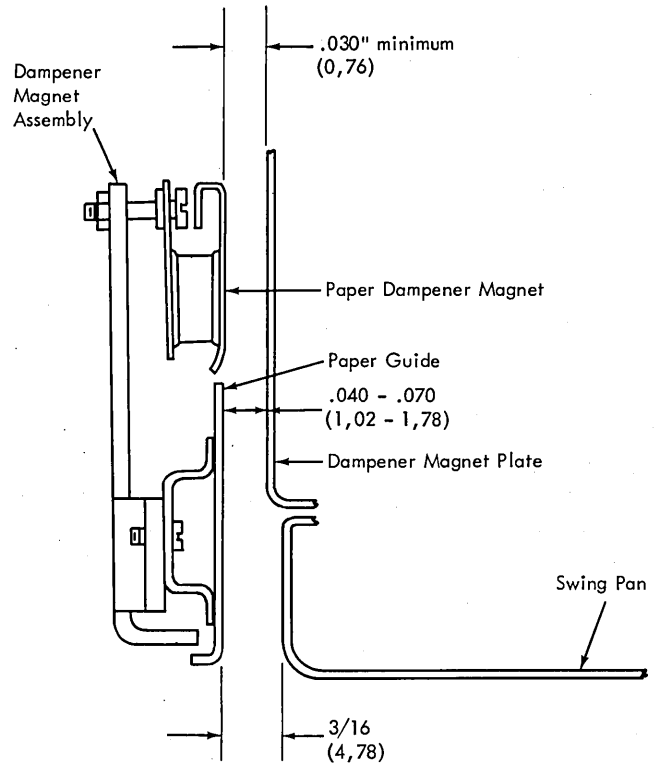


Figure 4-42. Electromagnetic Acoustical Dampener Adjustments

2. Position the dampener magnet plate (on the T-casting) .040 to .070 in. (1,02 to 1,78 mm) from the fixed paper guide (on the dampener magnet assembly) when the T-casting is latched closed. Maintain this adjustment along the entire length of both plates.

With this adjustment there should be a minimum clearance of .030 in. (0,76 mm) between the paper dampener magnets and the dampener magnet plate. The dampener magnets have been adjusted in the factory for this condition and should require adjustment only if a magnet assembly is replaced.

Adjustments 1 and 2 are provided for by slotted holes in the swing pan and the dampener magnet plate.

If the paper-dampener magnet is replaced, the face that contacts the paper must be within .010 in. (0,25 mm) of the vertical plane of the paper guide.

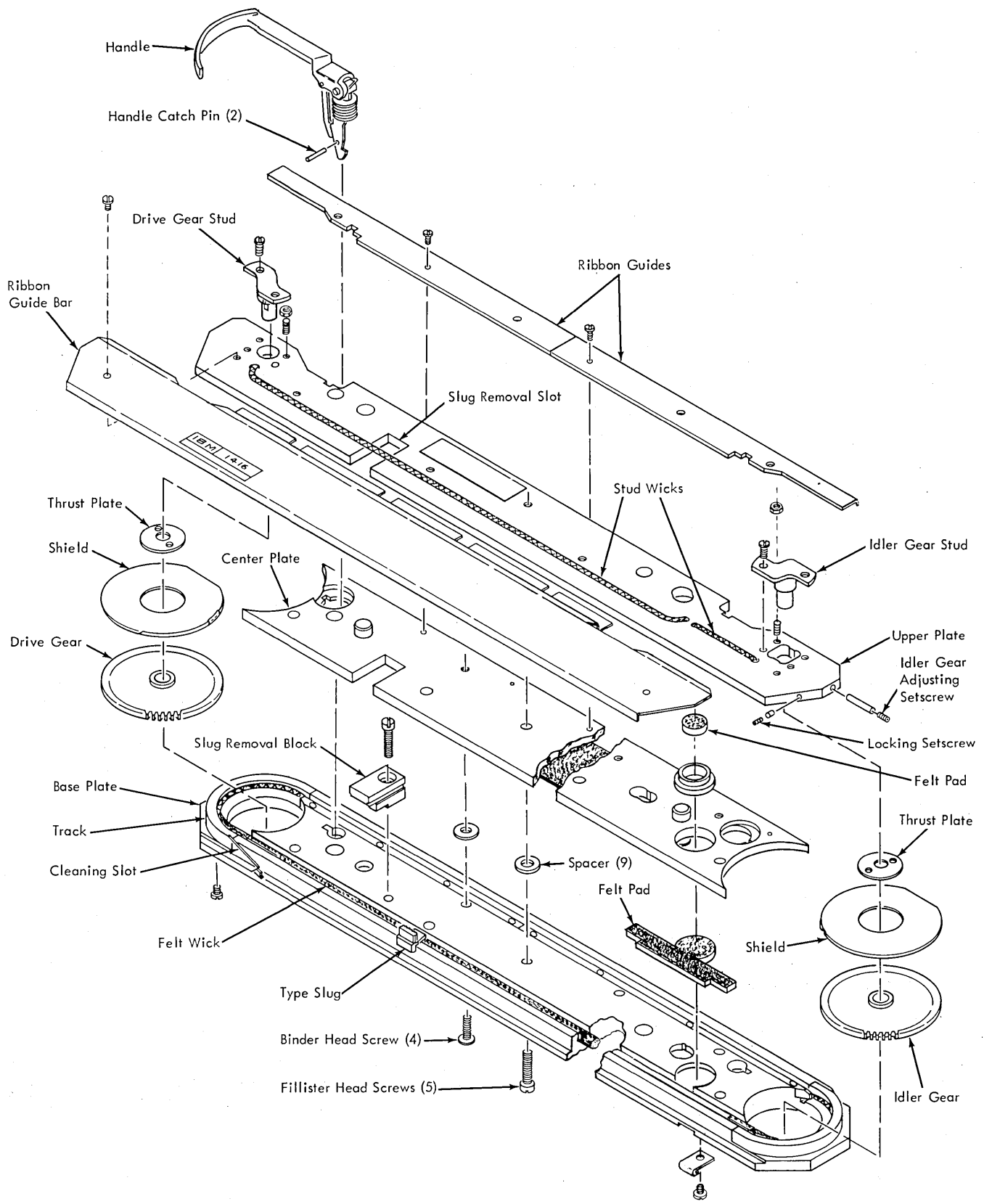


Figure 4-43. 1416 Interchangeable Train Cartridge

## 4.11 1416 INTERCHANGEABLE TRAIN CARTRIDGE

See Figure 4-43.

### 4.11.1 Train Slug Clearance Adjustment

The interslug gap adjusted meticulously according to the procedure given here may increase in a week or so to as much as .007 or .008 in. (0, 18 or 0, 20 mm). This is because oil, in a seemingly insignificant film between slugs, is thrown off as the train spins around its track.

Excessive oil in the space between slugs is undesirable because it changes the slug-to-slug clearance. Too much oil can temporarily reduce this clearance to the extent of causing momentary binds that result in sync checks. Then, a week or so later, this oil has been thrown off and produces excessive interslug clearance. The correct slug-to-slug clearance must be constantly maintained to ensure proper train operation.

#### Operation

If the slugs have been washed and air-dried as described in 3.1 and the type track lubricated as specified in 4.11.4 and the interslug gap adjusted as described here, then maintenance of the interslug gap should be automatic.

The oil film supplied by the train lubricator wick provides just enough balance to replace that thrown off by the train, and thus maintains an even amount of oil film between slugs. For this reason it is important not to over-lubricate the wick, and to make sure the oil reservoir in the train lubricator never runs dry. With the right amount of lubrication (as supplied by the automatic oiler), the interslug gap, once set correctly, changes very little.

Always be sure to use IBM lubricant (part 856381), or equivalent, for train lubrication as this special oil withstands high operating temperatures produced if the cartridge overheats. The accumulated slug-to-slug clearance of the type train should be between .001 to .003 in. (0, 03 to 0, 08 mm). Use the following procedure to check this clearance on the backside of the cartridge.

1. With the cartridge removed, separate any two adjacent slugs at a point to the left of the train idler gear (Figure 4-44). To do this, hold one of the slugs tight against the track with your left thumb. With your right hand, use a coin to move the adjacent slug to the right.
2. Hold the feeler gauge between your left thumb and forefinger so that the gauge projects no more than 3/16 in. (4, 78 mm) (Figure 4-45). This is to ensure that the gauge does not bottom against the track. Make sure the feeler gauge is clean. Insert the gauge in the separation made between the slugs in step 1 (at the butt, or top, not at the character center line).



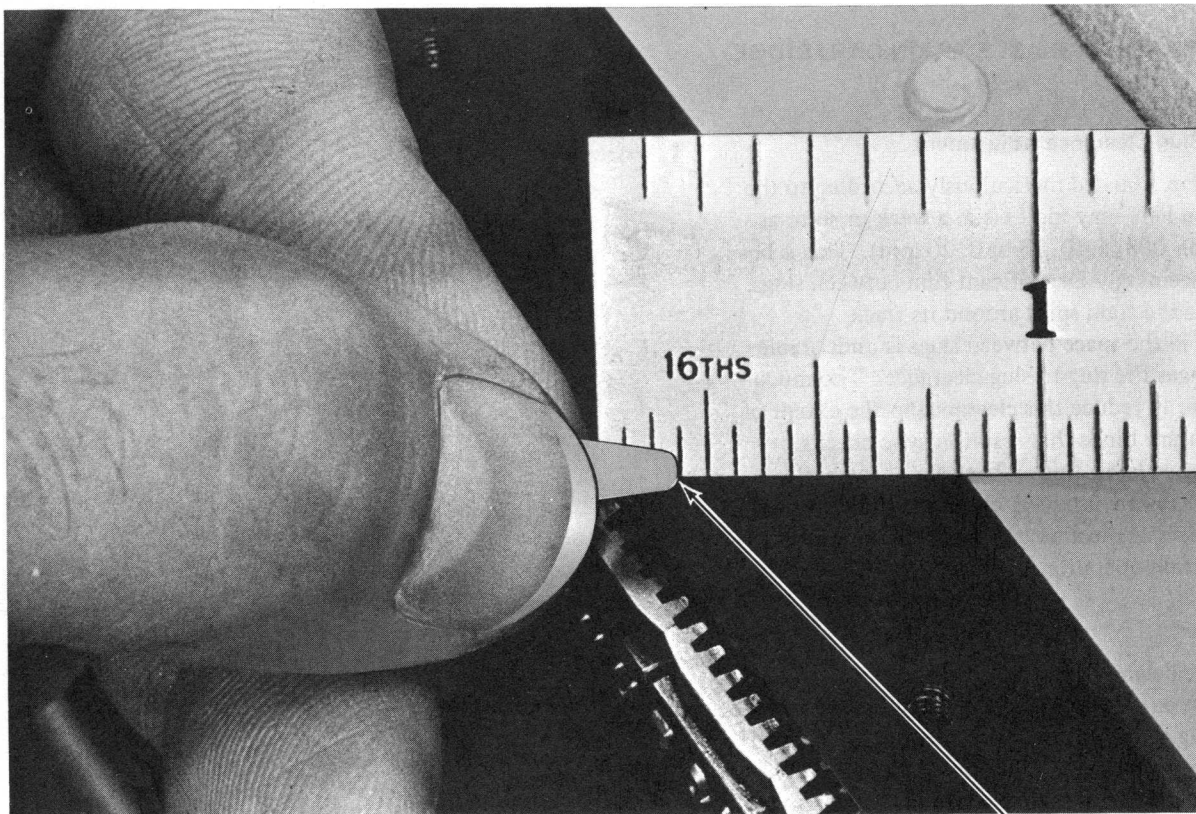
Figure 4-44. Method of Separating Type Slugs

3. With the feeler gauge held between the slugs, move the train to the right across the straight section of the track. Figure 4-44 shows this being done by engaging the adjacent slug to the right with the coin.

The clearance is correct if the .003 in. feeler gauge produces slight binds, while the .001 in. feeler gauge does not, as the train is moved. If the clearance is correct, rotate the train by hand several times to be certain it does not have binds or tight spots. If it is free, proceed to step 5. If it is not, the slug-to-slug clearance must be adjusted by performing step 4.

*Note:* You are checking for freedom of train movement, not for the freedom of the feeler gauge in the gap.

4. Correct the accumulated slug-to-slug clearance by adjusting the idler-gear pivot stud as follows:
  - a. Loosen the locking setscrew for the idler-gear adjusting setscrew (see Figure 4-43).
  - b. Loosen the two screws that hold the idler-gear stud.
  - c. Partially back out the adjusting setscrew. Move the idler-gear pivot stud against the backed-out adjusting setscrew. Clamp the pivot stud snugly (but not tightly) with the holding screws.



To Prevent bottoming in train, feeler gage projection should not exceed 3/16".

Figure 4-45. Checking Projection of Feeler Gauge

- d. Screw in on the adjusting setscrew slowly until the correct accumulated slug-to-slug clearance is obtained.

*Note:* Make this adjustment carefully because it can be made only in one direction; that is, by turning in on the adjusting setscrew. If you turn this screw in too far, you have lost the adjustment and must repeat steps a through d.

5. When the correct slug-to-slug clearance has been obtained, tighten the idler-gear pivot stud holding screws.
6. Recheck the slug-to-slug clearance as described in steps 1, 2, and 3. If it is incorrect, repeat all of step 4.

After performing step 6, install the cartridge in the machine and run the train under power for several minutes. Recheck the slug-to-slug clearance. If it is not correct, repeat step 4. If it is correct, proceed to step 7.

7. Replace the ribbon guides. They should be back against the top plate and should not interfere with the cartridge latch handles.

#### 4.11.2 Cartridge Interlock Switch Adjustment

Loosen the two mounting screws and position the cartridge interlock switch so that it is made with .010 to .020 in. (0, 25 to 0, 51 mm) overtravel when the cartridge is seated and locked on the movable base. Retighten the screws.

The cartridge interlock switch is located on the print side, in the center of the movable base (see Figure 4-36).

#### 4.11.3 Train Cartridge Disassembly

If only the upper plate needs to be removed, remove only the five long screws. The four short screws hold the center plate to the baseplate. They are located under the left and right ribbon guides.

1. Note the type arrangement present in the cartridge for reassembly purposes (Figure 4-88).
2. Remove the ribbon guide bar.
3. Remove the right and left ribbon guides.
4. Remove the pin from each handle assembly catch, and remove the handles.
5. Place the cartridge upside down on a flat surface with the drive gear to the left.

6. Remove the four short screws and the five long screws that hold the three plates of the cartridge together. Check their location for reassembly purposes.
7. Hold the plates together so the type slugs stay in position. Now turn the cartridge right side up with the drive gear to the left.
8. Remove the upper plate carefully.

*Note:* Use jackscrew for ease of disassembly.

9. Remove the drive gear, its shield, and thrust plate. Keep these parts together; do not change ends with any of these parts.
10. Remove the idler gear, its shield, and thrust plate. Keep these parts together; do not change ends with any of these parts.
11. Remove the center plate. *Be careful to retain all nine spacers. These special spacers are made to a very close thickness tolerance.*
12. Remove the type slugs from the track.
  - a. Check the slugs for wear of the drive teeth, upper side of tail, upper and rear area of track channel and the striking surface of the characters (Figure 4-46).
  - b. Check the drive and idler gear for wear of the gear teeth and the center bushings (Figure 4-47).
  - c. Check the cams (curved portion of rails) for wear on the inner circumference and top portion of the leading corners (Figures 4-48 and 4-49). The rails should be shiny. A brownish stain indicates excessive heating due to lack of lubrication.

If wear is visible on the cams, any new slugs installed wear quickly. Steps must be taken to obtain a replacement train before complete failure occurs.

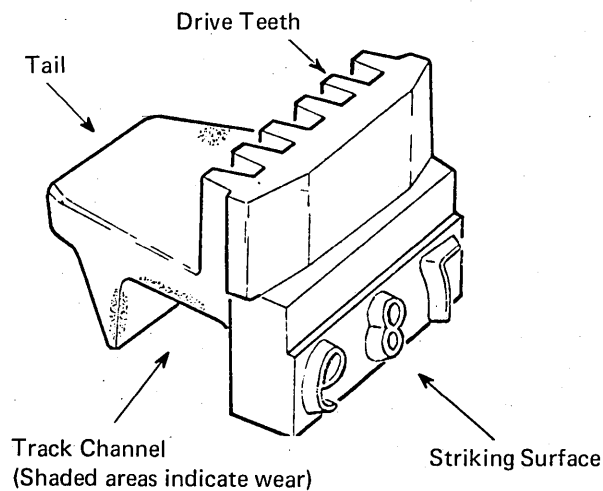


Figure 4-46. Type Slug

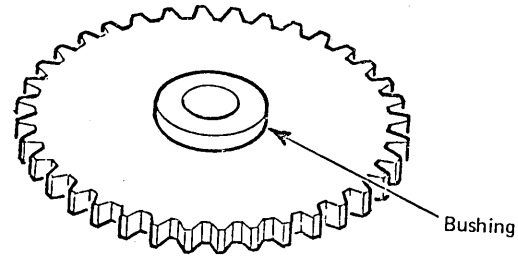


Figure 4-47. Idler Gear

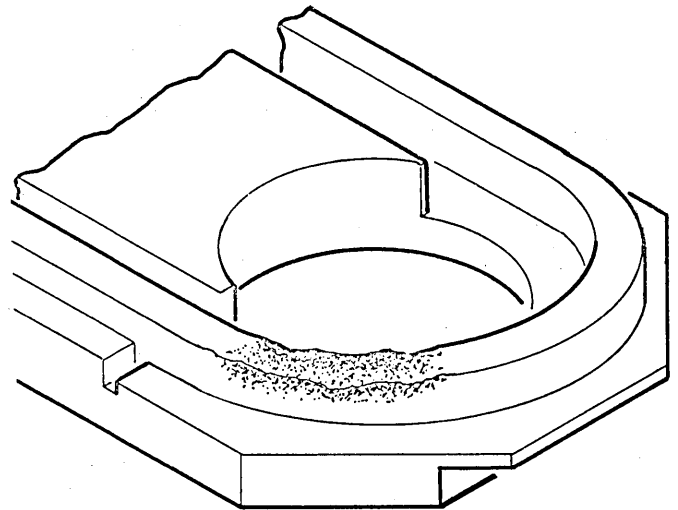


Figure 4-48. Type Rail End (Left)

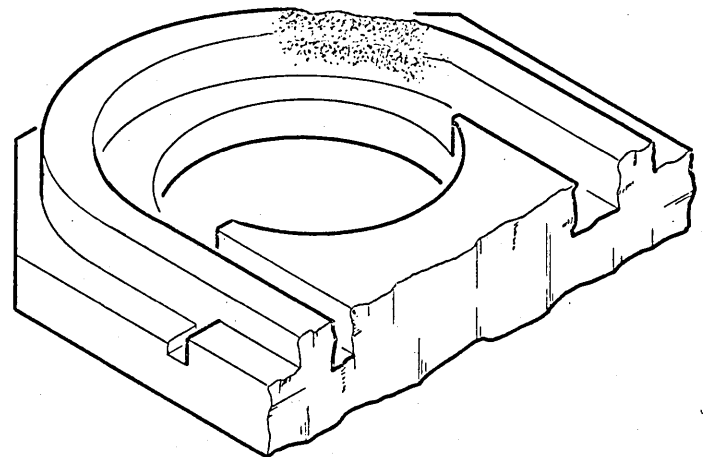


Figure 4-49. Type Rail End (Right)

13. Inspect all oil wicks and felt oil pads for the presence of ink. Wicks or pads saturated with ink do not transmit oil and should be replaced. Parts 856176, 856380 and 856483 are field replaceable.
14. Clean the type slugs before reassembling the cartridge.

#### 4.11.4 Train Cartridge Reassembly and Timing of the Type Slugs to the Cartridge

All surfaces of the train components must be absolutely clean. Small particles between spacers and plates cause binds.

1. Check the felt pads to make certain that contact is maintained from the plugs through the wicks in the bottom of the slug clearance slot. If a new felt plug is installed, apply about 50 to 60 drops of the special lubricant (part 856381) to it. **DO NOT OVER-OIL.**
2. Make sure that the drive and idler gear stud oil wicks are in contact with the studs and that they have been supplying oil to the studs. Normally, they do not require reoiling. They should be just damp. If new oil wicks are installed, apply only enough lubricant (part 856381) to dampen them.
3. Apply only a very thin film of lubricant (part 856381) to the type track on the baseplate. Over-oiling causes the train to start slowly and throw oil.
4. Make sure the type slugs are dry. Replace slugs in the train according to a slug-arrangement diagram for that particular train shown in Figure 4-86. The arrowhead represents the position of the marked tooth with respect to the starting position of the type arrangement. Install the slugs in sequence starting at this point on the top line and proceeding to the right. The right end of each line connects to the left end of the line below it. The last slug to be installed should be the one immediately to the left of the arrowhead.
5. Apply a thin film of oil to the nine washer-like spacers and place them centered on the screw holes in the baseplate. The oil helps hold the spacers in correct position during reassembly.
6. Assemble the center plate to the base and check to make sure that all nine spacers are still centered on the screw holes. With a spring hook, move the spacers as required.
7. Assemble the idler gear, shield, and thrust plate. Make certain these parts are installed on the same end of the cartridge as removed.
8. Assemble the drive gear, shield, and thrust plate. Time the drive gear to the type by locating the marked tooth of the drive gear between the 11th and 12th slug, counting clockwise from the marked slug. If a slug is not marked, see Figure 4-86.

#### CAUTION

Be sure that the drive and idler gear stud holding screws drop into the holes in the thrust plate before proceeding (Figure 4-50). Serious train binds may result if this is not done.

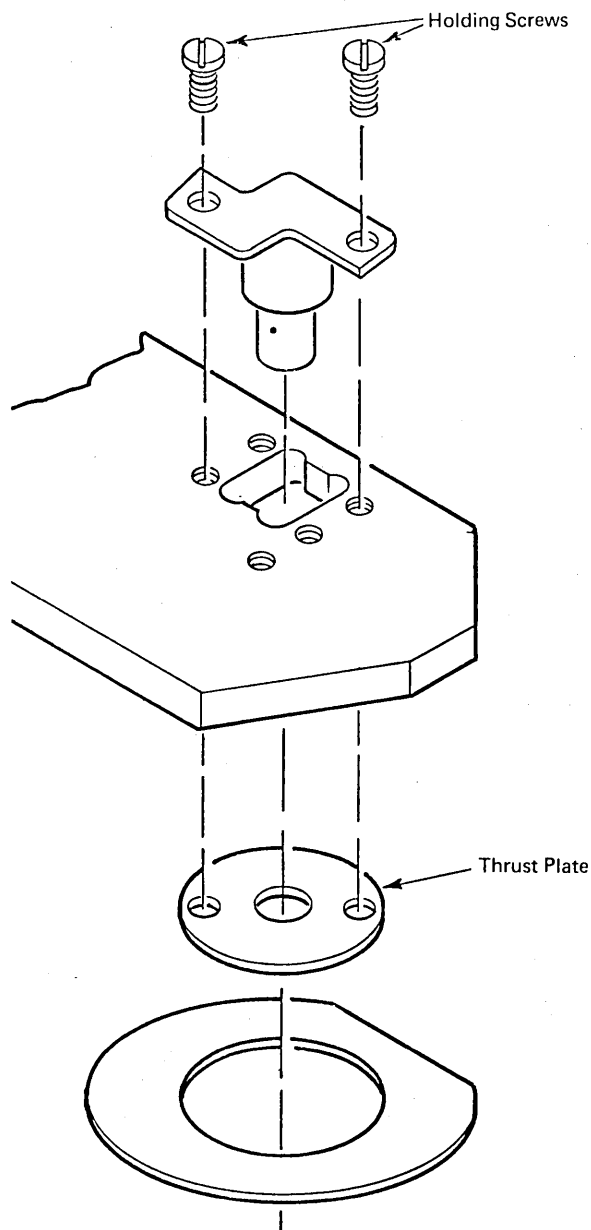


Figure 4-50. Idler Gear Stud and Thrust Plate

9. Place the upper plate in position.
10. Lift the cartridge carefully, squeezing the three plates together to maintain the position of the spacers. Now turn it upside down.
11. Check to be sure the spacers are still centered on the screw holes. If any have moved so they cannot be centered, the upper and center plates must be removed and the spacers repositioned. Repeat steps E, F, I and J, and again check to make certain the spacers are positioned properly on the screw holes. If the train binds after reassembly, loosen the holding screws one by one until the bind disappears. This indicates a spacer that has slipped out of place.

12. Insert all nine plate mounting screws. Be sure the shorter binder-head screws are mounted under the left and right ribbon guide positions. *Tighten these screws by starting at the center and working toward the end.* This is to avoid possible distortion of the assembly. If the end of the cartridge assembly is slipped over the edge of the bench, and the screws inserted from below, the possibility of the spacers slipping out of position is minimized.
13. Check for a clearance of .002 to .003 in. (0,05 to 0,08 mm) between the setscrews in the upper plate and the gear thrust plate (both ends). Adjust the setscrews as required (Figure 4-51).

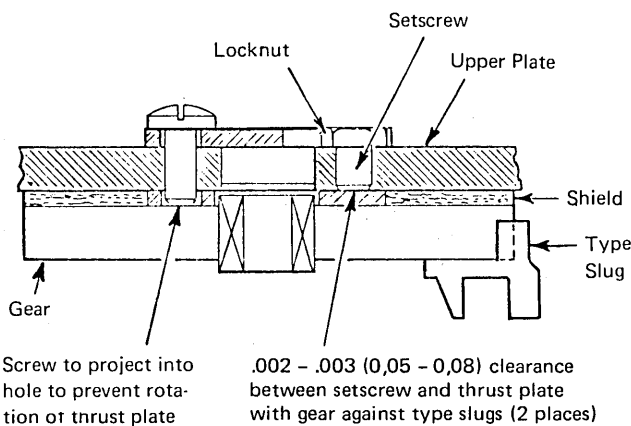


Figure 4-51. Upper Plate and Gear Clearance

14. Check the .001 to .003 in. (0,03 to 0,08 mm) slug-to-slug clearance of the train. Adjust to obtain this clearance if necessary.  
*Note:* You are checking for freedom of train movement, not for the freedom of the feeler gauge in the slot.
15. Replace the left and right ribbon guides. They should be back against the top plate and should not interfere with the cartridge latch handles.
16. Place the cartridge on its side and assemble the handles.
17. Replace the handle catch pin and heat shield.
18. Insert cartridge on the printer; run for five minutes. This throws all excess oil out of the slugs. Check, and if necessary, readjust slug-to-slug clearance.

#### 4.11.5 Procedure for Replacement of Cartridge Gears

The entire cartridge need not be disassembled to replace the two gears in the cartridge. Remove only the upper

plate and ribbon guides. The following instructions outline the most efficient and easiest method of replacing the gears.

Read all information provided in each step before attempting to perform the action indicated.

1. Before disassembly, clean the train by vacuuming and using the type cleaner paper.
2. Remove the cartridge from the machine and manually rotate the train until the R and - (hyphen) slugs line up with the arrow on the lower cartridge plate. The timing mark on the gear tooth should now be visible between these slugs. The tooth is marked by a small slot cut in the top of the tooth. This tooth is in line with the edge of the drive key slot which goes directly through the center of the gear. This can be easily observed on the replacement gear.
3. Note the type arrangement of the cartridge in case (because of an accident) it becomes necessary to put the slugs back in the correct order. (See Figure 4-86.)
4. Remove the ribbon guide bar and the left and right ribbon guides. (See Figure 4-43.)
5. Place the cartridge upside down with the drive gear to the left on a flat surface and remove the 5 long screws holding the upper cartridge plate. These are the screws farthest from you plus the center screw.
6. Remove the upper cartridge plate.
  - a. Turn cartridge over (topside up). This upper plate is located by two close tolerance dowel pins and must be kept perfectly parallel to the lower cartridge plate while it is being removed.
  - b. As an aid, a jackscrew hole is just to the right of the dowel pin hole on the drive gear end. Insert one of the screws removed in step 5, and screw it in, until it just touches the center plate.
  - c. The plates can now be separated by simultaneously lifting the plate at the idler end while turning the jackscrew at the drive gear end. To prevent binding on the dowel pins, the plates must be maintained parallel.
  - d. If the gears come up with the upper plate, push them down to keep them in place. This prevents loss of the type-slug order.



7. Remove the shield and thrust plates from each gear. The two shields are not identical and must be replaced in their original position.
8. Slide the idler end of the cartridge over the edge of the table. Push up from below and lift the idler gear out from above. Keep the type slugs in proper order.
9. Insert the new idler gear. Make certain that an empty tooth does not appear between any of the slugs. Be careful not to allow any dirt or ribbon fibers to get between the slugs. The idler gear has no timing relation.
10. Repeat the preceding steps with the new drive gear, but be sure the marked tooth is placed between the R and -. A pencil mark on the top of the gear in line with the timing tooth aids in keeping the gear in time with the R and - slugs during replacement. Later drive gears have a spot mark on the top side of the tooth as well as on the face. Reinstall the thrust plates and shields on their respective gears.

The flats on the gear shields are cut to provide clearance for the left and right ribbon guides. Replace accordingly.

11. Remove the screw used to jack the upper plate. Reinstall the plate. Start the gear studs into the respective gear bearings and lower the upper plate onto the dowel pins. Do not force it down; work it back and forth if it sticks. If it is perfectly parallel to the cartridge assembly, it goes on easily.

Position the thrust plates to allow the stud mounting screws to project into the clearance holes in the thrust plate. Rotate the thrust plates with a screwdriver until the screws line up with their respective clearance holes. The upper plate can now be fully seated.

12. Turn the cartridge over and replace the 5 screws. Be sure the spacers are in place at each screw hole. They should be, because the center plate has not been removed. This holds them in place.
13. Before tightening the 5 screws, loosen the other 4 and retighten all 9 screws finger-tight. The upper cartridge plate may bow if no clearance is between the thrust plates and their adjusting screws (Figure 4-51). At this time, check to make certain that some clearance is at these points before continuing with the tightening sequence. If necessary, back off slightly on the adjusting screws. (The 9 screws passing through the cartridge plates must be *very* tight, and tightened in sequence to prevent a warped assembly. *Starting with the center screw and working alternately outward*, tighten all screws to about 3/4 of their final torque.

Then repeat the sequence, tightening them to their final torque.)

14. Check for the clearance of .002 to .003 in. (0,05 to 0,08 mm) between the setscrews and the thrust plates. The setscrews are locked with a jam nut (Figure 4-53).
15. Before checking or making any adjustment to the slug-to-slug clearance, be sure there is no dirt lodged between the type slugs. Perhaps the best way to do this is to operate the cartridge for a minute or two on the machine.

#### CAUTION

Before operating under power, check to see that the train is not bound up tight. If it is, open the slug clearance as described until the train is free, and then run it under power without printing, and without a ribbon. Do not run the cartridge under power with excessive slug-to-slug clearance.

16. After running under power, check the slug-to-slug clearance. This can best be done with the cartridge in place on the T-casting.

#### 4.11.6 Individual Slug Removal and Replacement

1. Remove the cartridge from the printer.
2. Remove the ribbon guide bar (see Figure 4-43).
3. Remove the type-slug removal block.
4. Rotate the train until the slug to be removed is centered in the removal slot.
5. Remove the type slug.
6. Install the new type slug. Make certain that no paper dust or dirt from adjacent slugs gets in between them and the new slug.
7. Check for train binds caused by dirt accumulation.
8. Repeat this procedure until all desired slugs have been replaced.
9. Reassemble in reverse order.
10. Check the type-slug clearance after running for one minute. (See 4.11.1.)

#### 4.12 RIBBON MECHANISM

The ribbon mechanism is driven independently with a drive motor that runs continually. The clutches for the ribbon drive are under the control of the hydraulic unit. The ribbon drive causes the ribbon to move from one spool to the other so that the ribbon at the print line is changing continually. As the ribbon moves from the upper spool to the lower spool or the reverse of this, a correction device assists the ribbon to wind correctly. This feature must be adjusted properly to sense the correction control and cause the ribbon to wind straight.

## 4.12.1 Skew-Correction Mechanism

### 4.12.1.1 Sense Lever Adjustments

With the sense lever finger on the high dwell, the distance between the bottom of the sense finger and ribbon path should be  $5/32$  in. (3,96 mm) plus 0, minus  $1/32$  in. (0,79 mm) Figure 4-52.

#### CAUTION

Do not bind the sense finger pivot. Do not try to adjust the plate assembly.

### 4.12.1.2 Sense Lever Switch Adjustment

Position the switch to operate when the stud on the sense lever (Figure 4-52) rests on the switch plunger. The plunger must not bottom.

### 4.12.1.3 Gear Switch Adjustment

Adjust the switch to operate when the gear roller is on the switch plunger. The switch plunger must not bottom.

To make the ribbon drive operate continually for checking purposes tie CS-6-C to CS-2-M (-12V), or place a card between the carriage brushes and the contact roll and start the carriage.

### 4.12.1.4 Switch 1 and 2 Adjustment (Roll-Pin Type)

1. Rotate the eccentric shaft (Figure 4-53) so the roll pin is actuating the switch.
2. Adjust the location of the switch so the plunger just bottoms when a .010 in. feeler gauge is placed between the plunger and the roll pin.

### 4.12.1.5 Switch 1 and 2 Adjustment (Cam Type)

1. Rotate the eccentric shaft (Figure 4-53) so the cam is actuating the switch.
2. Adjust the position of the switch so when the plunger bottoms, there is .020 in. (0,51 mm) between the plunger and the high portion of the cam. This is to ensure that the cam is not driving the plunger against its stop.

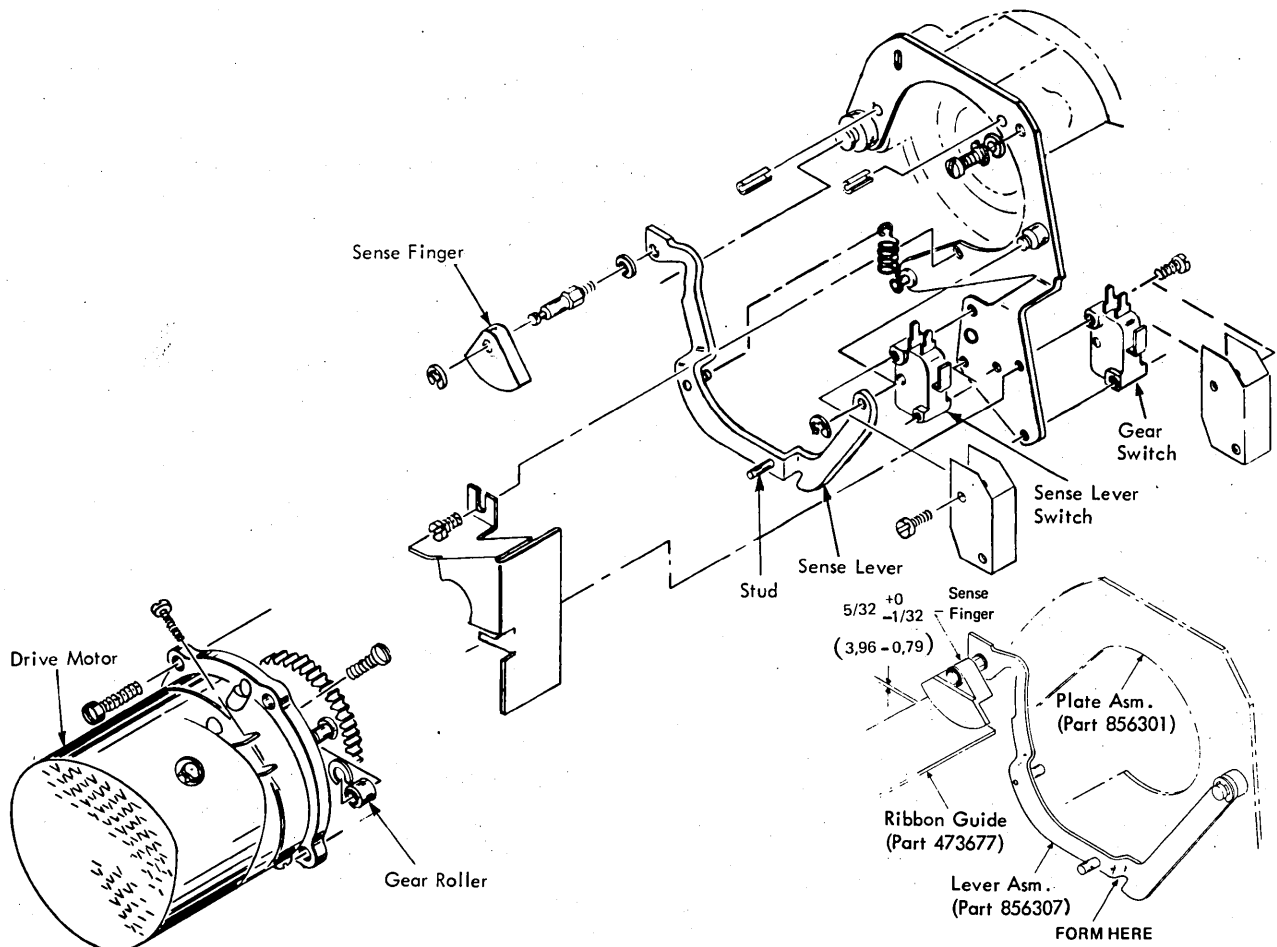


Figure 4-52. Sense Lever and Switches

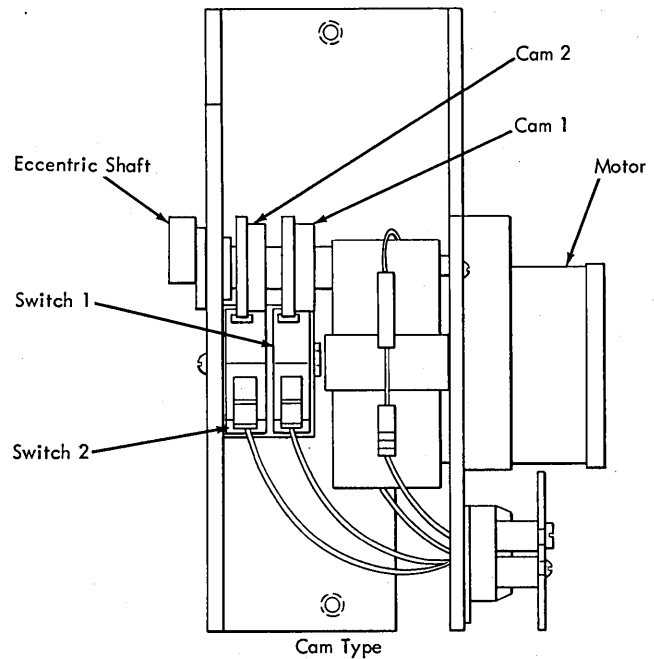
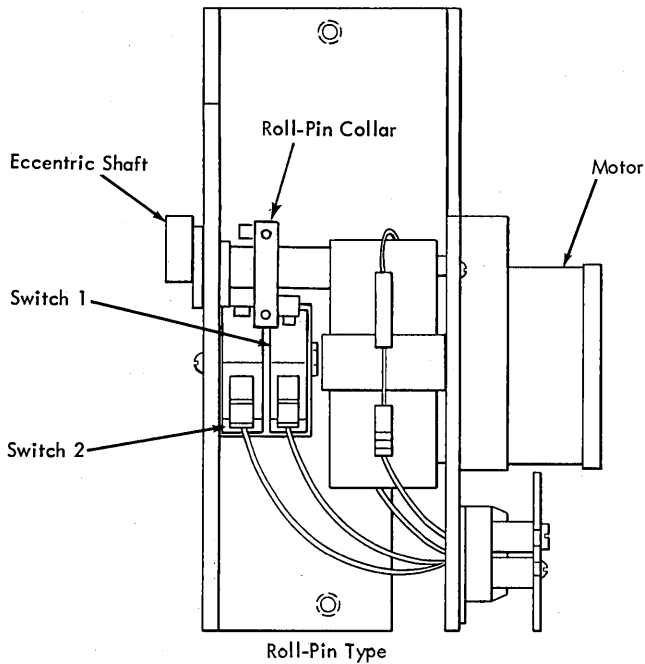


Figure 4-53. Skew Correction Drive

#### 4.12.1.6 Roll-Pin Collar Adjustment

1. Rotate the eccentric shaft counterclockwise (viewed from the right) so the eccentric positions the top of the pivot plate and upper left ribbon spool as far to the front as possible.
2. Loosen the roll-pin collar setscrews (Figure 4-53) and rotate the collar until switch 2 is just transferred (n/c points, opened). Be sure the collar is aligned properly with both switches.
3. Tighten the setscrews.

This adjustment provides for maximum skew correction. For less correction, adjust the collar to operate switch 2 either earlier or later.

#### 4.12.1.7 Switch-Cam Adjustment

1. Rotate the eccentric shaft counterclockwise (viewed from the right) so the eccentric positions the top of the pivot plate and upper left ribbon spool as far to the front as possible.
2. Loosen the setscrews in the cams (Figure 4-55) and rotate cam 2 until switch 2 is just transferred (n/o points, opened). Be sure the cam is properly aligned with the switch. Tighten the setscrew.
3. Turn the eccentric shaft 180° (upper left ribbon spool as far as possible to the rear). Rotate cam 1

until switch 1 is just transferred (n/o points, opened). Tighten the setscrews. Make sure the cam is aligned with the switch.

These adjustments provide for maximum skew correction. For less correction, adjust the cam to operate switch 2 either earlier or later.

#### 4.12.2 Ribbon Drive-Motor Positioning

1. Position the motor gear.
  - a. Loosen the clamp screws.
  - b. Position the gear so that the skew lever arm and the sense finger arm are operated by the roller on the gear and so that the gear meshes with both clutch shaft drive gears .040 in. (1, 02 mm) between the motor bushing and the motor gear.
  - c. Tighten the clamp screws.
2. Position the motor.
  - a. Loosen the motor-holding screws.
  - b. Position the motor to provide a wink of .001 to .005 in. (0, 03 to 0, 13 mm) between the motor drive gear and clutch shaft drive gears at the point of tightest engagement.

### 4.12.3 Ribbon Drive-Unit Positioning

1. Locate the sense finger (Figure 4-54).
  - a. Engage the shift lever in the right stop position.
  - b. Loosen the screws in the lower support bar.
  - c. Position the left edge of the sense finger a maximum of  $14\text{-}49/64 \pm 1/64$  in. ( $375,06 \pm 0,41$  mm) from the left upper base of the T-casting on which the ribbon spool center is mounted.
  - d. Be sure that the drive unit is as far to the right as possible in its locating slot when doing step c.
  - e. Tighten the screws in the lower support bar.
2. Provide free movement.
  - a. Loosen the screws in the upper ribbon-casting mounting gib.

- b. Position the gib for a maximum clearance of .003 in. (0,08 mm) to the ribbon casting without binding the casting as the unit is moved throughout its lateral range.
- c. Tighten the screws in the gib.

### 4.12.4 Ribbon Drive-Unit Removal

1. Remove the ribbon.
2. Remove the cover from the ribbon-drive unit.
3. Remove the wires to the ribbon-drive unit.
4. Remove the ribbon-drive unit.
  - a. Loosen the two screws on the right in the upper ribbon-casting mounting gib.
  - b. Remove the three screws on the left in the gib.
  - c. Slide the drive unit to the left and raise it to clear the lower mounting bar.
  - d. Lower the drive unit to clear the upper gib.
5. Reassemble in reverse order and position the unit during reassembly.



Figure 4-54. Ribbon Drive Assembly

#### 4.12.5 Ribbon-Shield Adjustment

1. Adjust the collars on the T-frame hinge pin to establish the parallel relationship of within .010 in. (0, 25 mm) between the lower edge of the ribbon guide bar lip and the top edge of the projection on the upper carriage ribbon guide (Figure 4-55).

The tongue on the left end of the ribbon shield assembly casting must enter the slot in the movable base freely (Figure 4-56).

2. Locate the inner surface of the ribbon shield .005 to .009 in. (0, 13 to 0, 23 mm) from the lower cartridge plate.

This is accomplished by adjusting the stop setscrew in the right end of the ribbon shield casting and the socket head screw in the left end of the shield assembly.

3. Return the ribbon shield to the print line when the T-casting is open by the ribbon-shield hinge spring. The tension on this spring is adjusted by turning the spring-adjusting collar located on the hinge pin.

#### 4.12.6 New Style Ribbon-Shield Replacement Procedure

1. Open machine cover and open T-casting.
2. Locate the new ribbon shield in the same horizontal position as the old one.
3. Using a pair of duckbill (or similar) pliers, peel the old indicator strip from the support bar.

4. Using a cleaning fluid and a clean rag, clean the entire support bar shield-mounting surface, and top and bottom edges thoroughly. Residual ink, foreign matter, and hand oils must be removed completely to ensure a good bond.

The following procedure is an aid in accurate placement of the tape-backed plastic ribbon shield on its support bar. Install the shield flush with the scribe line on the left end of the bar, and flush with the lower lip of the bar.

5. Remove the tape-backing strip from the shield (part 473813). Avoid touching the tape adhesive surface.
6. Align the left end of the shield with the scribe line and the lip edge and attach firmly. Pull gently on the other end while visually aligning the bottom edge of the shield flush with the lip.
7. Attach the strip by applying pressure slowly with the thumb from the scribe line across the length of the shield. Recheck alignments and correct if necessary.
8. Using a clean rag, press the adhesive portion to the support bar with a firm rubbing motion. Check to ensure that no air bubbles or voids remain, particularly at the four edges.
9. Apply a thin bead of sealant (part 889524) along the top of the support bar where it contacts the ribbon shield. Partially turn the right end of the shield down to apply the sealant behind the right-end casting.

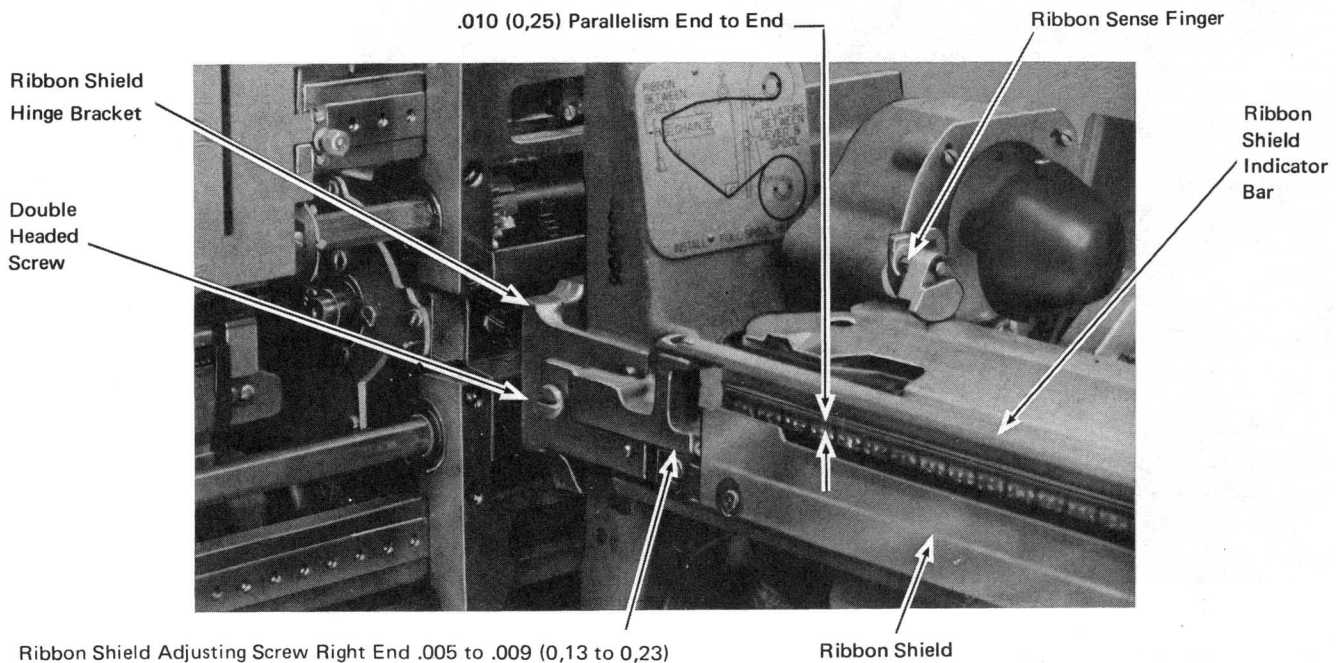


Figure 4-55. Ribbon Shield (Right End)

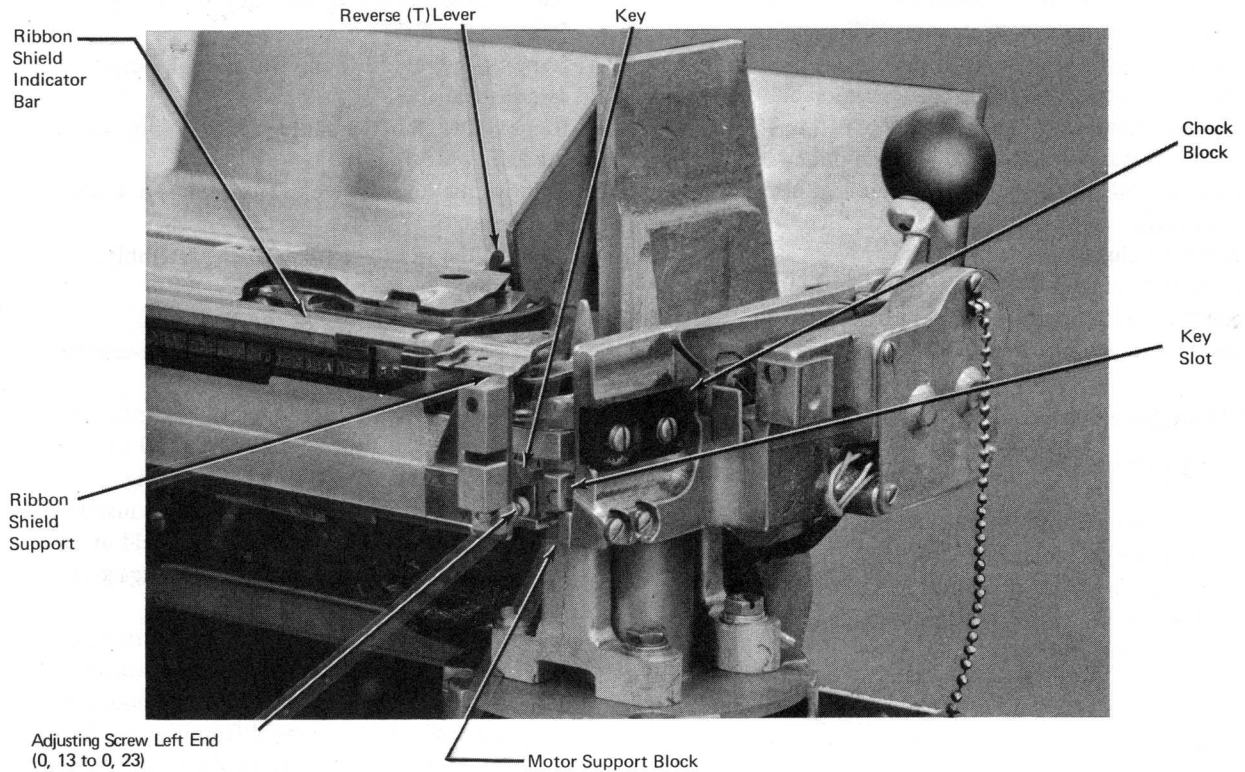


Figure 4-56. Ribbon Shield (Left End)

10. Smooth the bead with the finger and/or a clean, oil-free rag. This bead prevents train oil from seeping down between the shield and the bar and loosening the adhesive strip.

*Note:* The complete curing time of this sealant is about 24 hours. However, the shield can be used immediately after applying the sealant because it does not come in contact with any moving parts. When completely cured, any excess sealant should be removed by peeling. For ribbon-shield adjustment, see Print Quality Service Hint 23.

#### 4.12.7 Ribbon-Clutch Adjustment

1. Position the rotor assembly.
  - a. Seat the ribbon-clutch output pinion against the rotor assembly.
  - b. Position the rotor assembly for a clearance between the pinion and the shoulder on the clutch shaft of .001 to .004 in. (0, 03 to 0, 10 mm) (Figure 4-57).
  - c. Lock the rotor assembly to the shaft.

2. Friction style clutch adjustment (Figure 4-57):

- a. Adjust for an air gap of .010 to .021 in. (0, 25 to 0, 53 mm) between the clutch armature and rotor. Use shims .010 in. (0, 25 mm), .016 in. (0, 41 mm), or .025 in. (0, 64 mm) as required between the armature-retaining ring and the armature. The clutch face must be clean and free of oil.

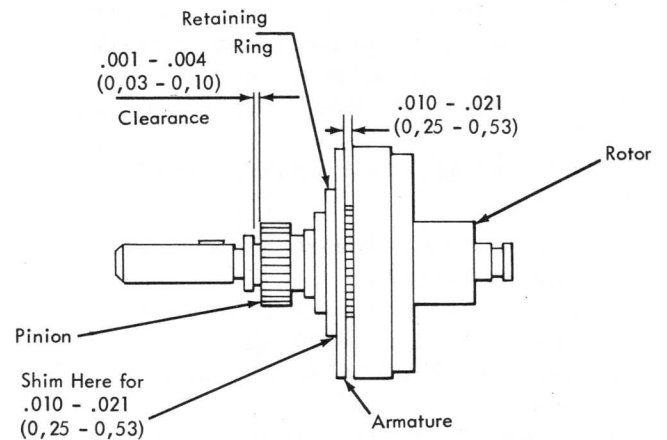


Figure 4-57. Friction-Style Ribbon Clutch

3. Replace the clutch-shaft assembly in the machine, taking care that the small key stays in the shaft and that the shaft goes through the output pinion inside the drive housing. The clutch pinion and the output pinion must engage their gear trains as this reassembly is done. (A light pin-punch mark in the side of the key helps keep it in place if it is loose.)
4. Replace the clutch magnet.
5. Replace the horseshoe clip on the clutch shaft.
6. Check the clutch operation under power by operating the reversing arm manually.

#### 4.12.8 Ribbon-Clutch Removal

1. Removal procedure:
  - a. Remove the cover and the ribbon assembly.
  - b. Remove the ribbon.
  - c. Move the ribbon-drive unit to the left.
  - d. Remove the cover over the left side of the lower ribbon drive.
2. Remove the lower ribbon drive (not necessary for clutch removal).
  - a. Remove the horseshoe clip on the lower ribbon-drive assembly.
  - b. Remove the lower ribbon drive.
3. Free the ribbon clutch.
  - a. Remove the horseshoe clip on the ribbon clutch shaft.
  - b. Remove the screws in the clutch magnet housing.
  - c. Remove the clutch magnet housing.
4. Remove the ribbon clutch.
  - a. Hold the clutch-shaft drive gear in your left hand to prevent it from falling. Be careful not to lose the key.
  - b. Remove the ribbon clutch from the right.

#### 4.12.9 Upper Ribbon-Drive and Drag-Assembly Removal

1. Remove the cover from the ribbon assembly.
2. Remove the ribbon.
3. Remove the ribbon-motor-drive-gear cover.
4. Remove the skew-assembly spring.
5. Remove the retaining clip to free the sense lever.
6. Remove the sense-lever assembly.
7. Remove the cover from the upper ribbon drive.
8. Move the ribbon-drive unit to the left. The nylon friction disk will probably drop as the

cover and spider-spring assembly are removed. Remove the disk.

9. Remove the retaining clip from the ribbon-spindle shaft.
10. Remove the ribbon-spindle shaft. Do not lose the key.
11. Remove the horseshoe clip from the spool-driver gear hub.
12. Remove the ribbon-drive and drag assembly.
13. Reassemble in reverse order.
  - a. Be certain the key is in the ribbon-spindle shaft.
  - b. As the ribbon-drive and drag assembly is installed, lift the reverse drag pawl to engage the reverse drag friction ring.
  - c. As the upper ribbon-drive cover is installed, the nylon friction disk must be held in position and the spider spring must engage it properly.
  - d. Check the reverse drag pawl by turning the spindle. The upper pawl should ratchet when the upper spindle is turned counter-clockwise (when viewed from the spindle end). The lower pawl should ratchet when the lower spindle is turned clockwise (when viewed from the spindle end).

#### 4.12.10 Lower Ribbon-Drive and Drag-Assembly Removal

1. Remove the cover from the ribbon assembly.
2. Remove the ribbon.
3. Remove the cover from the lower ribbon drive.
4. Move the ribbon-drive unit to the left.
5. Remove the retaining clip from the ribbon-spindle shaft. See Figure 4-54.
6. Remove the ribbon-spindle shaft. Do not lose the key.
7. Remove the retaining clip from the spool-driver gear hub.
8. Remove the ribbon-drive and drag assembly.
9. Reassemble in reverse order.
  - a. Be certain the key is in the ribbon-spindle shaft.
  - b. As the ribbon-drive and drag assembly is installed, the reverse drag pawl must be lifted to engage the reverse drag friction ring.
  - c. Check the reverse drag pawl by turning the spindle. The upper pawl should ratchet when the upper spindle is turned counter-clockwise (when viewed from the spindle end). The lower pawl should ratchet when the lower spindle is turned clockwise (when viewed from the spindle end).

#### 4.12.11 Ribbon-Drive and Drag Disassembly

1. After removing the drive-and-drag assembly (see Figure 4-54), stand the assembly up with the compression plate on top.
2. While holding the compression plates against spring tension, remove the three horseshoe clips.
3. Remove the upper compression plate, taking care not to lose the three compression springs that are now free.
4. Remove the three springs.
5. Remove the lower compression plate.
6. Remove the reverse drag friction ring.

#### CAUTION

Note the direction of the teeth on the friction ring. The teeth on the upper friction ring are opposite to the teeth on the lower friction ring. Therefore, these rings can be incorrectly assembled.

7. The friction surfaces of the friction ring, spool driver, and lower compression plate should be clean and free from oil.
8. Reassemble in reverse order.
  - a. Make certain that none of the three compression springs are lost.
  - b. Be certain that the reverse-drag friction ring is not installed backward. After the assembly is in the machine, the upper pawl should ratchet when the upper spindle is turned counterclockwise (viewed from the spindle end). The lower pawl should ratchet when the lower spindle is turned clockwise (viewed from the spindle end).

#### 4.12.12 Ribbon Tension Check

With the new style ribbon drag springs (part 517164) the ribbon drag is 1.5 to 4 pounds. This can be measured by using the standard push-pull scale.\*

To make this check, locate the scale on one of the ribbon drive plug winding pins (the scale must be perpendicular to the pins). Gently push or pull in the direction opposite to the ribbon winding until the ribbon drive plug begins to move. The pounds indicated are close enough to indicate the drag. Check on both upper and lower drive plugs. If the measurement is out of the range indicated, the ribbon drag needs servicing by cleaning or replacement.

Open the T-casting and hook the spring into one of the notches in the tube (used to engage the winding pin). Pull gently in the winding direction of the ribbon (while observing the scale) until the ribbon begins to move. The pounds indicated on the scale\* are close enough to inch-pounds for this measurement.

If this pull is outside the limits of 1-1/2 to 4 pounds (0, 68 to 1, 81 kg), the drag mechanism requires servicing.

#### 4.12.13 Ribbon Reversing Failures

Failure of the ribbon to reverse can result if the toggle plate spring (black — part 473795) and the ribbon reverse level spring (cadmium-plated — part 473796) are interchanged. The ribbon reversing switch (operated by the toggle plate) on the left; the ribbon correction switch is on the right.

#### 4.13 HYDRAULIC CARRIAGE: REMOVAL AND REPLACEMENT PROCEDURES

Models 3 and N1 printers use a hydraulic carriage. This is a two-speed carriage controlled by a punched paper tape or a forms-control buffer.

On a tape-controlled carriage, the tape passes between two sets of reading brushes that are separated by a distance equivalent to seven line spaces on the paper. These brushes sense the control holes punched in the tape by the operator. Stop signals sensed by the slow (upper) brushes during high-speed skips slow the skipping action of the carriage preparatory to stopping when the holes are sensed by the stop (lower) brushes.

Do not dismantle the hydraulic unit unless trouble is positively traced to this area. If disassembly is necessary, observe extreme cleanliness when reassembling the components. Never wipe the fluid filter with a cloth of any type. The filter pores can clog and cause reduced fluid pressure and many carriage failures. A spare reservoir-gasket assembly should be available before disassembling this unit. While the unit is disassembled, change the filter.

Carriage trouble can occur because of a low level of hydraulic fluid. An exposed hydraulic-motor port causes bubbling and traps air in the fluid. This causes carriage malfunction because of varying fluid pressure. Fluid level should be about to the bottom of the space/skip magnets (one gallon).

\*Use push-pull scale (office tool, part 461141).



## CAUTION

If either the space or skip control valve breaks or comes loose from the control magnet armature, it may fall to the bottom of the valve block assembly. This could cause hydraulic fluid to spew from the top of the valve assembly.

In cases of complete failure to space or skip, do not remove the hydraulic unit cover with power on. Do not turn power on with cover removed until space and skip valves have been checked.

### 4.13.1 Hydraulic-Unit Removal

1. Remove the 1403 covers.
  - a. On Model N1
    - (1) Open the top cover from the front.
    - (2) Open the right side door and remove the inner baffle.
    - (3) Open right rear cover and remove inner baffle.
    - (4) Open stacker door.
  - b. On Model 3
    - (1) Remove the front cover.
    - (2) Remove the rear cover.
    - (3) Remove the right cover.
    - (4) Remove the front inner cover, if necessary.
2. Clear the rear forms-stacker area (Model 3)
  - a. Slide the rear forms guide down.
  - b. Unfasten the Negator\* spring from the rear forms guide.
  - c. Slide the Negator spring all the way up.
3. Remove the rear guards.
  - a. Remove the guard over the emitter.
  - b. Remove the guard over the hydraulic drive belt.
  - c. Remove the guard over the stacker gears.
4. Remove the emitter wheel.
  - a. Move the translator frame to the left.
  - b. Loosen the setscrews that can be reached in the emitter collar.
  - c. Turn the forms-advance knob to turn the emitter.
    - d. Loosen the remaining setscrews in the emitter.
    - e. Remove the emitter collar.
    - f. Remove the emitter wheel.
5. Remove the emitter arm (transducer).
  - a. Remove the arm spring.
  - b. Remove the holding screw.
  - c. Remove the retainer screw, retainer spring, and spring block.
  - d. Remove the emitter arm.
  - e. Remove the emitter arm pivot collar.
6. Prepare to remove the hydraulic unit.
  - a. On Model N1.
    - (1) Disconnect the air hose and remove the hydraulic-unit air duct. Four screws hold this duct plate in place. When the screws are removed, the duct plate hangs by the resistor cable.
    - (2) Drain the oil from the reservoir.
    - (3) Remove the carriage tape tension idler mounting plate if necessary.
  - b. On Model 3
    - (1) Remove the sense amplifier mounting plate.
    - (2) Remove the blower.
    - (3) Drain the oil from the reservoir.
    - (4) Remove the carriage tape tension idler mounting plate, if necessary.
    - (5) Remove the screws from the rear heat sink resistor panel.
7. Free the hydraulic-drive unit.
  - a. Remove the electrical connections.
    - (1) Remove the top cover on the reservoir.
    - (2) Unplug the wires within the unit.
    - (3) Remove the two screws in the plug on the left of the unit.
    - (4) Remove the wires from the unit.
    - (5) Replace the cover over the opening in the top of the reservoir, and replace two screws to hold the cover.

\*Trademark of Hunter Spring Division of Ametek Inc.

- b. Remove the drive belt.
  - (1) Loosen the electric motor mounting screws.
  - (2) Lift the motor enough to free the drive belt.
  - (3) Clamp the motor at this position so that it can be used for support later.
  - (4) Remove the drive belt.
- c. Remove the three holding screws nearest the front (total of four) for the hydraulic unit (in the reservoir mounting plate fastened to the printer casting).
  - (1) Remove the front holding screw.
  - (2) Remove the center lower holding screw.
  - (3) Remove the center upper holding screw.

- 8. Consider the problem of removing the hydraulic unit. The unit is now being held by the rear mounting screw and the boss around the output shaft. Be careful not to damage this shaft as the unit is removed. If possible, two men should remove this unit. The unit must be withdrawn straight out to the right until the output shaft is clear. The electric motor can be used as a rest while you are supporting the unit.
- 9. Remove the hydraulic unit.
  - a. Support the unit.
  - b. Remove the rear mounting screw.
  - c. Remove the unit straight out.

#### 4.13.2 Hydraulic-Unit Replacement

- 1. Be careful in replacing this unit.
- 2. Follow the removal steps in the reverse order.
- 3. Do not fill the hydraulic unit with used fluid. Fill it with approximately 1 gallon of new fluid (part 477567) to provide the proper level (about to the bottom of the coils). Be sure that the fluid drain is closed before filling.
 

To facilitate filling the hydraulic unit and making carriage adjustments on the Model N1, open the cover from the rear and remove the sector-shaped right guard. Removing fuses 8 and 9 permits operation of the top cover under power without running the hydraulic motor. (Do not run the hydraulic motor without oil in the hydraulic unit.)

- 4. Recheck the internal adjustments after replacement of the hydraulic unit. Always include:
  - a. Magnetic emitter adjustment.
  - b. Dynamic adjustment of the carriage tape brushes (static adjustment on buffer-controlled carriage).
- 5. Adjust the following also, if required.
  - a. Space, skip, and bypass needle valves.
  - b. Carriage control circuits for single-, double-, and triple-spacing, and carriage interlocks.

#### 4.13.3 Hydraulic-Unit Reservoir Removal

*Note:* Replace the entire hydraulic unit in preference to replacing the pumps, motor, or detent blocks. Replacing these requires separating the channel plate assembly from the reservoir.

- 1. Preparing to remove the reservoir
  - a. On Model N1
    - (1) Open the top cover from the front.
    - (2) Open the right-side door and remove the inner baffle.
    - (3) Open the right rear cover and remove the inner baffle.
    - (4) Open the stacker door.
    - (5) Disconnect the air hose and remove the hydraulic-unit air duct. Four screws hold this duct plate in place. When the screws are removed, the duct plate hangs by the resistor cable.
    - (6) Drain the oil from the reservoir.
    - (7) Remove the carriage tape tension idler mounting plate, if necessary.
  - b. On Model 3
    - (1) Remove the front cover.
    - (2) Remove the rear cover.
    - (3) Remove the right cover.
    - (4) Remove the front inner cover, if necessary.
    - (5) Remove the sense amplifier mounting plate.
    - (6) Remove the blower.
    - (7) Drain the oil from the reservoir.
    - (8) Remove the carriage tape tension idler mounting plate, if necessary.
    - (9) Remove the screws from the rear heat sink resistor panel.

2. Remove the reservoir; sixteen screws hold it in place.
3. Replace it in a similar manner, but in reverse order.
4. Replace the remaining parts in reverse order. (Tighten screws with equal force to prevent leaks.)

Do not fill the hydraulic unit with used fluid. Fill it with approximately 1 gallon of new fluid (part 477567) to provide the proper level (about to the bottom of the coils). Be sure the fluid drain is closed before filling.

To facilitate filling the hydraulic unit and making the carriage adjustments on the Model N1, open the cover from the rear and remove the sector-shaped right guard. Removing fuses 8 and 9 permits the operation of the top cover under power without running the hydraulic unit motor. (Do not run the hydraulic unit without oil.)

#### 4.13.4 Control Valve Body Assembly Removal (Reservoir Removed)

1. Remove the reservoir (see 4.13.3). Sixteen screws hold it in place. They are all accessible from the right.

2. Remove the wires from the terminal block for the control magnets.
3. Remove the valve body assembly (Figure 4-58). Four screws hold it in place.
4. Replace it in a similar manner but in reverse order.
5. Replace the remaining parts in reverse order. (Tighten screws with equal force to prevent leaks.)

#### 4.13.5 Hydraulic-Unit Reassembly

*Note:* Replace the entire hydraulic unit in preference to replacing the component parts.

1. The channel plate assembly (Figure 4-58) should never be separated from the reservoir mounting (cover) plate except to replace a pump, motor, or detent block.
2. Reassemble the channel plate assembly to the reservoir mounting plate as follows.
  - a. Insert the holding screws and leave them loose.

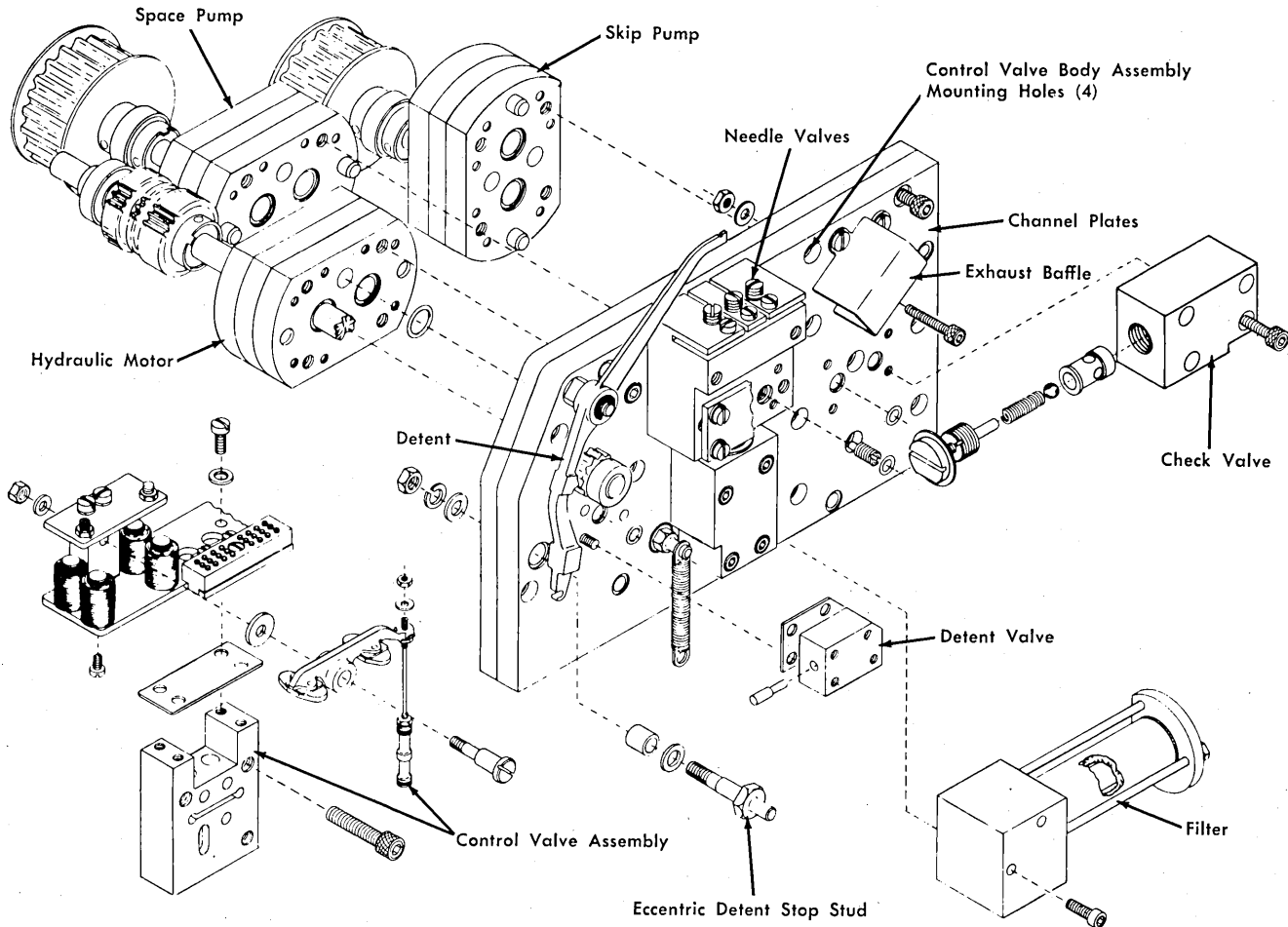


Figure 4-58. Hydraulic-Unit Drive Assembly

- b. Place the aligning tool (part 450980) around the output shaft of the motor and over the boss on the reservoir mounting plate.
  - c. This tool ensures that the output shaft is centered in relation to the outside circumference of the boss. The output shaft is then in alignment with the support-bearing mounting hole in the side frame.
  - d. Tighten the holding screws to fasten the channel plate assembly to the reservoir mounting plate.
  - e. Remove the aligning tool. If the tool cannot be removed and replaced with complete freedom from binds, the shaft and hub are misaligned. Loosen the holding screws and repeat steps b and d until the shaft and hub are aligned correctly. It may be necessary to snug the holding screws and tap the channel plate lightly to obtain correct alignment.
3. Install the pump and the motor oil seals. Using new oil seals for the space pump and the skip pump is advisable to minimize the possibility of leakage.
  4. Reassemble the components, with the exception of the pump pulleys, on the shafts of the pumps and on the shaft of the motor. Support each shaft to prevent bending when you re-pin the component parts to it.
  5. Reinstall the outboard bearing flanges:
    - a. Slide the outboard bearing flanges in place around the pump shafts and snug the holding screws.
    - b. Each shaft must be able to rotate freely.
      - (1) Rotate each shaft through at least 360° to check for freedom from binds.
      - (2) If necessary, readjust the outboard bearing flange by tapping lightly into the correct position.
    - c. When the shaft rotates freely without binds, tighten the holding screws to fasten the outboard bearing flange securely.
    - d. Recheck each pump shaft for freedom of rotation after the holding screws have been tightened.
  6. Reinstall the pulleys on the shafts, and support each shaft fully to prevent bending as the pulley is pinned to the shaft. Again, recheck each pump shaft for freedom of rotation. If binds are encountered, readjust the outboard bearing flanges. (See step 5.)
  7. Check or make (as required) all hydraulic-unit adjustments that can be made with the reservoir removed.
  8. Replace the valve body assembly. Four screws hold it in position.
  9. Replace the reservoir. Sixteen screws hold it in place. (Tighten screws with equal force to prevent leaks.)
  10. Replace the hydraulic unit and make the following adjustments.
    - a. Adjust the space needle valve
    - b. Adjust the skip needle valve.
    - c. Adjust the bypass needle valve.
    - d. Adjust the control circuitry for single-, double-, and triple-spacing and carriage interlocks.
    - e. Adjust the magnetic emitter.
    - f. Adjust the carriage tape brushes dynamically. (Not required on buffer-controlled carriages.)

#### 4.13.6 Hydraulic-Pump Drive-Belt Tension

Shift the drive motor in its slots to obtain 1/8 to 5/32 in. (3, 18 to 3, 96 mm) deflection of the belt halfway between the drive motor and the eject pump when applying a force of 1 pound (0, 454 kg).

#### 4.13.7 Hydraulic-Unit Leaks and Oil Seal Replacement Procedures

This procedure is for the removal of leaking hydraulic-unit oil seals. It is not considered leaking unless the leak noticeably affects the level of oil in the reservoir and/or the leak creates a problem; that is, an oil leak on the floor or forms. If the oil can be satisfactorily wiped up on preventive maintenance calls before causing a problem, or can be contained by the oil seal leak catcher system, do not replace seals. (See General Safety CE Memo No. 17.)

1. Shut off system power.
2. Determine where the unit is leaking.
 

The general procedure for determining the source of a leak is to wipe off the wet component and to check the unit periodically for a wet spot.

  - a. Wipe off the reservoir.
  - b. Check the reservoir gasket (part 475100).
  - c. Check the reservoir cover gasket (part 444425).
  - d. Check the draincock (part 444957) and drain tube connection.

- e. Check the space and eject shaft oil seals (part 444260).

- (1) Remove the hydraulic drive belt cover.
- (2) Check for visible signs of oil at the bottom of the pump-bearing retainer.

- f. Check the hydraulic motor shaft oil seal (part 444260). Signs of oil having run down the side of the frame casting below the hydraulic-unit output shaft indicate a leak.

3. Correct leaks as indicated.

- a. If gasket leaks, correct by tightening or replacing as required.
- b. If draincock leaks where it is threaded into housing, remove draincock, clean the threads on draincock, and in the housing with cleaning fluid. Apply gasket cement (part 450450) to draincock and install in reservoir.
- c. If draincock leaks through draincock into tubing, tap the end of the draincock lightly (on the screw that holds the handle).
- d. If oil leaks between drain tube and draincock, tighten tube clamp or replace drain tube if tube has become hard and tightening the clamp does not stop the leak.
- e. If the gaskets and draincock do not leak or have been corrected and:
  - (1) The motor shaft oil seal leaks enough to require replacing, proceed with Procedure 1.
  - (2) The eject or space pump-shaft oil seals leak enough to require replacing but motor oil seals do not; proceed to Procedure 2. Procedure 2 requires a special punch. See note under step 2 of Procedure 2.

4.13.7.1 Procedure 1

- 1. Remove the hydraulic unit (4.13.1).
- 2. Remove the output motor-shaft oil seal.
  - a. Remove the taper pins from the output shaft collar, gear, and seal retainer. *Support the shaft fully when removing taper pins to prevent any bending of the shaft.*

- b. Remove the collar.
- c. Remove the nylon spacer.
- d. Remove the bearing. A nylon insert is between the shaft and the inner race of the bearing, and a puller may be required.
- e. Remove the second nylon spacer.
- f. Remove the gear.
- g. Remove the seal-retaining collar.
- h. Remove the screws holding the seal-retaining washer, and remove the washer.
- i. Remove the shaft seal gasket.
- j. Remove the oil seal.

3. Motor-shaft oil seal replacement

- a. Install a new oil seal (part 444260).
- b. Install a new shaft seal gasket (part 444980).
- c. Reassemble the components in reverse order. *Support the shaft fully when pinning to prevent bending.*

4. Remove pump-shaft oil seal(s) as required. (Replace only leaking seals.) If removing both seals, identify the pulleys and seal retainer in order to replace them on the correct shaft.

- a. Remove the taper pin from input drive pulley. Take care not to bend the shaft. Remove the pulley.
- b. Remove the four screws holding the pump-bearing retainer and remove the retainer.
- c. Remove the nylon spacer from shaft.
- d. Remove the bearing. The bearing has a nylon insert between the shaft and the inner race, and a puller may be needed.
- e. Remove the second nylon spacer.
- f. Remove the pin in the seal retainer. Take care not to bend the shaft.
- g. Remove the shaft seal gasket (part 444980).
- h. Remove the oil seal (part 444260).

5. Replace the oil seal(s).

- a. Install a new oil seal (part 444260).
- b. Install a new shaft seal gasket (part 444980).
- c. Reassemble the components as in steps 4 through 6 in 4.13.5.

Each shaft must rotate freely without binds.

6. Replace the hydraulic unit as in steps 1 through 4 in 4.13.2.

#### 4.13.7.2 Procedure 2

Procedure 2 is for replacement of eject and space shaft seals when the motor-shaft seal does not require replacing.

1. Prepare to replace oil seal.
  - a. Remove all outside covers on the hydraulic end of the 1403, including the stacker-control assembly.
  - b. Remove the screw that holds the spring to the stacker-guide assembly.
  - c. Drain the hydraulic reservoir.
  - d. Remove the hydraulic drive belt cover.
  - e. Remove the drive belt.
  - f. See step 4 in Procedure 1 (4.13.7.1).

2. Remove the oil seal(s). (See step 4 in Procedure 1.)

A modified 10 in. (254 mm) drift punch (part 4032) is required to drive these pins. Grind the point to a diameter of 3/32 in. (2, 39 mm) for a distance of at least 5/8 in. (15, 9 mm) so that it just fits the pin holes.

3. Replace the oil seal(s). See step 6 in Procedure 1 (4.13.7.1).
  - a. Install a new oil seal (part 444260).
  - b. Install a new shaft seal gasket (part 444980).
  - c. Reassemble the components as in steps 4 through 6 in 4.13.5.

Each shaft must rotate freely without binds.

4. Replace the other components. Follow steps 1a through 1c of Procedure 2 in reverse order. Do not put used fluid back in the unit. Fill it with approximately 1 gallon of new fluid (part 477567) to provide the proper level (about to the bottom of the coils). Make certain that the fluid drain is closed before filling.

#### 4.14 CARRIAGE ADJUSTMENTS

The 1403 carriage adjustments can be grouped into two general categories: hydraulic-unit adjustments and carriage-control adjustments. Refer to Figure 4-60.

The first category includes mechanical adjustments for components within the hydraulic unit.

The second category includes adjustments for those electrical components that control the carriage. Some of these components are in the printer (E1 emitter and carriage tape brushes); others are singleshots in the system processor or control unit.

A visual representation of the results of these adjustments can be obtained by two methods. The first method uses a simple pencil trace. The second method uses a tachometer generator to produce a more accurate visual trace on the screen of an oscilloscope.

In all cases, the tachometer generator (called tach generator) method is preferred because it is more accurate.

*Note:* Certain adjustments for printers used with the IBM System/360 Model 20 can be made by alternate methods. These methods require the use of an Impulse Check Routine (ICR) or a Machine Function Test (MFT). These programmed diagnostic aids are indicated in the text where applicable.

##### 4.14.1 Carriage Adjustment Using the Pencil Trace

This method produces a graph that gives a visual representation of the results of the adjustments or timings involved. It consists of drawing a straight line with a pencil across the paper while the paper is spacing. You must move the pencil at a uniform rate that shows from four to ten spaces (single, double, or triple) on a sheet 11 in. (279, 4 mm) wide. Be careful not to apply too much pressure on the pencil, or an erroneous or distorted graph may result.

##### 4.14.2 Carriage Adjustment with the Tachometer Generator

The tach generator (Figure 4-59) converts the mechanical motion of the carriage into an electrical output for scop-ing. This is an extremely accurate method of adjusting and analyzing the hydraulic unit.

Before using the tach generator, check the adjustments of the space and skip needle valves (see 4.15.3). The forms tractor and upper and lower drive shafts must also be adjusted correctly. The tractor shaft relationship is correct when the upper tractor pins touch the top edge of the paper holes while the bottom tractor pins touch the bottom edge of the paper holes. Slight elongation of the holes under power is permissible.

##### 4.14.3 Tach Generator and Scope Connections

1. Connect a 1.0 mfd, 200V capacitor (part 253826) across the tach generator output terminals.
2. Remove the paper-advance knob from the upper tractor drive shaft. Install the tach generator (part 450976) and coupling (part 451290) on the shaft as shown in Figure 4-59 and tighten the setscrew.
3. Ground the scope and connect the vertical input and the scope ground to the tach generator terminals.

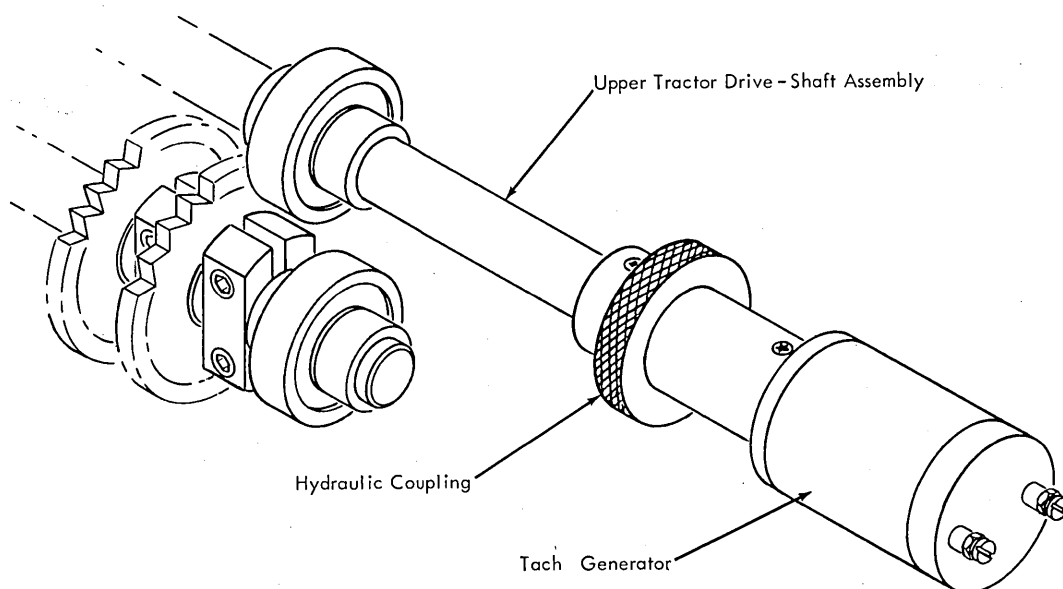


Figure 4-59. Tach Generator and Coupling

4. Sync the scope on the impulse to the space-start magnet. For Model 3 use terminal 2, resistor 4, logic page 02.01.1. Terminal 2 is to the right of the resistor as viewed from the rear of the printer. Do not use terminal 1 because accidental grounding causes the magnet coils to short out. For Model N1, use pin A on SMS card socket 6 (CS-6), logic page 01.08.1.  
 If a dual input scope is available, use the impulse to the space-stop magnet (terminal 2, resistor 3) as the second input to the scope. On single input scopes, two signals can be examined separately in relation to the start-magnet impulse.

#### CAUTION

A defective capacitor or one of incorrect rating alters the tach generator output trace on the scope. The capacitor should remove high-frequency oscillation from the scope trace without affecting pulse timing. Check by observing pulse timing with the capacitor in and out of the circuit.

Before making any adjustment, be sure the hydraulic unit is up to normal operating temperatures and speed (see 4.14.4). For Model 3 the hydraulic unit should be hot to the touch. Rapid temperature buildup can be obtained by blocking the hydraulic blower air intake with a card, and running in gear at high speed with covers closed for about 15 minutes.

The Model N1, due to its improved cooling system, should feel warm to the touch. The blower on the N1 cannot conveniently be blocked; however, the air flow can be blocked by placing a blank card (folded over on one end to prevent it from falling) between the blower duct and the hydraulic-unit reservoir. Loosening the duct to insert the card may be necessary.

The recommended servicing position for the Model N1 is with the top cover open from the rear and the sector-shaped guard removed.

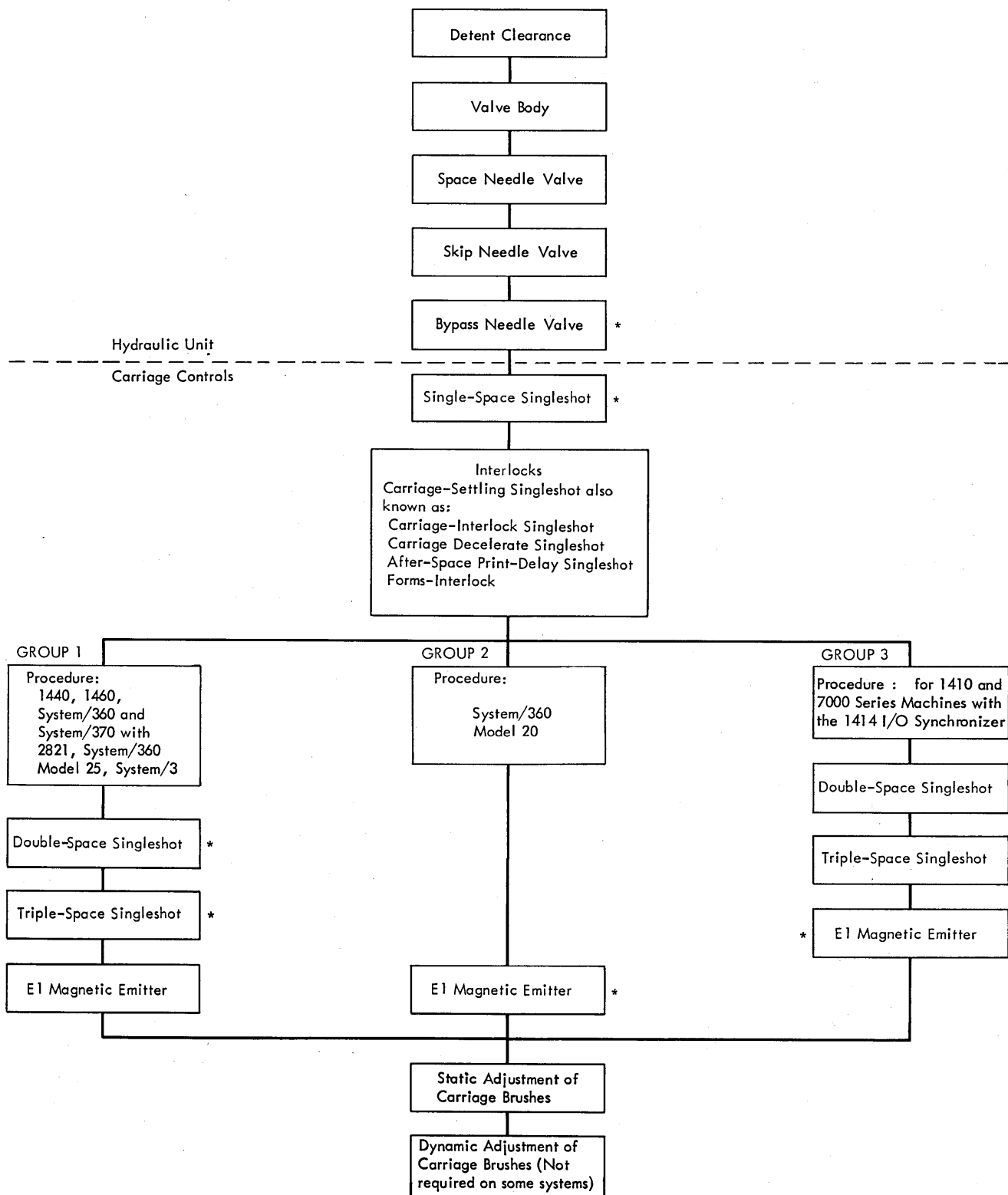
Make carriage adjustments in the sequence shown by the chart in Figure 4-60.

#### 4.14.4 Carriage Speed Check

Before making any adjustments, check the speed of the hydraulic motor to be sure it is not running slow. A quick check of the printer speed can be made by scoping the output of the E1 emitter. Because the emitter is driven by the hydraulic motor output shaft, it gives a reliable and accurate indication of the hydraulic motor speed. The duration of the interval between the corresponding edges of successive emitter pulses should be less than:

- a. 5.1 ms at slow speed (see 4.15.3)
- b. 2.3 ms at high speed (see 4.15.4).

For convenience, these pulses are available at the E1 hub on the CE panel.



\*The adjustments can be made by either the pencil-trace, the tach-generator, or, on some systems, a program method. (The program method cannot be used to make the bypass needle valve adjustment.)

Figure 4-60. Sequence of Carriage Adjustments



Normally, 5.1 ms for space or 2.3 ms for skip is the slowest a hydraulic unit operates. When a hydraulic unit is failing due to speed, usually a drastic increase in emitter pulse time (several tenths of a ms or more) or even a complete loss of emitter pulses occur. For a drastic reduction in speed, determine the cause (see 4.14.5). If a reduction in speed is not drastic, make the carriage adjustments. If the carriage can be adjusted satisfactorily, no further action is required; however, if it cannot be adjusted satisfactorily and speed is still slow, determine the cause (see 4.14.5).

The space and skip needle-valve adjustments affect hydraulic-unit speed. Adjust needle valves to provide just enough back pressure to hold the detent against the backstop (4.15.2.3 and 4.15.2.5).

#### 4.14.5 Slow-Running Hydraulic Unit (Space Speed)

If the hydraulic unit runs slowly at space speed, check for the following possible causes.

1. Severe bind on tractor assemblies. With power off, check by advancing the carriage in 6- and 8-line drive manually with the hydraulic detent arm disengaged.

#### CAUTION

Raise the carriage tape brushes to prevent damage if you turn unit backward.

2. Clogged filter. Check for foam in the unit or bubbles coming out of exhaust baffle. Exhaust baffle must be on.
3. Leak in hydraulic pressure system. Bubbles or turbulence coming out from any area in the hydraulic unit is an indication of a leak. This is usually caused by a trapped or missing O-ring. Bubbles coming out of the filter are an indication that the unit is running backward.
4. Defective check valve (between space and skip pump lower). Operate the skip armature manually to a start position while in continuous space speed. If the unit now gets up to normal skip speed, the check valve is defective.

Both check valves are similar and can be interchanged for checking purposes.

5. Space spool valve not opening enough in a start position. See 4.19.2.

### 4.15 HYDRAULIC-UNIT ADJUSTMENTS

#### 4.15.1 Hydraulic Detent Backstop Adjustment

This adjustment should not be necessary unless the detent or backstop has been replaced.

1. Raise the tape brushes to prevent any possible damage to them during this adjustment.
2. Remove the reservoir (casing) that encloses the hydraulic unit.
3. Be sure that the carriage is turned only in the forward direction.
4. Position the backstop with the high side of the eccentric down. This causes the pounding of the detent arm to tighten the holding nut.
5. Adjust the detent backstop for a clearance of .020 to .025 in. (0, 51 to 0, 64 mm) between the detent arm and the detent wheel when the arm is held against the backstop (Figure 4-61).
6. Replace the reservoir that encloses the hydraulic unit.

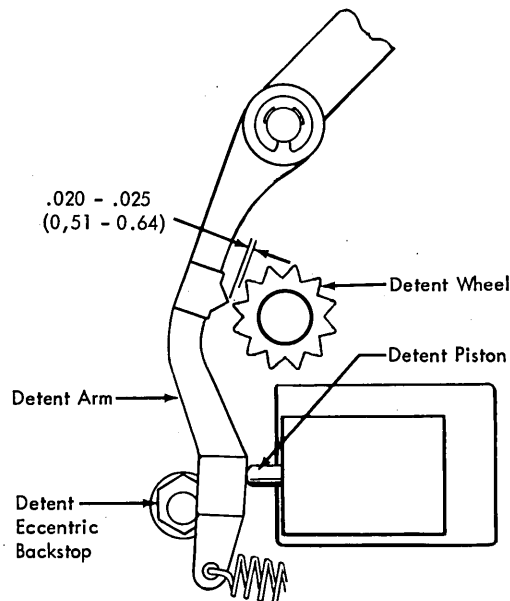


Figure 4-61. Detent Adjustment

#### 4.15.2 Valve Body Adjustments

Make these adjustments only if components have been replaced, or the valve body is not functioning satisfactorily. A check of the carriage start-stop response usually indicates whether the valve body is functioning correctly.

*Note:* Because valve body adjustments are difficult and time-consuming, a suspected valve body assembly should be replaced.

##### 4.15.2.1 Start-Stop Response

Using the tach generator (see 4.14.2) check the valve body adjustments by observing the carriage start-stop response time. The tractor shafts should start moving 3 to 4 ms. after the start impulse, and should begin to slow down 3 to 4 ms. after the stop impulse. Figure 4-62 shows the oscilloscope trace produced by the tach generator showing these conditions.

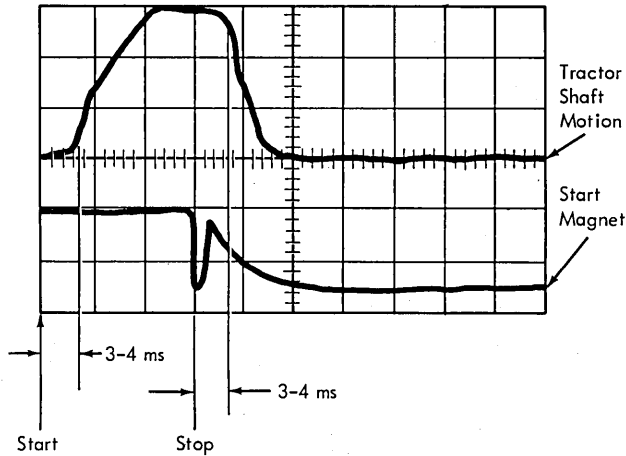


Figure 4-62. Carriage Start-Stop Response

Most start-stop response failures are caused by incorrect control valve body adjustments. Other possible causes of start-stop response failures are:

1. *Low voltage to the start-stop magnets.* (Should be 60V.)
2. *Open coil.* The start-stop magnet coil resistance measures about 18 ohms. With two coils in parallel, the resistance is 9 ohms. The voltage drop across a good pair of coils is about 5V. With one coil open, the drop goes to about 10V.

Erratic start-stop conditions can be caused by a bent hydraulic-unit output shaft, or by an intermittent bind in the tractor assemblies. Check by advancing the carriage manually in 6- and 8-line drive with the hydraulic detent arm disengaged.

#### CAUTION

Raise the carriage tape brushes to prevent damage if you turn the unit backward.

#### 4.15.2.2 Space Control Magnet Adjustment

1. Turn off the printer mainline switch to prevent the operation of the carriage-drive motor. Some of the following adjustments require that the system power be on so that the hydraulic unit space-start and space-stop magnets can be energized.
2. Remove the valve body assembly. If the reservoir is removed, to facilitate the adjustment procedures, mount the valve body temporarily back on the channel plates using the two upper holes of the plates and the two lower (tapped) holes in the valve body.

3. Add or remove the shims under the pivot support block to obtain .011 to .013 in. (0,28 to 0,33 mm) clearance between the start-magnet and stop-magnet cores and the armature (Figure 4-63). The optimum clearance between the armature and the magnets when in the neutral (de-energized) position is .011 to .013 in. (0,28 to 0,33 mm). Some spool valve units have a .011 to .014 in. (0,28 to 0,36 mm) clearance, which is correct. The spool valve adjustments are not critical. Normally, this adjustment must be changed only when related parts have been replaced.
4. Turn on the system power and energize the space-stop magnets.
5. With the space-stop magnet energized, adjust the backstop screw nearest the operating rod for .005 to .008 in. (0,13 to 0,20 mm) clearance (preferably .005 in. (0,13 mm)) between the armature and the stop-magnet cores (Figure 4-64).

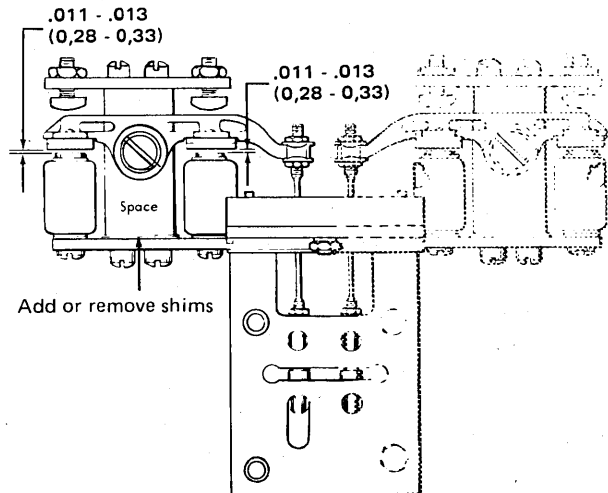


Figure 4-63. Space Start-Stop Magnet Armature in Neutral Position

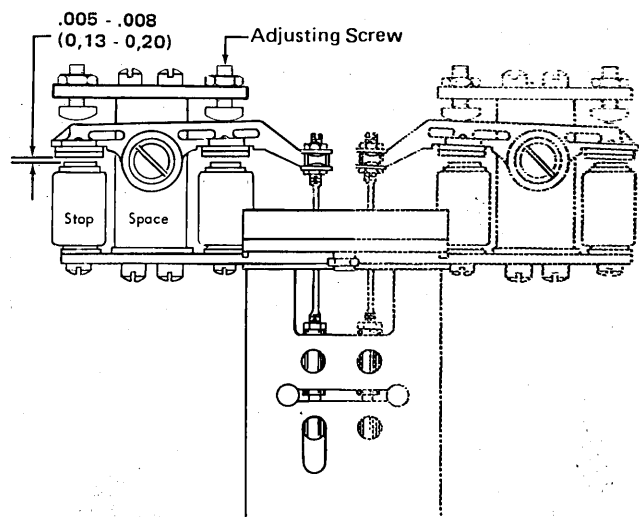


Figure 4-64. Space-Stop Magnet Energized

6. Turn off the system power.
7. Energize the space-start magnets.
  - a. Remove the wires from the space-stop magnet terminals and insert them into the space-start magnet terminals.  
 If the start magnet circuits in your particular printer return to -60V controlled, do step b because this voltage is not present with the print mainline switch off.  
 If, instead, the start magnet circuits return to -60V (not controlled) then step b is unnecessary, although no harm results from doing it.
  - b. Interchange the two -60V controlled start magnet return leads (TB-2-3 and TB-2-4) with the two -60V stop magnet return leads (TB-2-1 and TB-2-2).
  - c. Turn on the system power.
8. With the space-start magnet energized, adjust the backstop farthest from the operating rod for .005 to .008 in. (0, 13 to 0, 02 mm) clearance, preferably .005 in. (0, 13 mm) between the armature and the start-magnet cores (Figure 4-65).  
 If using a steel feeler gauge in the preceding steps is objectionable because of the attraction of the energized control magnets, use a data processing card to obtain these adjustments.
9. Slow operation results from a clearance of less than .005 in. (0, 13 mm). The armatures or cores have no residuals.
10. Turn off the system power.
11. Whenever this adjustment has been made, the space control valve adjustments must be checked.

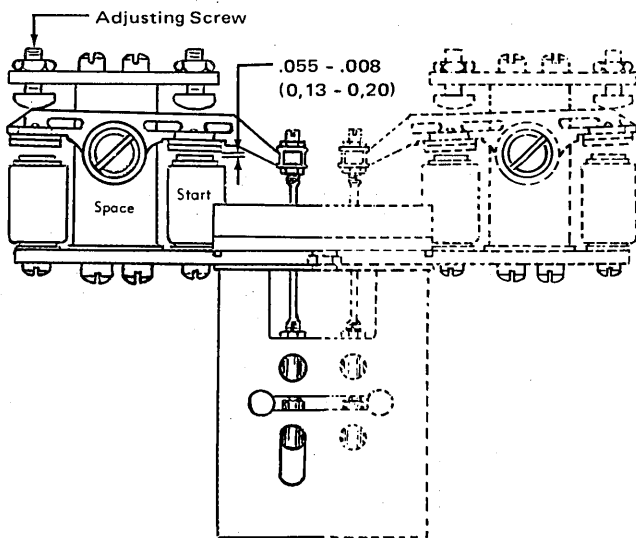


Figure 4-65. Space Start-Magnet Energized

#### 4.15.2.3 Space Control Valve Adjustment

1. Adjust the space-control magnets.
2. Be sure that at least half of the lower threaded portion of the operating rod is screwed into the control valve and that the locking nut at the upper end of the control valve is tight.

*Note:* No scratches, marks, or slight bends of any kind can be on the operating rod. These would lead to failure.

3. Turn on the system power.
4. With the space-start magnet energized, adjust the nuts at the top of the operating rod for .009 to .011 in. (0, 23 to 0, 28 mm) clearance between the top of the valve and the top surface of the rectangular port in the valve body (Figure 4-66).
  - a. This should result in .009 to .015 in. (0, 23 to 0, 38 mm) clearance between the bottom of the valve and the lower surface of the rectangular port with the stop magnet energized and the armature in the stop position (Figure 4-67).
  - b. The optimum adjustments of the .011 to .013 in. (0, 13 to 0, 33 mm) clearance and the .005 to .008 in. (0, 13 to 0, 2 mm) clearance for the control magnets result in a .020 to .024 in. (0, 51 to 0, 61 mm) control valve travel.  
 Readjusting the .011 to .013 in. (0, 28 to 0, 33 mm) set at the factory is not necessary unless related parts are replaced.
  - c. If the .009 to .015 in. (0, 23 to 0, 38 mm) clearance does not fall within the prescribed dimensions, the space control magnets must be readjusted within tolerance to obtain the correct clearance.

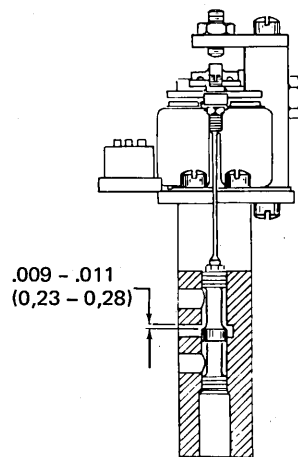


Figure 4-66. Space Valve in Start Position

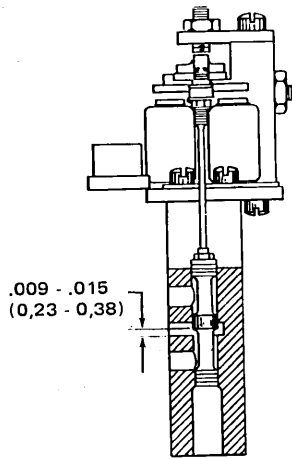


Figure 4-67. Space Valve in Stop Position

5. Turn off the system power and restore to their original positions the wires interchanged in steps 7a and b in 4.15.2.2.
6. Turn the tab on the lockwashers over to keep the nuts from loosening during operation.
7. Replace the valve body assembly.

#### 4.15.2.4 Skip Control Magnet Adjustment

*Note:* Adjust in the same manner as in 4.15.2.2.

#### 4.15.2.5 Skip Control Valve Adjustment

*Note:* Adjust in the same manner as in 4.15.2.3.

#### 4.15.3 Space Needle Valve Adjustment

1. Set up the carriage.
  - a. Remove the paper from the carriage.
  - b. Tape the forms-stop contacts closed.
  - c. Engage the manual clutch in either the 6- or the 8-lines-per-inch position.
  - d. Install an unpunched carriage tape. (On buffer-controlled carriage, use the tape provided with the printer.)
  - e. Lower the tape brushes.
2. Start the carriage by pressing the carriage restore key. (For buffer-controlled carriages, see system carriage diagnostics.)

*Note:* A 2020 Submodel 5 starts in high speed and then shifts into slow speed after rate limiter times out.

3. Before adjusting the needle valve, allow the carriage to drive at skip speed with the blower intake blocked for at least 15 minutes to bring the oil temperature up to operating level. The hydraulic unit should be hot to the touch before the needle valve adjustments are made. The model N1 runs cooler than the Model 3 and needs only be warm to the touch.
4. Loosen the lockscrew for the center needle valve (the center right screw, Figure 4-68).

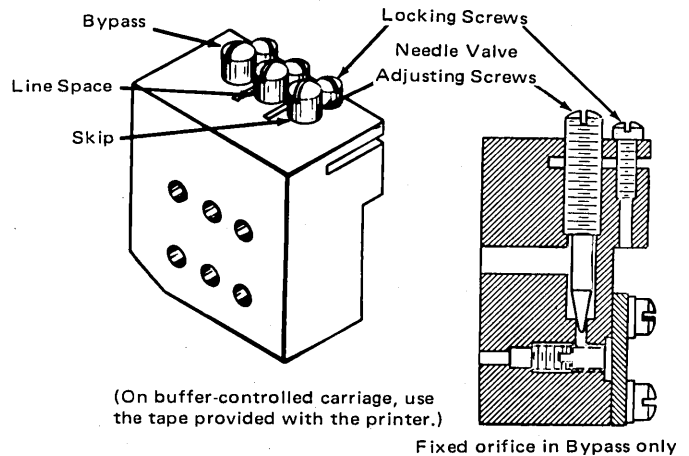


Figure 4-68. Needle Valves

5. Adjust the needle valve to cause the detent as follows.
  - a. Hold the screwdriver against the detent arm at the notch.
  - b. Back off on the center left screw (Figure 4-68) until you feel the detent nip the detent wheel. The impact is transmitted through the screwdriver.
6. Adjust the needle valve to stop the detent from nipping.
  - a. From the nip condition, close the needle valve only far enough to bring the detent to rest against the backstop.
  - b. Tighten the lockscrew (the center right screw).
7. After this adjustment has been made, the skip needle valve must be adjusted.
8. Check the carriage speed as described in 4.14.4.

#### 4.15.4 Skip Needle Valve Adjustment

1. Adjust the space needle valve. (See 4.15.3.)
2. Set up the carriage. Make certain:
  - a. No paper is in the carriage.
  - b. The forms-stop contacts are closed.
  - c. The manual clutch is engaged.
  - d. Unpunched carriage tape is installed. (On buffer-controlled carriage, use the tape provided with the printer.)
  - e. The tape brushes are lowered.

3. *For buffer-controlled carriages, omit step 3 and refer to system carriage diagnostics.*

Start the carriage in a programmed skip-to-1 before print. This should result in a skip-to-1 at high speed with no stop impulse available.

If the carriage goes into low instead of high speed, open the carriage-tape brush block, remove the carriage tape, place a blank card under the slow (upper) brushes, and close the brush block.

Open the brush block and remove the card. Replace the carriage tape, close the brush block, and press the printer check-reset and start keys. The carriage should now run at high speed.

*Note:* To attain high speed, removing the limiter card in the controlling device may be necessary. See system logics.

Loosen the lock screw for the skip needle valve (the front right screw, Figure 4-68). (See 1.10.2.)

Adjust the skip needle valve as follows.

- a. Hold a screwdriver against the detent arm at the notch.
- b. Back off on the front left screw (Figure 4-68) until you feel the detent nip the detent wheel. The impact is transmitted through the screwdriver.
  - (1) If no nipping is detected after turning out a maximum of five turns, stop the carriage motor so that the hydraulic pumps are not moving. Turn down on the front left screw until it is closed. Then back off five full turns on this screw. Tighten the lock screw (the front right screw).
  - (2) If nipping is detected, adjust the needle valve to stop the detent from nipping.

- c. From the nip condition, close the needle valve only far enough to bring the detent to rest against the backstop.
- d. Tighten the lock screw (the front screw). Stop the carriage.
- e. After this adjustment has been made, adjust the bypass needle valve.

Check the carriage speed as described in 4.14.4.

#### 4.15.5 Bypass Needle Valve Adjustment (Pencil-Trace or Tach-Generator Method)

Before proceeding, make sure the hydraulic unit is up to normal operating temperatures (warm for Model N1, hot for Model 3), and that the space needle valve and skip needle valve are in correct adjustment.

1. Adjust the E1 emitter and the circuits controlling triple-space sufficiently to provide consistent triple-spaces when the detent is held disengaged.
2. Program a loop to print blanks with triple-spacing. (On buffer-controlled carriages, see system carriage diagnostics.)
3. Set the manual clutch to the 6-lines-per-inch drive position.
4.
  - a. If using the pencil trace method, check that paper is in the carriage and that the upper front paper guides (if present) are removed.
  - b. If using the tach generator method, attach the tach generator as described in 4.14.3, and block the forms contact with a piece of card.
5. Loosen the bypass (right front) needle valve lock-screw (Figure 4-68) just enough to permit adjusting the needle valve.
6. Disengage the detent from the wheel by pressing down in the notch on the detent arm with a large screwdriver.
7. Start the printer by pressing the start key.
8. Adjust the bypass needle valve using the pencil trace or tach generator methods as follows.
  - a. Observe the scope trace produced by the tach generator or draw line graphs across the paper as described in 4.14.1.
  - b. Turn in on the bypass needle valve until it is too tight as shown by the scope trace and line graph in Figure 4-69.
  - c. Slowly back off the bypass needle valve until the line graph or scope trace resembles that for a correctly adjusted bypass in Figure 4-70.

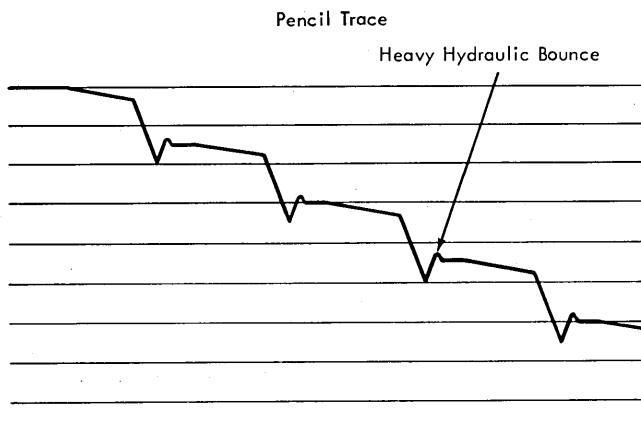
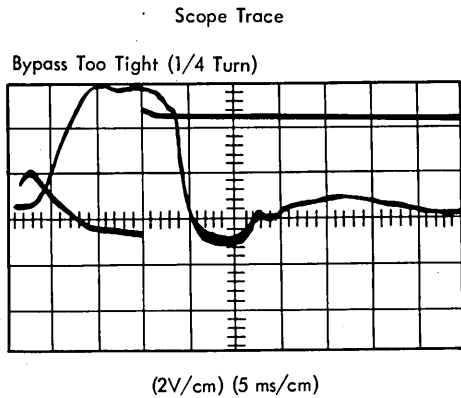


Figure 4-69. Bypass Too Tight (Hydraulic Bounce)

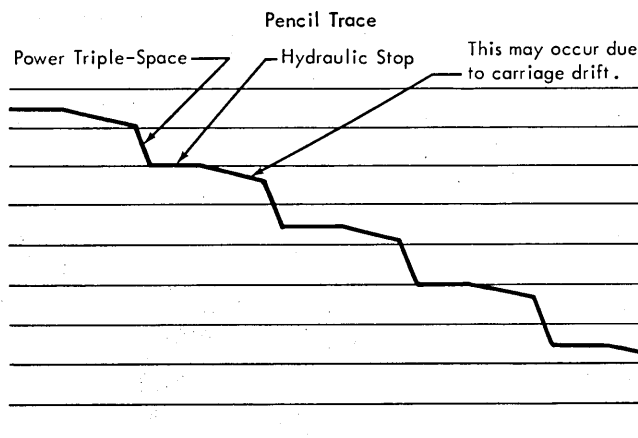
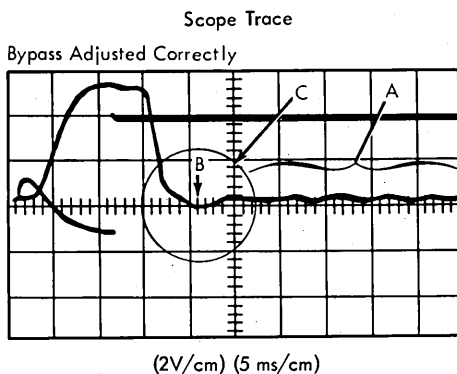


Figure 4-70. Bypass Adjusted Correctly

9. Tighten the lockscrew (right rear) and recheck the adjustment by making new line graphs or scope traces. A line graph having relatively square corners followed by carriage drift, or a scope trace indicating light hydraulic bounce verifies that the bypass needle valve is in correct adjustment. Notice that incorrect adjustment indications result from as little as one quarter turn of the bypass needle valve from its correctly adjusted position. Figure 4-71 shows the results produced if the bypass is adjusted too loosely.
10. Stop the machine.
11. Make the carriage control adjustments.

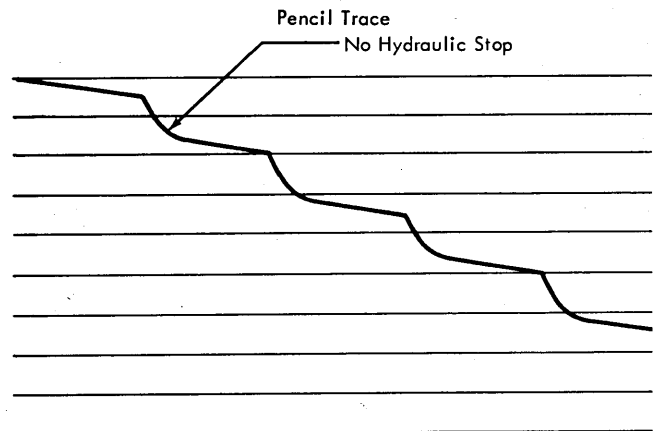
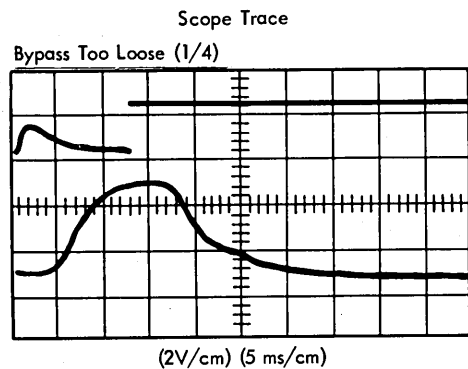


Figure 4-71. Bypass Too Loose

#### 4.16 CARRIAGE-CONTROL ADJUSTMENTS

Carriage operations are always controlled as follows.

1. Single-space is always controlled by the processor or control unit.
2. Double- or triple-space is controlled either by singleshots in the processor or control unit, or by the E1 emitter in the printer, depending on the system.
3. Skip operations over one space are controlled by the carriage E1 emitter in conjunction with the carriage tape brushes. (On buffer-controlled carriages, skip operations over three spaces are controlled by the E1 emitter.)

#### 4.16.1 Single-Space Singleshot Adjustment (Pencil-Trace, Tach-Generator, or System/3 Program Method)

Adjust the single-space singleshot (usually designated on the logic pages as either the 4.5-ms or 5.5-ms singleshot) to show minimum stabilization time as indicated by the line graphs on the paper or the oscilloscope trace produced by the tach generator.

You are adjusting an electrical component (singleshot) in the system to obtain the desired mechanical result (forms-tractor stabilization) in the printer. (For buffer-controlled carriages, see system carriage diagnostics.)

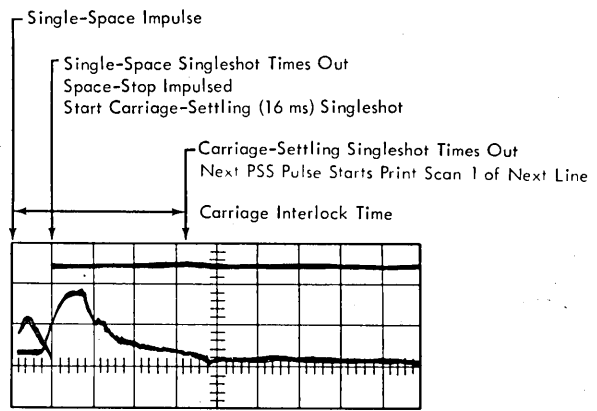
1. Set the manual clutch knob to the 6-lines-per-inch drive position.
2. Program for single-space after print, or print-and-branch only, with blanks in the print area. (Before-print space and print produces a double space, except on buffer-controlled carriages.)
3. Check that the paper is in the carriage and that the upper front paper guides (if present) are removed if using the pencil trace method. Block the forms contacts if using the tach generator method.
4. Start the carriage by pressing the start key.
5. Draw line graphs on the paper while it is feeding or observe the scope trace (Figure 4-72).
6. Adjust the single-space singleshot to produce a square line graph on the paper or to show minimum stabilization time on the scope trace produced by the tach generator (Figure 4-72).
7. The final adjustment of the single-space singleshot is for the best compromise between minimum overshoot at 6 lines per inch, and minimum pull-in at 8 lines per inch. (This is also a compromise for the minimum time from the impulse to the space-stop magnet until the tractor shafts are settled down.)

*Note:* The carriage-settling and forms-interlock adjustments must be made after making this adjustment.

8. Record the settings of the singleshots on the appropriate system logic page and hydraulic-unit decal for future reference.

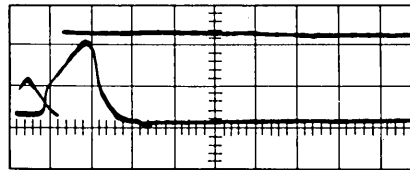
#### 4.16.2 Interlock Singleshots

The carriage interlock allows time for the carriage to settle down after spacing or skipping, and to control the start of the next print operation.



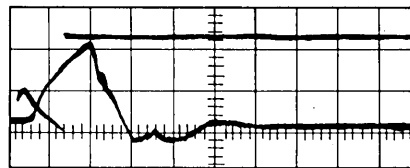
Singleshot Set at 4.6

Heavy Pull-In; 24 Milliseconds Total Time from Space-Start Signal until Tractor Shaft Movement Is Stopped



Singleshot Set at 6.0

Nearly Square Corner; 17 Milliseconds Total Time from Space-Start Signal until Tractor Shaft Movement Is Stopped



Singleshot Set at 6.8

Heavy Overshoot, 30 Milliseconds Total Time from Space-Start Signal until Tractor Shaft Movement Is Stopped

(2V/cm) (5 ms/cm)

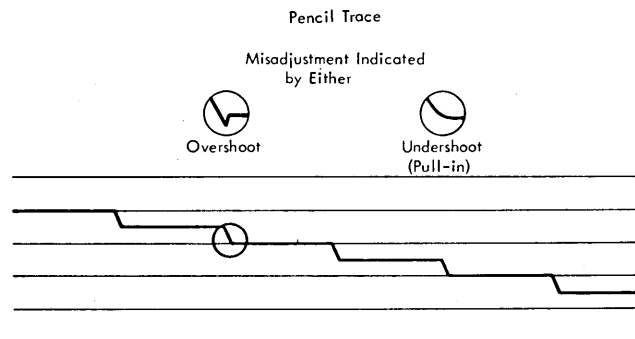


Figure 4-72. Single-Space Singleshot Adjustment

The name of the singleshot that controls this function is not consistent for all processors, control units, or reference material. This singleshot is known variously as:

- Carriage-settling singleshot
- Carriage-interlock singleshot
- Carriage-decelerate singleshot
- Carriage-ending singleshot
- After-space print delay singleshot

It is usually designated on the logic pages as the 16-ms singleshot. In this manual it is designated as the carriage-settling singleshot.

#### 4.16.2.1 Carriage-Settling Singleshot

This adjustment should be made with an oscilloscope; however, if the 1403 is connected to a System/360 Model 20, the ICR may be used instead.

To adjust the carriage-settling singleshot:

1. Observe and note the timing of the single-space singleshot.
2. Adjust the carriage-settling singleshot so that the total of the two timings (single-space singleshot plus carriage-settling singleshot) equals 20.8 ms.

This singleshot can be set most accurately by syncing on the start of the single-space singleshot, and adjusting the carriage-settling singleshot to time out 20.8 ms later.

The carriage-settling singleshot is timed for the difference between:

- a. The duration of the single-space singleshot
- b. The 20.8 ms carriage interlock time (20.4 for buffer-controlled carriage).

Figure 4-73 shows speeds and timing.

#### 4.16.2.2 Forms Interlock Singleshot Adjustment

The forms interlock provides sufficient time for the carriage to position the forms for printing when performing two or more successive carriage space or skip operations.

The singleshot that controls the forms interlock function is usually designated on the logic pages as the 10- or 14-ms singleshot.

System/360, System/370, and those systems using the 1414 I/O Synchronizer (1410, 7010, 7040, and 7044) or the buffer-controlled carriage do not have a forms interlock singleshot adjustment because this function is controlled in these systems by the carriage-settling singleshot.

To adjust the forms interlock singleshot, observe the timing of the single-space singleshot and adjust the forms interlock singleshot so that the total of the two timings is 19.7 ms.

The forms interlock singleshot can be set most accurately by syncing on the start of the single-space singleshot and adjusting the forms interlock singleshot to time out 19.7 ms later.

Record the settings of each singleshot on the appropriate system logic and hydraulic-unit decal for future reference.

Item	1403 Printer Models 3 and N1	
1	Cartridge Type	Train
2	Number of Print Positions	132
3	Maximum Printing Speed (LPM)	1100
4	Train Motor Speed (RPM)	3600
5	Train Velocity (IPS)	206
6	Time Required for Type to Move .001" (Microseconds)	5.0
7	Setting for Calibration of Print-Timing Dial with Print Density Lever Set at C	Has no dial
8	Timing Disk Speed (RFM)	1714
9	Time of Carriage Start Impulse	Print SS-1 of Print Scan 46
10	Time Required to Print One Line with Single Space (milliseconds)	54.54
11	Carriage Interlock Time (ms)	20.8
12	Carriage Type (Speed)	Dual

Timings for the Model 3 with PCS and the Model N1 with UCS or MCS are the same as above, except for maximum printing speed, which is 1400 lpm and the time of carriage-start impulse which occurs when printing is finished.

Figure 4-73. Carriage Reference Chart

#### 4.16.3 Double- and Triple-Space Singleshot and E1 Emitter Adjustments

A variable relationship exists between the double- and triple-space singleshots and the E1 emitter. The systems that use the 1403 printers are in three groups according to the way this relationship is used. A separate adjustment procedure is provided for each group of systems. Use the procedure group corresponding to the group involved (refer to Figure 4-60).



Group 1 includes the 1440 and 1460, System/3, System/360 Model 25, System/360 and System/370 models using the 2821 Integrated Control Unit. In this group, double- and triple-space singleshots are used to control double- and triple-spacing, respectively. The E1 emitter controls all programmed carriage tape (skip) operations over one space.

Group 2 includes the System/360 Model 20. In this group no singleshots are provided for double- or triple-spacing. Instead, the system uses the second and third E1-emitter pulses to end all programmed double- and triple-space operations and skip operations over one space.

Group 3 includes the 1410, and the 7000-series systems (7010, 7040, and 7044) with the 1414 I/O synchronizer.

In this group the double- and triple-space singleshots are set to a fixed value and used to blank out the first and second E1-emitter pulses for double- and triple-spacing. The carriage is stopped (when double- and triple-spacing) by the E1 pulses, however, and not by the singleshots. The E1 emitter is adjusted to control double- and triple-spacing as in group 2. Skips over one space (over three spaces on buffer-controlled carriages) are also controlled by the E1 emitter.

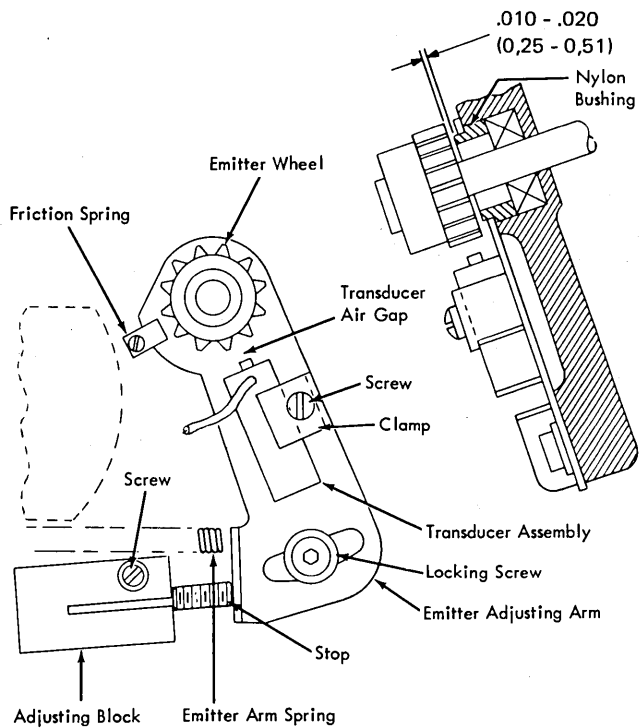


Figure 4-74. E1 Magnetic Emitter

#### 4.16.4 E1 Magnetic Emitter Adjustment

If the emitter is being replaced, the following initial adjustment should be made before proceeding.

Locate the emitter wheel on its shaft so that any one of the teeth on the wheel is just past, in a clockwise direction, the wedge on the front of the emitter transducer. The remaining adjustments are as follows.

1. The emitter wheel should be .010 to .020 in. (0,25 to 0,51 mm) from the nylon bushing as shown in Figure 4-74.
2. Loosen the transducer clamp screw, and adjust the transducer for .008 in. (0,20 mm) clearance to the emitter wheel. Figure 4-74 shows the transducer air gap.  
This adjustment can be varied to a minimum of .002 in. (0,05 mm) to meet the specified transducer output of 2 to 4.5V peak to peak and an E1 pulse duration of 1.1 to 1.5 ms at low speed.
3. Adjust the emitter output.
  - a. Disconnect the transducer leads from terminals 8 and 9 of the amplifier card.

#### CAUTION

Turn power off when removing or replacing the leads. If certain terminals are grounded, the amplifier-card components may be damaged.

- b. Connect one lead from the transducer to the scope probe and the other lead to the scope ground.
- c. With the emitter wheel operating continuously at low speed, the waveform must appear as shown in Figure 4-75 with an output of 2 to 4.5V peak to peak. Refer to step 2.

To operate continuously at low speed, remove the #1 carriage stop-brush wire or use a blank carriage tape, and press the restore key. On a 2020 Submodel 5, use a tape having a punch in channel 1. For buffer-controlled carriages, refer to system carriage diagnostics.

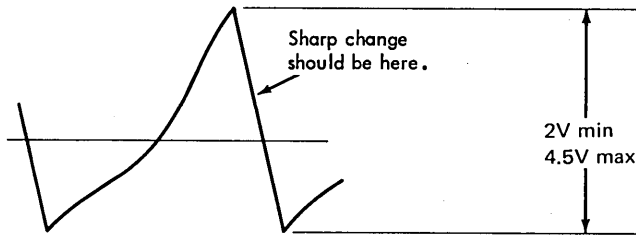


Figure 4-75. E1 Magnetic Emitter Waveform

4. If the observed waveform appears as shown in Figure 4-75, reconnect the lead that was on the scope probe to terminal 8, and the lead that was on the scope ground to terminal 9. If, however, the waveform has a rapid rise to the positive pulse and a slow drop to the negative pulse, reverse the leads when reconnecting them to the terminal block.
5. With all leads connected and the emitter wheel operating continuously at low speed, check the amplified output at the E1-sync point or terminal 1 on the amplifier card for:
  - a. -8V minimum (normally -12V)
  - b. 1.1 to 1.5 milliseconds duration
  - c. 2 to 30 microseconds rise time
  - d. 1 to 30 microseconds fall time.

#### 4.16.5 Procedure Group 1

Use this group for the following systems:

1440  
 1460  
 System/3  
 System/360 Model 25  
 System/360 and System/370 Models with the  
 2821 Control Unit.

##### 4.16.5.1 Double-Space Singleshot Adjustment (Pencil-Trace or Tach-Generator Methods)

1. Set the manual clutch knob to the 8-lines-per-inch drive position.
2. Program for double-space after-print only. (Before-print space and print gives three spaces.)
3. Check that the paper is in the carriage and that the upper front paper guides (if present) are removed when using the pencil trace method. The forms contacts may be blocked when the tach generator method is used.
4. Start the carriage by pressing the start key.
5. Draw line graphs on the paper while it is feeding (as described under 4.14.1).

6. Adjust the double-space (9.8-ms) singleshot to produce a square line graph on the paper, or to show minimum stabilization time on the scope trace produced by the tach generator. Be sure the carriage is double-spacing.
 

Figure 4-76 shows both the pencil and scope traces for the double-space singleshot adjustment.
7. Set the manual clutch to the 6-lines-per-inch drive position and repeat the observations of the line graph or scope trace.
8. The final adjustment of the double-space singleshot is to obtain the best compromise between:
  - a. Minimum overshoot at 6-lines-per-inch
  - b. Minimum pull-in at 8-lines-per-inch.

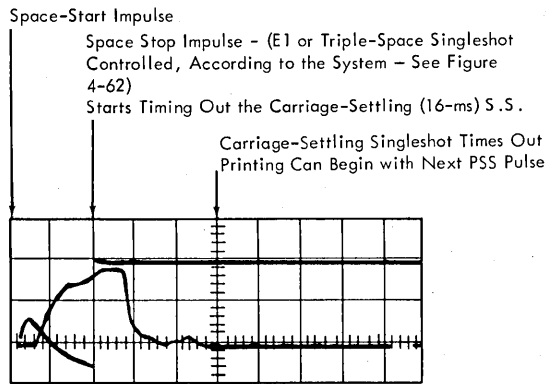
This represents a compromise for the minimum time from the impulse to the space-stop magnet until the tractor shafts are settled down.

##### 4.16.5.2 Triple-Space Singleshot Adjustment (Pencil-Trace, Tach-Generator, or System/3 Program Method)

1. Set the manual clutch to the 6-lines-per-inch drive position.
2. Program for triple-space (after-print only).
3. Check that paper is in the carriage and that the upper front forms guides (if present) are removed when using the pencil trace method. The forms contacts may be blocked when the tach generator method is used.
4. Start the carriage by pressing the start key.
5. Draw line graphs on the paper while it is feeding, or observe the scope trace. Be sure the carriage is triple-spacing.
6. Adjust the triple-space (13.8-ms) singleshot to produce square line graphs or minimum stabilization time as shown by the tach generator scope trace.
7. Set the manual clutch to the 8-lines-per-inch drive position and repeat the observations of the line graphs or scope traces. See the single-space singleshot-adjustment line graph and scope trace (Figure 4-72). Figure 4-77 shows the triple-space singleshot adjustment scope and pencil traces.
8. The final adjustment of the triple-space singleshot is to obtain the best compromise between:
  - a. Minimum overshoot at 6-lines-per-inch
  - b. Minimum pull-in at 8-lines-per-inch.

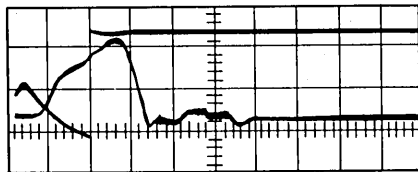
This is a compromise between 6 and 8-lines-per-inch for the minimum time between the space-stop magnet impulse and the time when the tractor shafts have settled down.

Scope Trace



E1 or Double-Space Singleshot Set to Best Condition

12 Milliseconds from Stop Impulse until Tractor Shaft Is Settled

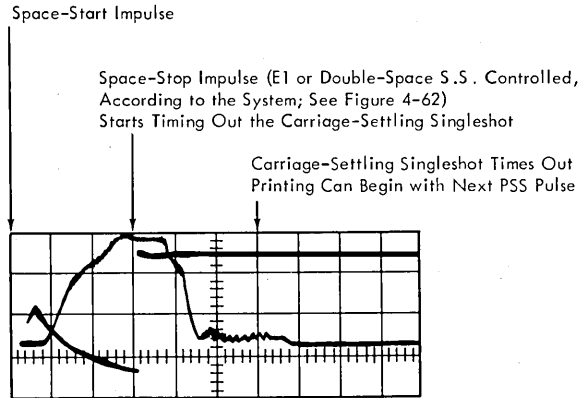


E1 or Double-Space Singleshot Set Early

19 Milliseconds from Stop Impulse until Tractor Shaft Is Settled

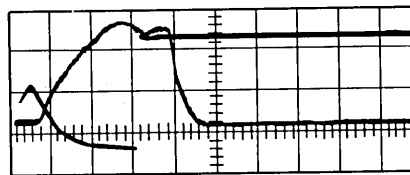
(2V/cm) (5 ms/cm)

Scope Trace



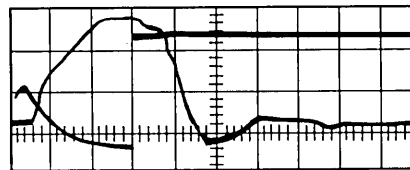
E1 or Triple-Space Singleshot Set Early

Trace Shows Pull-In 19 Milliseconds from Stop Impulse until Tractor Shaft Is Settled



E1 or Triple-Space Singleshot Set Correctly

8 Milliseconds from Stop Impulse until Tractor Shaft Is Settled



E1 or Triple-Space Singleshot Set Late

Trace Shows Overshoot 23 Milliseconds from Stop Impulse until Tractor Shaft Is Settled

(2V/cm) (5 ms/cm)

Pencil Trace

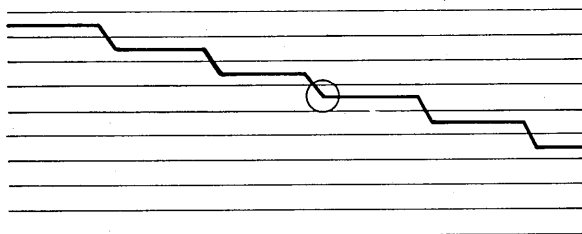
Misadjustment Indicated by Either



Overshoot



Undershoot (Pull-in)



Pencil Trace

Misadjustment Indicated by Either



Overshoot



Undershoot (Pull-in)

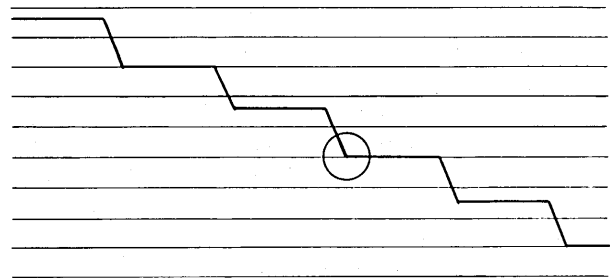


Figure 4-76. E1 Emitter or Double-Space Singleshot Adjustments for Double Spacing at 8-lines-per-inch

Figure 4-77. E1 Emitter or Triple-Space Singleshot Adjustments for Triple Spacing at 6-lines-per-inch

#### 4.16.5.3 E1 Magnetic Emitter Timing (Scoping Method Only)

Before this timing adjustment is made, the magnetic emitter should be in good mechanical adjustment as described in 4.16.4.

The double- and triple-space singleshots must be correctly adjusted first.

1. Program for double-space (after-print only).
2. Put the printer in 8-lines-per-inch drive.
3. Sync the scope on the impulse to the space-start magnet.
4. Observe the time when the double-space singleshot times out.
5. Display and observe the E1 magnetic emitter pulse. Compare the time that the double-space singleshot times out with the start of the magnetic emitter pulse nearest to the time out of the double-space singleshot.
6. Program for triple-space (after-print) in 6-lines-per-inch drive and observe the time that the triple-space singleshot times out.
7. Display and observe the E1-magnetic emitter pulse. Compare the time that the triple-space singleshot times out to the start of the emitter pulse.
8. Adjust the E1 emitter by shifting the emitter arm to provide pulses timed as closely as possible to the time out of the double- and triple-space singleshots (Figure 4-78). Split the difference so that time T1 and time T2 are approximately equal. (Use expanded sweep on the scope.) For actual scope traces, see Figures 1-59 and 1-60.

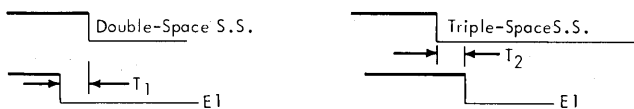


Figure 4-78. E1 Pulse To Singleshot Relationship

This timing is a compromise adjustment to provide emitter pulses timed as closely as possible to the time out of both the double- and triple-space singleshots.

*Note:* The carriage-tape brushes must be checked dynamically after this adjustment has been made. (Not required on buffer-controlled carriages.)

#### 4.16.6 Procedure Group 2

Use this group for System/360 Model 20. This group requires timing of the E1 emitter only.

Before making the timing adjustment, the magnetic emitter should be in good mechanical adjustment as described under 4.16.4.

#### 4.16.6.1 E1 Magnetic Emitter Timing (Pencil-Trace or Tach-Generator Methods)

1. Prepare the carriage.
  - a. If using the pencil trace method, see that paper is in the carriage and that the upper front paper guides (if present) are removed.
  - b. If using the tach-generator method, attach the tach generator as described under 4.14.2.
2. Set the manual clutch to the 6-lines-per-inch drive position.
3. Program a triple-space loop.
4. Start the carriage by pressing the start key.
5. Draw line graphs on the paper or observe the scope trace.
6. Shift the emitter arm to obtain the least tractor stabilization time as indicated by the line graph or scope trace (refer to Figures 4-76 or 4-77).
7. Change the program to double-space at 8-lines-per-inch.
8. Run the program and draw new line graphs or observe the scope trace.
9. Readjust the emitter arm as required to obtain the best compromise condition for minimum tractor-shaft stabilization time in double- (8-lines-per-inch) and triple-space (6-lines-per-inch) operations. Some overshoot may be necessary on triple-spacing at 6-lines-per-inch to prevent excessive pull-in during double-spacing at 8-lines-per-inch.
10. After completing the magnetic emitter timing adjustments, adjust the carriage-tape brushes dynamically as described in 4.16.9. (Not required on buffer-controlled carriages.)

#### 4.16.7 Procedure Group 3

Use this group for the following systems that use the 1414 I/O synchronizer:

1410, 7010, 7040, and 7044.

This group requires setting of the double- and triple-space singleshots to fixed values and adjustment of the E1 emitter. Before making the emitter adjustment, make certain the emitter is in good mechanical adjustment as described in 4.16.4.

#### 4.16.7.1 Double-Space Singleshot Adjustment

Program a double-space loop and set the double-space singleshot for 8 ms.

#### 4.16.7.2 Triple-Space Singleshot Adjustment

Program a triple-space loop and set the triple-space singleshot for 12 ms. Use the same procedure as described in 4.16.5.2.

*Note:* The carriage-tape brushes must be checked dynamically after this adjustment is made. (Not required on buffer-controlled carriages.)

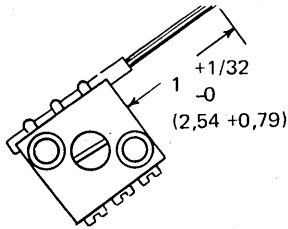
#### 4.16.7.3 E1 Magnetic Emitter Adjustment

Use the same procedure as described in 4.16.6.1 for Procedure Group 2.

The carriage-tape brushes must be checked dynamically after this adjustment is made. (Not required on buffer-controlled carriages.)

#### 4.16.8 Static Adjustment of the Carriage-Tape Brushes

1. Position the tape brushes for a 1 in.  $1 + 1/32 - 0$  in. (25, 4 + 0, 79 mm) projection from the brush holder (Figure 4-79). Hold the range of adjustment as close as possible because of possible difficulties in timing the stop brushes to the E1 emitter.



Projection From Brush Holder

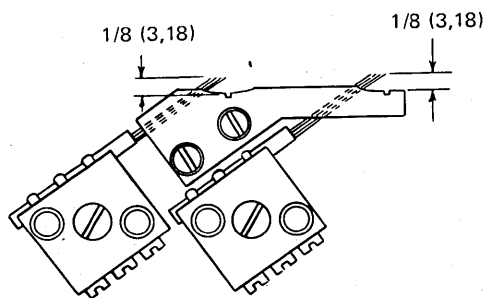


Figure 4-79. Carriage-Tape Brush Projection

2. Adjust the brush separator for approximate centering of the brushes in the separator slots by turning the threaded brush-guide pivot shaft in conjunction with the separator collars. Adjust for minimum end shake (of the separator)

and no binds or interference when the separator is pivoted out to enclose the brush tips. Position the threaded portion of the brush-guide pivot shaft so that the end is flush to  $1/32$  in. (0, 79 mm) recessed from the outside surface of the locknut.

3. With the unit opened and the brush separator held pivoted toward the brushes, check for a brush projection of  $1/8 \pm 1/64$  in. (3, 18  $\pm$  0, 38 mm). Adjust by repositioning the brushes in the brush blocks. Set the stop brushes within .010 in. (0, 25 mm) total variation for the full set within the  $1/8 \pm 1/64$  in. (3, 18  $\pm$  0, 38 mm) range.  
*Note:* On a skip operation, the tape stops with the hole one space past the brushes.
4. a. On tape-controlled carriages, adjust the brush blocks so that the toe of the shorter group of strands lines up with the scribed lines on the brush separator (when the brushes are held flush with the flat portion of the brush separator).  
b. On buffer-controlled carriages, install the tape provided with the printer and adjust the drive sprocket to have the brush just fully made in the tape hole.
5. Adjust the brush-frame pivot stud for friction sufficient to hold the brushes in any open (unlatched) position.
6. Adjust the brush-separator eccentric stop stud for  $.050 \pm .010$  in. (1, 27  $\pm$  0, 25 mm) clearance between the brush separator and the contact rolls at the scribed line (Figure 4-80).
7. Adjust the latch block to obtain .001 to .006 in. (0, 03 to 0, 15 mm) clearance between the latch pawl and latch block with the brush assembly fully depressed (Figure 4-80).
8. Adjust the brush-separator stop rod to ensure that the brush tips are below the active surface of the separator a minimum of  $1/32$  in. (0, 79 mm) when the unit is opened.
9. Align the tape-drive sprocket to obtain tracking of the program tape with clearance between the contact roll flanges and the tape edges. Position the locating collar against the left-hand side of the sprocket assembly.

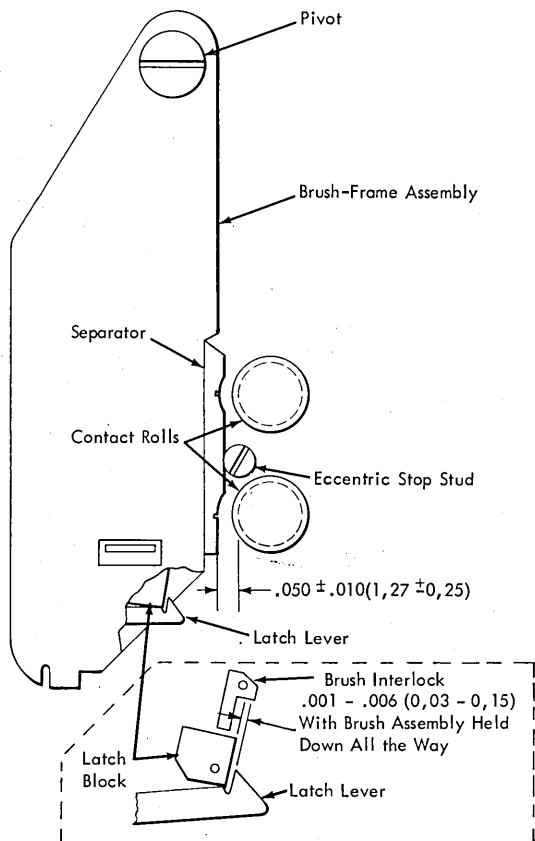


Figure 4-80. Carriage-Tape Brush Assembly Adjustments

10. Adjust the brush-separator stop plate (on the latch shaft) for an overlap of  $.046 \pm .015$  in. ( $1,17 \pm 0,38$  mm) from the front of the brush separator to the rear of the stop plate. When the brush unit is open and the brush separator is held fully pivoted toward the brushes, the end of the stop plate should be flush to  $.015$  in. ( $0,38$  mm) below the lower edge of the brush separator. As the unit is closed, the latch (upon contact with the latch block) should cause the stop plate to pivot free of the brush separator to permit latching.
11. Adjust the brush interlock switch so that the switch actuator transfers the switch before the latch pawl fully disengages the latch block. Adjust for minimum end shake with no binds.
12. After these adjustments have been made, adjust the carriage-tape brushes dynamically. (Not required on buffer-controlled carriages.)

#### CAUTION

Be sure the stop rod is located so that it can not contact the raised hub of the contact roll. Blown fuses could result.

#### 4.16.9 Dynamic Adjustment of the Carriage-Tape Brushes

(Not required on buffer-controlled carriages. If the 1403 is attached to a System/360 Model 20, use the MFT or the diagnostic for the corresponding system.)

Before making this adjustment, make certain the brushes are in good adjustment as described in 4.16.8.

1. Set up the carriage for dynamic adjustment.
  - a. Insert a carriage tape with a channel-1 punch on every third line.
    - Use a tape punched with the customer's tape punch.
  - b. Remove the forms and actuate the forms contacts.
  - c. Engage the manual clutch in 6-line drive.
  - d. Remove the wire from the channel-1 stop brush and press the carriage restore key.
2. Set up the scope for:
  - a. 1 millisecond/division horizontally.
  - b. 10V/division vertically.
  - c. Sync on negative shift of stop brush.
  - d. Probe the negative shift of the emitter at the CE test point.
3. On tape-controlled carriages, check that the tape stop brush makes  $1.5 (+.50 - 0)$  ms before the E1 emitter pulse. (All twelve channel stop brushes must meet this specified timing relationship to the magnetic emitter.) If adjustment is required, loosen the shaft expansion screw and rotate the tape drive sprocket to obtain the correct relationship. Then tighten the expansion screw.

#### CAUTION

Before tightening, apply a light film of Lubriplate 70, (part 435682) to the tapered portion of the screw to prevent any false indication of the screws being fully tightened.

Figure 4-81 shows the tach generator traces produced when skipping and the relationships of the various controlling pulses, including the carriage slow and stop brushes.

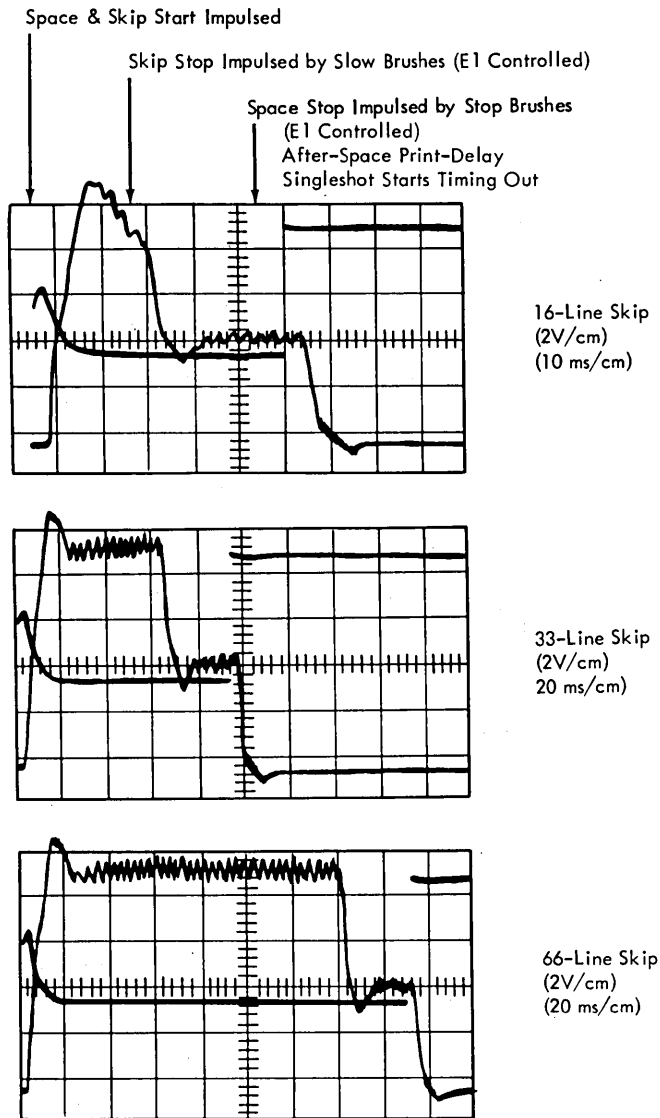


Figure 4-81. Tach Generator Traces for Skipping Operations

## 4.17 CHARACTER SET FEATURES

### 4.17.1 UCS/PCS/MCS Pulse Generation

UCS/PCS/MCS pulse generation in the train printers involves the movable base on the T-casting, the printer circuitry, and the print cartridge. The added UCS/PCS/MCS transducer replaces a filler block in a slot in the front of the movable base. The rotor is attached beneath a new design idler gear so that the type train cartridge, the PSS drum, and the UCS/PCS/MCS rotor are all driven by the train drive motor (Figure 4-82).

The correct operation of the UCS/PCS/MCS feature depends upon the timings and adjustments of its components. These include timing the type slugs to the cartridge, timing the cartridge to the keyed drive gear, timing the idler gear to the train drive gear, and correct UCS transducer adjustments.

*Note:* PCS is used on Model 3 only.

### 4.17.2 UCS/PCS/MCS Transducer Adjustments

The UCS/PCS/MCS transducer is held in its slot in the movable base by a clamp and a screw. A flat spring, alongside the transducer in its slot, holds the transducer snugly during adjustment when the clamp is loosened.

1. Adjust the air gap between the pointer and the transducer to obtain .0045 in. (0, 1 mm).
2. Adjust the emitter output.
  - a. Disconnect the leads from the transducer to terminals 8 and 9 of the amplifier card.

#### CAUTION

Turn power off when removing or replacing the leads. If certain terminals are grounded, the amplifier card components may be damaged.

- b. Connect the transducer lead that was on terminal 8 to the scope probe, and the lead that was on terminal 9 to the scope ground.
  - c. With the pointer continuously rotating, the waveform must appear as shown in Figure 4-83 with an output of 2 to 9V peak to peak.
3. If the observed waveform appears as shown in Figure 4-83, reconnect the transducer lead that was connected to the scope probe to terminal 8, and the lead that was connected to the scope ground to terminal 9. If, however, the waveform has a rapid rise in the positive direction, and a slow drop in the negative direction, reverse the leads when reconnecting them to the terminal block.

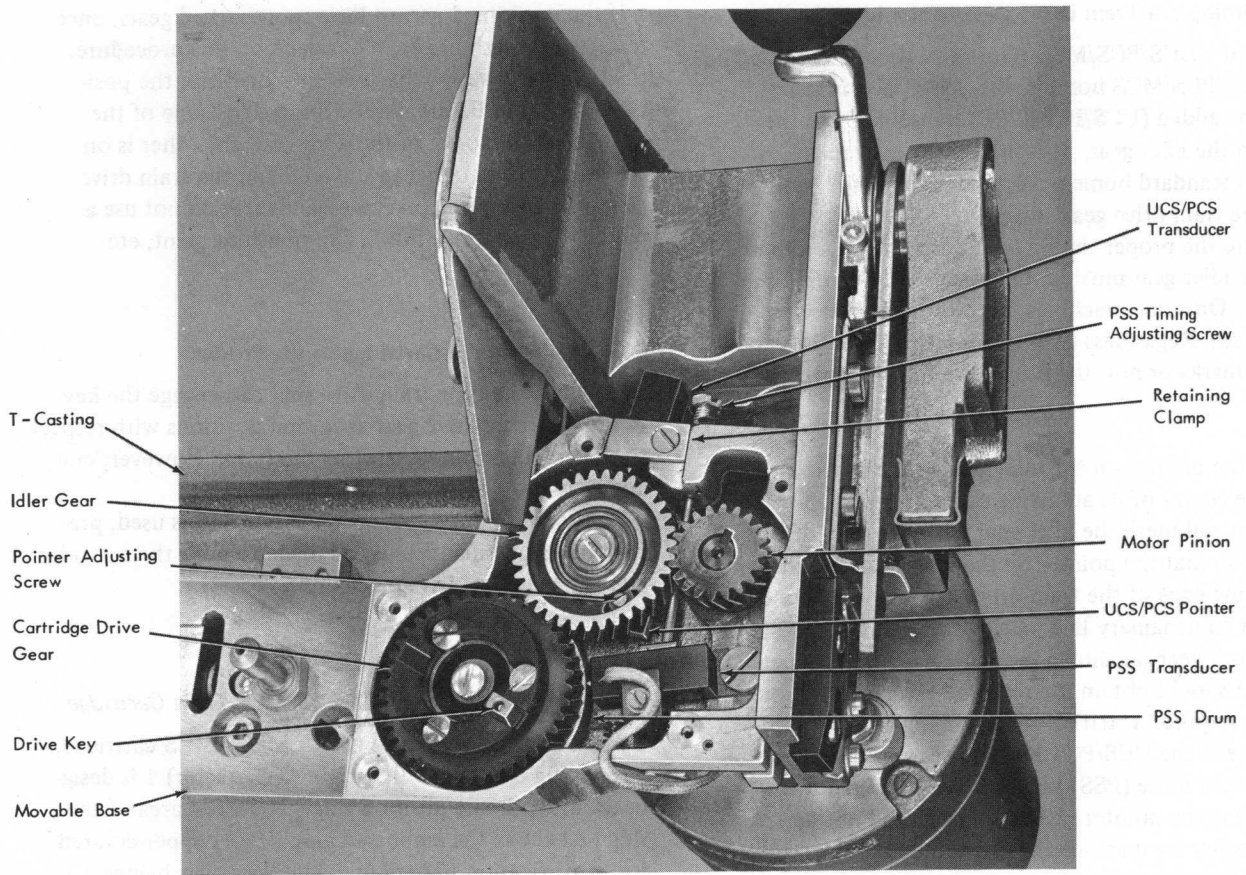


Figure 4-82. UCS/PCS/MCS Pulse Generator

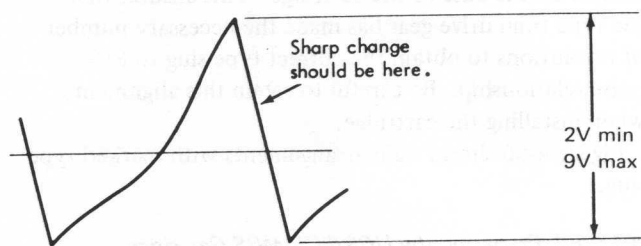


Figure 4-83. UCS/PCS/MCS Transducer Waveform

4. With all leads connected and the pointer operating continuously, check the amplified output at terminal 1 on the amplifier card for:
  - a. -8V minimum (normally -12V)
  - b. 1.1 to 1.5 milliseconds duration
  - c. 2 to 30 microseconds rise time
  - d. 1 to 30 microseconds fall time.

This UCS/PCS/MCS pulse is shaped and lengthened in the amplifier to produce an output of 1.2 to 2.0 milliseconds duration (Figure 4-84). This duration should overlap every fifth PSS home pulse whose duration is

only 5-120 microseconds. This overlapping action takes place due to the relationship of the train idler gear to the train drive gear. It selects and gates every fifth PSS home pulse as shown in Figure 4-84.

If the printer is attached to a System/360 Model 20, use the Impulse Check Routine (ICR) for this adjustment.

If the PSS home pulse occurs outside the home select gate, adjust the pointer on the idler gear. To prevent damage to the transducer, recheck the air gap before starting the machine.

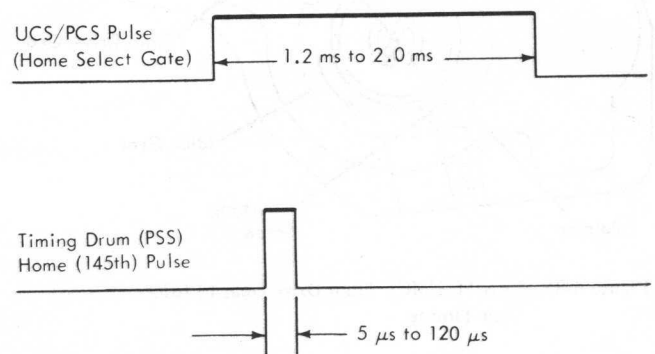


Figure 4-84. UCS/PCS/MCS Home Pulse Gating



#### 4.17.3 Timing the Train Drive Gear to the Idler Gear

The start of a UCS/PCS/MCS train revolution is indicated by the UCS/PCS/MCS home pulse. This pulse is generated by the added (UCS/PCS/MCS) transducer and the pointer on the idler gear. It is used to gate, or select, every fifth standard home pulse produced by the timing disk on the train drive gear.

To ensure the proper timing relationship between these pulses, the idler gear must be timed correctly to the train drive gear. On some machines, both of these gears are spot marked. Regardless of whether either or both gears have spot marks or not, the procedure for timing them is the same.

1. Set the pointer on the idler gear in the approximate center of its adjusting slot.
2. Align and mesh the idler gear with the train drive gear so that the pointer on the idler gear and the leading edge of the train drive-gear key are in line with an imaginary line passing through the centers of both gears as shown in Figure 4-85. This alignment should obtain the required timing condition. Any required variation in the timing relationship between the UCS/PCS/MCS pulses and the gated standard pulse (PSS) home can be obtained by shifting the pointer. Remeshing should not be necessary on machines having spot-marked gears. On machines without spot marks, it may be necessary to shift the gear mesh one tooth either way, if the proper pulse-timing relationship cannot be obtained within the adjustment limits of the pointer.

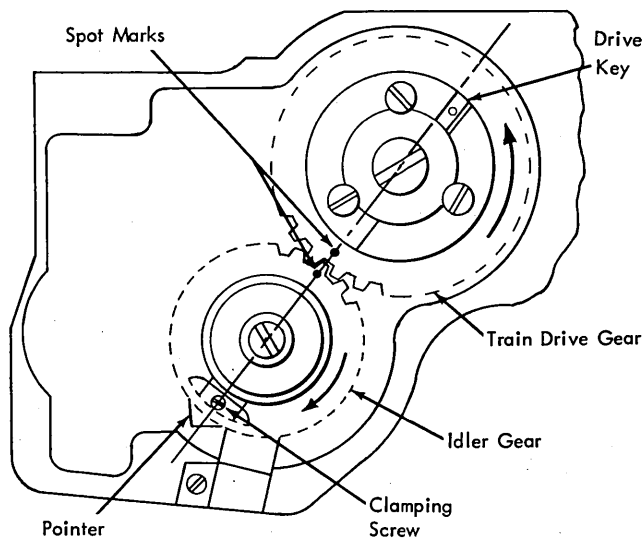


Figure 4-85. UCS/PCS/MCS Train Drive Gear to Idler Gear Timing

If the machine does not have spot-marked gears, once the correct mesh has been obtained by this procedure, the CE should supply his own spot marks in the positions shown in Figure 4-85. Observe that one of the spots is on the tooth of the idler gear; the other is on the tooth space (between the teeth) of the train drive gear. Because these gears are hardened, do not use a punch. Use a drop of dark nail polish or paint, etc.

#### 4.17.4 Timing the Cartridge to the Printer

The slot in the type train drive gear can engage the key in the cartridge drive gear at several positions with respect to the graphics (characters) on the train. However, one, and only one, of these positions is correct.

To ensure that only this correct position is used, preparatory adjustments must be made to both the cartridge and the cartridge-drive mechanism.

##### 4.17.4.1 Preparing the UCS/PCS/MCS Train Cartridge

To facilitate the timing of the UCS/PCS/MCS cartridge, a type slug containing the graphic (character) 1 is designated as the home position slug. The front area of this slug just above the embossed graphics is copper-colored for identification. There may be other slugs having a 1 graphic, but they do not have this distinctive coloration.

Align the graphic 1 on this marked slug with the arrow scribed on the base of the cartridge. This ensures that the type train drive gear has made the necessary number of revolutions to obtain the correct type slug to PSS pulse relationship. Be careful to retain this alignment when installing the cartridge.

Figure 4-86 shows train arrangements with marked type slug.

##### 4.17.4.2 Preparing the UCS/PCS/MCS Cartridge Drive Mechanism

Gear cover (part 856518) provides a universal method of timing the UCS/PCS/MCS cartridge. This cover (Figure 4-87) has a circular window near its center and a circular opening with a rectangular notch.

To time the cartridge drive mechanism, turn the cartridge drive gear until these two conditions are met:

1. The key on the cartridge drive gear aligns with the rectangular notch, as shown in Figure 4-87.
2. The UCS/PCS/MCS pointer-clamping screw is visible through the circular window.

The cartridge can now be installed correctly.



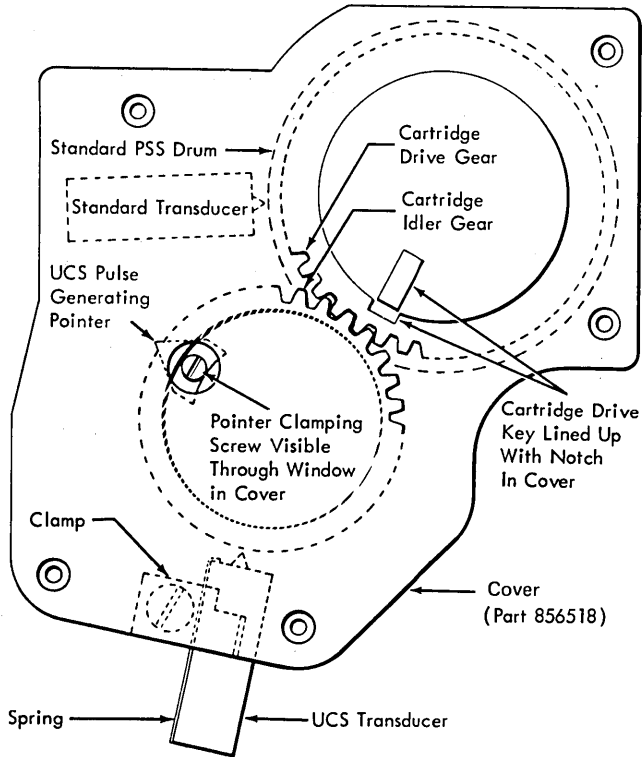


Figure 4-87. Timing the UCS/PCS/MCS Cartridge

#### 4.17.5 Installing the UCS/PCS/MCS Train Cartridge

With the cartridge and its drive mechanism prepared as described under 4.17.5, lower the cartridge carefully into position. Be careful to maintain the alignments indicated in these preparatory adjustments while engaging the slot in the train drive gear with the key on the cartridge drive gear. Lock the cartridge in position with its locking handles.

##### 4.17.5.1 UCS/PCS/MCS Train Cartridge Switch

When the UCS/PCS/MCS cartridge is locked in position on the printer, it closes a switch on the underside of the movable base to signal the printer that a UCS or PCS cartridge is installed. This activates the necessary system circuitry for correct operation with this cartridge.

In the System/360 and System/370 this switch prevents activation of the line -Y DUAL MODE SW UCB in a 2821 control unit having the UCS feature.

## 4.18 SELECTIVE TAPE LISTER (SLT) ADJUSTMENTS

### 4.18.1 Solenoid Air Gap

Adjust the solenoid backstop screw (Figure 4-88) for .031 in. (0,79 mm) nominal air gap between the solenoid plunger and the backstop. To do this:

1. Remove the paper ramp (four mounting screws).
2. Remove the leads to the pair of tape-advancing mechanisms that requires adjustment.
3. Remove the four mounting screws to remove the tape-advancing mechanisms from the machine.
4. Separate the pair of mechanisms. The three shafts that are interchangeable can be used with either mechanism.
5. Remove the shaft and paper-feed arm from the mechanism.
6. Loosen the locknut on the solenoid.
7. Fit a strip of the paper tape .0028 to .003 in. (0,05 to 0,08 mm) thick between the paper-feed following arm and the rubber stop (Figure 4-88).
8. Press the paper-feed follower arm in to hold the paper, and turn in on the backstop screw until the paper can be pulled out with a slight drag.
9. Back off the backstop screw 5/8 of a turn and tighten the locking nut.

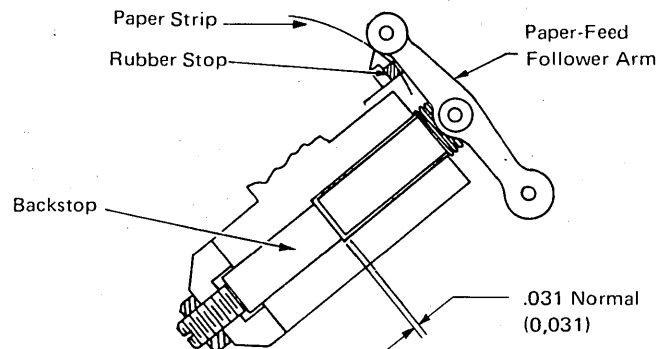


Figure 4-88. Solenoid Air Gap

### 4.18.2 Paper Feed Arm Stop

With the feed arm replaced and the solenoid operated manually, loosen the four screws that hold the paper-tear arm. Shift the arm to obtain .002 to .007 in. (0,05 to 0,18 mm) air gap between the paper-feed arm and the rubber stop (Figure 4-89).

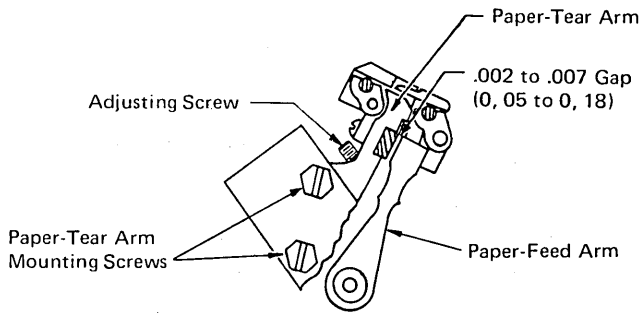


Figure 4-89. Paper-Feed-Arm Stop

#### 4.18.3 Gripper-Stop Spring

Place a .005 in. feeler gauge between the paper-feed arm and the paper-tear arm rubber stop. Move the paper-feed arm only (Figure 4-90). When the feed arm grips the feeler gauge, the grippers should just contact the stop spring. With a .010 in. feeler gauge in place of the .005 in. gauge, the gripper should not contact the stop spring. To change the spring position use the adjusting screw.

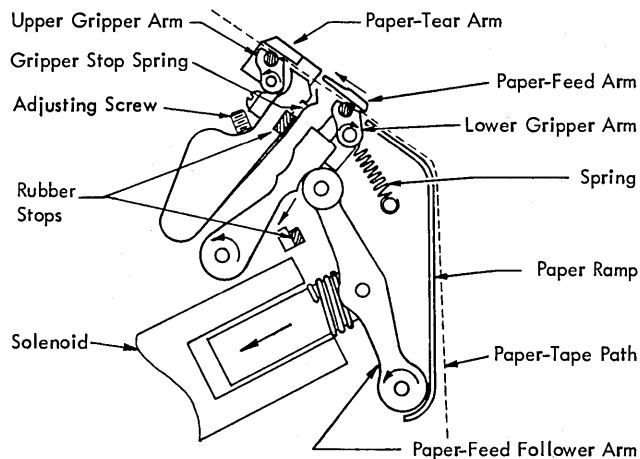


Figure 4-90. Tape Advancing Mechanism

#### 4.18.4 Paper Drag Levers

Paper drag levers are on the snap-in tape-guide plate. Adjust the tension of each lever to require 20 to 30 grams to pull a paper tape from under the lever. Use single-width tape to adjust each lever individually.

#### 4.18.5 Service Hints

Two conditions can cause overprinting:

1. The paper may not be feeding freely from the tape spool.
2. The rubber cylinder in the gripper arms may wear excessively flat. It can be rotated to get a new surface. Cut off any end that protrudes.

## 4.19 SELECTIVE TAPE LISTER FEATURE (CARRIAGE DRIVEN)

### 4.19.1 Console and Maintenance Features

#### 4.19.1.1 Error Recovery and Restart Procedures

Except for those conditions that actually stop the machine, the program must be set up to execute the action to be taken. The user's program must indicate to the operator when the machine becomes not-ready. Sense bit 1 indicates that operator intervention is required.

*Restart Procedures:* Bit 1 is set for any condition that causes the Model N1 to go not-ready. With the STL feature, this could result from erroneous spacing or tape breakage, which causes a forms-check indication and drops ready. An end-of-tape condition causes an end-of-forms indication, forms-check indication, drops ready, and raises the cover.

#### Operation Action

1. Record an erroneous spacing condition. When it is caused by a tape jam, note where the jam occurred.
2. Correct an end-of-tape or broken-tape condition.
3. Give a machine reset.
4. Manually skip, or program space or skip, affected tapes or all tapes to make the tape positions ready.
5. Allow program to continue.

### 4.19.2 Checks, Adjustments, and Removals

#### 4.19.2.1 Center Plate Guide and Sense Unit

Some adjustments are made more easily with the center plate guide and sense unit out of the machine. Also; in some of the adjustments the unit in question must be removed from the center plate assembly.

*Tape Sense Switch:* This adjustment should be made with the center plate guide and sense unit removed from the machine. It can then be taken to a bench or other convenient area for making the adjustments. Proceed as follows.

1. Remove the snap-in tape-guide plate and disconnect the cable.
2. Loosen the four screws that hold the center plate cover to the lower rear part of the guide plate. This allows access to the switch assemblies.
3. Remove the center plate switch assemblies individually for adjustment. Each switch assembly is attached to the center plate by one screw.

4. Adjust the tape sense switch so that the contact opens when the actuator has risen approximately halfway up the slope of the sense-wheel ratchet tooth (Figure 4-91). Check the wire contacts and replace if necessary. The ratchet tooth-actuator relationship can be observed through a viewing hole in the switch assembly bracket. Use a meter to observe contact break accurately.
5. Loosen the two sense-switch holding screws to make the adjustment. Retighten and replace the switch assembly on the center plate. Leave the cover off to perform the end-of-forms switch adjustments.

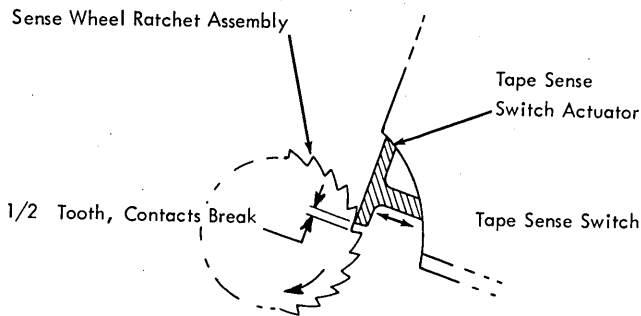


Figure 4-91. Tape Sense Switch Adjustment

**End-of-Forms Switch:** These adjustments must be made with the switches mounted on the center plate and the cover removed. The adjustments must be done with the center plate assembly off the machine.

Adjust the end-of-forms switches so that the n/c contacts open when the switch lever is pressed to within  $3/64 \pm 1/64$  in. ( $1, 19 \pm 0, 38$  mm) from the surface of the center plate (Figure 4-92). Check to ensure that the switch contacts close when the lever is released. The end-of-forms switches are mounted in the same brackets as the tape-sense switches. The switch is adjustable by loosening the two mounting screws. Retighten after each adjustment.

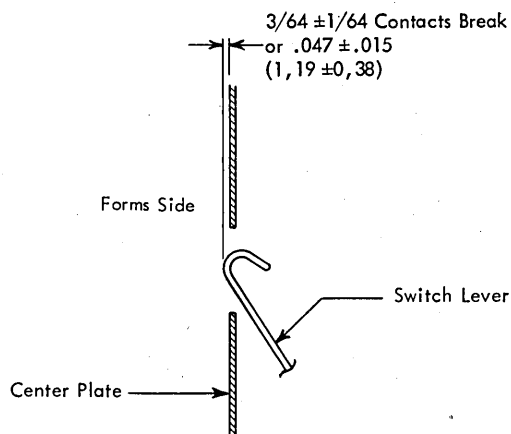


Figure 4-92. End-of-Forms Switch Adjustment

**Sense Pressure Pad:** The sense pressure pad should hold the paper tape against the sense wheel with sufficient pressure to cause the wheel to turn when the paper moves. Insufficient pressure may cause the wheel to turn only a portion of its cycle, or not at all. Excessive pressure may cause short spaces or tape breakage. Either malfunction causes a forms check.

Check the adjustment of the pressure pads as shown in Figure 4-93.

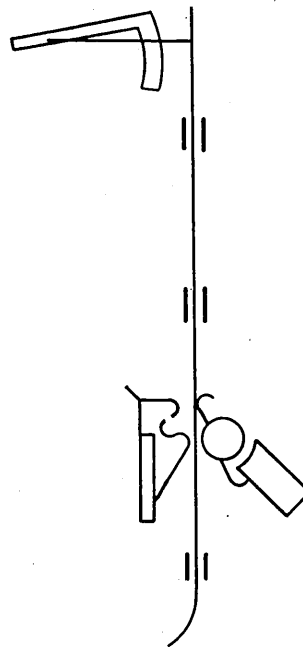


Figure 4-93. Sense Pressure Drag Measurement

1. Use a length of single-width 1.5 in. (38, 1 mm) paper tape that is approximately .004 in. (0, 10 mm) thick, 20-pound ( $76 \text{ g/m}^2$ ) stock.
2. Apply tension to the tape as shown, using a gram gauge or spring scale. (Reinforcing the tape may be necessary to prevent tearing.) Observe the force required to pull the tape through.
3. The force required should be 227 to 363 grams (.5 to .8 pound). Check all positions.

If the pressure is not within tolerance, determine which of the following adjustments gives the desired results.

1. The eccentric adjustment controls the pressure in all positions. (The eccentric studs are located on the pressure bar latch pivot and control its adjustment.)
2. The spring projection determines the pressure in one individual position.

*Note:* Damage to finger pull could restrict spring action. If this is suspected, check the operation with the finger pull removed.

*Eccentric Adjustment:* The eccentric adjustment is changed as follows.

1. Remove the center plate from the machine.
2. Remove the center plate cover from over the sense switches and locate the eccentric studs.
3. Loosen the locking nut. (The locking nut is located on the inside, except on some early machines in which the nut faces the access hole.)
4. Rotate the eccentric to adjust. The eccentric of the stud should always be left in the upward position (when the center plate is in a normal position) for correct operation of the mounting bar latch.
5. Tighten the locking nut and check the pressure as shown in Figure 4-93 and previously described. The recommended setting for the end pressure springs (1 and 8) is approximately 200 grams. This ensures that the other position falls in the desired range.
6. Check and adjust the other end if necessary. Both latches should operate evenly and with approximately the same forces.

*Spring Adjustment:* The nominal setting of spring projection is  $3/8 \pm 1/16$  in. ( $3,75 \pm 1,57$  mm) as shown in Figure 4-94. This adjustment can be changed by forming the spring in the area shown. Forming the spring to this tolerance is not necessary if correct pressure can be attained with the eccentric adjustment.

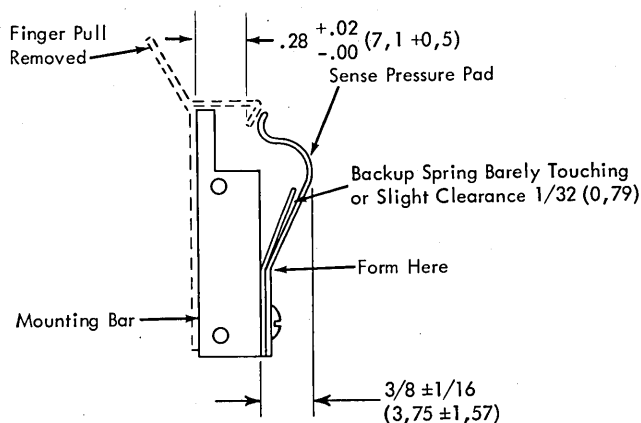


Figure 4-94. Sense Pressure Pad Adjustment

Two situations occur in which the spring should be formed. The first is when the correct drag pressure cannot be attained with the eccentrics. In this case, adjust the springs for  $3/8 \pm 1/16$  in. ( $3,75 \pm 1,57$  mm)

projection. The second is when the correct drag pressure cannot be attained in either one or several positions; adjust the springs for either the specified projection or to bring it in line with the other positions where the drag pressure measured correctly.

#### 4.19.2.2 Tape-Feed Unit

*Feed-Unit Assembly:* The feed-unit assembly is clamped to the upper tie bar. The assembly is positioned initially on the bar to obtain .002 in. (0,05 mm) maximum end play of the lister drive-shaft assembly with no thrust loading of the bearing. Because actually measuring this end play is not possible, the objective is for a minimum amount of play without a bind.

*Drive Shaft Idler Gear:* The idler gear between the drive shaft gear and the feed roll gear is located in an oversize hole. Adjust the idler gear so that it turns freely without binding and has no more than .002 in. (0,05 mm) backlash between each pair of mating gears of the three-gear train.

*Gripper-Tension Adjustment:* Adjust the gripper spring tension to ensure constant contact between the gripper and the feed-guide plate. Adjust by rotating the adjusting collar clockwise until light tension is exerted. This condition is approximately attained when the collar locking screw is horizontal (Figure 4-95).

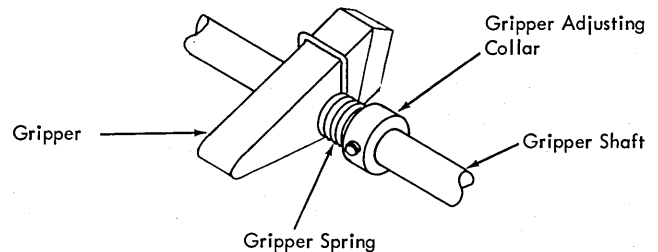


Figure 4-95. Gripper Tension Adjustment

*Feed Roll Shaft:* The center bearing support must be in correct adjustment to eliminate deflection and to ensure correct support of the feed roll shaft. Adjust as follows:

1. Bring position 4 or 5 feed pressure roller into contact with the feed roll. If the contact is not possible, adjust the feed magnet assembly.
2. Tighten the clamping screw of the center bearing support (Figure 4-96) until the feed-roll shaft deflects causing the armature gap of the feed magnet to increase slightly.
3. Back off the clamping screw just enough for the feed roll shaft to return to normal as noted by the feed-magnet armature gap.

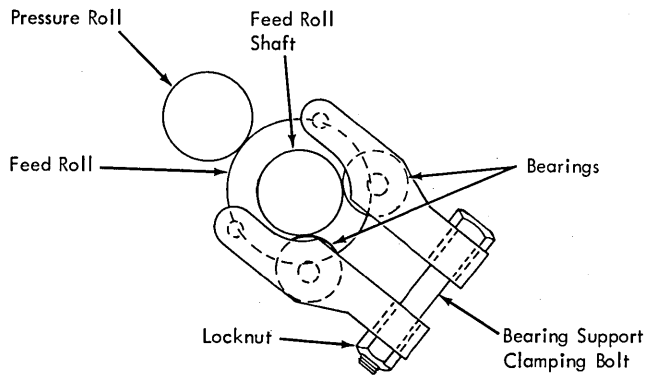


Figure 4-96. Center Bearing Support

**Removal and Replacement:** Follow this procedure if removing and replacing the feed-roll shaft assembly is necessary.

1. Remove the paper-guide chute assembly (part of the basic 1403-N1). This permits access to the terminal block.
2. Remove from the terminal block the wires that come from the tractors and input cable. Identify for ease of replacement.
3. Remove the magnet unit cover (two screws). Remove the gear guard (two screws).
4. Remove the feed unit assembly (four screws) from the top tie bar.
5. Remove the shaft center-support adjusting screw.
6. Remove the screws holding the back forms-guide plate. (The guide is only loosened, not detached.)
7. Remove the feed-roll drive gear from the feed-roll shaft by driving the taper pin that holds the drive gear.
8. Remove the feed frame right assembly (held by four dowel screws) and slide the frame from the unit.
9. Remove the collar from the left end of the feed-roll shaft and remove the shaft.
10. Reassemble in reverse order. Check the bearing support and armature adjustments and readjust as necessary. Check the feed unit assembly end-play and readjust if necessary. Check idler gear adjustment and readjust if necessary.

**Feed Magnet Assembly:** The feed magnet assembly adjustment has two phases (Figure 4-97). The yoke adjustment controls feed-roll pressure, the retainer adjustment controls armature travel. These adjustments should be checked and performed in the correct sequence.

#### Yoke Adjustment

1. Check for  $.015 + .003 - .00$  in. ( $0,38 + 0,08$  mm) clearance between the armature and the yoke when the armature is attracted as shown in Figure 4-97. Use a spring hook to apply light pressure .3 to .5 pounds (136 to 227 kg) on the armature just above the pivot. Do not use excessive pressure because this compresses the feed roll and gives a false reading.
2. Adjust, if necessary, by loosening the yoke holding screw and shifting the magnet assembly to obtain  $.015 + .003 - .00$  in. ( $0,38 + 0,08$  mm) between the armature and the yoke. Tighten the yoke holding screw.

#### Retainer Adjustment

1. Check for a clearance of  $.035 + .002 - .00$  in. ( $0,89 + 0,05$  mm) between the armature and the yoke when the armature is not attracted. If not within tolerance, proceed with step 2.
2. Loosen the retainer holding screw and shift the retainer to obtain the correct clearance. Position the retainer squarely with the armature so that no interference exists between either side of the armature and the retainer.
3. Tighten the retainer holding screw.

When the magnet assembly adjustments are complete, check to ensure that a 20 pound ( $76 \text{ g/m}^2$ ) paper tape passes freely between the feed roll and the feed magnet roller when the armature is released

#### 4.19.2.3 Tape Stacker Unit

The stacker drive belt should be adjusted so that a force of 1.5 to 2 pounds ( $0,68$  to  $0,91$  kg) pounds deflects the belt  $3/8$  in. ( $9,52$  mm) inwardly from the pulley tangent line. Adjust by raising or lowering the drive motor mounting slots.

#### 4.19.2.4 Access Window Latch

Adjust the access window latch block assembly in the mounting slots (with the latch pivot pin offset in the correct position) to provide the best latching action, and to provide  $.030$  to  $.060$  in. ( $0,76$  to  $1,52$  mm) gap in the paper path between the access window and the stacker mounting filler (Figure 4-98).

**Friction Stop:** Adjust the stop nut on the friction-adjusting screw to stop the window before it reaches the end of the raised portion of the slide when the window free falls from a vertical position.

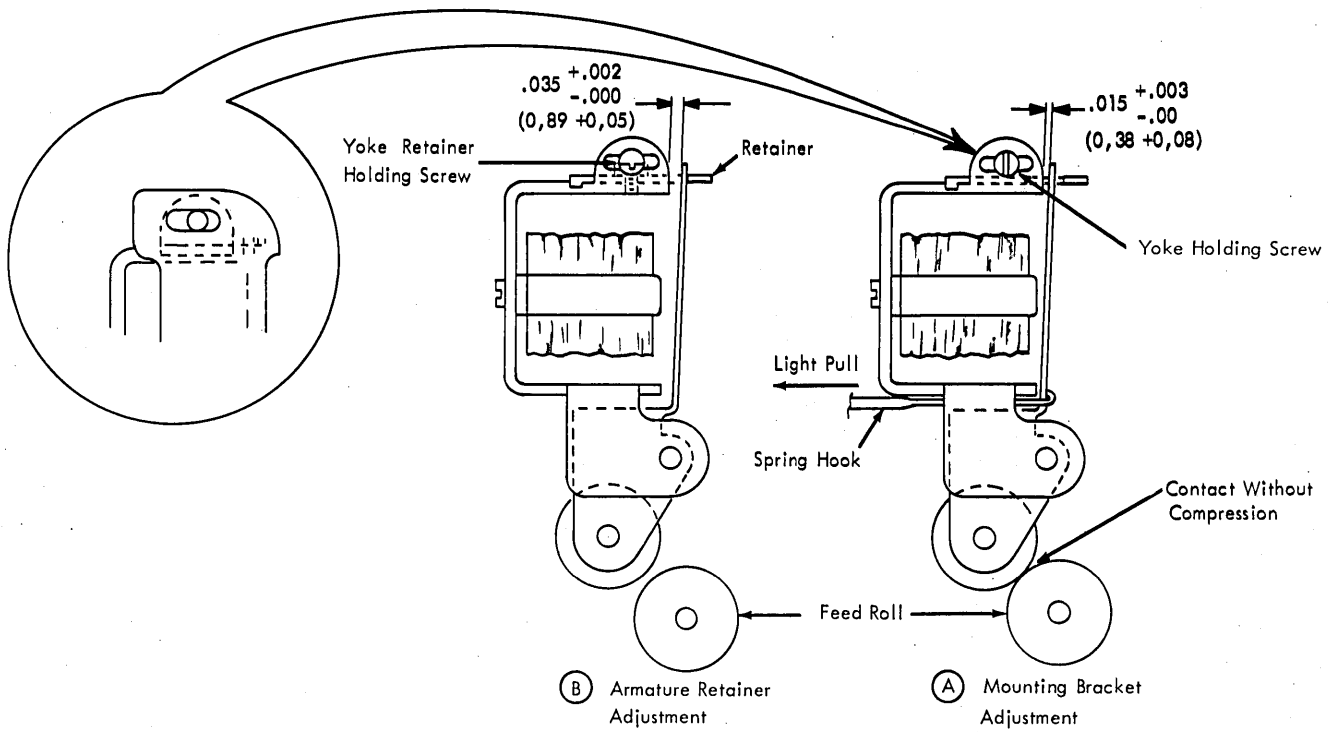


Figure 4-97. Feed Magnet Assembly Adjustments

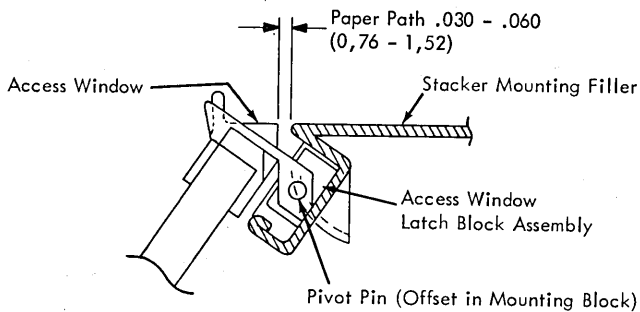


Figure 4-98. Access Window Latch

#### 4.19.2.5 Tape-Skip Length

Exact skip length is obtained by adjusting the potentiometer on SMS card B08. This card is accessible through the right rear door of the printer.

Make the adjustment with the yellow jumper wire installed between B07N and B08H. If you are unable to obtain the desired skip length, transfer the jumper wire from B08H to B08G and readjust the potentiometer.



#### 4.20 STL LOCATIONS

Figure 4-99 is a schematic view of the STL feature mounted on a Model N1 printer.

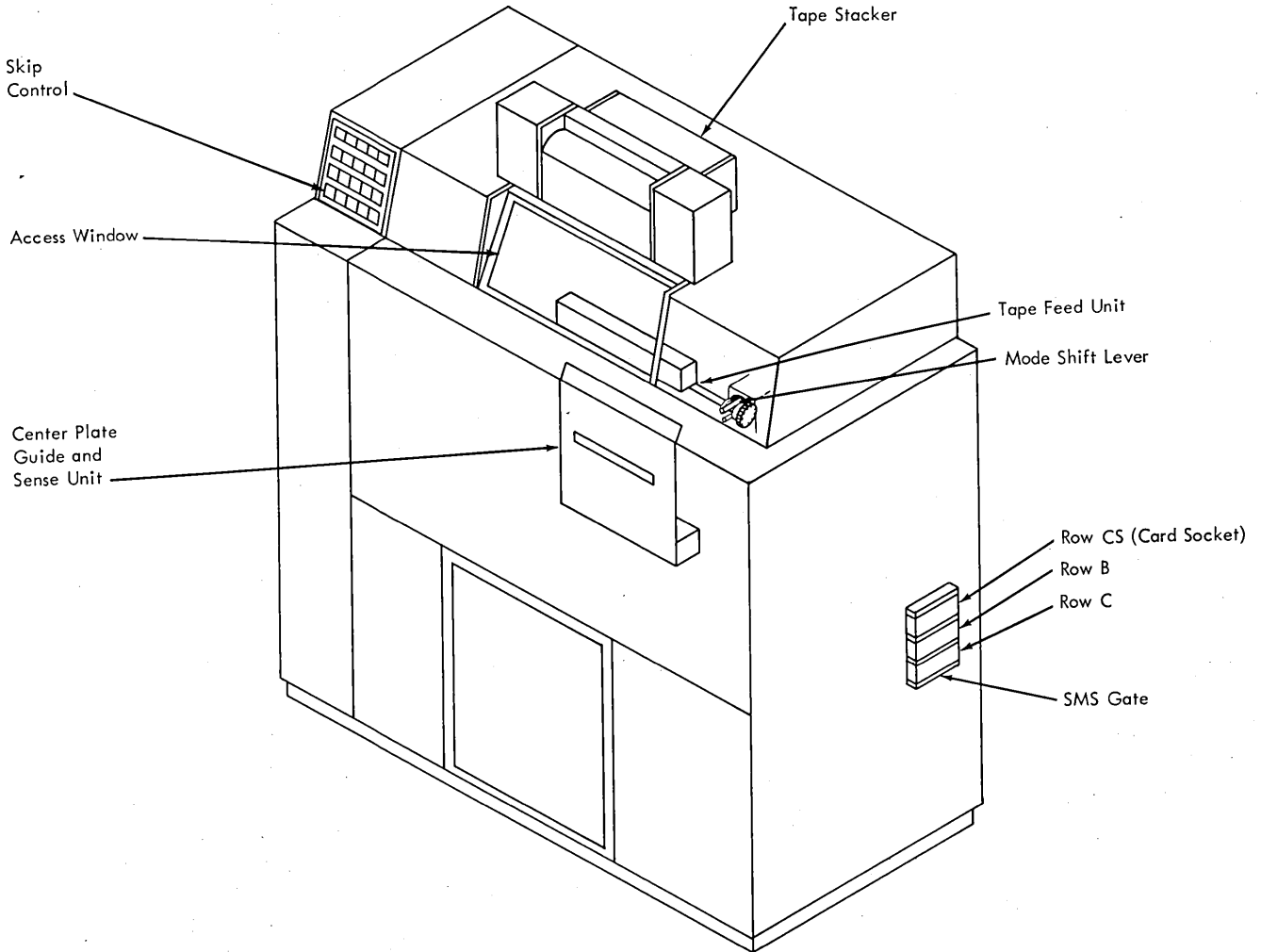


Figure 4-99. Schematic of STL Feature Locations

All 1403 power is supplied by the system. Except for the top-cover operating circuits, the Model N1 and Model 3 use the same power supply.

The mainline switch on the printer is in series with the system supply through a single conductor in each of the two shoe connector cables. This switch does not remove the dc voltages except the -60V or +60V controlled. It should not be operated while system power is on.

The printer circuits operate on 60V dc. The cover and stacker drive motors operate on ac voltages. These voltages are:

208V for 60-cycle machines

220V for 50-cycle (World Trade) machines.

The cover drive motors and the stacker drive motors use single-phase voltages.

### 5.1 VOLTAGE

The carriage motor, the type train drive motor, and the hammer blower motor are 208-230 volts ac 3-phase motors.

**DANGER**

Be careful of this voltage.

### 5.2 VOLTAGE VARIATION

When connected to the system, the printer must continue to perform all specified functions within the following voltage ranges.

Line Voltage  $\pm 10\%$

+60V dc	$\pm 10\%$ at component using voltage
-60V dc	$\pm 10\%$ at component using voltage
- 6V dc	$\pm 4\%$ at component using voltage
+ 6V dc	$\pm 4\%$ at component using voltage
-12V dc	$\pm 4\%$ at component using voltage
+12V dc	$\pm 4\%$ at component using voltage
-20V dc	$\pm 8\%$ at component using voltage

### 5.3 -60 and +60 Volt Hammer-Magnet Power Difference

Depending on the system to which the 1403 is attached, the hammer magnets require either +60V or -60V. All printers are interlocked so that no damage occurs if machines are mismatched.

Most of the printer components are in the same location on both Models N1 and 3 printers. However, in Model N1 some of the electrical components have been relocated, mostly to the left end of the machine.

### MACHINE SERIAL PLATE

On the Model N1 this plate is attached to the right-hand upper front corner of the end cover frame, or on the right end foot of the base casting.

On the Model 3 printer this plate is attached to the top surface of the right-hand cover frame.

Both machine serial plates are read from the inside of the machine.

### BLOWERS AND AIR FILTER

The two blowers and common air filter are in the left end of the Model N1. The air is drawn in through the various openings in the lower section of the machine (notably the large opening through which the cables pass) and through the filter. Some machines have louvers.

The filter can be removed or replaced through the left end door.

On the Model 3, the blower and filter on the left end of the machine are for the hammer unit. The blower for the hydraulic unit is located on the right end of the machine.

### COUNTERBALANCE MECHANISMS FOR MODEL N1

These mechanisms include counterbalance arms, bellcranks, cables, clamps, pulleys, and springs. The counterbalance arms and bellcranks are in full view when the covers are raised. The remaining components are hidden behind removable walls inside the right and left doors. The springs are inside the tubular metal shields.

### TERMINAL BLOCKS

The terminal block description and location are shown in Figure 6-1 for Model N1 and Figure 6-2 for Model 3.

### SHOE CONNECTOR RECEPTACLE

Shoe connector receptacles are located inside the left-side door (Figure 6-3) on the Model N1 and behind the left-end cover on the Model 3. The connectors number from left to right when viewed facing the left end of the machine.

### FUSES AND POWER RECEPTACLE

The Model N1 fuses are on the door of the fuse box inside the left-end door. The printer power cable receptacle is on the side of the fuse box (Figure 6-4).

The fuses on the Model 3 are located on the rear of the inside of the back cover. The power receptacle is located on the left end of the machine.

### RELAYS

The ac control relays are in the fuse box inside the left-end door on the Model N1 (Figure 6-3). The relays on the Model 3 are located on the left end of the machine just above the base near the front.

### REED RELAYS AND SMS CARDS

The reed relays are mounted on SMS cards. An eight-position SMS card receptacle group to receive these cards is located inside the right-side door (Figure 6-6). They are removable through the right-rear door.

The eight SMS card positions accommodate both the standard and UCS sense amplifiers as well as the meter relay, ribbon delay, and forms cover control circuitry. Cards are numbered (see Figure 6-5) from left to right when viewed through the open right-end door. The magnetic (E1) emitter amplifier card is mounted in this group ahead of position 1. Logic page 01.08.2 shows the SMS card socket assignments.

The carriage start pulse is now available in the Model N1 at SMS card socket 6 (CS-6), at pin A.

The relay terminals are shown on Figure 6-5 for ribbon correction and cover.

### CAPACITORS AND RESISTORS

Capacitors and resistors except those on the hydraulic unit of the printer, are mounted inside the fuse box. This box (Figure 6-7), inside the left-side access door, contains four relays in addition to the capacitors and resistors. All components are identified by labels inside the box.

### DANGER

Reverse voltage applied to any of the six condensers located on the resistor panel can cause them to explode. After servicing this area and before power is applied, immediately re-install the perforated steel resistor panel cover.

Terminal Blocks				
TB No.	No. of Terms	W.D. Loc.	Description	Physical Location
1	10	01.05.1	DC Input Voltages	Hydraulic Motor on Drive Side
2	8	02.01.1	Carriage Magnets	Under Hydraulic Reservoir Cover
3	4	01.07.1	Forms Switches & Hammer Unit Thermal	On Left Side Frame - Inside at Top
4	4	01.09.1	Hammer Unit Blower	Lower Left Side on Blower Motor
5	2 (4)	01.09.1	Ribbon Motor (50-Cycle)	Right Side of Ribbon Drive Assembly
6	4	01.08.1	Ribbon Clutch Coils	Right Side of Ribbon Drive Assembly
7	6	01.09.1	Train Motor	Left End of T - Casting - Inside
8	2	01.07.1	Train Motor Thermal	Left End of T - Casting - Inside
9	12	02.05.1 99.99.1	Cover Motor, Stacker Motor and Meter	Above SC-1 and SC-2 Connector Side
10 *	6	01.07.1	Upper Forms Switches	On Translator Frame - Behind Upper Tractors
11	6	01.07.1	Lower Forms Switches	On Translator Frame - Behind Lower Tractors
12	20	01.07.1 02.04.1	Selective Tape Lister Feature Only	On Top of Paper Feed Unit for Selective Tape
13	4	01.09.1	Hydraulic Drive Motor	Rear Right Side Under Hydraulic Motor
14	4	01.09.1	Hydraulic and Cartridge Blower Motor	Lower Left Side on Blower Motor
15	4	01.08.1	Ribbon Correction Cam Drive	Lower Left Side of T-Casting
16	4	02.05.1	Stacker Motor	Inside of Stacker Casting
17	2	01.09.1	Oiler and Correction Motors 50-Cycle	Inside T-Casting Right Side

\*TB-10 is Removed and Wires Transferred to TB-12 When Selective Tape Lister Feature is Used

Figure 6-1. Terminal Block Description and Location Chart, Model N1

Terminal Blocks				
TB No.	No. of Terms	W.D. Loc.	Description	Physical Location
1	10	01.05.1	DC Input Voltages	Machine Pan-Rear-Near Fuse Panel
2	8	02.01.1	Carriage Magnets	Under Hydraulic Reservoir Cover
3	4	01.01.1	Forms Switches & Hammer Unit Thermal	On Left Side Frame - Inside at Top
4	4	01.09.1	Hammer Unit Blower	On Motor Frame in Upper Left Rear of Machine
5	2	01.09.1	Ribbon Motor	Right Side of Ribbon Drive Assembly
6	4	01.08.1	Ribbon Clutch Coils	Right Side of Ribbon Drive Assembly
7	6	01.09.1	Chain Motor	Left End of T - Casting - Inside
8	2	01.07.1	Chain Motor Thermal	Left End of T - Casting - Inside
9	4	01.09.1	Hydraulic Unit Blower (50-Cy. Only)	On Manifold Assembly Right Side of Machine
10 *	5	01.07.1	Upper Forms Switches	On Translator Frame - Behind Upper Tractors
11	5	01.07.1	Lower Forms Switches	On Translator Frame - Behind Lower Tractors
12	20	01.07.1 02.04.1	Selective Tape Lister Feature Only	On Top of Paper Feed Unit for Selective Tape
13	24	01.08.1	Ribbon Idling Control	Left Front Inside Panel (1403-3) Near TB-7 (1403-1-2)
14	5	01.08.1	Ribbon Control Feature (1403-1-2)	In Relay Unit - Under Machine Pan
15	4	01.08.1	Ribbon Control (1403-1-2-3)	Left End of T - Casting
16	2	01.09.1	Oil Pump Motor (1403-3)	Right Side of T - Casting
17	2	01.09.1	220V AC Dist 50-Cycle Only	Machine Pan - Left End - Near Power Plug
18	8	01.08.3	Paper Damper Magnets (1403-3)	Behind Lower Magnet Damper Plate
19	8	01.08.3	Paper Damper Magnets (1403-3)	Same as TB-18
20	8	01.08.3	Paper Damper Magnets (1403-3)	Same as TB-18
21	4	01.09.1	Cartridge Blower 50-Cycle (Only) (1403-3)	On Cartridge Blower

\*TB-10 is removed and wires transferred to TB-12 when selective tape lister feature is used.

Figure 6-2. Terminal Block Description and Location Chart, Model 3

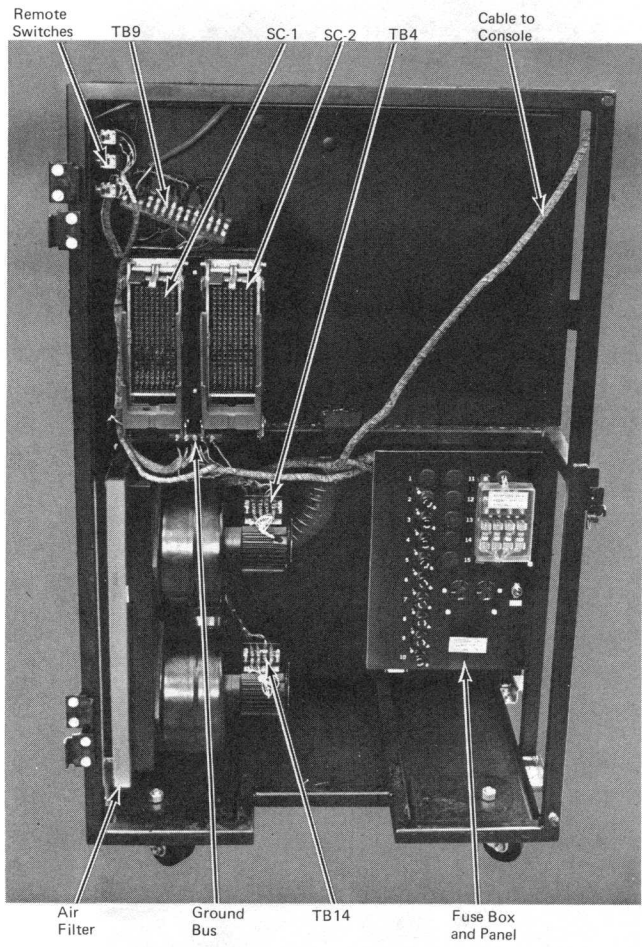
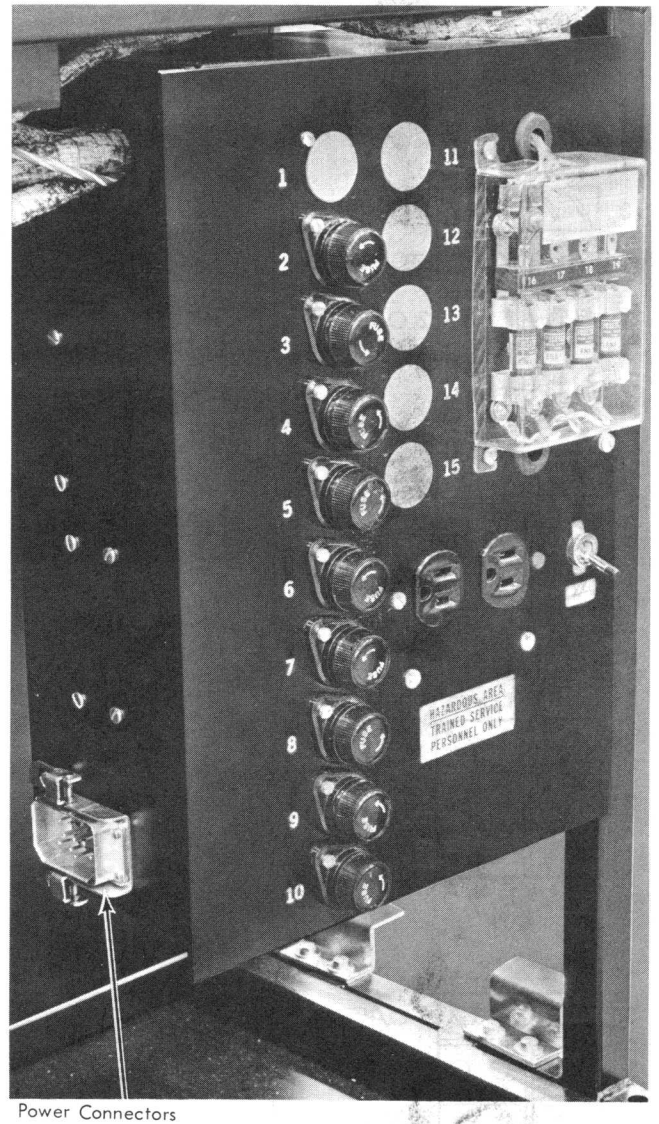


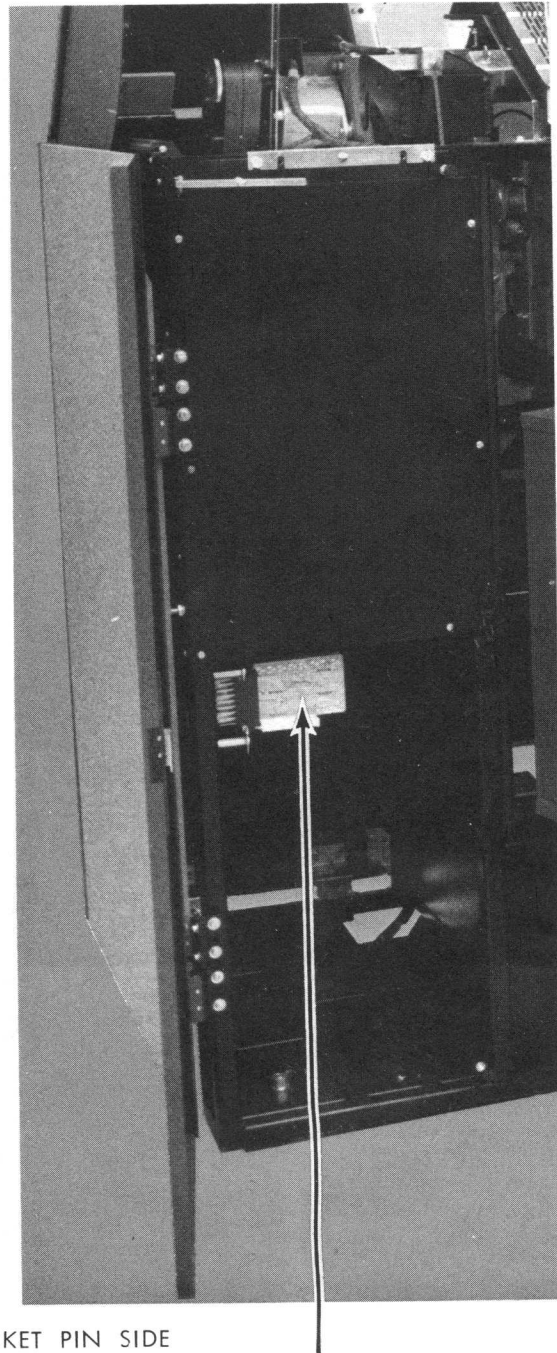
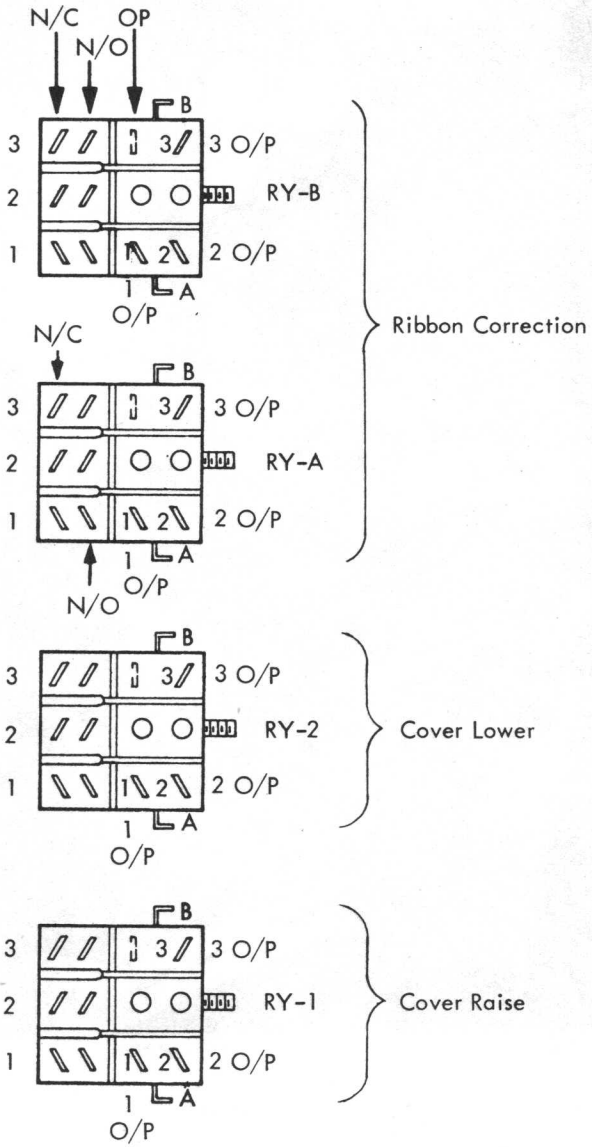
Figure 6-3. Left-End View, Model N1



Power Connectors

Figure 6-4. Fuse Box (Showing Power Receptacle)

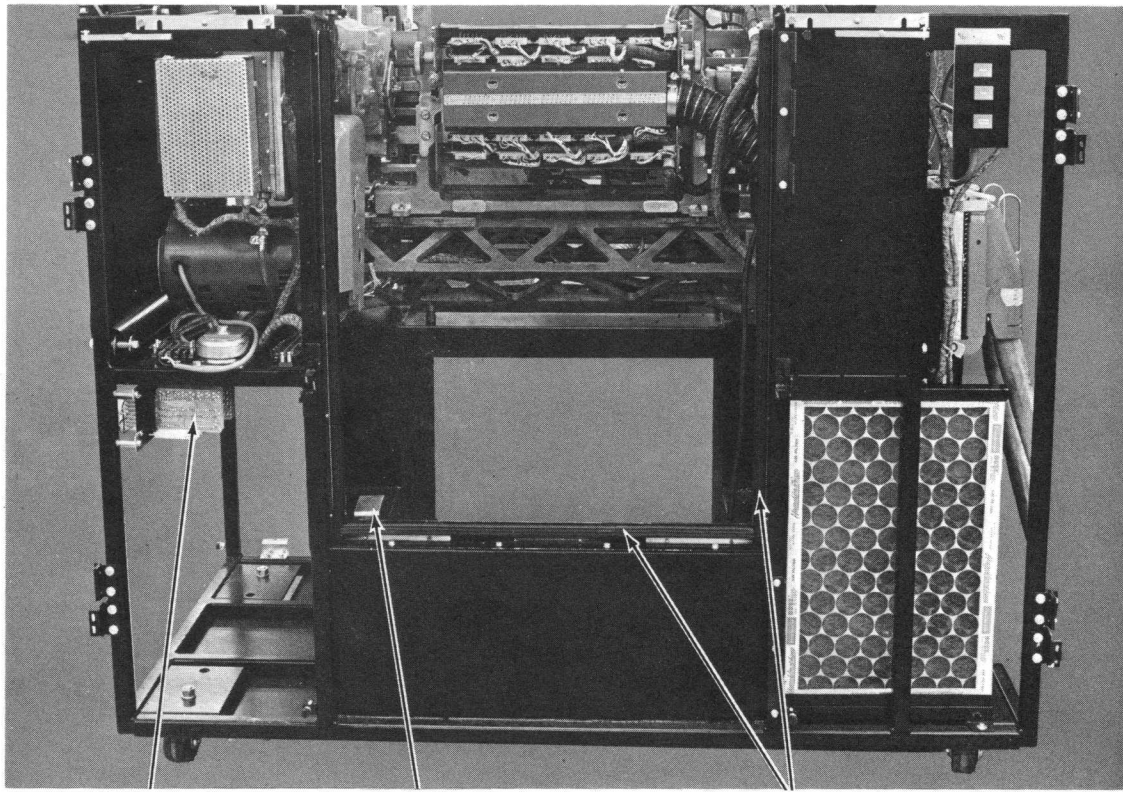
RELAY PART 2124703



8-POSITION SMS SOCKET PIN SIDE

DRUM SENSE AMP I 371885 01.08.2	DRUM SENSE AMP II 371886 01.08.2	DIFF. AMP 372496 01.08.2 (+60v. Feature only)		METER RELAY 372689 99.91.1	RIBBON DELAY 374624 (-60V) 375303 (+60V) 01.08.1	FORMS COVER CONTROL 372708 02.05.1	
CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7	CS-8

Figure 6-5. Relay and Socket Location and Numbering

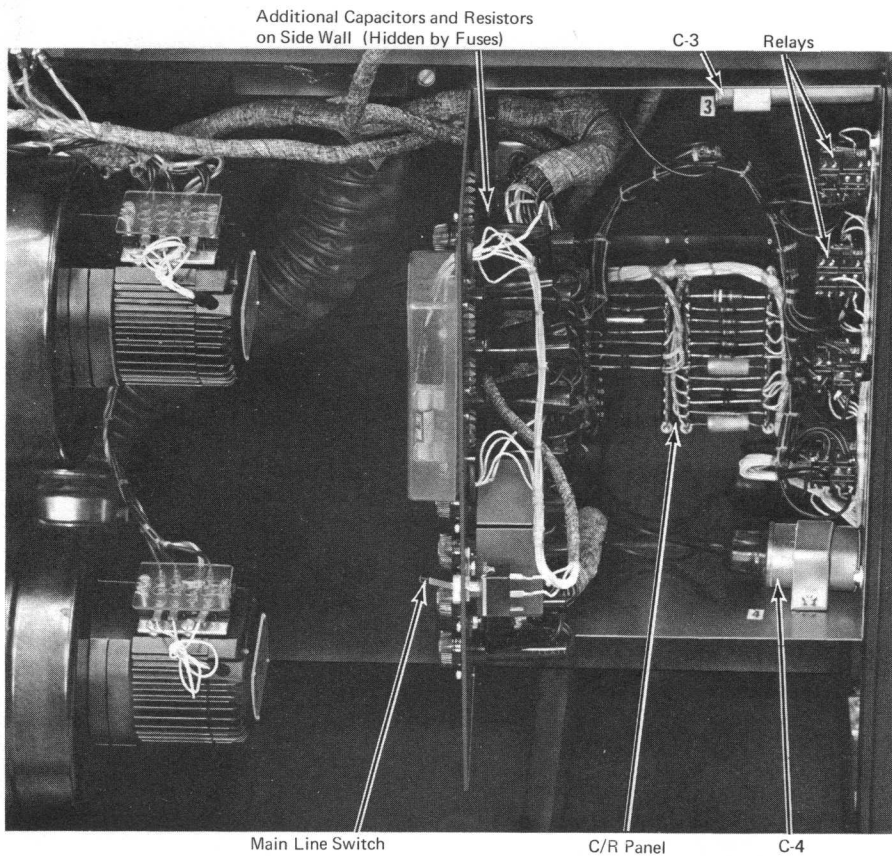


SMS Cards

Stacker Gate Support Bracket

Rubber Sound-Barrier Strips

Figure 6-6. Rear View



Additional Capacitors and Resistors on Side Wall (Hidden by Fuses)

C-3

Relays

Main Line Switch

C/R Panel

C-4

Figure 6-7. Interior of Fuse Box

Print quality is an important consideration with any 1403 Printer. However, where the output of a 1403 is used for input to an optical character recognition system, quality of printing becomes a prime consideration.

This is because a 1403 printer that is producing printing that is entirely satisfactory to customers who are visually reading the output may not be producing printing with the characteristics needed for low reject rates in reading machines.

See Figure A-1 glossary of print quality terms to assist in identifying various print quality concepts.

### A.1 PRINTING CHARACTERISTICS DEFINED

Some of the terms in this manual are unique to the subject of print characteristics. Definitions of these terms follow.

#### A.1.1 Average Edge

The typical edge of a printed character is not a straight line. The term average edge is defined as an imaginary line that bisects the edge irregularity (Figure A-2). Average edges of characters need to be clearly indicated because of the way in which the character recognition logic of the optical character reader is designed.

#### A.1.2 Stroke Width

A stroke is a portion of a character (Figure A-3). It can be a vertical, horizontal, curved, or slanted segment. Stroke width is the distance between the average edges of the stroke. (See Figure A-1.)

#### A.1.3 Density

Density or ink coverage is the blackness of a character (see Figure A-1, Items 3 and 4).

#### A.1.4 Contrast

Contrast is the difference in density measurement between the character and the background area. This can also be defined as the difference between print reflection from the printed character and background reflection from the surface of the document.

HHHH	CUTOFF (LEFT)	1
HHHH	CUTOFF (RIGHT)	2
HHHH	END TO END DENSITY	3
HHHH	SINGLE POSITION DENSITY	4
HHHH	DARK LEGS OR STROKES	5
HHHH	EXTRANEIOUS INK	6
HHHH	HORIZONTAL REGISTRATION	7
HHHH	LIGHT BOTTOMS	8
HHHH	LIGHT TOPS	9
1423	PHANTOM PRINTING	10
HHHH	SHADOW PRINTING	11
HHHH	SLUR	12
HHHH	STROKE WIDTH (NARROW and WIDE)	13
HHHH	VERTICAL REGISTRATION	14
HHHH	VOIDS	15
HHHH HHHH HHHH	WIGGLERS	16

Figure A-1. Print Quality Glossary of Terms



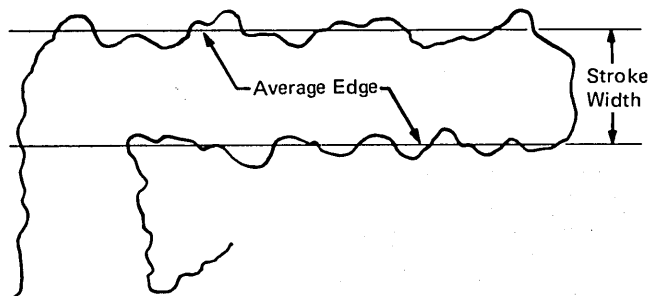
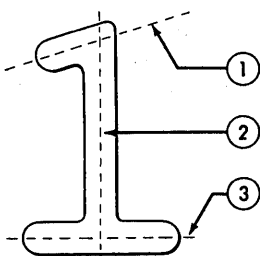


Figure A-2. Average Edge and Stroke Width



The three strokes that make up the character "One" are drawn by the dotted line.

Figure A-3. Character Stroke

### A.1.5 Extraneous Ink

Extraneous ink (or other particles) is any spot appearing within the reading area not between the average edges of the character (see Figure A-1, Item 6). This condition (Figure A-4) can be caused by streaks, smears, or splatter. No extraneous ink (or particle) whose area is equal to or greater than a half-cell area is acceptable (Figure A-5).

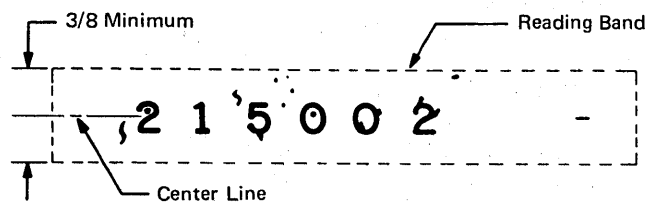


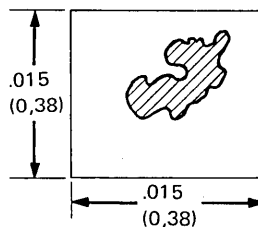
Figure A-4. Extraneous Ink

### A.1.6 Phantom Printing

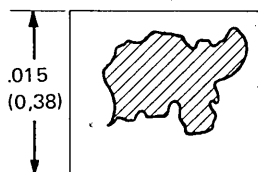
Phantom characters are usually found when printing on very stiff documents, such as card stock. They occur when a sequence, such as \*1xx3xx5, is printed, and occur because the machine options every third train character to every fourth hammer. See Figure A-1, Item 10. The phantom in this example is a 2 halfway between the 1 and 3.

If phantoms are suspected, a simple test can verify this by printing \*1xx3xx5xx and examining the blank spaces for 2, 4, etc.

\*x = any character



Because the extraneous-ink blotch in cell area 1 is less than half the area of the cell, it is not recognized and, therefore, is acceptable.



The ink blotch in cell area 2 is greater than half the cell area and is not acceptable.

This also applies to the "stringing out" of characters.

NOTE: 407-1 cell area = .01875 x .01875 (0,476 x 0,476)

407 - 1 Cell Areas

Figure A-5. Extraneous Ink and Cell Areas

If UCS feature is installed, a reduction in phantoms can be obtained by rearranging type slugs, thereby breaking up two-thirds of the phantom combinations.

To assist in this area, intersperse numeric and alphabetic slugs. The following is suggested for an AN arrangement:

Example: 123-GHI-456-JKL-789-MNO-0#@-PQR

Individual applications may dictate modifications to these.

See *IBM System/360 BPS Utility Program Operating Guide, Program Number 360P-UT-048, SC24-3396* for assistance in punching a new train image card deck with which to load the UCB.

Note: Throughput is affected by rearranging the type slugs. The chances of throughput being increased or decreased slightly are about equal.

### A.1.7 Voids

A stroke void in a character (Figure A-6) is a light spot that is completely surrounded by ink.

A character void (Figure A-6) is a light spot that is not completely surrounded by ink (see Figure A-1, Item 15).

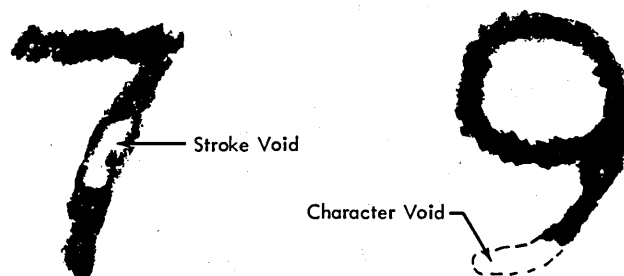


Figure A-6. Voids

### A.1.8 Slur

A slur is ink that is not a part of the average character outline. Smears, phantom printing, etc., are also included in this category (Figure A-1, Item 12).

## A.2 PRINT QUALITY MEASURING DEVICES

Two types of gauges are available for measuring print quality.

### A.2.1 Pocket Comparator

An integral part of this device (part 451595) (Figure A-7) is an engraved reticle containing the outlines of all the readable characters plus the outline of the permissible size of extraneous particles. Figure A-8 illustrates the 407-1 reticle (part 451596); and a 1428 reticle (part 451995) are also available. With this device you can observe whether or not the confines of the character are within the minimum and maximum character stroke widths. Detailed instructions accompany this device.

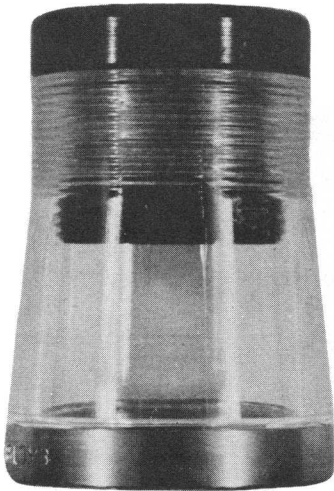


Figure A-7. Pocket Comparator

### A.2.2 Document Registration Gauge

The document registration gauge (Figure A-9) can be used to:

1. Locate printing properly on the document.
2. Check the character shape and stroke width.
3. Determine whether any extraneous particles are in the character-sensing strip (reading band).
4. Check for line skew (printed line must be parallel to the base line  $\pm 2^\circ$ ).
5. Check for proper character pitch and spacing (maximum character pitch is ten characters per inch).
6. Check the printing for proper vertical and horizontal registration.
7. Check preprinted vertical field marks for proper size and placement (a character cannot be located closer than .100 in. (2, 5 mm) to a preprinted field mark).
8. Check for proper layout and any mark-reading formats.
9. Check the relationship of the timing mark to the marking zone.
10. Define minimum clear areas between mark-read columns.
11. Permit measurement of dimensions and placement of the timing mark.
12. Check pen and pencil marks in the mark-read column for size and placement.

Specific instructions accompany the gauge. The document registration gauge for the 1418 is part 451590; for the 1428, part 451990. By using the pocket comparator and the document registration gauge, specific print faults can be identified. Observe the stroke width especially.

Character stroke width should measure .010 in. (0, 25 mm) through a .018 in. (0, 46 mm), except that a maximum of 25% of the stroke can range from .008 in. (0, 2 mm) through .022 in. (0, 6 mm). This recognizes that ribbon printing, when viewed through a magnifier, appears ragged and lacks sharpness of edge definition.

Figure A-10 illustrates character stroke width conditions.



Figure A-8. 407-1 Reticle for Pocket Comparator

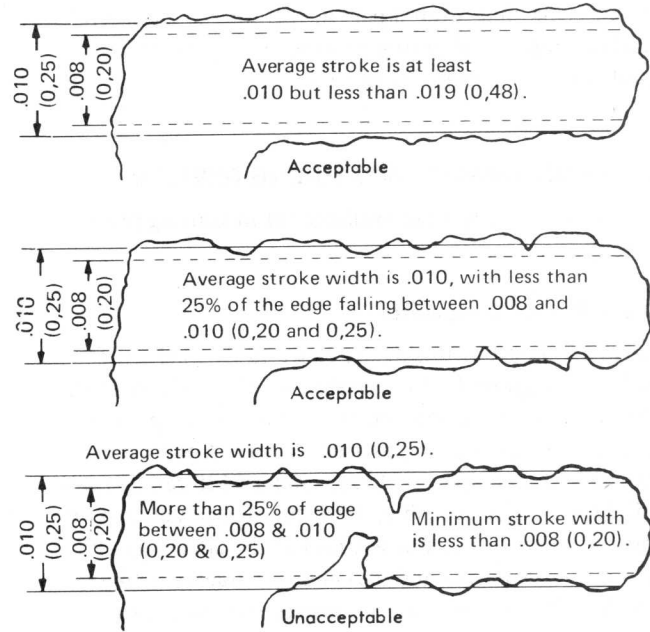


Figure A-10. Stroke Width Conditions

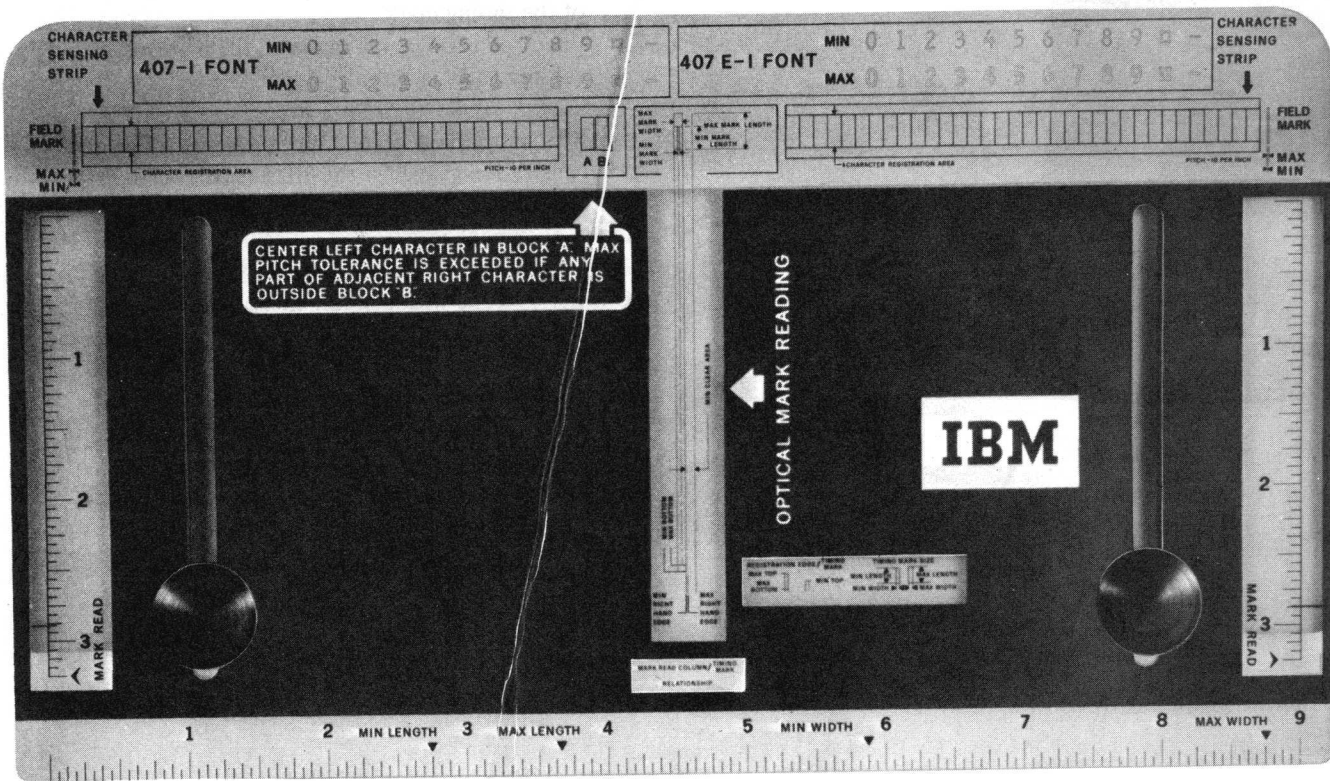


Figure A-9. Document Registration Gauge

## Appendix B. Specifications Summary

Maximum Printing Speed (LPM)	1100
Train Motor Speed (RPM)	3600
Train Velocity (IPS)	206
Time Required for Type to Move .001" (Microseconds)	5.0
Timing Disk Speed (RPM)	1714
Time of Carriage Start Impulse	Print SS-1 of Print Scan 46
Time Required to Print One Line with Single Space (Milliseconds)	54.54
Carriage Interlock Time (ms)	20.8
Carriage Type	Dual Speed