

IBM

Customer Engineering
Reference Manual

1402 Card Read-Punch

IBM® **Customer Engineering** **Reference Manual**

1402 **Card Read-Punch**

Preface

The maintenance information in this manual pertains to all models, 1, 2, 3, 4, 5, and 6, of the IBM 1402 Card Read Punch. The adjustments and procedures affect all models unless specifically identified.

Sixth Edition

This is a reprint of 231-0002-4 incorporating changes released in the following FE Supplement.

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

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IBM 1402 Card Read-Punch

Section 1. Introduction

Installation Procedure

1. Remove shipping braces, tape, plastic cover from relay gate and blocks under feed shock mounts.
2. If lower magazine throat has two flat springs skip to Step 3. If the lower magazine throat has a mirror finish:
 - a. Remove front and rear covers from sides of hopper casting.
 - b. Loosen screw at bottom of each flat spring and lift out file feed filler. See Figure 1-1.
 - c. Remove clip from stud on each support plate.
 - d. Remove tape, holding pivot pins in upper magazine. Move pins flush with upper magazine slides.
 - e. Hold upper magazine in vertical position; set into lower magazine so pivot pins are under fingers of lower magazine.
 - f. Place upper magazine struts on studs. Replace clips.
 - g. Slide pivot pins into support plate holes.
 - h. Tighten screws.
 - i. Replace file feed filler and covers.
 - j. Go on to Step 4.
3. If the lower magazine throat has two flat springs:
 - a. Remove two covers from sides of hopper casting.
 - b. Loosen screw at bottom of each flat spring and lift out file feed filler. See Figure 1-1.
 - c. Remove clip from stud on each support plate.
 - d. Hook magazine struts over studs and replace clips.
 - e. A split shaft, held by a set screw, is located just above file feed drive shaft. Slip both halves of shaft to center, inside of casting.
 - f. Put upper magazine in place and slide both halves of shaft from center so they hold magazine in place. Ends of split shaft should be flush with end of magazine holes.
 - g. Tighten set screw to secure split shaft.
 - h. Replace file feed filler.
 - i. Replace two covers.
4. Examine all relays (without removing) for displaced armatures.
5. Trip clutches and crank machine by hand, checking for binding conditions in feeds or card transport.
6. Install shroud 609386 on cable junction box.
7. After installing main line cord through bottom of machine, check that cable clamp is fastened securely to bottom plate of machine.
8. Check power supply voltages at CE Panel.
9. Check covers for proper fit and appearance.
10. Check operation of file feed. Adjust file feed delay resistor on relay gate so approximately a two-inch stack of cards enters hopper before feeding begins.
11. Run test decks to verify machine operation.

Specifications

Speed

READ FEED

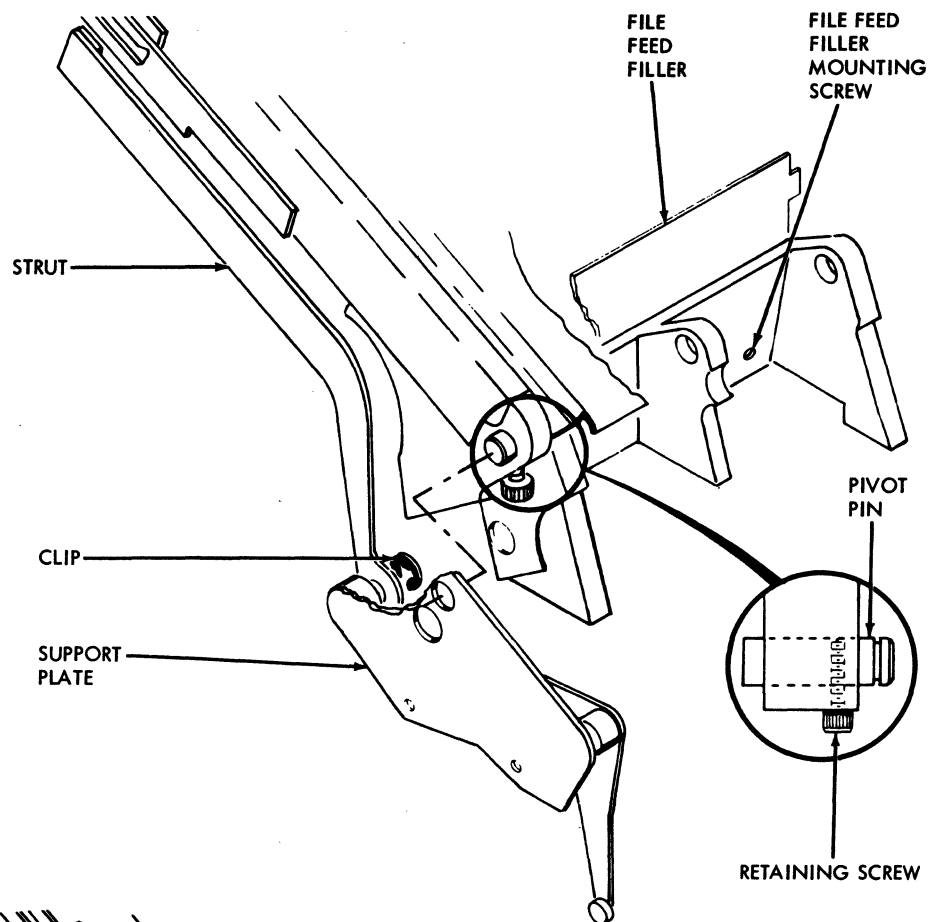
Models 1 & 3: Adjust motor pulley for $800 \pm 3 - 20$ cpm.

Model 2: Adjust motor pulley for 800 ± 15 cpm.

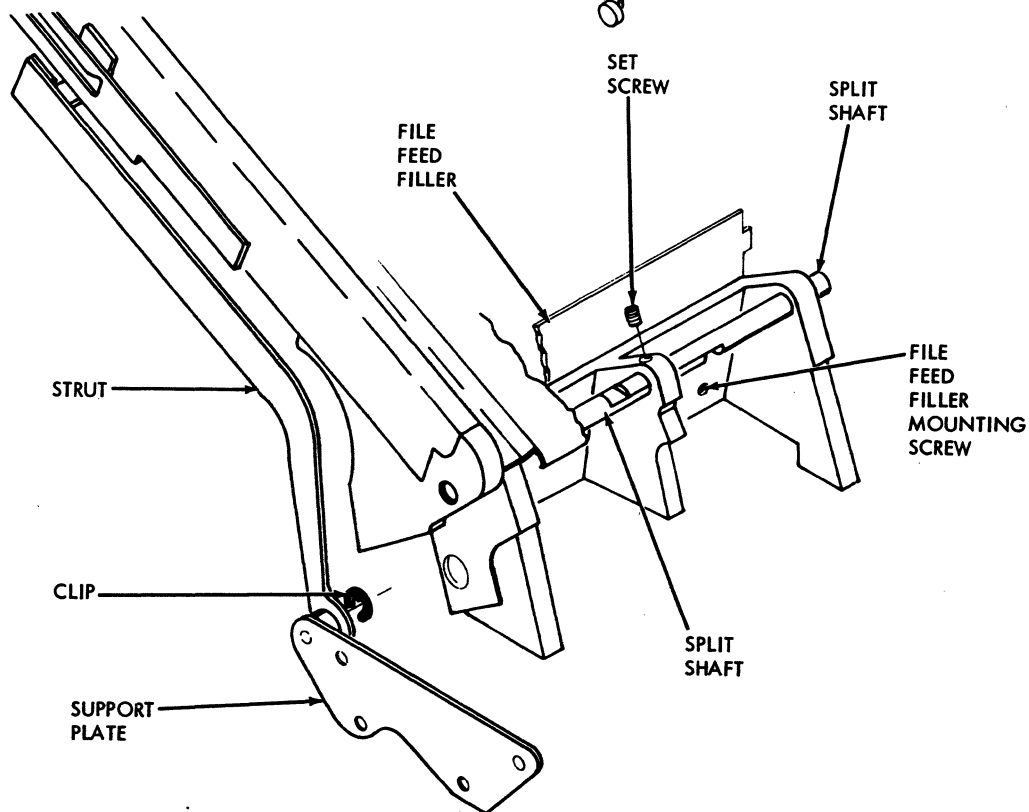
Models 4, 5, and 6: Adjust motor pulley for $450 \pm 2 - 15$ cpm.

PUNCH FEED

Adjust motor pulley for 250 ± 3 cpm.



NEW STYLE



OLD STYLE

Figure 1-1. File Feed Tray Mounting

Section 2. Preventive Maintenance

The prime objective of any maintenance activity is to provide maximum machine availability to the customer however; adjustments should not be made unless necessary.

Be visually alert for trouble indications any time you service the machine. Look for corrosion, wear,

cracks, burnt contacts, loose connections and clogged filters.

The three basic steps of preventive maintenance are to clean, lubricate, and inspect. Figure 2-1 shows recommended preventive maintenance routine.

Apply lubrication only in the quantity necessary to supply the immediate area involved. Wipe off excess.

CODE U R	LOCATION OPERATION	FREQ. MO.	LUBRICATE - CLEAN	OBSERVE
4	PUNCH FEED	3	CLEAN AND VACUUM FEED. LUBRICATE CONTACT AND FEED ROLL HANGER PIVOTS, ALL CLUTCH PIVOTS. . . . #9 LOWERING FRAME SLIDING SURFACES AND CAMS #17 LUBRICATE GEARS, ALIGNER CAMS. FEED ROLL OPENING CAM, PICKER KNIFE CAMS, PUNCH CLUTCH LATCH CAM, EXTENSION SPRING ENDS, PUNCH CLUTCH ARMATURE LATCH PIVOT. #17	BRUSHES FOR WEAR AND DAMAGE BRUSH TIMING PUNCH REGISTRATION BELT WEAR
	STACKER TRANS- PORT		CLEAN AND VACUUM TRANSPORT. LUBRICATE CARD PUSHER SLIDE CAM FOLLOWERS. #9 LUBRICATE CARD PUSHER SLIDE SPRING ENDS AND CAMS . #17 LUBRICATE STACKER JOGGLER CLUTCH SPRING GREASE FITTING. #20	BELT WEAR
0	FILTER			REPLACE IF DIRT IS VISIBLE FROM INSIDE
	MUFFIN FANS			MODEL 1: -20V SUPPLY; EARLY STAGE 2, 3V SUPPLY MODEL 2: -20V, +12V SUPPLIES (ONE FAN), -12V SUPPLY MODEL 3: PUNCH MAGNET DRIVERS (SMS GATE)
1	READ CLUTCH		LUBRICATE ARMATURE PIVOT AND LINK. #6 LUBRICATE LATCH, KEEPER, LOAD PAWL, DETENT PAWL, AND INTERMEDIATE ARM PIVOTS. #17 LUBRICATE ARM, KEEPER, LATCH, AND CLUTCH RATCHET WORKING SURFACES. #17 LUBRICATE CLUTCH NEEDLE BEARING AND REVERSE LOCK GREASE FITTINGS. #17	DETENT PAWL, KEEPER, LATCH, AND RATCHET FOR WEAR EXCESSIVE CLUTCH BACKLASH WHILE ENGAGED CLUTCH PULLEY SHOCK MOUNT FOR LOOSENESS
	READ FEED		CLEAN AND VACUUM FEED. LUBRICATE FEED ROLL HANGER PIVOTS AND ALL OTHER PIVOTS. #6 LUBRICATE GEARS, PICKER KNIFE CAM, EXTENSION SPRING ENDS. #17	BRUSHES FOR WEAR AND DAMAGE BRUSH TIMING BELT WEAR
2	FILE FEED		LUBRICATE CAM FOLLOWER ARM JOGGLER PIVOTS. . . . #9 LUBRICATE ALL OTHER PIVOTS #6 LUBRICATE FRONT JOGGLER SPRING ENDS, GEAR JOGGLER, CAMS, ADJUSTING SCREW SURFACES, CLUTCH LATCH CAM SURFACE, SIDE JOGGLER SIDE RETURN SPRING. #17 CLUTCH GREASE FITTING. #20	CLUTCH OVERTHROW BELT WEAR FEED ROLLS FOR GLAZE

Figure 2-1. 1402 Preventive Maintenance Routine Chart

CODE U R	LOCATION OPERATION	FREQ. MO.	LUBRICATE - CLEAN	OBSERVE
---------------	-----------------------	--------------	-------------------	---------

3		CB'S		LUBRICATE CB ARM PIVOTS AND ROLLERS #9	CONTACT CONDITION AND MOVEMENT CHECK TIMING OF CB'S CONNec- TED TO CE SERVICE PANEL
6		PUNCH	3	SEE NOTE 1. REMOVE FELT WICK AT TOP OF PUNCH UNIT AND LUBRICATE SIX OIL LINES. #9 LUBRICATE LATCH WICK, LINK PIVOTS #9 LUBRICATE STRIPPER CAVITY (SEE NOTE 2), LATCH SPRING, HOOKS, ARMATURE PIVOTS, SETUP BAIL CHANNEL, CAM SURFACES. #17 LUBRICATE NEEDLE BEARING GREASE FITTINGS, DIE LOCATING STUDS. #20	CHECK CAM FOLLOWER ADJUSTMENTS CHECK PUNCH BAIL AND SETUP BAIL FOR EXCESSIVE WINK. (SHOULD NOT EXCEED .010" IN VERTICAL PLANE WHEN CAM FOLLOWERS ARE HELD TIGHT AGAINST CAM.) CHECK TOP OF 80-MAGNET CORES FOR DIRT OR RUST CLEAN IF NECESSARY
5		GENEVA		FILL GENEVA HOUSING TO LINE IF OIL WINDOW IS RIGHT OF DRIVE PULLEY. #9 FILL GENEVA HOUSING TO 1/16" ABOVE LINE IF OIL WINDOW IS LEFT OF DRIVE PULLEY. #9 DRIVE GEARS. #17	CHECK GEAR WINK CLEARANCE CHECK FOR EXCESSIVE INTERNAL BACKLASH IN THE GENEVA MECHANISM ON AT LEAST TWO INTERMITTENT CYCLES BY HOLD- ING THE INPUT PULLEY AND ROCKING INTERMITTENT ROLLS BACK AND FORTH. CHECK FOR LOOSE PINS
7		DRIVE MOTORS	6	FILL DRIVE MOTOR OIL CUPS. #9	
8		GENEVA	12	REPLACE GENEVA OIL. #9	
		BASE		LUBRICATE COVER LATCHES AND OPERATING SURFACES #17	

NOTE 1: WITH THE REDESIGNED PUNCH FEED IT IS NOT NECESSARY TO REMOVE PUNCH UNIT TO LUBRICATE. HOLES HAVE BEEN PROVIDED IN THE SIDE FRAME SO ALL GREASE FITTINGS ARE ACCESSIBLE.

NOTE 2: BE SURE GREASE COMES OUT AROUND 1ST AND 80TH PUNCHES.

Figure 2-1. 1402 Preventive Maintenance Routine Chart (Cont.)

Section 3. Servicing Procedures

Read Feed

Timing Belts

All read feed belts, except the clutched feed roll drive belt, captive on some machines, are easily replaced and require no timing.

ADJUSTMENT

Belt, pulley, bearing, and shaft life will be increased if correct belt tension is maintained. The one pound (450 grams) pressure indicated in Figure 3-1 can be measured by using gram gage 450459 and X10 blade. When using the gram gage, the pointer must be as

near the midpoint of belt width as possible.

Clutched Feed Roll Drive Belt

This procedure is necessary only if the belt is captive.

REPLACEMENT

1. Remove solar cell unit.
 - a. Remove plastic cover, disk mounting screw, and disk.
 - b. Loosen three set screws in solar cell mounting plate. These screws retain the mounting plate to three spacer studs mounted in machine side frame. Carefully remove solar cell unit, and allow it to swing out of working area.

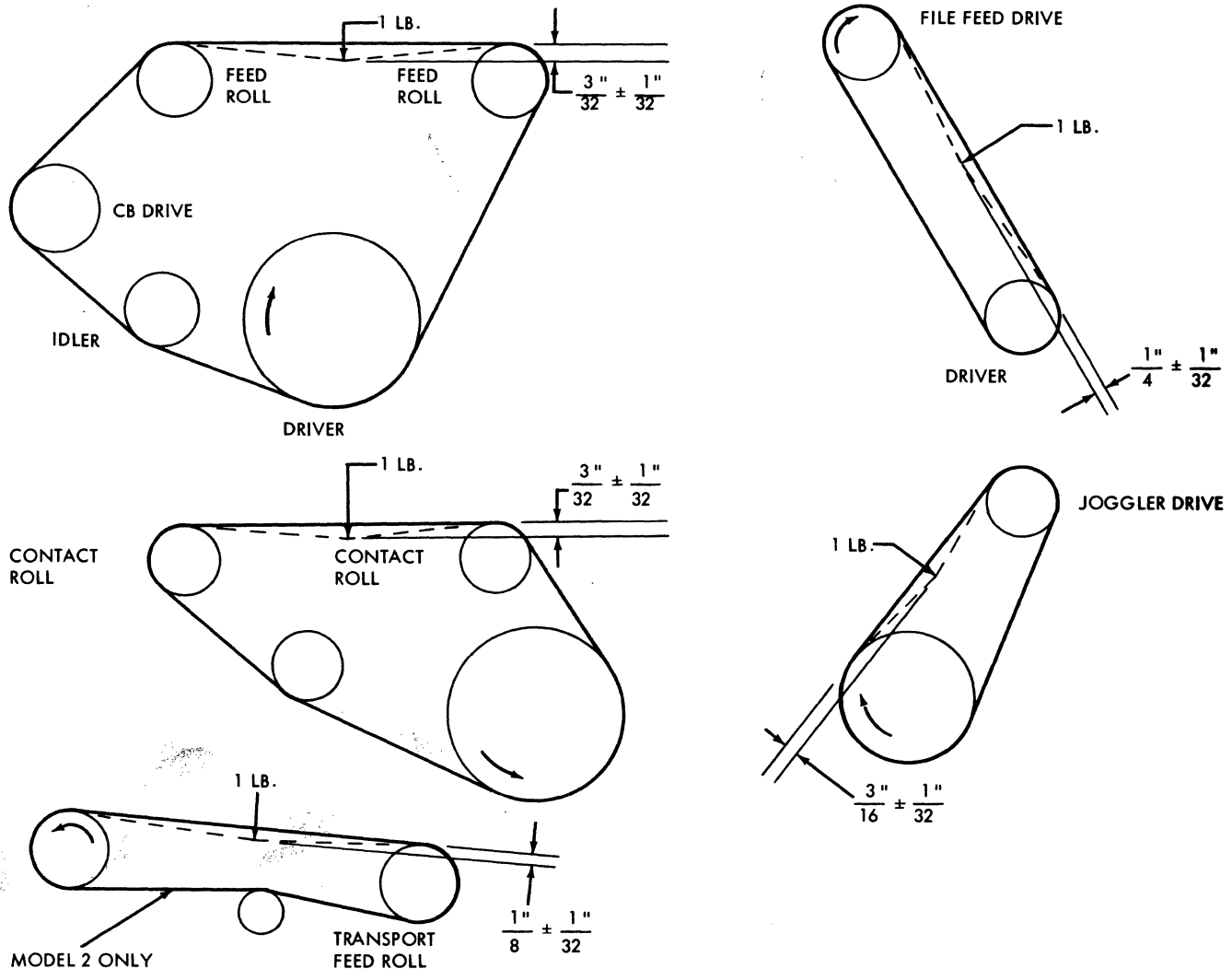


Figure 3-1. Reader Timing Belt Adjustments

2. Loosen idler pulley. Install belt and tighten with idler pulley.
3. Loosen picker knife camshaft drive pulley.
4. Trip clutch by hand and turn index to 216° for three-group brushes, or 212° for two-group brushes. Place card against first feed rolls, and manually turn picker camshaft in normal machine direction until feed knives touch card. Tighten pulley locking screws. This is a reference point. Check brush timing with timer index, and shaft picker camshaft to get proper timing.

NOTE: Any change in picker knife timing will directly affect RLCBs and solar CB.

5. After brushes are in time, reinstall solar cell unit.
 - a. Remount solar cell mounting plate flush against shoulder of three studs and tighten three set screws, located in mounting plate.
 - b. Reinstall disk, and slightly tighten mounting screw. Be sure disk is located in center of solar cell mounting block. If care has been taken in removing and reinstalling cell unit and disk, it will be located in same place (in reference to cell mounting block) as it was originally. See Figure 3-2.
6. To retune solar cell, refer to *Electrical Components, Solar Cell CB, Timing Procedure*.
7. At this point, it may be advisable to time RLCB's to ensure proper tolerance.

Reader Clutch

Adjustments of the reader clutch are the same on all models. Model 1, with Early Read special feature, uses a six-tooth ratchet clutch. The Early Read feature is standard on the Model 3, 4, 5, and 6. A two-tooth ratchet is used (standard) on other models.

Caution: Be sure the clutch is latched up when you finish working on it. Nipping and possible machine damage will result if the clutch is not latched.

The reader clutch can be adjusted either in machine or when clutch drive unit is removed. Steps 1-4 should

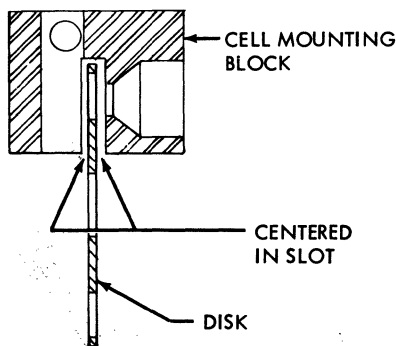


Figure 3-2. Disk Centering

be performed only when a new clutch assembly is installed, or when complete adjustment is to be made to center plate assembly and clutch magnet assembly. When a complete adjustment is to be made, the read clutch locating plate gage 610147 must be used.

NOTE: Use of this gage will ensure a parallel condition, at latch-up time, between drive arm latch surface and latch. If adjustments are to be made only to the armature, latch, and magnet, begin at Step 5.

ADJUSTMENTS

1. Remove clutch pulley assembly. See *Clutch Pulley Assembly, Removal*.
2. Remove latch keeper and latch from center plate assembly. See Figure 3-3.
3. Position locating gage on center plate assembly studs and clutch pulley shaft with positioning block loose. See Figure 3-4. Secure positioning block against bottom of center plate assembly as far to left as possible (Figure 3-3). Remove gage.
4. Reinstall latch keeper, spring, and latch. Follow *Clutch Pulley Assembly, Installation* for reassembly of clutch pulley assembly. See Figure 3-3.
5. Adjust armature pivot bracket to maintain .002" to .005" clearance between armature and core. See Figure 3-3.
6. There should be .020" to .022" clearance between armature and yoke with latch against backstop. See Figure 3-3B.
7. Hold armature attracted, and remove slack from linkage by pushing latch toward drive arm (Figure 3-3B). Position center plate assembly on positioning block to get slight drag on .008" feeler gage between latch and clutch drive arm. Tighten center plate assembly mounting screws. There should be at least 75% of latch in contact with drive arm assembly in latched condition.
- NOTE: Be sure to keep center plate against positioning block.
8. Loosen positioning block mounting screws and position block as far right (ear of locating block against plate) as possible. Lock mounting screws.
9. Adjust center eccentric keeper stop stud to obtain .000" to .020" between clutch drive arm and latch keeper at latch time. See Figure 3-3C.
10. Check for .002" clearance between step on ratchet and detent (backlash) with clutch engaged. If there is more than .002" clearance, install a longer detent.

NOTE: Seven new detents, 609737 through 609743, are available in .002" progressions. These detents are etched 1 through 7.

TIMING

This adjustment ensures that read feed dynamic timer is in time with clutch at engaging time.

1. Block the clutch armature attracted.
2. Crank machine and listen or feel for latch keeper to fall behind drive arm. This should happen at $315^\circ \pm 1^\circ$.
3. If index is not at $315^\circ \pm 1^\circ$ when latch keeper falls behind drive arm, loosen clamped hub on index drive shaft and turn index to 315° .
4. Tighten clamped hub.

NOTE: If timer index is moved, brush and CB timing will have to be checked.

Clutch Pulley Assembly

The clutch pulley includes the dogs and arms.

REMOVAL

1. If same clutch assembly is to be used, spot mark clutch pulley and picker knife cam shaft pulley to belt to retain RLCB's, solar CB, and picker knife timing.
2. Remove file feed drive belt.
3. Loosen clutch pulley belt idler.
4. Remove grease fitting on end of clutch shaft.
5. Loosen retaining clamp and remove clamp and file feed drive pulley together.
6. Remove clutch pulley drive belt.

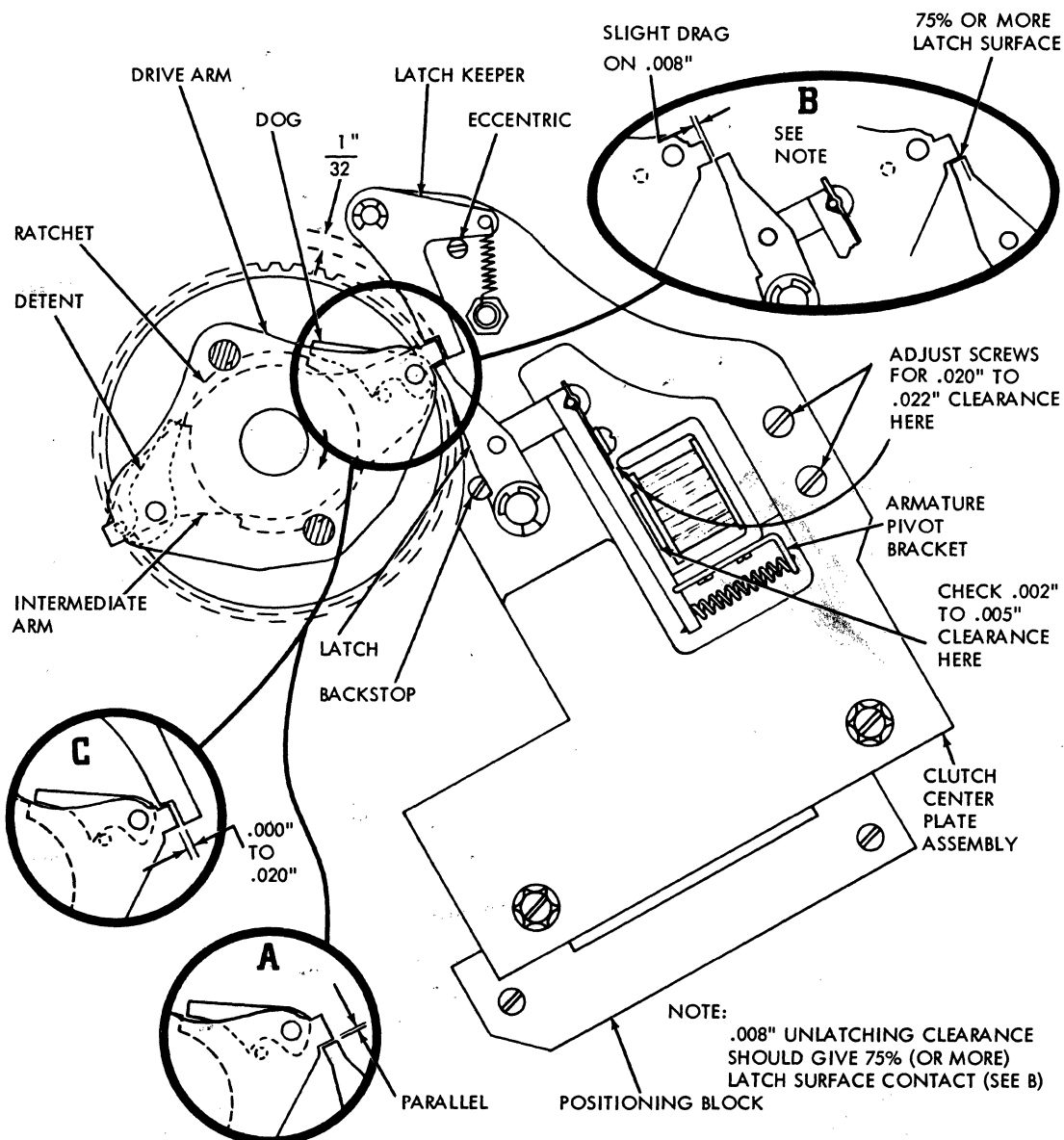


Figure 3-3. Reader Clutch Adjustments

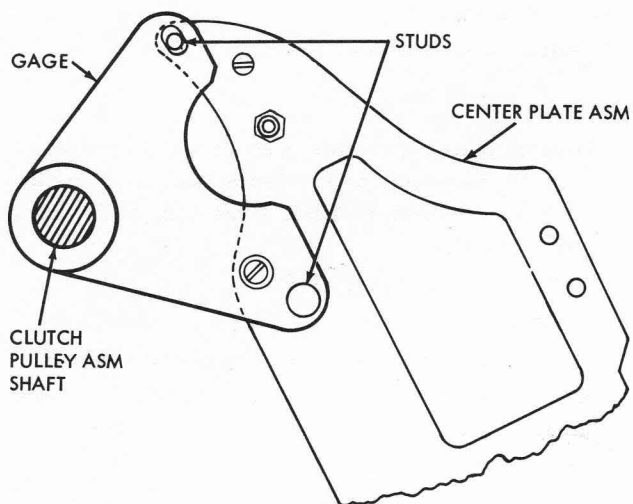


Figure 3-4. Latch Assembly Plate Alignment

7. Remove clutch pulley assembly. It may be necessary to loosen V-belt input pulley and move it towards the end of its shaft. See Figure 3-5.

INSTALLATION

When a new clutch pulley assembly is installed, the procedure listed under *Reader Clutch, Adjustment* should be performed.

1. Be certain that two thrust bearings (washers) are on shaft against clutch ratchet.
2. Install clutch pulley and operate the arms so that detent and dog fit into high dwell of ratchet.
3. Place two thrust bearings against clutch pulley.
4. Install clutch retaining clamp (and file feed pulley) allowing no end play of pulley.
5. Install clutch pulley belt with spot marks lined up; adjust idler.
6. Install grease fitting and file feed drive belt.
7. Reposition V-belt input pulley, if moved.
8. Check picker knife, RLCB's and solar CB timing.

Clutch Drive Assembly

REMOVAL

1. Inscribe lines along one end and side of unit to maintain front-to-rear and side-to-side location.
2. Remove dynamic timer index.
 - a. Remove screw from hand crank.
 - b. Remove two screws from index base.

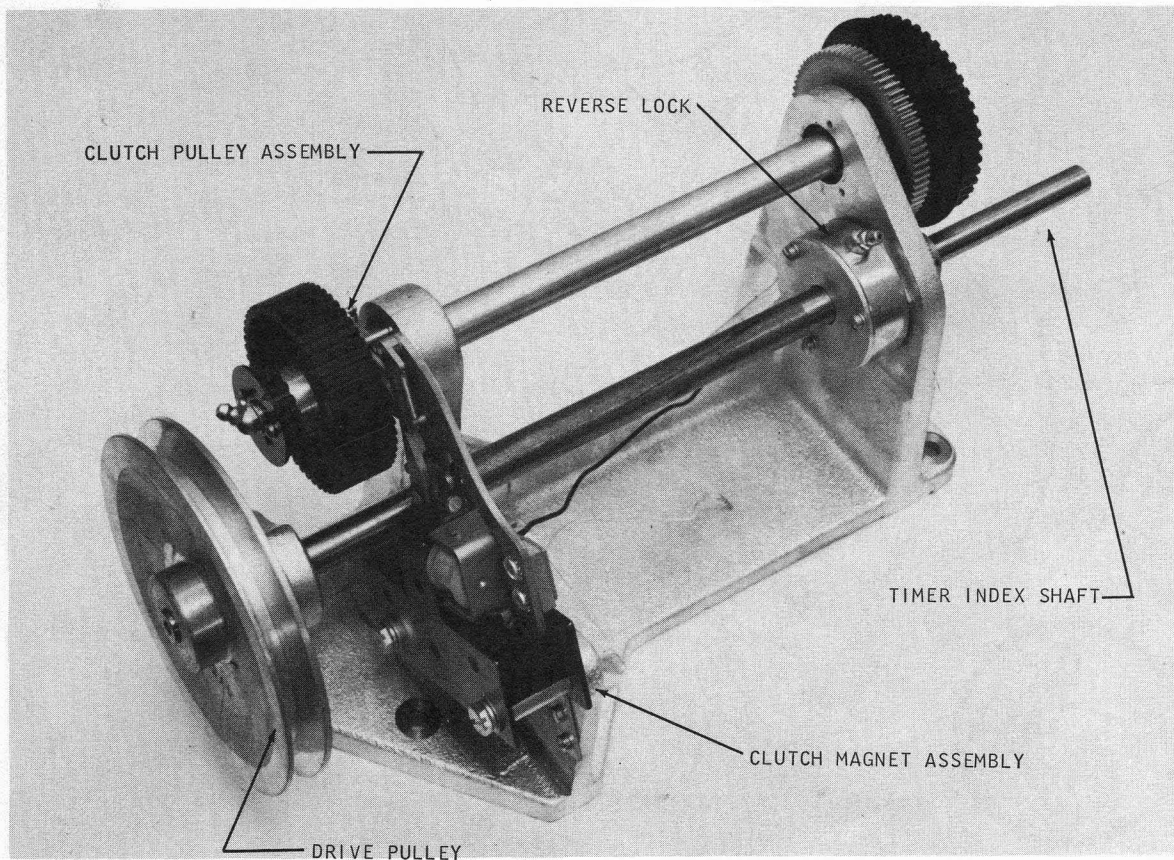


Figure 3-5. Clutch Drive Assembly

- c. Loosen clamped hub on index shaft.
 - d. Unplug index cable.
3. Remove four drive belts.
 - a. Contact roll drive (front).
 - b. File feed drive (rear).
 - c. Motor drive (rear).
 - d. Clutched feed roll drive.
4. Remove clutch magnet leads at terminal block.
5. Remove four hex-head clutch drive assembly mounting screws.
6. Remove assembly through rear of machine.

INSTALLATION

1. Set drive assembly into position from rear of machine.
2. Install four drive assembly mounting screws. Do not tighten.
3. Position clutch drive assembly on scribed lines. Tighten mounting screws.
4. Install dynamic timer index. Leave clamped hub loose.
5. Set index to $315^\circ \pm 1^\circ$. Block armature and crank machine until detent keeper falls behind drive arm. Tighten clamping hub.
6. Install clutch drive belt and adjust idler pulley. Loosen picker knife camshaft pulley locking screws.
7. Time picker knife camshaft by tripping read clutch and setting timer at 216° for a 3-group brush, or 212° for a 2-group brush.
 - a. Place a card in the hopper and against first feed rolls.
 - b. Turn camshaft in normal machine direction until feed knives touch the card.
 - c. Tighten pulley lock screws. (This is a starting point for brush timing; refer to wiring diagram for final brush timing.)
 - d. Change picker knife camshaft for proper brush timing by slipping drive pulley on camshaft.
8. Time RCCB's by using set screw-retained gear on the RCCB shaft.
9. Install the other three belts and unblock clutch armature.
10. Check timings.
 - a. Clutch engagement time ($315^\circ \pm 1^\circ$).
 - b. Brush impulse CB timing.
 - c. RCCB timing.
 - d. RLCB timing.

File Feed Clutch

ADJUSTMENTS

1. With clutch latch against latch step on sleeve, loosen split collar and rotate collar backwards until stopped by spring, fully uncoiled, inside of sleeve.
2. Hold split collar in this position and rotate detent gear to $1/16''$ past detent position. Tighten screws in split collar. This adjustment should result in $1/16''$ overthrow. See Figure 3-6.

REMOVAL

1. Remove covers, and upper and lower magazines.
2. Remove drive unit from machine.
3. Mark cams and shaft to maintain relationship. Remove rear pulley and front and rear jogger cams.
4. Remove rear bearing retainer plate.
5. Mark side jogger cam and shaft to maintain relationship.
6. Loosen side jogger cam, clutch hub (with grease fitting), and clutch drive gear on jogger cam shaft. (The set screws are seated in undercuts on shaft and must be loosened a full turn.) Slide shaft out rear of unit.
7. Remove clutch assembly through bottom of unit. The clutch can now be disassembled and spring can be removed.

INSTALLATION

Follow removal steps in reverse order. Be certain clutch latch and detent are in correct positions, and grease fitting is over slot in shaft. The clutch drive sleeve and side jogger cam should hold clutch together, with clutch in full mesh. The sleeve and side jogger cam should not squeeze clutch so tightly as to cause binding when clutch is latched. Check all drive unit adjustments after unit is replaced in machine.

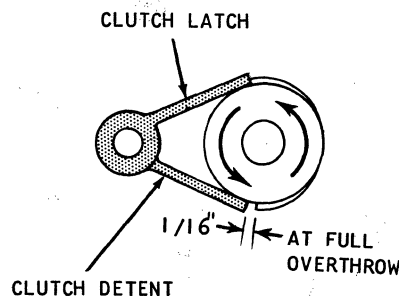


Figure 3-6. File Feed Clutch Adjustments

SERVICE CHECKS

1. The front jogger interlocking arm should have approximately $1/16$ " travel before contact makes.
2. Upper card deck support must be centered between side frames.
3. Front jogger operating levers must be free of binds between side plates and lower magazine.
4. Hopper bed plate springs must be $3/8" \pm 1/16"$ above hopper bed plate.
5. Speed nuts should not interfere with helical spring clutch. Use shims, P/N 603544, to shim lower magazine.
6. If flat springs are used, the lower magazine throat should be .020" to .040" above an imaginary plane determined by the tops of feed rolls. If throat is formed from mirror plate it should be set at .055" to .065" above feed rolls. See Figure 3-7.
7. File feed delay must allow three to five seconds for cards to feed from file into hopper before reader-clutching begins. A variable resistor, R-2, on left bottom corner of the relay gate, is provided for this adjustment.

File Feed Jogger

FRONT JOGGLER ADJUSTMENT

1. Crank file feed drive unit until front jogger cam followers are on low dwell. See Figure 3-8. Fill hopper to just below sensing pads on front jogger, and close jogger. Set adjusting screws on jogger

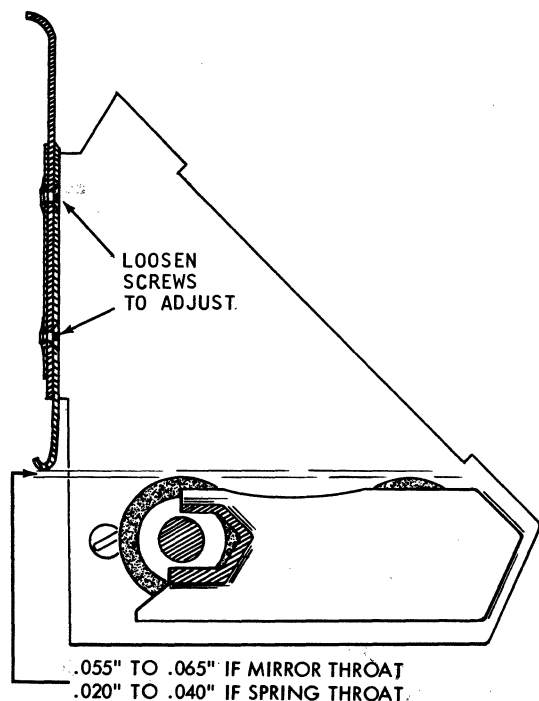


Figure 3-7. Lower Magazine Throat Adjustments

to just touch operating arms.

Under these conditions there should be .003" to .010" clearance between cards and lower end of joggling surfaces (lower end of joggling surfaces are in line with top of card feed knife posts).

- a. On some machines, this clearance is obtained by adjusting hopper post mounting bar by means of set screw. Then, hopper posts have to be adjusted also. Refer to *Hopper Adjustments*.
 - b. On other machines, hopper post mounting bar is pinned in position. The .003" to .010" clearance is obtained by shimming between pivot blocks and mounting bar.
2. Crank file feed drive until front jogger cam followers are on high dwell of cams. Fill hopper with cards until cards are level with top of sensing pads; close jogger. Hold rear cam follower against cam, and continue to operate unit. Stop when .005" to .008" clearance appears between cam follower arm and adjusting screws. Loosen clutch operating lever on its pivot shaft and fully seat clutch latch. With cam follower against cam, position clutch operating lever so it just touches turned-over ear on cam follower arm. Tighten set screws in clutch operating lever to secure it to shaft.

SIDE JOGGLER ADJUSTMENT

1. With a two-inch stack of cards in hopper, crank file feed drive until hopper jogger cam follower is on high dwell of cam. Set adjusting screw for .000" to .005" clearance between the top of deck and jogger arm. See Figure 3-9.
2. With hopper empty, crank machine until side jogger is fully extended.
Caution: There must be enough clearance to allow movement between jogger arm and hopper side plate, or jogger will break.
3. Lift side jogger arm at operating arm. See Figure 3-9. If interference exists, check distance between hopper side plates. See *Hopper and Picker Knives, Adjustment*.

Hopper and Picker Knives

Each picker knife block is fixed on its arm. Two hardened pieces are inserted in the block surface to resist wear. The inserts are ground to specifications. Replacement of picker block is required when insert becomes worn.

ADJUSTMENTS

1. Position picker knife cam followers for a minimum clearance (without binds) over entire periphery

of cams. Maximum clearance must not exceed .006" at any point.

2. Be sure file feed front jogger is adjusted, then shim hopper posts on mounting bar for clearance of .010" to .015" between posts and cards resting against throat knife.
3. With a clearance of $.062" \pm .005"$ between rear hopper side plate and rear side frame, adjust front side plate for .016" to .021" over length of card.
NOTE: This adjustment must center cards between rails in transport area ($5/16" \pm 1/32"$ from front rail).
4. Adjust hopper back plate card guide fingers for .020" to .050" clearance to hopper bed plate fingers. See Figure 3-10.
5. Position feed knife arms evenly on shaft so that

feed edge of picker knife block travels .020" to .030" beyond trailing edge of card when card is held against hopper posts.

6. Position throat roller so step, indicating center line of roller, is lined up with throat knife face.
7. The throat opening should be .0095" go, and .0105" no-go.
8. Time picker knife cams to feed card so the trailing edge of card aligns with face of throat knife at approximately 72° for 2-group brushes, and 75° for 3-group brushes.

NOTE: The preceding is only a reference point for making brush timings. When brushes are on scribed line (refer to *Brush Assembly Adjustment*), retime picker knife cam to obtain proper brush timing. See *Brush Assembly Timing*.

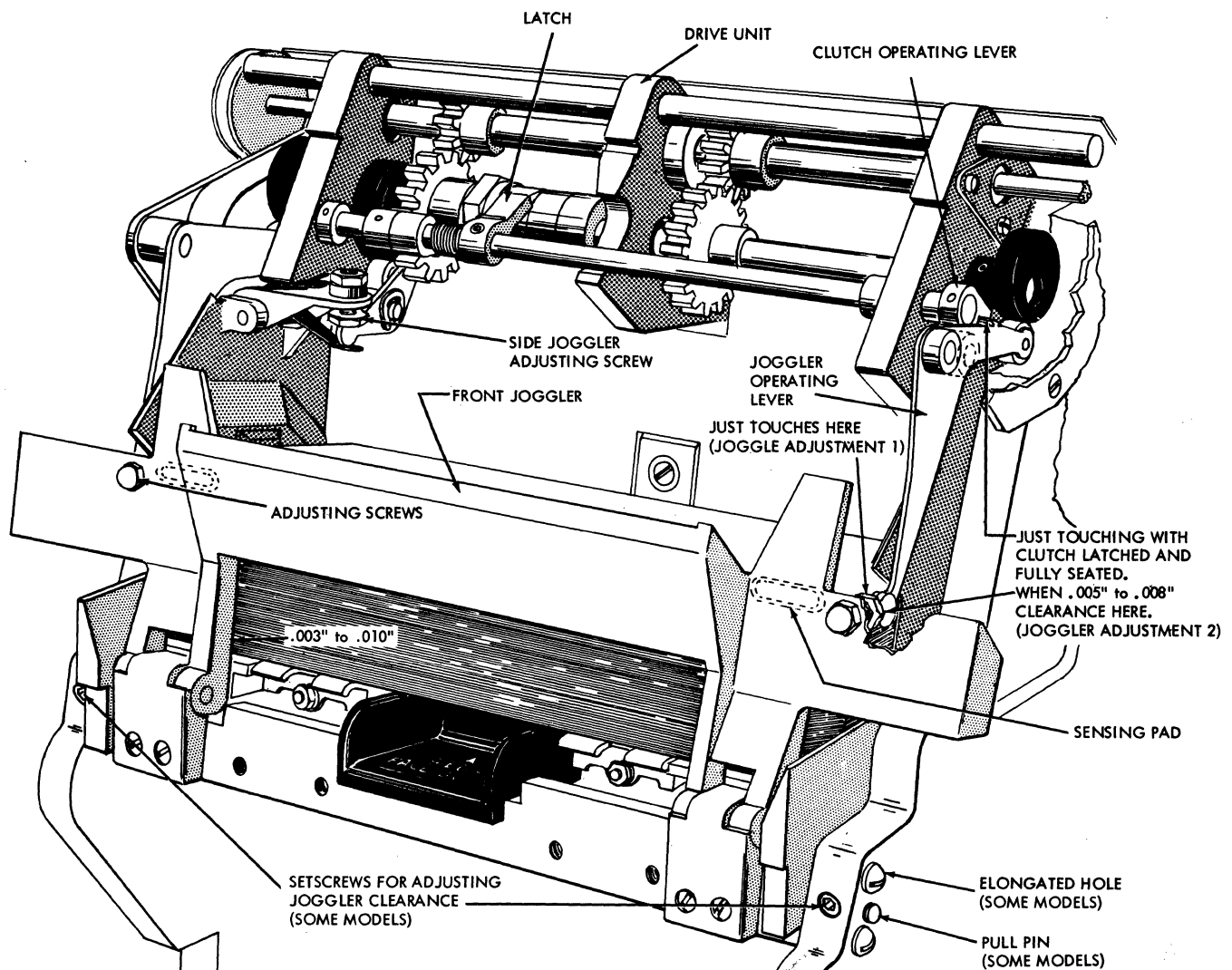


Figure 3-8. File Feed Adjustments

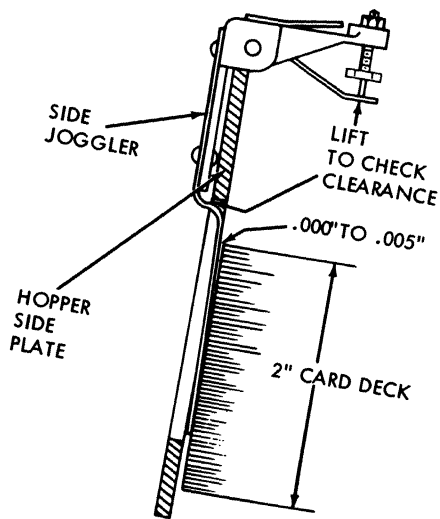


Figure 3-9. Side Joggler Adjustments

Card Weights

The relationship between the three springs on card weight is important in eliminating card misfeeding caused by a bouncing card weight. If the center spring is at high dimension, the two end springs must be set to high dimension. See Figure 3-11.

ADJUSTMENTS

1. Set center spring $15/64$ to $17/64$ below bottom of card weight.
2. Set end springs $7/32$ to $15/64$ below bottom of card weight.

Card Guides

Refer to Figure 3-12 for card guide specifications.

Brush Assembly

ADJUSTMENTS

1. Insert brush assembly into machine and check for $.015"$ to $.040"$ clearance between brush separator and contact roll with end to end variation $.015"$.
 a. Loosen four separator holding screws.

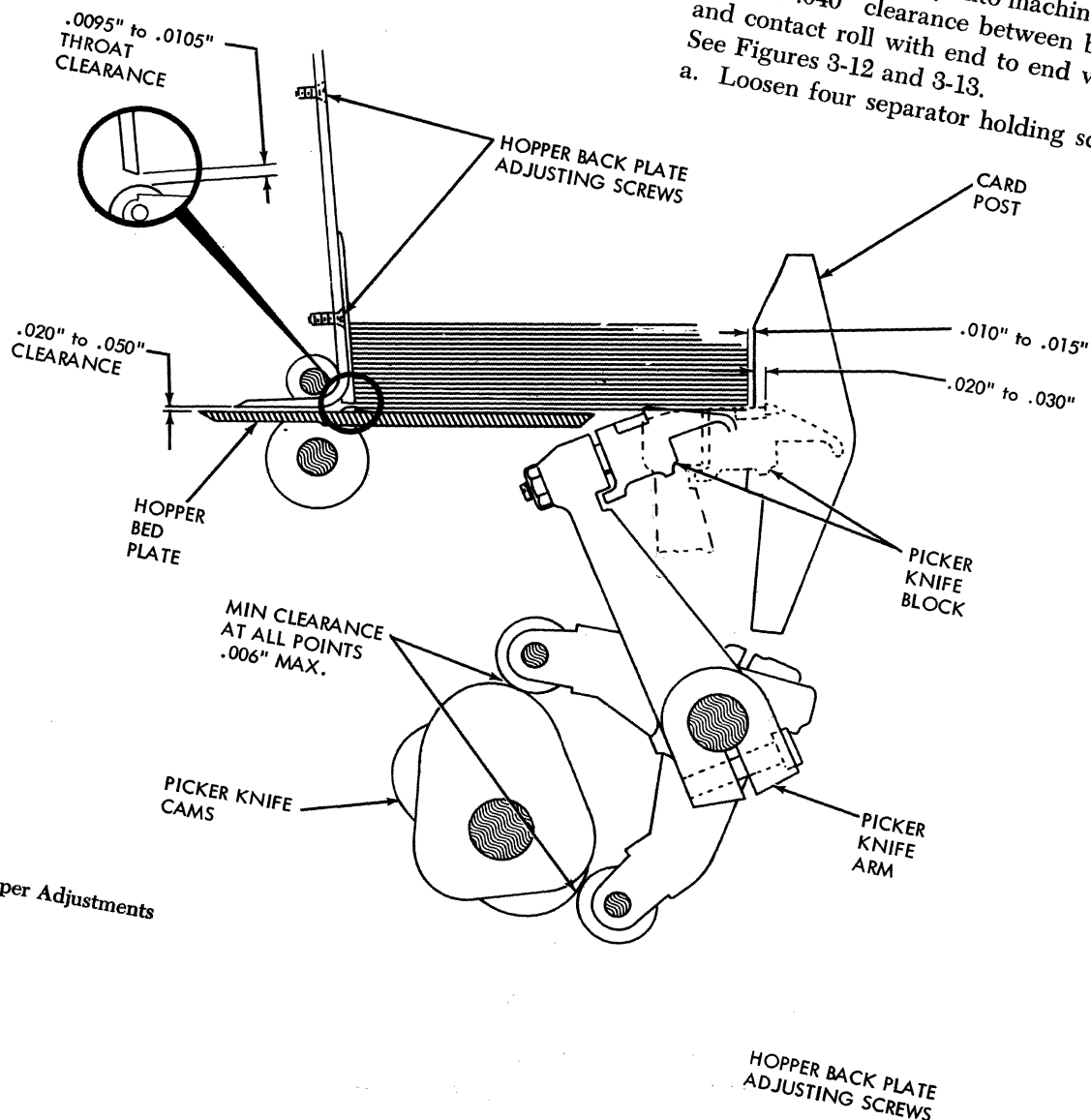


Figure 3-10. Hopper Adjustments

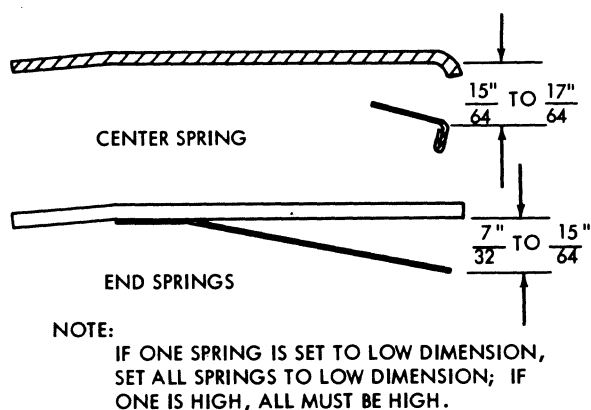


Figure 3-11. Card Weight Adjustments

- b. Place brush assembly in operating position.
 - c. Place .025" feeler gages between ends of separator and contact roll.
 - d. Hold brush separator down to feeler gages and tighten screws.
2. The scribed line (Figure 3-14) shows the best brush-to-contact-roll relationship. Four combinations of brushes and brush separators are in use.
- a. *Three group brushes; one scribed line:* These are used on Model 2 machines and some

Model 1's. Set heel of shortest brush group on scribed line + .030" — .020".

NOTE: + is toward the stacker, — is toward the hopper.

- b. *Three group brushes; two scribed lines:* These are used on Model 2 machines and some Model 1's. Set heel of shortest brush group on scribed line nearest hopper + .030" — .020".
 - c. *Two group brushes; one scribed line:* These are used on Model 3 machines and some Model 1's. Set heel of shortest brush group .050" + .030" — .020" beyond scribed line.
 - d. *Two-group brushes; two scribed lines:* These brushes are used on Models 3 and 4, and on some Model 1 machines. Set heel of shortest brush group on scribed line nearest stacker + .030" — .020".
3. Adjust brush assembly for correct lateral tracking of brushes.
- Caution:* Do not tighten set screws to a point where they bind the retractable frames.
- a. Center brushes in separator with two *Allen-Head setscrews in brush assembly frames.
 - b. With brush assembly in place, adjust screws in machine side frames for correct brush tracking.

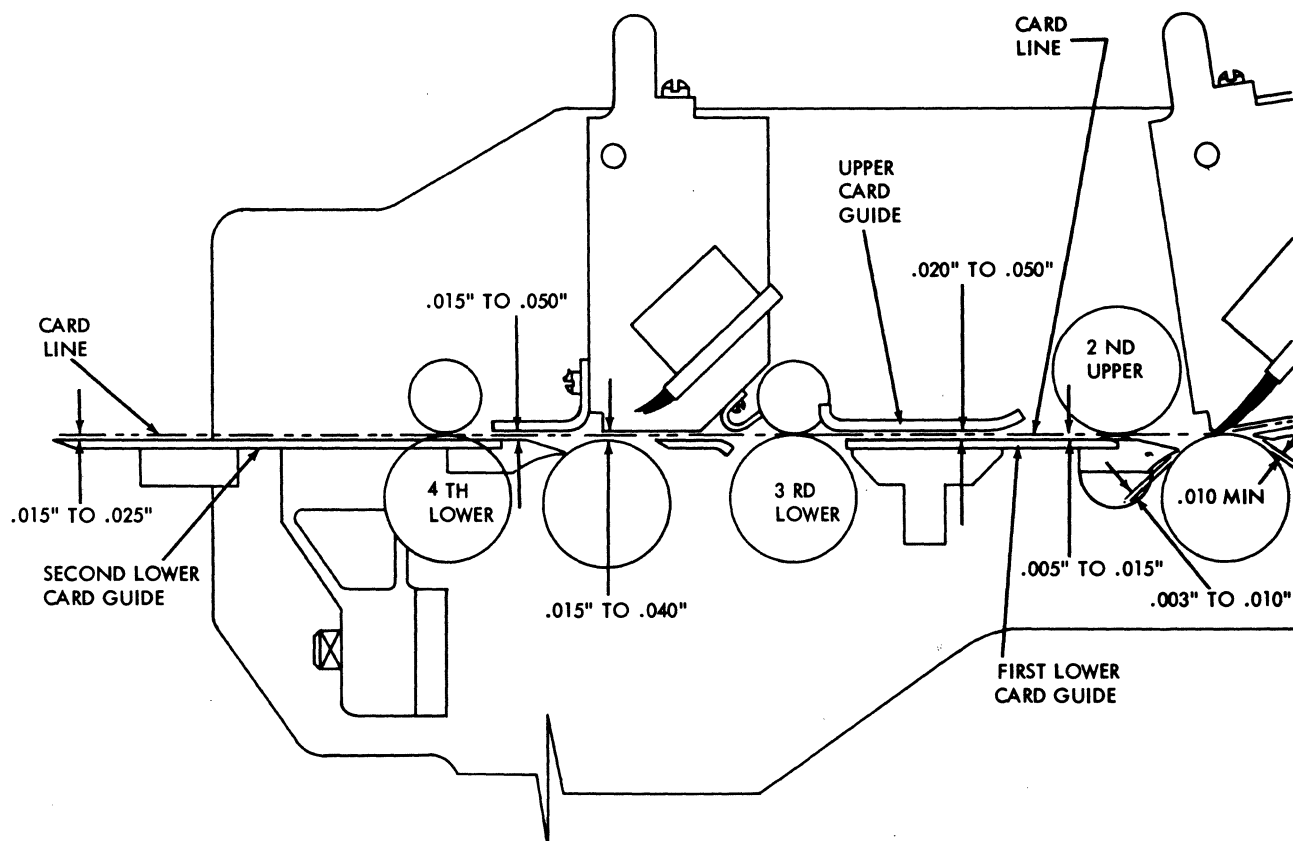


Figure 3-12. Reader Feed Adjustments

*Trade Name of Allen Manufacturing Company, Hartford, Connecticut.

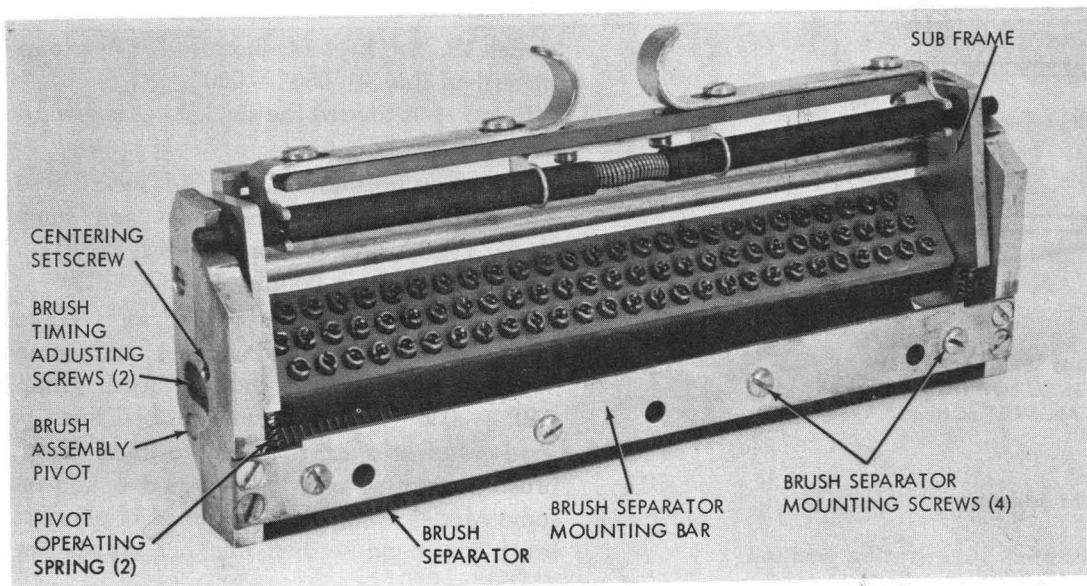


Figure 3-13. Brush Assembly

- c. Allow .003" clearance to prevent binding when brush assembly is removed or replaced.
4. Adjust brush assembly card guide for .015" to .050" clearance to lower card guide. See Figure 3-12.

TIMING

Proper timing establishes the proper relationship of brush to contact roll, punched card hole to brush, and

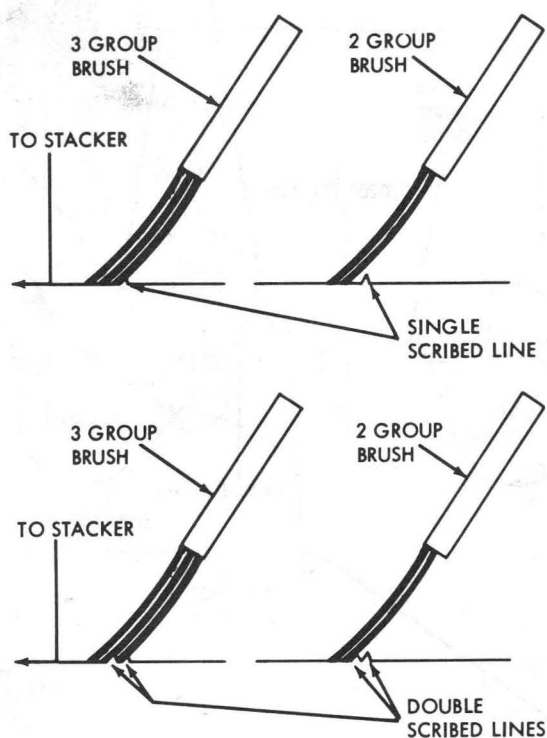


Figure 3-14. Brush Timing

CB impulse to punched card hole.

1. Check that brushes are on scribed line. See *Brush Assembly, Adjustment*.
2. Dynamically check that first and second read stations are 360° apart. If not, correct brush block on which brushes are furthest from scribed line.
3. Dynamically time brushes to wiring diagram by shifting picker knife timing. Do not time brushes by shifting them off scribed-line limits.
 - a. All brushes must make, dynamically, within $\pm 2^\circ$.
 - b. Loosen clamp on input pulley to time brushes; 12° brush at 5-time: M-80°, B-92°; 16° brush at 5-time: M-77°, B-93°.
- c. Check and correct RLCB's and SCCB's (if used).

Punch Feed

Timing Belts

The synchronous tooth of the punch clutch should be used as a reference point whenever units pertaining to the punch clutch are retimed. Unless this tooth is used, timing will be off by 90°, 180°, or 270°.

The synchronous tooth is that tooth whose driving face is opposite the centerline of one of the three tapped holes on the outside collar.

Refer to Figures 3-15 and 3-16 for belt locations and units that must be removed in the event of belt breakage.

MAIN DRIVE REPLACEMENT

1. Trip clutch between 230° and 300° , and turn input idler pulley, manually, until dog engages in clutch ratchet.
2. While holding armature in tripped position, continue turning machine until latching surfaces of clutch latch arm and dog carrier coincide. See Figure 3-21F. Punch feed index should be $315^{\circ} \pm \frac{1}{2}^{\circ}$.
3. Set timer index at 315° .
4. Slip input drive belt on geneva pulley and, while keeping the relationship between lower pulley and input idler pulley (315° at the clutch and 315° at the timer), slip belt onto both pulleys. Adjust tension and recheck timing relationship. Refer to *Timing Belt Adjustment*.
5. Time the geneva.
 - a. Loosen geneva pulley lock screws.
 - b. Set timer index and punch index to 0° .
 - c. Depress geneva lock pin into timing slot and tighten geneva pulley lock screws.

NOTE: At 315° , if everything is in time, geneva pin will detent and punch clutch will line up as described in Step 2.

DRIVE MOTOR BELT REPLACEMENT

1. Mark CR idler belt (3) and pulleys to maintain timing.
2. Loosen CR idler belt (3) and slip it off.
3. Install drive motor belt and tighten.
4. Install CR idler belt (3), line up reference marks, and tighten with idler pulley.

CR IDLER BELT REPLACEMENT

1. If there is enough room to work belt between the index pulley and cross-over shaft pulley, the index timer unit does not have to be removed from base. If removal is necessary, loosen three base mounting screws on timer index.
2. Install new belt; tighten idler pulley and, if necessary, tighten three base screw on timer index unit.
3. Retime index timer.
 - a. Loosen timer index set screws (Figure 3-15).
 - b. Unlatch punch clutch between 230° and 300° and, while holding armature in tripped position, continue turning machine until latching surface of clutch arm and dog carrier coincide (See Figure 3-21F).

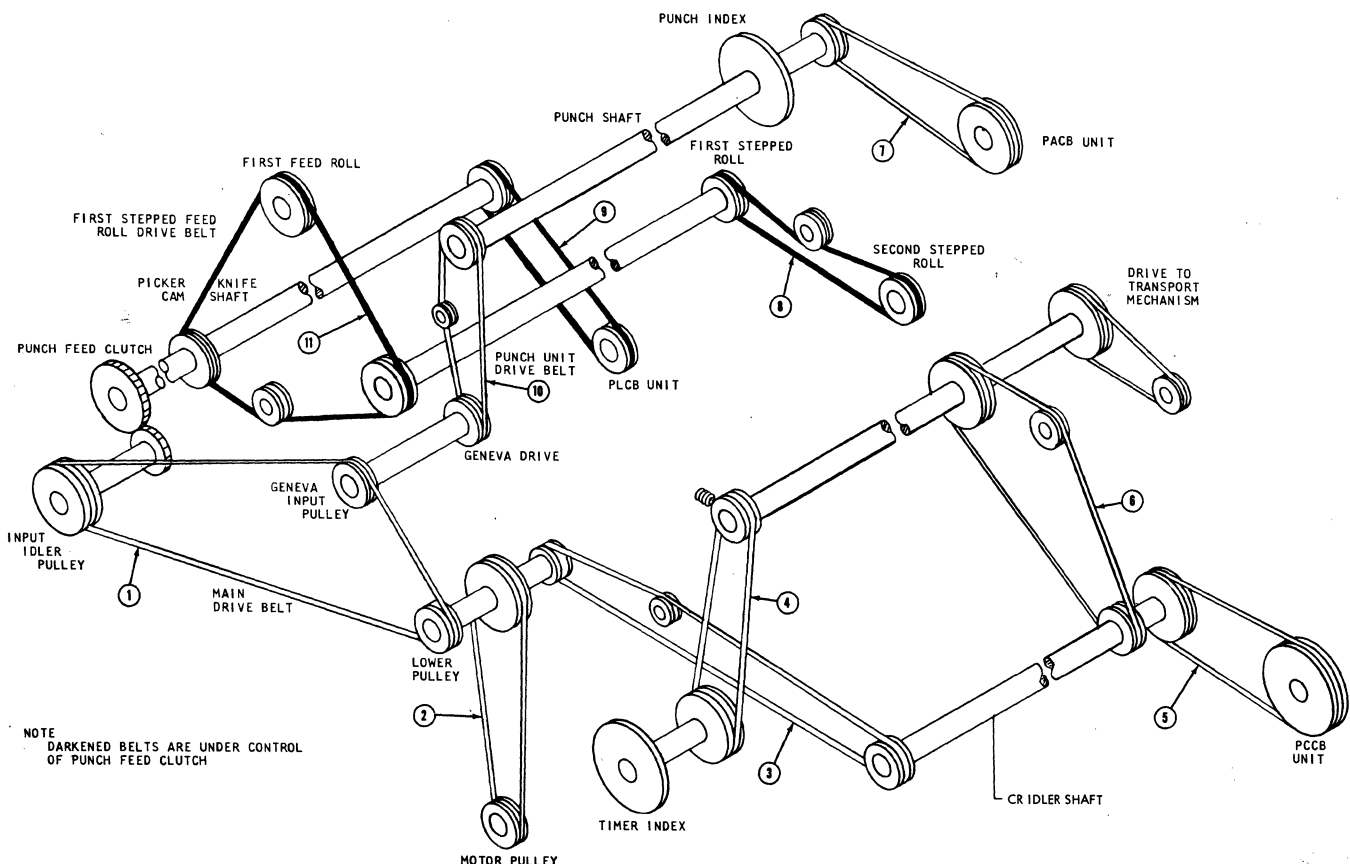


Figure 3-15. Punch Feed Timing Belts

- c. Set timer index to 315°, and tighten timer adjustment set screws.
4. Retime PCCB's.
 - a. Loosen PCCB pulley set screws.
 - b. Set timer index to make time of PCCB 4 (wiring diagram).
 - c. Turn PCCB unit in normal direction of rotation until PCCB 4 makes, and then tighten PCCB pulley set screws.

TIMER INDEX BELT REPLACEMENT

1. Loosen timer index mounting screws (3) if more clearance is needed in order to replace belt.
2. Install belt and adjust tension. Refer to *Timing Belt Adjustment*. If base screws were removed, pull timer unit to left and tighten mounting screws.
3. Time timer index.
 - a. Loosen index pulley set screw (See Figure 3-15).
 - b. Set punch unit to 0° and depress geneva pin.
 - c. Set index to 0° and tighten pulley set screw.

PCCB DRIVE BELT REPLACEMENT

1. Install new belt and (if necessary) adjust by loosening PCCB unit mounting bolts.

2. Time PCCB's.
 - a. Loosen PCCB adjusting set screws on drive pulley.
 - b. Set timer index to make time of PCCB 4 (wiring diagram), and turn PCCB unit in the normal operating direction until PCCB 4 makes.
 - c. Tighten set screws.

IDLER BELT REPLACEMENT

1. Remove PCCB drive belt and transport drive belt.
2. Install new belt and tighten with idler pulley. Refer to *Timing Belt Adjustments*.
3. Replace transport drive belt (no timing required) and PCCB drive belt.
4. Retime timer index. Refer to *Drive Motor Belt Replacement*, Steps 4 and 5.
5. Time PCCB's. Refer to *PCCB Drive Belt Replacement*, Steps 2 and 3.

PACB DRIVE BELT REPLACEMENT

1. Remove PACB unit from machine (three screws).
2. Mark two white nylon gears, and remove gear on belt pulley shaft.
3. Install new belt, and reinstall white nylon gear. Be sure timing marks are rematched.

NOTE: PACB shafts have two collars; each has

Belt Name and Reference Number	Belts or Units To Be Removed	Units to be Retimed After Belt Replacement
(1) Main Drive Belt		Punch Clutch, Geneva
(2) Drive Motor Belt	CR Idler Belt (3)	Timer Index, PCCB Unit
(3) CR Idler Belt	* Timer Index	Timer Index, PCCB Unit
(4) Timer Index Belt	* Timer Index	Timer Index
(5) PCCB Belt		PCCB Unit
(6) Idler Belt	PCCB Belt (5) Belt to Transport Assembly	Timer Index, PCCB Unit
(7) PACB Belt	PACB Unit	PACB Unit
(8) Second Stepped Feed Roll Belt		Second Stepped Feed Roll
(9) PLCB Belt		PLCB Unit
(10) Punch Unit Drive Belt		Punch Unit
(11) First Stepped Feed Roll Drive Belt	Main Drive Belt (1) Punch Clutch Magnet Bracket Assembly	First Stepped Feed Roll

* If there is sufficient belt replacement clearance, this unit does not have to be removed.

Figure 3-16. Punch Drive Belt Replacement Chart

a scribed line. The casting has two scribed lines which will coincide with collar lines at 0° on punch index (see Figure 3-17).

4. Align shaft lines with scribe lines on casting, and set punch index on 0°.
5. Slip the PACB belt over the punch pulley. If care is taken, the PACB unit can be tightened and both units will be in time. Refer to *Timing Belt Adjustments*.
6. If the PACB's are not in time, loosen PACB drive pulley screws.
 - a. Align two scribed marks on PACB mounting unit with collar scribed lines.
 - b. Set punch index to 0°, and depress geneva pin.
 - c. Tighten pulley screws.

SECOND STEPPED FEED ROLL DRIVE BELT REPLACEMENT

1. Loosen idler pulley. Install new belt and tighten with idler pulley. Refer to *Timing Belt Adjustments*.
2. For timing second stepped feed roll, refer to *Feed Rolls and Aligner Stations, Adjustments, Second Stepped Feed Rolls*, Steps 2 thru 7.

PLCB DRIVE BELT REPLACEMENT

1. Install belt.
2. Retime PLCB to timer by loosening PLCB shaft pulley clamping screws.

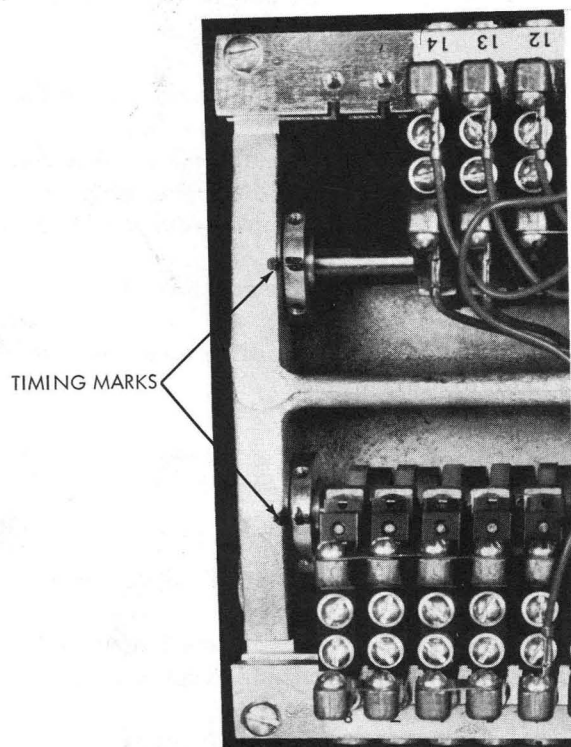


Figure 3-17. PACB Timing Marks

PUNCH UNIT DRIVE BELT REPLACEMENT

Do not remove geneva unit when punch unit drive belt is being replaced.

1. Loosen idler pulley. Install belt and tighten belt with idler pulley.
2. Retime punch by loosening locking screws on punch unit drive pulley.
 - a. Set punch and timer index to 0°.
 - b. Depress geneva pin and tighten pulley lock screws.

FIRST STEPPED FEED ROLL DRIVE BELT REPLACEMENT

1. Crank machine to 315° (until geneva pin detents).
2. Mark relationship of input idler pulley to punch drive gear.
3. Mark relationships of main drive belt to input idler pulley, geneva and main input pulley. Refer to Figure 3-18.
4. Loosen first stepped feed roll idler.
5. Remove locating pins in punch clutch magnet bracket assembly.

NOTE: Lower left pin is removed with puller; upper right pin is removed (from rear of machine) with a punch.

6. Remove lower mounting screw; loosen upper mounting screw. Punch clutch will now pivot down for belt removal clearance.
7. Install first stepped feed roll belt; adjust tension. Refer to *Timing Belt Adjustments*.
8. Install clutch mounting screws, but do not tighten.

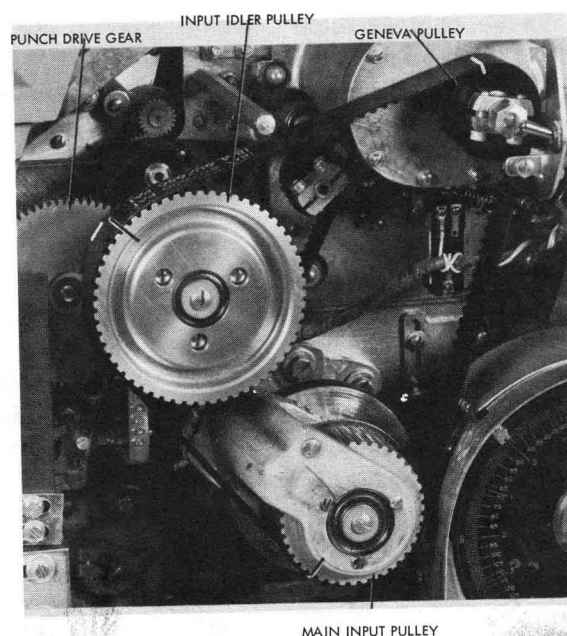


Figure 3-18. First Stepped Feed Roll Timing Belt Installation

9. Replace locating pins; tighten mounting screws.
10. At 315° on index, with geneva pin detented, align mark on punch drive gear with mark on input idler pulley. Also align marks on main drive belt with marks on input idler pulley, geneva and main input pulley. Clutch should latch at this time.
11. Retime first stepped feed roll. Refer to *Feed Roll and Aligner Stations, First Stepped Feed Roll*.

NOTE: When this procedure has been performed, feed mechanism should be in time.

OTHER DRIVE BELT REPLACEMENTS

The remaining drive belts in transport unit are easily replaced and require no timing after replacement.

Timing Belt Adjustments

Refer to Figure 3-19. Belt, pulley, bearing, and shaft life can be increased with proper belt tension. The one pound (450 grams) pressure indicated in Figure 3-19 is measured by using a gram gage (450459) and X10 blade.

When using gram gage to measure belt tension, pointer must be as near as possible to midpoint of belt width. Readings made at belt edge are inaccurate. Some belts are not included because they are inaccessible to a gram gage. Proper tension on these belts can be obtained by comparison to belts of similar span and width.

Punch Feed Clutch

ADJUSTMENTS

The clutch assembly is pinned at the factory, and should not be changed. Step 1 would only be performed if a new clutch assembly is installed.

1. Set clutch so latch arm is on horizontal centerline of picker camshaft within .005" (Figure 3-20).
 - a. Position unit sideways so keeper is flush with edge of dog carrier within .010" (Figure 3-22).
 - b. Form cam follower arm so cam follower is on middle of cam surface.
2. Turn machine to low dwell on clutch cam. Trip clutch; set adjusting screw for .018" to .030" unlatching clearance (Figure 3-21 A).
3. Crank machine to high dwell on clutch cam. Check for a minimum of 1/16" overlap of clutch latch arm on dog and dog carrier (Figure 3-21 B).
 - a. Reposition latch arm if necessary (check item 2).
4. Check for .003" to .005" clearance between dog carrier and keeper. Peen or stone the keeper to adjust it (Figure 3-21 B).
5. With cam follower on high dwell, position armature backstop plate, vertically, for .020" to .025"

overlap of armature and latch; position horizontally for .010" to .015" relatching clearance (Figure 3-21 C).

6. Adjust magnet assembly for .010" clearance between armature and core nearest pivot, and .025" between the armature and core farthest from the pivot when armature is latched (Figure 3-21D). This adjustment should give .003" to .005" clearance between armature and core nearest pivot when armature is attracted.
7. The clutch should unlatch with an .008" gage inserted between armature and core farthest from pivot point. It should not unlatch with a .010" gage inserted. Readjust overlap, if necessary (Step 5).
8. With cam follower on high dwell, set armature knockoff for .010" to .012" clearance between armature and knockoff (Figure 3-21E).
9. This adjustment is only for machines with a clutch tooth selector arm (Figure 3-20).
With the clutch tripped in the sync tooth and the clutch trip lever held down, adjust the clutch tooth selector arm for .010"-.030" clearance to the center of the low dwell of the selector cam. Make sure that clutch trips. Re-adjust within tolerance if necessary.

TIMING

This adjustment ensures that punch feed index is in time with punch clutch dog engaging time.

1. Trip clutch between 230° and 300°; crank machine manually until dog engages in clutch ratchet that lines up with set screw in outside collar.
2. While holding armature in tripped position, continue turning machine until latching surfaces of clutch latch arm and dog carrier coincide (Figure 3-21F).
3. Punch feed index should be at 315° ± ½°.
 - a. If punch feed index is not at 315°, loosen clamping hub of index drive pulley and turn index to 315°.
 - b. Tighten clamping hub.

NOTE: If any change is made in clutch timing, check timing of all other punch feed units.

MAGNET BRACKET ASSEMBLY REMOVAL

1. Remove locating pins in punch clutch magnet bracket assembly.
NOTE: Lower left pin is removed with puller; upper right pin is removed (from rear of machine) with a punch.
2. Remove mounting screws and lift out assembly.
3. Replace in reverse order. Be sure to set locating pins before tightening mounting screws.

CLUTCH RATCHET REMOVAL

1. Remove main drive belt.
2. Remove nut in center of idler pulley stud.
3. Pull stud and input idler pulley.
4. Remove screw in end of picker knife camshaft and pull gear and disk assembly off shaft.
5. Loosen three set screws and pull ratchet off the assembly. Do not lose spacer between two outside bearings.
6. Install in reverse order.
7. Re-time clutch, geneva, and PLCB's.

gears. If there is too much backlash, punching registration will be off. If there is no backlash, the gears will be damaged.

2. Check for geneva gear backlash.
 - a. Remove punch unit.
 - b. Crank machine to a point where intermittent rolls are held stationary for punching (approximately 4° before line of index).
 - c. Grip an intermittent roll and turn in both directions. Check for slight wink. Check both sets of rolls at all 12 digit-times.

Geneva

ADJUSTMENTS

Internal repairs to the geneva housing must be made at the factory.

1. Locate geneva housing on side frame to produce a perceptible minimum to $.0045''$ backlash in

TIMING

Check clutch timing before proceeding with this adjustment.

1. Geneva timing pin should seat at 0° and at alternate cycle points throughout a machine cycle. See Figure 3-23.

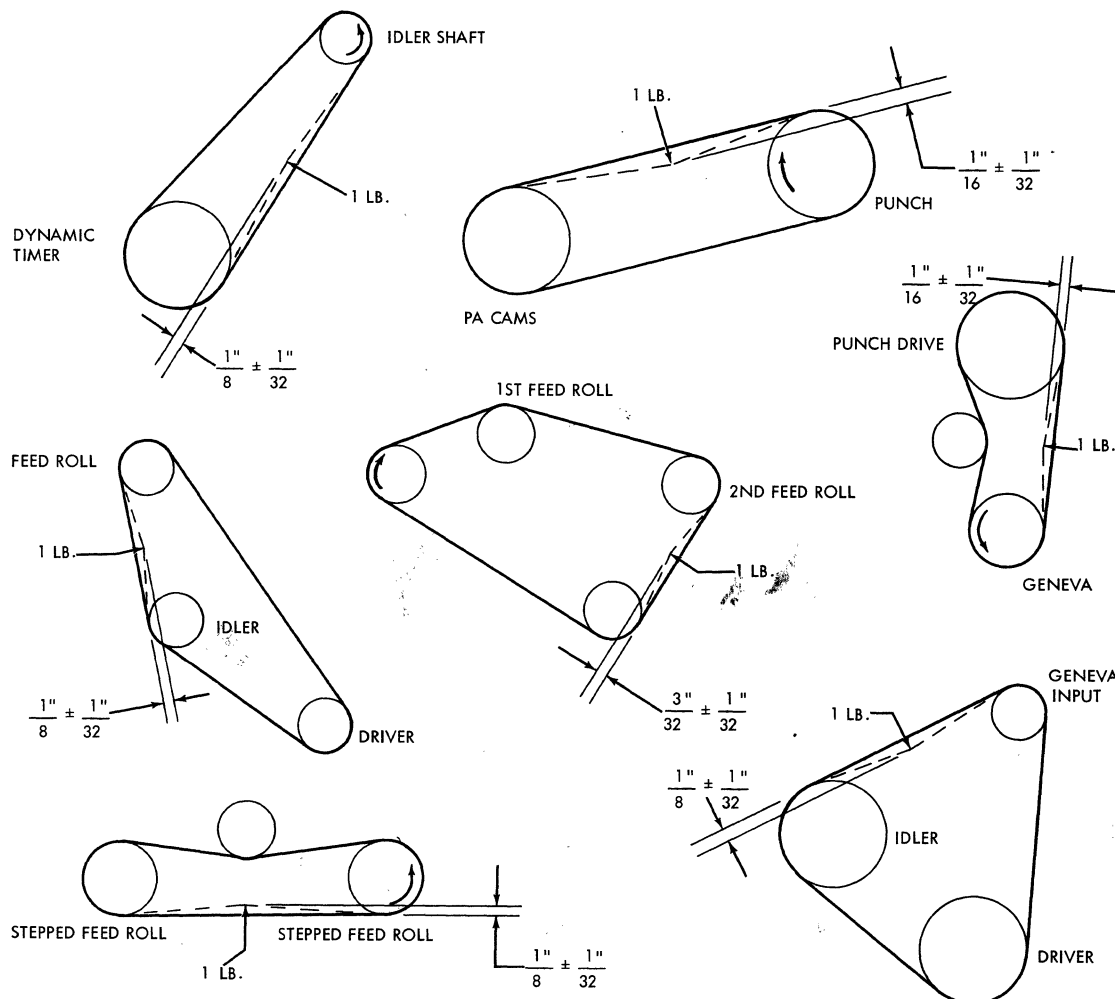


Figure 3-19. Punch Timing Belt Tensions

2. Time the geneva.
 - a. Turn machine to 0° on timer index.
 - b. Loosen split hub of geneva input pulley.
 - c. Crank machine until pin seats, and tighten pulley.
 - d. Check timing of punch unit and PACB unit.
3. Tighten geneva unit locating blocks against top and inside surfaces of locating slots in outside edge of geneva unit mounting flanges.

Hopper and Picker Knives

ADJUSTMENTS

1. On machines with adjustable left side aligner, locate left hopper side plate so there is .057" to .067" clearance to hopper sub-frame.
2. On machines with stationary left side aligner, locate left hopper side plate so a card will clear left side aligner by .010".
3. The right hopper side plate is adjusted for .008" to .012" clearance over length of the cards.
 - a. Check this clearance by placing approximately a one-inch stack of cards in hopper; insert one and then two cards vertically between cards in hopper and side plates. One card should be loose; two cards tight.
 - b. Make sure hopper side plates are at right angles to first set of feed rolls.
4. Position hopper posts for a clearance of .015" \pm .002" between hopper posts and stack of cards against throat knife.
 - a. Check for two-card clearance between hopper posts and stack of cards.
 - b. Adjust clearance by loosening screws in both ends of hopper post mounting bar, then shift bar to desired amount.
5. Position throat roller assembly so vertical center line of roller is aligned with edge of throat knife. Determine this position by the step in the block. This step indicates the center line of the roller. A .010" feeler gage will be parallel to card line when roller is centered under throat knife.
6. Position cam follower arms for no binding condition, over entire periphery of cams, with maximum clearance of .006" at any point between cams and followers.
7. Position feed knife arms evenly on shaft so edge of picker knife block travels .020" to .030" beyond trailing edge of card when card is held against hopper posts.
8. Throat opening should be .0095" go; .0105" no-go.
9. Adjust picker knife cam to deliver a card to first feed rolls at 185° \pm ½°.
 - a. Loosen cam on shaft.
 - b. Engage clutch and turn to 185°.
 - c. Turn cam on shaft until feed knives hold card snug against first feed rolls.
 - d. Tighten cam on shaft.

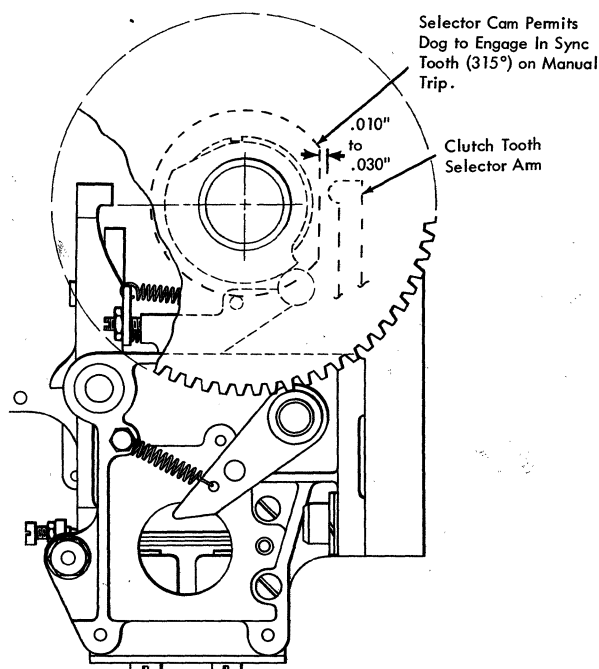


Figure 3-20. Punch Clutch Position

Card Guides

For machines that do not have a lowering frame, refer to *Redesigned Punch Feed* for card guide adjustments.

Four card guides must be kept in proper relationship to the card line. The first card guide is located just past the first feed rolls. The first upper card guide is removable and is replaced by a brush assembly if the Punch Feed Read special feature is on the machine. The first lower card guide, then, is altered to accommodate a contact roll.

ADJUSTMENTS

1. Hopper back plate guide should be .008" above card line.
2. First lower card guide must not be above point of contact of first upper and lower feed rolls. See Figure 3-24.

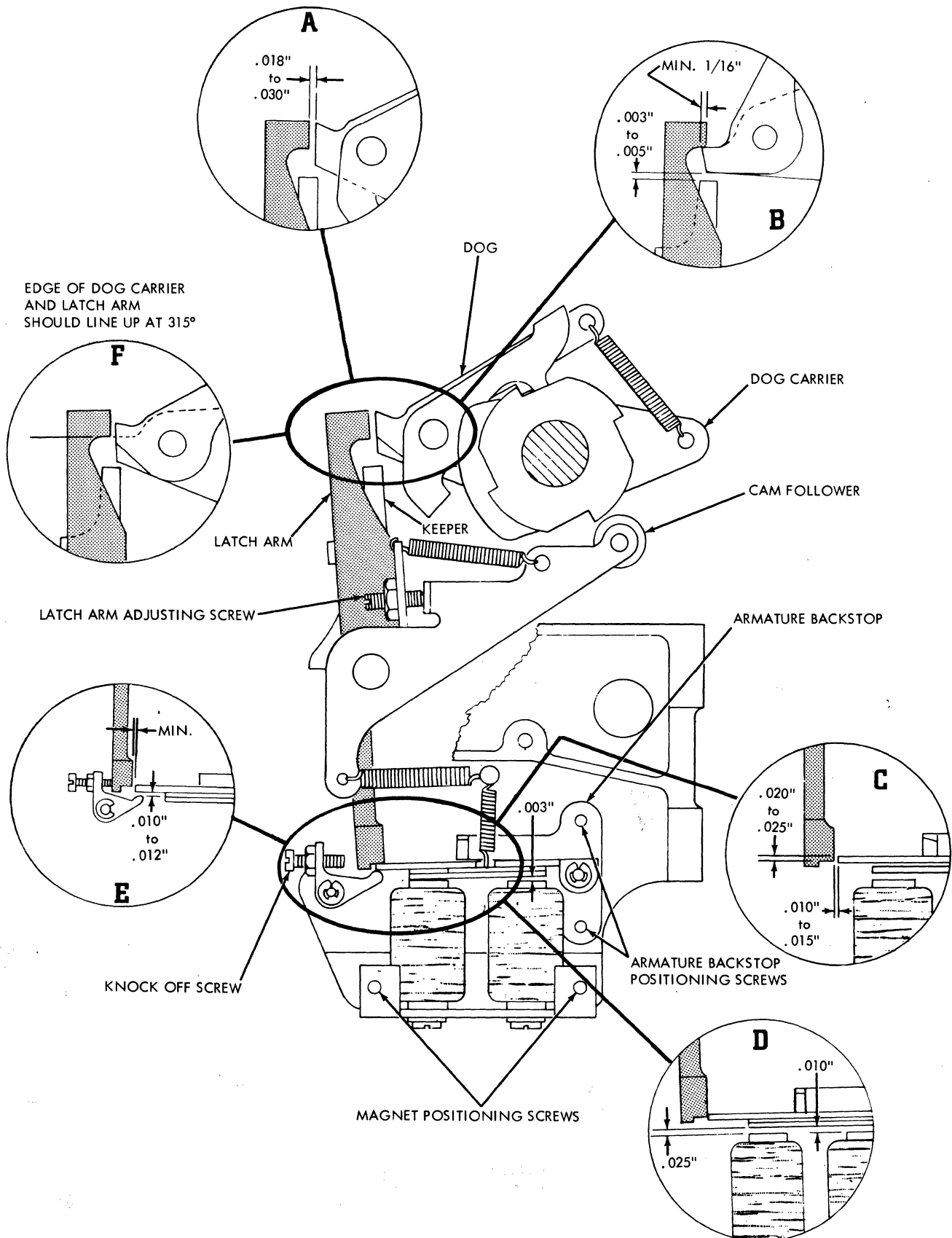


Figure 3-21. Punch Clutch Adjustments

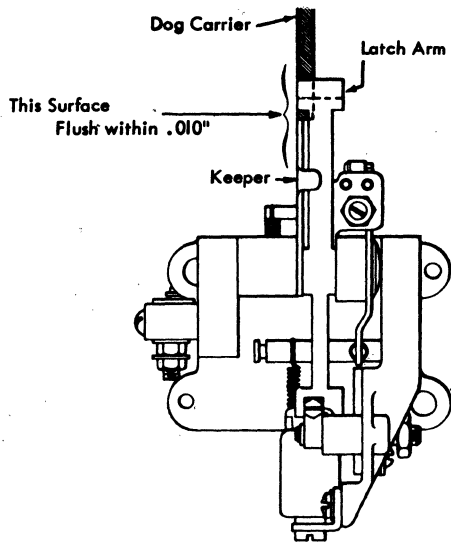


Figure 3-22. Punch Clutch Arm and Dog Carrier Relationship

3. Loosen hopper back plate and shift to obtain .012" to .030" clearance between lower card guide and hopper back plate guide.
4. Trailing edge of first lower card guide should be flush to .015" below leading edge of second lower card guide. See Figure 3-24.
5. Position first upper card guide for .012" to .030" clearance to lower card guide. Adjust by loosening screws in mounting bar and shifting guide to desired position.
6. Position second upper card guide for .012" to .030" clearance to lower guide.
 - a. Loosen tie bar holding screws.
 - b. Make certain the tip of the forward aligner is below the top surface of lower guide. Adjust by positioning the upper guide. (Aligners travel in a slot in the upper guide.)
7. Position third upper card guide for .012" to .030" clearance to lower guide by loosening mounting

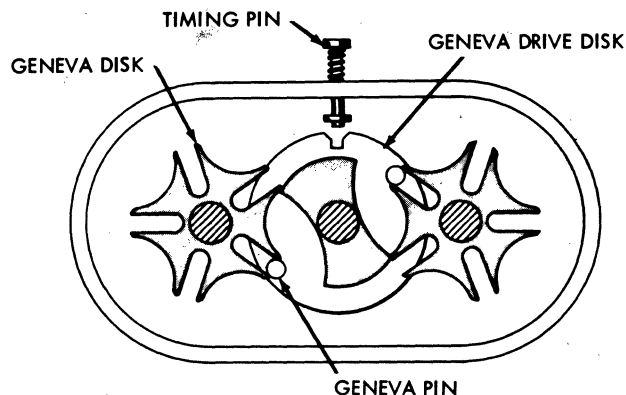


Figure 3-23. Geneva

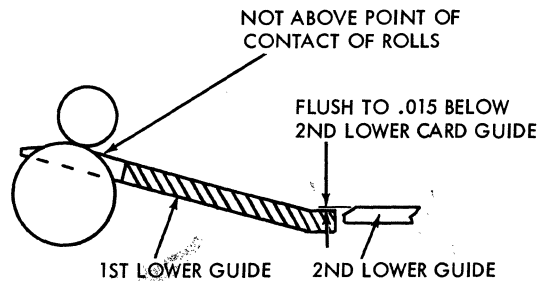


Figure 3-24. First to Second Lower Card Guide Alignment

- bar holding screws and shifting guide to desired position.
8. Position punch stacker transport lower card guide for .015" to .025" below card line level (determined by contact roll and sixth feed roll).
9. Position plastic tips on lower guides .003" to .010" from contact roll.
10. Punch stacker card lever bracket must be positioned for .012" to .050" clearance to lower card guide in stacker.

✓ Feed Rolls and Aligner Stations

For machines that do not have a lowering frame, refer to *Redesigned Punch Feed* for feed roll and aligner stations, checks, removals, and adjustments.

Timing of the first and second stepped feed rolls, first and second intermittent feed rolls, and the card aligners is checked by means of the following procedures. *These procedures, however, are not final adjustments.* The synchronous tooth is used for all of these steps. See Figure 3-25.

Danger: Be sure machine power is turned off before these adjustments are made.

FIRST STEPPED AND FIRST INTERMITTENT FEED ROLLS TIMING CHECK

1. Pivot hopper down.
2. Remove punch feed brushes, and PFR brushes or card guide.
3. Trip clutch at 300°.

NOTE: The following checks can be made either with punch unit installed or removed.

4. With clutch engaged (315°) crank machine to 333°.
5. Insert a card lengthwise from hopper end so it is between the rolls on one end of first stepped feed roll shaft. Make sure first intermittent feed roll does not interfere with card.
6. By turning feed backward, check that card is free at 331° and is gripped tightly by first stepped feed roll at 328°. This indicates first stepped roll is in time.
7. Crank machine to 352°.

8. Insert a card lengthwise between rolls on one end of first intermittent feed roll shaft. Insert another card lengthwise between other rolls of first intermittent feed roll.
9. Check that each card is free at 353° , and is gripped tightly at 357° . This indicates first intermittent feed roll is in time.

SECOND INTERMITTENT AND SECOND STEPPED FEED ROLLS TIMING CHECK

1. Trip clutch at 300° and, with clutch engaged (315°), crank machine to 290° .
2. Insert card between each of the pairs of rolls on second intermittent feed roll shaft. This card can be inserted from punch check brush station.
3. While turning feed backward, card should be free at 290° and gripped tight at 284° . This indicates second intermittent roll is in time.
4. At 285° , a strip of card can pass between the second stepped roll and its upper pressure rolls.
5. Crank machine to 292° and card should be free. Card should be gripped tightly by 295° . This assures that the second stepped roll is in time.

FORWARD AND SIDE ALIGNERS TIMING CHECK

When checking these timings, punch unit must be removed. The first stepped feed roll must be in time before checking the aligners. See Figure 3-26.

1. Latch the die into position to serve as card guide.
NOTE: Die card guide gage 610094 replaces the die in machines containing redesigned die and stripper, P/N 601981.
2. Insert timing gage 608183 (Figure 3-27).
3. Pivot hopper up and place cards in it. Trip clutch at 300° and crank machine until clutch engages (315°). Feed cards manually for two card cycles.
4. Continue cranking machine and check that card finishes forward aligning to within .005" of forward aligner timing marks on gage at 351° (Figure 3-28). This times forward aligner correctly.

NOTE: The following step is necessary on machines with adjustable left side aligner.

5. With machine still at 351° , check that left side aligner surface is against card and $37/64$ " from inside of left side frame. Check that right side aligner is just touching card at 351° .

NOTE: The following step is necessary on machines with a fixed left side-aligner block.

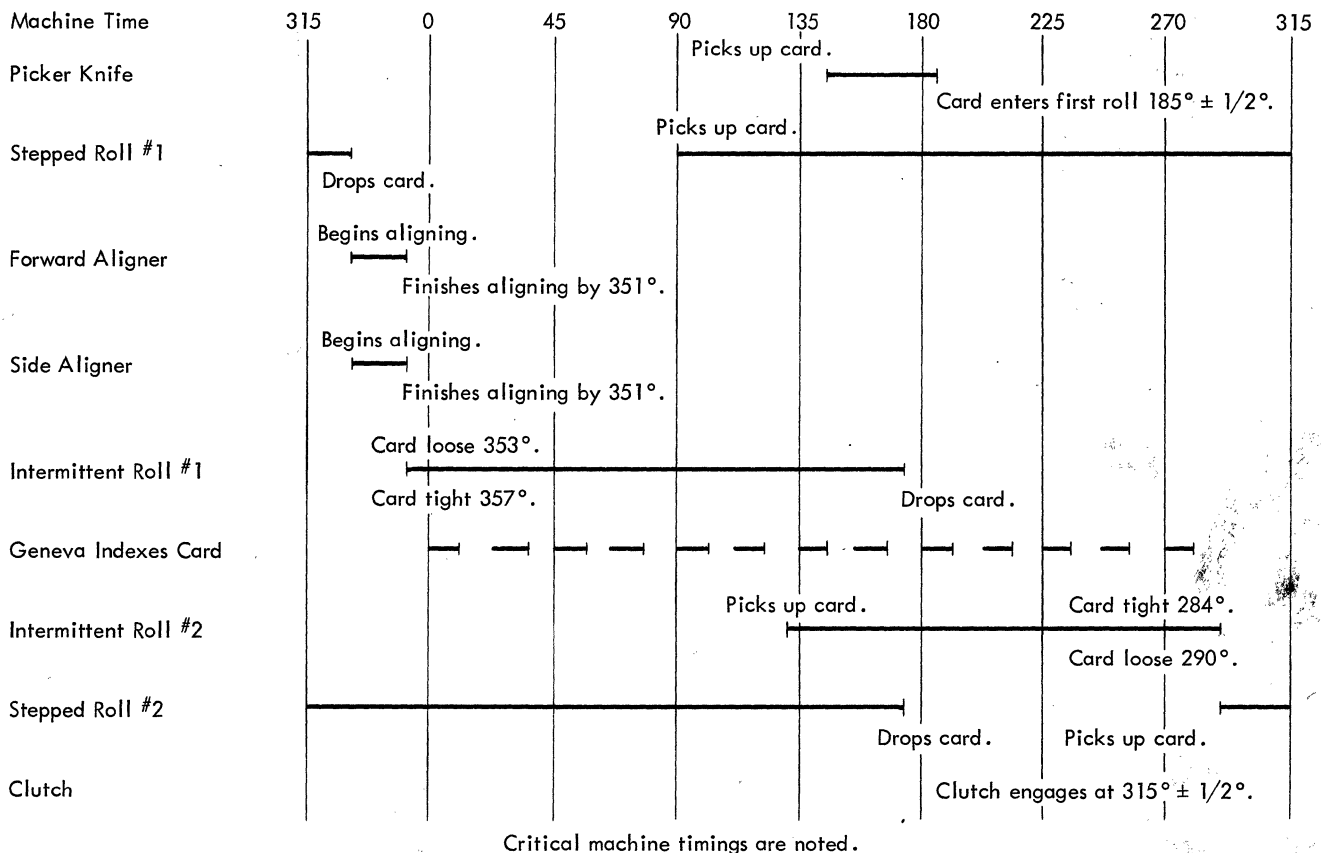


Figure 3-25. Punch Transport Timing

6. Check for .010" to .020" gap between card and left side-aligner block. Card must be fed while being held against the left hopper side plate, and the check must be made prior to alignment.
7. Feed cards while holding them against right hopper side plate. Prior to side aligning, check right side aligner surface for .005" minimum clearance to card as it feeds into aligner station.
8. Aligner surface must be parallel to end of card while card is held against left aligner block.

FIRST STEPPED FEED ROLL ADJUSTMENTS

The first stepped feed roll can be timed with punch unit in or out of machine.

1. Pivot hopper down and remove punch feed brushes and PFR brushes, or removable card guide.
2. Trip clutch at 300° and manually crank machine to 330°.
3. Loosen split hub of pulley on front end of first stepped feed roll.
4. With machine at 330°, turn first stepped feed roll by hand and feed a card lengthwise through one set of rolls of the first stepped feed roll. Make sure card is not passing through intermittent rolls.
5. When the first stepped feed roll stops feeding a

card, rotate roll slightly until a light drag is applied to the card.

6. Hold feed roll at this position and tighten pulley loosened in Step 3.
7. Check that card is held tightly by first stepped feed roll at 328°, and is free at 331°.
8. Retime first intermittent feed roll.
9. Check second stepped feed roll; retime if necessary.

FIRST INTERMITTENT FEED ROLL ADJUSTMENT

The first stepped feed roll must be in proper time before timing the first intermittent feed roll. Refer to *Timing Check, First Stepped and First Intermittent Feed Rolls*. The first intermittent feed roll can be timed with punch unit in or out of machine.

1. Pivot hopper down; remove punch feed brushes and PFR brushes, or removable card guide.
2. Trip clutch at 300° and crank machine to 352°.
3. Insert one card lengthwise between one pair of rolls of first intermittent feed roll shaft. Insert another card lengthwise between the other pair of rolls of first intermittent feed roll.
4. Crank machine to 356°.
5. Adjust card clearance at intermittent feed roll.
 - a. Loosen lock screw on eccentric (Figure 3-29).

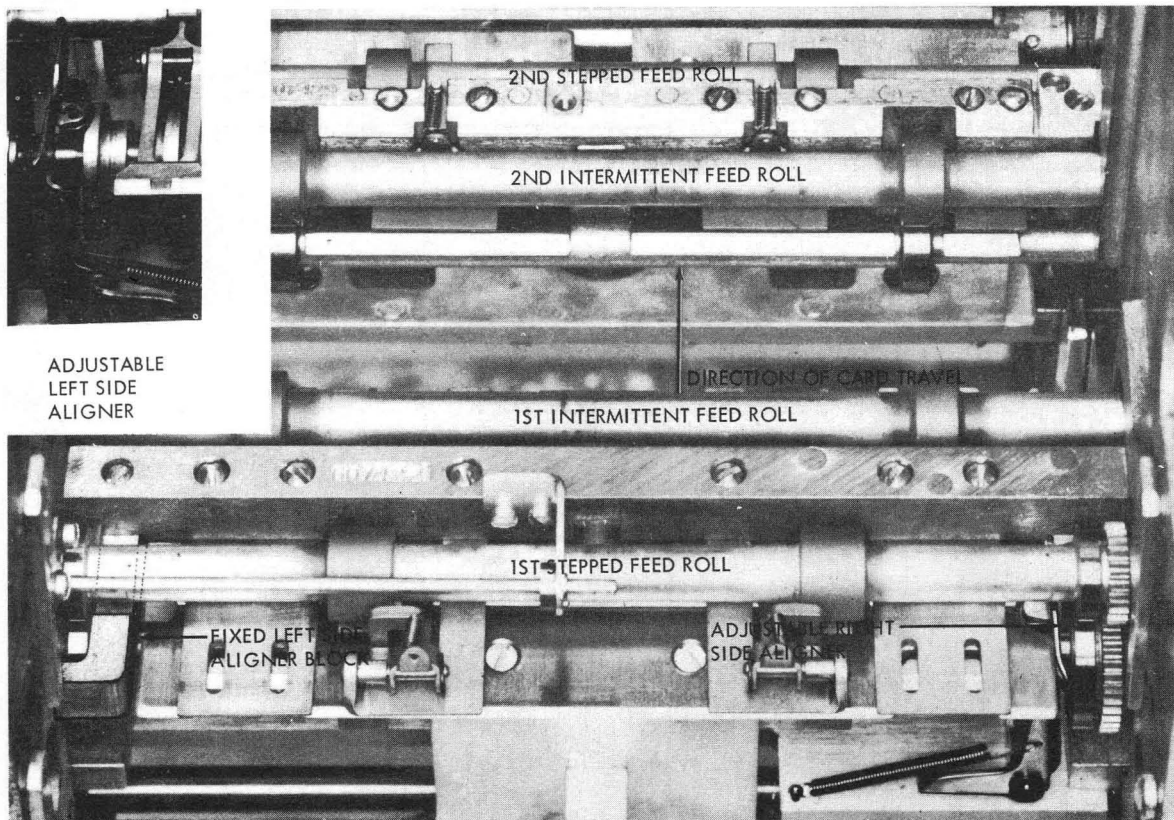


Figure 3-26. Feed Rolls and Aligner Stations

- b. Rotate eccentric so each card has light drag at 356° . Keep high side (indicated by punch marks) of eccentrics facing, but not necessarily aligned with punch marks on intermittent feed roll opening arms.
6. Check that each card is free at 353° , and gripped tightly at 357° .

SECOND STEPPED FEED ROLL ADJUSTMENTS

1. Remove punch feed brushes and PFR brushes or removable card guides.
2. Trip clutch at 300° and crank machine to 294° .
3. Loosen split hub of pulley on rear end of second stepped feed roll.

4. Keep machine at 294° ; turn second stepped roll by hand and feed card lengthwise through one set of rolls of second stepped feed roll shaft. Make sure card is not passing through intermittent rolls.
5. When second stepped feed roll begins feeding card, rotate roll slightly until the card experiences light drag.
6. Hold roll at this position, and tighten pulley loosened in Step 3.
7. Check that card is held tightly by second stepped feed roll at 295° , and is free at 292° .
8. Retime second intermittent feed roll.

SECOND INTERMITTENT FEED ROLL ADJUSTMENT

The second stepped feed roll must be in proper time

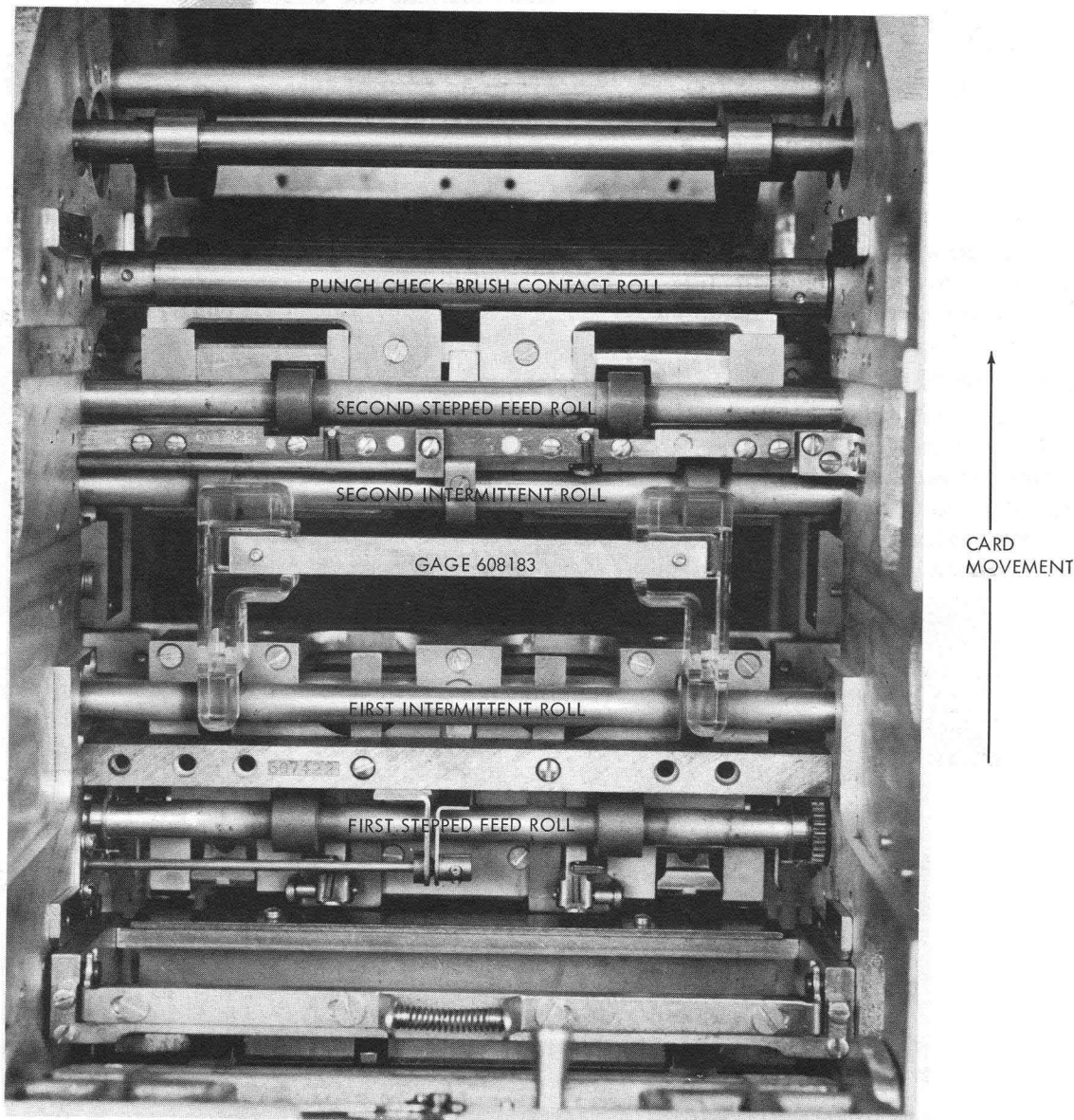


Figure 3-27. Gage Position in Punch Station

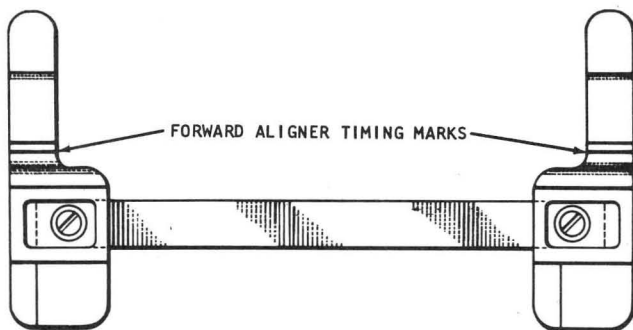


Figure 3-28. Gage 608183 Timing Mark

before timing second intermittent feed roll. Refer to *Timing Check, Second Intermittent and Second Stepped Feed Rolls*, Steps 1, 5, and 6. Second intermittent feed roll can be timed with punch unit in or out of machine.

1. Remove punch feed brushes and PFR brushes, or removable card guide.
2. Trip clutch at 300° and crank machine to 290°.
3. Insert one card lengthwise between one set of rolls of second intermittent feed roll shaft. Insert another card lengthwise between other set of rolls of second intermittent feed roll.
4. Crank machine backward to 286°.
5. Adjust card clearance at intermittent feed roll.
 - a. Loosen lock screw for eccentric (Figure 3-29).
 - b. Rotate eccentric so each card has light drag at 286°. Keep high side (indicated by punch marks) of eccentrics facing, but not necessarily aligned with, punch marks on intermittent

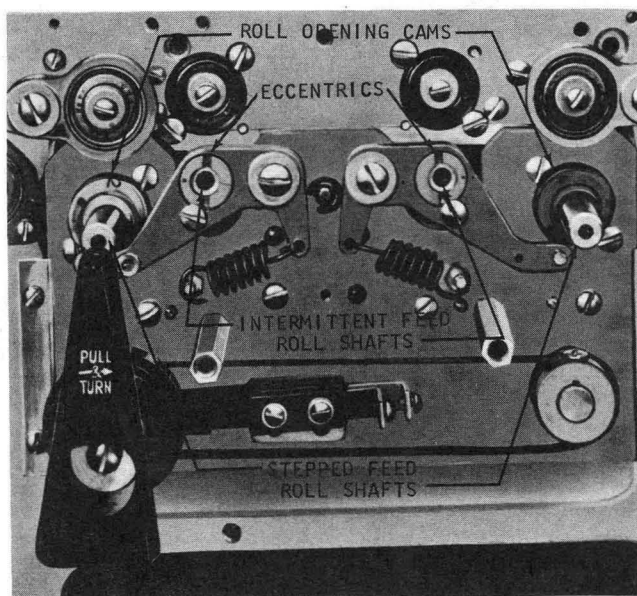


Figure 3-29. Roll Opening Device

feed roll opening arms.

6. Check that each card is free at 288° and gripped tightly at 284°.

FORWARD AND SIDE ALIGNER ADJUSTMENT

Before performing these adjustments, be sure first stepped feed roll is in time. Refer to *Timing Checks, First Stepped and First Intermittent Feed Rolls*, Steps 1 thru 6. To time the forward and side aligners, refer to *Timing Checks, Forward and Side Aligners*, Step 1 thru 7.

1. Check that forward aligner mounting bar is parallel to edge of plate on which it is mounted.
2. Place cards in hopper; block clutch at 300°, and crank machine one complete cycle to 351°. Remove block from clutch. Adjust forward aligners so trailing edge of card is against each aligning surface of forward aligners, and leading edge of card is within .005" of forward aligner timing marks on gage at 351° (Figure 3-28).
3. Adjust forward aligners.
 - a. Slightly loosen two screws of locking block. Locking block serves as support for forward aligner adjusting screw. Adjustment of forward aligner cannot be made accurately if block screws are loosened too far.
 - b. Turn forward aligner adjusting screw clockwise to move forward aligner away from hopper and counterclockwise to move forward aligner toward hopper. See Figure 3-30.
 - c. Retighten locking block screws after setting forward aligners.
4. Check forward aligner setting by manually feeding cards through machine to see that leading edge of card is within .005" of forward aligner timing marks at 351°.
5. This step is necessary only on machines with an adjustable left side aligner. With machine still at 351°, loosen left side aligner lock nut; turn left side aligner adjusting screw to position left side

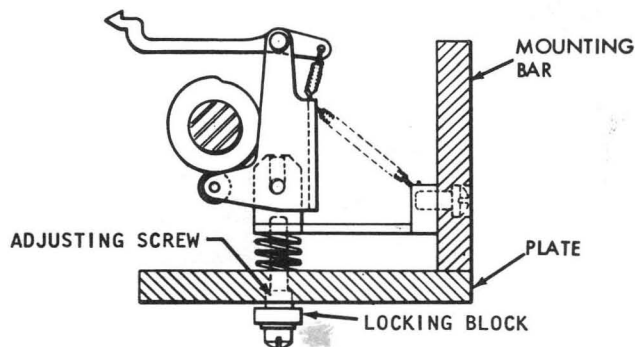


Figure 3-30. Forward Aligner, Side View

aligner surface 37/64" from inside of left side frame. Tighten lock nut. With card against left side aligner adjust right side aligner in similar manner so its aligning surface just touches card at 351°. Tighten lock nut.

6. To obtain clearances as outlined in Steps 6, 7 and 8 of *Forward and Side Aligner Check*, hopper side plates must be adjusted and side aligner must be formed.

SIDE ALIGNER REMOVAL

1. Remove punch unit from machine.
2. Remove die card lever.
3. Remove upper card guides and card guide mounting bar in aligning station.
 - a. Remove six screws holding card guides to mounting bar; slide guides toward front of machine.
 - b. Remove two screws from each end of card guide mounting bar and lift bar out.
4. Unhook second upper feed roll tension springs and remove lower card guides in aligner station.
5. Remove side aligner.
 - a. Disconnect spring from aligner.
 - b. Pull pivot pin and lift aligner out.
6. Replace in reverse order.

FORWARD ALIGNER REMOVAL

1. Follow first four steps of the preceding *Side Aligner Removal*.
2. Remove first intermittent feed roll shaft.
 - a. Remove first intermittent feed roll hangers.
 - b. Work intermittent feed roll shaft out rear of machine.
3. Remove forward aligner adjusting screw lock plates, and adjusting screws for both aligners.
4. Remove third upright card guide support.
 - a. Remove four screws through bottom of bed plate.
 - b. Forward aligners are mounted to this upright and will come out with it.

FIRST STEPPED FEED ROLL REMOVAL

1. Remove side aligners.
2. Remove four screws (two at each end) that hold support to side frames. The support is located below card guide support bracket. (The support is a metal plate, approximately $\frac{3}{8}$ " thick, that will interfere with removal of card guide support bracket.)
3. Remove two screws from small bracket between support and card guide support bracket. (One end of small bracket is slotted.)
4. Remove four screws (two at each end) that hold

card guide support bracket in place.

5. Drop card guide supports and forward aligners out bottom of roll opening assembly.
6. Remove first stepped feed roll pulley, gear on second stepped feed roll, and cam follower arms from front of machine.
7. Remove two screws from card bed plate. These screws are on front end under second intermittent roll.
8. Remove front side frame from roll opening device.
9. Remove pulley and bearing retaining screws from rear of stepped roll.

FOURTH UPPER FEED ROLL REMOVAL

1. Remove punch unit from machine.
2. Remove geneva, but do not remove locator blocks.
3. Remove bearing retainer screw from rear of fourth upper feed roll.
4. Remove upper card guides, and card lever in second intermittent station.
5. Remove screws from L-shaped bracket.
6. Remove screws from card guide mounting bar.
7. Lift out card guide and L-shaped bracket.
8. Tap shaft to front and out of rear bearing; remove.

FIFTH UPPER FEED ROLL REMOVAL

1. Remove punch unit from machine.
2. Remove belt and pulley from rear of second stepped feed roll.
3. Remove bearing retainer screw from rear of fourth upper feed roll.
4. Remove upper card guides, and card lever in second intermittent station.
5. Remove screws from L-shaped bracket.
6. Remove screws from card guide mounting bar.
7. Lift out card guide and L-shaped bracket.
8. Take out front bearing screw; tap shaft to rear and remove.

SECOND STEPPED FEED ROLL REMOVAL

1. Remove fifth upper feed roll. Refer to preceding *Fifth Upper Feed Roll Removal*.
2. Remove lower card guide between second intermittent and second stepped feed roll.
3. Remove four screws in bed plate.
4. Remove two rear screws and dowel from bed plate mounting block under first stepped roll and roll opening device.
5. Remove rear side frame on roll opening device.
6. Remove cam and gear from front of stepped roll shaft.

7. Pull stepped roll through rear.
8. Re-assemble in reverse order.
 - a. When replacing card guides between fourth and fifth upper rolls, guides must be laid in place, then mounting bar is put in place and screwed to guides.
 - b. Check for .012" to .030" clearance between upper and lower guides.

Brush Assemblies

ADJUSTMENT

1. For adjustments, except scribed-line setting, refer to *Read Feed, Brush Assemblies*.
2. Loosen locking screws at both ends of brush assembly and shift block so heels of brushes are .020" toward stacker from scribed line for two-group brushes; .020" toward hopper from scribed line for three-group brushes. This is a preliminary setting; actual location of brushes is determined by punch registration and brush timing.

TIMING

1. Check for correct punch registration.
2. Time brushes to wiring diagram timing chart by moving brush block. Do not change picker knife timing.

Punch Unit

ADJUSTMENTS

1. Run cards through machine and check the punching registration with card gage.
2. Laterally shift punching on card (horizontal registration) if necessary.
 - a. Loosen four holding screws on top of punch unit. See Figure 3-31.
 - b. Loosen locknut on horizontal adjusting screw and turn adjusting screw to permit shifting punch unit in direction required to correct horizontal registration. See Figure 3-31.
 - c. Move punch unit tightly against all three adjusting screws, and tighten holding screws.
 - d. Check registration. If necessary, repeat Steps a through c.
3. Vertically shift punching on card (vertical registration) if necessary. See Step 4 before proceeding.
 - a. Loosen four holding screws on top of punch unit. See Figure 3-31.
 - b. Loosen vertical adjusting screw locknuts and turn adjusting screws as required.
 - c. Tighten locking nuts on adjusting screws.
 - d. Move punch unit snug against all three adjusting screws.

- e. Tighten four top holding screws.
 - f. Check registration. If necessary, repeat Steps a through e.
4. If the vertical registration is off more than a few thousandths of an inch, the punch unit adjustment is not likely to be the cause. Investigate some other possible source of trouble such as:
 - a. Correct operation and timing of aligner station.
 - b. Proper card feeding (loose feed roll belts, etc.).
 - c. Worn or loose geneva studs and gears.

TIMING, MACHINES WITHOUT MAGNETIC PA EMITTER

Caution: Do not crank or start machine with timing rod in place.

1. With punch unit installed in machine, insert timing rod 610077 through rear punch unit side frame, through punch unit dial clearance hole, and into camshaft timing hole. Punch unit timing dial must now be at 0°.
2. Loosen split hub of punch unit drive pulley; crank punch transport to 0°. Geneva timing pin must detent in drive disk.
3. Tighten split hub on drive pulley. Punch unit is now timed to the transport and geneva.
4. With timing rod still in place, and PACB drive pulley loose, turn PACB shaft until timing marks on shaft hubs align with timing marks on PACB housing (Figure 3-17).
5. Tighten split hub of PACB drive pulley. PACB unit is now timed to punch unit.
6. Remove punch unit timing rod.
7. Crank machine and check punch unit index with dynamic timer index. At 0°, on dynamic timer index, punch index must read 0°, 120° or 240°.

TIMING, MACHINES WITH MAGNETIC PA EMITTER

Caution: Do not crank or start machine with timing rod in place.

1. Before timing the punch unit to the punch transport, the geneva unit must be in time. At 0° on the machine index the geneva timing pin must detent in drive disc.
2. With the punch unit installed in machine, insert timing rod 610007 through the timing holes in the emitter disc, rear punch unit frame, and punch cam shaft. If all three are not aligned it will be necessary to adjust the emitter disc.
3. Loosen split hub of punch drive unit pulley; crank punch transport to 0°. Geneva timing pin must detent in drive disc.

4. Tighten split hub on drive pulley. Punch unit is now timed to the transport and geneva.
5. With the punch unit in time, the timing holes will line up at 0° every third revolution of the machine index.

REMOVAL

1. Remove die.
2. Remove brush block assembly.
3. Remove two belts from punch unit shaft.
4. Remove four holding screws from top of unit.
5. Disconnect four multi-terminal connectors.
6. Lift punch unit from machine.

REPLACEMENT

1. Stepped side frame machines: (See illustration A.)

NOTE: Punch unit on this type of side frame requires four, two-inch long bushings (P/N 607770) in top plate. See Figure 3-31.

- a. With lowering frame fully down, install two punch unit adjusting plates 610688. Plates are

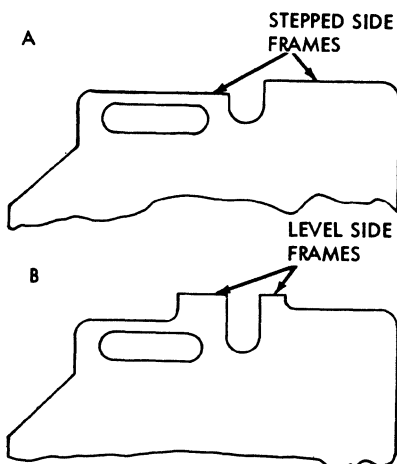
installed between first and second intermittent rolls; one to rear of punch transport; one to front.

- b. Raise lowering frame until just snug. The surface of plates is now on card line.
- c. Remove die from punch unit.
- d. Back adjusting bushings of punch unit into top plate. Place punch unit in machine so stripper rests on adjusting plates.
- e. Adjust bushings to 'square-up' punch unit in machine. Use gage 610692. Make sure all four bushings touch machine side frames while stripper rests on adjusting plates. Tighten bushing lock nuts.
- f. Remove punch unit and adjusting plates.
- g. Replace punch unit and secure with four mounting screws. Bottom surface of stripper is now on card line.
- h. Install die in machine.
- i. Time punch unit; refer to *Punch Unit, Timing*.
- j. When lowering frame is completely up, punch a few cards and check registration. Correct if needed. See *Punch Unit, Adjustment, Steps 2 and 3*.
- k. Machine is now ready for operation. If necessary to feed cards through punch transport with punch unit removed, use die card gage 610094 as lower card guide in punch station. Gage is installed from top of transport.

2. Level side frame machines: (See illustration B.)

NOTE: Punch unit installed on this type side frame requires four, half-inch, hex-head bushings 610093 in top plate. See Figure 3-31.

- a. Remove die from punch unit.
- b. Place punch unit in frame and secure with four 1 $\frac{1}{4}$ " screws.
- c. Install die in machine.
- d. Time punch unit. See *Punch Unit, Timing*.



- e. Raise lowering frame to operating position; punch a few cards; check registration, and correct if needed. See *Punch Unit, Adjustment, Steps 2 and 3*.
- f. Machine is now ready for operation. If necessary to feed cards through punch transport with punch unit removed, use die card gage 610094 as lower card guide in punch station. The gage is installed from top of transport.

Cam Follower Assembly

SERVICE CHECKS

These checks are made with cam follower removed from punch unit.

1. Four collars on pivot shaft should be tight against inner race of pivot bearings. See Figure 3-32.
2. Set screw holding cam follower pivot shaft, interposer bail pivot studs, and interposer setup bail pivot shaft should be tight.
3. Nuts on all cam follower bearing shafts and interposer setup bail pivot studs should be tight.
4. Check for wear, fretting corrosion, or lack of lubrication.

ADJUSTMENTS

1. Remove punch unit from machine.
2. With punch unit at room temperature, adjust so a .002" feeler gage (placed between the cam follower bearings listed below and their respective cam surfaces) experiences moderate drag at tightest point as cam shaft is rotated through one revolution. See Figure 3-33.
 - a. Punch bail complementary (top-inside) cam follower bearings.
 - b. Setup bail complementary (top-outside) cam follower bearings.
 - c. Punch bail active (bottom-inside) cam follower bearings.

NOTE: This adjustment does not apply to setup bail active (bottom-outside) cam follower bearings, because the 80 latch springs force these cam follower bearings to ride tight against their cam surfaces.

3. With cam follower bearings adjusted to .002" feeler gage, check that a .005" feeler gage will not pass freely between any cam follower bearing and its respective cam surface at any point around the cam circumference. If this .005" adjustment cannot be met, check to see that punch marks on the eccentric studs are up. The eccentric studs can be interchanged by mistake and the punch marks would be down. This would make proper

adjustment of the follower bearings impossible. See Figure 3-32.

TIMING

Caution: Do not operate machine with timing rod in punch unit.

1. Use timing rod 610077 to line up timing holes in cams with hole in punch unit left side frame.
2. Set punch index at 0°.

REMOVAL

1. Remove punch unit from machine.
2. Remove stripper assembly.
3. Remove two dowel pins in cam follower mounting plate. See Figure 3-32.
4. Remove four mounting screws. See Figure 3-32.
5. Separate cam follower assembly from punch unit.
6. Assemble in reverse order.

Interposer and Interposer Link

REMOVAL

1. Remove punch unit from machine.
2. Remove magnet unit from punch unit. It is not

HORIZONTAL REGISTRATION
ADJUSTING SCREW

VERTICAL REGISTRATION
ADJUSTING SCREWS (2)

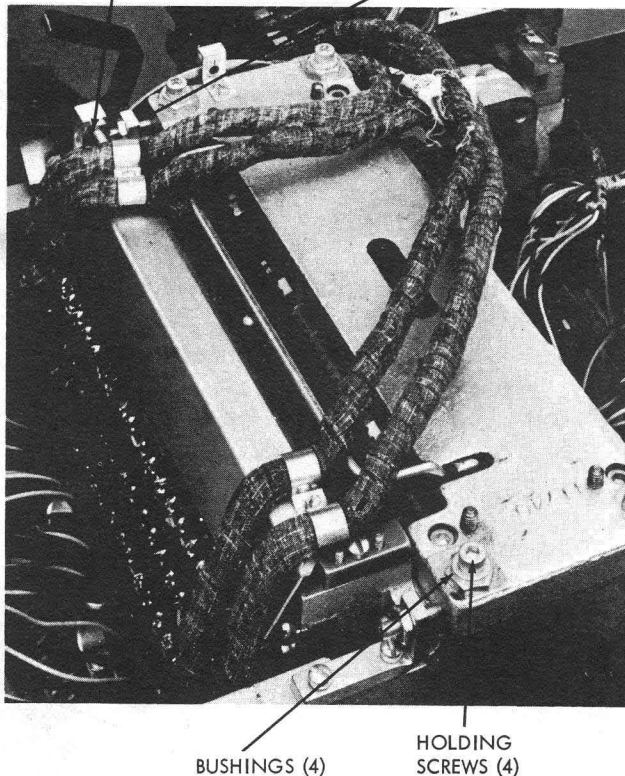


Figure 3-31. Punch Unit Adjusting Screws

necessary to remove the magnet bar assemblies.

3. Remove latch spring. See Figure 3-34.
4. Push latch to its lowest limit of travel. If this travel is not sufficient, remove the magnet bar assembly that contains the punch magnet controlling position to be removed.
5. Unhook interposer link from latch.
6. Remove interposer and interposer link.
7. Assemble in reverse order.

Interposer Guide Bar

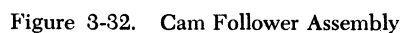
ADJUSTMENT

1. Remove punch unit from machine.
2. Check for .005" to .010" clearance between interposers and punch head.
 - a. With the punch magnet de-energized, insert .007" feeler gage between punch and interposer. See Figure 3-34.
 - b. Rotate punch unit camshaft through a complete revolution, and check that feeler gage experiences light drag at tightest point.
3. Adjust interposer guide bar.
 - a. Slightly loosen interposer guide bar clamping screws. See Figure 3-34.

- of stripper assembly to maintain punch registration when replacing on punch unit. Remove stripper assembly.

4. Set the drive unit on a flat surface and place gage 600914 as close as possible to right side frame. See Figure 3-33. Setup bail height must be gaged as closely as possible to drive unit side frame. Side frames must be in contact with surface on which gage is resting.
5. Turn punch unit camshaft until setup bail rests on top of gage. See Figure 3-33. Note index setting.
6. Remove gage without disturbing setup bail, and insert gage at left end of setup bail as closely as possible to left side frame.
7. Check index setting again to ensure that it has not changed since Step 5. The setup bail should rest on top of gage as in Step 5. Use eccentric stud at left end of bail to satisfy this condition. See Figure 3-33.

1. Remove punch unit from machine.
2. Remove punch magnet unit from punch unit. See Figure 3-35.
3. Mark or scribe a line on both ends and one side



8. Recheck adjustments after several rotations of punch unit camshaft. Setup bail height must be gaged as closely as possible to drive unit side frame. Side frames must be in contact with surface on which gage is resting. Careful adherence to these precautions and to the procedure outlined will result in bail parallelism within .003".

REMOVAL

1. Remove punch unit from machine. Refer to Figure 3-32 when performing Steps 2 through 8.
2. Remove cam follower assembly from drive unit.
3. Loosen set screws in collars on interposer setup bail pivot shaft, and on interposer setup bail.
4. Remove interposer setup bail pivot shaft.
5. Remove interposer setup bail pivot stud at column-one end.
6. Remove interposer setup bail.
7. Assemble in reverse order.
8. Check interposer setup bail adjustments.

Latch

REMOVAL

1. Remove punch unit from machine.
2. Remove magnet unit from punch unit. See Figure 3-35.
3. Remove magnet bar assemblies from magnet unit. See Figure 3-35.
4. Remove latch spring from latch. See Figure 3-34.
5. Push down on latch and unhook interposer link. See Figure 3-34.
6. Remove latch from magnet side of unit. It may be necessary to move latches next to the one being removed, in order to obtain sufficient room for removal. See Figure 3-36.
7. Assemble in reverse order.
 - a. Replace magnet unit on punch unit before replacing magnet bar assemblies.
 - b. Pull latches down to the lowest limit of travel by rotating the camshaft. This facilitates the installation of the magnet bar assemblies.
 - c. Position magnet bar against top of slot in magnet unit side frame.

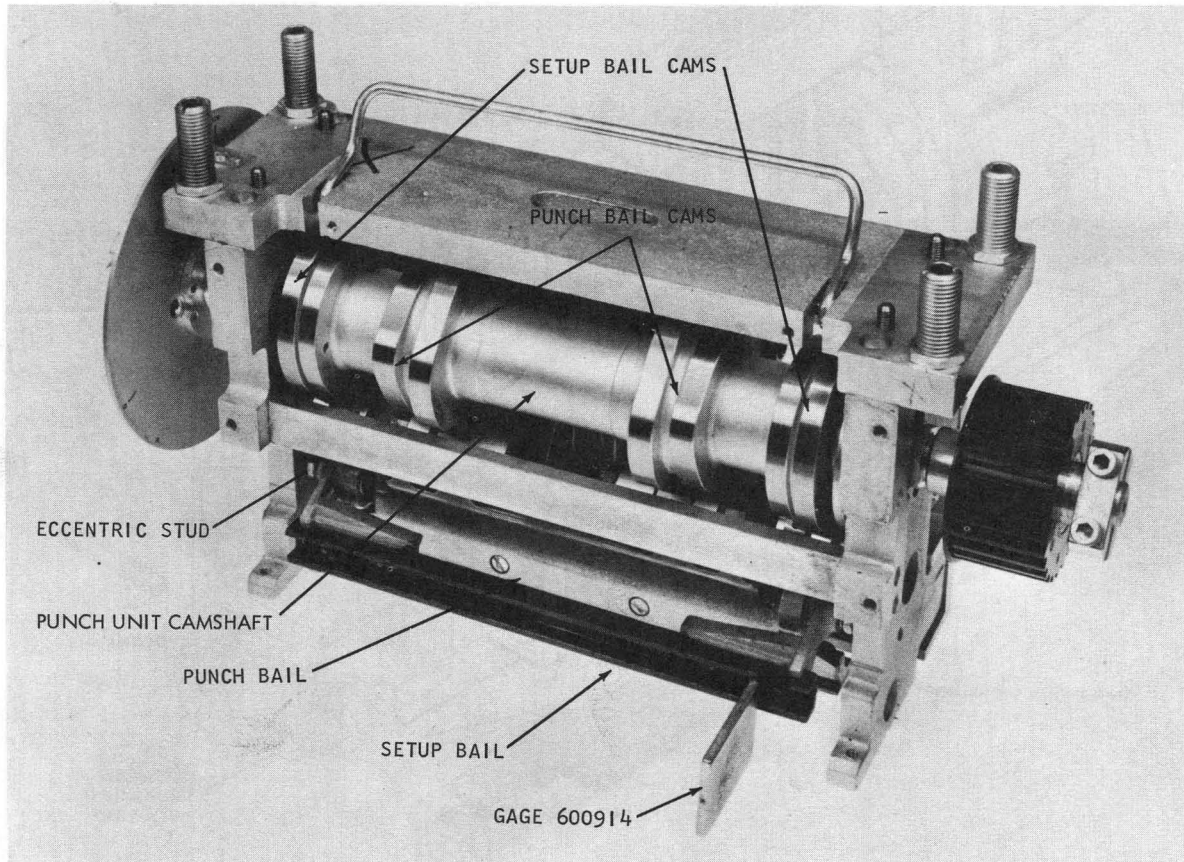


Figure 3-33. Drive Unit

Magnet Bar Assembly

REMOVAL

1. Remove magnet bar assemblies 2, 3, and 4 (counting from top to bottom). See Figure 3-35. *Caution:* Do not remove top bar with other three bars removed.
2. After inspection, replace bar assembly 4, and then 3. The four magnet bar assemblies should be installed tight against upper edge of mounting slots. Bar assemblies go in easier with latches in lowest position. Center magnet bar assembly so that nylon armature guide comb does not interfere with ears on latches.
3. Remove magnet bar assembly 1.
4. Replace magnet bar assembly 2, and then 1.

SERVICE CHECKS

1. Remove bar assembly and check armatures for

wear and for loose springs or rivets. Also check that armatures do not strike core.

2. Check between armatures and yokes for dirt and excess grease.
3. Make sure latches and latch guides do not bind.

ADJUSTMENT

1. Remove punch unit from machine.
2. Remove punch magnet unit from punch unit, if necessary.
3. Remove magnet bar assemblies from magnet unit.
 - a. Provide .002" to .004" clearance between armatures and cores. See Figure 3-34.
 - b. Check armature-to-pivot rod clearance. Set clearance between perceptible minimum movement to a maximum of .008" with operating end of armature held against yoke. See Figure 3-34.

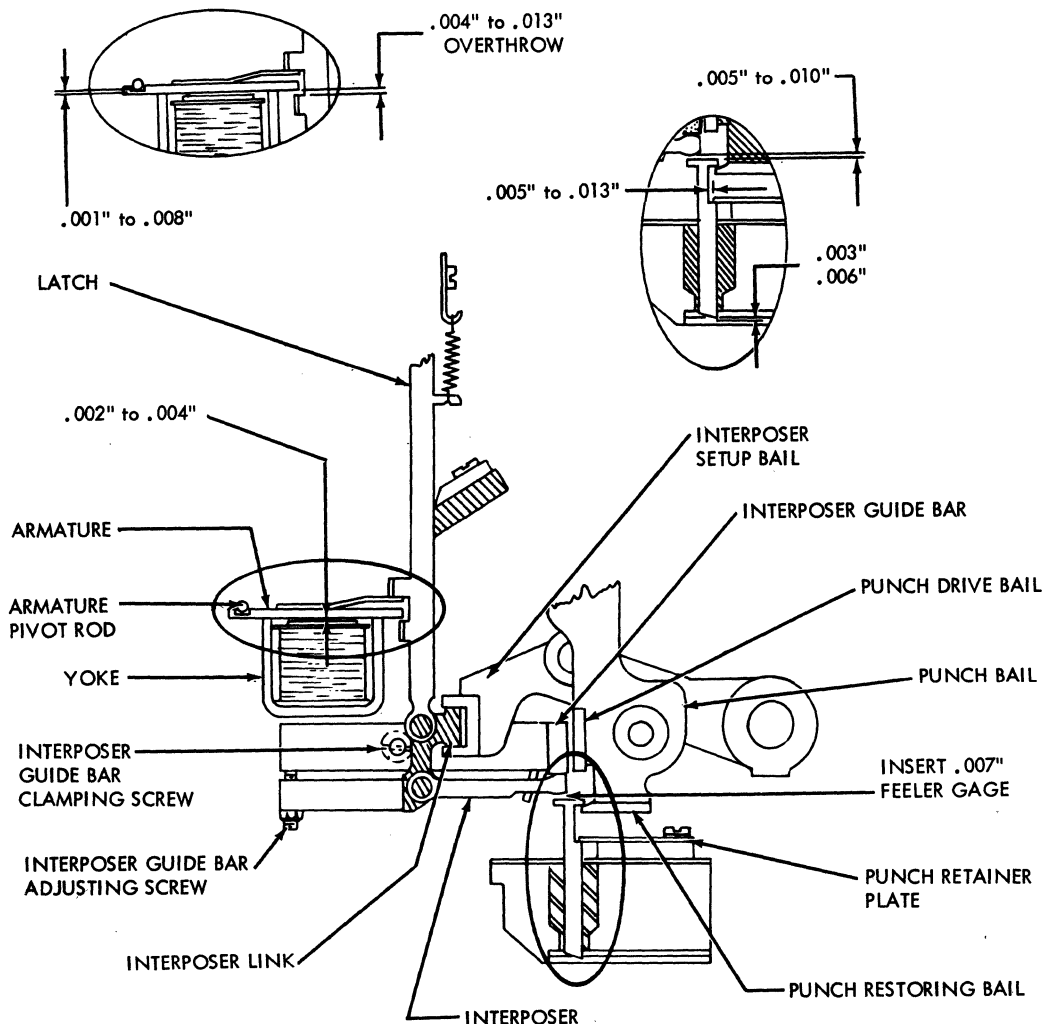


Figure 3-34. Punch Unit Adjustments

Magnet Unit

Adjustments to the magnet unit are made to ensure proper armature sealing.

ADJUSTMENTS

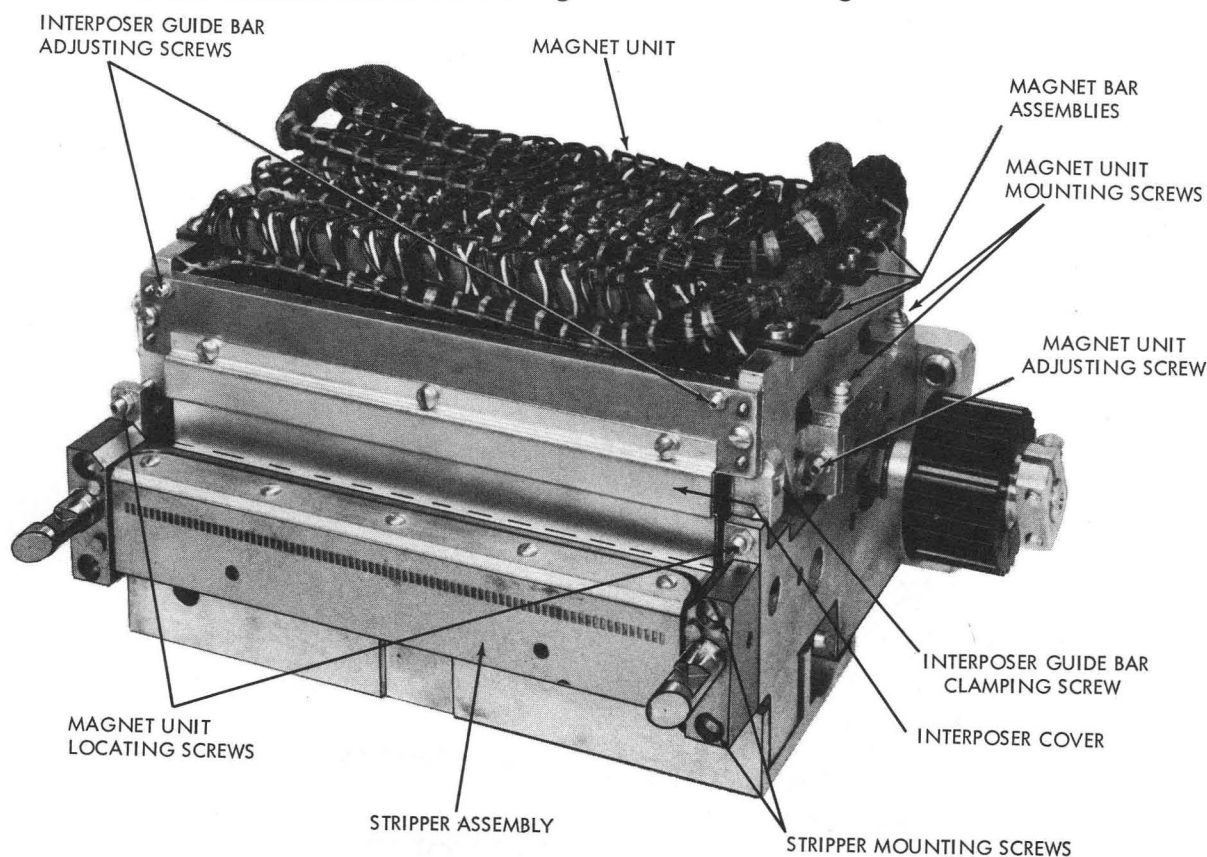
1. Remove punch unit from machine.
2. Turn punch camshaft until interposer setup bail is at lowest limit of travel.
3. Check .004" to .013" clearance between lower side of armature and latch at both column-1 and column-80 ends of unit. See Figure 3-34.
4. Adjust magnet unit on punch unit to obtain clearance.
 - a. Loosen magnet unit mounting screws. See Figure 3-35.
 - b. Loosen magnet unit adjusting lock nuts and adjust screws for .004" to .013" clearance between armature and latch. See Figure 3-34.

The magnet unit locating screws hold magnet unit against adjusting screws.

- c. With interposers centered over their respective punches, tighten mounting screws and recheck clearance between armature and latch.

REMOVAL

1. Remove punch unit.
2. Remove stripper assembly.
3. Remove interposer cover. See Figure 3-35.
4. Loosen magnet unit locating screws at each end of punch unit.
5. Remove four magnet unit mounting screws. Do not disturb magnet unit adjusting screws. See Figure 3-35.
6. Lift magnet unit off punch unit.
7. Use a rubber band to keep interposers from falling out.



1402 PUNCH MAGNETS
VIEWED FROM HOPPER

CABLE	A	80	76	72	68	64	60	56	52	48	44	40	36	32	28	24	20	16	12	8	4			
		B	79	75	71	67	63	59	55	51	47	43	39	35	31	27	23	19	15	11	7	3		
			78	74	70	66	62	58	54	50	46	42	38	34	30	26	22	18	14	10	6	2		
			77	73	69	65	61	57	53	49	45	41	37	33	29	25	21	17	13	9	5	1		
																							C	
																								D
																								CABLE

Figure 3-35. Punch Unit with Magnet Location Chart

REPLACEMENT

1. Position magnet unit as shown in Figure 3-36.
2. Align 80 interposers.
3. Carefully place drive unit on magnet unit so all 80 interposer links fit into interposer setup bail. See Figure 3-34.
4. Hold assemblies together; turn them over, and insert four magnet unit mounting screws. See Figure 3-35. Do not tighten these screws.
5. Tighten magnet unit locating screws and lock nuts.
6. Tighten magnet unit mounting screws.
7. Replace stripper assembly.
 - a. Check .004" to .013" latch overthrow. See Figure 3-34.
 - b. Check .005" to .010" interposer to punch clearance. See Figure 3-34.
8. Replace interposer cover.

Punch

REMOVAL

1. Remove punch unit from machine.

2. Remove stripper assembly.
 - a. Remove four mounting screws which hold stripper assembly to punch unit. See Figure 3-35.
 - b. Watch for shims which may be between stripper assembly and punch unit side frame.
3. Remove retainer plate from stripper assembly. See Figure 3-34.
4. Remove desired punch.
5. Assemble in reverse order.
 - a. Check for .005" to .013" punch-to-retainer-plate clearance before re-assembling stripper to punch unit. See Figure 3-34.
 - b. Check for .005" to .010" interposer-to-punch clearance. See Figure 3-34.

Stripper Assembly

REMOVAL

1. Remove punch unit from machine.
2. Scribe a line on both ends and one side of stripper assembly to maintain punch registration when replacing on punch unit.
3. Remove four screws and remove stripper from punch unit.

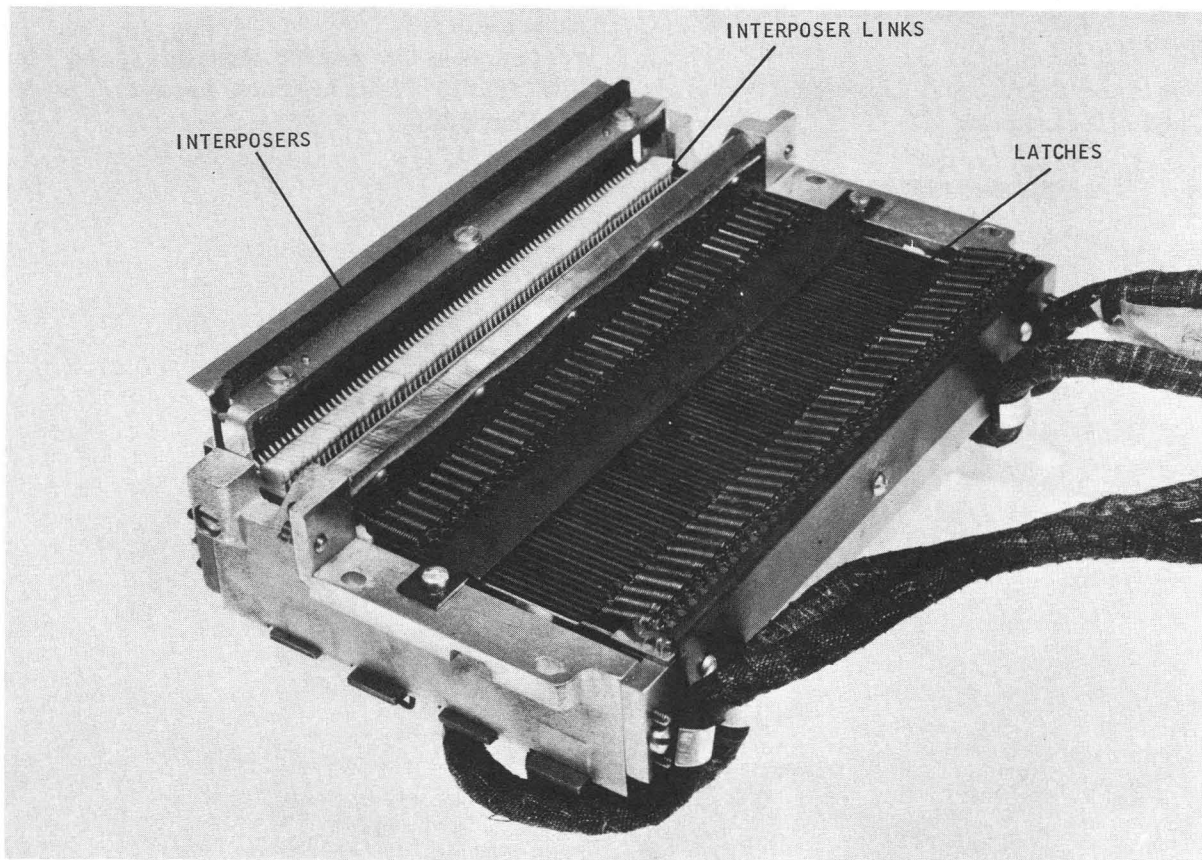


Figure 3-36. Magnet Unit

REPLACEMENT

1. Re-install stripper assembly in original position on punch unit.
2. Check that toes of punches retract .003" to .006" into stripper. See Figure 3-34. Adjust by adding or removing shims 437964 between the stripper assembly and punch unit side frame. (Shim 437964 is .003" thick.)
Caution: If toes of punches retract more than .006" within stripper, heels of punches may shear stripper plate.
3. Adjust retainer plate for .005" to .013" clearance between plate and punches. See Figure 3-34.

Transport and Stackers

Chute Blade and Selector Magnet

SERVICE CHECKS

1. Check for fretting corrosion or rust, and excessive wear at select magnet armature pivot. See Figure 3-37.
2. Check for dirt or oil between armature and magnet core piece.
3. Check for loose screws in armature stop, chute blades, and deflector spring.

ADJUSTMENTS

1. Lower control key and indicator light panel by loosening four screws.
2. Adjust chute blades, with chute blade mounting screw, for $1/32" \pm 1/64"$ clearance between end of lower chute blade and lower card guide plate. See Figure 3-38.
3. With pocket selector magnet armatures attracted, adjust each armature for $.035" \pm .003"$ clearance between upper part of armature and stop. See Figure 3-37.
4. Adjust selector magnet assembly (by means of the mounting screws) to position the chute blades $1/32" + 1/64" - 0$ above card line when the magnets are not energized, and $1/32" + 1/64" - 0$ below the card line when the magnets are energized. See Figure 3-37.
5. Adjust chute blade tension so that a force of 150 to 350 grams, applied to the 2 or 8 selector magnet armature at a point just under armature backstop, holds the armature fully attracted. A force of 75 to 200 grams should hold select magnet 1 or 4 armatures fully attracted. See Figure 3-37.
6. With chute blade removed and held on flat surface, tab, containing chute blade mounting screw hole, should project $1/8" \pm 1/64"$ above flat surface.
7. Position selector magnet deflector spring for .005" to .010" clearance above lower card guide. See Figure 3-37.

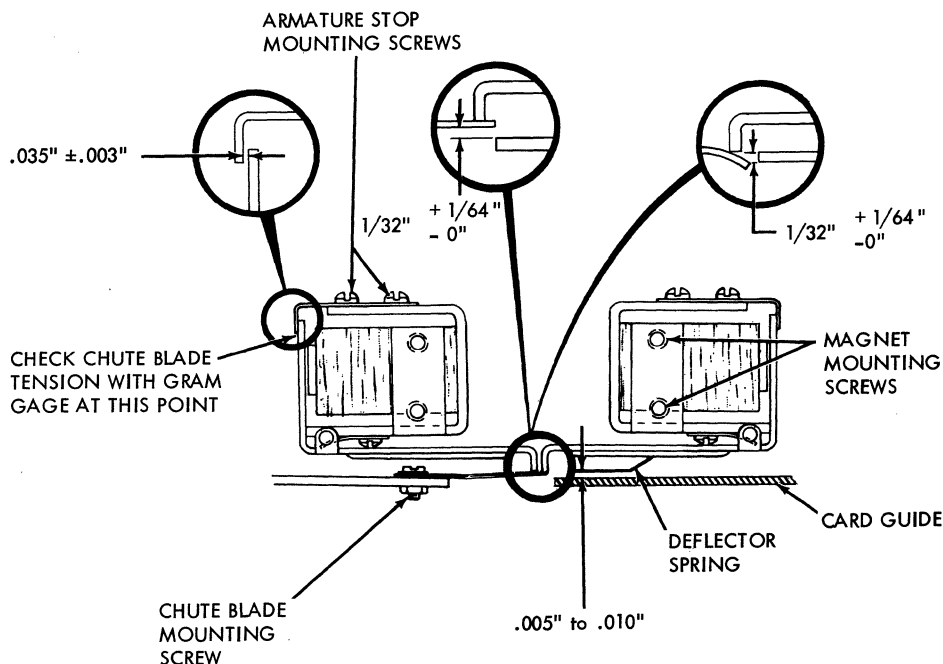


Figure 3-37. Chute Blade and Select Magnet Adjustments

Transport Rolls

ADJUSTMENTS

There are two types of lower tension rolls in use. Some use coil springs for tension, others use rubber blocks. The rubber block style employs a lock nut under the shear plate; the coil spring style uses a self-locking nut, which must be held with a wrench when it is being adjusted.

1. Lower pressure rolls must be centered directly below upper rolls. This can be done by inserting a .010" feeler gage between upper and lower rolls and adjusting lower roll mounting brackets until feeler gage is parallel to card line.
2. Tension on pressure rolls is adjusted by lower feed roll shaft mounting screws. A pull of 1.5 to 2.5 lbs. must be present when a card strip is pulled from between rolls (upper roll not turning). Tension on front and rear rolls should be within .25 lbs. Card must be pulled in the same direction as it is fed. Push-pull scale 9900012 may be used. After adjustment is made, be sure lock-nuts on the mounting screws are tight.

Jam Bar

SERVICE CHECKS

1. Check jam bar for correct operation.
2. Inspect jam tape for burrs.

ADJUSTMENTS

1. A jam bar must be positioned for .020" to .035" clearance between formed points and shear plates over entire length of card transport. At the junction of jam bar and jam bar lever, a .015" minimum is permissible. See Figure 3-39.
2. Tape must be adjusted so switch will operate with tape deflection of $1/16"$.

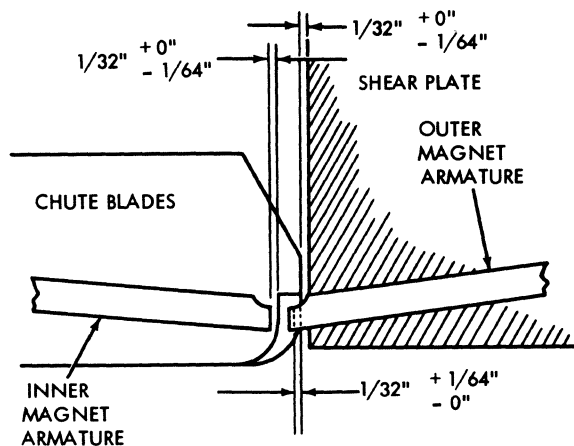


Figure 3-38. Chute Blade, Top View

3. Jam bar lever must be adjusted so bottom surface of shoe is $1/8" \pm 1/16"$ above lowest point of adjacent deflector springs.

Stacker

SERVICE CHECKS

1. Stacker card restraining and retaining levers must be clean and free of binds.
2. Card alignment levers should hold 5 to 30 cards before cards slip onto card pusher slide. See Figure 3-40.
3. Pusher and card support slides must be free of binds.

ADJUSTMENTS

1. Space between pocket separators must be $3 \frac{5}{16}" \pm 1/64"$.
2. Pocket separators must be square with transport rails within .015".
3. Form radial guide as in Figure 3-41.

Stacker Joggler

ADJUSTMENTS

1. Align four bearing bracket assemblies so the three shafts are free of binds.
2. Maintain $4.000" \pm .005"$ between bases of two inside bearing brackets. See Figure 3-42.
3. With center shaft assembly shifted toward read feed, and clutch hubs flush with spring sleeve, adjust clutch hub, identified by a red dot, for .003" to .005" clearance when spring sleeve is flush against mating hub.

Electrical Components

Solar Cell CB

The solar cell CB is mounted on the back end of the

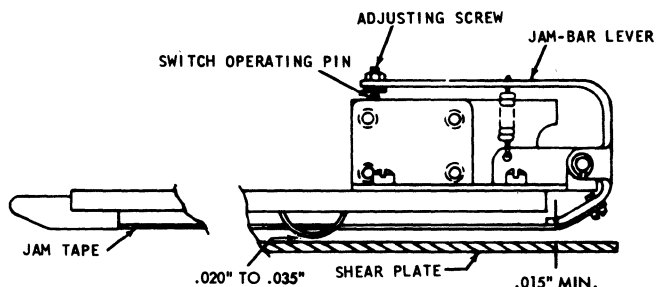


Figure 3-39. Jam Bar

the read feed picker knife cam shaft (Figure 3-43). This unit replaces RLCB's 4, 5, 6, 7, 8 and 9 on Model 1 machines. The solar cell CB is also used on the Model 3. The Model 2, however, uses mechanical circuit breakers.

SERVICE CHECKS

Caution: When a scope or meter is used, be careful not to short between SMS card terminals.

1. Control voltages from external supplies should be checked on SCTB 5, 6, 9 and 10. See Figure 3-44.
2. Check impulse duration for $3\frac{1}{2}^{\circ}$ to 4° on cold machine; 2° to $3\frac{1}{2}^{\circ}$ after one hour of machine operation.

TIMING

1. Set cam selector switch on CE aid panel to position 1. (Brush selector switch off.)
2. While depressing the non-process runout key, adjust the duration of CB pulse with potentiometer on the relay gate transistor panel, for $3\frac{1}{2}^{\circ}$ to 4° (700 to 800 μ s with a scope at SCTB1) on read dynamic timer dial. Final duration adjustment of 2° to $3\frac{1}{2}^{\circ}$ (400 to 700 μ s with a scope) should be made after one hour of power on.

Note: If adjustment is obtained, skip to step 8.

3. Visually check that disk is centered laterally in the slot in solar cell mounting block. Adjust if

necessary by loosening set screws and repositioning spindle on picker knife camshaft. Refer to Figure 3-44.

4. Set the potentiometer to give 1.8 v across lamp terminals (SCTB 4 and SCTB 6). This voltage is used to peak the solar cell output.
5. Remove machine power.
6. Unplug solar cell leads from SCTB 2 and SCTB 8 and connect to an IBM meter (yellow lead plus). Set the scale to a reading capable of measuring values from 0 to 500 μ a (.5 ma).
7. Manually trip clutch; bring power up and hand crank read feed to a digit CB time (disk slot opposite solar cell). Crank machine slowly to avoid passing index points where meter deflection occurs. A minimum of 150 μ a should be observed. Reposition and/or replace lamp or solar cell assemblies to obtain required output. See Figure 3-45. Return to Step 2 if lamp has been repositioned or replaced.
8. With power removed, and reader cranked to 9-time, a basic timing can be obtained by loosening disk retaining screw and rotating the disk until 9-time slot is opposite the light source. Refer to Figure 3-44.
9. To adjust the timing of the cell accurately, loosen the mounting plate screws (Figure 3-44) and rotate the mounting plate within the mounting slots. Check make and break time of CB pulses

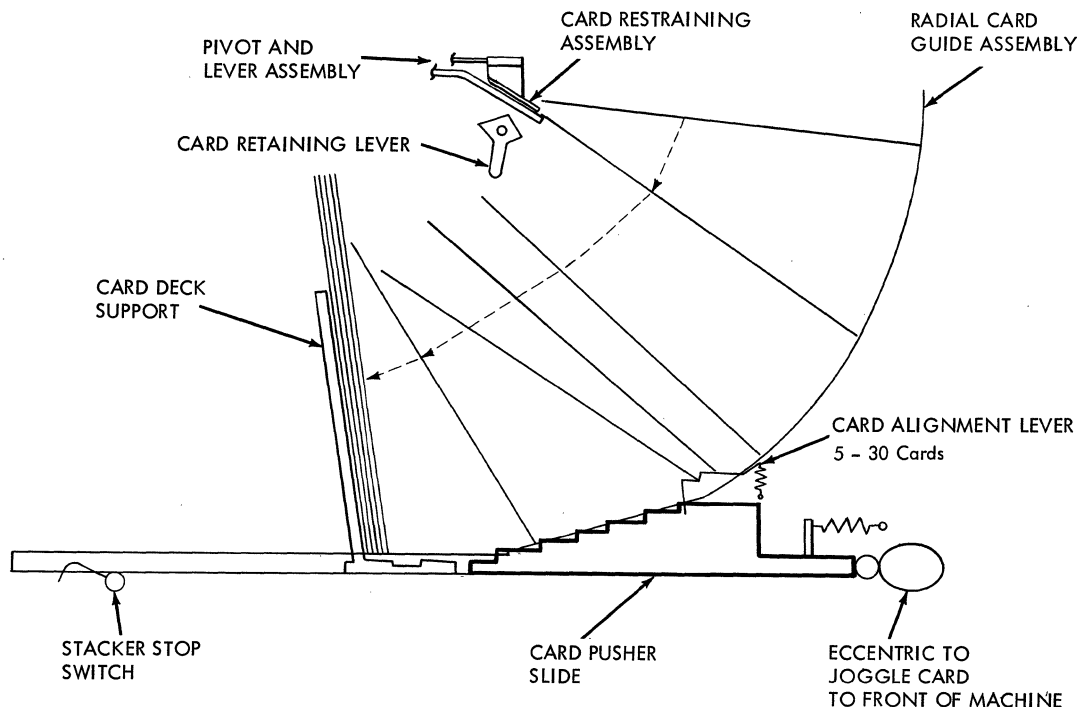


Figure 3-40. Stacker Schematic

ADJUSTMENT OF RADIAL STACKER CARD GUIDES

MALFORMED RADIAL CARD GUIDES CAN BE A CAUSE OF CARD JAMMING. THESE GUIDES SHOULD BE FORMED ACCORDING TO THE ILLUSTRATED PROFILE. DO NOT DISTORT THIS PROFILE TO ACCOMPLISH INSTALLATION.

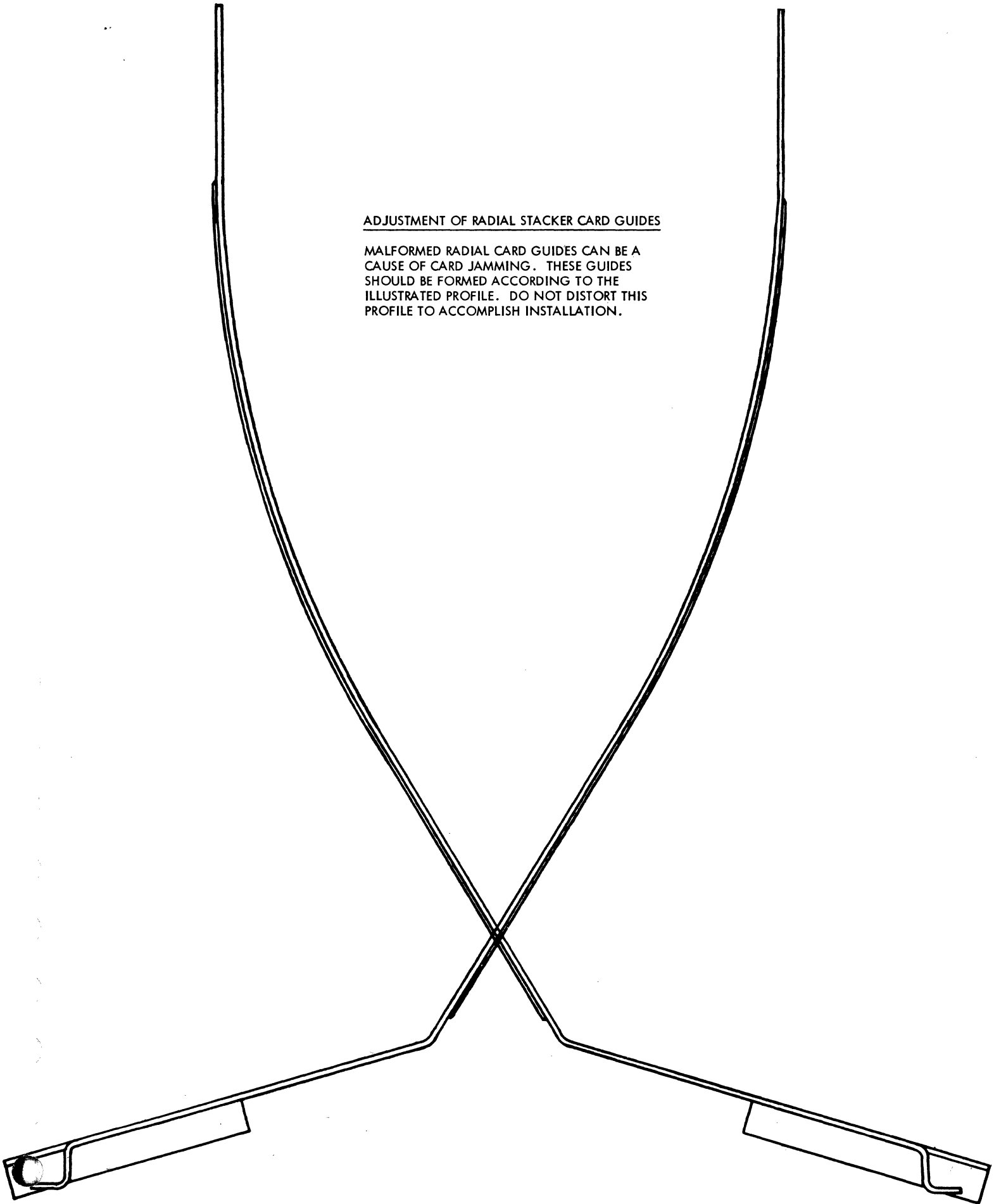


Figure 3-41. Radial Card Guide Outline

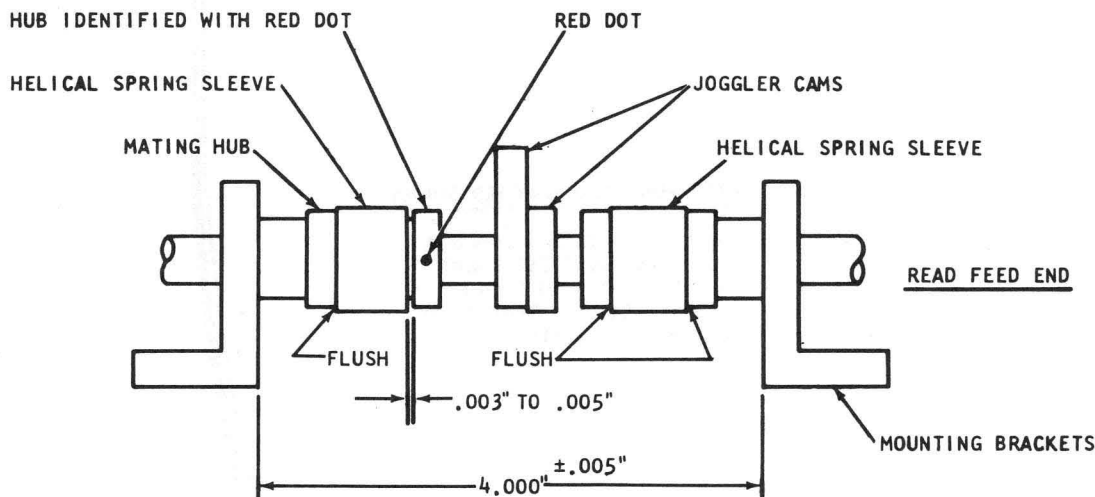


Figure 3-42. Center Stacker Joggler Assembly

at several digit times on timer. If the mounting plate slotted hubs do not allow proper adjustment, repeat Step 8.

Lamp Assembly

REMOVAL AND REPLACEMENT

1. Remove machine power.
2. Loosen two contact strap screws until lamp can be slid out of lamp holder. Unplug lamp lead from SCTB 6 and remove. Refer to Figure 3-44.
3. Reinstall lamp by plugging lamp lead into SCTB 6 and inserting lamp to its full depth into lamp holder. Retighten contact strap screws.
4. The lamp holder mounting screws must be loosened to permit the plastic lamp holder to be

shifted. This will permit the lamp base to seat firmly in the holder with the lens end fully seated against hole in solar cell mounting block. Refer to Figure 3-45.

5. Check solar cell output by setting lamp terminal voltage at 1.8 and measuring a minimum of 150 μ a across cell at any index point. Cell output may be peaked by rotating lamp in holder.

NOTE: Depress the end of the contact strap to relieve pressure. This will permit rotating and/or re-seating of lamp. It may be necessary to reposition lamp holder after rotation (Step 4).

Solar Cell Assembly

REMOVAL AND REPLACEMENT

1. Remove machine power.
2. Loosen set screw and remove solar cell assembly. Unplug solar cell leads from SCTB 2 and SCTB 8. Refer to Figure 3-44.
3. Reinstall solar cell assembly by inserting cell into cell mounting block and leaving approximately $\frac{1}{4}$ " of the metal sleeve exposed above the cell mounting block. Position the scribed locating mark so that it points toward the light source. Refer to Figure 3-44.
4. Connect solar cell leads to meter. Check output by setting lamp terminal voltage at 1.8. At an index point, measure for a minimum of 150 μ a across the cell (see Step 7 in solar cell timing procedure). To avoid damaging cell, use care when tightening cell retaining set screw. Refer to Figure 3-44.
5. Plug the solar cell leads into SCTB 2 (yellow lead) and SCTB 8.

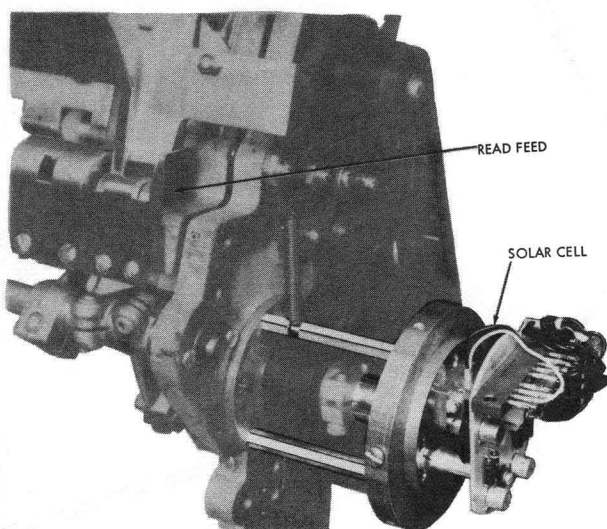


Figure 3-43. Solar Cell Position

Component Card Assembly

REMOVAL AND REPLACEMENT

1. Remove machine power.
2. Unplug (identify if necessary) the leads in the solar cell terminal block.
3. Remove the lamp holder mounting screws and lower component card mounting screw. Remove component card assembly.
4. To reinstall, replace the lamp holder and mounting screws. Adjust the lamp for proper position. See *Lamp Assembly, Removal and Replacement*, Step 4.
5. Plug all leads into terminal block.

Permissive Make Relays

The 1402 uses four and six-position high speed and

standard permissive make (PM) relays. All 1402 PM relays have 20 volt coils.

CONTACT REPLACEMENT

When a machine malfunction is caused by PM relay contacts failing to make, it may not be necessary to replace the entire relay. The following procedure should be used to replace individual contact wires, and to check common contacts for dust or corroded areas.

1. Remove the two relay yoke mounting screws and separate the contact molding assembly from the yoke assembly. This will expose the contact wires and common contacts. Use care to prevent breakage of coil wires from relay molding. Refer to Figure 3-46.
2. Using a screwdriver, press the contacts free of

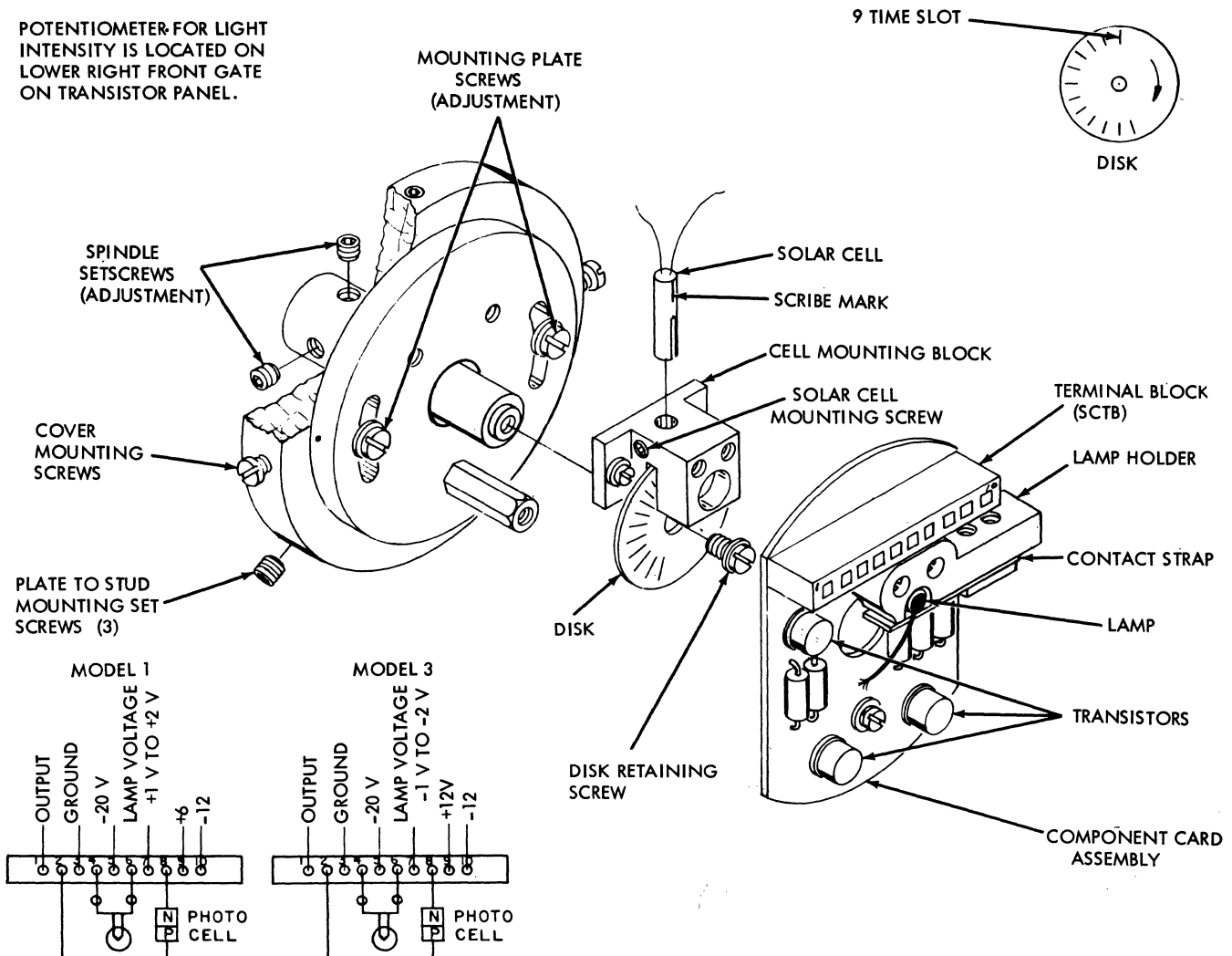


Figure 3-44. Solar Cell Adjustments

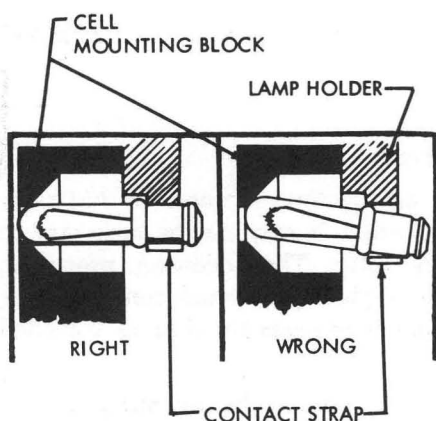


Figure 3-45. Solar Cell Lamp Position

- the locating hole and remove them from the molding.
3. Inspect the common contact point for dust or corrosion film. If necessary, lightly burnish the point. Do not attempt to clean the common contact if it is pitted or burned. This will result in increased air gap and loss of contact tension.
4. Check new contacts for correct configuration before installing. Refer to Figure 3-47.
5. Install new contact wires, one at a time, to avoid twisting.
6. Re-assemble yoke to contact molding assembly. The armature must be centered on the contact wires with equal dimensions between the end contacts and the ears of the molded armature actuator. Be certain that the yoke is held tightly against the mounting pads.
7. Check that wires are not crossed or misplaced

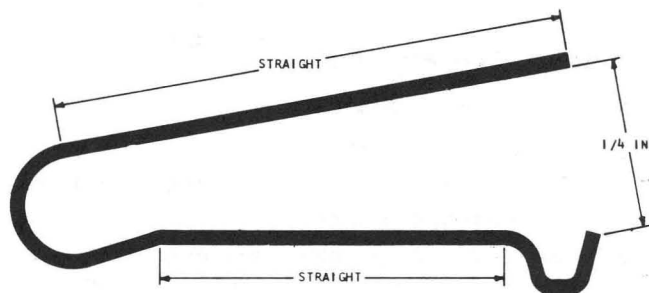


Figure 3-47. PM Relay Contact Wires

from the locating hole. Check for freedom of armature and coil leads and proper seating of armature pivot springs. Check the operation of relay contacts with the dynamic timer or oscilloscope.

Circuit Breakers

The RCCB's, RLCB's, PACB's and PLCB's are a plunger-type CB. If either point becomes burned on these assemblies, replace the entire assembly. The PCCB's are the unitized rocker type. The stationary arm of the CB has a removable contact point. However, if the operating arm contact point becomes burned, the entire contact assembly must be replaced. Stoning or cleaning of any of these cam contact surfaces is not practical.

Certain positions of the RLCB's and PACB's require circuit breakers with silver contact points. The silver points minimize "failure-to-make" problems as were previously encountered with tungsten points.

Caution: The silver point circuit breakers, identified by a white paint marking, must only be used in low-current applications. Use in other than specified

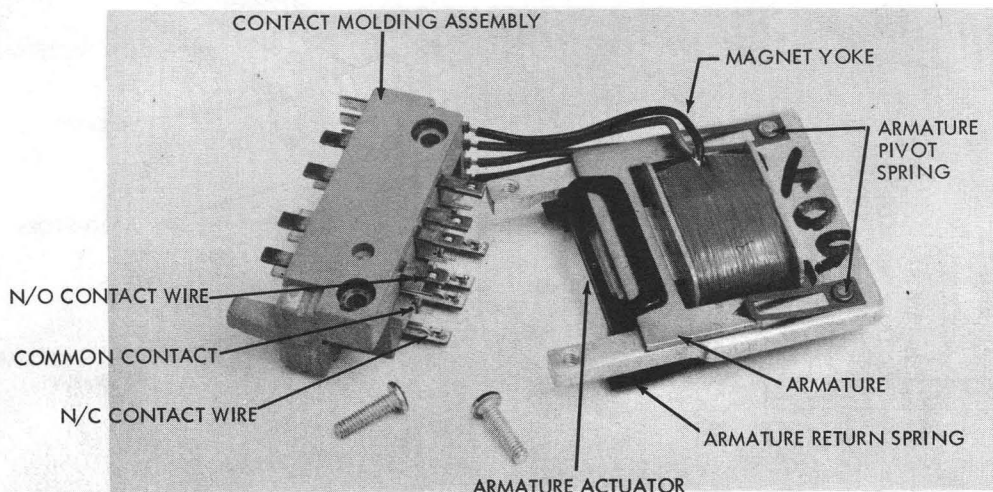


Figure 3-46. PM Relays

positions will lead to early failure, because of burning, and can cause noise problems in the processing unit. Machines equipped with a solar circuit breaker on the RL shaft will have only three RLCB's.

PACB's

These adjustments and procedures apply to machines that have PACB's.

ADJUSTMENTS

1. Scribe outline of mounting bar on PACB unit side frame.
2. Remove bar and CB's.
3. Inspect, clean and lubricate CB's as required.
4. Reposition bar in PACB unit on scribed lines.
5. Recheck CB timings to wiring diagram.

SCOPE PROCEDURE

This procedure is used for checking PACB's on a 1402 used with an IBM 1401 Data Processing System.

1. Manually program a punch and branch loop instruction. Enter 12 through 9 in locations 101 to 112.
2. Meter PACB's 9 and 10 to ensure correct make time, and duration.
3. Sync scope on - *T Brush Impulse* at integrator in 1401. See Logic 36.21.11.2.
4. Set time base of scope for 2 ms per division. Each division of the scope will then be 16° of the PACB unit. (Refer to Figure 3-49 when performing this and the following steps.)
5. Scope brush impulse CB's. Pulses should occur exactly 15 ms apart. This is to check the speed of the PACB unit and must be correct for this procedure to be accurate. Adjust as closely as possible with the split pulley on the punch drive motor. See Logic 36.21.11.2.
6. Scope - *T Punch Scan CB* and + *U Not Latch Reset*; See Logic 36.21.11.2.
7. Scope PACB 5, 6, 7, and 8 at PMT common in 1402.

8. Change time base and sync as desired to more closely check for bounce and duration of individual CB's.

The main purpose of this procedure is to reduce diagnostic time. If a 1401 has any of the following symptoms, check the denoted CB's for bounce, duration, and relation to other CB's.

SYMPTOMS	CHECK
1. Extra or missing punch scans.	1 & 2, 3 & 4, 11 & 12 or 5 through 8
2. Dropping punches.	5 through 8
3. Lacing columns or under-punching.	3 & 4 or 11 & 12
4. Dropping punches in the first few columns.	3 & 4 to 1 & 2*
5. Erratic punching or half-punching 9-edge of card.	1 & 2
6. Intermittent punch checks.	9 & 10
7. Changing characters in punch area.	1 & 2
8. Any random errors following or seemingly associated with a punch operation.	3 & 4 to 5, 6, 7 and 8

*Indicates timing relation of impulses.

Use of this procedure as a PM routine is recommended. To check for bounce or duration of individual pulses, sync scope-internal on pulse desired.

Magnetic PA Emitter

These timings and adjustments apply to machines that have the magnetic PA emitter installed.

TIMING EMITTER DISC

1. Loosen emitter disc locking screw.
2. Align emitter disc timing hole with timing holes in machine frame and punch cam shaft. Insert timing pin in the aligned holes.
3. Position emitter disc horizontally, so disc magnet is opposite number three coil pole (Figure 3-49A, Insert A).
4. Tighten emitter disc locking screw.

ADJUSTMENT OF EMITTER COILS

1. Position emitter housing for .062" ± .020" between emitter housing and emitter disc (Figure 3-49A).
2. Adjust coils for .013" ± .012" between coil pole tips and emitter disc.

Figure 3-48. (Deleted)

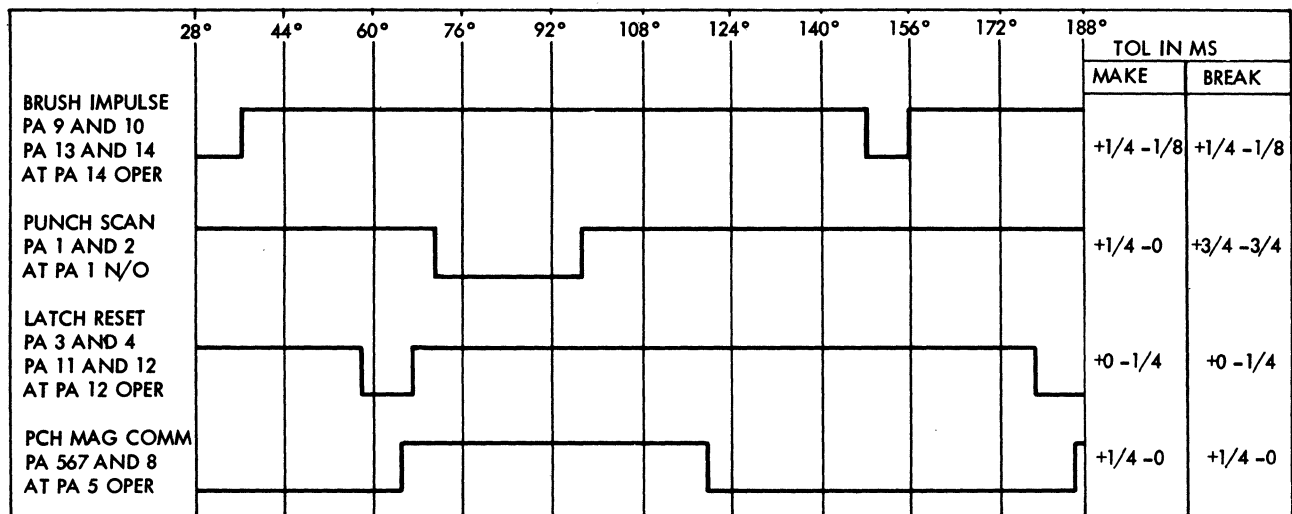


Figure 3-49. PACB Scope Pictures

Open Strap Contacts

ADJUSTMENTS

1. Adjust all contacts for 1/32" minimum air gap.
2. Position all card lever contacts to give a minimum of .020" movement of both contact points when the card lever is operated by a card.
3. Bounce may occur within the make and break tolerance of the card lever if the solid make and break is within wiring diagram tolerance.

RT and PT Relay, Model 3

ADJUSTMENTS

Adjust the drop out time of each relay so that the respective motor will continue to run for 30 seconds after the last card feed cycle. Potentiometers for adjusting the delay are mounted on the signal fuse bracket, (under the read feed) toward the rear of the machine.

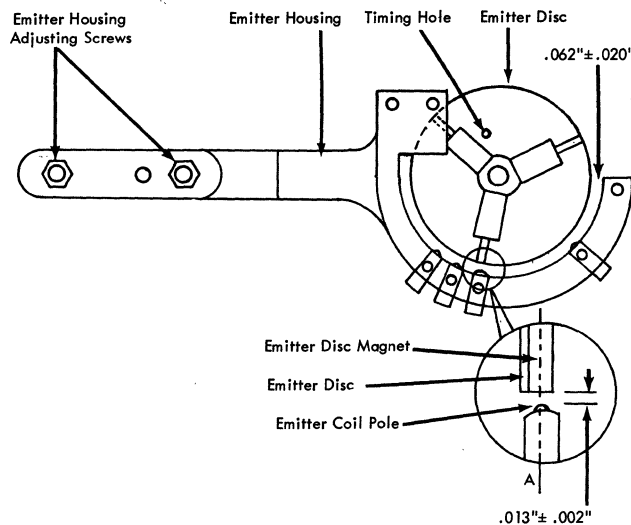


Figure 3-49a. PA Emitter Assembly

Punch Emitter, Model 2

This is a contact-type emitter, with contacts mounted around a molded block, and actuated by push rods. The push rods are operated by a roller, fastened to a rotor arm. The device is self-centering.

ADJUSTMENTS

1. Form contacts to obtain .006" to .008" air gap when roller is off the push rod.
2. Set duration of each contact for 13° to 17° by adjusting the rotor roller eccentric. See Figure 3-50. Duration is most easily set by commoning all contacts, and reading continuity from common to each contact with the dynamic timer.
3. Loosen locking screw on rotor and position rotor on shaft for correct timing according to wiring diagram. Retighten locking screw.

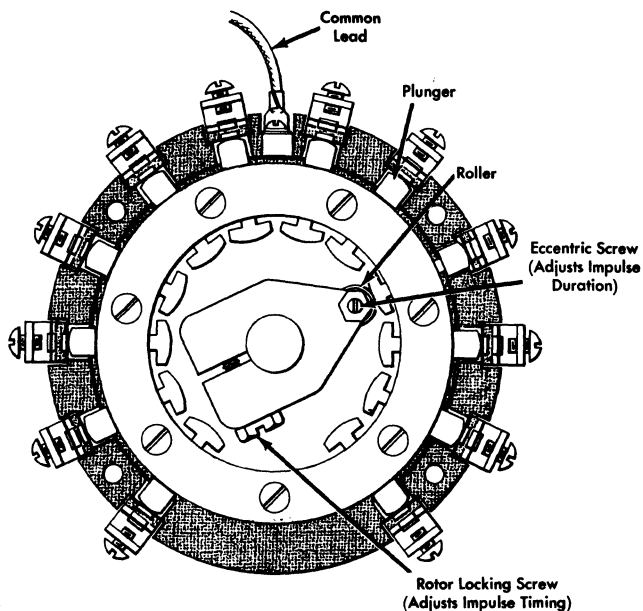


Figure 3-50. Contact Emitter

Power Supplies, Models 1 and 6

Models 1 & 6 contain two DC supplies and two AC supplies. In addition, three DC voltages are brought in for the solar cell CB circuits.

Most of the supplies listed can be measured at test hubs on the CE aid panel, but the two AC supplies must be measured at the supply. Measure the 115v AC across terminals one and two; the 130v AC supply across terminals six and eight. Acceptable voltages are shown in Figures 3-51 and 3-52.

SUPPLY VOLTAGE	TOLERANCE		CURRENT
	AT SUPPLY	AT POINT OF USE	
-20V DC*	± 2%	± 4%	15 AMPS
-60V DC **	±10%	±10%	10 OR 20 AMPS
130V AC	±5%	±10%	1250 WATT FERRO RESONANT
115V AC	±10% AT TRANSFORMER		20 AMPS

* THE 20 VOLT SUPPLY MUST BE SET AT 21 VOLTS.

** 60 VOLT SUPPLY NOT USED ON MODEL 4 & 5.

Figure 3-51. Models 1 and 6 Internal Supplies

SUPPLY VOLTAGE	TOLERANCE	
	AT SUPPLY	AT POINT OF USE
-12V DC	±2%	±4%
+30V DC	±2%	±4%
+6V DC	±2%	±4%

Figure 3-52. Models 1 and 6 External Supplies

Power Supplies, Model 2

The Model 2 contains four DC supplies and one AC supply. In addition +6v DC is brought into the read circuits. All listed voltages can be measured at CE aid panel test hubs except the +12v DC and 130v AC, which are measured between terminals six and seven and terminals six and eight of the respective supplies. Acceptable voltages are shown in Figure 3-53.

SUPPLY VOLTAGE	TOLERANCE		CURRENT
	AT SUPPLY	AT POINT OF USE	
-12V DC	±1%	±2%	20 AMPS
+12V DC	±1%	±2%	4 AMPS
-20V DC	±8%	±10%	6 AMPS
-60V DC	±10%	±10%	10 OR 20 AMPS
130V AC	±5%	±10%	1840 WATT FERRO RESONANT

Figure 3-53. Model 2 Internal Supplies

Power Supplies, Models 4 and 5

Models 4 & 5 contain one DC supply and two AC supplies. Three other DC voltages are brought in for the solar cell CB units. The -60v, DC supply is not mounted in the Models 4 & 5.

Motors

The Model 3 read and punch motors are equipped with thermal cutouts. The cutouts are reset manually by depressing a button on the rear of the motor.

Redesigned Punch Feed

Machine with the redesigned punch feed can be identified by the absence of the lowering frame.

Card Guides

All card guides except those included in the following adjustments are prelocated. No adjustments are required when removing and replacing the prelocated card guides.

ADJUSTMENTS

1. Check that hopper back plate guide is .008" above the card line.
2. Loosen screws on tie bar on the first lower card guide and shift the bar to obtain .020" to .050" clearance between the lower card guide and the hopper back plate guide (Figure 3-54).

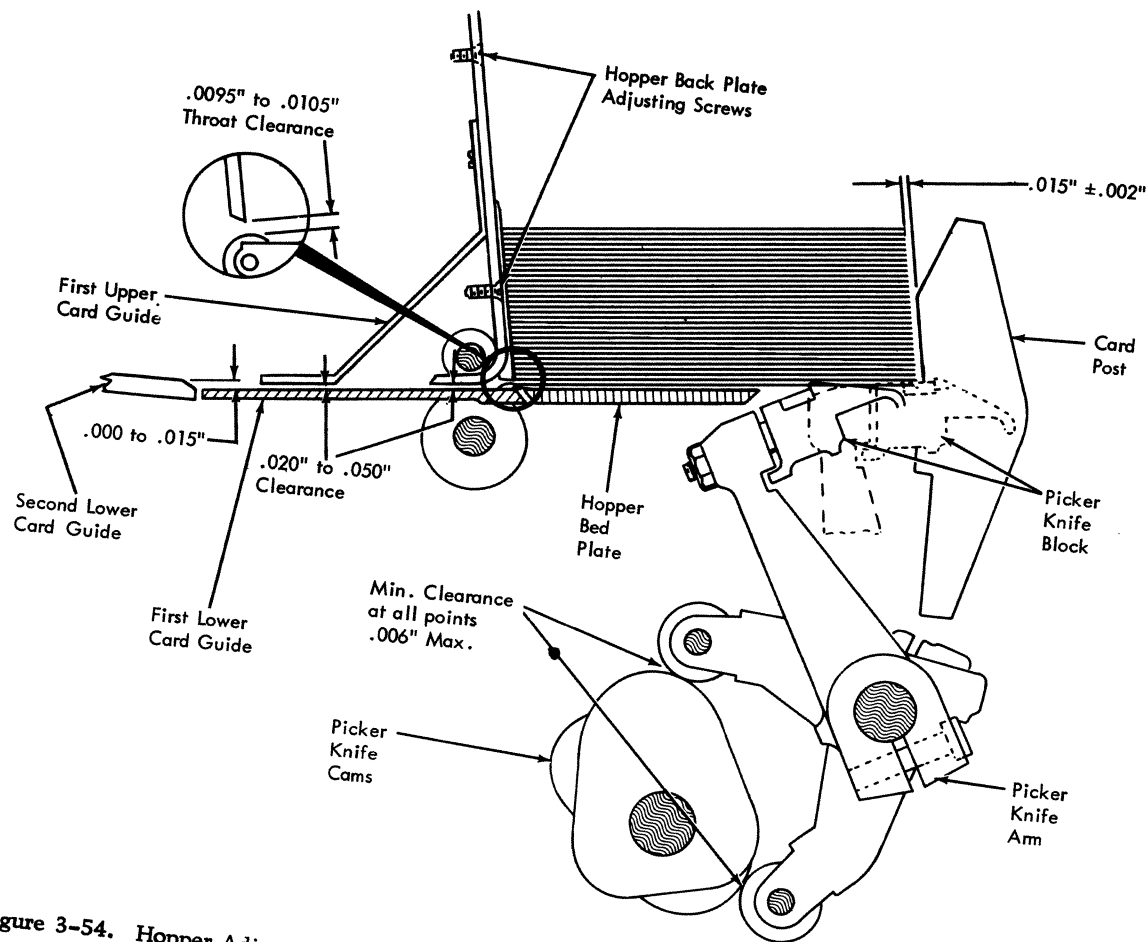


Figure 3-54. Hopper Adjustments

The leading edge of the first lower card guide should not be above the point of contact of the first, upper and lower feed rolls. The trailing edge of the first lower card guide should be flush within .015" below the second lower card guide (Figure 3-54).

3. Position the first upper card guide for .020" to .050" clearance between it and the first lower card guide. Adjust by loosening screws in mounting bar and shifting guide to desired position (Figure 3-54).
4. Position the second upper card guide to obtain a .012" to .025" clearance at the edge above the forward aligner, and a .012" to .030" at the edge towards the punch unit.
5. The sixth lower card guide is adjusted for .003"-.010" clearance between the edge of the plastic guides and the contact roll.
6. Adjust the card guide on the stacker contact bracket for a .012" to .050" clearance to the lower card guide.
7. Time the stacker contact to the machine wiring diagram.

Punch Transport Timings

Feed Roll Timing Check

NOTE: The feed roll and aligner station procedures should not be used as final adjustment procedures. These methods are intended only as a means of checking the timing of the first and second stepped feed rolls, first and second intermittent feed rolls and card aligners. It is not necessary to remove the punch unit from the machine.

Danger: Be sure all power has been removed from the machine.

FIRST AND SECOND, STEPPED ROLLS (FIGURES 3-55)

1. Trip clutch and turn machine to 0°. (At this time, the geneva can be dented to hold the timer at 0°).
2. The stepped-roll timing gage (Figure 3-56) should fit on the flat ends of the stepped-roll shafts.

FIRST AND SECOND INTERMITTENT ROLLS

1. Pivot hopper out. Remove PFR brushes, and punch check brushes.

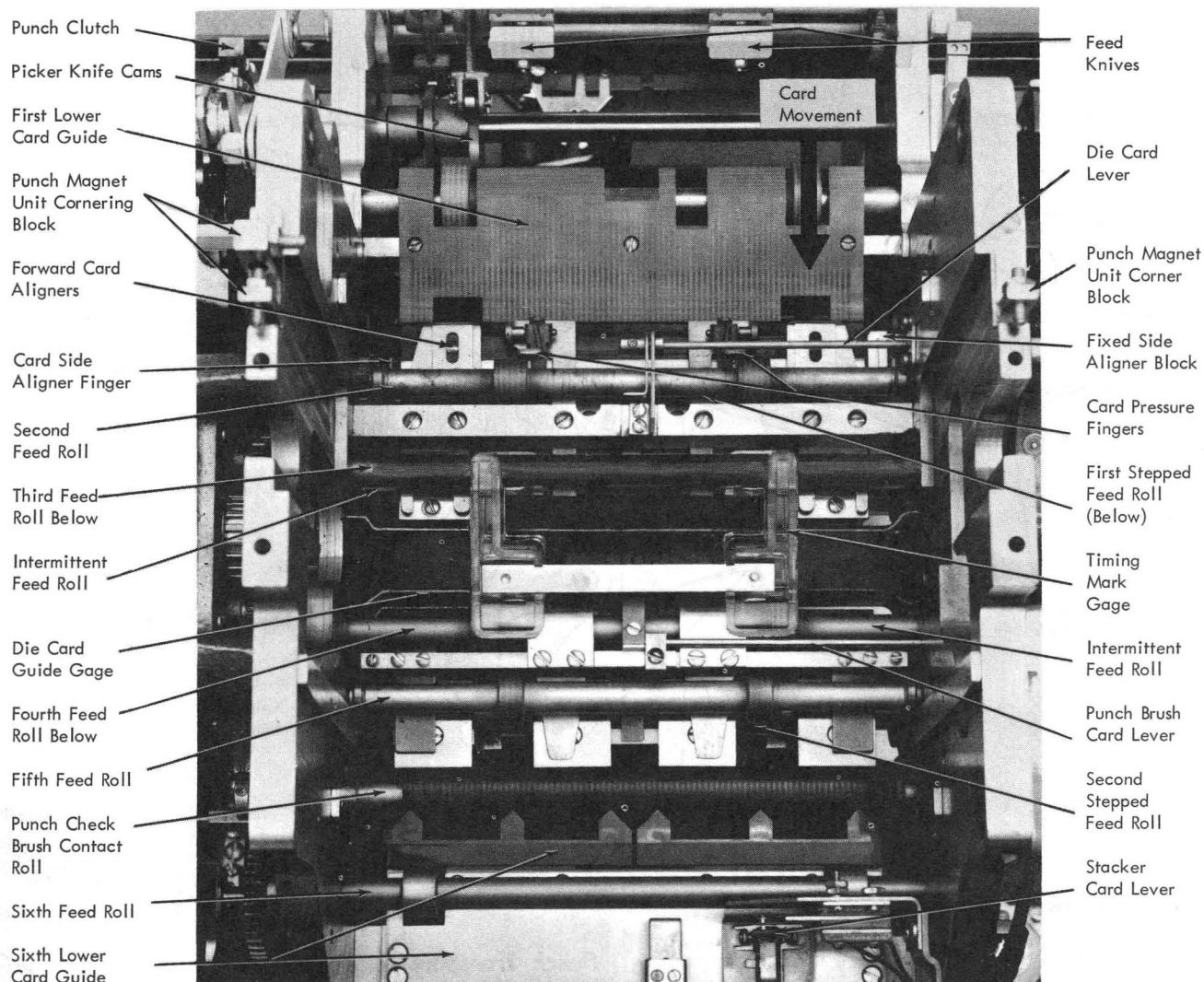


Figure 3-55. Punch Transport

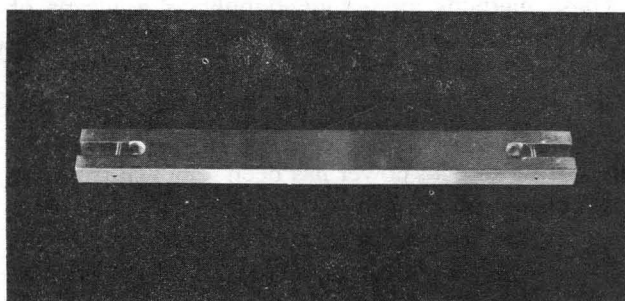


Figure 3-56. Stepped Roll Timing Gage

2. To check the first intermittent feed roll, trip the clutch and turn machine to 352°.
3. Insert cards lengthwise between each roll of the first, intermittent feed roll.

4. Check that each card is free at 353° and gripped tight at 357°. This indicates that the first, intermittent feed roll is in time (Figure 3-57).
5. To check the second intermittent feed roll, trip the clutch and turn machine to 290°.
6. Insert card between each of the rolls on the second intermittent feed roll. This card can be inserted from the punch-check brush station.
7. Turn the feed slightly backwards. The cards should still be free at 290° and gripped tight at 284°. This indicates that the second intermittent roll is in time (Figure 3-57).

Feed Roll Adjustments

FIRST AND SECOND, STEPPED ROLL

The punch unit need not be removed.

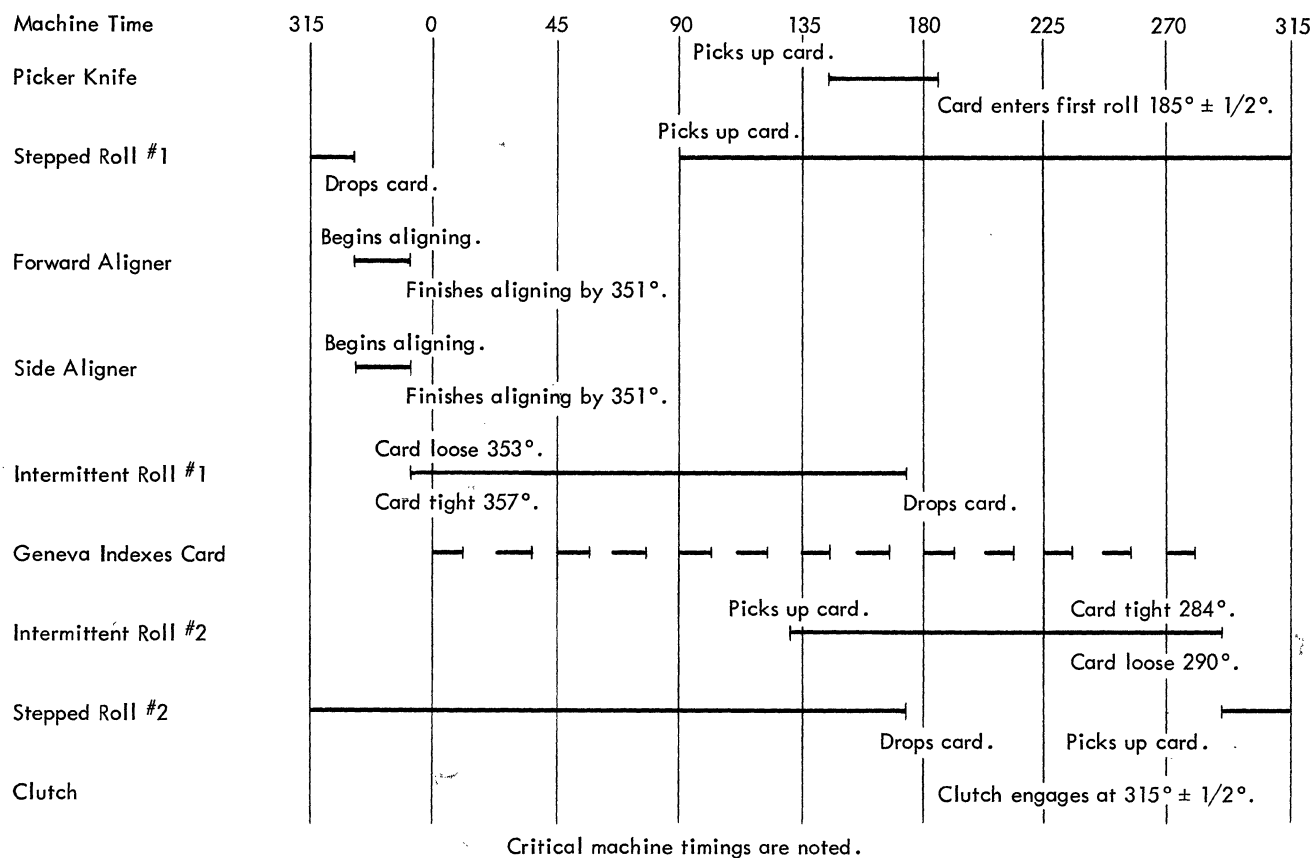


Figure 3-57. Punch Transport Timing

1. Loosen split-pulley hubs at both ends of first stepped feed roll.
2. Place stepped-roll timing gage on flat ends of stepped rolls.
3. Trip clutch and turn machine to 0°.
4. Detent geneva timing pin (to hold timing) and tighten split-hub pulleys on the stepped roll.
5. Remove stepped-roll timing gage.

FIRST INTERMITTENT ROLL

The first, stepped feed roll must be in proper time before timing the first, intermittent feed roll. For a timing check, refer to *Feed Roll Timing Check, First and Second, Intermittent Feed Roll*, steps 1 through 4.

NOTE: The first intermittent feed roll can be timed with the punch unit in the machine; however, it is easier when the punch unit is removed.

1. Pivot hopper out. Remove PFR and punch check brushes.
2. Trip clutch and turn machine to 352°.
3. Insert cards lengthwise between each roll of the first intermittent feed roll.
4. Turn machine to 356°.
5. Adjust eccentrics (only if necessary) at each end of the first, intermittent feed-roll shaft so that each card experiences a slight drag. Keep punch marks on the eccentrics facing punch marks on the intermittent feed roll, opening arms (Figure 3-58).

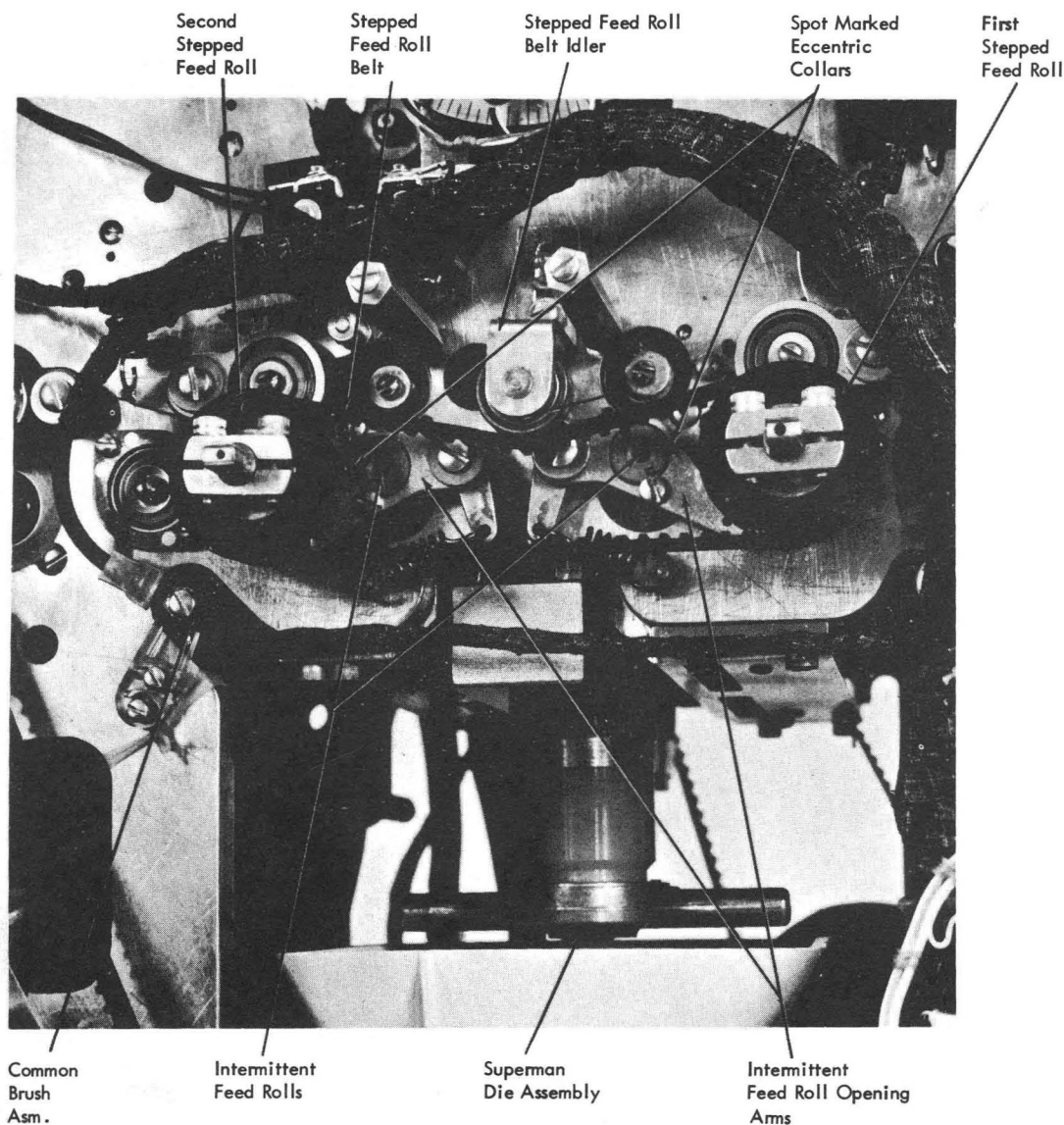


Figure 3-58. Intermittent and Stepped Rolls

6. Check that each card is free at 353° and gripped tight at 357° (Figure 3-57).

SECOND INTERMITTENT ROLL

The second, stepped feed roll must be in proper time before the second, intermittent feed roll is timed. For a timing check, refer to *Feed Roll Timing Check, First and Second Intermittent Rolls*, steps 5 through 7.

NOTE: The second, intermittent feed roll can be timed with the punch unit in the machine; however, it is easier when the punch unit is removed.

1. Trip clutch and turn machine to 290° .
2. Insert cards lengthwise between each roll of the second intermittent feed roll.
3. Turn machine backwards to 286° .
4. Adjust eccentrics (only if necessary) at each end of second intermittent feed roll shaft so that each card experiences a slight drag. Keep punch marks on eccentrics facing punch marks on intermittent feed-roll opening arms (Figure 3-58).
5. Check to see that each card is free at 290° and gripped tight at 284° (Figure 3-57).

Aligner Station Timing Check

To check these timings, the punch unit must be removed. The first stepped feed roll must be in time before the aligners are checked.

1. Place die card-guide (Figure 3-59) in die position (Figure 3-55).

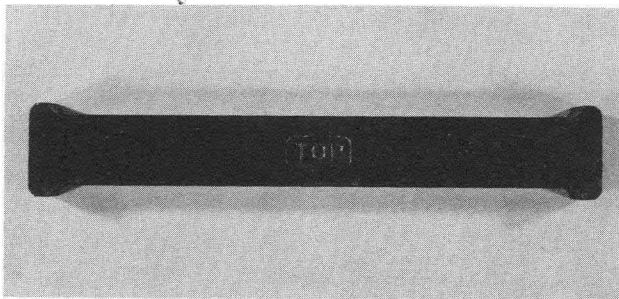


Figure 3-59. Die Card Guide

2. Place timing-mark gage over the die card-guide (Figure 3-55).
3. Place cards in the hopper; trip clutch and feed cards manually for two card cycles.
4. Continue turning machine and check that a card finishes forward aligning to within .005" of the forward aligner timing mark on the gage before 351° (Figure 3-60). The trailing edge of the card must travel at least $1/32$ inch past the feeding

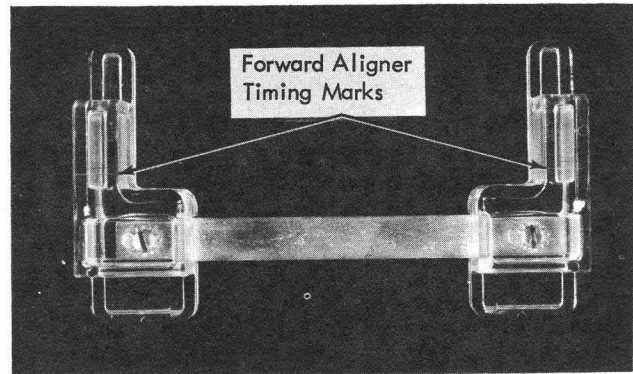


Figure 3-60. Timing Mark Gage

edge of the forward aligners prior to the forward movement of the forward aligners.

5. Check for .005"-.015" gap between card and fixed side-aligner block (Figure 3-55) under the following conditions:
 - a. The card must be fed while being held against the left, side plate of hopper.
 - b. The check must be made prior to side alignment.
6. Feed cards held against the right, side plate of hopper.
 - a. Check the right-side-aligner surface for .005" minimum clearance to the edge of card.
 - b. The check must be made prior to side alignment.

FORWARD AND SIDE ALIGNER ADJUSTMENTS

Before performing these adjustments, be sure the first stepped roll is in time. Refer to *Timing Check, First Stepped Feed Roll* and *First Intermittent Feed Roll*. Also, to basically get the forward and side aligners in time, refer to *Timing Checks, Forward and Side Aligners*.

1. Trip clutch and turn machine to 351° .
2. Adjust forward aligners so that the trailing edge of the card is against each aligning surface of the forward aligners, and that the leading edge is within .005" of the forward aligner timing mark on the timing-mark gage at 351° (Figure 3-60). Turn the adjusting screw of the forward aligner clockwise in order to move the forward aligner away from the hopper. Turn the adjusting screw counter-clockwise to move the forward aligner toward the hopper (Figure 3-61).
3. Check the forward aligner setting by manually feeding cards through the machine. Check that the leading edge of the card is within .005" of the forward-aligner timing marks at 351° . The trailing edge of the card must travel at least $1/32$

inch past the feeding edge of the forward aligners, prior to the forward movement of the forward aligners. Adjust the picker knife cam to obtain this clearance.

4. To obtain clearance as outlined in steps 5 and 6 of *Aligner Station Check*, the hopper sideplates must be adjusted and the side aligner must be formed.

Punch Feed Removals

ALIGNER ASSEMBLY

1. Remove punch magnet unit from machine.
2. Remove screws from second upper and lower card guides. Remove upper card guides and leave lower card guide loose.

Caution: Use care when removing and replacing aligner support because of side aligner and cam interference.

3. Move support toward stacker and then roll down and out. Remove four screws in bottom of aligner support; lower entire aligner assembly from machine.
4. Replace in reverse order. Unless adjustments are changed or parts replaced, the aligners need no re-timing.

FIRST STEPPED ROLL

1. Remove punch unit from machine.
2. Remove upper aligner card guides, aligner pres-

sure shoe guides, and loosen lower card guide.

3. Remove forward and side aligner assembly support bracket through bottom of feed.
4. Remove drive belt from first stepped feed roll on front side of machine, and the stepped-roll belt and pulley from rear end of the shaft.
5. Remove fixed side aligner block, stamped with an arrow and "Front" (Figure 3-55).
6. Remove tension springs from second upper and third lower feed-roll hanger.
7. Remove screw from bearing cap on front side of machine, and remove entire stepped-roll assembly through the front side frame.
8. Replace in the reverse order.

SECOND UPPER ROLL

1. Remove punch magnet unit from machine.
2. Remove upper card guides.
3. Remove screws from bearing and hanger.
4. Remove second upper feed roll through the rear side frame.
5. Replace in the reverse order.

THIRD UPPER ROLL (INTERMITTENT)

1. Remove punch magnet unit from machine.
2. Remove geneva housing but do not loosen locator blocks.
3. Remove hanger springs from the feed roll bearing.

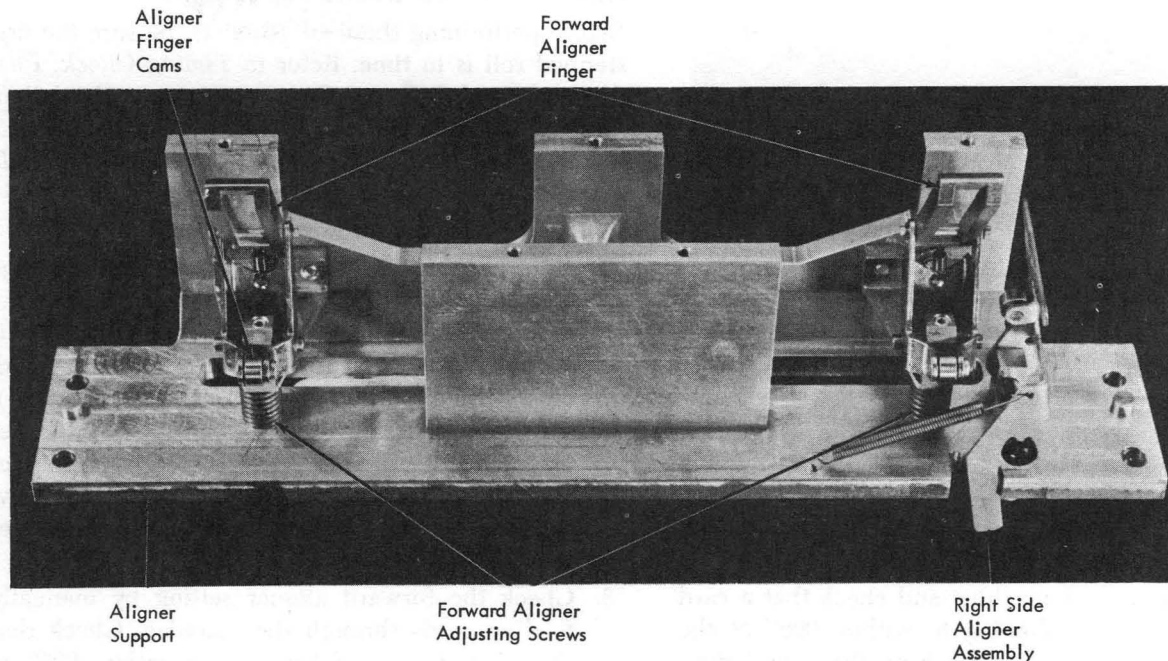


Figure 3-61. Forward Aligner Assembly

4. Remove bearing hanger pivot screw on rear side frame.
5. Remove upper card guides.
6. Tap feed roll towards front of machine and out through side frame.
7. Replace in the reverse order.

THIRD LOWER ROLL

1. Remove punch magnet unit from machine.
2. Remove support bracket from forward aligner out through bottom of punch feed.
3. Remove hanger springs from feed roll bearing.
4. Remove pivot screw from bearing hanger on rear side frame.
5. Pass lower feed roll through rear side frame.
6. Replace in the reverse order.

FOURTH UPPER ROLL (INTERMITTENT)

1. Remove punch magnet unit from machine.
2. Remove geneva housing but do not loosen locator blocks.
3. Remove bearing retainer screw from rear of fourth feed roll.
4. Remove upper card guides and card lever in second, intermittent station.
5. Tap the shaft towards front of machine and out through front side frame.
6. Replace in the reverse order.

FOURTH LOWER ROLL

1. Remove punch magnet unit from machine.
2. Remove hanger springs from feed roll bearing.
3. Remove pivot screw from bearing hanger on rear side frame.
4. Pass lower feed roll through rear side frame.
5. Replace in the reverse order.

SECOND STEPPED ROLL

1. Remove punch magnet unit from the machine.
2. Remove upper card guides, pressure shoes, and card-lever arm.
3. Remove lower card guide between second, intermittent and second, stepped feed roll.
4. Remove card guide support from bottom of feed.

5. Remove tension springs from upper, feed-roll hanger.
6. Remove stepped, feed-roll belt and pulley from shaft on rear side frame.
7. Remove bearing retainer screws and plate; pull stepped roll through front side frame.
8. Re-assemble in the reverse order; but, first replace the card guides between the fourth and fifth upper rolls. Then replace the guide mounting bar and attach the guides.

FIFTH UPPER ROLL

1. Remove punch magnet unit from machine.
2. Remove upper card guides.
3. Remove bearing retainer screws and hangers.
4. Pass the fifth upper feed roll through the rear side frame.
5. Replace in the reverse order.

PUNCH BRUSH CONTACT ROLL

1. Remove punch brush assembly.
2. Loosen and lower common brush holder on contact roll.
3. Remove retainer screws and plate on contact roll bearings.
4. Pass contact roll through rear side frame.
5. Replace in the reverse order.

SIXTH UPPER ROLL

Caution: Be careful when removing or replacing front bearing in hanger to avoid damage to the hanger.

1. Release tension springs on feed-roll hangers.
2. Remove screw from rear bearing hanger.
3. Pass feed roll through rear side frame.
4. Replace in reverse order.

SIXTH LOWER ROLL

1. Remove bracket from stacker card-lever contact.
2. Remove lower card guide.
3. Drive out taper pins located on front of feed roll.
4. Release tension springs on upper feed-roll hangers.
5. Remove bearing retainer screws and plate.
6. Pass feed roll through front side frame.
7. Replace in the reverse order.

Customer Engineering Service Panel

The customer engineering service panel (Figures 4-1, 4-2 and 4-3) on the 1402 Card Read-Punch allows the customer engineer to check certain areas of the machine without removing covers.

Caution: When the momentary contact display switches are operated, the common hub of the timer is grounded. Blown fuses and/or machine damage can result if external leads are connected when these switches are used.

Dial Display Switch: This toggle switch selects the timer index to be used with the service panel.

Off Line Card Feed: This rotary switch, when set to OFF LINE, allows the feeds to be operated independently of the system. The switch must be set to ON LINE for the system to operate the 1402.

Read Clutch Trip: This momentary contact switch allows the read clutch to be electrically tripped. The off line card feed switch must be set ON OFF LINE to make this switch effective.

Brush Selection: This rotary switch, when set to a brush position, internally connects brush 3 (outer light) and 78 (inner light) of the selected set of brushes to the dynamic timer. When the corresponding feed brush display switch is held on, the brush timing is displayed on the associated feed timer index.

For example; to check second read brush timing, set brush selection to SECOND READ and run card through the read feed with columns 3 and 78 punched. When the read brush display switch is held ON, the brush timing is displayed on the read feed index.

Read Brush Display: This momentary contact switch is used with the cam select switch. It displays the read feed brush timing.

Cam Selection: This rotary switch, when set to a position on the dial, selects a certain unit for a timing check.

Cams and Magnets, CB's and Emit: Only the Model 2

is equipped with this switch. This switch and the cam selection switch allow display of various cams and magnets, or 8, 4, 2, 1, A, B or C CB's or emitted 12's or 9's.

Read Cam Display: This momentary contact switch is used with the cam select switch. It displays the read feed CB selected for a timing check on the read feed index.

Voltage Hubs: Each power supply voltage can be checked at these hubs.

Read Sync: This switch is installed on all Model 3 machines, and on Model 1 machines with the Early Read Feature. Because the reader clutch has a six-tooth ratchet, this momentary contact switch is used to synchronize the read feed and the read index at 315° (for timing purposes). Functionally, the read sync switch is part of the customer engineering service panel; physically, the switch is mounted on a bracket beside the service panel.

Punch Service Switch Panel

Four switches (Figure 4-1) are used with the dynamic timer dial on the punch end of the machine. These switches are mounted near the punch timer dial.

Punch Clutch Trip: This momentary contact switch allows the punch clutch to be electrically tripped. The off line card feed switch must be set to OFF LINE to make this switch effective.

Sync: Because the punch feed has a four-tooth clutch ratchet, this momentary contact switch is used to synchronize the punch feed and the punch index at 315°.

Punch Brush Display: This momentary contact switch is used to display the timing of the punch check brushes when the brush selection switch is set to the PUNCH CHECK position.

Punch Cam Display: This momentary contact switch is used with the cam selection switch to display the punch feed CB selected for a timing check.

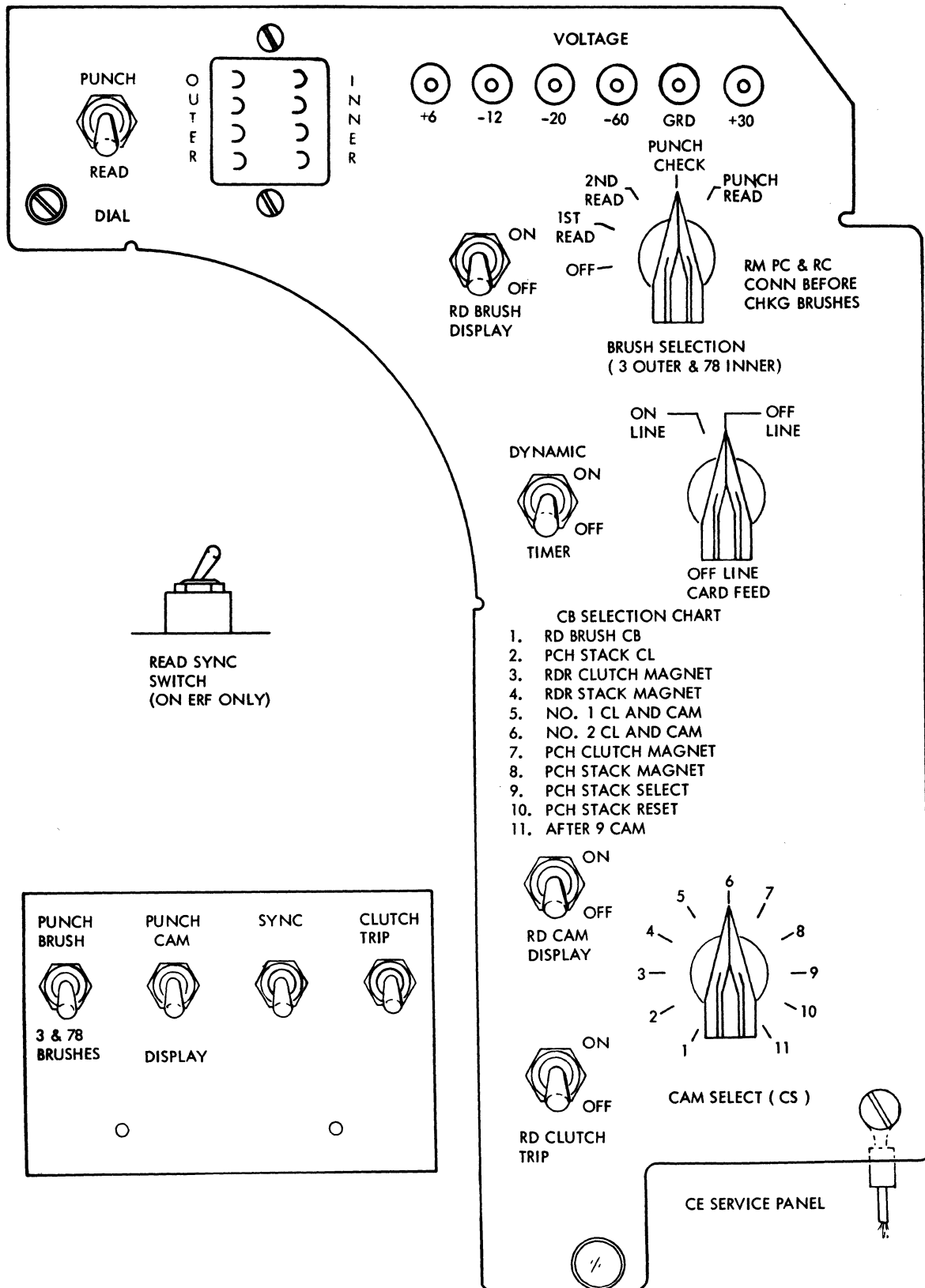


Figure 4-1. CE Service Panel, Models 1, 4, 5, & 6

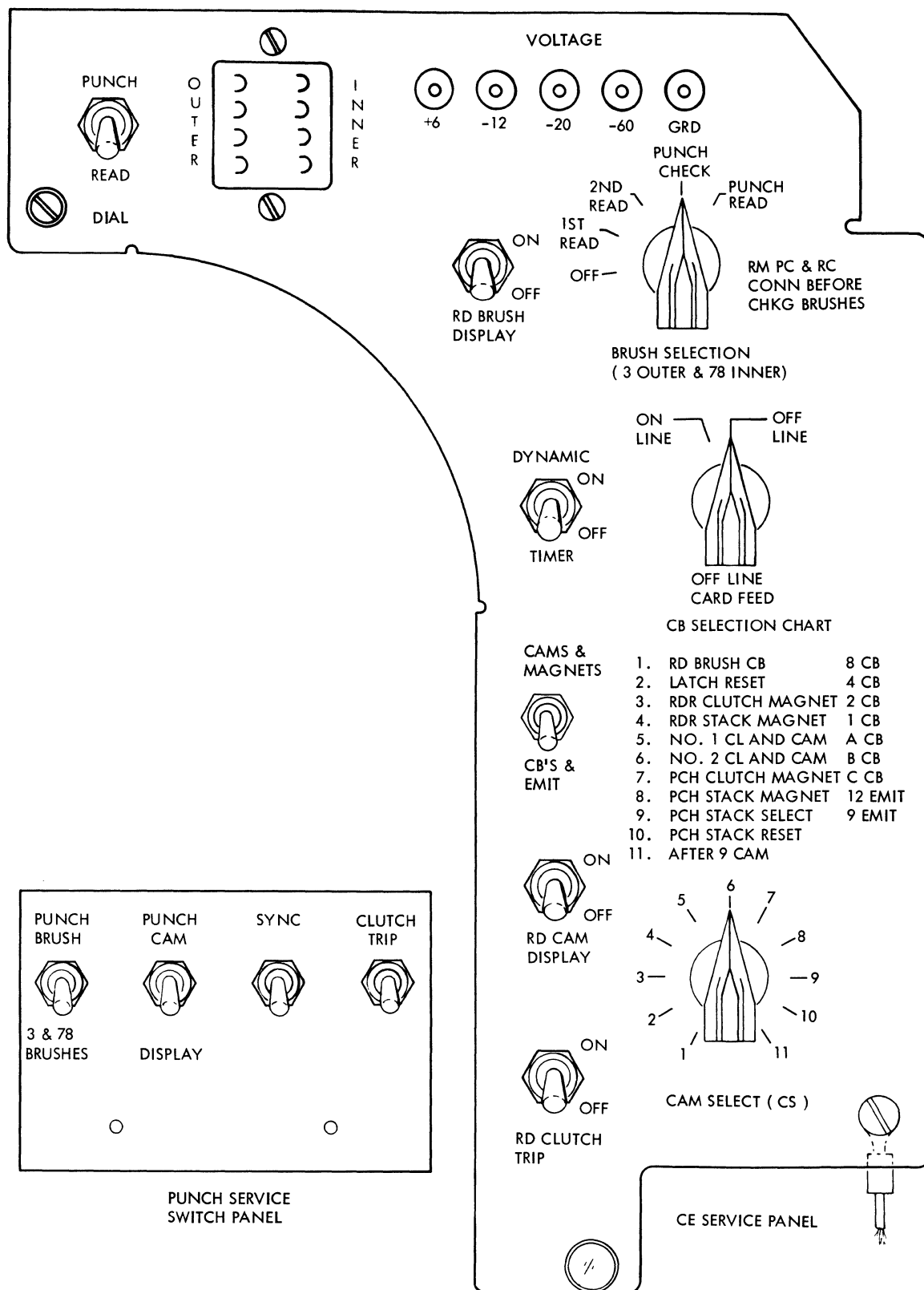


Figure 4-2. CE Service Panel, Model 2

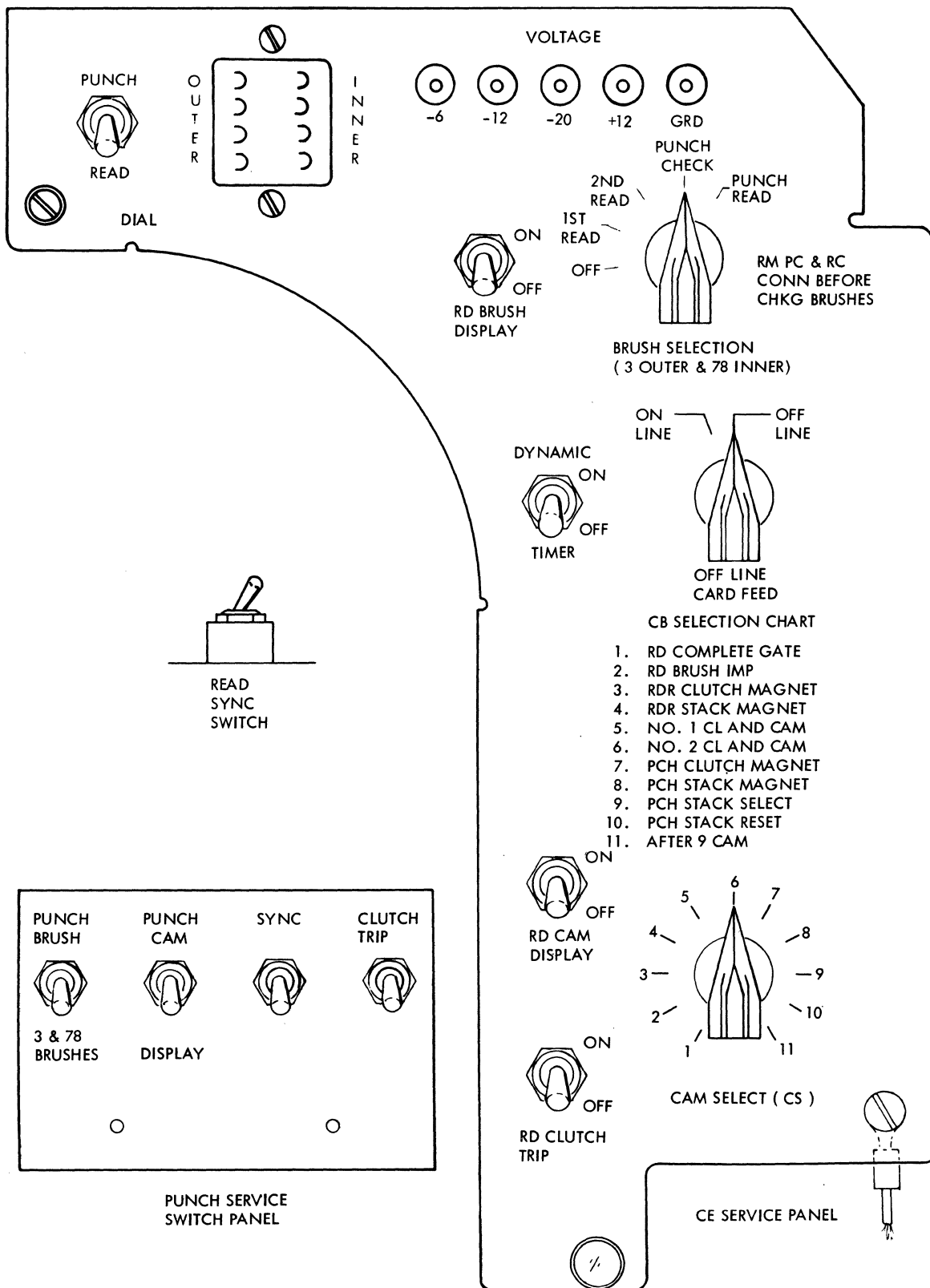


Figure 4-3. CE Service Panel, Model 3

51-80 Column Device

Hopper

Adjustments other than standard machine adjustments are described here.

ADJUSTMENTS

1. Position rear side plate so column 1 of a 51 column card centers on brush 15.
2. Retract side jogger, install a one-inch deck of cards against rear side plate. Position front side plate for one card go, two card no-go condition in relation to deck.
3. Adjust rubber-tipped arm on rear of side jogger so jogger, at its maximum outward travel, just touches card deck.
4. Align 51 column portion of front jogger within .003" of 80 column portion, both at sensing pads and at tips.
5. Position hopper card lever on its shaft so that contact operates when lever is $1/32"$ to $3/32"$ above picker knife surface. Pressure to operate the lever should be 18 to 24 grams.
6. Position throat roller so centerline aligns with throat knife face within .002". This adjustment is more critical on 51 column machines than on standard machines.

Pocket Selectors

SERVICE CHECKS

1. Check for proper lubrication, loose screws, worn parts, and binds.
2. With magnet energized, check that top surface of the chute blade is not above the top of the shear plate and not below the card line more than .025".

ADJUSTMENTS

1. Position selector magnet armature stop for .038" to .042" clearance between upper part of armature and stop. See Figure 5-1.
2. Position magnet plate assembly so that, when magnet is energized, top of chute blade is flush with top surface of shear plate, and not more than .025" below card line. When magnet de-energizes, tip of blade must rise at least .025" above card line.

Stackers

SERVICE CHECKS

1. Check for excessive accumulation of dust.
2. Check for binding of deck support slides.
3. Check that any stacker will operate full pocket stop switch.
4. Check for proper lubrication and loose parts.

ADJUSTMENTS

1. Loosen ledge assembly so that it slides easily.
2. Adjust deck support damping leaf springs to just touch channels in which they move.
3. Adjust deck support coil spring so a .50 to .55 lb. force, with no cards in stacker, pulls slide to a point just short of operating full stacker switch.
4. Form the stacker radial card guide to match the profile shown in Figure 5-2.

Punch Feed Read

Brushes

Brush timings and adjustments are the same as the punch check brushes. Refer to *Punch Feed, Brush Assemblies*.

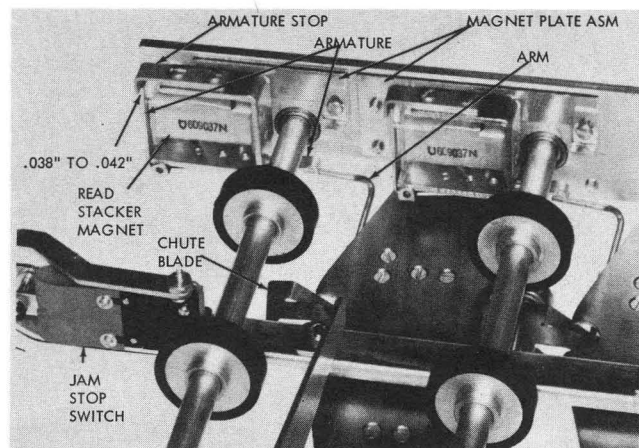


Figure 5-1. 51-80 Column Stacker Select Mechanism

ADJUSTMENT OF RADIAL STACKER CARD GUIDES

MALFORMED RADIAL CARD GUIDES CAN BE A CAUSE OF CARD JAMMING. THESE GUIDES SHOULD BE FORMED ACCORDING TO THE ILLUSTRATED PROFILE. DO NOT DISTORT THIS PROFILE TO ACCOMPLISH INSTALLATION.

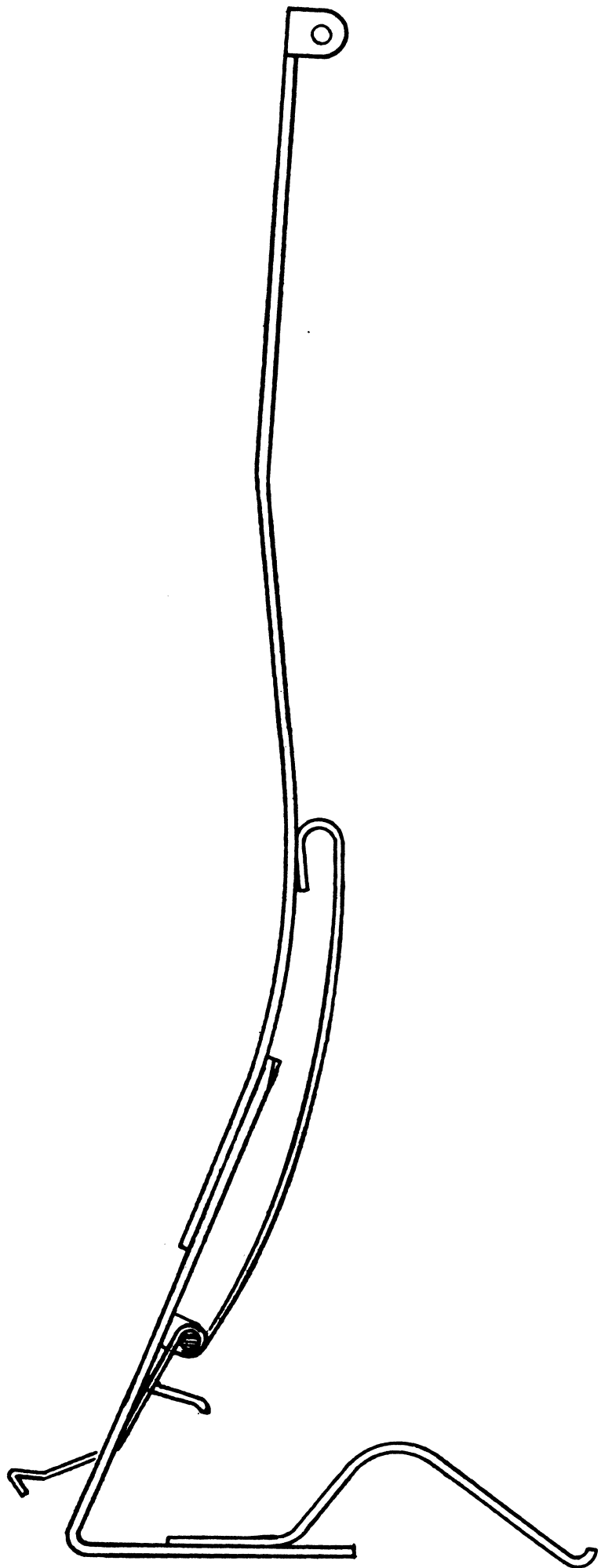


Figure 5-2. 51-80 Radial Card Guide Profile

Card Guides

SERVICE CHECKS

1. Check that tips of second lower card guide do not mark contact roll.
2. Check for bent hopper back plate fingers.

ADJUSTMENTS

1. Loosen second lower card guide mounting screws.
2. Position second lower card guide for .001" to .012" clearance to contact roll. See Figure 5-3.
3. Position punch hopper back plate for .012" to .030" clearance between back plate fingers and first lower card guide.

Early Read

The Early Read Feature clutch for the Model 1 is the standard clutch on Models 3 and 4. The Early Read Feature is standard on the Model 3 and 4.

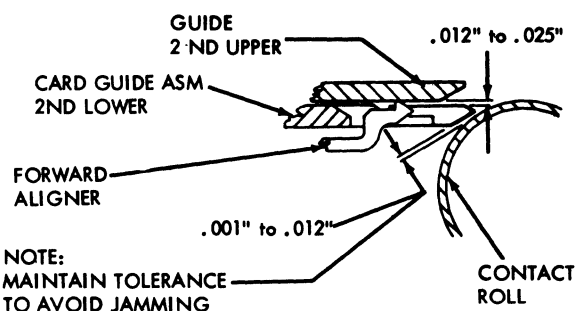


Figure 5-3. Punch Feed Read Card Guide Adjustments

Read Feed

Start and Run Data Flow

Refer to Figure 6-1.

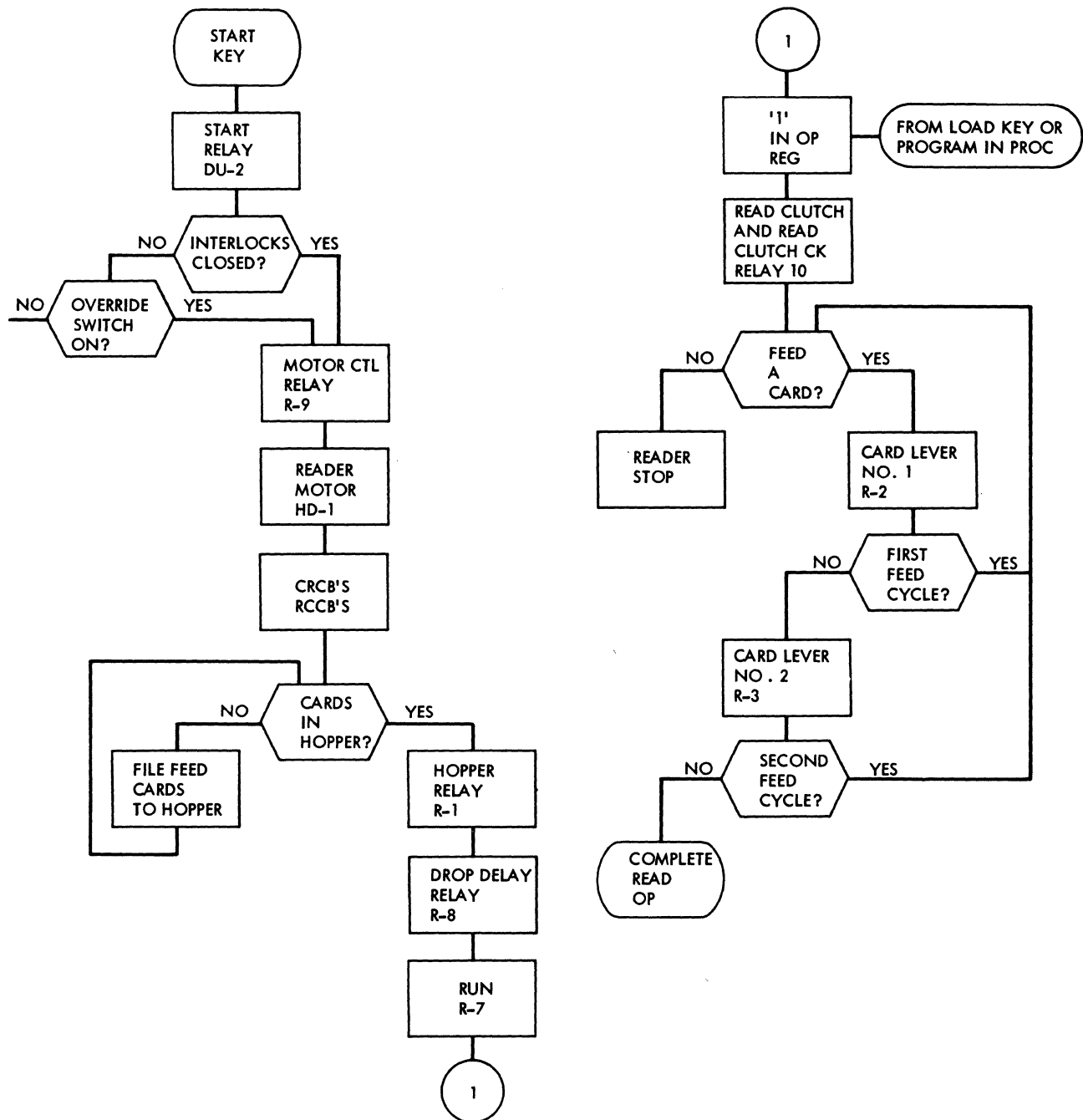


Figure 6-1. Reader-Start and Run Data Flow

Stop Data Flow

Refer to Figure 6-2.

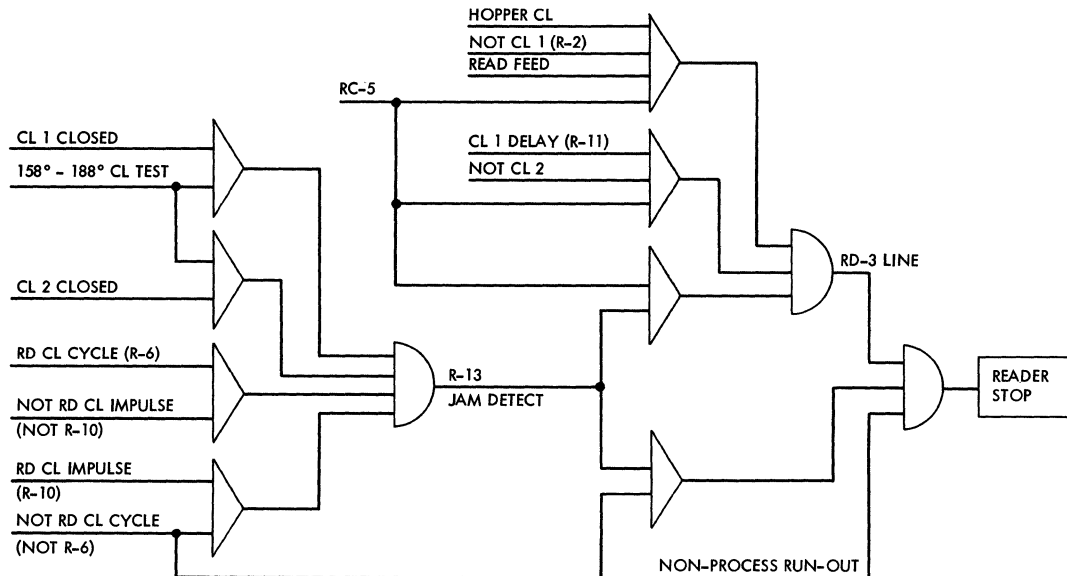


Figure 6-2. Reader-Stop Data Flow

Reader Stop Lights

CAUSES

1. Frequent misfeeding of cards: This is usually caused by insufficient weight over the picker knives, and indicates that the file feed needs adjusting.
The time delay should be at least three seconds before the clutch operates. At least a 1½" stack of cards should be in the hopper.
2. Bouncing of card levers 1 and 2: Set cam display switch first to POSITION 5 and then to POSITION 6. Observe timer index while switch is being set. A bouncing card lever will appear as a spot of light between 158° and 188°. Adjust card lever contacts.
3. Dropout of relays 2 or 10: This dropout could cause false reader stops.
4. Failure of clutch to latch or unlatch: If reader stops occur intermittently due to clutch failure, these stops may be difficult to diagnose. Refer to *Clutch Failures*.

Clutch Failures

The following methods should be followed to determine whether or not the clutch has failed to latch or unlatch.

METHOD A

This method pertains to 1402's used with an IBM 1401.

1. Sync the scope + External on pin "E" of the 1401 read feed trigger (1401 system logics page 36. 10. 11. 2). A Test hub is available on the CE Panel of some 1401's.
2. Display the read feed pick RL CB which will make at 120° and break at 170°. Set time base to 5 ms/Div and adjust uncalibrated knob as needed to get display shown. Set vertical deflection to 10 v/div.
3. Turn up scope intensity so the beam is visible on the scope face without a sync. (This cannot be done with the 561 scope.)
4. Any job that will cause failures may be run. Correct operation will display the read feed pick RLCB with a scope sync. See condition A in Figure 6-3.
5. If the scope traces without displaying the RLCB pulse, the clutch has failed to trip. This will be followed by a pulse at the left edge of the scope, without a sync if the clutch does engage at the next clutch latch time, following the initial failure, see condition B in Figure 6-3.
6. If the scope does not trace, but a RLCB pulse is seen at the left edge of the scope, this indicates a failure of the card feed clutch to latch, or indicates an extraneous clutch cycle. See condition C in Figure 6-3.

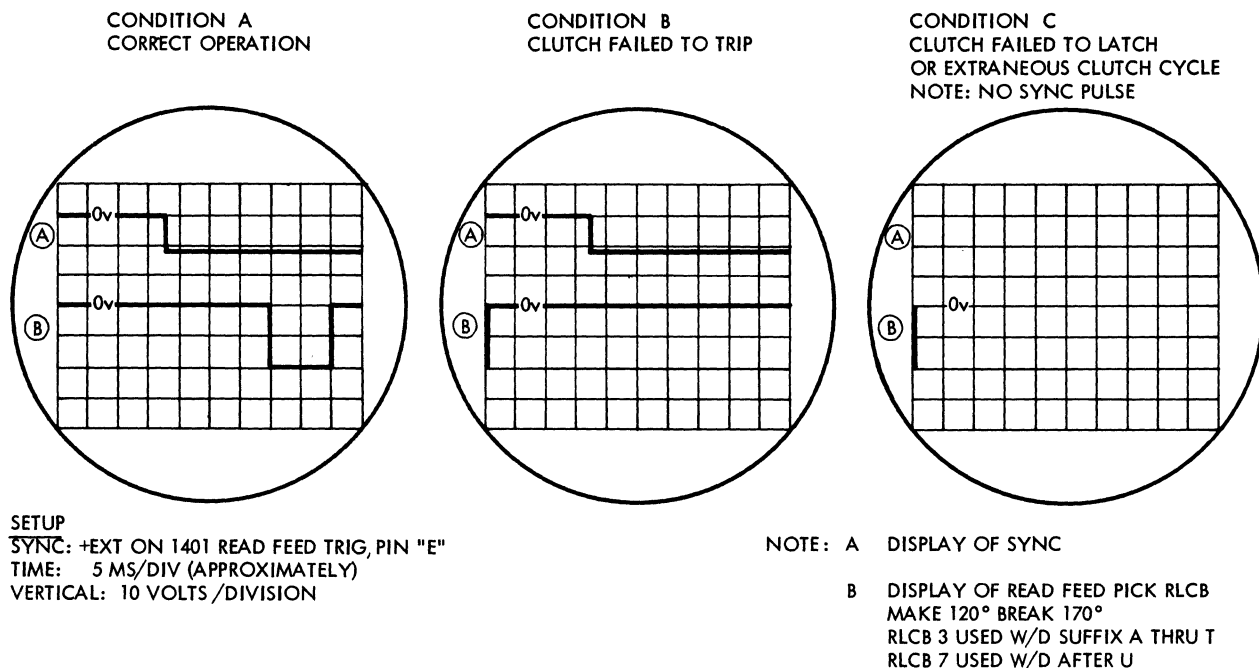


Figure 6-3. Clutch Failure Patterns

METHOD B

This method pertains to the Model 3 and all models with Early Read special feature.

1. On machines with Early Read Feature, the read clutch sync switch must be turned on. Set CE panel cam selector switch to CLC 1 or 2.
2. With this set-up on the 1402, the dynamic timer should always show the same timing of the CLC impulse. If the 1402 clutch fails to engage when it is tripped, the CLC impulse will move to another early read latching time.
3. When reader clutch problems exist, they may be the result of mechanical problems in the reader clutch. Typical troubles are:
 - a. Breakage of drive arms or dog/detent pivot studs on the reader clutch assembly causing reading failures or reader stops.
 - b. Dirt causing slow response when the clutch is tripped. Cleaning and lubricating the reader clutch once every 12 weeks is recommended for single shift operations. Refer to scheduled maintenance chart in this manual. The addition of additional .010" shim, 602033, between the intermediate arm and the drive arm will make the clutch less prone to contamination.
 - c. Eccentric screw adjustment causing failure of clutch to latch or unlatch. This is caused by eccentric screw adjustment if insufficient clearance is not maintained between the keeper latch, drive arm, and latch when the clutch is latched up.
 - d. Insufficient clearance between the detent and ratchet when the dog is engaged. The detent may not engage the ratchet wheel; whipping will result. Maintain a .002" clearance.
 - e. Incorrect armature spring tension or keeper latch spring tension causing slow clutch trip response.
 - f. Clutch magnet RCCB 5 making late causing clutch failure due to lack of time to engage. Set the RCCB on early limit of make tolerance.
 - g. Armature wear (notch) opposite upper arm of yoke causing the .020-.022 yoke to armature clearance to change, and the .002"-.005" armature-to-coil clearance to change. These two clearances must be maintained. It is difficult to observe the notch wear; therefore, check the adjustments periodically.
 - h. Loose reader clutch coil causing reader clutch unlatching failures.

Reader Check Lights

CAUSES

1. Card skewing between read stations: Inspect the feed area for uneven feed roll pressure. Pressure should measure at least 6 pounds on a strip of IBM card when drawn through any single set of feed rolls.

More information about feed rolls is available in 1402 EC-CEM 54.

2. Failure to read a certain column of the card: This failure is often the result of an open, somewhere between the brush and the row bit core in storage. Check by raising brush assembly from contact roll and measuring voltage between brush and ground. A normal brush should read -20v (an open line will be zero).
3. Brushes raised off contact roll.
4. Loose or broken common brush.
5. Bad brush impulse transistors.
6. Incorrect voltage on 20 v supply. Refer to 1402 EC-CEM 56.

Validity Lights

CAUSES

1. Intermittent make of read two, common brush.
2. Cards feeding late. Brush time spans the make of two impulse CB's.
3. Card feeding skewed. One brush reads two columns.

Brush Timing

Checking of brush timing or any 1402 timing requires removal of the 200-position connector in order to eliminate back circuits.

Circuit Breaker Timings

Excessive timing variations in clutched CB's or brush impulses can be caused by one of the following:

1. Loose motor drive belt.
2. Loose clutched feed roll belt.
3. Loose screws in the clutch pulley assembly.
4. Excessive flexibility of the clutch pulley shock mount because of defective bonding.
5. Excessive backlash in clutch (engaged) because of wear. Replace with a different-sized detent (P/N 609737 to 609743).

Refer to the *IBM 1401, Customer Engineering Reference Manual, Service Aids* for additional information.

Punch Feed

Start and Run Data Flow

See Figure 6-4.

Stop Data Flow

See Figure 6-5.

Punch Stop Lights

Refer to *Reader Stop Lights*.

Punch Check Lights

Refer to *Reader Check Lights*. Check PACB's 9 and 10.

Punch Check Brushes Out of Time

CAUSES

1. All digits out of time. Check tension of second stepped feed roll.
2. Lower digits (5-9) out of time. Check tension of sixth feed roll.

Faulty Punch Registration

CAUSES

1. Punching, off one digit: This may be caused by a loose main drive belt. If the belt is loose, latching the clutch may cause the belt to jump one tooth on the first stepped feed roll drive pulley.
2. Variable registration (12 through 9): This may be caused by:
 - a. Intermittent feed rolls becoming polished as a result of running the machine, excessively, without cards.
 - b. Insufficient intermittent feed roll tension resulting from bottoming of cam follower, or from a weak spring.
3. Registration across card, completely off: This may be caused by a mesh of geneva gears, or by a loose pin.
4. Slight variance of vertical registration: This may be caused by:
 - a. Insufficient pressure shoe spring tension. Be sure springs have not become polished at the point where they come in contact with a card.
 - b. Intermittent roll closing too soon and slightly moving the card at the end of previous geneva cycle.
5. Skewed punching and card marking: This can be caused by trailing edge of card not traveling past forward aligners at least 1/32".
6. Varying horizontal registration: This can be caused by aligner adjustment.

Dropping Punches

CAUSES

1. Incorrect interposer to punch clearance. Clearance should be .005" to .010".

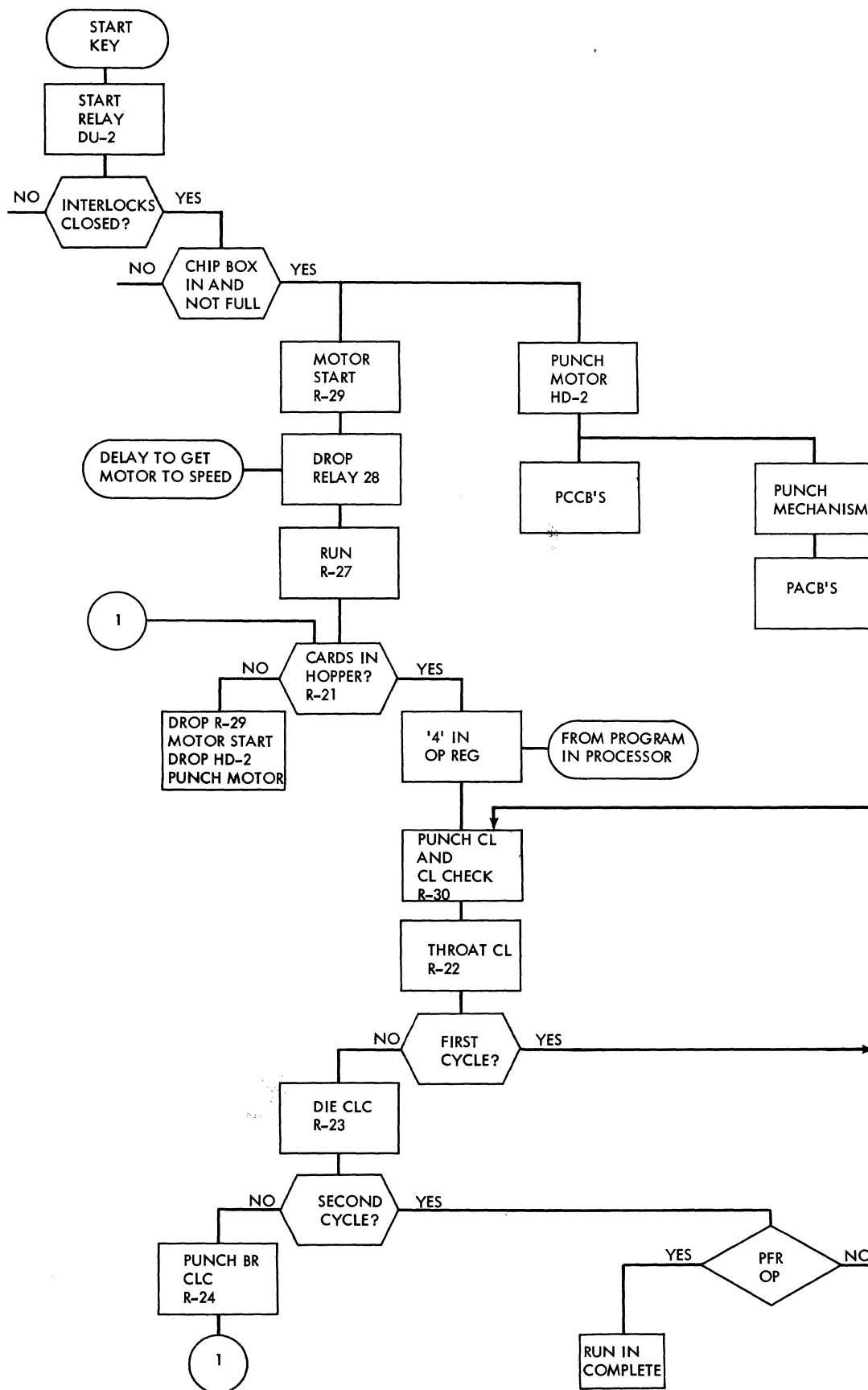


Figure 6-4. Punch-Start and Run Data Flow

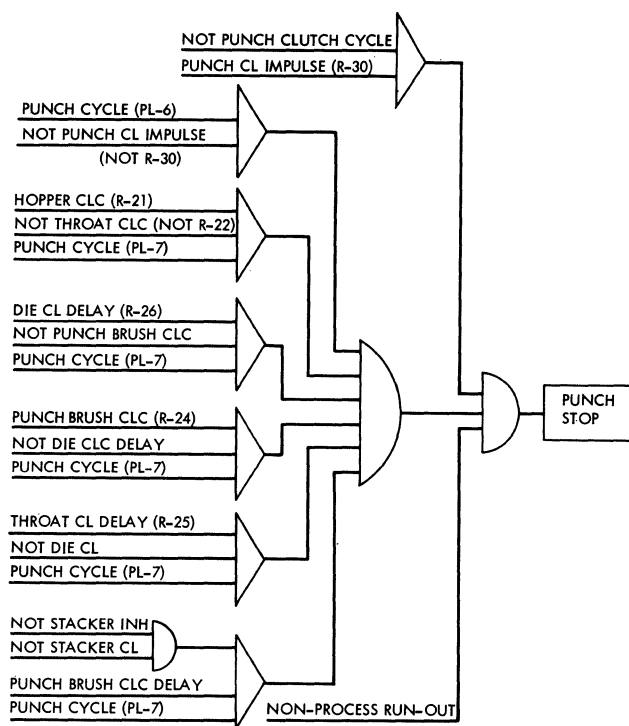


Figure 6-5. Punch-Stop Data Flow

2. Incorrect clearance between lower side of punch magnet armature and its latch. Clearance should be .005" to .010".
3. Incorrect punch magnet armature pivot rod clearance. Clearance should be .001" to .008".
4. Bent or loose punch magnet armature leaf springs.
5. Dislocated miniature punch magnet connector terminals.
6. PACB's 1 and 2, 3 and 4, and 5 through 8.

Multiple Punches

CAUSES

1. Clearance between lower side of punch magnet armature and latch. Check for at least .005".
2. Broken latch springs or latch spring hooks.
3. PACB 3 and 4, and 11 and 12.

Damaged Cards or Jams in Feed

1. Loose or damaged timing belts.
2. Incorrect timing of first stepped feed roll. This causes card to be nicked on leading edge of punched hole.
3. Incorrect punch unit timing. This causes torn or long holes.

Stacker

Faulty Stacking

CAUSES

1. Radial guides and pocket separator plates with rough finish that restrict cards from dropping correctly. The finish, if rough, should be smoothed in the direction of card movement. Use crocus cloth 450319.
2. Deformed radial guides. Remove and shape guide to correct profile. See Figure 3-41.

Card Jamming, Transport Area

CAUSES

1. Worn or hardened black neoprene rolls.
2. Uneven pressure roll tension. Tensions must be equal on both ends of transport roll, or cards will skew.

Section 7. Locations

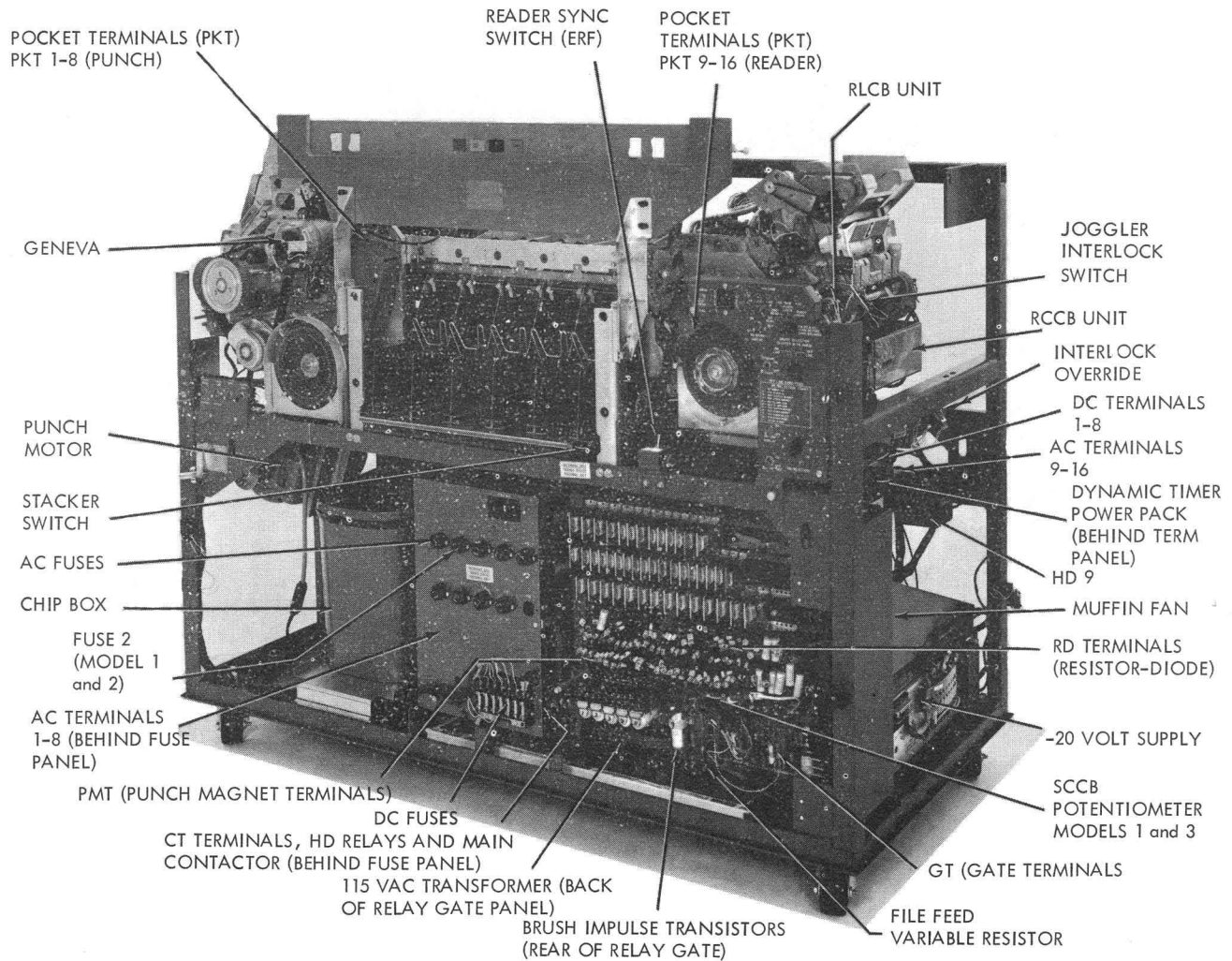


Figure 7-1. IBM 1402, Models 1, 4, & 6, Front View

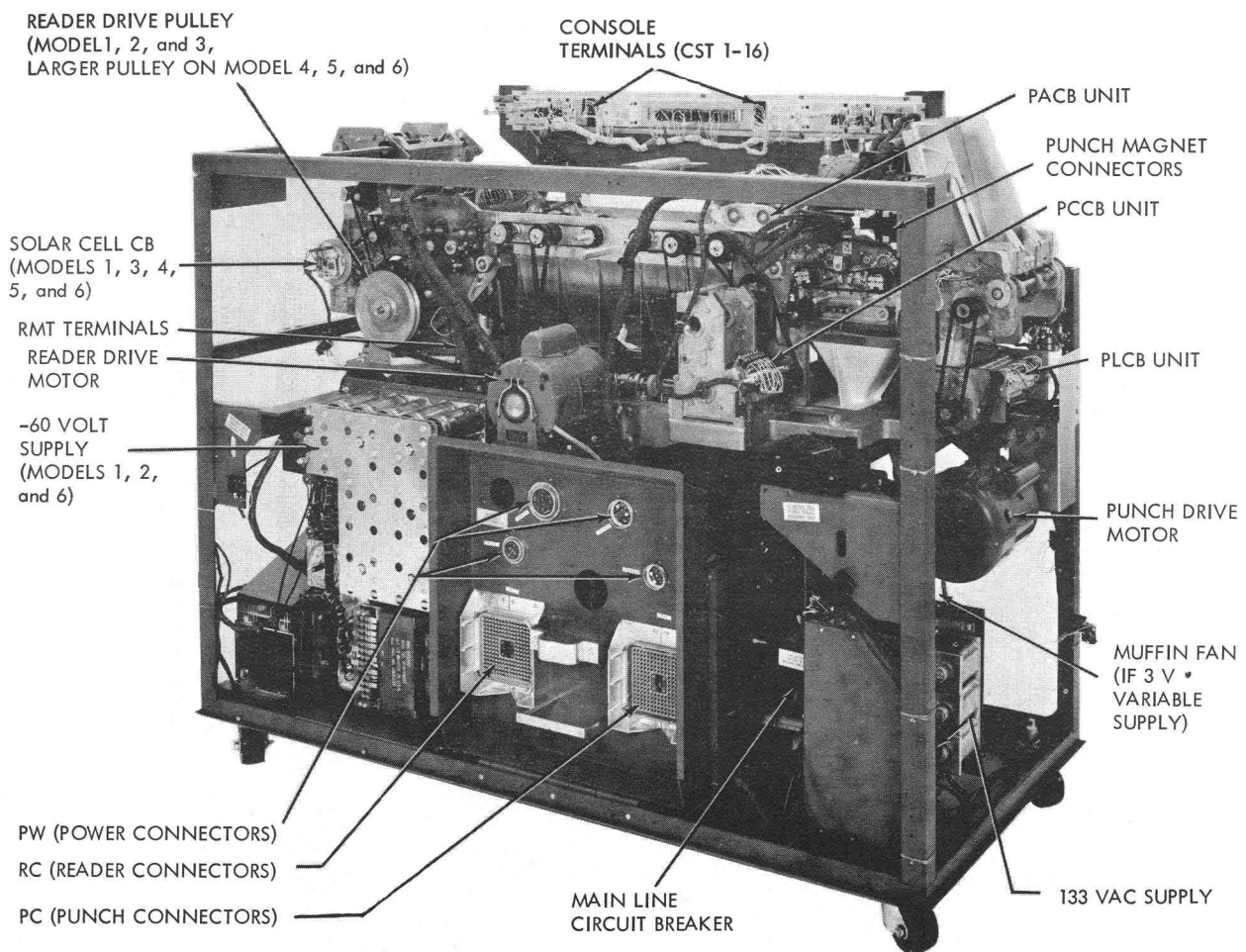


Figure 7-2. IBM 1402, Models 1, 4, 5, & 6, Rear View

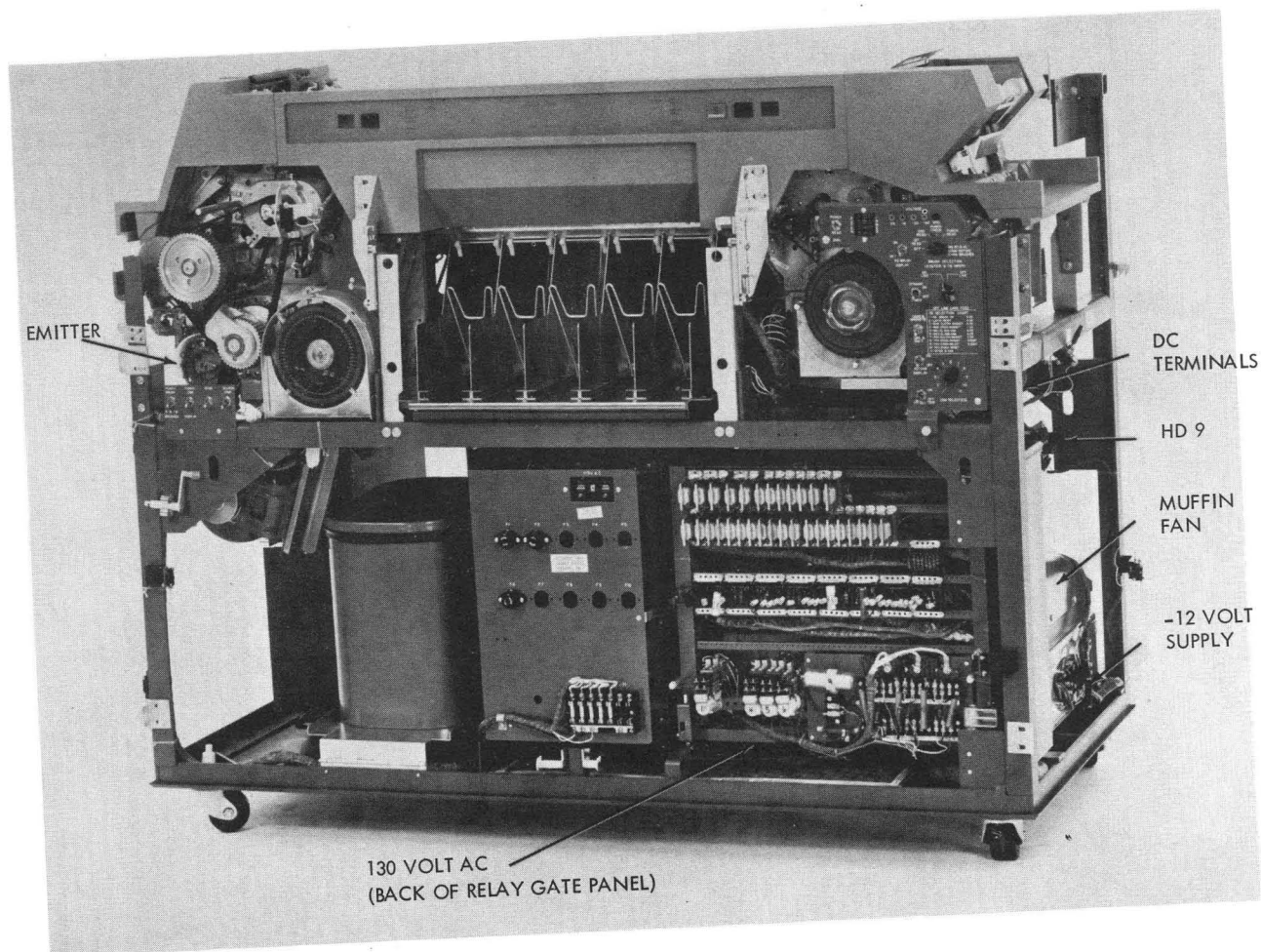


Figure 7-3. 1402 Model 2, Front View

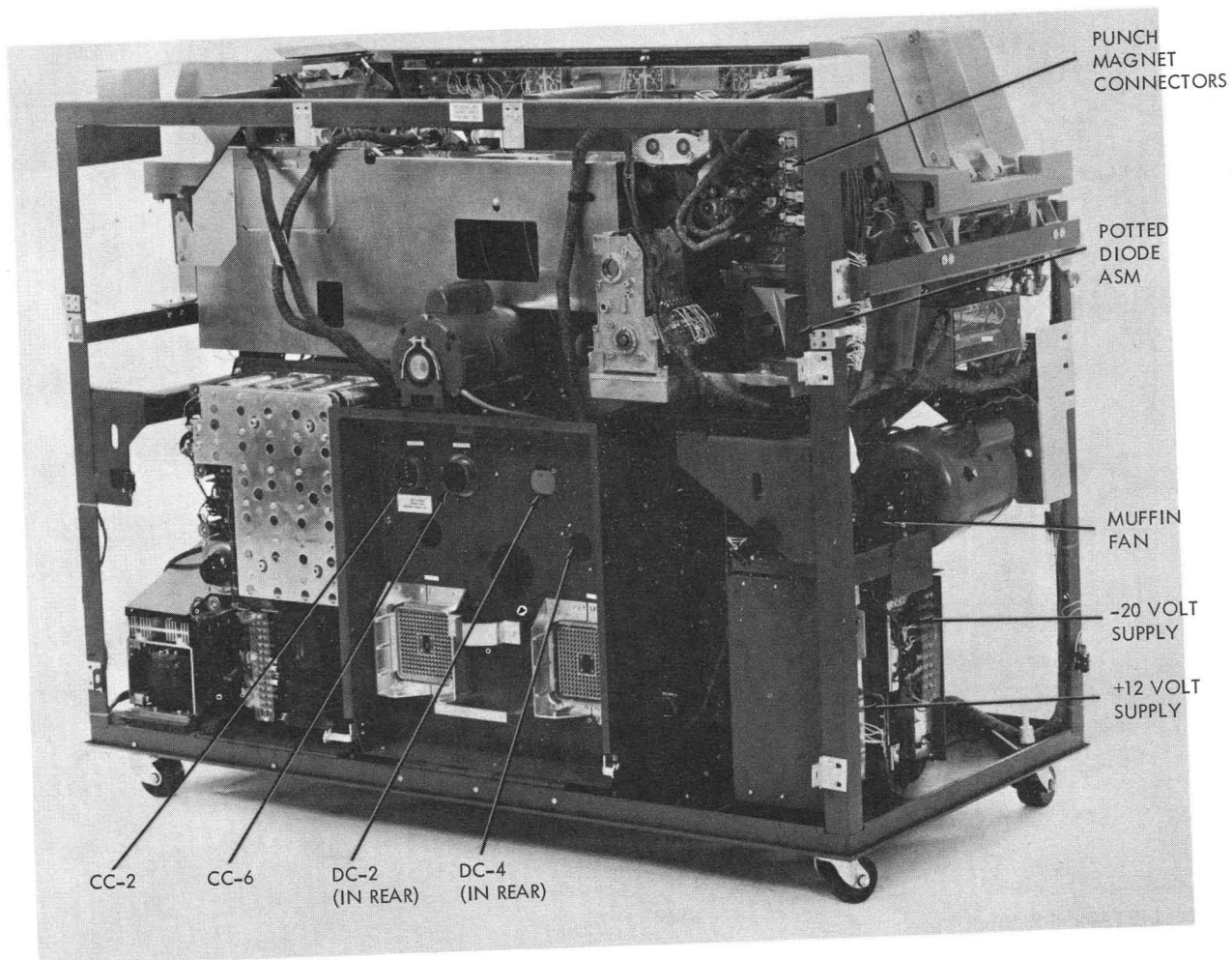


Figure 7-4. 1402 Model 2, Rear View

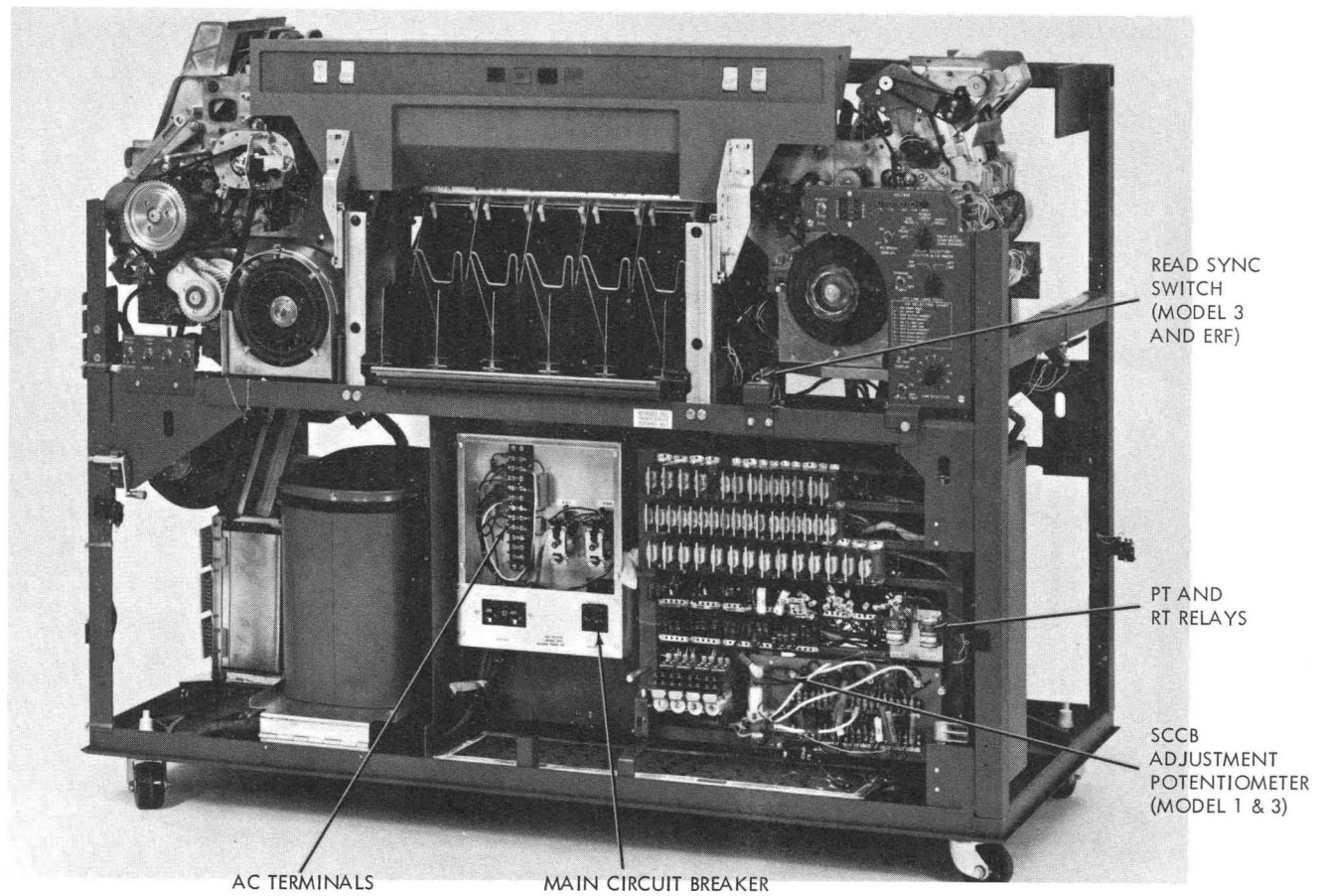


Figure 7-5. 1402 Model 3, Front View

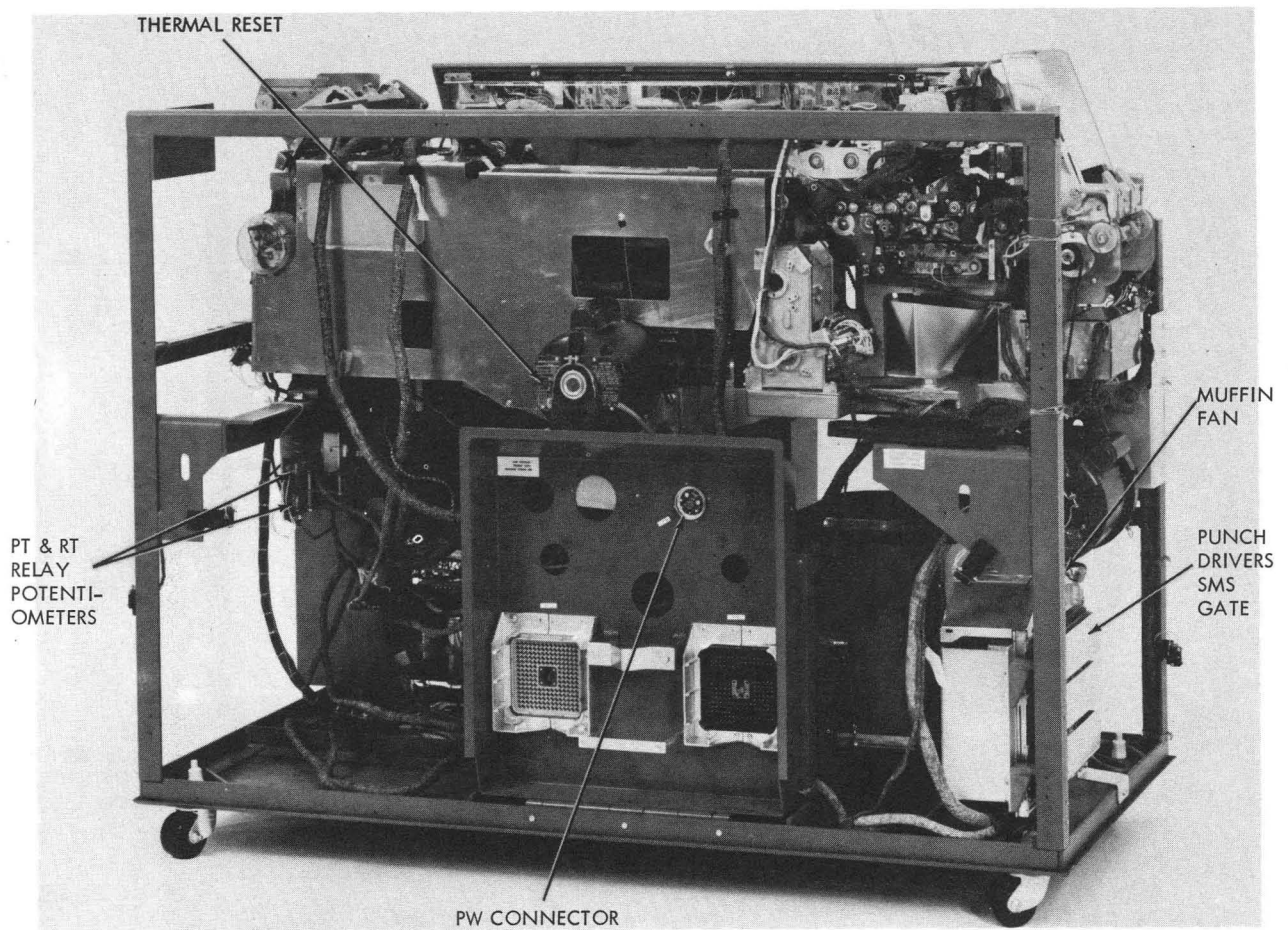


Figure 7-6. 1402 Model 3, Rear View

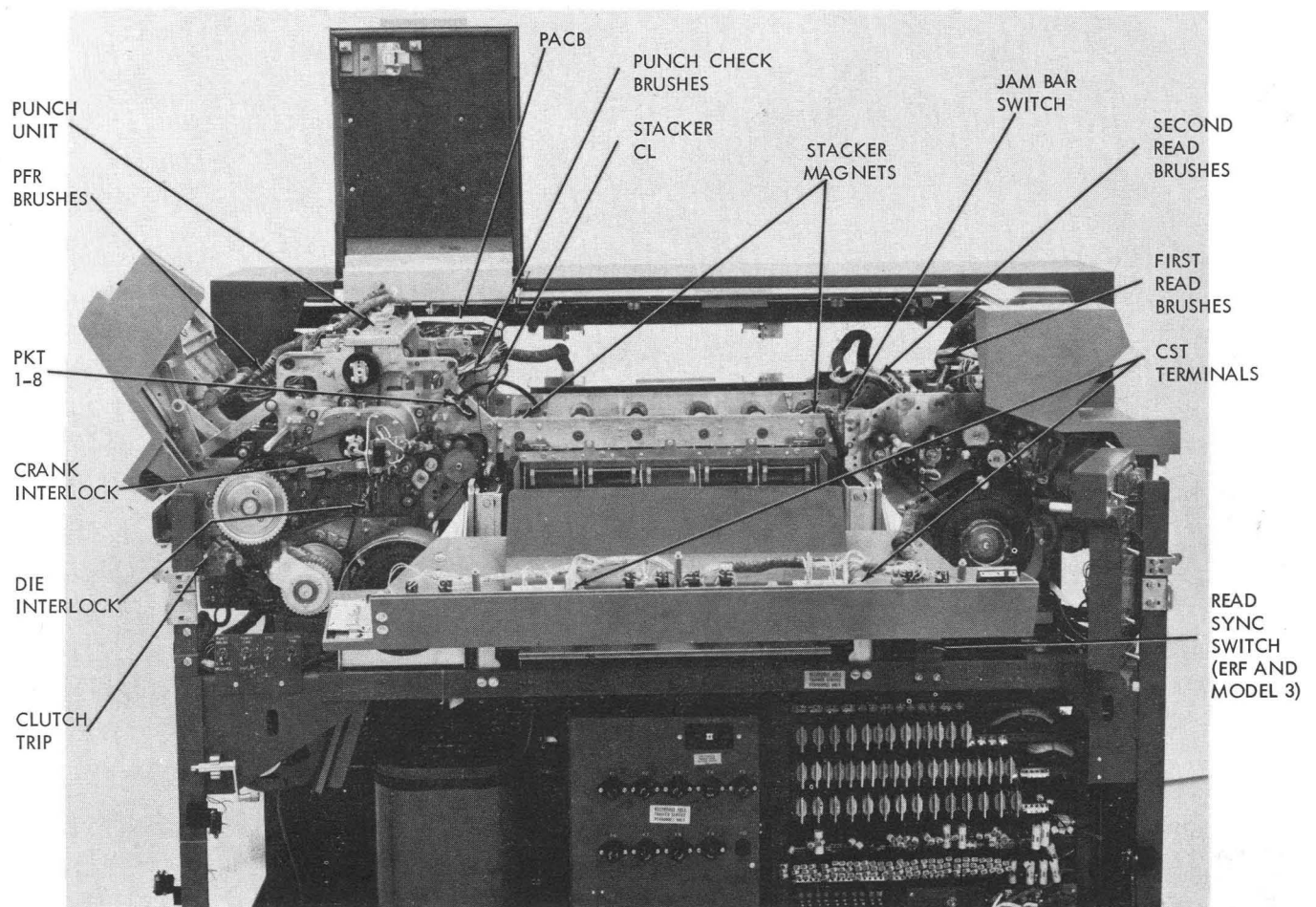


Figure 7-7. 1402 Card Transport

Section 8. Special Tools

NOTE: Special tools are shown in Figure 8-1.

Punch Timing Rod,

This rod is used to establish the timing relationship between the PA emitter disc, punch unit, and punch transport.

Timing Mark Gage,

This gage is used to time the forward card aligners in the punch-feed mechanism at 351°.

Die Card-Guide Gage,

This gage is placed in the punch-die station to form a lower card guide when the punch die and stripper is removed. This gage is used with the intermittent roll assembly gage.

Interposer Setup Bail Gage,

This gage is used to adjust the setup bail parallelism on the punch unit.

Stepped Feed Roll Assembly Gage,

This gage is used for timing the first and second stepped feed rolls.

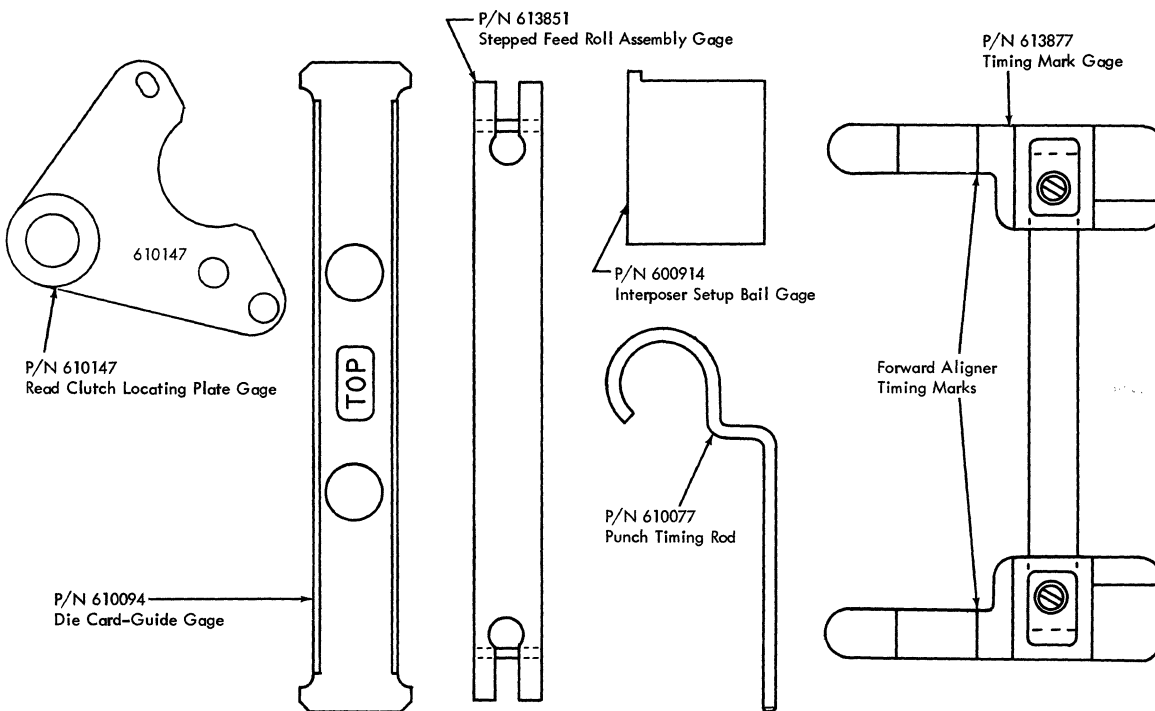
Read Clutch Locating Plate Gage,

This gage establishes the correct relationship between the center plate assembly and the clutch pulley assembly.

Punch Unit Adjusting Plates, 610688

These two flat rectangular plates establish the card line when installing the punch unit in machines having stepped side frames.

Punch Unit Squareness Gage, 610692



Note: Punch Unit Adjusting Plates and
Punch Unit Squareness Gage are
not shown in this illustration.

Figure 8-1. Special Tools



International Business Machines Corporation
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112 East Post Road, White Plains, N.Y. 10601