IBM Maintenance Library

129 Card Data Recorder Models 1, 2, and 3 (Serial Numbers 20,000 and Higher)

Theory - Maintenance

SY22-6882-3

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Fifth Edition (March, 1974)

This is a minor revision of SY22-6882-2. Minor changes have been made in Sections 4, 5, 9, 10 and 13. A technical change to the text or to an illustration is indicated by a vertical line to the left of the change. Changes are continually made to the information herein; any such changes will be reported in subsequent revisions or Technical Newsletters.

A form for readers' comments is provided at the back of this publication. If the form has been removed, comments may be addressed to IBM Canada Ltd., Laboratory Publications, Department 849, 1150 Eglinton Ave. E., Don Mills, Ontario M3C 1H7. Comments become the property of IBM.

This graphics integrated manual furnishes maintenance personnel with a learning tool and maintenance guide for all models of the IBM 129 Card Data Recorder (serial numbers 20,000 and higher). The publication is divided into sections that correspond to major units of the machine. Within sections, maintenance information such as service checks, adjustments, and removals, is integrated with the theory of operation for each unit of the machine. When learning the theory of operation of machine units, the student can, if he desires, ignore maintenance data; when maintaining the machine, service personnel can find all information related to a unit in one area of the manual.

The introduction contains diagrams of major units of the IBM 129. Callouts present a brief description of the unit members and indicate the sections of the manual that contain the detailed information. These diagrams provide the user with a basic visual index of the manual. An index at the back of the manual provides a more detailed reference.

Diagrams of circuit operations show the logic in simplified form. Important points are called out and described on the diagrams. When troubleshooting an operation, refer to the machine ALD pages called out on these diagrams. Part numbers referred to in this manual are IBM part numbers.

To use this manual effectively, the reader should be familiar with the following manuals:

IBM Component Circuits and ALD's, SY22-2798

IBM Power Supplies–SLT, SLD, ASLT, MST, SY22-2799

IBM Solid Logic Technology–Packaging, Tools, Wiring Change Procedure, SY22-2800

The following manuals describe the IBM 129 from an operator's viewpoint:

IBM 129 Card Data Recorder, Operator's Reference Manual, GA22-6968

IBM 129 Card Data Recorder/Machine Description, GA22-6980

Safety Procedures

For your own safety, practice caution at all times and be aware of potentially dangerous areas of the machine. Be sure to read and follow the safety suggestions in S229-1264, which is duplicated here.

Remember:

- Loose clothing can become entangled in the moving parts of the machine.
- Heat sinks are at an electrical potential. Do not short heat sinks to each other or to the machine side frame.
- Voltages developed in the resonant circuit of the power supply may be much greater than the line voltage.
- Follow the specific safety precautions that accompany many of the adjustments in this manual.

EQUIPMENT SAFETY

Mechanical

- Do not operate the machine under power with units disassembled, removed, or maladjusted. Keep tools clear of the mechanism when the machine is operating under power.
- Do not clean any plastic part of the IBM 129 with IBM Cleaning Fluid.
- Use only the IBM 129 jam removal tool when clearing difficult jams. Use of the IBM 29 card saw can severely damage optics in the punch/read station; remove the optics before using the jam removal tool.

Electrical

- Always replace blown fuses with fuses of the correct type and rating. Using fuses of a different type or higher rating could damage components.
- Remove power from the machine before replacing SLD cards or electrical components. Failure to do so could result in damage to a card being replaced or to other cards in the machine.
- Do not use meter clips on SLT pins; use only the SLT probe when metering from an SLT pin. Be careful not to ground or short the pins together.
- Do not test the light emitting diodes (LEDs) of the column indicator with an ohmmeter or continuity checker; the power rating of the LEDs is not sufficient for such a test.

DANGER
Cleaning the light source (glass) while it is hot may cause burns.

CE SAFETY PRACTICES

All Customer Engineers are expected to take every safety precaution possible and observe the following safety practices while maintaining IBM equipment:

1. You should not work alone under hazardous conditions or around equipment with dangerous voltage. Always advise your manager if you MUST work alone.
2. Remove all power AC and DC when removing or assembling major components, working in immediate area of power supplies, performing mechanical inspection of power supplies and installing changes in machine circuitry.
3. Wall box power switch when turned off should be locked or tagged in off position. "Do not Operate" tags, S229-1266, affixed when applicable. Pull power supply cord whenever possible.
4. When it is absolutely necessary to work on equipment having exposed operating mechanical parts or exposed live electrical circuitry anywhere in the machine, the following precautions must be followed:
   a. Another person familiar with power off controls must be in immediate vicinity.
   b. Rings, wrist watches, chains, bracelets, metal cuff links, shall not be worn.
   c. Only insulated pliers and screwdrivers shall be used.
   d. Keep one hand in pocket.
   e. When using test instruments be certain controls are set correctly and proper capacity, insulated probes are used.
   f. Avoid contacting ground potential (metal floor strips, machine frames, etc. — use suitable rubber mats purchased locally if necessary).
5. Safety Glasses must be worn when:
   a. Using a hammer to drive pins, riveting, staking, etc.
   b. Power hand drilling, reaming, grinding, etc.
   c. Using spring hooks, attaching springs.
   d. Soldering, wire cutting, removing steel bands.
   e. Parts cleaning, using solvents, sprays, cleaners, chemicals, etc.
   f. All other conditions that may be hazardous to your eyes. REMEMBER, THEY ARE YOUR EYES.
6. Special safety instructions such as handling Cathode Ray Tubes and extreme high voltages, must be followed as outlined in CEM's and Safety Section of the Maintenance Manuals.
7. Do not use solvents, chemicals, greases or oils that have not been approved by IBM.
8. Avoid using tools or test equipment that have not been approved by IBM.
9. Replace worn or broken tools and test equipment.
10. Lift by standing or pushing up with stronger leg muscles — this takes strain off back muscles. Do not lift any equipment or parts weighing over 60 pounds.
11. All safety devices such as guards, shields, signs, ground wires, etc. shall be restored after maintenance.
12. Each Customer Engineer is responsible to be certain that no action on his part renders product unsafe or exposes hazards to customer personnel.
13. Place removed machine covers in a safe out-of-the-way place where no one can trip over them.
14. All machine covers must be in place before machine is returned to customer.
15. Always place CE tool kit away from walk areas where no one can trip over it (i.e., under desk or table).
16. Avoid touching mechanical moving parts (i.e., when lubricating, checking for play, etc.).
17. When using stroboscope — do not touch ANYTHING — it may be moving.
18. Avoid wearing loose clothing that may be caught in machinery. Shirt sleeves must be left buttoned or rolled above the elbow.
19. Ties must be tucked in shirt or have a tie clasp (preferably nonconductive) approximately 3 inches from end. Tie chains are not recommended.
20. Before starting equipment, make certain fellow CE's and customer personnel are not in a hazardous position.
21. Maintain good housekeeping in area of machines while performing and after completing maintenance.

KNOWING SAFETY RULES IS NOT ENOUGH
AN UNSAFE ACT WILL INEVITABLY LEAD TO AN ACCIDENT
USE GOOD JUDGMENT — ELIMINATE UNSAFE ACTS
S229-1264-1

Artificial Respiration

GENERAL CONSIDERATIONS

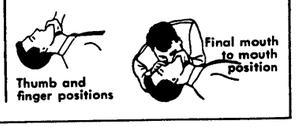
1. **Start Immediately, Seconds Count**
   Do not move victim unless absolutely necessary to remove from danger. Do not wait or look for help or stop to loosen clothing, warm the victim or apply stimulants.
2. **Check Mouth for Obstructions**
   Remove foreign objects — Pull tongue forward.
3. **Loosen Clothing — Keep Warm**
   Take care of these items after victim is breathing by himself or when help is available.
4. **Remain in Position**
   After victim revives, be ready to resume respiration if necessary.
5. **Call a Doctor**
   Have someone summon medical aid.
6. **Don't Give Up**
   Continue without interruption until victim is breathing without help or is certainly dead.

Reprint Courtesy Mine Safety Appliances Co.

Rescue Breathing for Adults Victim on His Back Immediately

1. **Clear throat** of water, food, or foreign matter.
2. **Tilt head back** to open air passage.
3. **Lift jaw up** to keep tongue out of air passage.
4. **Pinch nostrils** to prevent air leakage when you blow.
5. **Blow** until you see chest rise.
6. **Remove your lips** and allow lungs to empty.
7. **Listen** for snoring and gurglings, signs of throat obstruction.
8. **Repeat mouth to mouth breathings** 10-20 times a minute.

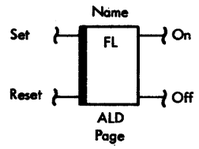
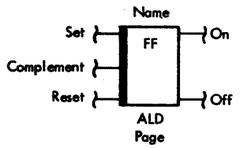
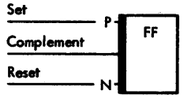
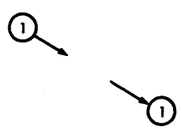
Continue rescue breathing until he breathes for himself.



Contents

Abbreviations

A	amperes
ac	alternating current
acc	accumulator
alpha	alphabetic
APM	Analysis Procedure Manual
AR	amplifier
BCD	binary coded decimal
bksp	backspace
buff	buffer
CC	column counter, card count
cd	card
CE	customer engineer
CF	card feed
CHAR BKSP	character backspace key
col	column
comp	complete
corr	correct
CR	column ring
ctr	counter
ctrl	control
CU	countup
dc	direct current
def	definition
DP	direct punch
DR	driver
dup	duplicate
EC	entry complete
EMC	electromagnetic compatibility
ent	entry
ESD	electrostatic discharge
FET	field effect transistor
FF	flip-flop (trigger)
FL	flip latch
fld	field
FLD BKSP	field backspace key
gnd	ground
inh	inhibit
init	initial
intlk	interlock
IR	incident report
KB	keyboard
KS	keystroke
kybd	keyboard
LC	latch contact
LED	light emitting diode
lkah	lookahead
LO	low order
lth	latch
lv	lever
LZ	left zero
MHz	megahertz
MP	multipunch
ms	milliseconds
MULT PCH	multipunch key
N	inverter
op	operation
osc	oscillator
pch	punch
POR	power-on reset
pos	position
prog	program
PROG SEL	program select key
PS	production statistics
RA/CF	record advance/card feed switch
rd	read
REG	register key
regen	regenerate
REL	release key
res	reset
R/P	read/punch
rst	reset
SC	self-check
S/D	skip/dup
sel	select
ser	serial
sw	switch
us	microseconds
V	volts
VC	verify correction
ver	verify
VER CORR	verify correction key
wrt	write
wte	write
xfer	transfer

Symbol	Description
	*Flip Latch* The "on" output is active when the "set" input is active; the on output remains active active until the latch is reset. The "off" output is active when the "reset" input is active; the off output remains active until the latch is set.
	*Flip-flop (Trigger)* Same as the flip latch, except that an active complement input switches the device to the opposite condition. *Note:* Some latches and triggers are shown with a "P" or an "N" on an input line to indicate that a shift in polarity is required at that input. Where a "P" appears, a shift from the inactive to the active state is required. When an "N" appears, a shift from the active to the inactive condition is required.
	
	*On-page Connectors* Indicate that a connection exists between two points on the same diagram. The pointer leaving the circle is aligned with another pointer and circle containing the same number.
	*Reference Symbol* The description next to a black symbol (callout) refers to the circuitry near the same reference symbol in the diagram.
1 **2**	Indicates that the adjustments must be performed in sequence, starting with **1**.

Note: Many of the logic lines shown on the operation diagrams (Section 9) are not accessible by the CE for scoping.

Symbol	Description
	**Theory of operation** information is given in the area indicated by this symbol.
	Step-by-step unit **adjustments** (with tolerances) are given in the area indicated by this screwdriver symbol.
	The **service check** given in the area indicated by this check symbol should be performed to determine whether a unit adjustment is necessary.
	Step-by-step unit **removal and replacement** procedures are given in the area indicated by this bolt-washer-nut symbol.

Section 1. IBM 129 Card Data Recorder Introduction

IBM 129 Card Data Recorder Model 3

The IBM 129 Card Data Recorder is a key-entry, card punching and verifying machine that uses both data and program storage to prepare standard 80-column cards for data processing.

The IBM 129 Card Data Recorder is available in three models:

Model 1—Punch, verify
Model 2—Punch, print
Model 3—Punch, verify, print.

The IBM 129 is capable of:

- Processing keyed data and simultaneously performing auto functions, such as skip or dup.
- Character, field, word, and record backspacing.
- Reading data and program cards into storage.
- Inserting automatic left zeros or left blanks.

The IBM 129 is equipped with:

- Two 80-position data storage units.
- A storage location for six program levels.
- A "no format" program level.
- An IBM 29-type interlocked 48-/64-character keyboard.

1.1 BASIC COMPONENTS

1.1.1 Card Stacker

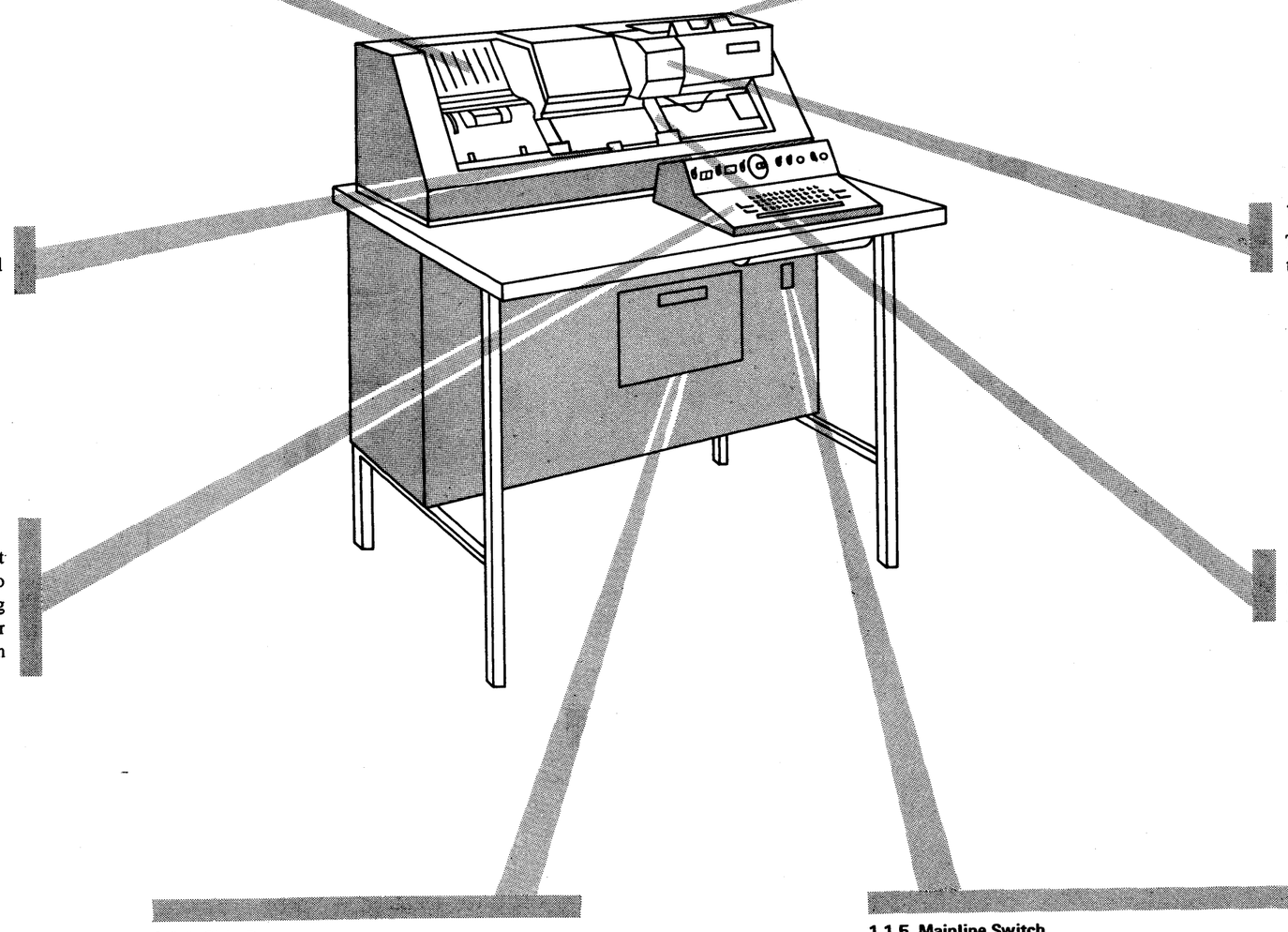
The card stacker holds about 500 cards and has a convenient card count scale. A full stacker operates a stacker stop switch that interlocks the card feed. Power is not turned off and operation may continue when the cards are removed from a full stacker.

1.1.2 Card Release Pushbutton

The card release pushbutton allows manual removal of a card from the punch/read station.

1.1.3 Keyboard

The keyboard contains the keys for a 64-character set and for control of the machine. The console is also part of the keyboard and contains the operating switches and controls. The keyboard pivots for convenience. See Section 3 for a complete description of the keys and switches.



1.1.4 Chip Box

The chip box collects the chips as they are punched from a card during a punch operation.

1.1.5 Mainline Switch

The mainline switch, when turned on, applies line voltage to the machine. When power is turned on, a power-on reset occurs and the machine is ready for use in program level 0.

1.1.6 Card Hopper

The card hopper holds about 500 cards. Cards are placed in the hopper, in front of the card feed pusher plate, face forward, with the 9-edge down. The hopper holds the cards to be processed during a punch or verify operation.

1.1.7 Print Unit (Models 2 and 3)

The print unit contains the mechanics used to print the 64 standard codes during a print operation.

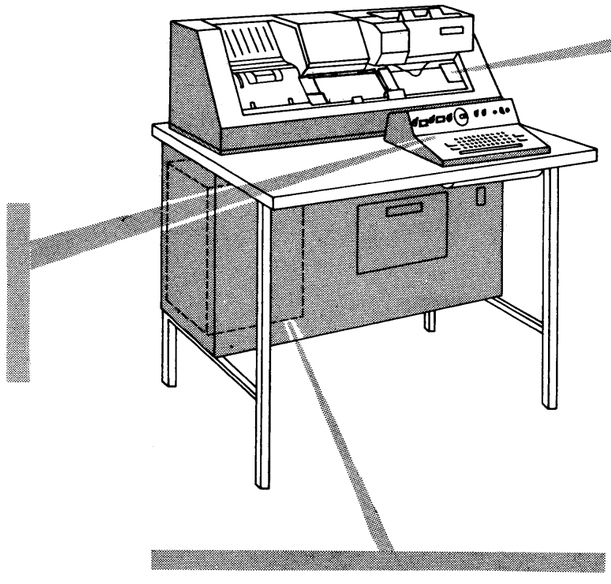
1.1.8 Punch/Read Station

Station where all cards are processed during a punch, print, verify, or read operation.

1.2 DATA STORAGE

The 129 Card Data Recorder contains input and output sections of data storage. Each storage section can store 80 characters or columns of card information recorded in electronic form. Data keyed for punching is stored (recorded) temporarily in buffer C and then is transferred to input storage. The column indicator shows the input storage position where the next column or character is to be recorded. If a character is keyed incorrectly, the machine can be backspaced and the correct character can be keyed. Rekeying erases the incorrect character in input storage and records the corrected character. After a card data record is completed in input storage, it is transferred to output storage and then punched in a card. While the card is being punched from output storage, the next card record can be keyed into input storage.

In a verify operation, the punched card to be verified is read into input storage, and the keyed data is compared with the data read into input storage. Errors can be corrected in input storage by a correction routine, and a correction card can be punched immediately after completion of verify operation.



1.2.1 Keyboard

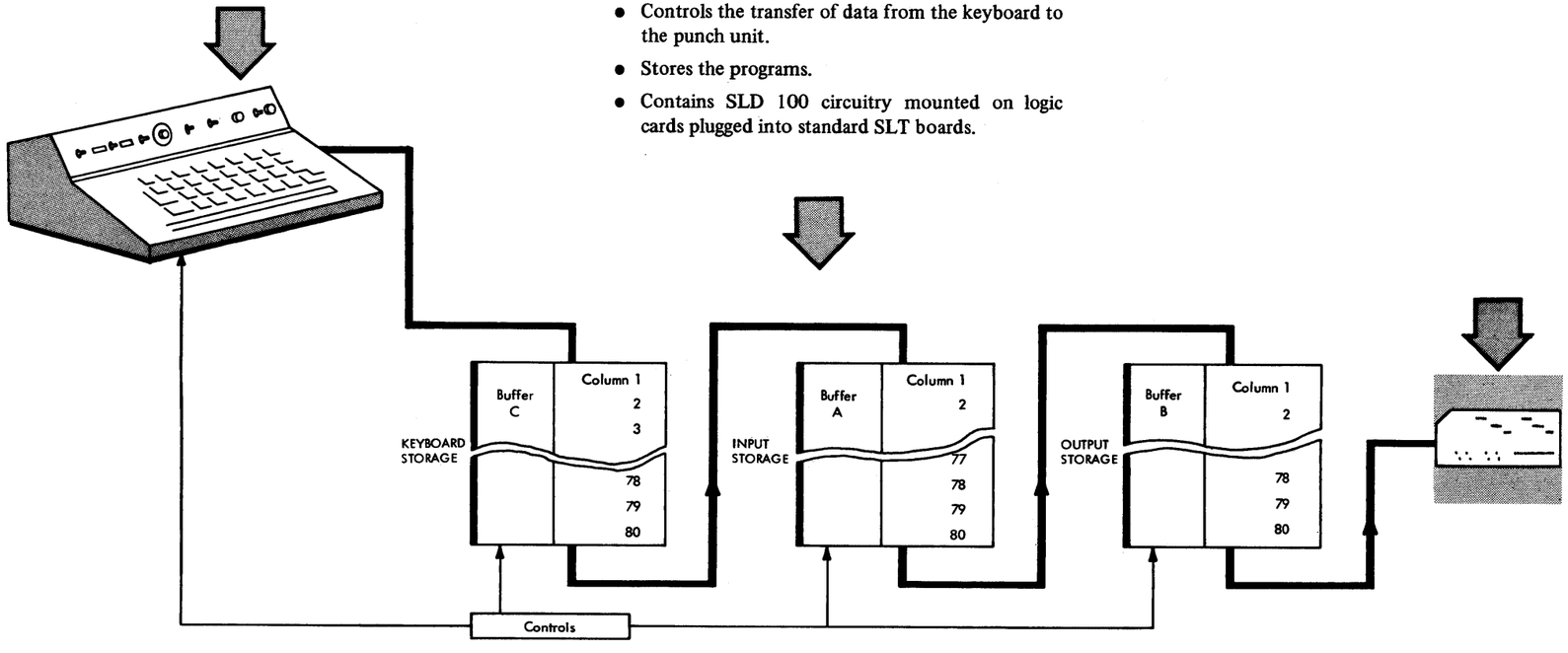
- Contains switches and controls that control machine functions.
- Contains 34 character keys and 12 or 14 function keys, depending on the model of the machine.
- Functions as data input device to storage.

1.2.2 Logic

- Controls transport functions.
- Stores data in field effect transistor (FET) storage buffers.
- Controls the transfer of data from the keyboard to the punch unit.
- Stores the programs.
- Contains SLD 100 circuitry mounted on logic cards plugged into standard SLT boards.

1.2.3 Card Transport

- Contains the electromechanical devices used to move cards for reading, punching, and printing.



Transport Rolls (See 5.1)

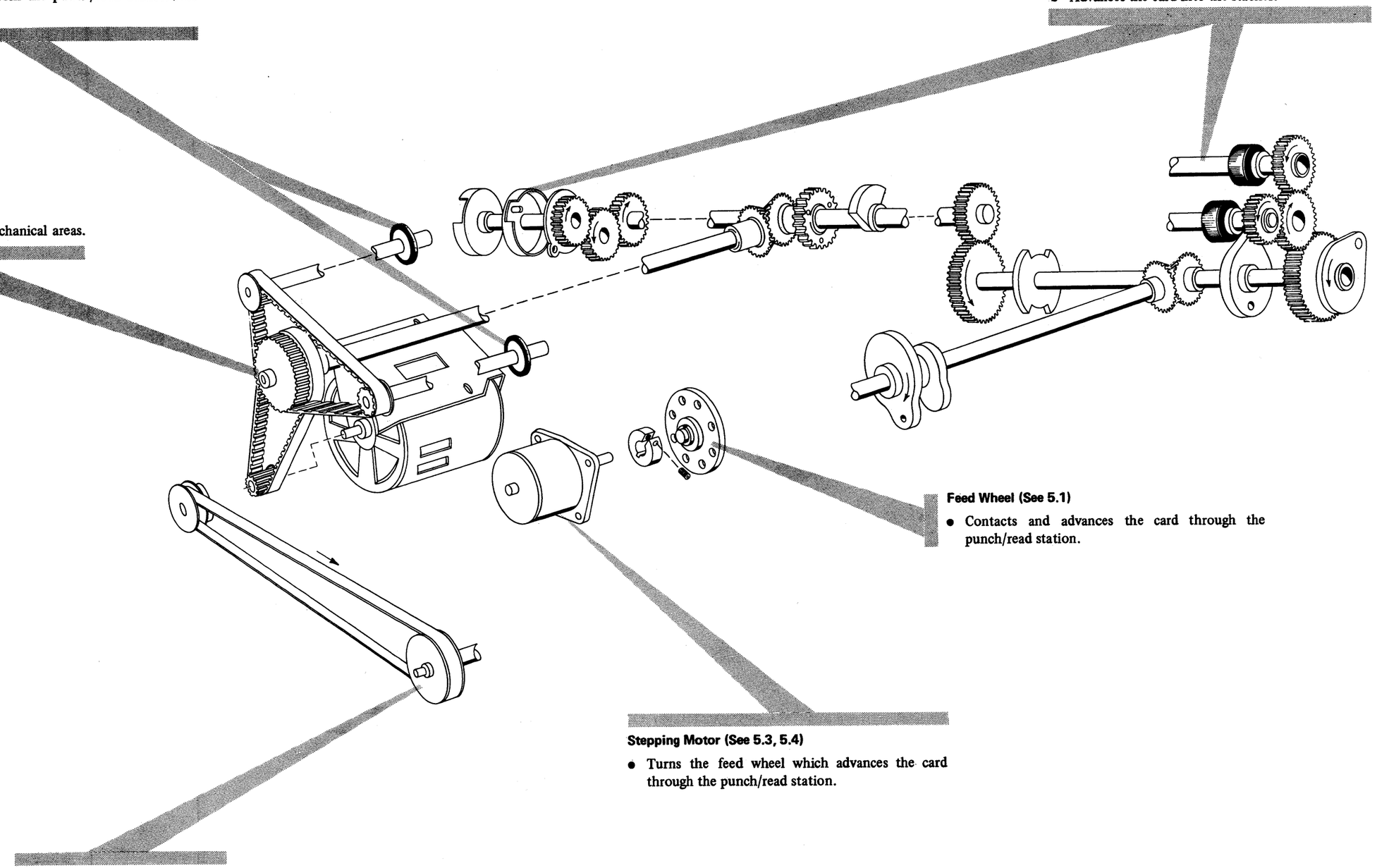
- Move the card from the punch/read station into the stacker.

Drive Mechanism (See 5.1, 5.2)

- Provides drive to the two main mechanical areas.

Card Feeding (See 5.6-5.10) and Stacking Mechanism (See 5.14, 5.15)

- Feeds and positions the card in the punch/read station.
- Advances the card into the stacker.



Feed Wheel (See 5.1)

- Contacts and advances the card through the punch/read station.

Stepping Motor (See 5.3, 5.4)

- Turns the feed wheel which advances the card through the punch/read station.

Punch Drive (See 6.1-6.4)

- Provides drive to the punch unit.

Pressure Rails (See 5.12)

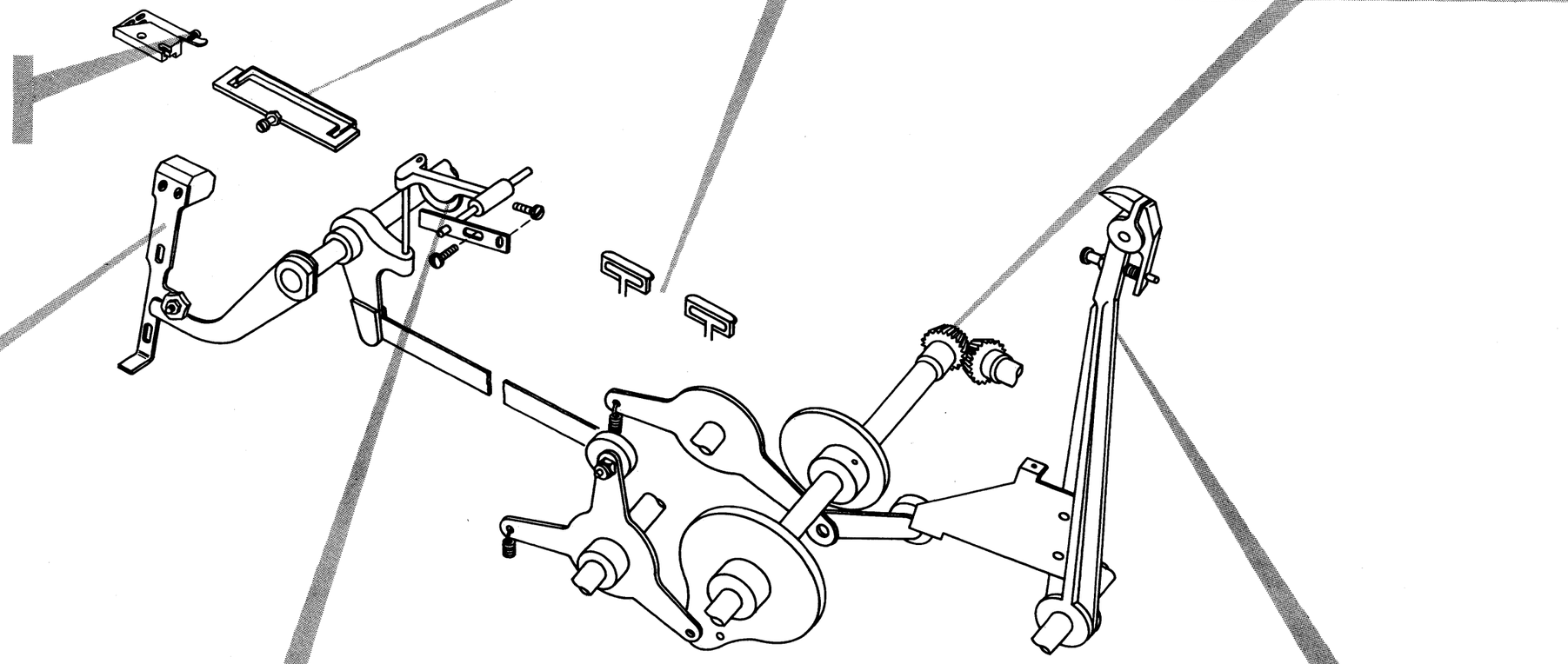
- Hold the card against the guide rails.

Bevel Gears (See 5.12)

- Controlled by the card feed clutch.
- Supply drive to the punch/read registration mechanism.

Eject Pressure Roll (See 5.12)

- Contacts the card with continuously turning transport rolls and transports the card from the punch/read station to the stacker.



Card Release (See 5.12)

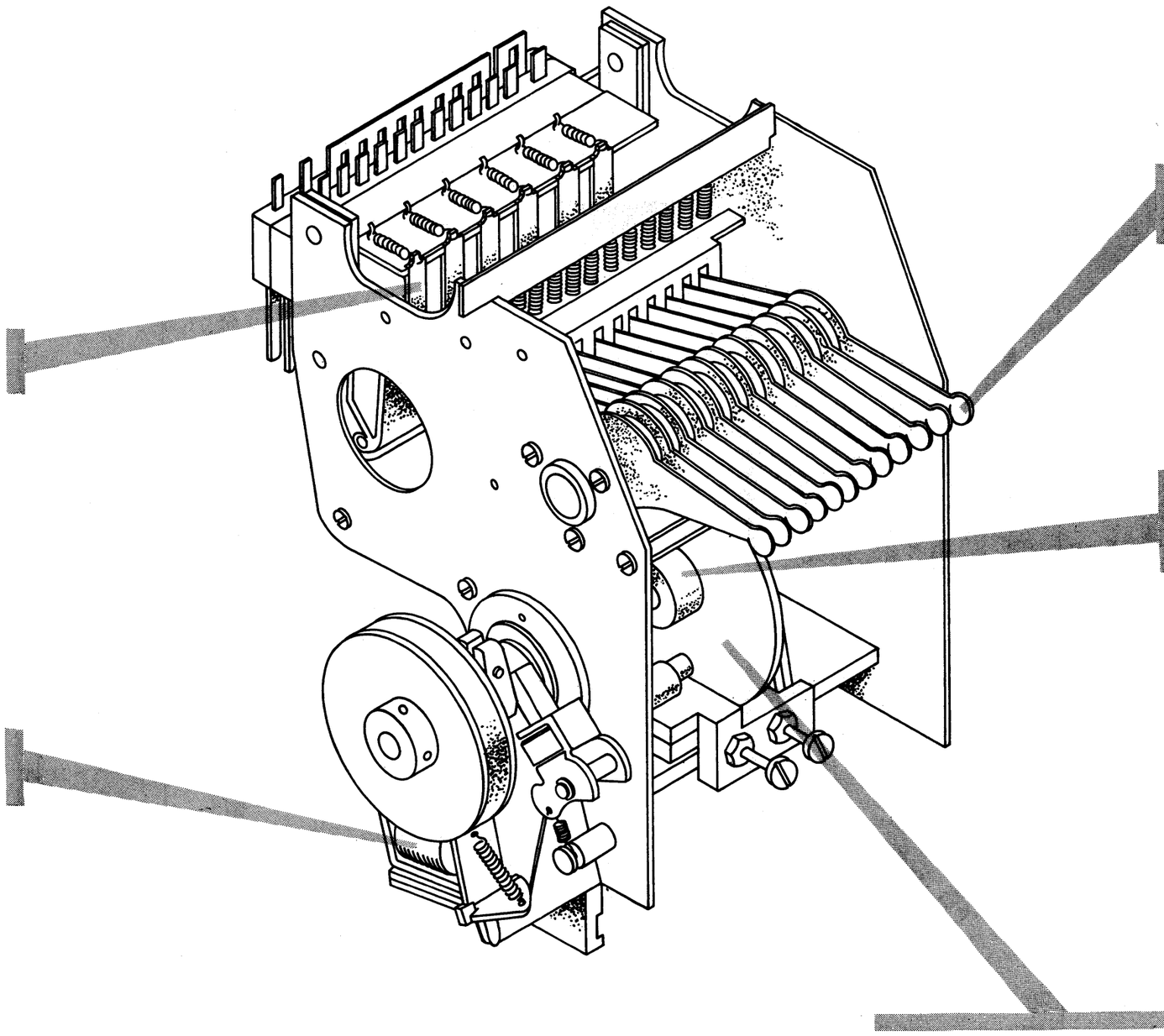
- Releases the card registered in the punch/read station.

Punch/Read Station Pressure Roll (See 5.12)

- Raises to allow card to enter the punch/read station.
- Holds the card against the feed wheel during processing.

Card Pusher Arm (See 5.12)

- Registers the card in the punch/read station.



Interposer Magnets (See 6.3, 6.4)

- Energize to allow the punch operating arms to engage the punch bail.

Punch Clutch (See 6.1, 6.2)

- Controlled by electronic logic.
- Engages for all punch and print operations.

Punch Operating Arms (See 6.3, 6.4)

- Operate the punch extensions for punching and printing.

Punch Drive Shaft (See 6.3, 6.4)

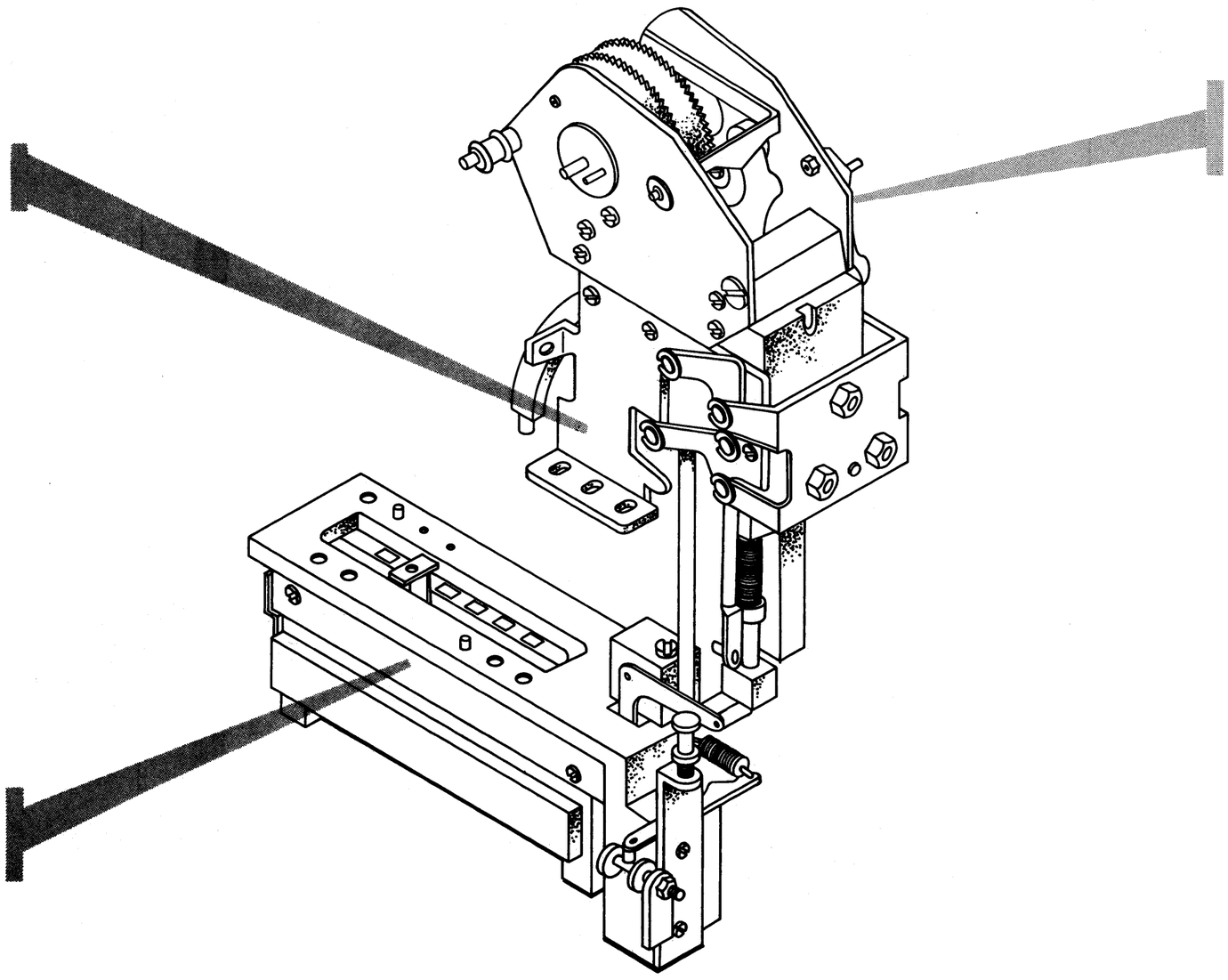
- Driven by a continuous V-belt drive.
- Controlled by the punch clutch.
- Operates the punch mechanism.

Punch Drive Photocell Assembly (See 4.5, 4.6)

- Provides the timing pulses during a punch cycle.

Print Unit (See 7.2, 7.4)

- Contains the code plate and print wires that print the characters on the card.



Ribbon Feed Unit (See 7.4)

- Feeds the ribbon during print operations.
- Driven through the print drive arms by the print drive rod.

Print Interposer Assembly (See 7.1, 7.4)

- Contains two sets of interposers that position the code plate horizontally and vertically.
- Interposers are operated by the punch extensions.

- Six program levels (1-6) and a "no program format" (program level 0) are standard.

- Program card codes for field definition, skip, dup, and alpha shift are the same as for the IBM 29 program level 1; self-check and left-blank codes are different.

- Program is read into storage (levels 1-3 to buffer A, 4-6 to buffer B) at start of particular application by inserting prepunched program card at the read station (punch/read station on verify models) and by pressing the READ pushbutton.
  – Card must be pre-registered and card bed must be clear for the READ pushbutton to be active.
  – PROGRAM MODE dial must be in one of six positions (1-6).
  – Only one program may be loaded at a time.
  – Program remains in storage either until power is turned off on the machine or another program-load operation takes place for that setting of the PROGRAM MODE dial.
  – Entering a program does not destroy data in either buffer, but does cause a record backspace in the input buffer.

- Program levels may be changed at any time during the keying of the record by pressing the PROG SEL key and a digit key (0-6).

- Programmed auto dup transfers data from previous record processed to following record.
  – Applications requiring manual insertion of a master card can have data automatically duplicated from that card without first keying such fields through the data read-in function.
  – Sensing an 11-punch during duplication of a numeric field does not cause a skip operation.
  – Manual duplication in program level 0 occurs at about ten columns per second as long as the DUP key is held down and a record has been previously keyed or read in.

- With REC ADV/CARD FEED set to AUTO, the program reverts to the setting of the PROGRAM MODE dial at the end of the record.

- With REC ADV/CARD FEED set to MANUAL, the program must be manually selected at the end of the record by pressing the PROG SEL key and a digit key (0-6).

- Power-on reset sets the programs to blanks; program levels 1-6 become 80 single-position fields in numeric shift; program level 0 becomes 80 single-position fields in alpha shift (standard).

Program Card Codes and Uses

Card Code	Use
12	Field definition; in each column of field except first.
11	Defines first column of auto skip field.
0	Defines first column of auto dup or auto verify field.
1	Defines column programmed for alphabetic (alpha) shift.
2	Defines first and last columns of self-check field; used in addition to normal field definition.
3	Defines first and last columns of left-zero verify field; used in addition to normal field definition.
12 and 11	Define column to be skipped in self-check field; not used in high- or low-order positions.

IBM 129 Card Data Recorder Model 3 Keyboard*
(With Self-check Feature)

*Model 1 and 2 keyboards are similar to Model 3 keyboards, except for minor key and switch changes. (See Section 3.1.)

3.1 KEYBOARD DESCRIPTION

3.1.1 Data Keys (Alpha, Numeric, Special Character, Space)

Pressing one of the data keys enters a character into the input buffer for punching, or compares it with the input buffer for verifying. Alpha or numeric shift is determined by program or manual control. The numeric –LZ key has a special use for left-zero fields; see "BLANK COLUMNS/LEFT ZERO CTRL (Control) Key," 3.1.5.

3.1.2 PROG SEL (Program Select) Key

Pressing the PROG SEL key followed by a data key (0-6) shifts the machine to the program level selected. Program level selection can be made any number of times during the keying of a record. On advancing to the next record, the program control returns to the level indicated by the setting of the PROGRAM MODE dial, if REC ADV/CARD FEED is set to AUTO.

If REC ADV/CARD FEED is set to MANUAL (column indicator at 00), pressing the PROG SEL key followed by a data key (0-6) selects that level for the next input record; punches and ejects present card (does not feed a card); and advances column indicator to column 01 of the next record, or to the first manual column if an auto field is programmed at the start of the record and AUTO SKIP/DUP is set to ON.

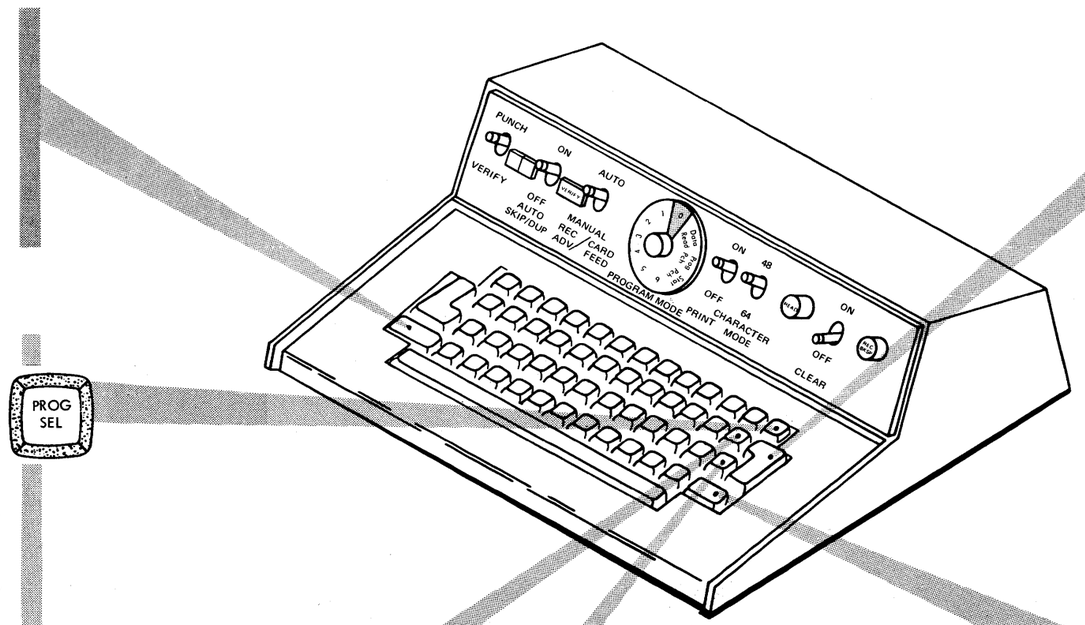
3.1.3 FEED (Card Feed) Key

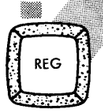
Punch Mode: Holding the FEED key down moves two cards from the hopper into the register and pre-register positions of the punch station. The key is inoperative when a card is registered at the punch station.

Verify Mode: Feeds one card from the hopper. The card is read at the punch/read station. Cards to be verified must be fed from the hopper; they cannot be inserted manually.

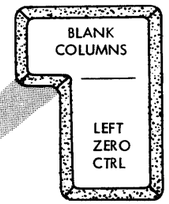
3.1.4 REG (Register) Key

If a card is pre-registered or manually inserted, the REG key registers the card at the punch/read station. Pressing this key does not feed a card from the hopper. This key is not operative in verify mode.





3.1.5 BLANK COLUMNS/LEFT ZERO CTRL (Control) Key



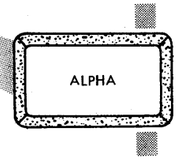
Punch Mode: Pressing the LEFT ZERO CTRL key, after a character or characters for a field are keyed, starts a left-zero (fill) operation if the keyboard is in numeric shift or starts a left-blank (fill) operation if the keyboard is in alpha shift. This key is not operative in the first position of any field.

Use –LZ key for minus (credit) over the units position and start LZ fill operation combined. For filled field (all digits, no 0's), use the MULT PCH key for minus over the units position. Maximum length of a single LZ field is 79 positions.

Verify Mode: In any field, pressing the BLANK COLUMNS key verifies blanks until a character or the end of a field is reached.

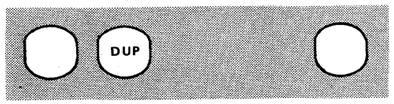
In the units position of a programmed left-zero field, this key only performs a left-zero control function. This key must be pressed after the verification of the units position of field; otherwise, the keyboard will lock. Use the –LZ key after units position verification for minus over the units position and LZ control operation combined.

3.1.6 ALPHA (Alphabetic Shift) Key

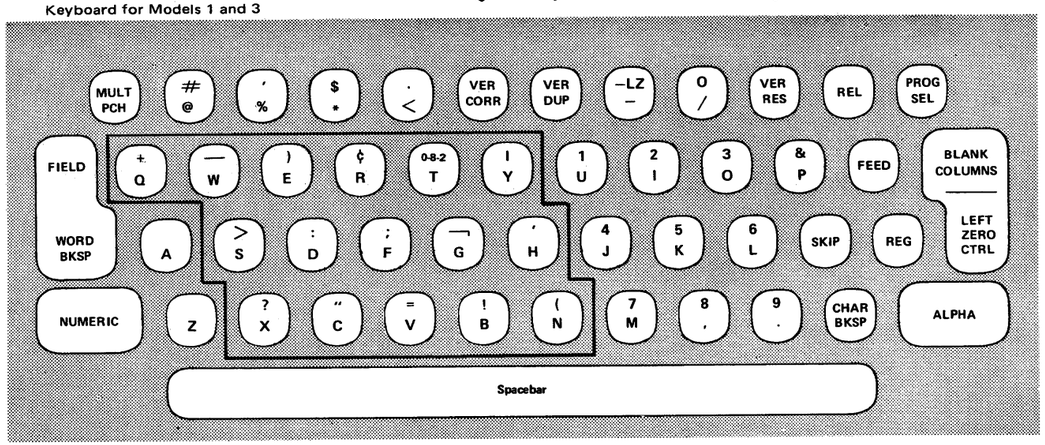


Pressing the ALPHA key shifts the keyboard into alpha mode, as long as the key is held down. When this key is released, machine returns to the shift indicated by the program.

Alternate Keys for Model 2



Keyboard for Models 1 and 3



3.1.7 AUTO SKIP/DUP Switch

When AUTO SKIP/DUP switch is ON, programmed auto skip/dup fields operate automatically at electronic speeds. Auto duplication of blanks does not stop the function. When this switch is OFF, fields operate as manual fields.

3.1.8 PUNCH/VERIFY Switch (Models 1 and 3)

When PUNCH/VERIFY switch is set to PUNCH, the machine operates as a punch. When PUNCH/VERIFY is set to VERIFY, the machine operates as a verifier. This switch should be set only when the card bed is clear and the column indicator shows 01.

Models with the direct punch control feature will have a center position on this switch to control the feature.

3.1.9 Column Indicator

The column indicator shows the position of the input buffer that will receive the next character. The column indicator shows 00 when REC ADV/CARD FEED is set to MANUAL and the input buffer is complete; shows 88 when a field or record must be reverified in verify mode; shows CC when a correction card should be punched in verify mode; and advances to 01 of next record when REC ADV/CARD FEED is set to AUTO.

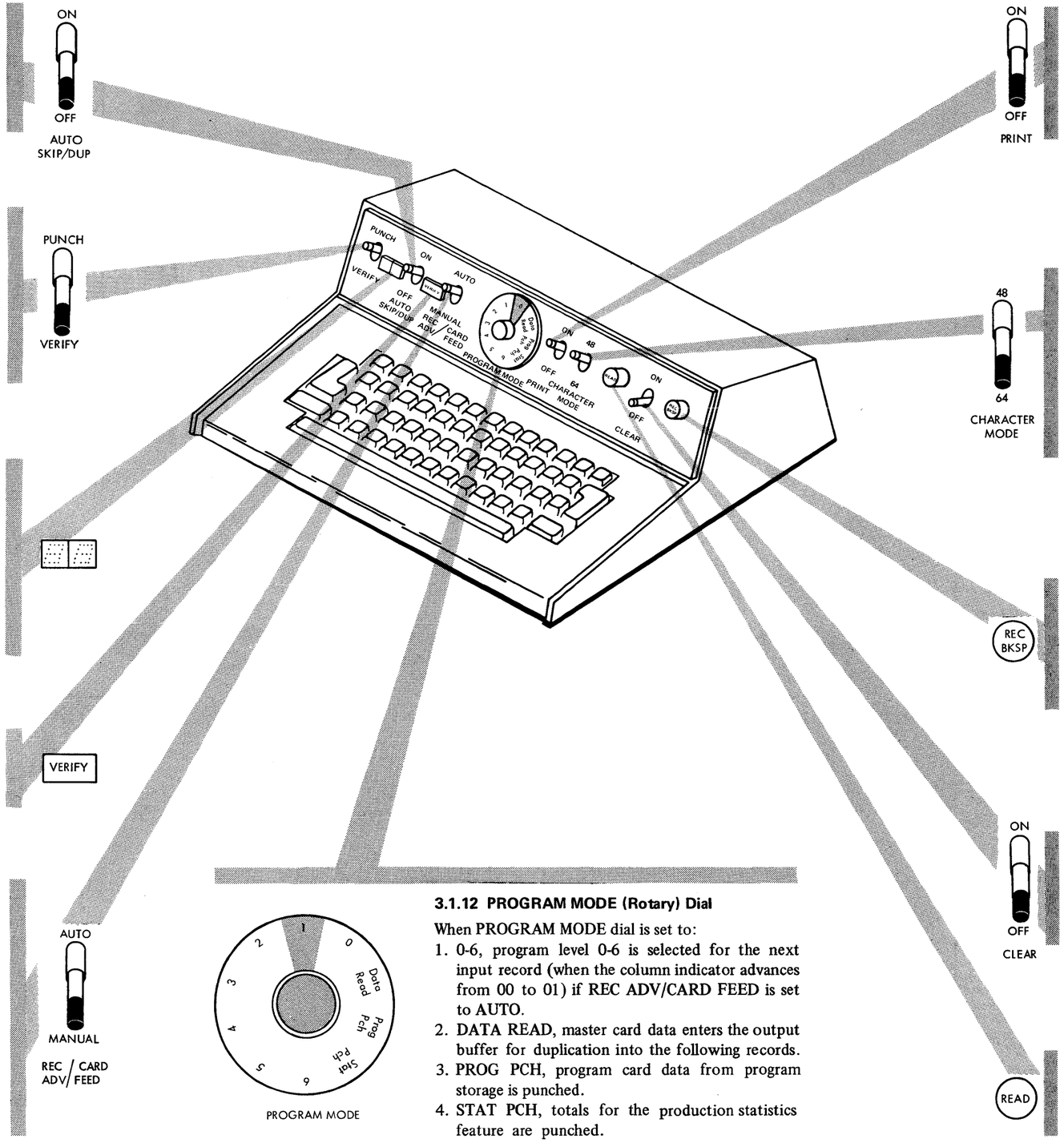
3.1.10 VERIFY Light

The VERIFY light indicates a verify error on verify models, and/or self-checking number error, if the self-check feature is used.

3.1.11 REC ADV (Record Advance)/CARD FEED Switch

When REC ADV/CARD FEED switch is set to:

1. AUTO, the machine advances from column 80 of one input record to column 01 of the next input record and sets the program level shown on the PROGRAM MODE dial.
2. MANUAL, the machine stops at column 00 of the current record and prevents a card feed cycle. This allows manual program selection for the next record or allows backspacing into the present input record for correction of the record before a card is punched.



3.1.12 PROGRAM MODE (Rotary) Dial

When PROGRAM MODE dial is set to:

1. 0-6, program level 0-6 is selected for the next input record (when the column indicator advances from 00 to 01) if REC ADV/CARD FEED is set to AUTO.
2. DATA READ, master card data enters the output buffer for duplication into the following records.
3. PROG PCH, program card data from program storage is punched.
4. STAT PCH, totals for the production statistics feature are punched.

3.1.13 PRINT Switch (Models 2 and 3)

When PRINT switch is set to ON during keying into input storage, the characters to be printed are the same as those punched in the card. All leading 0's are print suppressed, except for the units position of a field. Only the 64-character set will print.

3.1.14 CHARACTER MODE Switch

When CHARACTER MODE switch is set to:

1. 48, all data keys are active in alpha shift; in numeric shift, those keys outlined in the keyboard figure (Section 3.1) will lock the keyboard if pressed. The keyboard may be restored by pressing the CHAR BKSP or ALPHA key.
2. 64, all data keys are active in either alpha or numeric shift.

3.1.15 REC BKSP (Record Backspace) Pushbutton

When REC BKSP pushbutton is pressed, the column indicator returns to column 01 of the input buffer without changing the current program level, and any auto operation (skip/dup) programmed for column 01 is suppressed.

3.1.16 CLEAR Switch (Momentary Spring-loaded)

When CLEAR switch is held ON, all cards move out of the transport into the stacker and the column indicator returns to 01. Manual or auto dup will not operate in the first record following a clear operation.

3.1.17 READ Pushbutton

When READ pushbutton is pressed, program/data cards are read into the input buffer, in connection with the PROGRAM MODE dial.

3.1.18 MULT PCH (Multiple Punch) Key

Pressing the MULT PCH key places the keyboard in numeric shift and prevents the column indicator from advancing while separate codes are keyed. If the multiple punch special character is not one of the standard 64 characters, printing is suppressed.

3.1.19 FIELD/WORD BKSP (Field/Word Backspace) Key

Pressing the FIELD BKSP key returns the column indicator to the first column of the field being keyed. If in the first column of a field, pressing this key returns the column indicator to the start of the preceding manual field.

The FIELD BKSP key operates as a word backspace key when used in connection with the ALPHA shift key. Pressing the ALPHA shift key and the FIELD BKSP key returns the column indicator to the column following the last space that was spacebar entered, or to the first column of a manual field, whichever comes first. Any backspace key (character, field/word, or record) may be used to unlock a locked keyboard. A backspace does not change the current program level.

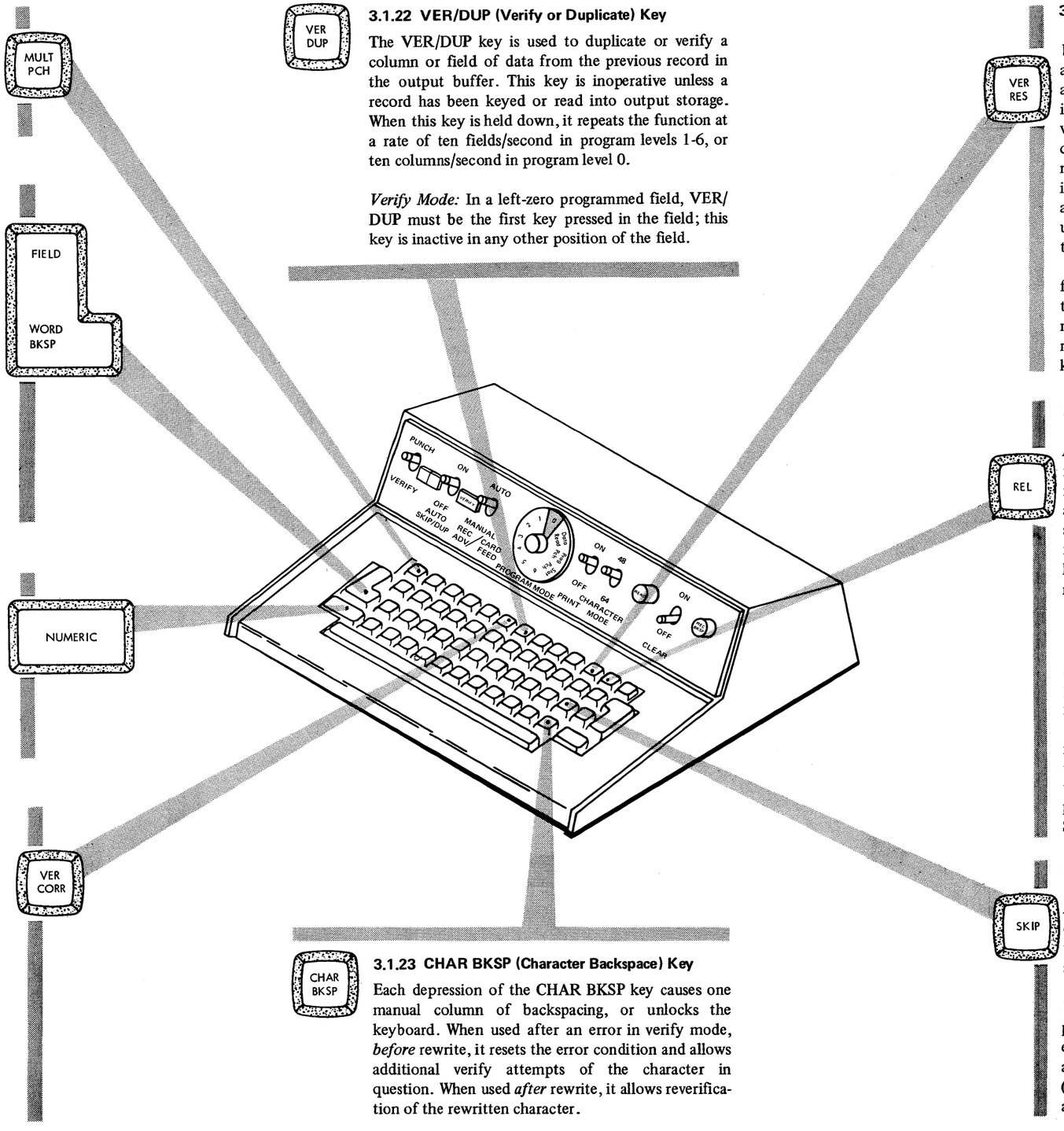
3.1.20 NUMERIC (Numeric Shift) Key

Pressing the NUMERIC key shifts the keyboard into numeric mode, as long as the key is held down. The numeric shift key must be held down when operating in program level 0 and numeric keying is required. The key is used to override alpha programming when under program control. If both the NUMERIC and ALPHA shift keys are pressed, numeric shift takes precedence.

3.1.21 VER CORR (Verify Correction) Key

Verify Mode Only: Pressing the VER CORR key in any field allows a rewrite of the remainder of the field; pressing this key after a record backspace operation allows a rewrite of the complete record. The keyboard locks (column indicator shows 88) and the field or record must be reverified.

At the completion of a record verify operation, if any rewrite correction has been made by use of the VER RES key procedure or the VER CORR key procedure, the machine locks with the column indicator showing CC. (CC indicates that a correction card should be punched.) Manually insert a blank card in the punch station and press the VER CORR key to punch out the corrected card. When other than 80 column cards are used, the corrected card will advance to the stacker after the next feed cycle.



3.1.22 VER/DUP (Verify or Duplicate) Key

The VER/DUP key is used to duplicate or verify a column or field of data from the previous record in the output buffer. This key is inoperative unless a record has been keyed or read into output storage. When this key is held down, it repeats the function at a rate of ten fields/second in program levels 1-6, or ten columns/second in program level 0.

Verify Mode: In a left-zero programmed field, VER/DUP must be the first key pressed in the field; this key is inactive in any other position of the field.

3.1.23 CHAR BKSP (Character Backspace) Key

Each depression of the CHAR BKSP key causes one manual column of backspacing, or unlocks the keyboard. When used after an error in verify mode, *before* rewrite, it resets the error condition and allows additional verify attempts of the character in question. When used *after* rewrite, it allows reverification of the rewritten character.

3.1.24 VER RES (Verify Reset) Key

Verify Mode Only: Pressing the VER RES key resets a verify error condition and allows a second attempt at verifying. If a verify error is signaled again, a reset is performed and the third keystroke rewrites storage with the new character. After the rewrite, perform a character backspace and reverify; otherwise, the machine locks at the end of the field (column indicator shows 88) and requires a field backspace and reverification. (A character backspace may be used to interrupt the error routine and allow additional verify attempts before a rewrite.)

On a Model 2 machine without the self-check feature, this key is blank. With the self-check feature, this key is named SC RES. On Model 1 and 3 machines without the self-check feature, this key is named VER RES. With the self-check feature, this key is named VER/SC.

3.1.25 REL (Release) Key

Punch Mode: The REL key moves the column indicator through column 80, and regeneration of manual fields is inhibited. The column indicator advances to column 00 if REC ADV/CARD FEED is set to MANUAL, or advances to column 01 of the next record if REC ADV/CARD FEED is set to AUTO. Fields programmed for auto dup past the point of release are duplicated if AUTO SKIP/DUP is ON.

Verify Mode: With REC ADV/CARD FEED set to AUTO, pressing the REL key causes a card to be released without verification and without OK punches in column 81; the card is stacked, and the next card is fed. With REC ADV/CARD FEED set to MANUAL, pressing the REL key moves the column indicator to column 00 to await operator action. (Use the FEED key or the CLEAR switch to continue the verify operation.) Fields programmed for auto verify past the point of release are verified if the AUTO SKIP/DUP switch is ON.

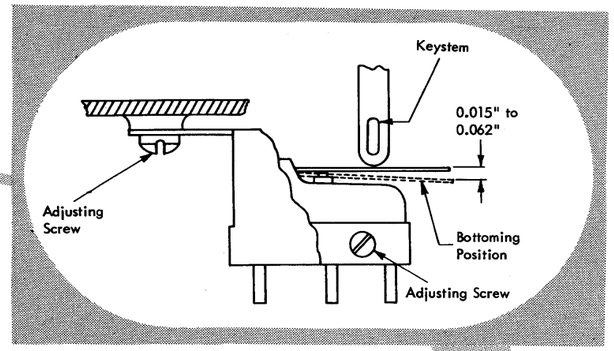
3.1.26 SKIP Key

Punch Mode: The SKIP key initiates a skip to the end of field definition. If there is no field definition or if the program is in level 0, this key provides a single space.

Verify Mode: If the column in which the SKIP key is pressed is blank, a skip without verification to the end of that field is started. If the column is punched, a verify error is signaled. In a programmed LZ (left-zero) verify field, the SKIP key is operative only as the first keystroke.

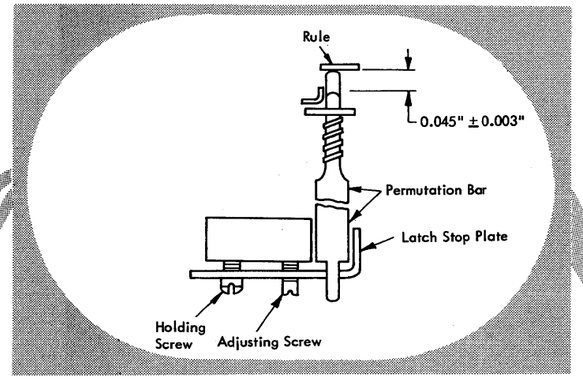
3.2.1 Keystem Switch

Using two adjusting screws, reposition switch to obtain 0.015- to 0.062-inch travel of switch lever after switch transfers.



3.2.2 Permutation Bar Travel

1. Press Q key.
2. Lay 6-inch rule across top of permutation bars.
3. Tripped permutation bar should be 0.045± 0.003 inch lower than others.
4. Repeat for F, K, and BLANK COLUMNS keys.



3.2.3 Permutation Bar Travel

Loosen latch stop plate holding screws and adjust bail stop plate adjusting screws to obtain 0.045± 0.003-inch drop of permutation bar when key is pressed.

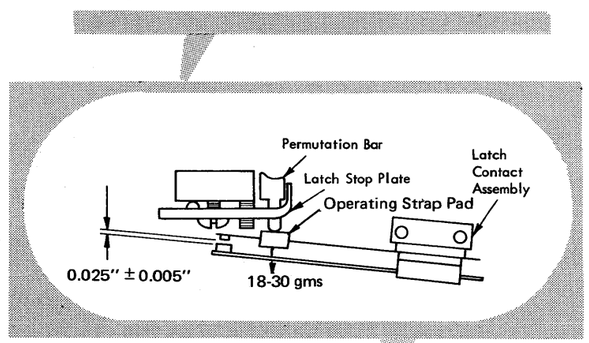
Conversion Table	
Inches	Millimeters
0.003	0,08
0.004	0,10
0.015	0,38
0.035	0,89
0.045	1,14
0.062	1,57

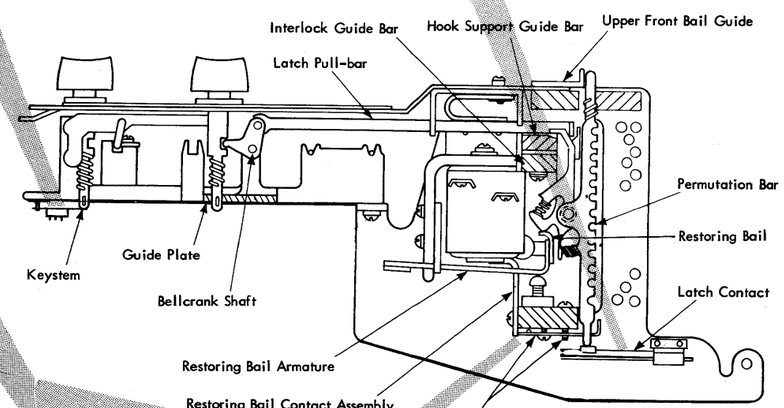
3.2.4 Latch Contact Assembly

With all latch assemblies restored and operating pad touching the bottom of the permutation bar, a clearance of 0.025" ± 0.005" should exist between contacts. When a pressure of between 18 gms and 30 gms is applied to the center of the operating strap pad, the contacts should close.

3.2.5 Latch Contact Assembly

1. Remove latch contact assembly.
2. Form operating straps so the contacts close when a pressure of between 18 gms and 30 gms (measured at the center of the operating strap pad) is applied.
3. Replace latch contact assembly, pivot assembly mounting bar to obtain a 0.025" ± 0.005" air gap between contacts on most latch contact assemblies. Stationary contacts may be formed to obtain the required air gap.





3.2.6 Restore Magnet

1 *Magnet Yoke Assemblies*

With all latch assemblies restored, place 0.004-inch gage between restoring bail armatures and two restore magnet cores. Hold restoring bail firmly in restored position. This adjustment results in 0.003 to 0.006 inch clearance between the cores and armatures when the armatures are in the energized position.

Adjust yoke assemblies so that restoring bail contacts all latches evenly at point (A). This should result in maximum of 0.010-inch overtravel of latch over latch bar.

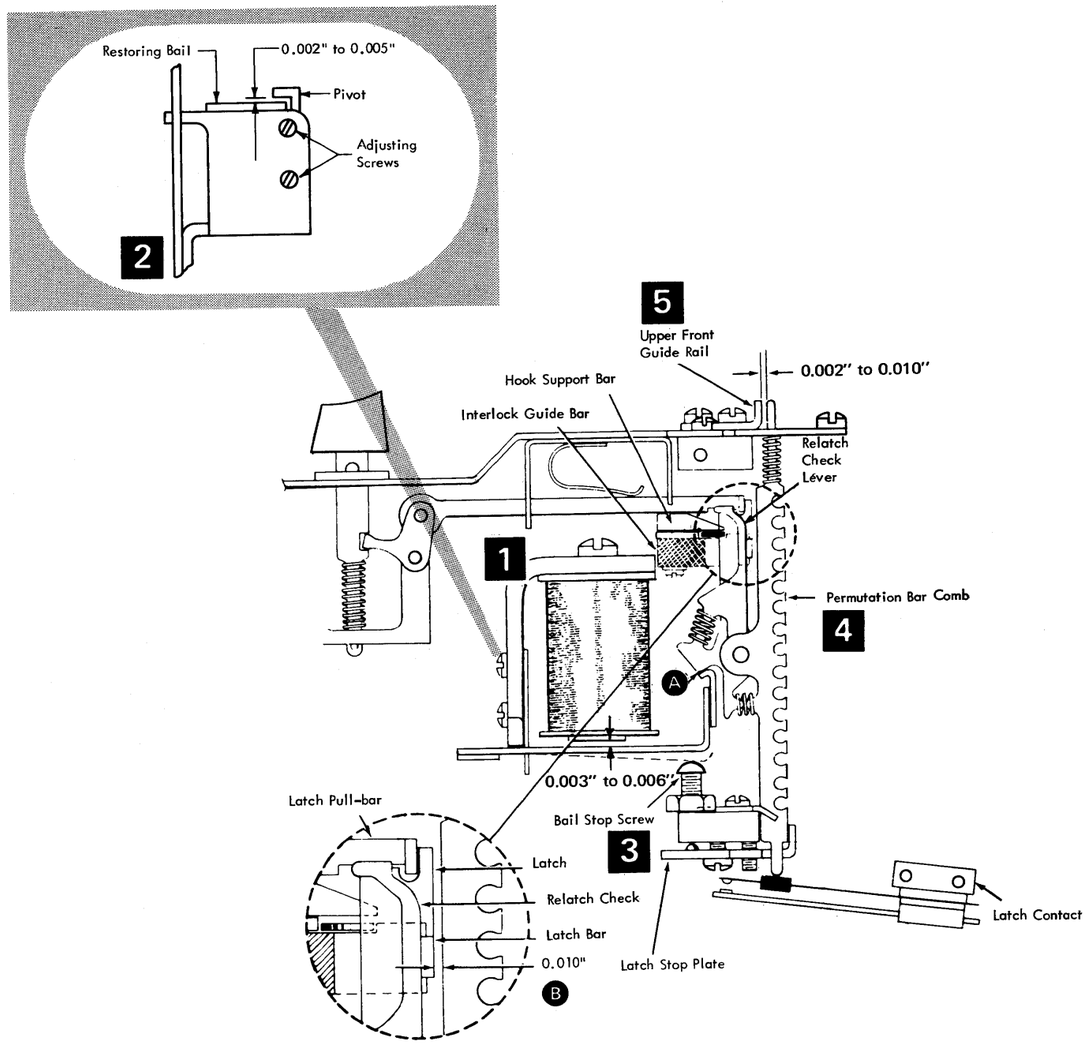
2 *Restoring Bail Pivot*

Adjust restoring bail pivot so that restoring bail operates freely with clearance of 0.002 to 0.005 inch with bail in deenergized position. Bail end play should be 0.010 inch maximum.

3 *Bail Stop Screw*

a. With keyboard restore magnets deenergized, adjust bail stop screw for 0.002-inch minimum clearance between restoring bail and latch arm of any tripped latch assembly (point (A)).
b. Check that clearance between armatures and center line of magnet cores is 0.030 inch maximum. If clearance is incorrect, adjustment 1 or 2 is incorrect.

After performing these adjustments, check the restoring bail contact adjustment (3.2.8).



Conversion Table	
Inches	Millimeters
0.001	0,03
0.002	0,05
0.004	0,10
0.005	0,13
0.008	0,20
0.010	0,25
0.015	0,38
0.030	0,76

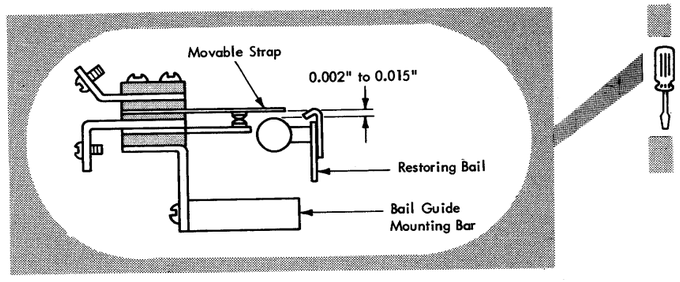
3.2.7 Upper Permutation Support

4 *Permutation Bar Comb*

Loosen two end screws in upper front guide rail and four screws holding guide comb. Position comb for 0.010 ± 0.005-inch clearance between latch bars and permutation bars ((B)). This clearance is to be maintained for all positions at least 2 inches in from first and last permutation bars.

5 *Guide Rail*

Position upper front guide rail evenly for 0.002 to 0.010 inch clearance to permutation bars.



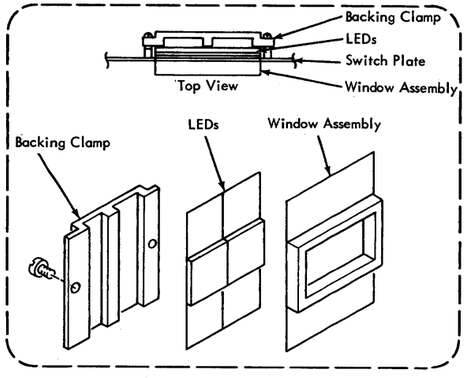
3.2.8 Restoring Bail Contact

With restore magnets deenergized, adjust restoring bail contact assembly for 0.002- to 0.015-inch air space between movable strap and restoring bail insulating disk. Form operating strap to require 210 ± 10 gram pressure to open contact.

3.2.9 Column Indicator (with Backing Clamp)

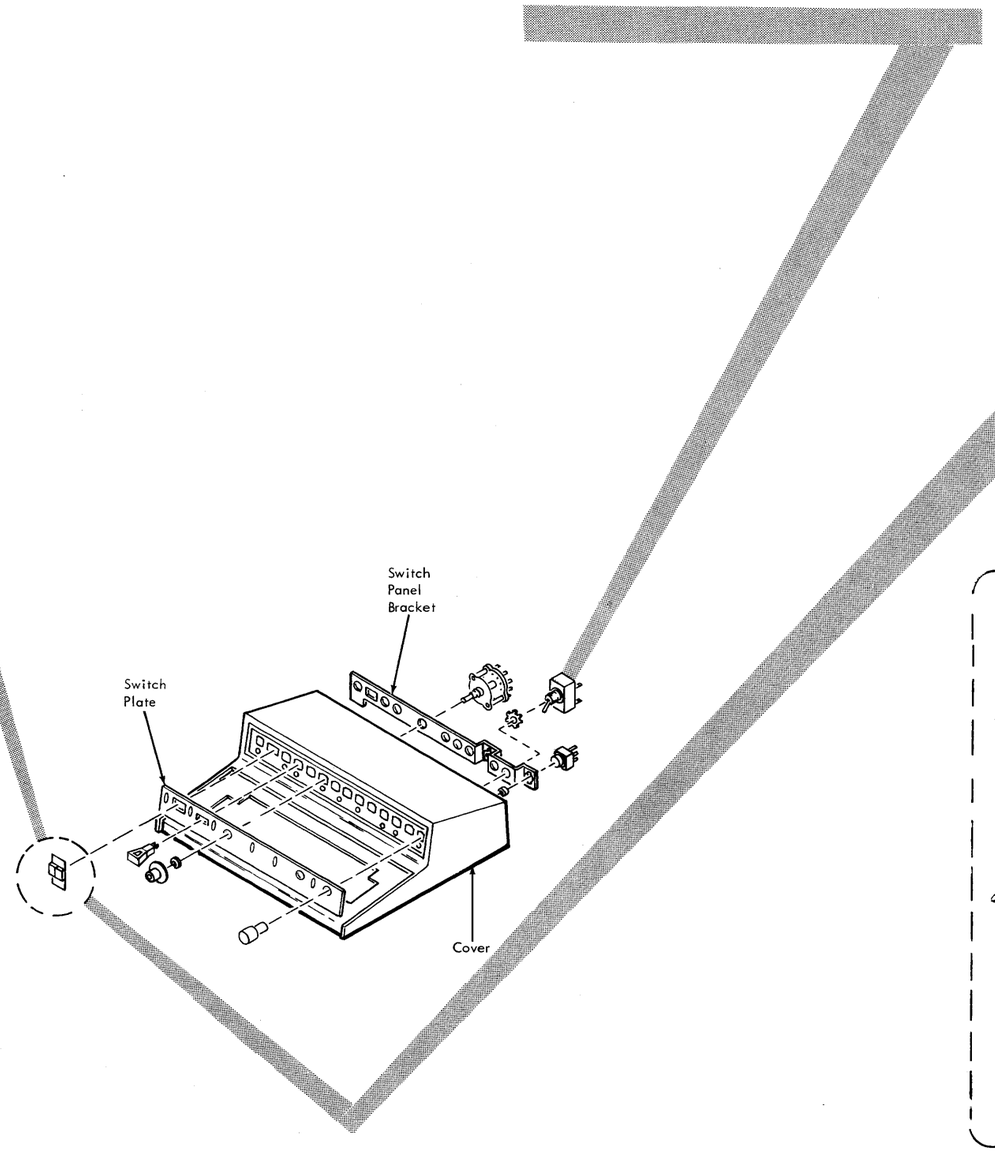
CAUTION
Do not test light emitting diodes (LEDs) with an ohmmeter or continuity checker. The power rating of the LEDs is not high enough for such a test.

1. Remove keyboard cover.
2. Remove switch plate by removing four screws that hold it to cover.
3. Remove two screws holding column indicator assembly to switch plate.
4. Remove backing clamp from LEDs.
5. Remove LEDs from window assembly and move LEDs through hole in cover. Unplug column indicator from logic gate and remove entire LED and cable assembly.
6. When replacing column indicator, be sure to route new cable in same way as removed cable. Be sure that cable is not on top of data cable in noise elimination cores, preventing cores from closing correctly.
7. Center switch plate around REC BKSP push-button and AUTO SKIP/DUP switch. Check that switches and pushbuttons do not bind.



3.2.10 Switches

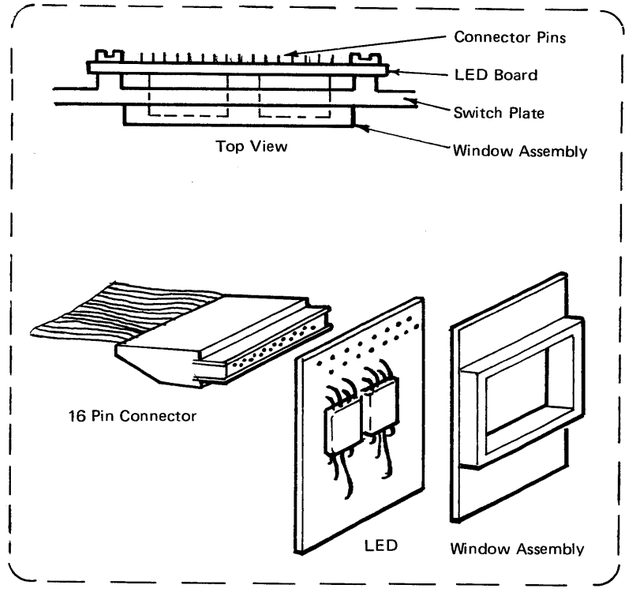
1. Remove keyboard cover.
2. Remove switch plate by removing four screws that hold it to cover.
3. Remove nut holding switch to cover; remove switch.
4. When reassembling, center switch plate around REC BKSP pushbutton and AUTO SKIP/DUP switch. Check that switches or pushbuttons do not bind.



3.2.11 Column Indicator (with 16 Pin Connector)

CAUTION
Do not test light emitting diodes (LEDs) with an ohmmeter or continuity checker. The power rating of the LEDs is not high enough for such a test.

1. Remove keyboard cover.
2. Remove switch plate by removing four screws that hold it to cover.
3. Unplug 16-pin connector from column indicator assembly. (Support the LED with your thumb and ease connector off from one corner. This procedure will prevent the LED assembly from flexing, which could cause damage to the LED components.)
4. Remove two screws holding column indicator assembly to switch plate.
5. When replacing 16-pin connector, align orange lead with mark on LED and lead-in one end pin first. This will align connector for easier mounting (do not bend pins as this will damage the connector).
6. If replacing column indicator cable, be sure to route new cable in same way as removed cable. Be sure that cable is not on top of data cable in noise elimination cores, preventing cores from closing correctly.
7. Center switch plate around REC BKSP push-button and AUTO SKIP/DUP switch. Check that switches and pushbuttons do not bind.



3.2.15 Keytop

1. Remove keyboard cover and bottom shield.
2. Insert straightened paper clip through slot in lower portion of keystem below guide plate. *(This prevents cutting the nylon retaining wire.)*
3. Place keyboard in opening on reading table.

CAUTION
Do not hold the keytop by its sides; sideward motion may break the keystem.

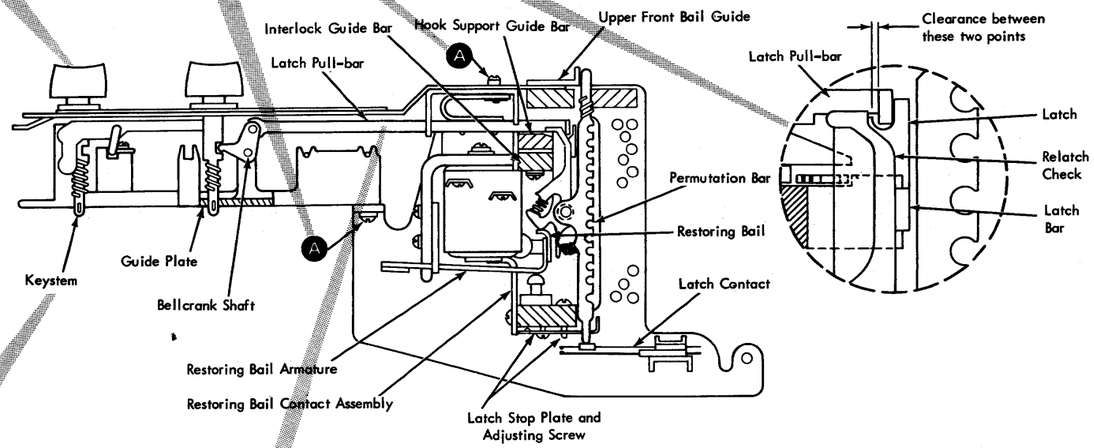
4. Hold front and rear parts of keytop with key button removal tool (part 9900373). Lightly move keytop from front to rear and pull up on keytop.
5. To replace keytop, insert follower rod (typewriter service tool, part 1012444) through keystems above upper plate and rubber bumper. Press new keytop onto keystem until fully seated. Keytop will then be aligned with keytops that are nearby.

3.2.16 Keystem

1. Remove keyboard cover and bottom shield.
2. Remove nylon retaining wire to free required keystem.
3. Lift key from unit while holding end of latch pull-bar clear of stem. *Be careful that the keystem spring does not drop into the unit.*
4. To reassemble, hold latch pull-bar free of latch and allow keystem bellcrank to rotate into keystem. Be sure that spring is assembled on keystem. Test position for binds.

3.2.17 Separate the Key and Permutation Units

1. Remove keyboard cover and bottom shield.
2. Remove two screws from top and bottom (A)
3. Slide key unit out of permutation unit. *Be careful that the Y-pull-bar does not hook on the center support screw.*
4. Check clearance of latch to pull-bar when reassembling.



3.2.18 Latch Pull-bar

1. Separate key and permutation units.
2. Slide out correct bellcrank shaft rod (follower rod aids in reassembly) until pivot rod disengages from bellcrank.
3. Remove faulty latch pull-bar.
4. Insert new pull-bar from top, engaging bellcrank with keystem.
5. Reassemble keyboard. Check clearance of latch to pull-bar.

3.2.19 Latch Assembly

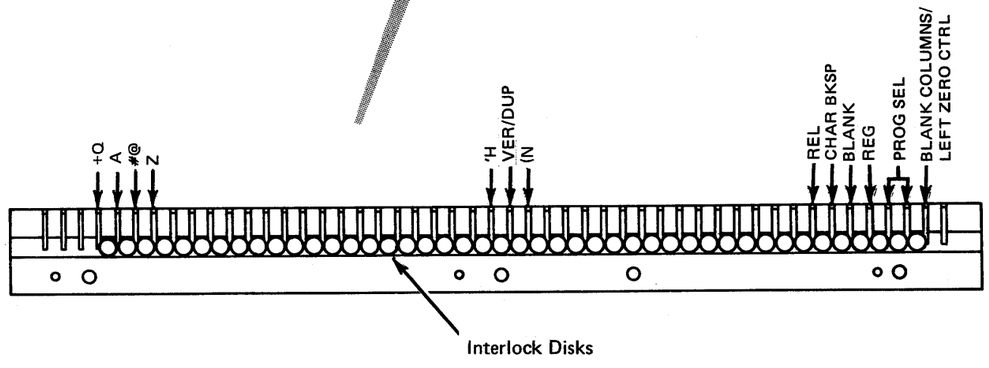
1. Separate key and permutation units.
2. Remove wires from all keystem contacts and restore magnets.
3. Loosen two mounting screws and remove restoring bail contact assembly.
4. Remove restoring bail by taking out one screw from one pivot and turning pivot block away from armature.
5. Remove latch contact mounting bar.
6. Remove four screws from latch stop plate.
7. Remove two springs on latch assembly to be removed. (The longer spring belongs between the latch and relatch check lever.)
8. Remove center support screw from upper latch assembly guide.
9. Set unit on back. Hold hook support bar while removing three screws that hold it; remove pivot screw.
10. Set permutation unit upright while holding hook support bar.
11. Slide hook support bar off to show interlock disks.

CAUTION
When an interlock is removed and the latch is tripped off, the latch bar can jump out.

12. Lift out interlock disks near latch assembly to be removed. The latch is free to come out of the bottom.

The figure shows the correct position of 44 interlock disks for an alphabetic keyboard.

After reassembling, check all adjustments.



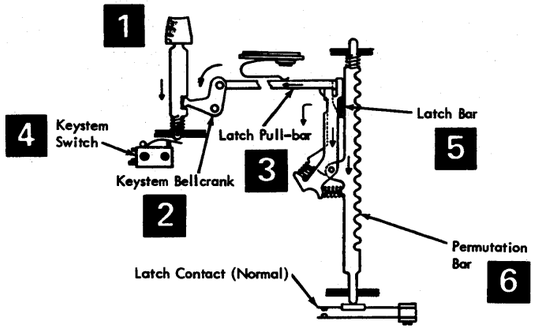
3.3 KEYBOARD OPERATION

1. Press Key
2. Keystem Pushes Bellcrank
3. Keystem Bellcrank Pivots, Moving Pull-bar Forward
4. Keystem Switch Transfers (Not on All Keys)
5. Latch Assembly Drops Off Latch Bar
6. Permutation Bar Drops and Makes Latch Contact

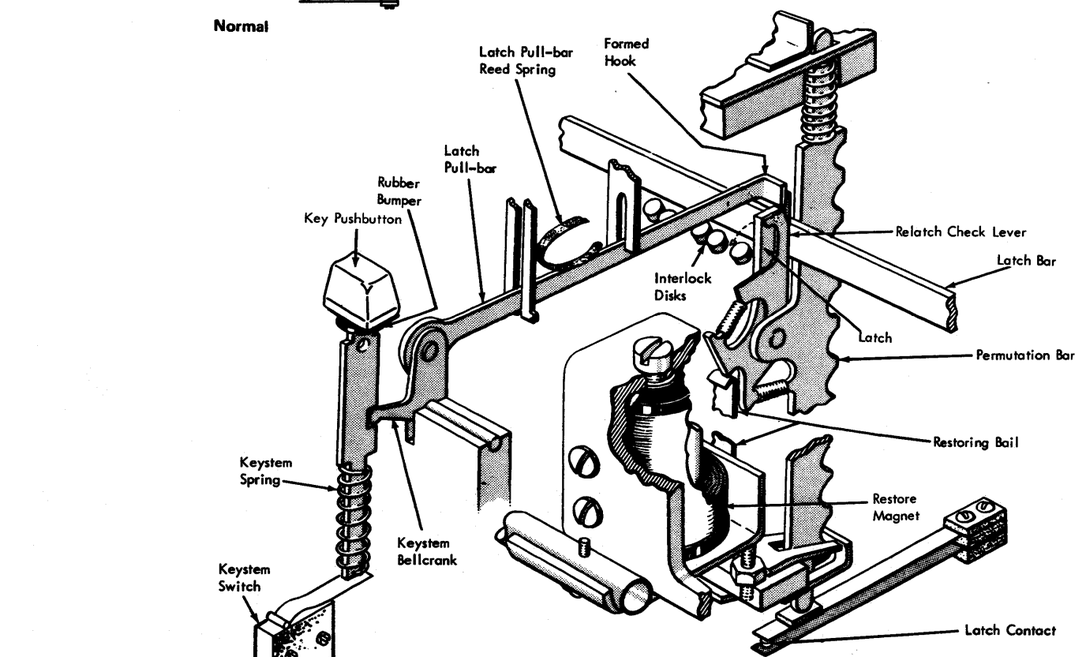
Keyboard Interlocked

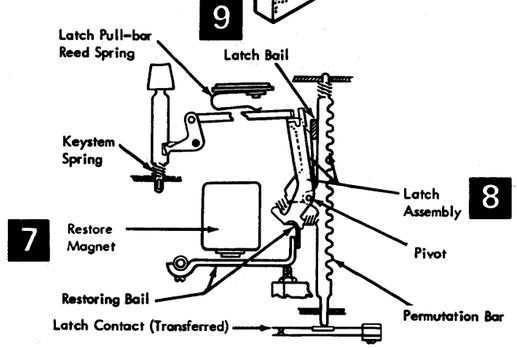
1. Key for latch B is tripped.
2. B moves interlock disks.
3. Key for interlock D is pressed, but interlock disk prevents tripping.

7. Restore Magnets Energize and Attract Restoring Bail
8. Restoring Bail Lifts Latch Assembly, Opening Latch Contact
9. Latch Engages Latch Bar. Latch Pull-bar Hook Engages Latch



Normal





Tripped

3.4 ELECTROMAGNETIC COMPATIBILITY (EMC)

EMC is the design necessary to allow a system to operate correctly under electrical and magnetic noise conditions.

Because transistors require significantly small signal and voltage levels, and operate in fast circuits, high-frequency, electrical-interference noises increase the machine sensitivity. Most large machine system rooms are protected against noise, whereas the 129 must operate in the usual keypunch room.

3.4.1 Electrostatic Discharge (ESD)

Electrostatic discharge (high-frequency noise) affects machines in three ways:

1. Direct discharge to machine frame, causing ground shift.
2. Discharge current path to any grounded item by arcing, causing emission of radio-frequency energy.
3. Discharge to a grounded item, common to system ground, causing ground shift.

Equipment discharge (metal to metal "arc") has five times the negative effects on the machine operation than personnel discharge (people to metal "arc"). This is because of resistance differences.

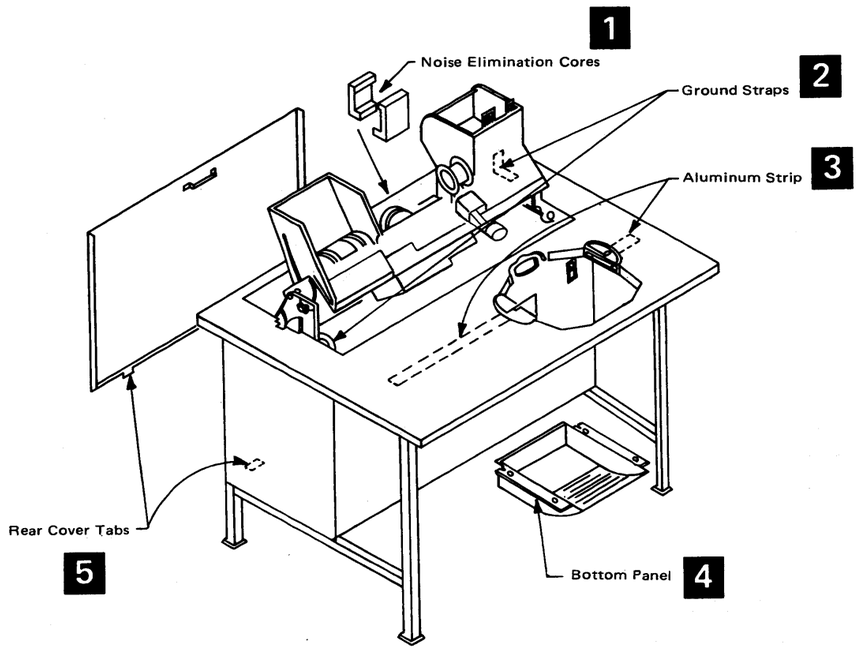
3.4.2 EMC Design in the 129

Devices to reduce ESD have been added to the 129 design. It is necessary that all EMC devices be correctly installed and maintained since, by design, they work with one another.

The keyboard is the most sensitive area to electrostatic discharge (ESD) or high-frequency noise effects within the 129.

1 Noise Elimination Cores

There is one noise elimination core made up of two halves. This core goes around the keyboard data cable and column indicator cable and is mounted inside the machine over the power supply. The cable is within the halves of the core and must allow the core halves to seat together. To be certain the cores are seated correctly and the cable is free, move the cable within the cores.



2 Ground Straps

Two ground straps are connected between the reading board supports and the machine side mounts. One strap is at the left front of the machine and the other is at the right rear of the machine.

3 Aluminum Strip

The keyboard frame mounts rest on conductive strips in nylon mounts, and a 2-inch wide aluminum strip is connected to the frame.

CAUTION

Keep the conductive strips in the nylon mounts free from oil, dirt, or card chips that might insulate instead of conduct. Be sure that the aluminum strip has no breaks in it and is connected tightly to the underside of the reading board.

Do not change the routing. The strips must be clamped by the frame screws and the side mounting screws.

4 Bottom Panel

The metal panel under the keyboard provides shielding from emission and draws off ground shift effects into the frame ground. This panel has a stripped and soldered area for good connection to the aluminum strips.

5 Rear Cover Tabs

On the rear cover are electrostatic discharge (ESD) connections made up of copper strips in the lower holes in the housing and soldered tabs on the rear cover.

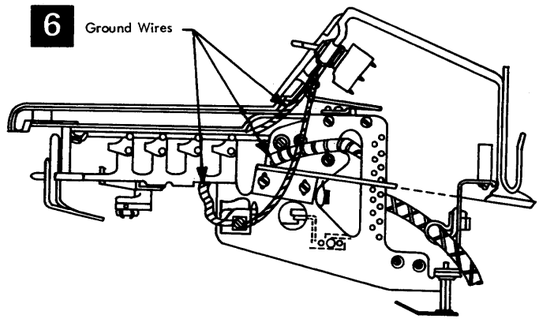
CAUTION

These areas are not to be colored and must be kept clean.

The 29/59 covers are not to be used on, or in place of, the 129 covers.

6 Ground Wires

In the keyboard are four ground wires that must be replaced if removed. Two wires, one on each side of the keyboard, run from the bottom frame to the switch panel bracket. One wire runs from the keyboard to the switch panel bracket; one wire runs from the guide plate to the bottom frame.



7 Filter Capacitors

Power-line filter capacitors are in the metal housing of the rear power on/off switch. Other machines switching on or off in the area may cause failure if the capacitors go bad or are incorrectly installed.

Twisted Pair Wiring

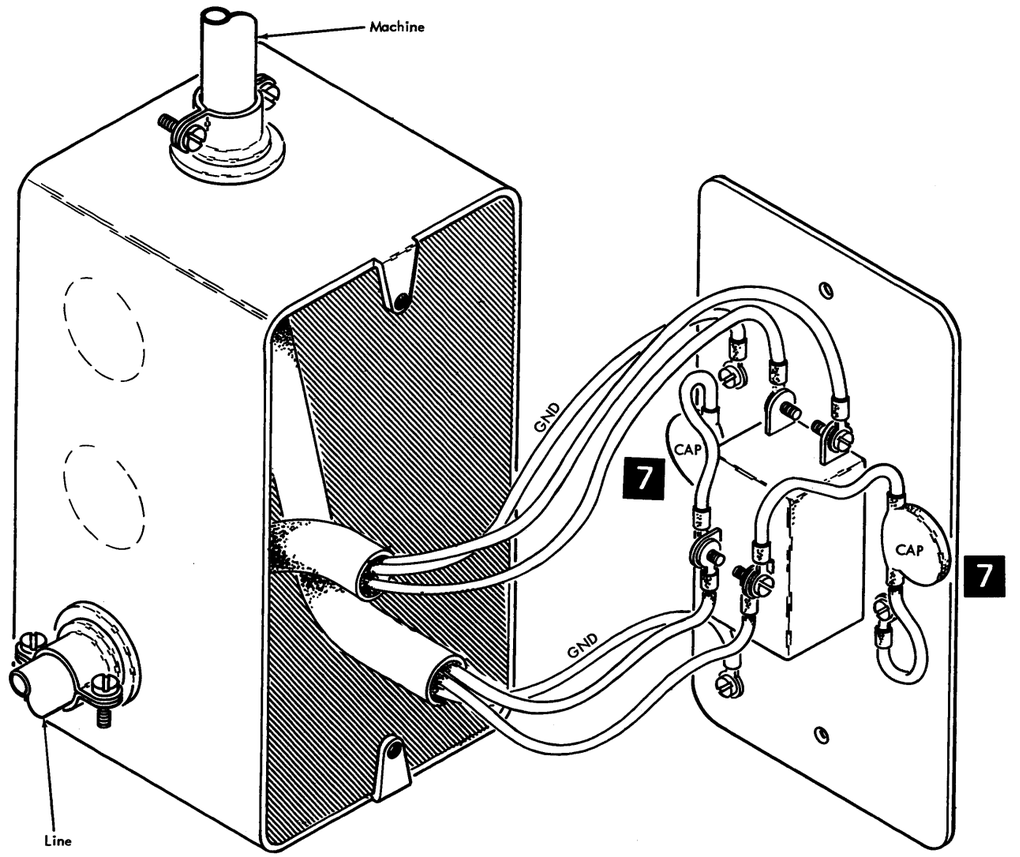
Twisted pairs of wire to the following units are used to prevent electrical noise:

1. Punch drive optic (circuit breaker) photocell.
2. Card feed optic (circuit breaker) photocell.
3. Full stacker detect switch.
4. Direct punch CE switch.

Power Cord

Line power cord should only be coiled outside the machine.

CAUTION
Coiling excess cord in the base of the case will cause machine failures. Excess cord should be coiled outside the machine or cut to the correct length.



Rear Power On/Off Switch

4.1 LIGHT SOURCE

4.1.1 Light Source

Note: Machines with serial numbers above 57,000 use a miniature lamp in place of the light pipe. Paragraph 4.1.1.1 does not apply to these machines.

1. Check that there are no shadows within 5/32 inch of light pipe.
2. Set CE meter to 15V dc scale. Connect negative meter lead to ground (D08 or EC3-B) and probe each photocell at edge connector or gate location (see chart).

Note: Use only SLT jumpers (part 961431 or 961432) on the meter when probing the board.

The results should be:

2.5V dc minimum with a card registered at punch/read station.

0.4V dc maximum with no card at punch/read station.

3. Perform light source and read optic adjustment (4.1.3, 4.1.4), as required.

4.1.2 Optical System Cleaning

The optical system should be cleaned at least once a year. All fiber optic components should be cleaned with IBM Cleaner (part 450608). Dampen a lint-free cloth and wipe both ends of the fiber optic units. Use a dry, clean cloth and wipe any film left by the cleaner.

CAUTION

Apply a minimum amount of cleaner. The cleaner must be used only on the optic units or on the upper and lower throat components of the read station. The cleaner may damage other materials.

DANGER

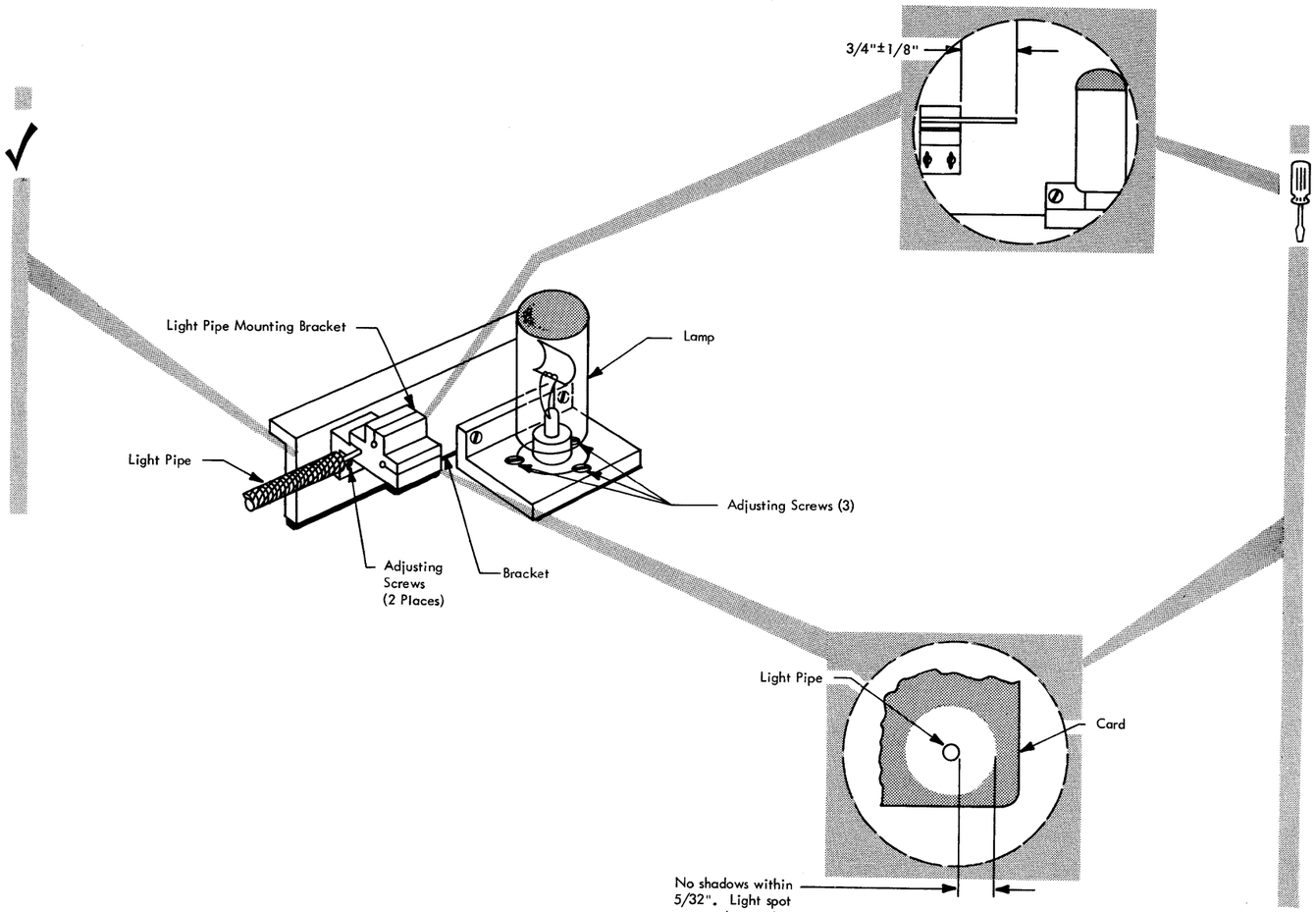
Cleaning the light source (glass) while it is hot may cause burns.

Clean bulb and remove dust from base.

Remove read optic block or throat plate; clean block and aperture.

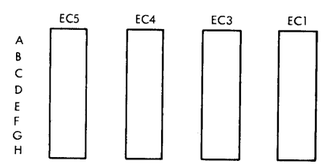
Clean lamp and photocard on card feed and punch units.

Clean light pipes and light source (bulb).



Photocell	Edge Connector	T3 *
PC12	EC3-H	B02
PC11	EC3-G	B03
PC0	EC3-F	B04
PC1	EC3-E	B05
PC2	EC3-D	B06
PC3	EC3-C	B07
Common	EC3-B	D08
PC4	EC3-A	B08
PC5	EC4-D	B09
PC6	EC4-E	B10
PC7	EC4-F	B11
PC8	EC4-G	B12
PC9	EC4-H	B13

* Note: U3 for VLCD machines



Edge Connector Layout
(Located on Back of Card Feed Unit)

4.1.3 Light Source and Read Optics (Light Pipe Machines)

Adjust light pipe so that 3/4±1/8 inch of pipe extends from mounting bracket.

1. With power on, adjust R3 (located in power supply; see Section 8) for lowest obtainable voltage with meter connected to TB2-3 and ground.
2. Place a blank card against end of light pipe and look for circle of light through card.
3. Loosen two screws on light pipe bracket and center light spot around light pipe vertically; tighten screws.
4. Loosen three holding screws on base of lamp and center light spot around light pipe horizontally; tighten screws. There should not be any visible shadows within 5/32 inch (about) of light pipe.
5. Set CE meter to 15V dc scale; connect positive meter lead to EC3-H or T3B02 (photocell 12) and negative lead to ground. With no card at read station, adjust R3 for maximum of 0.4V dc indication on meter.
6. Measure remaining photocells at T03 (U03 for VLCD machines) or edge connectors; adjust R3 so that all 12 photocells indicate 0.4V dc or less.
7. Set CE meter to ac scale and connect leads to TB2-3 and ground. Note indication on meter. Adjust R3 for 1±0.2V above noted reading but so that voltage does not exceed 5 volts.
8. Register blank card at read station. Check all 12 photocells. Meter must indicate more than 2.5V dc on each photocell.

4.1.4 Light Source and Read Optics (Miniature Read Lamp Machines)

1. Set CE meter to ac scale and connect leads to lamp terminals. With power on adjust R3 (located in power supply; see Section 8) to obtain a reading of 4.2 ± 0.1V ac on CE meter.
2. Set CE meter to 15V dc scale. Connect negative meter lead to ground (D08 or EC3 - B) and probe each photocell at edge connector or gate location (see chart).

Conversion Table	
Inches	Millimeters
1/8	3,18
5/32	3,96
3/4	19,05

4.2 PUNCH/READ STATION

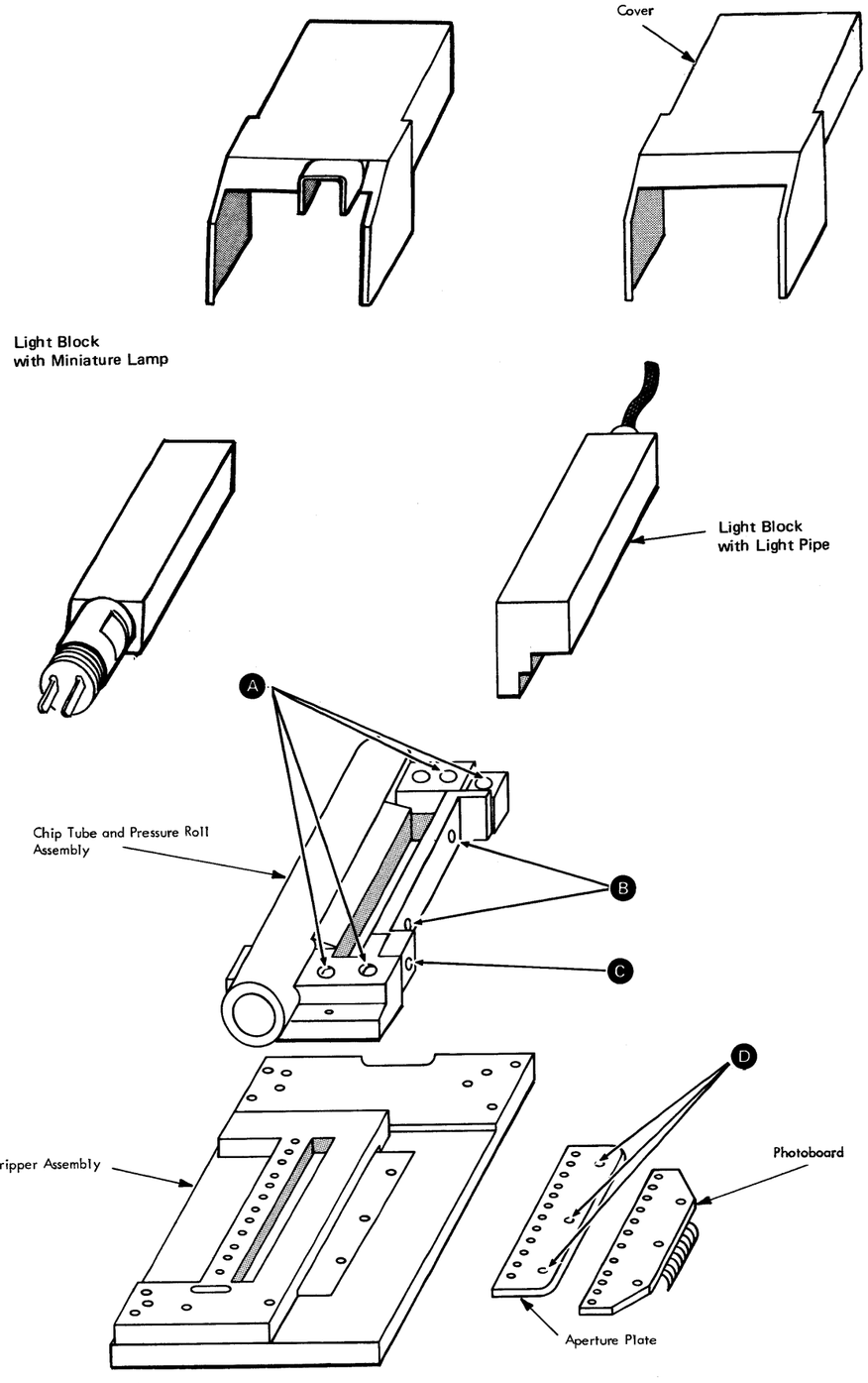
4.2.1 Punch/Read Station

For a service check on the punch/read station, refer to 4.1.1 and perform same check.

4.2.2 Photoboard and Aperture Plate

1. Perform steps 1 and 2 of read station light block removal (4.2.3).
2. Place blank card between die and stripper to keep card chips out of card path.
3. Remove four screws (A) that mount chip tube assembly to punch die stripper.
4. Remove light block screws (B) at upper and lower ends of chip tube.
5. Remove optic support bar mounting screw (C) and remove support bar.
6. Remove chip tube and optic support bar. Remove three aperture plate and three photoboard mounting screws (D)
7. Pull down slightly on photoboard cable from beneath transport; using spring hook, pick up aperture plate, being careful not to engage photoboard as well. If photoboard is to be removed, continue with steps 8 and 9.
8. Untape photoboard cable and unplug it at terminal.
9. Push photoboard cable upward from beneath transport and pull with spring hook.

To reassemble, reverse the procedure. Be sure that all chips are removed from the die before reassembling the chip tube, aperture plate, and photocell board. Cable leads should be perpendicular to the surface of the photoboard. Tighten the top aperture screw first, then tighten the bottom screw.



4.2.3 Read Station Light Block (Light Pipe Machines)

1. Remove punch station cover. Remove punch pressure rail cover.
2. Remove two screws (B) that hold light block to chip tube assembly. Lift out light block, taking out channel 9 end first.
3. Remove light pipe from mounting bracket. Push light pipe through clamp and feed frame, being careful not to bend light pipe excessively.

To replace the assembly, reverse the procedure. Be sure that the grommet near the optic housing is positioned so that it will not be damaged by the print unit.

4.2.4 Read Station Light Block (Miniature Lamp Machines)

1. Remove lamp terminal connectors.
2. Loosen locknut and unscrew lamp. Do not use lamp terminals for this purpose.
3. To replace, screw lamp into block, leave a 0.003 to 0.010 inch gap between lens and optic face. A strip of IBM card may be used to set this gap.
4. Tighten locknut and remove card.
5. Replace lamp cable push on connectors. Ensure that cable does not lie in chip chute.

4.2.5 Chip Tube

Perform steps 1 through 5 of the photoboard and aperture plate removal/replacement (4.2.2).

To reassemble, reverse the procedure, being sure not to lose the pressure roll spring and that the pressure roll operating pin is properly engaged.

4.3 CARD FEED PHOTOCELL ASSEMBLY

4.3.1 Card Feed Photocell

1. With card feed (CF) clutch latched at 0°, turn machine power off and set CE motor switch to off position. Turn machine power on.

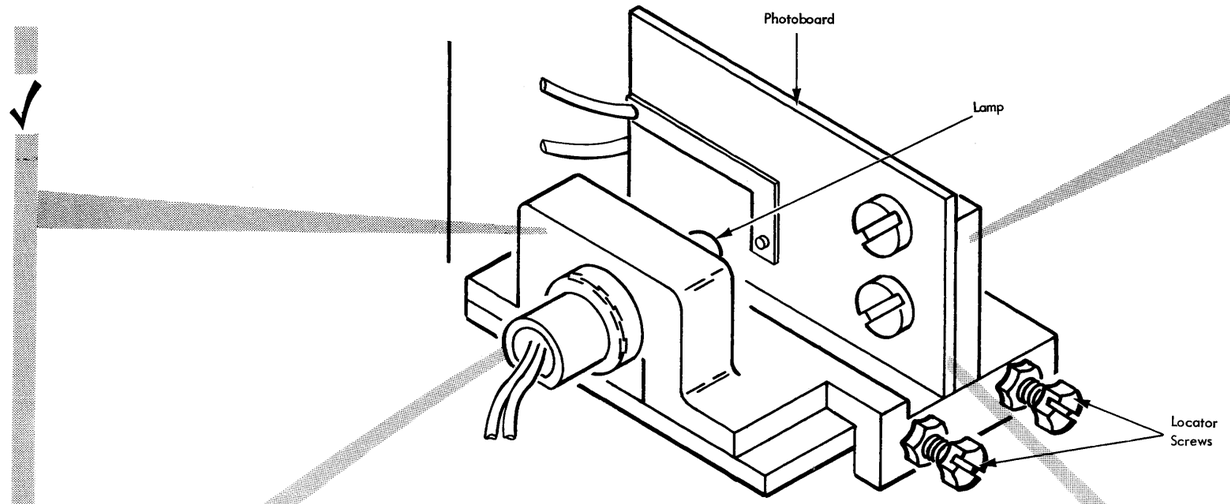
   CAUTION
   Always turn machine power off before changing the position of the CE switch.
   Do not use meter clips on the SLT pins; use only the SLT probe when metering from an SLT pin. Be careful not to ground or short the panel pins together.

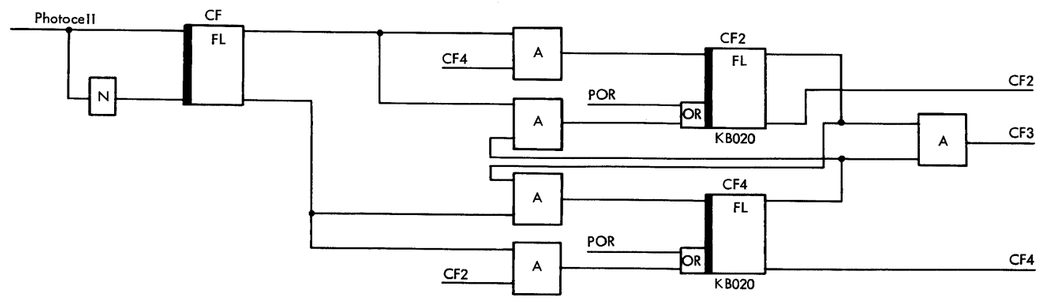
2. Set CE meter to 15V dc scale. Connect positive meter lead to N4J07. Connect negative lead to ground.
3. Trip CF clutch and manually advance drive mechanism. Meter indication should drop to a down level (0.0V to 0.7V dc) at 5°±1°.
4. Perform CF photocell adjustment (4.3.3), as required.
5. Photocell lens should be clear of timing disk by 0.070±0.020 inch.

4.3.2 Card Feed Lamp

1. Remove four screws that hold assembly to bracket. Remove assembly from machine.
2. Remove two lamp wires from cable connector.
3. Remove lamp and grommets from bracket; remove grommets. On reassembly, be sure that shoulder on lamp is flush against first grommet.

To reassemble, reverse the procedure. Perform the CF photocell service check (4.3.1).





4.3.3 Card Feed Photocell

1. Turn machine power off and set CE motor switch to off position.

   CAUTION
   Always turn machine power off before changing the position of the CE switch.
   Do not use meter clips on the SLT pins; use only the SLT probe when metering from an SLT pin. Be careful not to ground or short the panel pins together.

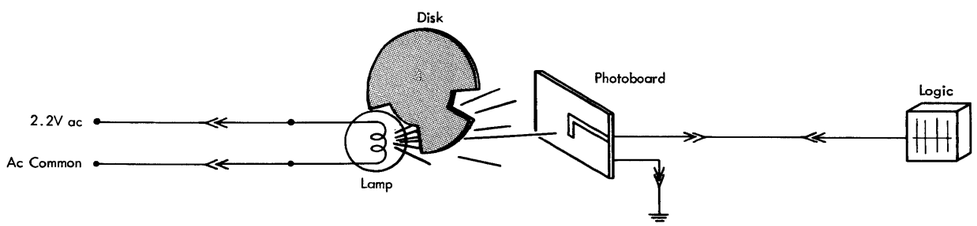
2. Set CE meter to 15V dc scale. Connect positive meter lead to N4J07. Connect negative lead to ground.
3. Trip CF clutch and manually advance drive mechanism until 5° is indicated on CF index.
4. Loosen four screws that hold photocell assembly to bracket. Loosen locator screws.
5. Slide assembly up or down until meter indication just drops to a down level (0.0V to 0.7V dc); tighten four mounting screws. Tighten two locator screws to within 0.001 inch of bracket.
6. Perform CF photocell service check (4.3.1).
7. Be sure photocell lens clears timing disk by 0.070±0.020 inch.

4.3.4 Card Feed Photoboard

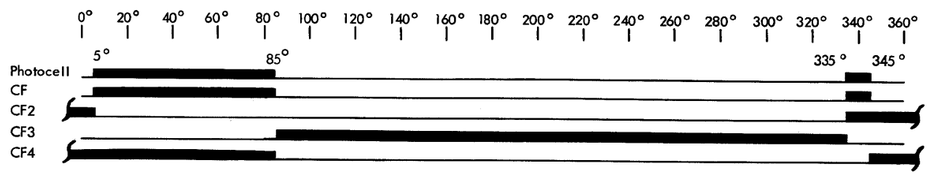
1. Remove four screws that hold photoassembly to bracket. Remove assembly from machine.
2. Remove two wires from edge connector to photoboard.
3. Remove two screws that hold photoboard to assembly; remove board.

To reassemble, reverse the procedure. Perform the CF photocell service check (4.3.1).

4.4 CARD FEED PHOTOCELL OPERATION



Conversion Table	
Inches	Millimeters
0.001	0,03
0.020	0,51
0.070	1,78



4.5 PUNCH DRIVE PHOTOCELL ASSEMBLY

4.5.1 Punch Drive Photocell

1. Turn machine power off and set CE motor switch to off position. Turn machine power on.

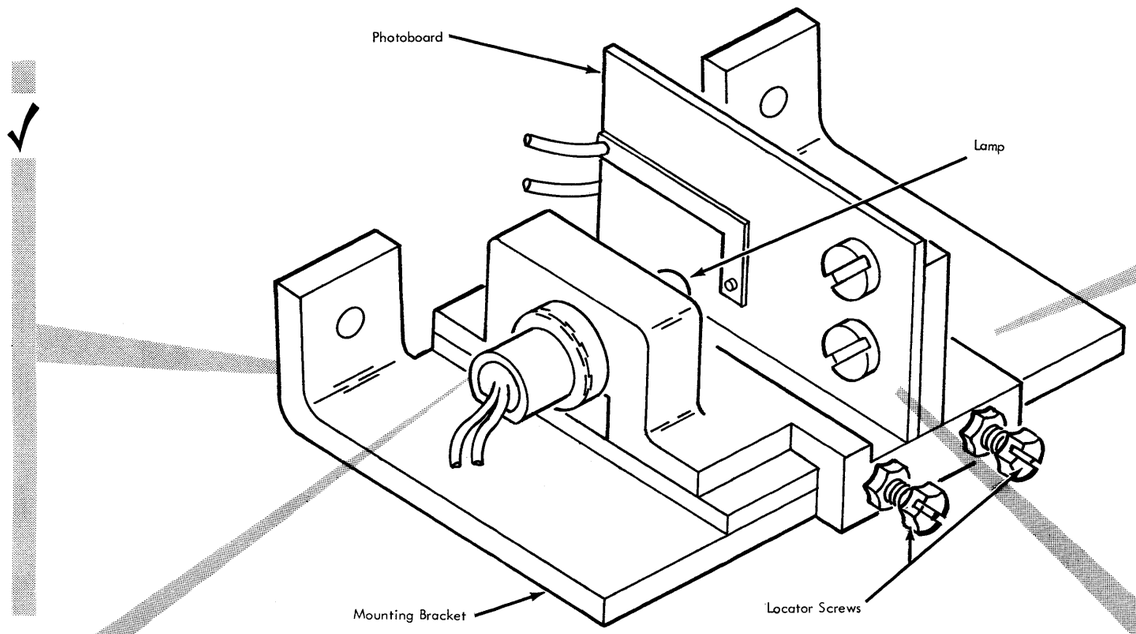
   CAUTION
   Always turn machine power off before changing the position of the CE motor switch.
   Do not use meter clips on the SLT pins; use only the SLT probe when metering from an SLT pin. Be careful not to ground or short the panel pins together.

2. Set CE meter to 15V dc scale and connect positive meter lead to N4J10. Connect negative meter lead to ground.
3. Meter should indicate an up level (2.0V to 6.0V dc).
4. Trip punch clutch and manually advance drive mechanism until meter indication drops to a down level (0.0V to 0.7V dc). This should occur at 5°±1°.
5. Perform punch drive photocell adjustment (4.5.3), if necessary.

4.5.2 Punch Drive Photolamp

1. Remove two screws that hold punch drive photocell assembly bracket to punch unit; remove assembly. (On reassembly, be sure that these screws are against the bottom of the hole before tightening them.)
2. Remove four screws that hold photoassembly to bracket.
3. Remove wires from cable connector to lamp.
4. Remove lamp and grommets from assembly.
5. Remove grommets from lamp.

To reassemble, reverse the procedure. Perform the punch drive photocell service check (4.5.1).



4.5.3 Punch Drive Photocell

1. Turn machine power off and set CE motor switch to off position. Turn machine power on.

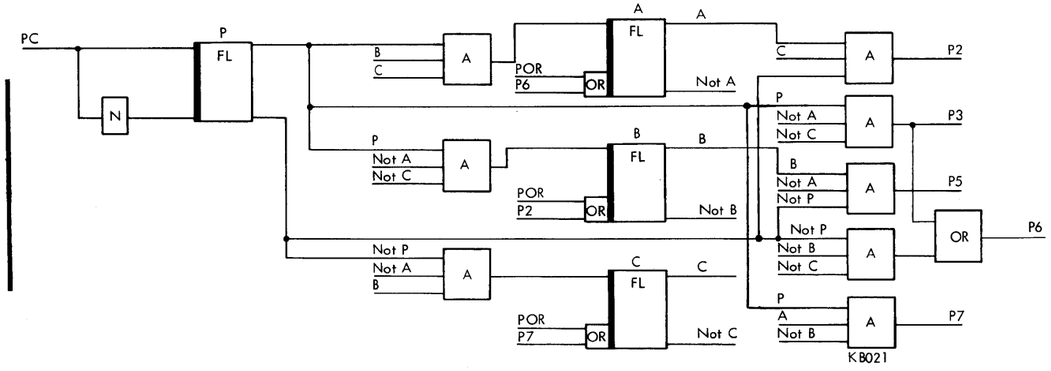
   CAUTION
   Always turn machine power off before changing the position of the CE motor switch.
   Do not use meter clips on the SLT pins; use only the SLT probe when metering from an SLT pin. Be careful not to ground or short the panel pins together.

2. Set CE meter to 15V dc scale and connect meter positive lead to N4J10. Connect negative lead to ground.
3. Manually trip punch clutch and advance drive mechanism until 5° is indicated on punch index.
4. Loosen four screws that hold assembly to bracket. Loosen two locator screws.
5. Position photocell assembly so that meter just switches from an up level (2.0V to 6.0V dc) to a down level (0.0V to 0.7V dc).
6. Tighten four mounting screws. Tighten two locator screws to within 0.001 inch of bracket.
7. Perform punch drive photocell service check (4.5.1).

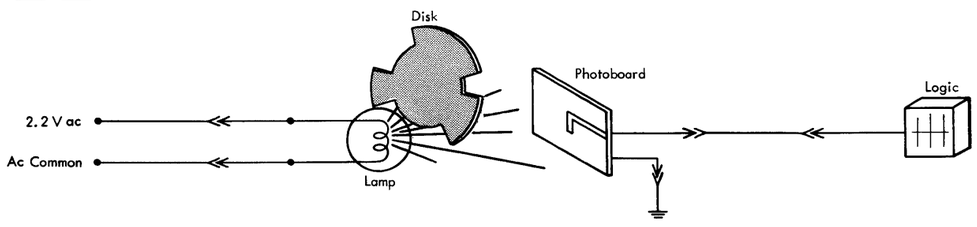
4.5.4 Punch Drive Photoboard

1. Remove two screws that hold punch drive photocell assembly bracket to punch unit. (On reassembly, make sure that these screws are against the bottom of the hole in the punch unit before tightening them.)
2. Remove wires from cable connector to photoboard.
3. Remove two screws that hold photoboard to assembly; remove board.

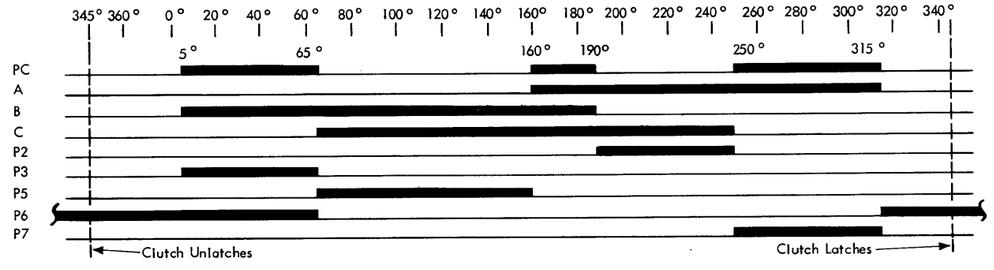
To reassemble, reverse the procedure. Perform the punch drive photocell service check (4.5.1).



4.6 PUNCH DRIVE PHOTOCELL OPERATION

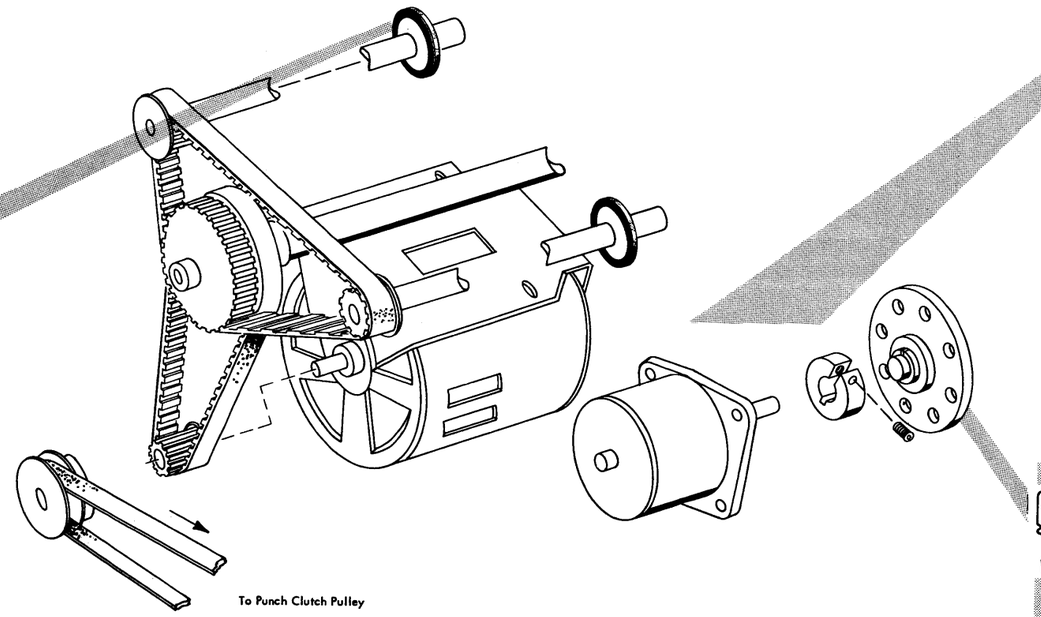


Conversion Table	
Inches	Millimeters
0.001	0,03



5.1 DRIVE MECHANISM

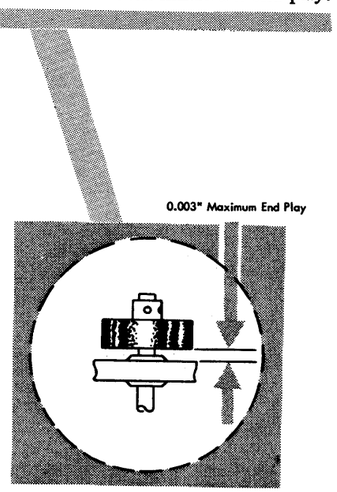
- Contains the motor, reduction drive, and stepping motor.
- Motor and drive power the card feed, punch mechanism, and continuously running transport rolls.
- Stepping motor advances the card through the punch/read station.

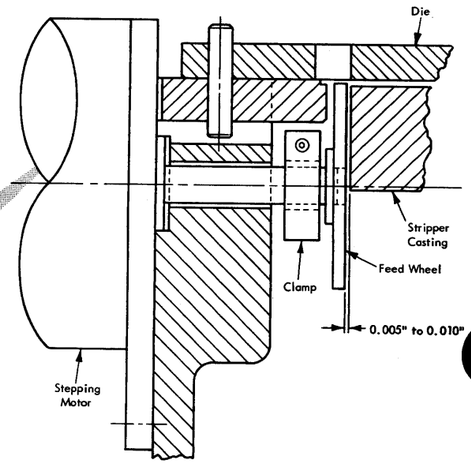


Drive Mechanism

5.1.1 Transport Rolls End Play

Position rubber transport rolls on drive shafts to prevent binds; allow 0.003-inch maximum end play.





5.1.2 Feed Wheel

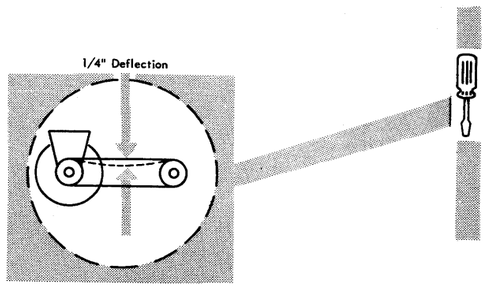
Clamp feed wheel on stepping motor shaft with 0.005 to 0.010 inch between side of feed wheel and surface of die and stripper casting.

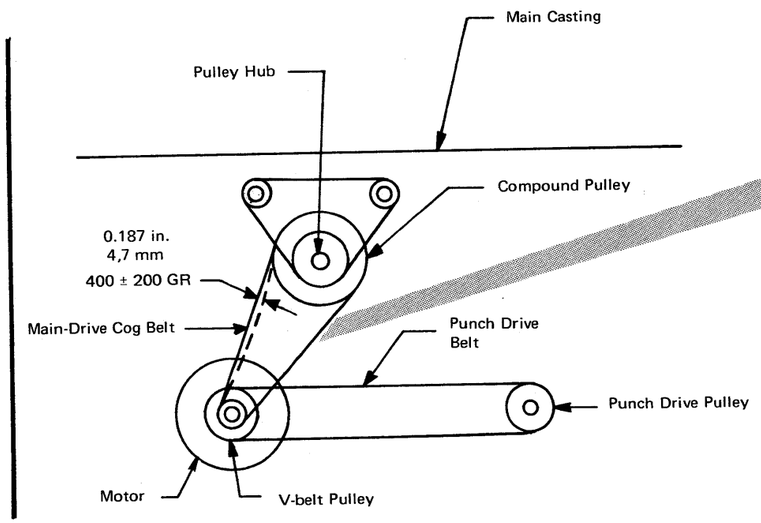
Conversion Table	
Inches	Millimeters
0.003	0,08
0.005	0,13
0.010	0,25
1/32	0,79
1/4	6,35

5.1.3 Punch Drive Belt Tension and Pulley Alignment

Position motor, using elongated holes in motor bracket, so that a force of 290±80 grams produces a 1/4-inch deflection of punch drive belt.

Hold one edge of a straight edge against face of punch drive pulley. Position motor so that V-belt pulley is aligned with other end of straight edge within 1/32 inch.



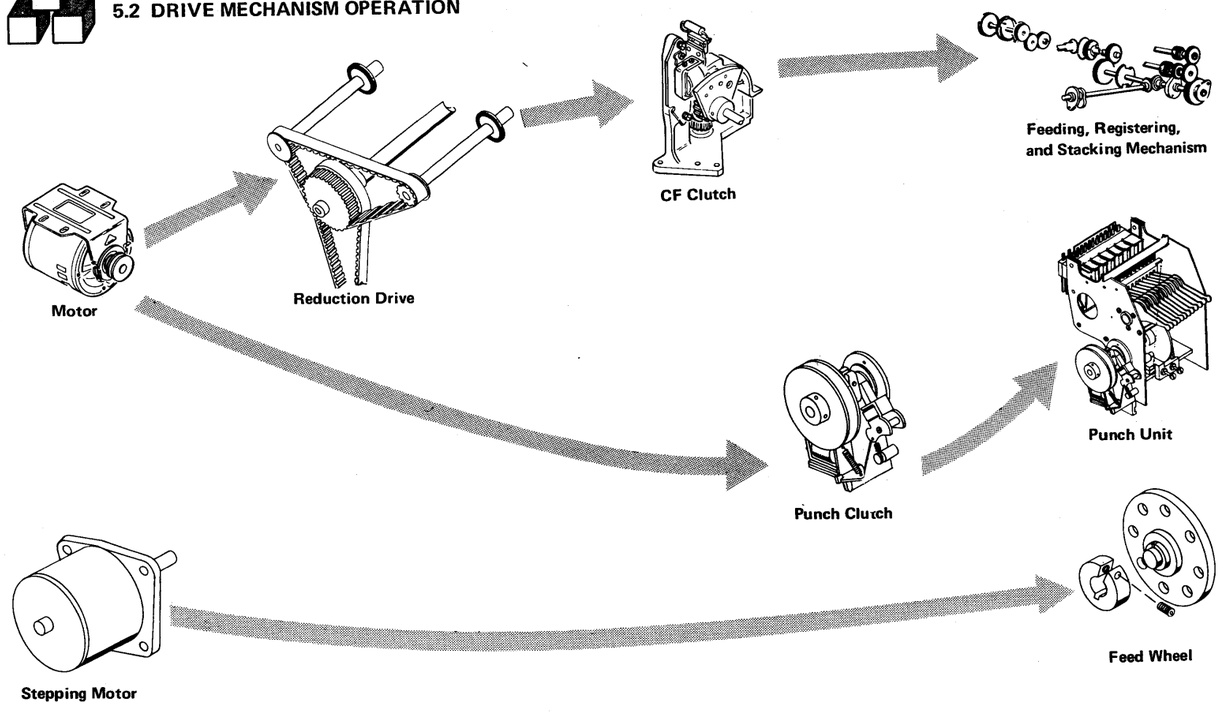


5.1.4 Main-Drive Cog Belt Tension Adjustment

Turn the fine tension adjusting screw so that a force of 400 ± 200 grams produces a 0.187 inch deflection of the belt midway between pulleys.

Conversion Table	
Inches	Millimeters
0.020	0,51
3-7/32	81,74
3-5/16	84,12
3-15/32	88,09
3-9/16	89,05

5.2 DRIVE MECHANISM OPERATION



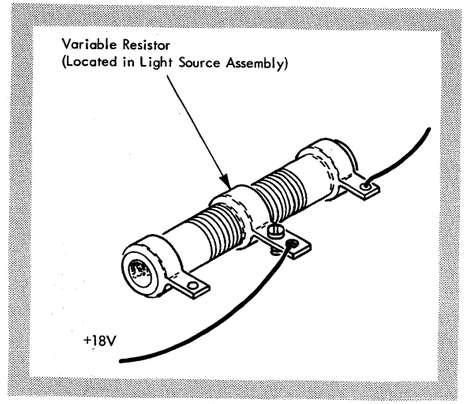
5.3.1 STEPPING MOTOR (Light Pipe Machines)

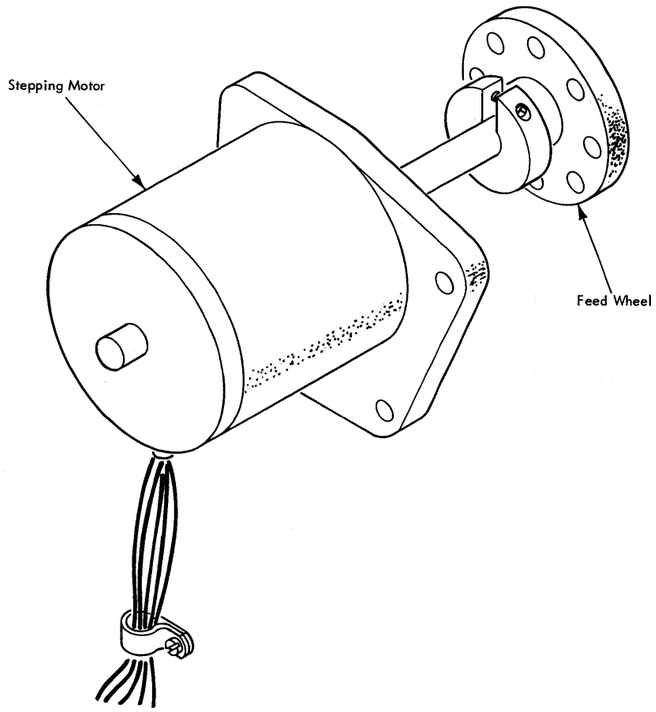
5.3.1.1 Stepping Motor

A low-tolerance, 1-ohm, 1.0% resistor is in series with the stepping motor and variable resistor. The low-tolerance resistor is on the back of the card feed unit at edge connector 1H and edge connector 1D. Before performing this service check, allow the machine to warm up for a minimum of 15 minutes.

1. Using CE voltmeter on a dc scale, connect + lead to EC-1H and – lead to EC-1D.
2. A reading of 1.8 to 1.9 volts across resistor indicates stepping motor is within correct electrical tolerances.

This is only a stepping motor check, not an adjustment.





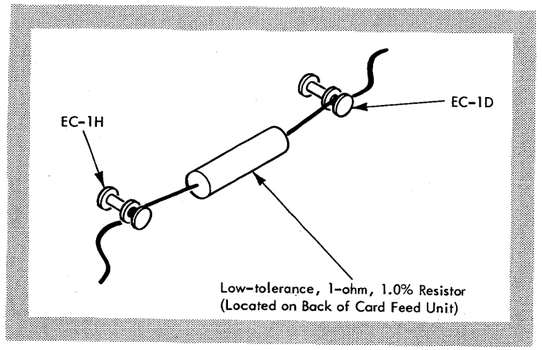
5.3.1.2. Stepping Motor

This is a *critical* adjustment and should not be performed to overcome other problems. This adjustment should only be performed if APM tests indicate adjustment is necessary. Before performing this adjustment, allow the machine to warm up for a minimum of 15 minutes.

Use low-tolerance dc voltmeter (part 460879), available in branch office, to make all electrical stepping motor adjustments.

CAUTION
Do not short out the variable resistor while performing this adjustment.

1. Make sure variable resistor clamping screw is tight while taking meter reading.
2. With meter set on low dc scale, connect + lead to EC-1H and – lead to EC-1D.
3. Adjust variable resistor (located in light source assembly underneath card feed unit) for a reading of 1.8 to 1.9 volts. This reading of 1.8 to 1.9 volts indicates motor current flow of 1.8 to 1.9 amperes.



Stepping Motor Assembly

5.3.1.3. Stepping Motor

1. Turn machine power off.
2. Remove center card guides and center bed plate.
3. Remove chip tube and light block assembly.
4. Position setscrew on feed wheel clamp so as to have access to it.
5. Turn machine power on to lock shaft.
6. Loosen setscrew on feed wheel clamp.
7. Remove three screws in stepping motor bracket.
8. Slide feed wheel off stepping motor shaft and remove stepping motor.

To reassemble, reverse the procedure. See feed wheel adjustment (5.1.2).

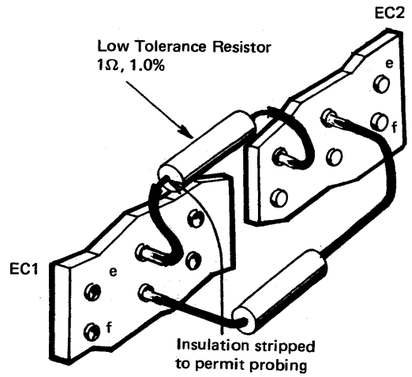
5.3.2 STEPPING MOTOR (Miniature Lamp Machines)

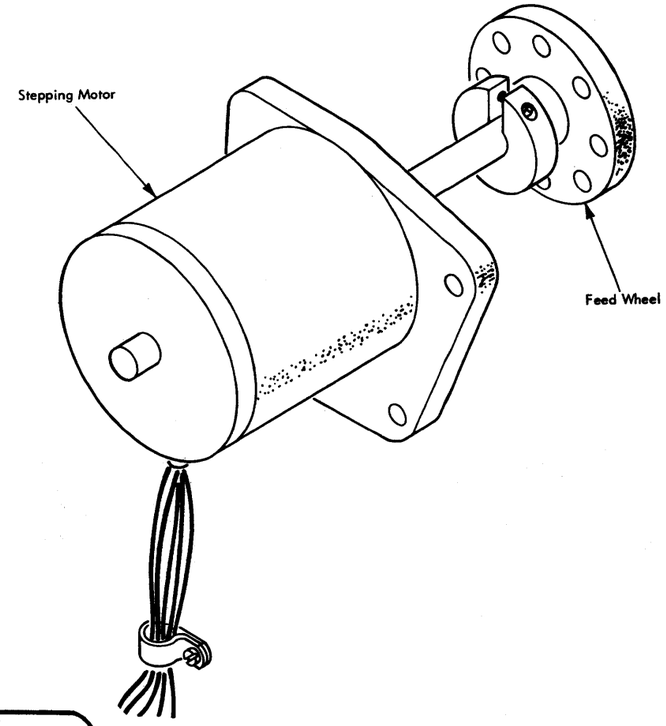
5.3.2.1 Stepping Motor

A low-tolerance, 1-ohm, 1.0% resistor is in series with the stepping motor and variable resistor. The low-tolerance resistor is located in the power supply at edge connector 2E and edge connector 1E. Before performing this service check, allow the machine to warm up for a minimum of 15 minutes.

1. Using CE voltmeter on a dc scale, connect + lead to EC-2E and – lead to EC-1E.
2. A reading of 1.8 to 1.9 volts across resistor indicates stepping motor is within correct electrical tolerances.

This is only a stepping motor check, not an adjustment.





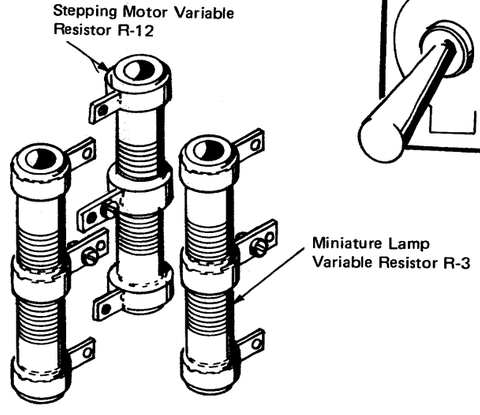
5.3.2.2. Stepping Motor

This is a *critical* adjustment and should not be performed to overcome other problems. This adjustment should only be performed if APM tests indicate adjustment is necessary. Before performing this adjustment, allow the machine to warm up for a minimum of 15 minutes.

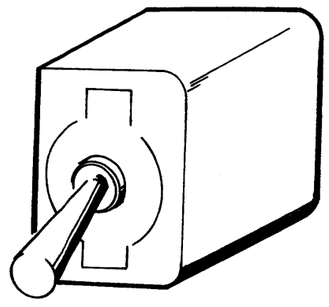
Use low-tolerance dc voltmeter (part 460879), available in branch office, to make all electrical stepping motor adjustments.

CAUTION
Do not short out the variable resistor while performing this adjustment.

1. Make sure variable resistor clamping screw is tight while taking meter reading.
2. With meter set on low dc scale, connect + lead to EC-2E and – lead to EC-1E.
3. Adjust variable resistor (located in the power supply) for a reading of 1.8 to 1.9 volts. This reading of 1.8 to 1.9 volts indicates motor current flow of 1.8 to 1.9 amperes.



Power Supply Variable Resistor Cluster



Stepping Motor Assembly

5.3.2.3 Stepping Motor

1. Turn machine power off.
2. Remove center card guides and center bed plate.
3. Remove chip tube and light block assembly.
4. Position setscrew on feed wheel clamp so as to have access to it.
5. Turn machine power on to lock shaft.
6. Loosen setscrew on feed wheel clamp.
7. Remove three screws in stepping motor bracket.
8. Slide feed wheel off stepping motor shaft and remove stepping motor.

To reassemble, reverse the procedure. See feed wheel adjustment (5.1.2).

5.4 STEPPING MOTOR OPERATION

- Is a sealed unit.
- Operates from an 18V dc source.
- Rotates 1.8 degrees for each step.
- Four steps are required for one card column.

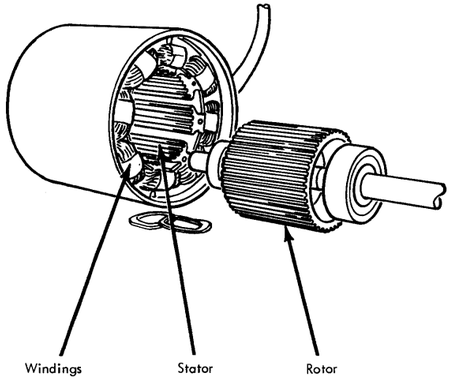
The stepping motor used in the 129 is a brushless dc motor. It has a soft iron rotor with 50 "teeth," and a stator with 48 teeth and 8 pole windings. Current is supplied to the motor through two stator windings at a time. When current flows through a set of windings, an electromagnetic field builds up between two stator poles. The magnetic flux passes through the iron rotor, forcing it to rotate to a point where teeth on the rotor are aligned with teeth on the stator.

As long as current continues to flow through the same two windings, the rotor remains in the same alignment with the stator; that is, the rotor is electrically detented. If an attempt is made to rotate the rotor manually, the motor will *appear* to be frozen. For the rotor to rotate, the set of windings must be deenergized and another set must be energized.

Motor control circuits energize the stator windings in a four-step sequence that steps the rotor 1/4 of a tooth (1.8 degrees) for each different set of energized windings. Four steps are required to advance a card one column.

Whenever machine power is on, LP1 and LP3 are energized, electrically detenting the rotor, to prevent the feed wheel from turning. Card punching (or reading) occurs only when the rotor is detented.

The stepping motor has no electrical brushes or gears, and requires no maintenance. *It should never be opened or disassembled.*

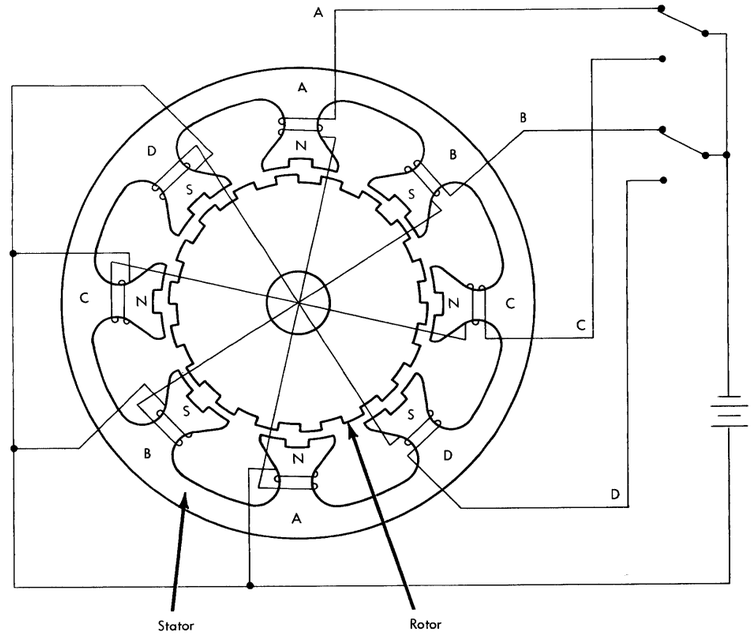


Step	Windings Energized	Active LPs
0	A and B	LP1 and 3
1	B and C	LP1 and 4
2	C and D	LP2 and 4
3	D and A	LP2 and 3
4(0)	A and B	LP1 and 3
1	B and C	LP1 and 4

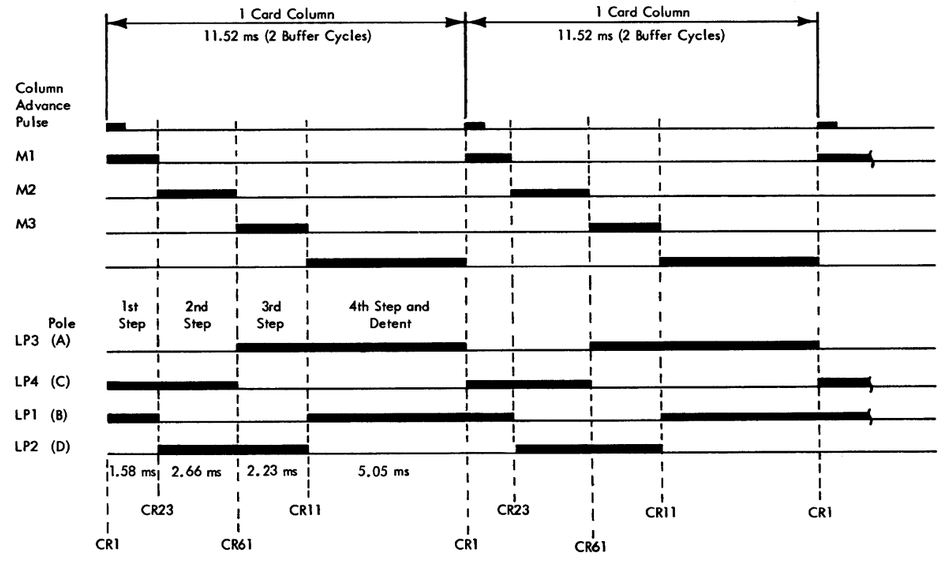
To reverse direction of rotation, sequence order is 0-3-2-1-0.

Switching Sequence

In this diagram, the rotor has 18 teeth and the stator has 16 teeth. The 129 stepping motor operates in the same manner, except the rotor has 50 teeth and the stator has 48 teeth.



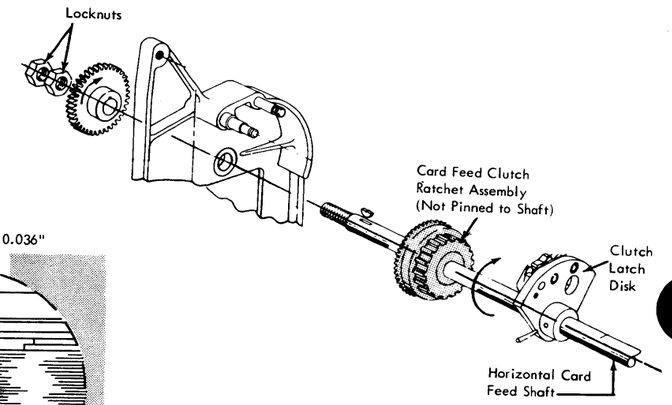
Winding Connections



5.5 CARD FEED CLUTCH

- Controls feed knives, card aligner fingers, pusher arm, CF timing disk, pressure roll opening device, and stacker.
- Is a dog-and-multitoothed ratchet clutch.
- Is controlled by card feed clutch magnet.

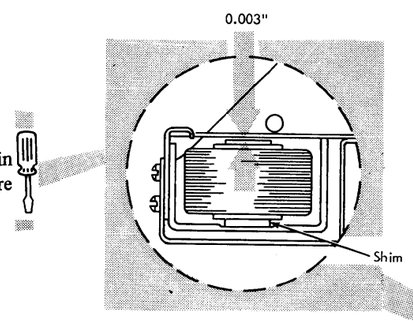
Note: Shaded gears and shafts are continuously running; unshaded gears and shafts are clutch controlled.



Card Feed Shaft

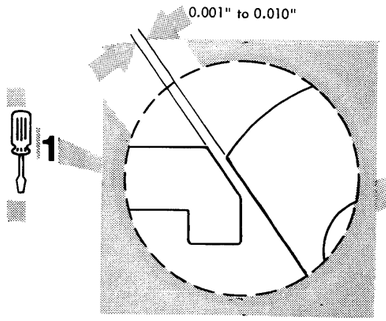
5.5.1 Card Feed Clutch

Add or remove shims (part 305271) to obtain 0.003-inch clearance between armature and core when armature is in attracted position.

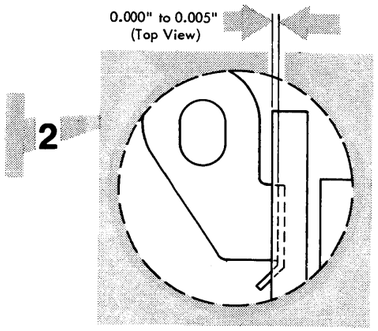


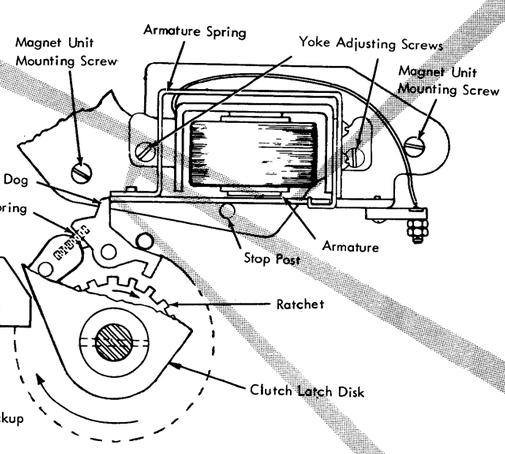
5.5.2 Antibackup Device

Position antibackup device, with clutch latched at 0°, to have overthrow clearance of 0.001 to 0.010 inch between antibackup device and clutch latch disk.



Position antibackup device, with clutch latched at 0°, to have sideward adjustment 0.005 to 0.000 inch (even) with clutch latch disk.

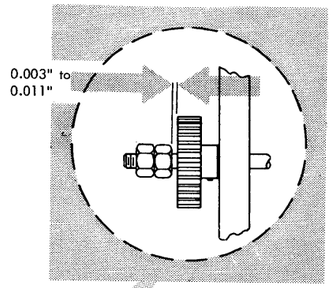


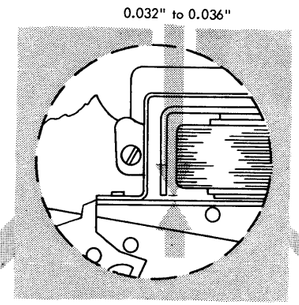


Card Feed Clutch

5.5.3 Card Feed Shaft End Play

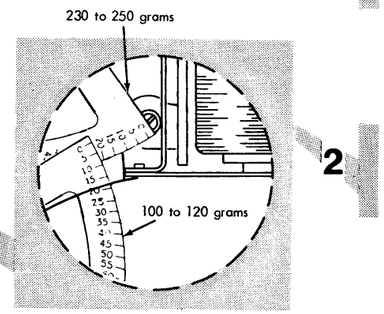
Adjust two locknuts on stacker end of CF shaft for 0.003- to 0.011-inch end play.



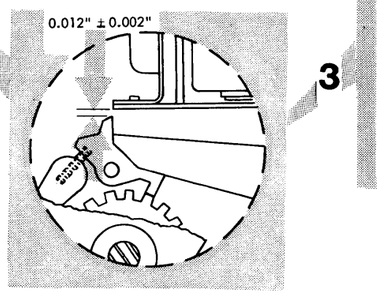


5.5.4 Card Feed Clutch

Adjust magnet yoke adjusting screw to obtain 0.032- to 0.036-inch clearance between armature and yoke.



Form armature spring to provide 100- to 120-gram downward pressure and 230- to 250-gram outward pressure.

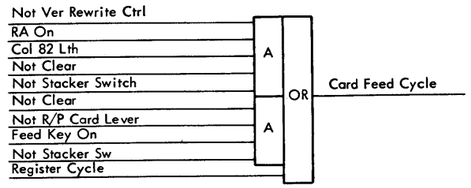


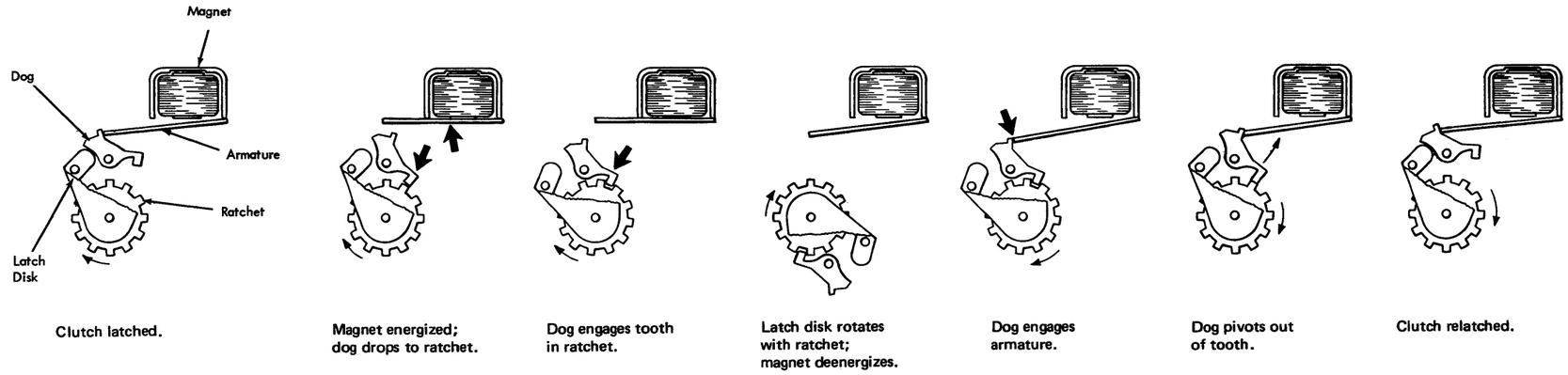
Position CF magnet unit to obtain 0.012 ± 0.002-inch unlatching clearance between armature and CF dog when armature is attracted and dog is resting on top of a ratchet tooth. With clutch latched at 0°, there should be minimum of 0.005-inch clearance between dog and ratchet teeth.

Conversion Table	
Inches	Millimeters
0.001	0,03
0.002	0,05
0.003	0,08
0.005	0,13
0.010	0,25

Conversion Table	
Inches	Millimeters
0.011	0,28
0.012	0,30
0.032	0,81
0.036	0,91

5.6 CARD FEED CLUTCH OPERATION





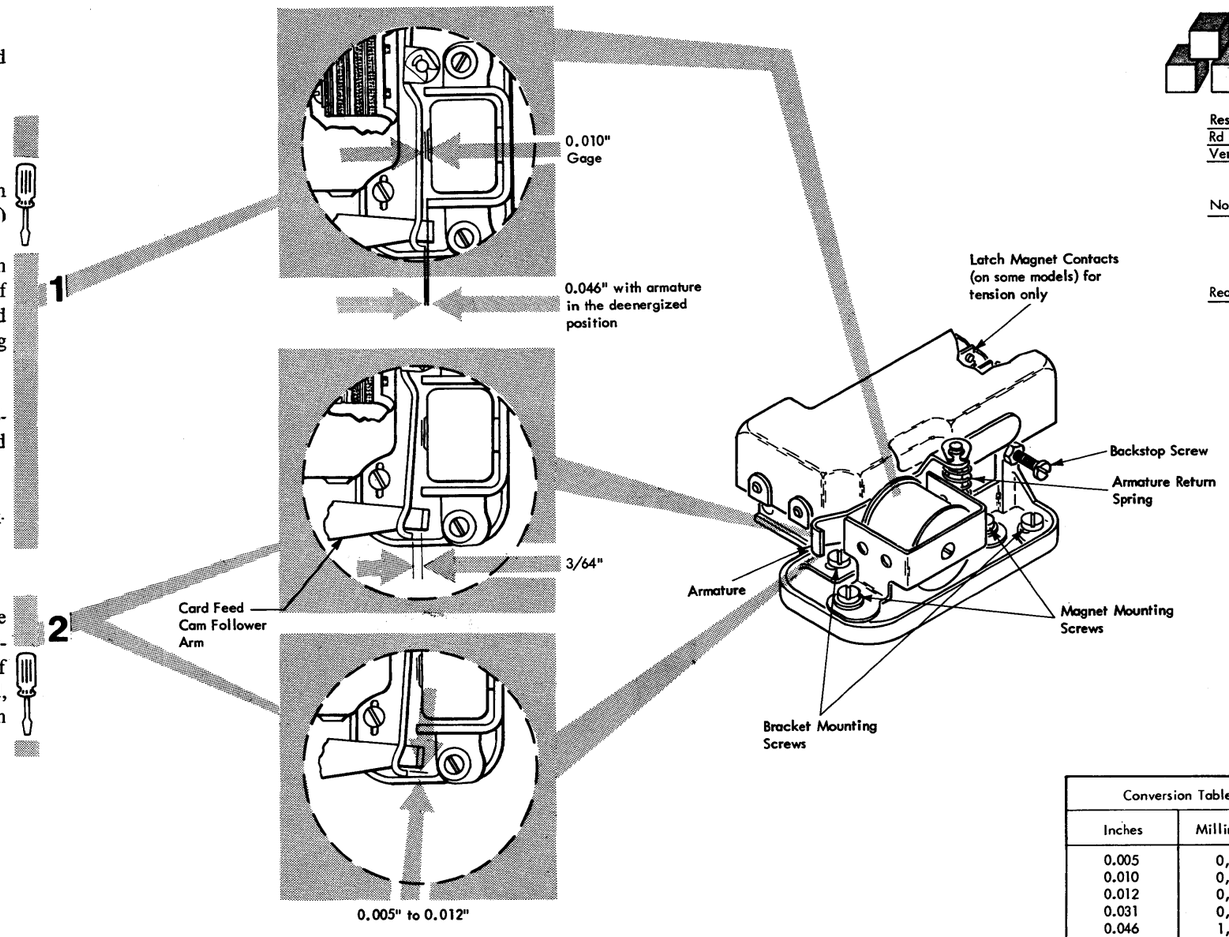
5.7 INHIBIT CARD FEED MAGNET

- Prevents the feed knives from feeding a card during a register cycle.

5.7.1 Inhibit Card Feed Magnet

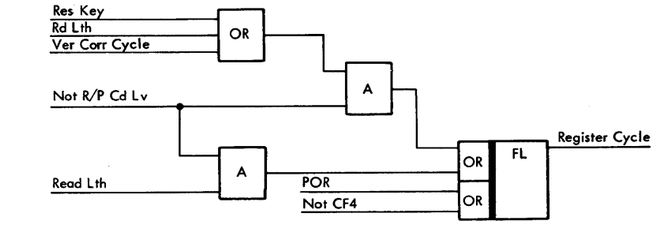
1. Latch magnet contact type only:
   Adjust armature backstop screw until latch magnet contacts rise 1/32 inch (0.031 inch) off their supports.
2. Loosen magnet mounting screws and position yoke so that armature strikes lower arm of yoke when 0.010-inch feeler gage is placed between armature and core; tighten mounting screws.
3. Armature return spring type:
   Adjust the backstop screw to obtain 0.046-inch clearance between the armature tip and the lower magnet yoke; tighten locknut.
4. Latch magnet contact type:
   Turn backstop screw two turns counterclockwise; tighten locknut.

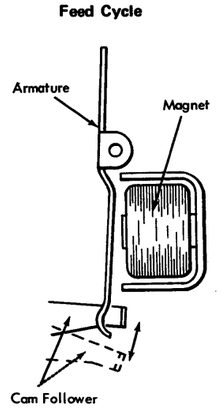
Loosen bracket mounting screws and move assembly to provide 3/64-inch (0.047-inch) clearance from latch magnet armature to tip of cam follower arm when magnet is deenergized, and 0.005- to 0.012-inch latching clearance when magnet is energized; tighten mounting screws.

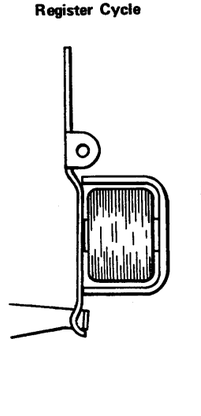


Conversion Table	
Inches	Millimeters
0.005	0,13
0.010	0,25
0.012	0,30
0.031	0,79
0.046	1,17
0.047	1,19

5.8 INHIBIT CARD FEED MAGNET OPERATION







5.9 CARD FEED MECHANISM

- The hopper stores the cards to be processed.
- The feed knives feed the cards from the hopper.
- The feed rolls move the card to the aligner fingers.
- The aligner fingers push the card downward against the pressure rails.

5.9.1 Card Feed Knives

With CF latch armature and cam follower arm engaged, loosen feed knife locking screws and adjust both knives evenly to give clearance of 0.015 inch (0.040 inch maximum) from feed knife projections to top edges of cards in hopper.

5.9.2 Magazine Springs

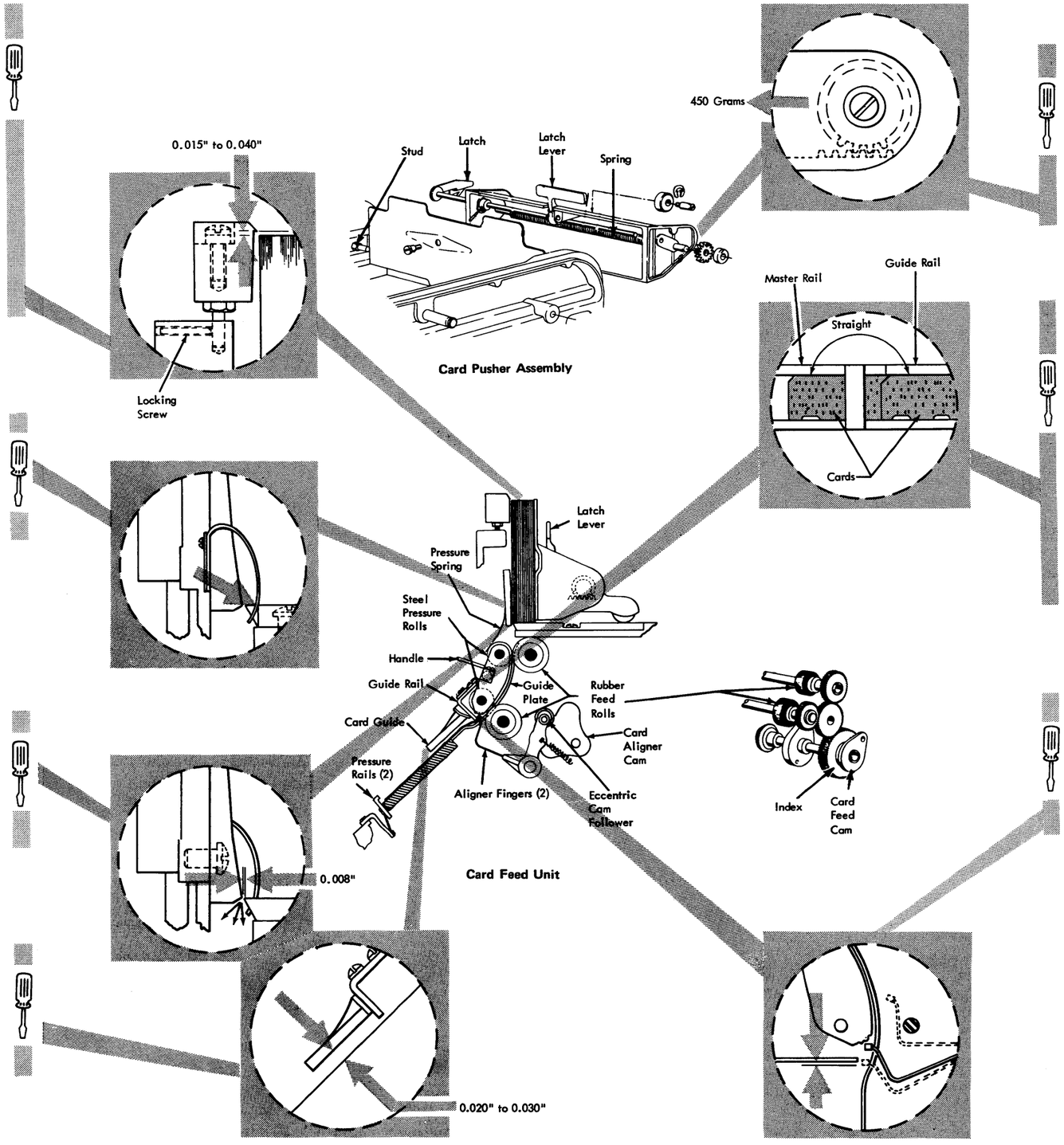
Form magazine springs to lightly touch feed bed.

5.9.3 Throat Knife

Adjust throat block to place high edge in direct line with top edge of throat knife. Adjust throat knife for 0.008- to 0.010-inch opening. If throat block is correctly adjusted, 0.008-inch gage passes freely between knife and block edges in three directions, but 0.010-inch gage does not.

5.9.4 Punch Station Card Guide

Position punch station card guide for 0.020- to 0.030-inch clearance between card guide and card bed at nearest point. Guide must not interfere with cards entering punch station or allow warped cards to strike end of die.



5.9.5 Card Pusher Plate

Remove stud that keeps pusher assembly from coming off rear of hopper. Move pusher plate toward rear of machine until drive gear disengages rack. Insert screwdriver into shaft slot and turn screwdriver 4 to 4-1/2 turns clockwise. Allow gears to evenly engage rack; replace stud. There should be 450-gram pressure on pusher plate with one card in hopper.

5.9.6 Punch Station Guide Rail

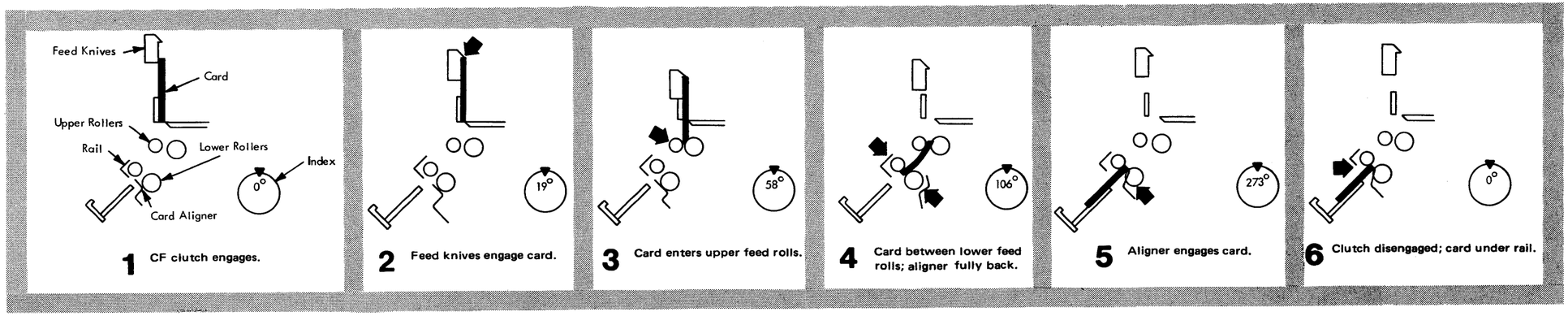
1. Overlap two blank cards by about ten columns and tape them together to serve as straight edge. Make sure that top edges of cards are straight.
2. Remove clear plastic card guide from center bed plate.
3. Press card release pushbutton and insert taped cards in punch station until overlapped portion of cards is between die and stripper. Make sure that top edge of card is squarely against upper guide (master) rail in center bed, then release card release pushbutton.
4. Loosen guide rail holding screws and position guide rail to evenly touch top of card in punch card bed; tighten holding screws.

5.9.7 Card Aligner Fingers

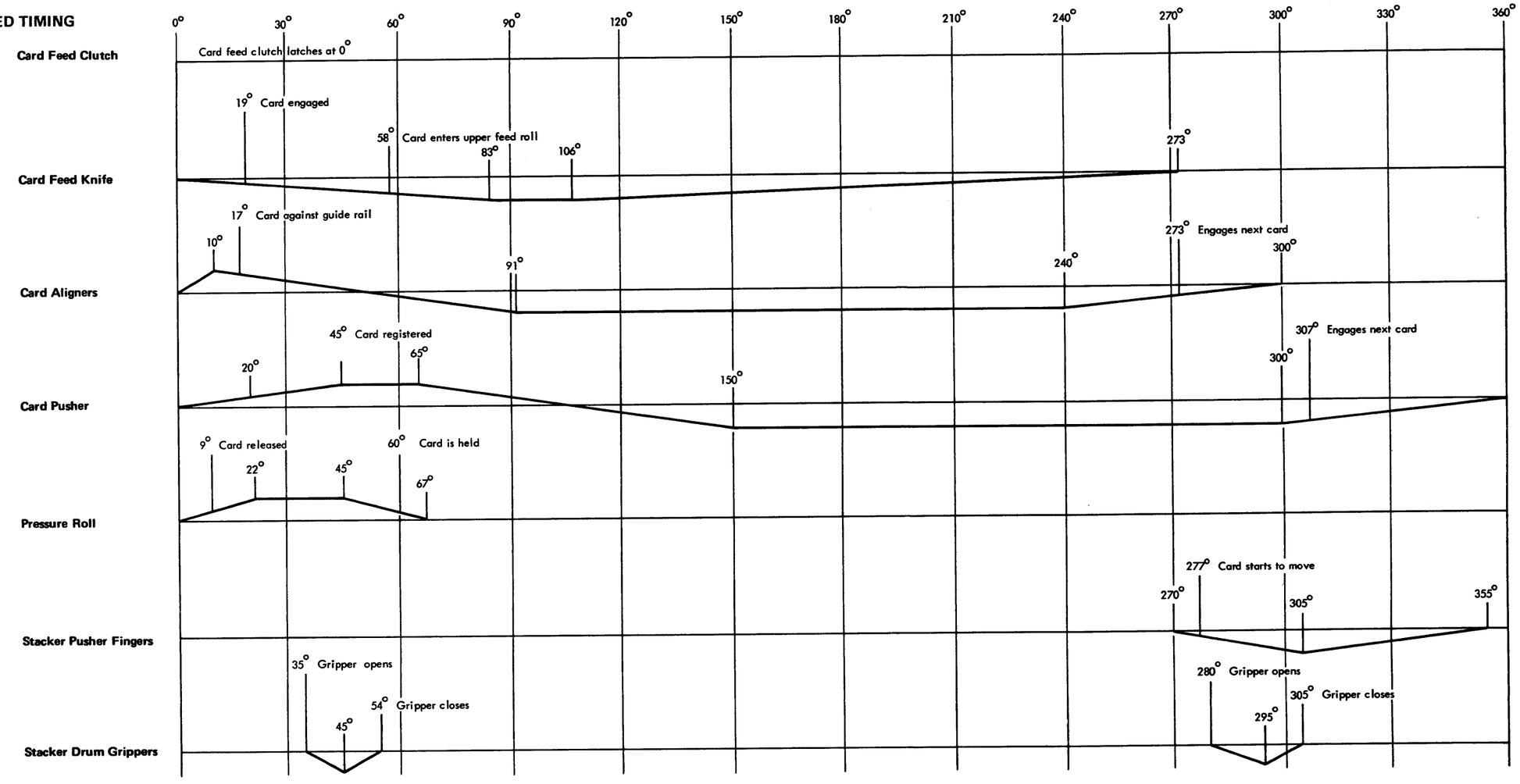
With cam follower on high dwell of cam, adjust eccentric so that aligner fingers are 0.035 to 0.055 inch past guide rail and eccentric is in position to give earliest finger motion (movement begins at 10° to 12°). Be sure that card slips off fingers correctly before it is held by feed wheel.

Conversion Table	
Inches	Millimeters
0.008	0,20
0.010	0,25
0.015	0,38
0.020	0,51
0.030	0,76
0.035	0,89
0.040	1,02
0.055	1,40

5.10 CARD FEED MECHANISM OPERATION



5.11 CARD FEED TIMING

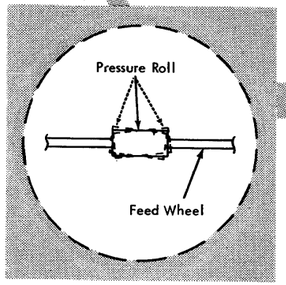


5.12 PUNCH/READ STATION REGISTRATION MAINTENANCE

5.12.1 Pressure Roll Skew

Check that the pressure rail tension is correct before making this adjustment.

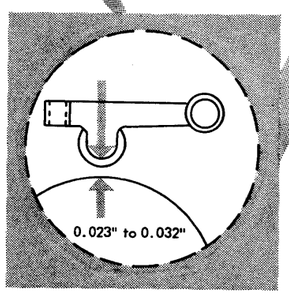
1. Loosen registration locking screw.
2. Adjust sideward position of punch/read station pressure roll with registration adjusting screw so that card rides against guide rail when card is being punched out. Be sure that card is not driven into guide rails so far that card bends.



5.12.2 Punch/Read Station Pressure Roll

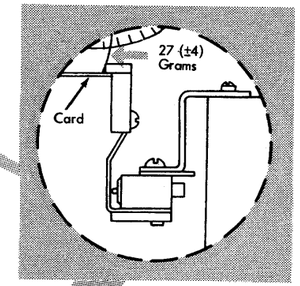
1. Turn power off and trip CF clutch. Manually turn card feed mechanism until cam follower is on high dwell of card stop cam.
2. Adjust eccentric on stop lever arm for 0.023- to 0.032-inch opening between pressure roll and feed wheel.

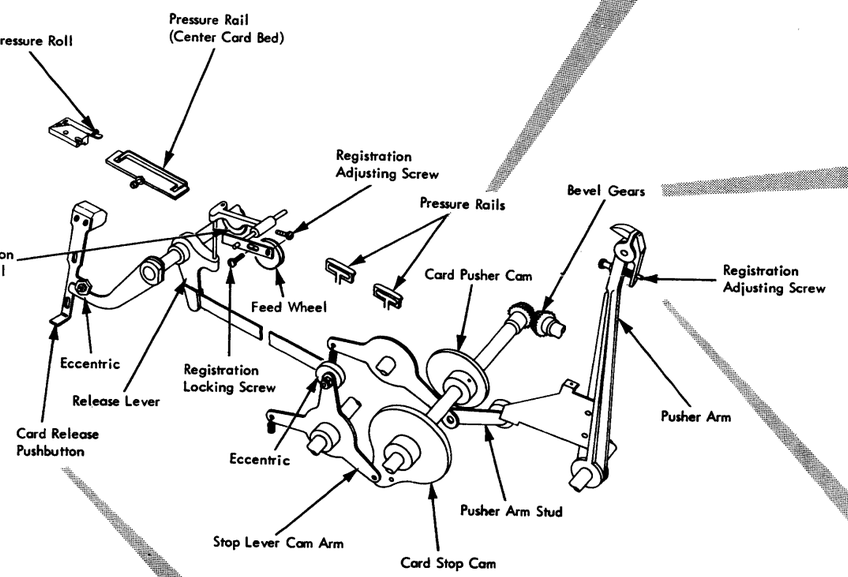
The pressure roll assembly used in the 129 stepping motor card punch differs from the assembly used in other card punches. When replacing this assembly, replace only with the correct part.



5.12.3 Punch/Read Station Pressure Rail

Adjust pressure rails to measure 27 ±4 gram pressure on a registered card. Measure tension required to move rail evenly away from card; blade of gage must be held squarely against center of edge on rail.

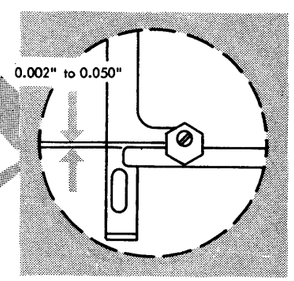




Punch/Read Station Assembly

5.12.4 Card Release Pushbutton

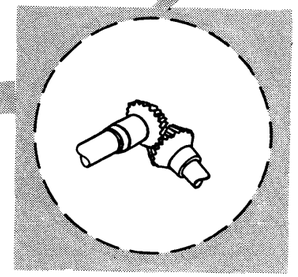
With card stop cam on low dwell, adjust eccentric on card release pushbutton to provide a clearance of 0.002 to 0.050 inch between card release pushbutton and release lever arms.



Conversion Table	
Inches	Millimeters
0.002	0,05
0.003	0,08
0.004	0,10
0.008	0,20
0.023	0,58
0.032	0,81
0.050	1,27

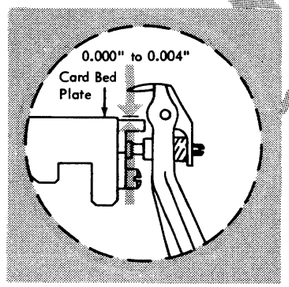
5.12.5 Bevel Gears

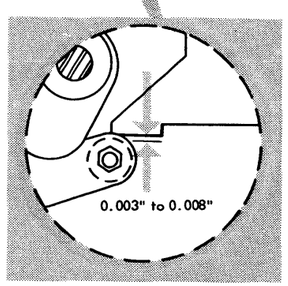
1. Loosen setscrews on index shaft bevel gear.
2. With CF clutch latched at 0°, rotate card stop cam to a point where cam follower is at approach but is not up on rise of cam.
3. With some clearance at meshpoint of bevel gears, tighten setscrews.



5.12.6 Punch/Read Station Registration

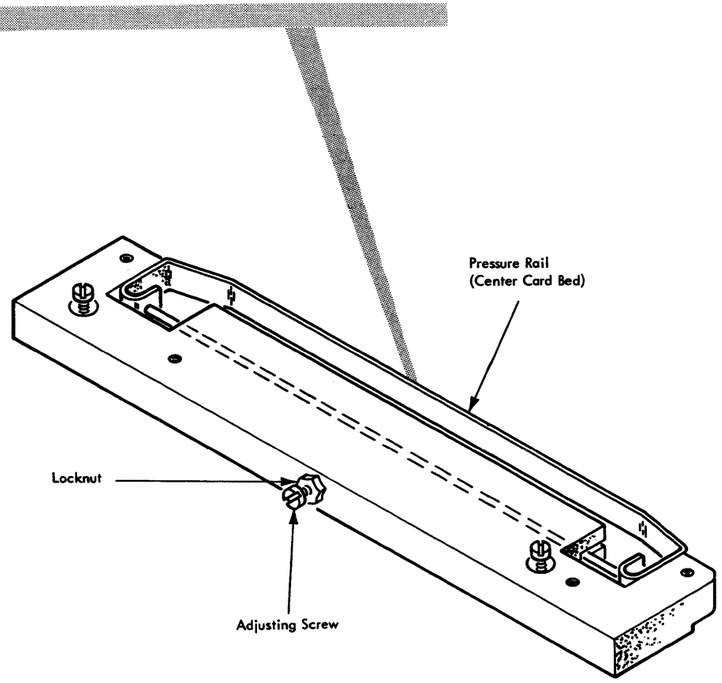
1. The stop card pusher arm is to be even with to 0.004 inch below top of bed plate.
2. Pull back pusher arm stud to be sure it does not interfere with registration.
3. Loosen locknut and set registration screw for best punching registration; tighten locknut.
4. Set card pusher cam on high point (card feed index at 50°) and adjust pusher arm stud for 0.003- to 0.008-inch clearance to pusher arm follower.





5.12.7 Pressure Rail (Center Card Bed)

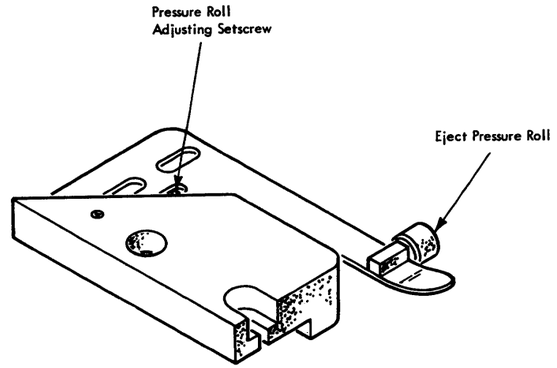
1. Adjust with machine in operating position.
2. Tear a blank card at column 60 (5-3/8-inch length) and position it on card bed plate between pressure rail and card guide rail in a "free" condition between eject station and punch/read station.
3. Turn adjusting screw counterclockwise until upper edge of card leaves card guide rail.
4. Turn adjusting screw clockwise until complete upper edge of card touches card guide rail.
5. Turn adjusting screw 2-3/4±1/4 additional turns clockwise and lock screw in place using locknut.



Pressure Rail Assembly

5.12.8 Eject Pressure Roll

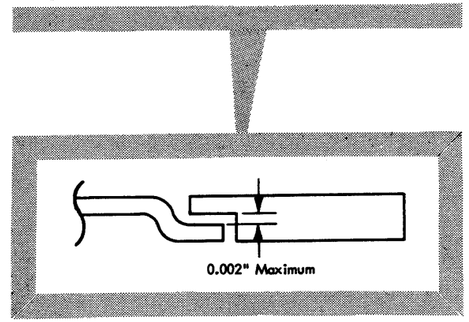
Adjust card eject pressure roll setscrew clockwise until roller rotates continuously, then turn setscrew counterclockwise until roller stops turning.



Eject Assembly

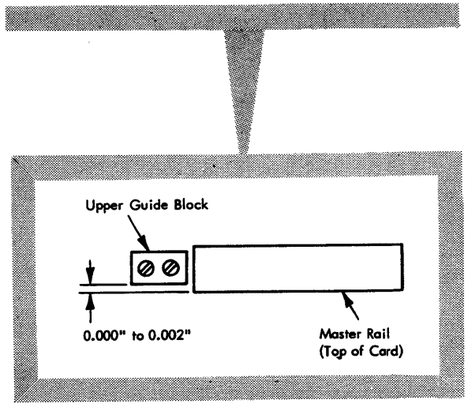
5.12.9 Master Station Bed Plate

Adjust setscrew at right end of bed plate for 0.002-inch maximum space between master rail and bed plate for length of rail.



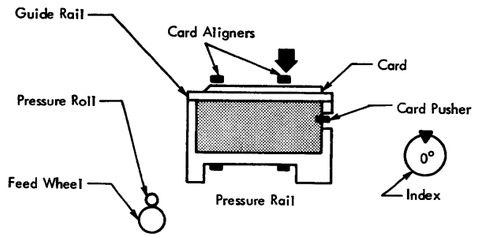
5.12.10 Upper Card Guide Adapter Block

Adjust upper card guide adapter block located at left of master rail so that guide is even with or not lower than 0.002 inch under master rail card surface.

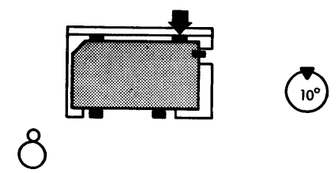


Conversion Table	
Inches	Millimeters
0.002	0,05
5-3/8	136,52

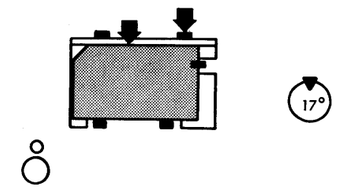
5.13 PUNCH/READ STATION REGISTRATION OPERATION



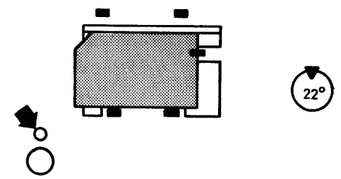
1 Card aligners against card and card under guide rail. CF clutch engages.



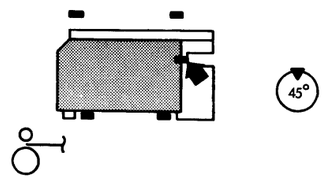
2 Aligners move card below guide rail and against pressure rails. Pressure roll begins opening (card at punch station is released at 9°) and card pusher begins moving forward.



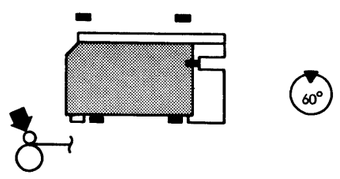
3 Card aligners continue downward and card pusher continues to fully register card. Card aligners retract, and card contacts guide rail.



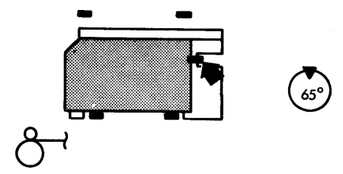
4 Pressure roll fully open.



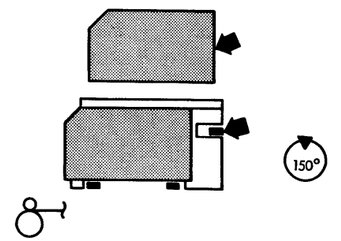
5 Card pusher fully forward; card between pressure roll and feed wheel. Pressure roll begins closing.



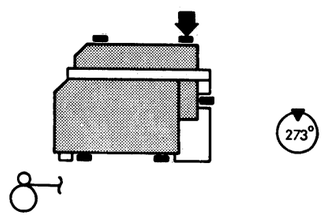
6 Pressure roll holds card. Card aligners begin to move back to receive next card.



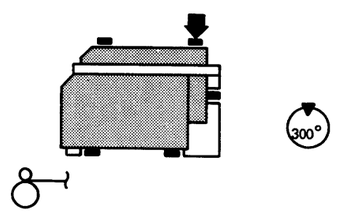
7 Card pusher begins moving back. Pressure roll closes fully at 67°.



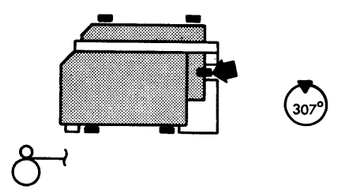
8 Card pusher fully back. Next card moving from hopper. (See "Card Feed Mechanism," Section 5.9 for timing.)



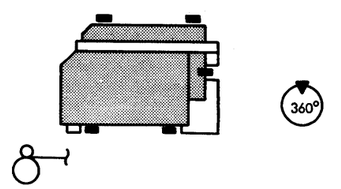
9 Card aligners engage next card.



10 Aligners stop; card pusher begins to move forward.



11 Card pusher engages card.



12 CF clutch latches. One card registered at the punch station; one card waiting in the pre-register station.

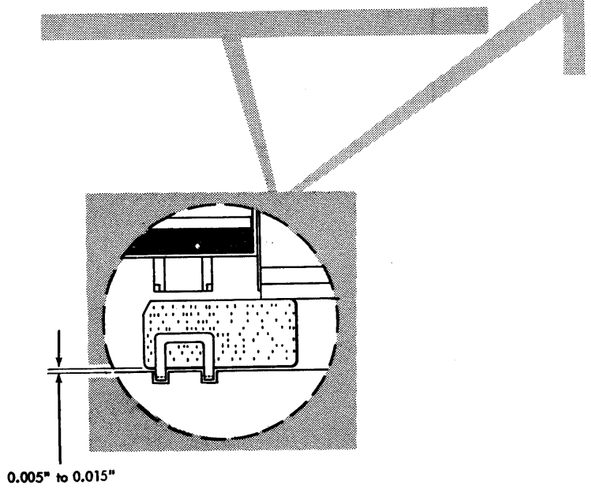
5.14 CARD STACKING MECHANISM MAINTENANCE

5.14.1 Card Pusher Fingers

5.14.1.1 Card Pusher Fingers

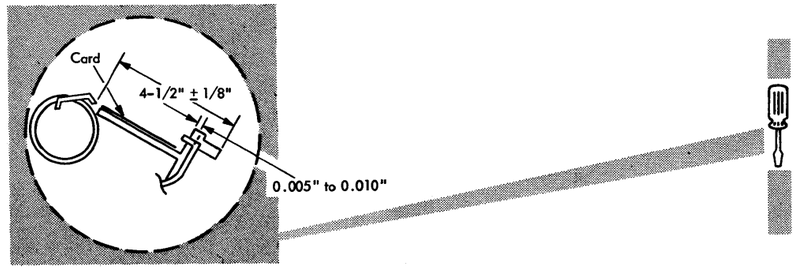
Turn off machine power and manually trip the card feed clutch. Manually advance the drive and observe operation.

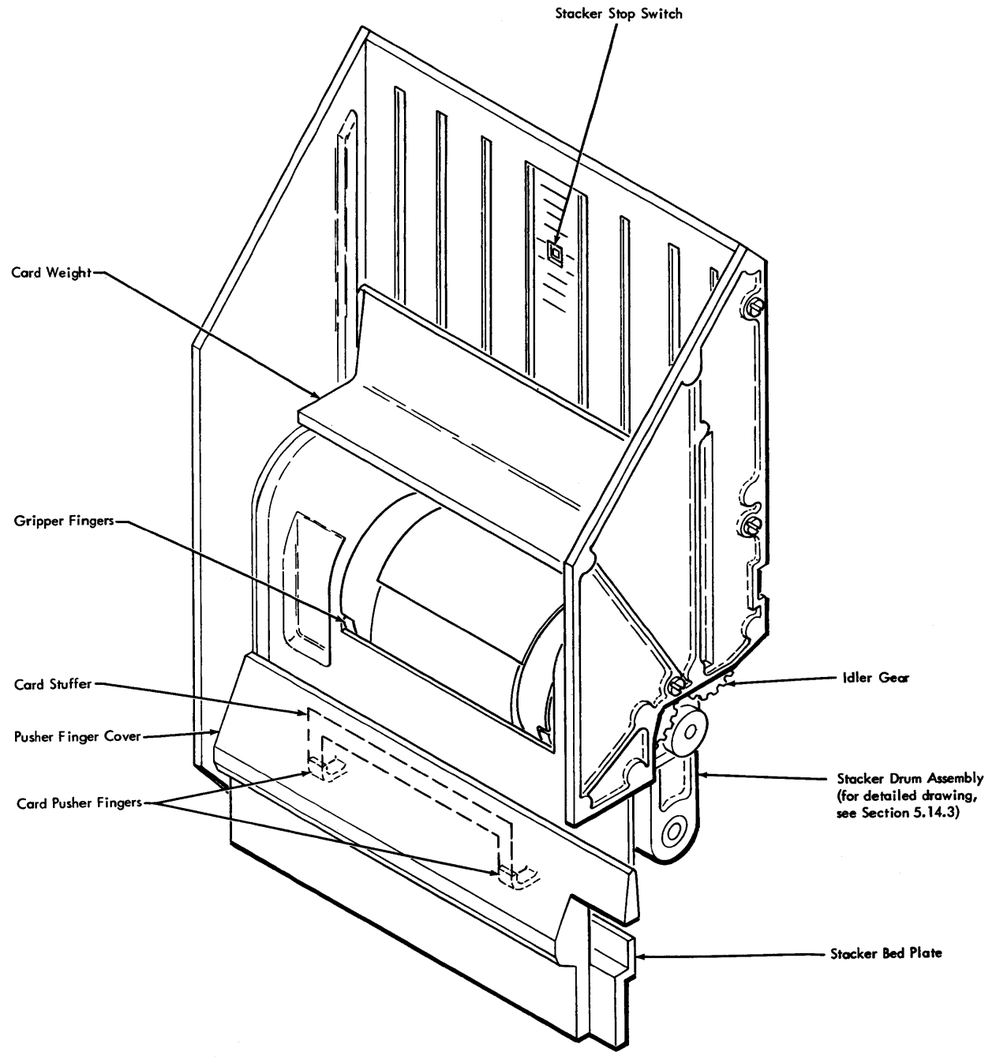
1. Check that clearance exists between tips of gripper fingers when they begin to open (about 280°) and top edge of a card; fingers must clear card when machine power is on.
2. Check that first gripper cams open a minimum of 0.093 inch (3/32 inch).
3. Check that grippers close evenly and hold card by 5/32±1/32 inch as pusher movement ends.
4. Check that card stuffer is properly seated on pusher fingers and does not interfere with cards entering stacker from eject station.
5. Check that pusher cam follower is contacting its cam on low dwell (does not rotate freely) and that fingers are against bumper. The roller can be seen and is accessible through space between punch drive and drive motor.
6. Check that pusher finger movement ends at about 305°.
7. Check that stacker bed plate rail is 0.005 to 0.010 inch above pusher fingers and that rail is 0.005 to 0.015 inch below bottom of card being held against upper guide rail.
8. Check that second gripper cams release card evenly and do not cause card damage during stacking operation.



5.14.1.2 Card Pusher Fingers

1. Remove stacker card guide.
2. Move card from center bed into stacker until a little past first pusher finger. Hold card squarely against top guide rail and down against bed plate to prevent card from bending.
3. Position stacker bed plate for 0.005- to 0.015-inch clearance between card rail and lower edge of card.
4. With CF clutch latched at 0° and the pusher finger cam follower on low dwell of cam, pull down pusher finger arm against bumper. While maintaining pressure on arm so that it remains in contact with bumper, adjust bumper so that pusher fingers are positioned about 0.020 inch below bed plate rail. *This is a temporary adjustment.*
5. Insert a fluted wrench into clamping screw on adjustable pusher lever and loosen screw until clamp is free. Again pull arm down against bumper and firmly tighten screw. (Because of tension in the mechanism, the pusher fingers may move away from the bumper.) Check that pusher fingers are 0.005 to 0.010 inch below the rail when adjustment is complete. If necessary, change temporary adjustment of bumper slightly and repeat this step.
6. Readjust bumper to have 0.000- to 0.005 clearance from pusher finger arm. Check that the follower roller is contacting the pusher cam (feel the cam follower to be sure that it does not rotate freely).
7. Be sure that gripper finger tips clear card when they begin to open with machine power on.





Stacker Assembly

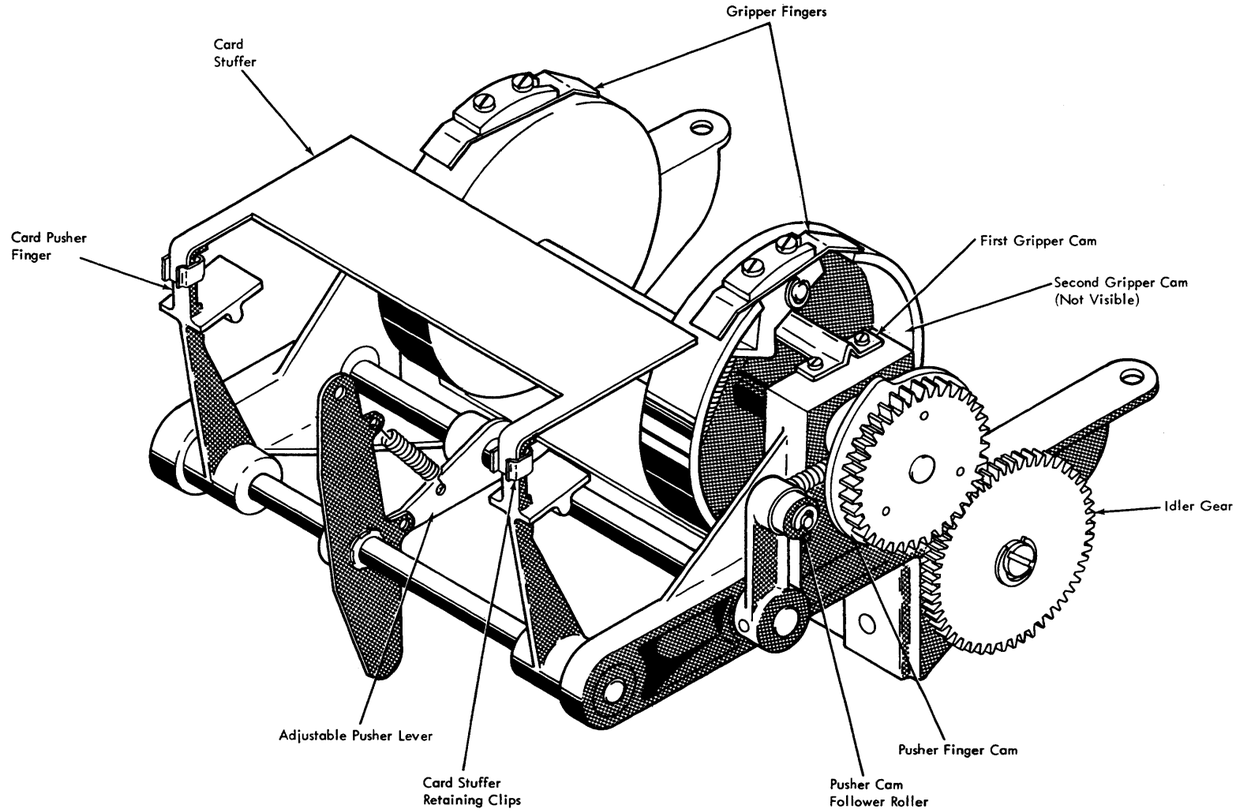
5.14.2 Stacker Bed Plate (Gear Mesh)

Turn machine power off and trip CF clutch. Manually advance drive mechanism until 280° is indicated on CF index. Mesh stacker idler gear and drive gear for closest measurement to 4-1/2±1/8 inches from tip of gripper fingers to front edge of transport casting.

Conversion Table	
Inches	Millimeters
0.005	0,13
0.010	0,25
0.015	0,38
0.020	0,51
1/32	0,79
0.093	2,36
1/8	3,18
5/32	3,96
4-1/2	114,30

5.14.3 Stacker Cam Timing
Pusher Finger Cam Timing

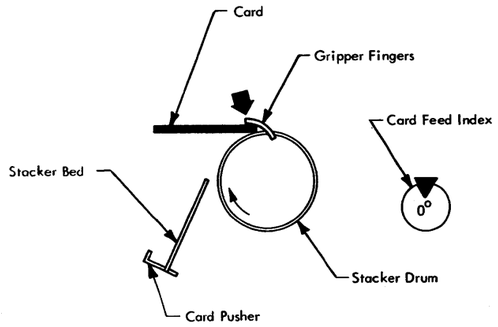
1. Check that there are no binds in stacking mechanism. Remove card stuffer and stacker bed plate from machine.
2. With machine power off, trip CF clutch and manually advance drive mechanism until 305° is indicated on CF index.
3. Loosen three screws on pusher finger cam and set cam so that cam follower is at start of high dwell on cam; tighten screws.
4. Adjust first gripper cams so that they close evenly and hold card when pusher finger movement ends. When card is stacked by manually advancing drive, grippers hold 1/8 inch of card.
5. Replace stacker bed plate on machine and turn power on. Observe stacking under power. Grippers should hold about 5/32±1/32 inch of card.
6. It may be necessary to readjust cam timing if tolerance is not met. If card is being pushed too far into grippers, it is necessary to retard timing of cam slightly. Remove stacker bed plate. Place pencil mark on pusher finger cam directly across from a tooth in drive gear. Loosen screws on pusher finger cam and move cam until mark is about 1/4 tooth in front of reference tooth; tighten screws. (This changes the timing by about 3°.) Move cam in opposite direction if grippers do not hold enough of card. Replace stacker bed plate and recheck steps 4 and 5.
7. Adjust second gripper cams to open evenly. With machine power on, check that grippers do not damage cards and that they provide even stacking against the bed plate.
8. Seat card stuffer (downward) on top of pusher fingers until retaining clips are detented and stuffer is against top of fingers.



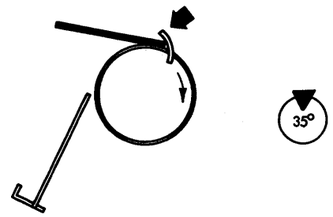
Card Stacking Assembly

Conversion Table	
Inches	Millimeters
1/32	0,79
1/8	3,18
5/32	3,96

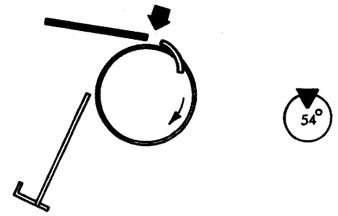
5.15 CARD STACKING MECHANISM OPERATION



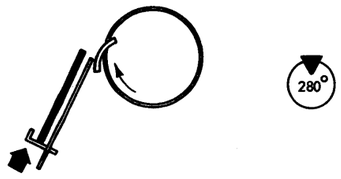
1 Card is in prestacked position. CF clutch engages; stacker drum begins to turn.



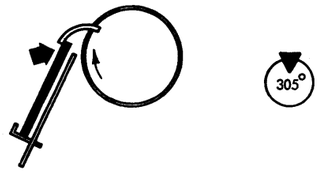
2 Gripper fingers begin to open at 35°.



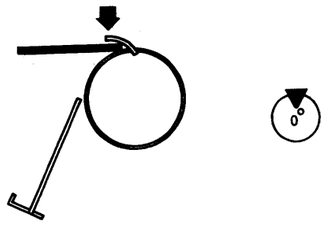
3 Card is stacked and gripper fingers are closed.



4 Card pusher moves up and engages card. Gripper fingers begin to open at 280°.



5 Card pusher at highest point of travel. Grippers close and hold card.



6 Clutch relatches; card is in prestacked position.

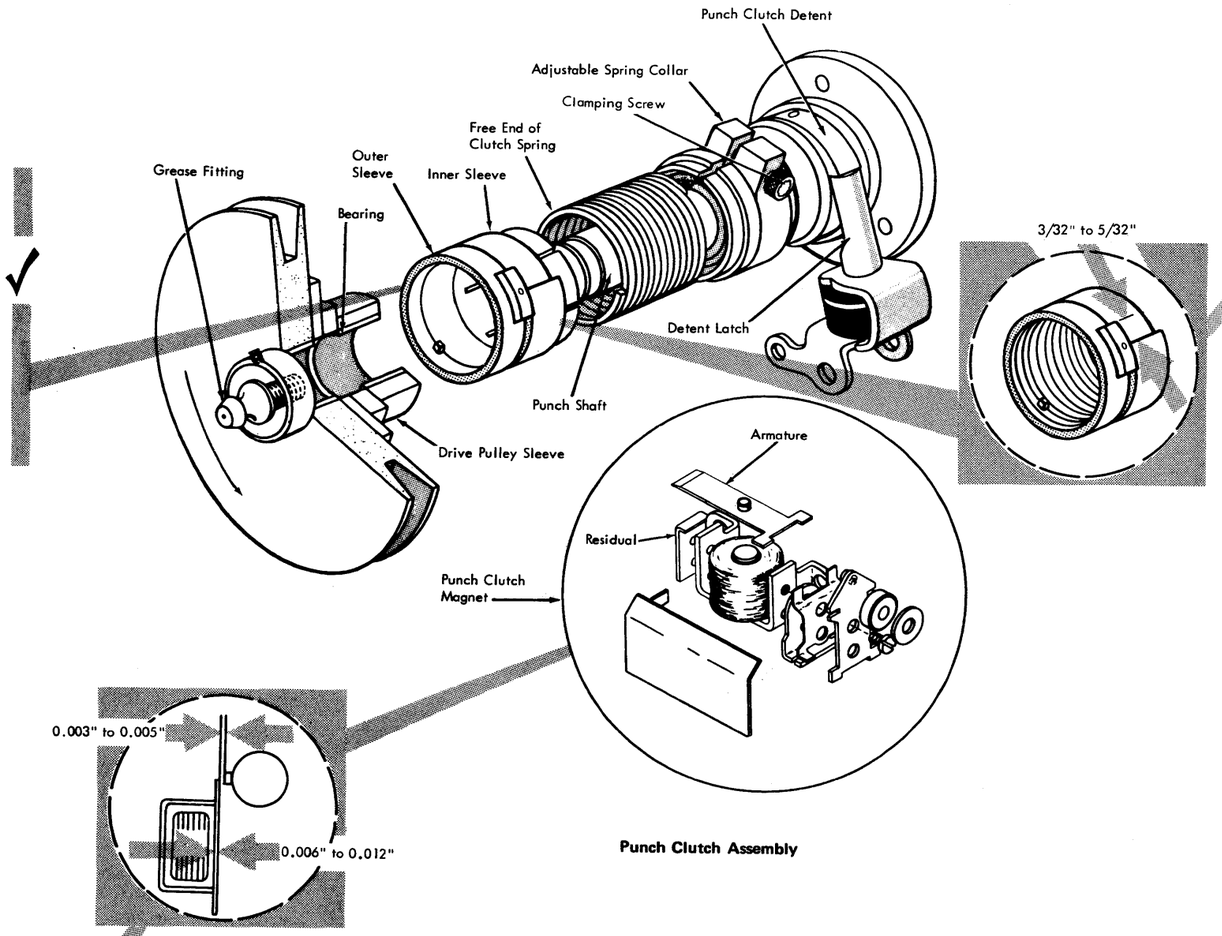
6.1 PUNCH CLUTCH

- A helical-spring clutch.
- Engages for all punch and print operations.

6.1.1 Punch Clutch

The clutch spring should be replaced if it is distorted. Replace the clamp if the clamp faces meet when tightened. Check the residual for wear.

1. Trip armature and check that outer sleeve leads inner sleeve by 3/32 to 5/32 inch. Punch clutch spring might not unwind (hangup) if lead distance is exceeded.
2. With clutch unlatched, turn drive pulley (not index wheel) until outer sleeve contacts armature and index stops; this should occur at 325°±10°.
3. Latch clutch and check for 1° to 3° overthrow.
4. Lubricate with IBM #23 grease.



Punch Clutch Assembly

6.1.2 Punch Clutch Magnet Assembly

1. Add or remove shims (part 305271) under core to obtain 0.006- to 0.012-inch clearance between armature and core with armature attracted.
2. Position magnet assembly to obtain 0.003- to 0.005-inch unlatching clearance between armature and steps on clutch sleeves.

Conversion Table	
Inches	Millimeters
0.003	0,08
0.005	0,13
0.006	0,15
0.012	0,30
3/32	2,39
5/32	3,96

6.1.3 Punch Clutch

1. Loosen clamping screw. Trip clutch armature and turn index wheel (not the drive pulley) forward until inner- and outer-sleeve latching surfaces can be seen.
2. Hold two sleeves in position and move collar so that clamping screw is accessible.
3. Turn outer sleeve clockwise against spring. This sleeve moves very easily counterclockwise, so keep the outer sleeve's projection against the end of the spring to prevent an incorrect indication of latching surface spacing.
4. Position inner-sleeve latching surface 3/32 to 5/32 inch behind outer-sleeve latching surface and keep clamping screw accessible.
5. While keeping outer sleeve projection against spring, press clamping collar and inner sleeve toward base of machine; tighten clamping screw.
6. Loosen clamping screw about 1/4 turn, allowing shaft to be turned inside spring with some resistance. Clamp must not be so loose that the spring moves inside the inner sleeve.
7. Turn index wheel forward until inner- and outer-sleeve latching surfaces are driven against armature. (If the index cannot be turned against this point, the clamp is too tight.)
8. Hold inner sleeve against armature and continue turning index wheel to 347°. This is 2° past the point where the detent drops into place. Tighten clamping screw; be sure it is tight.
9. Perform punch clutch service check (6.1.1).

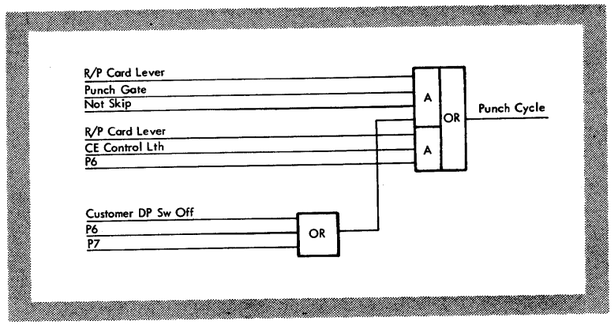
6.2 PUNCH CLUTCH OPERATION

The punch clutch is a friction-spring clutch with a continuously driven pulley and a drive pulley sleeve. One end of the spring clamps to the punch shaft. The clutch sleeves control the other end, which is around the drive pulley sleeve. Normally the drive pulley sleeve rotates freely on the end of the punch shaft, and the punch clutch magnet armature engages the step on the clutch sleeves.

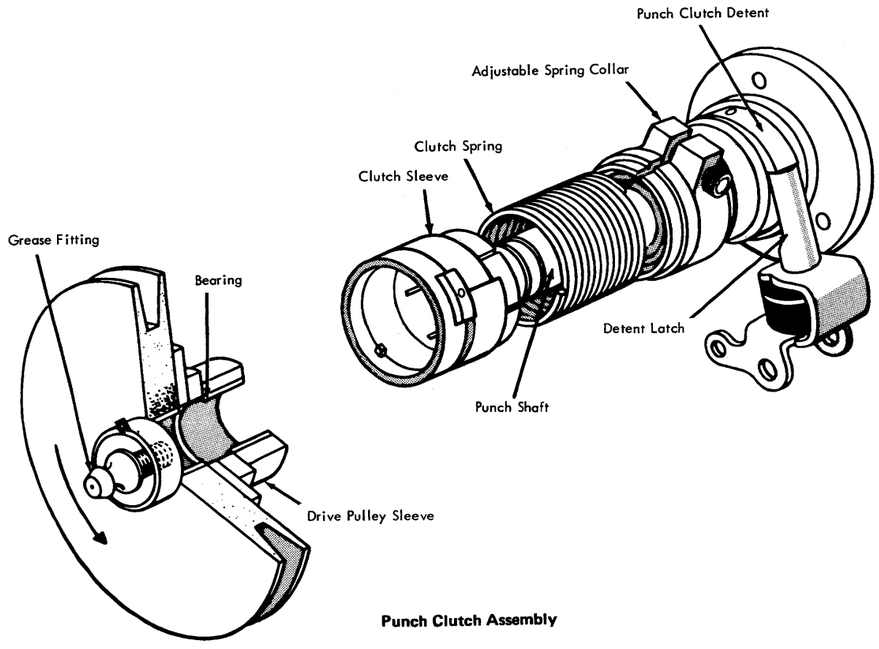
The normal diameter of the clutch spring is smaller than that of the drive pulley sleeve. Note that when the clutch is latched, the clutch sleeve unwinds the spring a little and the spring clears the drive pulley sleeve. When the clutch magnet energizes, the armature releases the clutch sleeves and allows the spring to hold the continuously running drive pulley sleeve, turning the punch shaft with the drive pulley.

To latch the clutch, force is needed because of the tension of the clutch spring. Under normal operating conditions, the shaft carries to a point where the clutch spring unwinds a little within the clutch sleeves after the sleeves engage the tip of the armature. A small amount of overthrow allows the detent latch to drop into place, preventing the clutch from turning backward.

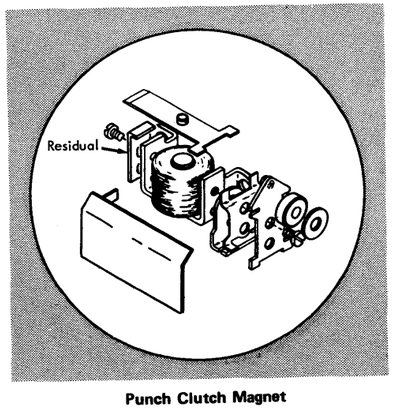
The clutch latches at 345° of the punch index.



Punch Clutch Circuit



Punch Clutch Assembly



Punch Clutch Magnet

6.3 PUNCH UNIT

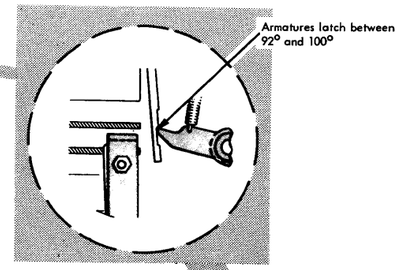
- Controlled by the punch clutch.
- Provides drive to the punch unit and the print unit.
- Provides timing pulses during a punch cycle.

6.3.1 Punch Magnet Unit

The position of the magnet unit affects three adjustments: unlatching, relatching, and knockoff.

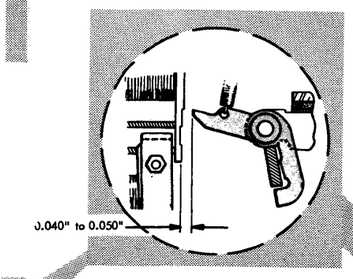
Install magnet unit with reasonable unlatching clearance as first step. Do not overtighten screws; magnet unit will be readjusted in step 2. Trip four interposers across unit and manually rotate index clockwise. Position magnet unit so that unlatched interposers, in downward motion, start to enter their armature notches at 92° and are in their notches at 100°.

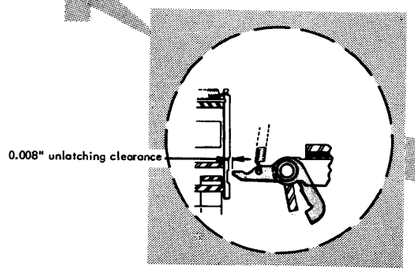
1



Shift magnet unit toward or away from interposers to obtain 0.040- to 0.050-inch clearance. This adjustment should result in 0.008-inch unlatching clearance for each interposer.

2

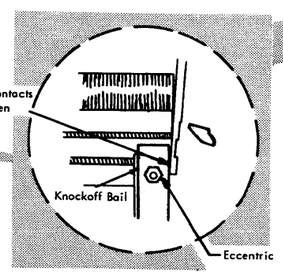




Adjust eccentric screw on knockoff bail to cause bail to contact an attracted armature at both ends of unit between 13° and 20°. If eccentricity is not enough, inspect cam follower for wear. (It may be necessary to pivot the complete magnet unit around the armature latching point to bring the bail closer to the armatures.)

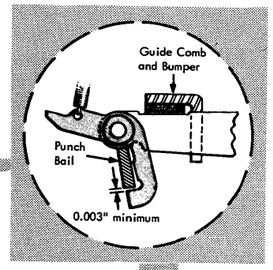
For a short time, attract each armature electrically. (The spring should cause the armature to drop away from the core.) If armatures remain attracted when circuit is deenergized, they should be replaced; residual magnetism causes excessive wear on knockoff bail.

3

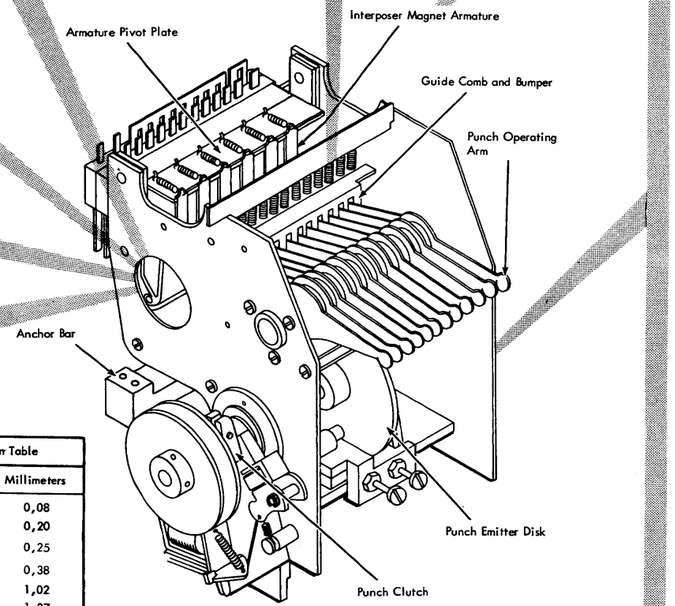


6.3.2 Guide Comb and Bumper

With clutch latched, adjust guide comb and bumper so that bumper part holds punch operating arms down against punch bail. When interposers are hooked under bail, there should be 0.003-inch (minimum) clearance between bottom of bail and interposers. Check adjustment by placing hand on punch arms to take up any clearance between top of bail and punch arms; then trip all interposer armatures. All positions should latch under bail.



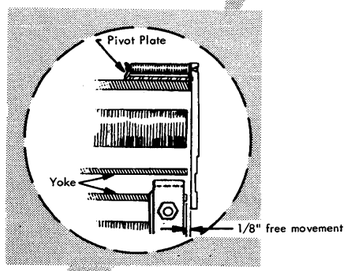
Conversion Table	
Inches	Millimeters
0.003	0,08
0.008	0,20
0.010	0,25
0.015	0,38
0.040	1,02
0.050	1,27
1/8	3,18



Punch Unit

6.3.3 Armature Pivot

Form armature pivot by lifting tip of armature until there is at least 1/8-inch free movement of operating end. Armature must touch yoke at both ends with 0.010- to 0.015-inch space between armatures and cores when armature is in energized position.

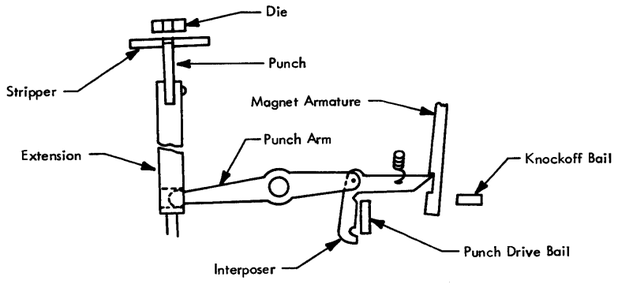


6.3.4 Punch Drive Unit

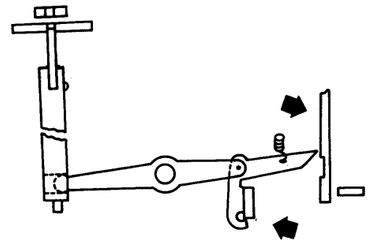
1. Remove:
   a. Belt guard and punch drive belt.
   b. Wires to punch drive unit.
2. On printing machines:
   a. Unhook print drive spring and trip punch clutch to prevent clutch damage. Hold index wheel and remove screw with left-hand threads from end of punch shaft. Unscrew grease plug from mounting plug.
   b. Remove spring retaining clip on vertical drive rod to relieve tension, and remove vertical drive rod guide plate. Disengage print rod from print arm by applying a little pressure on drive rod at lower end.
   c. Lift print drive mechanism from rear mounting plug.
3. Remove two screws from each end of drive unit anchor bar.
4. Loosen screws in front mounting plug enough to permit disengaging the plug. Remove rear mounting plug screws.
5. Move drive unit up and down (bed in vertical position) to free mounting plugs.
6. Turn drive unit clockwise and remove from base.

Before reinstalling the drive unit, manually push the extensions in as far as possible. Reverse the procedure to install the punch unit. Align the groove in the eccentric bearing to the mark on the print cam; check the printing of a printing machine (step 6 of print suppress magnet adjustment, 7.3).

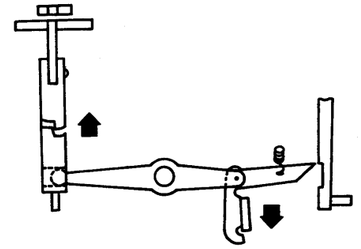
6.4 PUNCH UNIT OPERATION AND TIMING



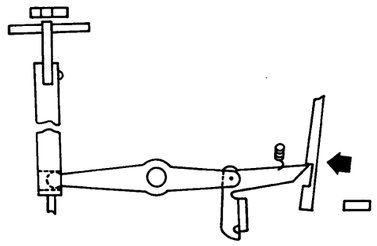
1 Punch interposer is in restored condition.



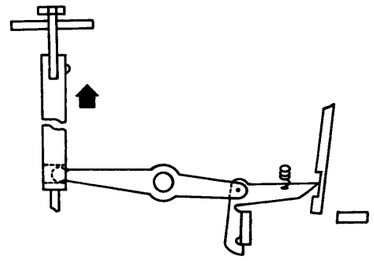
2 Output latch energizes interposer magnet and interposer armature is attracted. The interposer latches under punch bail.



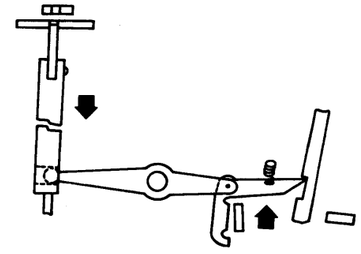
3 Punch drive bail is driven down by punch drive shaft. Punch extension starts upward travel.



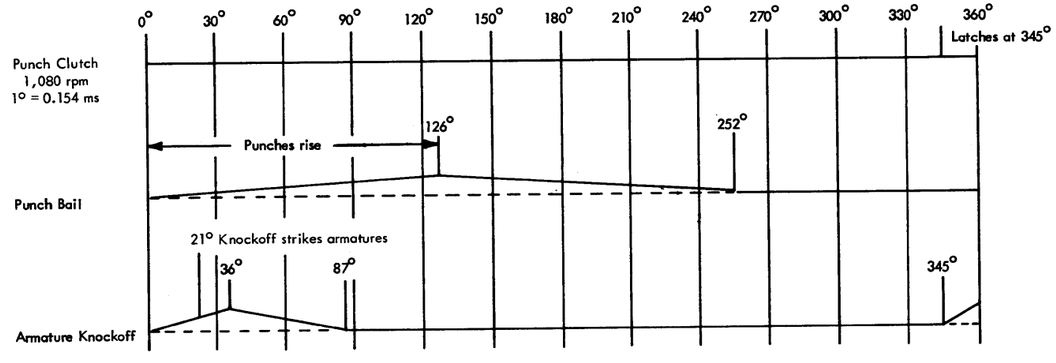
4 Interposer magnet deenergizes. Armature knockoff bail strikes interposers (21°).



5 Punches at highest point of travel (126°).



6 Interposers engage notches of armatures and unlatch from punch drive bail.



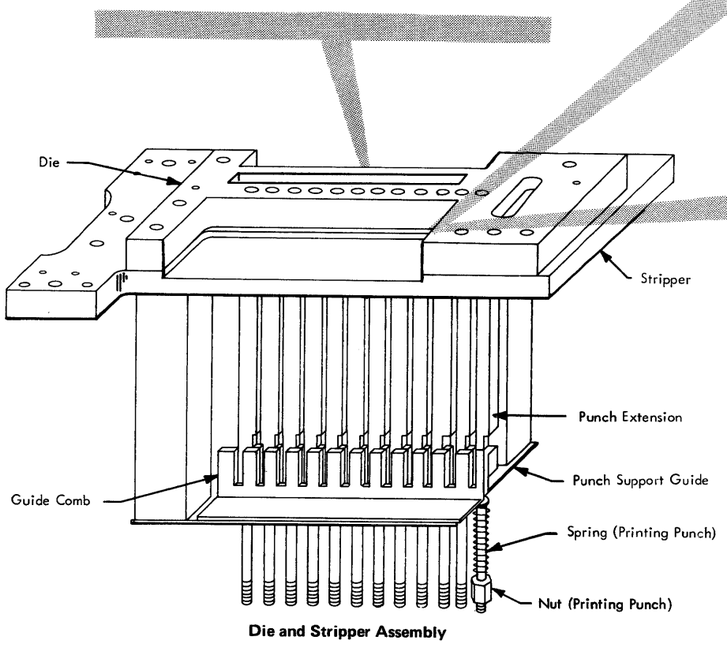
6.5 PUNCH DIE AND STRIPPER

- Performs the punching function.
- Punch extensions are powered by the punch operating arms.

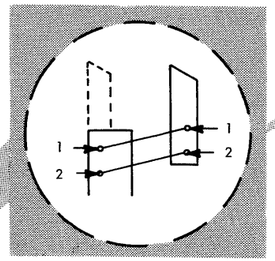
6.5.1 Die and Stripper

Crayon or pencil remains sometimes form on the underside of the die and can slow the card, resulting in off-registration punching. These remains can be removed with a feeler gage.

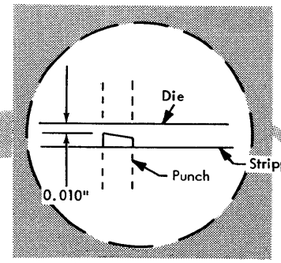
Die and stripper clearance is factory set for 0.012 to 0.017 inch on printing punches (0.015 to 0.019 inch on some machines with serial numbers above 57,000).



Die and Stripper Assembly



Printing Punch



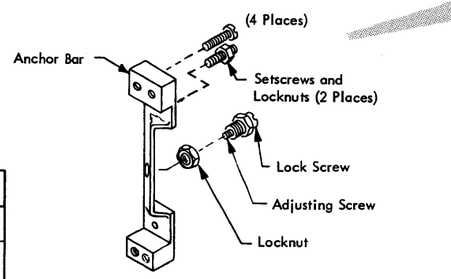
Nonprinting Punch

Conversion Table	
Inches	Millimeters
0.003	0,08
0.010	0,25
0.012	0,30
0.013	0,33
0.017	0,43

6.5.2 Punch Penetration (Model 2 or 3)

Correct punch penetration should result from the punch drive and drive yoke adjustment (7.1.1). Should additional penetration be needed, either readjust the anchor bar and recheck printing or move the punch retaining pin to the next higher-number hole. This provides 0.010-inch additional penetration.

Note: Always insert the retaining pin in the same numbered holes in both the extension and the punch.



6.5.3 Punch Penetration (Model 1)

This adjustment prevents partially punched holes or excessive penetration during the setup process. The heel of the lowest punch must enter 0.013 to 0.017 inch into the die.

1. Loosen:
   a. Anchor bar setscrew locknuts and setscrews.
   b. Adjusting screw and lock screw.
   c. Anchor bar holding screw.
2. Manually trip all punch interposer armatures.
3. Trip punch clutch armature and manually turn punch drive pulley until 126° (punches up) is indicated on punch index. Turn anchor bar adjusting screw until 0.010-inch gage passes between lowest punch and die. Turn in adjusting screw 1/8 turn to lower punches about 0.003 inch. Tighten holding screw after each attempt.
4. When the step 3 condition is met, remove feeler gage and back off two turns on adjusting screw; tighten locknut.
5. Turn two support screws in until they rest lightly against drive unit side frames; tighten locknuts. These setscrews are used as locators to prevent need for readjusting punch penetration if punch drive unit is removed.

6.5.4 Die and Stripper (Model 2 or 3)

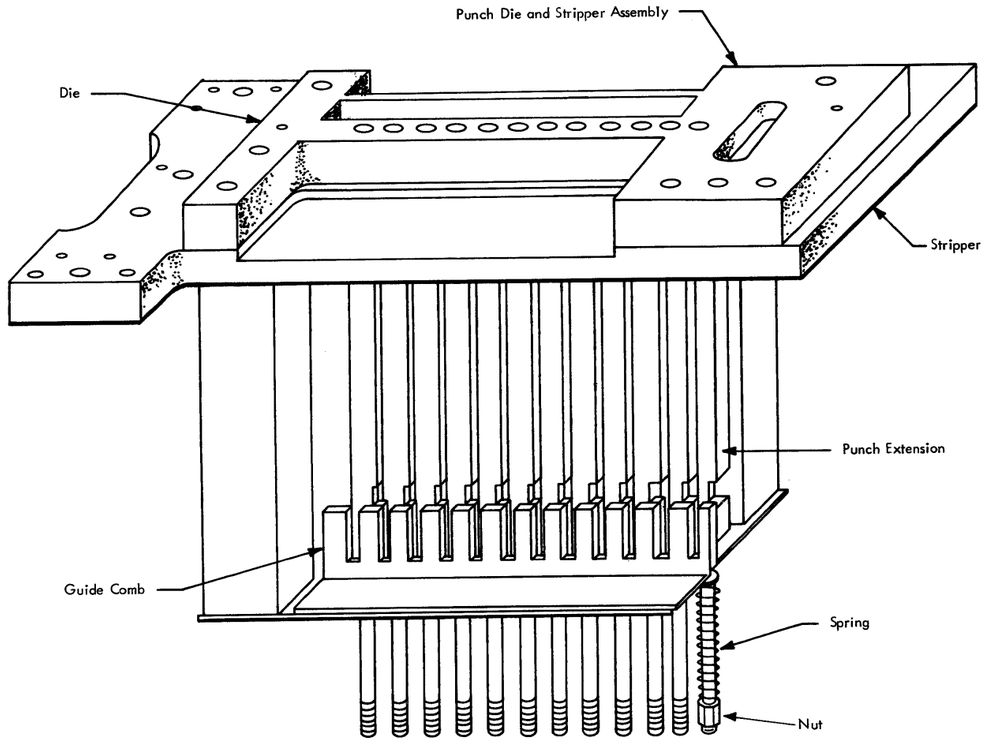
1. Remove:
   a. Print head (7.2.4).
   b. Chip tube and release pin. Be careful not to lose the pressure roll spring.
   c. Pressure rail covers and center bed upper card guide.
   d. Center bed plate.
   e. Print interposer unit (7.1.2).
   f. Horizontal shift spring.
   g. Die and stripper assembly mounting screws (3).
2. Remove bottom guide plate on punch extension. Lift each punch extension over punch arm and push extension into die.
3. Remove two die mounting screws.
4. With left hand holding punch extensions in place, remove die and stripper assembly from base.

To reassemble, reverse the procedure. Do not separate the die and stripper unnecessarily. Clear all card chips from the assembly before replacing the assembly in the machine.

6.5.5 Die and Stripper (Model 1)

1. Remove:
   a. Chip tube and release pin. Be careful not to lose the pressure roll spring.
   b. Pressure rail covers and center bed upper card guide.
   c. Center bed plate.
2. Remove lower guide plate on punch extension. Insert two or three 2-inch strips of card between die and stripper. Lift each punch extension over punch arm and push extension into die.
3. Remove two die mounting screws and remove assembly from casting.

To reassemble, reverse the procedure. Do not separate the die and stripper unnecessarily. Clear all card chips from the assembly before replacing the assembly in the machine.



Die and Stripper Assembly

Conversion Table	
Inches	Millimeters
2	50,8
6	152,4

6.5.6 Punch and Extension (Model 2 or 3)

1. Remove print interposer unit (7.1.2).
2. Remove lower guide plate on punch extension.
3. Remove punches by lifting each extension over its operating arm and pulling out.

To reassemble, reverse the procedure. Support the punch and extension on a 6-inch scale to aid in reassembly. (Note that the tip of the punch is toward the front of the machine.) Be sure that the retaining pin head is on the same side as the pin retaining plate.

6.5.7 Punch and Extension (Model 1)

1. Remove lower guide plate on punch extension.
2. Remove punches by lifting each extension over its operating arm and pulling out.

To reassemble, reverse the procedure. Support the punch and extension on a 6-inch scale to aid in reassembly. (Note that the tip of the punch is toward the front of the machine.) Be sure that the retaining pin head is on the same side as the pin retaining plate.

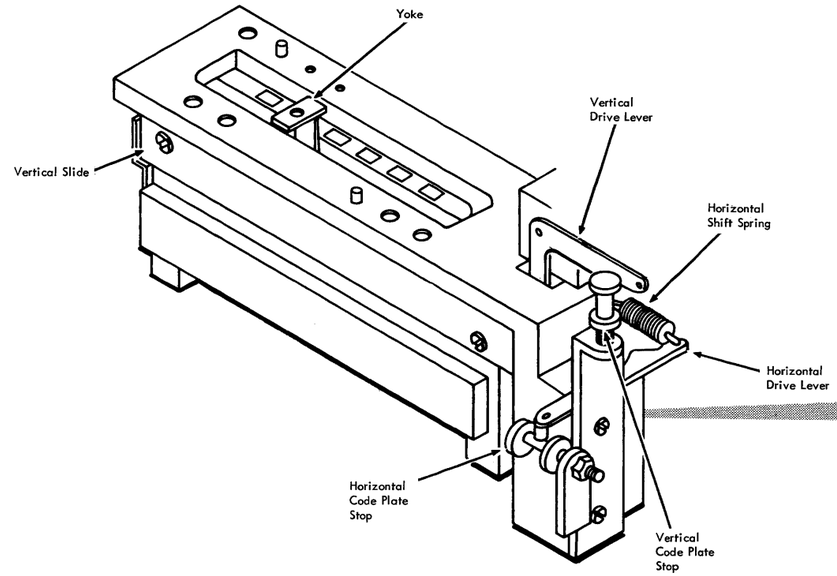
7.1 PRINT INTERPOSER ASSEMBLY

- Contains two sets of interposers.
- Provides the horizontal and vertical shift for code plate shifting.
- Operated by the punch extensions.

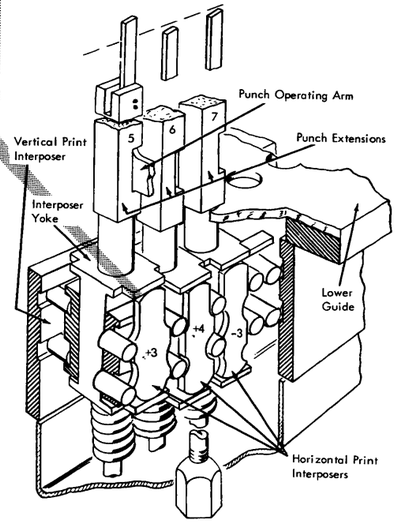
7.1.1 Punch Drive and Print Yoke

Clearance between the yokes and guides (0.015 to 0.020 inch) is provided by adjusting the punch drive unit. The clearance causes the rollers to contact the print interposers a minimum of 0.015 inch above the start of cam action. Because this clearance cannot be measured, perform the adjustment as follows:

1. Lubricate spring-loaded stops and slides with silicone grease where they contact casting of interposer unit. Lubricate interposers with IBM #6.
2. Remove belt guard. Remove punch drive belt to release tension on punch unit.
3. Loosen adjusting screw locknut, holding screw, and two support screws and locknuts in drive anchor bar. Unhook print drive spring.
4. Rotate drive unit counterclockwise, with punch clutch latched, until yokes can be felt to bottom on their inner guides. Turn adjusting screw in until it touches casting; back off 5/6 to 1 turn on adjusting screw. Tighten locknut and holding screw. Turn two support screws in until they rest against side frame; tighten locknuts.
5. Perform code plate clearance and print pressure adjustment (7.2.2).
6. Perform code plate alignment adjustment (7.2.1).
7. Reassemble machine and test punch penetration with standard codes.



Interposer Unit



Interposers

Conversion Table	
Inches	Millimeters
0.010	0,25
0.015	0,38
0.020	0,51
0.080	2,03

7.1.2 Interposer Unit

1. Remove punch extension cover, nuts, and springs. Remove punch optics assembly.
2. Remove spring retaining clip on vertical drive rod and release spring tension. Unhook horizontal shift spring.
3. Remove four mounting screws and pull print interposer assembly from punch extensions.

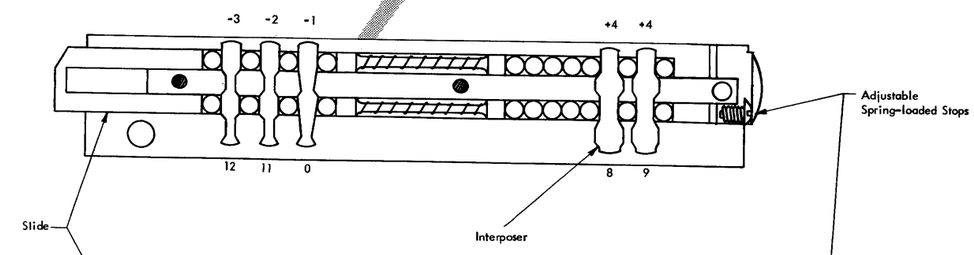
CAUTION
Keep tension on the horizontal slide to hold the interposers in place. On reassembly, install the short screw to the right of the 9-punch extension, facing the unit from the rear of the machine. Placing one of the longer screws in this position will bind the drive unit.

To reassemble, reverse the procedure.

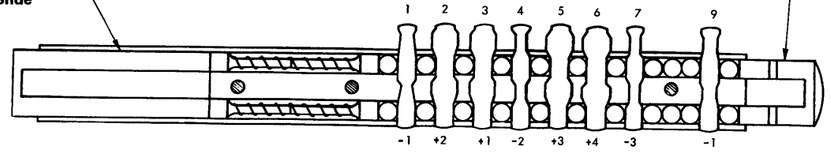
7.1.3 Print Interposers

The diagram shows the location of the print interposers as a guide to reassembling the print interposer assembly. Each unit of cam action causes 0.020-inch slide movement. A minus 1 cam has a 0.010-inch cut on both sides of the interposer, causing 0.020-inch slide movement. A plus 4 interposer moves the slide 0.080 inch. The plus or minus value is written on the interposer face. The ratio of slide movement to code plate shift is 10:11.

Vertical Slide



Horizontal Slide



Note: Slides are shown removed from the machine with the slot in the spring-loaded stops facing up.

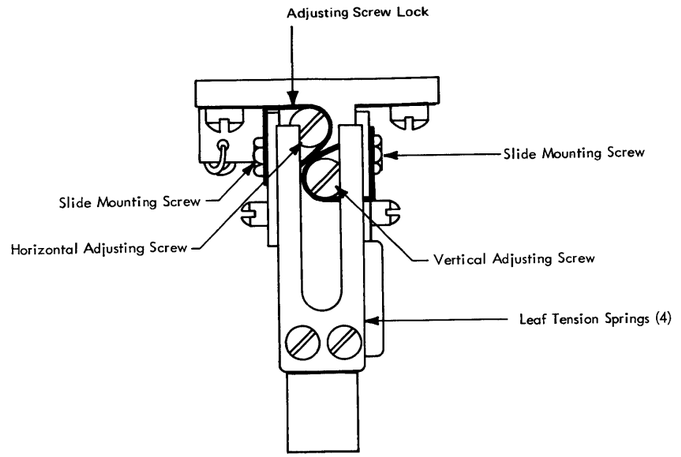
7.2 PRINT UNIT

7.2.1 Code Plate Alignment

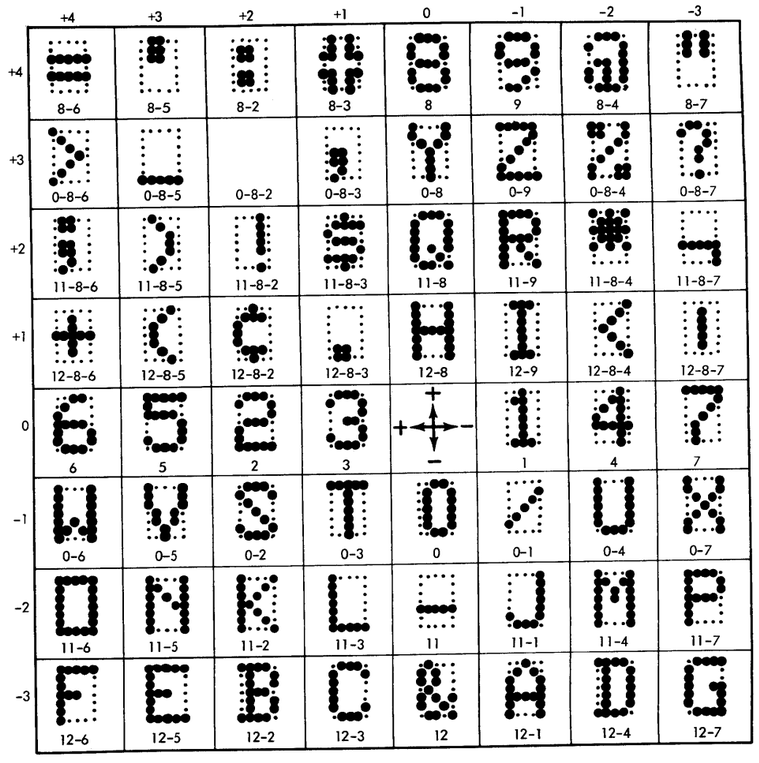
1. With machine power off and punch clutch latched, loosen bottom screw on vertical drive rod guide plate as observed from rear of machine.
2. Back out on horizontal and vertical stop adjusting screws.
3. Unhook horizontal shift spring, remove vertical spring retaining clip, and release spring tension.
4. Insert code plate aligning tools.
5. Position vertical drive rod guide plate to center both vertical drive studs within code plate slots and tighten top screw of vertical drive rod guide plate.
6. Using one hand, simultaneously apply pressure on vertical drive lever and horizontal slide to press internal springs. Reposition vertical drive rod guide plate to free code plate aligning tools; tighten guide plate screws.
7. Hook up horizontal shift spring; and while applying finger pressure on the vertical drive lever, turn horizontal adjusting screw in until code plate aligning tools are free.
8. Restore tension to vertical shift spring and replace spring retaining clip. Turn in vertical adjusting screw until code plate aligning tools are free.
9. Remove aligning tools.

The diagram shows the patterns of wires used for printing each character. Use it to determine when extra wires are being picked up in printing. If extra wires are printed, improve the code plate alignment as follows:

1. Remove code plate stops bracket. Turn power on and place machine in direct punch mode.



Interposer Assembly (Front View)



Character Patterns

2. Adjust vertical position of code plate while printing an 8:
   a. Turn vertical adjusting screw clockwise until unwanted dots appear; mark this position.
   b. Back out slowly on adjusting screw past a clean 8 until unwanted dots reappear; mark this position.
   c. Turn adjusting screw to center point between these two positions.
3. Adjust horizontal position of code plate while printing a 6:
   a. Turn horizontal adjusting screw clockwise until unwanted dots appear; mark this position.
   b. Back out slowly on adjusting screw past a clean 6 until unwanted dots reappear; mark this position.
   c. Turn adjusting screw to center point between these two positions.
4. Check to see that code plate is in alignment with vertical rows of print wires.
   a. While printing a 3, back out slowly on horizontal adjusting screw. If alignment is correct, all dots disappear simultaneously because code plate is being moved to its neutral position. If corner of number disappears first, readjust vertical guide plate bracket using aligning tool.
   b. If readjustment of guide plate is necessary, repeat steps 2 through 4.
5. Perform code plate stops adjustment (7.2.5).

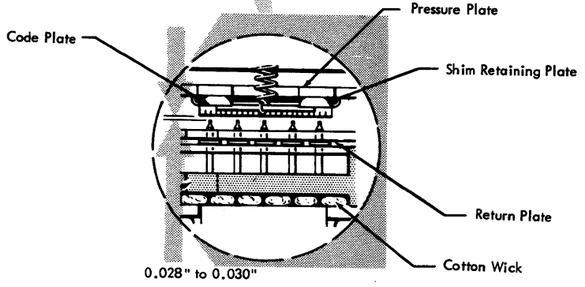
7.2.2 Code Plate Clearance and Print Pressure

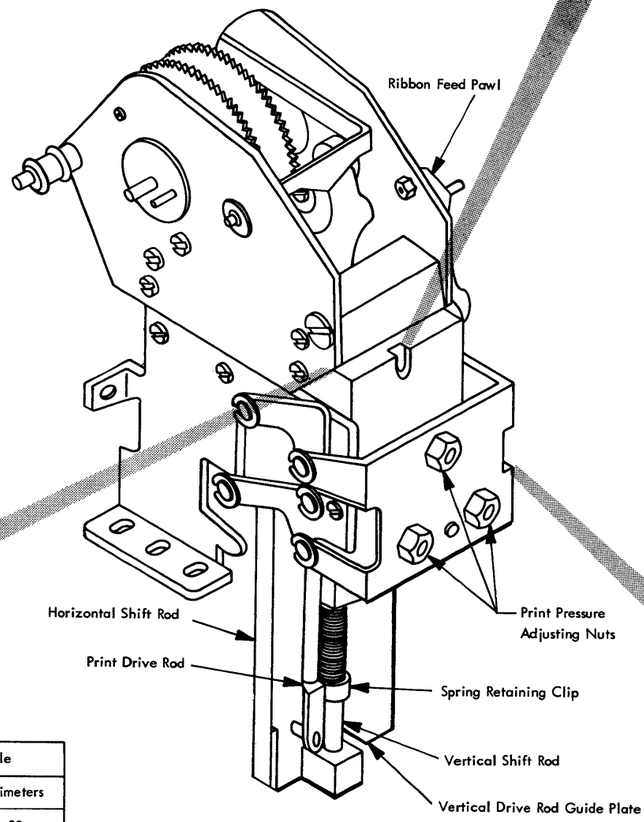
1. Start with one 0.003-inch shim (part 305243) and two 0.007-inch shims (part 228296) between pressure plate and shim retaining plate.

   Note: The code plate and shim retaining plate must be free of oil and grease because shifting failures may occur.

2. Turn three large pressure plate adjusting nuts counterclockwise until tight. Check for 0.028- to 0.030-inch clearance between code plate and print wires. Add or remove shims, if necessary.
3. Turn in evenly on three adjusting nuts, 1/4 turn at a time, until printing starts. Tighten locknuts after each step, and space before punching to prevent damage to print wires.

   A good test to show uneven printing can be obtained by disengaging the ribbon feed pawl and spring, and printing until the printing is light. Too much printing pressure will make the machine noisy and cause marks to appear when spacing.
4. Print arm roller must be free to lift 0.010 inch off cam, during print suppression, to reduce noise and wear on cam. Check clearance with print drive spring removed. Lifting movement drives wire collars 0.005 inch closer to wire guide plate than their return point after printing. If necessary, remove code plate shims and readjust printing pressure to obtain enough clearance to prevent wire return collars from striking wire guide plate. Code plate-to-wire clearance should be 0.028 to 0.030 inch.





Print Unit

Conversion Table	
Inches	Millimeters
0.003	0,08
0.005	0,13
0.007	0,18
0.010	0,25
0.028	0,71
0.030	0,76

7.2.3 Print Unit

Keep oil or grease off the back of the code plate to help prevent printing failures.

A broken or missing code plate projection can be easily determined for a particular character. A test of other characters many times determines whether there is a shifting error or a bind.

CAUTION
Running the machine with a missing or broken code plate return plunger or spring will result in broken wires or code plate projections.

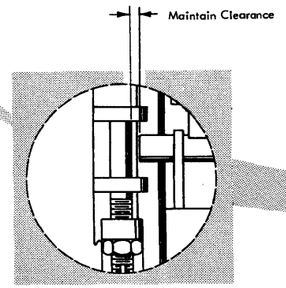
7.2.4 Print Head

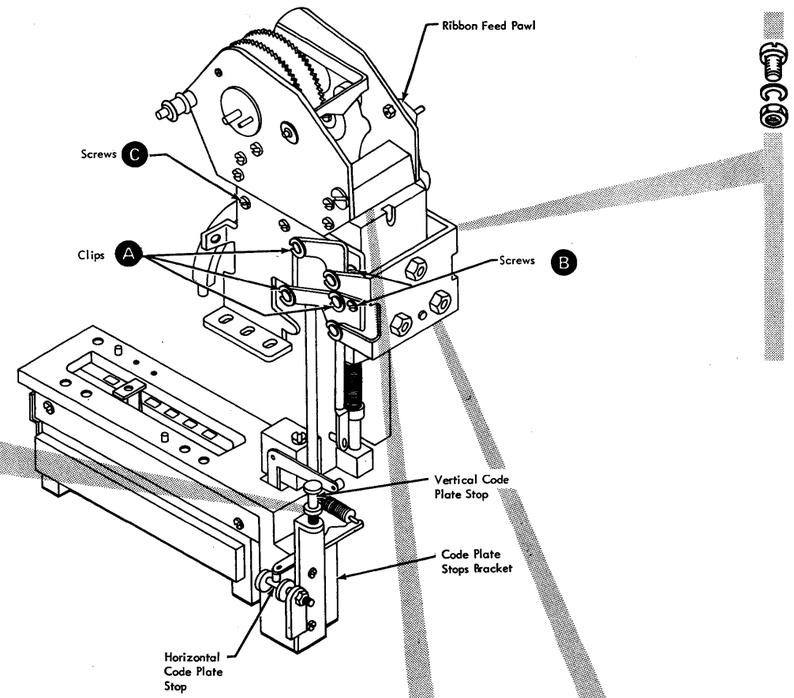
1. Remove ribbon spools. Slip them together and tape them to bed plate. Leave ribbon under die.
2. Unscrew gear at top end of flexible shaft (left-hand thread), if installed.
3. Pull print drive rod out of print arm. (On some units, it may be easier to remove the right horseshoe clip and slide the drive rod over, instead of disconnecting the drive rod from the stud.) Remove four screws holding print head to stripper; lift print head off guide pins and completely off base.

7.2.5 Code Plate Stops

1. Adjust code plate stops bracket so that horizontal stop clears stud on horizontal shift lever, and vertical stop is parallel to end of stud on vertical shift lever; tighten mounting screws.
2. Turn both adjustable stops to get 1/8-inch clearance in plus direction. Stud is then nearly centered between stops.
3. Unhook heavy spring to print cam follower and set punch index to 133°. Remove cover from punch extensions and manually push 6-punch to maximum upward position. Turn adjustable stop to touch horizontal shift lever stud; tighten locknut.
4. Manually push 8-punch to maximum upward position. Turn adjustable stop until it lightly touches vertical shift lever stud; tighten locknut.
5. Check adjustment in direct punch mode by punching patterns shown in diagram. Correct setting of code plate stops prints characters shown.

The stops must be checked and readjusted each time the blank position of the code plate is changed.





Print Unit

7.2.6 Print Wire Unit

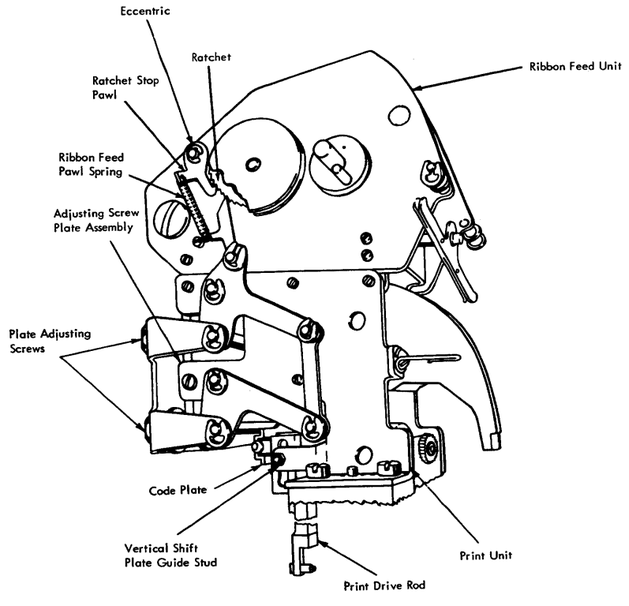
1. Pull three clips (A) and remove three shafts.
2. Note position of pressure plate for reassembly. The end with the wide cutout portion is nearer to the ribbon feed unit.
3. Remove two screws (B) from each side. Note that the adjusting screw plate assembly pivots slightly around its two dowel screws.
4. Remove pressure plate operating linkage.
5. After reassembly, impression may be lighter at one end of character. To correct condition, first try shifting adjusting screw plate. If condition is not corrected, perform print pressure adjustment (7.2.2).

Conversion Table	
Inches	Millimeters
1/8	3,18

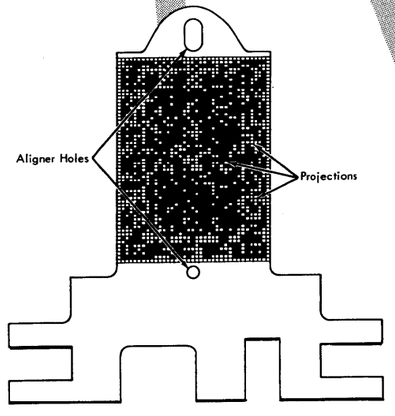
Punches	Direction		Character
	Horizontal	Vertical	
6	+4		
8		+ 4	
7	-3		
12,0		-4	*

* The print suppress magnet must be held open to print this character.

Test Patterns



Print Unit (Side View)



Code Plate

7.2.7 Code Plate

1. Remove ribbon spools and tape them to card bed.
2. Remove two screws (C) from each side of ribbon feed unit. Remove ribbon feed pawl spring. Lift off ribbon feed unit.
3. Remove code plate spring. Remove two clips and remove rods.
4. Lift pressure plate out through top of print unit.
5. Carefully remove code plate through bottom of print unit.

7.2.8 Print Wire

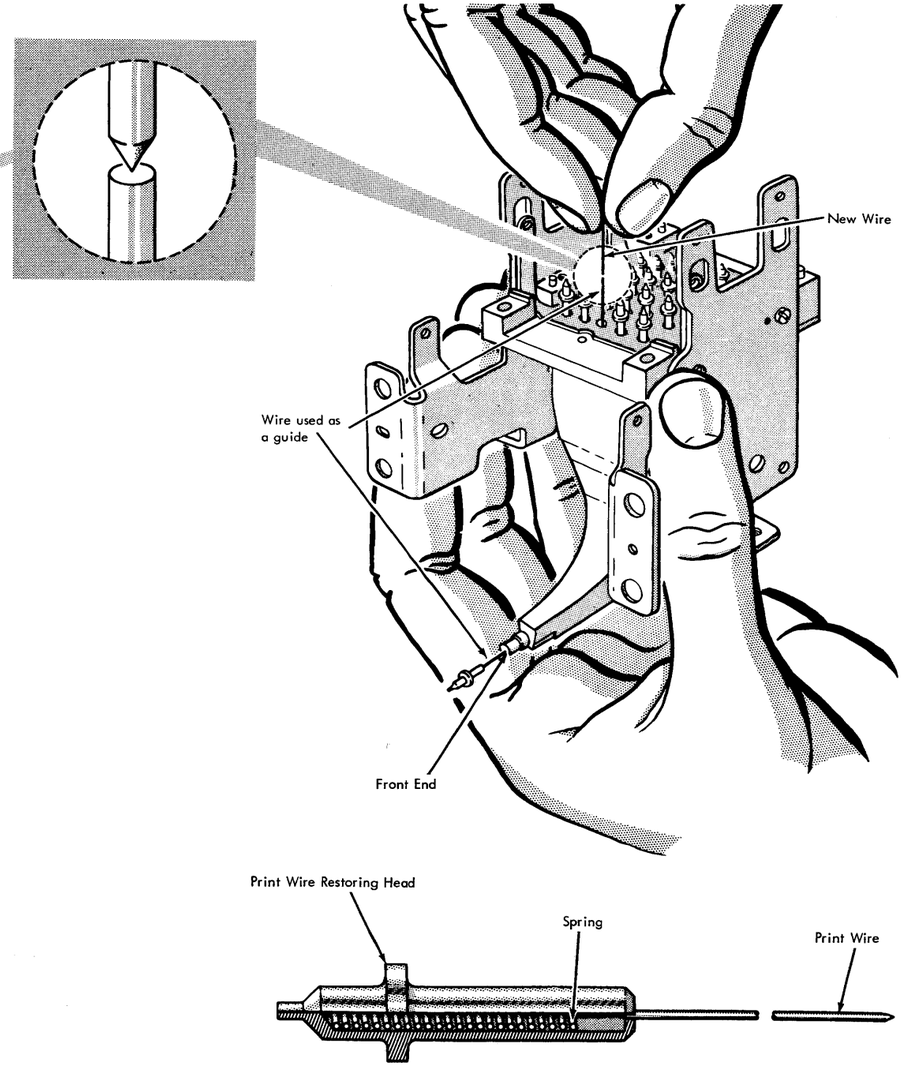
Single wires can be replaced. Be sure that the collar part of the wire, which extends through the guide plate, is the same size as the one being replaced.

CAUTION
Do not damage the cotton wick around the print wires. Damaging the wick may close the hole for the print wire, then it will not be possible to replace the print wire.

1. Remove print unit from machine and remove print wire unit.
2. Remove four holding screws and lift off rear-wire guide plate.
3. Pull out desired wire. Be sure to replace it in same position; all wires have different lengths. If print wire has been pulled out of its head, new wire may be inserted from front end and old wire may be pushed up enough to pull it out.

Note: Apply IBM #6 to any print wire before installing it in the print unit. Usually, a new wire can be installed without trouble by inserting it in the hole from which the old wire was removed. Stone the edge of a new wire lightly to remove any burrs. If the new wire cannot be easily inserted, insert another wire from the front end of the print unit and use that wire as a guide.

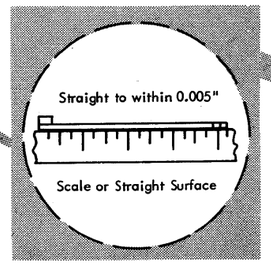
Reinstall the rear guide plate and pull the wires back against it. Cut off the end of the wire as close as possible to the wire guide and carefully stone it even with the other wires. Be careful not to point or bend the end of the wire. Oil the cotton wick with IBM #6.



Print Wire Replacement

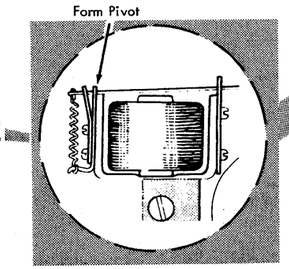
7.3 PRINT SUPPRESS MAGNET

When armature is placed on a straight surface, no point on armature should be more than 0.005 inch from straight surface. Form armature to obtain this tolerance.



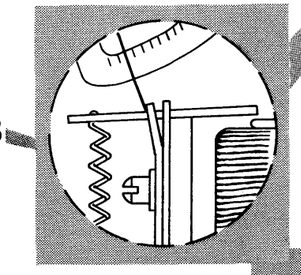
1

Adjust and form tips of armature pivot so that armature will be positioned squarely against both yokes.



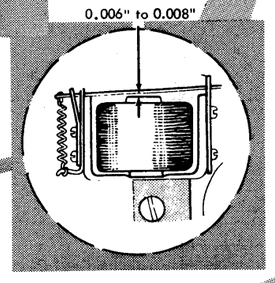
2

Form tips of armature return spring to require 60- to 100-gram pressure to move each tip from armature; sides must be within 10 grams of each other. Incorrect adjustment causes print suppression trouble.



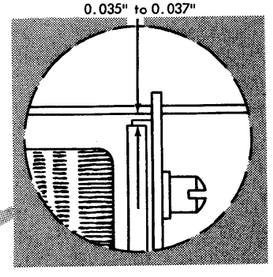
3

Add or remove shims (part 305271) between core and yoke to obtain 0.006- to 0.008-inch air space between armature and core when armature is in attracted position.

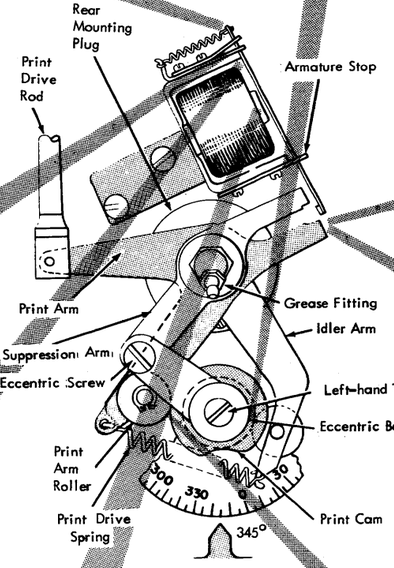


4

Adjust armature stop to obtain 0.035- to 0.037-inch air space between armature and residual with magnet deenergized. Armature must not touch side of stop.

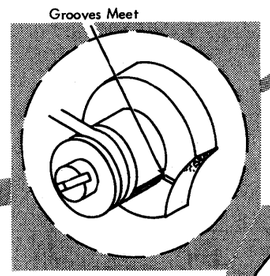


5



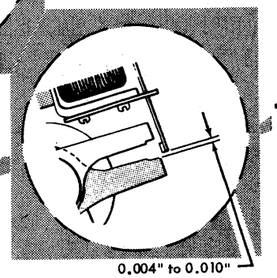
Print Suppress Magnet

With punch clutch latched, set eccentric bearing so that high side of bearing is aligned with V-groove on print cam.



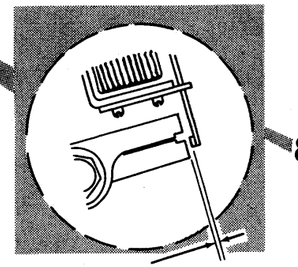
6

Attract armature and position magnet bracket so that armature interposer block clears side of print arm by 0.004 to 0.010 inch.



7

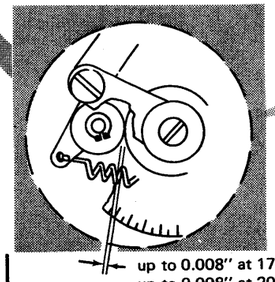
With armature deenergized, position magnet assembly so that armature interposer block clears both print arm and suppression arm by 0.001 to 0.010 inch with roller in low dwell of cam. (132° with plastic cam, 147° with metal cam).



0.001" to 0.010" at 147° metal cam
0.001" to 0.010" at 132° plastic cam

8

Adjust eccentric screw for up to 0.008 inch clearance between roller and plastic cam with punch index set to 175° (205° with metal cam). With armature in energized position, roller should not touch cam until 200° ± 20° plastic cam (205° to 230° with metal cam).



up to 0.008" at 175° plastic cam
up to 0.008" at 205° metal cam

9

Conversion Table	
Inches	Millimeters
0.001	0,03
0.004	0,10
0.005	0,13
0.006	0,15
0.008	0,20
0.010	0,25
0.035	0,89
0.037	0,94

7.4 PRINT MECHANISM OPERATION

The punch extensions on the printing card punch extend beyond the lower guide (A) to operate the print interposer mechanism. The punch extensions contain the interposer yokes, which operate the interposers. Each yoke is spring operated and positively restored, and can operate two interposers: one vertical and one horizontal.

In A, if the 5 interposer magnet is energized after the escapement, the punch bail causes the 5-punch operating arm to raise its punch. As the punch extension lifts, the yoke is forced to rise with it and to slide its print interposer up.

As the print interposer rises, the rollers on which it operates move the horizontal slide +3 (or 0.060 inch) toward the rear of the machine.

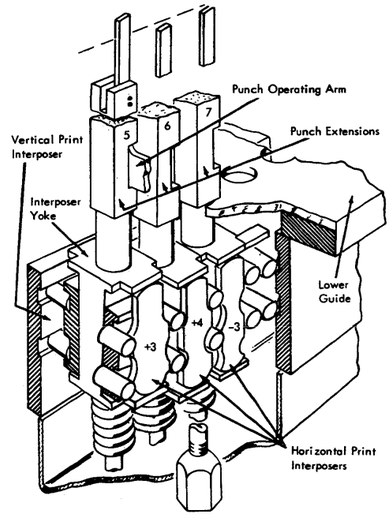
B shows that each roller in both sides of the interposer unit is under spring tension toward its stop (set by adjusting screws). All interposers with positive amounts are positively driven (by punch power) away from the fixed stop. Note that the 5-punch interposer positions the code plate only horizontally; there is no print interposer in the vertical slide assembly for the 5-punch.

For example, the punch code for P is 11-7. The 11-punch moves the code plate two units down (or 0.040 inch, B). The 7-punch also causes the code plate to move, but it positions the code plate three units (or 0.060 inch) to the left.

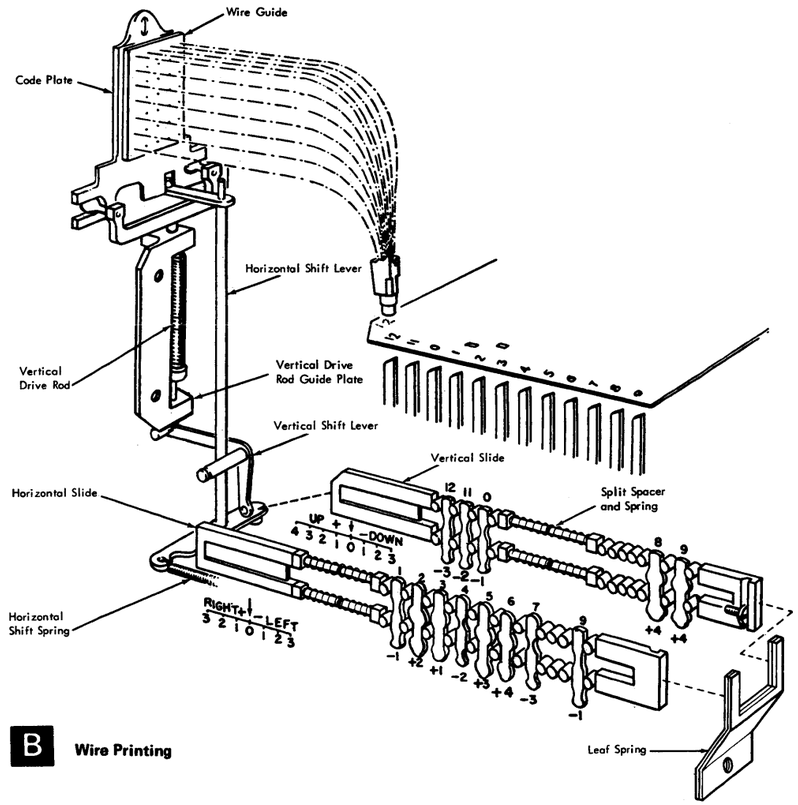
Note: The print wires are a nonmoving assembly. To print from a code plate projection on the left of its start position, the code plate must shift to the right. The same applies to vertical placement of code plate projections. B shows that the top print wires projecting from the code plate form the bottom of the printed letters. The bottom wires form the top of the letters.

C is a cutaway view of the upper left corner of the code plate, wire guide plate, and return plate. This section of the code plate prints a dot for each of the characters shown in the chart in C. The dot printed for any of the characters shown in the chart is the lowest left corner of the printed character on the card. The code plate is shown in its start position with the print wire restoring head aligned as in a spacing operation.

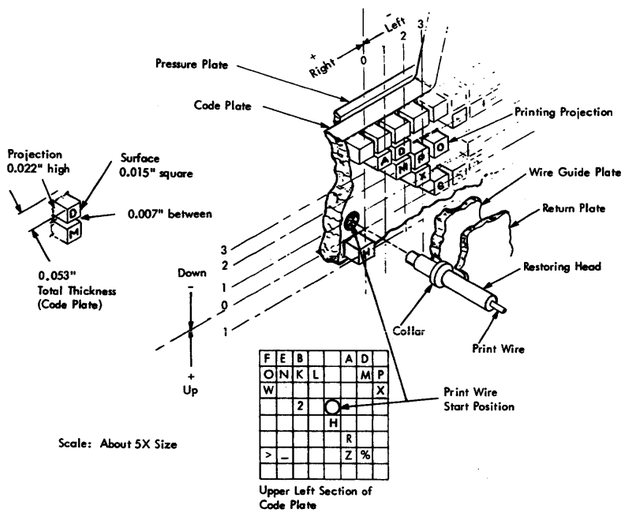
The 11-7 code results in a code plate shift of left 3 (–3 horizontal), down 2 (–2 vertical). The numbered lines in the enlarged view locate the center of the projections and the print wire start position. The 11-7 code shifts the code plate to strike the wire shown and to form the lowest point (dot) of the letter P.



A **Interposers**



B **Wire Printing**



C **Code Plate**

Conversion Table	
Inches	Millimeters
0.007	0,12
0.015	0,38
0.022	0,56
0.040	1,02
0.053	1,35
0.060	1,52

Through linkage with the print arm, the print cam allows the print arm spring to pull down on the print drive connecting link. This downward motion pivots the drive arms about their nonmoving shafts, and forces the pressure plate (D) and code plate against the print wires. The print cam positively restores the pressure plate.

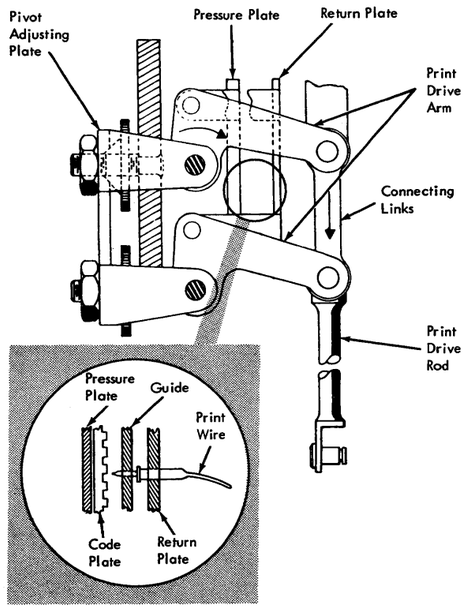
A return spring at the top of the code plate and two spring-driven pressure pins at the bottom drive the code plate away from the print wires. These springs make the code plate follow the pressure plate, but still allow the code plate to shift.

The print cam is on the punch shaft outside the punch index. The print arm and suppression arm are on the punch drive anchor pin extension, and the suppress magnet (E) is directly above.

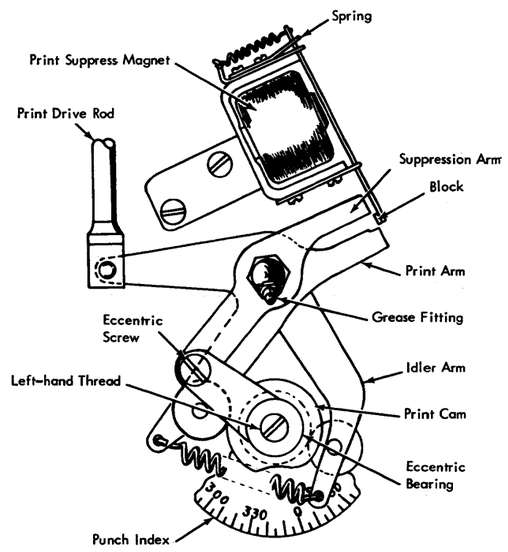
The print arm is spring operated and cam restored. To prevent printing, an interposer block on the print suppress magnet armature blocks the movement of the print arm. The print interposers continue to shift the code plate, but because the pressure plate is not operated, printing is suppressed. The idler arm equalizes the pressure on the punch shaft.

The print suppress arm is driven backward and forward by the eccentric drive link and eccentric bearing. The suppress arm moves the interposer block against the print arm, which lifts the print arm roller off the print cam. The suppress arm and linkage keep the print arm follower against the print cam (reducing noise and avoiding the need for a close clearance between the interposer block and the print arm).

The high-speed, print suppress magnet is under control of the print switch and decoding logic. The magnet armature travels at right angles to the yoke because of the suppress arm. A spring on the magnet yoke returns the armature against the stop.



D **Print Drive Rod and Pressure Plate**



E **Print Suppression**

7.5 PRINT TIMING

The diagram shows a print timing chart. The horizontal axis is measured in degrees of the punch drive unit index. The vertical axis represents thousandth-of-an-inch movement of the components that are called out.

The punch enters the card at 93° on the punch drive index and at this time has traveled about 0.125 inch from its restored position.

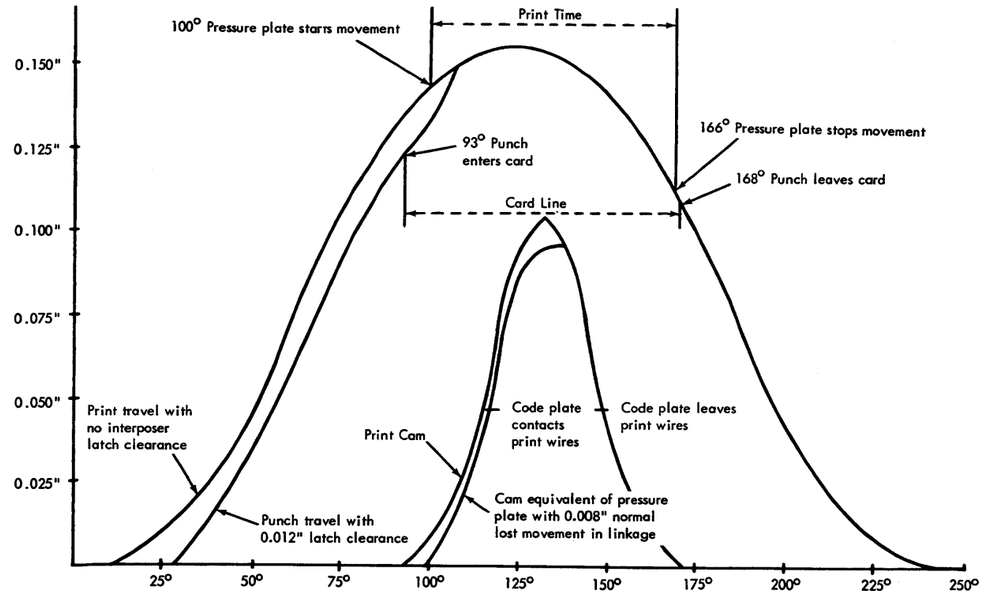
The pressure plate starts its movement at 100° and stops its movement at 166° of the punch cycle. During the 66° of the punch cycle that the pressure plate travels, it moves down toward the tips of the restoring heads about 0.100 inch.

The pressure plate forces the code plate down 0.050 inch before it contacts the print wires, the print wires are moved down 0.050 inch by the code plate, and the print wire movement occurs between about 115° and 150° of the punch cycle.

The horizontal and vertical interposers are positively restored and spring operated. The code plate is forced down toward the print wires by the pressure plate, and is restored along with the pressure plate.

The restoring heads rest on the return plate and the return plate is operated with the pressure plate. The print wires are restored by the return plate.

The cam follower on the print arm starts in the low dwell of the print cam at about 95° and is completely out of the low dwell at 170° of the punch cycle.



Print Timing Chart

Conversion Table	
Inches	Millimeters
0.008	0,20
0.012	0,30
0.025	0,64
0.050	1,27
0.075	1,91
0.100	2,54
0.125	3,18
0.150	3,81

8.1 POWER SUPPLY OPERATION

- Provides four dc and two ac voltages.
- Regulates all voltages with respect to changes in input but does not regulate them for all output conditions.

8.1.1 Power Supply

Power line filter capacitors are in the rear power on/off switch housing. If these filters are not good or incorrectly installed, machine failure may occur when other machines are switched on or off.

CAUTION
Coiling excess line cord in the base of the case will cause machine failures. Excess cord should be coiled outside the machine or cut to the correct length.

Note: Machine frame is at 0-volt level.

8.1.2 Power Supply and Line Switch

1. Disconnect line plug from its ac source.
2. Remove wires from TB2, TB1-3, and TB1-8, and cable from EC-1F, EC-2C, and EC-2E.
3. Remove the four screws from bottom of machine (and one screw inside chip box housing) that hold power supply to machine.
4. Loosen the two screws that mount CE line switch to the supply and place switch in assembly.
5. Turn supply 90° counterclockwise.
6. Tilt power supply by picking it up on right-hand side; remove the supply from the case.

To reassemble, reverse the procedure. Perform the light source (4.1.1) and stepping motor (5.3.1) service checks.

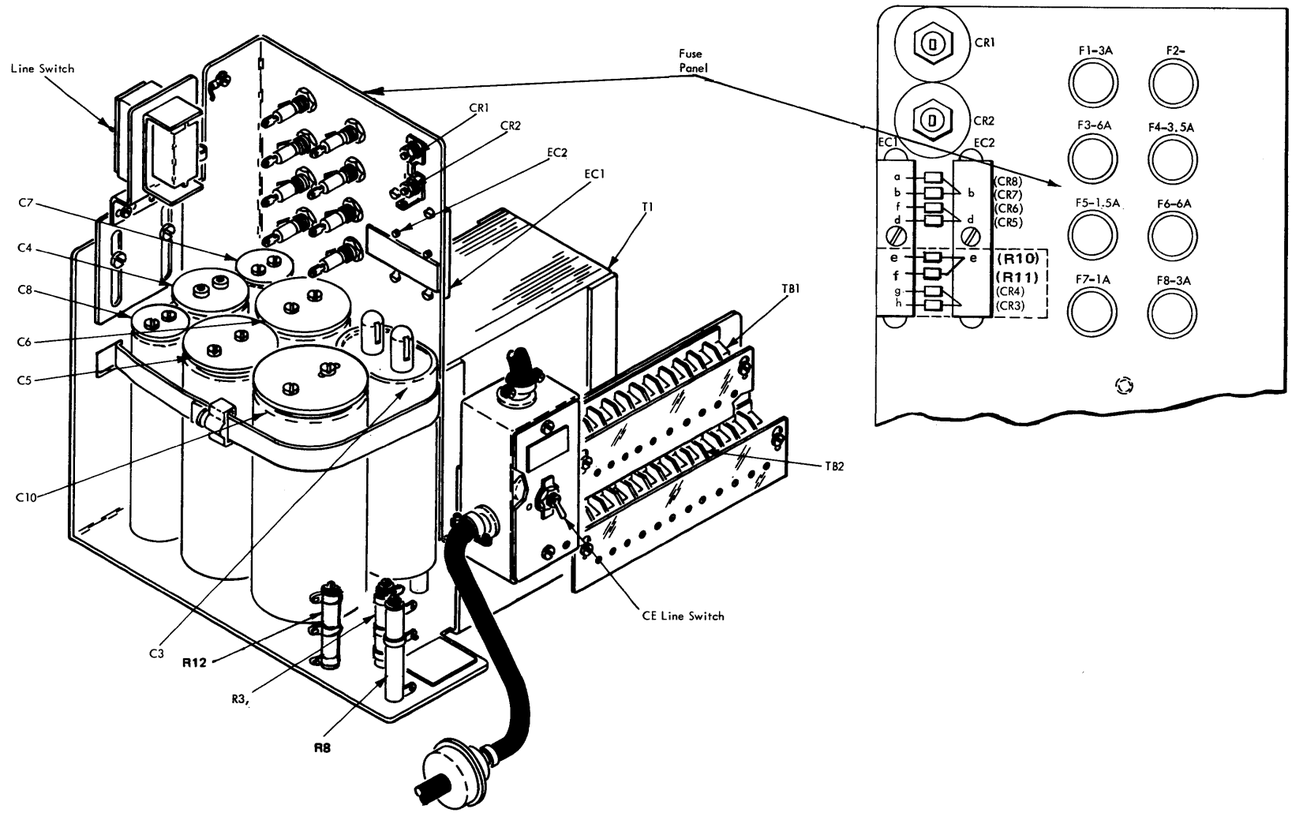
8.1.3 −11.1-volt Supply

The −11.1-volt buffer supply has a tolerance of 10.76 to 11.44 volts. The addition or removal of a pluggable feature card may cause the −11.1V dc supply to change by as much as 2 volts. The supply may be adjusted by:

1. Connecting a CE meter to H4D08 (positive lead) and to H4D13 (negative lead).

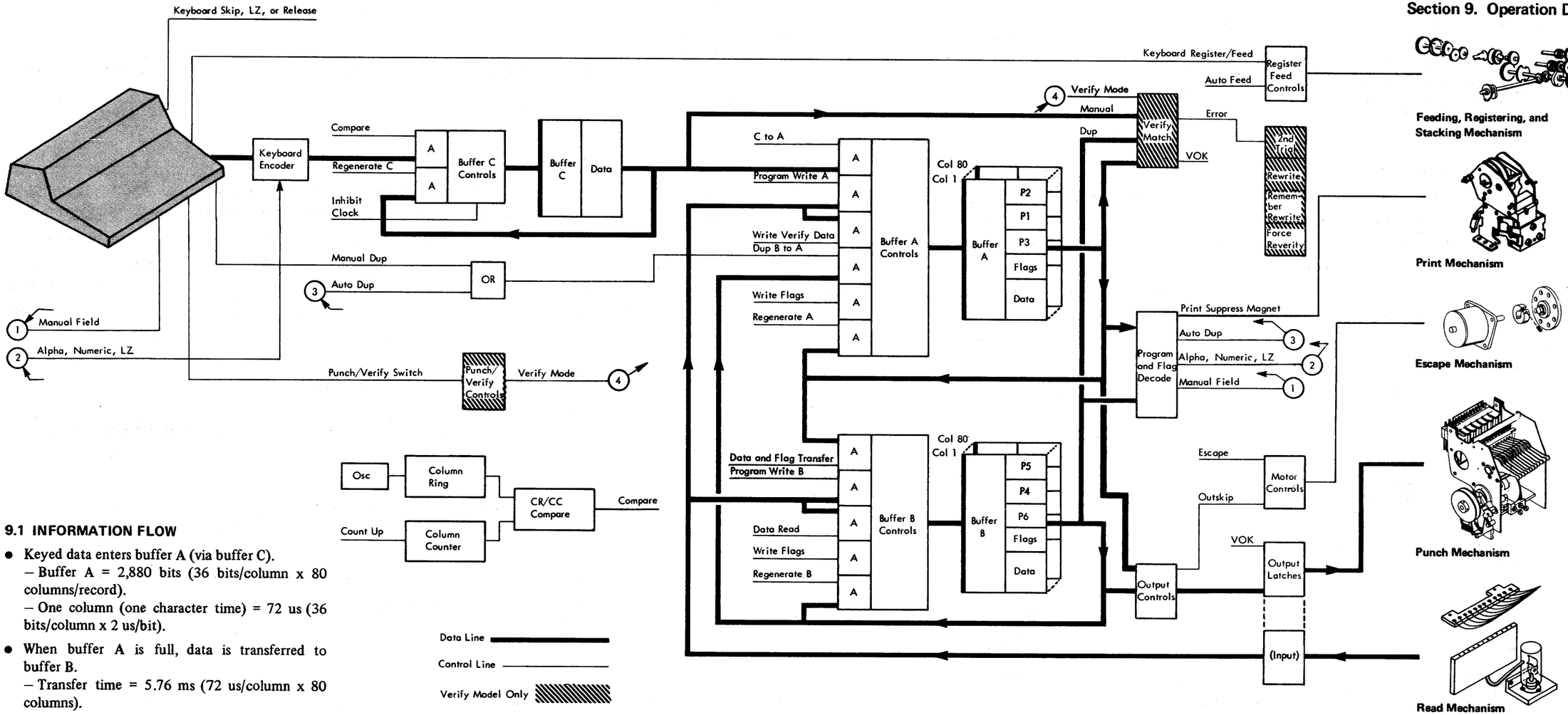
   CAUTION
   Do not use meter clips on SLT pins; use only the SLT probe tip when metering from an SLT pin. Be careful not to ground or short pins together.

2. Adjusting R8 to obtain an 11.1-volt indication on the meter.



Fuse	Rating	Description
F1	3A	+48V dc
F2	8A	100 to 115V ac Line Fuse
	6A	200 to 230V ac Line Fuse
F3	6A	+6V dc
F4	3.5A	Motor Fuse
F5	1.5A	2.2V ac
F6	6A	5V ac and 6V ac
F7	1A	−11.1V dc
F8	3A	+18V dc Stepping Motor

PWR



9.1 INFORMATION FLOW

- Keyed data enters buffer A (via buffer C).
  – Buffer A = 2,880 bits (36 bits/column x 80 columns/record).
  – One column (one character time) = 72 us (36 bits/column x 2 us/bit).
- When buffer A is full, data is transferred to buffer B.
  – Transfer time = 5.76 ms (72 us/column x 80 columns).
- Buffer B controls punchout.
  – Buffer B = 2,880 bits.
- Buffer C = 960 bits.
  – Provides path to buffer A for keyboard data.
  – Buffer C cycles three times for each buffer A cycle (960 bits = 1/3 buffer A bits).
  – Buffer C is used mainly for left-zero operation.
- All buffer storage is provided by field effect transistors (FETs).
  – Two records may be stored at one time: one in buffer A and one in buffer B.
  – While record in buffer B is being punched out, operator may key data into buffer A (if not presently filled).

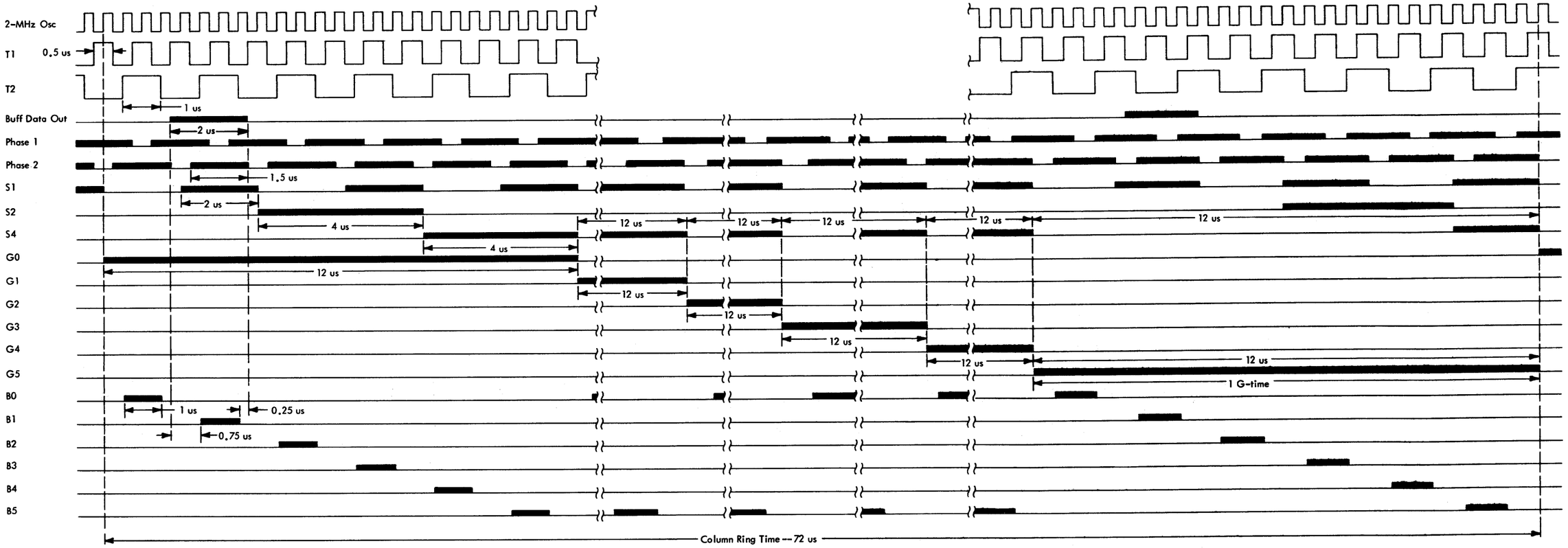
Gate	Pulse	Buffer A	Buffer B	Hollerith Code
G0	B0	Field Definition	Field Definition	12
	B1	Auto Skip — Program Level — 2	Auto Skip — Program Level — 5	11
	B2	Auto Dup	Auto Dup	0
	B3	Alpha Shift	Alpha Shift	1
	B4	Self-check	Self-check	2
	B5	Left Zero	Left Zero	3
G1	B0	Field Definition	Field Definition	12
	B1	Auto Skip — Program Level — 1	Auto Skip — Program Level — 4	11
	B2	Auto Dup	Auto Dup	0
	B3	Alpha Shift	Alpha Shift	1
	B4	Self-check	Self-check	2
	B5	Left Zero	Left Zero	3
G2	B0	Field Definition	Field Definition	12
	B1	Auto Skip — Program Level — 3	Auto Skip — Program Level — 6	11
	B2	Auto Dup	Auto Dup	0
	B3	Alpha Shift	Alpha Shift	1
	B4	Self-check	Self-check	2
	B5	Left Zero	Left Zero	3

Gate	Pulse	Buffer A	Buffer B	Hollerith Code
G3	B0	Punch	Punch	Control Flags
	B1	Print Suppress	Print Suppress	
	B2	High-order Print Suppress	High-order Print Suppress	
	B3	Left Zero	Read	
	B4	Keyboard Space		
	B5			
G4	B0	Data Bit 12	Data Bit 12	12
	B1	Data Bit 11	Data Bit 11	11
	B2	Data Bit 0	Data Bit 0	0
	B3	Data Bit 1	Data Bit 1	1
	B4	Data Bit 2	Data Bit 2	2
	B5	Data Bit 3	Data Bit 3	3
G5	B0	Data Bit 4	Data Bit 4	4
	B1	Data Bit 5	Data Bit 5	5
	B2	Data Bit 6	Data Bit 6	6
	B3	Data Bit 7	Data Bit 7	7
	B4	Data Bit 8	Data Bit 8	8
	B5	Data Bit 9	Data Bit 9	9

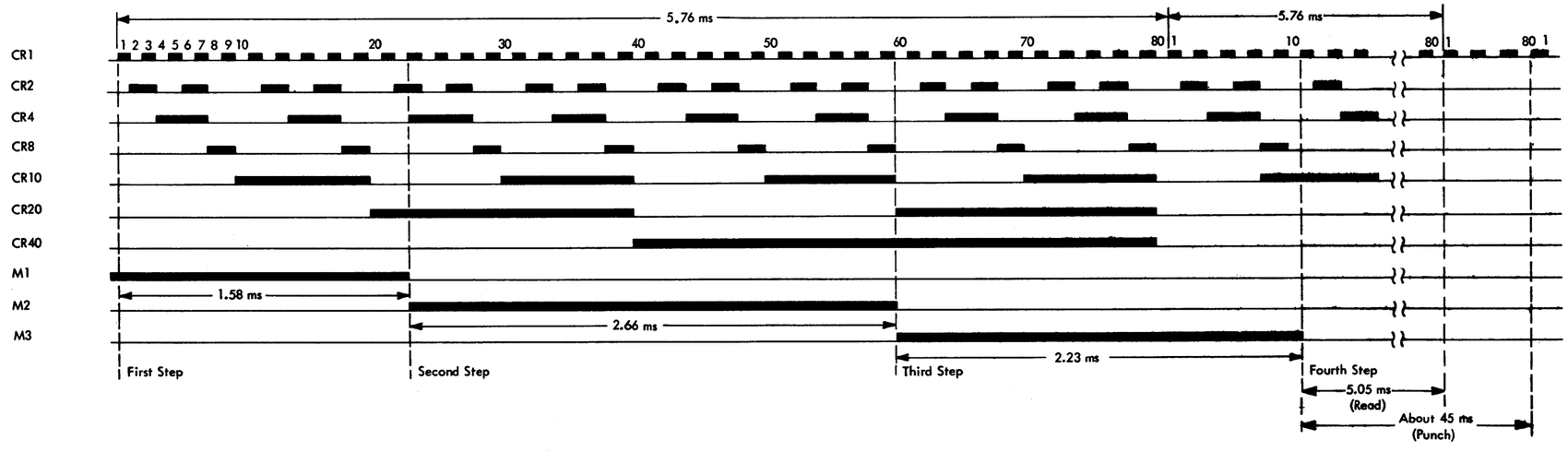
OPER DIAG

9.2 MACHINE TIMINGS

9.2.1 Basic Machine



9.2.2 Basic Motor



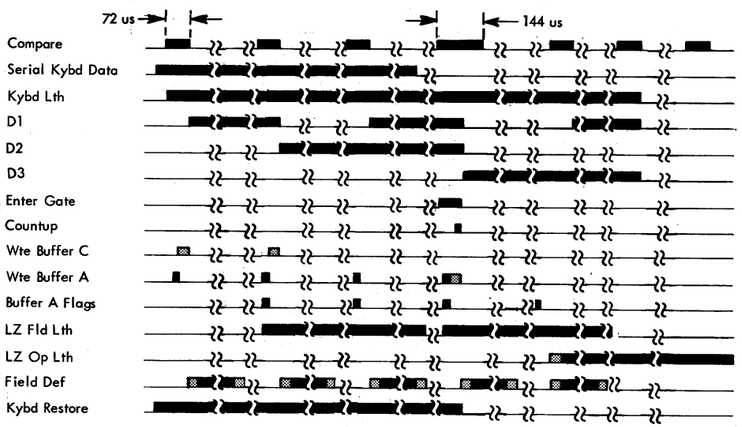
9.3 MANUAL DATA ENTRY (PUNCH MODE)

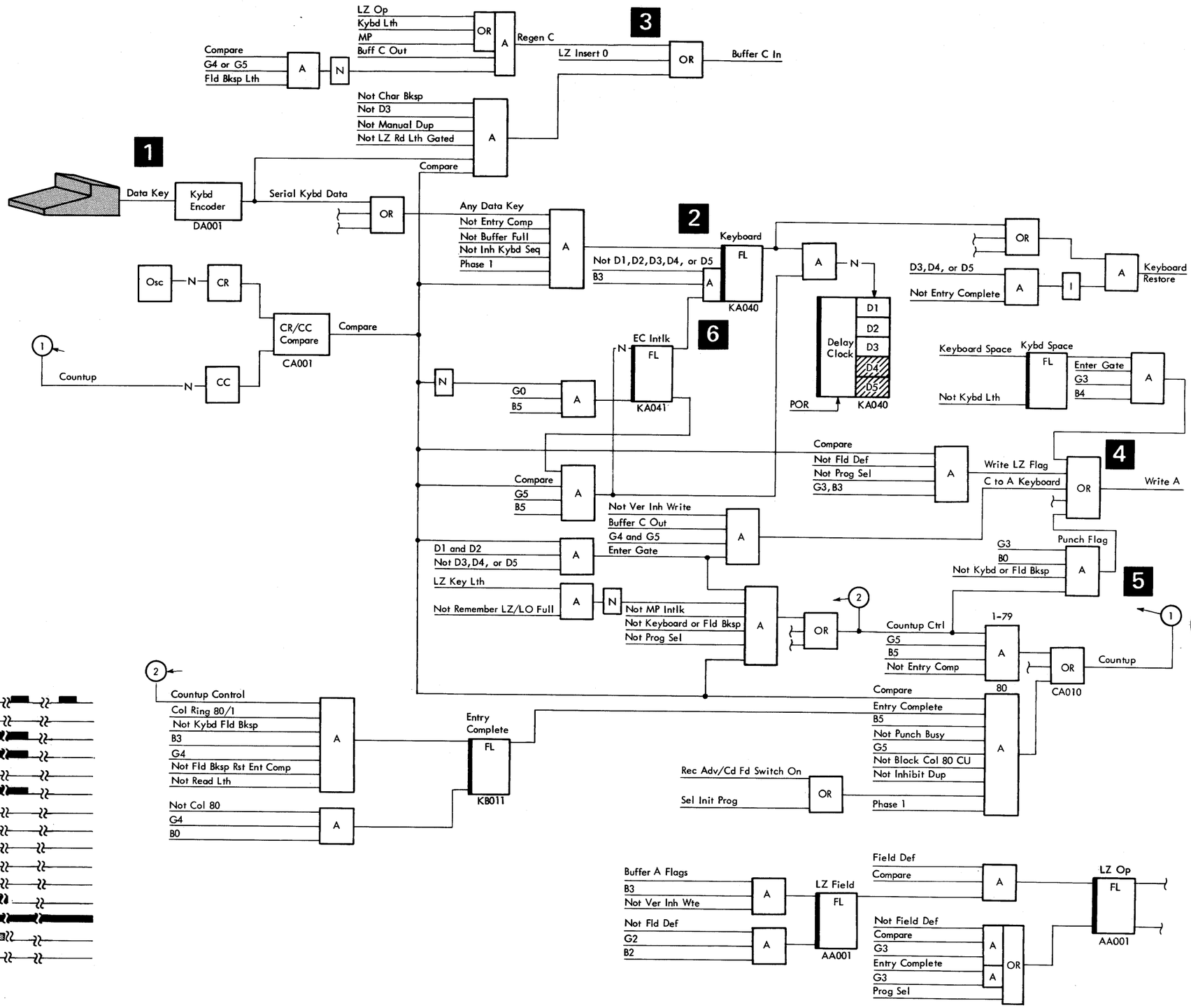
Pressing a data key in a manual field causes that character to be encoded and written in buffer C. When the column ring and the column counter are equal at enter gate time, the data in buffer C is transferred to buffer A. The keyboard is restored and the next character may be entered.

Circuit Objectives

1. Press a data key and encode the character.
2. Set the keyboard latch; start the delay clock at the fall of compare and start a keyboard restore cycle.
3. Write the keyboard data in buffer C.
4. Transfer data in buffer C to buffer A and write a punch flag in buffer A.
5. Advance the column counter.
6. Reset the keyboard latch.

Every manual field is a possible left-zero or blank-column fill field. Entering a manual field (compare and not field definition) causes an LZ flag to be written in the first column of the field (in buffer A). This flag sets the LZ field and the LZ operation latches. The LZ field latch goes on and off to mark the length of the field. The LZ operation latch causes all data to be regenerated in buffer C; the shift operation occurs in buffer C and the data must be retained. The LZ operation latch remains on until the next field is entered for manual keying or for an auto operation. The LZ shift or blank columns shift is started by pressing the BLANK COLUMNS/LEFT ZERO CTRL key; see Section 9.4.





9.4 BLANK COLUMNS/LEFT-ZERO SHIFT (PUNCH MODE)

A character must be manually entered in a field before pressing the BLANK COLUMNS/LEFT ZERO CTRL key. Pressing this key causes the manually entered data to be shifted to the right of the field, and spaces (alpha shift) or 0's (numeric shift) to be inserted to the left of the manually entered data.

Example: In a five-column manual numeric field, 753 is manually entered as data. The BLANK COLUMNS/LEFT ZERO CTRL key is pressed. The data is shifted to the right and the 0's are inserted to the left. The result is 00753 when punching out.

Pressing the –LZ key in a numeric field causes a normal LZ shift operation, except that an 11 and the units digit are simultaneously punched in the units position of the field.

Circuit Objectives

1. At least one manually entered character must be in the field before pressing the BLANK COLUMNS/LEFT ZERO CTRL key.

   Note: When the field was entered, the LZ operation latch came on.

2. Press the BLANK COLUMNS/LEFT ZERO CTRL key; set the LZ key latch.

3. Set the keyboard latch; start the delay clock and a keyboard restore cycle.

4. Detect the LZ flag in buffer A (in the high order position of the field) and set the LZ field latch.

5. At enter gate time, inhibit the buffer C clock for one data column (72 microseconds).

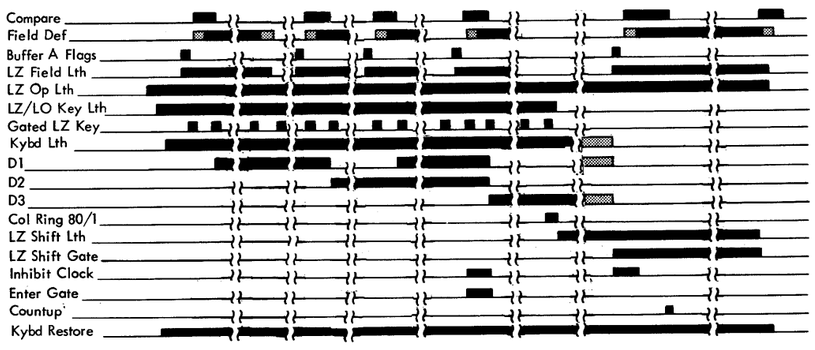
6. Set the LZ shift latch at the next column ring 80/1 and D3 clock pulse; hold the keyboard restored.

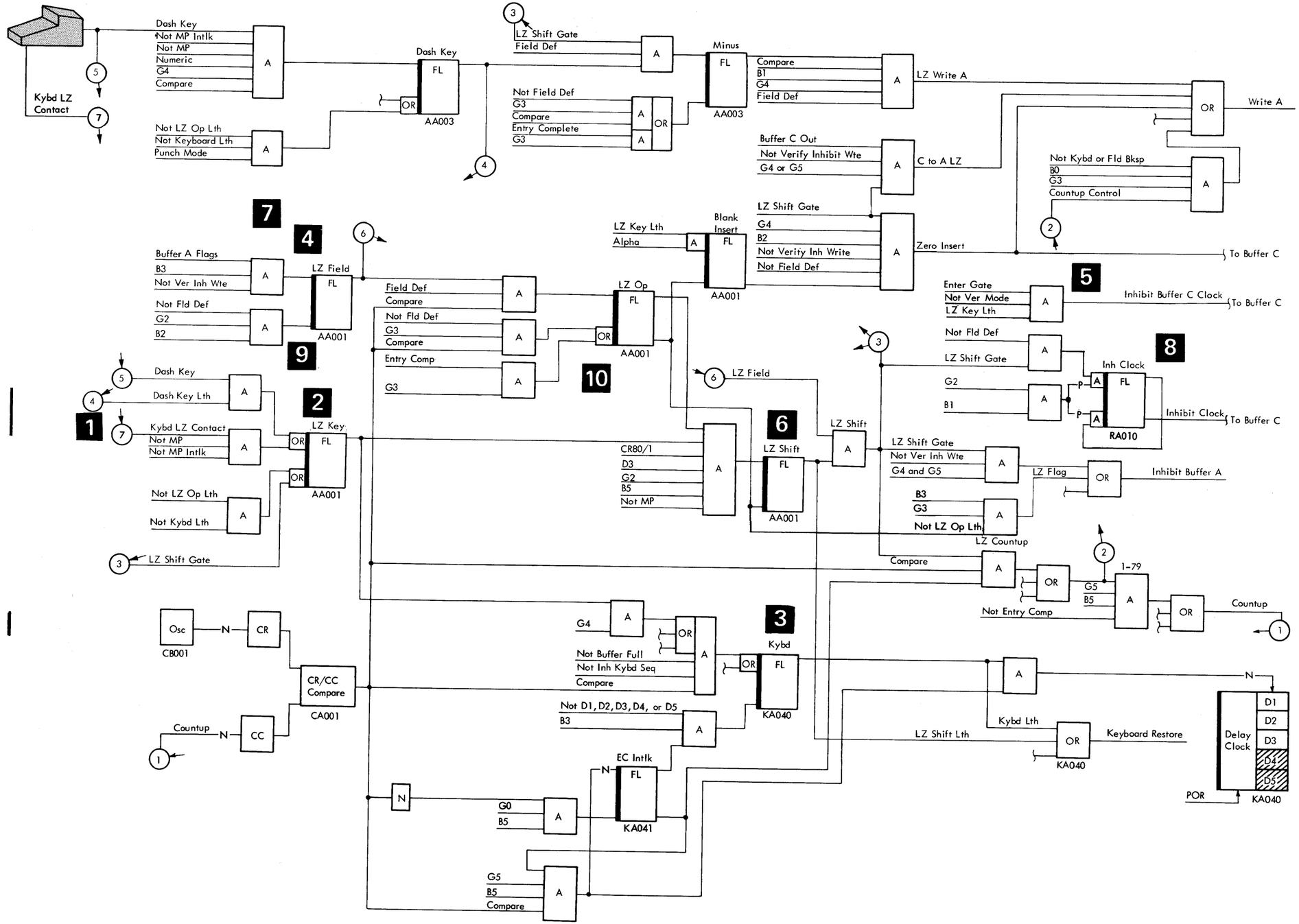
7. Detect the LZ flag and set the LZ field latch; reset the LZ key latch. LZ shift gate comes on at this time and inserts a 0 or blank in the first column of the field. LZ shift gate also transfers the field from buffer C to buffer A. The column counter is advanced at compare time and a punch flag is written in buffer A.

8. At the trailing edge of G2B1 and LZ shift gate, set the inhibit clock latch and inhibit the advance of buffer C of one data column (72 microseconds). Reset the inhibit clock latch.

9. Reset the LZ field latch at the drop of field definition. Repeat steps 6 through 9 until the start of the next field (compare and not field definition) is detected.

10. Reset the LZ operation and LZ shift latches. Restore the keyboard.




Dash Key
Not MP Intlk
Not MP
Numeric
G4
Compare
Kybd LZ Contact
Not LZ Op Lth
Not Keyboard Lth
Punch Mode
Dash Key
OR
AA003
LZ Shift Gate
Field Def
Not Field Def
G3
Compare
Entry Complete
Minus
AA003
Compare
B1
G4
Field Def
LZ Write A
Buffer C Out
Not Verify Inhibit Wte
G4 or G5
C to A LZ
OR
Write A
Not Kybd or Fld Bksp
B0
G3
Countup Control
LZ Shift Gate
G4
B2
Not Verity Inh Write
Not Field Def
Zero Insert
To Buffer C
LZ Key Lth
Alpha
Blank Insert
AA001
Enter Gate
Not Ver Mode
LZ Key Lth
Inhibit Buffer C Clock
To Buffer C
Buffer A Flags
B3
Not Ver Inh Wte
Not Fld Def
G2
B2
LZ Field
AA001
Field Def
Compare
Not Fld Def
G3
Compare
Entry Comp
G3
LZ Op
AA001
Not Fld Def
LZ Shift Gate
G2
B1
Inh Clock
RA010
Inhibit Clock
To Buffer C
Dash Key
Dash Key Lth
Kybd LZ Contact
Not MP
Not MP Intlk
LZ Key
AA001
Not LZ Op Lth
Not Kybd Lth
LZ Shift Gate
CR80/1
D3
G2
B5
Not MP
LZ Shift
FL
AA001
LZ Shift
LZ Shift Gate
Not Ver Inh Wte
G4 and G5
LZ Flag
OR
Inhibit Buffer A
B3
G3
Not LZ Op Lth
LZ Countup
Compare
OR
G5
B5
1-79
Not Entry Comp
OR
Countup
Osc
CB001
CR
CR/CC Compare
CA001
Countup
CC
G4
Not Buffer Full
Not Inh Kybd Seq
Compare
OR
Kybd
KA040
Not D1, D2, D3, D4, or D5
B3
EC Intlk
KA041
G0
B5
G5
B5
Compare
LZ Shift Lth
Kybd Lth
OR
Keyboard Restore
KA040
Delay Clock
D1
D2
D3
D4
D5
POR
KA040

9.5 MANUAL AND AUTO DUP (PUNCH MODE)

Pressing the DUP key or decoding an auto dup field in the program causes data to be transferred from buffer B to buffer A. The data in buffer B is regenerated because it may still be needed for punching out the card.

Field length is controlled by field definition.

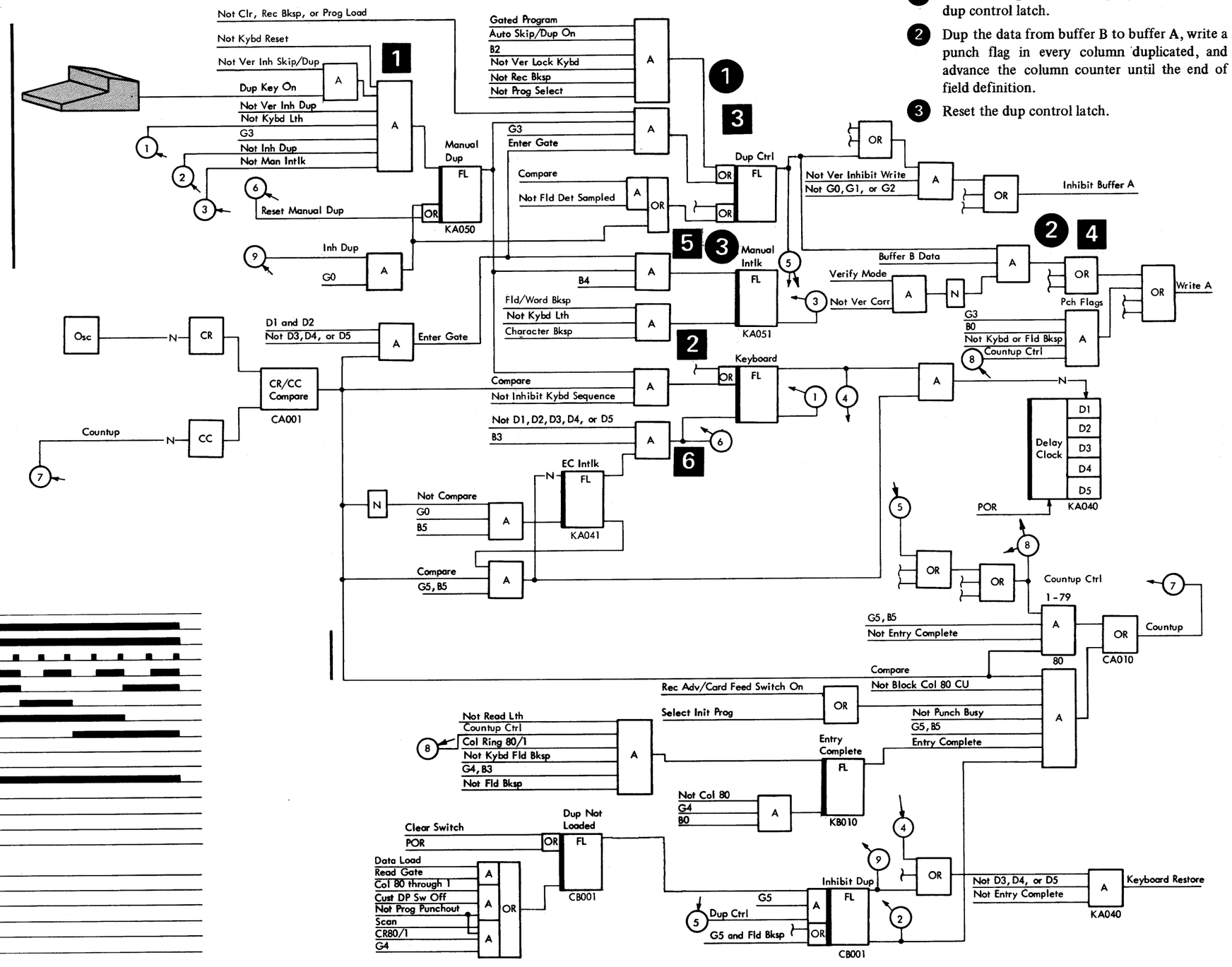
Dup information must be manually keyed or a data card must be read into storage after a power-on reset or a clear operation (setting the dup not loaded latch).

Circuit Objectives—Manual Dup

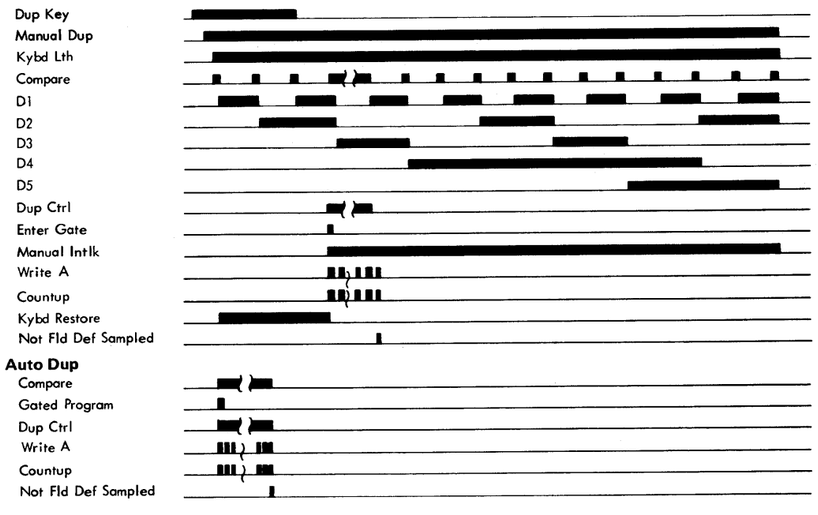
1. Press the DUP key and set the manual dup latch.
2. Set the keyboard latch and start the delay clock. D4 and D5 are allowed to become active in manual dup operation. This keeps the keyboard latch active until the drop of D5. The keyboard latch keeps the manual interlock latch active.
3. Set the dup control latch.
4. Dup the data from buffer B to buffer A, write a punch flag in every column duplicated, and advance the column counter.
5. Reset the dup control latch at the end of field definition.
6. Reset the manual dup and keyboard latches at the end of the delay clock cycle.

Circuit Objectives—Auto Dup

1. Detect a dup field in the program and set the dup control latch.
2. Dup the data from buffer B to buffer A, write a punch flag in every column duplicated, and advance the column counter until the end of field definition.
3. Reset the dup control latch.



Manual Dup



Auto Dup

9.6 MANUAL AND AUTO SKIP (PUNCH MODE)

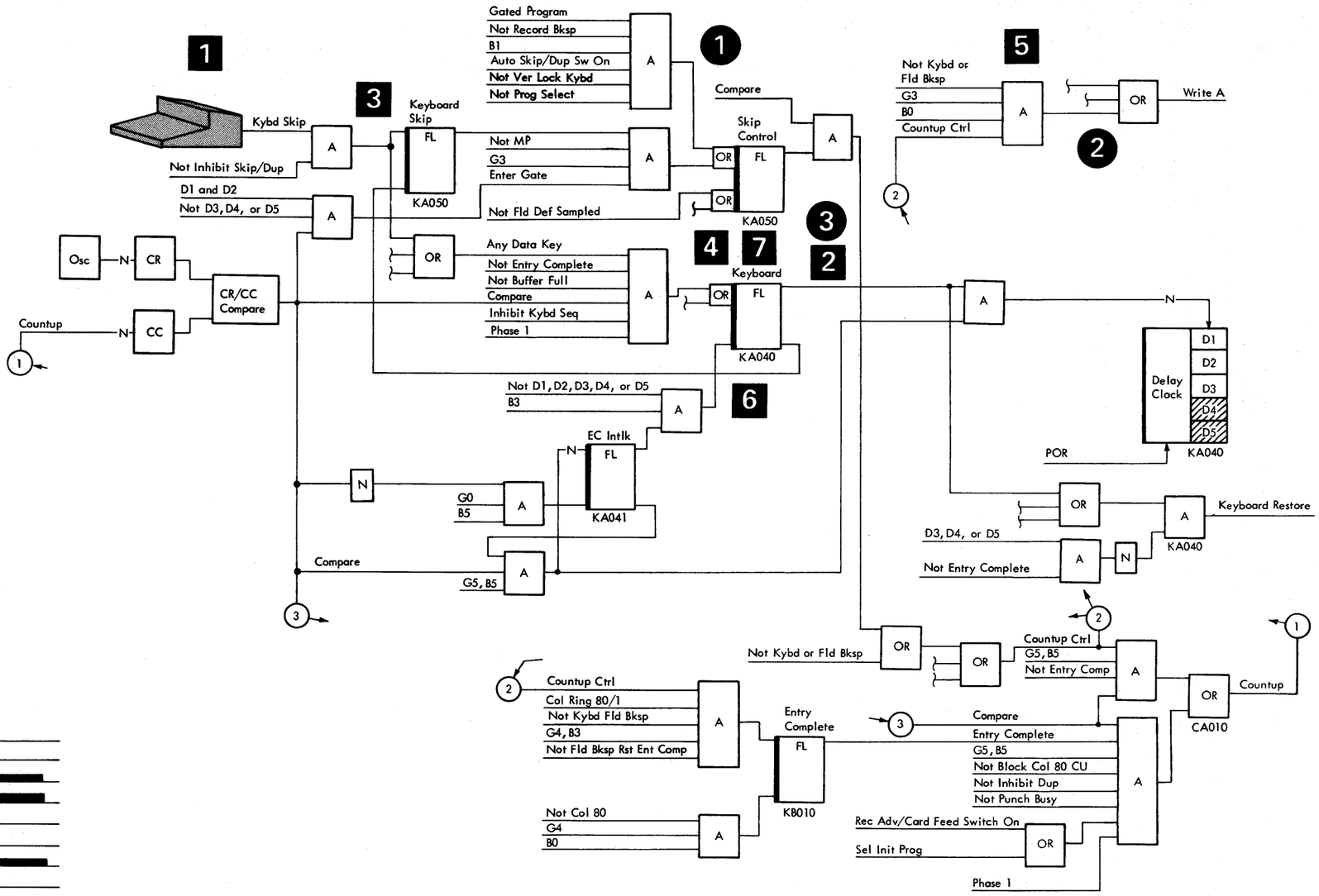
Pressing the SKIP key or detecting a skip field in the program causes *punch* flags to be written in storage for as long as the skip control latch is active. Detecting the end of field definition turns the skip control latch off.

Circuit Objectives–Manual Skip

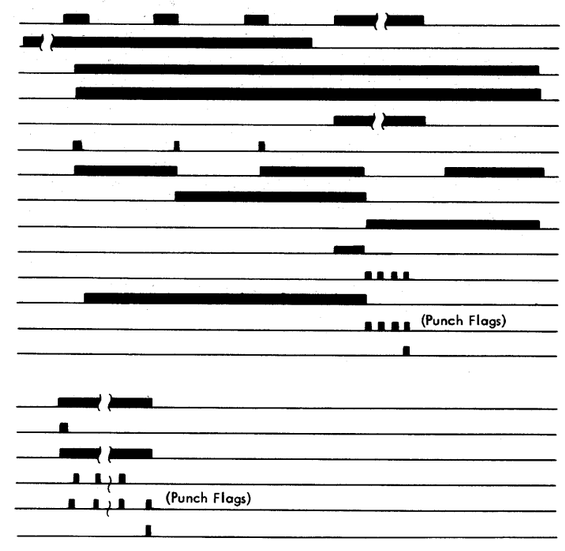
1. Press the SKIP key.
2. Set the keyboard latch at compare time; start the delay clock and a keyboard restore cycle.
3. Set the keyboard skip latch.
4. Set the skip control latch at enter gate time.
5. Write the punch flags and count up every compare time until the end of field definition.
6. Reset the restore circuit at the end of D2. Reset the keyboard and keyboard skip latches.
7. Reset the skip control latch when the end of field definition is detected.

Circuit Objectives–Auto Skip

1. Detect the skip field in the program; set the skip control latch.
2. Write the punch flags and count up every compare time until the end of field definition.
3. Reset the skip control latch when the end of field definition is detected.



Manual Skip



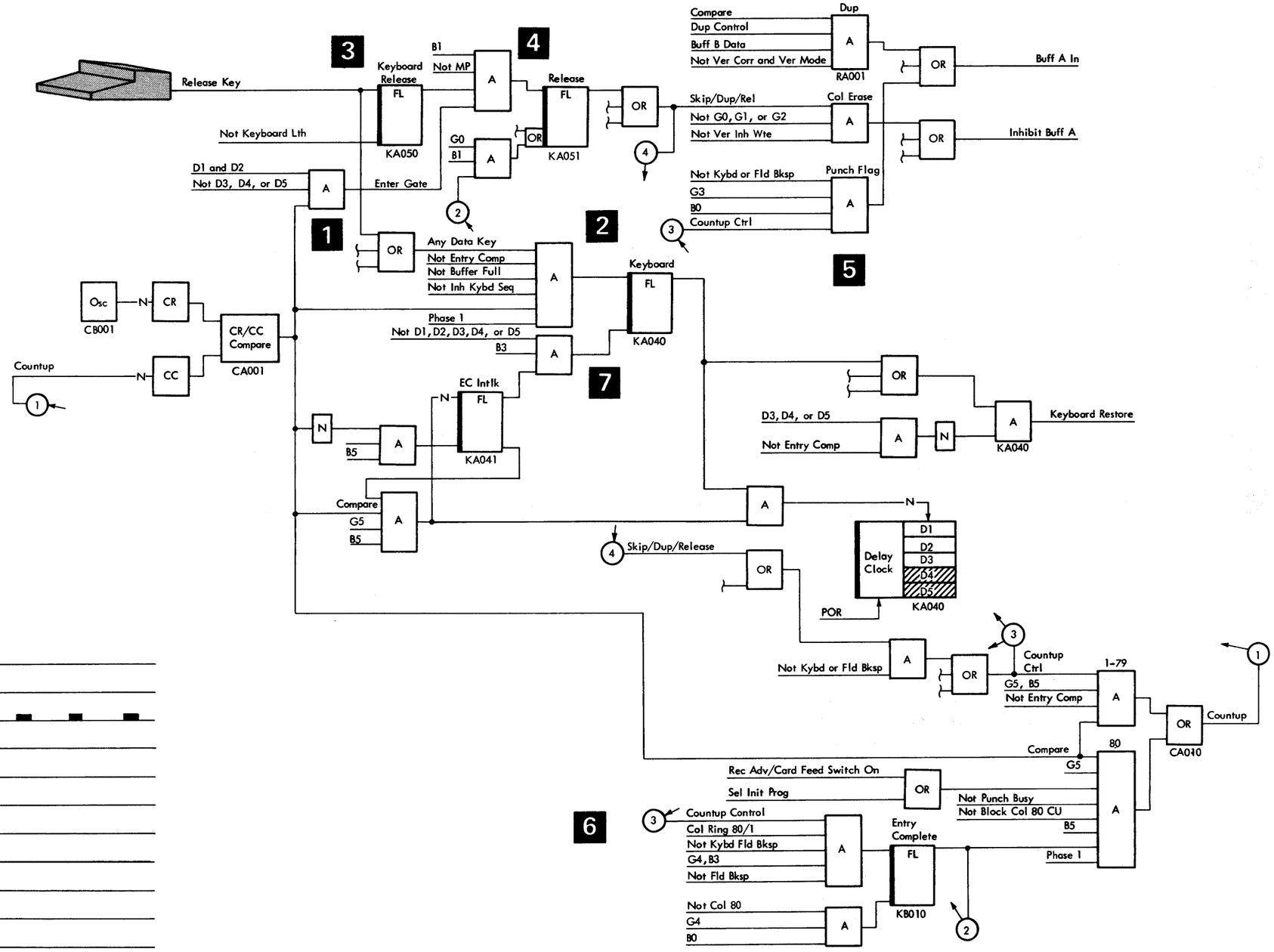
Auto Skip

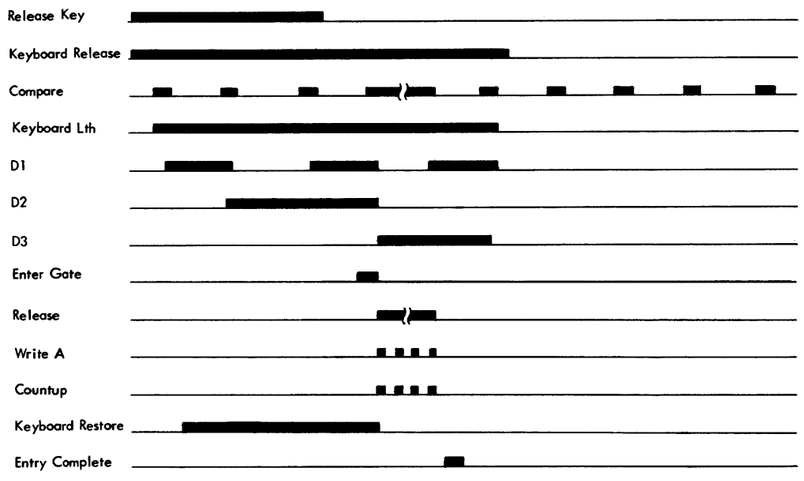
9.7 KEYBOARD RELEASE (PUNCH MODE)

When the REL key is pressed, the column counter advances and punch flags are written in storage for the remainder of the record. When the AUTO SKIP/DUP switch is set to ON, auto dup fields are duplicated. When column 80 countup is generated, the release latch is reset and the data and/or punch flags in buffer A are transferred to buffer B.

Circuit Objectives

1. Press the REL key and activate the any data key line.
2. Set the keyboard latch; start the delay clock at the drop of compare and start a keyboard restore cycle.
3. Set the keyboard release latch.
4. Set the release latch at enter gate time. This latch erases data in buffer A.
5. Advance the column counter. Write the punch flags in buffer A for as long as the release latch is active.
6. At column ring 80/1 time and countup control, set the entry complete latch; reset the release latch.
7. Reset the keyboard and keyboard release latches.





9.8 BACKSPACE

9.8.1 Field

Pressing the FIELD BKSP key in a field causes the column counter to be returned to the starting point of that field. This is accomplished by advancing the column counter 79 times for each position of the field to be backspaced. If the FIELD BKSP key is pressed at the starting point of a field, the column counter is returned to the starting point of the preceding manual field, bypassing auto dup or skip fields if the AUTO SKIP/DUP switch is ON.

Circuit Objectives

1. Press the FIELD BKSP key; set the keyboard field backspace latch.
2. Set the keyboard latch; start the delay clock and a keyboard restore cycle.
3. Set the field backspace latch.
4. At enter gate time, reset the keyboard field backspace latch.
5. At compare time, set the countdown latch.
6. Set the CC minus 1 latch. Reset the countdown latch and gate 79 phase 1 pulses to the column counter, suppressing compares. Reset the CC minus 1 latch; repeat steps 5 and 6 until no field definition is sampled.
7. When no field definition is sampled, set the stop latch. Reset the field backspace and keyboard latches.
8. Reset the stop latch.

Note: Regeneration of data in buffer A is inhibited at each compare time during a backspace operation.

9.8.2 Word

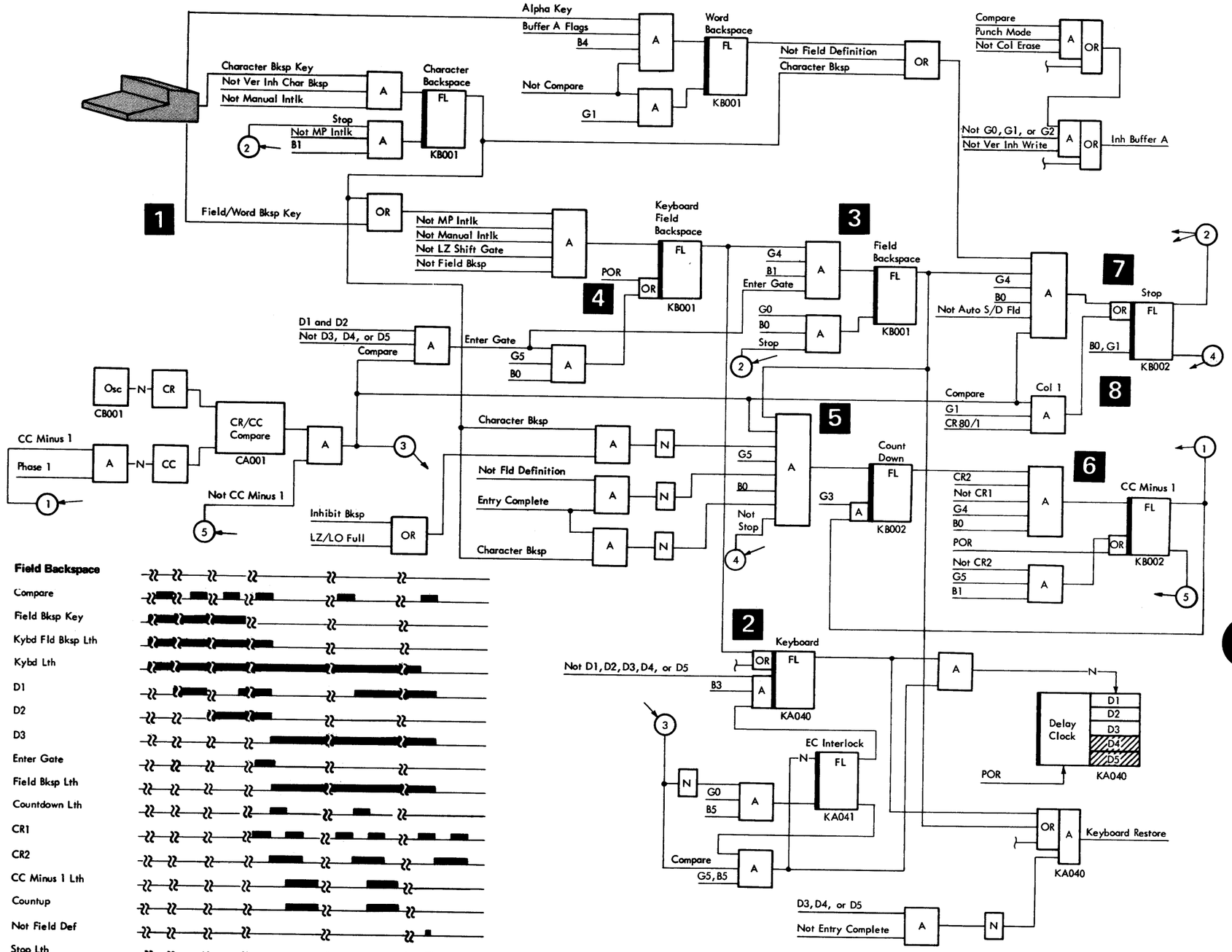
The word backspace operation is similar to a field backspace operation, except that a buffer A keyboard space flag also resets the operation and the ALPHA key must be held down setting the word backspace latch. Should the end of the field definition be detected before a keyboard space flag, the operation is reset.

9.8.3 Character

Pressing the CHAR BKSP key advances the column counter 79 times and, in effect, backspaces one character, bypassing the auto fields.

9.8.4 Record

Pressing the REC BKSP pushbutton sets the CC1 latch on and sets all the remaining column counter latches off.



9.9 PROGRAM/DATA LOAD

Pressing the READ pushbutton with a data or program card at the pre-register position registers the card and writes the read flags in buffer B. Because the card is registered with column 2 positioned under the read photocells, the card must be moved back one column. When the backup is complete, the first column is read and stored in the output latches.

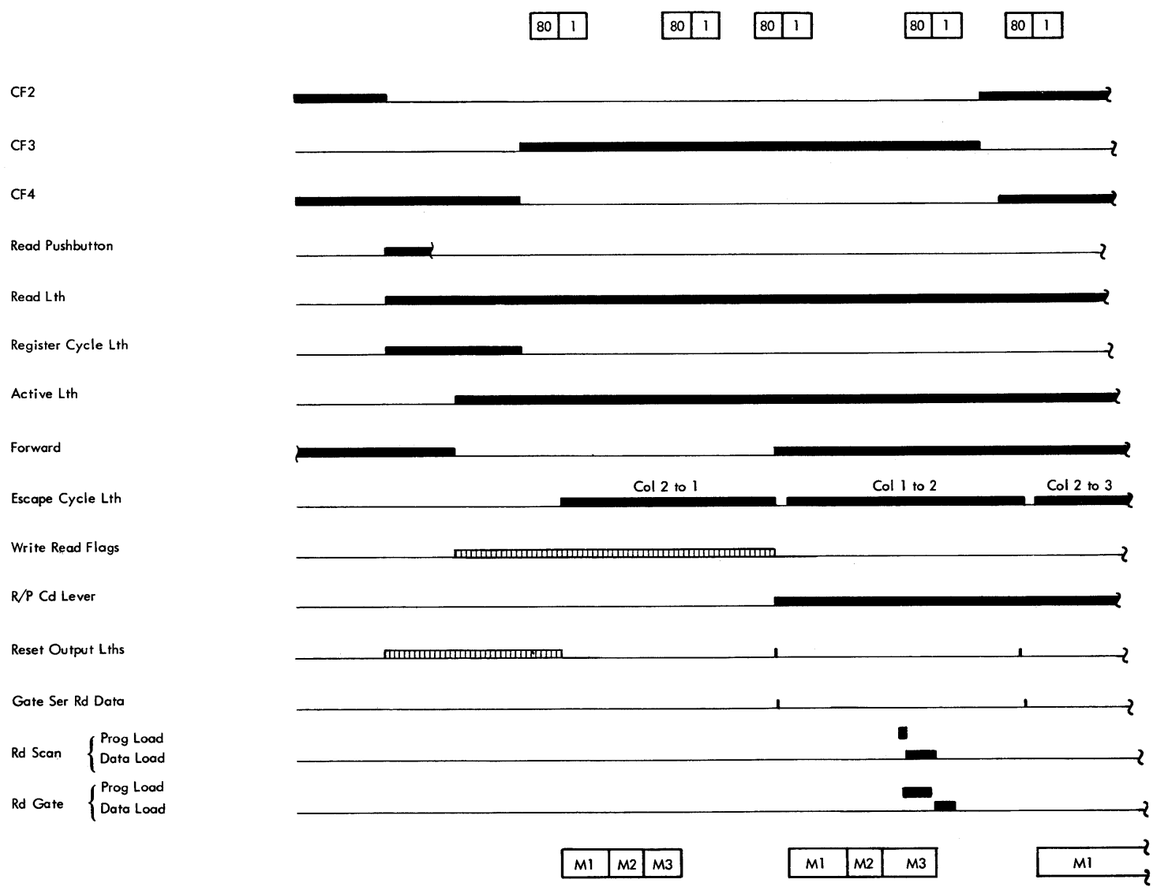
The card is then advanced to the next column and, as the card is advancing, the information in the output latches is gated into storage.

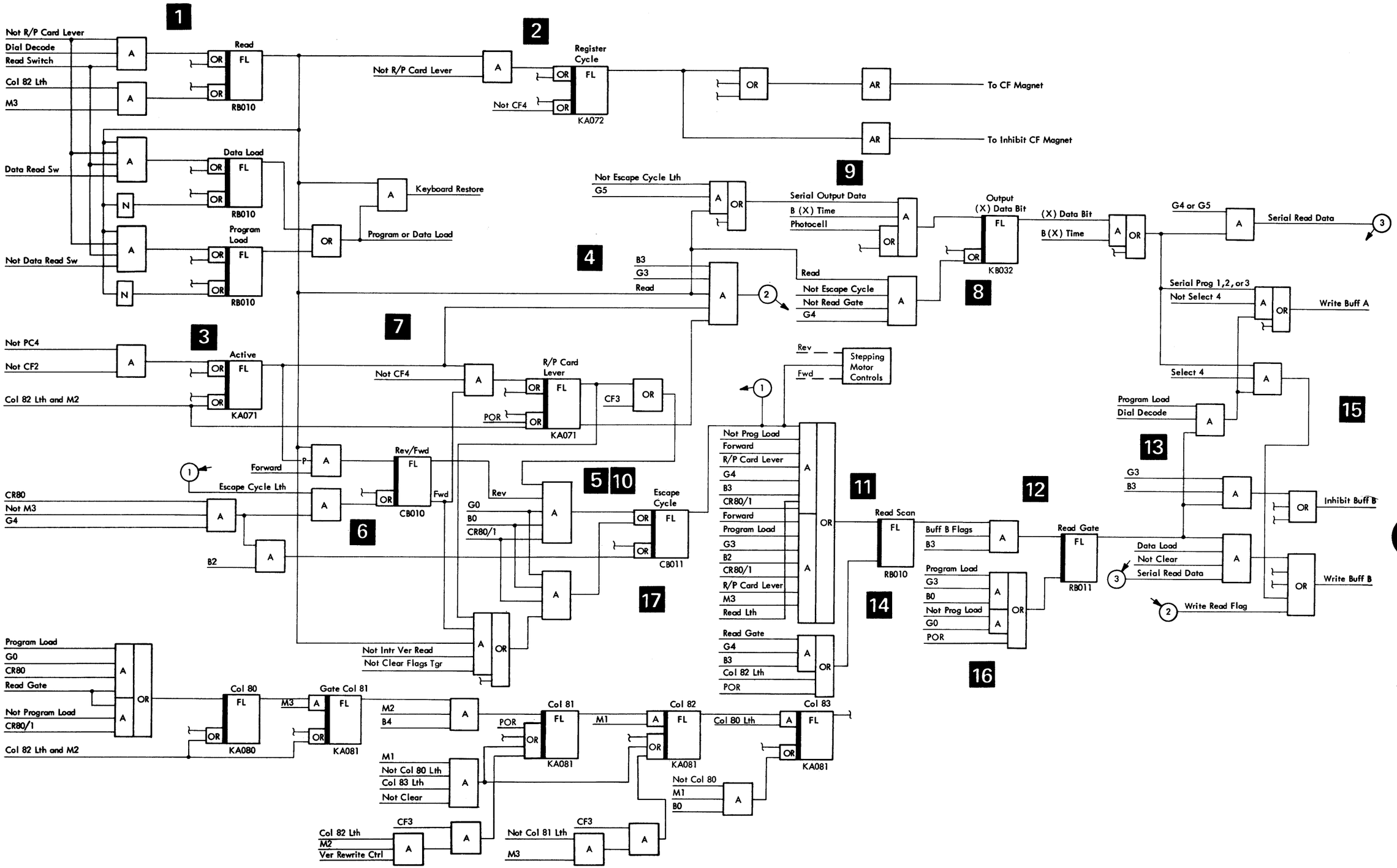
The operation (read column, advance, store) is repeated until all 80 columns have been read.

Circuit Objectives

1. Place the data or program card at the pre-register position and press the READ pushbutton. Set the read latch and the program load or data load latch.
2. Set the register cycle latch and register the card.
3. When the edge of the card is detected (not photocell 4), set the active latch and set the reverse/forward latch to reverse.
4. Write the read flags in buffer B.
5. Set the escape cycle latch and move the card back one column.
6. Reset the reverse/forward latch to forward.
7. Set the read/punch card lever latch. Reset the escape cycle latch.
8. Reset the output latches at G4 time.
9. Gate the photocell output to the output latches at G5 time.
10. Set the escape cycle latch and start advancing the card to the next column.
11. Set the read scan latch. (CR80, G4, and B3 for data load; CR80, G3, and B2 for program load.)
12. Set the read gate latch when the first read flag is detected in buffer B.
13. Inhibit the regeneration of the read flag.
14. Reset the read scan latch when a read flag is detected.
15. Gate program information to the correct buffer or gate the data to buffer B from the output latches at read gate time.
16. Reset the read gate latch.
17. Reset the escape cycle latch.

Repeat steps 8 through 17 until all 80 columns have been read into storage. When column 80 has been entered into storage, the column 80 latches are stepped. The read, program or data load, active, and read/punch lever latches are reset and the card advances to the stacker.




1
Not R/P Card Lever
Dial Decode
Read Switch
Col 82 Lth
M3
A
OR
FL
Read
RB010
Data Read Sw
Not Data Read Sw
N
Data Load
Program Load
2
Not R/P Card Lever
Not CF4
Register Cycle
KA072
AR
To CF Magnet
To Inhibit CF Magnet
3
Not PC4
Not CF2
Col 82 Lth and M2
Active
KA071
Keyboard Restore
Program or Data Load
4
B3
G3
Read
Not Escape Cycle Lth
G5
Serial Output Data
B (X) Time
Photocell
Output (X) Data Bit
KB032
8
9
(X) Data Bit
B(X) Time
G4 or G5
Serial Read Data
Serial Prog 1,2, or 3
Not Select 4
Write Buff A
Select 4
15
Program Load
Dial Decode
13
G3
B3
Inhibit Buff B
Write Buff B
Data Load
Not Clear
Serial Read Data
Write Read Flag
7
Not CF4
R/P Card Lever
POR
CF3
KA071
Not Escape Cycle
Not Read Gate
G4
Rev
Fwd
Stepping Motor Controls
Not Prog Load
Forward
R/P Card Lever
G4
B3
CR80/1
Forward
Program Load
G3
B2
CR80/1
R/P Card Lever
M3
Read Lth
11
Read Scan
RB010
14
Buff B Flags
B3
Program Load
G3
B0
Not Prog Load
G0
POR
12
Read Gate
RB011
16
Read Gate
G4
B3
Col 82 Lth
POR
5 10
Rev/Fwd
Forward
Escape Cycle Lth
CR80
Not M3
G4
B2
CB010
Escape Cycle
CB011
6
Rev
G0
B0
CR80/1
17
Not Intr Ver Read
Not Clear Flags Tgr
Program Load
G0
CR80
Read Gate
Not Program Load
CR80/1
Col 82 Lth and M2
Col 80
Gate Col 81
KA080
KA081
M3
M2
B4
Col 81
Col 82
Col 83
M1
Col 80 Lth
Not Col 80 Lth
Col 83 Lth
Not Clear
Not Col 80
M1
B0
Col 82 Lth
M2
Ver Rewrite Ctrl
CF3
Not Col 81 Lth
M3

9.10 PROGRAM SELECTION

A program may be selected by using either of two procedures:

1. By positioning the PROGRAM MODE dial at the correct program level position (with the REC ADV/CARD FEED switch set to AUTO). The program is selected when the column counter goes from 80 to 1.
2. By pressing the PROG SEL key and the correct numeric key (1-6).

Either selection procedure sets a combination of select latches that, when decoded, select the program level in buffer A or buffer B.

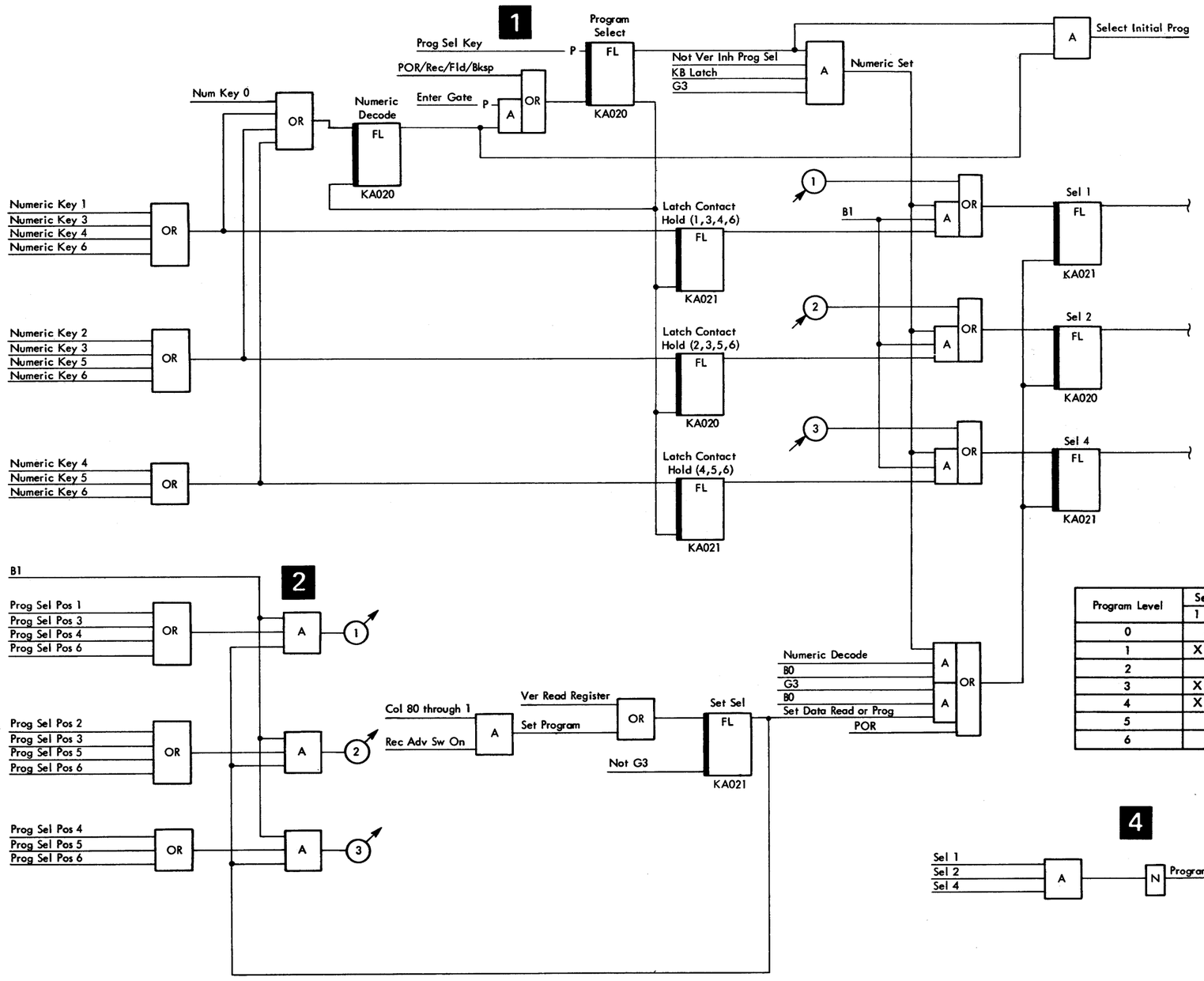
Circuit Objectives

1 The program select latch is set when the PROG SEL key is pressed. Pressing a numeric key (1-6) sets a latch-contact-hold latch. At B1 time, the correct combination of select latches is set. At enter gate time, the program select latch is reset.

2 With the REC ADV/CARD FEED switch set to AUTO, the program level that equals the setting of the PROGRAM MODE dial is selected when the machine advances from column 80 of one input record to column 01 of the next record.

3 The select latches are decoded to select the program level.

4 When all select latches are off, program off line sets the alpha latch.



9.11 PROGRAM PUNCHOUT

To punch a program from storage, the PROGRAM MODE dial must be set to PROG PCH (with REC ADV/CARD FEED set to MANUAL and AUTO SKIP/DUP set to OFF). After a blank card is registered at the punch station, press the REL key. This causes a normal data entry sequence and writes 80 punch flags in buffer A. When the punch flag is written in column 80, the entry complete latch is set, the column indicator goes to 00, and column 80 countup is inhibited.

Pressing the PROG SEL key conditions the program select circuits (as in a program select operation). When the program number is keyed, the select latches are set and the select initial program line allows a column 80 countup.

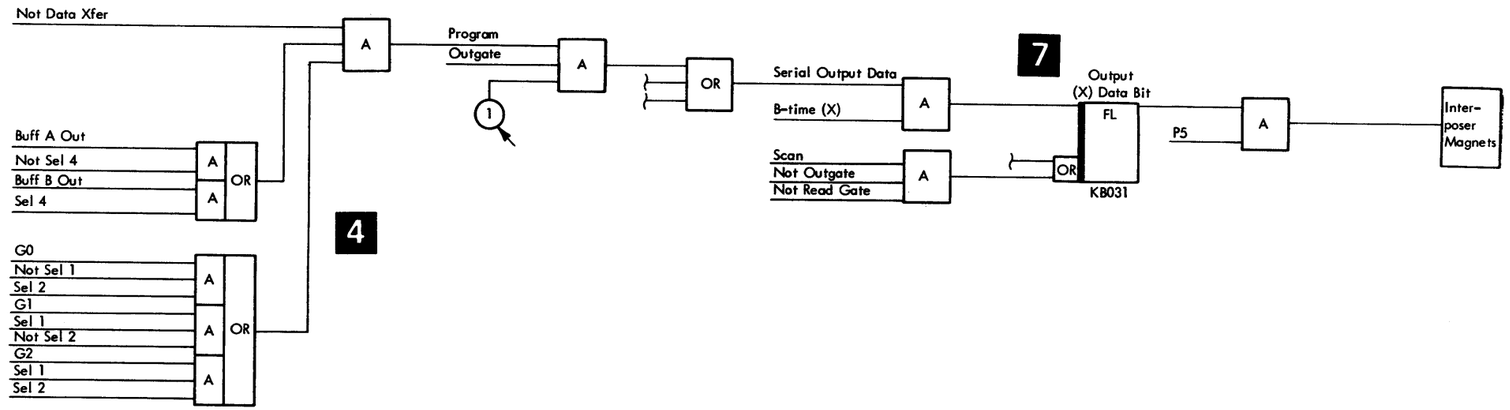
The countup in column 80 line sets the entry complete latch and causes a data transfer operation, which transfers punch flags in buffer A to buffer B.

When all 80 columns have been transferred, a punchout operation occurs. However, the program data may be read from either buffer A or buffer B and at G0, G1, or G2, as determined by the program level selected. Skipping is inhibited during a program punchout operation.

When column 80 of the program has been punched, the operation is reset and the program level that was punched out is automatically selected.

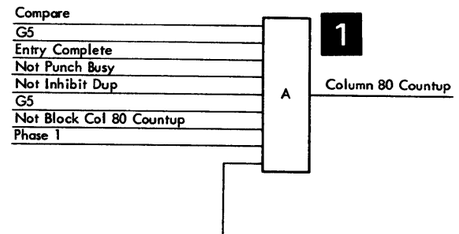
Circuit Objectives

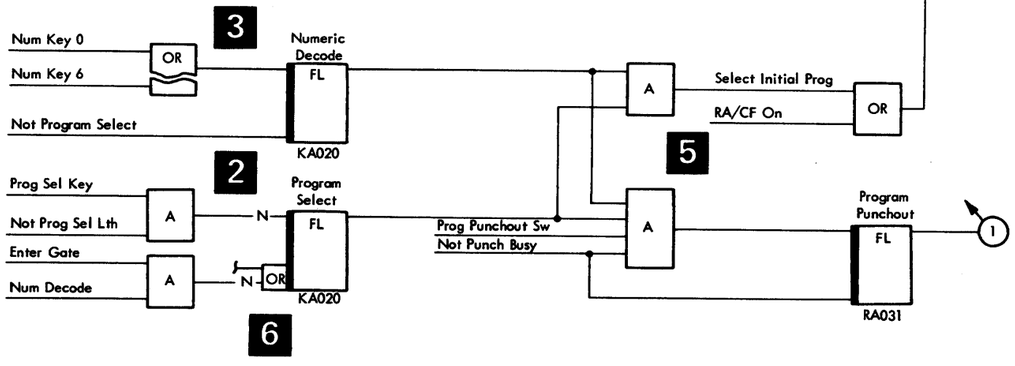
1. Press the REL key. When 80 punch flags have been written in buffer A, column 80 countup is inhibited.
2. Press the PROG SEL key and set the program select latch.
3. Key the program level to be punched and set the numeric decode latch.
4. Condition the program decode circuit.
5. Allow column 80 countup which starts a data transfer operation. Set the program punchout latch.
6. Reset the program select latch and the numeric decode latch at the drop of enter gate.
7. Begin a normal punchout operation, except that the output latches are set with program data.



Program Level	Select Line		
	1	2	4
0	All Off		
1	X		
2		X	
3	X	X	
4	X		X
5		X	X
6	X	X	X

Select lines are activated by pressing the correct numeric key (1-6).





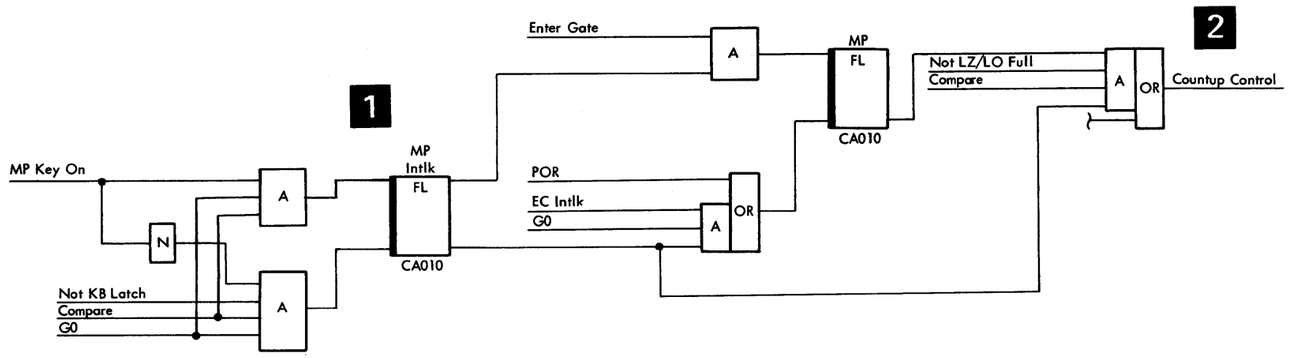
9.12 MULTIPUNCHING

A card column may be multipunched by pressing the MULT PCH key prior to pressing a data key. The MULT PCH key is held down until all data for the column has been keyed.

Circuit Objectives

1 Multipunching a column is done by blocking countup until all data for the column has been keyed. The MP interlock latch comes on when the MULT PCH key is pressed. At enter gate time, the MP latch is set. Countup is blocked until the MULT PCH key is released and the MP interlock latch is reset.

2 When the MULT PCH key is released, the multipunch interlock latch is reset and the column counter is advanced. Data in buffer C is transferred to buffer A (punch mode) or is gated to the verify match circuitry (verify mode). The multipunch latch is reset.



9.13 CLEAR

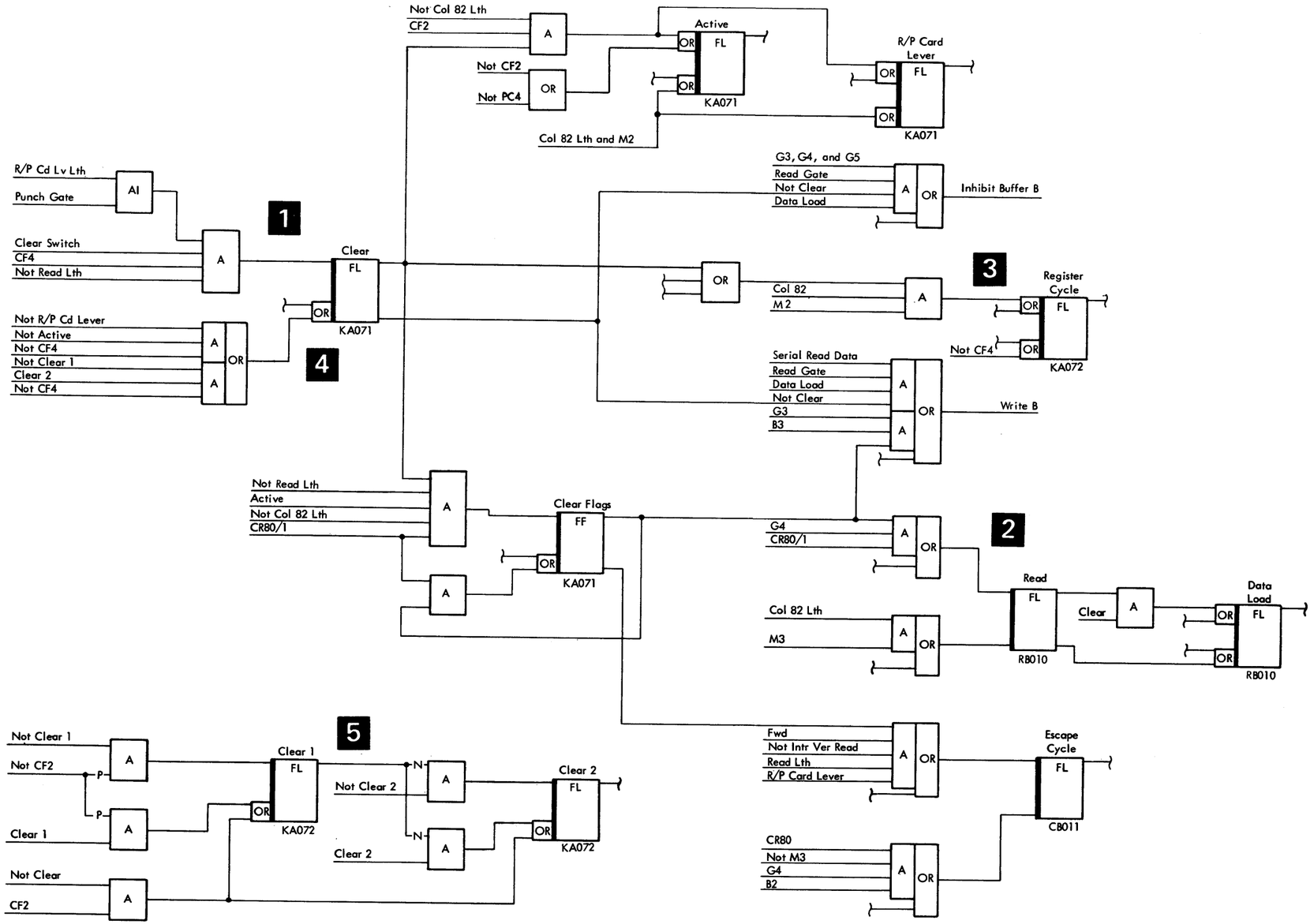
A data read cycle followed by a register cycle occurs when the CLEAR switch is operated.

The clear flags trigger is set and clear (read) flags (G3, B3) are written in all 80 columns of buffer B. The rest of the clear operation is similar to a data load, except that the writing of data in buffer B is inhibited.

The card is moved back one column. Buffer B is then scanned for clear flags (as in the read-scan, read-gate sequence of a data load operation) and the card is advanced. This sequence is repeated until all 80 columns have been processed and the card has advanced to the stacker.

Circuit Objectives

1. Set the clear latch which sets the active and the read/punch card lever latches as in a data load operation.
2. Set the read latch; start a normal data load operation, except inhibit the writing of data in buffer B.
3. At the end of the read cycle, reset the active and read latches. Start a register cycle and reset the clear latch if the R/P card lever latch line is not active.
4. If two cards were in the transport, the operation is repeated. Then the clear latch is reset if the R/P card lever latch line is not active.
5. Clear 1 latch is set during the first register cycle. Clear 2 latch is set and the clear 1 latch is reset during the second register cycle, forcing the clear latch off if a card jam occurs which prevents the card lever from dropping.



9.14 PUNCH/OUTPUT SKIP

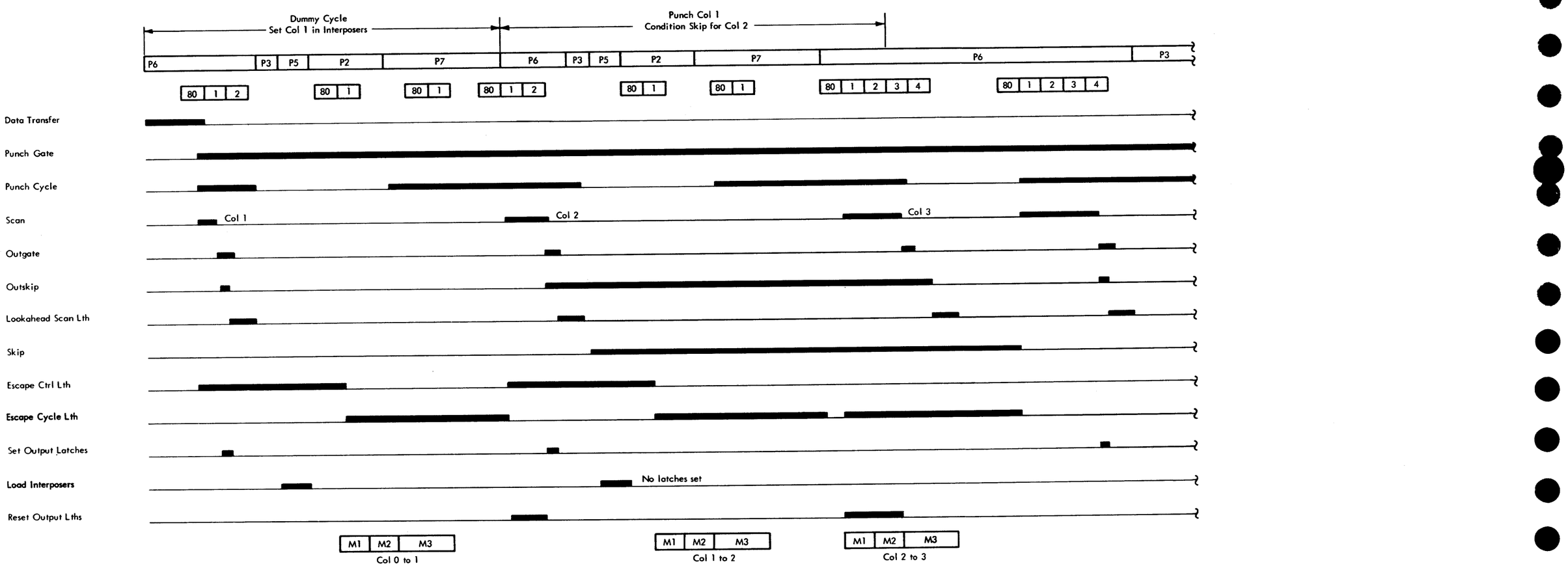
A punch operation requires punching a data column and escaping to the next column. The data for the column to be punched is stored mechanically in the interposers during the time that the previous column is being punched. For this reason, a dummy punch cycle in column 0 (one in which no punching occurs) is required to store data for column 1 in the interposers until it can be punched during the next punch cycle.

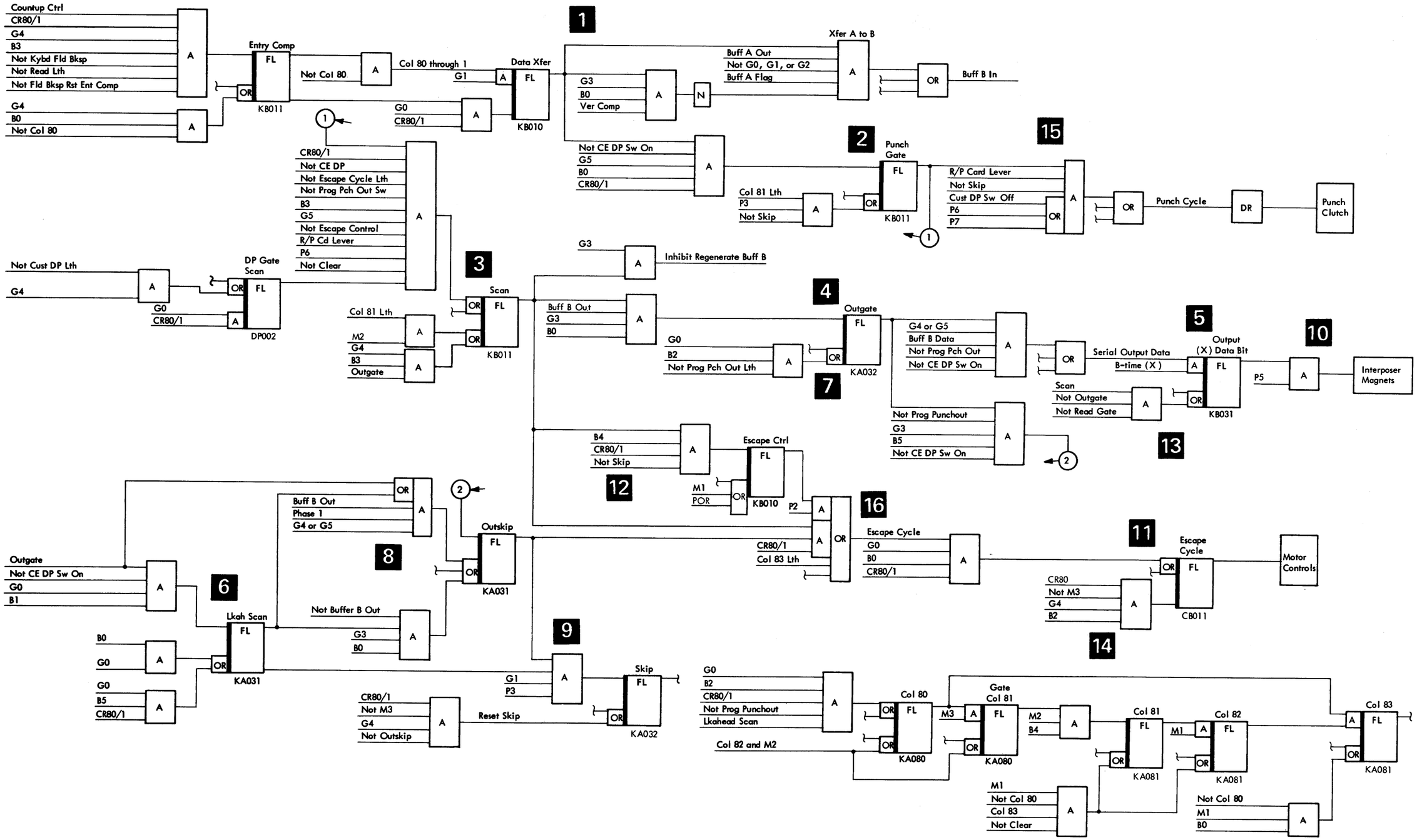
Skipping is done by checking contents of buffer B. If at least the next two columns contain no data, the columns are skipped and punch cycles are inhibited after the first blank column.

Circuit Objectives

1. When 80 columns have been entered into buffer A, the entry complete latch comes on and the data and punch flags in buffer A are transferred to buffer B.
2. When the data transfer is complete, the punch gate latch is set and a punch cycle is started.
3. At column ring 80/1 time, set the scan latch and the escape control latch.
4. Set the outgate latch when the first punch flag is detected in buffer B. Inhibit the regeneration of the punch flag, reset the scan latch, and set the outskip latch.
5. Gate the data in buffer B to the output latches and, if buffer B contains data, reset the outskip latch.
6. Set the lookahead scan latch.
7. Reset the outgate latch.
8. If the next column contains data, reset the outskip latch.
9. Reset the lookahead scan latch. If the outskip latch is active, set the skip latch.
10. Punch the data for the previous column and gate the data in the output latches to the interposers.
11. Set the escape cycle latch and advance the card one column.
12. Reset the escape control latch.
13. Reset the output latches.
14. Reset the escape cycle latch.
15. If the skip latch is off, start another punch cycle and repeat the scan and punch operations.
16. If the outskip latch is on, a punch cycle is inhibited and an escape cycle occurs.

When column 80 is punched, the column 80 latch is set. Punch and escape cycles occur and the column 80 latches are stepped. Punch gate latch is reset and the card advances to the stacker. If the REC ADV/CARD FEED switch is set to AUTO, another card is fed.




Countup Ctrl
CR80/1
G4
B3
Not Kybd Fld Bksp
Not Read Lth
Not Fld Bksp Rst Ent Comp
G4
B0
Not Col 80
A
OR
Entry Comp
FL
KB011
Not Col 80
Col 80 through 1
G1
Data Xfer
KB010
G0
CR80/1
1
CR80/1
Not CE DP
Not Escape Cycle Lth
Not Prog Pch Out Sw
B3
G5
Not Escape Control
R/P Cd Lever
P6
Not Clear
Not Cust DP Lth
G4
G0
CR80/1
DP Gate Scan
DP002
Col 81 Lth
M2
G4
B3
Outgate
Scan
KB011
3
1
G3
B0
Ver Comp
Buff A Out
Not G0, G1, or G2
Buff A Flag
Xfer A to B
N
Buff B In
Not CE DP Sw On
G5
B0
CR80/1
Col 81 Lth
P3
Not Skip
2
Punch Gate
KB011
15
R/P Card Lever
Not Skip
Cust DP Sw Off
P6
P7
Punch Cycle
DR
Punch Clutch
1
G3
Inhibit Regenerate Buff B
Buff B Out
G3
B0
4
Outgate
KA032
G0
B2
Not Prog Pch Out Lth
7
G4 or G5
Buff B Data
Not Prog Pch Out
Not CE DP Sw On
5
Output (X) Data Bit
Serial Output Data
B-time (X)
KB031
10
P5
Interposer Magnets
Scan
Not Outgate
Not Read Gate
Not Prog Punchout
G3
B5
Not CE DP Sw On
2
13
B4
CR80/1
Not Skip
12
Escape Ctrl
KB010
M1
POR
P2
16
CR80/1
Col 83 Lth
Escape Cycle
G0
B0
CR80/1
11
Escape Cycle
CB011
Motor Controls
CR80
Not M3
G4
B2
14
Outgate
Not CE DP Sw On
G0
B1
6
Lkah Scan
KA031
Buff B Out
Phase 1
G4 or G5
8
Outskip
KA031
Not Buffer B Out
G3
B0
B0
G0
G0
B5
CR80/1
9
G1
P3
Skip
KA032
CR80/1
Not M3
G4
Not Outskip
Reset Skip
G0
B2
CR80/1
Not Prog Punchout
Lkahead Scan
Col 82 and M2
Col 80
KA080
Gate Col 81
KA080
M3
M2
B4
Col 81
KA081
M1
Col 82
KA081
Col 83
KA081
M1
Not Col 80
Col 83
Not Clear
Not Col 80
M1
B0

9.15 CARD FEED AND REGISTER

The card feed clutch operates the feed knives, card aligner fingers, pusher arm, CF timing disk, pressure roll opening device, eject mechanism, and stacker. Only the operation of the feed knives can be inhibited during a card feed clutch cycle; this is done by picking the inhibit card feed magnet and the card feed magnet at the same time. The REG key is not operative in verify mode.

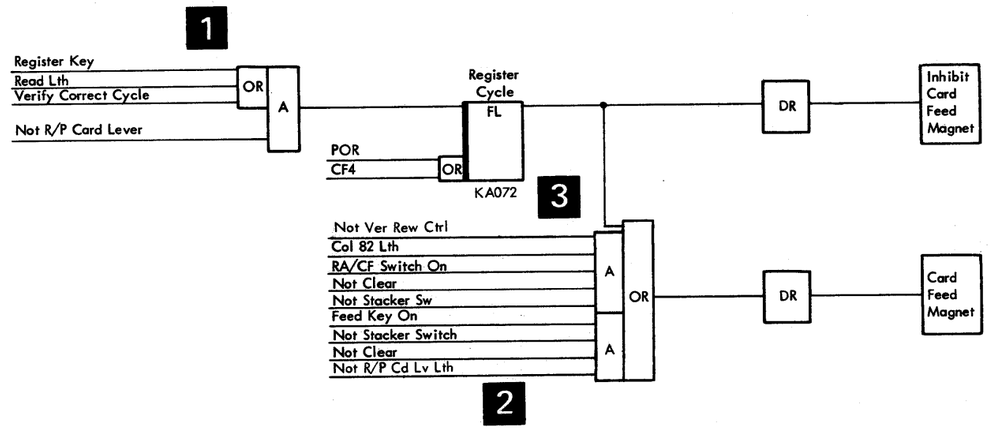
Circuit Objectives

1 Pressing the REG key (or the VER CORR key during a verify card repunch operation) sets the register cycle latch which activates the inhibit card feed magnet and starts a card feed cycle.

2 Pressing the FEED key starts a card feed cycle.

Note: In verify mode, two card feed cycles are needed to register the card. Pressing the FEED key starts the first cycle. The read latch is set in the first cycle, setting the register cycle latch which starts the second cycle.

3 When the punching or verification of a card is complete, a card feed cycle is started at column 82 latch time if the REC ADV/CARD FEED switch is set to AUTO. The second (register) cycle in verify mode is started by the read latch.



9.16 PRINT SUPPRESSION

Any character that is punched in a column of a card is also printed at the top of that column, unless the print suppress magnet is picked. This magnet is picked to suppress the printing of high-order 0's in a field and invalid characters (those outside the standard 64-character set). Single columns may be print suppressed by setting the PRINT switch to OFF.

Circuit Objectives

Suppression of High-order 0's:

1 A high-order print suppress flag (G3, B2) is automatically written in the first column of every field in buffer A. Because of that, high-order 0's, except in single-column fields, are suppressed in every field.

2 The high-order print suppress flag (from the first column of every field) sets the high-order print suppress latch. This latch stays on until:

3 An output latch other than 0 is set. This allows printing of the first nonzero digit of a field, or

4 The print lookahead latch, which is examining the next column, finds a high-order print suppress flag. This circuit allows printing the low-order 0 of an all-0 field, or

5 The end of the card is reached.

Suppression of Invalid Characters:

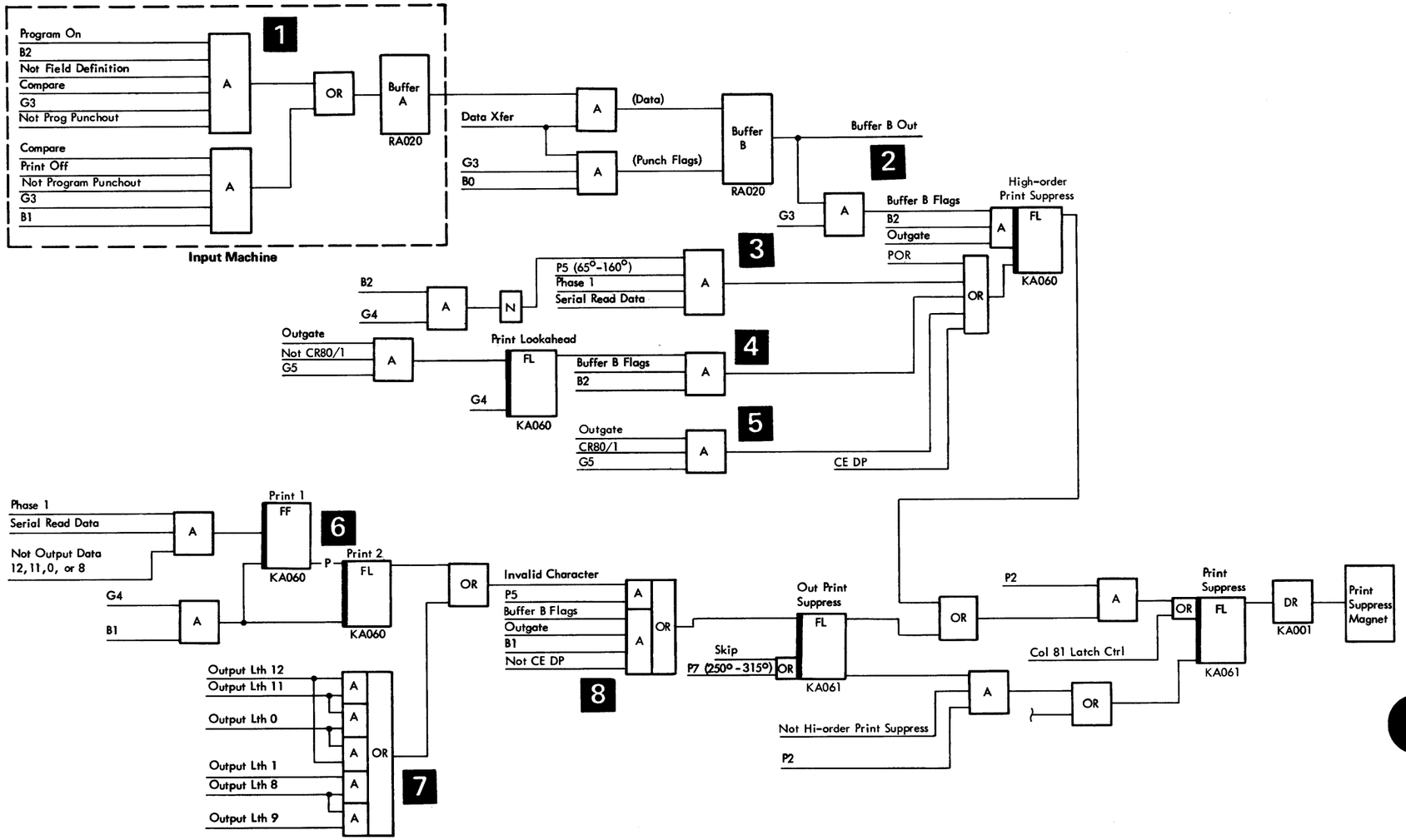
6 Starting at digit 1 time (G4, B3), the first output latch that is on sets the serial read data line which turns on the print 1 trigger. If another output latch is on, other than 8, the serial read data line complements the print 1 trigger (turns it off) which then turns on the print 2 latch.

7 The combinations of digits shown are invalid.

Print Suppression:

8 Printing in any column is suppressed when a print suppress flag (G3, B1) appears in storage for that column. The suppression of an entire field requires print suppress flags in each column of the field.

Verify Machines Only: Any punches in column 81 are print suppressed.



9.17 VERIFY READ

A verify read operation is similar to a data load, except that the information in the card is read into buffer A instead of buffer B. Also, when column 80 is read, the card remains at the punch station instead of advancing to the stacker.

When a card is fed from the hopper, the read circuits become active, the card is registered, and the read flags are written in buffer B.

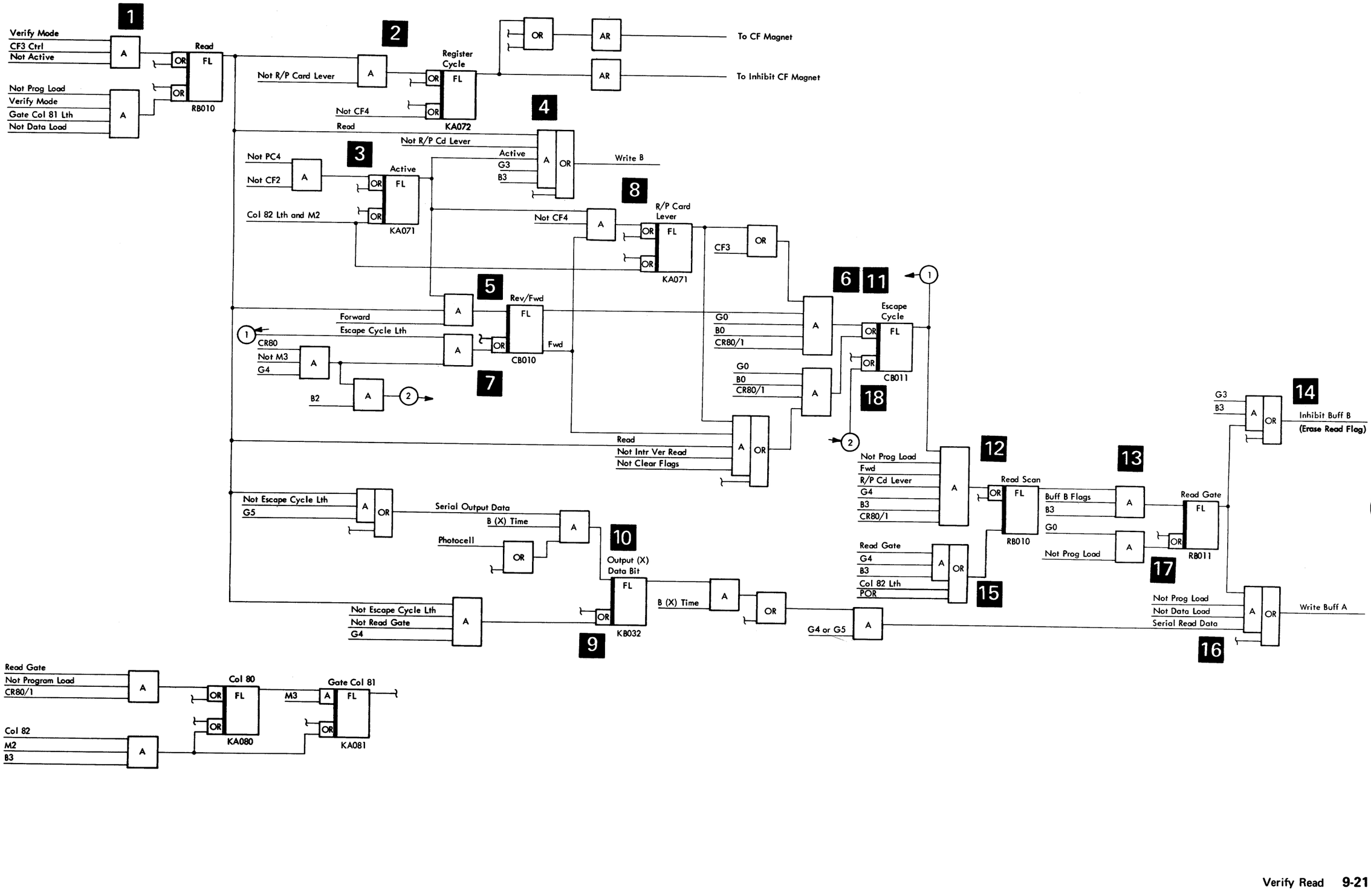
When the card is registered, it is moved back one column and column 1 is read into the output latches. Then the card advances to column 2 and, when the read flag is detected in column 1 of buffer B, the information in output latches is read into buffer A.

The operation (read column, advance, store) is repeated until all 80 columns have been stored in buffer A. When column 80 has been stored, card advance is inhibited so that column 81 may be punched, if the card verifies correctly.

Circuit Objectives

1. If no auto feed cycle occurs, press the FEED key. Set the read latch.
2. Set the register cycle latch and register the card.
3. Set the active latch when the edge of the card is detected (not photocell 4).
4. Write the read flags in buffer B.
5. Set the reverse/forward latch to reverse.
6. Set the escape cycle latch and move the card back one column.
7. Reset the reverse/forward latch to forward.
8. Set the read/punch card lever latch. Reset the escape cycle latch.
9. Reset the output latches at G0 time.
10. Gate the photocell output to the output latches at G5 time.
11. Set the escape cycle latch and start advancing the card to the next column.
12. Set the read scan latch.
13. When the first read flag is detected in buffer B, set the read gate latch.
14. Inhibit the regeneration of the read flag.
15. Reset the read scan latch when a read flag is detected.
16. Gate the data in the output latches to buffer A.
17. Reset the read gate latch.
18. Reset the escape cycle latch.

Repeat steps 9 through 18 until all 80 columns have been stored in buffer A. When column 80 is stored, the column 80 latch is set. When escapement from column 79 to column 80 is complete, the gate column 81 latch comes on, resetting the read latch and inhibiting further advancement of the card.


1
Verify Mode
CF3 Ctrl
Not Active
Not Prog Load
Verify Mode
Gate Col 81 Lth
Not Data Load
A
OR
FL
Read
RB010
2
Not R/P Card Lever
Register Cycle
Not CF4
KA072
OR
AR
To CF Magnet
To Inhibit CF Magnet
4
Read
Not R/P Cd Lever
Active
G3
B3
Write B
3
Not PC4
Not CF2
Active
Col 82 Lth and M2
KA071
8
Not CF4
R/P Card Lever
CF3
5
Forward
Escape Cycle Lth
Rev/Fwd
CR80
Not M3
G4
B2
CB010
Fwd
7
6
11
Escape Cycle
CB011
G0
B0
CR80/1
18
Read
Not Intr Ver Read
Not Clear Flags
12
Not Prog Load
Fwd
R/P Cd Lever
G4
B3
CR80/1
Read Scan
RB010
13
Buff B Flags
Read Gate
RB011
17
Not Escape Cycle Lth
G5
Serial Output Data
B (X) Time
Photocell
10
Output (X) Data Bit
KB032
9
Not Escape Cycle Lth
Not Read Gate
G4
B (X) Time
G4 or G5
Read Gate
G4
B3
Col 82 Lth
POR
15
14
G3
B3
Inhibit Buff B
(Erase Read Flag)
Not Prog Load
Not Data Load
Serial Read Data
Write Buff A
16
Read Gate
Not Program Load
CR80/1
Col 80
KA080
M3
Gate Col 81
KA081
Col 82
M2
B3

9.18 VERIFY AND VERIFY ERROR

Verifying a column by duplicating or by keying causes an entry sequence that is similar to the entry sequence in punch mode. At enter gate time, the keyboard data in buffer C or the information in buffer B to be duplicated is matched with the card data in buffer A. If both buffers contain the same data, no error occurs and the column counter is advanced, allowing the next column to be verified.

If the information in the buffers is not the same, a verify error occurs, the error indicator comes on, countup is inhibited, and the keyboard locks.

When a verify error occurs, the operator is allowed a retry. If the retry produces an error, a second retry is allowed, but the keyed character is written into storage in place of the error character.

If a rewritten character is immediately character backspaced and reverified, normal verification may be continued. If, however, the next character is keyed, the entire field (or record) must be reverified. This condition is indicated by 88 on the column indicator (all sections lighted).

Circuit Objectives (Error Condition)

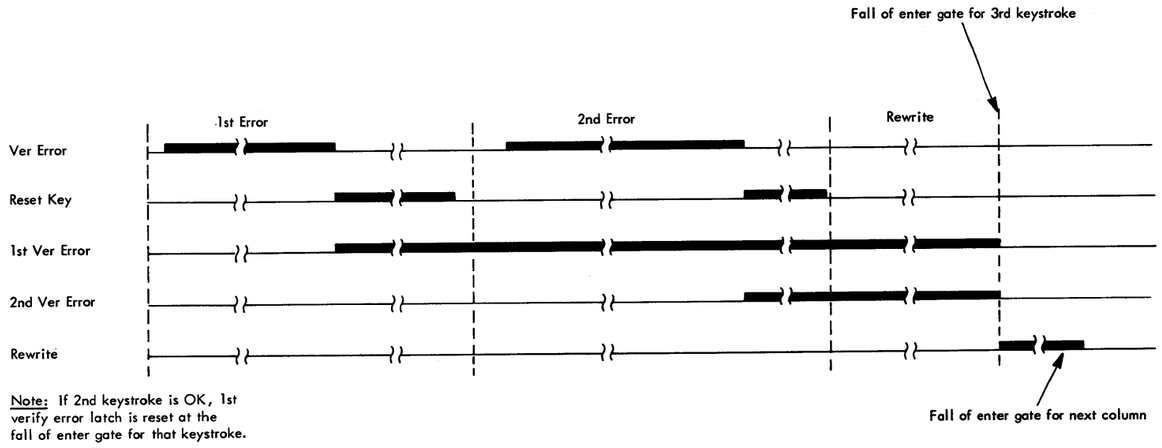
1. The verify error latch comes on when the data read from the card (in buffer A) and the keyed data (in buffer C) or the data to be duplicated (in buffer B) are not the same. The verify error latch lights the error indicator, blocks countup and entry complete if in column 80, and holds the keyboard restored.
2. Pressing the VER RES key resets the verify error latch.
3. The first verify error latch is set at the drop of the verify error latch.
4. Rekeying the digit causes a match of the information in buffer A with the keyed information in buffer C. If the information matches, the first verify error latch is reset (at the drop of enter gate) and the operation continues as normal. If the information in the buffers does not compare equally, the verify error latch is set again.
5. Pressing the VER RES key resets the verify error latch, and, at the drop of this latch, the second verify error latch is set.
6. The second verify error latch sets the inhibit verify OK latch, which prevents 2 and 3 from being punched in column 81.
7. When the character is keyed again, reset the first and second verify error latches.
8. Write the data in buffer C in buffer A.
9. Set the rewrite character latch.
10. If the character is backspaced and reverified, the rewrite character latch is reset.
11. If the next character is keyed without character backspacing, the rewrite character latch is reset and the remember rewrite latch is set at the drop of the rewrite character latch.
12. If the end of the field is reached and the remember rewrite latch is active, the force reverify latch is set. This latch lights all sections of the column indicator and locks the keyboard.

9.18.1 Verify Field or Record Correction

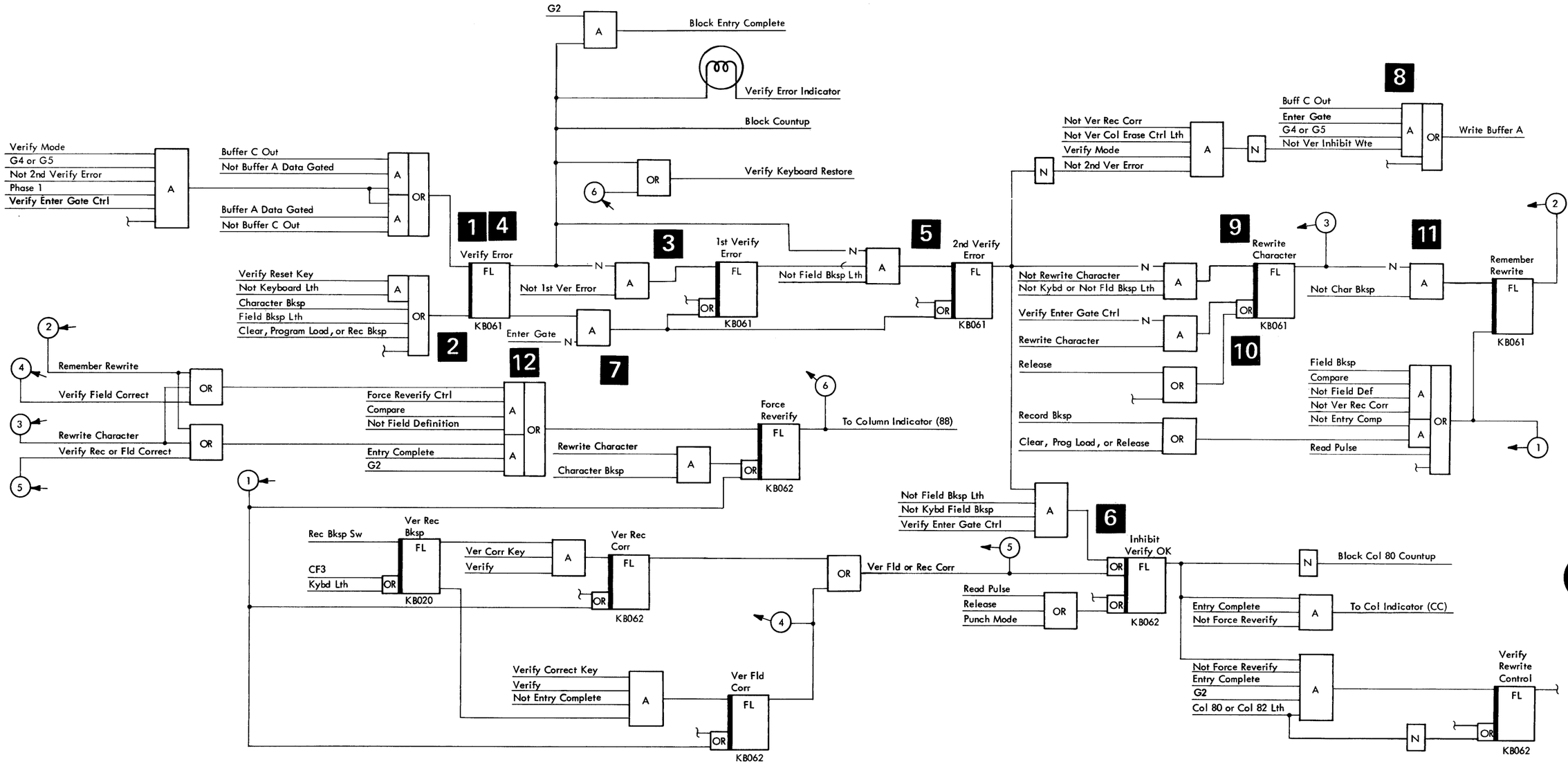
If the VER CORR key is pressed, a field may be rewritten in storage. If a field is rewritten, it must be reverified.

If the VER CORR key is pressed immediately after a record backspace, the entire record may be written in storage, and the record must be reverified.

Punching in column 81 of the error card is inhibited.



Note: If 2nd keystroke is OK, 1st verify error latch is reset at the fall of enter gate for that keystroke.


Verify Mode
G4 or G5
Not 2nd Verify Error
Phase 1
Verify Enter Gate Ctrl
A
Buffer C Out
Not Buffer A Data Gated
Buffer A Data Gated
Not Buffer C Out
OR
1 4
Verify Error
FL
KB061
2
Verify Reset Key
Not Keyboard Lth
Character Bksp
Field Bksp Lth
Clear, Program Load, or Rec Bksp
G2
Block Entry Complete
Verify Error Indicator
Block Countup
Verify Keyboard Restore
6
3
Not 1st Ver Error
N
1st Verify Error
Not Field Bksp Lth
5
2nd Verify Error
Enter Gate
7
12
Remember Rewrite
Verify Field Correct
Rewrite Character
Verify Rec or Fld Correct
Force Reverify Ctrl
Compare
Not Field Definition
Entry Complete
Rewrite Character
Character Bksp
Force Reverify
To Column Indicator (88)
KB062
Not Rewrite Character
Not Kybd or Not Fld Bksp Lth
Verify Enter Gate Ctrl
Rewrite Character
Release
Record Bksp
Clear, Prog Load, or Release
9
Rewrite Character
10
Not Ver Rec Corr
Not Ver Col Erase Ctrl Lth
Verify Mode
Not 2nd Ver Error
8
Buff C Out
Enter Gate
G4 or G5
Not Ver Inhibit Wte
Write Buffer A
Not Char Bksp
11
Remember Rewrite
Field Bksp
Compare
Not Field Def
Not Ver Rec Corr
Not Entry Comp
Read Pulse
Not Field Bksp Lth
Not Kybd Field Bksp
Verify Enter Gate Ctrl
6
Inhibit Verify OK
Read Pulse
Release
Punch Mode
Block Col 80 Countup
Entry Complete
Not Force Reverify
To Col Indicator (CC)
Not Force Reverify
Entry Complete
G2
Col 80 or Col 82 Lth
Verify Rewrite Control
Ver Rec Bksp
Rec Bksp Sw
CF3
Kybd Lth
KB020
Ver Corr Key
Verify
Ver Rec Corr
Ver Fld or Rec Corr
Verify Correct Key
Verify
Not Entry Complete
Ver Fld Corr

9.19 VERIFY LEFT ZERO/BLANK COLUMN (HIGH-ORDER POSITIONS)

9.19.1 Left Zero

Pressing the first character (or space) key in a programmed LZ field causes the column counter and the column indicator to be advanced until the first nonzero character (including blanks) is detected.

Detecting the end of the field (LZ program and field definition) inhibits advance to the next field. The LEFT ZERO CTRL key or the –LZ key must be pressed to advance to the next field. Pressing any other key locks the keyboard.

Dup or skip is inhibited after a character key has been pressed in the field.

9.19.2 Blank Column

The blank column operation is similar to an LZ operation, except that the operation is started by pressing the BLANK COLUMNS/LEFT ZERO CTRL key. Pressing this key at the start of a field sets the verify detect blank latch at enter gate time, which causes the column counter and the column indicator to be advanced until data or the end of the field is detected. If the BLANK COLUMNS/LEFT ZERO CTRL key is pressed in a column that contains data, the operation is ignored.

When column 80 is detected, and the column contains data, entry complete is inhibited and the card is not moved out of the punch station until verification of the column is complete.

Dup or skip is inhibited in a field if the BLANK COLUMNS/LEFT ZERO CTRL key has been pressed in that field.

Note: If the machine is in program level 0, the entire record is checked for blanks. Detecting a nonzero digit in the record resets the operation.

Circuit Objectives

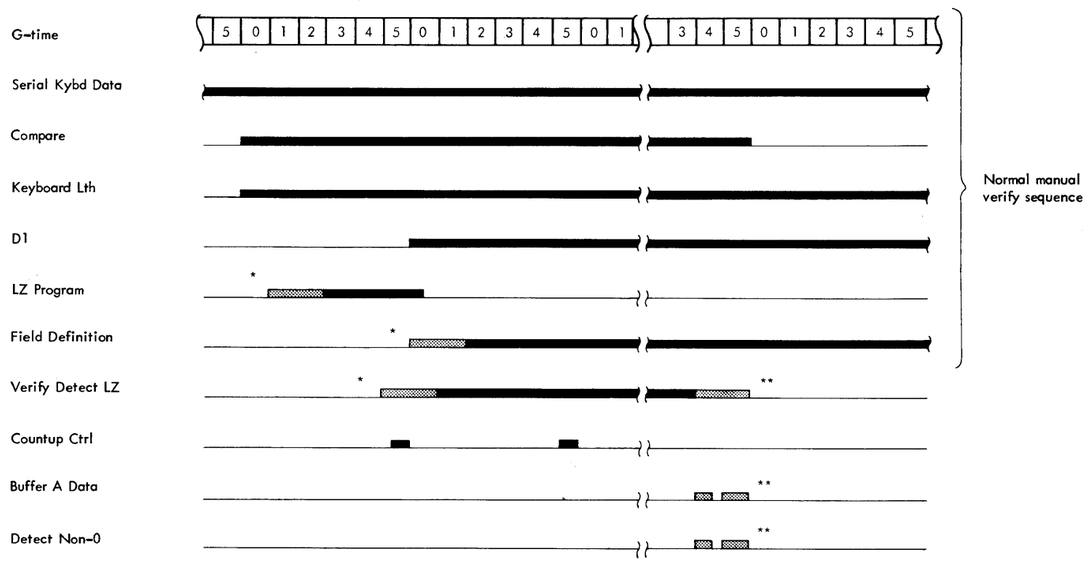
1. When the LZ field (gated program) is detected, set the verify LZ program latch.
2. Press a data key (or space key) to activate the serial keyboard data line as in a normal manual field. At compare time, set the keyboard latch.
3. Set the verify detect LZ latch. This latch conditions the countup circuitry; and at G5, B5 time, the column counter is advanced.

Note: The column counter is advanced at every G5, B5 time as long as the verify detect LZ latch is active.

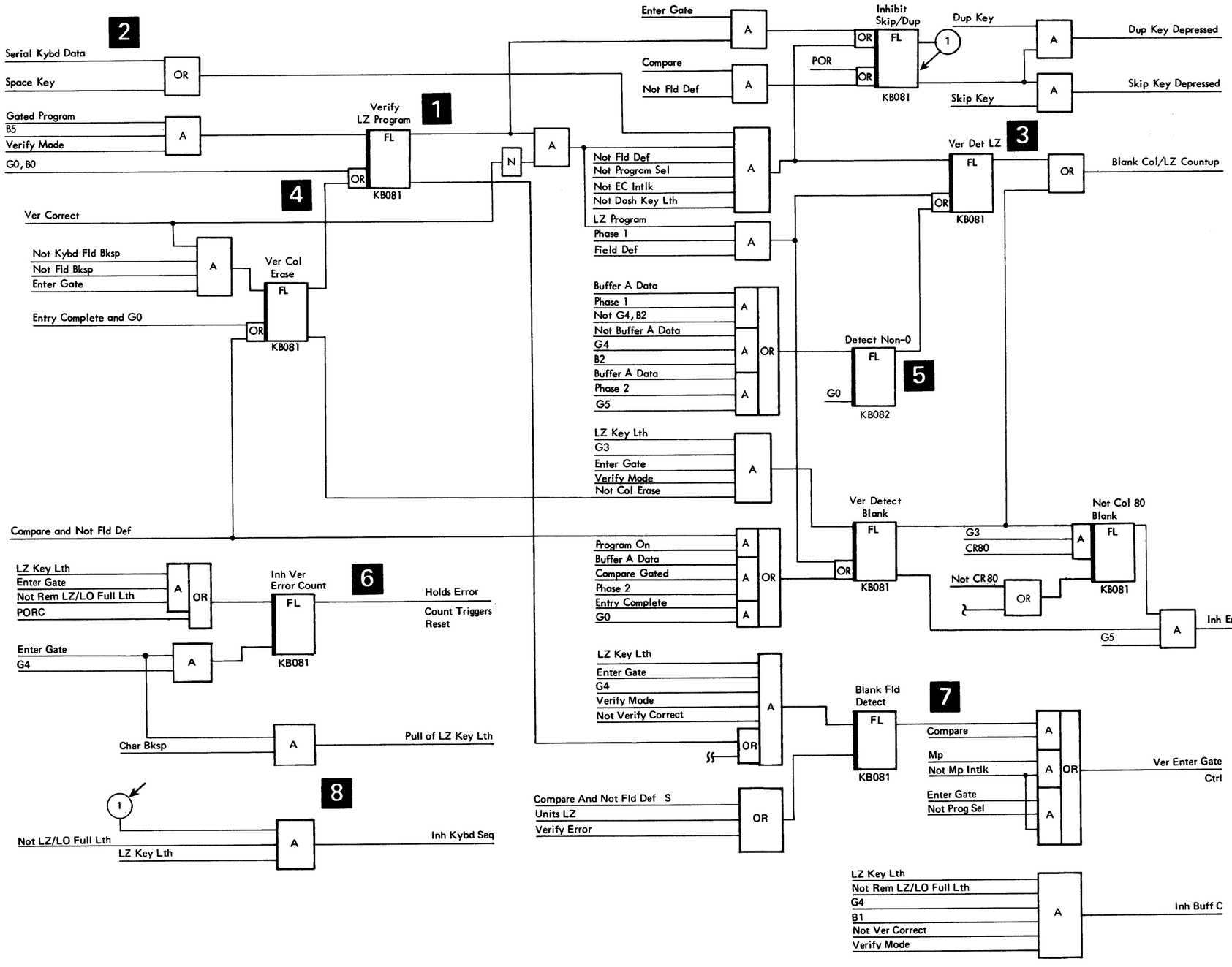
4. At G0, B0 time, reset the verify LZ program latch.
5. Detect a nonzero digit in buffer A. Set the detect non-0 latch. Reset the verify detect LZ latch. Countup is inhibited, compare drops, and a normal manual entry verify compare sequence starts.

On machines with serial numbers above 53,000, include steps 6 through 8 .

6. INH VER ERROR LT is set when LZ key is depressed as a data key. This prevents verify rewrite operation with the LZ key, except when used to change the units position overpunch.
7. BLANK FLD DETECT LT is set when the LZ key is depressed in any position of a field that is not programmed to be a verify LZ field. This allows automatic verification of blanks for the remainder of the field. (INH BUFF C signal prevents verify errors from occurring due to LZ key depression.)
8. INH KBD SEQ locks the keyboard if the LZ key is depressed in the middle of a programmed LZ field.



*Rise time depends on active program level.
**Rise or fall time depends on data in buffer.


2
Serial Kybd Data
Space Key
OR
Gated Program
B5
Verify Mode
G0, B0
A
Verify
LZ Program
1
FL
OR
KB081
4
Ver Correct
Not Kybd Fld Bksp
Not Fld Bksp
Enter Gate
A
Ver Col
Erase
FL
Entry Complete and G0
OR
KB081
N
A
Enter Gate
Compare
Not Fld Def
A
A
Inhibit
Skip/Dup
OR
FL
OR
KB081
POR
Dup Key
1
Skip Key
A
A
Dup Key Depressed
Skip Key Depressed
Not Fld Def
Not Program Sel
Not EC Intlk
Not Dash Key Lth
LZ Program
Phase 1
Field Def
A
Ver Det LZ
3
FL
OR
KB081
OR
Blank Col/LZ Countup
Buffer A Data
Phase 1
Not G4, B2
Not Buffer A Data
G4
B2
Buffer A Data
Phase 2
G5
A
A
A
OR
Detect Non-0
FL
G0
KB082
5
LZ Key Lth
G3
Enter Gate
Verify Mode
Not Col Erase
A
Ver Detect
Blank
FL
OR
KB081
Not Col 80
Blank
FL
KB081
G3
CR80
A
Not CR80
OR
G5
A
Inh Entry Comp
Compare and Not Fld Def
LZ Key Lth
Enter Gate
Not Rem LZ/LO Full Lth
PORC
A
OR
Inh Ver
Error Count
FL
KB081
6
Holds Error
Count Triggers
Reset
Enter Gate
G4
A
Char Bksp
A
Pull of LZ Key Lth
Program On
Buffer A Data
Compare Gated
Phase 2
Entry Complete
G0
A
A
A
OR
LZ Key Lth
Enter Gate
G4
Verify Mode
Not Verify Correct
A
OR
Blank Fld
Detect
FL
KB081
7
Compare
Mp
Not Mp Intlk
Enter Gate
Not Prog Sel
A
A
A
OR
Ver Enter Gate
Ctrl
Compare And Not Fld Def S
Units LZ
Verify Error
OR
1
Not LZ/LO Full Lth
LZ Key Lth
A
8
Inh Kybd Seq
LZ Key Lth
Not Rem LZ/LO Full Lth
G4
B1
Not Ver Correct
Verify Mode
A
Inh Buff C

9.20 VERIFY LEFT ZERO (UNITS POSITION)

Keying the units position of an LZ field in verify mode is similar to a non-LZ field, except that incrementing the column counter is inhibited and verification of the 11 zone is prevented until the LEFT ZERO CTRL key or the –LZ key is pressed.

When the LEFT ZERO CTRL or –LZ key is pressed, the 11 zone is verified and the column counter is advanced (except when a verify error occurs).

A verify error in the units position of an LZ field may be processed as any other verify error (reset, try again, reset and rewrite) or a backspace may be performed.

Circuit Objectives (Data Key)

Requirements: Units position is ready to be verified and the verify LZ program latch is active.

1. Press the data key, set the keyboard latch, and start the delay clock and a keyboard restore cycle.
2. Set the units LZ latch.
3. At enter gate time, gate the data in buffer A (except the 11) to the verify compare circuit. The 11 is inhibited by the compare numeric AND block. Set the verify error latch if buffers A and C do not contain the same numeric information.
4. Inhibit countup.
5. Set the LZ/LO full latch and the remember LZ/LO full latch. Set the inhibit keyboard sequence line; this line allows only the LEFT ZERO CTRL key to start the delay clock.
6. Set the minus units latch if there is an 11-punch stored anywhere in storage.
7. Reset the keyboard latch.

Circuit Objectives (Control Key)

8. Press the LEFT ZERO CTRL key or the –LZ key. If the LEFT ZERO CTRL key is pressed, set the LZ key latch. If the –LZ key is pressed, set the dash key latch (set overrides reset). At compare and G4 time, set the LZ key latch.
9. Deactivate the inhibit keyboard sequence line and set the keyboard latch. Start the delay clock and a keyboard restore cycle.
10. If the –LZ key was pressed, gate the serial keyboard data (G4, B1) to buffer C at each compare time.
11. At enter gate time, one of the following conditions exists:
    a. Dash key latch active–minus units latch inactive.
    b. Dash key latch inactive–minus units latch active.
    c. Dash key latch active–minus units latch active.
    d. Dash key latch inactive–minus units latch inactive.

    Conditions a and b gate the data in buffer A to the verify compare circuits and set the verify error latch.

    Condition c gates the data in buffer A to the verify match circuits. Because any 11-punch in buffer A sets the minus units latch, a verify match must be made between the 11-punch entered in buffer C by the –LZ key and the 11-punch in buffer A at enter gate time. A verify error occurs if the column being verified does not contain an 11.

    If the LEFT ZERO CTRL key is pressed and there are no 11-punches in the entire card (condition d), the data in buffer A is not gated to the verify match circuit at enter gate time. Because nothing has been entered in buffer C, by pressing the LEFT ZERO CTRL key, a valid verify match occurs.
12. If no error has occurred, advance the column counter.
13. Reset the LZ/LO full latch.
14. Reset the remember LZ/LO full latch.
15. Reset the units LZ and LZ minus units latches.
16. Reset the keyboard latch.
17. Reset the LZ dash key latch and/or the LZ key latch.

9.20.1 Units Position Error

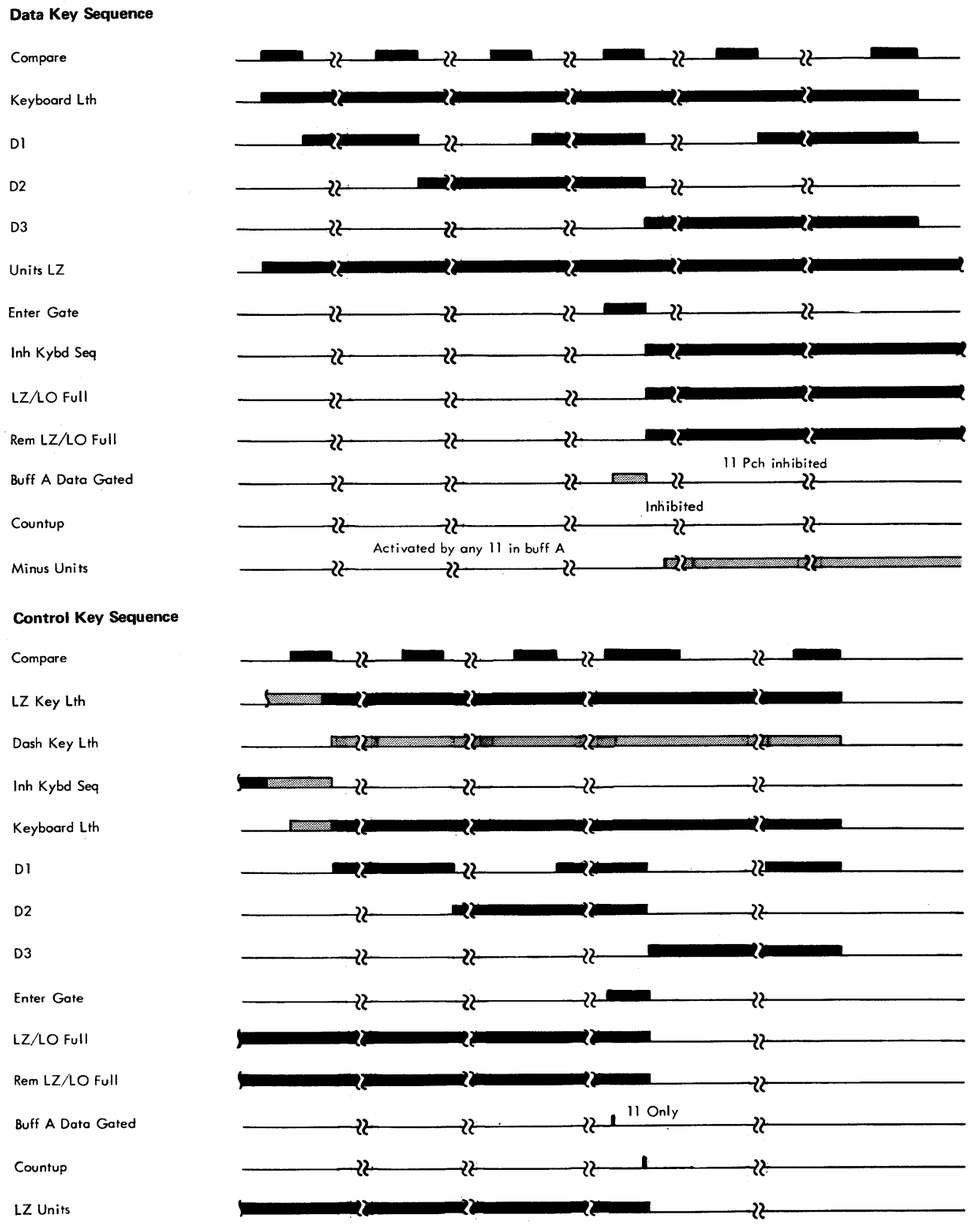
If an error occurs in the units position of an LZ field, it is not necessary to rewrite both the numeric and dash information in the column. Circuits A are provided to regenerate the portion of the column that is not being rewritten in buffer A.

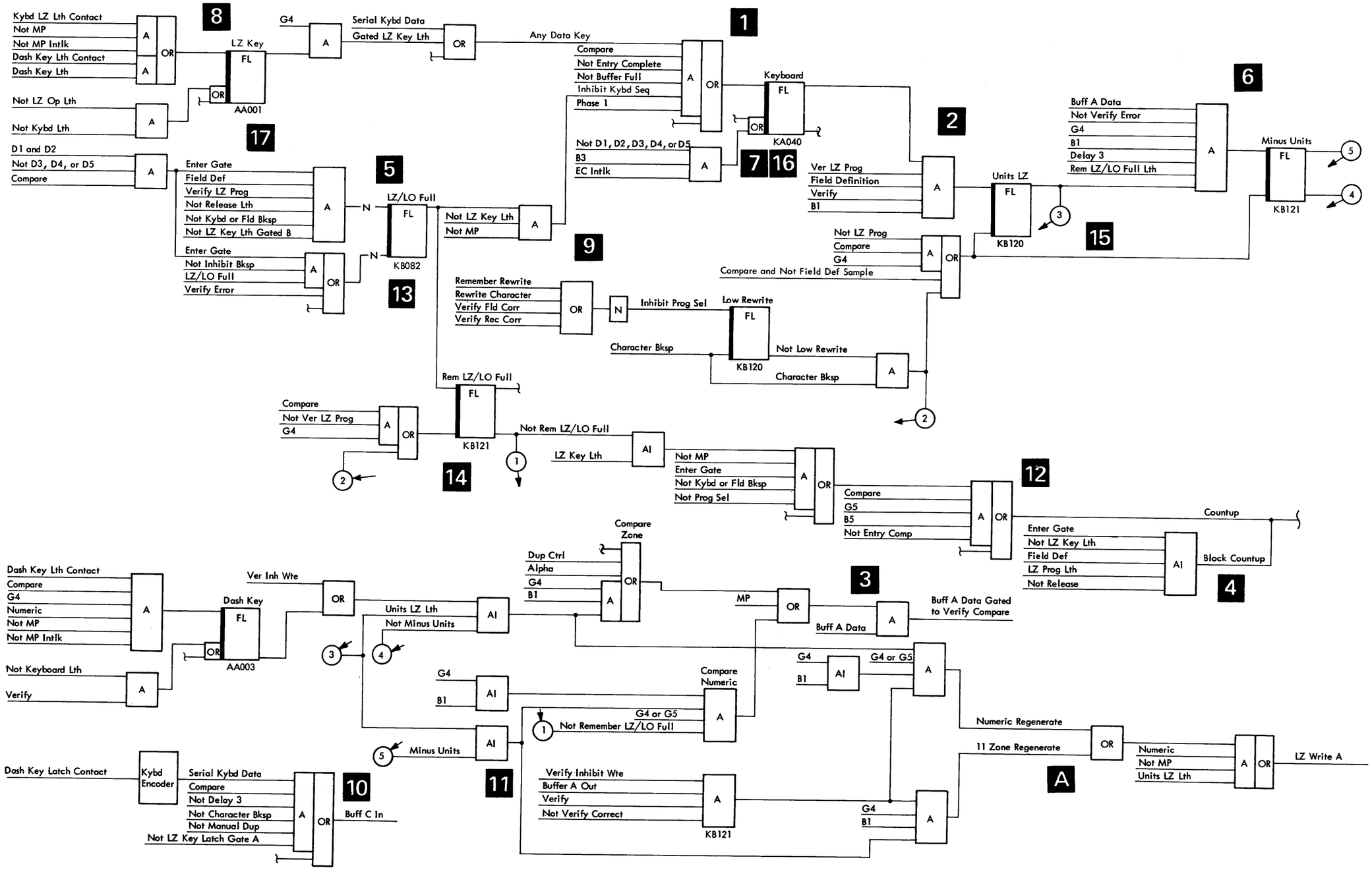
9.20.2 Multipunch

Pressing the MULT PCH key in the units position of an LZ field allows verification of all punches in the units position. All information, including zone information, must be accurately keyed or a verify error occurs when the MULT PCH key is released. The LEFT ZERO CTRL key or the –LZ key must be pressed to advance to the next field.

9.20.3 Alpha

Pressing the ALPHA shift key or programming an alpha shift in the units position of an LZ field gates both the numeric and zone data to the verify match circuit at enter gate time. An error occurs if the data in buffer A is not equal to the keyed data. The LEFT ZERO CTRL key or the –LZ key must be pressed to advance to the next field.




Kybd LZ Lth Contact
Not MP
Not MP Intlk
Dash Key Lth Contact
Dash Key Lth
A
OR
8
LZ Key
FL
AA001
G4
Serial Kybd Data
Gated LZ Key Lth
Any Data Key
1
Compare
Not Entry Complete
Not Buffer Full
Inhibit Kybd Seq
Phase 1
Keyboard
KA040
Not LZ Op Lth
Not Kybd Lth
17
D1 and D2
Not D3, D4, or D5
Compare
Not D1, D2, D3, D4, or D5
B3
EC Intlk
7 16
Enter Gate
Field Def
Verify LZ Prog
Not Release Lth
Not Kybd or Fld Bksp
Not LZ Key Lth Gated B
5
LZ/LO Full
N
KB082
Enter Gate
Not Inhibit Bksp
LZ/LO Full
Verify Error
13
Not LZ Key Lth
Not MP
9
Ver LZ Prog
Field Definition
Verify
B1
2
Units LZ
KB120
Buff A Data
Not Verify Error
G4
B1
Delay 3
Rem LZ/LO Full Lth
6
Minus Units
KB121
15
Not LZ Prog
Compare
G4
Compare and Not Field Def Sample
Remember Rewrite
Rewrite Character
Verify Fld Corr
Verify Rec Corr
Inhibit Prog Sel
Low Rewrite
Character Bksp
Not Low Rewrite
Rem LZ/LO Full
Compare
Not Ver LZ Prog
G4
Not Rem LZ/LO Full
LZ Key Lth
AI
Not MP
Enter Gate
Not Kybd or Fld Bksp
Not Prog Sel
14
12
Countup
Enter Gate
Not LZ Key Lth
Field Def
LZ Prog Lth
Not Release
Block Countup
4
Compare Zone
Dup Ctrl
Alpha
G4
B1
3
MP
Buff A Data
Buff A Data Gated to Verify Compare
Dash Key Lth Contact
Compare
G4
Numeric
Not MP
Not MP Intlk
Dash Key
AA003
Ver Inh Wte
Units LZ Lth
Not Minus Units
Not Keyboard Lth
Verify
Compare Numeric
G4 or G5
Not Remember LZ/LO Full
Minus Units
11
Numeric Regenerate
11 Zone Regenerate
A
LZ Write A
Numeric
Not MP
Units LZ Lth
Dash Key Latch Contact
Kybd Encoder
Serial Kybd Data
Compare
Not Delay 3
Not Character Bksp
Not Manual Dup
Not LZ Key Latch Gate A
10
Buff C In
Verify Inhibit Wte
Buffer A Out
Verify
Not Verify Correct
KB121

9.21 VERIFY COLUMN 81

When column 80 has been verified and a character has not been rewritten in the record, the data in buffer A is transferred to buffer B. This transfer is similar to a punch data transfer operation, except that the transfer of the punch flags is inhibited.

The 2 and 3 interposer magnets are energized and a punch cycle (dummy cycle to set the interposers) is started.

Because the card is positioned with column 80 at the punch station, an escape cycle is started to advance the card to column 81.

When the escape cycle is complete, another punch cycle is started and column 81 is punched. The card then advances to the stacker. Another card is fed and registered if the REC ADV/CARD FEED switch is set to AUTO.

If a character in the record was rewritten, the card is not punched in column 81. Instead, the card is released from the punch station but it is not stacked. The data in buffer A is transferred to buffer B and the punch flags are also transferred to buffer B. A correction card may then be punched. See the verify correction card operation (9.21.1) for the sequence.

Circuit Objectives (Verify OK Punch)

1. Set the entry complete latch.
2. Set the data transfer latch. Reset the entry complete latch.
3. Set the verify complete latch. This latch energizes the 2 and 3 interposer magnets and inhibits transfer of the punch flags from buffer A to buffer B. Reset the data transfer latch when all 80 columns have been transferred.
4. Set the punch gate latch and start a punch cycle.
5. Set the scan latch.
6. Set the escape control latch.
7. Set the escape cycle latch and advance the card one column.
8. Reset the escape control latch.
9. Set the column 81 latch.
10. Reset the escape cycle latch.
11. Start another punch cycle (column 81 is punched during this cycle).
12. Set the scan latch.
13. Set the escape control latch.
14. Reset the punch gate and verify complete latches.
15. Set the escape cycle latch and advance the card one column.
16. Reset the escape control latch.

The card is advanced and stacked. If the REC ADV/CARD FEED switch is set to AUTO, another card is fed and registered.

Circuit Objectives (Error in Card)

1. Set the entry complete latch when column 80 is verified.
2. Set the data transfer latch and transfer the data in buffer A, including the punch flags, to buffer B. Reset the data transfer latch when all 80 columns have been transferred.
3. Set the escape cycle latch and advance the card.

The escape cycle is repeated twice more, advancing the card to the stacker. However, the card is not stacked. The verify rewrite control latch is reset.

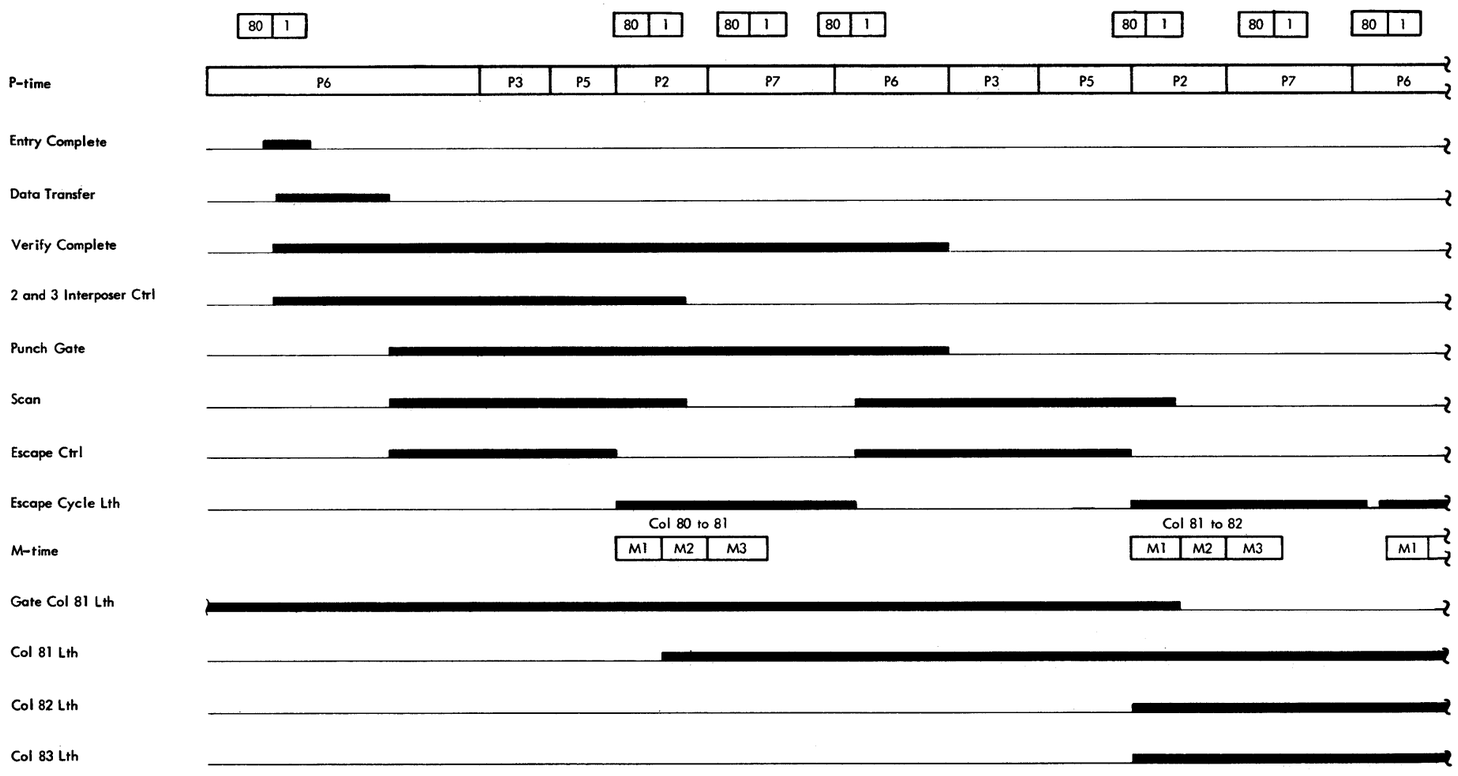
9.21.1 Verify Correction Card

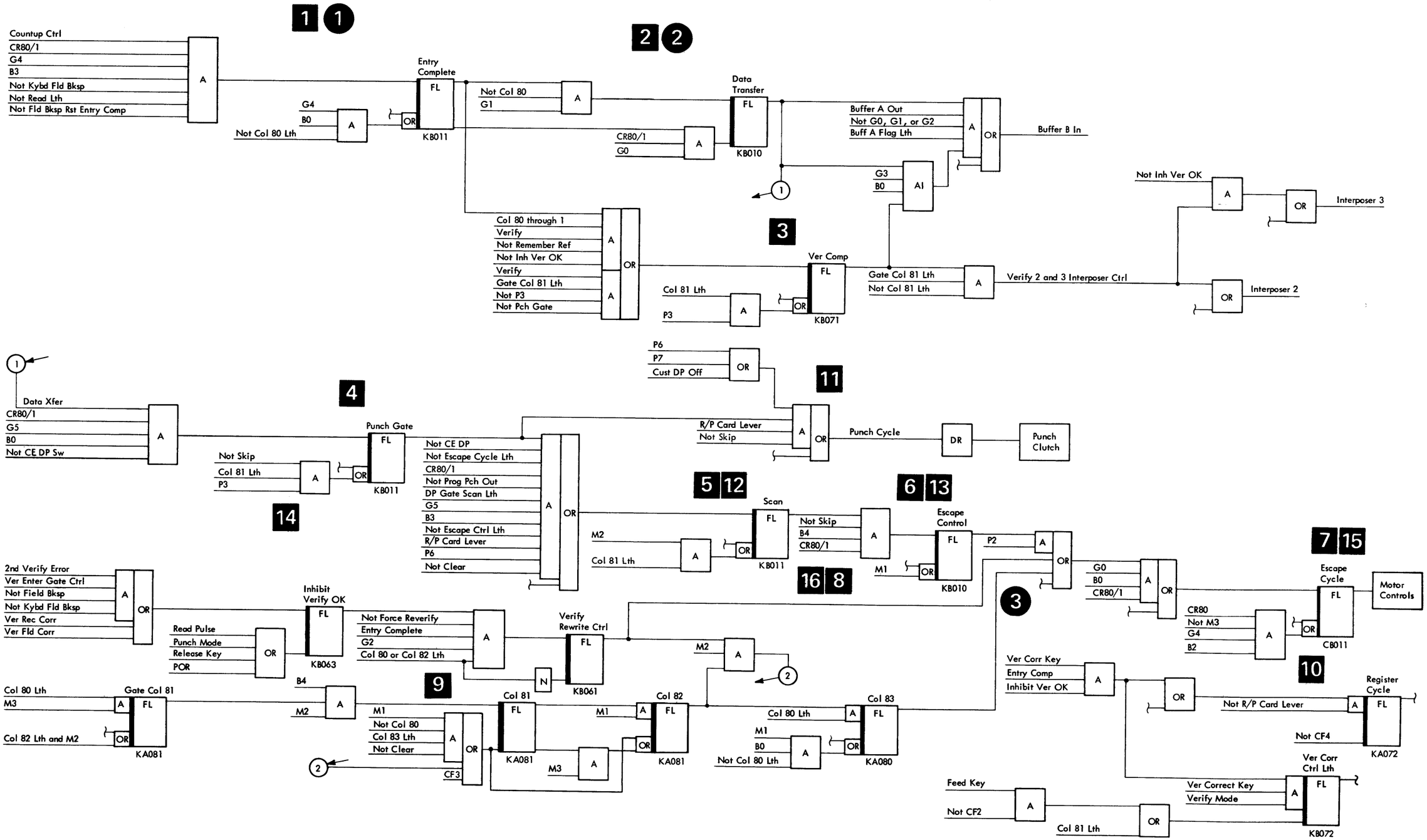
When a character has been rewritten in storage, and the error card has been released from the punch unit, CC is indicated on the column indicator. A blank card may be inserted at the pre-register station.

Pressing the VER CORR key registers the blank card and a normal punch operation (scan, escape, punch) occurs. When all 80 columns have been punched in the card, column 81 is punched with a 2 (OK). Punching the 2 in column 81 is similar to the verify OK punch operation, except that the 3-punch is inhibited by the verify OK latch.

Pressing the FEED key instead of the VER CORR key allows the next card to be verified without punching the correction card.

Verify OK Punch Sequence




1 1
Countup Ctrl
CR80/1
G4
B3
Not Kybd Fld Bksp
Not Read Lth
Not Fld Bksp Rst Entry Comp
A
G4
B0
Not Col 80 Lth
A
OR
Entry Complete
FL
KB011
Not Col 80
G1
A
2 2
Data Transfer
FL
KB010
CR80/1
G0
A
Buffer A Out
Not G0, G1, or G2
Buff A Flag Lth
A
OR
Buffer B In
G3
B0
AI
1
Not Inh Ver OK
A
OR
Interposer 3
3
Col 80 through 1
Verify
Not Remember Ref
Not Inh Ver OK
Verify
Gate Col 81 Lth
Not P3
Not Pch Gate
A
A
OR
Ver Comp
FL
KB071
Col 81 Lth
P3
A
OR
Gate Col 81 Lth
Not Col 81 Lth
A
Verify 2 and 3 Interposer Ctrl
OR
Interposer 2
P6
P7
Cust DP Off
OR
11
R/P Card Lever
Not Skip
A
OR
Punch Cycle
DR
Punch Clutch
1
Data Xfer
CR80/1
G5
B0
Not CE DP Sw
A
4
Punch Gate
FL
KB011
Not Skip
Col 81 Lth
P3
A
OR
14
Not CE DP
Not Escape Cycle Lth
CR80/1
Not Prog Pch Out
DP Gate Scan Lth
G5
B3
Not Escape Ctrl Lth
R/P Card Lever
P6
Not Clear
A
OR
5 12
M2
Col 81 Lth
A
Scan
FL
KB011
OR
6 13
Not Skip
B4
CR80/1
A
M1
Escape Control
FL
KB010
OR
16 8
P2
A
OR
7 15
G0
B0
CR80/1
A
OR
Escape Cycle
FL
CB011
Motor Controls
CR80
Not M3
G4
B2
A
OR
10
2nd Verify Error
Ver Enter Gate Ctrl
Not Field Bksp
Not Kybd Fld Bksp
Ver Rec Corr
Ver Fld Corr
A
OR
Inhibit Verify OK
FL
KB063
Read Pulse
Punch Mode
Release Key
POR
OR
Not Force Reverify
Entry Complete
G2
Col 80 or Col 82 Lth
A
9
N
Verify Rewrite Ctrl
FL
KB061
M2
A
2
Ver Corr Key
Entry Comp
Inhibit Ver OK
A
OR
Not R/P Card Lever
A
Register Cycle
FL
KA072
Not CF4
Col 80 Lth
M3
Gate Col 81
A
FL
OR
KA081
Col 82 Lth and M2
B4
M2
A
M1
Not Col 80
Col 83 Lth
Not Clear
A
OR
CF3
2
Col 81
FL
KA081
M1
A
Col 82
FL
KA081
OR
M3
A
Col 80 Lth
A
Col 83
FL
KA080
M1
B0
Not Col 80 Lth
A
OR
Feed Key
Not CF2
A
Col 81 Lth
OR
Ver Corr Ctrl Lth
Ver Correct Key
Verify Mode
A
FL
KB072

9.22 VERIFY SKIP/DUP

9.22.1 Verify Duplication

Data from a previously verified card read into buffer A is transferred to buffer B when the data transfer latch comes on (after all 80 columns have been verified). This data is then read out and matched with the data entered into buffer A from a detail card. Any difference between the contents of the two buffers causes a verify error.

Buffer B data is regenerated until a new master card is read in and verified.

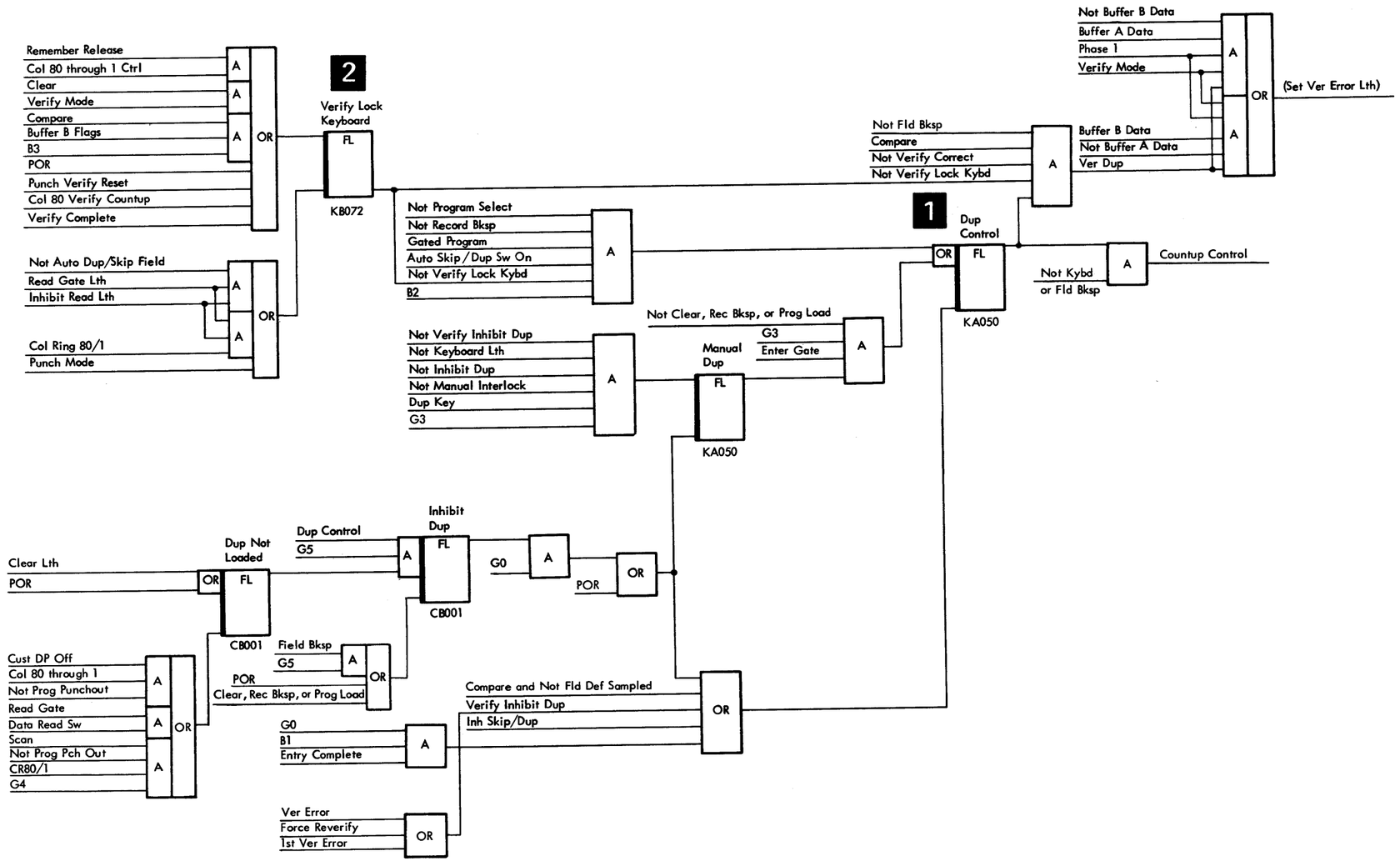
Circuit Objectives

1. The dup control latch can be set manually or under program control. The latch stays on until the DUP key is released or the program reaches the end of a dup field.
2. The verify lock keyboard latch makes sure that no more data matches take place once a verify operation has been ended or completed.

9.22.2 Verify Skip

An auto skip field in verify mode skips any data in that field.

In a manual verify field, if the SKIP key is pressed, a normal key verify entry sequence occurs and if the first column of the field contains data, a verify error occurs. If the column is blank, the field is skipped as in a normal (punch mode) skip operation, except the remainder of the field is not verified.



10.1 PRODUCTION STATISTICS

The production statistics feature counts keystrokes, cards, and verify correction keystrokes. The feature uses an FET buffer (buffer D) to hold the totals as they accumulate.

10.1.1 Keystroke Counter

This six-position counter (000,000 to 999,999) counts every data keystroke in punch and verify modes, and all functional keystrokes except: alpha, numeric, multipunch, feed, register, program select, dup, verify correction, and verify reset. The counter does not decrement. Overflow rolls the counter from 999,999 to 000,000 with no indication to the operator.

10.1.2 Card Counter

This four-position counter (0000 to 9999) counts every output record in punch mode, and every verify correct or correction punched card in verify mode. It does not count error cards in verify mode, program or data cards that are read in, or the production statistics total card. It counts program cards or accumulator total cards that are punched out. The counter does not decrement. Overflow rolls the counter from 9999 to 0000 with no indication to the operator.

10.1.3 Verify Correction Keystroke Counter

This four-position counter (0000 to 9999) counts each character rewrite keystroke in verify mode. The counter does not decrement. Overflow rolls the counter from 9999 to 0000 with no indication to the operator.

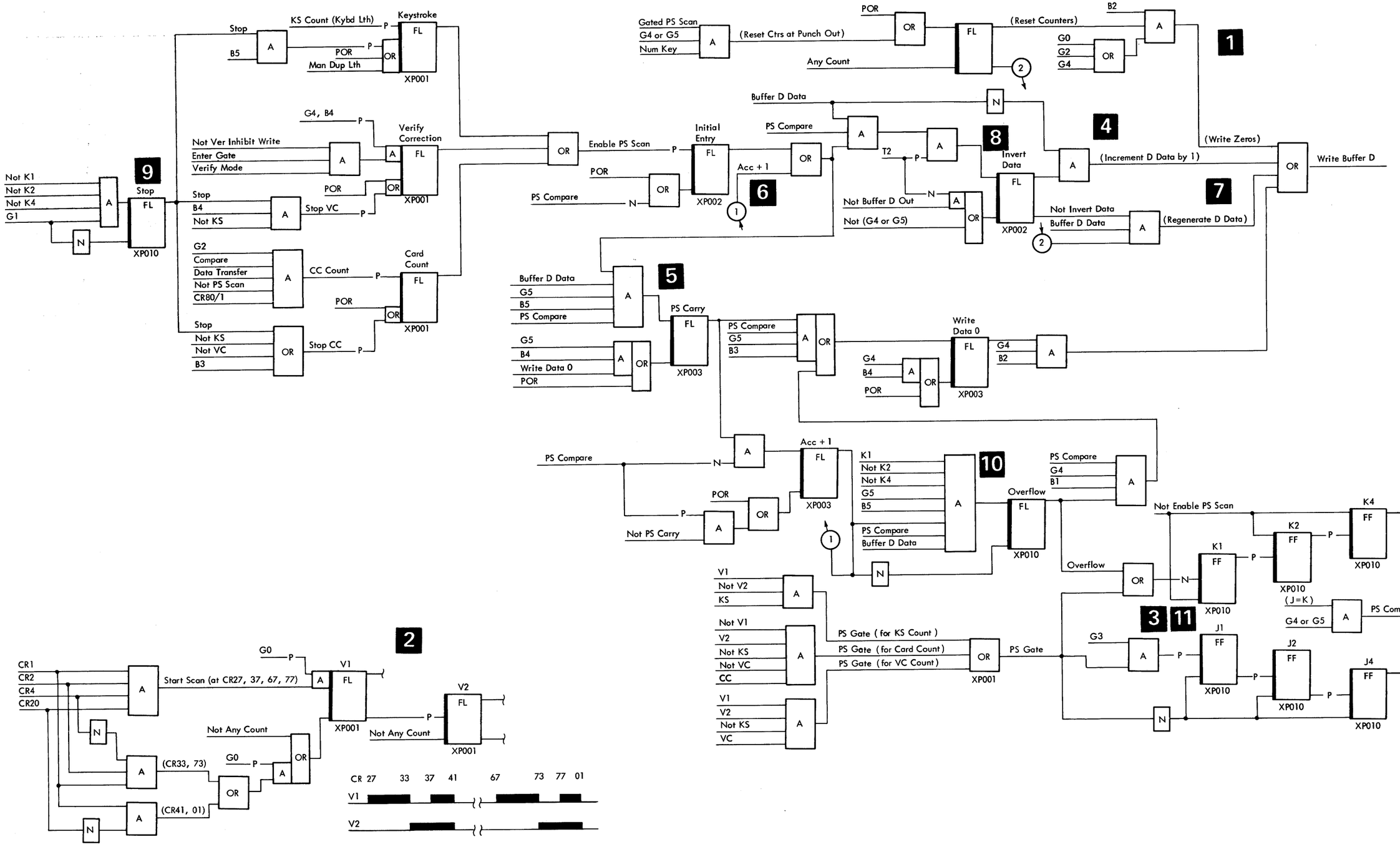
10.1.4 Punchout

All three totals can be punched out into columns 67 through 80 of a card at any time, under operator control (only 80 column cards will permit punch out of totals). Selective counter punchout is not possible. The operator can also control the resetting of the counters when they are punched out.

Totals are punched out without resetting the counters by:

1. Selecting the STAT PCH position on the PROGRAM MODE dial. This does not change the program level that was selected.
2. Registering a card at the punch/read station.
3. Punching information in columns 1 through 66 (if desired).
4. Pressing the REL key at (or before) column 67.

The counters are reset if a numeric key is pressed and held while the REL key is pressed.


Not K1
Not K2
Not K4
G1
N
A
9
Stop
FL
XP010
Stop
B5
A
KS Count (Kybd Lth)
P
POR
P
Man Dup Lth
OR
Keystroke
FL
XP001
G4, B4
P
Not Ver Inhibit Write
Enter Gate
Verify Mode
A
A
Verify Correction
FL
XP001
Stop
B4
Not KS
A
POR
Stop VC
P
OR
G2
Compare
Data Transfer
Not PS Scan
CR80/1
A
CC Count
P
POR
OR
Card Count
FL
XP001
Stop
Not KS
Not VC
B3
OR
Stop CC
P
OR
Enable PS Scan
P
POR
PS Compare
N
OR
Initial Entry
FL
XP002
Acc + 1
6
1
OR
Gated PS Scan
G4 or G5
Num Key
A
(Reset Ctrs at Punch Out)
POR
OR
FL
(Reset Counters)
Any Count
2
B2
A
G0
G2
G4
OR
1
Buffer D Data
N
PS Compare
A
T2
P
A
8
Invert Data
4
A
(Write Zeros)
(Increment D Data by 1)
OR
Write Buffer D
Not Buffer D Out
Not (G4 or G5)
N
A
OR
FL
XP002
Not Invert Data
Buffer D Data
A
(Regenerate D Data)
7
2
Buffer D Data
G5
B5
PS Compare
A
5
PS Carry
FL
XP003
G5
B4
Write Data 0
POR
A
OR
PS Compare
G5
B3
A
OR
Write Data 0
FL
XP003
G4
B4
POR
A
OR
G4
B2
A
PS Compare
N
A
Acc + 1
FL
XP003
POR
OR
P
Not PS Carry
A
K1
Not K2
Not K4
G5
B5
PS Compare
Buffer D Data
A
10
1
N
Overflow
FL
XP010
PS Compare
G4
B1
A
Overflow
OR
Not Enable PS Scan
N
K1
FF
XP010
K2
FF
P
XP010
K4
FF
XP010
(J=K)
3 11
G3
A
P
J1
FF
XP010
J2
FF
P
XP010
J4
FF
P
XP010
N
A
PS Compare
G4 or G5
V1
Not V2
KS
A
Not V1
V2
Not KS
Not VC
CC
A
PS Gate (for KS Count)
PS Gate (for Card Count)
PS Gate (for VC Count)
OR
XP001
PS Gate
V1
V2
Not KS
VC
A
CR1
CR2
CR4
CR20
A
Start Scan (at CR27, 37, 67, 77)
G0
P
A
V1
FL
XP001
P
Not Any Count
V2
FL
XP001
Not Any Count
N
A
(CR33, 73)
G0
P
A
OR
OR
A
(CR41, 01)
N
CR 27
33
37
41
67
73
77
01
V1
V2

Circuit Objectives

1 At power on, 0's are written into buffer D and the column ring in the base machine is started.

2 V1 and V2 latches, which are controlled by the column ring, determine when an entry can be made to buffer D:

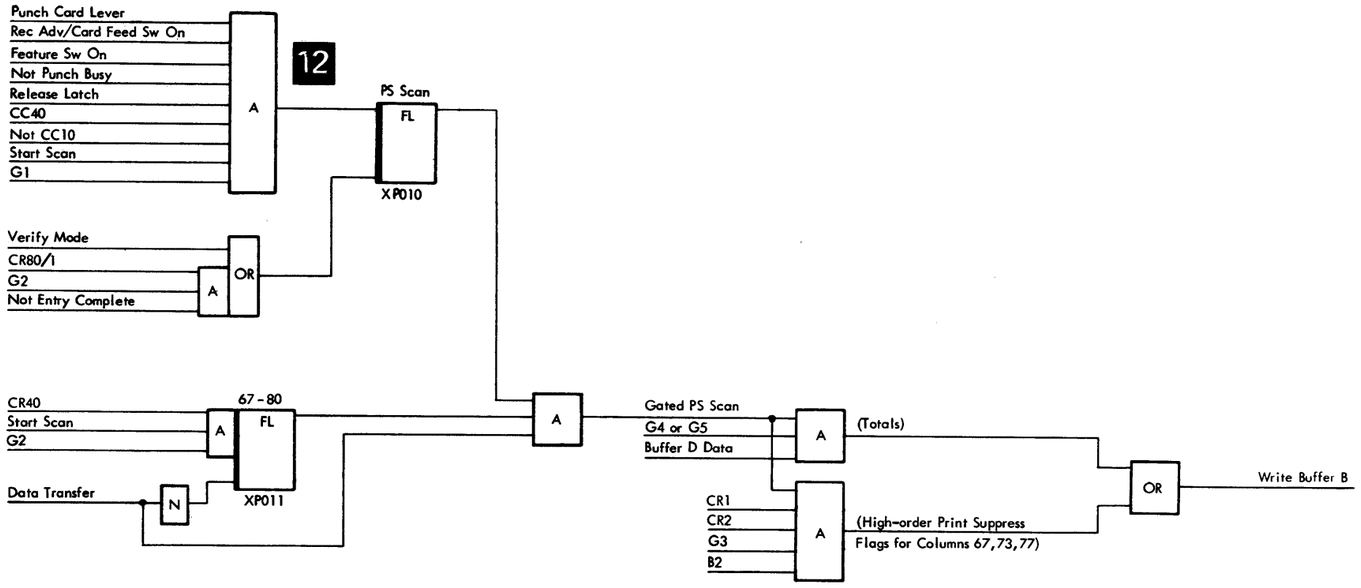
CR	*Buffer D Portion*
27-33 67-73	Keystroke Count
33-37 73-77	Card Count
37-41 77-01	Verify Correction Count

3 Two 6-position counters, J and K, together identify the individual positions (units, tens, and so on) of the three counters in buffer D. The K-counter is set to 6 before counting starts. It decrements by 1 each time that all positions of one of the three counters have been scanned. The J-counter increments by 1 for each CR time within each counter section of buffer D. For example, the J-counter increments six times between CR27 and CR33. When the J- and K-counters are equal, a PS compare pulse is generated.

4 Counting is performed by changing a digit in buffer D to the next higher digit (a 0 becomes a 1, and so on). A digit is changed by reading it out of the buffer and regenerating it one pulse later.

5 Incrementing starts at the low-order position of a counter. However, all positions of that counter must be scanned to see if any position other than the low-order must also be incremented. For example, when the KS counter contains 000299 (decimal) and a key is pressed, the counter must be incremented to 000300. At CR32, the units position is incremented to 0. The next time the tens position can be examined is at CR71. At this time, the acc +1 latch increments the tens position 6

7 Positions of a counter that do not change when the counter is incremented must be regenerated, unchanged. The initial entry latch is off because there is no PS compare pulse. Therefore, the invert data latch is not turned on 8



Buffer D (RA020)

CR 27 CR 67							33 73				37 77			41 01
	← Keystroke Count →						← Card Count →				← Ver Corr Count →			
0	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Units	Thousands	Hundreds	Tens	Units	Thousands	Hundreds	Tens	Units
1														
2														
3														
4														
5														
6														
7														
8														
9														

9 After three complete CR cycles, the six-position KS counter (or the four-position card counter or VC counter) has been completely scanned and the counter has decremented to 0. The stop latch prevents further scanning and sets the K-counter back to 6.

10 When a counter contains all 9's and it is incremented, it goes to all 0's (with no indication).

11 In counting cards or verify correction keystrokes, two dummy CR cycles are required to decrement the K-counter from 6 to 4 before counting is started. During the two dummy CR cycles, no PS compare pulse is generated.

12 For punching out totals, information in buffer D is transferred to buffer B, starting at column 67 of a data transfer operation. The PS scan latch inhibits the skip flags that are normally generated during a release operation. The latch also gates the totals from buffer D to buffer B during data transfer. Print suppress flags are written into the high-order position of each counter as it enters buffer B.

Note: The production statistics feature, with the exception of buffer D, is packaged in two cards.

10.2 ACCUMULATE

The accumulate feature allows card fields to be added under program control. The feature program, which is held in buffers that are separate from the base machine, determines which field or fields are accumulated. Only program levels 1 and 2 are active in the basic feature. Program levels 3 through 6 are available as an additional feature.

Accumulation occurs only after a complete record has been keyed into the base machine and transferred to the output buffer (B). As a result, on a verify machine, only verified or verify-corrected data is accumulated.

There are three separate 14-position accumulators. The program routes data to each accumulator as follows:

Program Punch	*Accumulator*
5	1
6	2
7	3

Any combination of the three program punches is correct; data enters the corresponding accumulators. The program punch (or punches) must be in the first column of a field. Field definition must start in the second column and continue to the last column of the field.

Positive and negative fields are accumulated. A negative field is defined by an 11-punch in the units position of the field.

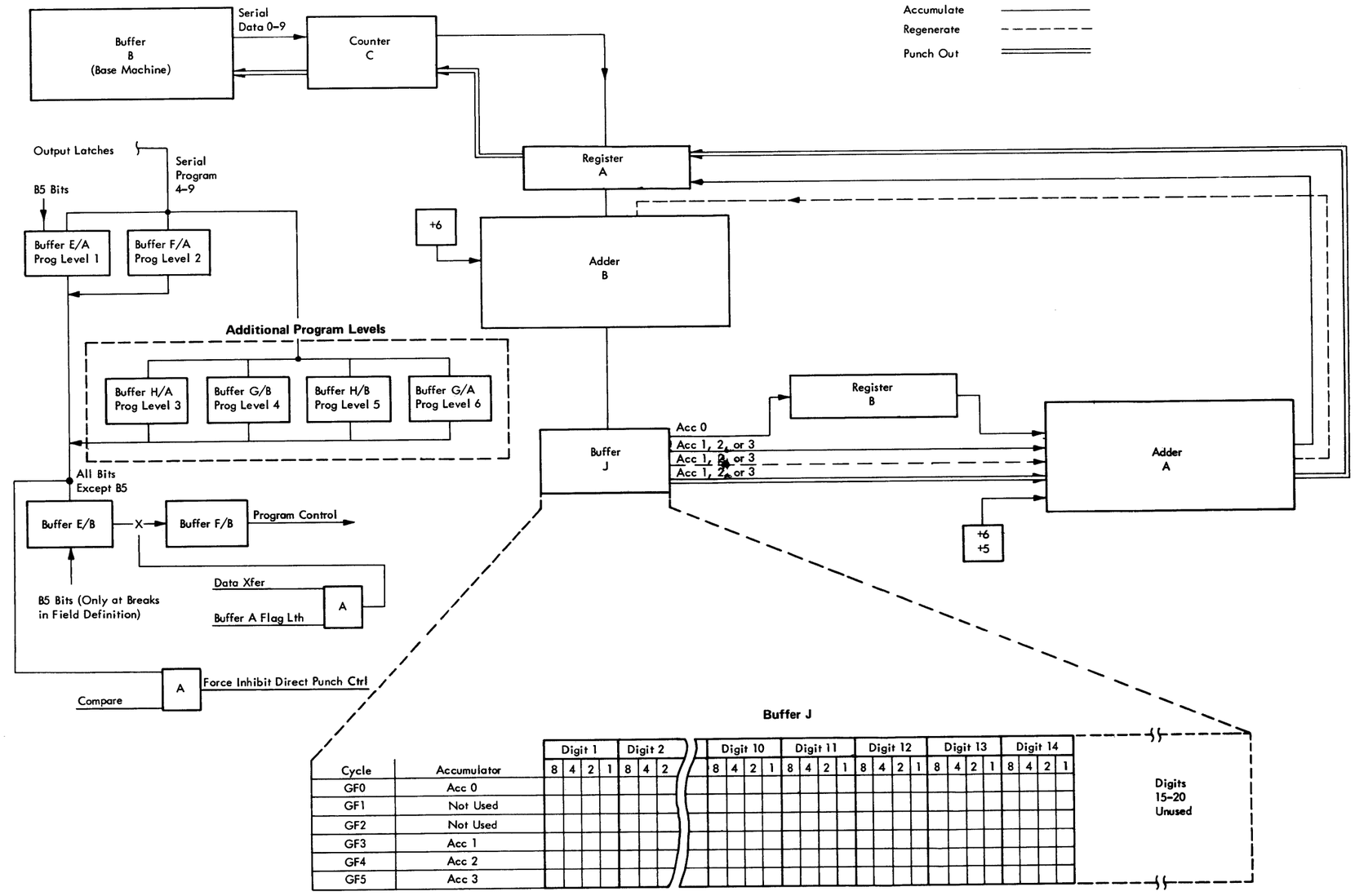
Totals are punched out under program control. Verification of totals on a verify machine is performed automatically, under program control.

10.2.1 Operation

During an accumulate cycle, the contents of a field in buffer B are added to the amount already in the designated accumulator (or accumulators). Buffer B data is converted to its BCD form and set into accumulator 0, which is a working accumulator for accumulators 1, 2, and 3. When the complete field has entered accumulator 0, addition begins.

Starting at the units position, accumulator 0 and the designated accumulator are combined in adder A. The sum from adder A enters adder B (via register A), where carry corrections are inserted. Then the sum enters the designated accumulator and the accumulate cycle is completed. Unused accumulators are regenerated during an accumulate cycle; all accumulators are continuously regenerated when no accumulation is taking place.

During punchout of totals, the designated accumulator is gated, starting at the high-order position, through adder A to register A. During punchout, adder A performs no function other than to provide a path to register A. Each column of the accumulator is converted to its base machine form in counter C. The data then enters buffer B in the base machine. Punchout starts when (1) the first column of an accumulate field has been transferred, or (2) a complete punch field has been transferred, or (3) column 80 has been processed.



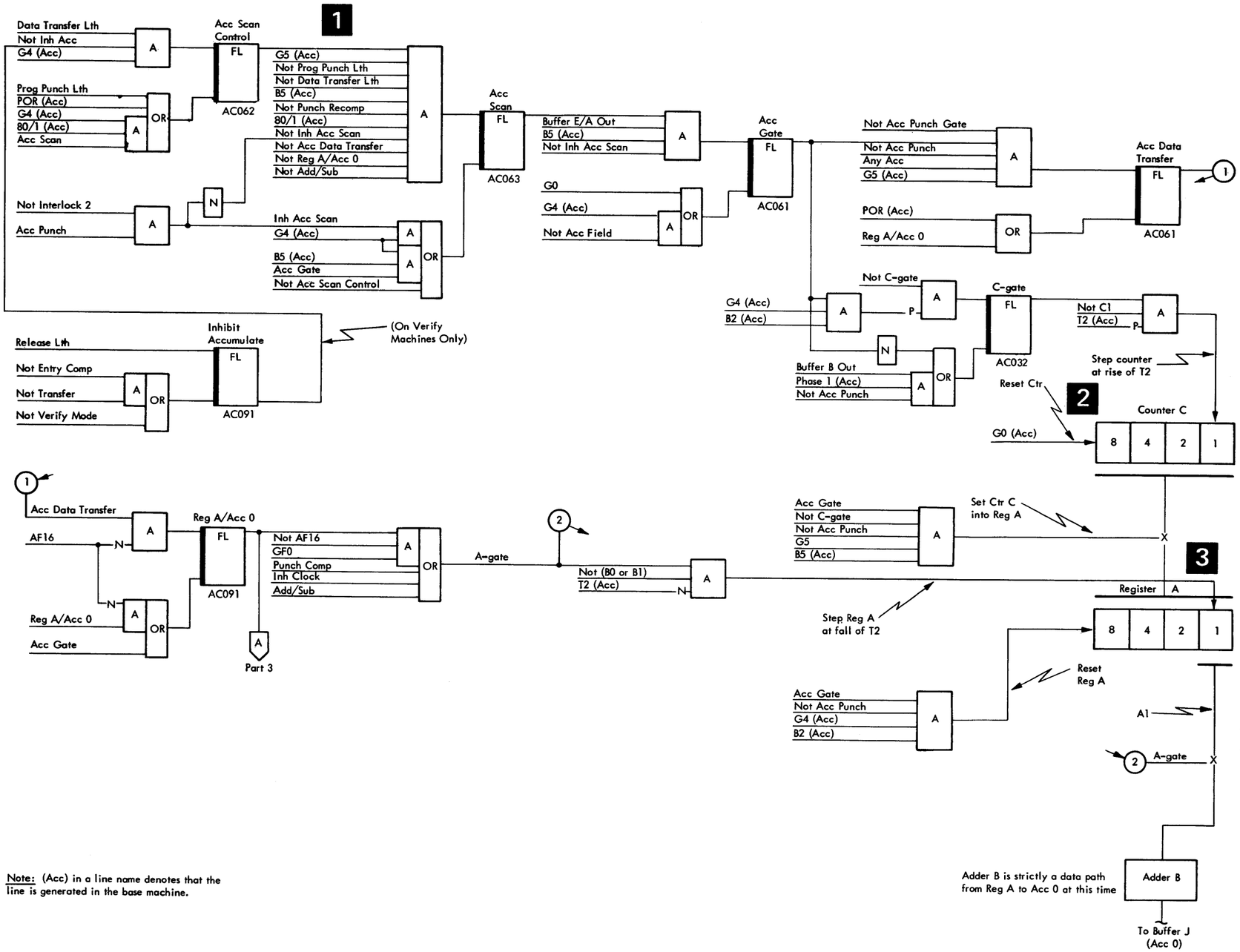
Accumulate Feature (Part 1 of 8)

10.2.2 Load Accumulator 0

1 When data in the base machine is transferred from buffer A to buffer B, the accumulate scan control latch comes on. When the transfer latch goes off, the accumulate scan latch comes on. When a B5 flag from the buffer E/A is detected, the accumulate gate latch comes on at G3, B3. However, the latch is reset at G4, unless the machine enters an accumulate field.

2 Data from buffer B in the base machine enters four-position counter C, one column at a time. Counter C converts the data to its binary form as follows: The counter starts at the rise of G4, B3 (the first T2 after G4, B2). It steps once at the rise of each T2 pulse until a data pulse from buffer B occurs. Counter C is then sitting at the BCD equivalent of that buffer B pulse.

3 The complete binary digit is set into register A. The A-gate line gates position A1 to accumulator 0, via adder B. At this time, adder B performs no function other than to provide a path to accumulator 0. The A-gate line also shifts each bit in register A one position to the right (toward position A1) at the fall of each T2 pulse. As a bit enters position A1, it is gated to accumulator 0. At the end of GF0, the complete binary digit is in the units position of accumulator 0.



Note: (Acc) in a line name denotes that the line is generated in the base machine.

Accumulate Feature (Part 2 of 8)

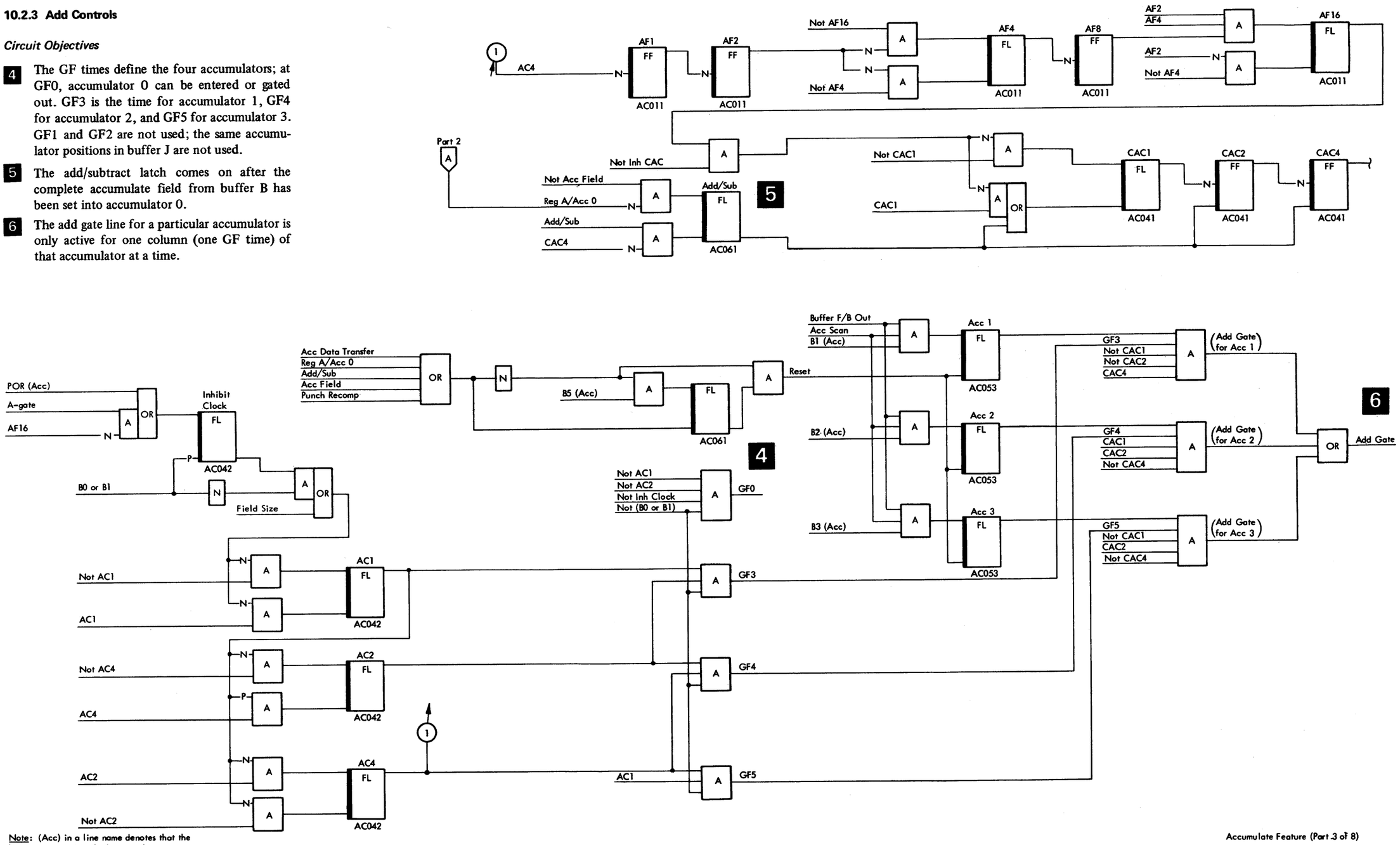
10.2.3 Add Controls

Circuit Objectives

4 The GF times define the four accumulators; at GF0, accumulator 0 can be entered or gated out. GF3 is the time for accumulator 1, GF4 for accumulator 2, and GF5 for accumulator 3. GF1 and GF2 are not used; the same accumulator positions in buffer J are not used.

5 The add/subtract latch comes on after the complete accumulate field from buffer B has been set into accumulator 0.

6 The add gate line for a particular accumulator is only active for one column (one GF time) of that accumulator at a time.



Note: (Acc) in a line name denotes that the line is generated in the base machine.

Accumulate Feature (Part 3 of 8)

10.2.4 Positive Accumulation

Circuit Objectives

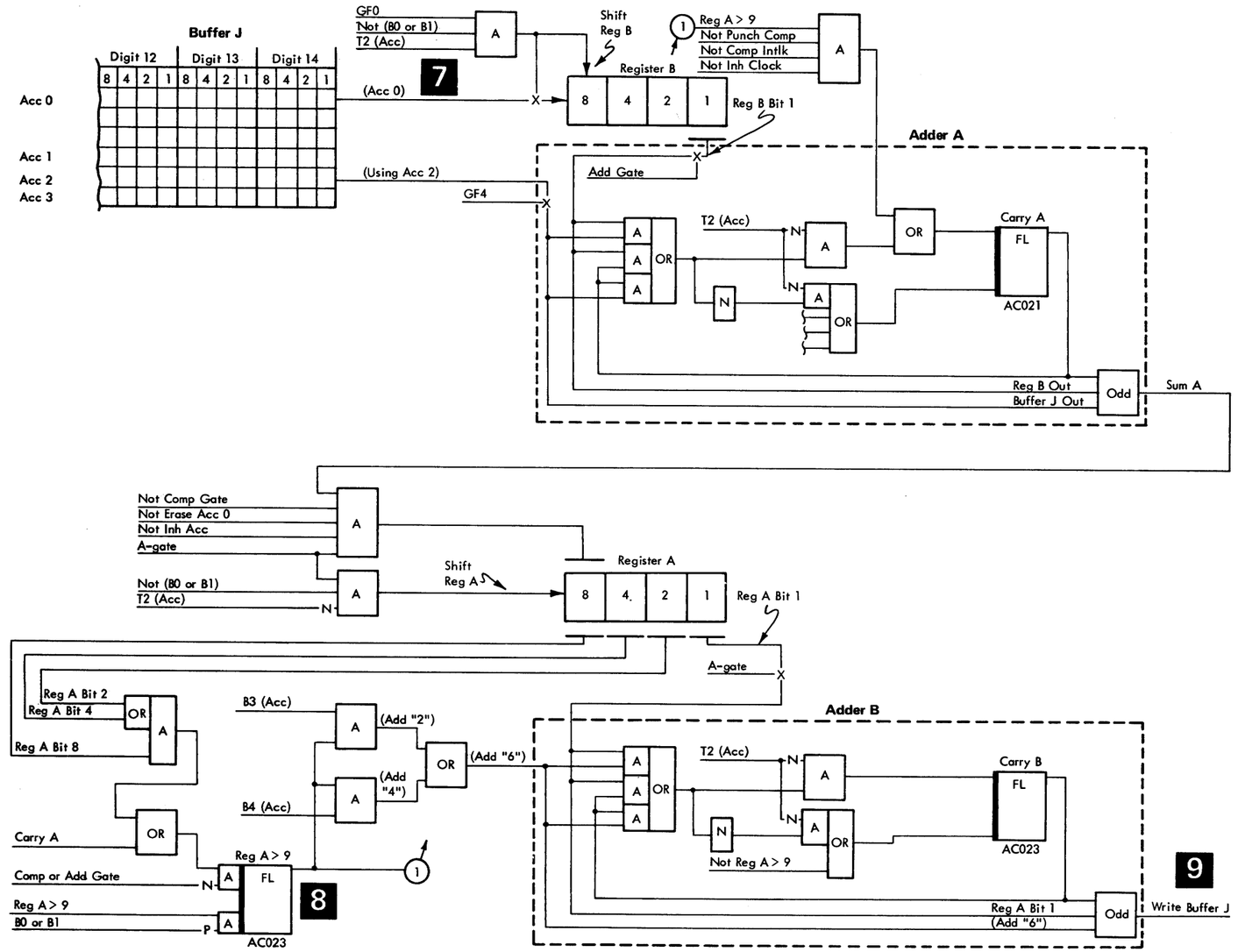
7 At GF0, the units position of accumulator 0 is gated to register B. If accumulator 2 is being used, its units position is gated to adder A at GF4. GF4 also brings up the add gate for accumulator 2, which gates the data in register B to adder A. Adder A forms a sum of the units position by checking each bit of the binary digit. Each T2 pulse shifts the contents of register B one position to the right toward B1, so that B1 is the only input to adder A from register B. A carry is formed when an input from both accumulators is present. After the carry latch turns on, it stays on until the carry can be inserted. Each bit of the sum from adder A is gated to register A and shifted toward the units position, until the complete sum of one column has been gated in.

8 If register A is larger than 9, a correction figure of 6 is added to register A when it is gated to adder B. Also, the carry A latch is set for the starting point of the next column. The following is an example of a correction:

If register A contains 1 1 0 0 (12)
0 1 1 0 (6)

A correction of 6 gives 0 0 1 0 (the "2" of "12") and carry to the next column

9 The output of adder B is written into the accumulator being used.



Note: (Acc) in a line name denotes that the line is generated in the base machine.

Accumulate Feature (Part 4 of 8)

10.2.5 Negative Accumulation

A negative number is accumulated as follows:

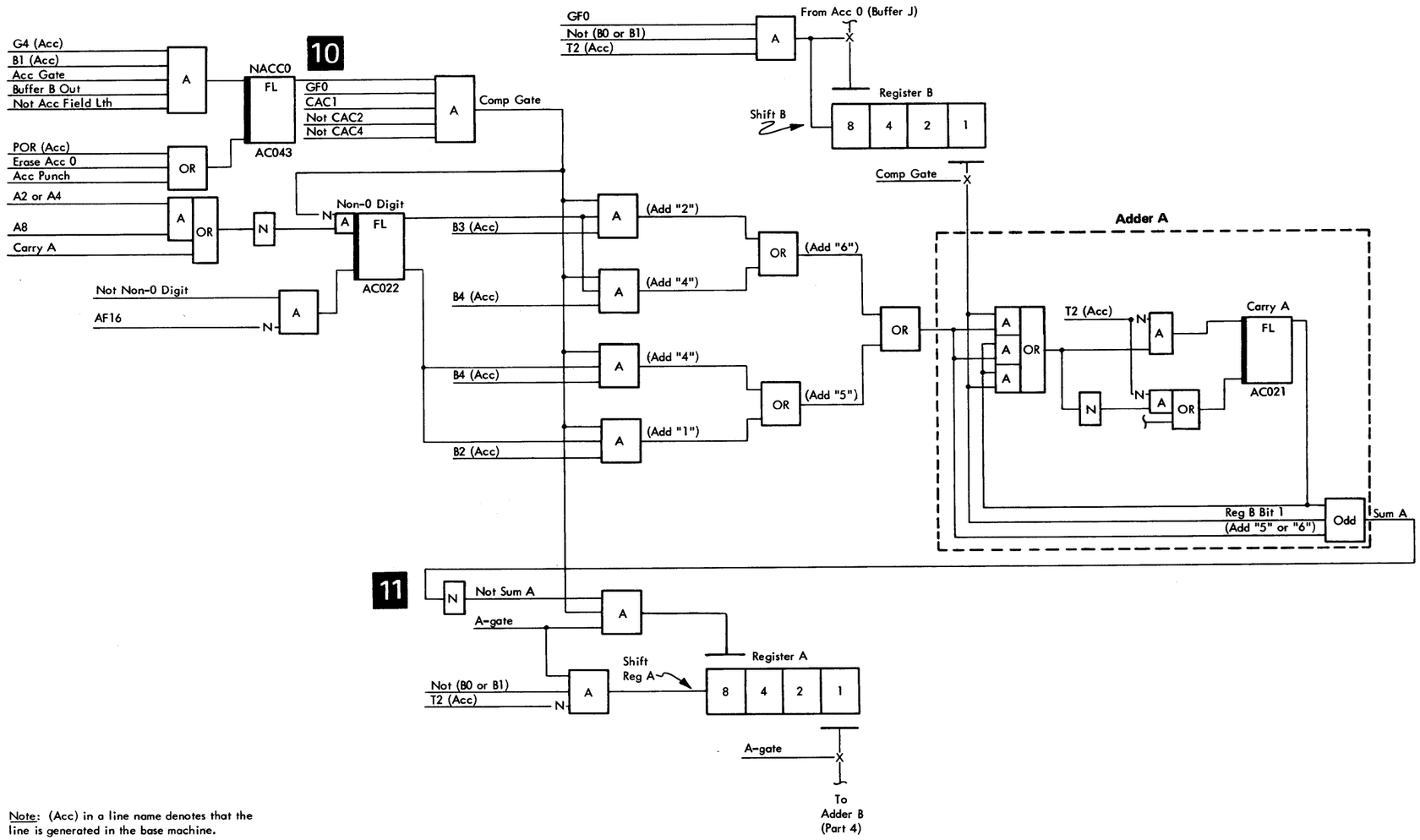
1. The number is gated from buffer B to accumulator 0, the same as for a positive number.
2. The number is complemented in adder A and register A. Then it is gated back to accumulator 0 in complement form.
3. Addition takes place between the complement number in accumulator 0 and the number in the accumulator being used.

Circuit Objectives

10 The accumulate field latch goes off as the units position of buffer B enters accumulator 0. If an 11 (G4, B1) is present in the units position, the NACC0 latch comes on. This latch generates a complement gate that forms the complement of accumulator 0, as follows:

When the units position of accumulator 0 is gated to adder A, a 5 is added to it (the non-0 digit trigger is off). For following columns, either a 5 or 6 is added, depending on the condition of the non-0 digit latch. This latch comes on after the first nonzero digit is encountered from buffer J.

11 The *inverted* form of sum A is then set back into accumulator 0. When the complete contents of accumulator 0 have been complemented, the add gate line is turned on and addition takes place, the same as for a positive number.



Note: (Acc) in a line name denotes that the line is generated in the base machine.

10.2.6 Total Punchout—Positive Total

Under program control, totals are gated from the accumulator to buffer B, starting at the high-order position of the accumulator. The accumulator may or may not be reset, as determined by the program:

Program Punch	*Operation*
4, 5	Punch out accumulator 1
4, 5, 8	Punch out and reset accumulator 1

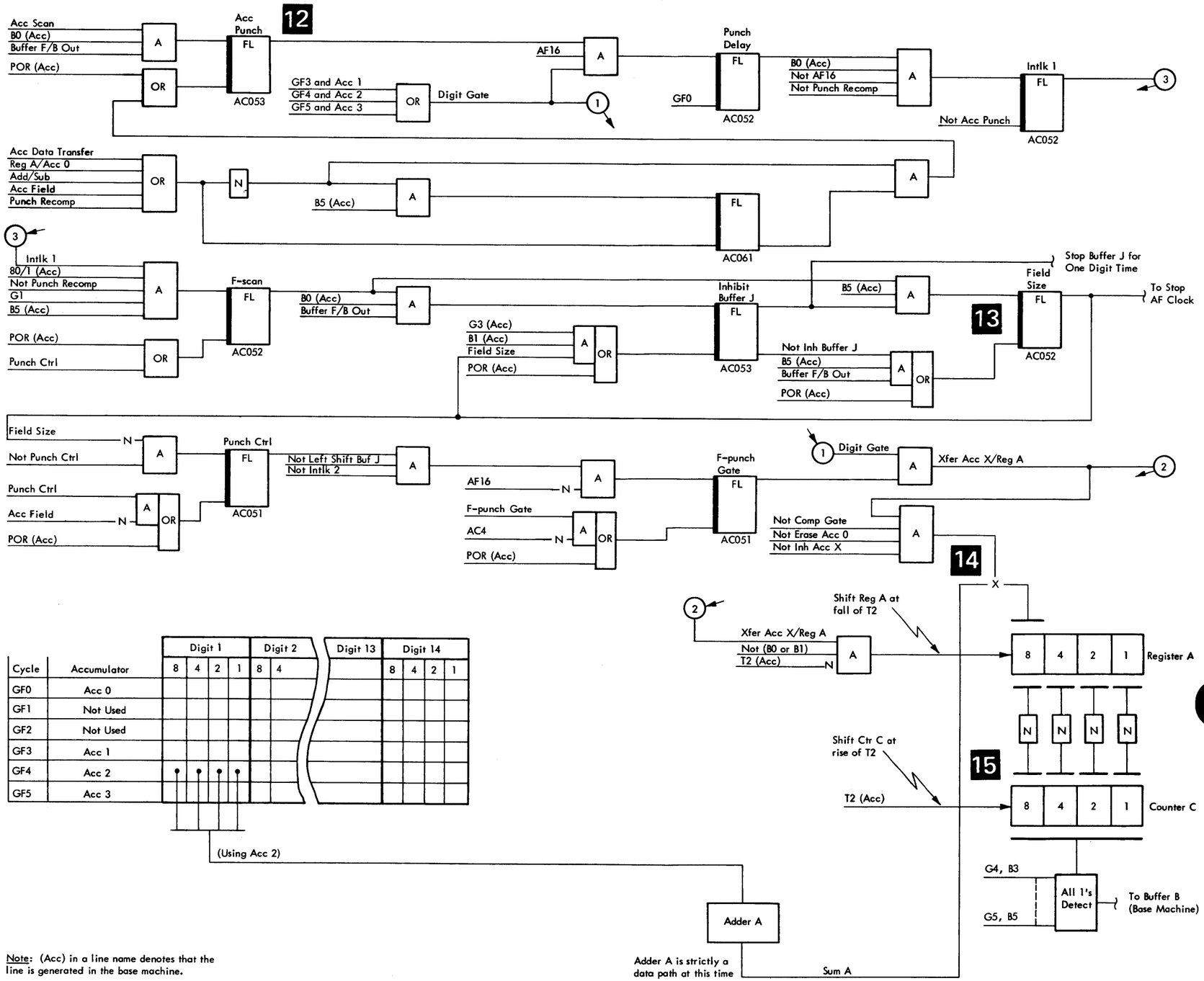
Circuit Objectives

12 The accumulator punch latch comes on when a punch flag is detected in the program buffer (F/B).

13 The inhibit buffer J latch stops buffer J for one digit time. The field size latch stops the AF clock until the high-order flag (B5) of the next field is recognized in buffer F/B. These two latches make sure that, at digit time, the high-order position of the accumulator is the first one gated out to register A.

14 The first of the four bits of the binary digit being outgated is set into position 8 of register A. As each bit is gated in, register A is shifted one position to the right (toward A1).

15 When the entire four-bit digit is in register A, the digit is inverted and set into counter C. The counter is then stepped at each T2 pulse until the counter contains all 1's. The *time* that counter C reaches all 1's is the same as the base machine digit time of the character that was originally gated into the counter from register A. The character pulse is gated to buffer B in the base machine.



Note: (Acc) in a line name denotes that the line is generated in the base machine.

Accumulate Feature (Part 6 of 8)

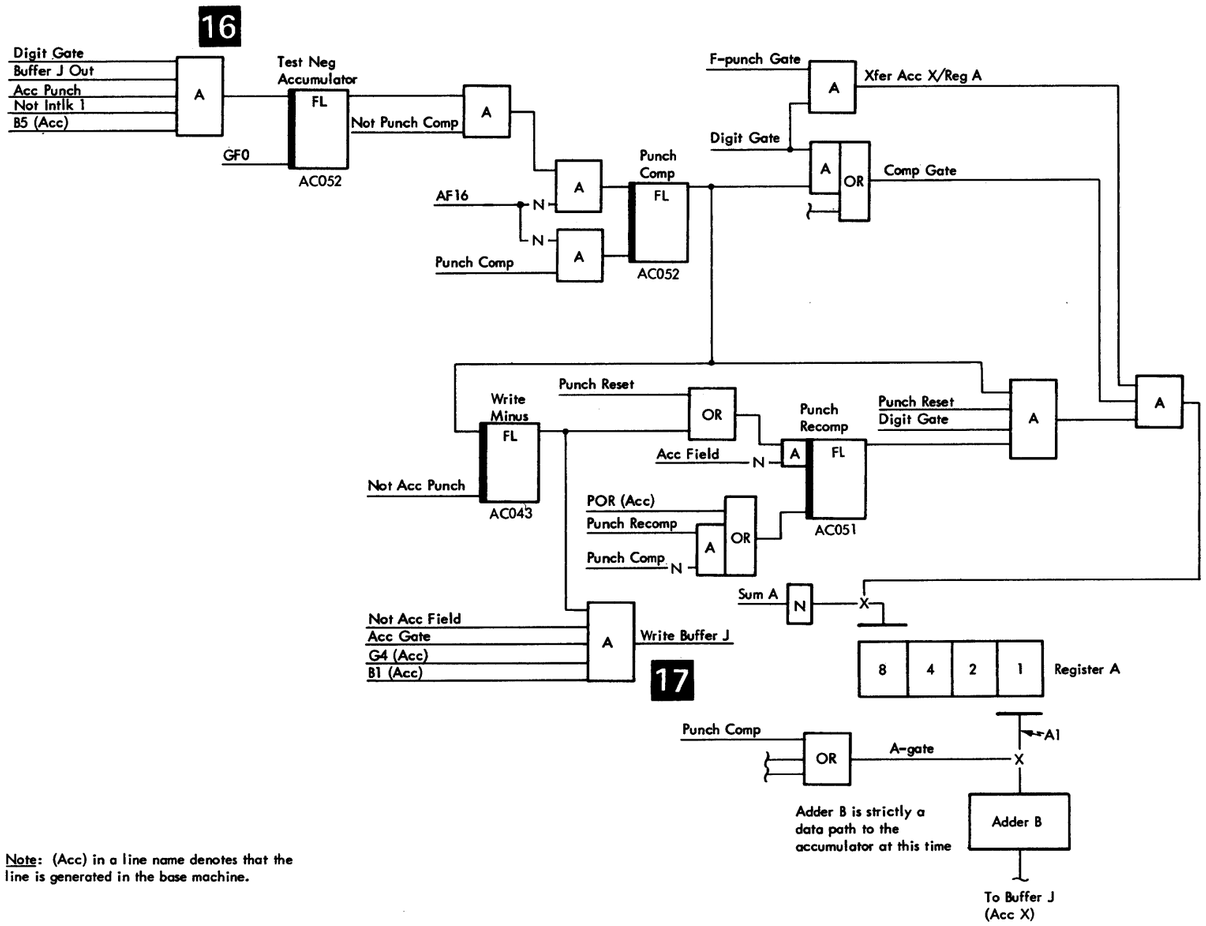
10.2.7 Total Punchout—Negative Total

A negative total, which is stored in an accumulator in complement form, is recomplemented and set back into the accumulator before it is punched out.

Circuit Objectives

16 A positive total has 0's in its unused positions (positions 15 through 20). A negative total has 9's in these positions. When the accumulator punch latch comes on, position 20 is the first accumulator position encountered. If this position contains an 8-bit (B5), the bit is recognized as being part of a binary 9. The 8-bit identifies the total as being negative, and the punch complement latch is set. This latch provides a complement gate, which inverts each bit from the accumulator as the bit enters register A. The punch complement latch brings up the A-gate line to gate the contents of register A back to the accumulator (via adder B). Once the recomplemented total is back in the accumulator, punchout begins. Refer to total punchout—positive total (10.2.6).

17 When the units position of the accumulator is gated to buffer B during punchout, an 11 (X-punch) is also gated. The X-punch in the units position of the total card identifies the total as being negative.



Note: (Acc) in a line name denotes that the line is generated in the base machine.

Accumulate Feature (Part 7 of 8)

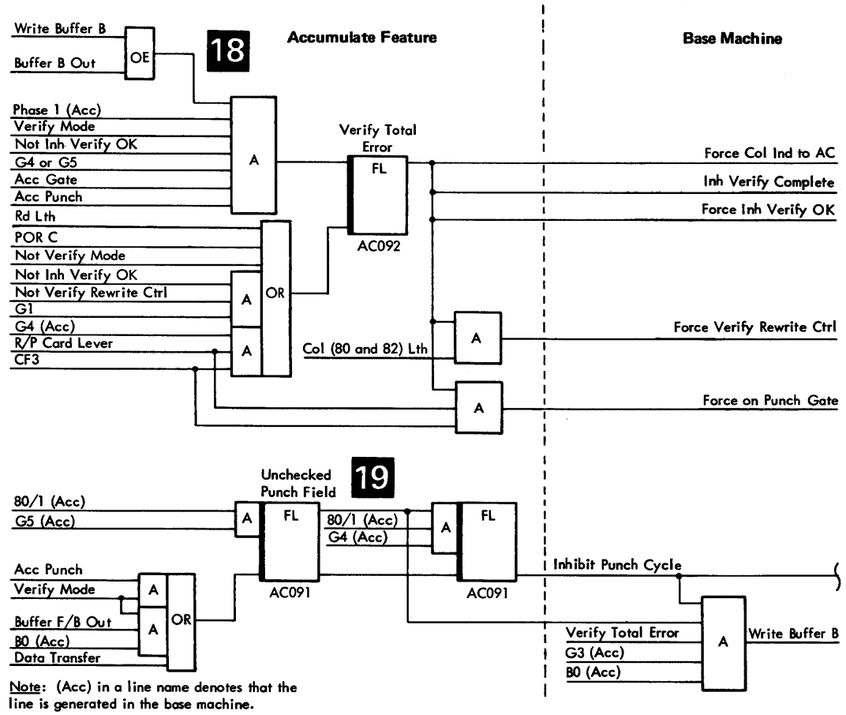
10.2.8 Verify Totals

Verification of totals is done automatically on verify machines.

Circuit Objectives

18 A comparison occurs between the totals punched into a total card and the contents of the accumulator (or accumulators). An unequal comparison sets the verify total error latch. This latch first forces the column indicator to 88, and then to AC. The latch also forces a verify error condition in the base machine.

19 If a total has been punched out but not verified, the unchecked punch field latch is reset and the 2 and 3 (OK) punches in column 81 are inhibited. Once the field has been verified, punching is allowed.



Note: (Acc) in a line name denotes that the line is generated in the base machine.

Accumulate Feature (Part 8 of 8)

10.3 SELF-CHECK

10.3.1 Introduction

The self-check feature makes sure that all digits of a number, such as an account or a part number, have been correctly keyed; only the variable data, such as quantities and amounts, need be verified in a second operation.

The self-check feature is available in two models: modulus 10 and modulus 11. Modulus 10 detects common types of errors: the incorrect keying of single digits and single transpositions. Modulus 11 detects the incorrect keying of single digits, single transpositions, and double transpositions. Programming and operating procedures are the same for both models. Note that either the modulus 10 or modulus 11 feature may be installed, but not both on the same machine.

The use of the self-check feature requires that a check digit be generated for each number to be self-checked. The check digit is always the units digit of the self-checking number. This becomes the self-check number, one digit longer than the original basic number.

The self-check field is programmed with a 2-punch in both the high- and low-order field positions, in addition to the normal field definition. No other program codes are needed. Checking can be performed in verify mode by manual keying, or it can be performed automatically if the cards were punched on a machine without the self-check device.

No special information is required by personnel who record these numbers on the original document, or by operators who enter the number on the card. When a self-check number is correctly keyed (including the check digit), normal machine operation is not affected or interrupted.

Self-checking numbers of modulus 10 are not compatible with those of modulus 11. Self-check digit generation, self-check punch elimination, and left-base numbers are not available for modulus 10 and modulus 11.

10.3.2 Modulus 10 Calculations

Modulus 10 detects incorrect keying of single digits and single transpositions. The following process is used to generate the check digit.

1. The units position and each alternate position of the basic code number are multiplied by 2.
2. A sum is formed of the products and the digits in the basic code number that are not multiplied by 2.

Example of Generating the Check Digit (Modulus 10)

Basic code number	6		1		2		4		8	
Units and every alternate position of basic code number	6				2				8	
Multiply by 2								×	2	
Product	1	2			4			1	6	
Digits not multiplied by 2			1			4				
Sum	1 + 2 + 1 + 4 + 4 + 1 + 6 = 19									
Next higher number ending in 0									20	
Subtract crossfooted total									−19	
Check digit									1	
Self-checking number							6	1	2 4 8 1	

3. The sum is subtracted from the next higher number ending in 0.
4. The difference is the check digit.

During the self-check operation, the same calculation is performed automatically; the total is added to the check digit and the sum is divided by 10. A remainder other than 0 indicates a self-check error.

In modulus 10 self-checking, the space and the 0 have the same numeric value, so that insignificant (leading) 0's may be replaced by spaces. The use of spaces is valid only when they are keyed. When the calculations on the basic number result in a check digit of 10, the digit 0 becomes the units digit of the self-checking number. Ten and 0 have the same value in this part of the calculation.

10.3.3 Modulus 11 Calculations

Modulus 11 detects single-digit keying errors and single or double transpositions. The main feature that separates the modulus 11 feature from other self-checking number systems is that modulus 11 is based on a weighted checking factor for each digit in the basic number being tested.

The following arithmetic process is used in modulus 11:

1. Each digit position of any basic number is assigned a weight (checking factor). The factors are 2, 3, 4, 5, 6, 7, 2, 3, 4, and so on, starting with the units position of the number and continuing toward the high-order position.
2. Multiply each digit by its checking factor and add the products.

Example of Generating the Check Digit (Modulus 11)

Basic number	9 4 3 4 5 7 8 4 2
Write digits of basic number	9 4 3 4 5 7 8 4 2
From right to left, write checking factors	4 3 2 7 6 5 4 3 2
Add the products	36 + 12 + 6 + 28 + 30 + 35 + 32 + 12 + 4 = total 195
Divide	195 divided by 11 = 17 plus a remainder of 8
Subtract	8 subtracted from 11 = 3 (the check digit)
Self-checking number	9 4 3 4 5 7 8 4 2 3

3. Because this is a modulus 11 operation, divide the sum of the products by 11, and subtract the remainder from 11. The result is the check digit.

In modulus 11 operation, basic numbers that require a check digit of 10 cannot be used as self-checking numbers. When the calculations on the basic number result in a check digit of 11, the digit 0 becomes the units digit of the self-checking number. Eleven and 0 have the same value in this part of the calculation.

10.3.4 Programming

A self-check field is programmed with a 2-punch in both the high- and low-order positions of the field, in addition to the normal field definition. Self-check fields may be partially or completely auto skipped or duped. In verify mode, an auto skip field is checked; in punch mode, the field is not checked.

Type of Field	Prog Code	Field Length: High Order				Units Pos
Manual	12		X	X	X	X
	11					
	0					
	2	X				X
Auto Dup	12		X	X	X	X
	11					
	0	X				
	2	X				X
Partial Auto Dup	12		X		X	X
	11					
	0	X				
	2	X				X
Auto Skip	12		X	X	X	X
	11	X				
	0					
	2	X				X
Manual with One Column Auto Skipped	12		X	X	X	X
	11			X		
	0					
	2	X				X
Partial Auto Dup with One Column Auto Skipped	12		X		X	X
	11				X	
	0	X				
	2	X				X
Auto Dup with One Column Auto Skipped	12		X	X	X	X
	11			X		
	0	X				
	2	X				X
Auto Skip with One Column Auto Skipped	12		X	X	X	X
	11	X		X		
	0					
	2	X				X

Note: Shaded area is auto portion of the field.

These rules apply when programming a self-check field:

- SC fields may be next to each other.
- Maximum length of an SC field is 79 columns.
- Left zero and self-check cannot be programmed in the same field.
- Every column to be auto skipped must have an 11-punch in the program.
- Single-column skips cannot be programmed in the high-order or units position of an SC field.
- Single-column skips cannot be programmed in the first manual columns after a partial auto dup.
- Self-check and accumulate cannot be programmed in the same field.

10.3.5 Operating Procedures

With a self-check field defined in the program, the self-checking number is keyed as it appears on the source document. Automatic calculations verify the correctness of the keystroke or of the self-checking number. If no self-check errors are detected, the keying operation is not interrupted and an 11 (self-check OK) is automatically punched in column 81.

If the check digit is recorded on the source document incorrectly or if any digit of the base number is punched incorrectly, the keyboard locks and the error condition is signaled by the SC error indicator on the keyboard control panel. The operator can then field backspace and try the field again. If an error keeps occurring, it indicates that the source document is in error.

When an SC error occurs, there are three normal procedures that will clear the condition in punch mode:

- Field backspace and rewrite the field.
- Field backspace and skip the field; this procedure leaves the self-check field blank, and prevents column 81 punching, unless there is another good self-check field in the record.
- Press the VER/SC key and key an & (12) or – (11). This procedure allows a 12-punch or an 11-punch in the units position of the field and inhibits an 11-punch in column 81.

In verify mode, there are four normal procedures that will clear the error condition:

- Field backspace, press the VER CORR key, and manually skip the field. Reverify the field. This procedure allows the field to be skipped and the operation to be resumed.
- Press the VER/SC key and key an 11 or a 12. This procedure requires that a correction card be punched. The correction card contains an 11-punch or a 12-punch in the units position of the self-check error field and does not have the self-check OK punch in column 81.
- Field backspace and press the VER CORR key; rekey the field. If the field is keyed correctly, the operation continues as normal. However, the field must be reverified. A correction card must be punched and the correction card is punched with an 11 in column 81, provided all SC fields are correct.
- Press the VER/SC key; press the MULT PCH key and key a – or an & and the check digit. This procedure allows a card with a known bad self-check field to be verified without losing the information in the field and without punching a correction card.

10.3.6 Backspacing

Backspacing on a self-check machine is the same as on the base machine with the following exceptions:

- Character or word backspacing *into* a self-check field is not effective.
- Field backspacing into a partial auto dup self-check field is to the first column of the field. If the AUTO SKIP/DUP switch is ON, the dup proceeds to the first manual column of the field.
- Character backspacing with a self-check error condition is ignored.
- Character backspacing into a column programmed for auto skip proceeds to the next manual column.

10.3.7 Release

In punch mode, the release operation is different, depending on the type and condition of the SC fields.

Release through or from First Column of a Self-check Field

Mode	Type	SC Field: Good	SC Field: Bad	SC Field: Blank Check Digit	Result
Punch	Manual			X	SC units position error.
	Auto Dup		X	X	
	Partial Auto Dup			X	
	Auto Dup	X			Release record, and X-punch in column 81 if no flagged field in record.
	Auto Skip	Acts like manual skip; no SC performed.			Release record, and no X-punch in column 81, unless there is another good SC field and no flagged fields.
Verify	Manual		X	X	SC units position error.
	Auto Skip		X	X	
	Auto Dup		X	X	
	Partial Auto Dup		X	X	
	Manual	X			Release record, but no punches in column 81 (2, 3, or 11).
	Auto Skip	X			
	Auto Dup	X			
	Partial Auto Dup	X			

In verify mode, operation of the REL key is similar to that in punch mode, except that column 81 is not punched.

Pressing the REL key in any position of an SC field other than high-order position is an incorrect operation and locks the keyboard. All SC fields are checked during a release operation.

10.3.8 Self-check Skip

Auto: In punch mode, programmed SC auto skip fields operate as normal skip fields, leaving the column or columns skipped blank. Self-checking is inhibited in skipped columns. An entire field or a portion of a self-check field may be auto skipped. Single-column skips (program code 12-11) are skipped, regardless of the position of the AUTO SKIP/DUP switch.

In verify mode, auto skip self-check fields are skipped, but they are checked for self-check errors. Should an SC error or a blank field be detected, a self-check error occurs.

Manual: The SKIP key is active only in the first column of a self-check field. Pressing the SKIP key in any position other than the high-order position of an SC field locks the keyboard.

The SKIP key is used to skip incorrect fields in verify mode.

10.3.9 Self-check Dup

Auto: Self-check fields may be partially or completely auto duped. The fields are checked as in a manual field and errors in the field cause a self-check error.

Manual: Pressing the DUP key in any column other than the first manual column of a self-check field is an incorrect operation and locks the keyboard. When a complete field is manually duped, a normal manual dup sequence occurs. Errors in the field are detected and a self-check error occurs.

10.3.10 Incorrect Procedures

There are several operations that cannot be performed in a self-check field. These operations cause the keyboard to lock. Field or record backspacing restores the keyboard and allows the operation to continue. Incorrect operations are:

- Pressing the REL key from a position other than the high-order position of a field.
- Pressing the LEFT ZERO CTRL or –LZ key in any column other than the first column.
- Pressing the SKIP key in any position of the field other than the high-order position.
- Pressing the DUP key in any position of the field other than the high-order position, or the first manual position in a partially duped field.
- Selecting a program in any position of a field other than the high-order position.
- Pressing a key other than the & or – key when flagging a self-check error field.

10.3.11 Keying the First Digit of a Self-check Field

Keying the first digit of an SC field causes a manual entry sequence to occur. When the column counter is incremented, the preliminary SC operation is started and the multiply factor (MF) is set up.

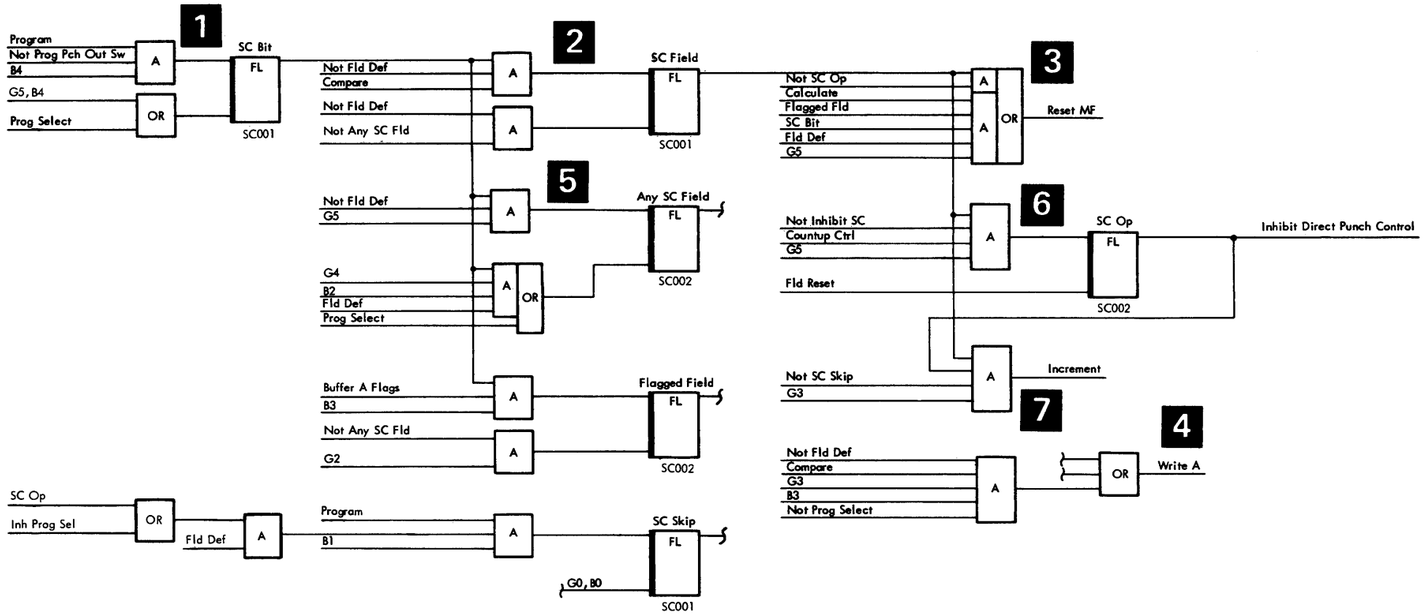
Circuit Objectives

Press a key and start a manual entry sequence:

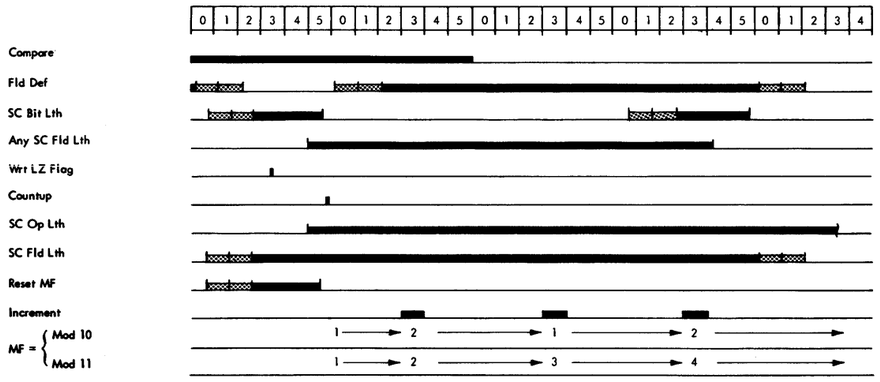
1. Set the SC bit latch each time an SC program code is detected in the buffer. (Time of set depends on the active program level.)
2. Set the SC field latch at compare time. This latch becomes active before the high-order position is keyed; it remains active throughout the field.
3. Reset the MF register.
4. Write an LZ flag in buffer A. (This flag is not read out of the buffer until the next clock cycle.)

   Note: The LZ field latch is disabled by the SC field.

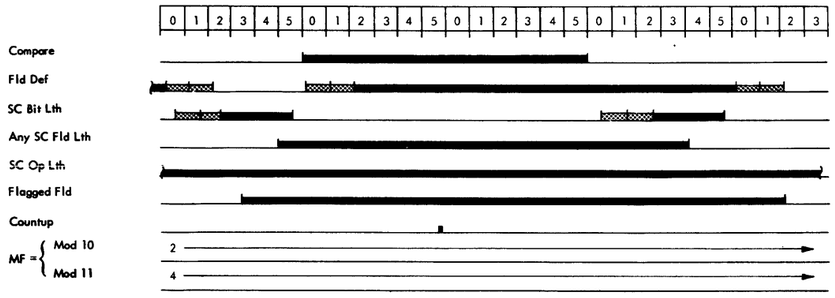
5. Set the any SC field latch.
6. When the countup pulse increments the column counter, set the SC op latch. This latch remains active until the SC field is completed (unless an incorrect operation is performed).
7. Increment the MF register with each position (except those being skipped) of the field. The result is retained until the units position of the field is keyed and calculations begin.



Keying First Position of a Self-check Field



Keying Middle Positions of a Self-check Field



10.3.12 Keying the Units Position of a Self-check Field

When the units position (the SC digit) of an SC field is keyed, the following sequence occurs:

1. The character is written into buffer A as in a normal manual entry operation, except that countup is inhibited.
2. The column ring advances another cycle.
3. The beginning of the self-check field is detected and each digit of the field is added in the accumulator.
4. The accumulator is tested for a 0 condition. If the accumulator is not 0, a self-check error occurs. See self-check error (10.3.16).
5. The column ring advances another cycle and, if the accumulator is 0 (SC field is good), the self-check operation is reset and the column counter is incremented.

Circuit Objectives

1 Start a normal manual entry sequence when the countup control line is active; set the EOF latch.

2 Inhibit the column counter increment.

3 Set the calculate latch.

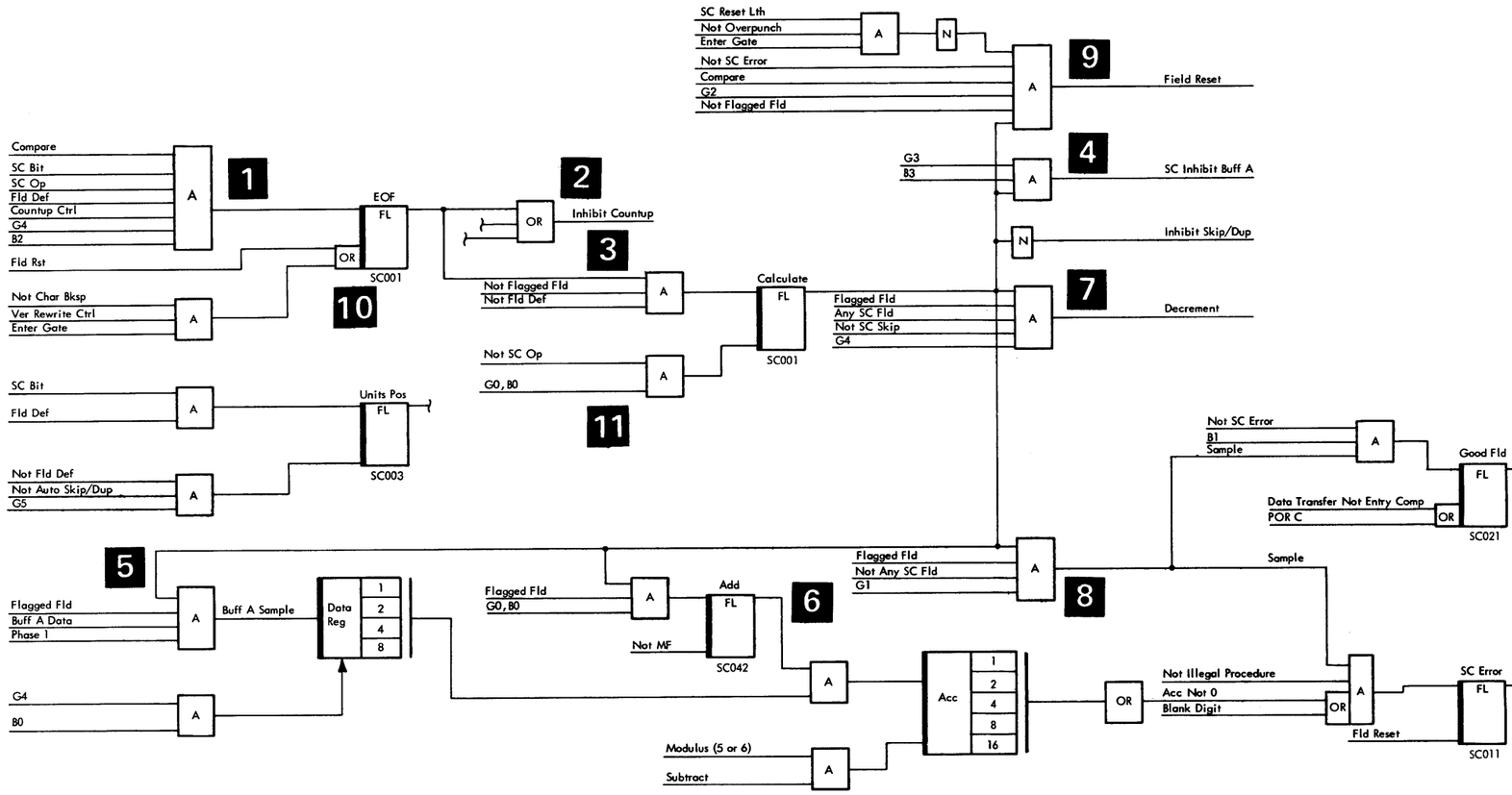
4 The column ring advances another cycle. When the beginning of the SC field is detected (LZ flag and no field definition), regeneration of the LZ flag is inhibited.

5 Buffer A data is sampled and set up in the data register.

6 Set the add latch and gate the data register bits to the accumulator, adding the digit as many times as directed by the contents of the MF register.

7 Decrement the MF register. Repeat steps 5, 6, and 7 until the units position of the SC field has been calculated.

8 Activate the sample line and test the accumulator for 0 (all triggers off). If the accumulator is not 0, set the SC error latch. See self-check error (10.3.16). Set the good field latch if the accumulator is 0.

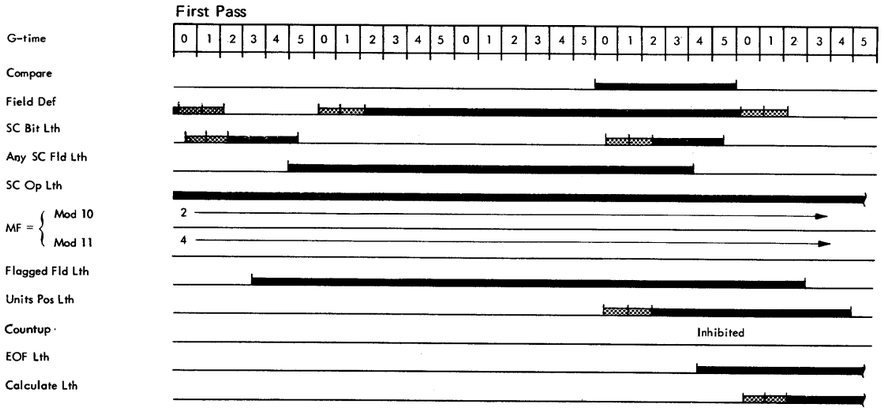


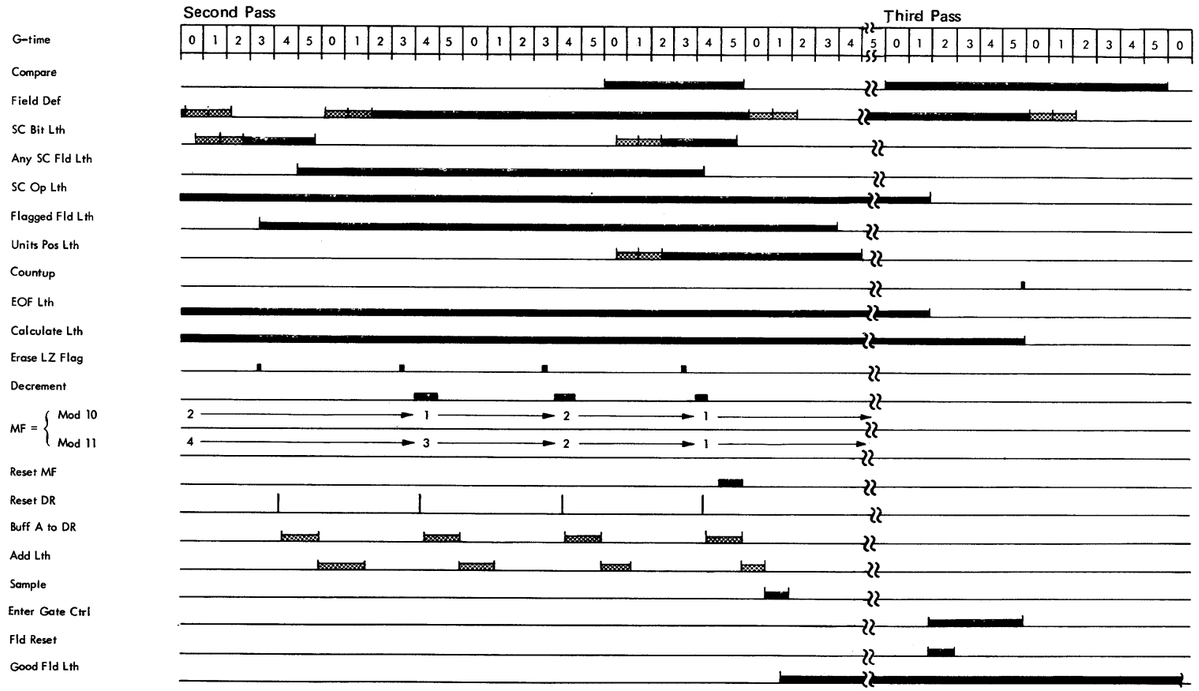
9 The column ring completes another cycle. When the units position of the field is detected again (compare is active), activate the field reset circuitry.

10 Reset the EOF latch; this allows the column counter to be incremented.

11 Reset the calculate latch.

SC Units Position Sequence





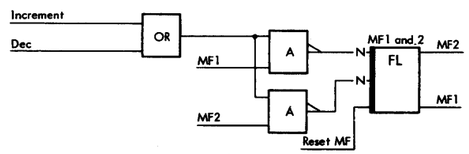
10.3.13 Multiply Factor Register

The multiply factor register controls the number of times a digit is added in the accumulator. The MF is set up when the first character of the field is keyed or duped.

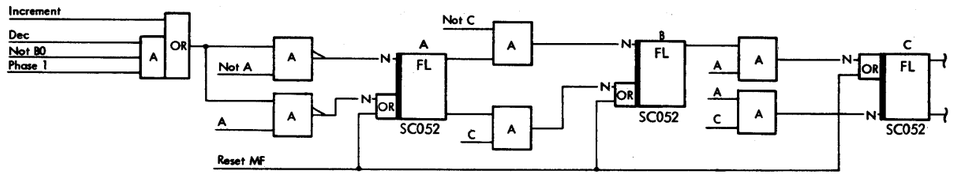
The MF register is set to 1 when the first position of the field is keyed or duped. As the column ring advances, the MF register is incremented with every position of the field.

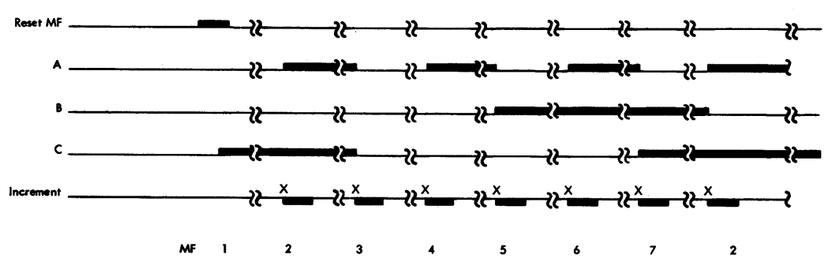
When the units position of the field is keyed or duped, and calculation of the field begins, the MF register gates the accumulator with the data register information. As each position of the field is calculated, the MF is decremented. Decrementing is accomplished by incrementing the MF register five times.

Modulus 10 MF Register



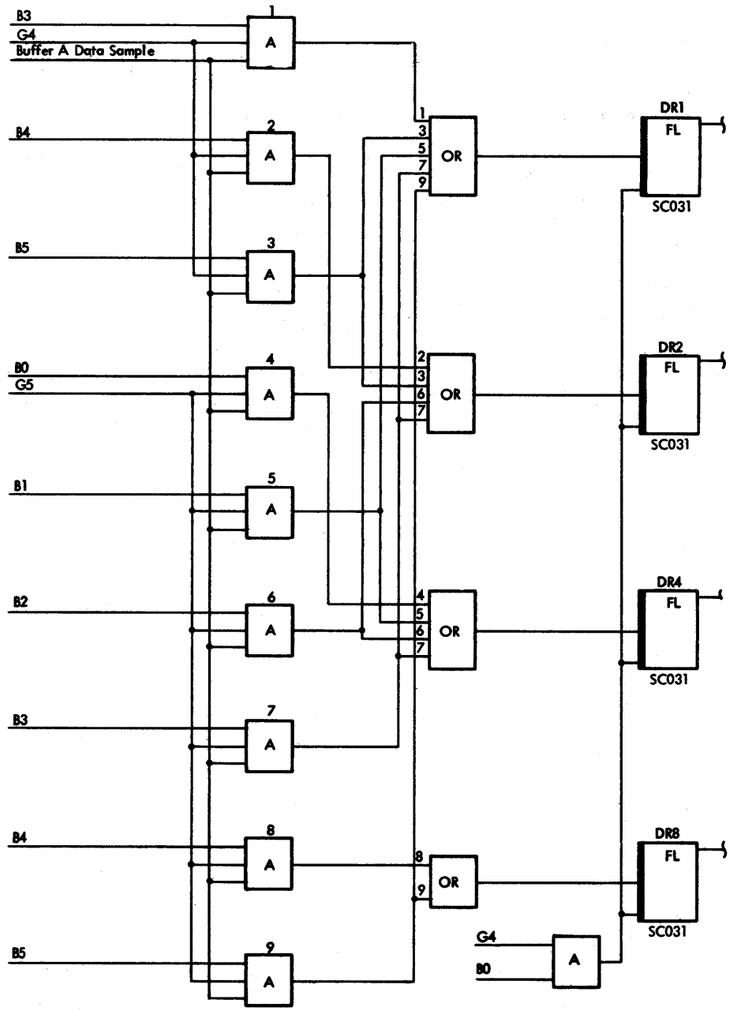
Modulus 11 MF Register





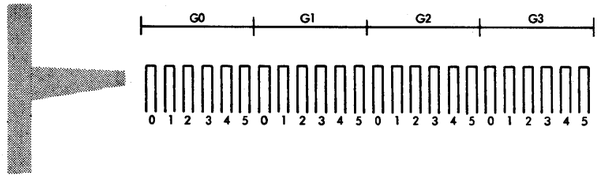
10.3.14 Data Register

The data register converts numeric codes read from buffer A into a binary code. A digit read from the buffer, and ANDed with a clock pulse, sets the correct data register latches.



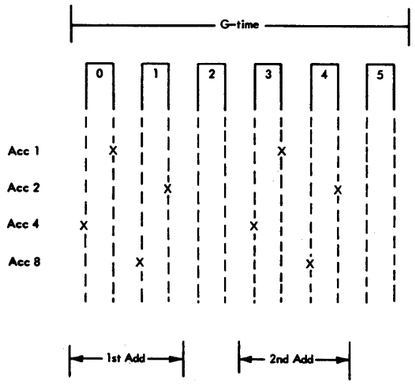
10.3.15 Calculations

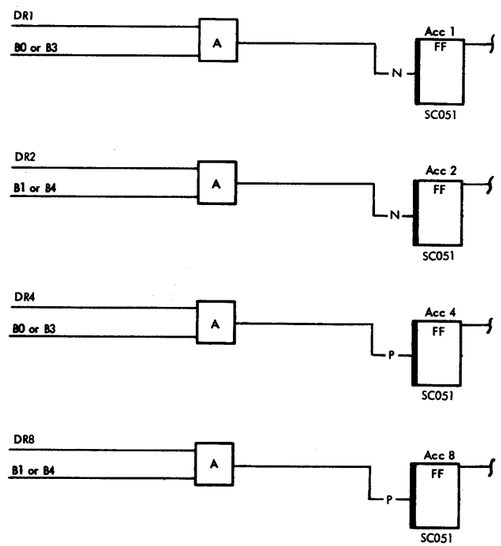
The accumulator is capable of adding a digit from the data register twice during a G-time. A number to be added seven times (MF = 7) requires three and one-half G-times; a number to be added six times (MF = 6) requires three G-times.



The binary coded digit in the data register is added, bit by bit, into the accumulator. Each bit is added at either the rise or the fall of its gating B-time. The triggers in the SC accumulator require a negative shift on the complement line to turn the trigger on or off.

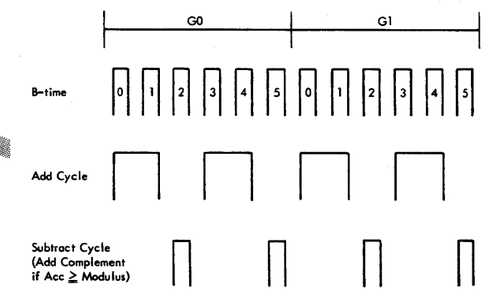
The diagram and timing chart show when an accumulator trigger changes state during an add cycle if the register lines are active.





The accumulator is a binary adder. If a trigger is off when a bit is added, the trigger turns on. If the trigger is on when a bit is added, it turns off and turns the next trigger on.

After each add cycle, the accumulator is sampled. If the total is equal to or greater than the modulus, the modulus is subtracted from the accumulator by adding the base 16 complement of the modulus (for modulus 10, 6 is added; for modulus 11, 5 is added).

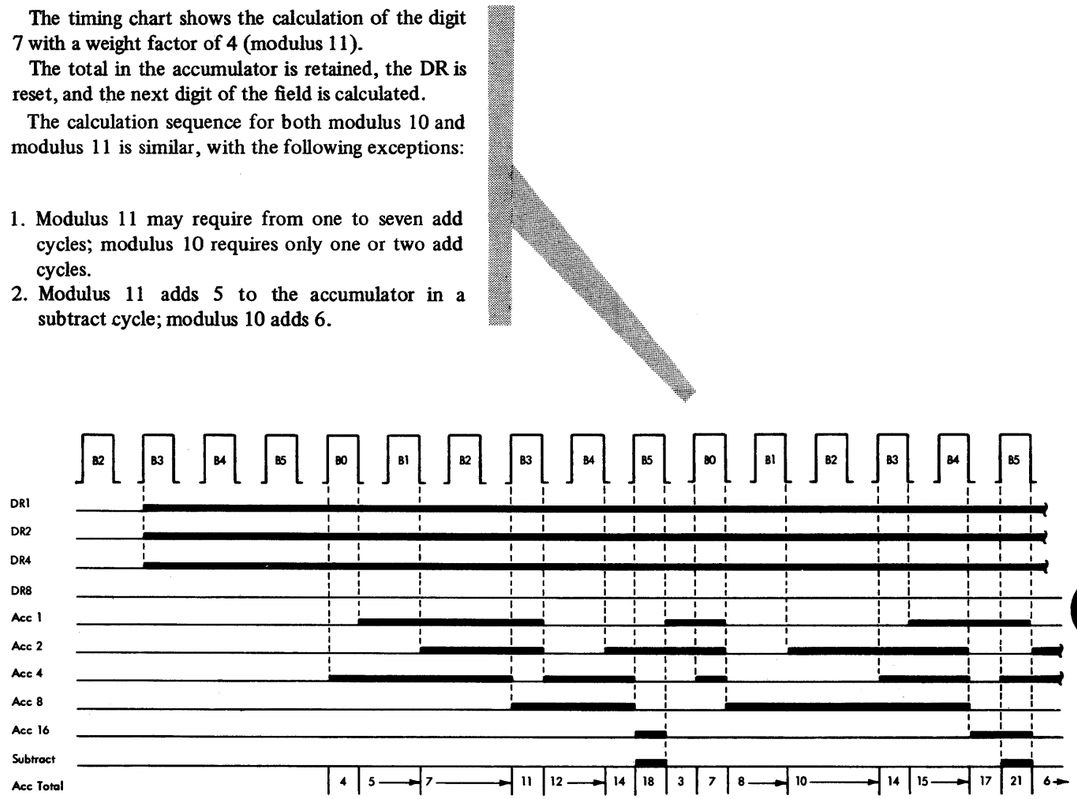


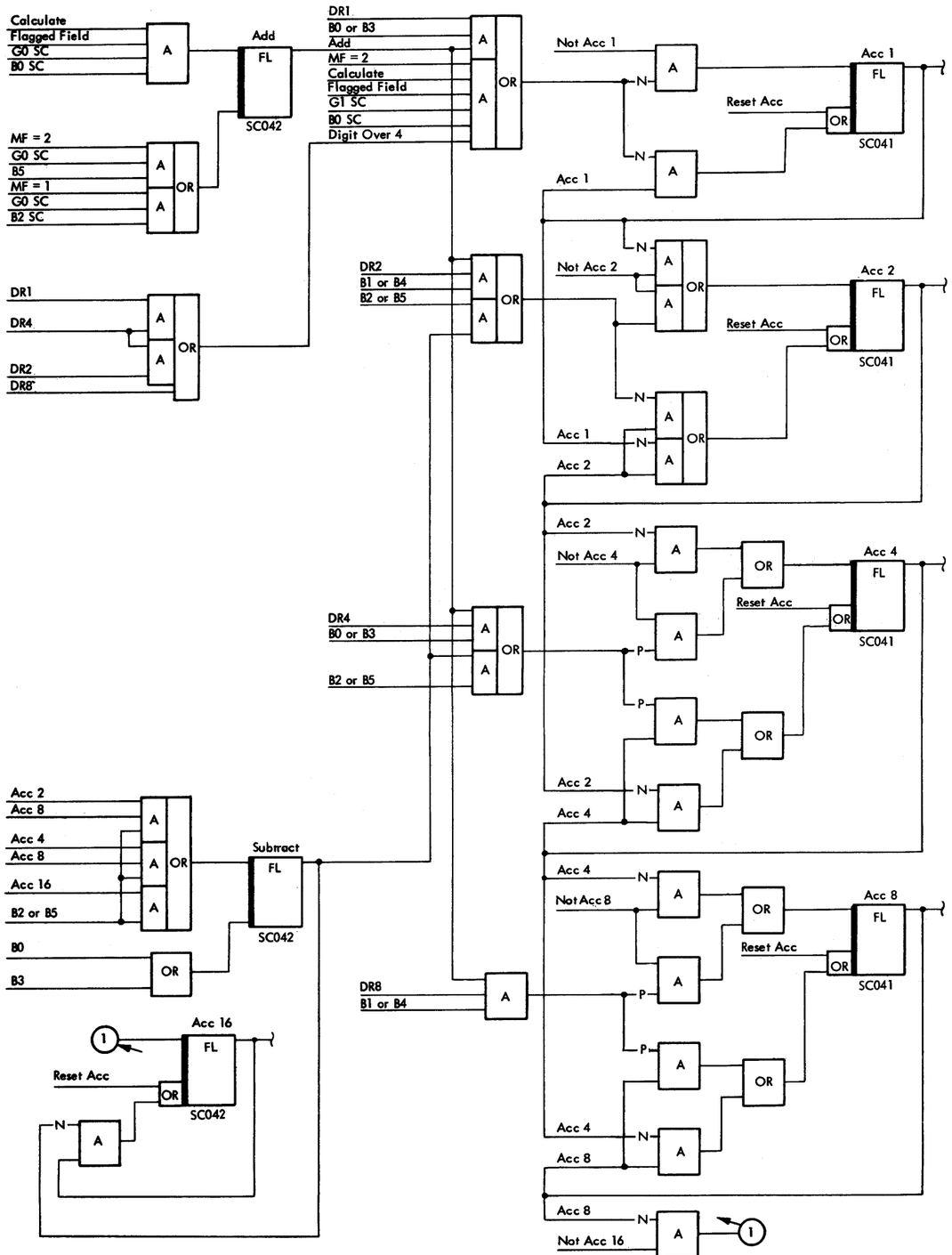
The timing chart shows the calculation of the digit 7 with a weight factor of 4 (modulus 11).

The total in the accumulator is retained, the DR is reset, and the next digit of the field is calculated.

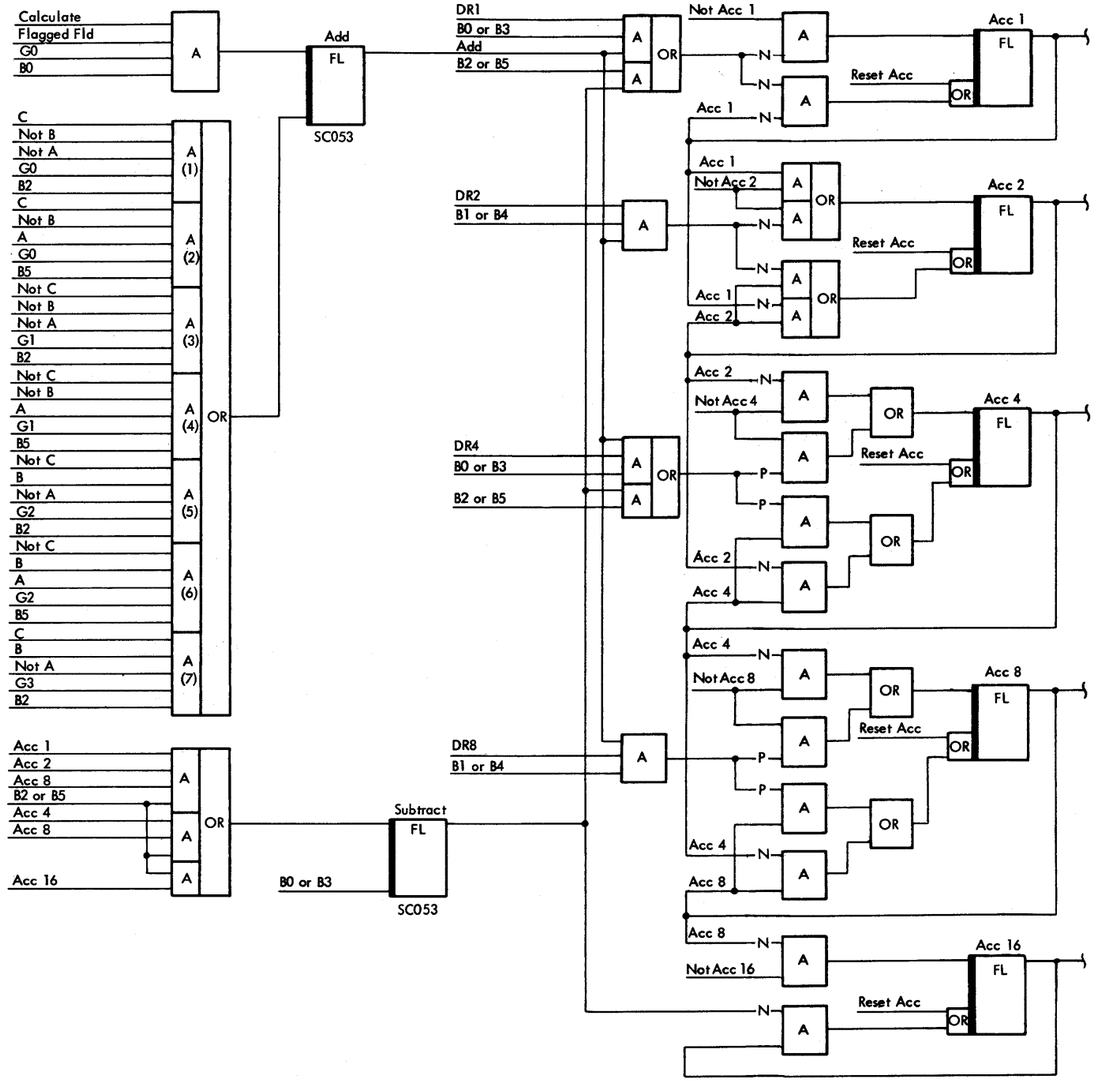
The calculation sequence for both modulus 10 and modulus 11 is similar, with the following exceptions:

1. Modulus 11 may require from one to seven add cycles; modulus 10 requires only one or two add cycles.
2. Modulus 11 adds 5 to the accumulator in a subtract cycle; modulus 10 adds 6.





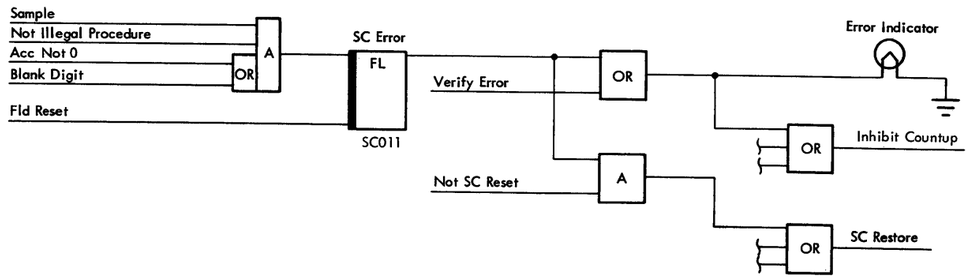
Modulus 10 Arithmetic



Modulus 11 Arithmetic

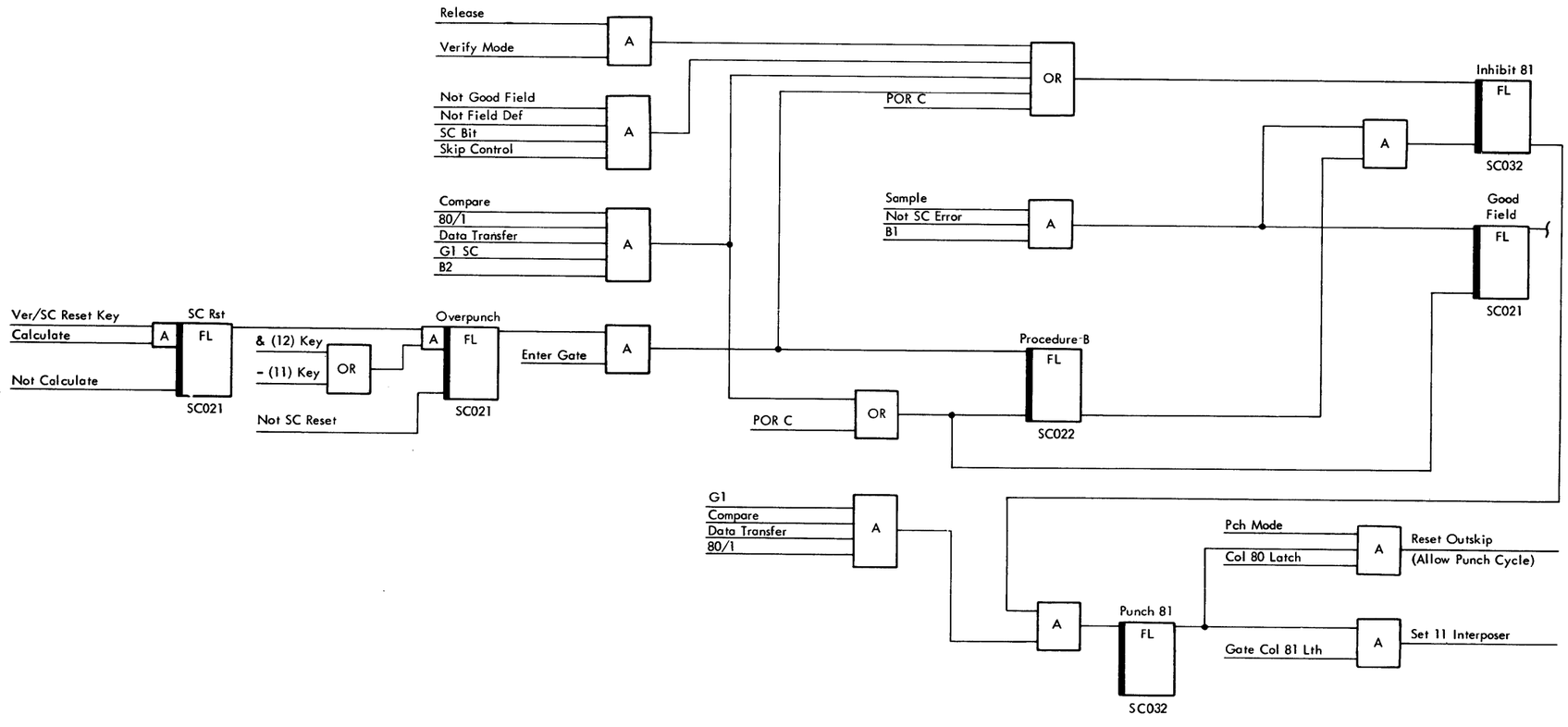
10.3.16 Self-check Error

If at sample time the accumulator is not 0, the self-check error latch is set, lighting the VER/SC error indicator, and the keyboard locks. Countup is inhibited to prevent the column counter from advancing out of the error field.



10.3.17 Flagging an Error Field

Pressing the VER/SC key and either a – or an & in an error condition, punches (flags) the units position of the self-check error field with an 11-punch or a 12-punch. This procedure inhibits punching column 81 with an 11 (the self-check OK punch).



10.4 DIRECT PUNCH CONTROL

In direct punch control mode, each keystroke is punched directly into the card. The card moves through the punch/read station in the same way as it does on the IBM 29 Card Punch. Direct punch mode is useful for operations where the card being punched is the source document and the operator must be able to read information on that card. By program control, the machine can be returned to buffered mode for any field desired.

10.4.1 Direct Punching

The customer direct punch latch comes on when the PUNCH/DIR PCH/VERIFY switch is set to the DIR PCH position.

Circuit Objectives

1 Countup control becomes active as the result of a keystroke, whether the keystroke is for direct or buffered data. Countup control sets direct punch inhibit backspace to prevent a record backspace or clear operation. Countup control also writes a punch flag in buffer A in the column that was keyed. At the drop of countup control, the force entry complete trigger is set.

2 The entry complete latch is set to force the machine to function as if the buffer were full.

3 The data transfer latch is set to transfer the data and the punch flag for the column keyed to buffer B. Data transfer also sets the punch gate latch, which starts a punch cycle.

4 When the punch flag from buffer A is transferred to buffer B, it sets the direct punch gate scan latch. This latch sets the scan latch; the scan latch sets the escape control latch to give a one-column escapement.

5 The escape cycle latch activates the punch gate pull-off circuit to stop the punch clutch after it completes one cycle.

10.4.2 Buffered Punching

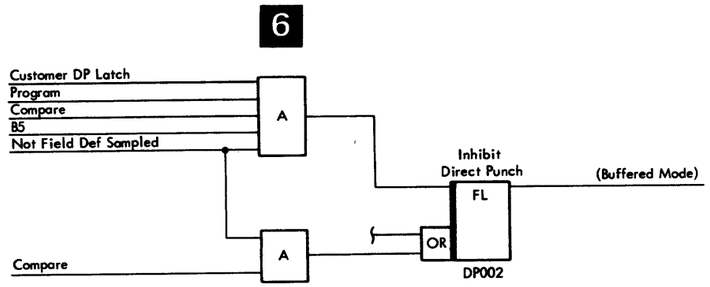
Circuit Objectives

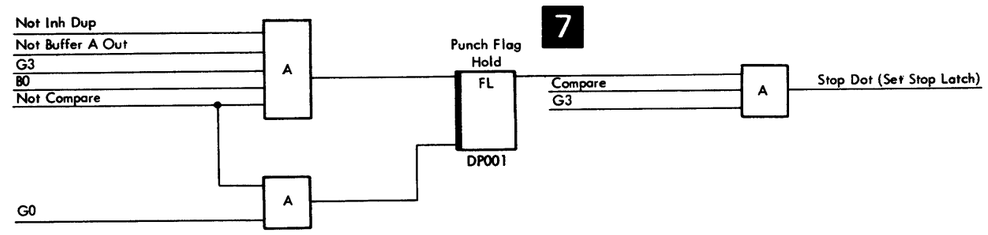
6 A 3 (G3, B5) in the program takes the machine out of direct punch mode. Keyed data in the column containing the 3 and in the following columns that contain a 12 (field definition) is entered into the buffer. This data is punched out during the next punch cycle.

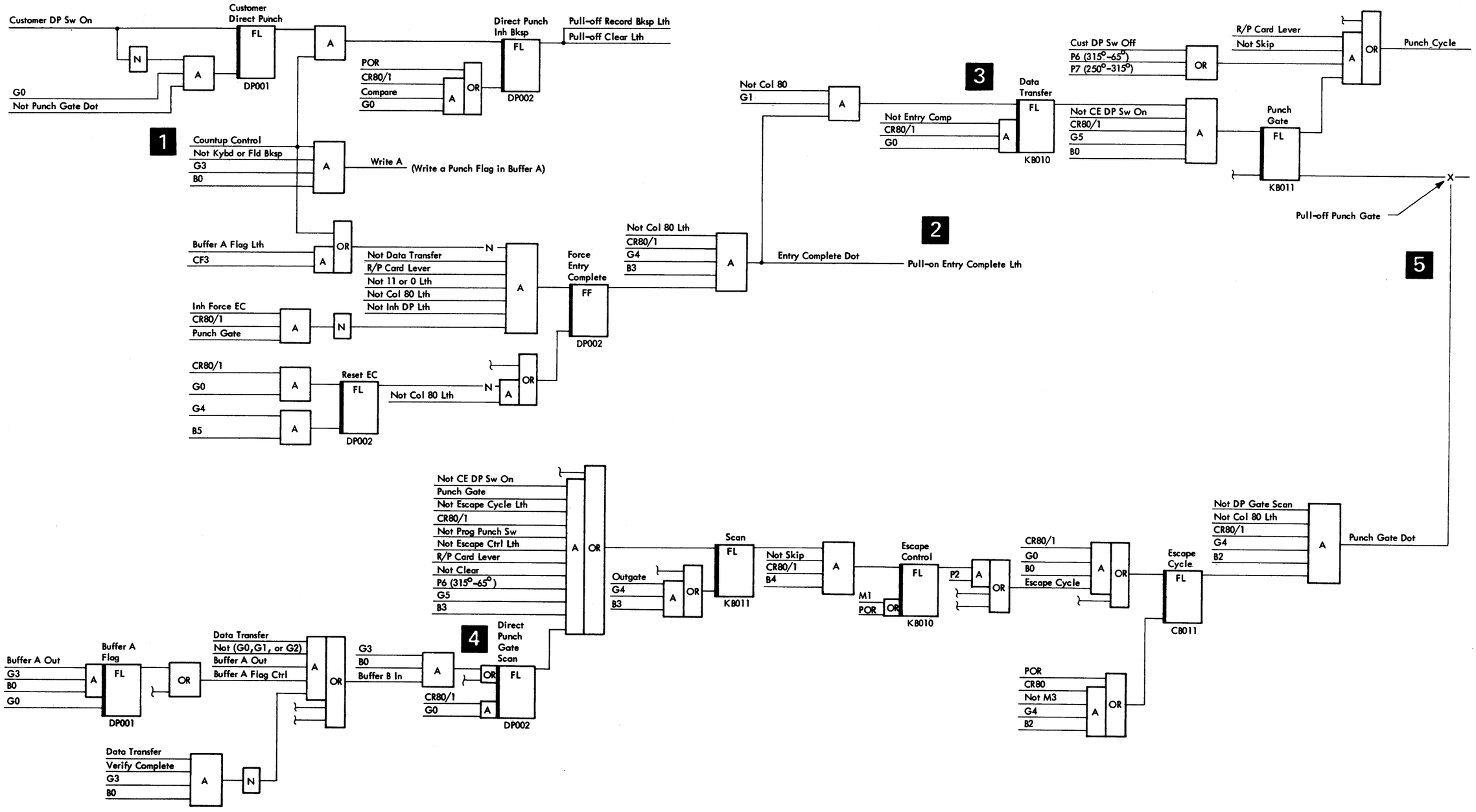
Note: Record backspacing and clear operations are not allowed in direct punch mode once a countup has been generated (either for buffered or direct data). Character or field backspacing over buffered columns is allowed before these columns are punched out.

Left-zero functions are only operative in buffered fields; they are inhibited in direct punch fields.

7 During a field or character backspace, the punch flag hold latch looks back one column for the absence of a punch flag. For example, if the machine is in column 50, the latch is looking at column 49. By setting the stop latch, the punch flag hold latch prevents backspacing into a column that has already been punched out.






Customer DP Sw On
Customer Direct Punch
FL
DP001
N
A
G0
Not Punch Gate Dot
A
Direct Punch Inh Bksp
FL
DP002
Pull-off Record Bksp Lth
Pull-off Clear Lth
POR
CR80/1
Compare
G0
A
OR
1
Countup Control
Not Kybd or Fld Bksp
G3
B0
A
Write A
(Write a Punch Flag in Buffer A)
Buffer A Flag Lth
CF3
A
OR
Not Data Transfer
R/P Card Lever
Not 11 or 0 Lth
Not Col 80 Lth
Not Inh DP Lth
N
A
Force Entry Complete
FF
DP002
Inh Force EC
CR80/1
Punch Gate
A
N
CR80/1
G0
A
Reset EC
FL
DP002
G4
B5
A
Not Col 80 Lth
N
A
OR
Not Col 80
G1
A
3
Not Entry Comp
CR80/1
G0
A
Data Transfer
FL
KB010
Not Col 80 Lth
CR80/1
G4
B3
A
2
Entry Complete Dot
Pull-on Entry Complete Lth
Cust DP Sw Off
P6 (315°-65°)
P7 (250°-315°)
OR
Not CE DP Sw On
CR80/1
G5
B0
A
Punch Gate
FL
KB011
R/P Card Lever
Not Skip
A
OR
Punch Cycle
X
Pull-off Punch Gate
5
Not CE DP Sw On
Punch Gate
Not Escape Cycle Lth
CR80/1
Not Prog Punch Sw
Not Escape Ctrl Lth
R/P Card Lever
Not Clear
P6 (315°-65°)
G5
B3
A
OR
Outgate
G4
B3
A
OR
Scan
FL
KB011
Not Skip
CR80/1
B4
A
Escape Control
FL
KB010
M1
POR
OR
P2
A
OR
CR80/1
G0
B0
Escape Cycle
A
OR
Escape Cycle
FL
CB011
Not DP Gate Scan
Not Col 80 Lth
CR80/1
G4
B2
A
Punch Gate Dot
4
Direct Punch Gate Scan
Buffer A Out
G3
B0
G0
Buffer A Flag
A
FL
DP001
OR
Data Transfer
Not (G0,G1, or G2)
Buffer A Out
Buffer A Flag Ctrl
A
OR
G3
B0
Buffer B In
A
OR
FL
CR80/1
G0
A
DP002
Data Transfer
Verify Complete
G3
B0
A
N
POR
CR80
Not M3
G4
B2
A
OR

10.5 VERIFY READ CONTROL

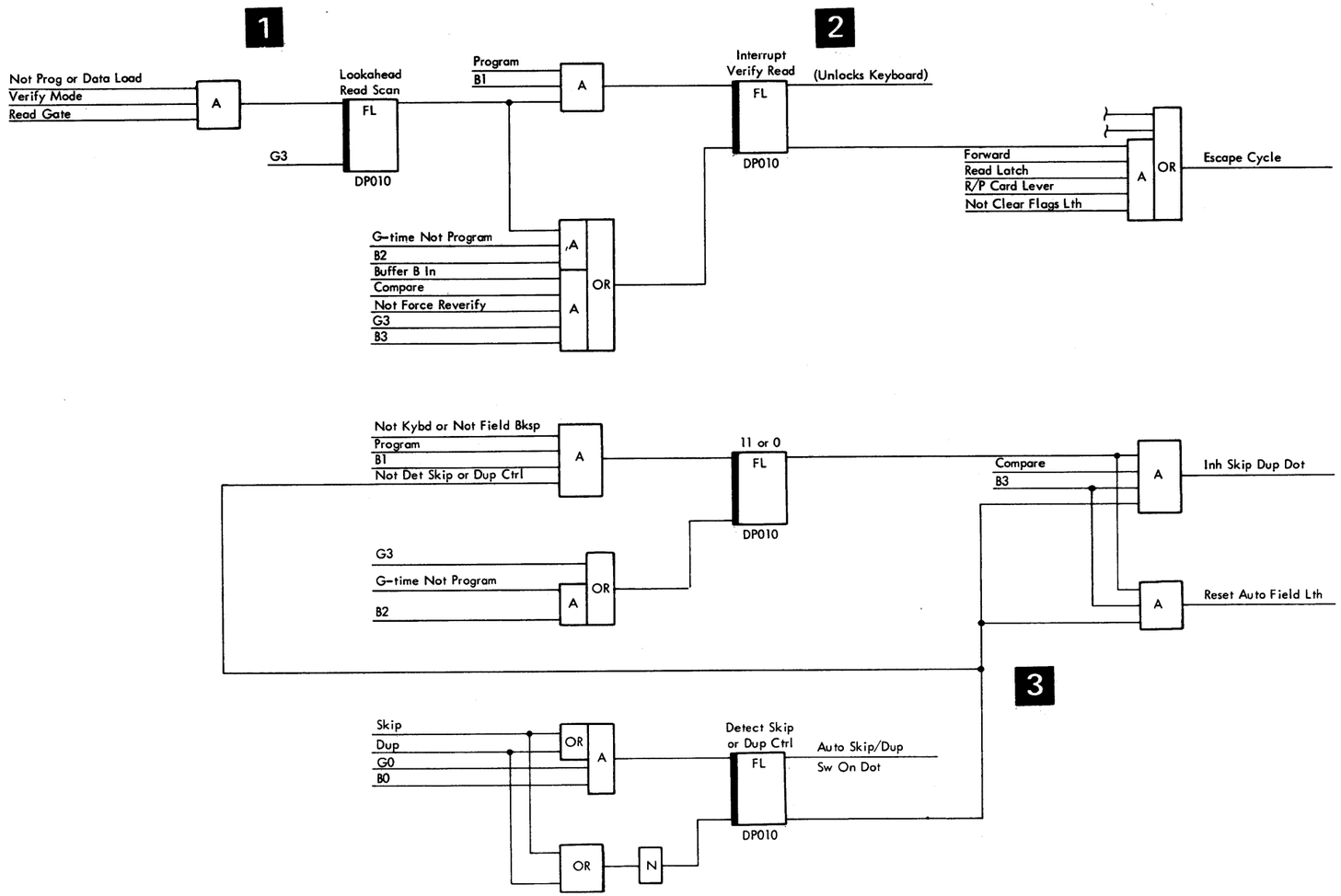
With the verify read control feature, an operator can verify a source document card. Under program control, the card can be stopped at any column during read in. Then, after the operator has verified the information read in, the read-in operation continues up to the next "stop" or to the end of the card.

Circuit Objectives

1 When a card to be verified starts through the punch/read station, the lookahead read scan latch comes on. If an 11 and a 0 are present in a column, the card stops in that column. The 11 sets the interrupt verify read latch. This latch stays on if a 0 is also present; if a 0 is not present, the latch is reset (a true skip has been detected).

2 The interrupt verify read latch unlocks the keyboard and stops escapement, so that the operator can verify the columns that have been read in.

3 In a normal operation (not verify read control), an 11 or a 0 sets the auto field latch, so that during a backspace operation, the machine backspaces over the complete field. A verify read control field is not an auto field, so character backspacing within the field is allowed. The detect skip or dup control latch is only on for a true skip or dup; the latch is off in a verify read control field. As a result, the auto field latch is reset to allow stopping within the field during a character backspace operation.



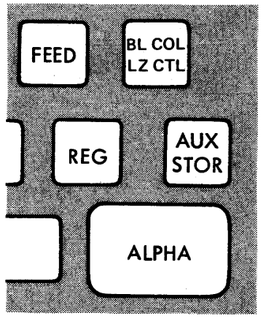
10.6 AUXILIARY STORAGE FEATURE

Auxiliary storage is available on all models without verify read control installed.

Auxiliary storage feature can be used:

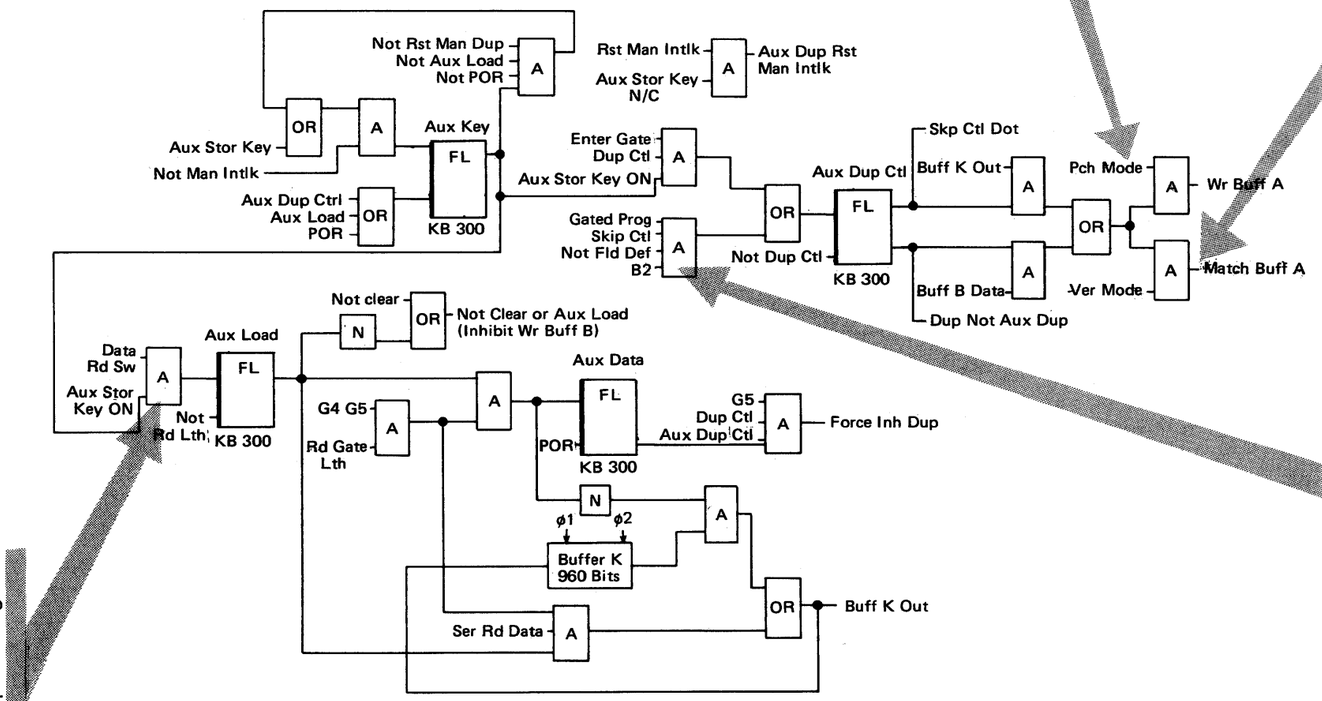
- In any program level.
- In punch or verify mode.

The keyboard has been modified by splitting the BLANK COLUMNS/LEFT ZERO CTRL key into two smaller keys, BLANK COLUMNS/LEFT ZERO and AUX STOR.



10.6.1 Description

The auxiliary storage feature provides storage for 80 columns of constant data (buffer K), that may be punched into a card (aux dup), or compared with data in a card (aux verify).



10.6.2 Auxiliary Read (Load Buffer K)

This operation reads master card information into auxiliary storage.

- Operate the CLEAR switch.
- Turn the program mode dial to DATA READ.
- Insert the master card at the read station.
- Press the AUX STOR key.

10.6.3 Auxiliary Duplication (Aux Dup)

- Press the AUX STOR key.

In punch mode, data in auxiliary storage punches into the card being processed by transferring data from buffer K to buffer A instead of B to A (as in a normal dup).

The AUX STOR key must be pressed for every field of duplication required.

Note: The program mode dial *must not be* in the DATA READ position.

10.6.4 Auxiliary Verify (Aux Ver)

- Press the AUX STOR key.

In verify mode, data in auxiliary storage is compared with data in the card being processed by matching buffer K to buffer A data.

The AUX STOR key must be pressed for every field of AUX VER required.

Note: The program mode dial *must not be* in the DATA READ position.

10.6.5 Auto Auxiliary Duplication (Auto Aux Dup)

During this operation, data in auxiliary storage is read into buffer A. An 11-0 in the first column of a field initiates auto aux dup if the AUTO DUP/SKIP switch is on.

10.7 INTERPRET

10.7.1 Introduction

The interpret feature is available on Models 2 and 3 without customer direct punch or verify read control installed.

The printing appears above the column interpreted and takes place column by column.

This feature can operate under program control to select skipping of columns (to eliminate interpreting), to eliminate 11 and 12 zones for numeric interpreting, and to allow left zero interpreting.

10.7.2 Description

With an interpret program loaded into storage and the PUNCH/INT VERIFY switch (Model 3) or PUNCH/INT switch (Model 2) set to INT, interpret mode becomes active as soon as a card is registered at the read punch station.

Place the prepunched cards in the hopper and take two feed cycles.

During the first card feed cycle:

- Interpret mode is set
- The punch suppress solenoid is energized
- The keyboard character keys are locked

During the second card feed cycle:

- The program level is set to the level specified by the Program Mode Switch.
- Program information is set into buffer A as control flags and transferred to buffer B before interpreting takes place.
- The first prepunched card is registered.
- The card moves backward to allow column 1 to be read.
- The card moves forward to allow column 2 to be read.

At this time the program is controlling the next function to take place, and it could be:

- Printing.
- Skipping.
- 12 and/or 11 elimination (printing the numeric portion).

By now the card feed cycle has finished and interpreting continues automatically.

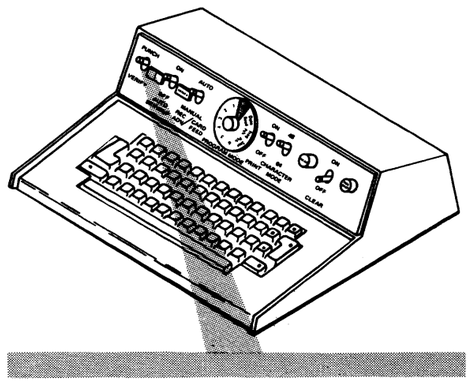
On any interpreting cycle the machine reads first, then prints. The IBM 129 is in both read and punch mode; read flags are used for reading and punch flags for printing.

10.7.3 Program Codes

	Code	Where Used	Function
AUTO	12	All columns except the first column of the field	Field definition
DUP/SKIP switch must be ON	11	First column of the field	Auto Skip
	0	Each column requiring 12 and/or 11 elimination	12 and 11 elimination
	1	First column of the field	Print left zeros

Note: Program codes 2 through 8 must not be used in conjunction with an interpret operation.

10.7.4 Switches and Data Flow 1



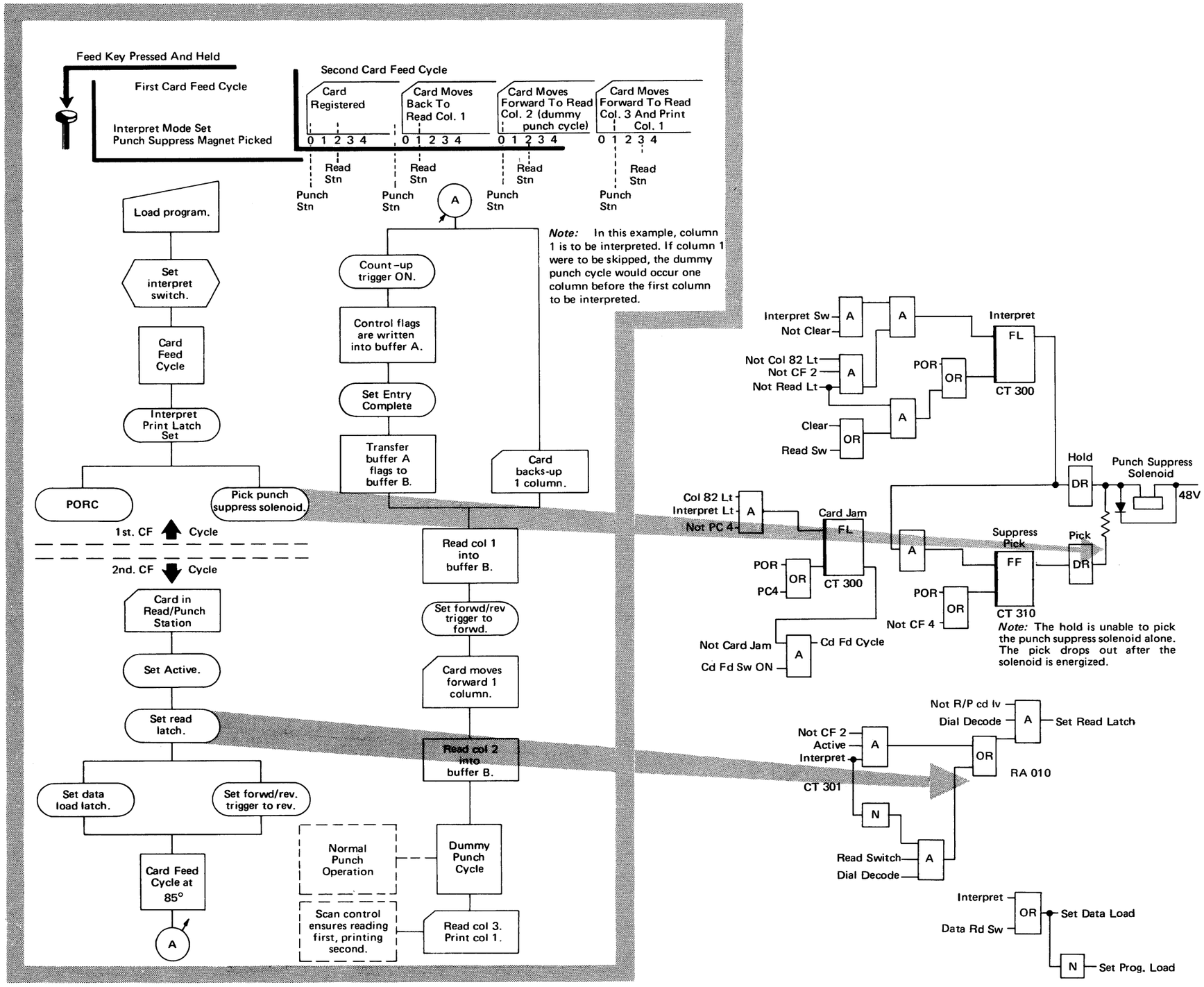
Model 3 has a 3 position switch.

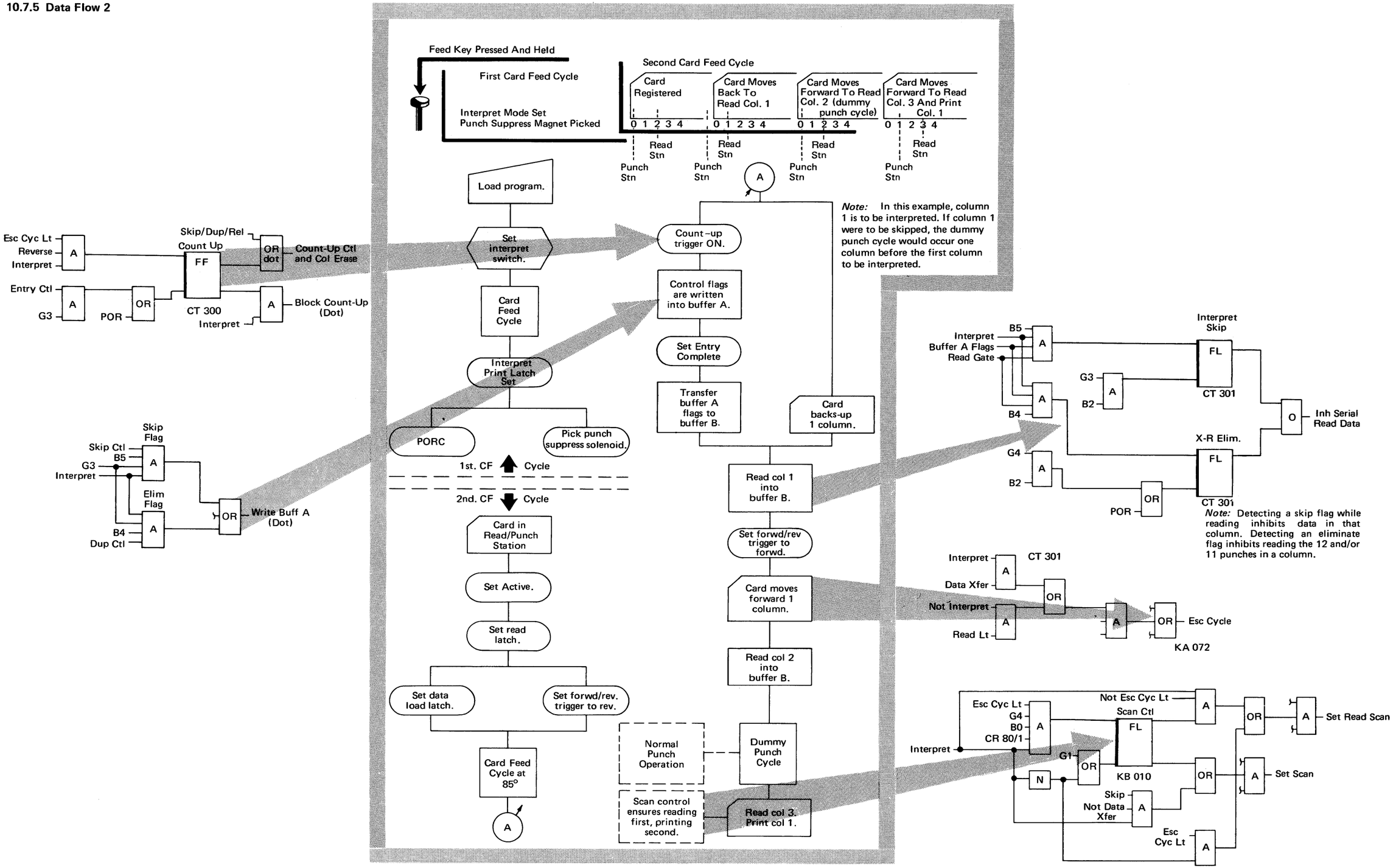
Model 2 has a 2 position switch.

For all Models:

- Interpreting speed is 18 cols/sec.
- Skip speed is 80 cols/sec.
- There is normal skipping of consecutive blank columns.

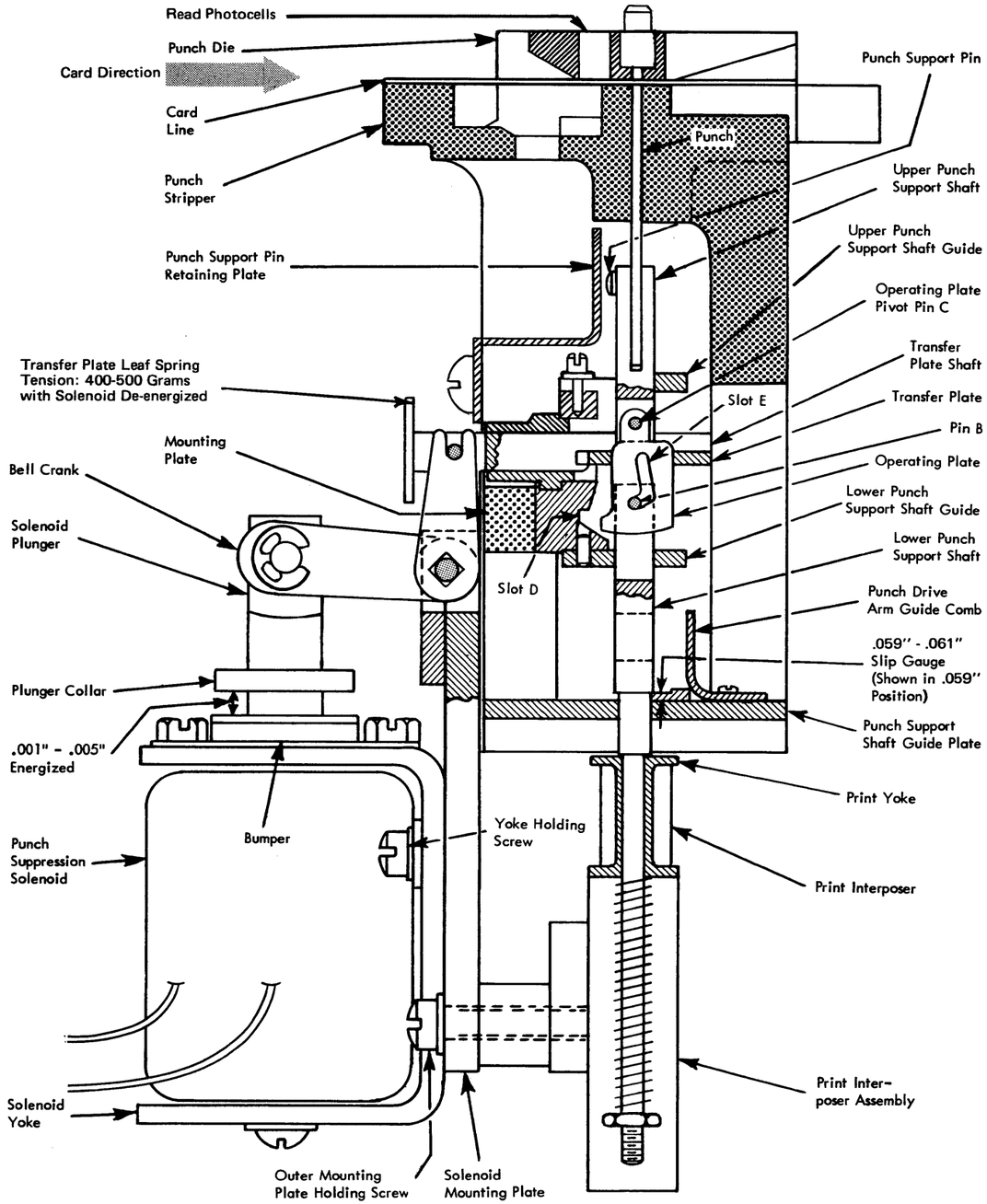
The standard punch die and interposer assembly is replaced by a punch suppress solenoid and interpret die and interposer assembly.




Feed Key Pressed And Held
First Card Feed Cycle
Interpret Mode Set
Punch Suppress Magnet Picked
Second Card Feed Cycle
Card Registered
Card Moves Back To Read Col. 1
Card Moves Forward To Read Col. 2 (dummy punch cycle)
Card Moves Forward To Read Col. 3 And Print Col. 1
0 1 2 3 4
Read Stn
Punch Stn
Load program.
Set interpret switch.
Card Feed Cycle
Interpret Print Latch Set
PORC
Pick punch suppress solenoid.
1st. CF Cycle
2nd. CF Cycle
Card in Read/Punch Station
Set Active.
Set read latch.
Set data load latch.
Set forwd/rev. trigger to rev.
Card Feed Cycle at 85°
A
Count-up trigger ON.
Control flags are written into buffer A.
Set Entry Complete
Transfer buffer A flags to buffer B.
Card backs-up 1 column.
Read col 1 into buffer B.
Set forwd/rev trigger to forwd.
Card moves forward 1 column.
Read col 2 into buffer B.
Normal Punch Operation
Dummy Punch Cycle
Scan control ensures reading first, printing second.
Read col 3. Print col 1.
Note: In this example, column 1 is to be interpreted. If column 1 were to be skipped, the dummy punch cycle would occur one column before the first column to be interpreted.
Esc Cyc Lt
Reverse
Interpret
Entry Ctl
G3
POR
Skip/Dup/Rel
Count Up
FF
CT 300
OR dot
Count-Up Ctl and Col Erase
Block Count-Up (Dot)
Skip Flag
Skip Ctl
B5
G3
Interpret
Elim Flag
B4
Dup Ctl
Write Buff A (Dot)
B5
Interpret
Buffer A Flags
Read Gate
B4
G4
B2
Interpret Skip
FL
CT 301
Inh Serial Read Data
X-R Elim.
Note: Detecting a skip flag while reading inhibits data in that column. Detecting an eliminate flag inhibits reading the 12 and/or 11 punches in a column.
Interpret
Data Xfer
Not Interpret
Read Lt
Esc Cycle
KA 072
Esc Cyc Lt
G4
B0
CR 80/1
G1
N
Not Esc Cyc Lt
Scan Ctl
KB 010
Set Read Scan
Set Scan
Skip
Not Data Xfer
Esc Cyc Lt

10.7.6 Punch Suppression Mechanism

The standard print punch support assembly has been modified to prevent transfer of motion to the punch during the interpret mode. This is called *suppress punching* and allows normal use of the code plate shift mechanism when the machine is interpreting.



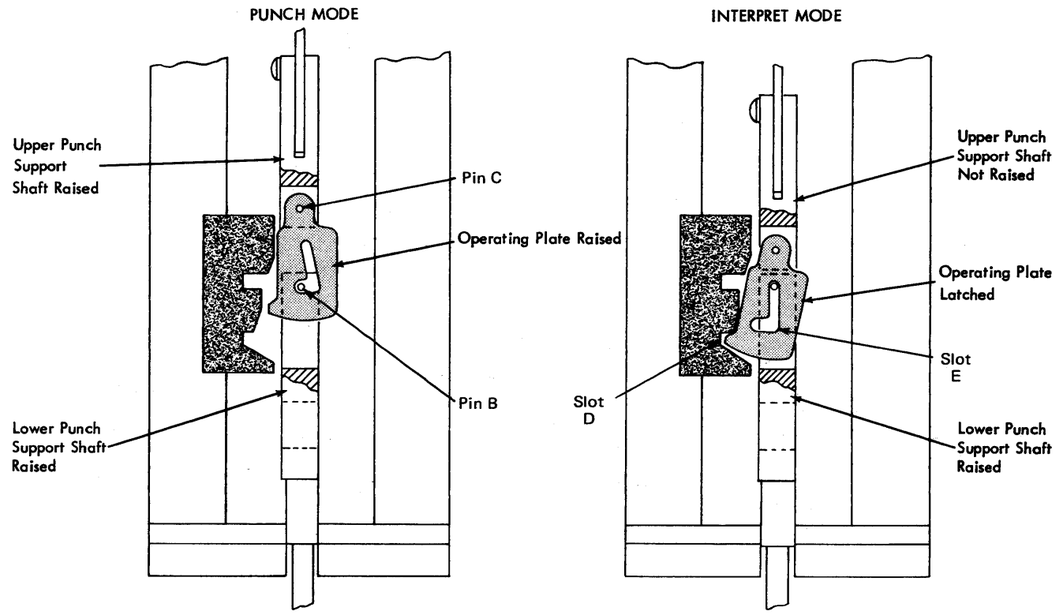
Punch-Suppression Mechanism

10.7.7 Lower Punch Support Shaft

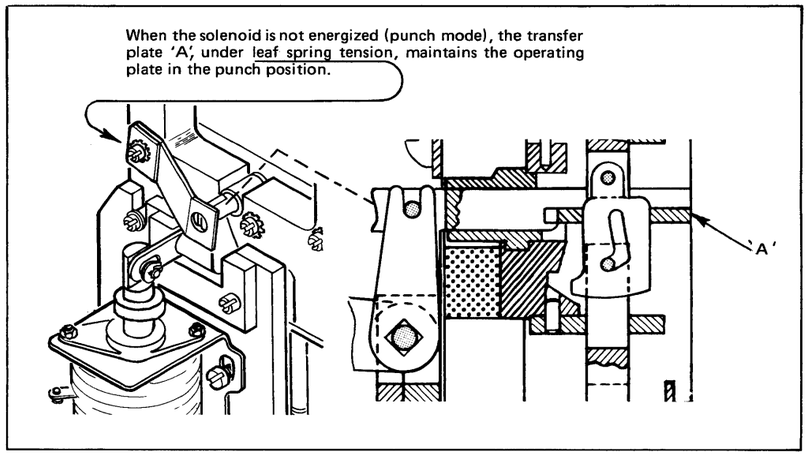
10.7.7.1 Punch Mode

In punch mode, the punch supports (upper and lower) form a solid extension from the punches to the punch operating arm (arms operated by interposer magnet energization and punch clutch action). Pin B is the connecting link between the lower and upper punch supports.

As the lower punch support is driven upward by the action of the punch operating arm, connecting pin B transmits the upward motion to the operating plate and to its pivot pin C. This action forces the upper punch support upward to drive the punch through the card.



Lower Punch-Support Shaft (Raised)



10.7.7.2 Printing

The print interposers, whether punching or interpreting, move with the lower punch supports. Through this action, the code plate is positioned by spring tension, and normal printing takes place.

10.7.7.3 Interpret Mode

In the interpret mode, the punch-suppress solenoid is energized. The force acting on the solenoid armature is sufficient to overcome the spring tension and force the transfer plate to shift. The transfer plate forces against all twelve operating plates pivoting them about their pivot points C. The lower projection of the operating plate fits into the slot D. Pin B is now free to move in the operating slot E and, as the lower punch support is driven upward, no motion is transmitted to the punch.

10.7.8 Punch Unit

10.7.8.1 Punch Unit and Punch Support Assembly Home-Position Definition

The home position of the punch support arms is defined as that position at which the punch drive unit is latched and the punch supports are at their lowest limit of travel. The punch-suppression mechanism is designed to operate correctly around tolerable differences of the home position of the punch supports. (The approximate home position can be set by using slip gages. Refer to "Punch Unit Removal".)

If the punch-drive unit is removed or if its fixed location changes, the punch supports must be returned to within approximate home position.

Proper adjustments to the home position of the punch unit and the punch drive unit are critical for correct machine performance. Because of the related mechanical linkage between these units, any adjustment to the home position of the punch drive arms will affect the home position of the punch supports.

The punch-suppression mechanism adjustments ensure that the operating plates will transfer completely when the machine is in the interpret mode. The operating plates must latch fully into the mounting plate to ensure that the pin in the lower punch support has free movement in the operating plate vertical slot.

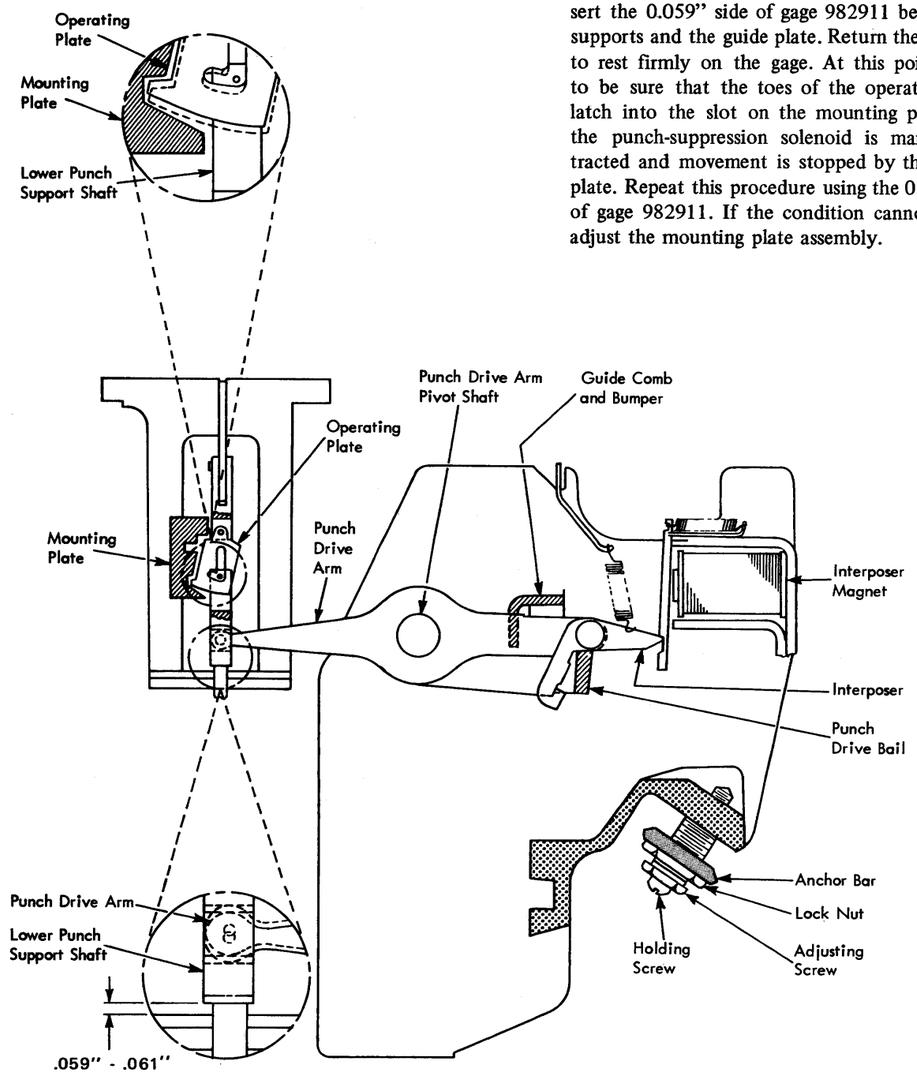
The vertical positions of the operating plates are determined directly by:

1. The horizontal alignment of the punch drive arms, and
2. The drive arm positions set by the anchor bar adjustment.

To permit all the operating plates to latch fully into the mounting plate at the same time, the mounting plate slot has been designed wide enough to permit a maximum vertical displacement of 0.008" between the highest and lowest operating plates.

Because the operating plate is positioned vertically by the punch drive arms, the horizontal alignment of the drive arms must be held within 0.008". In practice, the drive unit for the IBM 129 is manufactured to hold the alignment of the punch drive arms within 0.004". These are much closer tolerance limits than are necessary for other models of the IBM 129. This leaves 0.004" in which to set the anchor bar adjustment.

Do not attempt to energize the punch-suppress solenoid when the machine is operating (manually or autoduplicating) in punch mode.



10.7.8.2 Punch Unit Adjustments

No adjustments can be made with the punch unit installed in the machine. Assemble the major punch unit with the punch support guide plate and code-position frame casting, before checking the following adjustments. Adjust in the following sequence:

1. Push the punch support assemblies upward. Insert the 0.059" side of gage 982911 between the supports and the guide plate. Return the supports to rest firmly on the gage. At this point, check to be sure that the toes of the operating plates latch into the slot on the mounting plate when the punch-suppression solenoid is manually attracted and movement is stopped by the transfer plate. Repeat this procedure using the 0.061" side of gage 982911. If the condition cannot be met adjust the mounting plate assembly.
2. Check carefully that the operating plates can be freely moved by means of the transfer plate. Any indication of the slightest bind must be investigated and corrected.
3. With the operating plates in the interpreting position, check that the lower parts of the punch-support assemblies can operate freely in the vertical slots of the operating plates.
4. With the punch-suppress solenoid manually operated, adjust for 0.001" to 0.005" clearance between the solenoid plunger collar and the lower solenoid bumper by repositioning the solenoid.
5. Check that the return spring has an operating force of 400 to 500 grams. Remove the return spring and re-form to obtain correct tension. The solenoid must be de-energized when the operating force is measured. Use a formed paper clip or a similar device and ten times blade on the CE gram gage.
6. Operate the solenoid plunger manually and check to see that the transfer plate fully returns the operating plates to home position.
7. Reinstall the punch unit in the machine and connect the punch drive-unit operating arms to the punch supports. Install the loading springs and nuts on the punch supports.
8. Latch the punch clutch, and loosen the punch drive-unit and anchor-bar adjustment. Push all punch-support assemblies upward against the punch operating arms to take up the slack. Insert gage 982911 between the punch supports and the punch drive-arm guide comb with the 0.059" side of the gage under the step of the punch supports. Adjust the drive-unit anchor bar until the gage is gripped lightly by the lowest punch support. Lock down the anchor bar. Remove the gage and attempt to insert the 0.061" side of gage. It must not pass under any punch supports. Re-insert the 0.059 side of gage 982911 and check for free movement. Repeat this procedure until this condition is met.

Note: This procedure replaces punch penetration and the 0.015" to 0.020" interposer-yokes to print-interposer-guide-plate clearance used on the standard IBM 129.

Make an operational check of the punch-suppression mechanism before returning the machine to the operator. (See APM.)

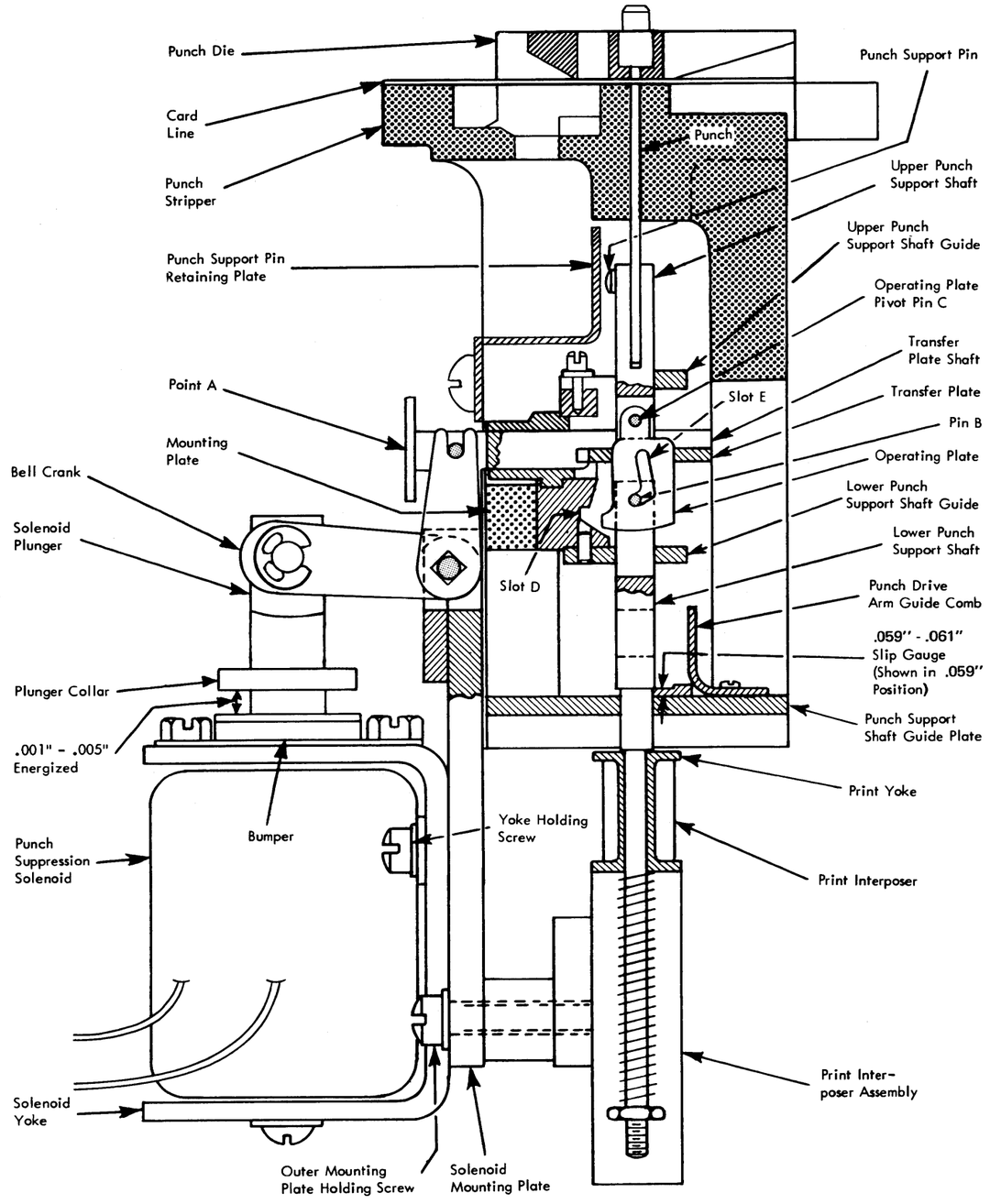
10.7.9 Removal/Replacement

10.7.9.1 Punch Unit Removal

Before removing the punch unit, carefully check all other possible trouble causes and be thoroughly familiar with information in this manual. Lubricate the punch unit carefully whenever it is removed from the machine for any reason.

1. Remove the punch extension cover, nuts, and springs. On reassembly, do not force the nuts tightly against the shoulder, for this can cause the extension to break off.
2. Remove vertical-drive-rod guide plate. Unhook horizontal shift spring.
3. Loosen the punch-suppress solenoid unit top mounting screw located under the card feed. Do not loosen the two outer screws holding the solenoid mounting plate to the print interposer assembly or the two screws holding the solenoid yoke to the mounting plate. The solenoid adjustments will be retained if the solenoid assembly and print interposer assembly are removed and replaced as a unit. If the screws holding these two assemblies are loosened, the solenoid bumper adjustments must be remade.

   Should it be absolutely necessary to remove the solenoid plate assembly, scribe the location marks of the plate on the code positioning casting and the punch support casting. Accurate scribe marks will enable you to relocate the solenoid plate assembly without losing the critical clearance of the solenoid to the bumper.
4. Remove the four mounting screws and pull the print interposer assembly and punch-support guide plate from the punch extensions. Keep the horizontal shift slide compressed to prevent displacement of the interposer and rollers. A rubber band can be used for this purpose.
5. Remove punch/read station cover, fibre optic and chip tube assembly.
6. Remove the print unit and print ribbon.
7. Remove the master-station upper guide, master station pressure-rail covers, and master-station bed plate.
8. Remove the two screws holding the punch unit in place. Disengage all punch drive arms from the punch support arms. Take the unit out from the top of the machine.



Punch-Suppression Mechanism

10.7.9.2 Punch Unit Replacement

Replace by reversing the steps used for removal.

When reversing step 7: to retain the solenoid bumper adjustments, the two screws holding the solenoid mounting plate to the print interposer assembly are not loosened. Replace the punch support guide plate, and then replace the print-interposer assembly and the solenoid assembly as a unit. Note that if the two assemblies have been separated, the solenoid bumper adjustments must be remade. Make sure that the solenoid assembly locates correctly on the pin of the transfer plate shaft.

Make sure that the punch drive-arm guide comb does not cause the drive arms to bind against the lower punch supports.

Set up the code-plate alignment as for standard card punches.

10.7.9.3 Punch Support Assembly Removal

1. Remove the punch unit.
2. Remove the lower guide plate.
3. Remove the retaining pin plate.
4. Remove the retaining pin.
5. Remove the punch support assembly.
6. Remove the punch.

Replace in reverse order. Make sure that the extensions run freely in their guides. Also, make sure the transfer plates operate freely.

10.7.9.4 Punch Drive Arm Replacement

Do not replace drive arms individually.

Correct functioning of the punch-suppression unit can be obtained only by maintaining close (manufacturing) tolerances in the drive unit. For this purpose, a matched set of 12 drive arms complete with pivot shaft and bail should be installed when a punch drive arms has to be replaced. (P/N 5404032)

Removal and replacement procedure is the same as for the standard IBM 129.

10.7.10 Installation Procedure

1. Remove the top cover and take out the shipping bolts that lock the bed in place.
2. Lubricate the punch clutch.
3. Lubricate the punch-suppression unit.
4. Special CE tools necessary for maintenance of this feature are available in the branch office or from Mechanicsburg.

- Part 982911, 0.059" - 0.061" slip gage.
- Protect the edges of these precision tools from damage and be careful not to bend them. Keep them wrapped in a lightly oiled cloth.

10.7.11 Service Aids

Detailed inspection of the punch unit cannot be made with the unit installed in the machine, but the following areas can be observed under operating conditions:

1. Solenoid plunger and bellcrank position.
2. Loosening of the screw retaining the leaf spring.
3. With the master station bed plate removed, the end of the transfer plate can be seen to determine its action.

The punch-drive unit anchor bar cannot be used as a means of adjusting punch penetration and/or printing to compensate for machine wear. Penetration is restricted by a 0.059" to 0.061" adjustment. The areas of wear and the means of correction are:

1. Punch-Drive Unit: Replace the punch-drive unit parts showing wear, or replace the entire unit.
2. Printing Mechanism: Adjust the fixed stops on the vertical and horizontal print interposer slides, or replace the print mechanism parts.
3. Punch Blades and Punch Support Assemblies: Move the punch blade up to the next hole.

Incorrect Punch-Drive Adjustment

If punching failures or punch-suppression failures cannot be localized to other causes, the drive arms are not positioning the operating plates within the tolerance of 0.008". Only four courses of action are now possible:

1. Remake the anchor bar adjustment.
2. If not successful, alter the position of the punch drive-arm pivot shaft bushings.
3. Replace the set of 12-punch drive arms (see "Punch Drive-Arm Replacements").
4. Replace the drive unit.

Punching Invalid Characters

If loss of punch penetration results from multi-punching operations (causing severe overshift of the print interposers), replace the punch extension springs with stiffer springs. (P/N 982904)

10.7.12 Lubrication

All components of the punch-suppression mechanism must be well lubricated and free moving. Lubricate the mechanism linkage carefully at each scheduled maintenance call and whenever the punch-suppression mechanism is removed from the machine for any reason. Lubricate the upper punch supports whenever they are accessible. Be sure that oil does not run into the solenoid.

By removing the bed plate and tilting the base, it is possible to run oil down a screwdriver blade and lubricate the bellcrank arm pivots and the left side of the punch-suppression mechanism.

Punch Support Mechanism: Lubricate the working parts lightly with IBM # 6 oil. Operate the punch-suppression mechanism to spread the oil along the shaft and into the bushing. Do not allow oil to run into the solenoid.

10.7.13 Maintenance Routine

The standard IBM 129 scheduled maintenance applies also to the IBM 129, Interpret.

If the punch-suppression mechanism is removed from the machine for any reason, clean and lubricate it, and then check it as in "Home Position Definition."

10.8 VARIABLE LENGTH CARD DEVICE

This feature allows the IBM 129 Data Recorder to process 51, 60, 66, and 80 column cards. The conversion from one card length to another is made by changing the settings of the feed hopper guides, the card pusher, and stacker stops. The basic machine has been modified in the following areas:

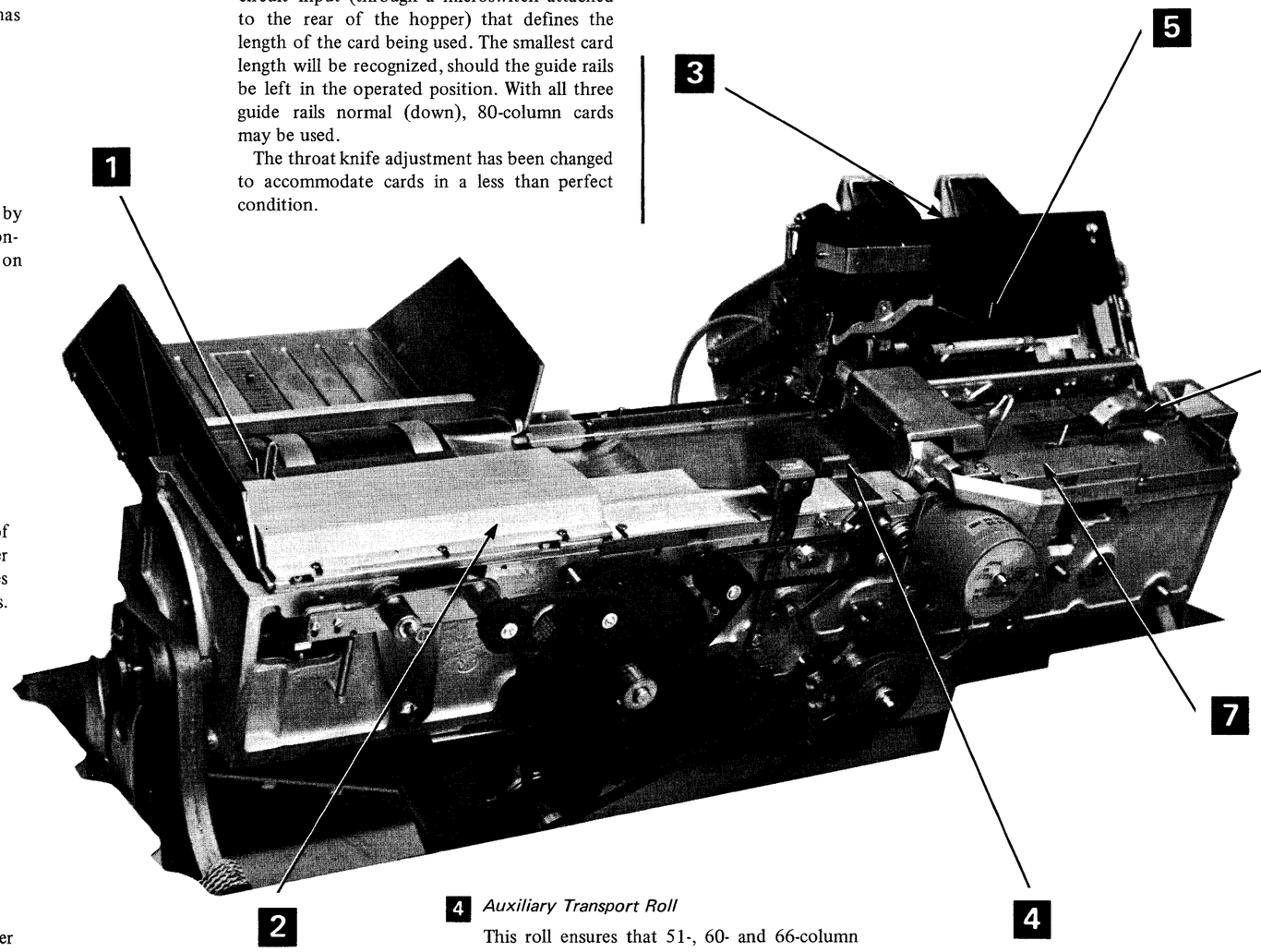
Hopper and card feed mechanism
Registration assembly
Card transport
Stacker assembly
Control logic

Note: Illustrated components are indicated by numbers on black backgrounds, such as **1** Non-illustrated components are indicated by numbers on white backgrounds.

3 *Hopper*

Three guide rails accommodate variable length cards. When selected, each guide rail provides circuit input (through a microswitch attached to the rear of the hopper) that defines the length of the card being used. The smallest card length will be recognized, should the guide rails be left in the operated position. With all three guide rails normal (down), 80-column cards may be used.

The throat knife adjustment has been changed to accommodate cards in a less than perfect condition.



5 *Card Feed*

Control over the feeding of 51-, 60- and 66-column cards (and of cards that are in less than perfect condition) has been enhanced by using a card lifter device and repositioning an aligner finger.

1 *Stacker*

An additional cam, attached to the left end of the stacker drum shaft, provides control over the auxiliary eject roll that, in turn, provides stacking for 51-, 60- and 66-column cards.

6 *Card Pusher*

A positionable card pusher must be set in the appropriate notch for 51-, 60-, 66- or 80-column cards. A guide spring serves the same function as the card pusher hood on the base IBM 129. Card overthrow at the punch/read station is restricted by allowing the card pusher to lightly grip the card during the register cycle. The die and stripper feed roll clearance has been modified to minimize card feed problems due to less than perfect card condition.

2 *Auxiliary Eject Roll*

Shorter-than-80-column cards require 'stacker timing' provided by the auxiliary eject roll.

A positionable stacker stop lever must be operated when using 51- or 60-column cards.

4 *Auxiliary Transport Roll*

This roll ensures that 51-, 60- and 66-column cards are presented firmly to the eject unit. The lower portion of this assembly (driven by an additional belt, continuously running) is cammed upward against a card that has been positioned between it and a stationary idler. The card is ejected to the left.

In verify correct mode, the corrected 51-, 60- or 66-column card does not eject to the stacker until the next feed cycle.

7 *Pressure Rails*

Pressure rails have been redesigned to contain shorter-than-80-column cards in good alignment at the punch/read station. A new card lever assembly provides drag on the card and stabilizes the card position during register and preregister cycles.

10:8.1 Adjustments

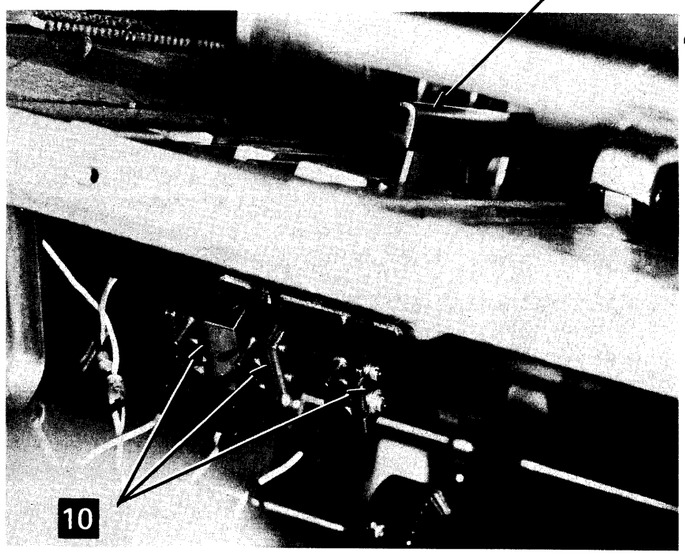
Note: Variable Length Card Device components are numbered.

8 *Throat Knife*

Adjust for .0095 to .011 inch opening.

9 *Rails*

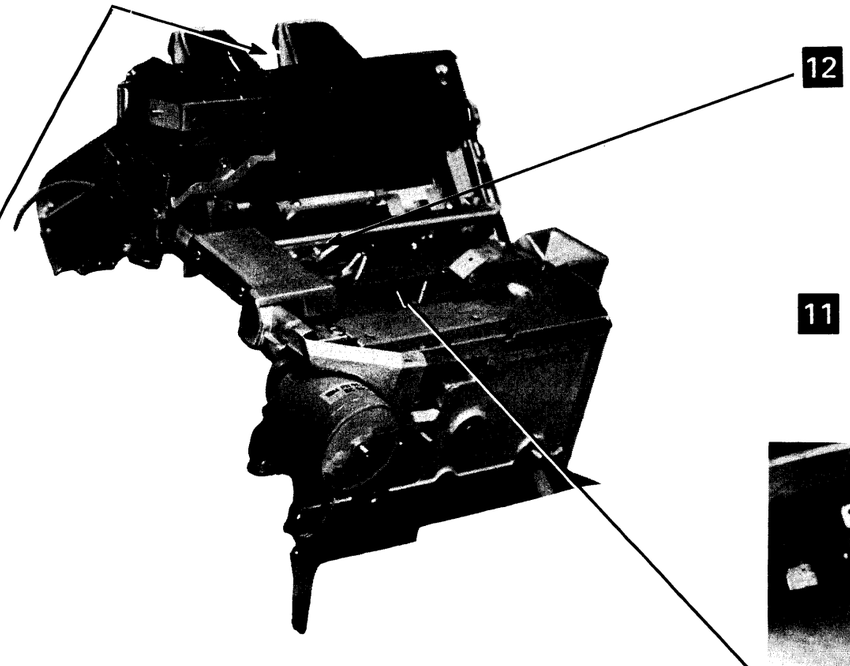
Rails must operate freely and should snap into position when operated.



10 *Microswitches*

When a rail is up (selected position), the corresponding microswitch is open. Check for this condition with a probe or meter.

The microswitches (3) are mounted on a bracket. The bracket should be positioned to allow the switches to operate freely in the slots.



11 *Card Lifter*

Criteria:

- Should restore to a position that does not interfere with a hand inserted card.
- Cam forward sufficiently to lift a card onto the card rail.

Location: On the same shaft as the aligner fingers, using a split hub.

Adjustment: With the aligner finger cam follower on the high dwell of the aligner cam (approximately 15 of a card feed cycle), adjust the lifter hub so that the tip of the lifter is ½ ± 1/32 inch from the upper card rail.

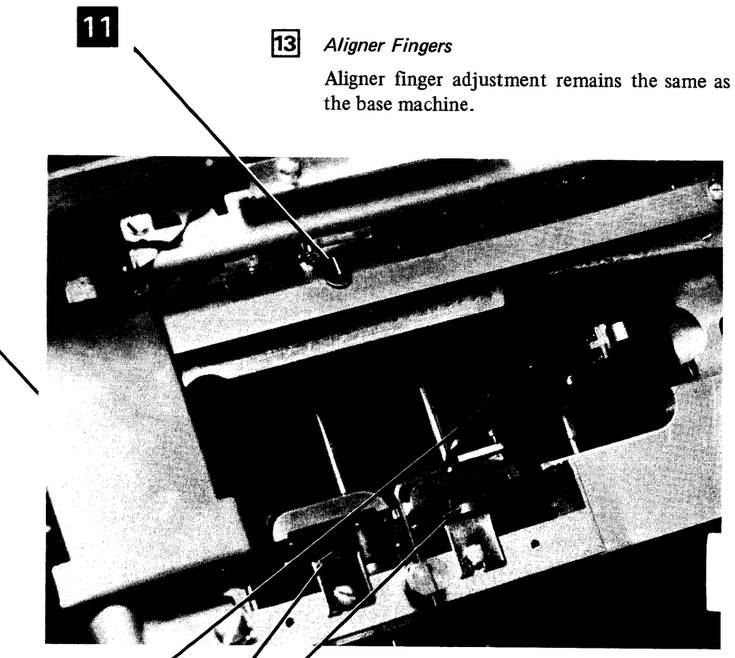
The card lifter hub should be positioned on the aligner shaft between the center and the left-hand aligner fingers, and .125 to .156 inch from the center finger.

12 *Punch Station Guide (Clear Plastic)*

This guide should be .060 to .080 inch above, and parallel to, the card bed.

13 *Aligner Fingers*

Aligner finger adjustment remains the same as the base machine.



14 *Pressure Rails*

Adjust to obtain 27 ± 4 grams pressure on a preregistered card.

Criteria:

- For this adjustment, have the left rail pressure equal to or higher than the right rail, and the left rail tipped slightly clockwise. (The right end of this rail must leave the card edge first.)

Relocate the friction rod when making this adjustment.

15 *Auxiliary Transport Roll*

The following adjustments must be completed first.

16 *Punch/Read Pressure Roll*

Adjust the eccentric on stop lever arm for .030 ± .005 inch opening between the pressure roll and the feed wheel.

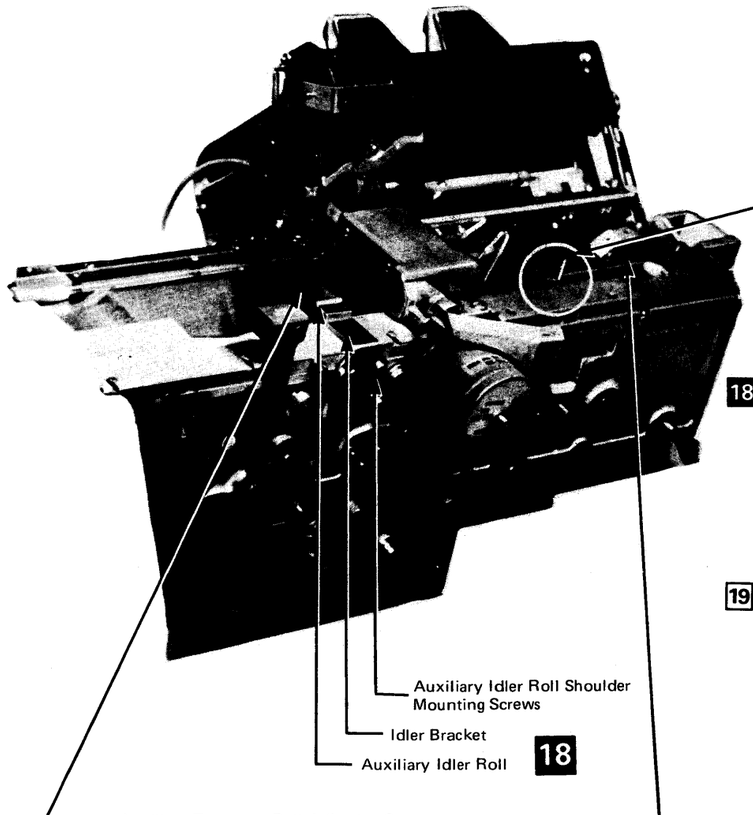
17 *Auxiliary Transport Belt Tension*

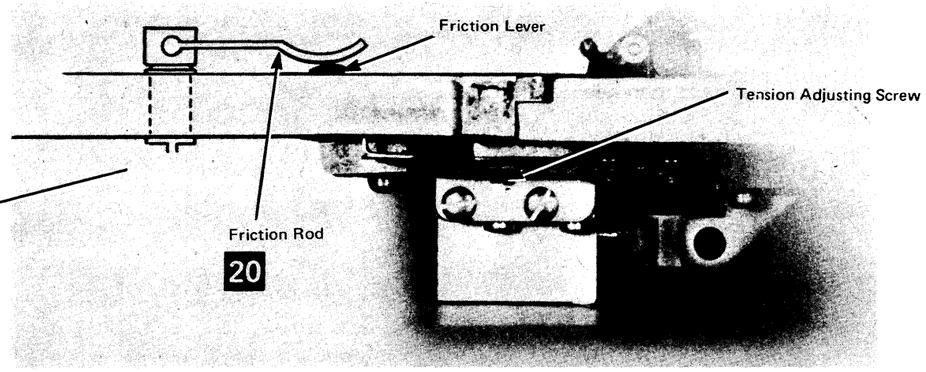
With the CF latched (0), loosen the eccentric pivot shaft lock screw (rear of shaft) and the auxiliary transport roll adjusting lock screw (accessible through the front casting to the right of the idler bracket) and adjust the pivot shaft to obtain belt slack at CF 0°. The pilot holes in the pivot shaft bushings should be in the lower quadrant. Mark the bushing and the casting for future removals.

The auxiliary transport roll shaft must have minimal end play (.002 to .004 inch). Adjust the collar and/or the roll on the shaft.

The auxiliary transport roll must rotate freely within the slot in the bedplate. Adjustment is accomplished by positioning the roll casting with the holding collars on the pivot shaft (accessible only by removing the bedplate).

Position the roller .002 to .006 inch below the level of the bedplate by loosening the lockscrew and turning the adjusting setscrew. Pushing the roller and the release button down at the same time allows the adjusting setscrew to contact the cam plate.





18 *Auxiliary Idler Roll*

Loosen the mounting screws and adjust the idler roll for .011 to .014 inch clearance to the bedplate.

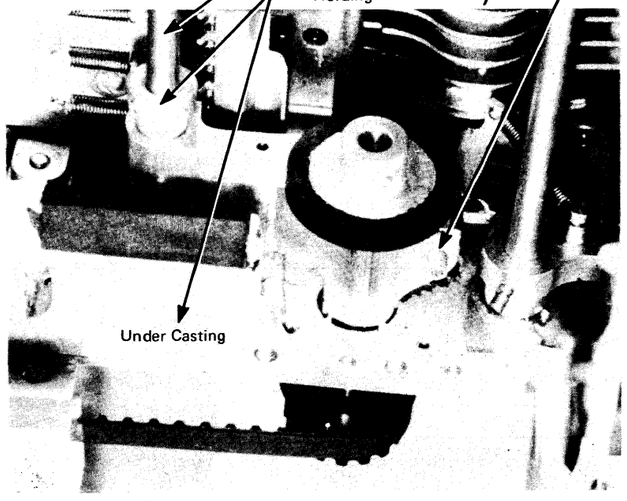
With all adjustments secure and components installed, check that a 51-column card escapes from this unit to the stacker.

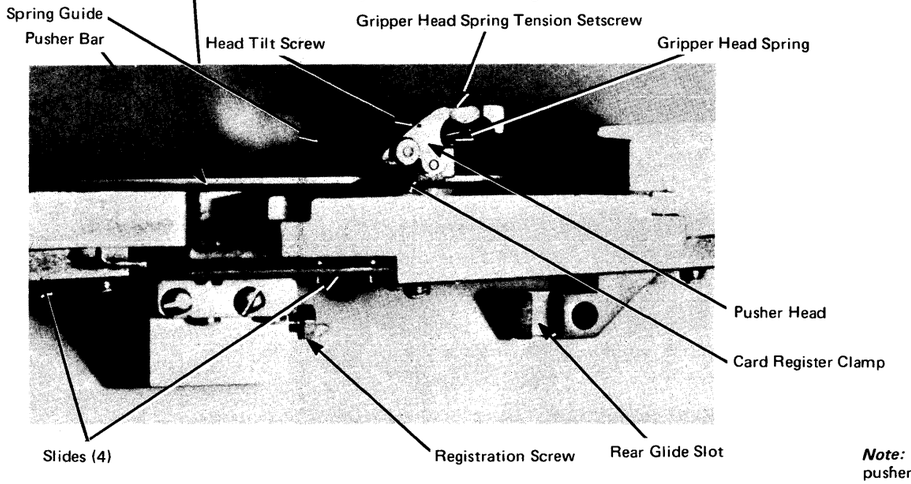
19 *Registration*

With the CF index at 55, make sure the card pusher eccentric stud is not touching and adjust the registration screw for correct registration (51-, 60-, 66- or 80-column card).

Adjust the card pusher eccentric stud to obtain .005 to .008 inch clearance to the pusher arm follower.

The spring guide must be at right angle to the pusher and parallel to the bedplate. The mounting end of the guide should clear the bedplate by .030 to .040 inch. Form the guide directly below its mounting screw.





20 *Card Friction Rod and Lever*

The purpose of the friction rod is to provide drag on the lower portion of the card and prevent clockwise rotation of short cards while registering.

Adjust the card friction rod so that the low point is .020 to .030 inch above the card bedplate and centered over the friction lever.

Position the card friction lever to operate freely in the hole in the register casting. Adjust the tension so that a pressure of 10 ± 2 grams is required to pull a strip of blank card between the rod and the lever while free of all rails and guides.

21 *Pusher Assembly*

With the detail station bedplate removed, adjust the slides so that the pusher bar moves freely but with minimum play.

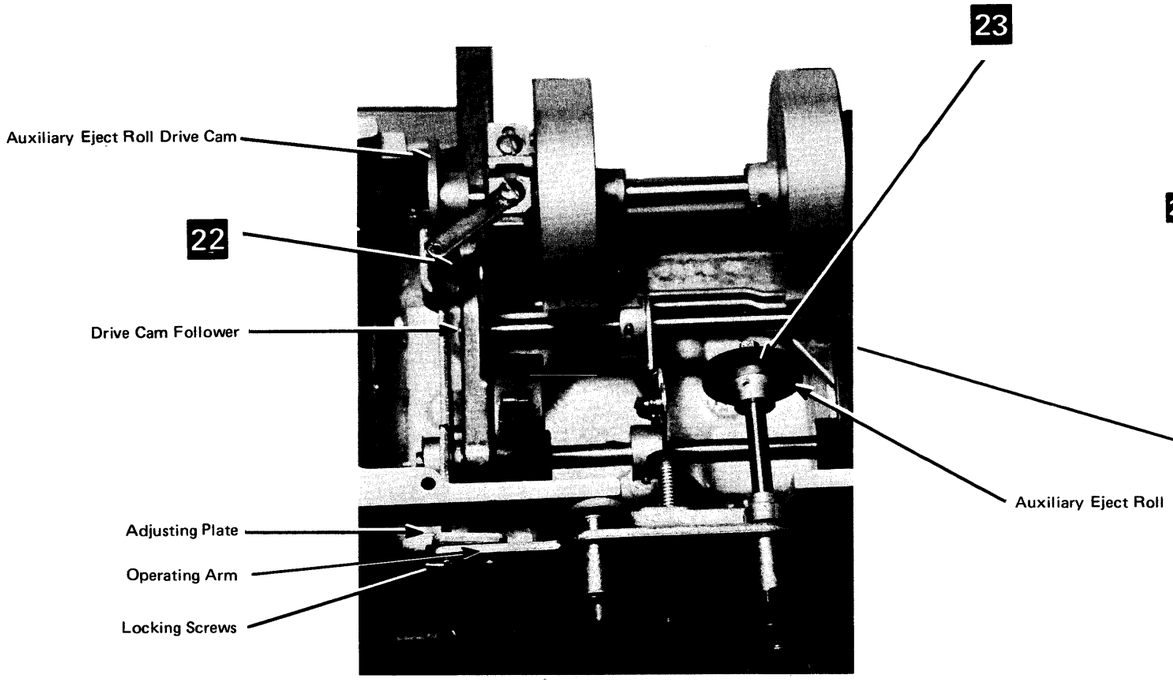
With the detail station bedplate installed, set the gripper head in the column 80 notch (CF time 55) and adjust the head tilt screw to obtain .001 to .003 inch between the card register clamp and the gripper head.

Criteria

- The gripper head spring tension must be sufficient to hold the card until the pressure roll takes over at CF 62°.

Adjust the gripper head spring tension so that with a strip of blank card manually inserted under the head and the machine turned forward to CF 55°, 125 ± 15 grms. are required to free the card.

Note: The bedplate may be removed without upsetting pusher assembly or registration adjustments.



With the CF index at 265 ± 5, loosen the adjusting plate locking screws and position the operating arm to provide .085 + .015 – 0 inches between the eject roll and the bedplate.

22 *Auxiliary Eject Roll Drive Cam Timing*

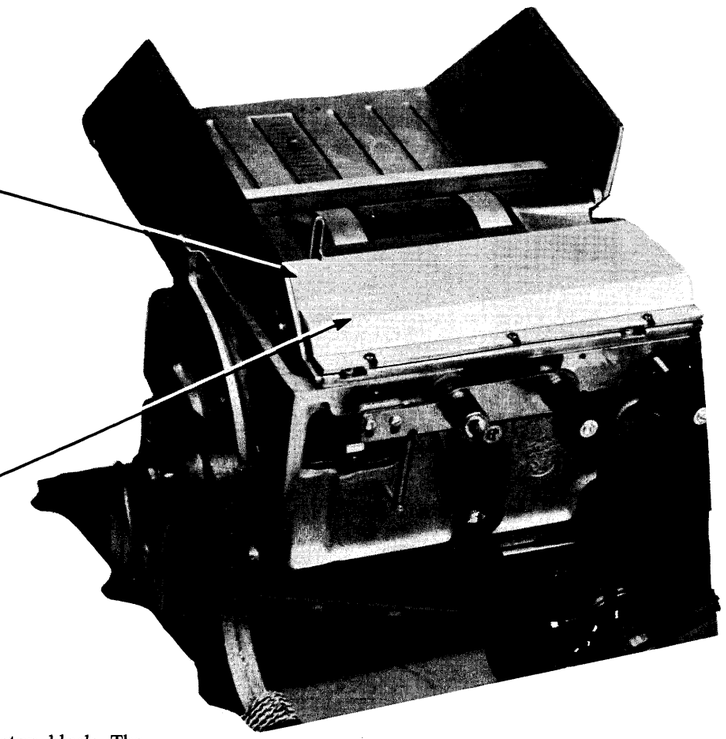
At 265 ± 5 on the CF index, the eject roll cam follower should be in the center of the low dwell of the drive cam (pilot hole).

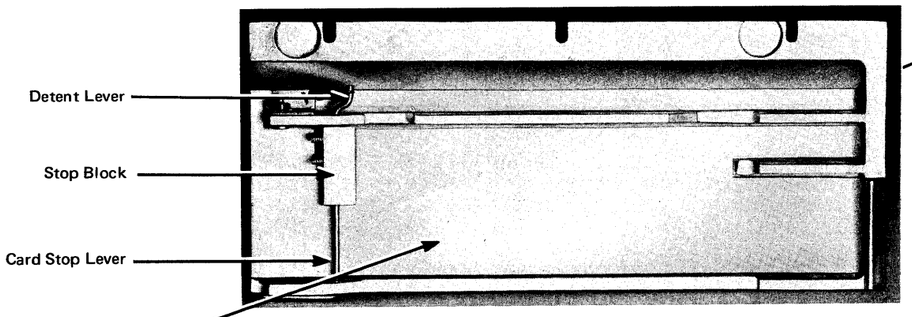
Adjust by loosening the cam holding screws (accessible through the rear of the stacker), hand crank the machine to 265 ± 5 on the CF index, and rotate the drive cam, observing when the pilot hole lines up with the cam follower and cam centers.

23 *Auxiliary Eject Roll*

The auxiliary eject roller should be positioned centrally in the slot in the bedplate.

Adjust the collar and/or the roller. Maintain minimal shaft endplay when obtaining this adjustment.





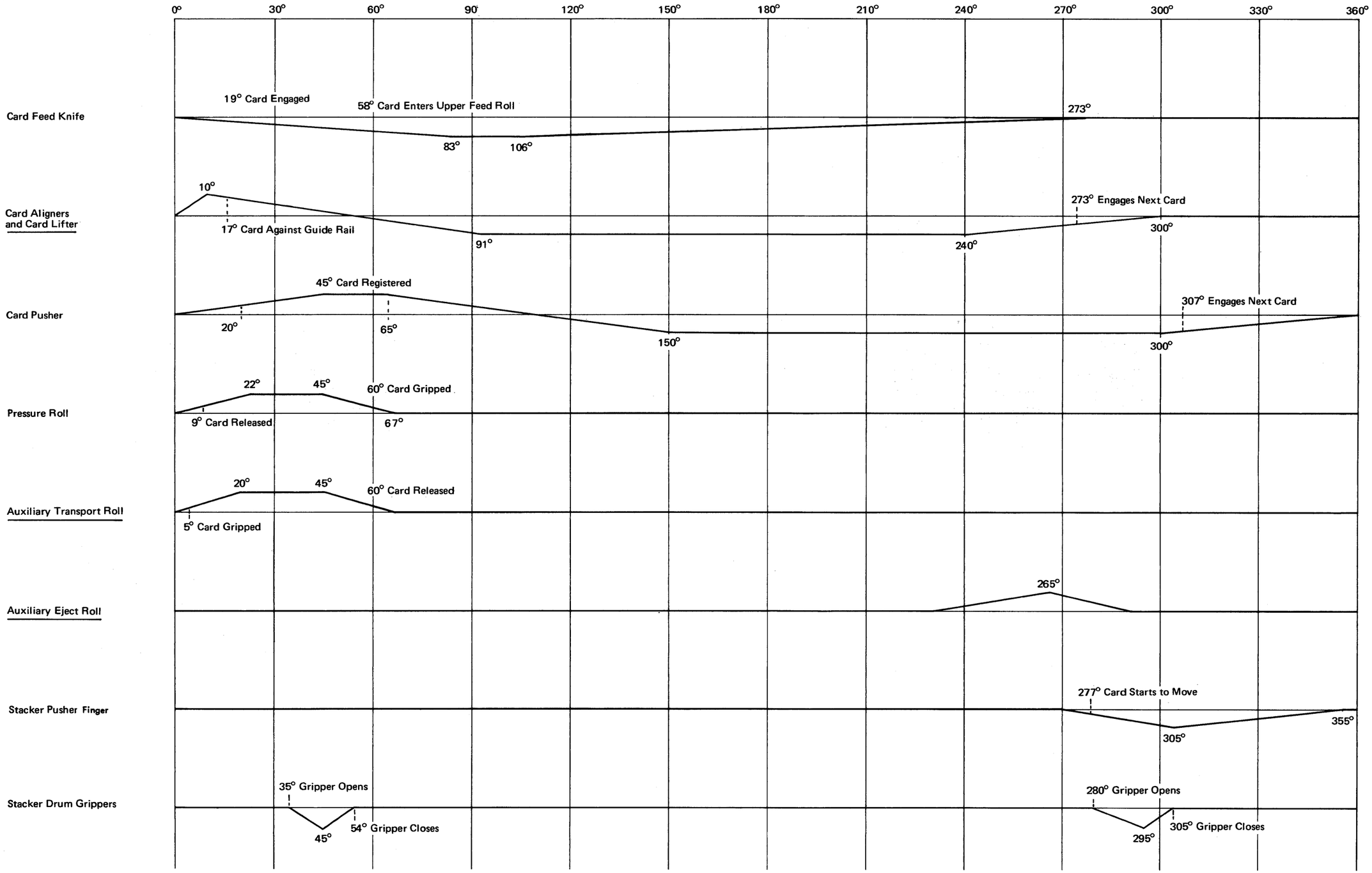
Adjust the stop block for a maximum of .010 inch end play without binding.

24 *Short Card Stop*

Two levers terminate in the stop block. The relationship between them is maintained by two setscrews. When the card stop lever is in the short card position (vertical), the stop block should be vertical. Loosen the card stop lever setscrew to obtain this.

When the card stop lever is in the long-card position, the detent lever must not interfere with card travel, yet provide good detenting for the stop lever.

Card Feed Timing



Removals

Auxiliary Transport Roll Assembly

1. Tilt transport to horizontal position and remove bedplate.
2. Remove auxiliary transport roll.
3. Remove timing belt and slide transport roll shaft out from front of machine.
4. Loosen inside collar on auxiliary transport assembly pivot shaft.
5. Disconnect auxiliary transport roll assembly spring.
6. Temporarily mark the high point of the eccentric pivot shaft front bushing on the bushing face and the transport casting. Remove the shaft locking screw, rear taper pin and eccentric bushing.
7. Remove pivot shaft from front of machine, being sure not to lose the collar. The auxiliary transport assembly can now be removed.
8. To reassemble, reverse procedure and align marks on eccentric bushing and casting.
9. Check standard eject roll adjustment as well as auxiliary transport roll adjustment.

Master Station Bedplate

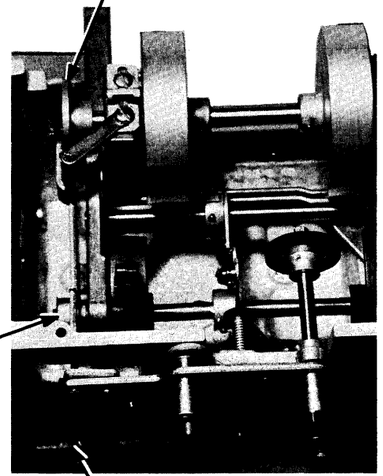
1. Tilt transport to horizontal position and remove belt shield.
2. Remove the card guide over the center rail, stacker pusher finger cover assembly, auxiliary transport idler roll, assembly, center bed pressure rail cover, pressure rail, standard eject assembly and manual card release slide assembly.
3. Remove the two bedplate mounting screws and slide the bedplate out from under the master rail with a slight upward pressure at the left end so that it comes clear of the stacker bed and swings out first toward the front of the machine.
4. To replace the bedplate slide the right upper corner into place first, making sure that the rubber pads are beneath all areas of the bedplate, and then swing the left end in place.
5. Replace the eject unit and adjust the pressure roll.
6. Replace all other parts removed in reverse order.

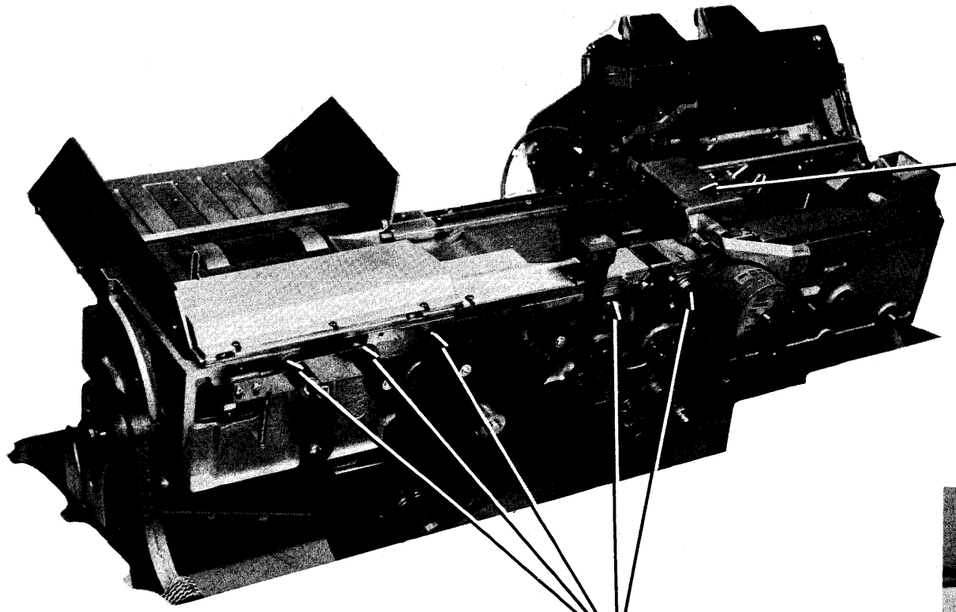
Punch/Read Station Bedplate

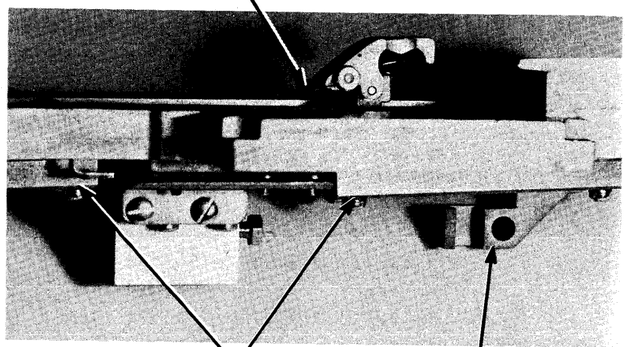
1. Remove pressure rail cover.
2. Remove friction rod (or rotate it clear of bed).
3. Loosen 4 screws and remove bedplate by lifting up the back end and then sliding it out sideways.
4. Replace bedplate by sliding it in sideways against the machined stop making sure that the pusher arm ball is engaged in the slot in the rear glide.

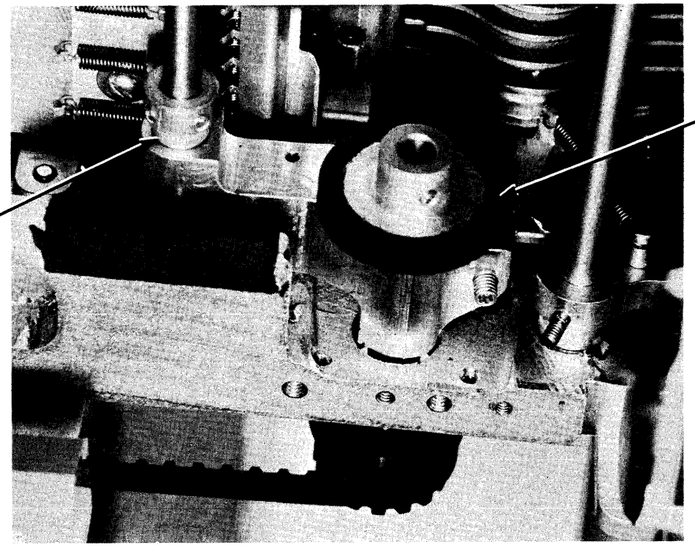
Note: Check that the pusher bar has free motion through its entire travel.

5. Replace and readjust friction rod.
6. Replace pressure rail cover.


Cam Surface
IBM #23 Grease
Pivot
IBM #6 Oil
Cam Surface
IBM #23 Grease


Keep die and stripper area clear of carbon dust build-up.
Shaft Bearings
IBM #10 Oil


Card Register Clamp. This must operate freely and be kept clean.
Roller and Riding Surface IBM #6 Oil
Slides IBM #6 Oil
Rear Glide IBM #23 Grease


Bushing
IBM #10 Oil

VARIABLE LENGTH CARD DEVICE OPERATING PROCEDURES

Select hopper guide rail for 51-, 60-, or 66-column cards.

Operate the stacker stop lever if using 51- or 60-column cards.

Position the pusher arm in the appropriate notch.

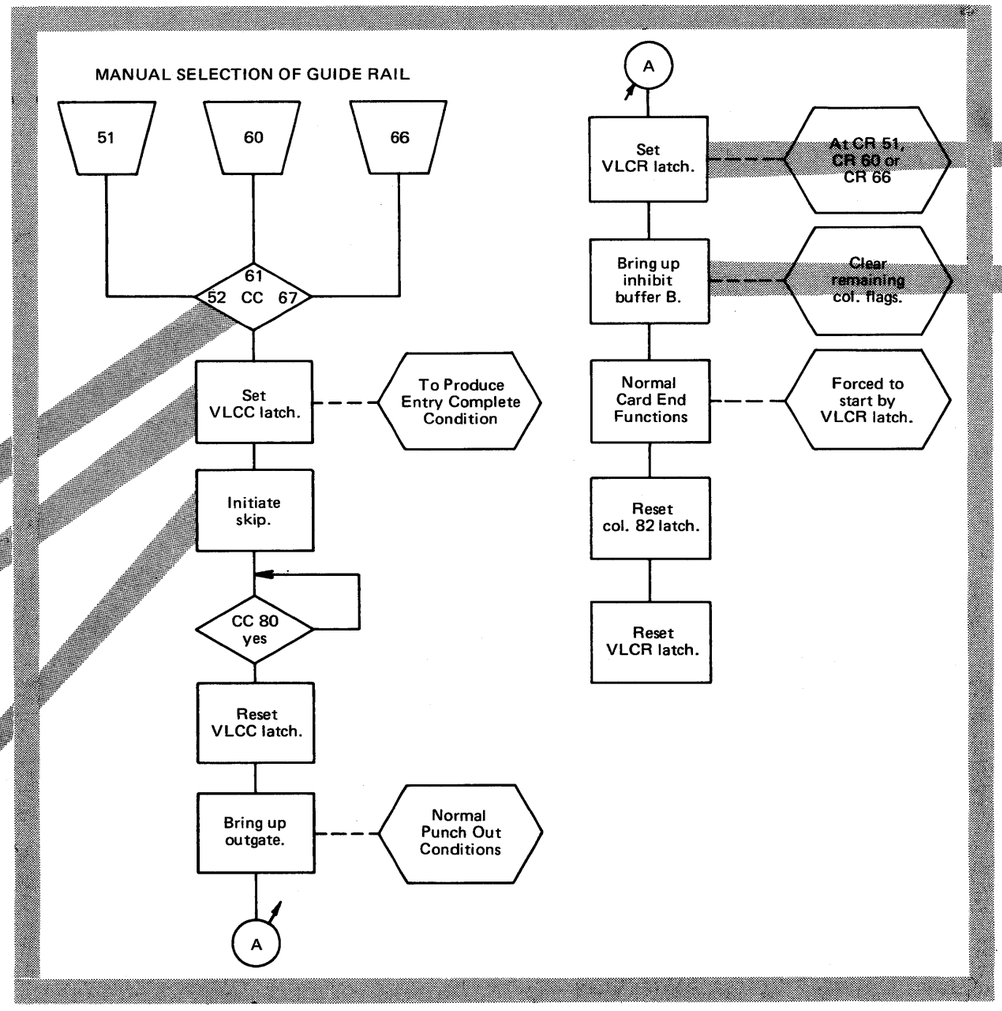
Program for the particular operation.

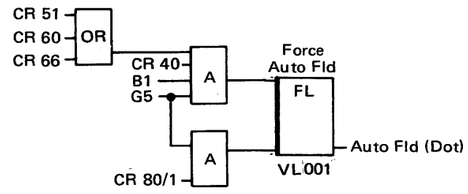
Set console switches as in normal 129 operation.

Place variable length cards in the hopper.

Commence card processing.

Note: For punchout of Production Statistics, use 80-column cards.





Enables backspace circuitry that may be used to recover from mistakes incurred in the last column of a variable length card.

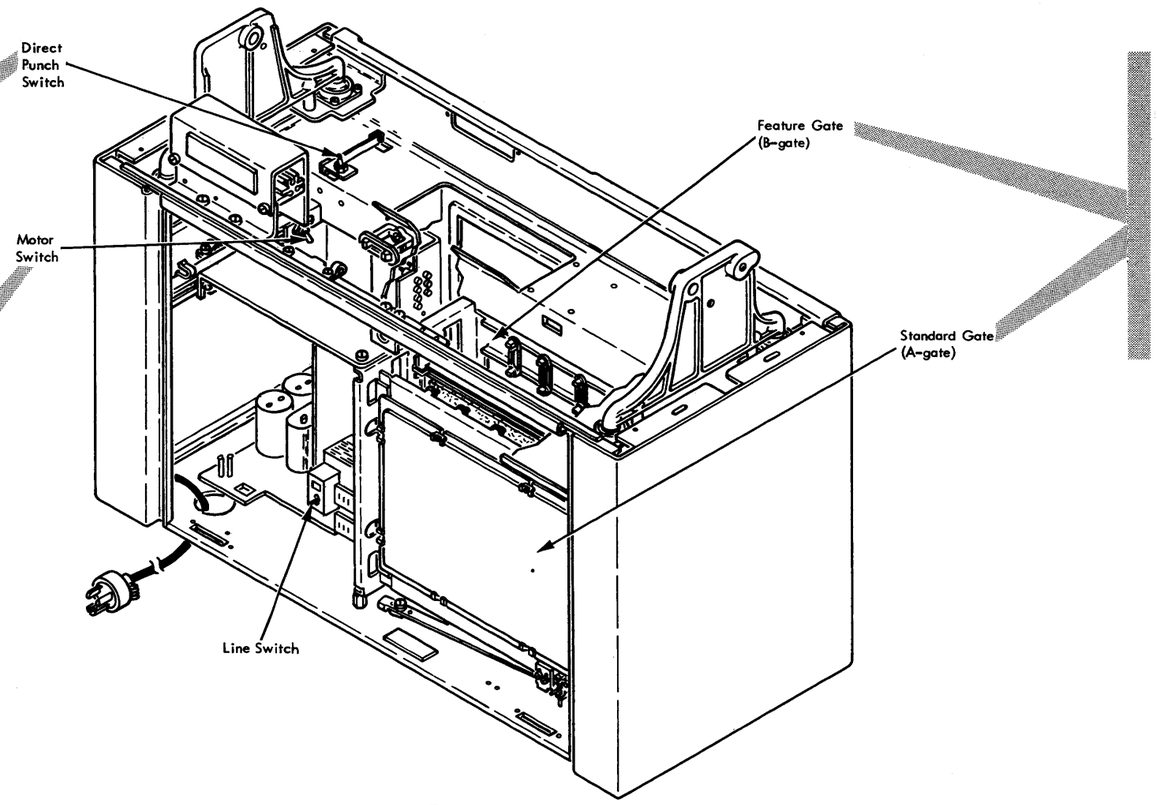
11.1 DIRECT PUNCH SWITCH

With the CE direct punch switch in the DP position, the mechanical functioning of the machine and about 25% of the logic can be checked. In DP mode, the 129 operates similar to an IBM 29; that is, keyed data bypasses the buffers and is set directly in the output LATCHES. The following keys do not function correctly in DP mode: MULT PCH, BLANK COLUMNS/LEFT ZERO CTRL, BKSP (all), DUP, SKIP, spacebar, REL, dash (–), minus left zero (–LZ), and PROG SEL. Pressing any of these keys causes false indications of machine operation.

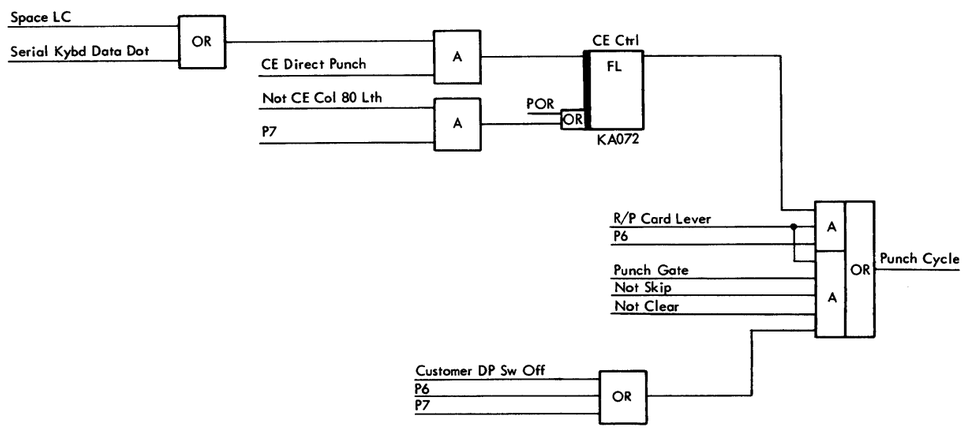
11.2 MOTOR SWITCH

The motor switch allows the CE to remove power from the drive motor without affecting the rest of the circuitry.

CAUTION
Machine power must be shut off before the motor switch is turned on or off. Machine functional logic failures will result if the motor switch is turned on or off with machine power on.



Rear View



11.3 CARD LOCATIONS

When looking at the pin side of the boards, card locations are numbered as follows:

1. *Standard Gate (A-gate):* Letters A through V from right to left. Numbers 2 through 5 from top to bottom.

2. *Feature Gate (B-gate):* Board locations are numbered B1 through D1 from right to left. Card locations within each board are lettered A through F from right to left.

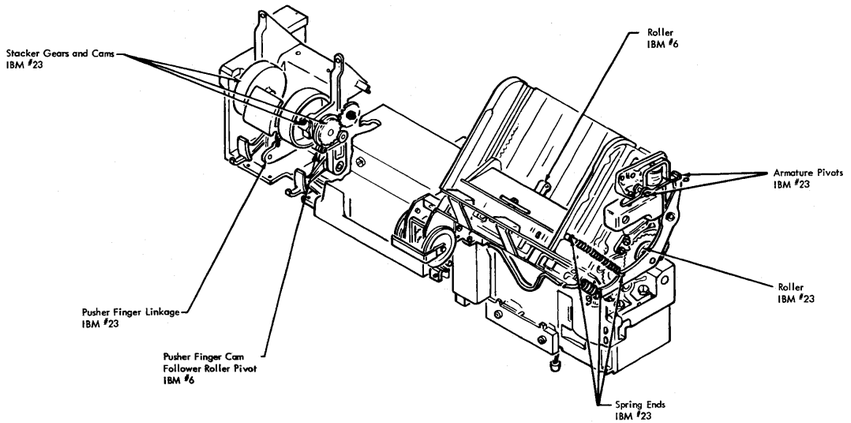
CE AIDS

12.1 PREVENTIVE MAINTENANCE ROUTINE CHART

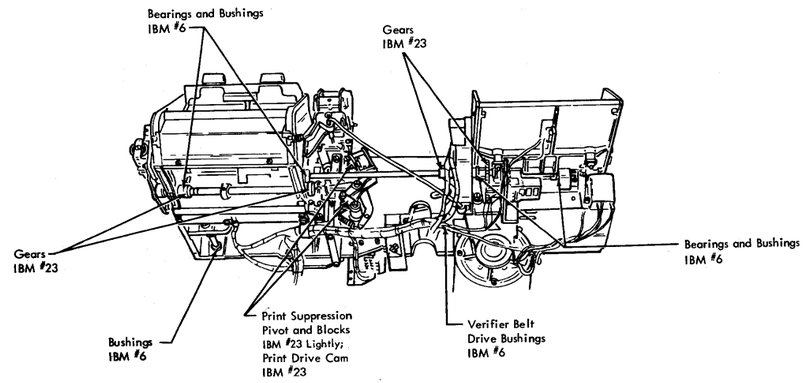
Code U	Location	Frequency (in months)	Required Maintenance	Observe	Lubrication Figure	Adjustment Section
1	Feed	12	Clean dirt from moving parts. Lubricate gears, cams, pivots, and card pusher finger cam follower roller.	Check card feeding and stacking.	A, B, F	5
2	Print	12	Lubricate gears, interposers, grease plugs, and cotton wicks.	Check printing.	D	7
3	Optics	12	Remove and clean read aperture plate assembly, lamp, and fiber optic block.	Light spot alignment.	--	4
4	Punch	12	Lubricate wicks, cams, and pivots.	Check for worn cams, bearings, and linkage.	C, D	6
9	Line Cord	12		Check condition of wires, plugs, terminals, and grounding.	--	--
--	Punch Clutch	Each Service Call	Lubricate grease fitting during each service call. Wipe off excess grease.	Check overthrow and outer-sleeve lead.	C	6
0	General	12	Clean dirt from moving parts and base. Be sure that all ESD components are correctly installed.	Check for loose wires, terminals, SLD cards, and connectors.	--	--
--	Keyboard	12		Check for binding or sticking keys and that the latch contacts are clean.	G	3

12.2 LUBRICATION HINTS

1. The die and punches should be lubricated yearly. Remove the light block and place a blank card in the center bed. Apply IBM #6 to the column 80 end of the card and move the card into the punch die and stripper, checking that the oiled portion of the card does not come in contact with the lower optics. Multipunch all punches in a couple of columns. Remove the card and wipe excess oil from the area.
2. All bronze and iron bearings should be lubricated with IBM #6.
3. All gears (except the print unit iron feed gears), cam surfaces, and armature pivots should be lubricated with IBM #23.
4. After greasing the punch clutch, remove excess grease from the sleeves and collar. This prevents grease from getting on the armature and magnet.
5. Do not use too much oil on the felt wicks in the punch unit. The oil may run down into the punch photo-optics.
6. To prevent sticking of print suppress armature, apply IBM #23 grease lightly to pivot and block.

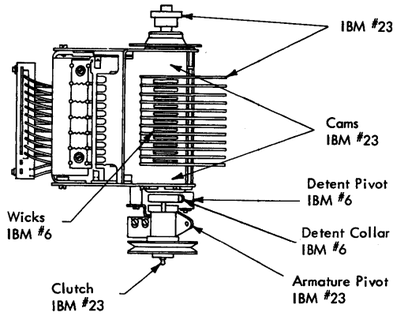


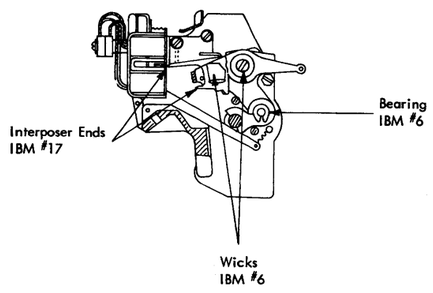
A



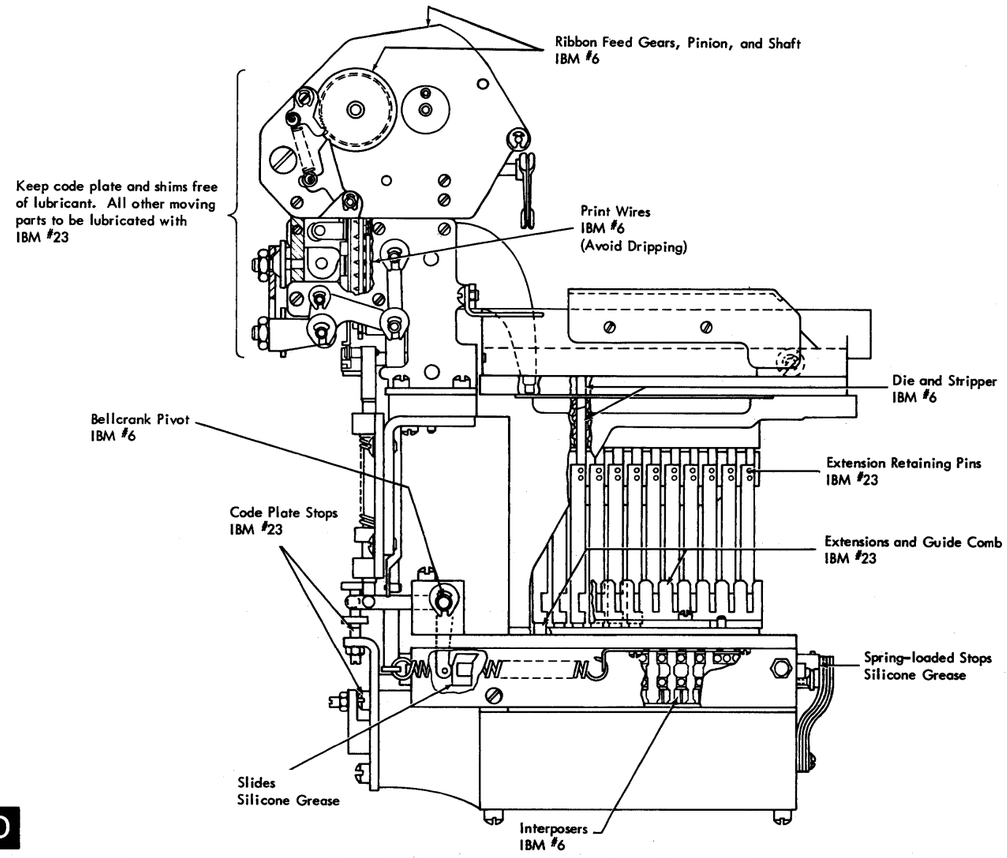
B

PM

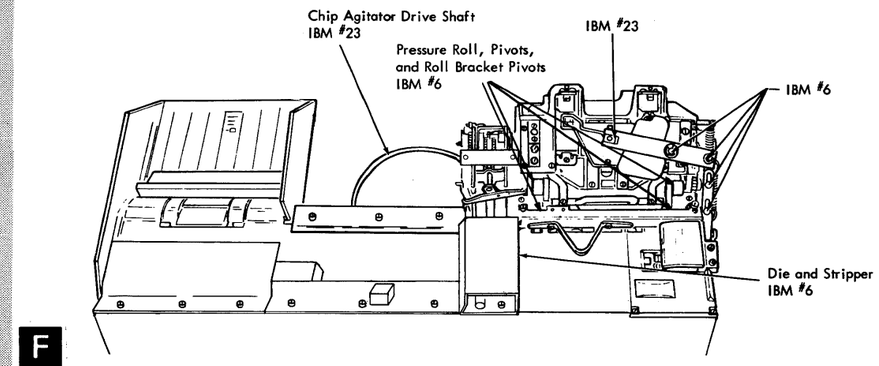

IBM #23
Cams
IBM #23
Detent Pivot
IBM #6
Wicks
IBM #6
Detent Collar
IBM #6
Armature Pivot
IBM #23
Clutch
IBM #23


Bearing
IBM #6
Interposer Ends
IBM #17
Wicks
IBM #6

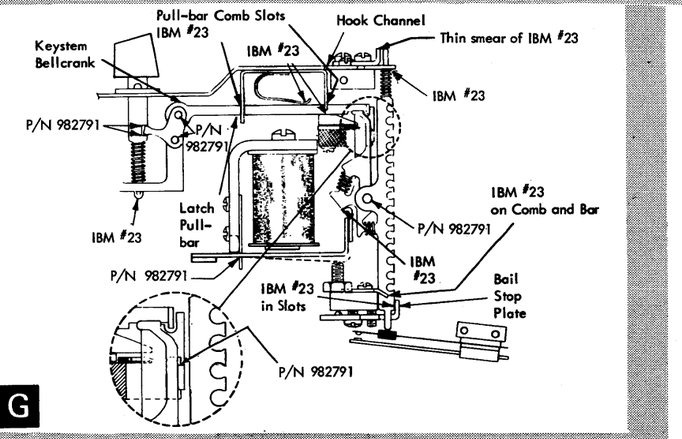
C


Ribbon Feed Gears, Pinion, and Shaft
IBM #6
Keep code plate and shims free of lubricant. All other moving parts to be lubricated with IBM #23
Print Wires
IBM #6
(Avoid Dripping)
Die and Stripper
IBM #6
Bellcrank Pivot
IBM #6
Extension Retaining Pins
IBM #23
Code Plate Stops
IBM #23
Extensions and Guide Comb
IBM #23
Spring-loaded Stops
Silicone Grease
Slides
Silicone Grease
Interposers
IBM #6

D


Chip Agitator Drive Shaft
IBM #23
Pressure Roll, Pivots,
and Roll Bracket Pivots
IBM #6
IBM #23
IBM #6
Die and Stripper
IBM #6

F


Pull-bar Comb Slots
IBM #23
Hook Channel
Thin smear of IBM #23
Keystem
Bellcrank
IBM #23
IBM #23
P/N 982791
P/N
982791
IBM #23
on Comb and Bar
Latch
Pull-
bar
P/N 982791
IBM #23
IBM #23
P/N 982791
IBM #23
in Slots
Bail
Stop
Plate
P/N 982791

G

Normal installation time for the IBM 129 Card Data Recorder is about one hour. All additional time for correcting adjustments must be entered on the IR (on a separate line entry) with the applicable time, service code 20 incomplete, major and minor units, and cause or symptom code.

13.1 PRELIMINARY CHECKS

Unpack the IBM 129 according to the unpacking/packing instructions shipped with the machine.

Note: Inspect machine for any damage. If damage exists, stop installation and ask your supervisor for a decision as to whether or not to continue with the installation.

Check for loose cable connectors, SLD cards, and components.

In cases where the machine has been subjected to cold or heat during shipment, check all areas that require IBM #6, particularly the print interposer assembly. Lubricate as required.

13.2 SHIPPING HARDWARE

Remove the two screws from the base pivot brackets. Remove the four screws, washers, and spacers from the rubber base mounts. Use caution when removing the right rear spacer to prevent damage to the base of the optic lamp assembly. Install the lamp shield. Save all removed hardware and packing instructions for later use. Remove the tape and rubber packing from the SLD gate. Remove the keyboard shipping screws.

CAUTION

Remove excessive line power cord from within the cabinet. Coil excessive line power cord outside the cabinet. A coiled cord can produce noise that may result in machine failure. (See 3.4.)

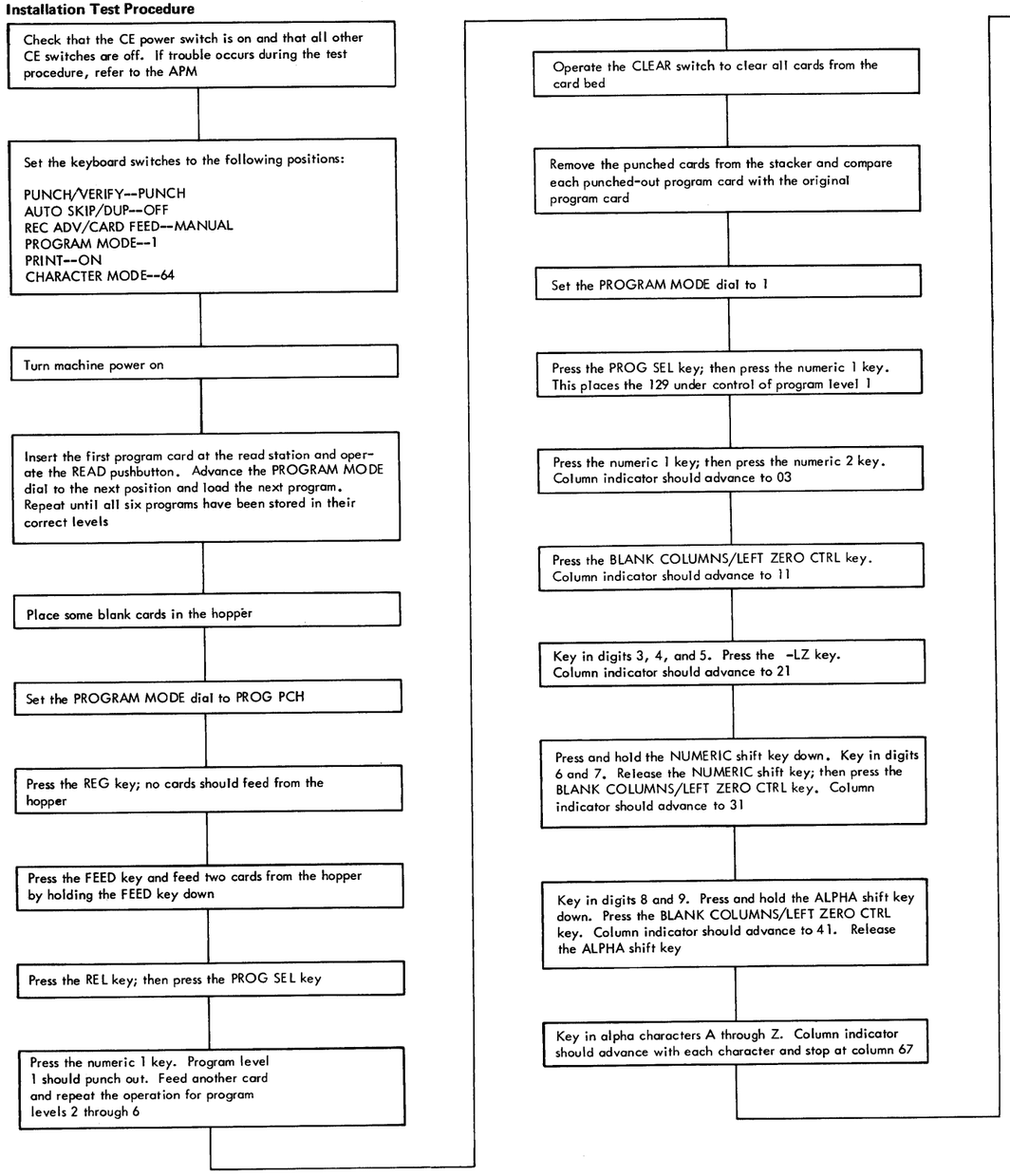
13.3 OPERATIONAL CHECKS

Punch Mode (All Machines): Use the program cards that are shipped with the machine to perform the installation test procedure.

Before starting the installation procedure, check the punch registration on the machine to be installed. If machine is out of adjustment, readjust before continuing.

Check the punch registration on the program cards shipped with the machine. If the cards are not punched in registration, punch new program cards before starting the operation.

Installation Test Procedure



INST PROC

A

Press and hold the MULT PCH key. Key in digits 2, 3, 4, and 5. Release the MULT PCH key. The column indicator should advance to 33

Press and hold the MULT PCH key. Key in digits 6, 7, 8, and 9. Release the MULT PCH key. The column indicator should advance to 34

Press the MULT PCH key. Key in digits 0 through 9; then release the MULT PCH key. The column indicator should advance to 35

Press the CHAR BKSP key. The column indicator should return to 34

Press the REL key. The card should punch out and the column indicator should indicate 01. Compare the punched-out card with Sample Card 2

Key in alpha characters A through Z, and the top row of the keyboard special character keys (except the dash)

Press and hold the NUMERIC shift key. Key in all special characters (except the dash) and the digits 0 through 9. Press the 0-8-2 special character key five times, the numeric 1 key five times, and then the 0-8-2 key five more times. Release the NUMERIC shift key

Press the REL key. The card should punch out and the column indicator should indicate 01. Note: The special character, 0-8-2, does not print if the 129 is functioning correctly. Operate the CLEAR switch

Set the REC ADV/CARD FEED switch to MANUAL

Set the PROGRAM MODE dial to DATA READ. Insert the last card prepared (Sample Card 3) into the read station. Press the READ pushbutton

Set the PROGRAM MODE dial to 3

Press and hold the DUP key. The column indicator stops at 00. Release the DUP key

Set the AUTO SKIP/DUP switch to ON and the REC ADV/CARD FEED switch to AUTO

Feed two cards. The first card should punch out and should be identical to the card just read into storage. The second card follows program level 3 in a skip and dup operation

Set the REC ADV/CARD FEED switch to MANUAL. Set the PROGRAM MODE dial to 4. Set the REC ADV/CARD FEED switch to AUTO. Press the FEED key and feed a card. The first card punched out will follow program level 3, all following cards program level 4.

Set the REC ADV/CARD FEED switch to MANUAL and repeat the operation for programs 5 and 6. When a card has been punched out under control of program 6, set the REC ADV/CARD FEED switch to MANUAL and set the CLEAR switch to ON to clear the card bed. Remove the blank cards from the hopper

End of the punch test. If you have a verify or a special feature model, perform the APM test for that feature. After testing is complete, return the machine to the customer for use, and complete the IR, code 20 complete.

Verify Mode: Complete the punch installation test before beginning the verify part of the procedure.

Set the keyboard switches to the following positions:

PUNCH/VERIFY -- VERIFY
AUTO SKIP/DUP -- OFF
REC ADV/CARD FEED -- MANUAL
PROGRAM MODE -- 1

Place the card prepared in the first punch test (Sample Card 1) in the hopper

Press the FEED key. The card feeds, registers, and skips to column 81

Press the PROG SEL key; then press the numeric 1 key

Key in digits 1 and 2. Press the BLANK COLUMNS/LEFT ZERO CTRL key. The column indicator should advance to 11

Key in digits 3, 4, and 5. Press the — (dash) key. The column indicator should advance to 21

Machines with SLD card PN 5863321 installed in location A1-G4

Press the BLANK COLUMNS/LEFT ZERO CTRL key. Press and hold the NUMERIC shift key; key in a 6 and a 7. The column indicator should advance to 31. Release the NUMERIC shift key

Press the BLANK COLUMNS/LEFT ZERO CTRL key. Key in digits 8 and 9. Column indicator should advance to 41

Key in alpha characters A through Z; then press the SKIP key. The column indicator should indicate 00

Set the REC ADV/CARD FEED switch to AUTO. The card should skip out and be stacked. There should be a 2 and a 3 punched in column 81

Place the card in the hopper and press the FEED key

Key the following information:
- Key in digits 1 and 2; press BLANK COLUMNS/LEFT ZERO CTRL key
- Key in digits 3, 4, and 5; press the -LZ key
- Press BLANK COLUMNS/LEFT ZERO CTRL key; press and hold the NUMERIC shift key; key in digits 6 and 7; release the NUMERIC shift key
- Press BLANK COLUMNS/LEFT ZERO CTRL key; press and hold the NUMERIC shift key; key in digits 8 and 9; release the NUMERIC shift key
- Key in alpha characters A through W

The column indicator should indicate 64

Press the space bar eight times. Press and hold the NUMERIC shift key; key in a 6 and a 7. The column indicator should advance to 31. Release the NUMERIC shift key

Press the space bar eight times. Key in digits 8 and 9. Column indicator should advance to 41

Key in alpha characters A through Z; then press the SKIP key. The column indicator should indicate 00

Set the REC ADV/CARD FEED switch to AUTO. The card should skip out and be stacked. There should be a 2 and a 3 punched in column 81

Place the card in the hopper and press the FEED key

Key the following information:
- Key in digits 1 and 2; press BLANK COLUMNS/LEFT ZERO CTRL key
- Key in digits 3, 4, and 5; press the -LZ key
- Press the space bar eight times; press and hold the NUMERIC shift key; key in digits 6 and 7; release the NUMERIC shift key
- Press the space bar eight times; press and hold the NUMERIC shift key; key in digits 8 and 9; release the NUMERIC shift key
- Key in alpha characters A through W

The column indicator should indicate 64

Press the W key again. The VERIFY light should come on

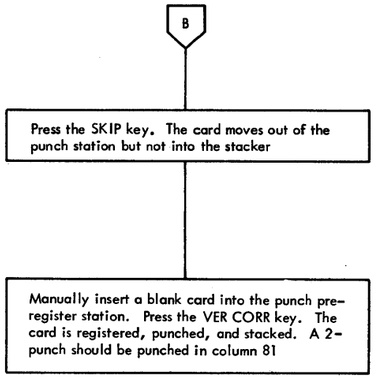
Press the VER RES key and the W key. The VERIFY light should go off and then on again

Press the VER RES key and key in alpha characters X, Y, and Z. The VERIFY light should go off; the column indicator should indicate 88

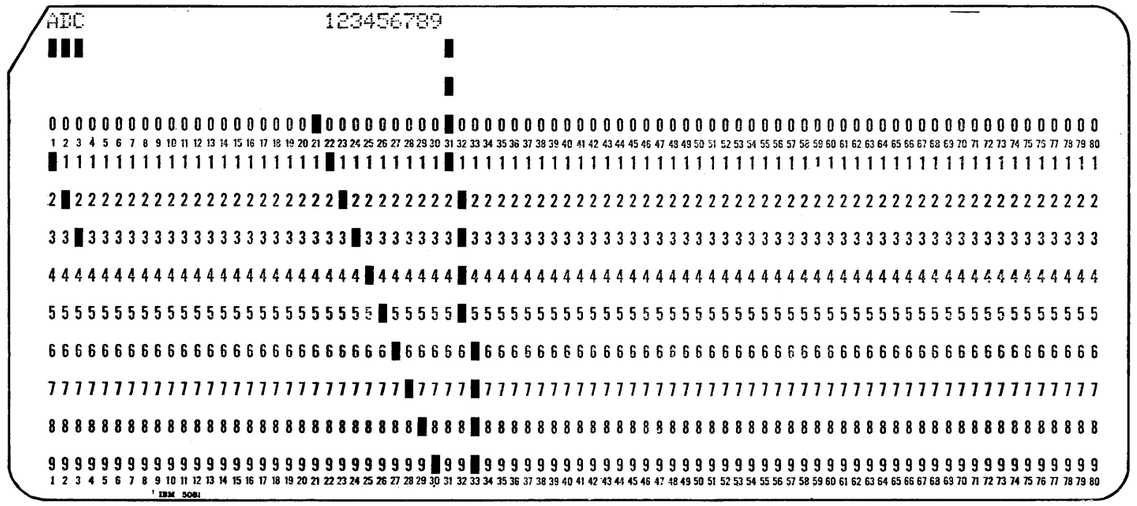
Press the FIELD BKSP key. The column indicator should return to 41

Key in alpha characters A through Z

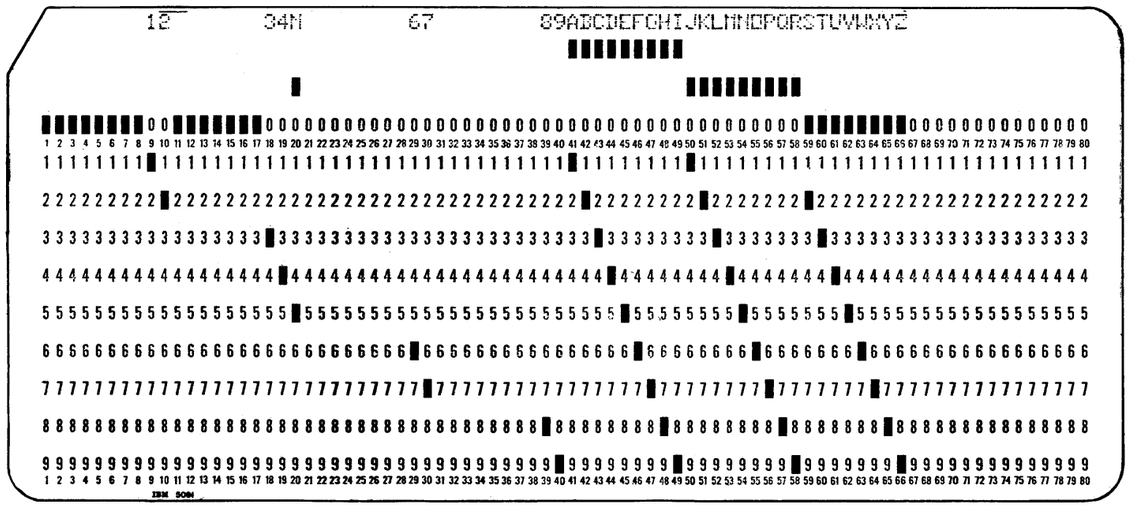
B



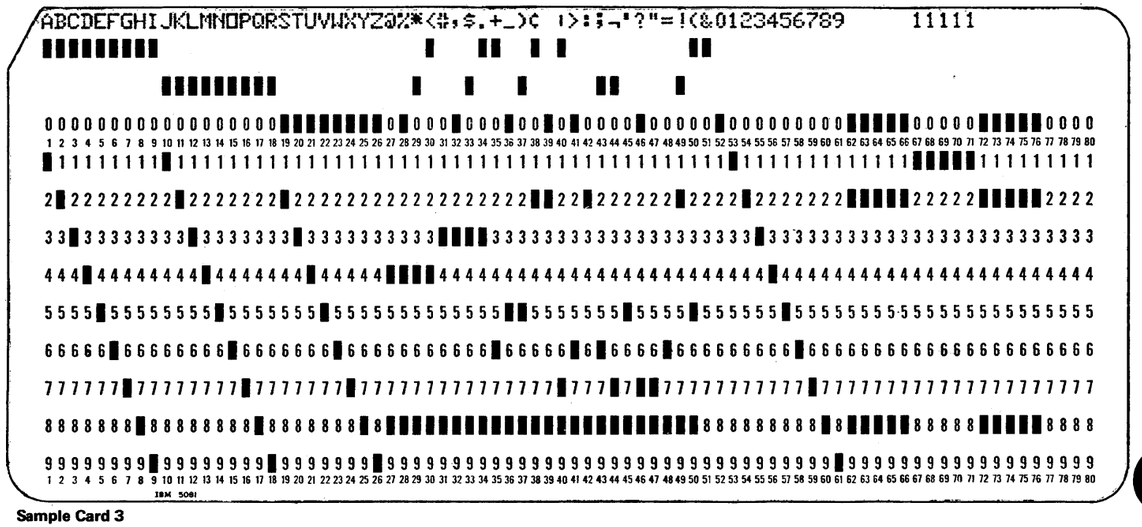
End of the verify portion of the installation test. If the machine has any features, perform the APM test for that feature; then return the machine to the customer for use. Complete your IR, code 20 complete.



Sample Card 2



Sample Card 1

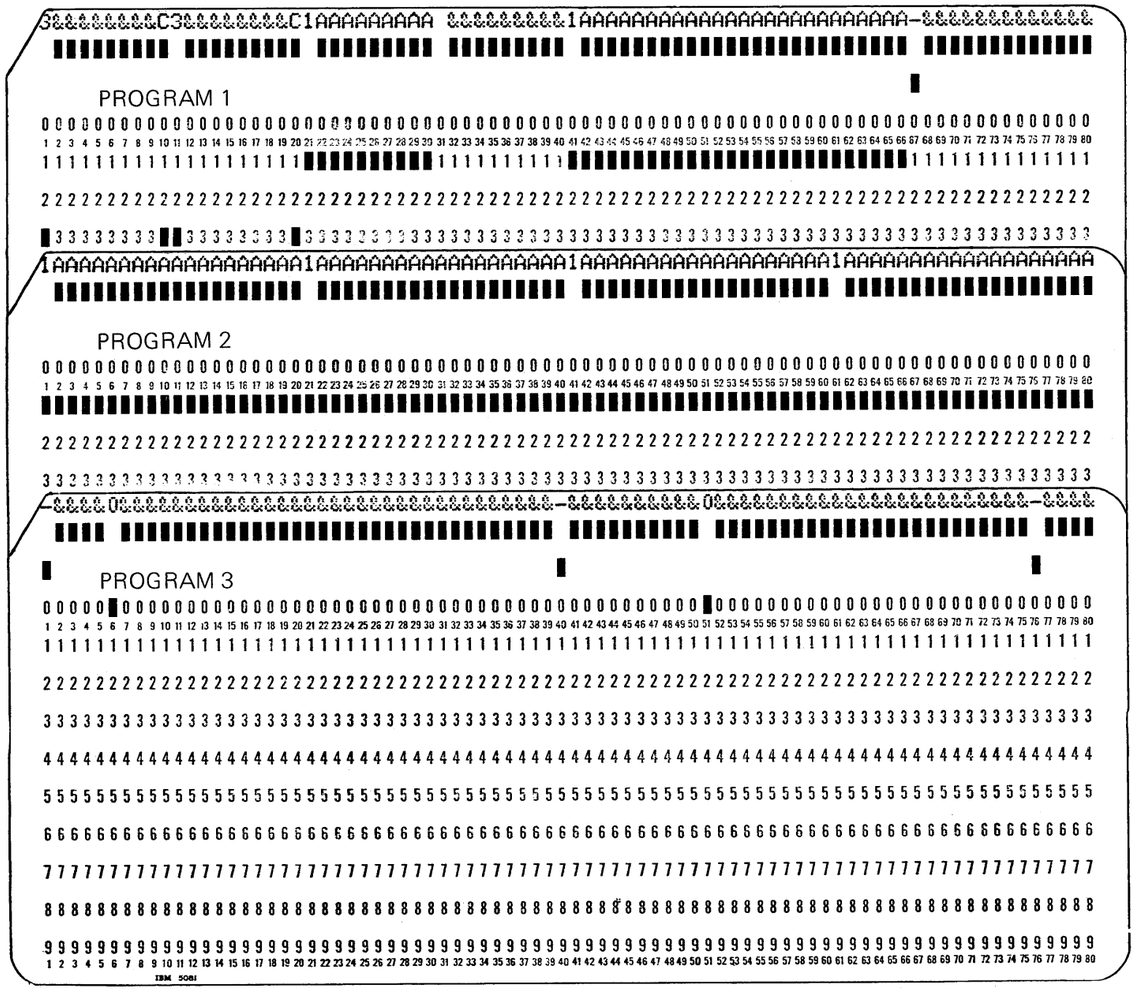


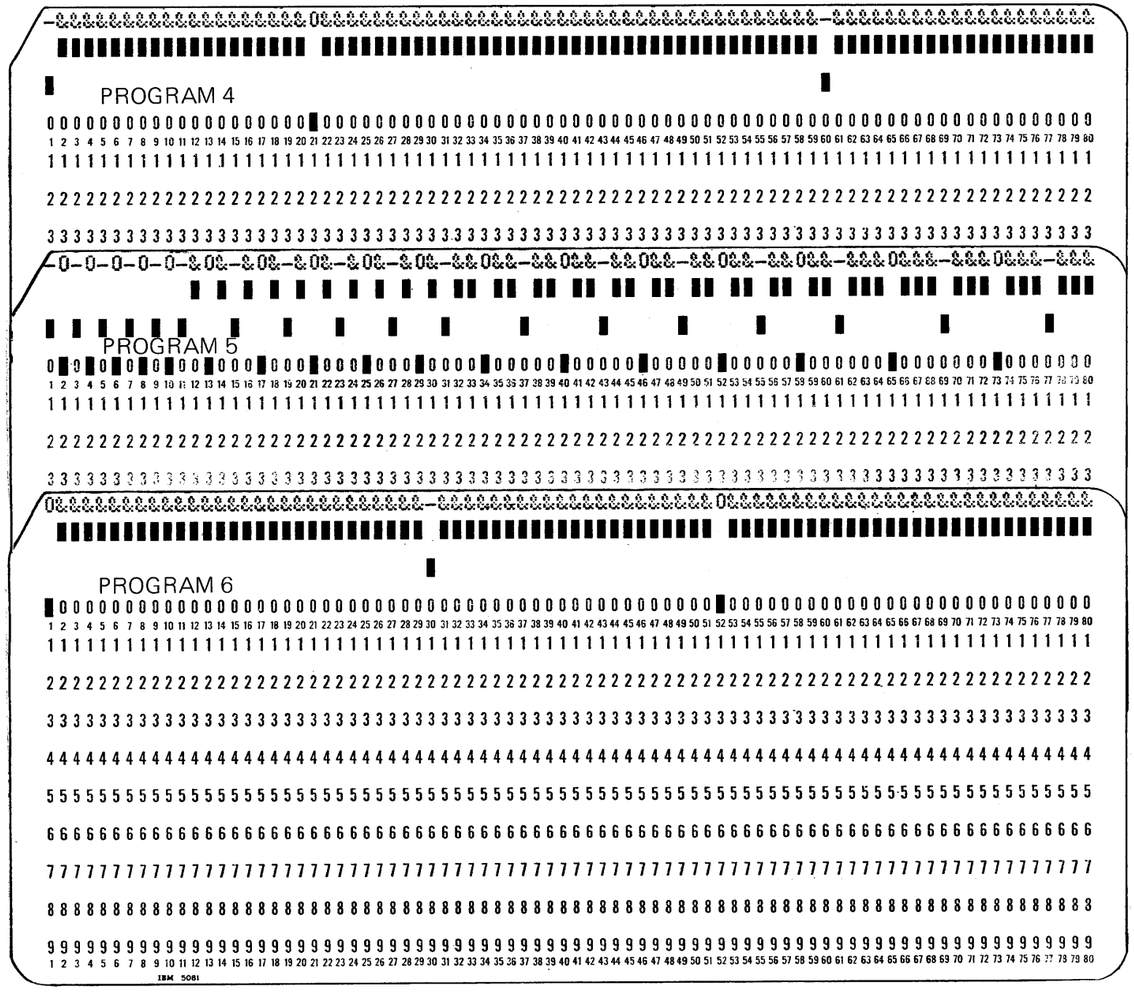
Sample Card 3

Note: Your card does not have to be keyed in this order.

13.4 INSTALLATION PROGRAM CARDS

The program cards used for the installation test are shown here.





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