

38 KEYBOARD UNIT

DESCRIPTION AND PRINCIPLES OF OPERATION

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1. GENERAL	
1.01 This section provides the description and principles of operation for the 11-unit code 38 keyboard unit (Figure 1). It is reissued to add information for the keyboard	

used on APL (A Programming Language) sets. Marginal arrows used to indicate changes or additions are omitted since Part 4 is the only addition to this section.

1.02 The keyboard unit provides mechanical to electrical conversion of an 8-level parallel code. Depressing the keytops convert, through a set of contacts, the mechanical motion into parallel electrical code paths. These paths, when connected into external electronic logic, are converted into 7-level ASCII (American National Standard Code for Information Interchange — X3.4-1968). The 8th bit level in the keyboard output is for parity.

1.03 Specific information covering adjustments, lubrication, and disassembly and reassembly of the keyboard unit, can be found in Sections 574-421-700TC, 574-421-701TC, and 574-421-702TC, respectively.

2. DESCRIPTION

2.01 The keyboard unit contains the major mechanisms to establish the 7-bit code for 128 graphic and function characters and the 8th parity bit. A graphic is a character which is printed and a function causes a mechanical or electrical action to be performed.

2.02 The major mechanisms are described in the upper portion of Figure 1. The keyboard mechanism is further divided into several basic mechanisms which are identified in Figures 2 and 3.

FEATURES

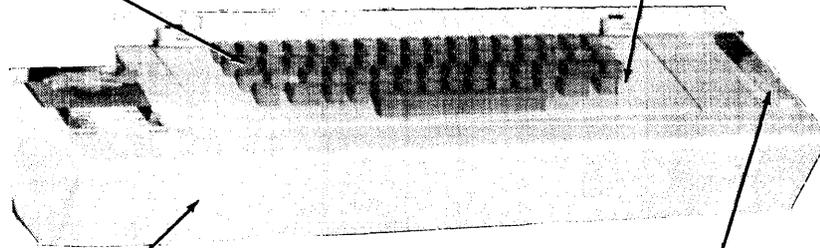
2.03 The keyboard is a 4-row configuration similar to the standard typewriter; Figures 4, 5, and 6 show the standard arrangements. The keyboard is capable of generating 128 ASCII characters and presenting them in parallel wire form to the transmitter distributor located in back of the printer unit. The distributor converts the code to a serial form for the printer, perforator, and reader, or to be sent over the signal line.

KEYBOARD MECHANISM

- Contains required keytops, codebars, and contacts to provide electrical paths for parallel code output.
- Upper and lower case characters. Keytop arrangement similar in appearance and operation to standard office typewriter.
- Special primary keys for frequently used control functions.
- Repeat character feature on any key without special repeat key.
- Transmission rate up to 100 words per minute.
- Parity keyboard. Originates 8-level coded characters where level 8 is used for even parity.

KEYTOP GUIDE

- Restrains horizontal motion of keytops.
- Protects keyboard mechanism from dust and other hazards.



front view

KEYBOARD HOOD

- Protects keyboard, reader and punch mechanisms from dust and other hazards.

CONTROL PANEL

- Local function keys.
- Special control keys and indicators.
- Additional keys and indicators may be added as required.

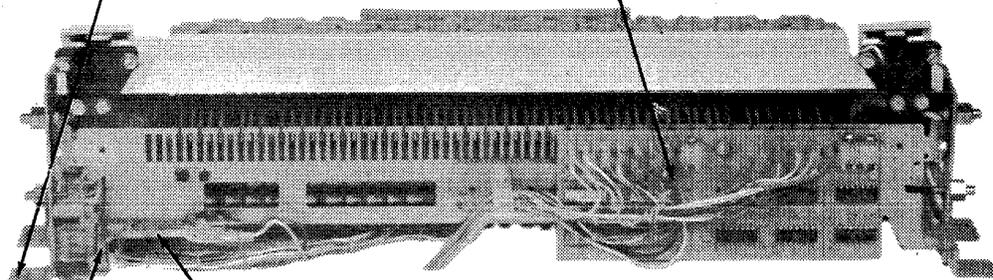
Figure 1 - Keyboard Unit

KEYBOARD LOGIC CARD

- Controls keyboard output to the distributor.
- Converts the keyboard parallel input to eight parallel output ASCII characters.
- Strapping options, 8th bit always marking or 8th bit always spacing, and all capitals generated from keyboard.

MOUNTING BRACKETS (each side)

- Provides facility to mount keyboard to printer casting.



rear view

KEYBOARD TRIP ARM

- Interfaces with the printer.
- Mechanically driven from printer.
- Mechanically resets keyboard mechanism.
- Operates enable contact.

ENABLE CONTACT

- Prevents a code sample during an idle condition.
- Open condition disables keyboard input logic.
- Closed condition completes ground path to keyboard contacts and input logic levels are established.
- Controls sampling period of contact mechanism.

Figure 2 - Keyboard Unit

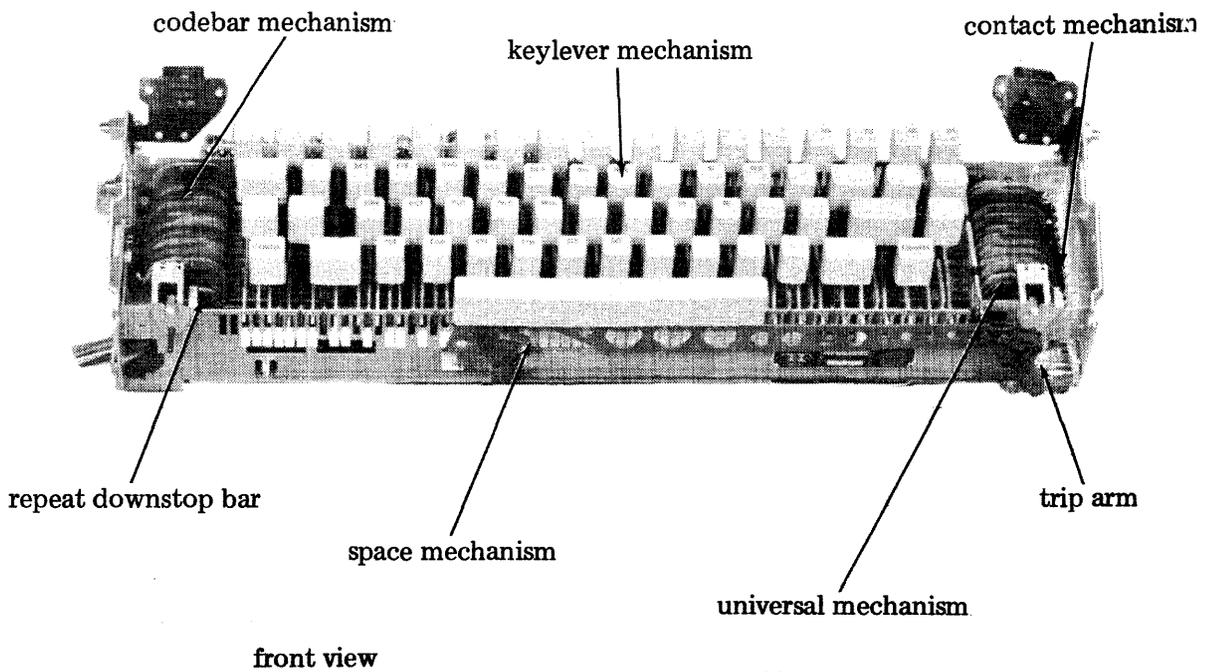


Figure 3 - Basic Mechanisms

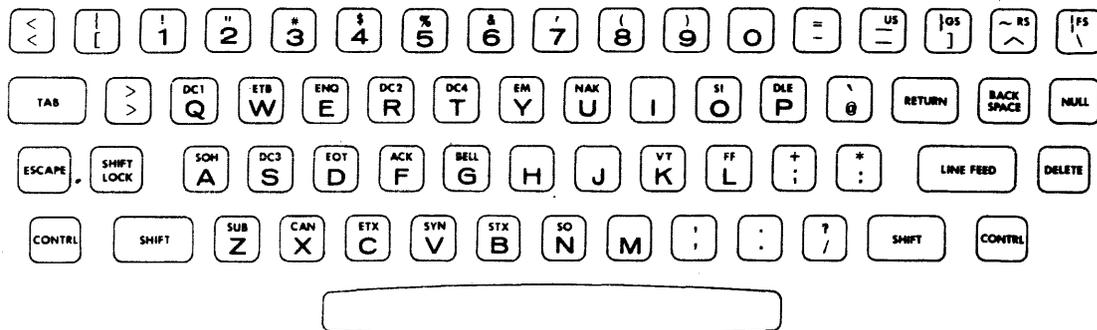


Figure 4 - AAW Keyboard Arrangement

2.04 The keyboard logic circuit card is mounted in back of the keyboard unit. This circuit card can be programmed through screw strap options for 8-bit marking or spacing, parity, or all upper case printing. As shipped from the factory the keyboard is enabled for upper and lower case, and for even parity operation (screw A tight, screw B loose, screw C loose on keyboard circuit card located at the rear of the keyboard). To enable keyboard for all capitals generation, tighten screw C. For 8th bit always marking, tighten screws A and B. For 8th bit always spacing, loosen screws A and B, refer to Figure 7.

Keylever Interlock

2.05 The keylever interlock prevents depressing of two or more primary keys simultaneously to a point where the keyboard is tripped. This prevents generation of a faulty code. Interlocking is accomplished by complimentary coding of the codebars.

Code Selection Lock

2.06 The code selected by depressing a key is locked in place by the trip arm. The trip arm locks the codebars in position during the code sampling period. At the end of the code sampling period, the reset mechanism on the printer returns the trip arm to its unoperated position, thus removing the code selection lock.

Nonrepeat and Repeat

2.07 The nonrepeat and repeat features are provided for all keylevers which trip the keyboard mechanism. If a key is nonrepeatable, the operator must release the depressed key and depress again to transmit the same character. The repeat feature provides transmission of a selected character by further depression of the key beyond the normal downstop position. The character is continuously transmitted until the key is released.

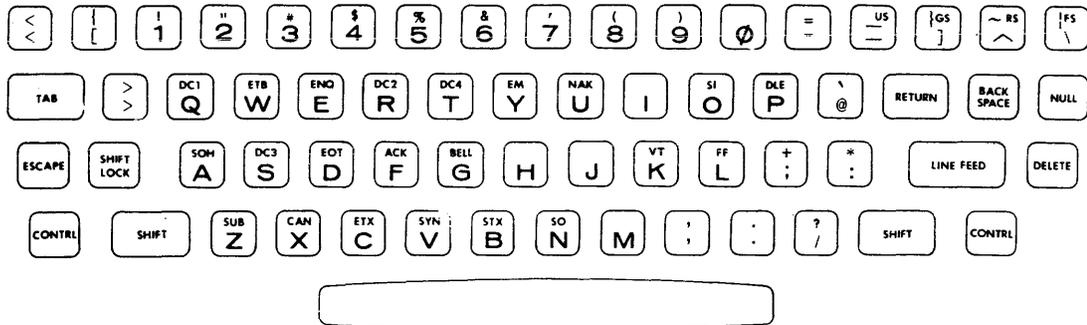


Figure 5 - ABW Keyboard Arrangement

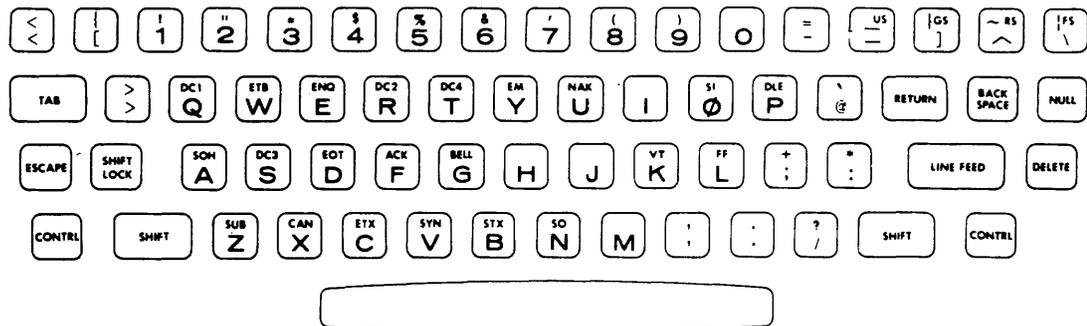
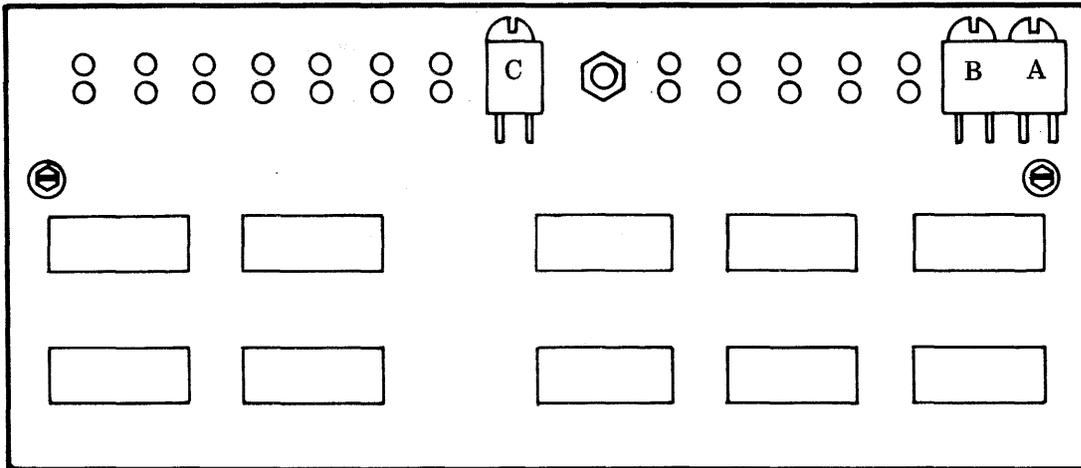


Figure 6 - ACW Keyboard Arrangement



rear view

Figure 7 - Keyboard Circuit Card

2.08 Any key which trips the keyboard mechanism can be made repeatable by removing a repeat blocking clip in the front frame of the unit. The associated key then can be depressed beyond the normal downstop position. The repeat blocking clip can be removed or inserted as desired (Figure 8). As shipped from the factory, the following keys are enabled for repeat operation:

- LINE SPACE colon (:) or asterisk*
- SPACE hyphen (-) or equals (=)
- NULL shift and unshift period (.)
- DELETE shift and unshift underscore (-)
- upper and lower case (X)

TECHNICAL DATA

2.09 The 38 keyboard mounts to the cover base pan, on the left and right side, by brackets and four screws. The keyboard has no means to generate its own electrical signals; therefore, electrical signal must be supplied to the keyboard. The control logic card has "OR power drivers" capable of sinking 150 ma at 40 volts (maximum). Electrical connections from the keyboard contacts terminate in a cable 3 feet 6 inches long with a Molex connector (J3).

Electrical Characteristics

- (a) Electrical contact ratings 5 volts at 3.3 ma

- (b) Power supply . . . +5 volts minimum
+6 volts maximum
at maximum current
of 180 ma

NOTE: Once used in applications over 20 volts dc, contacts can no longer be used in applications under 20 volts dc at a later time.

Logic

<u>DESCRIPTION</u>	<u>LOW</u>	<u>HIGH</u>
Binary state	1	0
Signal condition	mark	space
Voltage level	between circuit ground and 0.5 volts	+2.5 and 6 volts

Physical Characteristics

- Weight5 pounds
- Height 4-1/4 inches
- Width18 inches
- Depth 6-1/4 inches

Signaling Code

- Speed100 WPM
- Levels Eight
- Mark Closed contact
- Space Open contact
- Parity Even

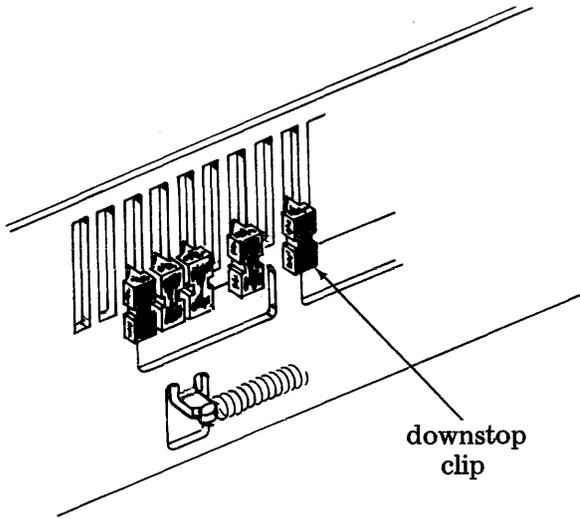


Figure 8 - Repeatable Key Feature

Keylever Spring Tension

Normal	Less than 7 ounces
Repeat	Less than 54 ounces

Environment

Temperature Ranges — This equipment is intended to be operated in a room environment within the temperature range of 40° F to 110° F. Serious damage to it could result if this range is exceeded. In this connection, particular caution should be exercised in using acoustical or other enclosures.

Relative humidity range

Minimum	0%
Maximum	95%

Character Arrangement

2.10 The character arrangement of the keytops is as shown in Figures 4, 5, and 6. The keytop arrangement is similar to that of a standard office typewriter. In addition, frequently used control functions are provided as primary keys. Designations within keytop are as they appear on the mechanism. Designations shown above the keytop are control function legends. The following chart lists the control character legend and designation. The function as screened on the keytop is listed for those designations where the screening and legend differ.

Control Characters

<u>LEGEND</u>	<u>DESIGNATION</u>
ACK	— Acknowledge
BEL	— Bell
BS	— Backspace

LEGEND DESIGNATION

CAN	— Cancel
CR	— Carriage return (RETURN)
DC1	— Device control 1
DC2	— Device control 2
DC3	— Device control 3
DC4	— Device control 4
DEL	— Delete
DLE	— Data link escape
EM	— End of medium
ENQ	— Enquiry
EOT	— End of transmission
ESC	— Escape (PREFIX)
ETB	— End transmission block
ETX	— End text
FF	— Form feed
FS	— File separator
GS	— Group separator
HT	— Horizontal tabulation (TAB)
LF	— Line feed (LINE FEED)
NAK	— Negative acknowledge
NUL	— Null
RS	— Record separator
SI	— Shift in
SO	— Shift out
SOH	— Start of heading
SP	— Space
STX	— Start text
SUB	— Start of special sequence
SYN	— Synchronize
US	— Unit separator
VT	— Vertical tabulation

3. PRINCIPLES OF OPERATION

3.01 The keyboard is mechanically coupled to and operated by the distributor clutch on the printer. The interface between the printer and keyboard is through the H-plate. The H-plate connects the keyboard trip arm to the reset mechanism. Through linkage under the printer the reset mechanism is connected to the distributor clutch (Figure 9). Refer to the pictorial diagram on the keyboard operation (Figure 10) and the related descriptive outline to get an overview concerning the operation of the keyboard mechanism.

3.02 When the spacebar, function or character key on the keyboard, is depressed the keyboard trip arm is released (tripped) and through the reset mechanism trips the distributor clutch. When the distributor clutch is tripped, it operates and starts the transmitter distributor which process the selected code. The enable contacts, on the back of the keyboard, lock this code in the keyboard circuit until the data bits have been sequentially transmitted. When the distributor clutch has made one complete revolution, the clutch latches, operating the reset mechanism which resets the keyboard trip arm and opens the enable contacts.

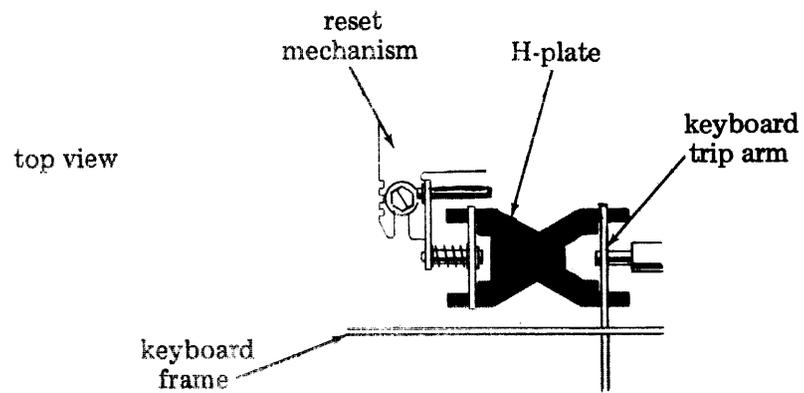
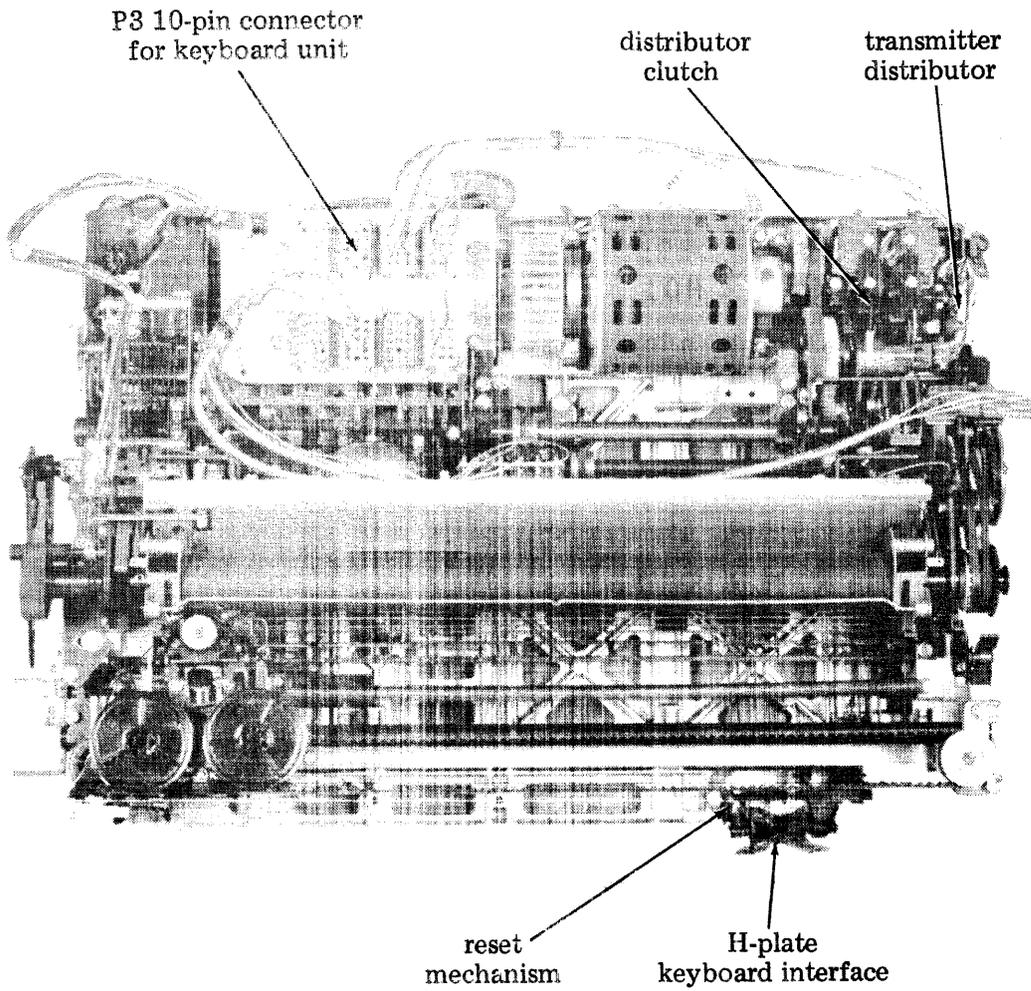


Figure 9 - 38 Printer

3.03 The principles of operation are divided into the mechanical operation and the electrical code generating logic of the keyboard unit. The mechanical operation is presented in: (1) a pictorial schematic of the unit; and (2) a series of mechanism drawings. Each illustration is supported with appropriate text to describe the purpose and operation of the mechanism. Where possible, the mechanism drawings are arranged in the order in which the mechanism operates. The electrical operation is limited to the elements which logically generate the eight levels of binary information.

KEYBOARD OPERATION

- A. Attendant holds depressed SHIFT key, to modify output of contact mechanism, while depressing a key for capital letters or symbols.
- B. Attendant holds depressed the CONTRL key, to modify output of contact mechanism, while depressing one of the function keys (eg, ETB, NAK or STX etc).
- C. Attendant depresses a character or function key in conjunction with A. or B. above.
- D. Attendant operates codebars other than SHIFT or CONTRL.
- E. Attendant operates SPACEBAR.
- F. Arrange code generating contacts.
- G. Engage and operate universal codebar.
- H. Release trip arm.
- I. Enable contacts (normally open) close to initiate sampling period of contact mechanism.
- J. Keyboard output in form of circuit paths furnished to external logic for processing and character or control generation.
- K. After sampling contact mechanism, reset trip arm.

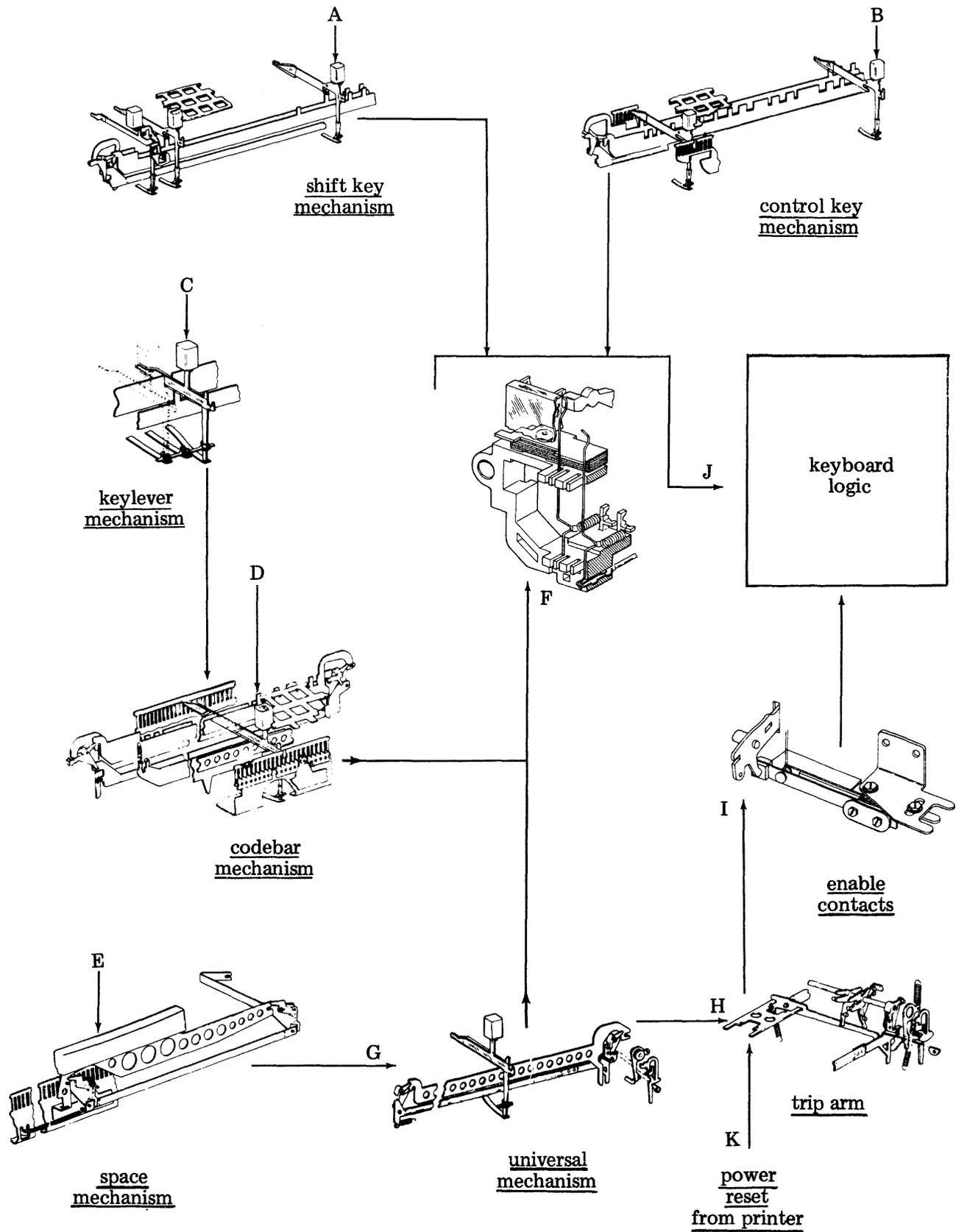


Figure 10 - Pictorial Diagram on Keyboard Operation

SHIFT KEY MECHANISM

Purpose

Changes character output of graphic primary keys from lower case graphics to upper case graphics, and mechanically blocks undesired primary keys.

Operation

The SHIFT key, when depressed, operates the shift codebar set, only. It does not trip the keyboard; ie, a recess in the SHIFT LOCK and both SHIFT keylevers prevent the keylevers from engaging the universal bar. The shift codebar set is spring biased so that the rear codebar is held upward. The rear codebar has two tine extension slots to receive the extensions of the two keylevers. When either SHIFT keytop is depressed, the other SHIFT keytop descends. The keylever

is depressed against its leaf spring and the shift codebar spring. When the rear codebar descends, the front codebar ascends to mechanically block undesired primary keys; and the shift contacts are operated to alter the keyboard logic circuit. When released, the codebar set returns to its normal unoperated condition. To generate an upper case graphic, the SHIFT key must first be depressed followed by an unblocked primary key. The primary key trips the keyboard.

SHIFT LOCK

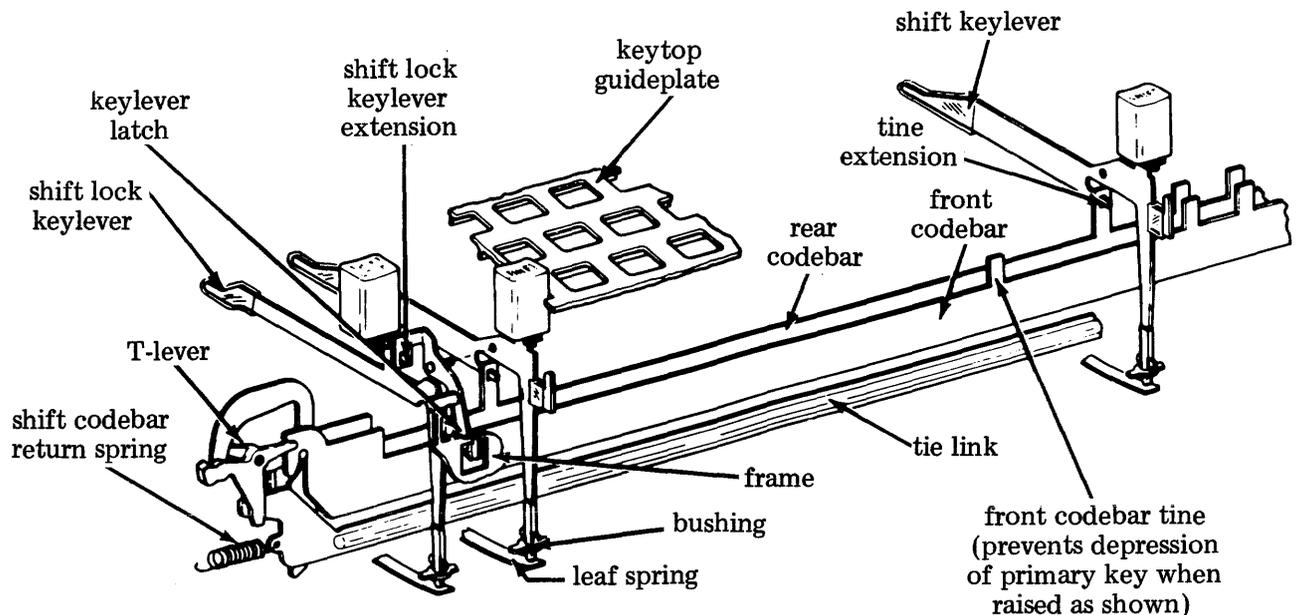
Purpose

Holds SHIFT key down.

Operation

With SHIFT LOCK key unoperated, the shift keylever latch will pivot toward rear as the SHIFT key is depressed. As SHIFT LOCK key is depressed, the shift lock keylever extension rotates keylever latch which carries the shift keylever downward. When SHIFT LOCK key is near lower end of its travel, the shift keylever latch engages the opening in the basket frame to hold SHIFT LOCK and both SHIFT keys in their de-

pressed positions. To unlock, SHIFT key must be depressed further to unhook the shift keylever latch. Depressing SHIFT key while in lock condition will cause the shift keylever latch to rotate toward the rear and unhook itself from the basket frame. With no pressure on SHIFT LOCK key, the shift lock keylever will lead the shift keylever during upward travel, thereby holding shift keylever latch toward the rear as both keys ascend.



CONTROL KEY MECHANISM

Purpose

Changes character output of certain primary keys from graphics to their control function equivalents, and mechanically blocks undesired primary keys.

Operation

The CONTRL (control) key, when depressed, operates the control codebar set only. It does not trip the keyboard, ie, a recess in each control keylever prevents the keylever from engaging the universal bar. The control codebar set is spring biased so that the rear codebar is held upward. The rear codebar accepts the CONTRL key input to operate the codebar set. When operated, the rear codebar descends as the front codebar ascends. The control contacts are operated to modify the keyboard logic

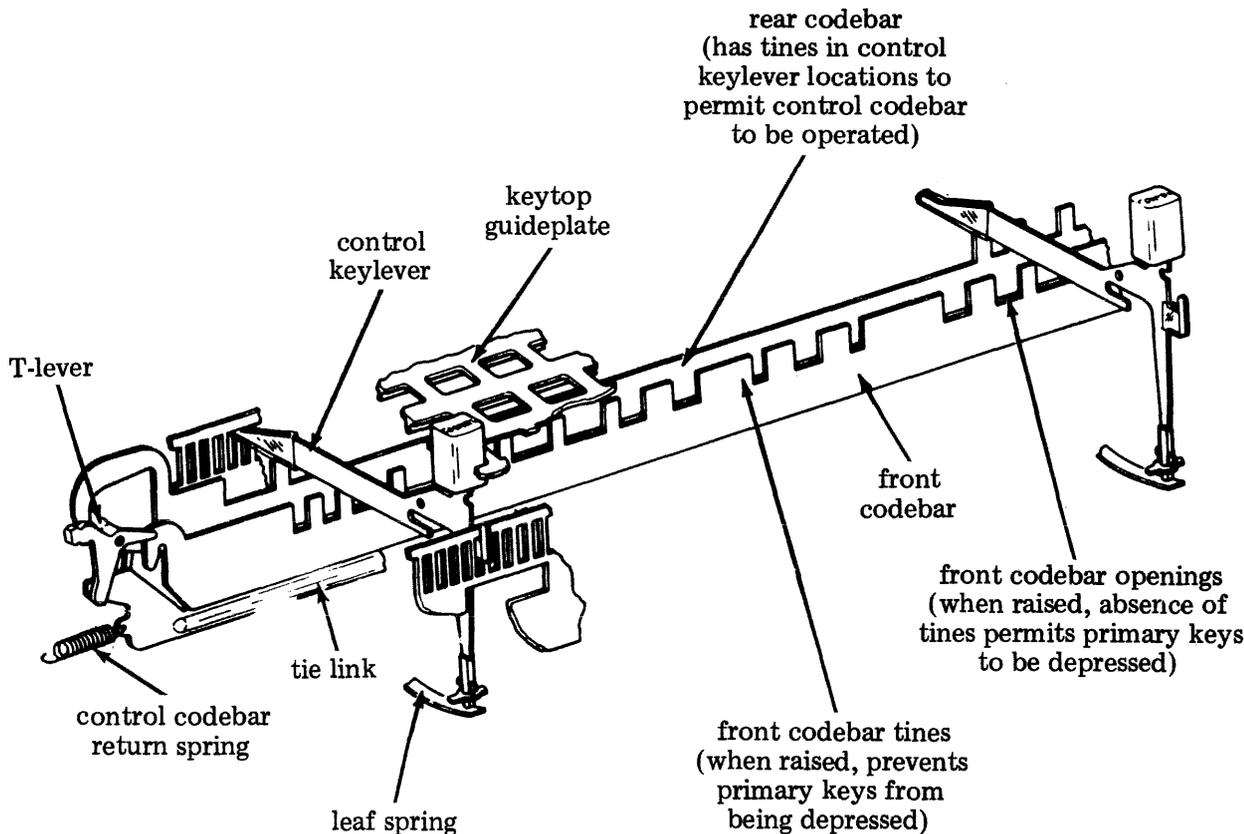
circuit. The front codebar rises to prevent certain primary keys from being depressed. The presence of a tine in the front codebar prevents the the primary key from being depressed; the absence of a tine permits the key to be depressed. The CONTRL key must first be depressed followed by an unblocked primary key in order to generate a function character. When released, the control codebar set, contacts, keylever, and keytop return to their normal unoperated position.

CONTROL FUNCTIONS

Operation

Control functions can be generated from special primary keys or from CONTRL plus graphic primary keys. The same control function cannot be generated by both methods. When a primary key exists for a

control function, eg, RETURN, both this primary key and the graphic primary key, M, would be blocked on control. RETURN can be generated in the shift or unshift mode but not in the control mode.



KEYLEVER MECHANISM

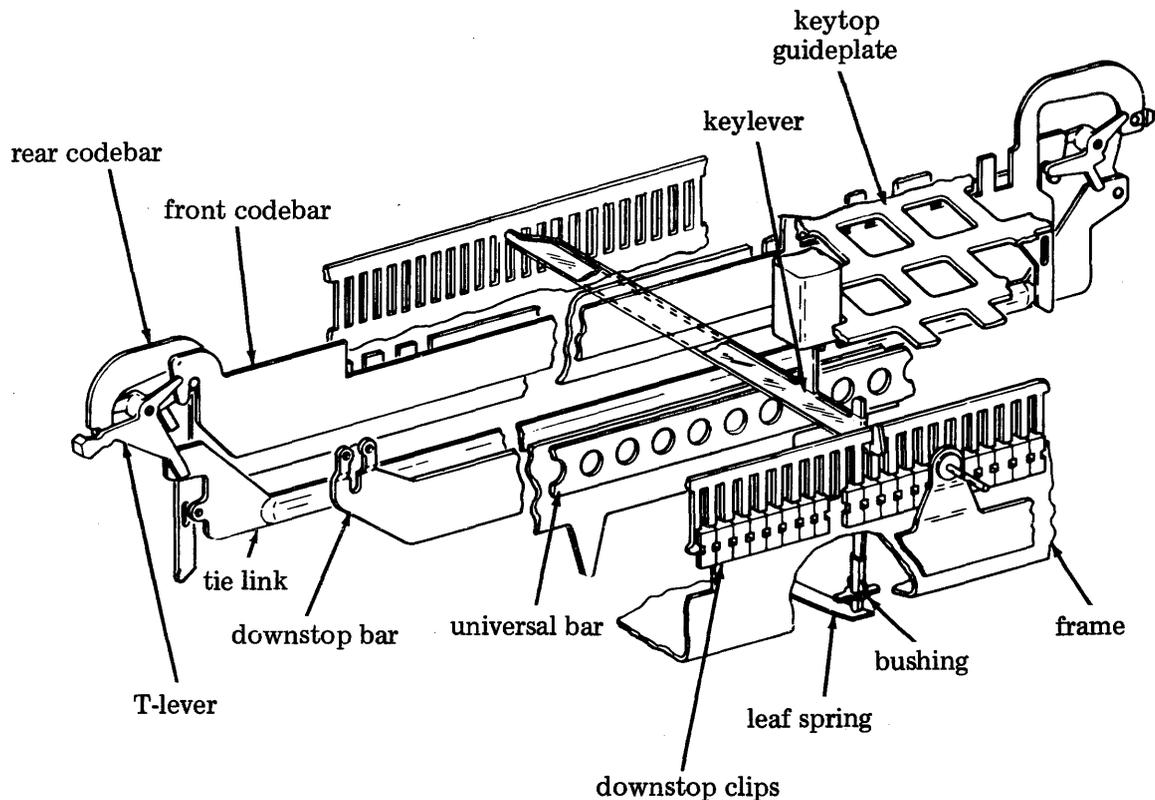
Purpose

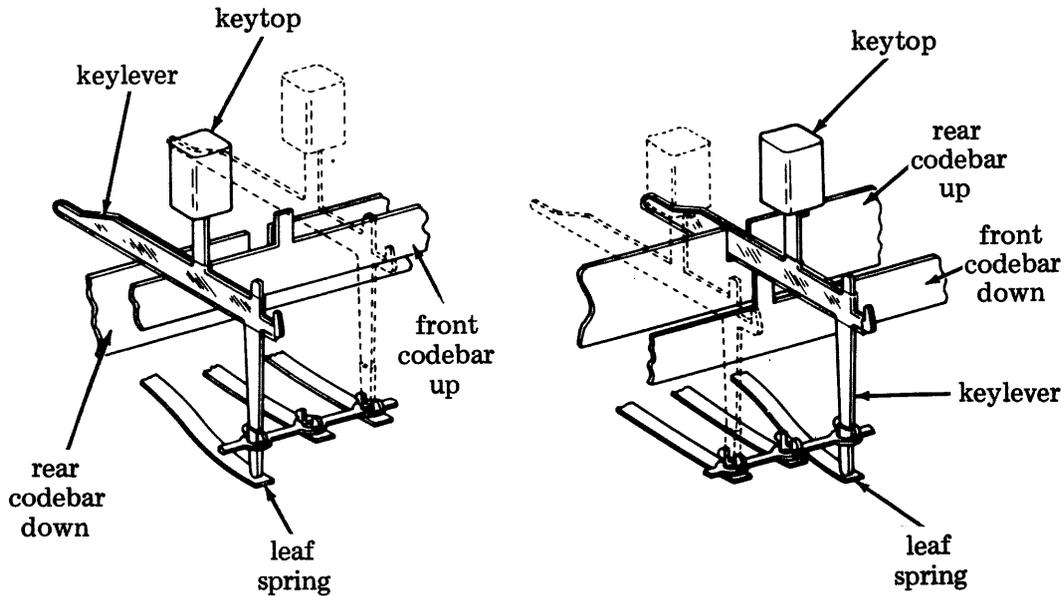
Positions the codebar sets which select the code combination associated with each primary key (other than SHIFT or CONTRL), and trips the keyboard.

Operation

When a primary key is depressed, the bottom surface of the keylever may reposition up to nine of the eleven codebar sets. The other two codebar sets are related to the SHIFT and CONTRL keys which, when depressed, will prevent depression of certain primary keys. A codebar set (operated by a primary keylever) will be repositioned when the solid portion of one codebar is up, and the open portion of the other codebar is down. As the keylever descends against its leaf spring, the codebar sets not previously positioned are repositioned; and the

universal bar is engaged to trip the keyboard. (When tripped, the codebar sets are locked in position and preventing another character from being selected before the keyboard is reset.) A plastic bushing provides a guide for the keylever. If not blocked by the downstop clip, the keylever can be depressed against increased spring tension by way of the downstop bar, to repeat the character. When released, the primary key is returned to the upward position by its leaf spring.





3.07 Keyboard Mechanism (continued)

SPACE MECHANISM

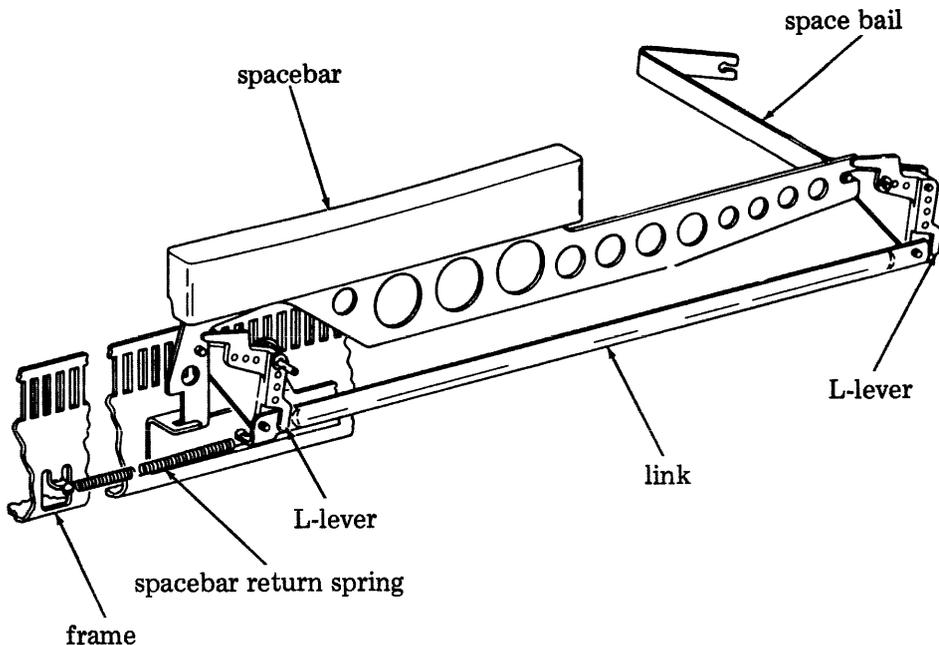
Purpose

Provide a means for originating the space character from a bar compatible (both in shape and location) with conventional keyboards. The space character can be generated with the keyboard in the shift or unshift mode but cannot be generated in the control mode.

Operation

Depressing the SPACEBAR (when not blocked by control) will cause the space bail to rotate downward against the codebar sets. Only those codebar sets whose rear or front tines are up (at the space bail position) will be engaged to operate their respective con-

tacts. The space bail, during its downward motion, engages the universal bar to trip the keyboard. When released, the space bail rises against the front and rear upstop bars by means of the spacebar return spring.



CODEBAR MECHANISM

Purpose

Provides the means for transferring keylever inputs to contact mechanism.

Operation

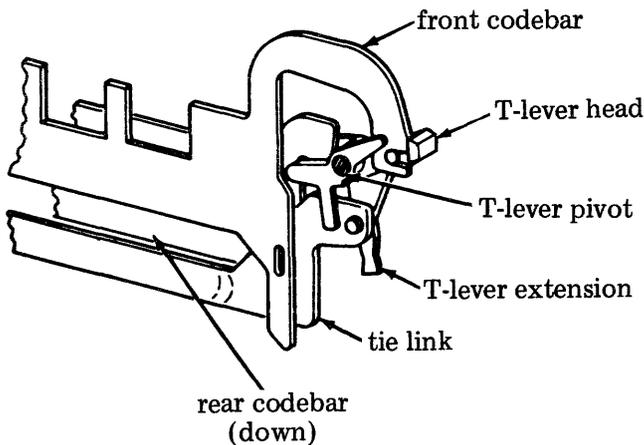
The codebar mechanism consists of the eight code level sets and the shift inhibit codebar set. The other two codebar sets, operated by the individual SHIFT and CONTRL keys, are associated with the shift and control mechanisms. Each codebar set consists of a front codebar, rear codebar, two T-levers, and a tie link.

Each codebar set can be placed in one of two states (binary). For purposes of discussion, the states are defined as follows: rear codebar up and front codebar down is the normal state; rear codebar down and front codebar up is the inverted state. (This state cannot be established by means of a keylever.) (The nine codebar sets are not spring biased as are the shift and control codebar sets. The normal and inverted states are based upon the assigned condition of the

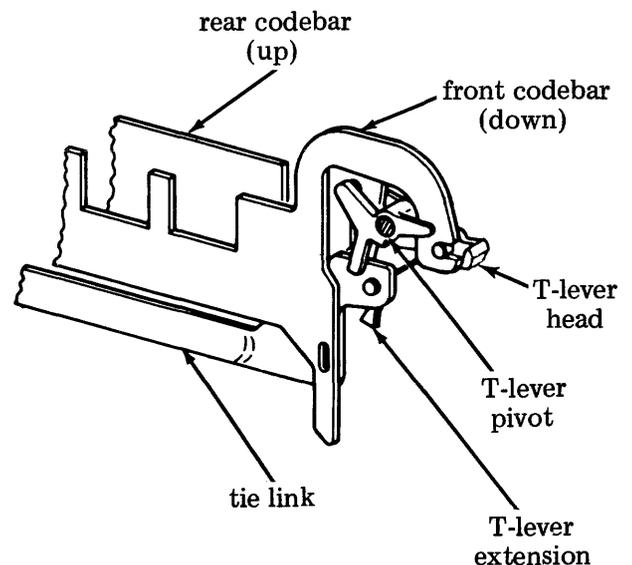
associated contacts.) The nine codebar sets are positioned by a keylever mechanism. At effective keylever locations the front codebar is the compliment of the rear codebar; ie, where the front codebar is solid, the rear codebar is open, and conversely, where the front is open, the rear is solid. At ineffective keylever locations, such as SHIFT, SHIFT LOCK, and CONTRL, keylevers cannot position the codebar sets.

The two T-levers are attached to the codebar set, one at each end and are connected by the tie link. When the front codebar is down, the right end T-lever head is down; when the rear codebar is down, the right T-lever is up. The T-lever head positions the contact wires in the contact mechanism to provide the electrical code path associated with the depressed keylever mechanism.

T-lever head fully up



T-lever head fully down



CONTACT MECHANISM

Purpose

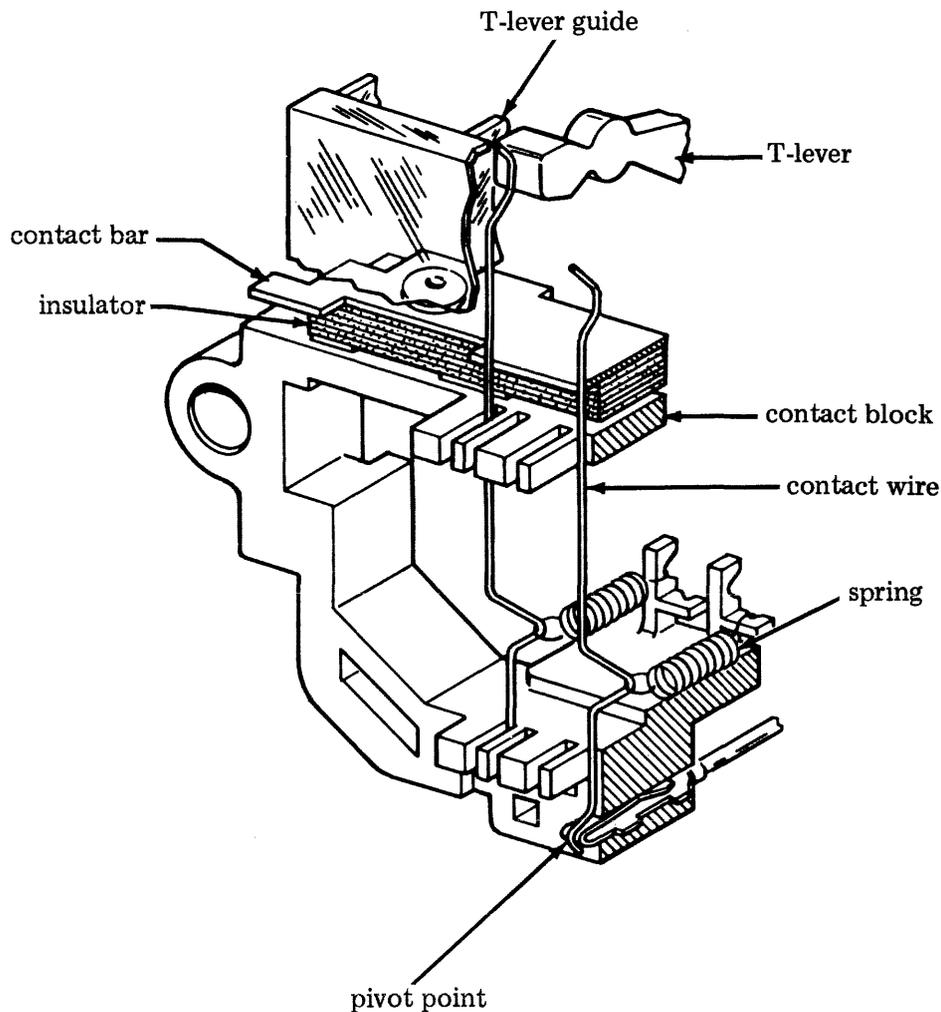
Provides circuit paths to external keyboard logic as determined by the depression of keylevers.

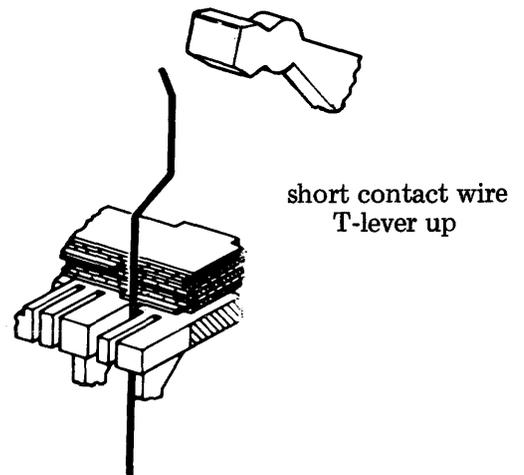
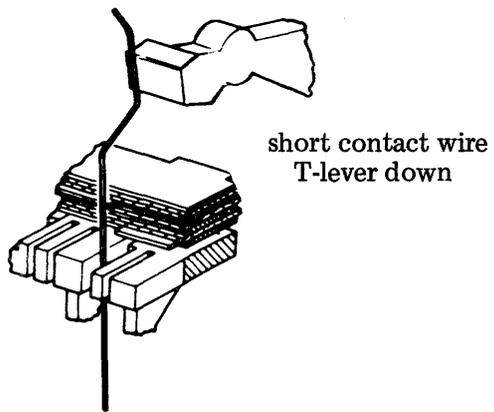
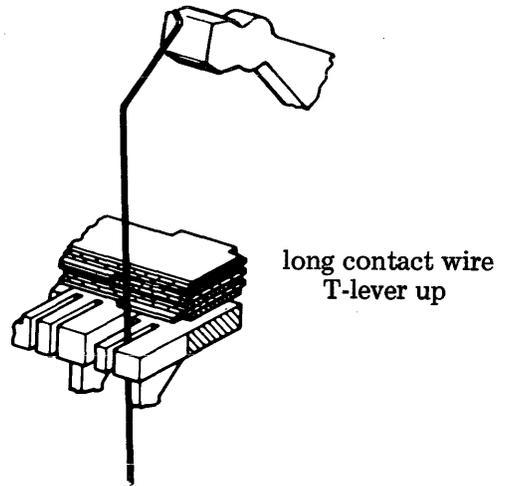
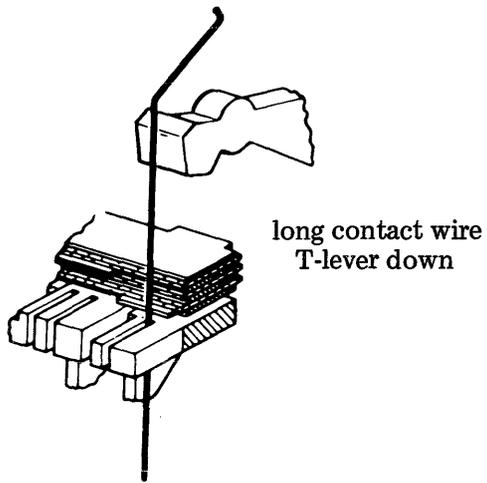
Operation

The contact mechanism consists of a contact block, a contact bar, insulators, and eleven contact wires. Two types of contact wires, short and long, are used. Slotted guides in the contact block hold the contact wires in place.

Each contact wire can be placed in one of two binary states. The contact wire is spring biased to a contact bar to provide the

electrical connection. Positioning of the T-lever up establishes an electrical connection for the shorter contact wire and opens the electrical connection of the longer contact wire. Conversely, positioning of the T-lever down opens the electrical connection of the shorter contact wire and establishes an electrical connection for the longer contact wire. Refer to Paragraph 3.14 for the electrical description of the contact mechanism.





3.10 Keyboard Mechanism (continued)

UNIVERSAL MECHANISM

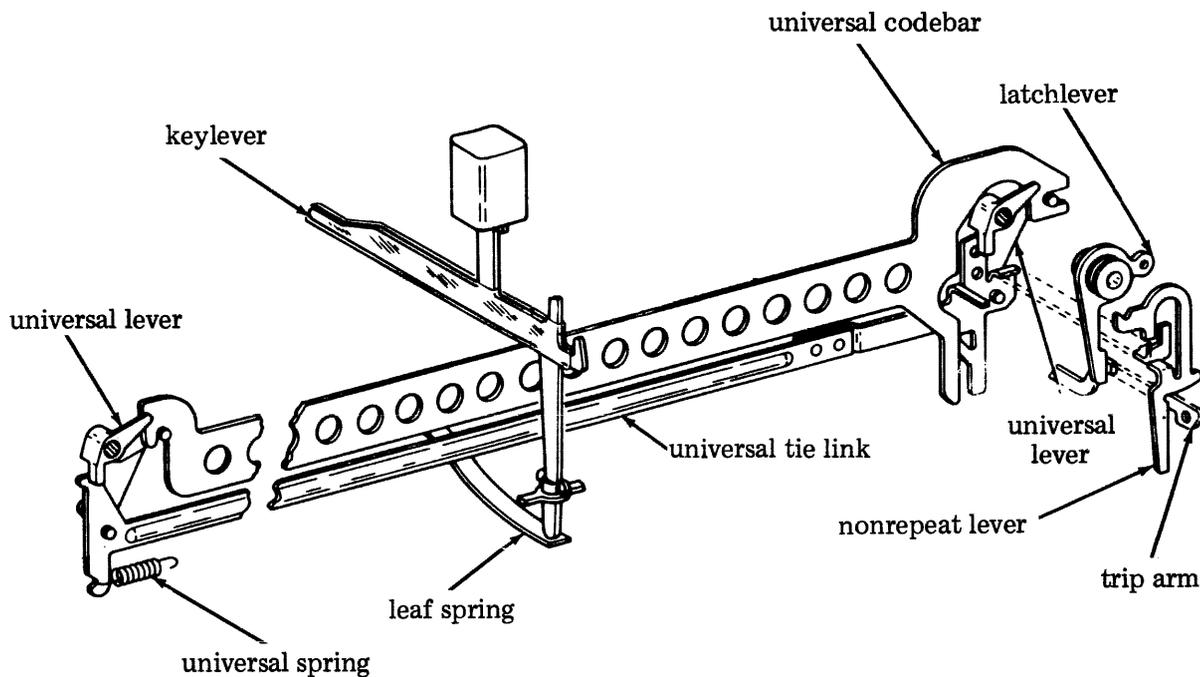
Purpose

Releases the trip arm.

Operation

The universal mechanism consists of a single codebar which is spring biased in the up position and its associated universal tie link is biased to the right. Depressing a primary key places the codebar mechanism in its coded position at which time the keylever engages the universal codebar. Further depressing of the keylever moves the universal codebar downward pivoting the universal levers. This moves the universal tie link to

the left. As the universal tie link moves to the left, it engages the nonrepeat lever and latchlever rotating them clockwise, releasing the trip arm. If the primary key is depressed beyond its normal downstop position, the universal tie link rotates the nonrepeat lever further to prevent latching of the trip lever. The character associated with the depressed keylever is thus continuously repeated until the trip lever is latched.



3.11 Keyboard Mechanism (continued)

TRIP ARM

Purpose

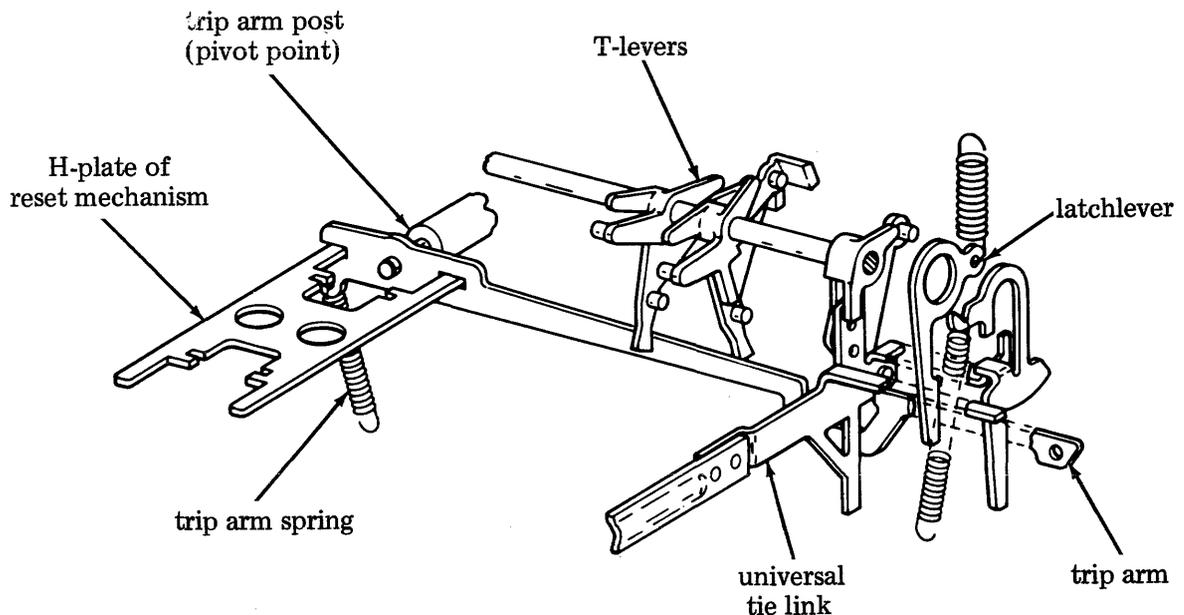
Lock T-levers in selected code position during code sampling period; trip reset mechanism; unlock T-levers at the end of code sampling period; pace operator to keyboard speed.

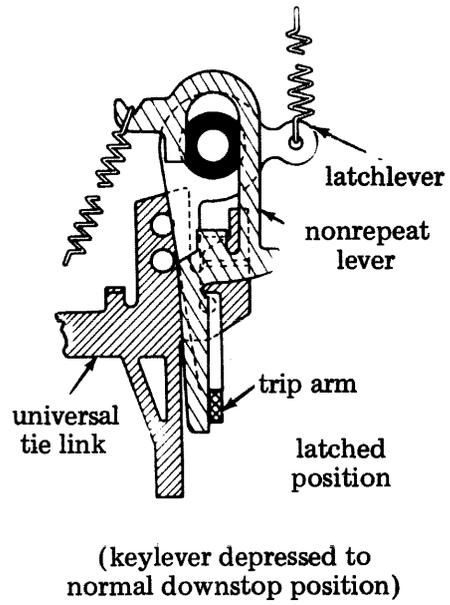
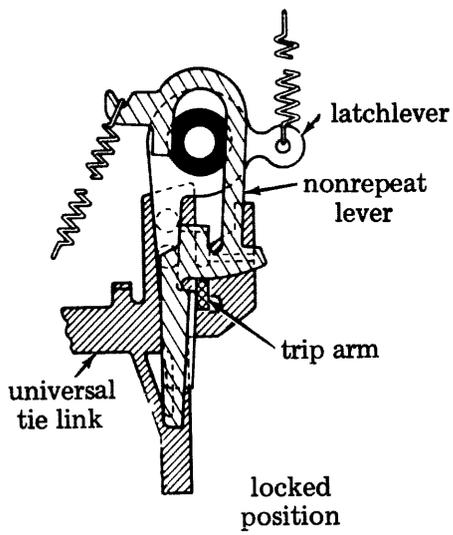
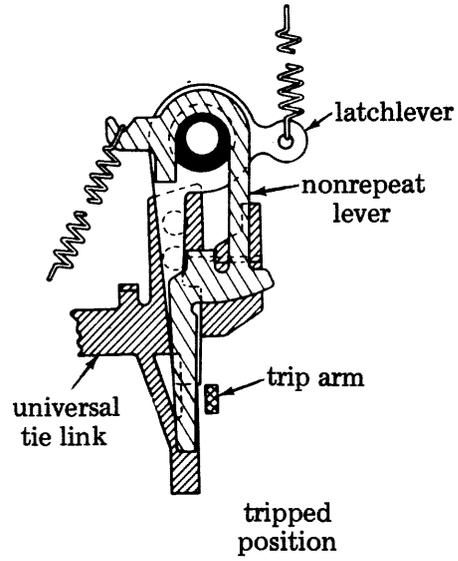
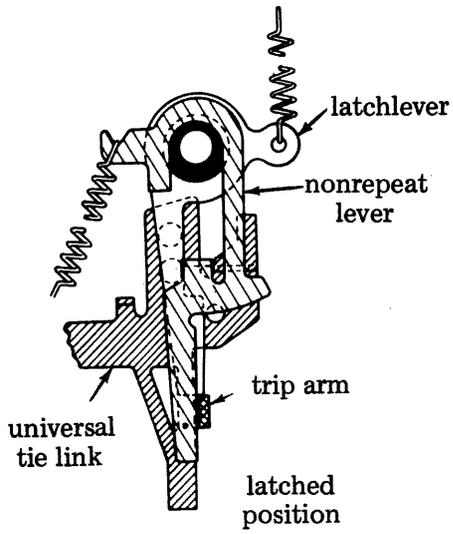
Operation

When the keyboard mechanism is in the unoperated condition, the trip arm is latched. When a primary key is depressed, the keylever engages the universal codebar and moves the universal tie link to the left. The universal tie link rotates the nonrepeat lever clockwise. The nonrepeat lever, in turn, rotates the latchlever clockwise releasing the trip arm. When released upward, the trip arm activates the reset mechanism. At the end of the reset mechanism cycle, the reset mechanism returns the trip arm to the

latched position.

Holding the primary key at the normal downstop position at the end of the reset cycle does not block latching of the trip arm. During the reset cycle the trip arm moves the nonrepeat lever upward into the cutout area of the latchlever. When the trip arm is moved downward at the end of the reset cycle, the latchlever spring rotates the latchlever counterclockwise over the trip arm.





3.12 Keyboard Mechanism (continued)

REPEAT MECHANISM

Purpose

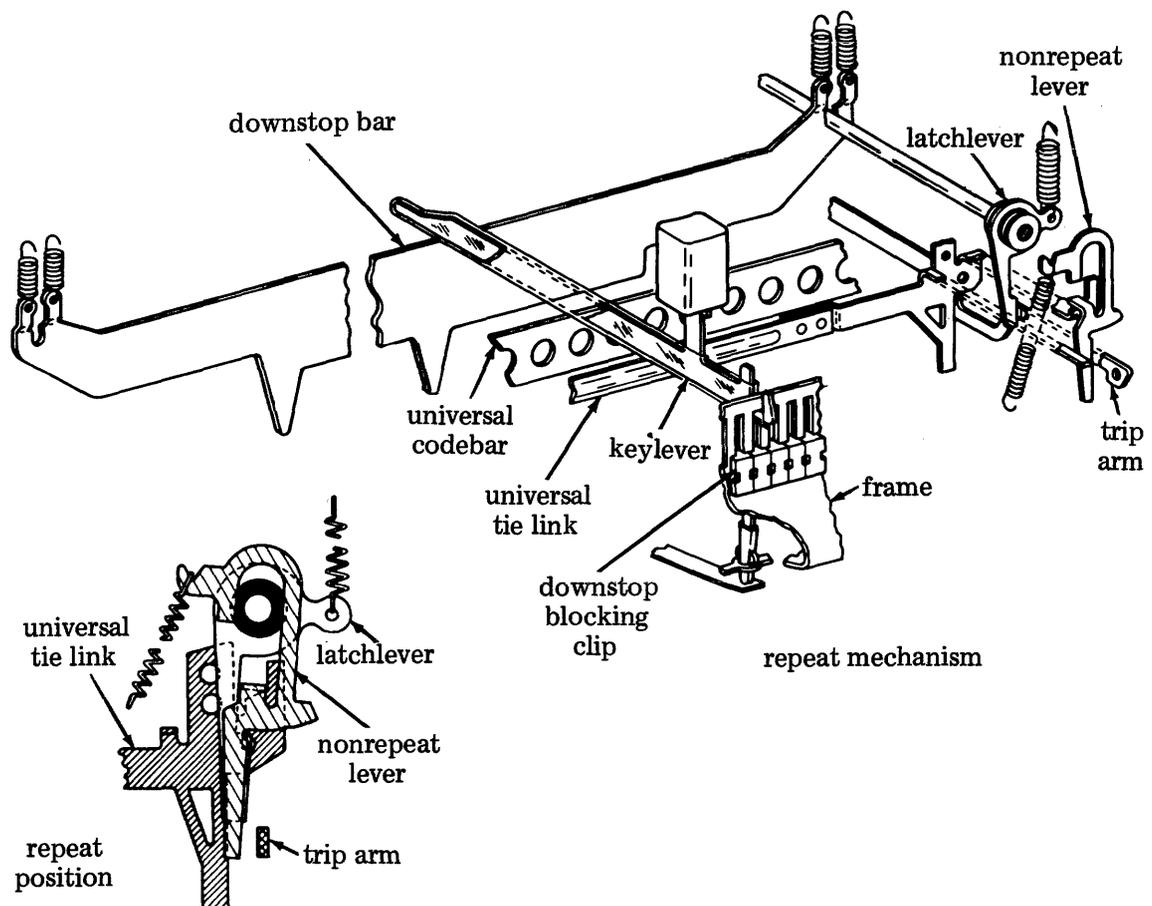
Blocks latching of trip arm when primary key is held depressed beyond normal downstop position, permitting repeat of character until primary key is released.

Operation

A keylever, not stopped by a downstop blocking clip, is stopped by the downstop bar when depressed by using normal finger pressure. Depressing the key further downward, on the spring-biased downstop bar, causes the universal codebar to move further downward. This moves the universal tie link further to the left. The nonrepeat lever strikes the vertical tab on universal tie link and is pressed against the latchlever. This prevents the latchlever from returning to the latched position when the trip arm is reset. The trip arm, not being latched again raises and activates the reset mechanism. This

action continues until the keylever is returned to the normal downstop position or released. When the keylever returns to the normal downstop position or is released, the nonrepeat lever does not block the return of the latchlever to its latching position and the repeat action is stopped.

Downstop blocking clips, which attach to the front keylever slots in the frame, block the downward movement of selected keylevers beyond the normal downstop position. Keylevers so blocked become non-repeatable.



3.13 Keyboard Reset

TRIP ARM RESET

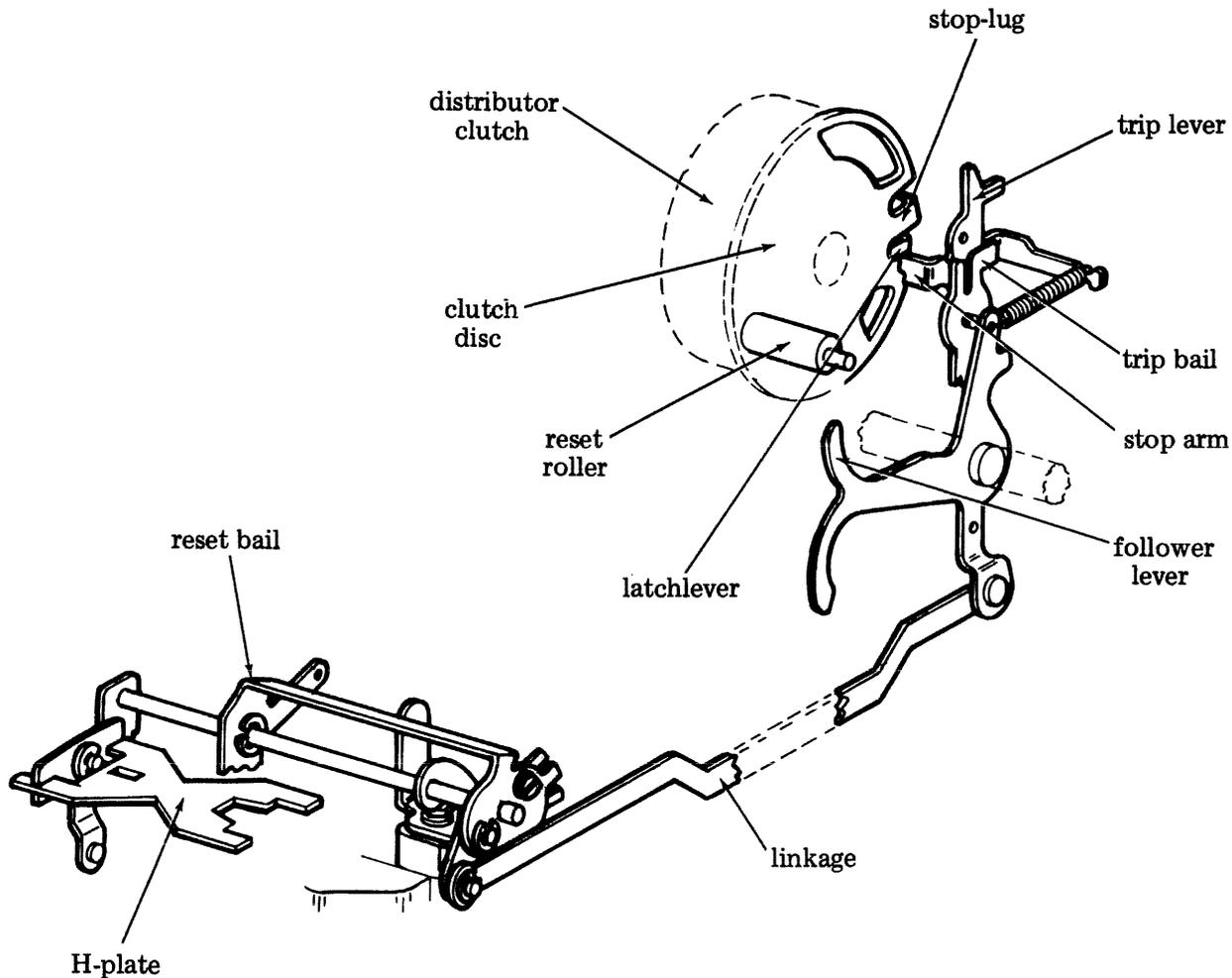
Purpose

Resets trip arm mechanism after a primary key has been depressed to permit subsequent key to be depressed.

Operation

When the trip arm is released and travels upward, its extension beyond the pivot point moves downward applying a clockwise rotational motion to the reset mechanism H-plate. The H-plate transfers the pivoting motion through the reset bail and linkage to the distributor clutch stop arm. The clutch stop arm, which is spring biased inward, is moved outward releasing the clutch latch-
lever. The clutch then disengages the clutch drum and the intermediate gear mechanism that drives the distributor through one cycle of operation. (As the clutch is a one-stop mechanism, 360 degree rotation of the clutch provides one cycle of operation.) During three-fourths of the cycle, 270

degrees, the H-plate does not move leaving the keyboard trip arm unlatched allowing the code to be processed by the distributor. At the beginning of the last one-fourth of the clutch cycle, the reset roller on the clutch disc engages the follower lever which through the linkage and reset bail pivots the H-plate counterclockwise. This action moves the keyboard trip arm downward to the latched position. The latched position of the keyboard trip arm holds the clutch stop arm in position to meet the latchlever at the end of the clutch cycle. Shortly after the keyboard trip arm is latched the distributor clutch latches and the keyboard and distributor are ready to process the next function or character.



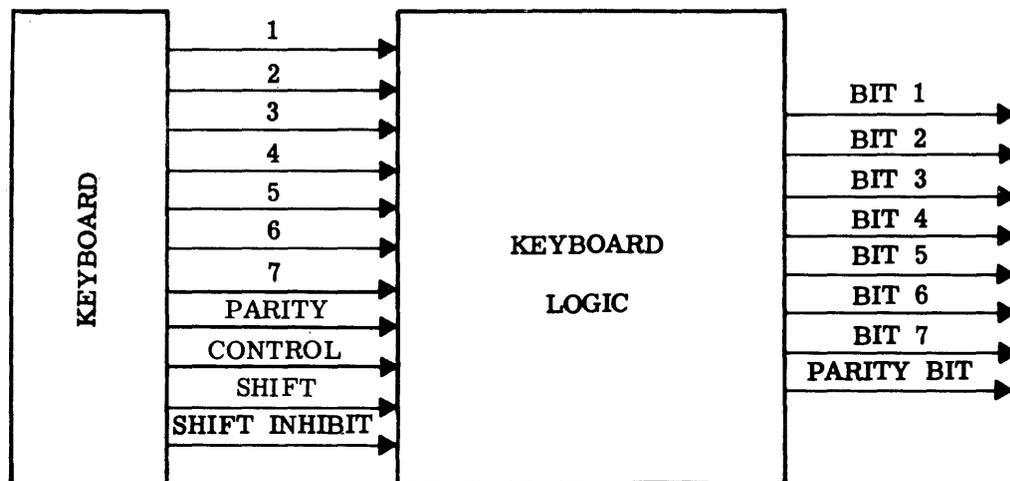
ELECTRICAL OPERATION

3.14 Keyboard Output

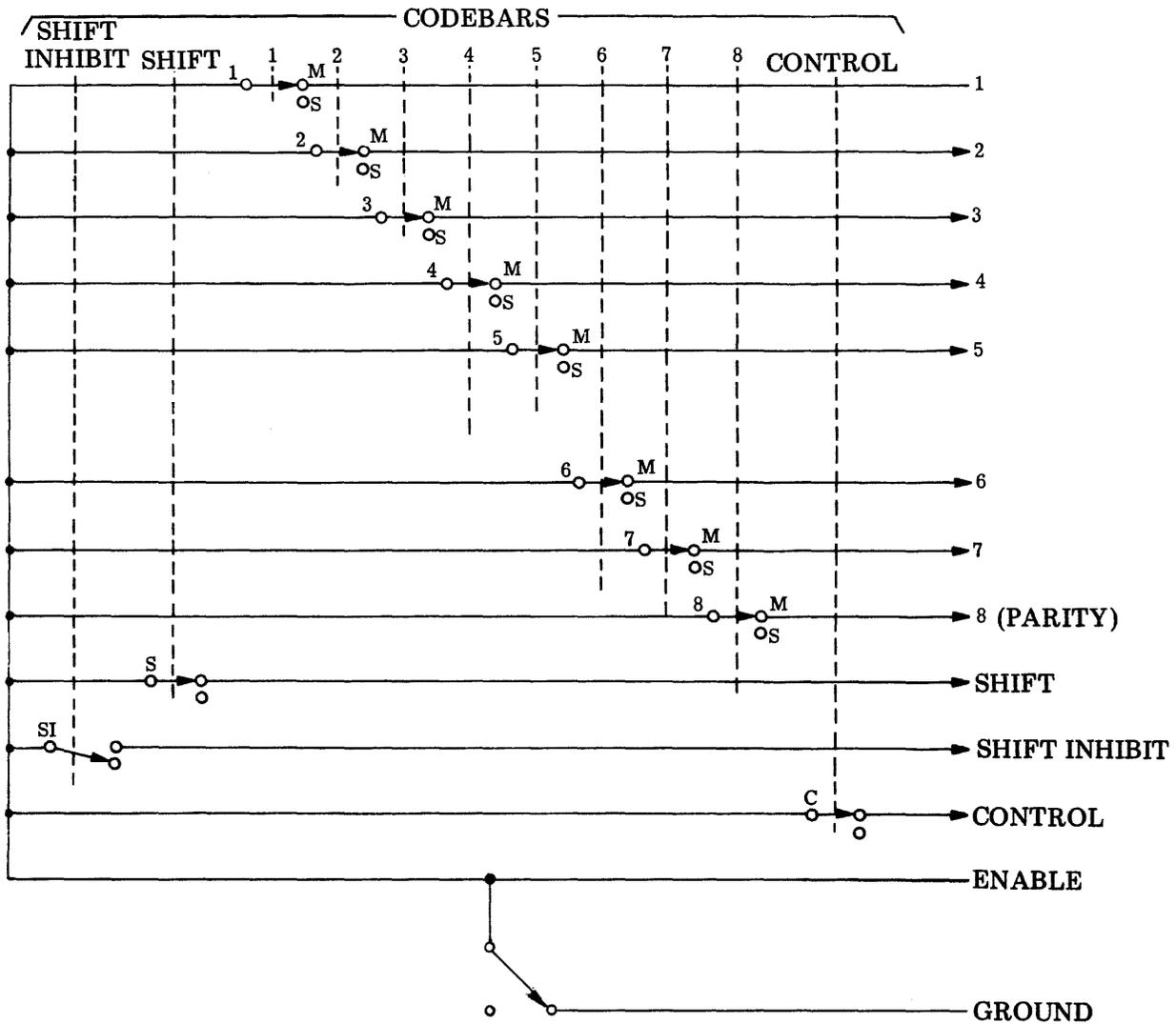
- (1) The output of the keyboard consists of eleven leads or circuit paths through the keyboard contact mechanism. This output is applied to the logic card to generate the 128 characters and controls.
- (2) As shown in the schematic diagram, the outputs are associated with specific codebars. The keys initiating the positioning of the codebars and the resulting contact operations affect the output as follows:
 - (a) Keyboard outputs 1 through 7 and parity occur when any key with the exception of SHIFT and/or CONTRL is depressed.
 - (b) The control and shift outputs occur when the CONTRL and SHIFT keys, respectively, are depressed.
 - (c) The shift inhibit output occurs when a key associated with only one character or control is depressed together with or independent of the SHIFT or CONTRL keys.
- (3) When a key is depressed alone or with the SHIFT or CONTRL key, the keyboard output is developed as follows:

- (a) Outputs 1 through 7 occur as binary state 1 or 0 according to the ASCII code for the character or control corresponding to the use of that key alone. For example, the binary state for outputs 1 through 7 is the same for the character A whether a lower or upper case A is entered into the keyboard.
- (b) The parity output state is binary 1 or 0 as determined by the total number of 1s in outputs 1 through 7. This output will be 1 or 0 to provide an even number of 1s in outputs 1 through 8.
- (c) The control output state is a binary 1 or 0 depending on whether the CONTRL key is depressed.
- (d) The shift output state is a binary 1 or 0 depending on whether the SHIFT key is depressed.
- (e) The shift inhibit output is binary state 1 if the depressed key can be used only to generate one character or one control.

3.15 Keyboard Logic — The keyboard logic output is in the form of bit permutations. Bits 1 through 7 are binary state 1 or 0 according to the character or control entered into the keyboard, and the parity bit is 1 or 0 to provide even parity.



KEYBOARD SCHEMATIC DIAGRAM



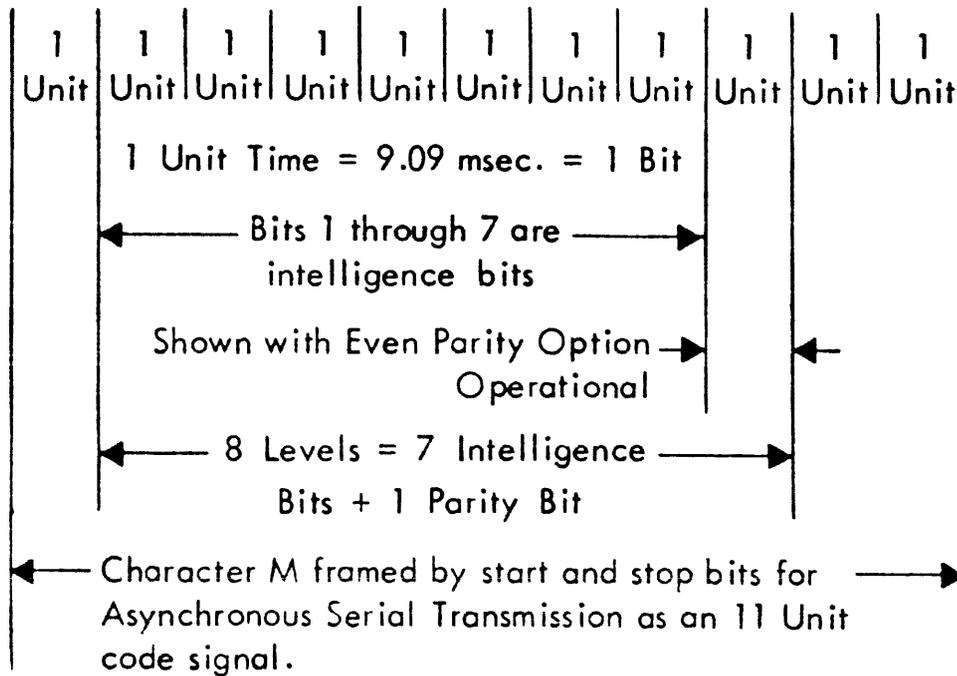
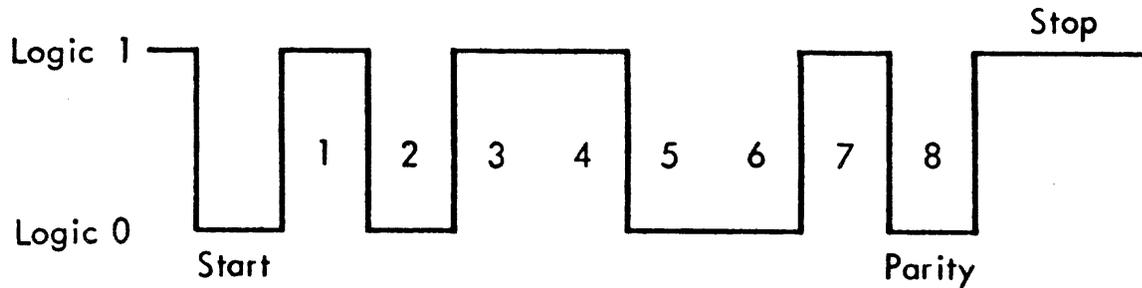
NOTE: The number 1 - 8 codebars are shown in the marking position. Shift, control and shift inhibit contacts are shown unoperated.

ASCII CHART

BITS				7	0				1						
				6	0		1		0		1				
				5	0	1	0	1	0	1	0	1			
4	3	2	1												
0	0	0	0	NUL	DLE	SP	0	@	P	\	p				
			1	SOH	DC1	!	1	A	Q	a	q				
		1	0	STX	DC2	"	2	B	R	b	r				
			1	ETX	DC3	#	3	C	S	c	s				
	1	0	0	EOT	DC4	\$	4	D	T	d	t				
			1	ENQ	NAK	%	5	E	U	e	u				
		1	0	ACK	SYN	&	6	F	V	f	v				
			1	BEL	ETB	'	7	G	W	g	w				
1	0	0	0	BS	CAN	(	8	H	X	h	x			
			1	HT	EM	)	9	I	Y	i	y			
		1	0	LF	SUB	*	:	J	Z	j	z				
			1	VT	ESC	+	;	K	[	k	{			
	1	0	0	FF	FS	,	<	L	\	l	|				
			1	CR	GS	-	=	M	]	m	}			
		1	0	SO	RS	.	>	N	^	n	~				
			1	SI	US	/	?	O	_	o	DEL				

Characters and controls are generated by use of a key alone (), with a SHIFT key (), or with a CONTRL key (). See Figure 5.

CODE STRUCTURE — 8-LEVEL 11-UNIT CODE
 (dc neutral signal is illustrated)



Mark-Logic 1 (Current) Space-Logic 0 (No Current)

Bits					0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1				
b ₇	b ₆	b ₅	b ₄	b ₃	b ₂	b ₁	COLUMN	ROW	0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	NUL	DLE	SP	0	←	P	→	*		
0	0	0	1	1	1	1	SOH	DC1	••	1	A	Q	α	?		
0	0	1	0	2	2	2	STX	DC2	—	2	B	R	⊥	ρ		
0	0	1	1	3	3	3	ETX	DC3	<	3	C	S	∩	τ		
0	1	0	0	4	4	4	EOT	DC4	≤	4	D	T	∟	~		
0	1	0	1	5	5	5	ENQ	NAK	=	5	E	U	€	↓		
0	1	1	0	6	6	6	ACK	SYN	≥	6	F	V	-	U		
0	1	1	1	7	7	7	BEL	ETB	>	7	G	W	∇	ω		
1	0	0	0	8	8	8	BS	CAN	≠	8	H	X	Δ	∩		
1	0	0	1	9	9	9	HT	EM	√	9	I	Y	∟	↑		
1	0	1	0	10	10	10	LF	SUB	)	]	J	Z	o	c		
1	0	1	1	11	11	11	VT	ESC	(	[	K	}	ı	}		
1	1	0	0	12	12	12	FF	FS	,	;	L	†	□	†		
1	1	0	1	13	13	13	CR	GS	+	-	M	X	|	÷		
1	1	1	0	14	14	14	SO	RS	.	:	N	◊	τ	‡		
1	1	1	1	15	15	15	SI	US	/	\	O	∧	○	DEL		

NOTE: Characters in shaded areas conform to 1968 ASCII.

Figure 12 - APL Characters Code Designations

APL SYMBOL	DESCRIPTION	APL SYMBOL	DESCRIPTION
¨	UMLAUT OR DIAERESIS	α	ALPHA
-	NEGATIVE	⌈	CEILING OR MAXIMUM
<	LESS THAN	⌋	FLOOR OR MINIMUM
≤	LESS THAN OR EQUAL TO	—	UNDERLINE
=	EQUAL	∇	DEL
≥	GREATER THAN OR EQUAL TO	Δ	DELTA
>	GREATER THAN	°	DEGREE (SMALL CIRCLE)
≠	NOT EQUAL	‘	QUOTE
∨	OR	□	QUAD
∧	AND	(	PARENTHESIS
-	MINUS	)	PARENTHESIS
÷	DIVISION	[	BRACKET
+	PLUS	]	BRACKET
x	TIMES	⊃	UNNAMED
?	ROLL	⊃	UNNAMED
ω	OMEGA	∩	UNNAMED
ε	ELEMENT	∪	UNNAMED
ρ	RHO	⊥	DECODE
~	NOT	⊤	ENCODE
↑	TAKE	|	ABSOLUTE VALUE OR RESIDUE
↓	DROP	;	SEMICOLON
ι	IOTA	,	CATENATION
π	PI TIMES	:	COLON
*	EXPONENT	.	DECIMAL
→	BRANCH	\	LEFT SLASH
←	ASSIGN	/	RIGHT SLASH
⊔	UNNAMED		
⊔	UNNAMED		

Figure 13 - APL Characters and Definitions

COMPLETED SYMBOL	DESCRIPTION	PRIMARY SYMBOL		OVER-STRIKE SYMBOL
⊗	LOGARITHM	○	B A C K S P A C E	*
⊘	REVERSAL OR ROTATE	○		|
⊙	TRANSPOSE	○		\
⊠	GRADE UP	Δ		|
∇	GRADE DOWN	∇		|
⊡	COMMENT OR LAMP	∩		○
⊢	QUOTE QUAD	‘		□
⊣	FACTORIAL COMBINATION	!		.
⊤	NAND	∧		~
⊥	NOR	∨		~
⊦	DEL TILDE	∇		~
⊧	I BEAM	⊤		⊥
⊨	UNNAMED	⊤		⊥
⊩	"ANY ST'D. SCALAR DYADIC OPERATOR"	○		.

Figure 14 - APL Overstrike Symbols