CONTROL DATA CORPORATION

CONTROL DATA INSTITUTE

SELECTRIC TYPEWRITER

TRAINING MANUAL · SECOND EDITION

movable
rack
backspace moves to the left

Torque limiter allow smooth takeoff

15 characters per sec

180 5 char words per minute

brake causes return carriage

5 operations on cam

- backspace
- space
- tab
- carrier return
- index

+ shift

SELECTRIC TYPEWRITER EQUIPMENT TRAINING MANUAL

SECOND EDITION

FOR TRAINING PURPOSES ONLY

This book was compiled and
written by instructional
personnel of

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CONTROL DATA CORPORATION

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FOREWORD

This manual has been written as a supporting text for technical training courses on the operation and maintenance of the Selectric Typewriter and the CONTROL DATA® 3192 Typewriter Controller. These equipments are representative of many typical input-output typewriter equipment configurations in common use with computer systems. The reader will find study questions interspersed throughout the reading matter. It is important that these questions be answered whenever they are encountered so that the reader can evaluate his grasp of the subject matter and his own progress through the text. Answers are provided in Appendix B.

INTRODUCTION

GENERAL CHARACTERISTICS

The IBM Selectric® Typewriter can be used as a standard office typewriter or as a computer input/output typewriter. The office machine is known as the 72 series and the input/output machine is known as the 73 series. The typewriter has a print speed of 15 characters per second when under computer control; when under operator control, its speed is limited to that of the operator. The typewriter referred to in this manual is the Model 731--which has an 11-inch carriage with an 8 1/2-inch writing line. The 731 is available in two versions: BCD (binary coded decimal) and Correspondence. The BCD version is limited to computer usage only since it uses non-standard print symbols. The Correspondence version can be used either as an office typewriter or as a computer input/output machine since it uses standard print symbols. Because of its versatility, the Correspondence version is more widely used.

COMPARISON OF SELECTRIC TO STANDARD TYPEWRITER

Basically, the Selectric typewriter performs the same functions as do all other typewriters; however, the method used to perform these functions differs greatly in most aspects.

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Three major areas in which the Selectric differs from other typewriters are:

1. Method of printing. Standard typewriters use typebars to imprint a character. The Selectric uses a spherical typehead to imprint a character.
2. Method of shifting. Standard typewriters raise and lower the typebar assembly to shift to lower or upper case characters. The Selectric rotates the typehead 180° to shift to either case.
3. Method of escapement (character spacing). Standard typewriters accomplish escapement by moving the entire carriage to the left. The Selectric accomplishes escapement by moving the typehead to the right.

KEYBOARD CHARACTERISTICS

Located on the keyboard of the Correspondence Selectric are 55 keybuttons and switches. These are separated into the following categories:

1. Print functions: 44 keybuttons represent 88 print characters. Each print keybutton represents two characters, one upper case and one lower case.
2. Operational functions: eight keybuttons represent the following six operational functions.
   SPACEBAR--moves the typehead one character space to the right.
   RETURN--quickly moves the typehead to the left margin stop.
   TAB--quickly moves the typehead to the right, usually several character spaces, until a preset stop is encountered.
   BACK SPACE--moves the typehead one character space to the left.
   INDEX--vertically spaces the paper one or two lines depending on the setting of the index selector lever which is not located on the keyboard.
   SHIFT (three keybuttons)--located at either side of the keyboard the SHIFT buttons are interconnected by means of a bail. When depressed, either button rotates the typehead 180° counter-clockwise to position the typehead upper case characters into the print zone. The third keybutton (LOCK) locks the shift buttons down, keeping the typehead in the upper case position.
3. ON/OFF: a two-position switch which applies 110 volts ac to the typewriter motor when ON and removes the 110 volts ac when OFF.
4. CLR/SET: a two-position switch which sets or clears tab settings which stop the typehead at preset locations along the print line on a tabulator operation.
5. MAR REL: When depressed, causes the rear of the margin rack to be raised to enable the typehead to move laterally past the left or right margin stops.

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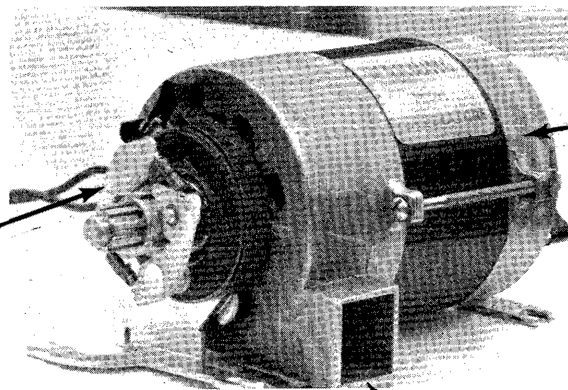


Figure 1. Shaded-Pole Motor

CHAPTER 1

MOTOR AND DRIVE

15 characters per sec 1628 RPM

also run 50 cps 1325 RPM

3 5/8 / 1 step down

The motor used in the selectric I/O printer can be either a 3-inch induction motor, known as a shaded-pole motor, or a capacitor-start motor. Either is a 60-cycle ac motor rated at 1/35 horsepower and operate at 115 volts. The more common of the two is the shaded-pole (figure 1). The motor is mounted at the left-rear corner of the printer and has a pulley (to the right) mounted on its rotor shaft.

The starting torque of the shaded-pole motor is low compared with that of the capacitor start and, therefore, uses a centrifugal clutch assembly. The starting torque of the capacitor-start motor, supplied by the capacitor, is high, thereby eliminating the need for a clutch assembly. The capacitor is mounted to the right of the motor. Internal circuit breakers in both motors prevent overheating of windings should breakage of parts or maladjustments cause machine lockup. The circuit breaker will alternately open and close as long as the power switch is left on and the motor is stalled. A cooling system is incorporated in the shaded-pole motor to prevent over-heating; however, the normally-hot motor can cause painful burns

FIGURES AND TABLES

if not handled properly. The ON/OFF switch (figure 2) located on the front right side of the printer controls power on and off as well as the keyboard lock mechanism (discussed in Chapter 4).

Drive is supplied by the motor to the printer via a belt running from an eight-toothed motor pulley to the cycle clutch pulley having a reduction in speed of 3 and 5/8 to 1. The motor pulley on the capacitor-start motor is set-

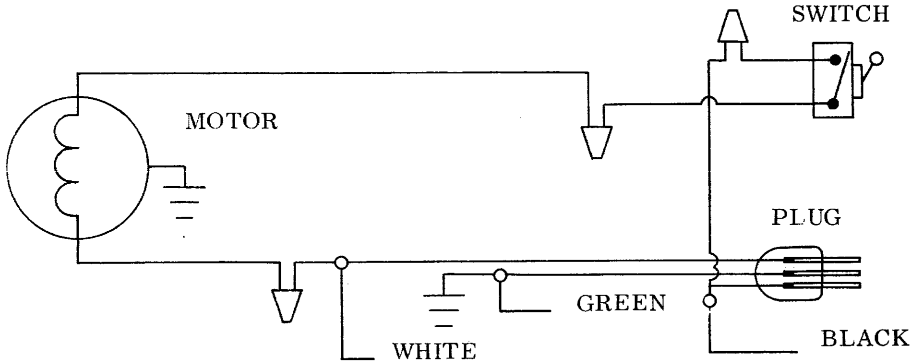


Figure 2. Shaded-Pole Motor Diagram

screwed to the rotor shaft and drives the cycle clutch pulley as soon as the motor begins to turn. On the shaded-pole motor, however, the motor pulley rides freely on the rotor shaft and is held in place by a grip ring on the end of the shaft. It has three ratchet teeth protruding radially from its left side. Set-screwed to the rotor shaft, just left of the pulley, is a clutch plate hub assembly (figure 3) which has two clutch pawls pivoting on the plate. The pawls are spring loaded against stop lugs on the clutch plate with the motor turned off. As the motor begins to rotate, centrifugal force makes the clutch pawls pivot on the studs of the clutch plate, pivoting the tips of the pawls into the three teeth of the still motionless pulley. As

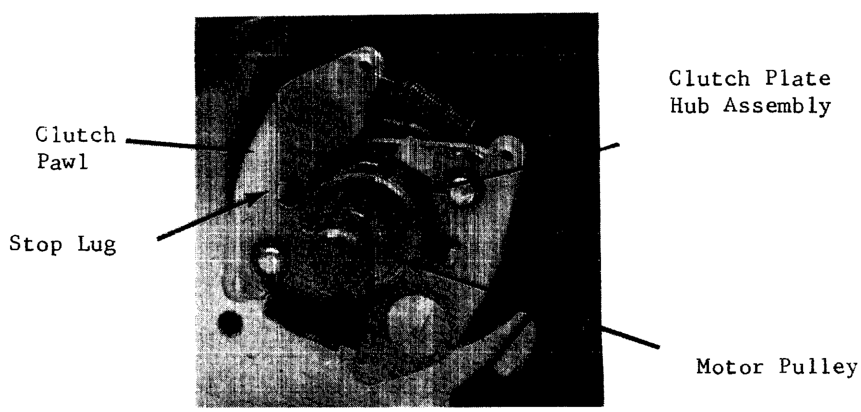


Figure 3. Motor Pulley Clutch

the motor approaches full speed, the tip of one of the pawls drives the motor pulley by engaging one of its three teeth. This drives the belt to the cycle clutch pulley which, in turn, supplies drive to the rest of the printer.

The cycle clutch pulley is mounted in the center of the power frame to a hub which is supported by a bronze bearing and rotates with the pulley. The cycle clutch pulley hub (figure 4) supports two shafts on either side which extend into it.

The shaft to the right (figure 4 and 5) is the operational cam shaft which rotates continuously, top to the front, when the motor is running. This shaft drives the following six operational functions: space, backspace, tabulator, shift, carrier return, and index. It also regulates the speed of the carrier during a tab operation. The left end of the operational cam shaft, which extends into the cycle clutch pulley hub, is supported by a vinyl sleeve which supplies a tight connection for the shaft in the hub and eliminates any vibrational noises.

The torque limiter hub, set-screwed to the left end of the operational shaft (figure 4), has two cutouts to accommodate two extensions of the clutch pulley hub. This supplies the drive connection between the hub and the operational

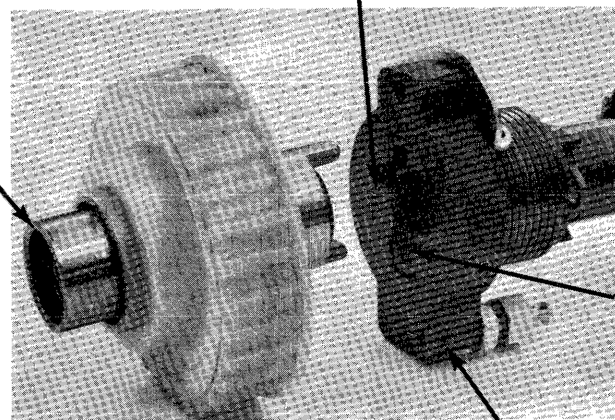


Figure 4. Drive Connection

shaft. Two nylon inserts which fit into the cutouts around the hub extensions permit a noise-free drive connection. To the right of the torque limiter hub are three spring clutches, two small pinion gears and two cams. These are used in the drive and/or control of all of the operational functions except shift.

The shaft to the left of the cycle clutch pulley hub is the cycle shaft (figure 5) which, unlike the operational shaft, is not in continuous rotation. A spring clutch is permitted to tighten about a hub on the rotating pulley hub to cause the cycle shaft to rotate whenever a character is to be printed (depression of a character keylever or selection of print magnets by the computer). To type a given character, the typehead must be correctly positioned by the cycle shaft. The cycle shaft rotates 180° (a complete print cycle), top to the front, for each character to be printed. At the end of a 180° rotation, the spring clutch disengages from the rotating pulley hub and the cycle shaft stops rotating. Each time it rotates, the cycle shaft directly drives two other shafts (figure 5) through a series of idler gears at the left of the printer. These two shafts are the print shaft -- which operates the print mechanism, ribbon feed and lift mechanism, and the type aligning mechanisms -- and the filter shaft, which operates the character selection mechanisms, the shift interlock, print escapement, and a spacebar lockout device. The print shaft rotates 360°, top to the rear, for each print cycle; the filter shaft rotates 180°, top to the front, for each print cycle.

Answer the following questions:

1. Why is a clutch assembly not required on a capacitor-start motor?

2. List the drive shafts, the amount of rotation of each, and the direction of rotation of each.

3. Which drive shaft powers other shafts? List the other shafts.

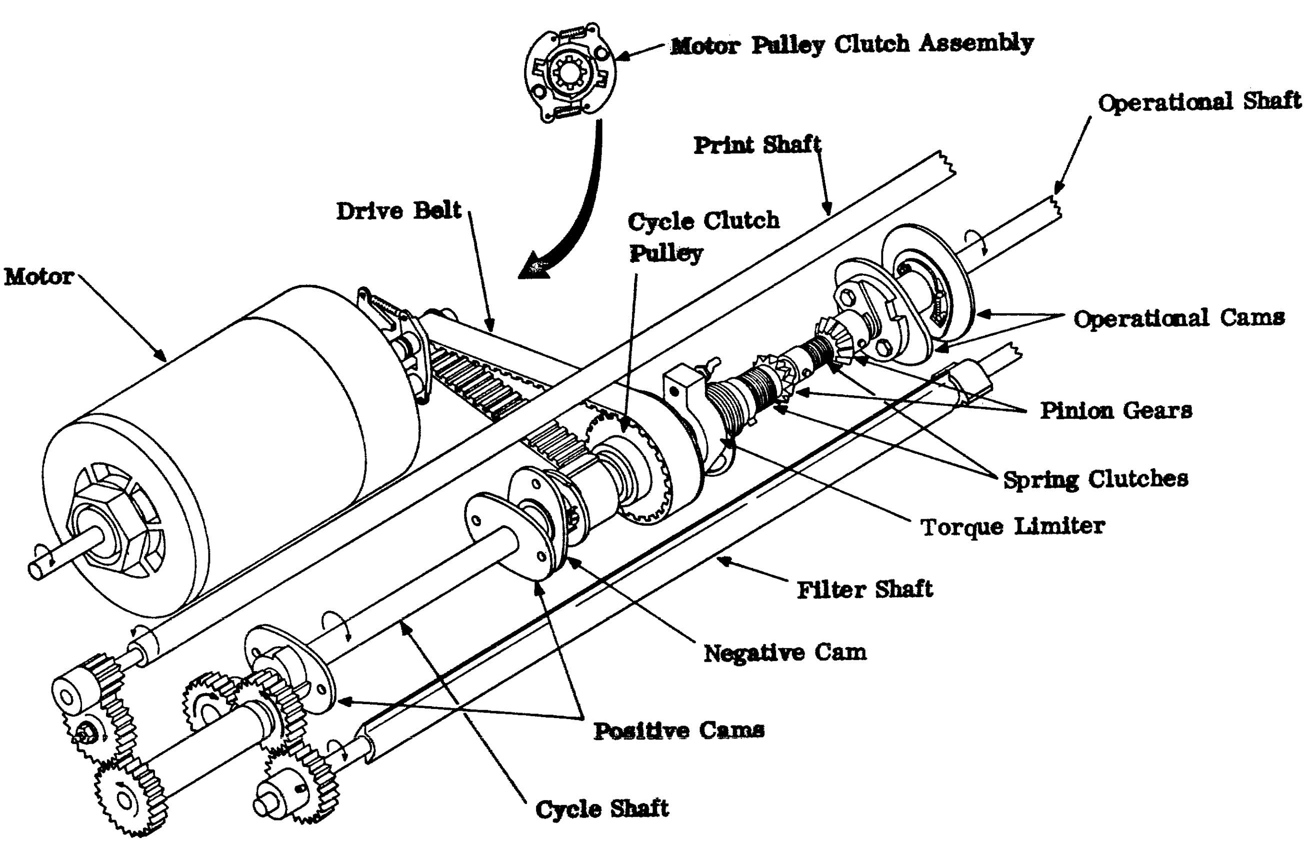


Figure 5. Drive Mechanism

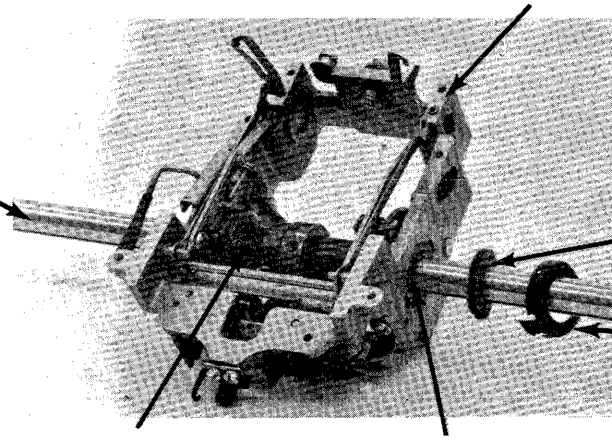


Figure 6. Front Carrier Support

CHAPTER 2

TYPEHEAD POSITIONING

CARRIER ASSEMBLY

CARRIER

The typehead, or print element, contains 88 characters and is supported by a box-shaped carrier (figure 6) which moves just in front of and laterally to the platen. The carrier transports the typehead along the writing line and contains almost all of the print mechanisms. It also supports the ribbon, ribbon lift and feed mechanisms, and a margin bracket. The print sleeve -- which contains the ribbon feed and lift cams, the detent cam, and the print cam -- is located at the front of the carrier and moves with the carrier left or right on the print shaft.

The print sleeve (figure 6) which fits into two bronze bearings within the carrier, rotates within the carrier and supports the carrier in the front. Two felt rings, called the print shaft wipers, enclose the print shaft and are held in place against each side of the carrier by retaining caps. The oil-soaked wipers supply a light film of oil to the print shaft as the print sleeve slides; they also keep the bearings lubricated to aid rotation of the print sleeve.

CARRIER SUPPORT

The carrier is supported in the rear (figure 7) on the escapement rack by the lower shoe and the upper shoe. The lower shoe consists of a nylatron block mounted to a rear plate of the carrier. The upper shoe is mounted on an eccentric stud spring-loaded against the top of the escapement rack. The left end of the load spring is anchored by a stud mounted on the plate. The free end of the spring presses against the bottom of the escapement bracket.

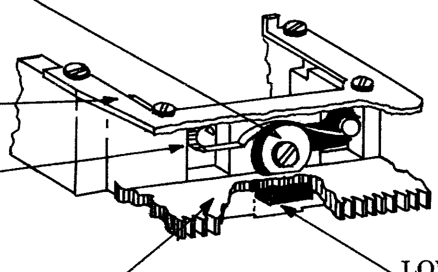


Figure 7. Rear Carrier Support

ROCKER

The rocker is a platform located within, and pivots at the rear of, the carrier on the rocker shaft (figure 8). Two bushings within the rocker ends form a bearing surface between the rocker and the rocker shaft. The rocker carries the typehead to and from the platen to allow for printing. The yoke, which acts as a pivot for the tilt ring, is attached solidly to the top of the rocker. Mounted to the top of the tilt ring is the upper ball socket to which the typehead is attached. As the rocker pivots toward the rear, it drives the typehead toward the platen.

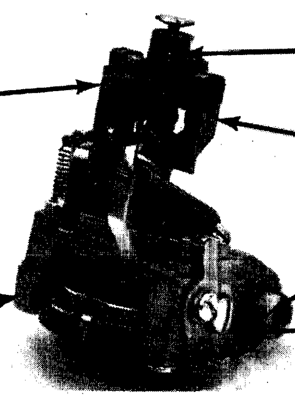


Figure 8. Rocker Assembly

TYPEHEAD

The 88 character typehead (figure 9) consists of two hemispheres -- one containing 44 upper-case characters, the other containing 44 lower-case characters. The typehead is divided into four circular bands of 22 characters -- each band having 11 lower case and 11 upper case characters. When the typehead is at rest, the middle character of the upper band (the letter Z for most typeheads) is in striking position. This is referred to as the home position. To print any character other than Z, the typehead must be tilted (up to three positions) from the home position and/or rotated (up to five positions clockwise or counterclockwise) from the home position. The tilting or rotating of the typehead operates the same in lower or upper case. The typehead always restores to the home position after any character has printed and before another character will print.

To position the typehead into upper case, it must be rotated 180° counterclockwise. To position the typehead into lower case it must be rotated 180° clockwise. Any lower-case character on the typehead is exactly 180° apart from its upper-case counterpart (e.g., z and Z). A spring clip on the top of the typehead is used to mount the typehead to a groove in the upper ball socket. The inside of the typehead is keyed to fit a pin at the base of the upper ball socket. The typehead cannot be locked into place unless the key fits over the pin, thereby allowing installation in only one position.

The typehead is removed or installed by pressing the two ears of the spring clip together. The ears of the spring clip always face toward the front when the typewriter is in lower case. As the typehead faces the platen, the 20 characters to the right of the home position are considered positive, whereas the 20 characters to the left are considered negative. Positive characters are brought into print position by a counterclockwise rotation of the typehead; negative characters by a clockwise rotation.

Table 1 illustrates the tilt and rotate positioning of the 88 characters on the typehead.

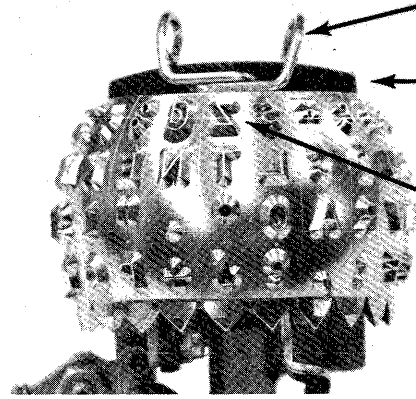


Figure 9. Typehead

TABLE 1. TYPEHEAD CHARACTER POSITIONING

UPPER CASE

Rotate	CW -5	-4	-3	-2	-1	0	+1	+2	+3	+4	CCW +5
Tilt 0	±	#	&	*	$	Z *	@	%	¢	)	(
Tilt 1	X	U	D	C	L	T	N	E	K	H	B
Tilt 2	M	V	R	A	O	°	.	"	I	S	W
Tilt 3	G	F	:	,	?	J	+	P	Q	Y	_

*Home Position

LOWER CASE

Rotate	CW -5	-4	-3	-2	-1	0	+1	+2	+3	+4	CCW +5
Tilt 0	1	3	7	8	4	Z *	2	5	6	0	9
Tilt 1	X	U	D	C	L	T	N	E	K	H	B
Tilt 2	M	V	R	A	O	!	.	'	I	S	W
Tilt 3	G	F	;	,	/	J	=	P	Q	Y	-

*Home Position

Answer the following questions:

1. What is the main purpose of the carrier?

2. What is the main purpose of the rocker?

3. Briefly, what is done to the typehead to enable any given character to print?

4. How many lower case characters in the fourth circular band in either hemisphere?

5. What prevents downward movement of the carrier at the rear?

CYCLE CLUTCH

The cycle clutch is the "heart" of the printer and a rotation will occur for each character printing. The cycle shaft (figure 10) extends from a bearing in the left side of the power-frame to the cycle clutch pulley hub in the center and powers all print operations.

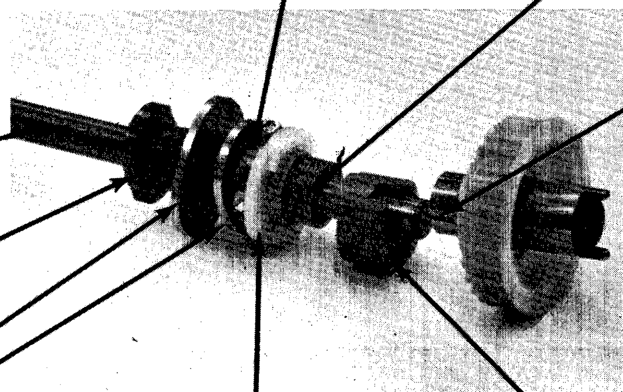


Figure 10. Cycle Clutch

A wrap spring called the cycle clutchspring, enables engaging the cycle shaft with the continuously-rotating pulley hub. The left end of the spring fits around the hub of the cycle shaft and is clamped to the hub by the cycle clutch collar (figures 10 and 12). The tip of the spring fits into a slot in the collar. The right end of the spring fits around the hub on the pulley and a tip of the spring fits into a slot in the cycle clutch sleeve. The inside diameter of the spring is smaller than that of the pulley hub and the spring will collapse tightly (engage) around the hub unless it is held disengaged. The cycle clutch sleeve (figure 11) prevents the spring from tightening around the rotating pulley hub (the sleeve, in turn, is held by the

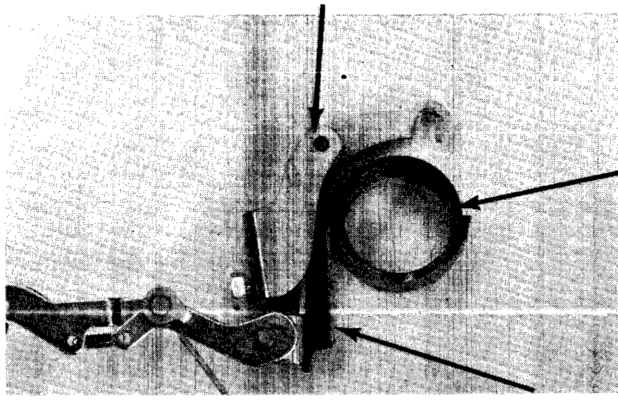


Figure 11. Cycle Clutch Latch

cycle clutch latch), permitting rotation of the cycle clutch pulley without rotating the cycle shaft.

Located on the cycle clutch sleeve are two lips 180° apart. As the cycle shaft rotates, one of the lips on the sleeve will be stopped by the cycle clutch latch. This allows just 180° of rotation. To cause rotation, the cycle clutch latch is pivoted to the front, out of the path of the cycle clutch sleeve. It is then pivoted back into the path of the next lip on the sleeve. The latch stops the right end of the spring but the left end of the spring must be allowed to rotate slightly farther to disengage the clutch from the hub on the cycle clutch pulley. This extra rotation is accomplished by momentum of the cycle shaft.

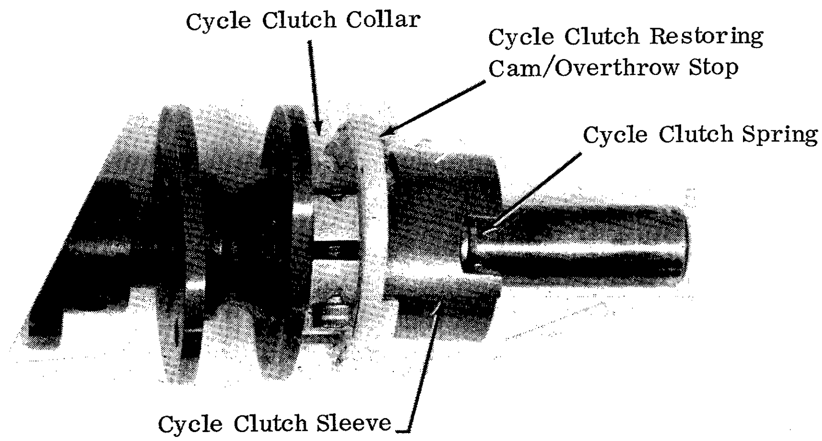


Figure 12. Cycle Clutch Stop

The cycle clutch restoring cam/overthrow stop has two lugs which project into notches on the left side of the cycle clutch sleeve (figure 12). As the sleeve is stopped by the latch, the cycle shaft with the restoring cam/overthrow stop attached to it continues to rotate until the lugs on the overthrow stop contact the extensions of the sleeve. At this time, forward motion of the cycle shaft is stopped and the shock created by the force of the stopping action causes the cycle shaft to attempt to bounce backwards. This is prevented by the cycle clutch check pawl (figure 13) which drops into a notch on the cycle clutch check ratchet. Both are located inside the powerframe at the left of the printer. The overthrow stop plus the check pawl assures that the cycle shaft always returns to the exact same position upon each 180° rotation.

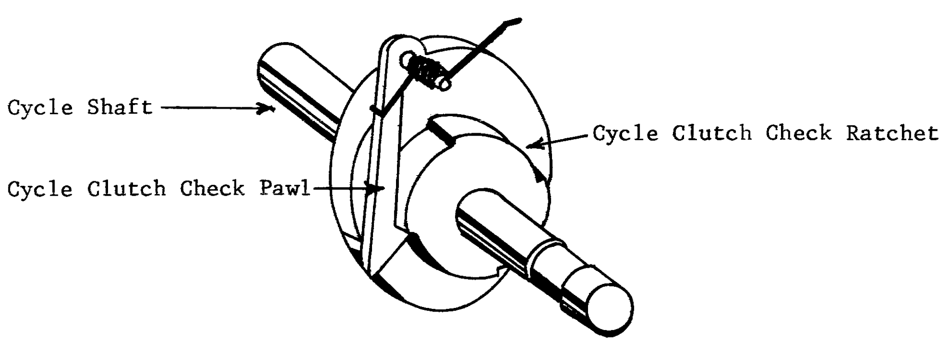


Figure 13. Cycle Clutch Check Pawl and Ratchet

PRINT FEEDBACK CONTACTS

Two sets of print feedback contacts (C1 and C2) are located at the left side of the machine outside the power frame (figure 14). These contacts are controlled by two cams mounted on the far left side of the cycle shaft.

The C1 contacts, which are located to the left of the C2 contacts, regulate the timing of an input operation. They will break (open) at approximately 85° of cycle shaft rotation and will make (close) at approximately 130° of cycle shaft rotation.

The C2 contacts cause a busy signal to be generated when they are transferred (open). The contacts will break at approximately 20° of cycle shaft rotation and will make at approximately 120° of cycle shaft rotation.

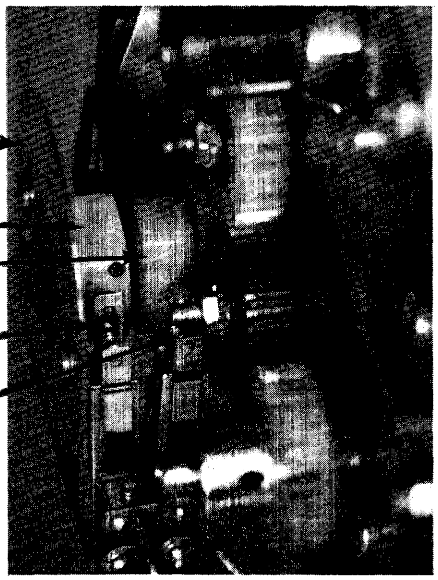


Figure 14. Print Feedback Contacts

Answer the following questions:

6. Why is the cycle shaft considered the "heart" of the printer?

7. Why are two "lips" used on the cycle clutch sleeve?

8. What action occurs to disengage the cycle clutch spring from the cycle clutch pulley hub after 180° of cycle shaft rotation?

LATCH BAIL

The purpose of the latch bail (figure 15) is to supply the motion needed to cause the typehead to tilt and/or rotate to the needed position to print a selected character. It is a square-shaped frame located just under the cycle shaft and pivots on the bail shaft mounted toward the front of the printer. The rear of the latch bail is held upward by an extension spring which connects to the power frame. A roller is located in each side of the latch bail and both rollers are held in contact with two cams, called the positive cams, on the cycle shaft. Each time the cycle shaft rotates 180° the latch bail is forced down in the rear.

Six selector latches sit in six recessed points at the rear of the latch bail. A plate runs across the rear of the latch bail. Each selector latch has a lip formed to the rear which fits under this plate. Each latch is held to the rear (under the latch bail plate) by an extension spring (figure 16). If they remain to the rear when the latch bail is forced downward they will be pulled down. Any latches pulled forward (unlatched) as the latch bail begins its downward motion will not be pulled down.

The first and third latches are used in the tilt differential mechanism. The differential mechanisms determine the amount of tilt and rotate the typehead is to receive. The fourth, fifth, and sixth latches are used in the rotate differential mechanism. The second latch is used for parity checking purposes and will be discussed later.

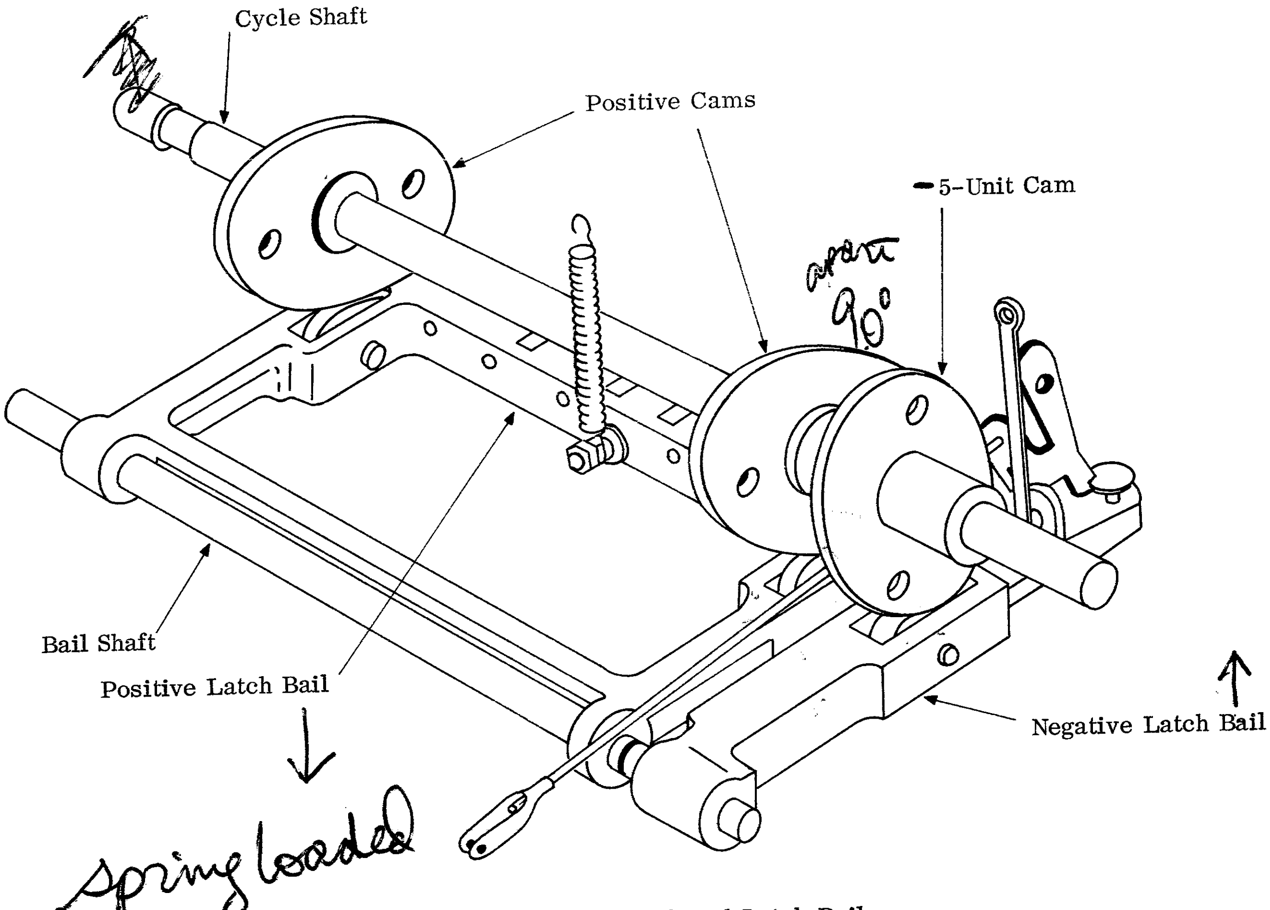


Figure 15. Cycle Shaft and Latch Bail

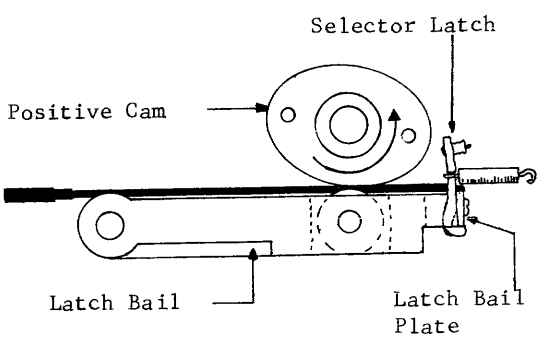


Figure 16. Latch Bail (Side View)

Answer the following questions:

9. What forces the latch bail to pivot downward?

10. What is the purpose of the latch bail?

Rotate & tilt of typehead is controlled by pos bail

The tilt mechanism raises the rear of the typehead to allow the desired character band to be in position so that a selected character in that band may strike the platen. The tilt ring is used to tilt the typehead upward from the rest position (figure 17). Movement of the tilt ring occurs by a pull from a link on the front right lower part of the tilt ring. The other end of the link is connected to the tilt pulley which is held upward by the tilt pulley spring. A narrow steel tape is connected from the tilt pulley through a cutout section of the rocker shaft out the left side of the carrier, around the left hand tilt pulley, across the printer, around the right hand tilt pulley, and is anchored to a pin in the right side of the carrier.

The right hand pulley is anchored to the frame. A pull on the tape (which pulls the tilt pulley, then the link, then pulls the front of the tilt ring down, pivoting the rear up) is accomplished by moving the left hand tilt pulley away from the side frame of the printer. Relaxing the pull on the tape allows the tilt pulley spring to restore the tilt ring to the rest position.

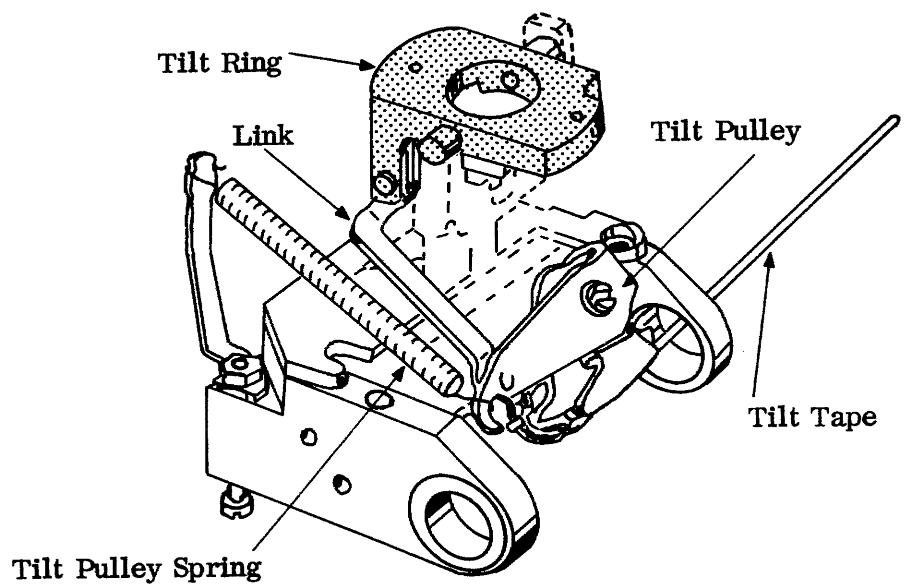


Figure 17. Rocker Assembly

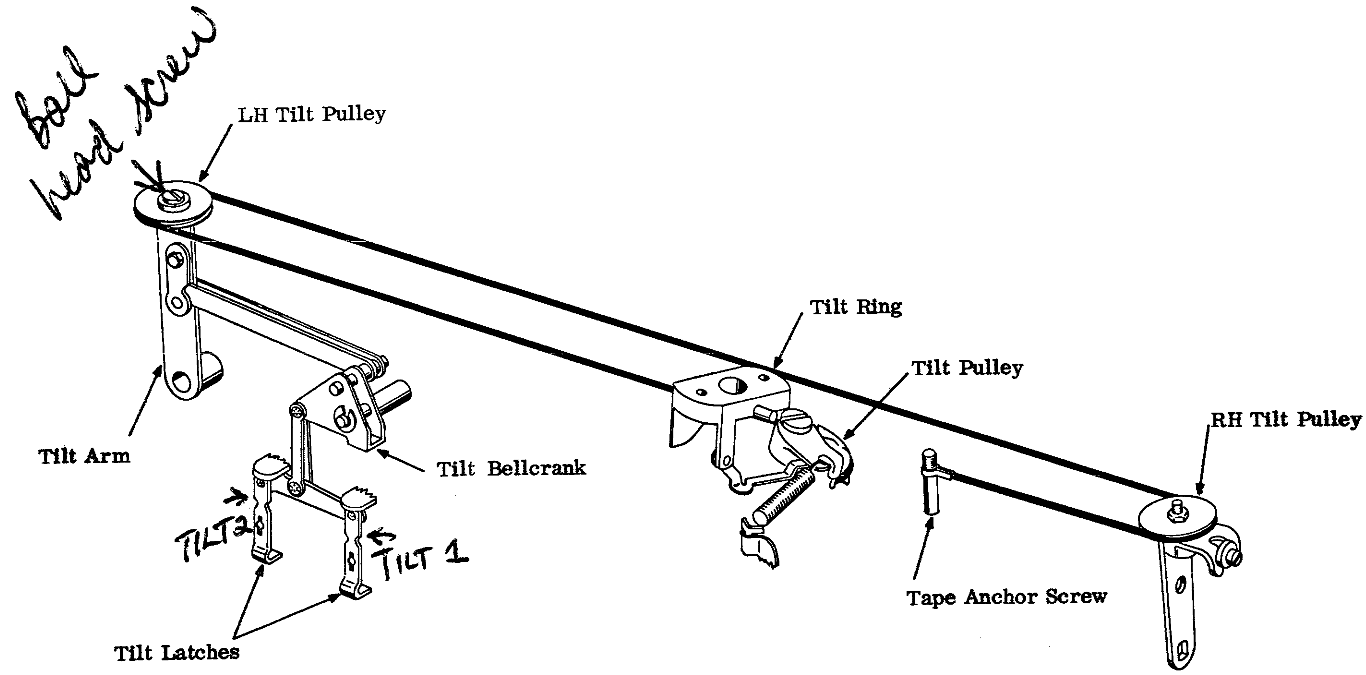


Figure 17A. Tilt Tape System

TILT DIFFERENTIAL

Figure 18 shows the tilt differential mechanism at rest. The two tilt latches are connected at each end of a horizontal arm by means of ball shouldered rivets which permit free movement of the latches. A vertical link attaches to the horizontal arm one-third the distance from the left of the arm and two-thirds from the right. This allows the leverage of one tilt latch to be greater than the other. The top of the vertical link connects to the tilt bellcrank. The bellcrank is connected to the tilt arm by means of a horizontal link. The tilt pulley is attached to the top of the tilt arm. The pulley is mounted on the tilt arm by means of a ball shouldered screw. This arrangement permits the pulley to remain horizontal despite movement by the tilt arm. Thus the tilt tape cannot jump off the pulley. When any combination of the tilt latches is pulled downward the tilt bellcrank rotates, forcing the tilt arm away from the powerframe and causing the typehead to tilt.

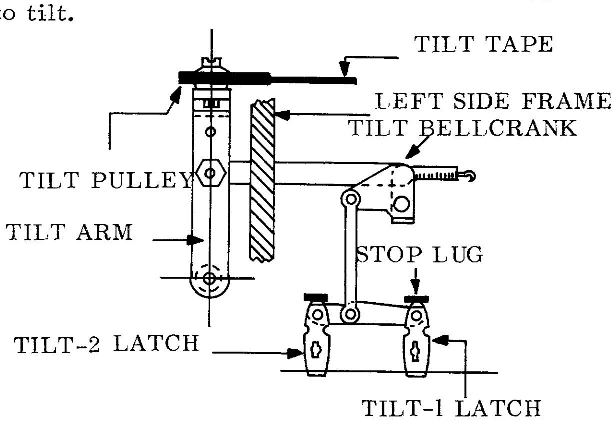


Figure 18. Tilt Differential at Rest

When the right hand tilt latch (tilt 1) is left under the latch bail (latched) with the left hand latch (tilt 2) unlatched, the top of the tilt 2 latch acts as a pivot point. Since the vertical link is connected one-third the distance from this pivot point it will only have a downward motion equal to one-third that of the tilt 1 latch being pulled by the latch bail. This causes sufficient bellcrank rotation and a subsequent push on the tilt arm to bring the second band of characters on the typehead to the print position. This is a tilt 1 operation (figure 19).

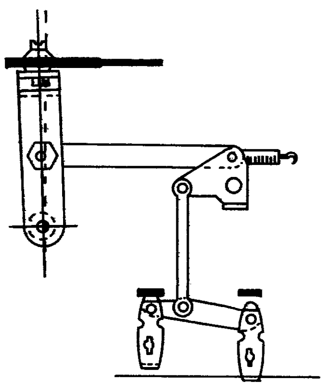


Figure 19.
Tilt-1 Operation

Leaving the tilt 2 latch under the bail and unlatching the tilt 1 latch creates a pull on the vertical link equal to two-thirds that of the downward motion of the tilt 2 latch. This is because the link is two-thirds the distance from the top of the tilt 1 latch, which is now acting as a pivot point. This causes sufficient bellcrank pull to tilt the typehead to the third band of characters. This is a tilt 2 operation (figure 20).

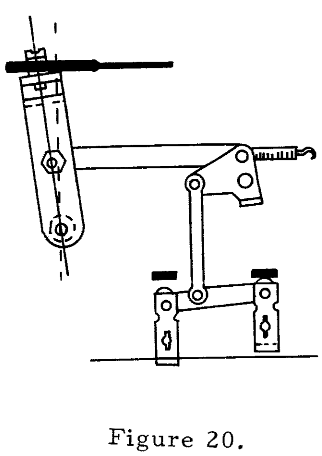


Figure 20.
Tilt-2 Operation

With both latches under the latch bail, the same amount of motion transfers to the vertical link as that of the latches since there is no pivot point. This rotates the bellcrank enough to tilt the typehead to the fourth band of characters. This is a tilt 3 operation (figure 21).

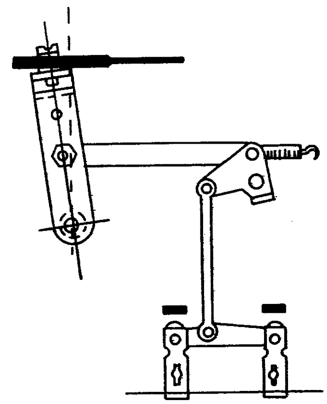


Figure 21. Tilt-3 Operation

If both latches are unlatched, then neither will move downward. Therefore, there is no downward motion of the vertical link and no rotation of the bellcrank. Thus the typehead does not tilt and the first bank of characters stays in the print position. This is a tilt 0 operation.

Answer the following questions:

11. What prevents the tilt tape from jumping off the left tilt pulley on a tilt 3 operation?

12. How is the tilt ring restored?

13. Malfunction: Tilt 2 will not remain latched (under the latch bail). What tilt operation will occur when the letter "Z" is depressed?

ROTATE MECHANISM

The purpose of the rotate mechanism (figure 22) is to rotate the typehead to the selected character within one of the four tilt bands.

The typehead is attached to the upper ball socket. The shoulder at the bottom of the upper ball socket fits closely into a hole in the tilt ring with just enough freedom to rotate freely. The tilt ring spacer, which is attached to the tilt ring, holds the upper ball socket in place. Shims are used to assure complete rotary movement of the upper ball socket with no up and down play.

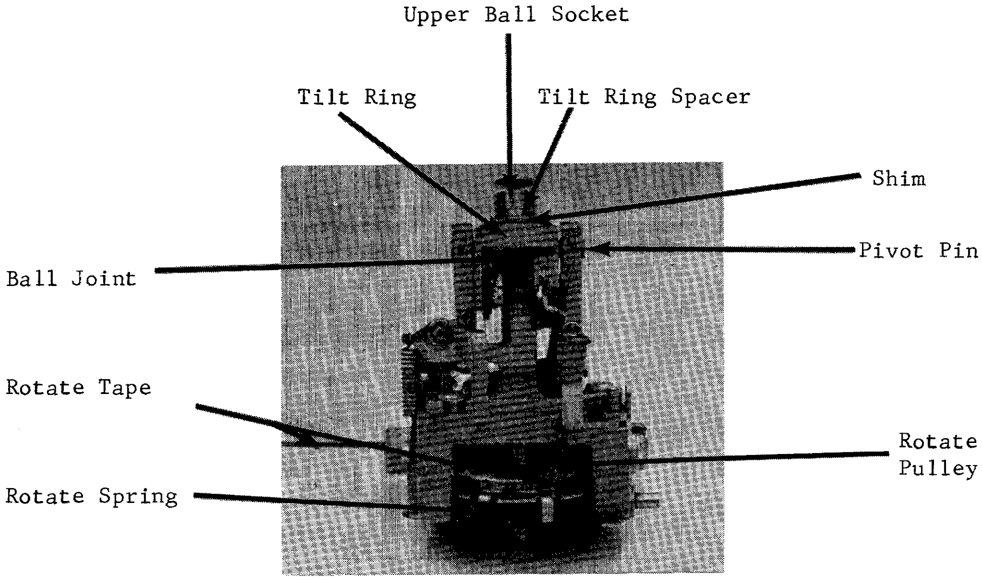


Figure 22. Rotate Mechanism, Rocker Portion

A ball joint connection, called the dog-bone (figure 23) fits into a hollow position in the underside of the upper ball socket. Each end of the dog-bone is slotted. The dog-bone fits over a pin in the upper ball socket. The other side of the dog-bone fits the same way in the lower ball socket which is also hollow. This type of connection acts as a universal joint and permits the typehead to be tilted and rotated at the same time.

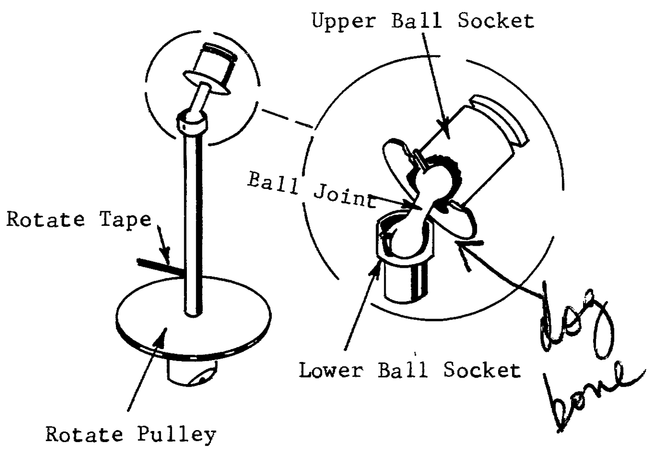


Figure 23. Rotate Mechanism, Rocker Portion

The lower ball socket is part of the rotate shaft (figure 23) which is held tightly within a hole in the rotate pulley by means of a set screw and wedging block arrangement. The rotate pulley is operated by a steel rotate tape similar to the tilt tape. One end of the tape has a T-connector while the other has an eyelet. The T end of the tape connects to the rotate pulley (figure 24) passes around a guide in the rocker, and out the left side of the carrier. As the tape leaves the left side of the carrier its edges are perpendicular to the ground. It is given a half twist, top toward the front, so that its edges are now parallel to the ground. It then passes around the rotate arm pulley and across the printer to pass around the shift arm pulley. It is then anchored to the right side of the carrier. A pull outward on either of the pulleys causes the rotate pulley, and thus the typehead, to rotate in a counterclockwise (positive) direction. An inward movement of either of the pulleys allows the typehead to rotate clockwise (negative) from rotate spring tension.

The rotate spring, which is a mainspring, is enclosed in a cage located immediately below the rotate pulley. The outer end of the spring is connected to the cage which is held stationary while the inner end of the spring is connected to a slot on the bottom of the rotate pulley. The inner part of the spring always tries to unwind in the clockwise direction; thus,

from keyboard R2 cable tipped alone
from mainframe R2a

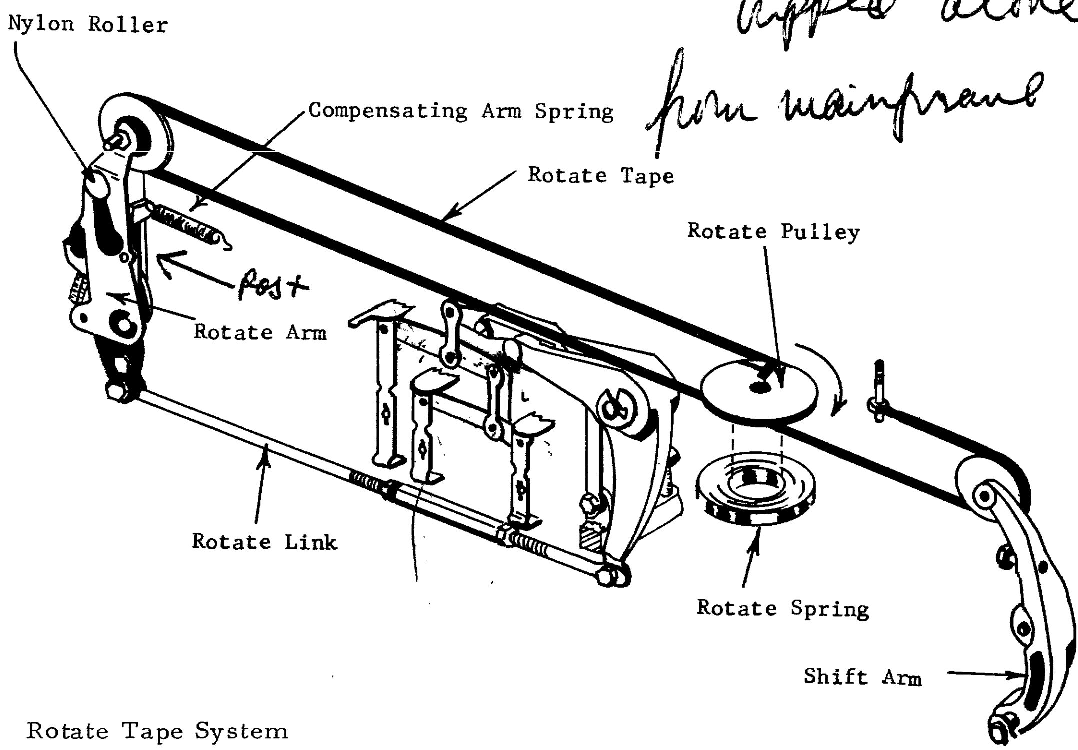


Figure 24. Rotate Tape System

the rotate pulley always has tension on it in the clockwise or negative direction and takes up tape if either of the pulleys moves toward the sideframe.

The left hand pulley, called the rotate pulley, governs the rotation of the typehead for all print selections. The right hand pulley, called the shift arm pulley, always rotates the typehead 180° and only moves during a shift operation -- at all other times, it is stationary.

POSITIVE ROTATE DIFFERENTIAL

Operation of the rotate differential is basically the same as that of the tilt differential. The latches are operated when under the latch bail; however, the typehead must sometimes be rotated up to five characters in either direction from home. This requires more latches and levers. Positive (counterclockwise) rotation will be explained first.

There are three latches in the rotate differential (figure 25) farthest to the right in the bail. From the left, they are labeled R2A, R1, and R2. The R1 and R2 latches are mounted to a lever by means of ball shouldered rivets. A vertical link is attached to the lever one-third the distance from the right (R2 side) of the lever. At the left end of the lever the R2A latch is connected by means of a ball-shouldered rivet. This latch is longer than the others to allow it to be under the bail. A second vertical link is connected two-fifths the distance from the right side of the second lever. This link is connected to the left side of an adjustable balance lever. The lever is adjustable to permit equal balance between a positive and negative rotation. The balance lever is connected, at approximately its mid-section, to the left end of the rotate bellcrank. The right end of the balance lever is connected to a vertical link, called the R5 or 5-unit link. For all positive rotations, the R5 link will be stationary.

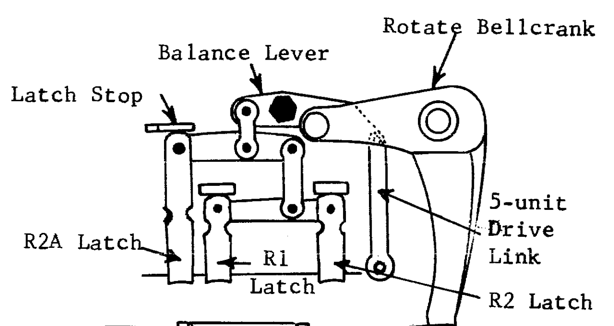


Figure 25. Rotate Differential at Rest

A positive rotation is created by downward motion of any of the latches. This causes a downward motion on the left end of the balance lever, pulling down on the left side of the rotate bellcrank. The bottom of the rotate bellcrank then moves to the right (counterclockwise) creating a pull on the adjustable rotate link. The left end of the rotate link is connected to the bottom of the rotate arm and a pull at this point causes the rotate arm to move away from the power frame creating a counterclockwise pull on the typehead.

For a rotate 1 operation, the R1 latch is under the bail while the R2 and R2A latches are unlatched. A rotate 2 requires the R2 latch be under the bail; a rotate 3, the R1 and R2 latches; a rotate 4, the R2 and R2A latches; and a rotate 5, all three latches must be under the bail. In a print operation initiated from the keyboard, the R2A latch is never used without the R2 latch. For a zero rotate operation, no latch is left under the bail. This permits one of the four characters in the home position to print. This is called a positive zero and is the only way to cause the printing of a home character from the keyboard.

For a positive one rotate operation (figure 26) the R1 latch is under the bail. The top of R2 latch acts as a pivot point up against its stop. Since the vertical link is connected one-third the distance from this pivot point, it is pulled down one-third as far as the R1 latch. The second lever pivots at its left side since the R2A latch is not being used. Since the second link is connected to this lever three-fifths from this pivot point, it will be pulled down only three-fifths as much as the first vertical link (which was one-third as far as the latch). Multiplying the two together gives a total pull on the balance lever of one-fifth the pull of the latch. This is sufficient to rotate the typehead one character counterclockwise.

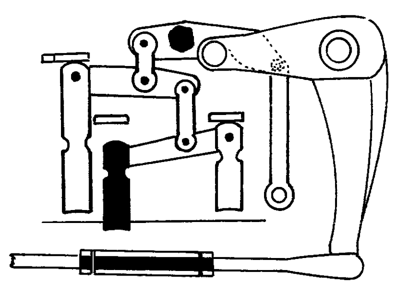


Figure 26. Positive 1 Rotate Operation

For a positive three rotate operation (figure 27) the R1 and R2 latches are under the bail, causing a full pull on the first vertical link of three-thirds or a pull of one. The second lever still pivots at the top of the R2A latch so that

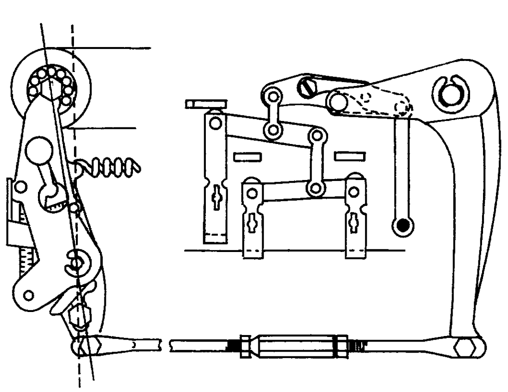


Figure 27. Positive 3 Rotate Operation

the balance lever is pulled down a total distance of three-fifths times one or three-fifths as far as the latches. This is sufficient to cause a counterclockwise rotation of three characters.

A positive five rotate operation (figure 28) requires that all latches be under the bail. Since the second lever does not pivot, the balance lever is pulled down five-fifths times three-thirds or as far as the three latches were pulled down. This will create a counterclockwise rotation of five characters.

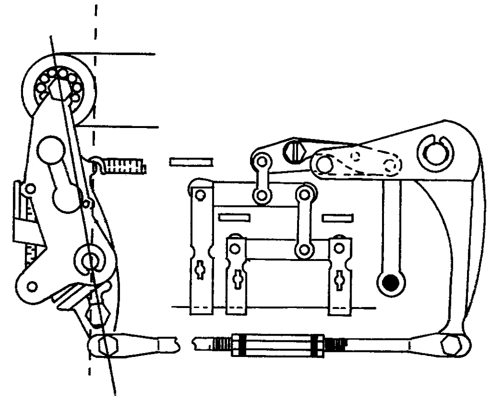


Figure 28. Positive 5 Rotate Operation

NEGATIVE ROTATION

Negative rotation is caused by operating the rotate bellcrank clockwise which, in turn, allows the rotate spring to rotate the typehead in a clockwise direction. Rotation of the bellcrank is governed by the balance lever. If the right side of the balance lever is forced to rise, the bellcrank must rotate clockwise. This action is accomplished by the five-unit link.

The bottom side of the five-unit link is attached to the five-unit bail (figure 29) which is normally held in a downward position. The five-unit bail is a single arm located under the cycle shaft and to the right of the latch bail. Like the latch bail, it pivots on the bail shaft. In the rest position, it is held downward by the five-unit cam which is mounted to the right of, and 90° out of phase with, the right hand positive cam on the cycle shaft. However, since the cycle shaft will rotate each time any character is to be printed, positive or negative, the five-unit bail will try to rise. This is prevented, on a positive operation, by the five-unit

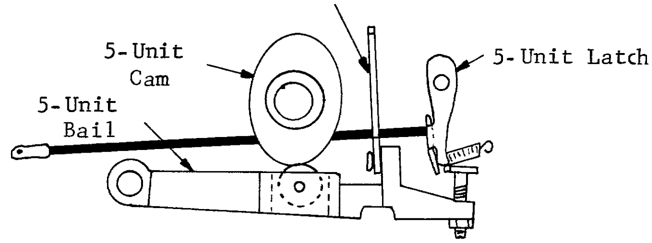


Figure 29. Five-Unit Bail at Rest

latch which is spring loaded to the rear and over an adjustable screw on the top rear of the five-unit bail (figure 30). Unless the five-unit latch is unlatched, the five-unit bail cannot rise.

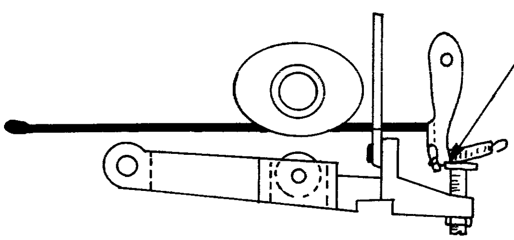


Figure 30. Five-Unit Bail During Positive Rotate Cycle

To print a negative character, the five-unit latch is unlatched. As the five-unit cam begins to rotate to the low dwell, the five-unit bail is pulled upward (figure 31) by pressure from the rotate spring and the compensating arm spring. These springs apply a constant clockwise force on the rotate bellcrank. This creates an upward pull on the right side of the balance lever which pulls upward on the five unit link, thus causing the five-unit bail to be pulled upward.

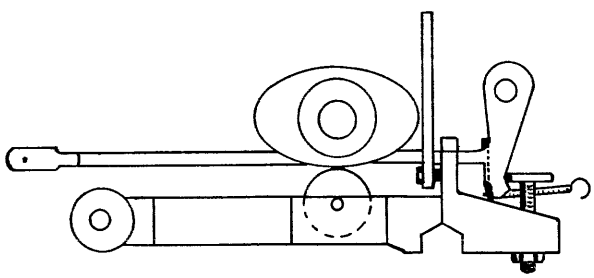


Figure 31. Five-Unit Bail During Negative Rotate Cycle

If no positive latch has been left under the latch bail, there will be no downward pull on the left side of the balance lever. This permits maximum clockwise rotation of the bellcrank and the typehead, allowing a negative five character to print (figure 32).

To print a negative character other than negative five, one or more positive latches must be left under the latch bail. This prevents the bellcrank from fully rotating in the clockwise direction and will cause a less than negative five typehead rotation.

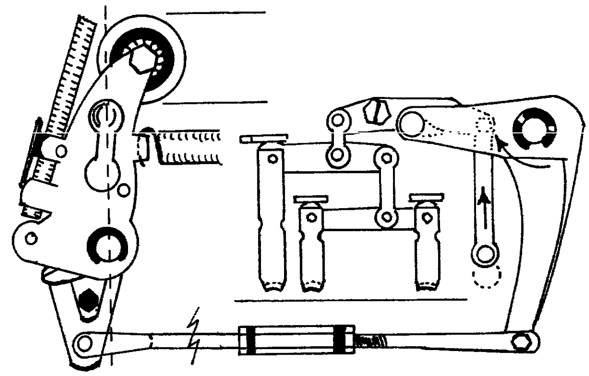


Figure 32. Negative 5 Rotate

To print a negative one character (figure 33) the R2 and R2A latches remain beneath the latch bail while R1 and R5 are unlatched (R5 must be unlatched to print any negative character). This permits only one-fifth total clockwise rotation of the bellcrank and the typehead.

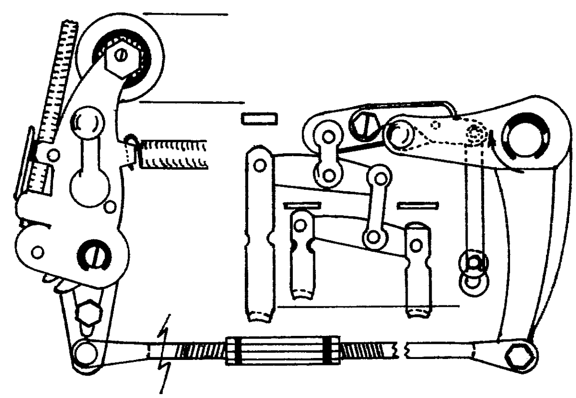


Figure 33. Negative 1 Rotate

Answer the following questions:

14. Why is the dog-bone slotted?

15. How much downward motion is supplied to the R2A latch for a +3 rotate operation from the keyboard?

16. What supplies the force necessary to pull the five-unit bail upward?

17. Which latches will be left beneath the latch bail (latched) when the letter "M" (Tilt 2, Rotate - 5) keylever is depressed?

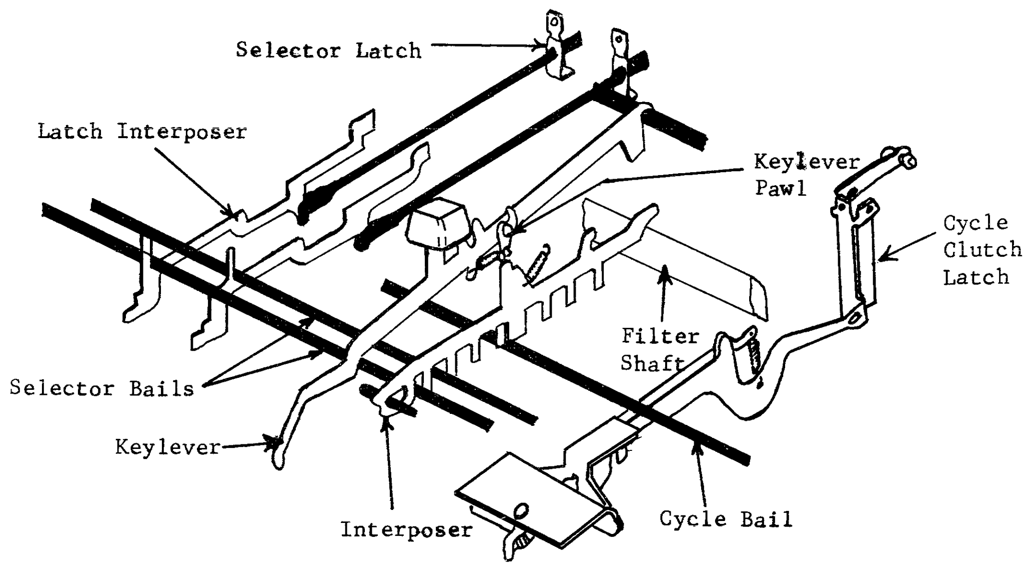


Figure 34A. Keyboard Section and Character Selection

CHAPTER 3 KEYBOARD AND CHARACTER SELECTION

PRINT SELECTION

KEYLEVERS

The keylevers pivot at the rear of the machine on a fulcrum rod (figure 34). Tension is supplied by a set of flat springs, with cupped tips, beneath the front of the keylevers, Due to the difference in leverage between the four rows of keys, auxiliary leaf springs of different sizes are used to supply a uniform force on all of the keylevers. Just to the rear of the keybutton are two adjustable lugs which are used to adjust the height of the keylever pawl. The keylever pawl, located to the rear of the adjustable lugs, is fastened to the keylever by means of a shoulder rivet; it is spring loaded forward and extends below the keylever, immediately above the keylever pawl contact surface of the selector interposer.

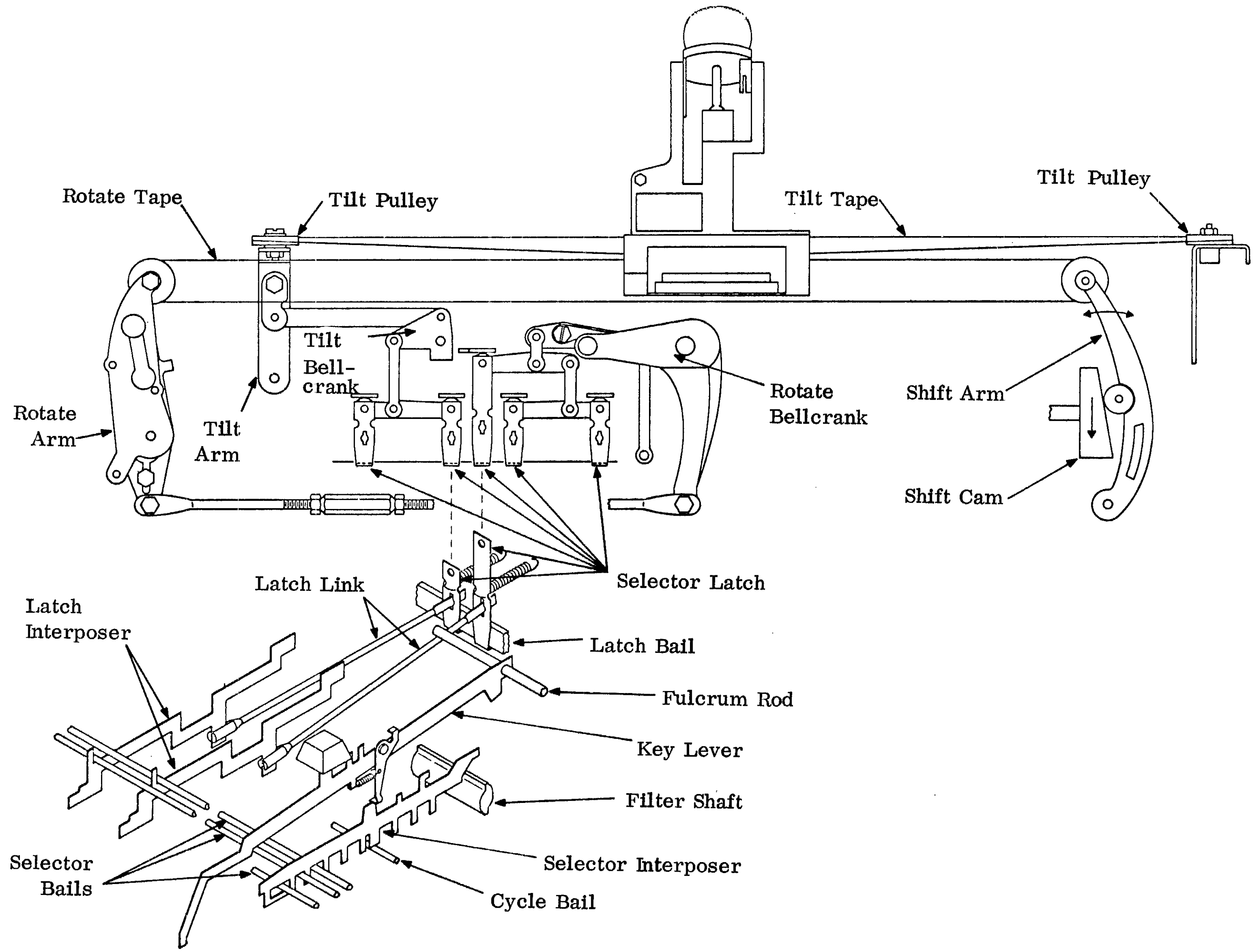


Figure 34B. Keyboard Selection Mechanism

SELECTOR INTERPOSERS

Each keylever has an interposer immediately below it (figure 35). The purpose of the interposers is to cause the selector latches that are not needed for a given character to be pulled from under the latch bail. The negative five latch will also be pulled if a negative rotate is selected. Each interposer has an elongated hole in the front through which passes a large fulcrum rod. This supports the front of the interposer as well as allowing free sliding and pivoting of the interposer. The interposers are separated from each other by guide combs at the front and rear which allow the interposers to move front to rear as well as up and down. The interposers are spring loaded up and to the rear; this is their rest position. Extending from each interposer are several lugs. Three lugs on each interposer are common to each other. The top middle lug is contacted by the keylever pawl which allows the interposer to be pushed downward. Another lug on the top but toward the rear of the interposer is hook-shaped and fits into the selector compensator tube which will be discussed shortly. The third common lug is located on the bottom of the interposer just beneath the keylever pawl lug. This lug is called the cycle clutch release lug. Its purpose is to release the cycle clutch causing it to rotate each time a character keylever is depressed.

Directly below the cycle clutch release lugs is the cycle bail (figure 34) which pivots up and down. Any interposer being pushed down will push the cycle bail down. This will release the cycle clutch latch and allow the cycle shaft to turn. The bottom of the lug is cut at an angle to the rear. This prevents interference between the interposer and the cycle bail when the interposer restores to the rest position, above the cycle bail. There can be up to seven lugs, in addition to the cycle clutch release lug, on the bottom of an interposer. The absence or presence of these lugs will determine which selector latches are to be left under the bail and which ones are to be pulled. No two interposers are alike.

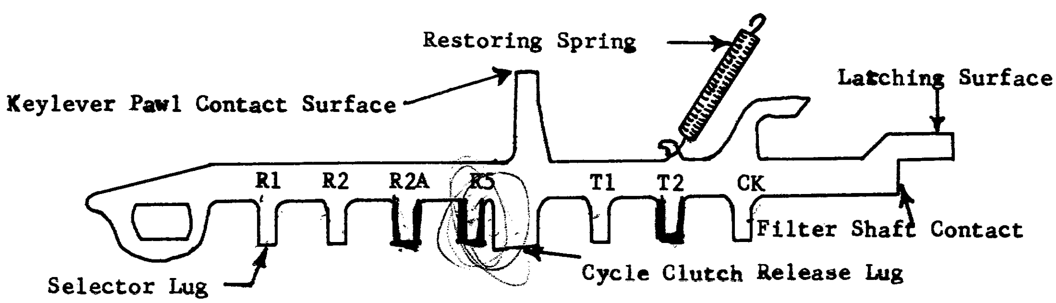


Figure 35. Selector Interposer

FILTER SHAFT

As the cycle shaft rotates 180°, a gear train at the left of the printer will cause the filter shaft to rotate 180°. When an interposer is pushed down it is brought into the path of the filter shaft (figure 34). As the filter shaft rotates it drives the interposer to the front of the machine which operates the character selection mechanism.

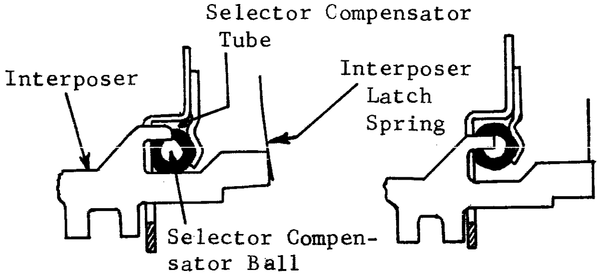
SELECTOR BAILS AND LINKS

There are seven selector bails (figure 34) mounted between the two sideframes. Their movement is rear to front. Each bail fits in front of a selector lug position on the interposers. Each selector lug that is present on any given interposer will push its associated selector bail forward. Seven latch interposers, located to the left of the printer under the selector bails, are controlled by the selector bails, one interposer for each bail.

Each interposer has a lug at the top which fits in front of its selector bail. As the bail (or bails) is pushed forward by the selector interposer, the associated latch interposer will be pulled forward. Attached to the rear of the latch interposers are adjustable links which connect to the seven latches. Thus, the end result of latching a selector interposer is the unlatching of a combination of selector latches.

INTERPOSER LATCH SPRINGS

From the time the interposer is pushed down by the keylever pawl to the moment of impact between the interposer and the filter shaft, enough time could elapse to allow the interposer to restore up before it is struck by the filter shaft. To prevent this from occurring, the latch spring is used (figure 36). The latch spring is a spring finger which is held slightly deflected to the rear when the interposer is at rest. When an interposer is pushed down, its latch spring snaps forward over the top of the interposer and holds it down until the filter shaft drives the interposer forward. The interposer can now be restored by its extension spring. This arrangement also allows an interposer to be latched while another is being operated. Thus, when the first interposer has restored, the second will then be immediately operated. This is called character storage and compensates for erratic typing rhythm.



A. at Rest B. Latched Down

Figure 36. Interposer Latch and Selector

SELECTOR COMPENSATOR

The purpose of the selector compensator is to prevent the depression of two keylevers simultaneously, which would cause a selection error. The compensator contains steel balls which are packed very close together. The hook-shaped lugs on top of all the interposers fit into slots in the selector compensator tube but, in the rest position, do not extend into the steel balls. The steel balls are adjusted, by means of adjusting screws at either end of the compensator tube, just loose enough for one interposer lug to fit between the balls (figure 36). Latching one interposer down shifts the balls in the tube tightly against one another to prevent another interposer from being latched down. Depressing two keylevers simultaneously (figure 37) will prevent either interposer from latching. When the interposer is driven forward by the filter shaft, its lug will be pushed from between the steel balls and another interposer can now be latched down.

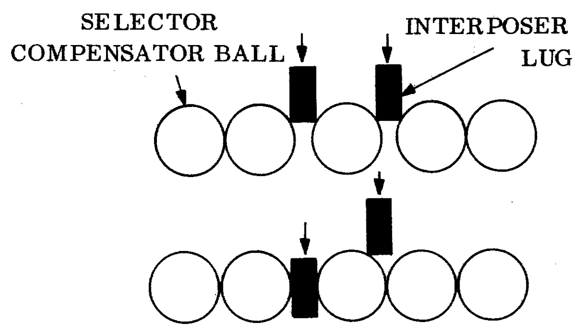


Figure 37. Selector Compensator Action

CYCLE CLUTCH LATCH

The cycle clutch latch (figure 38) must be tripped upon depression of a keylever or no printing will occur since the cycle shaft will not be rotating. A thin metal plate mounted to a rubber backing on the latch prevents the cycle clutch sleeve from rotating. Holding the sleeve stationary prevents the clutch spring from winding around the rotating pulley hub. On a bracket toward the front of the printer, the latch pivots from the top in a vertical position. The latch is held to the rear, under the lip of the cycle clutch sleeve, by the cycle clutch latch link and cycle clutch latch pawl. The latch pawl pivots on the link and the front of the pawl is spring loaded upward and into the cycle clutch keeper (figure 38). The latch link is spring-loaded to the front by an extension spring but it cannot move as long as the latch pawl is held by the keeper.

When an interposer is latched down it exerts a downward push on the bail which, in turn, pushes down on the latch pawl. As soon as the latch pawl is pushed past the keeper, the latch link will be pulled to the front by its extension spring. The bottom of the latch, being connected to the latch link, will now be pulled toward the front of the machine away from the cycle clutch sleeve which will now be allowed to rotate and bring the cycle clutch into operation.

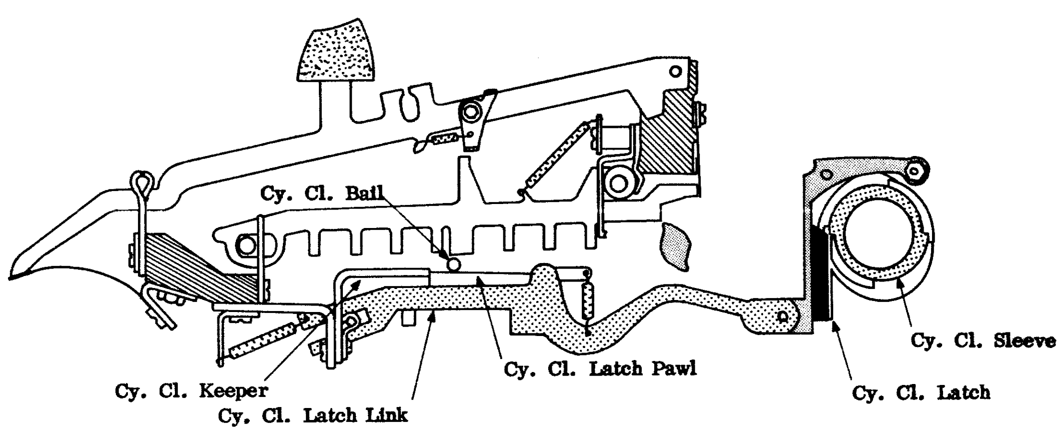


Figure 38. Cycle Clutch Latch Mechanism

The cycle bail damper (figure 39) is a series of two levers, one on each end of the power frame, which are used to lightly slow down the upward movement of the cycle bail when it restores. This prevents bouncing which could cause the bail to trip the latch pawl inadvertently. A downward extension of the damper rests against the front of the bail. An extension spring, connected between each damper and the cycle bail, acts to spring-load the bail upward and to hold the damper arm against the cycle bail to provide the dampening effect.

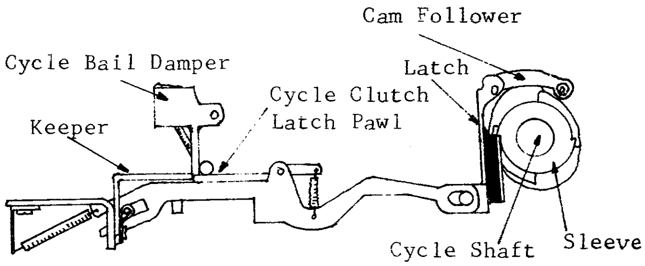


Figure 39. Cycle Clutch Latch Restoring Operation

RESTORING MECHANISM

The clutch latch restoring mechanism (figure 39) consists of a cam mounted to the cycle shaft and a cam follower arm which is an extension of the cycle clutch latch. The cam follower arm has an adjustable steel roller mounted on it which rides on the cam during a rotation of the cycle shaft. At rest, the roller is directly above the low spot on the restoring cam but not in contact with it. When an interposer is latched down, the cycle clutch latch will be pivoted forward from the cycle clutch sleeve. As this occurs the cam follower roller will drop onto the restoring cam. As the cam rotates with the cycle shaft, a high point of the cam will begin pushing the cam follower arm roller upward. As this occurs, the latch will be pivoted back into the path of the next lip of the sleeve and will stop sleeve rotation. As the latch is pivoted toward the rear, it will pull the latch link back far enough to permit the latch pawl to seat behind the keeper. The low point of the restoring cam will now be beneath the cam follower arm roller again and a restoring operation will have taken place.

EXTRA CYCLES

If for any reason the cycle clutch rotates without having at least one selector interposer latched down or a print magnet energized, a rotate +5 tilt 3 print operation will occur. On the correspondence typewriter the resultant character which prints will be a dash or underscore. This is a malfunction known as extra cycles.

SUMMARY OF A PRINT OPERATION

1. Depress print character keylever
2. Latch selector interposer down
3. Push down cycle bail
4. Trip cycle clutch latch pawl from keeper
5. Trip cycle clutch latch from sleeve
6. Begin rotation of cycle shaft
7. Begin rotation of filter shaft
8. Drive selector interposer forward
9. Push selector bail(s) forward
10. Pull latch interposer forward
11. Pull selector latches forward
12. Begin downward motion of latch bail (the dwell of the cams is such that the latch bail will not start downward at the same time that the cycle shaft begins to rotate -- this allows time to unlatch the latches).
13. Selector interposer restores
14. Restore cycle bail
15. Selector bail(s) and latch interposer(s) restore
16. Latches restore (by now the latch bail will have started downward and the latches will only ride on the side of the bail)
17. Cycle clutch cam follower arm begins to rise on the cam
18. Cycle clutch latch pawl restores on keeper
19. Cycle clutch latch stops rotation of cycle clutch sleeve after 180°
20. Latch bail restores upward (five-unit bail downward if it was used)
21. End of operation.

Holding the keylever down throughout the operation will cause the upper lug of the restoring interposer (figure 40) to contact the keylever pawl and hold it to the rear. The interposer cannot again be latched down until the keylever is released permitting the pawl to restore over the lug of the interposer. This assures a single operation for each depression of a keylever.

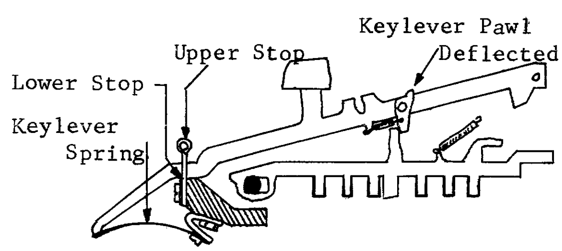


Figure 40. Keylever Held Depressed

Answer the following questions:

1. What is the purpose of the filter shaft?

2. When will the cycle clutch latch link be released?

3. The first and fifth (from the front) selector lugs are present on a selector interposer. Which upper case character does the interposer represent? Lower case character?

4. What assures a single print operation for a single depression of a single keylever?

PRINT SELECTION UNIT

The purpose of the print selection unit is to allow a computer or other output device to select the printer for a print operation. When printing occurs in this manner, most of the keyboard mechanism is by-passed. Seven magnets are used in the print selection unit (figure 41), one for each rotate latch, tilt latch and one for the check latch.

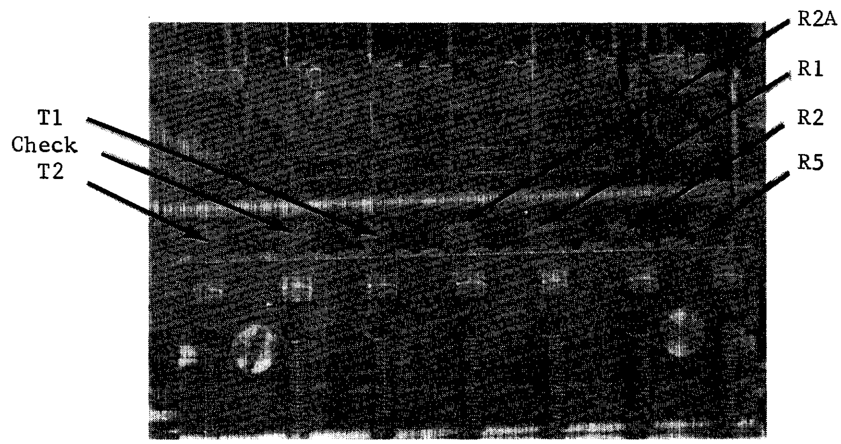


Figure 41. Selector Magnets

To print, two basic events must occur: 1) trip the cycle clutch and 2) unlatch the proper combination of latches.

CYCLE CLUTCH TRIP MECHANISM

When an armature attracts to its magnet, the operating end of the armature pushes the trip bail to the rear (figure 42). A link connected to the bail will also be pulled to the rear. The other end of the link connects to the latch lever. A hook on the front of the latch lever will pivot downward and disengage from a lug on the trip lever. The trip lever is spring

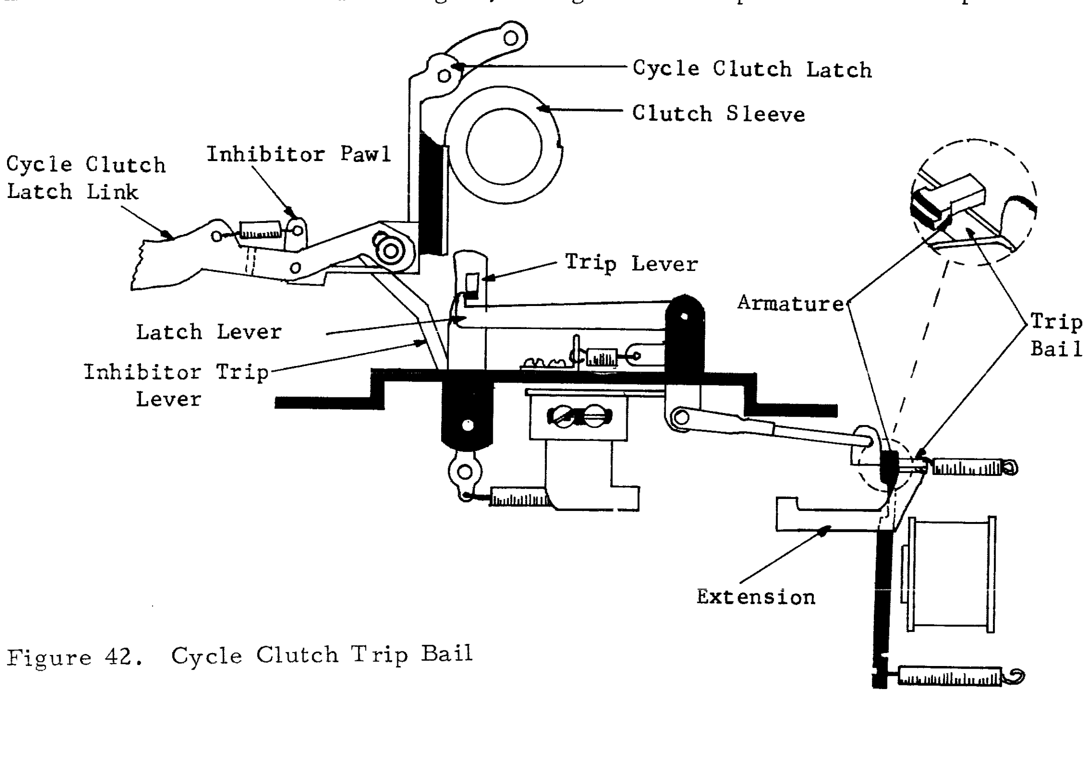


Figure 42. Cycle Clutch Trip Bail

loaded to the front and pivots toward the cycle clutch latch, tripping it free of the cycle clutch sleeve. At the same time the inhibitor trip lever will pivot through an arc and push the inhibitor pawl (which is spring-loaded upward) from the path of the cycle clutch latch. The cycle shaft can now rotate. As the restoring cam restores the cycle clutch latch to the rear, the latch will push the trip lever to the rear. The tip of the latch lever (being restored by the de-energizing magnets, plus a small extension spring) will now latch in front of the lug on the trip lever while the inhibitor pawl is allowed to restore upward and in front of the cycle clutch latch.

LATCH PUSHER CAMS

The latch pusher cams are located on the cycle shaft between the positive cams. The cams operate the latch pusher bail (figure 43) which allows the latch pushers to operate. As the cams begin to rotate with the cycle shaft, the bail immediately rises because the cam follower arms are entering the low dwell of the cams. Further rotation forces the pusher bail downward to a restored position at the end of the cycle shaft rotation (figure 44).

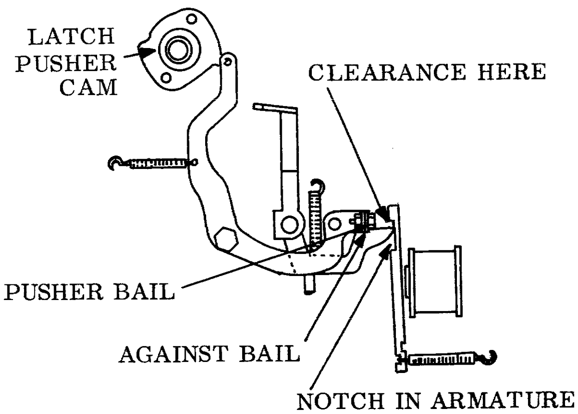


Figure 43. Latch Pusher at Rest

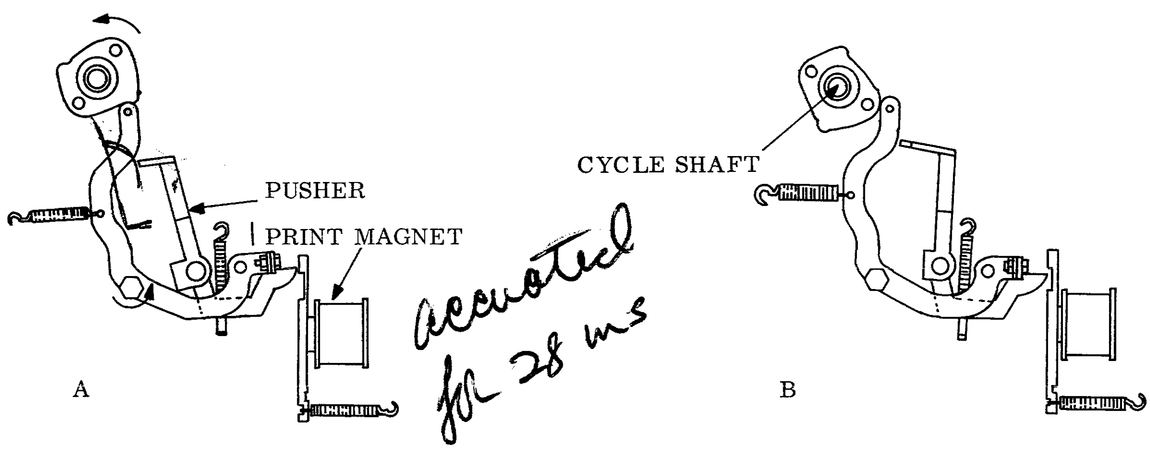


Figure 44. Latch Pusher Bail Operation

SELECTOR LATCH PUSHERS

There are seven latch pushers (figure 45) which pivot about the pivot shaft. The pushers are spring-loaded at the rear against the latch pusher bail. The tails of the latch pushers fit into notches in the operating end of the magnet armatures. The front end of each latch pusher, called the pusher, rests against the latch extension of the selector latches (figure 46). Any magnets that are pulsed will pull their associated armatures away from the tails of their latch pushers. As the latch pusher bail begins to rise because of latch pusher cam rotation, extension springs force the freed latch pusher tails to rise. The front of the pushers will then move their associated selector latches to the front and out from under the latch bail.

The notches in the armatures of magnets not pulsed prevent their respective latch pusher tails from being pulled upward when the latch pusher bail rises. Thus, their respective latches will remain beneath the latch bail and will be operated downward. As the latch pusher cams continue rotating, their high dwells will force the latch pusher bail downward. As this occurs, the tails of the latch pushers will be forced downward by the bail and will seat inside the notches of the magnet armatures.

SELECTOR ARMATURE RESTORATION

The cycle clutch trip bail make certain that the magnet armatures move away from the magnets at restoration time. An eccentric stud on the latch pusher bail arm pushes the trip bail downward which restores the armatures. This overcomes any residual magnetism which could develop and assures quick armature restoration.

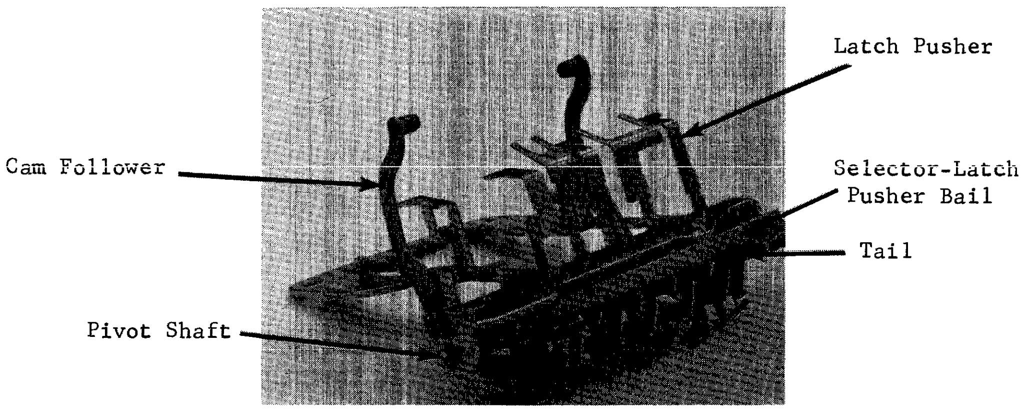


Figure 45. Selector-Latch Pusher

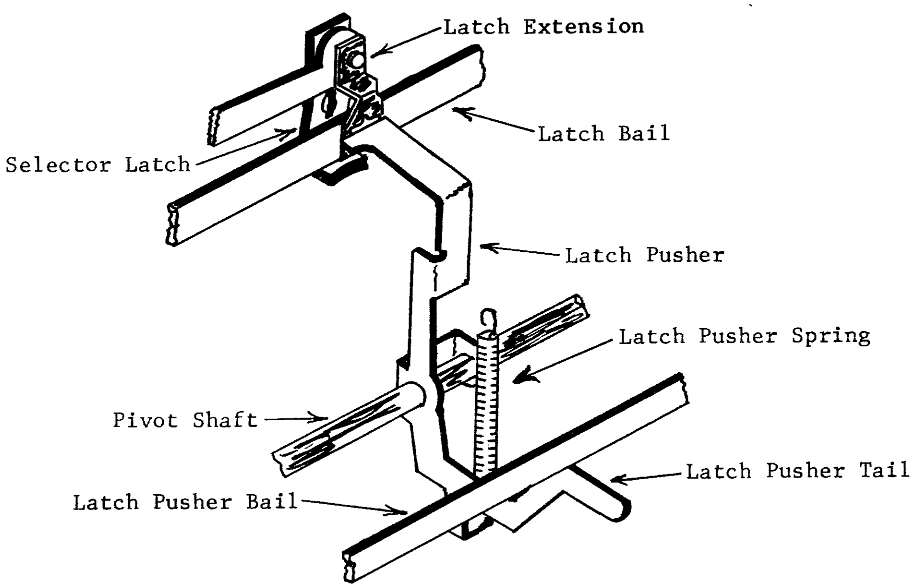


Figure 46. Latch Pusher Assembly

Answer the following questions:

5. What restores the latch lever?

6. By what is the latch pusher bail operated?

7. Are the latch pushers spring-loaded into the active or inactive position?

CONTACT ACTUATORS

There are seven contact actuators; each is operated by one of the selector latch extensions with the exception of the five-unit actuator which is operated by the five-unit bail (figure 47). Each selector latch extension is positioned immediately above the top of its contact actuator (figure 48). If a selector latch remains latched (beneath the latch bail) during a print operation, the latch and its extension will be operated downward. The latch extension will then push the actuator down in its guide and transfer two sets of transmitting contacts (figure 47) by means of two cross bars mounted on the bottom of each actuator. The spring tension of the contacts restores the actuator when the latches restore.

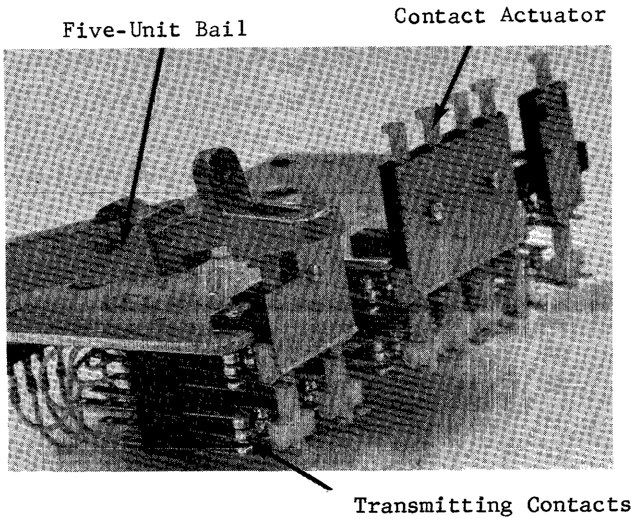


Figure 47. Contact Actuators

The five-unit actuator is operated upward by the spring tension of its contacts and is restored downward by the five-unit bail. During all positive operations the actuator is held downward by the bail; during a negative operation the bail will move upward allowing the contacts to operate upward.

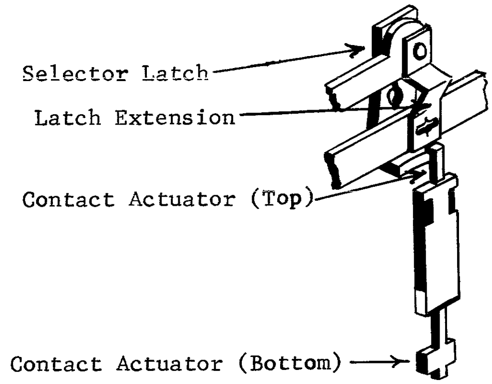


Figure 48. Contact Actuator and Selector Latch Extension

There are seven sets of transmitting contacts which cause a 7-bit code to be transmitted to the typewriter controller. Any transmitting contact which is operated by its actuator will cause an open to be felt in the controller for that associated bit position. This will be interpreted as a logical 0.

PARITY CHECK

The parity check monitors that an odd number of latches are unlatched during any print cycle, thereby providing immediate detection of a latch sticking beneath the latch bail or a latch popping out from beneath the bail. This assembly requires an extra latch, a selector bail, a latch interposer, a latch pusher and a magnet. The extra latch, called the check latch, does nothing but operate its associated actuator if the latch is left latched. When an output operation is initiated to the typewriter and only the check latch magnet is pulsed, a +5 rotate tilt 3 operation will occur.

Answer the following questions:

8. What restores the contact actuators?

9. Why will a dash (-) print in the event of extra cycles?

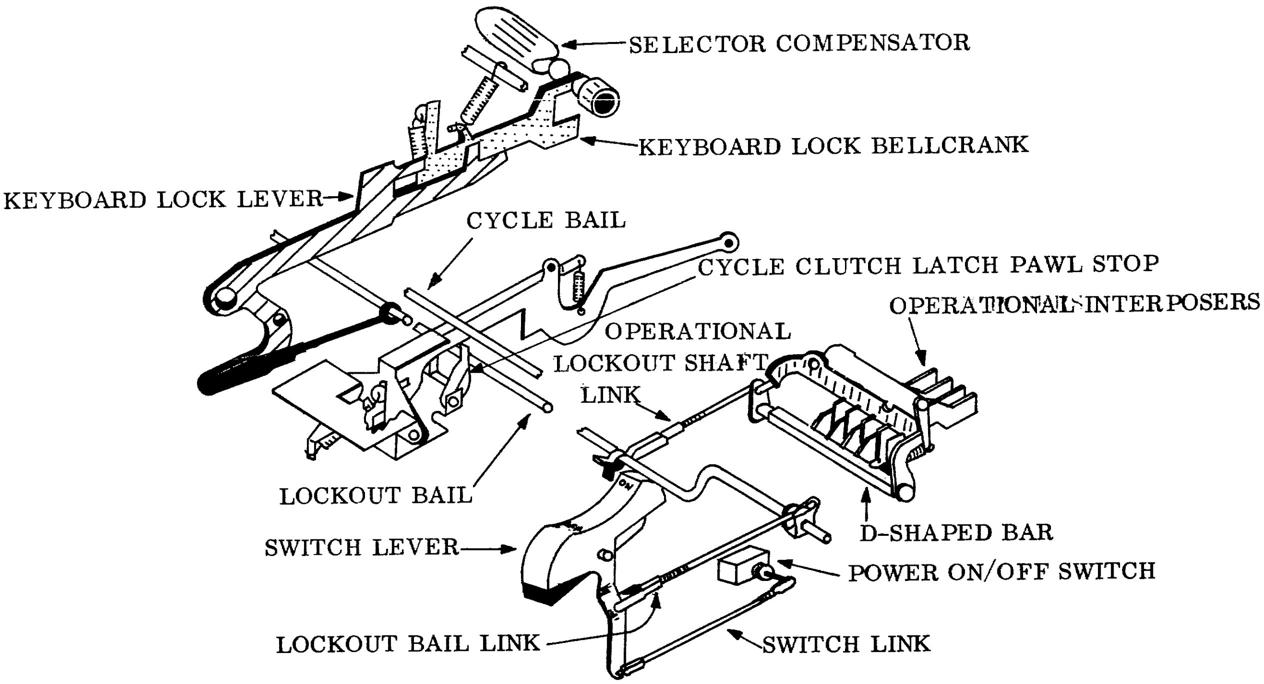


Figure 49. Power Off Keyboard Lock

CHAPTER 4

KEYBOARD LOCK

TYPES OF KEYBOARD LOCK

The keyboard lock mechanisms must be used during: 1) power off, 2) output mode (selection by an output device), and 3) line lock (carrier has reached right hand margin) conditions. In the first condition, a print operation is generally undesirable when power is first turned on. In the second condition, printing is undesirable from the keyboard when an output device, such as a computer, is outputting to the printer. In the third condition, printing is undesirable when the carrier has reached the right-hand margin.

POWER OFF KEYBOARD LOCK

Power off keyboard lock is accomplished by the link (figure 49) which attaches to the top part of the power on/off switch. The other end of the link attaches to a bellcrank which connects to the lockout bail extending across the printer beneath the keyboard.

When the switch is turned off, the bail pivots forward against the cycle clutch pawl stop located beneath the cycle clutch latch pawl extension. The pawl stop, when pushed forward, prevents the latch pawl from tripping and, in turn, prevents a cycle clutch operation. Simultaneously, a special bellcrank at the left side of the keyboard rotates into the selector compensator by means of a link attached to the lockout bail. This prevents the latching down of an interposer. At the right side of the lockout bail, a link rotates a D-shaped shaft located beneath the operational mechanism, thereby preventing the backspace, spacebar, tab, carrier return and indexing operational interposers from being unlatched.

OUTPUT MODE KEYBOARD LOCK

Output mode keyboard lock (figure 50) is accomplished by means of the keyboard lock solenoid which is held bolted to the underside of the frame by a bracket. The lockout lever is fastened to the bracket by a pivot screw. The sloped front surface of the lockout lever is spring-loaded upward except when the solenoid is energized. When energized, the solenoid pulls the lockout lever down. The sloped edge rides on the bail roller (figure 51) and forces the lock bail forward. Note that the lock bail is not the same as the lockout bail.

Attached to the lock bail are three links and a slide assembly (figure 50) which:

1. lock the functional keylevers and spacebar.
2. operate the keyboard lock contact.
3. lock all 44 character interposers.
4. return the machine to lower case if in upper case.
5. lock the cycle clutch latch pawl.

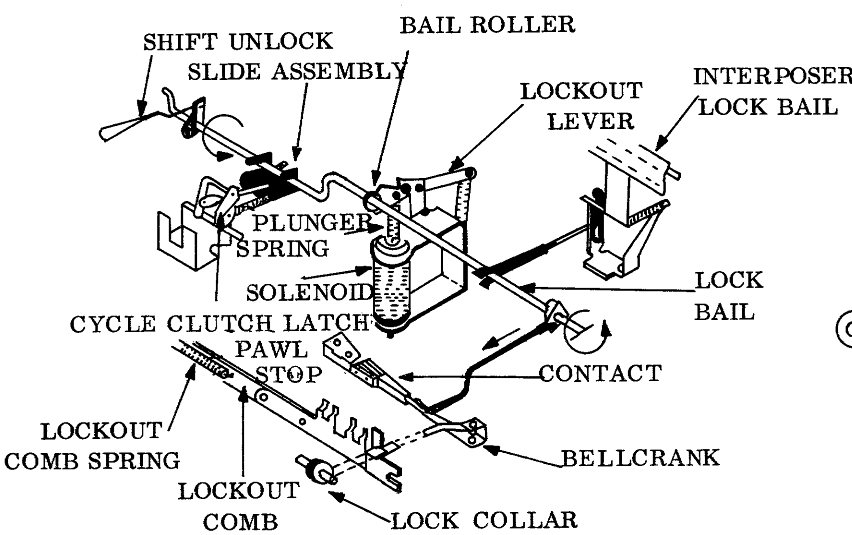


Figure 50. Output Mode Keyboard Lock

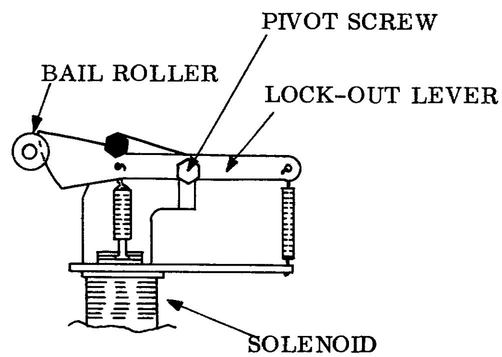


Figure 51. Lockout Lever

The link at the far right of the bail locks the functional keylevers. It is fastened to a bellcrank whose front end makes contact with the lockout comb. A push on the link by the lock bail causes the front of the bellcrank to move to the right allowing the lockout comb to spring-load to the right. The teeth of the lockout comb are now under the functional keylevers and block them from being pushed down. The spacebar, however, cannot be locked in this fashion since it has no keylever. Instead, a lock collar is fastened to the spacebar shaft. As the bellcrank moves to the right, the tip of it will slide under a step in the collar. This prevents the spacebar from being depressed (figure 52). The other end of the bellcrank transfers keyboard lock contacts.

The second link from the right is connected to the bottom of the wide interposer lock bail which runs the width of the printer. The bottom edge of the bail protrudes beneath the rear extensions of the interposers and, when pulled forward, prevents the interposers from being pushed down.

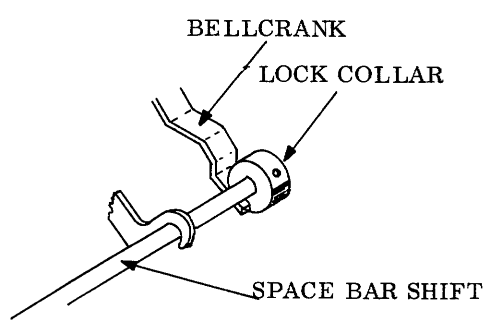


Figure 52. Spacebar Lock Collar

The third link, at the far left of the lock bail, operates the shift-lock interposer (figure 53). A frontward push on the link moves the interposer to the front where it makes contact with a stud on the lock arm. The lock will be pushed away from the shift stop, freeing the shift key, and allowing the printer to return to lower case.

The slide assembly (figure 50), by means of a link, will cause the cycle clutch pawl stop to pivot underneath the cycle clutch pawl preventing the cycle clutch from unlatching.

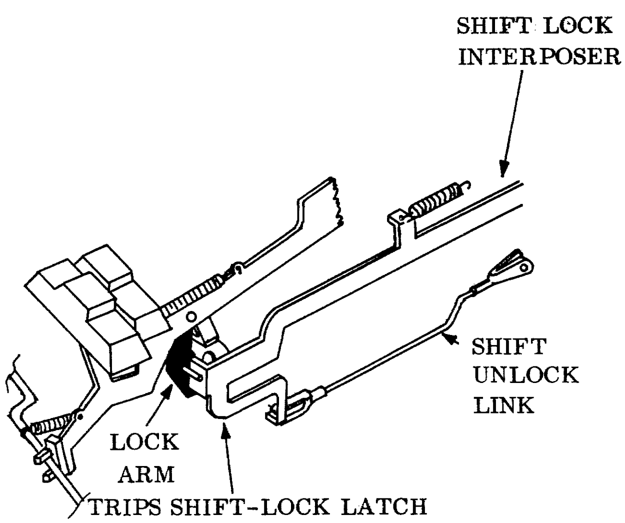


Figure 53. Shift-Lock Interposer

LINE LOCK KEYBOARD LOCK

The line lock keyboard lock (figure 54) is accomplished by the bellringer bail. As the carrier comes in line with the right hand margin stop, a raised surface of the line lock bracket, which is mounted to the carrier, makes contact with the bellringer bellcrank, causing it to rotate clockwise. The other end of the bellcrank forces the bellringer bail forward.

Welded to the left side of the bellringer bail is an arm which extends downward. Its tip is just above the keyboard lock lever (figure 54). As the bail moves forward, the arm is forced down, pushing the keyboard lock lever down. An extension spring connects the lock lever to the keyboard lock bellcrank and the bellcrank will now be pulled between the steel balls. This prevents a selector interposer from being latched down until a carrier return, a margin release, a spacebar, or a tab operation has been initiated.

Answer the following questions:

1. How does the power off keyboard lock prevent the cycle clutch from tripping?
2. What prevents the latching down of a selector interposer during a line lock keyboard lock?
3. Are the selector interposers prevented from latching during an output mode keyboard lock? If yes, how? If no, why not?

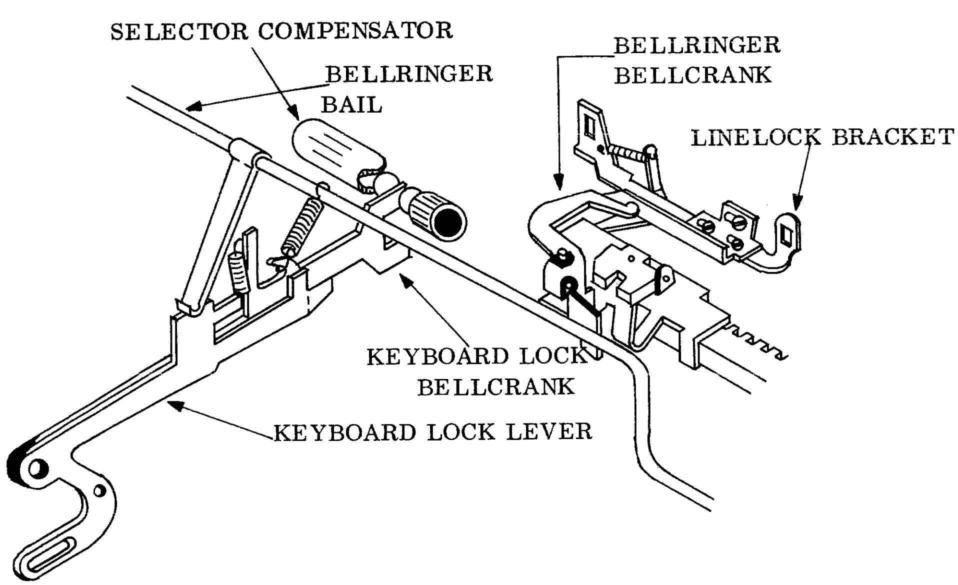


Figure 54. Line Lock Keyboard Lock

Figure 55. Shift Cam and Shift Arm

CHAPTER 5 SHIFT MECHANISM

SHIFT OPERATION

The shift mechanism rotates the typehead so as to position either the upper-case hemisphere or the lower-case hemisphere in front of the platen. Either of the two SHIFT keybuttons or the LOCK keybutton, while depressed, causes the typehead to rotate 180° counterclockwise, placing the upper-case hemisphere toward the platen. Releasing either SHIFT keybutton allows the typehead to rotate 180° clockwise, placing the lower-case hemisphere toward the platen.

The shift mechanism consists of the shift arm, shift cam, wrap spring clutch and clutch control, and interlocks. The mechanism, located on the outside of the power frame, is driven by the right end of the operational shaft.

When the right-hand rotate pulley (figure 55) moves away from or toward the powerframe, pressure on the rotate tape (see figure 24) causes the typehead to rotate.

The SHIFT keybuttons are located at the front corners of the printer and are linked together by the shift bail (figure 56). Depressing one keybutton will cause the other to drop. The LOCK keybutton is attached to the left SHIFT keybutton and, when depressed, will lock the SHIFT keybuttons down keeping the printer in upper case.

When either of the SHIFT keybuttons are depressed they become released from the locking mechanism. Either SHIFT keybutton causes the shift release link, at the right of the printer, to be pushed to the rear. The right-hand rotate pulley is attached to the shift arm which pivots left to right at the bottom. The rotate pulley is prevented from moving front to rear by the shift arm brace which is connected from the pivot pin to the shift arm. An adjusting screw near the top of the shift arm rests against a mounting screw in the frame while the printer is in lower case. Forcing the shift arm away from the sideframe causes the typehead rotation to upper case. This is accomplished by the shift cam.

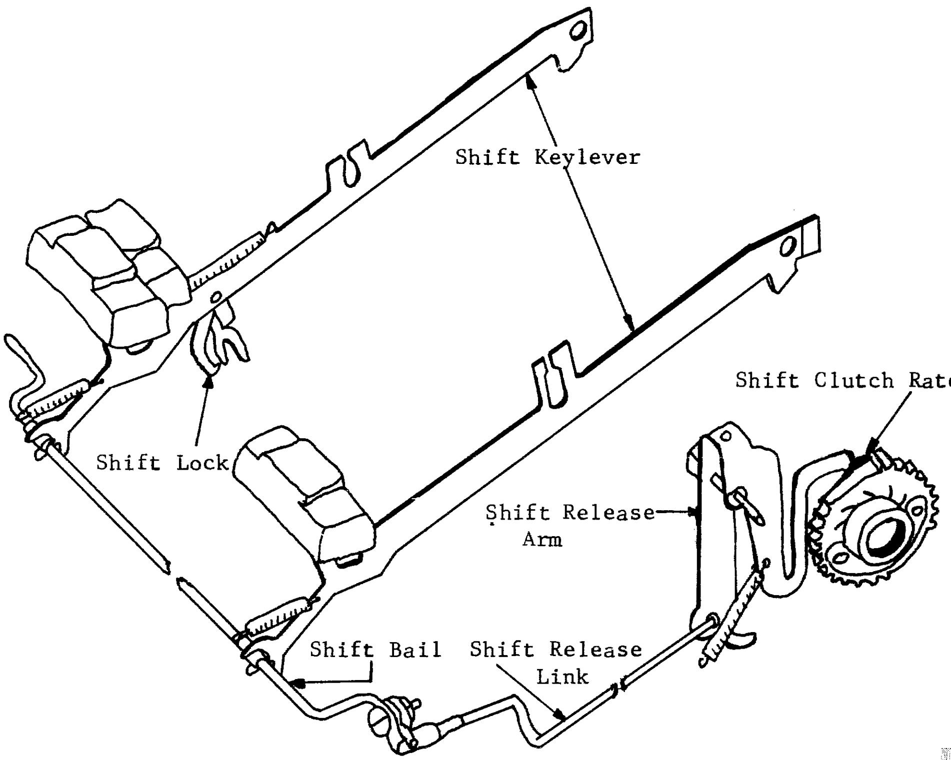
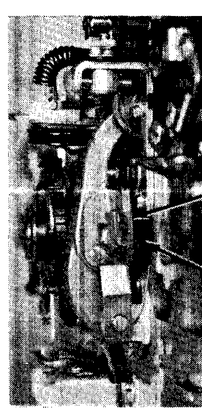
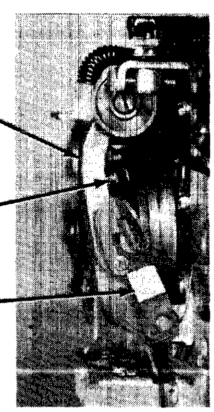


Figure 56. Shift Release Mechanism

The shift cam has a high point and a low point, 180° apart. It is round and fits about the operational shaft bearing extension on the outside of the powerframe. It rotates between two rollers, a fixed roller mounted to the sideframe and the shift arm roller which will ride the camming surface of the shift cam. The camming surface is not on the perimeter of the cam (it is round) but rather on the right side and the tension on the rotate pulley at the top of the shift arm holds the cam tightly between the two rollers. When the cam's low point is between the two rollers, the printer will be in lower case (figure 57a). Conversely, allowing the high point of the cam to ride between the two rollers will place the printer in upper case (figure 57b). The shift cam rotates only when a shift operation is called for and, with the operational shaft turning continuously, a spring clutch, of the type used in the cycle clutch, is used.



a. Lower Case Position



b. Upper Case Position

Figure 57. Shift Operation (Rear View)

Set-screwed to the operational shaft, just to the right of the shift cam, is the shift clutch arbor which rotates continuously with the operational shaft (figure 58). A wrap spring fits around the clutch arbor. An extension on the left side of the spring fits into a notch of an adjustable plate held tightly to the right side of the cam by two screws. The right extension of the spring fits into one of several notches in the left side of the shift clutch ratchet. The inside of the spring is smaller in diameter than the arbor and, if not held disengaged, the spring will collapse tightly about the arbor, causing it, the cam, and the ratchet to rotate 180°. As the cam rotates, the high or low point will either force the shift arm away from or toward the sideframe causing the typehead to rotate 180°.

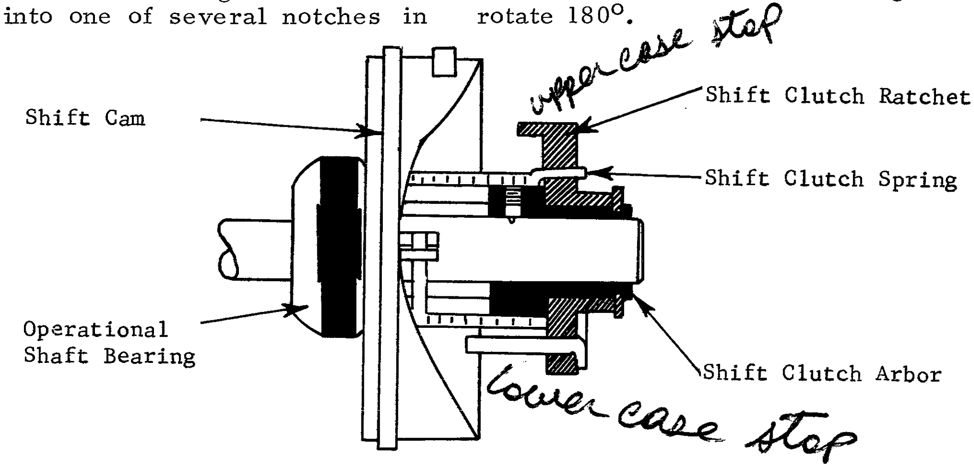


Figure 58. Shift Clutch

The shift release arm, which connects to the other end of the shift release link, holds the spring disengaged when a shift operation is not called for. The rear extension of the shift release arm has a flange formed to the right which makes contact with one of two lugs on the left side of the shift clutch ratchet (figure 59). While this contact is made, the ratchet will prevent the clutch spring from wrapping around the rotating arbor.

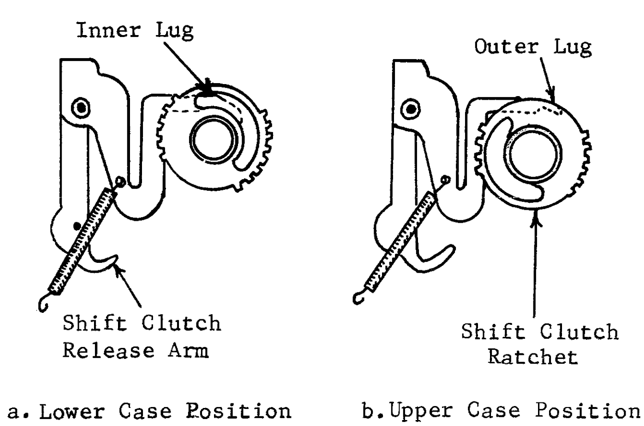


Figure 59. Shift Clutch Release Arm

The two lugs on the ratchet are called the inner lug (metallic) and the outer lug. In the lower-case position, the tip of the shift clutch release arm makes contact with the inner lug due to an extension spring on the shift clutch release arm pulling the arm downward.

As a SHIFT key is depressed, the shift release link is pushed to the rear, pushing the bottom of the shift release arm to the rear. This raises the formed tip of the shift release arm. The arm no longer makes contact with the inner lug of the ratchet, thereby allowing the spring to collapse about the turning arbor. As the cam rotates, it forces the shift arm away from the sideframe. When the mechanism has rotated 180°, the outer lug of the ratchet makes contact with the raised tip of the shift release arm. The spring unwinds and prevents rotation of the shift mechanism. The mechanism remains in the upper case position until the SHIFT key is released.

With the SHIFT key released, the shift release arm will fall away from the path of the ratchet's outer lug. A rotation of 180° then occurs, after which time the ratchet's inner lug makes contact with the shift release arm. The spring then unwinds and prevents rotation of the shift mechanism.

A shift cam stop, mounted to the adjustable plate of the cam, prevents the cam from overthrowing the rest position. The cam stop operates against the rear side of the inner lug. As rotation occurs, the shift cam stop (figure 60) follows the ratchet's inner lug. When the ratchet stops, the cam's momentum keeps it moving until the shift cam stop contacts the inner lug. At this time cam rotation ceases.

Mounted below the cam is the shift detent arm which pivots up and down. A nylon roller, mounted on the detent arm, is spring-loaded upward and rides on the outer perimeter of the cam. The roller seats into one of two notches, called detents, when the cam rests in either upper case or lower case. This assures exact cam positioning in either case (figure 61).

The shift cam brake (figure 60) is an adjustable spring steel arm having a nylon shoe mounted to its end. The brace prevents cam overthrow when shifting from upper case to lower case. As the shift begins, the shift arm roller rides from high point to low point of the cam. Because the arm is spring-loaded inward it tends to accelerate the speed of the cam and could cause excessive noise or parts breakage. However, a raised portion of the cam contacts the nylon shoe creating friction and causing the cam to slow down to normal speed. This makes the shift speed the same for both cases.

Figure 60. Shift Cam Stop and Brake

Figure 61. Shift Arm and Detent

CHARACTER INTERRUPTER

A character cannot be printed while a shift is in progress. This is so because an erroneous character would print since the typehead would not be in the home position as the rotate mechanism operates. By blocking the release of the cycle clutch, the print operation is delayed until the shift operation has completed.

The shift detent arm prevents printing during a shift operation. The front end of the arm is slotted (figure 62) to hold the character interrupter bail. Attached to the left end of the bail is the character interrupter pawl which is in line and slightly below the cycle clutch latch link. As the shift cam begins to rotate the detent roller must ride out of the detent. This pivots the front of the detent arm upward causing the character interrupter bail to pivot counterclockwise. The character interrupter

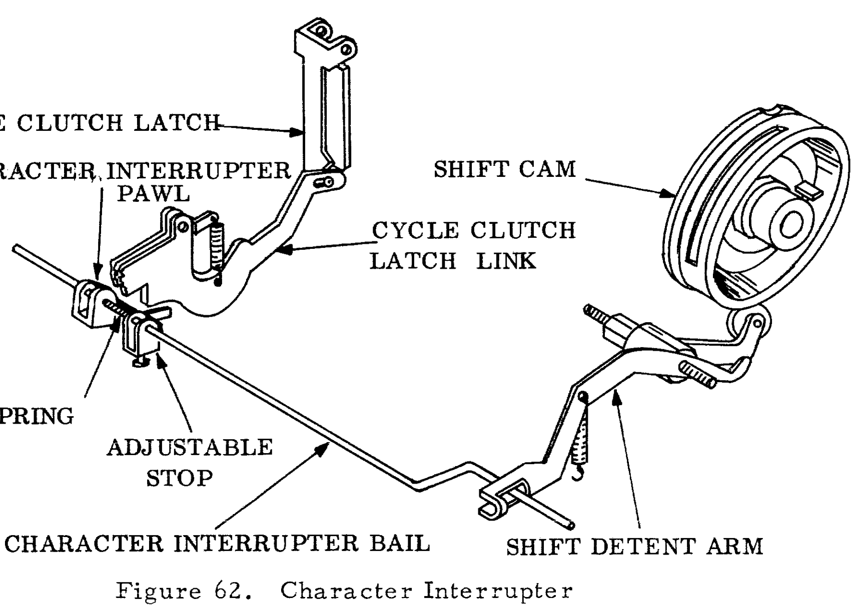


Figure 62. Character Interrupter

pawl pivots into the path of the cycle clutch latch link preventing sufficient forward movement to trip the cycle clutch latch from the sleeve. When shifting has completed, the detent roller seats in a detent notch of the cam. This moves down the front end of the detent arm and pivots the character interrupter pawl away from the latch link, allowing a print operation to be completed.

The character interrupter pawl is spring loaded to an adjustable stop on the interrupter bail (figure 62). The spring load allows the pawl to give way to the latch link in the event of a collision. A collision occurs between the pawl and the link if a character keylever and the shift key are depressed simultaneously. To prevent damage, the pawl yields to the link by overcoming the torsion spring as the bail rotates.

SHIFT INTERLOCK

With printing in progress, a shift must be inhibited. When ready to strike the platen, the typehead is locked in place by the tilt and rotate detents. At this time, a pull by the shift arm would cause parts breakage.

The shift interlock prevents a shift if a print operation is already in progress. The shift interlock arm (figure 63) is pivot-mounted on the right side of the frame. The rear portion of the shift interlock arm extends downward toward the top of the shift clutch ratchet. The front part of the interlock arm has a roller mounted to it; the arm is spring-loaded onto the shift interlock cam. The cam is mounted to the right end of the filter shaft with two set screws. It has already been shown that the shift mechanism will not be allowed to rotate until the ratchet is released. In the rest position, the shift interlock cam follower roller will be in the low dwell of the cam and the rear tip of the shift interlock will be above the shift clutch ratchet. However, when a keylever is depressed the rotation of the filter shaft causes the high point of the interlock cam to force the front of the shift interlock arm upward, pivoting the rear down into the teeth on the top of the ratchet. This prevents the ratchet from turning even though the shift release arm may be raised by depressing the shift key. The shift is then locked out until the cam on the filter shaft rotates to its low point and the interlock arm pivots away from the ratchet, allowing the ratchet to rotate.

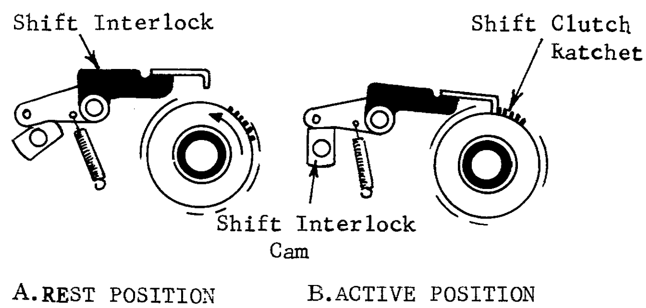


Figure 63. Shift Interlock

BEATING THE SHIFT

Should the shift key be depressed immediately after a character key, the shift arm could move somewhat before the filter shaft actuates the shift interlock. This could cause erroneous characters to print because the typehead would not be in the home position when the print cycle began. This is known as beating the shift and occurs most frequently when shifting from upper to lower case. It is no problem when in lower case because the shift arm roller is not in contact with the low point of the cam (the adjustable screw is contacting the side frame). To cause the shift arm to move, the cam must rotate somewhat before it forces the shift arm outward. This is sufficient time for the filter shaft to activate the shift interlock.

In upper case the shift arm roller is pressing directly against the raised portion of the cam; consequently, any cam rotation could allow the shift arm movement inward from the high point toward the low point. This problem is eliminated to a degree by allowing a long high dwell on the cam. Although the cam begins to rotate, the shift arm cannot move until a lower dwell comes under the roller. This is generally sufficient time for the filter shaft to activate the shift interlock.

SHIFT MAGNETS

The shift magnets (figure 64) allow the computer to control shifting. The two shift magnets are mounted on the right side of the powerframe beneath the shift cam. The magnet toward the front is the upper-case magnet. Its armature is long and comes in contact with a pin on the shift release arm. When the armature is attracted to the magnet the shift release arm will be pushed to the rear; a formed bottom extension of the armature will pivot downward. The lower-case armature, which is spring loaded to the front, slides into the formed end of the upper-case armature and prevents it from moving back up. This locks the shift in upper case. When the lower-case magnet is pulsed, its armature moves to the rear out of the formed end of the upper-case armature. This allows the upper-case armature to snap forward, enabling the shift release arm to move forward through the action of its extension spring. The shift now returns to lower case.

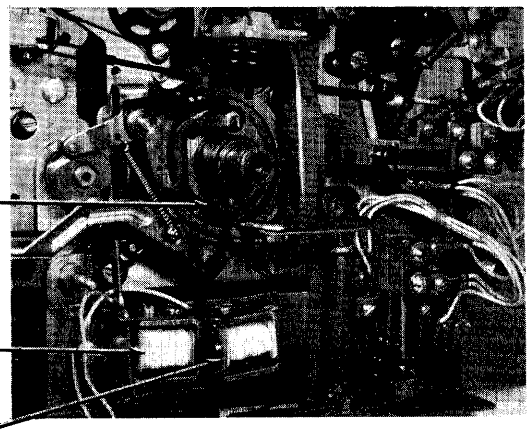


Figure 64. Beginning of Upper-Case Shift Operation (Shift Ratchet Missing)

SHIFT CONTACT AND CAM FOLLOWER ASSEMBLY

The shift contact and cam follower assembly is located on the right side of the frame to the rear and above the shift magnets (figure 65). It consists of a cam follower and two contact assemblies.

The cam follower is spring loaded onto the right side of the cam and leads the shift arm by 90°. When shifting to upper case, the high dwell of the cam will pass under the cam follower roller forcing it outward (figure 65). When the high point of the cam is under the shift arm roller the cam follower arm moves inward and comes to rest at a point midway between the high and low dwell.

When shifting to lower case, (figure 65) the low dwell of the cam will pass under the cam follower roller allowing it to move inward. As the low dwell continues toward the shift arm roller the cam follower arm moves out to another rest position halfway between the high and low dwells. The two rest positions are 180° apart from each other and are approximately midway between the high and low dwells. This arrangement permits the cam follower arm to move outward for an upper-case shift and inward for a lower-case shift but always returns to a rest position.

CONTACT ACTUATING ARM

The contact actuating arm (figure 65), setscrewed to the bottom of the cam follower arm, controls the feedback and transmitting contacts. As the cam follower moves outward (upper case) the actuating arm moves inward, transferring the two inner sets of contacts (figure 64). Moving the cam follower arm inward (lower case) pivots the actuator arm outward and transfers the two outer sets of contacts (figure 65). In both cases the actuator arm returns to the rest position.

SHIFT CONTACT ASSEMBLIES

There are two types of shift contacts (figure 65): feedback and transmitting. The feedback contacts (C3 and C4), located to the front of the transmitting contacts, generate a busy signal while being transferred (open). The C3 contacts, located to the left of the C4 contacts, transfer during an upper-case shift; the C4 contacts transfer during a lower-case shift. The transmitting contacts indicate what type of shift is occurring.

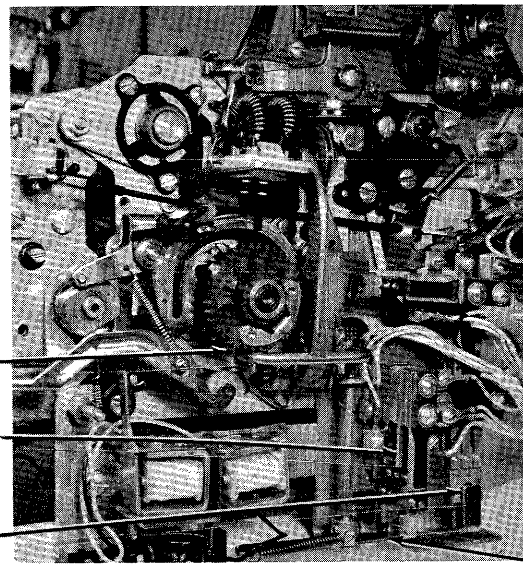


Figure 65. Beginning of Lower-Case Shift Operation

SHIFT MODE CONTACTS

The shift mode contacts indicate whether the printer is in upper or lower case. They are mounted just above the feedback and transmitting contact assemblies (figure 65). Either of these two contacts will always be held transferred by the shift arm tab bolted to the rear of the shift arm.

Answer the following questions:

1. What directly drives the shift cam during a shift operation?

2. What two things prevent overthrow of the shift cam?

3. What are the purposes of the shift detent arm?

4. When does "Beating the Shift" normally occur? Why?

5. What is the purpose of the cam follower arm?

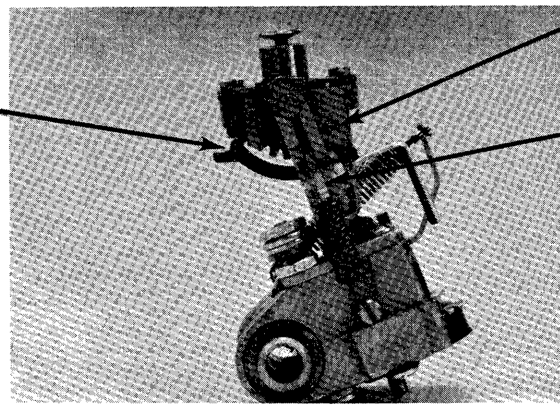


Figure 66. Tilt Ring Detenting

CHAPTER 6

ALIGNMENT

Alignment is the process of positioning the typehead exactly both vertically and horizontally, before printing. Several factors, including changing spring loads and system elasticity, can adversely affect alignment. This is undesirable since print quality is affected.

TILT ALIGNMENT

Tilt mechanism alignment assures proper vertical positioning of the typehead. This alignment also assures proper tilt band positioning during print. The tilt latches position the tilt ring coarsely; the tilt detent mechanism refines and locks the tilt ring to the exact desired position. A specific amount of play is present in the tilt ring at the point of connection between the tilt pulley link and the tilt ring. The play overcomes any tendency of the tilt mechanism to supply too much or too little motion to the tilt ring. Four V-shaped notches (figure 66) are located on the left side of the tilt ring, one for each of the four tilt positions (left to right, tilt 0 through tilt 3). The tilt detent is an arm which fits into a slot in the left side of the yoke and operates in the notches. The tilt detent is spring loaded upward into the notches. As the latches operate the tilt ring to the approximate position the tilt detent will then enter the correct notch and, because of the play, will seat the tilt ring in the exact print position (figure 66) by locking into the tip of the notch. It stands to reason, then, that if the tilt mechanism cannot coarse align the tilt ring within the limits of the tilt ring play, the tilt detent will not be able to lock into the center of the notch and a print failure will occur (cutting off characters, etc.) or the detent might enter the wrong notch. The largest variation in coarse alignment between any two of the tilt positions cannot exceed the tilt ring play. This variation is known as bandwidth (figure 67) and can be observed by half-cycling, in turn, a tilt 0 through tilt 3 character and observing the exact spot that the tilt detent enters the notch.

The procedure is as follows:

1. Power half-cycle the printer by placing the hooverometer handle (or the blade of a large screwdriver) on top of, and touching, the cycle clutch sleeve with the edge of it resting against the latch pivot pin (figure 68). Strike any character. The handle will catch the lip of the sleeve after 90° of rotation. Now turn power off. Observe the position of the check pawl to be certain that it is seated in the ratchet (figure 69). A power half-cycle is used to allow for all the stresses in the system.

2. Manually withdraw the detent from the notch and remove the tilt ring play by applying gentle pressure on the upper ball socket toward the rear.

3. Observe the point where the detent first touches the notch while allowing it to reenter.

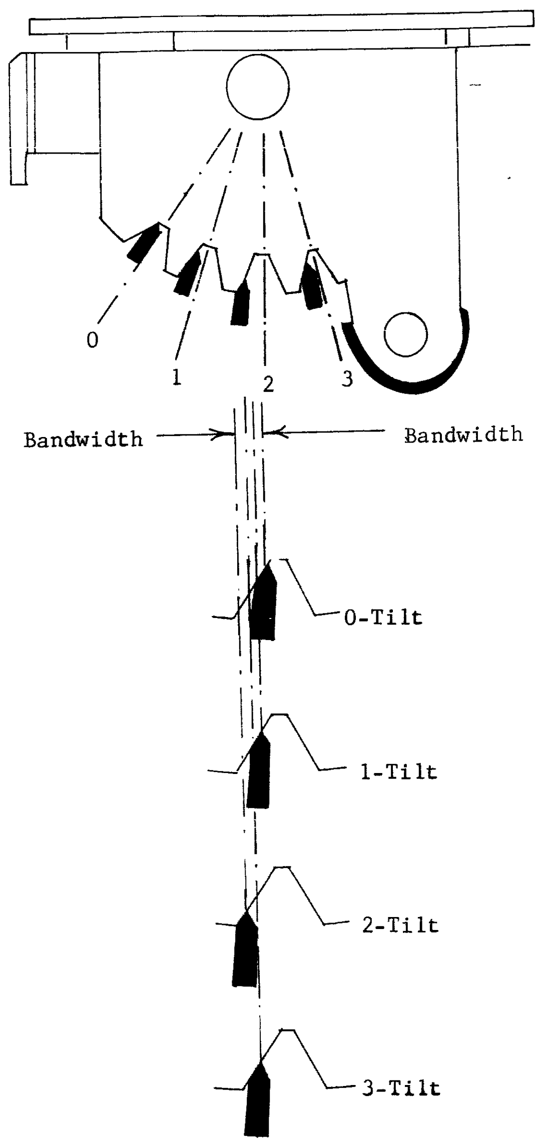
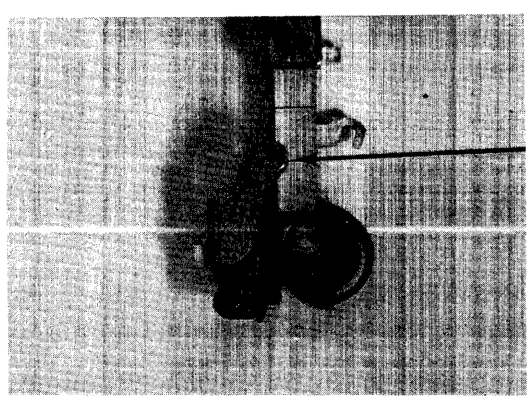


Figure 67. Bandwidth

When Half Cycling Printer Make Certain Cycle Clutch Check Pawl is engaged with Cycle Clutch Check Ratchet at 90° point of Cycle Shaft Rotation.



Hooverometer Handle Vertical and Against Latch Pivot Pin

Figure 68. Powered Half-Cycling Operation

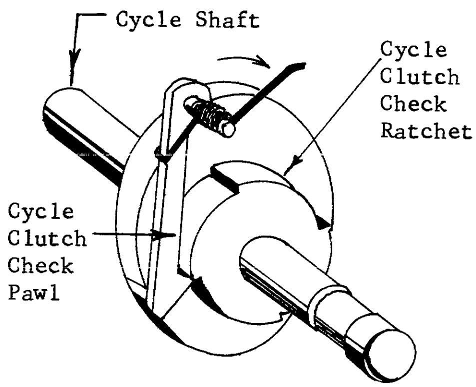


Figure 69. Cycle Clutch Check Pawl and Ratchet

If the bandwidth is incorrect, it can be corrected by moving the tilt link (figure 70) up or down in the elongated slot in the tilt arm, supplying less or more motion to the tilt ring for the given amount of motion produced by the tilt differential.

Vertical misalignment problems <u>cannot</u> be caused by the coarse alignment adjustments once the detent fully seats in the correct notch.

In all probability, the problem then will be one of the following:

1. Side play in the tilt detent.
2. Side play in the tilt ring.
3. Excessive upper ball socket play.
4. Loose typehead mounting.
5. Detent timing incorrect (not entering notch at correct time).
6. Vertical play in rear of carrier.
7. Worn rocker shaft bearings.

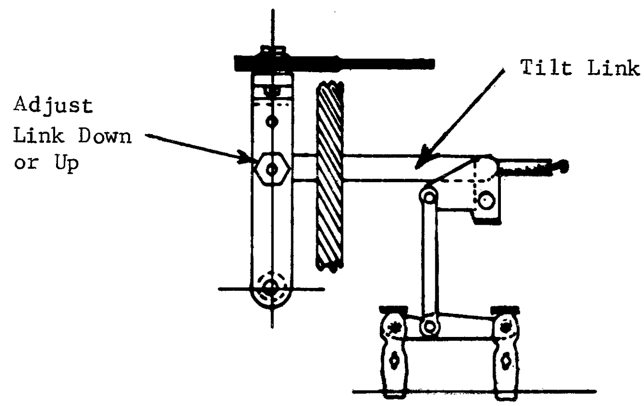


Figure 70. Tilt Differential

ROTATE ALIGNMENT

As in tilt alignment, a detent is used to lock the typehead in the correct horizontal position. This detent, called the rotate detent (figure 71), locks into V-shaped notches in the typehead skirt. Specific head play is created by backlash between the pins in the upper and lower ballsockets and the ball joint (dog-bone). Bandwidth is again used to permit proper adjustment of the rotate mechanism. The tilt detent is perpendicular to, and fits into a notch in the center of, the rotate detent. The rotate detent is spring loaded upward against the tilt detent.

Once the rotate detent has fully seated in the correct notch, horizontal misalignment cannot be attributed to coarse alignment. In all probability, the problem then will be one of the following:

1. Detent timing incorrect.
2. Rotate detent sideplay.
3. Rocker sideplay.
4. Escapement (spacing) problems.

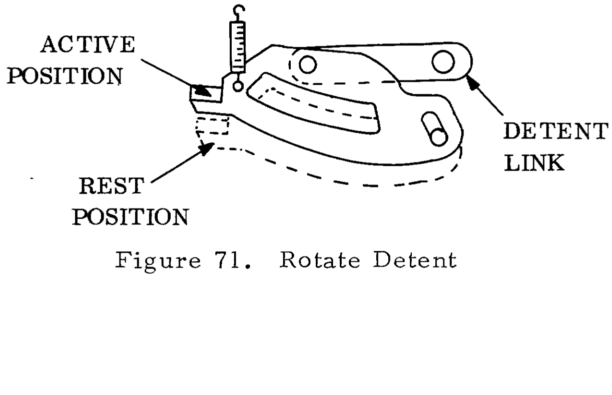


Figure 71. Rotate Detent

ROTATE BANDWIDTH

Bandwidth is the difference in detenting between the character which detents the farthest in the negative direction and the character which detents the closest to the center of the notch (least negative). To make this check, headplay must be removed in the negative (clockwise) direction (figure 72).

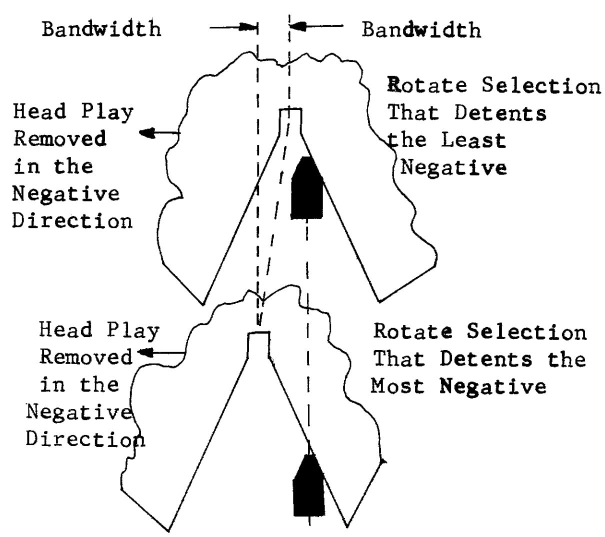


Figure 72. Bandwidth

HEADPLAY

Headplay is the distance the typehead moves horizontally with the rotate detent removed. It should be approximately 0.045 inches (figure 73).

TYPEHEAD HOMING

Typehead homing is the alignment of the typehead to the character that will detent the least negative (most positive) and still be on the negative (right) side of the notch. It should detent 0.010 to 0.020 inch from the center of the notch with the headplay removed in the negative direction (figure 73).

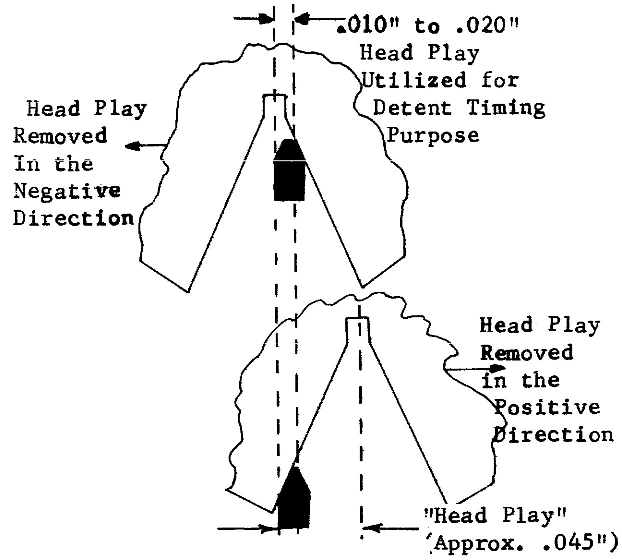


Figure 73. Typehead Homing

DETENTING

When the tilt and rotate detents are engaged, the typehead is locked. The detents must not be permitted to engage until the typehead has been coarsely positioned vertically and horizontally. Then the detents must be engaged to prevent the typehead from moving while it strikes the platen.

Preventing the tilt detent from rising also stops the rotate detent because of their mounting. An arm, called the detent actuating lever, is pivot-mounted on the left side of the rocker and comes in contact with an extension or leg of the tilt detent (figure 74). The front part of the detent actuating lever makes contact with a roller which rides freely on a pin connected to the detent cam follower. The detent cam follower, which pivots left to right at the bottom, rides against the edge of the detent cam setscrewed to the print sleeve. In the rest position, the high point of the cam forces the cam follower to the left which, in turn, holds the detent actuating lever to the left and thus holds the leg of the tilt detent to the left. This keeps both detents down and prevents them from engaging.

As a print operation occurs, the detent cam rotates with the print sleeve. When the typehead becomes coarsely positioned by the differential mechanisms, a low dwell of the detent cam allows the cam follower arm, the detent actuating lever, and the detent leg to move to the right because of the extension spring on the rear of the tilt detent. When this occurs, both detents will move upward and lock in the notches in the tilt ring and typehead.

The rotate detent (figure 71) contains an elongated slot at the front and slides into place rather than pivots. This sliding arrangement allows the rotate detent to seat at approximately the same angle in the typehead skirt for any of the four tilt positions.

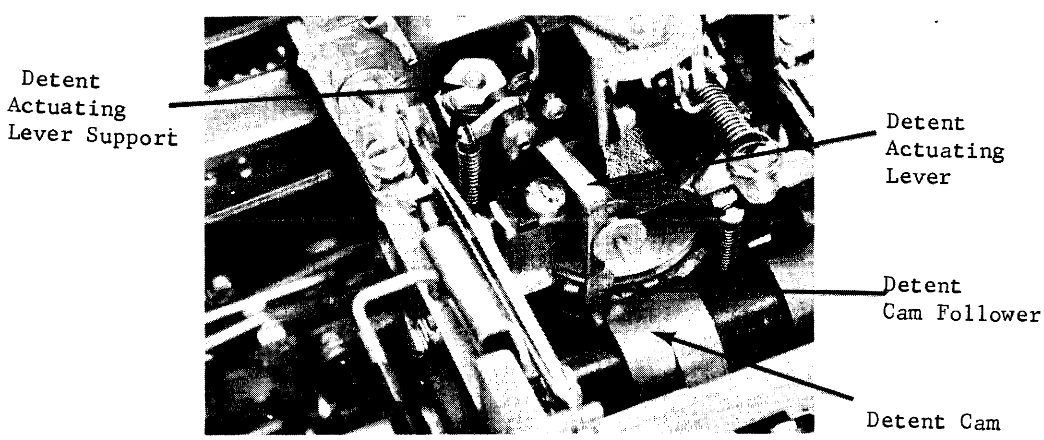


Figure 74. Detent Mechanism

As the typehead travels--locked by the detents--toward the platen, the detent cam continues to rotate but maintains the low dwell to keep the detents in place. Once a character has been printed, however, the typehead must return to the home position. A high dwell on the detent cam forces the detent mechanisms to the left, causing both detents to pivot out of the notches and allows restoration of the typehead to the home position.

Detent timing is critical and must be such that the detents will engage just as the typehead becomes positioned and disengage just as the typehead begins to tilt and/or rotate back to the rest position. Faulty detent timing can result in damage--especially to the typehead skirt teeth.

DETENT TIMING

If the rotate detent is allowed to enter the typehead too soon, it could enter the wrong notch. If this occurred on a positive rotation, the tape or typehead could break due to continued pull on the rotate tape. If it happened on a negative rotation, the tape would become relaxed and possibly jump off of the pulleys. This would probably cause tape breakage.

Detent timing is controlled by the timing of the print shaft with respect to the cycle shaft. It should be set as late as possible--without restricting the restoration of the typehead--to insure that the detents do not leave the typehead before printing occurs. This would affect print alignment.

Some of the factors affecting detent timing are: 1) typehead homing, 2) rotate and tilt adjustments, 3) print-shaft to cycle-shaft timing, and 4) detent actuating lever and cam adjustments.

WEAR COMPENSATOR

The wear compensator prevents head drift created by wear in the rotate system. The wear compensator is an integral part of the rotate arm and is able to sense and compensate for a change in position of the rotate arm caused by wear.

The rotate pulley spring and the compensating arm spring apply constant pressure to the rotate system in the negative direction. When wear occurs at pivot points, bearings, or any place that opposes the combined tension of these springs, the play developed will be taken up immediately by these springs, causing the rotate arm to move toward the sideframe slightly and the typehead to rotate slightly in the negative direction. This is known as drift. Excessive drift will cause incorrect character selection and possible damage if not corrected. Some amount of wear will occur because of metal-to-metal abrasion; although the wear compensator cannot prevent wear, it can prevent head drift caused by wear.

The wear compensator (figure 75) consists of three basic parts: 1) rotate arm, 2) compensating arm, and 3) nylon roller.

The rotate arm (figure 75) pivots on a large pin in a bracket on the outside left of the frame. Mounted on the top of the rotate arm is the left hand rotate pulley.

The compensating arm pivots at the same point as does the rotate arm. The rotate link connects to the lower extension of the compensating arm. The upper section fits between two sections of the rotate arm and is spring-loaded to the right by the compensating arm spring.

The nylon roller sits in a vertical slot in the rotate arm. This slot and the top of the compensating arm are at an angle to each other and form a V-shaped slot which holds the nylon roller in place.

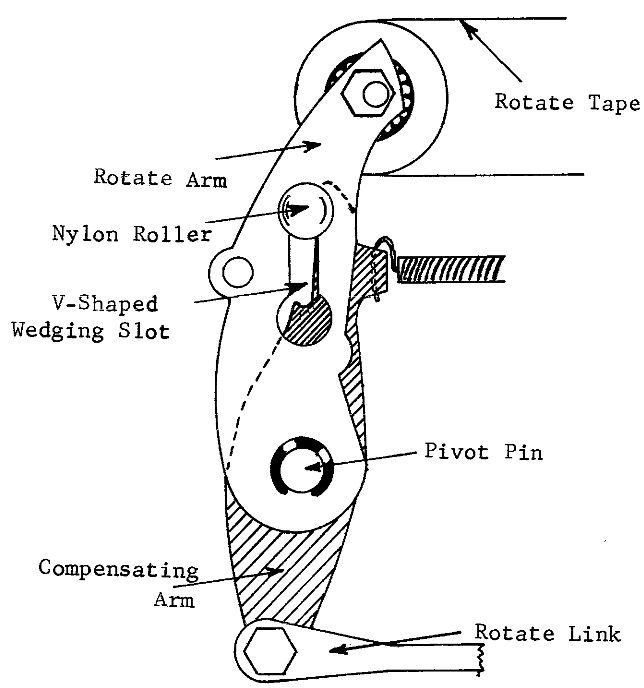


Figure 75. Basic Components of the Wear Compensator

Figures 76 - 79 demonstrate the basic action of the wear compensator.

Figure 76 shows the wear compensator at rest (zero rotate) with no wear introduced in the system. The combined tension of the rotate tape (from the rotate pulley spring) and the compensating arm are acting together to pull the arm to the right, in the negative direction. The rotate link is acting to overcome this tension. The nylon roller is positioned near the top of the slot.

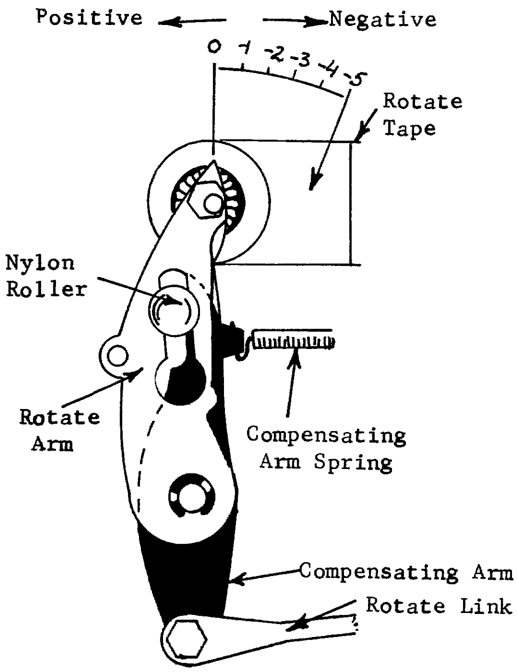


Figure 76. Zero Rotate Position

Figure 77 shows the wear compensator in the negative-5 position, still with no wear in the system. In this position, the eccentric stud on the top of the rotate arm is just barely touching the sideframe of the printer. The nylon roller is still at the top of the slot.

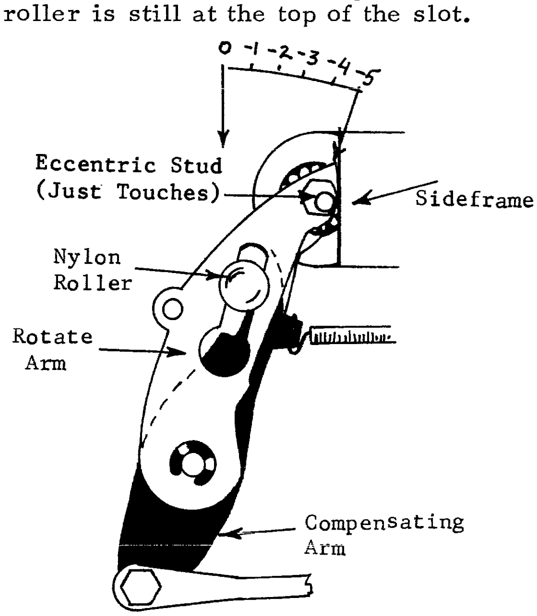


Figure 77. Negative-5 Position

Figure 78 shows the wear compensator in the rest position but with wear introduced in the system. Note that the pointer of the rotate arm is no longer vertical but has moved to the right. Wear has been taken up on the negative direction and drift has resulted. The nylon roller is still at the top of the slot.

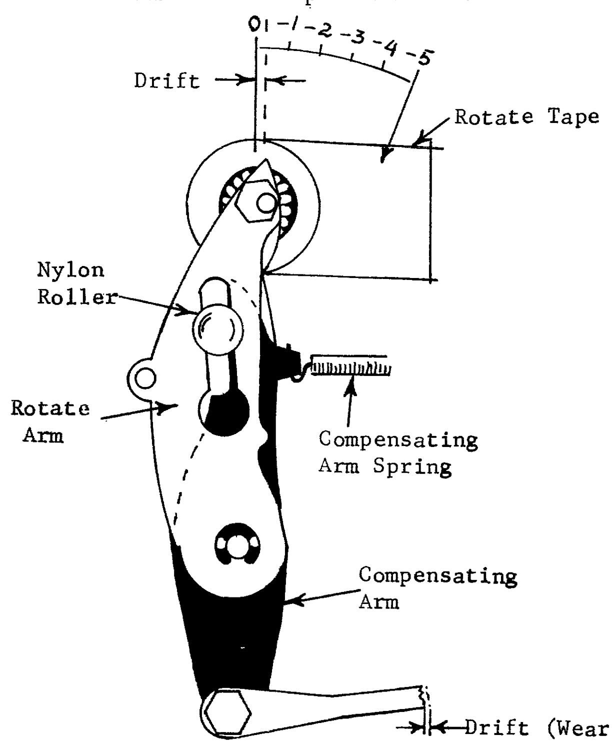


Figure 78. Zero Rotate Position With Drift

Figure 79 shows the wear compensator in the negative-5 position with wear in the system. As the arm moves toward the sideframe, the rotate differential system is attempting to supply exactly five units of negative motion to the rotate arm but, because it started at a point to the right of zero, the rotate arm will contact the sideframe--via the eccentric stud--before the full five units of motion have been expended.

The differential system continues supplying force but only the compensating arm keeps moving since nothing blocks its inward travel. As this occurs, the V-slot opens and the nylon roller drops. Wear has been compensated for and drift has been eliminated since the rotate arm returns to the zero position.

This, basically, is how the wear compensator works. However, all of the parts in the system which are opposing the combined spring tension of the rotate pulley spring and the compensating arm spring are being flexed, somewhat. Steel parts do have a measurable amount of flex when placed under stress.

When wear is introduced into the system it is possible for the nylon roller not to drop on a negative five operation, and compensate for that wear because of flexing. As the eccentric stud contacts the sideframe and the compensating arm keeps moving, the sideframe will

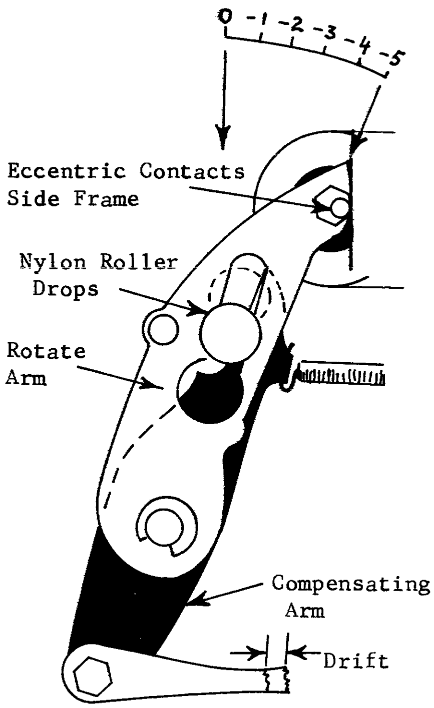


Figure 79. Negative-5 Position With Drift

oppose much of the spring tension of the system and the rotate arm and compensating arm are then allowed to relax. However, the nylon roller will still be held between them. In the flexed position they hold the roller very tightly. In the relaxed position they hold the roller loosely, but they do hold it. This develops into a situation where wear or drift in the system has not caused compensation to occur but rather has only allowed the parts with stress on them to relax. Therefore, something must be done to relax the pressure on the nylon roller before compensation. In other words, stress must be removed before compensation occurs. This will allow compensation to occur for even minute amounts of wear.

WEAR COMPENSATOR RATIO CHANGE

If the amount of motion supplied to the compensator arm can be increased sufficiently to relax the nylon roller and still not allow it to drop, then the roller will be prepared to drop if just the slightest amount of wear is detected in the system.

This is accomplished by means of a ratio change in the leverage supplied to the compensating arm. Through all rotate movements, from +5 to -4, there is a constant leverage ratio between a given amount of motion supplied by the rotate link to the bottom of the compensating arm, and the movement of the top of the rotate arm (which directly depends on the movement of the top of the compensating arm through the nylon roller). However, from a -4 to a -5 position, a ratio change will occur by allowing the compensating arm to rotate about a point lower (closer to the rotate link) than the pivot pin. When this occurs sufficient extra motion will be supplied to the top as compared to the bottom of the compensating arm to remove the stress. The nylon roller will then drop for even small amounts of wear.

The rotate eccentric arm (figure 80) provides the ratio change to the compensating arm. The rotate eccentric arm is spring-loaded to the right and has a hole in it which fits around the pivot pin. An eccentric shoulder protrudes from the arm with the center of the shoulder lower than the pivot hole. The compensating arm contains a large pivot hole (figure 81) which fits around the eccentric

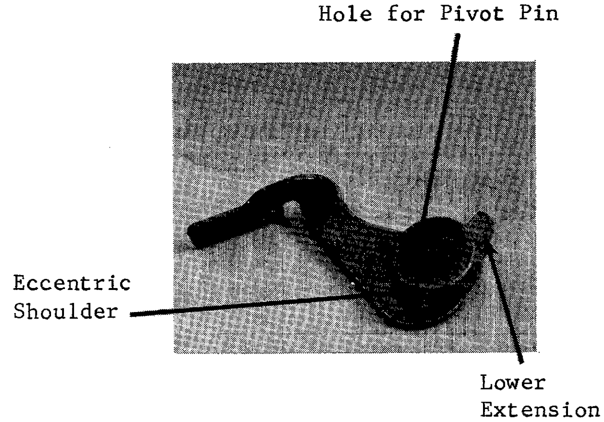


Figure 80. Rotate Eccentric Arm

shoulder of the rotate eccentric arm. Between the +5 and -4 positions the compensating arm and the eccentric arm act as one as they pivot about the pin. However, at approximately the -4 position, the lower extension of the eccentric arm will come in contact with a stop lug on the wear compensator bracket bolted

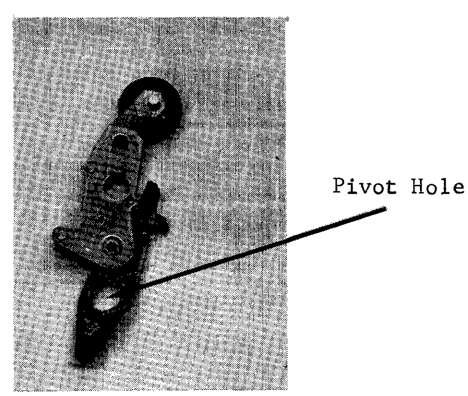


Figure 81. Compensating Arm Pivot Hole

to the sideframe (figure 82). When this occurs, eccentric arm movement is restricted and the compensating arm must now pivot about the eccentric shoulder of the eccentric arm (figure 83). Since the center of the eccentric shoulder is lower than the pivot pin, the compensating arm has now undergone a ratio change and the top of the compensating arm will move farther for a given amount of motion to the bottom of the compensating arm.

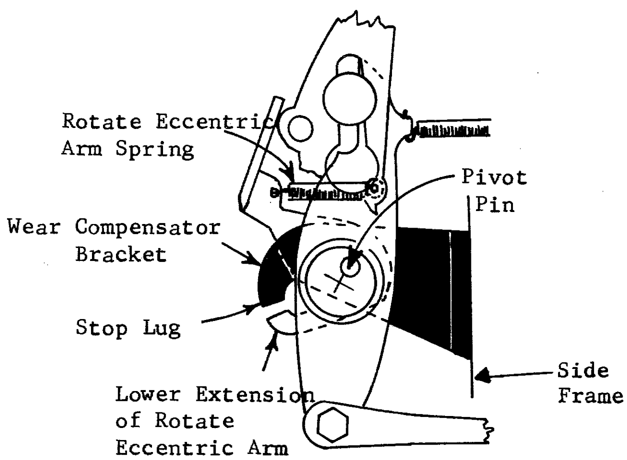


Figure 82. Zero Rotate Position

Because the rotate eccentric arm is spring loaded against the rotate arm by its extension spring (figure 83) and the rotate arm is spring loaded against the compensating arm by the rotate pulley spring through the nylon roller, all three will act as one until a -5 character is selected. When this occurs, the eccentric arm is stopped by the stop lug, but the rotate arm continues to follow the compensating arm until the eccentric stud contacts the sideframe. The

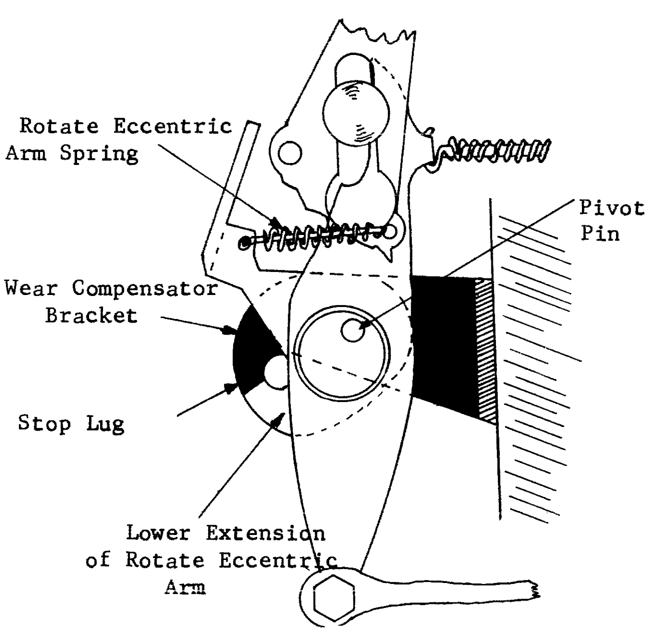


Figure 83. Negative-5 Position

compensating arm moves slightly farther, however, to use up the extra motion supplied by the leverage ratio change. At this time the roller will be completely relaxed and held lightly in place. Any drift (slack) now felt in the system will cause the compensator arm to be pulled farther by its spring and the roller immediately drops in the slot. Wear compensation has occurred.

The wear compensator compensates for wear in the system from the rotate arm, through the linkage and up to the -5 cam. It cannot compensate for wear in the positive latches, the latch bail, and the positive cams because these components are not used for a -5 operation. Wear at these points constitutes a part of the bandwidth and must be considered when adjusting for an allowable bandwidth.

Two other springs are also included in the wear compensator which have not been previously discussed (figure 84). One is the compensator assist spring which is connected between the rotate arm and the sideframe. Its purpose is to keep constant pressure on the rotate arm, against the roller, during a positive operation. Otherwise, momentum built up by the rotate arm could cause the arm to overthrow far enough to allow the roller to drop. This must not happen.

The second spring--called the compensator damper spring, a leaf spring--is mounted to the sideframe. Its purpose is to dampen out the shock caused when the eccentric stud contacts the sideframe. This prevents unnecessary stress on the system and eliminates rebounding which could cause the slot to open and the roller to drop.

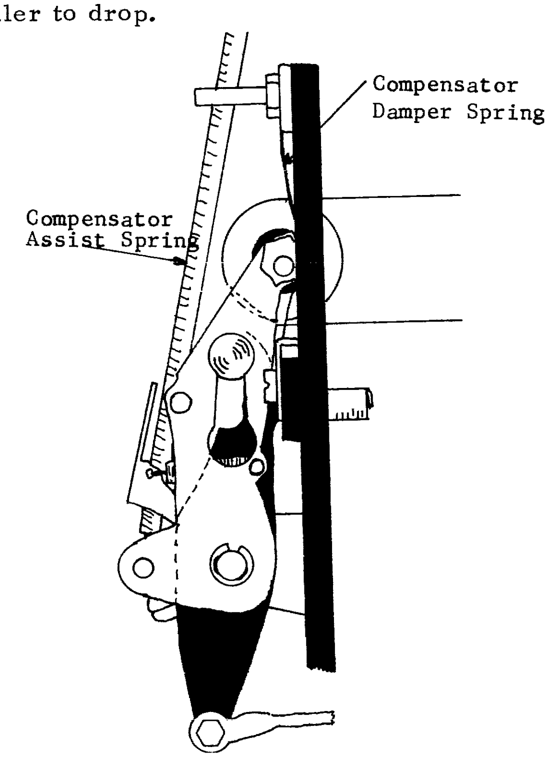


Figure 84. Wear Compensator

Answer the following questions:

1. What is tilt bandwidth?

2. Why can the wear compensator not compensate for wear in the positive latches?

3. How would vertical play in the rear of the carrier probably be visibly detected?

4. What directly holds the rotate detent out of the typehead notch?

5. What causes typehead "drift"?

6. Does the rotate detent slide or pivot into place? Why?

7. What action occurs to cause the nylon roller to drop in the slot?

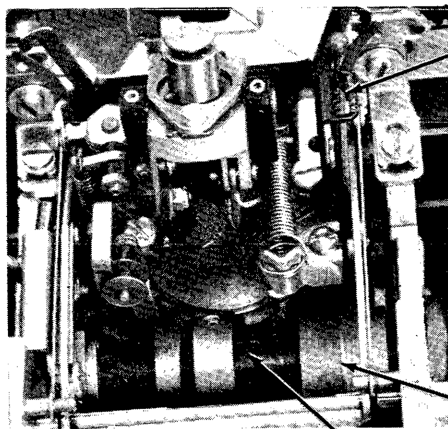


Figure 85. Print Sleeve and Cams

CHAPTER 7

PRINT OPERATION

PRINT MECHANISM

The print mechanism is powered by a double-lobed cam located on the far right of the print sleeve (figure 85). For our purposes, only the right side of the cam, called the high velocity cam, will be discussed.

The print cam follower assembly (figure 86) is mounted by means of a forked assembly on a pivot pin, below and to the rear of the print cam, in the right side of the carrier. The print cam follower roller mounts on a pin on the print cam follower. The roller is secured underneath the high velocity cam by a yoke

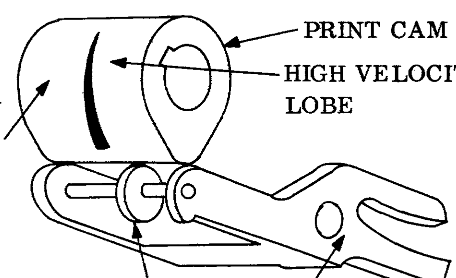


Figure 86. Print Cam Follower Assembly

which straddles the roller (figure 87) and by the spring-loaded yoke actuating lever (figure 88).

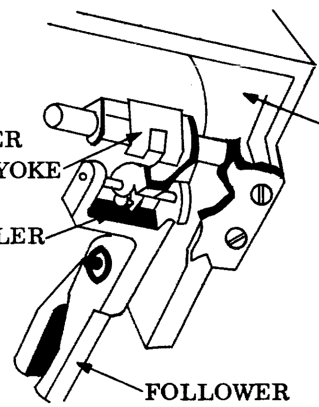


Figure 87. Print Cam Follower Roller Yoke

The pivot pin mounting for the forked end of the cam follower arm extends from the lower portion of the impression control lever assembly. This lever assembly (figure 85) mounts via a pivot screw on the right side of the rocker. Extending from the top of the lever assembly through the detent plate is the impression control lever topped with a red button. The lever has five adjustable positions and is held in place by detent notches in the detent plate. Changes in lever position cause the pin on the lower end of the lever to move backward or forward in the fork of the cam follower arm.

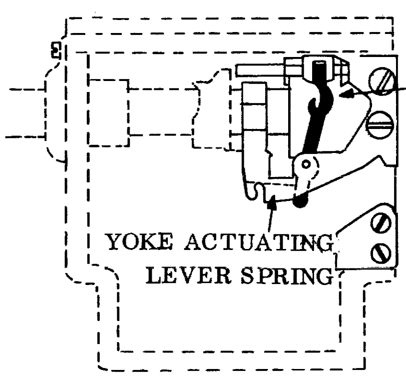


Figure 88. Yoke Actuating Lever

During a print operation, the print sleeve rotates. The high point of the print cam contacts the print cam follower, forcing the follower downward and pivoting the forked end upward. This raises the rocker, driving the typehead to the rear toward the platen. The contour of the cam is such that the typehead is powered to within a few thousandths of an inch of the platen and carried the remaining distance by momentum.

Varying the position of the impression control lever pin in the forked end of the cam follower varies the velocity with which the typehead is driven toward the platen. This, in turn, varies character impression (darker or lighter) on the paper.

As the impression control lever moves forward (toward number 5 on the detent plate), the pin will move backward in the forked slot (figure 89).

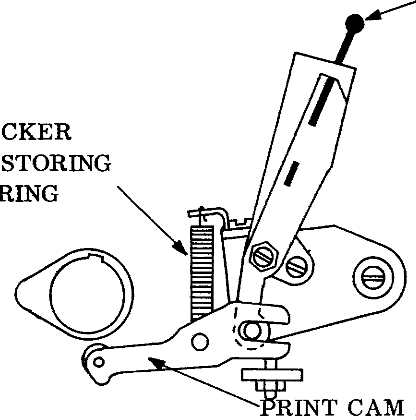


Figure 89. Impression Control

This increases the amount of powered flight to the typehead and creates a darker impression; however, varying the amount of powered flight can change the time relationship between typehead detenting and typehead printing. The timing must remain relatively constant. The contour of the forked slot in the cam follower arm assures this by allowing most of the change in powered travel to be felt as a change in the rest position of the typehead rather than a change in free flight time. The free flight time should vary only about 0.015 inch throughout the five different impression control settings. In other words, by varying the flight time minutely to make it proportional to the amount of powered flight time, the print time remains the same for all characters regardless of the typehead impact velocity.

COPY CONTROL

The copy control mechanism positions the platen front to rear to compensate for different thicknesses of typing material. This maintains the proper relationship of paper to impression control mechanism. The copy control lever located at the left top of the printer operates the copy control via an eccentric collar. The lever attaches to the copy control shaft, extending the width of the printer through both sideframes. Eccentric collars attached to each outside end of the shaft fit between adjusting parts connected to the carriage ends (figure 90). As the lever moves to the rear to any of five positions, both eccentrics rotate against the back sides of the platen adjusting plates, forcing the entire carriage (including platen and feed mechanism) to the rear. Forward lever motion forces the carriage forward, the most forward position being the normal print position.

PLATEN

The platen provides a solid backing for the paper during a print operation and enables vertical paper feed. A latch at each end locks the platen in place, removing all vertical and horizontal play from the platen. These latches are pivot-attached to the left and right carrier plates (figure 90).

Answer the following questions:

1. What holds the print cam follower roller beneath the high velocity lobe of the print cam?

2. By what is the force with which the typehead strikes the platen regulated?

3. What is the purpose of the Copy Control Mechanism?

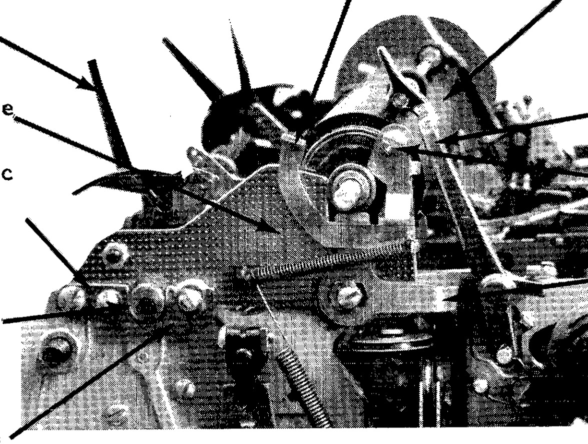


Figure 90. Copy Control Mechanism

MAINSPRING

The mainspring (figure 91) at the right rear of the printer supplies all the tension necessary to move the carrier to the right during escapement operation. The escapement shaft extends through a bearing assembly in the back plate of the printer into the center of the mainspring. A hub, setscrewed to the rear of the shaft, is grooved to allow the inner part of the mainspring to hook into it. The mainspring is wound so that the inner portion of the spring creates a counterclockwise rotary force to the escapement shaft. The escapement shaft extends forward through another ball bearing assembly in the powerframe and has an escapement/tab cord drum assembly setscrewed to its front end. The drum is spirally grooved to allow the drum to take up the escapement/tab cord. The cord is knotted and fits into a slot in the drum. It goes several turns around the drum, then runs over a guide roller, around a pulley assembly on the outside right of the powerframe, and connects to the right side of the carrier. As the mainspring rotates the escapement shaft in the counterclockwise direction, the escapement/tab cord drum winds the cord, causing the carrier to move to the right.

Attached to the escapement shaft, between the powerframe and the back plate, is the carrier return cord drum. The carrier return cord, which is attached to the drum in the same manner as the escapement/tab cord, goes several turns around the drum, over a guide roller assembly, around two pulleys at the left of the printer, and attaches to the left side of the carrier. During an escapement operation, this cord drum must release the cord to allow the carrier to move to the right. However, on a carrier return operation, this drum must rotate clockwise against the pressure of the mainspring to tighten the cord and move the

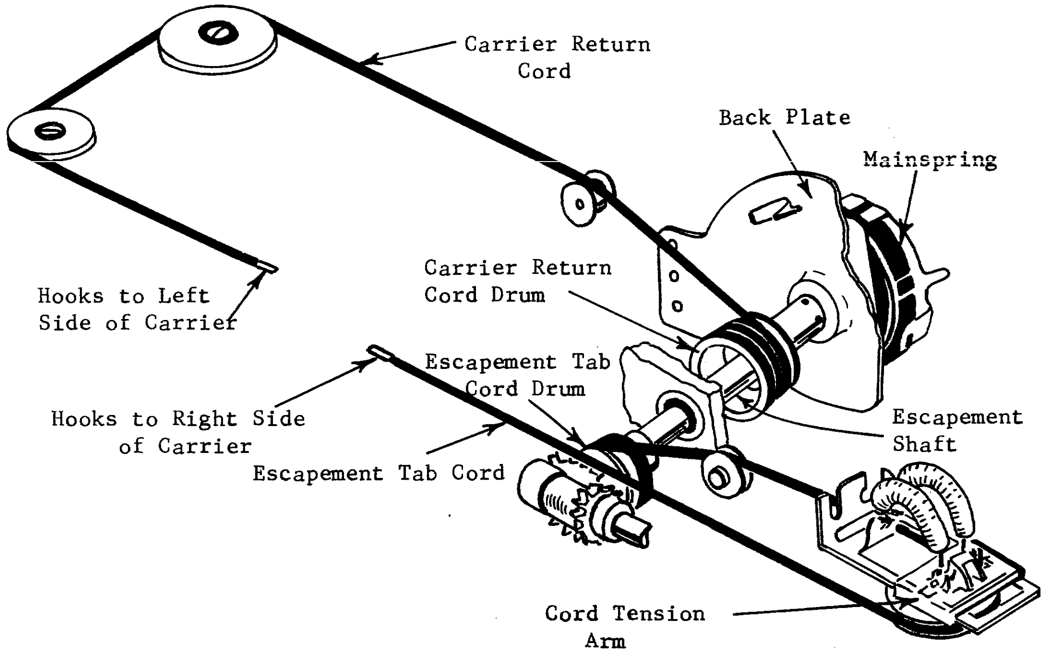


Figure 91. Mainspring and Cord System

carrier to the left. This is accomplished by the gears on the escapement/tab cord drum and will be discussed later.

On the outside right of the powerframe, the escapement/tab cord pulley (figure 91) mounts to the cord tension arm. A set of spiral springs connect the cord tension arm to the pulley mounting bracket and exert a constant pull to the right on the pulley. This pull takes up any slack which may develop in the cords because of the fast movements of the carrier to the left and right or because of stretched cords. The springs allow steady tension on the cords to permit smooth carrier motion.

Answer the following questions:

4. What is the purpose of the mainspring?

5. In which direction (clockwise or counter-clockwise) will the rear cord drum rotate during a backspace operation?

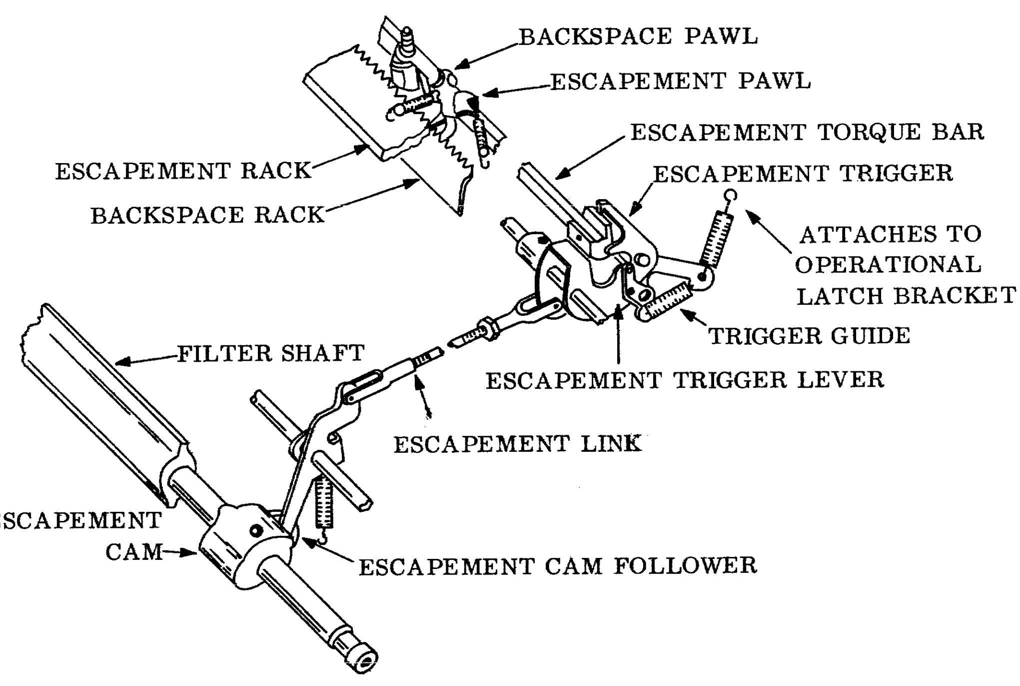


Figure 92. Print Escapement Mechanism

 Space

Print escapement is the moving of the carrier one space to the right upon completion of a character print. The entire print escapement mechanism is illustrated in figure 92. Assemblies contributing to print escapement are escapement bracket assembly, escapement rack, escapement torque bar, escapement trigger lever assembly, and escapement cam and cam follower.

ESCAPEMENT BRACKET ASSEMBLY AND ESCAPEMENT RACK

The escapement bracket assembly (figure 93) moves with, and is attached to, the top rear of the carrier. Attached to it are the escapement and backspace pawls, the tab lever and tab lever trigger plus various springs. The escapement rack is located to the rear of the carrier and beneath the escapement bracket. It is connected to each sideframe of the printer. Across the entire back edge of the rack are notches or teeth.

The escapement and backspace pawls contain elongated holes which fit over a stud on the left side of the escapement bracket. Both pawls are spring loaded to the right and forward, into the escapement and backspace racks. The backspace rack is located immediately below the escapement rack. In the rest position, the escapement pawl engages in a notch of the escapement rack. Because of pressure on the carrier from the mainspring, the pawl is pushed against the right edge of the notch to prevent the carrier from moving. In this position, the stud on the escapement bracket is

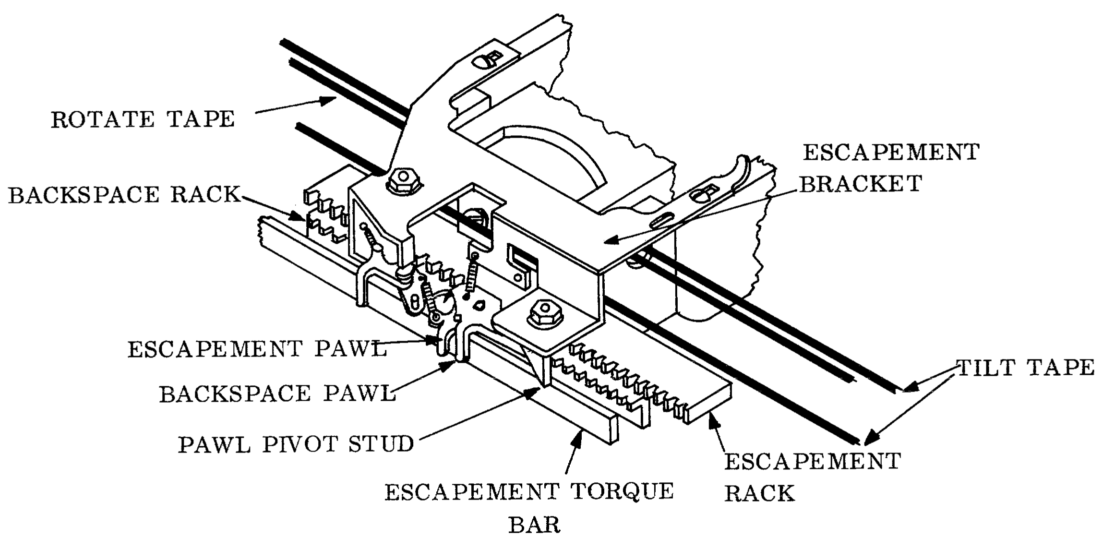


Figure 93. Escapement Bracket Assembly

pushed against the right edge of the elongated slot in the escapement pawl and backspace pawl (figure 94A).

To permit the carrier escapement, the escapement pawl, along with the backspace pawl, must be forced out of the rack. This is accomplished by the escapement torque bar. As the pawls leave their rack (figure 94B) their relatively light weight allows them to be immediately pulled to the right by their extension springs (figure 94C) so as to enter the next notch in the rack. The carrier then begins to move, allowing the pawls to seat in the next notch of the racks (figure 94D). The carrier then comes to a stop.

Note, only the escapement pawl restricts the carrier from moving. The backspace pawl sits loosely in the backspace rack. It must, however, be pivoted out of the rack for an escapement operation or the backspace rack would then restrict the movement of the carrier and a half-space operation would occur.

Figure 94D shows the clearance of the backspace pawl in its rack when the carrier is stopped by the escapement pawl. The backspace and escapement pawls are connected to each other by a pin (part of the escapement pawl) which fits through an elongated slot in the backspace pawl (figure 94). This arrangement forces the backspace and escapement pawls to move left and right together but allows them to move front to rear independently. The reason for this will be explained in the backspace topic of Chapter 8.

ESCAPEMENT TORQUE BAR

The flat torque bar pivots between the sides of the printer frame. It is located just to the rear of the escapement and backspace racks and pivots at the bottom, top towards the rear (figure 93). The torque bar must trip the escapement and backspace pawls from their racks to permit escapement. Each pawl has a lug

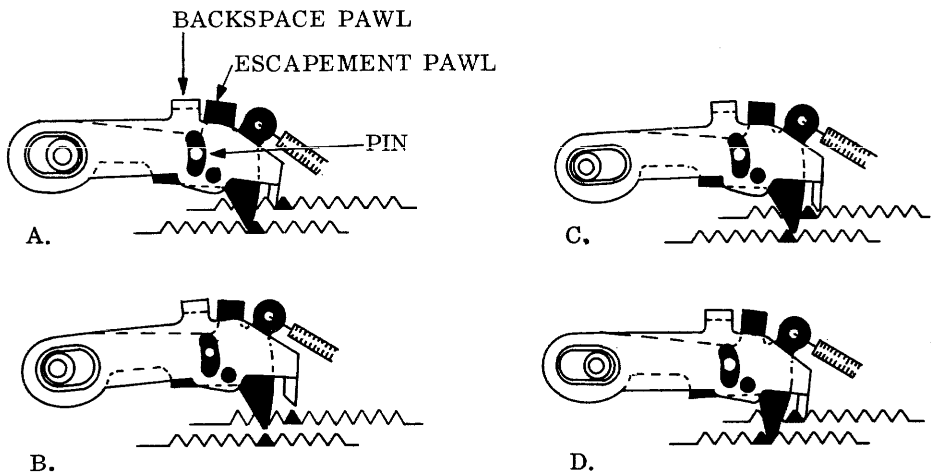


Figure 94. Escapement Pawl Operation.

which extends over the top of the torque bar and down the back. As the torque bar pivots to the rear it contacts these lugs and forces the pawls from their racks.

The torque bar is held in the rest position by an extension spring on the right side of the bar. Rotation of the torque bar to the rear is very fast; immediately upon tripping the pawls it is restored by its extension spring. Failure of the torque bar to restore immediately will result in incorrect spacing since the pawls cannot reseat in their racks.

The stud on which the pawls pivot brace the torque bar to overcome a tendency to bow to the front rather than push the pawls to the rear. This bowing tendency occurs from the force required to trip the pawls from their racks.

ESCAPEMENT TRIGGER LEVER ASSEMBLY

The escapement trigger, which operates the torque bar, mounts to the escapement trigger lever with a pivot connection. In the rest position, a hooked tip of the escapement trigger sits over a lug on the right end of the torque bar. Rear rotation of the torque bar requires a downward pull on the escapement trigger. As the trigger moves downward, a lower extension of the trigger contacts the trigger guide (figure 95). The trigger guide attaches to the inside of a rearward portion of the operational bracket. A small stud extends to the left from the trigger guide, just in front of the escapement trigger. When the downward moving trigger contacts the trigger guide stud, downward motion stops and the trigger is then cammed to the rear. As this occurs, the tip of the escapement trigger will be cammed away from the torque bar lug, allowing the extension spring to restore the torque bar (figure 95).

The escapement trigger lever, rotating downward, causes the escapement trigger to be pulled downward. The escapement trigger lever pivots on a shaft on the operational latch bracket which is mounted to the powerframe below the right end of the torque bar. One end of an escapement link connects to the front of the escapement trigger lever, the other end connects to the escapement cam follower arm. A forward pull on the link causes the rear of the trigger lever to move down, pulling the trigger down. As the trigger cams away from the torque bar lug, an extension spring (figure 95) connecting the bottom of the trigger to the

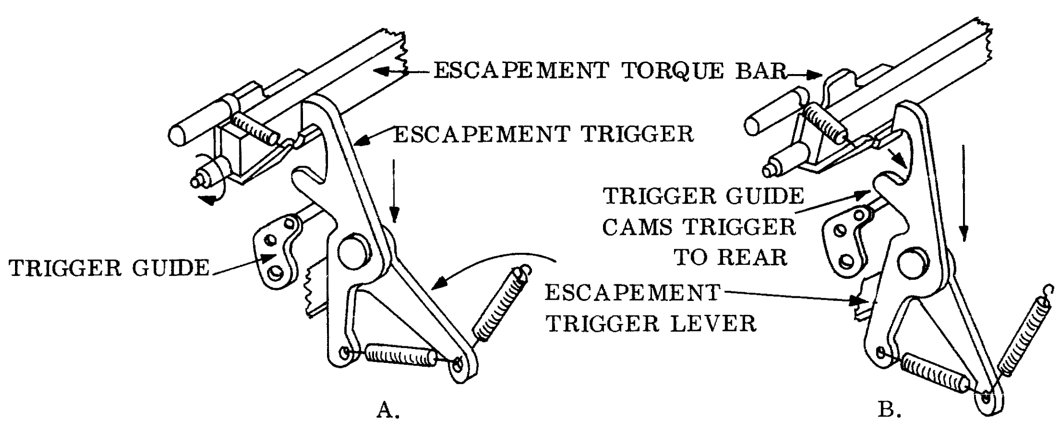


Figure 95. Escapement Trigger Operation

rear of the trigger lever restores the trigger forward. Another extension spring, on the rear of the trigger lever, connects to a rear extension of the operational latch bracket and restores the trigger lever to the rest position. When this occurs, the hooked tip of the trigger restores over the tip of the torque bar lug.

ESCAPEMENT CAM

The escapement cam (figure 92) mounts on the right side of the filter shaft. A spacing (escapement) operation is needed after each character print and the filter shaft must rotate 180° for each character print. The escapement cam follower pivots on a pin in a bracket located just to the rear of the filter shaft. A roller on the bottom of the cam follower rides on the escapement cam. As the high point of the cam rotates against the cam follower roller (near the filter shaft) the roller becomes forced to the rear, pivoting the top of the cam follower arm to the front. The escapement link, which connects to the top of the cam follower, is also pulled to the front. The pivot point of the trigger lever is above the escapement link connection and, thus, a pull on the link will cause the rear of the trigger lever to pivot downward.

The escapement cam timing is such that an escapement operation does not occur until the typehead begins leaving the platen after the print operation. This insures that the carrier is not moving while a print operation is occurring.

Answer the following questions:

6. What prevents the carrier from moving to the right.
7. What must occur for the pawls to completely reseat in their racks after the escapement torque bar has been released?
8. While the typehead is striking the platen, what prevents the escapement and backspace pawls from being pulled from their racks?
9. What restores the escapement trigger forward?
10. By what is the escapement torque bar rotated?

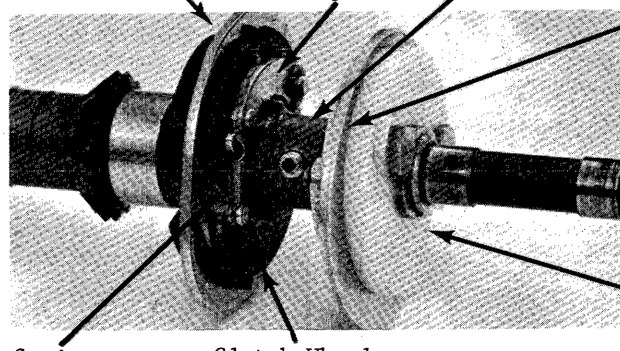


Figure 96. Operational Cams

CHAPTER 8

OPERATIONAL FUNCTIONS

OPERATIONAL CAMS

Two cams (figure 96) located on the right side of the operational shaft power five of the six operational functions. The remaining function, shift, was discussed in chapter 5. The double-lobed cam on the left rotates 180° for each operation it drives. This cam controls the space bar, tabulation, and backspace functions. The single-lobed cam on the right rotates 360° for each operation it drives. It controls the carrier return and indexing operations.

The cam on the left rotates only 180° to allow a space operation to keep up with a print operation--likewise, with a backspace or tab operation. This is not necessary for a carrier return or indexing operation.

The operational clutch ratchet (figure 96) has teeth on either end, and is set-screwed to the operational cam shaft which is in continuous rotation while motor power is on. The two cams are located at each end of the ratchet, but are held from rotating by their clutch release arms-- one for each cam (figure 97). Rotation of a cam occurs only when an operational function for that cam is selected.

Mounted to each cam is a cam pawl (figure 97). The cam pawl is mounted so as to engage with the rotating clutch ratchet. When this occurs, the cam rotates. The clutch wheel (figure 97) is attached to and forms a part of the cam assembly; it prevents the cam pawl from engaging with the clutch ratchet. Three oversized holes are located in the clutch wheel.

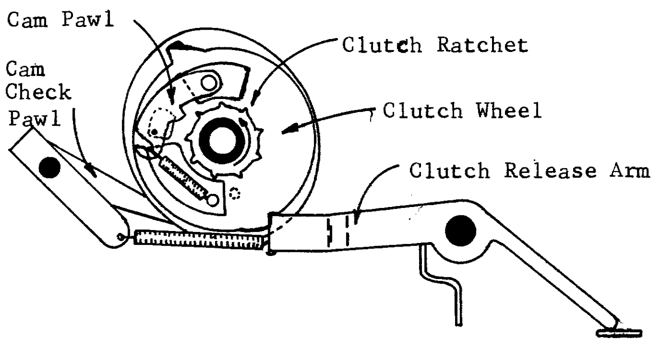


Figure 97. Operational Cam at Rest

The pivot point of the cam pawl is a pin connected to the cam through one of the oversized holes in the clutch wheel. The free end of the pawl has an extension pin connected to it which fits through another oversized hole in the clutch wheel. This end of the pawl is spring loaded toward the ratchet by an extension spring connected to the cam through the third oversized hole. The clutch release arm, however, holds the clutch wheel from moving. As long as the clutch wheel cannot rotate, the extension pin of the cam pawl is held by the edge of the slot in the clutch wheel. This prevents the cam pawl from pivoting into the ratchet. Disengaging the clutch release arm (figure 98) from the clutch wheel allows the cam pawl to pivot into the clutch ratchet by pressure from its extension spring. A tooth on the inside of the cam pawl then engages the moving ratchet, causing the entire cam assembly to rotate with the operational shaft. The clutch release arm is spring loaded upward by an extension spring. When the arm is allowed to restore, its tip will be in the path of a lug on the clutch wheel. Upon contact with the release arm, the clutch wheel stops. This drives the cam pawl away from the ratchet, since the extension pin on the pawl is forced to ride outward on the edge of the clutch wheel hole. Thus, the cam's rotation is stopped.

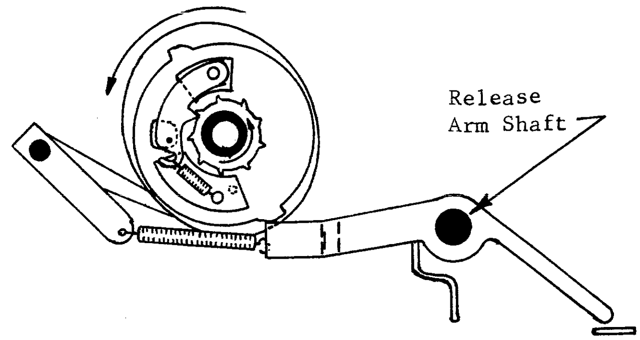


Figure 98. Operational Cam Active

However, the cam pawl spring always tries to pull the cam pawl into engagement with the clutch ratchet and, if the cam is not prevented from moving backward, the pawl will be allowed to rotate into the moving ratchet, causing a buzzing sound. This backward creep of the cam is prevented by the cam check pawl (figure 99), which engages with a notch on the outside of the cam when the pawl disengages from the ratchet. The notch is part of the cam check ring held in position to the outside of the cam by two screws. An eccentric collar on one of the screws allows adjustment of the cam check ring. This arrangement permits positive locking of the cam in the rest position.

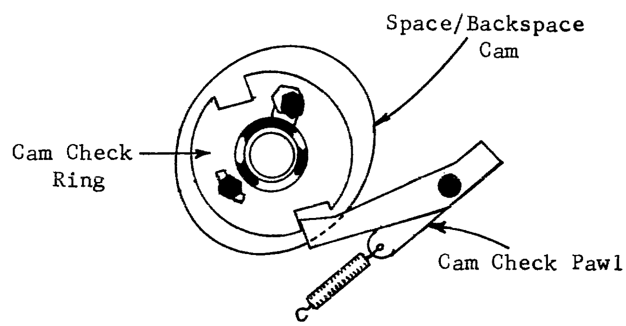


Figure 99. Operational Cam Check Pawl

OPERATIONAL CONTROL MECHANISMS

The operational control mechanism located beneath the operational cams selects the function to be operated, controls the movement of the cam, and transfers the motion of the cam to the operation selected.

To accomplish these purposes, each cam must have four basic parts in its control mechanism. They are:

1. an interposer which will select the operation.
2. a clutch release arm.
3. a method of restoring the interposer.
4. a cam follower to drive the operations.

All five operations controlled by the operational control mechanism are accomplished in a similar manner.

OPERATIONAL INTERPOSERS

There are five interposers, one for each operation. The interposers operate front to rear in slots in the operational control bracket. They are held latched forward by an adjustable guide attached to the front of the operational bracket (figure 101). The interposers are spring loaded to the rear by an extension spring attached to an extension at the rear of the operational bracket.

The interposer latch (figure 101) is pivot mounted to the front of the interposer. The latch is spring loaded up in front of the keylever pawl guide bracket by an extension spring connected from a bottom extension of the latch to a lug on the interposer. This locks the interposer forward against its spring tension.

Each of the five operational control keylevers has a pawl attached at the rear which extends through a slotted guide stud in the guide bracket. The pawl extends just above the front of the interposer (figure 101). When a keylever is depressed the lug pushes the interposer downward, freeing the latch from the guide bracket. This allows the interposer to spring load to the rear.

CLUTCH RELEASE ARMS

Each cam has a clutch release arm (figure 101). Both arms pivot on a shaft to the rear of the cams; both arms have three extensions from the pivot point. The forward extension is the stopping surface for the clutch wheel; it is spring loaded upward. The bottom extension, when contacted by an interposer, causes the front of the clutch release arm to pivot downward to release the clutch wheel. This extension on the left hand release arm extends through lugs on three interposers. This extension on the right hand release arm extends through the lugs of two interposers. The rear extension of the release arms contact the operational control bracket lug which acts as a stop lug for the release arm and controls the size of bite between the front of the release arm and the tooth on the clutch wheel. The extension spring (figure 101) on the clutch release arm attaches to the cam check pawl and holds the arm in contact with the clutch wheel tooth (figure 98).

CAM FOLLOWERS

There are two cam followers (figures 100 and 101), one for each cam. Both followers pivot on the same shaft as the clutch release arms. A roller at the top of each cam follower arm makes contact with its particular cam.

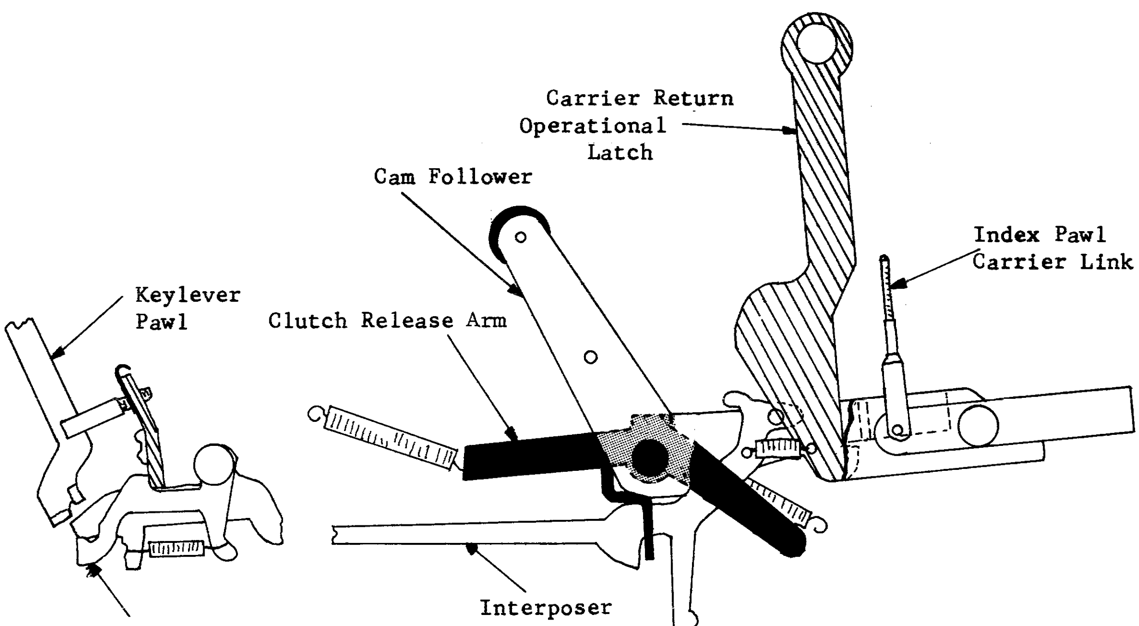


Figure 100. Carrier-Return/Indexing Operational Control

The cam followers are bellcrank type devices mounted to the rear of the cams. As a cam operates, the top of its follower becomes forced to the rear, pivoting the rear of the follower downward. On the rear of the carrier-return/indexing cam follower, a link is attached which operates the indexing mechanism. This link is pulled downward by the cam follower arm each time the cam rotates. The cam follower restores by an extension spring in the indexing mechanism, holding the roller against the cam.

The space, backspace, tab cam follower (figure 102) is wider than the carrier-return/indexing cam follower because it must control three operations. It is spring loaded upward against the cam by an extension spring which attaches to the operational latch bracket.

INTERPOSER RESTORING LEVER

Upon release to the rear to begin an operation, an interposer must immediately restore to enable the clutch release arm to return to the rest position and stop the rotation of the

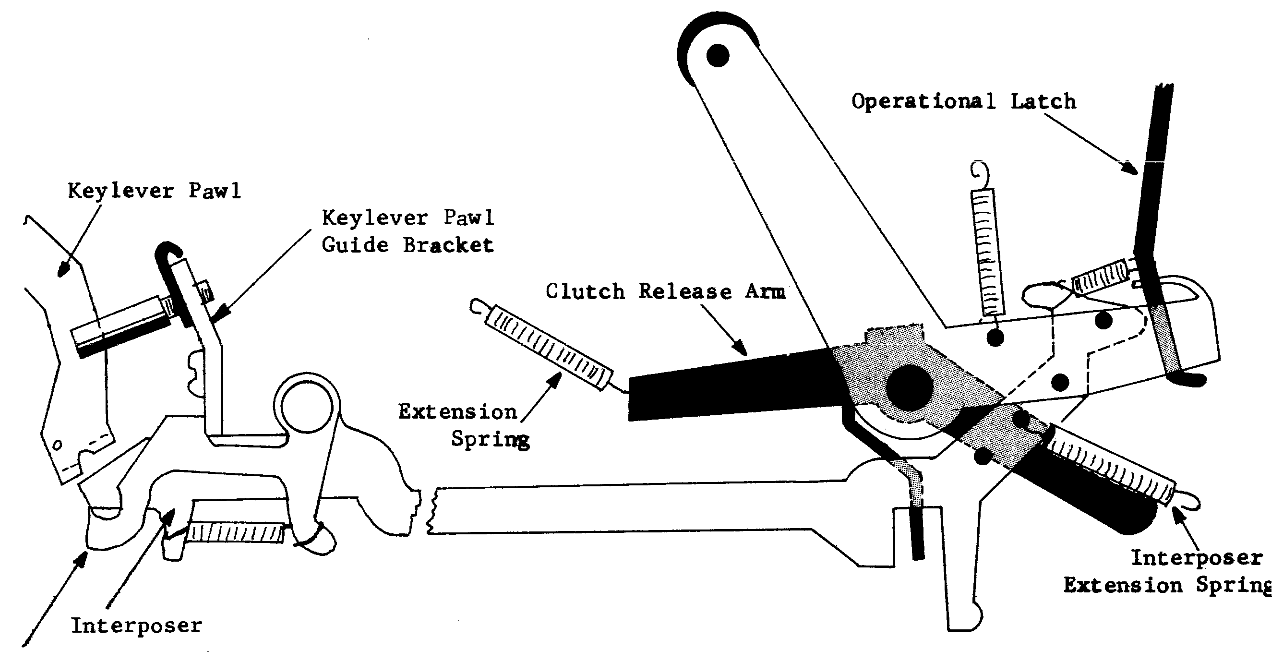


Figure 101. Space/Backspace/Tab Operational Control

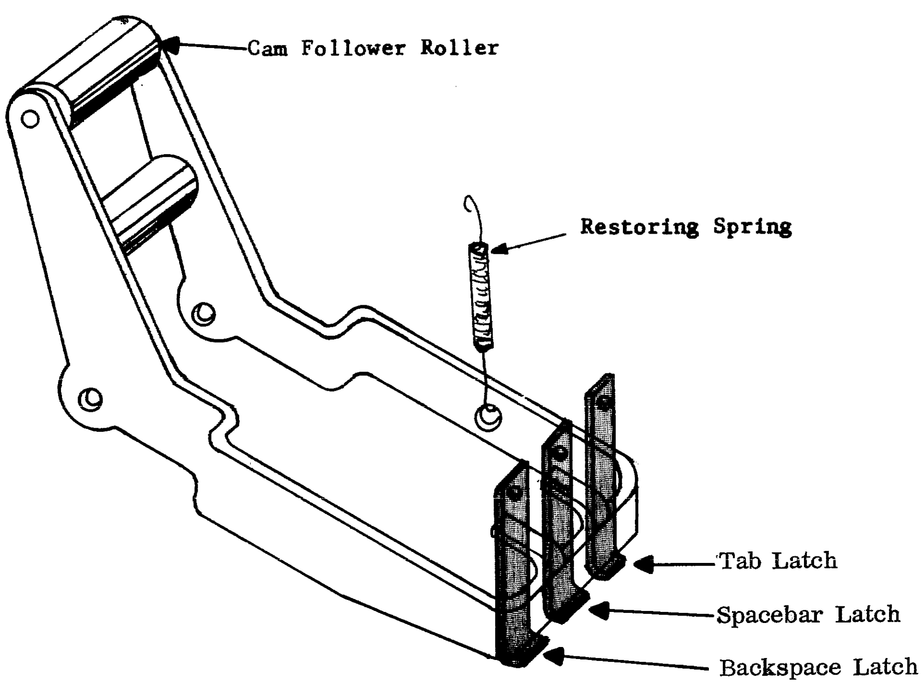


Figure 102. Space/Backspace/Tab Cam Follower.

cam. The interposer restoring lever (figure 103) pivots between the sides of the operational control bracket; it is located just to the rear of the interposers, causing them to be restored. A lug on either side of the restoring lever makes contact with both cam followers. Another lug, on the bottom of the restoring lever, makes contact with the rear portion of the five interposers. Either cam follower rotating backward by a cam forces the top of the restoring lever backward and pivots the bottom forward, pushing the interposer forward and allowing it to latch on the guide bracket.

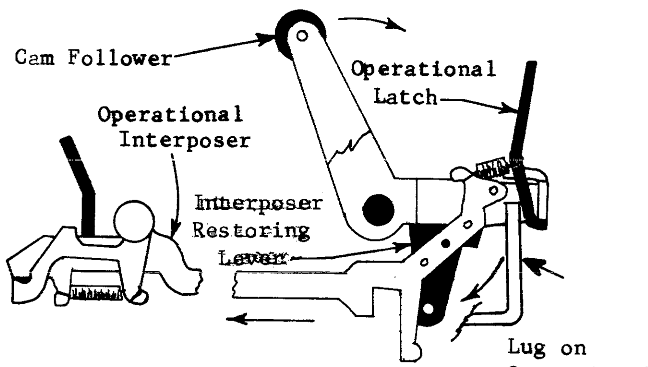


Figure 103. Operational Latch Locked to the Rear

OPERATIONAL LATCH SELECTION

All operations except index have a small, hook-shaped latch located to the rear and against the interposers. These are called the operational latches, and are attached at the top to their individual operational mechanisms. Indexing does not require an operational latch because it operates, through its link, whenever the carrier-return/indexing cam rotates. An interposer released to the rear not only trips a cam, permitting it to rotate, but also pushes the latch for that interposer to the rear. As the latch moves to the rear, its hooked portion extends beneath an extension on the cam follower arm. As the cam follower moves to the rear by the cam, the rear of the cam follower arm pivots downward, forcing the operational latch down. This activates the associated mechanism for the latch. However, as the cam follower moves to the rear, the interposer immediately begins to restore to the front. As this happens, an extension spring connected from the rear of the interposer to the latch exerts a pull forward on the latch, attempting to pull it from beneath the cam follower arm. This is prevented by a lug on the operational bracket (figure 103), which extends in front of the latch when forced down by the cam follower. As the low point of the cam allows the cam follower rear to restore upward, the operational latch clears the lug and immediately restores to the rest position against the interposer.

OPERATING SEQUENCE

Depressing an operational key causes the keylever pawl to trip its interposer from the keylever pawl guide bracket. As this occurs, the interposer is pulled to the rear by an extension spring. As the interposer spring loads to the rear, a lug on the interposer contacts the bottom extension of the clutch release arm and forces it to the rear. This causes the front of the clutch release arm to pivot out of engagement with the clutch wheel and begins a cam rotation. The interposer also pushes its operational latch to the rear and beneath the cam follower arm extension. As the cam rotates, it forces the top of the cam follower to the rear, pivoting the rear of the cam follower downward. This forces the operational latch downward, activating its mechanism. At the same time, the interposer restores to the front by the interposer restoring lever, which frees the middle extension of the clutch release arm and allows the arm to restore upward into the path of the next lug on the clutch wheel, stopping cam rotation. The low point of the cam coming under the cam follower arm, allows the rear of the arm to restore upward. This allows the selected operational latch to restore against its interposer, thereby completing the operation.

Answer the following questions:

1. What operational functions are not powered by the left hand operational shaft cam?

2. What prevents the cam pawl from rotating into the clutch ratchet?

3. What restores an operational interposer?

4. What controls the amount of bite between the clutch release arm and the clutch wheel?

5. Which operations do not make use of an operational latch?

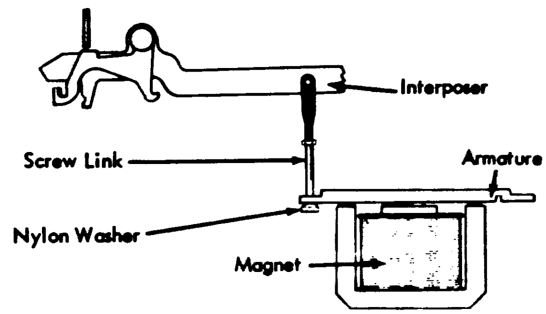
6. What is the purpose of the cam check pawl?

The operational selection unit consists of two assemblies: a magnet unit and a contact assembly (figure 104A). The entire unit mounts to the powerframe directly beneath the operational interposers.

MAGNET UNIT

The magnet unit consists of five magnet assemblies, one for each of the operational interposers. The magnet unit permits selection of an operational function from an external device without the need to depress a keylever. The magnets are mounted to a bracket on the powerframe. A link, connected to the operating end of the armatures of each magnet (figure 104B), also connects to each of the interposers. Latching a magnet creates a downward pull on the link, tripping the interposer from the guide bracket and permitting a normal operational sequence. The link is mounted to allow complete movement of the interposer without changing the length of the link.

A.



B.

Figure 104. Operational Selection Unit

CONTACT ASSEMBLY

The contact assembly consists of five sets of transmitting contacts, each having its own latch (figure 105). Each contact set has three separate contacts that make with three other contacts. A contact bail (figure 106) holds the contacts open. Two contact actuating arms are operated by two cam check pawls (figure 107). The right hand actuating arm is operated by the carrier-return/index check pawl and controls two sets of contacts. The left hand actuating

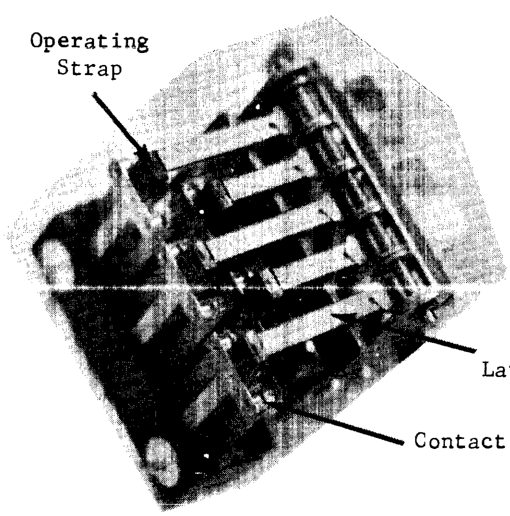


Figure 105. Operational Control Assembly

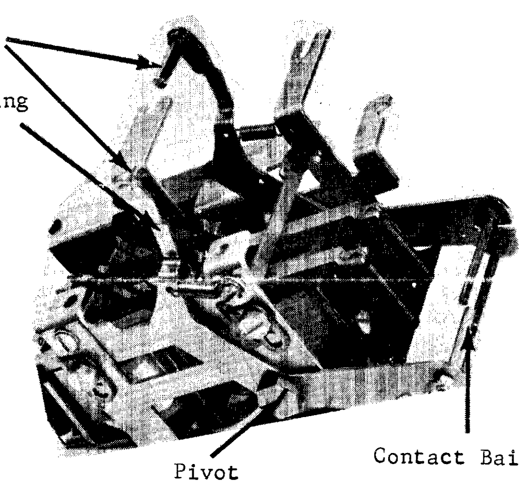


Figure 106. Actuating Arm

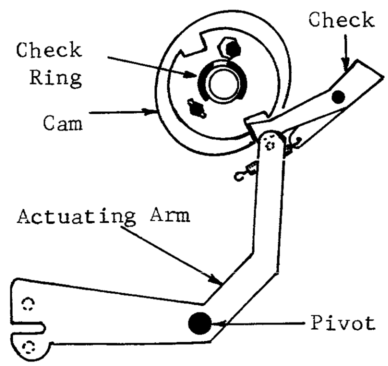


Figure 107. Actuating Arm Operated by Check Pawl

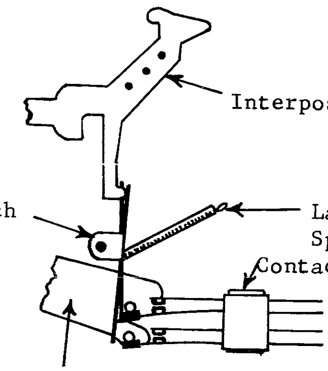


Figure 108. Contact Pawl and Latch Operation

arm is operated by the space/backspace/tab check pawl and controls three sets of contacts. A shouldered screw mounts the two arms to each side of the contact assembly. Both arms are shaped in a 90° angle and pivot near the bottom. Riveted to the top of each arm is a pin in contact with the bottom of the cam check pawl (figure 106). Two contact bails mount to the bottom of each contact arm with eccentric nuts which permit adjustment of the bails. As a cam begins to rotate, its check pawl is forced downward by the surface of the cam check ring. This forces the top of its actuating arm downward, pivoting the bottom up. When this occurs, whichever contacts are under control of the arm will then be held open by their respective latches, except the latch tripped by an interposer. This particular set of contacts will spring close. As the cam completes its rotation, the cam check pawl again seats in a notch in the check ring, allowing the actuator arm to rise through action of its extension spring. The bails, on the bottom of the arm, will then drop and hold open all contacts which they control.

CONTACT LATCHES

The contact latches (figure 108) pivot on a shaft mounted to the contact assembly. In the rest position, the lower end of each latch is in the path of the operating straps of the sets of contacts, but not contacting the operating straps. The contact bails hold the operating straps. This prevents drag when the contact latch is pivoted out of the path of the strap.

As an operational key is depressed, releasing an interposer to the rear, a lower extension of the interposer trips the top of the latch to the rear, causing the bottom end of the latch to pivot out of the path of the contact strap. As the actuator arm begins to move, the set of contacts whose latch was pivoted by the interposer will close. However, the other contacts operated by that particular actuator arm will be held open by their respective latches. When the actuator arm fully restores the contacts back to the open position, the bottom of the tripped latch will again seat to the rear in the path of the actuator strap.

FEEDBACK CONTACTS

The feedback contacts (figure 109) are located at the right rear corner of the powerframe near the mainspring. The contact nearer the powerframe is the carrier-return/index contact

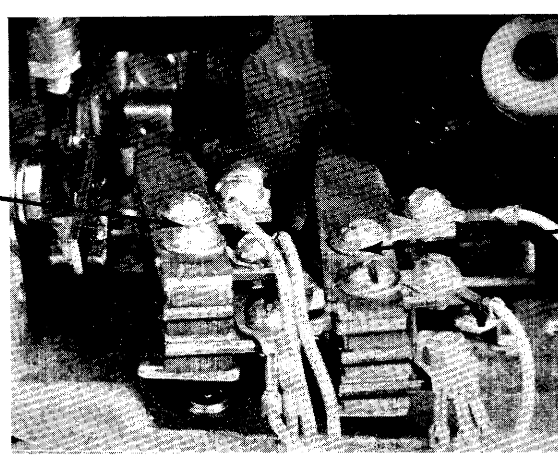


Figure 109. Operational Feedback Contacts

(C6); the other is the space/backspace/tab contact (C5). The C6 contacts operate by a tab on the cam follower lever; the C5 contacts operate by an auxiliary cam follower lever. As either lever moves down by rotation of the cam, the contacts close. Restoring either lever allows the contacts to spring open. The feedback contacts generate a busy signal while their cams are rotating.

Answer the following questions:

7. What operates the left hand actuating arm?

8. What is the purpose of the contact bails?

9. How long is the C6 contact held transferred?

SPACEBAR

The spacebar mechanism allows the carrier to move to the right without typing a character. It can be used to space between characters or to move the carrier quickly to the right along the typing line. Spacebar operation is similar to a print escapement operation in that the pawls must be tripped out of the escapement and backspace racks. The way the two operations differ is in the method of tripping the escapement trigger from the tab on the torque bar.

The spacebar (figure 110) located at the front of the printer is suspended on two lugs extending forward from the spacebar shaft. The spacebar shaft pivots on the left and right frames of the printer. A downward push on the spacebar causes the spacebar shaft to rotate. An extension of the spacebar shaft, called the spacebar stem, extends downward and contacts the spacebar tension spring (figure 110). The spacebar tension spring allows the spacebar to restore upward when released. Attached to the right end of the spacebar shaft is the spacebar operating arm. A spacebar lever connects to the spacebar operating arm by means of a forked slot. The spacebar lever pivots on a shaft toward the rear of the printer. At the rear of the spacebar lever is the spacebar lever pawl which rides in the forked slot of the keylever pawl guide bracket. A push downward on the spacebar causes the spacebar operating arm to rise. As the arm rises, the back of the spacebar lever pivots downward forcing the spacebar lever pawl downward. This contacts the front of the spacebar interposer, tripping it from the guide bracket. The interposer, spring loaded to the rear, pushes the spacebar latch beneath the cam follower arm, allowing the latch to operate downward by the cam follower arm. The spacebar latch mounts to a horseshoe-shaped bracket called the spacebar latch lever (figure 111) by a rivet joint, permitting free movement of the latch. The spacebar latch lever pivots on a pin on the operational latch bracket assembly located to the rear of the powerframe, just in front of the mainspring. As the latch operates downward by the cam follower arm, the spacebar latch lever pivots downward. An adjusting screw located on the spacebar latch lever contacts the trigger lever, causing it to pivot downward. As the trigger lever pivots downward it forces the trigger to cam the torque bar to the rear in the same manner as in the print escapement mechanism. This unseats the escapement and backspace pawls from their racks and allows an escapement operation.

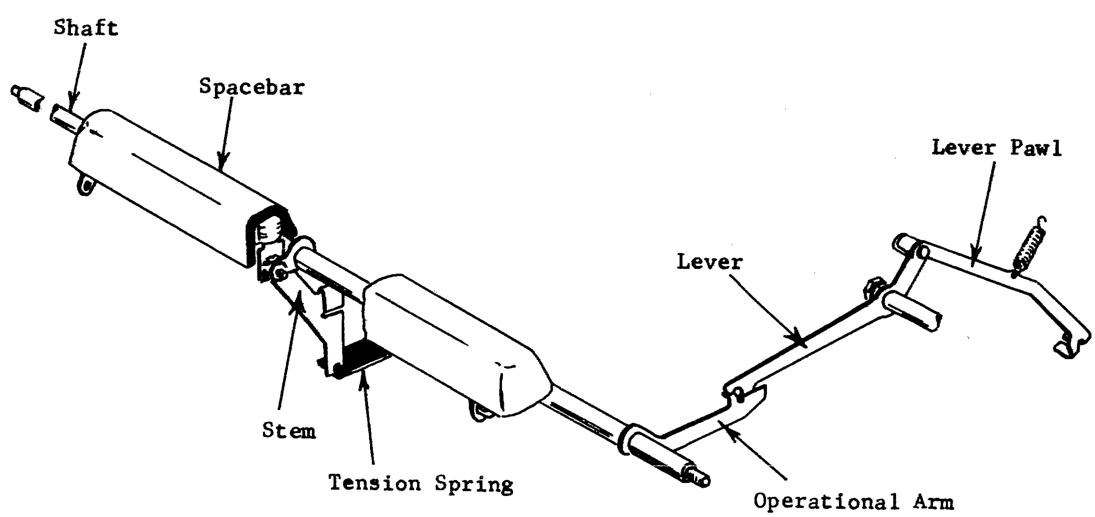


Figure 110. Spacebar Lever Mechanism

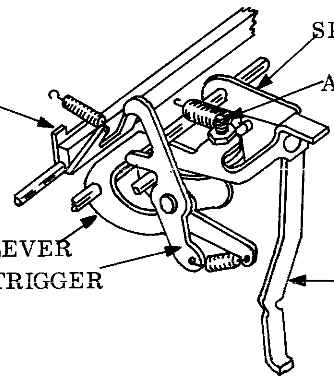


Figure 111. Spacebar Latch Operation

SPACEBAR LOCKOUT

Because both the spacebar mechanism and the print escapement mechanism operate by actuating the trigger lever, it might be possible to miss spacing between words. For example, if a character keylever and the spacebar were depressed, one immediately after the other, the trigger lever would be cammed downward by the print escapement mechanism. However, before the trigger could restore to the top of the torque bar lug, the spacebar would immediately cam the trigger lever down again but would not pull the torque bar down, since the trigger would not be above the lug. Consequently, no space would occur between words on the print line.

To be certain that the spacebar always actuates an escapement operation, the spacebar mechanism is placed in storage until the print operation ends. The spacebar lockout mechanism (figure 112) is located below the filter shaft within the operational control bracket and consists of an interlock interposer, a cam, and a bracket. The cam mounts on the filter shaft. When the shaft is in its rest position, an upper extension of the interlock interposer contacts the high point of the interlock cam. This permits a lower extension of the interlock interposer to clear the spacebar interposer, allowing it to move to the rear during a spacebar operation. When a print operation occurs, however, the filter shaft rotates. As the shaft rotates, the spacebar interlock cam rotates, allowing the upper extension of the interlock interposer to be spring-loaded forward enough for the lower extension of the interlock interposer to swing into the path of the spacebar interposer. At this time, if the spacebar is depressed, the spacebar interposer contacts the lower extension of the interlock interposer, preventing it from moving to the rear to initiate a spacebar operation. As the filter shaft completes its rotation, the high point of the spacebar interlock cam again forces the upper extension of the interlock interposer to the rear, pivoting the lower extension of interlock interposer downward. This releases the spacebar interposer, allowing it to move to the rear and initiate a spacebar operation.

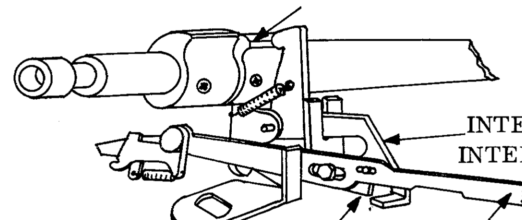


Figure 112. Spacebar Lockout

Should a character keylever and the spacebar be depressed simultaneously, a collision could occur between the spacebar interposer and the lower extension of the interlock interposer. To prevent damage, the upper extension of the interlock interposer spring loads into its active position but is power driven to the rest position. This is the only instance that the spacebar interposer will not be stored. Only a single space operation occurs.

Answer the following questions:

10. In what way do the spacebar and print escapement mechanisms differ?

11. What is the purpose of the spacebar lockout?

12. What actually occurs in the spacebar lockout to prevent the spacebar interposer from releasing to the rear?

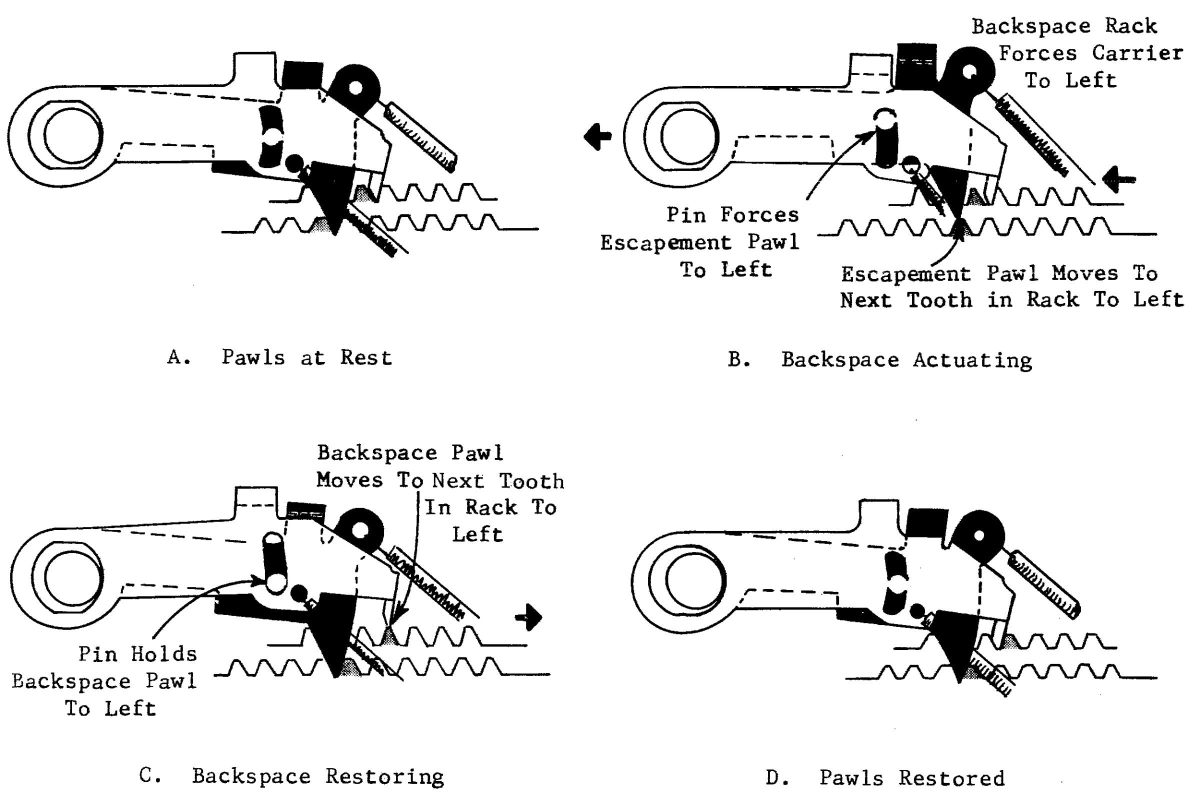
The backspace mechanism (figure 115) positions the carrier to the left one space at a time. Unlike the escapement rack anchored solidly to the sideframes of the printer, the backspace rack moves. In the rest position, the escapement pawl is held tightly to the right in the escapement rack by the weight of the carrier. The backspace pawl, however, sits freely in the backspace rack. To permit a backspace operation, the backspace rack must be pushed to the left. As the rack contacts the backspace pawl, the carrier is forced to the left, pivoting the escapement pawl out of the escapement rack. The pin, which is part of the escapement pawl, fits into a slot in the backspace pawl, forcing both pawls to move to the left together. At the same time, however, it allows the escapement pawl to pivot out of its rack while leaving the backspace pawl in the backspace rack (figure 114A). As the backspace rack continues to push to the left, the escapement pawl begins to drop into a tooth one notch back in the escapement rack. At the same time, the backspace rack begins to restore to the right. As this occurs the escapement pawl, already in a new notch in the escapement rack, prevents the carrier from being pulled to the right. Thus, as the backspace rack continues restoring to the right, the backspace pawl slides out of the backspace rack (figure 114B) and seats into the backspace rack one notch to the left. This is the rest position, the completion of the backspace operation. Depression of the backspace keylever (figure 115) causes the keylever pawl to trip the front of the interposer from the guide bracket.

The interposer then moves to the rear, pushing the backspace latch beneath the cam follower arm. The top of the backspace latch connects to the backspace bellcrank (figure 113) in such a manner that a downward pull on the latch causes the backspace bellcrank to pivot clockwise. Connected to the backspace bellcrank is an adjustable screw. This screw contacts the intermediate backspace lever, which pivots at the top of the operational latch bracket. As the backspace bellcrank and the adjustable screw force one end of the intermediate backspace lever to the right, the other end of the intermediate lever forces the backspace rack to the left, beginning a backspace operation. The adjustable screw provides the proper throw for the backspace rack. The backspace rack is spring loaded to the right by an extension spring which restores the backspace rack and mechanism when the rack has completed its travel.

Answer the following questions:

13. What forces the backspace pawl to pivot out of the backspace rack on a backspace restoring operation?

14. What restores the backspace operational latch?



A. Pawls at Rest

B. Backspace Actuating

C. Backspace Restoring

D. Pawls Restored

Figure 114. Backspace Operation

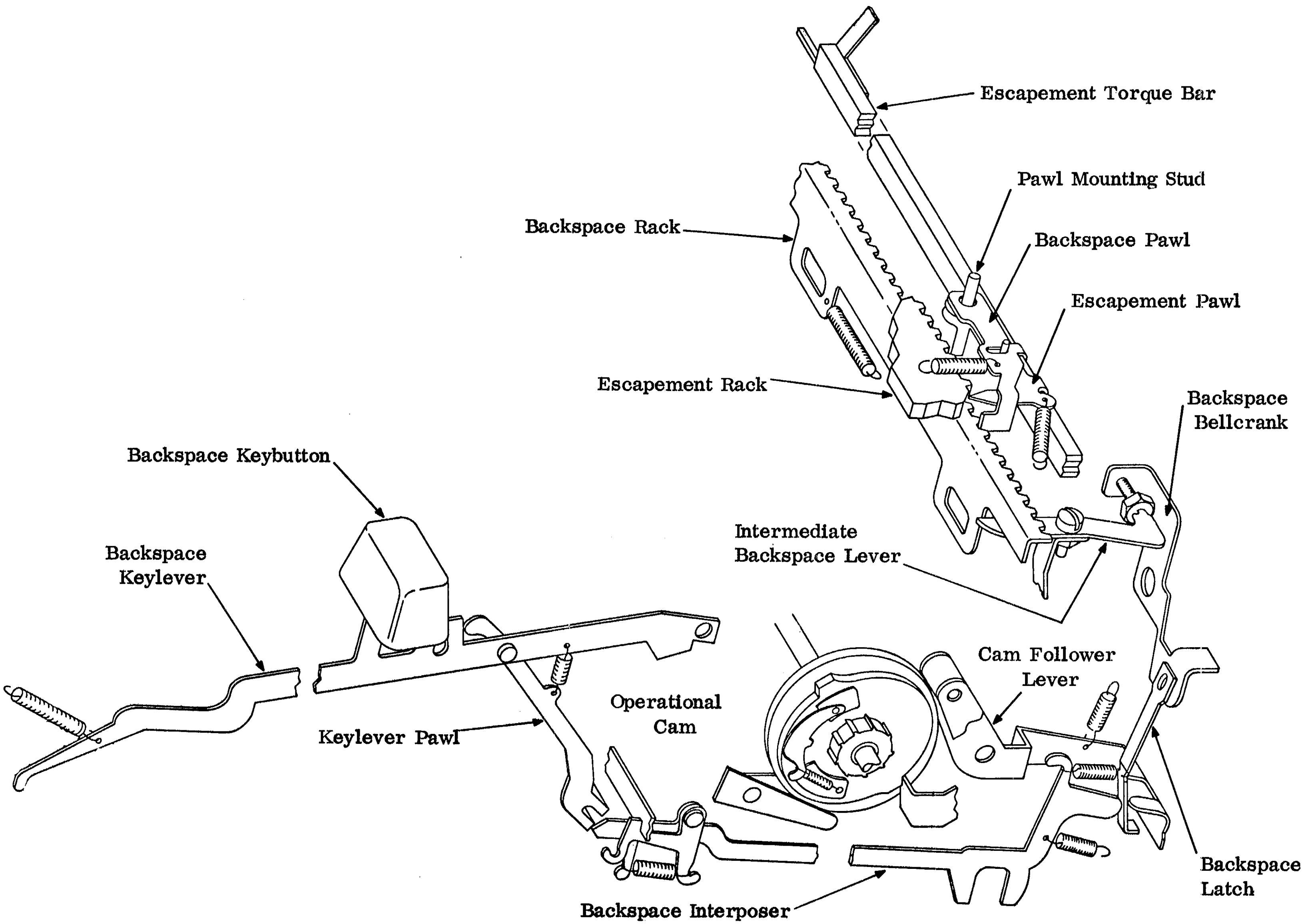


Figure 115. Backspace Mechanism

The carrier return mechanism (figure 116) powers the carrier to the left margin and indexes (line spaces) the paper.

The carrier moves to the left by the carrier return cord winding onto its drum as the drum rotates in a clockwise direction. Clockwise drum rotation opposes the tension of the mainspring, forcing it to rotate with the operational shaft. This is accomplished by the beveled gear on the space/tab cord drum. This gear meshes with a small pinion gear (figure 116) on the operational shaft. The pinion gear rotates freely on the operational shaft and is driven by a spring clutch. When the pinion gear rotates with the operational shaft via the spring clutch, it will rotate the space/tab cord drum in a clockwise direction, winding up the cord.

A hub on the pinion gear fits inside the carrier return clutch spring. The left side of the spring fits around, and is clamped tightly to a hub on the operational shaft. This allows the clutch spring to rotate continuously with the operational shaft. If the right end of the spring is pushed against the hub of the pinion gear, friction causes the spring to wrap around the hub and drive the pinion gear. A nylon shoe, mounted to the rear of the spring, applies pressure to the spring forcing it to wrap around the pinion hub. Separation of the shoe from the spring allows the spring to return to its normal position, releasing the drive to the pinion gear. The nylon shoe must compress the spring until the carrier returns to the left margin, when the shoe releases the spring and drops the drive to the pinion gear.

When depressed, the carrier return keylever causes the carrier return interposer to trip the carrier-return/index cam and pushes the carrier return operational latch beneath the cam follower arm. As the cam operates the cam

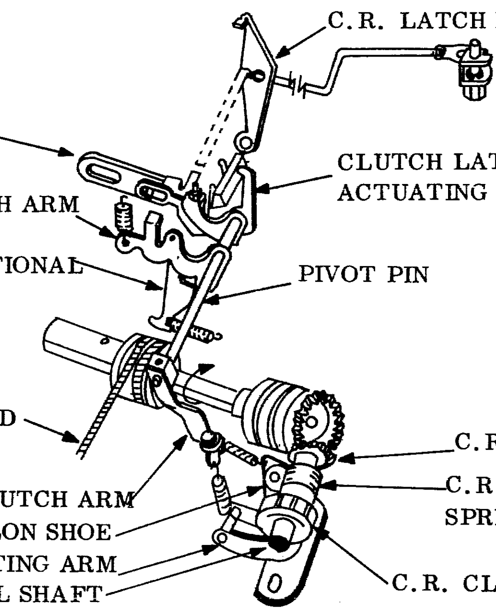


Figure 116. Carrier Return Mechanism

follower arm downward, it also activates the index mechanism, linespacing the paper. The carrier return operational latch attaches to the carrier return latcharm which pivots on a shaft on the operational latch bracket at the right rear of the printer. This same shaft is the pivot point for the escapement trigger lever and the spacebar latch lever.

Attached solidly to the right end of the pivot pin is a bellcrank-type device called the clutch latch actuating arm. As the operational latch is pulled down, an adjusting screw on the right side of the carrier return latch arm forces the rear of the clutch latch actuating arm downward. This causes:

1. the escapement torque bar to rotate to the rear by the top extension of the clutch latch actuating arm. This drives the escapement and backspace pawls from their racks to prevent a ratcheting effect as the carrier moves to the left.
2. the pivot pin, solidly attached to the clutch latch actuating arm, to rotate toward the rear. The other end of the pivot pin is setscrewed to the carrier return clutch arm which, in turn, is connected to the carrier return actuating arm by a heavy extension spring. The upward extension of the carrier return actuating arm contains the nylon shoe (figure 118). As the pivot pin rotates

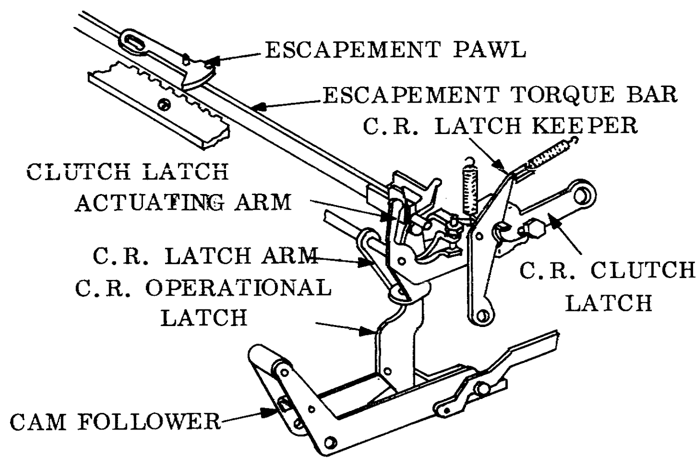


Figure 117. Carrier Return Latch Operation

to the rear it forces the carrier return clutch arm upward. This, in turn, pulls up on the carrier return actuating arm and causes the nylon shoe to pivot against the carrier return clutch spring, forcing it to drive the pinion gear. The heavy extension spring, extended somewhat, maintains constant pressure of the nylon shoe against the clutch spring.

3. The clutch latch actuating arm (figure 117) to lock into position, allowing the carrier return operation to continue--even after the cam ceases rotating--until the carrier reaches the left hand margin. At this time the actuating arm is released and the carrier return operation ceases.

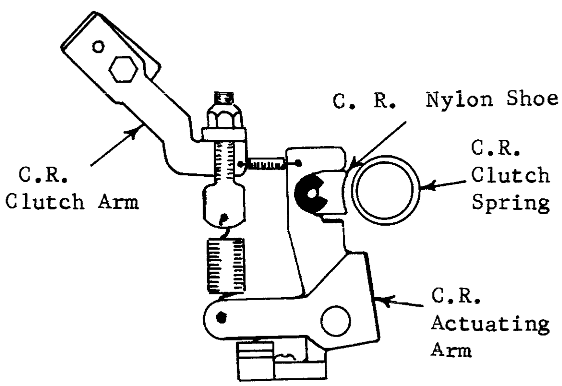


Figure 118. Carrier Return Clutch Actuating Mechanism

Attached to the rear of the actuating arm by means of a slotted hole and eccentric adjusting screw, is the carrier return clutch latch with an extension to the right. Spring-loaded against this extension is the carrier return latch keeper with a notch in its rear surface. As the rear of the clutch latch actuating arm pivots downward, the carrier return clutch latch pivots down far enough to allow the notch in the latch keeper to snap over the extension. This locks the actuating arm down. Attached to the latch keeper is a link extending toward the front of the printer and connecting to the carrier return unlatching bellcrank (figure 119).

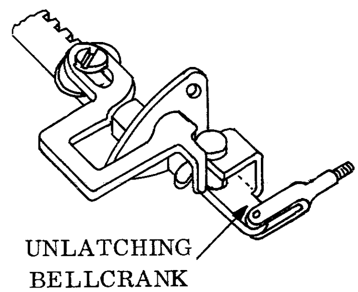


Figure 119. Carrier Return Unlatching Bellcrank.

The margin rack is located in front of the carrier mounts between the sideframes. The left end of the margin rack is springloaded to the right in the rest position. As the carrier strikes the left margin stop, the margin rack is forced to the left. An adjustable horseshoe-shaped right-hand extension of the rack contacts an arm of the unlatching bellcrank causing it to pivot forward. This exerts a pull on the unlatching link pulling the latch keeper far enough forward to allow upward restoration of the carrier return clutch latch. This restores the remainder of the carrier return mechanism. A small extension spring then pulls the nylon shoe to the rear, into the rest position away from the clutch spring. If the carrier return keylever is depressed while the carrier is in another carrier return operation, only an indexing operation occurs.

Should the carrier return keylever be pressed while the carrier is at the left margin, latching of the clutch is prevented since the latch keeper is pulled forward by its link. The cam still rotates, causing a carrier return operation to begin; however, with the carrier at the left margin, the cord drum cannot take up any more cord even though the pinion gear tries to drive it. Slippage must occur in the clutch mechanism to prevent damage. This is accomplished by the torque limiter spring (figure 120).

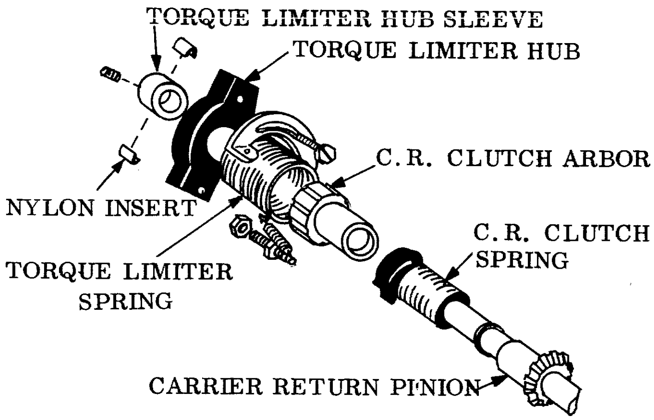


Figure 120. Torque Limiter, Exploded View

TORQUE LIMITER

The carrier return clutch spring is tightly fastened by a collar to the clutch arbor. The arbor is not directly driven by the operational shaft. The arbor shoulder fits into a heavy torque limiter spring. The left end of the spring is clamped to the torque limiter hub setscrewed to the operational shaft. The inside diameter of the torque limiter spring is considerably smaller than the clutch arbor which it drives. Even though the rotation of the operational shaft is in the unwinding direction of the spring, enough friction develops between spring and arbor to drive the arbor. However, unwanted slippage can still occur with this arrangement, so an extension spring is connected from an eye-hole in the right end of the torque limiter spring to a lug on the torque limiter hub. This prevents slippage during normal operation.

When the pinion gear can no longer drive the cord drum (carrier at the left margin), the clutch arbor is also prevented from rotating and the torque limiter spring then slips around the clutch arbor. This slippage also occurs at the beginning of a carrier return operation to allow smooth acceleration.

CARRIER RETURN INTERLOCK CONTACT

Three types of contacts are used in a carrier return operation. Two of them--C6 and transmitting--were discussed previously. The third type is an interlock contact (figure 121). The interlock contact prevents an output to the typewriter during a carrier return operation.

The carrier return interlock contact mounts to the right side of the powerframe and is operated by the carrier return clutch latch. As the clutch latch is forced down by the clutch latch actuating arm, the latch transfers interlock contacts. The contacts remain transferred until the keeper unlatches the clutch latch, at which time the contacts return to their rest position.

While transferred, the interlock contacts cause a busy signal to be generated. The busy signal is present throughout a carrier return operation.

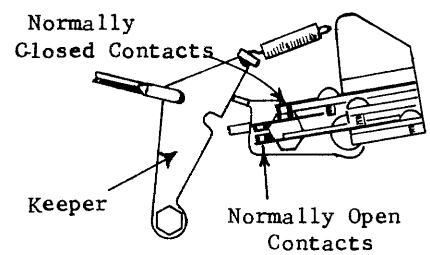


Figure 121. Carrier Return Interlock Contacts

Answer the following questions:

15. Does the mainspring aid or oppose a carrier return operation?
16. Is the clutch latch actuating arm solidly attached to the pivot pin? Why?
17. Why must the carrier return clutch latch be locked in the active position?
18. What drives the carrier return clutch arbor?
19. Why must slippage occur in the carrier return clutch mechanism?

INDEXING

The indexing mechanism (figure 122) line-spaces the paper vertically one or two spaces, depending upon the position of the index selector lever. Indexing occurs whenever the carrier return or indexing operational keybuttons are depressed. A ratchet is attached solidly to the right side of the platen. Indexing is accomplished by moving this ratchet with the indexing pawl.

When either the carrier return or indexing keybuttons are depressed, the carrier return/indexing cam begins to rotate. As it rotates, the rear of the cam follower arm is forced down causing a downward pull on the index link connected to the rear of the cam follower arm. Regardless whether the indexing operation is set for single or double space, the downward travel of the index link is always the same.

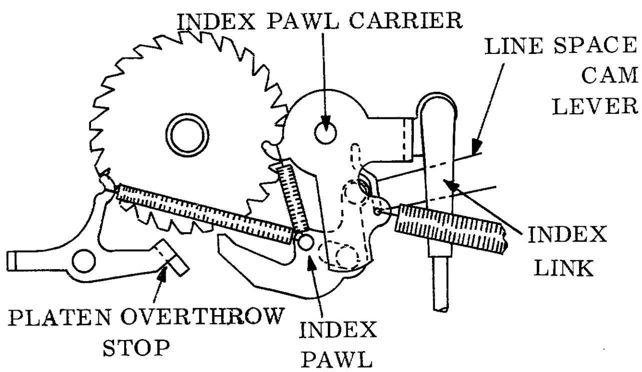


Figure 122. Index Mechanism, Rest Position

The top of the index link connects to a bell-crank device called the index pawl carrier which pivots on a pin at the right side of the powerframe. Attached to the other side of the index pawl carrier, by a rivet joint connection, is the index pawl. This arrangement permits free movement of the index pawl relative to the index pawl carrier. If the index link is to move the same distance for single space operation as for a double space, then the indexing pawl must be allowed to enter the ratchet sooner for double-space than for single-space operations. This is controlled by the line space cam lever which, in turn, is controlled by the index selector lever. Sufficient pull is exerted on the index link to always cause a double-space operation. To double space, the indexing pawl is allowed to immediately enter the ratchet. As the link is pulled down, the ratchet will be cammed forward by the pawl until the pawl contacts the platen overthrow stop (figure 123). At this time the ratchet is not allowed to rotate further, since it has rotated two notches. For a single-space operation, the pawl is restricted from immediately entering the ratchet and will first pass over one ratchet tooth. It then enters the ratchet, driving the ratchet until the pawl contacts the platen overthrow stop. At this time

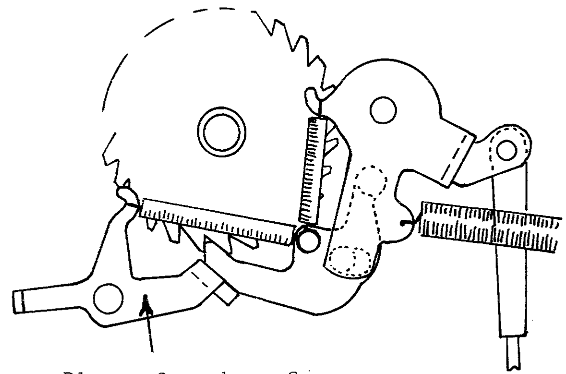
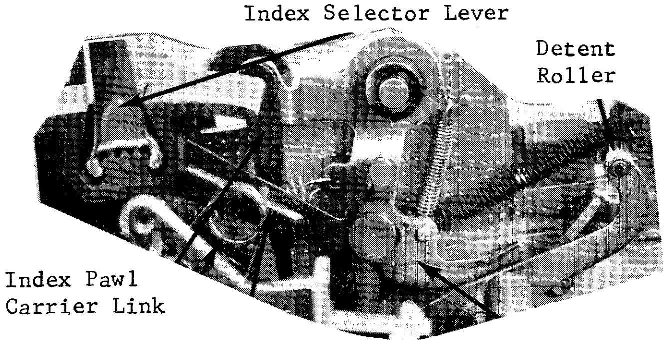


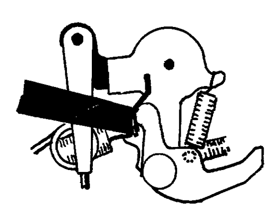
Figure 123. Index Mechanism, Active Position

the ratchet stops rotating. A stud at the side of the index pawl makes contact with one of two steps on the forward end of the cam lever. With the index selector lever forward for single space, the upper step of the line space cam lever (figure 124A) contacts the extension of the index pawl. This forces the index pawl to rest some distance from the ratchet. As the index link is pulled down the index pawl drives the distance of one ratchet tooth before entering the ratchet. The pawl then drives one more ratchet tooth, performing a single-space operation.

When the index selector lever is pushed to the rear the stud on the index pawl contacts the lower step on the line space cam lever (figure 124B). This holds the tip of the index pawl very close to the platen ratchet. When the index link is pulled down the pawl will immediately enter the platen ratchet and drive two spaces. A hairpin spring (figure 124A) holds the index selection lever in single or double-space position. Two lower extensions of the selection lever



a. Single Space Position



b. Double Space Position

Figure 124. Index Selection Mechanism

limit the travel of the lever to one of two positions as they will contact a stud on which the hairpin spring is mounted.

The platen overthrow stop (figure 123), mounted securely to the sideframe of the printer, prevents the platen from overthrowing farther than one or two space positions. As the index pawl rotates the ratchet, the pawl contacts the overthrow stop which wedges the pawl into the ratchet tooth and forces the ratchet to stop moving. Operation of the indexing mechanism occurs upon depression of the indexing keylever. The keylever pawl, spring-loaded to the index keylever, rides in the slot of the guide bracket. As the indexing keybutton is depressed, the keylever pawl is forced down, tripping the indexing interposer from the guide bracket, allowing it to initiate an indexing operation. A spring attached from the indexing pawl to the platen overthrow stop, spring-loads the index pawl toward the platen. As the indexing link begins its downward movement, the link tends to kick the platen ratchet, accelerating it. The spring allows the pawl to catch up to the ratchet so that they both reach the platen overthrow stop at the same time and the ratchet is prevented from moving any further.

The platen is held firmly in place and kept from creeping by the index detent lever located just below the platen. Mounted to the front end of the detent lever is a roller, spring-loaded into the teeth of the ratchet by an extension spring at the rear of the detent lever. As the ratchet rotates, the roller moves from one tooth to the next, assuring even spacing at all times.

Answer the following questions:

20. What prevents the platen from creeping?

21. What is the purpose of the platen overthrow stop?

TABULATOR

The tabulator mechanism quickly positions the carrier to the right along the writing line. The space/tab/backspace cam powers the tab operation. Several events occur during a tab operation:

1. Preset stopping point selected.
2. Escapement and backspace pawls released.
3. Escapement and backspace pawls held latched.
4. Speed of carrier controlled.
5. Restoration of pawls to their racks at correct time.

TAB SET AND CLEAR

The tab rack (figure 125), located just to the rear of the carrier, contains tab stops--one for each escapement position of the carrier. These tab stops operate friction-tight in grooves of the tab rack. Depressing the TAB keylever allows the carrier movement to the right until it contacts a set tab stop. Setting or clearing a tab stop is the function of the tab CLR/SET keybutton on the left of the keyboard.

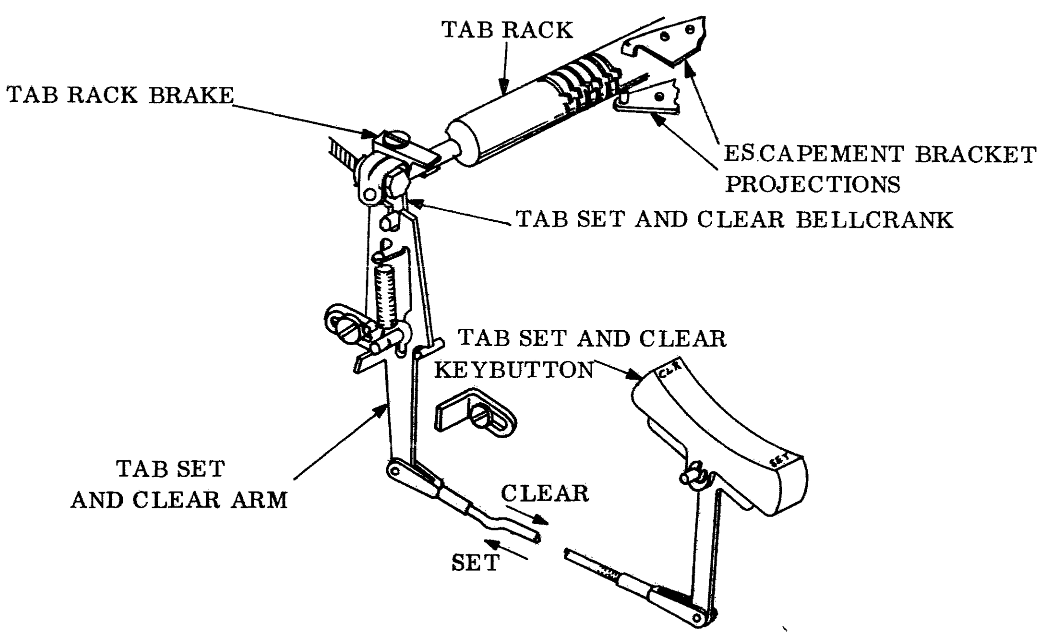


Figure 125. Tab Set and Clear Mechanism

The SET portion of the keybutton, when depressed, causes the front of the tab rack to rotate upward (figure 126A). As this occurs, one of the tab stops contacts an upper projection of the escapement bracket. The tab stop is then prevented from rotating with the tab rack and is forced downward in the tab rack. When the SET keybutton is released, the tab rack rotates back to its rest position, leaving the tab stop lower than the other stops and in a position to be contacted by the carrier on a tab operation (figure 126B).

The CLR portion of the keybutton, when depressed, rotates the front of the tab rack downward. The set tab stop which is lower than the other stops, contacts a lower projection of the escapement bracket and is prevented from rotating with the tab rack. Then the tab stop is forced upward in the tab rack (figure 126C). When the CLR keybutton is released, the tab stop is in the cleared position (figure 126D).

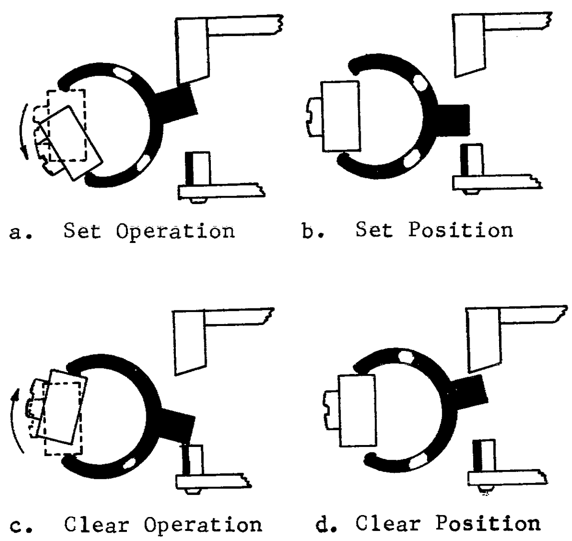


Figure 126. Tab Set and Clear Operation

To set or clear a tab stop, the carrier must be in position because projections from the carrier cause the operation to occur. One tab stop remains set at all times. It is located at the far right of the tab rack and is the tab final stop. This disengages the tab operation when the carrier has reached the limit of its travel to the right.

GANG CLEAR

The function of the gang clear is to clear all tab stops in one operation. This is accomplished by positioning the carrier to the far right, depressing and holding the CLR keybutton, and either causing a carrier return operation or manually moving the carrier to the left.

This gang clear operation requires a slightly different tab rack and a gang clear finger. The tab stops operate freely about a shaft which runs through the tab rack. Each stop rides in a slot of the tab rack. Sections of spring fingers (figure 127) are mounted to the entire length of the tab rack and operate against upper projections of each tab stop. The spring fingers hold the tab stops detented in a set or clear position.

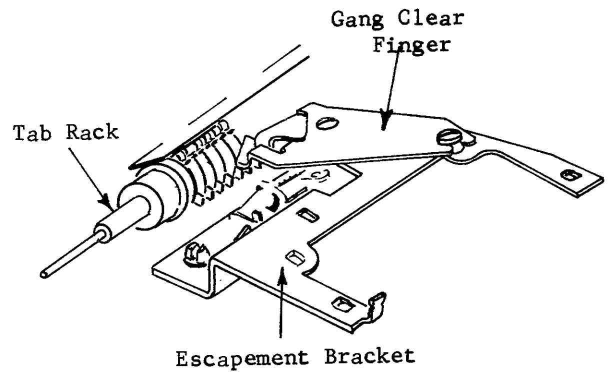


Figure 127. Gang Clear Finger

The projection of the gang clear finger extends just below the projections of the tab stops. A set operation is the same as described previously, in that a tab stop contacts an upper projection of the escapement bracket and is prevented from rotating upward with the tab rack (figures 128A and B).

When the CLR keybutton is depressed, the front of the tab rack rotates downward. The set tab stop contacts the gang clear finger and is prevented from rotating further. Since the tab rack still rotates, the tab stop is then pushed into the rest position (figures 128C and D).

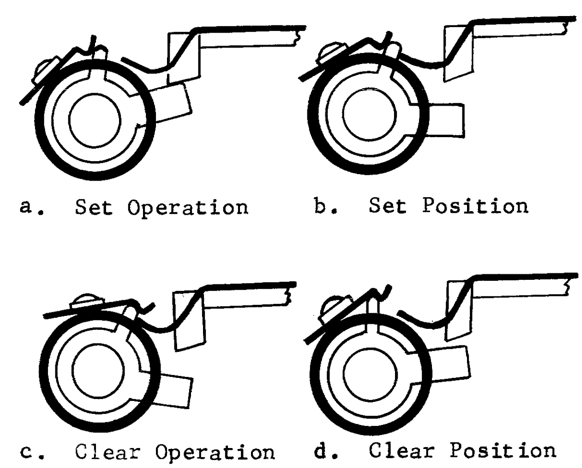


Figure 128. Tab Set and Clear (Gang Clear)

During a gang clear operation, the tab rack is held rotated in the clear position. As the carrier moves to the left, the beveled left side of the gang clear finger contacts the projections of the set tab stops and cams them upward into the rest position.

An extension spring on the tab set and clear arm restores the tab rack to the rest position from either a set or clear operation. A leaf spring, at the left end of the tab rack, applies braking action to the tab rack to prevent its overthrowing the rest position and either partially setting or clearing a tab stop.

KEYLEVER AND RELEASE ASSEMBLY

The TAB keylever, located on the left of the keyboard, operates a bail which extends across the front of the printer (figure 129). A keylever on the right actuates the tab interposer which releases the space/tab/backspace cam and pushes the tab latch beneath the cam follower arm. The upper end of the tab operational latch connects to a bellcrank. As the operational latch is pulled down by the cam follower, the other end of the bellcrank moves up. A link

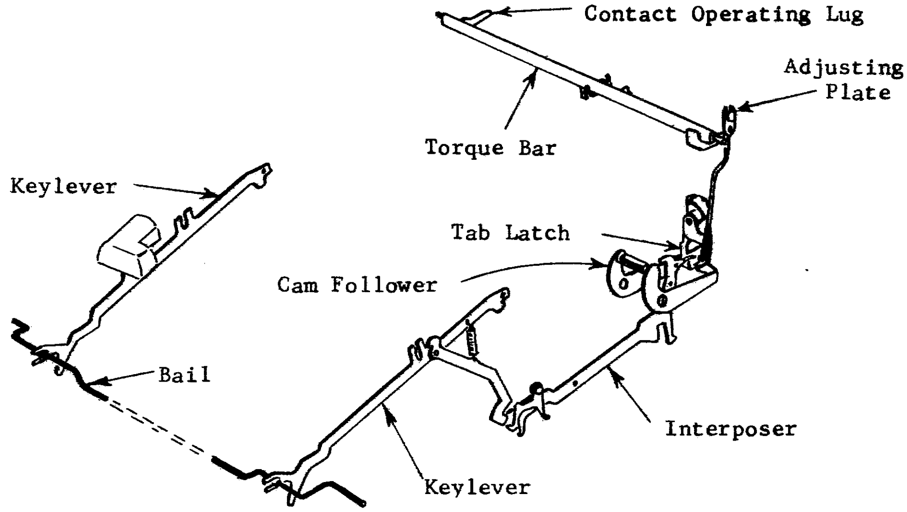


Figure 129. Tab Operational Mechanism

connects from this end of the bellcrank to an adjusting plate on the right end of the tab torque bar (figure 130). As the link is pushed up by the bellcrank, the bottom of the tab torque bar rotates to the rear, tripping the escapement and backspace pawls from their racks. The tab torque bar mounts the same as the escapement torque bar, though higher with its pivot point at the top.

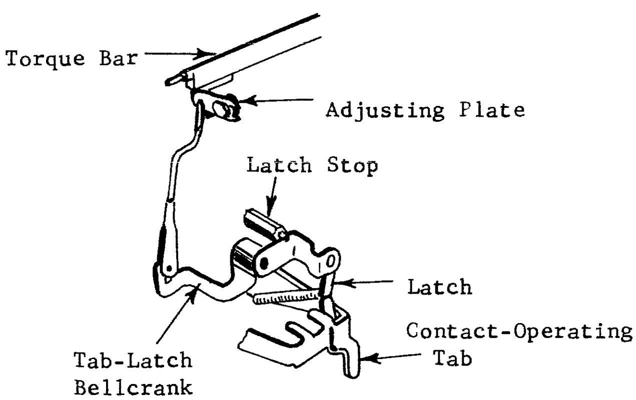


Figure 130. Tab Latch

TAB LATCHING

As the tab torque bar pivots to the rear, it contacts the tab lever trigger (figure 131) which moves the tab lever to the rear. The tab lever pivots on the escapement bracket on the same pivot pin as do the escapement and backspace pawls. As the tab lever pivots toward the rear, a lug on the front contacts the escapement and backspace pawls and trips them from their racks. A small latch, the tab-lever latch, pivots on the escapement bracket and is spring-loaded against the side of the tab lever assembly.

When the tab lever is pushed far enough to the rear to trip the escapement and backspace

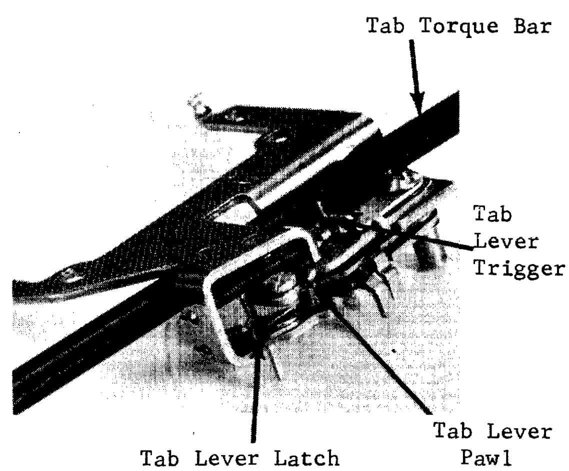


Figure 131. Tab Lever Trigger

pawls, the tab lever latch springs into a notch at the rear of the tab lever assembly and locks the tab lever assembly, along with the pawls, to the rear. The carrier is then free to move to the right.

OVERTHROW STOP

The tab overthrow stop (figure 132) mounts on the top of the escapement bracket and extends to the rear and down behind the tab lever trigger. The stop is adjustable and prevents the tab lever from overthrowing into the tab rack.

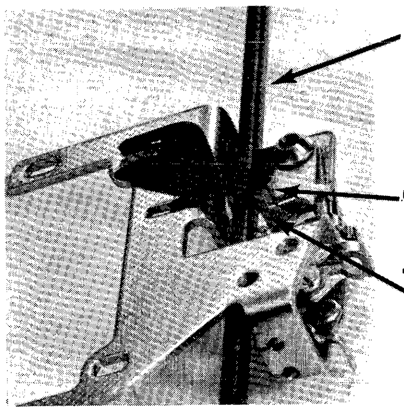


Figure 132. Tab Overthrow Stop

TAB GOVERNOR

The tab governor regulates the speed of the carrier during a tab operation. Excessive speed can cause a noisy operation, an inaccurate tab, or even damage due to excessive shock or vibration on components.

The pinion gear on the right side of the escapement cord drum meshes with the drum (figure 133). The pinion gear rides freely between two collars, both of which are setscrewed to the operational shaft. On the left, a clutch spring encloses a hub of the left collar; on the right, a hub of the pinion gear. The pinion gear rotates freely on the operational shaft. When the pinion is held stationary while the operational shaft turns, the spring slips around the hub of the pinion.

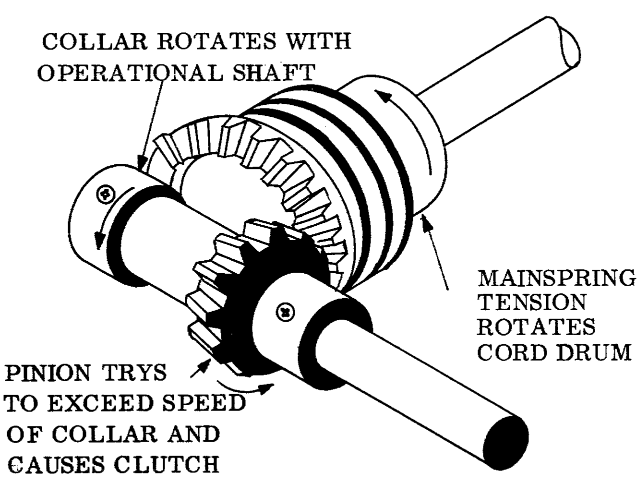


Figure 133. Tab Governor Mechanism

During a tab operation, mainspring tension forces the escapement cord drum to rotate counterclockwise, causing the pinion gear to rotate in the same direction as the operational shaft. The pinion gear, due to mainspring tension, begins to rotate faster than the operational shaft. When this occurs, friction causes the clutch spring to tighten about the two hubs. The mainspring then tries to accelerate the operational shaft but cannot because of drag in the system. This forces the pinion slowdown and drive at the same speed as the motor. Slowing the pinion forces the cord drum to slow down its taking up of the cord and cause the carrier to travel at the speed of the operational shaft.

The tab governor pinion gear, being the same size as the carrier return pinion gear, makes the speed of a tab operation the same as that of a carrier return operation.

TAB UNLATCHING

When the carrier reaches a set tab stop, the escapement pawl must immediately re-enter its rack to stop the carrier. An elongated hole in the pivot end of the tab lever allows it to move left and right, the same as the escapement and backspace pawls. The tab lever is spring loaded to the right. As the carrier moves to the right (figure 134A) the tip of the tab lever, called the tab lever pawl, contacts the tab stop, preventing the tab lever from moving any farther. The carrier, however, continues to move. As the escapement pawl also continues to move, a slot in the pawl (figure 135) allows it to drop off the lug on the tab lever and restore into the escapement rack (figure 134B), while the backspace pawl stays held to the rear (figure 136). Further carrier movement frees the tab lever latch from the notch in the tab lever pawl. The tab lever then restores and allows the backspace pawl to restore (figure 134C).

The escapement pawl must restore before the backspace pawl, otherwise the carrier could be off by one-half space due to the position of the backspace rack relative to the escapement rack.

As the tab latch releases the tab lever, the tab lever trigger (which also moves with the carrier) moves in front of a notch in the tab lever (figure 137) and allows the tab lever to restore forward by its extension spring and that of the backspace pawl. As the tab trigger begins to restore and the tab lever is snapped to the right into position for a new operation, the lug on the tab lever resets in front of the escapement pawl. The trigger is prevented from resting against the tab torque bar by a lug at the rear of the trigger which rests against the tab lever. The tab lever must be properly positioned to prevent escapement or backspace problems.

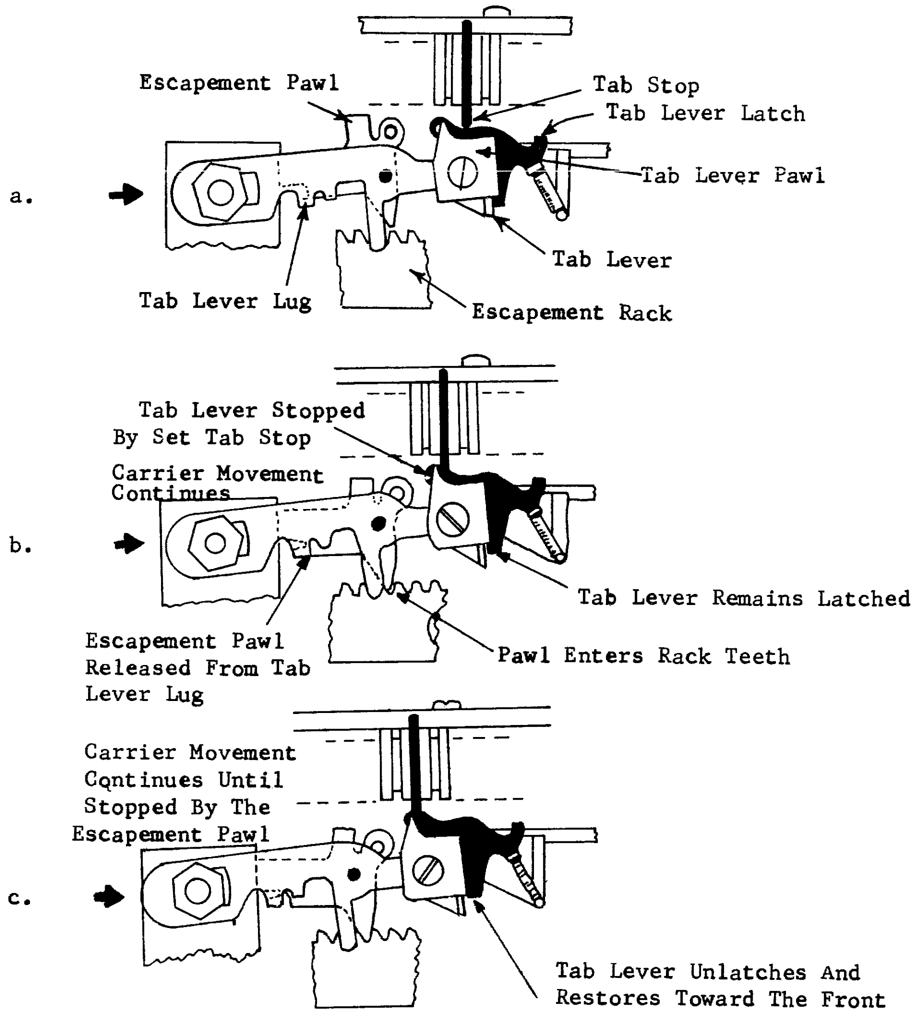


Figure 134. Tab Unlatching Operation

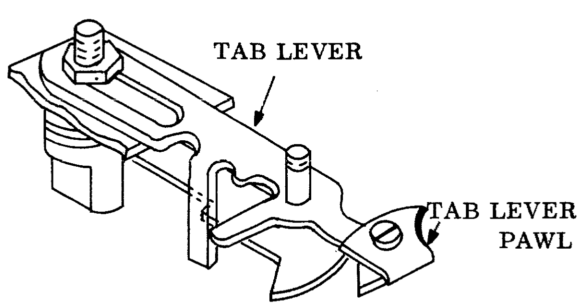


Figure 135. Tab Lever shown with Escapement Pawl

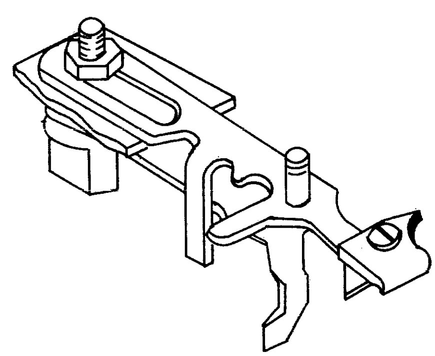


Figure 136. Tab Lever shown with Backspace Pawl

TAB INTERLOCK

A lug on the rear of the tab lever latch prevents the tab lever from latching during a carrier return operation, thereby preventing a tab (figure 138). If the tab were not locked out during a carrier return operation, the tab lever pawl would jam against a set tab stop and lock the carrier. During a carrier return operation, the lug on the tab lever latch is contacted by the escapement torque bar and pivots to the rear, preventing the latch from latching behind the tab lever pawl.

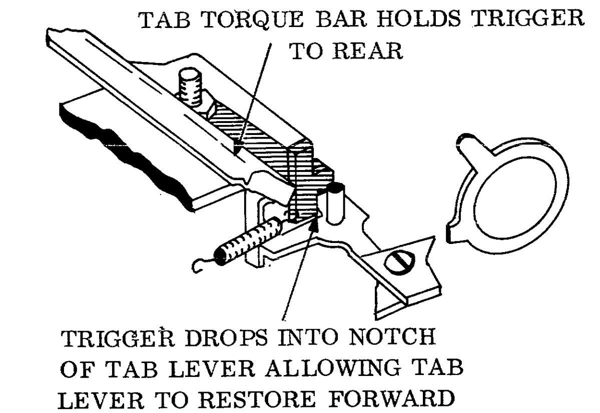


Figure 137. Tab Lever Trigger Operation

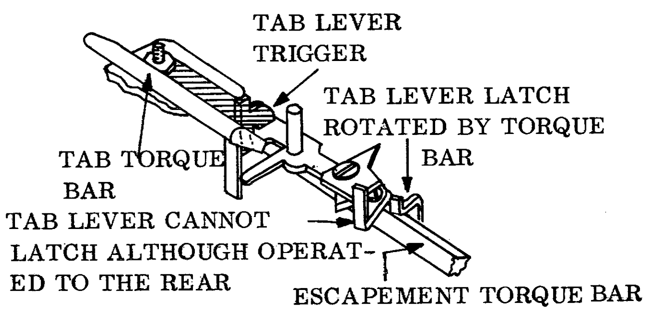


Figure 138. Carrier Return Tab Interlock

TAB CONTACTS

Three types of contacts are used in a tab operation. The first two, C5 and transmitting, were discussed previously. The third is the tab interlock contact which prevents an output to the printer while in a tab operation.

The tab interlock contact mounts inside the left rear of the powerframe by a bracket. An extension of the left rear of the torque bar, the tab arm, sits below a formed lip on the trigger lever of the switch (figure 139).

As the torque bar rotates to the rear it pulls up on the trigger lever. Further rotation of the torque bar causes the trigger lever to cam off

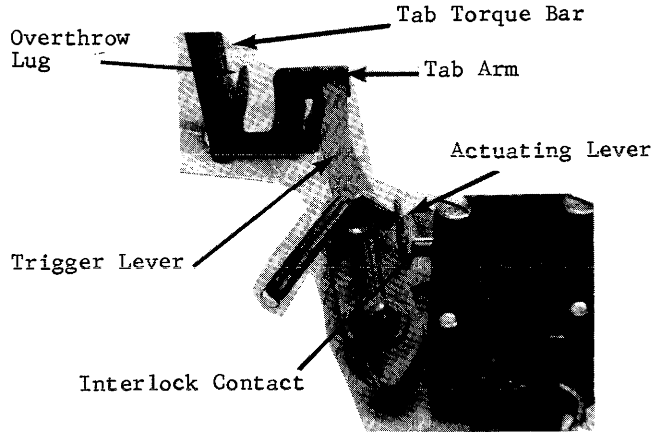


Figure 139. Tab Interlock

the tab arm but will still contact the rear of the tab arm, holding it to the rear. This forces the actuating lever to the rear, transferring the contact. When the tab lever restores, the torque bar restores, permitting the trigger lever to snap forward over the tab arm. The actuating lever then moves forward allowing the contact to retransfer. This is called a positive action interlock in that the contact will transfer when upward or rearward motion is applied to the trigger lever. These contacts cause a busy signal to be generated while they are transferred throughout the tab operation.

Answer the following questions:

22. In which direction does the tab rack rotate when the CLR keybutton is depressed?
23. What prevents the tab rack from overthrowing its rest position?
24. What directly pushes the tab lever to the rear?
25. What is the purpose of the tab governor?
26. What prevents the tab lever from latching during a carrier return operation?

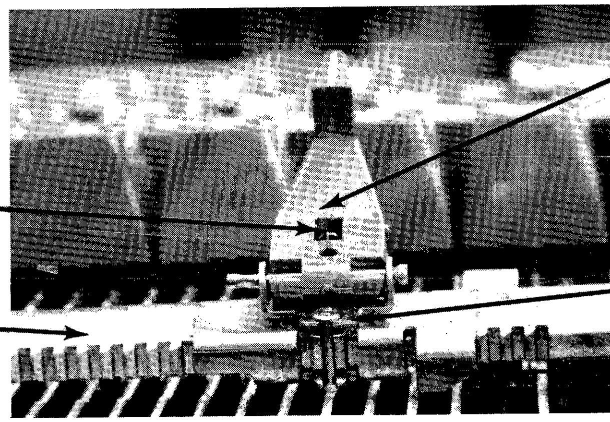


Figure 140. Left Margin Mechanism

CHAPTER 9

PAPER AND RIBBON CONTROLS

MARGIN CONTROL

Margin is the distance between the printed material and the edges of the paper and is determined by the position of margin stops along the margin rack. The margin stops restrict the travel of the carrier; the left margin stop directly restricts the carrier travel, the right margin stop restricts indirectly.

MARGIN STOPS

The margin stops (figure 140) are located on the margin rack located at the front of the printer and connects to the two sideframes. A slider and pin assembly on each of the two margin stops mesh with teeth in the rear of the margin rack. Attached to each slider and pin assembly is a lever which extends forward through a slot in the front case to allow easy accessibility. A small extension spring from the margin lever to the margin stop, spring-loads the lever forward, engaging the slider and pin assembly in the teeth of the margin rack. Either stop can be repositioned by pushing the lever toward the rear and sliding the entire stop assembly left or right along the margin rack. Releasing the lever allows the pin to reseat in the rack, locking the margin stop. A scribe line on the front of the lever indicates the position of the margin stop relative to a scale on the front cover of the printer. A pointer on the carrier indicates the position of the carrier.

An extension of the left margin stop is contacted by the margin stop latch located on the front lower portion of the carrier. This prevents the carrier from moving any farther to the left and causes the unlatching of the carrier return mechanism.

LINE LOCK

Preventing the carrier from printing past the right hand margin is the function of the line lock mechanism, explained in the Line Lock Keyboard Lock topic of chapter 4.

BELL

The bell, located at the left of the printer, is rung by the bell clapper attached to a bellcrank (figure 141). The bell clapper bellcrank lever is attached to, and operated by, the bell ringer bail. As the carrier contacts the right margin stop, the bellringer bellcrank forces the bellringer bail forward. This pivots the bellcrank lever down against the bellcrank. As the bellcrank pivots downward, the bell clapper and an extension arm are forced away from the bell. Further rotation of the bellcrank lever causes it to slip off the bellcrank. The bell clapper and the extension arm are spring loaded downward by an extension spring. The extension arm strikes the bell mounting stud causing the bellcrank to stop suddenly, but momentum allows the bell clapper to strike the bell once. When the bellringer bail restores, bellcrank lever restores above the bellcrank.

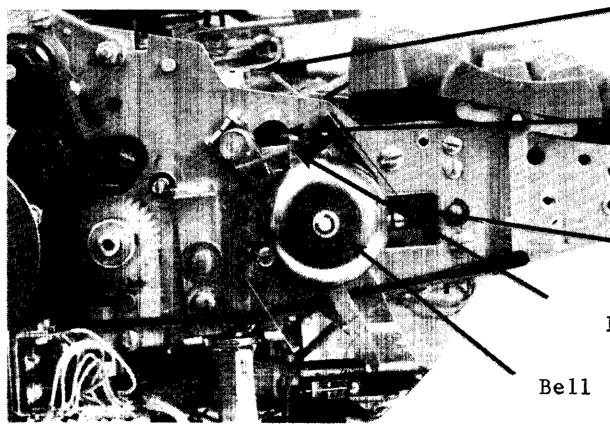


Figure 141. Bellringer Mechanism

MARGIN RELEASE

The MAR REL keybutton is located on the left of the keyboard and is attached to the margin rack (figure 142). It allows printing within either margin without moving the margin stops. This is accomplished by rotating the margin rack to pivot the stops up and out of the path of the line lock bracket on the carrier. A stud in the rear of the keylever rides in a slot of the margin release lever.

Depressing the keylever pivots the rear of the margin rack upward, which pivots the rear of the margin stops upward. A lug on the end of the margin rack, called the Final Margin Stop (figure 142), remains in the path of the carrier in the event that the carrier return is operated while the margin release keylever is held depressed.

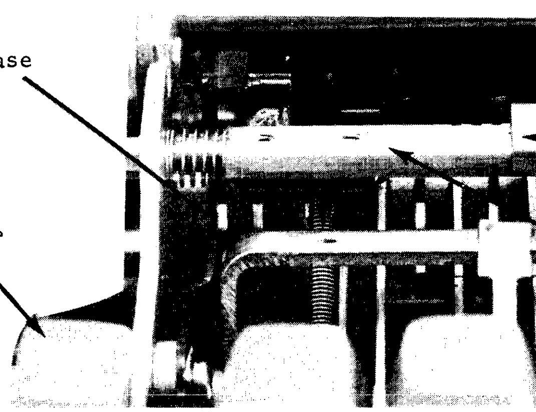


Figure 142. Margin Release Keylever

LAST COLUMN CONTACT

The last column contact (figure 143) is located at the left of the printer. Its purpose is to generate a signal when the carrier reaches the right margin stop. An arm, called the contact actuator arm is set-screwed to the left end of the bellringer bail. As the bail pivots forward by the bellringer bellcrank, the actuator arm pivots backward, operating the contact.

Answer the following questions:

1. What locks the margin stop?
2. What generates a signal to a computer when the carrier reaches the right margin stop?

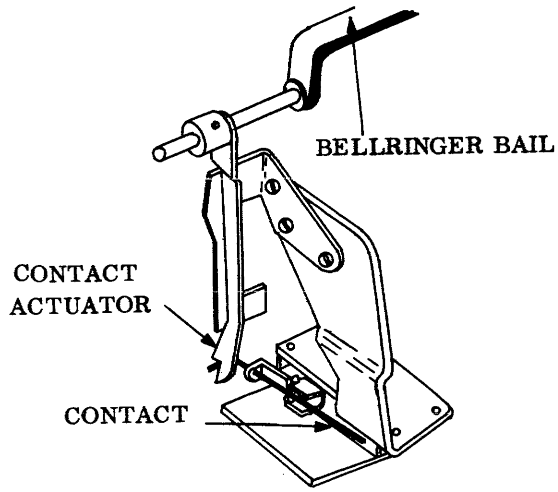


Figure 143. Last Column Contact

PAPER FEED AND RELEASE MECHANISMS

The paper feed mechanism (figure 144) controls the position of the paper both vertically and horizontally and feeds the paper vertically. Paper feed is accomplished by the front and rear feed rolls which press the paper tightly against the platen so that the paper moves with the platen when an indexing operation or manual turning of the platen occurs. Both feed rolls (the rear is larger) contain four rubber rollers spaced equally apart and molded to their roller shafts.

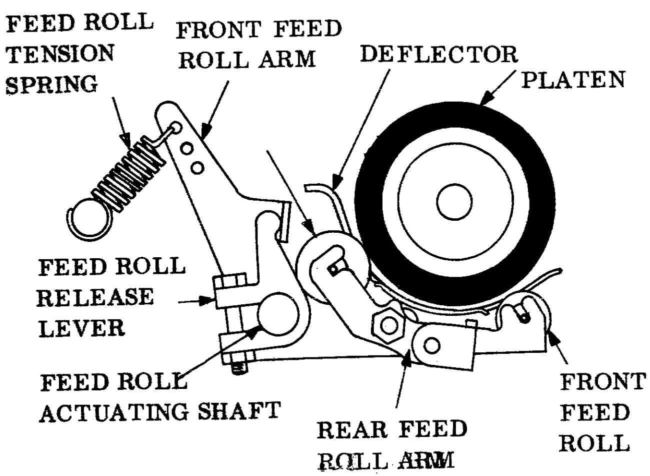


Figure 144. Paper Feed Mechanism

The front feed roll shaft is supported by two notches in the front feed roll arms (figure 145). The front feed roll arms pivot on the feed roll actuating shaft. Pressure of the front feed roll against the platen is supplied by two heavy extension springs which connect from one of several holes in both of the front feed roll arms to the carriage tie rod. The holes enable varying the pressure.

The rear feed roll shaft is supported by two notches in the rear feed roll arms which pivot on studs at the front of the paper feed mounting arms. The arms extend forward from the carriage tie rod. The front and rear feed roll arms are connected at each side by a shoulder screw. This arrangement allows the front feed roll arm extension springs to also supply pressure to the rear feed roll against the platen.

The paper deflector (figure 144), which is situated between the platen and the feed rolls, guides the paper around the platen. The deflector is supported by the feed rolls. A slotted lug at each end of the paper deflector fits over a stud on the paper feed mounting arm. An adjustable guide mounted at the left rear of the platen, on the case, positions the paper for the correct left margin. The line gage card holder, attached to the top-rear of the carrier, assists in holding the paper against the platen in the typing zone. The card holder is scaled with each mark representing the middle of a typed character space. The horizontal edge of the card holder marks the bottom of the print line. A mark at the top center of the card holder denotes the next character space to be typed.

OPERATION (PAPER INSERTION)

Paper is inserted into the top-rear of the platen, against the adjustable guide between the platen and the paper deflector. Turning the platen allows the paper deflector to guide the paper between the front feed roll and the platen. The paper is guided upward by the line gage card holder and is engaged by two rollers on the paper bail which hold the paper against the platen. The rollers also help feed the paper vertically when the bottom of the paper has left the front feed roll.

PAPER RELEASE

The paper release lever (figure 145), at the right end of the carriage, is used to release the pressure of the feed rolls against the platen.

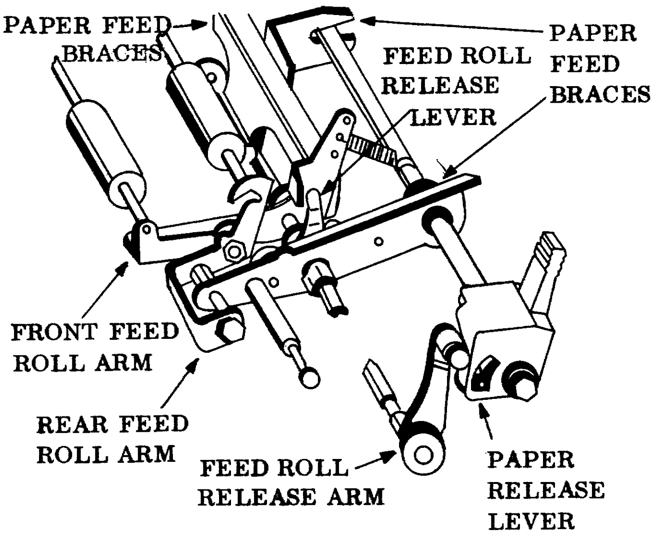


Figure 145. Paper Release Mechanism

This permits easier insertion and positioning of the paper. Pulling the paper release lever forward cams the top of the feed roll release arm forward and rotates the feed roll actuating shaft. As the actuating shaft rotates, two feed roll release levers, clamped to the shaft, push forward on two lugs of the front feed roll arms, forcing the front feed roll away from the platen. The rear feed roll is also forced away from the platen by means of the connection between the front and rear feed roll arms. Pulling the paper release lever to its forward stop allows the end of the feed roll release arm to detent over a point at the front of the paper release lever and hold it forward, in the released position.

Answer the following questions:

3. What are the purposes of the line gage card holder?

4. What is the purpose of the feed roll actuating shaft?

RIBBON MECHANISM

The ribbon mechanism contains two separate mechanisms--the ribbon lift mechanism and the ribbon feed and reverse mechanism. Both mechanisms are powered by cams on the print sleeve; both are located entirely within the carrier.

The function of the ribbon lift mechanism is to raise the ribbon to the print point before the typehead strikes the platen and then to lower it again to make the print line visible.

The function of the ribbon feed and reverse mechanism is to move the ribbon horizontally, keeping an unused portion at the print point, and to reverse the direction of the ribbon feed when the end of a spool has been reached. This unit is easily detachable from the carrier.

The ribbon is 9/16 of an inch wide and wound around two spools enclosed in a disposable cartridge unit. The ribbon load lever, located to the right front of the carrier, when pushed to the right, forces the ribbon lift guide assembly into an extreme upward position. This facilitates ribbon cartridge replacement. Pushing the ribbon load lever back to the left drops the ribbon lift guide to its normal position.

RIBBON LIFT MECHANISM

The ribbon lift cam, a single-lobed cam, is set-screwed to the print sleeve and located to the far left of the print sleeve. The cam rotates 360° for each print cycle. The cam follower mounts on the left carrier casting and pivots up and down. In the cam follower is a long slot (figure 146) in which the end of the ribbon lift control link rides.

Directly above the control link rests the ribbon lift guide assembly. Raising the cam follower, by means of the cam, forces the control link up against the guide assembly. This raises the rear of the guide assembly which pivots at the front of the carrier casting. The ribbon guide assembly is held in a vertical position by a flat link on each side of the ribbon lift guide. The flat links attach to two pins at the front of the carrier.

The position of the ribbon lift control link in the slot of the cam follower, determines the height to which the ribbon will be raised for a print operation. It is controlled by a button located at the left front of the carrier. The ribbon lift control is attached to the ribbon lift control lever (figure 146) which is pivot-mounted on the underside of the front carrier casting. The control lever is spring-loaded to the rear, against a stud on the ribbon lift lever which, in turn, is pivot-mounted on the front underside of the carrier casting.

As the button on the ribbon lift lever is moved to the left, the left side of the control lever is forced forward pulling the control link forward. This causes the other end of the control link to move forward in the slot of the cam follower, closer to the pivot point of the guide assembly. The closer the control link to the pivot point, the higher the guide assembly is raised by the cam follower.

The control lever has four notches on the

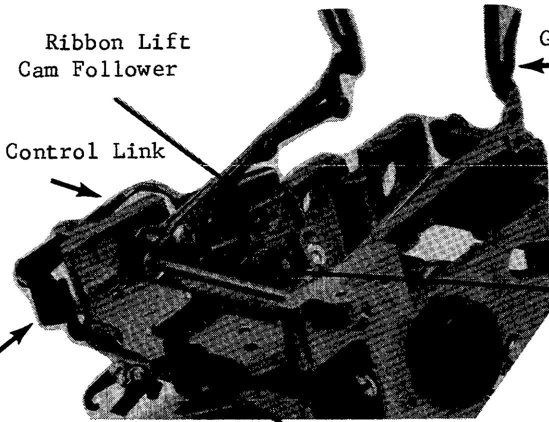


Figure 146. Ribbon Lift Mechanism

surface which ride against the lug on the ribbon lift lever. As the lever moves left or right, the lug will detent into one of the notches.

When the lever is at its far right position, the lug detents into the far right notch in the control lever. This causes no pull on the link, allowing it to seat at the rear of the slot in the cam follower. As the cam follower is raised by the cam, practically no motion will be transferred to the link and the guide assembly will not raise at all. This is called the stencil position since the ribbon is not used when typing stencils.

The next three positions to the left are print positions and will raise the ribbon high enough to be struck by the typehead. The second position raises the ribbon high enough to allow the upper half to be struck; the third position allows printing in the middle of the ribbon; and the fourth position raises the ribbon high enough for the lower half to be used. As the lever is moved to the left, the link pulls forward in the slot allowing more motion to be supplied to the guide assembly from the cam follower, creating more lift to the guide assembly. This arrangement allows maximum use of a ribbon before replacement is necessary.

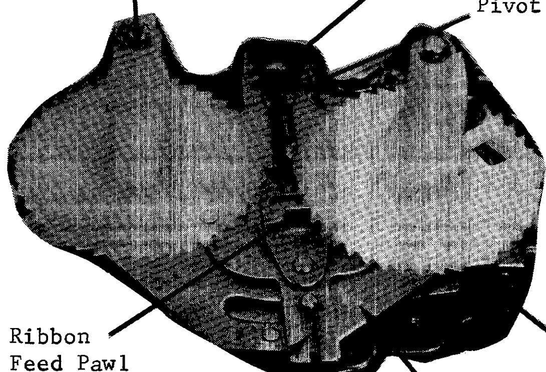


Figure 147. Ribbon Feed Mechanism, Top (New Style)

RIBBON FEED MECHANISM

The two ribbon spools fit over the cores of two ratchets (figure 147). Operation of either ratchet, by a pawl that moves front to rear, causes the spool of that ratchet to wind up ribbon. The position of the feed pawl determines which ratchet will feed. As the ribbon feed cam rotates it comes in contact with and forces down a lug on the ribbon feed lever. The feed lever is a bellcrank-type device pivot-mounted on a bracket that extends downward from the ribbon feed plate (figure 148). A top extension of the ribbon feed lever extends upward through a forked slot in the plate bracket and through an elongated hole in the feed pawl plate. This extension is spring-loaded forward, against the rear of the ribbon feed plate by the feed lever spring. The spring is attached to a hole above the pivot point in the lever and to the bottom of the plate bracket.

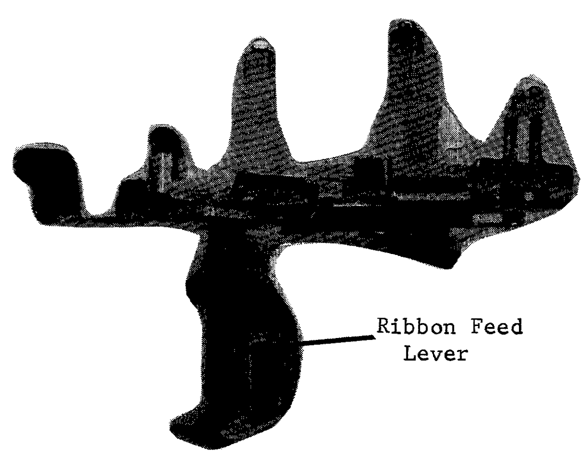


Figure 148. Ribbon Feed Mechanism (Bottom)

As the bottom of the feed lever is forced down by the cam, the upper extension pivots to the rear, pulling the feed pawl plate with it. As the feed pawl plate is pulled to the rear, the feed pawl, pivot-mounted on the plate, rotates one of the ratchets two notches--the amount of drive that the cam supplies. As the feed pawl restores forward after the operation, it slides across the teeth of the ratchet and attempts to turn the ratchet in the opposite direction. This is prevented by the detent lever (figure 147) which pivots on the underside of the ribbon feed plate.

A lug which extends upward from the detent lever fits through a slotted hole in the ribbon feed plate and on into a forked slot in a front extension of the feed pawl plate. As the plate pivots to the left, allowing the pawl to feed the left ratchet counterclockwise, the left end of the detent lever pivots to the rear into the left ratchet. This prevents the ratchet from turning clockwise. When the feed pawl plate pivots to the right, the pawl will be in position to feed the right ratchet clockwise while the right end of the detent lever prevents the ratchet from turning counterclockwise. One or the other end of the detent lever will always be engaged with its ratchet.

Two leaf springs (figure 152)--the retaining brake springs--are screwed to the plate and extend to the rear against both ratchets. These springs act as a brake to prevent the ratchets from spinning and possibly spilling ribbon.

RIBBON REVERSE MECHANISM

As ribbon feeds from one spool to another, the supply spool becomes exhausted. The direction of the ribbon feed operation must then reverse to allow the full spool to become the supply spool. This is accomplished by the ribbon reverse mechanism.

Reversing the direction of ribbon feed is accomplished by moving the ribbon feed pawl from one ratchet to the other. Located in the core of each ratchet is a bellcrank called the reverse trigger (figure 149). With ribbon around the spool, the trigger is held into the core.

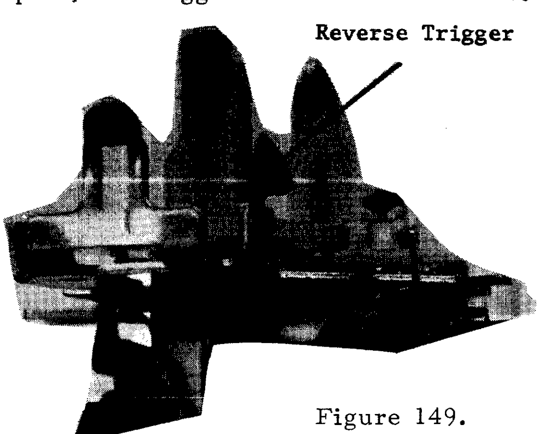


Figure 149.
Ribbon Reverse Trigger

When a spool empties, a hairpin spring forces the trigger out of the core through a slot in the ribbon spool. A lower extension of the trigger then pivots down through a hole in the ratchet and contacts the ribbon feed plate (figure 150). The empty spool rotates slightly farther causing the reverse trigger to be stopped by the side of the feed pawl plate. The trigger is then in the restoring path of the feed pawl plate.

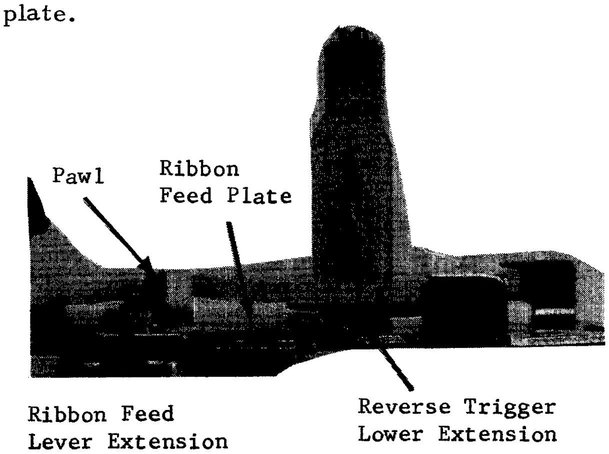


Figure 150. Reverse Trigger
Dropped On To Plate

As the feed pawl plate begins to restore, one side is stopped by the reverse trigger (figure 151) while the other side continues forward. This causes the front of the plate to pivot, flipping the pawl and the detent arm in the same direction. The feed pawl is then in position to feed the empty spool. Figure 152 illustrates the old-style ribbon feed mechanism which operates basically the same as the new-style mechanism.

Answer the following questions:

5. What determines the height to which the ribbon will be raised during a print operation?

6. What is the purpose of the ribbon feed leaf springs?

7. Briefly, how is ribbon reversal accomplished?

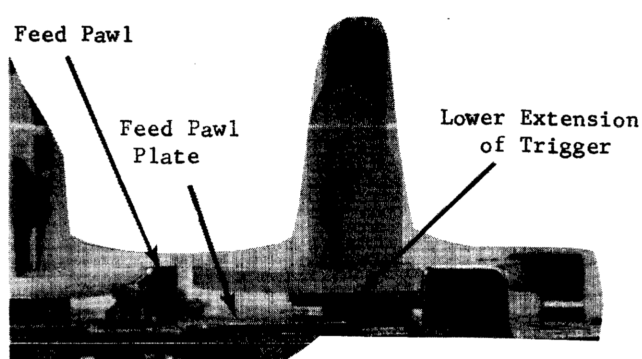


Figure 151.
Trigger in Path of Feed Pawl Plate

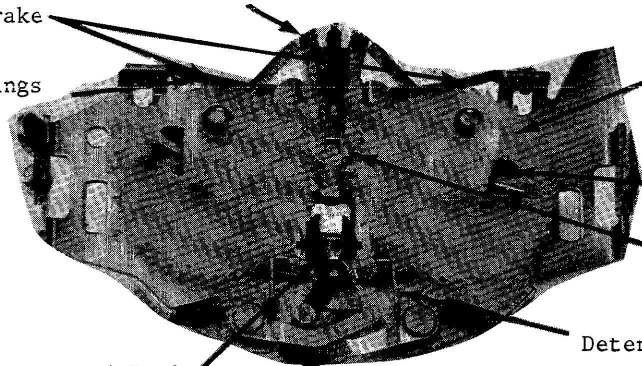


Figure 152. Ribbon Feed Mechanism, Old Style

Figure 153. 3192 Console Typewriter

CHAPTER 10

3192 CONSOLE TYPEWRITER

GENERAL CHARACTERISTICS

DESCRIPTION

The 3192 Console Typewriter (figure 153) is an on-line input-output (I/O) device; i.e. it requires no connection to a communication channel and no function codes are issued. The typewriter receives output data directly from storage via the lower six bits of the data bus. Inputs to storage are handled in the same manner.

The console typewriter consists of a selectric typewriter and a control panel mounted on a desk console.

Used in conjunction with block control and the register file, the typewriter may be used to enter a block of internal binary coded characters into storage and to print out data from storage. The two storage addresses that define the limits of the block must be stored in the register file prior to an input or output operation. Register 23* contains the initial character address of the block, and register 33 contains the last character address plus one. Because the initial character address is incremented for each storage reference, it always shows the address of the character currently being stored or dumped. Output operations occur at the rate of 15 characters per second. Input operations are limited by the operator's typing speed. In systems using the optional 3101 desk console, the 3192 is an integral part of the console.

*The upper nine bits of registers 23 and 33 should be "0".

OPERATION

The general order of events when using the console typewriter for an input or output operation is:

1. Turn on typewriter.
2. Set Tabs, margins spacing.
3. Clear.
4. Check status.
5. Type out or type in.

Set Tabs, Margins, and Spacing

All tabs, margins, and paper spacing must be set manually prior to the input or output operation. A tab may be set for each space on the typewriter between margins.

Clear

There are three types of clears which may be used to clear all conditions existing in the typewriter control.

External Master Clear. This signal clears all external equipments, the communication channels, the typewriter control, and sets the typewriter to lower case.

Clear Channel, Search/Move Control, or Type Control instruction (77.51). This instruction selectively clears a channel, the S/M control, or, by placing a "1" in bit 08 of the instruction, the typewriter control, and sets the typewriter to lower case.

Clear Switch on typewriter. This switch clears the typewriter control and sets the typewriter to lower case.

Status Checking

The programmer may wish to check the status of the typewriter before proceeding. This is done with the pause instruction. Status response is returned to the computer via two status lines.

CONSOLE SWITCHES AND INDICATORS

Figure 154 shows the switch arrangement of the typewriter control panel. The function of each switch appears in table 2. A rocker switch on the typewriter unit applies power to the typewriter motor.

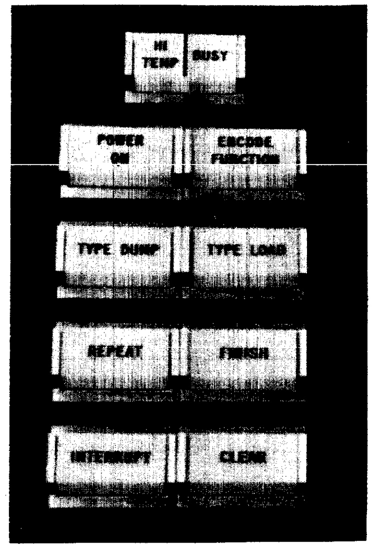


Figure 154. Typewriter Control Panel

INTERNAL BCD CODES

Table 3 lists the internal BCD codes, typewriter printout and upper or lower-case shift that applies to the console typewriter. All character transmission between the computation section and the 3192 is in the form of internal BCD. The 3192 logic makes the necessary conversion to the typewriter character code or function signals.

Answer the following questions:

1. What controls I/O operations to the typewriter?
2. Where can the address of the character currently being typed be located?
3. Which "Clear" will clear the typewriter control?
4. How many status responses are available from the controller? Name them.
5. Define the difference between type load and type dump.
6. Where is the switch located which will cause the POWER ON indicator to light?
7. What is the BCD code for the character "A"?

TABLE 2. CONSOLE TYPEWRITER SWITCHES AND INDICATORS

NAME	SWITCH (S) INDICATOR (I)	DESCRIPTION
HIGH TEMP	I	ON when the ambient temperature within the typewriter cabinet exceeds 110°F.
BUSY	I	ON to show that the TYPE DUMP switch has been pressed or the program has called for a TYPE DUMP operation.
POWER ON	I	ON to show that power is applied to the typewriter.
TYPE DUMP	S&I	This switch is in parallel with the TYPE DUMP switch on the console and causes the computer to send data to the typewriter for print-out. It is a momentary contact switch that is ON until the last character in the block has been printed or the CLEAR button is pressed.
TYPE LOAD	S&I	This switch is in parallel with the TYPE LOAD switch on the console and allows the computer to receive a block of input data from the typewriter. TYPE LOAD indicator remains ON until either the FINISH, REPEAT, or CLEAR button is pressed, or until the last character of the block has been stored. If the program immediately reactivates the typewriter, it may appear that the light does not go off.
REPEAT	S&I	This switch is pressed during a type load operation to indicate that a typing error occurred. This switch deactivates busy sense line 10 (see pause instruction). If the computer does not respond, this light remains ON.
FINISH	S&I	This switch is pressed during a type load operation to indicate that there is no more data in the current block. This action is necessary if the block that the operator has entered is smaller than the block defined by registers 23 and 33. This switch also deactivates busy sense line 09. If the computer does not respond, this light remains ON.
INTERRUPT	S&I	This switch is in parallel with the MANUAL INTERRUPT switch on the console and is used to manually interrupt the computer program.
ENCODE FUNCTION	S&I	This switch enables the typewriter to send to storage the special function codes for backspace, tab, carriage return, upper-case shift, and lower-case shift. Space is enabled at all times.
CLEAR	S&I	This switch clears the typewriter controls and sets the typewriter to lower case.

TABLE 3. INTERNAL BCD CODES

PRINT-OUT	CASE	INTERNAL BCD CODE	PRINT-OUT	CASE	INTERNAL BCD CODE
-	L	40	0	L	00
J	U or L	41	1	L	01
K	U or L	42	2	L	02
L	U or L	43	3	L	03
M	U or L	44	4	L	04
N	U or L	45	5	L	05
O	U or L	46	6	L	06
P	U or L	47	7	L	07
Q	U or L	50	8	L	10
R	U or L	51	9	L	11
°(Degree)	U	52	±	U	12
$	U	53	=	L	13
*	U	54	"	U	14
#	U	55	:	U	15
%	U	56	;	L	16
(Shift to UC)		57	?	U	17
(Space)		60	+	U	20
/	L	61	A	U or L	21
S	U or L	62	B	U or L	22
T	U or L	63	C	U or L	23
U	U or L	64	D	U or L	24
V	U or L	65	E	U or L	25
W	U or L	66	F	U or L	26
X	U or L	67	G	U or L	27
Y	U or L	70	H	U or L	30
Z	U or L	71	I	U or L	31
&	U	72	(Shift to LC)		32
,	U and L	73	.	U and L	33
(	U	74	)	U	34
(Tab)		75	'	L	35
(Backspace)		76	@	U	36
(Carriage return)		77	!	L	37

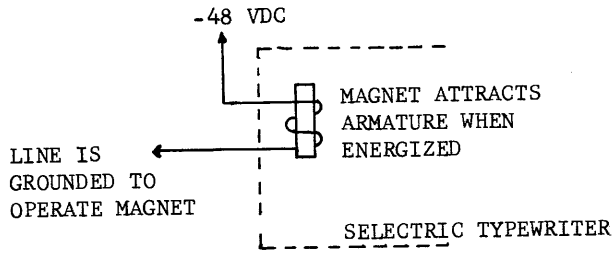


Figure 155. Typewriter Magnet Circuit

CHAPTER 11 TYPEWRITER SIGNALS AND LOGIC LEVELS

SIGNAL CHARACTERISTICS

INPUT SIGNALS

Input signals to the typewriter operate one or more of the typewriter magnets. Power requirement to operate the magnets is -48 vdc. Figure 155 shows the method used to energize the magnets.

For this manual, the typewriter magnets are considered to be in the logical 1 state when energized and in the logical 0 state when de-energized.

OUTPUT SIGNALS

Mechanically operated contacts generate typewriter output signals. Figure 156 shows the method used to electrically indicate the state of the transmitting contacts.

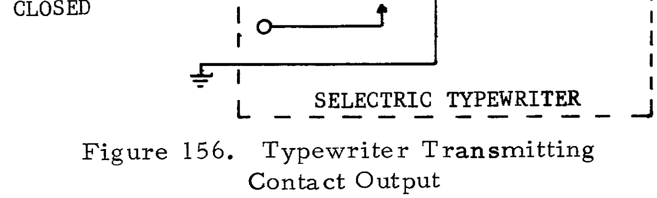


Figure 156. Typewriter Transmitting Contact Output

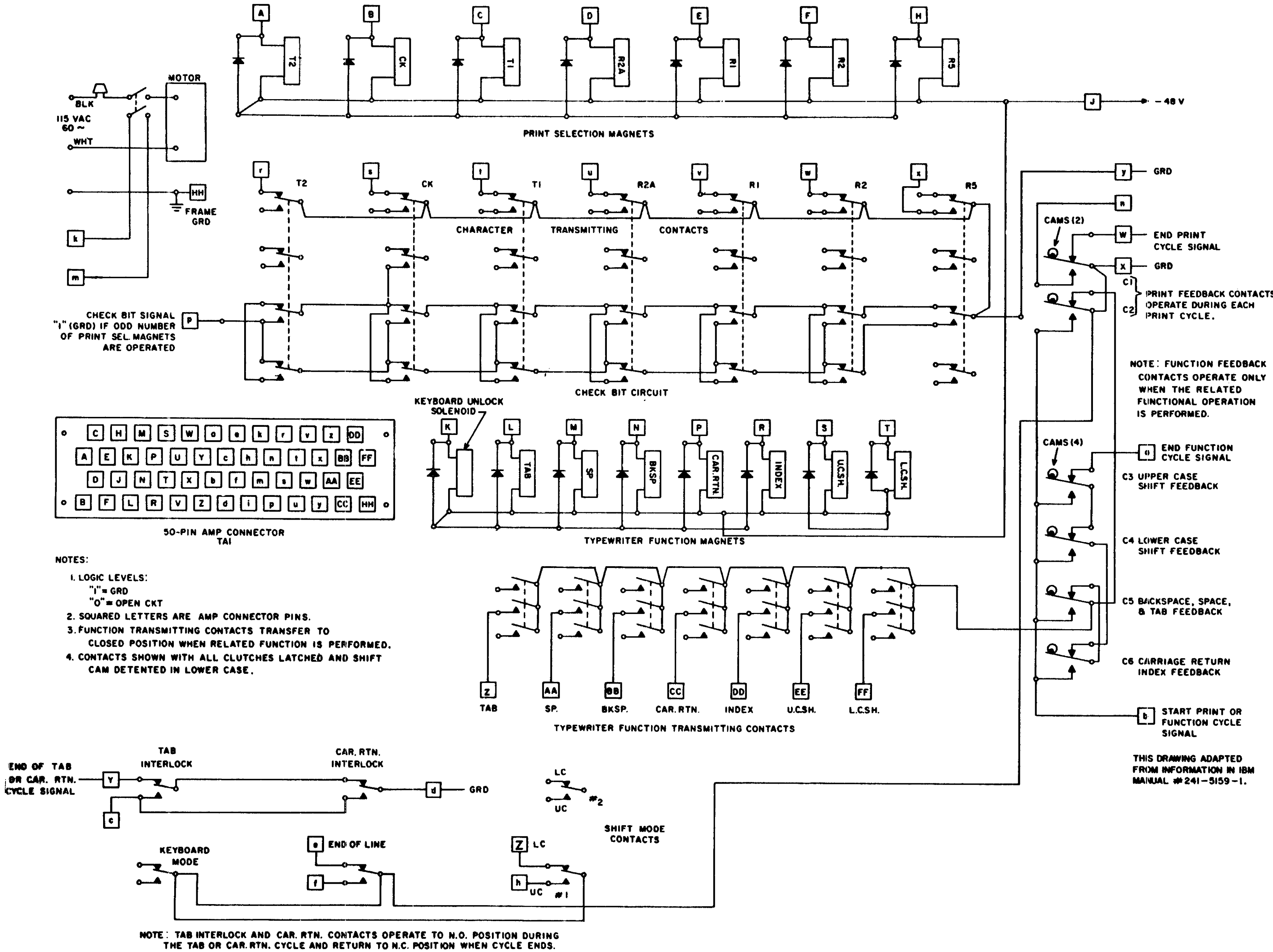


Figure 157. Selectric Typewriter Wiring Diagram

For this manual, all typewriter contacts and output lines are considered to be in the logical 1 state when grounded and in the logical 0 state when not grounded (open).

INPUT SIGNAL REQUIREMENTS

There are two types of typewriter input signals: 1) typewriter character code signals and 2) typewriter function signals.

TYPEWRITER CHARACTER CODE SIGNALS

Input typewriter character code signals operate the seven print selection magnets and cause the typewriter to print characters in accordance with the codes listed in table 7. The print selection magnets are shown in figure 157.

For reliable operation, the character selection magnets must be energized for approximately 28 milliseconds. Figure 158 shows the input signal timing requirements for the print selection magnets.

All typewriter character codes sent to the print selection magnets contain six bits plus an odd parity bit. Whenever the number of 1 bits in a character code equals an even number, the parity network in the typewriter control generates a 1 which is sent to magnet R5. If the parity bit is required and is not transmitted, the typewriter will print the wrong character. This will be the only indication of a transmission error.

TYPEWRITER FUNCTION SIGNALS

Typewriter function signals energize the function magnets and cause the typewriter to perform functions such as space or upper-case shift. Figure 157 shows the function magnets.

Each function magnet is related to one typewriter function. When a function magnet energizes, the related functional operation occurs.

Typewriter function signal timing requirements depend on the function being performed. Figure 159 shows signal timing for a typical functional operation.

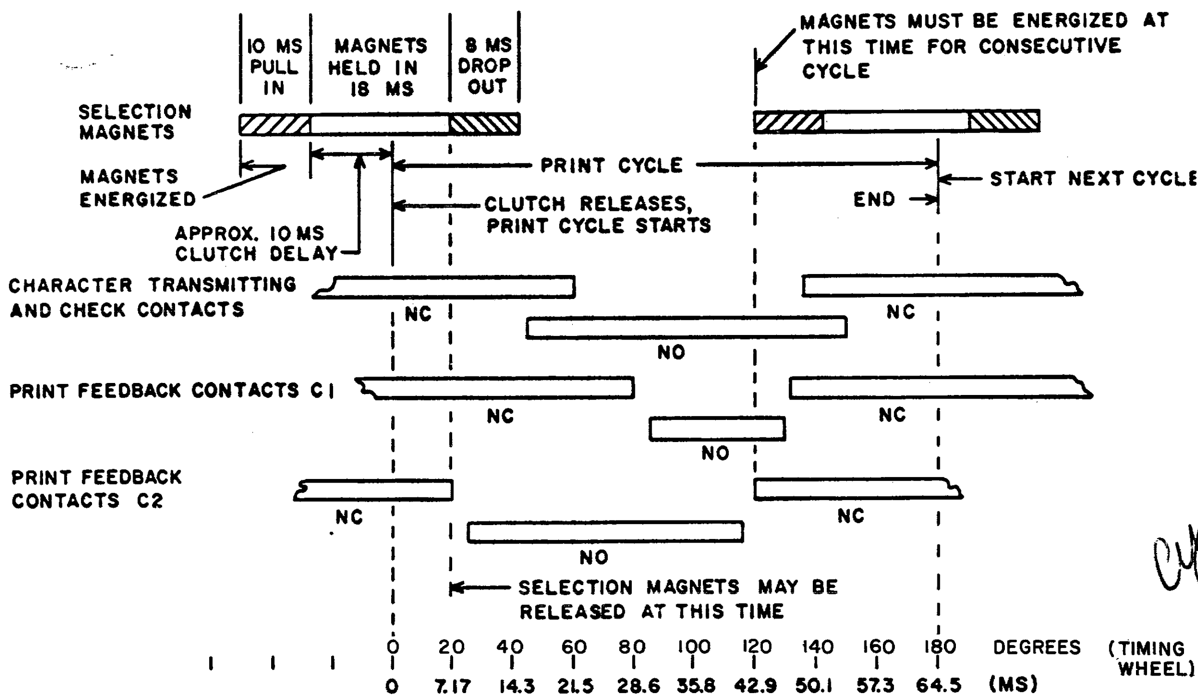


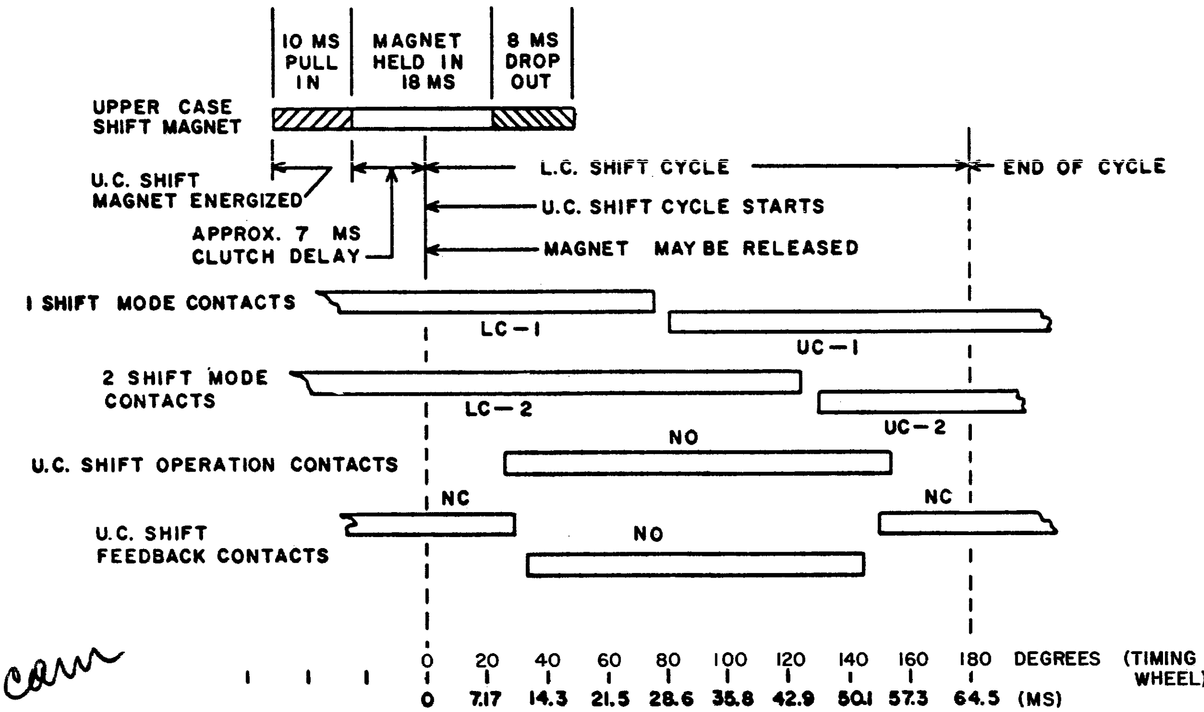
Figure 158. Character Cycle Timing (Approximate)

OUTPUT SIGNAL CHARACTERISTICS

There are four types of typewriter output signals:

1. typewriter character code
2. typewriter function
3. feedback
4. shift mode, end-of-line and power on signals.

These signals are generated during both keyboard operation and typeout operation of the typewriter. The term typeout refers to operation of the typewriter in response to signals sent to the print selection or function magnets.



shift cam

Figure 159. Upper-Case Shift Cycle Timing (Approximate)

TYPEWRITER CHARACTER CODE SIGNALS

When the typewriter prints a character, the typewriter transmitting contacts generate a 6-bit signal according to the code given in table 7. Figure 157 shows these contacts.

Contacts T2, CK, T1, R2A, R1 and R2 generate the 6-bit character code. These contacts are in the normally-closed (1) position. As the typewriter prints a character, those contacts which correspond to 0 bits in the character code will transfer to the open (0) position for a portion of the print cycle. Contacts which correspond to 1 bits in the character code will remain in the closed position throughout the print cycle. Contact R5 generates an odd parity bit (check print signal) which is not used in this system.

Figure 158 shows the character transmitting contact timing.

TYPEWRITER FUNCTION SIGNALS

Typewriter function contacts generate single-bit function signals. Figure 157 shows these contacts. There is one set of contacts for each of the typewriter functions. When a function is performed, the corresponding function contact transfers to the closed (1) position for a portion of the function cycle. Figure 159 shows the contact timing for a typical functional operation.

FEEDBACK SIGNALS

Eight sets of feedback contacts generate synchronizing signals during print and typewriter function operations. The feedback contacts are identified in figure 157.

Feedback signals serve two purposes:

1. During keyboard operations the feedback signals act as a timing reference enabling the typewriter control to sample the character code contacts or function code contacts at the proper time in the typewriter cycle.
2. During typeout operation (electrical operation) the feedback signals assure that the typewriter sustains the character code or function signals long enough for the selector mechanism to operate.

The feedback signals appear at typewriter terminals b, a, W and Y which are shown in figure 157. A 1 (ground) signal appears at terminal b near the beginning of a print cycle or any of the function cycles to signal the start of an operation. The output at terminal a, W, or Y (depending on the operation) transfers from 0 (open) to 1 (ground) near the end of the print or function cycle to signal that the operation is near the end.

Each of the feedback contacts is related to one or more typewriter operations and operates to the normally open position for a portion of the related operation cycle. Feedback contact relationships are:

Contacts C1 and C2 . . . . Print Cycle
Contact C3 . . . . Upper Case Shift
Contact C4 . . . . Lower Case Shift
Contact C5 . . . . Backspace, Space, Tab
Contact C6 . . Carrier Return, Index
Carrier Return
Interlock Contact . . . . . Carrier Return
Tab Interlock Contact . . . . Tab

Feedback contact timing for a character print cycle is shown in figure 158. Figure 159 shows feedback timing for a typical typewriter function operation.

SHIFT MODE, END-OF-LINE, AND POWER ON SIGNALS

The shift mode contacts indicate the typewriter shift mode at all times. The output at typewriter terminal Z is ground (1) when the typewriter is in lower-case mode and open (0) when the typewriter is in the upper-case mode.

The End-of-Line contacts (last column contacts) indicate when the typehead has reached the end of the line as indicated by the right margin stop setting. A carrier return will cause the end-of-line signal to drop. During keyboard operation, a keyboard lock prevents typing past the right margin stop; however, during typeout operations the carrier return is made automatically by the typewriter control which senses the end-of-line signal.

The power on sense contacts are an extra set of contacts included in the typewriter motor switch. In the power-on condition, the output at typewriter terminal m is ground (1).

Answer the following questions:

1. What voltage is felt by the transmitting contacts?
2. What logic levels are represented for a ground? An open?
3. For how long should a character selection magnet stay energized?
4. For approximately how long during a print cycle are print feedback contacts C2 transferred (open)?
5. Which print contact is used for the parity bit?
6. How many function signal bits are generated by the function contacts?

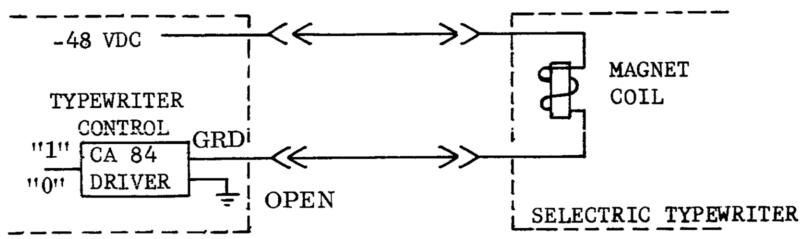


Figure 160. Typewriter Magnet Drive

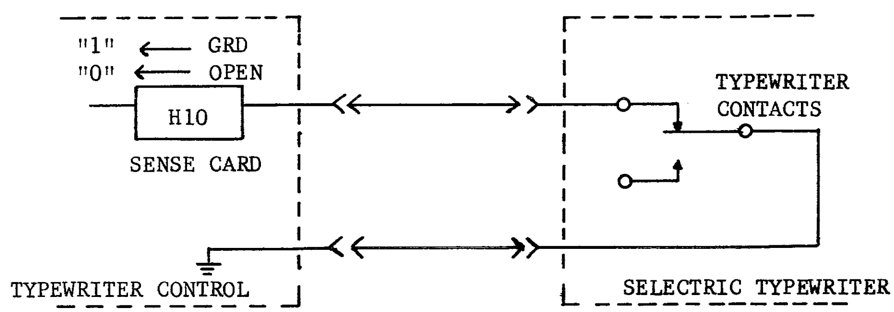


Figure 161. Typewriter Contact Sensing

CHAPTER 12

TYPEWRITER CONTROL

PURPOSE

The major functions of the console typewriter control are:

1. To convert selectric typewriter input and output signals to and from logic levels.
2. To provide timing control for input and output signals.
3. To translate 6-bit typewriter function codes to single-bit typewriter function signals which the typewriter can accept.
4. To translate single-bit typewriter function signals generated by the typewriter function contacts into 6-bit codes.

SIGNAL DEFINITIONS

Tables 4 through 6 define the signals transferred between the console typewriter and computation module.

SIGNAL CONVERSION

Figure 160 shows the method used to energize the selectric typewriter magnets. The CA84 driver provides a low impedance path to ground when the input is 1 (-5.8 volts). All drivers are designated by the logical term Dxxx.

Figure 161 shows the method used to sense the state of the typewriter contacts. The output of the H10 card is 1 when the input is ground and 0 when the input is open. All contact sense cards are designated by the logical term Ixxx.

TABLE 4. BIDIRECTIONAL SIGNALS, CONSOLE TYPEWRITER/COMPUTATION MODULE

Signal	Definition
Data Bits	The lower six lines of the data bus attach to the console typewriter control and are used to transfer six bits of data to and from the typewriter.

TABLE 5. SIGNALS FROM CONSOLE TYPEWRITER TO COMPUTATION MODULE

Signal	Definition
Busy	A 1 signal sent to the computation module whenever the typewriter control has been activated; appears as a 1 in the busy mask.
Clear Type In/ Type Out	A 1 transmitted when the CLEAR switch on the typewriter is pressed.
Strobe	A 1 indicating mechanical action taking place in the typewriter.
$\overline{\text{Repeat}}$	A 1 transmitted whenever REPEAT switch has not been pressed.
$\overline{\text{Finish}}$	A 1 transmitted whenever FINISH switch has not been pressed.

CHARACTER CODE

The basic selectric character codes are given in table 7. Each code contains seven bits which are designated as follows:

bit 0	T2
bit 1	T1
bit 2	CK
bit 3	R2
bit 4	R2A
bit 5	R1
bit 6	R5

The seventh bit, R5, is developed by a parity network in the typewriter control logic.

The presence of a 1 in any of the bit positions indicates that the particular latch will be pulled from beneath the latch bail. A 1 in the R5 position will pull the -5 latch, initiating a negative operation.

Since one of the seven bits is redundant, any six of the seven selectric code bits will give a unique set of 6-bit typewriter codes.

The reason typewriter bits T2, T1, CK, R2, R2A, and R1 are used is to suppress the code 00_8. Code 00_8 is designated as a pass code which the typewriter is not permitted to transmit because of system considerations. The selectric typewriter code for the characters - (dash) and _ (underline) would be 00_8, a pass code. The choice of bits T2, T1, CK, R2, R2A, and R1 results in code 04_8 for - (dash) and _ (underline). This is an acceptable code.

INTERRUPT

The console typewriter can generate an interrupt whenever the INTERRUPT switch on the typewriter is pressed.

With the Interrupt switch pressed, the computer is forced into a manual interrupt routine.

TYPEWRITER FUNCTION SIGNAL ENCODING AND DECODING

The typewriter control is designed to receive and transmit 6-bit function codes; however, the selectric typewriter receives and transmits separate single-bit signals for each typewriter function. Encoding and decoding logic in the

TABLE 6. SIGNALS FROM COMPUTATION MODULE TO CONSOLE TYPEWRITER

Signal	Definition
Ø to Data Bus	A 1 signal that gates the contents of the console typewriter's Ø register to the lower six bits of the data bus.
Data Bus to Ø	A 1 signal to the typewriter that transfers the contents of the data bus register to the typewriter Ø register.
Type Dump	A 1 signal sent by pressing the TYPE DUMP switch on the console or console typewriter or by the sensing of the console typewriter output instruction.
Type Load	A 1 signal sent by pressing the TYPE LOAD switch on the console or console typewriter or by the sensing of the console typewriter input instruction.
Clear Repeat	A 1 signal sent to clear the Repeat FF after the REPEAT switch has been pressed and the condition has been sensed using the pause instruction.
Clear Finish	A 1 signal sent to clear the Finish FF after the FINISH switch has been pressed and the condition has been sensed using the pause instruction.
Master Clear	A 1 signal that clears out all of the typewriter controls and set the typewriter to lower case.

typewriter control performs the necessary translation to and from 6-bit form.

INPUT CODING

The encoding logic used during type-in operations is shown in the diagrams (appendix A).

When a typewriter function is performed, I576 will be a 0, indicating that a special function operation is being performed. There will be a 1 output from one of the typewriter function sensing cards (I450 - I455); the other five function sensors will be 0.

The translation of the function signal into a 6-bit code is then accomplished by I570 - I575. Transmitters T000 - T005 will transmit the proper BCD code for the special function.

OUTPUT DECODING

The decoding logic used during type-out operations is shown in the diagrams (appendix A).

During type-out operations, the translation of the typewriter function codes from 6-bit form to single-bit form takes place in two steps:

1. The keyboard decoder logic converts the BCD output of the code expander logic into the proper machine code.
2. The special function translators will then translate this code further in order to enable the proper function magnet driver.

CASE CONTROL

The case control logic allows the operator to 1) preset the case with a case shift instruction and 2) allow the typewriter to perform the case shift automatically.

When a case shift instruction is sensed, the Case Preset FF is set; however, the typewriter will not shift case until the code for an upper or lower-case letter (A - Z) is sensed. This feature is normally used only when a typehead offering both upper and lower case letters is used.

Answer the following questions:

1. What signal sets the typewriter to lower case?

2. What signal is sent to the computer when the controller is active?

TABLE 7. TYPEWRITER CHARACTER CODES

UC	LC	R5	R1	R2A	R2	CK	T1	T2	TYPE CODE	TLT	ROT
A	A	1	0	0	1	0	1	0	12	2	-2
B	B	0	0	0	0	0	0	1	01	1	+5
C	C	1	0	0	1	0	0	1	11	1	-2
D	D	1	1	0	1	1	0	1	55	1	-3
E	E	0	1	0	1	0	0	1	51	1	+2
F	F	1	0	1	1	0	0	0	30	3	-4
G	G	1	1	1	1	1	0	0	74	3	-5
H	H	0	1	0	0	1	0	1	45	1	+4
I	I	0	0	0	1	1	1	0	16	2	+3
J	J	0	1	1	1	0	0	0	70	3	0
K	K	0	0	0	1	1	0	1	15	1	+3
L	L	1	1	0	0	0	0	1	41	1	-1
M	M	1	1	1	1	0	1	0	72	2	-5
N	N	0	0	1	1	0	0	1	31	1	+1
O	O	1	1	0	0	0	1	0	42	2	-1
P	P	0	1	0	1	1	0	0	54	3	+2
Q	Q	0	0	0	1	0	0	0	10	3	+3
R	R	1	1	0	1	1	1	0	56	2	-3
S	S	0	1	0	0	1	1	0	46	2	+4
T	T	0	1	1	1	1	0	1	75	1	0
U	U	1	0	1	1	1	0	1	35	1	-4
V	V	1	0	1	1	1	1	0	36	2	-4

NOTE: 1 = energize magnet
0 = magnet de-energized

UC	LC	R5	R1	R2A	R2	CK	T1	T2	TYPE CODE	TLT	ROT
W	W	0	0	0	0	0	1	0	02	2	+5
X	X	1	1	1	1	0	0	1	71	1	-5
Y	Y	0	1	0	0	0	0	0	40	3	+4
Z	Z	0	1	1	1	0	1	1	73	0	0
±	1	1	1	1	1	1	1	1	77	0	-5
@	2	0	0	1	1	1	1	1	37	0	+1
#	3	1	0	1	1	0	1	1	33	0	-4
$	4	1	1	0	0	1	1	1	47	0	-1
%	5	0	1	0	1	1	1	1	57	0	+2
¢	6	0	0	0	1	0	1	1	13	0	+3
&	7	1	1	0	1	0	1	1	53	0	-3
*	8	1	0	0	1	1	1	1	17	0	-2
(	9	0	0	0	0	1	1	1	07	0	+5
)	0	0	1	0	0	0	1	1	43	0	+4
_	-	0	0	0	0	1	0	0	04	3	+5
+	=	0	0	1	1	1	0	0	34	3	+1
°	!	0	1	1	1	1	1	0	76	2	0
:	;	1	1	0	1	0	0	0	50	3	-3
"	'	0	1	0	1	0	1	0	52	2	+2
,	,	1	0	0	1	1	0	0	14	3	-2
.	.	0	0	1	1	0	1	0	32	2	+1
?	/	1	1	0	0	1	0	0	44	3	-1

3. Observe table 7.
   a. Do all of the positive characters have an odd or even number of bits? If so, are they odd or even?
   b. Do all of the negative characters have an odd or even number of bits? If so, are they odd or even?
   c. Disregarding the R5 position, answer step (a) once again.
   d. Disregarding the R5 position, answer step (b) once again.

4. From the information in question 3, can a rule for determining whether a 7-bit code represents a positive or negative character be established using the R5 position as a guideline? State the rule.

5. Will a case shift instruction cause the typewriter to shift?

CHAPTER 13 — DATA FLOW SEQUENCES AND CHARTS

DATA FLOW — FLOW SEQUENCE FOR TYPE DUMP

Bus to O (R006) and type dump (R007) from block control

1. R007 (type dump) = 1
   a. Illuminate type dump light
   b. Clear O register
   c. Energize keyboard lock solenoid
2. R006 sets K020/021 (propagate)
   a. Drop clear to the O register
   b. Gate 6-bit character to the O register
   c. Set K026/027 (control busy)
   d. Busy (T006) to computer
3. O register to code expander
4. Code expander to ~~keyboard decoders~~
5. ~~Keyboard decoder~~ output (I230 - I235)
6. Enable upper or lower-case decoder
7. Parity generator
8. Set K022/023 (print) if change case is not set
9. ~~Keyboard decoder~~ and parity (if applicable) to type drivers
10. C2 contact breaks (20° of cycle shaft rotation)
11. Set K034/035 (type busy)
12. Clear K020/021 (propagate)
   a. Clear K022/023 (print)
   b. Clear O register
13. C2 contact makes (120° of rotation)
14. Clear K034/035 (type busy)
15. Clear K026/027 (control busy)
16. Drop busy to computer (T006 = 0)

Dropping busy signal from the typewriter sets Type Request FF in block control if the output is not complete, thus initiating the next output cycle.

FLOW SEQUENCE FOR CASE CONTROL ON TYPE DUMP

1. Character input to O register
2. O register to code expander
3. Lower-case decoder, upper-case decoder
   I255 = BCD codes of 0 1 2 3 4 5 6 7 8 9 = ; ' ! - / (lower case)
   I260 = BCD codes of ± " : ? +) @ $ # % & (* ° (upper case)
   NOTE: K046/047 (case indicator) will be set if typewriter is in lower case.

   Example: Assume the BCD code 02 is sent to the typewriter interface and the typewriter is currently in upper case:

   A

   I255 = 1 (lower-case decoder)
   I283 = 0 to I285 to D105 to typewriter (lower-case shift)
   I560 = 1 to set K014/015 (change case) which blocks the setting of K022/023 (print)
   Typewriter starts to shift to lower case
   C4 breaks
   Set K034/035 (type busy)
   Typewriter completes the shift to lower case
   C4 makes upon completion of shift
   Clear K034/035 (type busy)
   Clear K014/015 (change case) I580 = 1 for 300 usec.
   Set K022/023 (print)
   Normal print cycle follows

FLOW SEQUENCE FOR TYPE LOAD

A-17 Type Load (R008) from block control (activate buffer cycle): enable T000 - T005.
Strike key on typewriter.

1. C2 contact breaks at 20° of rotation (I591 = 1).
2. Set K034/035 (type busy).
3. C1 contact breaks at 85° of rotation (I540 = 1).
4. Set K036/037 (probe).
5. Gate character to O register.
6. O register to code expander.
7. Code expander to ~~lower-case encoder if K046/047 is set (case indicator) or upper-case encoder if case indicator is clear.~~ MACHINE CODE TO BCD
8. ~~Case encoders~~ to ~~encoder fan-in.~~

8. Machine code translators to encoder fan in

9. Encoder fan-in to transmitters (T000 - T005).
10. Set K044/045 (strobe enable) T008 = 1.
11. Send strobe to computer.

NOTE: Strobe will set Typewriter Request FF in the computer to start block control timing.

12. C2 makes at 120° of rotation (I592 = 1).
13. Clear K034/035 (type busy) T008 = 0.
14. Drop strobe to computer.
15. C1 makes at 130° of rotation which is the end of the print cycle (I541 = 1).
16. Clear K036/037 (probe).
17. Clear K044/045 (strobe enable).
18. Clear O register.

FLOW SEQUENCE FOR FINISH OR REPEAT

NOTE: Finish is used as the example, but repeat is the same. Either is operative only on type load.

1. Depress FINISH button, I463 = 1.
2. 40 msec delay.
3. Set K040/041 (clear I).
4. Set K042/043 (clear II) when $\overline{\text{control busy}}$.
5. T007 = 100 nsec 1 (clear type in/out).
6. Set K032/033 (finish).
7. 100 nsec delay.
8. Clear K040/041 (clear I).
9. Release FINISH button, I594 = 1.
10. 100 nsec delay.
11. Clear K042/043 (clear II).

NOTE: K032/033 (finish) will only clear if a 77.601000 instruction is executed or a master clear is performed.

FLOW SEQUENCE FOR CLEAR

1. Depress CLEAR button on typewriter, I464 = 1.
2. 40 msec delay.
3. Set K040/041 (clear I).
4. Set K042/043 (clear II) when $\overline{\text{control busy}}$.
5. T007 = 100 nsec 1 (clear type in/out).
6. Clear K032/033 (finish) and K030/031 (repeat).
7. 100 nsec delay.
8. Clear K040/041 (clear I).
9. Release CLEAR button, I594 = 1.
10. 100 nsec delay.
11. Clear K042/043 (clear II).

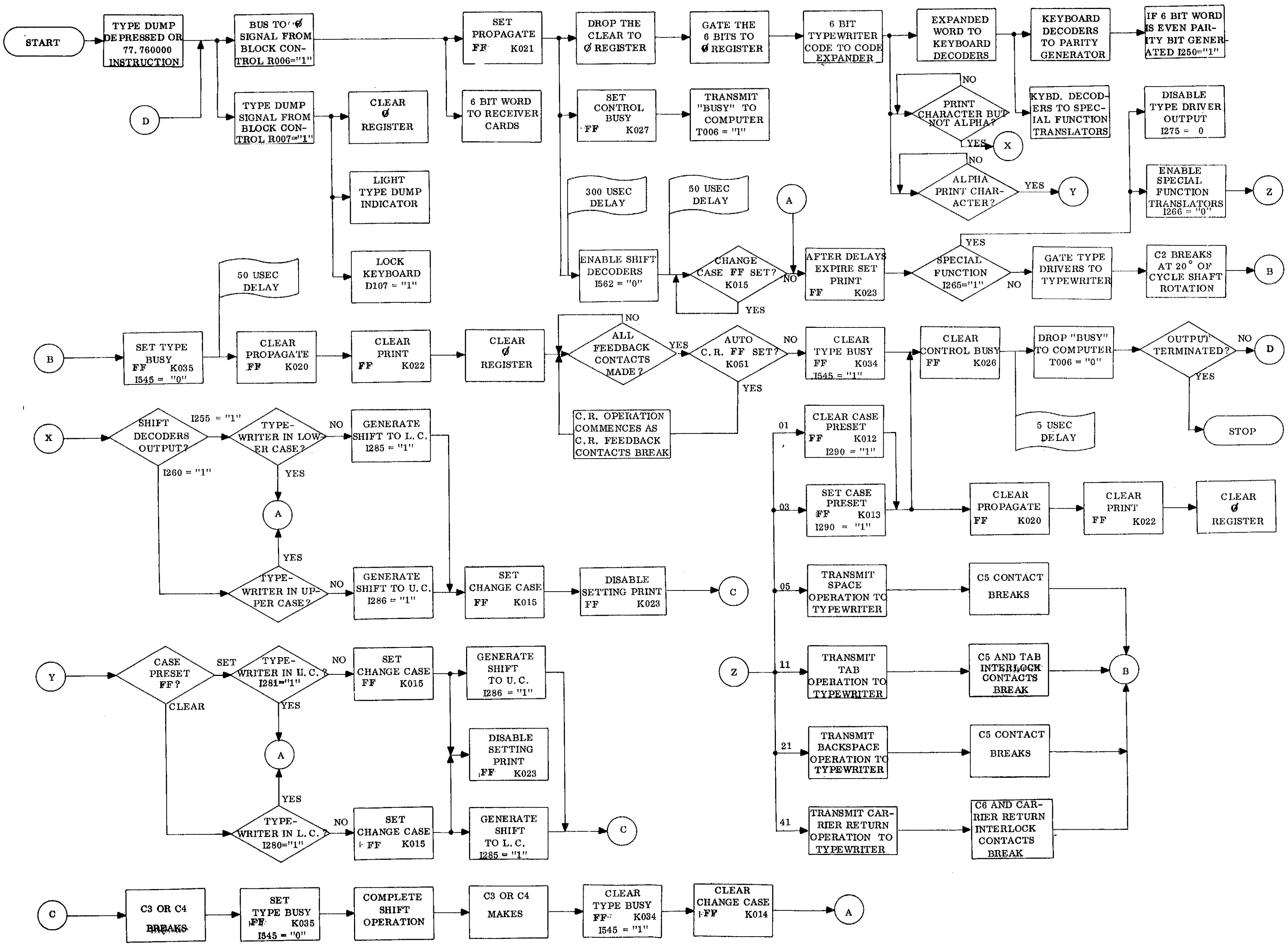


Figure 162. Flow Sequence for Type Dump

FOR TRAINING USE ONLY

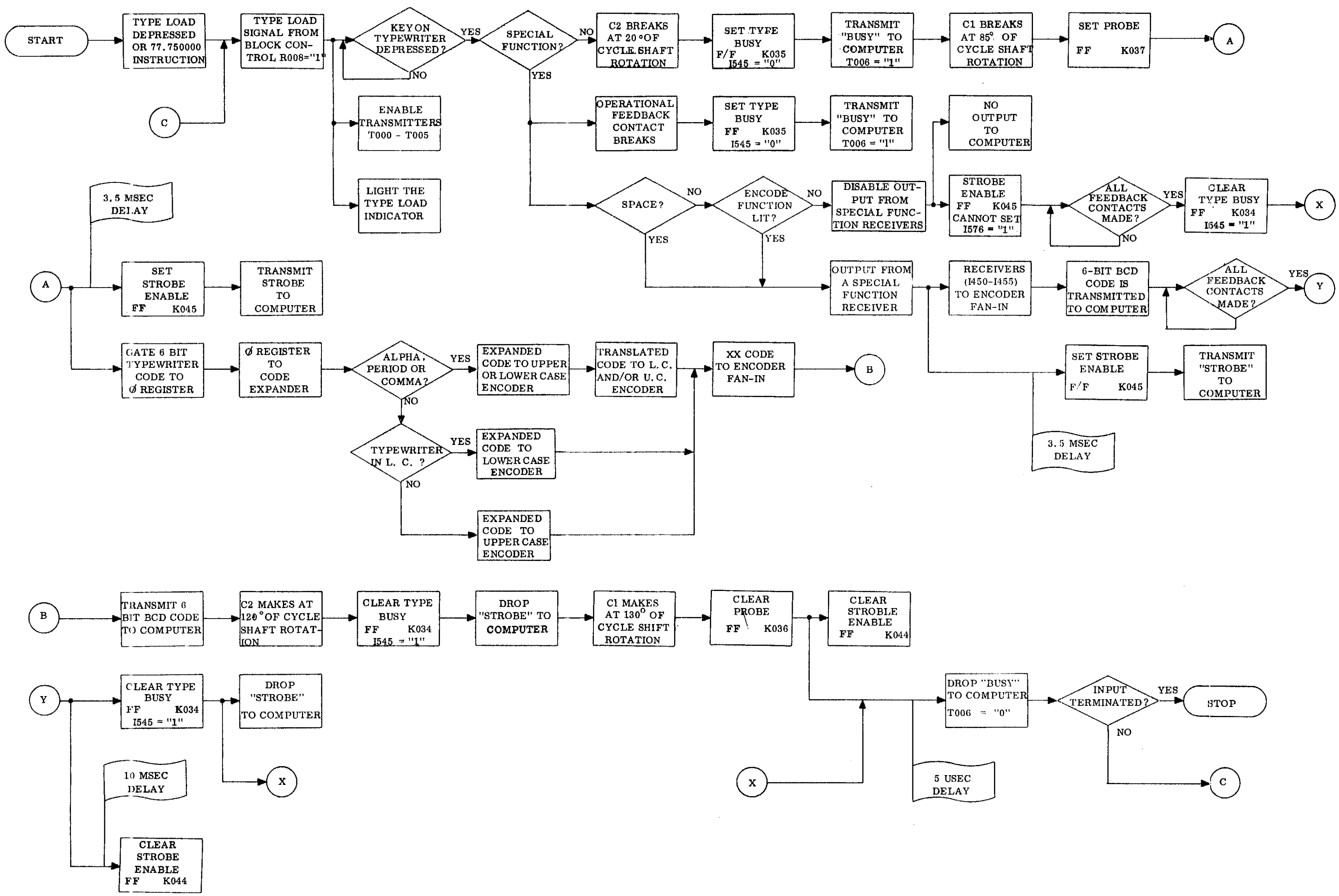


Figure 163. Flow Sequence for Type Load

FOR TRAINING USE ONLY

Figure 164. Repeat or Finish Flow Sequence

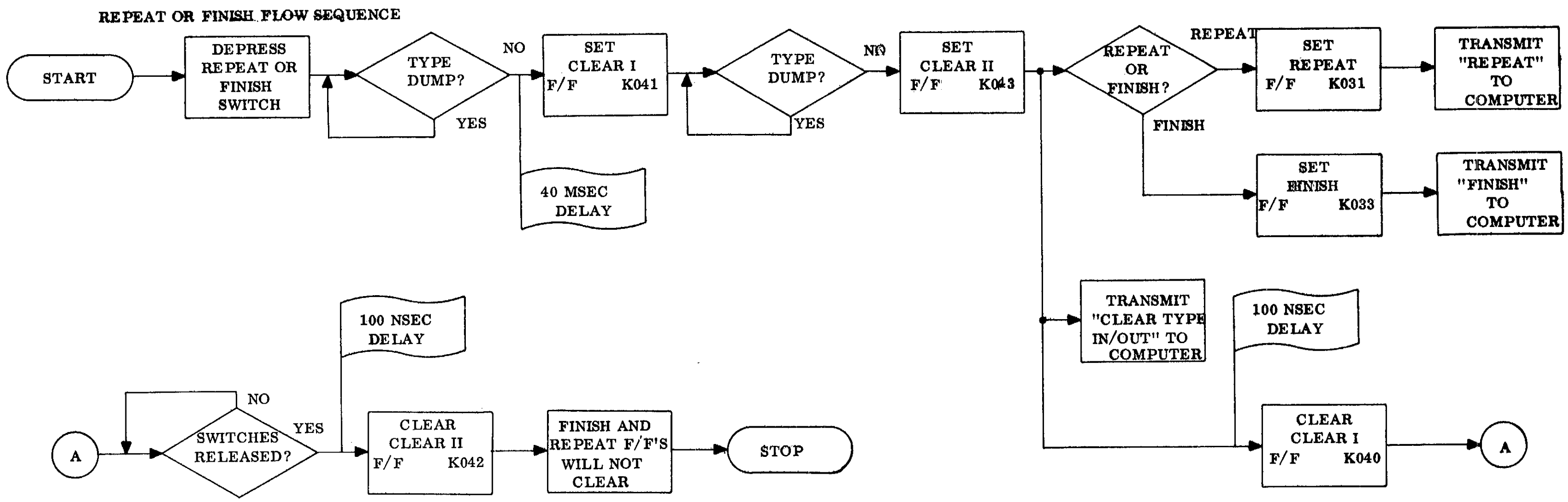
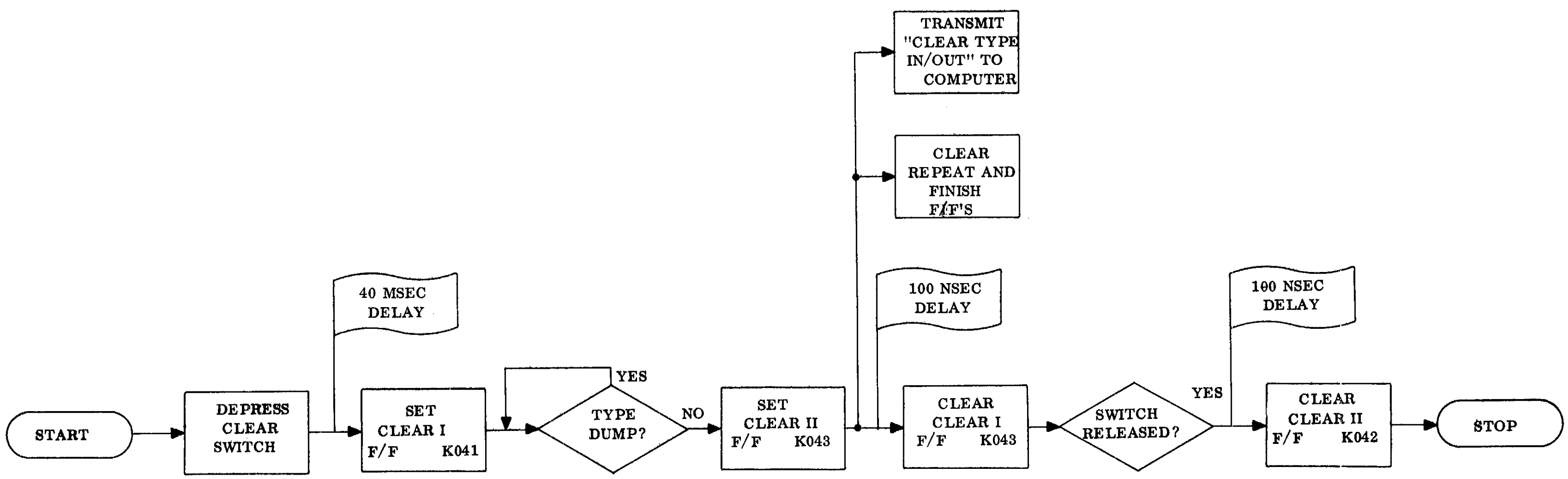


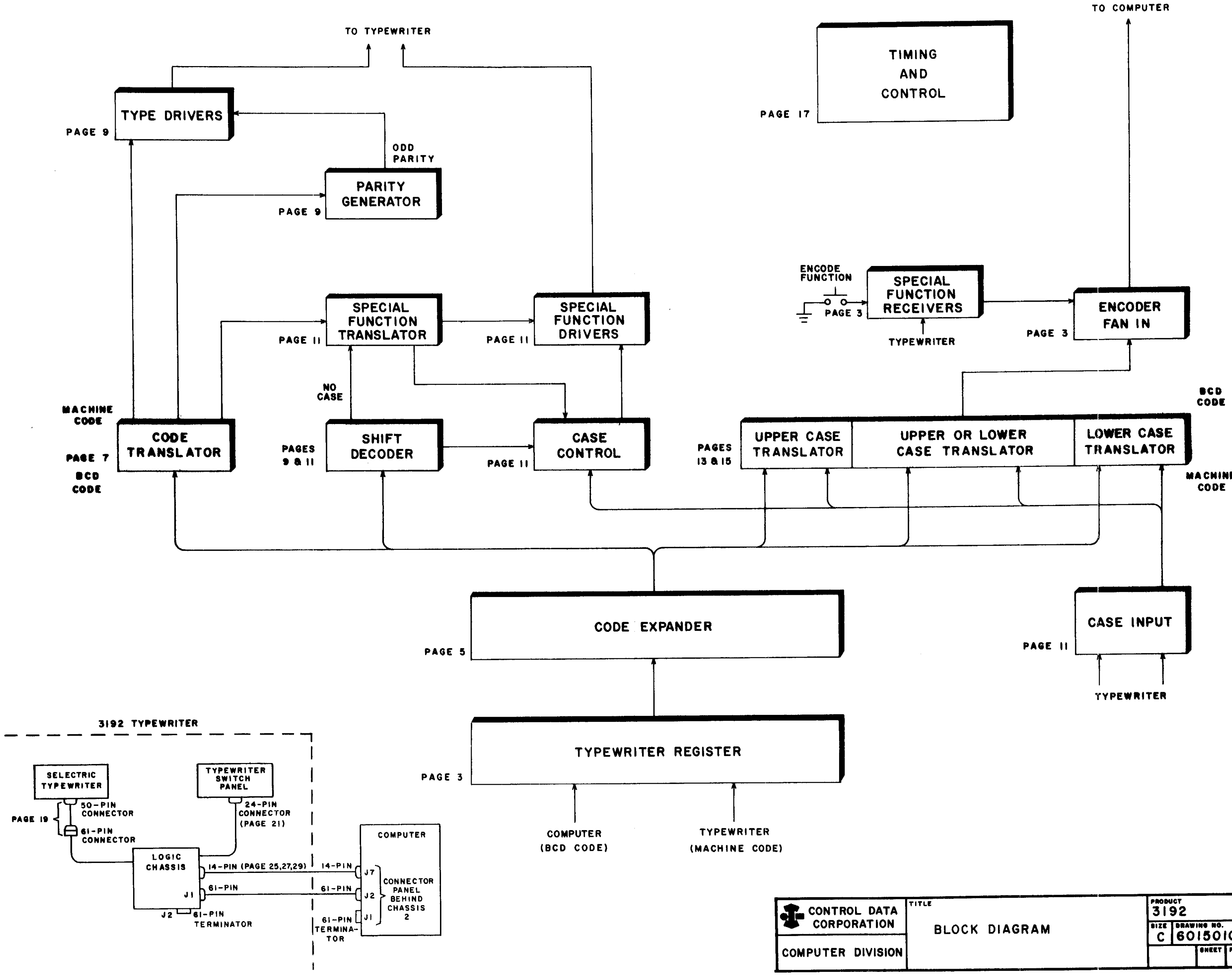
Figure 165. Clear Flow Sequence



APPENDIX A

DIAGRAMS

For Training Use Only



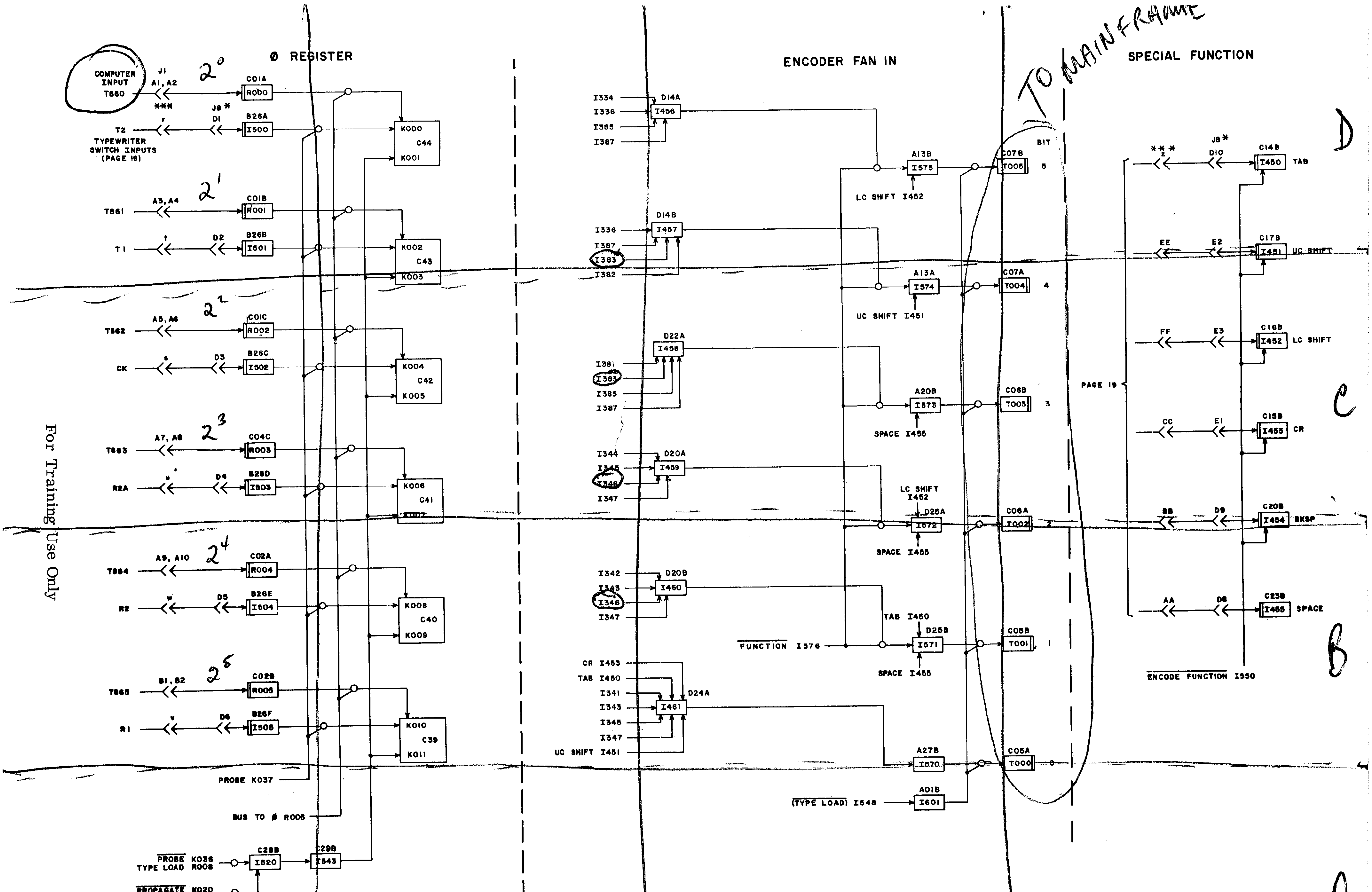
CONTROL DATA CORPORATION COMPUTER DIVISION	TITLE BLOCK DIAGRAM	PRODUCT 3192 SIZE C · DRAWING NO. 60150100 · REV A	SHEET · PAGE 1-1

TERM	LOCATION	PAGE	DEFINITION
I334	B19A	1-13	4X
I336	B17A		6X
I341	B16A		X1
I342	B15A		X2
I343	B14A		X3
I344	B13A	1-15	X4 — Upper, Lower, and U/L
I345	B12A		X5 — Case Translations
I346	B11A		X6 — (Internal BCD Code)
I347	B10A		X7
I381	A05B		1X
I382	A05A	1-13	2X
I383	A01A		3X
I385	B06A		5X
I387	B09B		7X
I548	A01B	1-17	Type Load
I550	D31F	1-21	Encode
I576	D29A		(Tab + UC Shift + LC Shift + CR + Bksp + Space)
K020	D44A		Propagate FF = 0
K036	D37C	1-17	Probe FF = 0
K037	D37D		Probe FF = 1
R006	C02C		Enable Bus To O
R007	C03A		Type Dump
R008	C03B		Type Load
T860		1-94	3100 C/E Diagrams
T861	*		
T862			
T863			
T864			
T865		1-93	3200 C/E Diagrams

*Terms are applicable to the 3100 and 3200 C/E Diagram.

For Training Use Only

For Training Use Only

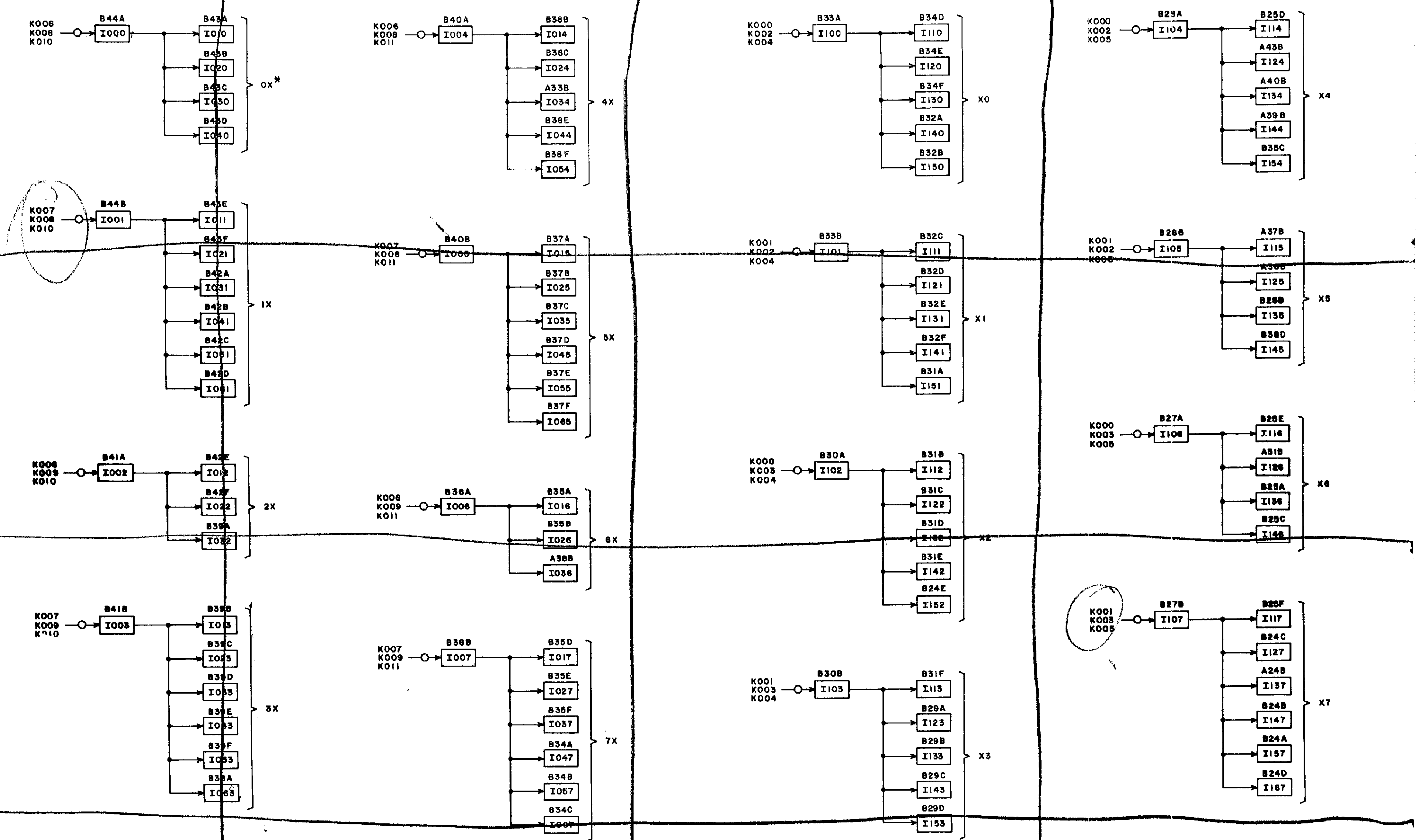


* J3 IN 3192-A

*** CONNECTOR ON TYPEWRITER

CONTROL DATA CORPORATION	TITLE	PRODUCT
COMPUTER DIVISION	Ø REGISTER, ENCODER FAN IN, SPECIAL FUNCTION RECEIVERS	3192
		SIZE C, DRAWING NO. 60150100, REV A
		SHEET, PAGE 1-3

TERM	LOCATION	PAGE	DEFINITION
K000	C44A	1-3	Ø Register (Both Set and Clear Outputs)
K001	C44B		
K002	C43A		
K003	C43B		
K004	C42A		
K005	C42B		
K006	C41A		
K007	C41B		
K008	C40A		
K009	C40B		
K010	C39A		
K011	C39B		



* INTERNAL BCD CODE FOR TYPE-OUT.
MACHINE CODE FOR TYPE-IN.

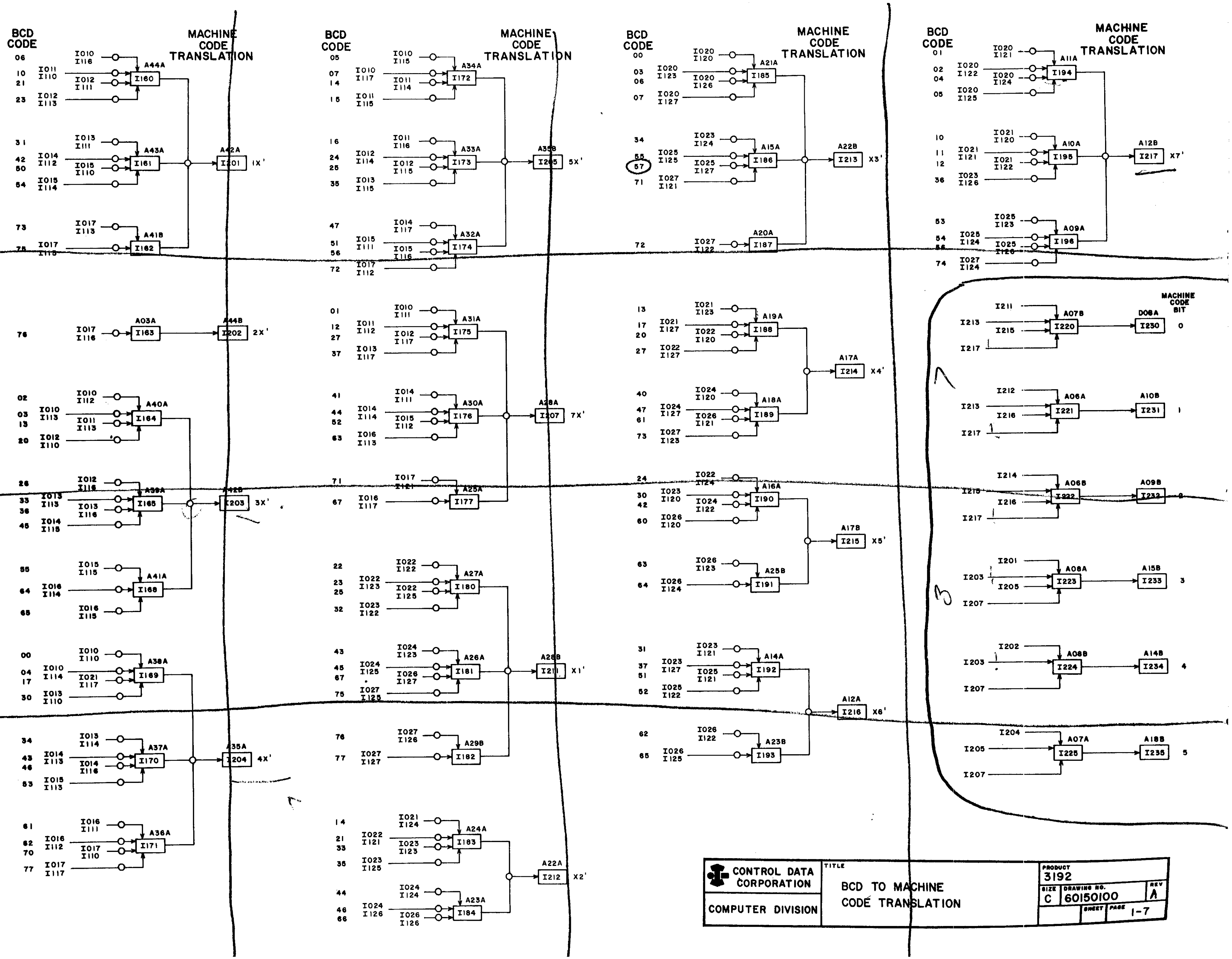
CONTROL DATA CORPORATION / COMPUTER DIVISION	TITLE: CODE EXPANDER	PRODUCT: 3192	
		SIZE: C	DRAWING NO.: 60150100	REV: A
		SHEET	PAGE: 1-5

For Training Use Only

TERM	LOCATION	PAGE	DEFINITION
I010	B43A	1-5	0X
I011	B43E		1X
I012	B42E		2X
I013	B39B		3X
I014	B38B		4X
I015	B37A		5X
I016	B35A		6X
I017	B35D		7X
I020	B43B		0X
I021	B43F		1X
I022	B42F		2X
I023	B39C		3X
I024	B38C		4X
I025	B37B		5X
I026	B35B		6X
I027	B35E		7X Code Expander Outputs
I110	B34D		X0
I111	B32C		X1
I112	B31B		X2
I113	B31F		X3
I114	B25D		X4
I115	A37B		X5
I116	B25E		X6
I117	B25F		X7
I120	B34E		X0
I121	B32D		X1
I122	B31C		X2
I123	B29A		X3
I124	A43B		X4
I125	A36B		X5
I126	A31B		X6
I127	B24C		X7

(Braces group all terms: locations → page 1-5; definitions → Code Expander Outputs)

FORM CA 210



CONTROL DATA CORPORATION

COMPUTER DIVISION

TITLE: BCD TO MACHINE CODE TRANSLATION

PRODUCT: 3192

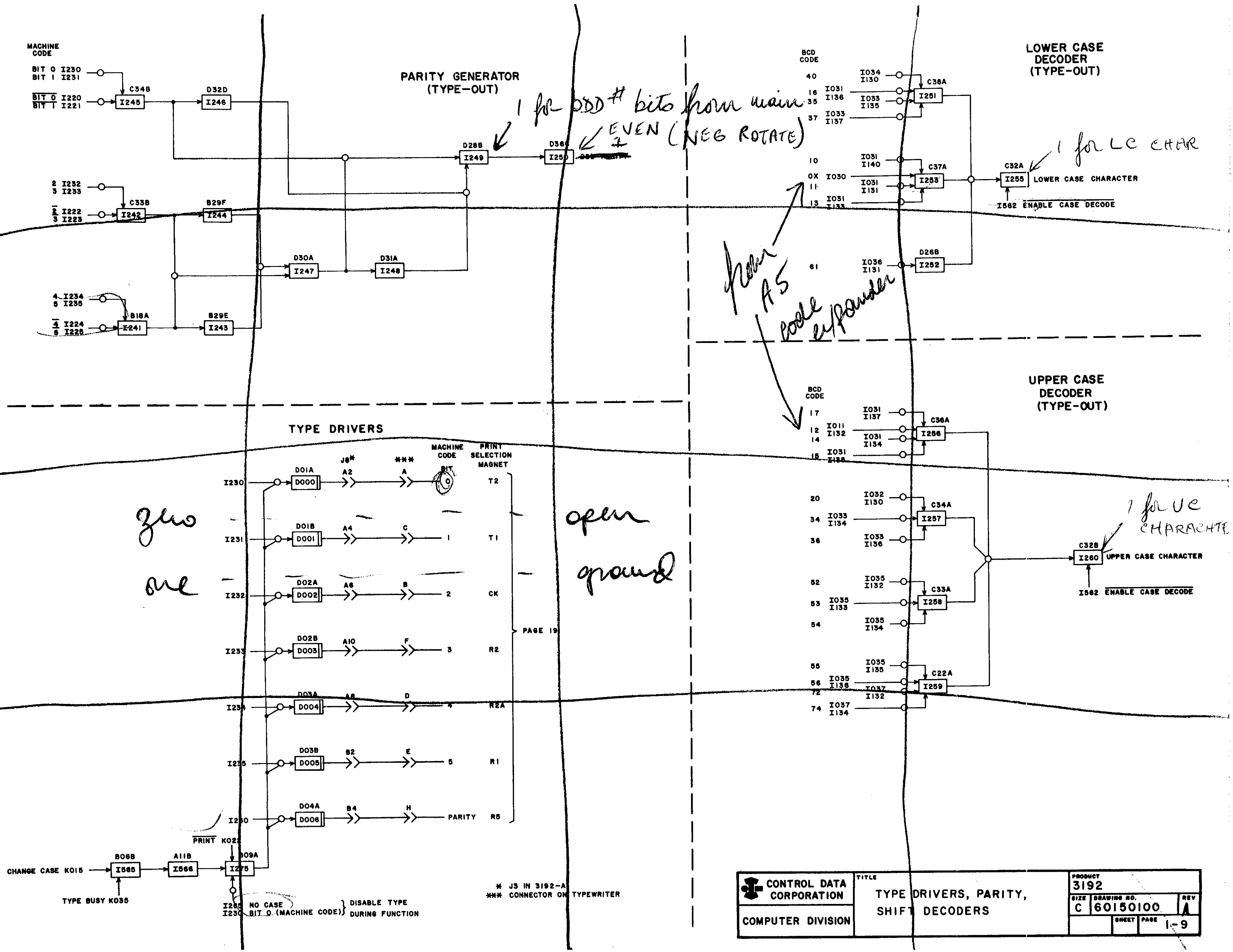
SIZE: C DRAWING NO. 60150100 REV A

SHEET / PAGE 1-7

For Training Use Only

For Training Use Only

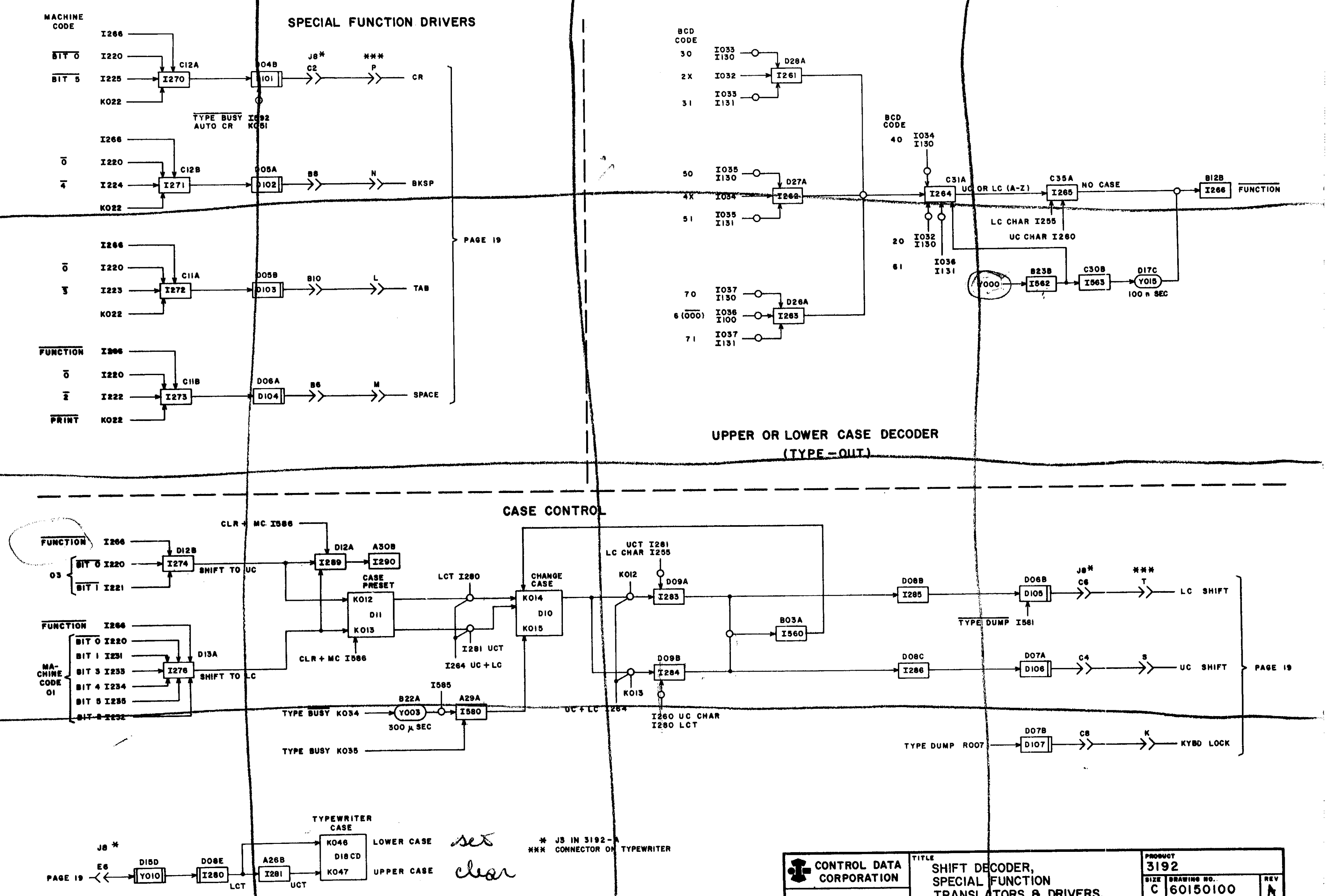
TERM	LOCATION	PAGE	DEFINITION
I011	B43E		1X
I030	B43C		0X
I031	B42A		1X
I032	B32A		3X
I033	B39D		3X
I034	A33B		4X
I035	B37C		5X
I036	A38B		6X
I037	B35F	1-5	7X From Code Expander
I130	B34F		X0
I131	B32E		X1
I132	B31D		X2
I133	B29B		X3
I134	A40B		X4
I135	B25B		X5
I136	B25A		X6
I137	A24B		X7
I140	B32A		X0
I220	A07B		Machine Code Bit 0 = 0
I221	A06A		Machine Code Bit 1 = 0
I222	A06B		Machine Code Bit 2 = 0
I223	A08A		Machine Code Bit 3 = 0
I224	A08B		Machine Code Bit 4 = 0
I225	A07A		Machine Code Bit 5 = 0
I230	D08A	1-7	Machine Code Bit 0 = 1 Code Translator
I231	A10B		Machine Code Bit 1 = 1
I232	A09B		Machine Code Bit 2 = 1
I233	A15B		Machine Code Bit 3 = 1
I234	A14B		Machine Code Bit 4 = 1
I235	A18B		Machine Code Bit 5 = 1
I265	C35A		No Case
I562	B23B	1-11	$\overline{\text{Enable Case Decode}}$
K015	D10B		Change Case FF = 1
K022	D43A	1-17	Print FF = 0
K035	D37B		Type Busy FF = 1



For Training Use Only

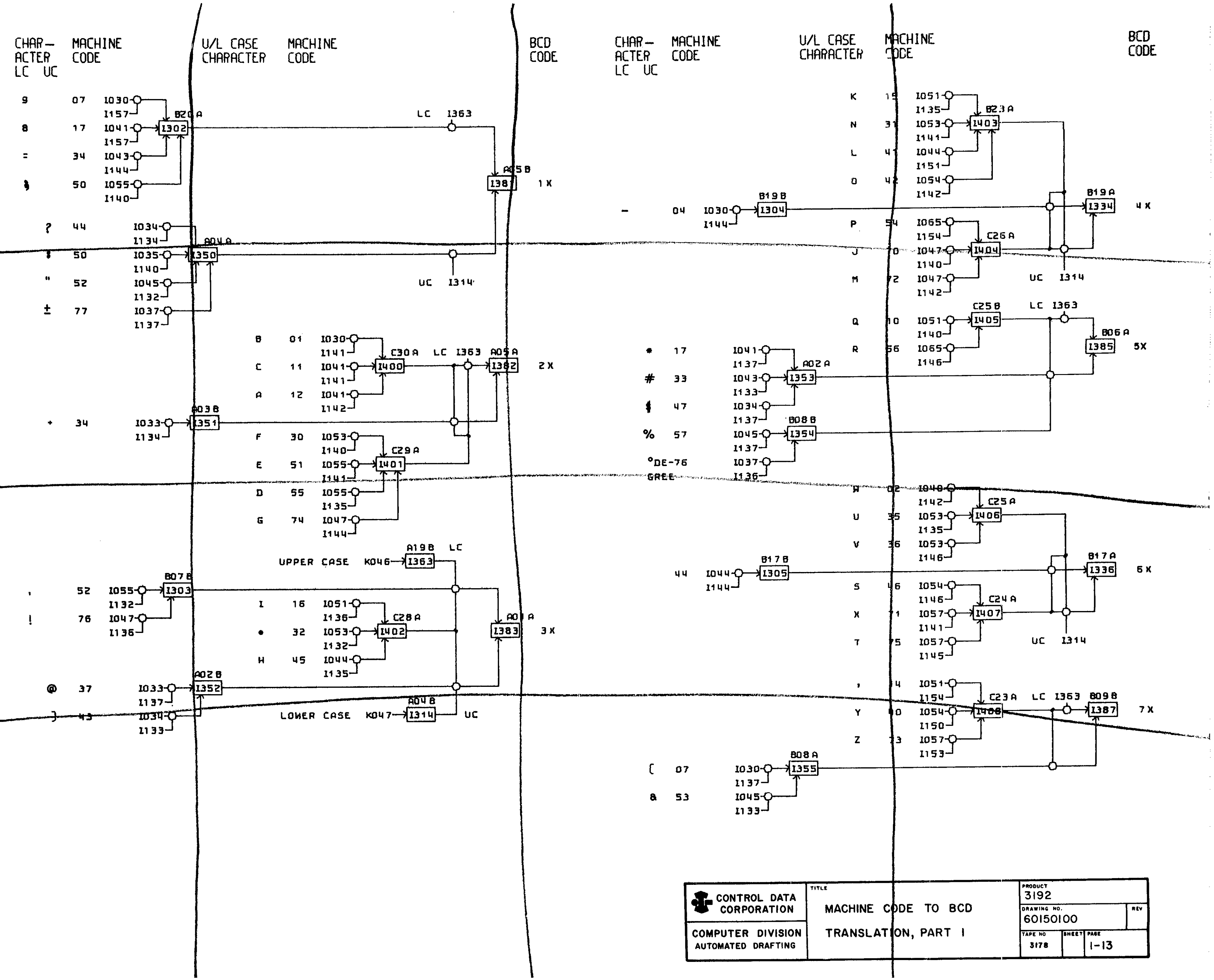
TERM	LOCATION	PAGE	DEFINITION	
I032	B39A		2X	
I033	B39D		3X	
I034	A33B		4X	
I035	B37C		5X	
I036	A38B	A-5	6X	Code Expander
I037	B35F		7X	
I100	B33A		$\overline{\text{X0}}$	
I130	B34F		X0	
I131	B32E		X1	
I220	A07B		Machine Code Bit 0 = 0	
I221	A06A		Machine Code Bit 1 = 0	
I222	A06B		Machine Code Bit 2 = 0	
I223	A08A		Machine Code Bit 3 = 0	
I224	A08B		Machine Code Bit 4 = 0	
I225	A07A	A-7	Machine Code Bit 5 = 0	Code Translator
I231	A10B		Machine Code Bit 1 = 1	
I232	A09B		Machine Code Bit 2 = 1	
I233	A15B		Machine Code Bit 3 = 1	
I234	A14B		Machine Code Bit 4 = 1	
I235	A18B		Machine Code Bit 5 = 1	
I255	C32A	A-9	Lower Case Character	
I260	C32B		Upper Case Character	
I581	C36B		$\overline{\text{Type Dump}}$	
I585	C35B		$\overline{\text{(Clear + MC)}}$	
I586	C22B		Clear + Master Clear	
I592	C24B		$\overline{\text{Type Busy}}$	
K022	D43A		Print FF = 0	
K034	D37A	A-17	Type Busy FF = 0	
K035	D37B		Type Busy FF = 1	
K051	B04B		Auto CR FF = 1	
R007	C03A		Type Dump	
Y000	D42A		Propagate	

For Training Use Only



CONTROL DATA CORPORATION COMPUTER DIVISION	TITLE SHIFT DECODER, SPECIAL FUNCTION TRANSLATORS & DRIVERS, CASE CONTROL	PRODUCT 3192 SIZE C · DRAWING NO. 60150100 · REV A PAGE 1-11

TERM	LOCATION	PAGE	DEFINITION	
I030	B43C		0X	
I033	B39D		3X	
I034	A33B		4X	
I035	B37C		5X	
I037	B35F		7X	
I040	B43D		0X	
I041	B42B		1X	
I043	B39E		3X	
I044	B38E		4X	
I045	B37D		5X	
I047	B34A		7X	
I051	B42C		1X	
I053	B39F		3X	
I054	B38F		4X	
I055	B37E		5X	
I057	B34B		7X	
I065	B37F	1-5	5X	From Code Expander
I132	B31D		X2	
I133	B29B		X3	
I134	A40B		X4	
I135	B25B		X5	
I136	B25A		X6	
I137	A24B		X7	
I140	B32A		X0	
I141	B32F		X1	
I142	B31E		X2	
I144	A39B		X4	
I145	B38D		X5	
I146	B25C		X6	
I150	B32B		X0	
I151	B31A		X1	
I153	B29D		X3	
I154	B35C		X4	
I157	B24A		X7	
K046	D19A	1-11	Upper Case Type	
K047	D19B		Lower Case Type	


CHAR-ACTER LC UC
MACHINE CODE
U/L CASE CHARACTER
MACHINE CODE
BCD CODE
UPPER CASE
LOWER CASE
CONTROL DATA CORPORATION
COMPUTER DIVISION
AUTOMATED DRAFTING
TITLE
MACHINE CODE TO BCD TRANSLATION, PART I
PRODUCT 3192
DRAWING NO. 60150100
REV
TAPE NO 3178
SHEET
PAGE 1-13

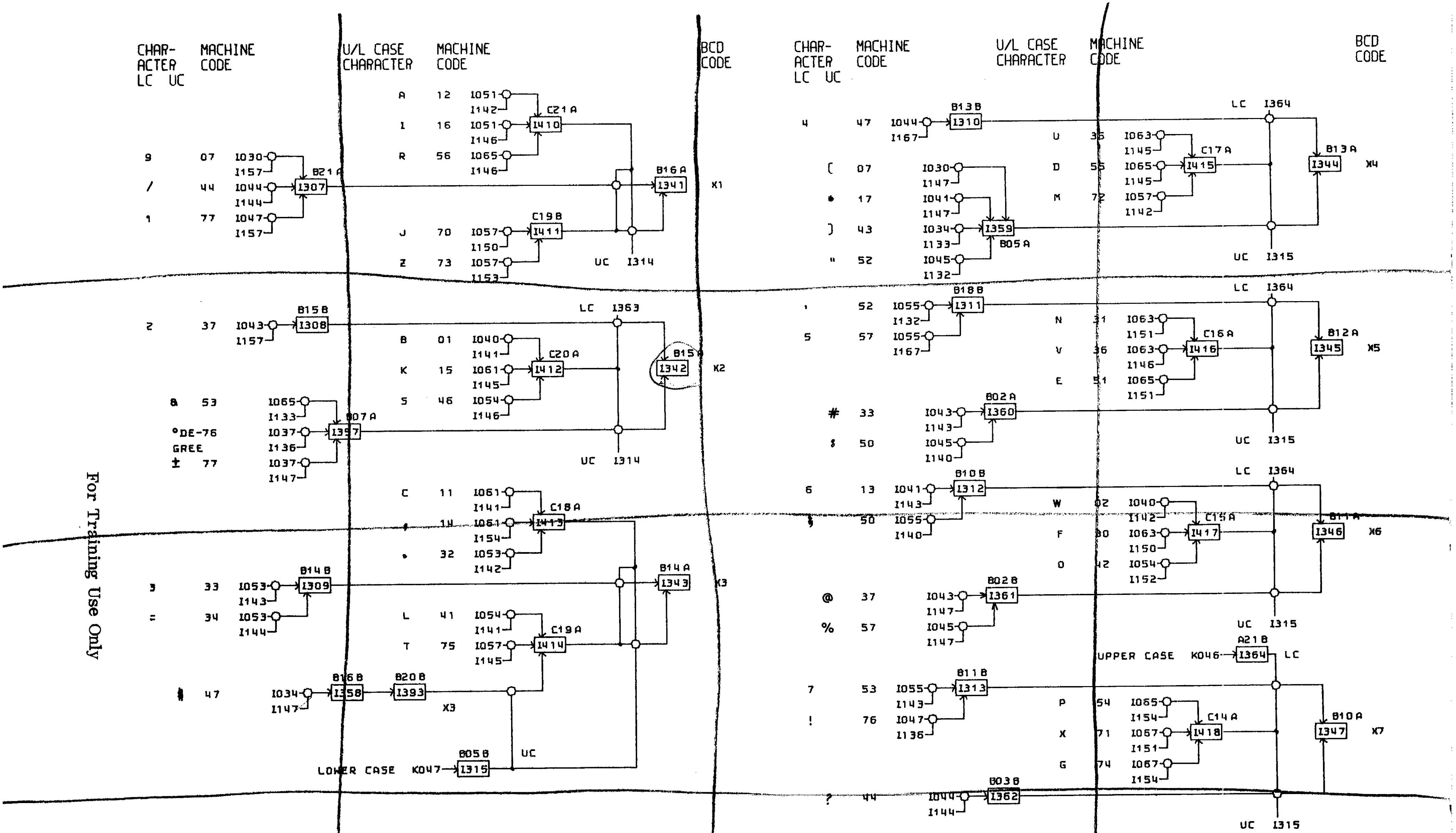
For Training Use Only

TERM	LOCATION	PAGE	DEFINITION
I030	B43C	1-5	0X — From Code Expander
I034	A33B	1-5	4X — From Code Expander
I037	B35F	1-5	7X — From Code Expander
I040	B43D	1-5	0X — From Code Expander
I041	B42B	1-5	1X — From Code Expander
I043	B39E	1-5	3X — From Code Expander
I044	B38E	1-5	4X — From Code Expander
I045	B37D	1-5	5X — From Code Expander
I047	B34A	1-5	7X — From Code Expander
I051	B42C	1-5	1X — From Code Expander
I053	B39F	1-5	3X — From Code Expander
I054	B38F	1-5	4X — From Code Expander
I055	B37E	1-5	5X — From Code Expander
I057	B34B	1-5	7X — From Code Expander
I061	B42D	1-5	1X — From Code Expander
I063	B38A	1-5	3X — From Code Expander
I065	B37F	1-5	5X — From Code Expander
I067	B34C	1-5	7X — From Code Expander
I132	B31D	1-5	X2 — From Code Expander
I133	B29B	1-5	X3 — From Code Expander
I136	B25A	1-5	X6 — From Code Expander
I140	B32A	1-5	X0 — From Code Expander
I141	B32F	1-5	X1 — From Code Expander
I142	B31E	1-5	X2 — From Code Expander
I143	B29C	1-5	X3 — From Code Expander
I144	A39B	1-5	X4 — From Code Expander
I145	B38D	1-5	X5 — From Code Expander
I146	B25C	1-5	X6 — From Code Expander
I147	B24B	1-5	X7 — From Code Expander
I150	B32B	1-5	X0 — From Code Expander
I151	B31A	1-5	X1 — From Code Expander
I152	B24E	1-5	X2 — From Code Expander
I153	B29D	1-5	X3 — From Code Expander
I154	B35C	1-5	X4 — From Code Expander
I157	B24A	1-5	X7 — From Code Expander
I167	B24D	1-5	X7 — From Code Expander
I314	A04B	1-15	Upper Case Type
I363	A19B	1-15	Lower Case Type

FORM CA 210

TERM	LOCATION	PAGE	DEFINITION
K046	D19A	1-11	Upper Case Type
K047	D19B	1-11	Lower Case Type

FORM CA 210



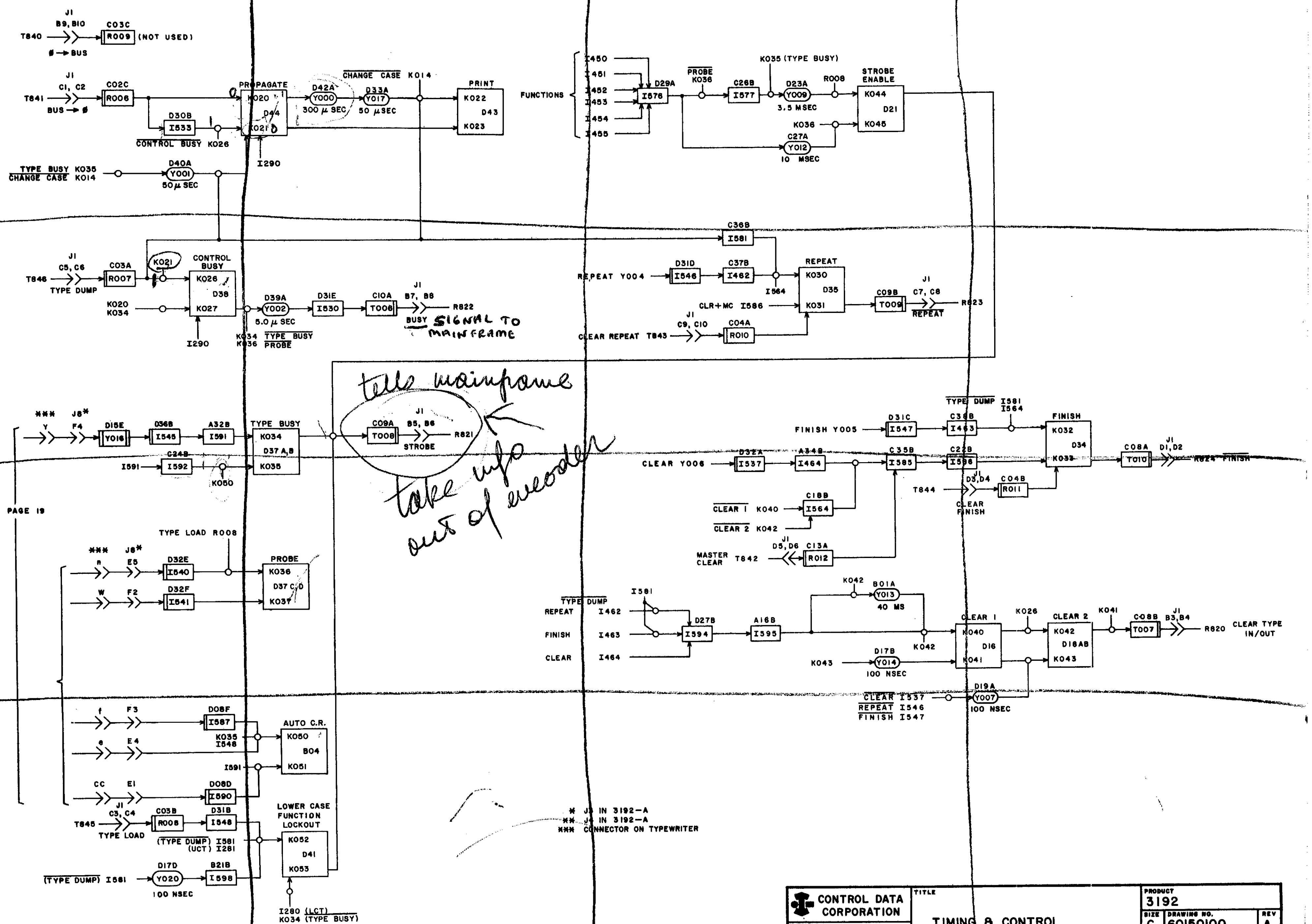
CONTROL DATA CORPORATION	TITLE	PRODUCT 3192
COMPUTER DIVISION AUTOMATED DRAFTING	MACHINE CODE TO BCD TRANSLATION, PART 2	DRAWING NO. 60150100 REV
		TAPE NO. 3179 SHEET PAGE 1-15

TERM	LOCATION	PAGE	DEFINITION
I280	D08E		Lower Case Type
I281	A26B	1-11	Upper Case Type
I290	A30B		Shift to UC + Shift to LC + Clear + Master Clear
I450	C14B	1-3	Tab
I451	C17B	1-7	UC Shift
I452	C16B		LC Shift
I453	C15B		Carriage Return
I454	C20B	1-3	Backspace
I455	C23B		Space
K014	D10A	1-11	Change Case FF = 0
T840			O to Bus
T841			Bus to TWR
T842			Master Clear
T843			Clear Repeat — Terms located in
T844			Clear Finish — computation section.
T845			Type In — (Chassis 2).
T846			Type Out
Y004	D15A		Repeat
Y005	D15B	1-21	Finish
Y006	D156		Clear

Note: All terms located on chassis 1 of the typewriter unless otherwise indicated.

Open = zero
Normal = one

For Training Use Only



CONTROL DATA CORPORATION

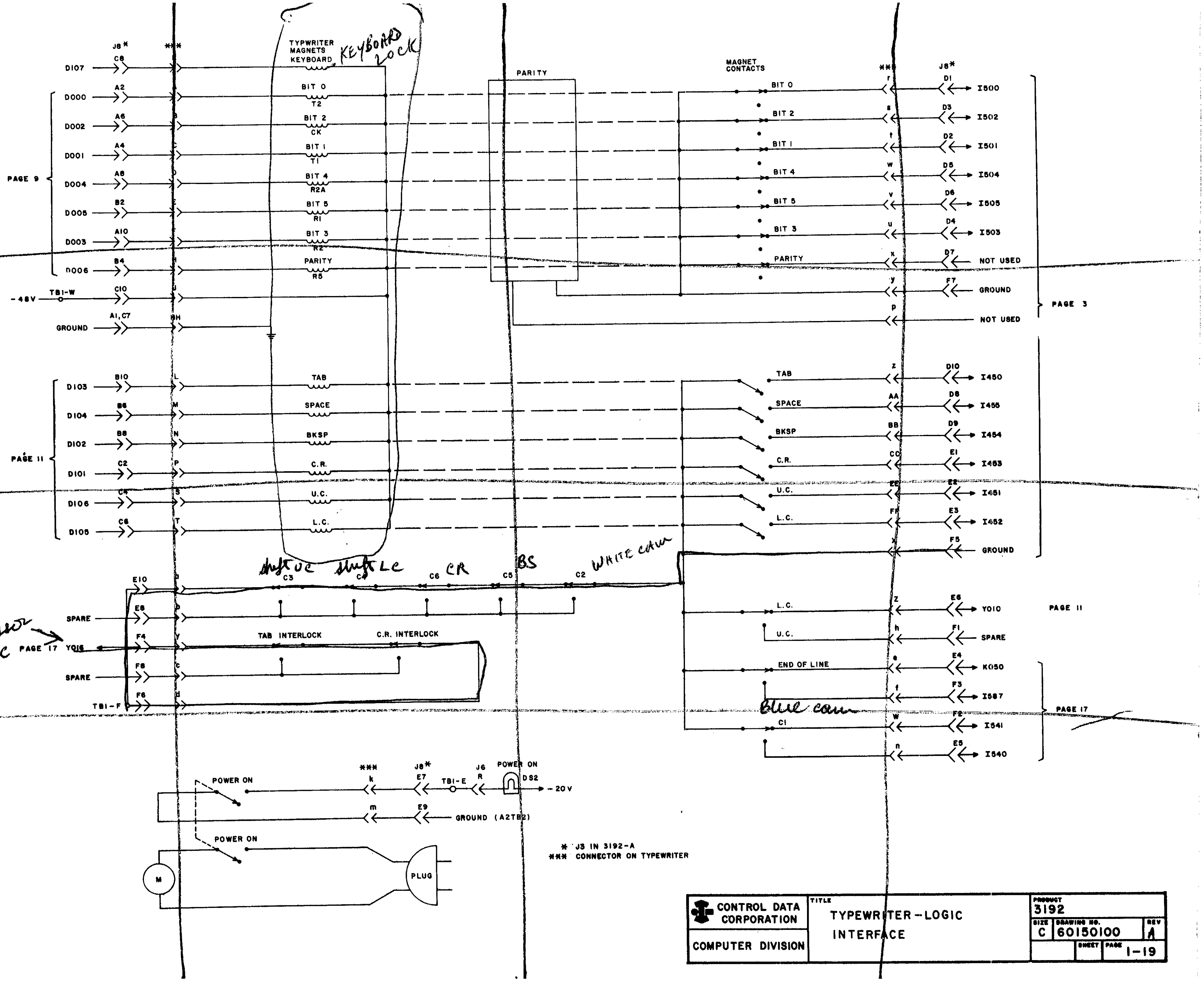
COMPUTER DIVISION

TITLE: TIMING & CONTROL

PRODUCT: 3192 | SIZE: C | DRAWING NO. 60150100 | REV A | PAGE 1-17

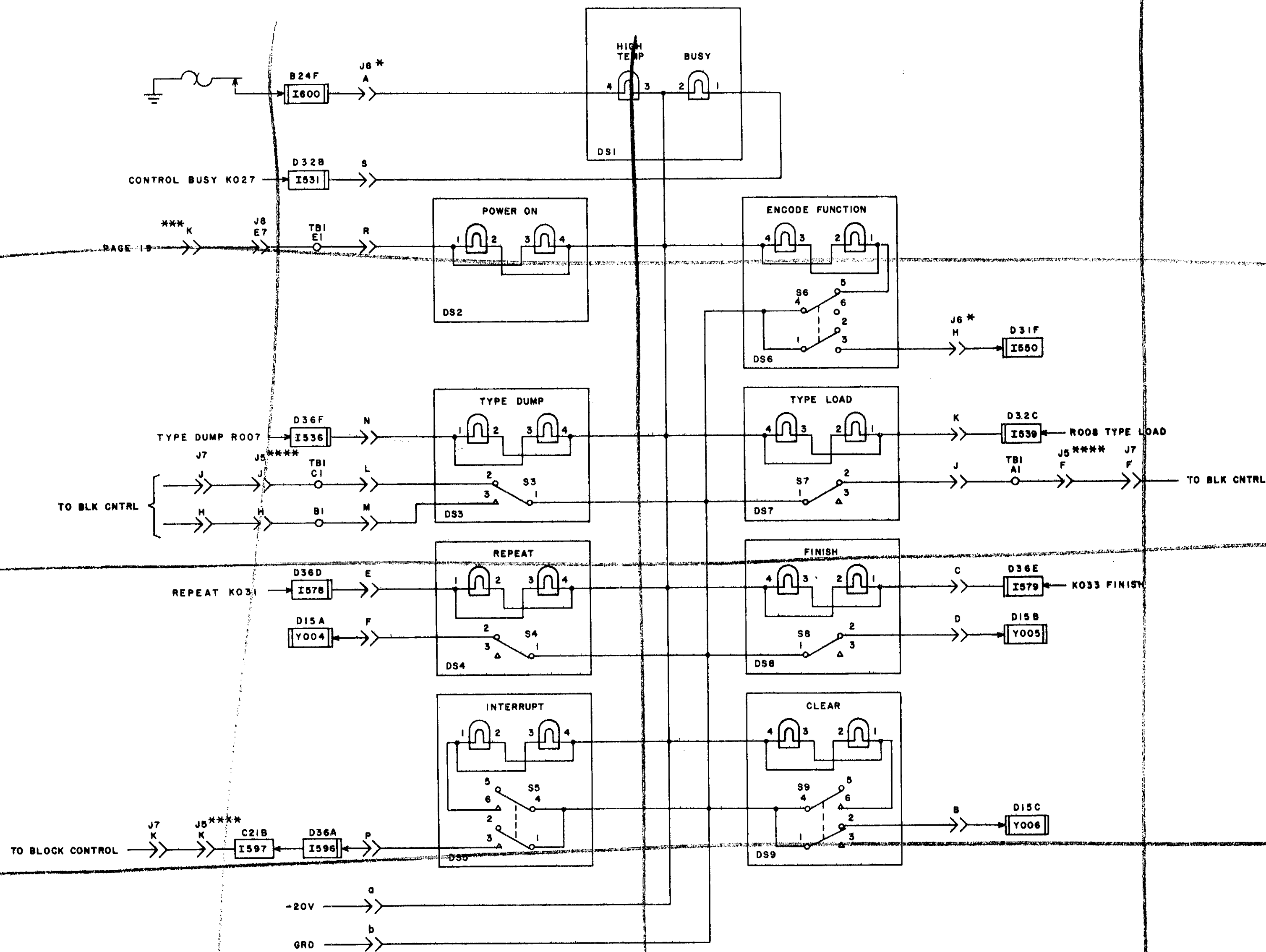
For Training Use Only

TERM	LOCATION	PAGE	DEFINITION
D000	D01A	1-9	Type Driver, Bit 0
D001	D01B	1-9	Type Driver, Bit 1
D002	D02A	1-9	Type Driver, Bit 2
D003	D02B	1-9	Type Driver, Bit 3
D004	D03A	1-9	Type Driver, Bit 4
D005	D03B	1-9	Type Driver, Bit 5
D006	D04A	1-9	Type Driver, Parity Bit
D101	D04B	1-11	Carriage Return Driver
D102	D05A	1-11	Backspace Driver
D103	D05B	1-11	Tab Driver
D104	D06A	1-11	Space Driver
D105	D06B	1-11	LC Shift Driver
D106	D07A	1-11	UC Shift Driver
D107	D07B	1-11	KYBD Lock Driver



For Training Use Only

TERM	LOCATION	PAGE	DEFINITION
K027	D38B	1-17	Control Busy
K031	D35B	1-17	Repeat
K033	D34B	1-17	Finish
R007	C03A	1-17	Type Dump
R008	C03B	1-17	Type Load

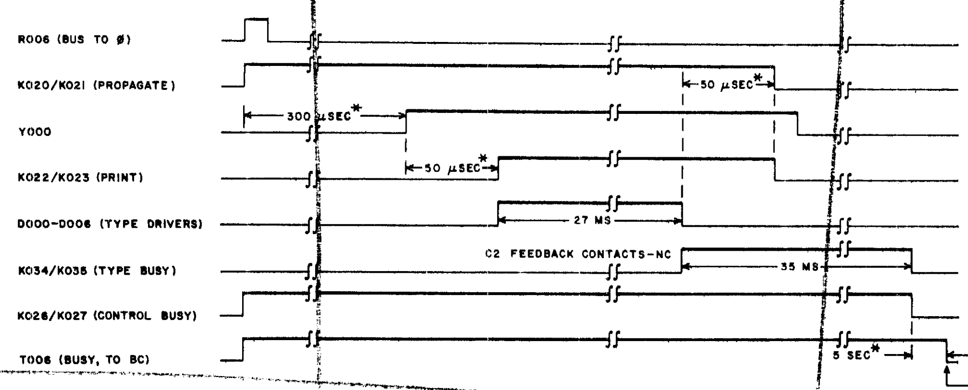


* J4 IN 3192-A
** J3 IN 3192-A
*** CONNECTOR ON TYPEWRITER
**** J6 IN 3192-A

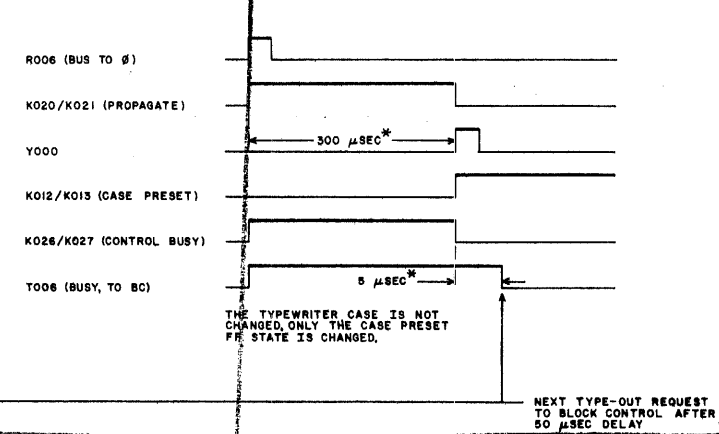
CONTROL DATA CORPORATION / COMPUTER DIVISION	TITLE: SCHEMATIC-SWITCH PANEL	PRODUCT: 3192 / SIZE: C / DRAWING NO. 60150100 / REV A / SHEET / PAGE 1-21

For Training Use Only

TYPE DUMP

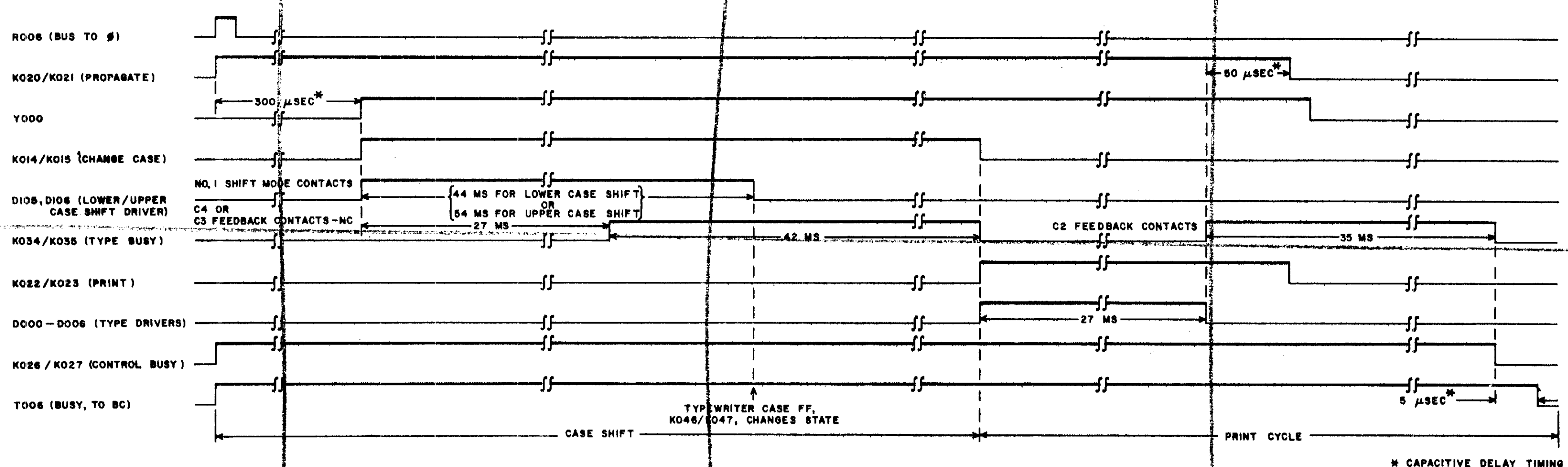


TYPE DUMP-FUNCTION-SHIFT TO UPPER CASE (57)

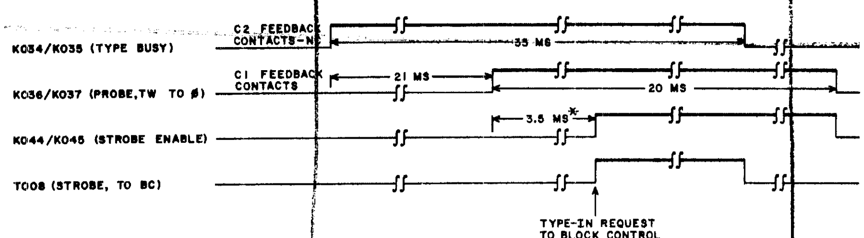


For Training Use Only

TYPE DUMP WITH CASE SHIFT



TYPE LOAD



NOTE:
THE TIMING CHARTS SHOW THE TIMING FOR PRINTABLE CHARACTERS, NOT FUNCTIONS, EXCEPT AS NOTED.

CONTROL DATA CORPORATION / COMPUTER DIVISION	TITLE: TIMING DIAGRAMS	PRODUCT: 3192	SIZE: C	DRAWING NO. 60150100	REV: A	SHEET	PAGE: 1-22

APPENDIX B

STUDY QUESTION ANSWERS

Chapter 1

1. It has a high starting torque.
2. a. operational shaft ---- continuous rotation ---- top to the front
   b. cycle shaft ---- 180° rotation ---- top to the front
   c. filter shaft ---- 180° rotation ---- top to the front
   d. print shaft ---- 360° rotation ---- top to the rear
3. cycle shaft. print and filter shafts.

Chapter 2

1. Transport the typehead along the print line.
2. Drive the typehead toward the platen.
3. It is tilted and/or rotated.
4. Eleven.
5. The upper carrier shoe against the escapement rack.
6. Drives all print operations.
7. To allow 180° of rotation.
8. Because of the clearance between the cycle clutch overthrow stop and the cycle clutch sleeve, momentum will allow the cycle shaft to rotate farther, forcing the spring to unwind, disengaging.
9. The positive cams.
10. To supply the motion needed to tilt and/or rotate the typehead to the print position.
11. A ball-shouldered screw mounting which keeps the pulley parallel with the tape.
12. The tilt pulley spring.
13. T0.
14. It permits a tilt and rotate operation to occur simultaneously.
15. None.
16. The rotate and compensator arm springs.
17. T2 and check.

Chapter 3

1. To drive the selector interposers forward.
2. When the latch pawl is tripped from the keeper.
3. The letter S.
4. The spring-loaded keylever pawl.
5. An extension spring and the de-energizing of the print magnets.
6. Two latch pusher cams.
7. Active.
8. The spring tension of the contacts.
9. All of the latches are beneath the latch bail as the cycle shaft rotates.

Chapter 4

1. The cycle clutch pawl stop, pivots into the path of the latch pawl preventing the pawl from tripping from the keeper.
2. The keyboard lock bellcrank in the selector compensator tube.
3. Yes. The interposer lock bail pivots forward and a bottom extension prevents the interposers from being pushed down.

Chapter 5

1. Shift clutch spring.
2. The shift cam stop and shift cam brake.
3. a. To delay a print operation until a shift operation is completed.
   b. To insure that the cam returns to the same position after each shift.
4. When shifting from upper to lower case. Because the shift arm roller rides directly on the shift cam.
5. To transfer the transmitting and feedback contacts by means of the actuator which is set-screwed to the cam follower.

Chapter 6

1. The largest variation in coarse alignment between any two of the tilt positions.
2. The positive latches are not used in a -5 operation, which is when compensation occurs.
3. Misalignment of characters on the paper.
4. The tilt detent.
5. Wear in the rotate system.
6. Slide. To allow the rotate detent to seat at approximately the same angle in the typehead skirt for any of the four tilt positions.
7. The compensating arm moves to the right while the rotate arm is stopped by the side frame. This widens the slot.

Chapter 7

1. The yoke and yoke actuating lever.
2. The impression control lever.
3. It positions the platen front to rear to compensate for different thicknesses of typing material.
4. It supplies the needed tension to move the carrier to the right during an escapement operation.
5. Clockwise.
6. The escapement pawl.
7. The carrier must move to the right.
8. The timing of the escapement cam.
9. A spring attached to the trigger and trigger lever.
10. The escapement trigger.

Chapter 8

1. carrier return, index, shift.
2. a. The clutch wheel when held by the clutch release arm.
   b. The cam check pawl.
3. The interposer restoring lever.
4. A lug on the operational control bracket.
5. index and shift.
6. To prevent backward creep of the cam.
7. space/backspace/tab cam check pawl.
8. To hold the operational contacts open.
9. For the duration of cam rotation.
10. The manner in which the escapement trigger is operated.
11. To insure that the spacebar will always actuate an escapement operation.
12. The lower extension of the interlock interposer pivots upward, into the path of the adjustable stop on the spacebar interposer.
13. The combination of the backspace rack restoring to the right and the escapement pawl seated in the escapement rack.
14. A spring on the backspace rack.
15. Oppose.
16. Yes. To rotate the pin and raise the carrier return clutch arm.
17. To allow the carrier time to reach the left margin.
18. The torque limiter spring.
19. a. To allow smooth acceleration of the carrier.
    b. To prevent possible damage.
20. The detent roller.
21. To prevent the platen from overthrowing farther than one or two space positions.
22. Top to the front.
23. Tab rack brake.
24. Tab lever trigger.
25. To limit the speed of a tab operation to that of the operational shaft.
26. A lug on the rear of the tab lever latch held by the escapement torque bar.

Chapter 9

1. A pin which is spring loaded into the margin rack.
2. The last column contact (also called the end of line contact).
3. a. To hold the paper against the platen in the typing zone.
   b. To indicate the bottom of the print line.
   c. To indicate the middle of the next print space.
   d. To indicate the middle of a typed character space.
4. To rotate the two feed roll release levers.
5. The position of the ribbon lift control link in the slot of the cam follower.
6. To act as brakes. This prevents the ratchets from spinning and possibly spilling ribbon.
7. By moving the ribbon feed pawl from one ratchet to the other.

Chapter 10

1. block control.
2. register file 23.
3. all three.
4. three: finish, repeat, busy.
5. a. type load -- computer input.
   b. type dump -- computer output.
6. On the typewriter.
7. 21.

Chapter 11

1. None. It is ground or an open.
2. a. Ground = 1.
   b. Open = 0.
3. Approximately 28 msec.
4. 35.73 msec.
5. R5.
6. One.

Chapter 12

1. master clear.
2. busy.
3. a. yes; odd.
   b. yes; odd.
   c. yes; odd.
   d. yes; even.
4. Yes. If the R5 position is equal to a 1, the character is negative; if the R5 position is equal to a 0, the character is positive.
5. No, not until an alpha character is sensed.

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