HIGH SPEED TAPE PUNCH UNIT

(DRPE TYPE)

DESCRIPTION AND PRINCIPLES OF OPERATION

CONTENTS

1. GENERAL

1.01 This section provides the description and principles of operation for the high speed tape punch unit (DRPE type). It is reissued to add engineering changes and a punch backup mechanism. Since this is a general revision, marginal arrows normally used to indicate changes are omitted. The photographs and illustrations are representative of most models.

1.02 The high speed tape punch unit uses tuned reed armatures, which are controlled by magnets to operate the punch pins. Tape feeding is accomplished with a spring driven escapement type feed mechanism.

1.03 Input to the unit is parallel and consists of shaped current pulses and a steady holding current. Output is perforated paper tape.

2. DESCRIPTION

2.01 The high speed tape punch unit (DRPE Type) is an electro-mechanical device that perforates coded information in paper tape (Figures 2, 3, 4, and 5). The unit produces code holes in paper tape in response to binary-parallel signals received from an electronic control unit. Early models operate at any speed up to 2000 words per minute (200 characters per second). Later models are available for operation up to 2400 words per minute (240 characters per second). These two types of units may be differentiated by the configuration of the reeds as shown in Figure 1.

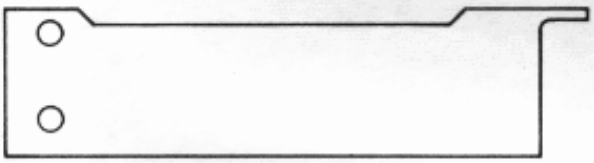
Note 1: Early design units may be equipped with solid reeds marked with an "X" on the fixed end. Inspect the reeds, and if they have the "X", do not use the punch at speeds over 850 words per minute. If higher speeds are required, replace the solid reeds with the laminated type (not marked with an "X").

Note 2: Because the majority of applications of DRPE type punches are required to operate below 1500 words per minute, the factory product is now adjusted to, and tested at, 1500 words per minute. For unit applications requiring 2400 words per minute operation, a suffix (/24) is added to the unit code, contained in the identification plate, starting with serial number 1753.

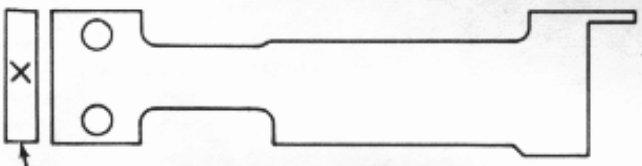
Example:

DRPE802 - denotes this unit is adjusted and tested for speeds up to 1500 words per minute.

DRPE802/24 - denotes this unit is adjusted and tested for speeds up to 2400 words per minute.



REED FOR 2000 WPM PUNCH UNIT



REED FOR 2400 WPM PUNCH UNIT
(850 WPM ONLY IF WITH "X" ON END)

Figure 1 - Reed Identification for 2000 and 2400 Words Per Minute Punch Units

USES

2.02 The high speed tape punch unit is intended for use in receive-transmit sets and high speed tape-to-tape receiving terminals. It is also compatible with computer type applications or wherever its high speed capability may be required.

ASSOCIATED EQUIPMENT

2.03 An electronic control unit provides the circuitry that converts low level signals to controlled, shaped, power signals capable of operating the punch magnets and reed armatures at the required high speeds. Connecting cables should be provided in the base or cabinet mounting facility. The chad chute, output tape guide and tape handling vary from application to application and, therefore, should also be provided as part of the mounting facility.

SIGNAL INPUT

2.04 Signal code input to the punch is binary and parallel. Any code pulse combination and the control and tape feed pulses are simultaneous. These consist of shaped current pulses and a steady holding current (Figures 6 and 7). This input is provided by the electronic equipment mentioned in 2.03. Output from the unit is perforated paper tape. When released by a signal, the strain energy that has been stored by electro-magnets in the steel tuned reed armatures, is utilized to operate the punch pins and to trigger the escapement mechanism that feeds the tape.

TAPE

2.05 With the appropriate punch block assembly and associated parts selected and installed, the unit can be capable of perforating either 11/16 inch, 7/8 inch, or 1 inch tape (Figure 10). Tape guide channels can be provided to align any of these tape widths.

CODE LEVELS

2.06 The punch will perforate, depending on the unit and punch block selected, either 5-, 6-, 7-, or 8-level tapes according to the following arrangement:

5 Levels	6 Levels	7 Levels	8 Levels
	0 1	0 1	0 1
0 1	0 2	0 2	0 2
0 2	0 3	0 3	0 3
0 F	*0 0 F	0 F	0 F
0 3	0 4	0 4	0 4
0 4	0 5	0 5	0 5
0 5	0 6	0 6	0 6
		0 7	0 7
			0 8

0 = Code Hole
F = Feed Hole
*0 = Advance Feed Hole (if so equipped)

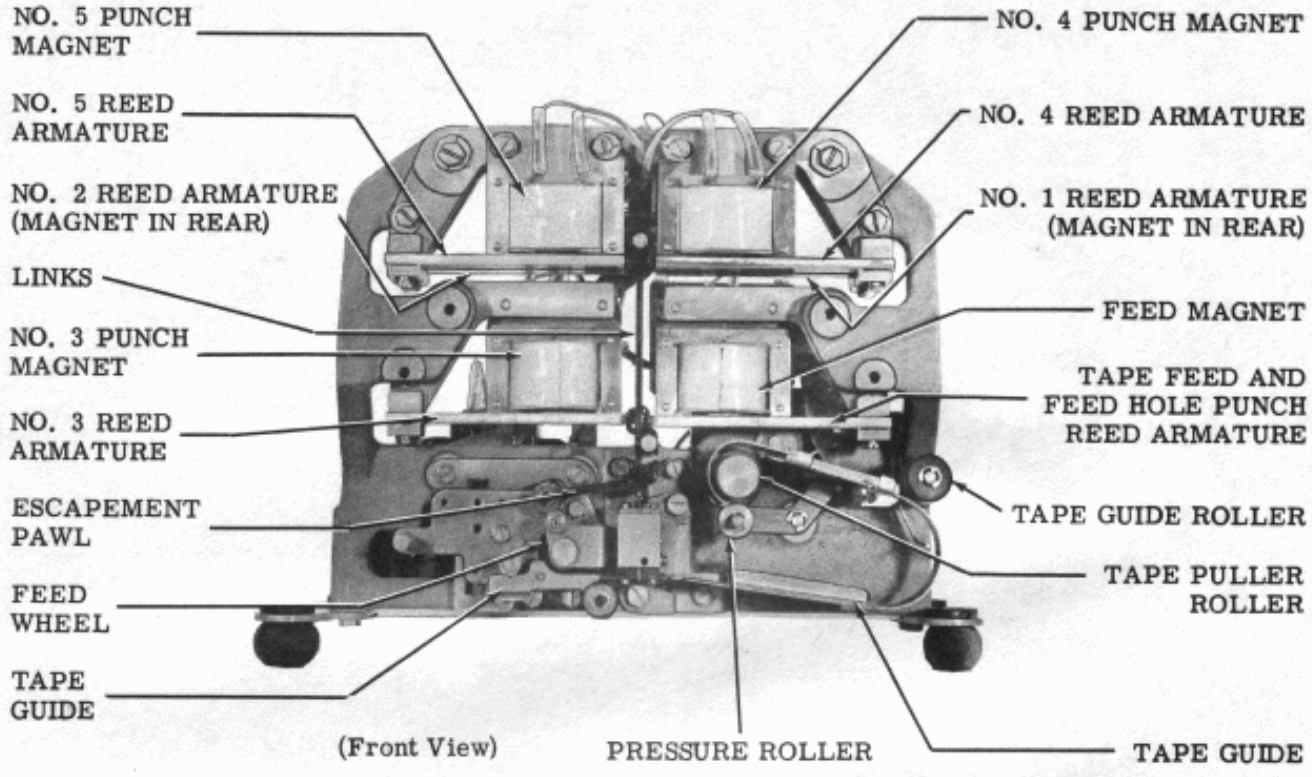


Figure 2 - Five-Level High Speed Tape Punch (Early Design)

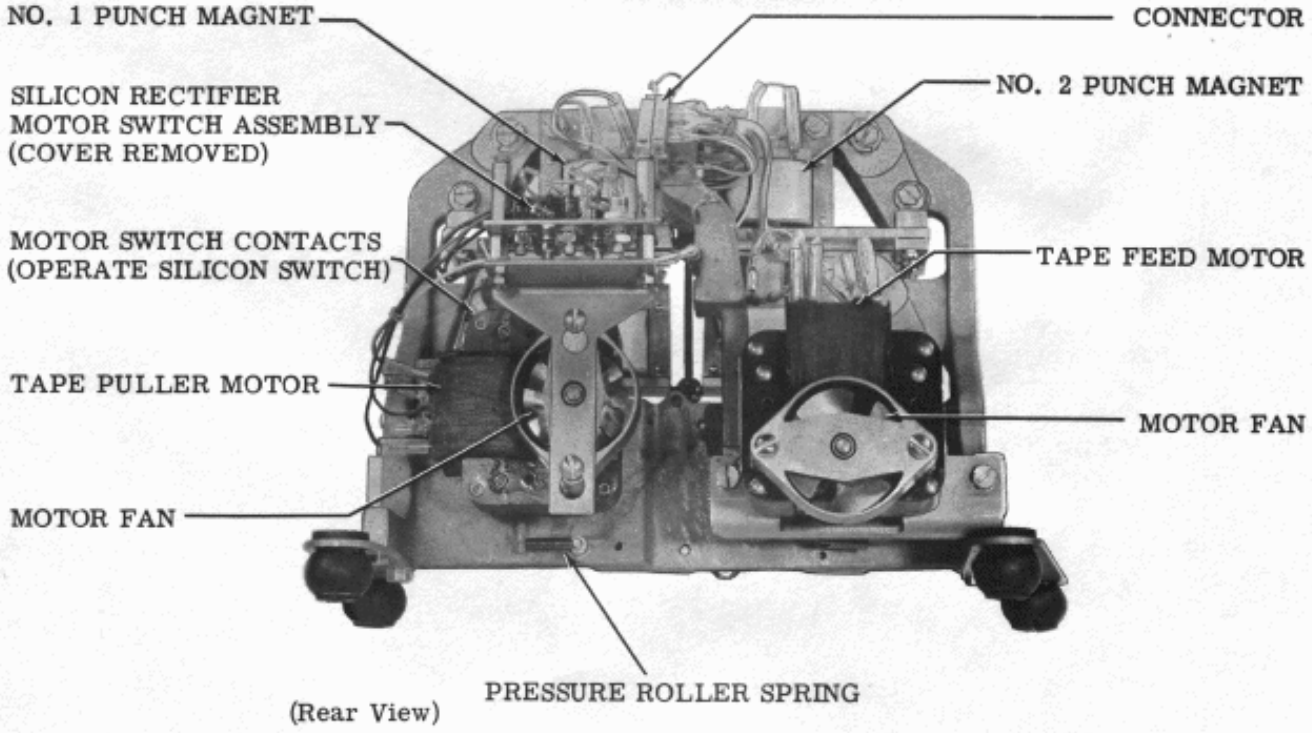


Figure 3 - Five-Level High Speed Tape Punch (Early Design)

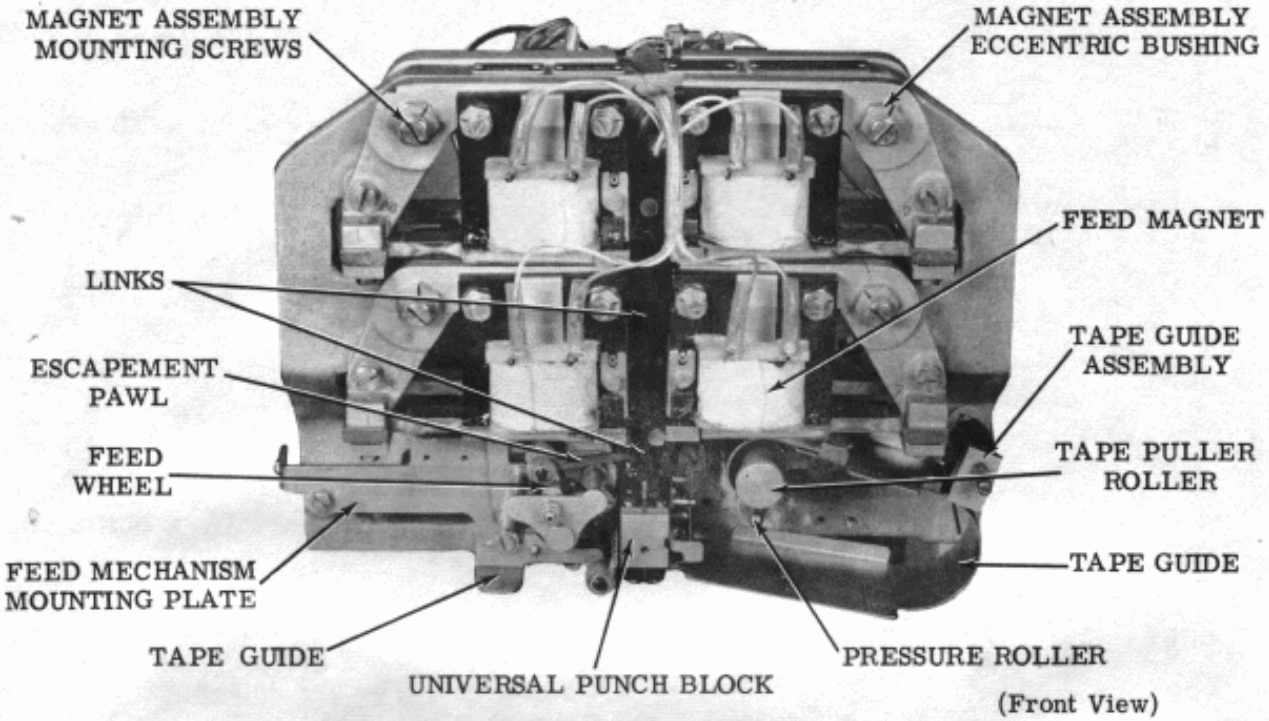


Figure 4 - Eight-Level High Speed Tape Punch (Later Design)

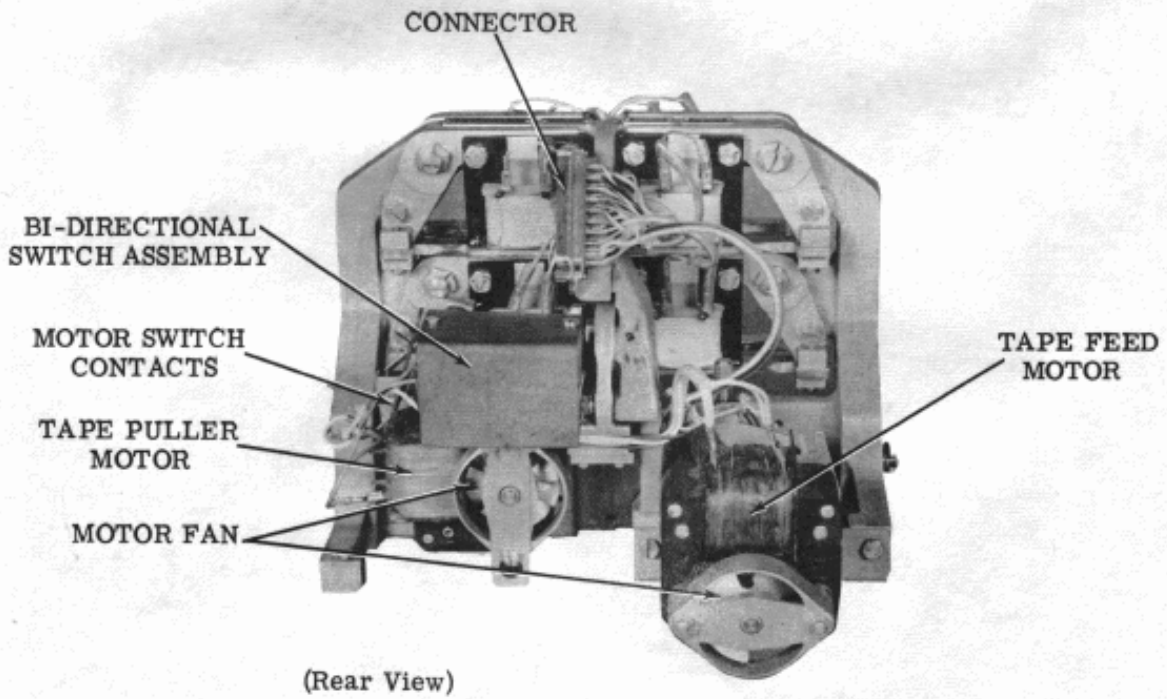


Figure 5 - Eight-Level High Speed Tape Punch (Later Design)

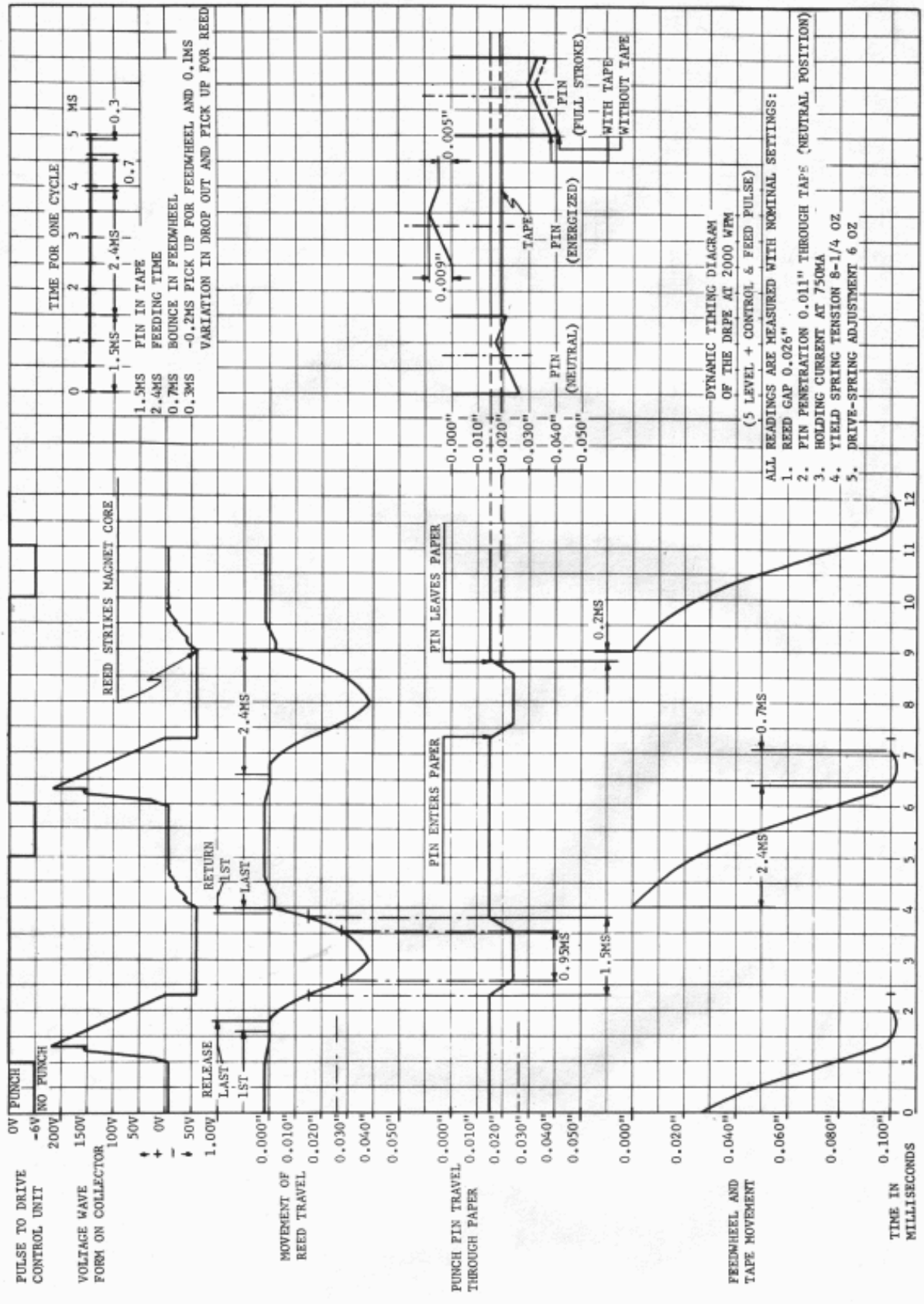


Figure 6 - Typical Dynamic Timing Diagram for 5-Level Punch Unit (Early Design)

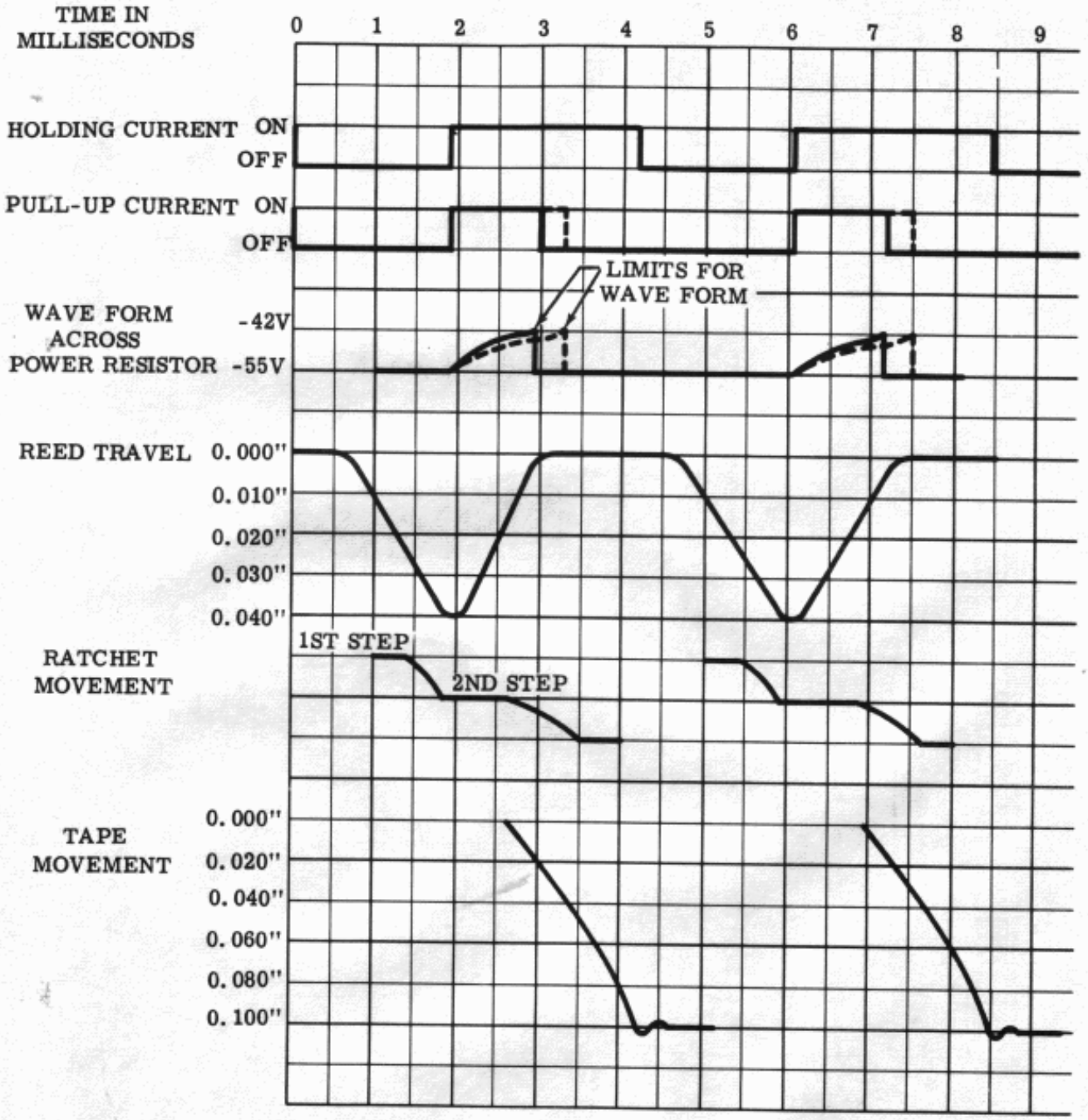


Figure 7 - Typical Dynamic Timing Diagram for 8-Level Punch Unit (Later Design)

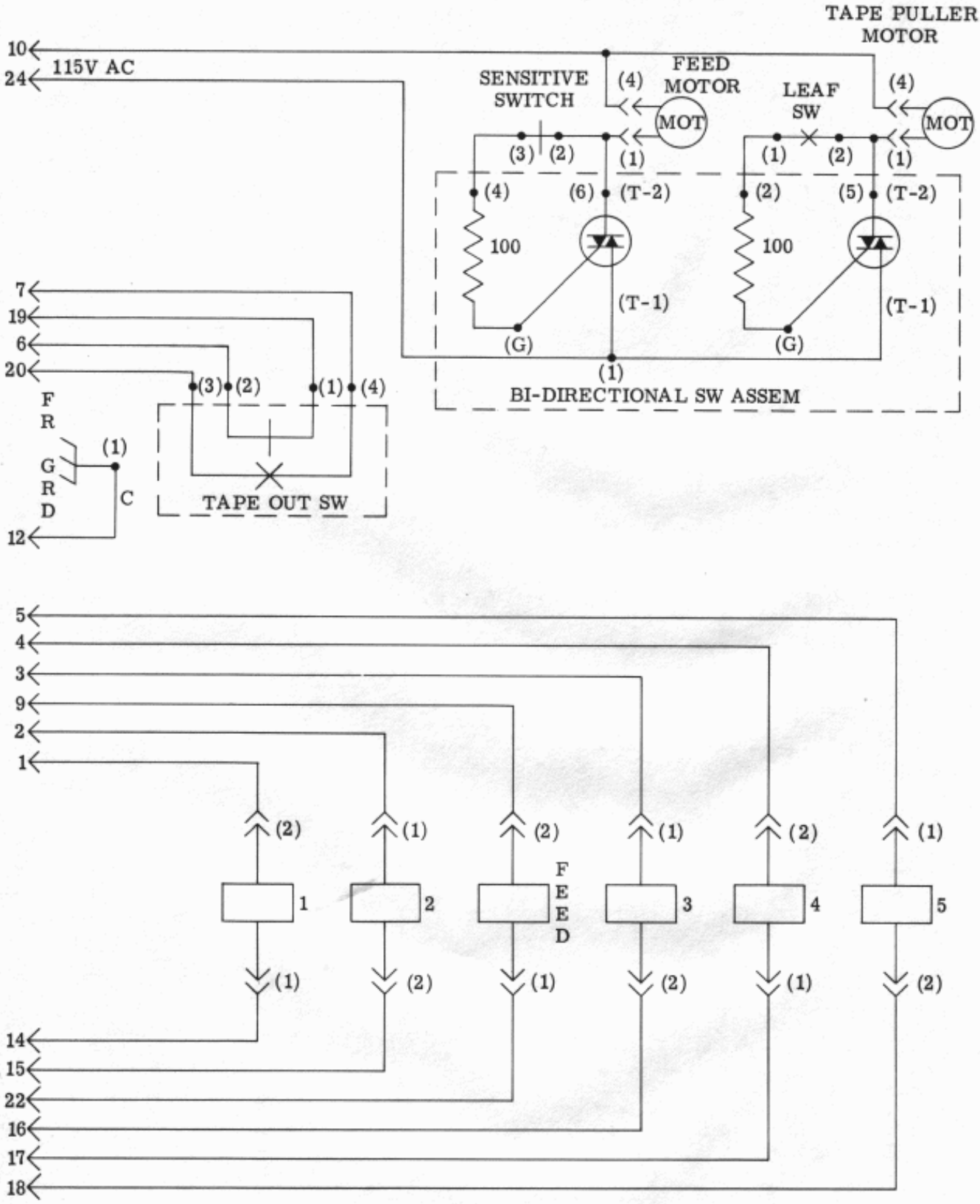


Figure 8 - Typical Schematic Wiring for High Speed Tape Punch Unit (Early Design)

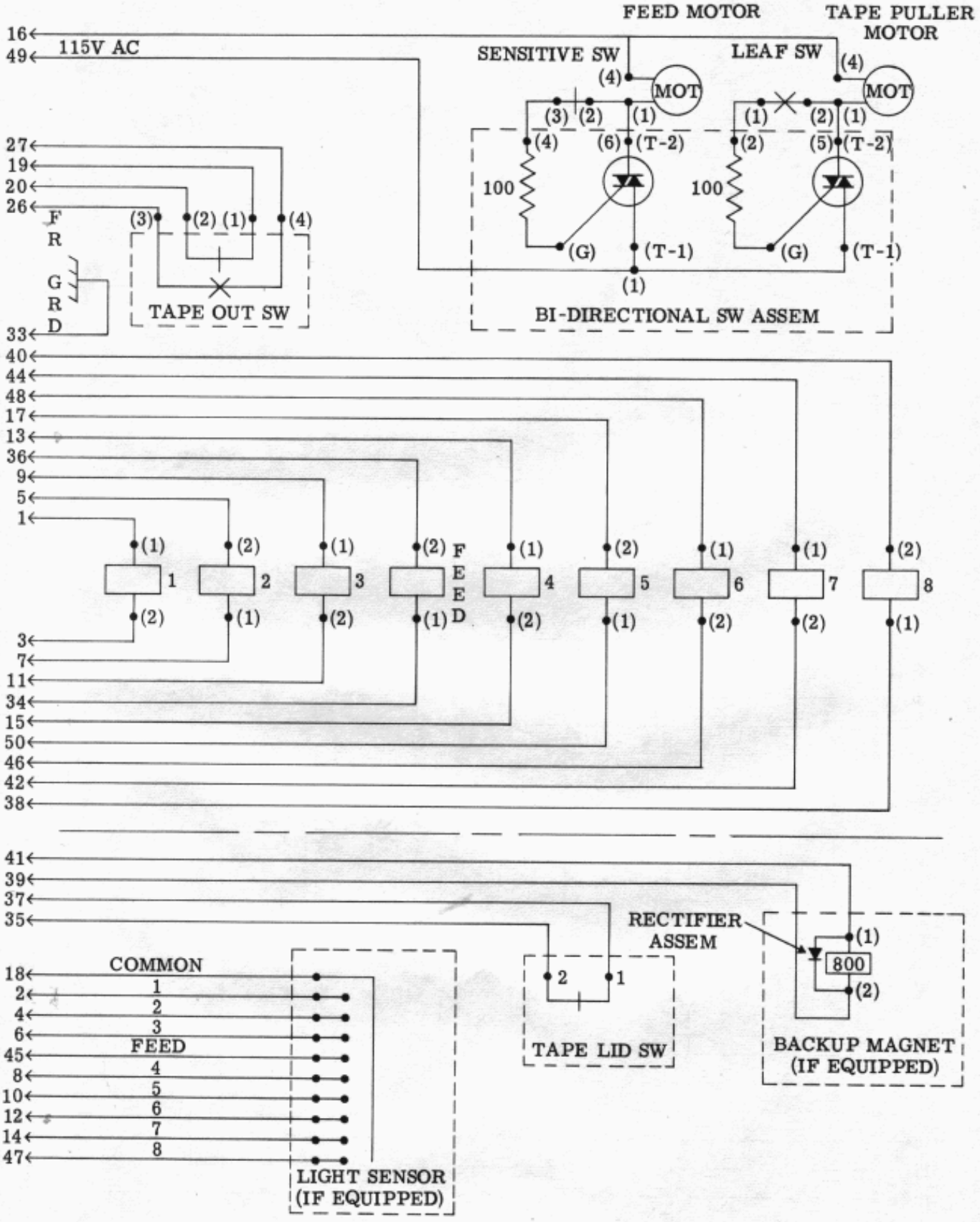
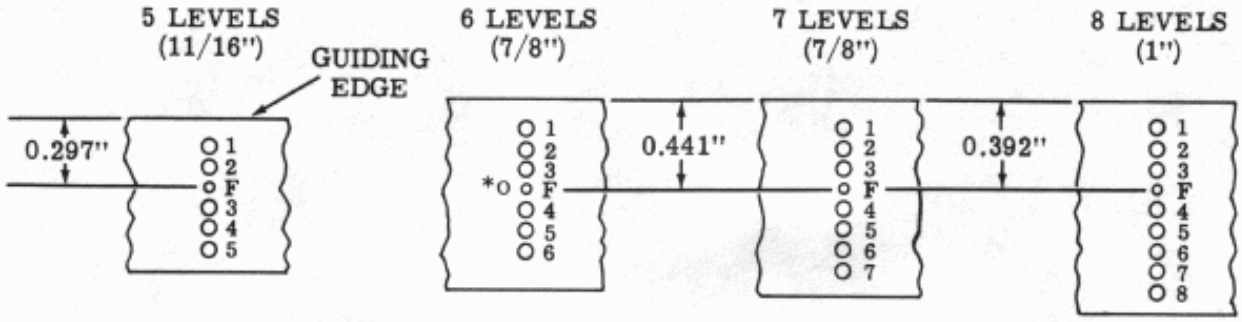


Figure 9 - Typical Schematic Wiring for High Speed Tape Punch Unit (Later Design)



CONFIGURATIONS OF CODE HOLES ← DIRECTION OF FEED

*o = FEED HOLE LOCATION (IF EQUIPPED WITH ADVANCE FEED HOLE PUNCH)

Figure 10 - Binary Permutation Code

SPEED AND TIMING

2.07 The high speed tape punch will operate at any speed up to 200 or 240 characters per second, depending on the model, in response to its incoming signals. There are no timing restrictions as to when the signals may be fed to the unit, except that the incoming signals cannot be at a higher rate than the units maximum rated speed.

OPERATING POWER AND TEMPERATURE

2.08 The high speed tape punch unit has two shaded pole motors (Figures 3 and 5). The input to these motors is 115 v ac, ±10%, 50 or 60 hertz (depending on unit application), 75 watts (each motor) at nominal voltage and 70°F ambient temperature. The unit may be operated in an environment ranging from 0 to 90 percent relative humidity and at an ambient temperature of +40°F to +110°F.

WEIGHTS AND DIMENSIONS

2.09 The 5-level tape punch weighs approximately 14 pounds and the 8-level unit weighs approximately 17 pounds, less variable features. The approximate overall dimensions less variable features, mounting facilities, and covers are 7-3/8 inches high, 9-3/8 inches wide, and 9-1/2 inches deep.

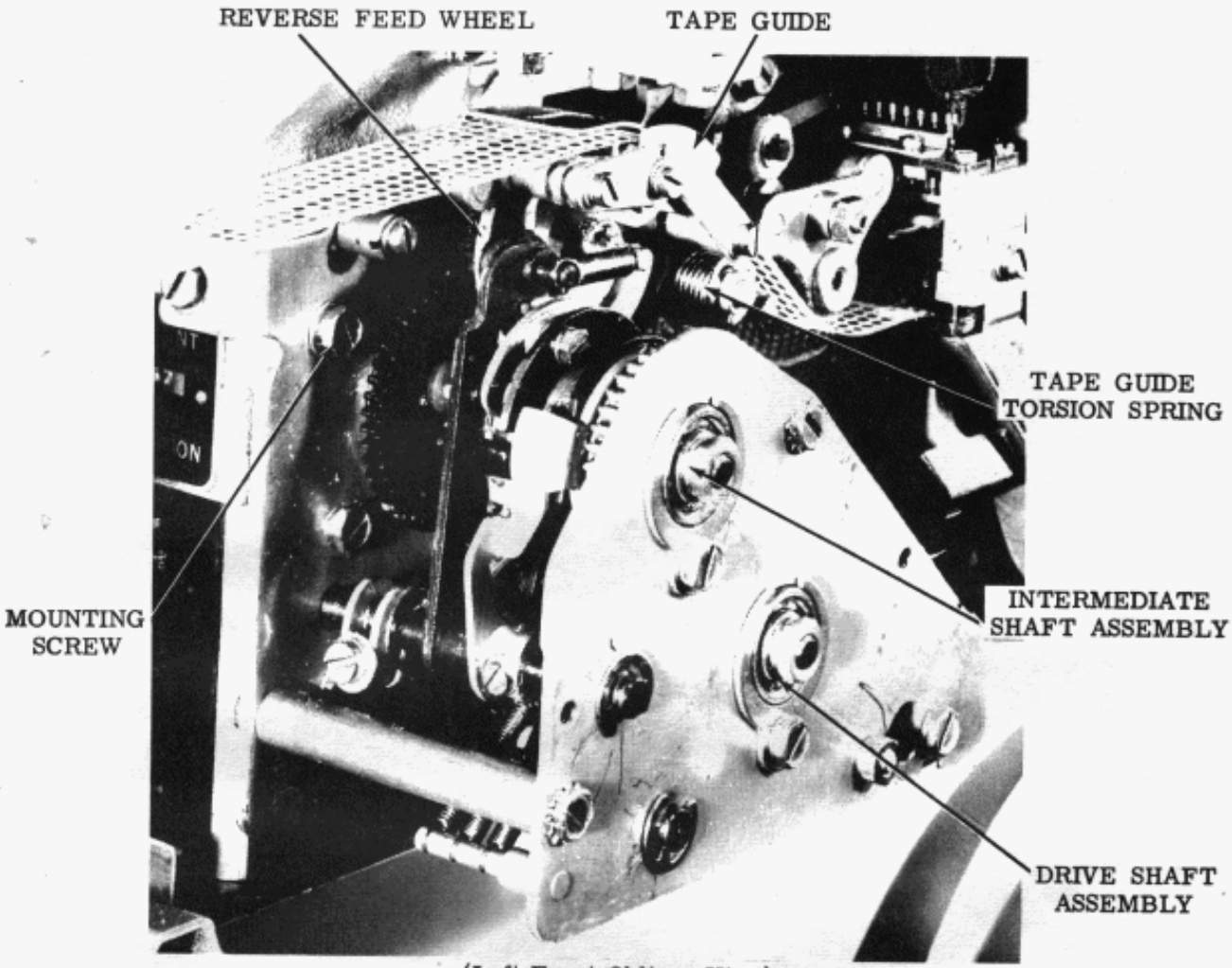
VARIABLE FEATURES

A. Photoelectric Reader (Verifier)

2.10 The high speed tape punch unit may be equipped with a photoelectric sensing assembly which includes a light source assembly, isolator tube, mirror tube assembly, chad chute, and a punch block with verifier (Figures 16 and 17). The verifier portion of the punch block contains the phototransistors. The parallel output of the phototransistors corresponds to the hole or no-hole condition of the paper tape and follows one character after the perforating position. The photoelectric reader assembly is intended for use in error detection systems or wherever it is necessary to regenerate a signal from the tape one character after perforation.

B. Punch Backup Mechanism

2.11 The backup mechanism is an electromechanical device which, when given an electrical pulse, passes the product tape through the punch block, of the tape punch unit, in the reverse direction for 80 characters (Figure 11). During normal forward operation of the associated punch unit, the forward feed wheel will feed tape to the left. The tape is passed through the tape guide assembly (not engaging the reverse feed wheel). When an electrical pulse is received by the backup mechanism, the tape guide assembly pivots allowing the reverse feed wheel to engage the tape and the forward feed



(Left Front Oblique View)

Figure 11 - Punch Backup Mechanism, Less Cover

wheel to disengage. The tape is then pushed backwards through the punch block for exactly 80 characters. The reverse feeding stops after the 80th character in the tape has been fed. The tape guide assembly then pivots again, disengaging the tape from the reverse feed wheel and engaging it with the forward feed wheel. The punch unit then proceeds to operate in the forward mode. The backup mechanism is intended for use in error detection and correction applications.

C. Universal Punch Block

2.12 Later design models (2400 wpm) of the high speed tape punch, either with or without the photoelectric reader, may be equipped with the adjustable universal punch block assembly which includes an adjustable tape guide (Figure 21). An operating lever on the universal punch block and an adjustable tape guide may be positioned to accommodate any of the available four different levels and three widths of tape.

3. PRINCIPLES OF OPERATION

RECEIVING SIGNALS (Figures 6, 7, 8, and 9)

3.01 The binary code pulse combination and simultaneous binary control and tape feed pulse, which are required input from the electronic control unit to operate the punch unit, consist of the following: a steady holding current through all magnet coils during the standby

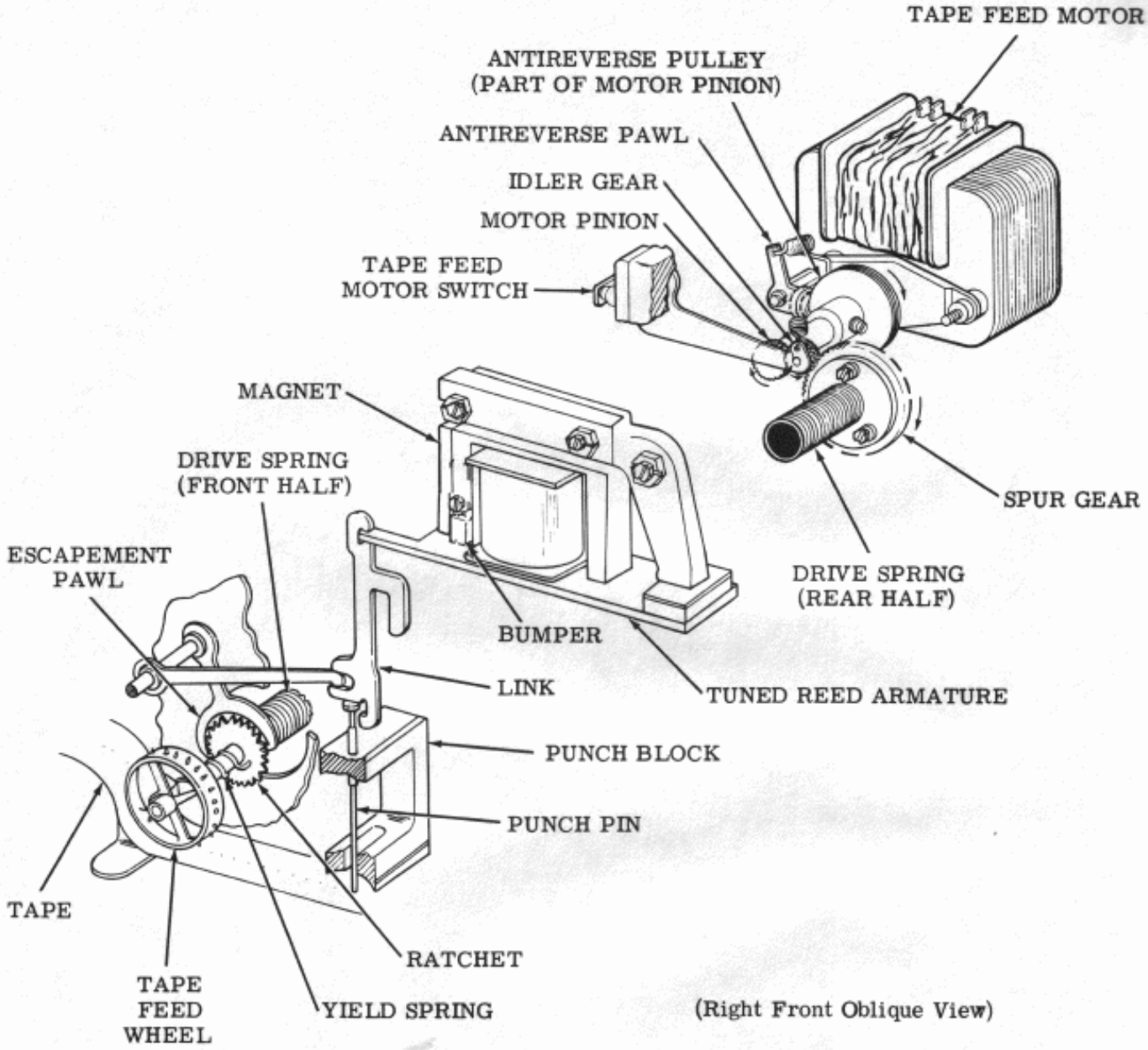
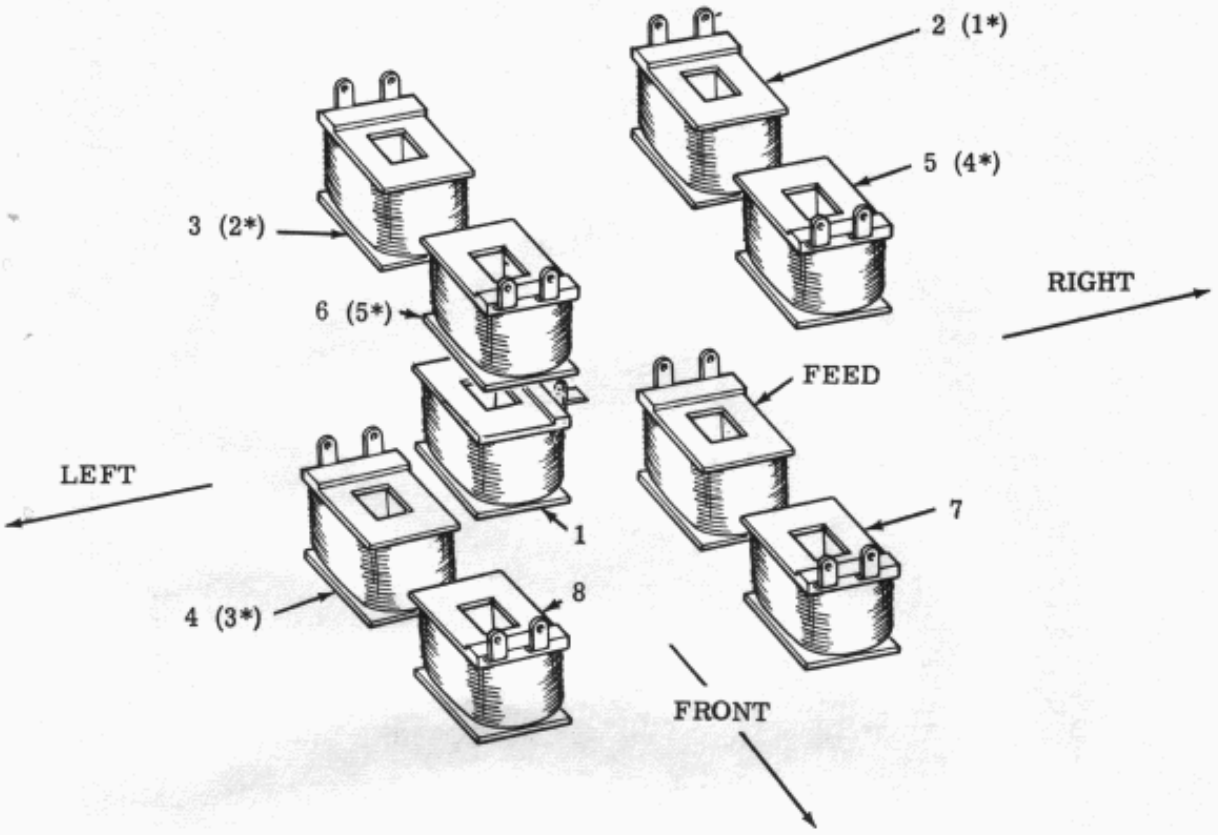


Figure 12 - Punch and Feed Mechanisms

(ready) period and through the coils of those code punch magnets that are to remain in a space (no-punch) state during the interval that a character code signal is being received. The tape feed hole for each character and any character marking code hole is punched in the tape through the release of a tuned reed armature during its no current interval of this character code signal. The no current interval, with its transition from holding current and back to the current state, is timed and spaced to match one-half of the natural resonant frequency cycle of a tuned reed combination that includes reed, linkage, punch and, in the case of the feed punch, the escapement and tape feed mechanism. Except for this wave shape-timing requirement, the high speed tape punch will accept the parallel wire binary signals at any speed from zero to its maximum rated number of words per minute without any changes or readjustments of the unit.

MAGNET AND REED ASSEMBLY (Figure 12)

3.02 Mark (Punch) Code Pulse: The tuned reed armature, through its rigid vertical link to the punch pin, punches the tape when it



5-LEVEL MAGNETS	OTHER MAGNETS	MAGNET POSITION
FEED	FEED	LOWER RIGHT REAR
	1-LEVEL	REAR CENTER
1*	2-LEVEL	UPPER RIGHT REAR
2*	3-LEVEL	UPPER LEFT REAR
3*	4-LEVEL	LOWER LEFT REAR
4*	5-LEVEL	UPPER RIGHT FRONT
5*	6-LEVEL	UPPER LEFT FRONT
	7-LEVEL	LOWER RIGHT FRONT
*5-LEVEL MAGNET	8-LEVEL	LOWER LEFT FRONT

Figure 13 - Punch Magnet Positions

is released from its magnet by a no current interval (mark code signal, or any signal in the case of a feed punch). A rapid reduction to the no current state is obtained by momentary application of a reverse voltage of approximately +250 volts by the external control unit to the punch magnet coil, thereby overcoming the holding current through the inductances of the control unit and the punch magnet coils. Near the end of this cycle, a negative pulse (approximately -50 volts) is applied, through a variable resistance in the control unit, to the punch magnet coil in time to quickly re-establish a holding current (approximately 750 ma at -17 v dc) that catches the tuned reed armature on its rebound and holds it against its magnet until the next punch pulse is received. Later model units are equipped with reed silencing bumpers.

3.03 Space (No Punch) Code Interval: Any tuned reed armature, except for one released by a control pulse and associated with

the feed punch mechanism, is held against its magnet during the character space code interval by the same holding current that passes through the magnet coil in the standby (ready) condition. The feed punch armature is released upon receipt of any code signals by a control pulse to punch and feed tape as described for the mark code pulse in 3.02.

3.04 The high speed punch comprises one magnet-punch mechanism to punch and feed tape, plus one for each code level to be punched. This provides six for a 5-level punch unit, or nine for an 8-level punch unit.

REED, LINK, AND PUNCH MECHANISM
(Figure 12)

3.05 Each tuned reed armature has an extended tip that is arranged to align with and fit into the upper notch of its associated link. The reed is adjustable within its clamp and is mounted to an adjustable magnet bracket which also mounts an adjustable magnet. This combination is adjusted for proper alignment, air gap, and height, so that the punch pin just penetrates the tape with the reed in its neutral (unoperated) position.

3.06 Each long and short link is notched at the top for the reed and at the bottom for the punch pin, thereby enabling the reed to punch the tape on its down stroke after release, and to retract the punch pins on its return (rebound) stroke. The long links are guided by a fixed guide at the top plus an adjustable guide affecting both long and short links near the bottom. The link for the tape feed hole punch has an additional notch on its left side to operate the tape feed escapement pawl.

3.07 A head at the top of each punch pin fits into the notch of the link at its right to punch the tape on a down stroke of the link and to retract the pin from the die plate on the up stroke. An adjustable retaining plate, mounted at the top left side of the punch block assembly, holds the pins in position in case of punch block adjustment or removal.

TAPE FEED AND FEED HOLE PUNCH
(Figures 12, 13, and 14)

3.08 Upon receipt of the binary control signal pulse at the tape feed hole punch magnet, the reed (armature) is released. These punch and feed mechanisms then operate in the following sequence:

(a) The reed to punch pin link first drives the pin into the tape far enough to hold the tape and prevent feeding.

(b) As the link continues downward it pivots the escapement pawl, thereby allowing the ratchet to escape by one tooth under torque of the drive spring. An extended stop lug on the ratchet rotates with the ratchet. This releases the tape feed wheel to rotate, under torque of the yield spring between the ratchet and feed wheel, when the feed wheel is later released by the tape and the punch pins are holding the tape.

(1) The drive spring is wound to its correct tension by a shaded pole motor through its pinion gear, a spring loaded idler gear with motor control switch, and a spur gear. (See Figures 8 and 9 for typical schematic wiring.)

(2) An antireverse pawl engages the groove in a pulley at the rear of motor pinion to prevent unwinding of the drive spring through the motor when power is removed by operation of the idler gear arm switch. This also prevents the idler gear spring and drive spring mechanisms from hunting for their balance positions.

(c) With the feed wheel still held against its yield spring torque by the tape; the armature, link and punch pin start their upward (rebound) movement. The escapement pawl is again pivoted and the ratchet escapes another tooth at approximately the same time that the feed hole punch pin (with other pins, if any) is withdrawn from the tape. The tape is now moved by the feed wheel, under torque of its yield spring, until the feed wheel is blocked by the extended stop on the ratchet (0.1 inch tape movement).

(1) The tape feed wheel revolves (moves) 1/10 of an inch at its periphery, where the tape rides, for each punch and feed cycle.

(2) To maintain the ten feed holes to the inch spacing, the distance between the point where the feed-wheel punch pin enters the tape must be an exact multiple of 0.1 inch, so that the feed hole is presented to the feed pin at the right point to avoid strain, distortion and relative motion between tape and feed wheel.

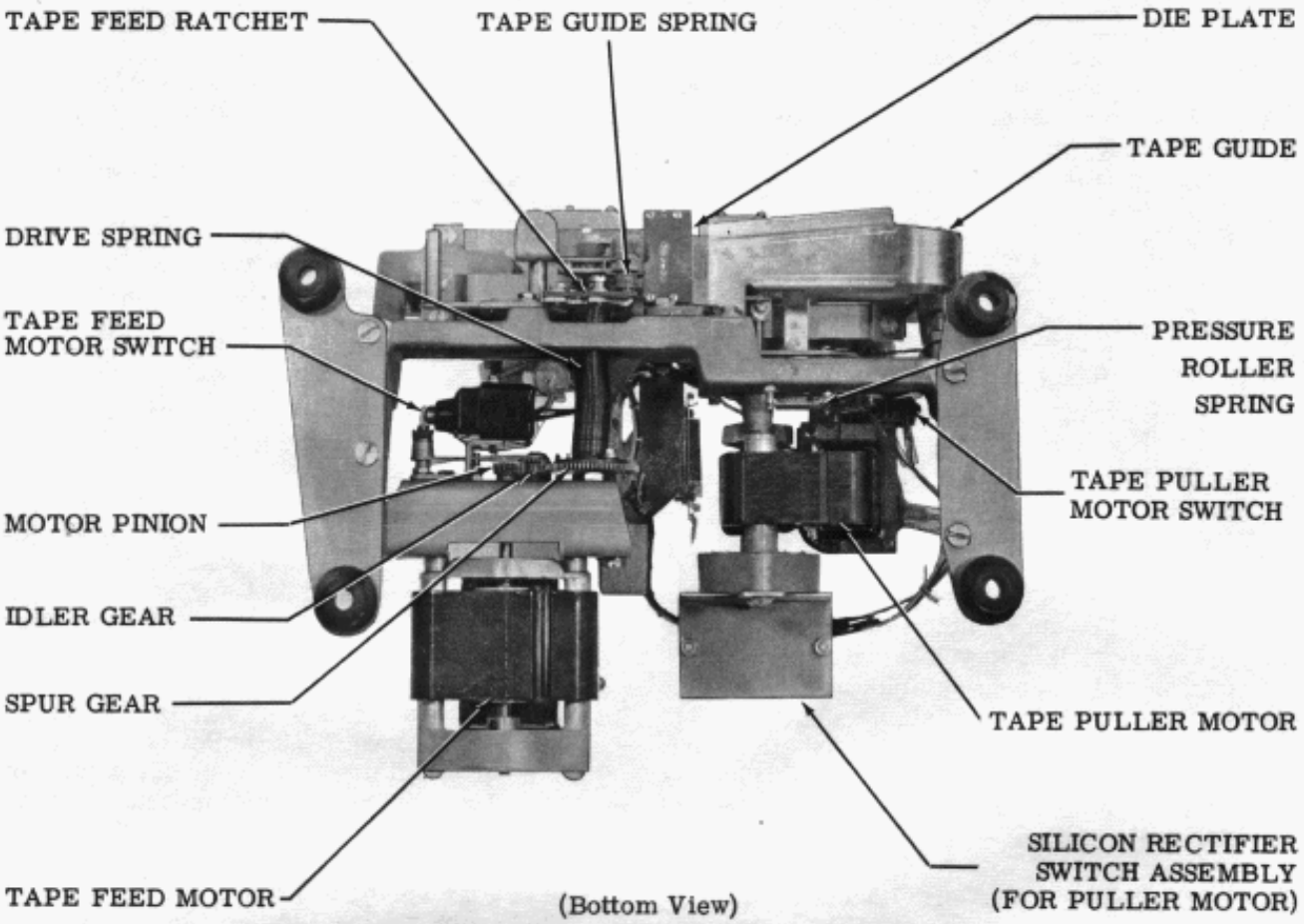


Figure 14 - High Speed Tape Punch

(3) The multiple of 0.1 inch distance may be adjusted, if necessary, by the TEN TO THE INCH adjustment given in the adjustment section.

(d) The reed (armature), with its link and punch pin, continues upward (rebounds) to its latched position against the magnet where it is held by the holding current until the start of the next character or tape feedout cycle.

TAPE PULLER AND GUIDES (Figure 15)

3.09 The unpunched paper tape is normally stored on a tape reel mounted on associated apparatus. From there it is pulled, by the drive roller and shaded pole motor, into the high speed tape punch from the upper right side of the unit as follows:

(a) The tape travels to the left, under the pulley at the extreme right hand of the unit.

(b) The tape continues to the left, over the top of the tape guide, through the shielded slot, to the underside of the tape guide.

(c) Tape is then pulled over and around the drive roller, on the motor shaft, returning it toward the right between the drive roller and the spring loaded pressure roller (directly under the drive roller).

(d) The tape continues to the right, over and around the tape tension lever.

(1) The tape tension lever maintains a predetermined, constant, low tension on the tape where it is presented to the punch block and tape feed wheel.

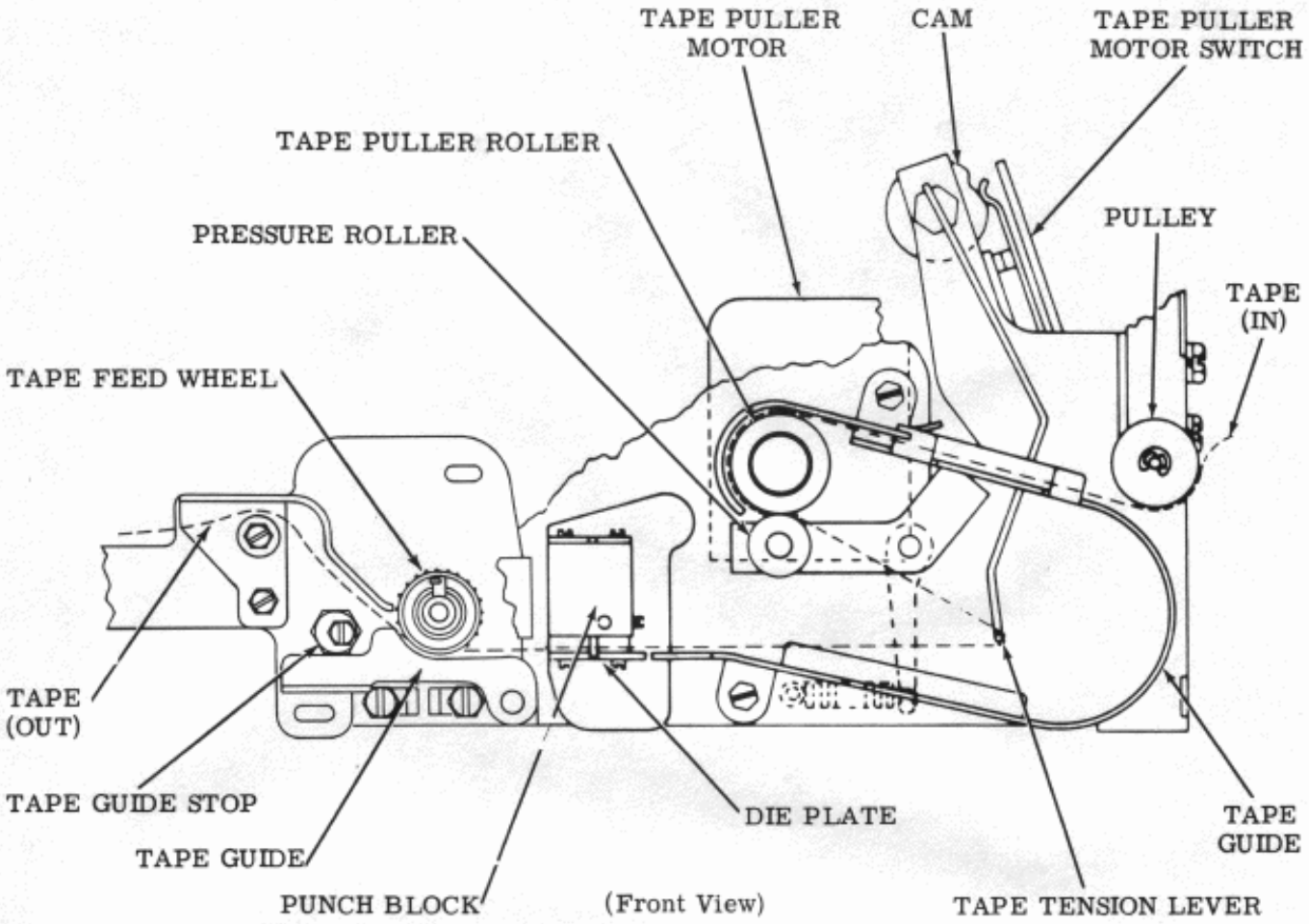


Figure 15 - Tape Puller and Guides

(2) This is accomplished by control of the tape puller motor through a torsion spring, double acting cam, and a switch at the opposite end of the tape tension lever. The motor power is thereby removed when the tape becomes too tight or too loose.

(e) From under the tension lever, the tape returns to the left and passes along the tape guide, then between the die plate and punch block. All punch pins must be in their retracted positions (reed armatures pulled up) before a new tape can be inserted at this point.

(f) The tape is then fed by the tape feed wheel and feed motor:

(1) Without Backup Mechanism: Between the feed wheel and a manually releasable, spring-loaded tape guide directly under the feed wheel. From the left of the feed wheel, it arches over and clear of the adjustable guide stop post, then over the tape guide post at the extreme left.

(a) An additional tape cover guide may be added after the feed wheel, as part of associated apparatus, to guide the tape to a tape winder.

(b) A chad chute, also part of associated apparatus, may be added under the punch die plate in order to dispose of the chad.

(2) With Backup Mechanism: Through the adjustable tape guide, of the backup mechanism, and exits the unit at the extreme left.

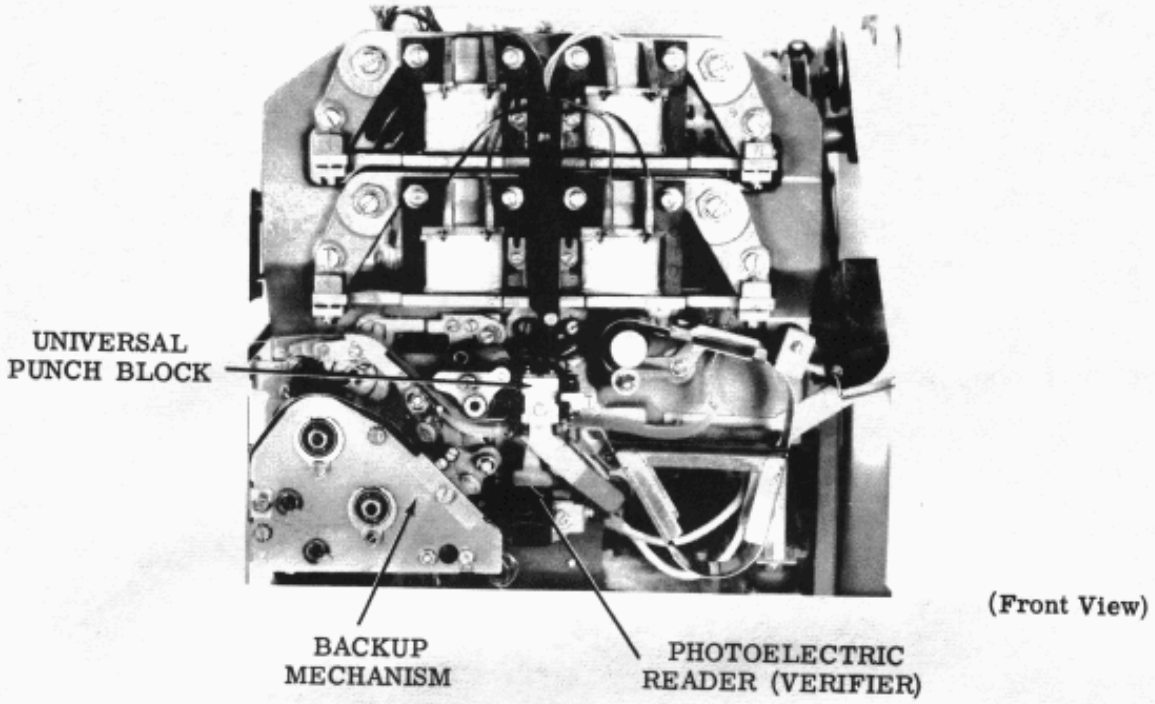


Figure 16 - 8-Level Tape Punch With Variable Features

VARIABLE FEATURES (Figure 16)

A. Photoelectric Reader (Verifier)

General

3.10 Light supplied by the light source assembly is directed onto the mirror in the mirror tube assembly. The mirror redirects the light through the die plate window onto the bottom surface of the tape, illuminating the character code which immediately follows the perforating position. If a hole is present, the light passes unobstructed through the hole in the tape, through the cover glass, and through the transistor tube to strike and activate the light sensitive transistor. The activated transistor indicates the presence of a hole by permitting current to pass through its circuit.

Light Source (Figure 17)

3.11 The light source consists of a quartz iodine lamp, collimating lens, and hardware to mount them. The lamp filament is positioned at the focal point of the lens to produce parallel light rays (collimated light).

Mirror Tube Assembly (Figure 17)

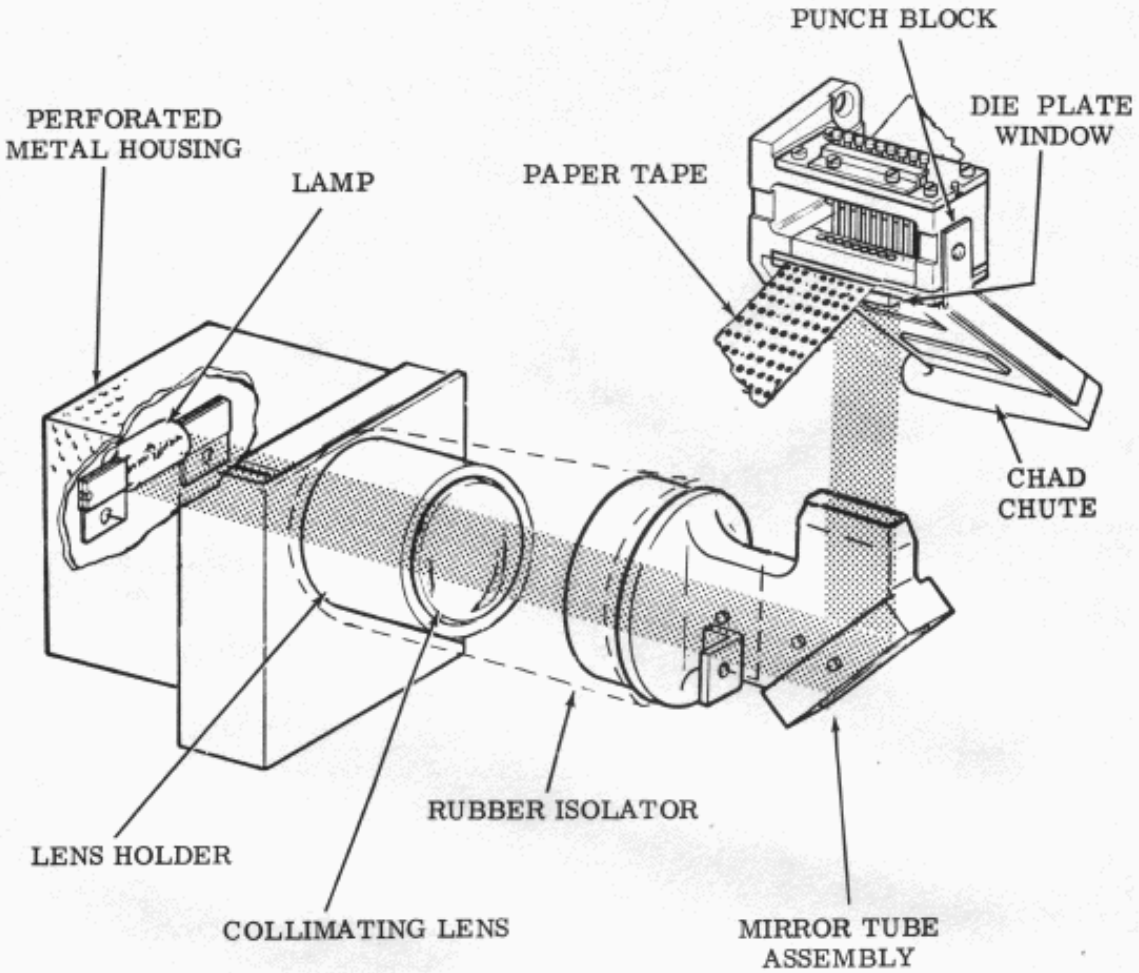
3.12 A rectangular flat mirror is positioned so that the center of the reflecting surface coincides with the intersection of the vertical center line through the fourth level code position and the optical center line. The mirror tube is designed to enclose the light path from the light source to the code verifying position in the punch, and to support the mirror.

Die Plate Window (Figure 17)

3.13 The die plate window, which is permanently bonded to the die plate on the punch block, protrudes below the die plate. Its purpose is to permit collimated light (from the light source) to pass through the die plate to the phototransistors.

Phototransistor Assembly
(Figures 17, 18, and 19)

3.14 Hole Condition (Figure 18): When a hole in the paper tape is in position over the die plate window, light passes from the light source assembly, through the die plate window,



(Left Front Oblique View)

Figure 17 - Photoelectric Reader (Verifier)

through the hole in the tape, and through a tube to the phototransistor which responds to the light. This results in a current (mark) condition.

3.15 No Hole Condition (Figure 19): When blank tape is in position over the die plate window, light cannot pass directly through the tape. Rather, the light is diffused and randomly oriented by the fibers in the tape. Further, as the diffused, disoriented light passes through the light directing tube, some of this light is absorbed and disoriented by the tube. The resulting "dim" light will not cause the phototransistor to respond. This results in a no current (space) condition.

3.16 Feed Hole (Figure 18): The code hole sensor tubes have an inside diameter of 0.062 inch (0.010 inch smaller than the code hole). In the case of the feed hole, the sensor tube is 0.054 inch so the web (that portion of tape between perforations) between feed holes will completely shut off the light. In this way an output is available from the feed hole when each character is advanced. This output can be used for detecting tape motion, as an input to a counter, or for anything that requires an output with each character advance.

B. Punch Backup Mechanism (Figures 11 and 20)

Forward Mode (Figure 20)

3.17 While the associated punch unit is punching tape, the backup mechanism is not functioning. The backup mechanism drive shaft

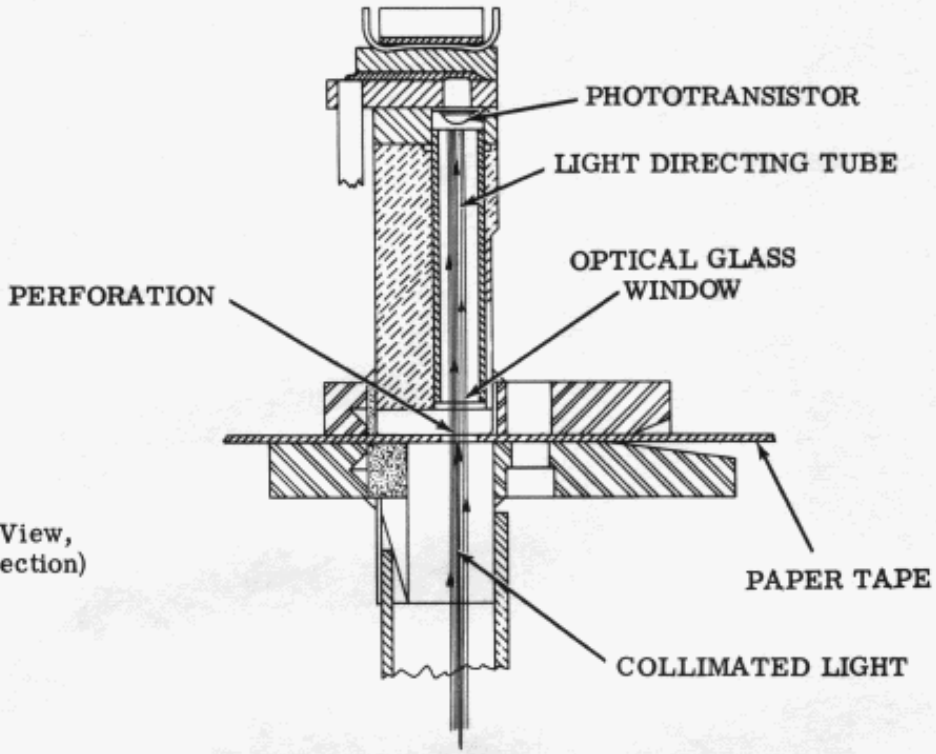


Figure 18 - Phototransistor Detects Perforation in Tape

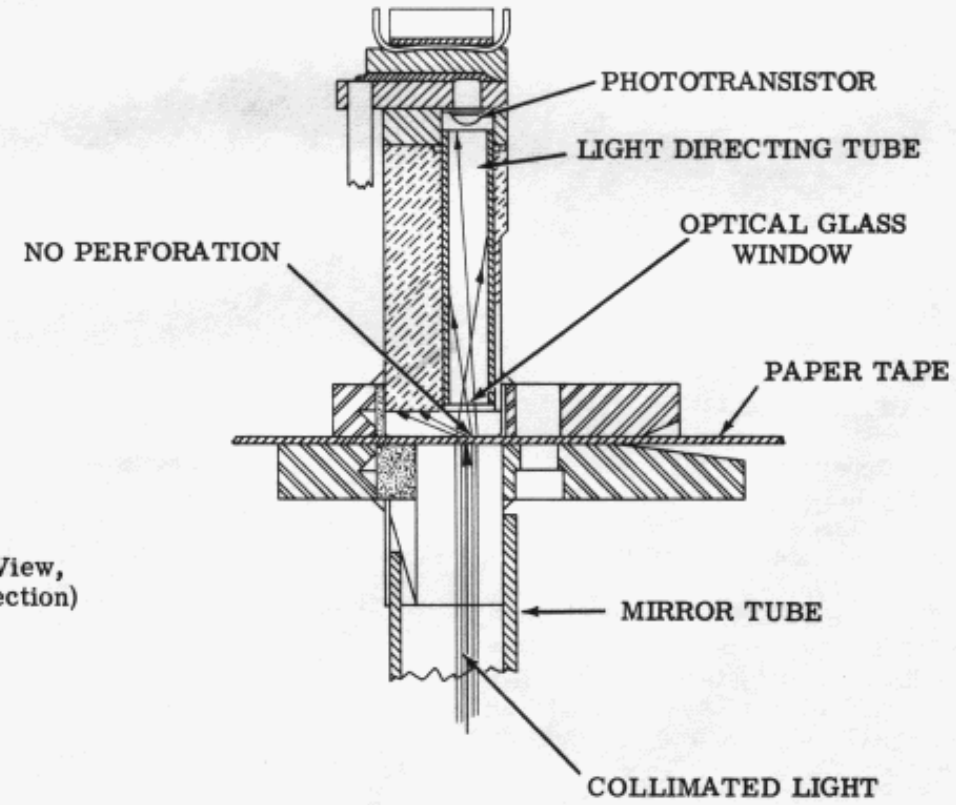


Figure 19 - Phototransistor Detects No Perforation in Tape

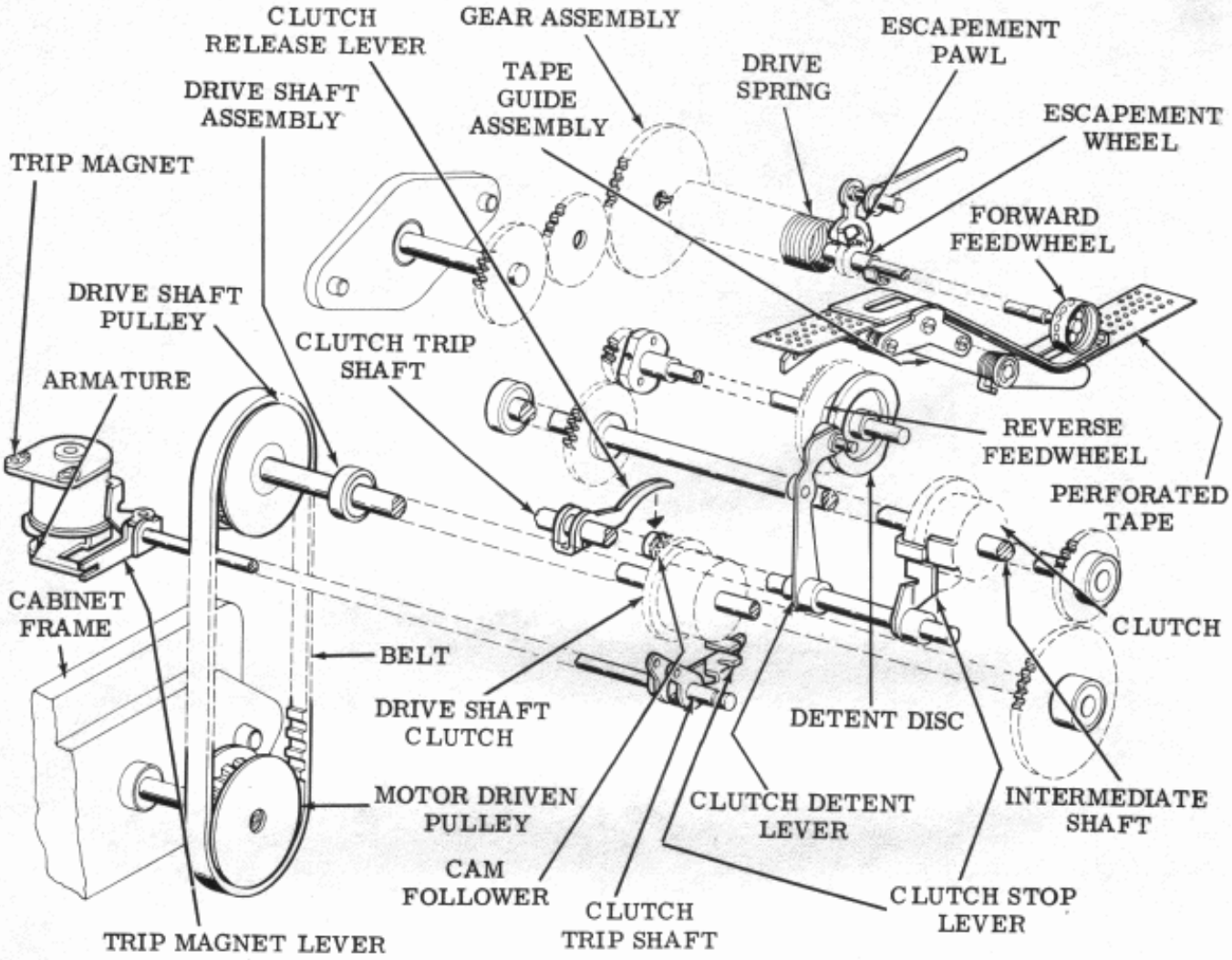


Figure 20 - Backup Mechanism (Left Front Oblique View)

is being driven clockwise at approximately 118 revolutions per minute by a 105 rpm shaded pole motor through a timing belt. Because the spring clutches are disengaged, only the gear on the drive shaft and the mating gear on the intermediate shaft (rotating counterclockwise) are rotating.

Reverse Mode (Figure 20)

3.18 When a 6 volt dc (70 ms) pulse is supplied to the trip magnet, the magnet armature is attracted to the core. The armature pulls on the lever attached to the clutch trip shaft causing it to rotate clockwise. The clutch stop lever is rotated away from the clutch disc lug allowing the drive clutch to engage.

3.19 Engagement of the drive clutch (Figure 20) causes the cam assembly to rotate with the shaft. At the same time, the tape guide cam follower arm starts to rotate counterclockwise. A post on the arm allows the tape lid switch lever to be rotated clockwise by its spring. The lever operates the tape lid switch, which is wired for normally closed operation.

3.20 The tape guide cam follower arm, as it rotates, causes the center of the tape guide assembly to move down and toward the left. The tape guide torsion spring (Figure 20) tends to bias the assembly counterclockwise. As the tape guide assembly rotates counterclockwise, it moves away from the right eccentric stud and continues to rotate until the left end of the assembly comes to rest on the left

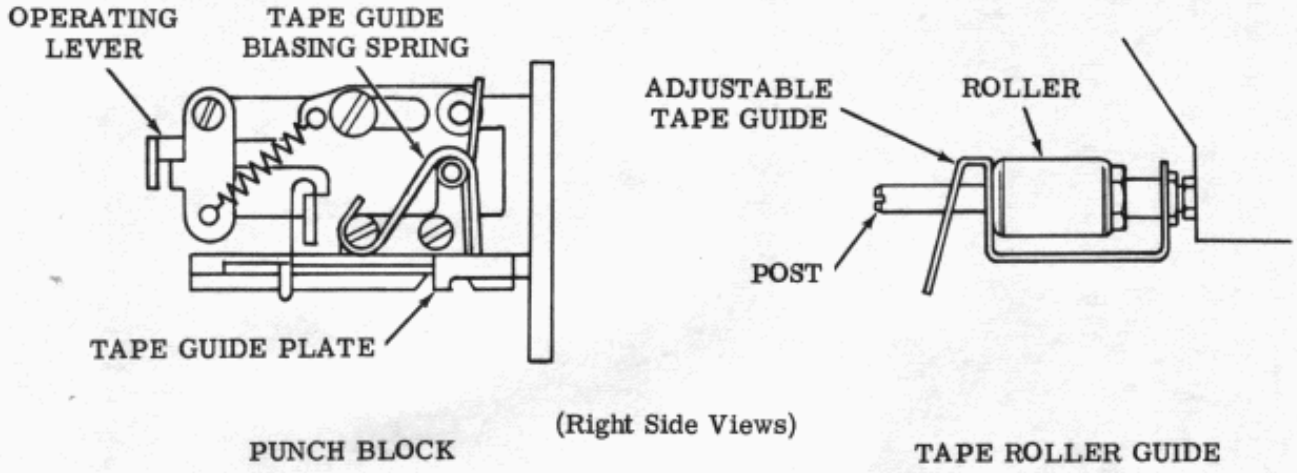


Figure 21 - Universal Punch Block and Roller Guide

eccentric stud. At this point, the tape is engaged by both the reverse feed wheel and the forward feed wheel until the tape guide cam follower arm is on the high part of the cam assembly. The forward feed wheel then disengages the tape.

3.21 As the tape guide cam assembly continues its rotation, the cam assembly roller strikes the clutch release lever causing the trip shaft to rotate counterclockwise. The rotation of the clutch stop lever releases the intermediate shaft clutch allowing it to engage. The drum and gear assembly begins to rotate counterclockwise causing the reverse feed wheel assembly to rotate clockwise. The reverse feed wheel assembly rotates twice to each rotation of the intermediate shaft. As the cutout on the feed wheel detent disc is completing the first rotation, the cam of the drum and gear assembly holds the detent lever away from the disc until the detent cutout has passed (Figure 20). When the detent cutout approaches the second complete revolution, the detent lever is no longer held away. The spring clutch of the intermediate shaft is stopped by its respective stop arm on the trip shaft, and the detent lever roller drops into the cutout on the detent disc. Because there are 40 teeth on the reverse feed wheel and its rotation is twice that of the intermediate shaft, 80 characters in the tape will be fed backwards.

3.22 Shortly after the drum and gear assembly is back to its original position, the tape lid cam follower arm starts to move down to the low part of the tape guide cam assembly. A post on the follower arm causes the switch lever to rotate counterclockwise closing the tape lid switch. At the same time, the center of the tape guide assembly is moving up and toward the right. The tape guide cam assembly rotates counterclockwise until its right side strikes the right eccentric stud. At this point, both feed wheels (forward and reverse) are again engaged with the tape. As the tape guide assembly begins to rotate clockwise, the left end moves away from the left eccentric stud, disengaging the tape from the reverse feed wheel. The cam follower arm stops rotating when the drive shaft cam completes its revolution and the spring clutch disengages. The backup mechanism is now in its neutral (forward) mode of operation.

C. Universal Punch Block (Figure 21)

3.23 The universal punch block is an 8-level punch block with a tape guide plate, tape guide biasing spring, and operating lever, that are adjustable to accommodate either 8-level (1 inch), 6- or 7-level (7/8 inch), or 5-level (11/16 inch) tape. Units equipped with this punch block are also equipped with an adjustable tape input guide roller.