HIGH SPEED TAPE PUNCH UNIT

(BRPE TYPE)

DESCRIPTION AND PRINCIPLES OF OPERATION

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1. GENERAL

1.01 This section contains description and principles of operation for the high speed tape punch unit (BRPE type). It is reissued to include information for all BRPE tape punch units, and to change the title. The photographs and drawings are typical of most models.

1.02 The punch unit uses a magnet controlled punch mechanism to produce perforated tape. The magnets may be controlled either by an electronic control unit or equivalent circuits furnished by the customer. Tape feeding is done with a spring driven escapement type feed mechanism. Timing for the electronic and equivalent circuits is provided by a magnetic pickup mounted on the punch unit.

1.03 The tape punch is used as a self-contained unit when mounted on a high speed reperforator base. Provisions are made for mounting the punch unit on any one of several bases with facilities to install electrical components that are used in the magnet circuits.

2. DESCRIPTION

2.01 The tape punch unit (Figure 1) records information at speeds to 110 characters per second. This information is received from control circuits as combinations of electrical code pulses, then converted to mechanical motions to punch corresponding combinations of code holes. Each combination of code pulses includes a feed pulse to advance the tape.

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 circuits that convert low-level signals to usable power signals capable of operating the punch magnets at varying

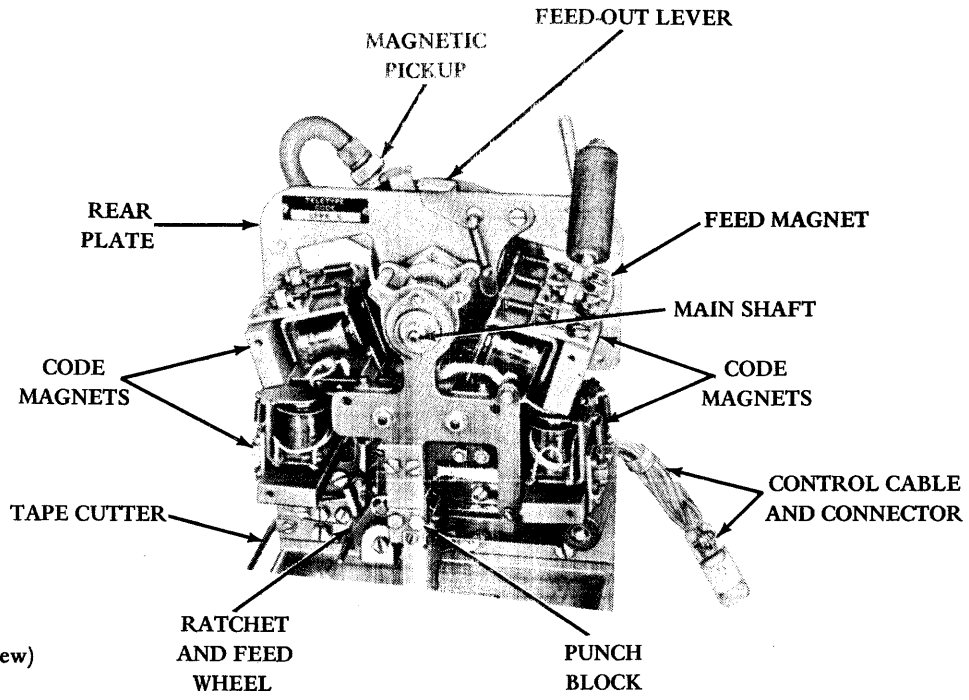


Figure 1 - Tape Punch Unit

speeds. Connecting cables should be provided in the base or cabinet mounting facility. The chad chute, output tape guide and tape handling vary from one application to another, 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. It receives the intelligence in the form of electrical code pulses on a multiple wire basis from the control circuits. These control circuits are triggered by a synchronization pulse which originates in the punch itself.

TAPE

2.05 With the appropriate punch block assembly and associated parts selected and installed, the punch unit is capable of punching either 11/16 inch, 7/8 inch, or 1 inch tape (Figure 2). 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
	01	01	01
01	02	02	02
02	03	03	03
0F	*00F	0F	0F
03	04	04	04
04	05	05	05
05	06	06	06
		07	07
			08

0 = Code Hole

F = Feed Hole

*0 = Advance Feed Hole (if so equipped)

TIMING

2.07 The high speed tape punch mechanism operates continuously. However, punching and feeding of tape occurs under the control of input signals received from electronic storage circuits. A magnetic pickup, mounted on the punch unit, controls the information in the storage circuits. In addition, the magnetic pickup and its associated

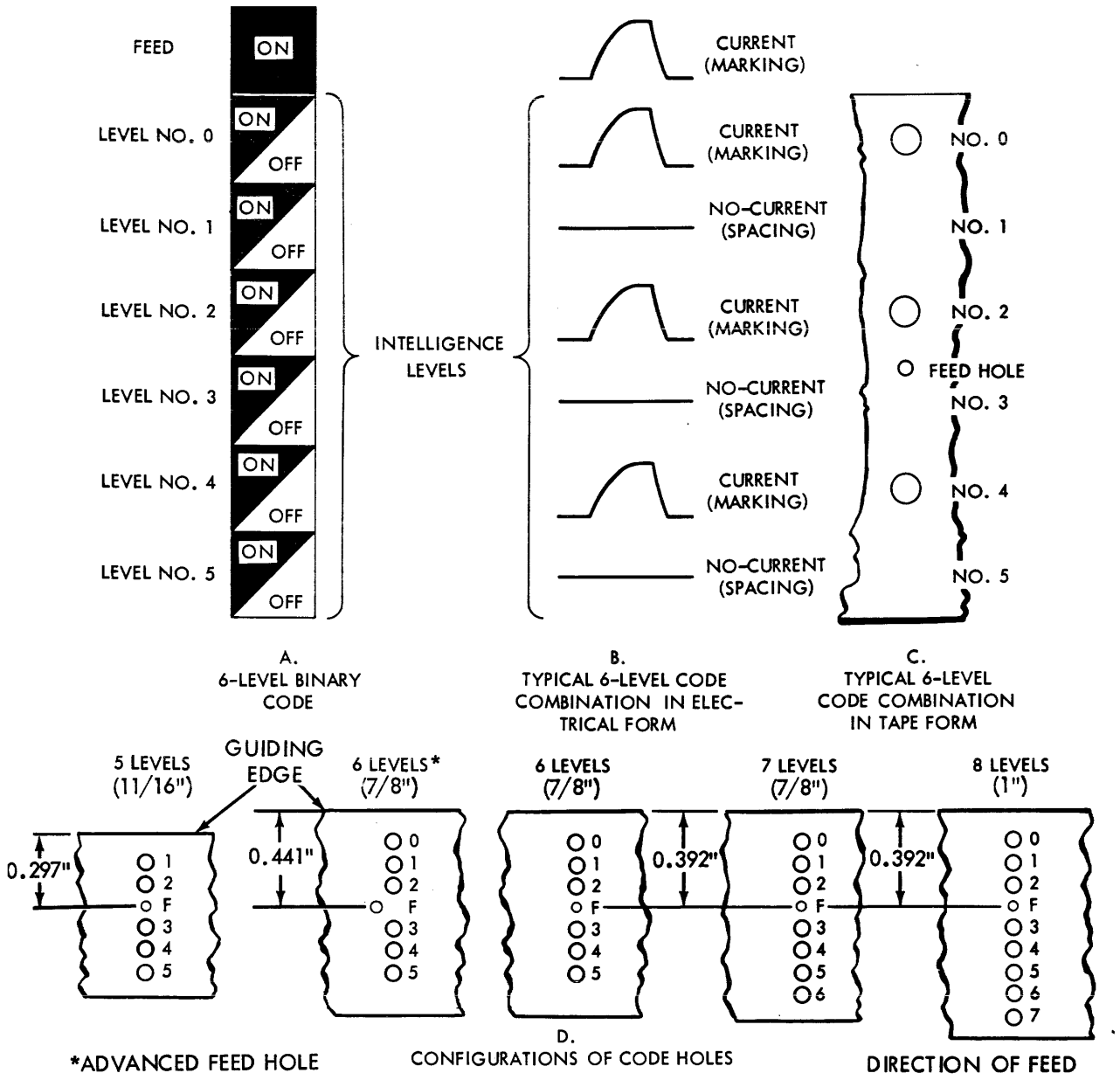


Figure 2 - Code Illustrations

iron insert can be adjusted to allow the full operation or release of the magnet armatures prior to the end of the mechanical selection interval of the operating cycle.

OPERATING POWER AND TEMPERATURE

2.08 Mechanical motion to operate the punch unit is produced by a two-pole single-phase synchronous motor which develops 1/20 horsepower at 3600 revolutions per minute. The punch unit may be operated in an environment ranging from 0 to 90 relative humidity and at an ambient temperature of +40°F to +110°F. The input to the motor is 115 v ac, +10%, 60 Hz, 65 watts at nominal voltage.

WEIGHTS AND DIMENSIONS

2.09 The tape punch unit weighs 8-1/2 pounds. The 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.

3. PRINCIPLES OF OPERATION

3.01 Figure 3 shows the related operations of a tape punch unit receiving a 5-level code with levels 1, 3, and 5 marking. The electrical, mechanical, and timing relationships shown are described in the following paragraphs.

3.02 Placing the toggle switch, on right side of punch unit, to the ON position applies ac power to the motor. The motor motion is rotary and is transmitted through a pinion and gear set to the drive mechanism. The drive mechanism converts the rotary motion to oscillating motion and then sends it to the punch and feed mechanisms.

3.03 Figure 4 shows the vertical motion of the punch and feed mechanism being plotted against the rotation of the main shaft. Top dead center (TDC) of the punch mechanism has been designated as the zero degree point. The drive mechanism is so designed that the feed mechanism reaches TDC 45 degrees after the punch mechanism.

3.04 A tape punch operation is the period from TDC of the punch mechanism to TDC of the feed mechanism (405 degrees). This is the time needed by the equipment to punch a character and advance the tape when an electrical code combination has been received. As shown in Figure 4, the operations overlap by 45 degrees.

3.05 The magnetic pickup (Figure 5) generates a sync pulse with each revolution of the flywheel. This pulse starts the transfer of the code combination from the signal converter storage register in the receiver set to the reperforator magnets.

3.06 If intelligence is present in the storage register, a combination of code and feed pulses is applied to the code and feed magnets. The punch mechanism punches code holes in the tape corresponding to the marking pulses received. A feed hole is automatically punched with each code combination. Punching occurs about midway through the operation as shown in Figure 4.

3.07 If intelligence is not present in the storage register, the tape punch undergoes an operation without punching or feeding tape.

3.08 The feed pulse energizes the feed magnet and causes the feed mechanism to advance the tape. This occurs late in the operation, after punching has been completed. Figure 6 shows the position and location of the feed magnet as well as the code level magnets.

4. DETAILED DESCRIPTION OF MECHANISMS

DRIVE MECHANISM

4.01 The drive mechanism (Figure 7) converts rotary motion to oscillating motion; then applies it to the punch and feed mechanisms. The conversion takes place on the main shaft at points specifically designed to form two cams. The forward cam, through a set of bearings and drive links, causes the transfer surface of the punch bail to oscillate. This motion is represented by the heavy solid line in Figure 4, and is directly imparted to the punch mechanism. A second cam on the main shaft causes the feed drive lever of the feed mechanism to oscillate. This motion is represented by the light solid line in Figure 4. The angular displacement of the two cams are so related that the feed drive link reaches TDC 45 degrees after the punch bail does. As long as the motor switch is on, the drive mechanism will run continuously and transfer motion to the punch and feed mechanisms.

4.02 Because the tape punch cycle is continuous, the feed and code pulses must be presented at specific times. A magnetic pickup is used to synchronize the delivery of the code pulses with the mechanical timing of the punch unit. The magnetic pickup consists of a coil with an iron core. With each shaft rotation, a permanent magnet inserted at the edge of the flywheel passes by the coil and induces a voltage in the coil. This voltage triggers the storage register circuit and starts the transfer of intelligence.

PUNCH MECHANISM

4.03 Figure 8 shows the punch mechanism. For each code level there is a code magnet, armature, blocking pawl, toggle linkage, drag link, and punch pin. When idle (motor running and no intelligence), the armatures are held away from the magnet pole faces by their springs. The armature is now in the spacing position, which in turn holds associated blocking pawls in their spacing position. As the drive mechanism cycles, it causes the punch bail and toggle linkages to oscillate.

4.04 When the toggle linkages move down at the beginning of each idling condition, toggle extensions engage the blocking pawls and cause the linkages to buckle at 51 degrees of shaft rotation. Vertical motion is imparted to the punch pins through the drag links. Since the toggle linkages are buckled, the vertical displacement of the pins is not enough to pass through the tape. Thus, the code holes are not punched. The travel of the pins for spacing is represented by the heavy dotted lines in Figure 4. Each operation of the drive mechanism causes a feed hole toggle arm and drag link (having no associated magnet or buckling knee) to drive a feed hole punch pin through the tape. In the idle condition, this pin moves up and down in the same hole.

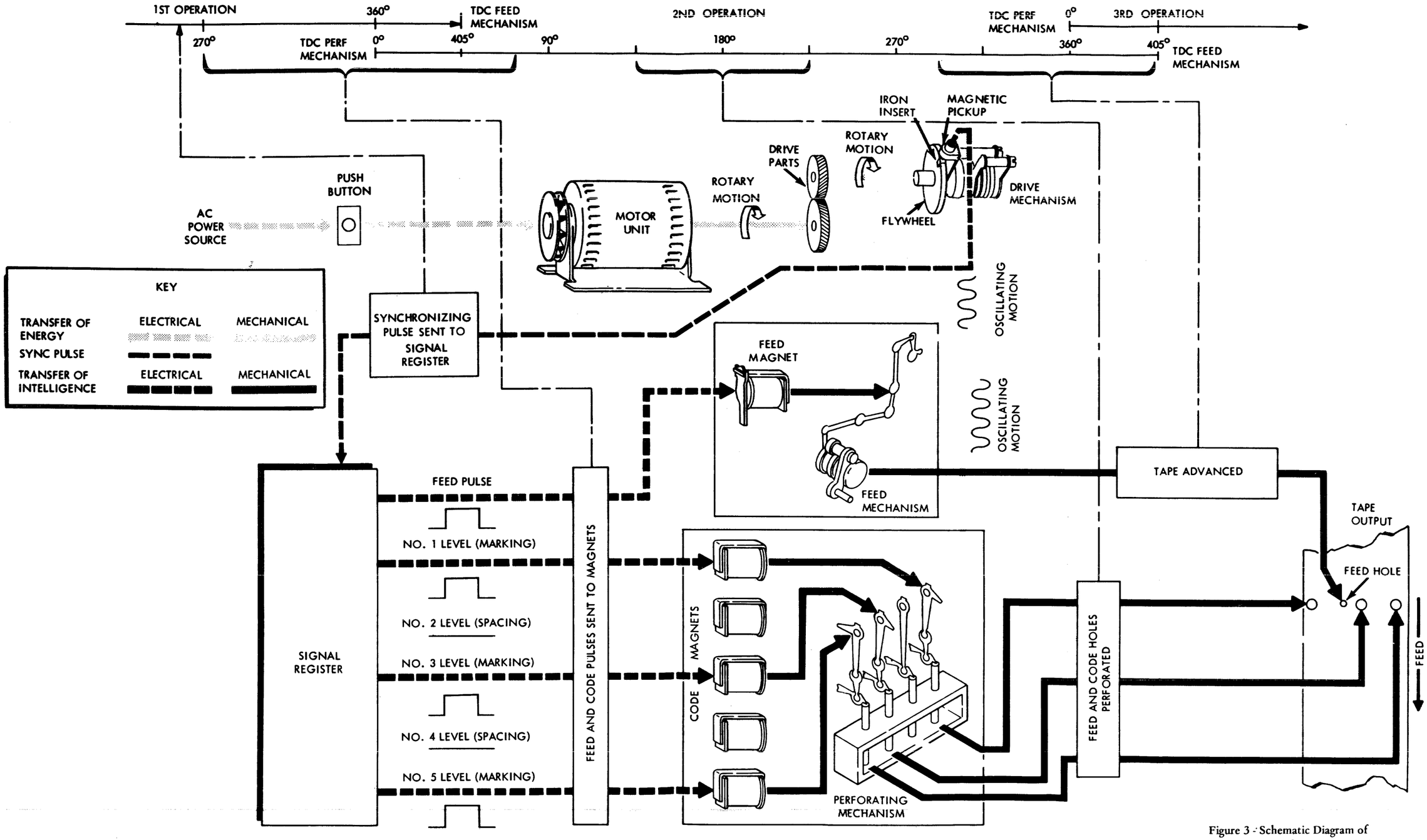


Figure 3 - Schematic Diagram of Reperforator Description

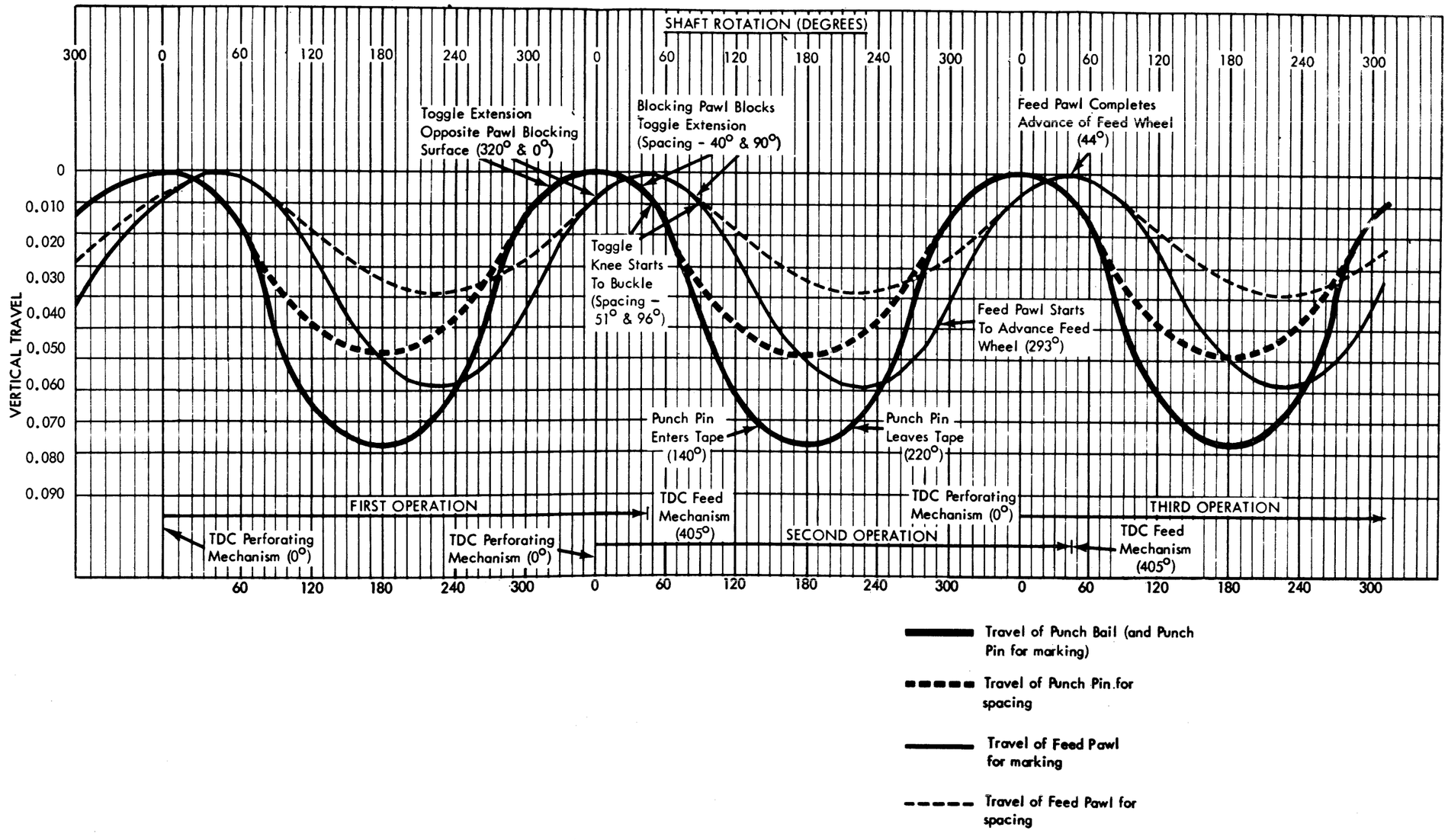
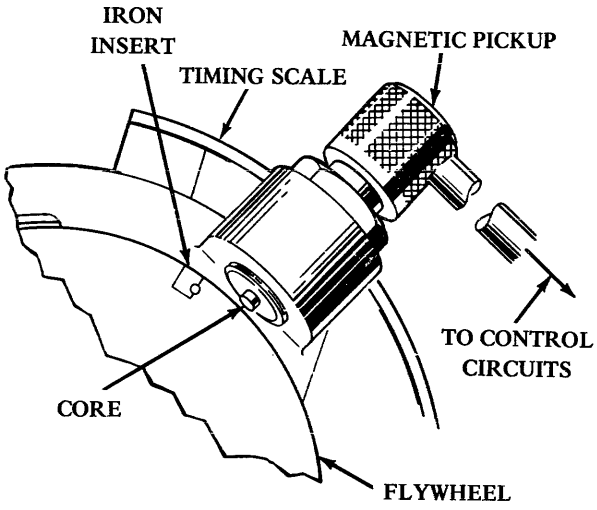


Figure 4 - Timing Diagram



(Right Side View)

Figure 5 - Magnetic Pickup

4.05 When a code combination is received, the magnets and associated parts corresponding to spacing levels operate as described in the two previous paragraphs. For marking levels in the code combination, the magnets are energized and pull their armatures to their operated (or marking) position. The armatures, in turn, hold the blocking pawls in their marking position. The timing is such that the armatures reach their marking position before the end of the selection interval (320 degrees to 40 degrees of shaft rotation) illustrated in Figure 4.

4.06 As the toggle linkages move down, the toggle extensions associated with marking levels clear their blocking pawls, and the unbuckled linkages drive their pins through the tape and punch code holes. The motion of the pins for marking is represented by the solid black line in Figure 4. As can be seen, perforation occurs about midway through the operation between 140 degrees and 220 degrees of shaft rotation. Each time tape is advanced, the feed hole punch pin perforates a feed hole.

FEED MECHANISM

4.07 The tape feed mechanism is shown in Figure 9. It includes a magnet and toggle linkage similar to those of the punching mechanism. In the idle condition the magnet is de-energized, and the armature and blocking pawl are held under spring tension in their spacing position. The drive mechanism, through the feed drive lever, causes the toggle linkage to oscillate. As the linkage moves down during the early part of each idling operation, it is buckled by the blocking pawl at 85 degrees of shaft rotation (Figure 4). The linkage rotates a pivot arm which lifts the feed pawl, but not enough to raise it above the next tooth on the feed wheel. The motion of the feed pawl for idling (or spacing) is represented by the light dotted line shown in Figure 4. In this condition the feed wheel is not rotated nor is tape advanced.

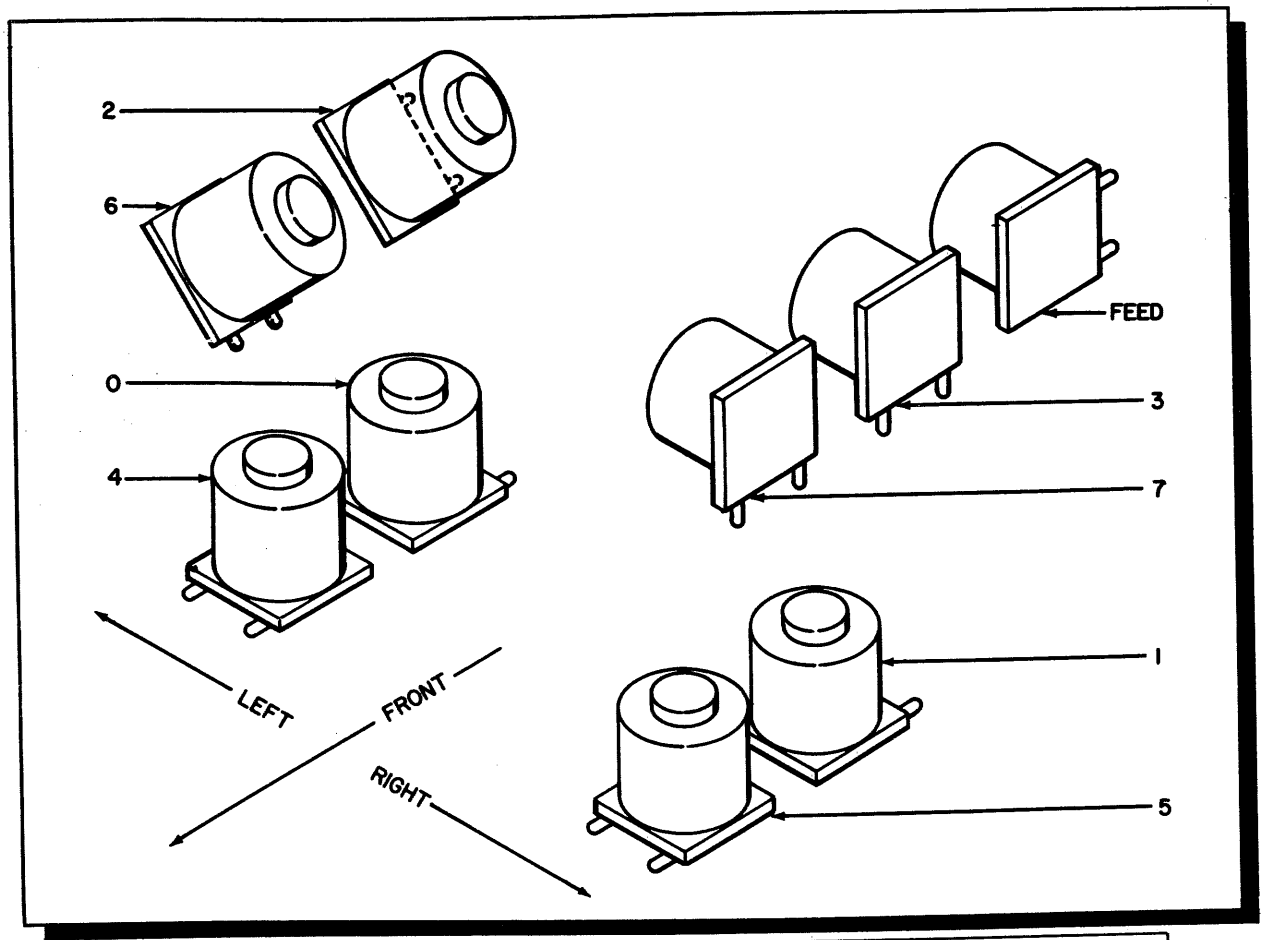
4.08 When a code combination is received, a feed pulse is applied to the feed magnet which pulls the armature and blocking pawl into their marking position. The timing is such that the armature does not reach its fully released position before the end of the feed selection interval (Figure 4). As the toggle linkage moves down during the early part of the operation, the toggle extension clears the blocking pawl; the linkage remains in its unbuckled condition, and the feed pawl is lifted above the next tooth on the ratchet. When the linkage moves up during the latter part of the operation, it causes the pawl to act on the ratchet and rotate the feed wheel one tooth. Pins on the periphery of the wheel engage the feed holes and advance the tape one character. As shown in Figure 4, feeding occurs between 293 degrees and 44 degrees of shaft rotation.

4.09 Near the end of its downward travel, the pawl is engaged by a wedge block which prevents over-travel. Consistent spacing of code perforations is ensured by a detent with a roller that is held under spring pressure against the ratchet. The detent secures the feed wheel and tape in position between feeding operations. Consistent spacing of the perforations in relation to the edge of the tape is maintained by a biasing spring which holds the tape against a reference surface on the block. The tape is fed into the punch block through a tape guide and is held on the feed wheel by a spring-biased tape lid which may be raised to initially insert the tape.

UNIVERSAL PUNCH MECHANISM

4.10 The punch units with the universal tape punch (Figure 10) are capable of perforating 11/16-inch tape with 5-level code, or 1 inch tape with 5-, 6-, 7-, or 8-level codes. To accomplish this, a manually operated mechanism is provided to mechanically vary the size of the punch block tape path to accept either 11/16 inch or 1 inch tapes. Associated with this mechanism is a variable tape guide mechanism and three switches which electrically control the 0, 6, and 7 code levels.

4.11 The production of 5-level, 11/16 inch tape is accomplished by lifting up on the control lever (on the right side of punch block), and allowing it to move forward under its own spring tension. This permits the rear edge of the punch block tape path to move forward, and simultaneously lowers a tape guide bias spring to form the front edge of the tape path. The switches for the 0, 6, and 7 levels should be operated to their OFF position, and the tape guideplate should be moved to its forward detented position.



MAGNET	POSITION	TERMINAL POSITION
FEED	UPPER RIGHT REAR	REAR
0 - PULSE	LOWER LEFT REAR	REAR
1 - PULSE	LOWER RIGHT REAR	REAR
2 - PULSE	UPPER LEFT REAR	REAR
3 - PULSE	UPPER RIGHT MIDDLE	DOWN ON 8 LVL. FRONT ON 5 LVL.
4 - PULSE	LOWER LEFT FRONT	FRONT
5 - PULSE	LOWER RIGHT FRONT	FRONT
6 - PULSE	UPPER LEFT FRONT	DOWN
7 - PULSE	UPPER RIGHT FRONT	DOWN

Figure 6 - Magnet Positions

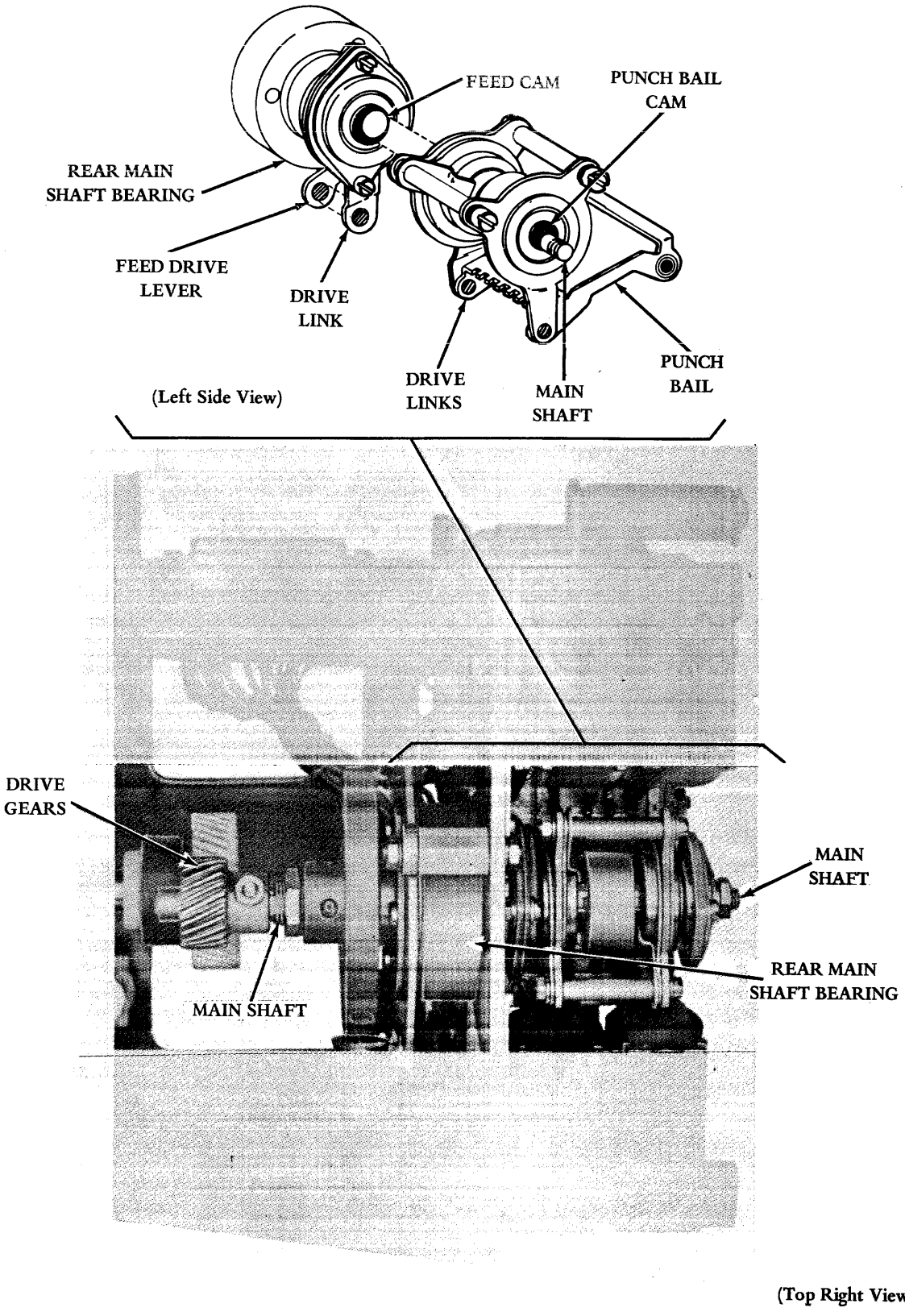


Figure 7 - Drive Mechanism

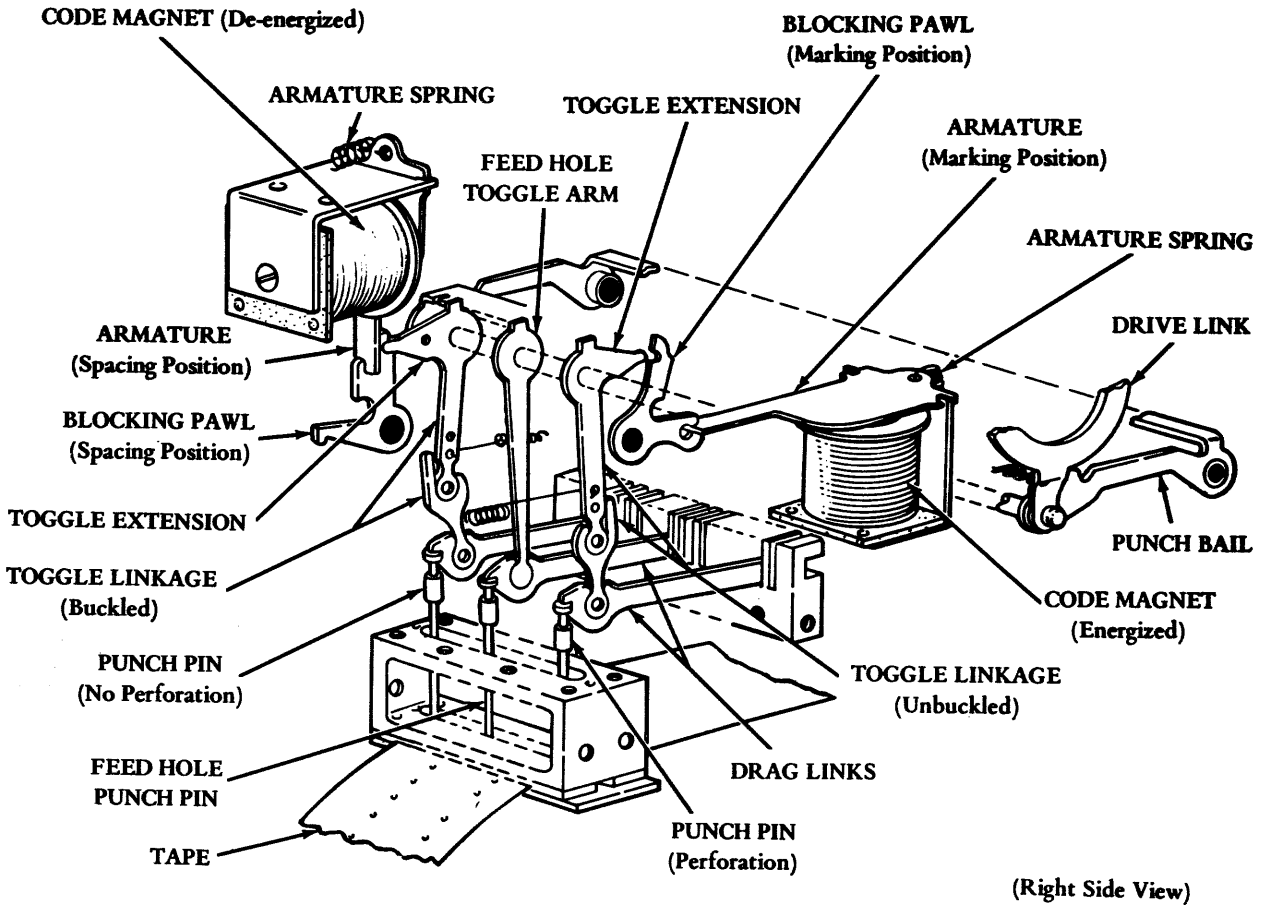


Figure 8 - Punch Mechanism

4.12 The production of 5-, 6-, 7-, or 8-level 1 inch tape is accomplished by pushing the control lever to the rear, while applying a slight downward pressure, until the control lever reaches its rear detent position. In this position, the rear edge of the tape path is moved back and the tape guide bias spring is retracted to clear the tape path for 1 inch tape. The switch for the 0-, 6-, or 7-level codes should be operated to their respective ON positions, depending upon the level of operation desired, and the tape guideplate should be operated to its rear detented position.

ELECTRICAL TIMING CHARACTERISTICS

4.13 The following data is for typical tape punch units:

(a) Punch and feed magnets fully attract their armatures about 3 milliseconds after being energized; they are fully released about 8 milliseconds after opening the circuit.

(b) Punch units that are pulsed from transistorized control units have magnets that operate on 28 v dc and require a 25 ohm resistor in series with each magnet to limit the operating current.

CAUTION: IF THE 25 OHM RESISTORS EXCEED 5 MILLISECONDS FOR ONE CHARACTER OPERATION, REMOVE THEM FROM THE BASE AND MOUNT EXTERNALLY, OR SUPPLY A BLOWER TO DISSIPATE THE HEAT.

(c) Punch units that are pulsed from tube type control units have magnets that operate on 115 v dc and require a 600 ohm resistor in series with each magnet to limit the operating current.

Note: Since magnet operation depends on the control circuits, the above values may be varied experimentally for specific applications.

(d) The punch and feed magnets should be provided with a square wave pulse of 4.5 milliseconds.

Note: Production tape punch units are adjusted to a standard optimum input signal of 4.5 milliseconds ±5%, without readjustment of the armature gap and/or spring tension. Field applications having control equipment generating signals other than 4.5 ms may need readjustment.

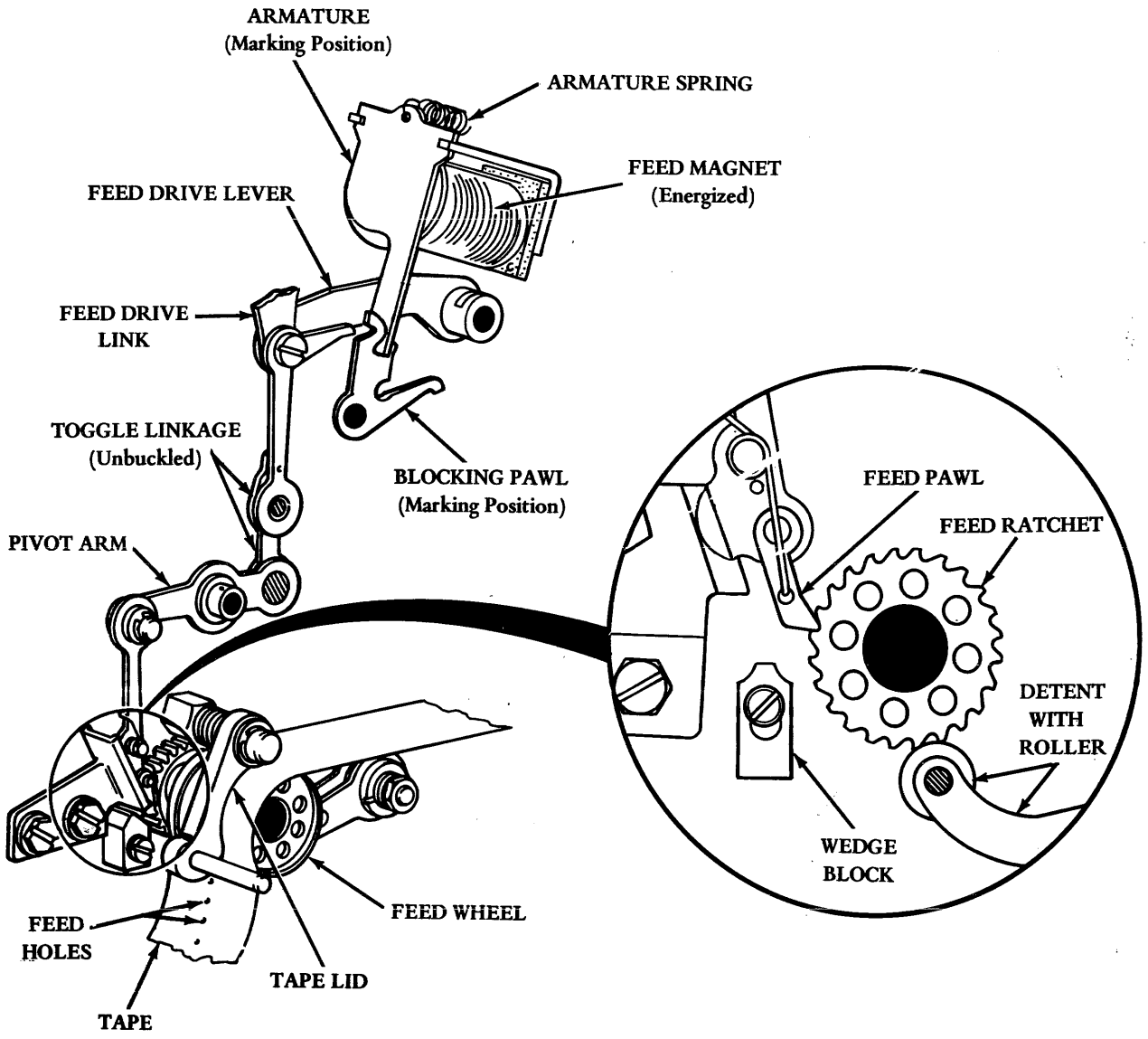


Figure 9 - Tape Feed Mechanism

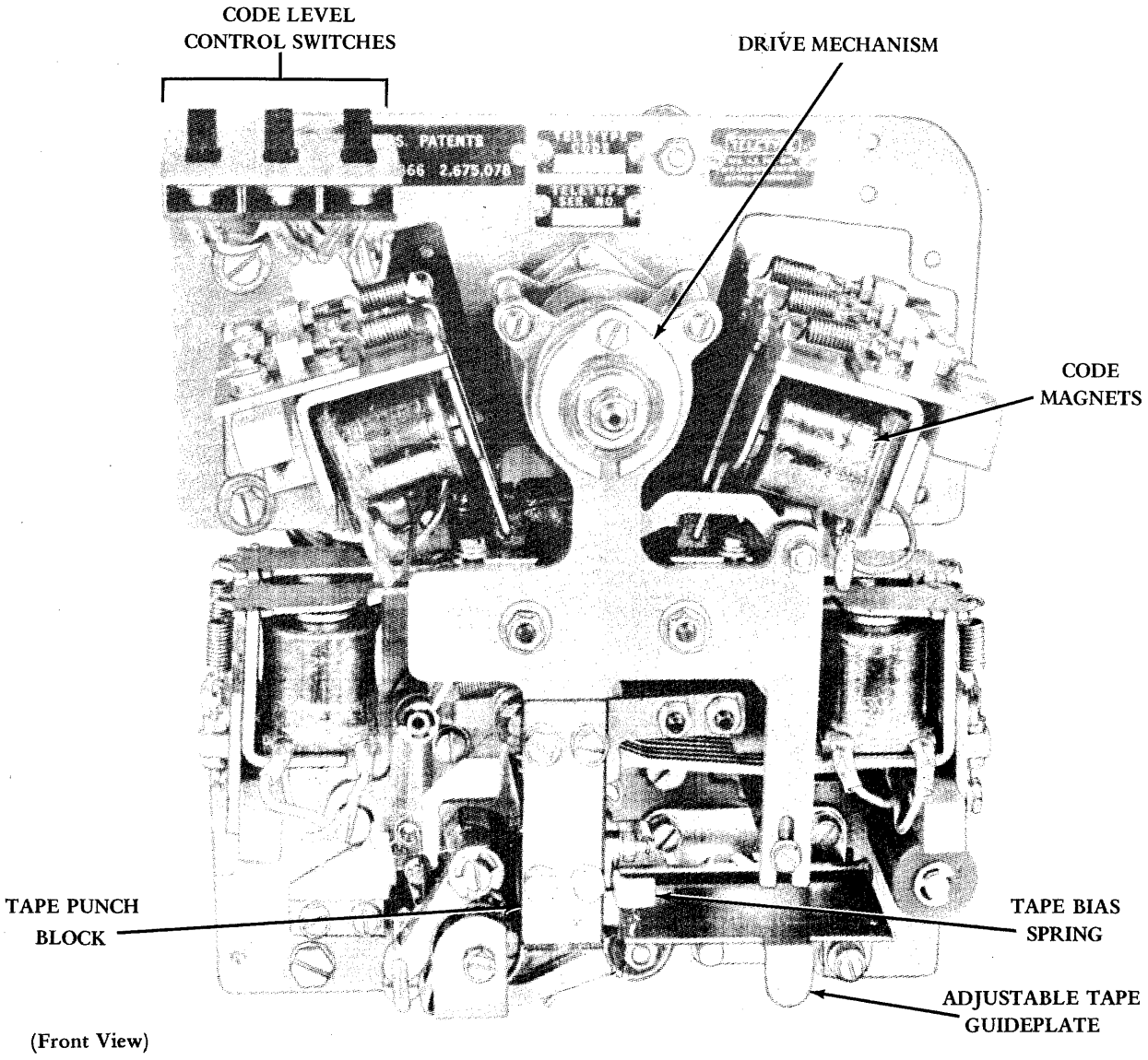


Figure 10 - Universal Tape Punch Unit

SYNCHRONIZATION

A. Early Design Magnet Pickup

4.14 The early design magnetic pickup generates a timing pulse for every revolution of the flywheel. At 63.3 operations per second it produces a 4 volt (peak-to-peak), 450 microsecond timing pulse. At 110 operations per second it produces a 6 volt (peak-to-peak), 250 microsecond timing pulse.

Note: The above values are obtained with a clearance of 0.010 inch between the magnet pickup and the flywheel when the pickup is connected to an equivalent circuit of a 0.01 mf capacitor and a 1000 ohm resistor in parallel.

B. Latest Design Magnet Pickup

4.15 The latest design magnetic pickup generates a timing pulse for every revolution of the flywheel. At 63.3 operations per second it produces a 30 volt (peak-to-peak), 450 microsecond timing pulse. At 110 operations per second it produces a 40 volt (peak-to-peak), 250 microsecond timing pulse.

Note: The above values are obtained with a clearance of 0.010 inch between the magnet pickup and the flywheel when the pickup is connected to an equivalent circuit of a 0.01 mf capacitor and a 1000 ohm resistor in parallel.