TAPE READERS (CX)

DESCRIPTION AND PRINCIPLES OF OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section provides description and principles of operation information for CX tape readers (Figure 1). It is reissued to change the title, add CX808 reader information, and to incorporate the latest engineering changes. There is no TCN information to be included at this time. Due to a general revision, marginal arrows are not used.

1.02 The CX tape reader (Figure 1) is an electromechanical device which senses intelligence recorded in fully perforated or chadless tape. Its output is electrical (from 5- to 8-level, depending on the reader). The reader senses tape at speeds up to 1071.42 words per minute (wpm).

1.03 The tape readers consist of a tape sensing mechanism, a tape feeding mechanism, a freewheeling mechanism (except CX806), a tape-out mechanism, a magnet operated latch-unlatch mechanism, and electrical contacts.

1.04 Tape sensing mechanism consists of spring-driven pins (through the tape holes) which are mechanically withdrawn when the hole configuration is sensed.

1.05 Tape feeding mechanism consists of a feed pawl, feed ratchet and wheel, and a detent in combination that advances the tape one step at a time while the tape holes are being sensed.

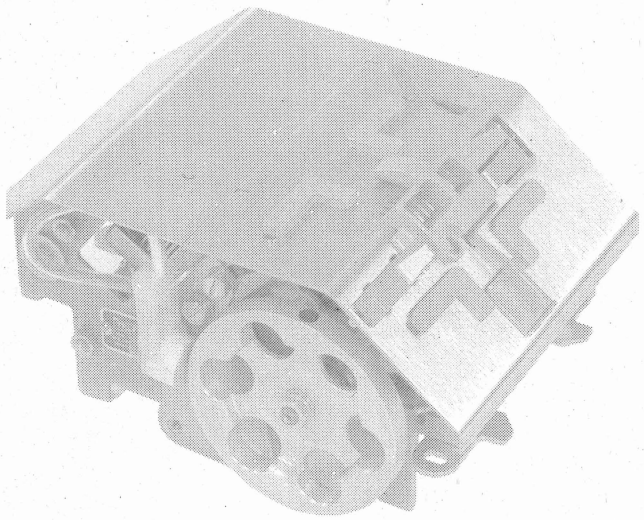


Figure 1 - CX Tape Reader (Typical)

Prepared for American Telephone and Telegraph Company by Teletype Corporation

1.06 Freewheeling mechanism consists of a lever and arm (except CX806), when operated, allows the feed wheel to rotate freely and the tape-out pin to be pulled down permitting tape insertion or repositioning with the tape lid down.

1.07 Tape-out mechanism consists of a pin and set of contacts that open or close the circuit controlling the operating magnet.

1.08 The latching mechanism consists of an electrically operated magnet and levers that permits the reader to operate by the latching and unlatching process which creates a stepping motion necessary to sense code holes in the tape.

1.09 References to left or right, up or down, top or bottom, etc, refer to the reader viewed with the flywheel facing the front (Figures 1, 2, and 3).

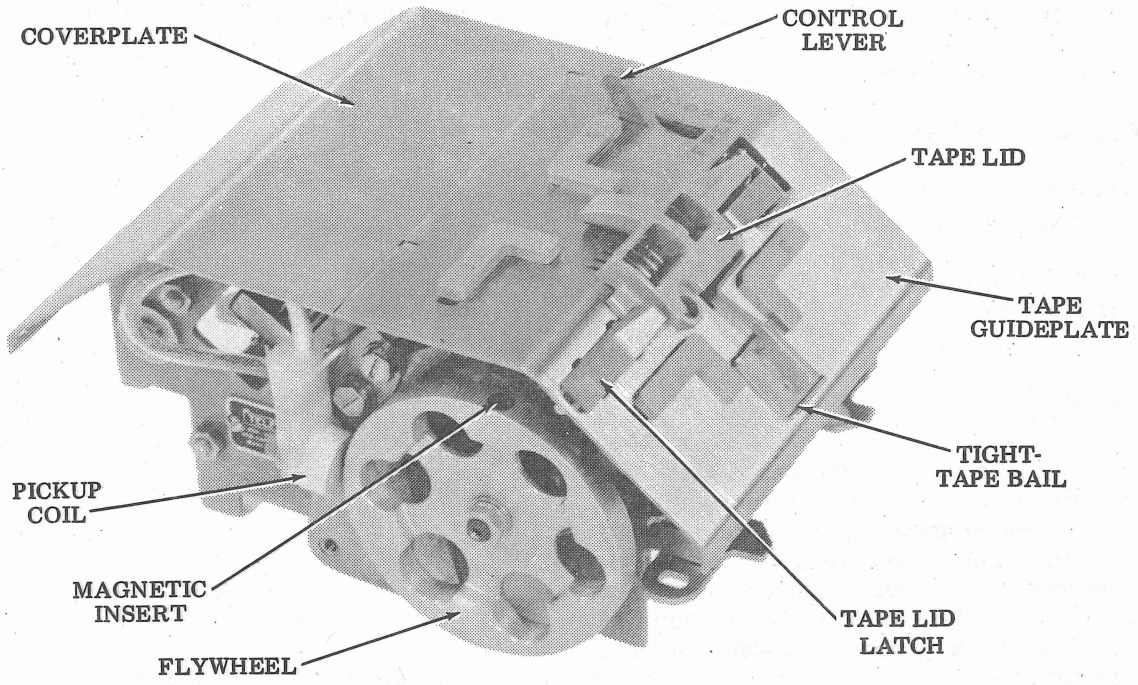
1.10 Circuits through which code contacts operate are external to the reader and may be either resistive, capacitive, or inductive. Readers CX602, 802, 805, 806, and 808 are equipped with heavy gold-plated code reading contacts. CX805, 806, and 808 also have heavy gold-plated control contacts.

1.11 Minimum contact rating for gold-plated contacts is 5 volts dc at 1 milliampere. Maximum rating is 12 volts dc at 16 milliamperes. For test purposes, use 5 volts dc at 4 milliamperes. External leads should be resistive.

1.12 The recommended cleaning interval for gold-plated contacts in special low-level applications (less than 250 microwatts and having an average weekly use of 60 hours) should not exceed 90 days. This interval may be reduced dependent on the signal circuit configuration, usage, and environment.

1.13 Use twill jean cloth (KS2423) to clean gold-plated contacts. Do not use burnishers, files, etc, which will remove the gold plating.

CAUTION: DO NOT USE GOLD-PLATED CONTACTS ALTERNATELY IN HIGH- AND LOW-LEVEL CIRCUITS BECAUSE HIGH-LEVEL OPERATION MAY DAMAGE THE GOLD PLATING AND IMPAIR THE CONTACTS USED IN LOW-LEVEL CIRCUITS. (SEE 1.12.)



(Right Front View)

Figure 2 - Tape Reader (With Single Pickup Coils)

Note: CX reader Parallel Contact Interface (PCI) information may be found in the appropriate technical reference (Marketing Handbook) for interfacing the CX reader to customer logic equipment.

2. DESCRIPTION

TECHNICAL DATA

A. Speed

2.01 Gear sets (or sprocket and timing belt) provide several specific speeds starting with 150 words per minute and are available for a maximum speed of 1071.42 words per minute.

Note: Drive sets used with 37 Type equipment provide speeds of either 100 or 150 words per minute.

B. Input

Punched Tape:

Fully perforated or chadless

Levels: 5, 6, 7, or 8 with in-line feed hole
6 with advanced feed hole

Widths: 11/16 inch (5-level)

7/8 inch (6- and 7-levels with in-line feed hole)

7/8 inch (6-level with advanced feed hole)

1 inch (8-level)

Characters per inch: 10

Code hole diameter: 0.072 inch

Feed hole diameter: 0.046 inch

C. Output

Code Contacts — Parallel Wire

Synchronization (where applicable)

Pulse Generator — Magnetic pickup pulse when main shaft is turning

Auxiliary Contacts — Contact closure when reader is sensing (reading) (not on CX808)

D. Motive Power

External Motor Unit

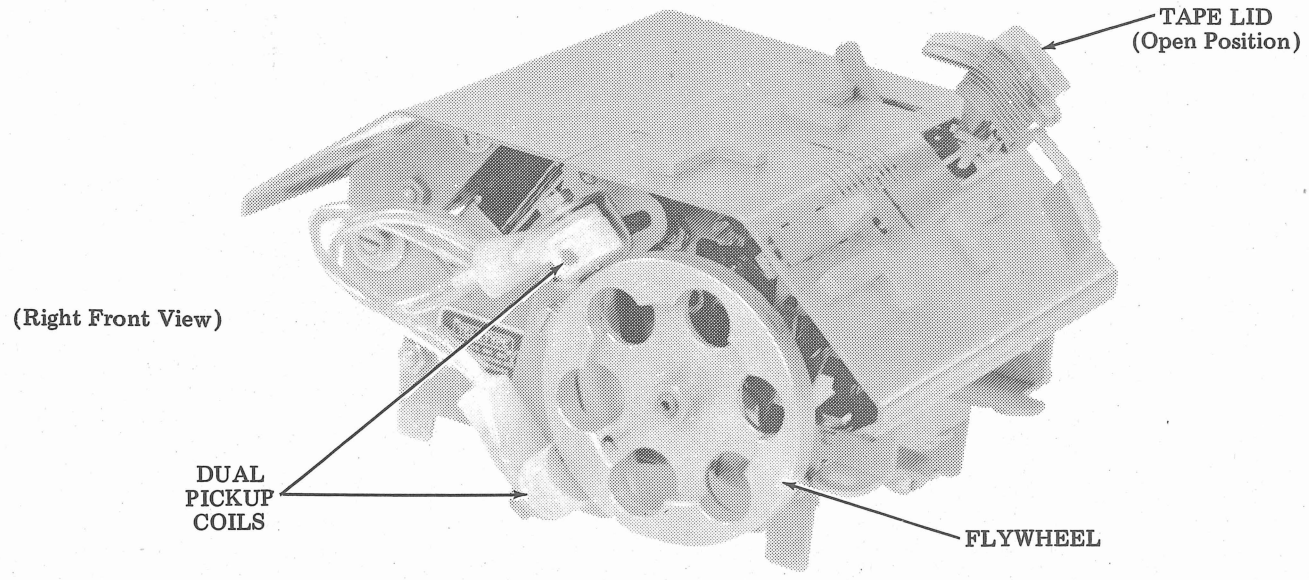


Figure 3 - Tape Reader (With Dual Pickup Coils)

E. Dimensions and Weight

Depth	3 inches
Width	5 inches
Height	3 inches
Weight	2-1/2 pounds

F. Code and Auxiliary Contacts

Note: For high speed CX readers — 450 wpm and up.

Rating — Minimum 28 volts dc at 0.15 milliamperes

Maximum 130 volts dc at 100 milliamperes

If necessary, arc suppression should be provided by external circuits.

G. Operating Magnet

2.02 An electronic driver is used with readers containing the 309M or 311M coil. Table A gives technical information for the various coils used with the readers.

2.03 When a pickup coil is used to control the operating magnet, the magnet should pick up or drop out within 27 milliseconds after the pickup coil pulse. It should remain in its selected position for a minimum of 33 milliseconds with a main shaft speed of 900 rpm.

2.04 If main shaft speed is 1800 rpm the magnet should pick up or drop out within 13.5 milliseconds after pickup coil pulse and remain in its selected position for a minimum of 16.5 milliseconds.

2.05 With the reader adjusted to this specification, the main shaft is operating at 1800 rpm (300 wpm or stepped down to 150 wpm). If a reader driver card (such as TP322054) is used that delays the magnet decay time, the reader cannot be stepped down to 150 wpm or cannot be stopped on the next character at 300 wpm.

2.06 The two auxiliary contacts (on contact block assembly) provide a contact closure generating an electrical pulse each time the tape is sensed. It provides an electrical pulse for readers without a pickup coil and flywheel, or may be used as an optional circuit by the customer.

H. Pulse Generator Coil (where applicable)

Type	261M
Timing	Adjustable 360 degrees
Coil Resistance	85 ohms ±10 percent
Magnetic Pickup Characteristics	See Figures 4 and 8
Auxiliary Contacts (where applicable)	

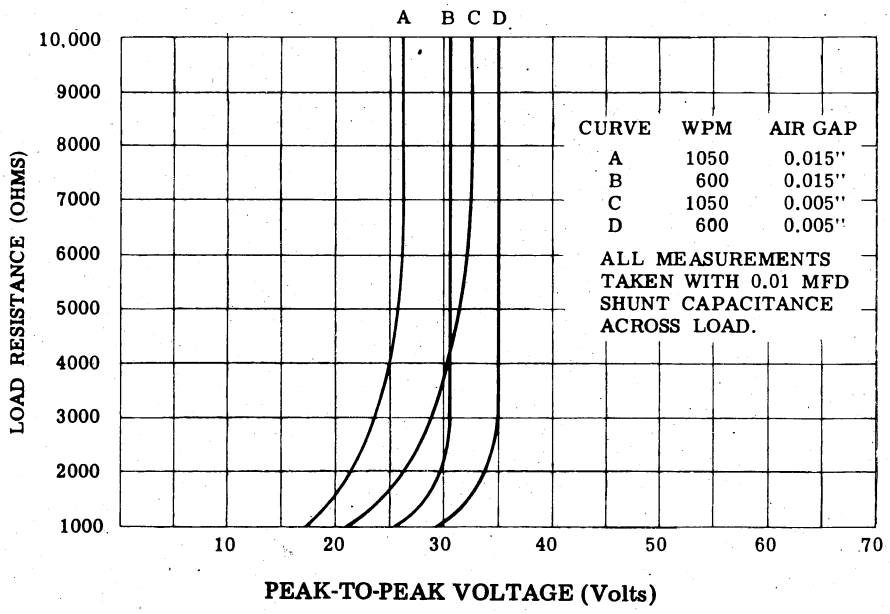


Figure 4 - Magnetic Pickup Characteristics

TABLE A

OPERATING MAGNET PICKUP TIME

TECHNICAL INFORMATION	OPERATING MAGNETS			
	260M COIL (Figure 5)	282M COIL (Figure 6)	309M COIL (Figure 7)	311M COIL (Figure 7)
Voltage	28 volts dc	48 volts dc	24 volts dc	24 volts dc
Pickup Time	4 to 15 ms	10 to 25 ms	7 to 10 ms	Within 27 ms
Dropout Time	7 to 18 ms	3 to 18 ms	3 to 4 ms	Within 13.5 ms
Pickup and Dropout Voltage Range	25 to 31 volts dc	43 to 53 volts dc	22.5 to 27.5 volts dc	21.5 to 26.5 volts dc

I. Temperature Ranges

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

CONFIGURATIONS

2.08 The tape readers (Figures 2, 3, 9, 10, and 12) are available in several different configurations to meet varying requirements. Table B lists the different features and characteristics of the tape readers.

2.09 CX806 is the same as CX805 except its control lever is replaced by a spacer. The spacer provides CX806 with a fixed run position and eliminates STOP and FREE positions.

2.10 Each reader however, is comprised of four basic mechanisms:

(1) Control mechanism which includes components for the following conditions (except CX806):

(a) Freewheeling
(b) Run
(c) Stop
(d) Tight tape
(e) Tape-out

(2) Latching mechanism
(3) Sensing mechanism
(4) Feed mechanism

2.11 The method of control depends on the application and may be either based on electrical timing signals generated by the reader or by external means. Readers not equipped with a magnetic pickup mechanism depend on external circuits or auxiliary contacts for timing (Figure 19).

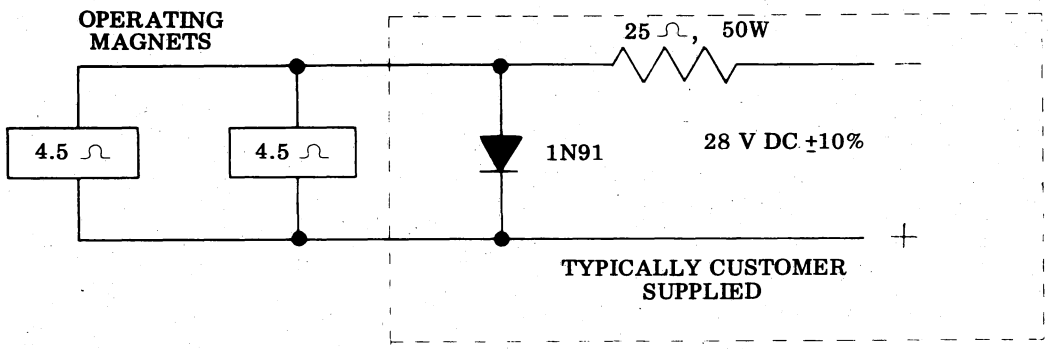
2.12 A main shaft, with bearings at each end, rotates continuously while the associated motor unit is operating. Sensing and feeding cams are part of the shaft. Both ends of the shaft are threaded for mounting the driven gear and flywheel.

2.13 Either 2-part or 3-part coverplate assemblies enclose the top of the reader. The 2-part coverplate assembly consists of a tape guideplate, secured to the reader by mounting brackets and screws, and a coverplate, held in place by a detent bracket. The 3-part assembly includes a guideplate and top plate, secured to the reader with mounting brackets and screws, and a coverplate, held in place by a detent bracket.

3. OPERATION

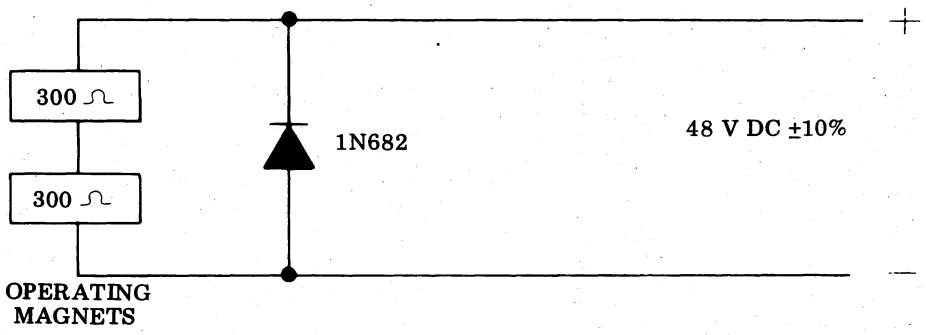
GENERAL

3.01 The operation of a typical reader is described below and illustrated in the pictorial schematic diagram, Figure 13.



Note: Magnet circuits with suppression diodes must observe polarity in relation to the diodes.

Figure 5 - Simplified Circuit for the Parallel-Connected 260M Coil Operating Magnet



Note: Magnet circuits with suppression diodes must observe polarity in relation to the diodes.

Figure 6 - Simplified Circuit for the Series-Connected 282M Coil Operating Magnet

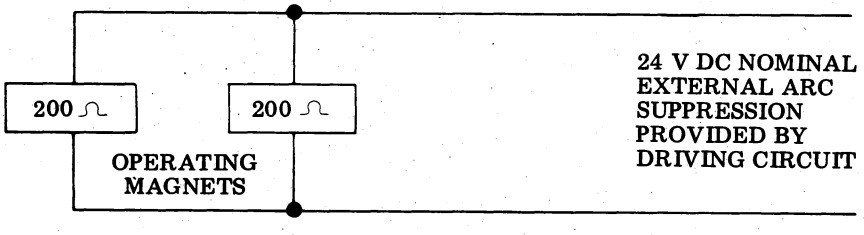


Figure 7 - Simplified Circuit for the Parallel-Connected 309M or 311M Coil Operating Magnet

TABLE B

TAPE READER FEATURES

FEATURES	TAPE READERS														
	CX1	CX2	CX600	CX601	CX602	CX603	CX700	CX701	CX800	CX801	CX802	CX803	CX805	CX806	CX808
Code Levels:															
Five	x	x													
Six			x	x	x	x									
Seven							x	x							
Eight									x	x	x	x	x	x	x
Contacts:															
Make-Only	x		x		x	x	x		x			x	x	x	x
Transfer		x		x				x		x	x				
Tape Width:															
11/16"	x	x									x	x			
7/8"			x	x	x	x	x	x			x	x			
1"									x	x	x	x	x	x	x
Advanced Feed Hole					x	x									
48-Volt Operation						x						x			
No Pickup Coil						x						x			
Single Pickup Coil	x	x	x	x	x		x	x	x	x	x				
Dual Pickup Coils													x	x	x
Auxiliary or Universal Contacts												x			
Gold-Plated Contacts					x						x		x	x	x
Similar to Reader		CX1	CX1	CX600	CX600	CX602	CX1	CX700	CX1	CX800	CX800	CX802	CX806	CX805	CX805

Note: CX1 corresponds to Bell 1A, CX802 to Bell 2A, and CX803 to Bell 5A.

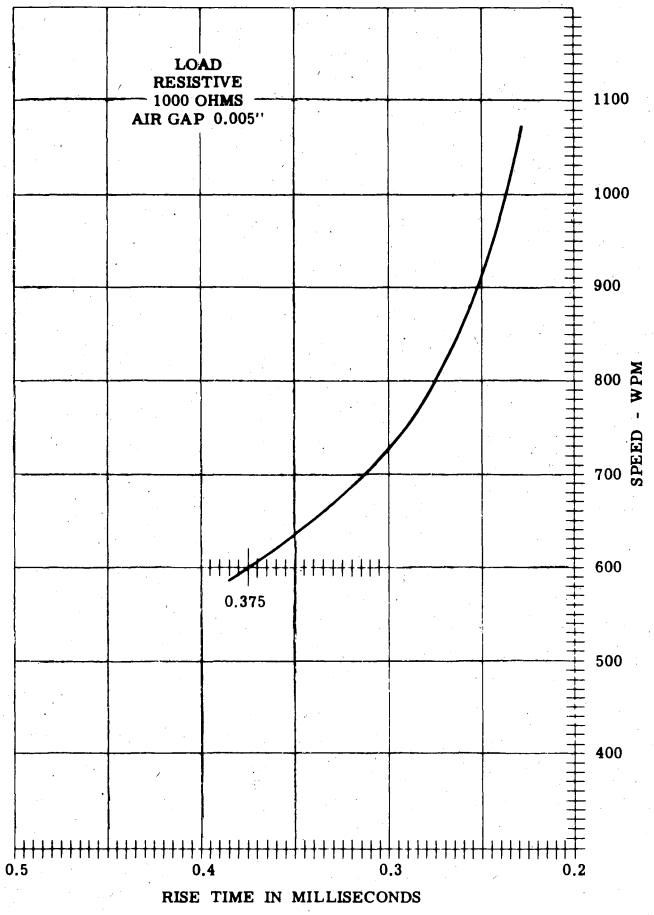


Figure 8 - Magnetic Pickup Characteristics

3.02 When ac power for the motor is applied, rotary motion is transferred to the reader main shaft through the gear and pinion. A synchronizing pulse is generated by the permanent magnet in the flywheel as it passes the pickup coil or by the auxiliary contacts on the contact block. This pulse is sent through the output circuits and on to the external equipment.

3.03 The electrical parallel output is suitable for operating either vacuum tube or transistorized electronic equipment when sensing contacts are operated within their current voltage limits.

3.04 Operation of the control lever to the RUN position, with tape in the reader, initiates the following actions:

(1) Power is supplied to operating magnet through start-stop and tape-out contacts.

(2) Magnet operates, releasing blocking lever.

(3) Cam on main shaft lifts feed and sensing followers away from blocking lever.

(4) Bail with sensing fingers is driven upward by sensing cam follower.

(5) Sensing fingers under tension of individual springs, pass through code holes in tape.

(6) Movement of transfer levers and actuator bars causes code and auxiliary timing contacts to close. (Figure 12).

(7) The contact mechanism consists of leaf springs with contacts that follow their sensing pins and provides a circuit or no circuit situation.

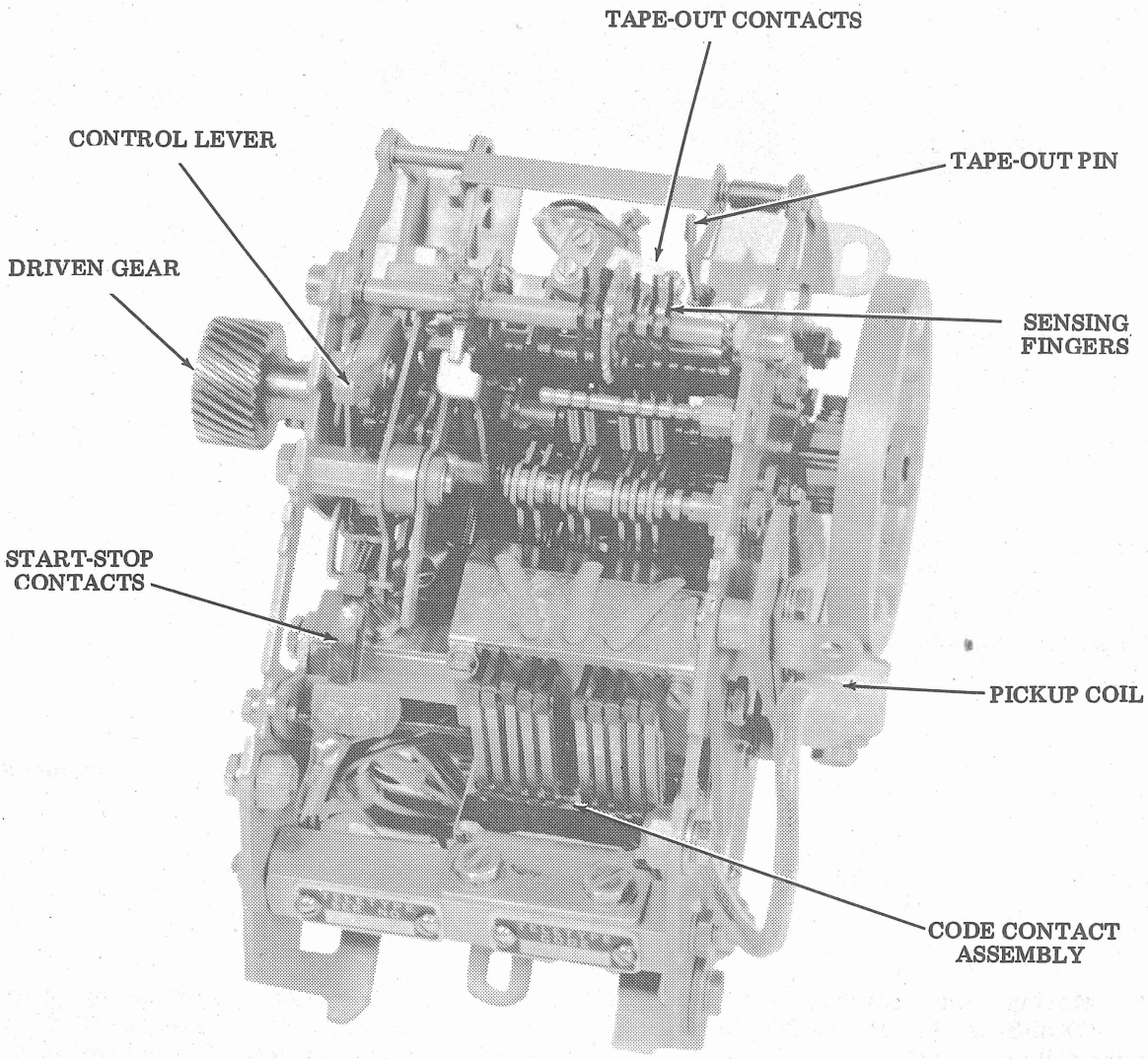
(8) Code and timing signals are sent through output circuits to external equipment.

(9) Feed mechanism advances tape preparatory to sensing next character.

CONTROL MECHANISM

3.05 Moving the control lever to the right (FREE) position results in the following actions (Figure 11).

- Camming surface of the control lever causes the right end of the intermediate control lever to move downward.
- A pin on the right end of the intermediate control lever bears down on the tape-out stop arm, which is secured to the tape-out extension, causing withdrawal of the tape-out pin.
- Another pin on the intermediate control lever operates the intermediate lever and disengages the feed pawl from the feed ratchet.
- The left end of the intermediate control lever raises the tight-tape arm which opens the lower contacts and closes the upper contacts of the start-stop contact assembly.
- Tape can now be inserted without lifting the tape lid, which is held in place by the lid latch mechanism.



(Top View)

Figure 9 - Tape Reader (Except CX808) (Coverplate Removed)

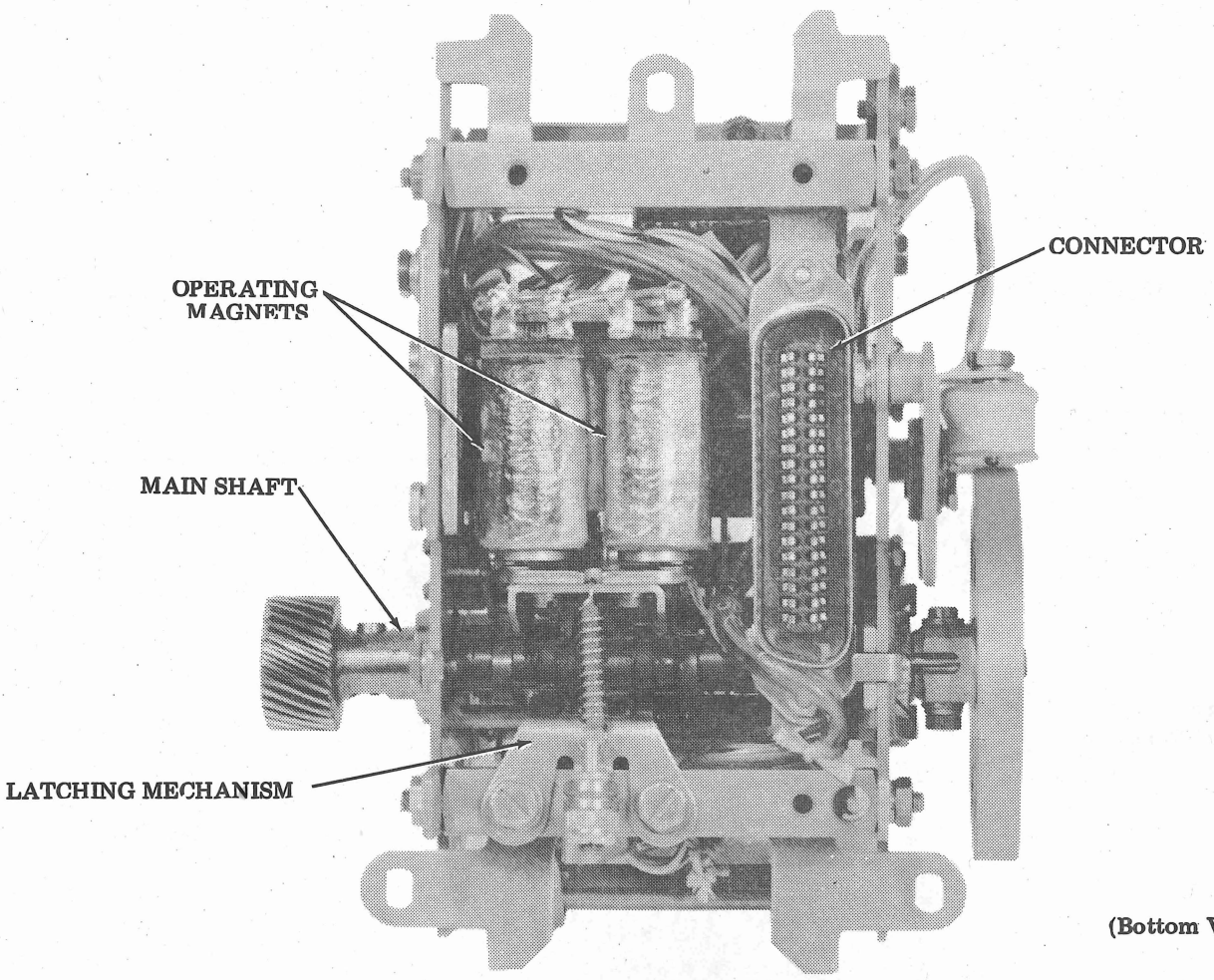


Figure 10 - Tape Reader

3.06 Moving the control lever (except CX806) to the left (RUN) position will initiate the following actions.

- Tape-out pin moves upward (under tension) through a hole in the tape guideplate. If tape is in gate, tape-out contacts will remain closed.
- Intermediate lever is moved away from the feed pawl allowing the pawl to engage the feed ratchet.
- Intermediate control lever releases the tight-tape arm and closes the lower contacts and opens the upper contacts of the start-stop contacts.
- Tape-out and start-stop contact closure completes the operating magnet circuit.

3.07 The reader is stopped by moving the control lever (except CX806) from RUN to STOP position. The control lever opens the start-stop contacts that interrupts the magnet drive circuit directly or through an interface logic circuit card, stopping the feeding-reading operation of the reader.

Note: For readers equipped for automatic operation, when the control lever is placed into the STOP position, the tight-tape arm opens both upper and lower contacts of the start-stop contact assembly. This permits remote (automatic) operation and control of the reader (CX805 and CX808 only).

3.08 If the tape becomes too tight during reader operation, the left end of the tight-tape bail moves the tight-tape arm upward,

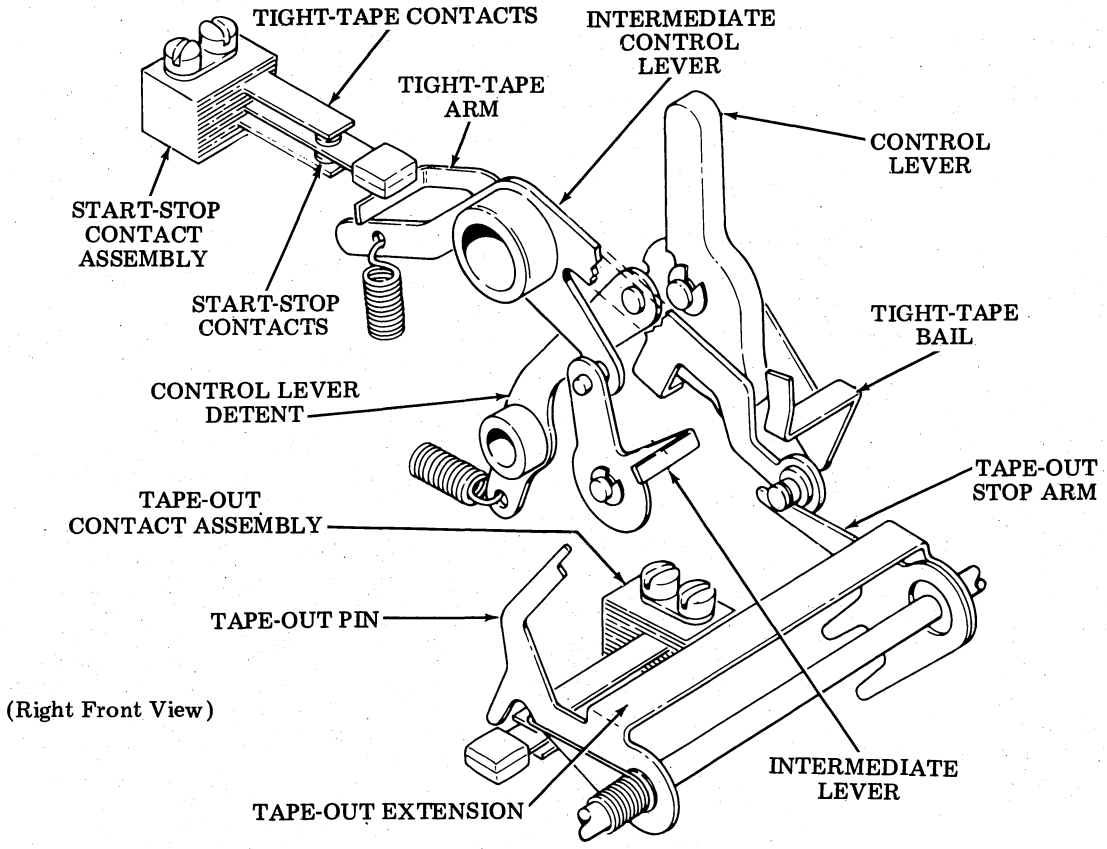


Figure 11 - Control Mechanism

causing the start-stop contacts to open. The operating magnet is released and the reader operation is stopped.

3.09 When the end of the tape is reached, absence of tape pressure on tape-out pin opens tape-out contacts and stops the reader.

LATCHING MECHANISM

3.10 When the operating magnet is energized, the following actions occur (Figure 14).

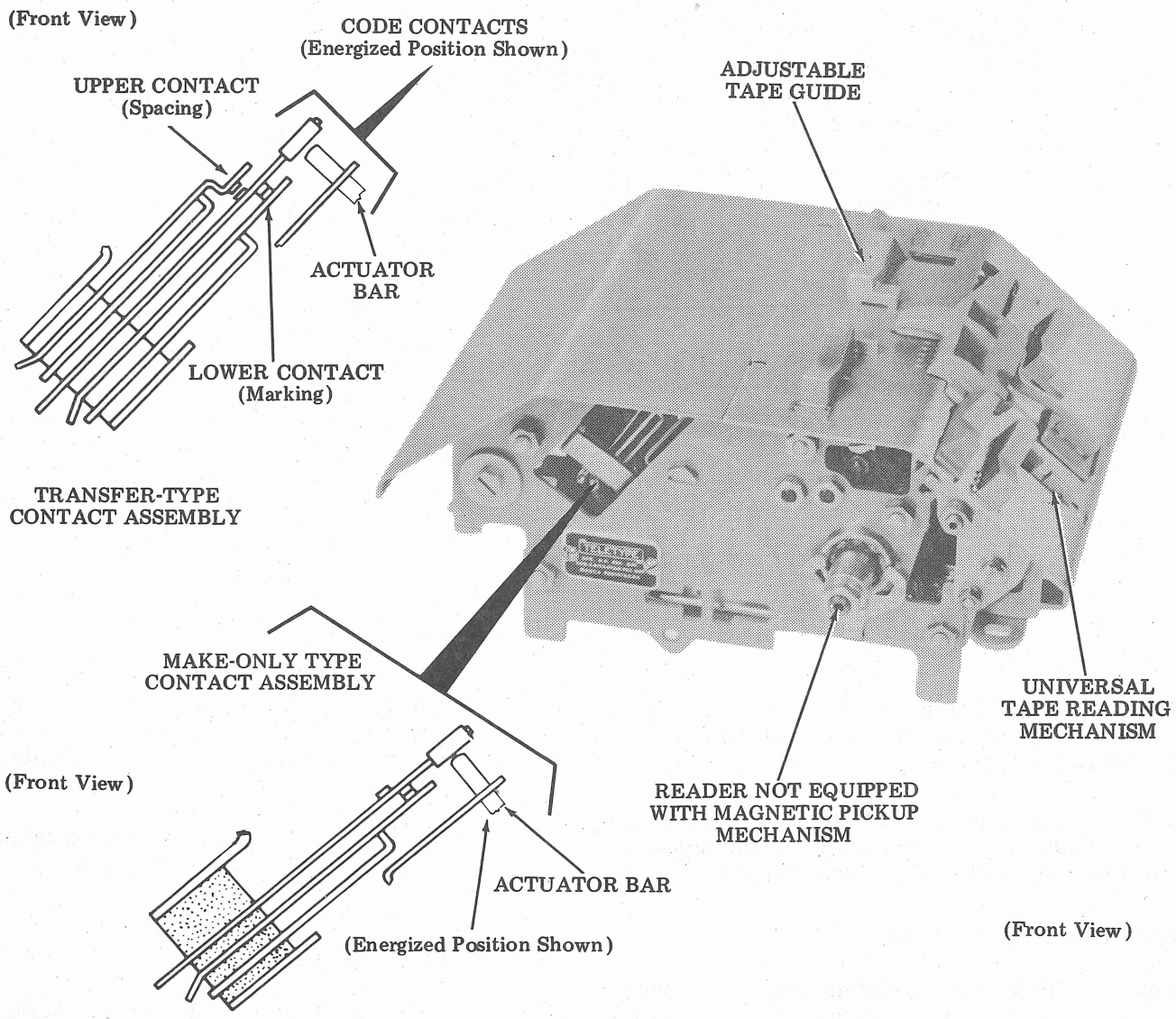
- Armature spring tension is overcome and armature is pulled to a position flush with the coil faces.
- Blocking surface of armature extension is moved from contact with the blocking lever.
- Cams on the main shaft lift feed and sensing cam followers away from the blocking lever.
- Blocking lever is free to rotate out of the path of the cam followers by its spring, completing the unlatching function.
- Latching and unlatching process takes place each cycle of reader operation.

SENSING MECHANISM

3.11 The following actions occur during operation of the sensing mechanism (Figure 15).

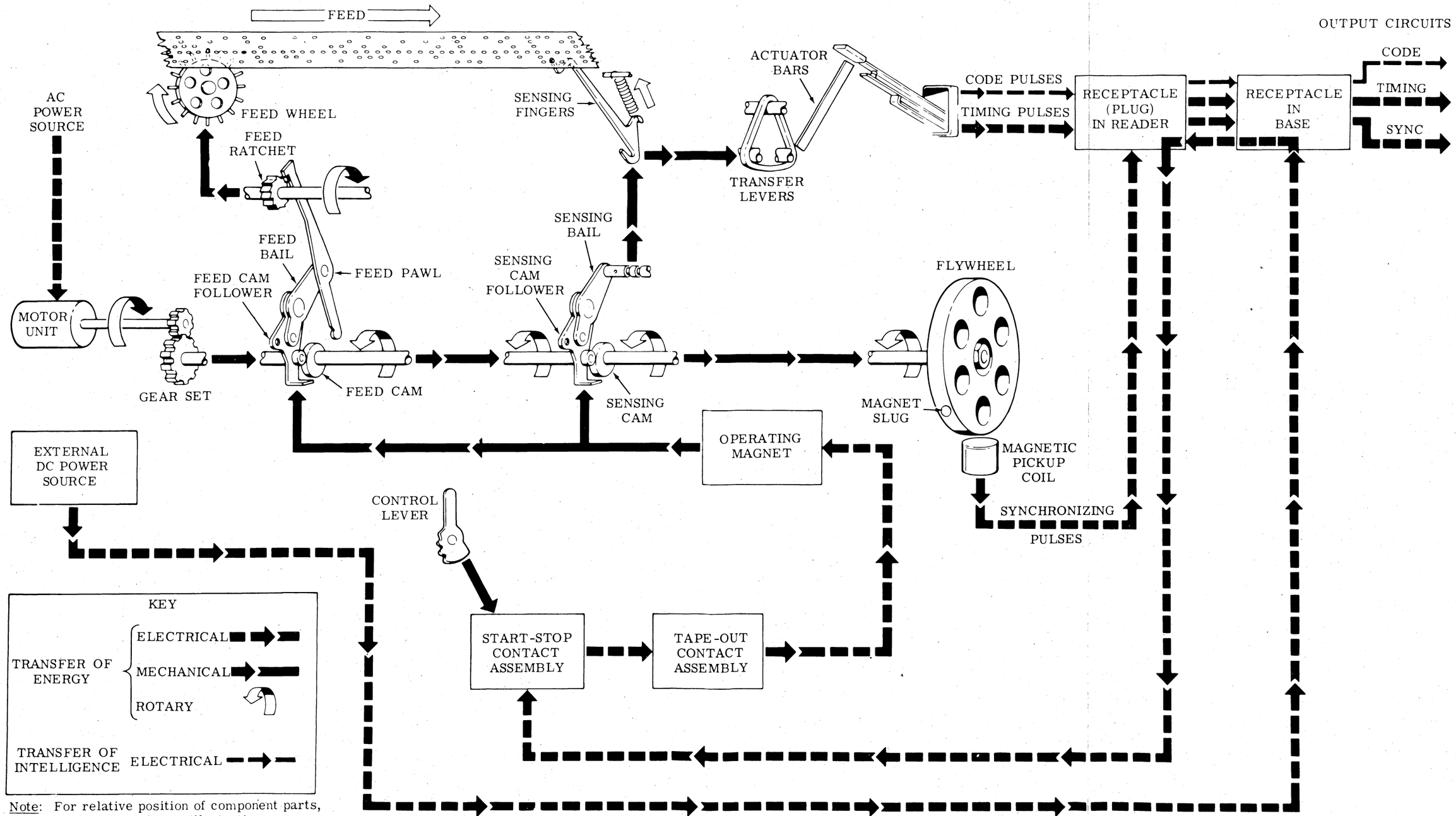
- Sensing fingers, which ride on a slotted guidepost are driven upward by their springs and sense tape as it is advanced.
- Sensing fingers are retracted collectively by the sensing bail. The slotted guidepost with sensing fingers is attached to the upper end of the bail. A cam follower is attached to the lower end of the bail.

Note 1: Readers with transfer-type contacts: The lower contact (marking) closes and upper contact (spacing) opens (in the energized position).



Note 2: Readers with make-only contacts: The contacts are marking when closed and spacing when open.

Figure 12 - Tape Reader (Without Magnetic Pickup Mechanism)



Note: For relative position of component parts, refer to appropriate figure illustrations.

Figure 13 - Typical Tape Reader Pictorial Schematic

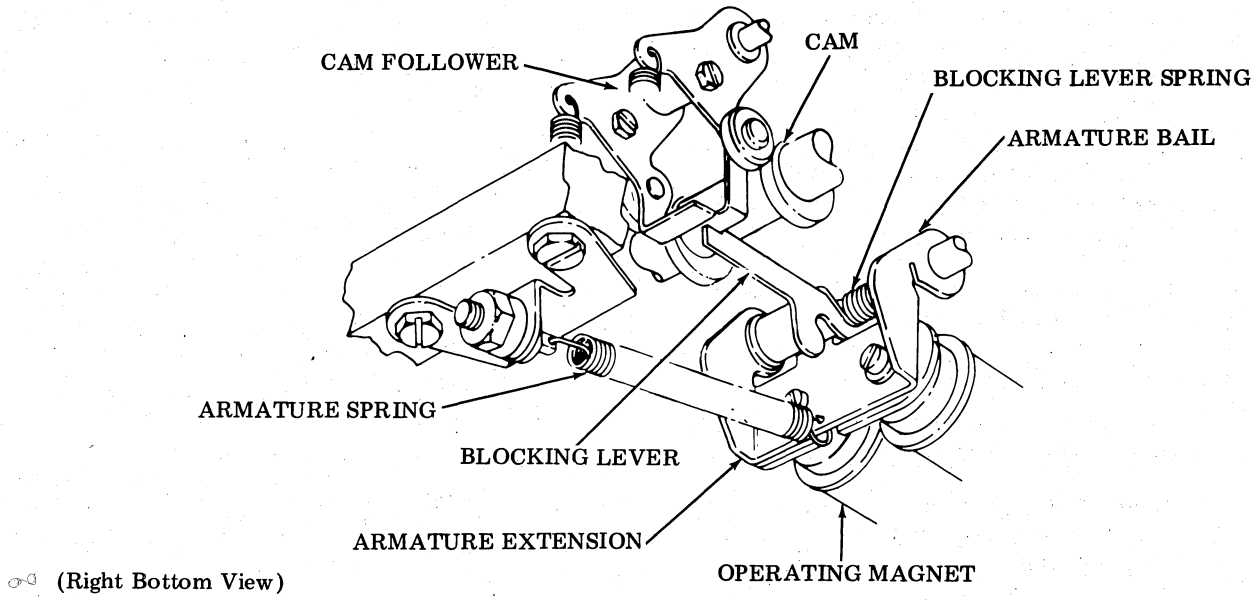


Figure 14 - Latching Mechanism

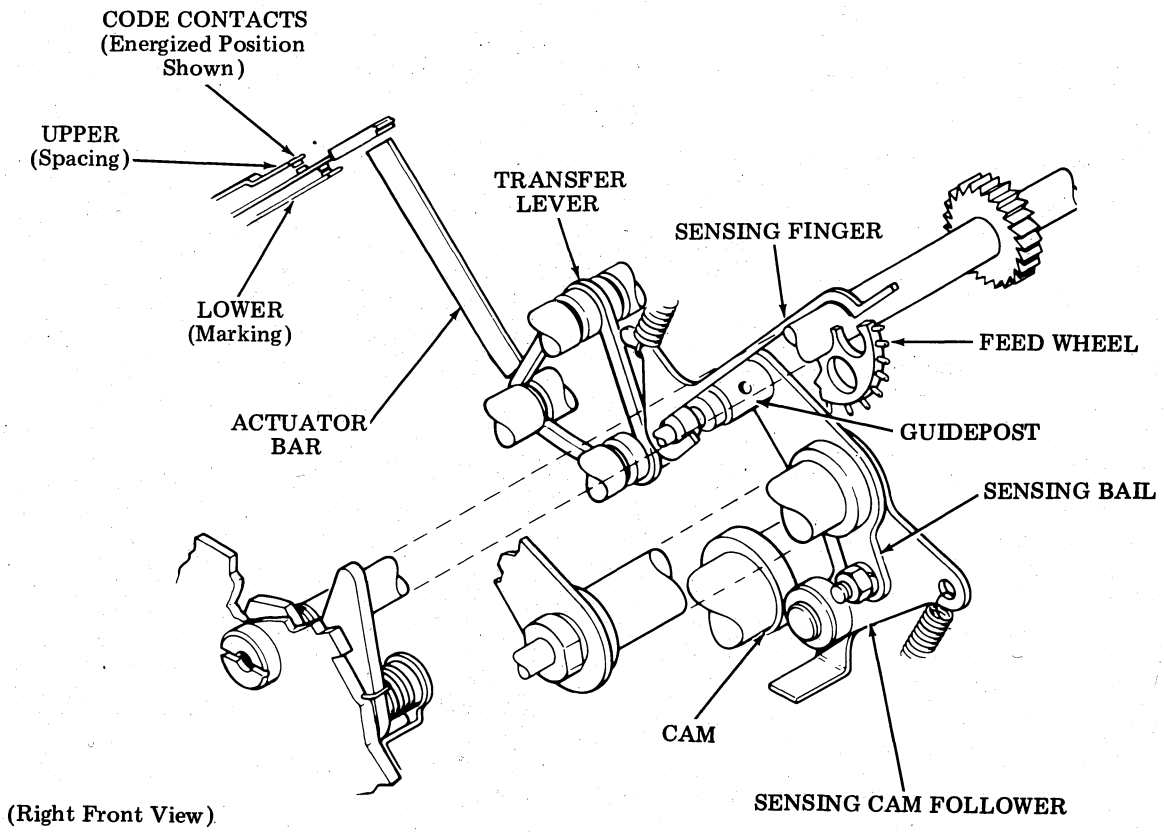


Figure 15 - Sensing Mechanism

- The movement of the sensing fingers is transmitted through the transfer levers to actuator bars which operate code contacts.
- The shoulder on the sensing finger guidepost causes two transfer levers, associated actuator bars and timing contacts to operate.

3.12 Sensing fingers respond to tape conditions as indicated below.

(a) No Hole in Tape

- Upward movement of individual sensing finger is stopped by the tape.
- Downward movement of associated code contact is stopped and contact remains open.

(b) Hole in Tape

- Sensing finger continues through the tape to its top point of travel, determined by the sensing cam.
- Code contact moves downward and closes when sensing finger travels through tape.

FEED MECHANISM

3.13 Motion for operating the feed mechanism is transferred from the feed cam as follows (Figure 16).

- Feed cam moves its follower which is secured to the lower end of the feed bail.
- Feed pawl is pulled downward by a pin on the upper end of the bail, causing the pawl to rotate the feed ratchet one position.
- Ratchet is then held in place by a detent roller while the pawl moves upward preparatory to the next feeding stroke. The pawl is moved upward by a spring attached to the cam follower.

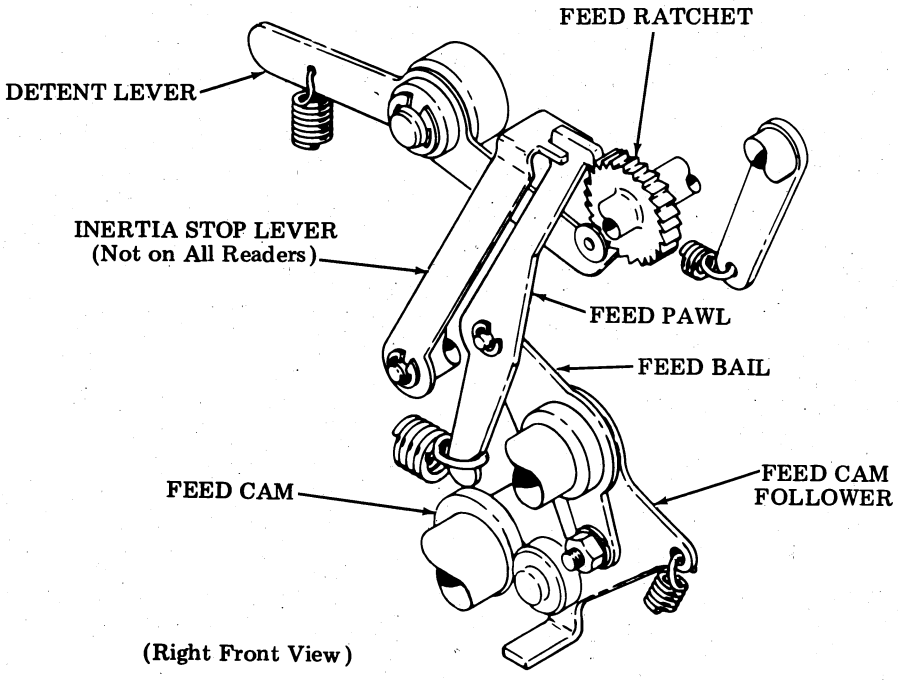


Figure 16 - Feed Mechanism

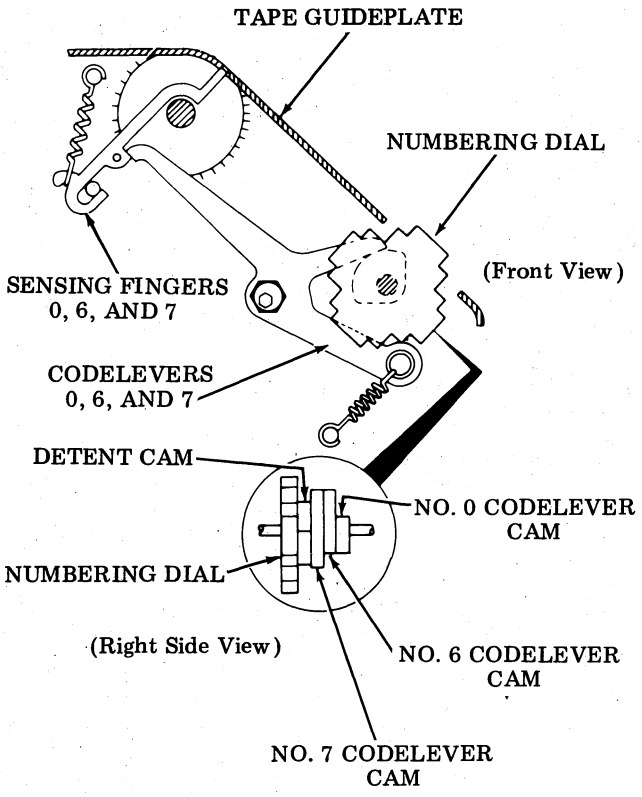


Figure 17 - Universal Tape Reading Mechanism

UNIVERSAL TAPE READING MECHANISM

3.14 The universal tape reading mechanism allows readers, so equipped, to alternately sense 5-, 6-, 7-, or 8-level tapes. Changing from one level to another is accomplished by turning the numbered dial located at the lower left corner of the tape guideplate (Figure 17).

3.15 When the numbered dial is rotated, the integral cam assembly operates three code levers. These levers, in turn, control sensing fingers of the 0-, 6th- and 7th-reading levels. With the dial detented in the number 5 position, each codelever is riding the high part of its respective cam, holding an associated sensing finger from mechanically sensing an unused level (0, 6th, and 7th). As the dial is rotated to the number 6-, 7-, or 8-position, the codelevers release, respectively, the 0-, 6th-, and 7th-level sensing fingers. To change the reading level, therefore, the operator need only rotate the dial until the number corresponding to the tape level to be read appears in view.

3.16 To guide the tape over the sensing fingers, two sets of movable tape guides are used. The guides are designed to accept the three standard tape widths (11/16 inch, 7/8 inch, and 1 inch) associated with 5-, 6-, 7-, and 8-level tape.

MAGNETIC PICKUP AND TIMING

3.17 During each revolution of the main shaft, the permanent magnet imbedded in the flywheel passes the pickup coil core (Figure 2), introducing a rapid change in the coil flux density. This causes the coil to generate a pulse which is used for triggering electronic circuitry. Instructions for adjusting the magnetic coil are contained in Section 592-801-700.

3.18 For readers with two pickup coils, each coil generates a ± 3 volts (± 3.5 volts maximum, ± 1.5 volts minimum) pulse. The pulse occurs when the main shaft is rotating the flywheel (equipped with a magnetic slug) and passes the permanently fixed coils.

3.19 The first pulse occurs at the beginning of code contact closure and the second pulse occurs 90 degrees later, approximately 150 degrees before the sensing and feed cam followers are on the high part of their cams (Figure 18).

3.20 When a pickup coil is used to control the operating magnet, the magnet should pick up or drop out within 27 milliseconds after the pickup coil pulse. It should remain in its selected position for a minimum of 33 milliseconds with a main shaft speed of 900 rpm.

3.21 If main shaft speed is 1800 rpm, the magnet should pick up or drop out within 13.5 milliseconds after pickup coil pulse and remain in its selected position for a minimum of 16.5 milliseconds.

3.22 With the reader adjusted to this specification, the main shaft is operating at 1800 rpm (300 wpm or stepped down to 150 wpm). If a reader driver card (such as TP322054) is used that delays the magnet decay time, the reader cannot be stepped down to 150 wpm or cannot be stopped on the next character at 300 wpm.

3.23 The two auxiliary contacts (on contact block assembly) provide a contact closure generating an electrical pulse each time the tape is sensed. It provides an electrical pulse for readers without a pickup coil and flywheel, or may be used as an optional circuit by the customer.

Note: For readers with transfer-type contacts, the pulse is generated at the beginning of contact closure. The second pulse occurs 90 degrees later and approximately 150 degrees before sensing and feed cam followers are on the high part of their cams.

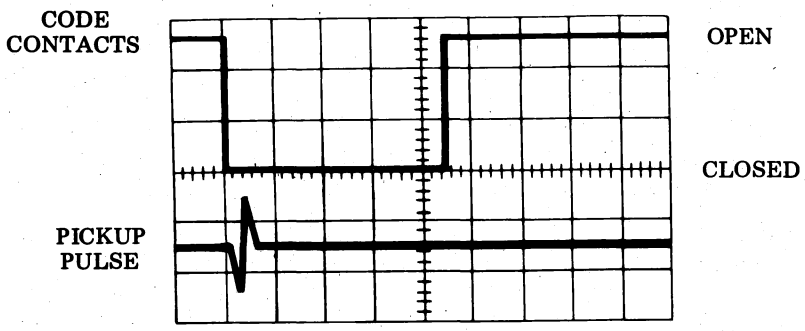


Figure 18 - Scope Trace of Pickup Pulse and Contact Closure

Note: Timing diagram applies to make-only type contacts. Feed pawl and sensing pin travel are plotted against degrees of shaft rotation. The lowest position of the sensing pin is designated as 0 degrees of shaft rotation.

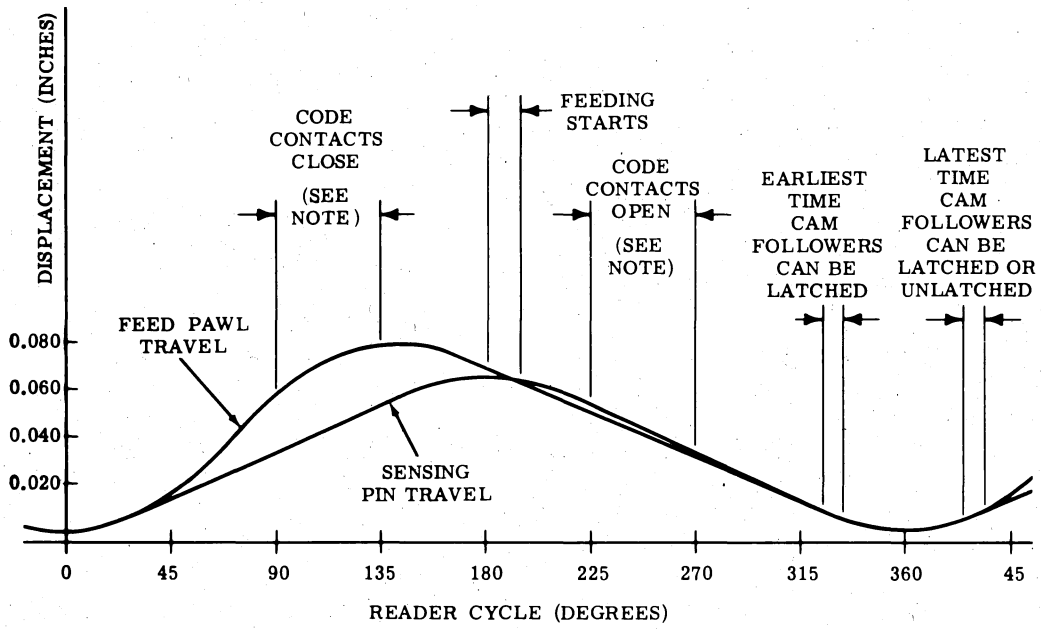


Figure 19 - Timing Diagram