35 TAPE PRINTER KEYBOARD

DESCRIPTION AND PRINCIPLES OF OPERATION

1. GENERAL

1.01 This section is reissued to incorporate recent engineering changes on the 35 tape printer keyboard. Since this is a general revision, marginal arrows, used to indicate changes, have been omitted. Information on the 35 typing reperforator base, previously included in this section, can now be found in Section 574-232-101.

1.02 The 35 tape printer keyboard provides mounting and transmission facilities for the 35 tape printer. In addition, it provides mounting facilities for a motor unit and various accessories.

2. DESCRIPTION

GENERAL (Figures 1 and 2)

2.01 The keyboard is a device for converting the mechanical action resulting from the depression of a key into electrical pulses that are transmitted over a signal line. In addition, it provides mounting facilities for a tape printer and a motor unit, as well as for a variety of accessories.

2.02 Motive force for activating the keyboard is derived from the motor unit by way of an intermediate shaft assembly. Electrical wiring to and from the keyboard is terminated in a connector and terminal boards.

2.03 The keyboard is operable on line at the following speeds: 60, 75, and 100 words per minute; or 368, 460, and 600 operations per minute. Operating speeds are varied by interchanging sets of gears that are supplied as optional components.

2.04 The major sections of the keyboard are the base assembly, keyboard mechanism, and the signal generator mechanism.

A. Base Assembly (Figures 1 and 2)

2.05 The base assembly provides mounting facilities for the keyboard and signal generator mechanisms, the intermediate gear shaft assembly, tape container, tape-out switch, a base casting for support of the tape printer, and a character counter mechanism. Certain

keyboards are also equipped with an electrical service assembly.

2.06   The intermediate gear shaft assembly includes three gears and a shaft. The assembly transfers motive power through a gear to the tape printer. Through a shaft connected to this gear motive power is conveyed to a pair of helical gears which in turn drive the signal generator mechanism.

2.07   The character counter mechanism contains a scale which records, in increments of one character, the length of the message transmitted, up to the 85-character equivalent of a page-printed teletypewriter line. An end-of-line indicator operates within the adjustable line length of 10 to 80 characters. Depressing the carriage return (RETURN) key returns the counter to zero and opens the lamp circuit.
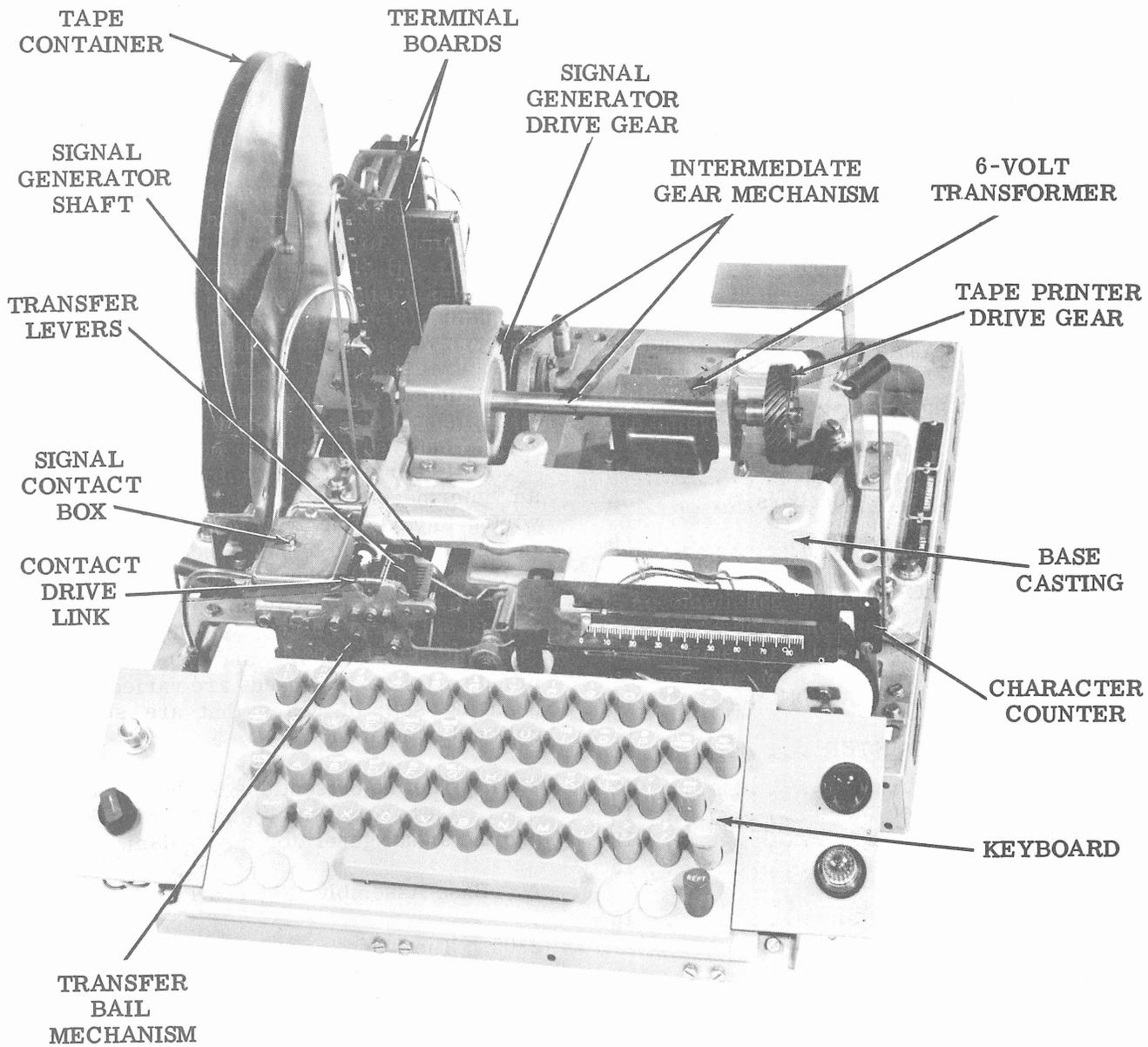
Figure 1 - Typical 35 Tape Printer Keyboard

2.08 The electrical service assembly (Figure 2) is included on certain keyboards and provides the following.

(a) A signal regenerator circuit to improve the output of the keyboards signal generator.

(b) A transistorized selector magnet driver circuit to amplify the incoming line signal to 500 milliamperes for operation of the tape printer selector magnets. Refer to the appropriate section for a description of this circuit.

(c) A motor control relay to permit control of the set's motor via the signal line. So equipped, the set may operate unattended. The sending station can turn the set on by sending a break, or turn it off after the data has been transmitted by sending the end of transmission code sequence. The motor con-
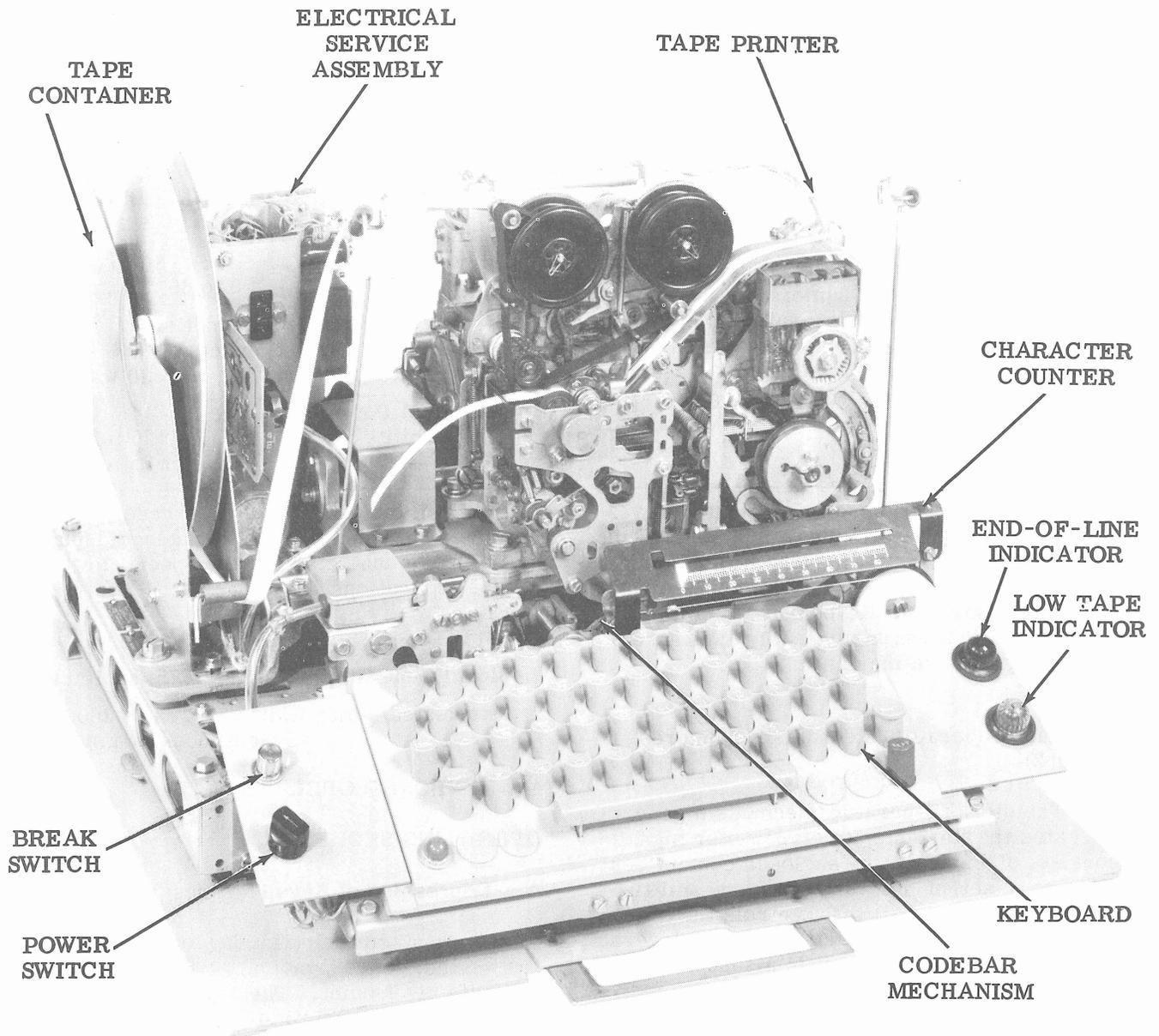
TAPE CONTAINER

ELECTRICAL SERVICE ASSEMBLY

TAPE PRINTER

CHARACTER COUNTER

END-OF-LINE INDICATOR

LOW TAPE INDICATOR

KEYBOARD

CODEBAR MECHANISM

BREAK SWITCH

POWER SWITCH

Figure 2 - Typical 35 Tape Printer Keyboard with Tape Printer

trol relay operates on 48 volts dc and may be equipped with contact protection.

(d) Two connectors, one for the copylights, the other for the low-tape circuit.

(e) Two terminal boards.

B. Keyboard Mechanism (Figures 1 and 2)

2.09 The keyboard mechanism contains the keytops, keylevers, codebars and levers, and other code selecting parts that transform the intelligence contained in the manual selection of a keytop into a teletypewriter code combination, represented by codebar positions. The code combination for the selected character is transferred from the codebars through transfer levers to the signal generator mechanism. In addition, this mechanism contains a rotary-type main POWER switch, a line BREAK switch, and tape-out and low-tape indicator lamps.

2.10 The keytops are positioned in a four row arrangement, with numerals, punctuation marks, and special symbols available in upper case positions. The spacebar is located centrally below these keys. A wedge lock assembly prevents the simultaneous depression of more than one keytop.

2.11 Some keyboards are equipped with an error detection feature called even parity. Even parity provides for adding a bit whenever the number of marking bits in a code combination is odd, and normally uses the eighth level for this purpose. Keyboards which are not equipped with the even parity feature will always have the eighth level marking.

C. Signal Generator Mechanism (Figures 1 and 2)

2.12 The signal generator mechanism generates the start-stop teletypewriter signal. It consists of, basically, an enclosed contact box containing a set of fulcrum-type transmitting contacts, a transfer bail that controls the opening and closing of the contacts, selector levers that engage the transfer bail in a sequence determined by the position of the codebars, and a multilobe cam which determines the duration of the signal code elements (bits). A shaft, which mounts a gear and clutch, receives motive power to drive the mechanism from a gear on the intermediate gear shaft assembly.

2.13 All keyboards now being manufactured have gold-plated signal generator contacts for both special low-voltage and standard voltage applications. Older keyboards may have tungsten contacts.

Note: Once used for standard voltage applications, the contacts may no longer be suitable for special low voltage applications.

3. TECHNICAL DATA

SIGNALS

Code . . . . 11-unit, equal bit American Standard Code for Information Interchange (ASCII)

Parity . . . . See 2.11

Line Current (Standard). . . . . . . 20 or 60 milliamperes

SIGNAL CONTACTS OPERATING LIMITS

Standard Application
Voltage . . . . .30 to 260 v dc
Current . . . . 0 to 60 milliamperes

Special Low Voltage Applications
(Gold-Plated Signal Contacts)
Normal Operation . . . . . . .30 to 20 v dc

Maximum Power Breaking
Capability. . . . . .120 milliwatts at 25 to 70 v dc

Note: If this power level is exceeded for appreciable time it may damage gold plating and make contacts unfit for special low voltage applications.

OPERATING SPEED

Signal Generator . . . . . 60, 75, or 100 wpm

Associated Motor Unit . . . . .3600 rpm (synchronous or governed)

4. KEYBOARD OPERATION

OPERATING SEQUENCE

A. Depression of Keys (Figures 3, 6, and 7)

4.01 As a code selecting keytop is depressed, the corresponding code lever rotates about its pivot point. The rear end of the code lever comes up and rotates the universal bail. The extension arm on the top of the universal bail moves out of engagement with the step at the rear end of the universal bail latch. This occurs when the key and corresponding code
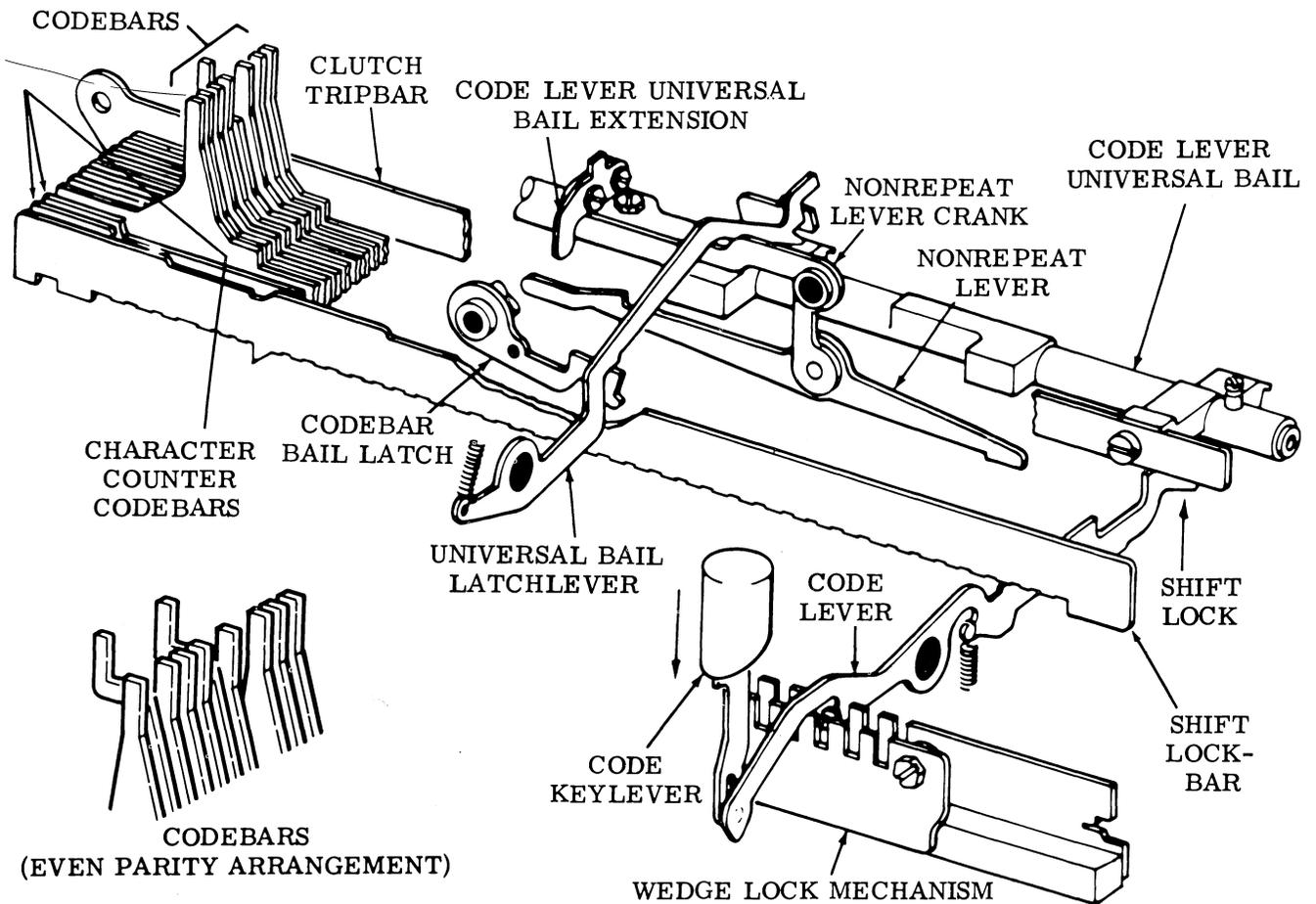
Figure 3 - Codebar and Code Lever Universal Bail Mechanism

lever are about two-thirds of the way toward full stroke. The universal bail latch then moves downward under spring force developed by the universal bail latch spring. As this latch comes down, it strikes the codebar reset bail latch-lever and carries it downward. When the corner of the reset bail latch descends beyond the center line of the needle bearing (mounted on the reset bail), the various spring forces acting on the reset bail cause it to swing to the right. This, in turn, allows the various codebars to move to the right (in the direction of the spring forces acting on each codebar). While this is happening, the code lever is moved up to its full position. Therefore, the code lever may stop some of the codebars from moving to their extreme right-hand position. The codebars have vertical extensions that engage a curved part of the signal generator transfer levers. Those codebars that are permitted to move to the extreme right also move the corresponding transfer lever to the right. However, those codebars

that are stopped, because their teeth engage the actuated code lever, do not quite touch or move their corresponding transfer levers. Hence, these transfer levers remain in their normal left-hand position (Figure 7).

4.02   Simultaneously with the trip-off of the reset bail and the movement of the codebars to the right, the clutch tripbar (located in the rear slots of the codebar guides) moves to the right. This clutch tripbar engages the clutch stop lever and moves it out of latch with the clutch stop-lug. Up to this point, all of the action has been caused by manual operation of the keytop and its associated code lever (Figure 3).

B.   Positioning of Codebars (Figures 5 and 6)

4.03   Once the clutch is tripped, it rotates continuously as long as the keyboard is turned on. Since the clutch shoes are mounted
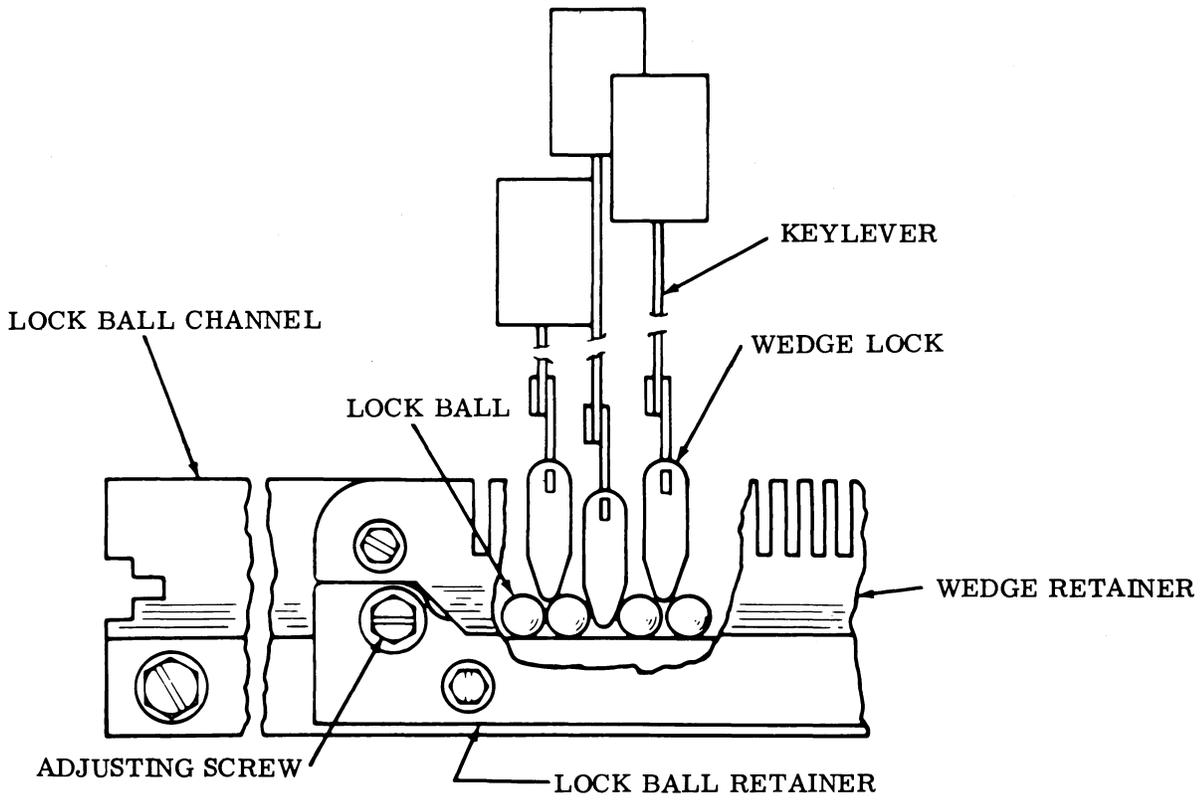
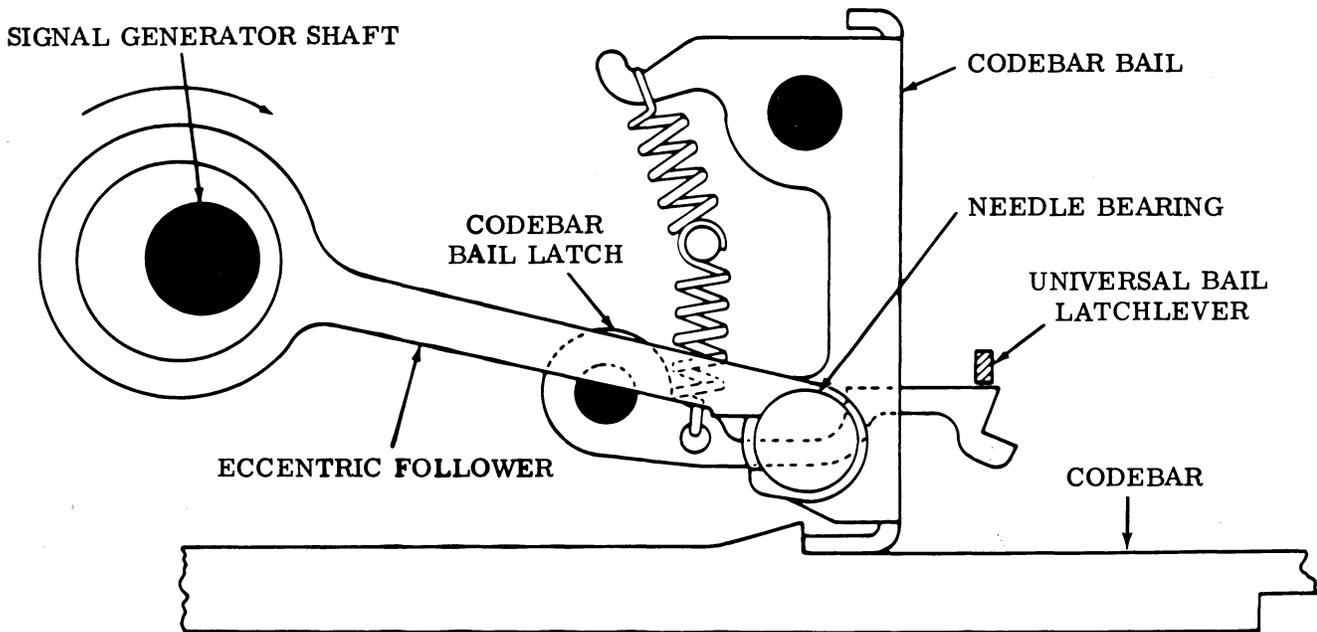Figure 4 - Wedge Lock Mechanism

Figure 5 - Codebar Bail Mechanism

on a plate that is part of the cam assembly, the cam begins to rotate (clockwise when viewed from the front of the keyboard).

4.04   The arrangement of the cam assembly is such that the fourth cam from the rear begins to push downward on its corresponding transfer lever. At almost the same time, the first cam from the front begins to move the transfer lever locking bail upward. The blade portion of this locking bail goes up beside a downward projection on each transfer lever. The locking projection is left or right of the locking bail, depending upon the position of the transfer lever (as set up by the permutation action of the codebars). Thus, in the first few

degrees of cam rotation, the permutated position of the transfer levers is located into position and the codebars are free to be reset in their normal latched position.

4.05   The cams and their corresponding transfer levers are numbered from rear to front. The number 4 cam engages its transfer lever first and moves it down. Since the start bit is always spacing, no codebar is required to engage this lever. Hence it is always held to the left by its spring. Therefore, as the fourth cam moves the lever down, the hook at the upper right side of the transfer lever engages the right side of the transfer (rocker) bail. This tips the transfer bail to the right and pulls the contact

Note: On nonparity keyboards, there is no number 8 codebar. A marking signal is automatically transmitted by the generator as the eighth sequential code bit.

SELECTED
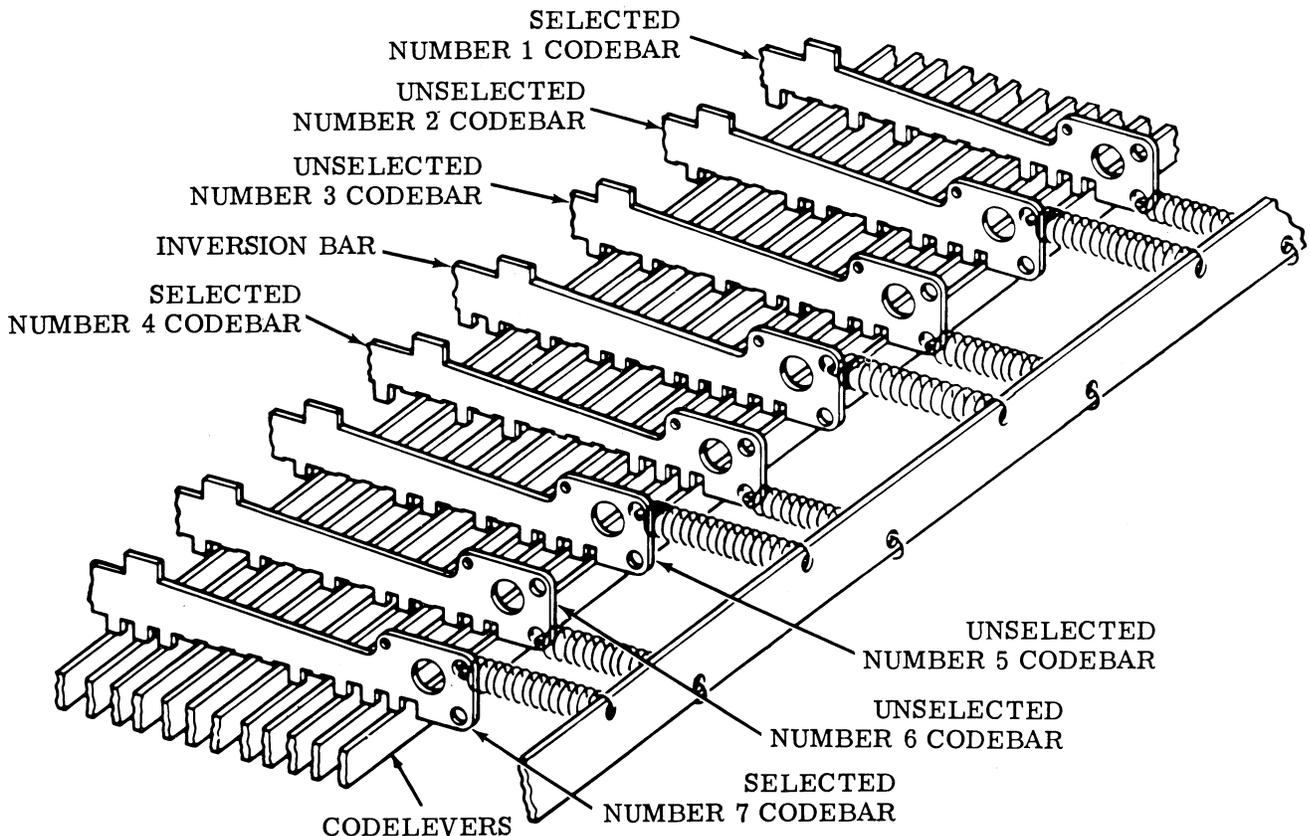NUMBER 1 CODEBAR

UNSELECTED
NUMBER 2 CODEBAR

UNSELECTED
NUMBER 3 CODEBAR

INVERSION BAR

SELECTED
NUMBER 4 CODEBAR

UNSELECTED
NUMBER 5 CODEBAR

UNSELECTED
NUMBER 6 CODEBAR

SELECTED
NUMBER 7 CODEBAR

CODELEVERS

Figure 6 - Codebar Selection

CONTACT BOX
SPRING

SPACING CONTACT
(SHOWN CLOSED)

MARKING CONTACT
(SHOWN OPEN)

CONTACT TOGGLE

DRIVE LINK

ECCENTRIC

CONTACT BOX

DRIVE LINK

TRANSFER BAIL

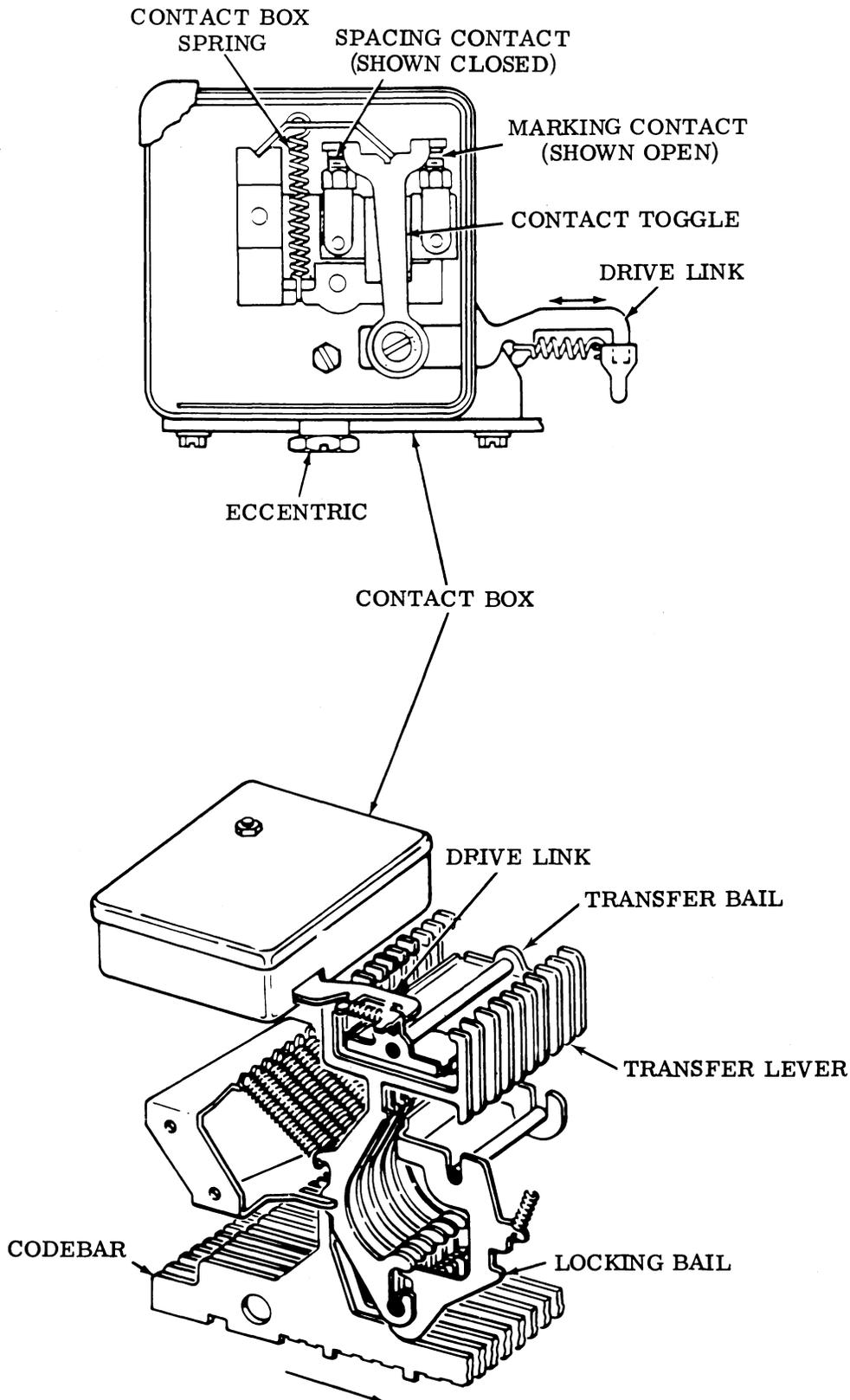TRANSFER LEVER

CODEBAR

LOCKING BAIL

Figure 7 - Transfer Lever Mechanism and Contact Box Mechanism

drive link to the right. The resulting action of the contact toggle is such that the left set of contacts acts as a pivot and the right-hand contacts begin to open. The right-hand contacts are the ones that control the signal current in single contact type operation. When these contacts are open, the result is no current in the signal circuit. Therefore, the first bit, the start bit of any character code, is a spacing (no current) bit.

4.06 The number 1 cam and the transfer lever move downward next. In turn, the upper left hook of the associated transfer lever pulls down on the rocker bail (holding it to the right or tilting it back to the left). This pushes the drive link to the left (or right) resulting in closing the right (or left) contacts and allowing a marking (or spacing) pulse to be transmitted.

4.07 Similarly, the remaining transfer levers are pulled downward by their respective cams. The resulting pulse is marking if the transfer lever is to the right or spacing if it is to the left. The last transfer lever is held to the right by a stop pin. Therefore, the last bit (the stop bit) is always marking (current on).

4.08 The locking bail is actuated by a cam lobe. This cam begins to move the locking bail up into its locking position almost as soon as the cam starts to rotate (Figure 7). Full lock position occurs approximately at the half-way point of the start bit (48-1/2 degrees of rotation). The dwell on the first cam from the front holds the lock bail in its lock position until after the beginning of the last bit. Then the cam pulls the bail down out of lock, and all transfer levers are free to return to their initial positions at a point about half-way through the stop bit.

C. Resetting of the Codebars (Figures 5 and 6)

4.09 Reset of the codebars is accomplished by means of an eccentric on the front of the cam assembly, which drives an eccentric follower arm (Figure 5). This arm engages a stud on the side of the reset bail and pulls the reset bail to the left as the cam rotates. At the peak position of the reset eccentric, the codebar reset bail latch is clear of the needle bearing stud. This permits the latch spring to pull the latch up into locking position and the codebar reset bail is latched as the eccentric drives the follower arm back to its initial position. As the codebar reset bail is moved to the left (into reset), it engages projections on the permutation codebars, clutch tripbar, and a step on the nonrepeat lever. Thus, all of these elements are moved to the left into latched reset position.

4.10 The reset eccentric is so positioned in angular relationship to the remainder of the cam that pick-up of the codebars and nonrepeat lever begins at 92-1/2 degrees. At 145 degrees, the codebars have been moved to the left a sufficient distance to permit the code lever (that determined the permutation) to drop down out of the universal bail. This permits the universal bail to rotate forward and kick the nonrepeat lever down and off the reset bail. At the same time, the extension of the universal bail moves in under its latchlever and holds this latchlever up almost in the same position that the pawl on the nonrepeat lever had held it in the early reset movement. With the universal bail latch held up, the reset bail continues to move to the left. Full rest occurs at approximately 180 degrees of cam rotation. As soon as the universal bail is permitted to move forward, a second keytop can be depressed. However, from that point on, full time of cam rotation must expire before a third and successive keytop can be operated.

REPEAT MECHANISM

4.11 Operation of the REPT (repeat) keylever simultaneously with one of the keylevers in the three lower rows or the spacebar disables the nonrepeat mechanism and causes the character or function selected to be repeated as long as the REPT keylever is held operated. The operated REPT keylever causes its function lever to raise the right end of the nonrepeat lever (Figure 8), and rotate it about its pivot point. In this position, the nonrepeat keylever cannot be engaged and operated by the codebar bail. Therefore, the nonrepeat bellcrank will not reset the operated code lever bail latchlever which then maintains both the code lever bail and the codebar bail latchlever in their operated positions until the REPT keylever is released.

SHIFT KEY MECHANISM

4.12 To obtain a shift bit inversion case character, the enlarged SHIFT key (at either side of the keyboard) is held down while depressing a complimentary key. The SHIFT key preconditions the keyboard for the function of adding or deleting (as the case may be) the number 5 code bit to obtain its complimentary key code. This is accomplished by means of a shift code lever engaging a diagonal camming surface, on the under side of the shift lockbar (outside slot of the codebar guide), and directing its motion to the left. As this motion develops, the bail riding the upper diagonal camming surface is raised. This permits the inversion codebar
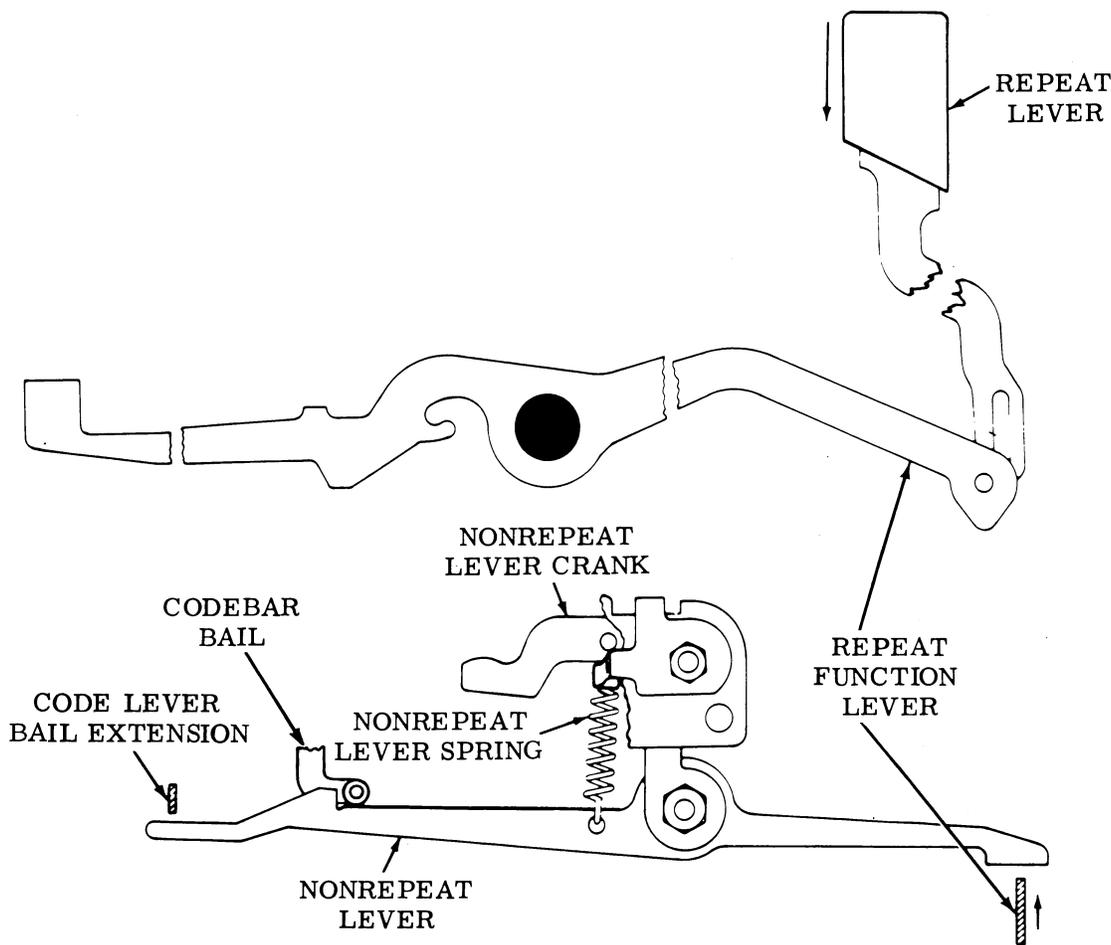
Figure 8 - Repeat Mechanism

(feed hole slot) to fall only when the complimentary key is depressed. This inversion bar, upon falling to the right, operates transfer lever number 5 by a mechanical connection. The code transmitted is then the addition or omission of the number 5 bit combined with the transfer levers selected by the complimentary key. Operation of the shift lockbar (Figure 3) automatically prevents operation of those keylevers which would not initiate transmission of a graphic code representation. The graphic representation transmitted in the shift position is indicated at the top of certain keytops on the front of the keyboard.

CONTROL KEY MECHANISM

4.13   Depression of the CTRL (control) key introduces the upper case of a specific key by the deletion of the number 7 bit. This is accomplished by the control code lever blocking the number 7 codebar from falling to the right.

There is no locking feature associated with this mechanism.

EVEN PARITY OPERATION (Figure 9)

4.14   Some keyboards are equipped with the error checking even parity feature in which the sum of marking bits in each code combination generated is even. The eighth bit, normally marking on nonparity keyboards, is made marking or spacing as required to maintain an even number of marking bits.

4.15   Depression of the SHIFT key inverts the no. 5 and 8 marking bits to spacing, or spacing bits to marking, as the case may be. This is a means of obtaining an upper case or symbol associated with a particular keytop and is accomplished by holding down the SHIFT key (at either side of the keyboard) while depressing a complimentary key. The SHIFT code lever prevents the no. 5 codebar from falling and at

SHIFT LOCK-
BAR ROLLER

CLUTCH TRIP
1
2
3
CONTROL LOCK
4
5 INVERSION
5
6
7
8 INVERSION
8
COUNTER
COUNTER RETURN
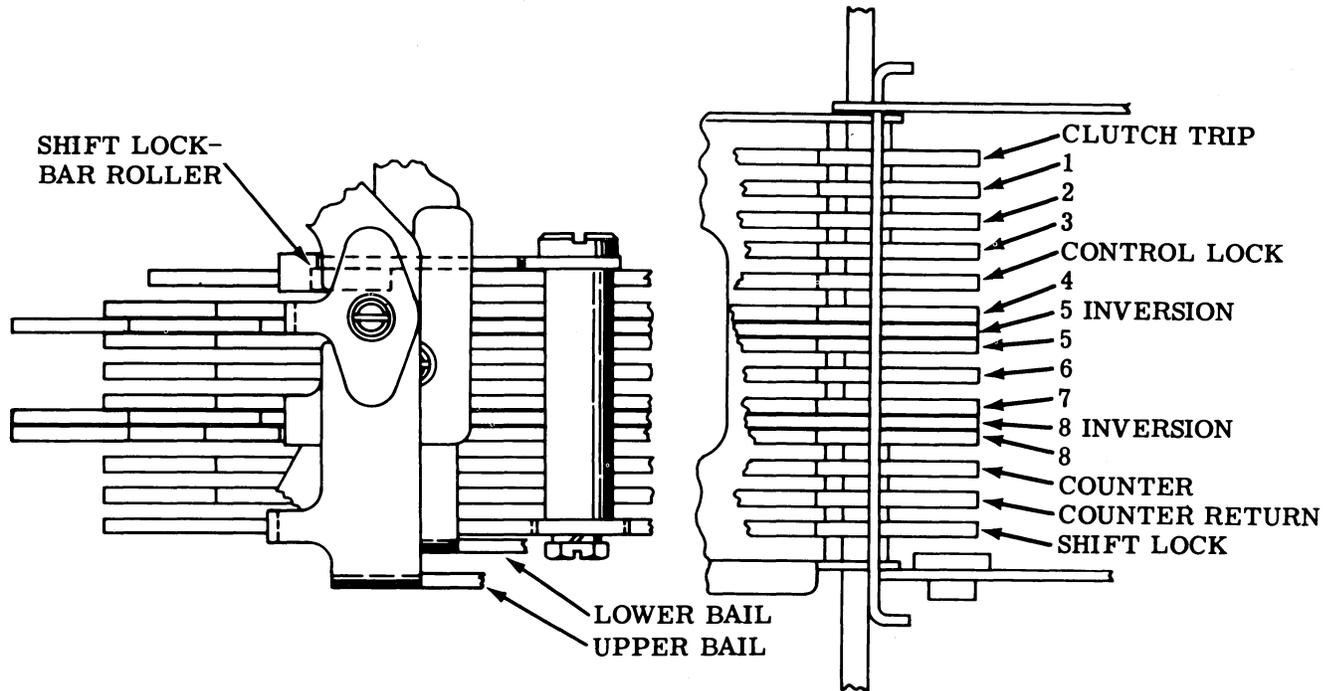SHIFT LOCK

LOWER BAIL
UPPER BAIL

Figure 9 - Even Parity Codebar Arrangement

the same time conditions the keyboard for the function of inverting the space-to-mark bit or the mark-to-space bit as required to obtain its complimentary key code with parity. This is accomplished by means of a shift code lever engaging a diagonal camming surface on the underside of the shift lockbar, directing its motion to the left. The shift lockbar serves a dual purpose; that is, it blocks out the selected group of keys and inhibits the complimentary keys from being actuated prematurely. As the motion to the left develops, the upper bail, riding the upper diagonal camming surface on the shift lockbar, is raised. This raises the blocking tine and permits the no. 5 inversion codebar, if coded marking, to fall. At the same time, a pivoted follower, attached to the shift lockbar, rides up a V shaped camming surface on the control lockbar. This raises the blocking surface of the lower blocking bail allowing the no. 8 inversion codebar to fall, if coded marking, and blocks the no. 8 codebar. Upon falling to the right, the codebars operate their respective transfer levers causing the proper permutation to be generated.

4.16   Depression of the CTRL key causes the seventh bit to space and the eighth to invert. This is a means of obtaining a control function with an even parity bit and is accomplished by holding down the control key while depressing a complimentary key. The CTRL key operates a control lockbar which serves the purpose of both blocking out those keys to which a control is not associated and preventing a complimentary key from being actuated prematurely by means of its saw tooth design. The control key code lever engages a diagonal camming surface on the underside of the control lockbar directing its motion to the left, as it blocks the no. 7 codebar from falling to the right (marking). As the motion develops, the follower, engaging the V shaped camming surface of the control lockbar, moves up raising the lower blocking bail. The lower bail, as it continues up, will unblock the no. 8 inversion codebar and permit the no. 8 inversion codebar to fall to the right (if coded marking). Upon falling to the right, the codebars operate their respective transfer levers causing the proper permutation to be generated.

4.17 Depressing both the SHIFT and CTRL keys while also depressing the proper complimentary key will generate S3 through S7 and NULL. As the SHIFT and CTRL keys are depressed, their key code levers engage a diagonal camming surface on the underside of their respective lockbars, directing them to the left. As the shift lockbar moves, its upper diagonal camming surface causes the upper blocking bail to rise, unblocking the no. 5 inversion codebar so that it may fall to the right if marking. The SHIFT key code lever blocks the no. 5 codebar. As the CTRL lockbar moves, the follower, attached to the shift lockbar, rides in the V shaped camming surface on the control lockbar. Since the total travel of the two lockbars is the same, the follower will not ride up on either of the camming surfaces and the lower blocking bail remains in its normal position. This causes the no. 8 inversion codebar to remain blocked and allows the no. 8 codebar to fall to the right when marking. The codebars, upon falling to the right, permit the proper combination of marking bits 1 through 8 to be generated.

CHARACTER COUNTER (Figures 10, 11 and 12)

4.18 The character counter is driven mechanically from the codebar mechanisms through the counter and counter reset codebars located in the second and third (from front) slots of the codebar basket. These codebars have drive projections which engage the forks of the feed and reset bails of the counter. As the codebars fall to the right when a key on the keyboard is struck, the counter mechanism is tripped. These functions may be divided into three distinct phases of operation of the counter mechanism, stepping, counter reset, and restart.

A. Stepping

4.19 Referring to sequence A (Figure 12), as a key is struck, the codebars fall to the right, carrying with them feed bail (1). The drive bail, which is linked to the feed bail, moves to the left slightly more than one tooth. As the codebars are reset under power, stepping bail (1) moves clockwise, causing the drive lever to advance the ratchet drum one tooth. The drive pawl prevents the ratchet drum from rotating counterclockwise until it is again tripped for the following character. When this occurs, the ratchet drum rotates slightly counterclockwise, coming to rest against the latchlever.

B. Counter Reset

4.20 Sequence B (Figure 12) illustrates the tripped position of the counter mechanism for a reset function. Reset bail (2) moves counterclockwise as its codebar falls to the right, causing the reset lever, in turn, to rotate clockwise. As the reset lever rotates clockwise, the reset lever extension moves downward until it falls under the shoulder of the projection on the drive and latchlevers under the action of its spring. When the counter bars are reset, as in C (Figure 12), the reset bail is rotated clockwise to its original position, causing the reset lever to rotate counterclockwise, carrying both the drive and latchlevers out of engagement with the ratchet teeth. The mechanism remains in this condition, and the ratchet drum assembly rotates rapidly counterclockwise (under the action of its return spring) until it reaches its zero position.

4.21 As the ratchet drum reaches its zero position, a stop on the ratchet strikes a stop lever fastened to the frame. The elastic impact is transmitted through the stop lever to the antibounce lever, whose lower end is normally in contact with the stop lever. The antibounce lever rotates counterclockwise, dropping in behind the ratchet stop. As the ratchet drum rebounds from the stop lever, its stop strikes the antibounce lever, preventing further motion and maintaining the antibounce lever in its actuated position. The ratchet continues to operate between the stop lever and antibounce lever until the energy in the system has been largely dissipated. The ratchet stop then remains in contact with the stop lever, permitting the antibounce lever to return to its normal position.

C. Restart

4.22 Sequence D (Figure 12) illustrates the restarting action of the counter mechanism for the character following a carriage return. As a key on the keyboard is depressed, the counter codebar falls to the right, the feed bail moves counterclockwise and the drive lever moves to the left. As the drive lever moves to the left, it is disengaged from the reset lever extension and falls into engagement with the ratchet tooth. As the codebars are reset under power, the feed bail rotates clockwise, and the feed lever begins to move to the right. As it does, its projection pushes the reset lever extension to the right and out of engagement with the latchlever, which falls into engagement with
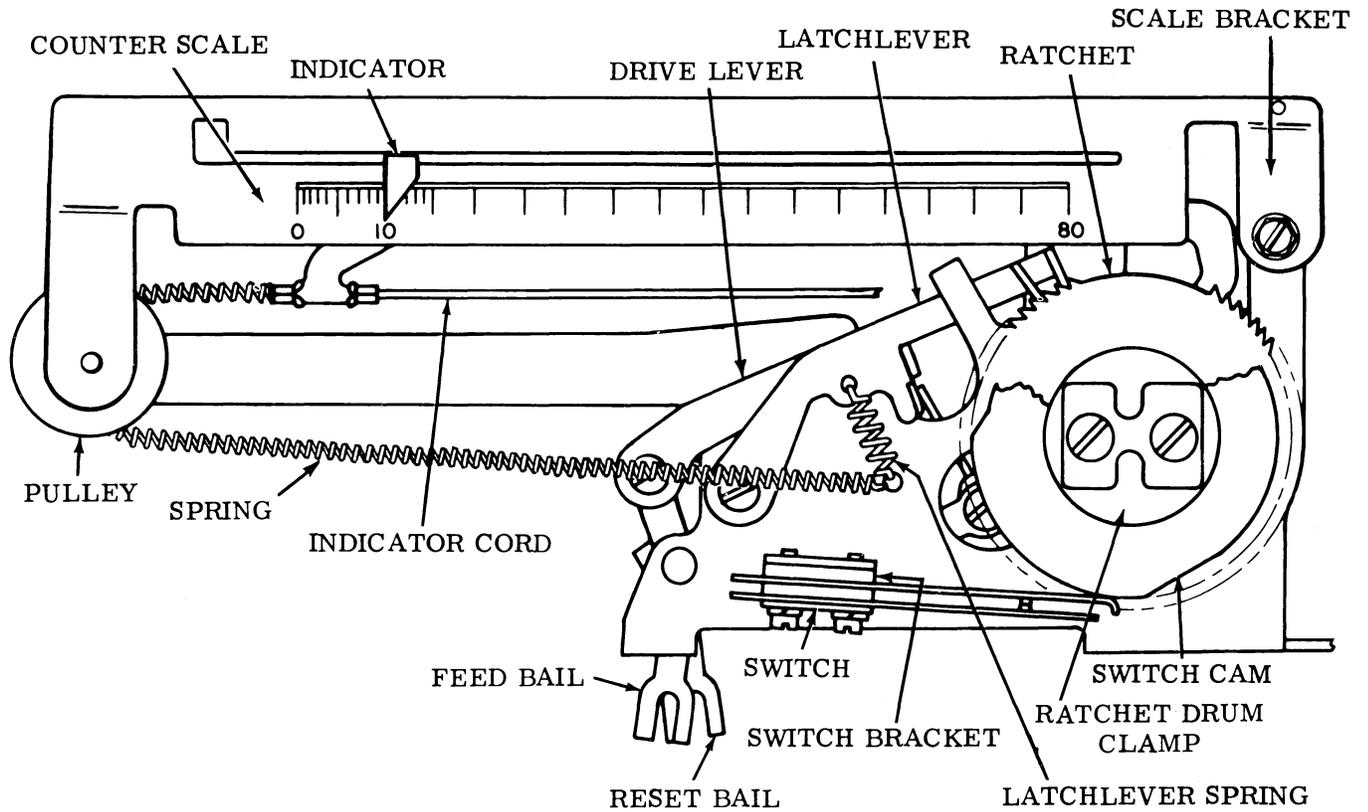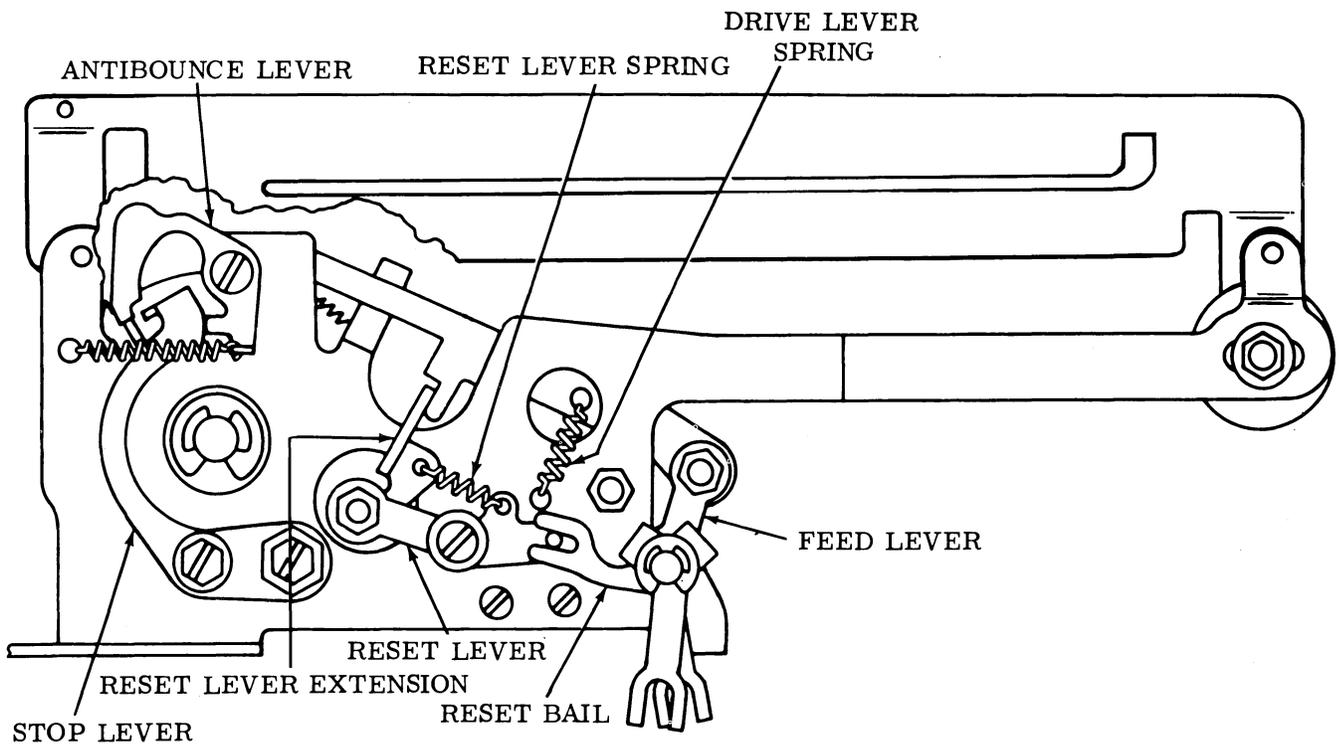
Figure 10 - Character Counter Mechanism

Figure 11 - Character Counter Mechanism, Rear View

I   II   III

A

B

C

D

STEPPING
POSITION

RESET
TRIPPED
POSITION

RESET
POSITION
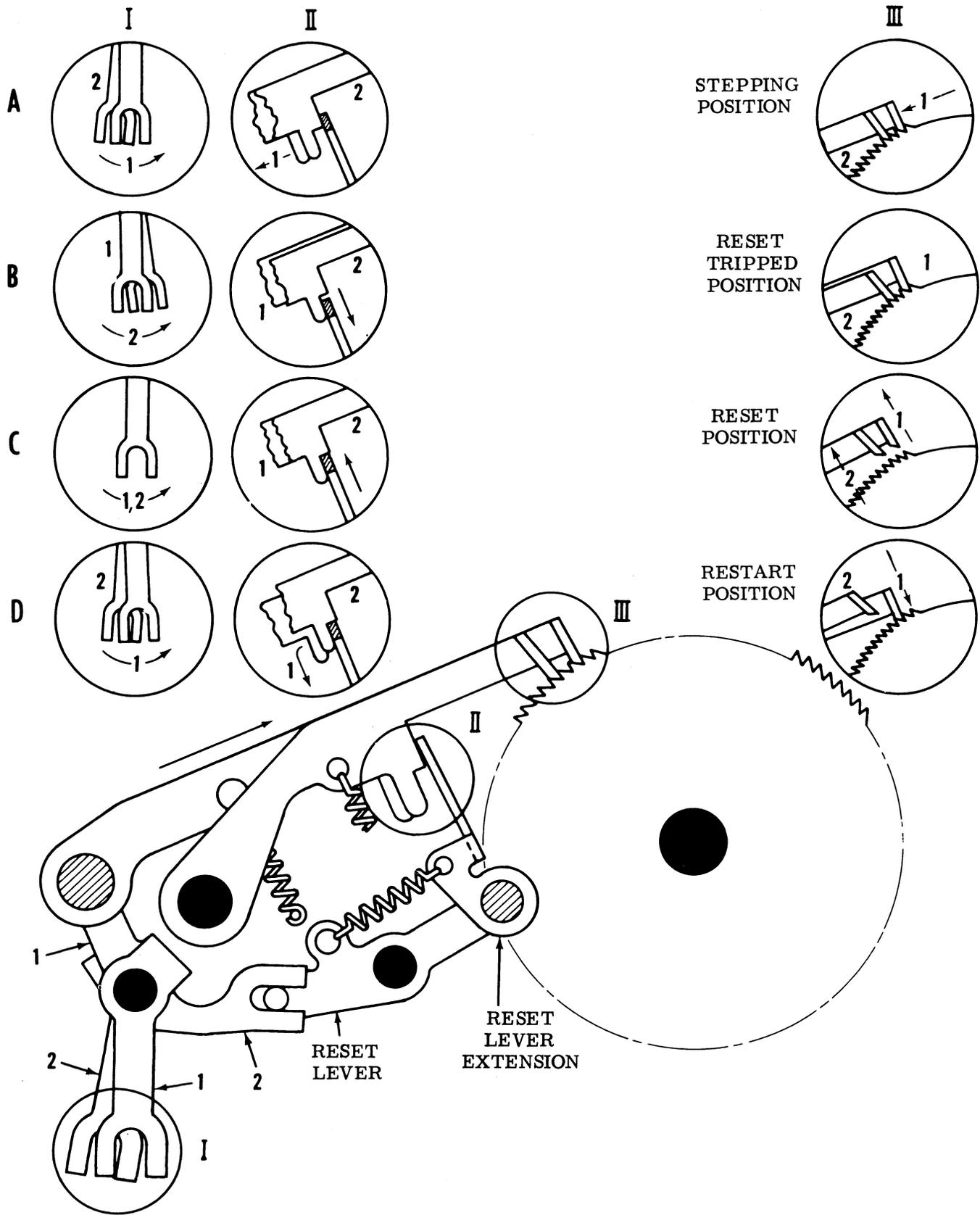
RESTART
POSITION

RESET
LEVER

RESET
LEVER
EXTENSION

Figure 12 - Operation of Character Counter Mechanism

the ratchet drum. As the drive lever completes its stroke, it steps the ratchet one tooth, as in the normal stepping operation.

D. End-of-Line Switch (Figure 10)

4.23 Operation of the end-of-line switch is controlled by a switch cam. The switch cam rotates with the ratchet drum and can be adjusted to close the switch at any typed line length from 10 to 80 characters.

TAPE CONTAINER

4.24 The tape container, mounted at the left rear of the keyboard, is designed to contain and feed 3/8 inch communications tape from eight inch rolls. A tape-out switch (Figure 13) illuminates a tape-out warning lamp in the lower left corner of the keyboard when the tape supply is down to less than 3/4 inch on the 2 inch tape core. The tape feeds through wire tape guides from the bottom of the tape container, from left to right across the keyboard, and into the tape chute of the tape printer.
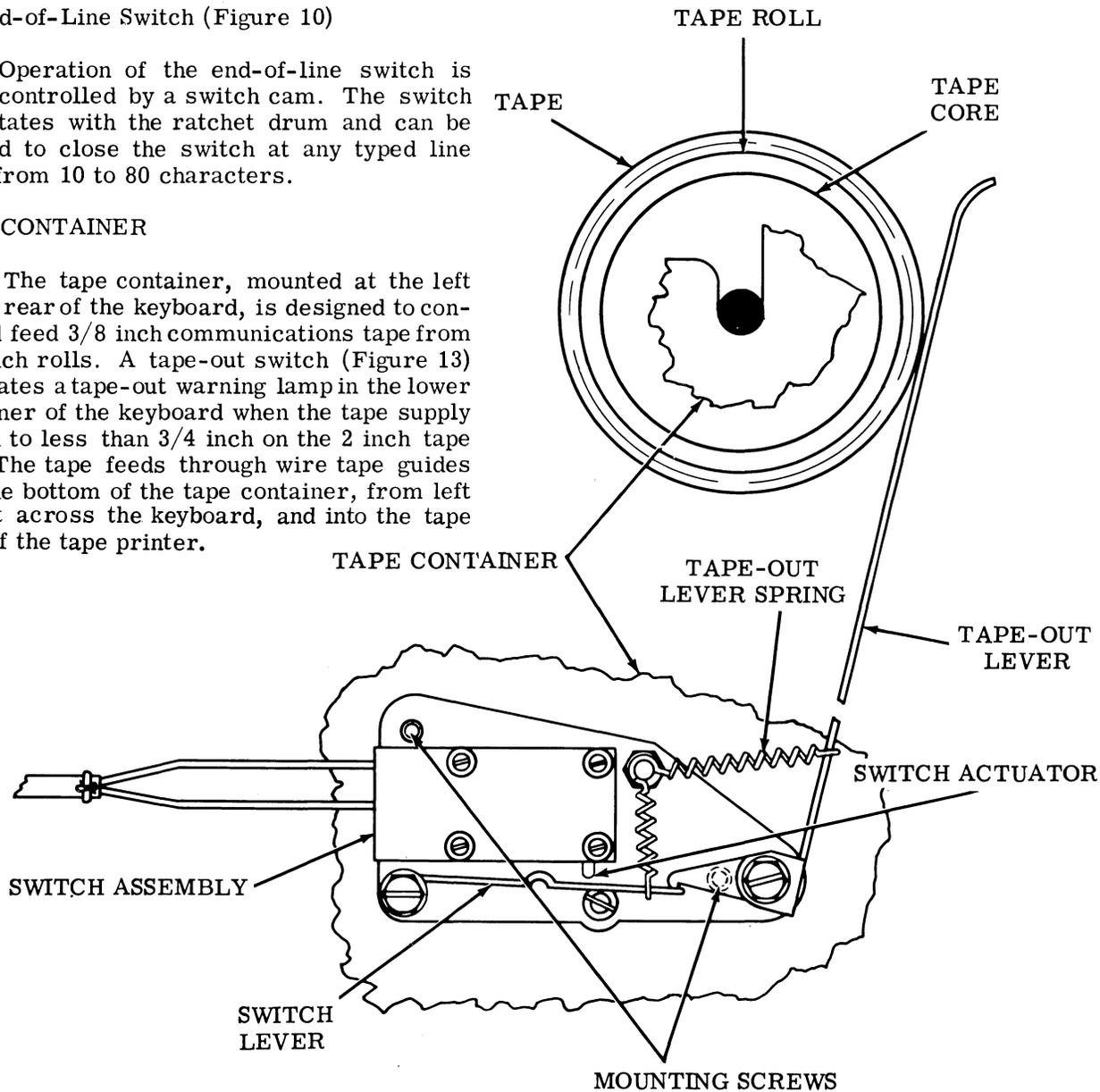
Figure 13 - Tape-Out Switch